

ASI® OEM Outdoor Solar Modules

for innovative autarchic electronic devices



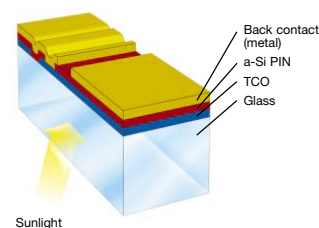
SCHOTT Solar is a leading OEM-supplier of solar modules for the electronics industry, offering a large variety of off-the-shelf modules and custom designed solar modules, adapted in size, shape and voltage to the needs of your product. With ASI® OEM technologies we can provide adequate solar modules either for outdoor or for indoor applications.

The technology of the ASI® OEM Outdoor solar modules is mainly intended for light conditions as found outdoors. Power classes are available in nearly each size. The patented ASI®-technology with its special stacked-cell design on the basis of silicon thin film guarantees years of unflinching high performance. ASI® OEM Solar Modules are intended for use by Original Equipment Manufacturers for the power supply of autarchic electronic and electrical devices and systems. Typical applications are Lighting, wireless application, traffic systems, security technology, telecommunication, mini solar home systems among others.



Application examples

- More Energy
- Double-stacked cells
- Stable performance
- Reliability and Quality
"Made in Germany"
- Easy integration
- Excellent value for money
- No toxic materials
- Any shape and sizes in low or high volumes



Cell construction

More energy: Independent surveys have shown that - under realistic weather conditions such as low light or high temperature - ASI®-technology produces approximately +20% more energy per rated Wp than other solar technologies.

Double stacked cells: Covers more light spectra from the sun light to provide best power converting.

Stable performance: ASI®-technology provides most stable performance over many years, in comparison to most competitors.

Reliability and Quality "Made in Germany": The patented ASI®-technology with its much defined circuit and laser structuring made by automated manufacturing processes ensures favourable prices, high performance and best reliability "Made in Germany".

Easy integration: The ready made ASI®-OEM construction ensures easy integration and high resistance against UV, temperature and weather, even in the most extreme conditions.

Excellent value for money: The optimal use of raw materials and automated manufacturing processes ensures favourable prices, high performance and environmental viability for all ASI® OEM modules.

No toxic materials: In comparison to CdTe or CIS solar technology, ASI®-OEM components contain no toxic materials.

Any shape and sizes: Manufacturing capabilities enable a wide range of module designing, voltage and current in low or high volumes.

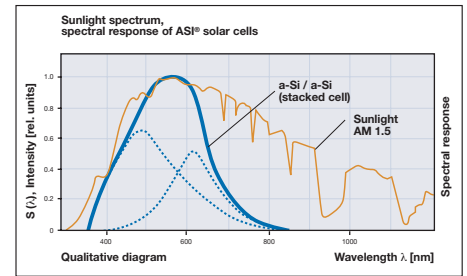
SCHOTT
solar

Technical Data

Characteristic data



Base material	Amorphous silicon (ASI®) on float glass	
Type of solar cells	a-Si/a-Si double stacked cells (PINPIN)	
Spectral response	350 – 750 nm (Peak at 550 nm)	
Connections	Contact areas for soldering, spring or other connections	
Polarity	Negative label visible on front	
Glass	Untrimmed edges, max. surface loading $s = 14 \text{ N/mm}^2$	



Electrical cell data*



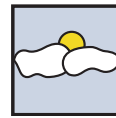
Typical data at		at 10 mW/cm ² (low light)	at 100 mW/cm ² (STC)
Voltage at nominal power	U_{mpp}	1000 mV	1200 mV
Current density at nominal power	I_{mpp}	0.50 mA/cm ²	5.30 mA/cm ²
Open-circuit voltage	U_{oc}	1350 mV	1630 mV
Short-circuit current density	I_{sc}	0.64 mA/cm ²	6.55 mA/cm ²
Nominal power density	P_{nom}	0.48 mW/cm ²	6.36 mW/cm ²



100 – 120 mW/cm² *



80 – 100 mW/cm² *



20 – 80 mW/cm² *



3 – 20 mW/cm² *

*) The module voltage is given by multiplying the cell voltage by the number of cells. The absolute currents for a specific module type can be obtained by multiplying the respective cell area by the current density shown in the above given electrical data.

