## PRODUCT OVERVIEW

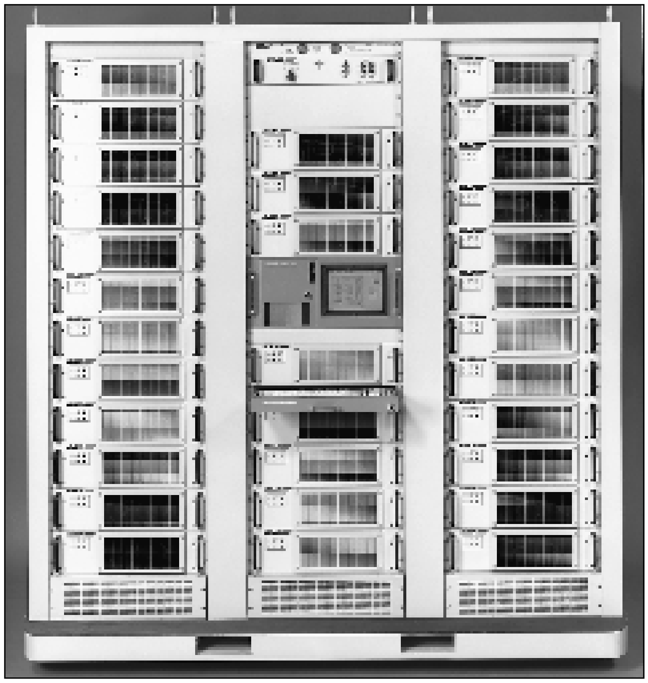
A spacecraft solar array is subjected to large temperature excursions, varying insolation (the amount of sunlight falling on the array), mechanical changes and aging, which substantially effect both its short and long term performance. In order to test the spacecraft's power environment, a cost-effective solution for ground based testing is to utilize a solar array simulator.

Elgar's Solar Array Simulator (SAS) reproduces all possible solar array outputs, based on the wide variety of input conditions that an array faces, including orbital rotation, spin, axis alignment, eclipse events, beginning-of-life and end-of-life operation. The SAS also provides complete programmable control of all the parameters that shape the solar cell I/V output curve. By being able to accurately simulate solar panels under various space conditions with complete control, a system developer can comprehensively verify design margins and quickly test, in production, spacecraft power systems and their associated electronics.

Each Elgar Solar Array Simulator is a fully integrated, turn-key system complete with Windows NT graphical user interface and hardware control software. It can be remotely controlled and addressable as a single device when integrated into a customer's test system. This control is accomplished via a standard ethernet or optional GPIB interface using standard SCPI format commands.

As a very important consideration in spacecraft testing, discrete hardware protection systems are a standard part of every SAS. These include subsystems that can remove power at the output of the SAS in under 10 microseconds. Each SAS string has an electronic circuit breaker and relay disconnect, so faults are localized and minimize disruption of the last process.

SAS Systems have been designed and delivered ranging from desktop, 2 channel, R&D units to systems capable of controlling two 64 channel SAS Systems simultaneously. Elgar's Space Power Simulation Group can assist in defining special requirements and customize each system using a standard building block approach. This allows each customer to get exactly what he/she wants while minimizing costs.



Solar Array Simulator

## FEATURES AND BENEFITS

### TOTAL CONTROL OF I/V BEHAVIOR

Elgar's Fast Profiling Current Source (FPCS) provides the ability to simulate real world solar array power more accurately than other technologies by allowing programmable control of all four parameters necessary to independently control the characteristic I/V diode output curve, or profile, of each FPCS channel.

In addition, the user may choose the non-parametric mode of operation and program I/V curves unique to his/her application.

The basic building block of an Elgar SAS is the FPCS. Each FPCS module simulates either one or two array strings, or can be series or paralleled with other FPCS modules to simulate larger array segments. Each FPCS channel delivers 450W of power; 2 channels are housed in a single 5-1/4" chassis. Open circuit voltage and short circuit current are scaled to meet a customer's requirements.

### DESIGNED TO OPERATE AT THE KNEE

The FPCS is designed to operate continuously at the peak power output, or the knee, of the solar array output. With a bandwidth of over 500 kHz, the FPCS is unconditionally stable at any point of the I/V curve. It can operate continuously at the peak power point of the output curve, into a sequential shunt unit (SSU), or into any other power system output topology.

The FPCS has been proven to supply peak power tracking, sequential shunt and series regulator power topologies. It has even been used to test Xenon Ion propulsion devices.

