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SANYO

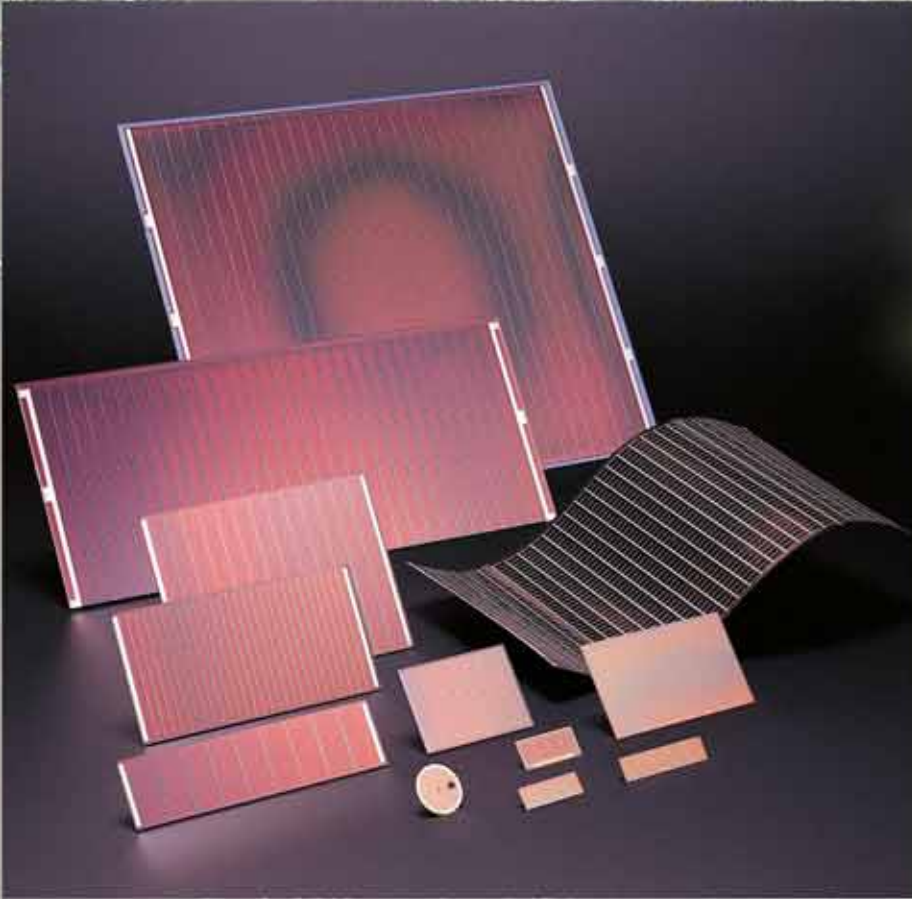
Amorphous Silicon Solar Cells / Amorphous Photosensors

2007-11



SANYO Semiconductor Co., Ltd.









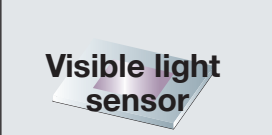

Amorton



The development of the solar cell is progressing with rapid speed. As a new energy tool which can effectively harness the amazing power of sunlight, solar cells have the potential to replace fossil fuels as our main means of power generation. Solar energy is both a clean and inexhaustible resource, and it can be used to produce electricity wherever and whenever sunlight is available. Of these technologies, amorphous silicon solar cells have many strengths that surpass those of the earlier crystalline silicon solar cells. In addition, they require little energy to manufacture and use less raw materials, and thus are truly environmentally friendly devices. This technology also allows larger area cells to be manufactured and can take advantage of the flexibility of thin film materials, and they have already been used in a wide range of applications. SANYO was one of the first companies to focus on amorphous silicon solar cells, and developed and is now mass producing the Amorton integrated type amorphous silicon solar cells that feature a new device structure.