*) Approximation: $1 \text{ mW/cm}^2 \triangleq \text{ca. } 1250 \text{ Lux}$

Stabilized data to standard test conditions (STC) with spectrum AM 1.5; at a cell temperature of 25 °C.

The nominal power may be initially approx. 18% higher

The quoted power figures are subject to a production tolerance of 10%.

The current values may be lower for certain design variants.

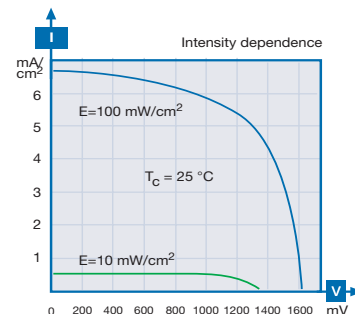
Quality assurance:

- Automated check during production (100%) of the fill factor FF and open-circuit voltage at 10.000 Lux (approx. 8 mW/cm²),

$$FF = I_{mpp} \times U_{mpp} \div I_{sc} \times U_{oc}$$

- Check of module power P_{max} at 100 W/m² (STC) by using an IEC certified solar simulator and measurement of the open-circuit voltage at 2.800 Lux (approx. 2.2 mW/cm²).

For module areas above 900 cm² these checks represent a 100% inspection, for smaller areas spot checks are performed. Other criteria upon mutual agreement.



Benchmark:

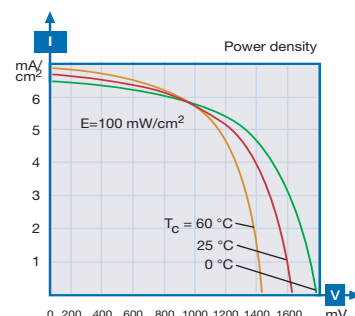
In comparison to other manufacturers which are offering initial data, ASI® is always given stabilized. Also the energy yield performance of ASI® is best under low light illumination conditions. Please ask for studies of independent institutes which are showing these benefits.

Cell temperature coefficients



Power	TK (P_{nom})	-0.2	%/K
Open-circuit voltage	TK (U_{oc})	-0.33	%/K
Short-circuit current	TK (I_{sc})	+0.08	%/K

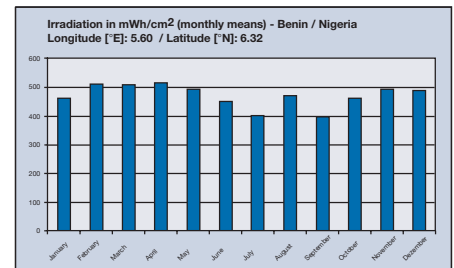
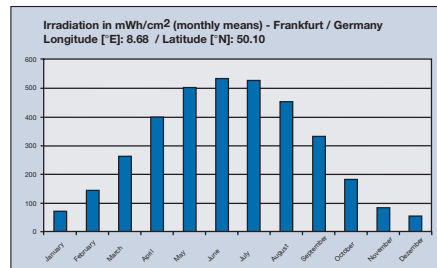
Benchmark: Other solar technologies have temperature coefficient on power of -0.5 %/K which effects power losses in high temperature.





Illumination Conditions

The diagrams beside show the irradiation solar energy per day at two different locations and the seasonal differences due to the geographical latitude.



The following tables show the expected energy output of ASI® OEM solar modules for two different locations under best and worst installation conditions.

