Chroma

Advancing Excellence

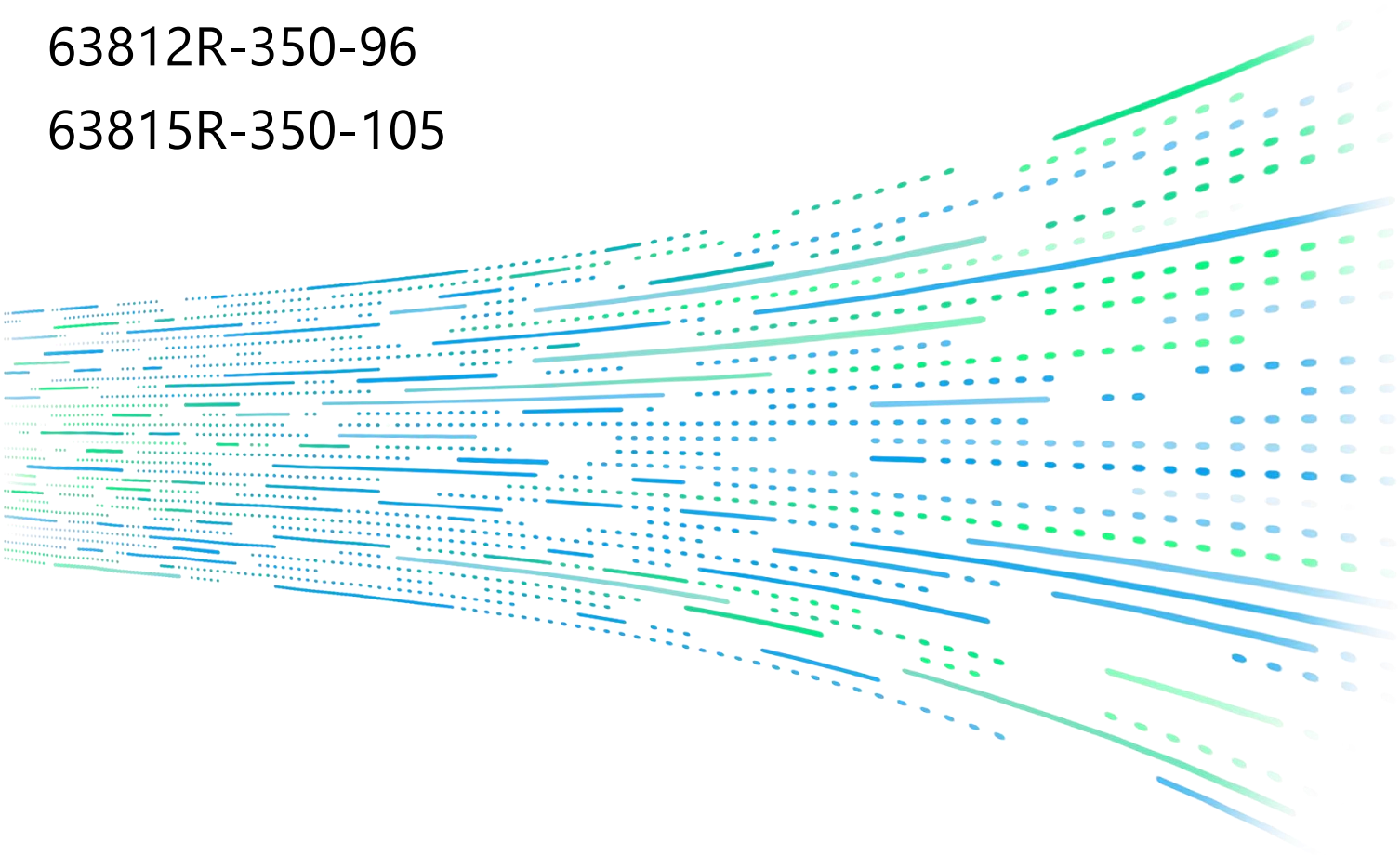
User's Manual

Regenerative AC Electronic Load

63809R-350-87

63812R-350-96

63815R-350-105



Regenerative AC Electronic Load
63809R-350-87
63812R-350-96
63815R-350-105
User's Manual

Version 1.2
March 2026

Legal Notices

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

Chroma ATE INC. makes no warranty of any kind with regard to this manual, including, but not limited to, the implied warranties of merchantability and fitness for a particular purpose. Chroma ATE INC. shall not be held liable for errors contained herein or direct, indirect, special, incidental, or consequential damages in connection with the furnishing, performance, or use of this material.

CHROMA ATE INC.
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Warranty

All of Chroma's instruments are warranted against defects in material and workmanship for a period of one year from the date of shipment. Chroma agrees to repair or replace any assembly or component found to be defective, under normal use during this period. Chroma's obligation under this warranty is limited solely to repairing any such instrument, which in Chroma's sole opinion proves to be defective within the scope of the warranty when returned to the factory or to an authorized service center. Purchaser is responsible for the shipping and cost of the service item to Chroma factory or service center. Shipment should not be made without prior authorization by Chroma.

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Material Contents Declaration

The recycling label shown on the product indicates the Hazardous Substances contained in the product as the table listed below.


: See **<Table 1>**.


: See **<Table 2>**.

<Table 1>

Part Name	Hazardous Substances					
	Lead	Mercury	Cadmium	Hexavalent Chromium	Polybrominated Biphenyls/ Polybromodiphenyl Ethers	Selected Phthalates Group
	Pb	Hg	Cd	Cr^{6+}	PBB/PBDE	DEHP/BBP/DBP/DIBP
PCBA	O	O	O	O	O	O
CHASSIS	O	O	O	O	O	O
ACCESSORY	O	O	O	O	O	O
PACKAGE	O	O	O	O	O	O

“O” indicates that the level of the specified chemical substance is less than the threshold level specified in the standards of GB 26572-2025, EU Directive 2011/65/EU, and 2015/863/EU.

“×” indicates that the level of the specified chemical substance exceeds the threshold level specified in the standards of GB 26572-2025, EU Directive 2011/65/EU, and 2015/863/EU.

Remarks:
1. The CE marking on the product is a declaration of product compliance with EU Directive 2011/65/EU and 2015/863/EU.
2. This product complies with the EU REACH regulation, and no SVHC is in use.

Disposal

Do not dispose of electrical appliances as unsorted municipal waste; use separate collection facilities. Contact your local government for information regarding the collection systems available. If electrical appliances are disposed of in landfills or dumps, hazardous substances can leak into the groundwater and get into the food chain, damaging your health and well-being. When replacing old appliances with new ones, the retailer is legally obligated to take back your old appliances for disposal at least for free of charge.

<Table 2>

Part Name	Hazardous Substances					
	Lead	Mercury	Cadmium	Hexavalent Chromium	Polybrominated Biphenyls/ Polybromodiphenyl Ethers	Selected Phthalates Group
	Pb	Hg	Cd	Cr^{6+}	PBB/PBDE	DEHP/BBP/DBP/DIBP
PCBA	×	O	O	O	O	O
CHASSIS	×	O	O	O	O	O
ACCESSORY	×	O	O	O	O	O
PACKAGE	O	O	O	O	O	O

"O" indicates that the level of the specified chemical substance is less than the threshold level specified in the standards of GB 26572-2025, EU Directive 2011/65/EU, and 2015/863/EU.

"×" indicates that the level of the specified chemical substance exceeds the threshold level specified in the standards of GB 26572-2025, EU Directive 2011/65/EU, and 2015/863/EU.

1. Chroma is not fully transitioned to lead-free solder assembly at this moment; however, most of the components used are RoHS compliant.
2. The environmentally friendly usage period of the product is assumed under the operating environment specified in each product's specification.
3. This product complies with the EU REACH regulation, and no SVHC is in use.

Disposal

Do not dispose of electrical appliances as unsorted municipal waste; use separate collection facilities. Contact your local government for information regarding the collection systems available. If electrical appliances are disposed of in landfills or dumps, hazardous substances can leak into the groundwater and get into the food chain, damaging your health and well-being. When replacing old appliances with new ones, the retailer is legally obligated to take back your old appliances for disposal at least for free of charge.

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Declaration of Conformity

For the following equipment :

Regenerative Grid Simulator, Regenerative AC Electronic Load

(Product Name/ Trade Name)

61805, 61809, 61810, 61812, 61815, 63809R-350-87, 63812R-350-96, 63815R-350-105

(Model Designation)

Chroma ATE Inc.

(Manufacturer Name)

88 Wenmao Rd., Guishan Dist., Taoyuan City 333001, Taiwan

(Manufacturer Address)

Is herewith confirmed to comply with the requirements set out in the Council Directive on the Approximation of the Laws of the Member States relating to Electromagnetic Compatibility Directive (2014/30/EU) and Low Voltage Directive (2014/35/EU). For the evaluation regarding the Directives, the following standards were applied :

EN 55011:2016+A1:2017+A11:2020+A2:2021 Group 1 Class A

EN IEC 61326-1:2021 Class A, EN IEC 61326-2-1:2021

EN 61000-3-12:2011, EN IEC 61000-3-11:2019

EN IEC/BS EN IEC 61326-1:2021 (industrial electromagnetic environment)

EN 61000-4-2:2009, EN IEC 61000-4-3:2020, EN 61000-4-4:2012,

EN 61000-4-5:2014+A1:2017, EN 61000-4-6:2014, EN 61000-4-8:2010

EN 61000-4-34:2007+A1:2009

IEC 61010-1:2010+A1:2016 (Edition 3.1), EN/BS EN 61010-1:2010+A1:2019

The equipment describe above is in conformity with Directive 2011/65/EU and 2015/863/EU of the European Parliament and of the Council on the restriction of the use of certain hazardous substances in electrical and electronic equipment.

The following importer/manufacturer or authorized representative established within the EUT is responsible for this declaration :

Chroma ATE Europe B.V.

(Authorized Representative Name)

Morsestraat 32, 6716 AH Ede, The Netherlands

(Authorized Representative Address)

Person responsible for this declaration:

Mr. Vincent Wu

(Name, Surname)

T&M BU/Vice President

(Position/Title)

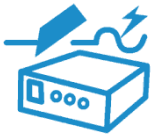
Taiwan	**2025.01.06**	Vincent Wu
(Place)	(Date)	(Legal Signature)

Safety Summary

The following general safety precautions must be observed during all phases of operation, service, and repair of this product. Failure to comply with these precautions or specific WARNINGS given elsewhere in this manual will violate the safety standards of design, manufacture, and intended use of the instrument. *Chroma* assumes no liability for the customer's failure to comply with these requirements.

BEFORE APPLYING POWER
Verify that the power is set to match the rated input of this device.

PROTECTIVE GROUNDING
Make sure to connect the protective grounding to prevent an electric shock before turning on the power.



NECESSITY OF PROTECTIVE GROUNDING
Never cut off the internal or external protective grounding wire, or disconnect the wiring of the protective grounding terminal. Doing so will cause a potential shock hazard that may bring injury to a person.

FUSES
Only fuses with the required rated current, voltage, and specified type (normal blow, time delay, etc.) should be used. Do not use repaired fuses or short-circuited fuse holders. To do so could cause a shock or fire hazard.

DO NOT OPERATE IN AN EXPLOSIVE ATMOSPHERE
Do not operate the instrument in the presence of flammable gases or fumes. The instrument should be used in an environment of good ventilation.

DO NOT REMOVE THE COVER OF THE INSTRUMENT
Operating personnel must not remove the cover of the instrument. Component replacement and internal adjustment can be done only by qualified service personnel.

⚠WARNING

1. If the output terminals and the circuit are energized while power is on, contact may result in serious injury or death. Do not touch the terminals when the unit is powered.
2. When in a Y connection, including L1/L2/L3, the neutral conductor (NEU) may carry the maximum current; therefore, all the wire diameters used must meet the maximum current requirement.
3. During transportation, keep the equipment in an upright, horizontal position. Do not transport or move it on its side, as this may damage the unit.

Safety Symbols

	**DANGER –** High voltage.
	**Explanation:** To avoid injury, death of personnel, or damage to the instrument, the operator must refer to the explanation in the manual.
	**High temperature:** This symbol indicates the temperature is hazardous. Do not touch to avoid personal injury.
	**Protective grounding terminal:** This symbol indicates that the terminal must be connected to the ground before operating the equipment to protect against electrical shock in case of a fault.
	**Functional grounding:** To identify an earth (ground) terminal in cases where the protective ground is not explicitly stated. This symbol indicates the power connector does not provide grounding.
	**Frame or chassis:** To identify a frame or chassis terminal.
	**Alternating Current (AC)**
	**Direct Current (DC) / Alternating Current (AC)**
	**Direct Current (DC)**
	**Push-on/Push-off power switch**
	The **WARNING** sign highlights an essential operating or maintenance procedure, practice, condition, statement, etc., which if not strictly observed, could result in injury to, or death of, personnel or long-term health hazards.
	The **CAUTION** sign highlights an essential operating or maintenance procedure, practice, condition, statement, etc., which if not strictly observed, could result in damage to, or destruction of, equipment.
	The **Notice** sign highlights an essential operating or maintenance procedure, condition, or statement.

Revision History

The following lists the additions and modifications in this manual at each revision.

Date	Version	Revised Sections
Apr. 2022	1.0	Completed this manual.
Dec. 2023	1.1	Modified the following: − "*Specifications*" in "*Overview*" chapter − "*Initial Inspection*", "*Input Connection*", and "*Connecting Remote Sense*" in "*Installation*" chapter − "*Stand-By*", "*Paralleling by UI*", and "*Protection*" in "*Using Regenerative AC Electronic Load*" chapter − "*Basic Definition*", "*Common Command Dictionary*", and "*Instrument Command Dictionary*" in "*Remote Operation*" chapter − Appendix "*TTL Signal Pin Assignments*" Added the following: − "*Sleep Mode*" to "*System Setup Menu*" section − "*3-phase Wiring for Paralleling Regenerative AC Electronic Loads*" to "*Signal Cable Connection for Parallel Mode*" section
Mar. 2026	1.2	Modified the following: − Front matter: Updated CE safety statement; table of contents. − Chapter 1 "*Overview*": Updated 1.2 *Features*; updated 1.3 *Specifications*; updated 1.4.2 Figures. − Chapter 2 "*Installation*": Updated 2.1 APG adapter board illustration; updated 2.3.1 title; updated 2.7 power-on procedure description. − Chapter 3 "*Operation*": Updated 3.1 function tree diagram; updated 3.2 messages; updated 3.3.1 *More Settings* illustration and 3.3.1.1 *Transient Degree* description; updated 3.4 mode illustrations/content (CCRE/CSRE/CR/CCPH/CSPH/CC/CP); updated 3.5 description and CAN/LAN illustrations; added 3.5.5 series/parallel mode settings; updated 3.6 illustration and function description; updated 3.7 *Unified Control via SoftPanel*; updated 3.8 system protection causes and troubleshooting; added 3.10 application description (List Mode). − Chapter 4 "*Series/Parallel*": Updated chapter title/description; added 4.1 single-unit wiring configuration and 4.2 series split-phase system configuration; updated 4.3.3 notes and maximum number of parallel units. − Chapter 5 "*Remote Operation*": Updated 5.4 content. − Appendix A: Updated pin descriptions for pins 5, 17, 22, and 24, and added notes.

Table of Contents

1. Overview

1.1 Introduction

Chroma 638XXR Series Regenerative AC Electronic Loads are equipped with multiple operating modes, including CC Rectified, CC Phase lead/lag, CS Rectified, CS Phase lead/lag, CC, CP, and CR. They are suitable for power draw testing and long-duration endurance testing of sources such as BOBC (V2H/L), AC EVSE[*1], hybrid PV inverters (off-grid type), residential energy storage inverters, UPS systems, and fuel cell AC generators.

With regenerative capability, the system converts energy efficiently and feeds it back to the utility grid. In addition to mitigating waste-heat issues, this also improves energy efficiency and supports environmental sustainability. Compared to conventional AC loads, the regenerative design delivers energy savings while also reducing carbon emissions.

Note *1: Inrush Current Box required for AC EVSE testing.

1.2 Features

- Input voltage range: 30–350V
- Input frequency range: 30–100Hz
- Rated apparent power regeneration capability; power can be recycled to grid with high efficiency after conversion
- Supports testing applications for BOBC, EVSE, and other EV-related products
- Selectable 1-phase/3-phase AC output
- Adjustable slew rate for current and power commands
- Configurable output limits for power/apparent power, current, CF, and PF
- Voltage waveform start angle configurable 0–359.99 degrees
- Synchronous TTL signal output for output current changes
- Provides power interruption and automatic loading upon restoration via Standby mode.
- Linear and non-linear load testing
- Inductive and capacitive load testing
- In all modes, energy can be fed back to grid with efficiency greater than 89%
- Digital interface: GPIB, CAN, USB, LAN
- Supports series and parallel operation (refer to Table 1-1)

Table 1-1

	63815R Series	
	Parallel	**Series**
3-Phase	10	N/A
1-Phase	N/A	N/A
Split Phase	N/A	2

1.3 Specifications

The following table lists the specifications of Chroma 63809R-350-87/63812R-350-96/63815R-350-105 Regenerative AC Electronic Loads. All specifications were verified following Chroma's standard test procedure. Unless otherwise specified, all specifications were tested under the condition of remotely connected voltage sense within temperatures of 25°C ± 1°C with a resistive load.

Model	63809R-350-87	63812R-350-96	63815R-350-105
Operating Range (Each Phase)			
Max. Current (RMS)	29 A_{RMS}	32 A_{RMS}	35 A_{RMS}
Max. Current (Peak)	87 A_{peak}	96 A_{peak}	105 A_{peak}
Voltage	30 – 350 V_{RMS}	30 – 350 V_{RMS}	30 – 350 V_{RMS}
Frequency	30 – 100 Hz	30 – 100 Hz	30 – 100 Hz
CC/CS Rectified Mode (Each Phase)			
Current	0 – 29 A_{RMS}	0 – 32 A_{RMS}	0 – 35 A_{RMS}
Accuracy (A)[*1]	0.3%+ 0.5% F.S.	0.3%+ 0.5% F.S.	0.3%+ 0.5% F.S.
Resolution (A)	0.01 A_{RMS}	0.01 A_{RMS}	0.01 A_{RMS}
Power	0 – 3 kVA	0 – 4 kVA	0 – 5 kVA [*8]
Accuracy (VA)[*2]	0.3% + 0.3% F.S.	0.3% + 0.3% F.S.	0.3% + 0.3% F.S.
Resolution (VA)	1 VA	1 VA	1 VA
Crest Factor	1.414 – 3.000	1.414 – 3.000	1.414 – 3.000
Accuracy (CF) [*3]	3.0% F.S.	3.0% F.S.	3.0% F.S.
Resolution (CF)	0.001	0.001	0.001
CC Phase Lead / Lag Mode (Each Phase)			
Current	0 – 29 A_{RMS}	0 – 32 A_{RMS}	0 – 35 A_{RMS}
Accuracy (A) [*1]	0.3% + 0.5% F.S.	0.3% + 0.5% F.S.	0.3% + 0.5% F.S.
Resolution (A)	0.01 A_{RMS}	0.01 A_{RMS}	0.01 A_{RMS}
Angle [*6]	-90° to +90° (Current source mode: +90.01° to +180° & -90.01° to -180°)	-90° to +90° (Current source mode: +90.01° to +180° & -90.01° to -180°)	-90° to +90° (Current source mode: +90.01° to +180° & -90.01° to -180°)
Accuracy (deg)	1% F.S.	1% F.S.	1% F.S.
Resolution (deg)	0.01°	0.01°	0.01°
CS Phase Lead / Lag Mode (Each Phase)			
Power	0 – 3 kVA	0 – 4 kVA	0 – 5 kVA[*8]
Accuracy (VA) [*2]	0.3%+ 0.3% F.S.	0.3%+ 0.3% F.S.	0.3%+ 0.3% F.S.
Resolution (VA)	1 VA	1 VA	1 VA
Angle	-84.26° to +84.26°	-84.26° to +84.26°	-84.26° to +84.26°
Accuracy (deg) [*4]	1% F.S.	1% F.S.	1% F.S.
Resolution (deg)	0.01°	0.01°	0.01°
Power Factor [*7]	0.100 – 1.000 (Lead/Lag)	0.100 – 1.000 (Lead/Lag)	0.100 – 1.000 (Lead/Lag)
Accuracy (PF)	1% F.S.	1% F.S.	1% F.S.
Resolution (PF)	0.001	0.001	0.001
CR Mode (Each Phase)			
Resistance	1 – 300 Ω	1 – 300 Ω	1 – 300 Ω
Accuracy (Ω)[*4]	0.3% + 0.5% F.S.	0.3% + 0.5% F.S.	0.3% + 0.5% F.S.
Resolution (Ω)	0.01 Ω	0.01 Ω	0.01 Ω
CC/CP Mode (Each Phase)			
Current	0 – 29 A_{RMS}	0 – 32 A_{RMS}	0 – 35 A_{RMS}
Accuracy (A) [*1]	0.3%+ 0.5% F.S.	0.3%+ 0.5% F.S.	0.3%+ 0.5% F.S.
Resolution (A)	0.01 A_{RMS}	0.01 A_{RMS}	0.01 A_{RMS}
Power	0 – 3 kW	0 – 4 kW	0 – 5 kW [*8]
Accuracy (W) [*5]	0.3% + 0.3% F.S.	0.3% + 0.3% F.S.	0.3% + 0.3% F.S.
Resolution (W)	1W	1W	1W
Crest Factor	1.414 – 3.000	1.414 – 3.000	1.414 – 3.000

Model	63809R-350-87	63812R-350-96	63815R-350-105
Accuracy (CF) *3	3.0% F.S.	3.0% F.S.	3.0% F.S.
Resolution (CF)	0.001	0.001	0.001
Power Factor	0.100 – 1.000 (Lead/Lag)	0.100 – 1.000 (Lead/Lag)	0.100 – 1.000 (Lead/Lag)
Accuracy (PF) *4	1% F.S.	1% F.S.	1% F.S.
Resolution (PF)	0.001	0.001	0.001
Measurement			
Voltage Reading			
Voltage	0 – 350 V_{RMS}	0 – 350 V_{RMS}	0 – 350 V_{RMS}
Resolution	0.01 V_{RMS}	0.01 V_{RMS}	0.01 V_{RMS}
Accuracy (RMS)	0.1% + 0.2% F.S.	0.1% + 0.2% F.S.	0.1% + 0.2% F.S.
Current Reading			
Current	0 – 29 A_{RMS}	0 – 32 A_{RMS}	0 – 35 A_{RMS}
Resolution	0.01 A_{RMS}	0.01 A_{RMS}	0.01 A_{RMS}
Accuracy (RMS)	0.4% + 0.3%F.S.	0.4% + 0.3% F.S.	0.4% + 0.3% F.S.
Peak Current	0 – 87 A_{peak}	0 – 96 A_{peak}	0 – 105 A_{peak}
Resolution	0.01 A	0.01 A	0.01 A
Accuracy (Peak)	0.4% + 0.6% F.S.	0.4% + 0.6% F.S.	0.4% + 0.6% F.S.
Real Power Reading			
Real Power	0 – 3 kW	0 – 4 kW	0 – 5 kW
Accuracy *2	0.4% + 0.8% F.S.	0.4% + 0.8% F.S.	0.4% + 0.8% F.S.
Reactive Power Reading			
Reactive	0 – 3 kVAR	0 – 4 kVAR	0 – 5 kVAR
Accuracy *2	0.4% + 0.8% F.S.	0.4% + 0.8% F.S.	0.4%+0.8% F.S.
Apparent Power			
Apparent Power	0 – 3 kVA	0 – 4 kVA	0 – 5 kVA
Accuracy *2	0.4% + 0.8% F.S.	0.4% + 0.8% F.S.	0.4% + 0.8% F.S.
Frequency Reading			
Frequency	30 – 100 Hz	30 – 100 Hz	30 – 100 Hz
Resolution	0.01 Hz	0.01 Hz	0.01 Hz
Accuracy *4	0.1% F.S.	0.1% F.S.	0.1% F.S.
Power Factor Reading			
Power Factor	0.100 – 1.000	0.100 – 1.000	0.100 – 1.000
Resolution	0.001	0.001	0.001
Accuracy *4	1% F.S.	1% F.S.	1% F.S.
Crest Factor Reading			
Crest Factor	1.414 – 3.000	1.414 – 3.000	1.414 – 3.000
Resolution	0.001	0.001	0.001
Accuracy *3	3.0% F.S.	3.0% F.S.	3.0% F.S.
Others			
Efficiency *12	89% (max.)		
Dimensions (W×D×H)	428 x 700 x 132.8 mm / 16.85 x 27.55 x 5.23 inch		
Weight	50 kg		
Protection	OVP, OCP, OPP, OTP, FAN		
Remote Interface	GPIB, CAN, USB & USB Host, LAN		
Temperature Range			
Operation	0°C to 40°C		
Storage	-40°C to 85°C		
Humidity *13	0% to 95%		

Model	63809R-350-87	63812R-350-96	63815R-350-105
Safety & EMC	CE		
Exhaust Airflow			
Air Flow Max. (CFM)	260		
Standby Power			
Max. Power*19	550 W		
Sleep Power			
Max. Power*20	120 W		
Energy Recovery*21			
Max. Regenerative Power	9 kVA	12 kVA	15 kVA
Max. Current THD	<7%	<5%	<5%

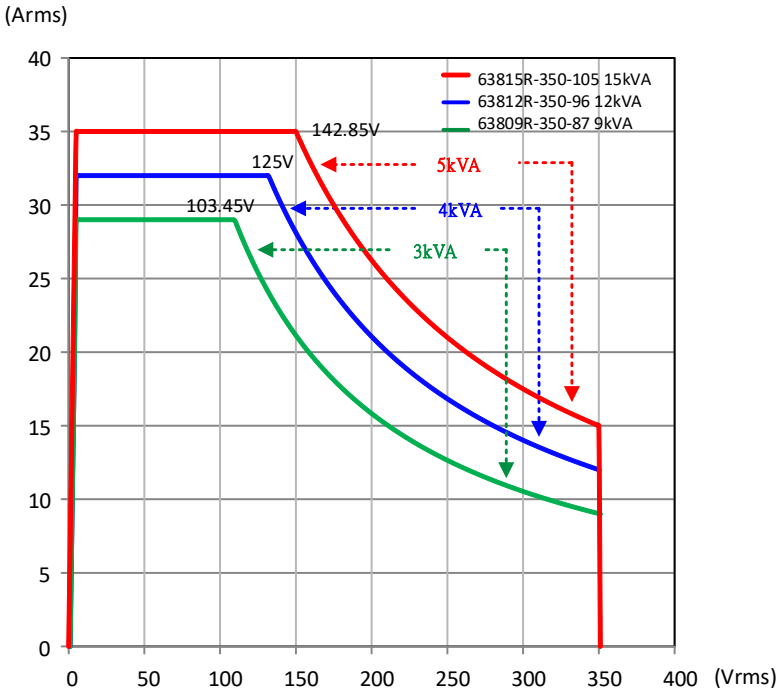
Note

*1: Conditions to meet the spec.: When operating in 3-phase and 1-phase mode, I_{RMS} ≥ 0.5A and the UUT voltage is sine wave (V_{thd} < 0.5% @ 50Hz/60Hz, CF=1.414).
*2: Conditions to meet the spec.: When operating in 3-phase mode, S ≥ 100VA and the UUT voltage is a sine wave. (V_{thd} <0.5% @ 30Hz–100Hz, CF=1.414) When operating in 1-phase mode, S ≥ 300VA and the UUT voltage is a sine wave. (V_{thd} <0.5% @ 30Hz–100Hz, CF=1.414).
*3: Conditions to meet the spec.: When operating in 3-phase mode, I_{RMS} ≥ 0.5A and the UUT voltage is a sine wave. When operating in 1-phase mode, I_{RMS} ≥ 1.5A and the UUT is a sine wave. (V_{thd} <0.5% @ 30Hz–100Hz, CF=1.414).
*4: Conditions to meet the spec.: When operating in 3-phase mode, I_{RMS} ≥ 2A and the UUT voltage is a sine wave. (VUUT ≥ 50 V_{RMS}; V_{thd} <0.5% @ 30Hz–100Hz, CF=1.414). When operating in 1-phase mode, I_{RMS} ≥ 6A and the UUT voltage is a sine wave. (VUUT ≥ 50 V_{RMS}; V_{thd} <0.5% @ 30Hz–100Hz, CF=1.414).
*5: Conditions to meet the spec.: When operating in 3-phase mode, P ≥ 100W and the UUT voltage is a sine wave. (V_{thd} <0.5% @ 30Hz–100Hz, CF=1.414). The UUT voltage and the regenerative AC load current must be in the same phase. When operating in 1-phase mode, P ≥ 300W and the UUT voltage is a sine wave (V_{thd} <0.5% @ 30Hz–100Hz, CF=1.414). The UUT voltage and the regenerative AC load current must be in the same phase.
*6: Supports current source mode and needs Phase limit set to OFF. See section 3.4.4.1 for the configuration method.
*7: Supports PF setting mode and needs Power Factor set to ON. See section 3.4.5.1 for the configuration method.
*8: When the input of model 63815R-350-105 Regenerative AC Electronic Load is 3Φ 200–240VAC, its load power will be derated to 80%.
*9: The load regulation condition is to set the sine wave output.
*10: If an extra breaker is required for wiring, be sure to use a circuit breaker larger than 50A.
*11: The current measurement display is 4 digits; for instance, if the measured current is between 10.00–99.99A, the minimum display digits are 00.01.
*12: The test efficiency is the maximum output power to a linear load when the output voltage is set to 250VAC.
*13: The operating humidity is non-condensing.
*14: The input voltage range of 63815R-350-105 is 3Φ 200–240Vac ± 10% with 12kVA maximum output power at 47–63Hz.
*15: When measuring the accuracy (RMS) in parallel mode, the defined accuracy (Peak) spec. needs to add the parallel unit modification. For instance, if the accuracy (RMS) is 0.4%+0.3%F.S, it has to be above >N Amp with output voltage set to 250VAC and frequency set to 60Hz to meet the specification. (N is the parallel unit.)
*16: The measurement-related specifications in a parallel mode such as current and power need to multiply the paralleled units, for instance, the output current (RMS) of 3 paralleled units is 35×3 = 105A and the output peak current is 315A.
*17: When the input of model 63815R-350-105 Regenerative AC Electronic Load is 3Φ 200–240Vac, its loading power will be derated to 80%.

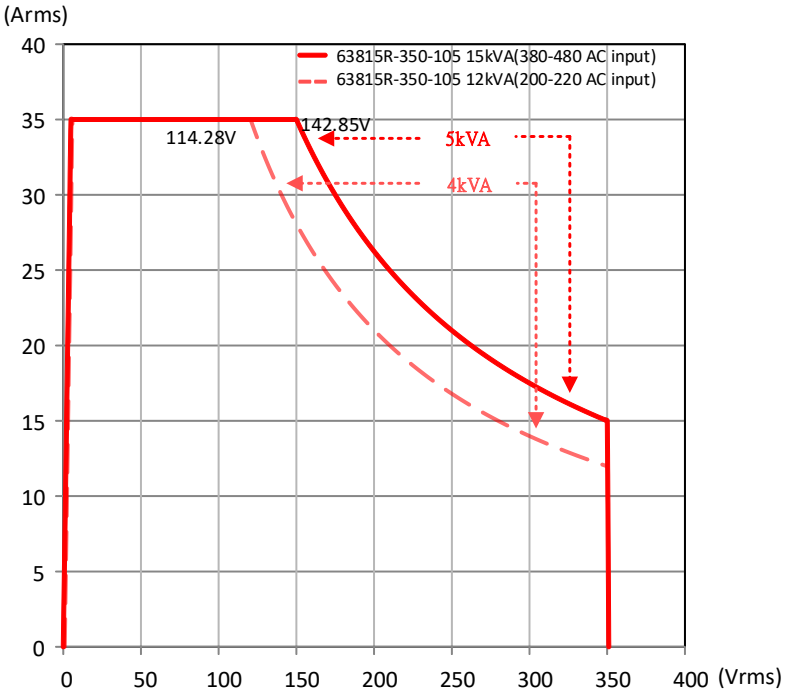
*18: See the voltage/current operating diagram below for the Regenerative AC Electronic Load's output capability.

Voltage / Current Operating Area

Operating Area per Phase @ AC Mode



Operating Area per Phase @ AC Mode



*19: 3P220V_{LL}/60Hz = 495W; 3P380V_{LL}/60Hz = 540W; 3P480V_{LL}/60Hz = 550W.
*20: 3P220V_{LL}/60Hz = 100W; 3P380V_{LL}/60Hz = 115W; 3P480V_{LL}/60Hz = 120W.
*21: The 63800R Series Regenerative AC Electronic Load has grid connections and energy recovery functions with complete protection mechanisms designed for the power input.

When the 63800R series detects overvoltage, undervoltage, abnormal frequency, three-phase unbalance, overcurrent, etc. on the AC power in the paralleled grid, it will instantly prompt a warning and stop loading. At the same time, the power module in the paralleled grid will be locked to protect user safety. After confirming that the power grid status is normal, restart the electronic load to connect to the grid again for comprehensive grid-tied protection.

1.4 Function Keys

1.4.1 Front Panel

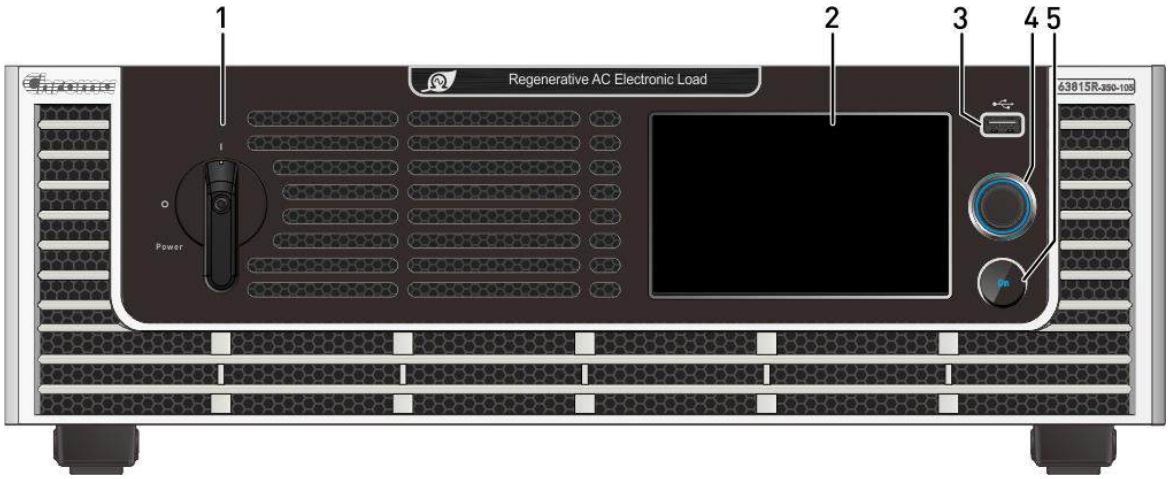


Figure 1-1 Front Panel

Table 1-2 Front Panel Description

Item	Symbol	Description
1		***Main power switch***: Powers the Regenerative AC Electronic Load on and off.
2		***LCD touch panel***: 5.0 inch LCD output settings and measurement results.
3		***USB HOST***: Captures the LCD screen. Only for use with a flash (thumb) drive to record data. See the warning below.
4		***RPG rotary knob***: Turn the RPG knob to adjust voltage and frequency and input programmed data.
5		***Output On button***: Turns output on and off without turning off the instrument. Light on means the output is ON and light off means the output is OFF.

⚠WARNING The USB HOST on the front panel can only be used to connect a USB flash drive. Do not connect to power banks or any other products.

1.4.2 Rear Panel

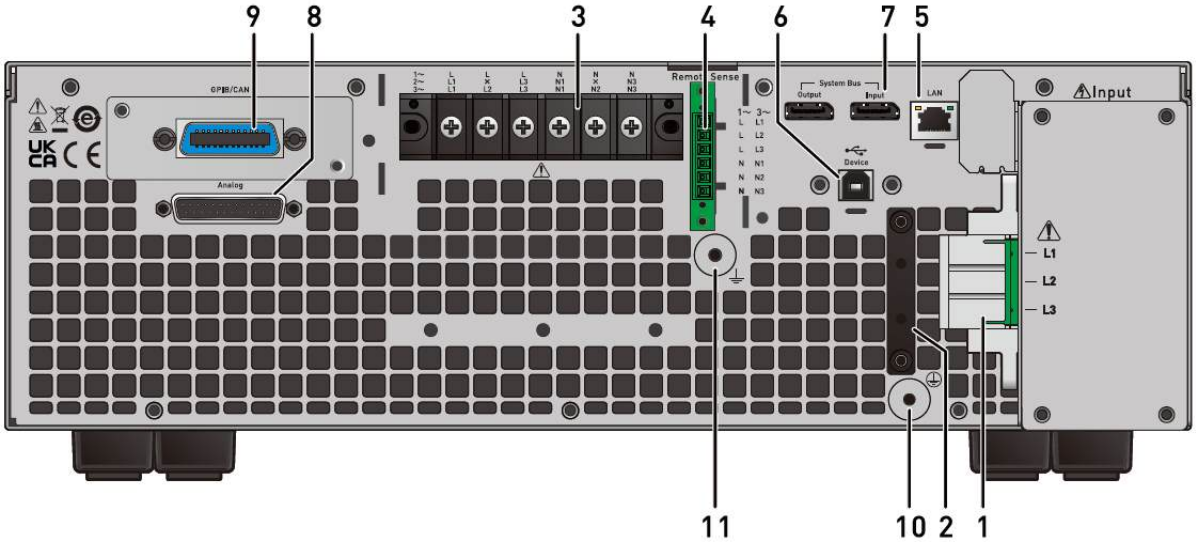


Figure 1-2 Rear Panel

Table 1-3 Rear Panel Description

Item	Name	Description
1	Input Connector	Used to connect the Regenerative AC Electronic Load to the utility mains.
2	Power Input Wire Fixing Bar	Allows for convenient connections to input connecting wires.
3	Output Connector	The output terminal of the Regenerative AC Electronic Load connects to the UUT.
4	Remote Sense	Remote voltage sense connection. Used to connect remote sense lines to the load to compensate for voltage drop caused by the output cable. Be sure that the “L1” terminal of the remote sense connects to the “L1” terminal of load while the “N” connects to the “N” terminal of load. (Do not use reverse polarity for connection.)
5	LAN	Used to connect to a network (LAN) control interface.
6	USB	USB control interface to connect an external PC for remote operation.
7	Parallel Signal Comm. Port	Used to interconnect devices for Master/Slave parallel operation.
8	Analog	The TTL I/O terminal transmits the I/O control signal (Fault_out, Remote Inhibit & AC_ON.) See *Appendix A* for the detailed pin assignment.
9	GPIB/CAN Connector (Option)	GPIB/CAN interface to connect the PC for remote operation.
10	Input Ground Terminal	Input ground terminal of regenerative AC electronic load to connect the earth.
11	Output Ground Terminal	Output ground terminal of regenerative AC electronic load to connect the earth.

Notice

1. Figure 1-3 shows the optional GPIB/CAN interface of model 63815R-350-105 (item 9). A cover plate is provided if this option is not purchased.

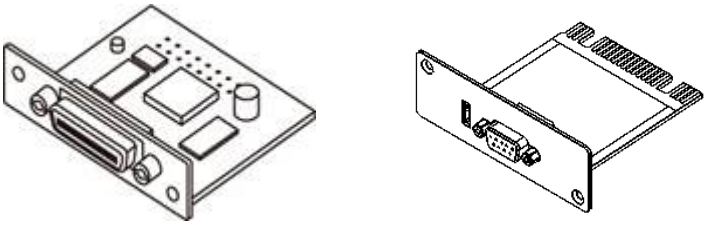


Figure 1-3 GPIB/CAN Interface

2. Figure 1-4 shows the docking board of the Analog terminal on the rear panel. The installation procedure is shown in the image below.

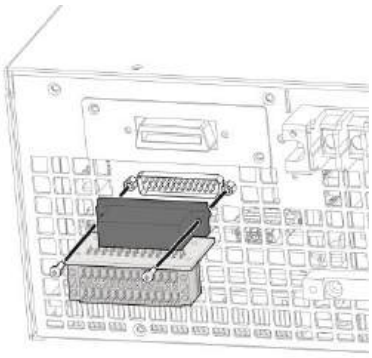


Figure 1-4 Installing Analog Terminal Docking Board

1.5 Dimensions

- Models 63809R-350-87 / 63812R-350-96 / 63815R-350-105 (Unit: mm)

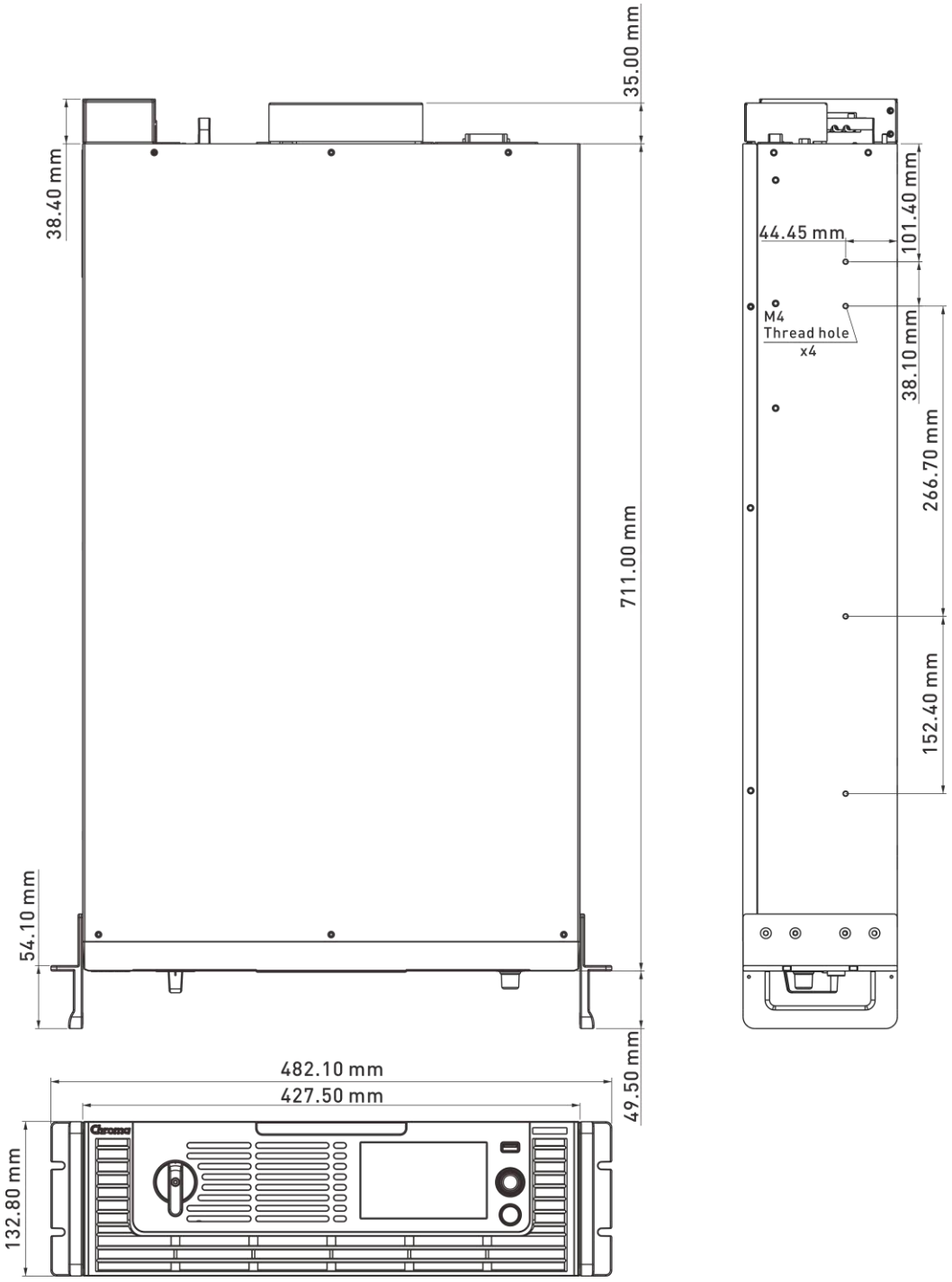


Figure 1-5 Dimensions of 63809R-350-87 / 63812R-350-96 / 63815R-350-105

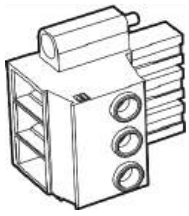
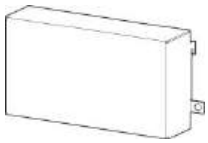
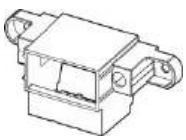
2. Installation

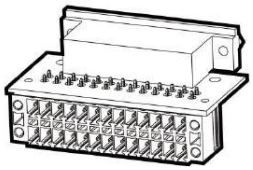
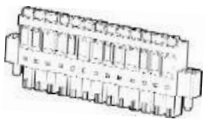
2.1 Initial Inspection

Before shipment, this device was inspected and found to be free of mechanical and electrical defects. When unpacking, inspect for damage that may have occurred in transit. Save all packing materials in case the instrument needs to be returned. If damage is found, file a claim with the carrier immediately. Do not return the product to Chroma without prior approval.

(1) Please check if there is any damage during transportation or missing accessories after unpacking.
(2) If any damage is found, file a return shipping request to “Chroma RMA” to receive authorization to return the device.

The accessories of models 63809R-350-87 / 63812R-350-96 / 63815R-350-105 are listed in the table below.

Standard Accessories				
Item				
Name	Input terminal block ×1pcs	Capacitive stylus pen ×1pcs	M4×10 screw ×2pcs	M4×12 screw ×3pcs
P/N	W52-000098	A55-000289	H61-401052	H69-401290
Item				
Name	M4×16 screw ×2pcs	M3×8 screw ×2pcs	M4×10 screw ×8pcs	M5×10 screw ×1pcs
P/N	H69-401550	H69-300850	H61-401020	H61-501020
Item				
Name	Output terminal block ×1pcs	Output busbar ×1pcs	Input terminal block ×1pcs	Output cable cleat ×1pcs
P/N	G29-000116	G52-000351	G29-000106	G32-015248

Item				
Name	Output cable cleat ×1pcs	Rack mounting kit ×2pcs	Stylus lanyard ×1pcs	Docking board for APG signal ×1pcs
P/N	G32-015296	G28-000146	G55-001131	8-61810101
Item				
Name	#4-40×7.93 screw ×2pcs	M4 Hex nut (GND) ×1pcs	13-Pin connector ×2pcs	
P/N	H66-000021	H71-000035	W52-000445	

Notice

1. Please keep all of the packing materials in case the device has to be returned for repair.
2. Do not return the instrument to the factory without obtaining prior RMA acceptance from Chroma.
3. Check if all accessories that are listed in the packing list have all been received.

CAUTION The Regenerative AC Electronic Load is too heavy for one person to safely lift and assemble. To avoid injury, ask for assistance during installation.

2.2 Precautions Before Use

The Regenerative AC Electronic Load has to properly connect to an AC source for operation. Since the device is fan-cooled, install in a location with sufficient airflow. The environment temperature should be under 40°C. When the instrument output configuration is a Y connection, ensure that L1/L2/L3 and NEU are in proper wire diameters to meet the maximum current requirements.

CAUTION

1. The weight borne by the Regenerative AC Electronic Load's top cover cannot exceed 10kg (22lbs).
2. The Regenerative AC Electronic Load must be connected to an appropriate AC power input.
3. The Regenerative AC Electronic Load is a fan-cooled instrument and thus needs to be installed in a place with sufficient air flow.
4. The ambient operating air temperature cannot exceed 40°C.

2.3 Input Power Specification

2.3.1 Ratings

Input voltage range:

63809R-350-87	63812R-350-96	63815R-350-105
3Ø 200–240V±10%V_{LL} (39A Max./Phase) 3Ø 380–480V±10%V_{LL} (21A Max./Phase)	3Ø 200–240V±10%V_{LL} (51A Max./Phase) 3Ø 380–480V±10%V_{LL} (27A Max./Phase)	3Ø 200–240V±10%V_{LL} (51A Max./Phase) 3Ø 380–480V±10%V_{LL} (34A Max./Phase)

All of the input voltage specifications are based on 3-phase AC line voltage (L-L).

Input frequency: 47–63Hz

⚠WARNING Input voltage that exceeds the specification may damage the Regenerative AC Electronic Load.

2.3.2 Input Connection

The input connection is located on the right of the instrument's rear panel. The power cable should be at least 105°C rated. The power cable input should have a rated current larger than or equal to the maximum rated current of the Regenerative AC Electronic Load.

Perform the steps below to achieve the connection shown in Figure 2-1:

a. Secure the power cable to the AC power terminal.
b. Insert the AC power terminal into the AC terminal block and lock the power input protection cover.
c. Secure the grounding terminal of the input power supply to the copper column on the chassis (an M4×0.7 flange nut is used).
d. Lock the safety anti-pull device to prevent the AC power terminal from falling off.

CAUTION

1. To protect the operator, the metal wire connected to the GND terminal has to be earth-grounded. In no cases should the Regenerative AC Electronic Load be operated without proper earth ground.
2. The power cable installation has to be performed by professional personnel in compliance with the local electrician's regulations.

