GENESYS Series Programmable AC Power Source

2kVA in 1U 0–350Vac/0–20Arms

3kVA in 1U 0–350Vac/0–30Arms

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

USER MANUAL

IA905-04-01

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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 Technical Data** webpage for updated documentation and user manuals:

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

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

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

Additional technical assistance, if required, can be obtained from the **TDK-Lambda Global Site**:

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

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 3.3: 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.

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://www.emea.lambda.tdk.com/uk/technical-data/

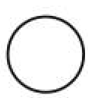
We encourage you to avoid printing test results and instead store a digital copy in your ERP system.

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 protections. TDK-Lambda shall not be liable for the user's failure to comply with these requirements.

SAFETY SYMBOLS AND MARKING ON THE EQUIPMENT

	**Warning**: There is a risk of danger. 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 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 Germany GmbH, Karl-Bold-Str. 40, Achern.

A UKCA marking 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 Technical Data** webpage for the declarations:

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

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.

EU RoHS

CE

The CE symbol on the product indicates compliance with the RoHS European Directive 2011/65/EU and 2015/863/EU.

Hazardous Substances					
Lead	Mercury	Cadmium	Hexavalent Chromium	Polybrominated Biphenyls / Polybrominated Diphenyl Ethers	Selected Phthalates Group
Pb	Hg	Cd	Cr	PBB / PBDE	DEHP / BBP / DBP / DIBP
O	O	O	O	O	O

'O' indicates that the hazardous substance is below the requirements of RoHS European Directive 2011/65/EU and 2015/863/EU.

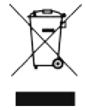
China RoHS

中华人民共和国中国电子行业标准 SJ/T 11364-2014（中国RoHS2）

People's Republic of China Electronic Industry Standard SJ/T 11364 -2014 (China RoHS2)

产品 / Product	Genesys Series Programmable AC Power Source: 2kVA, 3kVA					
有毒有害物质或元素 / Hazardous Substances						
零件名称 Part Name	铅 Pb	汞 Hg	镉 Cd	六价铬 Cr6+	多溴联苯 PBB	多溴二苯醚 PBDE
电路模块 / PCB Assembly	X	O	O	O	O	O
机箱（如适用）/ Enclosure (if applicable)	O	O	O	O	O	O
配件 / Accessories	O	O	O	O	O	O
此表依照SJ/T 11364-2014规定制定 This table is prepared in accordance with the provisions of SJ/T 11364-2014						
O =	指明产品所有均质材料包含的有害物质要低于GB/T26572限定的要求 Indicates that said hazardous substance contained in all of the homogeneous materials for this part is below the limit requirement of GB/T 26572.					
X =	指明产品所用的至少一种均质材料包含的有害物质高于GB/T26572限定的要求 Indicates that said hazardous substance contained in at least one of the homogeneous materials used for this part is above the limit requirement of GB/T 26572.					

Waste Electrical and Electronic Equipment (WEEE)



The label on the product indicates compliance with the WEEE directive.

EU Customers: At the end of the product life cycle, all products must be sent to a WEEE recycling center.

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 extremely. 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

CHAPTER 1: GENERAL INFORMATION

1.1 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. The instructions refer to the standard and blank panel power source, that include the built-in RS232/485, USB, and LAN interfaces. For information related to operation with the built-in interfaces, refer to their respective sections in this manual.

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 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.

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 Panel (VCP) program provides a graphical user interface.

Some of the key features of the power source are:

- **Rated Output Power**: 2kVA and 3kVA
- **Input Voltage Range**: 85–265V_{ac} 1-phase, 170–265V_{ac} 3-phase, and 342–528V_{ac} 3-phase
- **Rated Output Voltage**: 350V_{rms} / ±500V_{dc} (DC models only; refer to order code)
- **Rated Output Current**: 20A_{rms} / 30A_{rms}
- **Output Phase**: 1-phase
- **Phase Angle Range**: 0–359.9
- **Output Frequency Range**: 16–5000Hz (5kHz models), 16-1200Hz (1.2kHz models)
- **Crest Factor**: 4:1 (3kVA), 6:1 (2kVA)

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 mode
- Slew Rate
- Frequency
- Phase

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 proper operation of the power source

1.5 Parallel Operation

The parallel configuration of the power source consists of power sources configured to 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. Use the optional parallel kit (GAC/P) for connecting the units in parallel mode.
In parallel mode, the power source can be configured as follows:

- Single-phase
- Multi-phase
- Split-phase

CHAPTER 2: SPECIFICATIONS

Unless otherwise stated, specifications are warranted over the ambient temperature range of 0°C to 40°C.

Models			2kVA 1200Hz 2kVA 5000Hz	3kVA 1200Hz 3kVA 5000Hz
Programming				
AC output voltage (*1)				
Rated output RMS voltage (*2)		V	350 Line-Neutral	
Setting range (*3)		V	0–350.2	
Programming resolution		V	≤0.02	
Programming accuracy	16–1200Hz	%	≤0.2	
	1200.1–5000Hz	%	≤0.4	
AC output current				
Rated output RMS current (*4)		A	20	30
Setting range (*5)		A	0–20.2	0–30.2
AC output power				
Rated output apparent power		VA	2000	3000
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 (*2)		Vdc	±500	
DC voltage setting range (*6)		Vdc	0 – ±500	
Programming resolution		Vdc	≤0.02	
Programming accuracy		%	≤0.15	
DC output current				
Rated output DC current (*4)		Adc	20	30
Setting range (*7)		Adc	0–20.2	0–30.2
DC output power				
Rated output power		W	2000	3000
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		A	≤0.005	
RMS current accuracy		%	≤1	≤0.6
DC current resolution		Adc	≤0.005	
DC current accuracy		%	≤1	≤0.6
Peak current resolution		A_{pk}	≤0.005	
Peak current accuracy		%	≤1.5	
Output power				
Active (real) power resolution		W	≤0.2	
Active (real) power accuracy		%	AC: ≤2.25; DC: ≤4.5	AC: ≤1.5; DC: ≤3
Apparent power resolution		VA	≤0.2	
Apparent power accuracy		%	≤2.25	4
Frequency				
Resolution	16–1200Hz	Hz	0.01	
	1200.1–5000Hz	Hz	0.1	
Accuracy (*8)		%	≤0.1	
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	
	500–1200		≤0.7	
	1200–5000		≤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	

Models			2kVA 1200Hz 2kVA 5000Hz	3kVA 1200Hz 3kVA 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)		mVdc	≤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)		mVdc	≤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		-	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	12.4 @ 200Vac	18.5 @ 200Vac
	3-Phase 200		7.5 @ 200Vac	11.2 @ 200Vac
	3-Phase 480		4 @ 380Vac	6 @ 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 (*16)	1-Phase	%	78	81.5
	3-Phase 200		79	82.5
	3-Phase 480		79	82.5
Hold-up time (*15)		ms	≥10	
Inrush peak current (*17)		A	Less than 52	
Mechanical				
Cooling		-	Forced air cooling by internal fans. Airflow direction: From front panel to power supply rear	
Weight		Kg	≤8	
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	
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		-	Input, output (including sense), J9 and J10 are hazardous; J1, J2, J3, J4, J5, J6, J7 and J8 are non-hazardous	
Withstand voltage		V_{dc} 1min	Input–Output (including sense), J9 and J10 – J1, J2, J3, J4, J5, J6, J7, J8, J9 and J10: 4000 Output (including sense), J9 and J10 – J1, J2, J3, J4, J5, J6, J7 and J8: 3850 Output (including sense), J9 and J10–Ground: 3060 Input–Ground: 2835	
Isolation resistance		MΩ	>100 at 25°C, 70%RH, output to ground 500Vdc	
Isolation to ground		V	350Vac, 500Vdc	
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	
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	Operating	m / feet	2000 / 6562	
	Non-operating	m / feet	12000 / 39370	
Protective Functions				
Foldback protection		Output shutdown when power source changes mode from CV to CC mode or from CC to CV mode. User presetable		
Output overvoltage protection (OVP)		Output shutdown when overvoltage is sensed on the output. Programming range: 110%. Accuracy: ≤0.5%		
Output overvoltage protection (OVP) type		RMS – Shutdown when RMS voltage exceeds OVP RMS setting. Peak – shut-down 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. Programming range: Up to 120A		
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	2kVA 1200Hz 2kVA 5000Hz	3kVA 1200Hz 3kVA 5000Hz
Remote control interfaces (isolated from the output)		
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 supply OK #2 monitor	Push pull. Output on: 4.5–5.5V. Output off: 0–0.6V. Maximum source / sink current: 10mA	
Power supply OK #1 monitor	Open collector. Output on: On (0–0.6V). Output off: Off. Maximum voltage: 30V. Maximum sink current: 10mA	
Trigger in signals	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	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	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)	Enable / Disable power source output by electrical signal or dry contact. Output on: 0–0.6V or short. Output OFF: 2–30V or open	
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 - ≤1.3%; 3kVA - ≤0.9%	
Software / Firmware test sequences (*20)		
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		

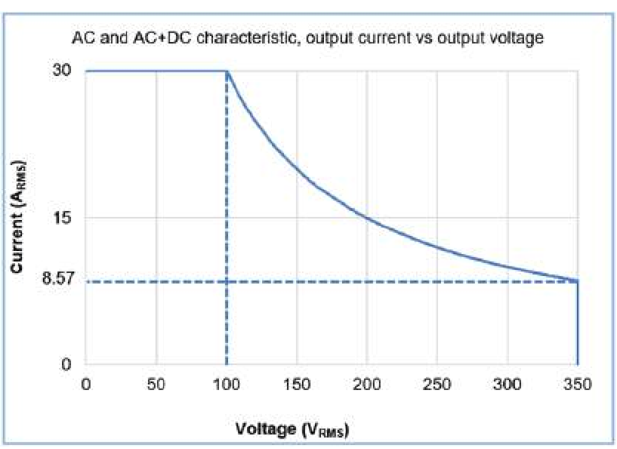


Figure 1: 3kVA AC and AC+DC characteristic

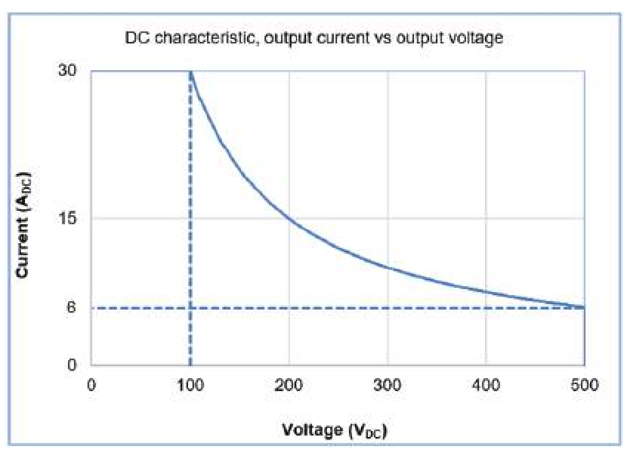


Figure 2: 3kW DC characteristic

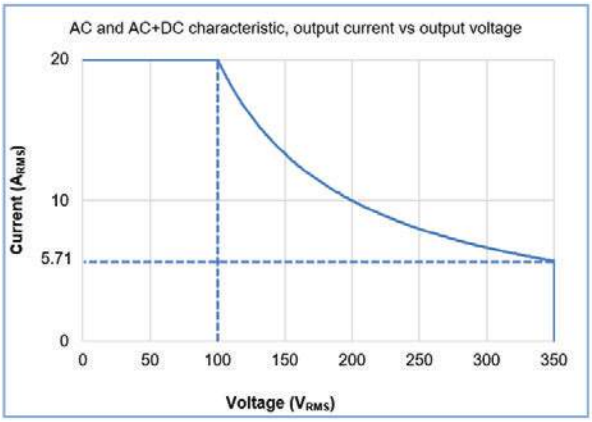


Figure 3: 2kVA AC and AC+DC characteristic

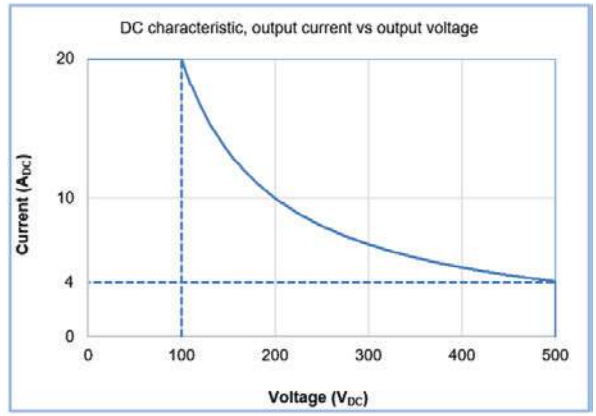


Figure 4: 2kW DC characteristic

NOTES:

*1: Combined with AC and DC output, the peak voltage must be between -500V and +500V.
*2: Minimum voltage is guaranteed to maximum 0.1% of rated output voltage (350V_{ac}, 500V_{dc}).
*3: Maximum RMS voltage setting range is associated with the output current setting. When the output current setting is above 5.714A for 2kVA or 8.571A for 3kVA, the output voltage setting is limited to rated output power. Refer to Figure 1 and Figure 3.
*4: Minimum current is guaranteed to maximum 0.2% of rated output current.
*5: Maximum RMS current setting range is associated with the output voltage setting. When the output voltage setting is above 100Vac, the output current setting is limited to rated output power. Minimum constant current regulation value is 5% of the rated output current.
*6: Maximum DC voltage setting range is associated with the output current setting. When the output current setting is above 4A for 2kW or 6A for 3kW, the output voltage setting is limited to rated output power. Refer to Figure 2 and Figure 4.
*7: Maximum DC current setting range is associated with the output voltage setting. When the output voltage setting is above 100Vdc, the output current setting is limited to rated output power.
*8: Accuracy is guaranteed above 5% of rated output voltage.
*9: Load power factor is 1.
*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 0.5% 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.
*13: At 10% to 90% of the 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.
*16: Typical at rated output power, rated output current, DC mode or sine wave, load power factor is 1. 3-Phase 200V models at 200Vac input voltage, 3-Phase 480V at 380Vac input voltage.
*17: Not including the EMI filter inrush current, less than 0.2ms. 1-Phase Input, at input line ≥ 240Vac, less than 70A.
*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.
*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 and Harmonic Analysis must be acquired in Genesys AC.

CHAPTER 3: UNPACKING, INSPECTION, AND REPACKING

3.1 Unpacking and Initial Inspection

WARNING

To avoid potential personal injury, handling, lifting, and carrying of the equipment shall only be done 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.

1. Carefully open the packing box and remove the accessories bag.
2. Gently remove the top foam cover of the front and rear panel.

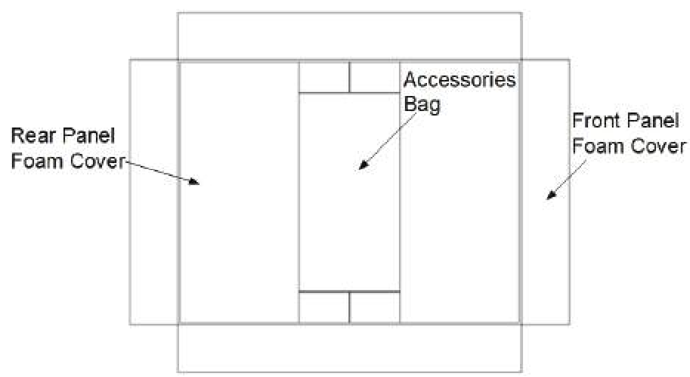


Figure 3-1: Unpacking

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.

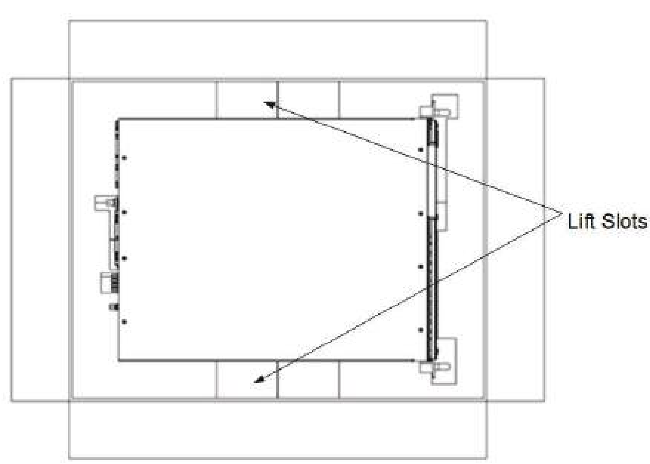


Figure 3-2: Removing the Power Source

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.

Item	Catalog No.	Manufacturer	Quantity	
			2kVA	3kVA
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	
Cover Base	-	-	1	
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, the appropriate AC input plug is supplied.

Table 3-1: Items Provided with the Power Source

NOTE

If any of the above item is missing, notify the nearest TDK-Lambda sales or service facility.

3.3 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.

4.2 Front Panel Display, Controls, and Indicators

Refer to **Figure 4-1** 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

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 4-2** and **Table 4-2** for the description of the Blank Front Panel Indicators.

Figure 4-2: Blank Front Panel Indicators

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, or LAN.
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 are lit for illustration purpose only.

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.

5.2 Rear Panel Controls and Connectors

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

Figure 5-1: Rear Panel Controls and Connectors

No.	Connection	Description
1	AC Input Connector	**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. 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	IPC 5/ 4-GF-7,62 PHOENIX CONTACT Refer to **Section 7.6: Connecting the Load** for detailed information on the connection of the output.
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)	BNC-type connector for monitoring the output voltage
7	Trigger Out (J6)	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)	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	Optional Interface Slot (J8)	Slot for an optional communication interface

Table 5-1: Rear Panel Controls and Connectors

(*1) 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 optional parallel kit (GAC/P) must be used and a cable connection must be made between the master (J9) and slave (J10).

WARNING

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

NOTE

(*3) All LEDs are lit for illustration purpose only.

CHAPTER 6: 2KVA/3KVA OUTLINE

Standard Unit Front View

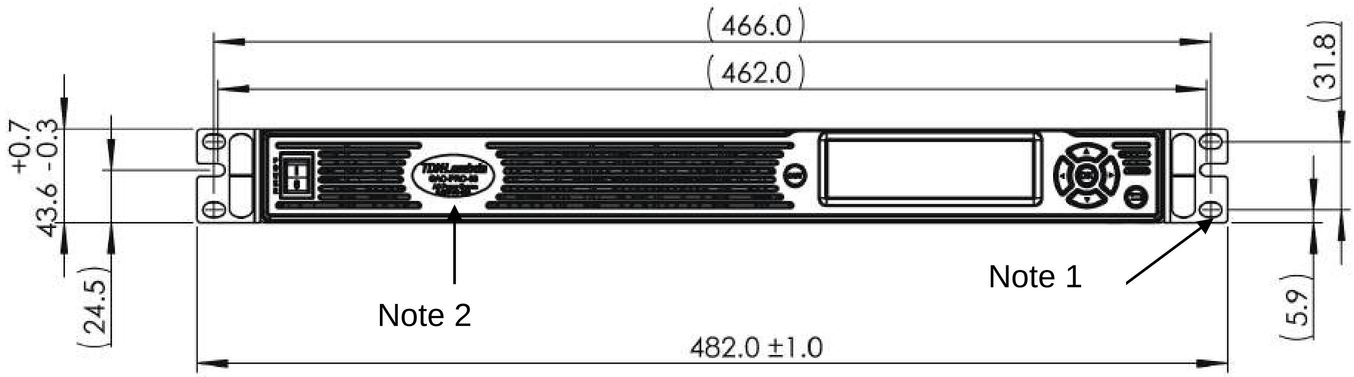


Figure 6-1: Front View

Standard and Blank Panel Unit Side View

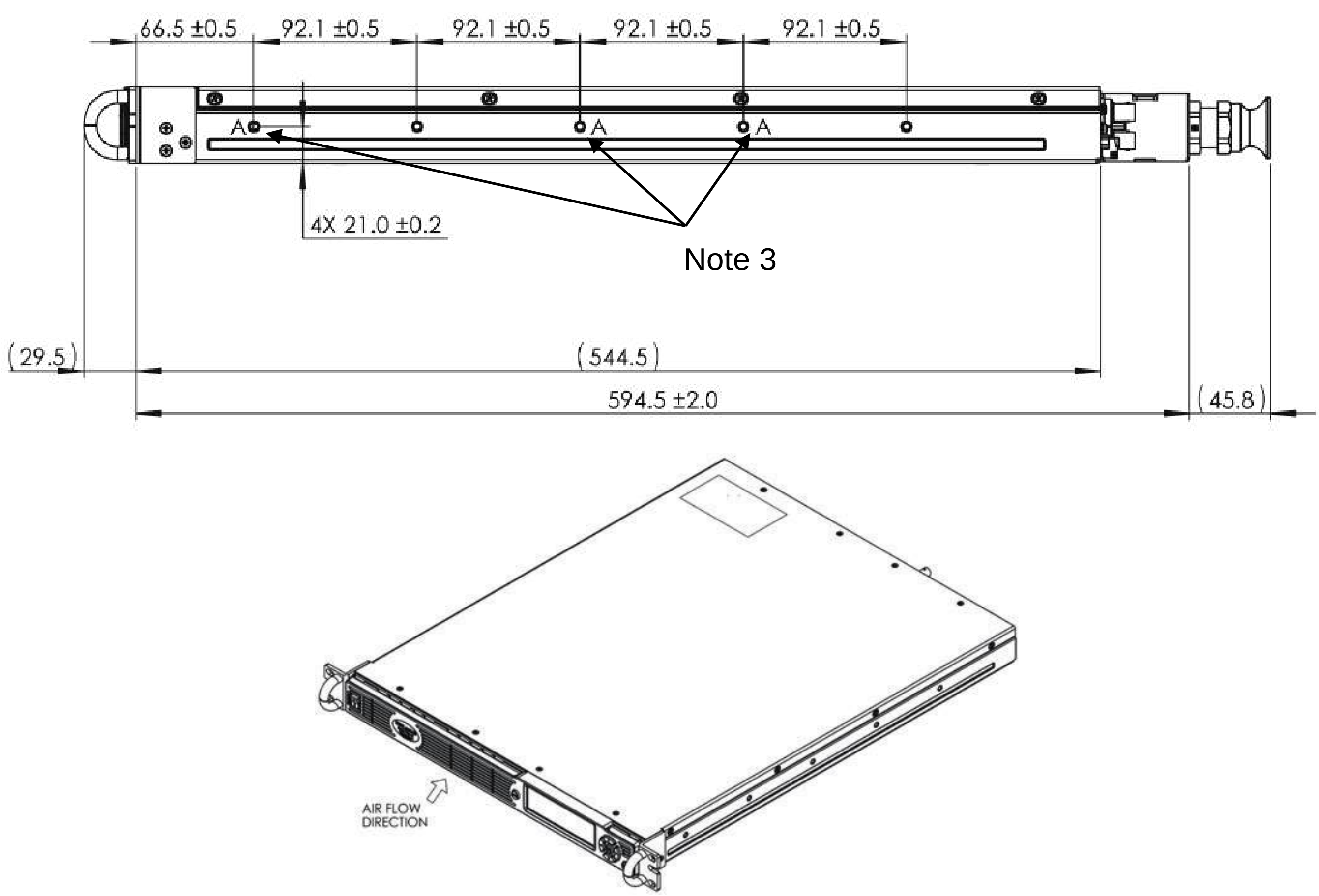


Figure 6-2: Side View

All dimensions are in mm

Standard and Blank Panel Unit Top View

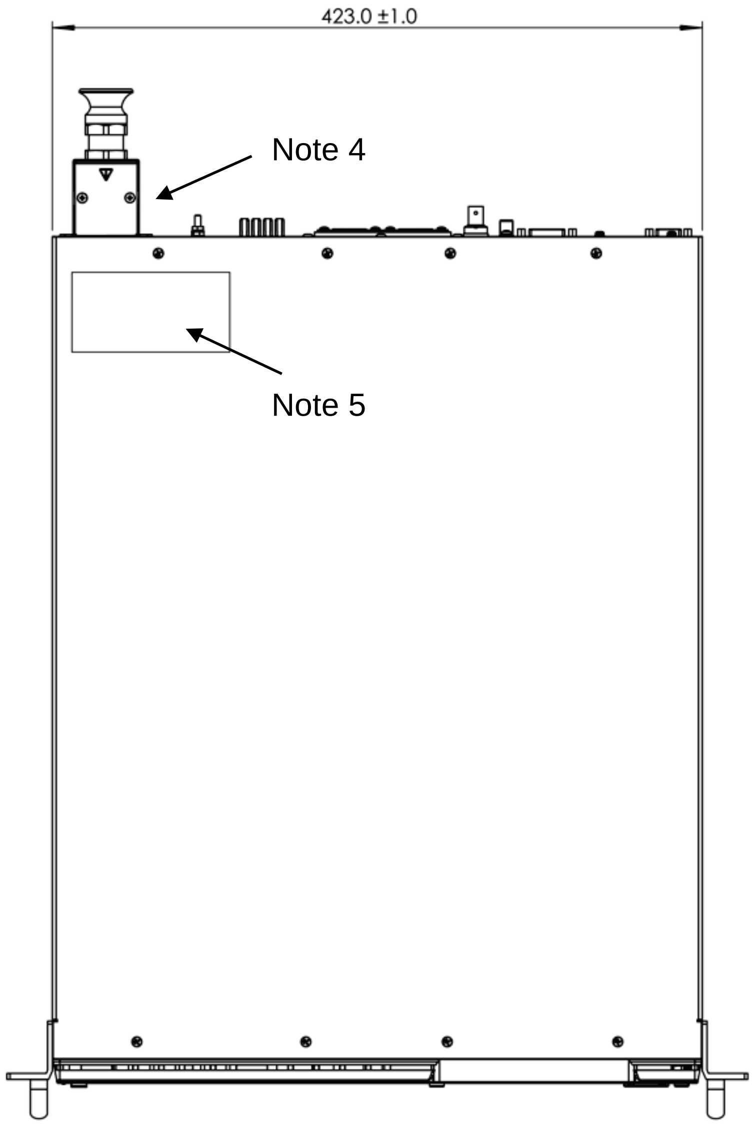


Figure 6-3: Top View

All dimensions are in mm

NOTES:

1. Mounting holes for 19” rack. Use M6x16 screws to fix the unit to the rack.
2. Company logo, model name, and output rating and are shown here according to the specifications.
3. Mounting holes for chassis slides; refer to **Section 7.3.2: Rack Mount Slides (Optional)**.

   Use #10-32x0.38” x 3 screws on each side in positions marked with A.
   Ensure that the screws **do not** penetrate more than 6.0 mm into the unit.
4. AC cable gland and strain relief bracket assembly.
5. AC input rating and safety approval symbols are shown here according to the specifications.

CHAPTER 7: INSTALLATION

WARNING

This equipment must be installed and put into operation by qualified personnel only. Protective measures must be installed to prevent unauthorized persons 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 an 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.	Item	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. Particular 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

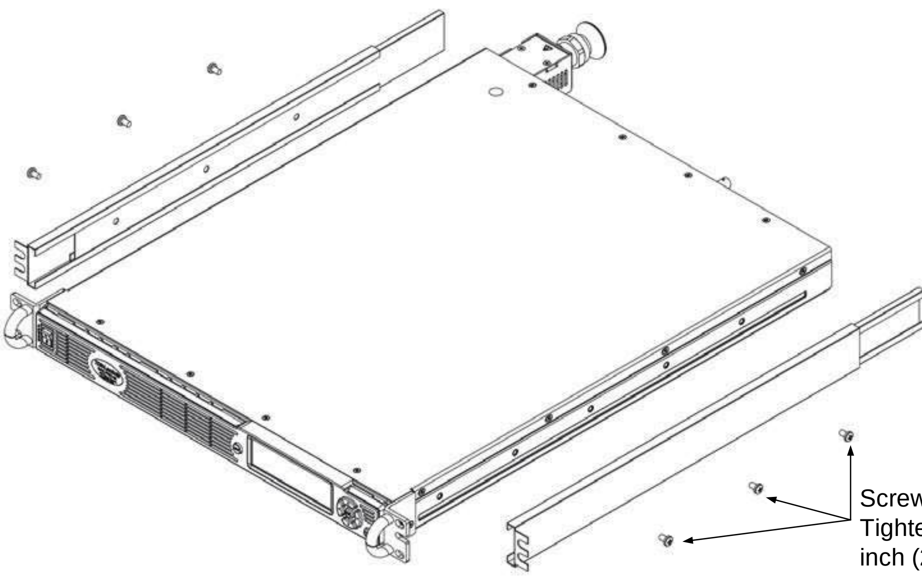


Figure 7-1: Rack Mounting

CAUTION

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

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).

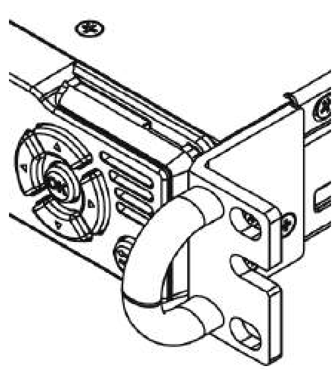


Figure 7-2: Installing the Power Source in a Rack

7.4 AC Input Power Connection

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

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

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.

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.

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 and 3kVA

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 7-3**.
3. Tighten the plastic nut onto the cable gland by using manual force only. The nut can be tightened to the cable gland within the strain relief bracket assembly.

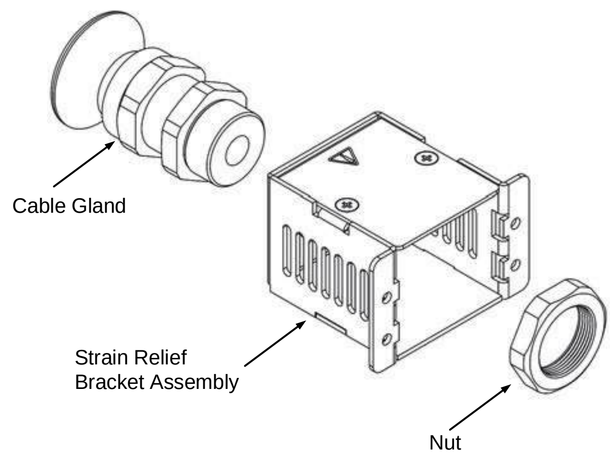


Figure 7-3: Insertion of the Plastic Nut into the Cable Gland

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. Strip 10 mm of the insulation from each wire, with an additional 10 mm from the ground wire.
6. Insert the AC cable through the cable gland and the strain relief bracket assembly, as shown in **Figure 7-4** (applicable for 4-wire 3-phase and 3-wire 1-phase; 1-phase shown).

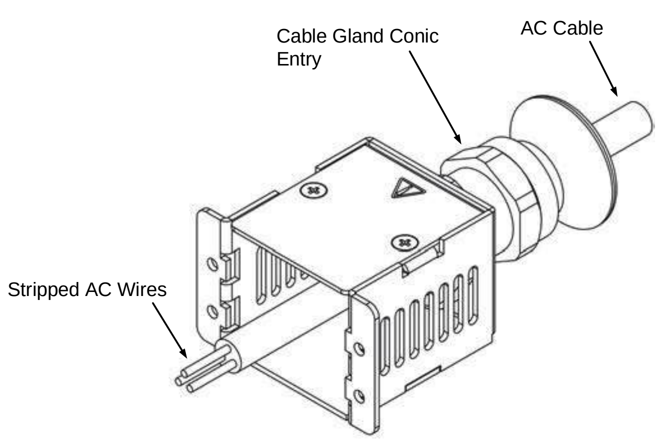


Figure 7-4: Insertion of the AC Cable through the Cable Gland and Strain Relief Bracket Assembly

7. Insert the AC wires into the AC input connector as shown in **Figure 7-5**.

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 4.5–5.3 Lbf-inch (0.5–0.6Nm).

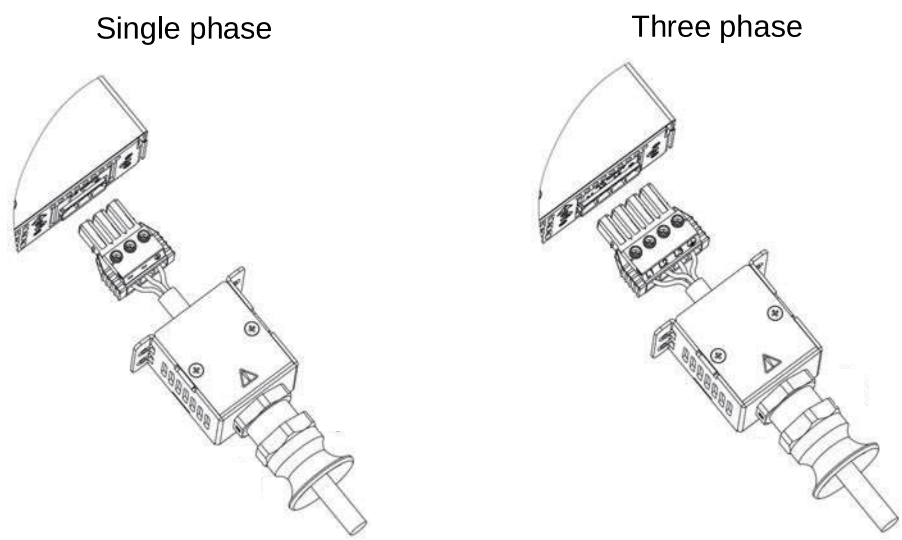


Figure 7-5: AC Wires fixed to the AC Connector

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 7-6** 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.

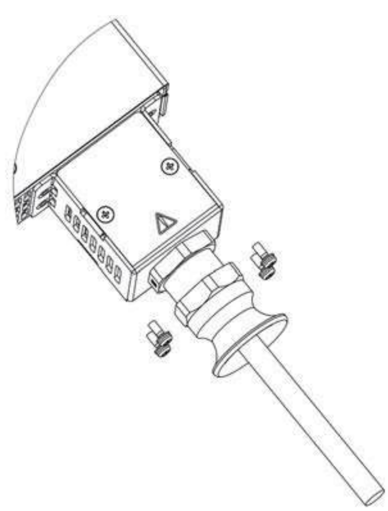


Figure 7-6: Strain Relief Bracket Assembled to Power Source Rear Panel

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. If the equipment must be operated by unqualified personnel, then they must be supervised by qualified personnel.

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 which ensures that the unit is operational. Refer to **Figure 4-1** and **Figure 5-1** 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. Ensure 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 to 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. Ensure 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**.
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. Ensure that **CV** LED illuminates.
6. Turn OFF the power switch.

7.6 Connecting the Load

7.6.1 Output Connections

The output 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, or the output may be floated. The unit must not float outputs more than +/- 500Vdc 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, 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 7-4** for the recommended wire in American and European dimensions, respectively, to limit the voltage drop.

Output Current	Recommended wires (mm^2)	Recommended wires (AWG)	Connector
0A–30A	6 (ferrules with plastic sleeves)	8	Phoenix contact IPC 5/ 4-STF-7,62.

Table 7-4: Recommended Wires Size

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 of 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. Un-twisted 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.

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 hardware on which the load wiring is mounted **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).

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

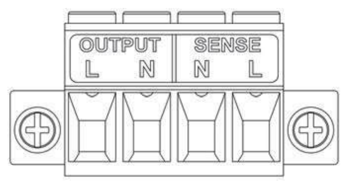


Figure 7-7: Output and Sense Connector

1. Prepare suitable wires and connector according to the recommendations in **Table 7-4.**
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 AC input conductors so that there is no possibility of contact between the conductors.

5. Insert the wires into the terminals as shown in **Figure 7-8** and tighten the terminal screws securely using a tightening torque of 6.2–7 lbf-inch (0.7–0.8Nm).

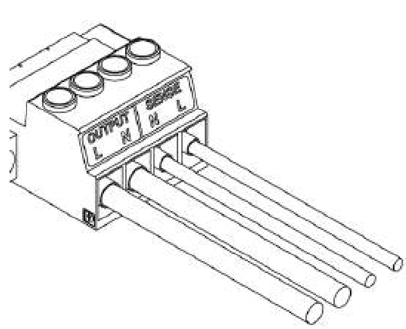


Figure 7-8: Inserting the Wires

NOTE

The wires connected to the sense terminals are to be used for remote sense only.

6. Tighten the connector to the power source rear panel as shown in **Figure 7-9** using a tightening torque of 5–6 lbf-inch (0.3–0.7Nm).

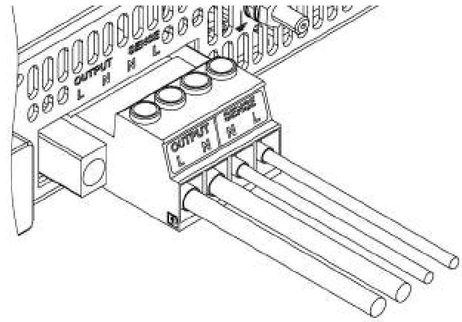


Figure 7-9: Tightening the Connector to the Power Source

7. Fix the output cover using 2 screws (WN1412(KA30X8)) provided with the power source; refer to **Figure 7-10**. Use a tightening of 5.2 lbf-inch (0.58Nm).

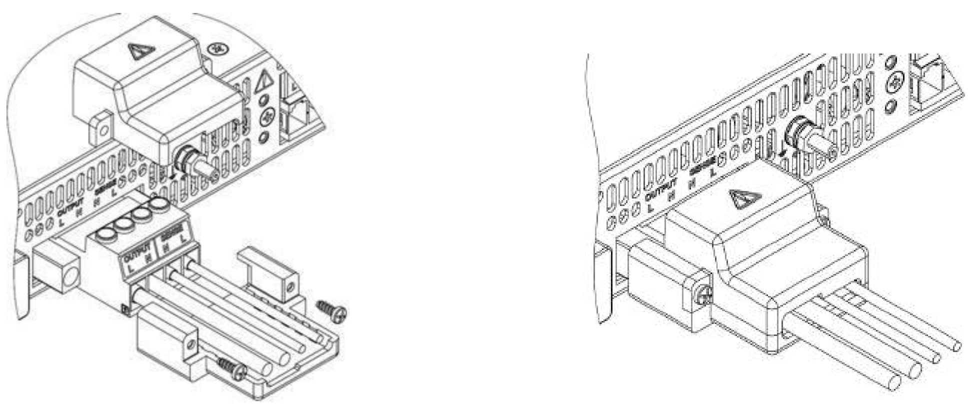


Figure 7-10: Fixing the Output Cover

8. Ensure that all connections are securely tightened.

CAUTION

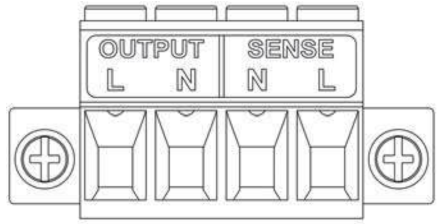
For high current outputs, it is very important to make the output connections properly and follow the instructions. Improper connections may result in excessive temperature rise or power source going into protection mode.

7.6.8 Grounding Outputs

Either the positive or negative output terminals can be grounded. 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

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



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 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 hardware on which the sense wiring is mounted **does not** short the sense 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).

7.7.1 Local Sensing

The power source is shipped with an open-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, 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's chassis or one of the output terminals if either of the output terminals is grounded.

7.7.4 Sense Connection

1. Follow steps 1–6 indicated in **Section 7.6.7: Making the Load Connections**.
2. Connect Sense line (SENSE L) from the power source to Sense line of the load.
3. Connect Neutral line (SENSE N) from the power source to Neutral line of the load.
4. Fix the output cover using 2 screws (WN1412(KA30X8)) provided with the power source; refer to **Figure 7-10**. Use a tightening of 5.2 lbf-inch (0.58Nm).
5. Ensure that all connections are securely tightened.
6. Turn ON the power source.
7. Set voltage sense setting to remote sense via front panel or communication.

NOTE

In order to ensure correct operation in remote sense mode, ensure that the voltage drop on the sensing wires meets product specifications.

7.7.5 Load Connection Options

7.7.5.1 Single Load, Local Sensing (Default)

Figure 7-11 shows recommended load connections 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.

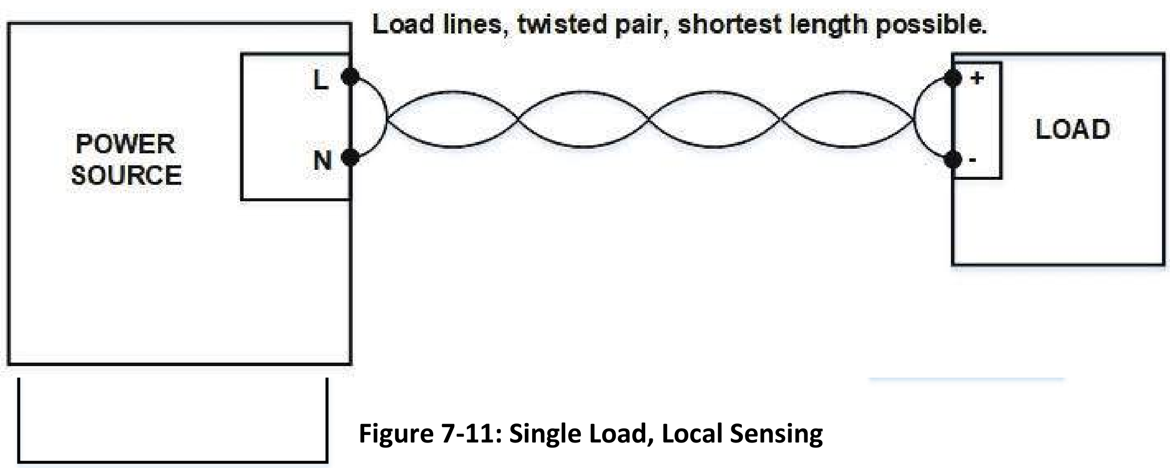


Figure 7-11: Single Load, Local Sensing

7.7.5.2 Single Load, Remote Sensing

Figure 7-12 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.

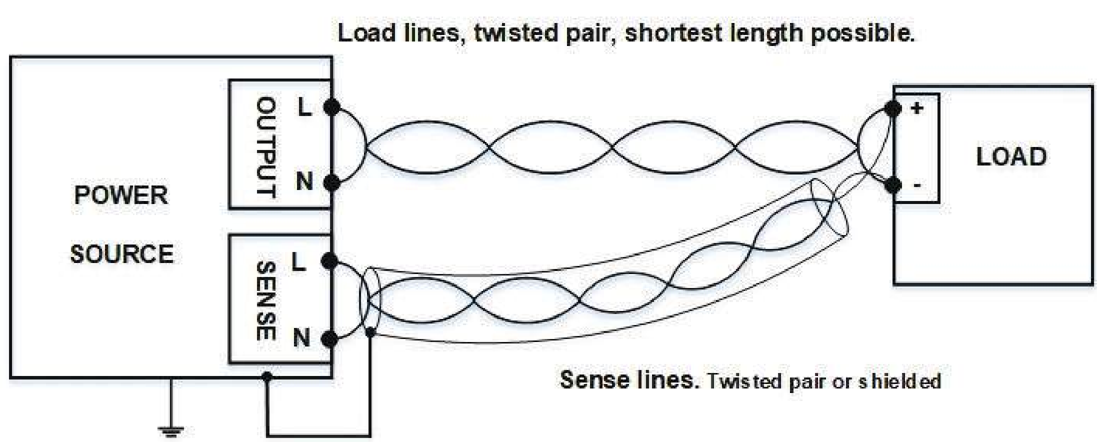


Figure 7-12: Single Load, Remote Sensing

7.7.5.3 Multiple Loads, Radial Distribution

Figure 7-13 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.

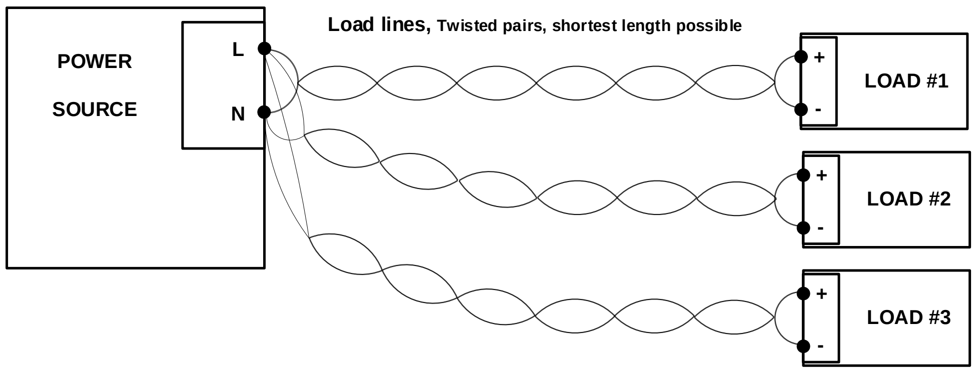


Figure 7-13: Multiple Loads, Radial Distribution

7.7.5.4 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 7-14**).

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.

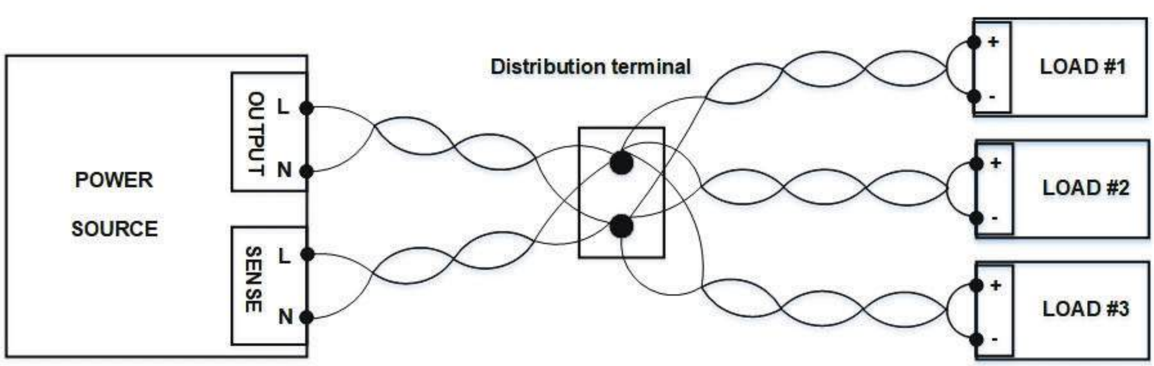


Figure 7-14: Multiple Loads, Distribution Terminals

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.

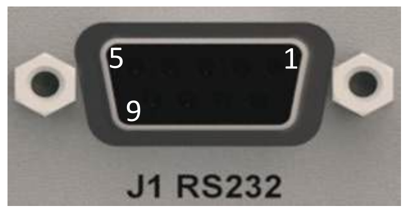


Figure 8-1: RS-232 and RS-485 Connector

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.

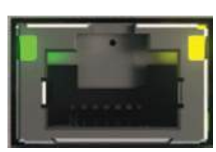


Figure 8-3: LAN Connector

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 **Table 8-3** for the pinout of the connector.

Figure 8-4: Remote Programming 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 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 on the J4 connector (except NC (Not Connected) pins) 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 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) 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 this function from the front panel.
Refer to **Section 14.13.5: Output Subsystem** to enable or disable this 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

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 three 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 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. Use the optional parallel kit (GAC/P).

Figure 8-8: 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 optional parallel kit must be used and a cable connection must be made between the master (J9) and slave (J10).

8.9 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.

9.1 Introduction

This chapter explains the navigation of 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.

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.

TDK·Lambda

Figure 9-1: Opening Screen

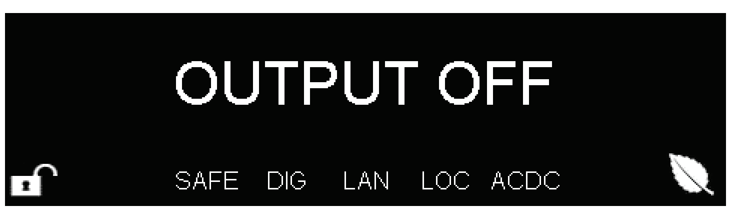


Figure 9-2: Dashboard-Output OFF

Figure 9-3: Dashboard-Output ON

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 mode, digital control (front panel or communication), LAN communication, local, and ACDC. It also indicates that the front panel is in locked mode.

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	Safe/Auto Start Mode	Refer to **Section 9.4.3: Protection Menu**.
DIG	External Control Mode	Refer to **Section 9.4.5: Configuration Menu**.
LAN	Communication Mode	Refer to **Section 9.4.4: Interface Menu**.
LOC	Local/Remote Mode	Refer to **Section 9.4.7: Display Menu**.
ACDC	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, tapping it, or clicking any button to the right of the touch-screen display opens the HOME screen. It is made up of three pages, as shown in **Figure 9-4,** and contains a total of nine main menus.

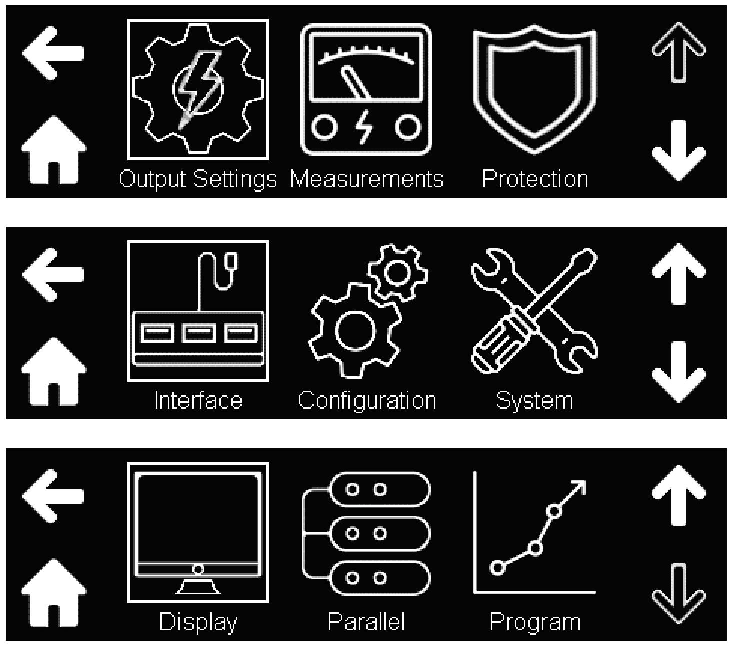


Figure 9-4: Main Menus

NOTE

Main menu **Parallel** is seen when the 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 to the right of the display.

The highlighted menu and sub-menu are always highlighted with a square selection box around them. In the picture below, the selection box can be seen around **Output Settings** and around **Voltage** which is a sub-menu under **Output Settings** menu**.**

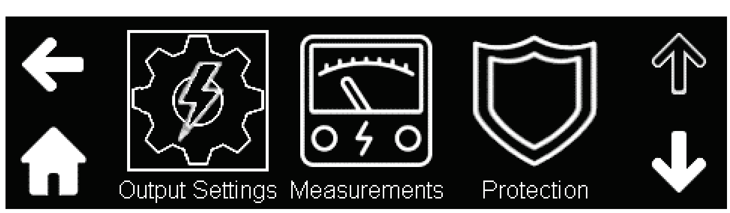


Figure 9-5: Highlighted Main Menu

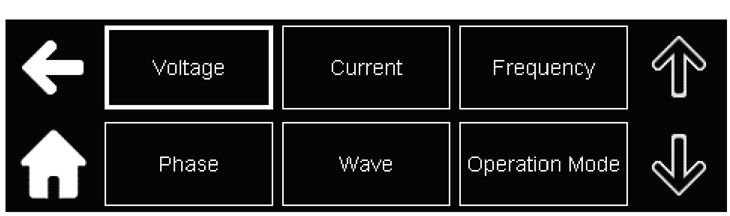


Figure 9-6: Highlighted Sub-menu

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 below.

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

Table 9-2: Representation of Front Panel Buttons

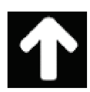
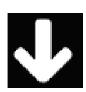
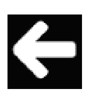
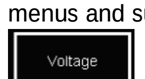
Icon	Representation
	**UP**
	**DOWN**
	**LEFT**
	**HOME**
	**BACK**
	**ENTER**
	**LOCK/UNLOCK**
All icons on the menus and sub-menus - Ex - 	**Represented in text (bold).** **Example -** Click **Voltage**

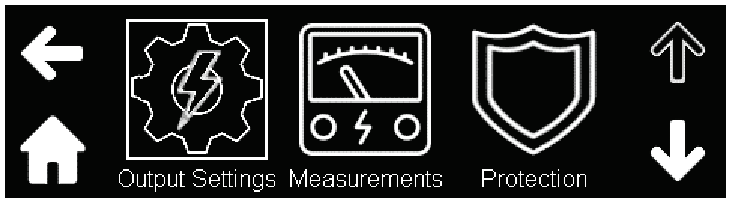
Table 9-3: Representation of Touch-Screen Display Icons

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 an **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.

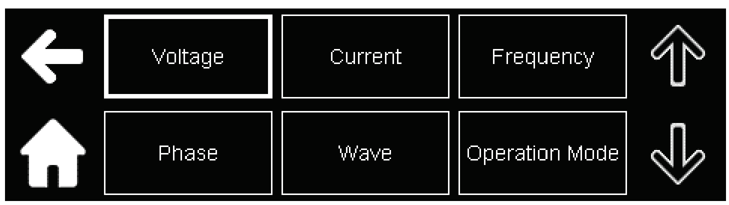
Each of these pages has main menus. One of the pages is shown below.



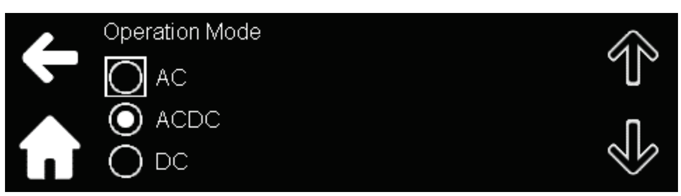
All pages on the HOME screen also have the following:

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

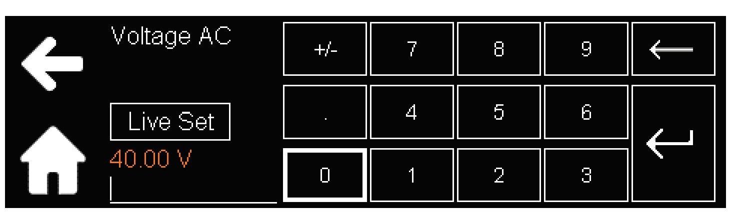
Tap on any main menu to enter the sub-menu screen. The sub-menu of **Output Settings** is shown below.



Some sub-menus have button icons for selecting the parameters, while others have entry fields. For sub-menus with button icons, tap on the required parameter for its selection. The parameters of **Operation Mode** 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 to 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 entered by clicking on any button to the right of the touch-screen display. Use the **NAVIGATION PANEL** to move across the pages and also across the main menus/sub-menus and select the main menu/sub-menus by clicking **OK**.

