REGENERATIVE GRID SIMULATOR

MODEL 61800 SERIES

Market demand for Distributed Resource (DR) products such as PV inverters and wind energy systems is steadily growing as the world strives for clean renewable energy sources. This demand has created a need for rigorous regulation testing to standards such IEEE 1547 / IEC 61000-3-15 / IEC 62116 ensuring proper and safe operation of on-grid products. It has become critical to manufacturers to conduct these tests to prove compliance and to relieve product liability concerns. Chroma's new 61800 family of Grid Simulators has been designed to fulfill these test requirements by providing a full 4 quadrant, fully regenerative, grid simulator with advanced features for compliance, safety and product verification testing.

The 61800 regenerative grid simulator allows users to vary relevant parameters in order to simulate real world grid environments and conditions. Supported variations include frequency, phase angle, voltage amplitude, voltage drops in either single or three phase modes. Unbalanced three phase conditions can easily be simulated. And most importantly, the regenerative feature of the 61800 grid simulator provides an effective energy saving method since energy generated by unit under test is fed back to the grid instead of dissipated as heat during operation.

The 61800 grid simulator could also meet test requirements with smart grid and EV related test applications, such as Vehicle to Grid (V2G) and Energy Storage System (ESS) testing. The 61800 is also capable of meeting IEC regulatory standards' (such as IEC 61000-3-2/-3-3/-3-1/-3-12) requirement for AC supply.

The 61800 regenerative grid simulator is not only limited to product development during R&D. Its extensive features are also valuable during design and quality verification as well as throughout various production stages. Using state-of-the-art digital control technology the 61800 can deliver up to 300VAC at output frequencies ranging from 30Hz to 100Hz. The AC+DC feature allows for applications which require a DC offset bias.

The 61800 series is also able to provide precision measurements such as RMS voltage, RMS current, true power, power factor, current crest factor and many others. By applying advanced DSP technology, the 61800 can easily simulate power line disturbance (PLD) using LIST, PULSE and STEP modes. Additional features such as the waveform synthesis function allows users to program various distorted harmonic waveforms which are required by some regulatory standards. GPIB (IEEE488.2), RS-232, USB and Ethernet interface are available to control the 61800 grid simulator remotely.
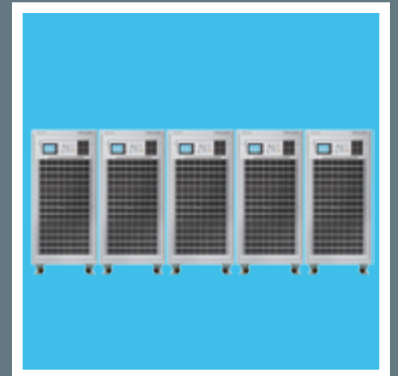
Regenerative Grid Simulator

