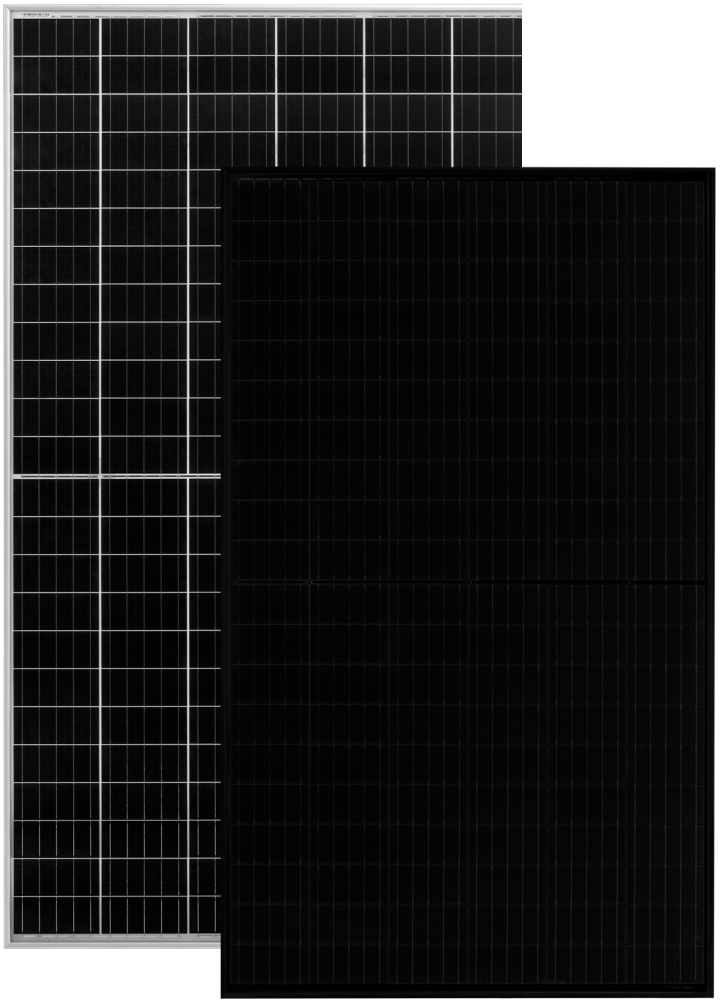
EAGLE HM

HALF CELL MODULE WHITE PAPER



Solar JinKO

What are EAGLE Half Cell modules (HM)?

The EAGLE HM module uses half-cut cell technology and half cell layout to improve power and performance. This technology delivers more power from the same number of cells and has enhanced reliability compared to full cell modules. The half-cut cell is a standard size solar cell (158.75mm x 158.75mm) that has been cut into two equal pieces (Fig. 1). Each half cell module is split into two sections of 60 half-cut cells that are connected in series. The two halves are connected in parallel in the center to give a complete module of 120 cells for 60 cell, and 144 for 72 cell (Fig. 2).

The half-cut cell improves module durability, since a smaller cell size reduces the likelihood of microcrack formation. The half cell layout reduces resistance in the cells, as wiring the two halves of the module in parallel cuts the current per cell in half. With the lower current comes a reduction in power loss internal to the cells. Power loss is proportional to the square of the current; therefore, power loss in the module is reduced by a factor of four ($P_{loss} = R * I^2$, where R is the resistance and I is the current). The lowered series resistance also improves fill factor and cell efficiencies, as shown in the comparison of electrical parameters for half cell and full cell modules in Table 1.

