

## PV Watts Calculation Values for an Enphase Micro-inverter System

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### **Purpose**

The introduction of a micro-inverter system has changed some of the long-held assumptions about a given site's performance and energy production expectations. This Application Note provides information on how to modify the variables of PV Watts calculations for the purpose of determining performance information for a solar installation using an Enphase Micro-inverter System.

### **PV Watts Calculator**

The PV Watt Photovoltaic Solar System Performance Calculator is maintained by the National Renewable Energy Laboratory (NREL) for ascertaining a solar system's performance given environmental conditions and equipment used. For some states, such as Colorado's XCEL program, this is the sole criterion for determining the state's rebate amount. The calculator can be accessed at <http://www.pvwatt.com/>

### **Default Derating Values**

The PV Watts calculator makes assumptions about a solar system using the model of a traditional deployment with a central inverter.

The calculator allows users to substitute its default input parameters with custom values. These derate factors include:

- \* DC rating
- \* DC-to-AC derate factor
- \* Array type
- \* Tilt angle
- \* Azimuth angle
- \* Electricity cost

For a detailed discussion of these factors, please reference the PV Watts page at:

[http://www.nrel.gov/rredc/pvwatts/changing\\_parameters.html](http://www.nrel.gov/rredc/pvwatts/changing_parameters.html)

## Derate Factor Elements

Some of the derate factors which make up the PV Watts overall assessment of a PV system's performance apply to Enphase deployments just as they would for a traditional solar deployment. These include:

- **"D/C Rating"**. The manufacturer's D/C rating is the same regardless of the inverter system used.
- **"Array Type"**. These factors include fixed, sun-tracking with one axis of rotation, and sun-tracking with two axes of rotation.
- **"Tilt-Angle" and "Azimuth Angle"**. These factors affect an Enphase system similarly to a traditional, central inverter deployment.

Where Enphase deployments deviate from – and improve on – traditional deployments is in variables such as the D/C-to-A/C derate factor elements, as follows:

- **"Module Mismatch"**. This is a phenomenon that is only relevant to a D/C string and does not have an effect on an Enphase Micro-inverter (one-inverter-per-module) installation.
- **"D/C Wiring"**. There are no long D/C homeruns with an Enphase deployment. There are no long DC runs or associated taps. There is no DC combiner box.



### Defaults for "D/C to A/C Derate Factor"

The following reflects default derate factors as excerpted from the PV Watts calculator:

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#### Calculator for Overall DC to AC Derate Factor

Component Derate Factors	Component Derate Values	Range of Acceptable Values
PV module nameplate DC rating	0.95	0.80 - 1.05
Inverter and Transformer	0.92	0.88 - 0.96
Mismatch	0.98	0.97 - 0.995
Diodes and connections	0.995	0.99 - 0.997
DC wiring	0.98	0.97 - 0.99
AC wiring	0.99	0.98 - 0.993
Soiling	0.95	0.30 - 0.995
System availability	0.98	0.00 - 0.995
Shading	1.00	0.00 - 1.00
Sun-tracking	1.00	0.95 - 1.00
Age	1.00	0.70 - 1.00
Overall DC to AC derate factor	<b>0.77</b>	<i>(PVWATTS Default)</i>

Calculate Derate Factor

HELP



## Enphase Micro-Inverter System values for "D/C to A/C Derate Factor"

Below is a list of values for an Enphase Micro-inverter system installation:

### Calculator for Overall DC to AC Derate Factor

Component Derate Factors	Component Derate Values	Range of Acceptable Values
PV module nameplate DC rating	<input type="text" value="0.95"/>	0.80 - 1.05
Inverter and Transformer	<input type="text" value="0.945"/>	0.88 - 0.96
Mismatch	<input type="text" value="0.995"/>	0.97 - 0.995
Diodes and connections	<input type="text" value="0.995"/>	0.99 - 0.997
DC wiring	<input type="text" value="0.99"/>	0.97 - 0.99
AC wiring	<input type="text" value="0.99"/>	0.98 - 0.993
Soiling	<input type="text" value="0.95"/>	0.30 - 0.995
System availability	<input type="text" value="0.99"/>	0.00 - 0.995
Shading	<input type="text" value="1.00"/>	0.00 - 1.00
Sun-tracking	<input type="text" value="1.00"/>	0.95 - 1.00
Age	<input type="text" value="1.00"/>	0.70 - 1.00
Overall DC to AC derate factor	<b>0.819</b>	

Calculate Derate Factor

HELP

#### Notes:

- The Enphase Micro-inverter's conversion efficiency is rated at 94.5%.
- "Module Mismatch" is not applicable to any degree using Enphase.
- "Diodes and Connections" nor "DC Wiring" are not a factor.
- "System Availability" is higher than the default because with an Enphase system there is no single point-of-system failure.

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## Conclusion

The values listed above represent a real-world deployment of an Enphase Micro-inverter System and reflect its benefits including higher system availability, improved energy harvest, minimal losses in D/C wiring runs, and increased production due to elimination of module mismatch. The introduction of a micro-inverter system has changed some of the long-held assumptions about a given site's performance and energy production expectations. Enphase Energy continues to endeavor to inform both the solar installer community, as well as individual states' rebate program administrators, about the differences and improvements that an Enphase Micro-inverter System brings to the model of solar energy generation.