Pairing Enphase microinverters with bifacial solar PV modules

Overview

The power output ratings of solar modules have consistently increased over time, which can be attributed to advancements in material science and R&D efforts by mono- and polycrystalline module producers.

Additionally, the introduction and maturation of bifacial modules have contributed to this photovoltaic (PV) technology trend.

Traditional opaque-back sheeted modules are monofacial. Power can be produced only from the front side of the module.

Using bifacial PV modules leads to greater power output than conventional monofacial PV modules as they can collect light reflected onto their backside from various sources, such as the ground or neighboring PV modules. Bifacial solar modules provide several benefits over traditional ones. They produce power from both sides, increasing overall energy generation. They are also more durable, as both sides are UV resistant, and the risks of potential-induced degradation (PID) are reduced when the module is frameless.

However, the performance of bifacial PV modules depends on various factors such as system design, installation methods, and location. Additionally, using bifacial modules in a smaller array footprint reduces balance of system (BOS) costs. These modules work best in flat commercial rooftops and ground-mounted arrays, with ample space for tilting the modules and a substantial amount of reflected light. Due to limited space between the module and the roof surface, the flush-mounted bifacial modules on a residential rooftop do not offer the same gains.

There may be no bifacial gain (0%) with roof-mounted racking for several reasons:

- Firstly, the amount of reflected light reaching the backside of the bifacial module is significantly reduced when the module is placed in a horizontal position on a roof. In contrast, ground-mounted bifacial modules can be tilted to optimize the amount of reflected light reaching the backside of the module.
- Secondly, roof-mounted bifacial modules may not have enough space between the module and the roof surface to capture reflected light effectively. The amount of reflected light reaching the backside of the module decreases as the distance between the module and the reflecting surface decreases. This means that flush-mounted bifacial modules may not offer the same gain as ground-mounted modules or modules with elevated racking.

Therefore, the orientation and placement of bifacial modules play a critical role in determining their performance and potential bifacial gain.

The global adoption of bifacial modules is now becoming widespread due to advances in bifacial technology, the decreasing cost premium compared to mono-facial modules, and the increasing industry experience with them.

Pairing with Enphase microinverters

When designing a solar PV system that utilizes bifacial modules, it is crucial to estimate the expected bifacial gain before selecting the microinverter. This estimation should take into account the conditions of the installation site. Based on the estimated gain, the Enphase microinverters used in the bifacial system should be chosen according to the electrical properties of the bifacial PV module related to the additional gain.

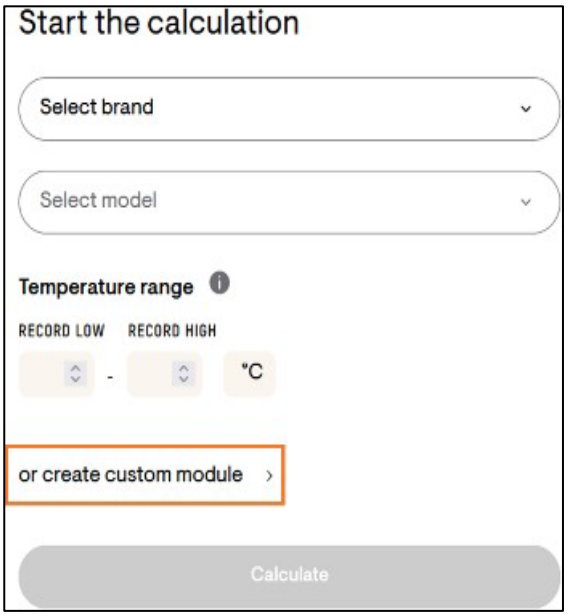
In bifacial modules, the output current increases with the rear side boost while the voltage remains constant, resulting in a higher module output power. *Enphase recommends using the real power (i.e., gained power) rather than the nominal/rated power of the bifacial PV module @ STC*. For instance, if a 10% gain is expected, the module output power associated with the 10% gain should be used rather than the module's nameplate (nominal) rating while checking for compatibility with Enphase microinverters.