- Frankfurt / Germany is representing Middle European irradiation conditions.
- Benin / Nigeria is representing irradiation conditions near the equator.
- The "optimum" conditions in the table are calculated for a fixed module installation with the best orientation to the sun.
- The "shaded" conditions are calculated for a year round shaded module.

The tables show the daily energy output in mWh of an ASI® Solar Module with an area of 25 cm². For Frankfurt in medium sun we will get in average 190 mWh/25cm² or on weakest month December approx. 50 mWh/25cm²:

	Frankfurt Germany		Benin Nigeria	
	sun	shading	sun	shading
January	85	30	433	129
February	177	53	474	135
March	290	87	469	145
April	388	122	475	146
May	442	160	457	144
June	451	176	417	142
July	454	168	372	141
August	431	135	439	145
September	360	99	366	146
October	219	64	430	141
November	101	35	460	129
December	71	24	457	121
Average	289	96	437	139

The given energy outputs are approximate and may vary depending on weather conditions, tolerances and reflectivity of surroundings.

Solar Module Calculation



The autonomous photovoltaic system has to be designed according to the energy consumption (mWh), system voltage (V) and installation light conditions (mW/cm²). An "all the year" operating system should be either designed according to the month with the lowest irradiation or the battery capacity is large enough to store sunny days energy for cloudy days.

Calculation Example:

Location: Frankfurt; sun and shadow average

System Voltage: 6 V Electronic and Battery
(8.4 Volt solar module is needed)

Daily energy consumption (stand by): 1 mA x 8.4 V x 24 h = 202 mWh

Daily energy consumption (operation): 750 mA x 8.4 V x 0.1 h = 630 mWh

Total energy consumption 832 mWh + 10% for electronic losses = 915 mWh

In combination with a large capacity battery, which can overtake the sunny days energy for weak winter months the module size is: $915 \text{ mWh} \div 190 \text{ mWh} \times 25 \text{ cm}^2 = 120 \text{ cm}^2$; i.e. ASI 3 Oo 07/122/115 FA with active size 110 mm x 112 mm.

In case the solar module should fully recharge every days consumption the module size is: $915 \text{ mWh} \div 47 \text{ mWh} \times 25 \text{ cm}^2 = 486 \text{ cm}^2$, i.e. ASI 3 Oo 07/144/325 FA with active size 132 mm x 322 mm

Limits

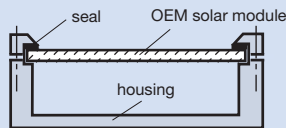


Permissible module temperature	-40 to +85°C
Relative humidity	Higher rel. humidities permissible depending on encapsulation.
Soldering conditions	300°C - 350°C; 3 s (flux-cored solder) solder wire recommendations on request

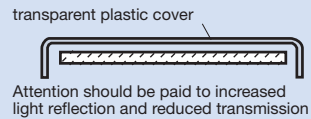
Module integration - Examples



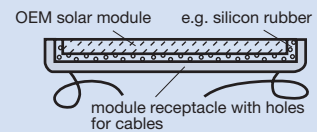
House integration



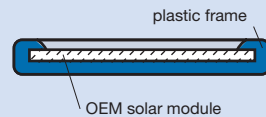
With transparent cover



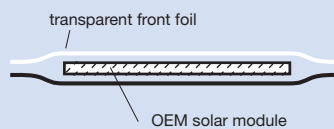
Embedding



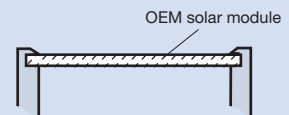
Moulded



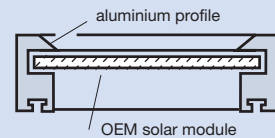
Laminated



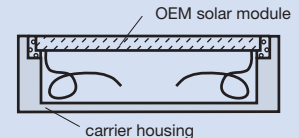
Clamping



Framed



Gluing



Corrosion protection: Corrosion protection is essential to the lifetime of the solar module. ASI® OEM modules are extremely resistant to temperature effects. Mounting of ASI® OEM modules must particularly provide protection against humidity. The proper choice of suitable sealing material is important. Please request for detailed "Handling Specification".

