Chroma

Regenerative Grid Simulator

61800-100

User's Manual

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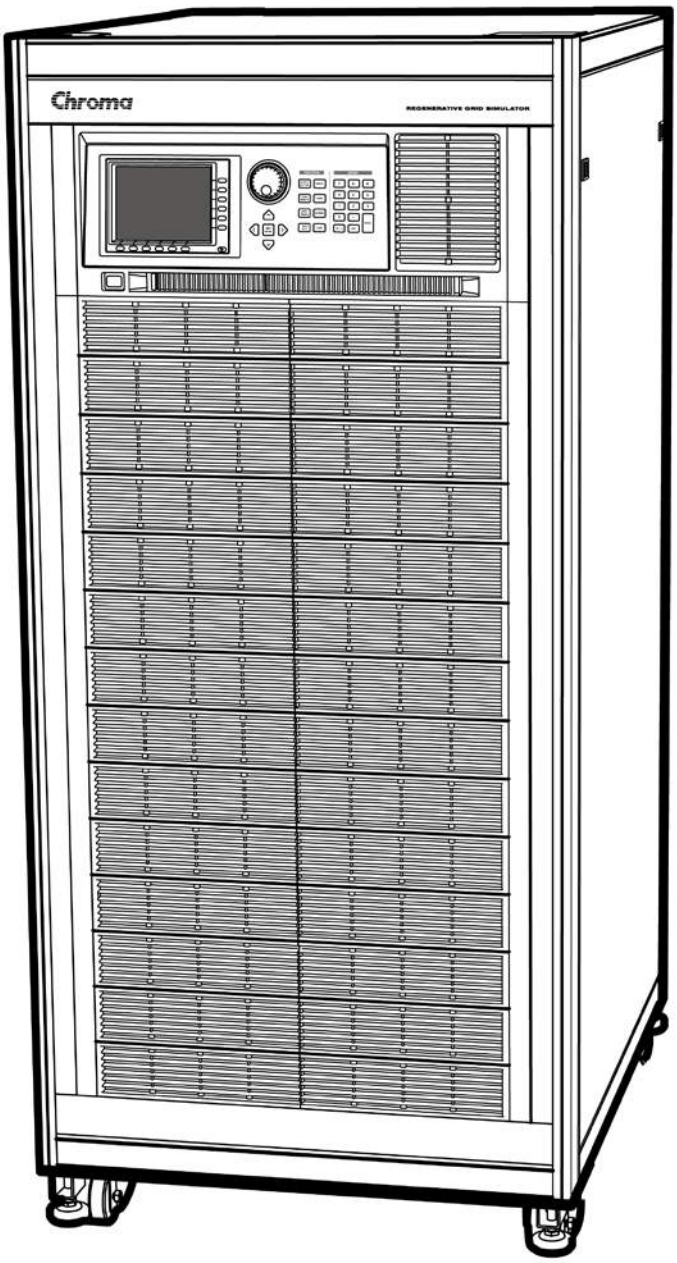

Version 1.1
April 2020

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CHROMA ATE INC.
66 Huaya 1st Road, Guishan, Taoyuan 33383, Taiwan

Warranty

All of Chroma's instruments are warranted against defects in material and workmanship for a period of one year from 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 SJ/T-11363-2006, 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 SJ/T-11363-2006, EU Directive 2011/65/EU, and 2015/863/EU.

Remarks:
1. The CE marking on product is a declaration of product compliance with EU Directive 2011/65/EU and 2015/863/EU.
2. This product is complied with EU REACH regulation and no SVHC 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 one, 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 SJ/T-11363-2006, 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 SJ/T-11363-2006, 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 environment-friendly usage period of the product is assumed under the operating environment specified in each product's specification.
3. This product is complied with EU REACH regulation and no SVHC 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 one, 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

(Product Name/ Trade Name)

61800-100, 61500-100

(Model Designation)

CHROMA ATE INC.

(Manufacturer Name)

66 Huaya 1st Road, Guishan, Taoyuan 33383, 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 (2014/30/EU) and Low Voltage Directive (2014/35/EU). For the evaluation regarding the Directives, the following standards were applied:

EN 61326-1:2013

EN 55011:2016, EN 61000-4-2:2009, EN 61000-4-3:2006/A1:2008/A2:2010
EN 61000-4-4:2012, EN 61000-4-5:2014, EN 61000-4-6:2014
EN 61000-4-8:2010

IEC/EN 61010-1:2010

The equipment describe above is in conformity with Directive 2011/65/EU of the European Parliament and of the Council of 8 June 2011 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 INC.

(Company Name)

66 Huaya 1st Road, Guishan, Taoyuan 33383, Taiwan

(Company Address)

Person responsible for this declaration:

Mr. Vincent Wu

(Name, Surname)

T&M BU Vice President

(Position/Title)

Taiwan	**2019.02.12**	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 instrument. Failure to comply with these precautions or specific WARNINGS given elsewhere in this manual will violate 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 power supply.

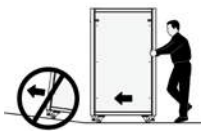
PROTECTIVE GROUNDING
Make sure to connect the protective grounding to prevent an electric shock before turning on the power.

NECESSITY OF PROTECTIVE GROUNDING
Never cut off the internal or external protective grounding wire, or disconnect the wiring of 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.



DO NOT MOVE THE EQUIPMENT ON SLOPE PAVEMENT
Do not move the equipment on slope pavement when changing the location. Be sure to use foot pads to stabilize the equipment when positioning it.

DO NOT MOVE THE EQUIPMENT ON BUMPY PAVEMENT
Do not move the equipment on bumpy pavement when changing the location. Be sure to use foot pads to stabilize the equipment when positioning it.

⚠WARNING

1. Lethal voltage, the output is up to 426V peak voltage.
2. If the output terminal and circuit are connected to output when the power is on, it could cause death if touches it.
3. Please make sure the floor is flat and endurable for maximum weight before placing the device. Please install it close to the primary structure (beams).
4. The load bearing of each foot pad is about 300kg. Considering the floor structure, it is suggested to use an iron plate of 350mm/350mm/10t to disperse the pressure.

Safety Symbols

	**DANGER –** High voltage.
	**Explanation:** To avoid injury, death of personnel, or damage to the instrument, the operator must refer to an explanation in the instruction manual.
	**High temperature:** This symbol indicates the temperature is now higher than the acceptable range of human. Do not touch it to avoid any personal injury.
	**Protective grounding terminal:** To protect against electrical shock in case of a fault. This symbol indicates that the terminal must be connected to ground before operation of equipment.
	**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 denotes a hazard. It calls attention to a procedure, practice, or the like, which, if not correctly performed or adhered to, could result in personal injury. Do not proceed beyond a **WARNING** sign until the indicated conditions are fully understood and met.
	The **CAUTION** sign denotes a hazard. It may result in personal injury or death if not noticed timely. It calls attention to procedures, practices and conditions.
	The **Notice** sign denotes important information in procedures, applications or the areas that require special attention. Be sure to read it carefully.

Moving the Device

Since the device weighs heavy, for your safety be sure to use tool to move it in accordance with the following figure.

The instrument must place horizontally during transportation and use. It is strictly forbidden to slant the device, or it may cause the device to be damaged.

Cleaning

It is suggested to regularly perform internal cleaning and maintenance. The standard period is 1 year. Due to different environment use conditions, the maintenance period can be adjusted according to your use environment. Please contact your local technical service personnel for related service requirements.

Revision History

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

Date	Version	Revised Sections
Sep. 2019	1.0	Complete this manual.
Apr. 2020	1.1	Modify the following: – "*Specifications*" in "*Overview*" chapter – "*1_Phase Mode*" in "*Local Operation*" chapter – "*Parallel/Series (Optional) Operation*" chaper – "*Instrument Command Dictionary*" in "*Remote Operation*" chapter Add the following: – Moving and cleaning description – "*AC Load Mode (Optional)*" chapter

Table of Contents

1. Overview

1.1 Introduction

The distributed power grids of today such as solar power and wind power generation are growing gradually. To cope with this trend, the equipment manufacturers have to follow the standards (IEEE 1547 / IEC 61000-3-15 / IEC 62116 for instance) to perform the tests and certify their equipment meets the standard. The Chroma 61800 Series Regenerative Grid Simulator released lately can provide the test solutions required for parallel grids. Its full four quadrant operation, energy recycling and voltage waveform editing functions (such as the simulation of voltage fall and harmonic distortion) are in compliance with the standard. Most importantly, the 61800 Series provides an effective energy saving solution that can feed the energy generated during testing back to the grid instead of consuming it as heat energy. Besides the distributed power test application, the 61800 Series Regenerative Grid Simulation can also apply to other green products associate tests like Vehicle to Grid (V2G) and Energy Saving System (ESS).

1.2 Feature

- Voltage: 0~300V
- Frequency: DC, 30Hz~100Hz
- Energy regenerative function with 100% rated current recycling capability
- Conform with the test applications of PV inverter, Smart Grid and EV associate products
- Selectable 1-phase/3-phase AC output
- Controllable voltage and frequency for change rate
- Output limit setting for voltage and current
- Voltage waveform setting for 0~360 switching degree
- Sync TTL signal Output for changed voltage
- LIST, STEP, PULSE mode for Power Line Disturbance (PLD) simulation
- Voltage interruption/transient simulation (conform with LVRT test)
- Distortion waveform synthesis of harmonics and interharmonics
- Parameter measurement functions including step of harmonic current
- Programmable analog interface
- Digital interface: GPIB, RS-232, USB and Ethernet
- Support parallel mode to meet high power output requirements (parallel mode only supports three-phase output)

1.3 Specifications

The following table lists the specification of Chroma 61800-100 Regenerative Grid Simulator. All specifications are verified in accordance with Chroma's standard test procedure. Unless otherwise specified, all specifications are tested under the condition of remote connected voltage sense within the temperature of 25 ± 1°C and load resistance.

Model	61800-100
AC Output Rating	
1-Phase Power	105kVA
3-Phase Total Power	105kVA
Power per Phase	35kVA
Voltage	
Output Voltage	0~300V_{LN} Optional HV: 0-500VLN
Accuracy [*1]	0.1%+0.2%F.S.
Resolution	0.1 V
Distortion [*1*2]	< 0.5% @30-65Hz < 0.8% @65-100Hz
Line Regulation	0.10%
Load Regulation [*3]	0.20%
Maximum Current (1-Phase) [*4]	
Output Current (RMS)	420A
Output Current (Peak)	1080A
Maximum Current (3-Phase/per phase) [*5]	
Output Current (RMS)	140A@250V (maximum CP)
Output Current (Peak)	360A
Frequency	
Range	DC, 30Hz ~ 100Hz
Accuracy [*1]	0.01%F.S
Resolution	0.01Hz
DC Output Rating (1-Phase) [*4]	
Power	52.5kW
Voltage [*4]	424V (Optional HV: 707V)
Current	210A
DC Output Rating (3-Phase/per phase) [*7]	
Power	17.5kW
Voltage [*6]	424V (Optional HV: 707V)
Current	70A
Current Harmonic Distortion [*8]	Source Mode < 5% (Typical)
	Regen Mode < 5%@3Ø 200-220V±10%V_{LL} < 6%@3Ø 380-400V±10%V_{LL} < 10%@3Ø 440-480V±10%V_{LL}
Power Factor	0.95 (Typical)
Input 3-Phase Rating (Each Phase)	
Voltage Range [*9]	3Ø 200-220V±10%V_{LL} 3Ø 380-400V±10%V_{LL} 3Ø 440-480V±10%V_{LL}
Frequency Range	47-63 Hz
Maximum Current	438A Max./Phase

Model	61800-100
	(3Ø200-220V±10%V_{LL}) 228A Max./Phase (3Ø 380-400V±10%V_{LL}) 200A Max./Phase (3Ø 440-480V±10%V_{LL})
Hold-up Time	>10ms
Measurement	
Voltage	
Range	0~300V_{LN} Optional HV: 0-500V_{LN}
Accuracy	0.1%+0.2%F.S.
Resolution	0.01 V
Current (Each Phase)	
Range	360A
Accuracy (RMS) *14	0.4%+0.3%F.S.
Accuracy (Peak) *14	0.4%+0.6%F.S.
Resolution*10	0.01 A
Power	
Accuracy	0.4%+0.4% F.S.
Resolution	0.1 W
Others	
Efficiency*11	80%(Typical)
Dimension (W×D×H)	780 x 1000 x 1740 mm 30.70×39.37×68.50 in.
Weight	1120kg
Protection	OVP, OCP, OPP, OTP, FAN
Remote Interface	GPIB, RS-232, USBTMC, Ethernet
Temperature Range	
Operating	0°C to 40°C
Storage	-40°C to 85°C
Humidity*12	0% to 95%
Safety & EMC	CE

Regenerative AC Load (ACL optional accessory)

Model	61800-100
Loading Current (per phase)	
Current	140A
Max. Current	360A_{peak}
Operating Voltage	
Range	50~300V_{LN}
Max. Voltage	424V_{peak}
Operating Frequency	
Range	30Hz ~ 100Hz
Accuracy	0.01% F.S.
Resolution	0.1Hz
Constant Current Rectification Mode (per phase)	
Current Range	0~140A
Accuracy	0.3% + 0.5%F.S. (above 2A)
Resolution	0.1A
Crest Factor Range	1.414~2.57

Model	61800-100
Crest Factor Resolution	0.001
Constant Power Rectification Mode (per phase)	
Power Range	0~35kW
Accuracy	0.3% + 0.6%F.S. (above 200W)
Resolution	10W
Crest Factor Range	1.414~2.57
Crest Factor Resolution	0.001
Constant Current Phase Variation Mode (per phase)	
Current Range	0~140A
Accuracy	0.3% + 0.5%F.S. (above 5A)
Resolution	0.1A
Phase Range	-90deg ~ +90deg (current source mode +90.1deg ~ +180deg & -90.1deg ~ -180deg)
Accuracy [*16]	0.6%F.S.(30~100Hz)
Phase Resolution	0.1deg
Constant Power Phase Variation Mode (per phase)	
Power Range	0~35kW
Accuracy	0.3% + 0.6%F.S. (above 1.5W)
Resolution	10W
Phase Range	-45deg ~ 0deg & +45deg ~ 0deg (current source mode +135deg ~ +180deg & -135deg ~ -180deg)
Accuracy [*16]	0.6%F.S.(30~100Hz)
Phase Resolution	0.1deg
Constant Resistance Mode (per phase)	
Range	1~300ohm
Accuracy	Convert to current value 0.3% + 0.7%F.S. (above 5A)
Resolution	0.1ohm
Current Harmonics	<3% (Full load at 250V/50Hz/sinewave)

210kVA 900VLN series high voltage function (optional accessory)

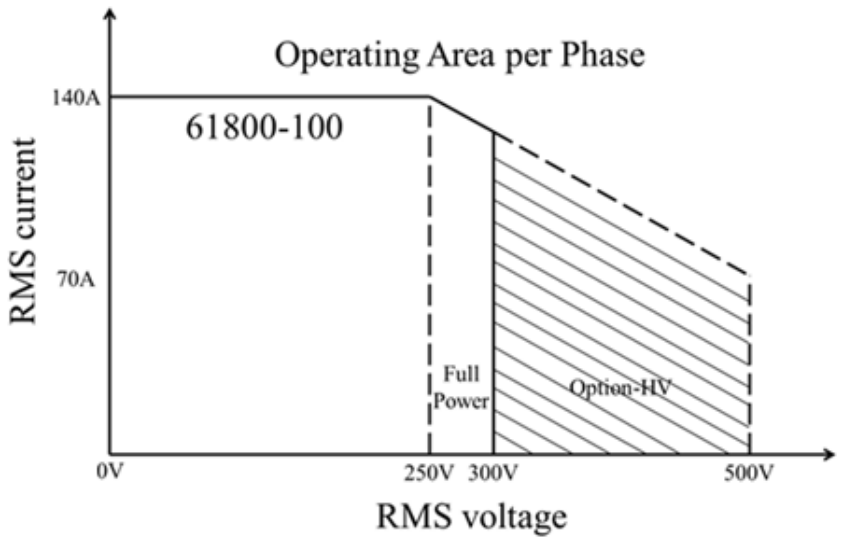
AC Output Rating	
3-phase Mode Total Power	210kVA
Power Per Phase	70KVA
Voltage	
Output Voltage	0~900V_{LN}
Accuracy [*1]	0.1%+0.2%F.S.
Resolution	0.1 V
Distortion [*1*2]	< 0.8% @50/60Hz < 1.0% @30Hz~100Hz
Voltage Regulation	0.10%

Load Regulation [*3]	0.20%
Max. Current (3-phase mode/ per phase) [*5]	
Output Current (RMS)	140A
Output Current (Peak)	360A
Frequency	
Range	DC, 30Hz ~ 100Hz
Accuracy [*1]	0.02% F.S.
Resolution	0.01Hz
DC Output Rating (3-phase mode/ per phase) [*7]	
Power	35kW
Voltage [*6]	1272V
Current	70A
Energy Regenerative Function	
Current Harmonic Distortion [*8]	Source Mode < 5% (Typical)
	Regen Mode < 5%@3Ø 200-220V±10%V_{LL} < 6%@3Ø 380-400V±10%V_{LL} < 10%@3Ø 440-480V±10%V_{LL}
Power Factor	0.95 (Typical)
Input 3-phase Rating (per phase)	
Voltage Range [*9]	3Ø 200-220V±10%V_{LL} 3Ø 380-400V±10%V_{LL} 3Ø 440-480V±10%V_{LL}
Frequency Range	47-63 Hz
Max. Current	438A Max./Phase (3Ø 200-220V±10%V_{LL}) 228A Max./Phase (3Ø 380-400V±10%V_{LL}) 200A Max./Phase (3Ø 440-480V±10%V_{LL})
Power Factor	0.95 (Typical)
Measurement	
Voltage	
Range	0~900V_{LN}
Accuracy	0.1%+0.2%F.S.
Resolution	0.01 V
Current [*10] (per phase)	
Range	360A
Accuracy (RMS) [*14]	0.4%+0.3%F.S.
Accuracy (Peak) [*14]	0.4%+0.6%F.S.
Resolution [*10]	0.01 A
Power	
Accuracy	0.4%+0.4% F.S.
Resolution	0.1 W
Others	
Efficiency [*11]	80%(Typical)
Dimension (W×D×H)	1700 x 1000 x 1740 mm / 62.92×39.37×68.50 in.
Weight	2240kg/4938lbs
Protection	OVP, OCP, OPP, OTP, FAN
Remote Interface	GPIB, RS-232, USB, Ethernet
Temperature Range	
Operatiing	0°C to 40°C
Storage	-40°C to 85°C

Humidity *12	0% to 95%
Safety & EMC	CE

Note

*1: The accuracy of voltage, frequency and maximum distortion tests use Power Analyzer Line Filter=50kHz and Update rate=250ms to measure the linear load. The referenced instrument is Model: YOKOGAWA WT3000.
*2: The maximum distortion test is the maximum output power to linear load when the output voltage is set to 500VAC.
*3: The load regulation condition is to set the sine wave output.
*4: The multi-simulator parallel mode does not support single-phase mode.
*5: The maximum current in parallel mode is N times the maximum current of a single unit. Ex. When 5 units are paralleled, the 61800-100 output current (RMS) is 140x5=900A and the output peak current is 2313A.
*6: The purpose of DC voltage output is to set the DC-bias for AC+DC.
*7: The DC output rating in parallel mode (per phase in 3-phase mode) is N times that of a single unit. Ex. When 5 units are paralleled, the 61800-100 DC output current is 70x5=350A.
*8: The current harmonic distortion in Energy Recycling Mode is 3Ø 220V_{LL}@60Hz, 3Ø 380V_{LL}@60Hz, 3Ø 480V_{LL}@60Hz.
*9: If an extra breaker is required for wiring, the input specification 3Ø 200-220V±10%V_{LL} must use the breaker larger than 450A. For the input specification 3Ø 380-400V±10% V_{LL} and 3Ø 440-480V±10%V_{LL}, the breaker larger than 250A should be used.
*10: The current measurement display is 4 digits, for instance if the measured current is between 10.00A-99.99A, the minimum display digits are 00.01.
*11: The test efficiency is the maximum output power to linear load when the output voltage sets to 250VAC.
*12: The operating humidity is in non-condensing state.
*13: 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.)
*14 The measurement related specifications in parallel mode such current and power need multiply the paralleled units, for instance, the output current (RMS) of 5 paralleled units is 140x5=700A and the output peak current is 1800A.
*15: See the voltage/current operating diagram below for the Regenerative Grid Simulator's output capability.
*16: The accuracy of test phase variation mode is 250VAC for input voltage and 140A for load current. F.S.=360°.
*17: The option-HV function used in parallel mode only supports the slave device that has the same function. For series high voltage mode, it requires two devices with option-HV function.



Voltage/Current Operating Range

1.4 Function Keys

1.4.1 Front Panel

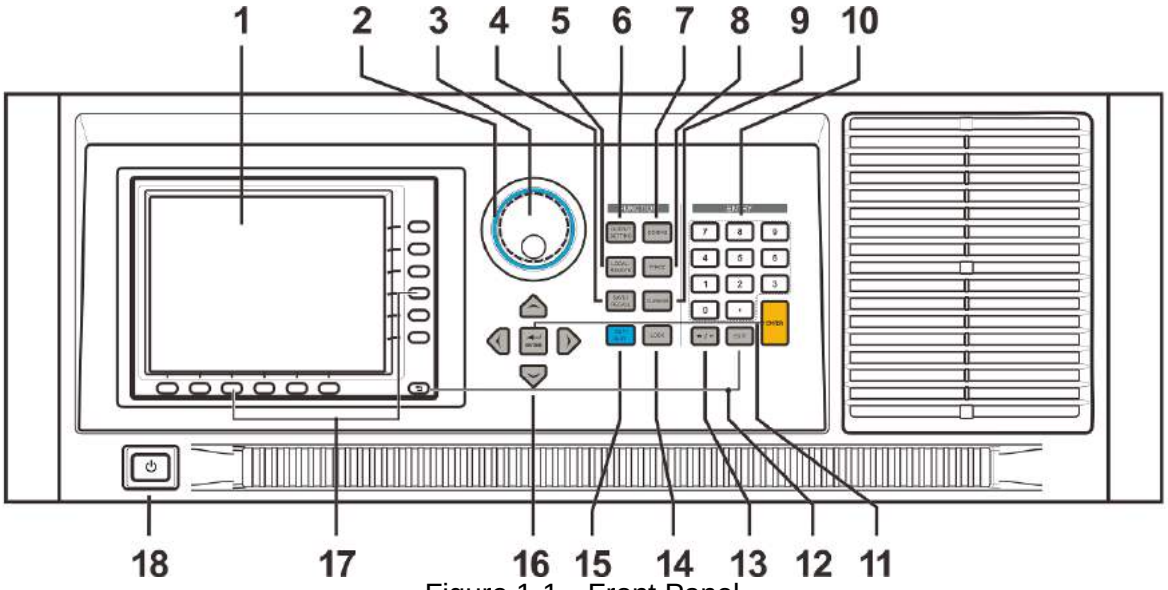
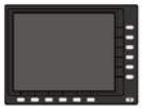
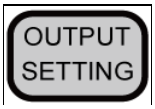
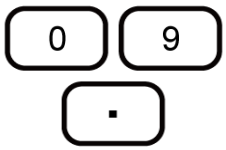
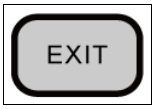
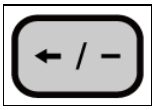
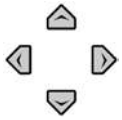
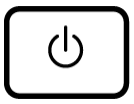


Figure 1-1 Front Panel

Table 1-1 Front Panel Description

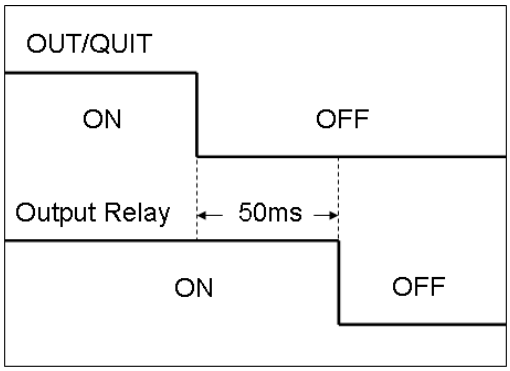
Item	Symbol	Description
1		***Display screen:*** 6.5 inch LCD to display the input/output settings and measured result.
2		***Display LED*:** It surrounds the rotary know and indicates the device is on when the light is on.

3		***RPG rotary knob*:** It allows the user to turn the RPG rotary knob to adjust the voltage, frequency and input the programmed data or selection.
4		***SAVE or RECALL key:*** Press this key on the MAIN PAGE can save/recall the output setting (see also 3.10.1) as well as the system data (see also 3.10.2.)
5		***LOCAL/REMOTE key:*** It switches to the control mode to "LOCAL" or "REMOTE".
6		***OUTPUT SETTING key:*** It skips to "Output: More Setting" for various functions settings.
7		***CONFIG key:*** It skips to "CONFIG PAGE" for various functions settings.
8		***PHASE key:*** It sets the phase to single or 3-phase.
9		***CURSOR key:*** It shows the cursor to set or adjust the value.
10		***Numeric and decimal keys:*** The numeric and decimal keys are for the user to input the digital data.
11		**ENTER** ***key:*** It confirms the setting of parameter.
12		***EXIT key:*** It returns to the previous menu.
13		***Backspace and decrease key:*** Press this key to erase the inputted number. Input minus "-", if there is no number before the cursor.
14		***LOCK key:*** Press it for 1 second to lock all keys and the knob. Press it again for 3~4 seconds to unlock it.
15		***OUT/QUIT key:*** Press this key can output the AC power or stop output voltage.
16		***Cursor movement keys:*** These four movement keys move the cursor to different direction. In normal mode, press any of it will change the cursor position.

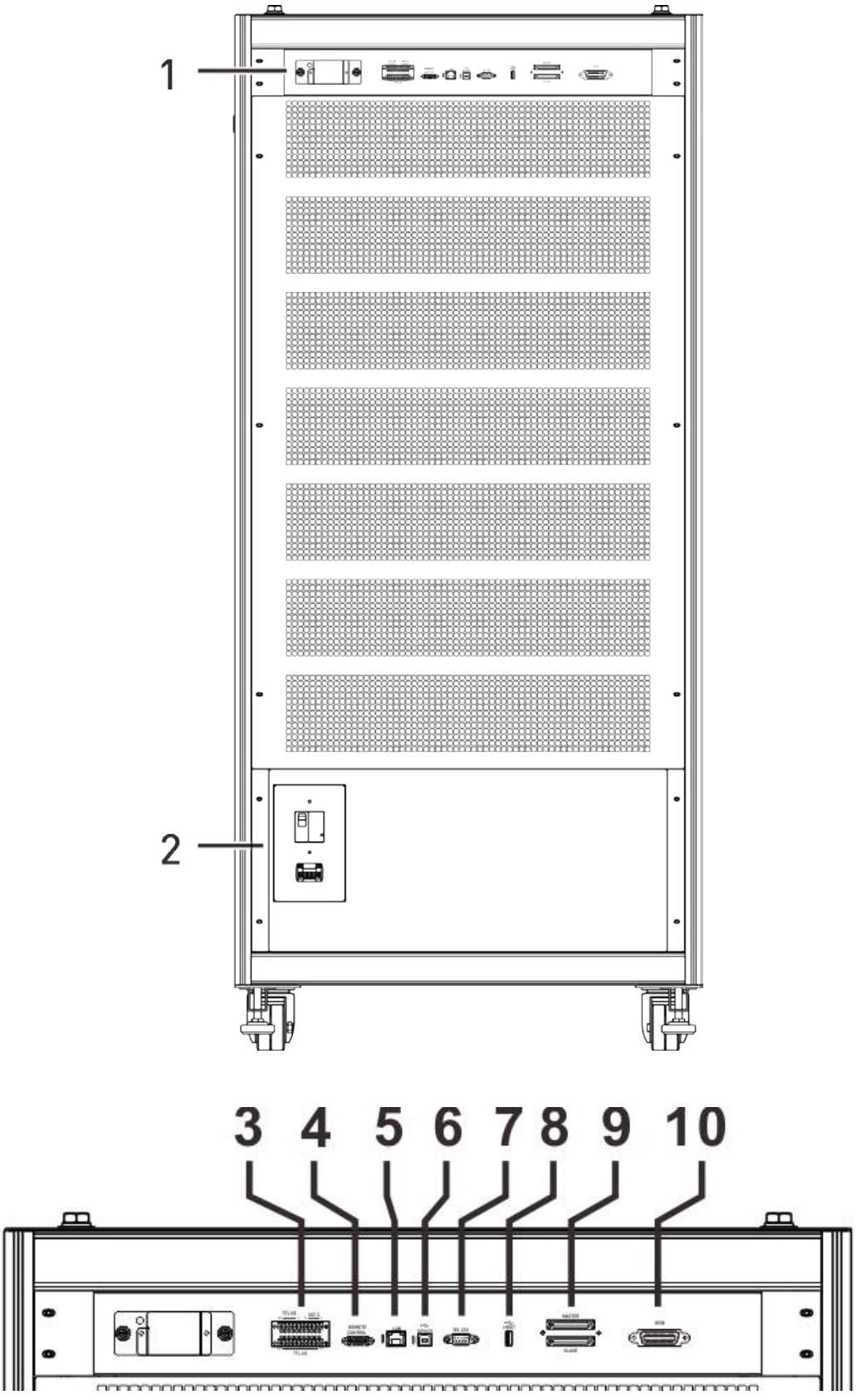
17		***Indication key:*** It sets the parameter or function following the description on the screen.
18		***Main power switch***: It powers on or off the Regenerative Grid Simulator.

Notice

To extend the usage of output relay, it will delay 50ms for release when **QUIT** is pressed. If the load connected is inductive load, it will provide a discharge route for inductor current during the delay time due to the characteristics of Inductor current freewheeling.



1.4.2 Rear Panel



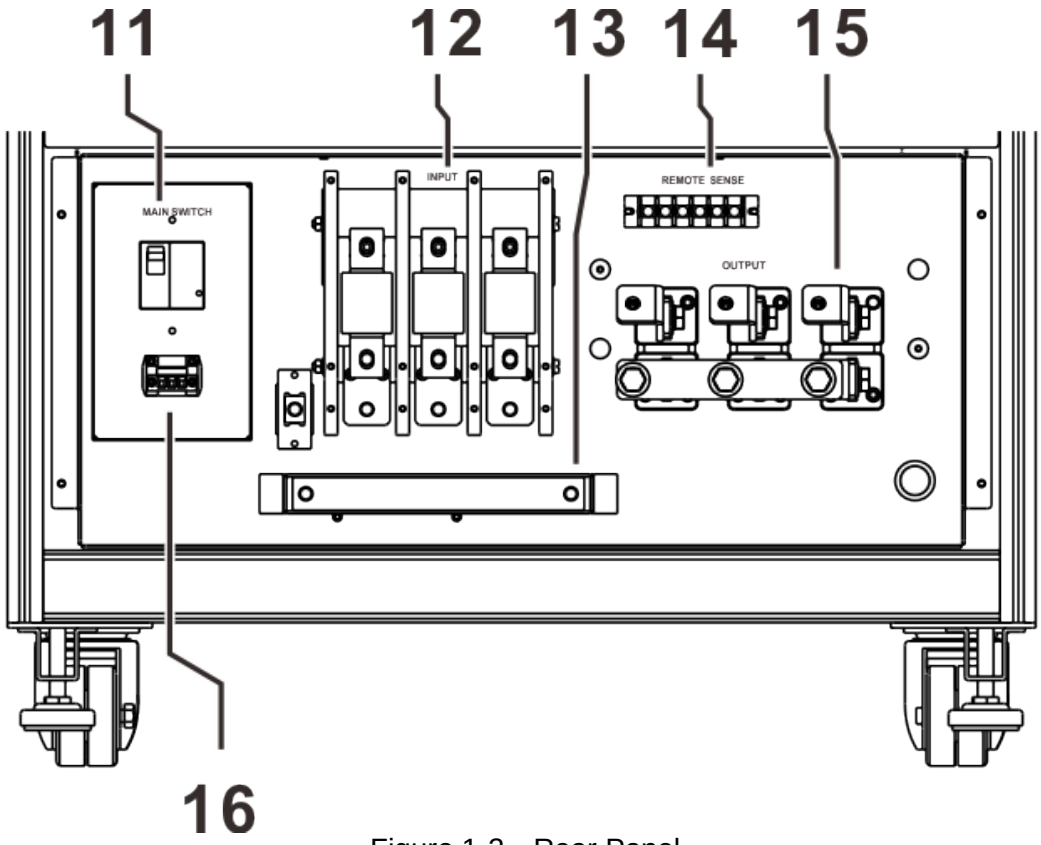


Figure 1-2 Rear Panel

Table 1-2 Rear Panel Description

Item	Name	Description
1	Rear Panel Control Interface	It contains Ext.Vref/TTL signal connector, remote control, GPIB, USB and RS-232 ports.
2	Input/Output Cable Connector (Safe casing)	Its internal has 3-phase power input and output terminal, the mains connector (3-phase) to the power input terminal, the power output connector to UUT and input no-fuse leakage breaker.
3	Ext. Vref./TTL I/O	The Ext.Vref port inputs analog signals to control the output waveform amplitude and the TTL I/O terminal to transmit the I/O control signal (Fault_out, Remote Inhibit & AC_ON.)
4	Remote Control	It is a remote control port to control the AC Source via an optional device.
5	Ethernet	It is the network (LAN) control interface.
6	USB	It is a USB control interface to connect the PC for remote operation.
7	RS-232	It is a 9-pin D-type male connector for RS-232 interface to connect the PC for remote operation.
8	Host USB	It is a USB control interface to connect the PC for remote operation.
9	Parallel Signal Comm. Port	It is used to transmit the signal for Master/Slave parallel output.
10	GPIB Connector	It is a GPIB interface to connect the PC for remote operation.
11	Input No-Fuse Breaker	When a 24Vdc voltage is provided externally, it will open the breaker (which can only be restored by hand) to cut off the system power.

12	Power Input Terminal	This input terminal connects the mains 3-phase power.
13	Input/Output Cable Fixing Bar	It fixes the 3-phase input/output connecting cable.
14	Remote Sense	It is the remote voltage sense. It senses the load directly to compensate the voltage drop caused by the cable. Be sure that the "Ls" terminal of the remote sense connects to the "L" terminal of load while the "Ns" connects to the "N" terminal of load. (Do not use reverse polarity for connection.)
15	Power Output Terminal	It is a 3-phase output terminal to connect to the UUT.
16	Trip Breaker Control Terminal	It connects the trip breaker control power.

2. Installation

2.1 Initial Inspection

Before shipment, this model was inspected and found to be free of mechanical and electrical defects. As soon as the device is unpacked, the user should inspect for any damage that may have occurred in transit. Save all packing materials in case the instrument has to be returned. If damage is found, please file a claim with the carrier immediately. Do not return the product to Chroma without prior approval.

2.2 Precautions before Use

1. First make sure that the floor is smooth and flat as well as endurable for maximum weight before placing the simulator.
2. The simulator has to connect to proper AC line input.
3. The Regenerative Grid Simulator is a fan cooling instrument thus needs to be installed in a place with sufficient air flow.
4. The operating temperature cannot exceed 40°C.

2.3 Input Power Specification

2.3.1 Ratings

Input voltage range:

61800-100
438 Max./Phase (3Ø 200-220V±10%V_{LL})
228A Max./Phase (3Ø 380-400V±10%V_{LL})
200A Max./Phase (3Ø 440-480V±10%V_{LL})

- The 61800 Series products have 3 types of input voltage range; be sure to select the correct 3-phase AC voltage before purchase.
- All of the input voltage spec is based on 3-phase AC line voltage (L-L).

Input frequency: 47-63 Hz

⚠WARNING It could cause the Regenerative Grid Simulator to be damaged if the input voltage is out of the spec.

2.3.2 Connecting for Input

The input connection plate is located at the bottom of the simulator. The power cable should be at least 85°C rated. The power cable input should have rated current larger or equal to the maximum rated current of Regenerative Grid Simulator.

Perform the steps below for connection as Figure 2-1 shows:

1. Remove the input cable connecting plate (safe casing) from the bottom of Regenerative Grid Simulator rear panel.
2. Connect the power cable to the power terminal of Regenerative Grid Simulator (see Figure 2-1.)
3. Slide the input cable connecting plate (safe casing) to cover the Regenerative Grid Simulator.
4. Secure the power cables using a fixing bar and lock with screw. ◦
5. Install the input cable connecting plate (safe casing) back.

CAUTION To protect the operator, the metal wire connected to GND terminal has to be earth grounded. In no cases the Regenerative Grid Simulator should not be operated without proper earth ground.

Voltage Range	Cable Spec.	Terminal Spec.
(3Ø 200-220V±10%V_{LL})	150mm^2(L1/L2/L3) 10mm^2(GND)	95-10(L1/L2/L3) 10-10(GND)
(3Ø 380-400V±10%V_{LL})	100mm^2(L1/L2/L3) 10mm^2(GND)	50-10(L1/L2/L3) 10-10(GND)
(3Ø 440-480V±10%V_{LL})	100mm^2(L1/L2/L3) 10mm^2(GND)	50-10(L1/L2/L3) 10-10(GND)

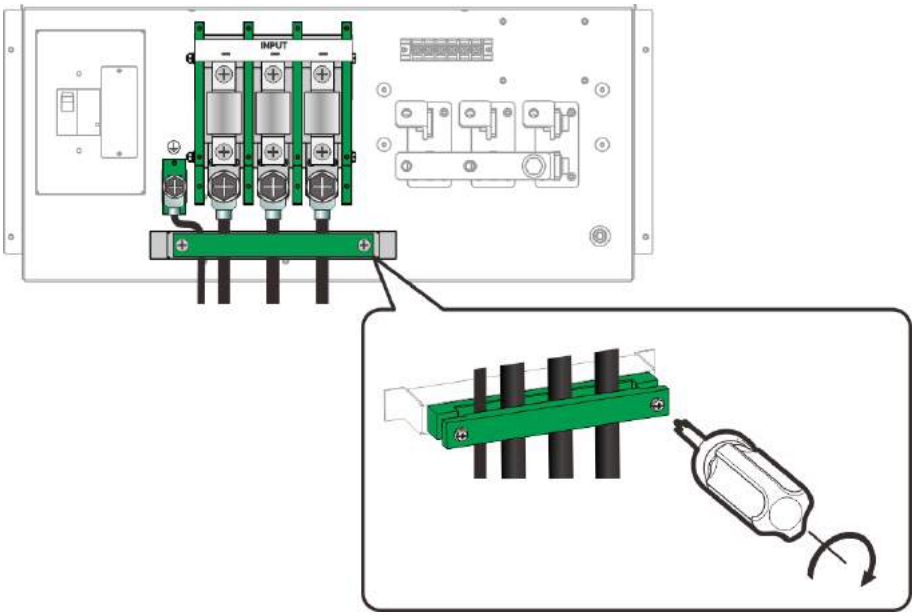


Figure 2-1 3-Phase Power Input Connection and Wiring Fixed Diagram

Notice

1. The power cable installation has to be performed by professional personnel in compliance with the local electrician regulation.
2. All of the input voltage spec is based on 3-phase AC line voltage (L-L).

3. Before connecting the input power cable, be aware of the color on the insulation tube and power cable. The brown, black and gray tubes indicate the 3-phase power cable L1, L2 and L3 while the green with yellow inlaid tubes is for GROUND.
4. To avoid improper torgue causing excessive contact impedance when wiring the input and output cable, it is suggested the input/output torgue for the M10 screw is 120kgf-cm.

2.4 Output Connection

The output terminal socket is located at the rear side of Regenerative Grid Simulator. The load is connected to the output terminal. For safety reason, the AC input/output cable must be secured with an appropriate tool and the casing has to be tightened up. The diameter the cable connected to the load has to be large enough so that it won't over heat when the output is over current, see Figure 2-2.

Notice When DC voltage is contained in the output voltage, the output terminal "L" is "+" and "COM/N" is "-".

WARNING For the simulator to dissipate heat smoothly, it is necessary to keep at least 1 meter space for the device front and rear panel for ventilation. Do not place the device against the wall or any other objects.

2.5 Connecting Remote Sense

The Remote Sense of the Regenerative Grid Simulator monitors the load voltage and compensates automatically to ensure the voltage transmitted to load is the set voltage.

Remove the cable connected to "L1", "L2", "L3" and "COM" from the Remote Sense terminal and change it by connecting to Load as Figure 2-2 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 Grid Simulator feedback circuit, thus it has to keep low resistance in order to maintain the best performance. If the sense wire is not connected or opened during operation, the Regenerative Grid Simulator may not be able to output. It is necessary to ensure that the sense wire connection is not opened. The sense wire is twisted to reduce the interference from external voltage and needs to be close to the load as possible.

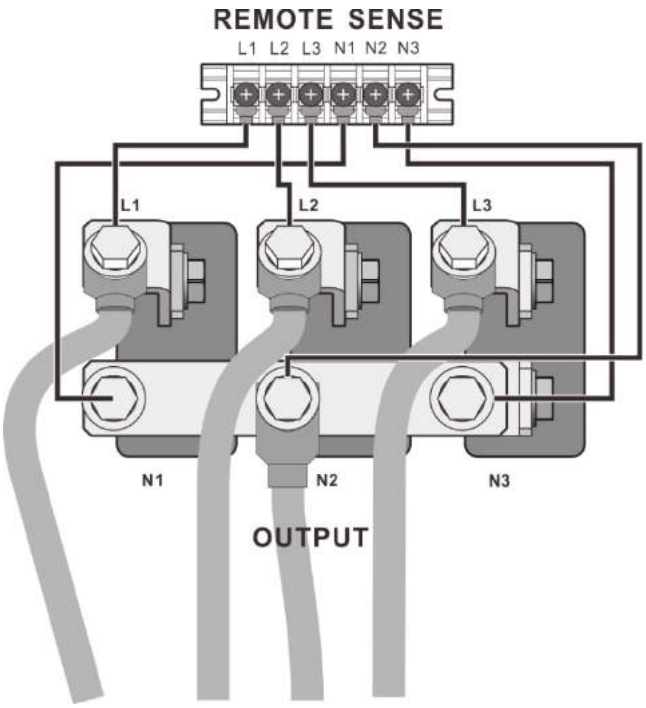


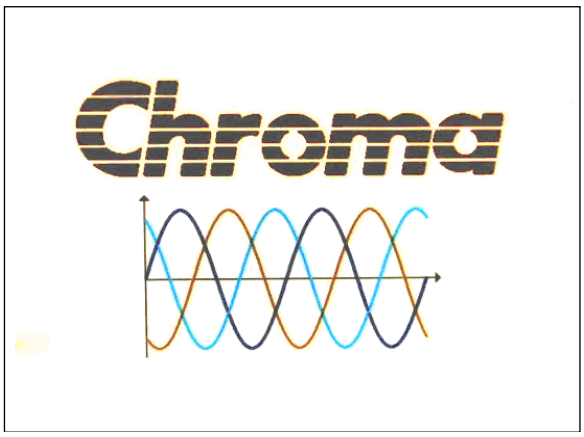
Figure 2-2 Connecting Output and Remote Voltage Sense

Notice When the output sets to single phase, the Remote Sense wire should connect to the output terminal of second phase.

2.6 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 cause potential electric shock hazard and result in personal injury.

Connect the power line and turn on the power switch on the front panel. The Regenerative Gird Simulator will begin a series of self tests. The LCD on the front panel will be on and display as below.



In the meantime the Regenerative Gird Simulator executes memory, data and communication self tests. The display shows the Model Number and Regenerative Gird Simulator's Serial No. after executing the self-test routines and each test item will show "OK" on the right if no error is found. It needs about 10 seconds for self-test to finish the routines and then the software version will show on the display.

"ERROR CODE" will appear on the right if one of the test items is failed.

When the self tests of memory, data and communication are done, the Regenerative Gird Simulator will conduct a power output self-test. The output relay is OFF during the procedure to ensure the load connected to the output terminal won't be damaged. The Regenerative Gird Simulator sets the output to 300Vac for voltage measurement. The power self-test fails and the display shows "NG" when the measured voltage is over 300V±100V. If the self-test is OK, the screen will change to the MAIN PAGE automatically.

Notice

1. The user can run self-diagnosis during power on self-test to see if there are any errors or NG (No Good) conditions.
2. The Regenerative Gird Simulator needs about 20 seconds to finish the self-test.

2.7 Maintenance and Cleaning

Remove all connected wires and cables on the instrument before cleaning. Use a brush to clean the dust on it and if there are stains on the chassis that cannot be removed by brush, wipe it with a volatile liquid. Do not use any corrosive liquid to avoid damaging the chassis. Use a damp cloth with soap and water or a soft detergent to clean the LCD front panel. Please send it back to the distributors or agents of Chroma for internal cleaning. Do not open the chassis cover arbitrarily

2.8 Common Environment Conditions

1. In door use only.
2. Altitude up to 2000m.
3. Temperature 0°C to 40°C.

3. Local Operation

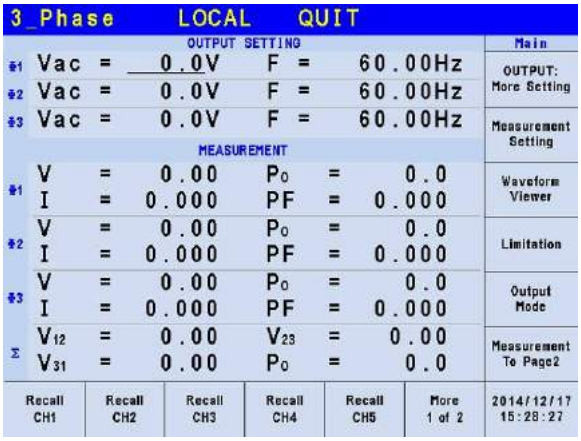
3.1 Introduction

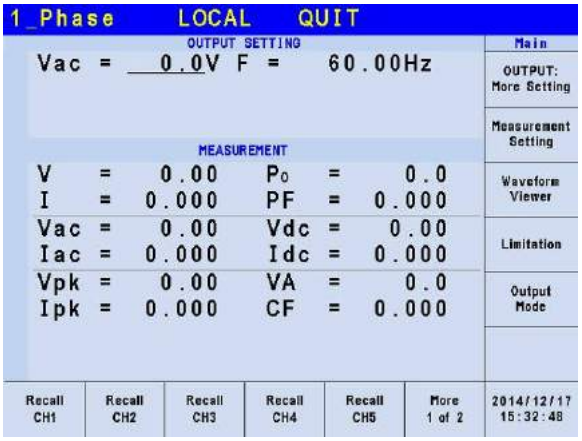
The Regenerative Grid Simulator can be configured to operate in local or remote mode. This section describes the operation in local mode using the keypad on the front panel for data entry and test. Local operation can be used directly when the Regenerative Grid Simulator is turned on.

3.2 Using Keyboard and RPG

The Regenerative Grid Simulator is equipped with a user friendly interface consisting of a keypad and a RPG (Rotary Pulse Generator) on the front panel. The LCD on Regenerative Grid Simulator displays the operations menu.

Figure 3-1 shows the command tree. The following describes how to use both the keypad and the RPG to set the commands. When the power-on procedure is completed (see 2.6), the display will show the MAIN PAGE (3_Phase Mode/1_Phase Mode) as below.





Press ▲, ▼, ◀, ▶ keys to move the cursor for item selection. Use numeric and decimal keys or RPG to set values and press **ENTER** to confirm them. The user can press the keys located at the LCD bottom or lower right to set the parameters or functions following the description on the screen, or press ⮌ to return to the MAIN PAGE.

In the MAIN PAGE, it can press the keys located at the LCD bottom or lower right to select the function list. Use ▲, ▼, ◀, ▶ to move the cursor after entering the function list. For digital setting, use the numeric and decimal keys or the RPG to set the value and then press **ENTER** for confirmation. For text setting, it can turn the RPG for selection and press **ENTER** for confirmation.

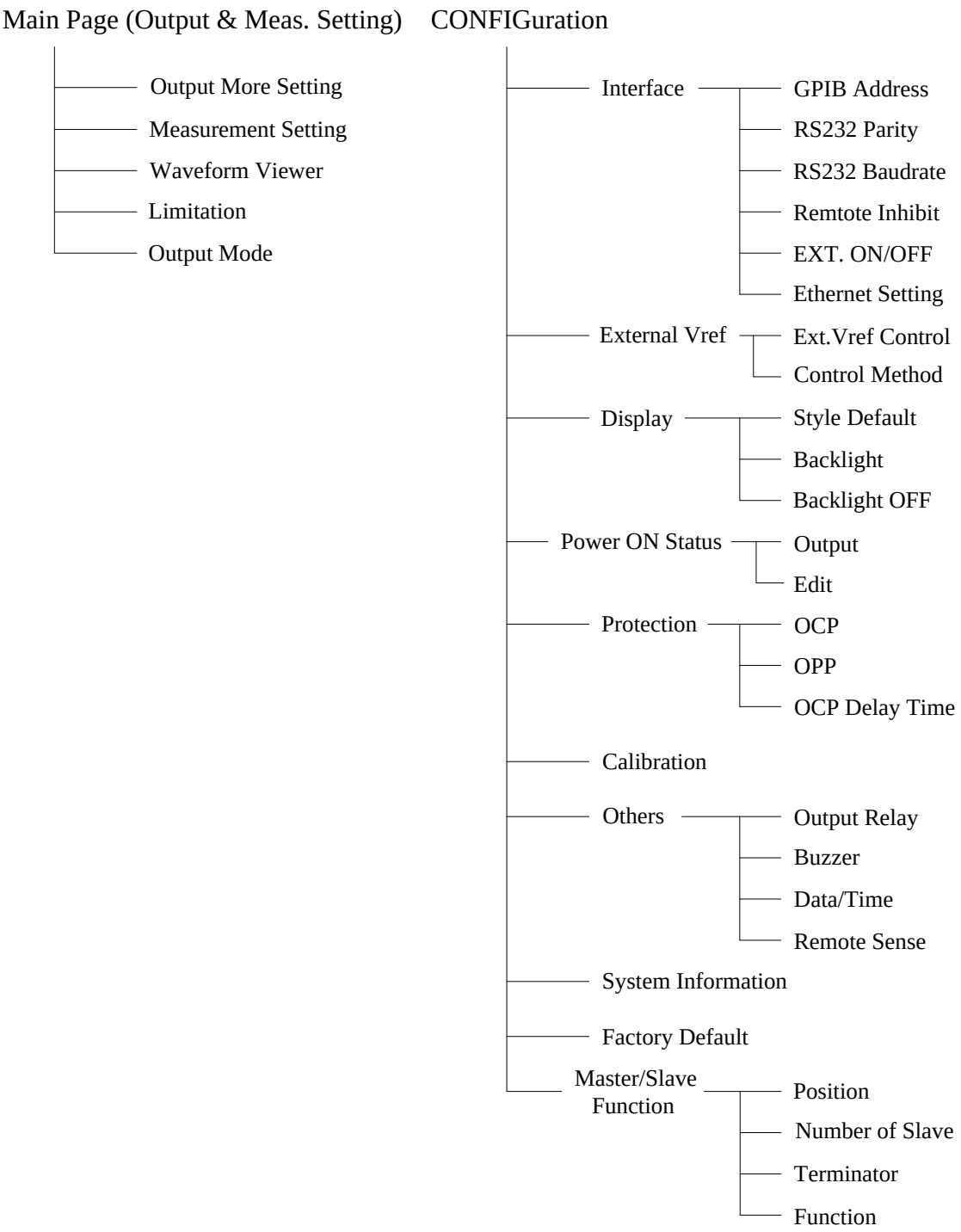

Main Page (Output & Meas. Setting)
Output More Setting
Measurement Setting
Waveform Viewer
Limitation
Output Mode
CONFIGuration
Interface
GPIB Address
RS232 Parity
RS232 Baudrate
Remtote Inhibit
EXT. ON/OFF
Ethernet Setting
External Vref
Ext.Vref Control
Control Method
Display
Style Default
Backlight
Backlight OFF
Power ON Status
Output
Edit
Protection
OCP
OPP
OCP Delay Time
Calibration
Others
Output Relay
Buzzer
Data/Time
Remote Sense
System Information
Factory Default
Master/Slave Function
Position
Number of Slave
Terminator
Function

Figure 3-1

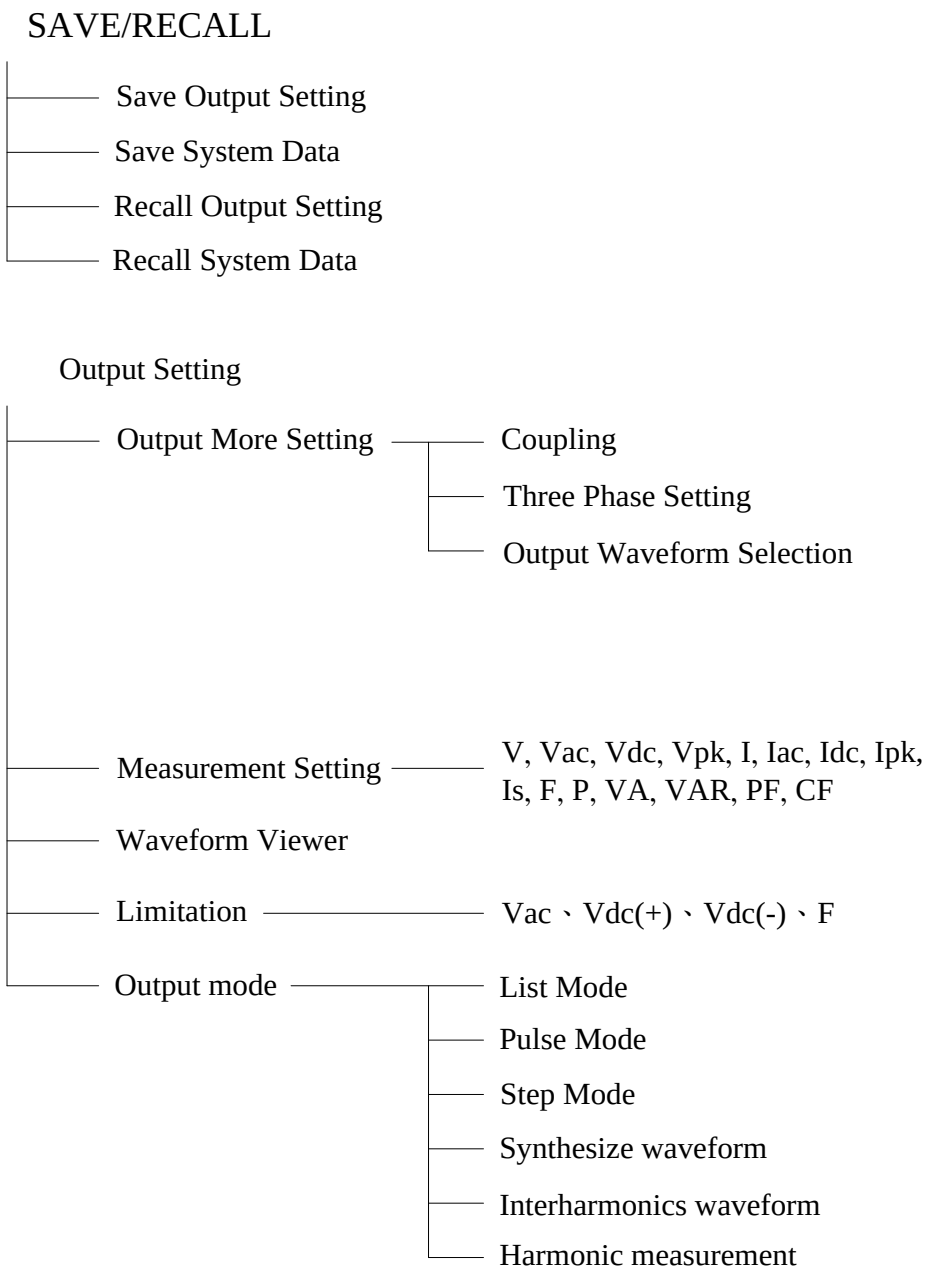
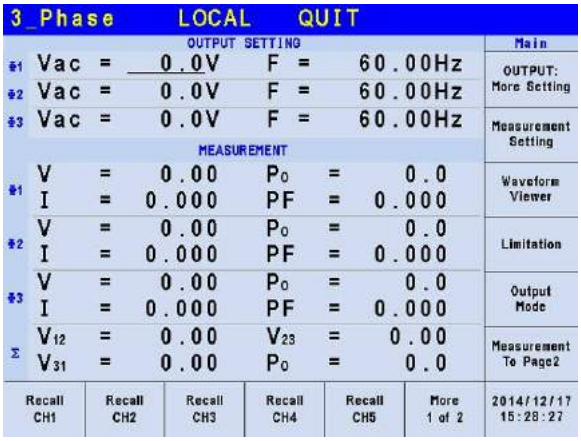
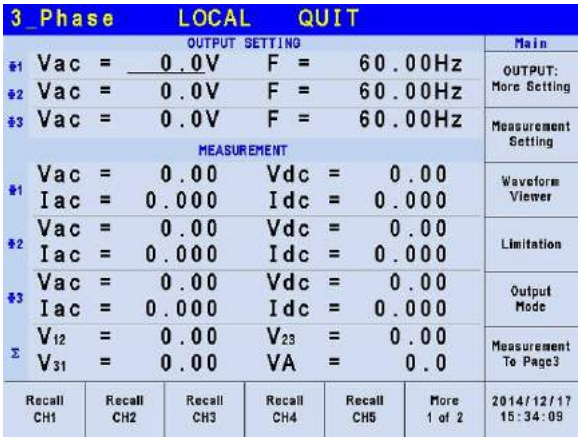


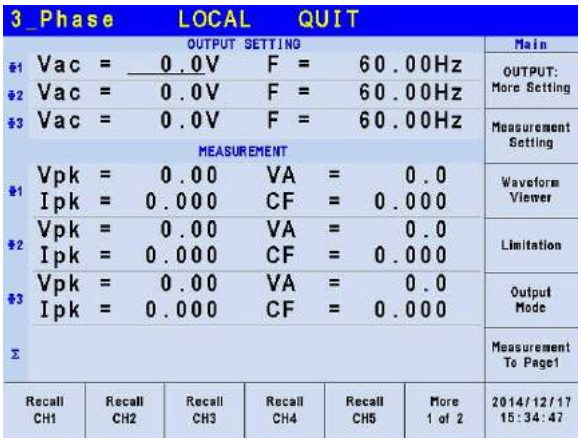
Figure 3-2

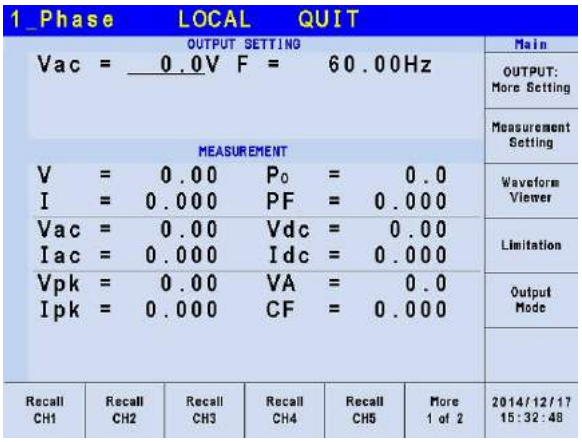
3.3 MAIN PAGE (for Output Setting and Measurement)

When the Regenerative Grid Simulator is turned on and finished the self-test, the screen displays the MAIN PAGE (3_Phase Mode/1_Phase Mode). The upper section on the screen shows the output setting. The default output setting can be set by the Power ON Status (see 3.4.4) under the CONFIG function key. The MEASUREMENT on the screen shows the items measured by the Regenerative Grid Simulator and each of them has 12 types totaling 3 pages as shown below.