Use the Enphase module compatibility calculator to check the bifacial module compatibility by following the below steps:

1. Installer/system designer must estimate bifacial gain based on mounting methods, mounting surface, etc. Consult the module manufacturer on how to estimate the gain.
2. Once the bifacial gain is estimated, refer to the module datasheet, and look for the bifacial gain adjusted parameters (V_{mp}, I_{mp}, V_{oc}, I_{sc}) from the module datasheet. For example, for a 10% bifacial gain, the installer can consider the highlighted electrical parameters from the module datasheet.

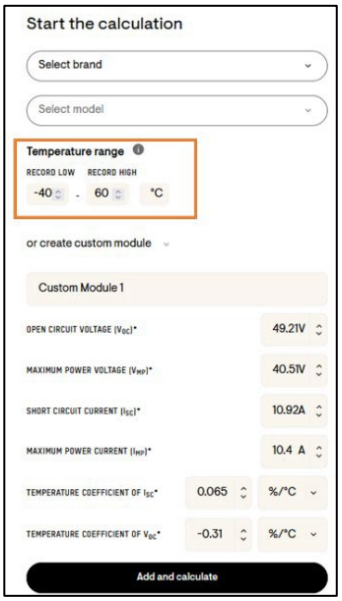
Electrical specification	Pmax gain from the rear side*				
Ground reflectance	10%	15%	20%	30%	30%
Peak power (0± 4.99 Wp) Pmax (Wp)	420	440	460	480	500
Maximum voltage, Vmpp (V)	40.51	40.51	40.52	40.52	40.53
Maximum current, Impp (A)	10.40	10.90	11.39	11.85	12.20
Open circuit voltage, Voc (V)	49.21	49.21	49.22	49.22	49.23
Short circuit current, Isc (A)	10.92	11.45	11.96	12.44	12.81
Module efficiency (%)	20.81	21.80	22.80	23.79	24.78
*Power gain from the rear side depends upon the ground reflectance (Albedo) & bifaciality factor					

3. Visit the Enphase module compatibility calculator webpage and create a custom module.

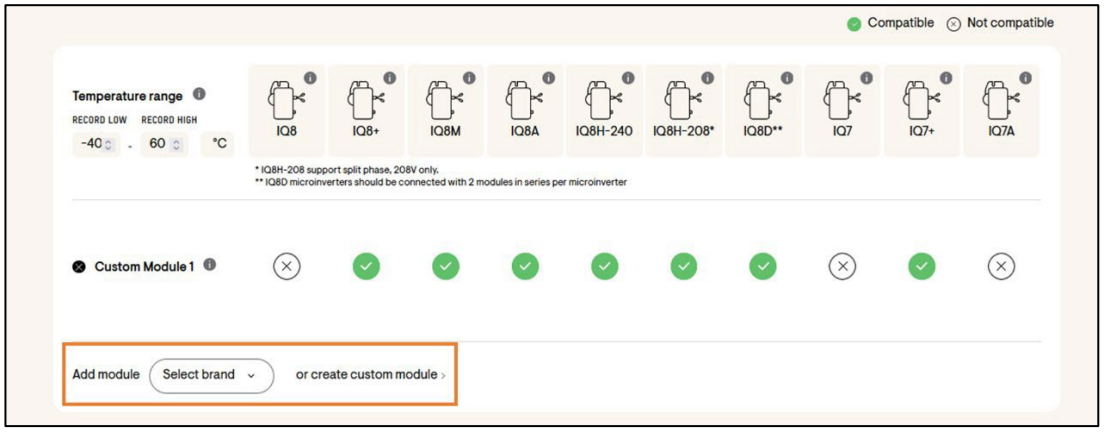


4. Enter the bifacial gain adjusted parameters (identified in step 2) along with the temperature coefficients of I_{sc} and V_{oc}.

NOTE: Enter the ambient temperature range before you click the “Add and calculate” radio button.



5. Once you click the "Add and calculate" radio button, the list of microinverters compatible with the bifacial gain-adjusted module parameters is displayed.



6. You can check the compatibility of multiple PV modules or PV modules with different gains by clicking the highlighted radio buttons from the compatibility chart.

Revision history

Revision	Date	Description
TEB-00024-1.0	July 2023	Initial release