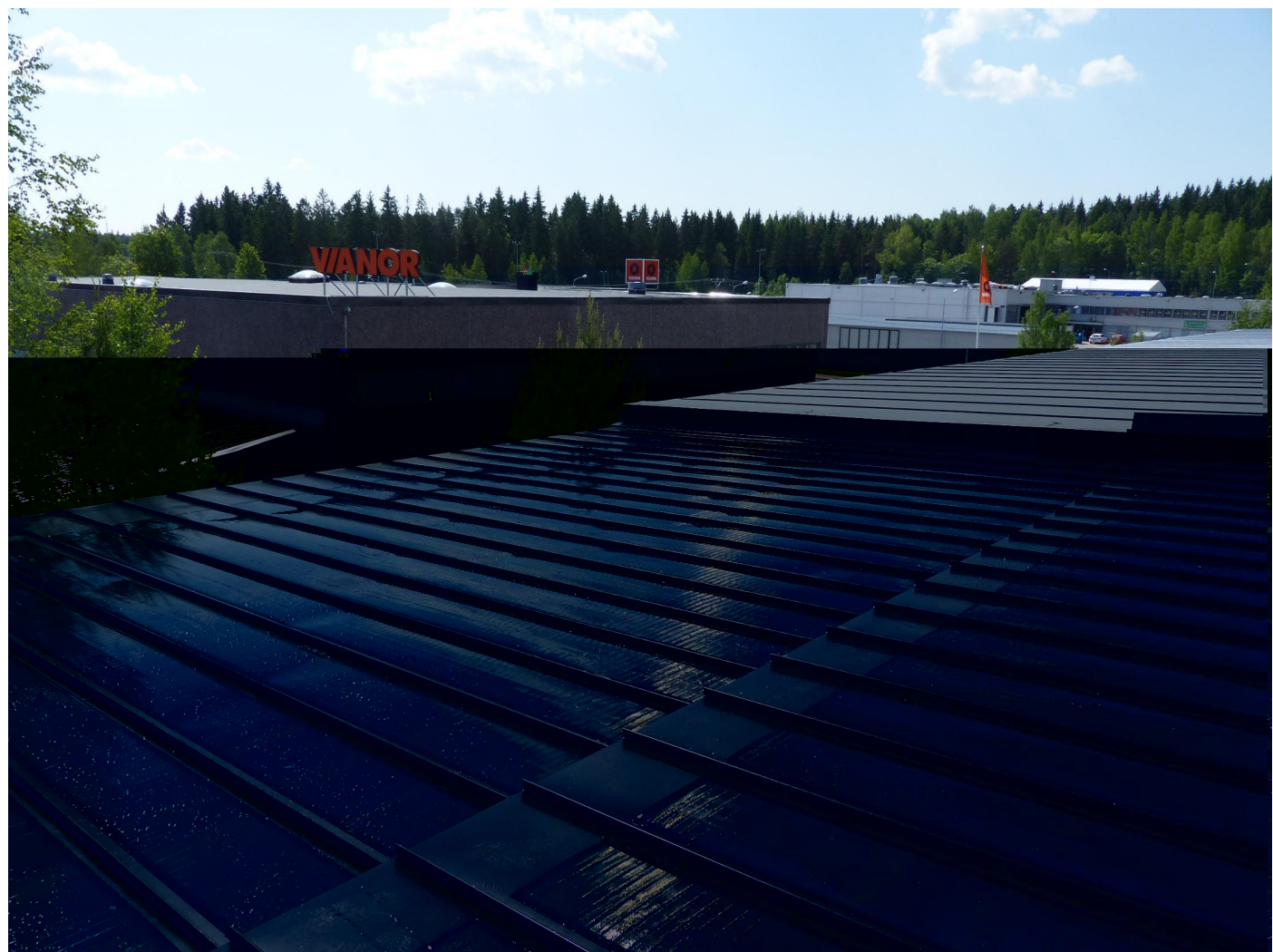




SINOLTECH

WWW.SINOLTECH.COM

Flexible* Powerful* Lightweight Solar Solution



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 low load capacity roofs, structures such as carports and storage facilities, curved surfaces, vehicles, floating reservoir covers, landfill membrane covers and many other applications.