Voltage Range	Cable Spec.	Terminal Spec.
(3Ø 200–240V ±10%V_{LL} 380–480V ±10%V_{LL})	8AWG (L1/L2/L3/GND)	E10-12 (L1/L2/L3) 8-6 (GND)

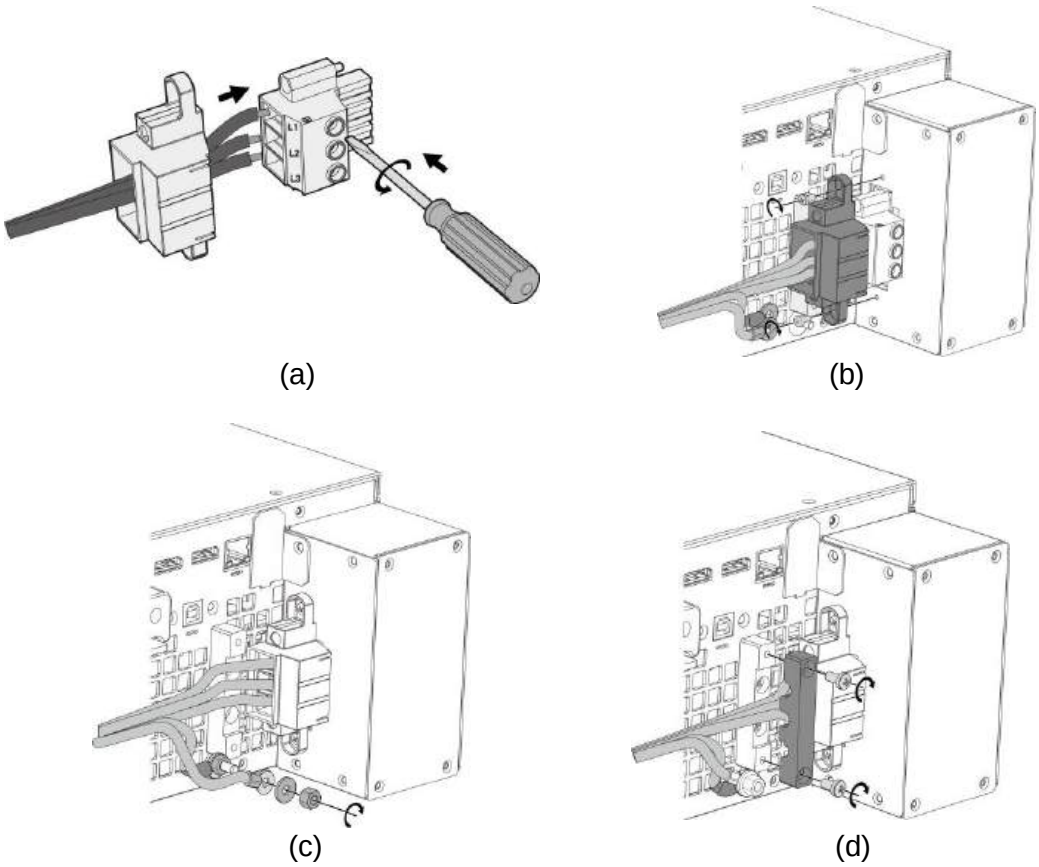


Figure 2-1 Input Power Connection and Wiring Fixed Diagram

Notice

1. The input voltage specifications are based on 3-phase AC line voltage (L-L).
2. The green or green with yellow inlaid grounding wire is to be connected to the ⏚ terminal.
3. The red, black, or blue power wire is to be connected to the L1, L2, and L3 terminals.

⚠WARNING

1. To protect the operator, the metal wire connected to the GND ⏚ terminal has to be earth-grounded. Under no circumstances should the Regenerative AC Electronic Load be operated without proper earth ground.
2. The power cable installation has to be performed by professional personnel in compliance with local electrical regulations.

CAUTION

1. Be sure to select the input wire with appropriate withstand voltage based on the input voltage.
2. To ensure safe operation, please select the breaker closest to the current rating of each phase based on the input power during installation, and connect it in series before the input terminal.
3. The breaker should be installed within the building for safe operation, please refer to Table 2-3 for related ratings.

The section area of the input current conductor and the outer diameter of the anti-pull wire should comply with the safe currents listed in Table 2-1.

Table 2-1 Recommended Wire Spec.

Conductor Area Section Area (mm^2)	Save Current (A) Copper Conductor	Anti-pull Diameter (mm)
8.0	55	6.65 ± 0.15

Table 2-2 lists the PVC (105°C) wire specifications when the ambient temperature is 30°C.

Table 2-2 PVC (105°C) Wire Specifications

Conductor Area		Save Current (A)	
Section Area mm^2	AWG	Copper Conductor	Aluminum Conductor
1.25	16	15	--
2.0	14	20	--
3.5	12	30	--
5.5	10	40	--
8.0	8	55	--
14	6	70	50
22	4	90	70
30	2	120	90
38	--	145	100
50	--	175	120
80	--	230	150
100	--	260	200
125	--	300	240
150	--	350	270
200	--	425	330
250	--	500	380
325	--	600	450
400	--	700	500
500	--	800	600

Table 2-3 Breaker Rating

Model	Breaker Rating (A)
63815R-350-105	51A max. @ 3Ø 200–240V ±10%V_{LL} 34A max. @ 3Ø 380–480V ±10%V_{LL}
63812R-350-96	51A max. @ 3Ø 200–240V ±10%V_{LL} 27A max. @ 3Ø 380–480V ±10%V_{LL}
63809R-350-87	39A max. @ 3Ø 200–240V ±10%V_{LL} 21A max. @ 3Ø 380–480V ±10%V_{LL}

2.4 Output Connection

The output terminal socket is located at the rear side of Regenerative AC Electronic Load. The load is connected to the output terminal. For safety, the AC input/output cable must be secured with an appropriate tool and the casing has to be tightened up securely. The cable diameter connected to the load has to be large enough so that it will not overheat if the output is over-current, see *Figure 2-2*.

Notice

1. When the output voltage contains a DC component, output terminal "L" is the "+" terminal and "N" is the "−" terminal.
2. This Regenerative AC Electronic Load supports single-phase and three-phase output. When configured in single-phase mode, install the output shorting copper busbar to short L1/L2/L3 together. Then connect the DUT's L and N respectively to the L1/L2/L3 shorting busbar and the NEUTRAL shorting busbar. See also *Figure 2-2*.
3. The Regenerative AC Electronic Load supports loading of DUTs with a Y-connected 3P4W configuration (with neutral N). It does not support loading of DUTs with Y-connected 3P3W (without neutral N) or Δ-connected 3P3W configurations.

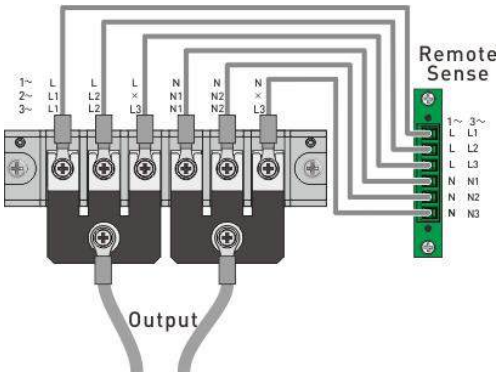
⚠WARNING

For the electronic load to dissipate heat properly, it is necessary to keep at least a 1-meter space free of obstruction in the front and rear panels for ventilation. Do not place the device against a wall or any other objects.

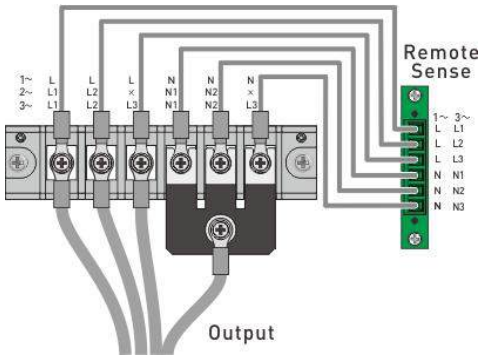
2.5 Connecting Remote Sense

The Remote Sense of the Regenerative AC Electronic Load monitors the UUT voltage to ensure the voltage transmitted to the load is the set voltage. The correct load value can be calculated only when CS, CP, and CR modes are executed. The reason that the voltage to the Regenerative AC Electronic Load does not equal the UUT set voltage is often due to the transmission cable being too long and there being a voltage drop.

Remove the cable connected to "L1", "L2", "L3", "N1", "N2" and "N3" from the Remote Sense terminal and change it by connecting to Load as Figure 2-3 shows. As the sense wire only sends a few MA (milliamps current), the sense metal wire is much thinner than the load wire. The sense wire is part of the Regenerative AC Electronic Load feedback circuit, thus it has to keep low resistance to maintain the best performance. If the sense wire is not connected or becomes open during operation, the Regenerative AC Electronic Load may not output voltage. It is necessary to ensure that the sense wire connection is secure and cannot open during operation. The sense wire should be twisted to reduce interference from external voltage and needs to be as short as possible.

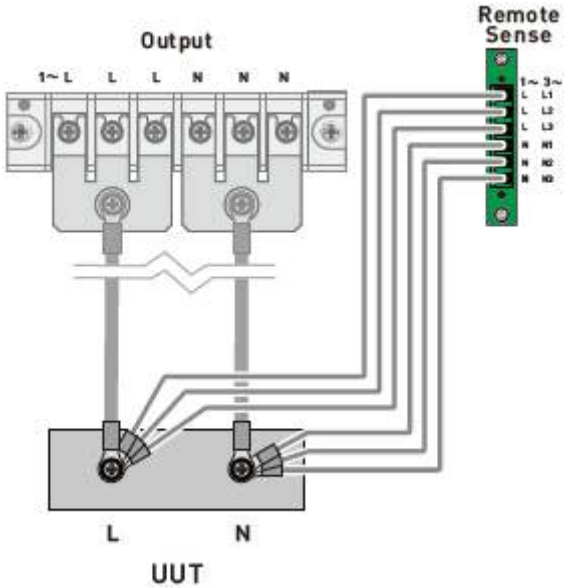


(a) 1-Phase

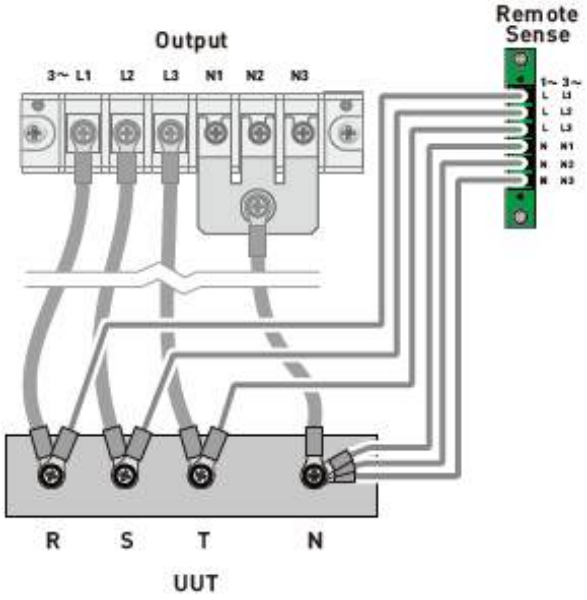


(b) 3-Phase

Figure 2-2 Connecting Output and Local Voltage Sense



(a) 1-Phase



(b) 3-Phase

Figure 2-3 Connecting Output and Remote Voltage Sense

Notice

1. The sensing leads should be as close as possible to the load and twisted together to reduce external voltage interference. The sensing leads only transmit a small amount of current (mA current), thus 18 AWG wire is recommended.
2. The output power cable of the Regenerative AC Electronic Load is at N contact. Since it will withstand 3 times of L current during a 1-phase connection, it is recommended to use a 2AWG wire.

2.6 Installing the Handle

Use M4x10 flat-head screws to attach the handle of the rack mounting kit when installing as shown in Figure 2-4.

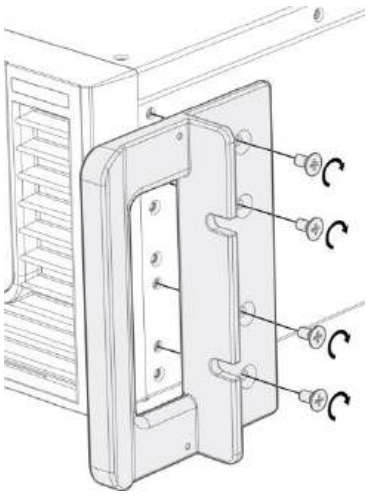
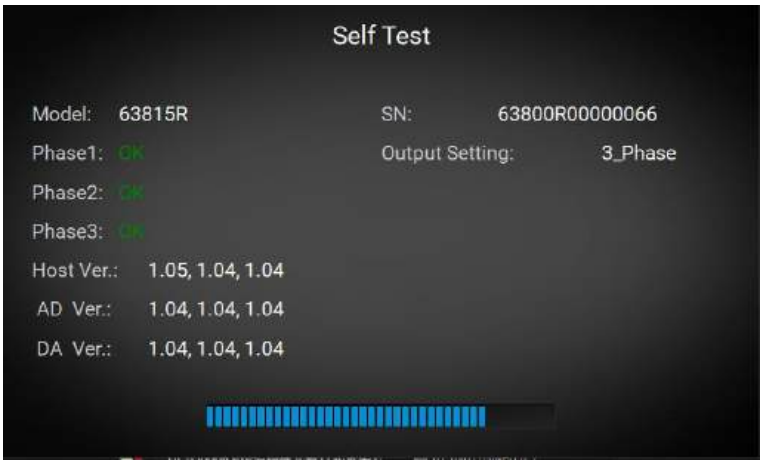


Figure 2-4

2.7 Power-On Procedure

CAUTION Before turning on the instrument, all protective earth terminals, extension cords, and devices connected to the instrument must be connected to a protective earth ground. Any interruption of the protective earth ground may create potential electric shock hazards and result in personal injury or death.

Connect the power line and turn on the power switch located on the front panel. The Regenerative AC Electronic Load will begin a series of self-tests. The LCD on the front panel will turn on and display following.



During initialization, the Regenerative AC Electronic Load executes memory, data, and communication self-tests. While the self-test is running, the display shows the instrument's Model number and serial number (SN). Each test item displays "OK" on the right if no error is found. The software version is also displayed.

After completing the self-tests for memory, data, and communication, the Regenerative AC Electronic Load will conduct an output power self-test. During this procedure, the output relay remains OFF to ensure that any load connected to the output terminals is not damaged. The Regenerative AC Electronic Load sets the output to 300Vac and measures the voltage. If the measured voltage exceeds 300V ± 30V, the output power self-test fails and the display shows "NG". If the test passes, the instrument automatically switches to the Main Page.

Notice

1. You can run self-diagnosis during a power-on self-test to see if there are any error conditions.
2. Self-testing requires about 20 seconds to complete.

2.8 Maintenance and Cleaning

Remove all connected wires and cables from the instrument before cleaning. Use a brush to clean dust and if there are stains on the chassis that cannot be removed by brush, wipe with a volatile liquid. Do not use any corrosive liquid to avoid damaging the chassis and do not open the chassis arbitrarily. Use a damp cloth with soap and water or a soft detergent to clean the front panel display or a screen cleaner designed for displays. Please send the unit back to the Chroma if internal cleaning is needed.

2.9 Common Environment Conditions

1. Indoor use only.
2. Altitude up to 2000 meters.
3. Be sure to place the device on a horizontal surface and do not use it vertically.
4. The operating ambient temperature is 0°C to 40°C.
5. The operating ambient humidity is 0%rh to 90% RH (non-condensing).
6. Storage temperature is -25°C to 70°C.
7. Storage humidity is 0%rh to 90% RH (non-condensing).
8. The input AC power voltage fluctuates up to ±10% of the rated voltage.
9. The transient overvoltage is CAT II pulse withstand voltage.
10. The pollution degree is II.

3. Operating the Regenerative AC Electronic Load

3.1 Function Modes

After completing startup, the screen shows the Main Page (3_Phase Mode/1_Phase Mode). To set the operating mode, select one of seven modes using the mode selection key in the upper right corner: CC, CP, CR, CC Rectified, CS Rectified, CC Lead/Lag, or CS Lead/Lag. The Meas. area on the screen shows the measurement items of the Regenerative AC Electronic Load. Each phase provides a total of 15 output measurement items, distributed across 3 pages (see section *3.3.2*). When powered on, the Regenerative AC Electronic Load can be operated manually. The command tree is shown in Figure 3-1 below.

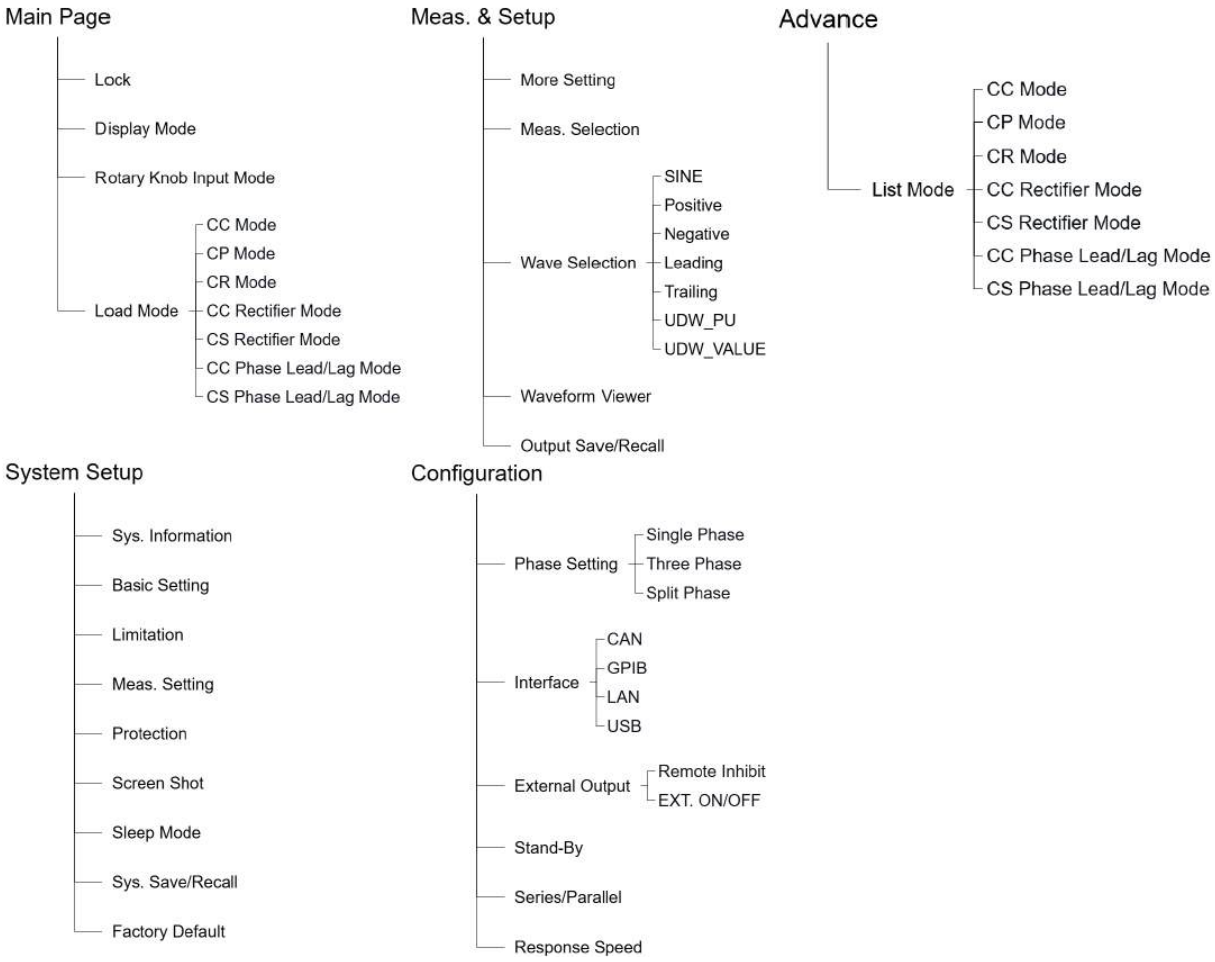


Figure 3-1 Regenerative AC Electronic Load Function Tree

3.2 The Crest Factor vs. Power Factor Relationship

The crest factor (CF) is the peak current divided by the root-mean-square (RMS) current. When the crest factor is set to 1.414, the DSP will produce a sinusoidal current waveform.

The power factor (PF) is defined as real power divided by apparent power. If the measured PF is different from the set value, the DSP will correct the current waveform position to match the PF value. For resistive loads, the power factor is 1. If V_{RMS} and I_{RMS} are constant, a decrease in power factor results from an increase in crest factor, and the effective product of voltage and current will decrease accordingly.

The relationship between PF and CF shown below is based on a sinusoidal input voltage waveform. This is because the estimation theory is established on the input voltage waveform, and the load current waveform is either a sinusoid or a corrected sinusoid.
For a fixed crest factor, the maximum power factor occurs when the input voltage waveform and the load current waveform overlap the most—that is, when the voltage and current peaks occur at the same time.
The minimum power factor occurs when the overlap between the input voltage waveform and the load current waveform is the smallest—that is, when the zero-crossing points of the voltage and current waveforms are the same.
Both situations are shown in Figure 3-2 and Figure 3-3.

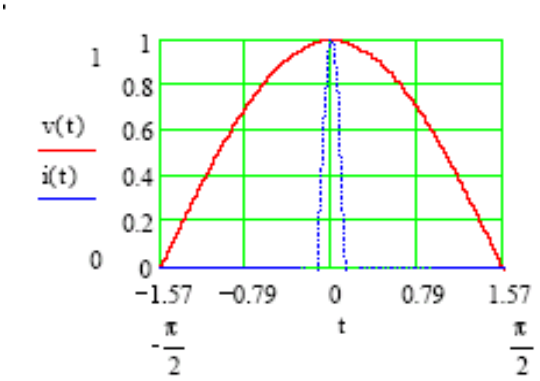


Figure 3-2 Maximum PF Passes Fixed CF

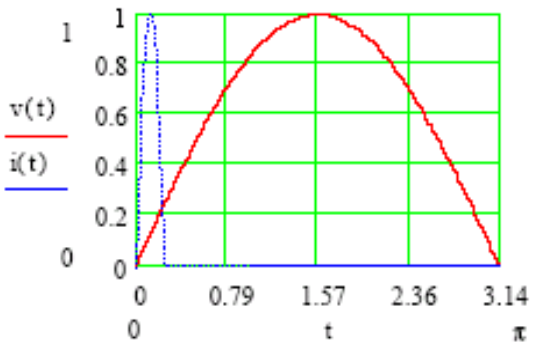


Figure 3-3 Minimum PF Passes Fixed CF

According to the theory, Figure 3-4 shows the relationship between PF and CF.

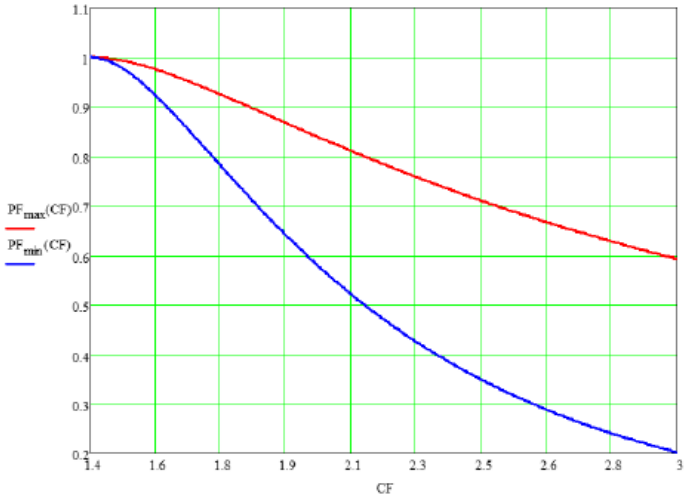


Figure 3-4 Relationship between PF and CF

Notice

1. *Figure 3-2* illustrates the maximum PF achievable at a specified CF setting in CC Rectified mode (see section 3.4.1) and CS Rectified mode (see section 3.4.2).
2. When Both is selected in CC (see section 3.4.6) and CP mode (see section 3.4.7), the CF and PF values need to be entered at the same time and their priority has to be set again in Both mode. If the setting is over the range shown in Figure 3-4, the Regenerative AC Electronic Load will automatically modify the user-defined range to a valid range. A further illustration is shown in the following 2 examples.

Example 1: (When the priority is CF and the UUT output voltage is 200 V_{RMS})

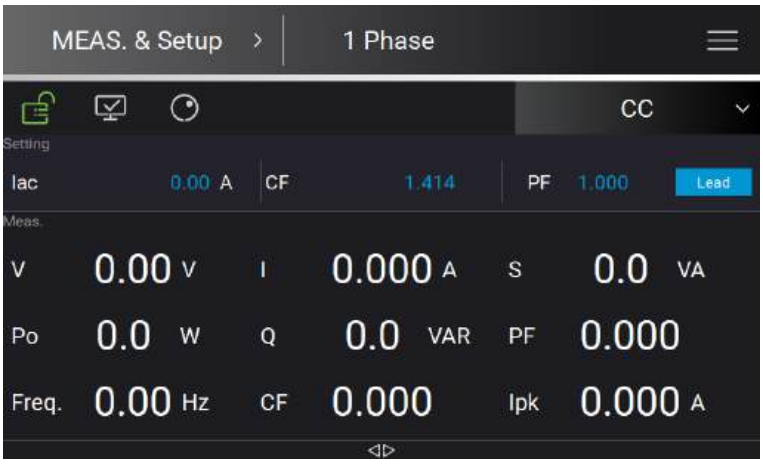
a. If CF=1.5 and PF=1 are set and the allowable PF value is CF=1.5, the valid range is 0.977 to 0.993. The system will load with the closest allowable PF value, in this case, a PF value of 0.993 will be used.
b. If CF=1.5 and PF=0.8 are set and the allowable PF value is CF=1.5, the valid range is 0.977 to 0.993. The system will load with the closest allowable PF value, in this case, a PF value of 0.977 will be used.
c. If CF=3 and PF=0.1 are set and the allowable PF value is CF=3, the valid range is 0.219 to 0.593. The system will load with the closest allowable PF value, in this case, a PF value of 0.219 will be used.
d. If CF=3 and PF=0.7 are set and the allowable PF value is CF=3, the valid range is 0.219 to 0.593. The system will load with the closest allowable PF value, in this case, a PF value of 0.593 will be used.

Example 2: (When the priority is PF and the UUT output voltage is 200 V_{RMS})

a. If PF=0.8 and CF=3 are set and the allowable CF value is PF=0, the valid range is 1.750 to 2.153. The system will load with the closest allowable CF value, in this case, a CF value of 2.153 will be used.
b. If PF=0.8 and CF=1.5 are set and the allowable CF value is PF=0.8, the valid range is 1.750 to 2.153. The system will load with the closest allowable CF value, in this case, a CF value of 1.750 will be used.
c. If PF=0.6 and CF=3 are set and the allowable CF value is PF=0.6, the valid range is 1.972 to 2.866. The system will load with the closest allowable CF value, in this case, a CF value of 2.866 will be used.
d. If PF=0.6 and CF=1.5 are set and the allowable CF value is PF=0.6, the valid range is 1.972 to 2.866. The system will load with the closest allowable CF value, in this case, a CF value of 1.972 will be used.

3.3 Using Meas. & Setup

When the Regenerative AC Electronic Load is turned on and the self-test is completed, the screen displays the Meas. & Setup (3_Phase Mode/1_Phase Mode) page shown below.

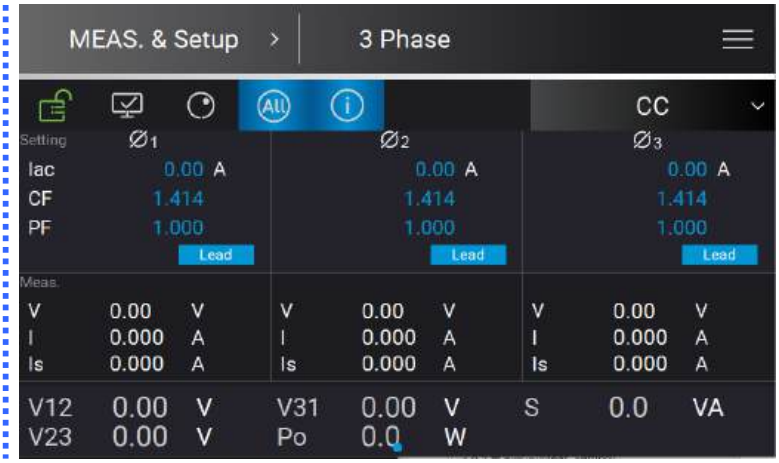


The definitions of the output parameters on the main page are as follows:

Parameter	Definition
Iac	Input AC in amperes.
P	Input real power in watts.
S	Input the apparent power in volt-amperes.
R	Input resistance in ohms.
CF	Sets the crest factor.
Deg	Input the current angle difference in degrees
PF	Sets the power factor.
Lead/Lag	Sets the power factor to lead (inductive) and lag (capacitive).

Pressing the **ON/OFF** button on the front panel enables the Regenerative AC Electronic Load to load based on the set parameters. Press **ON/OFF** again to stop loading.

Notice On the main page, tap ⓘ to display the hidden V12, V23, V31, S, and Po measurements.



The Regenerative AC Electronic Load provides an easy-to-use programming interface. Simply use the touch screen on the front panel and the RPG (rotary pulse generator) knob to complete operations and enter data. The following describes the usage of Meas. & Setup.

Numeric Keypad

On the main page, numeric values can be entered using the touch screen keypad to enter values, tap (enter) when done. Tap to cancel value entry and return to the previous page. The measured value is displayed on the top of the screen. Use (backspace) and CLR while inputting data to modify or clear the settings.

Notice

The user can set the value based on the value displayed on the upper left of the numeric keypad, and use the Max and Min keys to quickly set the maximum and minimum values available for the command.

3.3.1 More Settings

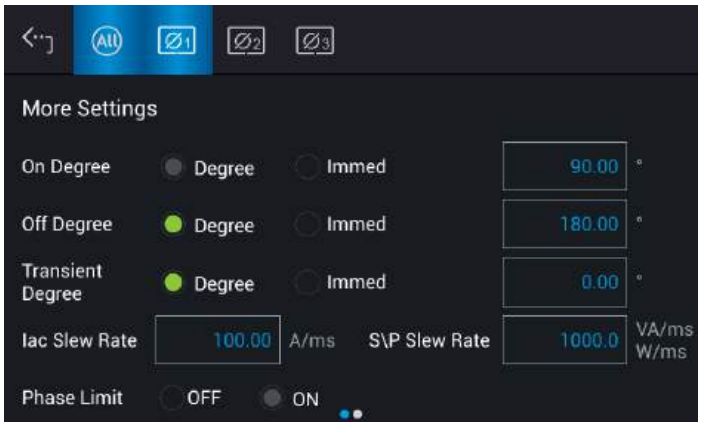
On the Meas. & Setup (3_Phase Mode/1_Phase Mode) page, tap to enter the menu. Select ‘More Settings’ to adjust more advanced output parameters, as described below.

3.3.1.1 Load Degree

The Regenerative AC Electronic Load allows you to control the phase angle at which the load current waveform starts or stops. Use On Degree, Off Degree, and Transient Degree on the screen to configure these settings.

The procedure for setting On Degree = 90 and Off Degree = 180 in single-phase/three-phase mode is as follows:

1. Tap the "On Degree" value field on the right.
2. Tap **9**, **0**, then tap ↵ to change the value to "90.00".
3. Tap the "Off Degree" value field on the right.
4. Tap **1**, **8**, **0**, then tap ↵ to change the value to "180.00".
5. Tap the "Transient Degree" value field on the right.
6. Tap **0**, then tap ↵ to set the value to "0.00".



Notice

1. If Off Degree = Immed, when **QUIT** is pressed, the load current is removed immediately and Off Degree cannot be set.
2. If Transient Degree = Immed, when switching the output voltage command, the output voltage switches immediately, and Transient Degree cannot be set.

3.3.1.2 Slew Rate of Load Transient

The Regenerative AC Electronic Load can adjust the slew rates of output transient waveform. There are Iac slew rate and S/P slew rate to control the voltage waveform when the output commands change.

Iac slew rate: Slew rate of current.
S/P slew rate: Slew rate of the load S/P command.

If the output setting is changed on the main page when the Regenerative AC Electronic Load is in the Load On state, the output voltage and frequency will change according to the Iac and S/P slew rate settings.
The procedure to set Iac slew rate = 0.1, S/P slew rate = 1 in 1_Phase Mode /3_Phase Mode is described below.

1. Tap the “Iac Slew Rate” value field.
2. Tap **0**, **.**, **1**, and ↵ to change the value to “0.1”.
3. Tap the “S/P Slew Rate” value field.
4. Tap **1**, and ↵ to change the value to “1”.

Notice

1. Though the input range of the Iac slew rate and S/P slew rate is quite large when using the SoftPanel software, the loading current may not apply the slew rate properly due to the hardware limit when the Iac slew rate and S/P slew rate are too large.
2. The Iac slew rate maximum is 800 A/ms, the minimum is 0.01 A/ms while the default is 100 A/ms, and only applicable to CC Rectified, CC Phase Lead/Lag, and CC mode.
3. The S slew rate maximum is 80k VA/ms, the minimum is 0.1 VA/ms while the default is 1000 VA/ms, and only applicable to CS Rectified and CS Phase Lead/Lag mode.
4. The P slew rate maximum is 80k W/ms, the minimum is 0.1 W/ms while the default is 1000 W/ms, and only applicable to CP mode.
5. The Iac slew rate or S/P slew rate cannot be adjusted in CR mode.
6. When **ON** is executed on the Regenerative AC Electronic Load, the output will reach the final state as set. Once **OFF** is executed, the output turns to 0V immediately. If you wish to set the slew rate to 0V, it is necessary to enter 0V and tap ↵ instead of executing **OFF** directly.

3.3.2 Meas. Selection

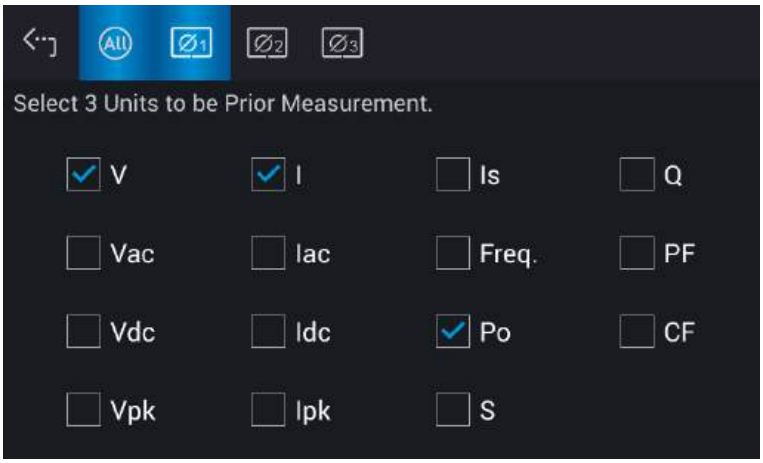
In Meas. & Setup (3_Phase Mode/1_Phase Mode) page, tap  Meas. Selection to enter the output waveform selection as the figure shown below. There are a total of 15 measurement items in the setting screen including voltage, current, output power, etc. Each phase can set 3 different measurement items to display on the main page.

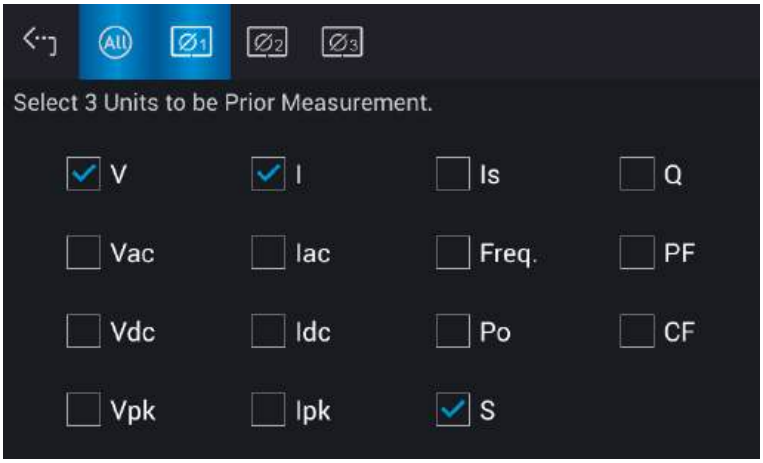
The definition of parameters:

V : The voltage measurement in Volts. (RMS measurement)
Freq. : The output frequency in Hertz.
I : The current measurement in Amperes. (RMS measurement)
Vac : The AC voltage measurement in Volts and the calculation formula = $Vac=\sqrt{(V_{RMS}^2 - Vdc^2)}$
Iac : The AC measurement in Amps and the calculation formula = $Iac=\sqrt{(I_{RMS}^2 - Idc^2)}$
PF : Power Factor, the calculation formula = Real Power / ($V_{RMS} \times I_{RMS}$)
CF : Crest Factor, the calculation formula = I_{peak}/I_{RMS}
Vdc : The DC voltage measurement in Volts.
Idc : The DC measurement in Amperes.
Vpk : The peak voltage measurement in Volts. The V_{peak} display is the Vp(+) or Vp(-) whichever is larger.
Ipk : The peak current measurement in Amperes. The I_{peak} display is the Ip(+) or Ip(-) whichever is larger.
Is : I surge, only measured when output changes.
Po The real power measurement in Watts.
Q : The reactive power in VAR, the calculation formula = $\sqrt{(V_{rms}I_{rms})^2 - P_o^2}$
S : The apparent power in volt-amperes and the calculation formula = $V_{RMS} \times I_{RMS}$

Below is the procedure to change the 3rd measurement item from Po to S in 3-phase mode.

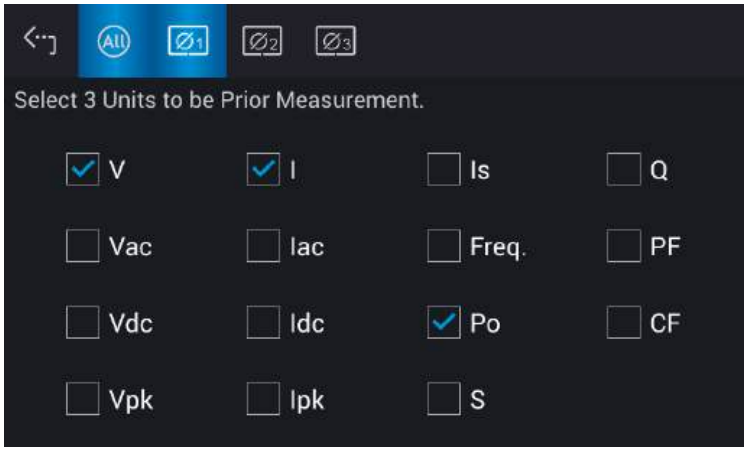
1. In Meas. & Setup (3_Phase Mode/1_Phase Mode) page, tap  : Meas. Selection.
2. Tap the ALL icon.
3. Unselect "Po".
4. Select "S".

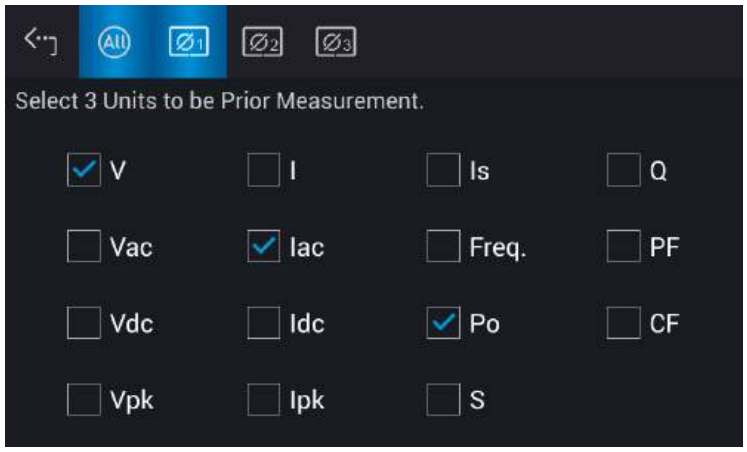




Below is the procedure for the 2nd measurement item from I to Iac in 1 phase mode.

1. In Meas. & Setup (3_Phase Mode/1_Phase Mode) page, tap Meas. Selection.
2. Unselect “I”.
3. Select “Iac”.





Notice When changing the selected measurement items, it is necessary to delete one before adding a new item if three items have already been selected.

3.3.3 Waveform Viewer

In Meas. & Setup (3_Phase Mode/1_Phase Mode) page, tap  Waveform Viewer to view the real-time output voltage/current waveform. There are a total of 3 channels available. Voltage, current, and time can be adjusted by the scale. The figure below shows the Waveform Viewer.

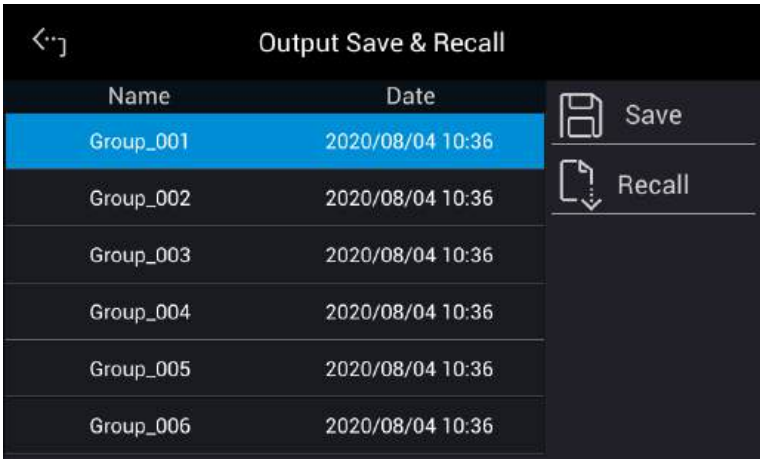
Ch1: #1V, #2V, #3V, #1I, #2I, #3I.
Ch2: #1V, #2V, #3V, #1I, #2I, #3I.
Ch3: #1V, #2V, #3V, #1I, #2I, #3I.
V (Scale): 10, 20, 40, 80, 120V/div.
I (Scale): 5,10, 20, 40, 60A/div.
Time (Scale): 0.2, 0.5, 1, 2, 5, 10, 50, 100, 200ms/div.

The procedure to set CH1 =#1V, CH2 =#2V, CH3 =#3V, V (Scale) = 40 V/div, I (Scale) = 5A/div, Time (Scale) = 2 ms/div in 1_Phase Mode /3_Phase Mode is described as below.

1. Tap CH1 on the right.
2. Select "#1V".
3. Tap CH2 on the right.
4. Select "#2V".
5. Tap CH3 on the right.
6. Select "#3V".
7. Tap V on the left.
8. Select "40V/div" to complete the setting.
9. Tap I on the left.
10. Select "5A/div" to complete the setting.
11. Tap Time on the left.
12. Select "2ms/div" to complete the setting.

3.3.4 Output Save/Recall

The Regenerative AC Electronic Load has 10 groups of memory to save the frequently used Iac, P, S, R, CF, Deg, PF, and Lead/Lag for later recall. Below is an example to save these parameters to Group_001 memory.

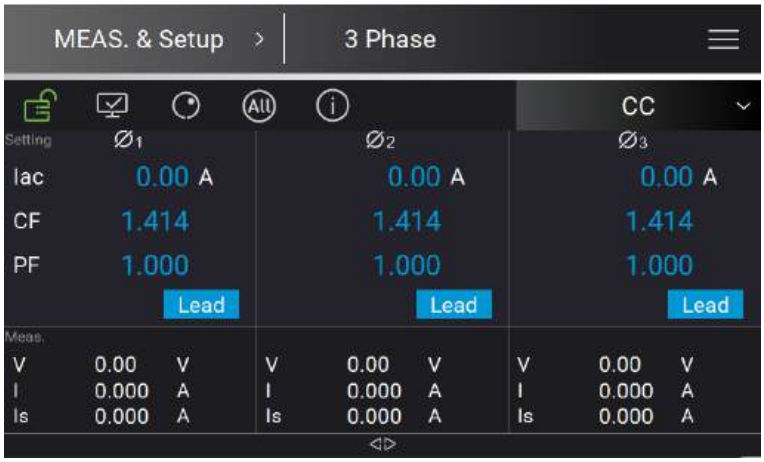


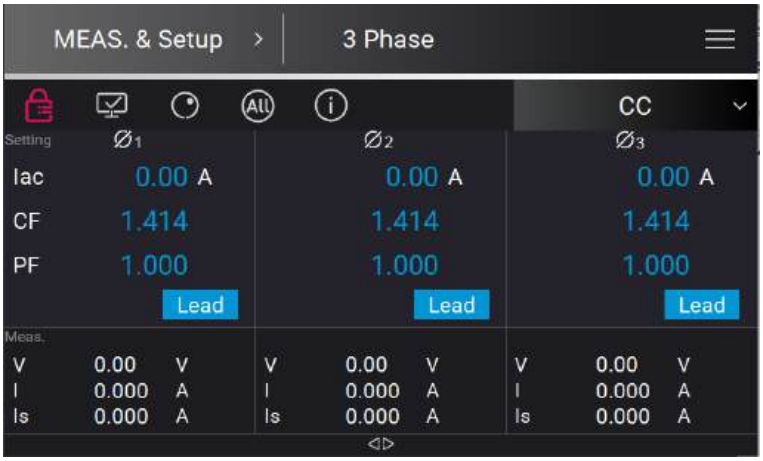
Notice

1. The save and recall output setting function can only be set in MEAS. & Setup menu.
2. The recall function is not valid when the loading mode changes (see section 3.3.8). For example, when the user saves the parameters in CC Rectified mode, the system will remember the parameters of 7 modes (see section *3.3.8*). However, if the user changes to CS Rectified mode for execution, the recall function will remain in CS Rectified mode.

3.3.5 Lock Button

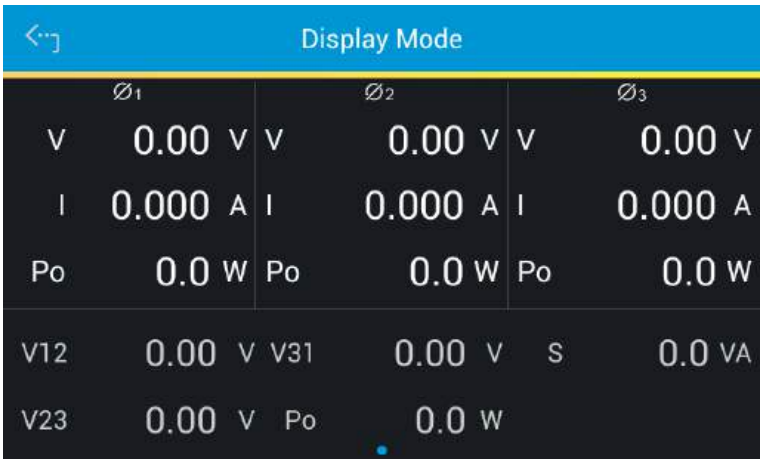
In Meas. & Setup (3_Phase Mode/1_Phase Mode) page, tap  to lock the panel selection functions. All touch functions are disabled except the lock key. Tap  again to unlock it.





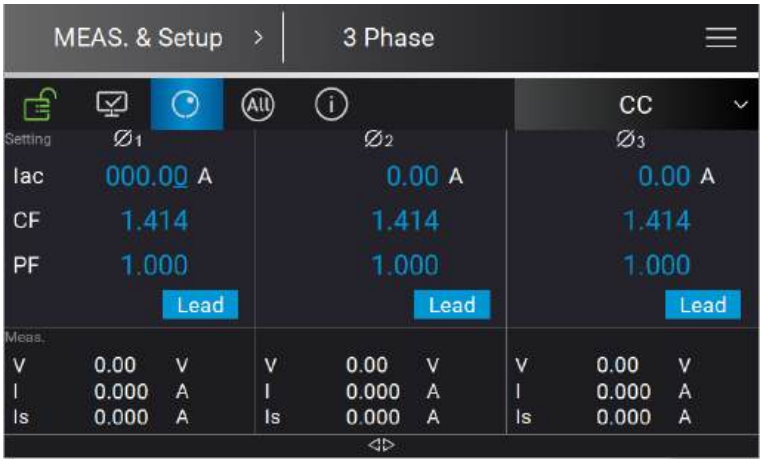
3.3.6 Display Mode

In Meas. & Setup (3_Phase Mode/1_Phase Mode) page, tap  to display the measurements, and tap  to return to the main page.



3.3.7 Rotary Knob Input Mode

In Meas. & Setup (3_Phase Mode/1_Phase Mode) page, tap  to use the rotary knob function. Tap to select the current, crest factor, angle, and power factor to be set. When the cursor appears, press down the rotary knob and the cursor can be moved to set the number of digits to be entered.



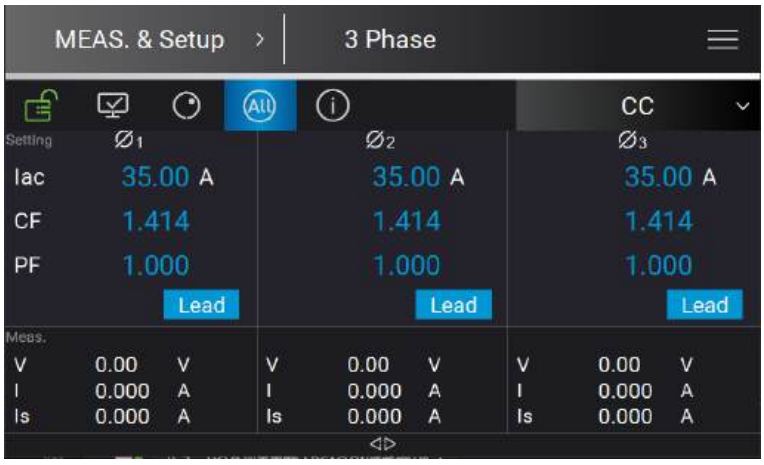
3.3.8 Setting Operating Mode

The Regenerative AC Electronic Load has 7 output modes: CC Rectified, CS Rectified, CR, CC Lead/Lag, CS Lead/Lag, CC, and CP. The user can use the output mode setting indicator (as shown below) on the upper right of the main screen to set the desired application.