Shading: During installation care should be taken to ensure that the active photovoltaic area is not shaded. The cells (strips), which produce the least current due to shading, determine the total module current.

Contacting



Preparation before soldering: The panels have several connections. All types have metal coatings as points (M) or stripes (J, JF, JFJ). The wires can be soldered directly on blank coating. However type MF and JF have punched removable foil points or stripes. These have to be taking off before soldering!

Soldering specification: The solder point exists of Nickel. An adequate solder wire is needed to get best results.

Solder station:

flat soldering tip temperature controlled

Soldering temperature:

300 – 350°C, typically 325°C, max 350°C

Soldering time:

typical 3 s

Please request for detailed "Handling Specification".



Dimensions and weights

Maximum module size	976 mm x 576 mm
Cell thickness	3.2 mm ± 0.3 mm (standard) 2.3 mm ± 0.3 mm (option) (thinner glass on request)
Weight	Length (m) x width (m) x thickness (mm) x 2.5 = Weight in kg

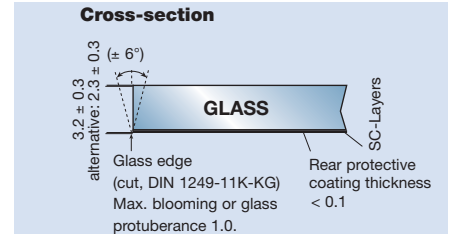
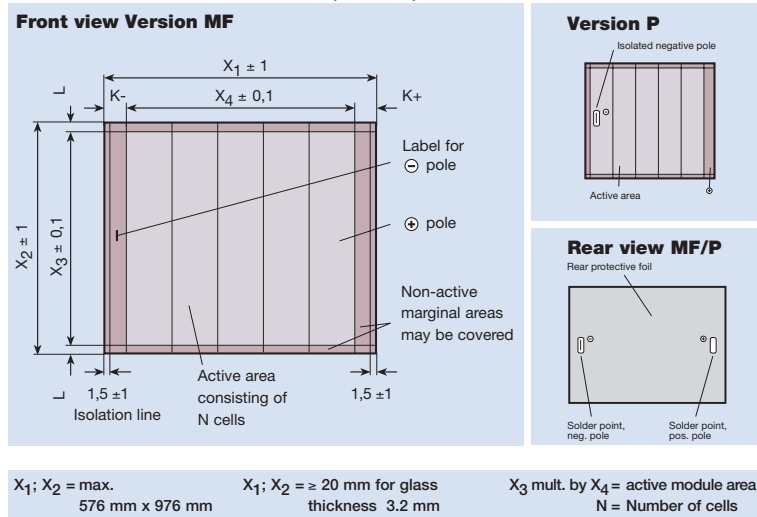
Nomenclature (for instance)



ASI	3	0o	05	/ 048 / 096	M	Module version
						Overall dimension in mm parallel to cell arrangement (x_2)
						Overall dimension in mm normal to cell arrangement (x_1)
						Number of cells (N)
						Technology designation referred to spectrum and intensity of illumination OEM outdoor
						Glass thickness in mm
						Technology: ASI®

Please ask for detailed
"List of available designs"

Dimensions and tolerances (in mm)



Module versions (multiple versions possible)



