The latest programmable solar array simulator power supply 62000H-S Series released by Chroma provide simulation of Voc (open circuit voltage) up to 1800V and Isc (short circuit current) up to 30A. The 62000H-S provides an industry leading power density in a small 3U high package. The solar array simulator is highly stable and has a fast transient response design, which are both advantages to MPPT performance evaluation on PV inverter devices.

The 62000H-S Series have many unique advantages including high speed & precision digitizing measurement circuits with a 100kHz A/D, 25kHz D/A controlled I-V curve and a digital filter mechanism. It can simulate an I-V curve accurately and respond to the mains ripple effect from the PV inverter. In addition, the built-in ENS0530/Sandia SAS I-V model in the standalone unit can easily program the Voc, Isc, Vmp, and Imp parameters for I-V curve simulation, without a PC controller.

The real solar array is influenced by various weather conditions such as irradiation, temperature, rain and shade by trees or clouds, which will affect the I-V curve output. The 62000H-S Series are capable of storing up to 100 I-V curves into the simulator memory, with a programmed time interval range of 1-15,000 seconds. It can simulate the I-V curve from the early morning to nightfall for PV inverter testing or dynamic I-V curve transient testing.

When high power solar array simulation is required, it is common to connect two or more power modules in parallel. The 62000H-S Series with a current range up to 30A and a voltage range up to 1800V offers a high power density envelope maximum of 18kW in a 3U package. It can easily parallel up to 11 units in a Master/Slave configuration to provide 198kW with current sharing and synchronized control signals for commercial utility PV inverter (10kW ~100kW) testing. The 62000H-S Series supplies have a smart Master/Slave control mode that makes the parallel operation fast and simple. In this mode, the master scales values and downloads data to slave units so that the programming is as simple as using a standalone unit.

The 62000H-S Series DC power supplies are very easy to operate from the front panel keypad or from the remote controller via Ethernet/USB/RS232/RS485/GPIB/APG. Its compact size (3U) makes it ideal for both benchtop and standard racking.
The Model 62000H-S Series have a built-in EN50530 and Sandia’s SAS model that can easily program the Voc, Isc, Vmp, Imp parameters to simulate different solar cell materials I-V characteristic outputs with fast response time. Moreover, the TABLE mode is capable of saving a 128~4096 point array of user programmed voltages and currents via a remote interface. It can easily create a shadowed I-V curve and the I-V PROGRAM mode can save up to 100 I-V curves and dwell time intervals (1-15,000s) in memory. These advantages provide steady repetitive control conditions required for PV Inverter design as well as for verification testing. The solar array simulator is ideal for the following testing:

- Design and verify the maximum power tracking circuit and algorithm of the PV inverter
- Verify the high/low limit of operating input voltage allowed for the PV inverter
- Verify the high/low limit of operating input voltage allowed for the inverter’s maximum power point
- Verify the static maximum power point tracking efficiency of the PV inverter.
- Measure and verify the overall efficiency & conversion efficiency of PV inverter *

SOLAR ARRAY I-V CURVE SIMULATION SOFTPANEL

The model 62000H-S Series include a graphical user Interface software through remote digital interface (USB / GPIB / Ethernet / RS232) control. The user can easily program the I-V curve of the 62000H-S Series as well as the I-V & P-V curves for real-time testing. In addition it will display the MPPT status for the PV inverter. Readings and the report function with real-time monitoring using the softpanel are shown left.

SIMULATES DIFFERENT SOLAR CELL MATERIALS I-V CHARACTERISTIC (FILL FACTOR)

The purpose of the PV inverter is to convert the dc voltage (from solar array) to the ac power (utility). The better a PV inverter can adapt to the various irradiation & temperature conditions of sun, the more power that can be fed into the utility grid over time. So, the MPPT performance is a very important factor for PV generation system. The model 62000H-S Series are capable of simulating different types of standard crystalline, multi-crystalline and thin-film fill factor* parameters to verify the MPPT tracking algorithm mechanism and efficiency.

