



The Leader In Flexible, Powerful, Lightweight Solar

MiaSolé leads the paradigm shift from rigid solar panels and all their limitations to flexible solar and all its possibilities

MiaSolé is the producer of powerful, lightweight and flexible solar cells. The innovative solar cell is based on the highest efficiency thin-film technology available today, and its flexible cell architecture makes it ideal for a wide variety of solutions ranging from commercial roofing solar panels to flexible mobile devices.

■ Why flexible solar?

Flexible lightweight solar cells and modules can go where rigid glass modules can't. This makes it possible to add solar energy generation to curved surfaces, vehicles, floating reservoir covers, landfill membrane covers, low load capacity roofs, structures such as carports and storage facilities, mobile devices and many other applications.

■ Why MiaSolé?

MiaSolé's advanced CIGS technology has an aperture efficiency as high as 17%

■ How do we do it?

We begin with high-grade stainless steel foil and use an advanced semiconductor deposition process, PVD, to produce the most controlled, stable, and powerful flexible stainless steel CIGS cell in the world. Once the cell structure is deposited on the foil, special transparent conductive oxides are applied, and a specialized plastic-cell interconnect mesh-wire system is laminated to the cell, which is in turn protected by special water barrier plastics. The transparent water barrier is key to the longevity of the MiaSolé FLEX module series. The special plastic backsheet has an internal aluminum film to prevent water transmission from eroding the powerful stainless steel CIGS cells.

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MiaSolé Flexible Solar Benefits

MiaSolé's unique solar cells are the key to the MiaSolé FLEX series modules—the world's most powerful lightweight flexible thin-film CIGS solar modules.

- **Lightweight:** Less than 2.4 kg/m² (<0.5 lb/ft²). Because FLEX-02 modules are so much lighter than heavy rigid silicon panels mounted with racks, they are the best solution for building structures with low dead load and environmental load limitations (such as snow). The modules are also ideal for other structures, such as autos, trucks, and RVs, that are not constructed to support the weight of traditional solar panels.
- **Powerful:** MiaSolé FLEX modules are the highest efficiency flexible thin-film CIGS modules in production today, with aperture efficiencies as high as 17% today, providing over four times the power generation per kilogram of silicon. In the future, efficiencies of up to 20% are expected.
- **Easy to Install:** MiaSolé FLEX modules use peel-and-stick application. This eliminates penetrations into the structure, reducing the chance of leaks. Peel-and-stick application also allows for installation on surfaces such as autos, trucks and RVs where racks would not be feasible, and lowers the balance-of-systems (BOS) costs and complexity when mounting FLEX modules on rooftops.
- **Flexible:** MiaSolé FLEX modules conform to curved surfaces, enabling solar power generation on surfaces not suited to traditional rigid silicon panels.
- **Resistant to Natural Disasters:** MiaSolé modules are thin (2.5mm) and adhere directly to surfaces, providing excellent wind and seismic resistance. The modules are also shatterproof, and won't break if struck by debris.
- **Reliable:** MiaSolé modules' unique redundant interconnect design enables industry-leading reliability.



CIGS Thin-Film Efficiency: Then vs. Now

The limiting factors with flexible solar modules have traditionally been tied to cost and overall efficiency. In the past, thin-film modules were expensive and converted a fraction of the energy from the sun into electricity, with efficiency rates between 8–10%. However, steady technological advances by MiaSolé have resulted in CIGS thin-film modules with a production aperture efficiency as high as 17%, comparable to rigid silicon panels. Today's flexible lightweight modules are a fraction of the thickness of polysilicon and produce four times the watts per kilogram, making them an increasingly strong alternative to rigid silicon.

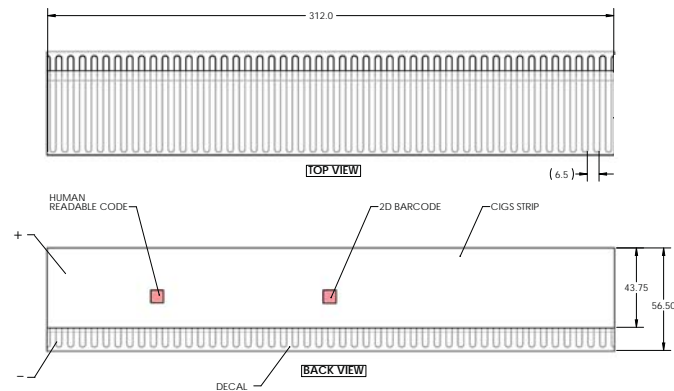
CIGS Solar Cell

MiaSolé thin-film CIGS solar cells on stainless steel substrate have high efficiency levels and provide significant advantages over conventional, rigid solar cells.