For the sub-menus with button icons, move to the required parameter using the **NAVIGATION PANEL** and select the required parameter 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 field 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 AC voltage, DC voltage, current limit, and frequency Setting of the phase ON and phase OFF of the output waveform Selection of the type of waveform Selection of the operating mode
	Measurements	Measurements: • Output voltage, current, their harmonics, and their Total Harmonic Distortion (THD) • Maximum and minimum instantaneous peak 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 of 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-2	Interface	Selection of the communication type and its configuration: • USB • LAN • RS232 • RS485 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
	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
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 difference between the phases
	Program	Programming different types of AC and DC sequencers Selecting the trigger source and trigger delay for triggering the sequencers Storing/ loading the sequencer values in/from the memory Aborting the sequencers to a user defined state

Table 9-4: Menu and Sub-Menu Screen

9.4 Menu Diagrams and Description

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

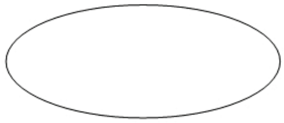
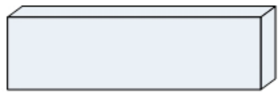
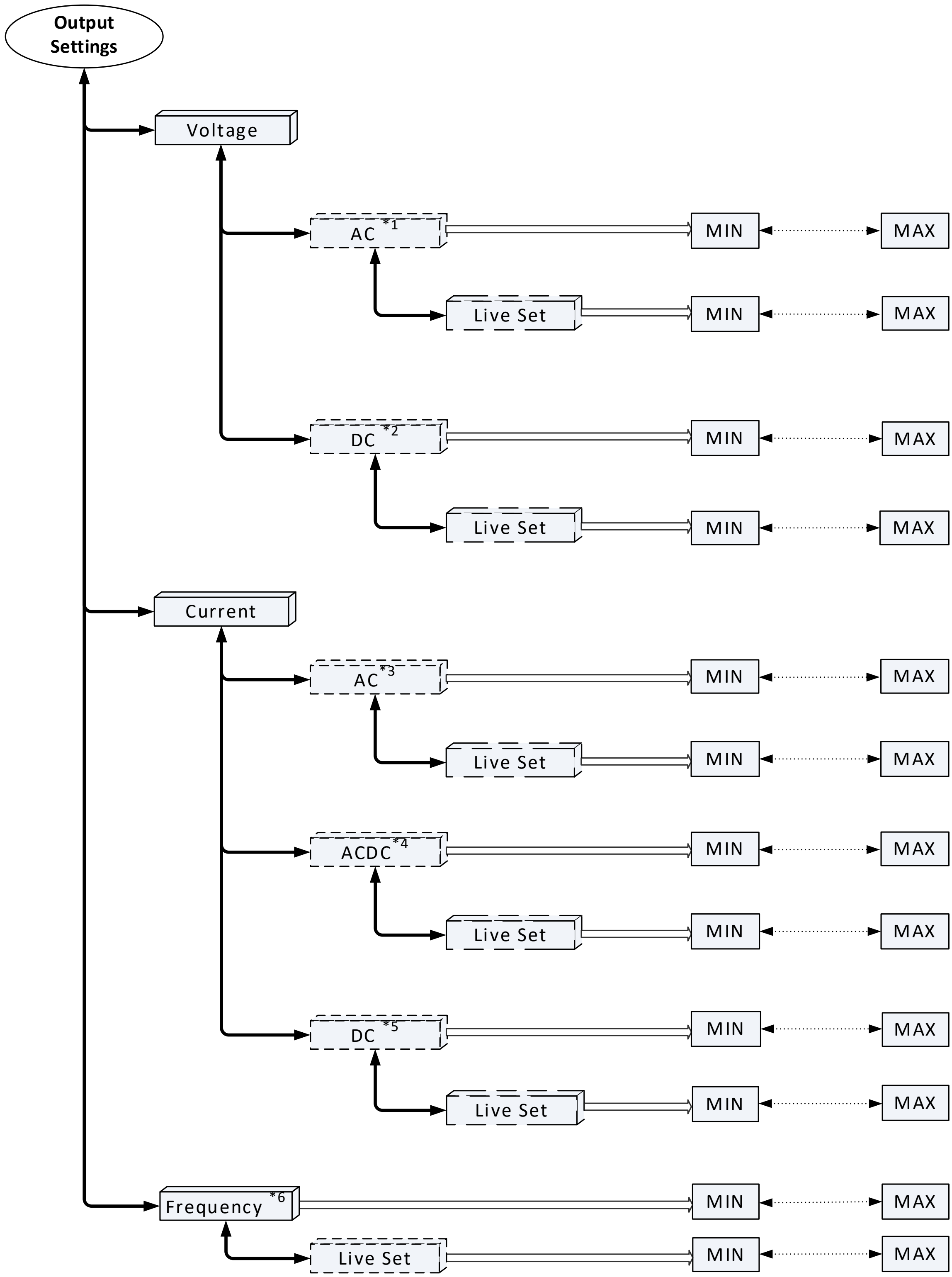
	**Main Menu**
	**Sub-menu (Level 1)**
	**Sub-menu (Level 2)**
	**Sub-menu (Level 3)**
	**Sub-menu (Level 4)**
	Sub-menu (Level 5)
	**Enter Values**
	**Select Parameters**
	**View / Read**

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

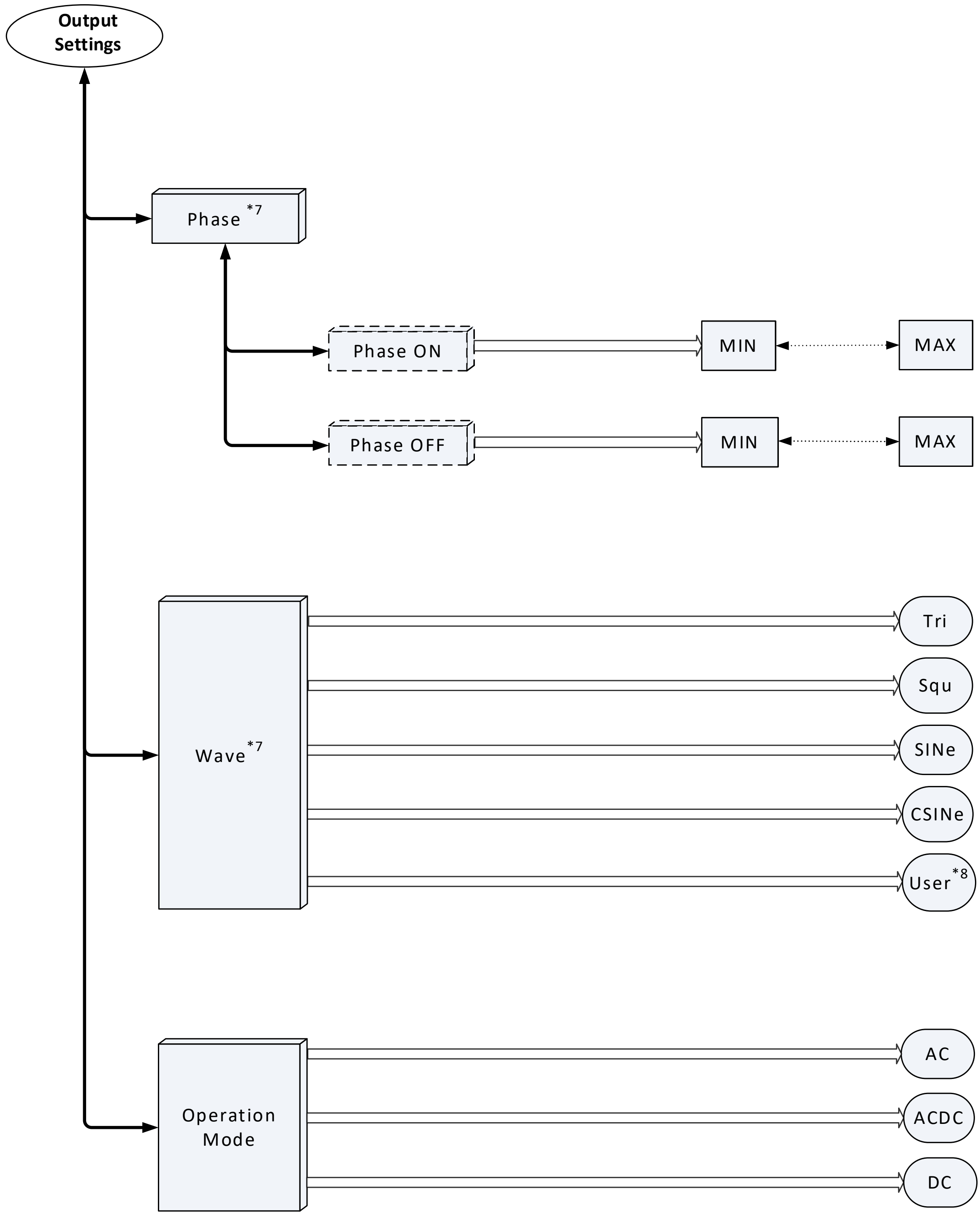
Each main menu can be accessed from the HOME screen in two ways:

- Use the **UP** or **DOWN** icon on the touch-screen display and tap on the required menu.
- Use the **NAVIGATION PANEL** to move to the required menu and click **OK**.

9.4.1 Output Settings Menu

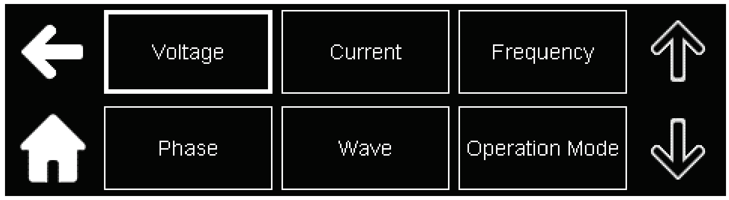


*1. Not available in DC mode.
*2. Not available in AC mode.
*3 Not available in ACDC and DC mode.
*4. Not available in AC and DC mode.
*5. Not available in ACDC and AC mode.
*6. Not available in DC mode.



*7. Not available in DC mode.
*8 Can be multiple waveforms.

After selecting **Output Settings**, its sub-menu opens.



NOTES

Refer to **Table 14-9** for the programming parameters of voltage, current, and frequency.
Refer to **Section 14.13.5: Output Subsystem** for the programming parameters of phase.

NOTE

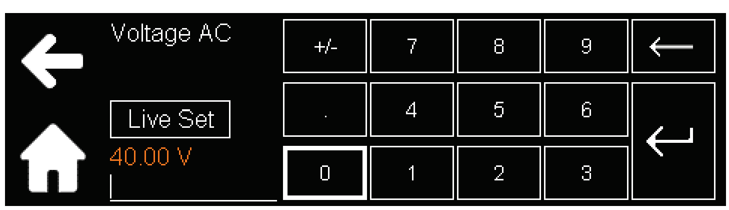
Frequency and Phase programming, and wave selection are not available in DC mode.

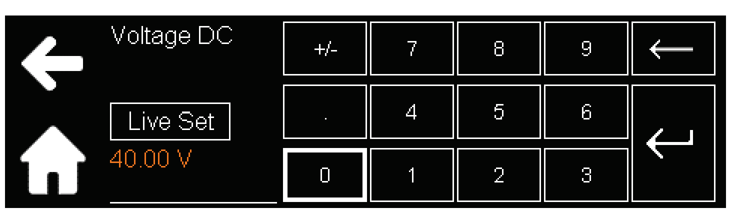
Voltage

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.



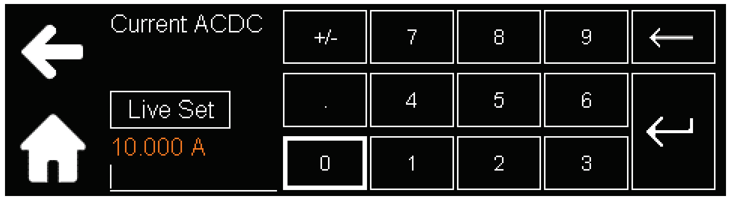


The DC offset can be set to a positive or negative value.

Current

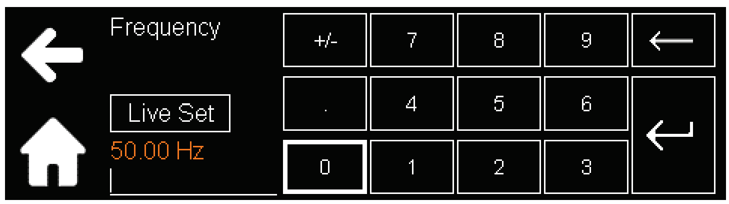
Click **Current**.

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



Frequency

Click **Frequency**.



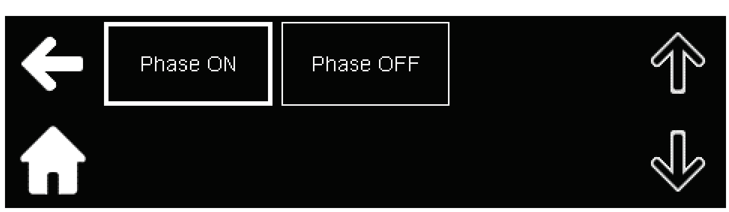
In addition, the programming windows for voltage, current, and frequency also have the following setup option: 

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

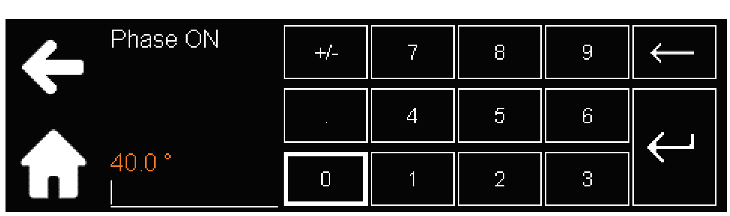
This screen allows for changing the value per digit. Use the **LEFT** or the **RIGHT** button on the **NAVIGATION PANEL** to move to the required digit. The value can be changed in one step by pressing the **UP** or the **DOWN** button once on the **NAVIGATION PANEL** or if they are kept pressed, the value scrolls continuously.

Phase

Click **Phase**.

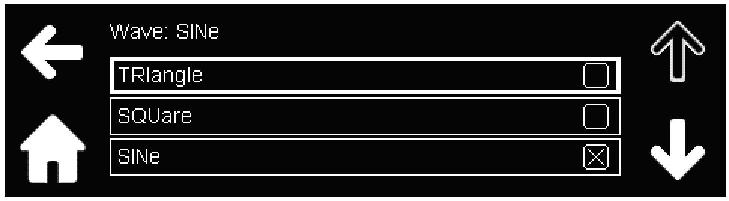


The window to set the value for phase ON is shown below.



Wave

Displays the built-in waveforms 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** to select the waveform.



The waveforms displayed depend on the waveform region selected; refer to [FUNCtion:]WAVeform:REGion <NR1> in **Section 14.13.6: Function Subsystem**. TRIangle, SQUare, SINe, and CSINe are available in all regions.

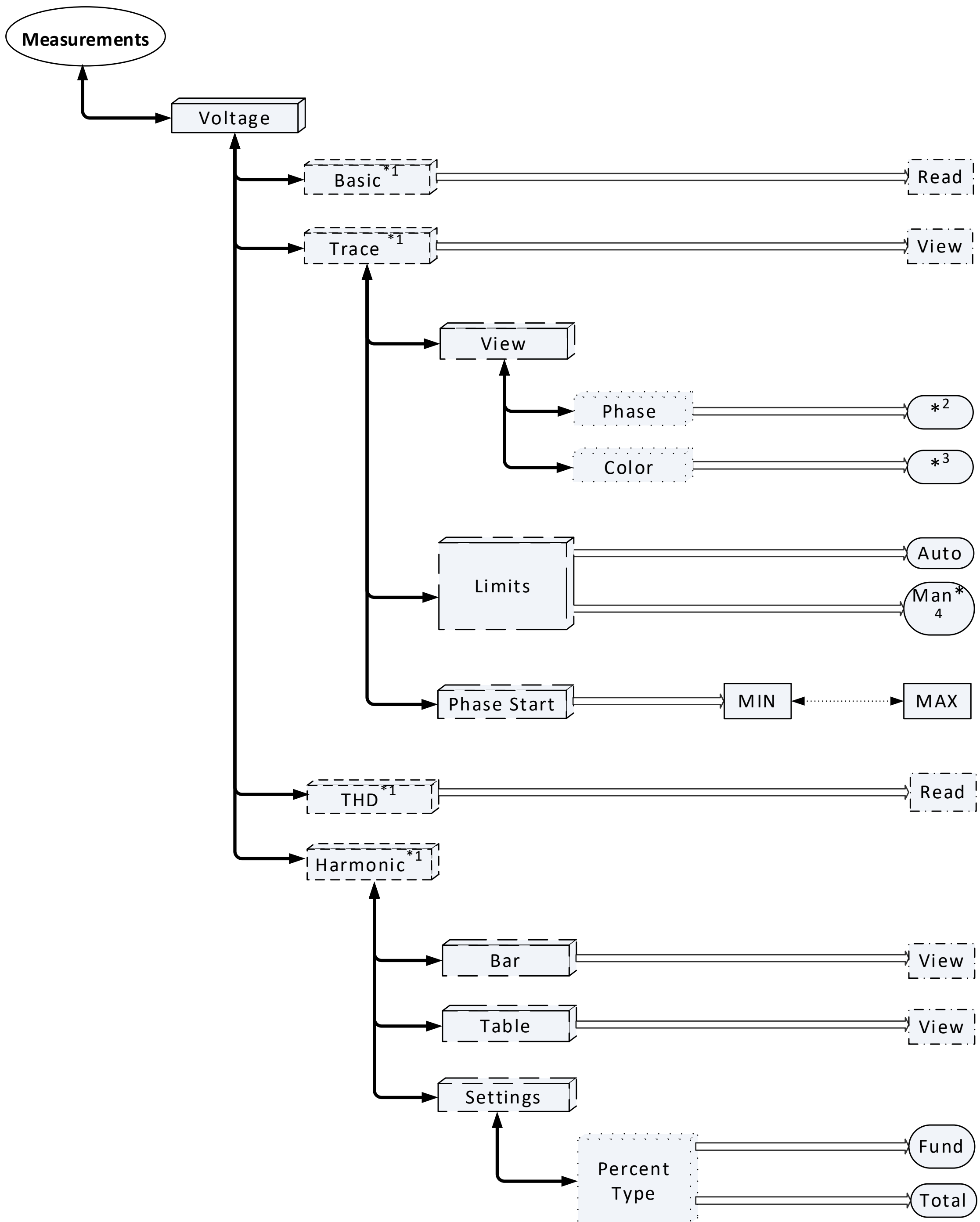
Operation Mode

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

NOTE

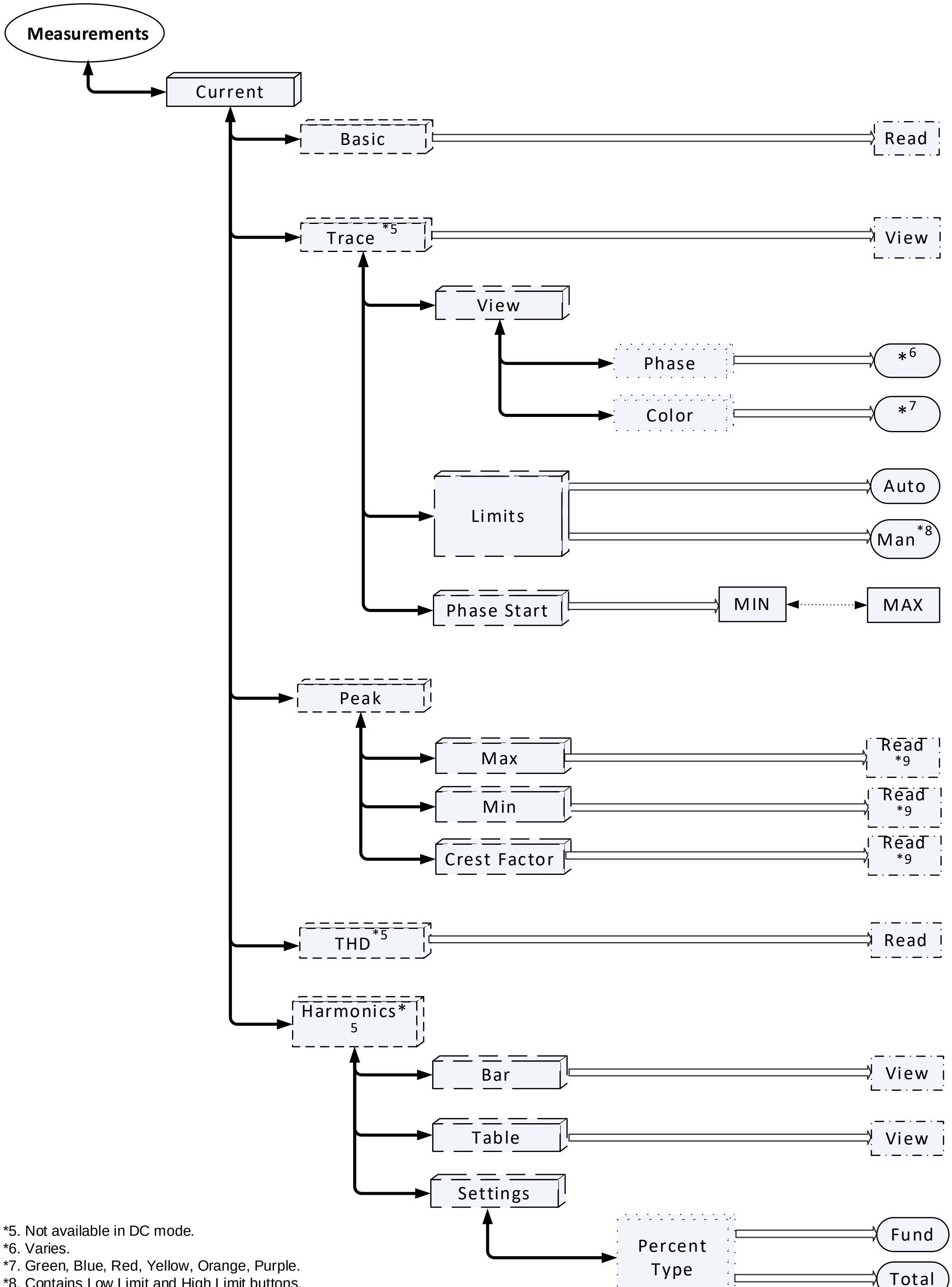
If the operation mode is changed while the output is ON, an “illegal command” message appears.

9.4.2 Measurements Menu



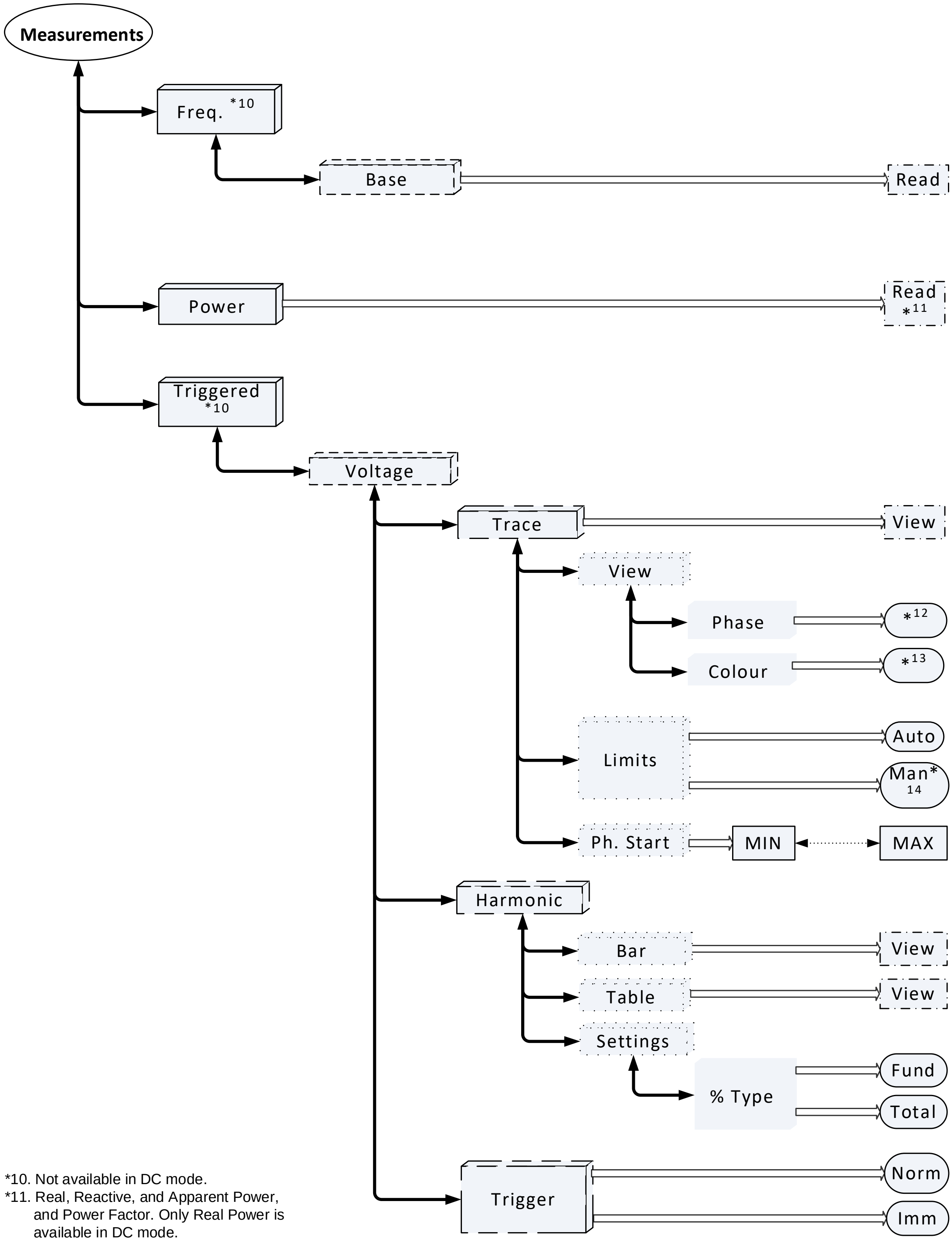
*1. Not available in DC mode.
*2. Varies.
*3. Green, Blue, Red, Yellow, Orange, Purple.
*4. Contains Low Limit and High Limit buttons.

MEASUREMENTS - CONTINUED



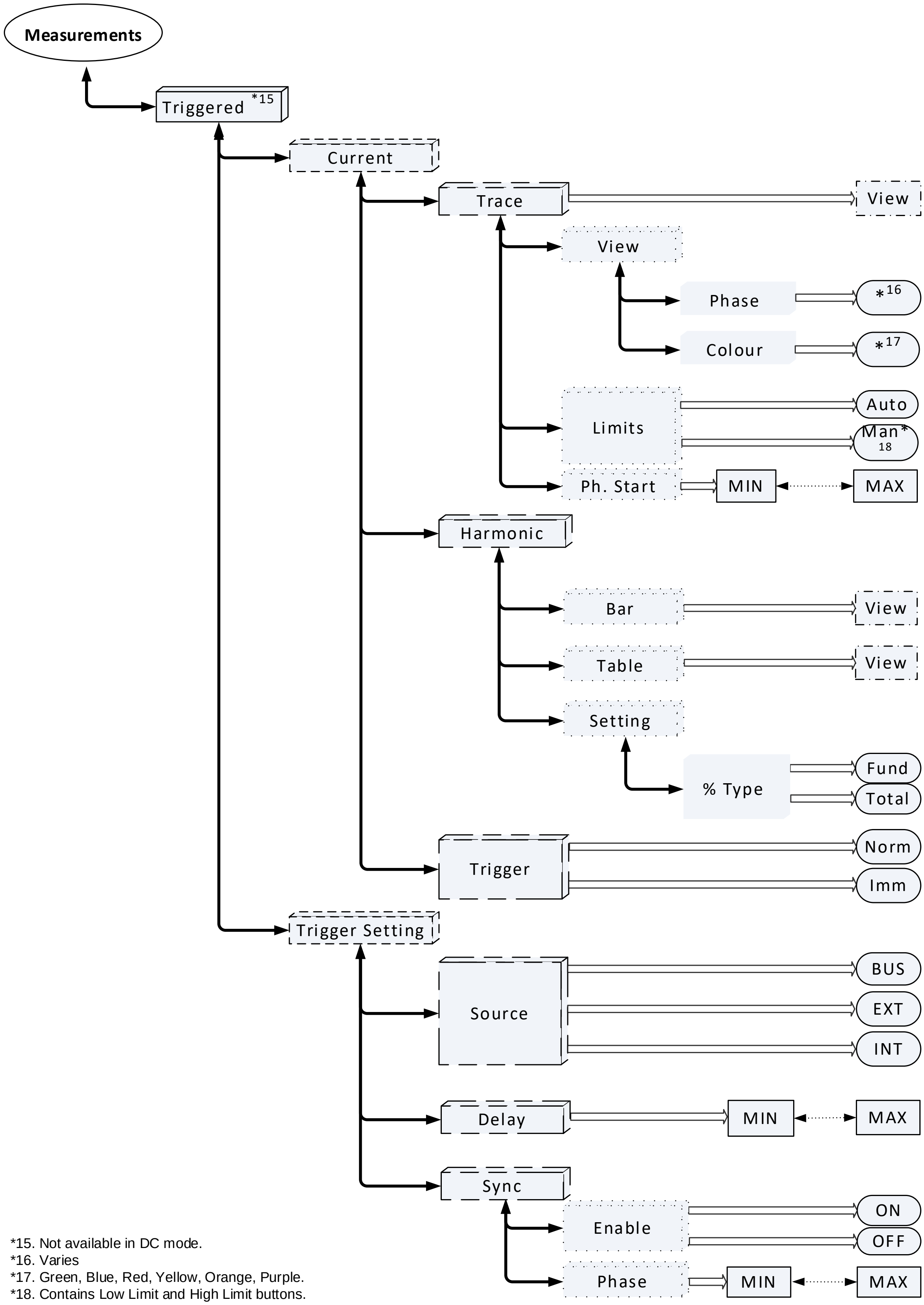
*5. Not available in DC mode.
*6. Varies.
*7. Green, Blue, Red, Yellow, Orange, Purple.
*8. Contains Low Limit and High Limit buttons.
*9. Also have reset menu.

MEASUREMENTS - CONTINUED



*10. Not available in DC mode.
*11. Real, Reactive, and Apparent Power, and Power Factor. Only Real Power is available in DC mode.
*12. Varies.
*13.Green, Blue, Red, Yellow, Orange, Purple.
*14. Contains Low Limit and High Limit buttons.

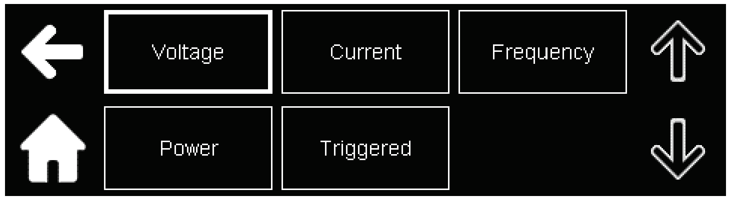
MEASUREMENTS - CONTINUED



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

After selecting **Measurements,** its sub-menu opens.

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



NOTE

In DC mode, **Frequency** and **Triggered** are not shown.

Voltage

Click **Voltage**.

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

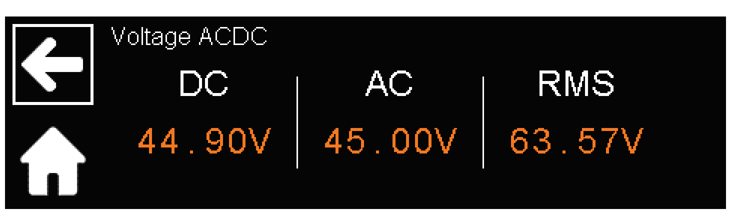
NOTE

In DC mode only direct measurements of the output voltage is seen.

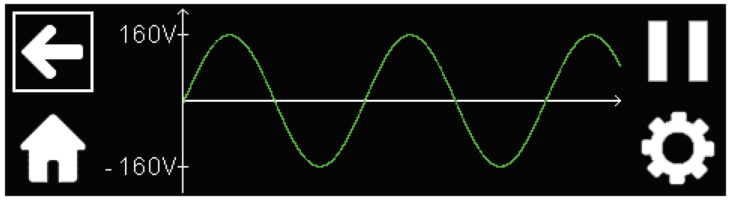
Click **Basic** to read the measured values.

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

ACDC mode: Displays the rms value of the output voltage. The value may include the AC component, DC offset, or both.

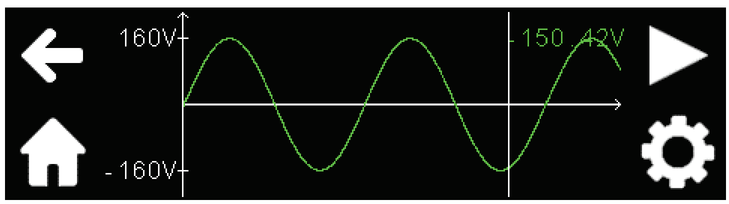


From the **Voltage** sub-menu, click **Trace** to display the real-time waveform of the output voltage.



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

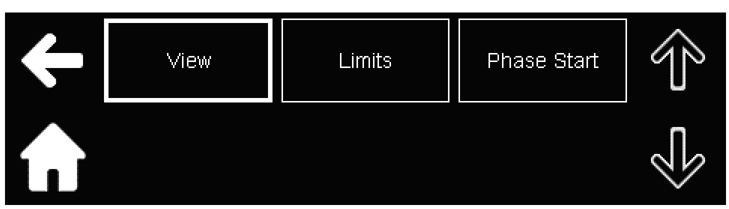
By pausing the capture, followed by tapping on the screen, a vertical cursor appears. By pressing and moving this cursor simultaneously, it can be used to select any position on the screen to display the instantaneous value of the output voltage. Alternatively, the **NAVIGATION PANEL** can also be used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



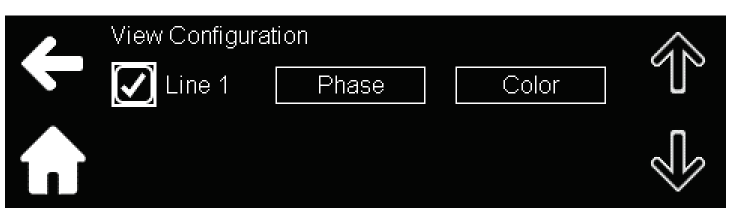
To display an expanded view of the waveform, zooming can be done on the display.

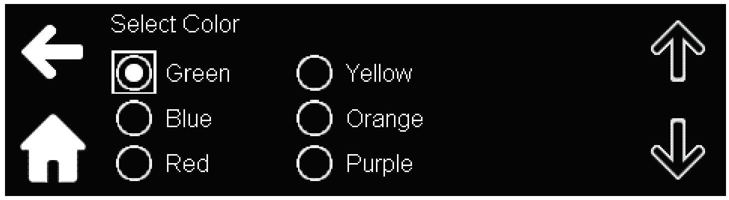
Keep the cursor pressed until it disappears. Keep on pressing the screen; move over the screen to select the portion of the waveform to be zoomed. Use to return from zoom.

Tap to enter the trace options.



Click **View** to select the phase to be displayed and the color of the displayed waveform.

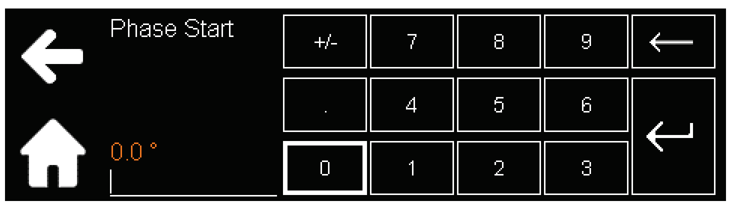




Click **Limits** to select the display limits.

- **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.

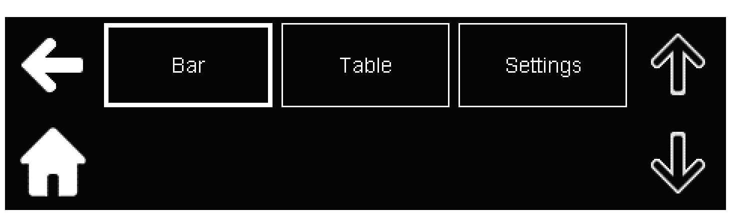
Click **Phase Start** to select the start phase of the waveform is to be displayed.



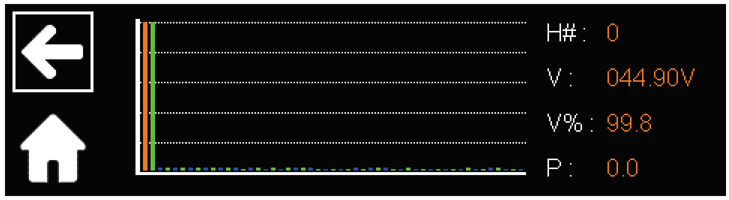
From the **Voltage** sub-menu, click **THD** to view the Total Harmonic Distortion of the output voltage.

The THD is calculated using harmonics 2 to 50 and is calculated relative to the fundamental frequency or total harmonic spectrum.

From the **Voltage** sub-menu, click **Harmonics t**o display the harmonics of the output voltage. Measurement 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 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:

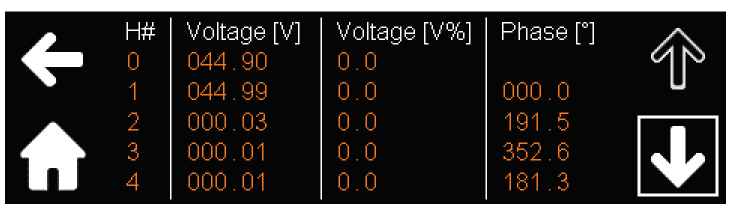
H#: the Harmonic Number

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.



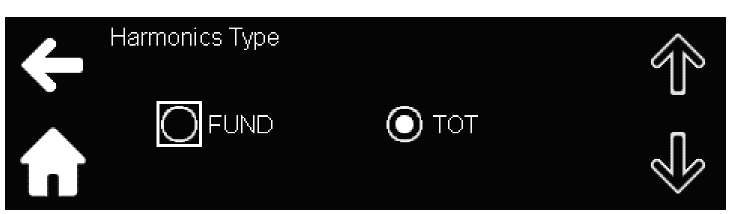
H#: the Harmonic Number

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 amplitude in percentage.



Refer to MEASure:HARMonic:PERCent[:TYPE] <DSC> in **Section 14.13.4: Measure Subsystem**.

Current

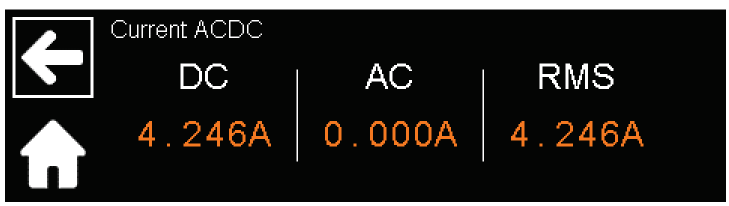
Click **Current**.

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 rms value of the output current. The value may include the AC component, DC offset, or both. A window with both the components is shown below.

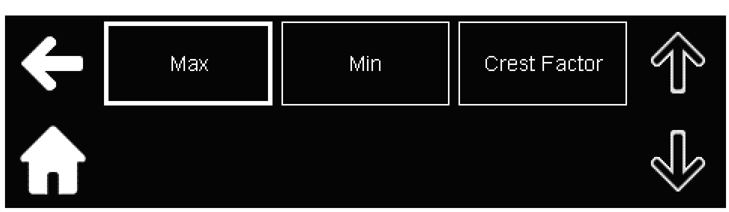


From the **Current** sub-menu, click **Trace** to display the real-time waveform of the output current.

NOTE

Follow the same procedure as explained in the **Voltage** sub-menu to display the real-time waveform.

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



The screen for the Crest Factor is shown below.

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

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 to display the THD and harmonics values.

Frequency

Click **Frequency**.

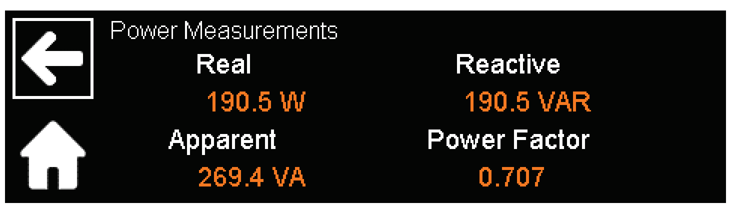
NOTE

Returned measured frequency is 0 if the output voltage is below 5%

Power

Click **Power**.

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



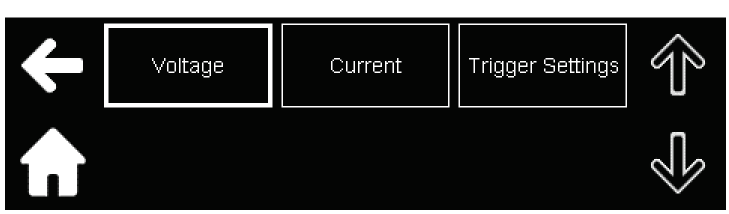
NOTE

The **Reactive**, **Apparent**, and **Power Factor** measurements are applicable in DC mode.

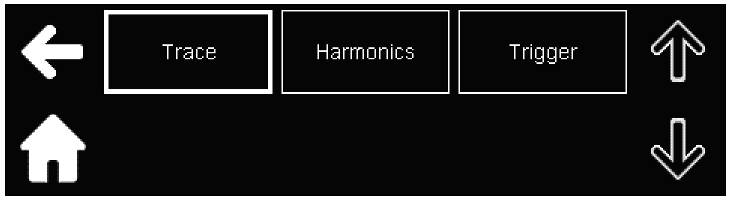
Triggered

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, as well as for their harmonics. Triggers can also be synchronized with different phase angles and delays, and different trigger sources can also be selected.

Click **Triggered**.



Click **Voltage** or **Current** to enter its setup option.



Trace:

NOTE

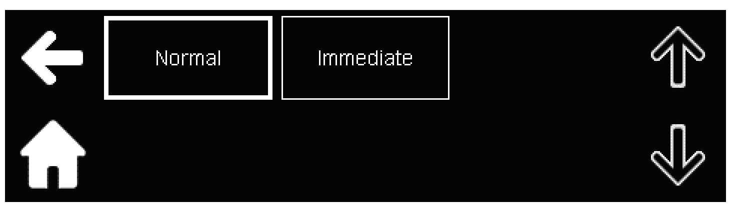
Follow the same procedure as explained in the **Voltage** sub-menu →**Trace** section to display the triggered waveform of the output voltage.

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.

Trigger:



Normal: sets a trigger with a delay.

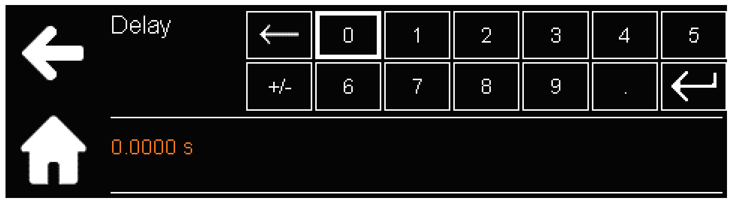
Immediate: sets a trigger without any delay.

From the **Triggered** sub-menu, click **Trigger Settings** to enter its setup option.

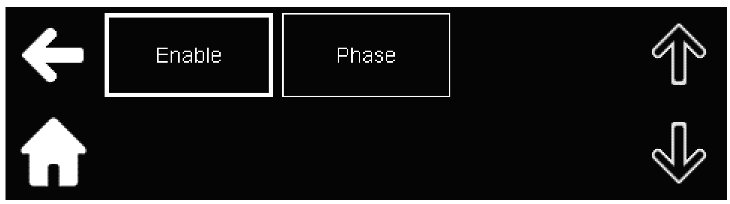
Click **Source** to selects the trigger source for measurements.

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

Click **Delay** for setting a delay for a 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 of trigger sources: BUS, external, and internal. Refer to MEASure:TRIGger:DELay <NRf> in **Section 14.13.4: Measure Subsystem.**



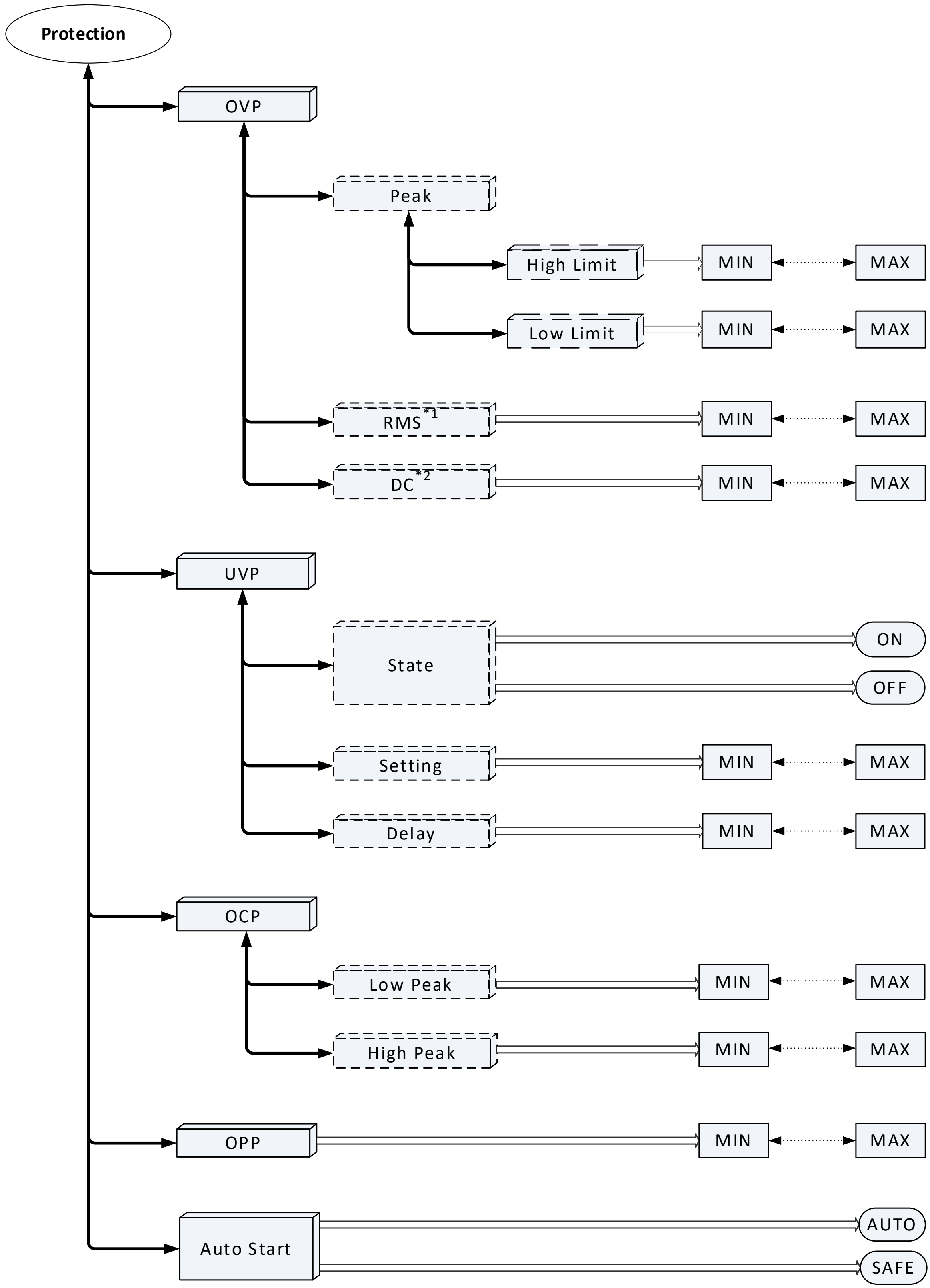
Click **Sync** to triggers measurements that can be synchronized with any phase angle.



Enable: enables or disables synchronization of the measurement trigger

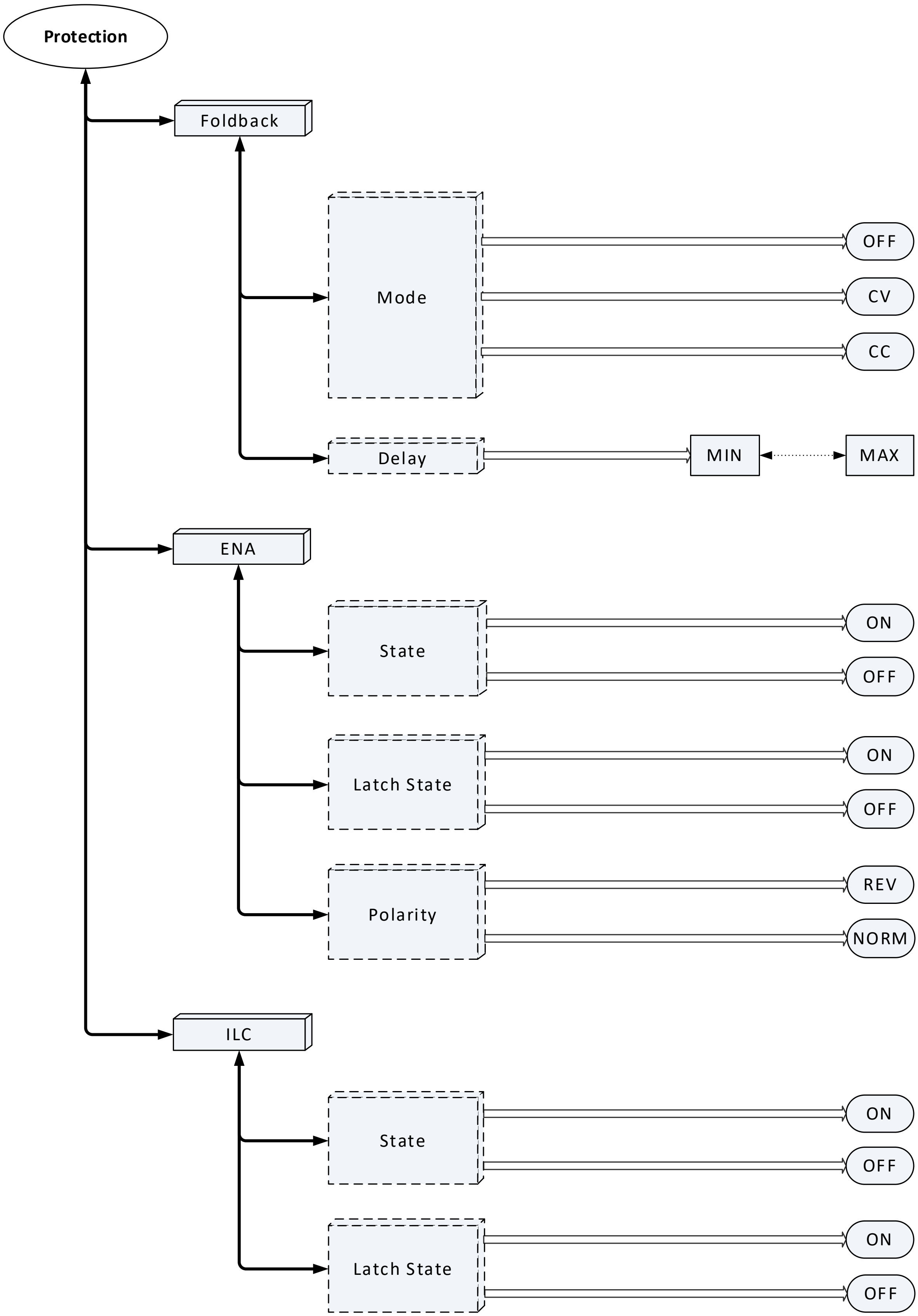
Phase: sets the synchronization phase of the measurement trigger. Refer to MEASure:TRIGger:SYNC:PHASe <NRf> in **Section 14.13.4: Measure Subsystem.**

9.4.3 Protection Menu

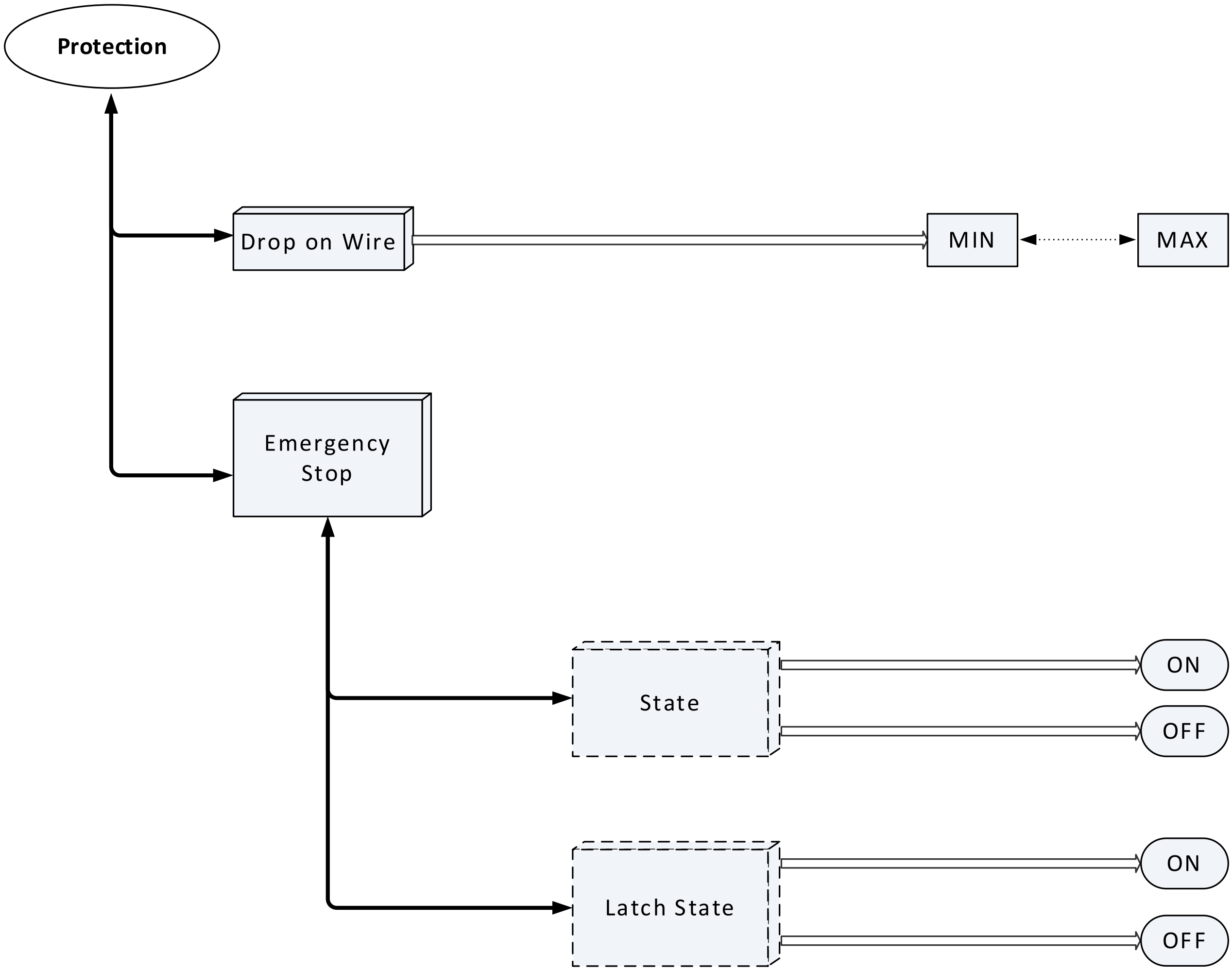


*1. Not available in DC mode.
*2. Not available in AC and ACDC mode.

