MODELING MAXIM'S SUBMODULE OPTIMIZERS IN PVSYST®

To simulate the benefit of submodule optimizers, Maxim has partnered with PVSyst to enable the modeling of Maxim's submodule optimizers using the industry standard in modeling software. Submodule optimizers are integrated into the junction box of modules from leading manufacturers and provide distinct energy production advantages for utility-scale systems. In a few simple steps, the designer can evaluate the energy production of several different design options, and offer the customer the highest yield possible.

For PVSyst Version 6.76 and later

Selecting an Optimized Module

PV Syst's database includes PV modules currently in production with Maxim's submodule optimizers. Simply select a manufacturer from the list and the appropriate module part number. Modules with submodule optimizers usually have part numbers that end with 'Maxim' as illustrated in Figure 1.
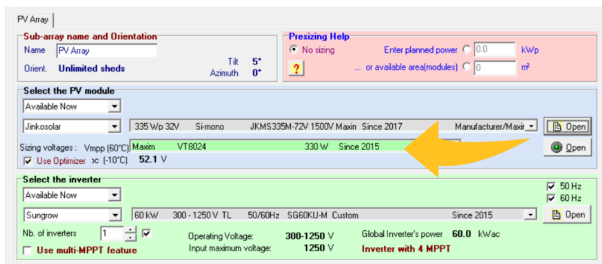

Figure 1: Select a Maxim module from a manufacturer's list of part numbers on the System page.

The optimizer integrated into that module will automatically appear in the drop-down menu below the module part number.

Defining an Optimized Module

If the desired module is not yet available, a standard module from the PVSyst database or a .pan file can be modified for use with Maxim optimizers. The designer need only add
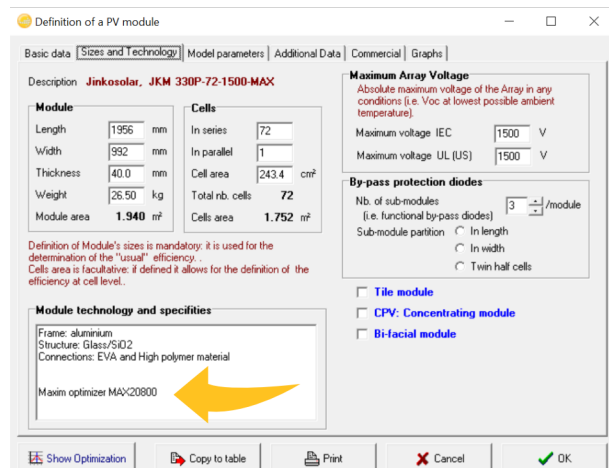

Figure 2: Module Definition with a Maxim part number on the Sizes and Technology page in PVSyst®.

the Maxim part number to the text box on 'Sizes and Technology' page as shown in Figure 2. Table 1 shows a list of Maxim's part numbers along with their output voltage limit. On manufacturer's datasheets with an integrated submodule optimizer, the V_{OC} parameter will often be the same as the $V_{LIM,OC}$ value shown below. Whenever a Maxim part number is added to a non-optimized module in PVSyst, the maximum voltage produced under any conditions will be the $V_{LIM,OC}$ value.

Part Number	Output Voltage Limit ($V_{LIM,OC}$)
MAX20800	35 $V_{LIM,OC}$ (Legacy 60 Cell Part)
MAX20800A	40.9 $V_{LIM,OC}$ (Legacy 72 Cell Part)
MAX20801A	31.8 $V_{LIM,OC}$ for 60 Cell modules up to 335W
MAX20801B	33.6 $V_{LIM,OC}$ for 72 Cell modules up to 355W
MAX20801C	37.2 $V_{LIM,OC}$ for 72 cell modules up to 395W

Table 1: Maxim part numbers and their corresponding output voltage limits ($V_{LIM,OC}$).

Simulating Longer Strings

PVSyst performs a check on the $V_{LIM,OC}$ and operating voltage (VOPER) range of the system to verify that the string conforms to both the system voltage class and the inverter maximum power point tracking (MPPT) window. The following equation describes the general rule for string sizing (rounded down to the nearest integer):

$$Max\ String\ Length = \frac{V_{LIM,OC}}{Max\ System\ Voltage}$$

It is essential to keep the V_{MP} (VOPER in PVSyst nomenclature) within the MPPT range of the inverter. The operating voltage limits appear within the 'Operating conditions' window on the 'System' page in PVSyst. If these values exceed the inverter limit or system voltage class limit, a warning will appear. When PVSyst calculates the operating points for each hour of the year, any losses incurred by operating outside the MPPT voltage window of the inverter appear in the production report.

Figure 3: The string sizing tool includes the voltage limiting function of the optimizers and calculates the operating limits for a given string length.

The maximum possible string length depends on the inverter's MPPT range. For example, PV strings in a 1500V system can be up to 42 modules in length when the modules utilize a MAX20801B optimizer.