Ideal Application:

- Landfills
- Reservoirs
- Roofs and other structures not built to support racks & panels, such as already-constructed carports that can be retrofitted for solar
- Transportation
- Off-grid applications

A-Si Type Thin Film Flexible Solar Panel, Bending Radius 140mm

Electrical Performance at STC		PVL-33	PVL-72	PVL-144
Nominal Power(W)	Pmpp(W)	33	72	144
Aperture Efficiency(%)	(%)	8	8	8
Power Output Tolerance(W)	(W)	+10/-10	+10/-10	+10/-10
Maximum Power Voltage(V)	Vmpp(V)	16	17.60	35.20
Maximum Power Current(A)	Impp(A)	2	4.09	4.09
Open Circuit Voltage(V)	Voc(V)	22	24.2	48.4
Short Circuit Current(A)	Isc(A)	2.55	5.1	5.1
Maximum System Voltage	IEC/UL(V)	1000/600		
Physical and Mechanical Specifications				
Length	mm	1300	2741	5392
Width	mm	378	378	378
Thickness(Module)	mm	2.5mm	2.5mm	2.5mm
Weight(without adhesive)	kg	1.5	2.8	4.8
Weight(with adhesive)	kg	1.80	3.25	5.7
Weight Area(without adhesive)	kg/m²	3.05	2.70	2.35
Weight Area(with adhesive)	kg/m²	3.66	3.14	2.80
Junction Box Type	IP68			
Cable Connections	AmphenolH4/ MC4 Compatible			
Cell Type	A-Si triple junction amorphous silicon solar cell			
Warranty	5 years workmanship;10/25 years power output			
Certification	CE			

Electrical Performance at STC		PVL-18	PVL-92	PVL-105	PVL-111
Nominal Power(W)	Pmpp(W)	18	92	105	111
Aperture Efficiency(%)	(%)	8	8	8	8
Power Output Tolerance(W)	(W)	+10/-10	+10/-10	+10/-10	+10/-10
Maximum Power Voltage(V)	Vmpp(V)	17.6	22.4	25.6	27.2
Maximum Power Current(A)	Impp(A)	1.02	4.09	4.09	4.09
Open Circuit Voltage(V)	Voc(V)	24.2	30.8	30.8	37.4
Short Circuit Current(A)	Isc(A)	1.28	5.1	5.1	5.1
Maximum Series Fuse Rating	(A)	10			
Maximum System Voltage	IEC/UL(V)	1000/600			
Physical and Mechanical Specifications					
Length	mm	750	3464	3946	4187
Width	mm	378	378	378	378
Thickness(Max at J-BOX/Module)	mm	2.5	2.5	2.5	2.5
Weight(without adhesive)	kg	1.2	3.7	3.8	4
Weight(with adhesive)	kg	1.4	4.26	4.45	4.67
Weight Area(without adhesive)	kg/m²	4.23	2.82	2.55	2.53
Weight Area(with adhesive)	kg/m²	4.94	3.25	2.98	2.95
Junction Box Type	IP68				
Cable Connections	AmphenolH4/ MC4 Compatible				
Cell Type	Copper Indium Gallium Diselenide(FLEX)				
Warranty	5 years workmanship;10/25 years power output				
Certification	CE				

A-Si Type 740mm width

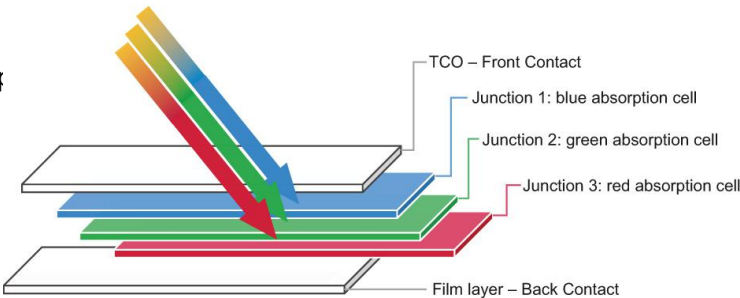
Electrical Performance at STC		SND10-65	SND12-79	SND14-92	SND16-105	SND18-118
Nominal Power(W)	Pmpp(W)	65.45	78.45	91.62	104.7	117.82
Aperture Efficiency(%)	(%)	8	8	8	8	8
Power Output Tolerance(W)	(W)	+10/-10	+10/-10	+10/-10	+10/-10	+10/-10
Maximum Power Voltage(V)	Vmpp(V)	16.0	19.2	22.4	25.6	28.8
Maximum Power Current(A)	Impp(A)	4.09	4.09	4.09	4.09	4.09
Open Circuit Voltage(V)	Voc(V)	22.0	26.4	30.8	35.2	39.6
Short Circuit Current(A)	Isc(A)	5.1	5.1	5.1	5.1	5.1
Maximum Series Fuse Rating	(A)	10				
Maximum System Voltage	IEC/UL(V)	1000/600				
Physical and Mechanical Specifications						
Length	mm	1295	1536	1777	2018	2259
Width	mm	740	740	740	740	740
Thickness(Max at J-BOX/Module)	mm	2.5	2.5	2.5	2.5	2.5
Weight(without adhesive)	kg	2.6	3.1	3.5	4.0	4.4
Weight(with adhesive)	kg	2.9	3.43	3.87	4.40	4.83
Weight Area(without adhesive)	kg/m²	2.70	2.70	2.66	2.66	2.63
Weight Area(with adhesive)	kg/m²	3.02	3.01	2.94	2.94	2.89
Junction Box Type	IP68					
Cable Connections	AmphenolH4/ MC4 Compatible					
Cell Type	Copper Indium Gallium Diselenide(FLEX)					
Warranty	5 years workmanship;10/25 years power output					
Certification	CE					