KEY FEATURES

- Cell efficiency level of up to 17% in a flexible form factor.
- Thin—0.33mm
- Lightweight—7.5 gm
- Ideal for many specialized uses. Versatile cell architecture means the size can be modified to suit various applications.
- Bendable and shatter—proof

CELL DIAGRAM



ELECTRICAL PERFORMANCE BY .5% EFFICIENCY BINS

Cell Efficiency			15.5%	16.0%	16.5%	17.0%
Nominal Power	P_{MPP}	[W]	2.12	2.18	2.25	2.32
Power Output Tolerance		[W]	+0.1/-0	+0.1/-0	+0.1/-0	+0.1/-0
Maximum Power Voltage	V_{MPP}	[V]	0.526	0.531	0.538	0.545
Maximum Power Current		I_{MPP}	[A]	4.04	4.11	4.17
Open Circuit Voltage	V_{OC}	[V]	0.661	0.664	0.670	0.673
Short Circuit Current		I_{SC}	[A]	4.70	4.70	4.70

THERMAL CHARACTERISTICS*

NOCT	[°C]	48
Temperature Coefficient of P_{MPP}	[%/°C]	-0.38
Temperature Coefficient of V_{OC}	[%/°C]	-0.28
Temperature Coefficient of I_{SC}	[%/°C]	0.008

* based on MiaSolé FLEX-02 module measurements

PHYSICAL AND MECHANICAL SPECIFICATIONS

Length	312 mm +2/-4 mm
Width	43.75 mm ± .05 mm
Thickness	.33 mm ± .1 mm
Weight	7.5 gm ± 0.1 gm
Cell Type	Copper Indium Gallium Diselenide (CIGS)



FLEX Series Modules

KEY FEATURES

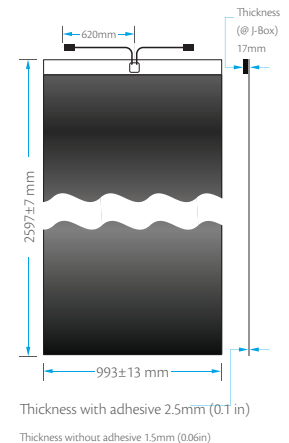
- Record efficiency levels in a flexible form factor
- Low installed weight at less than 2.4 kg/m² (<0.5lb/ft²)
- No penetrations, ballast or racking required
- Applicable for high wind load and high seismic hazard areas
- Bypass diodes reduce PV system shading losses
- Directly bonds to many approved surfaces

RELIABILITY AND SAFETY

- IEC 61646, IEC 61730-1 & -2, IEC 61701, IEC 62716
- UL 1703, ULC ORD C1703, UL 2703
- UL Class A over TPO – slope up to 2.5"