Increasing Density

Submodule optimizers have the unique ability to correct electrical effect of shade at the cell-string level. Unlike module optimizers, the designer can use these modules to improve the Ground Coverage Ratio (GCR) while increasing or maintaining the array's Specific Production (kWh/kWp/Yr). The primary methods for modeling the effect of inter-row shading are the Unlimited Sheds, and 3D Model array types.
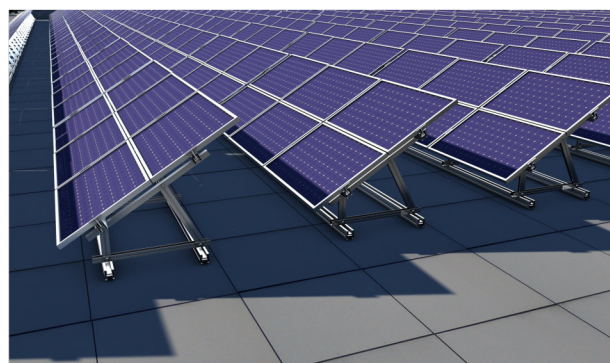

Figure 4: At high GCRs, inter-row shading impacts the bottom cell string in each row of modules.

Simulating using Unlimited Sheds or Unlimited Trackers

Designers can use the 'Unlimited Sheds' or 'Unlimited Trackers' modeling methods in PVSyst to evaluate the effect of increased density on a given site. This function will apply shade equally to every row of modules (a 'shed' in PVSyst nomenclature) without the need to create a 3D model for the site. This is very useful in the preliminary site evaluation phase of a project. In the Maxim model, the designer must adjust the number of electrical regions from the industry standard one per module, to one per cell-string (3 per module).
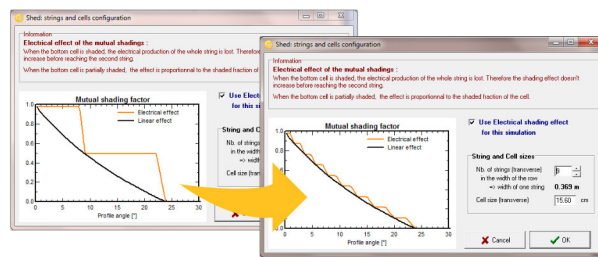

Figure 5: Adjust the number of electrical regions from one per module, to one per cell-string when using Unlimited Sheds.

Adjusting the number of electrical regions sets up PVSyst to calculate shading at the submodule level. This step is not necessary when using other modeling methods like a 3D model or a simple Fixed Tilted Plane.

Simulating using a 3D model

The designer can use the 3D construction tool to create an array where the array layout and site dimensions are known. This method only requires the designer to select a Maxim module in the System Definition and create an accurate 3D layout. PVSyst calculates the shade on each cell-string and the corrective effect of the integrated submodule optimizers.

Other Settings
Mismatch

By default, mismatch losses are zero when an optimized module is selected. This value can be changed based on the designer's assumptions. When using non-optimized modules, Maxim recommends that the designer enter a 2.4% value in the 'Modules Mismatch Losses' field and use the default values in the other fields.
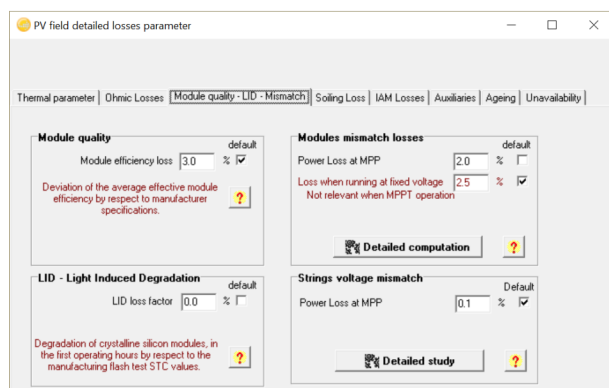

Figure 6: Default mismatch losses in PVSyst for a non-optimized system.

Degradation

PVSyst versions 6.74 and later use an annual performance degradation coefficient to determine a system's lifetime and year-one energy production. Maxim recommends that the designer set the degradation rate to 1.0%/Yr for a standard system and 0.6%/Yr for Maxim optimized systems. The default rate in PVSyst is 0.4% for all systems, and the designer should change these values manually in the Detailed Losses section of the software.
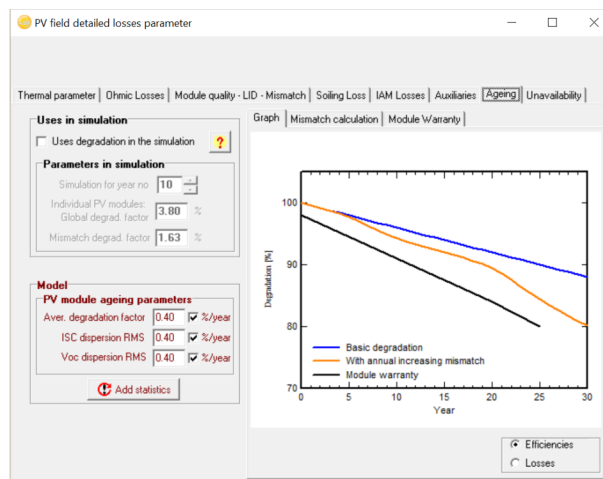

Figure 7: Default degradation curves in PVSyst.

Conclusion

The industry standard PVSyst modeling software supports the simulation of PV modules and systems utilizing Maxim's Submodule Optimizers. Rely on Maxim and PVSyst to confidently design the highest producing and most cost-effective utility-scale PV Systems.

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