The definition of output parameters:

Vac : AC output voltage in Volts
F : Output frequency in Hertz.
Vdc : DC output voltage in volts.

Press **OUT/QUIT** enables the Regenerative Grid Simulator's output with the set Vac, F and Vdc. Press it again the Regenerative Grid Simulator output is disabled

Notice

When Coupling = AC+DC, the output is the sum of Vac and Vdc. However, the combination of peak voltage cannot exceed 424.2V. The output voltage will skip to 0V automatically and trigger the protection (OVP) if it exceeds the voltage limit.

Following lists the definition of measurement parameters:

V : It is the voltage measurement in Volts. (True RMS measurement)
F : It is the output frequency in Hertz.
I : It is the current measurement in Amps. (True RMS measurement)
P : It is the real power measurement in Volts.
PF : It is Power Factor and the calculation formula = Real Power / (Vrms × Irms)
CF : It is Crest Factor and the calculation formula = Ipeak/Irms
Vdc : It is the DC voltage measurement in Volts.
Idc : It is the DC current measurement in Amps.
Ip : It is the peak current measurement in Amps. The Ipeak display is the Ip (+) or Ip (-) whichever is larger.

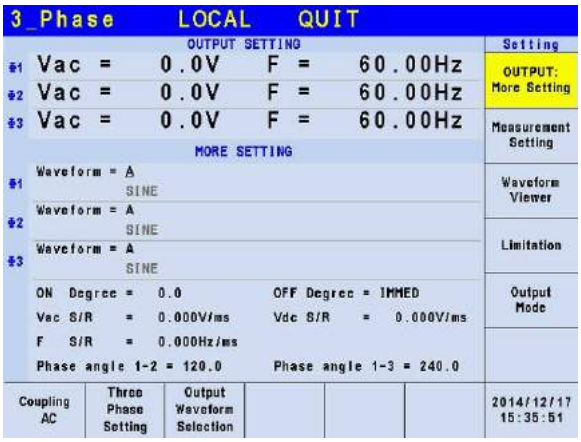
Is : It is I surge that is only measured when output changes as defined in section 3.3.2.2.

VA It is the apparent power in Volt-Ampere and the calculation formula = Vrms × Irms.

VAR : The calculation formula = $\sqrt{VA^2 - P^2}$

3.3.1 OUTPUT: More Setting

Press OUTPUT: More Setting in the MAIN PAGE (3_Phase Mode/1_Phase Mode) (see section 3.3); a line of output functions will appear at the bottom of the screen as described below.

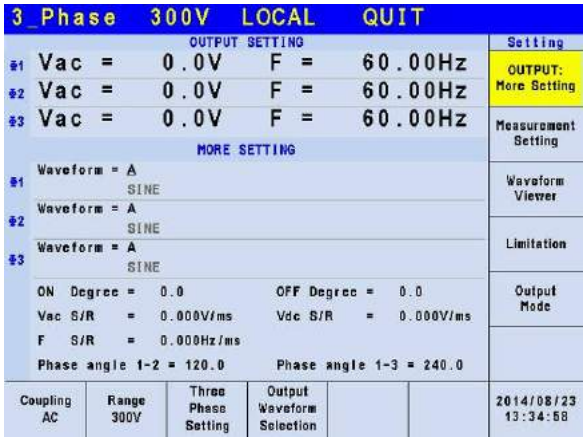


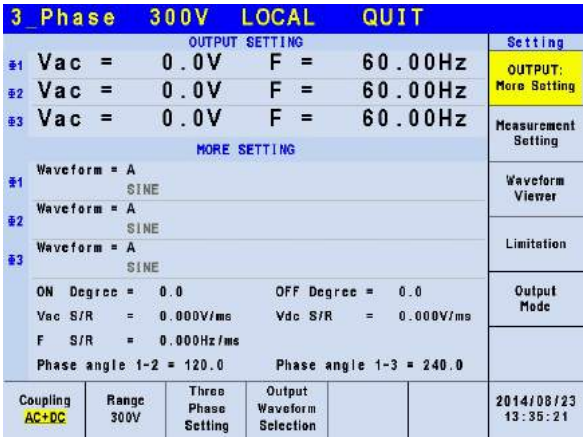
3.3.1.1 Coupling Output Mode (AC+DC, AC, DC)

The Regenerative Grid Simulator has 3 types of output: AC+DC, AC and DC. The coupling can be set to meet a variety of applications.

The setting procedure from AC to AC+DC is described below:

1. Press Coupling at the bottom.
2. Turn the RPG to change the selection from AC to AC+DC and press **ENTER**.





Notice

Since the Regenerative Grid Simulator does not have as many capacitors as the common DC Power Supply, some voltage fluctuations and transient load characters are not the same. This Regenerative Grid Simulator is able to provide positive and negative voltage without changing the output connector. When the capacitor charging current is too high, it may raise output volatility concerns.

Though the Regenerative Grid Simulator has AC/DC/AC+DC output mode, the features are still different from the common DC Power Supply when in pure DC mode as explained below.

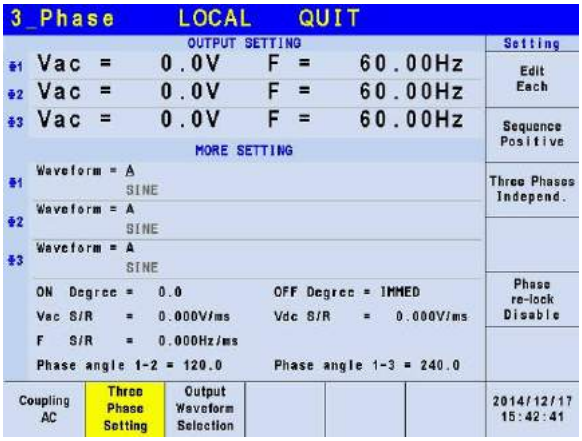
1. The output voltage ripple is bigger because there is no output capacitor.
2. When the output current reaches the current limit set point, the output voltage will be cut off and in protection mode. It will not stay in constant current mode with a voltage drop like common DC sources.

3.3.1.2 Setting Three Phase Output

Press Three Phase Setting to enter into the function as shown below.

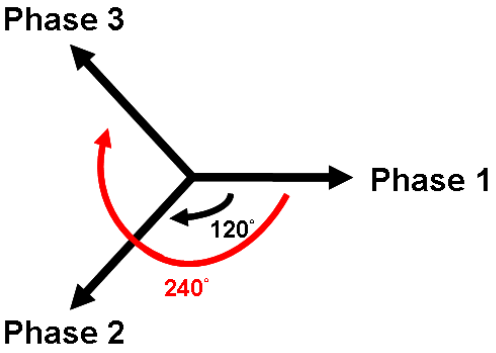
Edit: All, Each

Press Edit to set "Each" or "All" for 3-phase output voltage limit.



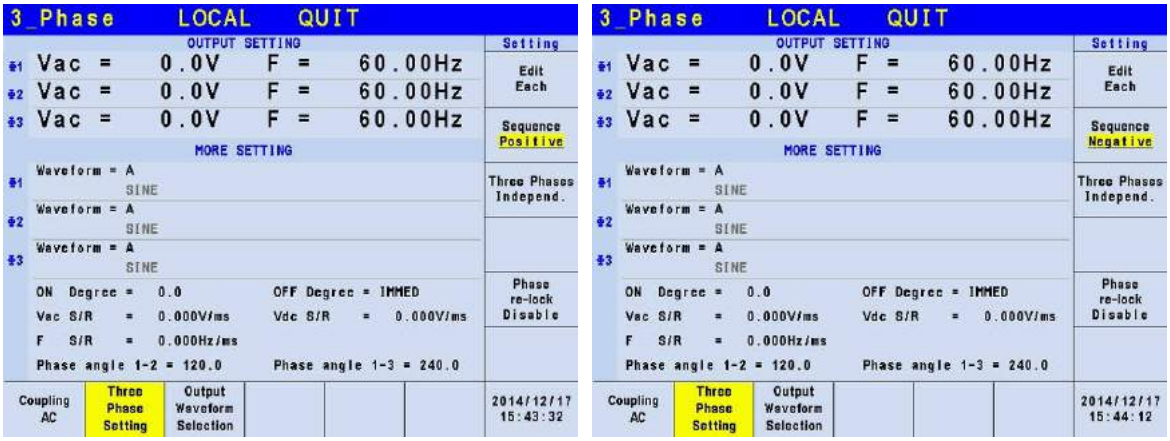
Sequence: Positive, Negative

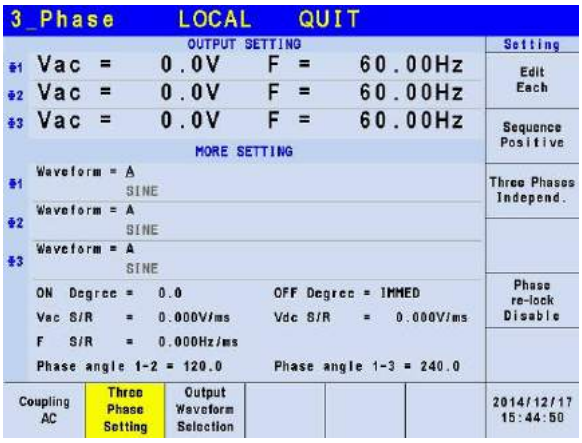
For example, the phase difference degree of 3-phase in positive balance is 120 degrees as shown below.



Press Sequence to set the Positive/Negative sequence for Regenerative Grid Simulator's 3-phase voltage output. The following lists the procedure to set the 3-phase output voltage sequence to Negative.

1. Press Sequence on the right.
2. Use RPG to select "Negative" and press **ENTER**.



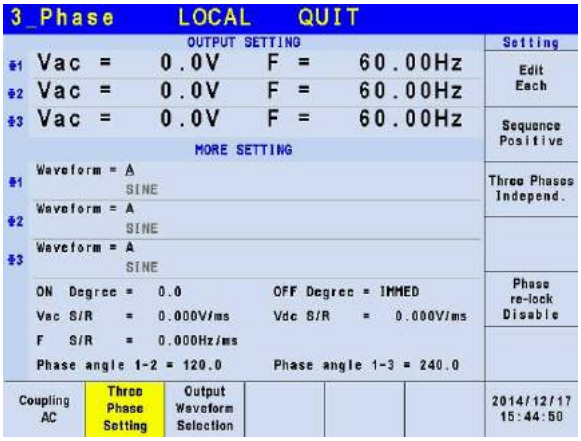


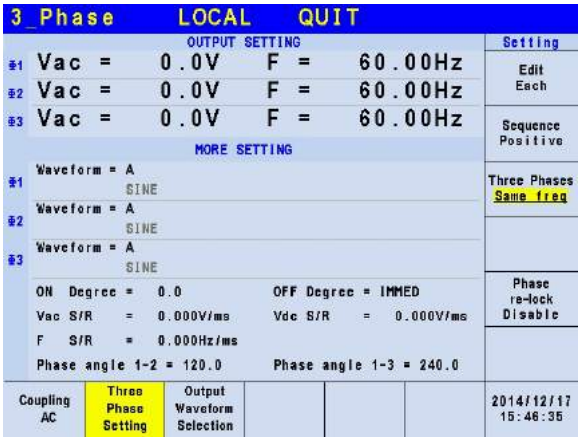
Three Phases: Independ., Same Freq, Balance

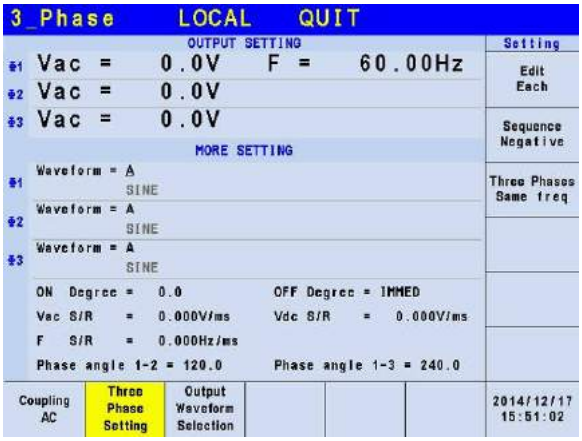
Press Three Phases to set the relationship among the Regenerative Grid Simulator 3-phase output voltage, which are Independ., Same Freq and Balance.

Following lists the procedure to set the same frequency for 3-phase voltage output.

1. Press Three Phases on the right.
2. Use RPG to select "Same freq" and press **ENTER**.

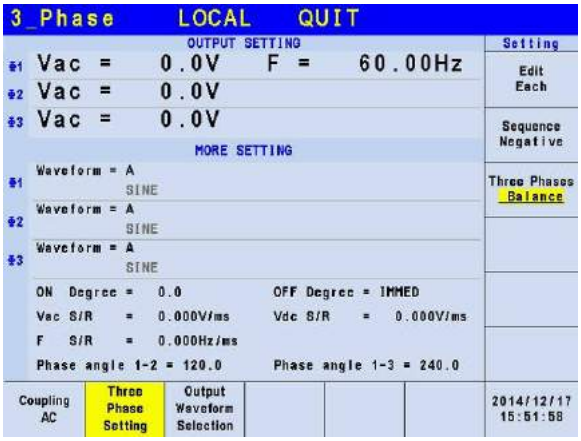


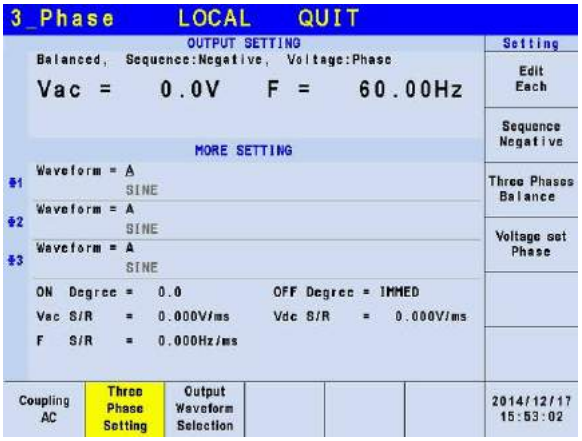


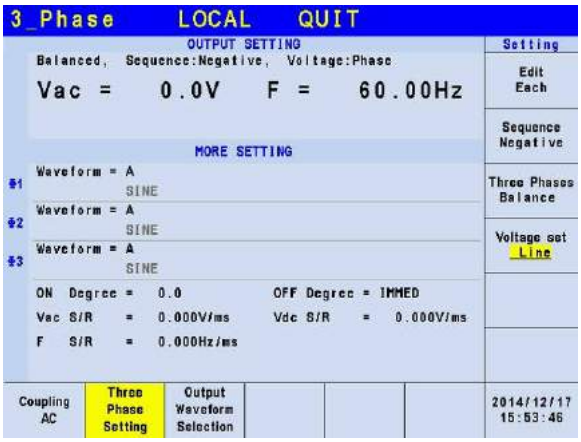


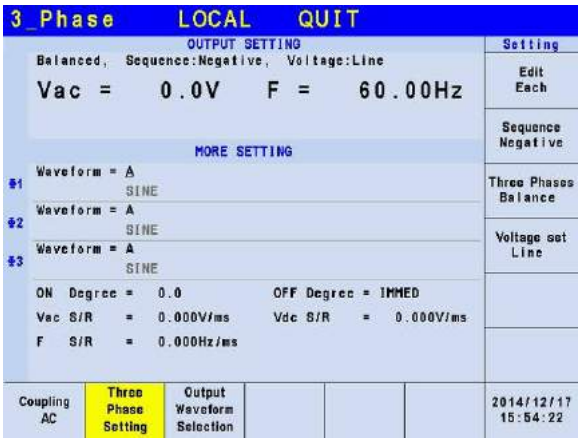
When 3-phase balance is in use, the user may set the output voltage to be Phase Volt or Line Volt. Below is the procedure for setting the 3-phase voltage output to 3-phase balance.

1. Press Three Phases on the right.
2. Use RPG to select "Balance" and press **ENTER**.
3. Press Voltage set on the right.
4. Use RPG to select "Line" and press **ENTER**.





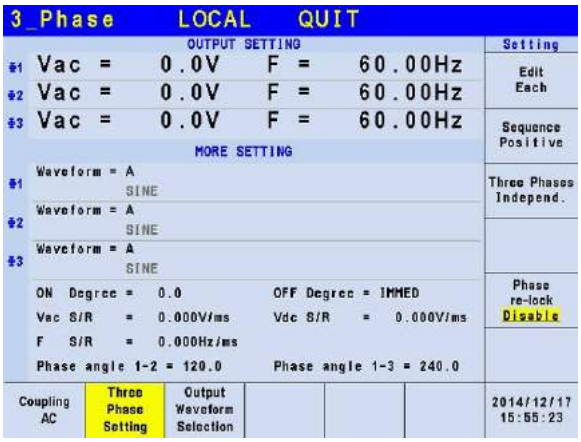


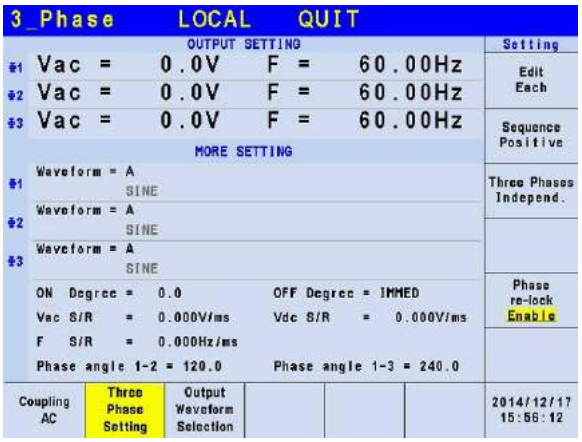


Phase re-lock: Enable, Disable

Phase re-lock is used to lock the phase again. Since the output voltage and frequency are set separately when the Regenerative Grid Simulator is in 3-phase mode, users can set the 3-phase for different frequency output. Assuming the 3-phase output frequencies are varied and users set them to the same when the phase re-lock function is disabled, the phase difference of the 3-phase output does not return to default (each phase difference is 120°) as Figure 3-3 shows. The phase difference of 3-phase output will return to default (each phase difference is 120°) as Figure 3-4 shows when the phase re-lock function is enabled.

Press Phase re-lock on the right to enable or disable the function.





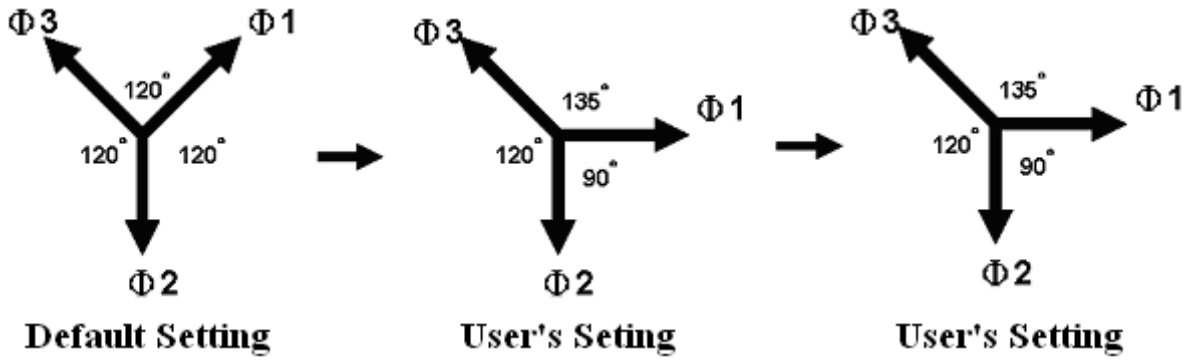


Figure 3-3 Phase Re-lock Disabled

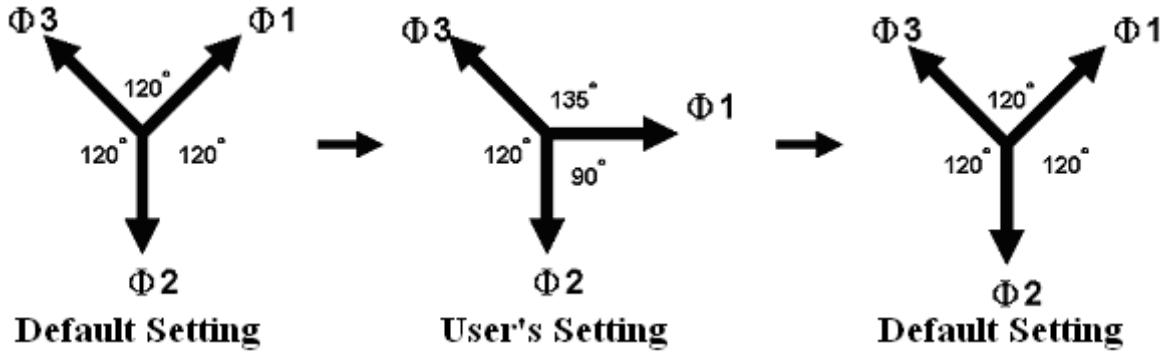


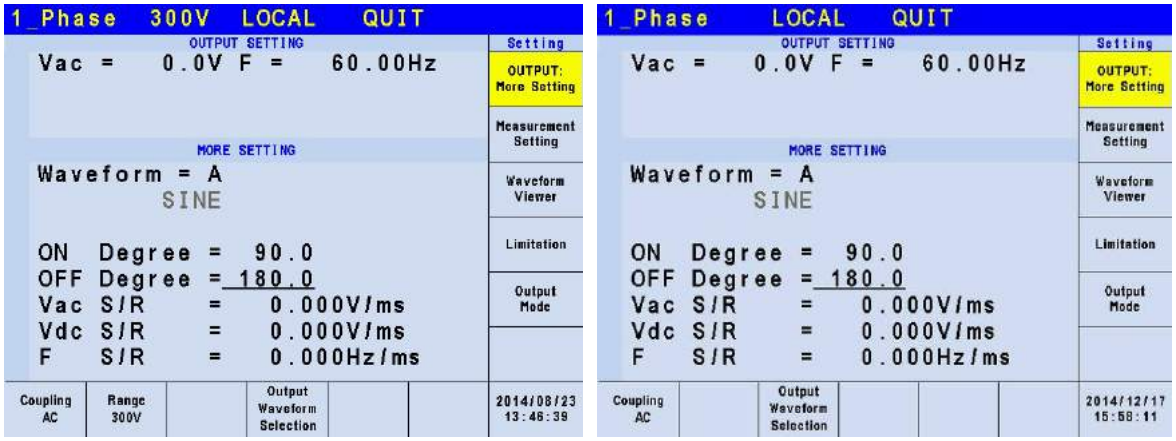
Figure 3-4 Phase Re-lock Enabled

3.3.1.3 Output Degree

The Regenerative Grid Simulator can control the degree of the waveform during output or when stopping the output. In the MAIN PAGE (3_Phase Mode/1_Phase Mode) (see 3.3) press OUTPUT: More Setting on the right to set ON Degree and OFF Degree.

Following is the procedure to set the output phase degree to ON Degree = 90 and OFF Degree=180 in 1_Phase Mode /3_Phase Mode.

1. Press OUTPUT: More Setting on the right.
2. Move the cursor to "ON Degree=" command position.
3. Press **9**, **0**, and **ENTER** to change the value to "90.0".
4. The cursor moves to "OFF Degree=" command position automatically.
5. Press **1**, **8**, **0**, and **ENTER** to change the value to "180.0".



Notice

If "OFF Degree=IMMED" when **QUIT** is pressed, the output voltage jumps off immediately. If a degree is already set, it will output voltage till it reaches the set degree. Input “OFF Degree= 360” will turn into “OFF Degree= IMMED”.

3.3.1.4 Slew Rate of Output Transient

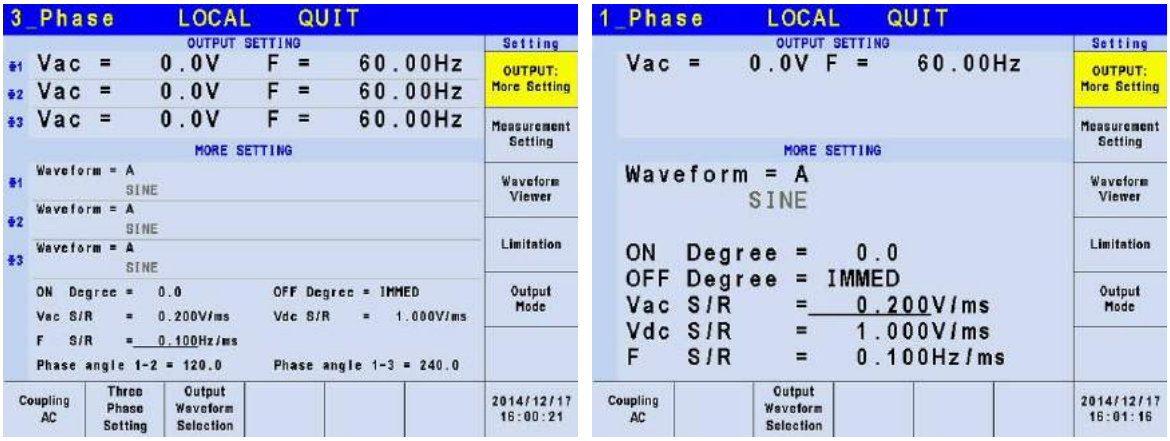
The Regenerative Grid Simulator has the ability to set the slew rates of the voltage waveform. This is done through 3 commands in OUTPUT: More Setting. They are Vac S/R, F S/R and Vdc S/R, which control the change speed of voltage waveform.

Vac S/R: It is the slew rate of Vac output.
F S/R: It is the slew rate of frequency output.
Vdc S/R: It is the slew rate of Vdc output.

Change the output setting in MAIN PAGE when the Regenerative Grid Simulator is in OUT mode, the output voltage and frequency will change to follow the setting of Vac S/R, F S/R and Vdc S/R.

The procedure of setting Vac S/R =0.2, F S/R =0.1 and Vdc S/R =1 in 1_Phase Mode /3_Phase Mode is described below.

1. Move the cursor to “Vac S/R =” command line.
2. Press **0**, **.**, **2** and **ENTER** to change the value to “0.2”.
3. The cursor moves to “F S/R =” command automatically, press **0**, **.**, **1** and **ENTER**.
4. The cursor moves to “Vdc S/R =” command automatically, press **1** and **ENTER**.

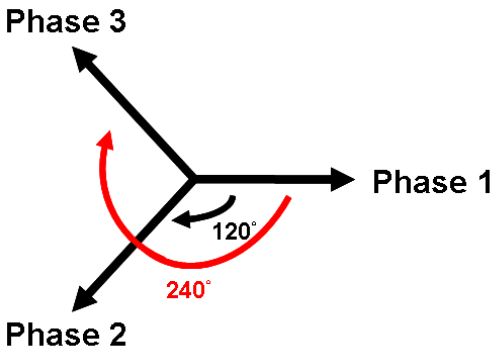


Notice

1. When setting Vac S/R = 0, F S/R = 0, Vdc S/R = 0, the output transient outputs in the highest speed.
2. Though the input range of Vac S/R, F S/R, Vdc S/R is quite large when using the software editor, the output voltage may not apply the slew rate properly due to the hardware limit when the Vac S/R, F S/R and Vdc S/R are too large. The maximum of Vac S/R and Vdc S/R is 1200V/ms and the minimum is 0.001V/ms. The maximum of F S/R is 1600Hz/ms and the minimum is 0.001Hz/ms.
3. When executing **OUT** on the Regenerative Grid Simulator the output will reach the final state as set. Once QUIT is executed, the output turns to 0V immediately. If the user wishes to output the set slew rate to 0V, it is necessary to key in 0V and press **ENTER** instead of pressing **QUIT** directly.

3.3.1.5 Output Degree of 3-Phase Voltage Output

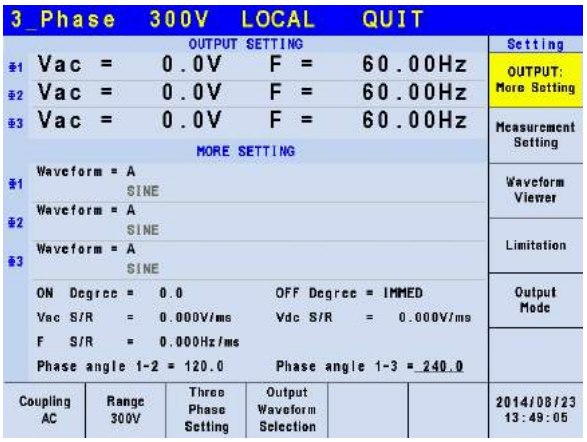
On the other hand the Regenerative Grid Simulator is able to set the phase difference degree for 3-phase output voltage. For instance the phase difference among the 3 phases is 120 degree for the output voltage with 3-phase balance positive sequence as the figure shown below.



Following lists the procedure for setting the output voltage to 3-phase balance with 120 degree phase difference among the 3 phases.

1. Move the cursor to "Phase angle 1-2 =" command line.
2. Press **1**, **2**, **0** and **ENTER**.

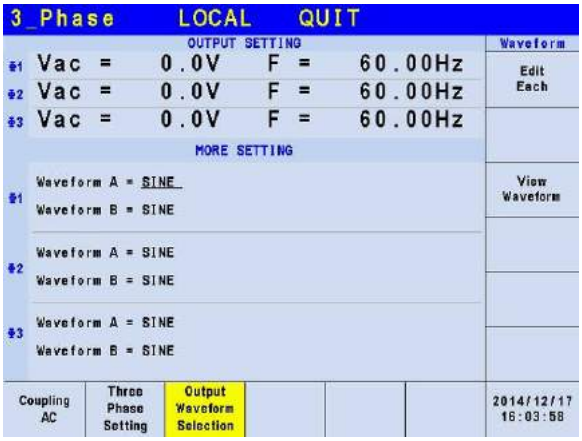
3. Move the cursor to “Phase angle 1-3 =” command line.
4. Press **2**, **4**, **0** and **ENTER**.



Notice Since the 3-phase voltage output of the Regenerative Grid Simulator is running separately, it is able to set the phase difference of 3-phase output to unbalance, such as Phase angle 1-2 = 100, Phase angle 1-3 = 200.

3.3.1.6 Output Waveform Selection

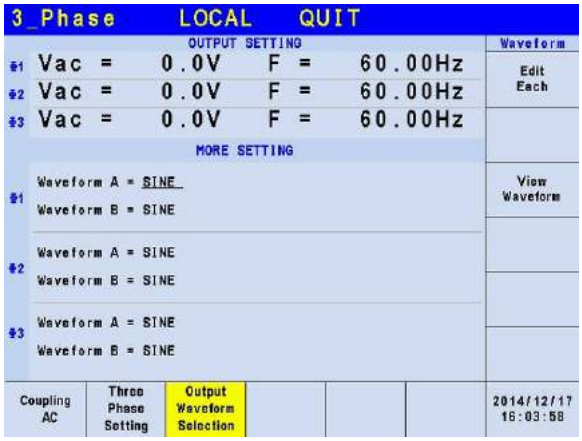
The Regenerative Grid Simulator has two sets of unique waveforms, A and B. Each of them has sine, square, clipped sine waveforms and 30 sets of built-in waveforms along with 6 sets of user defined waveforms.

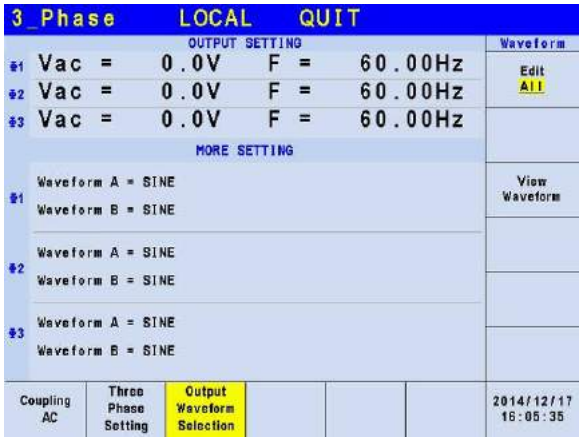


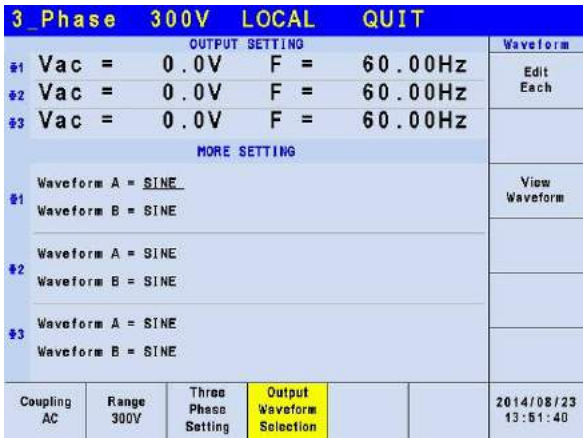
Follow the steps below to set the 3-phase waveform to A and to sine:

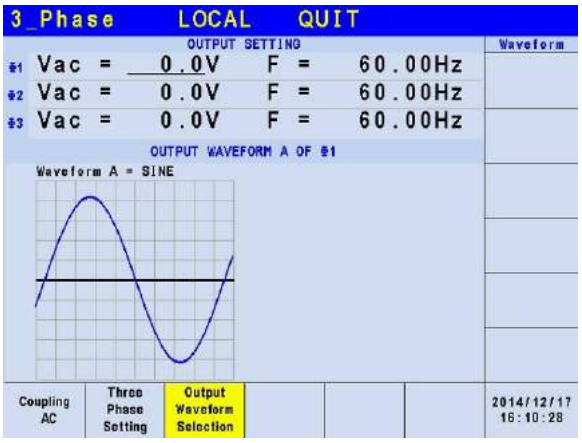
1. Press Edit on the right and use RPG to change the selection to All.
2. Move the cursor to WAVE A command line.
3. Turn the RPG to select “SINE” and press **ENTER**.

The user can press “View Waveform” on the right to view the set waveform.



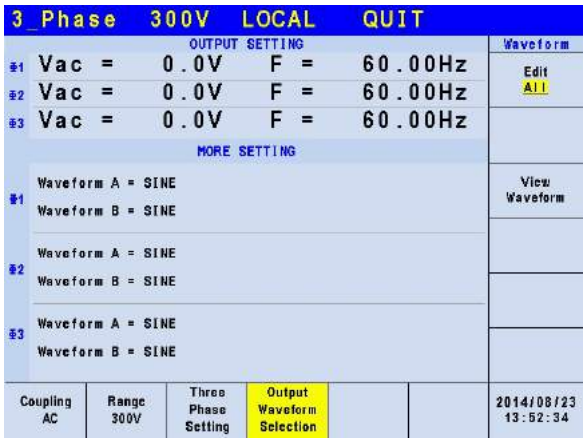


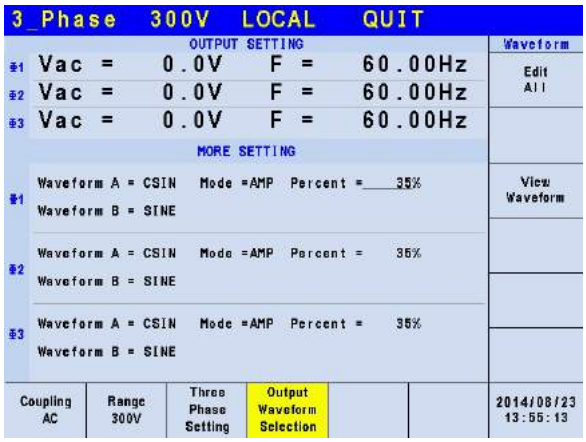


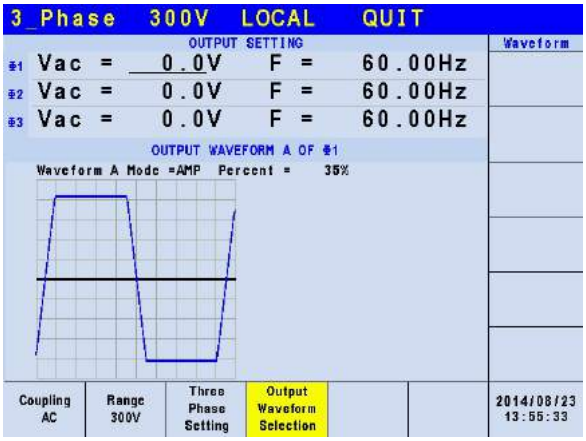


Follow the steps below to set the A waveform of 3-phase to clipped sine with a total harmonic distortion of 35%.

1. Press Edit on the right and use RPG to change the selection to All.
2. Move the cursor to the WAVE A command line and select "CSIN".
3. The LCD screen to show MODE and PERCENT.
4. Turn the RPG to change MODE to "THD" and press **ENTER**.
5. Press **3**, **5** and **ENTER** to set the THD to be 35%.







Notice

1. Clipped sine waveform can be programmed via “Amplitude” or “Total Harmonic Distortion”. The amplitude range is from 0 to 100% (100%: without clipping) while the Total Harmonic Distortion range is from 0 to 43% (0%: without distortion.)
2. The user defined waveform needs to be defined by and downloaded from the remote PC.
3. For detail DST waveform, please see *Appendix B Built-in DST Waveform*.

⚠WARNING

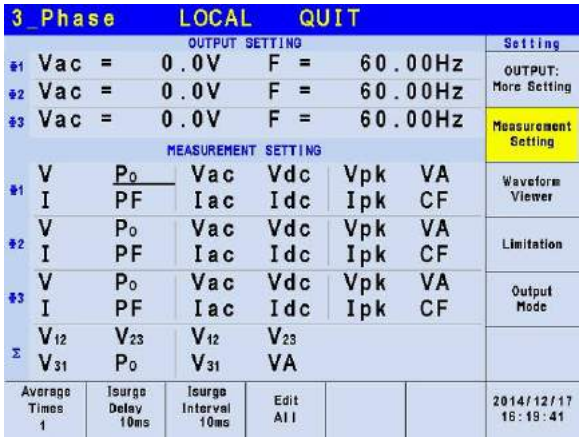
1. When using the user defined waveform, it may damage the Regenerative Grid Simulator if the waveform frequency exceeds 100Hz.
2. Due to the bandwidth restriction of Regenerative Grid Simulator, distortion may occur on the output especially when the user defined waveform contains high frequency.
3. If the user defined waveform or the set DST waveform exceeds the voltage limit, OUTPUT OVP or DST Protection will occur.

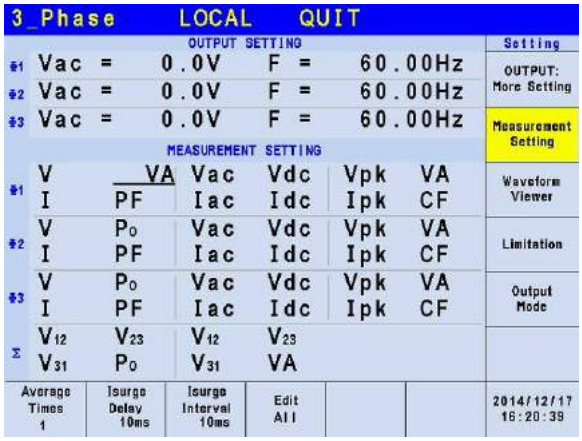
3.3.2 Measurement Setting

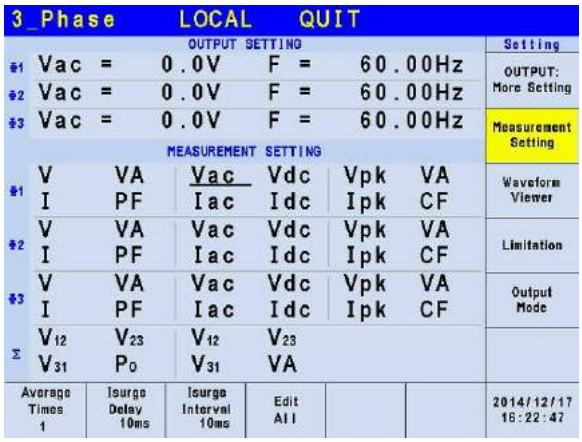
Press Measurement Setting in the MAIN PAGE (3_Phase Mode/1_Phase Mode) to set the measurement as the figure shown below. There are 12 measurement items in the setting screen such as voltage, current, output power and etc. The setting is done by moving the cursor to each item and use the RPG to select the required test item and press **ENTER**.

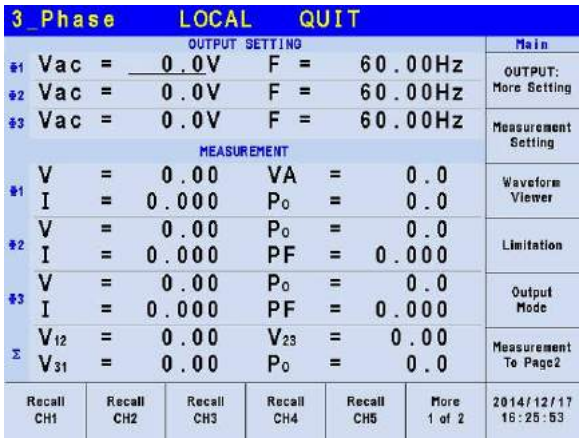
Below is procedure to change the 3rd measurement item from Po to VA in 3-phase mode.

1. Press Measurement Setting in the MAIN PAGE (3_Phase Mode).
2. Move the cursor to “Po”.
3. Use the RPG to select “VA” and press **ENTER**.
4. Press ⮌ to return to the MAIN PAGE.



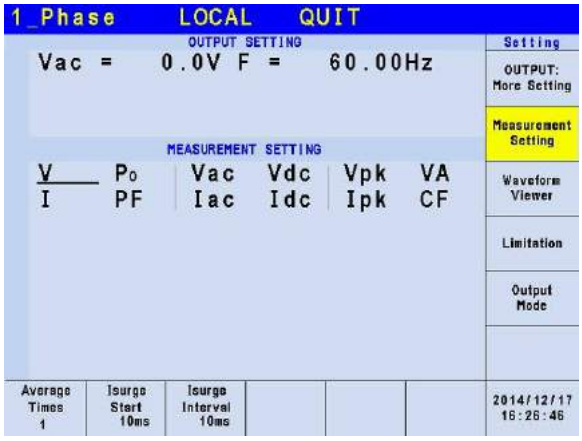


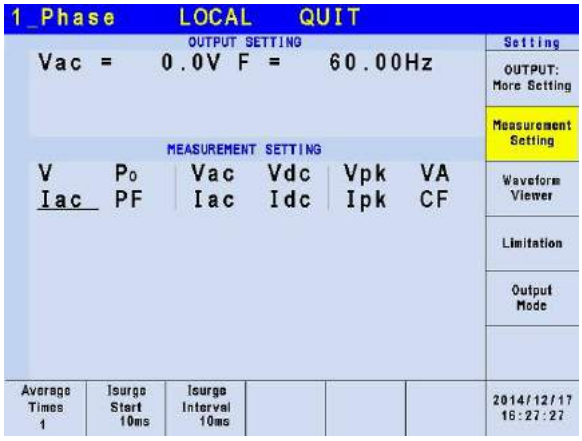


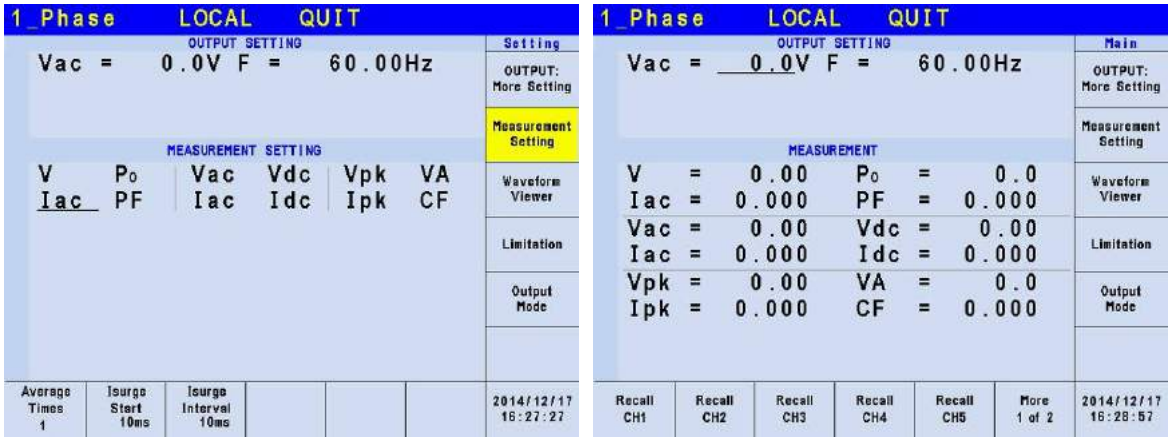


Below is the procedure to the 2nd measurement item from I to Iac in 1 phase mode.

1. Press Measurement Setting in the MAIN PAGE (1_Phase Mode).
2. Move the cursor to "I".
3. Use the RPG to select "Iac" and press **ENTER**.
4. Press ⮌ to return to the MAIN PAGE.







3.3.2.1 Average Times

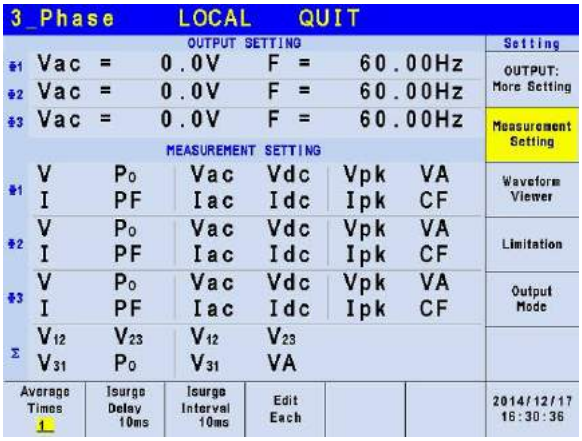
Average Times is the sampling average of voltage/current RMS and voltage/current peak. The Regenerative Grid Simulator uses moving windows for sampling. When “4” is selected for Average Times it indicates it will be sampling 4 times in moving windows.

Press Average Times at the bottom to set the average times for sampling. When the measurement is fluctuated severely, higher sampling average times can be set to improve the measurement accuracy. The average times for sampling to be set are listed below.

Average Times: 1, 2, 4, 8, 16 and 32.

Follow the steps below to set the sampling average times to 1.

1. Press Average Times at the bottom.
2. Turn RPG to switch to “1” and press **ENTER**.

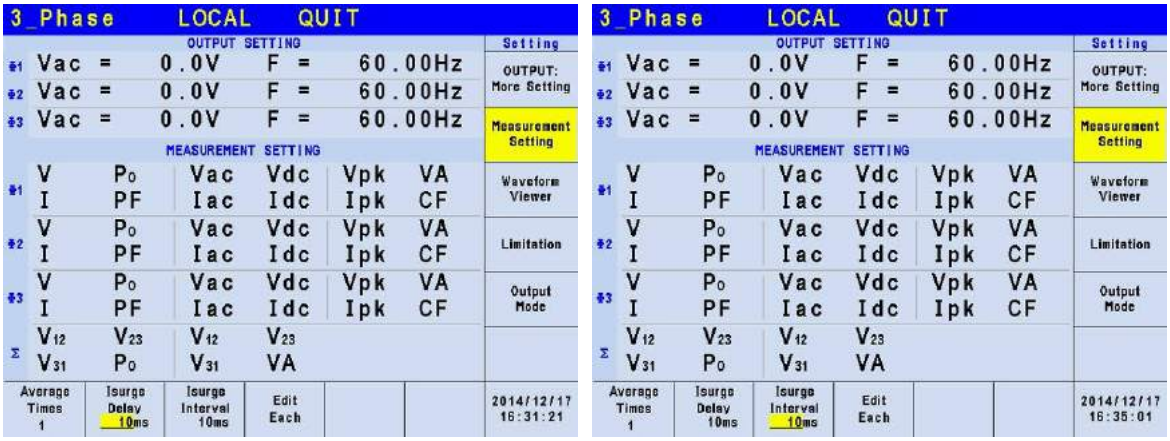


3.3.2.2 Isurge Delay, Isurge Interval

The Isurge in Measurement Setting is the surge peak current output by the Regenerative Grid Simulator. Isurge measurement starts after Isurge Delay when the voltage output changes. The measurement time is set by Isurge Interval. These two functions can be set by Measurement Setting.

The procedure for setting Isurge Delay = 10 ms, Isurge Interval = 10 ms is described below.

1. Move the cursor to "Isurge Delay =" command line.
2. Press **1**, **0** and **ENTER** to change the value to "10.0".
3. Move the cursor to "Isurge Interval =" command line.
4. Press **1**, **0** and **ENTER** to change the value "10.0".



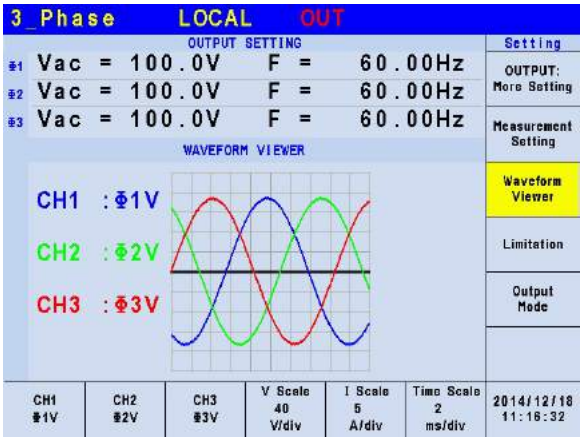
3.3.3 Waveform Viewer

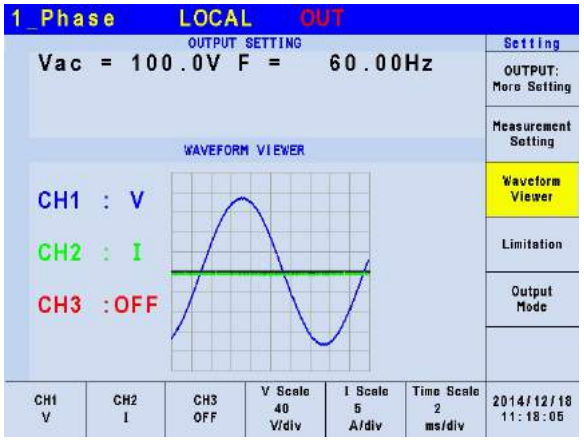
Waveform Viewer can be used to see the real time output voltage/ current waveform. There are a total of 3 CH available. Voltage, current and time can be adjusted by the Scale command. The figure below shows the Waveform Viewer.