A-Si Type Thin Film Flexible Solar Panel, Bending Radius 140mm

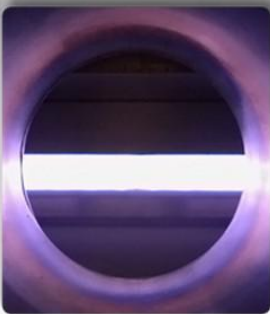
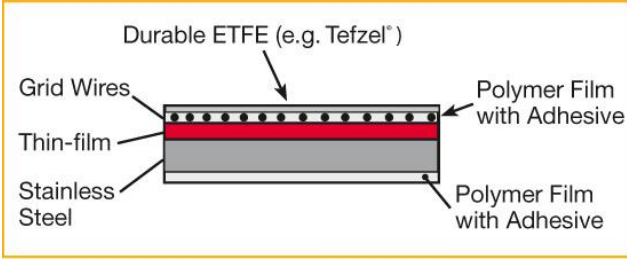
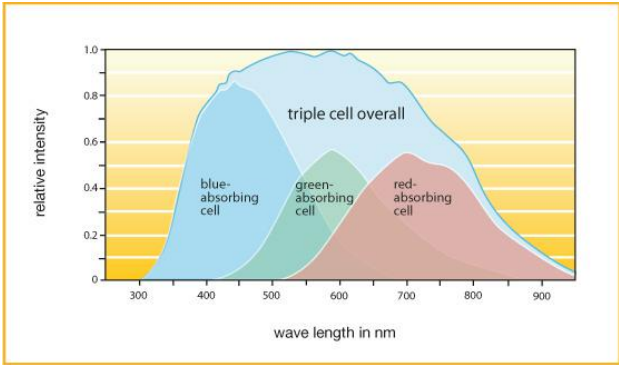
Electrical Performance at STC		SND20-131	SND22-144	SND32-210	SND34-223	SND44-288
Nominal Power(W)	Pmpp(W)	130.9	139.9	210	223	288
Aperture Efficiency(%)	(%)	8	8	8	8	8
Power Output Tolerance(W)	(W)	+10/-10	+10/-10	+10/-10	+10/-10	+10/-10
Maximum Power Voltage(V)	Vmpp(V)	32	35.2	51.2	54.4	70.4
Maximum Power Current(A)	Impp(A)	4.09	4.09	4.09	4.09	4.09
Open Circuit Voltage(V)	Voc(V)	44	48.4	70.4	74.8	96.8
Short Circuit Current(A)	Isc(A)	5.1	5.1	5.1	5.1	5.1
Maximum Series Fuse Rating	(A)	10				
Maximum System Voltage	IEC/UL(V)	1000/600				
Physical and Mechanical Specifications		SND20-131	SND22-144	SND32-210	SND34-223	SND44-288
Length	mm	2500	2741	3946	4187	5392
Width	mm	740	740	740	740	740
Thickness(Max at J-BOX/Module)	mm	2.5	2.5	2.5	2.5	2.5
Weight(without adhesive)	kg	4.9	5.3	7	7.4	10.6
Weight(with adhesive)	kg	5.37	5.8	7.68	8.12	11.5
Weight Area(without adhesive)	kg/m²	2.64	2.61	2.40	2.39	2.66
Weight Area(with adhesive)	kg/m²	2.90	2.86	2.63	2.62	2.88
Junction Box Type	IP68					
Cable Connections	AmphenolH4/ MC4 Compatible					
Cell Type	Copper Indium Gallium Diselenide(FLEX)					
Warranty	5 years workmanship;10/25 years power output					
Certification	CE					

A-Si Technology, Multi-Junction

- 1. Unique triple-junction thin-film cells made from amorphous silicon and germanium
- 2. Cell absorbs red, green and blue light through three different cell layers
- 3. Flexible Solar PV-laminates produce energy when the sun is low, through cloud cover and when installed at non-ideal angles