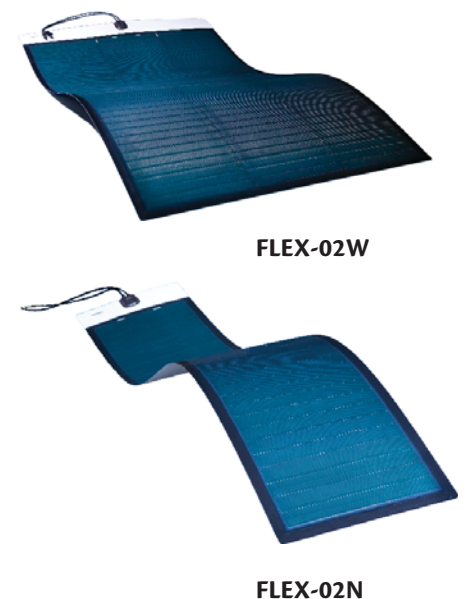
WARRANTY

- 5 year workmanship
- 10/25 year warranty against power loss



FLEX-02W Specifications

Length	2597±7 mm (102.2±.3 in)
Width	993±13 mm (39.1±.5 in)
Module Thickness	2.5 mm (0.1 in)
Weight	6.2 kg (13.7 lbs) with adhesive
Weight/Area	2.4 kg/m ² (0.5 lb/ft ²) with adhesive
Junction Box Type	IP68
Cable Connections	MC4 Compatible
Cell Type	Copper Indium Gallium Selenide (CIGS)
Bend Radius	508 mm (20 in) minimum
Warranty*	5 year workmanship; 10/25 year power output
Certifications	UL 1703, ULC ORD C1703, UL 2703, UL Class A over TPO - slope up to 2.5" IEC 61646, IEC 61730-1 & -2, IEC 61701, IEC 62716, DEWA



FLEX-02NS, FLEX-02N and FLEX-02NL Specifications

	FLEX-02NS Series	FLEX-02N Series	FLEX-02NL Series
Length	1722±7 mm (67.8±.3in)	2597±7 mm (102.2±.3 in)	5922±7 mm (233.1±.3 in)
Width	363±13 mm (14.3±.5in)	363±13 mm (14.3±.5 in)	363±13 mm (14.29±.5 in)
Module Thickness	2.5 mm (0.1 in)	2.5 mm (0.1 in)	2.5 mm (0.1 in)
Weight with adhesive	1.9kg (4.1lb)	2.7 kg (5.9 lb)	6.4 kg (14.1 lb)
Weight/Area	2.9 kg/m ² (0.6 lb/ft ²) with adhesive		
Junction Box Type	IP68		
Cable Connections	MC4 Compatible		
Cell Type	Copper Indium Gallium Diselenide (CIGS)		
Warranty*	5 year workmanship, 10/25 year power output		
Certifications	UL 1703, ULC ORD C1703, UL 2703, IEC 61646, IEC 61730-1 & -2, IEC 61701, IEC 62716, DEWA		

*Please see full warranty for details.

ELECTRICAL PERFORMANCE AT STC¹

FLEX-02W SERIES CIGS MODULE

			FLEX-02 340W	FLEX-02 350W	FLEX-02 360W	FLEX-02 370W	FLEX-02 380W
Nominal Power	P_{MPP}	[W]	340	350	360	370	380
Aperture Efficiency	η	[%]	14.8%	15.3%	15.7%	16.1%	16.6%
Power Output Tolerance		[W]	+10/-0	+10/-0	+10/-0	+10/-0	+10/-0
Maximum Power Voltage	V_{MPP}	[V]	29.3	29.9	30.4	31.0	31.5
Maximum Power Current	I_{MPP}	[A]	11.61	11.72	11.83	11.94	12.06
Open Circuit Voltage	V_{OC}	[V]	37.5	37.9	38.3	38.6	39.0
Short Circuit Current	I_{SC}	[A]	13.54	13.55	13.56	13.57	13.58
Maximum Series Fuse Rating		[A]	25				
Maximum System Voltage	(IEC/UL)	[V]	1000/600				

FLEX-02NS SERIES CIGS MODULE

			FLEX-02 65NS	FLEX-02 70NS	FLEX-02 75NS	FLEX-02 80NS	FLEX-02 85NS
Nominal Power	P_{MPP}	[W]	65	70	75	80	85
Aperture Efficiency	η	[%]	13.2%	14.2%	15.3%	16.3%	17.3%
Power Output Tolerance		[W]	+5/-0	+5/-0	+5/-0	+5/-0	+5/-0
Maximum Power Voltage	V_{MPP}	[V]	17.7	18.5	19.3	20	20.8
Maximum Power Current	I_{MPP}	[A]	3.67	3.79	3.89	3.99	4.09
Open Circuit Voltage	V_{OC}	[V]	23.2	23.7	24.3	24.8	25.3
Short Circuit Current	I_{SC}	[A]	4.47	4.49	4.52	4.55	4.58
Maximum Series Fuse Rating		[A]	10				
Maximum System Voltage	(IEC/UL)	[V]	1000/600				

