Elgar SAS - Solar Array Simulator

450/900 W
500/1000 W

450 or 500 W/channel Solar Array Simulator

- Total control of I/V behavior
- Designed to operate at the knee
- Fast profiling current source
- Bus overvoltage protection
- Hardware shutdown system
- Multiple master SAS systems can be connected to create very large SAS systems
- Customer defined output connectors

≈	208	400	480

ETHERNET GPIB

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.

The Elgar SAS system 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 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. AMETEK's Engineered Solutions 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 id needed while minimizing costs.

Features And Benefits

Total Control Of I/V Behavior

AMETEK'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 the 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 or 500W 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

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AMETEK PROGRAMMABLE POWER

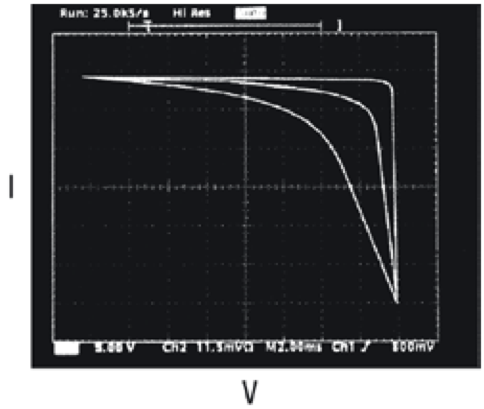
requirements.

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 Proven Source
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 following is a short list of the many companies now using the Elgar Solar Array Simulators:

Ball Aerospace
Boeing Research
Boeing Space Systems
Boeing Rocketdyne
Jet Propulsion Lab
Lockheed-Martin
Motorola Space and Systems Technology
Northrop Grumman (TRW Space)
Northrop Grumman
Space Systems Loral
Thales Alemia Space ETCA
Thales Rome
Thales Camus
Thales Torino
Thales L'Aquita
Thales ETCA
Thales Milano
Goodrich
Astrium (Matra Marconi, DASA)
Bristol Aerospace
Clemessy
European Space Agency – ESTEC
Israeli Aircraft Industries, MBT
Korea Aerospace Research Institute
Korea Aerospace Industries
Mitsubishi Electric Corporation
Mitsubishi Heavy Industries
NEC Toshiba Space Systems, Ltd.
Patria
Surrey Satellite
Siemens
Swedish Space Corporation
Terma Aerospace

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 and 500 and 1000 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. They can also be paralled to achieve much higher channel counts and power levels.

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

SAS - Specifications

Specifications	Specifications are guaranteed over a temperature range of 0-40° C, unless otherwise noted.
Power Ratings	Dual 450 watt or 500 watt outputs, or a single 900 watt or 1000 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 power envelope to an individual customer's requirement at no additional charge. Outputs can be set for voltages (Voc) of up to 150 Voc and output current (Isc) of up to 15 amps per channel.
Ripple and Noise	**(In the range of 20 Hz - 20 MHz, with outputs floating or grounded)**
Constant Voltage	rms ±0.025% of maximum, 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 load
Load Switching Recovery Time	2 µsec seconds. Current recovers to within 90% of programmed value in less than 2 microseconds when switched from short circuit to variable load.
Programming Accuracy	at 25°C ±5°C
Voltage	+0.06% of setting (± 0.06% of maximum Voc)
Current	+0.1% of setting (± 0.1 % maximum Isc)
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
Readback Accuracy	at 25°C ±5°C
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
Output Capacitance	or 70nf accross output terminals
Constant Voltage	rms 0.025% of max Voc p+p 0.025% of max Voc
Constant Current	rms 0.05% of max Isc p+p 0.05% of max Isc

Notes