



SOLAR ELECTRIC PANELS FOR RAILROAD APPLICATIONS

Solarex, the world leader in photovoltaics, offers solar panels and systems custom designed for railroad applications. Solarex customized panels feature AAR standard output terminals and vandal-resistant construction. The highly reliable solar electric systems provide an ideal power source in remote locations where more conventional power sources are unavailable and too costly to install or maintain.



The Model 2000/2 photovoltaic panel is a two volt nominal unit designed to charge a single lead-acid or nickel-cadmium battery. The Model 2000/12 solar panel, a 12 volt nominal unit, will charge six lead-acid or nine nickel-cadmium batteries. Both models feature 36 corrosion-resistant 75 mm silicon solar cells encapsulated in silicon rubber and protected by tempered, textured glass faceplates and rugged anodized aluminum backplates. A mounting

hardware package is included with each panel or system to simplify field assembly.

Solarex solar electric systems are providing power for a wide range of signalling and communications functions including track circuitry, branch and mainline crossing signals, dragging detectors, and ground to

train communications. The systems have proven their reliability through years of railroad industry service.

In numerous applications throughout the U.S. and worldwide, Solarex photovoltaic systems are contributing to the effectiveness and efficiency of railroad communication and signalling operations.



A 400 watt Solarex photovoltaic array provides power for track code units and intermediate signals near Spokane, Washington.

FEATURES

Solar Cell

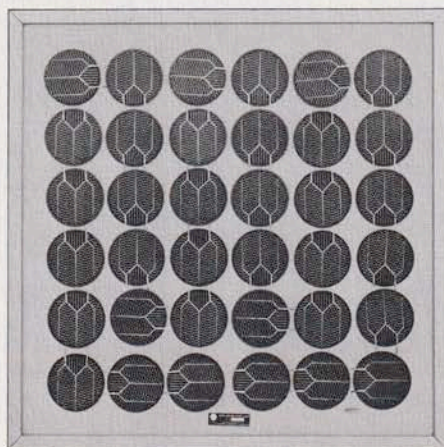
- Nickel solder metallization provides excellent corrosion resistance and high power performance.
- Patented tantalum-oxide anti-reflective coating remains stable over the long term and ensures maximum cell efficiency.

Faceplate

- Tempered, textured glass withstands severe weather conditions such as hail, ice, and sand; and rapid temperature variations such as those present in desert environments.
- Glass is a preferred packaging material for hot, desert environments since glass and silicon have similar coefficients of expansion.

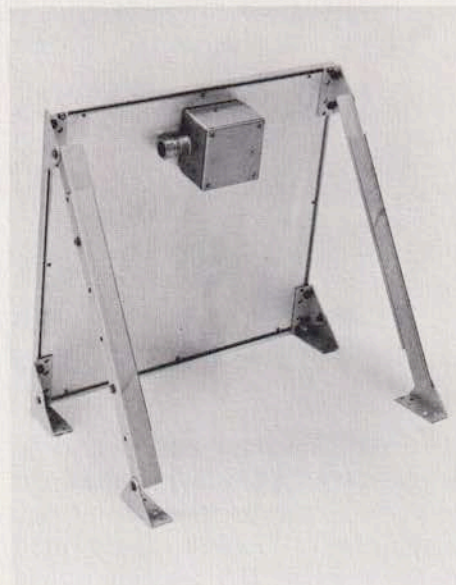
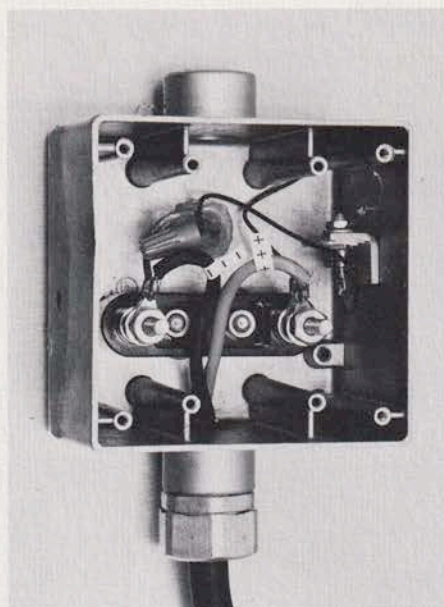
Panel Construction

- Thirty-six 75mm round cells are connected in series. This assures adequate charging voltage for 12 volt nominal batteries, e.g. six lead-acid or nine nickel-cadmium batteries. (2000/12 only).
- Thirty-six 75mm cells are wired in a 6 series/6 parallel configuration to provide charging voltage for a 2 volt nominal battery, e.g. one lead-acid or one nickel-cadmium battery. (2000/2 only).
- UV stabilized silicon rubber cell encapsulation resists discoloration and provides a thermally stable, shock-resistant environment.



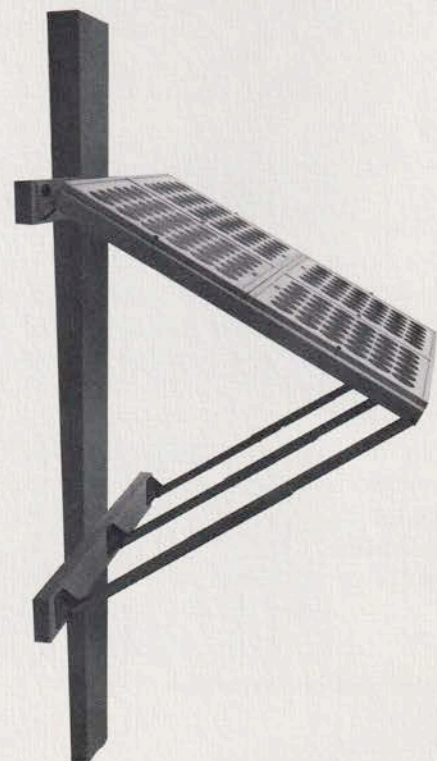
Model 2000/12

- Stress relief loops in redundant cell interconnects maintain connector integrity during thermal expansion and contraction.
- Weatherproof, UL approved junction box is fitted with AAR #9 terminals to simplify field wiring.
- In-line blocking diode in the junction box prevents reverse current flow from the battery through the panel during darkness. (2000/12 standard, 2000/2 optional).
- One-eighth inch thick anodized aluminum backplate provides extra protection from vandalism and harsh environments.



Mounting Hardware

- Anodized aluminum telescoping legs and pivoting feet make the panel readily adaptable to pole and flat surface mounting. Telescoping legs allow the panel to be installed at the appropriate tilt angle.
- Stainless steel hardware with 1/2" hexagonal head nuts and bolts conforms to AAR standard terminal nut size to simplify the signal maintainers' field installation task.



Frame

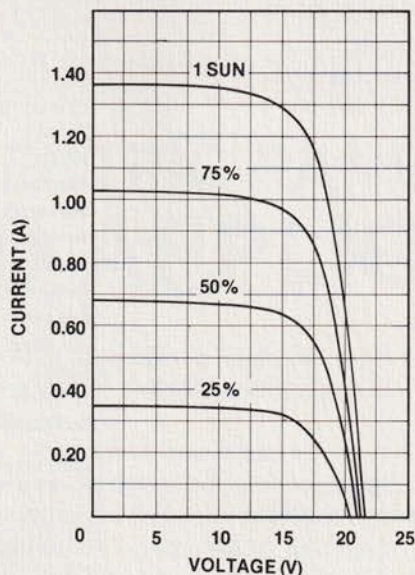
- Extruded, anodized aluminum frame is highly corrosion resistant.
- Locating routes on front surface allow accurate drilling, if necessary when mounting array.
- The back surface of the frame contains two continuous threaded channels: one which accepts 1/4-20 bolts, for interconnecting panels and mounting array; and a second, which accepts the 6-32 bolts that attach the protective backplate.