FLEX-02N SERIES CIGS MODULE

			FLEX-02 110N	FLEX-02 115N	FLEX-02 120N	FLEX-02 125N	FLEX-02 130N
Nominal Power	P_{MPP}	[W]	110	115	120	125	130
Aperture Efficiency	η	[%]	14.4%	15.0%	15.7%	16.4%	17.0%
Power Output Tolerance		[W]	+5/-0	+5/-0	+5/-0	+5/-0	+5/-0
Maximum Power Voltage	V_{MPP}	[V]	28.9	29.7	30.5	31.3	32.0
Maximum Power Current	I_{MPP}	[A]	3.81	3.87	3.93	4.00	4.06
Open Circuit Voltage	V_{OC}	[V]	37.1	37.6	38.1	38.6	39.1
Short Circuit Current	I_{SC}	[A]	4.5	4.52	4.53	4.55	4.57
Maximum Series Fuse Rating		[A]	10				
Maximum System Voltage	(IEC/UL)	[V]	1000/600				

FLEX-02NL SERIES CIGS MODULE

			FLEX-02 265NL	FLEX-02 275NL	FLEX-02 285NL	FLEX-02 295NL	FLEX-02 305NL
Nominal Power	P_{MPP}	[W]	265	275	285	295	305
Nominal Efficiency	η	[%]	14.7%	15.3%	15.8%	16.4%	16.9%
Power Output Tolerance		[W]	+10/-0	+10/-0	+10/-0	+10/-0	+10/-0
Maximum Power Voltage	V_{MPP}	[V]	69.0	70.7	72.3	73.8	75.3
Maximum Power Current	I_{MPP}	[A]	3.84	3.89	3.94	4.00	4.05
Open Circuit Voltage	V_{OC}	[V]	87.9	89.0	90.0	91.0	92.1
Short Circuit Current	I_{SC}	[A]	4.51	4.52	4.54	4.55	4.57
Maximum Series Fuse Rating		[A]	10				
Maximum System Voltage	IEC/UL	[V]	1000/600				

¹Standard Test Conditions (STC): 1000 W/m², 25°C cell temperature, AM 1.5 spectrum

Solar Engineered for Today's Membrane Roof Systems

MiaSolé FLEX-02W Series – the world's most powerful flexible thin-film solar modules.

High Performance Solar Roofing in a Lightweight Format

The FLEX-02W Series modules are designed for low-slope commercial roofs. The FLEX modules bond directly onto the membrane roof system, eliminating the need for solar racking, concrete ballasts, and roof penetrations. Integration of the low-profile, thin-film modules onto the membrane roof surface protects against seismic movement and high winds. MiaSolé FLEX modules simplify project logistics and reduce labor costs and installation times. The final installed solar solution is lightweight, making it ideal for low weight bearing building structures.

Features and Benefits

- Factory Applied Self-Adhesive—Simple Peel-and-Stick Application
- Aperture Efficiency Rating of up to 17%
- Lightweight—2.4 kg/m² (0.5 lb/ft²)
- High Wind Zone Performance
- Low Labor and Balance-of-System (BOS) Costs
- Direct Bonding on TPO with some roof manufactures
- Optional: Secondary Membrane Panel Option for Older TPO Roofs
- Provides four times the wattage per kilogram than silicon panels
- No ballast or racking/No rails or custom purlins
- No module grounding
- Non-penetrating
- Building-integrated PV module
- Designed for high wind & seismic zones



Layout Modules



Clean & Prep TPO



Peel & Stick Modules to TPO

The 3M FLEX module installation in Columbia, Missouri did not require expensive retrofitting—due to the lightweight FLEX modules the building could continue to support the annual snow load in addition to the solar system. The directly adhered modules provide excellent wind resistance, and caused no increased risk of roof leakage and damage to valuable equipment in the building. According to Bill Moore, 3M Columbia plant manager, “MiaSolé has been a great partner in helping us establish a solar energy footprint. Their expertise helped us determine how to install a solar array on an older roof section and identify a qualified installer. The installation performs well and creates electricity each day that is essentially maintenance free.” Since the system was installed in December 2013, there have been no reports of problems due to wind damage or roof leakage, and performance is better than expected.

Metal Roofing Systems with High Efficiency Thin Film Solar

MiaSolé FLEX series modules are the highest efficiency, flexible thin solar modules on the market today.

