APPLICATION NOTE 6403

Solar FAQs

Abstract: Frequently asked questions about our solar industry.

How do the Maxim Integrated cell-string optimizers operate?

Maxim's cell-string optimizers are highly integrated DC-DC converters that replace traditional bypass diodes to more effectively reduce the impact of series and parallel mismatch frequently present during system operation. Rather than completely bypassing an underperforming cell string, the Maxim device actively harvests the available power and regulates the cell string's output current. This ensures that the underperforming cell string can always contribute power without impacting the output of the highest performing cell strings.

What is unique about Maxim's offering relative to existing module-level electronics solutions?

Relative to existing solutions that attach to the outside of modules (i.e., DC optimizers or microinverters), the Maxim offering is unique as it addresses both mismatch between modules AND within modules between cell strings. This provides three times the maximum power point tracker (MPPT) granularity per system.

How do the Maxim cell-string optimizers interoperate with an inverter?

Maxim's solution was designed to work with standard string inverters—both transformer-based and transformerless. The inverter determines the global system MPPT and Maxim performs MPPT on each cell string reacting in real-time to sources of mismatch.

Can the Maxim cell-string optimizers work with any inverter or are there unique requirements?

The sampling frequency of the Maxim devices is considerably higher than the inverter MPPT, allowing the two devices to work seamlessly in any operating condition. Maxim has also focused closely on other elements of inverter interoperability including arc-fault detection and performed joint testing with leading inverter manufacturers to ensure optimal field performance. Unlike all other DC optimizers, installers will appreciate that there is no change to their existing installation and commissioning process. There are no additional devices to install or communication infrastructure to configure.

Do Maxim-enabled modules allow more flexibility in string sizing or placement in shade?

While designing a system with Maxim-enabled modules can be identical to a conventional string-inverter design, the addition of Maxim's IC can afford additional flexibility in string lengths and an increased tolerance for placing modules in partial shading. As long as the individual string lengths independently fall within the inverter sizing guidelines, strings of differing lengths can be combined in parallel on a single-inverter MPPT channel without affecting system performance. The high granularity of shade mitigation within a Maxim-enabled module means that a module placed in partial shade can still produce power throughout the day without negatively impacting the rest of the system.

How does the addition of a Maxim IC affect the reliability of the module relative to conventional modules?

The Maxim IC is a one-for-one replacement of the diode. The devices have similar reliability characteristics and have little statistical impact. The chip-level power solution is based on standard proven Maxim design blocks and an analog semiconductor manufacturing process with

over 2 billion similar devices functioning in harsh environmental conditions. In practical applications, the Maxim device ensures that power is always harvested from its associated cell string. This eliminates the possibility of hot spots and electronic device heating during bypass, thus increasing the reliability of the other module components. Furthermore, because of the MPPT granularity, underperforming cells impact only cells within the cell string rather than every cell in the module.

How does the addition of a Maxim IC affect the reliability of the module relative to traditional MLPE solutions?

Maxim's highly integrated three-chip solution can be compared to board-level solutions containing hundreds of discrete ICs. Maxim's solution provides a significant statistical and practical reliability improvement over these complex implementations.

Do module OEMs warranty the Maxim-enabled module differently than conventional modules?

All module OEMs selling Maxim-enabled modules provide warranties identical to their conventional counterparts. Based on extensive reliability assessments, leading OEMs have concluded that Maxim devices meet their high standards for quality product components.

What is the cost impact of adding Maxim-enabled modules to my system design?

Today, Maxim optimizer ICs are slightly more expensive than bypass diodes but a fraction of the cost of other module-level electronics. While the cost of adding a Maxim-enabled module to a conventional system might represent a few cents per Watt, the increased harvest associated with a minimal amount of mismatch present will result in rapid payback and long-term financial benefit. If a system designer utilizes Maxim-enabled modules to increase the system density (by increasing ground coverage ratio or placing modules closer to shade objects), the amortization of fixed costs over a larger system could result in a cost improvement on Day 1.

Which module OEMs have adopted the Maxim cell-string optimizer?

Several solar module manufacturers have integrated Maxim technology into their panels including Jinko Solar, Trina Solar, ET Solar, and Q Cells. We will continue to add more partner panel manufacturers to this list as their products become commercially available. Check www.maximintegrated.com/solar for our updated partner list.

I manufacture solar modules. How can I adopt the Maxim solution?

Maxim has enabled a turnkey J-box solution that can be quickly integrated into a conventional module design for testing, certification, and production. Please contact Maxim for samples, module design and testing guidelines, and commercial terms.

What incremental performance can I expect when using Maxim-enabled modules relative to conventional modules or currently available module-level electronics solutions (DC optimizers/microinverters)?

The performance increases from more granular MPPT depend greatly on the amount of mismatch in the system. While the leading module-level DC optimizer can ensure an underperforming module does not impact adjacent modules, it does not provide visibility within the module to address mismatch between cell strings. In a randomly dispersed shade event (i.e., tree shade), the Maxim-enabled solution provides small incremental performance gains beyond a DC optimizer or microinverter. However, with an evenly distributed shade distribution (e.g., cross-bank shading, soiling, snow melt, etc.) addressing the inter-module mismatch while

harvesting power from the shaded cell string results in significant incremental performance. If shade is evenly distributed, a module-level solution does not detect mismatch between modules and is unable to be addressed.

Are there tools available to simulate the performance of a Maxim-enabled system in a variety of shade conditions?

Software modeling tools, such as Aurora Solar or PVsyst, can provide simulations for Maxim-enabled modules, which can be compared to standard modules or modules with alternative panel optimizer technologies.

Are there any rules for adapting the forecasted losses with Maxim-enabled modules when using the PVWatts® Calculator or the System Advisor Model (SAM)?

SAM and PVWatts Calculator are general reference tools and not specifically designed for systems with shade. The software asks for losses in % of energy, which is completely based on the designer's assumptions about energy loss. For Maxim, you may consider reductions in percentage loss for soiling or mismatch assumptions over standard modules. An alternative approach is to use Aurora Solar or PVsyst.

Will Maxim-enabled modules support the module level shutdown requirement published in NEC 2017 690.12?

To comply with array level shutdown as required by NEC 2014, article 690.12, installers can combine a Maxim-enabled module, an external RSD, and a string inverter for a simple, low-cost three-part solution. For NEC 2017 690.12 module-level shutdown (stipulated by code on or after January 1, 2019), Maxim is working with the industry in the SunSpec Alliance to create an open-standard solution enabling compatibility amongst a wide variety of inverters and modules. This approach will provide the industry with flexibility to use best-in-class building blocks rather than proprietary vertical power solutions. The Maxim implementation will be the lowest cost PLC-based optimized/shutdown solution in the market.

Where would I purchase Maxim Integrated modules?

In the USA, Maxim-enabled modules can be purchased from leading distributors including: CED, Sonepar (and affiliates), CivicSolar, BriteStreet, and Soligent or directly from supporting module OEMs. Maxim Integrated is building distribution partnerships in Europe, Japan, Latin America, and Australia. Please ask your preferred distributor if they currently carry a Maxim-enabled solution.

Do Maxim-enabled modules provide module-level monitoring and performance data?

Maxim's optimization solution is a simple, low-cost, industry-compatible technology to increase energy harvesting that lowers the cost of energy. To keep this solution simple we do not add complex communication networks or wireless gateways, which can add complexity and cost to a project. If you need monitoring, you can get string-level, revenue-grade monitoring from most string inverter solutions on the market today.