### THE PROVEN SOURCE

The following companies are now using Elgar Solar Array Simulators:

Alcatel ETCA

Alenia Officine Galileo

Ball Aerospace

Boeing Defense & Space

Boeing North American

European Space Agency (ESTEC)

Hughes Space & Communications

Lockheed Martin Astro Space

Lockheed Martin Astronautics

Lockheed Martin Missiles & Space

Matra Marconi Space

Space Systems Loral

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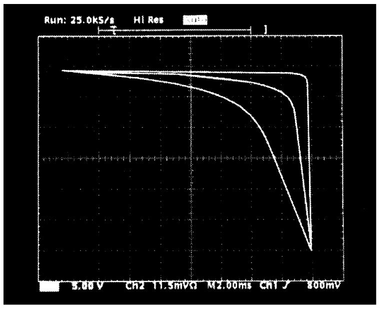


V

**I/V DIODE OUTPUT CURVE CONTROL PARAMETERS**

**Voc** Maximum programmed open circuit voltage at no load

**Isc** Maximum programmed short circuit current operating into short

**Rs** Maximum programmed effective series resistance (voltage mode slope adjustment)

**N** Curve factor (current mode steepness adjustment)

**QUICK CURVE RECALCULATION**

Since the FPCS is capable of a smooth transition from one calculated curve to another without any output disturbances, varying insolation patterns can easily be simulated. With a maximum curve update rate of 4 times/second, entire orbits can easily be simulated with fine time resolution. An alternate mode can be programmed to allow the FPCS to operate in power supply constant current mode, where recalculation is even faster.

**EMBEDDED COMPUTER IN EACH MODULE**

An embedded Motorola microprocessor in each FPCS module provides the computational power necessary to calculate the output transfer function, to communicate via a fiber optic data link to the system computer and to continuously monitor the state of the power sections.

**FASTEST SWITCHING RECOVERY TIME**

Elgar systems feature switching recovery time of 2 microseconds or less.

**450 AND 900 WATT MODULES**

Systems can be as small as one 450 watt channel or as large as 128 channels with a total output power of up to 57,600 watts.

**SIMULATES BOTH SILICON AND GALLIUM ARSENIDE ARRAYS**

Silicon, gallium arsenide, and other types of solar array panels can be simulated realistically. The FPCS technology was specifically designed to operate into sequential shunt unit (SSU) as well as peak power tracking and linear regulation systems.

**GALVANIC ISOLATION OF OUTPUTS**

Each FPCs chassis is controlled via a fiber optic link to eliminate nuisance ground loops associated with other hardwired control systems, such as RS 232 or GPIB.

## SPECIFICATIONS

Specifications are guaranteed over a temperature range of 0-40° C, unless otherwise noted.

**Power Ratings:** Dual 450 watt outputs, or a single 900 watt output in a single rackmount chassis 5-1/4" in height offer nearly twice the power density in the same package.

**Output Ratings:** Elgar will scale the open current voltage (Voc) to maximize the short current (Isc) within the 450/900W envelope to an individual customer's requirement at no additional charge. Outputs can be set for 450 watts or 900 watts per channel with voltages (Voc) of up to 145 Voc and output current (Isc) of up to 15 amps per channel.

**Programming Accuracy:** at 25ºC ±5ºC

**Voltage:** ±0.06% of setting (± 0.06% of maximum Voc)

**Current:** ±0.1% of setting (± 0.1 % maximum Isc)

**Ripple and Noise:** (In the range of 20 Hz - 20 MHz, with outputs floating or grounded)

**Constant Voltage:** RMS ±0.025% of maximum Voc; p-p ±0.25% of maximum Voc

**Constant Current:** RMS ±0.05% of maximum Isc; p-p ±0.5% of maximum Isc Note: Test conditions maximum Voc, maximum Isc, N = 44, Rs = 0.5, load = 3Ω resistive

**Line Regulation:** Change in output voltage or current for any line change

**Voltage:** ±0.01% of maximum Voc

**Current:** ±0.1 mA ± 0.005% of maximum Isc

**Load Switching Recovery Time:**
<2 seconds. Current recovers to within 90% of programmed value in less than 2 microseconds when switched from short circuit to variable load.

**Readback Accuracy:** at 25ºC ±5ºC

**Voltage:** ±0.1% of reading ±0.1% of maximum Voc

**Current:** ±0.2% of reading ±0.2% of maximum Isc and tested at the factory at the system level

$$V = \frac{Voc \cdot \ln[2-(I / Isc)^{N}] / \ln(2) - Rs \cdot (I-Isc)}{1+ Rs \cdot Isc / Voc}$$

*Voc, Isc, N and Rs are programmable values. The values of Voc and Isc control the curve endpoints. N and Rs control the current and voltage mode curve slopes, respectively.*


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