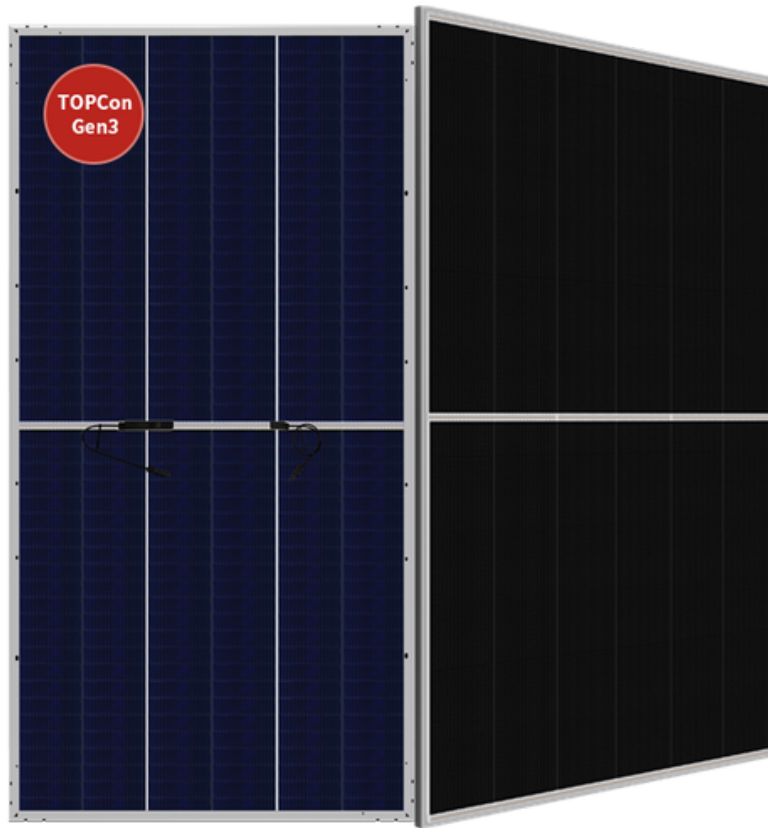




TOPCon Gen3 Modules

Technical White Paper

Canadian Solar

2026 July

1. About Canadian Solar

Canadian Solar is one of the world's largest solar technology and renewable energy companies. Founded in 2001 and headquartered in Kitchener, Ontario, the Company is a leading manufacturer of solar photovoltaic modules; provider of solar energy and battery energy storage solutions; and developer, owner, and operator of utility-scale solar power and battery energy storage projects — delivering solar, storage, system integration and long-term operation under a single accountable partner.

Over the past 25 years, Canadian Solar has successfully delivered nearly 177 GW of premium-quality, solar photovoltaic modules to customers across the world. Through its subsidiary e-STORAGE, Canadian Solar had shipped over 20 GWh of battery energy storage solutions to global markets as of March 31, 2026, and had a \$3.5 billion contracted backlog as of May 8, 2026.

Since entering the project development business in 2010, Canadian Solar has developed, built, and connected approximately 12.2 GWp of solar power projects and 6.4 GWh of battery energy storage projects globally. Its geographically diversified project development pipeline includes 24 GWp of solar and 81 GWh of battery energy storage capacity in various stages of development.

Canadian Solar is one of the most bankable companies in the solar and renewable energy industry, having been publicly listed on the NASDAQ since 2006.

2.Canadian Solar TOPCon Gen3 High-Power-Density Modules: Advanced Technology & High Reliability

As a global leader in solar innovation, Canadian Solar continuously advances PV materials and manufacturing technologies to improve product performance, reliability, and quality. In 2022–2023, the company launched a comprehensive N-type TOPCon portfolio based on 182 mm and 210 mm wafers, offering monofacial and bifacial modules across multiple formats and power classes to meet diverse application needs worldwide.