The setting procedure from CC to CC Rectified is described below:

1. Tap the output mode indicator 

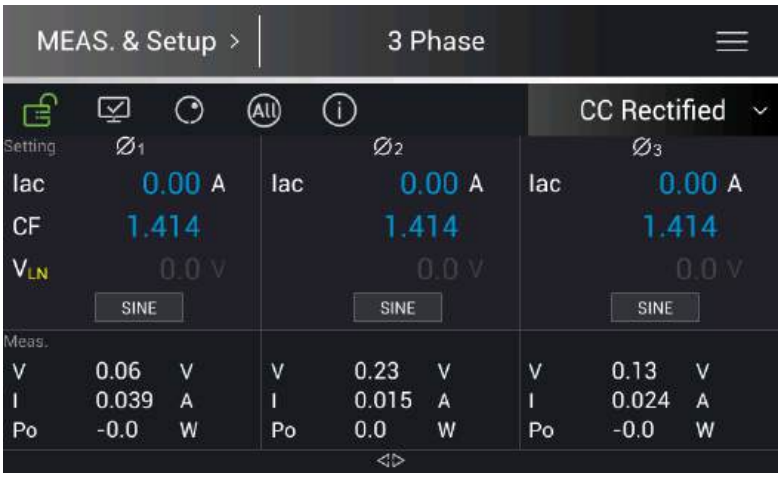
on the upper right.
2. Select “CC Rectified”.

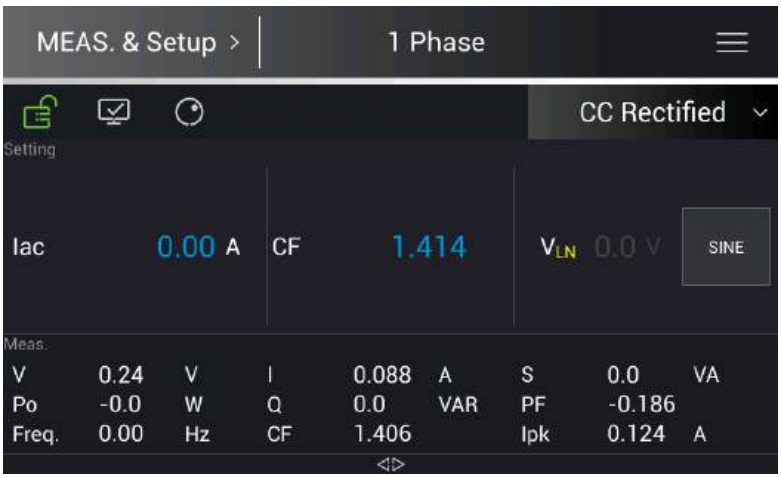


3.4 Manual Operation

3.4.1 CC Rectified Mode

In CC Rectified mode, the user can change the settings for the RMS load current amplitude (Iac) and crest factor (CF) on the Main Page.

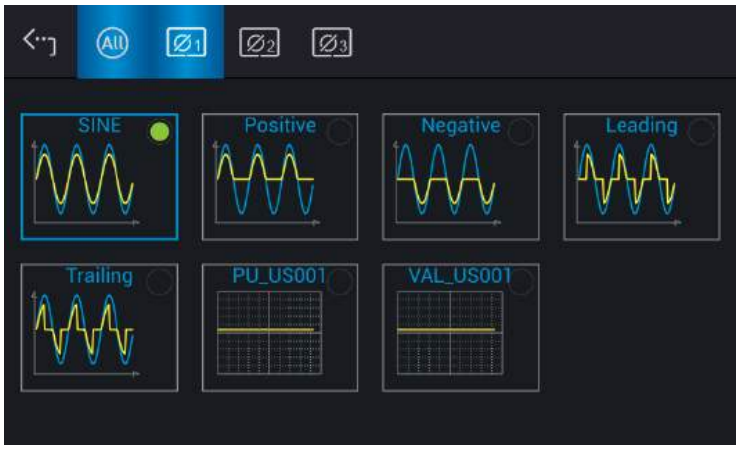




3.4.1.1 Waveform Selection

The Regenerative AC Electronic Load allows the user to select an output waveform for each phase. On the Meas. & Setup screen (3_Phase Mode / 1_Phase Mode), tap  and choose Waveform Selection.

Available waveforms include: Sine, Positive (half-sine), Negative (half-sine), Leading (-edge sine), Trailing (-edge sine), and the user-defined waveforms PU_US000 and VAL_US000 (7 waveforms in total).

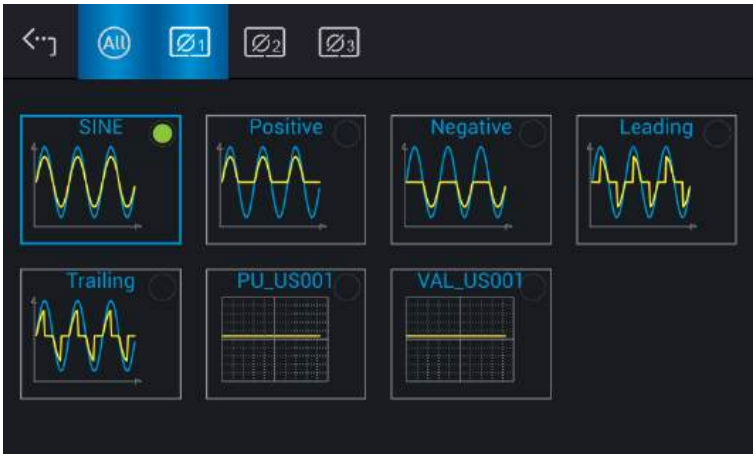


PU_US000 and VAL_US000 are user-defined waveforms. They can be used to simulate real load current waveforms. You can import captured current waveform data (e.g., from an oscilloscope) or create a waveform by editing it, and then use the SoftPanel graphical software to store the waveform in the Regenerative AC Electronic Load for loading with the user-defined waveform.
A total of 200 waveform slots are available, with each waveform containing 1024 points. For point setting details, refer to the control panel user manual for the Chroma 61800 Series. VAL_US000 loads according to the defined waveform, while PU_US000 adds a scaling factor so that the same waveform can be applied with different amplitudes, providing additional test scenarios.

Setting a user-defined waveform for all three phases:

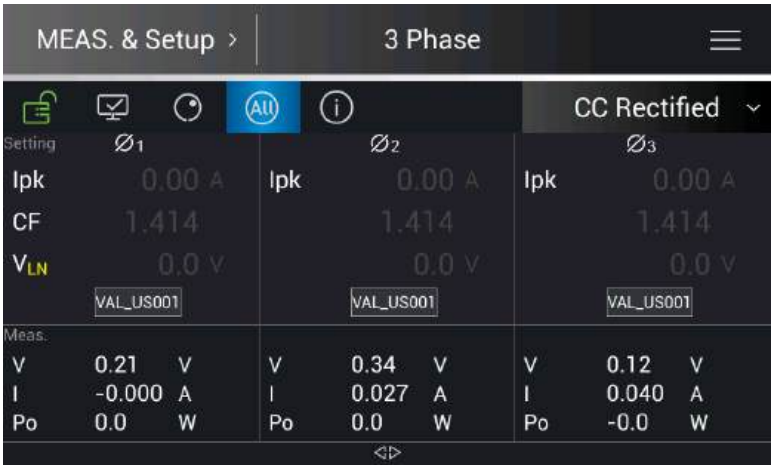
1. Switch to CC Rectified mode and tap  at the top of the screen.

2. On the Meas. & Setup screen (3_Phase Mode / 1_Phase Mode), tap  and choose Waveform Selection.

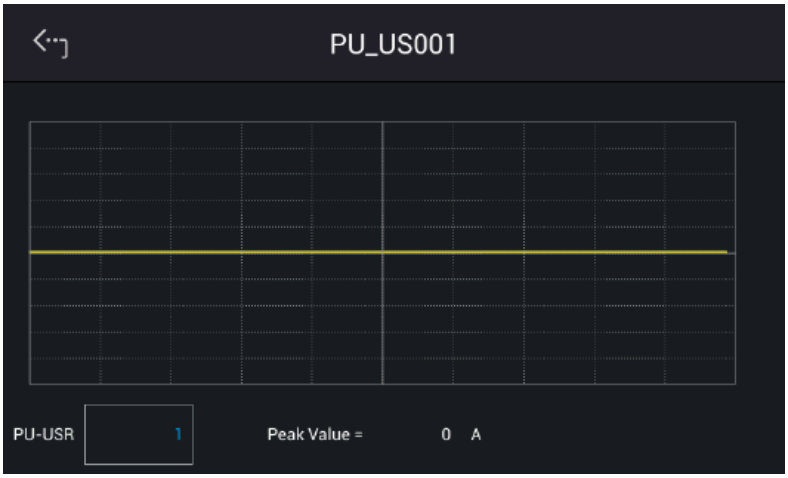


3. Press and hold VAL_US001 (hold for 1 second) to view the currently configured waveform. You can also select VAL_USR to choose a different output waveform.

4. After confirming the load waveform, return to the Meas. & Setup screen. The actual load waveform will follow the edited settings.



If you want to dynamically adjust the amplitude while using the same waveform, select PU_US000. This mode also provides 200 selectable waveform slots.

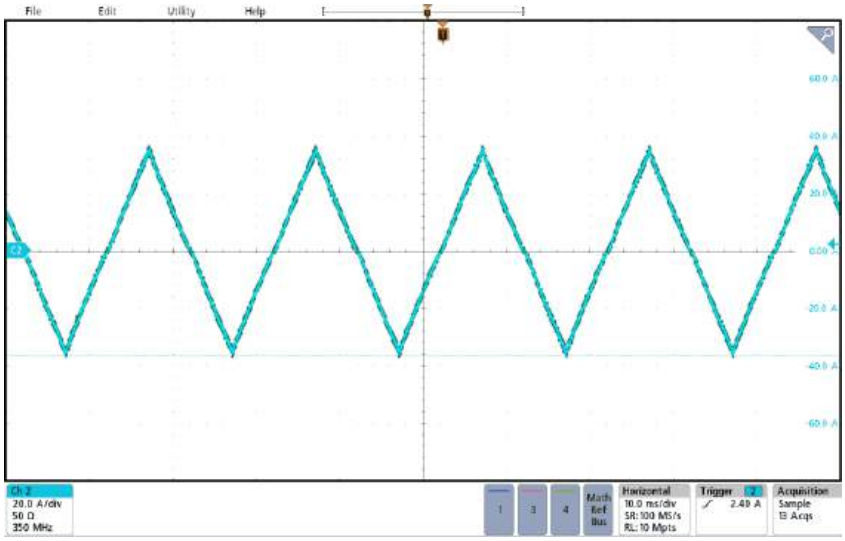


After confirming the load waveform, return to the Meas. & Setup screen. The actual load waveform will follow the edited waveform and the scaling factor settings.

Loading a triangular waveform with a peak current of 35A using SoftPanel:

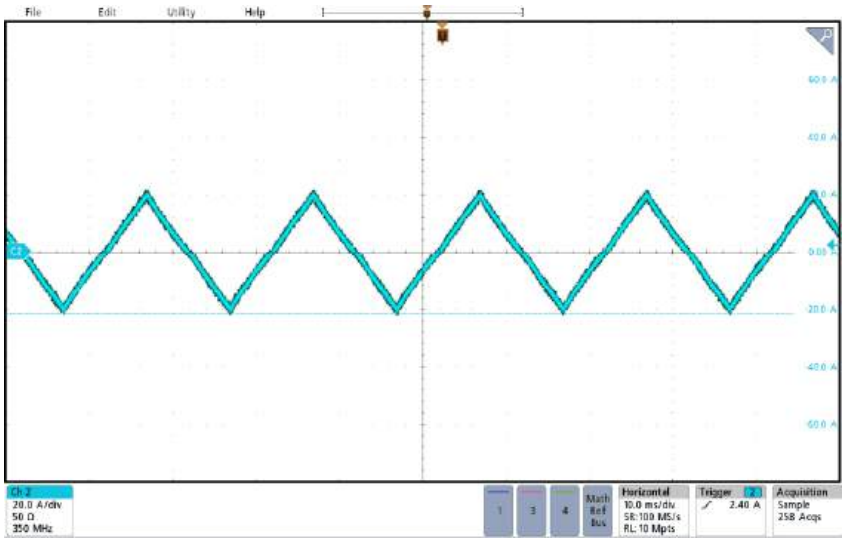
1. Select VAL_US001.

Actual output waveform:



2. Select PU_US001 and set Ipk to 20A.

Actual output waveform:



Setting the waveform for all three phases to Leading-edge sine:

1. Touch the output selection key at the top of the screen and set the output to ALL.
2. Select the Leading icon.
3. To enlarge and view the configured waveform, press and hold the Leading icon for 1 second.

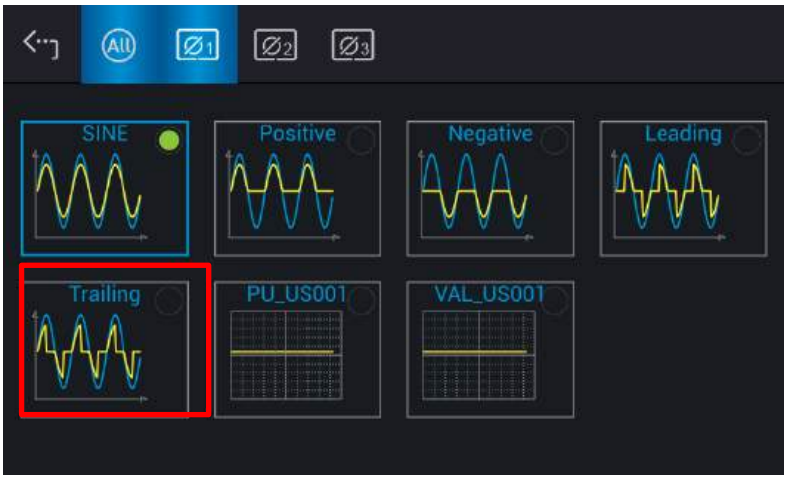
Notice Load waveform setting is available only when CC Rectified mode is selected.

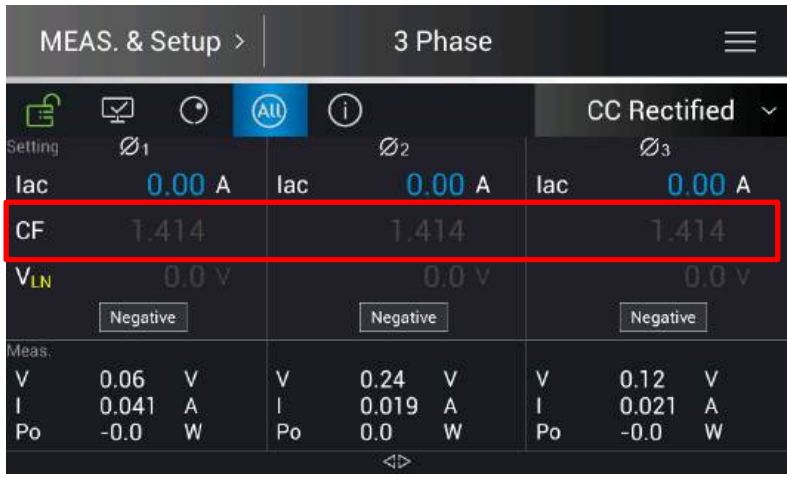
3.4.1.2 More Settings in CC Rectified Mode

In Meas. & Setup (3_Phase Mode/1_Phase Mode) page, tap ☰ to enter the menu, and select More Settings to perform advanced settings as described below.

Notice

1. When the selected load waveform is not a sine wave, "More Settings" is not available.
2. CF setting is not provided when the selected load waveform is not a sine wave. For example, the CF setting will be grayed out and executed using CF=1.414 when returning to the Meas. & Setup page after Trailing is selected, as shown in the figures below.





A. On Degree

In CC Rectified mode, the Regenerative AC Electronic Load can control the phase angle at which the load current waveform is applied, or it can operate in immediate loading mode (Instant Load On). When On Degree is set to Degree, the specified angle controls the start angle of the load current, and the crest factor (CF) of the load current can be adjusted on the main screen. When On Degree is set to Immed, the unit operates in immediate loading mode, and the UUT output voltage VLN must be set on the main screen.

A-1: Setting On Degree = 90 (single-phase/three-phase mode):

Tap the On Degree value field and select Degree.

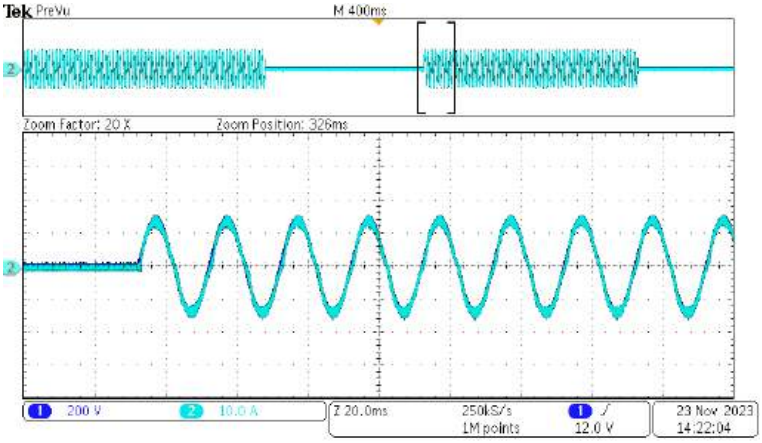
Tap **9**, **0**, then tap  to set the value to “90.00”.

A-2: Setting immediate loading to 10A with UUT voltage V_{LN} = 200V (single-phase/three-phase mode):

Tap the On Degree value field and select Immed.

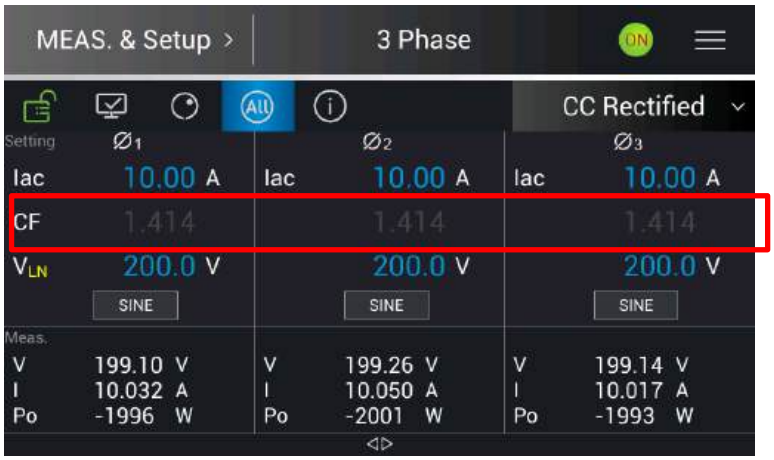
Return to the main screen. In the VLN value field, press **2**, **0**, **0**, then tap  to set the value to 200.0.

Actual output waveform:

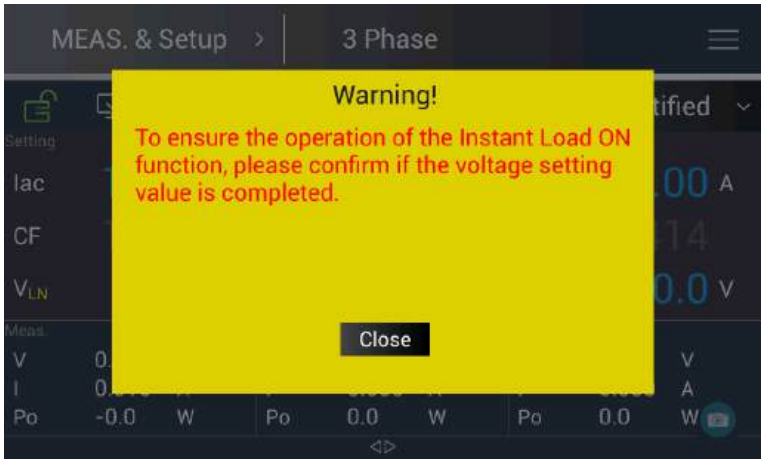


Notice

1. When Immed is selected, CF cannot be set on the main screen. The output current is limited to a sine wave with CF=1.414, and the slew function cannot be adjusted; it is determined by the actual voltage.

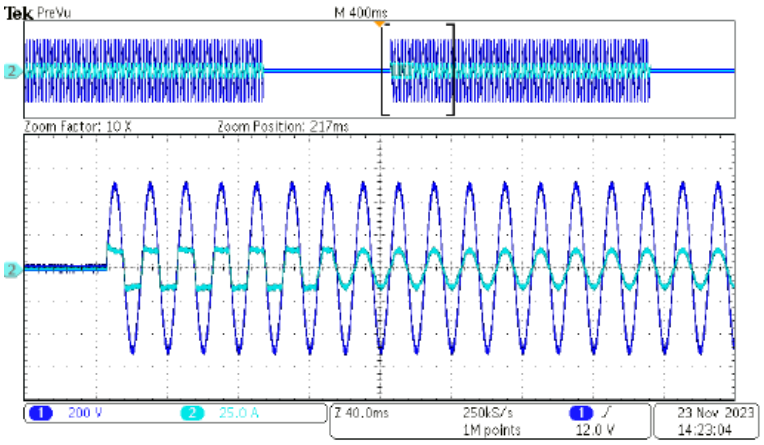


2. When Immed is selected, if the user presses **ON** without entering the UUT voltage V_{LN}, a notification appears on the main screen to remind the user to enter V_{LN} before the load can be applied.

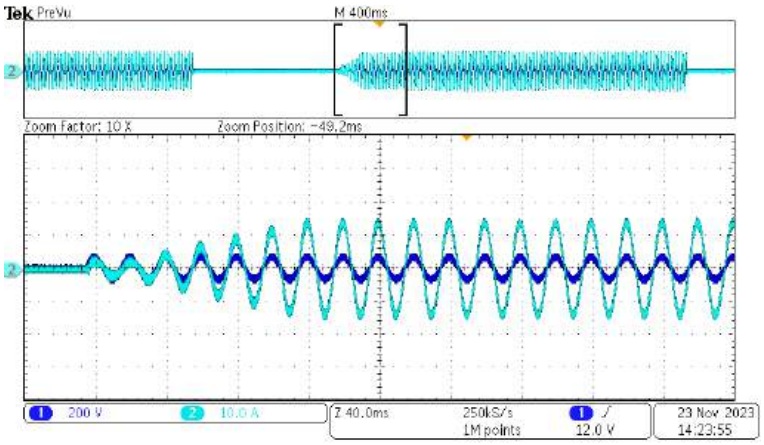


To prevent a mismatch between the entered UUT voltage V_{LN} and the actual UUT voltage, this mode includes a protection mechanism. If the entered V_{LN} does not match the actual UUT voltage, the output current waveform may become abnormal.

a. When the entered V_{LN} is lower than the actual UUT voltage:



b. When the entered V_{LN} is higher than the actual UUT voltage:

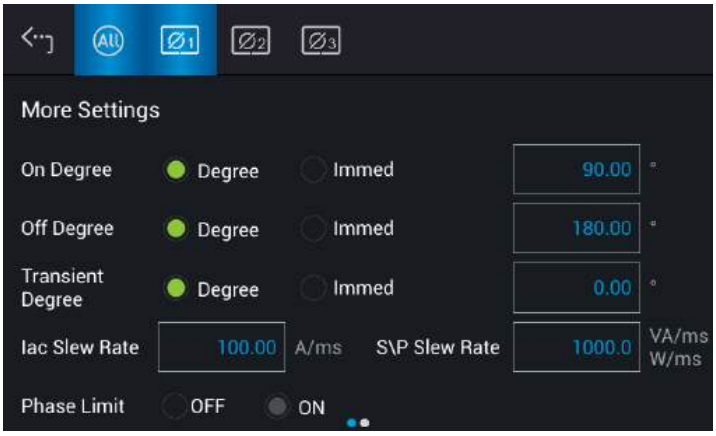


B. Off Degree

In CC mode and CCRE, the regenerative AC electronic load can control the phase angle at which the load current waveform is removed (output stops). Use Off Degree to configure this setting.

Setting Off Degree = 180 (single-phase/three-phase mode):

1. Tap the Off Degree value field.
2. Tap **1** , **8** , **0** , then tap ↵ to set the value to 180.0.



Notice When the user presses **QUIT**, if Off Degree = Immed is selected, the load current is removed immediately. At the same time, the Off Degree value field is grayed out and cannot be set.

C. Transient Degree

The Regenerative AC Electronic Load can control the phase angle at which the load current waveform transitions during a change. Use Transient Degree to configure this setting.

D. Slew Rate

The regenerative AC electronic load allows you to adjust the transient slew rate so that, when the load current command or apparent power command changes, the rate of change of the current waveform can be controlled. The available parameters include Iac Slew Rate and

S/P Slew Rate.

Iac Slew Rate: The slew rate of the load Iac command.

When the Regenerative AC Electronic Load is in the Load On state, changing the load current setting on the Main Page will take effect according to the Iac Slew Rate setting.

Setting Iac Slew Rate = 200 (single-phase/three-phase mode):

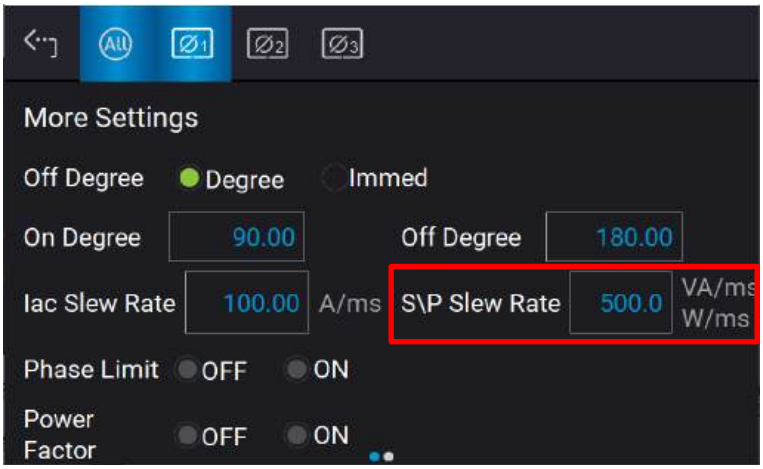
1. Tap the Iac Slew Rate value field.
2. Tap **2** , **0** , **0**, then tap ↵ to set the value to 200.

S/P Slew Rate: The slew rate of the load S/P command.

When the Regenerative AC Electronic Load is in the Load On state, changes to the load power setting on the Main Page take effect according to the S/P Slew Rate setting.

Setting S/P Slew Rate = 500 (single-phase/three-phase mode):

1. Tap the S/P Slew Rate value field.
2. Tap **5** , **0** , **0**, then tap ↵ to change the value to 500.



Notice

1. The maximum setting for Iac Slew Rate is 800A/ms and the minimum is 0.01A/ms.
2. When the Regenerative AC Electronic Load is turned **ON**, the output immediately reaches the final state according to the setting. When the load is turned **OFF**, the load current changes to 0A immediately.
   If you want the output to ramp down to 0A at the specified slew rate, enter 0A and tap  rather than turning the output **OFF** directly.

3.4.2 CS Rectified Mode

In CS Rectified mode, the user can change the settings of apparent power (S) and crest factor (CF) on the Main Page.

Notice

Refer to section *3.2* for the corresponding diagram of the maximum measurable PF under a specified CF state.

3.4.2.1 CS Rectified Mode – More Settings

A. On/Off Degree

In CS Rectified mode, the Regenerative AC Electronic Load can control the phase angle at

which the load current waveform is applied or removed. Use On Degree and Off Degree on the screen to configure these settings.

Setting On Degree = 90 and Off Degree = 180 (single-phase/three-phase mode):

1. Tap the On Degree value field.
2. Tap **9**, **0**, then tap ↵ to set the value to 90.00.
3. Tap the Off Degree value field.
4. Tap **1**, **8**, **0**, then tap ↵ to set the value to 180.00.

Notice When the user presses **QUIT**, if Off Degree = Immed is selected, the load current is removed immediately. At the same time, the Off Degree value field is grayed out and cannot be set.

B. Slew Rate

The Regenerative AC Electronic Load allows you to adjust the transient slew rate so that, when the load current command or apparent power command changes, the rate of change of the current waveform can be controlled. The available parameters include Iac Slew Rate and S/P Slew Rate.

Iac Slew Rate: The slew rate of the load Iac command.

When the Regenerative AC Electronic Load is in the Load On state, changing the load current setting on the Main Page takes effect according to the Iac Slew Rate setting.

Setting Iac Slew Rate = 200 (single-phase/three-phase mode):

1. Tap the Iac Slew Rate value field.
2. Tap **2**, **0**, **0**, then press ↵ to set the value to 200.

S/P Slew Rate: The slew rate of the load S/P command.

When the Regenerative AC Electronic Load is in the Load On state, changing the load power setting on the Main Page takes effect according to the S/P Slew Rate setting.

Setting S/P Slew Rate = 500 (single-phase/three-phase mode)

1. Tap the S/P Slew Rate value field.
2. Tap **5**, **0**, **0**, then press  to set the value to 500.

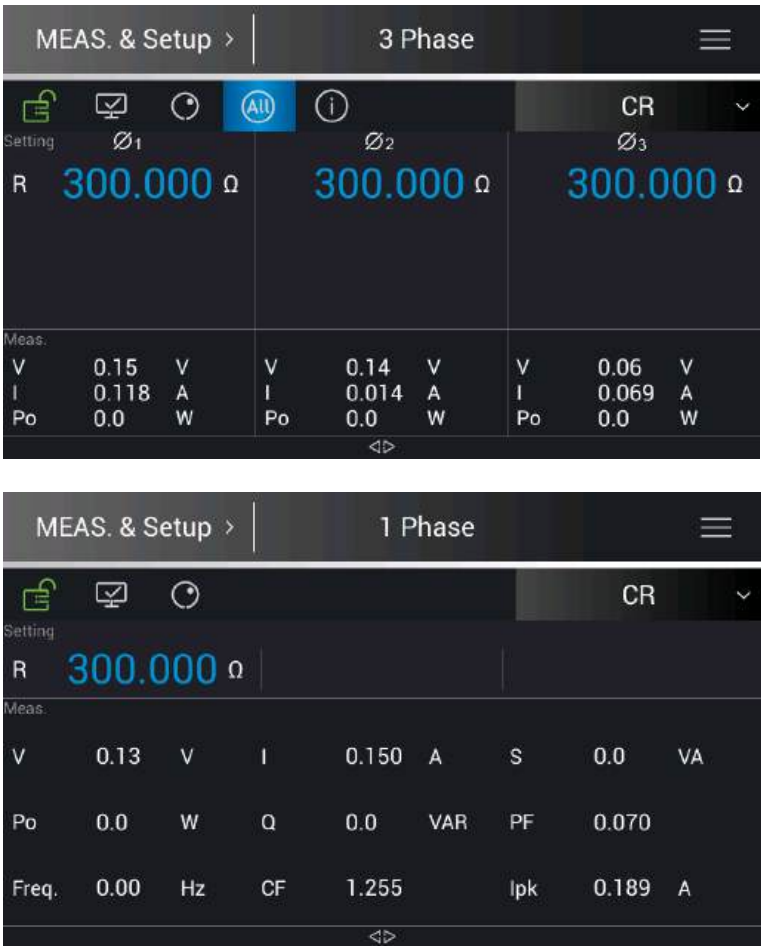
Notice

The maximum setting for Iac Slew Rate is 800 A/ms, and the minimum is 0.01 A/ms.

When the Regenerative AC Electronic Load is turned ON, the output immediately reaches the final state according to the setting. When it is turned OFF, the load current immediately changes to 0A. If you want the output to ramp down to 0A at the specified slew rate, you must enter 0A and press  , rather than turning the output OFF directly.

3.4.3 CR Mode

In CR mode, the user can change the resistance value (R) on the Main Page.



3.4.3.1 CR Mode – More Settings

On the Meas. & Setup main page (3_Phase Mode / 1_Phase Mode), tap the icon in the upper-right corner to open the Meas. & Setup function menu, then select More Settings to configure advanced output parameters. The functions are described below.

A. On Degree

In CR mode, the Regenerative AC Electronic Load can control the phase angle at which the load current waveform is applied, or it can operate in immediate loading mode. When On Degree is set to Degree, the specified angle controls the start angle of the load current. When On Degree is set to Immed, the unit operates in immediate loading mode.

A-1 Setting On Degree = 90 (single-phase/three-phase mode)

1. Tap the On Degree value field and select Degree.
2. Press **9**, **0**, then press ↵ to set the value to 90.0.

A-2: Setting On Degree to Immed: Tap the On Degree value field and select Immed.

B. Off Degree

In CR mode, the Regenerative AC Electronic Load can control the phase angle at which the load current waveform is removed (output stops). Use Off Degree to configure this setting.

Setting Off Degree = 180 (single-phase/three-phase mode):

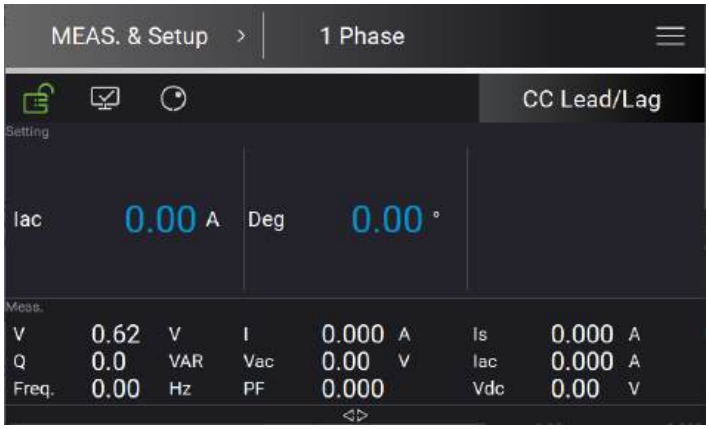
1. Tap the Off Degree value field.
2. Tap **1** , **8** , **0** , then tap ↵ to set the value to 180.00.

Notice When the user presses **QUIT**, if Off Degree = Immed is selected, the load current is removed immediately. At the same time, the Off Degree value field is grayed out and cannot be set.

In CR mode, Iac Slew Rate and S/P Slew Rate are not active. However, if these parameters are modified while in CR mode, the settings are still saved. After switching to another mode, the instrument will operate according to the saved Iac Slew Rate or S/P Slew Rate settings.

3.4.4 CC Phase Lead/Lag Mode

When in CC Phase Lead/Lag mode, it can change the current amplitude and phase setting on the main page.



3.4.4.1 More Settings in CC Phase Lead/Lag Mode

In Meas. & Setup (3_Phase Mode/1_Phase Mode) page, tap  to enter the menu and select More Settings to perform advanced settings as described below.

A. On/Off Degree

See section *3.4.1.2* for details.

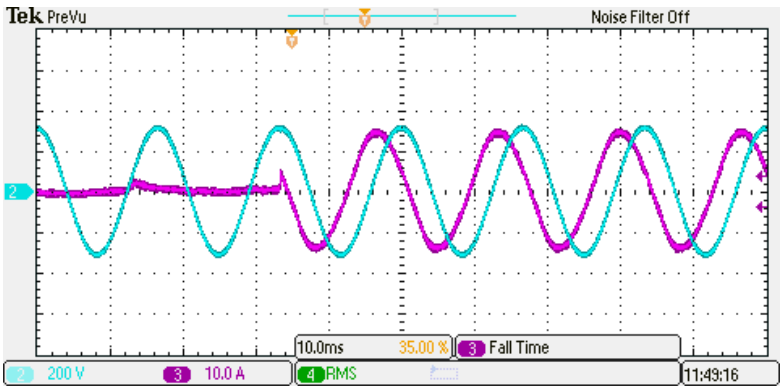
Notice

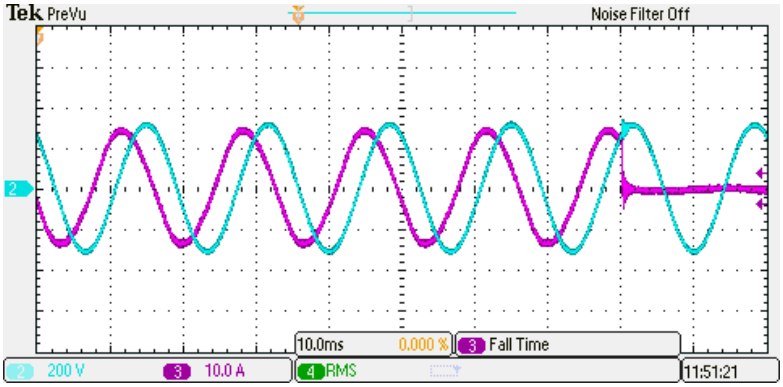
The procedure to set the phase (Deg) on the Main Page and On/Off Degree in More Settings at the same time, for example, to set I=10A, Deg =-70, On degree=90, and Off degree=60 in 3-phase, is described below.

1. Tap "I" on the Main Page.
2. Tap 1, 0, and  to change the value to "10".
3. Tap "Deg" in the Main Page.
4. Tap -, 7, 0, and  to change the value to "-70".

5. Tap  to go to the More Settings menu.
6. Tap “On Degree” in More Settings.
7. Tap **9**, **0**, and  to change the value to "90".
8. Tap the “Off Degree” value field in More Settings.
9. Tap **6**, **0**, and  to change the value to "60".

The measured results are as follows according to the above steps when the UUT is in 220V phase voltage.





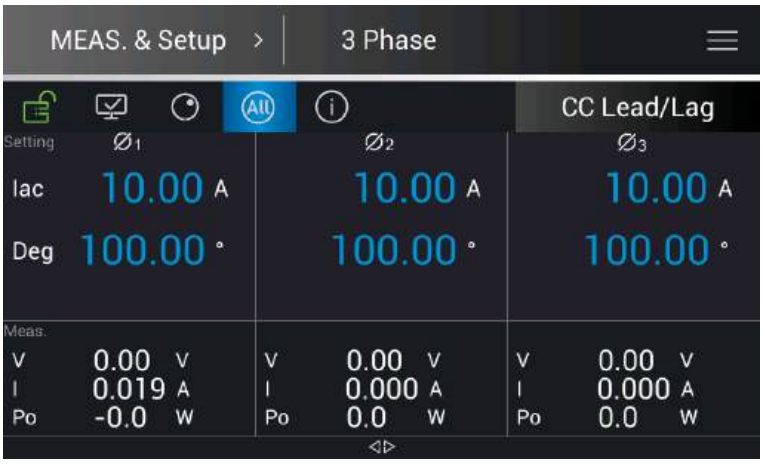
B. Slew Rate

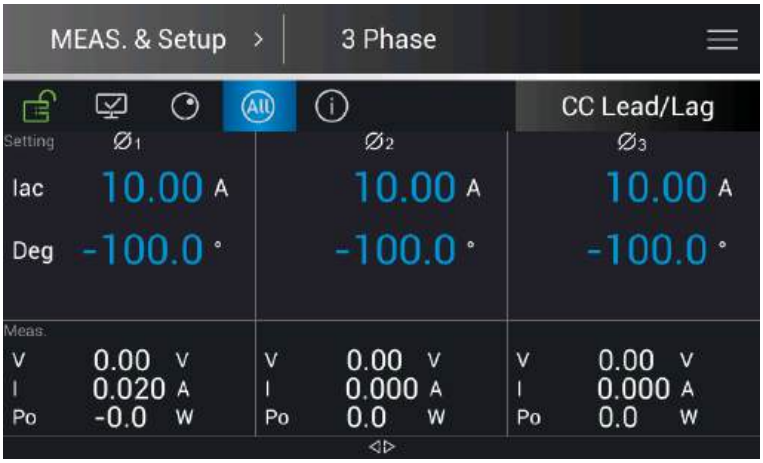
See section 3.4.1.2 for the detailed description.

C. Phase Limit (default is ON)

The Regenerative AC Electronic Load in CC and CS Phase Lead/Lag Mode can change to the Current Source Mode by setting the Phase limit OFF (to >90° or <-90° range). The setting sequence is as follows.

1. Tap OFF on the Phase Limit to remove the phase setting limit.
2. Return to Meas. & Setup to set the required phase.





Notice When the Phase Limit is set to OFF, set the phase to >90˚ or <-90˚, and then set the Phase Limit to ON, the phase set by Meas. & Setup will return to 0˚.

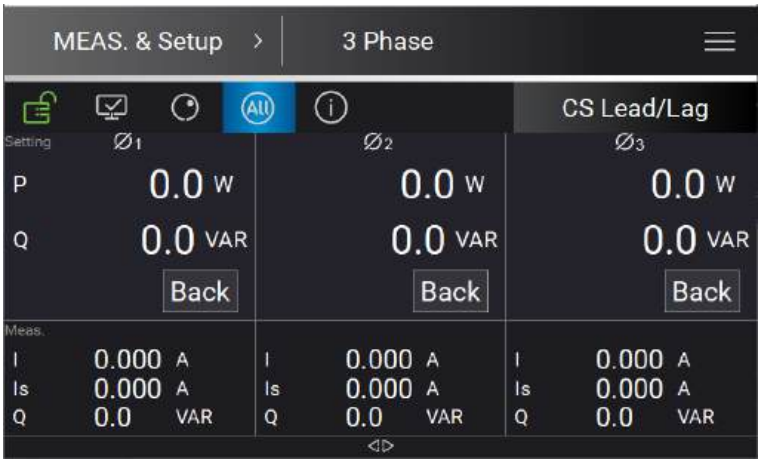
WARNING When the Phase Limit is set to OFF, the phase setting range can be greater than 90˚ or less than -90˚. The Regenerative AC Electronic Load at this time is a current source output, which will feed back power to the UUT. Be sure to confirm the characteristics of the UUT that must have recharge power consumption or power regenerative function to avoid damaging the equipment.

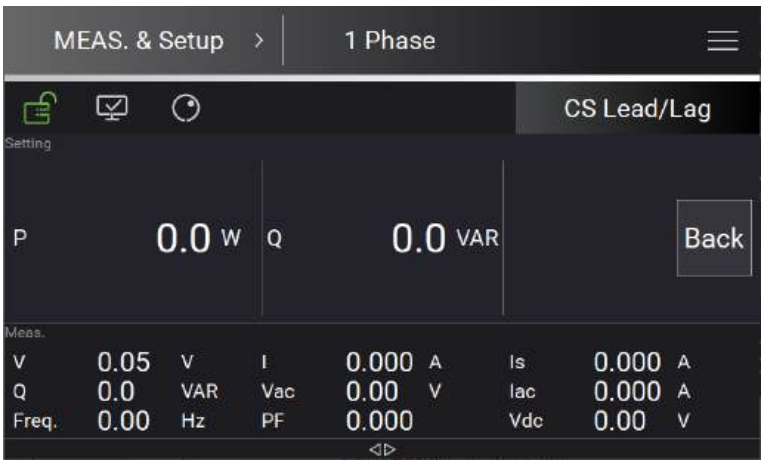
3.4.5 CS Phase Lead/Lag Mode

When in CS Phase Lead/Lag mode, it can change the apparent power and phase setting on the main page.

Notice

Tap **PQ** on the main page, it can confirm the Real power (P) and Reactive power (Q). Tap **Back** to return to the setup menu.





3.4.5.1 More Settings in CS Phase Lead/Lag Mode

In Meas. & Setup (3_Phase Mode/1_Phase Mode) page, tap  to enter the menu and select More Settings to perform advanced settings as described below.

A. On/Off Degree

See section *3.4.1.2* for the detailed description.

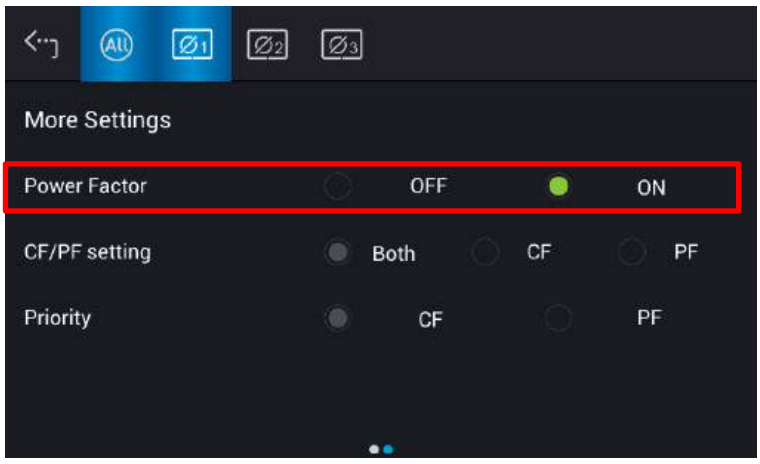
B. Slew Rate

See section *3.4.1.2* for the detailed description.

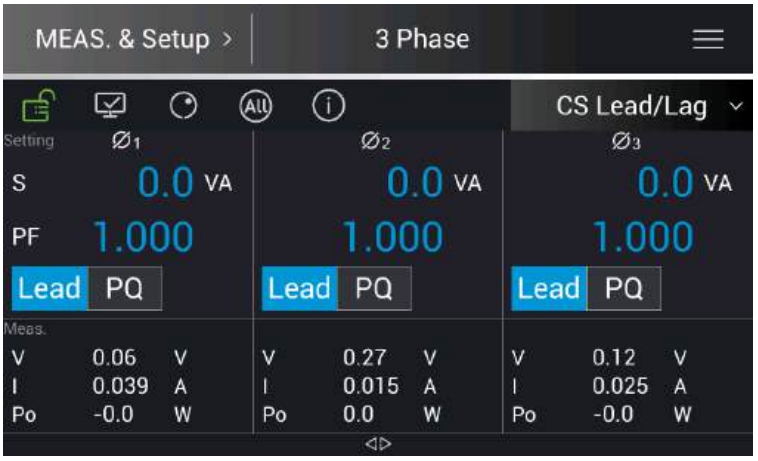
C. Power Factor (default is OFF)

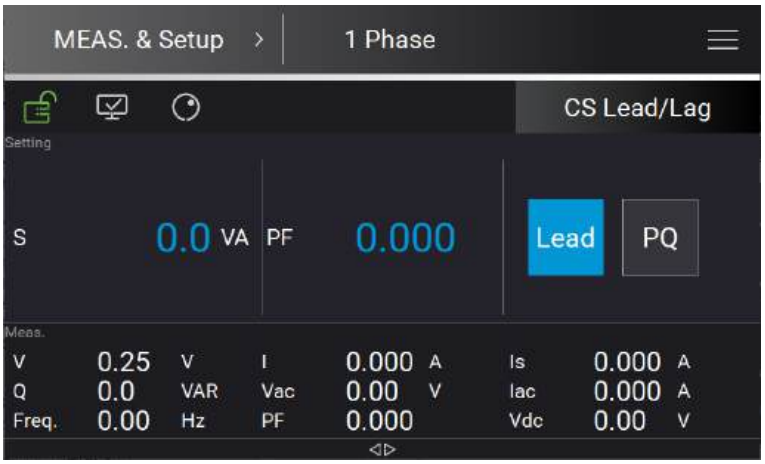
The Regenerative AC Electronic load in CS Phase Lead/Lag mode provides Power Factor (PF) for setting as described below.

1. Tap ON behind Power Factor to enable the PF setting.



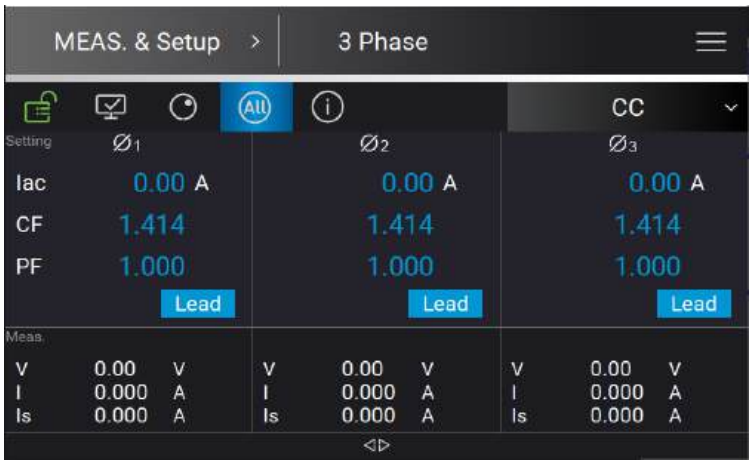
2. Return to Meas. & Setup to set the required PF.
3. When set to Lead, it means the phase of the load current is ahead of the UUT voltage phase. When set to Lag, it means the phase of the load current lags behind the UUT voltage phase.

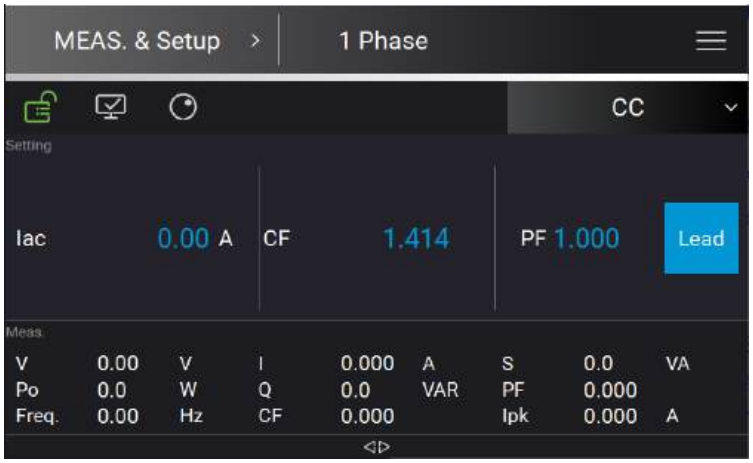




3.4.6 CC Mode

In CC Mode, the current amplitude, CF, and PF settings can be changed on the Main Page.





When set to Lead, it means that the current loading phase leads the UUT voltage phase. When set to Lag, it means the current loading phase lags behind the UUT voltage phase.

3.4.6.1 More Settings in CC Mode

In Meas. & Setup (3_Phase Mode/1_Phase Mode) menu, tap  to enter the menu, and select More Settings to configure advanced parameters as described below.

A. On/Off Degree

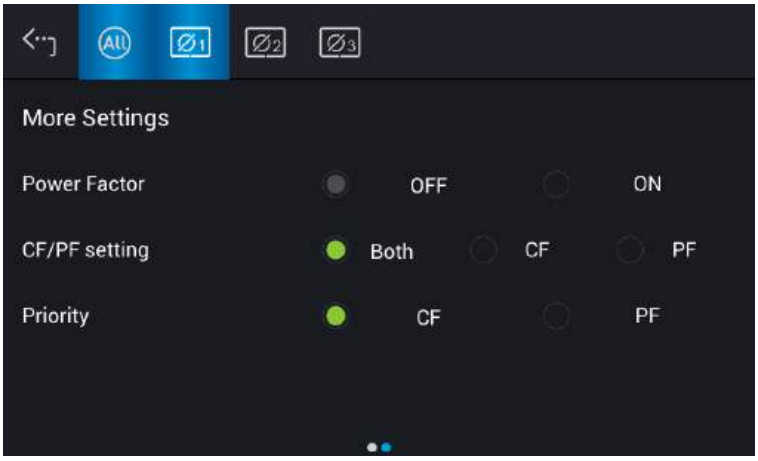
See section *3.4.1.2* for the detailed description.