MODEL 61800 SERIES
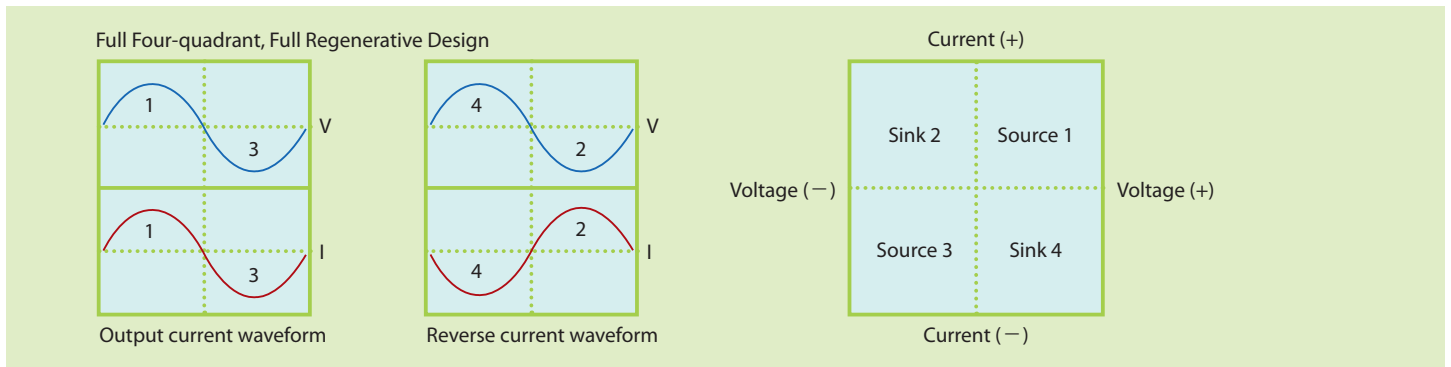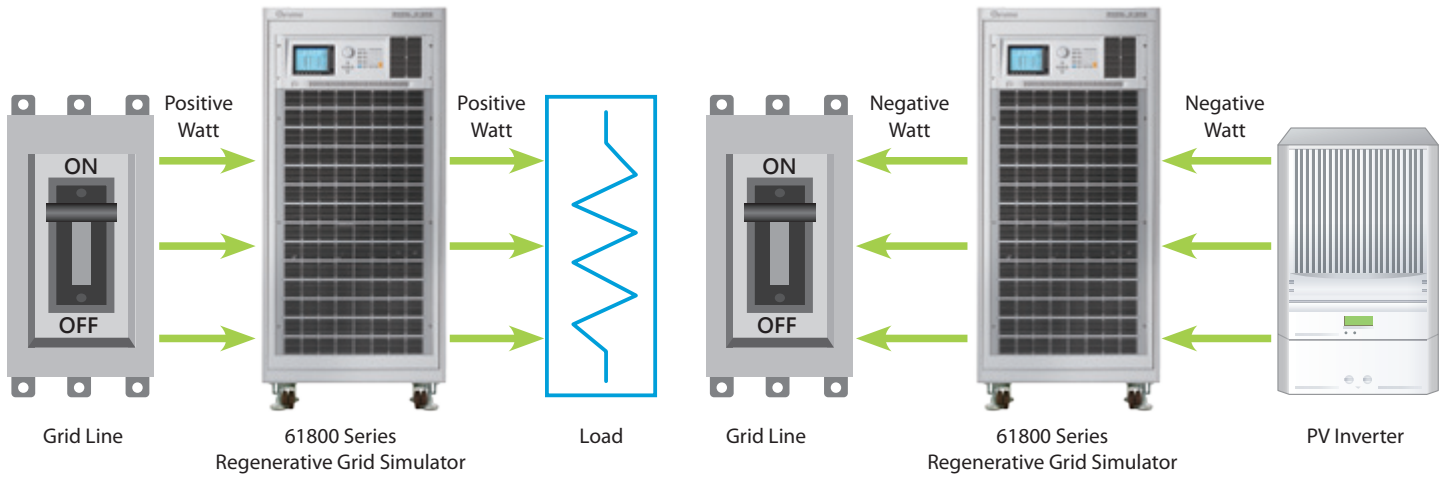
Key Features

- Output Power
  61830 : 30kVA ; 61845 : 45kVA ; 61860 : 60kVA
- Output Voltage: 0-300V
- Output Frequency: DC, 30Hz-100Hz
- User selectable single phase or three phase output
- Full 4 quadrant, fully regenerative up to 100% of output current rating
- Specifically designed for PV inverter, Smart Grid and EV related test applications
- Programmable slew rate settings for voltage and frequency
- Programmable voltage and current limits
- Turn on, turn off phase angle control
- LIST, PULSE, STEP mode functions for testing Power Line Disturbance (PLD) simulation
- Voltage dips, short interruption and voltage variation simulation
- Harmonics, inter-harmonics waveform synthesizer
- Comprehensive measurement capability, including current harmonics
- Analog programmable interfaces
- Remote interface: GPIB, RS-232, USB and Ethernet
- Parallel output for higher power applications (Three phase only)

