

MSX Laminates



Meeting the demands of customers who need the high quality of Solarex's industry-leading MSX photovoltaic modules, but not the module frame, all MSX modules are now available in frameless configuration. These products, known as "laminates" because they comprise laminated layers of tempered glass, solar cells, and encapsulation materials, are useful in applications where the standard module frame is unnecessary or redundant. In all respects except framing, the laminate product line is identical to the standard MSX module line, sharing its field-proven materials, rigorous quality control, industry-leading warranty, UL listing, and tight power tolerances.

MSX laminates are available with maximum power outputs ranging between 5 watts and 240 watts. Their pri-

mary uses are in architectural applications, in large arrays, as a power source integrated into a product, and as a component for countries developing photovoltaic manufacturing capability.

ARCHITECTURAL APPLICATIONS

Laminates are often used as dual-purpose architectural sheathing, where the laminate serves as a building's exterior cladding while contributing to its energy needs. In such applications, the laminate is captured in a framing system integrated with the building's roof or facade. Because it replaces traditional sheathing material, the net cost of the laminate is effectively reduced.

Solarex laminates are presently in use as roof-mounted residential and institutional power sources, as components of manufactured housing, and in curtain wall systems in commercial buildings.

LARGE ARRAYS

In some large photovoltaic arrays, standard module frames may duplicate other support elements in the array structure. By specifying laminates rather than framed modules in such arrays, a designer enjoys more latitude in the design process and may simultaneously reduce overall system cost.

In these applications—and in all applications of laminates—the designer must be fully cognizant of the design criteria for framing and supporting the laminate. These may include wind loading, module gripping, shading of cells by the frame, maintenance of electrical isolation, and rain- and snow-shedding characteristics.



The entranceway canopy of the Aquatic Center at Georgia Institute of Technology is roofed with a 4.5 kW array of Solarex PowerWall™ MSX-240/AC laminates. With their integrated inverters, these laminates provide grid-synchronized AC power. They use an optional clear Tedlar® backing material which emphasizes the precision of solar cell placement and provides soft natural lighting under the canopy.



CONSUMER/OEM PRODUCTS

Laminates also find application in a range of consumer products, with the laminate incorporated in the product. Including a photovoltaic power source in a product can enhance its utility, expand its sites of use, and differentiate the product from its competition.



A Solarex laminate is integrated with the case of this home/yard product.

Using a laminate rather than a module in some products affords advantages similar to using them in large arrays: enhanced integration of the solar unit in the product, enhanced product design freedom, and cost savings.

NATIONAL ENERGY PROGRAMS

Laminates also find use in national development or energy programs. Purchasing laminates and framing them locally is a viable entry route for a country developing its own photovoltaic program. The capital cost associated with framing is minimal, yet the framing activity may offer an opportunity for a value-added program which supports national goals.

INDIVIDUALLY TESTED, LABELED, AND WARRANTED

As part of the final inspection procedure, every MSX laminate is tested in a solar simulator and labeled with its actual output — voltage, current, and power at maximum power point — at Standard Test Conditions and Standard Operating Conditions. Furthermore, MSX laminates are covered by our industry-leading limited warranty, which guarantees:

- that no laminate will generate less than its guaranteed minimum power when purchased;
- long-term power. For all MSX laminates, at least 90% of the guaranteed minimum for ten years; and — for MSX-40 and larger laminates — at least 80% of the guaranteed minimum for twenty years.

Contact Solarex's Marketing Department for full terms and limitations of this unparalleled warranty.

DUAL VOLTAGE CAPABILITY

With the exception of the MSX-5 and -10, which are fixed at 12V nominal output, and the MSX-240 — fixed at 48V nominal output — all laminates are field-switchable between two voltages by moving cell string output wires in the integral junction box. The MSX-120 may be wired for 12 or 24 volts nominal output; other laminates are switchable between 6 and 12 volts nominal.

This enables a good match with virtually any system voltage requirement, and allows simple and effective installation of blocking or bypass diodes.

LARGE VERSATILE JUNCTION BOX

The junction box of all laminates, except the MSX-5 and -10, has sufficient space not only to connect the laminate into a system, but to enclose array series/parallel connections, diodes, and — in smaller systems — a charge regulator, saving the cost of dedicated enclosures for these purposes.

- Junction box material: impact-resistant, high-dielectric-strength molded thermoplastic resin.
- Internal volume 411 cc, large enough for easy connection and manipulation of wiring and diodes.
- Terminals accept bare wire as large as AWG #10 and a wide range of connectors.
- Cover screws are captive, not easily lost.
- Box accepts cable or conduit.

The MSX-120 includes two of the junction boxes described above. The MSX-5 and -10 use a permanently sealed junction box with a 10-foot (3-meter) AWG #18 two-conductor power lead.