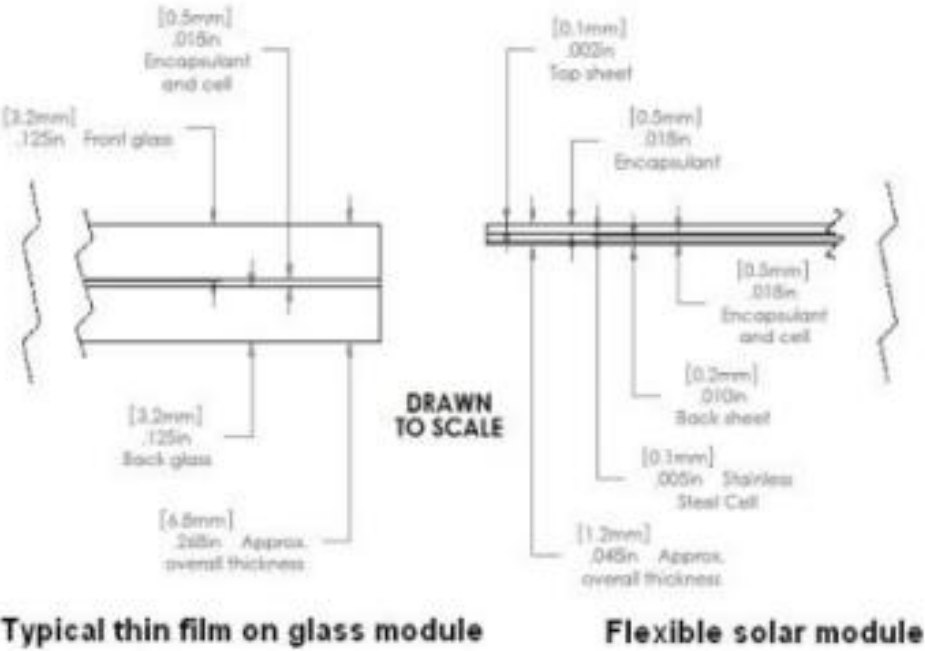
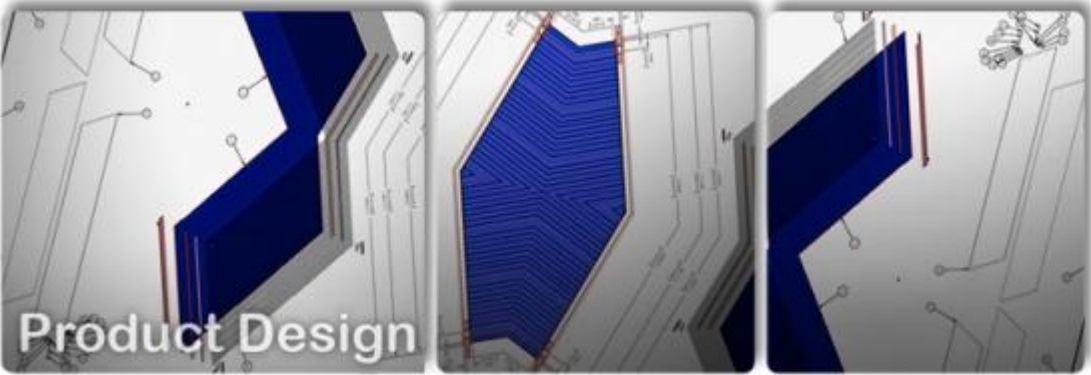


Roll-up thin film solar panels on stainless steel plates are manufactured by a roll-to-roll process. Which allows the company to produce triple-junction thin-film silicon solar cells on rolls of thin stainless steel substrates, three feet wide and up to one mile long. The long stainless steel web is guided through a series of vacuum chambers for the deposition of nine semiconductor layers using a plasma enhanced chemical vapor deposition process, and back-reflector and top electrode layers using a sputtering process. The combined thickness of the layers for the triple-junction solar cell is approximately one hundredth of the thickness of a typical sheet of paper. Therefore, only a small amount of silicon is used. We have made advancements to the manufacturing process that allows it to market these products at a very attractive price point. However, the basic technology used in the cells and packaging techniques used in the modules are well proven, predictable and have an operating history of over ten years in the field.



Technology

Utilizing an industry-leading roll-to-roll manufacturing process to produce solar cell layers. In just two integrated steps, this process transforms a strip of steel three feet wide and a mile long into the largest solar cell in the world. This giant solar cell is then cut, wired, interconnected and encapsulated into finished flexible thin-film silicon PV module products.



For roof with metal sheet



For carport roof



For golf cart roof



For landfill with membrane sheet

Flexible solar panel for Carport

The installation of solar (photovoltaic or PV) carports on both private- and public-owned parking lots provides a new and cost-effective opportunity for generating clean, renewable energy without consuming additional land resources. Solar PV carports can provide far more power generation area compared to the more limited rooftop surface commonly used for many solar installations.

Parking lots, in general, have more solar potential and less shading issues than rooftop solar and can be easier to install than rooftop solar installations and be less disruptive to the facility. Two additional advantages to mounting solar on carports versus roof-mounted solar arrays include no roof penetrations, which increase exposure to potential water leaks, and the ability to avoid additional roof inspection or engineering and repair costs regarding the age, service life and integrity of the building's roof.