ELECTRICAL CHARACTERISTICS

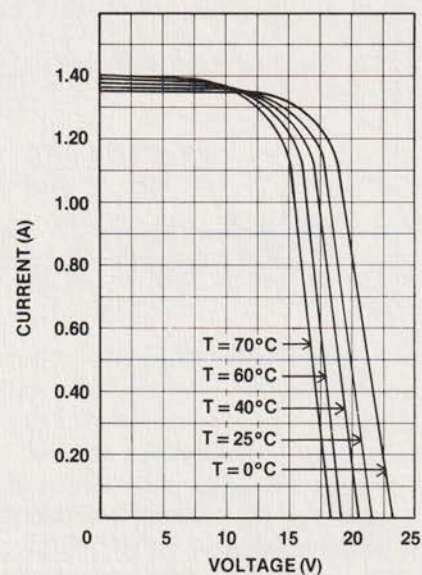
Model 2000/12

Peak Power (W).....	20
Voltage (V) at peak power.....	16.2
Nominal voltage.....	14
Current (A) at nominal voltage.....	1.3
Open-circuit voltage.....	21

Performance at Various Light Intensities, T = 25°C



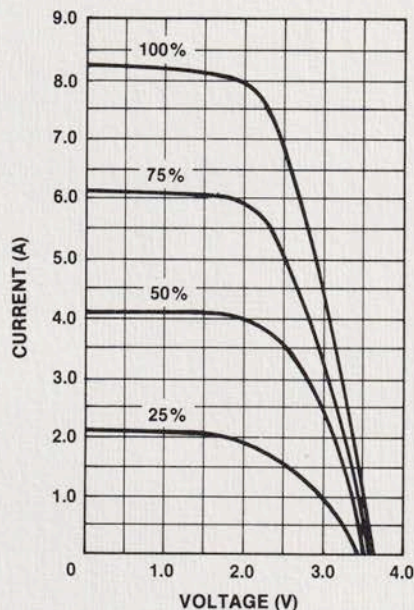
Performance at Various Temperatures at AM1 (1 KW/m²)



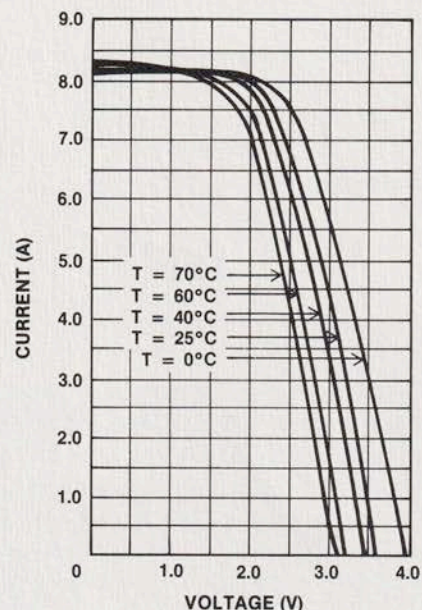
Model 2000/2

Peak Power (W).....	20
Voltage (V) at peak power.....	2.7
Nominal voltage.....	2.3
Current (A) at nominal voltage.....	7.8
Open-circuit voltage.....	3.5

Performance at Various Light Intensities T = 25°C



Performance at Various Temperatures at AM1 (1KW/m²)



NOTES:

1. Panels are measured under full sun illumination (1 KW/m²) at 25°C ± 3°C cell temperature. Minimum performance is 10% less than nominal. The ruling specification is peak watts. For a more detailed explanation, see our *Electrical Performance Measurements* bulletin.

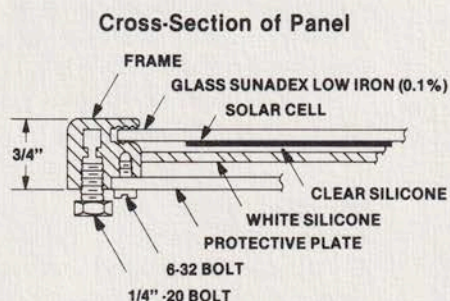
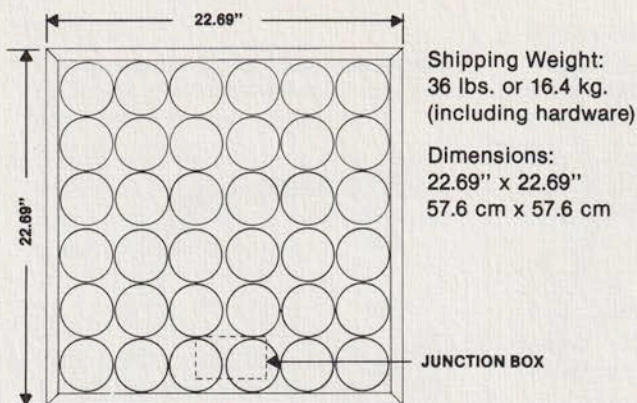
2. Electrical characteristics vary with temperature.