B. Slew Rate

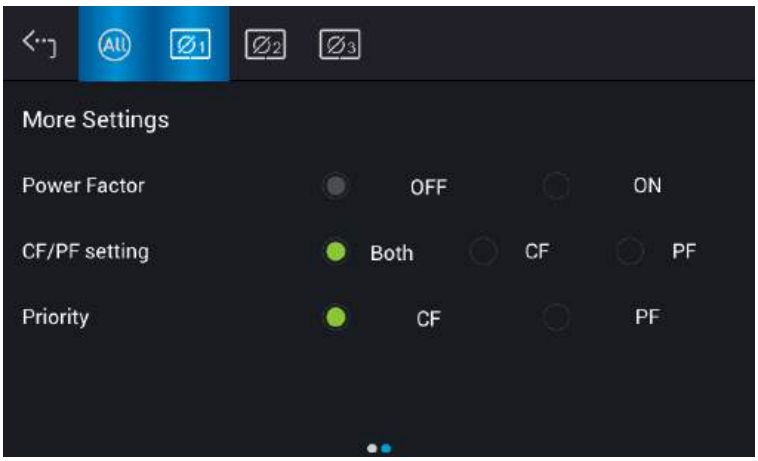
See section *3.4.1.2* for the detailed description.

C. CF/PF

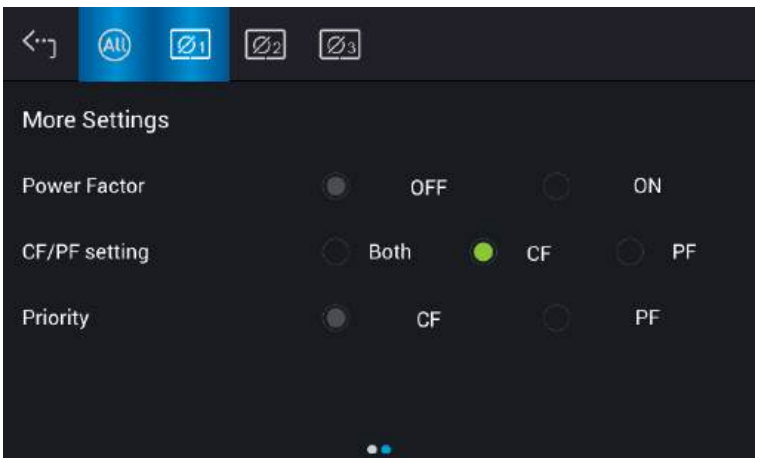
Swipe to the second page of More Settings to adjust CF/PF settings. In CC mode, there are 3 configurable parameters: CF, PF, and Both.



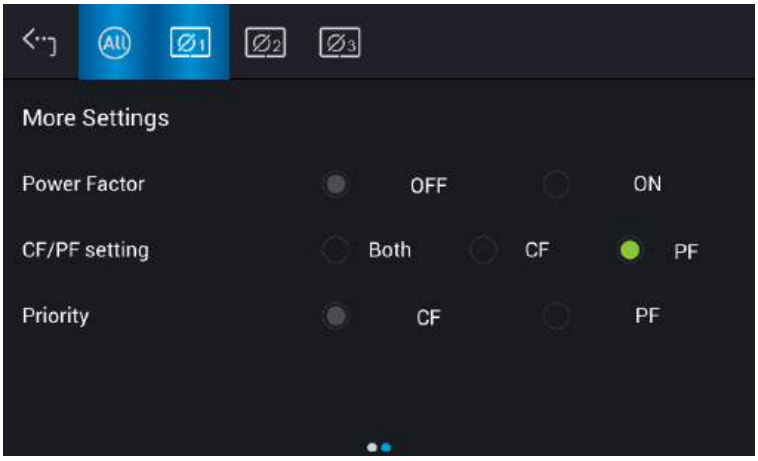
1. Both (default)
   When set to Both, it requires setting the priority. When the priority is set to CF, the PF setting range is limited by the CF setting value (see Figure 3-4). On the contrary, if the priority is set to PF, the CF setting range will be limited by the PF setting value (see Figure 3-4).



2. CF
   When CF only is selected, the PF will be set to the maximum corresponding to the current CF setting (Figure 3-4) and cannot be changed.

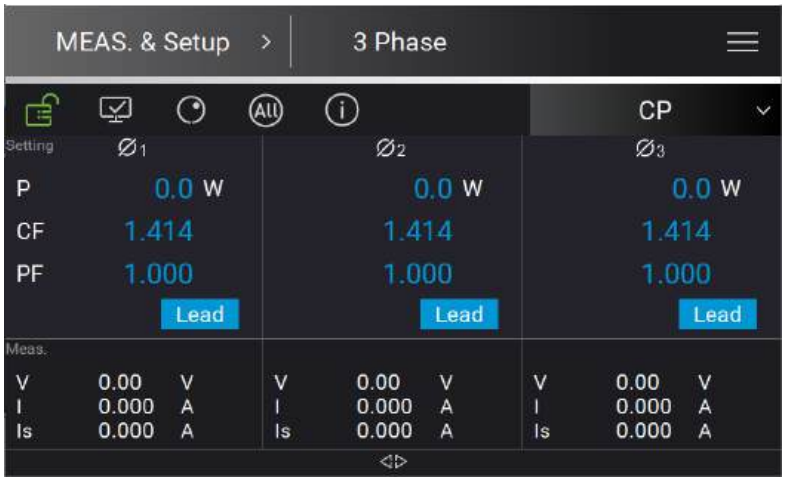


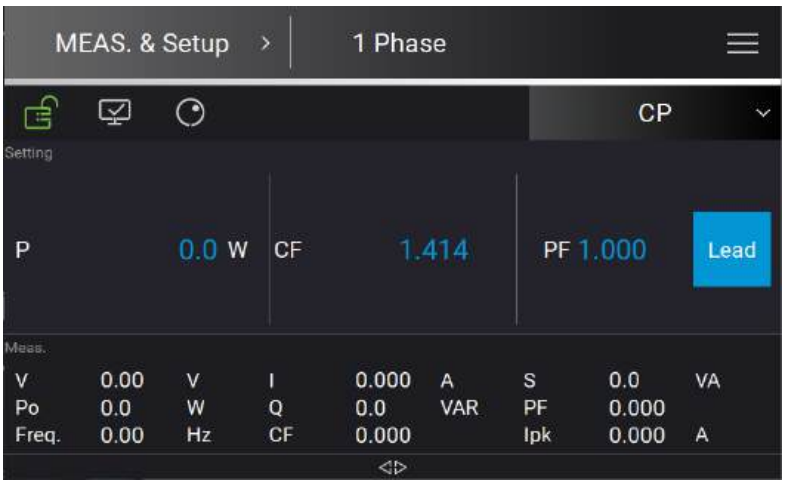
3. PF
When PF only is selected, the CF will be set to the maximum corresponding to the current PF setting (Figure 3-4) and cannot be changed.



3.4.7 CP Mode

When in CP Mode, it can change the power amplitude, CF, and PF settings on the main page.

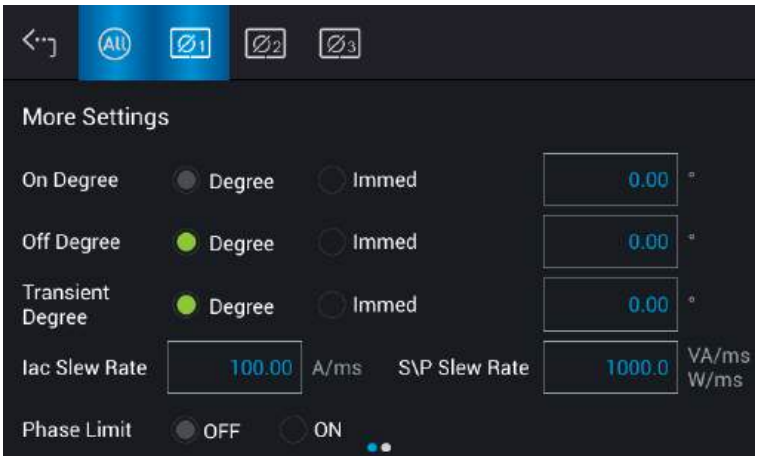




When set to Lead, it means that the current loading phase leads to the UUT voltage phase. When set to Lag, it means the current loading phase lags behind the UUT voltage phase.

3.4.7.1 More Settings in CP Mode

In Meas. & Setup (3_Phase Mode/1_Phase Mode) menu, tap  to enter the menu, and select More Settings to perform advanced settings as described below.



A. On/Off Degree

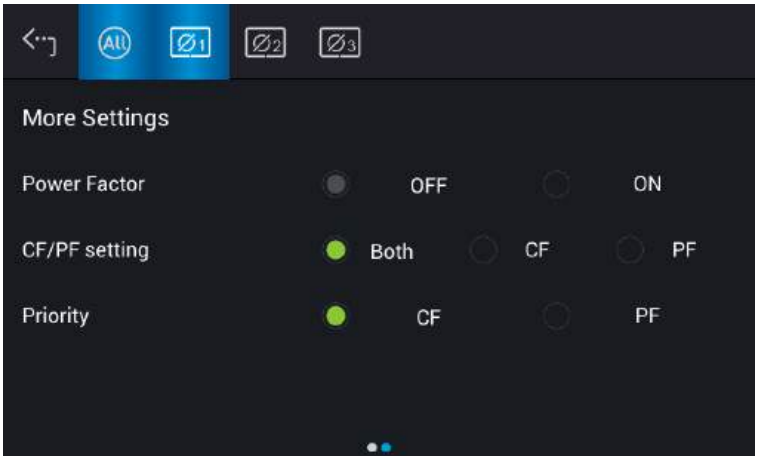
See section 3.4.1.2 for the detailed description.

B. Slew Rate

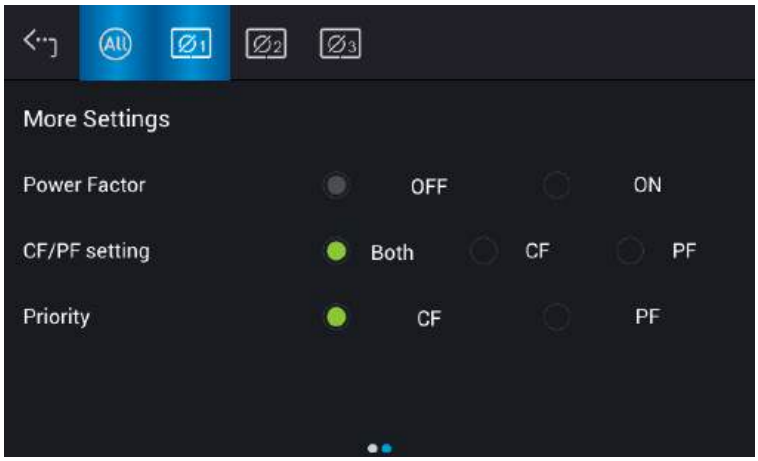
See section 3.4.1.2 for the detailed description.

C. CF/PF

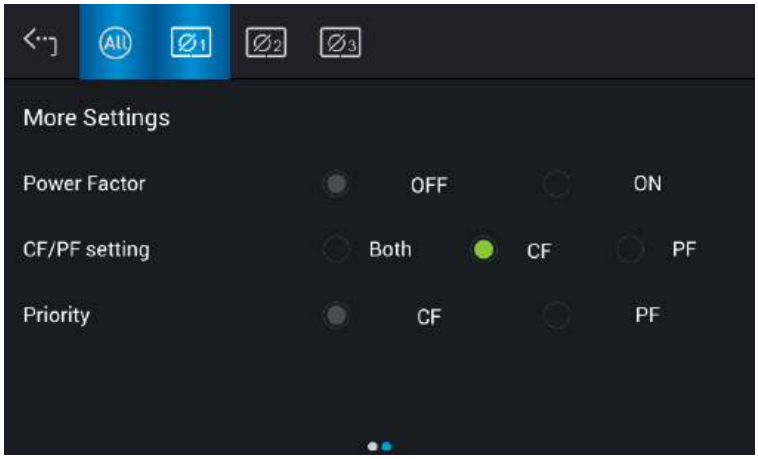
Slide to the second page of More Settings to perform CF/PF settings. In CP mode, there are CF, PF, and Both 3 parameters for setting.



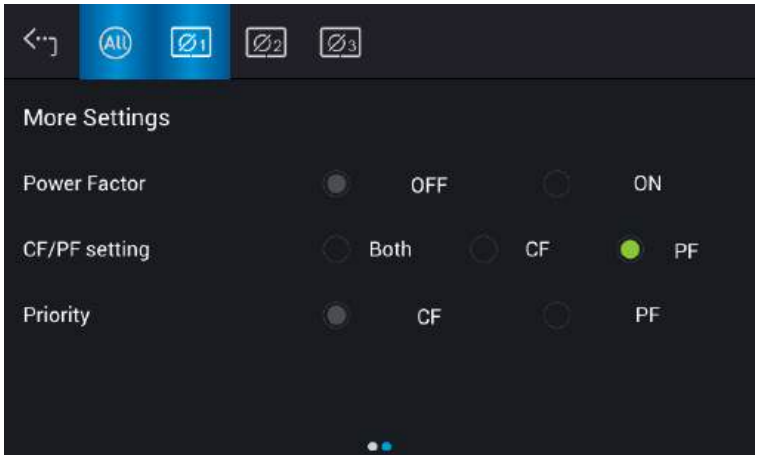
1. Both (default)
   When set to Both, it requires setting the priority. When the priority is set to CF, the PF setting range is limited by the CF setting value (see Figure 3-4). On the contrary, if the priority is set to PF, the CF setting range will be limited by the PF setting value (see Figure 3-4).



2. CF only
   When CF only is selected, the PF will be set to the maximum corresponding to the current CF setting (Figure 3-4) and cannot be changed.



3. PF
   When PF only is selected, the CF will be set to the maximum corresponding to the current PF setting (Figure 3-4) and cannot be changed.

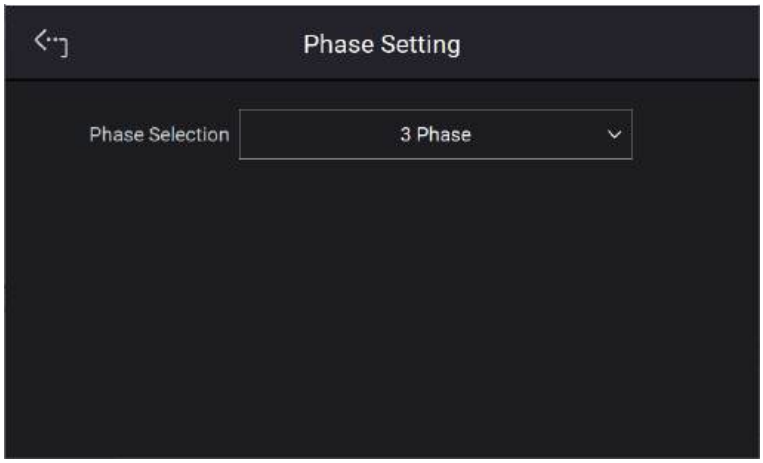


3.5 Configuration Menu

On the Main Page, tap Menu in the upper-left corner and select Configuration to open the Configuration function menu. It provides six functions: Phase Setting, Interface, Remote Output, Stand-By, Series/Parallel, and Response Speed.

3.5.1 Phase Setting

Tap Menu and select Configuration to show the Phase Setting menu. Users can also switch the mode to 3-phase or 1-phase.



3.5.1.1 Three Phase Mode

The Regenerative AC Electronic Load can be set to 3-phase AC load by tapping the Menu and selecting Configuration to show the Phase Setting menu and switch to 3-phase mode if desired.

The procedure for setting the Regenerative AC Electronic Load to 3-phase mode is described below.

1. Tap Phase Selection

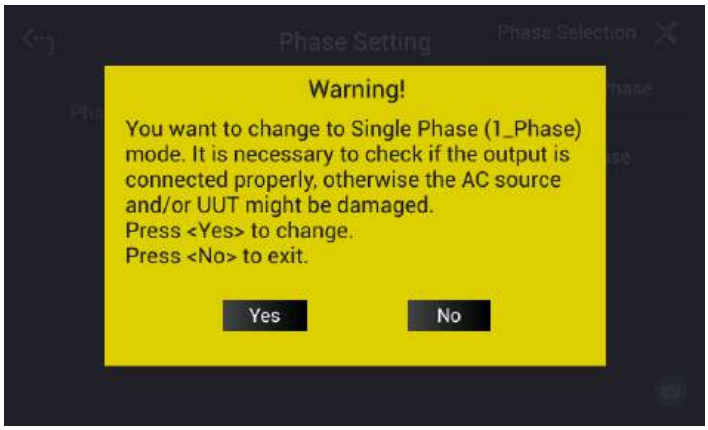
2. Select “3 Phase” mode.
3. Make sure the output connection is in 3-phase mode and tap Yes to change it.

3.5.1.2 Single Phase Mode

The Regenerative AC Electronic Load can be set to 1-phase AC load by tapping Menu and selecting Configuration to show the Phase Setting menu and switch to 1-phase mode when it is required.

The procedure for setting the Regenerative AC Electronic Load to 1-phase mode is described below.

1. Tap Phase Selection.
2. Select “Single Phase” mode.
3. Make sure the output connection is in 1-phase mode and tap Yes to change it.



Notice

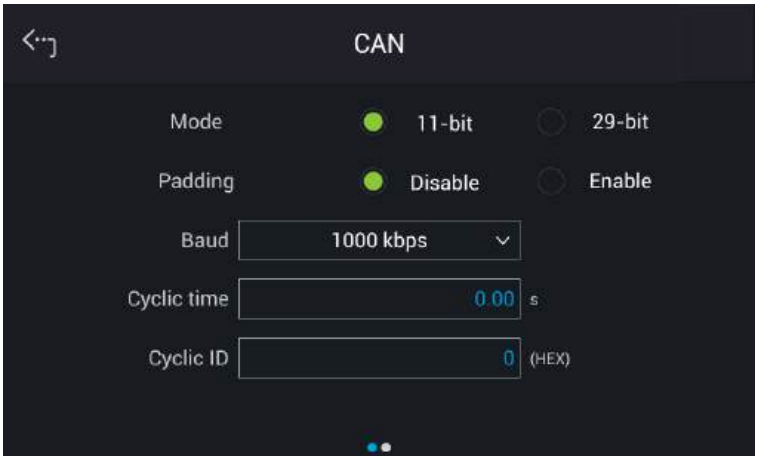
1. When switching between 1-phase and 3-phase mode, the set output value will be reset to zero to avoid damaging the UUT.
2. When switching 1-phase mode to 3-phase mode, the user should check if the output L_1, L_2, and L_3 short-circuit copper bars are removed to prevent the Regenerative AC Electronic Load from triggering a protection error.

3.5.2 Interface for Remote Operation

3.5.2.1 CAN

Tap Menu, select Configuration and Interface to show the Interface Select menu. Select CAN to perform the settings starting with the baud rate.

1. Tap CAN in the "Interface" menu.
2. Tap the bit number for Mode.
3. Tap Disable or Enable for Padding.
4. Tap Baud to select the baud rate.
5. Tap Cyclic Time to set the desired time.
6. Swipe left to the second page, and tap ID to set the position.
7. Tap Mask to set the position.
8. Tap Cyclic ID to set the position.
9. Tap SCPI ID to set the position.
10. Tap Apply to execute each parameter setting.
11. Touch the upper left corner to return to the Menu setting.
12. Tap "MEAS. & Setup" to return to the main screen.



3.5.2.2 GPIB

Tap Menu, select Configuration and Interface to show the Interface Select menu. Tap GPIB to enable. It is necessary to set the GPIB address to 30 before conducting a remote operation in 1_Phase Mode /3_Phase Mode.

1. Tap GPIB address.
2. Input value 30 to complete the setting.

Notice The address range is from 1 to 30.

3.5.2.3 LAN

Tap Menu, Configuration, and Interface to show the Interface Select menu. Tap LAN to set it.

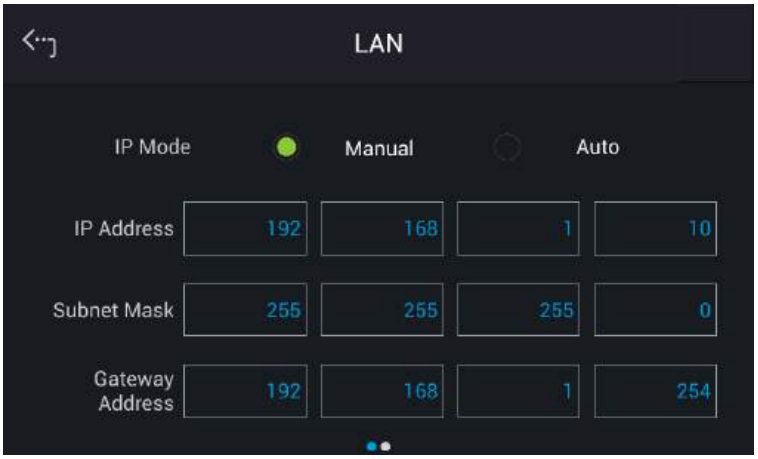
Notice

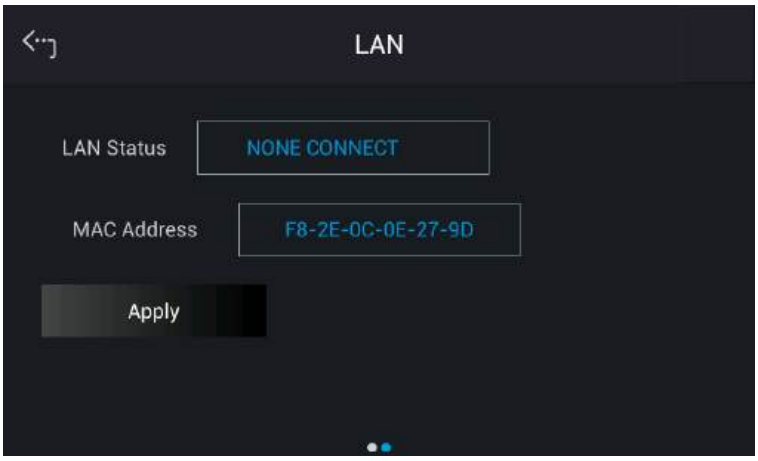
1. The user needs to connect the network cable to the Regenerative AC Electronic Load for auto-detection.
2. If the network cable is not connected properly, it may cause the Regenerative AC Electronic Load screen to show abnormally. Turn off the Regenerative AC Electronic Load to resolve the network cable problem and reboot it to clear the abnormal screen.

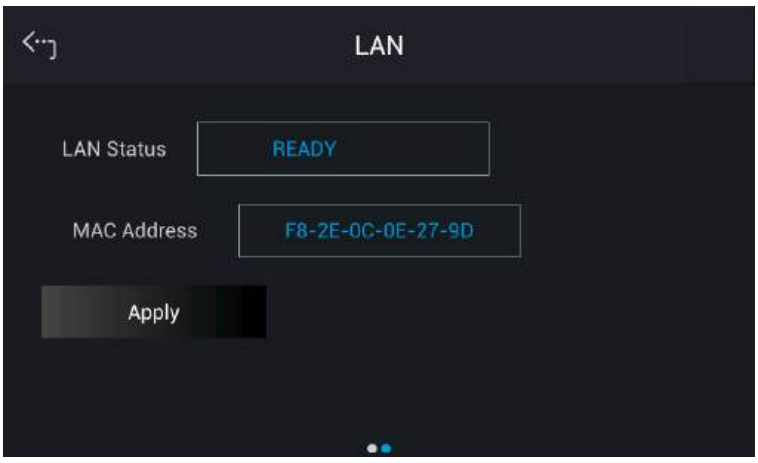
1. Tap LAN to enter into the address setting screen.

   Auto Detect:
   The default of IP mode is Auto. Swipe left to the second page, the Regenerative AC Electronic Load will automatically detect the external network address.

   Manual Detect:
   1. Tap IP Mode to set it to Manual.
   2. Tap the IP Address and set it.
   3. Tap the Subnet Mask and set it.
   4. Swipe left to the second page, tap Gateway Address, and set it.
   5. Tap “Apply” and wait for the connection.
   6. Touch the upper left corner to return to the Menu setting.
   7. Tap “MEAS. & Setup” to return to the main page.







Notice

1. The LAN STATUS is displayed automatically in the following 5 types:
   READY: The network is connected.
   CONNECTING. . . .: The network is connecting.
   NONE CONNECT: The network is not connected.
   SETTING. . . .: The network is under setting.
   ETHERNET MODULE FAIL: The network module has failed.
   DUPLICATE IP: The IP setting is duplicated.
   RENEWAL FAIL: DHCP renewal has failed.
   IDENTIFY: It means the identification is performed.
   DECONFIG: Network configuration is changed.

2. The ETHERNET IP address is 0–255. In the ETHERNET setting, IP MODE=Auto will get the address automatically and IP MODE=Manual will get the address manually. Once the IP address is set, it needs to set APPLY=YES for the address to be in effect.

3.5.2.4 USB

Tap Menu, select Configuration and Interface to show the Interface Select menu. Tap USB to query the USB address.

1. On the “Interface” page, select USB to enter into the USB Address screen.
2. Touch the upper left corner to return to the Menu setting.
3. Tap “MEAS. & Setup” to return to the main page.

Notice This function is for users to query the USB Address only.

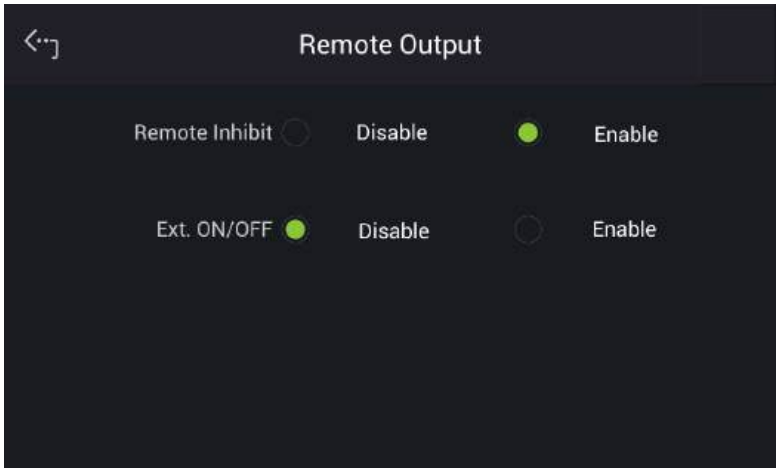
3.5.3 Remote Output

The output of Regenerative AC Electronic Load can be inhibited by external control or manual trigger. To remotely inhibit the device a TTL signal is applied to the terminal on the rear panel (see *Appendix A*) Remote Inhibit and EXT. ON/OFF must be set in the Remote Output menu by tapping Menu in the upper left corner and selecting the Configuration menu. There are two remote inhibit output states: Enable and Disable.

Remote Inhibit: When the Remote Inhibit is enabled and the remote inhibit signal is LOW, this will disable the output. The device remains disabled even when the Remote Inhibit returns to HIGH. You must press the **ON/OFF** button to enable the output again.

The procedure for setting Remote Inhibit to enable 1-phase/3-phase modes is described below.

Select “Enable” for Remote Inhibit.



EXT. ON/OFF: When the EXT. ON/OFF is enabled on the Regenerative AC Electronic Load and the EXT. ON/OFF signal is LOW, the Regenerative AC Electronic Load will disable the output. The Regenerative AC Electronic Load will automatically restart the output when the EXT. ON/OFF signals turn to HIGH.

The procedure to set EXT. ON/OFF to enable in 1-phase/3-phase mode is described below.

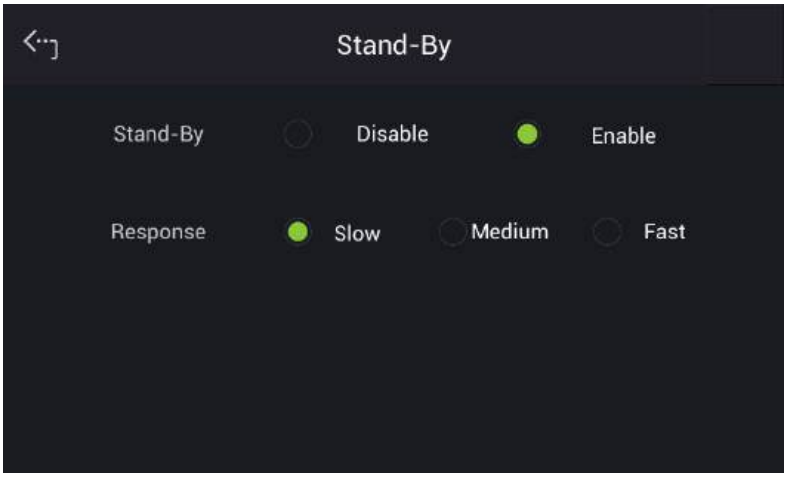
Select "Enable" for Ext. ON/OFF.

Notice

The output of the Remote Inhibit transmits the TTL signals via a special I/O connector. See *Appendix A* for the detailed TTL signal pin assignments.

3.5.4 Stand-By

Tap Menu and Configuration in the upper left corner to select the Stand-By function for setting.



Stand-By mode: Enable

The Stand-By mode is default set to Enable. When the UUT voltage is abnormal, the Regenerative AC Electronic Load will enter into Standby mode if it is enabled. The LED of the output “On” button on the front panel is always on. Once the UUT output voltage reaches the loading state, the Regenerative AC Electronic Load will use the settings on the main page to perform loading.

Notice

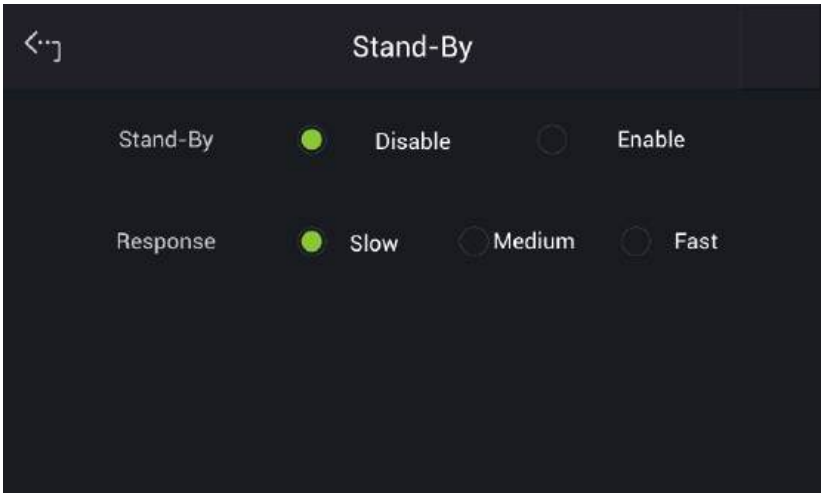
When the UUT output voltage is generated to a loadable state, the Regenerative AC Electronic Load will assess it and start loading <1s after the voltage is rebuilt.

Response: Slow/Medium/Fast

The Response default is set to Slow. This function has three response options for the regenerative AC electronic load to detect the UUT’s abnormal voltage. It can cope with different types of voltage abnormalities on the UUT, allowing the regenerative AC electronic load to enter the standby mode smoothly.

Notice

When the Response is switched to Medium/Fast, the sensitivity of the regenerative AC electronic load will increase when detecting the UUT’s voltage, making it easier for the electronic load to enter Stand-By mode.



Stand-By mode: Disable

When the UUT voltage is lower than the operable range of Regenerative AC Electronic Load, the Regenerative AC Electronic Load will trigger low voltage protection (DA_UUT_UVP) if this function is enabled. The protection can be cleared by command. The user must confirm the UUT voltage status at present. If the UUT voltage outputs normally, clear the protection and the loading can be performed as usual.

Notice

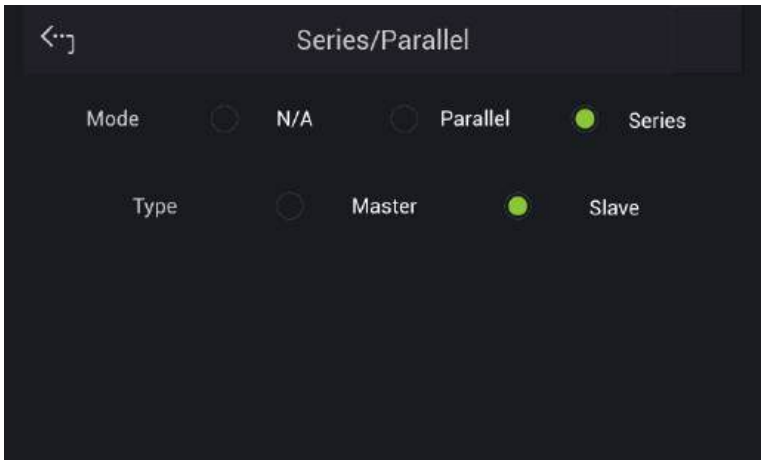
When performing the regulation test of voltage drop within a short time (ex: UL-2231-2, SAE-J1772), be sure to disable this function. It is suggested to use CR mode for testing.

3.5.5 Series/Parallel Settings

3.5.5.1 Series Setup Procedure

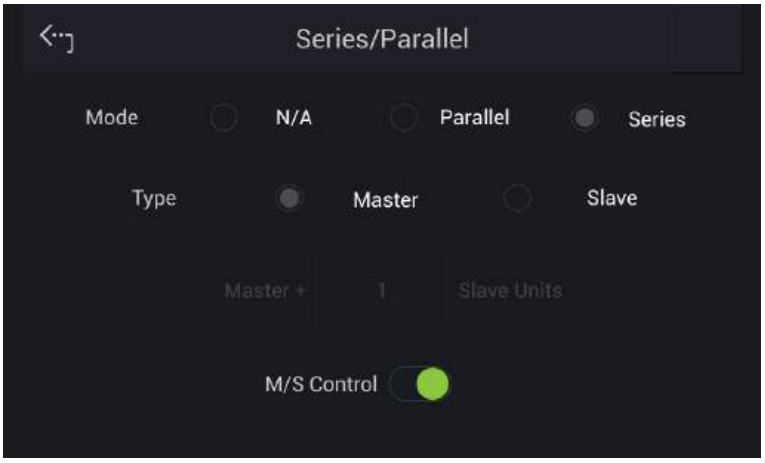
To set a single Regenerative AC Electronic Load as a Slave, on the Main Page tap Menu (upper-left corner), select Configuration, and then select Series/Parallel to configure series operation. The settings are as follows:

1. For Mode, select Series.
2. For Type, select Slave.



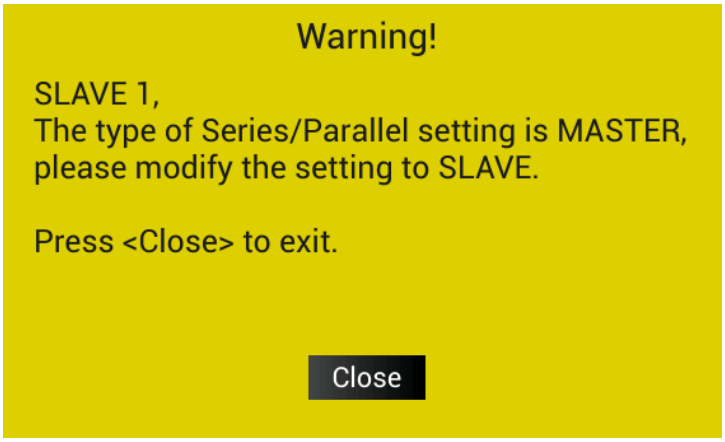
To set a single Regenerative AC Electronic Load as a Master, tap Menu, select Configuration, and then select Series/Parallel to configure series operation. The settings are as follows:

1. For Mode, select Series.
2. For Type, select Master.
3. Enable the M/S Control toggle.



4. The Slave units will now display Slave on their screen.
5. The Main Page displays the series status icon : showing that the Regenerative AC Electronic Load is operating in Series mode.

Notice In series operation, at least one unit must be set as Slave. Otherwise, a Warning message is displayed when the Master is enabled.



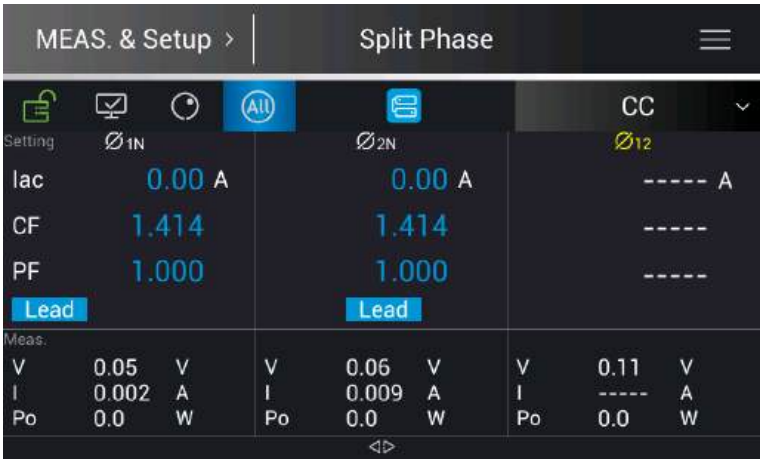
After disconnecting from series split-phase operation, the Phase Setting of each unit returns to 3-Phase Mode.

3.5.5.2 Series Output Mode Setting

In series mode, the Regenerative AC Electronic Load supports Split Phase Mode only.

3.5.5.2.1 Split Phase Mode

When split-phase AC is required, configure the Regenerative AC Electronic Load for series operation.



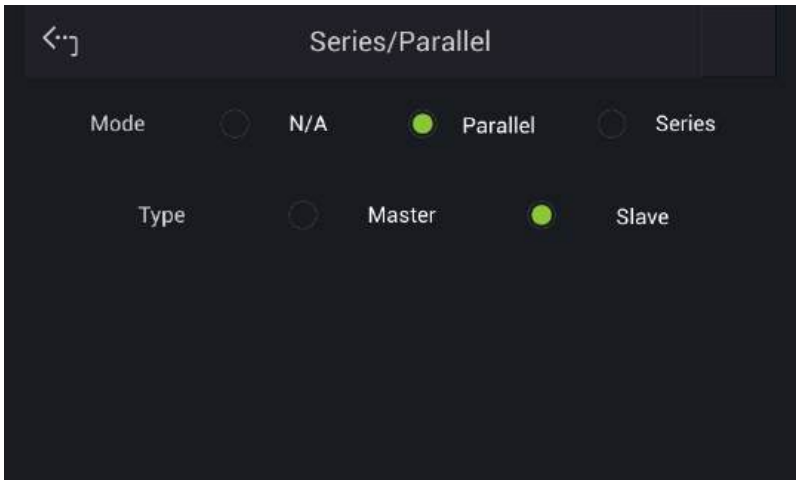
1. In the 63800R Series, series operation supports Split Phase Mode only. 1-Phase Mode and 3-Phase Mode are not supported in series operation.
2. Series settings can be configured only when a standalone unit is in 3-Phase Mode. Series operation cannot be configured in 1-Phase Mode.
3. Split Phase Mode is supported only when two standalone units of the same model are connected in series.

3.5.5.3 Parallel Setup Procedure

When parallel operation is used, the total number of units is 1 + N, where the maximum supported value of N is 9. (In other words, up to 10 units in total.)

To set a single Regenerative AC Electronic Load as a Slave, on the Main Page tap Menu, select Configuration, and then select Series/Parallel to configure parallel operation. The settings are as follows:

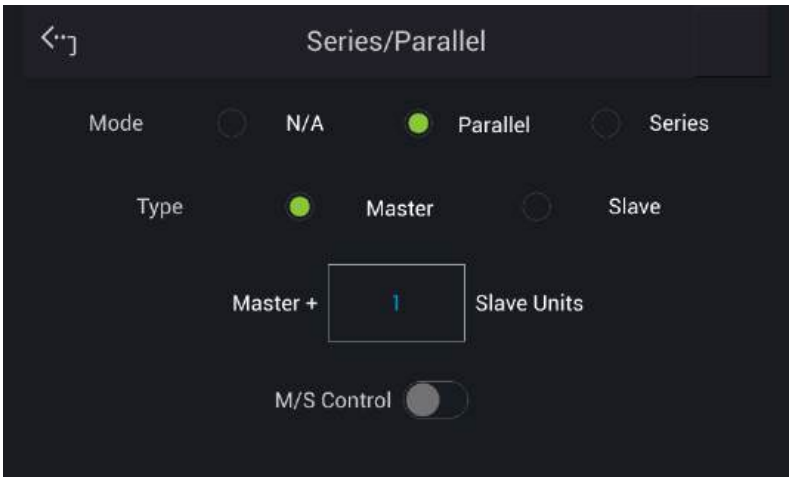
1. For Mode, select Parallel.
2. For Type, select Slave.



To set a single unit as a Master, on the Main Page tap Menu, select Configuration, and then select Series/Parallel to configure multi-unit parallel operation. The settings are as follows:

1. For Mode, select Parallel.

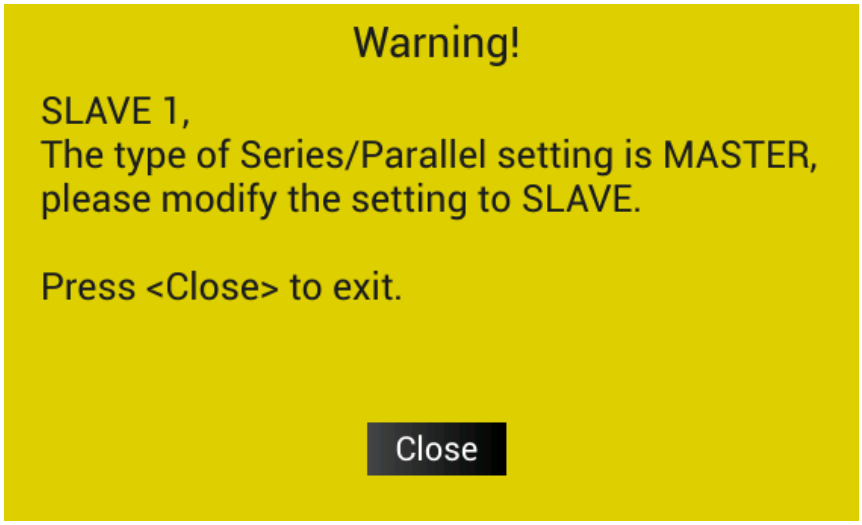
2. For Type, select Master.
3. Select the value field for Master + “N” Slave Units.
4. Set the number of connected Slave units.
5. Enable the M/S Control toggle.



6. The Slave units will now display Slave on their screens.
7. After the Master unit returns to the Main Page, the parallel status icon is displayed, indicating Parallel mode.

Notice

1. In parallel operation, at least one unit must be set as Slave. Otherwise, a Warning message is displayed when the Master is enabled.



2. After exiting parallel operation, the Phase Setting of each unit remains the same as it was during parallel operation.

⚠WARNING

1. The rule for the number of Slave Units under a Master is: Total units = 1 + N. For example, for two units in parallel, set the Master + “N” Slave Units field to 1. Incorrect settings may cause parallel operation to fail.
2. When changing the number of parallel units, first exit parallel mode and turn off the instrument power. Adjust the number of parallel

signal cable connections according to Total units = 1 + N.
For example, for five units in parallel, four signal cable connections are required. Then turn on the instrument power and perform the setup procedure. If the number of units does not match the signal cable connections, parallel operation may fail.

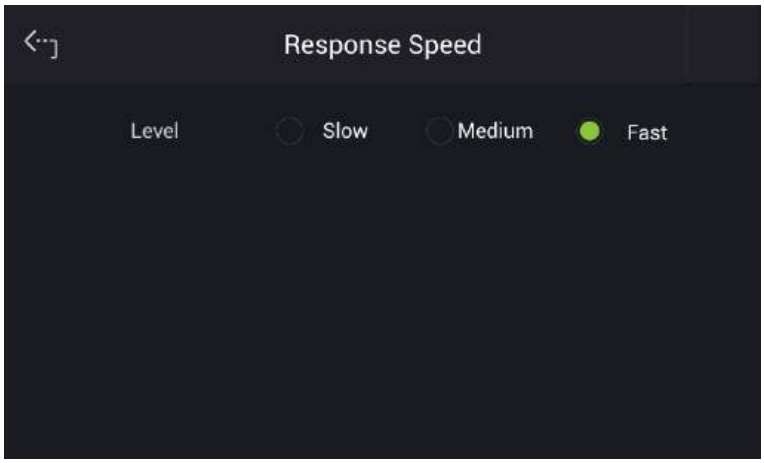
3.5.5.4 Parallel Output Mode Settings

For more information about these settings, refer to Section *3.5.1.*

Notice In the 63800R Series, parallel operation supports 3-Phase Mode only. 1-Phase Mode is not supported.

3.5.6 Response Speed

The Regenerative AC Electronic Load provides three control response speed levels: Slow, Medium, and Fast. Depending on the requirements of the UUT voltage source, the user can adjust the system response bandwidth to achieve stable loading. The default response speed is Fast.

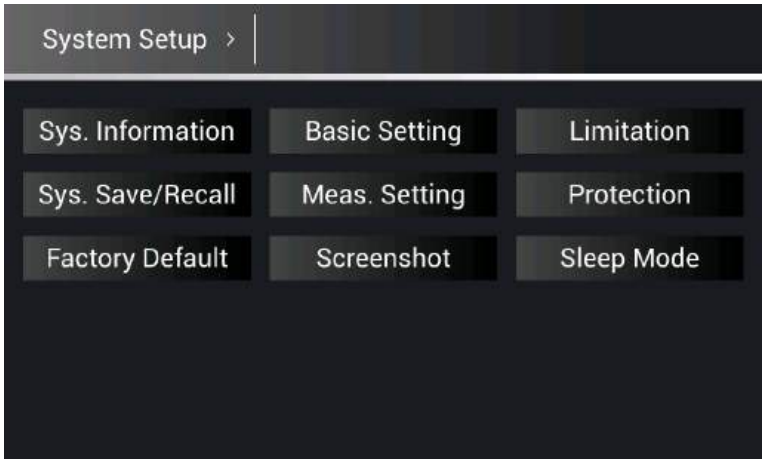


Notice The response speed level can be adjusted independently in 1-Phase Mode, 3-Phase Mode, and Parallel mode.

⚠WARNING If the user has changed the response speed to Slow, performing Factory Default resets the response speed to Fast. If the UUT cannot operate properly at the Fast response speed level, the Regenerative AC Electronic Load may enter protection mode or the UUT may malfunction.

3.6 System Setup Menu

On the Main Page, tap Menu (upper-left corner) and select System Setup. In the System Setup function menu, you will find 9 functions: Sys. Information, Sys. Save/Recall, Factory Default, Basic Setting, Screenshot, Limitation, Meas. Setting, Sleep Mode, and Protection.



3.6.1 Sys. Information

Tap Menu, System Setup, and Sys. Information to view the Regenerative AC Electronic Load system information.

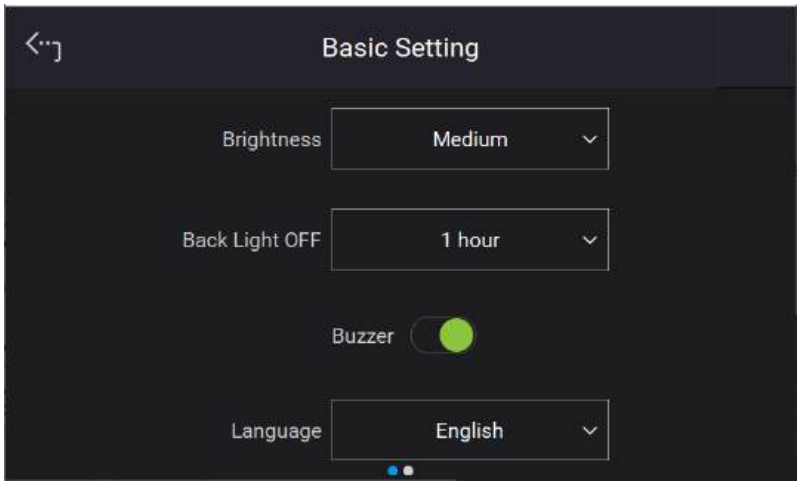
3.6.2 Basic Setting

Tap Menu, System Setup, and Basic Setup to set the LCD backlight brightness, eco mode, buzzer, language, and time/date.

Backlight: Low, Medium, High
Backlight OFF: Never, 1 min, 3 mins, 5 mins, 10 mins, 30 mins, 1 hour, 3 hours

Follow the procedure below to set the Brightness = Medium, Backlight OFF = 1 hour in 1_Phase Mode /3_Phase Mode.

1. Tap Brightness.
2. Select “Medium”.
3. Tap Backlight OFF.
4. Select “1 hour” to complete the setting.



Notice The user can press down the RPG rotary on the front panel to wake up the Regenerative AC Electronic Load during Back Light OFF.

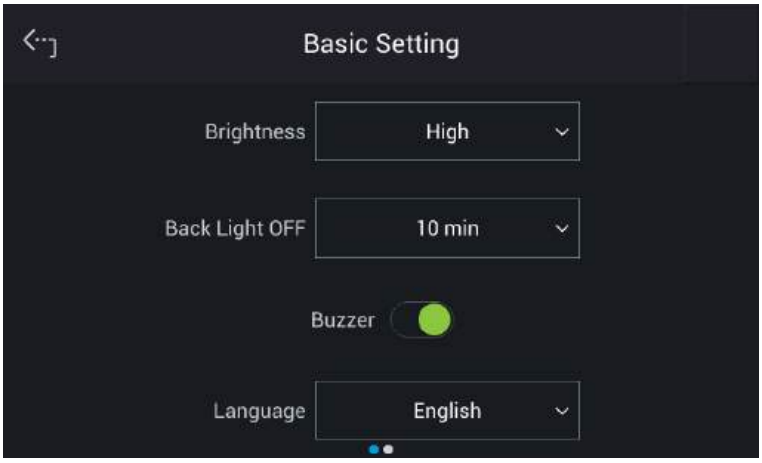
When tapping the menu on the front panel or turning the RPG rotary knob, a buzzer on the Regenerative AC Electronic Load will beep. This can be turned off.

