

The SA-5 module—the smallest in BPSolarex's Millennia™ module series—uses advanced tandem-junction thin-film technology to transform light energy into electricity. Typical commercial applications of the SA-5 include electric fencing, remote telemetry, instrumentation systems, security sensors and signals. It is also well-suited to various small electrical jobs around the farm, home, or RV, such as maintaining charge on vehicle batteries, powering lanterns, fans, lights and other 12 VDC devices.

BPSolarex is a pioneer in thin-film technology, which creates solar cells by depositing semiconductor alloys in thin layers on glass. A major development in both efficiency and stability, the tandem-junction structure stacks two solar cells vertically, with each cell tuned for optimum conversion of different segments of the spectrum. The resulting modules are, in terms of energy delivered, as much as 25% less expensive than traditional photovoltaics.

Proven construction

The SA-5's materials reflect BPSolarex's collective 45 years of experience with PV systems installed in virtually every climate on Earth. The module front is a 3mm sheet of glass; the back is Tedlar™ with EVA (ethylene vinyl acetate) encapsulation providing a weatherproof seal. The module's back and sides are enclosed by an impact-resistant low-profile Lexan™* frame.

Complete, factory-wired

The module is complete and ready to install. Electrical output is via a 9-foot (2.7m) AWG 18-2 cable with sealed, strain-relieved electrical connections.

Power, materials and workmanship warranted

The SA-5 is covered by Limited Warranties which warrant:

- freedom from defects in materials and workmanship for one year;
- at least 80% of rated minimum power for five years (rated minimum power is the lower margin of the module's power [Pmax] tolerance window.)

Contact our Marketing Department or your sales representative for full terms of these warranties.

Millennia photovoltaics are conservatively rated, taking into account the attenuation which occurs during the first several months of a thin film product's solar exposure. When first deployed, Millennia modules generate as much as 18% above rated power. In some applications, this initial power bonus must be considered when sizing power system components such as wiring and switchgear.



SA-5

A competitive edge for consumer/OEM products

The SA-5 may also be special-ordered as a frameless laminate, designated the MST-5, for incorporation into OEM products. For many of these products, incorporating a photovoltaic power source can enhance utility, expand applications, and differentiate the product from its competition.

More delivered energy

Millennia modules operate on a broader power curve than most modules. The Millennia's comparatively rounded I-V curve means that, when it's operating near peak power point, a voltage change produces a smaller current change than occurs in a module with a sharper curve "knee." Thus, the Millennia can

The Natural Source for Electricity™

SA-5 modules are often used to power instrumentation measuring pressure and flow rates in the petroleum industry and water systems.



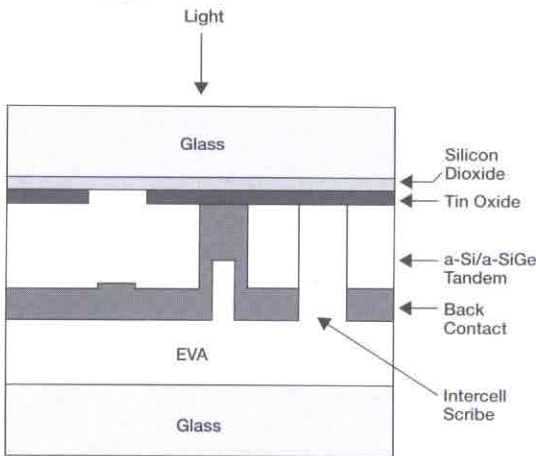
deliver higher power over a range of output voltages and, in many applications, more energy than other modules of equal rating.

Laser-scribed monolithic structure

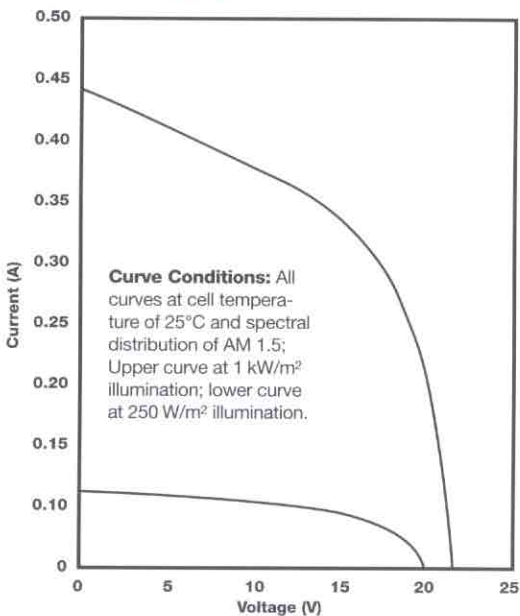
Millennia modules are made in BPSolarex's new automated thin film manufacturing facility. A patented laser-scribing procedure forms the individual solar cells, with all intercell electrical connections (shown below) internal to the module. This monolithic structure is innately reliable.