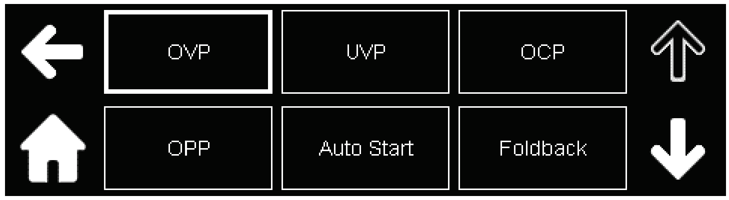
PROTECTION - CONTINUED

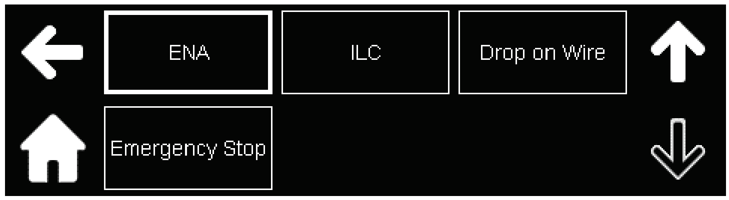


PROTECTION-CONTINUED



After selecting **Protection**, its sub-menu opens.





NOTES

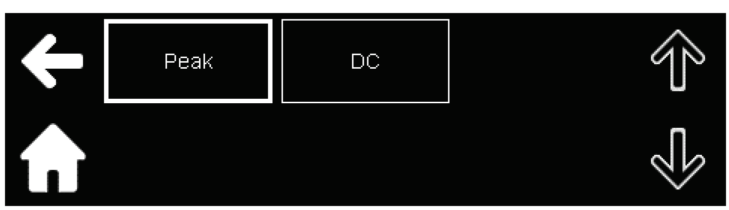
Refer to **Section 14.13.8: Source Subsystem** for the programming parameters of OVP, UVP, OCP, OPP, and Drop on wire. Refer to **Section 14.13.5: Output Subsystem** for the programming parameters of Foldback.

OVP

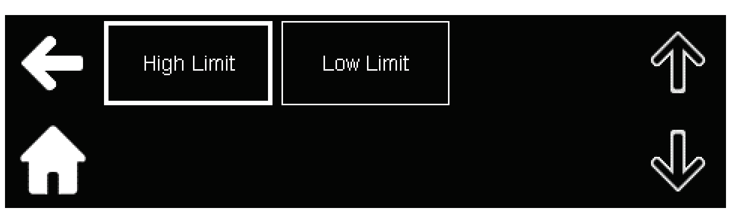
The Over-Voltage Protection (OVP) protects the customer's equipment from Over-Voltage by detecting the peak, rms, and DC values of the output voltage.

Click **OVP**.

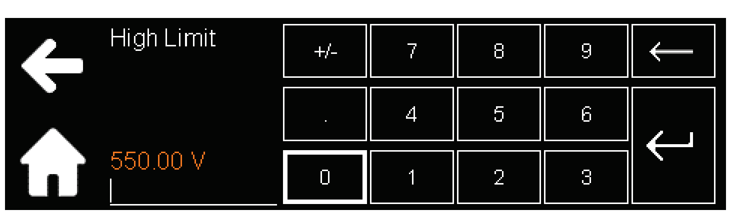
The window for OVP setting in DC mode is shown below.



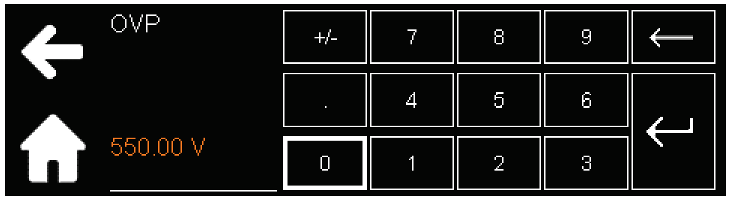
Click **Peak** to set the high limit and low limit of the peak OVP level.



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



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



UVP

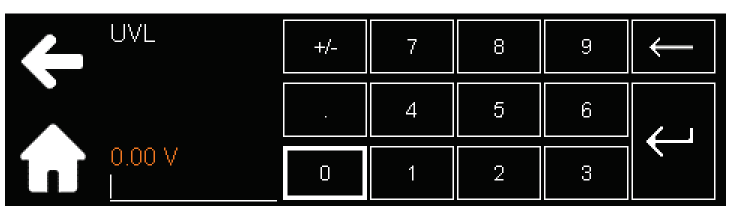
The Under-Voltage Protection (UVP) protects the customer equipment from Under-Voltage.

Click **UVP**.

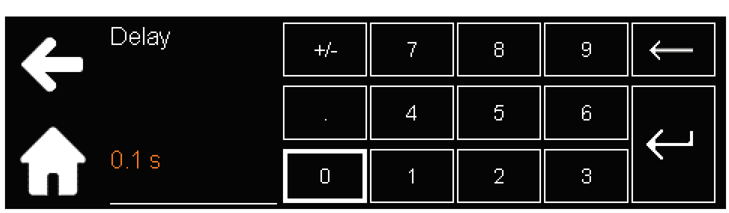
Click **State** to enter its setup options.

- **ON**: This mode prevents the voltage setting below the UVL level and disables the output when the measured voltage reaches the UVL level.
- **OFF**: This mode prevents the voltage setting below the UVL level.

Click **Setting** for setting the required Under-Voltage limit (UVL).



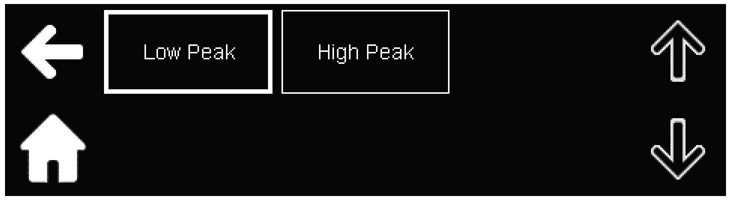
Click **Delay** for setting the required Under-Voltage Protection (UVP) delay.



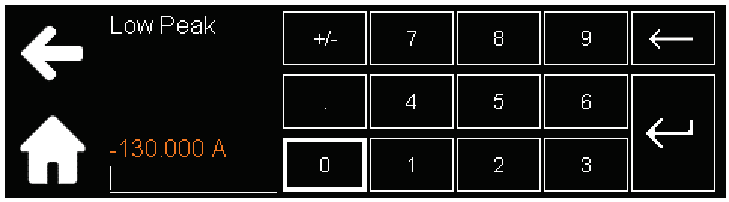
OCP

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

Click **OCP**.



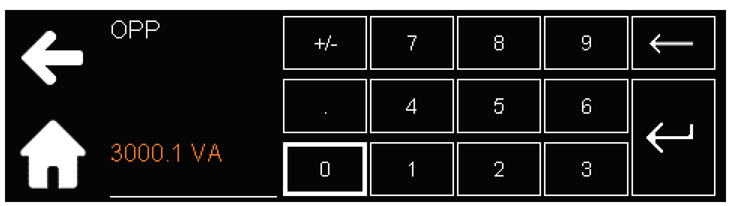
The window to set the low peak limit is shown below.



OPP

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

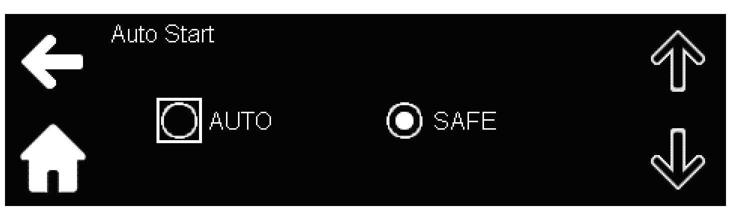
Click **OPP**.



Auto Start

This defines how the power source recovers from a non-latched fault or after an AC reset.

Click **Auto Start**.

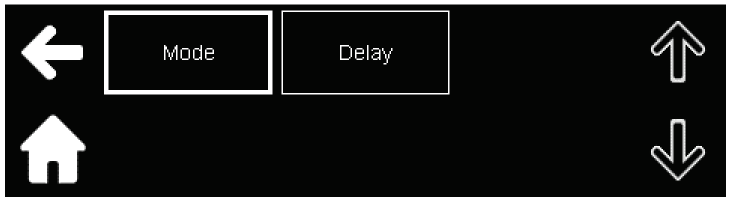


- **AUTO**: The power source recovers to the previous state (before the non-latching fault occurred) or to the last setting if an AC recycle was done.
- **SAFE**: The power source is restored to last operating setting and the output always returns to OFF.

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.

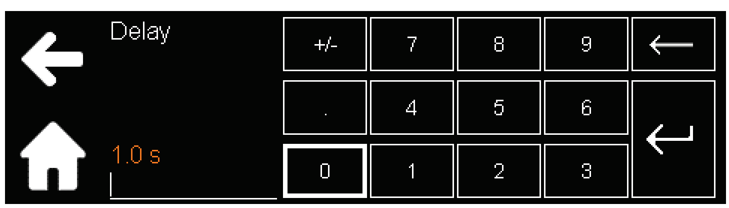
Click **Foldback**.



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** for setting the delay period following which foldback is activated.



ENA

The ENA signal serves as the power source enable control.

Click **ENA**.

Click **State** to enable or disable the ENA function.

Click **Latch State** to enable or disable the ENA latch function.

Click **Polarity** to set the type of polarity.

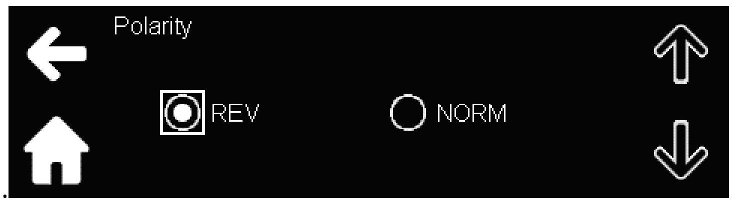
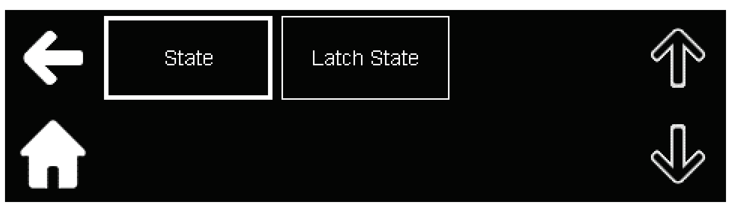


Table 11-6 shows the status of the power source output with respect to the ENA signal and its polarity.

ILC

The ILC signal serves as the power source enable control.

Click **ILC**.



Click **State** to enable or disable the ILC function.

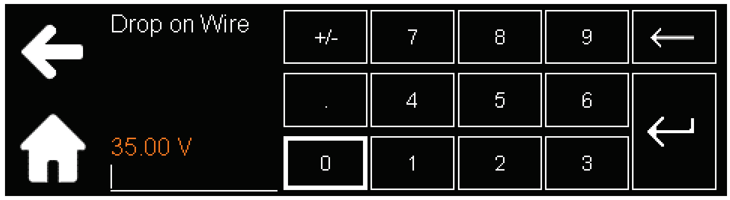
Table 11-7 shows the status of the power source output with respect to the ILC signal.

Click **Latch State** to enable or disable the ILC latch function.

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.

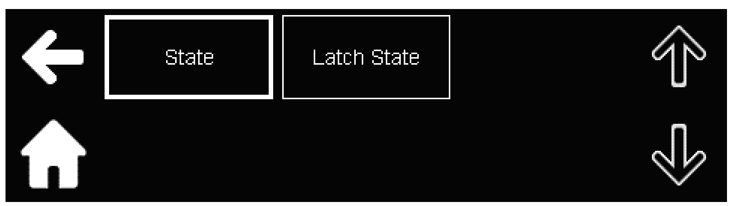
Click **Drop on Wire**.



Emergency Stop (Emergency Power OFF)

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

Click **Emergency Stop**.

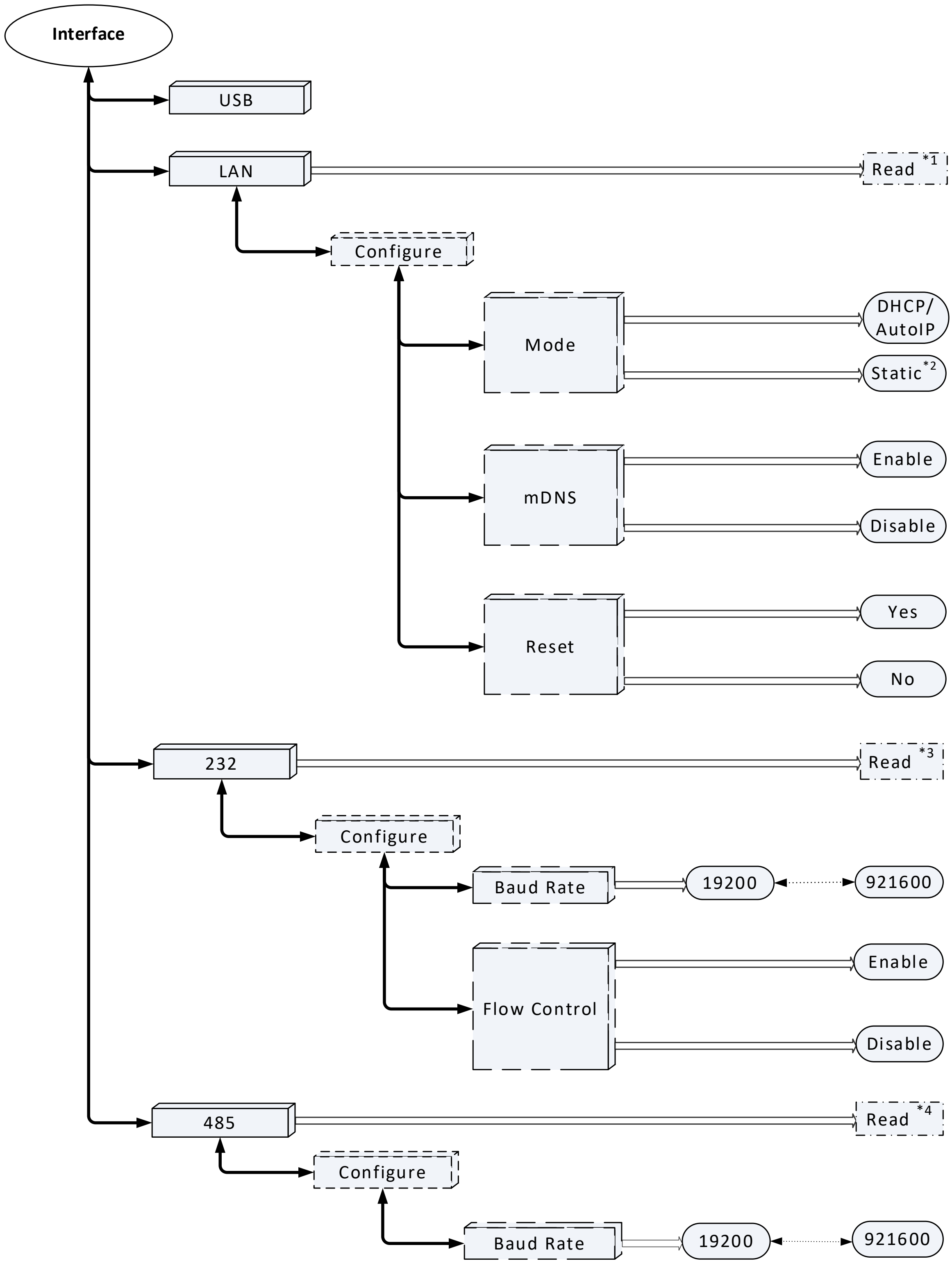


Click **State** to enable or disable the emergency stop function.

Click **Latch State** to enable or disable the emergency stop latch function.

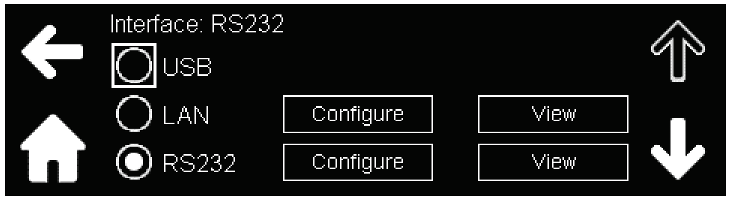
Table 8-4 shows the status of the power source output with respect to the Emergency Stop (Emergency Power OFF) signal.

9.4.4 Interface Menu



*1. Mode, IP address, MAC address, host name, subnet mask, DNS server, default gateway, and mDNS settings.
*2 IP Address, Subnet Mask, Default Gateway, DNS Server and mdns settings.
*3. Baud rate and flow control.
*4. Baud rate.

After selecting **Interface**, its sub-menu opens.



USB

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

LAN

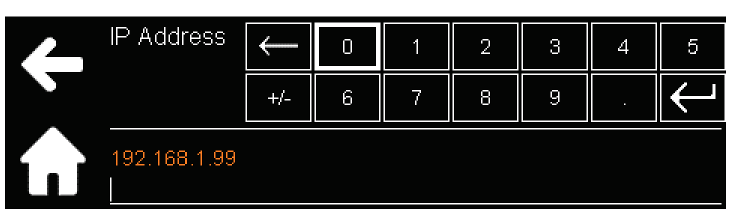
Click **LAN** to select the LAN interface.

LAN →Configure

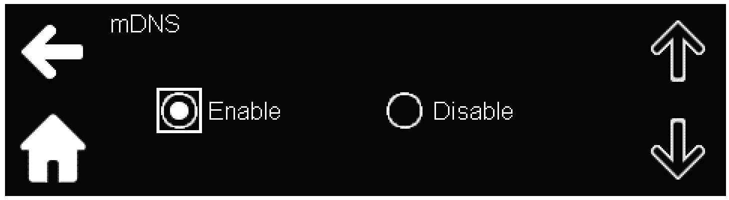
Click **Configure** to configure the LAN settings. The default mode is DHCP/Auto IP.

Click **Mode** to select the LAN operating mode.

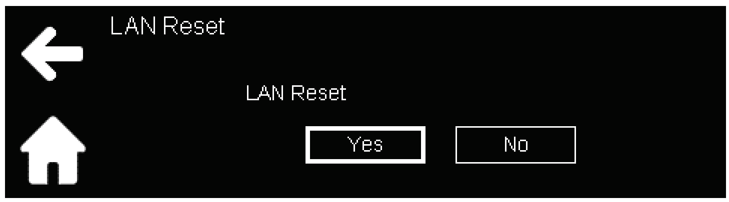
- **DHCP/Auto-IP (default)**: In this mode, the network assigns the IP address, Subnet Mask, Default Gateway, and DNS server.
- **STATIC**: In this mode, IP Address, Subnet Mask, Default Gateway, mDNS server, and DNS settings are entered by the user. After selecting **STATIC**, move back one screen to enter the details. The screen to set the IP Address is shown below.



Click **mDNS** (Multicast DNS) to enable or disable it.

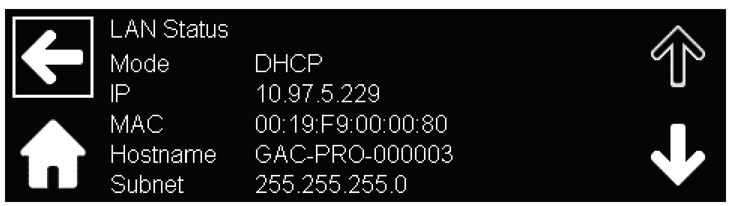


Click **Reset** to restore the LAN settings to default.



LAN→View

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

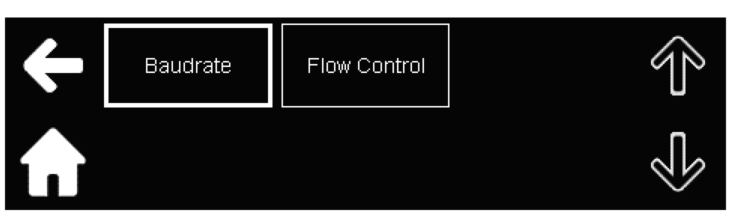


RS232

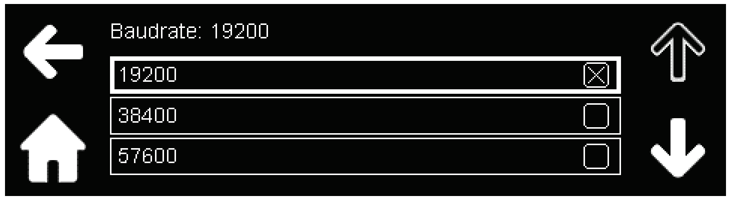
Click **RS232** to select the 232 interface.

RS232→Configure

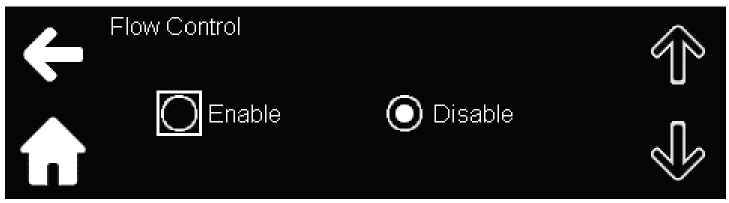
Click **Configure** to configure the RS232 interface. The settings must match the settings of the external controller.



Click **Baudrate** to select the operating baudrate. Options are: 19200 to 921600.



Click **Flow Control** to enable or disable 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.

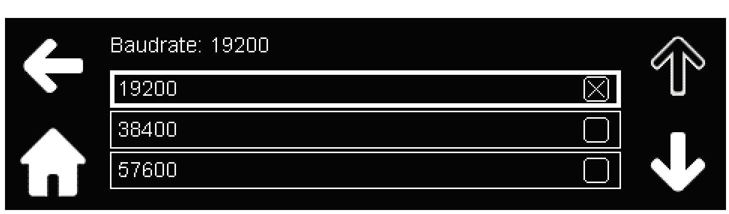
RS485

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

RS485→Configure

Click **Configure** to configure the baudrate. The setting must match the settings of the external controller.

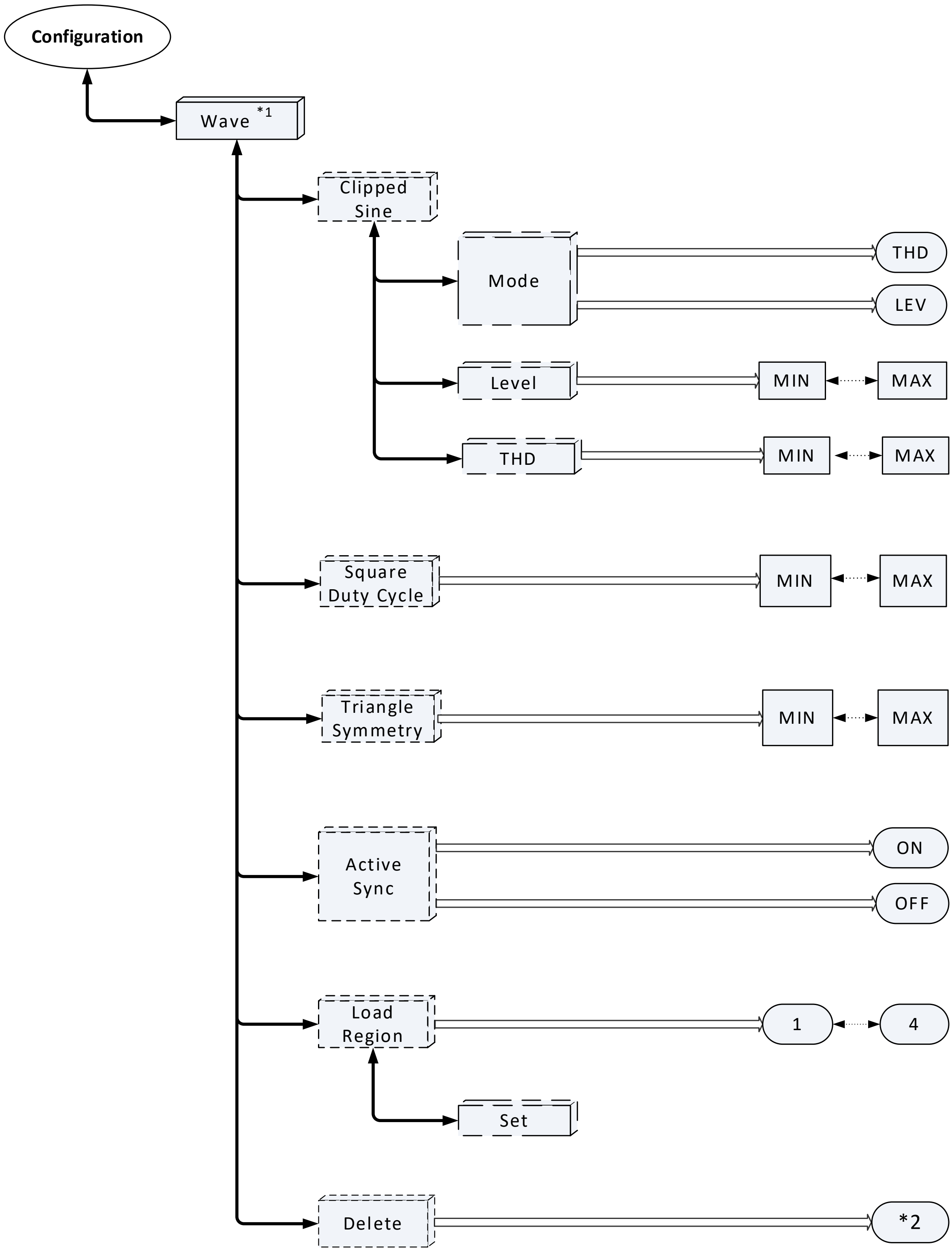
Click **Baudrate** to select the operating baudrate. Options are: 19200 to 921600.



RS485->View

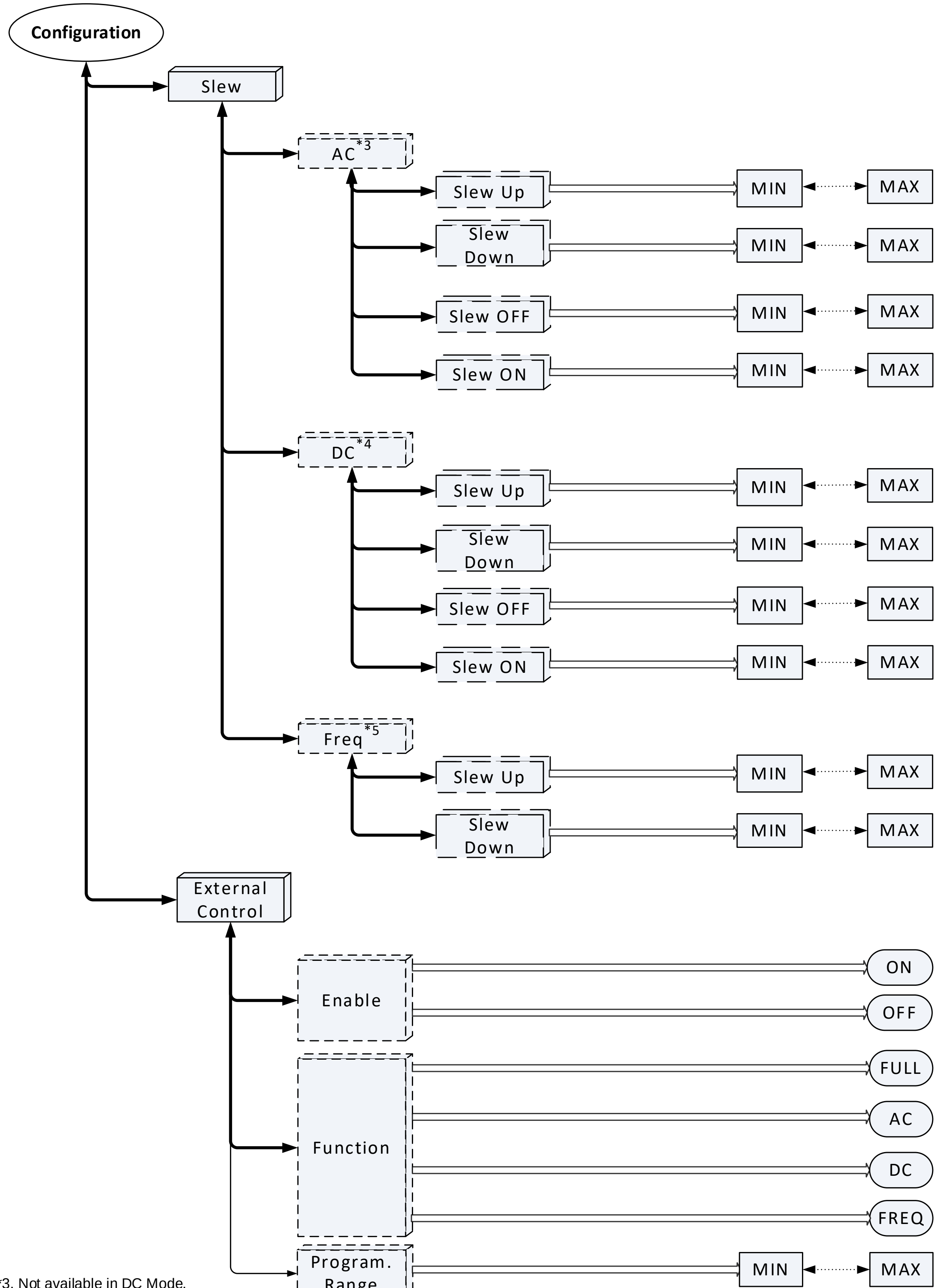
Click **View** to display the RS485 settings.

9.4.5 Configuration Menu

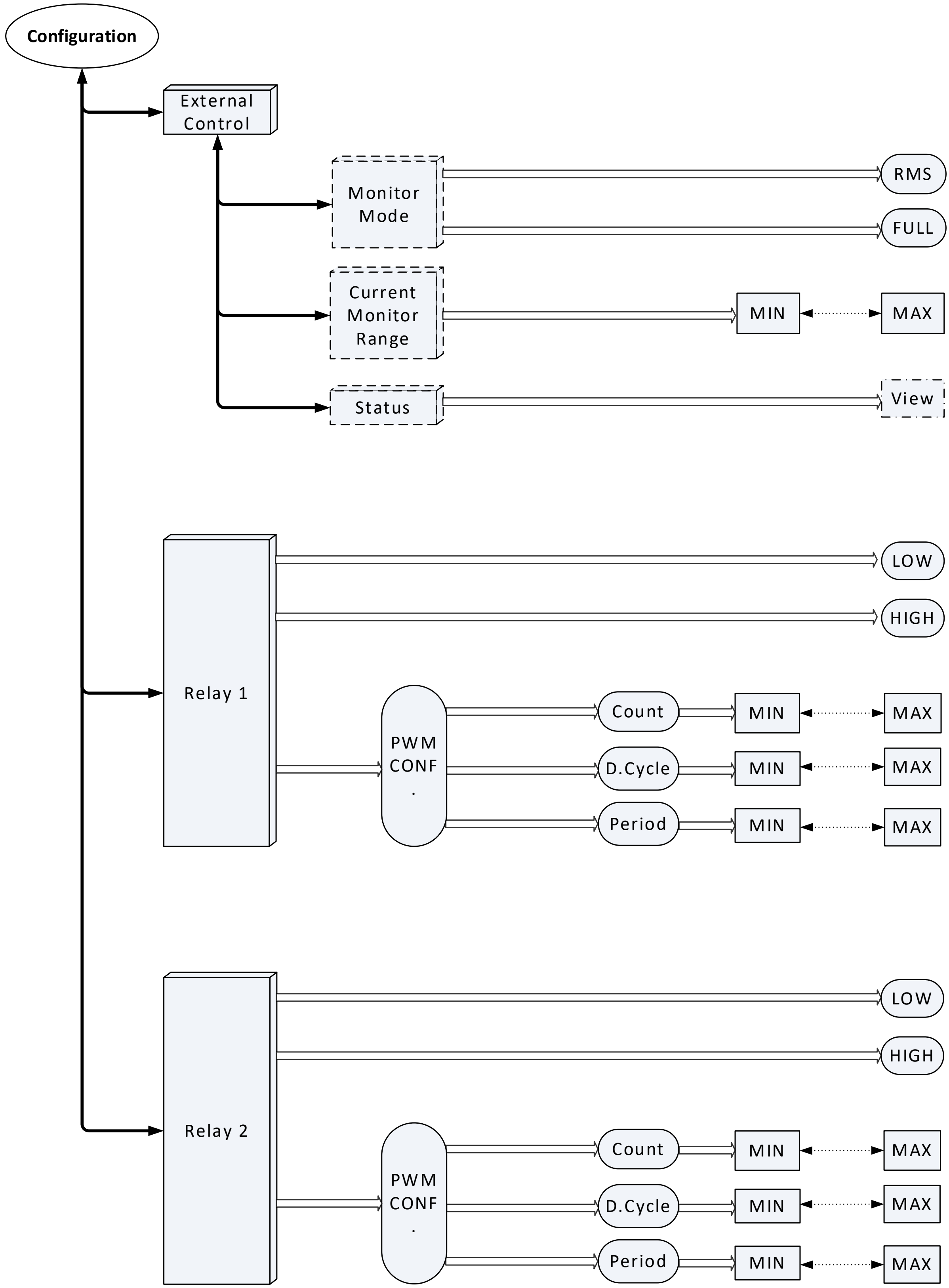


*1. Not available in DC mode.
*2. Delete User built waveforms.

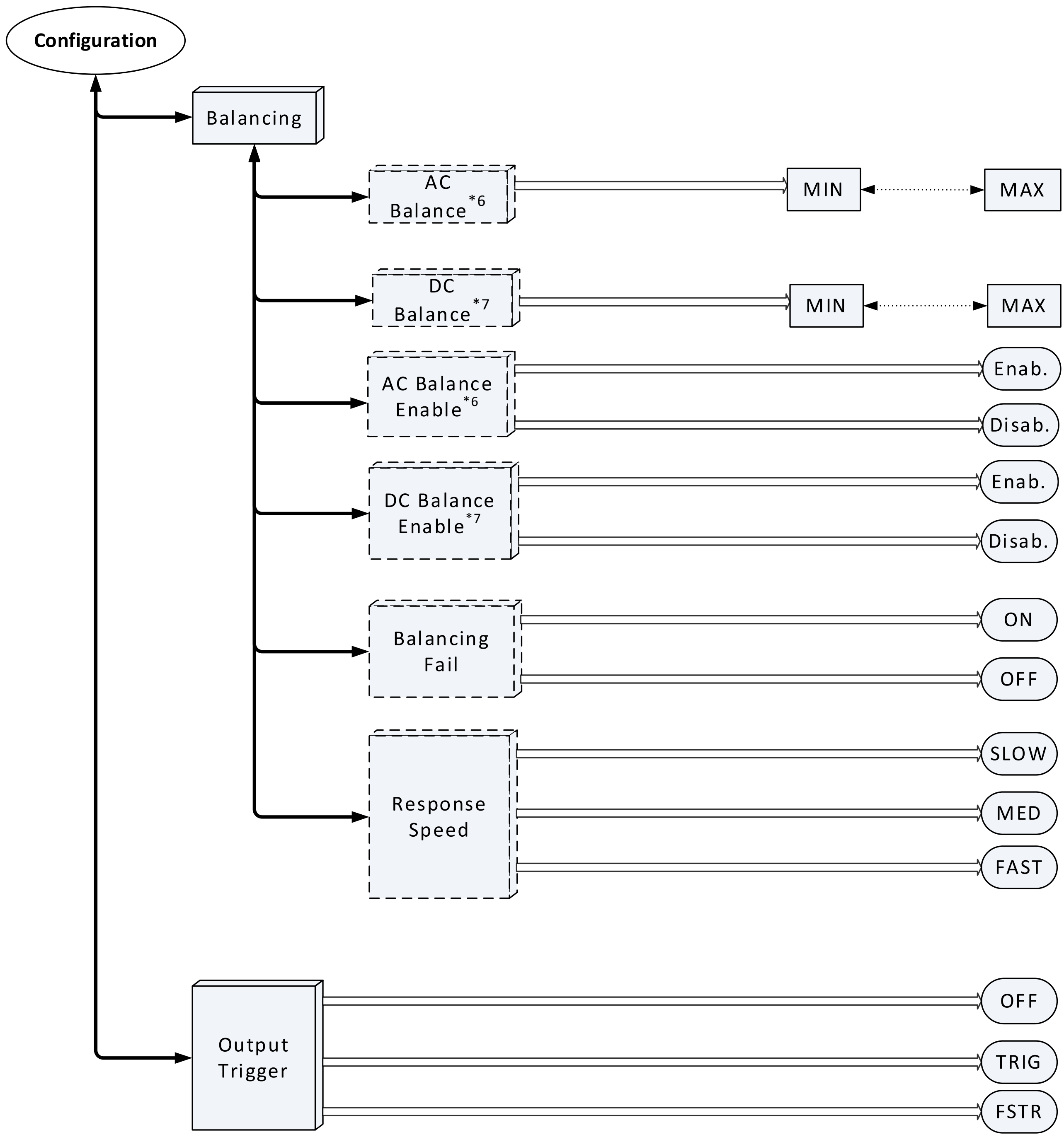
CONFIGURATION - CONTINUED



*3. Not available in DC Mode.
*4. Not available in AC mode.
*5. Not available in DC mode.

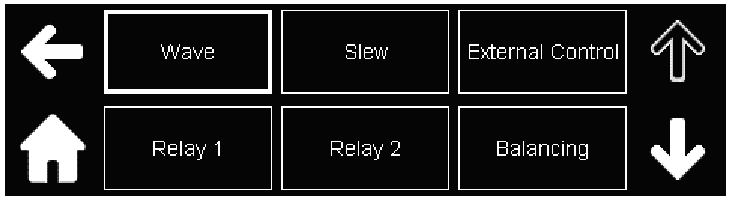

Configuration
External Control
Monitor Mode
RMS
FULL
Current Monitor Range
MIN
MAX
Status
View
Relay 1
LOW
HIGH
PWM CONF.
Count
MIN
MAX
D.Cycle
MIN
MAX
Period
MIN
MAX
Relay 2
LOW
HIGH
PWM CONF.
Count
MIN
MAX
D.Cycle
MIN
MAX
Period
MIN
MAX

CONFIGURATION - CONTINUED



*6. Not available in DC mode.
*7. Not available in AC mode.

After selecting **Configuration**, its sub-menu opens.



Wave

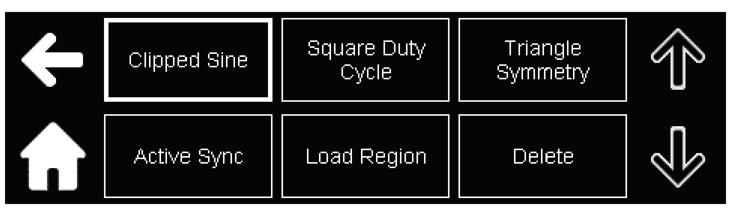
This sub-menu allows to create waveforms that are actually modified built-in waveforms. Different levels, duty-cycle, symmetries, and THD levels can be programmed.

Additionally, all the user created waveforms (not sequencers) 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.

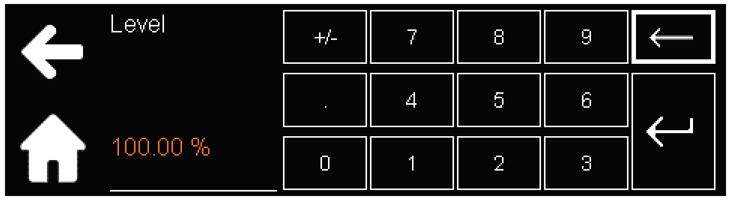
Click **Wave**.



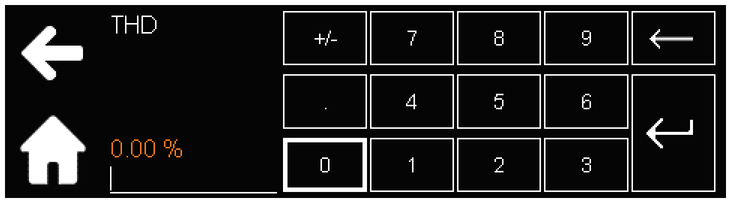
Click **Clipped Sine** to **c**ontrols various parameters of the Clipped Sine wave.

Mode: Selects the CSINe attribute (LEVel or THD) used to generate the CSINe wave.

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

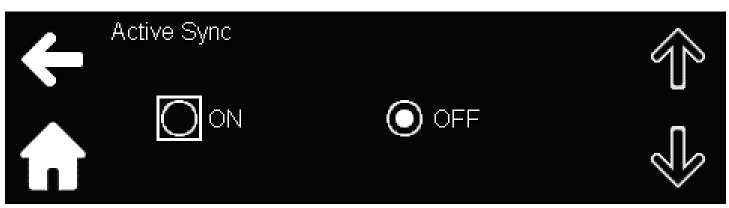


THD: Sets the Total Harmonic Distortion (THD) level of the built-in clipped sine wave.



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.

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**.



Under **Wave** sub-menu, click **Load Region** to select the region for storing or loading 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 to program the slew rate of the up and down programming of the AC voltage, DC voltage, and frequency.

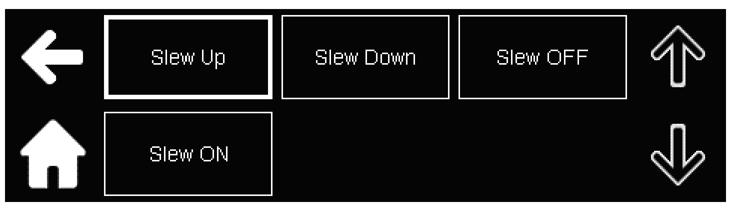
NOTE

Refer to **Table 14-9** for the programming parameters of the slew rate.

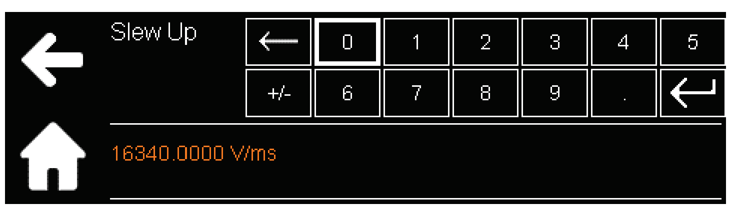
Click **Slew**.

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

Click **AC**.



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



Click **Slew Down** to set the slew down programming.

Click **Slew OFF** to set the slew down programming during ON to OFF transition.

Click **Slew ON** to set the slew up programming during OFF to ON transition.

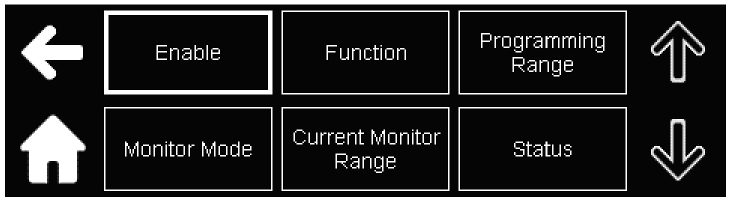
NOTES

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.
Maximum slew rate is limited by the hardware.

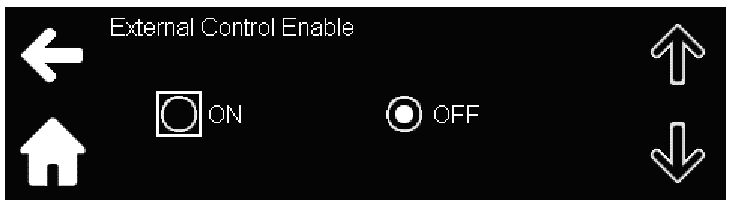
External Control

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

Click **External Control**.



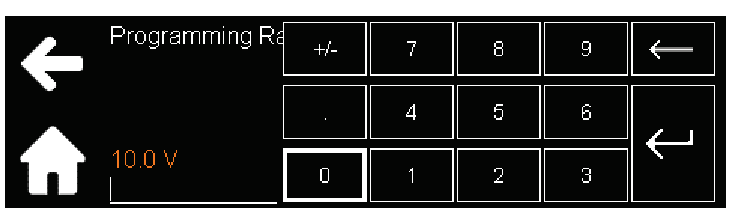
Click **Enable** to enable or disable programming with an external voltage reference.



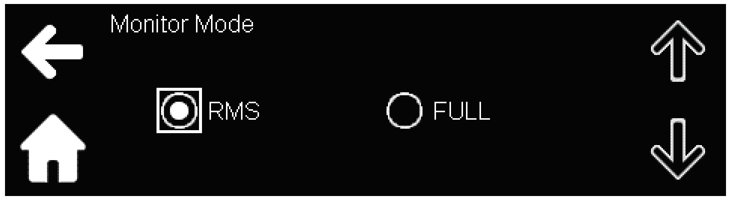
Under **External Control** sub-menu, click **Function** to set the analog programming function. The argument indicates which parameter is controlled via analog programming.

Refer to **Table 11-5** for an explanation of different types of arguments and how they control the programming parameters.

Under **External Control** sub-menu, click **Programming Range** to set the range for analog programming and monitoring. The range is 2.5–10V.

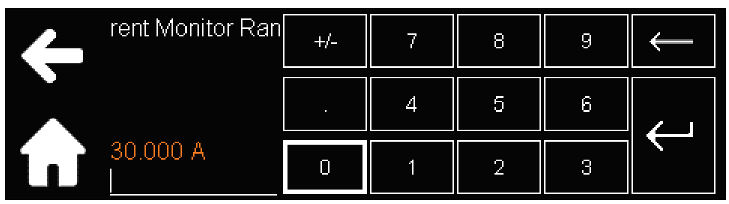


Under **External Control** sub-menu, click **Monitor Mode** to set the analog monitoring function. The argument indicates which parameter is controlled via analog monitoring.

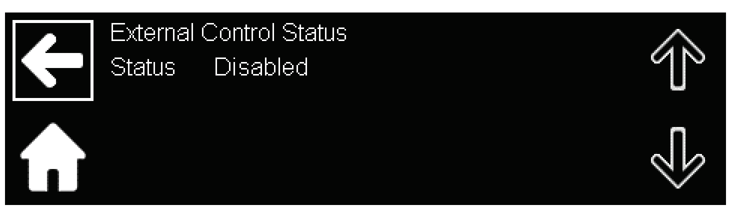


Refer to SYSTem:EXTernal:MONitor[:MODE][#] <DSC> in **Section 14.13.10: System Subsystem** for an explanation of different types of arguments and how they control the monitoring parameters.

Under **External Control** sub-menu, click **Current Monitor Range** to set 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 monitoring range.

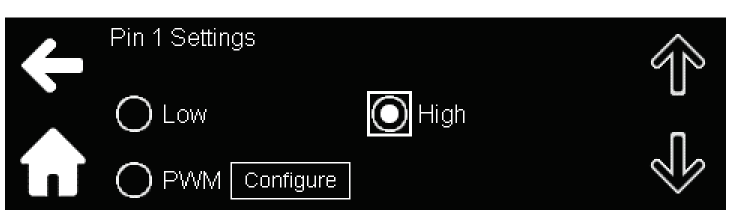


Under **External Control** sub-menu, click **Status** to return the actual state of the source of the voltage reference programming.



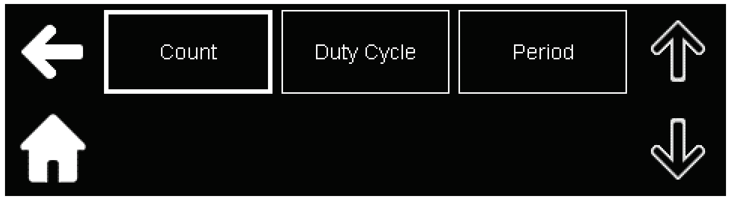
Relay 1

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** to enter its setup option.

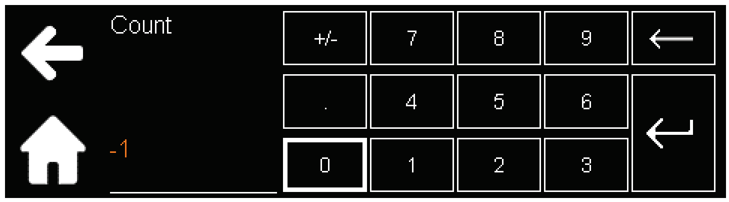


- **Low**: The signal is low.
- **High**: The signal is high.
- **PWM**: The signal is in the form of pulses.

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



Count: Set the number of generated pulses.



Duty Cycle: Set the Duty Cycle

Period: Set the Period

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

Relay 2

Relay 2 is an additional general-purpose, open-drain user-programmable pin that has exactly 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.**

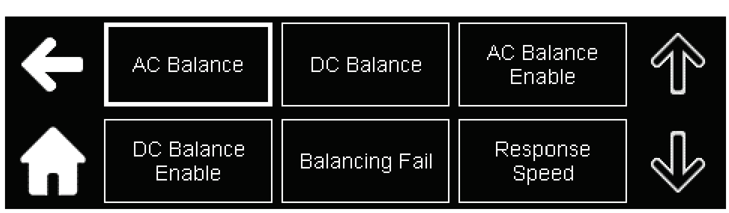
Balancing

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.

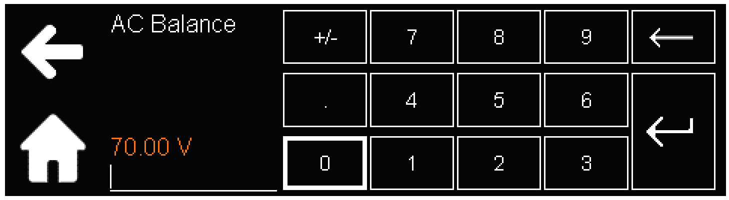
NOTE

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

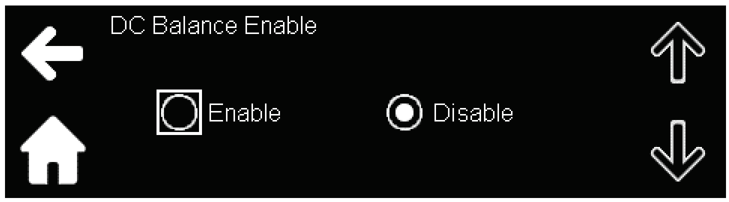
Click **Balancing.**



The window to set the voltage correction level for the AC component is shown.

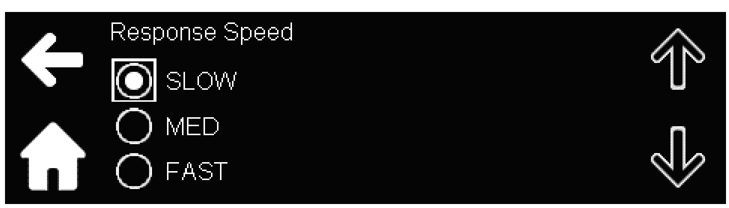


The window to enable or disable the balancing in DC mode is shown.



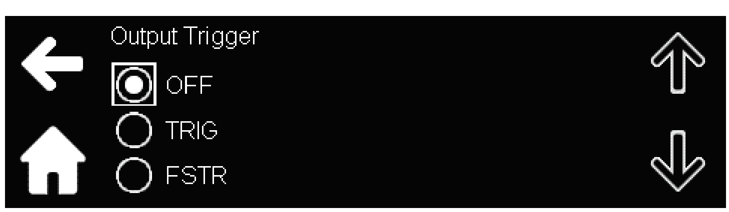
Under **Balancing** sub-menu, click **Balancing Fail** to enable or disable the balancing failure fault. If disabled, the fault does not cause the output to be turned off, and the fault is not reported.

Under **Balancing** sub-menu, click **Response Speed** to set the response speed of voltage balancing. This also affects the transition time between CV and CC.

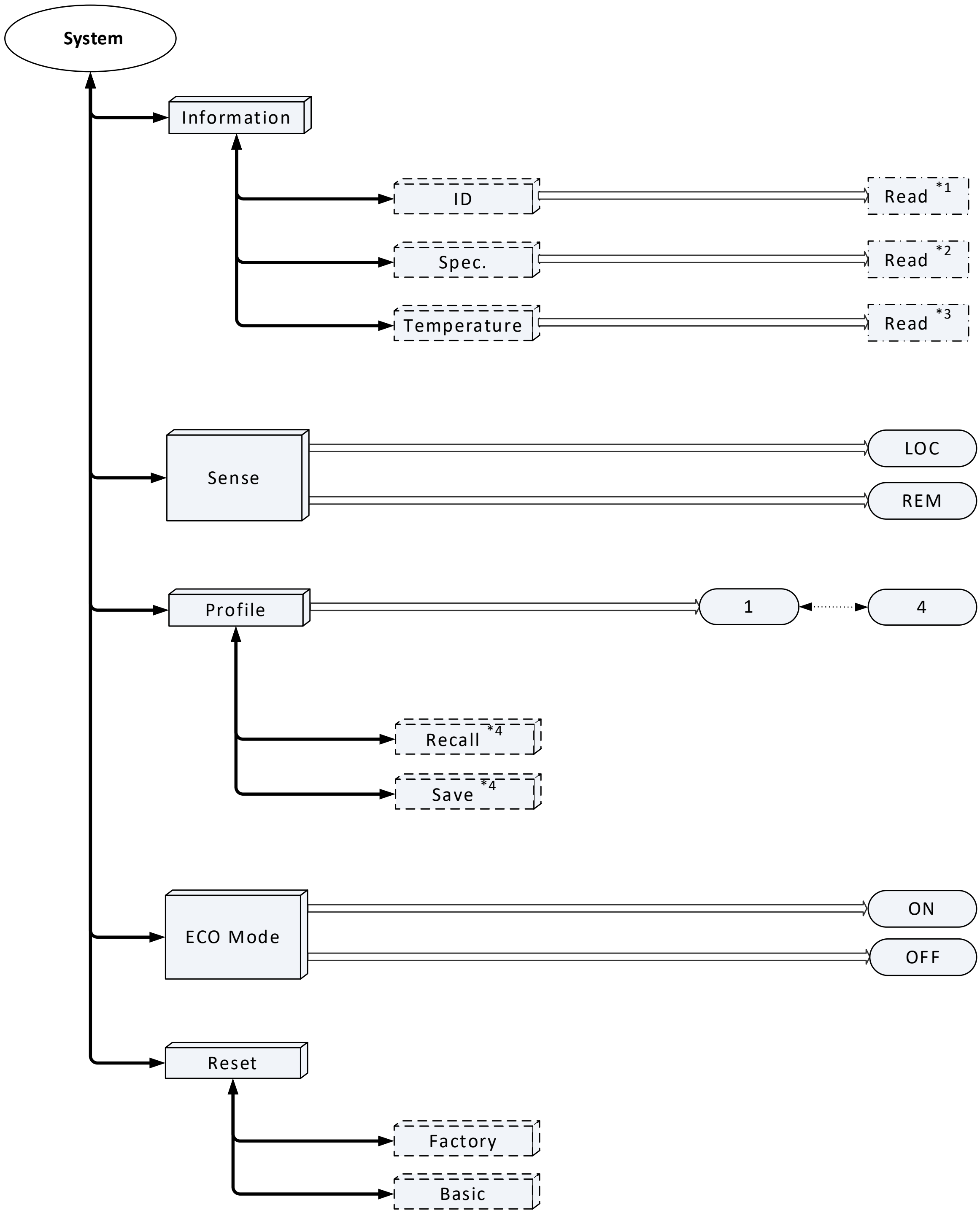


Output Trigger

Click **Output Trigger** to set the operation mode of the Trigger Out signal (J4-23). Refer to **Section 14.13.5: Output Subsystem**.

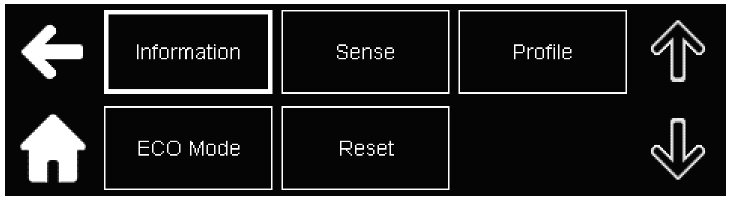


9.4.6 System Menu



*1. Power Source information – IDN, serial no., software versions.
*2. Power Source specifications – voltage rating, current rating, power rating, frequency.
*3. Internal Temperature.
4. Save and Recall have a Yes/No option.