60kVA x 5 = 300kVA

Chroma

RS-232   Ethernet   USB   GPIB

FUNCTIONS AND APPLICATIONS

The 61800 Regenerative Grid Simulator is a full 4 quadrant, full regenerative, AC power supply designed for common electrical product testing such as home appliances, and industrial electronics needing a programmable input source. In additional, the 61800 is design to simulate grid characteristics for testing PV inverter and on-line UPSs. As shown below, power can be both sink and source from the UUT seamlessly for to support different types of applications. In cases where the UUT sources current a detection circuit will sense the excess power and recycled it back to the grid.

ON / OFF	Positive Watt →	Positive Watt →	
Grid Line	61800 Series Regenerative Grid Simulator	Load

ON / OFF	← Negative Watt	← Negative Watt
Grid Line	61800 Series Regenerative Grid Simulator	PV Inverter

Full Four-quadrant, Full Regenerative Design

Output current waveform

Reverse current waveform

	Current (+)	
Sink 2		Source 1
Voltage (−)		Voltage (+)
Source 3		Sink 4
	Current (−)	

In addition to supply clean, precise and stable AC voltage for regular applications, the 61800 is capable of simulating various types of distorted voltage waveforms and transient conditions required by product validation testing. These are accomplished as shown below using built-in programmable waveform functions such as LIST/STEP/PULSE modes. The STEP and PUSLE functions allow users to perform single or continuous step changes of output voltage. While the LIST mode is a more versatile function as it allows users to compose complex waveforms of up to 100 sequences. Voltage waveforms required by immunity specifications such as IEC 61000-4-11 (short interruption and voltage dropout) can easily be achieved by the 61800 Regenerative Grid Simulator.
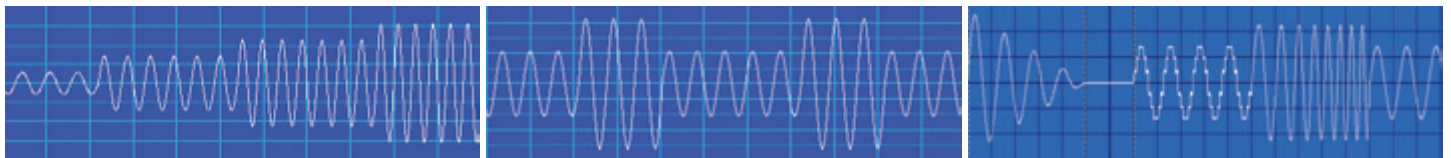
STEP Mode

PULSE Mode

LIST Mode

The SYNTHESIS function allows users to create periodic harmonic voltage waveforms of up to 50 orders based on a 50/60Hz fundamental frequency. The INTERHARMONIC function allows users to perform frequency sweeps ranging from 0.01Hz to 2400Hz on top of the 50/60Hz fundamental frequency. This special function assists users in locating the resonance points.
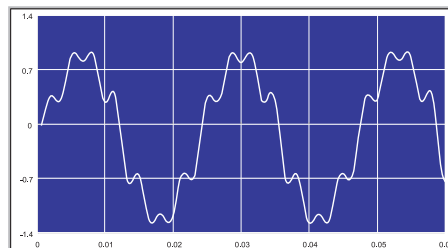
Harmonics Waveform
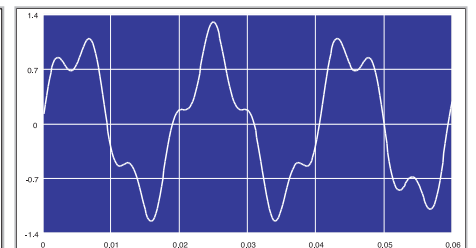
Interharmonics Waveform

Implement for Micro Grid Testing

The 61800 Regenerative Grid Simulator is capable of simulating various test conditions such as voltage distortion, frequency variation, etc., in order to meet the Micro Grid test requirements. Most importantly, the regenerative feature of 61800 series product could sink the power generated by the Discrete Generator (DG) on the micro Grid and feed the power back to the main grid. The input side of 61800 series product has specifically designed to be isolated from the main grid. Hence additional isolation for Discrete Generator (DG) on Micro Grid is not required.

