IMT SOLAR

Standard Test Conditions (STC) in the Photovoltaic(PV) Industry

APPLICATION NOTE

Photovoltaic cells and modules produce output power (watts) that is relative to the irradiance level at the device and also to the temperature of the device. The series of I-V curves below show this relationship.

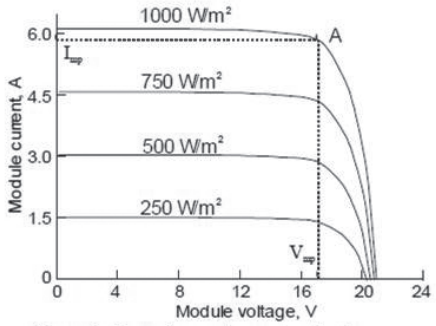


Figure 1. Dependence of current and voltage on incident sunlight levels.

As seen in these I-V curves, as the irradiance level incident on the PV device changes, the short circuit current (Isc) changes proportional to the irradiance. However, the open circuit voltage (Voc) remains almost the same.

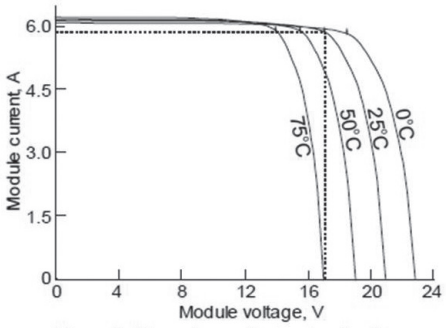


Figure 2. Dependence of current and voltage on temperature for sunlight level of 1000 W/m².

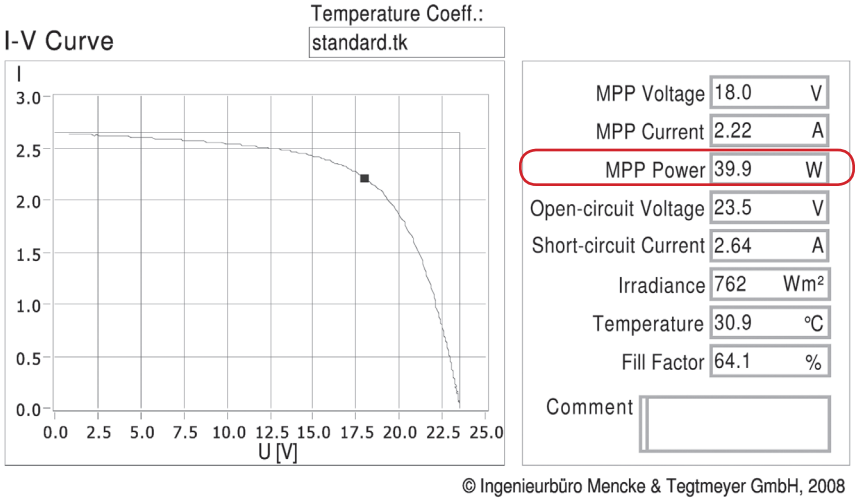
As seen in these I-V curves, as the temperature of the PV device changes, the open circuit voltage (Voc) changes inversely proportional to the temperature. However, the short circuit current (Isc) remains almost the same.

Because of the effects of both irradiance and temperature on the I-V curve characteristics and the resulting Maximum Power Point (MPP), a set of test conditions had to be established that establishes the values of both irradiance and temperature at which PV manufacturers rate the output of their devices. This set of test conditions is known as the "STC" or Standard Test Conditions for the PV industry. By having the nameplate data of solar panels based upon these conditions, the PV designer who is evaluating various PV panel products knows the irradiance and temperature conditions under which the nameplate data was measured.

In the PV industry . . . STC specifies a temperature of 25°C and an irradiance of 1000 W/m2 with an air mass 1.5 (AM1.5) spectrum. These correspond to the irradiance and spectrum of sunlight incident on a clear day upon a sun-facing 37°-tilted surface with the sun at an angle of 41.81° above the horizon. This condition approximately represents solar noon near the spring and autumn equinoxes in the continental United States with surface of the cell aimed directly at the sun.

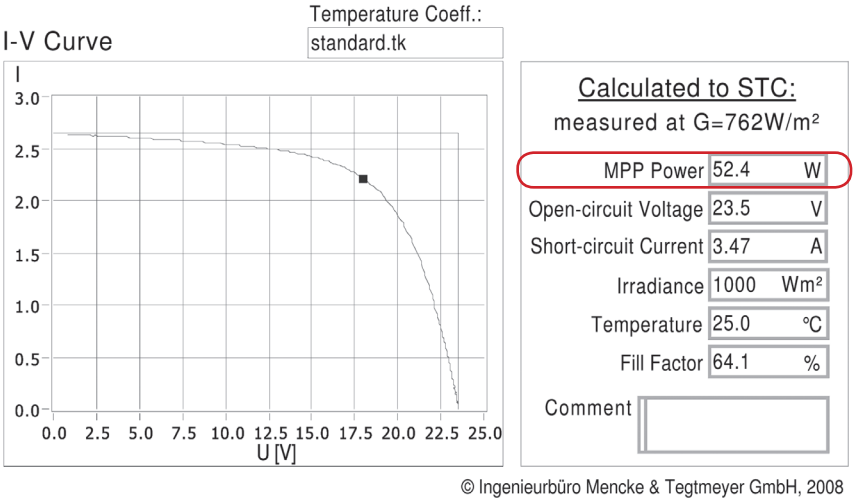
Similarly, when testing PV modules in the field prior to installation, the measurements for Isc, Voc, or better yet . . . the I-V curve itself . . . must be recalculated to the Standard Test Conditions of 1000 Watts per Square Meter of irradiance and 25 degrees Celsius in order to compare the measurements against the nameplate data.

The following I-V curve taken on a PV panel at a job site shows the values of all parameters taken at the irradiance and temperature levels at the jobsite, and then shows them after the software has recalculated them to STC conditions.



This first I-V curve is the actual curve under field conditions . . . irradiance was 762 W/m2 and temperature was 30.9 degrees Celsius. At these field conditions, the rated power (maximum power point or MPP Power) is shown to be 39.9 watts.

In order to compare this to the nameplate data, we first must extrapolate this data to Standard Test Conditions (STC) of 1000 W/m2 and 25 degrees C. Without doing so, if this panel's nameplate rating is 50W and we are only showing an MPP reading of 39.9W, we might suspect a problem.



The PC software that comes with this curve analyzer quickly recalculates this data to Standard Test Conditions. It shows the irradiance level at which the test was taken but then recalculates all values to STC conditions of 1000 W/m2 and 25 degrees C. The values for MPP Power, Voc, and Isc can now be compared accurately to the nameplate data on the back of the panel.

You can see the MPP Power is now showing as 52.4 W. If this panel has a nameplate rating of 50W, you would see the panel is testing as good.

I-V curves shown above were taken with the MINI-KLA handheld I-V curve analyzer from IMT SOLAR

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