Amorton

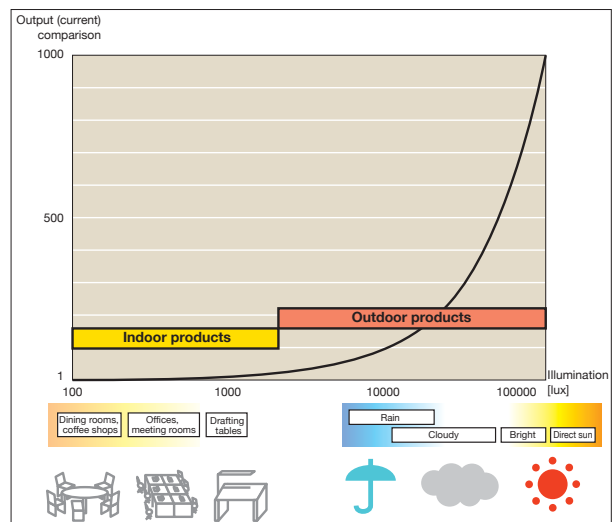
Features of Amorton

Place used	Substrate	Feature	Reference
 <p>Indoors</p>	Glass 	Low price (basic substrate)	Page 5
	Stainless steel 	Thin, light weight, unbreakable, can easily be formed in arbitrary shapes, highly precise dimensions	Contact your SANYO representative.
	Film 	Thin, light weight, unbreakable, bendable, can easily be formed in arbitrary shapes	Contact your SANYO representative.
 <p>Outdoors</p>	Glass 	Low price (basic substrate)	Page 5
	Stainless steel 	Thin, light weight, unbreakable, can easily be formed in arbitrary shapes, highly precise dimensions	Contact your SANYO representative.
	Film 	Thin, light weight, unbreakable, bendable, can easily be formed in arbitrary shapes	Page 6
 <p>Visible light sensor</p>		Support designs with arbitrary sizes and patterns as required by the application	Page 9

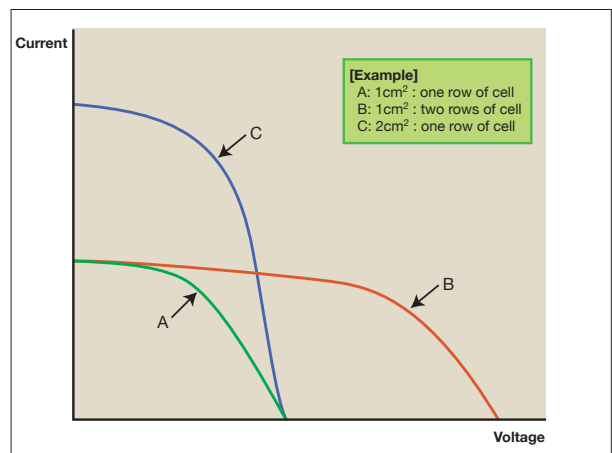
Contact: The person in charge of Amorton products TEL.03-3837-6306

Relationship between illumination level and output

The figure shows the relationship between illumination level and output. There is an enormous difference between the illumination levels indoors and outdoors. SANYO provides two types of products, indoor products for use in the low illumination levels common in indoor environments and outdoor products for the high illumination levels common outdoors.



Relationships between number of rows of the cell and cell area (Illumination level is constant.)



Amorton List (Glass Substrate)

General-Purpose Products

● Specifications

1 Indoor products

Model	Typical operating characteristics (Initial)				External dimensions (mm)	Weight (g)
	FL-200lux		FL-50lux (Reference value)			
AM-1456	1.5V-	5.3µA	1.4V-	1.30µA	25.0×10.0	0.7
AM-1411	1.5V-	8.0µA	1.4V-	2.00µA	29.6×11.8	1.0
AM-1437	1.5V-	8.0µA	1.4V-	2.00µA	29.6×11.8	1.0
AM-1407	1.5V-	11.5µA	1.4V-	2.85µA	38.0×12.5	1.3
AM-1417	1.5V-	12.5µA	1.4V-	3.10µA	35.0×13.9	1.3
AM-1424	1.5V-	20.0µA	1.4V-	5.00µA	53.0×13.8	2.0
AM-1454	1.5V-	31.0µA	1.4V-	7.75µA	41.6×26.3	3.0
AM-1513	1.8V-	15.0µA	1.6V-	3.75µA	55.0×13.5	2.0
AM-1805	3.0V-	15.5µA	2.6V-	3.85µA	55.0×20.0	3.0
AM-1801	3.0V-	18.5µA	2.6V-	4.60µA	53.0×25.0	3.6
AM-1815	3.0V-	42.0µA	2.6V-	10.50µA	58.1×48.6	7.8
AM-1816	3.0V-	84.0µA	2.6V-	21.00µA	96.7×56.7	15.6

Indoor products (for high illumination levels)

Model	Typical operating characteristics (Initial)				External dimensions (mm)	Weight (g)
	FL-200lux		SS-10k lux (Reference value)			
AM-1819	3.0V-	6.9µA	4.0V-	0.41mA	31.0×24.0	2.2
AM-1820	3.0V-	13.3µA	4.0V-	0.79mA	43.0×26.0	3.1

* Glass thickness is 1.1mm.