Biofuel Power

Generator

Solar Power

Grid Line

61800
Regenerative

Energy Storage System

Wind Power

EVSE
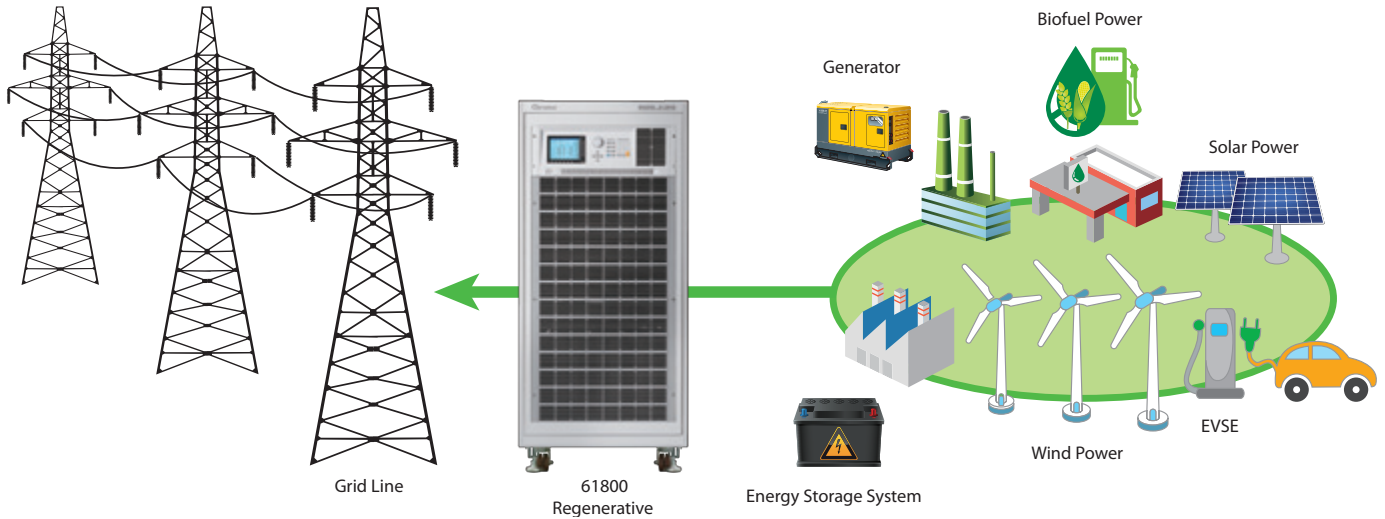
Implement for Grid Tied DG Regulations Testing

The 61800 series Regenerative Grid Simulator is capable of meeting the following regulations designated for Grid Tied Discrete Generator testing such as IEEE 1547 / IEC 61000-3-15 / IEC 62116 :

√ Voltage Abnormality Test
√ Frequency Abnormality Test
√ Anti-islanding Test
√ Low Voltage Ride Through Test
√ Immunity Test (IEC 61000-4-11/-4-34)
√ Limit Test (IEC 61000-3-2/-3-3)

Effective Energy Saving Solution

The 61800 Regenerative Grid Simulator provides an effective energy saving solution as the energy generated by Discrete Generator (DG) is fed back to the grid instead of dissipated as heat during operation.