Ch1: Φ1V, Φ2V, Φ3V, Φ1I, Φ2I, Φ3I.
Ch2: Φ1V, Φ2V, Φ3V, Φ1I, Φ2I, Φ3I.
Ch3: Φ1V, Φ2V, Φ3V, Φ1I, Φ2I, Φ3I.
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 for setting CH1 =Φ1V, CH2 =Φ2V, CH3 =Φ3V, 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. Press CH1 at the bottom.
2. Turn the RPG to change to "Φ1V" and press **ENTER**
3. Press CH2 at the bottom.
4. Turn the RPG to change to "Φ2V" and press **ENTER**.
5. Press CH3 at the bottom.
6. Turn the RPG to change to "Φ3V" and press **ENTER**.
7. Press V Scale at the bottom.
8. Turn the RPG to change to "40" and press **ENTER**.
9. Press I Scale at the bottom.
10. Turn the RPG to change to "5" and press **ENTER**.
11. Press Time Scale at the bottom.
12. Turn the RPG to change to "2" and press **ENTER**.





3.3.4 Limitation

The Limit of Regenerative Grid Simulator 1-phase/3-phase output mode is set separately. For instance, the Vac Limit setting will apply the settings of the 1-phase mode when changing it from the 3-phase mode.

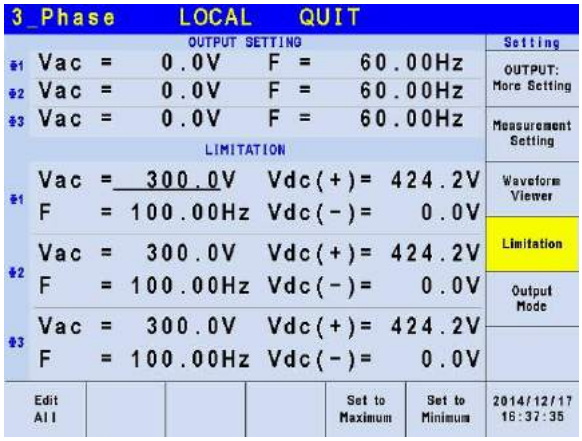
3.3.4.1 Vac Limit

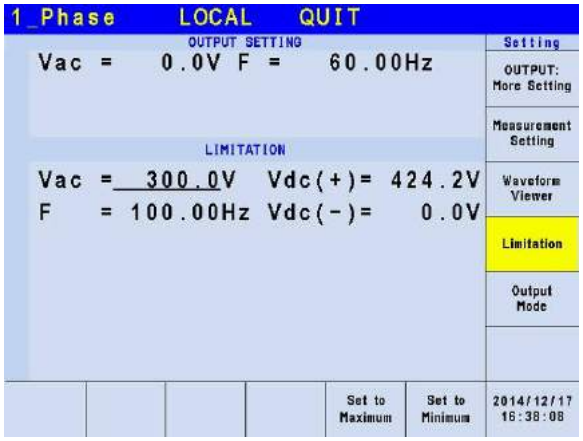
Vac Limit sets the Vac value in MAIN PAGE (3_Phase Mode/1_Phase Mode). Press Limitation on the right in MAIN PAGE (3_Phase Mode/1_Phase Mode) to set the Vac Limit. This command protects the planned program instead of the hardware.

Press Edit at the bottom to set the limitation of the 3-phase voltage output for “Each” or “All”.

The procedure to set Vac Limit = 300V in 1_Phase Mode /3_Phase Mode is described below.

1. Move the cursor to “Vac =” command line.
2. Press **3**, **0**, **0** and **ENTER** to change the value to “300.0”.



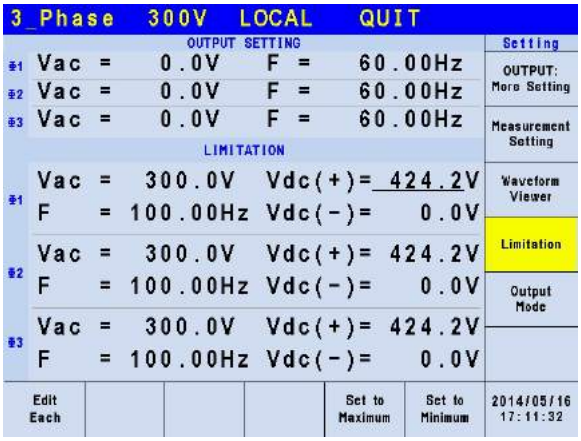


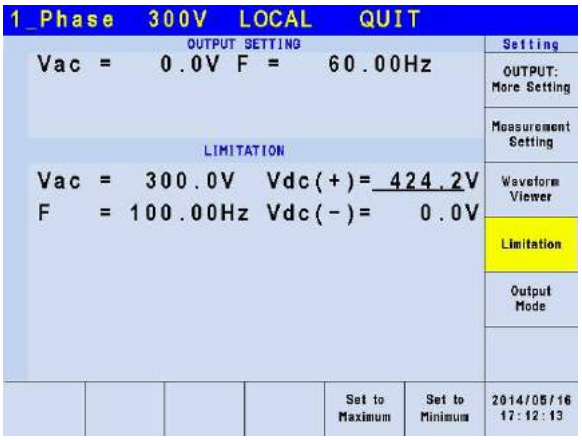
3.3.4.2 Vdc Limit (+), Vdc Limit (-)

Vdc Limit (+) and Vdc Limit (-) restrict the Vdc setting in MAIN PAGE (3_Phase Mode/1_Phase Mode). These two items can be set in the Limitation function (see 3.3.4). The Vdc setting can exceed Vdc Limit (+) but cannot be under Vdc Limit (-).

The procedure for setting Vdc (+) = 424.2V, Vdc (-) = 0V in 1_Phase Mode /3_Phase Mode is described below.

1. Move the cursor to "Vdc (+) =" command line.
2. Press **4**, **2**, **4**, **.**, **2** and **ENTER** to change the value to "424.2".
3. Move the cursor to "Vdc (-) =" command line.
4. Press **0** and **ENTER** to change the value to "0.0".



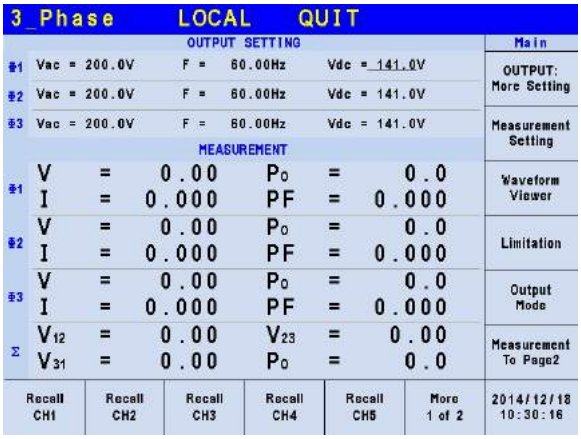


Notice It should restrict the Vdc value when the output contains it. It may cause damage if the output polarity is reversed especially the load polarity.

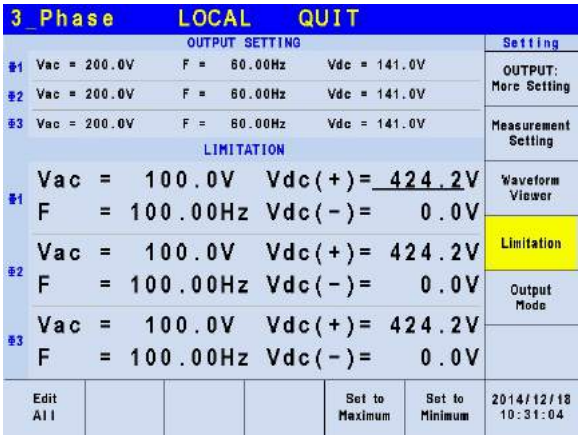
CAUTION

1. If the set Limitation is smaller than the main menu setting, the set value in main menu will equal to the one set by Limitation when the setting is done.

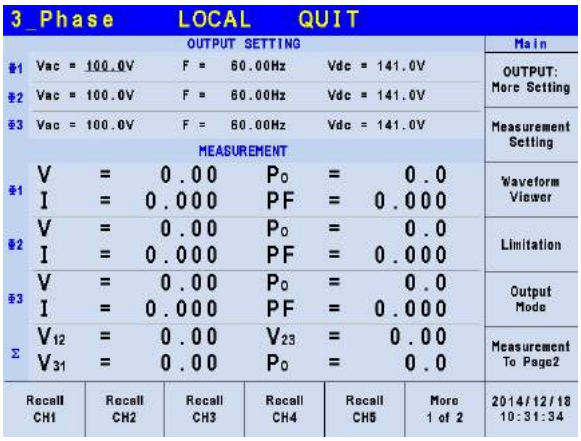
Ex. (1) The original main menu sets Vac = 200V.



(2) The Limitation sets Vac Limit =100V.

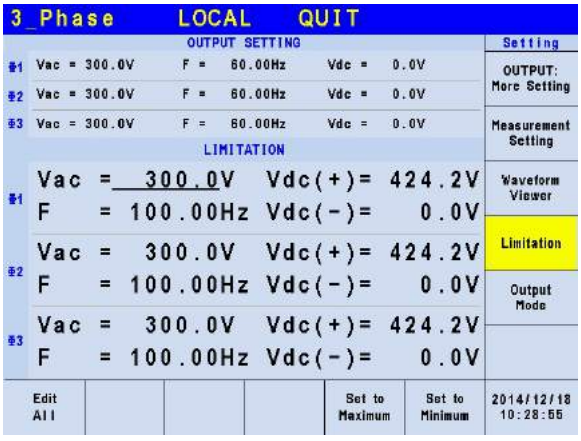


(3) When return to the main menu, the value will be the one set by Limitation.



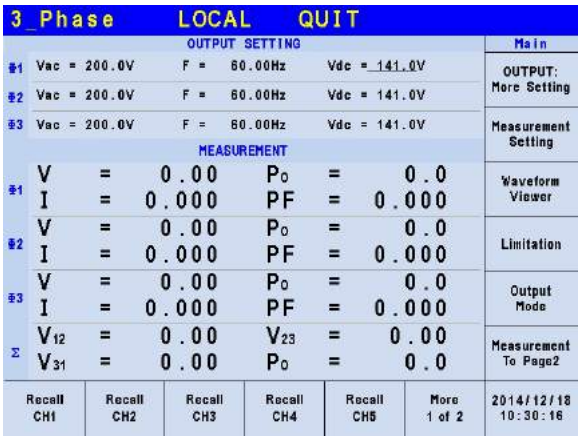
2. When AC+DC is selected for Coupling output mode, the output voltage will be restricted by voltage specification.

Ex. (1) It is unable to the DC voltage if the AC voltage is set to maximum output voltage. If the AC voltage sets to Vac = 300V, it is unable to set the DC voltage to 0V.



(2) The DC voltage will limit to system protection point if the AC voltage is not set to the maximum output voltage specification. When the AC voltage

sets to Vac = 200V, the DC voltage can only set to 141V at a maximum.



3.4 CONFIG Function Key

Press **CONFIG** in the **FUNCTION** keys shown below to enter into CONFIG function (3_Phase Mode/1_Phase Mode.)

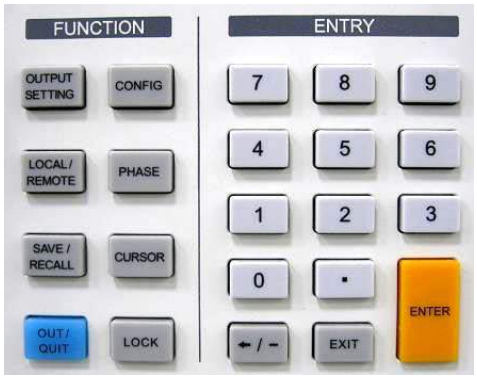
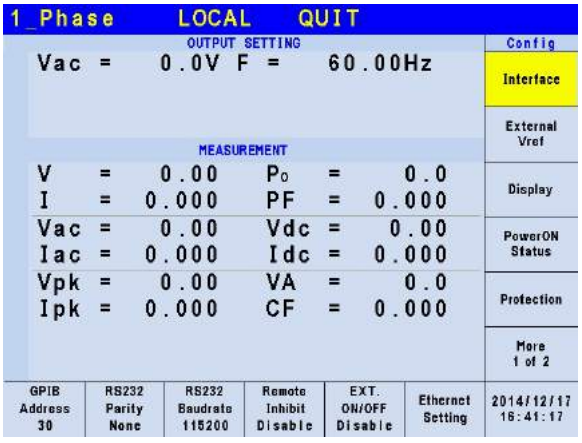


Figure 3-5 FUNCTION Keys

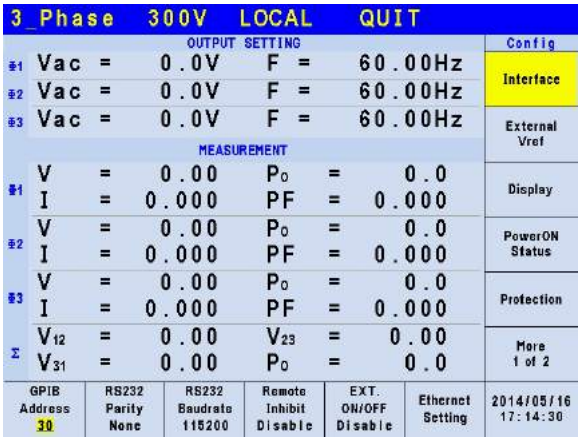


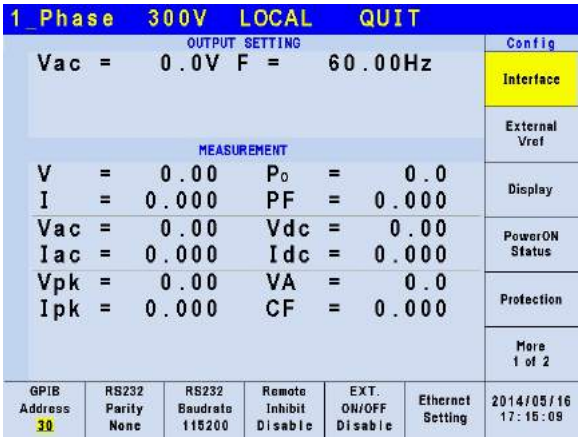
3.4.1 Interface

3.4.1.1 GPIB Address, RS-232 Parity/Baudrate

The Regenerative Grid Simulator also has remote operation mode that can be activated by the CONFIG function (3_Phase Mode/1_Phase Mode.) It is necessary to set GPIB address to 30 before conducting remote operation in 1_Phase Mode /3_Phase Mode.

1. Press GPIB address at the bottom.
2. Turn the RPG to change the address and press **ENTER** to set address 30.

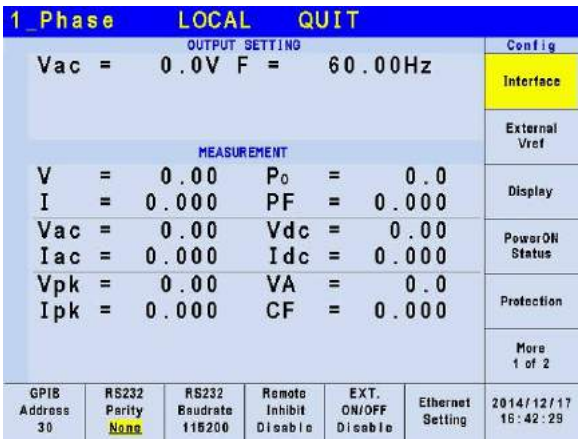


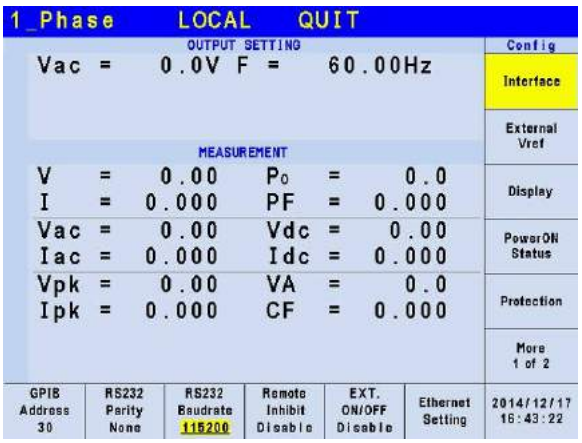


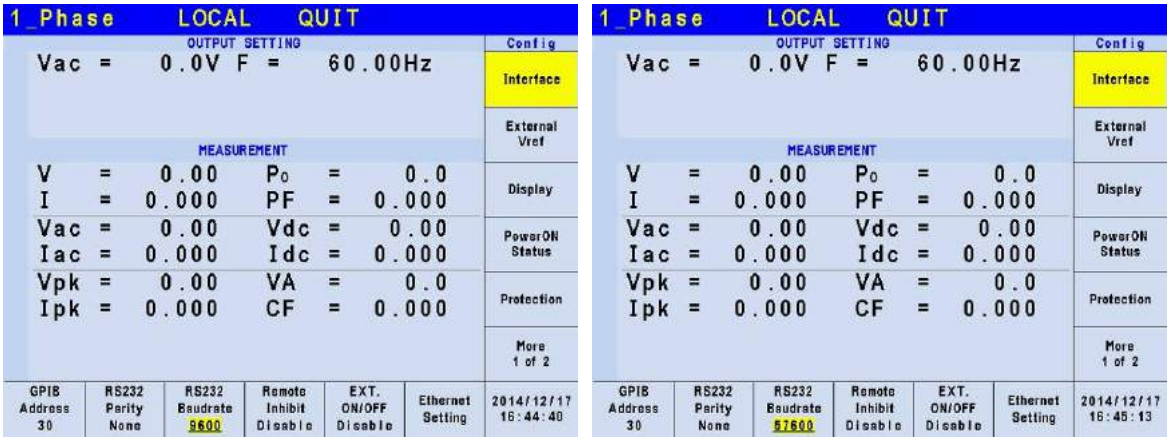
Notice The address range is from 1 to 30.

The Regenerative Grid Simulator uses the RS-232C bus to provide remote operation. Follow the steps below to set the communication protocol. Set Parity=None and Baudrate =115200 in 1_Phase Mode /3_Phase Mode as described below:

1. Press RS232 Parity at the bottom.
2. Turn the RPG to select None and press **ENTER**.
3. Press RS232 Baudrate at the bottom. Turn the RPG to “115200” and press **ENTER**.







Notice The baudrate selections are 9600/19200/38400/57600/115200 and the selections for parity are EVEN/ODD/NON.

3.4.1.2 Remote Inhibit, EXT. ON/OFF

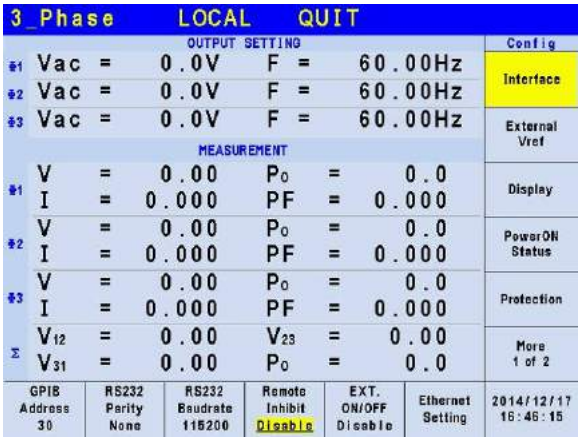
The output of Regenerative Grid Simulator can be inhibited by external control or manual trigger. The output signal of the remote inhibit (remote control) is received from the TTL terminal on the rear panel (see *Appendix A*.) Remote Inhibit and EXT. ON/OFF are set by the CONFIG function (3_Phase Mode/1_Phase Mode). There are two remote inhibit output states: Enable and Disable.

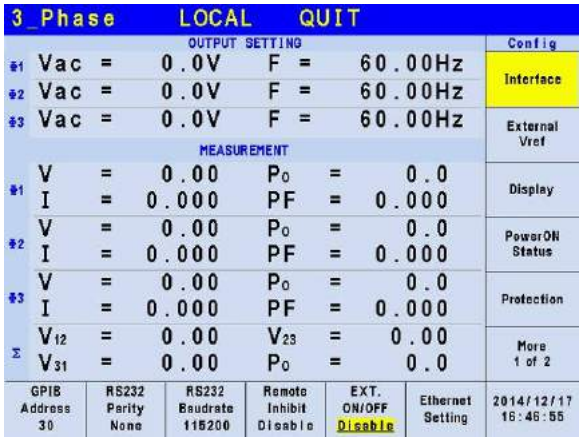
Remote Inhibit: When the Remote Inhibit is enabled on the Regenerative Grid Simulator and the Remote Inhibit signal is LOW, the Regenerative Grid Simulator will disable the output. The Regenerative Grid Simulator holds the output disabled even when the Remote Inhibit signal turns to HIGH. In order to re-enable the output, the user must press **OUT/QUIT**.

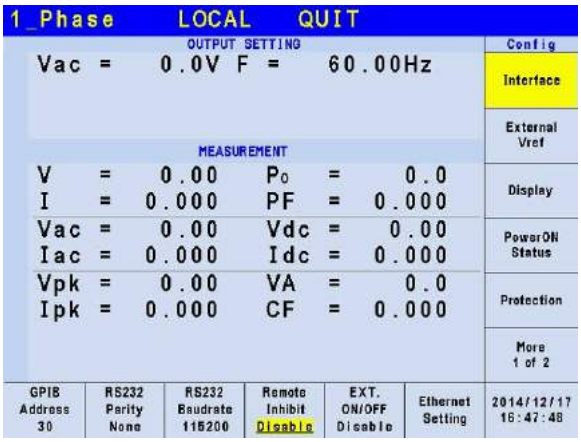
EXT. ON/OFF: When the EXT. ON/OFF is enabled on the Regenerative Grid Simulator and the EXT. ON/OFF signal is LOW, the Regenerative Grid Simulator will disable the output. The Regenerative Grid Simulator will re-enable the output when the EXT. ON/OFF signal turns to HIGH.

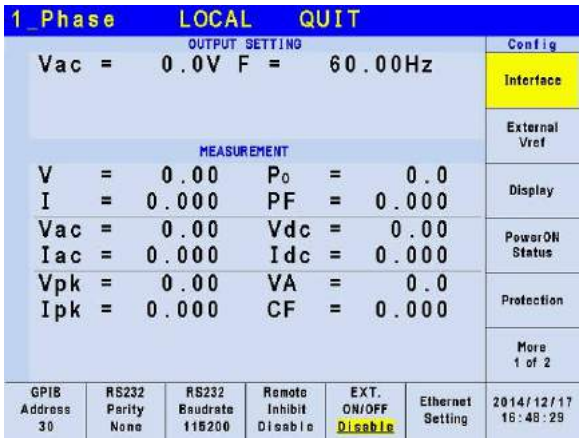
The procedure for setting Remote Inhibit/EXT. ON/OFF to disable in 1_Phase Mode /3_Phase Mode is described below.

1. Press Remote Inhibit/EXT. ON/OFF at the bottom.
2. Turn the RPG to change to "Disable" and press **ENTER**.









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

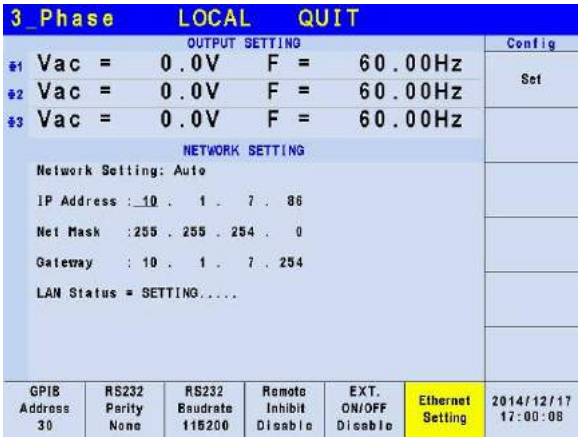
3.4.1.3 Ethernet Setting

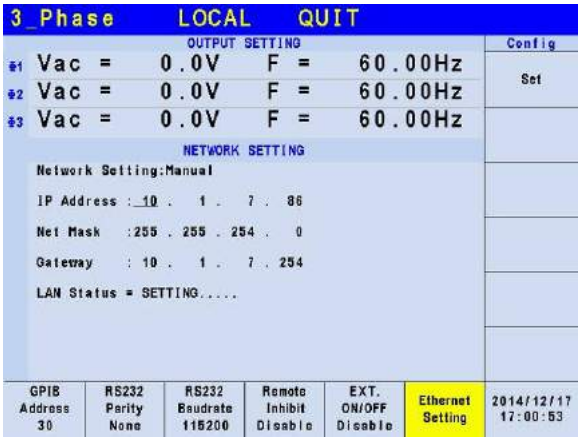
The Regenerative Grid Simulator can be operated remotely through a network once the Ethernet Settings are complete.

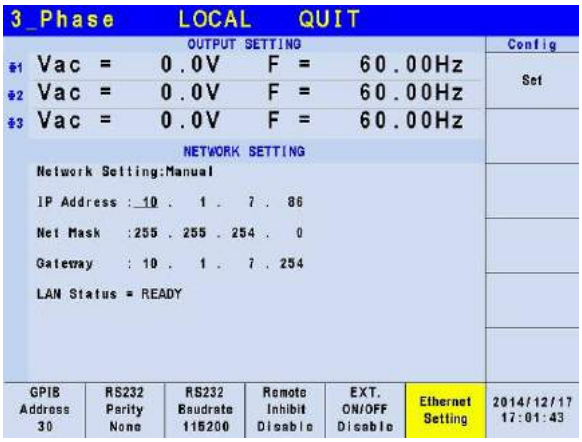
Network Setting: Auto, Manual

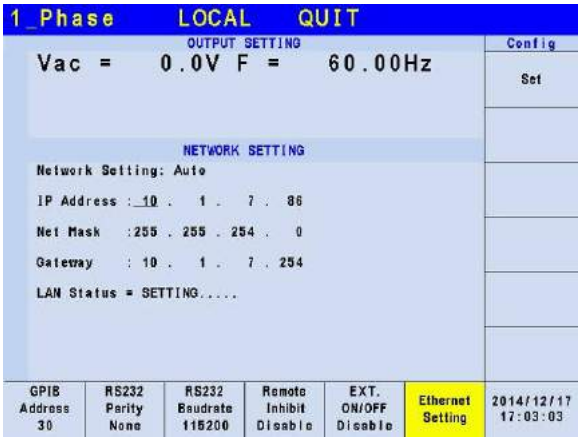
The procedure for setting Network Settings manually in 1_Phase Mode/3_Phase Mode is described below.

1. Press Ethernet setting at the bottom.
2. Move the cursor to “Network Setting:.”
3. Turn the RPG to change to Manual and press **ENTER**.
4. Set the IP Address, Net Mask and Gateway.

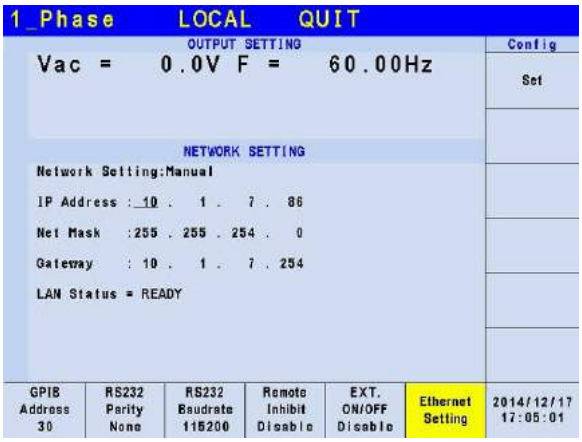

3_Phase LOCAL QUIT
OUTPUT SETTING
Config
Set
#1 Vac = 0.0V F = 60.00Hz
#2 Vac = 0.0V F = 60.00Hz
#3 Vac = 0.0V F = 60.00Hz
NETWORK SETTING
Network Setting: Auto
IP Address : 10 . 1 . 7 . 86
Net Mask :255 . 255 . 254 . 0
Gateway : 10 . 1 . 7 . 254
LAN Status = SETTING.....
GPIB Address 30
RS232 Parity None
RS232 Baudrate 115200
Remote Inhibit Disable
EXT. ON/OFF Disable
Ethernet Setting
2014/12/17 17:00:08


3_Phase LOCAL QUIT
OUTPUT SETTING
Config
Set
#1 Vac = 0.0V F = 60.00Hz
#2 Vac = 0.0V F = 60.00Hz
#3 Vac = 0.0V F = 60.00Hz
NETWORK SETTING
Network Setting:Manual
IP Address : 10 . 1 . 7 . 86
Net Mask :255 . 255 . 254 . 0
Gateway : 10 . 1 . 7 . 254
LAN Status = SETTING.....
GPIB Address 30
RS232 Parity None
RS232 Baudrate 115200
Remote Inhibit Disable
EXT. ON/OFF Disable
Ethernet Setting
2014/12/17 17:00:53


3_Phase LOCAL QUIT
OUTPUT SETTING
Config
Set
#1 Vac = 0.0V F = 60.00Hz
#2 Vac = 0.0V F = 60.00Hz
#3 Vac = 0.0V F = 60.00Hz
NETWORK SETTING
Network Setting:Manual
IP Address : 10 . 1 . 7 . 86
Net Mask :255 . 255 . 254 . 0
Gateway : 10 . 1 . 7 . 254
LAN Status = READY
GPIB Address 30
RS232 Parity None
RS232 Baudrate 115200
Remote Inhibit Disable
EXT. ON/OFF Disable
Ethernet Setting
2014/12/17 17:01:43


1_Phase LOCAL QUIT
OUTPUT SETTING
Config
Set
Vac = 0.0V F = 60.00Hz
NETWORK SETTING
Network Setting: Auto
IP Address : 10 . 1 . 7 . 86
Net Mask :255 . 255 . 254 . 0
Gateway : 10 . 1 . 7 . 254
LAN Status = SETTING.....
GPIB Address 30
RS232 Parity None
RS232 Baudrate 115200
Remote Inhibit Disable
EXT. ON/OFF Disable
Ethernet Setting
2014/12/17 17:03:03


1_Phase LOCAL QUIT
OUTPUT SETTING
Config
Set
Vac = 0.0V F = 60.00Hz
NETWORK SETTING
Network Setting:Manual
IP Address : 10 . 1 . 7 . 86
Net Mask :255 . 255 . 254 . 0
Gateway : 10 . 1 . 7 . 254
LAN Status = SETTING.....
GPIB Address 30
RS232 Parity None
RS232 Baudrate 115200
Remote Inhibit Disable
EXT. ON/OFF Disable
Ethernet Setting
2014/12/17 17:03:41


1_Phase LOCAL QUIT
OUTPUT SETTING
Config
Set
Vac = 0.0V F = 60.00Hz
NETWORK SETTING
Network Setting:Manual
IP Address : 10 . 1 . 7 . 86
Net Mask :255 . 255 . 254 . 0
Gateway : 10 . 1 . 7 . 254
LAN Status = READY
GPIB Address 30
RS232 Parity None
RS232 Baudrate 115200
Remote Inhibit Disable
EXT. ON/OFF Disable
Ethernet Setting
2014/12/17 17:05:01

3.4.2 External Vref

The Regenerative Grid Simulator allows the user to use analog control signals (simulated) from an external device to set its output (optional card is required.) The External Vref terminal socket at the rear panel allows users to apply signals to the Regenerative Grid Simulator for output voltage setting. The External Vref and the Control Method can be set by the CONFIG function (3_Phase Mode/1_Phase Mode). External Vref has two coupled modes to indicate the output of Regenerative Grid Simulator: Amplifier and Level. When the user is using single phase Ext. Vref, the signal inputted by terminal pin Ext-V Φ2 is the main control signal. Refer to *Appendix A* for the pin assignment of TTL terminal. The voltage delay time for External-V reference signal input to external output is 70us.

Amplifier: The output voltage (Vout) is the composition of the voltage set in MAIN PAGE and the supplemental programmed voltage inputted externally. The external V reference voltage range is from -10 V to 10V. When Vac=0 and Vdc=0 in MAIN PAGE, the following formula can be used to calculate Vout.

Vout (dc) = Vref (dc) / 10 Vdc × 424.2 Vdc
or
Vout (ac) = Vref (ac) / 7.072 Vac × 300 Vac

Ex (1): Set Vout to 100Vdc:
The applied external output voltage is V= 2.357Vdc, Vout = 100Vdc

Ex (2): Set Vout to 100Vac:
The applied external output voltage is V= 2.357Vac, Vout = 100Vac

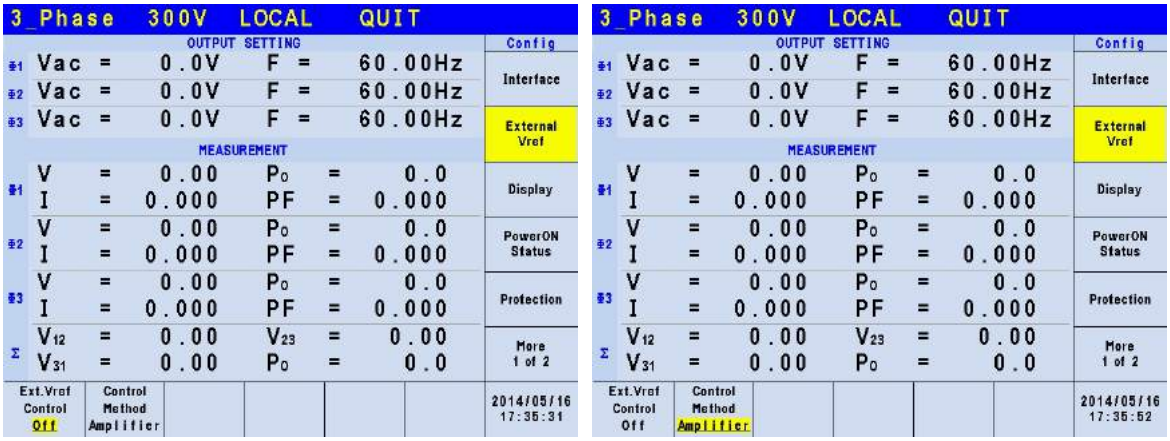
Level: It is the linear proportional output of output voltage (Vout (ac)) RMS programmed by the DC V reference. The Vreference range is from -10V to 10V. The following formula can be used to calculate Vout:

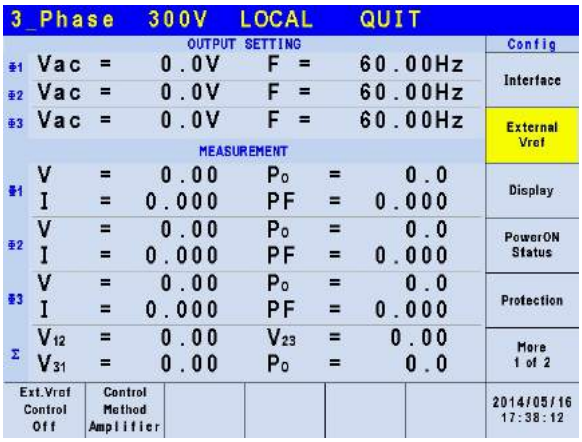
Vout (ac) = ｜Vref (dc)｜ / 10 Vdc × 300Vac

Ex (1): Set Vout to 100Vac:
The applied external output voltage is V= 3.333Vdc (or -3.333Vdc), Vout = 100Vac

The setting of Ext. Vref Control = OFF, Control Method = Amplifier is described below.

1. Press Ext. Vref Control at the bottom.
2. Turn the RPG to change ON to OFF and press **ENTER**.
3. Press Control Method at the bottom.
4. Turn the RPG to select Amplifier and press **ENTER**.





Notice

When Ext. Vref Control =ON, Control Method =Level, the output voltage (Vout) can only be controlled by the level of the external DC programming voltage. It is unable to control the Vout amplitude from the front panel keys until Ext. Vref Control=OFF is set.

⚠WARNING

1. When Control Method = Amplifier and the Vref frequency exceeds 100Hz, it could damage the Regenerative Grid Simulator. The user should obey the following formula:
   When set to **Amplifier** mode, F>100Hz: must be Vref (pk-pk, V) * F (Vref, Hz) < 4000 VHz.
   When set to **Level** mode, F>100Hz: must be Vref (pk-pk, V) * F (Vref, Hz) < 2000 VHz.
2. The output may be distorted due to the bandwidth restriction of Regenerative Grid Simulator, especially when the external V reference has too many high frequency components.
3. If the output voltage is over the limit, OUTPUT OVP or DST Protection will occur.

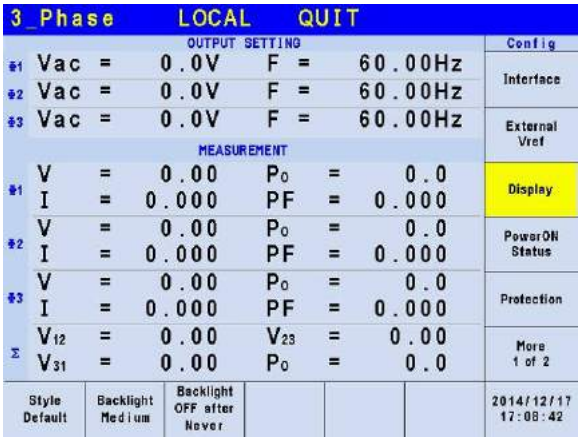
3.4.3 Display

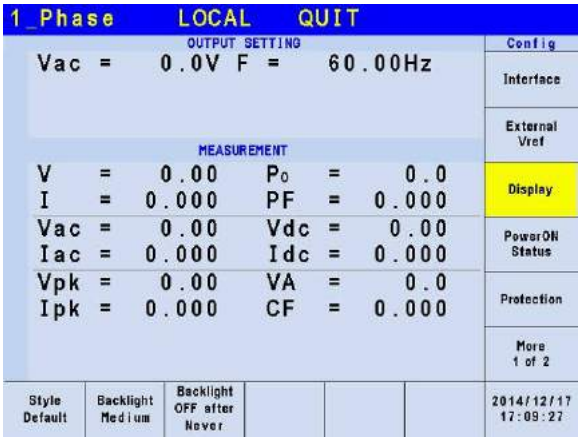
The brightness of the backlight and power save mode settings of the LCD can be set in the CONFIG function (3_Phase Mode/1_Phase Mode.)

Style: Default.
Backlight: Low, Medium and High.
Backlight OFF after: Never, 1 min, 3 mins, 5 mins, 10 mins, 30 mins, 1 hour and 3 hours.

The procedure for setting Backlight = Medium, Backlight OFF after = Never in 1_Phase Mode /3_Phase Mode is listed below.

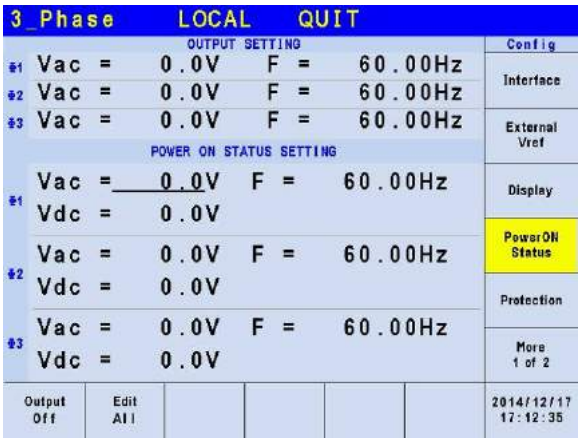
1. Press Backlight at the bottom.
2. Turn the RPG to Medium and press **ENTER**.
3. Press Backlight OFF after at the bottom.
4. Turn the RPG to select Never and press **ENTER**.

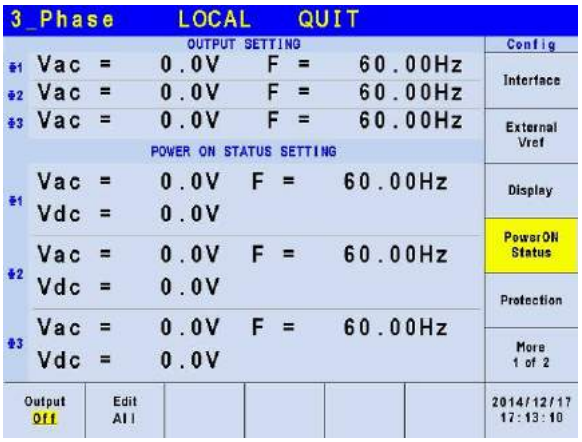


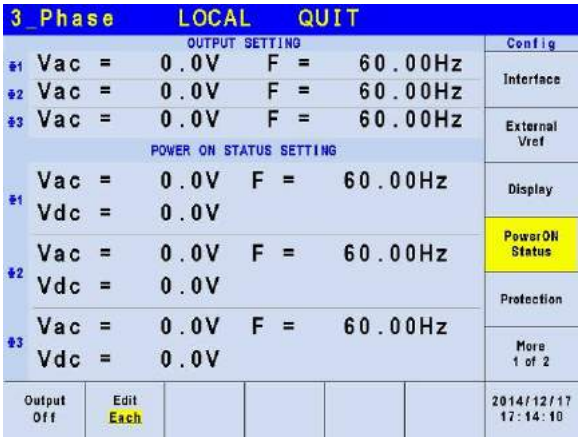


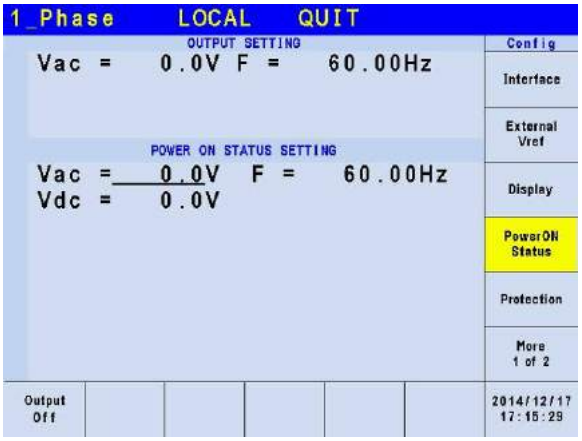
3.4.4 Power ON Status

The user can set the output state of Regenerative Grid Simulator during power on using the Power ON Status in the CONFIG function (3_Phase Mode/1_Phase Mode). Once it is set users should save the data before power off. With the output set to Off, the Regenerative Grid Simulator will not enable the output voltage after it is powered on. With it set to On, the Regenerative Grid Simulator will enable the output by default after powered on.









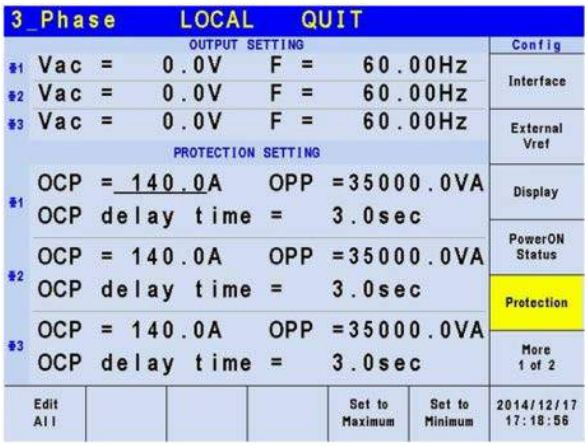
3.4.5 Protection

The Regenerative Grid Simulator's Protection for 1-phase/3-phase output mode is set separately. For instance, the Protection will apply the settings of 1-phase when switching from 3-phase to 1-phase mode rather than the Protection settings of any phase under 3-phase mode.

The Protection in the CONFIG function (3_Phase Mode/1_Phase Mode) is able to set the limit of the output RMS current (OCP), output power (OPP) and the Delay Time for triggering the current protection. The limit in this command is to protect the program instead of the hardware.

Following shows the procedure of setting the current limit = 140 A (maximum for 61800-100), power limit = 35000VA (maximum for 61800-100), delay time for trigger current protection = 3 sec.

1. Move the cursor to "OCP =" command line.
2. Press **1**, **4**, **0** and **ENTER** to change the value to "140.0".
3. Move the cursor to "OPP =" command line.
4. Press **3**, **5**, **0**, **0**, **0**, **ENTER** to change the value to "35000.0".
5. Move the cursor to "Delay time =" command line.
6. Press **3**, **ENTER** to change the value to "3.0".



Notice

1. When “OCP = 0.0 A”, it means the limit of output current equals to the specification limit.
2. The setting of the delay time for trigger 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 to1s. However, it will go into protection when it is over 1s. The resolution is 0.1s.

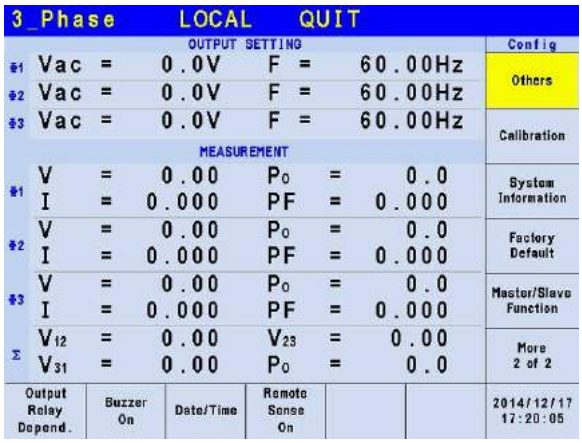
Notice

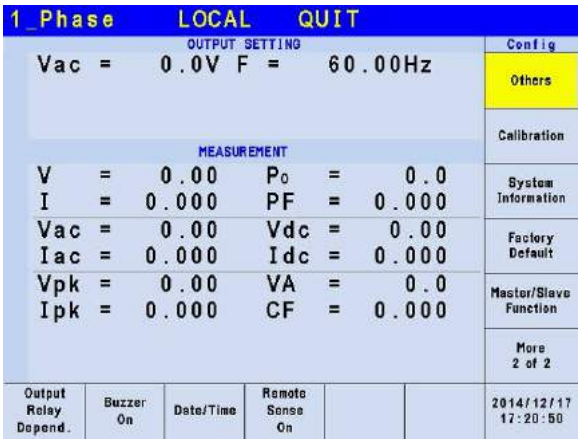
The protection point varies by the measurement error, thus it may act before reaching the protection point set.

3.4.6 Others

Press MORE on the right in CONFIG function (3_Phase Mode/1_Phase Mode) to go to the second page and press Others on the right to set Output Relay, Buzzer, Date/Time and Remote Sense.

Output Relay: Depend and Always ON.
Buzzer: on and off.
Date/Time: Year, Month, Day, Hour, Minute and Second.
Remote Sense: on, off.

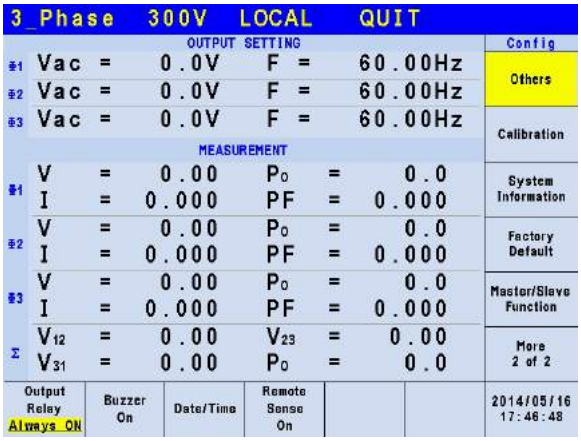


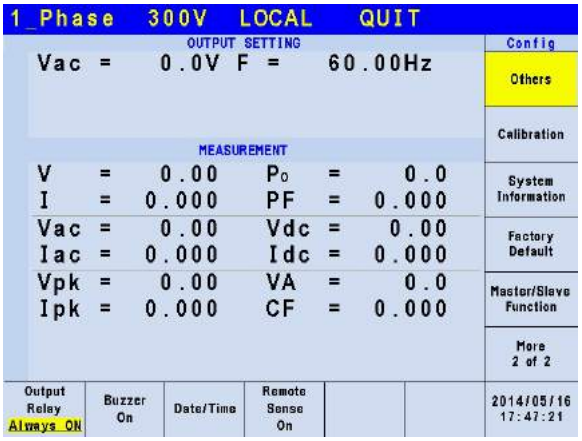


The output circuit on the Regenerative Grid Simulator has a relay to connect to the load. When the output relay is “Always ON”, it indicates the output relay is closed (connected) even if the Regenerative Grid Simulator output state is in QUIT mode. When the output relay is “Depend.”, it indicates the output relay is closed (connected) only when the output state is in OUT mode. If the output state is in QUIT mode, the output relay will be opened (disconnected.) Output relay can be set in the SETUP function.

The procedure for setting the output relay to Always ON in 1_Phase Mode /3_Phase Mode is described below.

1. Press Output Relay at the bottom.
2. Turn the RPG to set the output relay to Always ON and press **ENTER**. When the output relay is working, the Regenerative Grid Simulator will click once.



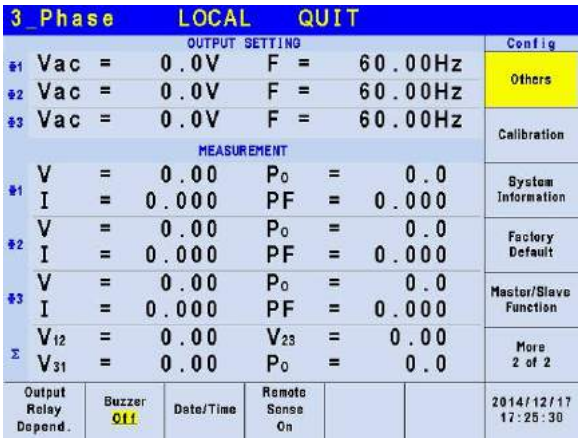


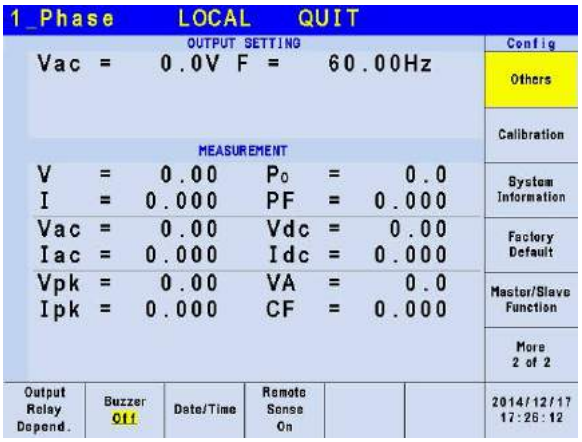
Notice Check if the Regenerative Grid Simulator has voltage output before powering it off. To ensure the safety of hardware, it is prohibited to power off the Regenerative Grid Simulator in Output state.

Next, the Regenerative Grid Simulator buzzer beeps when the panel keys are pressed or the RPG rotary is turned. If the user does not want the buzzer active, it may be turned off.

Following procedure describes the procedure for turning off the buzzer in 1_Phase Mode /3_Phase Mode.

1. Press Buzzer at the bottom.
2. Turn the RPG to change ON to OFF and press **ENTER**.



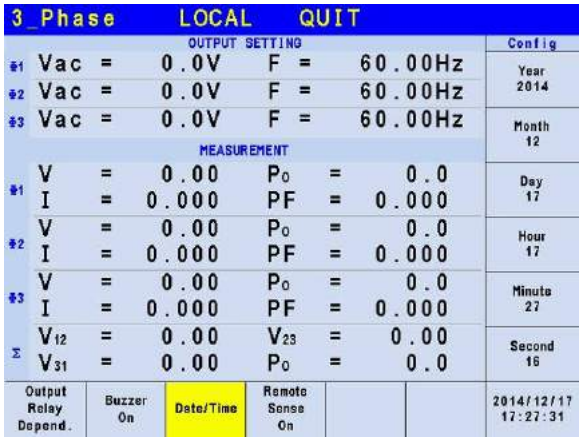


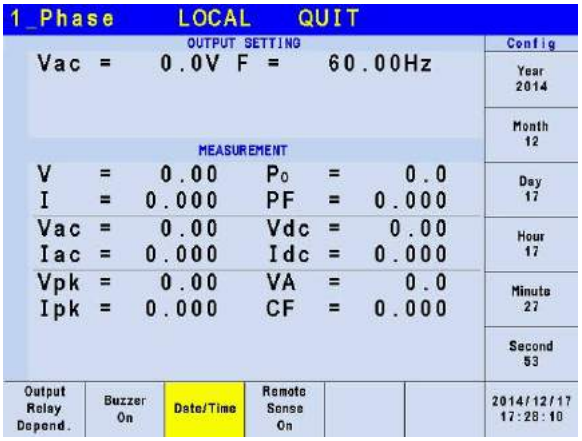
Set the time and date of Regenerative Grid Simulator.

Date/Time: Year, Month, Day, Hour, Minute, Second.

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

1. Press Date/Time at the bottom.
2. Select the item (Year/Month/Day/Hour/Minute/Second) to be set and press the button on the right.
3. Use the RPG to change the selected item and press **ENTER**.



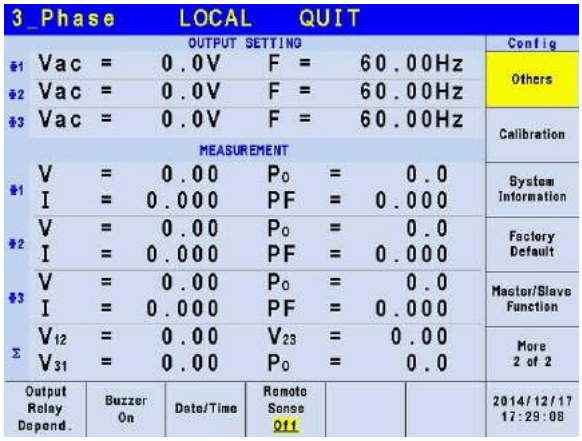


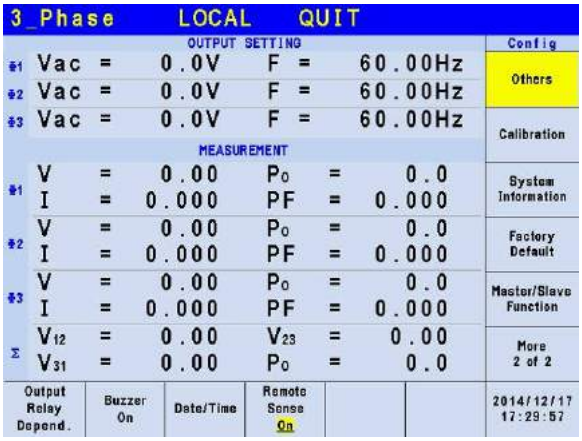
At last, it can enable the Remote Sense to monitor the load voltage and compensate automatically to make sure the voltage sends to load is the set voltage.