- 2024, launched TOPCon Gen1 high-power modules. Through innovative 182 × 210 mm rectangular wafer technology, we completed a full value-chain technology reconstruction from crystal growth and wafer slicing to cells and modules.
- 2025, launched TOPCon Gen2 high-power modules with power up to 650 W. While enabling maximum container space utilization, the products deliver higher power generation revenue for customers.
- 2026, launched TOPCon Gen3 high-power modules with power up to 670 W and a conversion efficiency up to 24.8%. With further power enhancement and lower system costs and lower LCOE, deliver higher returns for customers and investors.

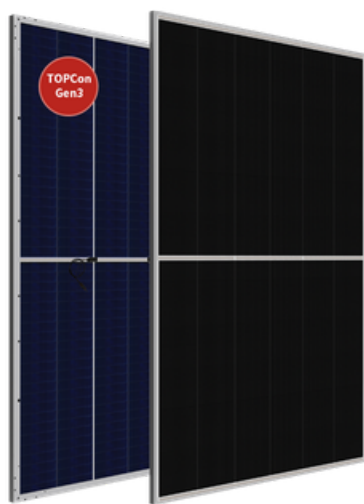


Figure 1. Canadian Solar TOPCon Gen3 Module CS6.3-66TB

Module Type	Gen2 CS6.2-66TB	Gen3 CS6.3-66TB
Size (mm)	2382*1134*30	2382*1134*30
Module Power	630~650W	650~670W
Bifaciality	Up to 85%, 80±5%	Up to 90%, 85±5%
Temp Coeff. (Pmax)	-0.29%/°C	-0.26%/°C
Warranty	1%, 0.4%	1%, 0.35%
Cell Cut	Half Cut	Multi-cut
Appearance	Cell Inter-gap	Cell Overlap

Table 1. Module Information of Canadian Solar TOPCon Gen3 Module CS6.3-66TB

Advanced Cell Finger Design

Canadian Solar adopts advanced screen-printing technology and improves printing quality. As shown in Figure 2, conventional screens have wider line openings and significant height fluctuations in the fingers. PI screens and electroformed screens with ultra-fine finger openings can produce uniform line profiles, improve efficiency while ensure printing quality and also reduce Ag consumption.

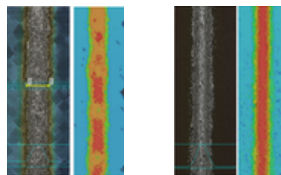


Figure 2. Microscopic characterization of conventional fingers and Gen3 products fingers

Compared with conventional SMBB technology, Canadian Solar adopts the distributed current collection design in the cell pattern of its Gen3 modules. This design significantly improves current collection capability. More soldering points make cell stress distribution more uniform while enabling Gen3 modules to deliver excellent anti-aging performance.

Compared with conventional TOPCon cells, the advanced optimization of the polysilicon layer structure further reduces parasitic optical absorption by the polysilicon layer, improving cell efficiency while significantly enhancing cell bifaciality.

Multi-cut Cell Technology

The 182 Pro TOPCon Gen3 modules use large-format N-type 182 mm × 213 mm TOPCon cells and precise non-destructive multi-cut technology, which divides each standard large-format cell into four pieces. After cutting, each cell undergoes edge passivation to protect the cut edge and eliminate edge damage, increasing cell efficiency by more than 0.5%.



Figure 3. Multi-cut cells



Figure 4. Multi-cut edge passivation

In addition, minimizing cutting damage is critical to ensuring cell quality under multi-cut conditions. Canadian Solar uses non-destructive cell-cutting technology, delivering smoother cross-sections, less lattice damage, higher yield, and stronger long-term reliability, thereby ensuring production stability and soldering quality for 1/4 cells.



Figure 5. Cell cutting damage



Figure 6. Non-destructive cell cutting

Cell Overlap and High Power Density

The 182 Pro Gen3 modules adopt an innovative “cell overlap” layout. Through a special low-stress cell shingling solution, greatly increasing the energy-area ratio within the effective light-receiving area of the module. This means that, within the same module dimensions, more cell surface area is available for power generation, directly contributing approximately 0.8% additional power gain in TOPCon 3.0 product.