AC Power

PV Inverter

Solar Cell
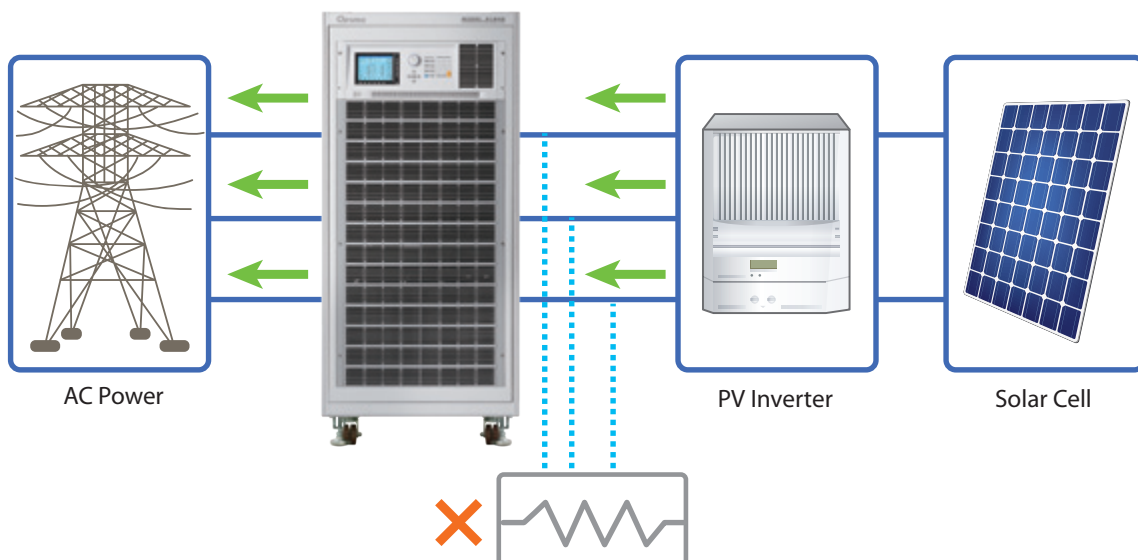
Implement for Low Voltage Ride Through (LVRT) Testing

The Low Voltage Ride Through (LVRT) function of grid tied PV inverter has clearly defined when abnormality occurs on the main AC grid (such as: voltage drop), the PV inverter must remain operable and sustain the main AC grid for certain specific time period, for instance: the BDEW standard requires the PV inverter to remain operable and delivering reactive power for at least 150ms when the grid voltage has dropped to 15% of the nominal value.

The 61800 Regenerative Grid Simulator is fully capable of meeting the LVRT test requirements, as user could program the required transient test conditions by implement the LIST mode function with minimum time resolution setting of 0.1ms. Moreover, user could also study and evaluate the impact on PV inverter performance due to grid line voltage distortion, by implementing the harmonic synthesis function of 61800 series product. The frequency resolution of 61800 is 0.01Hz which has met the BDEW requirement.
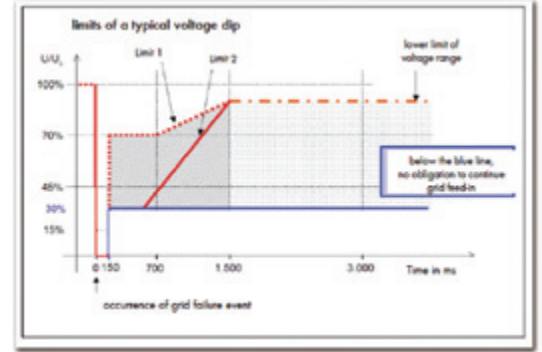
| Test number	U/UN	LVRT duration (ms)
1	≦ 0.05	≧ 150
2	0.2 - 0.5	≧ 550
3	0.45 - 0.55	≧ 950
4	0.7 - 0.8	≧ 1400

Implement for Anti-islanding Testing

By incorporating the 61800 Regenerative Grid Simulator with the 8000 ATS and A800067 RLC load, the test system is capable of meeting IEC 1547 / IEC 62116 test requirements for Anti-islanding test.