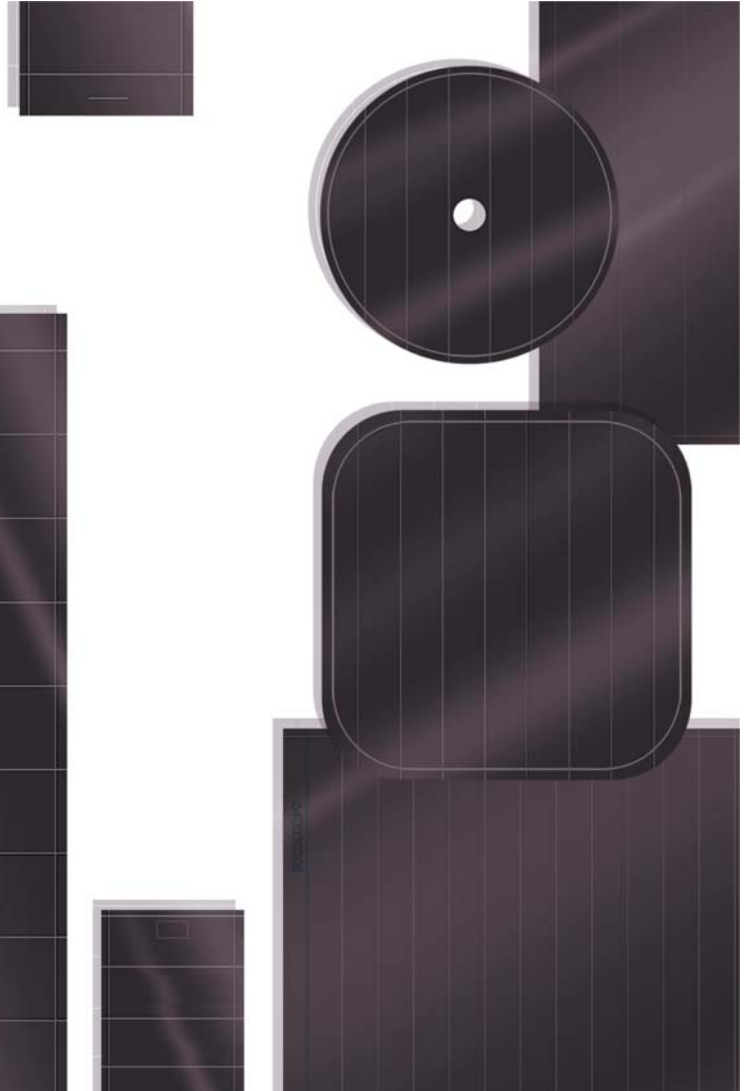
Rear side protection:	
<input type="checkbox"/> Version F	with transparent protection foil – Standard
<input type="checkbox"/> Version C	without protection foil
Contact area (for Version F):	
<input type="checkbox"/> Version M	with removable foil points for contact areas
<input type="checkbox"/> Version J	with removable foil stripes for contact areas
<input type="checkbox"/> Version JJ	with free stripes for contact areas
Extra options:	
<input type="checkbox"/> Version A	with extra wide surrounding laser isolation line
<input type="checkbox"/> Version I	with isolation circle for a drilling hole
<input type="checkbox"/> Version K	circular solar module
<input type="checkbox"/> Version N	with cables and sealed solder area
<input type="checkbox"/> Version P	isolation minus pole (to in large active area)
Other options on request	

Customized solar modules

Besides a broad range of standard modules, customized versions in ASI® thinfilm technology can be specially manufactured for series production. Here, the solar module is based on a dedicated semiconductor design. The glass base area of 1000 x 600 mm² is subdivided to form submodules according to the customer's layout specification. Electrically inactive regions are provided between these submodules, and a computer controlled glass-cutting machine makes the cut without damaging the active layers. Due to the high degree of automation and the low setting up costs, the ASI® thinfilm technology represents the most economic method of manufacturing small customized modules.

The solar modules are available in a range of:

- Size (max. 576 x 976 mm²)
- Shapes (rectangular (standard), round)
- Electrical voltages (number of cells)
- Even transparent and inactive areas can be incorporated!



MANAGEMENTSYSTEM
DQS-zertifiziert nach
DIN EN ISO 9001:2000 · Reg.-No. 2184
DIN EN ISO 14001:1996 · Reg.-No. 2184

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