Follow the procedure below to turn off the buzzer 1_Phase Mode /3_Phase mode.

Slide the Buzzer indicator left to disable it.

Follow the procedure below to switch the language to English in 1_Phase Mode /3_Phase mode.

1. Tap Language.
2. Select "English".

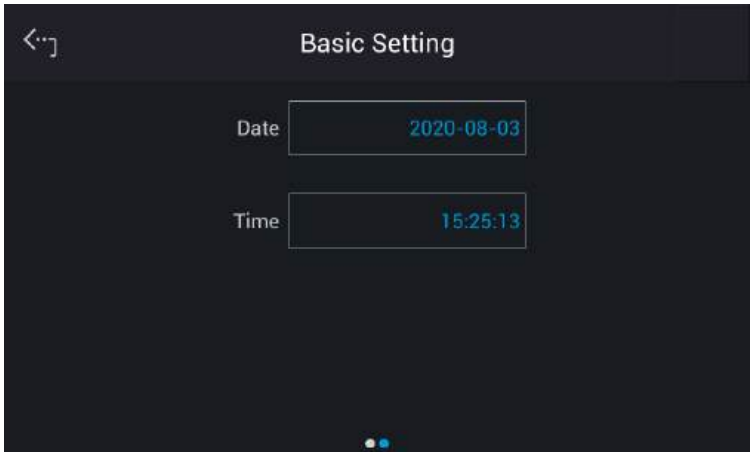


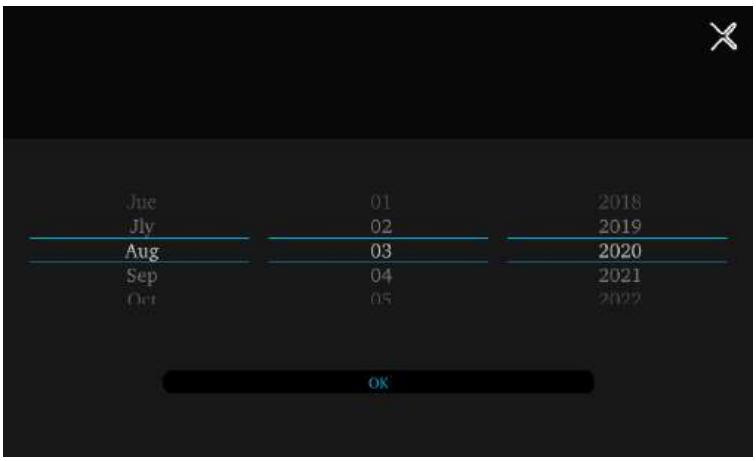
Set the time and date as follows:

Time: Hour, Minute
Date: Month, Day, Year

Follow the procedure below to set the date and time in 1_Phase Mode /3_Phase mode.

1. Slide the screen to the second page to set the Date and Time.
2. Tap the Date or Time indicator.
3. Select the desired item (Year/Month/Day/Hour/Minute/Second) to begin the setting.





3.6.3 Limitation

The limitation of the Regenerative AC Electronic Load for 1-phase and 3-phase is set individually. For instance, the Iac Limit setting will apply the settings of the 1-phase mode when changing it from the 3-phase mode. Tap Menu, System Setup, and Limitation to set Iac Limit, CF Limit, and S Limit. This command protects the user's program instead of hardware.

3.6.3.1 Iac Limit

The Iac Limit restricts the Iac value on the main page (3_Phase Mode/1_Phase Mode).

Tap "All" to choose whether the three-phase load current limit is set individually for each phase or applied to all phases simultaneously.

To set Iac Limit = 15A in 3_Phase Mode, follow the procedure below.

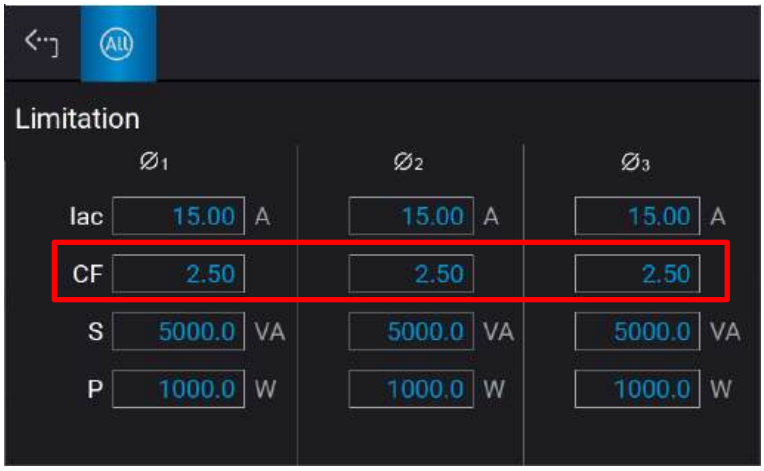
1. Tap "All".
2. Tap "Iac".
3. Enter **1**, **5**, and tap ↵ to change the value to "15.0".

3.6.3.2 CF Limit

The CF Limit restricts the CF setting on the main page (3_Phase Mode/1_Phase Mode).

The procedure for setting CF = 2.5 in 3_Phase mode is described below.

1. Tap ALL.
2. Tap “CF”.
3. Tap [2], [.], [5] and tap [↵] to change the value to “2.5”.

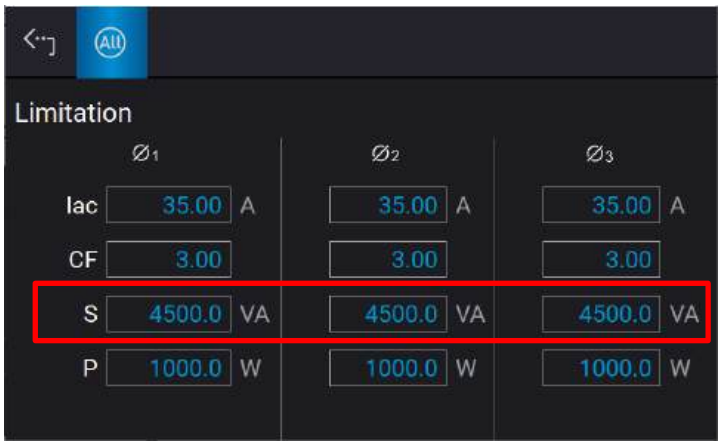


3.6.3.3 S Limit

The S Limit restricts the S value on the main page (3_Phase Mode/1_Phase Mode).

Tap “All” to set the limitation of the 3-phase loading voltage for each or all. The procedure to set S Limit = 4500VA in 3_Phase Mode is described below.

1. Tap “All”.
2. Tap “S”.
3. Enter [4], [5], [0], [0], and tap [↵] to change the value to “4500.0”.

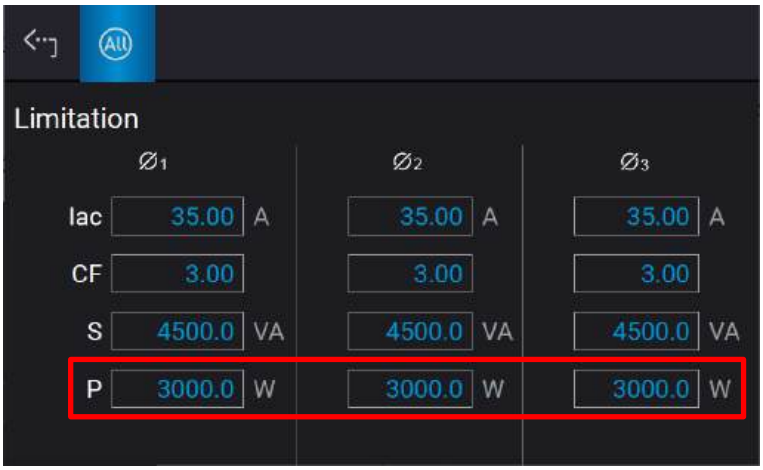


3.6.3.4 P Limit

The P Limit restricts the P value on the main page (3_Phase Mode/1_Phase Mode).

Tap All to set the limitation of the 3-phase loading power for each or all. The procedure to set P Limit = 3000W in 3_Phase Mode is described below.

1. Tap "All".
2. Tap "P".
3. Enter **3**, **0**, **0**, **0**, and tap ↵ to change the value to " 3000.0 ".



3.6.4 Sys. Save/Recall

See section *3.3.4* for details.

3.6.5 Meas. Setting

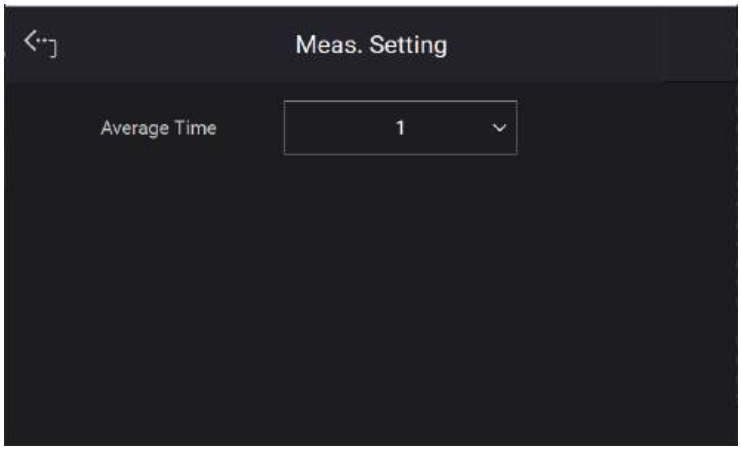
3.6.5.1 Average Times

On the Main Page, tap Menu (upper-left corner), select System Setup, and then select Meas. Setting. On this page, "Average Times" specifies the number of samples averaged for the RMS voltage/current values and the peak voltage/current values.
The Regenerative AC Electronic Load samples using a moving window method.
Average Times thus indicates how many samples are averaged within the moving window. For example, when Average Times is set to 4, the instrument averages 4 samples within the moving window.

To set the averaging count, tap the Average Times value dropdown. When a measurement fluctuates severely, you can set a higher averaging count to improve the measurement accuracy. The available settings are: 1 (default), 2, 4, 8, 16, and 32.

Follow the steps below to set the sampling averaging count to 1.

1. Tap the Average Times value dropdown.
2. Select "1".



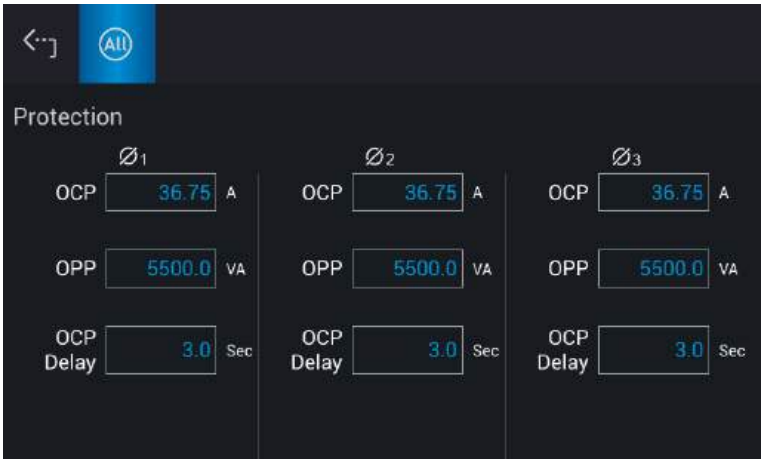
3.6.6 Loading Protection

The Regenerative AC Electronic Load's protection for 1-phase/3-phase output mode is set separately. For instance, the protection settings will apply the settings of 1-phase mode without applying the protection settings of any phase in 3-phase mode when switching from 3-phase to 1-phase mode.

Tap Menu, System Setup, and Protection to set the limit of the output RMS current (OCP), output power (OPP), and the Delay Time for triggering the current protection. The protection is only valid in Meas. & Setup (3_Phase Mode/1_Phase Mode). The purpose of this command is to protect the UUT.

The following shows the procedure of setting the current limit = 36.75 A (maximum for model 63815R-350-105), power limit = 5500 VA (maximum for model 63815R-350-105), delay time for trigger current protection = 3 sec.

1. Tap ALL.
2. Select "OCP "of Phase 1
3. Enter **3**, **6**, **.**, **7**, **5**, and tap to change the value to "36.75".
4. Tap "OPP" of phase 1.
5. Enter **5**,**5**,**0**,**0**, and tap to change the value to "5500".
6. Tap "Delay time" of phase 1.
7. Enter **3**, and tap to change the value to "3.0".



Notice

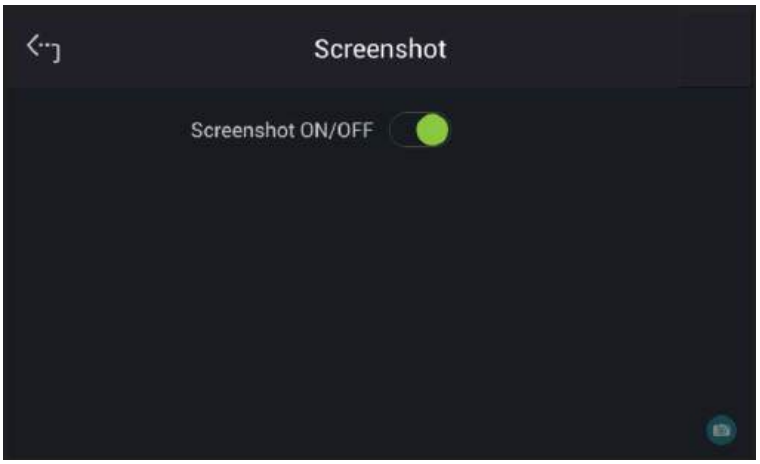
1. The setting of the delay time for current protection is only valid when the current is within the specification. When the output exceeds the specification, it is still valid if the current protection delay trigger is between the set 0.1 to 1s. However, the device will enter protection mode if it exceeds 1s. The resolution is 0.1s.
2. The protection point varies by the measurement error, thus it may act before reaching the protection point set.

Notice

When switching between 1-phase and 3-phase mode, the setting will be reset to zero to avoid damaging the Unit Under Test (UUT).

3.6.7 Screenshot

Tap Menu, System Setup, and Screenshot to access the screenshot function of the Regenerative AC Electronic Load.

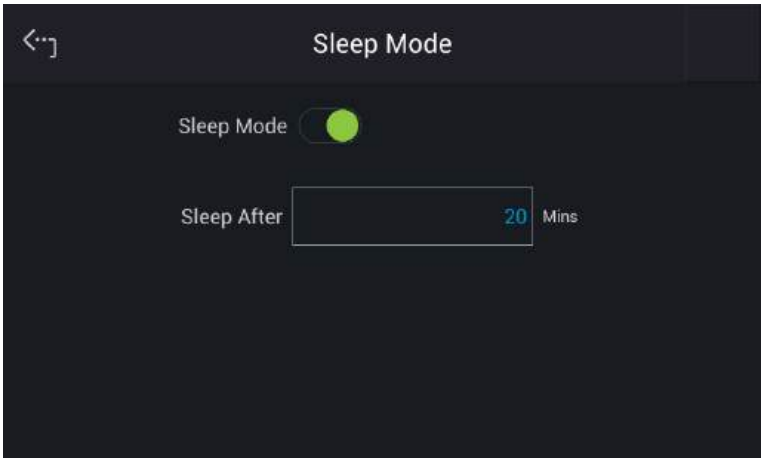


When the Screenshot function is turned to ON, a camera icon will appear at the lower right corner of the screen. Insert a USB 2.0 flash drive into the USB HOST on the front panel for file storage. Tap the camera icon to take screenshots as desired.

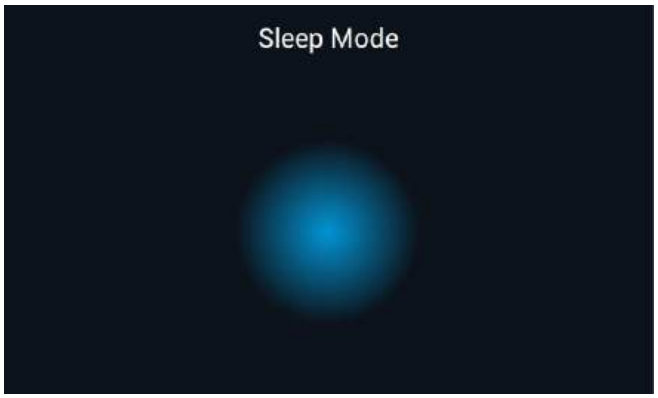
3.6.8 Sleep Mode

Tap Menu, System Setup, and Sleep Mode to set this function on the Regenerative AC Electronic Load.

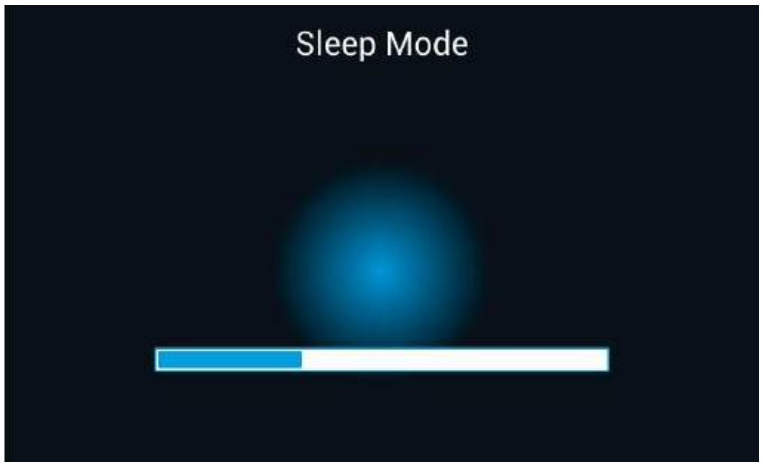
Setting the Sleep Mode to ON or OFF can determine if the Regenerative AC Electronic Load needs to enter sleep mode. You can also adjust the time before entering sleep mode. The range is 5 to 60 minutes.



When entering sleep mode, a “breathing light” animation will be displayed on the screen. At this time, the power consumption is reduced as follows to save energy: 3P220V_{LL}/60Hz = 100W; 3P380V_{LL}/60Hz = 115W; 3P480V_{LL}/60Hz = 120W.



There are two ways to restore the Regenerative AC Electronic Load to Stand-By mode. First, tap the screen once to wake up the electronic load. Second, use the command **SYSTem:SLEEP:WAKEUP** to perform the wakeup. Using these two ways can restore the electronic load to the loading state. The waiting time for waking up is about 15 seconds.

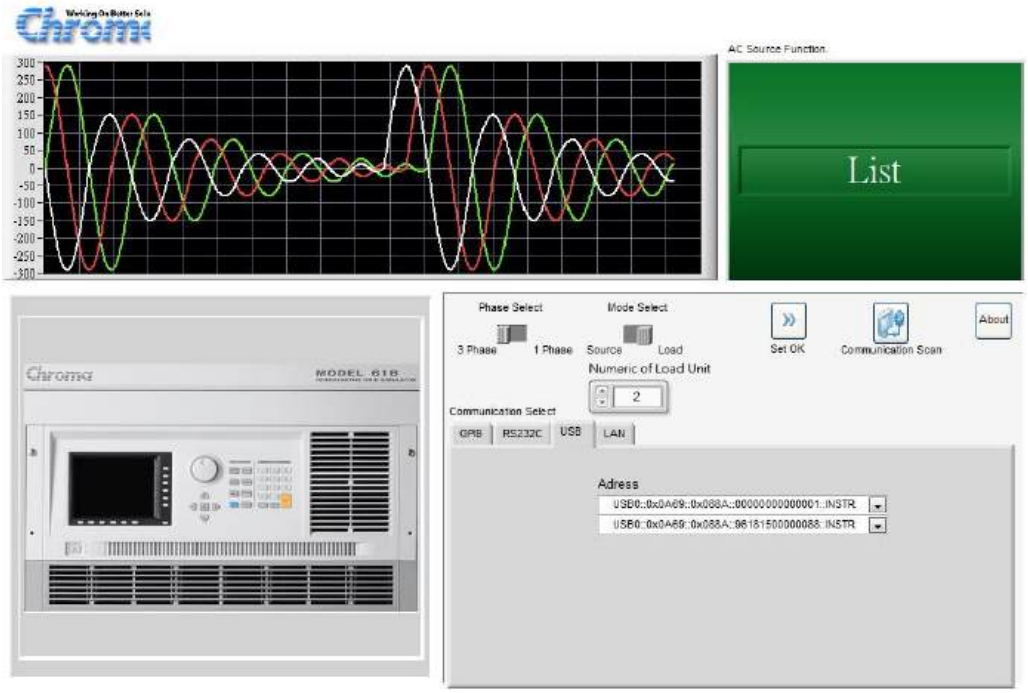


Notice

When waking the unit using SYSTem:SLEEP:WAKEUP, include a wait time of at least 15 seconds in the program, then send SYST:SLEEP:STAT? to confirm the status. If the response is STANDBY, the instrument is ready to accept the next command.
Sleep Mode is set to OFF by default.

3.7 Unified Control via SoftPanel

The Regenerative AC Electronic Load supports unified multi-unit control through Chroma's software control interface, SoftPanel. The following example describes how to configure unified control for two units using USB as the primary communication interface.



1. Open the SoftPanel settings screen.
2. For Communication Select, select USB.
3. For Phase Select, select 3 Phase.
4. For Mode Select, select Load.
5. For Number of Load Unit, set the value to 2 (maximum: 3 units).
6. Press Set OK.

Notice When using SoftPanel unified control, all Regenerative AC Electronic Loads must operate using the same communication interface. If units are connected using different communication interfaces, parallel operation may fail.

Notice SoftPanel unified control is electrically different from parallel operation configured on the instrument (single-unit UI parallel mode). When loading the same UUT voltage source, SoftPanel unified control cannot achieve the same phase-lock synchronization and transient performance as instrument parallel mode. If you require a load start angle or initial command synchronization, use the instrument UI Parallel mode. Refer to section *3.5.5.3* for more information.

Notice When using SoftPanel unified control, Stand-By mode is disabled by default. If Stand-By mode is required during parallel operation, use the instrument UI Parallel mode. Refer to section *3.5.5.3* for more information.

⚠WARNING For output wiring of each unit, refer to section *2.5*. Incorrect wiring may cause unified control to fail or may result in equipment damage.

3.8 Protection

The Regenerative AC Electronic Load has both software and hardware protection. When protection errors occur, the Regenerative AC Electronic Load will disable the output and disconnect the output relay. The display will show the protection status. There are two types of protections: recovery and latch. For recovery protection, please remove the erroneous load and tap Confirm to release protection and return to normal operation.

For latch protection, the protection cannot be released by tapping Confirm. Please remove

the erroneous load, and restart the Regenerative AC Electronic Load to regain normal operation.

The table below lists the output protections:

Message	Protection	Possible Cause	Troubleshooting
SYS_FANFAIL	Occurs when the fan is checked during power-on. (Latch)	1. The fan is blocked due to foreign objects or dust. 2. The fan is not connected. 3. The fan is broken or invalid. 4. The fan circuit is malfunctioning.	1. Check the fan on the module having protection and clear the foreign object. 2. Check the connection of the fan on the module having protection. 3. Replace the broken or invalid fan. 4. Contact your local Chroma representative, distributor, or service center.
SYS_FANLOCK	1. It prevents damage to compulsory cooling components. 2. Prevents the fan from blocking due to foreign objects or abnormal circuits. (Latch)		
SYS_OTP	The ambient temperature is too high. (Latch)		
SYS_ISHARE_ERR_SIN	1. Prevents you from incorrectly connecting the output. 2. Prevents module errors from causing unbalanced current sharing. Only valid for a standalone unit in 1-phase. (Recovery)	1. Each power module is abnormal. 2. The current sharing circuit is abnormal. 3. Digital communication is abnormal.	1. Inspect the communication cable and make sure the connection is correct. 2. Contact your local Chroma representative, distributor, or service center.
SYS_ISHARE_ERR_PAR	1. Prevents you from incorrectly connecting the output. 2. Prevents module errors from causing unbalanced current sharing. Only valid when paralleled in multiple devices. (Recovery)	1. Each power module is abnormal. 2. The current sharing circuit is abnormal. 3. Digital communication is abnormal.	1. Inspect the communication cable and make sure the connection is correct. 2. Contact your local Chroma representative, distributor, or service center.
SYS_OVP(1/2/3)	Occurs when the output voltage exceeds the system-set voltage limit. (Recovery)	1. The external source is too large. 2. The external inductive load is open.	1. Make sure the external circuit is correct. 2. Check if the circuit is short-circuited. 3. Confirm the

Message	Protection	Possible Cause	Troubleshooting
		3. The UUT capacitive load is too big.	external circuit characteristics.
SYS_OCP(1/2/3)	It occurs when the output current exceeds the system-set current limit. (Recovery)	1. The UUT impedance is too low. 2. Temporary short circuit. 3. The RCD load impedance is too small. 4. The UUT capacitive load is too big.	1. Remove the UUT and make sure the protection value is correctly set. 2. Remove the UUT and confirm its correctness. 3. Add a current limit resistor. 4. Set the voltage slew rate.
SYS_OPP(1/2/3)	It occurs when the output power exceeds the system-set power limit. (Recovery)	1. The UUT impedance is too low. 2. Temporary short circuit.	1. Remove the UUT and make sure the protection value is correctly set. 2. Remove the UUT and confirm its correctness.
SELF_TEST_NG(1/2/3)	It occurs when the auxiliary power of the DC/AC power module is running self-detect protection. (Latch)	1. The auxiliary power of the DC/AC module is abnormal. 2. The measurement circuit of the DC/AC module is having an error. 3. The digital module is having an error.	Contact your local Chroma representative, distributor, or service center.
SYS_DA_COM_ERR (1/2/3)	It occurs when checking the communication status between the Host and the DC/AC module. (Latch)	1. The auxiliary power of the DC/AC module is abnormal. 2. The Host auxiliary power is abnormal. 3. The communication cable is abnormal.	1. Check if the communication cable is correctly connected. 2. Contact your local Chroma representative, distributor, or service center.
SYS_AD_COM_ERR (1/2/3)	It occurs when checking the communication status between the Host and the AC/DC module. (Latch)	1. The auxiliary power of the AC/DC module is abnormal. 2. The Host auxiliary power	1. Check if the communication cable is correctly connected. 2. Contact your local Chroma

Message	Protection	Possible Cause	Troubleshooting
		is abnormal. 3. The communication cable is abnormal.	representative, distributor, or service center.
SYS_PAR_EMARGE	The occurred digital communication error causes abnormal parallel output when paralleled multiple devices. (Recovery)	1. The auxiliary power of the DC/AC module is abnormal. 2. The Host auxiliary power is abnormal. 3. The communication cable is abnormal.	1. Check if the communication cable is correctly connected. 2. Contact your local Chroma representative, distributor, or service center.
SYS_PAR_COM_ERR			
SYS_PAR_WIRE_LOSS			
SYS_REMOTE_INHIBIT	Occurs when the remote is inhibited.		Check if the communication cable is correctly connected.
SYS_AD_NO_MAIN	The main program for the power-on AC/DC module self-test is abnormal.	The AC/DC module triggers protection.	Contact your local Chroma representative, distributor, or service center.
SYS_DA_NO_MAIN	The main program for the power-on DC/AC module self-test is abnormal.	The DC/AC module triggers protection.	Contact your local Chroma representative, distributor, or service center.
SYS_DSP_NO_MAIN	The main program for the power-on HOST self-test is abnormal.	The HOST triggers protection.	Contact your local Chroma representative, distributor, or service center.
SYS_CALI_BND_ERR	The calibrated value of the power-on test is out of range.	The HOST triggers protection.	Contact your local Chroma representative, distributor, or service center.

The table below lists the module protection:

Message	Protection	Possible Cause	Troubleshooting
AD_VDC_OVP(1/2/3)	Occurs when the AC/DC power module outputs over VDC voltage. (Latch)	1. The output transient power is too high (the protection phase VDC is over 850V.) (Regen mode) 2. The AC/DC	1. Remove the UUT and make sure the operation is correct. 2. Contact your local Chroma representative, distributor, or

Message	Protection	Possible Cause	Troubleshooting
		module measurement circuit is abnormal.	service center.
AD_VDC_UVP(1/2/3)	Occurs when the AC/DC power module outputs under VDC voltage. (Latch)	1. The output transient power is too high (the protection phase VDC is under 720V.) (Source mode) 2. The AC/DC module measurement circuit is abnormal. 3. The AC/DC module relay drive signal is abnormal or the relay is damaged 4. The AC/DC module PWM drive signal is abnormal. 5. The AC/DC power module is abnormal or damaged.	1. Remove the UUT and make sure the operation is correct. 2. Contact your local Chroma representative, distributor, or service center.
AD_VAC_UBL(1/2/3)	It indicates that the line input is unbalanced or phase failure. (Latch)	1. The input power supply is connected wrong (V_{LL} difference 10%). 2. The input power has phase failure. 3. The AC/DC module fuse is broken. 4. The AC/DC module measurement circuit is abnormal.	1. Check if the 3-phase input line voltage meets the rated value. 2. Measure the AC/DC module fuse and replace it. 3. Contact your local Chroma representative, distributor, or service center.
AD_VRS_OVP(1/2/3) AD_VTR_OVP(1/2/3) AD_VST_OVP(1/2/3) AD_Vd_OVP(1/2/3)	It indicates that the line input voltage is over the specification. (Latch)	1. The input power is abnormal. 2. The AC/DC module measurement circuit is	1. Check if the input power meets the rated value. 2. Contact your local Chroma representative,

Message	Protection	Possible Cause	Troubleshooting
		abnormal.	distributor, or service center.
AD_VRS_UVP(1/2/3) AD_VTR_UVP(1/2/3) AD_VST_UVP(1/2/3) AD_Vd_UVP(1/2/3)	It indicates that the line input voltage is under the specification. (Latch)	1. The input power is abnormal. 2. The AC/DC module input fuse is broken. 3. The AC/DC module measurement circuit is abnormal.	1. Check if the input power meets the rated value. 2. Contact your local Chroma representative, distributor, or service center.
AD_IR_OCP(1/2/3) AD_IS_OCP(1/2/3) AD_IT_OCP(1/2/3)	It indicates that the line input current is over the limit. (Latch)	1. The output transient power is too high. 2. The AC/DC module measurement circuit is abnormal.	1. Remove the UUT and make sure the operation is correct. 2. Contact your local Chroma representative, distributor, or service center.
AD_OTP(1/2/3)	It occurs when the internal temperature of the AC/DC power module is too high. (Latch)	1. The operating environment temperature is over. 2. The module power switch is abnormal. 3. The circuit detection is malfunctioning. 4. The detecting transformer is malfunctioning.	1. Eliminate the ambient overheating problem. 2. Contact your local Chroma representative, distributor, or service center.
AD_TF_OTP(1/2/3) DA_TF_OTP(1/2/3)	It occurs when the internal temperature of the power module transformer is too high. (Recovery)		
DA_OTP(1/2/3)	It occurs when the internal temperature of the DC/AC power module is too high. (Latch)		
DA_UTP(1/2/3)	It occurs when the internal temperature of the DC/AC power module is too low. (Latch)		
AD_FRE_ERR(1/2/3)	It protects the module side when the AC/DC power module input voltage and frequency are abnormal. (Latch)	1. The input power is abnormal. 2. The AC/DC module input fuse is broken. 3. The AC/DC module measurement circuit is abnormal.	1. Check if the input power meets the rated value. 2. Contact your local Chroma representative, distributor, or service center.

Message	Protection	Possible Cause	Troubleshooting
AD_PFC_STARTFAIL (1/2/3) AD_AC_STARTFAIL(1/2/3) DD_LLC_STARTFAIL (1/2/3) DD_LLC_STARTFAIL(1/2/3)	It protects the module side when the AC/DC power module start fails. (Latch)	1. The input power is abnormal. 2. The AC/DC module input fuse is broken. 3. The AC/DC module measurement circuit is abnormal.	1. Check if the input power meets the rated value. 2. Contact your local Chroma representative, distributor, or service center.
AD_MEM_ERR(1/2/3)	The AC/DC power module CPU self-tests if the memory is operating normally. (Latch)	1. The digital circuit of the power supply module is abnormal. 2. The AC/DC module CPU is abnormal.	Contact your local Chroma representative, distributor, or service center.
AD_HARD_ERR(1/2/3)	It prevents other AC/DC power modules or tablet power supply abnormalities from causing the DC/AC power module to output abnormal voltage to the output end.	1. The D board input voltage is <22Vdc. 2. All protections occurred by any pre-stages and notify the pre-stages of other groups.	Contact your local Chroma representative, distributor, or service center.
AD_PWM_TOP_FAULT (1/2/3) AD_PWM_BOT_FAULT (1/2/3)	It is the AC/DC power module that drives signal protection. (Latch)	1. The drive signal is abnormal (the power parts are short-circuited.) 2. The AC/DC module digital circuit is abnormal.	Contact your local Chroma representative, distributor, or service center.
DA_PWM_R_FAULT(1/2/3) DA_PWM_L_FAULT(1/2/3)	It is the DC/AC power module that drives signal protection. (Latch)	1. The DC/AC module digital circuit is abnormal.	
DD_IP_OCP(1/2/3)	DC/DC power module primary side over current protection. (Latch)	1. The output transient power is too high. 2. The DC/DC module measurement circuit is abnormal.	1. Remove the UUT and make sure the operation is correct. 2. Contact your local Chroma representative, distributor, or service center.

Message	Protection	Possible Cause	Troubleshooting
DD_IO_SRC_OCP(1/2/3)	It is the DC/DC power module's secondary side over current protection. (Latch)	1. The output transient power is too high. 2. The DC/DC module measurement circuit is abnormal.	1. Remove the UUT and make sure the operation is correct. 2. Contact your local Chroma representative, distributor, or service center.
DD_IO_REG_OCP(1/2/3)			
DD_VO_OVP_F(1/2/3)	It is the DC/DC power module's secondary side over-voltage protection in a transient state. (Latch)	1. The input power is abnormal. 2. The DC/DC module measurement circuit is abnormal.	1. Check if the input power meets the rated value. 2. Contact your local Chroma representative, distributor, or service center.
DD_VO_UVP_S(1/2/3)	It is the DC/DC power module's secondary side under voltage protection in a steady state. (Latch)	1. The input power is abnormal. 2. The AC/DC module input fuse is broken. AC/DC 3. The DC/DC module measurement circuit is abnormal.	1. Check if the input power meets the rated value. 2. Measure the AC/DC module input fuse and replace it. 3. Contact your local Chroma representative, distributor, or service center.
DD_VO_UVP_F(1/2/3)	It is the DC/DC power module's secondary side under voltage protection in a transient state. (Latch)		
DD_SHORT(1/2/3)	It is the primary side over current protection of the DC/DC power module. (Latch)	1. The DC/DC power module drive signal is abnormal (the power parts are short-circuited.) 2. The DC/AC power module output is abnormal.	Contact your local Chroma representative, distributor, or service center.
DA_OVP(1/2/3)	Occurs when the transient output voltage exceeds the module voltage limit or voltage specification. (Latch)	1. The external source is too large. 2. The external inductive load is open. 3. The UUT capacitive load is too big.	1. Make sure the external circuit is correct. 2. Check if the circuit is short-circuited. 3. Confirm the external circuit characteristics.
DA_OCP(1/2/3)	It occurs when the transient output	1. The UUT impedance is	1. Remove the UUT and make sure

Message	Protection	Possible Cause	Troubleshooting
	current exceeds the module current limit or current specification. (Latch)	too low. 2. Temporary short circuit. 3. The RCD load impedance is too small. 4. The UUT capacitive load is too big.	the protection value is correctly set. 2. Remove the UUT and confirm its correctness. 3. Add a current limit resistor. 4. Set the voltage slew rate.
DA_OCP_S(1/2/3)	It occurs when the transient RMS output current exceeds the module current limit or current specification. (Latch)	1. The UUT impedance is too low. 2. The temporary loading RMS current is too large to cause SYS_OCP (1/2/3) and the protection speed is not enough.	1. Remove the UUT and make sure the protection value is correctly set. 2. Remove the UUT and confirm its correctness.
DA_OPP(1/2/3)	It occurs when the transient output power exceeds the module power limit or power specification. (Latch)	1. The UUT impedance is too low. 2. Temporary short circuit.	1. Remove the UUT and make sure the protection value is correctly set. 2. Remove the UUT and confirm its correctness.
DA_SENSE_FAULT(1/2/3)	It occurs when the remote voltage sensing function is on and the signal line is not connected or wrong. (Recovery)	1. The remote sense wiring is not connected or connected wrong. 2. The remote connection impedance is too large. 3. The output relay malfunctions.	1. Check the remote sense wiring. 2. Shorten the distance to UUT and eliminate the impedance. 3. Contact your local Chroma representative, distributor, or service center.
DA_SHORT(1/2/3)	It occurs when the output is short-circuited. (Recovery)	1. The UUT impedance is too low. 2. Temporary short circuit.	1. Remove the UUT and confirm its correctness. 2. Make sure the external connection is correct.
DA_HARD_ERR(1/2/3)	It prevents the AC/DC power module or the digital power supply from being abnormal,	1. The auxiliary power supply on the digital board is abnormal. 2. The AC/DC	Contact your local Chroma representative, distributor, or service center.

Message	Protection	Possible Cause	Troubleshooting
	causing the DC/AC power module to output abnormal voltage.	module triggers protection.	
DA_FW_PWMSHORT (1/2/3)	It indicates that the digital control signal of the DC/AC power module is abnormal. (Latch)	1. The DC/AC power module digital control board is broken. 2. The auxiliary power supply on the DC/AC power module digital board is abnormal.	Contact your local Chroma representative, distributor, or service center.
DA_ISHARE_ERR_F (1/2/3)	1. It prevents you from incorrectly connecting the output. 2. It prevents module errors from causing unbalanced current sharing. (Recovery)	1. The digital control board on the DC/AC power module is broken. 2. The measurement circuit on the DC/AC power module board is abnormal. 3. The output relay is malfunctioning.	Contact your local Chroma representative, distributor, or service center.
DA_IC_OCP(1/2/3)	It prevents damage to the components of DC/AC power modules. (Recovery)	1. The digital control board on the DC/AC power module is broken. 2. The passive component circuit on the DC/AC power module is abnormal. 3. The measurement circuit on the DC/AC power module board is abnormal.	Contact your local Chroma representative, distributor, or service center.
DA_Vdamp_OVP(1/2/3)	It prevents damaging the damping resistance under abnormal operation. (Recovery)		
DA_UUT_UVP(1/2/3)	It means the UUT voltage is too low.	The DC/AC module triggers protection.	1. Remove the UUT and confirm its correctness. 2. Make sure the external connection is correct.
DA_UUT_OFP(1/2/3)	It means the UUT voltage frequency is over the operating range.		
DA_UUT_UFP(1/2/3)	It means the UUT voltage frequency is		

Message	Protection	Possible Cause	Troubleshooting
	under the operating range.		
DA_UUT_OVP_VDC *1 (1/2/3)	It means the UUT voltage has too much DC voltage component.		
DA_UUT_fault *2	It means the UUT frequency has changed too much, and it cannot be restored to carry on loading.	The DC/AC module triggers protection.	1. Remove the UUT and confirm its correctness. 2. Make sure the external connection is correct.
DA_PLL_FAIL *3	It means the DC/AC module phase lock is abnormal.	The DC/AC module triggers protection.	1. Remove the UUT and confirm its correctness. 2. Make sure the external connection is correct. 3. Contact your local Chroma representative, distributor, or service center.
DA_SRAM_ERR	It means the DA_SRAM power-on test is abnormal.	The DC/AC module triggers protection.	Contact your local Chroma representative, distributor, or service center.

Notice

The protection message is marked _F(FAST) and _S(SLOW) by transient and steady state.
The protection point varies by the measurement error, thus it may act before reaching the protection point set.

Note

*1: It measures the UUT phase voltage to be ±30Vdc, and the protection trips after counting for 5 seconds.
*2: It measures the UUT to be Vthd>2%, and the protection trips after counting for 5s. Vthd may rise abnormally due to the zero-point distortion of the UUT voltage waveform, and the high voltage change rate near the voltage zero point may cause the current to spike, directly triggering the protection. Adjusting the Stand-By mode response speed described in section *3.5.4* to SLOW can increase the voltage distortion tolerance of the Regenerative AC Electronic Load.
*3: The Regenerative AC Electronic Load detects phase lock abnormality and trips protection after counting for 5 seconds. The possible cause is that the voltage waveform changes due to the instability of the UUT, resulting in the Regenerative AC Electronic Load being unable to load within the specification-defined range.

3.9 Verification

3.9.1 Introduction

This chapter contains test procedures for checking the operation and specification of the Chroma 63800R Series Regenerative AC Electronic Load. The tests are performed using the 63800R Series models and some required equipment. The required test equipment is listed in Table 3-1. Please refer to the *Performance Tests* section for equipment connection and test procedure. You can use the verification tables included in the measurement verification section to validate the specification. For detailed information on operation and programming please refer to *Chapter 3 and Chapter 5.*

If any of the models covered in the manual (63809R-350-87/63812R-350-96/63815R-350-105) require service, please refer to your local Chroma Sales and Support Office: https://www.chromaate.com/en/chroma/global/americas

3.9.2 Equipment Required

The following table lists the equipment or its equivalent required for verification.

Table 3-1 Equipment Recommended for Verification

Equipment	Characteristics	Recommended Model
Current Transducer	400A	DC-CT (IT 400-S)
Power Meter		Chroma 66204 ×1 set Chroma A662020 ×1 set (DC-CT Power)
AC Source	$105A_{peak}$ $0\text{-}35A_{RMS}$ $0\text{-}350V_{RMS}$ 30-100Hz,DC	Chroma 61815 ×1 set
Regenerative AC Electronic Load		Chroma 63809R-350-87/63812R-350-96/63815R-350-105

Connection
Connect the Regenerative AC Electronic Load, AC Source, Power Meter, and Current Transducer as shown in Figure 3-5.

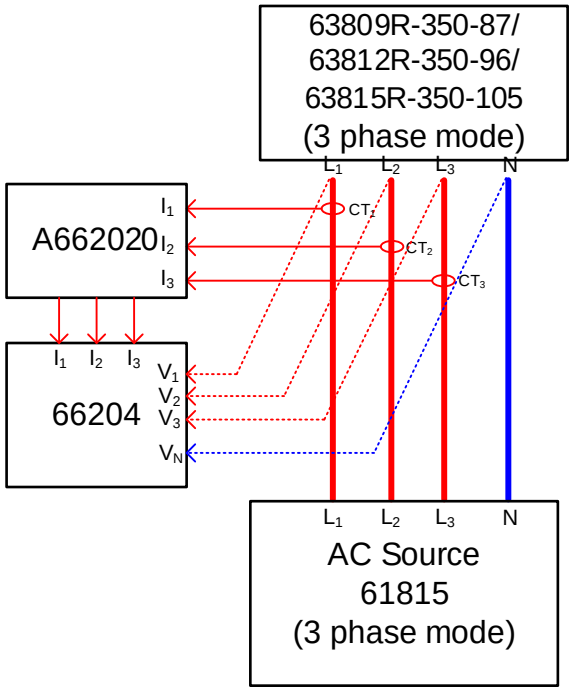


Figure 3-5

Notice

When verifying the Chroma 63800R Series Regenerative AC Electronic Loads, be sure to connect the remote sense cable to the AC Source output terminal. Refer to section *2.5* for the connection in detail.

3.9.3 Performance Tests

3.9.3.1 Current and CF Setting and Measurement Verification in CC Rectified Mode

This test verifies if the current setting and measurement accuracy are within specifications when operating in Meas. & Setup (3_Phase) CC Rectified mode. For each Power Meter reading, the front panel display of the current measurement should be within the specification.

Regenerative AC Electronic Load reading amps = current setting ± inaccuracy

PM (Vac): V_{RMS} voltage measurement of Power Meter AC voltage
PM (Iac): I_{RMS} current measurement of Power Meter AC
PM (CF): CF measurement of Power Meter AC

Checking current

A. Connect the Regenerative AC Electronic Load, AC Source, Power Meter, and Current Transducer as shown in *Figure 3-5*. Use the Power Meter to measure the AC Iac current.
B. Enter the Meas. & Setup (3_Phase Mode) page to start performing the load verification

listed in Table 3-2.

C. Load the test current. Power on the AC Source and set the output voltage (sinewave) as shown in Table 3-2. The current protection of the AC Source must be greater than $35A_{RMS}$ with power protection larger than 5kVA.

Table 3-2 Current Setting and Measurement Verification Table (with Load)

Φ1									
Model	**Current (std.)**	**Output Voltage**	**CF**	**Current Accuracy**		**PM(Iac) Current**	**Panel Measured Current**	**Panel Display Current Spec.**	**CF Spec. 3% F.S PM(CF)**
				Max.	**Min.**				
63809R-350-87	29A	50V	2.000	29.23A	28.76A			Std. ±0.20A	
	20A	150V	2.000	20.20A	19.79A			Std. ±0.16A	
	12A	250V	2.000	12.18A	11.81A			Std. ±0.13A	
	8A	350V	2.000	8.16A	7.83A			Std. ±0.11A	
63812R-350-96	32A	50V	2.000	32.25A	31.74A			Std. ±0.22A	
	25A	150V	2.000	25.23A	24.76A			Std. ±0.19A	
	16A	250V	2.000	16.20A	15.79A			Std. ±0.16A	
	11A	350V	2.000	11.19A	10.80A			Std. ±0.14A	
63815R-350-105	35A	50V	2.000	35.28A	34.72A			Std. ±0.24A	
	25A	150V	2.000	30.26A	29.73A			Std. ±0.20A	
	18A	250V	2.000	18.22A	17.77A			Std. ±0.17A	
	12A	350V	2.000	12.21A	11.78A			Std. ±0.15A	
Φ2									
Model	**Current (std.)**	**Output Voltage**	**CF**	**Current Accuracy**		**PM(Iac) Current**	**Panel Measured Current**	**Panel Display Current Spec.**	**CF Spec. 3% F.S PM(CF)**
				Max.	**Min.**				
63809R-350-87	29A	50V	2.000	29.23A	28.76A			Std. ±0.20A	
	20A	150V	2.000	20.20A	19.79A			Std. ±0.16A	
	12A	250V	2.000	12.18A	11.81A			Std. ±0.13A	
	8A	350V	2.000	8.16A	7.83A			Std. ±0.11A	
63812R-350-96	32A	50V	2.000	32.25A	31.74A			Std. ±0.22A	
	25A	150V	2.000	25.23A	24.76A			Std. ±0.19A	
	16A	250V	2.000	16.20A	15.79A			Std. ±0.16A	
	11A	350V	2.000	11.19A	10.80A			Std. ±0.14A	
63815R-350-105	35A	50V	2.000	35.28A	34.72A			Std. ±0.24A	
	25A	150V	2.000	30.26A	29.73A			Std. ±0.20A	
	18A	250V	2.000	18.22A	17.77A			Std. ±0.17A	
	12A	350V	2.000	12.21A	11.78A			Std. ±0.15A	
Φ3									
Model	**Current (std.)**	**Output Voltage**	**CF**	**Current Accuracy**		**PM(Iac) Current**	**Panel Measured Current**	**Panel Display Current Spec.**	**CF Spec. 3% F.S PM(CF)**
				Max.	**Min.**				
63809R-350-87	29A	50V	2.000	29.23A	28.76A			Std. ±0.20A	
	20A	150V	2.000	20.20A	19.79A			Std. ±0.16A	
	12A	250V	2.000	12.18A	11.81A			Std. ±0.13A	
	8A	350V	2.000	8.16A	7.83A			Std. ±0.11A	
63812R-350-96	32A	50V	2.000	32.25A	31.74A			Std. ±0.22A	
	25A	150V	2.000	25.23A	24.76A			Std. ±0.19A	
	16A	250V	2.000	16.20A	15.79A			Std. ±0.16A	
	11A	350V	2.000	11.19A	10.80A			Std. ±0.14A	
63815R-350-105	35A	50V	2.000	35.28A	34.72A			Std. ±0.24A	
	25A	150V	2.000	30.26A	29.73A			Std. ±0.20A	
	18A	250V	2.000	18.22A	17.77A			Std. ±0.17A	
	12A	350V	2.000	12.21A	11.78A			Std. ±0.15A	

3.9.3.2 Power and CF Setting and Measurement Verification in CS Rectified Mode

This test verifies if the power setting and measurement accuracy are within specifications when operating in Meas. & Setup (3_Phase) CS Rectified mode. For each Power Meter reading, the front panel display of power measurement should be within the specification.

Regenerative AC Electronic Load reading power = power setting ± inaccuracy

PM (Vac): V_{RMS} voltage measurement of Power Meter AC voltage
PM (S): VA measurement of Power Meter apparent power S
PM (CF): CF measurement of Power Meter AC voltage

Checking current

A. Connect the Regenerative AC Electronic Load, AC Source, Power Meter, and Current Transducer as shown in *Figure 3-5*. Use the Power Meter to measure the apparent power S.
B. Enter Meas. & Setup (3_Phase Mode) to perform the verification listed in Table 3-3.
C. Turn on the AC Source and set the output voltage (sinewave) as Table 3-3 shows. The current protection of the AC Source must be greater than $35A_{RMS}$ with power protection larger than 5kVA.