FL: White fluorescent lamp

SS: Solar simulator

2 Outdoor products

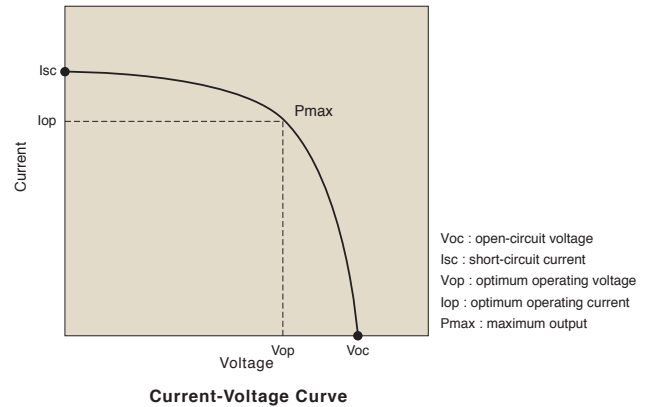
Model	100mW/cm ²		SS-50k lux (Initial)		External dimensions (mm)	Weight (g)
	Typical operating characteristics (Initial)	Pmax (Vop-Iop)	Typical operating characteristics (Initial)	Pmax (Vop-Iop)		
AM-5308	(1.7V- 68.8mA)	117mW (1.9V- 61.5mA)	(1.7V- 31.1mA)	58mW (1.9V- 29.2mA)	50.1× 47.2★	6.4
AM-5302	(1.7V- 105.0mA)	181mW (1.9V- 95.5mA)	(1.7V- 47.0mA)	86mW (1.9V- 45.1mA)	31.2× 117.8	16.3
AM-5413	(2.2V- 16.7mA)	39mW (2.6V- 15.0mA)	(2.2V- 7.5mA)	18mW (2.6V- 7.1mA)	33.0× 23.9★	2.1
AM-5412	(2.2V- 39.8mA)	93mW (2.6V- 35.8mA)	(2.2V- 17.9mA)	44mW (2.6V- 16.9mA)	50.1× 33.1	7.3
AM-5610	(3.3V- 5.1mA)	18mW (3.9V- 4.6mA)	(3.3V- 2.3mA)	8mW (3.9V- 2.2mA)	25.0× 20.0	2.2
AM-5613	(3.3V- 31.6mA)	110mW (3.9V- 28.2mA)	(3.3V- 14.5mA)	52mW (3.9V- 13.3mA)	60.1× 36.7	9.8
AM-5608	(3.3V- 36.0mA)	125mW (3.9V- 32.0mA)	(3.3V- 16.5mA)	59mW (3.9V- 15.1mA)	60.1× 41.3	11.0
AM-5605	(3.3V- 115.4mA)	401mW (3.9V- 102.7mA)	(3.3V- 52.9mA)	189mW (3.9V- 48.6mA)	62.3× 117.8	32.5
AM-8706	(3.9V- 19.9mA)	81mW (4.6V- 17.7mA)	(3.9V- 9.0mA)	39mW (4.6V- 8.3mA)	36.1× 41.3★	4.1
AM-8704	(3.9V- 23.8mA)	97mW (4.6V- 21.0mA)	(3.9V- 10.7mA)	46mW (4.6V- 9.9mA)	41.2× 41.3★	4.6
AM-8705	(3.9V- 26.9mA)	109mW (4.6V- 23.8mA)	(3.9V- 12.1mA)	52mW (4.6V- 11.3mA)	36.1× 55.1★	5.4
AM-8703	(3.9V- 32.1mA)	131mW (4.6V- 28.5mA)	(3.9V- 14.5mA)	62mW (4.6V- 13.4mA)	41.2× 55.1★	6.2
AM-5710	(3.9V- 32.6mA)	134mW (4.6V- 29.0mA)	(3.9V- 14.7mA)	63mW (4.6V- 13.7mA)	62.3× 37.0★	6.3
AM-8702	(3.9V- 34.4mA)	140mW (4.6V- 30.5mA)	(3.9V- 15.5mA)	67mW (4.6V- 14.4mA)	57.7× 41.3★	6.5
AM-5706	(3.9V- 45.9mA)	186mW (4.6V- 40.5mA)	(3.9V- 21.0mA)	88mW (4.6V- 19.1mA)	70.0× 50.0	15.5
AM-8701	(3.9V- 46.6mA)	190mW (4.6V- 41.2mA)	(3.9V- 21.0mA)	90mW (4.6V- 19.4mA)	57.7× 55.1★	8.6