61800 Series
Regenerative Grid Simulator

8000 Automatic
Test System

61800 Series
Regenerative Grid
Simulator

A800067
RLC Load
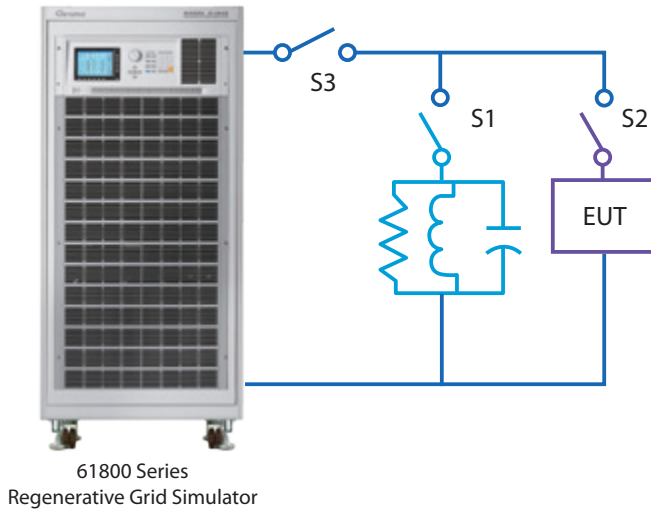
SOFTPANEL

The 61800 Softpanel is a Graphical User Interface specifically designed to provide users with an easy to use interface for configuring the instrument. The self explanatory graphical panels provide control of the 61800 with just a few clicks of a button. The Softpanel is also equipped with data recording functions allowing multiple measurements to be recorded and saved simultaneously.
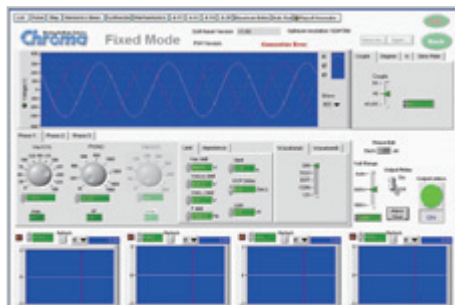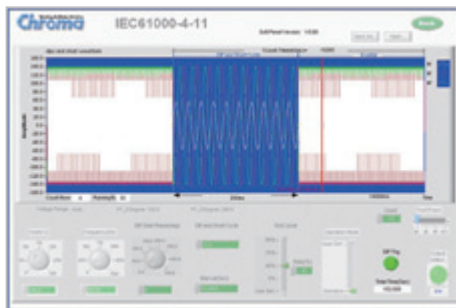