The conductive oxide layer is applied by a proprietary process which yields excellent film uniformity, improves optical coupling and enhances module efficiency. The combination of laser processing and ultra-uniform textured tin oxide film produces a module which is both efficient and attractive. The laser's precision means cell divisions can be very thin, maximizing the glass surface area devoted to power production.

Module Typical Cross-section



SA-5 I-V Curve



Safety and quality certified

The SA-5 is designed under BPSolarex's ISO 9001-certified quality system, is listed by Underwriter's Laboratories, and is approved by Factory Mutual Research for application in NEC Class 1, Division 2, Group C & D hazardous locations.



SA-5 Typical Electrical Characteristics

Maximum power (P_{max})	5W
Voltage at P_{max} (V_{mp})	16.1V
Current at P_{max} (I_{mp})	0.31A
Short-circuit current (I_{sc})	0.44A
Open-circuit voltage (V_{oc})	21.9V
P_{max} tolerance	±10%
Maximum DC system voltage	30V

Notes

These data represent the performance of typical modules as measured at their cable ends, and do not include the effect of such additional equipment as diodes. The data are based on measurements made in accordance with ASTM E1036-85 corrected to SRC (Standard Reporting Conditions, also known as STC or Standard Test Conditions), which are:

- illumination of 1 kW/m² (1 sun) at spectral distribution of AM 1.5 (ASTM E892-87 global spectral irradiance);
- cell temperature of 25°C.

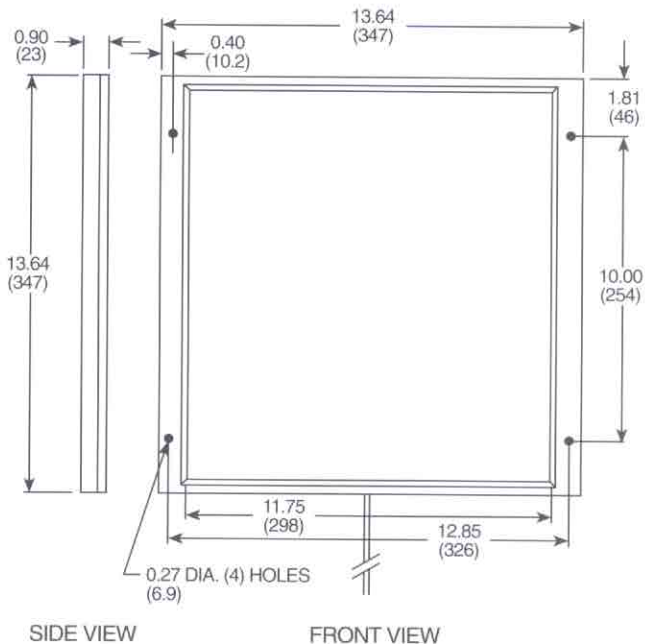
Millennia modules respond to short-term temperature changes similarly to crystalline silicon modules, but their long-term response is a complex function of insolation and temperature history. Under typical conditions, ambient temperature changes cause Millennia peak power to vary no more than 10%.

Mechanical Characteristics

Weight 3.2 pounds (1.5 kg)

Dimensions Dimensions in brackets are in millimeters
Unbracketed dimensions are in inches
Overall tolerances ±1/8" (3mm)

MST-5 laminate dimensions: 12" x 12.9" x 0.2"
304mm x 324mm x 4mm



SA-5 Amorphous Silicon Module



The SA-5 solar-electric module uses the most advanced of the photovoltaic technologies—thin films of semiconductive and conductive materials deposited on glass—to transform light energy to electricity. The SA-5 is designed for use primarily in systems with 12-volt batteries and, in full sunlight, provides over 300mA of current at typical battery charging voltage. Its proven encapsulation system and durable polycarbonate frame ensure long outdoor life, high reliability, and quick, easy installation.