Remote Sense: on, off.

Follow the procedure below to enable the remote voltage sense in 1_Phase Mode /3_Phase Mode.

1. Press Remote Sense at the bottom.
2. Turn the RPG to change ON to OFF and press **ENTER**.



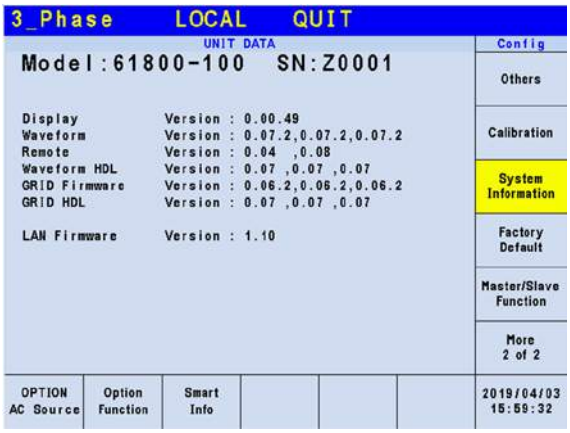


3.4.7 Calibration

See the descriptions in Chapter 4 for the detailed calibration procedures.

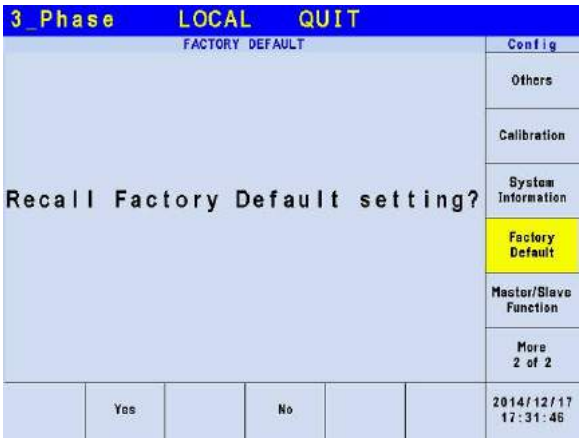
3.4.8 System Information

Press MORE on the right in the CONFIG function (3_Phase Mode/1_Phase Mode) to go to next page. Press System Information on the right to see the system information of the Regenerative Grid Simulator.



3.4.9 Factory Default

Press MORE on the right in the CONFIG function (3_Phase Mode/1_Phase Mode) to go to next page. Press Factory Default on the right and Yes at the bottom to return to the factory default.



3.5 PHASE Function Key

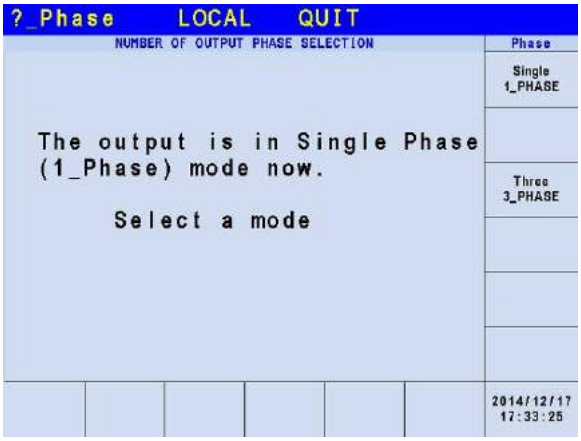
Press **PHASE** function key in Figure 3-5 to go to the switch 3_Phase Mode/1_Phase Mode.

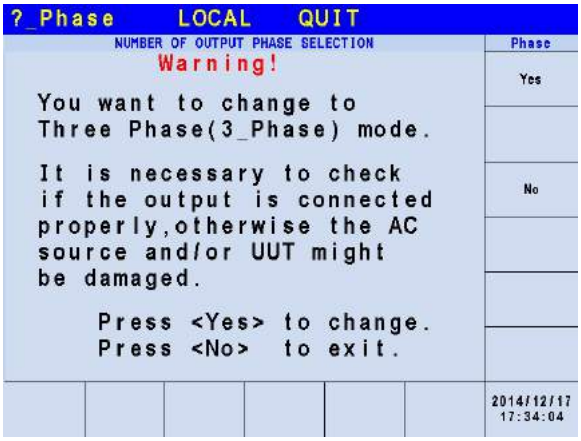
3.5.1 3_Phase Mode

The Regenerative Grid Simulator can be set to 3-phase AC power by pressing the **PHASE** function key to switch to 3_Phase Mode when it is required.

The procedure for setting the Regenerative Grid Simulator to 3-phase mode is described below.

1. Press **PHASE** function key.
2. Press Three 3_PHASE on the right.
3. Press Yes on the right to confirm the change.



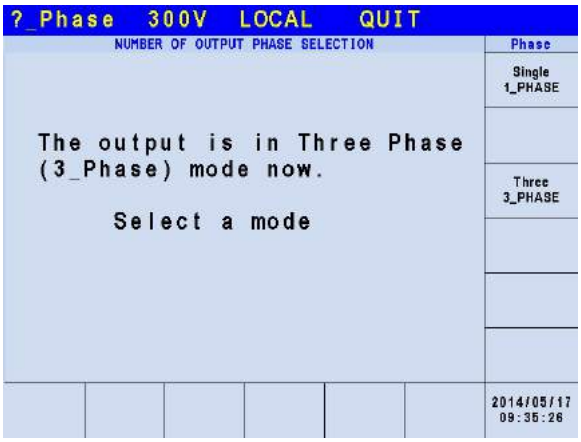


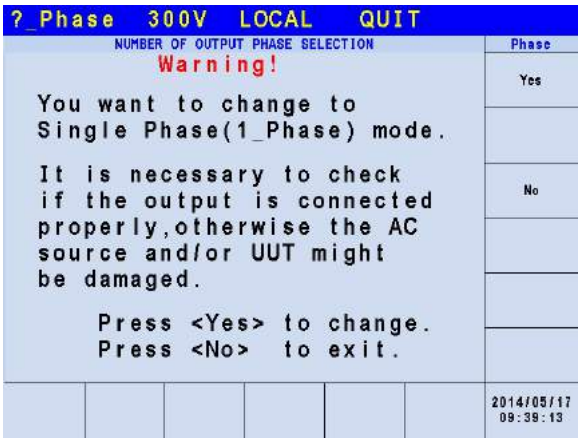
3.5.2 1_Phase Mode

When the 3-phase power of the Regenerative Grid Simulator is not enough to drive the load, the 3-phase output can be paralleled to one of the phases. Pressing the **PHASE** function key can change the Regenerative Grid Simulator setting from 3-phase to 1-phase.

The procedure for setting the Regenerative Grid Simulator to 1-phase mode is described below.

1. Press **PAHSE** function key.
2. Press Single 1_PHASE on the right.
3. Press Yes on the right to confirm the change.





Notice

1. When switching between 1-phase and 3-phase mode, the set output value will be reset to zero to avoid damaging the Unit Under Test (UUT).
2. When loading in single mode, be sure to use three sets of output terminals for connection to avoid causing damage due to excessive differences during current output.

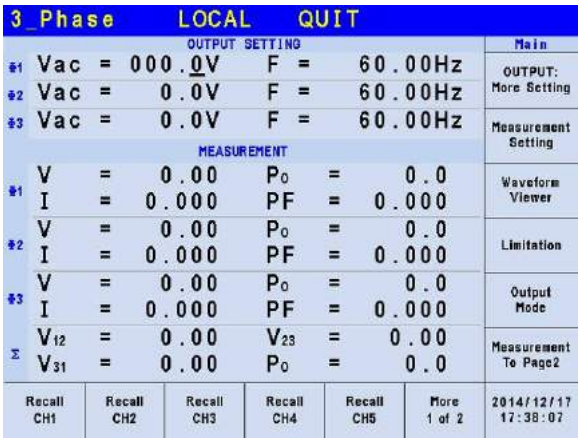
3.6 CURSOR Function Key

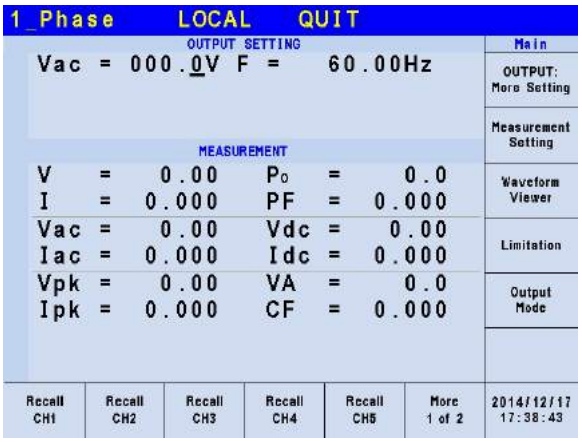
Press **CURSOR** function key in Figure 3-5 to set the value of a single digit.

The RPG can be used to set the digit of hundred, decade, figure and 1st place after the decimal point for voltage or frequency to save time in inputting the values.

The procedure for setting the 1st place after the decimal point for output voltage Vac in 1_Phase Mode /3_Phase Mode is described below.

1. Move the cursor to "Vac =" command line.
2. Press **CURSOR** function key.
3. The cursor will shorten to one digit range.
4. Move the cursor to the 1st digit after decimal point and use the RPG to change the value.
5. Press **CURSOR** function key again to exit it.

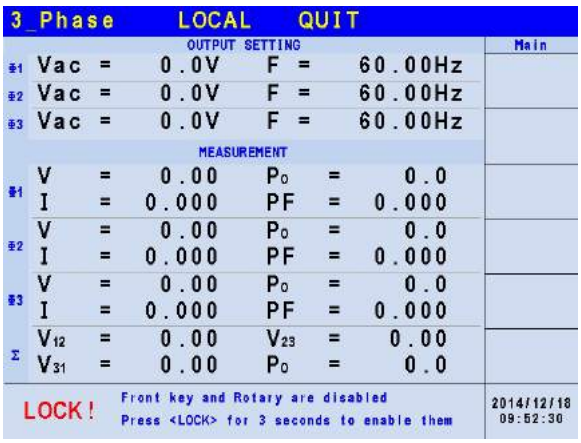


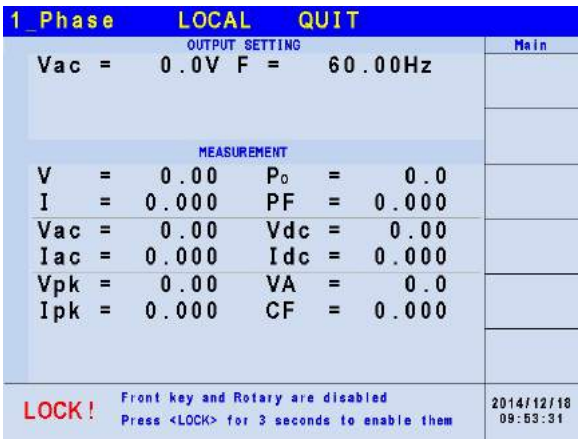


3.7 LOCK Function Key

Press **LOCK** function key in Figure 3-5 to lock the function.

Press this key to lock all functions on the panel and making all keys invalid. Press **LOCK** for 3~3.5 seconds to unlock it.





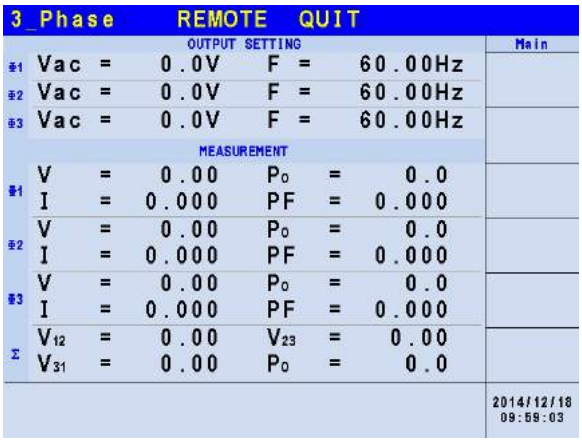
3.8 OUTPUT Function Key

Please refer to section 3.3.1 for the detail description of OUTPUT function key.

3.9 LOCAL/REMOTE Function Key

Press **LOCAL/REMOTE** function key in Figure 3-5 to switch to remote control.

When the Regenerative Grid Simulator is in REMOTE state and controlled by an external device, press this key to release the REMOTE state and return to LOCAL control.

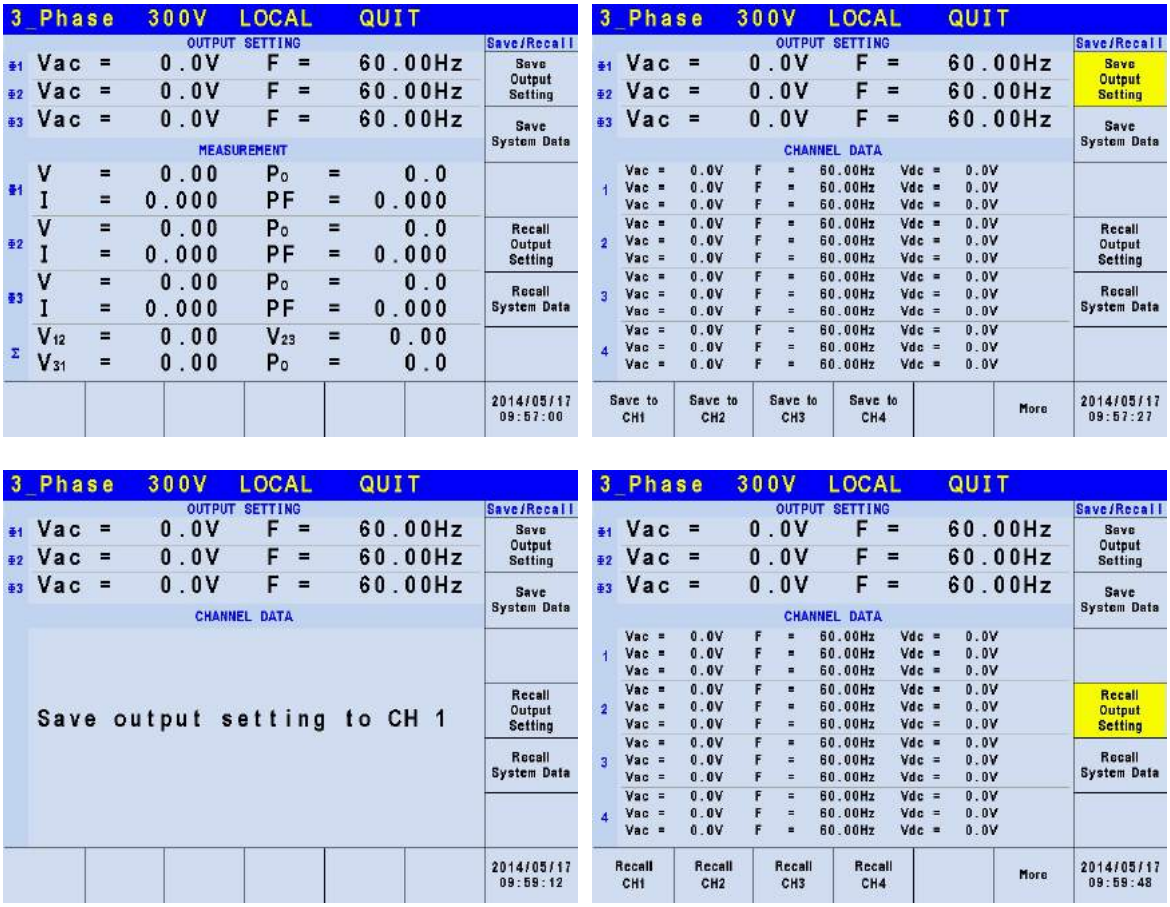


3.10 SAVE/RECALL Function Key

The Regenerative Grid Simulator has two modes for users to save and recall the output setting or system information as described in section 3.10.1 and 3.10.2. Press **SAVE/RECALL** function key in Figure 3-5 to access the save and recall functions.

3.10.1 Save/Recall Output Setting

The Regenerative Grid Simulator has 10 channels for users to save the frequently used Vac, F and Vdc for recall. For example, enter the setting and save it to CH1 memory in MAIN PAGE (3_Phase Mode) (see 3.3.)

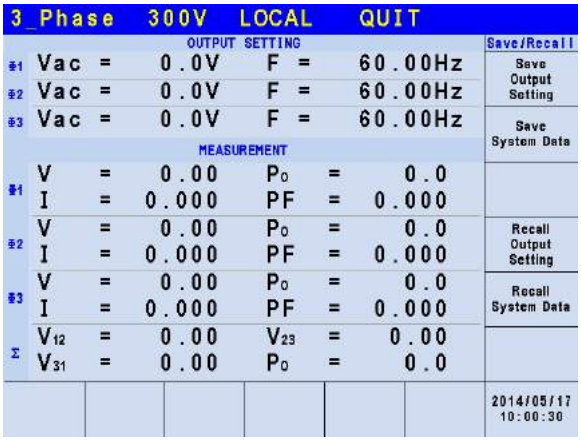


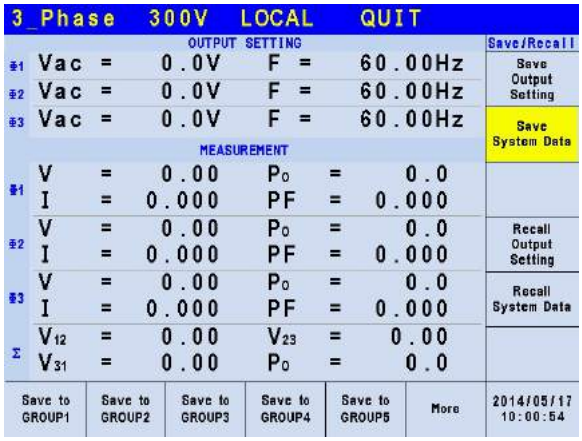
Notice

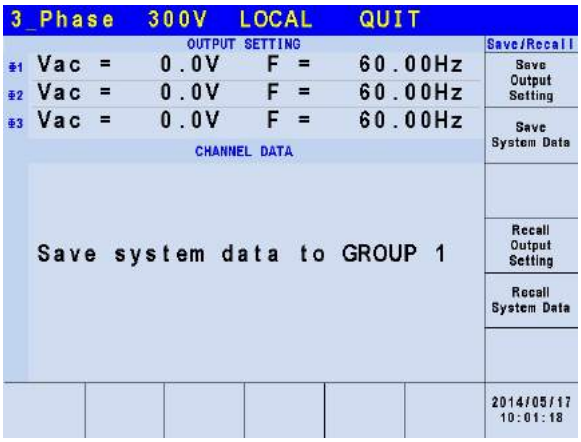
1. Only the save and recall settings are set in MAIN PAGE. Other parameters are ignored.
2. In different output coupling modes (see 3.3.1.1) the missing settings will be adjusted to Vac=0V, F=60Hz, Vdc=0V automatically. For example, when executing save in DC output mode Vac=0V, F=60Hz, Vdc is the setting in MAIN PAGE.

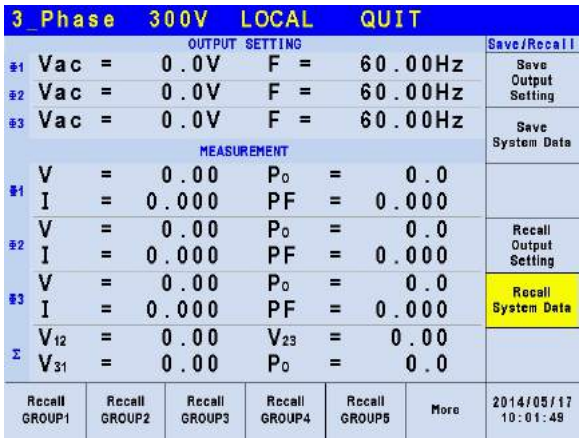
3.10.2 Save/Recall System Data

The Regenerative Grid Simulator has 10 groups of memory for users to save and recall system data. System data contains all parameters in the function keys such as MAIN PAGE (see 3.3) and CONFIG (see 3.4). Press **SAVE/RECALL** in MAIN PAGE (3_Phase Mode) (see 3.3) and press the LCD at the bottom to save the system data as shown below.









Notice

The Regenerative Grid Simulator has 11 groups of memory: GROUP 0, GROUP1~10. GROUP 0 will save the power-on default. The data saved in GROUP 0 will be recalled automatically and loaded when the Regenerative Grid Simulator powers on again. As to the data saved in GROUP 1~10 memory groups, they need to be called manually for loading.

3.11 Protection

The Regenerative Grid Simulator has both software and hardware protection. When protection occurs the Regenerative Grid Simulator will stop the output and disconnect the output relay. The display shows that the source is in protection mode. To normal output after the Recovery protection is triggered, please address any issues and press **ENTER** to release protection for normal operation. To normal output after the Latch protection is triggered, remove the error load and restart ⏻ to release protection for normal operation.

The table below lists the output protection:

Message	Protection	Possible Cause	Troubleshooting
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.
(φ1/2/3) DA_OCP	It occurs when the transient output current exceeds the module current limit or current specification. (Latch)		
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.
(φ1/2/3)DA_OPP	It occurs when the transient output power exceeds the module power limit or power specification. (Latch)		
SYS_OVP(1/2/3)	It 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. 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.
(φ1/2/3)DA_OVP	It occurs when the transient output voltage exceeds the module voltage limit or voltage specification. (Latch)		
(φ1/2/3)DA_SHORT	It occurs when the output is short circuited. (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.
(φ1/2/3)DA_SENSE_FAULT	It occurs when the remote voltage sense is enabled but the signal cable is disconnected or error. (Latch)	1. The Remote sense wire is disconnected or connected wrong. 2. The remote	1. Confirm the wiring connection of Remote sense 2. Shorten the distance between UUT and remove

		connection impedance is too big. 3. The output relay is failure.	the impedance. 3. Change the broken output relay.
(φ1/2/3)DA_DST_PROT_F	DC/AC power module internal parts transient over rated protection. (Recovery)	1. The output voltage waveform and frequency set by the user is over the rated DC/AC power module internal parts. 2. The DC/AC module measurement circuit is having error. 3. The DC/AC module digital circuit is having error. 4. The digital module is having error.	1. Reset the output voltage waveform and frequency. 2. Check and replace the DC/AC module board that is having protection phase. 3. Check and replace the DC/AC digital module board that is having protection phase. 4. Check and replace the digital module board.
(φ1/2/3)DA_DST_PROT_S	DC/AC power module internal parts steady state over rated protection. (Recovery)		
Remote - Inhibit	It occurs when remote is inhibited.		
SYS_UVP(1/2/3)(ACL)	It occurs when the UUT voltage is lower than the set voltage limit. (Recovery)	The external UUT output is short-circuited.	1. Remove the UUT and check its circuit characteristics. 2. Check if the circuit is short-circuited. 3. Check the external circuit characteristics.
(φ1/2/3)DA_UVP(ACL)	It occurs when the UUT transient output voltage is lower than the operating voltage limit. (Latch)		

The table below lists the module protection:

Message	Protection	Possible Cause	Troubleshooting
FAN_FAIL_TR	It occurs when the auxiliary power module fan is malfunction. (Latch)	1. The fan is blocked due foreign object or dust. 2. The fan is not	1. Check the fan on the module having protection and clear the foreign
(φ1/2/3)AD_FAN_FAIL	It occurs when the		

	AC/DC power module fan is malfunction. (Latch)	connected. 3. The fan is broken or invalid. 4. The fan circuit is malfunction.	object. 2. Check the connection of fan on the module having protection. 3. Replace the broken or invalid fan. 4. Replace the fan circuit board.
(φ1/2/3)DA_FAN_FAIL	It occurs when the DC/AC power module fan is malfunction. (Latch)		
(φ1/2/3)AD_DUST	It occurs when the AC/DC module is dusty. (Latch)	The AC/DC module has accumulated dust or foreign object.	Check the AC/DC module of each phase for dust and clean it.
(φ1/2/3)DA_DUST	It occurs when the DC/AC module is dusty. (Latch)	DC/AC module has accumulated dust or foreign object.	Check the DC/AC module of each phase for dust and clean it.
OTP_TR	It occurs when the auxiliary power module internal temperature is too high. (Latch)	1. The operating environment temperature is over. 2. The power IGBT module is having error. 3. The detection circuit is having error.	1. Solve the environment overheat problem. 2. Check the error IGBT module and replace it. 3. Check the error fan circuit board with sense wire and replace them.
(φ1/2/3)AD_OTP	It occurs when the AC/DC power module internal temperature is too high. (Latch)		
(φ1/2/3)DA_OTP	It occurs when the DC/AC power module internal temperature is too high. (Latch)		
(φ1/2/3)AD_OVP_LINE_RS_F (φ1/2/3)AD_OVP_LINE_ST_F (φ1/2/3)AD_OVP_LINE_TR_F	It occurs when the circuit transient input voltage is higher than the spec. (Latch)	1. Input power error. 2. The AC/DC module measurement circuit is having error.	1. Check if the input power meets the rated voltage. 2. Check and replace the protected AC/DC module board.
(φ1/2/3)AD_OVP_LINE_RS_S (φ1/2/3)AD_OVP_LINE_ST_S (φ1/2/3)AD_OVP_LINE_TR_S	It occurs when the circuit steady input voltage is higher than the spec. (Latch)		
(φ1/2/3)AD_UVP_LINE_RS_F (φ1/2/3)AD_UVP_LINE_ST_F (φ1/2/3)AD_UVP_LINE_TR_F	It occurs when the circuit transient input voltage is lower than the spec. (Latch)	1. Input power is having error. 2. The AC/DC module input Fuse is broken. 3. The AC/DC module measurement	1. Check if the input power meets the rated voltage. 2. Measure the AC/DC module input fuse and replace it.
(φ1/2/3)AD_UVP_LINE_RS_S (φ1/2/3)AD_UVP_LINE_ST_S (φ1/2/3)AD_UVP_LINE_TR_S	It occurs when the circuit steady input voltage is lower		

	than the spec. (Latch)	circuit is having error.	3. Check and replace the protected AC/DC module board.
(φ1/2/3)AD_UNBALANCE _LINE	It occurs when the circuit input is unbalanced or open phase. (Latch)	1. The input power is connected wrong. (10% line voltage difference) 2. The input power is disconnected (open phase.) 3. The AC/DC module fuse is broken. 4. The AC/DC module measurement circuit is having error.	1. Check if the input power meets the rated voltage. 2. Measure the AC/DC module input fuse and replace it. 3. Check and replace the protected AC/DC module board.
FREQ_LINE_ERR(φ1/2/3)	It occurs when circuit input frequency is over the spec. (Latch)	The Mains frequency is incorrect.	Check the Mains frequency. (47Hz-63Hz)
(φ1/2/3)AD_OCP_LINE_R_F (φ1/2/3)AD_OCP_LINE_S_F (φ1/2/3)AD_OCP_LINE_T_F	It occurs when circuit transient input current is over the limit. (Latch)	1. The output transient power is too high. (The input current is over 135Arms.) 2. The AC/DC module measurement circuit is having error.	1. Remove the UUT and check if the operation is correct. 2. Check and replace the protected AC/DC module board.
(φ1/2/3)AD_OCP_LINE_R_S (φ1/2/3)AD_OCP_LINE_S_S (φ1/2/3)AD_OCP_LINE_T_S	It occurs when the circuit steady input current is over the limit (Latch)		
(φ1/2/3)AD_OPP_LINE_R_F (φ1/2/3)AD_OPP_LINE_S_F (φ1/2/3)AD_OPP_LINE_T_F	It occurs when the circuit transient input is over power.(Latch)	1. The output transient power is too high. (The input power is over 84kW.) 2. The AC/DC module measurement circuit is having error.	1. Remove the UUT and check if the operation is correct. 2. Check and replace the protected AC/DC module board.
(φ1/2/3)AD_OPP_LINE_R_S (φ1/2/3)AD_OPP_LINE_S_S (φ1/2/3)AD_OPP_LINE_T_S	It occurs when the circuit steady input is over power. (Latch)		
(φ1/2/3)AD_OVP_VDC_F	It occurs when the power module internal DC BUS transient voltage is higher than the spec. (Latch)	1. The output transient power is too high. (The protected phase VDC is higher than 700V.) (Regen mode) 2. The AC/DC	1. Remove the UUT and check if the operation is correct. 2. Check and replace the protected AC/DC module
(φ1/2/3)AD_OVP_VDC_S	It occurs when the power module		

	internal DC BUS steady voltage is higher than the spec. (Latch)	module measurement circuit is having error.	board.
(φ1/2/3)AD_UVP_VDC_F	It occurs when the power module internal DC BUS transient voltage is lower than the spec. (Latch)	1. The output transient power is too high. (The protected phase VDC is lower than 600V) (Source mode) 2. The AC/DC module measurement circuit is having error. 3. AC/DC module relay driver signal is incorrect or the relay is broken. 4. The AC/DC module PWM driver signal is incorrect. 5. The AC/DC power module is abnormal or broken.	1. Remove the UUT and check if the operation is correct. 2. Check and replace the protected AC/DC module board. 3. Check and replace the protected AC/DC module board. 4. Check and replace the protected AC/DC power module board. 5. Check and replace the protected AC/DC power module board.
(φ1/2/3)AD_UVP_VDC_S	It occurs when the power module internal DC BUS steady voltage is lower than the spec. (Latch)		
(φ1/2/3)AD_OCP_IDC_F	It occurs when the power module internal DC BUS transient state is over current. (Latch)	1. The output transient power is too high. (The protected phase IDC is higher than 38Arms) (Source /Regen mode) 2. The AC/DC module measurement circuit is having error. 3. The AC/DC power module is abnormal or broken. 4. The DC/AC power module is abnormal or broken.	1. Remove the UUT and check if the operation is correct. 2. Check and replace the protected AC/DC module board. 3. Check and replace the protected AC/DC power module board. 4. Check and replace the protected DC/AC power module board.
(φ1/2/3)AD_OCP_IDC_S	It occurs when the power module internal DC BUS steady state is over current. (Latch)		
(φ1/2/3)AD_OPP_PDC_F	It occurs when the power module internal DC BUS	1. The output transient power is too high. (The	1. Remove the UUT and check if the operation

	transient state is over power. (Latch)	protected phase PDC is higher than 26.25kW.) (Source/ Regen mode) 2. The AC/DC module measurement circuit is having error. 3. The AC/DC power module is abnormal or broken. 4. The DC/AC power module is abnormal or broken.	is correct. 2. Check and replace the protected AC/DC module board. 3. Check and replace the protected AC/DC power module board. 4. Check and replace the protected DC/AC power module board.
(φ1/2/3)AD_OPP_PDC_S	It occurs when the power module internal DC BUS steady state is over power. (Latch)		
SYS SELF_AD_1 SYS SELF_AD_2 SYS SELF_AD_3	It occurs when the auxiliary power of AC/DC power module is running self detect. (Latch)	1. The AC/DC module auxiliary power is having error. 2. The AC/DC module measurement circuit is having error. 3. The digital module is having error.	1. Check and replace the AC/DC module auxiliary power board of protected phase. 2. Check and replace the AC/DC module board of protected phase. 3. Check and replace the digital module board.
SYS SELF_DA_1 SYS SELF_DA_2 SYS SELF_DA_3	It occurs when the auxiliary power of DC/AC power module is running self detect. (Latch)	1. The DC/AC module auxiliary power is having error. 2. The AC/DC module measurement circuit is having error. 3. The digital module is having error.	1. Check and replace the DC/AC module auxiliary power board of protected phase. 2. Check and replace the DC/AC module board of protected phase. 3. Check and replace the digital module board.
SYS SELF_CS	It occurs when the	1. The digital	1. Check and

	auxiliary power of digital module is running self detect. (Latch)	module auxiliary power is having error. 2. The digital module measurement circuit is having error. 3. The digital module is having error.	replace the digital module board. 2. Check and replace the digital module board. 3. Check and replace the digital module board.
SYS SELF_E	It occurs when the interface and panel auxiliary power is running self detect. (Latch)	1. The auxiliary power of digital interface module is having error. 2. The measurement circuit of digital interface module is having error. 3. The digital module is having error.	1. Check and replace the digital interface module board. 2. Check and replace the digital interface module board. 3. Check and replace the digital module board.
(φ1/2/3)AD_PWM_FAULT (1/2/3)	It occurs when the AC/DC power module driving signal is having error. (Latch)	1. The driving signal is having error. (The power element is short circuited.) 2. The AC/DC module measurement circuit is having error. 3. The DC/AC module digital circuit is having error.	1. Check and replace the power module board of protected phase. 2. Check and replace the AC/DC module digital board of protected phase. 3. Check and replace the DC/AC module digital board of protected phase.
(φ1/2/3)DA_PWM(1/2)_FAULT	It occurs when the DC/AC power module driving signal is having error. (Latch)		
SYS SELF_TEST_NG_1 SYS SELF_TEST_NG_2 SYS SELF_TEST_NG_3	It occurs when the self-test of DC/AC power module output voltage is no good. (Recovery)	1. The DC/AC module voltage calibration of protected phase is having error. 2. DC/AC module measurement circuit is having error. 3. The DC/AC module digital circuit is having	1. Execute voltage calibration again. 2. Check and replace the DC/AC module board of protected phase. 3. Check and replace the DC/AC module

		error. 4. The digital module is having error.	digital board of protected phase. 4. Check and replace the digital module board.
SYS_INT_OFF	It occurs when the circuit of auxiliary power module or digital module is having error. (Latch)	1. The auxiliary power (VD) is having error. 2. The digital module protection circuit is having error.	1. Check and replace the auxiliary power module. 2. Check and replace the digital module.
SYS_INT_AUX_OUT	It occurs when the auxiliary power module is having error. (Latch)	1. The auxiliary power (VP) is having error. 2. The auxiliary power protective circuit is having error.	Check and replace the auxiliary power module.

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.

4. Calibration

4.1 Introduction

The Regenerative Grid Simulator has built in simple procedures for the user to operate for calibrating the output and measuring the accuracy without opening the case. When executing the calibration procedure, the voltmeter, ammeter, appropriate load and +10Vdc power supply are required. See Figure 4-1 for the connection of these instruments. The calibration items contain output voltage, output current and external reference voltage. However, it does not need to calibrate all of the three items at the same time. If desired, it can select one of them for calibration.

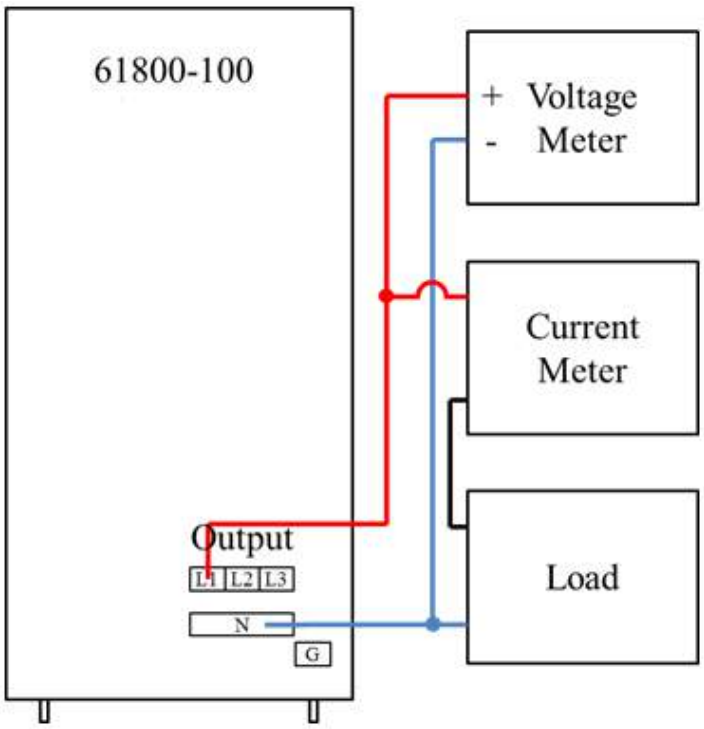


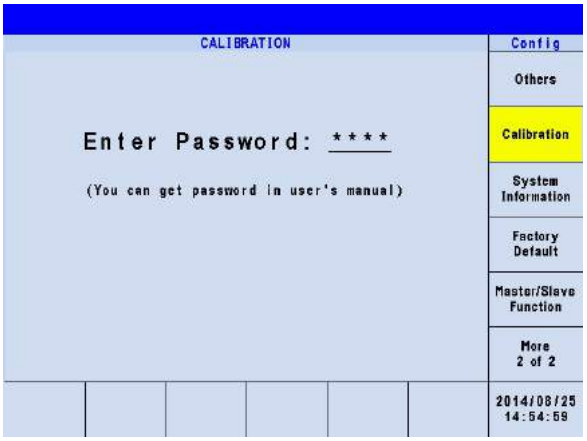
Figure 4-1

Notice

1. For the environment temperature of 25°C, it is required to warm up for 20 minutes before calibration so that the Regenerative Grid Simulator can reach the normal working temperature and make sure the calibrated values are correct.
2. The Voltage Meter cable ensures remote sense also connects to terminal.

4.2 Manual Calibration Function

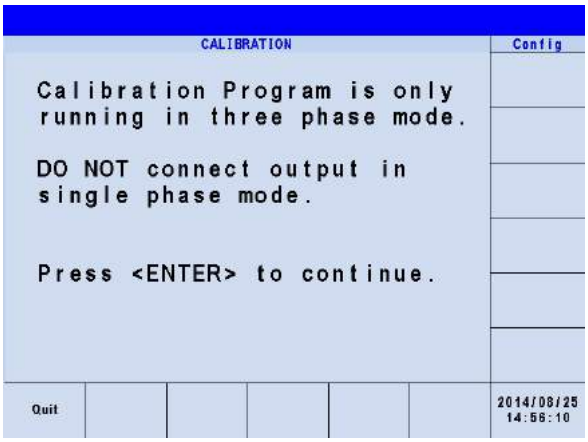
Select "Calibration" in the CONFIG function (3_Phase Mode/1_Phase Mode) to input the calibration procedure. For safety reason, the user is required to enter the password to show the calibration items. The password is listed in this manual to ensure the user has read the manual before performing calibration.



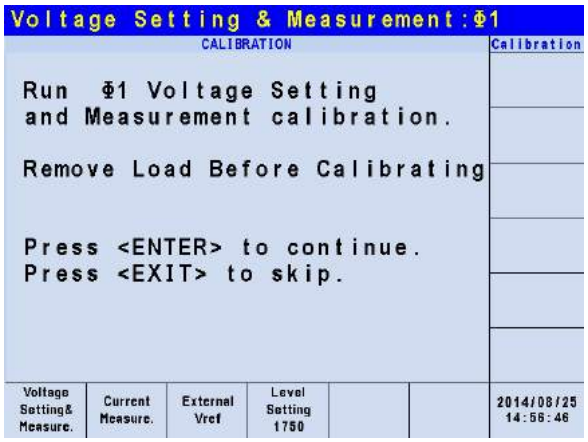
Notice

1. The password for entering the calibration procedure is "3621 ". Input it and press **ENTER** to confirm it.
2. Before calibrating the Regenerative Grid Simulator, the user should read the procedure clearly. Otherwise, the memory data could be lost due to improper operation.

The screen is displayed as below after the correct password is entered. The LCD shows that the calibration can only be performed in 3_Phase mode and it is prohibited to switch to 1_Phase mode. Press **ENTER** to continue the calibration procedure.



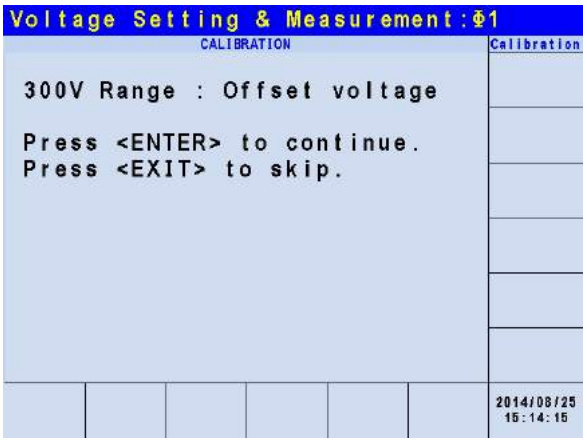
The user can choose to calibrate the voltage, current and external reference voltage.



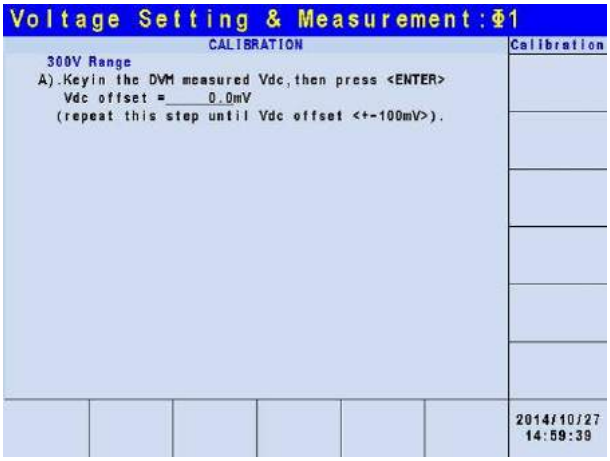
Voltage setting & Measure: It calibrates the output voltage and the accuracy of voltage measurement.
Current Measure: It calibrates accuracy of current measurement.
External Vref.: It calibrates the external Vref.
Level Setting: It adjusts the response speed.

4.2.1 Calibrating Output Voltage and Voltage Measurement

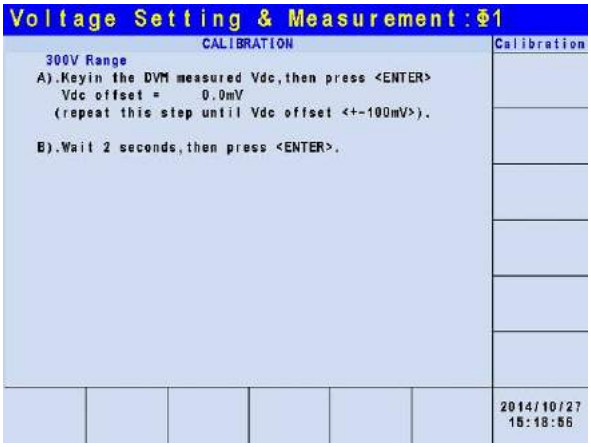
After entered the password, the CALIBRATION CHOICES are shown on the screen as described in section 4.2. Press Voltage setting & Measure to output voltage and execute the measurement calibration.

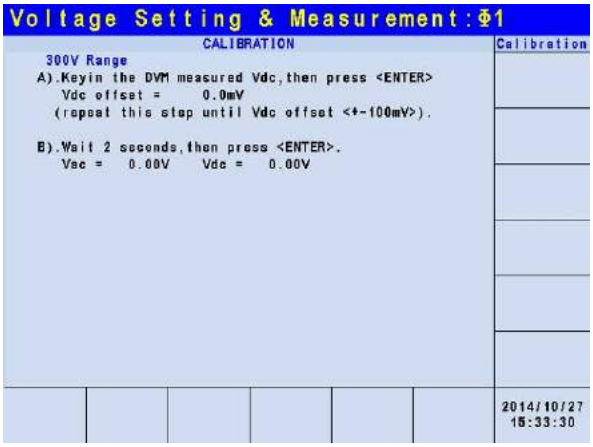


In measurement calibration, it will ask the user if performing Offset voltage calibration for 300V range. Press **ENTER** to continue the Offset voltage calibration. Press **EXIT** to skip the Offset voltage calibrating and enter into the 300V Range Setting & Meas. procedure.

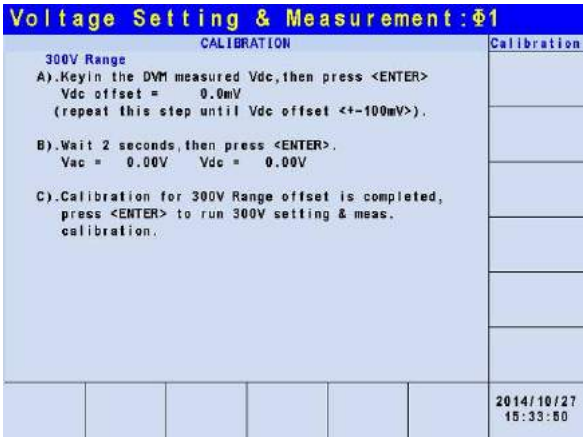


In the calibration procedure step A for 300V Range (Offset voltage), the user should use the DVM to measure the DC output voltage of Regenerative Grid Simulator in the unit of mV and then key in the value on the LCD. Monitor the DVM readings and enter the DC output voltage repeatedly till the DC output is lower than ±100 mV.

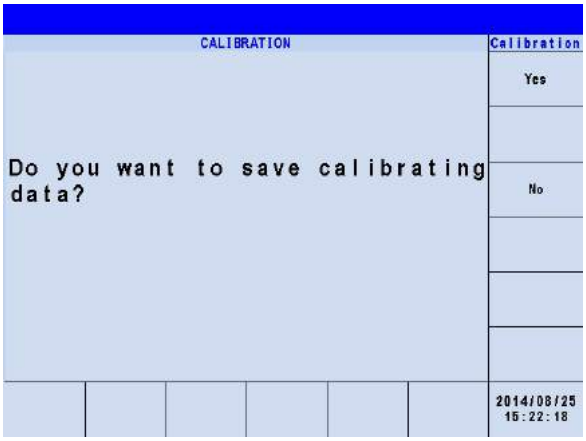




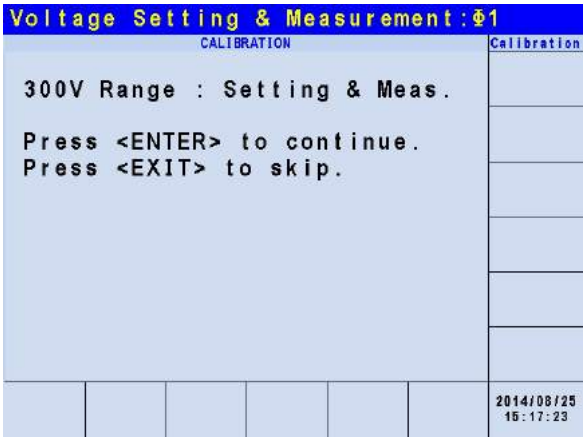
In step B, the LCD shows the differences of Vac and Vdc measured by the Regenerative Grid Simulator that are generated internally. Wait for 2 seconds and press **ENTER**, the LCD will show the voltage offset Vac and Vdc calculated by the Regenerative Grid Simulator



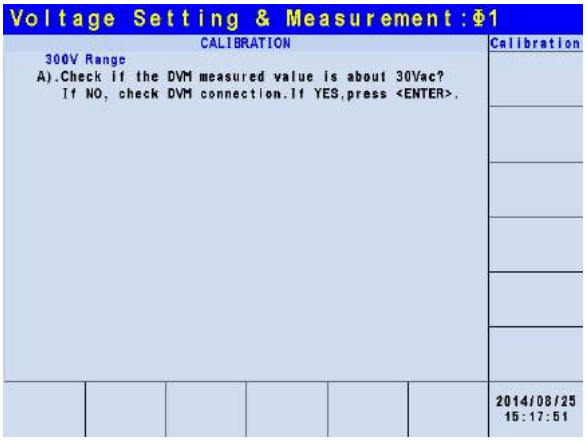
In step C, the LCD shows the calibration for 300V Range offset is completed. Press **EXIT** to enter into the saving screen as shown below or press **ENTER** to continue the 300V setting and measurement calibration.



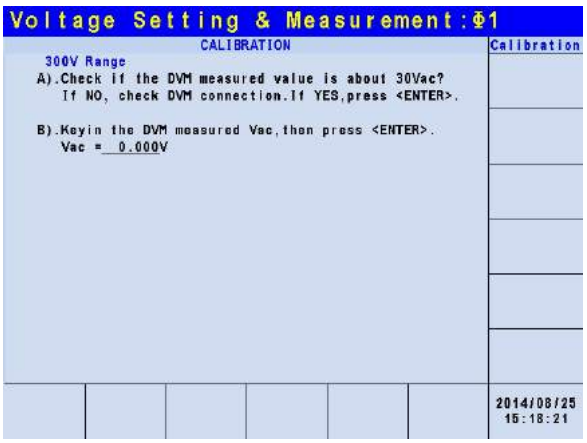
Press **EXIT** in step C and the LCD will show for saving. Press Yes on the right to save the calibration results.



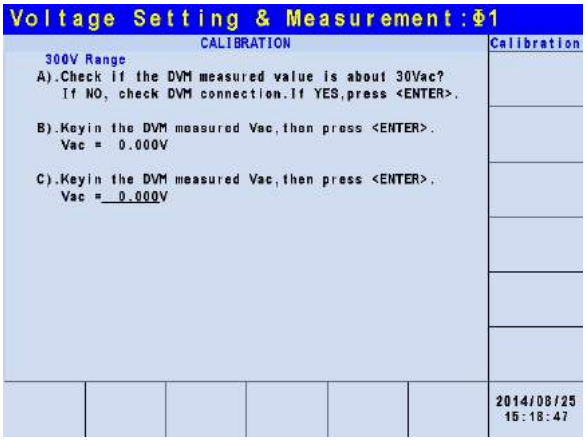
When the 300V Range (Offset voltage) calibration is done, the LCD will ask the user if executing the 300V Range Setting & Meas. Press **ENTER** to continue the setting and measurement calibration. Press **EXIT** to skip the Setting & Meas. to enter into the Calibration main screen.



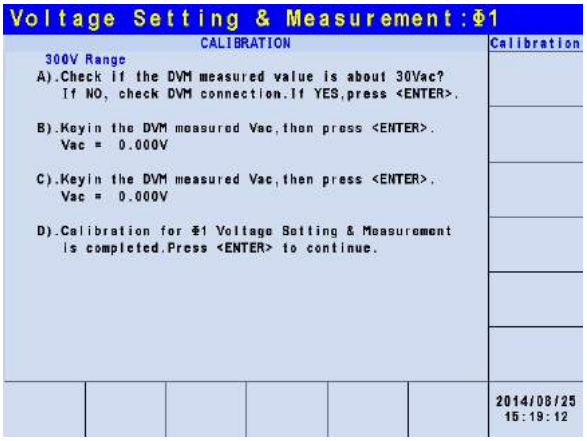
In the calibration procedure step A for 300V Range Setting & Measurement, the user should remove the load. Check the digital DVM measured output AC voltage for about 30Vac. This is simply to confirm the connection and then press **ENTER**.



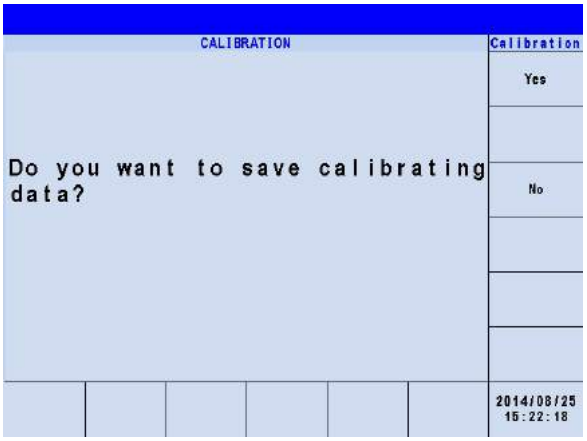
In step B, check the digital DVM measured output voltage for about 240VAC. Enter the digital DVM measured value and press **ENTER**.



In step C, check the digital DVM measured output voltage for about 300VAC. Enter the digital DVM measured value and press **ENTER**.



In step D, the LCD shows the calibration for 300V Range Setting & Meas. is completed. Press **EXIT** to enter into the saving screen as shown below or press **ENTER** to continue other voltage calibration.



Press **EXIT** in step D and the LCD will show for saving. Press Yes on the right to save the calibration results.

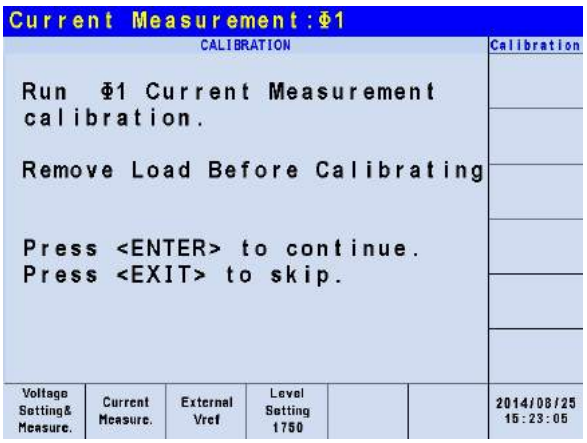
Notice

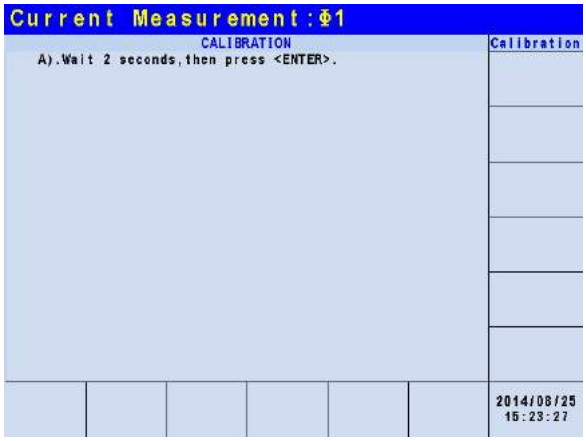
1. In the last step, the user can press **ENTER** to continue calibrating the 2nd phase or the 3rd phase.

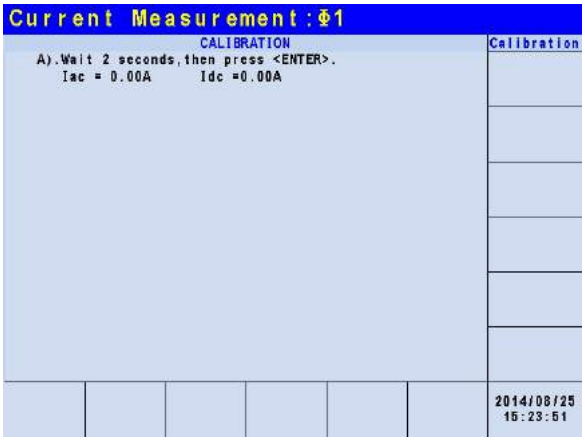
2. In the previous screen, if **EXIT** is pressed but the results are not saved, the calibrated values will remain till the Regenerative Grid Simulator is powered off.