Solar PV parking canopies offer the parking lot owner and the environment considerable value:

1. Highly desirable shade for parked cars.
2. Rain and snow protection
3. Protection from hail damage
4. Reduced UV exposure
5. Reduced parking lot temperatures and heat island effect
6. Low-cost renewable power generation
7. Low power distribution and energy transmission cost for the utilities.
8. Improved municipal energy independence



Lightweight Flexible Solar vs. Glass:

Traditionally most solar carports use conventional heavy glass crystalline solar modules installed on rails over large heavy gauge structural steel building components requiring large support columns with deep concrete piers or large ballast blocks. Even carports designed and built using architectural metal panels require additional heavy gauge structural steel, railing and roof clamps, all adding weight and cost to the solar carport.

Sinoltech thin film flexible modules offer the same high efficiency power output as standard crystalline modules while weighing less than 0.7 lb/sf vs the 3-5 lbs. /sf for crystalline modules.

The lighter weight of the flexible solar modules means less structural steel is required in the carport design, which means less cost and faster construction time. Solar carports constructed with the flexible solar module can use light-gauge roll-formed steel, which allows the support columns to be placed further apart, creating a more open design.

Good wind and seismic performance engineering is important to carport design. With traditional glass modules, there is concern about the stresses of wind and seismic movement. In addition, purlins can sag when support columns are placed far apart, impacting glass module and rail attachment. Architectural metal panels with flexible solar modules provide stiffer support surfaces, can span wider distances, and are engineered for good wind and seismic performance while using lighter structural support.

Installing Solar Modules onto Existing Carports

Many facility owners have existing carports without solar. Owners often want to retrofit these existing carports, only to realize that the original design and construction will not support the additional weight of convention crystalline modules. Until now, the only option was to tear down the existing carport structure and to design and rebuild the carport to support conventional solar.

SINOLTECH flexible and lightweight thin-film solar modules can be installed over existing carports constructed with architectural metal panels and some square rib corrugated metal panels without affecting the current weight limitation design. On carports with non-compatible metal panel profiles, these metal panels can be removed and replaced with new architectural metal panels without having to modify the existing support structure at a cost lower than full replacement. SINOLTECH flexible solar modules can be installed on site, requiring fewer installers and equipment, speeding up both new construction and retrofit installations, all at a lower cost.



Flexible solar panel for Commercial Rooftop

High Performance Thin Film Solar in a Lightweight and Flexible Form Factor

The FLEX solar panel product is the ideal solar solution for metal and low-slope commercial roofs. These panels are lightweight and can be directly bonded to both **metal** and **membrane system roofs** — eliminating the need for solar racking, reducing weight load and significantly lowering project costs.

For metal roofs, the FLEX series PV modules can be installed over a wide range of standard architectural metal roof panels, including flat and striated panel pans ranging from 16 to 36 inches wide. As an example, the FLEX Series modules can be directly applied to square rib corrugated panels to create solar parking canopies.

For today's advanced membrane roof systems, the FLEX modules bond directly onto the membrane, 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. The FLEX PV 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:

1. Factory Applied Self-Adhesive – Simple Peel-and-Stick Application
2. High power output under low light conditions
3. Lightweight
4. High Wind Zone Performance
5. Low Labor and Balance of System (BOS) Costs
6. Optional: Factory Laminated on Metal Panel for Rapid Installation
7. Optional: Field Applied Modules — On-site Roll Forming — Retrofit
8. Direct Bonding on Membrane Roofs from Some Roof Manufacturers
9. Optional: Secondary Membrane Panel Option for Older Membrane Roofs

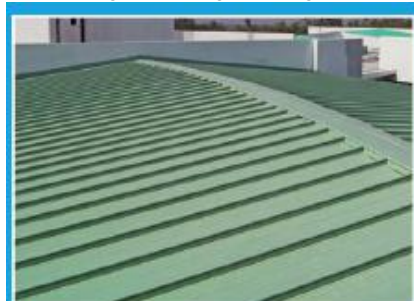
--Metal Roofing Systems with High Efficiency Thin - Film Solar Panel

High Performance, Flexible, Lightweight Thin-film Solar modules are the ideal solar solution for metal roofs.