*Fill Factor = (Imp*Vmp)/(Isc*Voc)
STATIC MPPT EFFICIENCY TESTING
The 62150H-600S DC power supply with solar array simulation can program the I-V curve through SAS mode and table mode via front panel or softpanel easily and up to 100 I-V curves can be stored in the unit. The user can recall the I-V curve from 62150H-600S afterwards for testing and monitoring the MPPT performance of PV inverter with the real-time tracking feature. The softpanel allows the user to set the duration for static MPPT efficiency testing. Each curve test time should be set at between 60s-600s for best MPPT efficiency performance analysis.

\[
\eta_{\text{MPPT}} = \frac{1}{P_{\text{mpp}} \cdot T_M} \sum V_{dc} \cdot I_{dc} \cdot \Delta T
\]

\(V_{dc}\) = Sampled value of the inverter’s input voltage
\(I_{dc}\) = Sampled value of the inverter’s input current
\(T_M\) = Overall measuring period
\(P_{\text{mpp}}\) = MPPT power provided by the solar array simulator power supply

DYNAMIC MPPT EFFICIENCY TESTING
The latest test standards EN50530, CGC/GF004 & Sandia have provided a procedure for testing patterns of the dynamic MPPT efficiency of inverters, those standards can accelerate the MPP tracking algorithm mechanism to the optimal for PV inverter manufactures. The advanced Dynamic MPPT Test function complies with EN50530, CGC/GF004, CGC/GF035, Sandia test regulations and can be controlled via the graphical softpanel by selecting CGC/GF004, CGC/GF035, Sandia or EN50530 I-V mathematical expressions and test items. This function simulates the irradiation intensity and temperature change of the I-V curve under actual weather variations to test the PV inverter’s dynamic MPPT performance. The GUI will calculate the MPPT performance for analysis after running the test. A test data recording function is integrated into the software where users can edit and control the test parameters to be recorded such as voltage, current, power, watt and MPPT performance along with the sampling interval (1~10,000s) and total time length to facilitate the analysis and validation of the PV inverter.

SHADOW I-V CURVE SIMULATION
It has easy-to-use software to simulate the shadowed I-V curve and its dynamic change as the figure shown aside. The user can select the PV Module from the database or create individual PV module parameters for storage; and then set the amount of PV string to form a PV Array in series or parallel. Next, the user can set the irradiation, temperature, moving direction and time of dynamic shadowed change for PV Module that can simulate the cloud cover change or make Shadow I-V curve simulation for other shadow such as under the trees or the buildings. Each I-V curve is formed with maximum 4096 data points of voltage and current.

EVALUATING THE PV INVERTER’S CONVERSION EFFICIENCY *
The photovoltaic I-V curve model of Sandia Lab and EN50530’s built in the softpanel allows the user to input the maximum dc input power (Pmax), I-V Fill Factor, Vmin, Vnom and Vmax desired to test the PV Inverter. Click the maximum power percentage value (5%, 10%, 20%, 25%, 30%, 50%, 75%, 100%) desired directly and , the softpanel will produce the tested solar cell I-V curve automatically. Next, download it to the standalone unit to start simulating the I-V curve for the PV Inverter to test the conversion efficiency. *Required an extra power meter.
REAL WORLD WEATHER SIMULATION
The real world weather simulation function allows the user to import real conditions of irradiation and temperature profiles of a whole day from excel file to Softpanel, in order to simulate the irradiation intensity and temperature level from early morning to nightfall. It can also set the interval time resolution to 1s for I-V curve update rate and enable the user to perform MPPT tracking tests under the simulation of actual weather environments.

AUTO RUN FUNCTION OF STATIC & DYNAMIC MPPT TESTING
In order to easily test the static & dynamic MPPT performance of standard EN50530 & Sandia for PV inverter, the SoftPanel has an auto run function, which the user only has to set the Vmin, Vnom, Vmax, Pmax, Stabilization time & Testing period time parameter and testing items of EN50530 & Sandia, then the softpanel can run tests automatically and generate reports after finished.

<table>
<thead>
<tr>
<th>ENS0530 Dynamic MPPT Efficiency Test Report (30%~100%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>From-to W/m²</td>
</tr>
<tr>
<td>300-1000</td>
</tr>
<tr>
<td>Slope W/m²</td>
</tr>
<tr>
<td>10</td>
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<tr>
<td>10</td>
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<td>10</td>
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<td>10</td>
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<tr>
<td>10</td>
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<tr>
<td>10</td>
</tr>
<tr>
<td>Total</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ENS0530 Static MPPT Efficiency Test Report</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPPT voltage of the simulated I/U characteristic of the PV generator</td>
</tr>
</tbody>
</table>

REPORT FUNCTION
The softpanel also provides data recording capabilities, which include: voltage, current, power, energy and MPPT efficiency and the corresponding parameter sampling time (1s~10000s) for the recording process. The report can be utilized for R&D design characterization verification, QA verification and production quality control.