AM-5815	(4.5V- 2.5mA)	12mW (5.2V- 2.3mA)	(4.5V- 1.1mA)	6mW (5.2V- 1.1mA)	31.8× 10.8★	0.9
AM-5812	(4.5V- 19.8mA)	93mW (5.2V- 17.8mA)	(4.5V- 8.9mA)	44mW (5.2V- 8.4mA)	59.0× 28.7★	4.6
AM-5813	(4.5V- 25.0mA)	117mW (5.2V- 22.6mA)	(4.5V- 11.3mA)	55mW (5.2V- 10.7mA)	41.2× 60.2★	6.7
AM-8804	(4.5V- 33.3mA)	156mW (5.2V- 30.0mA)	(4.5V- 15.1mA)	74mW (5.2V- 14.2mA)	48.1× 55.1★	7.2
AM-5814	(4.5V- 38.6mA)	180mW (5.2V- 34.7mA)	(4.5V- 17.4mA)	85mW (5.2V- 16.4mA)	55.1× 60.1★	9.0
AM-8801	(4.5V- 41.9mA)	196mW (5.2V- 37.7mA)	(4.5V- 18.9mA)	93mW (5.2V- 17.8mA)	57.7× 55.1★	8.6
AM-5904	(5.0V- 9.9mA)	52mW (5.9V- 8.7mA)	(5.0V- 4.5mA)	24mW (5.9V- 4.1mA)	40.1× 33.1	5.9
AM-5912	(5.0V- 15.3mA)	80mW (5.9V- 13.6mA)	(5.0V- 7.0mA)	38mW (5.9V- 6.4mA)	42.9× 47.2★	5.6
AM-5909	(5.0V- 22.2mA)	116mW (5.9V- 19.6mA)	(5.0V- 10.1mA)	55mW (5.9V- 9.3mA)	60.1× 41.3	11.0
AM-5914	(5.0V- 23.1mA)	121mW (5.9V- 20.4mA)	(5.0V- 10.6mA)	57mW (5.9V- 9.7mA)	50.1× 55.1★	7.5
AM-5913	(5.0V- 30.1mA)	157mW (5.9V- 26.6mA)	(5.0V- 13.8mA)	74mW (5.9V- 12.6mA)	60.1× 55.1	14.7
AM-5907	(5.0V- 45.7mA)	241mW (5.9V- 40.8mA)	(5.0V- 20.6mA)	114mW (5.9V- 19.3mA)	75.0× 55.0	18.3
AM-5902	(5.0V- 60.8mA)	317mW (5.9V- 53.7mA)	(5.0V- 27.8mA)	150mW (5.9V- 25.4mA)	150.0× 37.5	25.0
AM-7A03	(5.5V- 227.0mA)	1336mW (6.6V- 202.3mA)	(5.5V- 113.0mA)	702mW (6.6V- 106.3mA)	150.0× 165.0	110.0
AM-7D08	(7.2V- 172.0mA)	1303mW (8.5V- 153.2mA)	(7.2V- 85.0mA)	684mW (8.5V- 80.5mA)	150.0× 165.0	110.0
AM-5E02	(7.7V- 23.2mA)	189mW (9.2V- 20.5mA)	(7.7V- 10.6mA)	89mW (9.2V- 9.7mA)	75.0× 55.0	18.3
AM-7E04	(7.7V- 104.0mA)	852mW (9.2V- 92.6mA)	(7.7V- 50.0mA)	447mW (9.2V- 48.6mA)	150.0× 110.0	74.0
AM-5S06	(15.4V- 11.4mA)	188mW(18.4V- 10.2mA)	(15.4V- 5.1mA)	89mW (18.4V- 4.8mA)	124.5× 29.5★	10.0
AM-7S03	(15.4V- 70.0mA)	1133mW(18.4V- 61.6mA)	(15.4V- 34.5mA)	595mW (18.4V- 32.4mA)	150.0× 165.0	110.0

Note: The above table shows standard weights without lead.