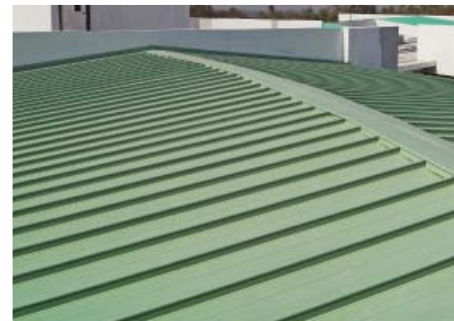
BlueScope, the leading manufacturer of steel roofing products for the Australian market, installed the first prototype of its Building Integrated PV Thermal (BIPV-T) hybrid roofing system in 2014. This new technology integrates new COLORBOND® Steel roofing with MiaSolé FLEX modules and draws air through the two skins of the roof through a plenum to provide warm or cool fresh air for the home. In BlueScope's BIPV-T design, a patented profile of the metal roof forms both the air plenum and a flat surface for the installation of photovoltaic (PV) modules. The solar modules generate electricity, while the air inside the channels is warmed by the sun, then drawn into the building for heating in the winter months. During clear summer evenings, the steel roof cools below ambient temperature and the air is then drawn into the building for night-time cooling. This roof is billed by ARENA chief executive Ivor Frischknecht as "an exciting new renewable energy solution that combines steel roofing with cutting-edge thin film solar modules."

High Performance of Thin-film Solar in a Lightweight and Flexible Form Factor

The FLEX Series product is the ideal solar solution for metal roofs. These panels are lightweight and can be directly bonded to the roof—eliminating racking, reducing weight load, and significantly lowering labor and project costs. FLEX modules can be installed over a wide range of standard architectural and specific exposed fastener metal roof panels. For example, the FLEX Series modules can be directly applied to industry-standard 7.2 trapezoid rib corrugated panels to create solar parking and RV canopies.

Features and Benefits

- Factory Applied Self-Adhesive—Simple Peel-and-Stick Application
- Aperture Efficiency Rating of up to 17%
- Lightweight—2.9 kg/m² (0.6 lb/ft²)
- High Wind Zone Performance
- Lowest Solar Rooftop Installation Cost
- Optional: Factory-laminated on Metal Panel for Rapid Installation
- Optional: Field-applied Modules and On-site Roll Forming to retrofit existing roofs
- Integrated profile for aesthetic appeal
- Low installation cost
- Provides four times the wattage per kilogram than silicon panels
- Superior resistance to wind



Steep-slope Standing Seam



Low-slope Corrugated



Solar Parking Canopies

FLEX Modules for Carports

The MiaSolé FLEX-02W Series—the world’s most powerful lightweight and flexible thin-film solar module—is a perfect fit for new and existing carports.

Solar Carport Benefits:

- Provide highly desirable shade for parked cars, delivering increased owner comfort and a lower carbon footprint when the car is started and cooled
- Sun, rain, snow and hail protection
- Reduced parking lot temperatures and a lower heat-island effect
- Large power-generation area when compared to traditional roofs
- Fewer engineering and inspection challenges than traditional rooftop solar installations
- Fewer shading issues than traditional roofs

MiaSolé FLEX for Carport Benefits:

- Lightweight: less than 2.4 kg/m² (<0.5 lb/ft²)—Ideal for today’s cost-optimized carport structures
- Easy to install—simply peel-and-stick
- Bonds directly to 7.2 inch corrugated metal panels and standing-seam metal roofing
- Ideal for retrofitting solar onto existing carports
- Resistant to wind and seismic events; won’t detach or shatter if struck by debris
- Blends into the carport—minimal protrusion above the carport structure
- Theft and vandalism resistant
- Conforms to curved carport surfaces
- Low weight—four times the wattage per kilogram than silicon
- No rails or custom purlins
- No module grounding
- Non-penetrating
- Building-integrated PV module
- Designed for high wind and seismic zones



photo courtesy of Baja Carports

MiaSolé installed its FLEX-02 solar modules over an existing carport, built by Baja Construction, at the Oakley Executive RV and Boat Storage facility. According to Baja Construction CEO Robert Hayworth, “The MiaSolé FLEX module installation was incredibly fast. The peel-and-stick application was ideal for our standard light-gauge 7.2 corrugated roll-formed steel carport roof, and the completed design is not visible from the ground level. MiaSolé allowed me to add solar energy generation to the carport without any changes to the structure.”