MASTER / SLAVE PARALLEL OPERATION UP TO 198KW
When high power is required, it is common to connect two or more power supplies in parallel. The 62000H-S series supplies have a smart master / slave control mode making the parallel operation fast and simple. In this mode, the master scales values and downloads data to slave units with a high speed sync signal process and automatic current sharing control.

Remote GPIB/USB/RS232
RS485/Ethernet

Local Front Panel

Master
SYSTEM BUS
Slave
CUSTOMIZATION SOLAR ARRAY SIMULATOR UP TO 1500KW

Model A620029 CSU

- Connect multiple 150kW solar array simulator in parallel (0~1000V/0~2500A/0~1500kW)
- Simultaneous display of output voltage and current
- Current sharing capability up to 1.5MW
- Standard USB/GPIB/Ethernet interface

Note: In order to substantially reduce harmonic currents and increase energy efficiency, please adding a Schaffner ECOsine™-Passive Harmonic Filters device between power supply and grid.

ORDERING INFORMATION

<table>
<thead>
<tr>
<th>Power Rating</th>
<th>Model Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>2kW</td>
<td>62020H-150S</td>
<td>Programmable DC Power Supply 150V/40A/2kW with Solar Array Simulation</td>
</tr>
<tr>
<td>5kW</td>
<td>62050H-600S</td>
<td>Programmable DC Power Supply 600V/8.5A/5kW with Solar Array Simulation</td>
</tr>
<tr>
<td>10kW</td>
<td>62100H-600S</td>
<td>Programmable DC Power Supply 600V/17A/10kW with Solar Array Simulation</td>
</tr>
<tr>
<td>15kW</td>
<td>62150H-600S</td>
<td>Programmable DC Power Supply 600V/25A/15kW with Solar Array Simulation</td>
</tr>
<tr>
<td></td>
<td>62150H-1000S</td>
<td>Programmable DC Power Supply 1000V/15A/15kW with Solar Array Simulation</td>
</tr>
<tr>
<td>18kW</td>
<td>62180H-1800S</td>
<td>Programmable DC Power Supply 1800V/30A/18kW with Solar Array Simulation</td>
</tr>
</tbody>
</table>

Options

- A620024: GPIB Interface for 2kW/5kW/10kW/15kW models (Factory installed)
- A620039: GPIB Interface for 12kW/18kW models
- A620025: Ethernet Interface for 62000H series (Factory installed)
- A620026: Rack Mounting kit for 62000H series
- A620027: Parallel Power Stage 15kW for 62150H-600S
- A620028: Parallel Power Stage 15kW for 62150H-1000S
- A620034: Parallel Power Stage 18kW for 62180H-1800S *3
- A620029: Control and Supervisor Unit for 150kW~1.5MW
- A620030: 19" Rack (41U) for 62000H-S Series (380Vac input)
- B620000: 19" Rack Mounting Kit 2U for 62020H-150S

Note *1: Call for more information regarding the customized solar array simulator of 150kW~1.5MW.
Note *2: All models output power are available for 200/220Vac, 380/400Vac and 440/480Vac line voltage.
Note *3: Call for availability
1. POWER Switch
2. VFD Display
   Display setting, readings and operating status
3. LOCK Key
   Lock all settings
4. OUTPUT Key
   Enable or disable the output
5. CONFIG Key
   Set the system configuration
6. VOLTAGE Key
   Set the output voltage
7. CURRENT Key
   Set the output current
8. PROG Key
   Program the sequence
9. NUMERIC Key
   Set the data
10. ROTARY Key
    Adjust the V&I and set the parameter