The modules are lightweight and can be directly bonded to the roof-eliminating racking, reducing weight load, and significantly lowering labor and project costs. SINOLTECH FLEX Solar 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:

1. Factory Applied Self-Adhesive-Simple Peel-and-Stick Application
2. Aperture Efficiency is high
3. Lightweight-2.9 kg/m² (0.6 lb/ft²)
4. Provides Four Times the Wattage per Kilogram as Silicon
5. High Wind Zone Performance
6. Lowest Rooftop Solar Installation Cost
7. Optional: Factory-laminated on Metal Panels for Rapid Installation
8. Optional: Field-applied Modules and On-site Roll Forming to Retrofit Existing Roofs



Steep-slope Standing Seam



Low-slope Corrugated



Solar Parking Canopies



--Solar Engineered for Today's Membrane Roof Systems

High Performance Solar Roofing in a Lightweight Format

The flexible solar modules are designed for low-slope commercial roofs-perfect for today's advanced membrane roof systems. 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. The 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:

1. Factory-applied Self-Adhesive-Simple Peel-and-Stick Application
2. Aperture Efficiency is high
3. Lightweight—2.4 kg/m² (0.5 lb/ft²)
4. Provides Four Times the Wattage per Kilogram as Silicon
5. High Wind Zone Performance
6. Low Labor and Balance-of-System (BOS) Costs
7. Direct Bonding on Certain Roof Membranes
8. Secondary Membrane Panel Option for Older Membrane Roofs

Back adhesive brand: HelioBond_PVA_600BT_R7

Fully Sticky



Flexible solar panel for Residential Rooftop

High Performance Thin Film Solar for Residential Rooftops

The Thin Film Flex Series solar modules are designed for building integrated solar applications over a wide range of residential standing seam metal roof panels. SINOLTECH's FLEX series solar panels can be applied onsite and are available factory laminated onto metal roof panels to reduce onsite labor cost. Unlike conventional glass modules and rack systems that cover the metal roof, the SINOLTECH flex series solar modules bond directly onto the metal roof panel and blend in with architectural standing seam panels preserving the visual look and design of the architectural metal roof panels.

Without heavy and expensive solar racking, roof penetrations are eliminated and the reduction in weight load significantly lowers project costs and stress on the roof and home. In addition, since the roof and the solar system are now one BIPV (Building-integrated Photovoltaic) product, project logistics are greatly simplified, and installation labor costs and time are reduced.

Integration of the low profile, BIPV roof modules onto a residential roof surface protects against seismic movement and high winds.

The final installed solar solution is lightweight, maintains normal roof warranty, and is ideal for low weight bearing building structures.

Features and Benefits:

Factory Applied Self-Adhesive – Simple Peel & Stick Application

Lightweight – 0.7 lb/ft²

High Wind Zone Performance

Low Labor and Balance of System (BOS) Costs



NON-ROOF SOLUTIONS

Transportation

The lightweight, flexible solar panel fit smoothly to vehicle surfaces, while the no-penetration peel-and-stick attachment results in no penetrations into the vehicle surface.

The low-profile panels reduce the instance of damage due to vandalism and accidents, while providing superior performance in the high-wind environments trucks, trains, and other vehicles experience.



Marine

The low-profile SINOLTECH FLEX solar modules offer superior performance in high-wind environments, making them an ideal solution to provide solar power on boats.

The low-profile unobtrusive design also maintains the aesthetic appeal of the boat. The panels are so lightweight that they do not require retrofitting the boat structure for support, and they can be easily mounted and removed. The high efficiency rating enables the highest energy production possible in a flexible panel, crucial on a boat with little free space.



Landfill Cover

Solar Landfill Cover Benefits:

1. Landfills are located on large, open areas with no commercial or agriculture use or value perfect for solar installations.
2. Closing and sealing landfills with a synthetic TPO membrane cover reduces costs compared to conventional standard methods.
3. Flexible modules can be bonded directly to the membrane cover, providing power generation capability.
4. 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.
5. Large power-generation area and fewer shading issues when compared to rooftop solar.
6. Excellent complement to landfill gas technology to increase overall energy output.

FLEX modules provide the following benefits when used on landfill covers:

- Easy to install: simply peel-and-stick module onto the membrane used to contain, cover and close the landfill
- Non-penetration installation protects the environment
- Flexible: conforms to the contours of the landfill and accommodates differential settlement
- Resistant to theft and vandalism Wind and seismic resistant
- Shatter-proof: won't break if struck by debris



NON-ROOF SOLUTIONS

Reservoir Covers

Installing solar modules on reservoir covers allows reservoir owners and municipalities to generate power using the water surface area without consuming valuable land area for a solar array. Due to reduced evaporation, a 3-acre storage pond covered with a solar reservoir cover could save over four million gallons of water each year. In addition, solar reservoir covers ensure less water contamination and algae growth, minimizing water treatment costs.

Solar reservoir covers offer a large power-generation area and less shading issues when compared to rooftop solar. The cooling effect of the water also improves solar module performance. And for reservoir-based hydro power plants, solar power provides an ideal supplement to hydro-based power generation.

Solar Reservoir Cover Benefits:

1. Generate power using the water surface area without consuming valuable land area for a solar array
2. Reduced evaporation due to the solar covering a 3-acre storage pond covered with solar panels could save over four million gallons of water each year.
3. Less water contamination and algae growth, minimizing water treatment and associated labor costs
4. Large power generation area when compared to rooftop solar Modules are naturally cooled by the water for better performance
5. Fewer shading issues than rooftop solar
6. For reservoir-based hydro power plants, solar power can supplement hydro-based generation during the day when sunlight is available.

