Panasonic Group’s goal is producing eco-friendly products.

Customer Consultation Service

By pursuing energy conservation, we provide our customers with products that support the reduction of CO₂ emissions.

- Our company supplies high-quality high-reliability products; however, any and all semiconductor products may fail or malfunction. Such probabilistic failures or malfunctions might cause accidents or incidents that could endanger lives, problems that might produce smoke or fire, or accidents that might damage property.

- Upon using the technical information or products described herein, neither warranty nor license shall be granted with regard to the intellectual property rights or any other rights of our company or any third party. Our company shall not be liable for any claim or suits with regard to a third party’s intellectual property rights.

- Information (including circuit diagrams and circuit parameters) herein are only examples; the volume of production is not guaranteed.

- Any and all information described or contained herein is subject to change without notice due to product/technology improvements, etc. When using any and all of our products described or contained herein, please consult us prior to such use. Without such consultation or inquiry, the customer shall be held solely responsible.

- If you intend to use our products for applications outside the standard applications and/or outside the scope of the intended standard applications, any and all of our products described or contained herein are, with regard to standard application, intended for use as general electronics equipment, and the customer must take care in ensuring the safety of equipment. To verify the symptoms and states that cannot be evaluated in independent devices, the customer should always evaluate and test devices mounted in its products or equipment. To promote resource recycling, we reduce the consumption of new resources. Products are made using recycled resources collected from used products.

- In the event that any or all our products described or contained herein correspond to restricted freight regulations stipulated in the Foreign Exchange and Foreign Trade Act, such products may require an export license from the concerned authorities in accordance with the above law.

- Specifications of any or all of our products described or contained herein stipulate the performance, characteristics, and functions of the described equipment, refer to the Delivery Specifications for the product that you intend to use.

- Any and all information described or contained herein is subject to change without notice due to product/technology improvements, etc.

- Our company assumes no responsibility for equipment failures that result from using products at values that exceed (even momentarily) the rated values (such as maximum ratings, operating condition ranges, or other parameters) listed in the products specifications of any and all of our products described or contained herein.

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- When using your product, consider a fail-safe or redundant design.

- These products are not water-resistant, or water-repellent, or shock-resistant. When using them outdoors, avoid getting them wet by placing them in an airtight container, when appropriate.

- Carefully clean the sides to remove stains.

- Pressing or scratching the energy-generating area with a hard object may decrease the output.

- If the light-receiving side is stained/smudged, the electrical output will decline due to a decrease in the incident light.

- Avoid touching solar cells during the daytime because they get very hot when the sunlight is strong.

- When using your product, consider a fail-safe or redundant design.

- Please test your products for anomalies and circumstances that cannot be predicted by evaluating a single Amorton.

- ★Store in a cool (under a specific temperature range of -20℃~70℃), low-humidity environment free of corrosive substances.

- ★Do not apply an outdoor Amorton to a product that requires an indoor environment. The necessary output may not be obtained under high illumination.

- ★When using your product, consider a fail-safe or redundant design.

- ★These products are not water-resistant, or water-repellent, or shock-resistant. When using them outdoors, avoid getting them wet by placing them in an airtight container, when appropriate.

- ★Carefully clean the sides to remove stains.

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- ★Please test your products for anomalies and circumstances that cannot be predicted by evaluating a single Amorton.

- ★Do not apply an outdoor Amorton to a product that requires an indoor environment. The necessary output may not be obtained under low light levels.

- ★When using your product, consider a fail-safe or redundant design.

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Amorphous Silicon Solar Cells

Solar cells are classified by their material: crystal silicon, amorphous silicon, or compound semiconductor solar cells. Amorphous refers to objects without a definite shape and is defined as a non-crystal material. Unlike crystal silicon (Fig. 2) in which atomic arrangements are regular, amorphous silicon features irregular atomic arrangements (Fig. 1).