Table 3-3 Power Measurement Verification Table

Φ1									
Model	**Power (std.)**	**Output Voltage**	**CF**	**Power Accuracy**		**PM(S) Power**	**Panel Measured power**	**Panel Display Power Spec.**	**CF Spec. 3% F.S PM(CF)**
				Max.	**Min.**				
63809R-350-87	1200VA	50V	1.414	1212.6VA	1187.4VA			Std. ±28.8VA	
	2000VA	150V	1.414	2015.0VA	1985.0VA			Std. ±32.0VA	
	2500VA	250V	1.414	2516.5VA	2483.5VA			Std. ±34.0VA	
	3000VA	350V	1.414	3018.0VA	2982.0VA			Std. ±36.0VA	
63812R-350-96	1500VA	50V	1.414	1516.5VA	1483.5VA			Std. ±38.0VA	
	2500VA	150V	1.414	2519.5VA	2480.5VA			Std. ±42.0VA	
	3000VA	250V	1.414	3021.0VA	2979.0VA			Std. ±44.0VA	
	4000VA	350V	1.414	4024.0VA	3976.0VA			Std. ±48.0VA	
63815R-350-105	1600VA	50V	1.414	1619.8VA	1580.2VA			Std. ±46.4VA	
	2500VA	150V	1.414	2522.5VA	2477.5VA			Std. ±50.0VA	
	3500VA	250V	1.414	3525.5VA	3474.5VA			Std. ±54.0VA	
	5000VA	350V	1.414	5030.0VA	4970.0VA			Std. ±60.0VA	

Φ2									
Model	**Power (std.)**	**Output Voltage**	**CF**	**Power Accuracy**		**PM(S) Power**	**Panel Measured power**	**Panel Display Power Spec.**	**CF Spec. 3% F.S PM(CF)**
				Max.	**Min.**				
63809R-350-87	1200VA	50V	1.414	1212.6VA	1187.4VA			Std. ±28.8VA	
	2000VA	150V	1.414	2015.0VA	1985.0VA			Std. ±32.0VA	
	2500VA	250V	1.414	2516.5VA	2483.5VA			Std. ±34.0VA	
	3000VA	350V	1.414	3018.0VA	2982.0VA			Std. ±36.0VA	
63812R-350-96	1500VA	50V	1.414	1516.5VA	1483.5VA			Std. ±38.0VA	
	2500VA	150V	1.414	2519.5VA	2480.5VA			Std. ±42.0VA	
	3000VA	250V	1.414	3021.0VA	2979.0VA			Std. ±44.0VA	
	4000VA	350V	1.414	4024.0VA	3976.0VA			Std. ±48.0VA	
63815R-350-105	1600VA	50V	1.414	1619.8VA	1580.2VA			Std. ±46.4VA	
	2500VA	150V	1.414	2522.5VA	2477.5VA			Std. ±50.0VA	
	3500VA	250V	1.414	3525.5VA	3474.5VA			Std. ±54.0VA	
	5000VA	350V	1.414	5030.0VA	4970.0VA			Std. ±60.0VA	
Φ3									
Model	**Power (std.)**	**Output Voltage**	**CF**	**Power Accuracy**		**PM(S) Power**	**Panel Measured power**	**Panel Display Power Spec.**	**CF Spec. 3% F.S PM(CF)**
				Max.	**Min.**				
63809R-350-87	1200VA	50V	1.414	1212.6VA	1187.4VA			Std. ±28.8VA	
	2000VA	150V	1.414	2015.0VA	1985.0VA			Std. ±32.0VA	
	2500VA	250V	1.414	2516.5VA	2483.5VA			Std. ±34.0VA	
	3000VA	350V	1.414	3018.0VA	2982.0VA			Std. ±36.0VA	
63812R-350-96	1500VA	50V	1.414	1516.5VA	1483.5VA			Std. ±38.0VA	
	2500VA	150V	1.414	2519.5VA	2480.5VA			Std. ±42.0VA	
	3000VA	250V	1.414	3021.0VA	2979.0VA			Std. ±44.0VA	
	4000VA	350V	1.414	4024.0VA	3976.0VA			Std. ±48.0VA	

-Continued on next page-

63815R-350-105	1600VA	50V	1.414	1619.8VA	1580.2VA			Std. ±46.4VA	
	2500VA	150V	1.414	2522.5VA	2477.5VA			Std. ±50.0VA	
	3500VA	250V	1.414	3525.5VA	3474.5VA			Std. ±54.0VA	
	5000VA	350V	1.414	5030.0VA	4970.0VA			Std. ±60.0VA	

3.9.3.3 Resistance Setting and Measurement Verification in CR Mode CR Mode

This test verifies if the resistance setting and measurement accuracy are within specifications when operating in Meas. & Setup (3_Phase) CR mode. For each Power Meter reading, the front panel display of the current measurement should be within the specification.

Regenerative AC Electronic Load reading current = resistance setting (convert to current) ± inaccuracy

PM (Vac): V_{RMS} voltage measurement of Power Meter AC voltage
PM (Iac): I_{RMS} measurement of Power Meter AC
ACL (F): Frequency measurement of AC voltage of Regenerative AC Electronic Load

Checking current

A. Connect the Regenerative AC Electronic Load, AC Source, Power Meter, and Current Transducer as shown in Figure 3-5. Use the Power Meter to measure the AC I_{RMS}.
B. Enter into Meas. & Setup (3_Phase Mode) to start performing the verification listed in Table 3-4.
C. Turn on the AC Source and set the output voltage (sinewave) as Table 3-4 shows. The current protection of the AC Source must be greater than $35A_{RMS}$ with power protection larger than 5kVA.

Table 3-4 Resistance Setting and Measurement Verification Table (with Load)

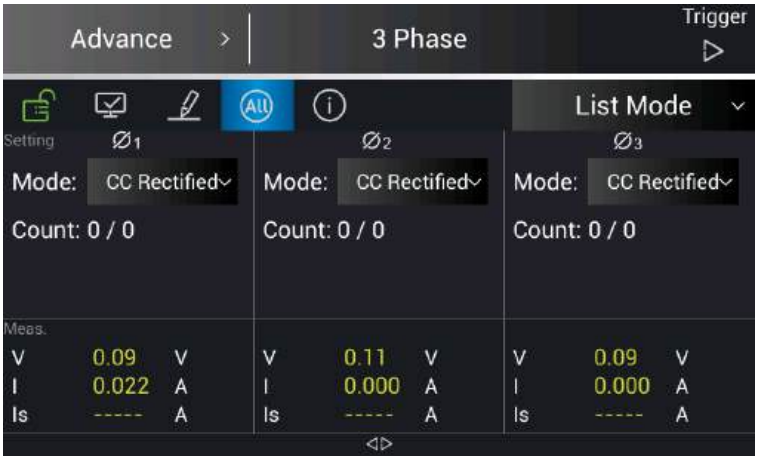
Φ1								
Model	**Resistance (std.)**	**Output Voltage**	**Current Accuracy**		**PM(Iac) Current**	**Panel Measured Current**	**Panel Display Current Spec.**	**CF Spec. 3% F.S PM(CF)**
			Max.	**Max.**				
63809R-350-87	1.72Ω	50V	29.23A	28.76A			Std. ±0.20A	
	7.5Ω	150V	20.20A	19.79A			Std. ±0.16A	
	20.83Ω	250V	12.18A	11.81A			Std. ±0.13A	
	43.75Ω	350V	8.16A	7.83A			Std. ±0.11A	
63812R-350-96	1.56Ω	50V	32.25A	31.74A			Std. ±0.22A	
	6Ω	150V	25.23A	24.76A			Std. ±0.19A	
	15.62Ω	250V	16.20A	15.79A			Std. ±0.16A	
	31.81Ω	350V	11.19A	10.80A			Std. ±0.14A	
63815R-350-105	1.42Ω	50V	35.28A	34.72A			Std. ±0.24A	
	6Ω	150V	30.26A	29.73A			Std. ±0.20A	
	13.88Ω	250V	18.22A	17.77A			Std. ±0.17A	
	29.16Ω	350V	12.21A	11.78A			Std. ±0.15A	

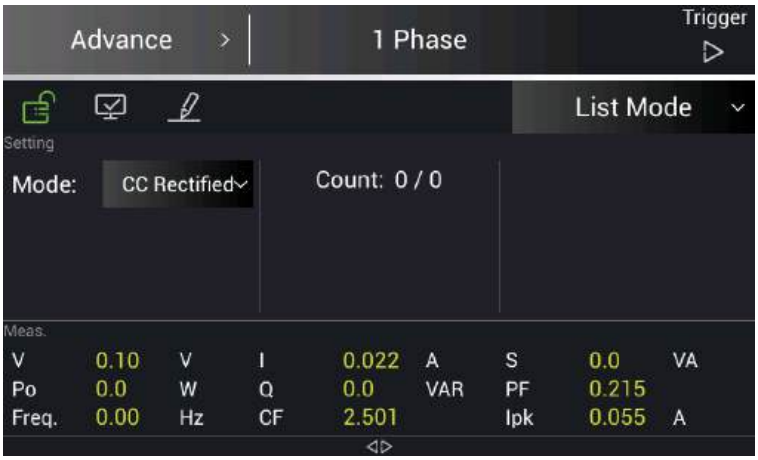
Φ2								
Model	**Resistance (std.)**	**Output Voltage**	**Current Accuracy**		**PM(Iac) Current**	**Panel Measured Current**	**Panel Display Current Spec.**	**CF Spec. 3% F.S PM(CF)**
			Max.	**Max.**				
63809R-350-87	1.72Ω	50V	29.23A	28.76A			Std. ±0.20A	
	7.5Ω	150V	20.20A	19.79A			Std. ±0.16A	
	20.83Ω	250V	12.18A	11.81A			Std. ±0.13A	
	43.75Ω	350V	8.16A	7.83A			Std. ±0.11A	
63812R-350-96	1.56Ω	50V	32.25A	31.74A			Std. ±0.22A	
	6Ω	150V	25.23A	24.76A			Std. ±0.19A	
	15.62Ω	250V	16.20A	15.79A			Std. ±0.16A	
	31.81Ω	350V	11.19A	10.80A			Std. ±0.14A	
63815R-350-105	1.42Ω	50V	35.28A	34.72A			Std. ±0.24A	
	6Ω	150V	30.26A	29.73A			Std. ±0.20A	
	13.88Ω	250V	18.22A	17.77A			Std. ±0.17A	
	29.16Ω	350V	12.21A	11.78A			Std. ±0.15A	
Φ3								
Model	**Resistance (std.)**	**Output Voltage**	**Current Accuracy**		**PA(Iac) Current**	**Panel Measured Current**	**Panel Display Current Spec.**	**CF Spec. 3% F.S PA(CF)**
			Max.	**Max.**				
63809R-350-87	1.72Ω	50V	29.23A	28.76A			Std. ±0.20A	
	7.5Ω	150V	20.20A	19.79A			Std. ±0.16A	
	20.83Ω	250V	12.18A	11.81A			Std. ±0.13A	
	43.75Ω	350V	8.16A	7.83A			Std. ±0.11A	
63812R-350-96	1.56Ω	50V	32.25A	31.74A			Std. ±0.22A	
	6Ω	150V	25.23A	24.76A			Std. ±0.19A	
	15.62Ω	250V	16.20A	15.79A			Std. ±0.16A	
	31.81Ω	350V	11.19A	10.80A			Std. ±0.14A	
63815R-350-105	1.42Ω	50V	35.28A	34.72A			Std. ±0.24A	
	6Ω	150V	30.26A	29.73A			Std. ±0.20A	
	13.88Ω	250V	18.22A	17.77A			Std. ±0.17A	
	29.16Ω	350V	12.21A	11.78A			Std. ±0.15A	

3.10 Application Notes

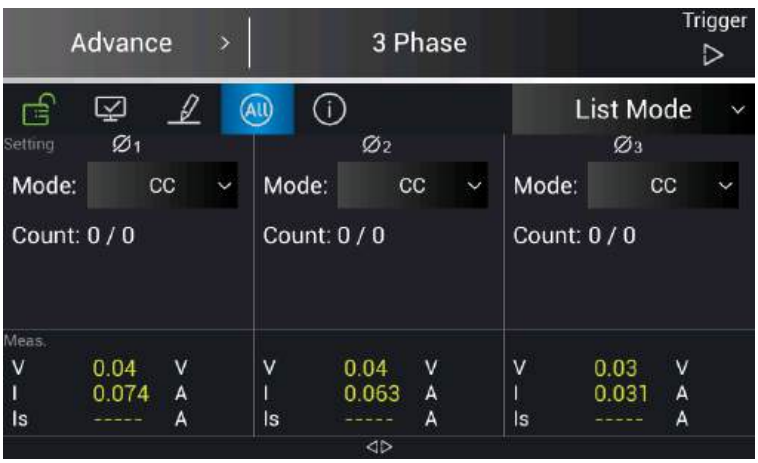
3.10.1 List Mode

From Menu (upper-left corner), select Advanced to enter the Advanced settings screen, then select List Mode in the upper-right corner.

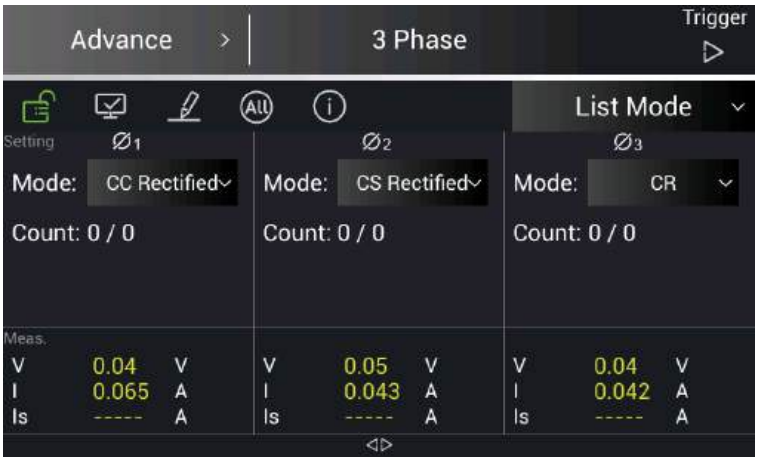




Select the required load mode based on your application. For the functions of each mode, refer to the descriptions in Section *3.5.5*.



In 3_Phase Mode, disable the output "All" setting so that each phase can be configured with a different load mode.

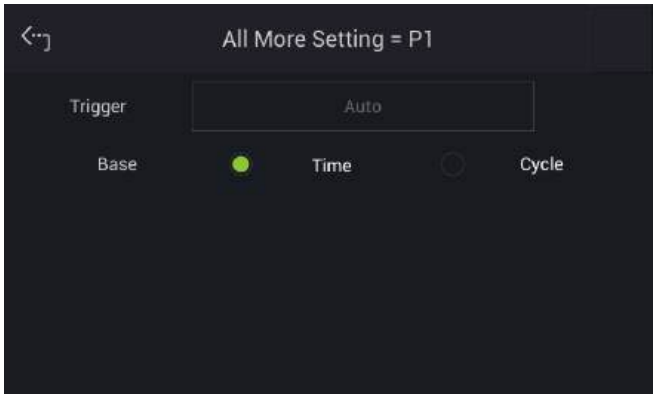


3.10.1.1 Sequence Length Unit Setting (Time / Cycle)

On the List Mode screen, tap the Edit key at the top of the screen to enter the settings screen.

Round Count: The number of cycles for the entire sequence. In 3-Phase Mode, the cycle count can be set independently for each phase (0 to 65535; 0 = infinite).

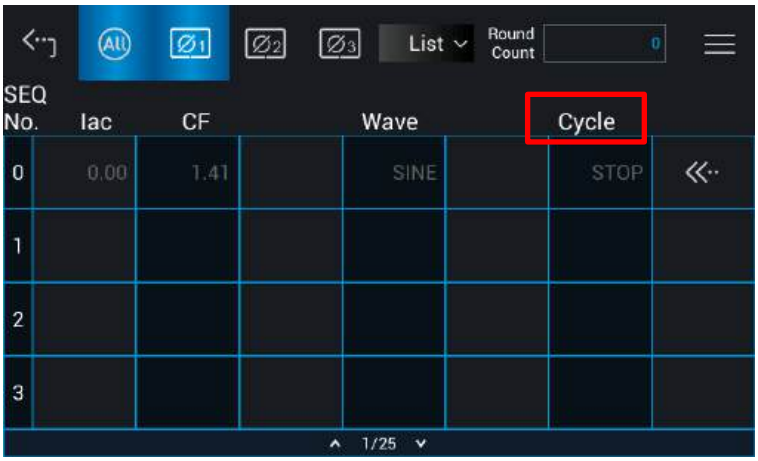
Tap the top-right function key to enter More Settings and set the sequence length unit.



Base (sequence length unit): Time / Cycle

Time: Sequence length is specified by time (0 to 60000 ms; 0 = STOP).
Cycle: Sequence length is specified by cycles (0 to 5000; 0 = STOP).

Select “Cycle” for the sequence length unit.
Then return to the settings screen, which will reflect the change.



3.10.1.2 List Mode Usage Examples

A. 3-phase mode Loop example

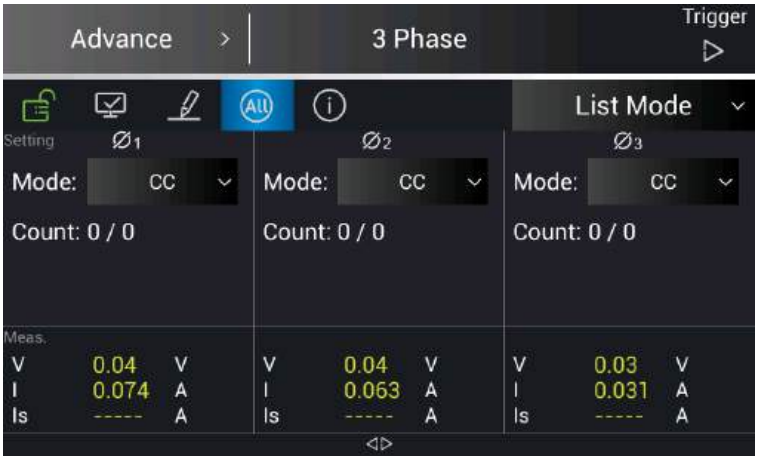
In CC Mode, configure each phase with different loading behavior.

Phase 1: Different Iac level and length (Cycles) for each sequence; execute forward once and then reverse once.
CF = 1.414, PF = 1
Iac = 5A (1 Cycle) → Iac = 15A (2 Cycles) → Iac = 25A (3 Cycles) →
Iac = 25A (3 Cycles) → Iac = 15A (2 Cycles) → Iac = 5A (1 Cycle)

Phase 2: Different CF value for each sequence; repeat twice.
Iac = 10A, PF = 1
CF = 1.414 (3 Cycles) → CF = 2 (3 Cycles) → CF = 3 (3 Cycles) →
CF = 1.414 (3 Cycles) → CF = 2 (3 Cycles) → CF = 3 (3 Cycles)

Phase 3: Different Iac level and length (Time) for each sequence; repeat three times.
CF = 1.414, PF = 1
Iac = 5A (10ms) → Iac = 15A (20ms) → Iac = 25A (40ms) →
Iac = 5A (10ms) → Iac = 15A (20ms) → Iac = 25A (40ms) →
Iac = 5A (10ms) → Iac = 15A (20ms) → Iac = 25A (40ms)

Set each phase to **CC Mode**, then configure as follows.



1. Phase 1
Trigger: Auto **Base**: Cycle
CF/PF Setting: Both **Priority:** CF

Sequence 0: Iac = 5A
CF = 1.414
PF = 1
Cycle = 1

Sequence 1: Iac = 15A
CF = 1.414
PF = 1
Cycle = 2

Sequence 2: Iac = 25A
CF = 1.414
PF = 1
Cycle = 3

Round Count: 1
Round Mode: Loop

Loop No.0: Start-Seq = 0
End-Seq = 2
Count = 1

Loop No.1: Start-Seq = 2
End-Seq = 0
Count = 1

2. Phase 2
Trigger: Auto **Base:** Cycle
CF/PF Setting: Both **Priority:** CF

Round Count: 2
Sequence 0: Iac = 10A
CF = 1.414
PF = 1
Cycle = 3

Sequence 1: Iac = 10A
CF = 2
PF = 1
Cycle = 3

Sequence 2: Iac = 10A
CF = 3
PF = 1
Cycle = 3

Loop No.0: Start-Seq = 0
End-Seq = 2
Count = 1

3. Phase 3
Trigger: Auto **Base:** Time
CF/PF Setting: Both **Priority:** CF

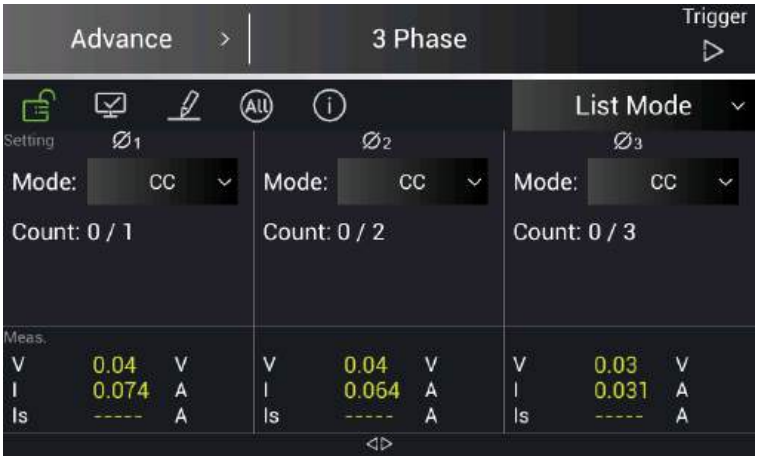
Round Count: 3
Sequence 0: Iac = 5A
CF = 1.414
PF = 1
Time = 10

Sequence 1: Iac = 15A
CF = 1.414
PF = 1
Time = 20

Sequence 2: Iac = 25A
CF = 1.414
PF = 1
Time = 40

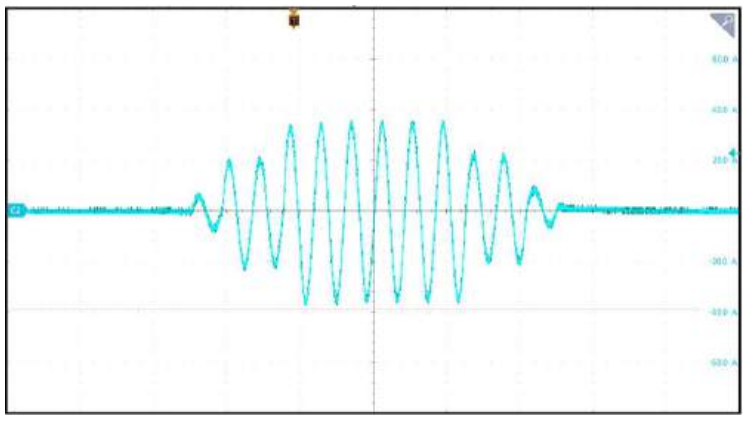
Loop No.0: Start-Seq = 0
End-Seq = 2
Count = 1

After configuration, the screen appears as shown in the figure below.

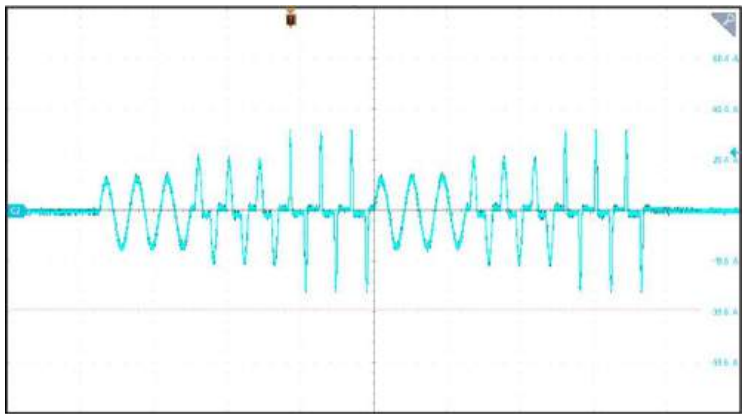


4. After configuration, the triggered waveforms are as shown in the figure below.

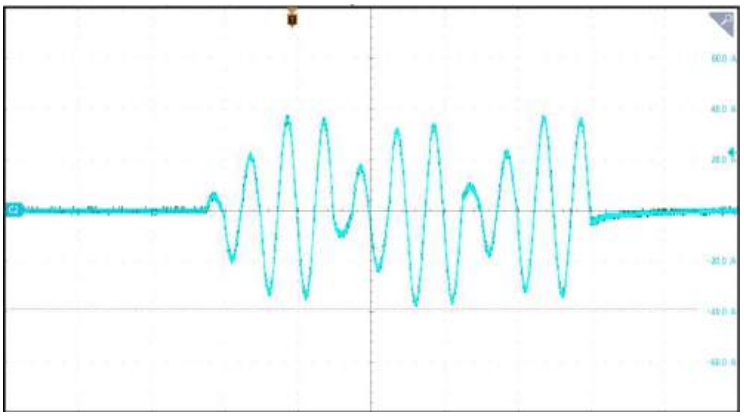
Phase 1



Phase 2



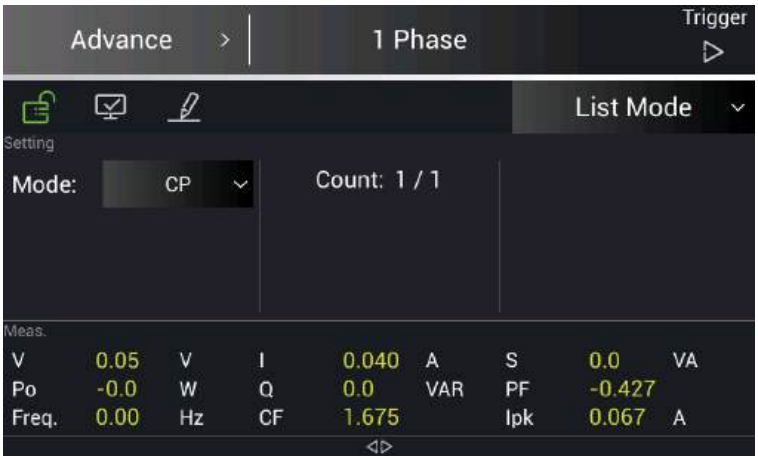
Phase 3



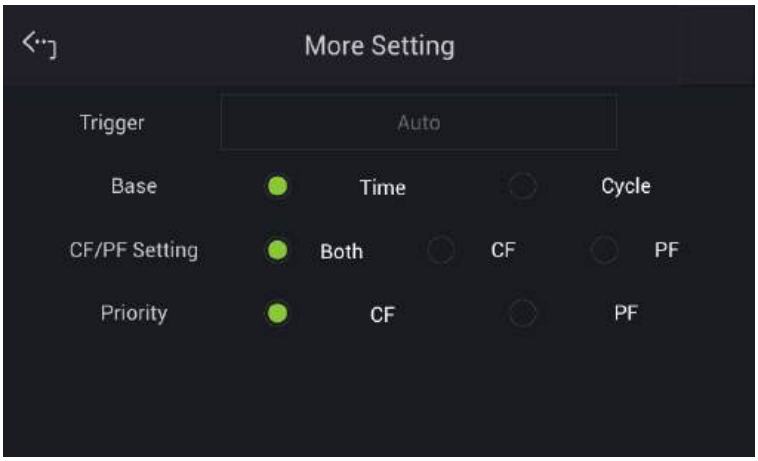
B. 1-phase mode Loop example

In CP Mode, set a different load level and length (Time) for each sequence.
CF = 1.414, PF = 1
P = 300W (10ms) → P = 600W (20ms) → P = 900W (40ms)

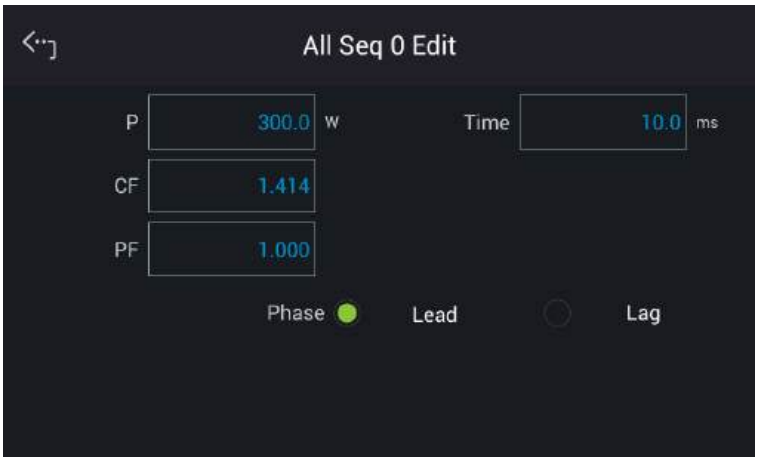
Set to **CP Mode**, then configure:



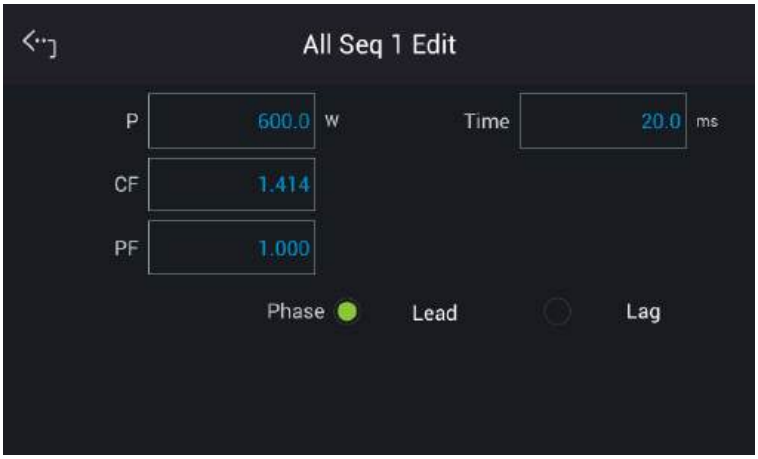
More Settings
Trigger: Auto **Base:** Time
CF/PF Setting: Both **Priority:** CF



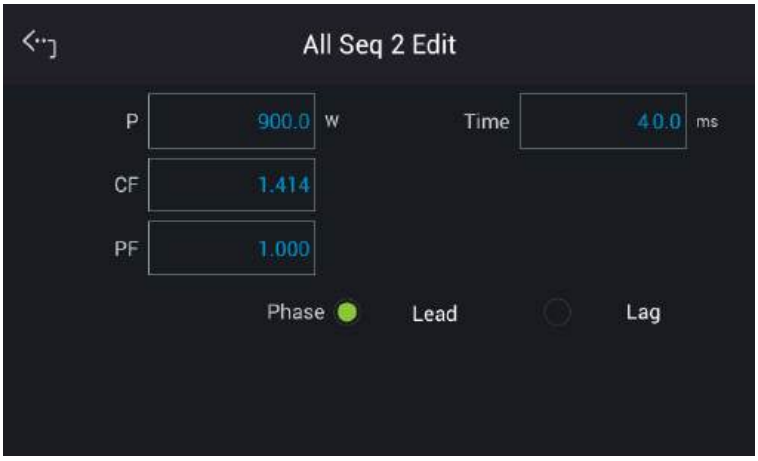
Sequence 0: P = 300W
CF = 1.414
PF = 1
Time = 10ms



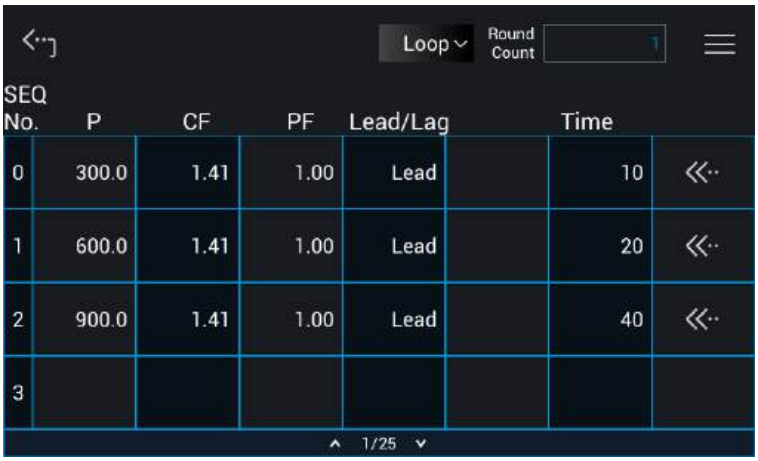
Sequence 1: P = 600W
CF = 1.414
PF = 1
Time = 20ms



Sequence 2: P = 900W
CF = 1.414
PF = 1
Time = 40ms



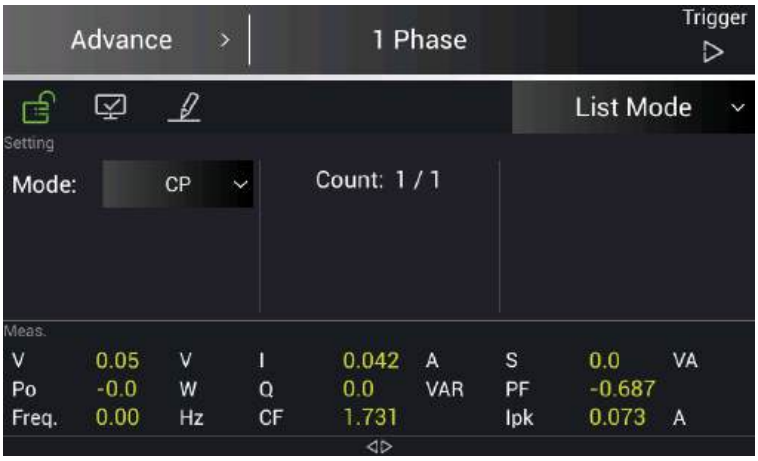
Round Count: 1
Round Mode: Loop



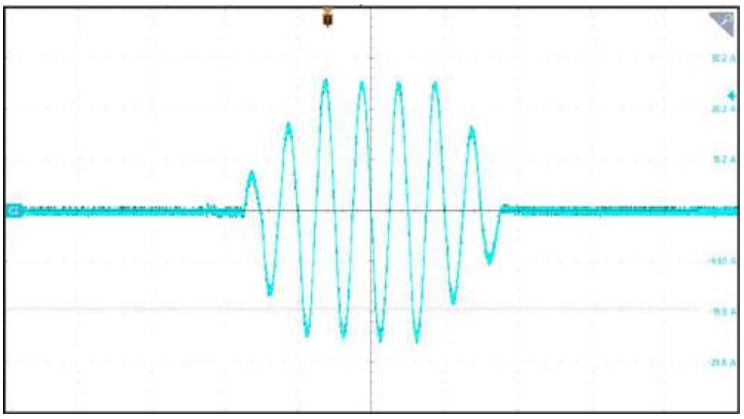
Loop No.0: Start-Seq = 0
End-Seq = 2
Count = 1

Loop No.1: Start-Seq = 2
End-Seq = 0
Count = 1

After configuration, the screen appears as shown in the figure below.



After configuration, the triggered waveform is shown in the figure.

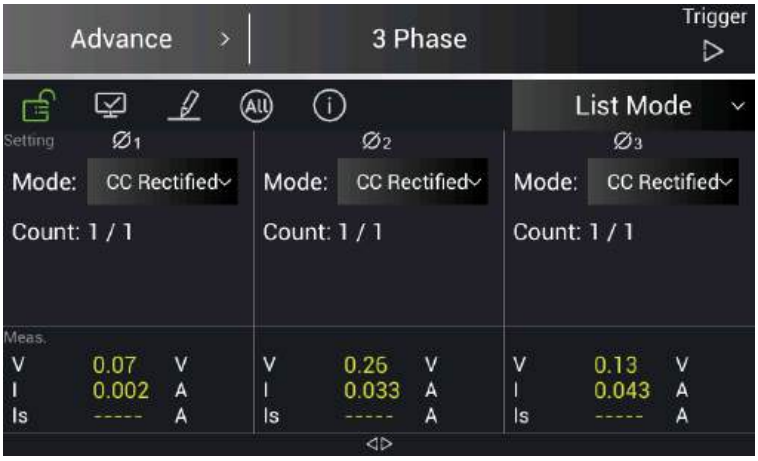


C. Capturing different household appliance waveforms in 3-phase mode and simulating different loads on each phase

Divide each of the three captured waveform datasets into ten equal segments, and load them into the Regenerative AC Electronic Load (for the loading method, refer to user's manual for the Chroma 61800 Series control panel).

- Waveform set 1: VAL_US001 to VAL_US010
- Waveform set 2: VAL_US011 to VAL_US020
- Waveform set 3: VAL_US021 to VAL_US030

Set each phase to **CC Rectified Mode**, then configure:



1. Phase 1
List Mode
Trigger: Auto; **Base:** NA
Round Count: 1
Sequence 0 - 9: Set each Waveform (Wave) in order to VAL_US001 - VAL_US010

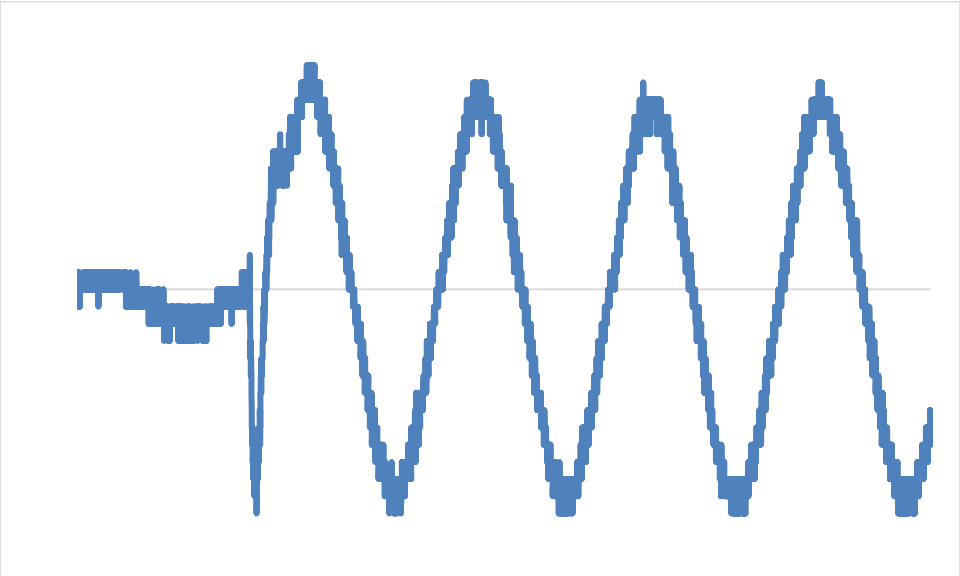
2. Phase 2
List Mode
Trigger: Auto; **Base:** NA
Round Count: 1
Sequence 0 - 9: Set each Waveform (Wave) in order to VAL_US011 - VAL_US020

3. Phase 3
Trigger: Auto; **Base:** NA
Round Count: 1
Sequence 0 - 9: Set each Waveform (Wave) in order to VAL_US021 - VAL_US030

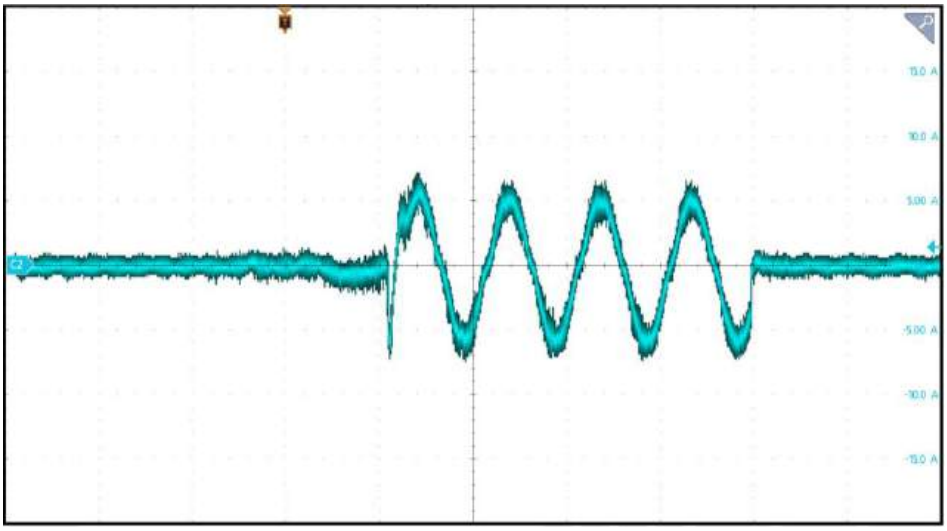
4. After configuration, the triggered waveforms will appear as follows:

Phase 1

Captured current waveform

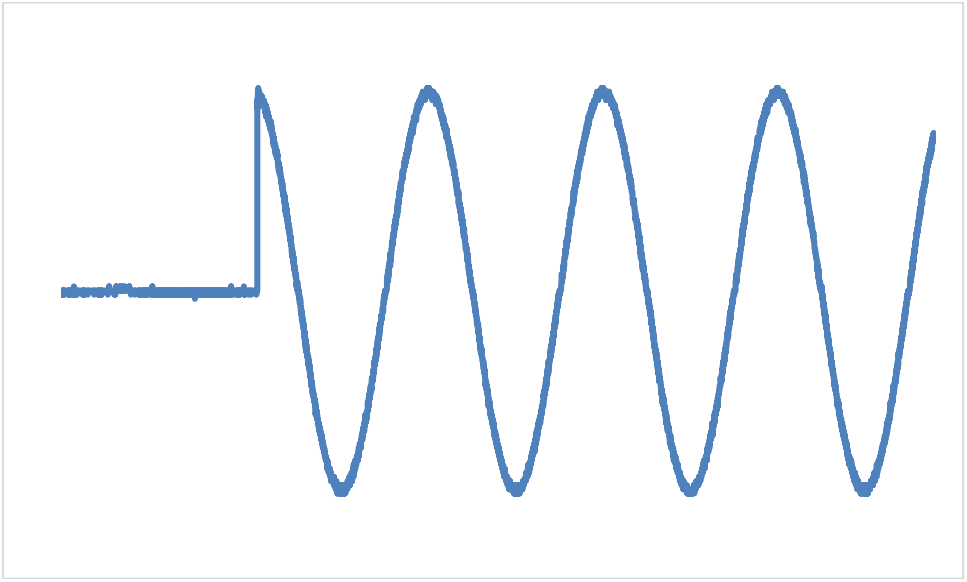


Actual current waveform

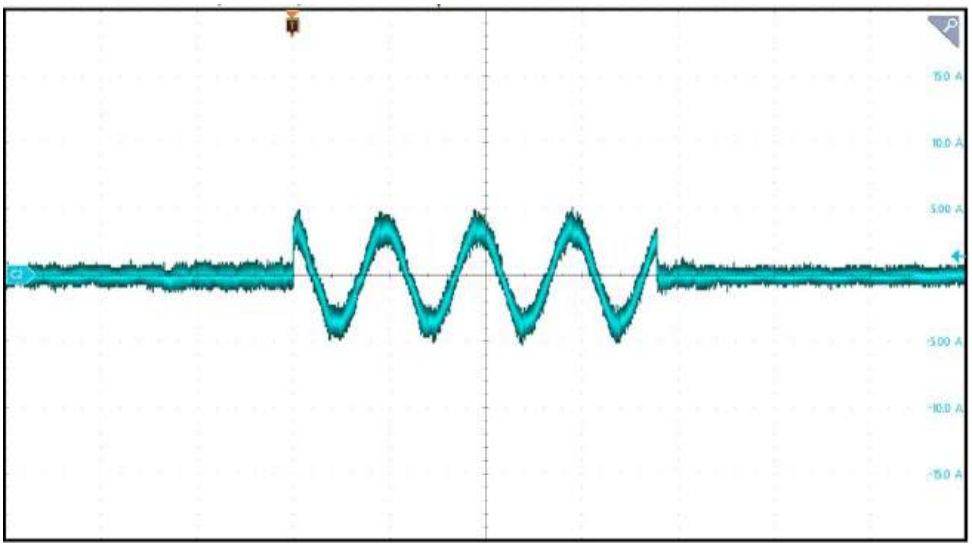


Phase 2

Captured current waveform

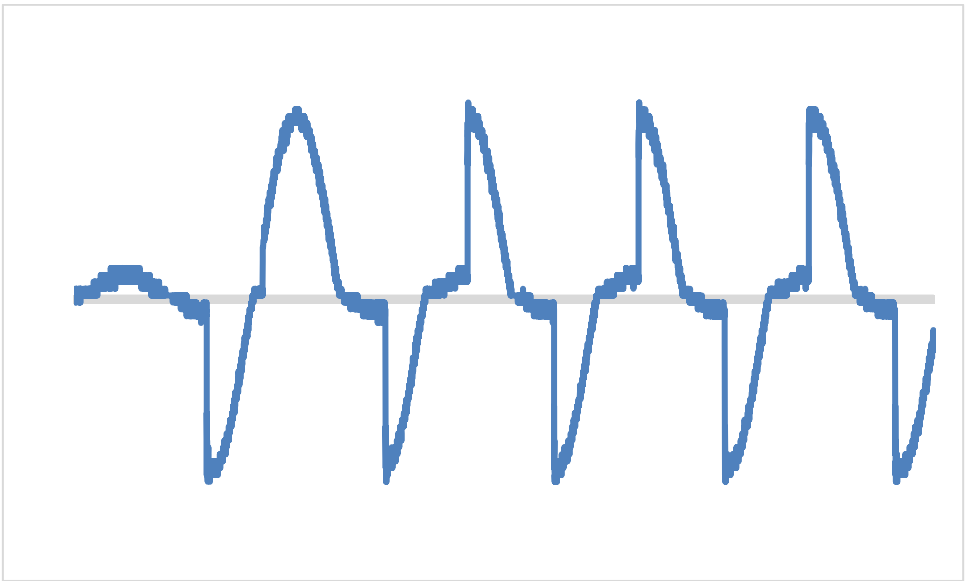


Actual current waveform

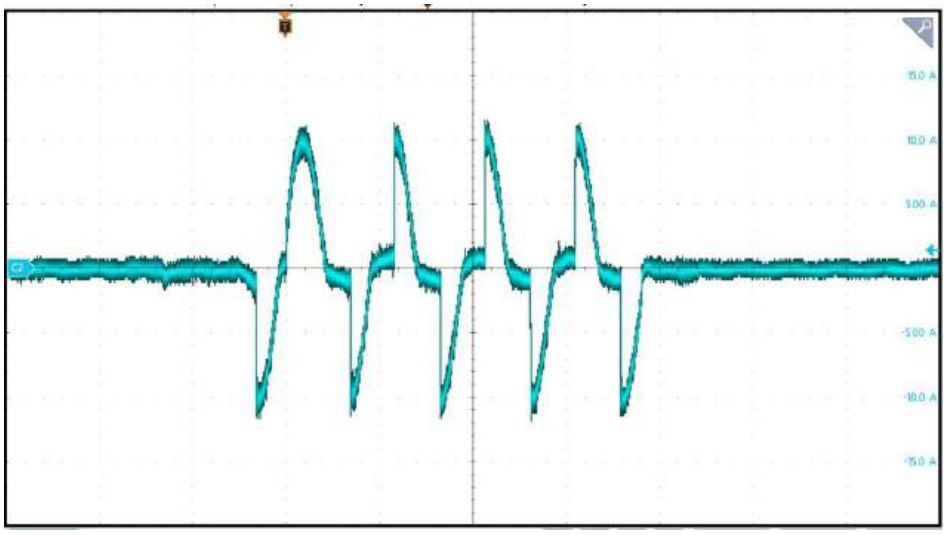


Phase 3

Captured current waveform



Actual current waveform



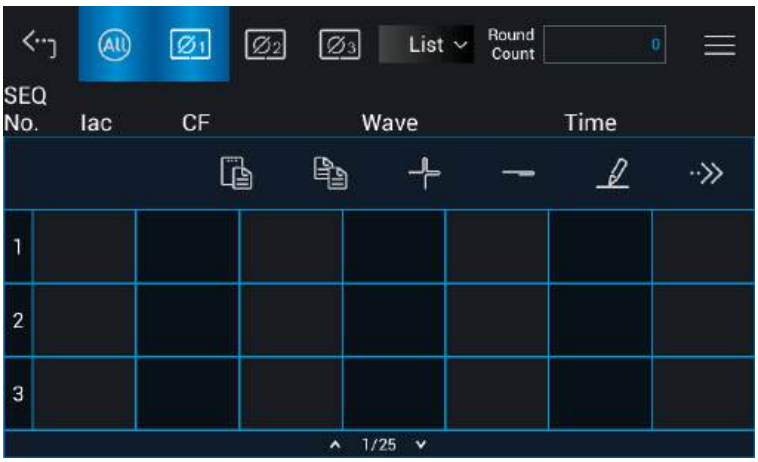
3.10.1.3 List Mode - Run Mode Settings

List Mode Setting:

When the Regenerative AC Electronic Load operates in List Mode, there are two run modes for executing the configured load waveform: List and Loop. In List mode, sequences are executed in order according to their SEQ. No. (0–99). Refer to "Example C" in section *3.10.1.2*.

On the setting screen, use the menu (List ^) to select List (List) ◦

On the settings screen, select and swipe left, tap Add Sequence or Delete Sequence , then tap Edit to begin editing sequences.



Loop Mode Setting:

In this mode, the configured load waveforms are executed in order according to their Loop No. (0–99). Refer to “Example A” and “Example B” in *3.10.1.2*.

On the settings screen, use the menu List to select Loop Loop.

Tap the upper-right function key to enter Loop Setup.

Waveform programming in Loop Mode is done by combining sequences. Output starts from the Start-Seq value of Loop No .0, proceeds sequence by sequence to the End-Seq value, and repeats according to the Count value. It then advances to the next loop and continues until a loop with Count = 0 is reached. Finally, the above process repeats according to Count and then stops. Configure the load sequence order as required.

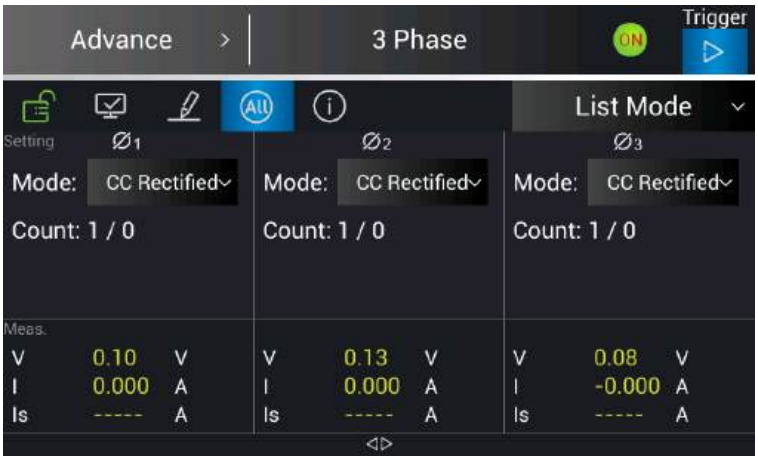
No.: Loop number. All loops must start from 0. The maximum number of loops is 99.