Flex solar module benefits:

Lightweight: less than 2.4 kg/m2 (<0.5 lb/ft2)-Ideal for floating structures

Easy to install-simply peel-and-stick onto reservoir membrane

Resistant to wind,

Shatter-proof, won't break if struck by debris



LED Lighting

For lighting applications, this means that the power generated by a flex panel is sufficient to power an LED streetlight for up to eight days, meaning even in times of inclement weather the light will be powered.

The Flex panels curve around the light pole structure, eliminating the need for a separate rack. Not only does this reduce the chance of vandalism and theft, but it preserves the aesthetic appeal of the light. In addition, the manner in which the FLEX panels lay on top of the cylindrical shape of the pole increases wind resistance. A traditional solar light with rectangular panel can only withstand 70 to 90 mph winds while a light powered by a flexible panel can withstand 150+ mph.

Because solar-powered lighting is self-contained, it is off-grid and can be used in remote installations and is unaffected by power outages.

Customer Challenge-

1. Provide outdoor lighting that preserves resources, has no moving parts and is virtually maintenance-free
2. Panels need to:
Generate sufficient power
Easily fit onto existing poles
Withstand the outdoor environment
Look good

Solution with flexible solar panels-

1. Flexible panels curve around light pole, preserving the look of the light
2. Lights can withstand 150+ mph winds and have low risk of theft and vandalism
3. Powerful enough to charge battery to power light for eight days



Advantage:

Flexible Cell vs. Polysilicon

Flexible Cell	Polysilicon
Flexible • Can fit around curved structures • Can be integrated into materials	Rigid • Not bendable • Requires racking to install
Lightweight • No retrofitting required • Can be used in applications such as consumer goods where weight is a concern	Heavy • Roofs require reinforcement to support weight
Durable • Won't break/Resistant to vandalism • No risk of microcracks to cells	Breakable • Can shatter • Cells can develop microracks
Bonded Directly to Surface • Lower installation costs • Resistant to theft	Requires Mounting Hardware • Drives up installation costs • Subject to theft
Thin-2mm-3mm • Unobtrusive • Superior wind resistance	Thick-40mm-50mm • Visible • Subject to wind uplift
Aesthetically Pleasing • Uniform “black-tie” appearance • Dark interconnect wires	Clunky-looking • Checkerboard appearance • Bulky paneling does not conform to the roof
Powerful • 288W form factor for large TPO installations • More watts per KG	Not as powerful • Traditional 60-cell house module 260-290 watts • Utility sized 72-cell field module is only 290-310W
Safer • FLEX modules are lightweight-won't injure people or property in high wind or earthquake • No cell degradation at high voltage • No grounding wires to corrode	Dangerous in environmental emergencies • Metal racks+box modules can damage people and property in an earthquake • Metal racks+box modules hazardous in the event of wind pull-off

FAQ:

1. What is efficiency?

Module efficiency characterizes a PV module’s ability to convert available sunlight into useable power within a given area. The formula to calculate efficiency is:

$$\text{Efficiency (\%)} = \frac{\text{Module Power Rating (W}_p\text{)}}{1000 \text{ W/m}^2 * \text{Total PV module area (m}^2\text{)}}$$

The module area is the total area of the product that includes both the active and inactive area. Aperture efficiency is when only the active area of a PV module is considered. This does not include the inactive area.

2. What is the maximum rated power of PV module?

Maximum rated power of a PV module is the nominal power rating that is based on STC.

3. What does STC mean?

STC stands for Standard Test Conditions. STC has three conditions:

- 1) Cell Temperature 25 deg C
- 2) Irradiance 1000 W/m2
- 3) Air Mass 1.5

4. What is rating tolerance?

The tolerance is specified on the datasheet by a “+/-”label by a nominal rating. This is the nominal deviation from a specification.

5. What is temperature coefficient? How does temperature and sunlight impact PV system performance?

On the datasheet, you’ll notice 3 different temperature coefficients:

- 1) Temperature Coefficient of Pmpp
- 2) Temperature Coefficient of Voc
- 3) Temperature Coefficient of Isc

The performance of a PV cell behaves differently depending upon applied sunlight and temperature. The sunlight (aka irradiance) significantly impacts the current of the PV cell. The temperature has a significant impact on the voltage of PV cell.

At higher irradiance levels, the current goes higher, which means the temperature coefficient is positive.

At higher temperatures, the voltage goes lower, which is why the temperature coefficient is negative.

The Pmpp temperature coefficient is the factor that impacts the maximum rated power per deg C.