4.2.2 Calibrating Current Measurement

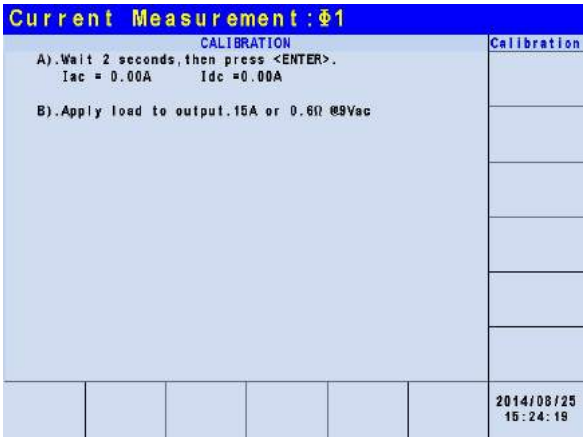
After entered the password, the CALIBRATION CHOICES are shown on the screen as described in section 4.2. Press Current Measure to calibrate the current measurement.



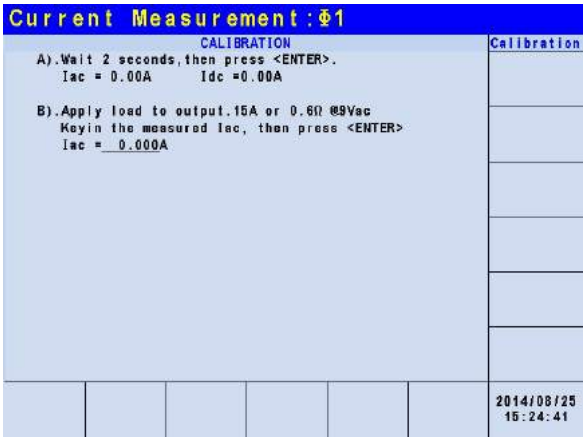




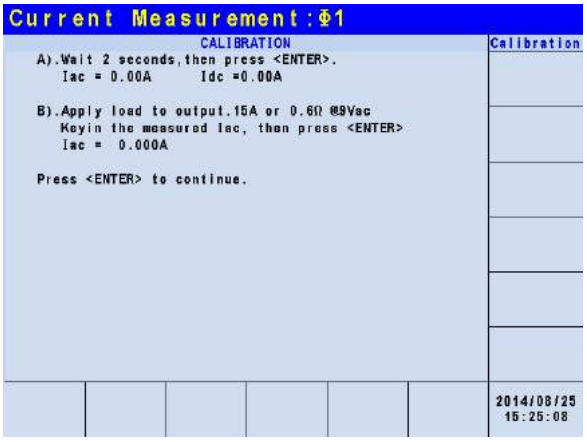
In the Current Measure. ACCURACY CALI. step A, the LCD shows the differences of Iac and Idc measured by the Regenerative Grid Simulator that are generated internally. Wait for 2 seconds and press **ENTER**, the Iac = 0.00A and Idc = 0.00A.



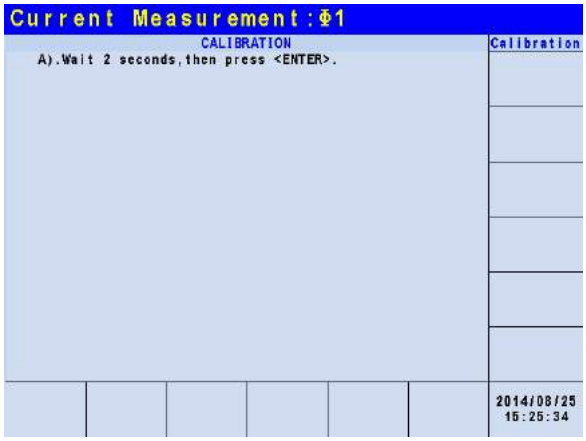
In step B, adjust the load to 0.6Ω for output and press **ENTER**. The Regenerative Grid Simulator will output 9Vac.

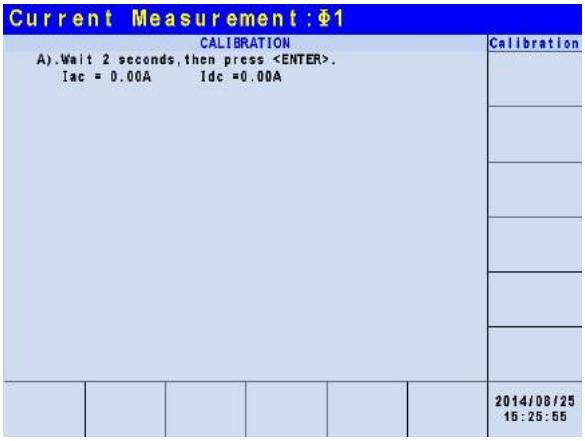


Use the ammeter (or power analyzer) to measure the output current. Input the measured value and press **ENTER**.

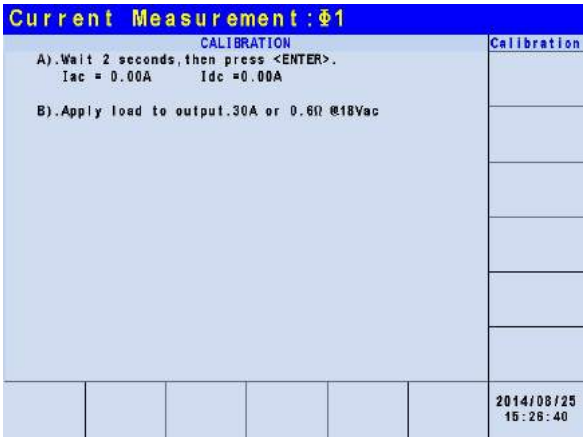


Press **ENTER** to continue the calibration procedure and disconnect the load now.

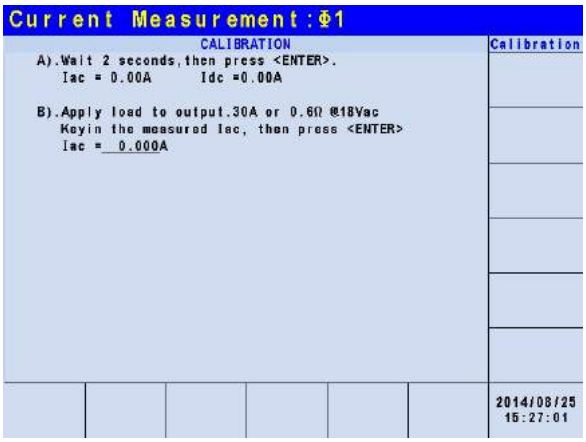




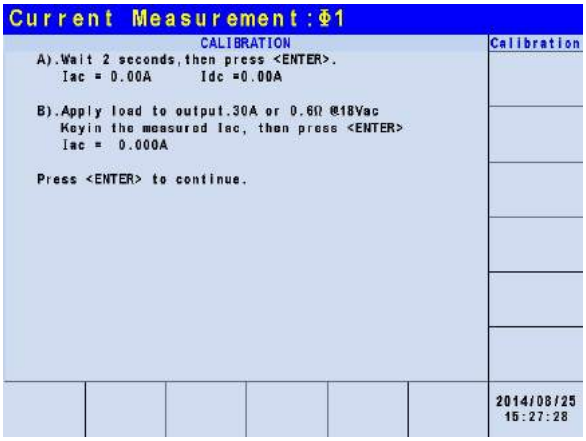
In step A, the LCD shows the differences of Iac and Idc measured by the Regenerative Grid Simulator that are generated internally. Wait for 2 seconds and press **ENTER**, the Iac = 0.00A and Idc = 0.00A.



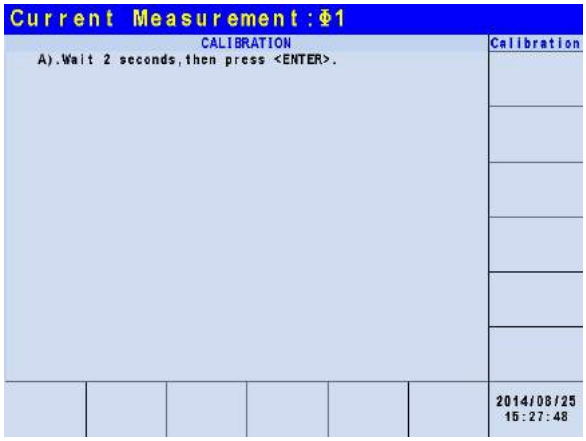
In step B, adjust the load to 0.6Ω for output and press **ENTER**. The Regenerative Grid Simulator will output 18Vac。

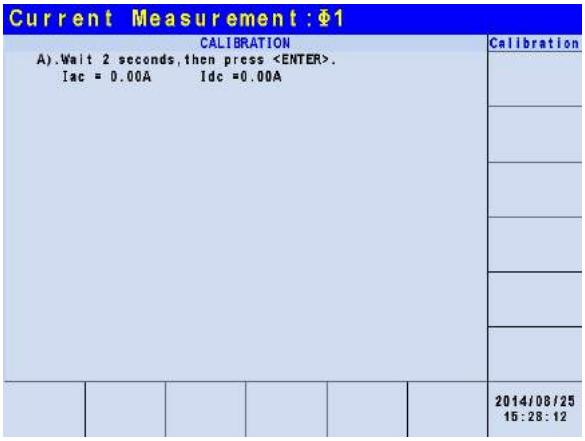


Use the ammeter (or power analyzer) to measure the output current. Input the measured value and press **ENTER**.

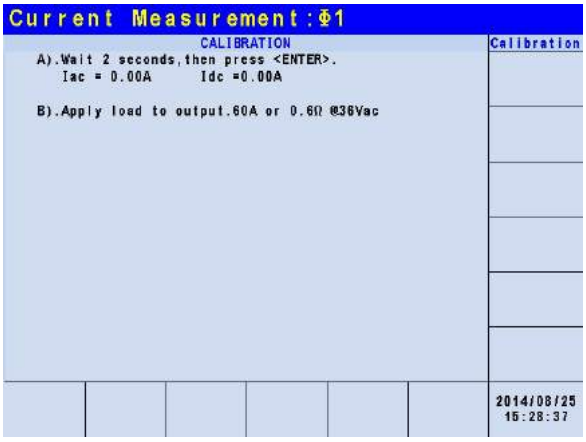


Press **ENTER** to continue the calibration procedure and disconnect the load now.



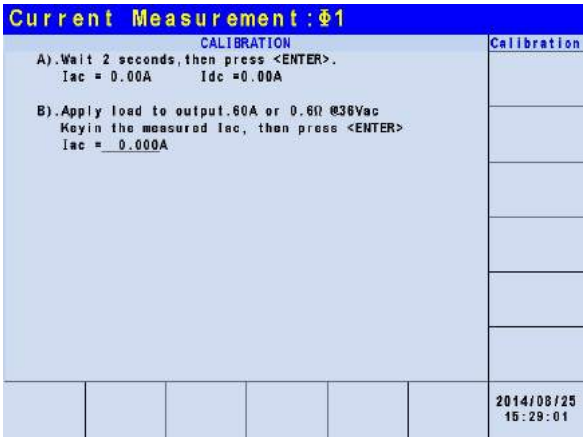


In step A, the LCD shows the differences of Iac and Idc measured by the Regenerative Grid Simulator that are generated internally. Wait for 2 seconds and press **ENTER**, the Iac = 0.00A and Idc = 0.00A.

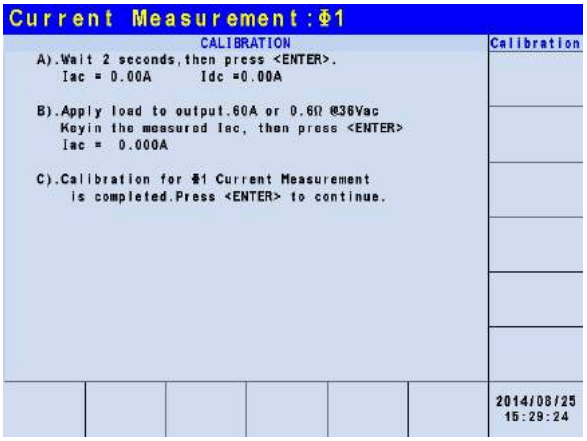


In step B, adjust the load to 0.62Ω for output and press **ENTER**. The Regenerative Grid Simulator will output 36Vac。

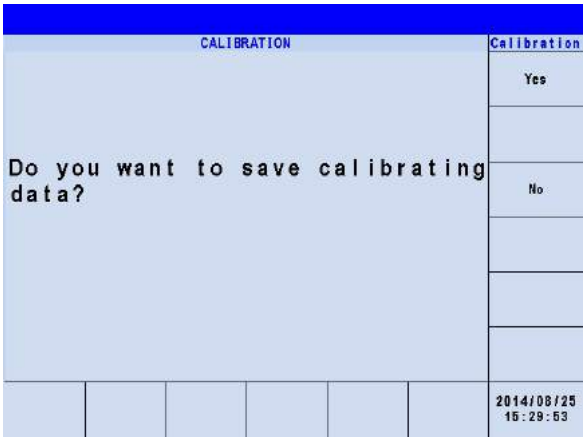
Notice When the Regenerative Grid Simulator is model 61800-100, the simulated power output will be 300Vac.



Use the ammeter (or power analyzer) to measure the output current. Input the measured value and press **ENTER**.



Step C is the last step of Current Measure. ACCURACY CALI. Press **ENTER** to continue the 2nd and 3rd phase current calibration or press **EXIT** to leave this screen. The LCD appears as shown below. Press Yes on the right to save the calibration results.



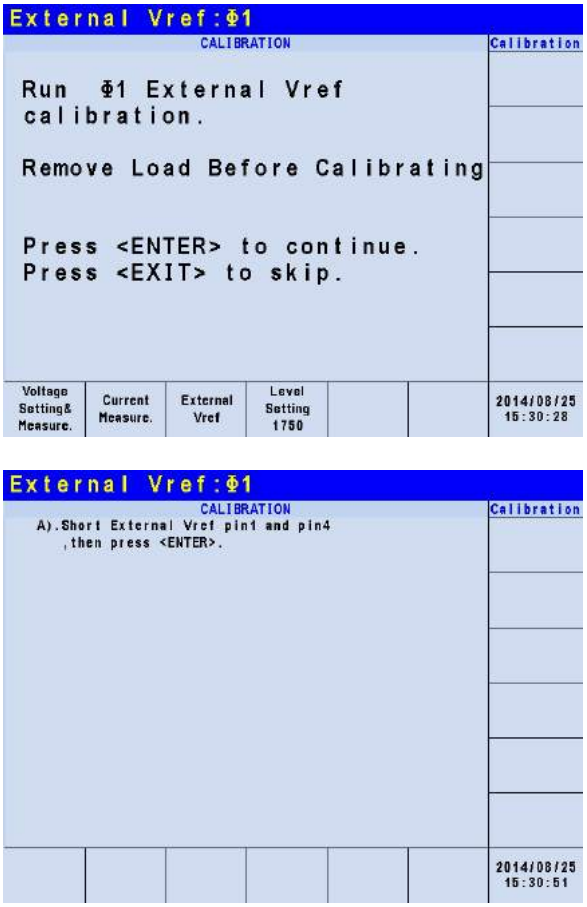
Notice

1. The resistance of applied load has to be constant so that the load current and output voltage is proportional. If not, the step B of URRENT MEAS. ACCURACY is meaningless. The user can use the current that meets step C as the calibration value.
2. Remove protection temporary when executing the calibration. If the

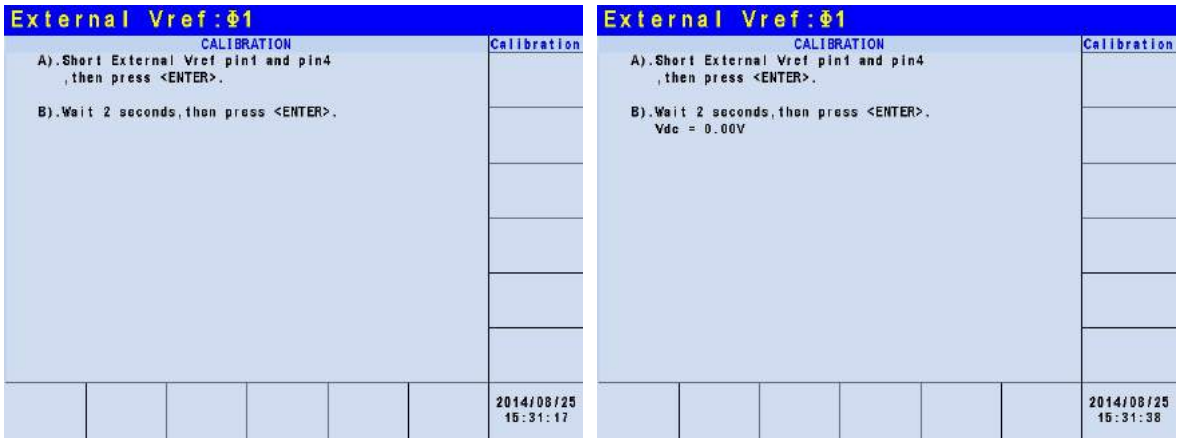
applied load is inappropriate, it could cause the Regenerative Grid Simulator to be damaged.

4.2.3 Calibrating External Vref

After entered the password, the CALIBRATION CHOICES are shown on the screen as described in section 4.2. Press External Vref to calibrate the external Vref.

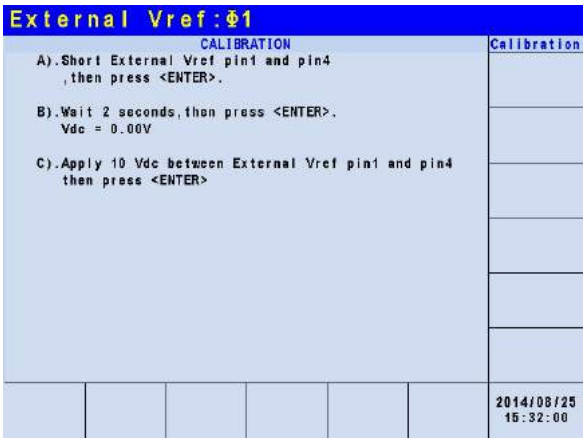


Step A: Short circuit the pin 1 and pin 4 on the Ext. Vref input terminal and press **ENTER**.

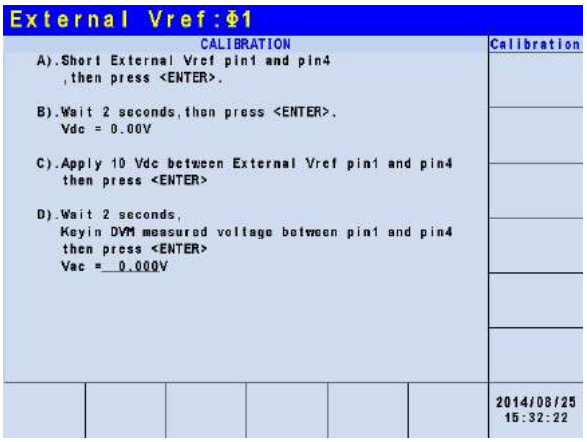


Step B: When the Vref input terminal is short circuited, set the input to 0V and then the LCD

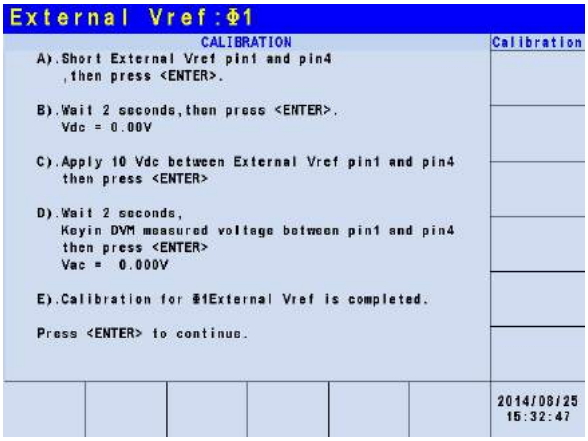
will show the Vdc measured by the Regenerative Grid Simulator. The offset voltage is generated by internal ingredients. Wait for 2 seconds and press **ENTER**, the LCD will show the voltage offset Vdc calculated by the Regenerative Grid Simulator.



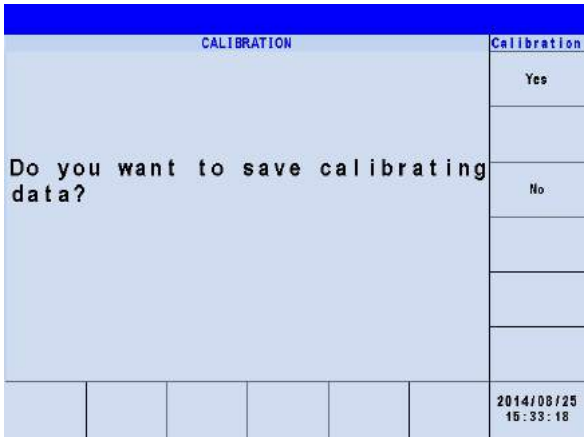
Step C: Disconnect the pin 1 and pin 4 on the Ext. Vref input terminal. Input DC voltage 10Vdc between pin 1 and pin 4 and press **ENTER**.



Step D: Use a digital DVM to measure the voltage between pin 1 and pin 4 on the Ext. Vref input terminal. Input the DC voltage and press and press **ENTER**.



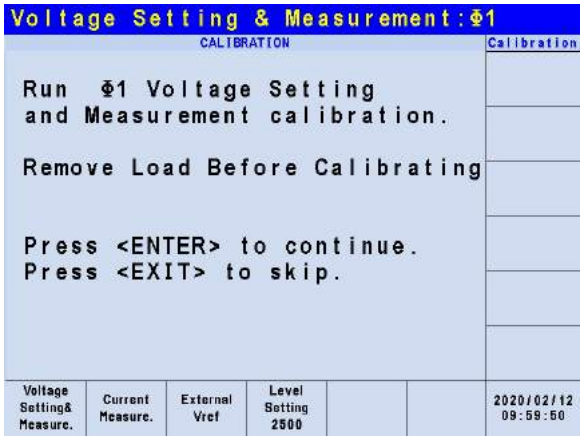
Step E: It is the last step for External Vref CALI. Press **EXIT** to enter into the saving screen as shown below or press **ENTER** to continue other voltage calibration.

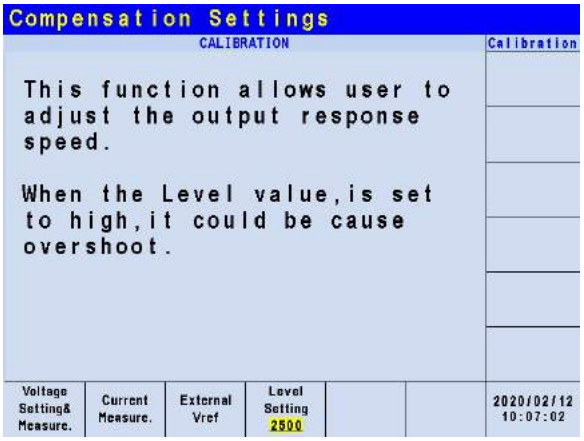


Press **EXIT** in step E and the LCD will show for saving. Press Yes on the right to save the calibration results.

4.3 Adjusting Response Speed

After entered the password, the CALIBRATION CHOICES are shown on the screen as described in section 4.2. The Regenerative Grid Simulator allows the user to adjust the bandwidth response speed. The default is 2500 that is varied with the UUT. The output response speed is set by Level which the higher level the faster response speed and vice versa.





Procedure for adjusting the response speed:

1. Press Level Setting function key.
2. Turn the RPG to change the response speed and press **ENTER**.

Notice After changing this Level value, it is necessary to re-calibrate the three-phase voltage value.

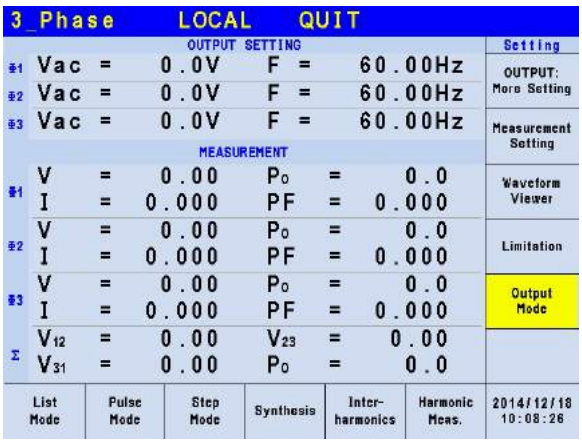
⚠WARNING For some circumstances, the output voltage could cause Overshoot if the Level setting is too high.

5. Application

5.1 Overview

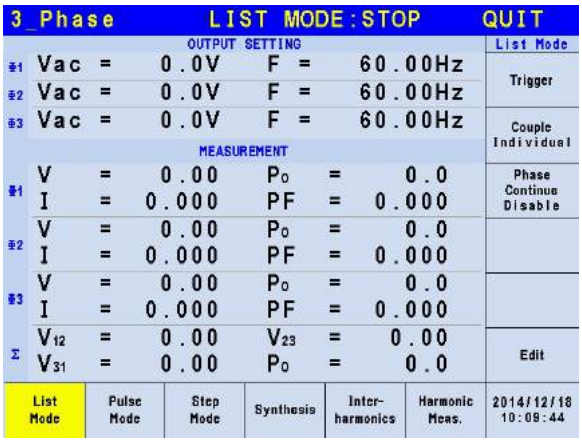
The Regenerative Grid Simulator not only can program a stable sinusoidal output voltage and frequency, but also provides powerful features to simulate power line interrupts. Users can change the output using the Sequences in LIST mode (see 5.2), or change the output to step by step in STEP mode (see 5.4.) With these functions, the simulations of conditions such as cycle loss, transient peak and power attenuation are very easy.

The Regenerative Grid Simulator is able to measure the related power parameters provided in MAIN PAGE (see 3.3); also it can provide harmonic measurements up to 50 orders (see 5.7.) In addition, the Regenerative Grid Simulator allows the user to edit different harmonic components to synthesize the harmonic distortion waveform (see 5.5). It has the ability to program the inter-harmonic frequency and components, as well as to sweep and overlap the static fundamental waveforms (see 5.6).



5.2 List Mode

Press Output Mode on the right on the MAIN PAGE (see 3.3) to go into the Output Mode command line and press List Mode at the bottom to go into the List Mode command line.



Press Edit on the right to go to the setting page.

The waveform programming in List mode is a combination of Sequences. The output waveform starts from Sequence = 0 and one Sequence after another until the Time or Cycle = 0, stopping the action. The Sequences following will not be executed. Users can edit the output voltage sequence as needed.

Trigger method: Auto / Manual / Excite.
Auto: It finishes all counts when triggered.
Manual: It executes the sequence waveform once, same as Count = 1.
Excite: It is Remote-Excite via the pin 13 of TTL terminal that is triggered by the external trigger signal. See *Appendix A TTL Signal Pin Assignments* for the detail pin assignment.

Couple: Individual / Φ1+Φ2+Φ3.
Individual: The three phases are set separately.
Φ1+Φ2+Φ3: The setting of second/third phase is the same as the setting of the first phase, so the user only needs to set the first phase.

Phase Continue: Disable/Enable.
Disable: When set to disable, the starting angle of every sequence will follow the Degree setting for motion.
Enable: When set to enable, the starting angle of every sequence will vary automatically following the last output angle of previous sequence. The Degree of all sequences will be invalid when set to enable.

Base sequence unit: Time / Cycle.
Time: The sequence unit is time.
Cycle: The sequence unit is cycle.

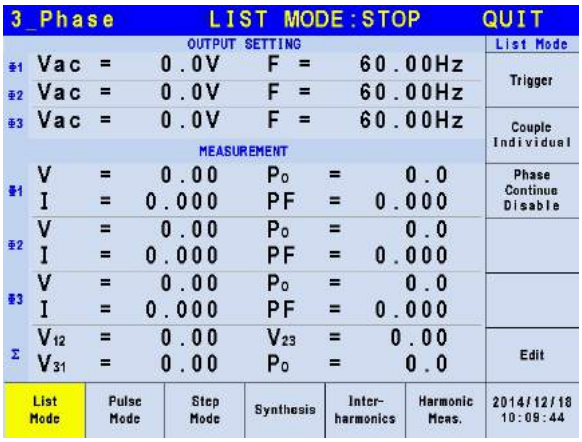
Count: The entire sequence execution times, Count = 0: unlimited execution.

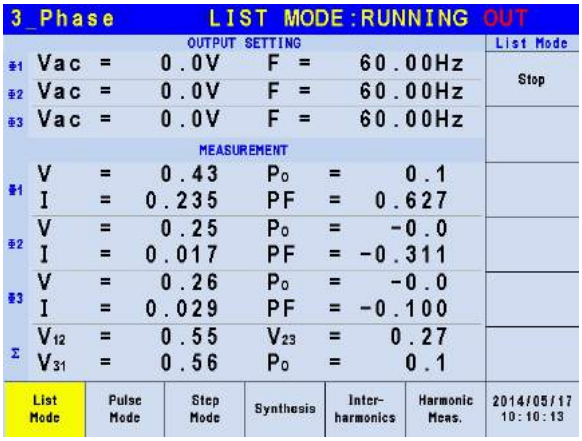
Sequence: Sequence number.
The sequence has to start from 0 and the maximum sequence number is 99. The phase difference of the second/third phase and the first phase of Sequence 0 is fixed to differ 120°. Therefore, the user cannot use the angle of the second/third phase in Sequence 0.

Degree: The phase angle when the sequence starts.
Vac start, F start, Vdc start: The initial waveform when the sequence starts.
Vac end, F end, Vdc end: The final waveform when the sequence ends.

Waveform= A / B: Select waveform (see 3.3.3.)

After setting the sequences, press Execution Page on the right to exit List mode and the LCD will show LIST MODE: STOP on the top. STOP indicates the present trigger state. Users can press Trigger on the right to trigger the output and the LCD will show RUNNING to indicate that the List mode is under execution. At the same time users can press Stop to cease the List waveform output. When the Regenerative Grid Simulator finishes all Sequences and Counts, the LCD will return to its initial state and display STOP. The Regenerative Grid Simulator will QUIT at the same time, as shown below.





If the Regenerative Grid Simulator is under operation, pressing **OUT/QUIT** will stop the output and the waveform will be zero volts. Press **OUT/QUIT** again and the Regenerative Grid Simulator only outputs the waveform set in MAIN PAGE. Trigger must be pressed to re-trigger the source.

When pressing ⮌ to exit LIST page, the programmed LIST mode waveform will be closed.

Example of LIST Mode in 1_Phase Mode:

Trigger: Auto, **Base**: Time, **Count**: 1

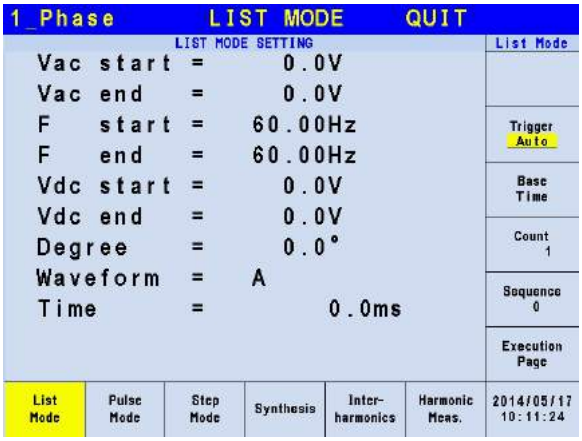
LIST MODE SETTING:

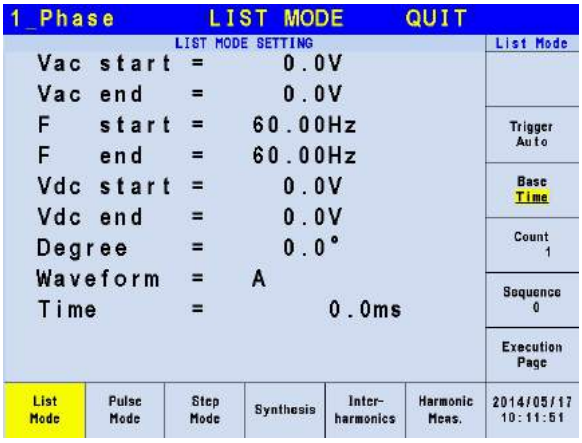
Sequence 0: Vac start = 20V, Vac end = 100V
F start = 50Hz, F end = 50Hz
Vdc start = 0V, Vdc end = 0V
Degree = 90°, Time = 50ms
Waveform = A

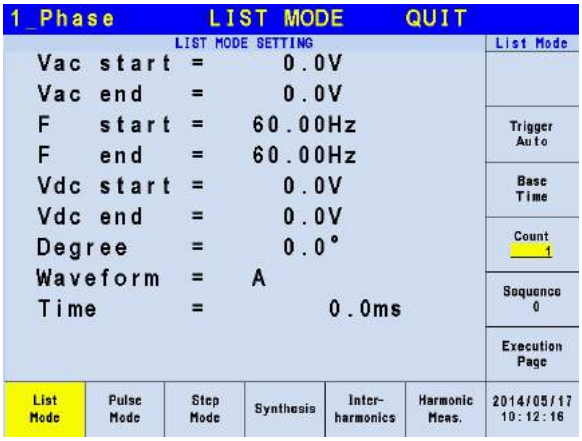
Sequence 1: Vac start = 20V, Vac end = 20V
F start = 50Hz, F end = 50Hz
Vdc start = 0V, Vdc end = 100V
Degree = 0°, Time = 50ms
Waveform = A

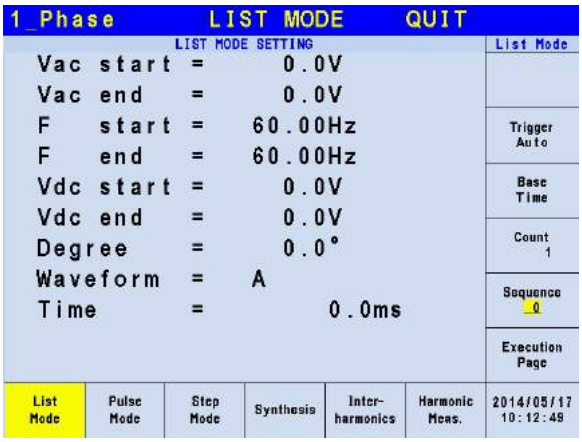
Sequence 2: Vac start = 20V, Vac end = 120V
F start = 50Hz, F end = 100Hz
Vdc start = 0V, Vdc end = 0V
Degree = 0°, Time = 100ms
Waveform = A

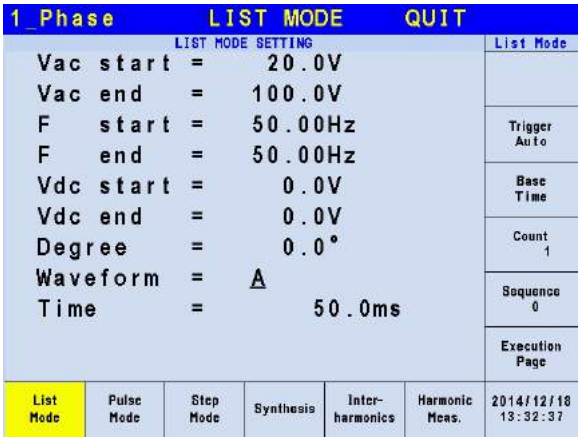
Following lists the setting pages of LIST MODE.

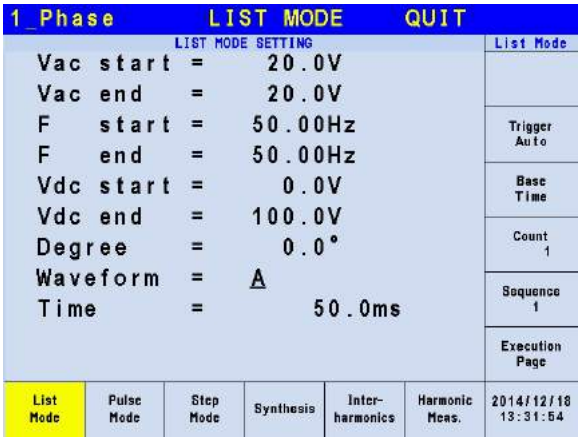


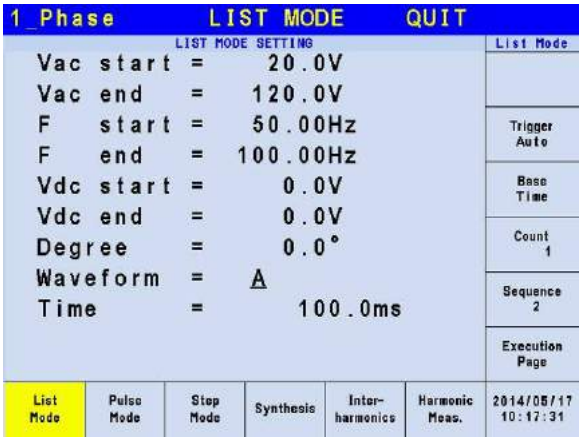



1_Phase
LIST MODE
QUIT
LIST MODE SETTING
Vac start = 0.0V
Vac end = 0.0V
F start = 60.00Hz
F end = 60.00Hz
Vdc start = 0.0V
Vdc end = 0.0V
Degree = 0.0°
Waveform = A
Time = 0.0ms
List Mode
Trigger Auto
Base Time
Count 1
Sequence 0
Execution Page
List Mode
Pulse Mode
Step Mode
Synthesis
Inter-harmonics
Harmonic Meas.
2014/05/17 10:12:16


1_Phase
LIST MODE
QUIT
LIST MODE SETTING
Vac start = 0.0V
Vac end = 0.0V
F start = 60.00Hz
F end = 60.00Hz
Vdc start = 0.0V
Vdc end = 0.0V
Degree = 0.0°
Waveform = A
Time = 0.0ms
List Mode
Trigger Auto
Base Time
Count 1
Sequence 0
Execution Page
List Mode
Pulse Mode
Step Mode
Synthesis
Inter-harmonics
Harmonic Meas.
2014/05/17 10:12:49

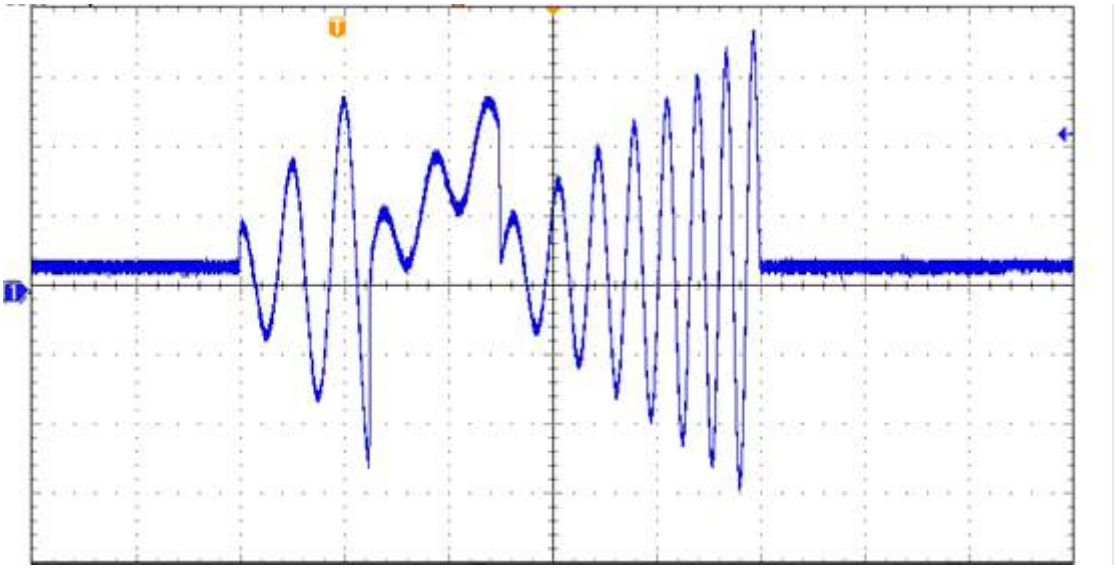

1_Phase
LIST MODE
QUIT
LIST MODE SETTING
Vac start = 20.0V
Vac end = 100.0V
F start = 50.00Hz
F end = 50.00Hz
Vdc start = 0.0V
Vdc end = 0.0V
Degree = 0.0°
Waveform = A
Time = 50.0ms
List Mode
Trigger Auto
Base Time
Count 1
Sequence 0
Execution Page
List Mode
Pulse Mode
Step Mode
Synthesis
Inter-harmonics
Harmonic Meas.
2014/12/18 13:32:37


1_Phase
LIST MODE
QUIT
LIST MODE SETTING
Vac start = 20.0V
Vac end = 20.0V
F start = 50.00Hz
F end = 50.00Hz
Vdc start = 0.0V
Vdc end = 100.0V
Degree = 0.0°
Waveform = A
Time = 50.0ms
List Mode
Trigger Auto
Base Time
Count 1
Sequence 1
Execution Page
List Mode
Pulse Mode
Step Mode
Synthesis
Inter-harmonics
Harmonic Meas.
2014/12/18 13:31:54

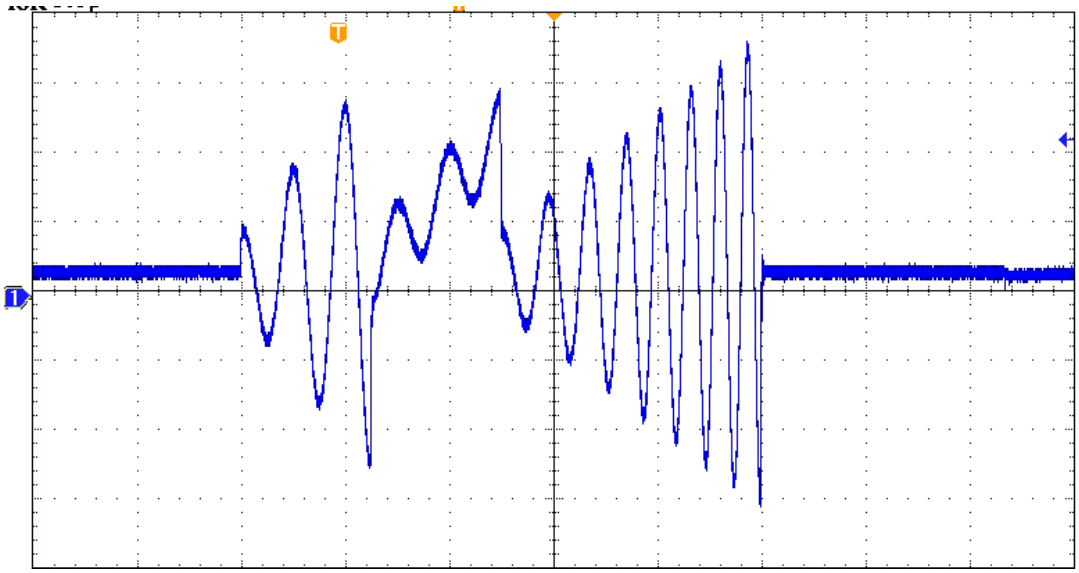

1_Phase
LIST MODE
QUIT
LIST MODE SETTING
Vac start = 20.0V
Vac end = 120.0V
F start = 50.00Hz
F end = 100.00Hz
Vdc start = 0.0V
Vdc end = 0.0V
Degree = 0.0°
Waveform = A
Time = 100.0ms
List Mode
Trigger Auto
Base Time
Count 1
Sequence 2
Execution Page
List Mode
Pulse Mode
Step Mode
Synthesis
Inter-harmonics
Harmonic Meas.
2014/05/17 10:17:31

The trigger waveform when the settings are done is shown below:

Phase Continue Disable:

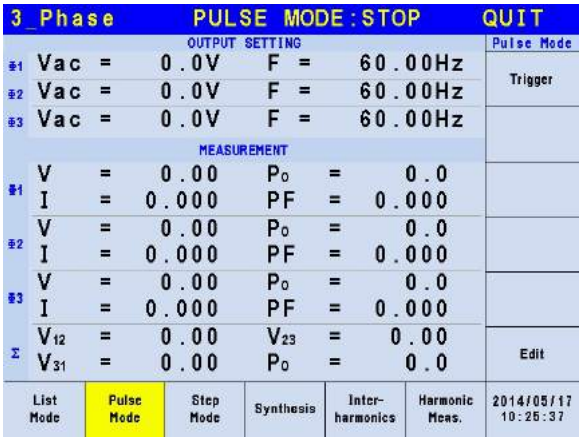


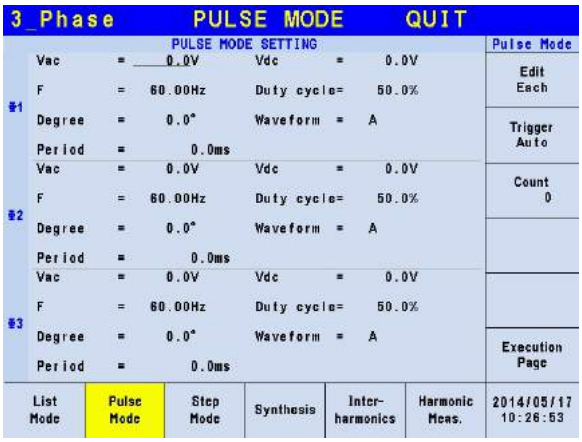
Phase Continue Enable:



5.3 Pulse Mode

Press Output Mode on the right on the MAIN PAGE (see 3.3) to go into the Output Mode command line and press Pulse Mode at the bottom to go into the Pulse Mode command line.



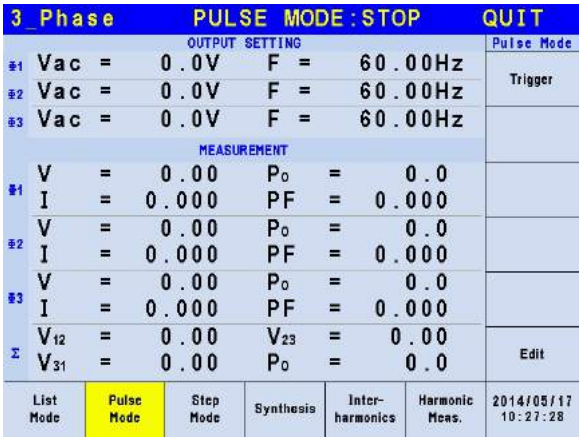


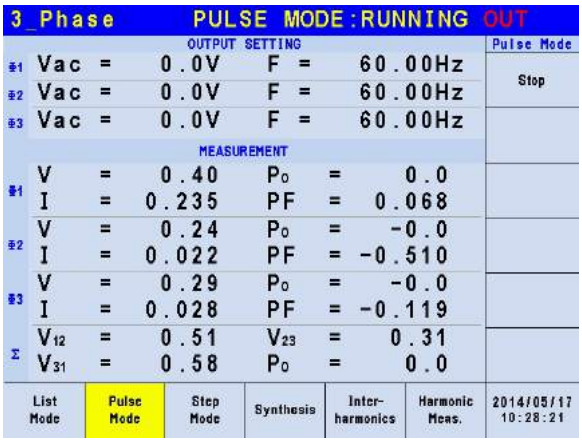
PULSE mode allows users to program a special waveform and add it to the normal output settings in MAIN PAGE. Waveform programming specifies the time ratio and the duty cycle of the pulse voltage.

Trigger method: Auto / Manual / Excite.
Auto: It finishes all counts when triggered.
Manual: It executes the sequence waveform once, same as Count = 1.
Excite: It is Remote-Excite via the pin 13 of TTL terminal that is triggered by the external trigger signal. See *Appendix A TTL Signal Pin Assignments* for the detail pin assignment.

Count: The count number of pulse.
Vac, F, Vdc: The Vac, F and DC output in pulse voltage.
Duty cycle: The pulse ratio during a duty cycle.
Period: The total length of the duty cycle.
Waveform = A / B: Select waveform (see 3.3.3.)
Degree: The output phase degree of pulse.

After setting the sequences, press Execution Page on the right to exit Pulse mode and the LCD will show PULSE MODE: STOP on the top. STOP indicates the present trigger state. Users can press Trigger on the right to trigger the output and the LCD will show RUNNING to indicate Pulse mode is under execution. The user can also press Stop to cease the Pulse waveform output. When the Regenerative Grid Simulator finishes all Sequences and Counts, the LCD will return to its initial state and display STOP. The Regenerative Grid Simulator will QUIT at the same time, as shown below.





If the Regenerative Grid Simulator is operating, pressing **OUT/QUIT** will stop the output and the waveform will be zero volts. Press **OUT/QUIT** again the Regenerative Grid Simulator will output the waveform set in MAIN PAGE. Trigger must be pressed to re-trigger the source.

When pressing ⮌ to exit PULSE page, the pulse will be closed.

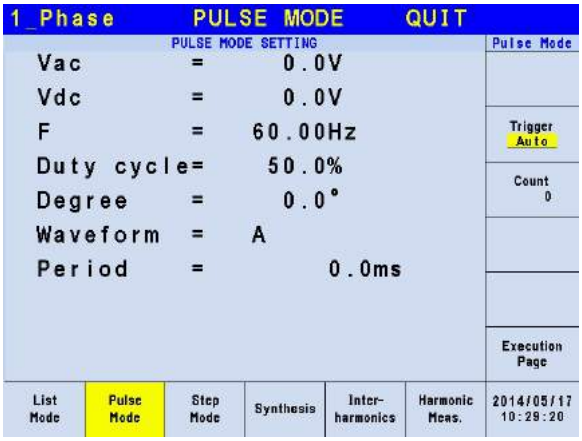
Example of PULSE Mode in 1_Phase Mode:

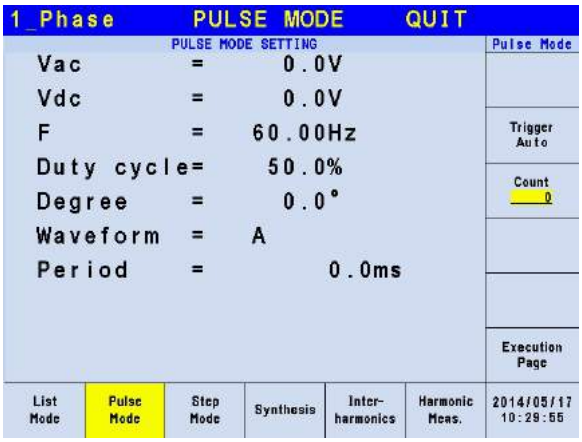
OUTPUT SETTING: Vac = 50V, F = 50Hz

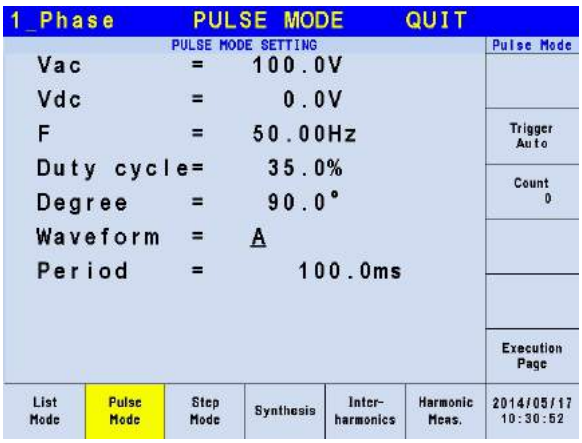
PULSE MODE SETTING:
Vac = 100V, Vdc = 0V
F = 50Hz, Duty cycle = 35%
Period = 100ms, Degree = 90°
Waveform = A

Trigger: Auto, **Count**: 0

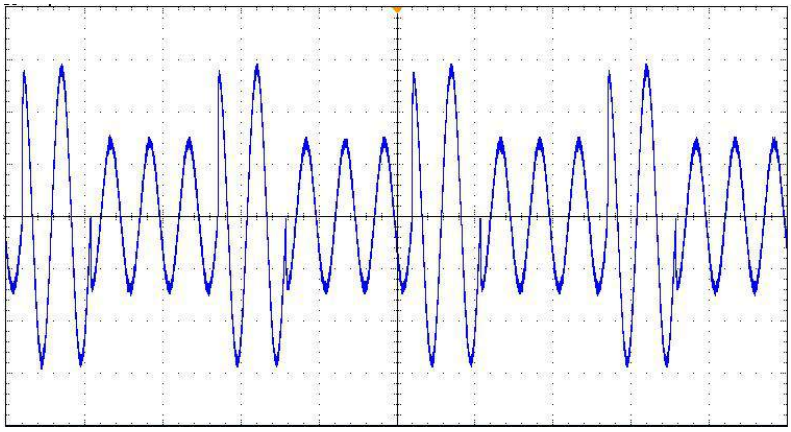
The following lists the setting pages of PULSE MODE.







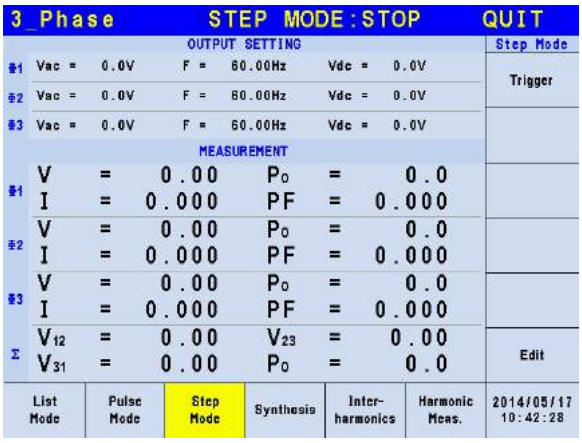
The trigger waveform when the settings are done is shown below:



Notice The Degree function in Pulse mode can only trigger the pulse mode angle once. To trigger the pulse mode for the same angle every time, it can be implemented via List mode.

5.4 Step Mode

Press Output Mode on the right on the MAIN PAGE (see 3.3) to go into the Output Mode command line and press Step Mode at the bottom to go into the Step Mode command line.