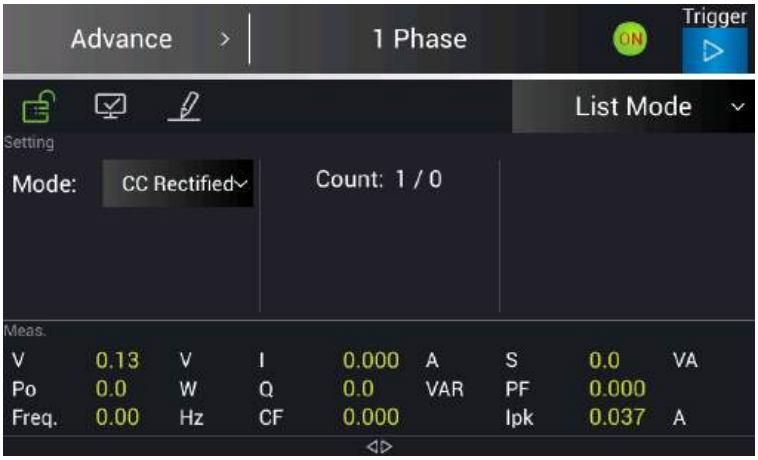
Start-Seq.: The first sequence number executed in this loop.

End-Seq.: The last sequence number executed in this loop.

Count: Number of executions for this loop (maximum 10000). Count = 0 means the loop is not executed.

After setting sequences, tap the Back key to exit the editing screen. Tap the upper-right Trigger key to trigger output. The Trigger key turns blue to indicate List Mode output is running. The status icon at the top of the screen indicates the Regenerative AC Electronic Load output is ON .
You can tap Trigger again to stop List waveform output. When all sequences and Counts are complete, the LCD no longer shows the output ON indication and the Regenerative AC Electronic Load output turns off automatically (as shown below).

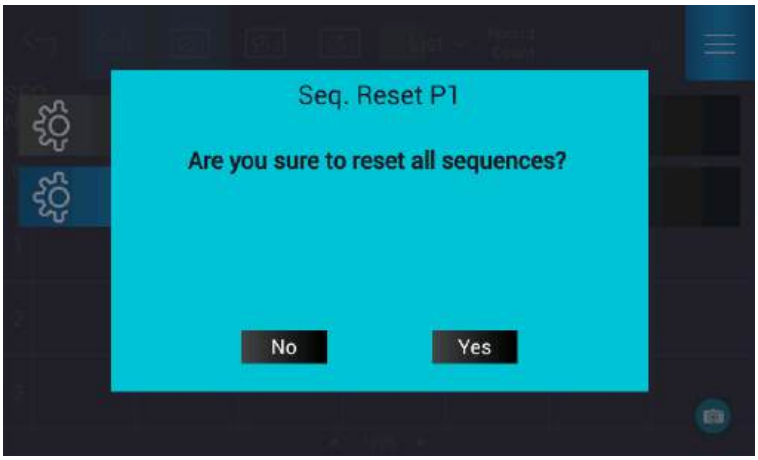




If the Regenerative AC Electronic Load is running and you press the **ON/OFF** button, the output stops and the waveform becomes zero current. If you then press **ON/OFF** again, the Regenerative AC Electronic Load outputs only the waveform configured on the Meas. & Setup screen (3_Phase Mode / 1_Phase Mode). To restart List Mode output, you must tap Trigger again.

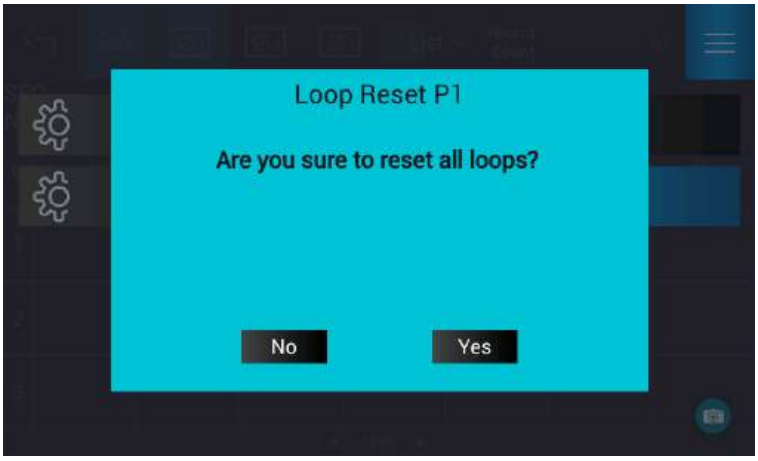
Resetting Loop and Sequence settings

Tap the upper-right function key  to enter List Reset.



This function clears all sequence settings. Tap Yes to clear.

Tap the upper-right function key  to enter Loop Reset. This function clears all loop settings. Tap Yes to clear.



This function clears all loop settings. Tap Yes to clear.

Notice In List Mode, on the settings screen, select and swipe left. You can then tap the icons to copy and paste a sequence.

4. Single-Unit and Series/Parallel System Wiring

4.1 Supported Wiring Configurations for Single-Unit Operation

4.1.1.1 3P4W, Y Wire

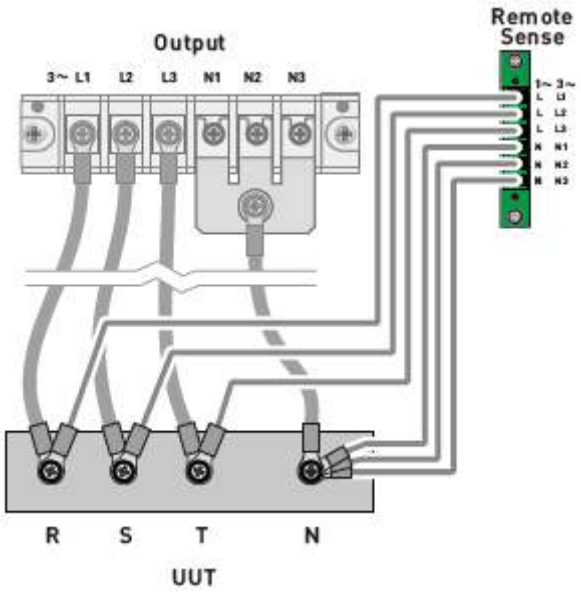


Figure 4-1 Wiring diagram for 3P4W, Y Wire

4.1.1.2 3P, Independent

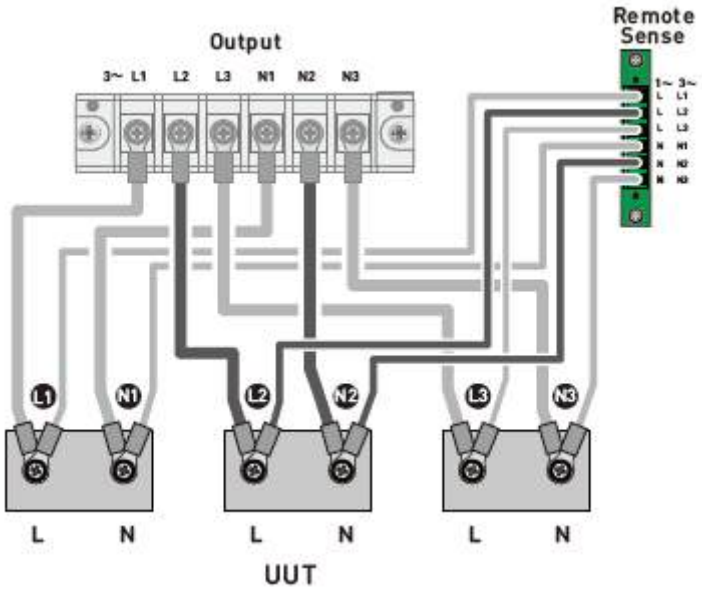


Figure 4-2 Wiring diagram for 3P, Independent

4.1.1.3 1P2W

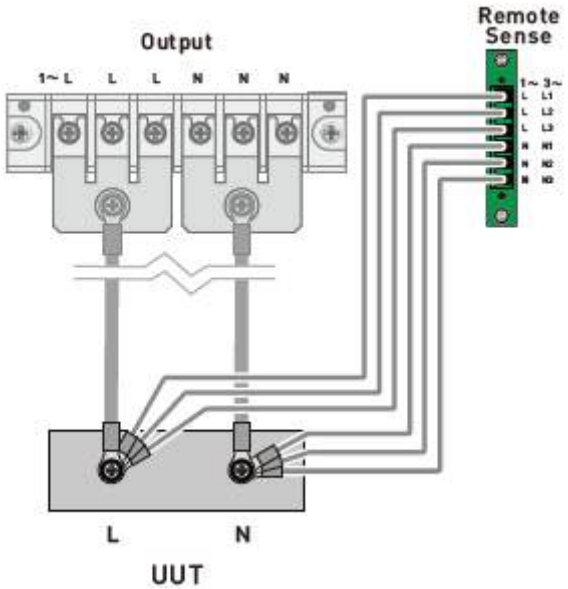


Figure 4-3 Wiring diagram for 1P2W

Notice The Regenerative AC Electronic Load supports loading UUTs with Y-connected 3P4W wiring (with neutral N). It does not support loading UUTs with Y-connected 3P3W wiring (without neutral N) or Δ-connected 3P3W wiring.

4.2 Series Split-Phase System Configuration

To connect the Regenerative AC Electronic Load in series, series operation supports a maximum of two units. The system configuration is shown below.

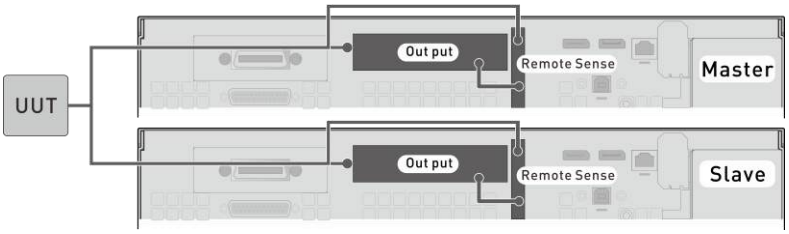


Figure 4-4 Signal wiring diagram for two units in series

Notice Series operation supports only units with the same power rating/model.

4.2.1 Signal Wiring for Two Units in Series

When the Regenerative AC Electronic Load is used in series mode, one communication cable is required to transmit series configuration information. The wiring diagram is shown below.

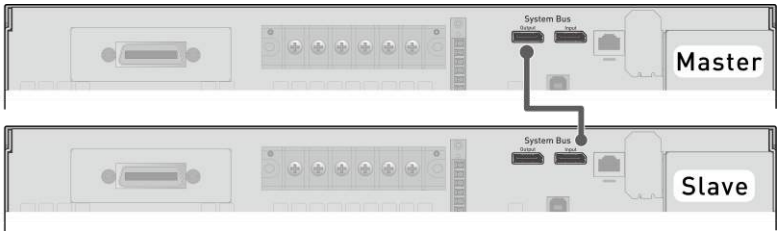
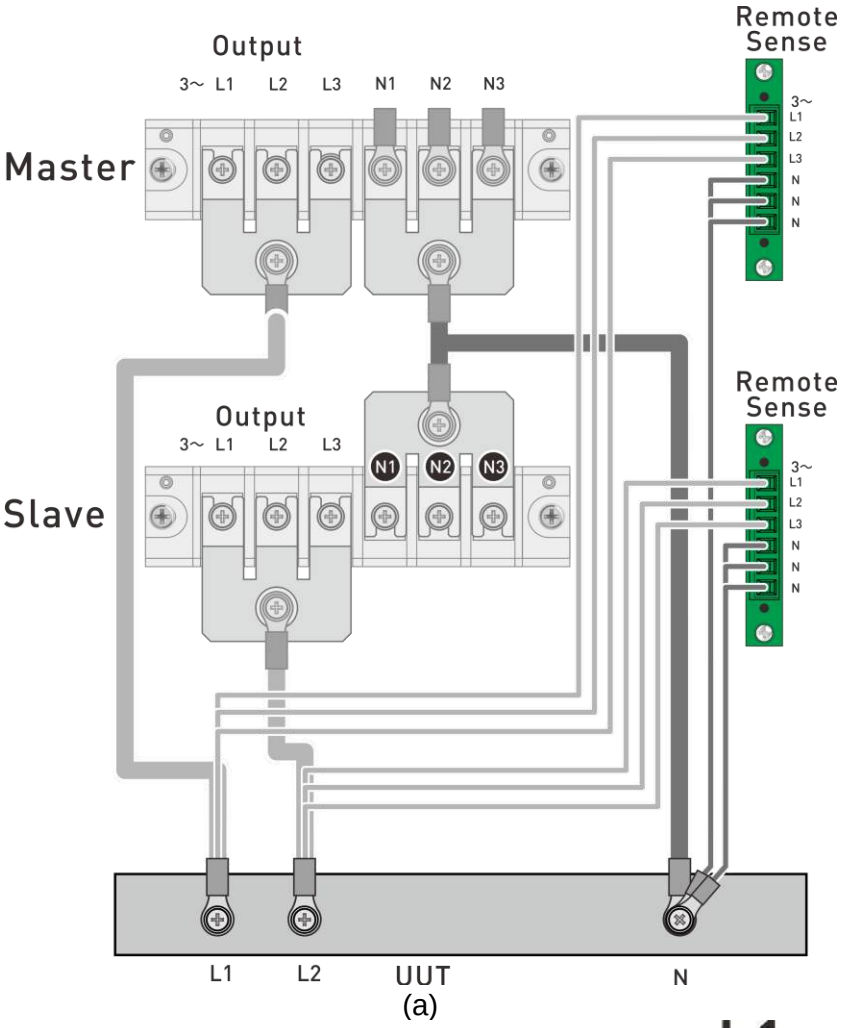


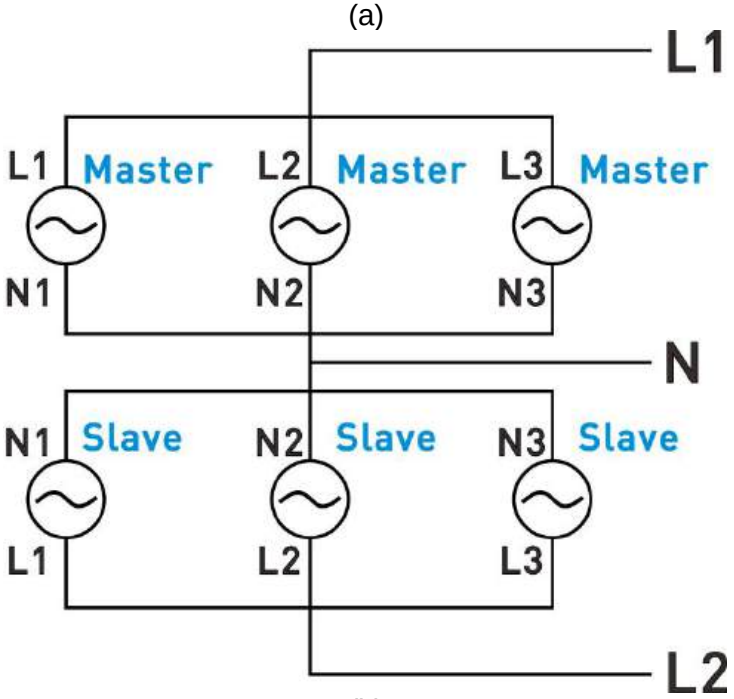
Figure 4-5 Signal wiring diagram for two units in series

4.2.2 Hardware Split-Phase Wiring for Series Operation

When the Regenerative AC Electronic Load is used in series mode, the load wiring and remote sense wiring are shown below. The split-phase series wiring example for two units is shown in *Figure 4-7*.



(a)



(b)

Figure 4-6 Wiring diagram for two units in split-phase series operation

Notice In the 63800R Series, series operation supports Split Phase Mode only. 1-Phase Mode and 3-Phase Mode are not supported in series operation.

4.3 Signal Cable Connection for Parallel Mode

4.3.1 Connecting Cable for Two Units

When the Regenerative AC Electronic Loads are used in parallel mode, a parallel communication cable is required to transmit the data. The connection is shown below.

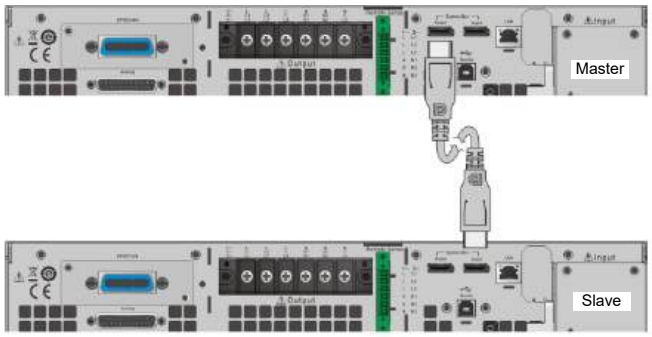


Figure 4-7 Diagram for Connecting Two Units in Parallel

4.3.2 Connecting Cables for Three Units

When the Regenerative AC Electronic Loads are used in parallel mode, two parallel communication cables are required to transmit the data. The connection is shown below.

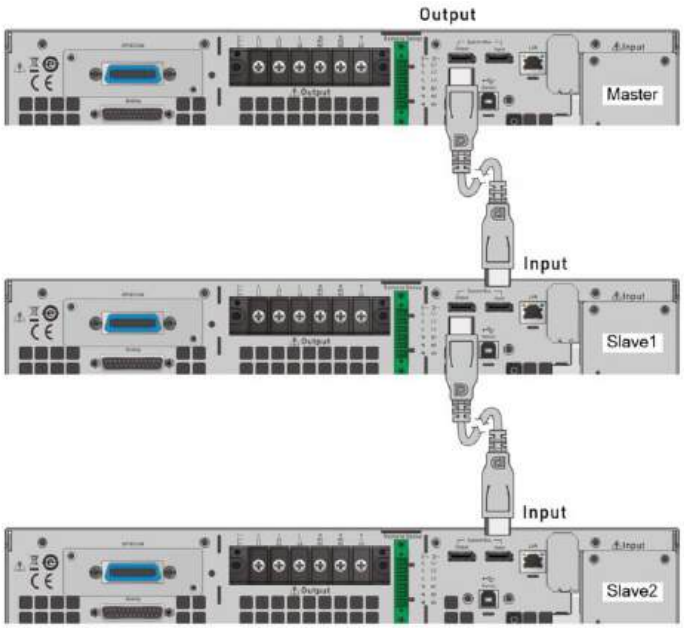


Figure 4-8 Diagram for Connecting Three Units in Parallel

4.3.3 3-phase Wiring for Parallel Operation

When the Regenerative AC Electronic Load is used in parallel mode, the load wiring and remote sense wiring are shown below. The 3-phase parallel connection is shown in *Figure 4-9*, taking three units as an example.

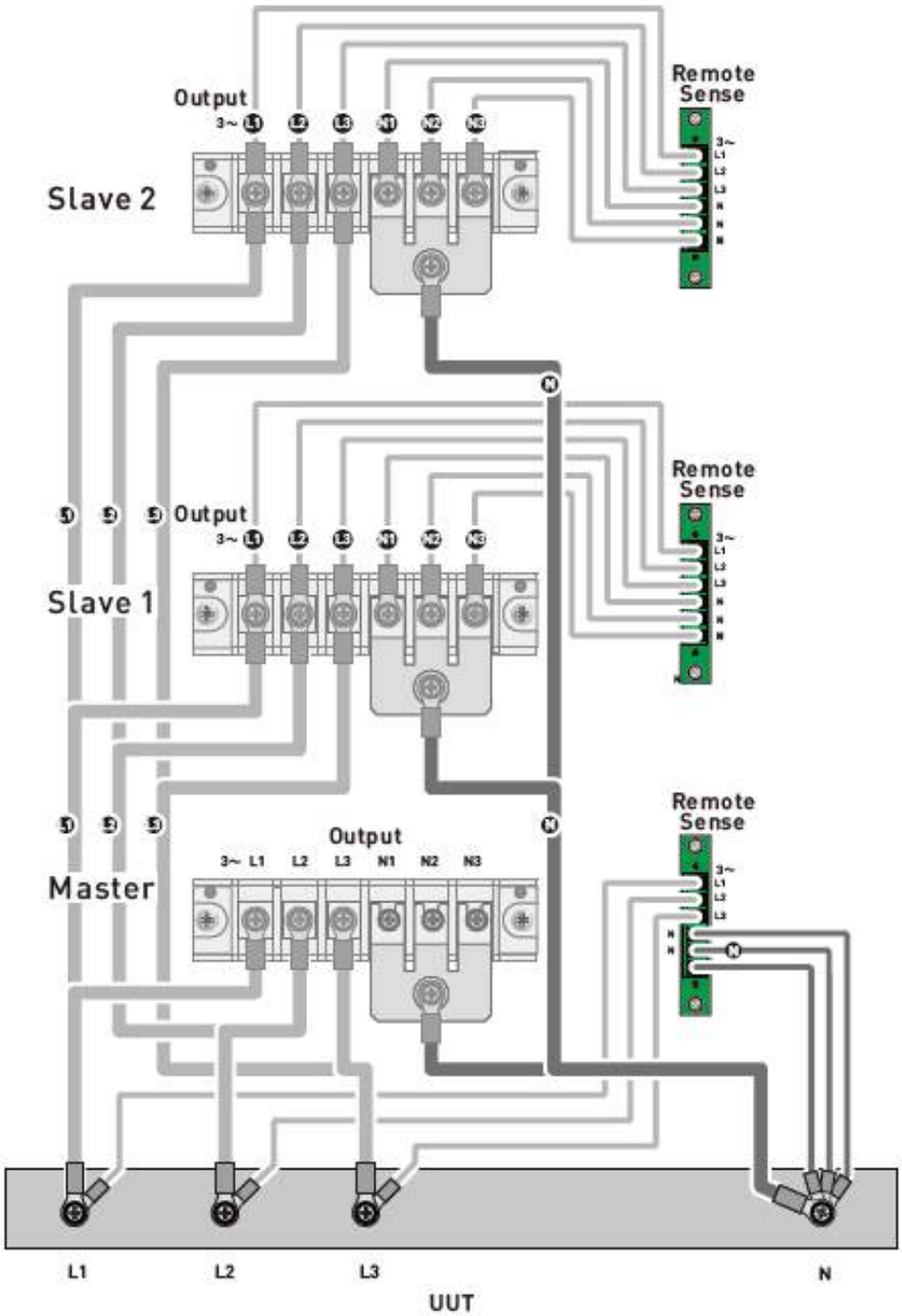


Figure 4-9 Wiring Diagram for Paralleling 3 Electronic Loads in 3-phase Mode

Notice

1. In the 63800R Series, parallel operation supports 3-Phase Mode only. 1-Phase Mode is not supported.
2. In multi-unit parallel operation of the 63800R Series, the maximum load current per phase in 3-Phase Mode is 35 A × (N+1), where

(N+1) is the total number of units. Up to 10 units in parallel are supported, as shown in Table 4-1 below.

Table 4-1

63800R Series Model	Parallel Mode	
	Max. Parallel No. N+1 (Max. = 10)	Max. Output Current (A) per Phase
63809R-350-87	N+1	29 × (N+1)
63812R-350-96	N+1	32 × (N+1)
63815R-350-105	N+1	35 × (N+1)

3. For multi-unit parallel operation, configure the system according to the required system topology. The communication cable must be less than 1.5m. Contact Chroma sales for the appropriate communication cables.
4. Before using parallel operation, verify that the circuit breaker capacity is sufficient. Also connect the protective earth of all power cords to the same grounding point, and ensure proper grounding.
5. All units of the same 63800R Series model can be connected in parallel. The maximum supported configuration is 10 units. For setups over 10 units, contact Chroma sales or your distributor.

4.4 Settings

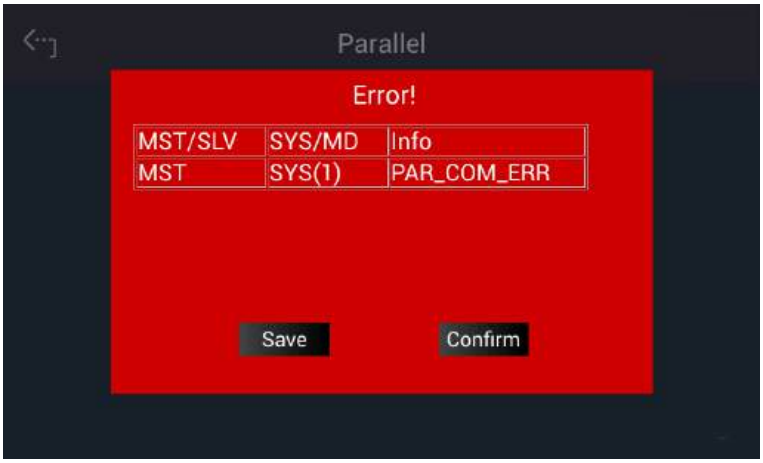
See section *3.5.5* for details.

4.5 Troubleshooting

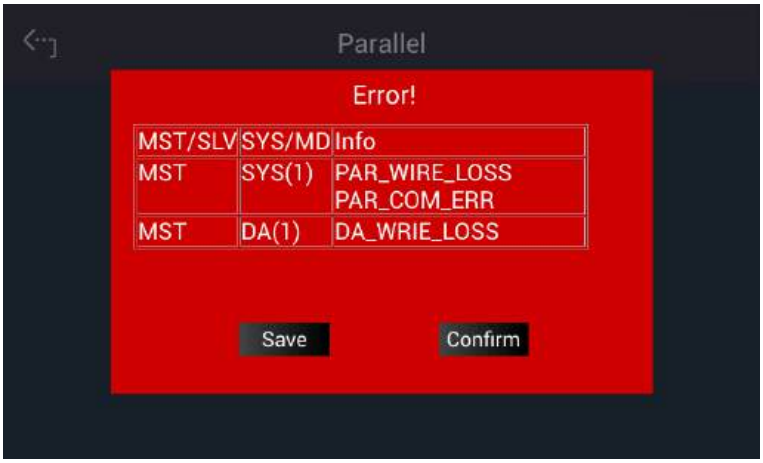
When paralleling multiple devices, each device must have a parallel cable to transmit the signals. When the Slave number is set incorrectly an error message will result, follow the procedure below for troubleshooting and re-execute parallel/series connection as needed.

4.5.1 Wire Loss

If “SYS_PAR_COM_ERR” occurs when enabling the Master connection, check to see if the parallel/serial cable is properly connected and the fixture for parallel/series connection is properly installed. Also, check to see if another Regenerative AC Electronic Load is set to Slave.



If the parallel/series cable is not connected properly or disconnected when enabling the Master connection, an "SYS_PAR_WIRE_LOSS" warning will appear. In this case, turn the device off first, check if the parallel/serial cable is connected firmly, and reboot.



5. Remote Operation

5.1 Introduction

The Regenerative AC Electronic Load can be controlled remotely via USB, GPIB, or LAN.

The USB interface supports USB 2.0/USB 1.1 while the GPIB interface is an 8-bit parallel data bus that is synchronized by the bus command from the host.

5.1.1 USB Interface

(1) Hardware Support: USB 2.0 and USB 1.1
(2) Software Support: USBTMC class and USB488 subclass
(3) OS Support: Windows 7/10
(4) Installing Driver: The USB Interface of Regenerative AC Electronic Load supports USBTMC, so if the PC's operating system (OS) supports USBTMC (installed NI-VISA runtime version 3.00 or above) there is no need to install other drivers. The operating system will search for the standard USBTMC driver installation program automatically.

If the PC OS does not support USBTMC, it is suggested to install the NI-VISA runtime version 3.00 or above first. When the installation of NI-VISA runtime is done, the USBTMC driver program is stored in the OS. The PC can communicate with the Regenerative AC Electronic Load via NI-VISA after using a USB once connected.

Related Documents:
1. USB Test and Measurement Class (USBTMC) specification, Revision 1.0, www.usb.org
2. USB Test and Measurement Class USB488 subclass specification, Revision 1.0, www.usb.org

5.1.2 GPIB Interface

The default GPIB address is 30 and it can be changed from the "Configuration" menu (see *3.5.2.2*.)

GPIB Capability	Description	Interface Function
Talker/Listener	Commands and response messages can be sent and received via the GPIB bus. Status information can be retrieved by serial query.	AH1, SH1, T6, L4
Service Request	The Regenerative AC Electronic Load sets the SRQ to be true if there is a service request.	SR1
Remote/Local	When the Regenerative AC Electronic Load is turned on in local mode, it can operate the front panel. In remote mode, all other touch buttons are invalid except  . Tapping  can return to local mode.	RL1

5.1.3 LAN Interface

To remote program, a Regenerative AC Electronic Load via a PC with a LAN interface, confirm the IP address, Gateway address, and Net Mask in advance. See 3.5.2 for detailed settings. To ensure reliable data transmission, TCP is used for data transmission and the communication port is 5025.

5.1.4 CAN Interface

The pin definition is listed in the table below.

Pin	Signal	Direction	Description
1	NC	-	Not connected
2	CAN_L	Input or Output	CAN Differential Signal (Low)
3	DGND	-	Digital Ground
4	NC	-	Not connected
5	NC	-	Not connected
6	NC	-	Not connected
7	CAN_H	Input or Output	CAN Differential Signal (High)
8	NC	-	Not connected
9	NC	-	Not connected

5.2 Introduction to Programming

All commands and response messages are transmitted in ASCII code. The response messages must be read completely before sending a new command; otherwise, the remaining response messages will be lost and a query interrupt error will occur.

5.2.1 Conventions

Angle brackets	<	>	Items in angle brackets are parameter abbreviations.
Vertical bar	|		Vertical bar separates alternative parameters.
Square brackets	[	]	Items in square brackets are optional. For example, OUTP [:STATe] means that :STATe may be omitted.
Braces	{	}	Braces indicate the parameters that may be repeated. The notation <A> {<, B>} means that parameter "A" must be entered while parameter "B" may be omitted or entered once or many times.

5.2.2 Numerical Data Formats

All data programmed to or returned from the Regenerative AC Electronic Load are in ASCII format. The data can be numerical or character string.

Symbol	Description	Example
NR1	It is a digit with no decimal point. The decimal is assumed to be on the right of the least significant digit.	123, 0123
NR2	It is a digit with a decimal point.	12.3, .123
NR3	It is a digit with a decimal point and an exponent.	1.23E+2

5.2.3 Boolean Data Format

Boolean parameter <Boolean> applies ON|OFF format only.

5.2.4 Character Data Format

The character strings returned by a query command may be in either of the following forms:
<CRD> Character Response Data: character string with a maximum length of 12.
<SRD> String Response Data: character string.

5.2.5 Basic Definition

Command Tree Table:
The commands of the Regenerative AC Electronic Load are structured hierarchically (i.e. tree system). The full path must be specified to obtain a particular command. The path is represented in the table by placing the highest node in the farthest left position of the hierarchy. Lower nodes in the hierarchy are indented in the position to the right under the parent node.

Program Header:
The program header is the keyword to identify the command according to the IEEE 488.2 syntax described in section 5.4. The Regenerative AC Electronic Load accepts characters in both upper and lower cases without any distinction. The program header consists of two unique types, the common command header, and the instrument-controlled header.

Common Command and Query Header:
The syntax of common commands and query headers are described in IEEE 488.2. They are used along with the IEEE 488.2 defined common commands and queries. The commands with leading “*” are common commands.

Instrument-Controlled Header:
An instrument-controlled header can be applied to all instrument commands. Each header has a long form and a short form. The Regenerative AC Electronic Load only accepts the exact short and long forms. A special notation is used to distinguish the short form header from the long one of the same in this section. The short form of the header is shown by upper case characters while the rest of the headers are shown in lower case.

Program Header Separator (:):
If a command has more than one header, a colon must be used to separate them (FETC:CURR?, LOAD:CCRE:CURR 10). At least one space is required to separate the data and program header.

Program Message:
The program message consists of many elements including zero sequence or message components that are separated by the separator (semicolon.)

Program Message Component:
A program component is a single command, programming data, or query.

Example: LOAD:MODE? , OUTPut ON

Program Message Component Separator (;):
The separator (semicolon ;) separates the program message components from another in a program message.

Example: LOAD:CCRE:CURR 20;:OUTP ON<PMT>

Program Message Terminator (<PMT>):
A program message terminator can end the program message. There are three permitted terminators:

(1) <END>: end or identify (EOI)
(2) <NL>: new line which is a single ASCII encoded byte 0A (10 decimals).
(3) <NL> <END>: new line with EOI.

Notice The response message is terminated by <NL> <END> for GPIB, and <NL> for USB and LAN.

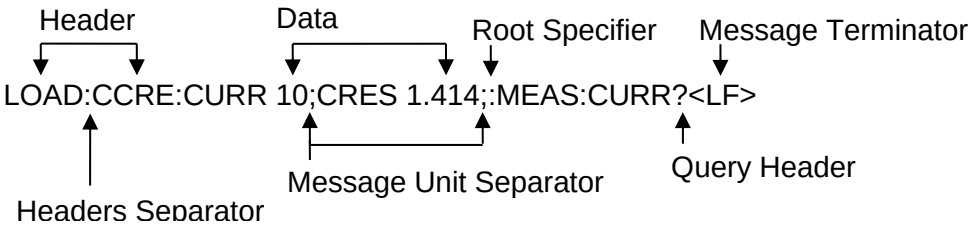


Figure 5-1 Structure of Command Message

5.3 Traversal of the Command Tree

Multiple message units can be sent in one program message. The first command usually refers to the root node. Subsequent commands refer to the tree level same as the previous command in a program message. When the colon is ahead of the program message component it changes the header path to root level.

Example:

OUTPut:PROTection:CLEar	All colons are header separators.
OUTPut:PROTection:CLEar;:LOAD:CCRE:CURR 20	Only the third colon is a specified root.

5.4 Commands of Regenerative AC Electronic Load

This section addresses the syntax and parameters of all commands for the Regenerative AC Electronic Load. The examples provided for each command are common examples.

Syntax Form	Syntax definition is in a long format header; however, only a short format header appears in the examples.
Parameter	Most commands require a parameter.
Return Parameter	All queries return a parameter.
Model	If a command applies only to specific models, those models are listed in the Model only entry. If there is no Model only entry, the command applies to all models.

5.4.1 Common Command Dictionary

The common commands begin with a " * " and consist of three letters and/or one " ? " (query). Common commands and queries are listed alphabetically. The common commands and queries are listed in alphabetic order.

*CLS — Clear status
This command clears the following registers:
(1) Questionable Status Event
(2) Status Byte
(3) Error Queue

*ESE <n> — Bit assignment of the Standard Event Status Enable register
This command sets bits in the Standard Event Status Enable register.
If one or more enable bits in the Standard Event register are set, the ESB bit in the Status Byte register is also set.

Bit Assignment of Standard Event Status Enable Register

Bit Position	7	6	5	4	3	2	1	0
Bit Name	PON	- - -	CME	EXE	DDE	QYE	- - -	OPC

CME = Command Error
EXE = Execution Error
PON = Power On
DDE = Device-dependent error
OPC = Operation Completed
QYE = Query Error

*ESE? — Queries the value of the Standard Event Status Enable register.

*ESR? — Queries and returns the Standard Event Status register, then automatically clears. The bits of configuration are the same as the Standard Event Status Enabled register.

*IDN? — Queries the manufacturer, model no., serial no., and firmware version of the Regenerative AC Electronic Load.
Return Parameter Chroma,63815R-350-105,00000000123456,1.00
Chroma : Manufacturer
63815R-350-105 : Model no.
00000000123456 : Serial no.
1.00 : Firmware version

*RCL <n> Recalls previously saved settings from the specified memory location.
Parameter: 0 - 10 (0 = factory default)

*SAV <n> Saves the settings to the specified memory location.
Parameter: 1 - 10

*RST Resets the Regenerative AC Electronic Load to its initial state. It is better to wait for 3 seconds before sending the next command.

*SRE Sets conditions of the Service Request Enable Register. If one or more enable bits in the Status Byte Register is set, the MSS and RQS of the Status Byte Register are set as well.

*SRE? This query returns the value of the Service Request Enable Register.

*STB? This query returns the value of the Status Byte Register.

Bit Assignment of Status Byte Register

Bit Position	7	6	5	4	3	2	1	0
Condition	- -	MSS RQS	ESB	MAV	QUES	- -	- -	- -

ESB = Event Status Byte Summary
QUES = Questionable Status Summary
RQS = Request for Service
MSS = Master Status Summary
MAV = Message Available

*TST? Queries the self-test result of the Regenerative AC Electronic Load.

5.4.2 Instrument Command Dictionary

Commands followed by question marks (?) are in query forms. When a command has both command and query forms, it is noted in the description of the query syntax.

5.4.2.1 SYSTEM Subsystem

SYSTem
- **:ERRor?**
- **:VERSion?**
  - **:INTernal?**
- **:LOCal**
- **:REMote**
- **:DATE**
- **:TIME**
- **:MODule**
  - **:VERSion?**
- **:SLEEP**
  - **:MODE**
  - **:TIME**
    - **:STATe?**
  - **:STATe?**
  - **:WAKEUP**
- **:COMMunicate**
  - **:CAN**
    - **:CYClic**
      - **:TIME**
      - **:TIME?**
      - **:ID**
      - **:ID?**
    - **:BAUD**
    - **:BAUD?**
    - **:ID**
    - **:ID?**
    - **:MASK**
    - **:MASK?**
    - **:MODE**
    - **:MODE?**
    - **:PADding**
    - **:PADding?**
    - **:SCPI**
      - **:ID**
      - **:ID?**
    - **:RESPonse**
      - **:ID**
      - **:ID?**
    - **:APPLY**

SYSTem:ERRor?

Description	: This command queries the error string of the command parser.
Query Syntax	: SYSTem:ERRor?
Parameter	: None
Return Parameter	: Error string response as follows:

0, "No error"	-113, "Undefined header"	-211, "Data stale"
-101, "Invalid character"	-121, "Invalid character in number"	-221, "Setting conflict"
-102, "Syntax error"	-123, "Numeric overflow"	-222, "Data out of range"
-103, "Invalid separator"	-124, "Too many digits"	-223, "Too much data"
-104, "Data type error"	-131, "Invalid suffix"	-224, "Self-test failed"
-105, "GET not allowed"	-141, "Invalid character data"	-225, "Too many errors"
-106, "Illegal parameter value"	-148, "Character data not allowed"	-226, "Data exceed V_{peak} value"
-108, "Parameter not allowed"	-151, "Invalid string data"	-410, "INTERRUPTED"
-109, "Missing parameter"	-158, "String data not allowed"	-430, "DEADLOCKED"
-112, "Program mnemonic too long"	-203, "Command protected"	-440, "UNTERMINATED"

SYSTem:VERSion?

Description : This query requests the version of Regenerative AC Electronic Load that is compatible with the SCPI specification.
Query Syntax : SYSTem:VERSion?
Parameter : None
Return Parameter : Current version (XX.XX)

SYSTem:LOCal

Description : This command can only be used under the control of LAN and USB. If SYST:LOC is programmed, the Regenerative AC Electronic Load will be set in the LOCAL state, and the front panel will work.
Query Syntax : None
Parameter : None
Return Parameter : None

SYSTem:REMote

Description : This command can only be used under the control of LAN and USB. If SYST:REM is programmed, the Regenerative AC Electronic Load will be set in the REMOTE state, and the front panel will be disabled except the "LOCAL/REMOTE" button.
Query Syntax : None
Parameter : None
Return Parameter : None

SYSTem:DATE

Description : Sets the date of the real-time clock of the Regenerative AC Electronic Load.
Query Syntax : SYSTem:DATE?
Parameter : <year>,<month>,<day>
Return Parameter : 2013,01,01

SYSTem:TIME

Description : Sets the time (24H) of the real-time clock of the Regenerative AC Electronic Load.
Query Syntax : SYSTem:TIME?
Parameter : <hour>,<minute>,<second>
Return Parameter : 20,30,01

SYSTem:VERSion:INTernal? [<n>]

Description : This query requests the Regenerative AC Electronic Load to identify the HOST subsystem version.
Query Syntax : SYSTem:VERSion:INTernal? [<n>]
Parameter : <n>: It selects the HOST subsystem, range: 1~2, 1: DSP-CPU1, 2: DSP-CPU2.
Return Parameter : Current version (XX.XX)

SYSTem:MODule:VERSion? <n>[,<m>]

Description : This query requests the Regenerative AC Electronic Load to identify the subsystem version of an internal power module.
Query Syntax : SYSTem:MODule:VERSion? <n>[,<m>]
Parameter : <n>: It selects the phase of a power module, range: 1~3.
<m>: It selects the subsystem of power module, range: 1~2, 1: AD, 2: DA.
Return Parameter : Current version (XX.XX)

SYSTem:SLEEP:MODE

Description : This command sets the sleep mode of the Regenerative AC Electronic Load to be on or off.
Query Syntax : SYSTem:SLEEP:MODE?
Parameter : ENABLE | DISABLE
Return Parameter : ENABLE | DISABLE

SYSTem:SLEEP:TIME

Description : This command sets the time for the Regenerative AC Electronic Load to countdown to sleep mode.
Query Syntax : SYSTem:SLEEP:TIME?
Parameter : <NR1>, range: 5 to 60 (Unit: minute)
Return Parameter : 5 to 60

SYSTem:SLEEP:TIME:STATe?

Description : This command queries the time the Regenerative AC Electronic Load has slept.
Query Syntax : SYSTem:SLEEP:TIME:STATe?
Parameter : None
Return Parameter : 0 to 18446744073709551615 (Unit: second)

SYSTem:SLEEP:STATe?

Description : This command queries the state of the Regenerative AC Electronic Load in sleep mode.
Query Syntax : SYSTem:SLEEP:STATe?
Parameter : None
Return Parameter : STANDBY | SLEEP

SYSTem:SLEEP:WAKEUP

Description : This command sets the wakeup state of the Regenerative AC Electronic Load.
Query Syntax : None
Parameter : None
Return Parameter : None

SYSTem:COMMunicate:CAN:CYClic:TIME

Description : This command sets the time of the CAN Bus device's cyclic return data function.
Query Syntax : SYSTem:COMMunicate:CAN:CYClic:TIME?
Parameter : <NR2>, range: 0 to 60.00 (Unit: second)
Return Parameter : 0 - 60

SYSTem:COMMunicate:CAN:CYClic:ID

Description : This command sets the ID code of the destination device in the CAN Bus device's cyclic return data.
Query Syntax : SYSTem:COMMunicate:CAN:CYClic:ID?
Parameter : <NR1>,
11-bit format : 0 to 2047
29-bit format : 0 to 536870911
Return Parameter : 11-bit format : 0 to 2047
29-bit format : 0 to 536870911

SYSTem:COMMunicate:CAN:BAUD

Description : This command sets the baud rate of CAN Bus device for data transmission.
Query Syntax : SYSTem:COMMunicate:CAN:BAUD?
Parameter : <NR1>, range: 0 to 12
0: 10kbps, 1: 20kbps, 2: 40kbps, 3: 50kbps, 4: 80kbps, 5: 100kbps, 6: 125kbps, 7: 200kbps, 8: 250k, 9: 400kbps, 10: 500kbps, 11: 800kbps, 12: 1000kbps
Return Parameter : 0 - 12

SYSTem:COMMunicate:CAN:ID

Description : This command sets the ID code of the CAN Bus device.
Query Syntax : SYSTem:COMMunicate:CAN:ID?
Parameter : <NR1>,
11-bit format : 0 to 2047
29-bit format : 0 to 536870911
Return Parameter : 11-bit format : 0 to 2047
29-bit format : 0 to 536870911

SYSTem:COMMunicate:CAN:MASK

Description : This command sets the acceptance filter of the CAN Bus device.
Query Syntax : SYSTem:COMMunicate:CAN:MASK?
Parameter : <NR1>,
11-bit format : 0 to 2047
29-bit format : 0 to 536870911
Return Parameter : 11-bit format : 0 to 2047
29-bit format : 0 to 536870911

SYSTem:COMMunicate:CAN:MODE

Description : This command sets the format of the CAN Bus device data frame.
Query Syntax : SYSTem:COMMunicate:CAN:MODE?
Parameter : <NR1>, range: 0 to 1
0: 11-bit, 1: 29-bit
Return Parameter : 0 to 1

SYSTem:COMMunicate:CAN:PADding

Description : This command enables or disables the zero padding function of the data returned by the CAN Bus device.
Query Syntax : SYSTem:COMMunicate:CAN:PADding?
Parameter : <NR1>, range: range: 0 to 1
0: disable, 1: enable
Return Parameter : 0 to 1

SYSTem:COMMunicate:CAN:SCPI:ID

Description : This command sets the ID code of the destination device for returning the SCPI query command of the CAN Bus device.
Query Syntax : SYSTem:COMMunicate:CAN:SCPI:ID?
Parameter : <NR1>,
11-bit format : 0 to 2047
29-bit format : 0 to 536870911
Return Parameter : 11-bit format : 0 to 2047
29-bit format : 0 to 536870911

SYSTem:COMMunicate:CAN:RESPonse:ID

Description : This command sets the ID code of the destination device for the handshake message returned by the CAN Bus device.
Query Syntax : SYSTem:COMMunicate:CAN:RESPonse:ID?
Parameter : <NR1>,
11-bit format : 0 to 2047
29-bit format : 0 to 536870911
Return Parameter : 11-bit format : 0 to 2047
29-bit format : 0 to 536870911

SYSTem:COMMunicate:CAN:APPLY

Description : This command confirms the input action of all setting parameters of the CAN Bus device.
Query Syntax : SYSTem:COMMunicate:CAN:APPLY?
Parameter : None
Return Parameter : UNDONE | DONE

5.4.2.2 INSTRUMENT Subsystem

INSTrument
:EDIT
:Couple
:NSELect
:SELect
:PHASe
:STATus?

INSTrument:EDIT

Description : It is very convenient to use a programmed command to set all phases at the same time for a Regenerative AC Electronic Load that is equipped with multiple phases. If INST:EDIT ALL has been programmed, it will be sent to all phases. INST:EDIT EACH command disables EDIT ALL command.

Query Syntax : INSTrument:EDIT?
Parameter : EACH | ALL
Return Parameter : EACH | ALL

INSTrument:COUPle
Description : It is easy to use a command to program all phases in a Regenerative AC Electronic Load with multiple phases. If INST:COUP ALL is programmed, this command will be sent to all phases. INST:COUP NONE command will cancel COUP ALL command.
Query Syntax : INSTrument:COUPle?
Parameter : NONE | ALL
Return Parameter : NONE | ALL

INSTrument:NSELect
Description : This command sets individual output for subsequent commands or queries in the multi-phase model. If INST:COUP NONE has been programmed, the phase selection command will send to a specific output phase set by INSTrument:NSELect. If INST:COUP ALL has been programmed, all remote operation commands will send to all output phases. This command only affects the set voltage and queries the measurement data. For instance, if "INST:COUP ALL", "INST:NSEL 2" and "Meas:VOLT?" are programmed, the Regenerative AC Electronic Load will return Φ 2 measurement voltage. INST:NSEL follows the number to select the phase.
Query Syntax : INSTrument:NSELect?
Parameter : 1 | 2 | 3
Return Parameter : 1 | 2 | 3

INSTrument:SELect
Description : This command sets individual output for subsequent commands or queries in the multi-phase model. If INST: COUP NONE has been programmed, the phase selection command will send to a specific output phase set by INSTrument: SELect. If INST: COUP ALL has been programmed, all remote operation commands will be sent to all output phases. This command only affects the set voltage and queries the measurement data. For instance, if "INST:COUP ALL ", "INST:SEL OUTPUT2", and "Meas: VOLT?" are programmed, the Regenerative AC Electronic Load will return Φ 2 measurement voltage. INST:SELect follows the number to select phase.
Query Syntax : INSTrument:SELect?
Parameter : OUTPUT1 | OUTPUT2 | OUTPUT3
Return Parameter : OUTPUT1 | OUTPUT2 | OUTPUT3

INSTrument:PHASe
Description : This command switches between single-phase and three-phase mode.
Query Syntax : INSTrument:PHASe?
Parameter : THREE | SINGLE
Return Parameter : THREE | SINGLE

INSTrument:STATus?

Description : Queries the status of the power modules for each phase in the Regenerative AC Electronic Load.

Bit Configuration of Protection Status Register for Power Module (per Phase)

Bit Position	15-10	9	8	7	6	5	4	3	2	1	0
State	---	INHIBIT	OVP	INP	OCP	FAN	SHT	OTP	OPP	INT-DA	INT-AD

INHIBIT: Remote Inhibit
OVP: Output Voltage Protection
INP: Line Input Protection
OCP: Over Current Protection
FAN: Fan Failure
SHT: Output Short Circuit Protection
OTP: Over Temperature Protection
OPP: Over Power Protection
INT-DA: DC/AC Power Module Protection
INT-AD: AC/DC Power Module Protection

Query Syntax : INSTrument:STATus?
Parameters : No parameter: Queries the module status specified by the INST:SEL and INST:NSEL commands.
With parameter: <n> (0 to N); 0: Master, 1 to N: Slave1 to SlaveN
Queries the status of all modules on the Master and Slave units in series/parallel operation.

Return Parameter : 0 - 65535 (2^{16} - 1)

INSTrument:STATus:AD?