For example, if the temperature coefficient is -0.35 %/deg C, this means that for every degree above 25 deg C cell temperature (based on STC), you’ll see a -0.35% impact on the nominal voltage rating.

6. What factors contribute to the overall system performance of a PV system?

“System performance” is a term we use to describe how closely the energy output of the PV system matches up with expectations.

When determining whether a PV system is outperforming, meeting expectations or underperforming, it is very important to establish expectations based on technically sound assumptions.

There are a number of factors that can contribute overall to the absolute system performance of a PV system which may include:

- 1). Type of PV modules: product, technology, electrical specifications etc.
- 2). Installation location (determines environmental factors)
- 3). Ambient Temperature

- 4). Irradiance at the PV module
- 5). Shading
- 6). The azimuth (Direction of PV plane in relation to due north) and tilt angle of the PV modules
- 7). The cell temperature during operation: is there air flow on the back of the modules?
- 8). The type of inverters being used
- 9). System Application: Directly Adhered vs. Ballasted system
- 10). Length of DC wiring: i.e. Homerun Wiring (cables between PV Array and Inverter)
- 11). Module level power electronics, for example DC optimizers.
- 12). Soiling : dirt on the PV modules, debris, leaves

7. What makes the Thin Film FLEX modules different from conventional C-Si solar modules?

- 1) Flexible – conforms to curved surfaces
- 2) Lightweight – structures don't have to be reinforced to support the weight of racks and panels
- 3) Powerful – the efficiencies are superior to other thin-film modules, rivaling rigid silicon modules
- 4) Wind resistant – low profile modules offer little resistance to wind
- 5) Theft resistant – once attached, FLEX modules are difficult for a thief to remove (but can be removed by the owner if necessary)
- 6) Easy to install – peel-and-stick application requires very little training. In addition, the modules offer superior resistance to damage in seismic events and are difficult to steal once installed.
- 7) Shatterproof – FLEX modules will not shatter when struck by debris
- 8) Improved shade performance – FLEX modules use bypass diodes for every two cells that ensure that every cell receiving lights contributes to the module output
- 9) Improved aesthetics – the thin modules are unobtrusive and blend into surfaces
- 10) Doesn't require ballasting – many municipalities are restricting the use of ballast to secure solar modules. FLEX modules adhere directly to surfaces using peel-and-stick adhesive.
- 11) No roof penetrations – no increased risk of leaks or damage to surfaces

8. What BOS components are required to install a FLEX module?

Since FLEX modules are flexible, lightweight and frameless, the modules can be directly adhered to the surface. This avoids the necessity of a mechanical racking system and ballasting. This also provides the benefit of having no roof penetrations. For the electrical installation, all other BOS components like combiner boxes, wire management, and inverters would still be required.

9. Which inverters are FLEX modules compatible with?

On non-metal surfaces, any type of inverter is compatible with modules. For metal surfaces, Please consult with a technical engineer.

10. Micro-inverters vs. string inverters vs. central inverters: What is the difference?

Central inverters start at around 100kW to as large as 10MW inverters. These inverters can be very large and heavy. The central inverter design is optimized for utilizing the least number of inverters at the site and is usually ideal for large ground mount projects. This is typically the most cost-effective solution from an installed cost standpoint. However, if a 1MW project utilizes a 1MW central inverter, the production at the site has a single failure point at the inverter. This adds O&M cost for any loss of energy production and the need for more skilled labor for any maintenance and repair in the case of an event. This is the reason why more EPCs are starting to use the string inverter configuration for large projects. There is a higher potential for cost savings from an O&M perspective. String inverters are usually 10kW-80kW sized inverters that are ideal for commercial rooftop applications. Although you may need more string inverters for a project when comparing to a central inverter configuration, you can take advantage of multiple failure points, more max power tracking throughout the system, string level monitoring and lower skilled labor that is required for maintenance and repair. Micro-inverters are designed to attach to a single or a couple of PV modules at a time. Although this configuration is more expensive than the other inverter configurations, it offers more maximum power tracking throughout the system, module-level monitoring and better energy output in shaded conditions. Micro-inverters are ideal for the residential market where the projects are smaller and more likely subject to shading conditions that are difficult to avoid. Also, since they are attached at the module-level, they can provide more control over the system with the ability to shut off the power and energize the DC homerun cables between the PV system and the inverter.

11. What type of surfaces are FLEX modules compatible with?

-TPO membranes
-Modified Bitumen
-Coated Steels, PVDF, SMP, Polyseter, Acrylic, Galvalume Plus, Galvaneal
-EPDM membranes
-Polycarbonate
-Other Materials, including Multiple RV Backsheets, PVDF film(kynar), Tefzel, Glass, Stainless steel, Noryl, Lexan, Xyron, Fiberglass reinforced plastics, Aluminum

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