As a result, the reciprocal action between photons and silicon atoms occurs more frequently in amorphous silicon than in crystal silicon, allowing more light to be absorbed. Thus, an ultrathin amorphous silicon film less than 1 μm (1/1000 of 1 mm) can be produced and used for power generation. Our company developed Amorton, the world’s first integrated (series-connectable) amorphous silicon solar cell, using decomposed material gases to form a film on top of a series of substrates. For example, during the manufacturing process that utilizes glass as a substrate, once the transparent electrode is formed, a film of amorphous silicon is layered onto it. The metal film electrode is then formed and finally the solar cell is covered with a protective film. Since our patterning technology allows for multiple solar cells connected in series to be created on a single substrate, solar cells of any chosen voltage can be designed to suit any application.

What is “Amorton”?  
“Amorton” is the product name of Panasonic’s Amorphous Silicon Solar Cells, which was named by integrating amorphous silicon and photons (particles of light).

History

1975 : Research begins on amorphous silicon solar cells  
1978 : Integrated (series connection structure) amorphous silicon solar cells are developed  
1980 : “Amorton”, world’s first amorphous silicon solar cells for commercial use, became a product  
2010 : The production of one billion amorton

Principles of Power Generation

Power is generated in solar cells due to the photovoltaic effect of semiconductors.

- When a semiconductor is exposed to a light source of suitable intensity, a large number of electrons (−) and holes (+) are generated and form electricity.
- At a p/n junction between two different semiconductor materials, the electrons are collected in the n-type material and the holes are collected in the p-type material by internal electric field.
- When an external load is connected, electricity flows through the load. Then generated electricity can be used.
Features

Copes easily with device’s required drive voltage
Since multiple cells can be simultaneously connected in a series when the solar cells are formed, unlike the fabrication technique used with crystalline silicon solar cells in which multiple solar cells are severed and connected, it is easy to create cells with a variety of voltages.

Variety of shapes and forms
The methods used in amorphous silicon films have special features that allow other substrates, such as stainless steel or plastic films, to be used instead of customary glass substrates. This means that previously unknown solar cells can also be created, including solar cells that are round, square, or any other complex shape or solar cells that can even be bent. It is also possible to create areas in these solar cells that just consist of transparent glass by etching.

High sensitivity within visible light spectrum
The human eye is sensitive to light from a range of about 400 to 700 nm wavelengths. Since amorphous silicon solar cells are sensitive to light with essentially the same wavelengths, they can also be used as visible light sensors.

<table>
<thead>
<tr>
<th>Location of use</th>
<th>Substrate</th>
<th>Features</th>
<th>References</th>
</tr>
</thead>
<tbody>
<tr>
<td>Indoors</td>
<td>Glass</td>
<td></td>
<td>Page 7</td>
</tr>
<tr>
<td></td>
<td>Stainless steel</td>
<td></td>
<td>Contact us.</td>
</tr>
<tr>
<td></td>
<td>Film</td>
<td></td>
<td>Contact us.</td>
</tr>
<tr>
<td>Outdoors</td>
<td>Glass</td>
<td></td>
<td>Page 7</td>
</tr>
<tr>
<td></td>
<td>Film</td>
<td></td>
<td>Page 8</td>
</tr>
<tr>
<td>Visible light sensor</td>
<td>Glass</td>
<td></td>
<td>Page 8</td>
</tr>
</tbody>
</table>

Amorton applications: examples of use

- Wristwatches / Clocks / Wall clocks
- Calculators
- Energy-harvesting equipment
- Wireless sensor networks / RFID tags / RF remote controls for digital home appliances, etc.
- Power sources for multiple cards attached to displays
- Power sources of wearable terminals
- Toys
- e-books
- Garden lights, sensor lights, LED blinkers (curbstone markers, etc.)
- Car accessories and battery chargers
- Security devices
- Power sources for other electric equipment and digital displays
- Reduction of battery replacements and extension of battery life for appliances using dry cells and coin batteries
- IoT
- The power supply for human body sensors, the power supply for temperature & humidity sensors

*Please contact us about replacing selenium cells.
Categories of Light Sources
Amorton is available for use under a variety of light sources.

<table>
<thead>
<tr>
<th>Artificial light</th>
<th>Natural light</th>
</tr>
</thead>
<tbody>
<tr>
<td>● Incandescent light</td>
<td></td>
</tr>
<tr>
<td>● Fluorescent light</td>
<td></td>
</tr>
<tr>
<td>● Electric discharge lamps</td>
<td></td>
</tr>
<tr>
<td>● Light-emitting diodes (LED)</td>
<td></td>
</tr>
<tr>
<td>Sunlight</td>
<td></td>
</tr>
</tbody>
</table>

Concerning sunlight
Since the nature of sunlight varies by season and climate, the conditions for measuring the output of solar cells have been unified as a world standard.

**<STC: Standard Test Conditions>**
- Solar irradiance: 1000W/m² (=100mW/㎠)
- Spectrum: AM-1.5
- Cell temperature: 25°C (degrees Celsius)

AM (Air mass) is used for the sunlight spectrum. AM-0 indicates the distance traveled by the sunlight through space: AM-0 in outer space, AM-1 when the sun is at the equator, and AM-1.5 in the latitudinal area of Japan.

Illumination Levels as References
- Brightness around Amorton is critical because it is used both indoors and outdoors.
- Unit of luminous intensity is lux (lx).

<table>
<thead>
<tr>
<th>Fluorescent light</th>
<th>Sunlight</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Conditions</strong></td>
<td><strong>Illumination levels (lx)</strong></td>
</tr>
<tr>
<td>Design stands (partially illuminated)</td>
<td>~ 1,000</td>
</tr>
<tr>
<td>Offices and conference rooms</td>
<td>300 ~ 600</td>
</tr>
<tr>
<td>Restaurants, coffee shops, dressing/changing rooms</td>
<td>75 ~ 150</td>
</tr>
<tr>
<td>Indoor emergency staircases</td>
<td>less than 75</td>
</tr>
</tbody>
</table>

Radiant Spectrum of Light Source and Spectral Sensitivity of Solar Cells

Light wavelength differs depending on the light sources to which they are exposed. Spectral sensitivity of solar cells also differs depending on the category. Amorphous silicon solar cells provide light-sensing capability similar to the human eye.
Amorton Configuration

View of Electrical Properties of Amorton

The figure to the right shows Amorton’s electrical properties by current-voltage curves, which change depending on the incident light intensity and on the surrounding temperature of the solar cells.

Voc : Open-circuit voltage
Isc : Short-circuit current
Vpm : Optimum power operating voltage
Ipm : Optimum power operating current
Pm : Maximum power =Vpm x Ipm
Vope : Operating voltage (specified voltage)
Iope : Operating current
※Current drastically changes under Vpm or higher. For keeping the stable current under the anticipated illumination level, set the Vope as high as or lower than the Vpm.

Relationship Between Number of Rows on Solar Cell/Cell Area and Electrical Properties

The current generated by solar cells is proportional to their area. Therefore, when the cell area is doubled under a specified illumination level, the current is also doubled. When the number of cells is doubled, the voltage is doubled due to the circuit series. The electrical properties specific to relevant use are available by adjusting the number of solar cells and the cell area.
Amorton Electrical Properties

- **Electrical Properties of Amorton for Indoor Use**

<table>
<thead>
<tr>
<th>Substrate</th>
<th>Open-circuit voltage</th>
<th>Short-circuit current</th>
<th>Maximum power</th>
<th>Light source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Glass</td>
<td>0.63V/cell</td>
<td>17.0μA/cm²</td>
<td>7.3μW/cm²</td>
<td>FL-200lx(25℃)</td>
</tr>
<tr>
<td>Film</td>
<td>0.7V/cell</td>
<td>19.6μA/cm²</td>
<td>9.0μW/cm²</td>
<td>FL-200lx(25℃)</td>
</tr>
</tbody>
</table>

The illumination level of light sources used outdoors, such as fluorescent or incandescent light, ranges from 50 to 1,000 lux. Indoors, Amorton is most suitable for such small equipment as electronic calculators.

(Since Amorton is designed for outdoor use, please it under 1,000 lux.)

- **Electrical Properties of Amorton for Outdoor Use (glass type)**

<table>
<thead>
<tr>
<th>Open-circuit voltage</th>
<th>Short-circuit current</th>
<th>Maximum power</th>
<th>Light source</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.89V/cell</td>
<td>14.8mA/cm²</td>
<td>7.89mW/cm²</td>
<td>AM-1.5, 100mW/cm(25℃)</td>
</tr>
</tbody>
</table>

Generally, the illuminance of natural light ranges from 10,000 to 100,000 lux. Amorton’s outdoor illuminance specifications make it suitable for small devices intended for use outdoors, such as outdoor lighting fixtures.

- **Electrical Properties of Amorton for Outdoor Use (film type)**

<table>
<thead>
<tr>
<th>Open-circuit voltage</th>
<th>Short-circuit current</th>
<th>Maximum power</th>
<th>Light source</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.82V/cell</td>
<td>12.0mA/cm²</td>
<td>5.6mW/cm²</td>
<td>AM-1.5, 100mW/cm(25℃)</td>
</tr>
</tbody>
</table>
Amorton Electrical Properties

- Generally, the illuminance of natural light ranges from 10,000 to 100,000 lux.
- Amorton’s outdoor illuminance specifications make it suitable for small devices intended for use outdoors, such as outdoor lighting fixtures.

### Electrical Properties of Amorton for Outdoor Use (glass type)

- Open-circuit voltage: 0.89V/cell
- Short-circuit current: 14.8mA/c㎡
- Maximum power: 7.89mW/c㎡
- Light source: AM-1.5, 100mW/c㎡ (25℃)

#### Current-Voltage Characteristics of a Cell

<table>
<thead>
<tr>
<th>Voltage [V/cell]</th>
<th>Current [mA/㎠]</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.8</td>
<td>0</td>
</tr>
<tr>
<td>1.5</td>
<td>1.0</td>
</tr>
<tr>
<td>1.2</td>
<td>0.2</td>
</tr>
<tr>
<td>0.8</td>
<td>0.4</td>
</tr>
<tr>
<td>0.6</td>
<td>0.6</td>
</tr>
<tr>
<td>0.4</td>
<td>0.8</td>
</tr>
<tr>
<td>0.2</td>
<td>1.0</td>
</tr>
</tbody>
</table>

### Electrical Properties of Amorton for Outdoor Use (film type)

- Open-circuit voltage: 0.82V/cell
- Short-circuit current: 12.0mA/c㎡
- Maximum power: 5.6mW/c㎡
- Light source: AM-1.5, 100mW/c㎡ (25℃)

#### Current-Voltage Characteristics of a Cell

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</tr>
<tr>
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</tr>
<tr>
<td>0.4</td>
<td>0.8</td>
</tr>
<tr>
<td>0.2</td>
<td>1.0</td>
</tr>
</tbody>
</table>

### Relationship between Output and Illuminance

- **Film type**
  - Voc: 0.82V/cell
  - Isc: 12.0mA/c㎡
  - Maximum power: 5.6mW/c㎡
  - Light source: AM-1.5, 100mW/c㎡ (25℃)

### Relationship between Output and Temperature

- **Film type**
  - Voc: -0.3%/℃
  - Isc: 0.08%/℃

### Relationship between Output and Illuminance

- **Glass type**
  - Voc: 0.89V/cell
  - Isc: 14.8mA/c㎡
  - Maximum power: 7.89mW/c㎡
  - Light source: AM-1.5, 100mW/c㎡ (25℃)

### Relationship between Output and Illuminance

- **Glass type**
  - Voc: 0.82V/cell
  - Isc: 12.0mA/c㎡
  - Maximum power: 5.6mW/c㎡
  - Light source: AM-1.5, 100mW/c㎡ (25℃)

### Lightproof [Outdoors]

- **Film type**
  - Voc: -0.3%/℃
  - Isc: 0.08%/℃

### Lightproof [Outdoors]

- **Glass type**
  - Voc: -0.3%/℃
  - Isc: 0.08%/℃

---

(※) SS: solar simulator

---

6
### Amorton Product List (made with a glass substrate)

#### Indoor products

<table>
<thead>
<tr>
<th>Products name</th>
<th>Voc</th>
<th>Isc</th>
<th>Vope-Iope</th>
<th>External dimensions (mm)</th>
<th>Weight (g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>AM-1312</td>
<td>1.9V</td>
<td>17.6mA</td>
<td>1.2V-16.2mA</td>
<td>38.0×12.5×1.1</td>
<td>1.3</td>
</tr>
<tr>
<td>AM-1456</td>
<td>2.5V</td>
<td>6.4mA</td>
<td>1.5V-5.9mA</td>
<td>25.0×10.0×1.1</td>
<td>0.7</td>
</tr>
<tr>
<td>AM-1411</td>
<td>2.5V</td>
<td>9.5mA</td>
<td>1.5V-8.6mA</td>
<td>29.6×11.8×1.1</td>
<td>1.0</td>
</tr>
<tr>
<td>AM-1437</td>
<td>2.5V</td>
<td>9.2mA</td>
<td>1.5V-8.5mA</td>
<td>29.6×11.8×1.1</td>
<td>1.0</td>
</tr>
<tr>
<td>AM-1407</td>
<td>2.5V</td>
<td>13.1μA</td>
<td>1.5V-12.2mA</td>
<td>38.0×12.5×1.1</td>
<td>1.3</td>
</tr>
<tr>
<td>AM-1417</td>
<td>2.5V</td>
<td>14.1μA</td>
<td>1.5V-13.3mA</td>
<td>35.0×13.9×1.1</td>
<td>1.3</td>
</tr>
<tr>
<td>AM-1424</td>
<td>2.5V</td>
<td>22.0μA</td>
<td>1.5V-20.6mA</td>
<td>53.0×13.8×1.1</td>
<td>2.0</td>
</tr>
<tr>
<td>AM-1454</td>
<td>2.5V</td>
<td>35.2μA</td>
<td>1.5V-33.3mA</td>
<td>41.6×26.3×1.1</td>
<td>3.0</td>
</tr>
<tr>
<td>AM-1513</td>
<td>3.1V</td>
<td>16.8μA</td>
<td>1.8V-15.9mA</td>
<td>55.0×13.5×1.1</td>
<td>2.0</td>
</tr>
<tr>
<td>AM-1522</td>
<td>3.1V</td>
<td>62.2μA</td>
<td>2.1V-58.7mA</td>
<td>55.0×40.5×1.1</td>
<td>6.3</td>
</tr>
<tr>
<td>AM-1656</td>
<td>3.7V</td>
<td>3.6μA</td>
<td>2.6V-3.4mA</td>
<td>15.0×15.0×0.7</td>
<td>0.4</td>
</tr>
<tr>
<td>AM-1713</td>
<td>4.4V</td>
<td>16.7μA</td>
<td>3.0V-15.2mA</td>
<td>96.6×10.0×1.1</td>
<td>2.7</td>
</tr>
<tr>
<td>AM-1719</td>
<td>4.4V</td>
<td>18.6μA</td>
<td>3.0V-17.3mA</td>
<td>41.6×26.3×1.1</td>
<td>3.1</td>
</tr>
<tr>
<td>AM-1819</td>
<td>5.0V</td>
<td>8.1μA</td>
<td>3.0V-6.5μA</td>
<td>31.0×20.0×1.1</td>
<td>2.2</td>
</tr>
<tr>
<td>AM-1820</td>
<td>5.0V</td>
<td>14.8μA</td>
<td>3.0V-13.8μA</td>
<td>43.0×26.0×1.1</td>
<td>3.1</td>
</tr>
<tr>
<td>AM-1805</td>
<td>5.0V</td>
<td>16.8μA</td>
<td>3.0V-15.7μA</td>
<td>58.0×20.0×1.1</td>
<td>3.0</td>
</tr>
<tr>
<td>AM-1801</td>
<td>5.0V</td>
<td>20.2μA</td>
<td>3.0V-18.9μA</td>
<td>53.0×25.0×1.1</td>
<td>3.6</td>
</tr>
<tr>
<td>AM-1815</td>
<td>5.0V</td>
<td>48.2μA</td>
<td>3.0V-45.7μA</td>
<td>58.1×48.6×1.1</td>
<td>7.8</td>
</tr>
<tr>
<td>AM-1816</td>
<td>5.0V</td>
<td>96.7μA</td>
<td>3.0V-92.2μA</td>
<td>96.7×56.7×1.1</td>
<td>15.6</td>
</tr>
</tbody>
</table>

#### Outdoor products

<table>
<thead>
<tr>
<th>Products name</th>
<th>Width x length x thickness</th>
<th>Weight (g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Width</td>
<td>96.7×56.7×1.1</td>
<td>15.6</td>
</tr>
<tr>
<td>Length</td>
<td>96.7×56.7×1.1</td>
<td>15.6</td>
</tr>
<tr>
<td>Width</td>
<td>96.7×56.7×1.1</td>
<td>15.6</td>
</tr>
<tr>
<td>Length</td>
<td>96.7×56.7×1.1</td>
<td>15.6</td>
</tr>
</tbody>
</table>

Note: The above table shows standard weights, excluding lead. The above patterns are representative operating patterns (initial/default values). "SS" : solar simulator.

---

### Amorton Product List (watches)

<table>
<thead>
<tr>
<th>Products name</th>
<th>Voc</th>
<th>Isc</th>
<th>Vope-Iope</th>
<th>External dimensions (mm)</th>
<th>Weight (g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>AM-1407</td>
<td>2.5V</td>
<td>13.1μA</td>
<td>1.5V-12.2mA</td>
<td>38.0×12.5×1.1</td>
<td>1.3</td>
</tr>
<tr>
<td>AM-1417</td>
<td>2.5V</td>
<td>14.1μA</td>
<td>1.5V-13.3mA</td>
<td>35.0×13.9×1.1</td>
<td>1.3</td>
</tr>
<tr>
<td>AM-1424</td>
<td>2.5V</td>
<td>22.0μA</td>
<td>1.5V-20.6mA</td>
<td>53.0×13.8×1.1</td>
<td>2.0</td>
</tr>
<tr>
<td>AM-1454</td>
<td>2.5V</td>
<td>35.2μA</td>
<td>1.5V-33.3mA</td>
<td>41.6×26.3×1.1</td>
<td>3.0</td>
</tr>
<tr>
<td>AM-1513</td>
<td>3.1V</td>
<td>16.8μA</td>
<td>1.8V-15.9mA</td>
<td>55.0×13.5×1.1</td>
<td>2.0</td>
</tr>
<tr>
<td>AM-1522</td>
<td>3.1V</td>
<td>62.2μA</td>
<td>2.1V-58.7mA</td>
<td>55.0×40.5×1.1</td>
<td>6.3</td>
</tr>
<tr>
<td>AM-1656</td>
<td>3.7V</td>
<td>3.6μA</td>
<td>2.6V-3.4mA</td>
<td>15.0×15.0×0.7</td>
<td>0.4</td>
</tr>
<tr>
<td>AM-1713</td>
<td>4.4V</td>
<td>16.7μA</td>
<td>3.0V-15.2mA</td>
<td>96.6×10.0×1.1</td>
<td>2.7</td>
</tr>
<tr>
<td>AM-1719</td>
<td>4.4V</td>
<td>18.6μA</td>
<td>3.0V-17.3mA</td>
<td>41.6×26.3×1.1</td>
<td>3.1</td>
</tr>
<tr>
<td>AM-1819</td>
<td>5.0V</td>
<td>8.1μA</td>
<td>3.0V-6.5μA</td>
<td>31.0×20.0×1.1</td>
<td>2.2</td>
</tr>
<tr>
<td>AM-1820</td>
<td>5.0V</td>
<td>14.8μA</td>
<td>3.0V-13.8μA</td>
<td>43.0×26.0×1.1</td>
<td>3.1</td>
</tr>
<tr>
<td>AM-1805</td>
<td>5.0V</td>
<td>16.8μA</td>
<td>3.0V-15.7μA</td>
<td>58.0×20.0×1.1</td>
<td>3.0</td>
</tr>
<tr>
<td>AM-1801</td>
<td>5.0V</td>
<td>20.2μA</td>
<td>3.0V-18.9μA</td>
<td>53.0×25.0×1.1</td>
<td>3.6</td>
</tr>
<tr>
<td>AM-1815</td>
<td>5.0V</td>
<td>48.2μA</td>
<td>3.0V-45.7μA</td>
<td>58.1×48.6×1.1</td>
<td>7.8</td>
</tr>
<tr>
<td>AM-1816</td>
<td>5.0V</td>
<td>96.7μA</td>
<td>3.0V-92.2μA</td>
<td>96.7×56.7×1.1</td>
<td>15.6</td>
</tr>
</tbody>
</table>

Note: The above table shows standard weights, excluding lead. The above patterns are representative operating patterns (initial/default values). "SS" : solar simulator.

---

The following are the standard products included in our lineup. Designs may be customized based on requests. For inquiries, please refer to the back cover.

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Amorton Product List (made with a glass substrate)

### Outdoor products

The following are the standard products included in our lineup. Designs may be customized based on requests. For inquiries, please refer to the back cover.

<table>
<thead>
<tr>
<th>Products name</th>
<th>Vope-Iope</th>
<th>Pm (Vpm-Ipm)</th>
<th>External dimensions (mm)</th>
<th>Weight (g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>AT-7665</td>
<td>3.0V-17.3mA</td>
<td>58mW (3.6V-16.2mA)</td>
<td>125×70×1.1</td>
<td>2.0</td>
</tr>
<tr>
<td>AT-7664</td>
<td>3.0V-16.6mA</td>
<td>62mW (4.2V-14.7mA)</td>
<td>125×70×1.1</td>
<td>4.0</td>
</tr>
<tr>
<td>AT-7666</td>
<td>3.0V-14.3mA</td>
<td>571mW (3.6V-143.6mA)</td>
<td>110×50×1.1</td>
<td>13.0</td>
</tr>
<tr>
<td>AT-7705</td>
<td>3.5V-16.2mA</td>
<td>62mW (4.2V-14.7mA)</td>
<td>125×70×1.1</td>
<td>4.0</td>
</tr>
<tr>
<td>AT-7802</td>
<td>4.0V-14.3mA</td>
<td>62mW (4.2V-14.7mA)</td>
<td>125×70×1.1</td>
<td>4.0</td>
</tr>
<tr>
<td>AT-7963</td>
<td>4.5V-100.0mA</td>
<td>505mW (5.4V-93.5mA)</td>
<td>108×50×1.1</td>
<td>13.0</td>
</tr>
<tr>
<td>AT-7563</td>
<td>15.0V-125.2mA</td>
<td>980mW (16.8V-58.3mA)</td>
<td>210×40×1.1</td>
<td>25.0</td>
</tr>
<tr>
<td>AT-7564</td>
<td>15.0V-121.0mA</td>
<td>1960mW (16.8V-116.7mA)</td>
<td>210×40×1.1</td>
<td>50.0</td>
</tr>
</tbody>
</table>

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Amorton Product List (watches)

The following are the standard products included in our lineup. Designs may be customized based on requests. For inquiries, please refer to the back cover.

<table>
<thead>
<tr>
<th>Products name</th>
<th>Substrate</th>
<th>Vope-Iope</th>
<th>External dimensions (mm)</th>
<th>Weight (g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>AL-2402</td>
<td>Stainless steel</td>
<td>Fluorescent light : 200lx (25℃)</td>
<td>φ30x0.7</td>
<td>1.3</td>
</tr>
<tr>
<td>AT-2400B</td>
<td>Film</td>
<td>1.5V-18.5μA</td>
<td>26.3x26.8x0.18</td>
<td>0.1</td>
</tr>
<tr>
<td>AT-2606B</td>
<td>Film</td>
<td>2.6V-14.6μA</td>
<td>26.3x26.8x0.18</td>
<td>0.1</td>
</tr>
<tr>
<td>AM-2709B</td>
<td>Glass</td>
<td>3.0V-3.3μA</td>
<td>φ30x0.7</td>
<td>1.3</td>
</tr>
</tbody>
</table>

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Amorton Product List (photosensors)

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<table>
<thead>
<tr>
<th>Products name</th>
<th>Substrate</th>
<th>Voc</th>
<th>Isc</th>
<th>External dimensions (mm)</th>
<th>Weight (g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>AM-30-11</td>
<td>Glass</td>
<td>0.6V</td>
<td>17.7μA</td>
<td>14.0x13.0x1.1</td>
<td>0.6</td>
</tr>
</tbody>
</table>

Fluorescent light : 200lx(25℃)

How to look at the Products name

**AM–1407C–OO**

- **Kind of the substrate**
  - AM: Glass type
  - AL: Stainless steel type
  - AT: Film type

- **Number of cells**
  - (Series connection)
  - 1 : 1 cell
  - 2 : 2 cell
  - 3 : 3 cell
  - A: 10 cell
  - B: 11 cell

- **Development Number**
  - 01
  - 02
  - 99
  - A0
  - A1

- **Customer number**
  - We give the customer number at the time of a mass production

- **Terminal structures**
  - A, CA, CAR : With lead wire
  - B, C, CS : Without lead wire
Effects on Output in Shaded Areas

### Circuit Reference Examples

#### Specified usage examples

**① Direct connection type**

**Application**
Toys, DC motors, IoT, etc.

![Direct connection type diagram]

- **Load**
- **Solar cell**

---

**② Combination-type primary battery**

**Application**
Clocks (both wall and table clocks), thermometer/hygrometers, remote controls, calculators, IoT, etc.

![Combination-type primary battery diagram]

- **Load**
- **Solar cell**
- **Voltage control**
- **Primary battery**
- **Back-flow-preventing diode**

- A Schottky Barrier Diode is recommended because its voltage drop is smaller.

---

**③ Rechargeable battery**

**Application**
Watches (wristwatches), clocks (both wall and table clocks), garden lights, PC peripheral devices, mobile chargers, battery chargers, short-range communication terminals, car accessories, LED lighting devices, flickering devices, traffic buttons, IoT

![Rechargeable battery diagram]

- **Load**
- **Solar cell**
- **Voltage control**
- **Charge control**
- **Back-flow-preventing diode**
- **Rechargeable battery, Capacitors, etc**

- A Schottky Barrier Diode is recommended because its voltage drop is smaller.

---

### Effects on Output in Shaded Areas

<table>
<thead>
<tr>
<th>Indoors</th>
<th>B type</th>
<th>C type</th>
<th>CS type</th>
<th>CA type</th>
</tr>
</thead>
<tbody>
<tr>
<td>![Diagram of B type connections]</td>
<td>![Diagram of C type connections]</td>
<td>![Diagram of CS type connections]</td>
<td>![Diagram of CA type connections]</td>
<td></td>
</tr>
</tbody>
</table>

- **Load**
- **Solar cell**

---

**Circuit Reference Examples**

**① Direct connection type**

**Application**
Toys, DC motors, IoT, etc.

![Direct connection type diagram]

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- **Voltage control**
- **Charge control**
- **Back-flow-preventing diode**
- **Rechargeable battery, Capacitors, etc**

- A Schottky Barrier Diode is recommended because its voltage drop is smaller.

---

※How connectors are attached can be adjusted to meet customer requirements.
By providing the following information, we can respond to your inquiries more smoothly. Please contact us at the information found on the back cover.

## In the case of general purpose products

<table>
<thead>
<tr>
<th>Application (Please provide the following information)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Products name</td>
<td></td>
</tr>
<tr>
<td>Usage environment</td>
<td></td>
</tr>
<tr>
<td>Types of rechargeable battery</td>
<td></td>
</tr>
<tr>
<td>Terminal connection method</td>
<td></td>
</tr>
<tr>
<td>Experience of using solar cell (Yes or No)</td>
<td></td>
</tr>
<tr>
<td>Other requests</td>
<td></td>
</tr>
</tbody>
</table>

## In the case of customized products

<table>
<thead>
<tr>
<th>Application (Please provide the following information)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Usage environment</td>
<td></td>
</tr>
<tr>
<td>External dimensions (installation space)</td>
<td></td>
</tr>
<tr>
<td>Required voltage</td>
<td></td>
</tr>
<tr>
<td>Required current</td>
<td></td>
</tr>
<tr>
<td>Types of rechargeable battery</td>
<td></td>
</tr>
<tr>
<td>Terminal connection method</td>
<td></td>
</tr>
<tr>
<td>Experience of using solar cell (Yes or No)</td>
<td></td>
</tr>
<tr>
<td>Other requests</td>
<td></td>
</tr>
</tbody>
</table>