* Glass thickness of ★ marks model is 1.1mm. Glass thickness without ★ marks model is 1.8mm.
FL: White fluorescent lamp SS: Solar simulator

Features of Amorton

The features of Amorton are shown by the current-voltage curve in the figure.
The curve changes depending on the incident light intensity and the surrounding temperature.



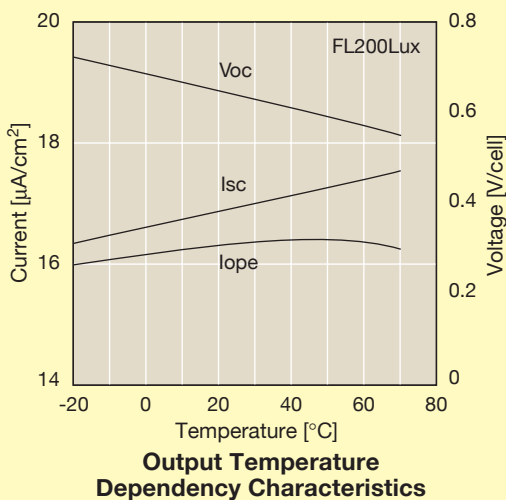
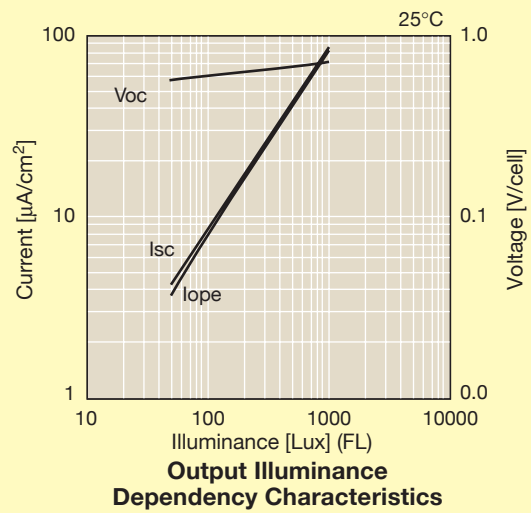
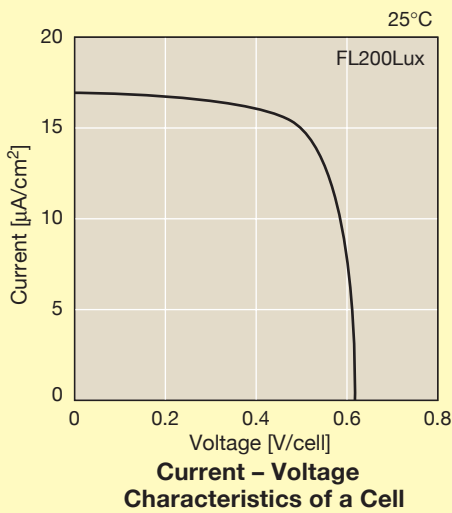
Output Characteristics

Output Characteristics of Indoor use Amorton

Artificial light, such as fluorescent and incandescent light, is used indoors. The illuminance of these light sources ranges from 20 lux to 1,000 lux. Indoors, therefore, Amorton is most suitable for small equipment such as electronic calculators. Please use under 1,000 lux.