11. Analog programming interface
    For analog level to program and monitor output voltage & current
12. RS-232 or RS-485 Interface (alternative)
13. System Bus
    For master/slave parallel and series control
14. USB Interface
15. OUTPUT Terminal
    Connect the output cable to a UUT
16. System Fan
    With fan speed control
17. Current Sharing Terminal
    Connect the cable to slave unit
18. Sense Terminal
    Connect the UUT for voltage compensation
19. GPIB or ETHERNET Interface
    (Option for 2kW/5kW/10kW/15kW models)
20. GPIB Interface (Option for 18kW model)
21. Ethernet Interface (for 18kW model)
22. AC Input Terminal
### Electrical Specifications: With Solar Array Simulation

#### Model Specifications

<table>
<thead>
<tr>
<th>Model</th>
<th>62020H-150S</th>
<th>62050H-600S</th>
<th>62100H-600S</th>
<th>62150H-600S</th>
<th>62150H-1000S</th>
<th>62180H-1800S</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Output Ratings</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Output Voltage</td>
<td>0 ~ 150V</td>
<td>0 ~ 600V</td>
<td>0 ~ 600V</td>
<td>0 ~ 1000V</td>
<td>0 ~ 1800V</td>
<td></td>
</tr>
<tr>
<td>Output Current</td>
<td>0 ~ 40A</td>
<td>0 ~ 8.5A</td>
<td>0 ~ 17A</td>
<td>0 ~ 25A</td>
<td>0 ~ 15A</td>
<td>0 ~ 30A</td>
</tr>
<tr>
<td>Output Power</td>
<td>2000W</td>
<td>5000W</td>
<td>10000W</td>
<td>15000W</td>
<td>15000W</td>
<td>18000W</td>
</tr>
</tbody>
</table>

#### Line Regulation
- Voltage: ± 0.01% F.S.
- Current: ± 0.05% F.S.

#### Load Regulation
- Voltage: ± 0.05% F.S.
- Current: ± 0.1% F.S.

#### Voltage Measurement
- Range: 60V / 150V, 120V / 600V, 120V / 600V, 120V / 600V, 200V / 1000V, 1100V / 1800V
- Accuracy: 0.05% + 0.05% F.S.

#### Current Measurement
- Accuracy: ± 1% of full-scale output

#### Output Noise & Ripple
- Voltage Noise (P-P): 450 mV, 1500 mV, 1500 mV, 1500 mV, 2550 mV, 3500 mV
- Voltage Ripple (rms): 65 mV, 650 mV, 650 mV, 650 mV, 1950 mV, 750 mV
- Current Ripple (rms): 80 mA, 150 mA, 3000 mA, 450 mA, 270 mA, 250 mA

#### OVP Adjustment Range
- Range: 0 ~ 110% programmable from front panel, remote digital inputs.
- Accuracy: ± 1% of full-scale output

#### Programming Response Time
- Rise Time: 50% F.S., CC Load
  - 10ms (6.66A loading)
  - 10ms (6.66A loading)
- Rise Time: No Load
  - 10ms
- Fall Time: 50% F.S., CC Load
  - 10ms (6.66A loading)
- Fall Time: No Load
  - 30ms

#### Slew Rate Control
- Voltage Slew Rate Range
  - 0.001V/ms ~ 15V/ms
  - 0.001V/ms ~ 20V/ms
- Current Slew Rate Range
  - 0.001A/ms ~ 1A/ms, or INF
  - 0.001A/ms ~ 0.1A/ms, or INF
- Minimum Transition Time
  - 0.5ms
- Transient response time
  - Recovers within 1ms to ± 0.75% of steady-state output for a 50% to 100% or 100% to 50% load change (1A/us)
- Efficiency
  - 0.77 (Typical)
  - 0.87 (Typical)
  - 0.9 (Typical)

#### Programming & Measurement Resolution
- Voltage (Front Panel): 10 mV, 10 mV, 10 mV, 10 mV, 10 mV
- Current (Front Panel): 1mA, 1mA, 1mA, 1mA, 1mA
- Voltage (Digital Interface): 0.002% of Vmax
- Current (Digital Interface): 0.002% of Imax
- Voltage (Analog Interface): 0.04% of Vmax
- Current (Analog Interface): 0.04% of Imax

#### Programming Accuracy
- Voltage (Front Panel and Digital Interface): 0.1% of Vmax
- Current (Front Panel and Digital Interface): 0.3% of Imax
- Voltage (Analog Interface): 0.2% of Vmax
- Current (Analog Interface): 0.3% of Imax