After selecting **System**, its sub-menu opens.

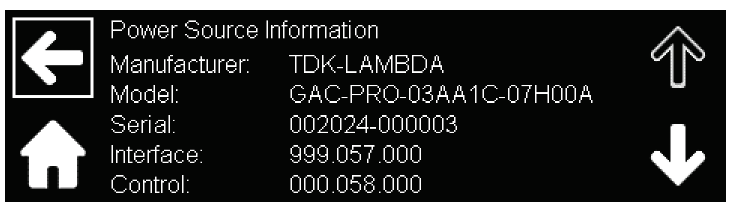


Information

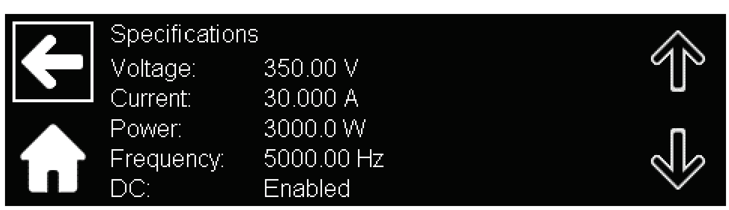
This section provides information about the power source.

Click **Information**

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



Click **Specifications** to display the specifications of the power source such as voltage, current, power, and frequency rating.



Click T**emperature** to display the measured internal temperature.

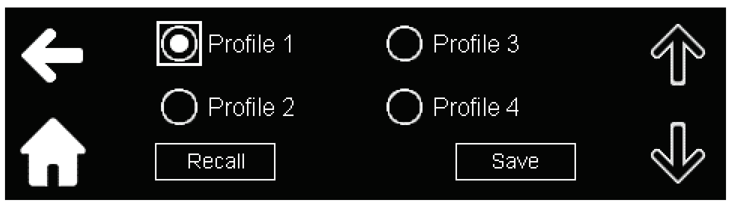
Sense

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. Refer to **Table 13-1** (Save and Recall)



Select the profile and then the required button.

ECO Mode

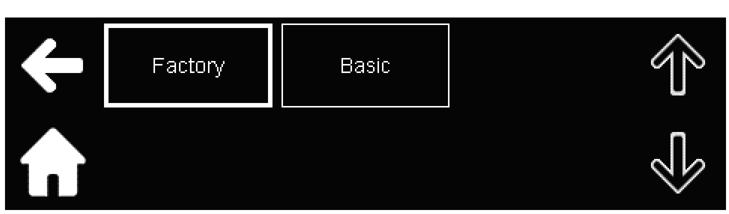
Click **ECO mode** to enable or disable the ECO mode. Refer to OUTPut:ECO[:MODE][:ENABle] <Bool> in **Section 14.13.5: Output Subsystem**.

NOTE

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

Reset

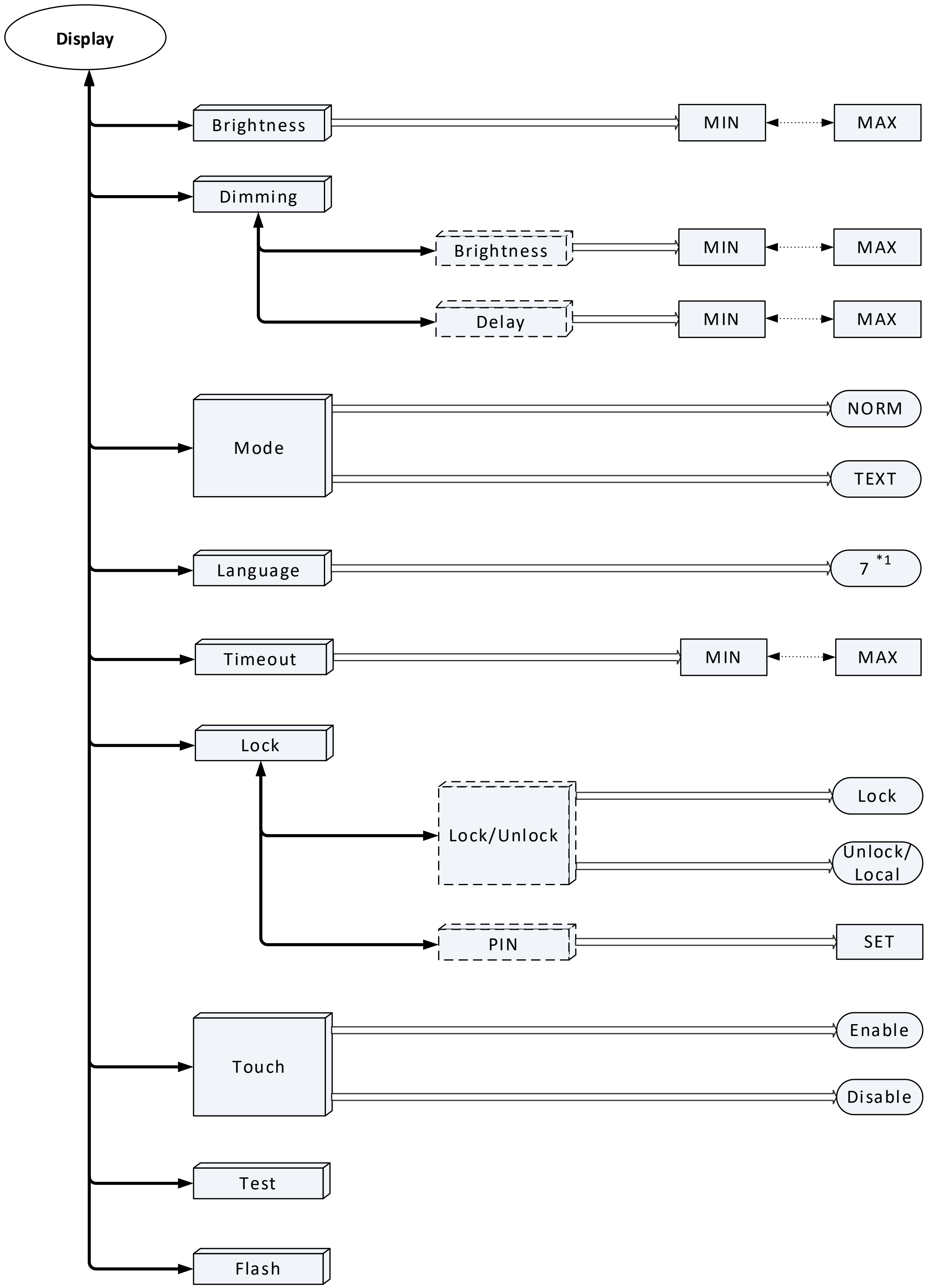
Click **Reset**



Click **Factory** to make a factory reset (defaults settings); refer to **Table 13-1**.

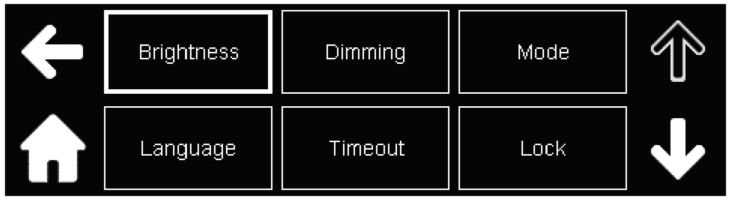
Click **Basic** to make a reset; refer to **Table 13-1**.

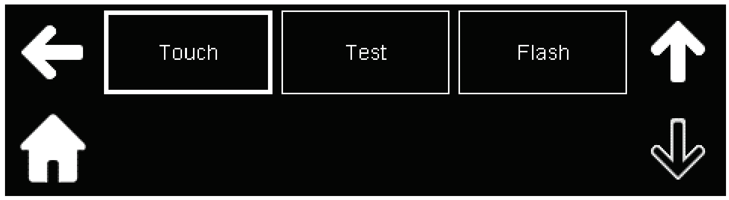
9.4.7 Display Menu



*1. Total of 7 languages.

After selecting **Display**, its sub-menu opens.



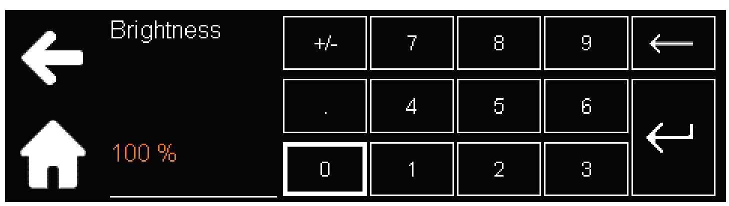


NOTE

For the programming parameters of Brightness, Dimming, Mode, and Timeout, refer to **Section 14.13.1: Display Subsystem.**

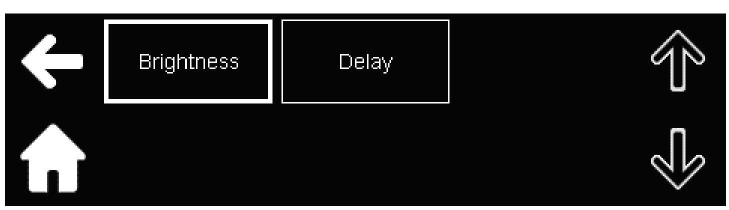
Brightness

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

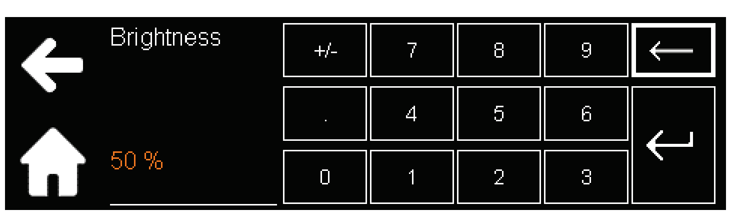


Dimming

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



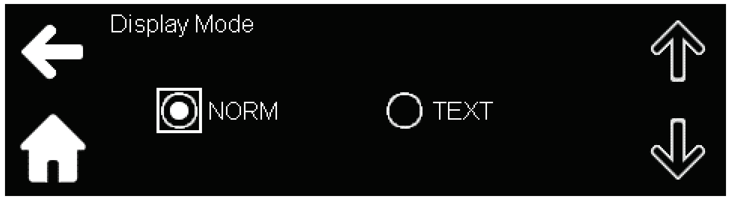
Click **Brightness** to set the dimming brightness.



Click **Delay** for setting the dimming delay.

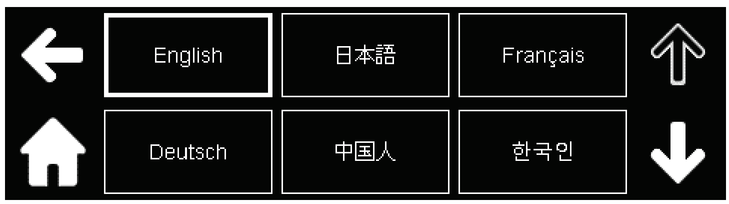
Mode

Click **Mode** to select the type of content to be displayed on the dashboard.



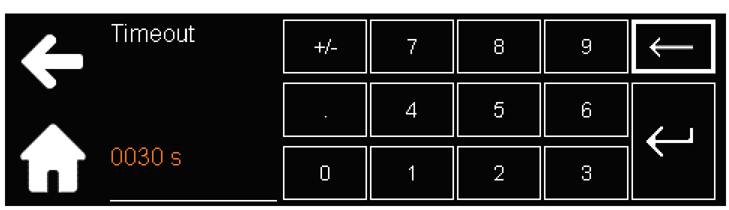
Language

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



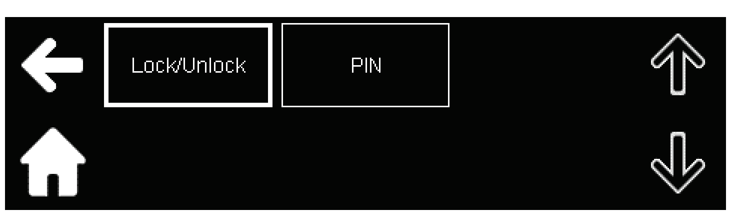
Timeout

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



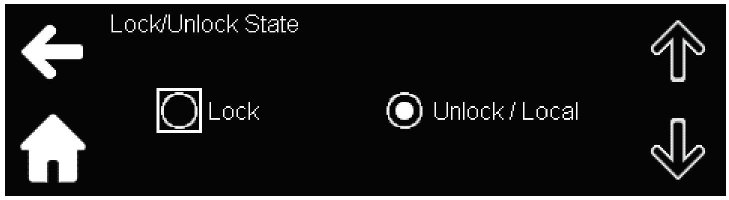
Lock

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** 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.

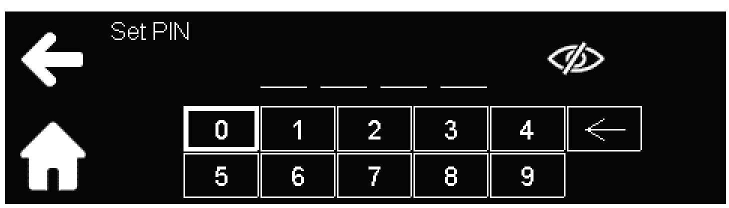
NOTE

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

A) Locking the front panel with the PIN.

1. From the **Lock** sub-menu, click **PIN** to enter its setup option.

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 **Lock.**

   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** to enter its setup option.
2. Enter the PIN.
3. Click **Unlock.**

   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. Clicking the icons transfers you to step 2.

C) Modifying the PIN.

1. From the **Lock** sub-menu, click **PIN** to enter its setup option.
2. Click **Modify.**

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

B) Deleting the PIN.

1. Under the **Lock** sub-menu, click **PIN** to enter its setup option.
2. Enter the PIN and click **Delete.**

   The PIN is deleted.

Touch

Click **Touch** to enables or disables the touch screen.

NOTE

NAVIGATION PANEL is active if the touch screen is disabled.

Test

Click **Test** to put the display into a test mode. Click the icon to blank the display. Tap on the screen to bring back the display.

Flash

Click **Flash** to flash the front panel display.

9.4.8 Parallel Menu

*1. Select the number of phases.

NOTE

This menu is available for a Parallel setup only.

After selecting **Parallel**, its sub-menu opens.

Configure

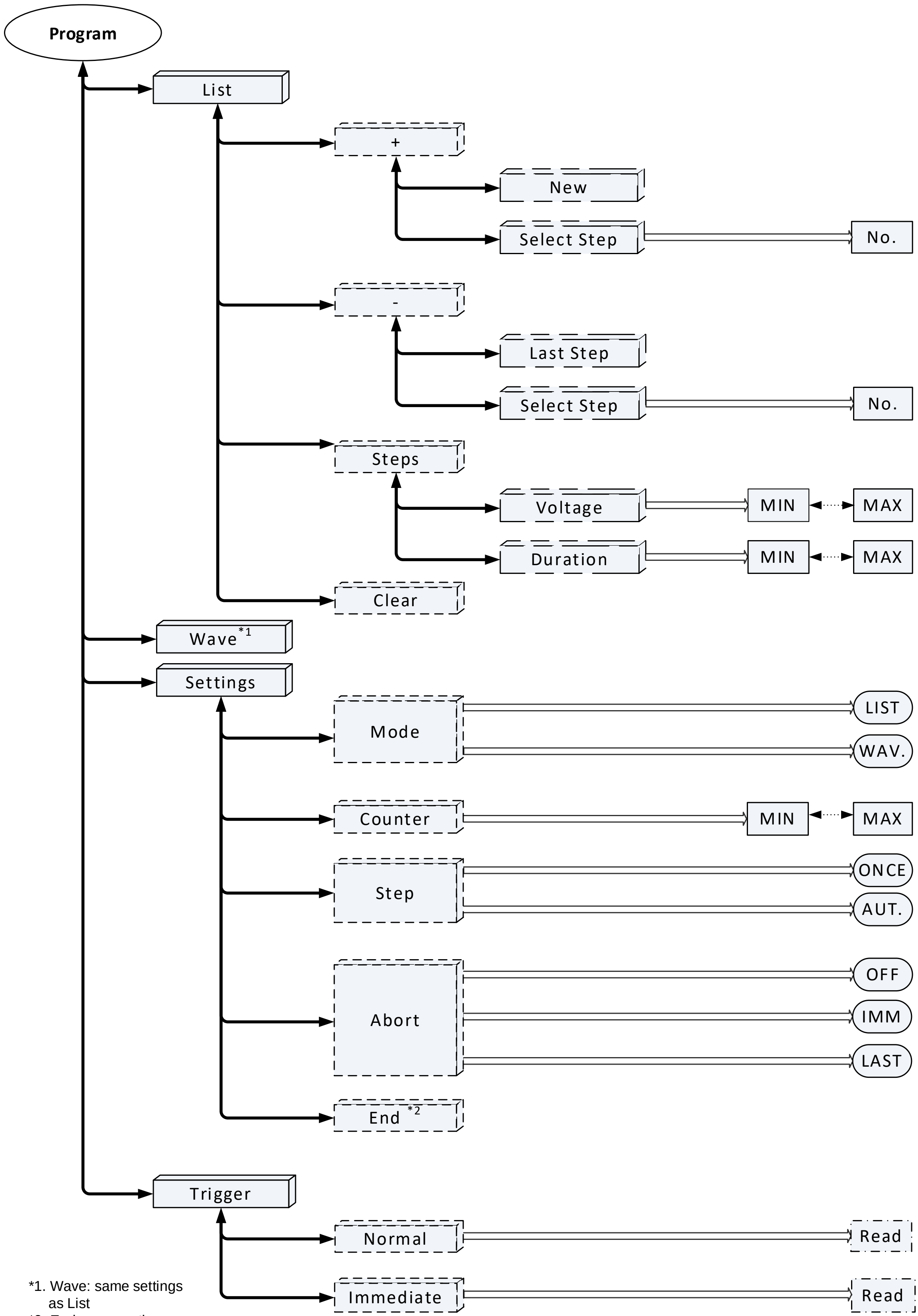
Sets the number of phases for the output.

Phase Shift

Sets the phase difference between phase 1 and the other phases.

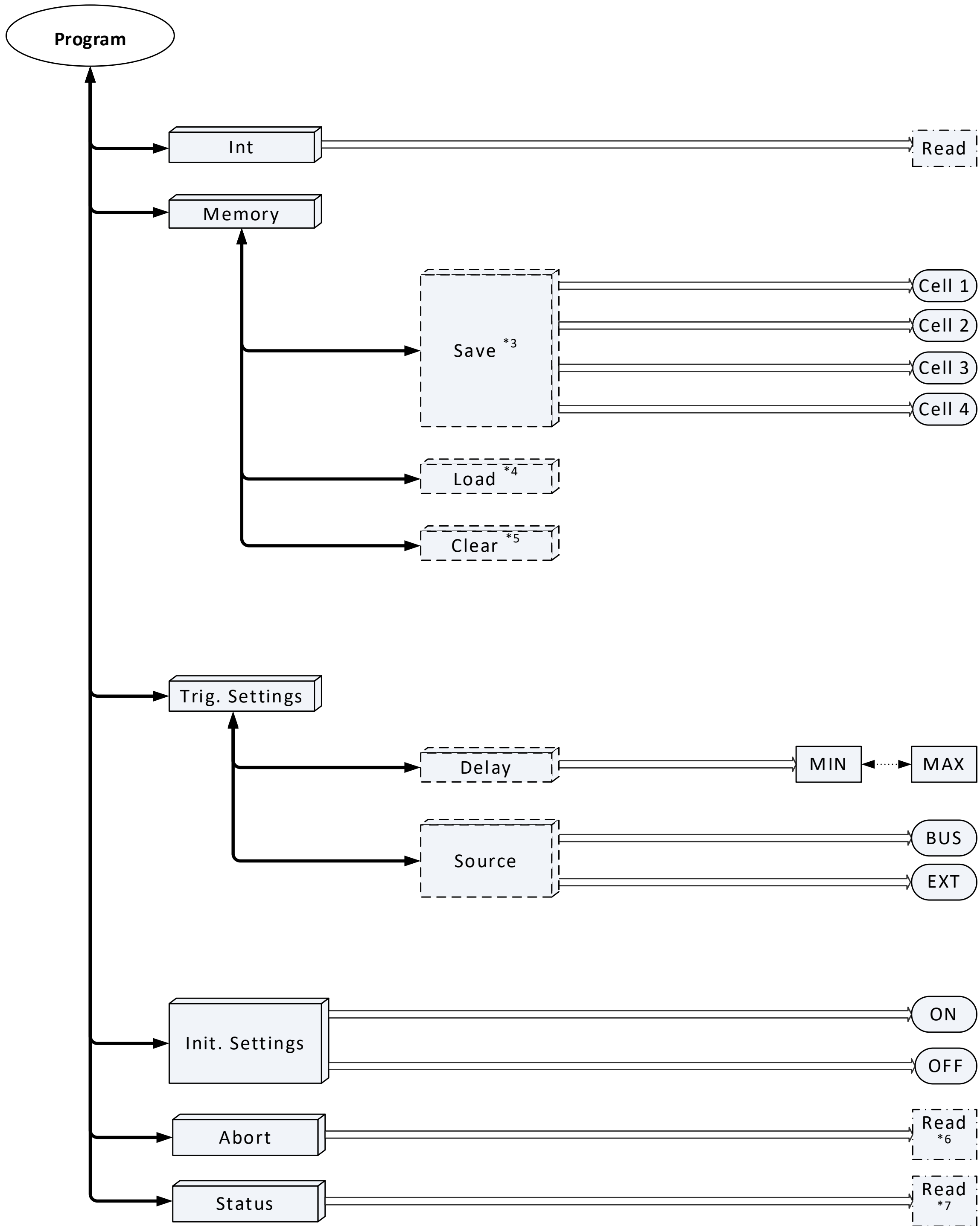
9.4.9 Program Menu

PROGRAM DC



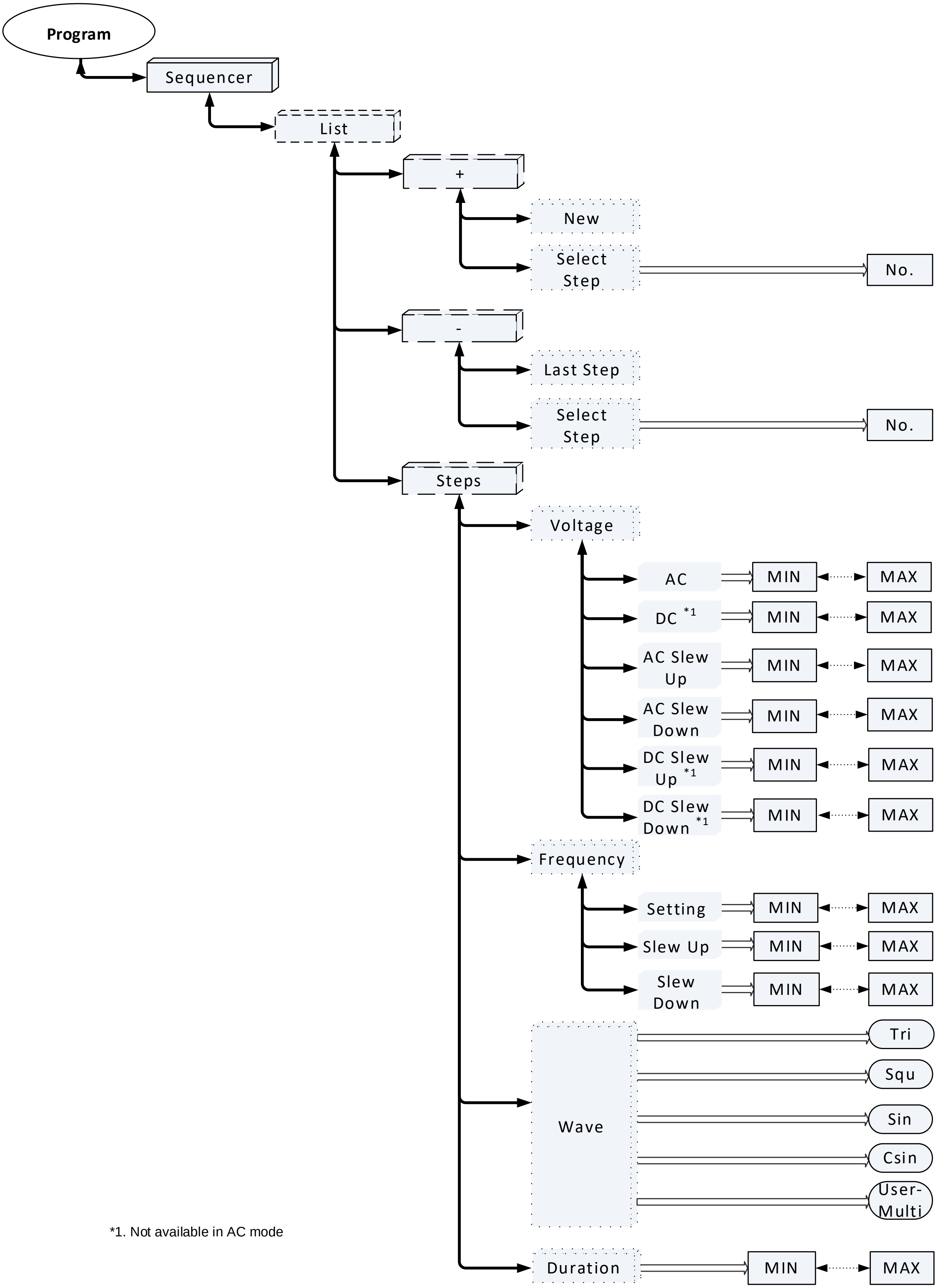
*1. Wave: same settings as List
*2. End: same options as abort

PROGRAM DC - CONTINUED



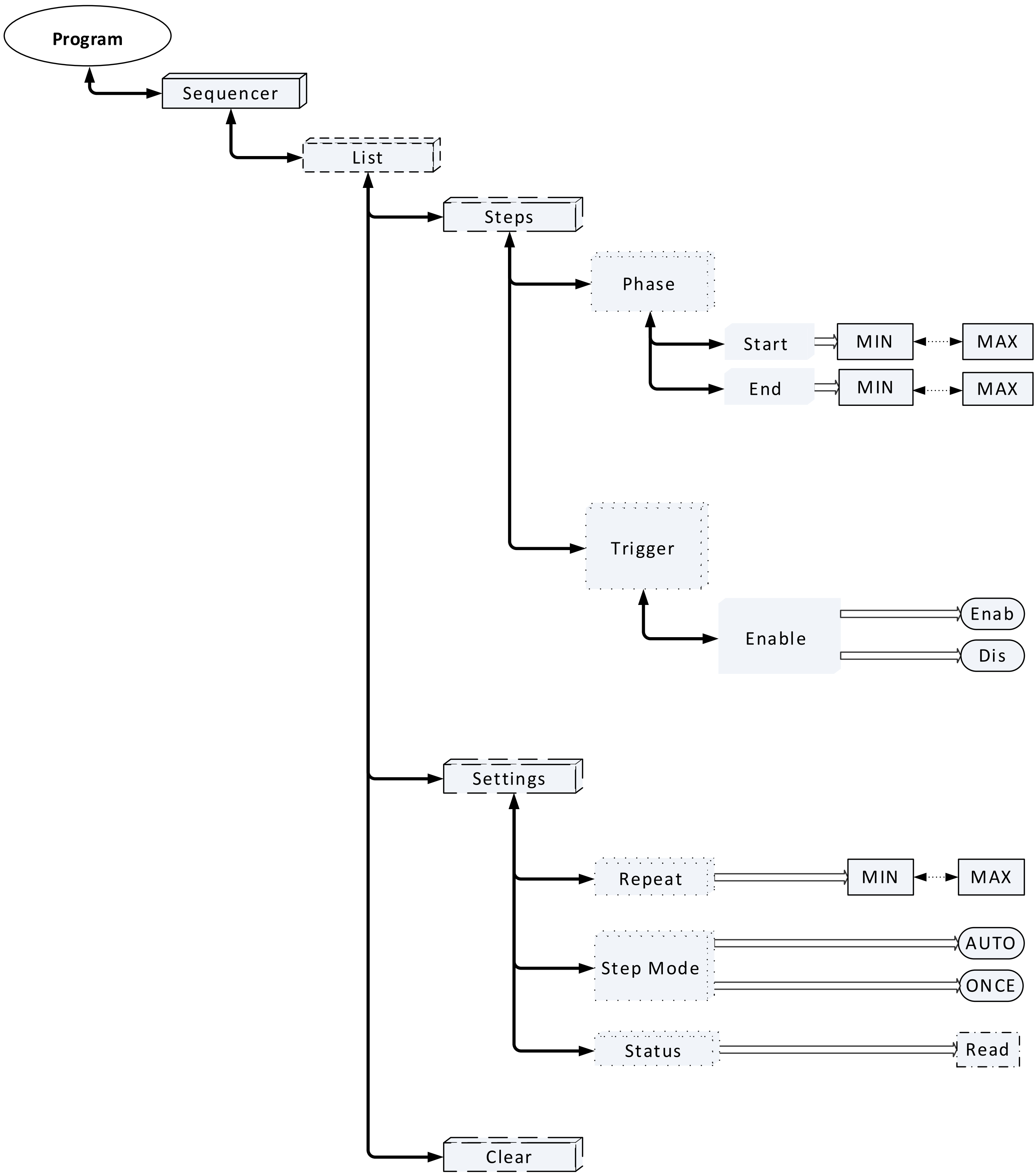
*3. Contains save button
*4. Same options like save and also includes load button
*5.Same options like save and also includes clear button
*6. Abort Status
*7. Sequence Status

PROGRAM ACDC

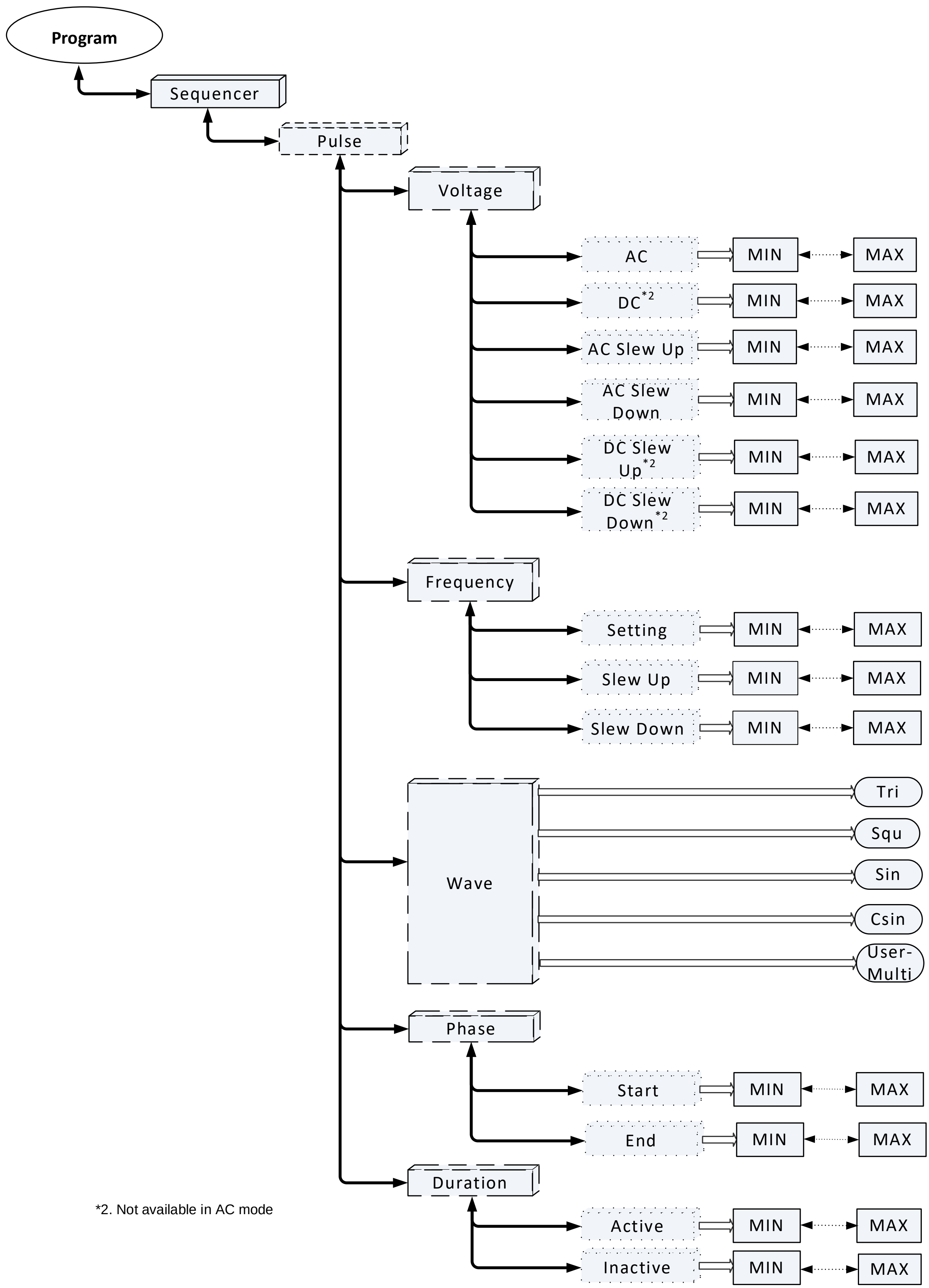


*1. Not available in AC mode

PROGRAM ACDC - CONTINUED

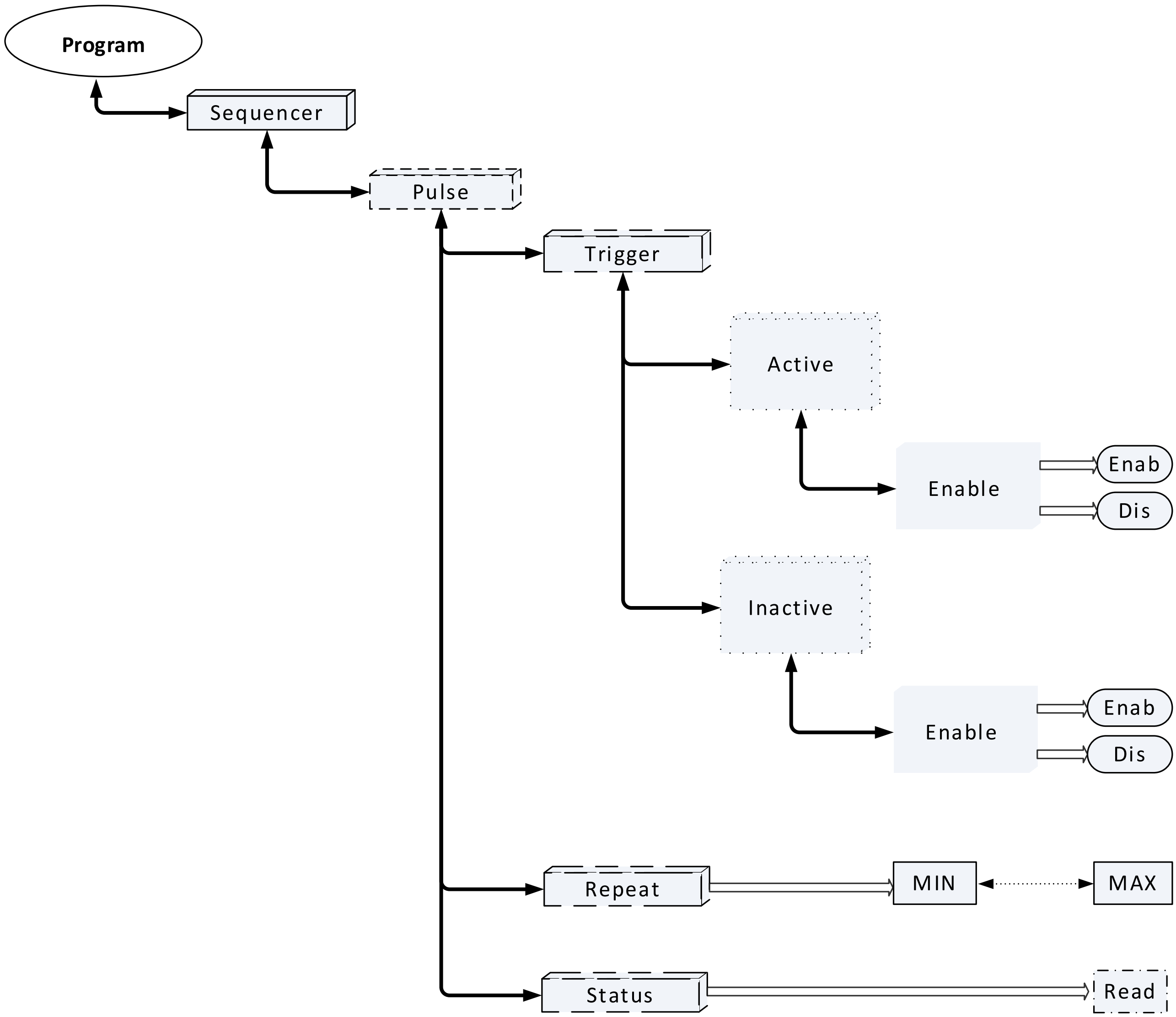


PROGRAM ACDC - CONTINUED

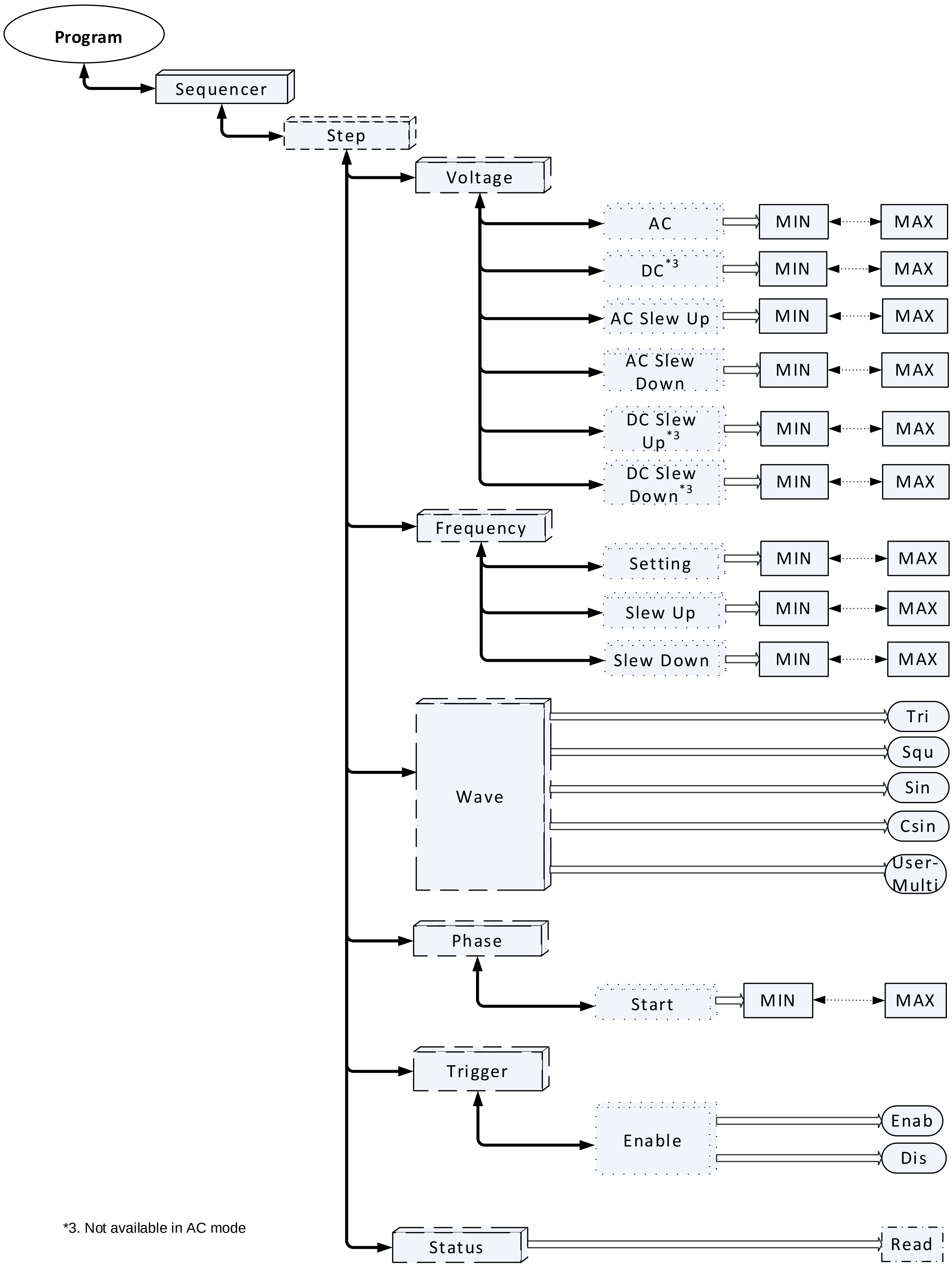


*2. Not available in AC mode

PROGRAM ACDC - CONTINUED

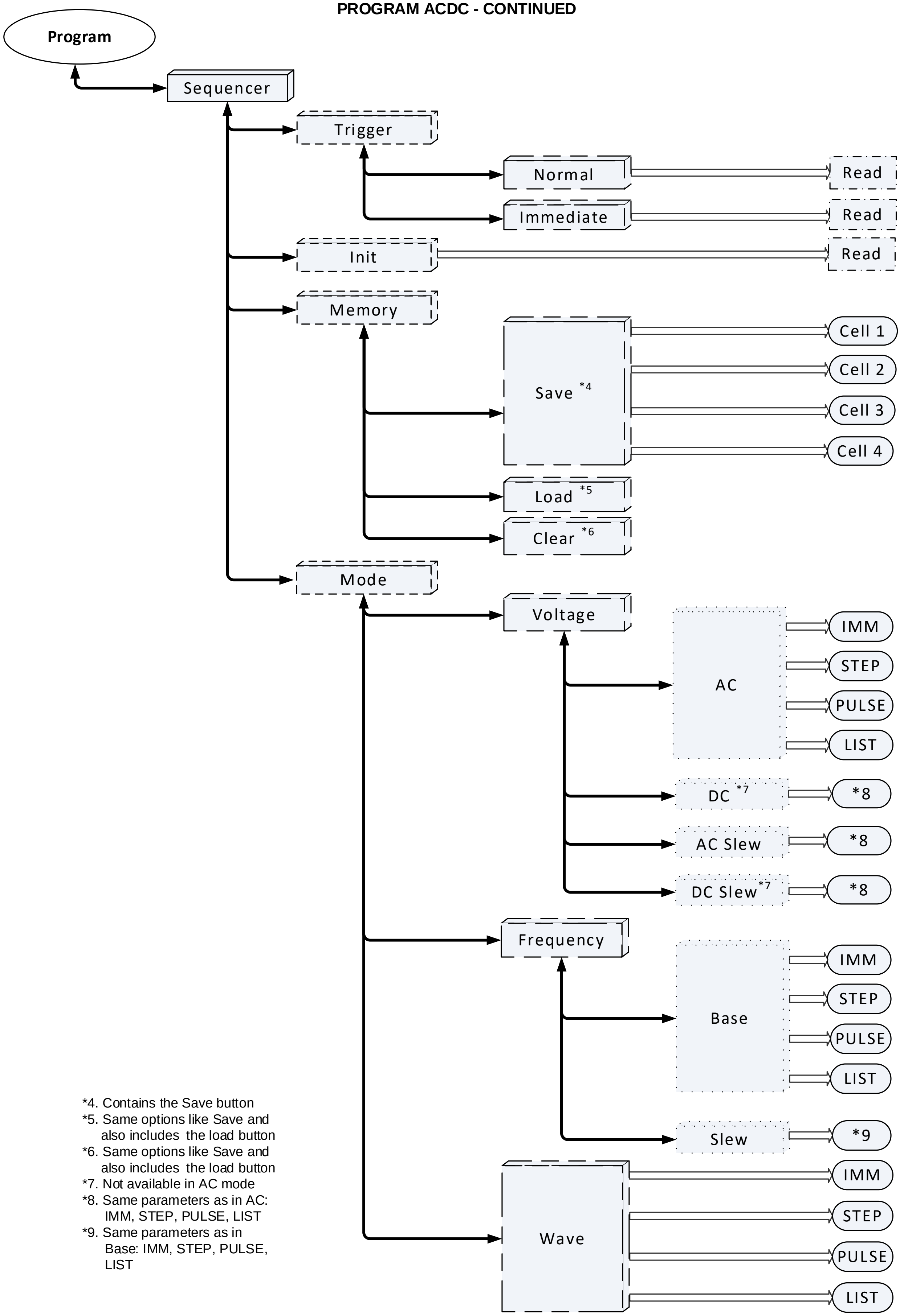


PROGRAM ACDC - CONTINUED



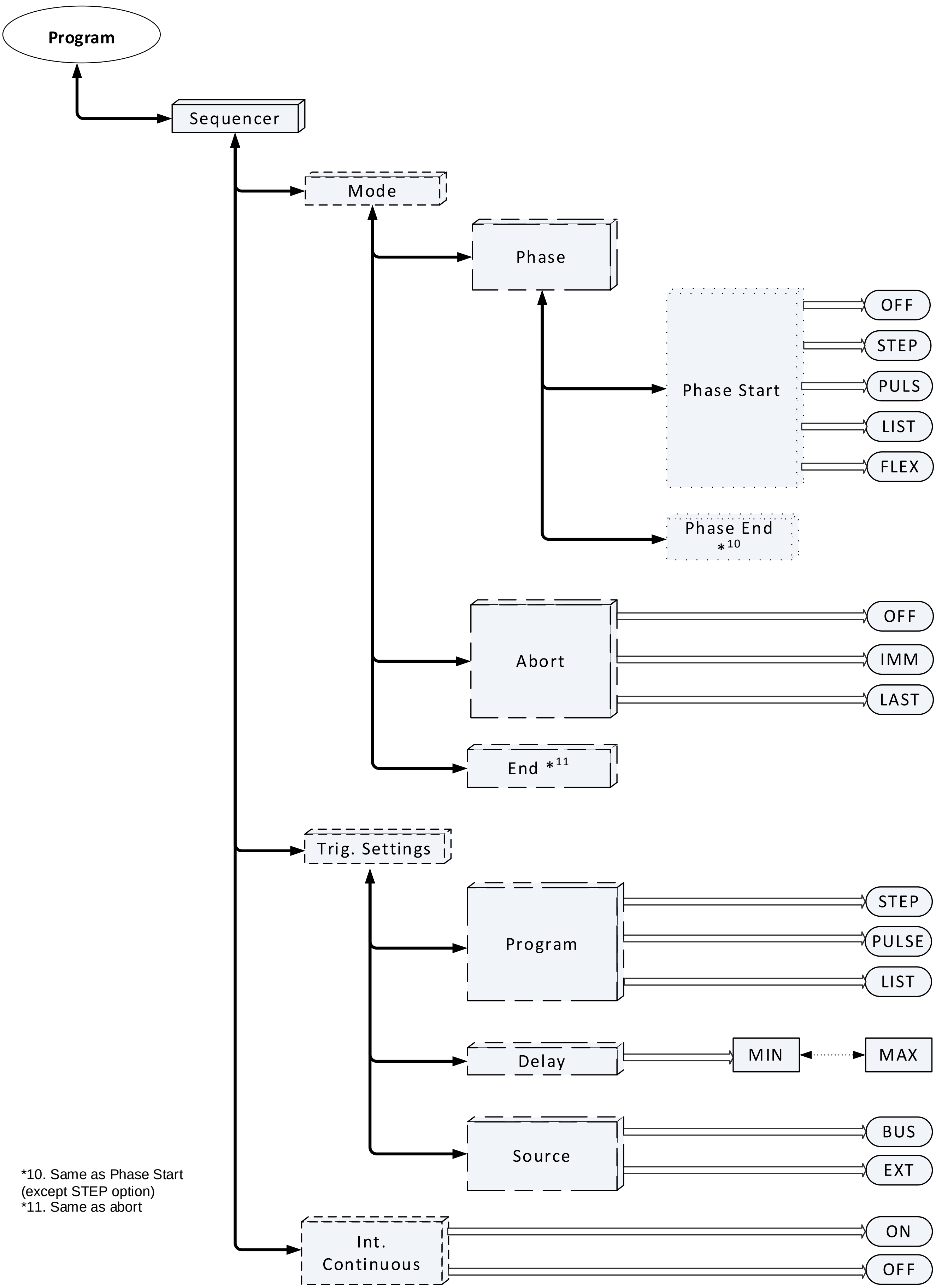
*3. Not available in AC mode

PROGRAM ACDC - CONTINUED



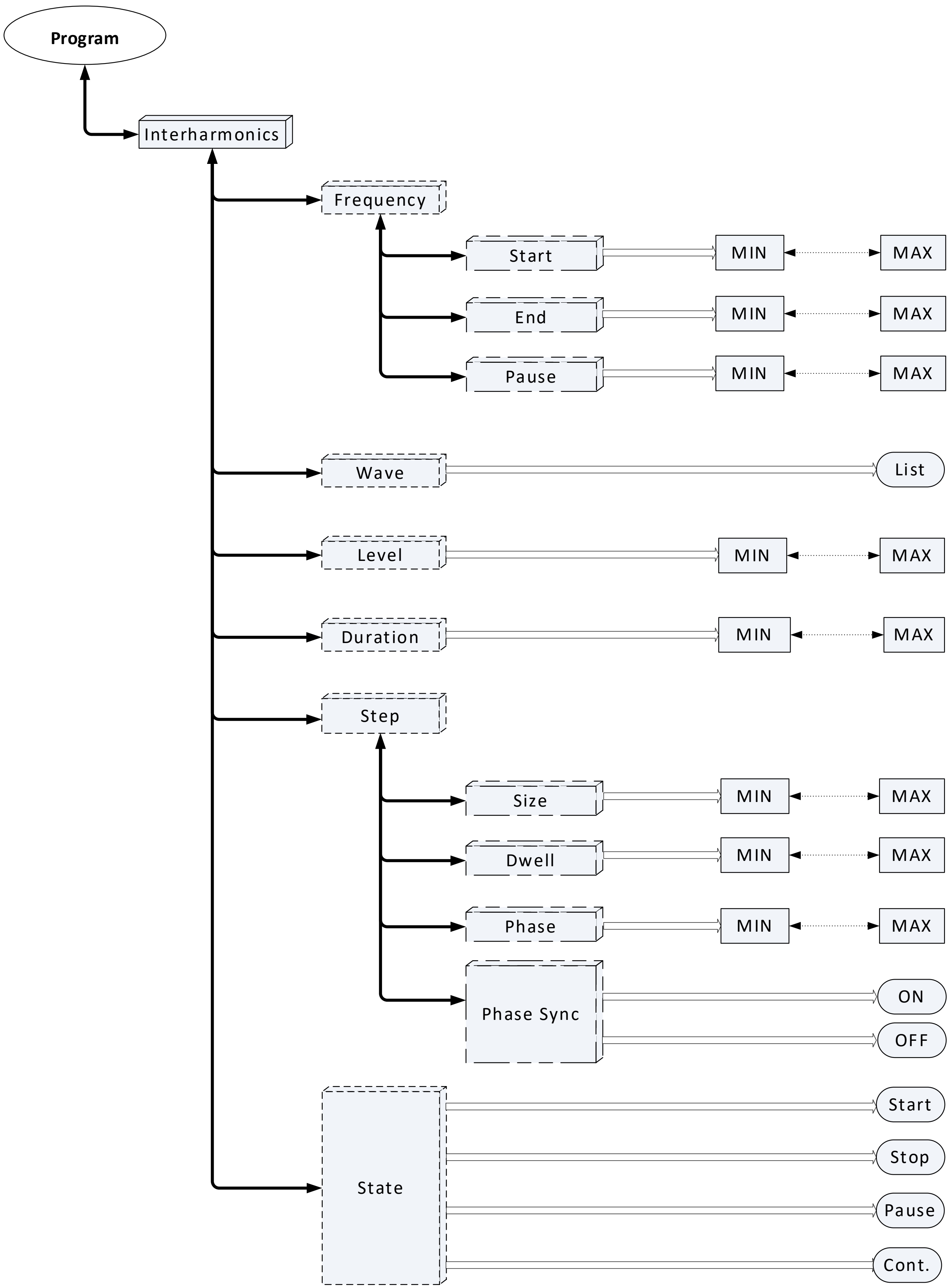
*4. Contains the Save button
*5. Same options like Save and also includes the load button
*6. Same options like Save and also includes the load button
*7. Not available in AC mode
*8. Same parameters as in AC: IMM, STEP, PULSE, LIST
*9. Same parameters as in Base: IMM, STEP, PULSE, LIST

PROGRAM ACDC - CONTINUED



*10. Same as Phase Start (except STEP option)
*11. Same as abort

PROGRAM ACDC - CONTINUED

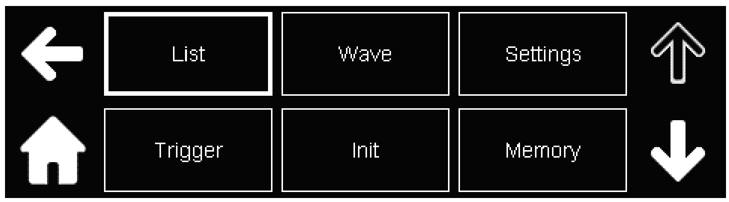


The menu is mainly related to the sequencer function and all the settings for the sequencers can be carried out from this menu. The sequencer functions are available for the AC, ACDC, and the DC modes.

For Sequencer In DC mode only

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

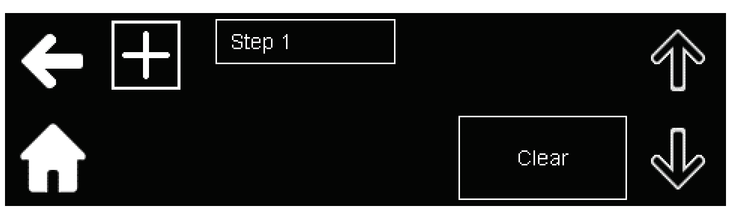
After selecting **Program**, the sub-menu opens.



List

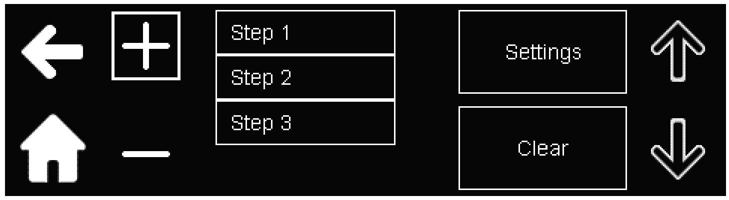
This sub-menu allows to add or remove the steps or make modifications to the present steps in the list sequencer. The duration and voltage level of each step can also be programmed.

Click **List**

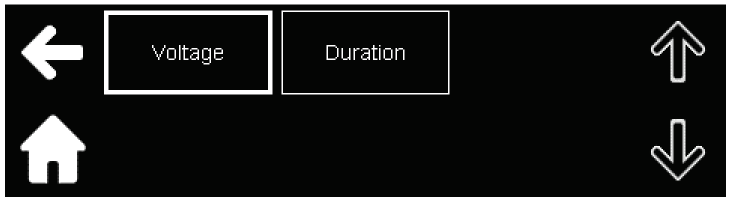


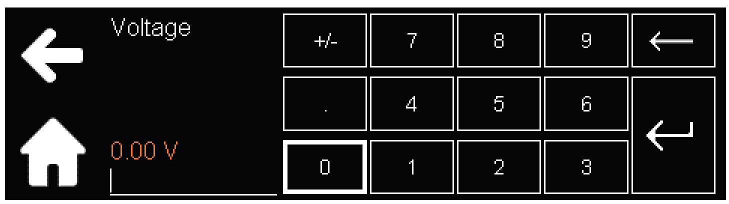
⊞: This adds steps to the list. By default, the first step in the list is Step 1. Click ⊞ to add another step.