Description : Queries the AC/DC power module status for each phase in Regenerative AC Electronic Load.
Query Syntax : INSTrument:STATus:AD? {<n>}
Parameters : No parameter: Queries the module status specified by the INST:SEL and INST:NSEL commands.
With parameter: <n> (0 to N); 0: Master, 1 to N: Slave1 to SlaveN
Queries the status of all modules on the Master and Slave units in series/parallel operation.
Return Parameter : 0 - 4294967295 (2^{32} - 1)

Bit[n]	Description	Bit[n]	Description	Bit[n]	Description	Bit[n]	Description
0	AD_VDC_OVP	8	DD_VO_OVP_F	16	DD_IO_REG_OCP	24	AD_MODEL_RES_ERR
1	AD_VDC_UVP	9	DD_VO_UVP_F	17	AD_RLY_STARTFAIL	25	DD_SHORT
2	AD_VRS_OVP	10	AD_IR_OCP	18	AD_PWM_TOP_FAULT	26	AD_MEM_ERR
3	AD_VTR_OVP	11	AD_IT_OCP	19	AD_PWM_BOT_FAULT	27	DD_LLC_STARTFAIL
4	AD_VST_OVP	12	AD_IS_OCP	20	AD_AC_STARTFAIL	28	AD_VAC_UBL
5	AD_VRS_UVP	13	AD_Vd_OVP	21	AD_PFC_STARTFAIL	29	DD_IP_OCP
6	AD_VTR_UVP	14	DD_IO_SRC_OCP	22	AD_HARD_ERR	30	AD_Vd_UVP
7	AD_VST_UVP	15	AD_OTP	23	DD_VO_UVP_S	31	AD_FRE_ERR

INSTrument:STATus:DA?

Description : This command queries the DC/AC power module status of each phase in Regenerative AC Electronic Load.
Query Syntax : INSTrument:STATus:DA? {<n>}
Parameters : No parameter: Queries the module status specified by the INST:SEL and INST:NSEL commands.
With parameter: <n> (0 to N); 0: Master, 1 to N: Slave1 to SlaveN
Queries the status of all modules on the Master and Slave units in series/parallel operation.
Return Parameter : 00 ~ 4294967295 (2^{32} - 1)

Bit[n]	Description	Bit[n]	Description	Bit[n]	Description	Bit[n]	Description
0	DA_OCP	8	DA_HARD_ERR	16	DA_IC_OCP	24	DA_SRAM_ERR
1	DA_UUT_OVP_VLN	9	DA_PWM_R_FAULT	17	DA_VDAMP_OVP	25	DA_CALIB_ERR
2	DA_OVP	10	DA_PWM_L_FAULT	18	DA_OCP_S	26	-
3	DA_FW_PWMSHORT	11	DA_OTP	19	DA_WIRE_LOSS	27	-
4	DA_UUT_OVP_VLL	12	DA_UUT_UVP	20	DA_UTP	28	-
5	DA_OPP	13	DA_SHORT	21	DA_UUT_OVP_VDC	29	-
6	DA_SENSE_FAULT	14	DA_UUT_OFP	22	DA_UUT_FAULT	30	-
7	DA_ISHARE_ERR_F	15	DA_UUT_UFP	23	DA_PLL_FAIL	31	-

5.4.2.3 FETCH and MEASURE Subsystem

FETCh | MEASure

```
[:SCALar]
    :CURRent
        :AC?                    It queries the rms current of the AC component.
        :DC?                    It queries the DC level.
        :ACDC?                  It queries the current (AC+DC) rms.
        :AMPLitude:MAXimum?     It queries the peak current.
        :CREStfactor?           It queries the current crest factor.
    :FREQuency?                 It queries the frequency.
    :POWer
        :AC
            [:REAL]?            It queries the real power.
            :APParent?          It queries the apparent power.
            :REACtive?          It queries the reactive power.
            :PFACtor?           It queries the power factor.
            :TOTal?             It queries the total power.
            :TOTal:APParent?    It queries the total apparent power.
    :VOLTage
        :AC?                    It queries the rms voltage of the AC component.
        :DC?                    It queries the DC voltage.
        :ACDC?                  It queries the rms voltage.
        :AMPLitude:MAXimum?     It queries the peak voltage.
    :LINE
        :V12?                   It queries the voltage difference of phases 1 & 2.
        :V23?                   It queries the voltage difference of phases 2 & 3.
        :V31?                   It queries the voltage difference of phases 3 & 1.
```

This command enables you to get measurement data from the Regenerative AC Electronic Load via MEASure and FETCh. MEASure triggers the acquisition to get new data before returning data, while FETCh returns the previously acquired data from the measurement buffer.

FETCh[:SCALar]:CURRent:AC?
MEASure[:SCALar]:CURRent:AC?
Description : Returns the RMS current of the AC component delivered at the output terminals.
Query Syntax : FETCh:CURRent:AC?
MEASure:CURRent:AC?
Return Parameter : <NR2>

FETCh[:SCALar]:CURRent:DC?
MEASure[:SCALar]:CURRent:DC?
Description : Returns the DC current delivered at the output terminals.
Query Syntax : FETCh:CURRent:DC?
MEASure:CURRent:DC?
Return Parameter : <NR2>

FETCh[:SCALar]:CURRent:ACDC?
MEASure[:SCALar]:CURRent:ACDC?
Description : Returns the RMS current (AC+DC) delivered at the output terminals.
Query Syntax : FETCh:CURRent:ACDC?
MEASure:CURRent:ACDC?
Return Parameter : <NR2>

FETCh[:SCALar]:CURRent:AMPLitude:MAXimum?
MEASure[:SCALar]:CURRent:AMPLitude:MAXimum?
Description : Returns the absolute value of the peak current.
Query Syntax : FETCh:CURRent:AMPLitude:MAXimum?
MEASure:CURRent:AMPLitude:MAXimum?
Return Parameter : <NR2>

FETCh[:SCALar]:CURRent:CREStfactor?
MEASure[:SCALar]:CURRent:CREStfactor?
Description : Returns the output current crest factor, defined as the ratio of peak output current to RMS output current.
Query Syntax : FETCh:CURRent:CREStfactor?
MEASure:CURRent:CREStfactor?
Return Parameter : <NR2>

FETCh[:SCALar]:FREQuency?
MEASure[:SCALar]:FREQuency?
Description : Queries the frequency of the output-terminal voltage, in hertz (Hz).
Query Syntax : FETCh:FREQuency?
MEASure:FREQuency?
Return Parameter : <NR2>

FETCh[:SCALar]:POWer:AC[:REAL]?
MEASure[:SCALar]:POWer:AC[:REAL]?
Description : Returns the real power at the output terminals, in watts (W).
Query Syntax : FETCh:POWer:AC?
MEASure:POWer:AC?
Return Parameter : <NR2>

FETCh[:SCALar]:POWer:AC:APParent?
MEASure[:SCALar]:POWer:AC:APParent?

Description : Returns the apparent power at the output terminals, in volt-amperes (VA).
Query Syntax : FETCh:POWer:AC:APParent?
MEASure:POWer:AC:APParent?
Return Parameter : <NR2>

FETCh[:SCALar]:POWer:AC:REACtive?
MEASure[:SCALar]:POWer:AC:REACtive?

Description : Returns the reactive power at the output terminals, in volt-amperes reactive (var). The reactive power is calculated as follows:
VAR = $\sqrt{APPARENTPOWER^2 - REALPOWER^2}$
Query Syntax : FETCh:POWer:AC:REACtive?
MEASure:POWer:AC:REACtive?
Return Parameter : <NR2>

FETCh[:SCALar]:POWer:AC:PFACtor?
MEASure[:SCALar]:POWer:AC:PFACtor?

Description : Returns the power factor at the output terminals. The power factor is calculated as follows:
PF = TRUE POWER / APPARENT POWER
Query Syntax : FETCh:POWer:AC:PFACtor?
MEASure:POWer:AC:PFACtor?
Return Parameter : <NR2>

FETCh[:SCALar]:POWer:AC:TOTal?
MEASure[:SCALar]:POWer:AC:TOTal?

Description : Returns the sum of real power at the 3-phase output terminals, in watts (W).
Query Syntax : FETCh:POWer:AC:TOTal?
MEASure:POWer:AC:TOTal?
Return Parameter : <NR2>

FETCh[:SCALar]:POWer:AC:TOTal:APParent?
MEASure[:SCALar]:POWer:AC:TOTal:APParent?

Description : Returns the sum of apparent power at the 3-phase output terminals, in volt-amperes (VA).
Query Syntax : FETCh:POWer:AC:TOTal:APParent?
MEASure:POWer:AC:TOTal:APParent?
Return Parameter : <NR2>

FETCh[:SCALar]:VOLTage:AC?
MEASure[:SCALar]:VOLTage:AC?

Description : Returns the RMS voltage of the AC component at the output terminals.
Query Syntax : FETCh[:SCALar]:VOLTage:AC?
MEASure[:SCALar]:VOLTage:AC?
Return Parameter : <NR2>

FETCh[:SCALar]:VOLTage:DC?
MEASure[:SCALar]:VOLTage:DC?
Description : Returns the DC voltage at the output terminals.
Query Syntax : FETCh[:SCALar]:VOLTage:DC?
MEASure[:SCALar]:VOLTage:DC?
Return Parameter : <NR2>

FETCh[:SCALar]:VOLTage:ACDC?
MEASure[:SCALar]:VOLTage:ACDC?
Description : Returns the RMS voltage (AC+DC) at the output terminals.
Query Syntax : FETCh[:SCALar]:VOLTage:ACDC?
MEASure[:SCALar]:VOLTage:ACDC?
Return Parameter : <NR2>

FETCh[:SCALar]:VOLTage:AMPLitude:MAXimum?
MEASure[:SCALar]:VOLTage:AMPLitude:MAXimum?
Description : Returns the absolute value of the peak voltage.
Query Syntax : FETCh:VOLTage:AMPLitude:MAXimum?
MEASure:VOLTage:AMPLitude:MAXimum?
Return Parameter : <NR2>

FETCh[:SCALar]:LINE:V12?
MEASure[:SCALar]:LINE:V12?
Description : Returns the line-to-line voltage between Phase 1 and Phase 2 at the output terminals.
Query Syntax : FETCh[:SCALar]:LINE:V12?
MEASure[:SCALar]:LINE:V12?
Return Parameter : <NR2>

FETCh[:SCALar]:LINE:V23?
MEASure[:SCALar]:LINE:V23?
Description : Returns the line-to-line voltage between Phase 2 and Phase 3 at the output terminals.
Query Syntax : FETCh[:SCALar]:LINE:V23?
MEASure[:SCALar]:LINE:V23?
Return Parameter : <NR2>

FETCh[:SCALar]:LINE:V31?
MEASure[:SCALar]:LINE:V31?
Description : Returns the line-to-line voltage between Phase 3 and Phase 1 at the output terminals.
Query Syntax : FETCh[:SCALar]:LINE:V31?
MEASure[:SCALar]:LINE:V31?
Return Parameter : <NR2>

5.4.2.4 OUTPUT Subsystem

OUTPut
[:STATe]
:PROTection
:CLEar
:STATe?

OUTPut[:STATe]

Description : This command enables or disables the output of the Regenerative AC Electronic Load.
Query Syntax : OUTPut[:STATe]?
Parameter : OFF | ON
Return Parameter : OFF | ON

OUTPut:PROTection:CLEar

Description : This command clears the warning status of protection. All conditions that generate the faults must be resolved before the protection is cleared.
Query Syntax : None
Parameter : None
Return Parameter : None

OUTPut:PROTection:STATe?

Description : This command queries the value of the protection status register.

Bit Configuration of Protection Status Register for Each Phase Power Module

Bit Position	15-10	9	8	7	6	5	4	3	2	1	0
State	---	INHIBIT	OVP	INP	OCP	FAN	SHT	OTP	OPP	INT-DA	INT-AD

INHIBIT: Remote Inhibit
OVP: Output voltage protection
INP: Line input protection
OCP: Over current protection
FAN: Fan failure
SHT: Output short circuit protection
OTP: Over temperature protection
OPP: Overpower protection
INT-DA: DC/AC power module protection
INT-AD: AC/DC power module protection

Query Syntax : OUTPut:PROTection:STATe?
Parameter : None
Return Parameter : <NR1>, 0 ~ 65535 (2^{16}-1)

5.4.2.5 MSTSLV Subsystem

MSTSLV

:FUNCtion
:STATus
:SELect
:SLVNUM

MSTSLV:FUNCtion

Description : This command sets parallel or unparalleled the Regenerative Electronic Loads.
Query Syntax : MSTSLV:FUNCtion?
Parameter : DISABLE | ENABLE
Return Parameter : DISABLE | ENABLE

MSTSLV:FUNCtion:STATus?

Description : This command queries the parallel status at present. It returns WAIT to indicate that the device is under paralleling or unparalleling.
Query Syntax : MSTSLV:FUNCtion:STATus?
Parameter : None
Return Parameter : DISABLE | ENABLE | WAIT

MSTSLV:SELect

Description : This command sets the role for paralleling.
Query Syntax : MSTSLV:SELect?
Parameter : <NR1>, range: 0~2, 0: MASTER, 1: SLAVE 1, 2: SLAVE 2.
Return Parameter : <NR1>

MSTSLV:SLVNUM

Description : If MSTSLV:SEL 0 is set, this command can set the number of SLAVEs.
Query Syntax : MSTSLV:SLVNUM?
Parameter : <NR1>, range: 1~2，1: SLAVE no. is 1, 2: SLAVE no. is 2.
Return Parameter : <NR1>

5.4.2.6 CONFIGURE Subsytem

[SOURce:]

CONFigure
:INHibit
:EXTON
:AVERage

[SOURce:]CONFigure:INHibit

Description : This command sets the Remote Inhibit function.
Query Syntax : [SOURce:]CONFigure:INHibit?
Parameter : DISABLE | ENABLE
Return Parameter : DISABLE | ENABLE

[SOURce:]CONFigure:EXTON

Description : This command sets the External ON/OFF control.
Query Syntax : [SOURce:]CONFigure:EXTON?
Parameter : DISABLE | ENABLE
Return Parameter : DISABLE | ENABLE

[SOURce:]CONFigure:AVERage

Description : This command sets the average times for measurement.
Query Syntax : [SOURce:]CONFigure:AVERage?
Parameter : 1 | 2 | 4 | 8 | 16 | 32
Return Parameter: 1 | 2 | 4 | 8 | 16 | 32

5.4.2.7 STATUS Subsystem

STATus
:OPERation
[:EVENt]?
:ENABle
:QUEStionable
:CONDition
[:EVENt]?
:ENABle
:NTRansition
:PTRansition

STATus:OPERation[:EVENt]?
Description : This command queries the Operation Status register.
Query Syntax : STATus:OPERation[:EVENt]?
Parameter : None
Return Parameter : Always 0.

STATus:OPERation:ENABle
Description : This command sets the Operation Status Enable register. The register is the shield when a specific bit is enabled from the Operation Status register.
Query Syntax : STATus:OPERation:ENABle?
Parameter : <NR1>, valid range: 0 ~ 65535
Return Parameter : <NR1>

STATus:QUEStionable:CONDition?
Description : This query returns the value of the Questionable Condition register. It is a read-only register that saves the questionable condition of Regenerative AC Electronic Load in real-time.
Query Syntax : STATus:QUEStionable:CONDition?
Parameter : None
Return Parameter : <NR1>

STATus:QUEStionable[:EVENt]?
Description : This query returns the value of the Questionable Event register. It is a read-only register that saves all items that passed the Questionable NTR and/or PTR filter. If the QUES bit in the Service Request Enabled register has been set and the Questionable Event register > 0, the QUES of the Status Byte register will be set as well.
Query Syntax : STATus:QUEStionable[:EVENt]?
Parameter : None
Return Parameter : <NR1>

STATus:QUEStionable:ENABle
Description : The command sets or reads the value of the Questionable Enable register. The register is the shield when a specific bit is enabled to set the QUES bit of the Status Byte register from the Operation Status register.
Query Syntax : STATus:QUEStionable:ENABle?
Parameter : <NR1>, valid range: 0 ~ 65535
Return Parameter : <NR1>

STATus:QUEStionable:NTRansition

Description : This command sets or reads the value of Questionable NTR registers.
The operation of these registers is the same as the polarity filter of Questionable Enable and Questionable Event registers that lead to the following actions:

* When a bit of the Questionable NTR register is set to 1, a 1-to-0 transition of the corresponding bit in the Questionable Condition register will make that bit in the Questionable Event register set.

* When a bit of the Questionable PTR register is set to 1, a 1-to-0 transition of the corresponding bit in the Questionable Condition register will make that bit in the Questionable Event register set.

* If the two same bits in both NTR and PTR registers are set to 0, no transition of that bit in the Questionable Condition register can set the corresponding bit in the Questionable Event register.

Bit Configuration of Questionable Status Register

Bit Position	15-10	9	8	7	6	5	4	3	2	1	0
Condition	---	INHIBIT	OVP	INP	OCP	FAN	SHT	OTP	OPP	INT-DA	INT-AD

INHIBIT: Remote Inhibit
OVP: Output voltage protection
INP: Line input protection.
OCP: Over current protection.
FAN: Fan failure.
SHT: Output short protection.
OTP: Over temperature protection.
OPP: Over power protection.
INT-DA: DC/AC power module protection
INT-AD: AC/DC power module protection

Query Syntax : STATus:QUEStionable:NTRansition?
Parameter : <NR1>, valid range: 0 ~ 65535
Return Parameter : <NR1>

STATus:QUEStionable:PTRansition

Description : This command sets or reads the values of the Questionable PTR register. Please refer to the description of the previous command.
Query Syntax : STATus:QUEStionable:PTRansition?
Parameter : <NR1>, valid range: 0 ~ 65535
Return Parameter : <NR1>

5.4.2.8 LOAD Subsystem

LOAD
- **:MODE**
- **:CCREctified**
  - :CURRent
  - :CREStfactor
  - :SHAPe
- **:CPREctified**
  - :POWer
  - :CREStfactor
- **:CR**
  - :RESistor
- **:CCPHase**
  - :CURRent
  - :DEGRee
- **:CPPHase**
  - :POWer
  - :DEGRee
  - :PF
  - :PF
    - :MODE
- **:CCCOnstant**
  - :CURRent
  - :CREStfactor
  - :PF
  - :PF
    - :MODE
- **:CPCOnstant**
  - :POWer
  - :CREStfactor
  - :PF
  - :PF
    - :MODE
- **:CONStant**
  - :MODE
  - :MODE
    - :PRIOrity
- **:PHASe**
  - :LIMit
  - :ON
    - :IMMediate
  - :OFF
    - :IMMediate
  - :TRANSient
    - :IMMediate
- **:SLEW**
  - :CURRent
  - :POWer
- **:LIMit**
  - :CURRent
  - :CREStfactor
  - :POWer

[:APParent]
:REAL
:STANdby
:RESPonse
:OUTPut
:RESPonse
:LIST
:MODE
:COUNt
:RULE
:TRIG
:STATe
:STATus
:DATA
:CCRE
:CSRE
:CR
:CCPH
:CSPH
:CCCO
:CPCO
:LOOP
:CCRE
:CSRE
:CR
:CCPH
:CSPH
:CCCO
:CPCO
:CLEar
:SEQuence
:CCRE
:CSRE
:CR
:CCPH
:CSPH
:CCCO
:CPCO
:CLEar
:POINts
:TRACe

LOAD:MODE

Description : This command sets the Load operating mode.
Query Syntax : LOAD:MODE?
Parameter : CCRE | CPRE | CR | CCPH | CPPH | CCCO | CPCO
Return Parameter : CCRE | CPRE | CR | CCPH | CPPH | CCCO | CPCO

LOAD:CCREctified:CURRent

Description : This command sets the loading current in CC rectified mode.
Query Syntax : LOAD:CCREctified:CURRent?
Parameter : <NR2>, valid range: 0.0 ~ 35.00 (unit: A)
Return Parameter : <NR2>

LOAD:CCREctified:CREStfactor

Description : This command sets the crest factor in CC rectified mode.
Query Syntax : LOAD:CCREctified:CRES?
Parameter : <NR2>, valid range: 1.414 ~ 3.000
Return Parameter : <NR2>

LOAD:CCREctified:SHAPe

Description : This command sets the waveform shape of the loading current in CC rectified mode.
Query Syntax : LOAD:CCREctified:SHAPe?
Parameter : SINE | POS | NEG | LEAD | LAG
Return Parameter : SINE | POS | NEG | LEAD | LAG

LOAD:CPREctified:POWer

Description : This command sets the loading power in CS rectified mode.
Query Syntax : LOAD:CPREctified:POWer?
Parameter : <NR2>, valid range: 0.0 ~ 5000.0 (unit: VA)
Return Parameter : <NR2>

LOAD:CPREctified:CREStfactor

Description : This command sets the crest factor of loading current in CS rectified mode.
Query Syntax : LOAD:CPREctified:CREStfactor?
Parameter : <NR2>, valid range: 1.414 ~ 3.000
Return Parameter : <NR2>

LOAD:CR:RESistor

Description : This command sets the loading resistance in CR mode.
Query Syntax : LOAD:CR:RESistor?
Parameter : <NR2>, valid range: 1 ~ 300 (unit: Ohm)
Return Parameter : <NR2>

LOAD:CCPHase:CURRent

Description : This command sets the loading current in CC Lead/Lag mode.
Query Syntax : LOAD:CCPHase:CURRent?
Parameter : <NR2>, valid range: 0.0 ~ 35.00 (unit: A)
Return Parameter : <NR2>

LOAD:CCPHase:DEGRee

Description : This command sets the phase degree between the loading current and UUT voltage in CC Lead/Lag mode.
Query Syntax : LOAD:CCPHase:DEGRee?
Parameter : Phase Limit ON :<NR2>, valid range: -90.0 ~ 90.0 (unit: Degree)
Phase Limit OFF :<NR2>, valid range: -180.0 ~ 180.0 (unit: Degree)
Return Parameter : <NR2>

LOAD:CPPHase:POWer

Description : This command sets the loading power in CS Lead/Lag mode.
Query Syntax : LOAD:CPPHase:POWer?
Parameter : <NR2>, valid range: 0.0 ~ 5000.0 (unit: VA)
Return Parameter : <NR2>

LOAD:CPPHase:DEGRee

Description : This command sets the phase degree between the loading current and UUT voltage in CS Lead/Lag mode.
Query Syntax : LOAD:CPPHase:DEGRee?
Parameter : Phase Limit ON :<NR2>, valid range: -84.26 ~ 84.26 (unit: Degree)
Phase Limit OFF :<NR2>, valid range: -84.26 ~ 84.26 (unit: Degree)
Return Parameter : <NR2>

LOAD:CPPHase:PF

Description : This command sets the PF value of the loading current and UUT voltage in CS Lead/Lag mode. This setting is linked to LOAD:CPPHase:DEGRee.
Query Syntax : LOAD:CPPHase:PF?
Parameter : <NR2>, valid range: 0.1~1.000
Return Parameter : <NR2>

LOAD:CPPHase:PF:MODE

Description : This command sets the current in CP phase mode to lead or lag behind the UUT voltage. This setting is linked to LOAD:CPPHase:DEGRee.
Query Syntax : LOAD:CPPHase:PF:MODE?
Parameter : LEAD | LAG
Return Parameter : LEAD | LAG

LOAD:CPPHase:POWer:REAL?

Description ：This command queries the loading equivalent real power in CS Lead/Lag mode.
Query Syntax ：LOAD:CPPHase:POWer:REAL?
Parameter ：None
Return Parameter ：<NR2>

LOAD:CPPHase:POWer:REACtive?

Description ：This command queries the loading equivalent reactive power in CS Lead/Lag mode.
Query Syntax ：LOAD:CPPHase:POWer:REACtive?
Parameter ：None
Return Parameter ：<NR2>

LOAD:CCCOnstant:CURRent

Description : This command sets the CC mode loading current.
Query Syntax : LOAD:CCCOnstant:CURRent?
Parameter : <NR2>, valid range: 0.0 ~ 35.00 (unit: A)
Return Parameter : <NR2>

LOAD:CCCOnstant:CREStfactor

Description : This command sets the loading crest factor in CC mode. Its high and low limits are linked to the PF setting value.
Query Syntax : LOAD:CCCOnstant:CREStfactor?
Parameter : <NR2>, valid range: 1.414 ~ 3.000
Return Parameter : <NR2>

LOAD:CCCOnstant:PF

Description : This command sets the PF value of the CC mode loading current and UUT voltage. Its high and low limits are linked to the CREStfactor setting value.
Query Syntax : LOAD:CCCOnstant:PF?
Parameter : <NR2>, valid range: 0.1~1.000
Return Parameter : <NR2>

LOAD:CCCOnstant:PF:MODE

Description : This command sets the CC mode loading current leads or lags the UUT voltage.
Query Syntax : LOAD:CCCOnstant:PF:MODE?
Parameter : LEAD | LAG
Return Parameter : LEAD | LAG

LOAD:CPCOnstant:POWer

Description : This command sets the CP mode loading power.
Query Syntax : LOAD:CPCOnstant:POWer?
Parameter : <NR2>, valid range: 0.0 ~ 5000.0 (unit: W)
Return Parameter : <NR2>

LOAD:CPCOnstant:CREStfactor

Description : This command sets the loading crest factor in CP mode. Its high and low limits are linked to the PF setting value.
Query Syntax : LOAD:CPCOnstant:CREStfactor?
Parameter : <NR2>, valid range: 1.414 ~ 3.000
Return Parameter : <NR2>

LOAD:CPCOnstant:PF

Description : This command sets the PF value of the CP mode loading current and UUT voltage. Its high and low limits are linked to the CREStfactor setting value.
Query Syntax : LOAD:CPCOnstant:PF?
Parameter : <NR2>, valid range: 0.1~1.000
Return Parameter : <NR2>

LOAD:CPCOnstant:PF:MODE

Description : This command sets the CP mode loading current leads or lags the UUT voltage.
Query Syntax : LOAD:CPCOnstant:PF:MODE?
Parameter : LEAD | LAG
Return Parameter : LEAD | LAG

LOAD:CONStant:MODE

Description : This command sets the operating mode for setting the CF and PF value in CC/CP mode.
Query Syntax : LOAD:CONStant:MODE?
Parameter : BOTH | CF | PF
Return Parameter : BOTH | CF | PF

LOAD:CONStant:MODE:PRIOrity

Description : This command sets the priority order of CF and PF values in CC and CP mode when the operation mode of CF and PF is set to BOTH.
Query Syntax : LOAD:CONStant:PRIOrity?
Parameter : CF | PF
Return Parameter : CF | PF

LOAD:PHASe:LIMit

Description : This command switches the input range of the phase parameter.
Query Syntax : LOAD:PHASe:LIMit?
Parameter : ON | OFF
Return Parameter : ON | OFF

LOAD:PHASe:ON

Description : Sets the start angle of the current waveform in AC Load mode. The default is ON, which indicates 0 degrees.
Query Syntax : LOAD:PHASe:ON?
Parameter : <NR2>, valid range: 0.0 - 359.9
Return Parameter : <NR2>

LOAD:PHASe:ON:IMMediate

Description : Sets the current waveform to start immediately in AC Load mode.
Query Syntax : LOAD:PHASe:OFF:IMMediate?
Parameter : ENABLE | DISABLE
Return Parameter : ENABLE | DISABLE

LOAD:PHASe:OFF

Description : Sets the end angle of the current waveform in AC Load mode.
Query Syntax : LOAD:PHASe:OFF?
Parameter : <NR2>, valid range: 0.0 - 359.9
Return Parameter : <NR2>

LOAD:PHASe:OFF:IMMediate

Description : Sets the current waveform to end immediately in AC Load mode.
Query Syntax : LOAD:PHASe:OFF:IMMediate?
Parameter : ENABLE | DISABLE
Return Parameter : ENABLE | DISABLE

LOAD:PHASe:TRANSient

Description : Sets the phase angle at which the current waveform changes in AC Load mode.
Query Syntax : LOAD:PHASe:TRANSient?
Parameter : <NR2>, valid range: 0.0 - 359.9
Return Parameter : <NR2>

LOAD:PHASe:TRANSient:IMMediate

Description : Sets the current waveform to change immediately in AC Load mode.
Query Syntax : LOAD:PHASe:TRANSient:IMMediate?
Parameter : ENABLE | DISABLE
Return Parameter : ENABLE | DISABLE

LOAD:SLEW:CURRent

Description : This command sets the current slew rate in CC/CCRE/CCPH mode.
Query Syntax : LOAD:SLEW:CURRent?
Parameter : <NR2>, valid range: 0.01 ~ 800.0 A/ms
Return Parameter : <NR2>

LOAD:SLEW:POWer

Description : This command sets the power slew rate in CP/CPRE/CPPH mode.
Query Syntax : LOAD:SLEW:POWer?
Parameter : <NR2>, valid range: 0.1 ~ 80000.0 VA/ms
Return Parameter : <NR2>

LOAD:LIMit:CURRent

Description : This command limits the current setting range.
Query Syntax : LOAD:LIMit:CURRent?
Parameter : <NR2>, valid range: 0.0~ 35.00 (unit: A)
Return Parameter : <NR2>

LOAD:LIMit:CREStfactor

Description : This command limits the CF setting range.
Query Syntax : LOAD:LIMit:CREStfactor?
Parameter : <NR2>, valid range: 1.414 ~ 3.000
Return Parameter : <NR2>

LOAD:LIMit:POWer:APParent

Description : This command limits the apparent power setting range.
Query Syntax : LOAD:LIMit:POWer:APParent?
Parameter : <NR2>, valid range: 0.0 ~ 5000.0 (unit: VA)
Return Parameter : <NR2>

LOAD:LIMit:POWer:REAL

Description : This command limits the real power setting range.
Query Syntax : LOAD:LIMit:POWer:REAL?
Parameter : <NR2>, valid range: 0.0 ~ 5000.0 (unit: W)
Return Parameter : <NR2>

LOAD:STANdby

Description : This command enables or disables the Stand-by function.
Query Syntax : LOAD:STANdby?
Parameter : ENABLE | DISABLE
Return Parameter : ENABLE | DISABLE

LOAD:STANdby:RESPonse

Description : This command sets the response speed of Stand-by mode.
Query Syntax : LOAD:STANdby:RESPonse?
Parameter : SLOW | MEDIUM | FAST
Parameter : SLOW | MEDIUM | FAST

LOAD:OUTPut:RESPonse

Description : This command sets the loading response speed in Load mode
Query Syntax : LOAD:OUTPut:RESPonse?
Parameter : SLOW | MEDIUM | FAST
Return Parameter : SLOW | MEDIUM | FAST

LOAD:LIST:MODE

Description : This command queries the loading of Phase Select in List mode.
Query Syntax : LOAD:LIST:MODE?
Parameter : CCRE | CSRE | CR | CCPH | CSPH | CCCO | CPCO
Return Parameter : CCRE | CSRE | CR | CCPH | CSPH | CCCO | CPCO

LOAD:LIST:COUNt

Description : This command sets the Round Count of Phase Select in List mode.
Query Syntax : LOAD:LIST:COUNt?
Parameter : <NR1>, valid range: 0 ~65535
Return Parameter : <NR1>

LOAD:TRIG

Description : This command sets the trigger for Load list mode to start or stop execution.
Parameter : ON | OFF
Return Parameter : ON | OFF

LOAD:TRIG:STATe?

Description : This command queries the Trigger output state of List mode.
Parameter : ON | OFF
Return Parameter : ON | OFF

LOAD:LIST:STATus?

Description : This command queries the List Mode execution status.
Query Syntax : LOAD:LIST:STATus?
Return Parameter: <arg1>,<arg2>,<arg3>,<arg4>,<arg5>,<arg6>,<arg7>, <arg8>, <arg9>, <arg10>

<arg1> : Execution status <CRD>: OFF | RUNNING | PAUSE
<arg2> : Execution mode <CRD>: CCRE | CSRE | CR | CCPH | CSPH | CCCO | CPCO
<arg3> : LIST execution times <NR1>
<arg4> : Total LIST execution times <NR1>
<arg5> : The currently executing loop <NR1>
<arg6> : The number of times the current loop executed<NR1>
<arg7> : The total executions of the current loop <NR1>
<arg8> : The start sequence of current loop <NR1>
<arg9> : The end sequence of current loop <NR1>
<arg10> : The execution sequence of current loop <NR1>

LOAD:LIST:DATA:CCRE

Description : This command sets the execution parameters of CC Rectified mode in Load LIST function.
Syntax : LOAD:LIST:DATA:CCRE <arg1>,<arg2>,<arg3>,<arg4>
Parameter : <arg1>: Trigger Source <CRD>: AUTO | MANUAL | EXCITE
<arg2>: Dwell Base <CRD>: TIME | CYCLE
<arg3>: Reserved
<arg4>: UDW Type <NR1>: 0(PU) | 1(Value)
Query Syntax : LOAD:LIST:DATA:CCRE?
Return Parameter : <arg1>,<arg2>,<arg3>,<arg4>

LOAD:LIST:DATA:CSRE

Description : This command sets the execution parameters of CS Rectified mode in Load LIST function.
Syntax : LOAD:LIST:DATA:CSRE <arg1>,<arg2>,<arg3>
Parameter : <arg1>: Trigger Source <CRD>: AUTO | MANUAL | EXCITE
<arg2>: Dwell Base <CRD>: TIME | CYCLE
<arg3>: Reserved
Query Syntax : LOAD:LIST:DATA:CSRE?
Return Parameter : <arg1>,<arg2>,<arg3>

LOAD:LIST:DATA:CR

Description : This command sets the execution parameters of CR mode in Load LIST function.
Syntax : LOAD:LIST:DATA:CR <arg1>,<arg2>,<arg3>
Parameter : <arg1>: Trigger Source <CRD>: AUTO | MANUAL | EXCITE
<arg2>: Dwell Base <CRD>: TIME | CYCLE
<arg3>: Reserved
Query Syntax : LOAD:LIST:DATA:CR?
Return Parameter : <arg1>,<arg2>,<arg3>

LOAD:LIST:DATA:CCPH

Description : This command sets the execution parameters of CC Lead/Lag mode in Load LIST function.
Syntax : LOAD:LIST:DATA: CCPH <arg1>,<arg2>,<arg3>
Parameter : <arg1>: Trigger Source <CRD>: AUTO | MANUAL | EXCITE
<arg2>: Dwell Base <CRD>: TIME | CYCLE
<arg3>: Reserved
<arg4>: Phase Limit <CRD>: OFF | ON
Query Syntax : LOAD:LIST:DATA:CCPH?
Return Parameter : <arg1>,<arg2>,<arg3>,<arg4>

LOAD:LIST:DATA:CSPH

Description : This command sets the execution parameters of CS Lead/Lag mode in Load LIST function.
Syntax : LOAD:LIST:DATA:CSPH <arg1>,<arg2>,<arg3>,<arg4>
Parameter : <arg1>: Trigger Source <CRD>: AUTO | MANUAL | EXCITE
<arg2>: Dwell Base <CRD>: TIME | CYCLE
<arg3>: Reserved
<arg4>: Phase Limit <CRD>: OFF | ON
Query Syntax : LOAD:LIST:DATA:CSPH?
Return Parameter : <arg1>,<arg2>,<arg3>,<arg4>

LOAD:LIST:DATA:CCCO

Description : This command sets the execution parameters of CC mode in Load LIST function.
Syntax : LOAD:LIST:DATA:CCCO<arg1>,<arg2>,<arg3>,<arg4>
Parameter : <arg1>: Trigger Source <CRD>: AUTO | MANUAL | EXCITE
<arg2>: Dwell Base <CRD>: TIME | CYCLE
<arg3>: Reserved
<arg4>: CF/PF setting <CRD>: BOTH | CF | PF
<arg5>: CF/PF priority <CRD>: CF | PF
Query Syntax : LOAD:LIST:DATA:CCCO?
Return Parameter : <arg1>,<arg2>,<arg3>,<arg4>,<arg5>

LOAD:LIST:DATA:CPCO

Description : This command sets the execution parameters of CP mode in Load LIST function.
Syntax : LOAD:LIST:DATA:CPCO<arg1>,<arg2>,<arg3>,<arg4>
Parameter : <arg1>: Trigger Source <CRD>: AUTO | MANUAL | EXCITE
<arg2>: Dwell Base <CRD>: TIME | CYCLE
<arg3>: Reserved
<arg4>: CF/PF setting <CRD>: BOTH | CF | PF
<arg5>: CF/PF priority <CRD>: CF | PF
Query Syntax : LOAD:LIST:DATA:CPCO?
Return Parameter : <arg1>,<arg2>,<arg3>,<arg4>,<arg5>

LOAD:LIST:LOOP:CCRE

Description : This command sets the loop-related parameters of CC Rectified mode in the Load LIST function.
Syntax : LOAD:LIST:LOOP:CCRE <arg1>,<arg2>,<arg3>,<arg4>
Parameter : <arg1>: Loop No <NR1> 0~99
<arg2>: Count <NR1> 0:Disable 1~10000
<arg3>: Start Seq <NR1> 0~99
<arg4>: End Seq <NR1> 0~99
Query Syntax : LOAD:LIST:LOOP:CCRE?
Return Parameter : <arg1>,<arg2>,<arg3>,<arg4>

LOAD:LIST:LOOP:CSRE

Description : This command sets the loop-related parameters of CS Rectified mode in the Load LIST function.
Syntax : LOAD:LIST:LOOP:CSRE <arg1>,<arg2>,<arg3>,<arg4>
Parameter : <arg1>: Loop No <NR1> 0~99
<arg2>: Count <NR1> 0:Disable 1~10000
<arg3>: Start Seq <NR1> 0~99
<arg4>: End Seq <NR1> 0~99
Query Syntax : LOAD:LIST:LOOP:CSRE?
Return Parameter : <arg1>,<arg2>,<arg3>,<arg4>

LOAD:LIST:LOOP:CR

Description : This command sets the loop-related parameters of CR mode in the Load LIST function.
Syntax : LOAD:LIST:LOOP:CR <arg1>,<arg2>,<arg3>,<arg4>
Parameter : <arg1>: Loop No <NR1> 0~99
<arg2>: Count <NR1> 0:Disable 1~10000
<arg3>: Start Seq <NR1> 0~99
<arg4>: End Seq <NR1> 0~99
Query Syntax : LOAD:LIST:LOOP:CR?
Return Parameter : <arg1>,<arg2>,<arg3>,<arg4>

LOAD:LIST:LOOP:CCPH

Description : This command sets the loop-related parameters of CC Lead/Lag mode in the Load LIST function.
Syntax : LOAD:LIST:LOOP:CCPH <arg1>,<arg2>,<arg3>,<arg4>
Parameter : <arg1>: Loop No <NR1> 0~99
<arg2>: Count <NR1> 0:Disable 1~10000
<arg3>: Start Seq <NR1> 0~99
<arg4>: End Seq <NR1> 0~99
Query Syntax : LOAD:LIST:LOOP:CCPH?
Return Parameter : <arg1>,<arg2>,<arg3>,<arg4>

LOAD:LIST:LOOP:CSPH

Description : This command sets the loop-related parameters of CS Lead/Lag mode in the Load LIST function.
Syntax : LOAD:LIST:LOOP:CSPH <arg1>,<arg2>,<arg3>,<arg4>
Parameter : <arg1>: Loop No <NR1> 0~99
<arg2>: Count <NR1> 0:Disable 1~10000
<arg3>: Start Seq <NR1> 0~99
<arg4>: End Seq <NR1> 0~99
Query Syntax : LOAD:LIST:LOOP:CSPH?
Return Parameter : <arg1>,<arg2>,<arg3>,<arg4>

LOAD:LIST:LOOP:CCCO

Description : This command sets the loop-related parameters of CC mode in the Load LIST function.
Syntax : LOAD:LIST:LOOP:CCCO <arg1>,<arg2>,<arg3>,<arg4>
Parameter : <arg1>: Loop No <NR1> 0~99
<arg2>: Count <NR1> 0:Disable 1~10000
<arg3>: Start Seq <NR1> 0~99
<arg4>: End Seq <NR1> 0~99
Query Syntax : LOAD:LIST:LOOP:CCCO?
Return Parameter : <arg1>,<arg2>,<arg3>,<arg4>

LOAD:LIST:LOOP:CPCO

Description : This command sets the loop-related parameters of CP mode in the Load LIST function.
Syntax : LOAD:LIST:LOOP:CPCO <arg1>,<arg2>,<arg3>,<arg4>
Parameter : <arg1>: Loop No <NR1> 0~99
<arg2>: Count <NR1> 0:Disable 1~10000
<arg3>: Start Seq <NR1> 0~99
<arg4>: End Seq <NR1> 0~99
Query Syntax : LOAD:LIST:LOOP:CPCO?
Return Parameter : <arg1>,<arg2>,<arg3>,<arg4>

LOAD:LIST:LOOP:CLEar

Description : This command clears all loop data in the Load LIST function.
Syntax : LOAD:LIST:LOOP:CLEar
Parameter : None
Return Parameter : None

LOAD:LIST:SEQuence:CCRE

Description : This command sets the sequence-related parameters of CC Rectified mode in the Load LIST function.
Syntax : LOAD:LIST:SEQuence:CCRE <arg1>,<arg2>,<arg3>,<arg4>,<arg5>, <arg6>
Parameter : <arg1>: Seq No <NR1>, range: 0~99
<arg2>: Iac <NR2>, range: 0~35 (A), default: 0, resolution: 0.01
<arg3>: CF <NR2>, range: 1.414~3, default: 1.414, resolution: 0.01
<arg4>: Reserved
<arg5>: Wave <CRD>: SINE | POS | NEG | LEAD | LAG | PU_USR1…PU_USR200 | VAL_USR1…VAL_USR200, default: SINE
<arg6>: Dwell <NR2>, range: 0.1~60000 (ms), default: 0, resolution: 0.1
Query Syntax : LOAD:LIST:SEQuence:CCRE?
Return Parameter : <arg1>,<arg2>,<arg3>,<arg4>,<arg5>,<arg6>

LOAD:LIST:SEQuence:CSRE

Description : This command sets the sequence-related parameters of CS Rectified mode in the Load LIST function.
Syntax : LOAD:LIST:SEQuence:CSRE <arg1>,<arg2>,<arg3>,<arg4>,<arg5>
Parameter : <arg1>: Seq No <NR1>, range: 0~99
<arg2>: S <NR2>, range: 0~5500 (VA), default: 0, resolution: 0.1
<arg3>: CF <NR2>, range: 1.414~3, default: 1.414, resolution: 0.01
<arg4>: Reserved
<arg5>: Dwell <NR2>, range: 0.1~60000 (ms), default: 0, resolution: 0.1
Query Syntax : LOAD:LIST:SEQuence:CSRE?
Return Parameter : <arg1>,<arg2>,<arg3>,<arg4>,<arg5>

LOAD:LIST:SEQuence:CR

Description : This command sets the sequence-related parameters of CR mode in the Load LIST function.
Syntax : LOAD:LIST:SEQuence:CR <arg1>,<arg2>,<arg3>,<arg4>
Parameter : <arg1>: Seq No <NR1>, range: 0~99
<arg2>: R <NR2>, range: 0~300(Ω), resolution: 0.01
<arg3>: Reserved
<arg4>: Dwell <NR2>, range: 0.1~60000 (ms), resolution: 0.1
Query Syntax : LOAD:LIST:SEQuence:CR?
Return Parameter : <arg1>,<arg2>,<arg3>,<arg4>

LOAD:LIST:SEQuence:CCPH

Description : This command sets the sequence-related parameters of CC Lead/Lag mode in the Load LIST function.
Syntax : LOAD:LIST:SEQuence:CCPH <arg1>,<arg2>,<arg3>,<arg4>,<arg5>
Parameter : <arg1>: Seq No <NR1>, range: 0~99
<arg2>: Iac <NR2>, range: 0~35 (A), resolution: 0.01
<arg3>: Phase <NR2>, range: 0~360 (°), resolution: 0.01
<arg4>: Reserved
<arg5>: Dwell <NR2>, range: 0.1~60000 (ms) , resolution: 0.1
Query Syntax : LOAD:LIST:SEQuence:CCPH?
Return Parameter : <arg1>,<arg2>,<arg3>,<arg4>,<arg5>

LOAD:LIST:SEQuence:CSPH

Description : This command sets the sequence-related parameters of CS Lead/Lag mode in the Load LIST function.
Syntax : LOAD:LIST:SEQuence:CSPH <arg1>,<arg2>,<arg3>,<arg4>,<arg5>,<arg6>,<arg7>
Parameter : <arg1>: Seq No <NR1>, range: 0~99
<arg2>: S <NR2>, range: 0~5500 (VA), resolution: 0.1
<arg3>: Phase <NR2>, range: 0~360 (°), resolution: 0.01
<arg4>: PF <NR2>, range: 0.203~1, resolution: 0.01
<arg5>: LeadLag <CRD>: LEAD | LAG
<arg6>: Reserved
<arg7>: Dwell <NR2>, range: 0.1~60000 (ms), resolution: 0.1
Query Syntax : LOAD:LIST:SEQuence:CSPH?
Return Parameter : <arg1>,<arg2>,<arg3>,<arg4>,<arg5>,<arg6>,<arg7>

LOAD:LIST:SEQuence:CCCO

Description : This command sets the sequence-related parameters of CC mode in the Load LIST function.
Syntax : LOAD:LIST:SEQuence:CCCO <arg1>,<arg2>,<arg3>,<arg4>,<arg5>,<arg6>,<arg7>
Parameter : <arg1>: Seq No <NR1>, range: 0~99
<arg2>: Iac <NR2>, range: 0~35 (A), resolution: 0.01
<arg3>: CF <NR2>, range: 1.414~3, resolution: 0.01
<arg4>: PF <NR2>, range: 0.203~1, resolution: 0.01
<arg5>: LeadLag <CRD>: LEAD | LAG
<arg6>: Reserved
<arg7>: Dwell <NR2>, range: 0.1~60000(ms), resolution: 0.1
Query Syntax : LOAD:LIST:SEQuence:CCCO?
Return Parameter : <arg1>,<arg2>,<arg3>,<arg4>,<arg5>,<arg6>,<arg7>

LOAD:LIST:SEQuence:CPCO

Description : This command sets the sequence-related parameters of CP mode in the Load LIST function.
Syntax : LOAD:LIST:SEQuence:CPCO <arg1>,<arg2>,<arg3>,<arg4>,<arg5>,<arg6>,<arg7>
Parameter : <arg1>: Seq No <NR1>, range: 0~99
<arg2>: P <NR2>, range: 0~5500 (VA), resolution: 0.1
<arg3>: CF <NR2>, range: 0.414~3, resolution: 0.01
<arg4>: PF <NR2>, range: 0.203~1, resolution: 0.01
<arg5>: LeadLag <CRD>: LEAD | LAG
<arg6>: Reserved
<arg7>: Dwell <NR2>, range: 0.1~60000 (ms), resolution: 0.1
Query Syntax : LOAD:LIST:SEQuence:CPCO?
Return Parameter : <arg1>,<arg2>,<arg3>,<arg4>,<arg5>,<arg6>,<arg7>

LOAD:LIST:SEQuence:CLEar

Description : This command clears all sequence data in the Load LIST function.
Syntax : LOAD:LIST:SEQuence:CLEar
Parameter : None
Return Parameter : None

LOAD:LIST:SEQuence:POINts?

Description : This command returns the valid sequence number of the List mode.
Syntax : LOAD:LIST:SEQuence:POINts?
Parameter : None
Return Parameter : None

Appendix A TTL Signal Pin Assignments

The Analog Interface is a 25-pin terminal located on the rear panel as shown in Figure A-0-1.

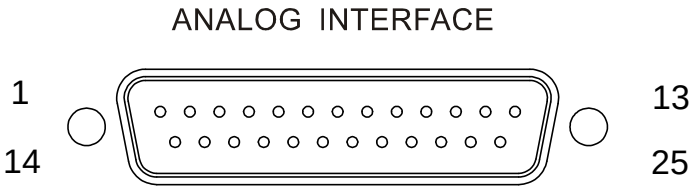
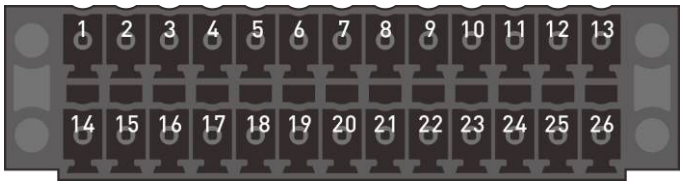


Figure A-0-1

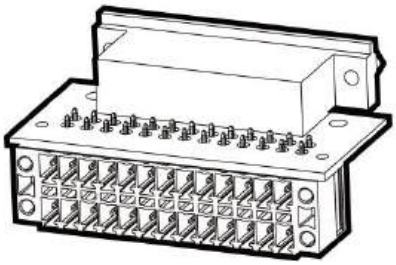
Pin No.	Signal	I/O	Description
1	Reserved	O	
2	AC-ON	O	This pin turns to HIGH when the Regenerative AC Electronic Load outputs voltage and turns to LOW when output stops.
3	Reserved	N.C.	
4	Phase	O	1-phase/3-phase mode relay signal switch for external controller. When the Phase signal is LOW, the Regenerative AC Electronic Load is in 3-phase output mode, and if the Phase signal is HIGH, the Regenerative AC Electronic Load is in 1-phase output mode.
5	Split-phase	O	LOW when the unit is operating in other modes; HIGH when the unit is in Split Phase Mode output.
6	/ Remote-Inhibit	I	Controls the Remote Inhibit signal. When the Remote Inhibit signal is LOW, the Regenerative AC Electronic Load stops output; however, if the Remote Inhibit signal turns HIGH now the simulator remains no output until the ON/OFF button is pressed to restart output.
7	Reserved	N.C.	
8	Reserved	I	
9	Reserved	I	
10	Reserved	N.C.	
11	Reserved	N.C.	
12	Reserved	N.C.	
13	Reserved	N.C.	
14	/ FAULT-OUT	O	The voltage level of this pin is HIGH when the Regenerative AC Electronic Load is in normal mode. It will turn to LOW when the Regenerative AC Electronic Load is in protection mode.
15	Reserved	I	
16	APIDGND		Digital I/O signal ground.
17	Parallel	O	LOW in standalone operation. Goes HIGH when operating in Parallel/Series mode.
18	Reserved	I	
19	APIDGND		Digital I/O signal ground.
20	Reserved	O	
21	Reserved	I	
22	APIGND		Analog I/O signal ground.
23	Reserved	N.C.	
24[*1]	APIGND		Analog I/O signal ground.
25	Reserved	N.C.	

Notice

1. When using a Docking board for expansion, the pin order is the same as the Analog order, as shown below.



2. The Docking board is shown below.



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