VOLTAGE (VOC)	increases by	2mV/°C/cell	below	25°C
	decreases by		above	
CURRENT (ISC)	increases by	25uA/cm ² /°C	above	25°C
	decreases by		below	
POWER (peak)	increases by	0.3%/°C	below	25°C
	decreases by		above	

3. The curves are representative of the performance of typical panels at the terminals, without any additional equipment such as diodes, cabling, etc. The curves are intended for reference only.

MECHANICAL SPECIFICATIONS

MODELS 2000/2 and 2000/12



PANEL PERFORMANCE

Estimated Daily Single Panel Output (Ampere Hours/Day) in Selected U.S. Cities*

	Type 2000/2 Nominal Voltage = 2.3		Type 2000/12 Nominal Voltage = 14	
	Yearly Average	Worst Case Winter	Yearly Average	Worst Case Winter
Albuquerque	45	37	8	7
Chicago	33	21	6	4
Denver	41	33	7	6
Houston	35	29	6	5
Jacksonville	35	29	6	5
Minneapolis	33	21	6	4
New Orleans	35	29	6	5
Sacramento	37	21	7	4
Salt Lake City	41	29	7	5
San Diego	45	29	8	5
Seattle	29	13	5	3
St. Louis	33	21	6	4
Washington, D.C.	29	21	5	4

*Assuming panel is installed at optimum tilt angle, facing south, with no shading.

RELIABILITY AND ENVIRONMENTAL SPECIFICATIONS

Solarex panels are subjected to intensive quality control during manufacture and rigorous testing before shipment. They are designed to meet or exceed the following tests with no performance degradation:

- Repetitive cycling between -40°C and 100°C .
- Prolonged exposure to 90-95% humidity at 70°C .
- Simulated wind loading of 200 lbs. per ft^2 .

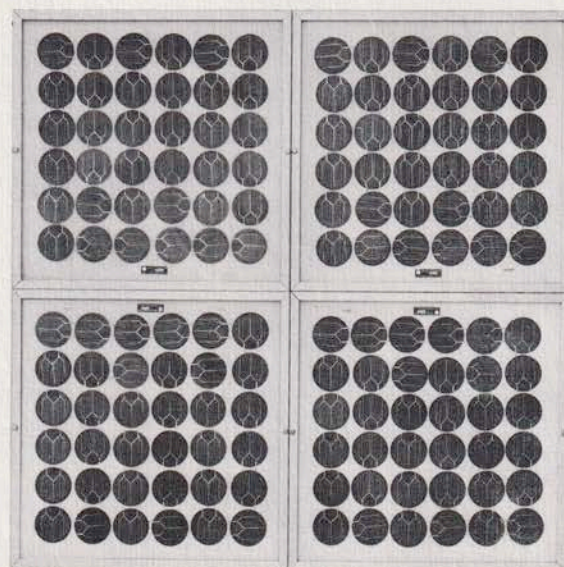
Solarex high-technology solar cells are individually tested before assembly, the panel is carefully inspected at critical manufacturing stages, and each unit is electrically tested for conformance to Solarex standards before assignment of its serial number. Tens of thousands of Solarex panels are in use around the world, performing reliably for private industry, individual consumers, and government agencies.

THE MODEL 8000/12 ARRAY

Solarex offers the 8000/12 solar array customized for railroad applications. The array is rated at 80 watts (peak) to deliver approximately 5.2 amps at 14 volts (nominal).

The Model 8000/12 is composed of four Model 2000/12 photovoltaic panels. The panels are electrically interconnected with weatherproof cabling, and the array includes an output junction box fitted with AAR standard #9 terminals. The array hardware includes anodized aluminum telescoping legs and pivoting feet, and $\frac{1}{2}$ " hexagonal head stainless steel hardware for easy installation.

The array measures 48.5" x 48.5" (123 cm x 123 cm) and, when packed for shipping, weighs approximately 150 lbs (68.2 kg).



For more information contact Solarex Sales Department.