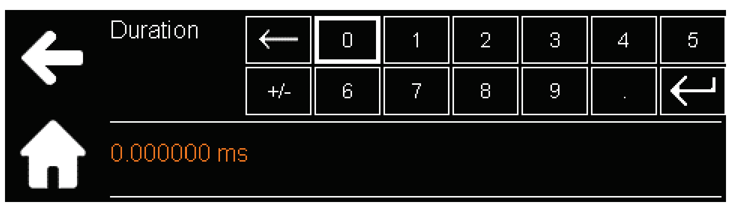
- Click **New** if a new step is to be added. This button adds steps in sequence; Step 2, Step 3, and so on.
- Click **Select Step** if we want to add a new step to a particular index. For example, if the sequence consists of Step 1 to Step 3, click **Select Step** and then enter **3** to insert a step at location 3. The step that was in location 3 moves to 4.

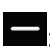


Steps: This programs the voltage level and the duration of each step. Refer to **Section 14.13.7.6: DC Sequencer** for the programming range. Click **Step 'x'** to enter its setup option.







: 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 becomes the step at location 2.

Clear: Clears all the steps in the sequencer.

Wave

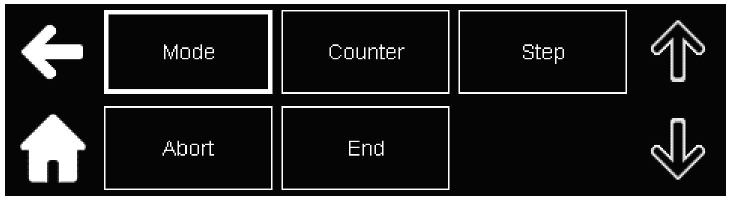
From the **Program** sub-menu, click **Wave** allows to add or remove the steps in the wave sequencer or make modifications to the present steps. The duration and voltage level of each step can also be programmed from this sub-menu.

NOTE

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

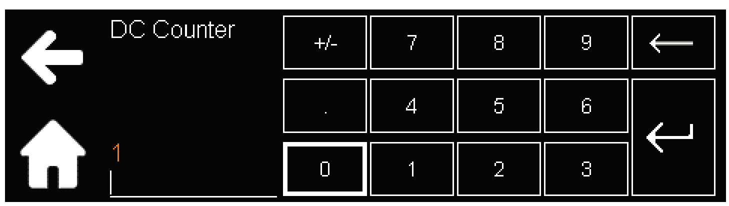
Settings

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: programs the number of times the entire sequence is to be iterated. Refer to **Section 14.13.7.6: DC Sequencer** for the programming range.



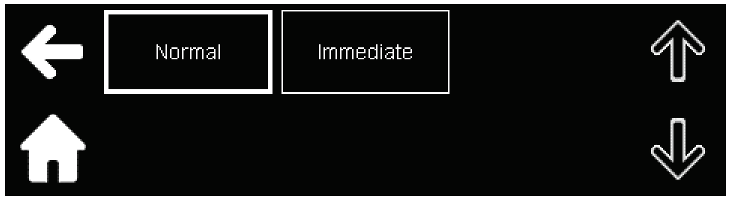
Step: selects if each step in the sequencer is to be run at one time or the complete sequence is to be run.

Abort: The settings of the power source at abort state can be programmed; refer to [PROGram:]DC:MODE:ABORt <DSC> in **Section 14.13.7.6: DC Sequencer**.

End: the settings of the power source at end state can be programmed.
Refer to [PROGram:]DC:MODE:END <DSC> in **Section 14.13.7.6: DC Sequencer**.

Trigger

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



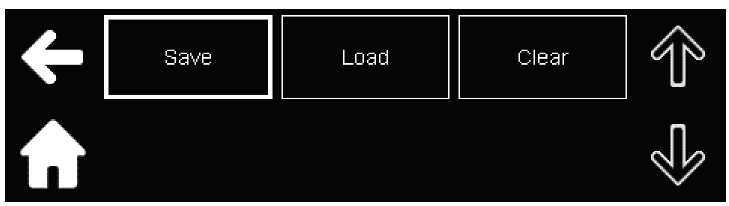
- **Normal:** trigger the sequence with a delay.
- **Immediate:** triggers the trigger

Int

This initiates the trigger.

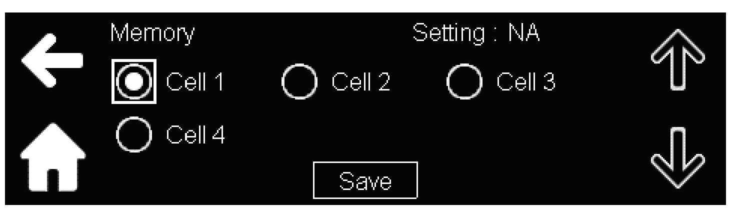
Memory

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



- **Save**: Saves a sequence to a memory location.

  Click **Save** to enter its setup option.



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

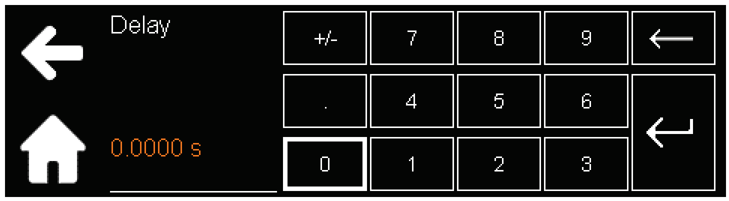
- **Load**: Loads a sequence from a memory location.
- **Clear**: Clears a sequence from a memory location.

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 **Section 14.13.11: TRIGger Subsystem**

Delay: sets the delay. Refer to **Section 14.13.11: TRIGger Subsystem** for the programming range.



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 and after the sequence has completed, thus preventing the need for re-initiation.

Click **Initiate Settings**

- **ON**: The trigger system is continuously initialized.
- **OFF**: The trigger system is to be initialized every time a trigger is to be sent.

Abort

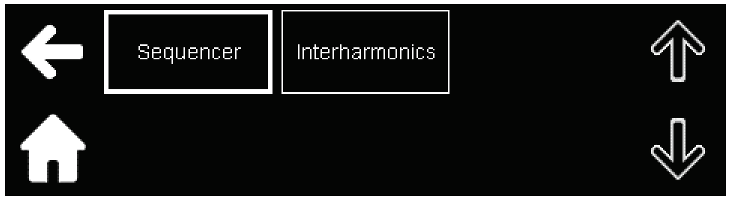
Aborts the sequence

Status

Indicates the status of the sequencer, the node that is being executed, and the iteration (repetition) number.

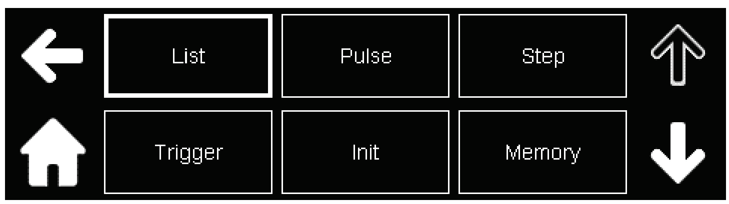
For Sequencer In AC and ACDC mode only

After selecting **Program**, the sub-menu opens.



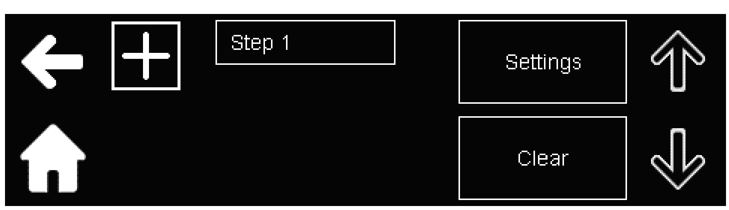
Sequencer

This sub-menu allows 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

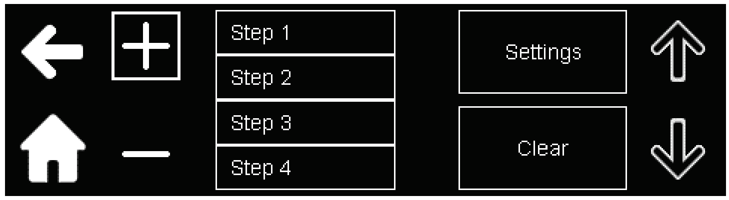
Click **List** to enter its setup options. All the parameters related to the list sequencer are programmed in this sub-menu.



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

Click **New** if a new member is to be added. This button adds members in sequence; member 2, member 3, and so on.

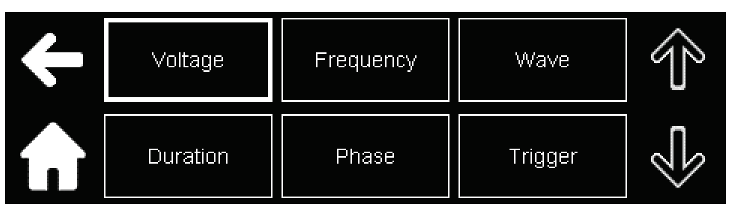
Click **Select Step** if we want to add a new member to a present location. For example, if the sequence consists of member 1 to member 3, click **Select Step** and then enter **3** to insert a member at location 3. The member that was in location 3 moves to 4.



: The removes members from the list.

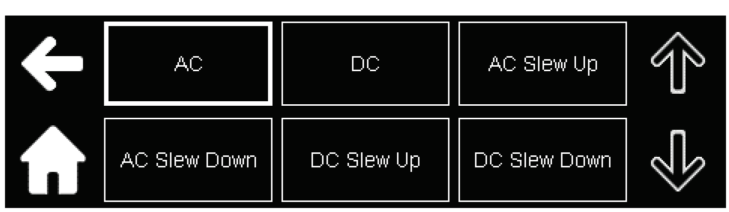
Click **Last Step** to remove the last member.
Click **Select Step** to remove the required member. For example, click **Select Step** and then enter **2** to remove the member at location 2. The member at location 3 becomes the member at location 2.

Steps: The parameters related to the list sequencer are programmed in this sub-menu. Click **Step 'x'** to enter its setup option.

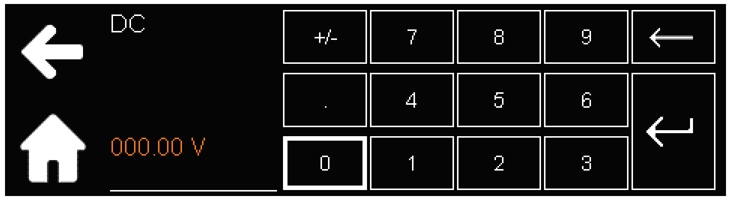


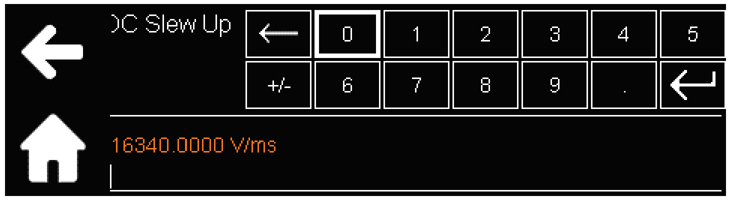
- **Voltage**: sets the voltage amplitude and its slew rate.

  The icons for setting all the levels in ACDC mode is shown below. Refer to **Section 14.13.7.3: AC/ACDC Sequencer - LIST Subsystem** for the programming range.



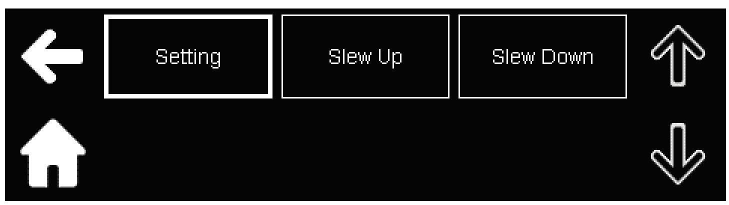
The window to set the DC level and its slew rate up programming is shown below.



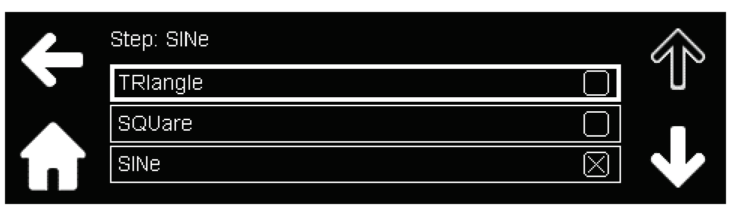


- **Frequency**: sets the output frequency and its slew rate. These can be set in AC and ACDC mode.

  The icons to set the levels is shown below. Refer to **Section 14.13.7.3: AC/ACDC Sequencer - LIST Subsystem** for the programming range.

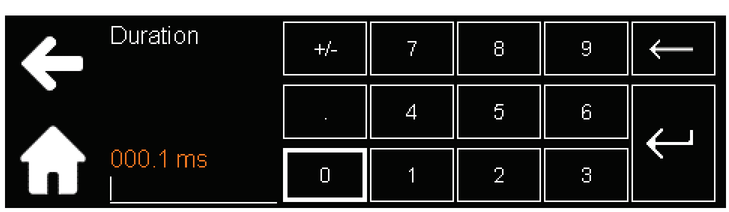


- **Wave**: selects the waveform to which the parameters are applied.

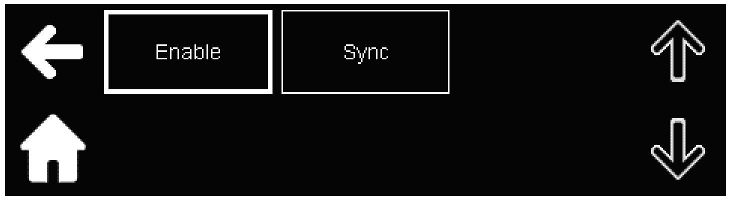


- **Duration**: sets the duration. Refer to **Section 14.13.7.3: AC/ACDC Sequencer - LIST Subsystem** for the programming range.

  The window to set the duration is shown.



- **Phase**: sets the phase at which the step starts and ends. Refer to **Section 14.13.7.3: AC/ACDC Sequencer - LIST Subsystem** for the programming range.
- **Trigger**: enables or disables the trigger out signal when the list member starts executing; refer to **Section 14.13.7.3: AC/ACDC Sequencer - LIST Subsystem.**



Click **Enable** to enable or disable the trigger out signal.

Click **Sync** to define the sync for the trigger out signal.

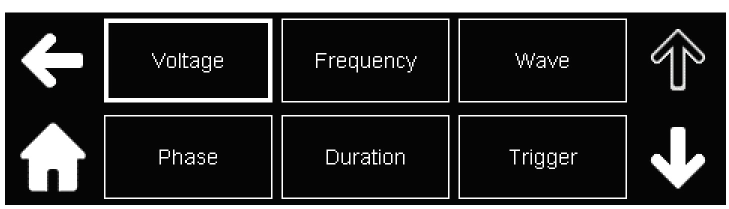
From the **List** sub-menu, click **Settings** to set other parameters related to the list sequencer.

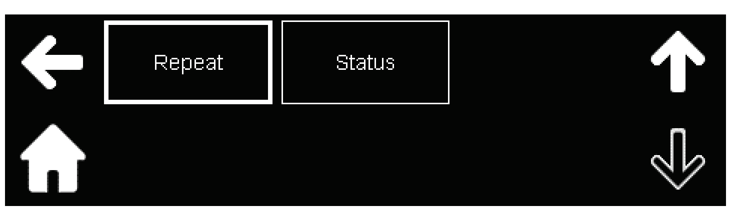
- **Repeat:** sets the number of times the list is repeated
- **Step Mode**: sets the power source to execute the whole sequence or a single step once the trigger is received
- **Status**: indicates the state of the sequencer, the member number (node) that is being executed, and the iteration (repetition) number.

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.

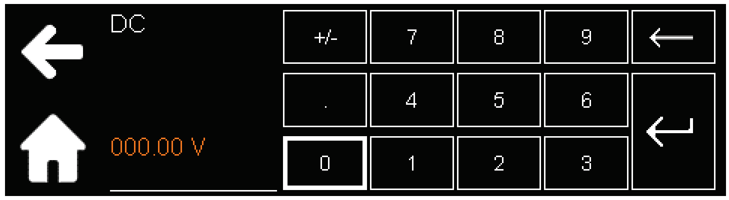


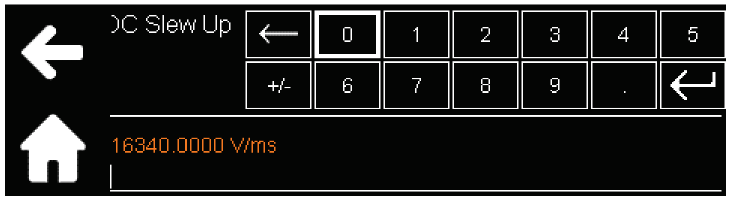


Voltage: sets the voltage amplitude and its slew rate.

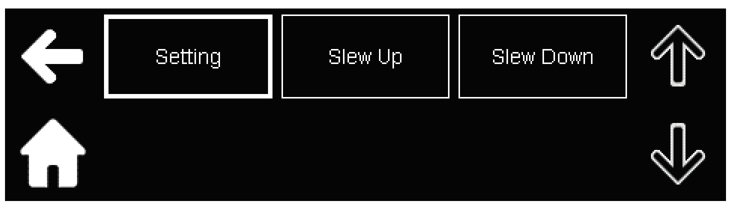
The icons for setting all the levels in ACDC mode is shown below. Refer to **Section 14.13.7.1: AC/ACDC Sequencer - Pulse Subsystem** for the programming range.

The window to set the DC level and its slew rate up programming is shown below.

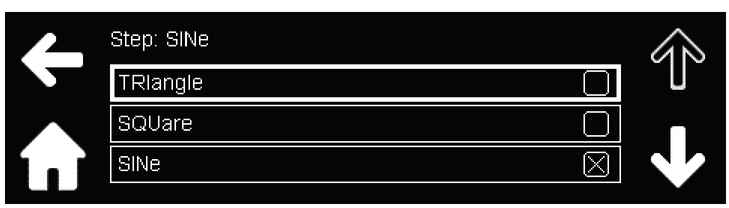




Frequency: sets the output frequency and its slew rate. These can be set in AC and ACDC mode. The icons to set the levels is shown below. Refer to **Section 14.13.7.1: AC/ACDC Sequencer - Pulse Subsystem** for the programming range.

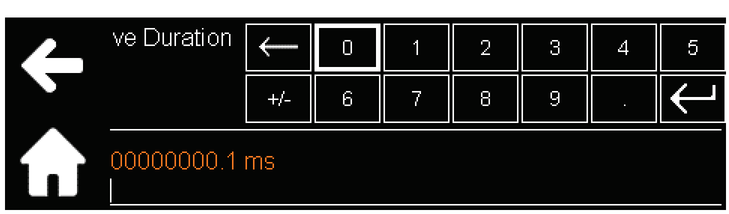


Wave: selects the waveform to which the parameters are to be applied.



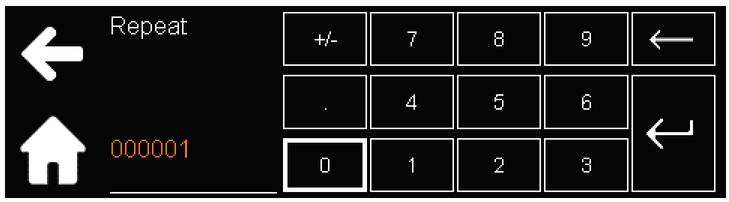
Phase: sets the phase at which the pulse starts and ends. Refer to **Section 14.13.7.1: AC/ACDC Sequencer - Pulse Subsystem** for the programming range.

Duration: sets the active and inactive duration of the pulse. Refer to **Section 14.13.7.1: AC/ACDC Sequencer - Pulse Subsystem** for the programming range.
The window to set the active duration is shown.



Trigger: enables or disables the trigger out signal when the pulse program enters the active and/or inactive state.

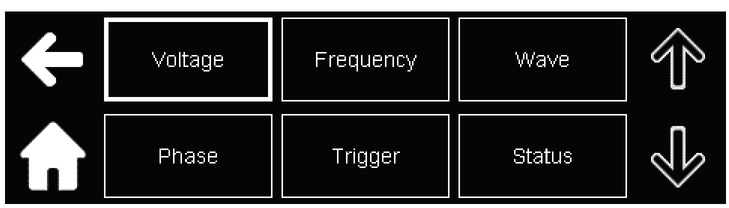
Repeat: Sets the number of times the pulse (active state) is repeated. Refer to **Section 14.13.7.1: AC/ACDC Sequencer - Pulse Subsystem** for the programming range.



Status: indicates the state of the sequencer, the duration type, 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.

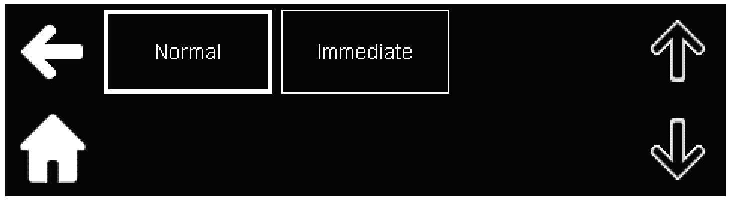


Voltage: sets the voltage amplitude and its slew rate. Refer to **Section 14.13.7.2: AC/ACDC Sequencer - Step Subsystem** for the programming range.
Frequency: sets the output frequency and its slew rate. These can be set in AC and ACDC mode. Refer to **Section 14.13.7.2: AC/ACDC Sequencer - Step Subsystem** for the programming range.
Wave: selects the waveform to which the parameters are to be applied.
Phase: sets the phase at which the step starts. Refer to **Section 14.13.7.2: AC/ACDC Sequencer - Step Subsystem** for the programming range.
Trigger: enables or disables the trigger out signal when the step program enters the active state.
Status: indicates the status of the step sequencer.

NOTE

The windows to set the above parameters for the step sequencer looks the same as that for the pulse sequencer.

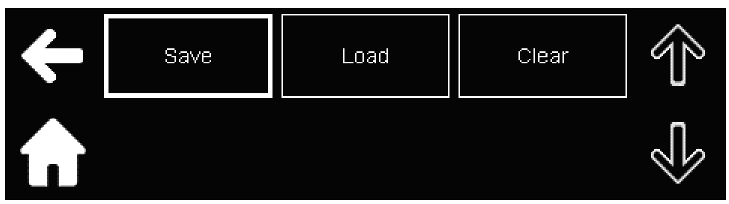
Under **Sequencer** sub-menu, click **Trigger** to enter its setup option.



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

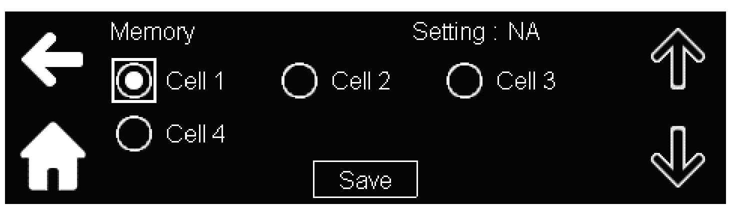
Under **Sequencer** sub-menu, click **Int** to initiate the trigger.

Under **Sequencer** sub-menu, click **Memory** to enter its setup option.



- **Save**: Saves a sequence to a memory location.

  Click **Save** to enter its setup option.



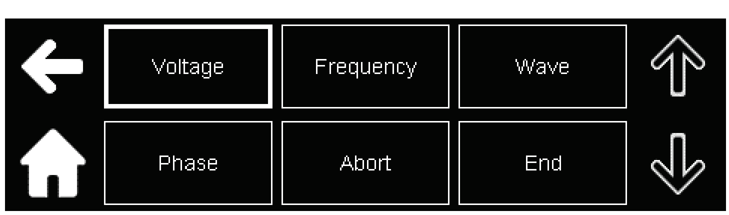
  Click on any of the cell and then click **Save** to save the settings.

- **Load**: Loads a sequence from a memory location.
- **Clear**: Clears a sequence from a memory location.

NOTE

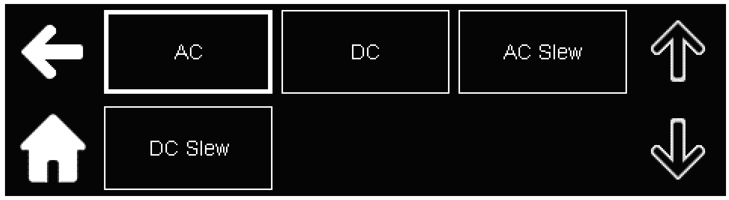
The window for Load and Clear looks the same as the window for Save, except for the **Load** and **Clear** button.

Under **Sequencer** sub-menu, click **Mode** to enter its setup option. This sub-menu allows to select the mode that controls the parameters of the waveform when a sequence is triggered. Refer to **Section 14.13.7.4: 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.

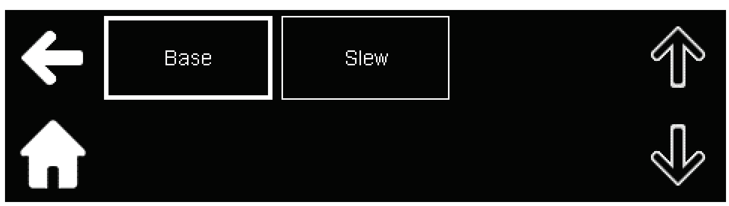


These parameters can be controlled by Imm, Step, Pulse, and List modes.

For example, click **AC** to select the mode.

Frequency: Frequency setting and its slew rate can be controlled by different modes.

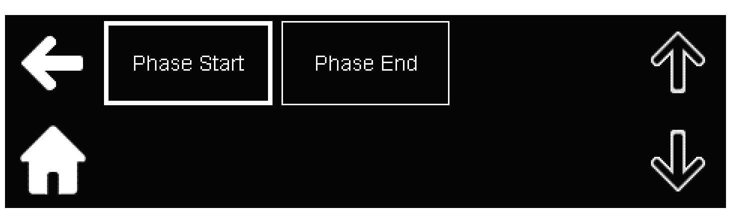
Click **Frequency** to select the different parameters. This parameter can be controlled by Imm, Step, Pulse, and List modes.



Wave: The waveform can be controlled by different modes. This parameter can be controlled by Imm, Step, Pulse, and List modes.

Phase: Phase Start and Phase End can be controlled by different modes.

Click **Phase.**

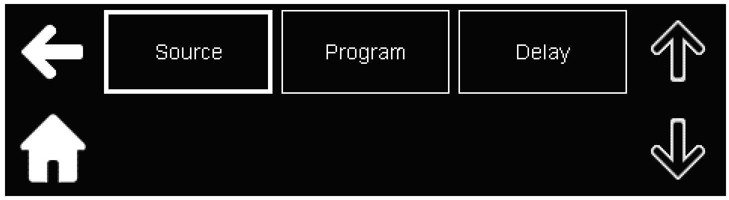


The phases can be controlled by Off, Step, Pulse, List, and Flex modes.

Abort: Sets the behavior of the power source when ABORt is sent. Abort is controlled by Off, Imm, and Last.

End: Sets the behavior of the power source when End is sent. End is controlled by Off, Imm, and Last.

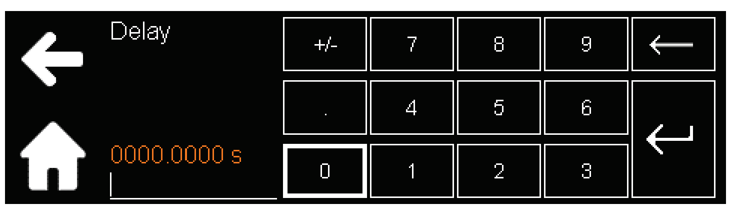
Under **Sequencer** sub-menu, click **Trigger Settings** to enter its setup option. This sub-menu allows to set the mode that controls the sequencer, the delay for triggering the sequence, and the source of the trigger.



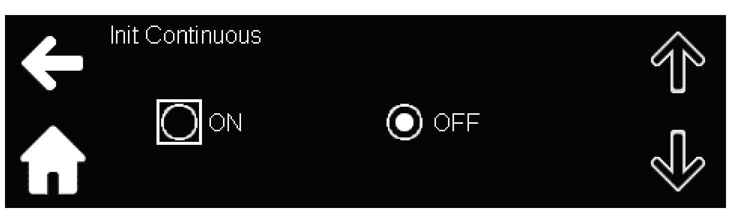
Source: selects the trigger source. Refer to **Section 14.13.11: TRIGger Subsystem**.

Program: selects which mode controls the sequencer waveform.

Delay: sets the delay. Refer to **Section 14.13.11: TRIGger Subsystem** for the programming range.



Under **Sequencer** sub-menu , click **Initiate Continuous** to enter its setup option. 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.

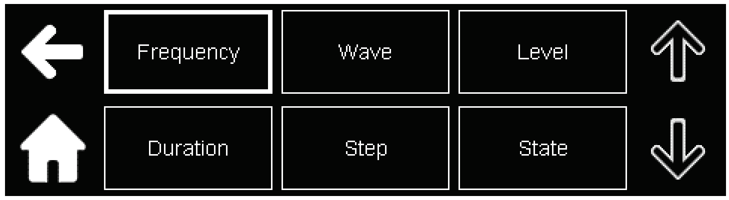


- **ON**: The trigger system is continuously initialized.
- **OFF**: The trigger system is to be initialized every time a trigger is to be sent.

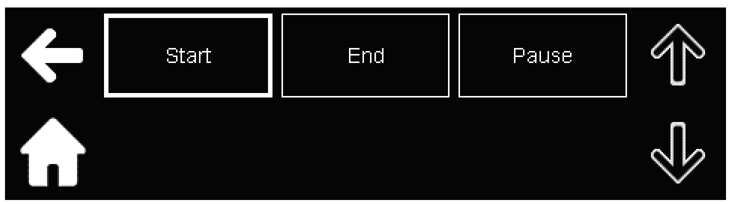
Interharmonics

In the Interharmonics function, a frequency waveform with a variable voltage component is added to the base frequency to test certain interferences.

Click **Interharmonics.** Refer to **Section 14.13.12: IHARmonics (Iinterharmonics Subsystem)** for the programming parameters.



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.

Click **Wave** to select the waveform used for the interharmonics.

Click **Level** to set the weight (in percentage) of the interharmonics amplitude relative to the amplitude of the fundamental frequency.

Click **Duration** to set 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

Click **State** to control 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.

CHAPTER 10: COMMUNICATING WITH RS232, RS485, USB, AND LAN

10.1 Introduction

This chapter describes the communication protocol, configuration, and operation of RS232, RS485, USB, and LAN interfaces that can be used to operate the power source.

The power source may be operated through four interfaces as shown in the **Table 10-1**.

No.	Mode	Control Type	Description
1	LAN	Control using an Ethernet connection	Disables serial port. Local and analog modes may still be used to set, measure, and read.
2	Local	Control using the front panel display and buttons	LAN and serial ports may still be used to set, measure, and read.
3	Serial	Control using RS-232, RS-485, or USB	Disables the LAN port. Local and analog modes may still be used to set, measure, and read.
4	Analog	Control using analog signals	LAN, local, or serial communication may still be used to measure and set protections.

Table 10-1: Types of Interfaces

NOTE

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. Refer to **Section 8.1: Serial RS232 and RS485 Connector (J1)** to view the RS232 and RS485 connector and its pinout.

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 (*1)	Clear to Send	Twisted pair
8	RTS (*1)	Request to Send	

Table 10-2: Pinout for RS232 Cable

NOTE

(*1) CTS and RTS (flow control signals) are optional and can be enabled or disabled from the front panel or with a communication command as per the application.

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

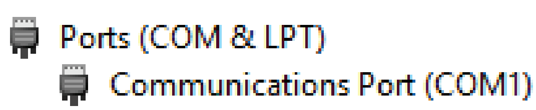
Refer to **Section 9.4.4: Interface Menu** to select 232 or 485 from the **Interface** menu.
Refer to **Section 14.13.10: System Subsystem** to select 232 or 485 with a communication command.

10.2.3 Baudrate Setting and Flow Control

Refer to **Section 9.4.4: Interface Menu** to select the baudrate and flow control from the **Interface** menu.
Refer to **Section 14.13.10: System Subsystem** to select the baudrate and flow control with a communication command.

10.2.4 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

This 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.

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)

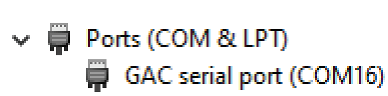
To communicate with the unit, it is recommended to install the USB driver before connecting the USB cable.

To install the USB driver:

1. Click on the **TDK-Lambda Technical Centre** webpage: https://www.emea.lambda.tdk.com/software
2. Select Genesys AC Source and then select Virtual Control Panel.
3. Download, decompress, and install the file.
4. After the installation is completed, open Virtual Control Panel and install the USB driver.

   For more information on the installation process, refer to Virtual Control Panel Installation and Application Guide available on the same webpage.
5. 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 **Interface** menu.
Refer to **Section 14.13.10: System Subsystem** to select USB 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

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 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

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 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

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	Web page server with Java scripts

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, 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 and the rear panel LAN status LED (green) Duplicate IP detection with blinking of the front panel 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 **Interface** menu.

Refer to **Section 14.13.10: System Subsystem** to select LAN 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.

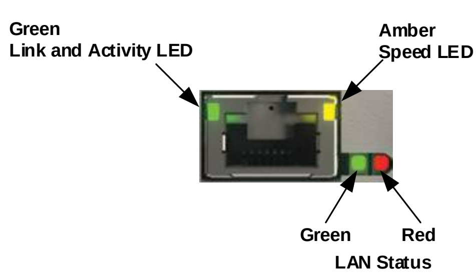


Figure 10-2: LAN LEDs

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 the cases the front panel 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 LAN cable must be arranged by the customer. 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.

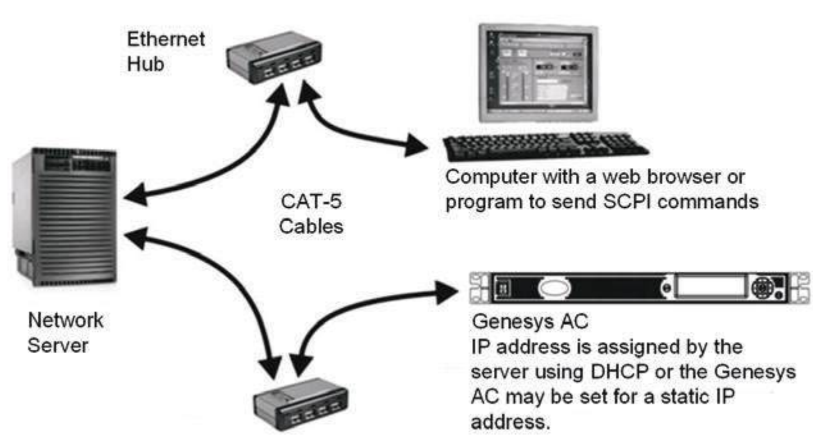


Figure 10-3: Network with a DHCP Server

- **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.

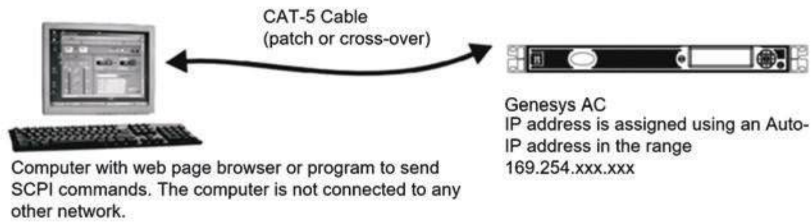


Figure 10-4: Peer-to-Peer Network

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 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 on the **LAN Modify** web page, via setting on the front panel, or with 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 on the **LAN Modify** web page, via setting on the front panel, or with a communication command. Refer to **Section 10.4.6.3: Changing the IP Address**.

	DHCP	Auto-IP	Static IP
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 the IP and MAC Addresses

Refer to **Section 9.4.4: Interface Menu** to view the IP address and MAC address from the **Interface** menu.

10.4.6.3 Changing the IP Address

Refer to **Section 9.4.4: Interface Menu** to set the IP address from the **Interface** menu.
Refer to **Section 10.4.7.8: LAN Settings Page** to set the IP address on the **LAN Modify** page.
Refer to **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 **LAN Modify** page, or with 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 <USTR>.
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 they might be interpreted incorrectly by the network server.

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**.
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 DNS Service Name can be created on the **LAN Modify** web page; refer to **Section 10.4.7.8: LAN Settings Page o**r via a communication command; refer to SYSTem[:COMMunicate]:LAN:DESCription <USTR>.
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 they might be interpreted incorrectly by the network server.

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 their default from the front panel.
Refer to **Section 14.13.10: System Subsystem** to reset the power source LAN settings to their 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 states values
- displaying measurements for up to six 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. The Home page appears.
3. 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). The Home page appears. If the web page does not open, perform LAN reset.

10.4.7.3 The Home Page

The Home page appears when the web page is opened after entering the IP address in the web browser.

Figure 10-5: 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 as 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, and Display.

10.4.7.4 Logging In

To make changes to any page other than the Home page, the user must login first.

When any menu other than the **Home** menu is clicked, **LOGIN** appears.

1. Click **LOGIN**. The field to enter the password appears.

By default, the password field is empty. If the password is not at default, enter it.

2. Click **Submit**.

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 another 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 10-6: Control → Basic Control Page

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

Measurements

Figure 10-7: Basic Control–Measurements

NOTE

If the output is OFF, the measurements are not displayed.

Settings

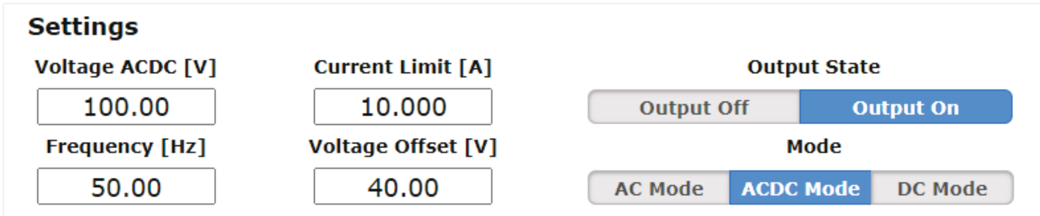


Figure 10-8: Basic Control–Settings

To change a setting, set the desired value and click **Enter** on the keyboard. To select an output state or operating mode, click the desired button. The selected output state or operating mode is indicated with a blue background in the log-in state or with a blue-colored text in the log-out state.

NOTE

Refer to **Table 14-9** 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, an error message is displayed if the operating mode is changed.

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
- High and low peak current protection (OCP) levels
- Over-Power protection (OPP) levels
- Auto-Start/Safe-Start mode
- Foldback protection mode
- Drop on Wire

Click **Control** and then **Protection** to enter the **Protection** page.

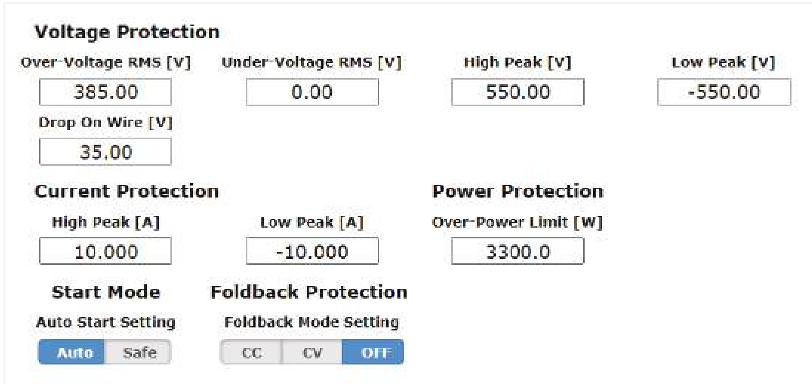


Figure 10-9: Control → Protection Page

To change a 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** and **Current Protection**.

Control → Measurements

This page displays the following measurements:

- Detailed measurement of 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: 2	Phase: 3
Frequency [Hz]	0060.01	0060.00	0060.00
Voltage RMS [V]	020.00	241.66	111.79
Voltage AC [V]	020.00	220.01	100.00
Voltage DC [V]	000.01	-099.99	049.97
Current RMS [A]	00.119	00.085	00.034
Current AC [A]	00.091	00.053	00.026
Current DC [A]	00.076	-00.066	00.021
Crest Factor	4.727	2.794	5.356
Apparent Power [VA]	00002.4	00020.6	00003.8
Active Power [W]	00000.3	00016.6	00002.9

Figure 10-10: Control → Measurements Page

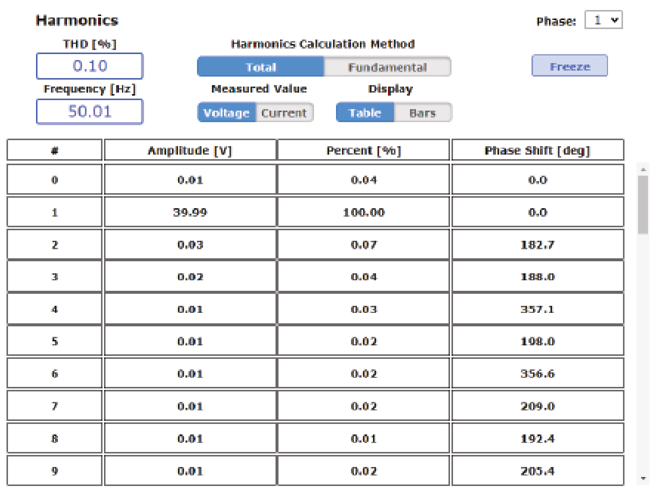
This page provides more detailed measurements and is an addition to **Measurements** in the **Basic Control** page. The voltage and current rms values are split and displayed with their respective AC and DC values.

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	108.0
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 10-11: Harmonics in Table Format

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 10-11**) or in bars format (refer to **Figure 10-12**). Use the respective button under **Display** to select table or bars format.

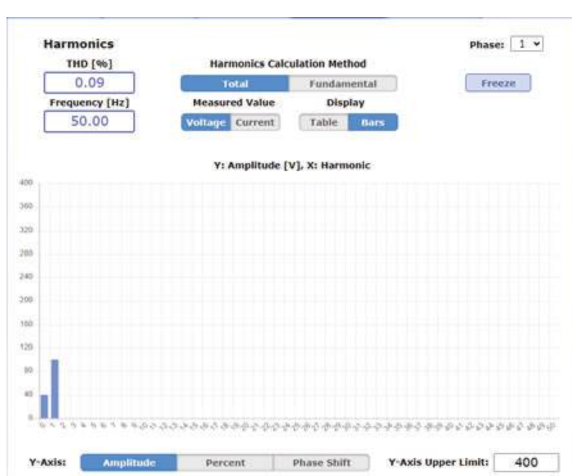


Figure 10-12: Harmonic in Bars Format

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. Move the mouse over the bars to view the harmonic number and its value. The Y-axis represents the maximum allowable limit.
Use **Freeze** to freeze the samplings.

NOTE

If the output is OFF, the measurements is not displayed.

Control → Direct Access

Click **Control** and then **Direct Access** to enter the **Direct Access** page.

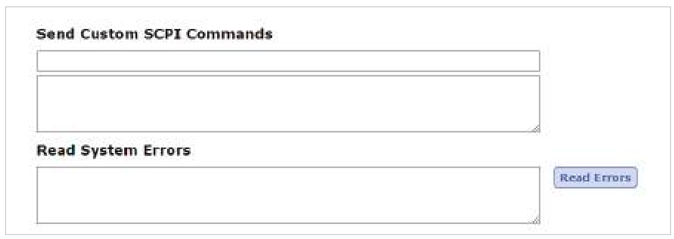


Figure 10-13: Control → Direct Access

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 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 by SCPI 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 you to view and configure the power source's LAN settings.

LAN Settings ➔ Configure Page and LAN Settings ➔ Configure ➔ Modify Page

Click **LAN Settings. Configure** page is displayed as default and can be used to view the LAN settings.

Present LAN Configuration	
IP Address Source:	DHCP/Auto IP
Actual IP Address:	10.97.5.229
Static IP Address Setting:	192.168.1.99
Subnet Mask:	255.255.255.0
Default Gateway:	10.97.4.1
Hostname:	GAC-PRO-03AA1C-07H00A-002024-000003
Description:	Genesys Power Source-002024-000003

Modify

Figure 10-14: 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 actual IP address assigned to the power source through DHCP/Auto-IP or Static IP

Static IP Address Setting

The default Static IP address. After a Static IP address is assigned, the Actual IP Address and Static IP Address Setting are the same. After a LAN reset, the Static IP Address Setting goes to default again.

Subnet Mask

The subnet mask assigned to the power source through DHCP/Auto-IP or Static IP

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 as DNS-SD Service Name

The **LAN Settings➔ Configure ➔ Modify** page allows changing of the LAN settings. The following page appears after **Modify** is clicked.

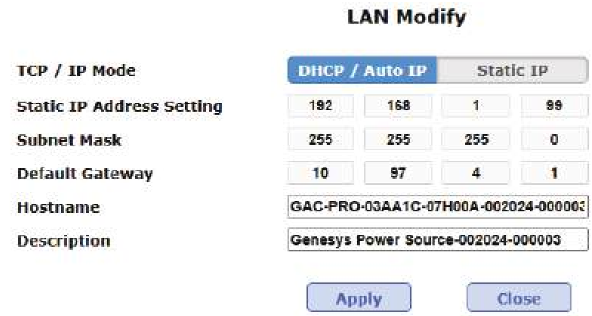


Figure 10-15: LAN Configure → Modify Page-DHCP/Auto IP

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 10-15.**

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 10-16**.

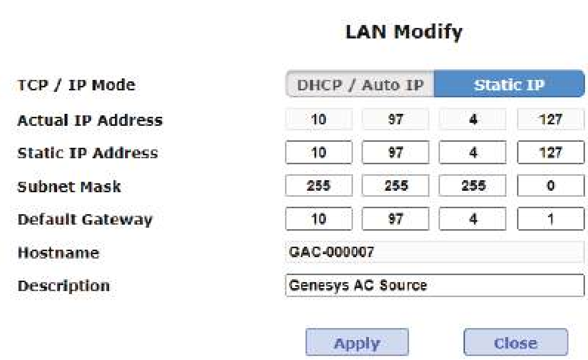


Figure 10-16: LAN Configure → Modify Page-Static IP

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 or any button on the display, by tapping the display on the front panel, or by using the SCPI command.

NOTE

You 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.

Present LAN Configuration	
LAN Timeout:	1800
Ping Server:	Enabled
Vxi Discovery:	Enabled
Multicast DNS Enable:	Enabled
UDP Enable:	Enabled
Max. No. of Connections:	4

Modify

Figure 10-17: LAN Advanced Page

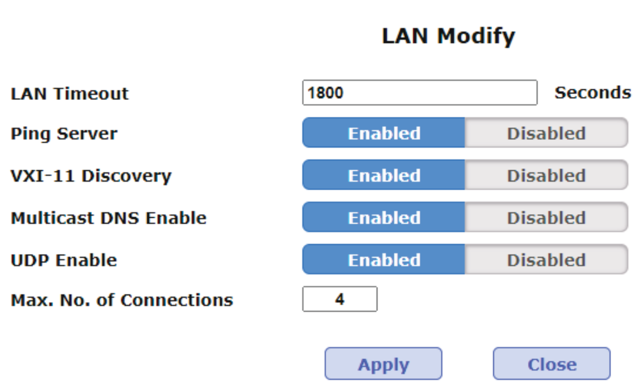


Figure 10-18: LAN Advanced → Modify Page

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, which 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 they can be changed.

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 or any button on the display, by tapping the display on the front panel, or by using the SCPI command.

NOTE

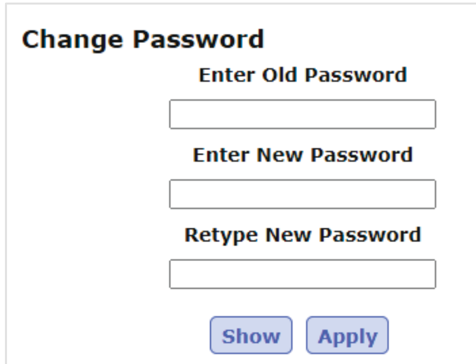
You may be required to perform AC reset of the power source after changing the LAN settings.

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. 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.

Windows is a trademark of Microsoft Corporation.

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.

Example of VISA resource descriptors are:

Format: 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.

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. Responses to queries are sent back automatically with a line-feed terminator and carriage return appended.

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. 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?; refer to **Section 14.13.10: System Subsystem**.

10.4.10 Connecting Over WAN

To connect over 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 on the J4 connector (except NC (Not Connected) pins) 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 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 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)

Trigger In triggers an execution of a sequence.
To select the trigger source via the front panel, refer to **Section 9.4.9: Program Menu**. To select the trigger source via a communication command, refer to **Section 14.13.11: TRIGger Subsystem**.

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)**, and the type of programming source can be detected using the Local/Remote Analog Monitor **(J4-5)**.

11.6.2 Local/Remote Analog Enable (J4-6)

The Local/Remote Analog Enable pin accepts an electrical signal or dry contact to select between local or remote programming of the output voltage.
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 set the mode via the front panel, refer to **Section 9.4.5: Configuration Menu.** To set the mode via a communication command, refer to **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 11-4: 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 these signals to the voltage source with a series resistor to limit the sink current to less than 10mA.

NOTE

If the Analog input (J4-6) is 2–30V or open (disabled), the external programming source is not relevant.

11.7 Trigger Out #2 (J4-7)

Trigger out signal to indicate that the triggered measurements data that was captured is ready.

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 range.

Mode	Maximum Monitoring Value
AC and ACDC	rms voltage rating
DC	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 range to programming range).

Mode	Maximum Monitoring Value
AC, DC, and ACDC	DC voltage rating

To select RMS control or FULL control via the front panel refer to **Section 9.4.5: Configuration Menu.** To select RMS control or FULL control via 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 of the output voltage can be controlled with a Local/Remote analog enable pin that accepts an electrical signal or dry contact. 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.

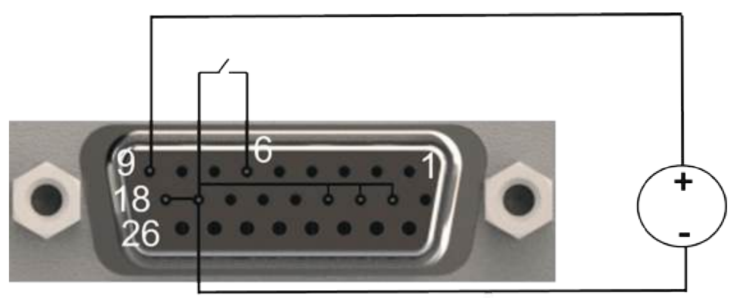
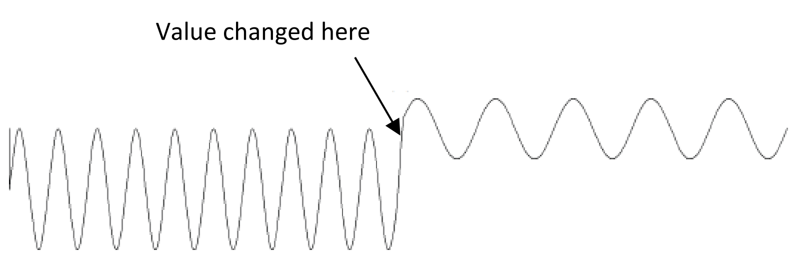
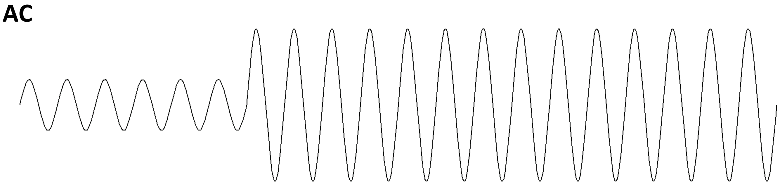


Figure 11-1: Setup for External Voltage Programming

The selection range for external (analog) voltage programming is 2.5V to 10V. To set the range via the front panel, refer to **Section 9.4.5: Configuration Menu.** To set the range via a communication command, refer to **Section 14.13.10: System Subsystem**. The control range is dependent on the selection range.

There are four different types of voltage programming as shown in **Table 11-5**.

Mode	Value Set	Control Range (V)
Full 	Instantaneous (AC, DC, Frequency) (Applicable for DC enabled units only)	±2.5 to ±10. Ex- With 2.5V selection range, the control range is -2.5V to +2.5V
AC 	AC Voltage	2.5 to 10 Ex- With 5V selection range, the control range is 0 to 5V

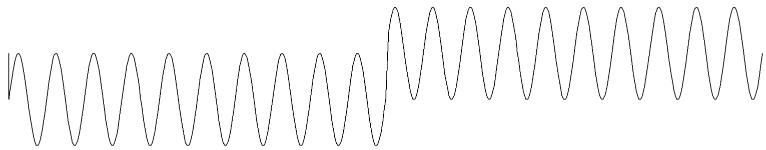
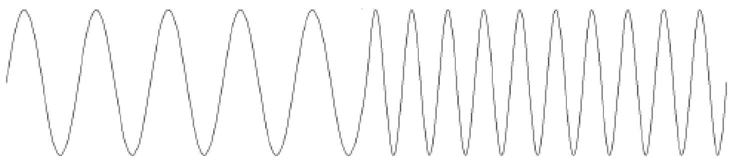
DC 	DC Voltage (Applicable for DC enabled units only)	±2.5 to ±10 Ex- With 3V selection range, the control range is -3V to +3V
Freq 	Frequency	2.5 to 10 Ex- With 10V selection range, the control range is 0V to 10V

Table 11-5: 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.

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**.

11.10.1 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 select the polarity with a communication command, refer to OUTPut:ENA:POLarity[:STATe] <DSC> in **Section 14.13.5: Output Subsystem.**

11.10.2 ENABLE IN and ENABLE IN Polarity

Table 11-6 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 11-6: ENABLE IN (ENA) Signal and Polarity

NOTE

If the ENA function is disabled, the connection between J4-10 and J4-11 and/or the polarity setting has no effect on the output and the output always remain ON.

CAUTION

To prevent possible 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.

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.**

Table 11-7 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 11-7: INTERLOCK IN (ILC) Signal

NOTE

If the ILC function is disabled, the connection between J4-19 and J4-11 has no effect and the output always remain ON.

CAUTION

To prevent possible 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 **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 11-8: 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)

Trigger signal to start the measurements. Refer to MEASure:TRIGger:SOURce <DSC> in **Section 14.13.4: Measure Subsystem**.

11.14 Trigger Out #1 (J4-23)

Trigger Out is an active high output signal. The signal is user selectable and there are three trigger out modes. Refer to OUTPut:TTLTrg:MODE[#] <DSC> in **Section 14.13.5: Output Subsystem**.

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 11-9: 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	AC-OK 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 11-10: 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 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 range.

Mode	Maximum Monitoring Value
AC, DC, and ACDC	rms 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).

Mode	Maximum Monitoring Value
AC, DC, and ACDC	DC current rating

To select the mode via the front panel, refer to **Section 9.4.5: Configuration Menu.** To select the mode via a communication command, refer to SYSTem:EXTernal:MONitor[:MODE][#] <DSC> in **Section 14.13.10: System Subsystem**.

CHAPTER 12: PROTECTIVE FUNCTIONS, FAULTS, AND ALARMS

12.1 Introduction

There are several conditions that cause protection, faults, and alarms. When any fault or protective function occurs, the respective fault 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 triggers.