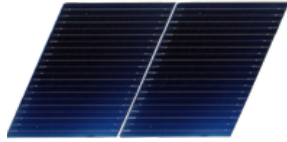


Figure 7. Conventional cell gap

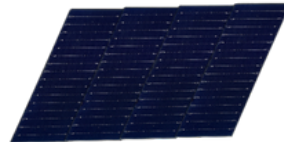


Figure 8. Overlap of multi-cut cells

Electrical and Optical Dual Gains

The Gen3 products adopt 1/4 cells, which effectively reduce the operating current of each cell and mitigate the impact of minor micro-defects on overall performance. Since electrical power loss is proportional to the square of current ($P_{\text{loss}} = I^2 \times R$), reducing cell operating current substantially lowers internal resistive losses in the module, resulting power gain by approximately 1%.

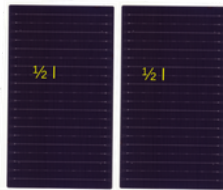


Figure 9. Half-cut current

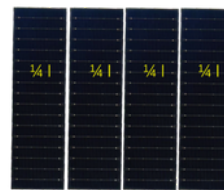


Figure 10. 1/4 cut current

Meanwhile, the Gen3 modules fully optimize optical utilization efficiency. The front layer of the module adopts double anti-reflection coated glass with ultra-high transmittance, which minimizes light reflection and absorption on the panel surface to boost incident luminous flux. In addition to the gap reflective film between cell strings, front glass reflective film and edge light guide film are newly added to realize secondary reflection. These optical gain measures can bring an additional power improvement of approximately 0.5% to the modules.

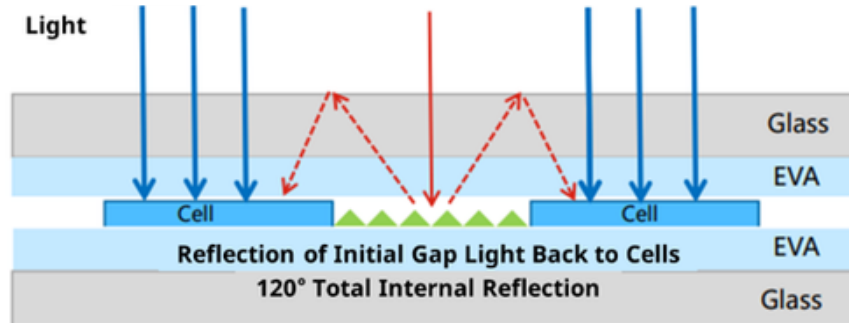


Figure 11. Schematic Diagram of the Light Reflection Film

Industry-Leading Enhanced Reliability Testing

Through years of technological accumulation, CSI Solar has developed PV module reliability test standards (Table 2) based on 2x or even 3x IEC requirements, ensuring product reliability throughout the service life. This applies equally to the Gen3 modules.

Testing	IEC 61730 / 61215 Standards	Canadian Solar Standards
Damp Heat (DH)	1,000 hours	2,000~3,000 hours
Thermal Cycling (TC)	200 cycles	400~600 cycles
Humidity Freeze (HF)	10 cycles	20~30 cycles
PID	96 hours	192 hours
UV	NA*	120 kWh/m ²

Table 2. Comparison between IEC Standards and Canadian Solar Standards

*IEC 61215 currently does not include a standardized UV testing requirement. The relevant standard is expected to be published by the end of 2026.