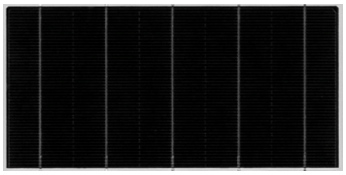
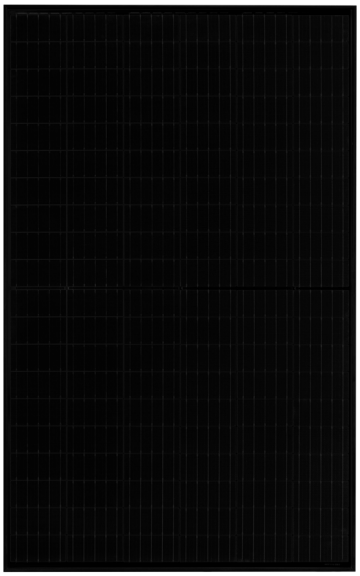
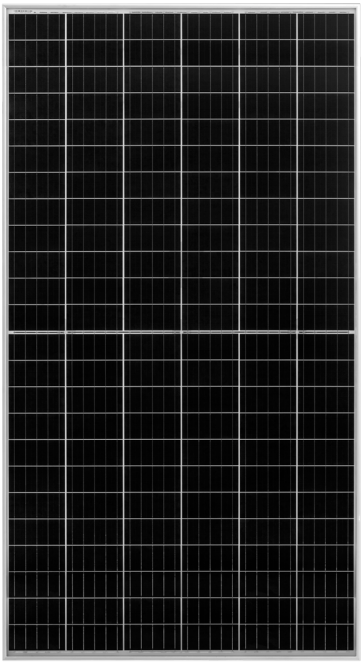


Fig. 1



EAGLE 60HM G2



EAGLE 72HM G2

Fig. 2

Module Type	Cell Power (W)	Module Power (W)	Power Difference (W)	Efficiency Factor	Voc (V)	Isc (A)	Vmp (A)	Rs (Ω)	Rsh (Ω)
Half Cell Module #1	4.19	259.335	7.088	0.780	37.219	8.935	30.957	0.341	112.594
Full Cell Module #1	4.19	252.247		0.760	37.423	8.872	30.424	0.473	158.417
Half Cell Module #2	4.48	275.027	7.756	0.806	37.600	9.075	32.156	0.267	120.838
Full Cell Module #2	4.19	267.271		0.786	37.851	8.982	31.255	0.435	161.224

Table 1. 60 cell module results for electrical key parameters.

The performance of a 72 cell reference module and a 144 EAGLE HM module are shown in Table 2. Module power increases from 315 W to 330 W, a 4.7% increase. The power increase mainly results from a short circuit current gain of 3.1%. The fill factor of the module is also increased by 1.4 % which is attributed to a reduction in series resistance.

Parameter	Full Cell	Half Cell	Delta (%)
Pmpp (W)	315.2	330.0	+ 4.7
Voc (V)	46.0	46.1	+0.2
Isc (A)	9.08	46.1	+3.1
FF (%)	75.5	76.6	+1.4

Table 2. 72 cell module results for electrical key parameters.

The layout of the half cell module also improves performance in shading conditions compared to a full cell module. For example, if the bottom half of a full cell module is shaded, the power output of the complete module is zero since all the cells are connected in series. The layout of the EAGLE HM module ensures that in the same conditions with half of the module shaded, the other half connected in parallel is still producing full power.

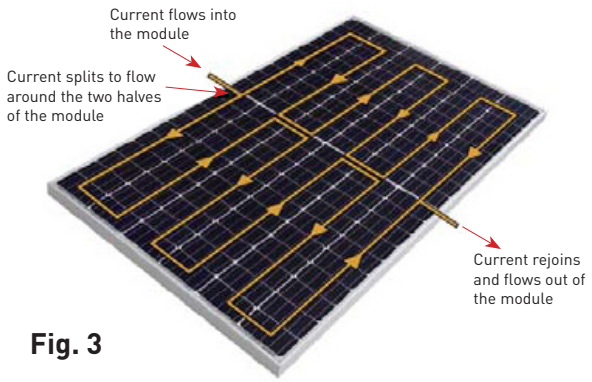


Fig. 3

Module Type	Parameter	Mode 1	Mode 2	Mode 3	Mode 4
Full Cell Modules	Voc (V)	37.73	37.68	37.47	37.13
	Isc (A)	9.06	5.76	1.40	1.25
	P (W)	254	164	32	26
	Power loss (%)		35.43	87.40	89.76
Half Cell Modules	Voc (V)	37.60	37.55	37.42	37.37
	Isc (A)	9.075	8.996	8.992	8.891
	P (W)	275	244	178	156
	Power loss (%)		11.27	35.27	43.27

Table 3. Power loss comparison between half cell module and full cell module under 4 different shady conditions (Mode 1 through 4)

How will customers benefit from half cell technology?

EAGLE HM modules increase efficiency and performance within the same footprint, which means customers can save on cost. These more powerful modules help customers reduce overall balance of system costs and thus overall LCOE. In rooftop applications, the EAGLE HM modules may enable certain systems that may have otherwise been infeasible due to shading or space constraints.