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 latched and non-latched faults list, refer to **Table 12-1**.

Latched: There are four methods to recover from a fault or protective state after the fault condition is removed:

- output ON from the front panel or with a communication command
- recycling of the power switch (*)
- recycling of AC (*)
- sending the Output Protection Clear command (*)

NOTE

(*) Recycling the power switch or AC or sending the Output Protection Clear command automatically clear the Questionable Condition Event Register.

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 any fault occurs:

- output power is disabled.
- the fault message is displayed.
- the alarm LED blinks at a 1Hz frequency.
- 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.

Faults/Protective Functions	Latched	Non-latched	Questionable Condition and Event Register Bit
AC	-	Yes	1
Over-Temperature Protection (Hardware)	Yes	-	2
Foldback	Yes	-	3
Over-Voltage Protection (rms)	Yes	-	4
Over-Power Protection	Yes	-	5
Front Panel Output OFF	Yes	-	6
Under-Voltage Protection	Yes	-	7
Parallel Acknowledge	Yes	-	8
General Error	Yes	-	9
Parallel Error	Yes	-	10
Parallel Wait Slave	Yes	-	11
Power Switch OFF	-	Yes	12
Communication Watchdog Timeout	Yes	-	13
E-STOP	Yes	-	14
Peak Over-Voltage	Yes	-	15
Drop-On-Wire	Yes	-	16
Peak Drop-On-Wire	Yes	-	17
Hardware	-	-	18
Ambient Over-Temperature Protection (Software)	Yes	-	19
Over-Power Protection (Low Line)	Yes	-	20
Peak Over-Current	Yes	-	21
Shorted Output	Yes	-	22
Over-Frequency	Yes	-	23
Under-Frequency	Yes	-	24
Voltage Controlled Frequency (Power Factor)	-	Yes	25
Current Imbalance	Yes	-	26

Table 12-1: Faults and Protective Functions

NOTE

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 Event Register are still be set to **1** unless this register is read.

12.3 Displaying the Faults on the Front Panel

It is possible that more than one fault or a protective function may be triggered. When any fault occurs, the respective fault message appears on the display.

Figure 12-1: Single Fault

If a fault exists, and any other faults occur later, that fault will not be seen but there will be an indicator (**right** arrow) that indicates that more faults have occurred and can they be viewed by pressing the **right** button. As shown in **Figure 12-2**, Enable shutdown occurs first and the figure also shows that Enable shutdown is followed with E-STOP shutdown.

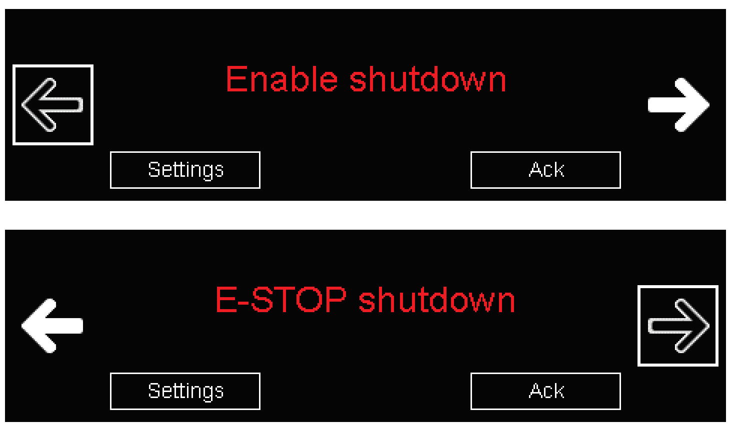


Figure 12-2: Multiple Faults

When more than two faults occur, all of them can be viewed by using the **left** and the **right** buttons.

CHAPTER 13: MEMORY CONFIGURATION

13.1 Introduction

The power source has a number of memory configuration modes that can be used to restore it to a pre-determined state.

13.2 Default Setting or Factory Reset

To restore the factory default settings from the front panel, refer to **Section 9.4.6: System Menu**.
To restore the factory default settings with the rear panel switch, press and hold the **Reset** button for 5 to 10 seconds. This also sets the communication interface to USB.
To restore the default settings with a communication command, refer to System:FRST [<DSC>] in **Section 14.13.10: System Subsystem.**

NOTE

If this function is performed, the power source loses communication as the communication settings change and the addressing is lost.

13.3 Reset

This function sets parameters to their reset state.

13.4 Last Setting Memory

This function stores the power source state and settings into the non-volatile memory at AC fail.
The settings are restored at AC ON.

13.5 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.

13.6 Recall <1–4>

This function recalls the power source state and settings from the non-volatile memory.
User can recall up to 4 sets of parameters.

NOTE

To reset, save, or recall the settings via the front panel refer to **Section 9.4.6: System Menu**.
To reset, save, or recall the settings with a communication command, refer to *RST. *SAV, or *RCL in **Section 14.12: SCPI Common Commands.**
For a complete table on Default Settings, Reset, Last Setting, Save and Recall parameters, refer to **Table 13-1**.

13.7 Non-Volatile Memory Parameters

Command / Function	Factory Reset	Reset	Last Setting	Save Recall and PON Profile	Parallel System Change	Number of Phases Change
*ESE <NR1>	0	-	+	+	0	-
*PSC <Bool>	0	-	+	+	0	-
Profiles (*RCL/*SAV)	-	-	-	-	Clears all profile slots 1-4	Clears all profile slots 1-4
*SRE <NR1>	0	-	+	+	-	-
DISPlay[:WINDow][:STATe][#] <Bool>	ON	-	+	-	-	-
DISPlay[:WINDow]:BRIGhtness[#] <NR1>	80	-	+	-	-	-
DISPlay[:WINDow]:DIMMing:BRIGhtness[#] <NR1>	50	-	+	-	-	-
DISPlay[:WINDow]:DIMMing:DELay[#] <NR1>	60	-	+	-	-	-
DISPlay[:WINDow]:FLASh[#] <Bool>	OFF	-	-	-	-	-
DISPlay[:WINDow]:MODE[#] <DSC>	NORM	-	+	-	-	-
DISPlay[:WINDow]:TOUCh[#] <Bool>	ON	-	+	-	-	-
DISPlay[:WINDow]:IDLE:TIMeout[#] <NR1>	60	-	+	-	-	-
DISPlay[:WINDow]:LANGuage[#] <DSC>	ENG	-	+	-	-	-
DISPlay[:WINDow]:TEXT[#] <STR>	-	-	+	-	-	-
DISPlay[:WINDow]:TEXT:FORMat[#] <NR1>,<NR1>,[<NR1>],[<NR1>]	-	-	+	-	-	-
INITiate:CONTinuous <Bool>	OFF	-	+	+	OFF	-
MEASure:ARRay:PHASe <NRf>	0	-	+	+	0	-
MEASure:HARMonic:PERCent[:TYPE] <DSC>	FUND	-	+	+	FUND	-
MEASure:TRIGger:DELay <NRf>	0	-	+	+	0	-
MEASure:TRIGger:SYNC:ENABle <Bool>	OFF	-	+	+	OFF	-
MEASure:TRIGger:SYNC:PHASe <NRf>	0	-	+	+	0	-
MEASure:TRIGger:SOURce <DSC>	BUS	-	+	+	BUS	-
OUTPut[:STATe] <Bool>	OFF	OFF	+[*1]	+	OFF	OFF
OUTPut:ECO[:MODE][:ENABle] <Bool>	OFF	-	+	+	OFF	-
OUTPut:ENA[:STATe] <Bool>	OFF	-	+	+	OFF	-
OUTPut:ENA:LATCh[:STATe] <Bool>	OFF	-	+	+	OFF	-
OUTPut:ENA:POLarity[:STATe] <DSC>	REV	-	+	+	REV	-
OUTPut:ESTOp[:STATe] <Bool>	OFF	-	+	+	OFF	-
OUTPut:ESTOp:LATCh[:STATe] <Bool>	ON	-	+	+	ON	-
OUTPut:ILC[:STATe] <Bool>	OFF	-	+	+	OFF	-
OUTPut:ILC:LATCh[:STATe] <Bool>	OFF	-	+	+	OFF	-
OUTPut:PHASe:ON <NRf>	-1	-	+	+	-1	-
OUTPut:PHASe:OFF <NRf>	-1	-	+	+	-1	-
OUTPut:PON[:STATe] <DSC>	SAFE	SAFE	+	+	SAFE	-
OUTPut:PON:PROFile <DSC>	-	-	-	-	LAST[*2]	-
OUTPut:PROTection:FOLDback[:MODE] <DSC>	OFF	OFF	+	+	OFF	-

OUTPut:PROTection:FOLDback:DELay <NRf>	1	1	+	+	1	-
OUTPut:RELay1[:STATe][#] <DSC>	LOW	LOW	+	+	LOW	-
OUTPut:RELay1:COUNt[#] <NR1>	-1	-1	+	+	-1	-
OUTPut:RELay1:DCYCle[#] <NRf>	0.5	0.5	+	+	0.5	-
OUTPut:RELay1:PERiod[#] <NR1>	1	1	+	+	1	-
OUTPut:RELay2[:STATe][#] <DSC>	LOW	LOW	+	+	LOW	-
OUTPut:RELay2:COUNt[#] <NR1>	-1	-1	+	+	-1	-
OUTPut:RELay2:DCYCle[#] <NRf>	0.5	0.5	+	+	0.5	-
OUTPut:RELay2:PERiod[#] <NR1>	1	1	+	+	1	-
OUTPut:TTLTrg:MODE[#] <DSC>	OFF	-	+	+	OFF	-
[FUNCtion:]WAVeform[:ACTivate][:NAME] [#] <USTR>	SINe	SINe	+	+	SINe	-
[FUNCtion:]WAVeform[:ACTivate]:SYNC:ENABle [#] <Bool>	OFF	OFF	+	+	OFF	-
[FUNCtion:]WAVeform:SQUare:DCYCle[#] <NRf>	50	50	+	+	50	-
[FUNCtion:]WAVeform:TRIangle:SYMMetry [#] <NRf>	50	50	+	+	50	-
[FUNCtion:]WAVeform:CSINe:LEVel[#] <NRf>	100	100	+	+	100	-
[FUNCtion:]WAVeform:CSINe:THD[#] <NRf>	0	0	+	+	0	-
[FUNCtion:]WAVeform:CSINe:MODE[#] <DSC>	LEV	LEV	+	+	LEV	-
[FUNCtion:]WAVeform:REGion <NR1>	1	1	+	+	1	-
[PROGram:]PULSe:VOLTage:AC[#] <NRf>	0	-	-	-	0	-
[PROGram:]PULSe:VOLTage:AC:SLEW:UP[#] <NRf>	4400/16340*7	-	-	-	4400/16340*7	-
[PROGram:]PULSe:VOLTage:AC:SLEW:DOWN [#] <NRf>	4400/16340*7	-	-	-	4400/16340*7	-
[PROGram:]PULSe:VOLTage:DC[#] <NRf>	0	-	-	-	0	-
[PROGram:]PULSe:VOLTage:DC:SLEW:UP [#] <NRf>	4400/16340*7	-	-	-	4400/16340*7	-
[PROGram:]PULSe:VOLTage:DC:SLEW:DOWN [#] <NRf>	4400/16340*7	-	-	-	4400/16340*7	-
[PROGram:]PULSe:FREQuency <NRf>	50	-	-	-	50	-
[PROGram:]PULSe:FREQuency:SLEW:UP <NRf>	100000	-	-	-	100000	-
[PROGram:]PULSe:FREQuency:SLEW:DOWN <NRf>	100000	-	-	-	100000	-
[PROGram:]PULSe:WAVeform[#] <USTR>	SINe	-	-	-	SINe	-
[PROGram:]PULSe:PHASe:STARt <NRf>	0	-	-	-	0	-
[PROGram:]PULSe:PHASe:END <NRf>	0	-	-	-	0	-
[PROGram:]PULSe:DURation:ACTive <NRf>	0.1	-	-	-	0.1	-
[PROGram:]PULSe:DURation:INACtive <NRf>	0.1	-	-	-	0.1	-
[PROGram:]PULSe:REPeat <NR1>	1	-	-	-	1	-
[PROGram:]PULSe:TTLTrg:ENABle [#] <Bool>,<Bool>	0,0	-	-	-	0,0	-
[PROGram:]STEP:VOLTage:AC[#] <NRf>	0	-	-	-	0	-
[PROGram:]STEP:VOLTage:AC:SLEW:UP[#] <NRf>	4400/16340*7	-	-	-	4400/16340*7	-

[PROGram:]STEP:VOLTage:AC:SLEW:DOWN [#] <NRf>	4400/16340*7	-	-	-	4400/16340*7	-
[PROGram:]STEP:VOLTage:DC[#] <NRf>	0	-	-	-	0	-
[PROGram:]STEP:VOLTage:DC:SLEW:UP[#] <NRf>	4400/16340*7	-	-	-	4400/16340*7	-
[PROGram:]STEP:VOLTage:DC:SLEW:DOWN [#] <NRf>	4400/16340*7	-	-	-	4400/16340*7	-
[PROGram:]STEP:FREQuency <NRf>	50	-	-	-	50	-
[PROGram:]STEP:FREQuency:SLEW:UP <NRf>	100000	-	-	-	100000	-
[PROGram:]STEP:FREQuency:SLEW:DOWN <NRf>	100000	-	-	-	100000	-
[PROGram:]STEP:WAVeform[#] <USTR>	SINe	-	-	-	SINe	-
[PROGram:]STEP:PHASe:STARt <NRf>	0	-	-	-	0	-
[PROGram:]STEP:TTLTrg:ENABle[#] <Bool>	0	-	-	-	0	-
[PROGram:]LIST:VOLTage:AC[#] <NRf>{,NRf}	0	-	-	-	0	-
[PROGram:]LIST:VOLTage:AC:SLEW:UP [#] <NRf>{,NRf}	4400/16340*7	-	-	-	4400/16340*7	-
[PROGram:]LIST:VOLTage:AC:SLEW:DOWN[#] <NRf>{,NRf}	4400/16340*7	-	-	-	4400/16340*7	-
[PROGram:]LIST:VOLTage:DC[#] <NRf>{,NRf}	0	-	-	-	0	-
[PROGram:]LIST:VOLTage:DC:SLEW:UP [#] <NRf>{,NRf}	4400/16340*7	-	-	-	4400/16340*7	-
[PROGram:]LIST:VOLTage:DC:SLEW:DOWN [#] <NRf>{,NRf}	4400/16340*7	-	-	-	4400/16340*7	-
[PROGram:]LIST:FREQuency <NRf>{,NRf}	50	-	-	-	50	-
[PROGram:]LIST:FREQuency:SLEW:UP <NRf>{,NRf}	100000	-	-	-	100000	-
[PROGram:]LIST:FREQuency:SLEW:DOWN <NRf>{,NRf}	100000	-	-	-	100000	-
[PROGram:]LIST:WAVeform[#] <USTR>	SINe	-	-	-	SINe	-
[PROGram:]LIST:PHASe:STARt <NRf>{,NRf}	0	-	-	-	0	-
[PROGram:]LIST:PHASe:END <NRf>{,NRf}	0	-	-	-	0	-
[PROGram:]LIST:DURation <NRf>{,NRf}	0.1	-	-	-	0.1	-
[PROGram:]LIST:REPeat <NR1>	1	-	-	-	1	-
[PROGram:]LIST:STEP <DSC>	ONCE	-	-	-	ONCE	-
[PROGram:]LIST:TTLTrg:ENABle[#] <Bool>{,Bool}	OFF	-	-	-	OFF	-
[PROGram:]MODE:VOLTage:AC <DSC>	IMM	-	-	-	IMM	-
[PROGram:]MODE:VOLTage:DC <DSC>	IMM	-	-	-	IMM	-
[PROGram:]MODE:WAVeform <DSC>	IMM	-	-	-	IMM	-
[PROGram:]MODE:FREQuency <DSC>	IMM	-	-	-	IMM	-
[PROGram:]MODE:VOLTage:AC:SLEW <DSC>	IMM	-	-	-	IMM	-
[PROGram:]MODE:VOLTage:DC:SLEW <DSC>	IMM	-	-	-	IMM	-
[PROGram:]MODE:FREQuency:SLEW <DSC>	IMM	-	-	-	IMM	-
[PROGram:]MODE:PHASe:STARt <DSC>	OFF	-	-	-	OFF	-
[PROGram:]MODE:PHASe:END <DSC>	OFF	-	-	-	OFF	-
[PROGram:]MODE:ABORt <DSC>	OFF	-	-	-	OFF	-
[PROGram:]MODE:END <DSC>	IMM	-	-	-	IMM	-
[PROGram:]DC:COUNter <NR1> | INFinity	1	-	-	-	1	-

[PROGram:]DC:LIST:DWELl <NRf>{,<NRf>}	0.1	-	-	-	0.1	-
[PROGram:]DC:LIST:VOLTage[#] <NRf>{,<NRf>}	0	-	-	-	0	-
[PROGram:]DC:STEP <DSC>	ONCE	-	-	-	ONCE	-
[PROGram:]DC:WAVE:TIME <NRf+>{,<NRf>}	0.1	-	-	-	0.1	-
[PROGram:]DC:WAVE:VOLTage[#] <NRf>{,<NRf>}	0	-	-	-	0	-
[PROGram:]DC:ACTivate <DSC>	LIST	-	-	-	LIST	-
[PROGram:]DC:MODE:ABORt <DSC>	IMM	-	-	-	IMM	-
[PROGram:]DC:MODE:END <DSC>	IMM	-	-	-	IMM	-
[SOURce:]CURRent[:LEVel][:IMMediate][:AC][#] <NRf>	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[#] <NRf>	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[#] <NRf>	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] <NRf>	130[*3]	130[*3]	+	+	130[*3]	-
[SOURce:]CURRent:PROTection:PEAK:LOW[:LEVel] <NRf>	-130[*3]	-130[*3]	+	+	-130[*3]	-
[SOURce:]FREQuency[:IMMediate] <NRf>	50	50	+	+	50	-
[SOURce:]FREQuency:SLEW:DOWN <NRf>	100000	100000	+	+	100000	-
[SOURce:]FREQuency:SLEW:UP <NRf>	100000	100000	+	+	100000	-
[SOURce:]MODE <DSC>	AC	AC	+	+	AC	-
[SOURce:]PHASe:SHIFt[#] <NRf>	0	0	+	+	-[*4]	-[*4]
[SOURce:]POWer:PROTection[:AC][:LEVel] <NRf>	2200/3300[*3][*5]	2200/3300[*3][*5]	+	+	2200/3300[*3][*5]	-
[SOURce:]POWer:PROTection:ACDC[:LEVel] <NRf>	2200/3300[*3][*5]	2200/3300[*3][*5]	+	+	2200/3300[*3][*5]	-
[SOURce:]POWer:PROTection:DC[:LEVel] <NRf>	2200/3300[*3][*5]	2200/3300[*3][*5]	+	+	2200/3300[*3][*5]	-
[SOURce:]VOLTage[:LEVel][:IMMediate][:AC][#] <NRf>	0	0	+	+	0	0
[SOURce:]VOLTage[:LEVel][:IMMediate]:ACDC[:AC][#] <NRf>	0	0	+	+	0	0
[SOURce:]VOLTage[:LEVel][:IMMediate]:ACDC:DC[#] <NRf>	0	0	+	+	0	0
[SOURce:]VOLTage[:LEVel][:IMMediate]:DC[#] <NRf>	0	0	+	+	0	0
[SOURce:]VOLTage:BALance:RESPonse[:SPEed] <DSC>	SLOW	SLOW	+	+	SLOW	-
[SOURce:]VOLTage:BALance:AC <NR1>	70	70	+	+	70	-
[SOURce:]VOLTage:BALance:AC:ENABle <Bool>	1	1	+	+	1	-
[SOURce:]VOLTage:BALance:DC <NR1>	75	75	+	+	75	-
[SOURce:]VOLTage:BALance:DC:ENABle <Bool>	0	0	+	+	0	-
[SOURce:]VOLTage:BALance:FAIL[:ENABle] <Bool>	1	1	+	+	1	-
[SOURce:]VOLTage:AC:SLEW:OFF <NRf>	4400	4400	+	+	4400	-
[SOURce:]VOLTage:AC:SLEW:ON <NRf>	4400	4400	+	+	4400	-

[SOURce:]VOLTage:AC:SLEW:DOWN[#] <NRf>	4400/16340[*7]	4400/16340[*7]	+	+	4400/16340[*7]	4400/16340[*7]
[SOURce:]VOLTage:AC:SLEW:UP[#] <NRf>	4400/16340[*7]	4400/16340[*7]	+	+	4400/16340[*7]	4400/16340[*7]
[SOURce:]VOLTage:DC:SLEW:OFF <NRf>	4400	4400	+	+	4400	-
[SOURce:]VOLTage:DC:SLEW:ON <NRf>	4400	4400	+	+	4400	-
[SOURce:]VOLTage:DC:SLEW:DOWN[#] <NRf>	4400/16340[*7]	4400/16340[*7]	+	+	4400/16340[*7]	4400/16340[*7]
[SOURce:]VOLTage:DC:SLEW:UP[#] <NRf>	4400/16340[*7]	4400/16340[*7]	+	+	4400/16340[*7]	4400/16340[*7]
[SOURce:]VOLTage:PROTection[:AC]:PEAK:HIGH [:LEVel] <NRf>	550	550	+	+	550	-
[SOURce:]VOLTage:PROTection[:AC]:PEAK:LOW [:LEVel] <NRf>	-550	-550	+	+	-550	-
[SOURce:]VOLTage:PROTection:ACDC:PEAK:HIGH [:LEVel] <NRf>	550	550	+	+	550	-
[SOURce:]VOLTage:PROTection:ACDC:PEAK:LOW [:LEVel] <NRf>	-550	-550	+	+	-550	-
[SOURce:]VOLTage:PROTection:DC:PEAK:HIGH [:LEVel] <NRf>	550	550	+	+	550	-
[SOURce:]VOLTage:PROTection:DC:PEAK:LOW [:LEVel] <NRf>	-550	-550	+	+	-550	-
[SOURce:]VOLTage:PROTection:DROP[:LEVel] <NRf>	35	35	+	+	35	-
[SOURce:]VOLTage:PROTection[:AC][:LEVel] <NRf>	385	385	+	+	385	-
[SOURce:]VOLTage:PROTection:ACDC[:LEVel] <NRf>	385	385	+	+	385	-
[SOURce:]VOLTage:PROTection:DC[:LEVel] <NRf>	550	550	+	+	550	-
[SOURce:]VOLTage:PROTection:LOW:DELay <NRf>	0.1	0.1	+	+	0.1	-
[SOURce:]VOLTage:PROTection[:AC]:LOW:STATe <Bool>	0	0	+	+	0	-
[SOURce:]VOLTage:PROTection[:AC]:LOW[:LEVel] <NRf>	0	0	+	+	0	-
[SOURce:]VOLTage:PROTection:ACDC:LOW:STATe <Bool>	0	0	+	+	0	-
[SOURce:]VOLTage:PROTection:ACDC:LOW[:LEVel] <NRf>	0	0	+	+	0	-
[SOURce:]VOLTage:PROTection:DC:LOW:STATe <Bool>	0	0	+	+	0	-
[SOURce:]VOLTage:PROTection:DC:LOW[:LEVel] <NRf>	0	0	+	+	0	-
STATus:ALM:CONFigure <NR1>	4294967295	-	+	+	4294967295	-
STATus:OPERation:ENABle <NR1>	0	-	+	+	0	-
STATus:QUEStionable:ENABle <NR1>	0	-	+	+	0	-
SYSTem[:COMMunicate]:RS485:ADDRess <NR1>	6	-	+	-	-	-
SYSTem[:COMMunicate]:RS485:ADDRess:STATe <Bool>	0	-	+	-	-	-
SYSTem[:COMMunicate]:RS485:TERMination:STATe <Bool>	1	-	+	-	-	-
SYSTem[:COMMunicate]:BAUDrate <DSC>	921600	-	+	-	-	-
SYSTem[:COMMunicate]:INTerface <DSC>	USB	-	+	-	-	-

SYSTem[:COMMunicate]:LAN:IP[:STATic] <SRD>	192.168.1.99[*8]	-	+	-	-	-
SYSTem[:COMMunicate]:LAN[:CONFigure]:IPSource <DSC>	DHCP[*8]	-	+	-	-	-
SYSTem[:COMMunicate]:LAN[:CONFigure] :SUBNetmask <SRD>	255.255.255.0[*8]	-	+	-	-	-
SYSTem[:COMMunicate]:LAN[:CONFigure] :DEFGateway <SRD>	0.0.0.0[*8]	-	+	-	-	-
SYSTem[:COMMunicate]:LAN[:CONFigure] :DNSserver <SRD>	0.0.0.0[*8]	-	+	-	-	-
SYSTem[:COMMunicate]:LAN[:CONFigure] :HOSTname <STR>	Refer to LAN section[*8]	-	+	-	-	-
SYSTem[:COMMunicate]:LAN[:CONFigure] :DESCription <STR>	Refer to LAN section[*8]	-	+	-	-	-
SYSTem[:COMMunicate]:LAN:UDP:ENABle <Bool>	1[*8]	-	+	-	-	-
SYSTem[:COMMunicate]:LAN[:CONFigure] :MDNSenabale <Bool>	1[*8]	-	+	-	-	-
SYSTem[:COMMunicate]:LAN[:ADVanced]:TIMEout <NR1>	1800[*8]	-	+	-	-	-
SYSTem[:COMMunicate]:LAN[:ADVanced] :PINGenable <Bool>	1[*8]	-	+	-	-	-
SYSTem[:COMMunicate]:LAN[:ADVanced] :VXIdiscovery <Bool>	1[*8]	-	+	-	-	-
SYSTem[:COMMunicate]:LAN:CONNections <NR1>	4[*8]	-	+	-	-	-
Web server (web page) login password	None[*8]	-	-	-	-	-
SYSTem[:COMMunicate]:RS232:CONTrol <Bool>	0	-	+	-	-	-
SYSTem:ERRor:ENABle <Bool>	1	-	+	-	1	-
SYSTem:EXTernal:ENABle[#] <Bool>	0	-	+	+	0	0
SYSTem:EXTernal:RANGe[#] <NR2>	10	-	+	+	10	10
SYSTem:EXTernal:FUNCtion[#] <DSC>	AC	-	+	+	AC	AC
SYSTem:EXTernal:MONitor[:MODE][#] <DSC>	FULL	-	+	+	FULL	FULL
SYSTem:EXTernal:MONitor:CURRent[:MAX][:LEVel][#] <NRf>	30[*4]	-	+	+	30[*4]	30[*4]
SYSTem:PHASe:CONFiguration <NR1>	-	-	+	+	-[*4]	-[*4]
SYSTem:PSOK:DELay <NRf>	0	-	+	+	0	-
SYSTem:REMote[:STATe] <DSC>	LOCal	-	-	-	-	-
SYSTem:SENSe[:STATe] <DSC>	LOCal	-	+	+	LOCal	-
TRIGger:PROGram [<DSC>]	STEP,PULSe,LIST	-	-	-	STEP,PULSe,LIST	-
TRIGger:DELay <NRf>	0	-	-	-	0	-
TRIGger:SOURce <DSC>	BUS	-	-	-	BUS	-
IHARmonics:DURation <NRf>	0.1	-	+	+	0.1	-
IHARmonics:FREQuency:STARt <NRf>	50	-	+	+	50	-
IHARmonics:FREQuency:END <NRf>	50	-	+	+	50	-
IHARmonics:FREQuency:PAUSe <NRf>	-1	-	+	+	-1	-
IHARmonics:LEVel <NRf>	0	-	+	+	0	-
IHARmonics:STEP:SIZE <NRf>	1	-	+	+	1	-

IHARmonics:STEP:DWELl <NRf>	0.1	-	+	+	0.1	-
IHARmonics:STEP:PHASe <NRf>	0	-	+	+	0	-
IHARmonics:STEP:PHASe:SYNC:ENABle <Bool>	0	-	+	+	0	-
IHARmonics:STATe <DSC>	OFF	-	-	-	OFF	-
IHARmonics:WAVeform <USTR>	SINe	-	+	+	SINe	-

Table 13-1: Non-Volatile Memory Parameters

*1: Power source output will turn on only of Auto-Start is enabled.
*2: Saved profiles are deleted in case of a Parallel System Change (Clears all profile slots 1-4).
*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.

13.8 Program Store, Load, and Clear Memory Functions

Command / Function	Store/Load:AC[*1]	Clear:AC[*2]	Store/Load:DC[*3]	Clear:DC[*4]
[PROGram:]PULSe:VOLTage:AC[#] <NRf>	+	+	-	-
[PROGram:]PULSe:VOLTage:AC:SLEW:UP[#] <NRf>	+	+	-	-
[PROGram:]PULSe:VOLTage:AC:SLEW:DOWN[#] <NRf>	+	+	-	-
[PROGram:]PULSe:VOLTage:DC[#] <NRf>	+	+	-	-
[PROGram:]PULSe:VOLTage:DC:SLEW:UP[#] <NRf>	+	+	-	-
[PROGram:]PULSe:VOLTage:DC:SLEW:DOWN[#] <NRf>	+	+	-	-
[PROGram:]PULSe:FREQuency <NRf>	+	+	-	-
[PROGram:]PULSe:FREQuency:SLEW:UP <NRf>	+	+	-	-
[PROGram:]PULSe:FREQuency:SLEW:DOWN <NRf>	+	+	-	-
[PROGram:]PULSe:WAVeform[#] <USTR>	+	+	-	-
[PROGram:]PULSe:PHASe:STARt <NRf>	+	+	-	-
[PROGram:]PULSe:PHASe:END <NRf>	+	+	-	-
[PROGram:]PULSe:DURation:ACTive <NRf>	+	+	-	-
[PROGram:]PULSe:DURation:INACtive <NRf>	+	+	-	-
[PROGram:]PULSe:REPeat <NR1>	+	+	-	-
[PROGram:]PULSe:TTLTrg:ENABle[#] <Bool>,<Bool>	+	+	-	-
[PROGram:]STEP:VOLTage:AC[#] <NRf>	+	+	-	-
[PROGram:]STEP:VOLTage:AC:SLEW:UP[#] <NRf>	+	+	-	-
[PROGram:]STEP:VOLTage:AC:SLEW:DOWN[#] <NRf>	+	+	-	-
[PROGram:]STEP:VOLTage:DC[#] <NRf>	+	+	-	-
[PROGram:]STEP:VOLTage:DC:SLEW:UP[#] <NRf>	+	+	-	-
[PROGram:]STEP:VOLTage:DC:SLEW:DOWN[#] <NRf>	+	+	-	-
[PROGram:]STEP:FREQuency <NRf>	+	+	-	-

[PROGram:]STEP:FREQuency:SLEW:UP <NRf>	+	+	-	-
[PROGram:]STEP:FREQuency:SLEW:DOWN <NRf>	+	+	-	-
[PROGram:]STEP:WAVeform[#] <USTR>	+	+	-	-
[PROGram:]STEP:PHASe:STARt <NRf>	+	+	-	-
[PROGram:]STEP:TTLTrg:ENABle[#] <Bool>	+	+	-	-
[PROGram:]LIST:VOLTage:AC[#] <NRf>{,NRf}	+	+	-	-
[PROGram:]LIST:VOLTage:AC:SLEW:UP[#] <NRf>{,NRf}	+	+	-	-
[PROGram:]LIST:VOLTage:AC:SLEW:DOWN[#] <NRf>{,NRf}	+	+	-	-
[PROGram:]LIST:VOLTage:DC[#] <NRf>{,NRf}	+	+	-	-
[PROGram:]LIST:VOLTage:DC:SLEW:UP[#] <NRf>{,NRf}	+	+	-	-
[PROGram:]LIST:VOLTage:DC:SLEW:DOWN[#] <NRf>{,NRf}	+	+	-	-
[PROGram:]LIST:FREQuency <NRf>{,NRf}	+	+	-	-
[PROGram:]LIST:FREQuency:SLEW:UP <NRf>{,NRf}	+	+	-	-
[PROGram:]LIST:FREQuency:SLEW:DOWN <NRf>{,NRf}	+	+	-	-
[PROGram:]LIST:WAVeform[#] <USTR>	+	+	-	-
[PROGram:]LIST:PHASe:STARt <NRf>{,NRf}	+	+	-	-
[PROGram:]LIST:PHASe:END <NRf>{,NRf}	+	+	-	-
[PROGram:]LIST:DURation <NRf>{,NRf}	+	+	-	-
[PROGram:]LIST:REPeat <NR1>	+	+	-	-
[PROGram:]LIST:STEP <DSC>	+	+	-	-
[PROGram:]LIST:TTLTrg:ENABle[#] <Bool>{,Bool}	+	+	-	-
[PROGram:]MODE:VOLTage:AC <DSC>	+	+	-	-
[PROGram:]MODE:VOLTage:DC <DSC>	+	+	-	-
[PROGram:]MODE:WAVeform <DSC>	+	+	-	-
[PROGram:]MODE:FREQuency <DSC>	+	+	-	-
[PROGram:]MODE:VOLTage:AC:SLEW <DSC>	+	+	-	-
[PROGram:]MODE:VOLTage:DC:SLEW <DSC>	+	+	-	-
[PROGram:]MODE:FREQuency:SLEW <DSC>	+	+	-	-
[PROGram:]MODE:PHASe:STARt <DSC>	+	+	-	-
[PROGram:]MODE:PHASe:END <DSC>	+	+	-	-
[PROGram:]MODE:ABORt <DSC>	+	+	-	-
[PROGram:]MODE:END <DSC>	+	+	-	-
[PROGram:]DC:COUNter <NR1> | INFinity	-	-	+	+
[PROGram:]DC:LIST:DWELl <NRf>{,<NRf>}	-	-	+	+
[PROGram:]DC:LIST:VOLTage[#] <NRf>{,<NRf>}	-	-	+	+
[PROGram:]DC:STEP <DSC>	-	-	+	+

[PROGram:]DC:WAVE:TIME <NRf>{,<NRf>}	-	-	+	+
[PROGram:]DC:WAVE:VOLTage[#] <NRf>{,<NRf>}	-	-	+	+
[PROGram:]DC:ACTivate <DSC>	-	-	+	+
[PROGram:]DC:MODE:ABORt <DSC>	-	-	+	+
[PROGram:]DC:MODE:END <DSC>	-	-	+	+

*1: Refers to [PROGram:]LOAD:AC <NR1> and [PROGram:]STORe:AC <NR1> commands.
*2: Refers to [PROGram:]CLEAr:AC <NR1> command.
*3: Refers to [PROGram:]LOAD:DC <NR1> and [PROGram:]STORe:DC <NR1> commands.
*4: Refers to [PROGram:]CLEAr:DC <NR1> command.

NOTES

[PROGram:]CLEAr:AC <NR1> and [PROGram:]CLEAr:DC <NR1> 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** character (ASCII 13, 0x0D), the **Line Feed** (ASCII 10, 0x0A) character, 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 In MEASure:CURRent:HARMonic? <NR1>

14.5.3 Braces { }

Braces (**{ }**) enclose parameters within a command string. For example [PROGram:]WAVE:CURRent {2.0,2.5,3.0} is entered as[PROGram:]WAVE:CURRent 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[#]? <NR1>

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[:STATe] 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 **$** followed by two hex characters. Command and query can have a checksum. In the case of a query, the response also have a checksum. There is no CR between the command string and the **$** sign.

For example, the checksum for OUT?$37 is calculated as follows:

O = 0x4F, U = 0x55, T = 0x54, ? = 0x3F. 0x4F + 0x55 + 0x54 + 0x3F = 0x0137

Checksum is the least significant byte – 0x37.

14.11 Status, Fault, and SRQ Registers

14.11.1 SCPI Register Tree

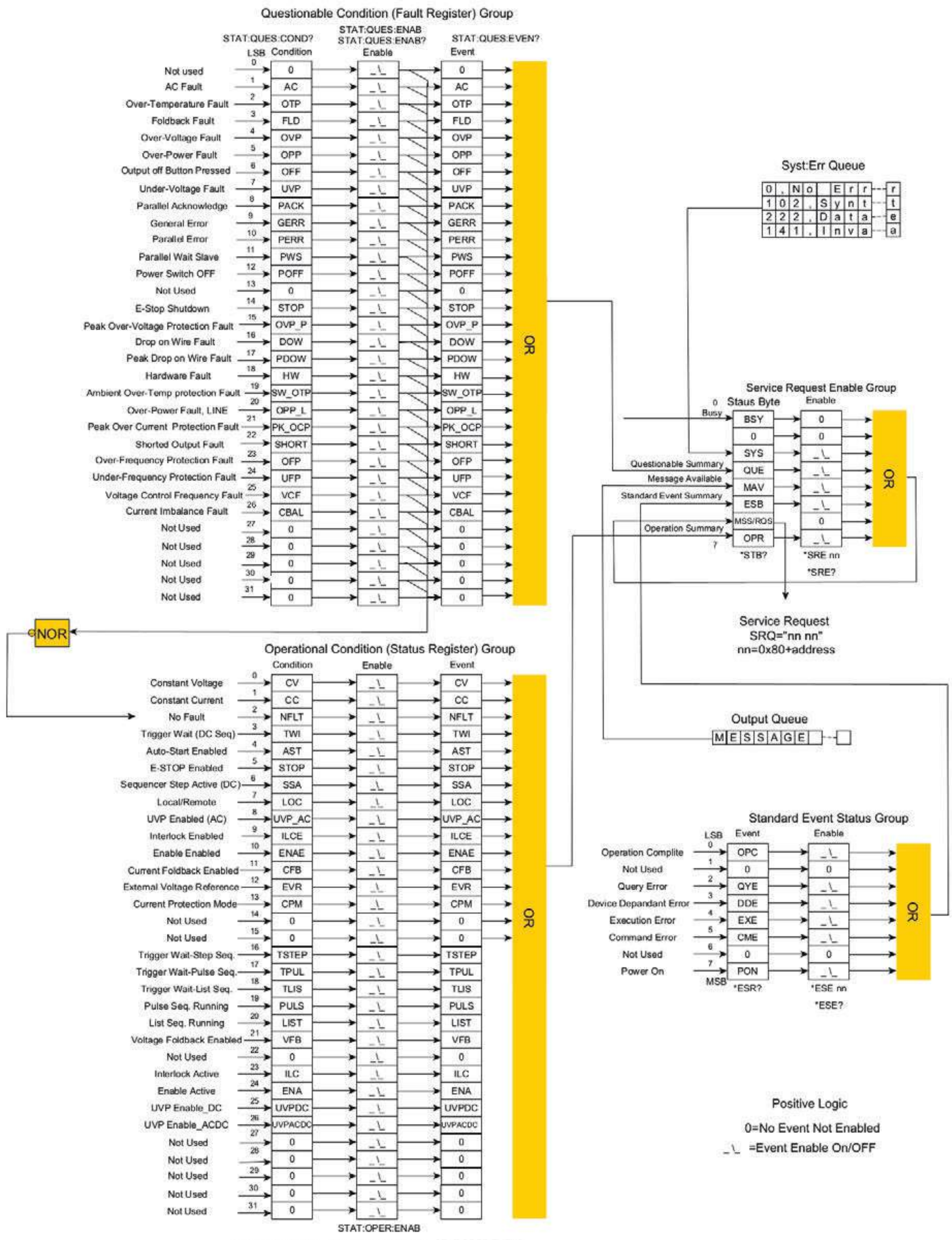


Figure 14-1: SCPI Register Tree Diagram

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 Enable Registers can be set by the user 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

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	0	Not Used
28	0	Not Used
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	CPM	Current Protection Mode
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
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. Standard Event Status event registers 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 32762	Device Dependent
4 (EXE)	-200 to -299	Execution	2 (QUE)	-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?; refer to **Section 14.13.10: System Subsystem.**

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 by -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 in the Status Byte Register of 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"
-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"

Error Number	Error Description
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"
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”

Error Number	Error Description
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"
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"

Error Number	Error Description
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"
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
"DCDC/BUCK OCP failure"
Startup failure
"DCDC failure"
COMM failure
DCAC OCP
Latch signals disabled
Fan failure
Global Shutdown
DCAC OVP

14.11.7 Service Request Enable Group Structure

The Service Request Enable Group summarizes the events of the Questionable Condition Group, the Standard Event Status Group, and the Operational Condition Group, only if these groups 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 14-6** 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 14-6: Service Request Enable Register

BSY: 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 for a command, or (*, three letters, and a question mark (?) for a query). Common commands are defined by the IEEE 488.2 standard to perform common interface functions.

*CLS

Function	Performs the following actions over the register tree: • clears the Standard Event Status Event Register, Operation Condition Event Register, and Questionable Condition Event Register • clears the Status Byte • clears the Error Queue • clears the Output Queue

*ESE <NR1>

Function	Sets the bits 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 Standard Event Status Event Register 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> 0–189

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 Switch On, **CME**: Command Error, **EXE**: Execution Error, **DDE**: Device Dependent Error, **QYE**: Query Error, **OPC**: Operation Complete.

*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 Switch 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.

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 name, serial number, and firmware revisions of the interface.
Return	<SRD>
Example	TDK-LAMBDA,GAC-PRO-03AA1C07H00A,1234567-1234,001.000.000

*OPC

Function	Sets Operation Complete (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 query completes.

*OPT?

Function	Returns the type of the optional card installed.
Return	<SRD> **0**: No Option Installed

*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 command. Refer to **Table 13-1** for the restored parameters.
Parameter	1,2,3,4

NOTE

*RCL without a parameter restores the power source to a state that was stored in memory location 1.

*RST

Function	Executes reset; refer to **Table 13-1**.

*SAV [<NR1>]

Function	Saves the state of the power source to a specific memory location; refer to **Table 13-1** for the saved parameters.
Parameter	1,2,3,4

NOTE

*SAV without a parameter stores the state of the power source in memory cell 1.

*SRE <NR1>

Function	Sets the bits of the Enable Register in the Service Request Enable Group. This register determines which bits of 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) summary, **ESB**: Standard Event Status Register summary, **MAV**: Output Queue Message available, **QUE**: Questionable Condition (Fault Register) summary, **SYS**: System Error Queue Message available.

*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) summary **MSS/RQS**: Request Service **ESB**: Standard Event Status Register summary **MAV**: Output Queue Message available **QUE**: Questionable Condition (Fault Register) summary **SYS**: The System Error query is not empty **BSY**: The operation is not complete
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 *TRG command activates the sequencer with a delay.

Use TRIGger[:IMMediate] to override the delay setting; refer to **Section 14.13.11: TRIGger Subsystem**.

*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.

ABORt

Function	This command cancels any sequencer actions in progress. It returns the trigger system to an idle state. The TWI bit in the Condition Register under the Operational Condition (Status Register Group) is cleared after ABORt is sent.

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 but only phase 1 replies to a query.

NOTE

All queries are returned with unpadded 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

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.

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

The brightness of the display returns to its original level (set with DISPlay[:WINDow]:BRIGhtness) if the dimming option is disabled.

DISPlay[:WINDow]:FLASh[#] <Bool>

Function	Flashes the display
Parameter	0|1 or OFF|ON
Query	DISPlay[:WINDow]:FLASh[#]?
Return	<Bool>

NOTE

The display stops flashing 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]: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	Selects 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 are 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	Selects 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
Query	DISPlay[:WINDow]:MODE[#]?
Return	<DSC>

NOTE

If the user touches the dashboard while it is displaying a text message (**TEXT** mode), the display enter the settings menu.

DISPlay[:WINDow]:PIN:CODE:STATe[#]?

Function	Indicates if a **PIN** code has been set to lock the display
Return	<Bool>

NOTE

The PIN code can only be set using the display menu; refer to **Section 9.4.7: Display Menu**.

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 would 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]:TOUCh[#] <Bool>

Function	Enables or disables the touch panel
Parameter	0|1 or OFF|ON
Query	DISPlay[:WINDow]:TOUCh[#]?
Return	<Bool>

DISPlay[:WINDow]:TEST[#] <Bool>

Function	All the pixels on the display are turned ON or OFF
Parameter	0|1 or OFF|ON **0, OFF**: pixels are turned OFF **1, ON**: pixels are turned ON (white color, 100% brightness)
Query	DISPlay[:WINDow]:TEST[#]?
Return	<Bool>

NOTE

The display returns to normal 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), or if the display was tapped.

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 by 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	<STR>
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 the DISPlay[:WINDow]:MODE command.

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: 36. The default is 5 (size 36). 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

* W3SCHOOLS is a trademark of Refsnes Data AS.

14.13.2 Initiate Subsystem

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.

NOTE

When power source is in the INIT (active) state, it is not possible to change any parameters in the sequencer programming. Send ABORt (refer to **Section 14.12: SCPI Common Commands**) to stop the sequence and allow changes in parameters.

INITiate:CONTinuous <Bool>

Function	Sets the re-initiation of the trigger
Parameter	0|1 or OFF|ON **0, OFF**: Trigger is not initiated continuously. The trigger system must be re-initiated with the INITiate command for each trigger. **1, ON**: Trigger is initiated continuously
Query	INITiate:CONTinuous?
Return	<Bool>

14.13.3 Instrument Subsystem

INSTrument:[N]SELect <NR1>

Function	Sets 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>.
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 DC voltage
Return	Array of <NR2>

MEASure:ARRay:PHASe <NRf>

Function	Sets the start phase 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 system, this command sets the start phase for Phase 1 only. The start phase for all other phases is shifted relative to the start of Phase 1 by the value set in [SOURce:]PHASe:SHIFt#; refer to **Section 14.13.8: Source Subsystem**.

MEASure:HARMonic:PERCent[:TYPE] <DSC>

Function	Selects 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>

Current Measurements Subsystem

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 measured 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 measured 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 data acquirement of a set of data, the last measured set of data is returned.

MEASure:CURRent:CREStfactor[#]?

Function	Returns the measured Crest Factor
Return	<NR2>

MEASure:CURRent:DC[#]?

Function	Returns the DC component of the measured output current
Return	<NR2>
Unit	A

NOTE

The measured value includes only the DC component of the measured 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].
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 value 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].
Return	<NR2> or array of <NR2>
Unit	A
Array Size	Maximum of 51

NOTES

<NR1> defines the last harmonic number to be returned. If <NR1> is 25, all harmonics from 0 to 25 are returned.

Harmonic 0 is the DC component.

Harmonic 1 is the fundamental frequency.

In DC operation mode, only the DC component is returned (harmonic 0). The rest of the harmonics return 0 if the harmonics are queried above harmonic 0.

If a query is sent during the data acquirement of a set of data, the last measured set of data is returned.

If argument is (<DSC>) 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	<NR2> or array of <NR2>
Unit	º (degree)
Array Size	Maximum of 51

NOTES

<NR1> defines the last harmonic number to be returned. If <NR1> is 25, all harmonics from 0 to 25 are 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 acquirement of a new set of data, the last 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]

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[#].

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[#].

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 samples, 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. The frequency measurement, however, is available for each phase.

Measured frequency is 0 if the output voltage is below 5%

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

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 measured 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 measured 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 data acquirement of a new set of data, the last measured set of data is returned.

MEASure:VOLTage:DC[#]?

Function	Returns the DC component of the measured output voltage
Return	<NR2>
Unit	V

NOTE

The measured value includes only the DC component of the measured 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].
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 value 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].
Return	<NR2> or array of <NR2>
Unit	V
Array Size	Maximum of 51

NOTES

<NR1> defines the last harmonic number to be returned. If <NR1> is 25, all harmonics from 0 to 25 are returned.

Harmonic 0 is the DC component.

Harmonic 1 is the fundamental frequency.

In DC operation mode, only the DC component is returned (harmonic 0). Rest of the harmonics return 0 if the harmonics are queried above harmonic 0.

If a query is sent during the data acquirement of a new set of data, the last measured set of data is returned.

If no argument (<DSC>) is 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	<NR2> or array of <NR2>
Unit	º (degree)
Array Size	Maximum of 51

NOTES

<NR1> defines the last harmonic number to be returned. If <NR1> is 25, all harmonics from 0 to 25 are 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 acquirement of a new set of data, the last 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]

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 is being acquired at that moment.

MEASure:TRIGger:IMMediate

Function	This generates a trigger for measurements without any delay if the trigger source is set to BUS.

NOTE

MEASure:TRIGger:IMMediate overrides the trigger delay (refer to MEASure:TRIGger:DELay <NRf>) and activates the trigger immediately.

MEASure:TRIGger:DATA:READy?

Function	Returns the **data ready** flag. 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 **data ready** flag is not reset, the same set of data is read.

MEASure:TRIGger:DELay <NRf>

Function	Sets a delay for a triggered measurement. It is the time between the trigger event from a specified trigger source to the start of any corresponding measurements.
Parameter	0–3600
Unit	s
Query	MEASure:TRIGger:DELay?
Return	<NR2>

NOTE

Trigger delay is relative to phase 1.

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 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 of Phase 1. The triggering phase of all other phases is shifted relative to the start of Phase 1 by the value set in [SOURce:]PHASe:SHIFt[#].

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 is set to TRIG and if at least one of the sequencer programs has enabled its output trigger (see commands [PROGram:]STEP:TTLTrg:ENABle, [PROGram:]PULSe:TTLTrg:ENABle, and [PROGram:]LIST:TTLTrg:ENABle in the Program Subsystem).
Query	MEASure:TRIGger:SOURce?
Return	<DSC>

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 data acquirement of a new set of data, the last measured set of data is returned.

MEASure:TRIGger:CURRent:HARMonic:ARRay[#]? <NR1>[,<DSC>]

Function	Returns an array of the measured rms value 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]
Return	<NR2> or array of <NR2>
Unit	A
Array Size	Maximum of 51

NOTES

<NR1> defines the last harmonic number to be returned. If <NR1> is 25, all harmonics from 0 to 25 are returned.

Harmonic 0 is the DC component.

Harmonic 1 is the fundamental frequency.

In DC operation mode, only the DC component is returned (harmonic 0). Rest of the harmonics return 0 if the harmonics are queried above harmonic 0.

If a query is sent during the data acquirement of a new set of data, the last measured set of data is returned.

If no argument (<DSC>) is 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	<NR2> or array of <NR2>
Unit	º (degree)
Array Size	Maximum of 51

NOTES

<NR1> defines the last harmonic number to be returned. If <NR1> is 25, all harmonics from 0 to 25 are 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 acquirement of a new set of data, the last measured set of data is returned.

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 acquirement of a new set of data, the last measured set of data is returned.

MEASure:TRIGger:VOLTage:HARMonic:ARRay[#]? <NR1>[,<DSC>]

Function	Returns an array of the measured rms value 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].
Return	<NR2> or array of <NR2>
Unit	V
Array Size	Maximum of 51

NOTES

<NR1> defines the last harmonic number to be returned. If <NR1> is 25, all harmonics from 0 to 25 are returned.

Harmonic 0 is the DC component.

Harmonic 1 is the fundamental frequency.

In DC operation mode, only the DC component is returned (harmonic 0). Rest of the harmonics return 0 if the harmonics are queried above harmonic 0.

If a query is sent during the data acquirement of a new set of data, the last measured set of data is returned.

If no argument (<DSC>) is 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	<NR2> or array of <NR2>
Unit	º (degree)
Array Size	Maximum of 51

NOTES

<NR1> defines the last harmonic number to be returned. If <NR1> is 25, all harmonics from 0–25 are 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 acquirement of a new set of data, the last measured set of data is returned.

14.13.5 Output Subsystem

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.

The query returns the actual state of the output. To know the actual state of the setting, refer to OUTPut:SETting?

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 actually 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: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]?

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 mainly noticeable when a slow output-off slew rate is applied using [SOURce:]VOLTage:AC:SLEW:OFF and/or [SOURce:]VOLTage:DC:SLEW:OFF. 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 the OUTPut ON command is sent until the output state actually becomes ON, which can up to two seconds in ECO mode.

OUTPut:ENA[:STATe] <Bool>

Function	Enables or disables the ENA function; refer to **Table 11-6.**
Parameter	0|1 or OFF|ON **0, OFF**: ENA function is disabled and the power source ignores the signal on the ENA pin **1, ON**: ENA function is enabled and the power source acts according to the signal on the ENA pin and the ENA polarity pin.
Query	OUTPut:ENA[:STATe]?
Return	<Bool>

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
Query	OUTPut:ENA:LATCh[:STATe]?
Return	<Bool>

OUTPut:ENA:POLarity[:STATe] <DSC>

Function	Sets the polarity of the ENA signal; refer to **Table 11-6.**
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:ESTOp[:STATe] <Bool>

Function	Enables or disables the E-STOP (Emergency Power OFF) function; refer to **Table 8-4**.
Parameter	0|1 or OFF|ON **0, OFF**: E-STOP function is disabled and the power source ignores the signal on the E-STOP pin **1, ON**: E-STOP function is enabled and the power source acts according to the signal on the ESTOP pin
Query	OUTPut:ESTOp[:STATe]?
Return	<Bool>

OUTPut:ESTOp:LATCh[:STATe] <Bool>

Function	Enables or disables the latching 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:ILC[:STATe] <Bool>

Function	Enables or disables the ILC function; refer to **Table 11-7**.
Parameter	0|1 or OFF|ON **0, OFF**: ILC function is disabled and the power source ignores the signal on the ILC pin **1, ON**: ILC function is enabled and the power source acts according to the signal on the ILC pin
Query	OUTPut:ILC[:STATe]?
Return	<Bool>

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
Query	OUTPut:ILC:LATCh[: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 system CC is returned if at least one phase is in CC mode.

OUTPut:PHASe:ON <NRf>

Function	Sets the start phase 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 is 0° when the output is turned on. • when changing waves, the start phase of the output wave is equal to the end phase of the previous output wave.
Parameter	-1|0–359.9
Unit	º (degree)
Query	OUTPut:PHASe:ON?
Return	<NR2>

NOTES

[FUNCtion:]WAVeform[:ACTivate]:SYNC:ENABle# must be set to 1/ON to activate the phase angle.

In a multi-phase system, this command sets the ON phase of Phase1 only . The ON phase of all other phases is shifted relative to the ON phase of Phase1 by the value set in [SOURce]:PHASe:SHIFt#.

OUTPut:PHASe:OFF <NRf>

Function	Sets the end phase of the output waveform. After receiving the output OFF command, the power source waits until the specified end phase is reached before turning the output off. The value of the end phase is also the phase 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 (relays)

[FUNCtion:]WAVe:ACTivate:SYNC:ENABle must be set to 1/ON to activate the phase angle.

In a multi-phase system, this command sets the OFF phase of Phase1 only . The OFF phase of all other phases is shifted relative to the OFF phase of Phase1 by the value set in [SOURce]:PHASe:SHIFt#.

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 (before the fault occurred).
Query	OUTPut:PON[:STATe]?
Return	<DSC>

OUTPut:PON:PROFile <DSC>

Function	Set power-on (startup) profile options: *SAV command, factory reset, or last state. A profile stored by *SAV command will be loaded as soon as AC is applied, and power switch is turned on.
Parameter	LAST|FRST|1|2|3|4
Query	OUTPut:PON:PROFile?
Return	<DSC>

NOTE

If FRST, 1, 2, 3 or 4 is set, OUTPut:PON[:STATe] command has no effect; output setting will act according to the selected profile.

Before loading a profile (1, 2,3, or 4), it must be saved by *SAV.

If power switch is already on, setting power switch off for at least 5 seconds will reload power on profile following power switch on.

OUTPut:PON:PROFile:FRST:INTerface <DSC>

Function	Set communication interface at power-on (startup) if OUTP:PON:PROFile FRST option is set.
Parameter	USB|RS232|RS485|LAN
Query	OUTPut:PON:PROFile:FRST:INTerface?
Return	<DSC>

OUTPut:PROTection:CLEar

Function	Clears the latching faults

NOTE

An actual fault condition must be removed before the latch can be cleared.