OPTIONS AND CUSTOM DESIGNS

Solarex has substantial experience in custom design of laminates and modules, including ultralight laminates (as little as 0.45 lbs/sq ft), non-glass units, flexible laminates, and custom shapes. Optionally, laminates are available with factory-installed blocking diodes, voltage regulators, and pigtail leads instead of junction boxes.



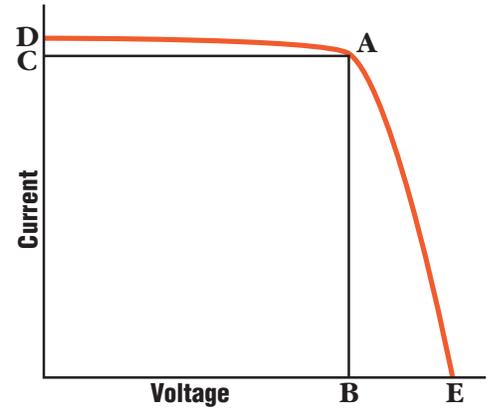
An ultralight Solarex custom laminate powers a robotic lawnmower.

ELECTRICAL CHARACTERISTICS

	A Typical max power (P_{max})	B Voltage @ P_{max}	C Current @ P_{max}	Guaranteed min P_{max}	D Short-circuit current (I_{sc})	E Open-circuit voltage (V_{oc})
MSX-240	240W	68.4V	3.5A	228W	3.8A	84.2V
MSX-120	120W	34.2V	3.5A	114W	3.8A	42.6V
MSX-83	83W	17.1V	4.85A	80W	5.27A	21.2V
MSX-77	77W	16.9V	4.56A	72W	5.0A	21.0V
MSX-64	64W	17.5V	3.66A	62W	4.0A	21.3V
MSX-60	60W	17.1V	3.5A	58W	3.8A	21.1V
MSX-56	56W	16.8V	3.35A	54W	3.6A	20.8V
MSX-53	53W	16.7V	3.2A	50W	3.4A	20.6V
MSX-50	50W	17.1V	2.92A	47.5W	3.17A	21.1V
MSX-40	40W	17.1V	2.34A	37.5W	2.53A	21.1V
MSX-30	30W	17.1V	1.75A	28W	1.9A	21.1V
MSX-20	20W	17.1V	1.17A	18W	1.27A	20.8V
MSX-10	10W	17.1V	0.58A	9W	0.6A	21.1V
MSX-5	5W	16.8V	0.27A	4W	0.29A	20.6V

Notes:

- Except for the MSX-240 and -120, whose data are given for the 48V and 24V nominal configurations respectively, these data represent the performance of typical laminates wired in 12V configuration as measured at their output terminals, and do not include the effect of such additional equipment as diodes and cabling. The data are based on measurements made at Standard Test Conditions (STC), which consist of illumination of 1 kW/m² (1 sun) at a spectral distribution of AM 1.5 and a cell temperature of 25°C.
- Under most operating conditions, the cells in a laminate operate hotter than the ambient temperature, a fact which must be considered when designing some systems. NOCT (Nominal Operating Cell Temperature) is an indication of this temperature rise, and is the cell temperature under Standard Operating Conditions (SOC), which are:
 - 20° ambient temperature;
 - solar irradiation of 0.8 kW/m²;
 - average windspeed of 1 m/s, with the wind oriented parallel to the plane of the array, and all sides of the array fully exposed to the wind.
 The NOCT of typical Solarex laminates is 49°C.
- For all laminates, temperature coefficient of V_{oc} = - 75 mV/°C, temperature coefficient of I_{sc} = 0.075%/°C, and temperature coefficient of P_{max} = - 0.45%/°C



PROVEN MATERIALS AND CONSTRUCTION

The materials and components used in these laminates reflect Solarex's more than two decades of experience with photovoltaics installed in virtually every climate on Earth.

- Semicrystalline silicon solar cells: efficient, attractive, stable.
- Laminates are rugged and weatherproof: cell strings are laminated between sheets of ethylene vinyl acetate (EVA) and tempered glass.
- Tempered glass superstrate: highly light-transmissive (low iron content), inert, impact-resistant.
- Proven cell interconnection technique and matched thermal coefficient of expansion of glass and cells ensure electrical integrity in severe temperature ranges.

SAFETY APPROVED

MSX laminates are listed by Underwriter's Laboratories for electrical and fire safety (Class C fire rating). Listing for the MSX-240 is pending.