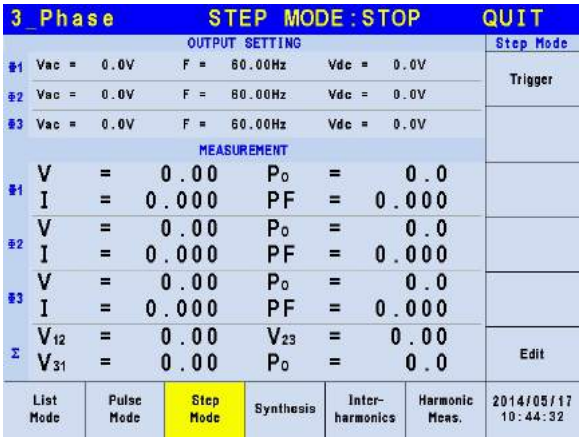
STEP Mode provides a simple auto switch function to change the output voltage by stepping. Waveform programming sets the item with an initial voltage, specifies the dwell time and the

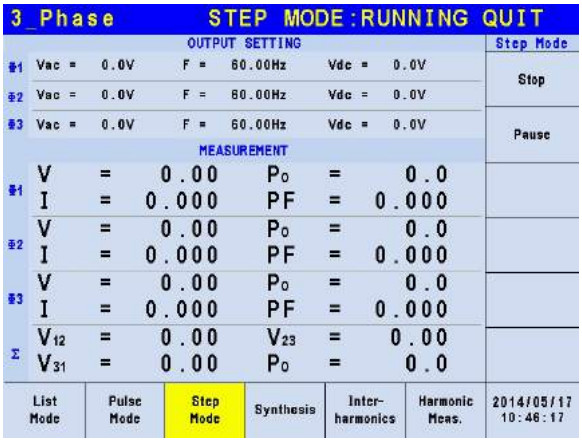
change of each step as well as the step number. The output voltage will keep the last state after execution.

Trigger method: Auto / Manual.
Auto: It finishes all counts when triggered.
Manual: The output voltage changes a step every time it operates.

Count: The count number of each change**.**
Dwell: The time for each step.
Vac, F, Vdc: The Vac, F, DC initial value when STEP mode starts.
ΔVac, ΔF, ΔVdc: The difference value of each step. (It can be negative.)
Waveform = A / B: Select waveform (see 3.3.3.)
Degree: The output phase angle of each step.

Press Step Mode at the bottom to go STEP page. The LCD shows STEP MODE: STOP on the top. STOP indicates the present trigger state. Users can press Trigger to trigger the output and the LCD will show RUNNING to indicate Step mode is executing the output. Stop and Pause will show on the screen when the output is triggered. Stop ceases the waveform change of STEP, while Pause keeps the STEP waveform until the user presses TRIG_CONTINUE. When the Regenerative Grid Simulator finishes all Counts, the LCD will show STOP and the Regenerative Grid Simulator will QUIT.



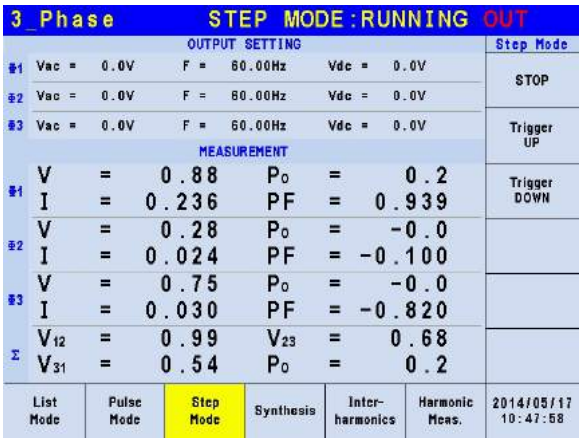


If the Regenerative Grid Simulator is outputting, pressing **OUT/QUIT** will stop the output and the waveform will be zero volts. Pressing **OUT/QUIT** again and the Regenerative Grid Simulator will output the waveform set in MAIN PAGE. Users must press Trigger again to re-trigger the output. If the Regenerative Grid Simulator is not outputting, the user can press

ENTER to output the STEP waveform directly.

When pressing ⮌ to exit the STEP page, the STEP waveform will stop execution.

The LCD shows Trigger UP and Trigger DOWN when **Trigger = Manual**. The output waveform changes to next voltage if Trigger UP is selected; and the output waveform changes to previous voltage if Trigger DOWN is selected.

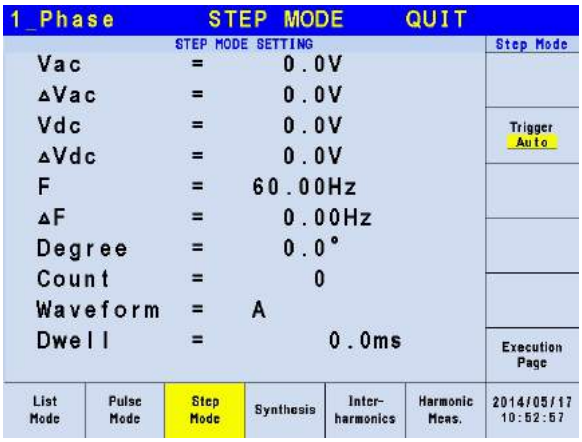


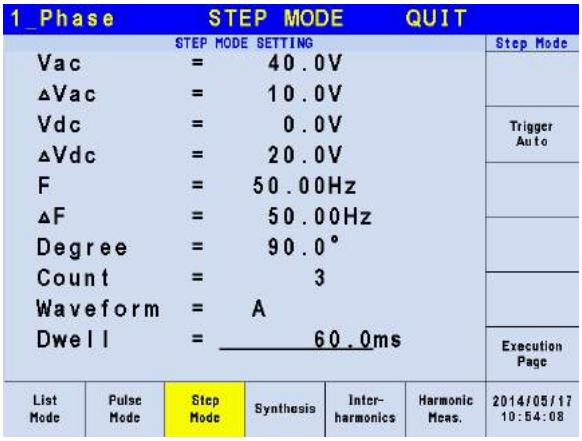
Example of STEP Mode in 1_Phase Mode:

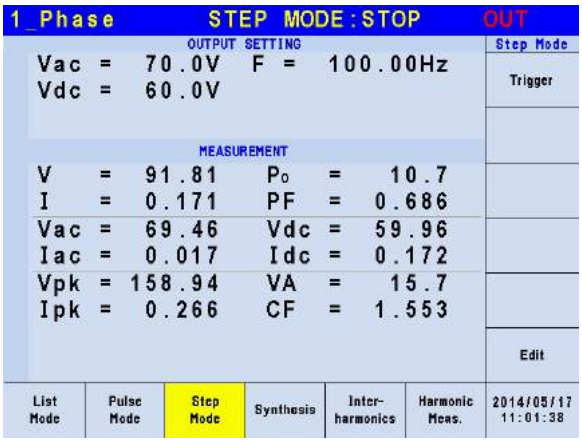
Trigger: Auto

STEP MODE SETTING:
Vac = 40V, ΔVac = 10V
F = 50Hz, ΔF = 10Hz
Vdc = 0V, ΔVdc = 20V
Degree = 90°, Dwell = 60ms
Count = 3，Waveform = A

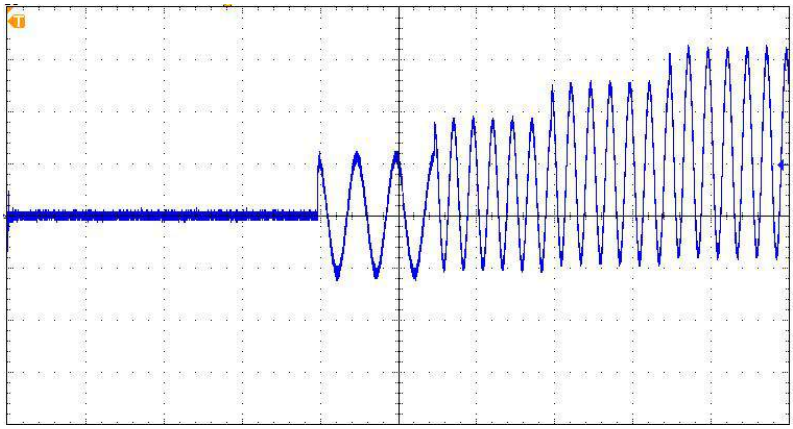
Following lists the setting pages of STEP MODE.





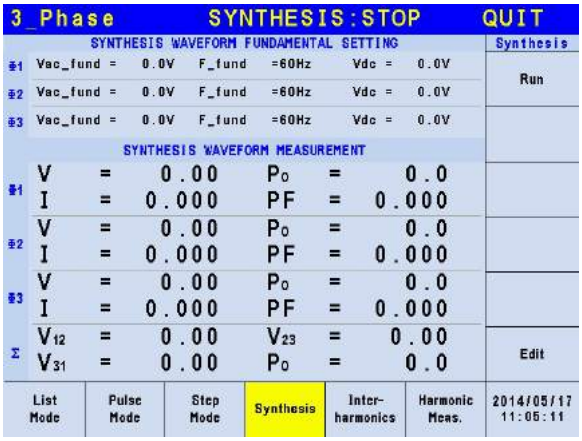


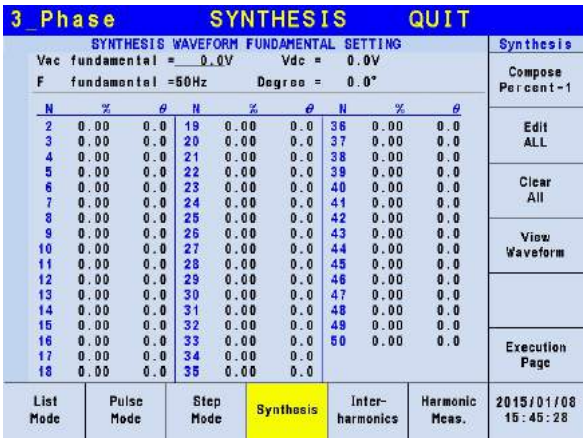
The trigger waveform when the settings are done is shown below:



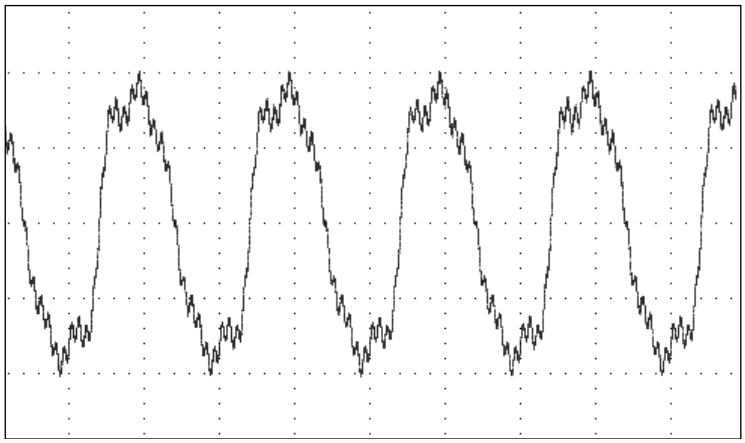
5.5 Synthesis Waveform

Press Output Mode on the right in MAIN PAGE (see 3.3) to enter into the Output Mode command line. Next press Synthesis at the bottom to go into the Synthesis command line. Pressing Edit on the right will enter the Synthesis editing window.





61800 Series Regenerative Grid Simulator provides a Synthesis function for the user to synthesize waveform. The harmonic components range up to 50 orders with the fundamental frequency limited to 50Hz or 60Hz. The user can program the size and phase of each order easily on the LCD. The following is an example figure of the synthesis waveform.



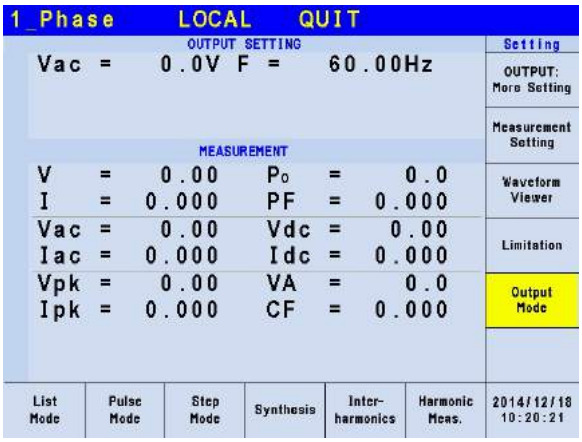
Compose = Value-1 / Value-2 / Value-3/ Percent-1 / Percent-2 / Percent-3: The data form of each harmonic order.

Value: The absolute value.
Percent: The percentage of the fundamental frequency voltage.

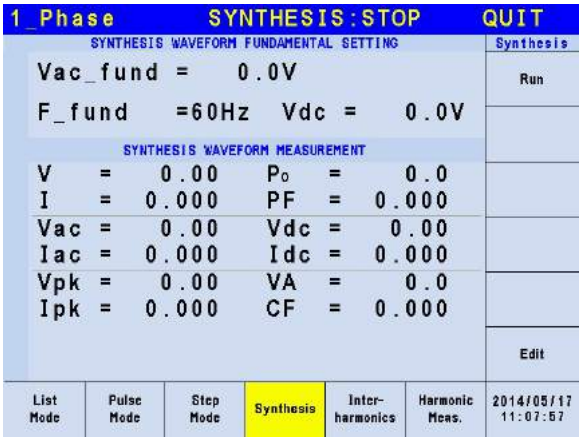
The user can program 6 types of synthesis waveform to execution or save.

Vac fundamental: The fundamental frequency voltage, the maximum is limited by RANGE (see 3.3.1.2.)
F fundamental = 50 / 60Hz: The fundamental frequency.
Vdc: The DC voltage component.
Degree: The start angle of the output waveform.

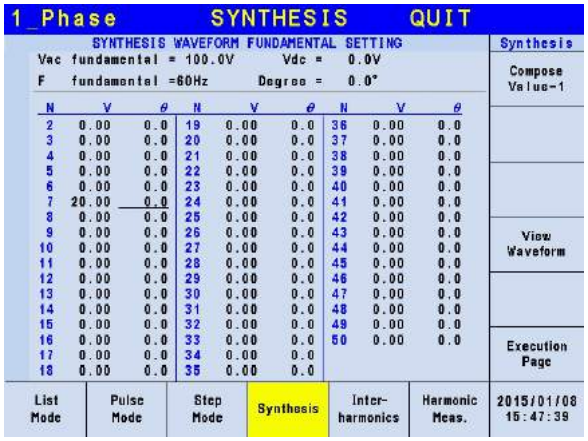
Following is the example of using Synthesis Mode in 1_Phase Mode:



Press Output Mode on the right in MAIN PAGE to select any Mode for application.



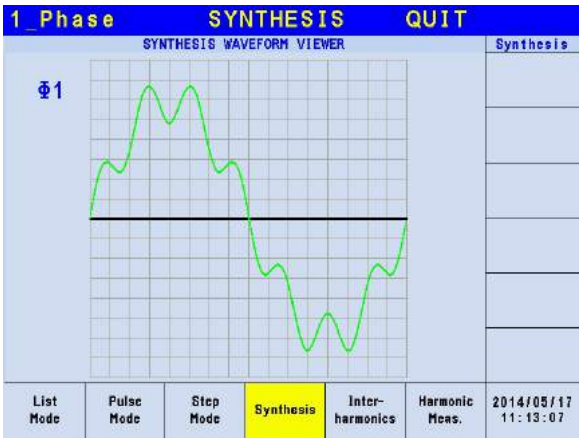
Next, press Synthesis at the bottom to go to Synthesis Mode.



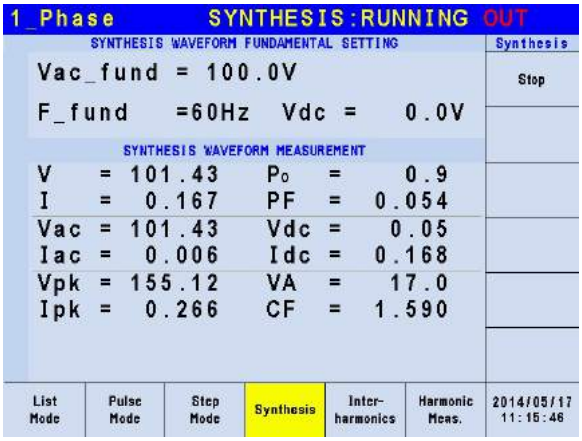
Press Edit on the right to go to editing screen. Use the arrow keys to move the cursor to the appropriate column and use numeric keys to key-in the setting, and then press **ENTER**. The example uses the following settings:

OUTPUT SETTING: Vac = 100V, F = 60Hz

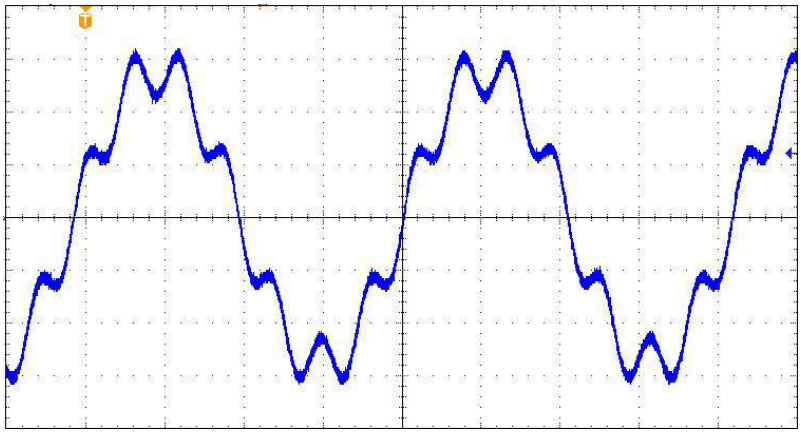
Compose = Percent-1
Edit = Φ3
Vac fundamental = 100.0V
F fundamental = 60Hz
Vdc = 0.0V
Degree = 0.0°



Once the settings are edited, the user can press View Waveform on the right to view the edited output waveform. Press Return to go to previous page.



Press Execution Page on the right to return to the Synthesis Mode page. Next, press Run on the right to output the waveform.



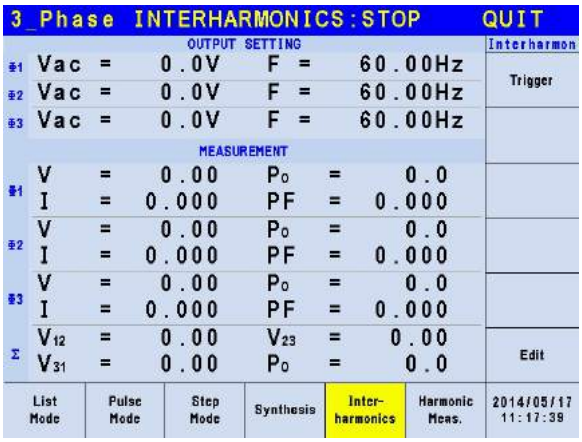
The figure above is the output voltage waveform of the Regenerative Grid Simulator, measured by an oscilloscope and is the same as the user edited waveform.

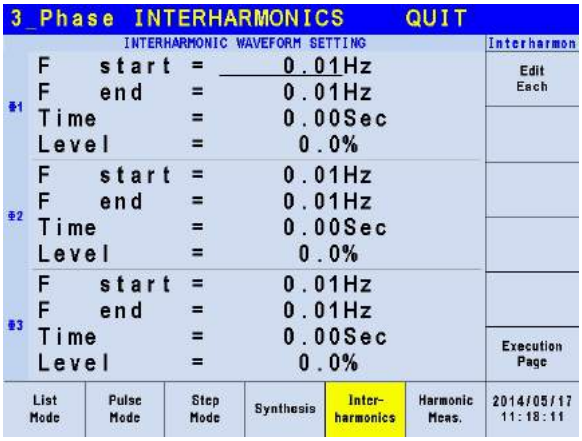
Notice

1. In order to protect the power stage of Regenerative Grid Simulator for practical use, it is necessary to limit the synthesis value or the percentage of each order.
   - $2 \leq$ order ≤ 10, value $\leq$ 90V or percentage $\leq$ 30%.
   - $11 \leq$ order ≤ 20, value $\leq$ 60V or percentage $\leq$ 20%.
   - $21 \leq$ order ≤ 40, value $\leq$ 30V or percentage $\leq$ 10%.
   - $41 \leq$ order ≤ 50, value $\leq$ 15V or percentage $\leq$ 5%.
2. If the synthesis waveform exceeds the voltage limit, OUTPUT OVP or DST Protection will occur.

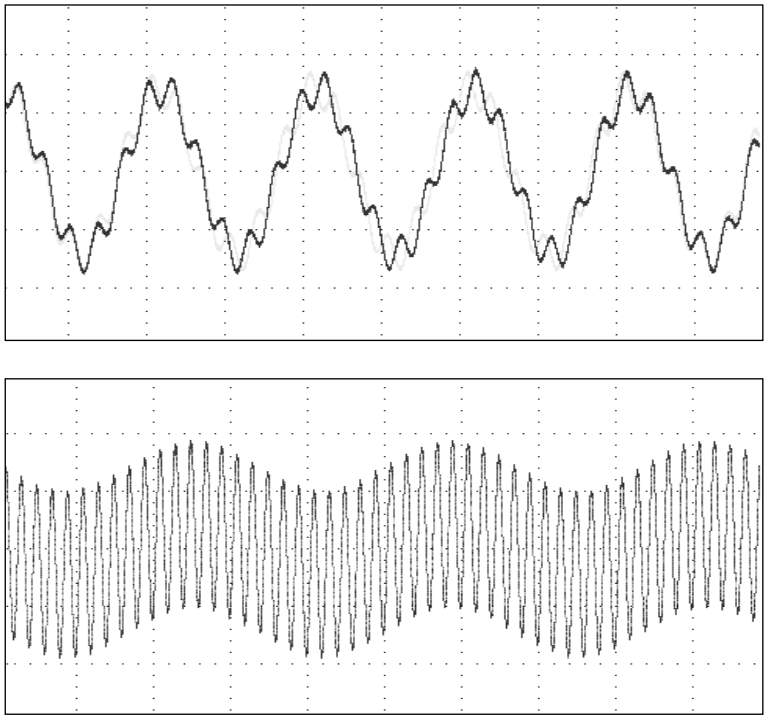
5.6 Inter-harmonics Waveform

Press Output Mode on the right in the MAIN PAGE (see 3.3) to enter into the Output Mode command line. Next press Inter-harmonics at the bottom to go to the Inter-harmonics command line. Press Edit on the right to enter the Inter-harmonics editing window.



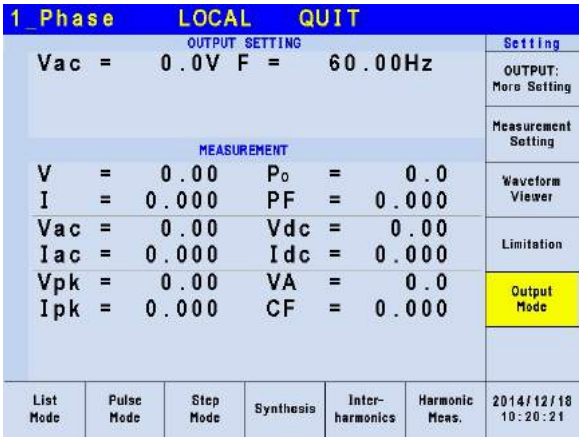


For the Regenerative Grid Simulator Inter-harmonics function, besides the fundamental voltage output, another frequency of variable voltage component is added to test certain anti-interference. Following is the example figure of an inter-harmonic:

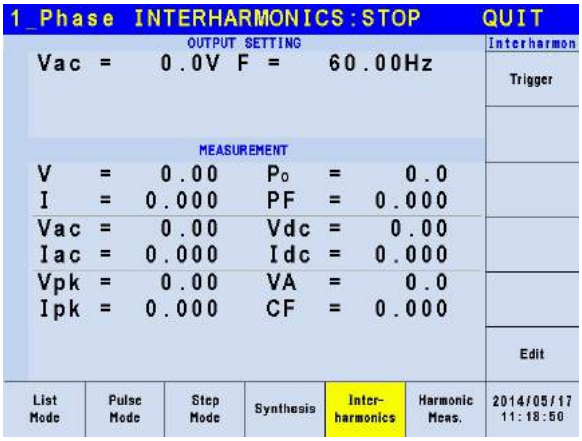


F start: The start frequency of scanning wave. The range is 0.01Hz ~ 3000Hz.
F end: The end frequency of scanning wave. The range is 0.01Hz ~ 3000Hz.
Level: The rms of scanning wave that is the percentage of fundamental voltage set in MAIN PAGE.
Time: The scanning time from F start to F end.

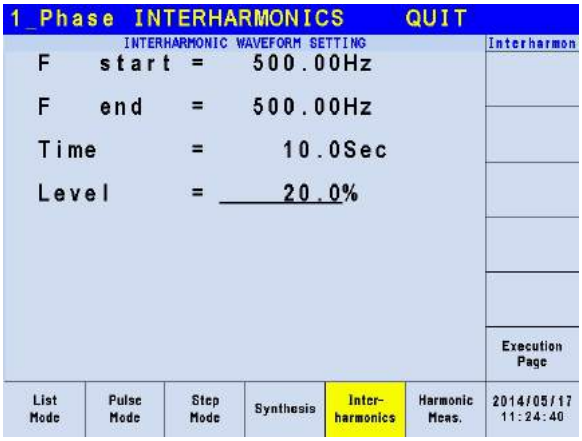
The following is the example of using Inter-harmonics Mode in 1_Phase Mode:



Press Output Mode on the right in the MAIN PAGE to select any Mode for application.



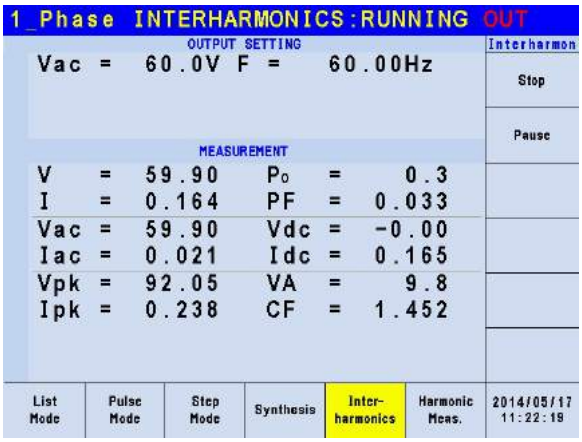
Next, press Inter-harmonics at the bottom to go to Inter-harmonics Mode.



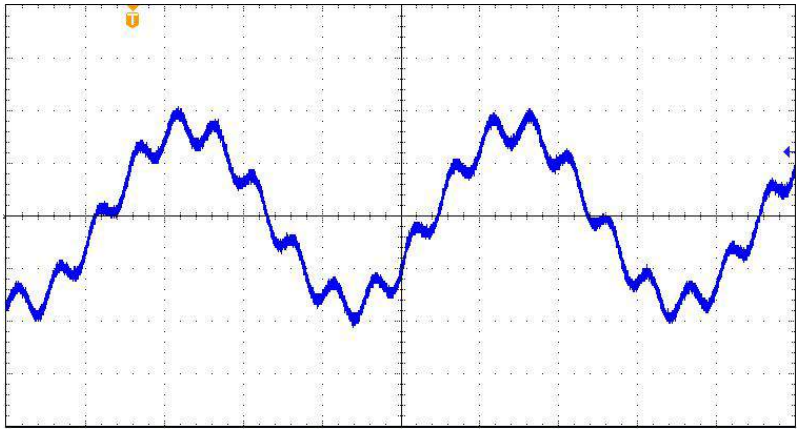
Press Edit on the right to go to the editing screen. Use the arrow keys to move the cursor to the column to be set and use the numeric keys to key-in the setting and then press **ENTER**. The example uses the following settings:

OUTPUT SETTING: Vac = 60.0V, F = 60Hz
F start = 500.0Hz
F end = 500.0Hz
Level = 20.0%

Time = 10.0Sec



Press Execution Page on the right to return to the Inter-harmonics Mode page. Next press Trigger on the right to output the waveform.



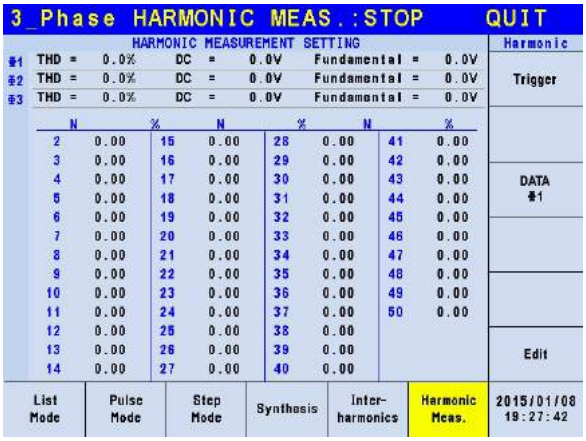
The figure above is the output voltage waveform of the Regenerative Grid Simulator measured by an oscilloscope and is the same as the user edited waveform.

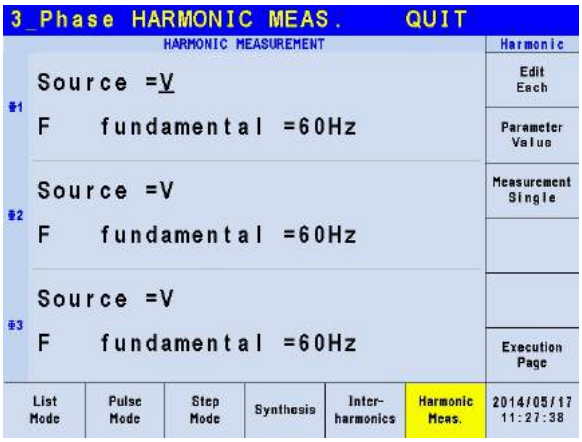
Notice

1. In order to protect the power stage of Regenerative Grid Simulator for practical use, it is necessary to limit the F start and F end related Level.
   * If 0.01Hz ≤ F start or F end ≤ 500Hz, Level ≤ 30%.
   * If 500Hz < F start or F end ≤ 1000Hz, Level ≤ 20%.
   * If 1000Hz < F start or F end ≤ 2400Hz, Level ≤ 10%.
   * If 2400Hz ≤ F start or F end ≤ 3000Hz, Level ≤ 5%.
2. If the inter-harmonics waveform is over the voltage limit, OUTPUT OVP or DST Protection will occur.

5.7 Harmonic Waveform

Press Output Mode on the right in the MAIN PAGE (see 3.3) to enter into the Output Mode command line. Next press Harmonic Meas. at the bottom to go to the I Harmonic Meas. command line. Press Edit on the right to enter the Harmonic Meas. editing window.





This function can measure the Total Harmonic Distortion (THD) of the fundament frequency 50Hz or 60Hz, the DC current, and the fundamental frequency of output current or voltage, also can measure 2 ~ 50 orders of harmonic values.

Source = V / I: It measures the source signal output voltage or output current.

V: The output voltage.
I: The output current.

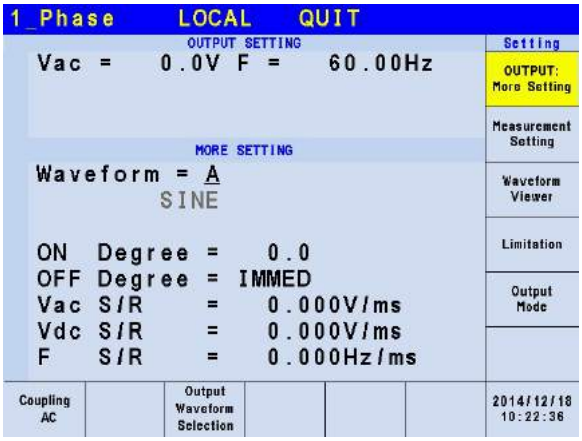
F fundamental = 50 / 60 Hz: The fundamental frequency of source signal.
Measurement = Single / Continue: The way the measurement result displays on LCD.

Single: The display will keep the measured data when set. It takes about 3 seconds to get the results.
Continue: The display updates the measured data when set. It takes about 10 seconds to get stable results.

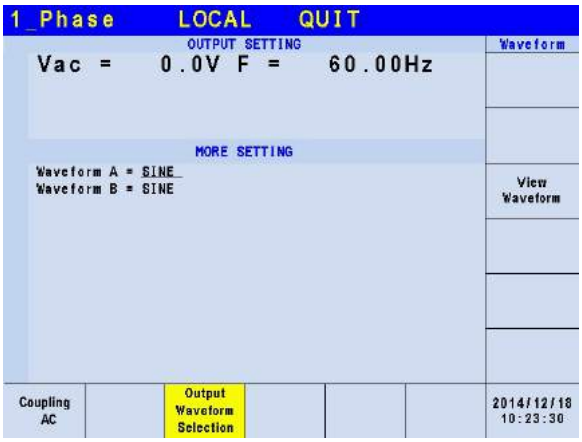
Parameter = Percent / Value: The data form of each harmonic component.

Percent: The percentage of fundament frequency value.
Value: The absolute value.

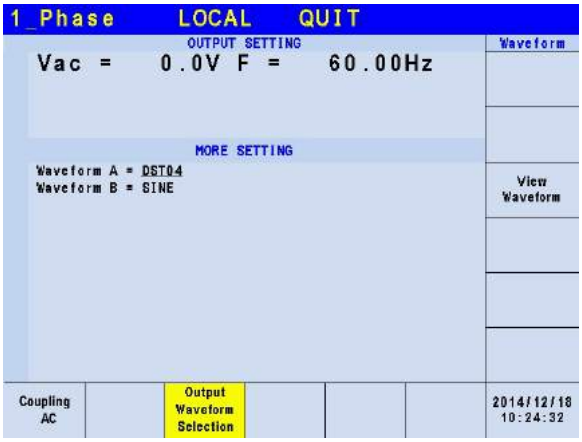
Following is an example of using Harmonic Meas. Mode in 1_Phase Mode:



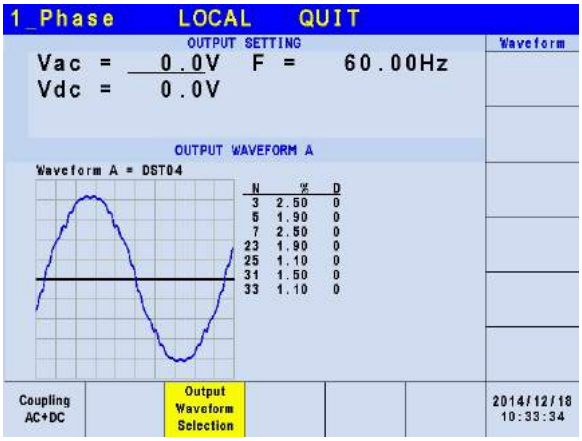
Press OUTPUT: More Settings on the right in the MAIN PAGE to enter into the output selections page.



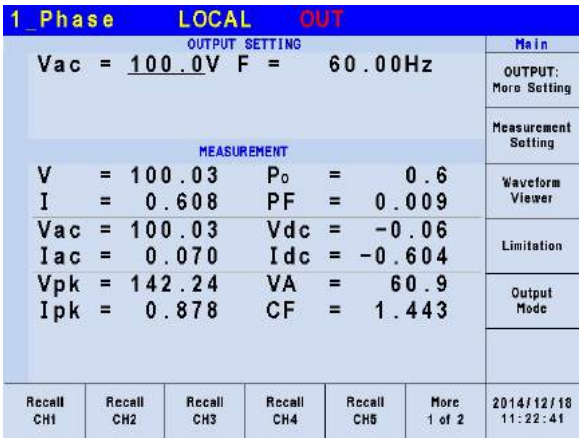
Next, press Output Waveform Selection at the bottom to go to the output waveform selection page.



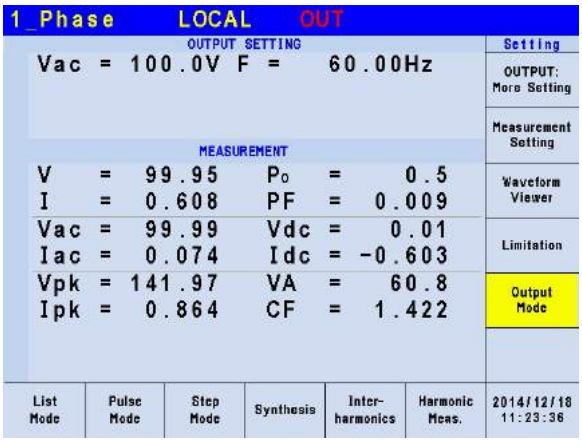
Set the Waveform A to DST04 waveform.



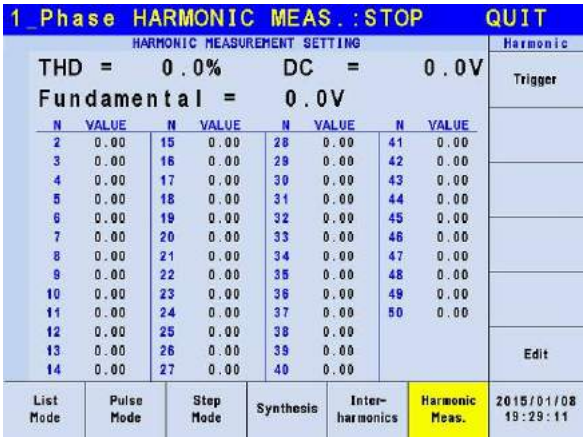
When the waveform setting is done, press View Waveform on the right to view the output waveform, the ratio of each harmonic order and the output angle.



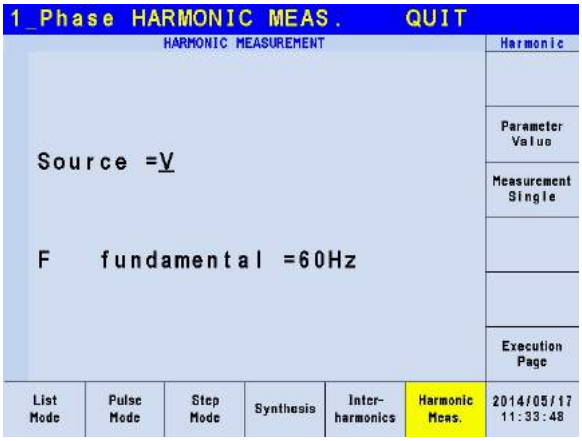
Press Return to go back to the MAIN PAGE and set the Vac to 100.0V, then press **OUT/QUIT** to output waveform.



Press Output Mode on the right in the MAIN PAGE to select any Mode.

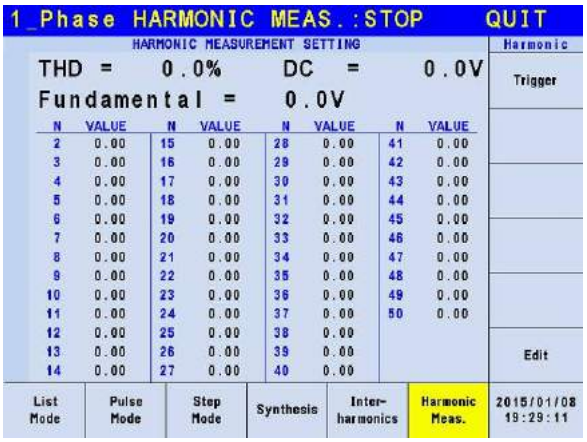


Next, press Harmonic Meas. at the bottom to go to the Harmonic Meas. Mode.



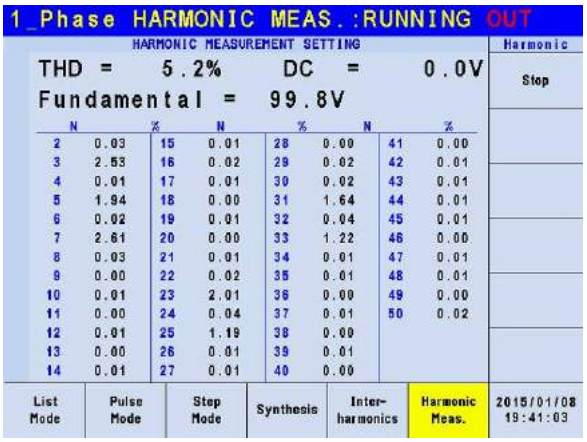
Press Edit on the right to go to the editing screen. Use the arrow keys to move the cursor to the column to be set and use the numeric keys to enter the setting and then press **ENTER**. The example uses the following settings:

Source = V
F fundamental = 60 Hz
Measurement = Continue
Parameter = Percent

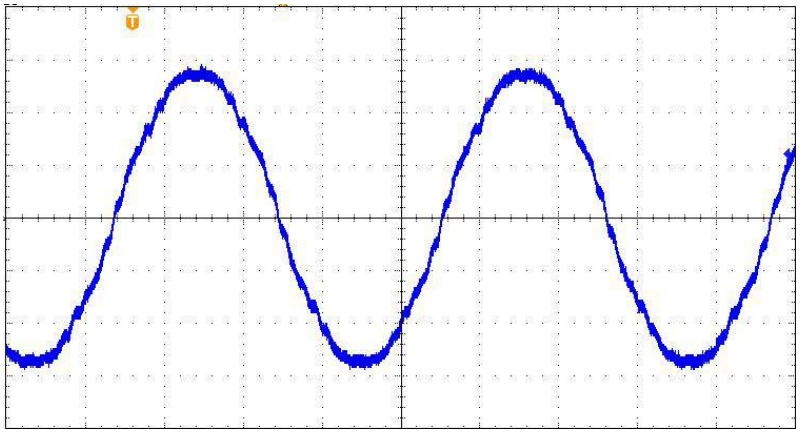


Press Execution Page on the right to return to the Harmonic Meas. Mode page. Next press

Trigger on the right to perform the output voltage harmonic measurement.



After triggered, the user can press DATA on the right to view the measurement of a phase.



The figure above is the output voltage waveform of the Regenerative Grid Simulator measured by an oscilloscope and is the same as the user edited waveform.

Notice

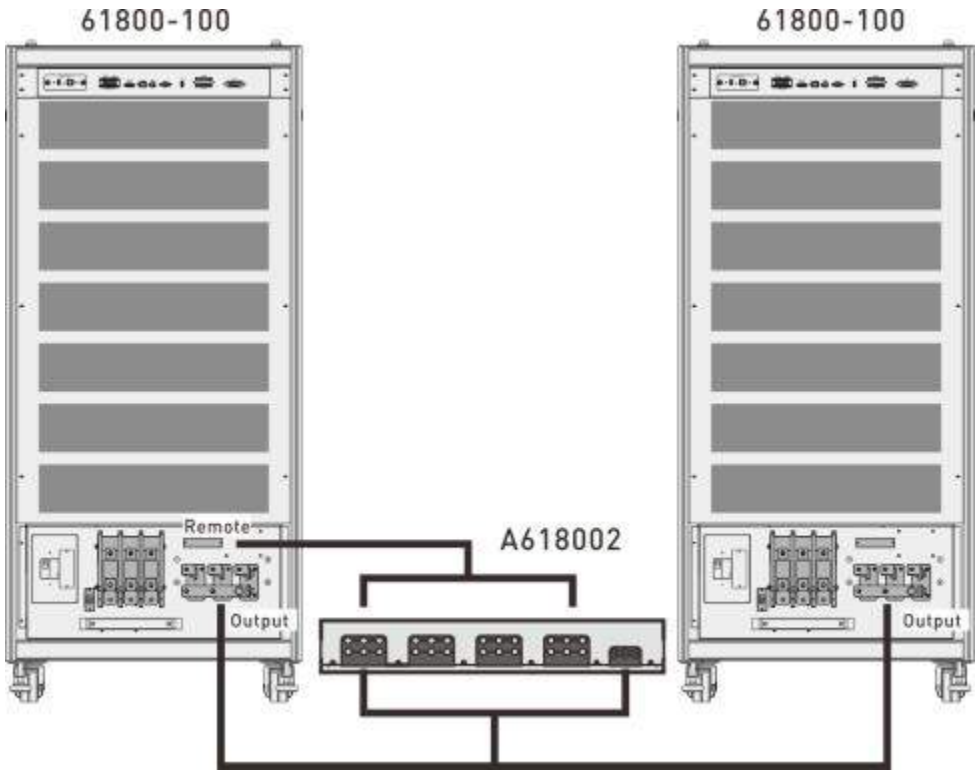
When the user presses Trigger to execute the current harmonic measurement, the Regenerative Grid Simulator will adjust the internal gain automatically by the measured data so that the Regenerative Grid Simulator can get more accurate data of each harmonic. Thus, it is better to wait for the load to be stable before executing the harmonic measurement. In addition, the load cannot be changed during measurement or the retrieved data may lose its accuracy or cause over current protection.

6. Parallel/Series (Optional) Operation

6.1 Parallel Connection for Regenerative Grid Simulators

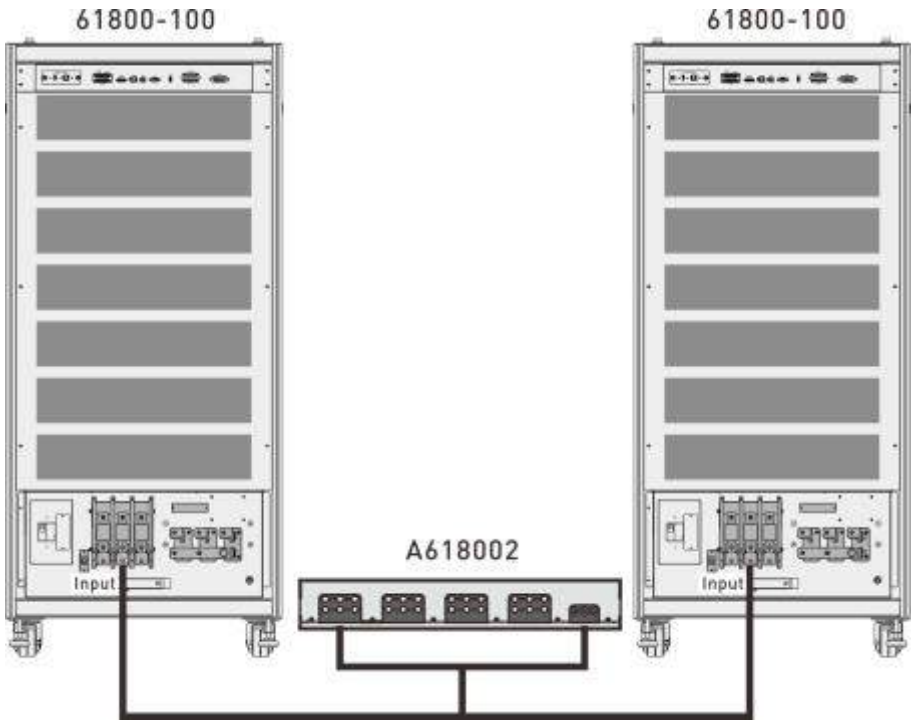
6.1.1 Connecting Two Simulators at Output in Parallel

It can use a fixture of Terminals for Parallel Connection (A618002) to connect the output of two Regenerative Grid Simulators as the figure shown below for parallel mode use.



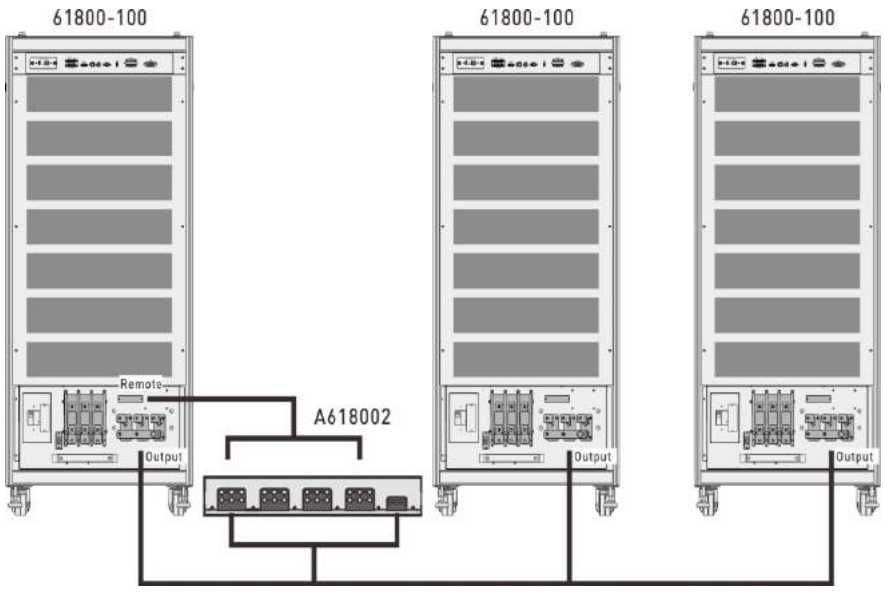
6.1.2 Connecting Two Simulators at Input in Parallel

It can use a fixture of Terminals for Parallel Connection (A618002) to connect the input of two Regenerative Grid Simulators as the figure shown below for use in parallel mode.



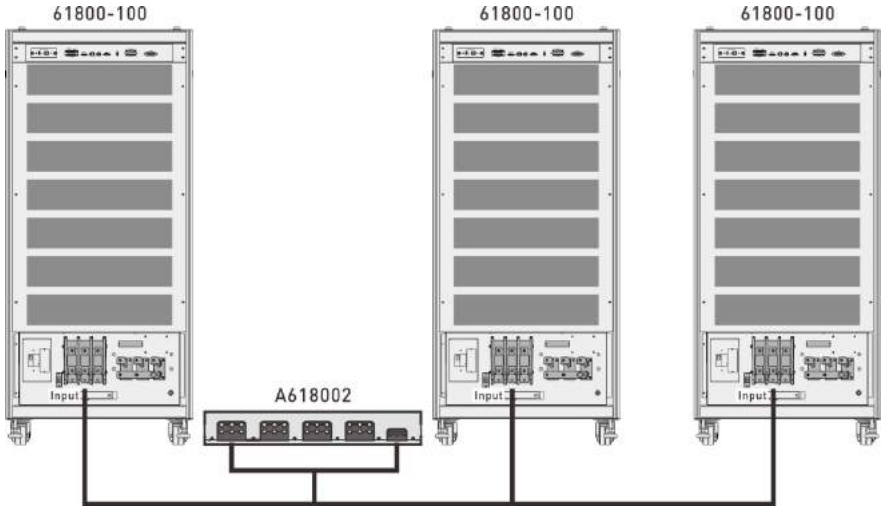
6.1.3 Connecting Three Simulators at Output in Parallel

It can use a fixture of Terminals for Parallel Connection (A618002) to connect the output of three Regenerative Grid Simulators as the figure shown below for parallel mode use.



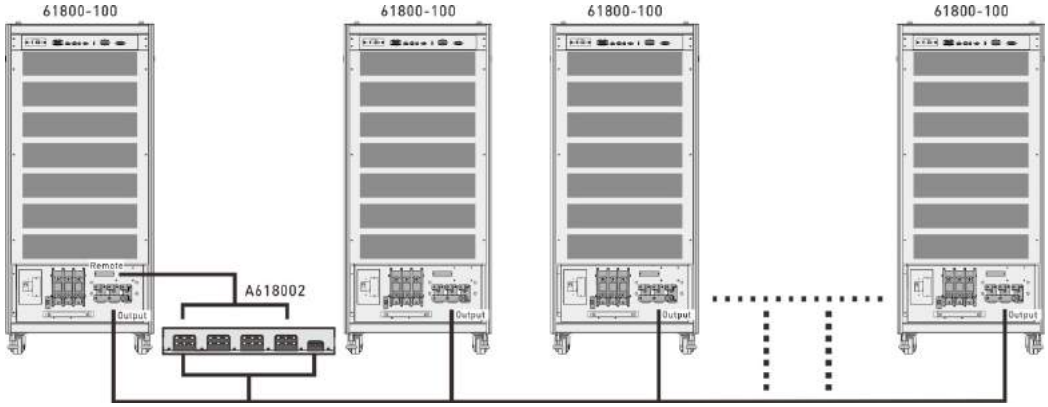
6.1.4 Connecting Three Simulators at Input in Parallel

It can use a fixture of Terminals for Parallel Connection (A618002) to connect the input of three Regenerative Grid Simulators as the figure shown below for parallel mode use.



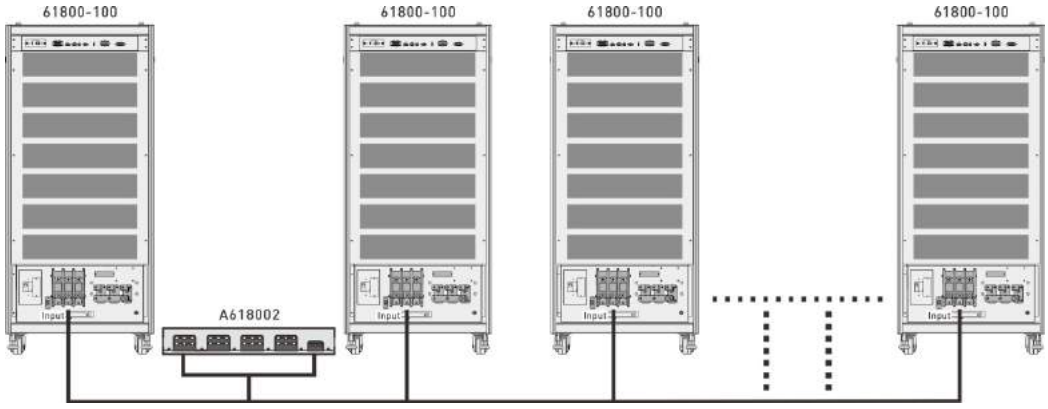
6.1.5 Connecting Four or Five Simulators at Output in Parallel

It can use a fixture of Terminals for Parallel Connection (A618002) to connect the output of four or five Regenerative Grid Simulators as the figure shown below for parallel mode use.



6.1.6 Connecting Four or Five Simulators at Input in Parallel

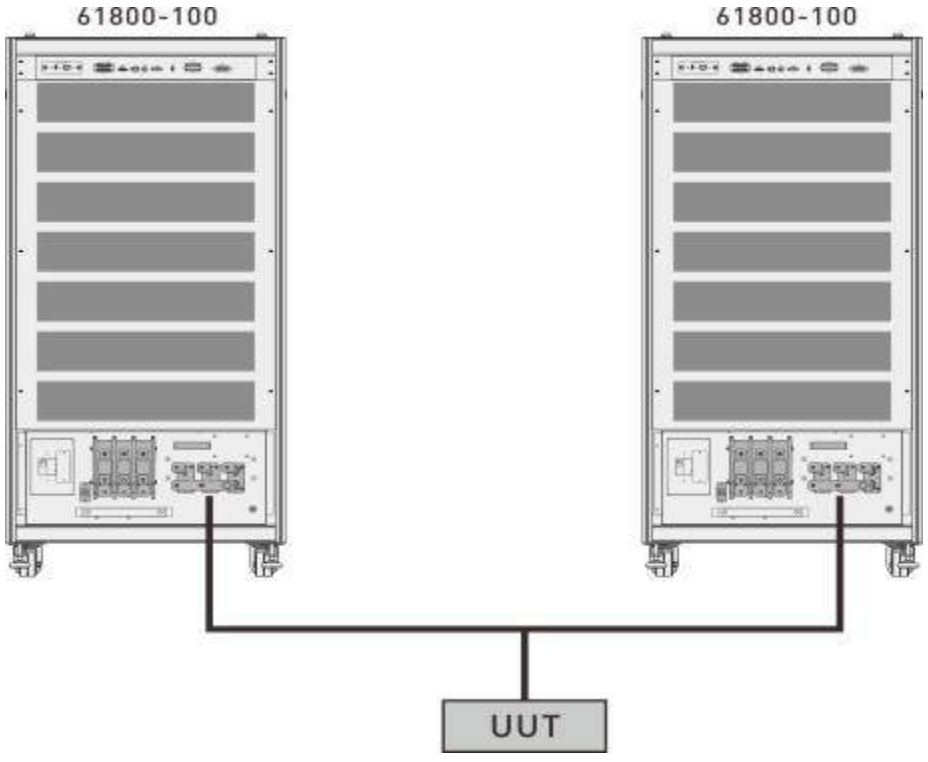
It can use a fixture of Terminals for Parallel Connection (A618002) to connect the input of four or five Regenerative Grid Simulators as the figure shown below for parallel mode use.



