

# AM1.5G Spectrum Adjustable Solar Simulator: SS-PST100R

## Introduction

The SS-PST solar simulator is the best partner for accurate efficiency measurements of high-efficiency tandem solar cells.

With the rapid development of high-efficiency tandem solar cells, especially perovskite/crystalline silicon tandem solar cells, the requirements for accurate measurement of the conversion efficiency of tandem cells have received a lot of attention. According to the latest IEC 60904-1-1 testing standard for tandem cells, to achieve accurate testing of tandem solar cells, the requirements for the simulator are as follows:

1. The output spectral mismatch can be less than 6% (class A++ grade).
2. The output spectrum is adjustable.
3. The output irradiance intensity is adjustable.

In the past, the dual-lamp (xenon and halogen lamps) solar simulator has been considered as the best solution for testing tandem solar cells. However, the maintenance cost is too high! For example, the lifetimes of the xenon lamp and the halogen bulbs are 10 times different (halogen lamps are about 50 hours). This makes it necessary for the users to adjust the irradiance spatial uniformity and output spectral match of the dual light source system every 50 hours.

Recently, LED solar simulators attract high attentions. For the LED simulator, although the spectrum can be adjusted appropriately, the spectral coverage and spectral difference (SPC and SPD parameters) are still very different from the AM1.5G spectrum. In particular, different color LEDs have different lifetime and aging speed. Therefore, the calibration of the spectral output for LED solar simulators needs to be done more frequently, which directly increases the time cost of maintenance and use.

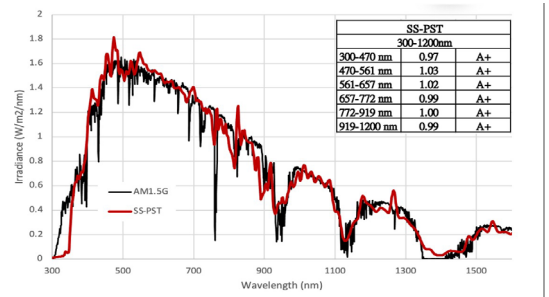
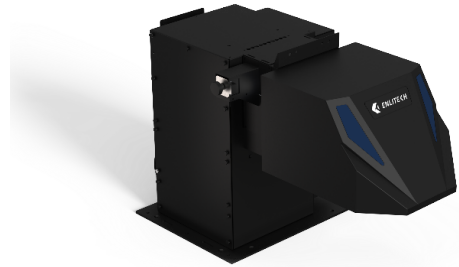
In order to meet the test requirements of the IEC specification for tandem solar cells, while taking into account the reliability and time cost of daily use, Enlitech has launched the SS-PST100R solar simulator. The SS-PST100R solar simulator adopts the Enlitech's latest spectrum-control technology on single xenon lamp, which can manipulate the spectrum of a single xenon lamp to achieve the very high spectral match level which is comparable to the level of dual-lamp solar simulator. The output spectrum of the SS-PST solar simulator can meet the AM1.5G spectrum requirements from 300–1700nm with an average spectral mismatch  $\leq 6\%$  (IEC 60904-9:2020).

The difficulty in using and maintenance of dual-lamp solar simulator is the huge lifetime mismatch (1000hr:50hr for Xe:Halogen lamp). The single xenon lamp design of SS-PST solar simulator overcomes the lamp lifetime mismatch problem. The whole system working time can be over 1000 hr for one-time lamp replacement. It not only greatly reduces the light source adjustment time, but also increases the data reproducibility of sample testing.

Another feature of the SS-PST solar simulator is the tunable spectrum.

Compared with the multi-lamp LED simulator, SS-PST has better SPC spectral coverage and lower SPD spectral deviation rate.

Therefore, SS-PST is very suitable for accurate testing of perovskite/crystalline silicon tandem solar cells.



	Spectral Match (300~1200nm)	SPC (100% is ideal)	SPD (0% is ideal)
SS-PST solar simulator	A++	100%	1.2%
Dual-lamp simulator (Ideal Case)	A++	100%	3.2%
Dual-lamp simulator (real case)	A+	100%	4~8%
SS-X	A+	100%	3.3%
US simulator	A	100%	6.7%

The performance comparison table of Super Solar Simulator SS-PST and other simulators. Evaluated by the IEC 60904-9:2020 standard, SS-PST not only has a spectral rating of A++, 100% SPC spectral coverage, but also a better SPD spectral error performance (1.2%), especially, compared to dual-lamp solar simulators (3.2%~8%).

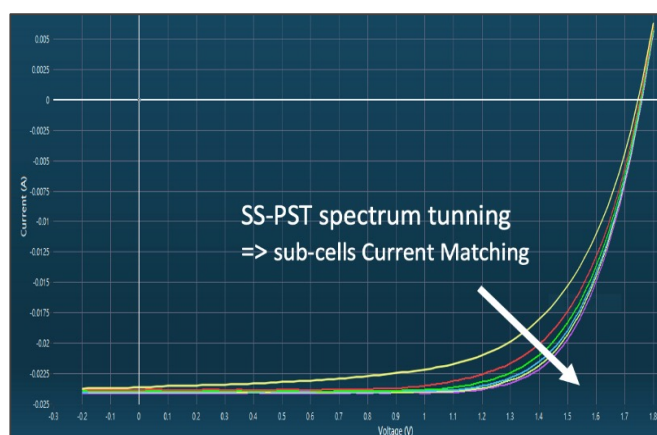
## Application

- Perovskite/crystalline silicon tandem solar cells.

## Specification

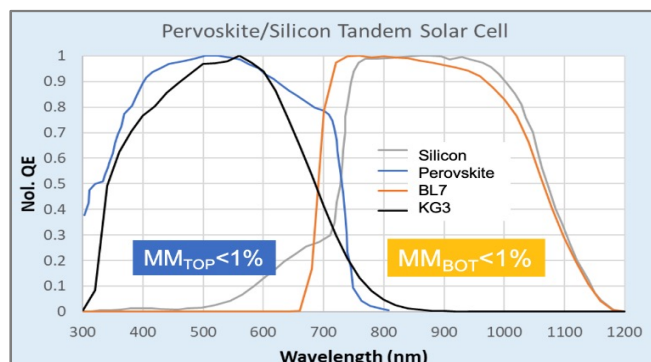
SS-PST100R	
Illumination Area	100 x 100 mm <sup>2</sup>
Spectrum Range	300~1650 nm
Spectrum	A++
In-stability	A+
Uniformity	A
Reference Cell (option)	KG3 for Perovskite Top BL7 for Si Bottom
Spectrometer (option)	HS-IL

## Testing Results / Publications



### Perovskite/Si Tandem solar cell IV test

SS-PST simulator testing IV curves of perovskite/crystalline silicon tandem solar cells tested by SS-PST solar simulator. With the tuning of the output spectra of SS-PST solar simulator, the sub-cells reach the spectral matching and current matching conditions, which will make an increase of fillfactor and conversion efficiency.



### The suitable reference cells of Perovskite/Si Tandem solar cell IV testing

The BL7 and KG3 reference cells are paired with the SS-PST solar simulator. They have the lowest spectral mismatch (<1%) with crystalline silicon bottom cells and perovskite top cells. It is the best match for accurate testing of Perovskite/Si tandem solar cells.