Typical commercial applications of this module include operation of electric fences, infrared sensors, and signals. It is also well-suited to various small electrical jobs around the home, farm, boat or RV, such as maintaining charge on marine or vehicle batteries; powering fans, lights and portable communications equipment, and operating other 12 VDC devices.

The SA-5 is protected by an impact-resistant polycarbonate frame which totally encloses the module edges and back. Only eight-tenths of an inch thick, this low-profile frame allows the module to be nearly flush with the mounting surface. The SA-5 is also available in an unframed configuration for incorporation directly into OEM products.

OUTPUT TESTED AND WARRANTED

These modules are tested twice before shipment, and are covered by a limited five year warranty for electrical output, materials and workmanship. Full terms of this warranty are available from Solarex sales representatives.

ENHANCES RELIABILITY AND DISTINCTIVENESS

Including a photovoltaic module in a product helps to differentiate it, both functionally and cosmetically, from its competition. Included in the product's battery circuit, the SA-5 may be used to charge the battery or to supplement the battery's output. Either way, the reliability of the power is enhanced and the battery lasts longer.



LASER PROCESSING: MORE POWER, MORE VOLTAGE, MORE RELIABILITY

Solarex amorphous silicon modules are manufactured using automated processes similar to those used for semiconductor manufacturing. These processes result in a monolithic module precision-layered with conductive and semiconductive films. These films are laser-scribed, using a patented method, into individual solar cells. The laser's ability to scribe cleanly and precisely produces a superior product in several respects:

- Cell divisions are very narrow, allowing more module surface to be devoted to power production. Thus, a module of given size generates more power.
- Voltage characteristics and overall performance at low light levels are improved.

The series and parallel connections between cells (which determine the module's voltage and current output) are completed *internal to the module* (see Figure 1), resulting in an ultra-reliable module without solder joints.

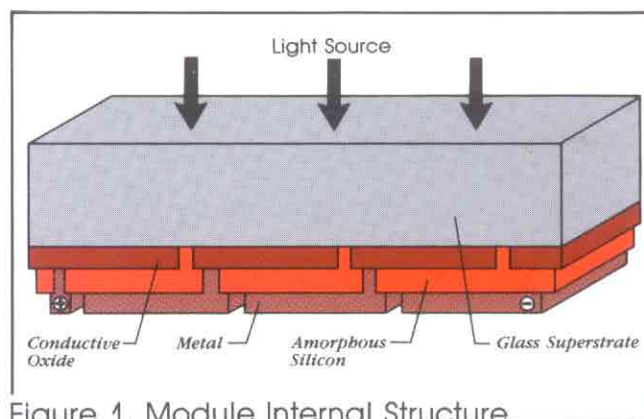


Figure 1. Module Internal Structure

ATTRACTIVE AND EFFICIENT

Solarex amorphous silicon modules have a uniformly black surface. Although the product's uniformity and darkness make it extremely attractive, its appearance is actually a byproduct of tightly controlled manufacturing processes developed to optimize the module's light-trapping ability and overall optical and electrical characteristics.

PROVEN MATERIALS AND CONSTRUCTION

The materials used in the SA-5 reflect Solarex' more than a decade of experience with solar modules and systems installed in virtually every climate on Earth. The module surface is impact-resistant solar-grade glass. The back and sides of the module are enclosed by a low-profile *Lexan™ frame. Strong and impact-resistant, the frame provides excellent protection against environmental stress. The module may be mounted from front or back using the predrilled 0.265-inch-diameter holes in the frame corners.

Power output is via a stress-relieved ten-foot two-conductor cable which extends from the edge of the module. The cable's two #18 AWG leads are insulated with polyethylene, and the cable jacket is PVC.