OUTPut:PROTection:FOLDback[:MODE] <DSC>

Function	Disable the power source output if a transition between operating modes occurs
Parameter	OFF|CC|CV
Query	OUTPut:PROTection:FOLDback[:MODE]?
Return	<DSC>
Example	OUTPut:PROTection:FOLDback[:MODE] CC disables the power source output if it enters the CC mode.

OUTPut:PROTection:FOLDback:DELay <NRf>

Function	Sets the time delay from the foldback fault event to the output being disabled
Parameter	0.1–25.5
Unit	s
Query	OUTPut:PROTection:FOLDback:DELay?
Return	<NR2>

OUTPut:RELay1[:STATe][#] <DSC>

Function	Sets Programmable Pin #1 (J4-21); refer to **Table 11-8**
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 the OUTPut:RELay1:COUNt[#], OUTPut:RELay1:DCYCle[#], and the OUTPut:RELay1:PERiod[#] commands.

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 programable pin state is set to PWM.
Parameter	0–1
Unit	%. 0.5=50%, 1=100%
Query	OUTPut:RELay1:DCYCle[#]?
Return	<NR1>

OUTPut:RELay1:PERiod[#] <NR1>

Function	Sets the pulse period. This is valid only if the programable pin state is set to PWM.
Parameter	1–3600
Unit	ms
Query	OUTPut:RELay1:PERiod[#]?
Return	<NR1>

OUTPut:RELay2[:STATe][#] <DSC>

Function	Sets Programmable Pin #2 (J4-20) in the rear panel connector; refer to **Table 11-8**
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 the OUTPut:RELay2:COUNt[#], OUTPut:RELay2:DCYCle[#], and the OUTPut:RELay2:PERiod[#] commands.

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	<NR1>

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:TTLTrg:MODE[#] <DSC>

Function	Sets the operation mode of the Trigger Out signal (J4-23)
Parameter	OFF|FSTR|TRIG **If the sequencer is disabled:** **OFF mode**: a trigger is not generated **TRIG mode**: a trigger is generated if the output state changes **FSTR 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 sequencer (STEP, PULSE, or LIST) is enabled:** **OFF mode**: the trigger signal is not generated **TRIG mode**: A trigger is generated according to the settings of [PROGram:]STEP:TTLTrg:ENABle, [PROGram:]PULSe:TTLTrg:ENABle, or [PROGram:]LIST:TTLTrg:ENABle **FSTR mode**: an output pulse is generated automatically any time a step (of a STEP, PULSe or LIST) is completed.
Query	OUTPut:TTLTrg:MODE[#]?
Return	<DSC>

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

Use [FUNCtion:]WAVeform:SCAN? to display the list of the currently loaded waveforms.

The name is case sensitive.

[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 of the new wave is equal to the phase 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 set in OUTPut:PHASe:OFF is reached. The start phase of the new wave is equal to the setting stored in OUTPut:PHASe:ON.
Query	[FUNCtion:]WAVeform:ACTivate:SYNC:ENABle[#]?
Return	<Bool>

[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

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.

The name is case sensitive.

[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: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:]WAVe:TRIangle:SYMMetry[#]?
Return	<NR2>

[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:]WAVe:CSINe:LEVel[#]?
Return	<NR2>

[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>

[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:SCAN?

Function	Returns a list of currently loaded waves in the power source in the order they were inserted by the user
Return	<STR>
Example	TRIangle, SQUare, CSINe, SINe, Demo

NOTE

TRIangle, SQUare, CSINe, SINe are built-in in the power source.

[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, -1 to 1
Example	[FUNCtion:]WAVeform:POINts sam,0.5,0.5,-0.5,0.6,.06
Query	[FUNCtion:]WAVeform:POINts? <STR>
Return	Array of <NR2>
Example	[FUNCtion:]WAVeform:POINts? sam returns 0.5,0.5,-0.5,0.6,.06

NOTES

FnName is the name of the waveform to be created. Name of the waveform is entered without quotes (USTR data type).

The minimum number of points is two.

Names (FnName) are case-sensitive. The name must not exceed 10 characters including lower-case characters, upper-case characters, and numbers.

The maximum point, regardless of its value, represents the waveform’s amplitude. For example, if all points input by the user for a waveform are all 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 query has a maximum resolution of 0.00001.

[FUNCtion:]WAVeform:POINts:OVERwrite <USTR>,<NRf>,<NRf>{,<NRf>}

Function	Overwrites an arbitrary waveform
Parameter	FnName, -1 to 1
Example	[FUNCtion:]WAVeform:POINts:OVERwrite sam,0.5,0.5,-0.5,0.6,.06

NOTES

FnName is the name of the waveform to be created. Name of the waveform is entered without quotes (USTR data type).

The minimum number of points is two.

Names (FnName) are case-sensitive. The name must not exceed 10 characters including lower-case characters, upper-case characters, and numbers.

The maximum point, regardless of its value, represents the waveform's amplitude. For example, if all points input by the user for a waveform are all 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.

If the waveform doesn't exist, it is created.

The waveform's points cannot be overwritten while the wave is active.

[FUNCtion:]WAVeform:TEMPlate <USTR>,<STR>,<NR2>

Function	Create a new waveform based on a built-in waveform
Parameter	FnName,BuiltInName,Value **FnName**: the name of the new waveform. If the waveform already exists, its points are overwritten. Name of the waveform is entered without quotes (USTR data type). **BuiltInName**: the name of the built-in waveform (SQUare|TRIangle|CSINe), excluding SINe, on the basis of which the new waveform will be 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[#]).
Example	[FUNCtion:]WAVeform:TEMPlate Square20,SQU,20

NOTE

A waveform name (FnName) must not exceed 10 characters. Names are case-sensitive. Only lower-case and upper-case characters and numbers are allowed.

[FUNCtion:]WAVeform:REGion <NR1>

Function	Stores the created waveform in the selected region in the memory. Only the waveforms programmed with [FUNCtion:]WAVeform:POINts, [FUNCtion:]WAVeform:POINts:OVERwrite, and [FUNCtion:]WAVeform:TEMPlate are stored in these regions. Also loads the waveform from the selected region in the memory. Each region can store 50 waveforms giving a total of 200 waveforms.
Parameter	1–4
Query	[FUNCtion:]WAVe:REGion?
Return	<NR1>

NOTES

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:]WAVe:SCAN?

14.13.7 Program Subsystem

	Output Voltage and Current Programming Values	
	2kVA	**3kVA**
Voltage	**AC mode**: 0–350.2Vac **ACDC mode**: 0–350.2Vac, -350.2–350.2Vdc **DC mode**: -500.2–500.2Vdc	
Current	5% of Irated to 20.2A	5% of Irated to 30.2A

	Voltage 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 14-7: Programming Values

14.13.7.1 AC/ACDC Sequencer - Pulse Subsystem

[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 14-7**
Unit	V
Query	[PROGram:]PULSe:VOLTage:AC[#]?
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 14-7**
Unit	V/ms
Query	[PROGram:]PULSe:VOLTage:AC:SLEW:UP[#]?
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 14-7**
Unit	V/ms
Query	[PROGram:]PULSe:VOLTage:AC:SLEW:DOWN[#]?
Return	<NR2>

[PROGram:]PULSe:VOLTage:DC[#] <NRf>

Function	Sets the DC offset of the pulse voltage in ACDC mode
Parameter	Refer to **Table 14-7**
Unit	V
Query	[PROGram:]PULSe:VOLTage:DC[#]?
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 14-7**
Unit	V/ms
Query	[PROGram:]PULSe:VOLTage:DC:SLEW:UP[#]?
Return	<NR2>

[PROGram:]PULSe:VOLTage:DC:SLEW:DOWN[#] <NRf>

Function	Sets the slew rate for down programming of the DC offset of the pulse voltage in ACDC mode
Parameter	Refer to **Table 14-7**
Unit	V/ms
Query	[PROGram:]PULSe:VOLTage:DC:SLEW:DOWN[#]?
Return	<NR2>

[PROGram:]PULSe:FREQuency <NRf>

Function	Sets the frequency of the pulse output
Parameter	Refer to **Table 14-7**
Unit	Hz
Query	[PROGram:]PULSe:FREQuency?
Return	<NR2>

[PROGram:]PULSe:FREQuency:SLEW:UP <NRf>

Function	Sets the slew rate for up programming the frequency of the pulse output
Parameter	Refer to **Table 14-7**
Unit	Hz/ms
Query	[PROGram:]PULSe:FREQuency:SLEW:UP?
Return	<NR2> 5.4f

[PROGram:]PULSe:FREQuency:SLEW:DOWN <NRf>

Function	Sets the slew rate for down programming the frequency of the pulse output
Parameter	Refer to **Table 14-7**
Unit	Hz/ms
Query	[PROGram:]PULSe:FREQuency:SLEW:DOWN?
Return	<NR2>

[PROGram:]PULSe:WAVeform[#] <USTR>

Function	Adds a name to the pulse waveform
Parameter	name
Query	[PROGram:]PULSe:WAVe[#]?
Return	<USTR>

NOTES

name: name of the waveform entered without quotes (USTR data type)

name is case sensitive

[PROGram:]PULSe:PHASe:STARt <NRf>

Function	Sets the phase at which the pulse starts.
Parameter	-1|0–359.9 If the value of the start phase is -1, the start phase of the pulse is equal to the end phase 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 of Phase 1. The start phase of all other phases is shifted relative to the start of Phase 1 by the value set in [SOURce:]PHASe:SHIFt[#].

[PROGram:]PULSe:PHASe:END <NRf>

Function	Sets the phase at which the pulse ends.
Parameter	-1|0–359.9 If the value of the end phase is -1, the end phase is disabled and the pulse stops when its active duration has elapsed, regardless of the end phase 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 of Phase 1. The end phase of all other phases is shifted relative to the start of Phase 1 by the value set in [SOURce:]PHASe:SHIFt[#].

[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:ACTive?
Return	<NR2>

[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> Possible 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
Example	ACTIVE,3 The Pulse is actively running (ACTIVE) and is in its third repetition.

NOTE

Idle and Wait state always return with 1 for the current node and current repetition. Ex - IDLE,1,1

[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:TTLTrg:MODE must be set to TRIG to enable this command to affect the Trigger Out signal.

14.13.7.2 AC/ACDC Sequencer - Step Subsystem

[PROGram:]STEP:VOLTage:AC[#] <NRf>

Function	Sets the AC component rms amplitude of the pulse voltage in AC and ACDC mode.
Parameter	Refer to **Table 14-7**
Unit	V
Query	[PROGram:]STEP:VOLTage:AC[#]?
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 14-7**
Unit	V/ms
Query	[PROGram:]STEP:VOLTage:AC:SLEW:UP[#]?
Return	<NR2>

[PROGram:]STEP:VOLTage:AC:SLEW:DOWN[#] <NRf>

Function	Sets the slew rate for down programming of the AC component of the step voltage in AC and ACDC mode
Parameter	Refer to **Table 14-7**
Unit	V/ms
Query	[PROGram:]STEP:VOLTage:AC:SLEW:DOWN[#]?
Return	<NR2>

[PROGram:]STEP:VOLTage:DC[#] <NRf>

Function	Sets the DC offset of the pulse voltage in ACDC mode
Parameter	Refer to **Table 14-7**
Unit	V
Query	[PROGram:]STEP:VOLTage:DC[#]?
Return	<NR2>

[PROGram:]STEP:VOLTage:DC:SLEW:UP[#] <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 14-7**
Unit	V/ms
Query	[PROGram:]STEP:VOLTage:DC:SLEW:UP[#]?
Return	<NR2>

[PROGram:]STEP:VOLTage:DC:SLEW:DOWN[#] <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 14-7**
Unit	V/ms
Query	[PROGram:] STEP:VOLTage:DC:SLEW:DOWN[#]?
Return	<NR2>

[PROGram:]STEP:FREQuency <NRf>

Function	Sets the frequency of the step output
Parameter	Refer to **Table 14-7**
Unit	Hz
Query	[PROGram:]STEP:FREQuency?
Return	<NR2>

[PROGram:]STEP:FREQuency:SLEW:UP <NRf>

Function	Sets the slew rate for up programming the frequency of the step output
Parameter	Refer to **Table 14-7**
Unit	Hz/ms
Query	[PROGram:]STEP:FREQuency:SLEW:UP?
Return	<NR2>

[PROGram:]STEP:FREQuency:SLEW:DOWN <NRf>

Function	Sets the slew rate for down programming the frequency of the step output
Parameter	Refer to **Table 14-7**
Unit	Hz/ms
Query	[PROGram:]STEP:FREQuency:SLEW:DOWN?
Return	<NR2>

[PROGram:]STEP:WAVeform[#] <USTR>

Function	Adds a name for the generated step waveform
Parameter	name
Query	[PROGram:]STEP:WAVe[#]?
Return	<USTR>

NOTES

name: name of the waveform entered without quotes (USTR data type)

name is case sensitive

[PROGram:]STEP:PHASe:STARt <NRf>

Function	Sets the phase at which the step starts.
Parameter	-1|0–359.9 If the value of the start phase is -1, the start phase of the step is equal to the end phase 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 of Phase 1. The start phase of all other phases is shifted relative to the start of Phase 1 by the value set in [SOURce:]PHASe:SHIFt[#].

[PROGram:]STEP:STATe?

Function	Queries the state of the step sequencer
Query	[PROGram:]STEP:STATe?
Return	<DSC> Possible 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:TTLTrg:MODE must be set to TRIG to enable this command to affect the Trigger Out signal.

14.13.7.3 AC/ACDC Sequencer - LIST Subsystem

NOTE

If a LIST response contains multiple comma-separated values, the number of values returned is equal to the maximum number of values entered by the user for any of the LIST settings. The last value entered by the user for a given LIST setting is repeated in the setting's response. For example, the user enters:

LIST:VOLT:AC 1,2,3

LIST:DUR 1,2

Since the maximum number of LIST settings entered is three (1,2,3), the values returned to the user are:

LIST:VOLT:AC? → 1,2,3

LIST:DUR? → 1,2,2

So, the last value of LIST:DUR is replicated to meet the number of values entered with LIST:VOLT:AC.

At least one item must be entered in the list.

[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 DC mode
Parameter	Refer to **Table 14-7**
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: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 14-7**
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: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 14-7**
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:DC[#] <NRf>{,NRf}

Function	Sets the DC offset of the voltage for each member in the list in ACCDC mode
Parameter	Refer to **Table 14-7**
Unit	V
Example	[PROGram:]LIST:VOLTage:DC 20,29,30,30
Query	[PROGram:]LIST:VOLTage:DC[#]?
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 AC and ACDC mode
Parameter	Refer to **Table 14-7**
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:VOLTage:DC:SLEW:DOWN[#] <NRf>{,NRf}

Function	Sets the slew rate of down programming of DC offset for each member in the list
Parameter	Refer to **Table 14-7**
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:FREQuency <NRf>{,NRf}

Function	Sets the frequency of each member in the list
Parameter	Refer to **Table 14-7**
Unit	Hz
Example	[PROGram:]LIST:FREQuency 50,75.5,100,500
Query	[PROGram:]LIST:FREQuency?
Return	<NR2>{,NR2}

[PROGram:]LIST:FREQuency:SLEW:UP <NRf>{,NRf}

Function	Sets the slew rate of up programming the frequency for each member in the list
Parameter	Refer to **Table 14-7**
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:FREQuency:SLEW:DOWN <NRf>{,NRf}

Function	Sets the slew rate of down programming the frequency for each member in the list
Parameter	Refer to **Table 14-7**
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:WAVeform[#] <USTR>

Function	Add a name for the generated list waveform.
Parameter	name
Query	[PROGram:]LIST:WAVe[#]?
Return	<USTR>

NOTES

name: name of the waveform entered without quotes (USTR data type).

name is case sensitive

[PROGram:]LIST:PHASe:STARt <NRf>{,NRf}

Function	Sets the starting phase of each member in the list
Parameter	-1|0–359.9 If the value of a node's start phase is -1, the start phase of the node is equal to the end phase of the previous output node.
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 of Phase 1. The start phases of all other phases are shifted relative to the start of Phase 1 by the value set in [SOURce:]PHASe:SHIFt[#].

[PROGram:]LIST:PHASe:END <NRf>{,NRf}

Function	Sets the ending phase of each member in the list
Parameter	-1|0–359.9 If the value of a node's end phase is -1, the end phase is disabled. The node stops when its duration has elapsed, regardless of the end phase.
Unit	º (degree)
Example	[PROGram:]LIST:PHASe:END 30,40,-1,45
Query	[PROGram:]LIST:PHASe:END?
Return	<NR2>{,NR2}

[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:SIZE?

Function	Returns the number of nodes in the sequence.
Return	<NR1>

[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: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 node being executed, and the repetition number
Query	[PROGram:]LIST:STATe?
Return	<DSC>,<NR1>,<NR1> Possible 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

Idle and Wait state always return with 1 for the current node and current repetition. Ex - IDLE,1,1

[PROGram:]LIST:TTLTrg:ENABle[#] <Bool>{,<Bool>}

Function	Defines the node 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 node. **1, ON**: a trigger signal is generated when the LIST program starts executing the given node.
Example	[PROGram:]LIST:TTLTrg:ENABle OFF,ON,ON,OFF,OFF A trigger signal is generated when nodes 2 and 3 are started.
Query	[PROGram:]STEP:TTLTrg:ENABle[#]?
Return	<Bool>{,Bool}

NOTE

OUTPut:TTLTrg:MODE must be set to TRIG in order for this command to affect the Trigger Out signal.

14.13.7.4 PROGram MODE Commands

NOTE

A few commands in this section have the same type of parameter. The parameter is summarized in **Table 14-8**.

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 14-8: Mode Parameters

[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 14-8.**
Query	[PROGram:]MODE:VOLTage:AC?
Return	<DSC>

[PROGram:]MODE:VOLTage:DC <DSC>

Function	Sets the sequence mode to set the DC voltage in ACDC mode
Parameter	Refer to **Table 14-8**
Query	[PROGram:]MODE:VOLTage:DC?
Return	<DSC>

[PROGram:]MODE:WAVeform <DSC>

Function	Sets the mode of the waveform
Parameter	Refer to **Table 14-8**
Query	[PROGram:]MODE:WAVe?
Return	<DSC>

[PROGram:]MODE:FREQuency <DSC>

Function	Sets the mode of the frequency
Parameter	Refer to **Table 14-8**
Query	[PROGram:]MODE:FREQuency?
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 mode and ACDC mode
Parameter	Refer to **Table 14-8**
Query	[PROGram:]MODE:VOLTage:AC:SLEW?
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 14-8**
Query	[PROGram:]MODE:VOLTage:DC:SLEW?
Return	<DSC>

[PROGram:]MODE:FREQuency:SLEW <DSC>

Function	Sets the mode of the slew rate of the output frequency
Parameter	Refer to **Table 14-8**
Query	[PROGram:]MODE:FREQuency:SLEW?
Return	<DSC>

[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 at each new segment. The start phase at a new segment is continuous (i.e., it continues from the end phase of the previous segment). **STEP**: the sequencer sets the start phase when the STEP sequencer is triggered **PULSe**: the sequencer sets the start phase when the PULSE sequencer is triggered **LIST**: the sequencer sets the start phase of each new segment according to the list of the start phases **FLEX**: all types of sequencers can set the start phase. The start phase value is taken from the settings of the program that is triggered. If several programs are triggered at once, the start phase is taken in the following order: STEP (highest priority), PULSE, and then LIST (lowest priority).
Query	[PROGram:]MODE:PHASe:STARt?
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 at each new segment. The segment ends as soon as its duration has expired, without waiting for a specific end phase. **PULSe**: the sequencer sets the end phase when the PULSE sequencer is triggered **LIST**: the sequencer sets the end phase of each new segment according to the list of the end phases **FLEX**: all types of sequencers can set the end phase. The value is taken from the settings of the program that is triggered. If several programs are triggered at once, the end phase is taken in the following order: PULSE (highest priority) and then LIST (lowest priority).
Query	[PROGram:]MODE:PHASe:END?
Return	<DSC>

[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) 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) 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: be aware that the 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) 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) 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: 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. It defines what happens when the sequencer ends successfully without the user sending ABORt.

[PROGram:]MODE:END 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 with **IMM** and **LAST** parameters behave in the same way when used with the pulse sequencer as the sequencer stops with the IMM values.

14.13.7.5 AC/DC/ACDC Sequencer - Memory Commands

[PROGram:]LOAD:AC <NR1>

Function	Loads an AC sequence from the memory that was previously stored with [PROGram:]STORe:AC. The command loads all STEP, PULSe, LIST, and MODE settings.
Parameter	1–4
Query	[PROGram:]LOAD:AC? This query indicates which AC memory cell is loaded.
Return	<NR1>

NOTE

If any loaded sequence data has 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 AC sequence settings to memory
Parameter	1–4

[PROGram:]CLEAr:AC <NR1>

Function	Clears an AC sequence from the memory.
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.

[PROGram:]LOAD:DC <NR1>

Function	Loads a DC sequence that was previously stored with [PROGram:]STORe:DC in the memory.
Parameter	1–4
Query	[PROGram:]LOAD:DC? This query indicates which memory cell is loaded.
Return	<NR1>

NOTE

If any loaded sequence data has changed but has not been stored yet or if no sequence is loaded, the reply is 0.

[PROGram:]STORe:DC <NR1>

Function	Stores DC sequence settings to memory
Parameter	1–4

[PROGram:]CLEAr:DC <NR1>

Function	Clears a DC sequence from the memory.
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 be 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.

14.13.7.6 DC Sequencer

[PROGram:]DC:COUNter <NR1> | INFinity

Function	Sets the iterations counter for the sequencer
Parameter	1–999999|INF 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: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 14-7**
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: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 14-7**
Unit	V
Example	[PROGram:]DC:WAVE:VOLTage 2.0,2.5,3.0
Query	[PROGram:]DC:WAVE:VOLTage[#]?
Return	<NR2>{,NR2}

NOTE

Atleast one point must be entered.

[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:STATe?

Function	Queries the state of the DC sequencer, the current node 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

Idle and Wait state always return with 1 for the current node and current repitition. Ex - IDLE,1,1

[PROGram:]DC:MODE:ABORt <DSC>

Function	Sets the behavior of the power source when the ABORt command 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: be aware that 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. Note: be aware that the output behavior may not reflect the IMMediate changes.
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.

14.13.8 Source Subsystem

	Output Voltage and Current Programming Values	
	2kVA	**3kVA**
Voltage	**AC mode**: 0–350.2Vac **ACDC mode**: 0–350.2Vac, -350.2–350.2Vdc **DC mode**: -500.2–500.2Vdc	
Current	5% of Irated to 20.2A	5% of Irated to 30.2A

	Voltage 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 14-9: Programming Values

[SOURce:]CURRent[:LEVel][:IMMediate][:AC][#] <NRf>

Function	Sets the rms amplitude of the output current in AC mode
Parameter	Refer to **Table 14-9**
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 14-9**
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 14-9**
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	0.5–130
Unit	A
Query	[SOURce:]CURRent:PROTection:PEAK:HIGH[:LEVel]?
Return	<NR2>

NOTES

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	-130–0.5
Unit	A
Query	[SOURce:]CURRent:PROTection:PEAK:LOW[:LEVel]?
Return	<NR2>

NOTES

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 14-9**
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 14-9**
Unit	Hz/ms
Query	[SOURce:]FREQuency: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 14-9**
Unit	Hz/ms
Query	[SOURce:]FREQuency: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>

[SOURce:]PHASe:SHIFt[#] <NRf>

Function	Sets the phase difference 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>.

[SOURce:]POWer:PROTection[:AC][:LEVel] <NRf>

Function	Sets the level of Over-Power protection (OPP) in AC mode
Parameter	1–110% of Pmax or (102% of the CP level if CP is enabled)
Unit	VA
Query	[SOURce:]POWer:PROTection[:AC][:LEVel]?
Return	<NR2>

[SOURce:]POWer:PROTection:ACDC[:LEVel] <NRf>

Function	Sets the level of Over-Power protection (OPP) in ACDC mode
Parameter	1–110% of Pmax or (102% of the CP level if CP is enabled)
Unit	VA
Query	[SOURce:]POWer:PROTection:ACDC[:LEVel]?
Return	<NR2>

[SOURce:]POWer:PROTection:DC[:LEVel] <NRf>

Function	Sets the level of Over-Power protection (OPP) in DC mode
Parameter	1–110% of Pmax or (102% of the CP level if CP is enabled)
Unit	W
Query	[SOURce:]POWer:PROTection:DC[:LEVel]?
Return	<NR2>

[SOURce:]VOLTage[:LEVel][:IMMediate][:AC][#] <NRf>

Function	Sets the rms amplitude of the output voltage in AC mode
Parameter	Refer to **Table 14-9**
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 14-9**
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 14-9**
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 14-9**
Unit	V
Query	[SOURce:]VOLTage[:LEVel][:IMMediate]:DC[#]?
Return	<NR2>

[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>

NOTE

Corrections applied with a faster response may negatively impact the stability of the output voltage.

[SOURce:]VOLTage:BALance:AC <NR1>

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.
Parameter	0–350
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 <NR1>

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.
Parameter	-500–500
Unit	V
Query	[SOURce:]VOLTage:BALance:DC?
Return	<NR1>

[SOURce:]VOLTage:BALance:DC:ENABle <Bool>

Function	Enables or disables the voltage correction for the DC component 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: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 14-9**
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 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 14-9**
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[: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 14-9**
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 14-9**
Unit	V/ms
Query	[SOURce:]VOLTage[:AC][: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 14-9**
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, disables the slew OFF function. The power source slews up using the ON slew 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 14-9**
Unit	V/ms
Query	[SOURce:]VOLTage:AC: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: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 14-9**
Unit	V/ms
Query	[SOURce:]VOLTage:DC: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 14-9**
Unit	V/ms
Query	[SOURce:]VOLTage:DC:SLEW:UP[#]?
Return	<NR2>

[SOURce:]VOLTage:PROTection[:AC]:PEAK:HIGH[:LEVel] <NRf>

Function	Sets the upper limit of the peak Over-Voltage protection (OVP) in AC mode
Parameter	-550–550
Unit	V
Query	[SOURce:]VOLTage:PROTection[:AC]:PEAK:HIGH[:LEVel]?
Return	<NR2>

[SOURce:]VOLTage:PROTection[:AC]:PEAK:LOW[:LEVel] <NRf>

Function	Sets the lower limit of the peak Over-Voltage protection (OVP) in AC mode
Parameter	-550–550
Unit	V
Query	[SOURce:]VOLTage:PROTection[:AC]:PEAK:LOW[:LEVel]?
Return	<NR2>

[SOURce:]VOLTage:PROTection:ACDC:PEAK:HIGH[:LEVel] <NRf>

Function	Sets the upper limit of the peak Over-Voltage protection (OVP) in ACDC mode
Parameter	-550–550
Unit	V
Query	[SOURce:]VOLTage:PROTection:ACDC:PEAK:HIGH[:LEVel]?
Return	<NR2>

[SOURce:]VOLTage:PROTection:ACDC:PEAK:LOW[:LEVel] <NRf>

Function	Sets the lower limit of the peak Over-Voltage protection (OVP) in ACDC mode
Parameter	-550–550
Unit	V
Query	[SOURce:]VOLTage:PROTection:ACDC:PEAK:LOW[:LEVel]?
Return	<NR2>

[SOURce:]VOLTage:PROTection:DC:PEAK:HIGH[:LEVel] <NRf>

Function	Sets the upper limit of the peak Over-Voltage protection (OVP) in DC mode
Parameter	-550–550
Unit	V
Query	[SOURce:]VOLTage:PROTection:DC:PEAK:HIGH[:LEVel]?
Return	<NR2>

[SOURce:]VOLTage:PROTection:DC:PEAK:LOW[:LEVel] <NRf>

Function	Sets the lower limit of the peak Over-Voltage protection (OVP) in DC mode
Parameter	-550–550
Unit	V
Query	[SOURce:]VOLTage:PROTection:DC:PEAK:LOW[:LEVel]?
Return	<NR2>

[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[:AC][:LEVel] <NRf>

Function	Sets the rms limit of Over-Voltage protection (OVP) in AC mode
Parameter	(V_{acset}*1.05)–385
Unit	V
Query	[SOURce:]VOLTage:PROTection[:AC][:LEVel]?
Return	<NR2>

[SOURce:]VOLTage:PROTection:ACDC[:LEVel] <NRf>

Function	Sets the rms limit of Over-Voltage protection (OVP) in ACDC mode
Parameter	($V_{acdcset}$*1.05)–385
Unit	V
Query	[SOURce:]VOLTage:PROTection[:AC][:LEVel]?
Return	<NR2>

[SOURce:]VOLTage:PROTection:DC[:LEVel] <NRf>

Function	Sets the limit of Over-Voltage protection (OVP) in DC mode.
Parameter	(V_{dcset}*1.05)–550
Unit	V
Query	[SOURce:]VOLTage:PROTection:DC[: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>

[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 prevents the voltage setting below the UVL level. **1, ON**: UVP enabled. This mode prevents the voltage setting below the UVL level and disables the output when the measured voltage reaches the UVL level.
Query	[SOURce:]VOLTage:PROTection[:AC]:LOW:STATe?
Return	<Bool>

NOTE

UVP function is disabled if Under-Voltage limit setting is below 5% of the rated power source voltage.

[SOURce:]VOLTage:PROTection[:AC]:LOW[:LEVel] <NRf>

Function	Sets the rms limit of the Under-Voltage protection (UVP) in AC mode.
Parameter	0–(V_{acset}/1.05)
Unit	V
Query	[SOURce:]VOLTage:PROTection[:AC]:LOW[:LEVel]?
Return	<NR2>

[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 prevents the voltage setting below the UVL level. **1, ON**: UVP enabled. This mode prevents the voltage setting below the UVL level and disables the output when the measured voltage reaches the UVL level.
Query	[SOURce:]VOLTage:PROTection:ACDC:LOW:STATe?
Return	<Bool>

[SOURce:]VOLTage:PROTection:ACDC:LOW[:LEVel] <NRf>

Function	Sets the rms limit of the Under-Voltage protection (UVP) in ACDC mode.
Parameter	0–($V_{acdcset}$/1.05)
Unit	V
Query	[SOURce:]VOLTage:PROTection:ACDC:LOW[:LEVel]?
Return	<NR2>

[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 prevents the voltage setting below the UVL level. **1, ON**: UVP enabled. This mode prevents the voltage setting below the UVL level and disables the output when the measured voltage reaches the UVL level.
Query	[SOURce:]VOLTage:PROTection:DC:LOW:STATe?
Return	<Bool>

[SOURce:]VOLTage:PROTection:DC:LOW[:LEVel] <NRf>

Function	Sets the limit of the Under-Voltage protection (UVP) in DC mode.
Parameter	0–(V_{dcset}/1.05)
Unit	V
Query	[SOURce:]VOLTage:PROTection:DC:LOW[:LEVel]?
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 possible fault/event which generates alarm event.
Parameter	0–4294967295
Query	STATus:ALM:CONFigure?
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 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	-	-	-	-	-	UVP_ ACDC	UVP_ DC	ENA
Position	23	22	21	20	19	18	17	16
Name	ILC	-	VFB	LIST	PULS	TLIS	TPUL	TSTEP

Position	15	14	13	12	11	10	9	8
Name	-	-	CPM	EVR	CFB	ENAE	ILCE	UVP_AC
Position	7	6	5	4	3	2	1	0
Name	LOC	SSA	STOP	AST	TWI	NFLT	CC	CV

Name: - means Not Used

UVP_ACDC: ACDC Under-Voltage Protection.
Set to **1** when protection mode is enabled in ACDC mode.

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.

CPM: Current Protection Mode.
Set to **1** when the protection fault is activated.

EVR: External Voltage Reference.
Set to **1** when the analog voltage programming channel is set.

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.

	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. **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: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: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 is according to 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	-	-	-	-	-	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	-	POFF	PWS	PERR	GERR	PACK
Position	7	6	5	4	3	2	1	0
Name	UVP	OFF	OPP	OVP	FLD	OTP	AC	-

Name: - means Not Used

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

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.

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.

	OPP_LINE: Over-Power Protection. fault due to AC input line is low at 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 **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 **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>

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?
Returns	<NR1>

14.13.10 System Subsystem

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. Create an AC recycle or turn the power switch OFF and then ON. A minimum interval of five seconds is required at the power switch OFF state.

SYSTem[:COMMunicate]:RS485:ADDRess:STATe <Bool>

Function	Enables 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 RS485 bus termination.
Parameter	0|1 or OFF|ON
Query	SYSTem[:COMMunicate]:RS485:TERMination:STATe?
Return	<Bool> 0|1

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[: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]:INTerface <DSC>

Function	Sets the communication interface
Parameter	USB|LAN|RS232|RS485|OPTion
Query	SYSTem[:COMMunicate]:INTerface?
Return	<DSC>

NOTE

Power Source addressing is lost after an interface change if RS485 addressing mechanism is enabled by SYSTem[:COMMunicate]:RS485:ADDRess:STATe <Bool>

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.

SYSTem[:COMMunicate]:LAN:HOST?

Function	Reads the Host Name
Return	<SRD>
Example	GAC-02AA1A-000001

SYSTem[:COMMunicate]:LAN:IPSource <DSC>

Function	Sets the source of the IP address (STATIC/DHCP)
Parameter	STAT|DHCP
Query	SYSTem[:COMMunicate]:LAN:IPSource?
Return	<DSC>

NOTE

This command closes the LAN connection.

SYSTem[:COMMunicate]:LAN:IP[:STATic] <SRD>

Function	Sets a static IP address
Parameter	<SRD>xxx.xxx.xxx.xxx
Query	SYSTem[:COMMunicate]:LAN:IP[:STATic]?
Return	<SRD>
Example	192.200.0.10, 192.9.33.110

NOTES

The query returns the setting of the static IP address. For current IP, refer to SYSTem[:COMMunicate]:LAN:IP:ACTual?

Leading zero's must not be added to commands and they are not added to queries.

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:ACTual?

Function	Returns the actual IP address used by the unit
Query	SYSTem[:COMMunicate]:LAN:IP:ACTual?
Return	<SRD>
Example	192.200.0.10, 192.9.33.110

NOTES

Leading zeroes are not added to queries.

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: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: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
Query	SYSTem[:COMMunicate]:LAN:SUBNetmask?
Return	<SRD>

SYSTem[:COMMunicate]:LAN:DEFGateway <SRD>

Function	Sets the default gateway
Parameter	xxx.xxx.xxx.xxx
Query	SYSTem[:COMMunicate]:LAN:DEFGateway?
Return	<SRD>

SYSTem[:COMMunicate]:LAN:DNSserver <SRD>

Function	Sets the DNS server
Parameter	xxx.xxx.xxx.xxx
Query	SYSTem[:COMMunicate]:LAN:DNSserver?
Return	<SRD>

SYSTem[:COMMunicate]:LAN:HOSTname <USTR>

Function	Sets the Host name
Parameter	The Host name
Example	SYST:LAN:HOST GACPRO555.
Query	SYSTem[:COMMunicate]:LAN:HOSTname?
Return	<USTR>

SYSTem[:COMMunicate]:LAN:DESCription <USTR>

Function	Sets the description
Parameter	The Description name
Example	SYST:LAN:DESC TDK-GAC-PRO
Query	SYSTem[:COMMunicate]:LAN[:CONFIGure]:DESCription?
Return	<USTR>

NOTE

All commands from SYSTem[:COMMunicate]:LAN:SUBNetmask to SYSTem[:COMMunicate]:LAN:DESCription close the LAN connection, if executed.

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:MDNSenable <Bool>

Function	Enables or disables the MDNS
Parameter	0|1 or OFF|ON
Query	SYSTem[:COMMunicate]:LAN:MDNSenable?
Return	<Bool>

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: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:VXIdiscovery <Bool>

Function	Enables or disables the VXI discovery
Parameter	0|1 or OFF|ON
Query	SYSTem[:COMMunicate]:LAN[:ADVanced]:VXIdiscovery?
Return	<Bool>

SYSTem[:COMMunicate]:LAN:CONNections <NR1>

Function	Sets maximum overall number of TCP connections, VISA connections and opened web pages by users.
Parameter	1–4
Query	SYSTem[:COMMunicate]:LAN:CONNections?
Return	<NR1>

NOTE

This command closes the LAN connection, if executed.

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:DATE?

Function	Returns the date of the last calibration **Format**: yyyy/mm/dd
Return	<SRD>
Example	2024/12/17

SYSTem:ERRor:ENABle <Bool>

Function	Enables or disables the log of the last 10 error messages in an error queue. The setting is saved in the EEPROM
Parameter	0|1 or OFF|ON
Query	SYSTem:ERRor:ENABle?
Return	<Bool>

NOTE

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".

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 list of up to 10 messages formatted as number-string pairs in FIFO order.
Return	<SRD>

NOTE

When no error exists, 0,"No error" is returned.

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>

SYSTem:EXTernal:STATe[#]?

Function	Returns the actual type of the source of voltage programming
Query	SYSTem:EXTernal:STATe? If SYSTem:EXTernal:ENABle is set to 1 or ON and the LOC/REM rear-panel pin (**J4-6**) is connected to common, an external voltage source is used to program the power source. In all other cases, the front panel or communication is used.
Return	<Bool>

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>

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>. The control range is dependent on the selected range. There are four different types of voltage programming: **Mode** / **Value Set** / **Control Range (V)** FULL / Instantaneous (AC, DC, Frequency) / ±2.5 to ±10. (Applicable for DC enabled units only.) AC / AC Voltage / 2.5 to 10 DC / DC Offset Voltage / ±2.5 to ±10. (Applicable for DC enabled units only.) FREQ / Frequency / 2.5 to 10
Example	If frequency mode (FREQ) is selected, and if SYSTem:EXTernal:RANGe is set to 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 is set to 2.5V, the programming range is -2.5 to 2.5V which is equivalent to -500 to 500V. Refer to **Section 11.9: External (Analog) Voltage Programming (J4-9)** for some examples.
Query	SYSTem:EXTernal:FUNCtion?
Return	<DSC>

NOTE

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

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 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 range to programming range). **Mode** / **Maximum Monitoring Value** AC, DC, and ACDC / DC voltage/current rating
Query	SYSTem:EXTernal:MONitor[:MODE]?
Return	<DSC>

NOTE

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:MONitor:CURRent[:MAX][:LEVel][#] <NRf>

Function	Sets the maximum analog current monitoring value when the SYSTem:EXTernal:MONitor[:MODE] is set to FULL.
Parameter	(Current rating)–120
Unit	A
Query	SYSTem:EXTernal:MONitor:CURRent[:MAX][:LEVel]?
Return	<NR2>

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
Example	SYST:FRST USB returns to factory default settings with USB as the default interface

NOTES

Factory Reset does not affect acknowledgment of advanced parallel configuration (does not affect power source configuration.

SYSTem:FRST sent without a parameter sets USB communication interface.

]SYSTem:FIRMware[:VERSion]?

Function	Returns the firmware versions (in order): Interface, Master Control, Display
Return	<SRD>

SYSTem:PHASe:CONFiguration <NR1>

Function	Sets the number of phases in the system
Parameter	1–3
Query	SYSTem:PHASe:CONFiguration?
Return	<DSC> When system setup is required, NA is returned since the number of phases is unknown and needs to be set by the user.

CAUTION

Ensure that the output of all power sources on the same phase are 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 3 power sources, the possible configurations are: 1,2,3. For example, in the three-phase configuration, each phase contains one power sources. In the one-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: 2^{32}-1
Unit	Minutes
Return	<NR1>

SYSTem:PON:TIME:AC?

Function	Returns the total time the power source is connected to the AC. Max value: 2^{32}-1
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:REMote[:STATe] <DSC>

Function	Sets the control of the power source to local, remote, or Local Lockout (LLO) mode
Parameter	LOC|REM|LLO **LOC:** (Local) enables the front panel control **REM**: (Remote) disables the change of settings from the front panel. Preview of the settings is possible. **LLO**: (Local Lockout) the same as remote, but in addition, it also disables the unlocking of the front panel.
Query	SYSTem:REMote[:STATe]?
Return	<DSC>

NOTES

LLO mode can be unlocked 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	LOC|REM **LOC**: Local Sensing is selected **REM**: Remote Sensing is selected
Query	SYSTem:SENSe[:STATe]?
Return	<DSC>

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[:IMMediate]

Function	Generates an immediate trigger. It is ACTIVE only if BUS is selected as a trigger source

NOTE

The TRIGger[:IMMediate] command overrides the TRIGger:DELay setting; it activates trigger immediately. Refer to *TRG (refer to **Section 14.12: SCPI Common Commands**) to activate trigger with a delay function.

TRIGger:DELay <NRf>

Function	Sets a time delay between the trigger event of a specified trigger source to the start of any corresponding trigger action.
Parameter	0–3600
Unit	s
Query	TRIGger:DELay?
Return	<NR2>

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.
Parameter	STEP|PULSe|LIST
Example	TRIGger:PROGram STEP, TRIGger:PROGram STEP,PULSe,LIST
Query	TRIGger:PROGram?
Return	<DSC>

TRIGger:SOURce <DSC>

Function	Selects a trigger source for sequencers
Parameter	BUS|EXTernal BUS: *TRG, TRIGger[:IMMediate], or the front panel can be used. EXT: Rear panel Trigger In #1 pin (J4-4).
Query	TRIGger:SOURce?
Return	<DSC>

14.13.12 IHARmonics (Iinterharmonics Subsystem)

NOTE

All types of voltage balancing and slew modes (voltage and frequency) are disabled in Interharmonics mode.

IHARmonics:DURation <NRf>

Function	Total duration of the interharmonics sweep
Parameter	0.1–12960000
Unit	ms
Query	IHARmonics:DURation?
Return	<NR2>

IHARmonics:FREQuency:STARt <NRf>

Function	Start frequency of the interharmonics wave sweep
Parameter	16–5000, depending on the power source rated frequency
Unit	Hz
Query	IHARmonics:FREQuency:STARt?
Return	<NR2>

IHARmonics:FREQuency:END <NRf>

Function	End frequency of the interharmonics wave sweep
Parameter	16–5000, depending on the power source rated frequency
Unit	Hz
Query	IHARmonics:FREQuency:END?
Return	<NR2>

NOTES

Once the frequency sweep reaches 1200Hz or 5000Hz, it continues in the backward direction, i.e., 4999, 4988, and so on.

The end frequency must be greater than the start frequency.

IHARmonics:FREQuency:PAUSe <NRf>

Function	Pause the interharmonics sweep at the selected frequency
Parameter	-1|16–5000, depending on the power source rated frequency
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:LEVel <NRf>

Function	Weight (in percentage) of the interharmonic amplitude relative to the amplitude of the fundamental frequency
Parameter	0–100
Unit	%
Query	IHARmonics:LEVel?
Return	<NR1>

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:STEP:SIZE <NRf>

Function	Step size applied during sweep between start and end frequency
Parameter	1–5000, , depending on the power source 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:STEP:DWELl <NRf>

Function	Duration of each step in the interhamonic 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	Start phase 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	Enable phase synchronization during the interharmonics wave sweep. If disabled, each step starts at the phase at which the previous step ended.
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. The start phase of the base wave is always specified by the OUTPut:PHASe:ON setting. The secondary wave added to the base wave starts with the phase set by IHARmonics:STEP:PHASe. **0 / OFF**: if disabled, each step starts at the phase at which the previous step ended.
Query	IHARmonics:STEP:PHASe:SYNC:ENABle?
Return	<Bool>

IHARmonics:STATe <DSC>

Function	Start or stop 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:WAVeform <USTR>

Function	Waveform used for the interharmonics
Parameter	name
Query	IHARmonics:WAVeform?
Return	<USTR>

NOTES

The fundamental waveform is taken from [FUNCtion:]WAVeform:ACTivate.

name: name of the waveform entered without quotes (USTR data type).

name is case sensitive.

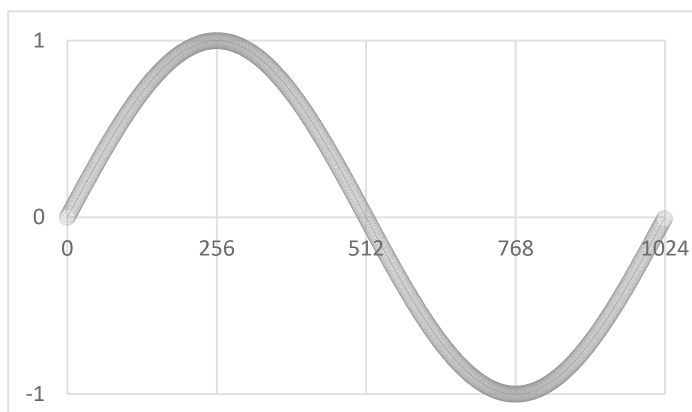
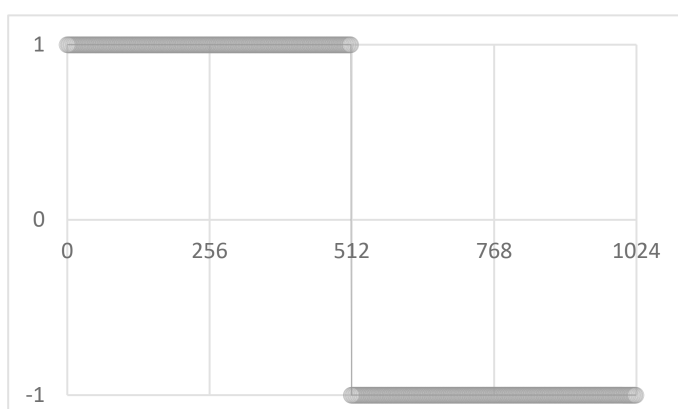
CHAPTER 15: WAVEFORMS

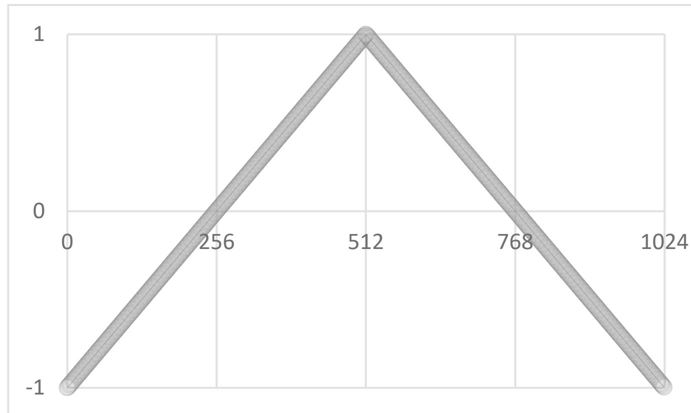
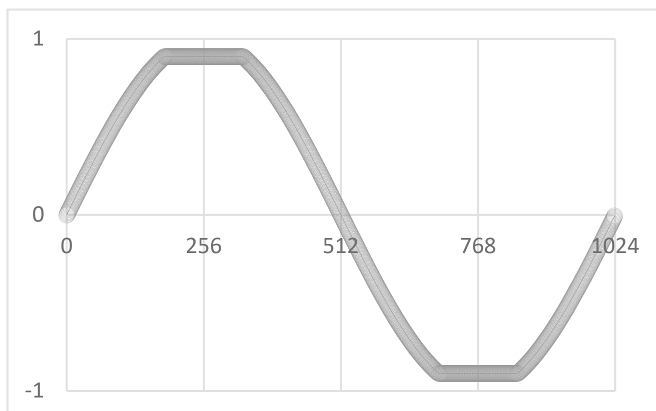
15.1 Introduction

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 on the basis of 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	

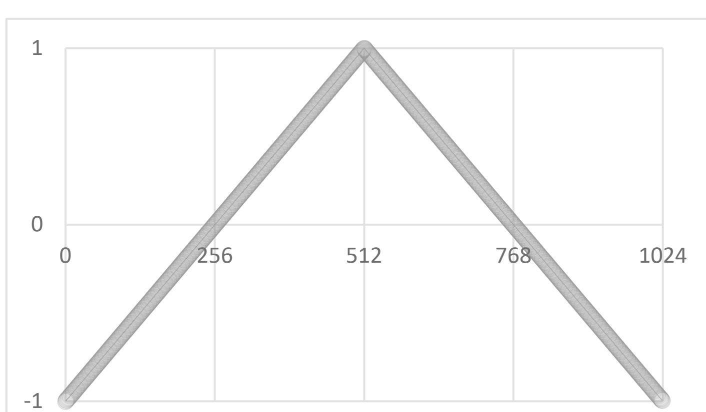
Description	Image
TRIANGLE	
CSINE (Clipped Sine)	

15.3 Custom Waveforms

15.3.1 Waveforms Based On Built-In Waveforms

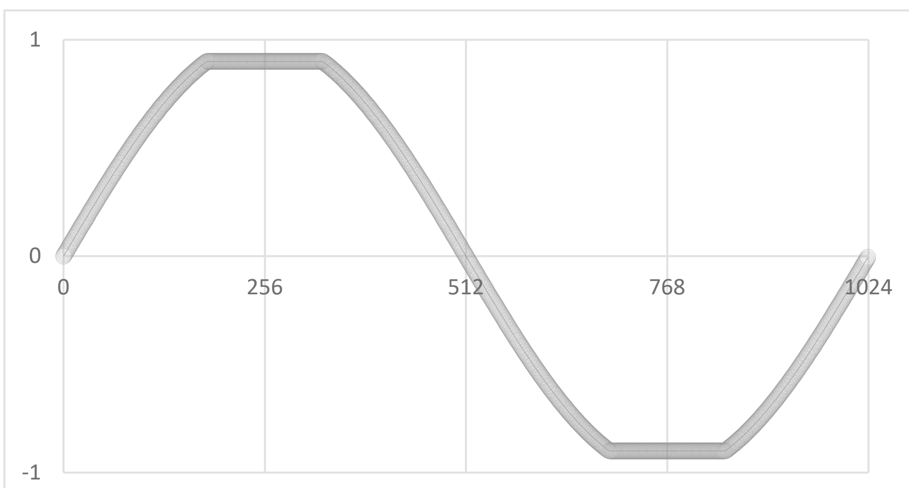
By using the built-in waveforms, the user can generate additional waveforms by modifying the points that were used to generate the built-in waveform. Still, the amplitude of the points is between -1 and 1 and the number of points is 1024. Refer to **Section 14.13.6: Function Subsystem.**

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 output of the power source. 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.

The modes can be selected via a communication command; refer to [PROGram:]DC:ACTivate <DSC> in **Section 14.13.7.6: 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.

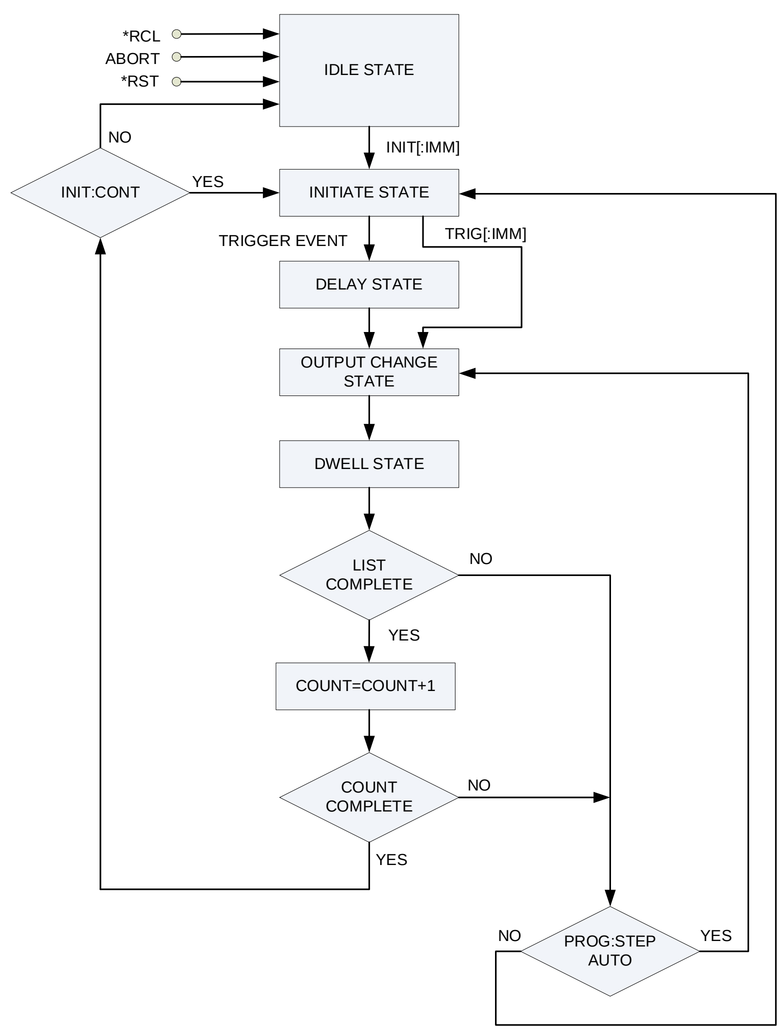


Figure 16-1: LIST Sequence Flowchart

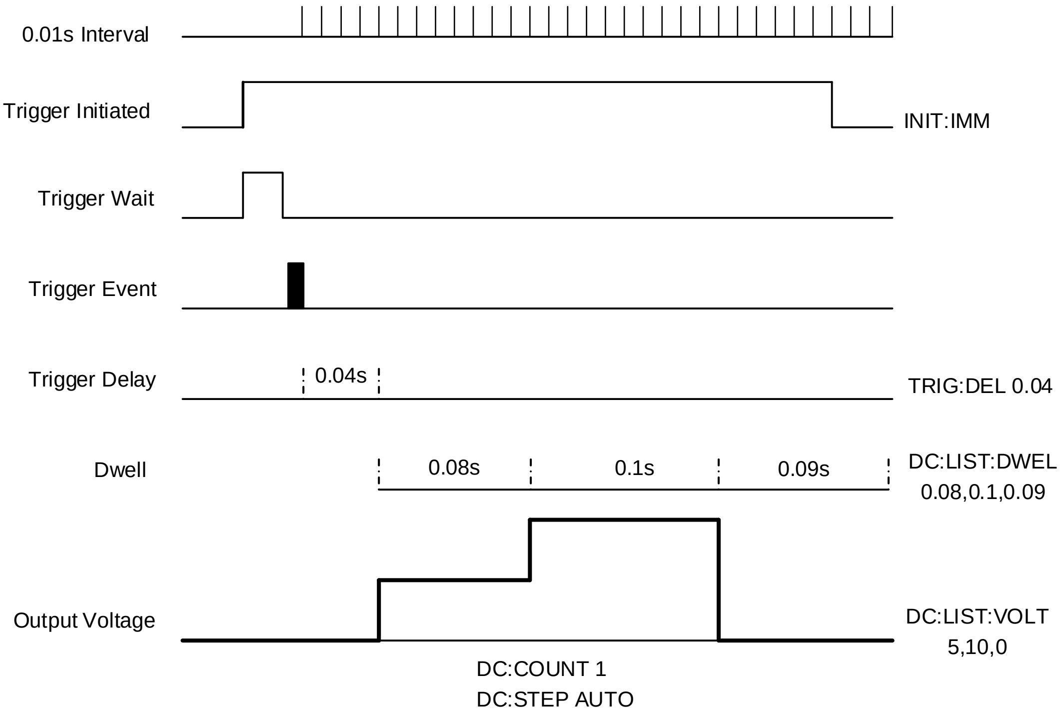


Figure 16-2: LIST Sequence Example

When the sequence is completed, the behavior of the system is determined by [PROGram:]DC:MODE:END; refer to **Section 14.13.7.6: DC Sequencer.**

16.3 Wave Mode

In the WAVE mode, the output value is changed in slopes as determined by the parameters in the WAVE.

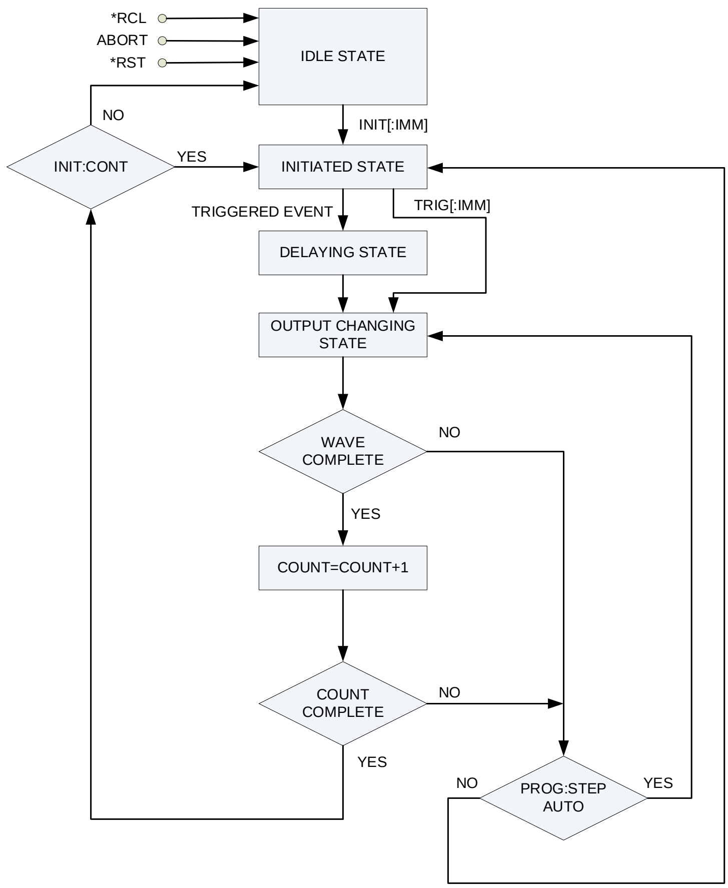


Figure 16-3: WAVE Sequence Flowchart

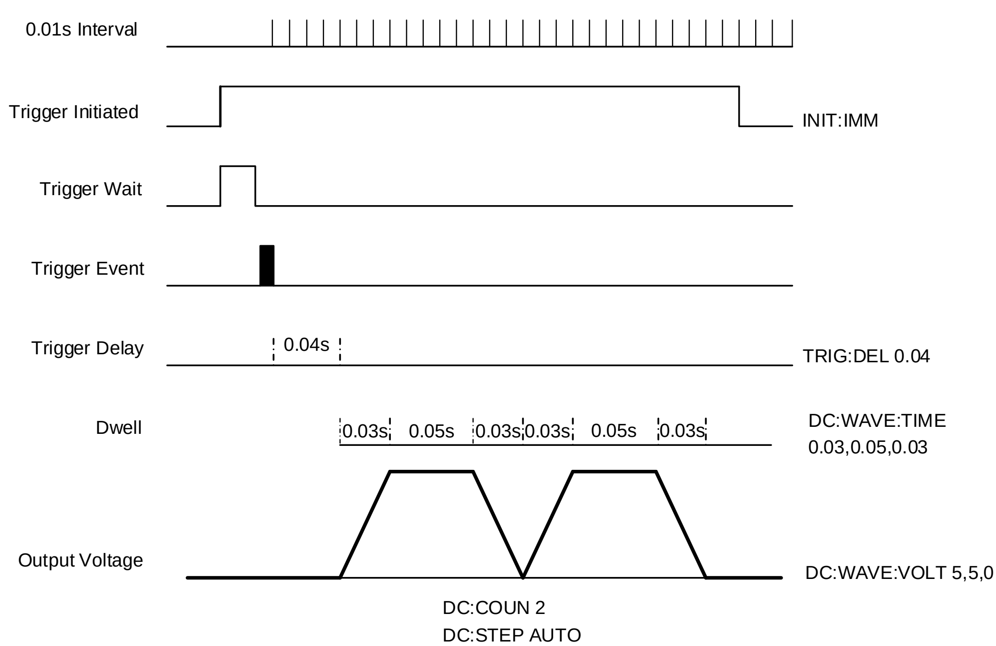


Figure 16-4: Wave Sequence Example

When the sequence is completed, the behavior of the system is determined by [PROGram:]DC:MODE:END; refer to **Section 14.13.7.6: DC Sequencer.**

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.

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 done via the front panel (refer to **Section 9.4.9: Program Menu**) or with INITiate:CONTinuous (refer to **Section 14.13.2: Initiate Subsystem**).

16.4.4 Trigger System

The trigger system consists of the Trigger In function and synchronizes sequencer waveforms.

16.4.4.1 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 via the front panel (refer to **Section 9.4.9: Program Menu**) or via TRIGger:SOURce <DSC> (refer to **Section 14.13.11: TRIGger Subsystem)**.

16.4.5 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 TRIGger:DELay <NRf> in **Section 14.13.11: TRIGger Subsystem**.

16.4.6 Sequencer Functions

16.4.6.1 Counter

Sets the number of performed iterations.

16.4.6.2 List / Wave Value

Sets the output voltage points in a list or wave.

16.4.6.3 Dwell State (List)

Sets the time for which a specific value in the LIST mode remains in effect.

16.4.6.4 Time State (Wave)

Sets the time taken (slope) to move between two points in the WAVE.

16.4.6.5 Step

Executes a single step or a complete sequence.

16.4.7 Abort

Stops the sequencer execution and returns the system to the idle state. Use ABORt; refer to **Section 14.12: SCPI Common Commands**.
If ABORt is sent while the continuous flag is **1**, the system returns to the idle state.

NOTE

Counter, List/Wave Value, Dwell State (List), Time State (Wave), and Step can be set via the front panel (refer to **Section 9.4.9: Program Menu**) or with commands (refer to **Section 14.13.7.6: DC Sequencer**).

16.4.8 Load

Loads a sequence from a memory cell.AC/DC/ACDC Sequencer - Memory Commands

16.4.9 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 14.13.7.5: AC/DC/ACDC Sequencer - Memory Commands**).

16.4.10 LIST Mode Example

NOTE

Start condition: Assume 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
DC:LIST:DWEL 1000,1000,500,1500	Sets the dwell values to 1000,1000,500,1500
DC:STEP AUTO	Sets the execution mode to AUTO
DC:COUN 1	Set the number of iterations to 1
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

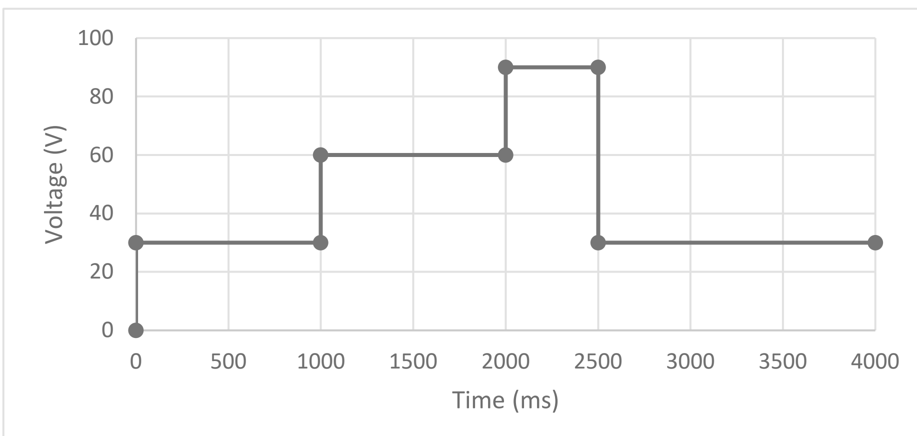


Figure 16-5: LIST Mode Example

16.4.11 WAVE Mode Example

NOTE

Start condition: Assume 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
DC:WAVE:TIME 1000,500,500,500,500,1500,500	Set the time values to 1000,500,500,500,500,1500,500
DC:STEP AUTO	Sets the execution mode to AUTO
DC:COUN 1	Set the number of iterations to 1
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

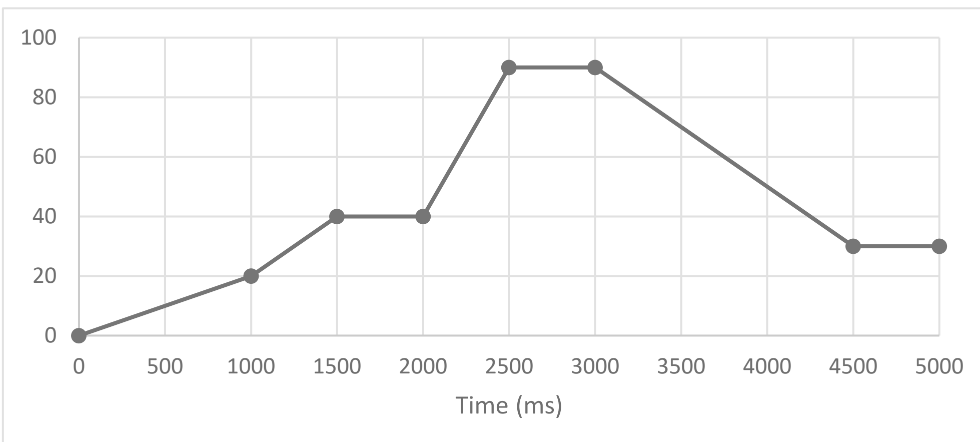


Figure 16-6: WAVE Mode Example

NOTES

If sequencer system is enabled (INITIATED STATE), the power source does not accept additional LIST/WAVE and dwell/time parameters. Use the Abort command before applying new parameters.

If the sequencer system is enabled (INITIATED STATE), the power source does not load previously stored sequences. Use the Abort command before applying new parameters.

If the Sequencer function is enabled (INITIATE STATE), Analog Programming is disabled.

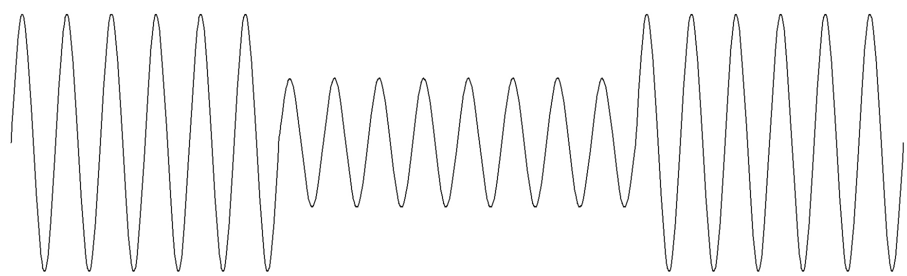
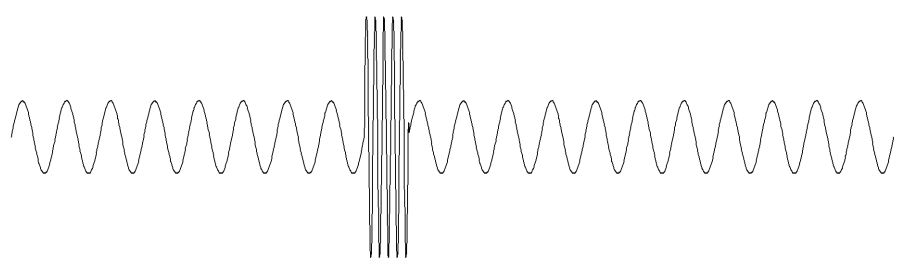
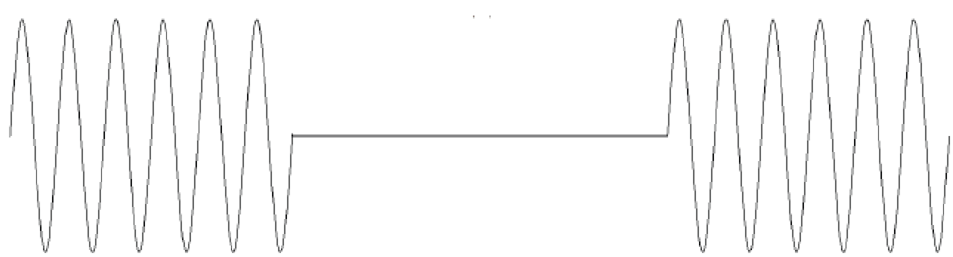
17.1 Introduction

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.

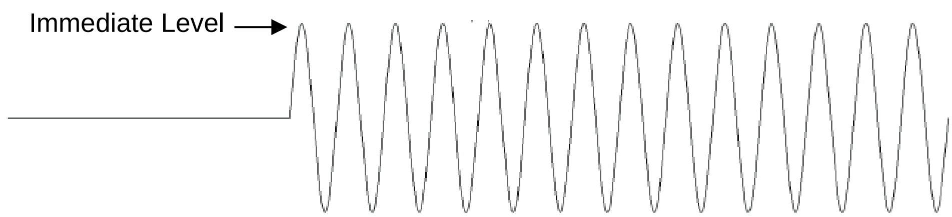
Sags	
Peaks	
Power Loss	

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; refer to **Section 14.13.7.4: PROGram MODE Commands**. **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.

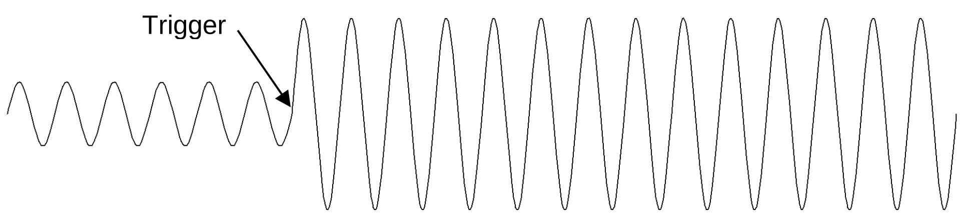


Figure 17-1: Step Voltage

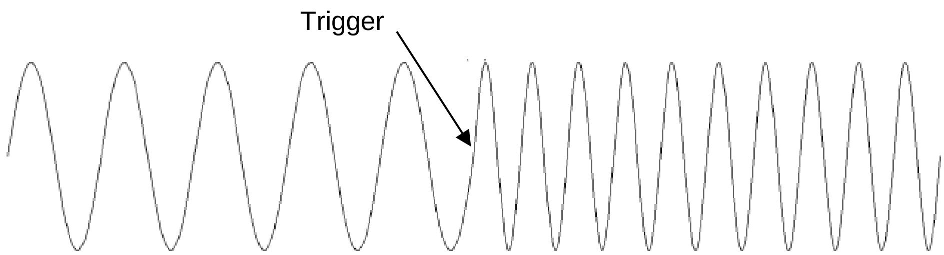


Figure 17-2: Step Frequency

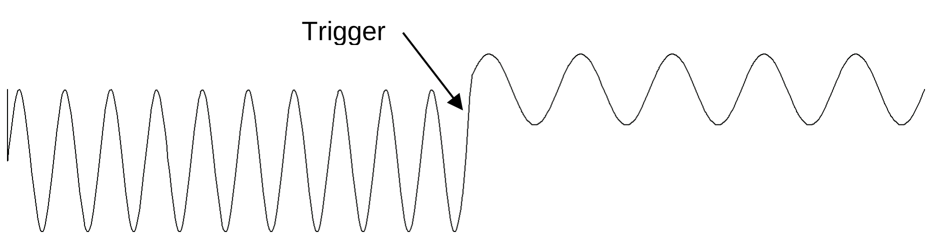


Figure 17-3: Step AC and DC Voltage, Frequency

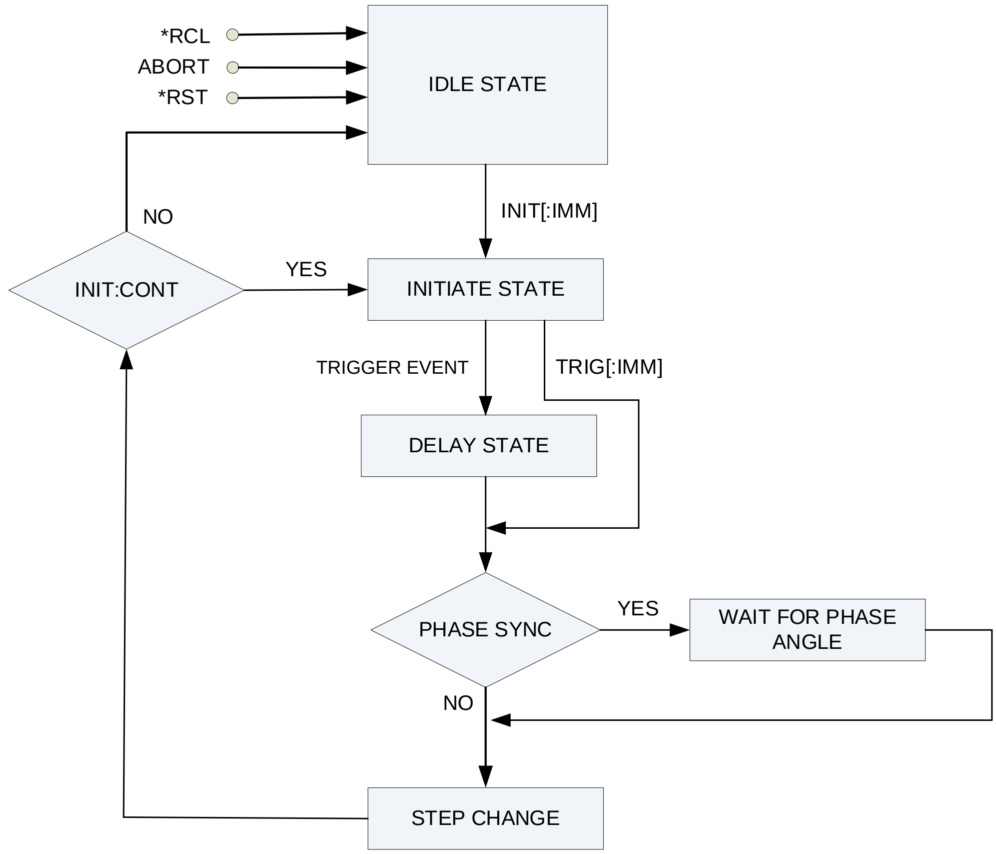
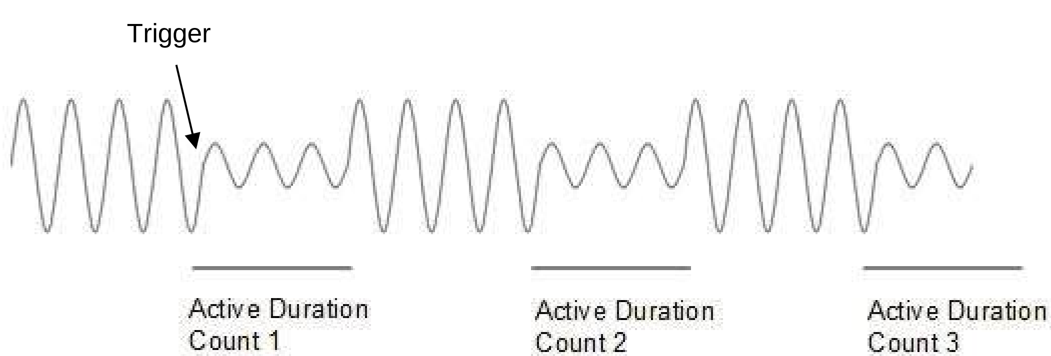


Figure 17-4: Step Sequence Flowchart

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; refer to **Section 14.13.7.4: PROGram MODE Commands.** The figure below shows that the pulse count is 3 and each count has an active duration. The output voltage changes during the active time.



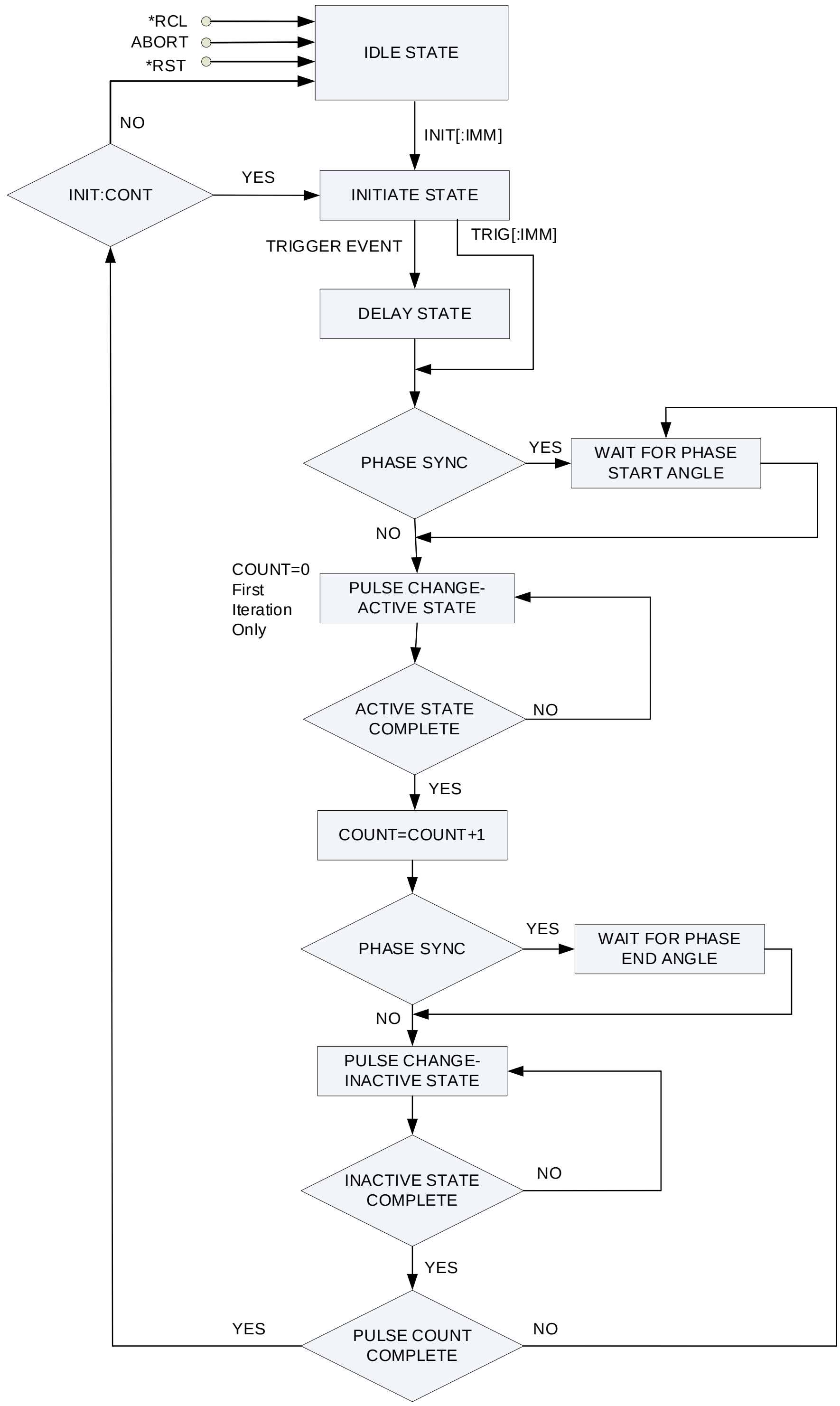
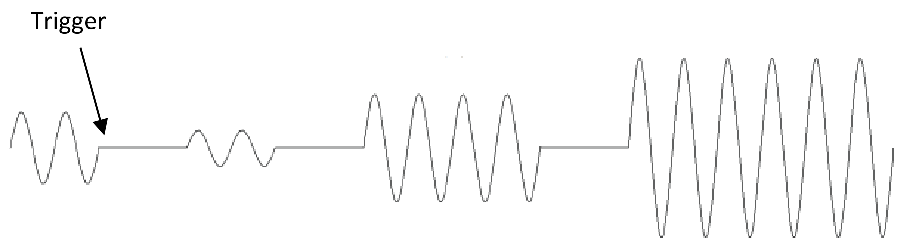


Figure 17-5: Pulse Sequence Flowchart

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; refer to **Section 14.13.7.4: PROGram MODE Commands**. The figure shows different voltage and frequency levels separated by 0-volt levels.



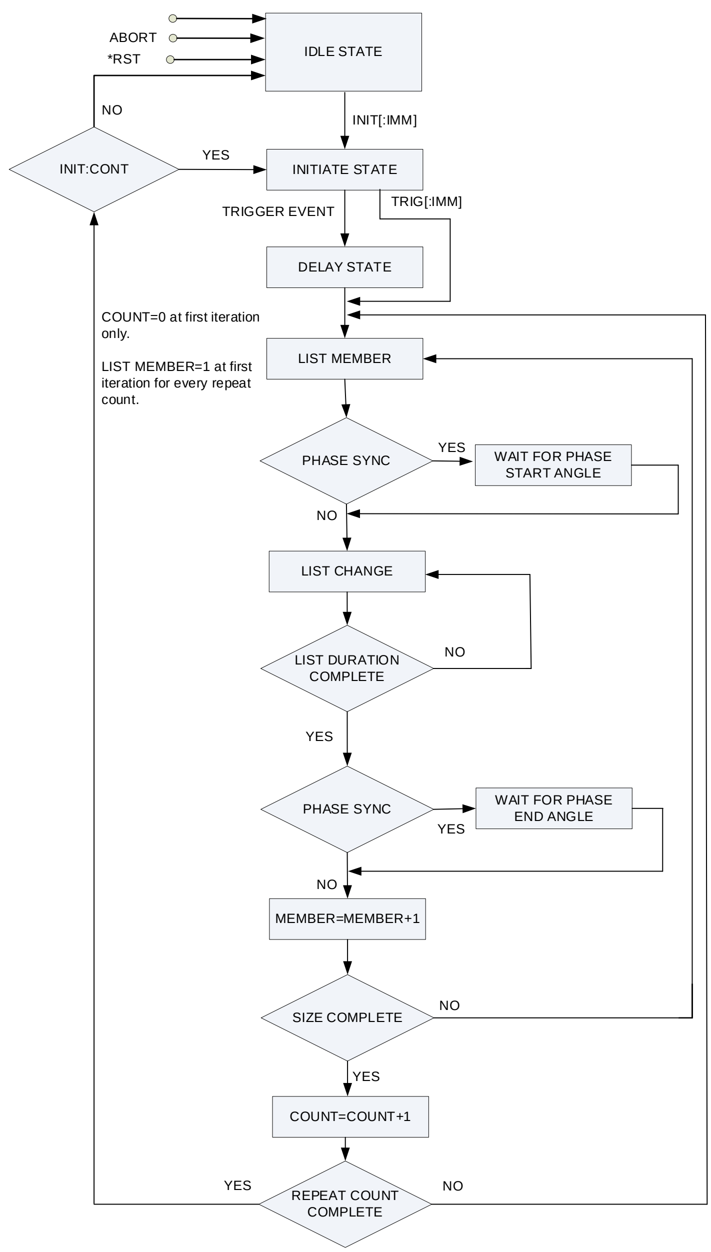


Figure 17-6: List Sequencer Flowchart

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**.

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 was used to move from the idle 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. 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 done via the front panel (refer to **Section 9.4.9: Program Menu**) or with INITiate:CONTinuous (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 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 (refer to **Section 14.13.11: TRIGger Subsystem**).

Trigger In source can be selected via the front panel (refer to **Section 9.4.9: Program Menu**) or via TRIGger:SOURce <DSC> (refer to **Section 14.13.11: TRIGger Subsystem).**

17.3.4.2 Trigger Out

Trigger Out is an active high output signal located on the rear panel connector: J4-23. There are three trigger out modes available: OFF, TRIG, and FSTR.
Refer to OUTPut:TTLTrg:MODE[#] <DSC> in **Section 14.13.5: Output Subsystem** for more details on the trigger out modes.

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 TRIGger:DELay <NRf> in **Section 14.13.11: TRIGger Subsystem**.
To override the trigger delay, use TRIG[:IMMediate].

17.3.6 Sequencer Functions - Common

17.3.6.1 Abort

Stops the sequencer execution and returns the system to the idle state. This can be done with ABORt; refer to **Section 14.12: SCPI Common Commands**.
If ABORt is sent while the continuous flag is **1**, the system returns to the idle state.

17.3.6.2 Load

Loads a sequence from a memory cell.

17.3.6.3 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:AC and [PROGram:]STORe:AC (refer to **Section 14.13.7.5: AC/DC/ACDC Sequencer - Memory** Commands**)**.

17.3.7 Sequencer Function - Step Sequencer

17.3.7.1 Step Value

The AC level, DC offset, and frequency can be set.

17.3.7.2 Start Phase

The phase at which the step starts can be set.

17.3.7.3 Slew Rate

The slope can be controlled using the slew rate function. Slew rate control can be used for the ac level, dc offset, and frequency.

NOTE

For setting the Step Value, Start Phase, and Slew Rate, refer to **Section 14.13.7.2: AC/ACDC Sequencer - Step Subsystem**.

17.3.8 Sequencer Function - Pulse Sequencer

17.3.8.1 Pulse Value

The AC level, DC offset, and frequency can be set.

17.3.8.2 Start Phase

The phase at which the pulse starts can be set.

17.3.8.3 Ends Phase

The phase at which the pulse ends can be set.

17.3.8.4 Slew Rate

The slope can be controlled using the slew rate function. Slew rate control can be used for the ac level, dc offset, and frequency.

17.3.8.5 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.

17.3.8.6 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**.**

17.3.8.7 Pulse Counter

Sets the number of times the pulse cycle (active state) is repeated.

NOTE

For setting the Pulse Value, Start Phase, End Phase, Slew Rate, Active and Inactive State, and Pulse Counter, refer to **Section 14.13.7.1: AC/ACDC Sequencer - Pulse Subsystem**

17.3.9 Sequencer Function - List Sequencer

17.3.9.1 List Value

The AC level, DC offset, and frequency for each member in the list can be set.

17.3.9.2 Start Phase

The start phase can be set for each member in the list.

17.3.9.3 End Phase

The end phase can be set for each member in the list.

17.3.9.4 Slew Rate

The slope can be controlled using the slew rate function. Slew rate for the AC level, DC offset, and frequency for can be set for each member in the list.

17.3.9.5 List Duration

Each member in the list sequence can be set for a particular duration.

17.3.9.6 List Repeat

Sets the number of times that the list is repeated.

17.3.9.7 List Step

The sequence can be set to be executed all at once or a single step at a time.

NOTE

For setting the List Value, Start Phase, End Phase, Slew Rate, List Duration, List Repeat, and List Step, refer to **Section 14.13.7.3: AC/ACDC Sequencer - LIST Subsystem**.

17.3.10 Typical Sequencer Examples

17.3.10.1 Step Sequencer

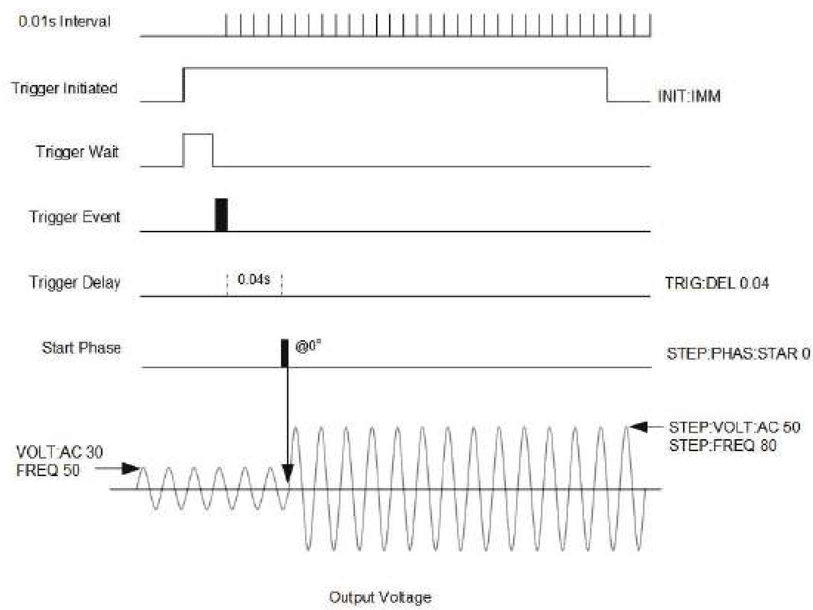


Figure 17-7: Step Sequence Example

Initial Settings (after AC reset): Output ON, AC Mode, built-in sine wave, AC 30, FREQ 50

MODE:WAV STEP	Sets the sequence mode of the waveform mode to STEP
STEP:WAV SIN	Sets the sequence mode of the waveform to SIN
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 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 17-7)

17.3.10.2 Pulse Sequencer

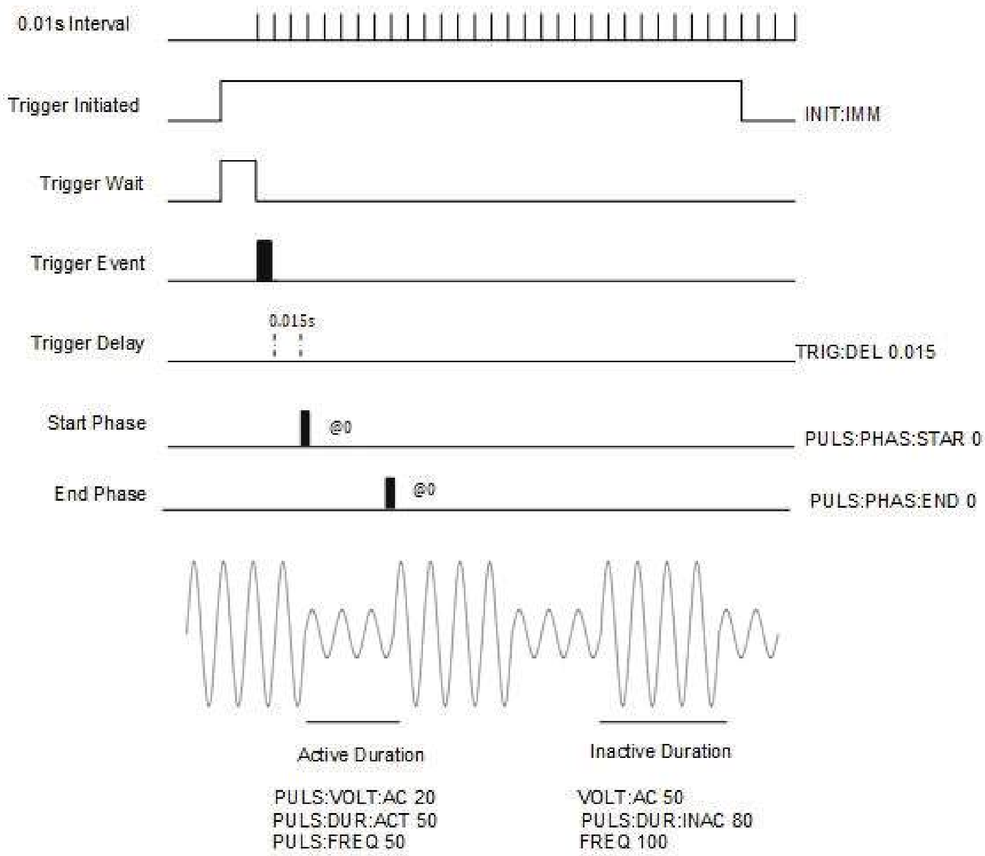


Figure 17-8: Pulse Sequence Example

Initial Settings (after AC reset): Output ON, AC Mode, built-in sine wave, AC 50, FREQ 100

MODE:WAV PULS	Sets the sequence mode of the waveform mode to PULSE
PULS:WAV SIN	Sets the sequence mode of the waveform to SIN
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 to 0°
PULS:PHAS:END 0	Sets the end phase 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 20	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
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 17-8)

NOTE

During the inactive duration the immediate value of voltage and frequency is applied.

17.3.10.3 List Example

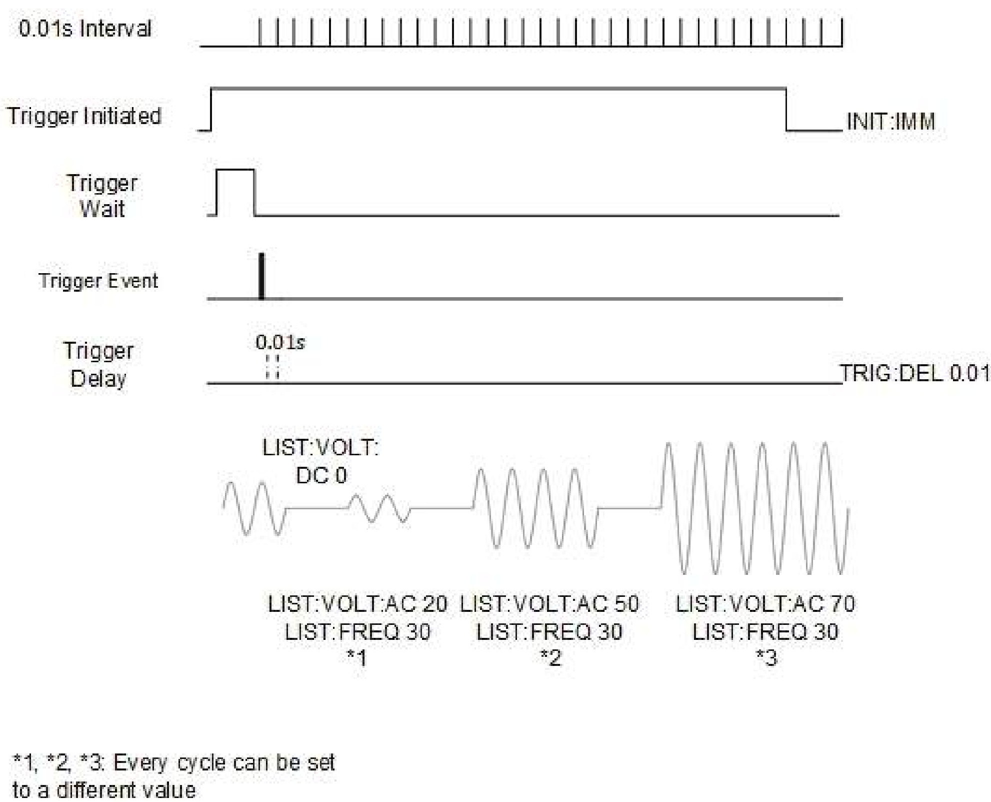


Figure 17-9: List Sequencer Example

Initial Settings (after AC reset): Output ON, AC Mode, built-in sine wave, AC 50, FREQ 100

MODE:WAV LIST	Sets the sequence mode of the waveform mode to LIST
LIST:WAV SIN	Sets the sequence mode of the waveform to SQUARE
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 0,30,0,30,0,30	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 index of the last node which is included in the output sequence.
LIST:DUR 1000,1000,1000,1000,1000,1000	Sets the duration of each item in the list
LIST:REP 1	Sets the number of times the list is repeated
LIST:STEP AUTO	Sets the power source to execute the whole sequence or a single step 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 17-3: Pulse Sequence Example (For Figure 17-9)

CHAPTER 18: PARALLEL OPERATION

18.1 Introduction

The parallel configuration of the power source consists of power sources configured for various phases or to a single phase to increase the power per phase. Several power sources may share a phase in parallel or each power source may be on a separate phase.

In parallel mode, the power sources can be configured as:

- **System Master + Phase Master**: This unit is the master for the entire system (single-phase, split 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), this unit alerts the user. This may be called as the Phase Master for its own phase.
- **Phase Master**: The user can program this via the System Master. The Phase Master controls the slaves 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.
- **Slave**: Single unit, controlled by the Phase Master. The user can control the slave unit via the Phase Master only. 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 Phase Master power switch.

18.2 Typical Configurations

NOTE

Units assigned to a specific phase must be sequential and must be connected directly to one another without units with 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.

18.2.1 Single-Phase

In this configuration, the first unit is always the System Master + Phase Master and the rest of the units are slaves.

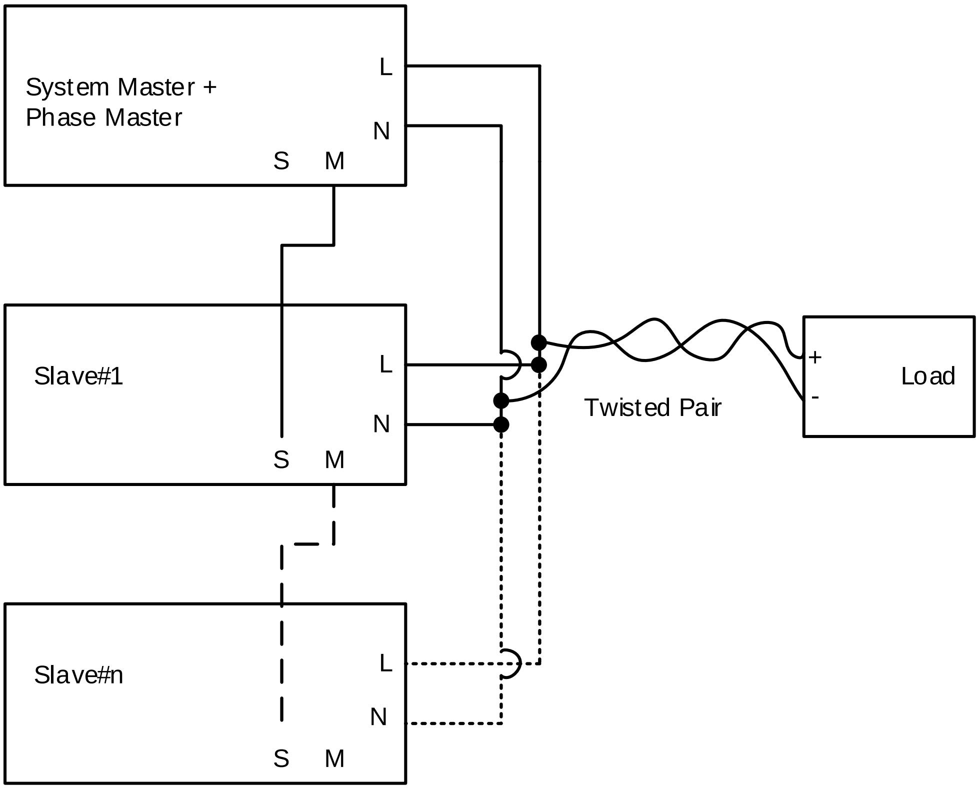


Figure 18-1: Single-Phase Connection

NOTE

Neutral (N) of all the units must be shorted

18.2.2 Split Phase

In this configuration, there is a System Master + Phase Master with additional slaves (optional), and there is a Phase Master also with additional slaves (optional).

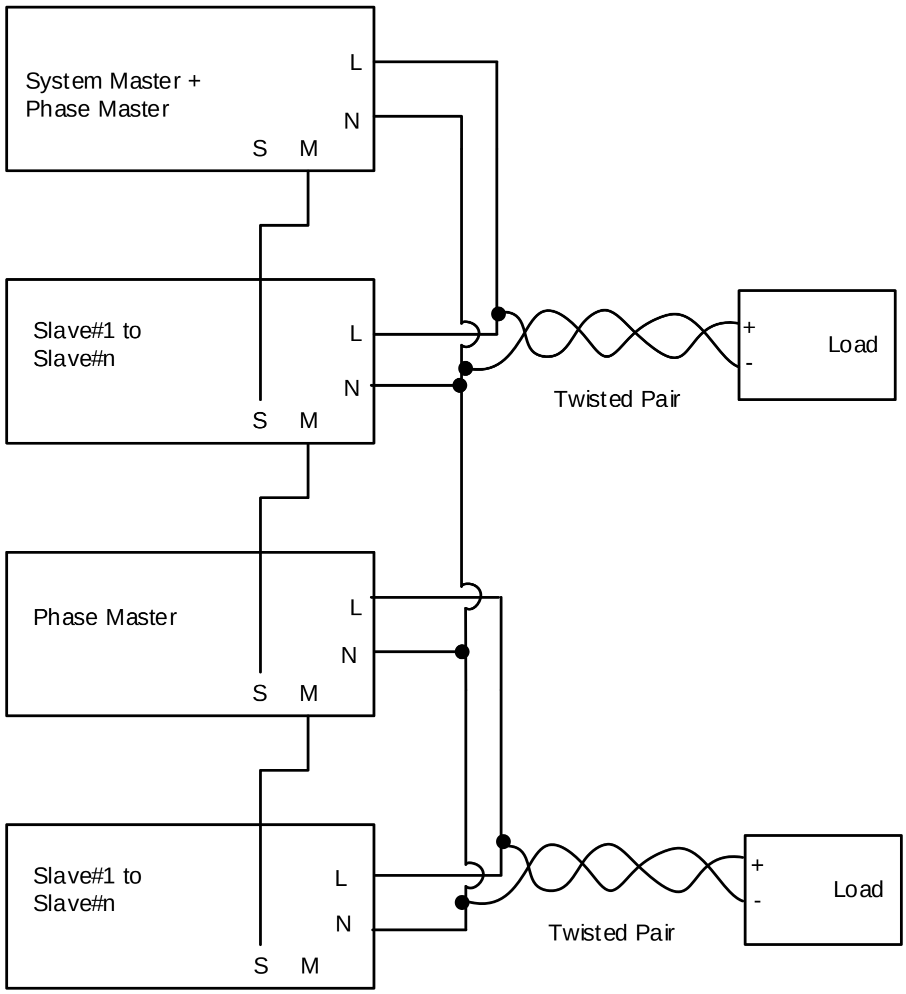


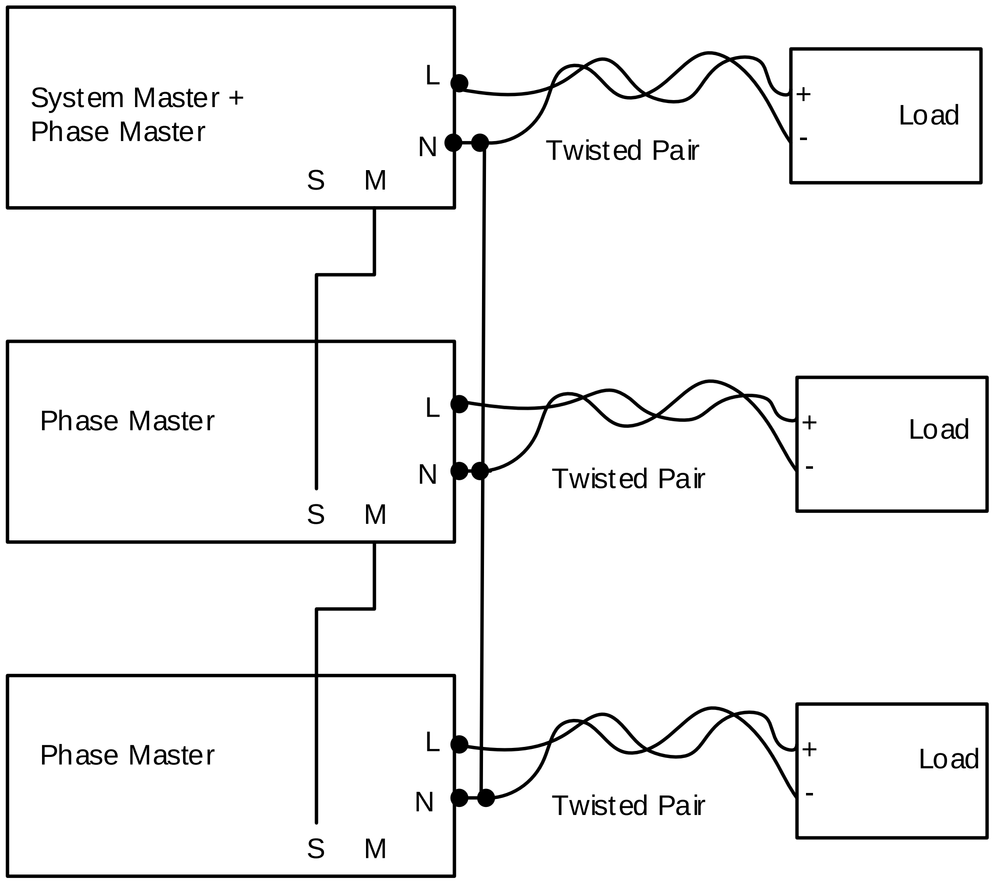
Figure 18-2: Split-Phase Connection

NOTE

Neutral (N) of all the units must be shorted

18.2.3 Three Phase

In this configuration, there is a System Master + Phase Master and two additional phase masters.



NOTE

Neutral (N) of all the units must be shorted

18.2.4 Three Phase with Optional Slaves and Remote Sense

In this configuration, there is a System Master + Phase Master with optional slaves and there are two Phase Masters also with optional slaves.

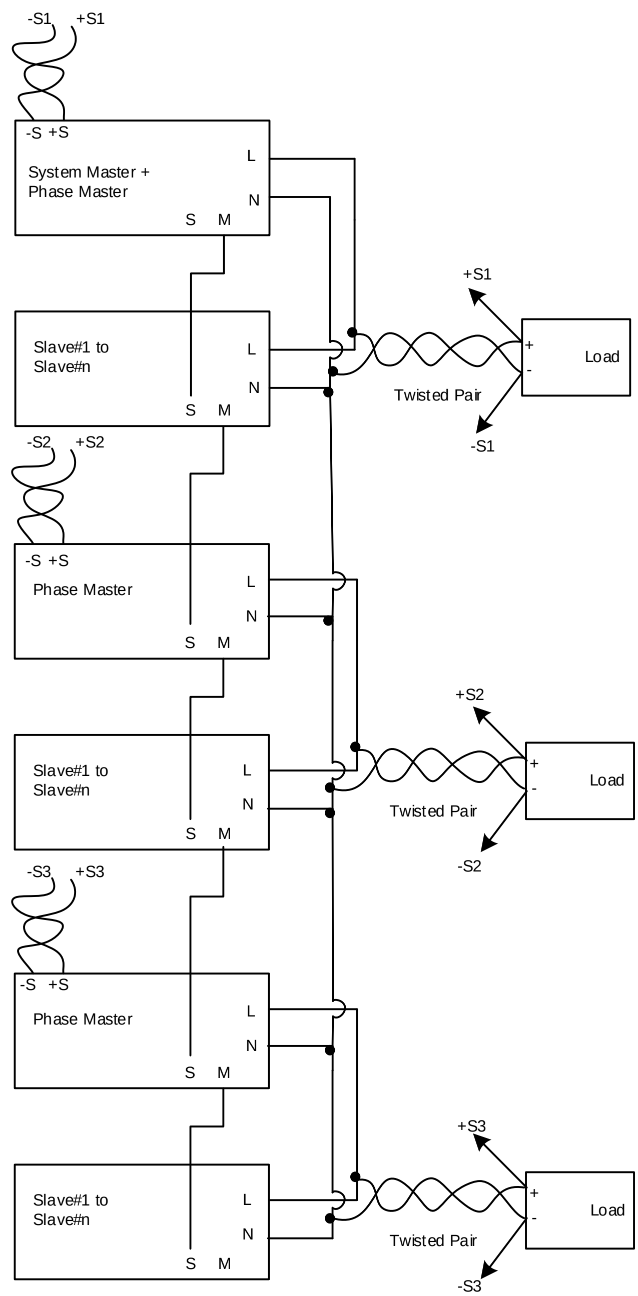


Figure 18-3: Three Phase Connection

NOTE

Neutral (N) of all the units must be shorted

18.3 System Setup and Assembly

18.3.1 System Assembly

CAUTION

System assembly must be performed only when the whole system is disconnected from the AC mains.

System assembly is established by using the optional 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 18-4 shows how a system looks after it is assembled.

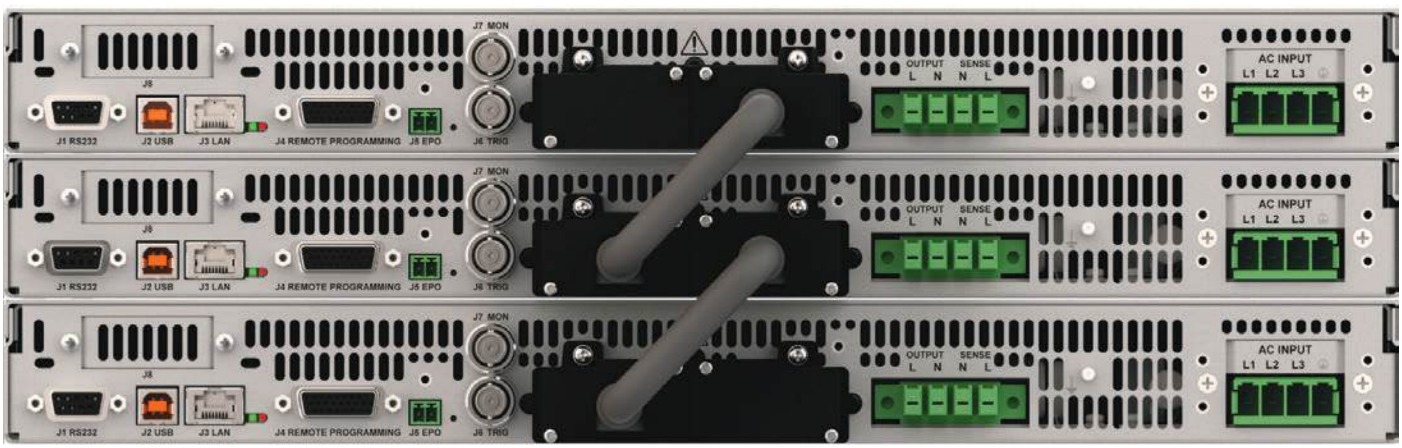


Figure 18-4: System Assembly

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 user must specify the number of units for each phase. The System Master + Phase 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 + Phase Master creates a construction fault and shows the fault on the display.

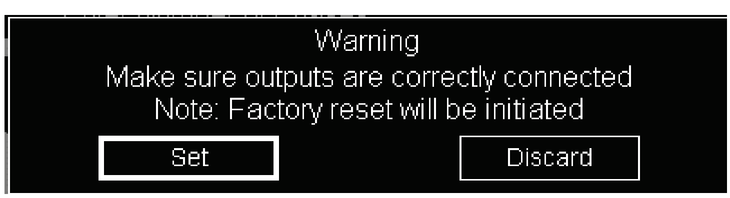
The acknowledgement process is performed on the System Master+ Phase Master, and the process is available via the front panel or communications.

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 + Phase Master.

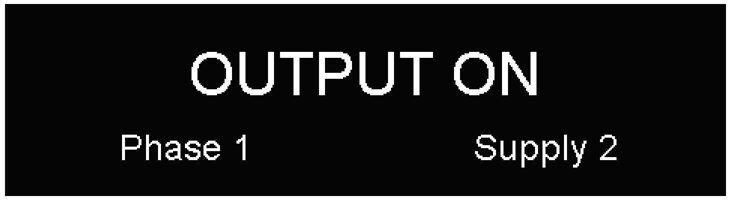
The following message appears on the other units.

2. Click **Settings** on the System Master + Phase Master.
3. Select the number of phases. The following message appears.



4. Click **Set.**

Figure shows a 1 phase system with one System + Phase Master (first unit) and one slave (second unit).



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.

18.3.4 Parallel Operation

18.3.5 Operation of the Slave Units

During operation, slave units show **OUTPUT ON** or **OUTPUT OFF**, or faults if a fault has occurred. Each slave unit displays its own fault. The display on the slave units are disabled.

18.3.6 Faults System

The fault system combines the faults of all the units. The System Master + Phase 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 + Phase Master.
If a fault occurs, the Phase Master updates the System Master + Phase Master that a fault has occurred in the system.

18.3.7 Advanced 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**.