Maxim Submodule Optimizers
Residential and Commercial DC Optimization
Submodule Optimization

**Simplicity**
Factory installed, no added system components or complexity

**Performance**
Three MPPT per module for granular performance optimization

**Value**
Reduce Capex and LCOE with longer strings and mismatch recovery

**Reliability**
Technology proven over 20 years in mission critical applications
Deep MPPT Granularity

- Conventional PV Modules are current limited by the weakest cell
- Shaded, Soiled, Cracked, or Aged Cells weaken the entire string or are bypassed
- Maxim Optimizers mitigate mismatch for up to 30% more power in a variety of challenged conditions
Flexible PV System Design

• Residential Flexibility
  > String modules of different orientations in series
  > Combine strings of different length on a single MPP channel
  > No external boxes, gateways, trunk cabling, or network communications

• Commercial
  > Increased number of modules per string; reduce homeruns
  > Tighter row pitch with minimal row-shade losses
  > Choose simplest stringing method without performance penalty

• Shade and Soiling Tolerance
  > Design with fewer constraints to shading objects
  > Reduce cleaning and maintenance requirements
Residential System Design Flexibility

- Distributed MPPT enables flexible PV site design
- No performance penalty design; use the “easiest” installation
Longer Strings

• Limit 60-cell module output to 35V across all temperatures and irradiances
• Enables more modules on small systems and fewer strings on large systems
• Longer strings amortize fixed costs over more kW and enable lower effective $/W

Voltage Limiting

Enables 20-35% Longer Strings

<table>
<thead>
<tr>
<th>Design Parameter</th>
<th>Standard</th>
<th>Maxim</th>
</tr>
</thead>
<tbody>
<tr>
<td>Min Design Temp*</td>
<td>-10°C</td>
<td>--</td>
</tr>
<tr>
<td>Max VOC</td>
<td>43V</td>
<td>35V</td>
</tr>
<tr>
<td># Modules Per String</td>
<td></td>
<td></td>
</tr>
<tr>
<td>600V</td>
<td>14</td>
<td>16</td>
</tr>
<tr>
<td>1000V</td>
<td>23</td>
<td>26</td>
</tr>
</tbody>
</table>

10-20% Longer strings enables system capex cost savings
Commercial System Design Flexibility

- Mitigate effect of row shading caused by tight row pitches
- Install more modules on area constrained systems
- Enables 10-20% denser rooftop systems with no performance penalty
Mismatch Tolerance

- Many conditions unexpectedly and severely degrade system power production
- Relax O&M requirements and impact of unforeseen environmental influences
Two palm trees equally affecting MAXIM and Panel Optimizer strings
Maxim submodule optimizer outperforms panel optimizer by > 4%
Installation Simplicity

• No external boxes to install or communication networks to debug
• Broad compatibility with string inverters from all manufacturers
Modeling with Maxim Submodule Optimizers

- System design with Maxim optimizers is a built-in to the industry leading modeling tools
## Competitive Comparison

<table>
<thead>
<tr>
<th>Benefit</th>
<th>Diode</th>
<th>Maxim Optimizer</th>
<th>Panel Optimizer</th>
<th>Micro-Inverter</th>
</tr>
</thead>
<tbody>
<tr>
<td>Triple MPPT Per Module</td>
<td>✗</td>
<td>✓</td>
<td>✗</td>
<td>✗</td>
</tr>
<tr>
<td>Increase String Length</td>
<td>✗</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Increase Ground Coverage and Density</td>
<td>✗</td>
<td>✓</td>
<td>✗</td>
<td>✗</td>
</tr>
<tr>
<td>Eliminate Hot Spots &amp; Diode Failures</td>
<td>✗</td>
<td>✓</td>
<td>✗</td>
<td>✗</td>
</tr>
<tr>
<td>Broad Inverter Compatibility</td>
<td>✓</td>
<td>✓</td>
<td>✗</td>
<td>✗</td>
</tr>
<tr>
<td>Proven High Reliability</td>
<td>✗</td>
<td>✓</td>
<td>✗</td>
<td>✗</td>
</tr>
<tr>
<td>Factory integrated, zero install time</td>
<td>✓</td>
<td>✓</td>
<td>✗</td>
<td>✗</td>
</tr>
</tbody>
</table>

Reduce Installation Costs, Improve Performance, Minimize Investment Risk

The Only Module Integrated Optimization Solution