Typical Cell Characteristics (25°C)

Open-circuit voltage	Short-circuit current	Maximum output	Light source
0.63 V/cell	17.0 μ A/cm ²	7.0 μ W/cm ²	FL200lux



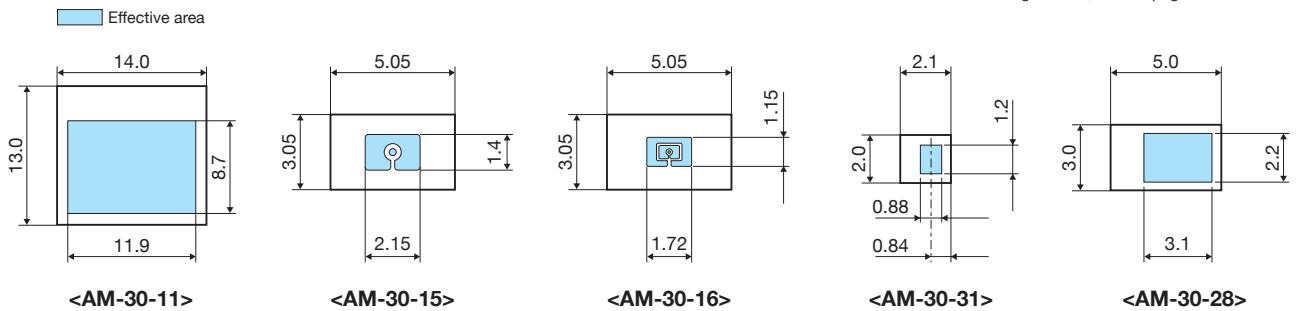
FL: fluorescent light
Voc: open-circuit voltage
Isc: short-circuit current
Iope: operating current

Temperature coefficient
Voc: -0.3%/°C
Isc: +0.08%/°C
Pmax: -0.2%/°C

Amorton Photosensors List

Model		Number of elements	External dimensions (mm)	Short-circuit current TYP.	Dark current (VR = 50mV) MAX.
AM-30-11	C, CS, CA	1	14.0 × 13.0 (Glass 1.1t)	17.7μA*1	—
AM-30-15	C	2	5.05 × 3.05 (Glass 0.7t)	Center area: 80nA*2 Around area: 2.8μA*2	Center area: 100pA Around area: 100pA
AM-30-16	C	3	5.05 × 3.05 (Glass 0.7t)	Center area: 50nA*2 Around area (Inside): 0.4μA*2 Around area (Outside): 1.3μA*2	Center area: 100pA Around area (Inside): 100pA Around area (Outside): 100pA
AM-30-28	CS	1	5.0 × 3.0 (Glass 0.7t)	7.5μA*2	10pA
AM-30-31	C	1	2.1 × 2.0 (Glass 0.4t)	1.2μA*2	10pA
AM-30-33	C	1	5.0 × 3.0 (Glass 0.7t)	7.5μA*2	10pA

*1: At 200lux, white fluorescent light
 *2: At 1000lux, fluorescent light for color illuminator
 * For terminal configurations, refer to page 8.



SANYO can also provide custom products.

Features of Amorton Photosensors

Amorphous Photosensor is a kind of Photo Diode, and can detect light and its intensity.

— Amorphous visible-light photosensor <AM-30-28>
 - - - Human eye spectral sensitivity
 ···· Single crystal silicon photosensor

Relative sensitivity

Wavelength [nm]

Spectral Sensitivity of Amorphous Photosensor

High Sensitivity detection within the visible-light spectrum

Human eyes are sensitive to the light wavelength ranging from approximately 400nm to 700nm. Amorphous photosensors have sensitivity in the same range and provide light sensing capability similar to human eyes.

Current [A]

Illuminance [lux]

Dependence of Isc Characteristics on Illumination

Output current is proportional to illumination

Accurate light detection is possible because output current increases proportionally to the illumination.

<AM-30-15>

Effective area

Amorphous Photosensor Pattern Shape Example

Flexibility in pattern shaping or sizing

Amorphous photosensors provide flexible designing in size and shape to fit your needs.

Solar Cell Output and Light Sources

The output of solar cells differ depending on the categories of light sources to which they are exposed. This is because photoelectric conversion efficiency changes with respect to the wavelength and intensity of the light.