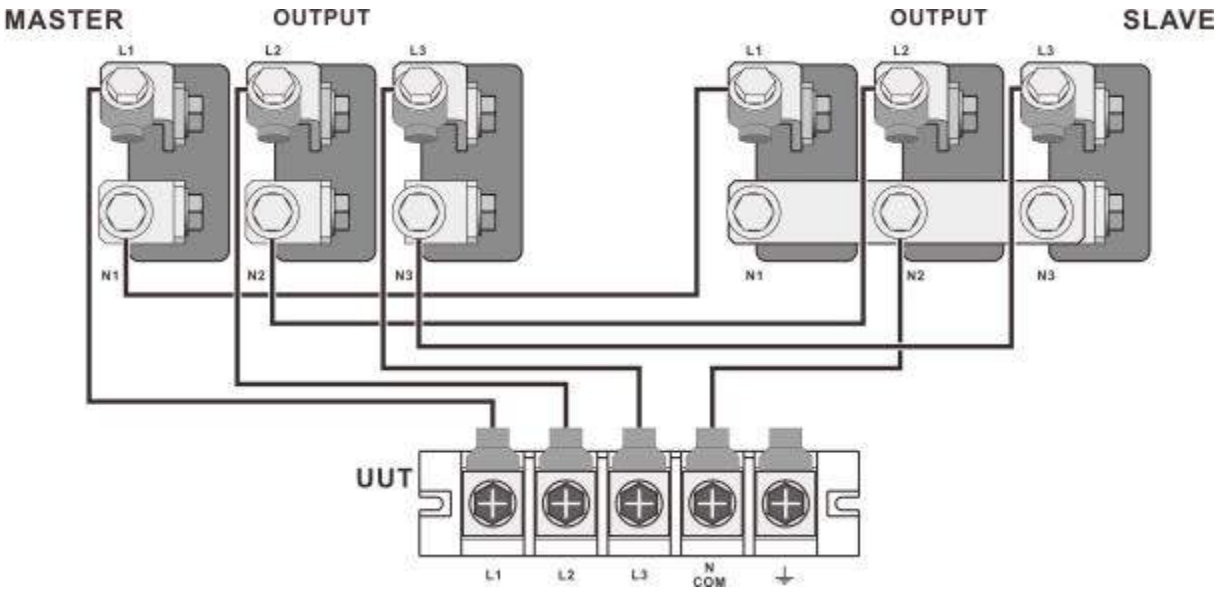
6.2 Series Connection for Regenerative Grid Simulators (Optional)

6.2.1 Connecting Two Simulators at Output in Series

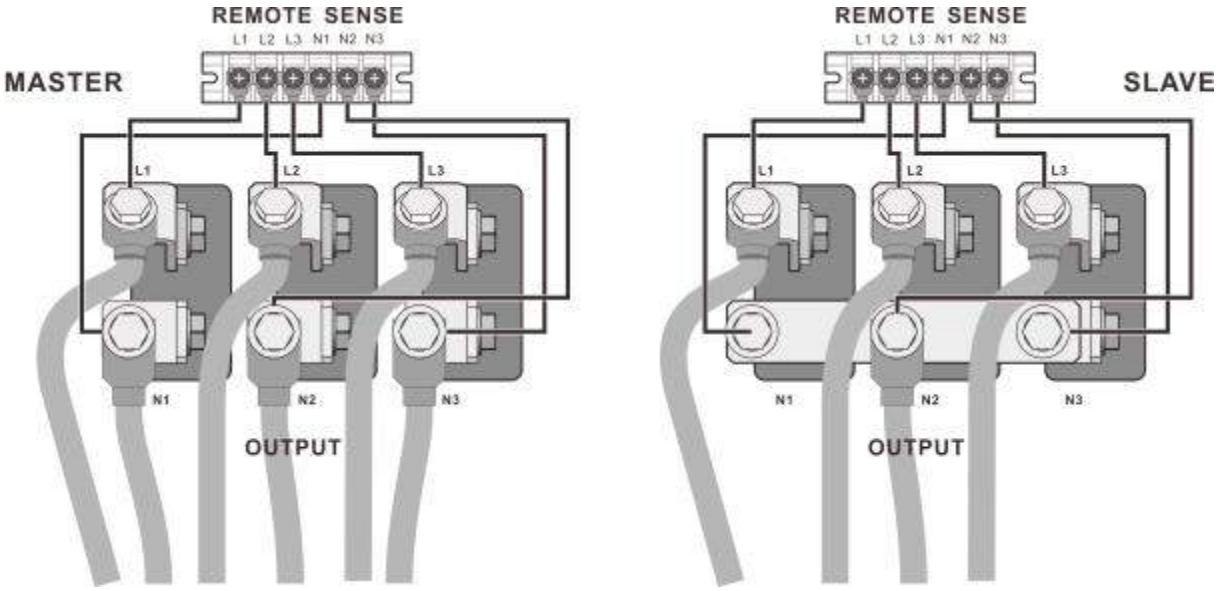
Follow the figure shown below to connect two Regenerative Grid Simulators for use in series mode.



The UUT is connected in between the Master and Slave Regenerative Grid Simulators. The wiring diagram for connecting the output power to the UUT terminals is shown in the figure below.



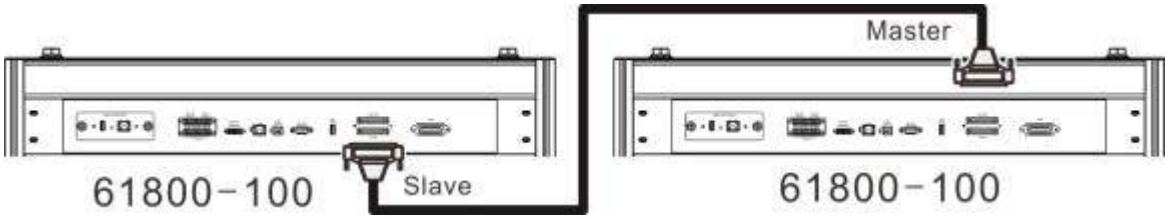
The REMOTE SENSE wires of the Master and Slave Regenerative Grid Simulators are connected to the terminals at the Master and Slave rear in sequence. The REMOTE SENSE wiring diagram is shown below.



6.3 Signal Cable Connection for Parallel Mode

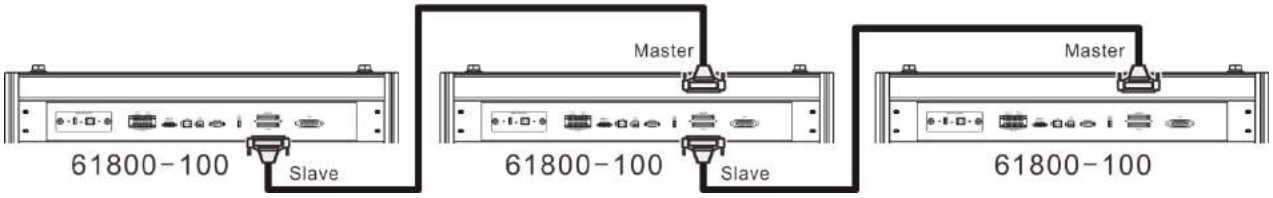
6.3.1 Connecting Cable for Two Units

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



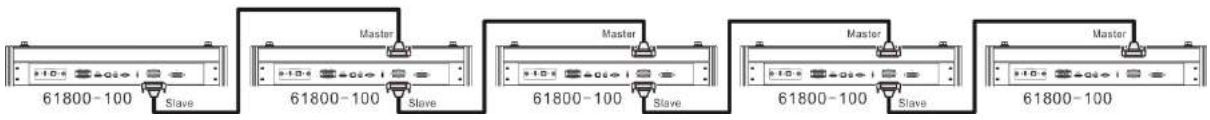
6.3.2 Connecting Cables for Three Units

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



6.3.3 Connecting Cables for Five Units

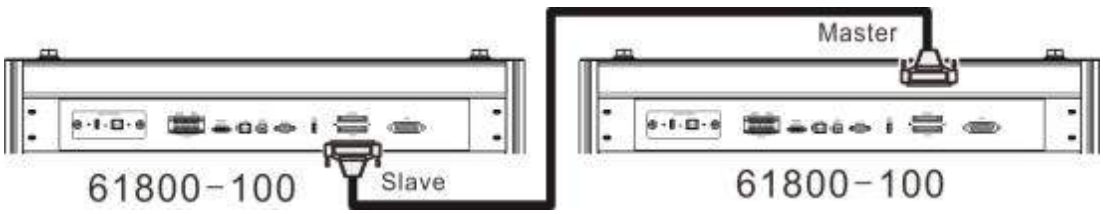
When the Regenerative Grid Simulators are used in parallel mode, four parallel communication cables are required to transmit the data. The connection is shown below.



6.4 Signal Cable Connection for Series Mode (Option)

6.4.1 Connecting Cable for Two Units

When the Regenerative Grid Simulators are used in series mode, a series communication cable is required to transmit the data. The connection is shown below.



6.5 Settings

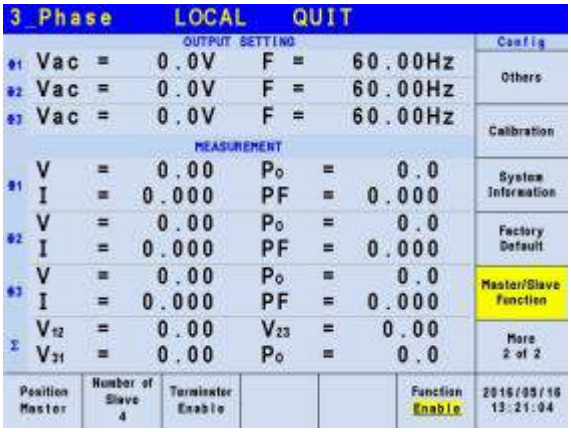
6.5.1 Setting Regenerative Grid Simulator to Slave

To set a single regenerative grid simulator to Slave, press **CONFIG** in **FUNCTION** menu to enter into the CONFIG menu (Master/Slave Function). Follow the steps below to set the connection of multiple devices to be parallel or series (optional).

1. Press Master/Slave Function key.
2. Press the Position key at the bottom.
3. Turn the RPG to change the Position key to Slave1, and press **ENTER** to confirm it.
4. If the device has two terminals, press the Terminator key at the bottom, and turn the RPG to change the Terminator key to Enable.

Notice

1. The Master and the connected Slave devices are all set to Terminator/Enable.
2. Only 2 models are provided for series connection (optional). The Position key can only set to Slave1.
3. When paralleling 3 units, see section 6.3.2 for cable connection. When setting Master/Slave, the recommended left-most connection is Master, and then Master, Salve1, and Salve2 from left to right. In this case, the Master and Salve2 are set to Terminator/ Enable.
4. When paralleling 5 units, see section 6.3.3 for cable connection. When setting Master/Slave, the recommended left-most connection is Master, and then Master, Salve1, Salve2, Salve3, and Salve4 from left to right. In this case, the Master and Salve4 need to set Terminator/ Enable.



6.5.2 Setting Regenerative Grid Simulator to Master

Press **CONFIG** in **FUNCTION** menu to enter into the CONFIG menu (Master/Slave Function). Follow the steps below to set the connection of multiple devices to be parallel or series (optional).

1. Press the Master/Slave Function key.
2. Press the Position key at the bottom.
3. Turn the RPG to change the Position key to Master, and press **ENTER** to confirm it.

4. Press the Number of Slave key at the bottom.
5. Turn the RPG to select the Slave number to be connected in parallel or series (optional), and press **ENTER** to confirm it.
6. If the device has two terminals, press the Terminator key at the bottom, and turn the RPG to change the Terminator key to Enable.
7. Press the Function key at the bottom.
8. If the device is in parallel mode, turn the RPG to change the Function key to Parallel. If the setting device is in series mode (optional), turn the RPG to change the Function key to Series, and press **ENTER** to confirm it.
9. The screen returns to the main menu when set to Master, and prompts Slave when set to Slave.

Notice

1. At least one device has to set to Slave in parallel connection, or "System Connection Fail!" will prompt when setting the Master to Enable. See the section below for troubleshooting.
2. Only 2 models are provided for series connection (optional). The Number of Slave key can only set to 1.

⚠WARNING

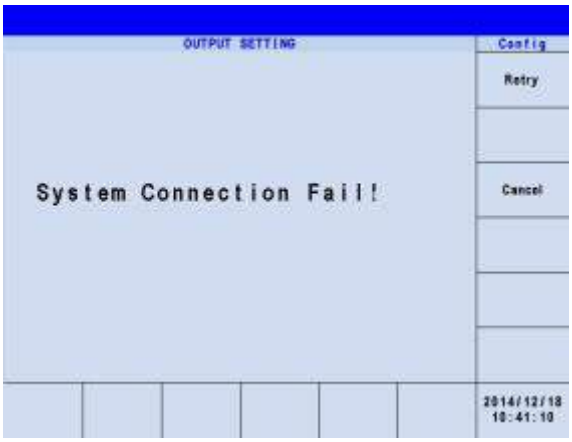
1. When setting the Number of Slave in Master, the rule is N-1 of total regenerative grid simulators. For instance, when setting two simulators for parallel connection, the Number of Slave is 1, and setting two simulators for series connection, the Number of Slave is 1. Incorrect setting of parallel or series number may result in connection failure or damaging the device.
2. The 61800-100 and 61860 Series models cannot be used in parallel / series due to different internal transmission mechanism.

6.6 Troubleshooting

When parallel or series (optional) connection is applied to multiple devices, each device must have a parallel/serial cable to transmit the signals. When the Slave number is set wrong for connection or an error message is prompted during connection, follow the procedure listed below for troubleshooting and execute parallel/series connection again.

6.6.1 BUS Wire Loss

If “System Connection Fail!” occurs when enabling the Master connection, check if the parallel/serial cable is properly connected and the fixture for parallel/series connection or another regenerative grid simulator is set to Slave. If OK, press Retry on Master to reconnect it.



If the parallel/series cable is not connected properly or disconnected when enabling the Master connection, a “SYS SYS_ BUS-WIRE LOSS” warning will appear. First, turn the device off first and check if the parallel/serial cable is connected firmly and reboot for connection again.

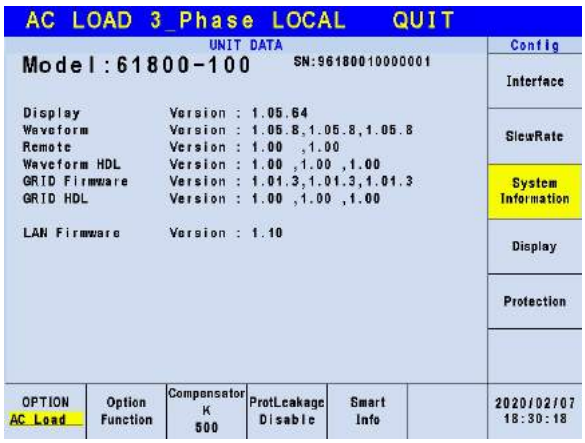
When “SYSTEM SHUTDOWN” warning occurs during connection, turn the device off first and check if the parallel/serial cable is connected firmly and reboot for connection again.


3_Phase
REMOTE
QUIT
OUTPUT SETTING
Main
Φ1 Vac = 0.0V F = 60.00Hz
Φ2 Vac = 0.0V F = 60.00Hz
Φ3 Vac = 0.0V F = 60.00Hz
PROTECTION
Warning!
SYS SYS_SHUTDOWN
2014/12/18
10:59:32

7. AC Load Mode (Optional)

7.1 Switching Method

To set a single regenerative grid simulator to ACL mode, press **CONFIG** in **FUNCTION** menu to enter into the CONFIG menu (System information). Follow the steps below to set the AC load.



1. Press they System Information key.
2. Press the OPTION key.
3. Turn the RPG to change OPTION key to AC Load, and press **ENTER**.
4. Restart the simulator when the LED screen shows restart message.

Notice

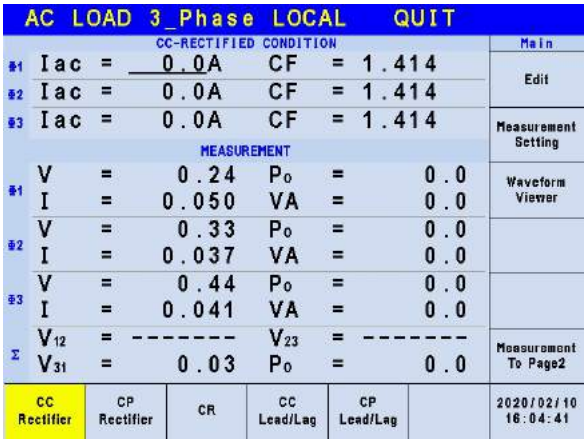
1. The load function in 61800-100 and 61860 Series models cannot be set and used in parallel due to different transmission mechanism.
2. The AC load mode provides bandwidth response speed adjustment. The default value of Compensator K is 500, which is adjusted according to DUT's test items. The output response speed is set by the K value. The higher the K value, the faster the response speed, and vice versa.

7.2 Load Function Interface

When the load mode is turned and self-test procedure is done, the menu will show MAIN PAGE (ACL Mode). To set the load function, it can be done in the CC Rectifier, CP Rectifier, CR, CC Lead/Lag, and CP Lead/Lag function keys at the bottom. The MEASUREMENT menu shows the test items of regenerative AC load, and each phase has 12 types of output test items that are same as the regenerative grid simulator, 3 pages in total (see section 3.3).

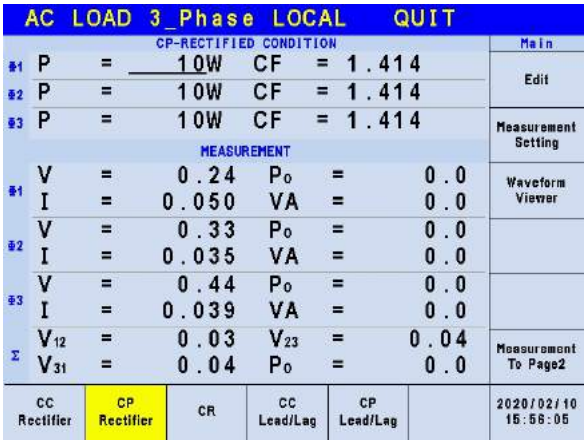
7.2.1 CC Rectifier Mode

When in CC Rectifier mode, it can change the current amplitude and crest factor (CF) settings，in MAIN PAGE.



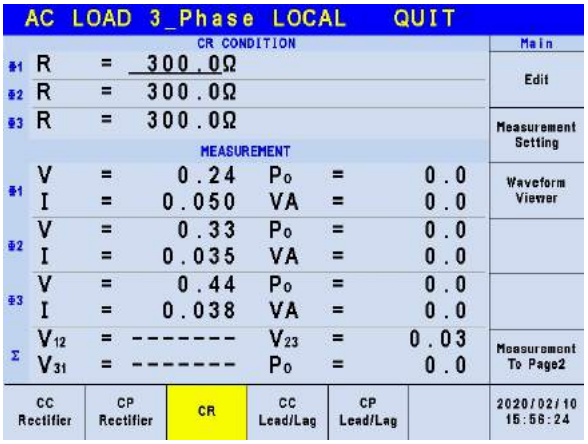
7.2.2 CP Rectifier Mode

When CP Rectifier mode, it can change the power and crest factor (CF) settings in MAIN PAGE.



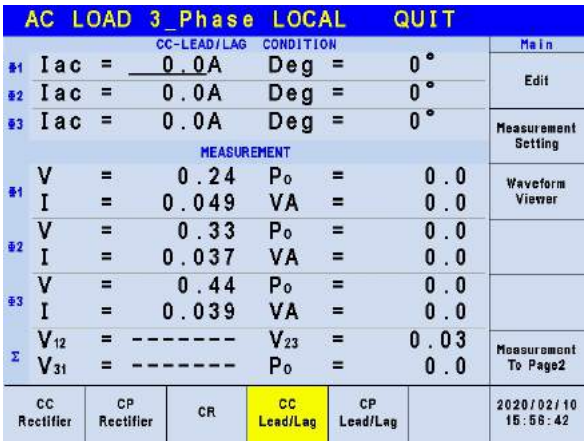
7.2.3 CR Mode

When in CR mode, it can change the resistance settings in MAIN PAGE.

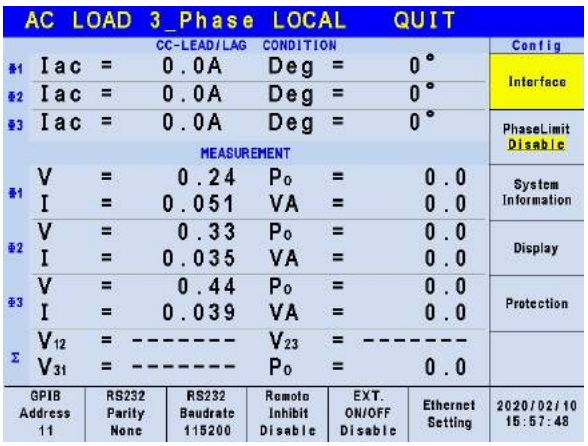


7.2.4 CC Lead/Lag Mode

When in CC Lead/Lag mode, it can change the current amplitude and phase settings in MAIN PAGE. It can change to current mode by removing the Phase limit (>90° or <-90°) following the steps below.

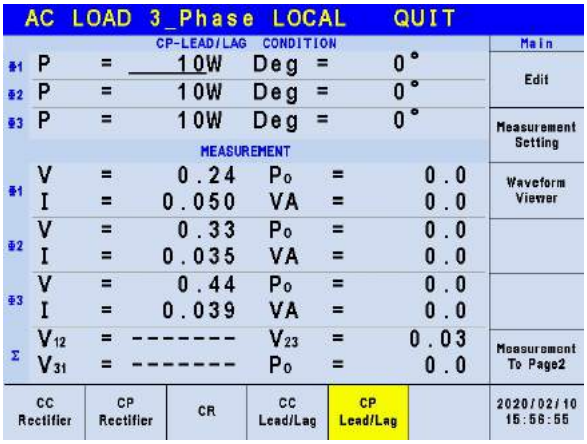


1. Press **CONFIG** to enter into CONFIG menu.
2. Press the Phase limit key.
3. Turn the RPG to change Phase limit Disable and press **ENTER**.

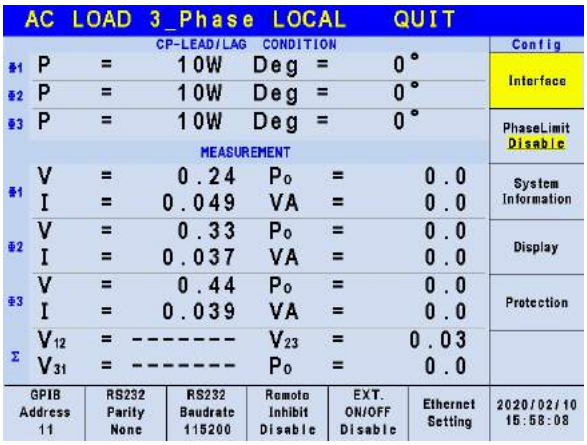


7.2.5 CP Lead/Lag Mode

When in CP Lead/Lag mode, it can change the power and phase settings in MAIN PAGE. It can change to current mode by removing the Phase limit following the steps below.



1. Press **CONFIG** to enter into CONFIG menu.
2. Press the Phase limit key.
3. Turn the RPG to change Phase limit Disable and press **ENTER**.



8. Remote Operation

8.1 Introduction

The Regenerative Grid Simulator is able to do remote control via USB, GPIB, RS-232 or Ethernet. The USB interface supports USB 2.0/USB 1.1. The GPIB interface is an 8-bit parallel data bus that is synchronized by the bus command from the host. RS-232C interface is a serial bus with less powerful functions; however, the user can do basic remote control via simple programs.

8.1.1 USB Interface

(1) Hardware Support: USB 2.0 and USB 1.1
(2) Software Support: USBTMC class and USB488 subclass
(3) OS Support: Windows 98/2000/XP/Vista
(4) Installing Driver: The Regenerative Grid Simulator USB Interface supports USBTMC, so if the PC OS supports USBTMC (installed NI-VISA runtime version 3.00 or above) it is no need to install other drivers. The OS 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 OS. The PC can communicate with the Regenerative Grid Simulator via NI-VISA after using the USB cable to connect them.

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

8.1.2 GPIB Interface

The default of GPIB address is 30 and it can only be changed from the “CONFIG” function menu (see 3.4.)

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 Grid Simulator sets the SRQ to be true if there is a service request.	SR1
Remote/Local	When the Regenerative Grid Simulator is powered on in local mode, it can operate the front panel. In remote mode, all other keys are invalid except **LOCAL/REMOTE**. Press **LOCAL/REMOTE** can return to local mode.	RL1

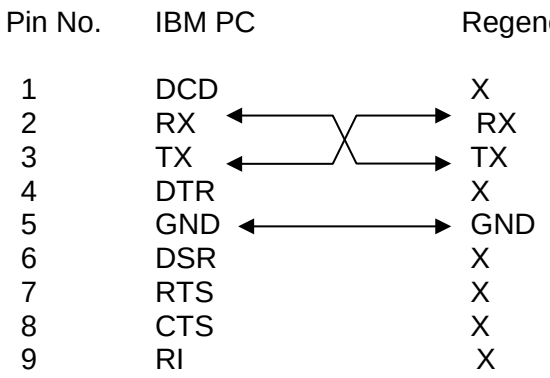
8.1.3 RS-232C Interface

The baud rate of the Regenerative Grid Simulator is set to **115200** with parity set to None. For the RS-232C parameters such as baudrate and parity can be set via "CONFIG" function menu (see section 3.4.)

Only TxD and RxD signals are used for data transmission. The connector is a 9-pin D-subminiature **male** connector. The following table describes the pins and signals of RS-232C connector.

Pin No.	Input/Output	Description
1	---	No Connection
2	INPUT	RxD
3	OUTPUT	TxD
4	---	No Connection
5	GND	GND
6	---	No Connection
7	---	No Connection
8	---	No Connection
9	---	No Connection

Interconnection between the computer (compatible with IBM PC) and the Regenerative Grid Simulator is illustrated below:



8.1.4 Ethernet Interface

To remote program a Regenerative Grid Simulator via a PC with Ethernet interface, it needs to confirm the IP address, Gateway address and Subnet mask in advance. See 3.4.1.3 for detail settings. To ensure reliable data transmission, TCP is used for data transmission and the communication port is 2101.

8.2 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.

8.2.1 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.

8.2.2 Numerical Data Formats

All data programmed to or returned from the Regenerative Grid Simulator are ASCII. 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

8.2.3 Boolean Data Format

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

8.2.4 Character Data Format

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

8.2.5 Basic Definition

Command Tree Table:
The commands of the Regenerative Grid Simulator are structured hierarchically, which is called tree system. Full path must be specified to obtain a particular command. This 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:
Program header is the key word to identify the command according to the IEEE 488.2 syntax described in section 8.4. The Regenerative Grid Simulator accepts characters in both upper and lower cases without any distinction. 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:
Instrument-controlled header can be applied to all instrument commands. Each header has a long form and a short form. The Regenerative Grid Simulator 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 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?, VOLT:DC 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: FREQ?, OUTPut ON.

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

Example: VOLT:AC 110;FREQ 120<PMT>

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

(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 RS-232C.

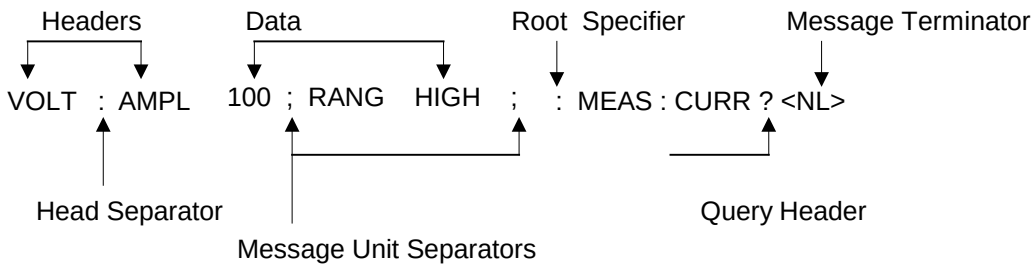


Figure 8-1 Structure of Command Message

8.3 Traversal of the Command Tree

Multiple program 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; : VOLT : AC 100	Only the third colon is a specified root.

8.4 Commands of Regenerative Grid Simulator

This section talks about the syntax and parameters of all commands for the Regenerative Grid Simulator. The examples of each command can be used in common.

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

8.4.1 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 command 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> — Standard event status enabled

This command programs the Standard Event register bits. If one or more enabled events of Standard Event registers are set, the ESB of Status Byte Register is set as well.

Bit Configuration of Standard Event Status Enabled 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? Return standard event status enabled

*ESR? The query reads the Standard Event readings of Event register and clears it. The bits of configuration are the same as Standard Event Status Enabled Register.

*IDN? Return the Regenerative Grid Simulator identification string.
Return Parameter Chroma ATE,61800,123456,01.00
Chroma ATE : Company name
61800 : Model name
123456 : Serial number
01.00 : Firmware version

*RCL<n> Restore the values of specified group that stored in memory previously.
Parameter 1 - 10

*SAV<n> Save the values to a specified group in memory.
Parameter 1 - 10

* RST It resets the Regenerative Grid Simulator to the initial states. It's better to wait for 3 seconds to send the next command.

*SRE It sets conditions of Service Request Enabled Register. If one or more of the enabled events of the Status Byte Register is set, the MSS and RQS of Status Byte Register are set too.

*SRE? This query returns the Service Request Enabled Register.

*STB? This query returns the Status Byte Register.

Bit Configuration 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? It queries the self-test result of the Regenerative Grid Simulator.

8.4.2 Instrument Command Dictionary

The commands are listed in alphabetical order. 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 query syntax.

8.4.2.1 SYSTEM Sub-System

SYSTem
:ERRor?
:VERSion?
:LOCal
:REMote
:DATE
:TIME

SYSTem:ERRor?
Description : This command queries the error string of the command parser.
Query Syntax : SYSTem:ERRor?
Parameter : None
Return Parameter : Error string response: No Error
Data Format Error
Data Range Error
Too Many Errors
Execution Error

SYSTem:VERSion?
Description : This query requests the Regenerative Grid Simulator to identify itself.
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 RS-232C. If SYST : LOC is programmed, the Regenerative Grid Simulator 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 RS-232C. If SYST : REM is programmed, the Regenerative Grid Simulator will be set in the REMOTE state, and the front panel will be disabled except the “<PAGE/EXIT> key.
Query Syntax : None
Parameter : None
Return Parameter : None

SYSTem:DATE
Description : This command sets the date of the Regenerative Grid Simulator real time clock.
Query Syntax : **SYSTem:DATE?**
Parameter : <year>,<month>,<day>
Return Parameter : 2013,01,01

SYSTem:TIME
Description : This command sets the time (24H) of the Regenerative Grid Simulator real time clock.
Query Syntax : **SYSTem:TIME?**

Parameter : <hour>,<minute>,<second>
Return Parameter : 20,30,01

8.4.2.2 INSTRUMENT Sub-System

INSTrument
:EDIT
:Couple
:NSELect
:SELect
:PHASe
:OPTION

INSTrument:EDIT
Description : It is very convenient to use a programmed command to set all phases at the same time for a Regenerative Grid Simulator that 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 : None

INSTrument:COUPle
Description : It is easy to use a command to program all phases in a Regenerative Grid Simulator with multiple phases. If INST: COUP ALL is programmed, the 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

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 Grid Simulator will return Φ 2 measurement voltage. INST: NSEL follows the number to select 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 send 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 Grid Simulator 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:OPTION

Description : This command sets the instrument to be AC Source or AC Load.
Query Syntax : INSTrument:OPTION?
Parameter : SOURCE | LOAD
Return Parameter : SOURCE | LOAD

8.4.2.3 FETCH and MEASURE Sub-System

FETCh | MEASure

[: SCALar]	
: CURRent	
: AC?	It queries the rms current of AC component.
: DC?	It queries the DC current level.
: ACDC?	It queries the current (AC+DC) rms.
: AMPLitude:MAXimum?	It queries the peak current.
: CRESTfactor?	It queries the current crest factor.
: INRush?	It queries the inrush current.
: 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 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 phase 1 & 2.
:V23?	It queries the voltage difference of phase 2 & 3.
:V31?	It queries the voltage difference of phase 3 & 1.

This command enables users to get measurement data from the Regenerative Grid Simulator via MEASure and FETCh. MEASure triggers the acquisition to get new data before returning data, while FETCh returns the previously acquired data from measurement buffer.

FETCh [: SCALar] : CURRent : AC?
MEASure [: SCALar] : CURRent : AC?
Description : These queries return the rms current of AC component that is output from the output terminal.
Query Syntax : FETCh : CURRent : AC?, MEASure : CURRent : AC?
Return Parameter : <NR2>

FETCh [: SCALar] : CURRent : DC?
MEASure [: SCALar] : CURRent : DC?
Description : These queries return the DC current that is output from the output terminal.
Query Syntax : FETCh : CURRent : DC?, MEASure : CURRent : DC?
Return Parameter : <NR2>

FETCh [: SCALar] : CURRent : ACDC?
MEASure [: SCALar] : CURRent : ACDC?
Description : These queries return the rms current that is output from the output terminal.
Query Syntax : FETCh : CURRent : ACDC?, MEASure : CURRent : ACDC?
Return Parameter : <NR2>

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

FETCh [: SCALar] : CURRent : CREStfactor?
MEASure [: SCALar] : CURRent : CREStfactor?
Description : These queries return the output current crest factor. It is the ratio of peak output current to rms output current.
Query Syntax : FETCh : CURRent : CREStfactor?
MEASure : CURRent : CREStfactor?
Return Parameter : <NR2>

FETCh [: SCALar] : CURRent : INRush?
MEASure [: SCALar] : CURRent : INRush?
Description : These queries return the inrush current that is output from the output terminal.
Query Syntax : FETCh:CURRent: INRush?, MEASure: CURRent : INRush?
Return Parameter : <NR2>

FETCh [: SCALar] : FREQuency?
MEASure [: SCALar] : FREQuency?
Description : These queries return the output frequency in Hertz.
Query Syntax : FETCh : FREQuency?
MEASure : FREQuency?
Return Parameter : <NR2>

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

Description : These queries return the real power that is output from the output terminals in watt.
Query Syntax : FETCh : POWer : AC?
MEASure : POWer : AC?
Return Parameter : <NR2>

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

Description : These queries return the apparent power that is output from the output terminals in volt-ampere.
Query Syntax : FETCh : POWer : AC : APParent?
MEASure : POWer : AC : APParent?
Return Parameter : <NR2>

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

Description : These queries return the reactive power that is output from the output terminals in volt-ampere. Reactive power is calculated by the following formula:

$$\text{VAR} = \sqrt{APPARENTPOWER^2 - REALPOWER^2}$$

Query Syntax : FETCh : POWer : AC : REACtive?
MEASure : POWer : AC : REACtive?
Return Parameter : <NR2>

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

Description : These queries return the power factor that is output from the output terminals. Power factor is computed by:
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 : These queries return the total of real power that is output from 3-phase output terminal in watt.
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 : These queries return the total apparent power that is output from 3-phase output terminal in volt-ampere.
Query Syntax : FETCh:POWer:AC:TOTal:APParent?
MEASure:POWer:AC:TOTal:APParent?
Return Parameter : <NR2>

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

Description : These queries return the rms of AC component that is output from the output terminal.
Query Syntax : FETCh [: SCALar] : VOLTage : AC?
MEASure [: SCALar] : VOLTage : AC?
Return Parameter : <NR2>

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

Description : These queries return the DC composite voltage that is output from the output terminal.
Query Syntax : FETCh [: SCALar] : VOLTage : DC?
MEASure [: SCALar] : VOLTage : DC?
Return Parameter : <NR2>

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

Description : These queries return the rms that is output from the output terminal.
Query Syntax : FETCh [: SCALar] : VOLTage : ACDC?
MEASure [: SCALar] : VOLTage : ACDC?
Return Parameter : <NR2>

FETCh [: SCALar] : VOLTage: AMPLitude : MAXimum?
MEASure [: SCALar] : VOLTage : AMPLitude : MAXimum?

Description : These queries return the absolute value of peak voltage.
Query Syntax : FETCh : VOLTage: AMPLitude : MAXimum?,
MEASure : VOLTage : AMPLitude : MAXimum?
Return Parameter : <NR2>

FETCh [: SCALar] : LINE : V12?
MEASure [: SCALar] : LINE : V12?

Description : These queries return the line voltage between phase 1 and 2.
Query Syntax : FETCh [: SCALar] : LINE : V12?
MEASure [: SCALar] : LINE : V12?
Return Parameter : <NR2>

FETCh [: SCALar] : LINE : V23?
MEASure [: SCALar] : LINE : V23?

Description : These queries return the line voltage between phase 2 and 3.
Query Syntax : FETCh [: SCALar] : LINE : V23?
MEASure [: SCALar] : LINE : V23?
Return Parameter : <NR2>

FETCh [: SCALar] : LINE : V31?
MEASure [: SCALar] : LINE : V31?

Description : These queries return the line voltage between phase 3 and 1.
Query Syntax : FETCh [: SCALar] : LINE : V31?
MEASure [: SCALar] : LINE : V31?
Return Parameter : <NR2>

8.4.2.4 OUTPUT Sub-System

OUTPut
[: STATe]
: RELay
: SLEW
: VOLTage
: AC
: DC
:FREQency
: COUPling
: MODE
: PROTection
:CLEar
: XHV

OUTPut [:STATe]
Description : This command enables or disables the output of the Regenerative Grid Simulator. Disabled output is to set the output voltage amplitude to 0 Volt.
Query Syntax : OUTPut [: STATe]?
Parameter : OFF | ON
Return Parameter : OFF | ON

OUTPut:RELay
Description : This command sets output relay on or off.
Query Syntax : OUTPut : RELay?
Parameter : OFF | ON, ON sets the output relay of the Regenerative Grid Simulator on (close), OFF sets the output relay of the Regenerative Grid Simulator off (open).
Return Parameter : OFF | ON

OUTPut:SLEW : VOLTage : AC
Description : This command sets the slew rate of the AC output voltage.
Query Syntax : OUTPut : SLEW : VOLTage : AC?
Parameter : <NR2>, the valid range is 0.000V/ms ~ 1200.000V/ms.
Return Parameter : <NR2>

OUTPut:SLEW : VOLTage : DC
Description : This command sets the slew rate of the DC composite voltage.
Query Syntax : OUTPut : SLEW : VOLTage : DC?
Parameter : <NR2>, the valid range is 0.000V/ms ~ 1200.000V/ms.
Return Parameter : <NR2>

OUTPut:SLEW : FREQuency
Description : This command sets the slew rate of the output frequency.
Query Syntax : OUTPut : SLEW : FREQuency?
Parameter : <NR2>, the valid range is 0.000 Hz/ms ~ 1600.000Hz/ms
Return Parameter : <NR2>

OUTPut:COUPling
Description : This command selects the coupling of the output signals.
Query Syntax : OUTPut : COUPling?

Parameter : AC | DC | ACDC
Return Parameter : AC | DC | ACDC

OUTPut:MODE
Description : This command sets the operation mode and "FIXED" mode is the general operation mode.
Query Syntax : OUTPut : MODE?
Parameter : FIXED | LIST | PULSE | STEP | SYNTH | INTERHAR
Return Parameter : FIXED | LIST | PULSE | STEP | SYNTH | INTERHAR

OUTPut:PROTection : CLEar
Description : This command clears the latch that disables the output when over current (OCP), over temperature (OTP), over power (OPP) or remote inhibit (RI) is detected. All conditions that generate the faults must be resolved before the latch is cleared.
Query Syntax : None
Parameter : None
Return Parameter : None

OUTPut:XHV
Description : This command the XHV function to on or off. (Optional)
Query Syntax : OUTPut : XHV?
Parameter : OFF | ON, ON enables the simulator's XHV function while OFF disables the simulator's XHV function.
Return Parameter : OFF | ON

8.4.2.5 SOURCE Sub-System

[SOURce :]
CURRent
: LIMit
: DELay
: INRush
: STARt
: INTerval
FREQency
[: {CW | IMMediate}]
: LIMit
VOLTage
[: LEVel][: IMMediate][:AMPLitude]
: AC
: DC
: LIMit
: AC
: DC
: PLUS
: MINus
POWer
: PROTection
FUNCtion
: SHAPe
: SHAPe

: A
: A
: MODE
: THD
: AMP
: B
: B
: MODE
: THD
: AMP

[SOURce:] CURRent : LIMit
Description : This command sets the rms current limit of the Regenerative Grid Simulator for protection.
Query Syntax : [SOURce :] CURRent : LIMit?
Parameter : <NR2>, the valid range is 0.00 ~ maximum current spec. of the specific model (unit: A.)
Return Parameter : <NR2>

[SOURce:] CURRent : DELay
Description : This command sets the time delayed for triggering over current protection.
Query Syntax : [SOURce :] CURRent : DELay?
Parameter : <NR2>, the valid range is 0.0 ~ 5.0 (unit: 0.1 second.)
Return Parameter : <NR2>

[SOURce:] CURRent : INRush : STARt
Description : This command sets the time to start the inrush current measurement.
Query Syntax : [SOURce :] CURRent : INRush : STARt?
Parameter : <NR2>, the valid range is 0 ~ 9999 (unit: ms.)
Return Parameter : <NR2>

[SOURce:] CURRent : INRush : INTerval
Description : This command sets the measuring interval for inrush current measurement.
Query Syntax : [SOURce :] CURRent : INRush : INTerval?
Parameter : <NR2>, the valid range is 0 ~ 9999 (unit: ms.)
Return Parameter : <NR2>

[SOURce:] FREQuency [: {CW | IMMediate}]
Description : This command sets the output waveform frequency for the Regenerative Grid Simulator in Hz.
Query Syntax : [SOURce :] FREQuency [: {CW | IMMediate}]?
Parameter : <NR2>, the valid range is 15.00 ~ 100.00 (unit: Hz.)
Return Parameter : <NR2>

[SOURce:] FREQuency : LIMit
Description : This command sets the output frequency limit for the Regenerative Grid Simulator.
Query Syntax : [SOURce :] FREQuency : LIMit?
Parameter : <NR2>, the valid range is 15.00 ~ 100.00 (unit: Hz)
Return Parameter : <NR2>

[SOURce:] POWer:PROTection

Description : This command sets the OPP (Over Power Protection) for the Regenerative Grid Simulator.
Query Syntax : [SOURce :] POWer:PROTection?
Parameter : <NR2>, the valid range is 0.0 ~ maximum power of specific model (unit: W.)
Return Parameter : <NR2>

[SOURce:] VOLTage [: LEVel][: IMMediate][: AMPLitude] : AC

Description : This command sets the AC composite output voltage in Volts.
Query Syntax : [SOURce :] VOLTage [: LEVel][: IMMediate][: AMPLitude] : AC?
Parameter : <NR2>, the valid range is 0.0 ~ 300.0.
Return Parameter : <NR2>

[SOURce:] VOLTage [: LEVel][: IMMediate][: AMPLitude] : DC

Description : This command sets the DC composite output voltage in Volts.
Query Syntax : [SOURce :] VOLTage [: LEVel][: IMMediate][: AMPLitude] : DC?
Parameter : <NR2>, the valid range is -424.2 ~ 424.2.
Return Parameter : <NR2>

[SOURce:] VOLTage : LIMit : AC

Description : This command sets the Vac LIMIT to restrict the value of Vac.
Query Syntax : [SOURce :] VOLTage : LIMit : AC?
Parameter : <NR2>, the valid range is 0.0 ~ 300.0 (unit: V.)
Return Parameter : <NR2>

[SOURce:] VOLTage : LIMit : DC : PLUS

Description : This command sets the Vdc Limit(+).
Query Syntax : [SOURce :] VOLTage : LIMit : DC : PLUS?
Parameter : <NR2>, the valid range is -424.2 ~ 424.2 (unit: V)
PS: The lower limit cannot exceed Vdc Limit(-).
Return Parameter : <NR2>

[SOURce:] VOLTage : LIMit : DC : MINus

Description : This command sets the Vdc Limit(-).
Query Syntax : [SOURce :] VOLTage : LIMit : DC : MINus?
Parameter : <NR2>, the valid range is -424.2 ~ -424.2 (unit: V)
PS: The upper limit cannot exceed Vdc Limit(+).
Return Parameter : <NR2>

[SOURce:] FUNCtion : SHAPe

Description : This command specifies the waveform buffer. The Regenerative Grid Simulator output has two buffers and users need to specify to use the contents of the waveform buffer A or B.
Query Syntax : [SOURce :] FUNCtion : SHAPe?
Parameter : A | B
Return Parameter : A | B

[SOURce:] FUNCtion : SHAPe : A

Description : This command specifies the waveform buffer A for use.
Query Syntax [SOURce :] FUNCtion : SHAPe : A?
Parameter : SINE | SQUA | CSIN | DST<01..30> | USR<01..06>
Return Parameter : SINE | SQUA | CSIN | DST<01..30> | USR<01..06>

[SOURce:] FUNCtion : SHAPe : A : MODE

Description : This command selects the mode for the clipping in waveform buffer A for use.
Query Syntax : [SOURce :] FUNCtion : SHAPe : A : MODE?
Parameter : AMP | THD
Return Parameter : AMP | THD

[SOURce:] FUNCtion : SHAPe : A : THD

Description : This command sets the clipped THD percentage for the clipping in waveform buffer A.
Query Syntax : [SOURce :] FUNCtion : SHAPe : A : THD?
Parameter : <NR2>, the valid range is 0.0% ~ 43%.
Return Parameter : <NR2>

[SOURce:] FUNCtion : SHAPe: A : AMP

Description : This command sets the clipped peak percentage for the clipping in waveform buffer A.
Query Syntax : [SOURce :] FUNCtion : SHAPe : A : AMP?
Parameter : <NR2>, the valid range is 0.0% ~ 100%.
Return Parameter : <NR2>

[SOURce:] FUNCtion : SHAPe : B

Description : This command specifies the waveform buffer B for use.
Query Syntax : [SOURce :] FUNCtion : SHAPe : B?
Parameter : SINE | SQUA | CSIN | DST<01..30> | USR<01..06>
Return Parameter : SINE | SQUA | CSIN | DST<01..30> | USR<01..06>

[SOURce:] FUNCtion : SHAPe : B : MODE

Description : This command selects the mode for the clipping in waveform buffer B for use.
Query Syntax : [SOURce :] FUNCtion : SHAPe : B : MODE?
Parameter : AMP | THD
Return Parameter : AMP | THD

[SOURce:] FUNCtion : SHAPe : B : THD

Description : This command sets the clipped THD percentage for the clipping in waveform buffer B.
Query Syntax : [SOURce :] FUNCtion : SHAPe : B : THD?
Parameter : <NR2>, the valid range is 0.0% ~ 43%.
Return Parameter : <NR2>

[SOURce:] FUNCtion : SHAPe: B : AMP

Description : This command sets the clipped peak percentage for the clipping in waveform buffer B.
Query Syntax : [SOURce :] FUNCtion : SHAPe : B : AMP?
Parameter : <NR2>, the valid range is 0.0% ~ 100%.
Return Parameter : <NR2>

8.4.2.6 CONFIGURE Sub-System

[SOURce:]
CONFigure
: INHibit
: EXTernal
: COUPling
: EXTON

[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 : EXTernal
Description : This command sets if enabling the External-V Reference function.
Query Syntax : [SOURce :] CONFigure : EXTernal?
Parameter : OFF | ON
Return Parameter : OFF | ON

[SOURce:] CONFigure : COUPling?
Description : This command sets the External-V Reference to be AC_AMPLIFIER or DC_LEVEL to control the Regenerative Grid Simulator output.
Query Syntax : [SOURce :] CONFigure : COUPling?
Parameter : AC | DC
Return Parameter : AC | DC

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

8.4.2.7 PHASE Sub-System

[SOURce:]
PHASe
: ON
: OFF
: P12
: P13
: SEQuence
: THREE
: RELOCK
:BALanced :RELOCK

[SOURce:] PHASe: ON
Description : This command sets the transition angle when the waveform shifts. The default is ON meaning 0 degree.
Query Syntax : [SOURce :] PHASe : ON?

Parameter : <NR2>, the valid range is 0.0 ~ 359.9.
Return Parameter : <NR2>

[SOURce:] PHASe: OFF
Description : This command sets the transition angle when the waveform ends.
Query Syntax : [SOURce :] PHASe : OFF?
Parameter : <NR2>, the valid range is 0.0 ~ 360.0, 360.0: means IMMED.
Return Parameter : <NR2>

[SOURce:]PHASe:P12
Description : This command sets the phase difference of Φ1 and Φ2.
Query Syntax : [SOURce :]PHASe:P12?
Parameter : <NR2>, the valid range is 0.0 ~ 359.9.
Return Parameter : <NR2>

[SOURce:]PHASe:P13
Description : This command sets the phase difference of Φ1 and Φ3.
Query Syntax : [SOURce :]PHASe:P13?
Parameter : <NR2>, the valid range is 0.0 ~ 359.9.
Return Parameter : <NR2>

[SOURce:]PHASe:SEQuence
Description : This command sets the phase sequence in 3-phase mode.
Query Syntax : [SOURce :]PHASe:SEQuence?
Parameter : POS | NEG
Return Parameter : POSITIVE | NEGATIVE

[SOURce:]PHASe:RELOCK
Description : This command sets the relock function in 3-phase mode.
Query Syntax : [SOURce :]PHASe:RELOCK?
Parameter : ENABLE | DISABLE
Return Parameter : ENABLE | DISABLE

[SOURce:]PHASe:THREE
Description : This command sets the operation mode in 3-phase mode.
Query Syntax : [SOURce :]PHASe:THREE?
Parameter : INDEPEND | SAMEFREQ | BALANCE
Return Parameter : INDEPEND | SAMEFREQ | BALANCE

[SOURce:]PHASe:THREE:BALanced
Description : This command sets the voltage operation mode in 3-phase balanced mode.
Query Syntax : [SOURce :]PHASe:THREE:BAL?
Parameter : PHASE | LINE

8.4.2.8 STATUS Sub-system

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 specific bit is enabled from Operation Status register.
Query Syntax : STATus : OPERation : ENABle?
Parameter : <NR1>, the valid range is 0 ~ 255.
Return Parameter : Always 0.

STATus : QUEStionable : CONDition?
Description : This query command returns the value of Questionable Condition register. It is a read only register that saves the questionable condition of Regenerative Grid Simulator in real time.
Query Syntax : STATus : QUEStionable : CONDition?
Parameter : NONE
Return Parameter : <NR1>, the valid range is 0 ~ 511.

STATus : QUEStionable [: EVENt] ?
Description : This query command returns the value of Questionable Event register. It is a read only register that saves all items that passed Questionable NTR and/or PTR filter. If the QUES bit in Service Request Enabled register has been set and Questionable Event register > 0, the QUES of Status Byte register will be set too.
Query Syntax : STATus : QUEStionable [: EVENt]?
Parameter : NONE
Return Parameter : <NR1>, the valid range is 0 ~ 511.

STATus : QUEStionable : ENABle
Description : The command sets or reads the value of Questionable Enable register. The register is the shield when specific bit is enabled to set the QUES bit of Status Byte register from Operation Status register.
Query Syntax : STATus : QUEStionable : ENABle?
Parameter : <NR1>, the valid range is 0 ~ 511.
Return Parameter : <NR1>

STATus : QUEStionable : NTRansition

Description : These commands set or read the value of register. The operation of these registers is the same as polarity filter of Questionable Enable and Questionable Event registers that lead 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 to be set.

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

* If the two same bits in both NTR and PTR registers are set to 0, none 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	15-9	8	7	6	5	4	3	2	1	0
Condition	---	OVP	INP	OCP	FAN	SHT	OTP	OPP		

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.

Query Syntax : STATus : QUEStionable : NTRansition?
Parameter : <NR1>, the valid range is 0 ~ 511.
Return Parameter : <NR1>

STATus : QUEStionable : PTRansition

Description : These commands set or read the values of Questionable PTR register. Please refer to the description of previous command.
Query Syntax : STATus : QUEStionable : PTRansition?
Parameter : <NR1>, the valid range is 0 ~ 511.
Return Parameter : <NR1>

8.4.2.9 TRACE Sub-system

TRACe
: RMS

TRACe
Description : This command sets the user-defined waveform data. It needs 1024 data points to create a period of waveform. Users have to normalize the data and make the maximum point equal to 32767 or the minimum point equal to -32767.
Syntax : TRACe <waveform_name>, <amplitude> {,<amplitude>}
Parameter : <waveform_name>:US<n>, n=1~6, <amplitude>:<NR1>, the valid range is -32767 ~ 32767.
Example : TRACe US1 100 200 …32767... 500 800 <= 1024 points
This command requires about 1 second for execution.

TRACe : RMS
Description : This command sets the rms value of user's waveform. Users need to calculate the root mean square value for 1024 data points.
Syntax : TRACe : RMS <waveform_name>, <rms>
Parameter : <waveform_name>:US<n>, n=1~6, <rms>:<NR1>, the valid range is 0 ~ 32767.
Example : TRACe : RMS US1 27000

8.4.2.10 LIST Sub-system

[SOURce:]
LIST
: COUPling
:TRIG
: POINts?
: COUNt
: DWELl
: SHAPe
: BASE
: VOLTage
: AC
: STARt
: END
: DC
: STARt
: END
: FREQuency
: STARt
: END
: DEGRee
OUTPut
: MODE

TRIG
TRIG : STATE?

[SOURce:]LIST : COUPling

Description : This command sets the function of list mode.
Query Syntax : [SOURce:] LIST : Coupling?
Parameter : ALL | NONE
Return Parameter : ALL | NONE

[SOURce:]LIST : TRIG

Description : This command sets the trigger type of list mode.
Query Syntax : [SOURce:] LIST : TRIG?
Parameter : AUTO | MANUAL|EXCITE
Return Parameter : AUTO | MANUAL|EXCITE

[SOURce:] LIST : POINts?

Description : This command returns the valid order number of list mode.
Query Syntax : [SOURce:] LIST : POINts?
Parameter : None
Return Parameter : <NR1>, the valid range is 0 ~ 100.