Geomembrane Covers for Water Reservoirs and Landfills

Placing solar modules on water reservoir and landfill covers is an ideal way to boost power generation capability.

Water Reservoir and Landfill Cover Benefits:

- Both are located on large, open areas with no commercial or agriculture use or value—perfect for solar installations.
- Large power-generation area and fewer shading issues when compared to rooftop solar.
- Excellent complement to landfill gas technology and hydro-based power generation to increase overall energy output.

For Reservoirs:

- Reduced evaporation due to the solar covering—a three-acre storage pond covered with solar panels could save over four million gallons of water each year.
- Less water contamination and algae growth, minimizing water treatment and associated labor costs.
- Modules are naturally cooled by the water for better performance.

For landfills:

- Closing and sealing landfills with a synthetic TPO membrane cover reduces costs compared to conventional standard subtitle D methods. Flexible modules can be bonded directly to the membrane cover.
- Membrane covers and flexible modules are a perfect combination for sloped landfill sites where conventional solar arrays cannot be installed due to slope and live-load limitations.



MiaSolé FLEX offers these benefits when used on geomembrane covers:

- Easy to install—simply peel-and-stick module onto the membrane used to cover the reservoir or landfill
- Non-penetration installation means no increased risk of leakage, protecting the environment
- Flexible—conforms to the contours of the landfill and accommodates differential settlement
- Lightweight: less than 2.4 kg/m² (<0.5 lb/ft²)—Ideal for floating structures
- Provides four times the wattage per kilogram than silicon
- Resistant to theft and vandalism
- Wind- and seismic-resistant
- Shatter-proof—won't break if struck by debris



photos of Dynactiv Power developed by Benecke-Kaliko

Off-grid

Many solar applications are considered "off-grid" when the power they generate is self-contained. Following are a few examples of off-grid applications where MiaSolé FLEX modules provide unique benefits:

Trucking and Transportation

- Lightweight panels curve around the chassis of trucks and other vehicles without additional support
- Integrated design means less chance of damage
- Doesn't interfere with vehicle aerodynamics at high speeds
- Most powerful flexible solar panel on the market today for maximum power generation



Consumer Applications

- Flexible panels work with many types of devices and formats
- Lightweight panels keep overall weight of the device low
- Dark color is aesthetically appealing
- Most powerful flexible panel on the market today



Off-grid Lighting

- Flexible modules curve around light and charging pole structures for an unobtrusive look
- Modules can withstand 150+ mph winds and have low risk of theft and vandalism
- Generates four times the wattage per kilogram compared to silicon panels
- Powerful enough to charge the battery to power the light for multiple days



photos courtesy of ClearWorld

ClearWorld, LLC, headquartered in Harahan, Louisiana, has a bold mission: to harnesses the cleanest, most abundant renewable energy source available—solar energy—to provide outdoor lighting that preserves resources, requires no moving parts, and is virtually maintenance-free. MiaSolé's bendable panels wrap around the ClearWorld light pole, eliminating the solar rectangle "wing" design of typical solar street light panels. This reduces the chance of vandalism and theft, because the flexible panels don't shatter and they are located 12' above street level. Without an awkward solar panel support structure, the aesthetic of the street light is also preserved.

ClearWorld lights are hurricane and flood resistant. The ability of the FLEX panels to conform to the light pole increases wind resistance. A traditional solar light with rectangular panel can withstand 70 to 90 mph winds, while a light powered by a MiaSolé flexible panel can withstand 150+ mph. Because the power source is located 12' up, flood protection is provided. Furthermore, the curved design of the MiaSolé FLEX panel performs better in high temperatures, allows for better solar absorption throughout the day through a curved axis, and resists panel surface build up of dirt, grass, bird droppings, etc.

Thanks to MiaSolé, ClearWorld is able to provide their customers a solution that is even less expensive to install and operate than a traditional incandescent street light, with virtually no maintenance costs, no electrical costs, and greater lamp-life hours.



Contact Us

2590 Walsh Avenue
Santa Clara, California 95051, USA

info@miasole.com
www.miasole.com

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