Main Operation Menu

Interharmonic Test
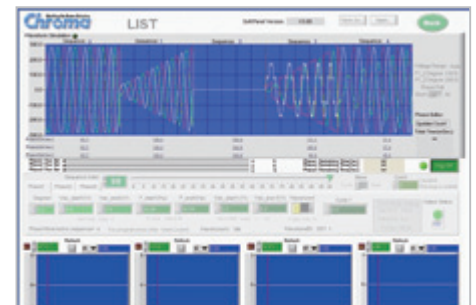
Transient Voltage Programming
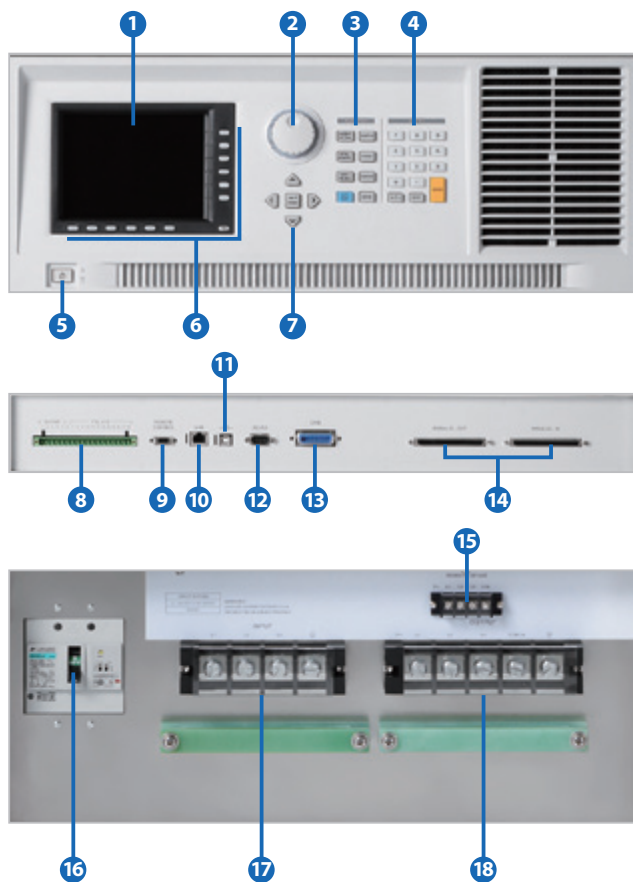
Voltage DIP, Short Interruption, Variation Test

Distorted Waveform Editor

Recording Function

PANEL DESCRIPTION

1. **LCD Display**
2. **Rotary Knob:**
   For adjusting voltage, frequency and other parameter setting
3. **Function Key:**
   Hot keys for quick parameter setting
4. **Numeric Key:**
   For data entry
5. **On/Off Power Switch**
6. **Soft Keys:**
   Supports menu driven interface
7. **Cursor movement Keypad**
8. **External V reference/TTL I/O Port:**
   External analog signal for voltage control and signals for system integration
9. **Remote Control Port used for handheld controller**
10. **LAN (Ethernet) Port**
11. **USB Interface**
12. **RS-232 Interface**
13. **GPIB Interface**
14. **Master/Slave parallel port :**
    Used when paralleling more then one unit
15. **Remote Sense:**
    For line voltage compensation
16. **Main Power Breaker:**
    NFB with leakage current detection ability
17. **Input AC power terminal**
18. **Output Terminal**

ORDERING INFORMATION

61830 : Regenerative Grid Simulator 30kVA

61845 : Regenerative Grid Simulator 45kVA

61860 : Regenerative Grid Simulator 60kVA

A618001 : Softpanel for 61800 Series

A618002 : Terminals for parallel connecting

* Support higher than 300V output voltage capability, please contact Chroma sales representative for detailed information.