[SOURce :] LIST : COUNt

Description : This command sets the number of times the list executed before completion.
Query Syntax : [SOURce :] LIST : COUNt?
Parameter : <NR1>, the valid range is 0 ~ 65535.
Return Parameter : <NR1>

[SOURce :] LIST : DWELl

Description : This command sets the sequence of dwell time list points.
Query Syntax : [SOURce:] LIST : DWELl?
Parameter : <NR2>, …, <NR2>, the valid range is 0 ~ 99999999.9 (unit: ms.)
Return Parameter : <NR2>, …, <NR2>

[SOURce :] LIST : SHAPe

Description : This command sets the sequence of waveform buffer list points.
Query Syntax : [SOURce:] LIST : SHAPe?
Parameter : A|B, …, A|B
Return Parameter : A|B, …, A|B

[SOURce :] LIST : BASE

Description : This command sets the time base of list.
Query Syntax : [SOURce:] LIST : BASE?
Parameter : TIME | CYCLE
Return Parameter : TIME | CYCLE

[SOURce :] LIST : VOLTage : AC : STARt

Description : This command sets the sequence of AC start voltage list points.
Query Syntax : [SOURce:] LIST : VOLTage : AC : STARt?
Parameter : <NR2>, …, <NR2>, the valid range is 0.0 ~ 300.0.
Return Parameter : <NR1>, …, <NR2>

[SOURce :] LIST : VOLTage : AC : END

Description : This command sets the sequence of AC end voltage list points.
Query Syntax : [SOURce:] LIST : VOLTage : AC : END?
Parameter : <NR2>, …, <NR2>, the valid range is 0.0 ~ 300.0.
Return Parameter : <NR2>, …, <NR2>

[SOURce :] LIST : VOLTage : DC : STARt

Description : This command sets the sequence of DC start voltage list points.
Query Syntax : [SOURce:] LIST : VOLTage : DC : STARt?
Parameter : <NR2>, …, <NR2>, the valid range is -424.2 ~ 414.2.
Return Parameter : <NR1>

[SOURce :] LIST : VOLTage : DC : END

Description : This command sets the sequence of DC end voltage list points.
Query Syntax : [SOURce:] LIST : VOLTage : DC : STARt?
Parameter : <NR2>, …, <NR2>, the valid range is -424.2 ~ 414.2.
Return Parameter : <NR2>, …, <NR2>

[SOURce :] LIST : FREQuency : STARt

Description : This command sets the sequence of start frequency list points.
Query Syntax : [SOURce:] LIST : FREQuency : STARt?
Parameter : <NR2>, …, <NR2>, the valid range is 15.00 ~ 100.00 (unit: Hz.)
Return Parameter : <NR2>, …, <NR2>

[SOURce :] LIST : FREQuency : END

Description : This command sets the sequence of end frequency list points.
Query Syntax : [SOURce:] LIST : FREQuency : END?
Parameter : <NR2>, …, <NR2>, the valid range is 15.0 ~ 100.00 (unit: Hz.)
Return Parameter : <NR2>, …, <NR2>

[SOURce :] LIST : DEGRee

Description : This command sets the sequence of phase angle list points.
Query Syntax : [SOURce:] LIST : DEGRee?
Parameter : <NR2>, …, <NR2>, the valid range is 0.0 ~ 359.9.
Return Parameter : <NR2>, …, <NR2>

OUTPut : MODE

Description : This command sets the operation mode.
Query Syntax : OUTPut : MODE?
Parameter : FIXED | LIST | PULSE | STEP | SYNTH | INTERHAR
Return Parameter : FIXED | LIST | PULSE | STEP | SYNTH | INTERHAR

TRIG

Description : This command sets LIST mode in OFF, ON execution state after setting OUTPut: MODE LIST. If users wish to change the parameters, it's necessary to set TRIG OFF then OUTPut: MODE FIXED. Then, set OUTPut : MODE LIST again to get ready to set TRIG ON.
Query Syntax : TRIG : STATE?
Parameter : OFF | ON
Return Parameter : OFF | RUNNING

8.4.2.11 PULSE Sub-system

[SOURce :]
PULSe
: VOLTage
: AC
: DC
: FREQuency
: SHAPe
: SPHase
: COUNt
: DCYCle
: PERiod
: TRIG

OUTPut
: MODE

TRIG
TRIG : STATE?

[SOURce :] PULSe : VOLTage : AC
Description : This command sets AC voltage for the duty cycle of PULSE mode.
Query Syntax : [SOURce :] PULSE : VOLTage : AC?
Parameter : <NR2>, the valid range is 0.0 ~ 300.0.
Return Parameter : <NR2>

[SOURce :] PULSe : VOLTage : DC
Description : This command sets the DC voltage for the duty cycle of PULSE mode.
Query Syntax : [SOURce :] PULSE : VOLTage : DC?
Parameter : <NR2>, the valid range is -424.2 ~ 424.2.
Return Parameter : <NR2>

[SOURce :] PULSe : FREQuency
Description : This command sets the frequency for the duty cycle of PULSE mode.
Query Syntax : [SOURce :] PULSE : FREQuency?
Parameter : <NR2>, the valid range is 15.0 ~ 100.00 (unit: Hz.)
Return Parameter : <NR2>

[SOURce :] PULSe : SHAPe
Description : This command selects the waveform buffer for PULSE mode.
Query Syntax : [SOURce :] PULSE : SHAPe?
Parameter : A | B
Return Parameter : A | B

[SOURce :] PULSe : SPHase
Description : This command sets the start phase angle of duty cycle for PULSE mode.
Query Syntax : [SOURce :] PULSE : SPHase?
Parameter : <NR2>, the valid range is 0.0 ~ 359.9.
Return Parameter : <NR2>

[SOURce :] PULSe : COUNt

Description : This command sets the number of times the pulse executed before completion.
Query Syntax : [SOURce :] PULSE : COUNt?
Parameter : <NR2>, the valid range is 0 ~ 65535.
Return Parameter : <NR2>

[SOURce :] PULSe : DCYCle

Description : This command sets the duty cycle of PULSE mode.
Query Syntax : [SOURce :] PULSE : DCYCle?
Parameter : <NR2>, the valid range is 0 % ~ 100 %.
Return Parameter : <NR2>

[SOURce :] PULSe : PERiod

Description : This command sets the period of the PULSE mode.
Query Syntax : [SOURce :] PULSE : PERiod?
Parameter : <NR2>, the valid range is 0 ~ 99999999.9 (unit: ms.)
Return Parameter : <NR2>

[SOURce:]PULSe : TRIG

Description : This command sets the TRIG type of PULSE mode.
Query Syntax : [SOURce:] PULSe : TRIG?
Parameter : AUTO | MANUAL|EXCITE
Return Parameter : AUTO | MANUAL|EXCITE

OUTPut : MODE

Description : This command sets the operation mode.
Query Syntax : OUTPut : MODE?
Parameter : FIXED | LIST | PULSE | STEP | SYNTH | INTERHAR
Return Parameter : FIXED | LIST | PULSE | STEP | SYNTH | INTERHAR

TRIG

Description : This command sets PULSE mode in OFF execution state after setting OUTPut : MODE PULSE. If users want to change the parameters, it's necessary to set TRIG OFF then OUTPut : MODE FIXED. Then, set OUTPut : MODE PULSE again to get ready to set TRIG ON.
Query Syntax : TRIG : STATE?
Parameter : OFF | ON
Return Parameter : OFF | RUNNING

8.4.2.12 STEP Sub-system

[SOURce:]
STEP
: VOLTage
: AC
: DC
: FREQuency
: SHAPe
: SPHase
: DVOLtage

: AC
: DC
: DFRequency
: DWELl
: COUNt
: TRIG

OUTPut
: MODE
TRIG
TRIG: STATE?

[SOURce :] STEP : VOLTage : AC
Description : This command sets the initial AC voltage of STEP mode.
Query Syntax : [SOURce :] STEP : VOLTage : AC?
Parameter : <NR2>, the valid range is 0.0 ~ 300.0.
Return Parameter : <NR2>

[SOURce :] STEP : VOLTage : DC
Description : This command sets the initial DC voltage of STEP mode.
Query Syntax : [SOURce :] STEP : VOLTage : DC?
Parameter : <NR2>, the valid range is -424.2 ~ 424.2.
Return Parameter : <NR2>

[SOURce :] STEP : FREQuency
Description : This command sets the initial frequency of STEP mode.
Query Syntax : [SOURce :] STEP : FREQuency?
Parameter : <NR2>, the valid range is 15.0 ~ 100.00 (unit: Hz.)
Return Parameter : <NR2>

[SOURce :] STEP : SHAPe
Description : This command selects the waveform buffer of STEP mode.
Query Syntax : [SOURce :] STEP : SHAPe?
Parameter : A | B
Return Parameter : A | B

[SOURce :] STEP : SPHase
Description : This command sets the start phase angle of STEP mode.
Query Syntax : [SOURce :] STEP : SPHase?
Parameter : <NR2>, the valid range is 0.0 ~ 359.9.
Return Parameter : <NR2>

[SOURce :] STEP : DVOLtage : AC
Description : This command sets the AC voltage change in each step.
Query Syntax : [SOURce :] STEP : DVOLtage : AC?
Parameter : <NR2>, the valid range is -300.0 ~ 300.0.
Return Parameter : <NR2>

[SOURce :] STEP : DVOLtage : DC
Description : This command sets the DC voltage change in each step.
Query Syntax : [SOURce :] STEP : DVOLtage : DC?
Parameter : <NR2>, the valid range is -424.2 ~ 424.2.
Return Parameter : <NR2>

[SOURce :] STEP : DFRequency

Description : This command sets the frequency change in each step.
Query Syntax : [SOURce :] STEP : DFRequency?
Parameter : <NR2>, the valid range is -100.00 ~ 100.00 (unit: Hz.)
Return Parameter : <NR2>

[SOURce :] STEP : DWELl

Description : This command sets the dwell time in each step.
Query Syntax : [SOURce :] STEP : DWELl?
Parameter : <NR2>, the valid range is 0 ~ 99999999.9 (unit: ms.)
Return Parameter : <NR2>

[SOURce :] STEP : COUNt

Description : This command sets the number of times the step executed before completion.
Query Syntax : [SOURce :] STEP : COUNt?
Parameter : <NR2>, the valid range is 0 ~ 65535.
Return Parameter : <NR2>

[SOURce:] STEP : TRIG

Description : This command sets the TRIP type of STEP mode.
Query Syntax : [SOURce:] STEP : TRIG?
Parameter : AUTO | MANUAL
Return Parameter : AUTO | MANUAL

OUTPut : MODE

Description : This command sets the operation mode.
Query Syntax : OUTPut : MODE?
Parameter : FIXED | LIST | PULSE | STEP | SYNTH | INTERHAR
Return Parameter : FIXED | LIST | PULSE | STEP | SYNTH | INTERHAR

TRIG

Description : This command sets STEP mode in OFF, ON execution state after setting OUTPut : MODE STEP. If users want to change the parameters, it's necessary to set TRIG OFF then OUTPut : MODE FIXED. Then, set OUTPut : MODE STEP again to get ready to set TRIG ON.
Query Syntax : TRIG : STATE?
Parameter : OFF | ON
Return Parameter : OFF | RUNNING

8.4.2.13 SYNTHESIS Sub-system

[SOURce:]

SYNThesis

: COMPose
: AMPLitude
: PHASe
: FUNDamental
: DC
: FREQuency
: SPHase

OUTPut
: MODE

TRIG
TRIG: STATE?

[SOURce :] SYNThesis : COMPose
Description : This command sets the data format of each harmonic order. VALUE: absolute value, PERCENT: basic computer percentage. Users can program 6 waveforms for execution.
Query Syntax : [SOURce :] SYNThesis : COMPose?
Parameter : VALUE1 | VALUE2 | VALUE3 | PERCENT1 | PERCENT2 | PERCENT3
Return Parameter : VALUE1 | VALUE2 | VALUE3 | PERCENT1 | PERCENT2 | PERCENT3

[SOURce :] SYNThesis : AMPLitude
Description : This command sets the amplitude of each harmonic order. The maximum order is 50.
Query Syntax : [SOURce :] SYNThesis : AMPLitude?
Parameter : <NR2>, …, <NR2>
Valid range:

Order	Value	Percentage
2 ~ 10	0 ~ 90.0	0 ~ 30.00
11 ~ 20	0 ~ 60.0	0 ~ 20.00
21 ~ 30	0 ~ 30.0	0 ~ 10.00
31 ~ 40	0 ~ 30.0	0 ~ 10.00
41 ~ 50	0 ~ 15.0	0 ~ 5.00

Return Parameter : <NR2>, …,<NR2>

[SOURce :] SYNThesis : PHASe
Description : This command sets the phase angle of each harmonic order.
Query Syntax : [SOURce :] SYNThesis : PHASe?
Parameter : <NR2>, …, <NR2>, the valid range: 0.0 ~ 359.9
Return Parameter : <NR2>, …, <NR2>

[SOURce :] SYNThesis : FUNDamental
Description : This command sets the fundamental AC voltage in SYNTHESIS mode.
Query Syntax : [SOURce :] SYNThesis : FUNDamental?
Parameter : <NR2>, the valid range: 0.0 ~ 300.0.
Return Parameter : <NR2>

[SOURce :] SYNThesis : DC
Description : This command sets the DC voltage to add the voltage waveform in SYNTHESIS mode.
Query Syntax : [SOURce :] SYNThesis : DC?
Parameter : <NR2>, the valid range: -424.2 ~ 424.2.
Return Parameter : <NR2>

[SOURce :] SYNThesis : FREQuency

Description : This command sets the fundamental frequency in SYNTHESIS mode.
Query Syntax : [SOURce :] SYNThesis : FREQuency?
Parameter : 50 | 60
Return Parameter : 50 | 60

[SOURce :] SYNThesis : SPHase

Description : This command sets the start phase angle in SYNTHESIS mode.
Query Syntax : [SOURce :] SYNThesis : SPHase?
Parameter : <NR2>, the valid range: 0.0 ~ 359.9
Return Parameter : <NR2>

OUTPut : MODE

Description : This command sets the operation mode. User should quit output before setting OUTPut : MODE SYNTH**.**
Query Syntax : OUTPut : MODE?
Parameter : FIXED | LIST | PULSE | STEP | SYNTH | INTERHAR
Return Parameter : FIXED | LIST | PULSE | STEP | SYNTH | INTERHAR

TRIG

Description : This command sets SYNTHESIS mode in OFF, ON execution state after setting OUTPut : MODE SYNTH. If users want to change the parameters, it's necessary to set TRIG OFF then OUTPut : MODE FIXED. Then, set OUTPut : MODE SYNTH again to get ready to set TRIG ON.
Query Syntax : TRIG : STATE?
Parameter : OFF | ON
Return Parameter : OFF | RUNNING

8.4.2.14 INTERHARMONICS Sub-system

[SOURce :]
INTERHARmonics
: FREQuency
: STARt
: END
: LEVel
: DWELl

OUTPut
: MODE

TRIG
TRIG : STATE?

FETCh | MEASure
: INTERHARmonics
: FREQuency? It queries the sweeping frequency.

[SOURce :] INTERHARmonics : FREQuency : STARt

Description : This command sets the start frequency of sweep wave for

INTERHARMONICS mode.
Query Syntax : [SOURce :] INTerharmonics : FREQuency : STARt?
Parameter : <NR2>, the valid range is 0.01 ~ 3000.0 (unit: Hz.)
Return Parameter : <NR2>

[SOURce :] INTERHARmonics: FREQuency : END
Description : This command sets the end frequency of sweep wave for INTERHARMONICS mode.
Query Syntax : [SOURce :] INTerharmonics : FREQuency : END?
Parameter : <NR2>, the valid range is 0.01 ~ 3000.00 (unit: Hz.)
Return Parameter : <NR2>

[SOURce :] INTERHARmonics: LEVel
Description : This command sets the rms. range of sweep wave in percentage level.
Query Syntax : [SOURce :] INTerharmonics : LEVEl?
Parameter : <NR2>, the valid range is 0% ~ 30% in 0.01 Hz ~ 500 Hz
0% ~ 20% in 500.01 Hz ~ 1000 Hz
0% ~ 10% in 1000.01 Hz ~ 2400 Hz
0% ~ 5% in 2400.01 Hz ~ 3000 Hz
Return Parameter : <NR2>

[SOURce :] INTERHARmonics: DWELl
Description : This command sets the dwell time of sweep wave.
Query Syntax : [SOURce :] INTerharmonics : DWELl?
Parameter : <NR2>, the valid range is 0.00 ~ 99999.99 (unit: sec.)
Return Parameter : <NR2>

OUTPut : MODE
Description : This command sets the operation mode.
Query Syntax : OUTPut : MODE?
Parameter : FIXED | LIST | PULSE | STEP | SYNTH | INTERHAR
Return Parameter : FIXED | LIST | PULSE | STEP | SYNTH | INTERHAR

TRIG
Description : This command sets INTERHARMONICS mode in OFF, ON, PAUSE or CONTINUE execution state after setting OUTPut : MODE INTERHAR. If users wish to change the Parameter, it has to set TRIG OFF and OUTPut : MODE FIXED, next OUTPut : MODE INTERHAR in order to set TRIG ON.
Query Syntax : TRIG : STATE?
Parameter : OFF | ON | PAUSE | CONTINUE
Return Parameter : OFF | RUNNING | PAUSE

FETCh [:SCALar] : INTERHARmonics: FREQuency?
MEASure [:SCALar] : INTERHARmonics: FREQuency?
Description : These query commands return the sweep frequency stacked on base voltage.
Query Syntax : FETCh : INTERHARMonics : FREQuency?
MEASure : INTERHARMonics : FREQuency?
Return Parameter : <NR2>

8.4.2.15 Harmonic Sense Sub-system

[SOURce:]
CONFigure
: HARMonic
: SOURce
: TIMES
: PARameter
: FREQuency
SENSe
: HARMonic

FETCh | MEASure
[: SCALar]
: HARMonic
: THD? It returns the % of total harmonic distortion.
: FUNDamental? It returns the fundamental frequency.
: ARRay? It returns the array of all harmonic orders.

[SOURce :] CONFigure : HARMonic : SOURce
Description : This command sets the measured power source in harmonic analysis mode.
Query Syntax : [SOURce :] CONFigure : HARMonic : SOURce?
Parameter : VOLT | CURR
Return Parameter : VOLT | CURR

[SOURce :] CONFigure : HARMonic : TIMES
Description : This command sets the way the measurement result of harmonic analysis displayed on LCD.
SINGLE: It keeps the measured data on the display when set.
CONTINUE: It updates the measured data on the display when set.
Query Syntax : [SOURce :] CONFigure : HARMonic : TIMes?
Parameter : SINGLE | CONTINUE
Return Parameter : SINGLE | CONTINUE

[SOURce :] CONFigure : HARMonic : PARameter
Description : This command sets the data format for each harmonic order.
Query Syntax : [SOURce :] CONFigure : HARMonic : PARameter?
Parameter : VALUE | PERCENT
Return Parameter : VALUE | PERCENT

[SOURce :] CONFigure : HARMonic : FREQuency
Description : This command sets the fundamental frequency of original waveform.
Query Syntax : [SOURce :] CONFigure : HARMonic : FREQuency?
Parameter : 50 | 60
Return Parameter : 50 | 60

SENSe : HARMonic
Description : This command sets the harmonic measurement on/off. It has to execute "ON" before every new search or measurement. Only 3 seconds are required for the result. The parameter has to set to "OFF" if users wish to measure other data.
Query Syntax : SENSe : HARMonic?
Parameter : ON | OFF

Return Parameter : ON | OFF

FETCh [:SCALar] : HARMonic : THD?
MEASure [:SCALar] : HARMonic : THD?
Description : This query command returns the % of total harmonic distortion.
Query Syntax : FETCh : HARMonic : THD?
MEASure : HARMonic : THD?
Return Parameter : <NR2>

FETCh [:SCALar] : HARMonic : FUNDamental?
MEASure [:SCALar] : HARMonic : FUNDamental?
Description : This query command returns the fundamental frequency output current or voltage.
Query Syntax : FETCh : HARMonic : FUNDamental?
MEASure : HARMonic : FUNDamental?
Return Parameter : <NR2>

FETCh [:SCALar] : HARMonic : ARRay?
MEASure [:SCALar] : HARMonic : ARRay?
Description : This query command returns the array of all harmonic orders.
Query Syntax : FETCh : HARMonic : ARRay?
MEASure : HARMonic : ARRay?
Return Parameter : <NR2>

8.4.2.16 ACL Subsystem (Optional)

LOAD:
:MODE
CCREctifier
:CURRent
:CREStfactor
CPREctifier
:POWer
:CREStfactor

CR
:RESistor
CCPHase
:CURRent
:DEGRee
CPPHase
:POWer
:DEGRee
:PF
:MODE

PHASe
:LIMit

LOAD:MODE
Description : This command sets the ACL operating mode.
Query Syntax : LOAD: MODE?

Parameter : CCRE | CPRE | CR | CCPH | CPPH
Return Parameter : CCRE | CPRE | CR | CCPH | CPPH

LOAD:CCREctifier:CURRent
Description : This command sets the loading current in CCREctifier mode.
Query Syntax : LOAD: CCREctifier : CURRent?
Parameter : <NR2>, valid range: 0.0 ~ 100.0 (unit: A)
Return Parameter : <NR2>

LOAD:CCREctifier:CRES
Description : This command sets the current crest factor in CCREctifier mode.
Query Syntax : LOAD: CCREctifier : CRES?
Parameter : <NR2>, valid range: 1.414 ~ 2.57
Return Parameter : <NR2>

LOAD:CPREctifier:POWer
Description : This command sets the loading power in CPREctifier mode.
Query Syntax : LOAD: CPREctifier: POWer?
Parameter : <NR2>, valid range: 10 ~ 20000 (unit: W)
Return Parameter : <NR2>

LOAD:CPREctifier:CRES
Description : This command sets the current crest factor of loading power in CPREctifier mode.
Query Syntax : LOAD: CPREctifier: CRES?
Parameter : <NR2>, valid range: 1.414 ~ 2.57
Return Parameter : <NR2>

LOAD:CR:RESistor
Description : This command sets the corresponding resistance value when loading 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 CCPHase mode.
Query Syntax : LOAD: CCPHase: CURRent?
Parameter : <NR2>, valid range: 0.0 ~ 100.0 (unit: A)
Return Parameter : <NR2>

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

LOAD:CPPHase:PF
Description : This command sets the PF value of loading current and DUT voltage in **CPPHase** mode. This setting is linked to **LOAD:CCPHase: DEGRee**.

Query Syntax : LOAD: CPPHase: PF?
Parameter : valid range: 0.707~1
Return Parameter : <NR2>

LOAD:CPPHase:PF:MODE
Description : This command sets the loading current to be ahead or behind the DUT voltage in **CPPHase** mode. This setting is linked to **LOAD:CCPHase:DEGRee**.
Query Syntax : LOAD: CPPHase: PF: MODE?
Parameter : LEAD | LAG
Return Parameter : LEAD | LAG

LOAD:CPPHase:POWer
Description : This command sets the loading power in CCPHase mode.
Query Syntax : LOAD: CPPHase: POWer?
Parameter : <NR2>, valid range: 10 ~ 20000 (unit: W)
Return Parameter : <NR2>

LOAD:CPPHase:DEGRee
Description : This command sets the phase degree of loading current and DUT voltage phase in **CPPHase** mode
Query Syntax : LOAD: CPPHase: DEGRee?
Parameter : Phase Limit is ON: <NR2>, valid range: -45.0 ~45.0 (unit: Degree)
Phase Limit is OFF: <NR2>, valid range: 135.0 ~ 225.0 (unit: Degree)
Return Parameter : <NR2>

LOAD:PHASe: LIMit
Description : This command sets the range of on/off angle when phase mode is set.
Query Syntax : LOAD: PHASe: LIMit?
Parameter : ON | OFF
Return Parameter : ON | OFF

8.5 Command Summary

Common Commands

* CLS	Clear status
* ESE<n>	Enable standard event status
* ESE?	Return enabled standard event status
* IDN?	Return the Regenerative Grid Simulator ID
* RCL<n>	Recall the Regenerative Grid Simulator file
* RST	Reset the Regenerative Grid Simulator to initial states
* SAV<n>	Save the Regenerative Grid Simulator status
* SRE	Set request enable register
* STB?	Return status byte
* TST?	Return the self-test result of Regenerative Grid Simulator

Instrument Commands

SYSTem
: ERRor?
: VERSion?
: LOCal
: REMote
: DATE
: TIME

INSTrument
: EDIT
: Couple
: NSELect
: SELect
: PHASe

FETCh | MEASure
[: SCALar]
: CURRent
: AC?
: DC?
: ACDC?
: AMPLitude:MAXimum?
: CRESTfactor?
: INRush?
: FREQuency?
: POWer
: AC
[: REAL]?
: APParent?
: REACtive?
: PFACtor?
: TOTal?
: TOTal:APParent?
:VOLTage
: AC?
: DC?
: ACDC?
: AMPLitude:MAXimum?
:LINE
:V12?
:V23?
:V31?

OUTPut
[: STATe]
: RELay
: SLEW
: VOLTage
: AC
: DC
:FREQency
: COUPling

```
    : MODE
    : PROTection
        :CLEar

[SOURce:]
    CURRent
        : LIMit
        : DELay
        : INRush
            : STARt
            : INTerval

    FREQency
        [: {CW | IMMediate}]
        : LIMit

    VOLTage
        [: LEVel][: IMMediate][:AMPLitude]
            : AC
            : DC
        : LIMit
            : AC
            : DC
                : PLUS
                : MINus

    POWer
        : PROTection

    FUNCtion
        : SHAPe
        : SHAPe
                : A
                : A
                    : MODE
                    : THD
                    : AMP
                : B
                : B
                    : MODE
                    : THD
                    : AMP

    LIST
    : Coupling
    : TRIG
        : POINts?
        : COUNt
        : DWELl
        : SHAPe
        : BASE
        : VOLTage
            : AC
                : STARt
```

: END
: DC
: STARt
: END
: FREQuency
: STARt
: END
: DEGRee
PULSe
: VOLTage
: AC
: DC
: FREQuency
: SHAPe
: SPHase
: COUNt
: DCYCle
: PERiod

STEP
: VOLTage
: AC
: DC
: FREQuency
: SHAPe
: SPHase
: DVOLtage
: AC
: DC
: DFRequency
: DWELl
: COUNt

SYNThesis
: COMPose
: AMPLitude
: PHASe
: FUNDamental
: DC
: FREQuency
: SPHase

INTERHARrmonics
: FREQuency
: STARt
: END
: LEVEl
: DWELl
: MODe

[SOURce:]
PHASe
: ON
: OFF

[SOURce:]
CONFigure
: INHibit

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

TRACe
: RMS

TRIG
TRIG: STATE?

Appendix A TTL Signal Pin Assignments

Green terminal with female connector:

Pin No.	Signal	Description
1	Ext-V Φ1	Φ1 External-V Reference signal input (-10V~10V)
2	Ext-V Φ2	Φ2 External-V Reference signal input (-10V~10V) This is the input pin of external voltage signal for single phase use.
3	Ext-V Φ3	Φ3 External-V Reference signal input (-10V~10V)
4	AGND	External-V Reference signal grounding
5	+12V	12V voltage output (providing current 1A)
6	Reserved	
7	AGND	External-V Reference signal grounding.
8	AGND	External-V Reference signal grounding.
9	AC-ON	This pin turns to HIGH when the Regenerative Grid Simulator outputs voltage and turns to LOW when quits output.
10	/ FAULT-OUT	The voltage level of this pin is HIGH when the Regenerative Grid Simulator is in normal mode, it will turn to LOW when the Regenerative Grid Simulator is in protection mode.
11	/ Ext-ONOFF	When EXT-ONOFF is enabled and the voltage level of this pin turns to LOW, the Regenerative Grid Simulator output will be open and it will close on the contrary.
12	/ Remote-Inhibit	When the voltage level of this pin turns to LOW, it can inhibit the Regenerative Grid Simulator output or trigger mode.
13	/Remote-Excite	When this pin receives a negative edge signal (from High to Low), it can trigger the transient output of Regenerative Grid Simulator.
14	/Transient	When the output of Regenerative Grid Simulator changes, this pin will send out a low level 64us or remain at high level.
15	Reserved	
16	Reserved	
17	Reserved	
18	Reserved	
19	Reserved	
20	AGND	
21	Reserved	
22	Reserved	
23	Reserved	
24	AGND	

Appendix B Built-in DST Waveform

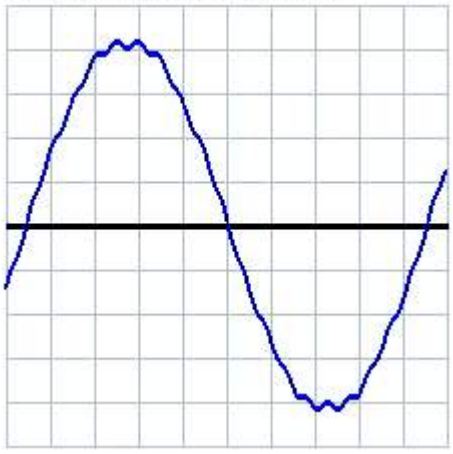
The ratios of all built-in waveforms' steps are measured under no load.

Waveform A = DST01

N	%	D
5	9.80	0
7	15.80	0
8	2.16	0

DST01

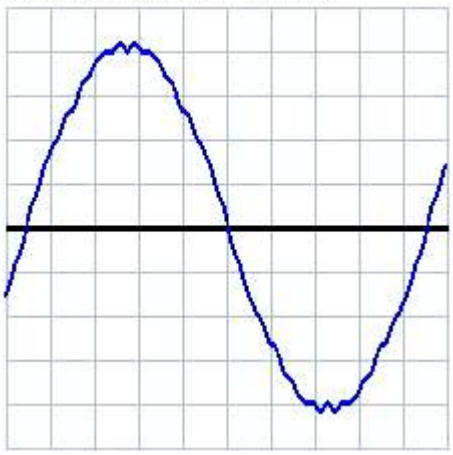
Waveform A = DST02



N	%	D
3	1.50	0
7	1.50	0
19	2.00	0

DST02

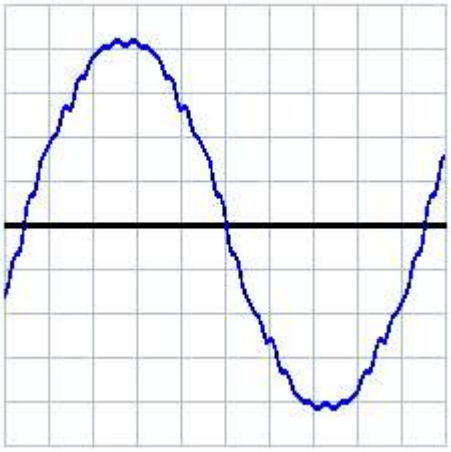
Waveform A = DST03



N	%	D
3	2.00	0
5	1.40	0
7	2.00	0
23	1.40	0
31	1.00	0

DST03

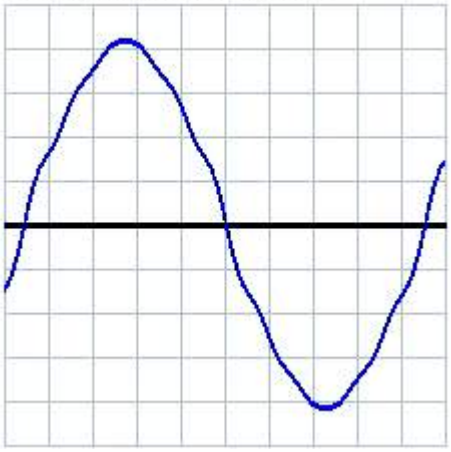
Waveform A = DST04



N	%	D
3	2.50	0
5	1.90	0
7	2.50	0
23	1.90	0
25	1.10	0
31	1.50	0
33	1.10	0

DST04

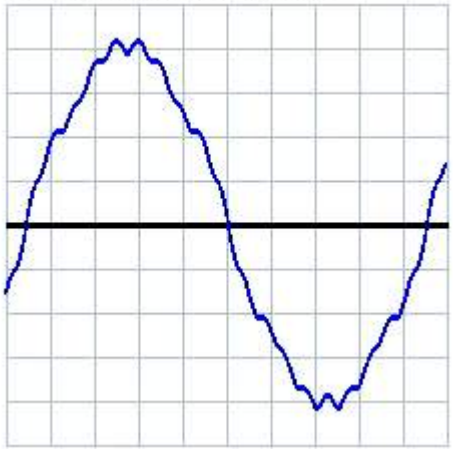
Waveform A = DST05



N	%	D
3	1.10	0
5	2.80	0
7	1.40	0
9	2.30	0
11	1.50	0

DST05

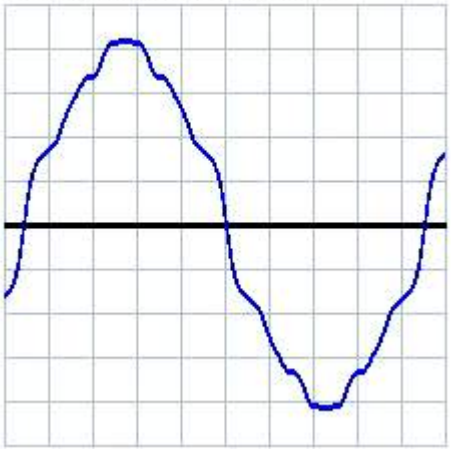
Waveform A = DST06



N	%	D
3	1.65	0
5	4.20	0
7	3.45	0
15	1.05	0
19	3.00	0

DST06

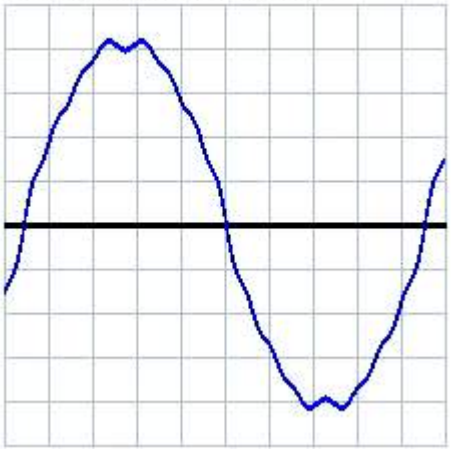
Waveform A = DST07



N	%	D
3	2.20	0
5	5.60	0
7	2.80	0
9	4.60	0
11	3.00	0
15	1.40	0
21	1.00	0

DST07

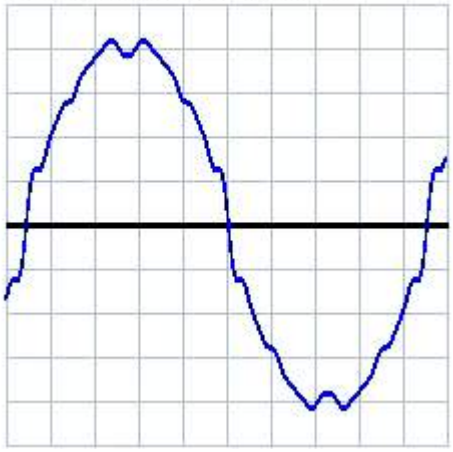
Waveform A = DST08



N	%	D
3	4.90	0
5	1.60	0
7	2.70	0
11	1.40	0
15	2.00	0
17	1.10	0

DST08

Waveform A = DST09

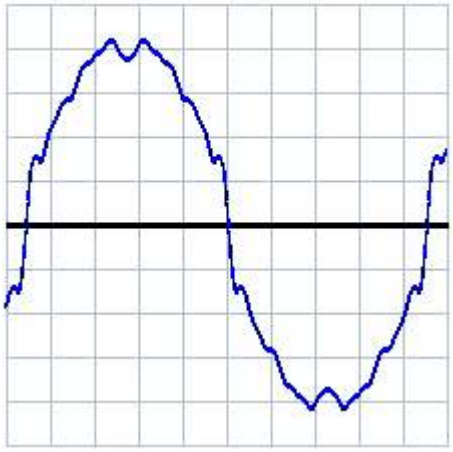


N	%	D
3	7.35	0
5	2.40	0
7	4.05	0
11	2.10	0
13	1.05	0
15	3.00	0
17	1.65	0
19	1.05	0
21	1.05	0

N	%	D
23	1.20	0
25	1.05	0

DST09

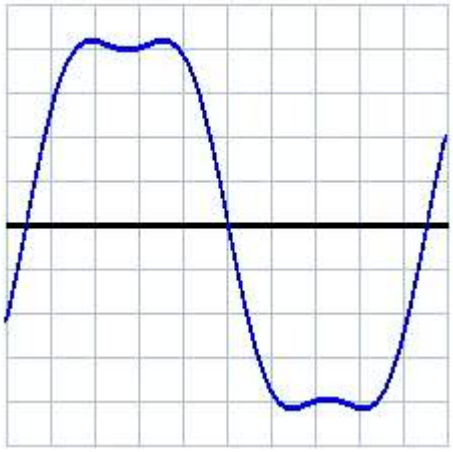
Waveform A = DST10



N	%	D	N	%	D
3	9.80	0	21	1.40	0
5	3.20	0	23	1.60	0
7	5.40	0	25	1.40	0
9	1.20	0			
11	2.80	0			
13	1.40	0			
15	4.00	0			
17	2.20	0			
19	1.40	0			

DST10

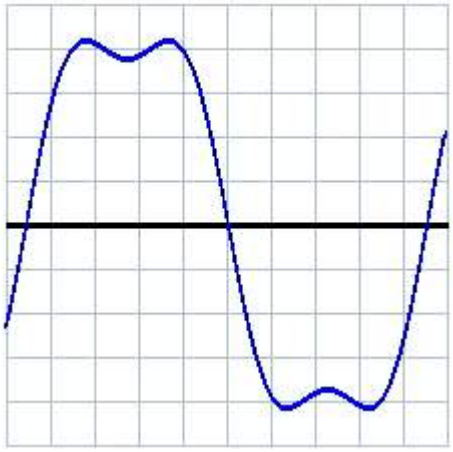
Waveform A = DST11



N	%	D
3	17.75	0

DST11

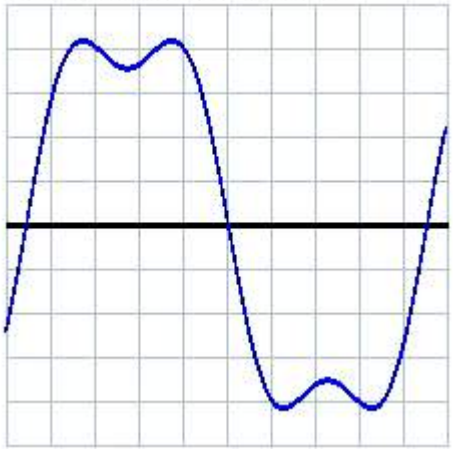
Waveform A = DST12



N	%	D
3	21.25	0

DST12

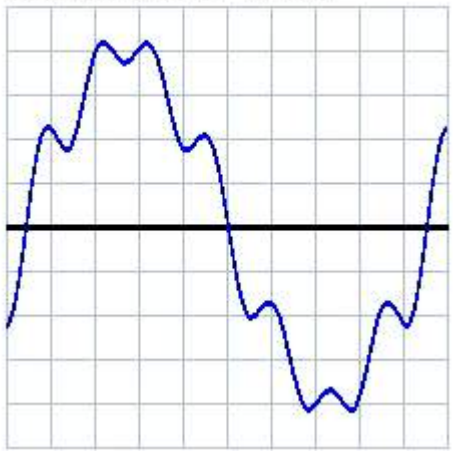
Waveform A = DST13



N	%	D
3	24.50	0

DST13

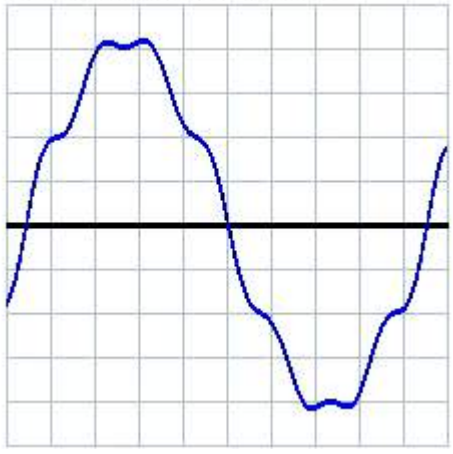
Waveform A = DST14



N	%	D
2	2.30	0
5	9.80	0
7	15.80	0
8	2.50	0

DST14

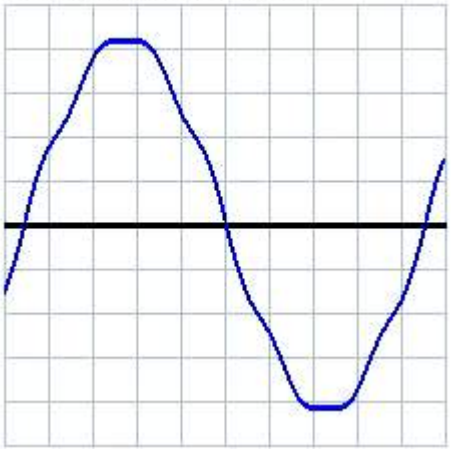
Waveform A = DST15



N	%	D
2	1.15	0
5	4.90	0
7	7.90	0
8	1.25	0

DST15

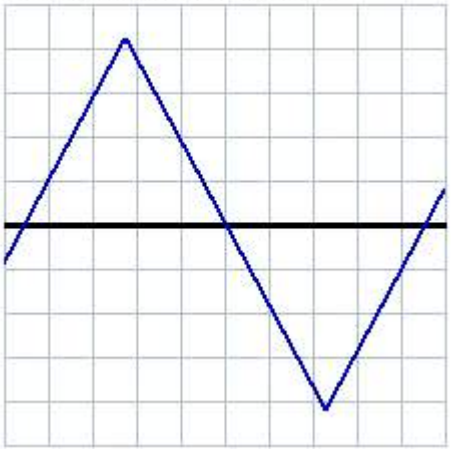
Waveform A = DST16



N	%	D
5	2.45	0
7	3.95	0

DST16

Waveform A = DST17

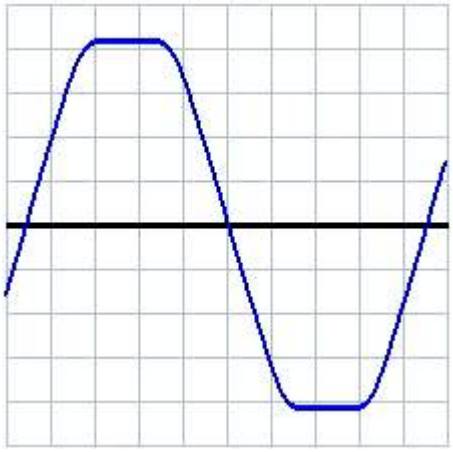


N	%	D
3	11.11	180
5	4.00	0
7	2.04	180
9	1.23	0
11	0.83	180
13	0.59	0
15	0.44	180
17	0.35	0
19	0.28	180

N	%	D
21	0.23	0
23	0.19	180
25	0.16	0
27	0.14	180

DST17

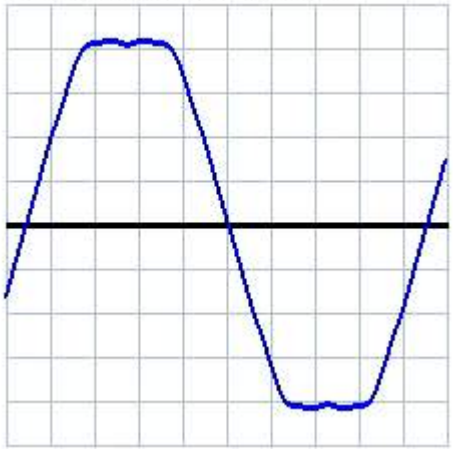
Waveform A = DST18



N	%	D
3	7.17	0
5	3.42	180
9	0.80	0

DST18

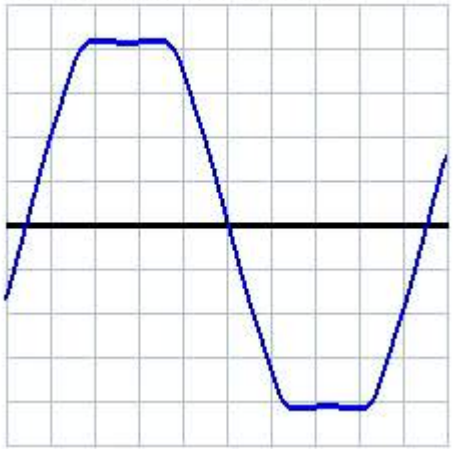
Waveform A = DST19



N	%	D
3	8.07	0
5	3.55	180
9	0.96	0
13	0.92	180

DST19

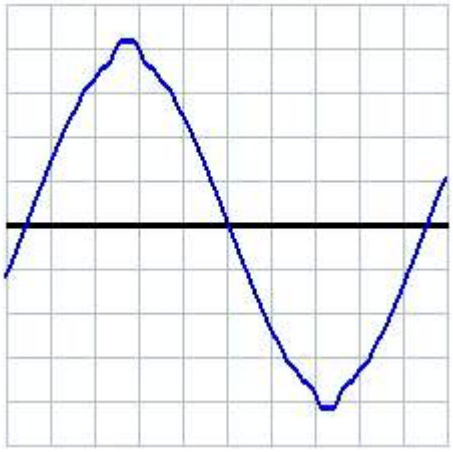
Waveform A = DST20



N	%	D
3	9.38	0
5	3.44	180
9	1.12	0
13	0.50	180

DST20

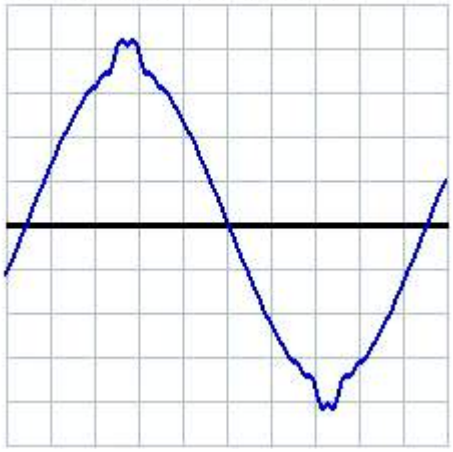
Waveform A = DST21



N	%	D
3	2.06	180
5	1.77	0
7	1.62	180
9	1.23	0
11	0.91	180
13	0.54	0
23	0.51	0
25	0.53	180

DST21

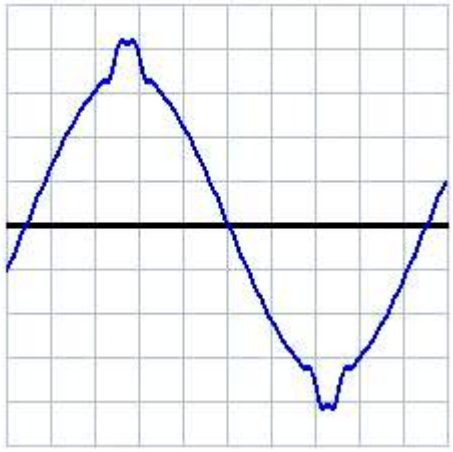
Waveform A = DST22



N	%	D	N	%	D
3	3.08	180	27	0.69	0
5	2.72	0	29	0.56	180
7	2.43	180			
9	1.97	0			
11	1.41	180			
13	0.86	0			
21	0.62	180			
23	0.73	0			
25	0.77	180			

DST22

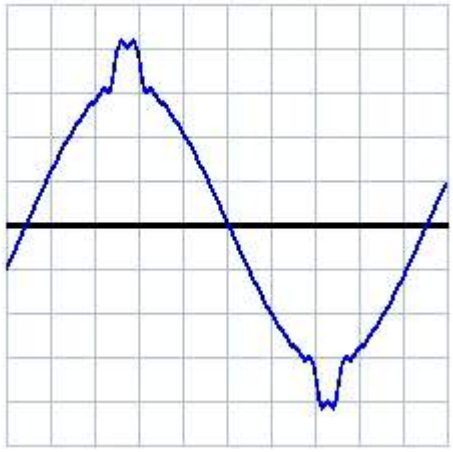
Waveform A = DST23



N	%	D	N	%	D
3	4.28	180	23	0.97	0
5	3.77	0	25	1.04	180
7	3.27	180	29	0.75	180
9	2.57	0			
11	1.93	180			
13	1.22	0			
15	0.55	180			
19	0.46	0			
21	0.83	180			

DST23

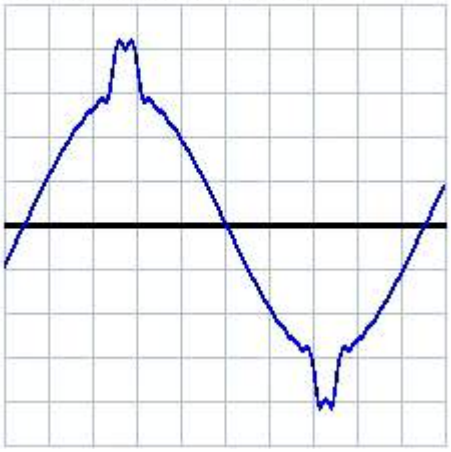
Waveform A = DST24



N	%	D	N	%	D
3	5.74	180	23	1.28	0
5	5.11	0	25	1.35	180
7	4.44	180	27	1.22	0
9	3.52	0	29	0.98	180
11	2.63	180			
13	1.65	0			
15	0.80	180			
19	0.61	0			
21	1.07	180			

DST24

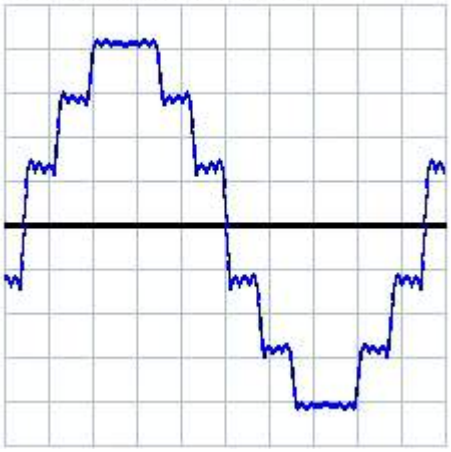
Waveform A = DST25



N	%	D	N	%	D
3	7.35	180	23	1.64	0
5	6.60	0	25	1.73	180
7	5.74	180	27	1.56	0
9	4.57	0	29	1.24	180
11	3.41	180			
13	2.16	0			
15	1.04	180			
19	0.74	0			
21	1.35	180			

DST25

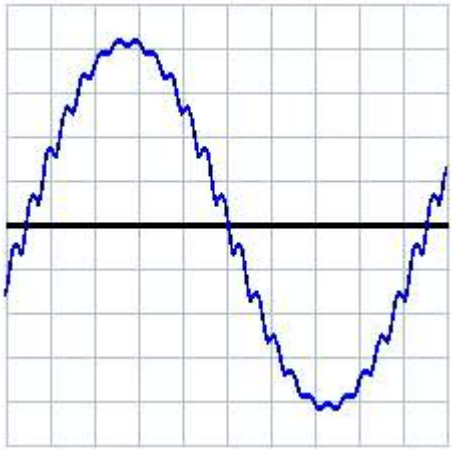
Waveform A = DST26



N	%	D	N	%	D
5	3.41	0	35	2.34	0
7	2.55	0	37	2.21	0
11	9.22	0			
13	7.68	0			
17	0.90	0			
19	0.90	0			
23	3.88	0			
25	3.56	0			
31	0.50	0			

DST26

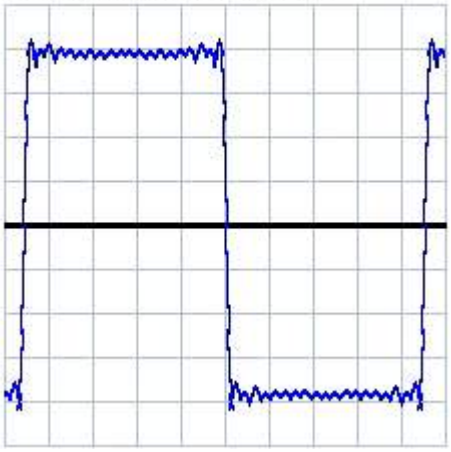
Waveform A = DST27



N	%	D
21	1.24	0
23	4.91	0
25	2.21	0

DST27

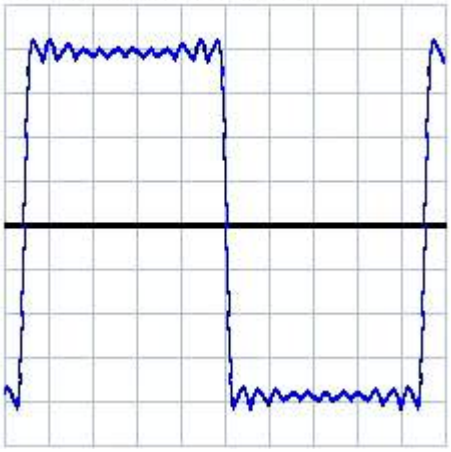
Waveform A = DST28



N	%	D	N	%	D
3	33.39	0	21	4.52	0
5	20.01	0	23	4.00	0
7	13.76	0	25	3.49	0
9	10.70	0	27	2.91	0
11	8.39	0	29	2.45	0
13	7.06	0	31	1.94	0
15	5.85	0	33	1.95	0
17	4.86	0	35	1.91	0
19	4.86	0	37	1.89	0
			39	1.83	0

DST28

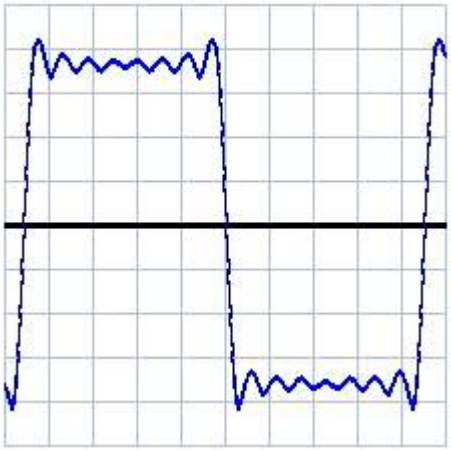
Waveform A = DST29



N	%	D	N	%	D
3	33.39	0	21	4.48	0
5	20.01	0	23	3.93	0
7	13.75	0	25	0.89	0
9	10.70	0	27	0.92	0
11	8.37	0	29	0.94	0
13	7.05	0	31	0.94	0
15	5.84	0	33	0.94	0
17	4.84	0	35	0.93	0
19	4.83	0	37	0.92	0
			39	0.91	0

DST29

Waveform A = DST30



N	%	D
3	33.39	0
5	20.01	0
7	13.75	0
9	10.70	0
11	8.33	0
13	6.99	0
15	5.26	0

DST30

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