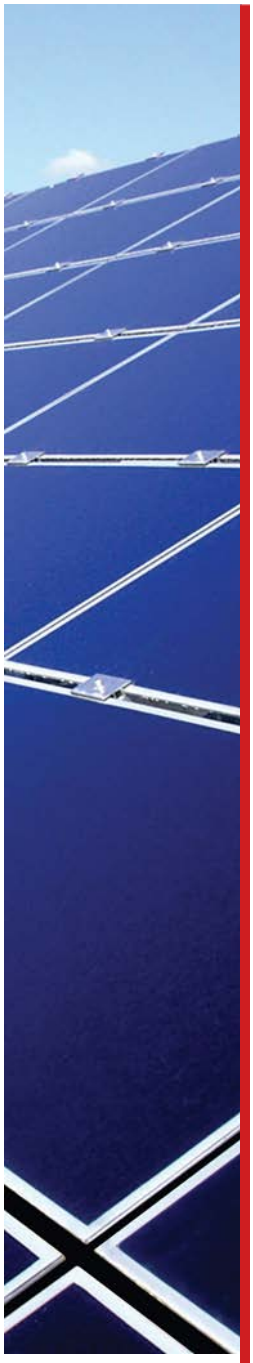

FS Series PV Module Power Ratings at PVUSA Test Conditions (PTC)

The information presented in this document provides supplemental information about the maximum power output (P_{Mpp}) of the First Solar FS Series PV Modules when operating under PVUSA Test Conditions (PTC).

The maximum power output performance ($P_{Mpp,STC}$) of all First Solar modules is measured relative to internationally recognized Standard Test Conditions (STC[1]) as shown in Row 1 of Tables 1, 2, 3, 4, 5, 6, 7a, and 7b. Additionally, the temperature response of each rated module is determined, and the results are used to obtain a P_{Mpp} temperature coefficient $T_K(P_{Mpp,STC})$. The value of this temperature coefficient is determined by an independent laboratory by evaluating the I(V) characteristic of sample modules operating over a range of temperatures. In addition, the independent laboratory determines the Normal Operating Cell Temperature (NOCT[3]) of each product type.

Module conversion efficiency (η) is calculated for each product type based on its power rating and surface area.

The module operating temperature at PTC is then given by:

$$T_{\mathrm{mod},PTC} = 20°C + 1.389 \cdot (NOCT - 20°C) \cdot (0.9 - \eta)$$

Once calculated, this module operating temperature is used to determine maximum power output performance at PTC:

$$P_{Mpp,PTC} = P_{Mpp,STC} \cdot (1 + (\frac{T_K(P_{Mpp,STC})}{100}) \cdot (T_{\mathrm{mod},PTC} - 25))$$

The results for $P_{Mpp,PTC}$ are shown in Row 2 of Tables 1, 2, 3, 4, 5, and 6.

This data will be updated periodically and without notice to best represent the current module production as First Solar continues on a roadmap to higher efficiencies. Some variation of temperature response among other modules in this same bin is normal, and to be expected. Typical variance of temperature coefficients is in the range of +/- 0.04%/°C.

Please note that First Solar specification values used in PTC calculations within this application note are intended to represent array level characteristics. Any module ratings or PTC calculations using test results from individual modules or small sample quantities of modules may be subject to individual metastability effects and individual variation and should not be used solely as the basis of system performance estimates or projected array level behavior.

Test Conditions	Nominal Value (tolerance)	Symbol (unit)	FS-267	FS-270	FS-272	FS-275	FS-277	FS-280
STC[1]	Maximum Power (+/-5%)	P_{mpp}^{STC} (W)	67.5	70	72.5	75	77.5	80
PTC[2]	Maximum Power (+/-5%)	P_{mpp}^{PTC} (W)	64.8	67.2	69.8	72.2	74.6	76.9

Table 1 – FS Series 2 PV Modules

Test Conditions	Nominal Value (tolerance)	Symbol (unit)	FS-380	FS-382	FS-385	FS-387	FS-390	FS-392	FS-395
STC[1]	Maximum Power (+/-5%)	P_{mpp}^{STC} (W)	80	82.5	85	87.5	90	92.5	95
PTC[2]	Maximum Power (+/-5%)	P_{mpp}^{PTC} (W)	76.0	78.4	80.8	83.4	85.8	88.5	90.9

Table 2 – FS Series 3 and Series 3 Black PV Modules

Test Conditions	Nominal Value (tolerance)	Symbol (unit)	FS-390-PLUS	FS-392-PLUS	FS-395-PLUS	FS-397-PLUS	FS-3100-PLUS
STC[1]*	Maximum Power (+/-5%)	P_{mpp}^{STC} (W)	90.0	92.5	95.0	97.5	100.0
PTC[2]*	Maximum Power (+/-5%)	P_{mpp}^{PTC} (W)	85.2	87.6	90.0	92.4	94.8

Table 3 – First Solar Series 3 Black Plus Modules

Test Conditions	Nominal Value (tolerance)	Symbol (unit)	FS-492	FS-495	FS-497	FS-4100	FS-4102	FS-4105
STC[1]	Maximum Power (+/-5%)	P_{mpp}^{STC} (W)	92.5	95.0	97.5	100.0	102.5	105.0
PTC[2]	Maximum Power (+/-5%)	P_{mpp}^{PTC} (W)	87.3	89.7	92.1	94.5	96.9	99.3

Table 4 – First Solar Series 4 Modules

Test Conditions	Nominal Value (tolerance)	Symbol (unit)	FS-4102-2 FS-4102A-2	FS-4105-2 FS-4105A-2	FS-4107-2 FS-4107A-2	FS-4110-2 FS-4110A-2	FS-4112-2 FS-4112A-2	FS-4115-2 FS-4115A-2	FS-4117-2 FS-4117A-2
STC[1]	Maximum Power (+/-5%)	P_{mpp}^{STC} (W)	102.5	105.0	107.5	110.0	112.5	115.0	117.5
PTC[2]	Maximum Power (+/-5%)	P_{mpp}^{PTC} (W)	95.0	97.4	99.7	102.1	104.5	105.2	107.5

Table 5 – First Solar Series 4V2 Modules

Test Conditions	Nominal Value (tolerance)	Symbol (unit)	FS-4107-3 FS-4107A-3	FS-4110-3 FS-4110A-3	FS-4112-3 FS-4112A-3	FS-4115-3 FS-4115A-3	FS-4117-3 FS-4117A-3	FS-4120-3 FS-4120A-3	FS-4122-3 FS-4122A-3
STC[1]	Maximum Power (-0W, +5W)	P_{mpp}^{STC} (W)	107.5	110.0	112.5	115.0	117.5	120.0	122.5
PTC[2]	Maximum Power (-0W, +5W)	P_{mpp}^{PTC} (W)	100.2	102.6	104.9	107.3	109.7	112.1	114.5

Table 6 – First Solar Series 4V3 Modules

[1] Standard Test Conditions (STC): 25°C cell temperature, 1000 W/m^2 total irradiance, AM 1.5 spectrum

[2] PVUSA Test Conditions (PTC): 20°C ambient temperature, 1000 W/m^2 total irradiance , and 1 m/s wind speed

[3] Normal Operating Cell Temperature (NOCT): cell temperature attained in a module mounted in an open rack at fixed tilt orientation, receiving 800 W/m^2 total irradiance, with an ambient temperature of 20°C and wind speed of 1m/s.