1. Categories of light sources

The general light source for solar cells is sunlight out of doors, and fluorescent or incandescent light indoors. The following outline describes the various categories:

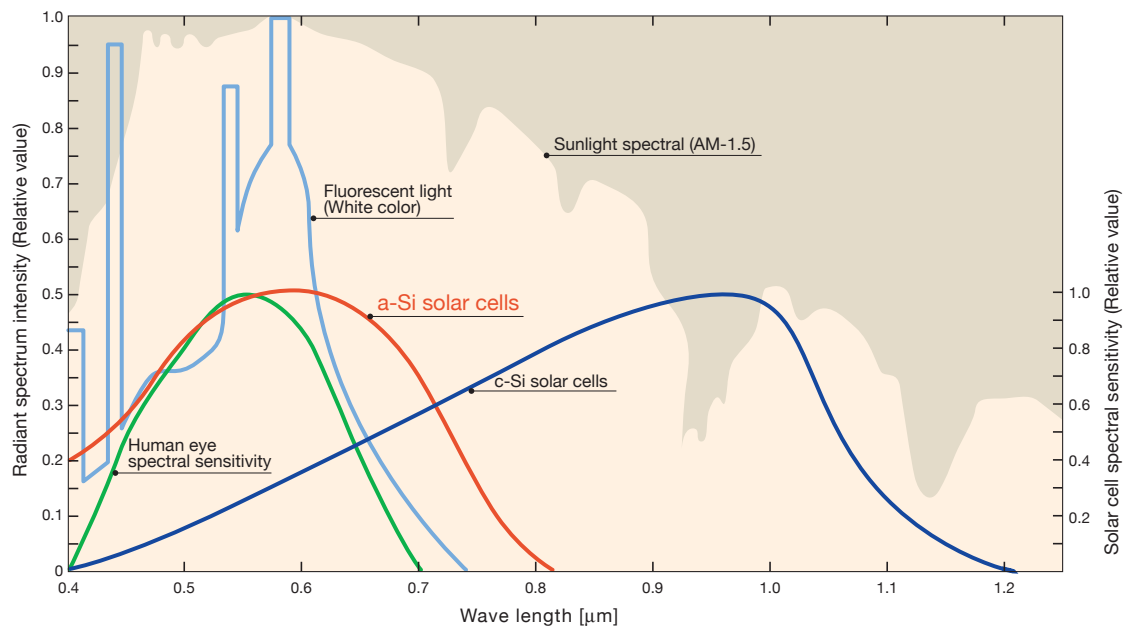
Light source			
	Sunlight		Artificial light
AM-0	Outer space (solar light at global average revolution orbit)	Incandescent light	General-use incandescent light, halogen lamp
AM-1	When the sun is directly overhead (0m above sea level at the equator, vertical sunlight at meridian passage)	Fluorescent light	Daylight, white, and warm white colors
AM-1.5	When zenithal angle (Sunlight angle 0° when sun is directly overhead) is 48.2°.	Electric discharge lamp	Mercury-vapor lamp, sodium-vapor lamp, xenon lamp
Other	AM-2 (when zenithal angle is 60°), etc.		

2. Brightness

When sunlight and fluorescent light are compared in terms of brightness, the results are shown as follows:

[Light Source] Sunlight		Fluorescent light	
Condition	Illuminance (lux)	Condition	Illuminance (lux)
Direct sun	100,000 to 120,000	Design stand (partially illuminated)	Around 1,000
Bright	50,000 to 100,000	Office/conference room	300 to 600
Cloudy	10,000 to 50,000	Restaurants/coffee shops	Below 200
Rain	5,000 to 20,000		

3. Radiant spectrum of light source and spectral sensitivity of solar cells



Precautions in Handling Amorton and Amorphous Photosensors



Do not scratch the rear surface with a hard object because it could damage amorphous silicon (1 μ m thick active layer) and causes electrical malfunction even though the surface is protected by resin coating.



Be careful not to get injured with the sharp edges of the substrate material (glass or stainless steel).



Employ robust and airtight encapsulation when the cell is expected to receive mechanical shocks by falling objects or exposed to harsh weather conditions. Note shattered glass pieces can cause injury and humid environment can damage the cell.



Avoid touching the cell in the daytime because you may get burned with heat particularly when the insolation is strong.



Do not touch the light-receiving side with bare hands because it stains the surface and affect electrical output.



Static electricity can damage the cell. As it deemed necessary, consider a proper method to remove static electricity.



Store in cool, low-humid environment without corrosive gas to avoid possible damages to the cell.



Consider fail-safe or prolixity in your product design.



●SANYO Semiconductor Co.,Ltd. Website

http://www.semic.sanyo.co.jp/index_e.htm

This catalog provides information as of November, 2007.
Specifications and information herein are subject to change without notice.

SANYO

SANYO Semiconductor Co., Ltd.

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