RELIABILITY AND ENVIRONMENTAL SPECIFICATIONS

These laminates meet or exceed JPL Block V test criteria, and meet CEC 503, IEC 1215, and IEEE 1262 specifications. They are manufactured in Solarex's ISO 9001-certified facilities and are rigorously tested before shipment. Tests include:

- Repetitive cycling between -40°C and 90°C
- Repetitive cycling between -40°C and 85°C at 85% relative humidity
- 1000-hour exposure to 85°C at 85% relative humidity
- Wind loading exceeding 125 mph
- Impact of one-inch hail at terminal velocity (52 mph) without breakage

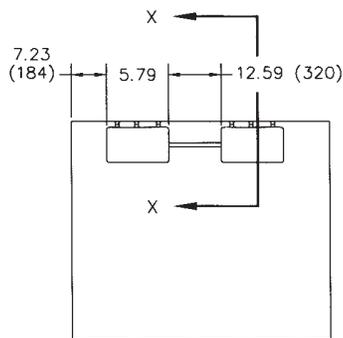
MECHANICAL CHARACTERISTICS

	Dim. A Laminate width ±1/16" (1.5mm)	Dim. B Laminate length ±1/16" (1.5mm)	Dim. C Max. recommended frame overlap, Sides	Junction box position	Dim. D Junction box set-in	Weight pounds (kg)
MSX-240	44-1/8" (1121mm)	74-7/16" (1891mm)	0.8" (20mm)	dwg. 4	See drawing	46.4 (21.2)
MSX-120	38-5/8" (981mm)	43-13/64" (1097mm)	0.7" (18mm)	dwg. 1	See drawing	24.6 (11.2)
MSX-83 MSX-77 MSX-70	25-5/8" (651mm)	43-13/64" (1097mm)	0.6" (15mm)	dwg. 2	18.71" (475 mm)	15.3 (6.9)
MSX-64 MSX-60 MSX-56 MSX-53	19-23/64" (492mm)	43-13/64" (1097mm)	0.4" (10mm)	dwg. 2	18.71" (475 mm)	11.6 (5.3)
MSX-50	19-23/64" (492mm)	36-15/32" (926mm)	0.4" (10mm)	dwg. 2	15.34" (390 mm)	10 (4.5)
MSX-40	19-23/64" (492mm)	29-5/8" (752mm)	0.4" (10mm)	dwg. 2	11.92" (303 mm)	8 (3.6)
MSX-30	19-23/64" (492mm)	22-7/8" (581mm)	0.4" (10mm)	dwg. 2	8.55" (217 mm)	6 (2.7)
MSX-20	16-1/8" (410mm)	19-23/64" (492mm)	0.4" (10mm)	dwg. 2	5.17" (131 mm)	4.3 (2.0)
MSX-10	10-21/64" (262mm)	16-1/8" (410mm)	0.4" (10mm)	dwg. 3	4.29 (109 mm)	2.6 (1.2)
MSX-5	10-21/64" (262mm)	9-25/64" (239mm)	0.4" (10mm)	dwg. 3	4.29 (109 mm)	1.8 (0.8)

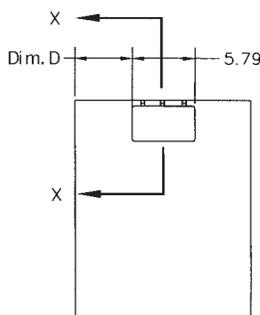
Laminate thickness = 0.188"±0.020" (4.8mm±0.5mm) except for MSX-240, which is 0.25"±0.020" (6.4mm±0.5mm)
 Maximum recommended frame overlap on the ends of all laminates is 0.4" (10 mm)

Dimensions below in inches and (mm)

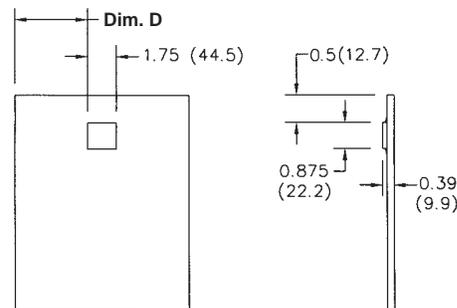
**Junction Box
Position — Dwg. 1**



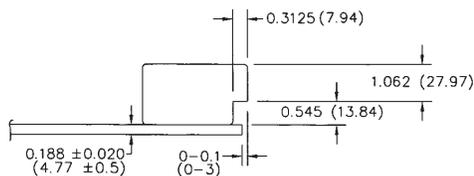
**Junction Box
Position — Dwg. 2**



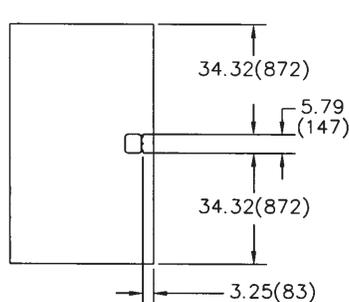
**Junction Box
Position — Dwg. 3**



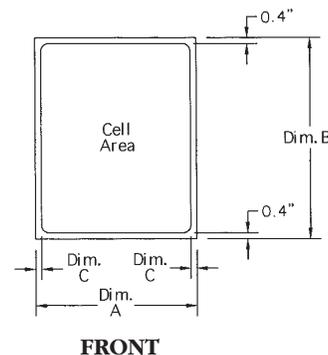
**SECTION X-X
Dwg. 1 and Dwg. 2**



**Junction Box
Position — Dwg. 4**



**Overall
Dimension Drawing**



For more information, contact: