# Specifications of Solar Pro

<table>
<thead>
<tr>
<th>System Requirements</th>
<th>World</th>
<th>MONSOLA-11</th>
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<tbody>
<tr>
<td>OS</td>
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<tr>
<td>CPU</td>
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<td>Memory</td>
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<td>Hard Disk</td>
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<td>Screen Resolution</td>
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<td>USB Port</td>
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<table>
<thead>
<tr>
<th>Meteorological Data</th>
<th>Built-in Data</th>
<th>Importable Data</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>World 1,368 places</td>
<td>Actual measured data, meteonorm annual data, SolarGIS (TMY data), NSRDB (SUNY 10-km gridded data), TMY 3 data, METPV-11</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Circuit Configuration</th>
<th>Cell Type</th>
<th>Inverter</th>
<th>Number of Modules</th>
<th>Max. Series-Parallel Module Number</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mono-crystalline, Polycrystalline, Amorphous, Hybrid, HIT, CIS, CIGS</td>
<td>Up to 400 inverters</td>
<td>Up to 160,000 modules</td>
<td>Limitless within number of modules</td>
</tr>
</tbody>
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| Creatable Objects | PV Array (Up to 400 modules for each array), House, Building, Array Area, Pyramid, Prism, Truncated Pyramid, Free Form, Tree, Polyhedron, Skyline |

This brochure’s described contents are as of November 2017. Specifications are subject to change without notice.
World's first full-scale simulation software
Solar Pro is a full-fledged simulation software released ahead of the world in 1997. It achieves highly precise, module-level power and energy generation calculation by the integration of instantaneous values taking into consideration the effects of solar radiation and shading.

State-of-the-art technology recognized by the world
It was introduced as state-of-the-art simulation software by "PHOTON", Photovoltaic specialized magazine in Germany in 2001, after that we have continued improvements constantly. Solar Pro has been widely used in the world.

Contributing to the dissemination of photovoltaic power generation
Solar Pro's technology has been highly appreciated by many public institutions. We received Kyoto SME Excellence Technology Award in 2003, and were also elected as an accredited project for Small Business Creative Activity Promotion Act and an Oscar certified company.

Precise simulation considering the influence of shadows
If the module is partially shaded, the power generation capacity of the entire string decreases, and the power generation of the system decreases markedly. Solar Pro will perform accurate simulation taking into consideration the influence of shadows in module units.

Simple drawing function for complex system designs
It corresponds widely to placement setting, system of tracking type and Furthermore, it is possible to adjust back and forth or right and left, and to a direction different from the tilt of method such as flat putting and wall mega solar etc. the tilt of the photovoltaic array freely, simulate the case where it is directed the roof or placed in a complicated place.

Reflected light simulation to prevent light damage beforehand
The glare of the reflected light of the solar panel became a social problem, and consideration to reflected light became indispensable when examining panel installation method. With Solar Pro, you can specify seasons and time zones and see how the reflected light affects the surroundings.
**Flexible layout design of solar panels**

Many simulation software programs have restrictions on designing solar panel orientations and angles. With Solar Pro, you can perform simulations in any arrangement pattern, such as the entire wall of a building or a panel arrangement in a complicated slope.

**Promotion and Sales activities**

In addition to conducting simulations, Solar Pro can organize the cost of the designed equipment into an estimate, or you can create a customized report using the derived results.

**Cost Estimate**

Users can create and print a project cost estimate that includes a bill of material for modules and inverters. Construction, Equipment, and other miscellaneous costs can also be added.

**Create original reports**

From detailed simulation results, you can freely arrange graphs and forms to create customized reports.

**Education and Research**

Solar Pro, which enables accurate simulation of various patterns, is also ideal for research and educational use of photovoltaic power generation. You can learn expert system designs easily by understanding motion of shadows and reflected light with animation.
Enhanced design support function

Framing plan input function
You can design buildings and install PV modules efficiently with this function. You can also create buildings intuitively with mouse and read a DXF file as a draft to draw a roof. It is easy to set up under complicated conditions with disapproval area, dormer, chimney, and auto module installation functions.

Choose Building Shapes
You can choose default building shapes such as buildings and houses which are close to their complete images.

Map Service
Insert Bing Maps images into 3D CAD interface to aid in precise design. Solar Pro can also import screenshots and other image files.

Simulation Wizard
Solar Pro has the useful wizard function for rough estimations so that users without any PV/architectural knowledge can operate PV power simulation without difficulty. Additionally, objects are able to be modified through the detailed setting menu. In case of covering solar panels over roofs and walls, setting is simple.

Increased variation of photovoltaic array tilt
In addition to adjust the tilt of photovoltaic array back and forth, it can adjust the tilt right and left. The tilt of PV array can also be directed to a different direction from the tilt of the roof or simulated in a complicated place.

Optimum design
Designed to simulate the array azimuth angle, panel orientation, and arrays spacing to maximize annual / daily electricity generation. Lead to more efficient design by realizing optimized design per parameter.

Comprehensive database to increase accuracy
Photon Module and Inverter Database
It has a variety of module and inverter data from the Photon database.

Various Weather Data
It can import various weather data such as Meteonorm annual data, SolarGIS (TMY data), NSRDB (SUNY 10-km gridded data), METPV-11, etc.
Function Guide

Various display functions

- Shadow Movements
  By inputting location (longitude and latitude), and date and time, you can see a shadow at the entered location and time. It also shows the continuous movements of shadows during the day by animation.

- Shadow Trajectory
  It shows all shadow trajectories within designated time interval. You can fully see shadow patterns in the time interval even when shadows inter-cross each other complicatedly.

- Interlocked with Shadow Movement
  Calculation and shadow movement on the CAD screen are interlocked so that you can see the shadow influence reflected on the graph.

- Reflected Light Movement
  By inputting location (longitude and latitude), and date and time, users can see reflected lights. It also shows the continuous movements of reflected lights during a day by animation.

- Reflected Light Trajectory
  It shows all reflected light trajectories within designated time interval. You can see how reflected lights affect nearby buildings.

- Image and video output
  Simulation results of shadows and reflected light can be output as images and videos. It is also possible to set titles and comments on videos. You can see images and videos of simulation results on personal computer, smartphone or tablet, so you can use it widely for presentations, PR, etc.

Prediction of power generation by highly scientific calculations based on instantaneous value

- Integration of Instantaneous Calculations
  Integrating instantaneous calculations of irradiance, instead of the simple calculation based on the annual irradiation amount, results in valid and precise calculation of generated energy. It supports arch type, tracking type and other special systems, too.

Calculation on I-V Characteristics Graph
  By calculating PV system as a circuit combining the current equation per module, it shows a precise I-V curve which takes account of circuit linkage of each module. Various changes of I-V curves resulted from the deference of the shadow influence can be compared, therefore evaluation on environment where a system performs effectively.

Module connection setting
  You can design module connections. Modules are colored to visualize strings and inverter connections on the 3D CAD screen. It is possible to connect across arrays and multiple inverters.

Interlock between Module Connection and Shadow Figure
  You can find module connections relatively unaffected by shadows with designing them in a different direction. As fig. 1 shows, in case the shadows are falling on the PV arrays similarly, the generated power is largely different depending on a way of module connection.
Simulation principle of Solar Pro

Solar Pro integrates the instantaneous value of the generated electric power and leads to highly accurate results.

1. Calculation per Module
   Calculate the current equation taking into consideration the state of sunshine and shadow for each module.
   
   A combination of electric current and voltage is derived according to the situation such as the installation condition of each module and the type of module, and is represented as an IV curve. Therefore, it is possible to calculate accurately even in complicated situations such as different installation conditions and modules in different wiring configurations.
   
   **calculation:**
   
   \[
   I = I_{ph} - I_0 [\exp(C(V+I \cdot R_s)) - 1] - (V+I \cdot R_s) / R_p
   \]

   - It reflects the state and connection of modules one by one.
   - Consider the effects of shading on all modules in a string, not just the one being shaded.

2. Calculation on I-V Characteristics Graph
   Draw an IV curve from a combination of electric current and voltage and find the maximum power point.
   
   An I-V curve graph is a basic graph displaying performance of PV modules. In Solar Pro, a possible combination of electric current and voltage is calculated precisely by altering load resistance accordingly.

3. Generated Power
   Plot the maximum power point obtained from the IV curve as generated power.

Enable highly accurate and scientifically grounded calculations by integrating instantaneous values instead of calculating from annual accumulated solar radiation.

There are detailed calculations and simple calculations for yearly calculations. You can also select the calculation interval in units of 1 minute.

The solar radiation incident on the PV array is calculated using direct irradiance, scattered light, and ground reflected light. This allows you to determine the total amount of solar radiation (tilted surface solar radiation) received by the PV array, whatever orientation the PV array is installed in.

**A Temperature Influences**

Rise in PV temperature during daytime shows decrease in voltage. It is one of the unique characteristics of Solar Pro to analyze the influence by temperature at the voltage base.

**B Shadow Influences**

This graph shows electric decreasing voltage, electric current, and electric power. It can reflect the calculation of shadow changing momentarily.

**C Operating Conditions on Inverters**

It reflects inverter’s setting such as operate, stop, action on capacity-over.