SPECIFICATIONS

Model	61830	61845	61860
AC Output Rating			
Output Phase	1 or 3 selectable	1 or 3 selectable	1 or 3 selectable
Max. Power	30kVA	45kVA	60kVA
Per Phase	10kVA	15kVA	20kVA
Voltage			
Range	$0\sim300V_{LN}/0\sim520V_{LL}$	$0\sim300V_{LN}/0\sim520V_{LL}$	$0\sim300V_{LN}/0\sim520V_{LL}$
Accuracy	0.2%+0.2%F.S.	0.2%+0.2%F.S.	0.2%+0.2%F.S.
Resolution	0.1V	0.1V	0.1V
Distortion *1	< 0.5% @ 50/60Hz < 0.8% @ 30Hz~100Hz	< 0.5% @ 50/60Hz < 0.8% @ 30Hz~100Hz	< 0.5% @ 50/60Hz < 0.8% @ 30Hz~100Hz
Line regulation	0.10%	0.10%	0.10%
Load regulation	0.20%	0.20%	0.20%
Max. Current (1-Phase Mode)			
RMS	150A	225A	300A
Peak	450A	675A	900A
Max. Current (each phase in 3-Phase Mode)			
RMS	50A	75A	100A
Peak	150A	225A	300A
Frequency			
Range	30Hz ~ 100Hz	30Hz ~ 100Hz	30Hz ~ 100Hz
Accuracy	0.01%	0.01%	0.01%
DC Output (1-Phase Mode) *2			
Power	15kW	22.5kW	30kW
Voltage	424V	424V	424V
Current	75A	112.5A	150A
DC Output (3-Phase Mode)			
Power	5kW	7.5kW	10kW
Voltage	424V	424V	424V
Current	25A	37.5A	50A
Harmonics Synthesis Function			
Harmonics range	up to 50 harmonics order @ 50/60Hz fundamental frequency		
Input Rating			
Voltage Operating Range *3	$3\emptyset$ 200~220V$\pm$10%V$_{LL}$, 47~63Hz $3\emptyset$ 380~400V$\pm$10%V$_{LL}$, 47~63Hz $3\emptyset$ 440~480V$\pm$10%V$_{LL}$, 47~63Hz	$3\emptyset$ 200~220V$\pm$10%V$_{LL}$, 47~63Hz $3\emptyset$ 380~400V$\pm$10%V$_{LL}$, 47~63Hz $3\emptyset$ 440~480V$\pm$10%V$_{LL}$, 47~63Hz	$3\emptyset$ 200~220V$\pm$10%V$_{LL}$, 47~63Hz $3\emptyset$ 380~400V$\pm$10%V$_{LL}$, 47~63Hz $3\emptyset$ 440~480V$\pm$10%V$_{LL}$, 47~63Hz
Current	125A Max./Phase ($3\emptyset$ 200~220V$\pm$10%V$_{LL}$) 65A Max./Phase ($3\emptyset$ 380~400V$\pm$10%V$_{LL}$) 58A Max./Phase ($3\emptyset$ 440~480V$\pm$10%V$_{LL}$)	190A Max./Phase ($3\emptyset$ 200~220V$\pm$10%V$_{LL}$) 100A Max./Phase ($3\emptyset$ 380~400V$\pm$10%V$_{LL}$) 87A Max./Phase ($3\emptyset$ 440~480V$\pm$10%V$_{LL}$)	250A Max./Phase ($3\emptyset$ 200~220V$\pm$10%V$_{LL}$) 130A Max./Phase ($3\emptyset$ 380~400V$\pm$10%V$_{LL}$) 115A Max./Phase ($3\emptyset$ 440~480V$\pm$10%V$_{LL}$)
Power factor	0.99 (Typical)		
Measurement			
Voltage			
Range	0~300V	0~300V	0~300V
Accuracy	0.2%+0.2%F.S.	0.2%+0.2%F.S.	0.2%+0.2%F.S.
Current			
Range (peak)	150A	225A	300A
Accuracy (RMS)	0.4%+0.3%F.S.	0.4%+0.3%F.S.	0.4%+0.3%F.S.
Accuracy (peak)	0.4%+0.6%F.S.	0.4%+0.6%F.S.	0.4%+0.6%F.S.
Power			
Accuracy	0.4%+0.4% F.S.	0.4%+0.4% F.S.	0.4%+0.4% F.S.
Others			
Efficiency	80% (Typical)		
Protection	OVP, OCP, OPP, OTP, FAN		
Safety & EMC	CE (include EMC & LVD)		
Dimension (H x W x D)	1740 x 780 x 1000 mm (include wheel set)	1740 x 780 x 1000 mm (include wheel set)	1740 x 780 x 1000 mm (include wheel set)
Weight	850kg	850kg	870kg

Note*1 : Maximum distortion is tested on output 250V with maximum current to linear load
Note*2 : The DC function is mainly intended as DC offset for AC+DC output voltage function
Note*3 : Must be specified at time of order. All inputs are L-L, 3Ø, 3 wire+GND
All specifications are subject to change without notice.