#### Parallel Operation
- Master / Slave control via CAN for 10 units up to 150kW *1 (Parallel: ten units) up to 198kW *3

#### Auto Sequencing (I-V program)
- Number of programs: 10
- Number of sequences: 100
- Dwell time Range: 1s ~ 15,000S
- Trig. Source: Manual / Auto

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**Note**

*1: Max. Power is 20kW for 62020H-150S.
*2: There is parallel mode for DC power supply when the I-V curve function is enabled.
*3: For higher power > 198kW, please call for availability.
*4: Recovers within 1.5ms to ± 1.5% of steady-state output for a 50% to 75% or 75% to 50% load change (0.1A/ms)
### GENERAL SPECIFICATIONS

<table>
<thead>
<tr>
<th>Model</th>
<th>62020H-150S</th>
<th>62050H-600S</th>
<th>62100H-600S</th>
<th>62150H-600S</th>
<th>62150H-1000S</th>
<th>62180H-1800S</th>
</tr>
</thead>
<tbody>
<tr>
<td>Remote Interface</td>
<td></td>
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</tr>
<tr>
<td>Analog programming</td>
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<td>Standard</td>
<td>Standard</td>
<td>Standard</td>
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<td>RS485</td>
<td>Standard</td>
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<tr>
<td>GPIB</td>
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<tr>
<td>System bus(CAN)</td>
<td>Standard for master/slave control</td>
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<tr>
<td>Ethernet</td>
<td>Optional</td>
<td></td>
<td></td>
<td></td>
<td>Standard</td>
<td></td>
</tr>
</tbody>
</table>

### GPIB Command Response Time

- **Vout setting**: GPIB send command to DC source receiver <20ms
- **Measure V&I**: Under GPIB command using Measure <25ms

### Analog Interface (I/O) *

- **Voltage and Current Programming Inputs (I/P)**: 0-10Vdc / 0 ~ 5Vdc / 0 ~ 5k ohm / 4 ~ 20 mA of F.S.
- **Voltage and Current monitor output (O/P)**: 0 ~ 10Vdc / 0 ~ 5Vdc / 4 ~ 20mA of F.S.
- **External ON/OFF (I/P)**: TTL : Active Low or High (Selective)
- **DC, ON Signal (O/P)**: Level by user define (Time delay = 1 ms at voltage slew rate of 10V/ms.)
- **CV or CC mode Indicator (O/P)**: TTL Level High=CV mode ; TTL Level Low= CC mode
- **OTP Indicator (O/P)**: TTL : Active Low
- **System Fault indicator (O/P)**: TTL : Active Low
- **Auxiliary power supply (O/P)**: Nominal supply voltage : 12Vdc / Maximum current sink capability : 10mA
- **Safety interlock (I/P)**: Time accuracy : <100ms
- **Remote inhibit (I/P)**: TTL : Active Low

### Auto Sequencing (List Mode)

- **Number of program**: 10
- **Number of sequence**: 100
- **Dwell time Range**: 5ms ~ 15000S
- **Trig. Source**: Manual / Auto / External

### Auto Sequencing (Step Mode)

- **Number of program**: 10
- **Number of sequence**: 100
- **Dwell time Range**: 1ms ~ 15000S
- **Trig. Source**: Manual / Auto / External

### Input Specification

- **Input Voltage**: 3Phase, 3Wire+Ground
  - 1Ø 200~220Vac ± 10% VLN
  - 3Ø 200~220Vac ± 10% VLL ; 3Ø 380~400Vac ± 10% VLL
  - 3Ø 440~480Vac ± 10% VLL

### AC Frequency range

- 47 ~ 63Hz

### Max Current (each phase)

- 200/220Vac: 15.2A
- 380/400Vac: 22A
- 440/480Vac: 19A

### General Specification

- **Maximum Remote Sense Line Drop Compensation**: 2% of full scale voltage per line (4% total)
- **Operating Temperature Range**: 0ºC ~ 40ºC
- **Storage Temperature Range**: -40ºC ~ 85ºC
- **Dimension (HxWxD)**: 89x428x465 mm / 3.5x16.85x16.73 inch
- **Weight**: Approx. 17 kg/37.44 lbs
- **Approval**: CE

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All specifications are subject to change without notice. Note * : None APG interface for A620027/A620028/A620034

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Get more product & distributor information in Chroma ATE APP

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