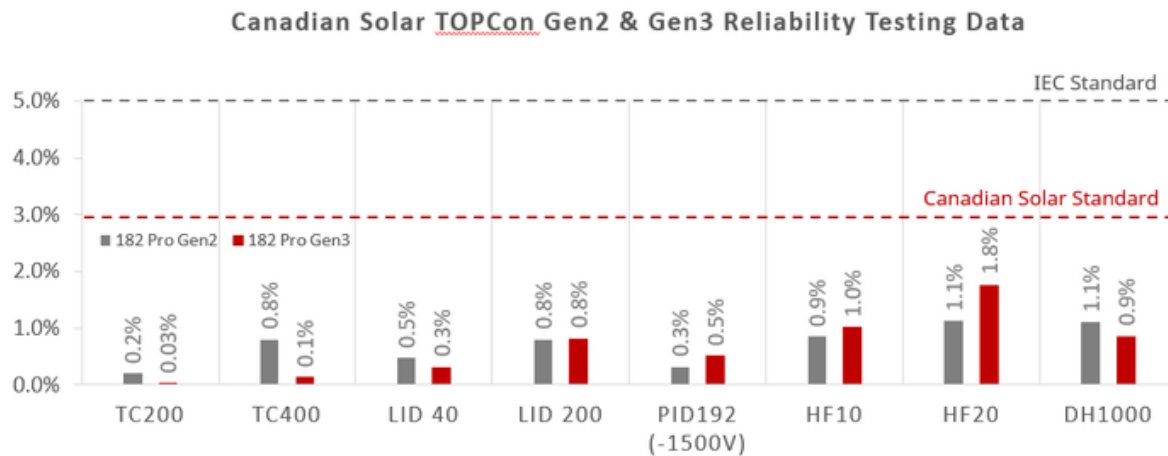


Figure 12. Test Results of Gen3 High-Power Modules

3.Canadian Solar TOPCon Gen3 High-Power-Density Modules: High-Performance Advantages

Superior Bifaciality

The Gen3 TOPCon modules significantly improve module bifaciality by enhancing the rear-side polysilicon passivation layer structure of the cells and optimizing the module rear-side design. Specifically, the optimized technology for the polysilicon lay on the cell rear side substantially reduces parasitic absorption of the polysilicon layer and increases rear-side current density. This improves both cell efficiency and product bifaciality. Furthermore, the Gen3 modules reduce the transverse reflective film shading on the rear side, reducing rear-side shading area by around 1.7% and further improving rear light capture capability and bifacial power generation performance. Overall, these enhancements increase the bifaciality of Gen3 products by 5% (Figure 13).

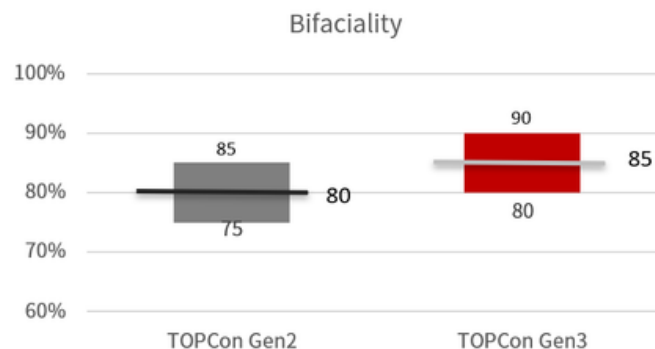


Figure 13. Module bifaciality of TOPCon Gen2 and Gen3

Superior Output Power under High-Temperature Conditions

The rise in operating temperature of modules will affect their output power. The cells of Canadian Solar's Gen3 products adopt advanced surface passivation and cut-edge passivation technologies, which effectively increase cell voltage. As a result, the power temperature coefficient of Gen3 products is reduced to $-0.26\%/^{\circ}\text{C}$, enabling higher power output under high-temperature environments.

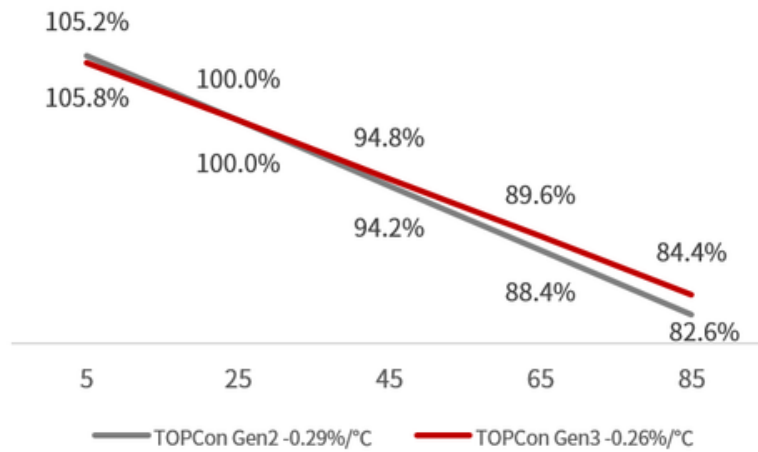


Figure 14. Impact of Power Temperature Coefficient on Module Power

Lower Hot-Spot Temperature

Benefiting from 1/4 cells and optimized circuit design, TOPCon Gen3 modules show significantly lower hot-spot temperatures under extreme shading conditions. Testing indicates that the maximum hot-spot temperature is approximately 30°C lower than that of conventional modules. Lower hot-spot temperature means lower power degradation caused by hot spots and reduced module safety risks in real-world applications, further improving system operational stability and safety.

Excellent Product Power Warranty

TOPCon Gen3 products adopt a new design concept for cell patterns and distributed soldering technology, enhancing current collection and improving the module's resistance to thermal cycling. The modules use a multi-cut circuit design to effectively reduce electrical losses while substantially lowering hot-spot temperature. Advanced lamination processes improve encapsulation quality and reduce module edge stress. In summary, Gen3 products provide superior power warranty performance, with first-year degradation $\leq 1\%$, subsequent annual linear degradation as low as 0.35%, and module power remaining above 88.85% of the original power at the end of the 30-year warranty period, providing stronger assurance for lifecycle energy yield.

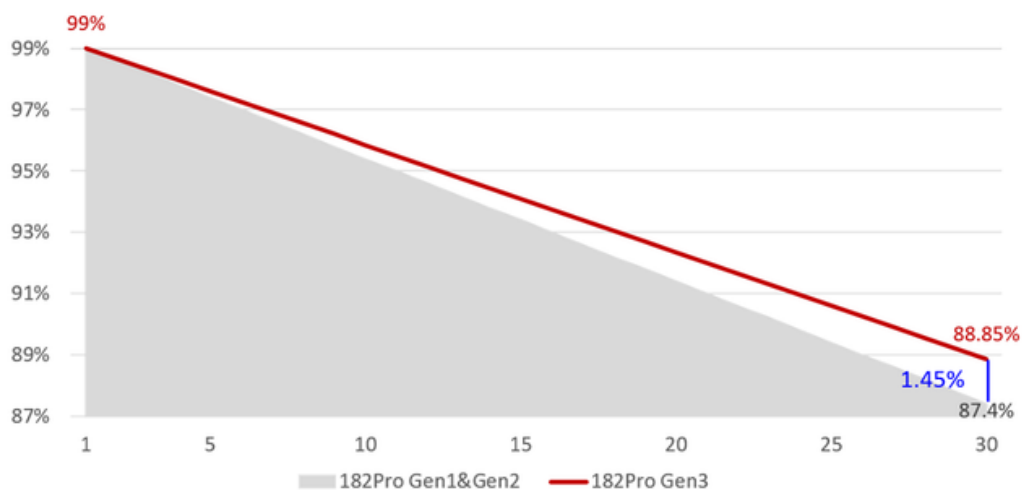


Figure 15. TOPCon Product Power Warranty

4.Canadian Solar TOPCon Gen3 High-Power-Density Modules: Increasing Energy Yield and Reducing LCOE

Taking a 28.7 MW project in Spain as an example, we compare the energy yield difference between Canadian Solar's Gen3 module CS6.3-66TB-655W and a same-format BC module rated at 660 W (Table 3).

	MODULE	Canadian Solar TOPCon Gen3 CS6.3-TB-655	BC-660
Module	Power (W)	655	660
	Size (mm)	2382*1134*30	2382*1134*30
	Weight (kg)	32.8	32.8
	Module Efficiency	24.2%	24.4%
	Imp (A)	15.36	16.03
	Vmp (V)	42.7	41.18
	Voc (V)	50.4	49.92
	ISC (A)	16.38	16.7
System	DC/AC Ratio	1.3	1.3
	String Length@Lowest Temperature -3°C	28	28
Mounting	String Number per Tracker	3	3
	Module Number per Tracker	84	84
	Module Power per Tracker (W)	55,020	55,440
DC BOS	Power / Combiner Box (W)	330,120	332,640
	Number of Combiner Box (1P)	18	18
	Cable Cross-Sectional Area (mm ²)	4	4
Remark	Bifaciality	85%	75%

Table 3. Simulated System Parameters of Canadian Solar TOPCon Gen3 Module and Same-Format BC Module

Further Improving Energy Yield

Canadian Solar TOPCon Gen3 module CS6.3-66TB features better bifaciality and superior low-irradiance performance, enabling higher power output. In the same project, simulation results show that the Gen3 module CS6.3-66TB delivers higher energy yield (Table 4).

Item	Canadian Solar TOPCon Gen3 CS6.3-TB-655	BC-660	Canadian Solar TOPCon Gen3 Module's Better Performance
Temperature Loss	-2.39%	-2.39%	0
Received Irradiance Ratio of Plane Array	38.48%	38.57%	-0.09%
First Year Degradation	-1.00%	-1.00%	0
Bifacial Gain	6.08%	5.42%	↗ 0.66%
Low Light Loss	-0.84%	-1.16%	↗ 0.32%
Energy Yield (kWh/kW)	2,162.0	2,142.8	↗ 0.89%
Lifetime Energy Yield (MWh/kW)	61.57	61.02	↗ 0.90%

Table 4. Energy Yield Comparison between Gen3 Module CS6.3-66TB-655W and Same-Format BC Module 660W

Further Reducing LCOE

Taking the 28.7 MW project in Spain as an example, simulation results show that, under the same DC capacity, the TOPCon Gen3 module CS6.3-66TB can increase first-year energy yield by 0.89% and 30-year lifecycle energy yield by 0.55% compared with the same-format BC module. Combining BOS cost reduction and energy yield improvement, the LCOE of the TOPCon Gen3 module CS6.3-66TB-655W is 0.72% lower than the same-format 660 W BC module (Figure 16).

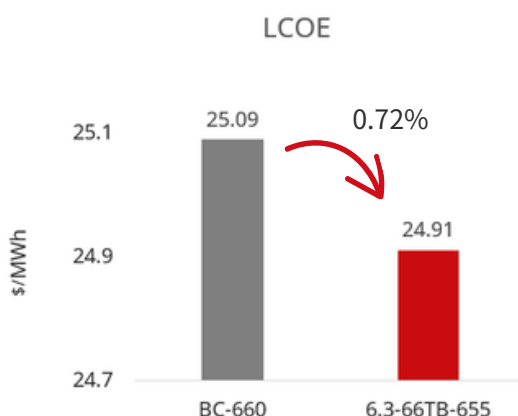


Figure 16. LCOE Comparison between Gen3 Module CS6.3-66TB-655W and Same-Format BC Module 660W

5.Canadian Solar TOPCon Gen3 High-Power-Density Modules: Create More Energy for PV Systems

Canadian Solar's TOPCon Gen3 modules deliver up to 670 W power and 24.8% efficiency through advanced cell and module innovations. Featuring higher bifaciality, improved temperature coefficient, lower degradation, and enhanced reliability, they help maximize energy yield and reduce LCOE.

Available from August 2026, the TOPCon Gen3 modules combine high power, strong energy generation, and long-term reliability to create greater value for customers and investors.

Canadian Solar TOPCon Gen3 High-Power-Density Module Technical White Paper

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Website: <https://www.csisolar.com/>



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