SAFETY APPROVED

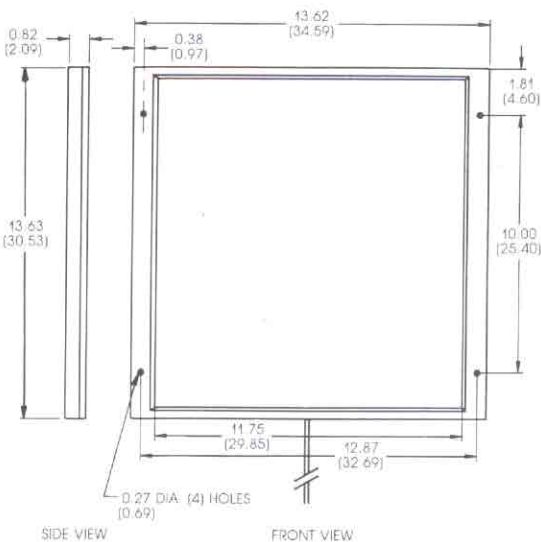
The SA-5 module is listed by Underwriter's Laboratories for electrical and fire safety (class "C" fire rating) and is approved by Factory Mutual Research for application in NEC Class 1, Division 2, Group D hazardous locations.



MECHANICAL CHARACTERISTICS

Weight: 3.2 pounds (1.5 kg)

Dimensions: Dimensions in brackets are in centimeters. Unbracketed dimensions are in inches.



*Lexan is a registered trademark of General Electric Company.

ELECTRICAL CHARACTERISTICS

The SA-5 is designed to produce voltage and current appropriate to 12V battery charging over a broad segment of its I-V curve adjacent to the design operating point.

Typical Electrical Characteristics¹

Current at design operating point (I_{op})	290 mA
Voltage at design operating point (V_{op})	17.5V

Minimum Characteristics at STC²

Voltage at maximum power (V_{mp})	15V
Current at maximum power (I_{mp})	340 mA ³
Open-circuit voltage (V_{oc})	23V
Short-circuit current (I_{sc})	380 mA

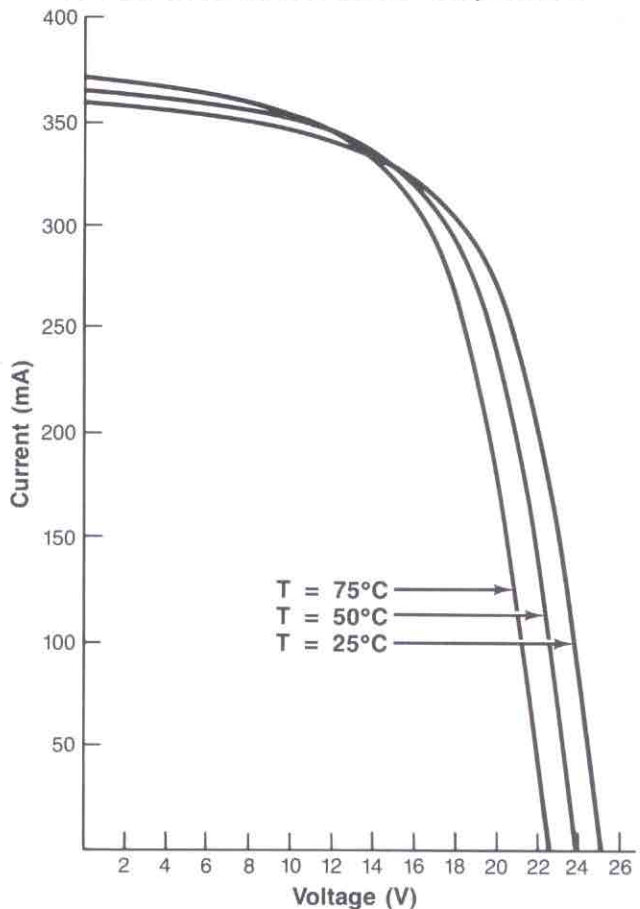
Temperature Effects

Temperature coefficient of current	300 $\mu A/^{\circ}C$
Temperature coefficient of voltage	-60 mV/ $^{\circ}C$
Temperature coefficient of power	-0.3%/ $^{\circ}C$

Notes:

- These are the characteristics of a typical SA-5 in full sun at ambient temperature of 20°C.
- Minimum initial characteristics are based on measurements made at Standard Test Conditions (STC), which are:
 - Illumination of 1 kW/m² (1 sun) at spectral distribution of AM 1.5
 - Cell temperature of 25°C
- The SA-5 is covered by a limited two-year warranty which guarantees that, at STC, it will generate at least 80% of the specified I_{mp} with voltage fixed at V_{mp} .

I-V Characteristics at 3 Module Temperatures



For More Information, Contact: