Solmetric PV Analyzer Application Note

Mounting SolSensor on a Tripod

Introduction

The Solmetric PV Analyzer comprises the I-V Measurement Unit and the SolSensor Integrated Wireless Reference Sensor. In most applications, the SolSensor is mounted to the frame of a module. This guarantees that the irradiance sensor faces the same direction as the module itself ("plane of array" orientation), and allows easy placement of a thermocouple on the backside of a PV module. Another requirement is that the I-V Measurement Unit and SolSensor be located within wireless communication range of one another.

There are two measurement applications in which array-mounting of the SolSensor is problematic.

1. In some commercial rooftop installations the point of I-V Measurement Unit is at ground level and the array is not only far away but also not in line of sight (metal roofs are the worst case).
2. In building-integrated (BIPV) arrays, it may not even be possible to access the array for mounting of SolSensor

The solution to these problematic applications is to locate SolSensor on a tripod that is located within wireless range of the I-V Measurement Unit. The following considerations are discussed in this Applicaiton Note:

1. Selection of sensor types in the PVA software
2. Limitation to high-irradiance conditions
3. Selection of SolSensor tripod-mounting location
4. Setting up SolSensor on a tripod

Selection of Sensor Type in the PVA Software

The PVA software compares the I-V curve measurement with a predicted curve shape that's determined by the advance PV performance model. The performance metric called **Performance Factor** is calculated from this comparison and displayed on the PVA measurement screen. The performance model requires inputs data on irradiance, temperature, and tilt.
The PVA software provides alternate methods for obtaining each of these sensor values. Tripod-mounting of the PVA at a distance from the array requires that these sensor types be selected:

- Irradiance: SolSensor
- Temperature: From I-V
- Tilt: SolSensor

To select these options, go to the **Utility** menu and select **Global Sensor Configuration**. Select your options from the drop lists.

Warning: Changing the global sensor configuration cannot be reversed. Always back up your project file before changing the global sensor configuration.

Limitation to High-Irradiance Conditions

In the **From I-V** temperature method, the average PV module cell temperature is calculated from the measured open circuit voltage (Voc). The value of Voc is a good indicator of temperature for crystalline silicon modules. (We do not have extensive experience with thin film modules, but it is likely that the method is somewhat less accurate for thin film due to seasonal variation in module performance parameters.)
There are two key limitations to the From I-V temperature method:

1. If the number of modules in the string does not match the number of modules you specified in the Array Navigator tree, the calculated temperature will be incorrect and the Performance Factor will be less accurate. Shorted bypass diodes have the same effect, but to a smaller degree.
2. The From I-V temperature method is accurate only at high irradiance values. The temperature accuracy gets progressively worse as irradiance drops below the STC conditions of 1000 W/m2. The acceptable irradiance range varies with PV module design. For most crystalline silicon modules, the irradiance should be at least 800 W/m2 in the plane of the array. This is not achievable in all installations, not at all latitudes and times of year. We do not have a means to correct the temperature values that were collected under low irradiance conditions.

Selection of a SolSensor tripod-mounting location

There are two requirements on location of the SolSensor tripod:

1. Locate the tripod within wireless range of the PC and I-V Measurement. The three are linked by a wireless mesh network, so any of the three can relay signals between the other two, extending your range flexibility.
2. Locate the tripod so that SolSensor has the same view of the sky as the array itself.

Solar irradiance has multiple components. Direct sunlight are the rays we picture coming directly from the sun. But another important component is scattered (diffuse) light (from moisture and particles in the air, and clouds). The cloudier or more overcast the conditions, the greater percentage of total irradiance comes from scattered light. If SolSensor is located at ground level near the side of a building or next to a tree, a big section of the sky will be blocked, causing SolSensor to ‘see’ a much lower irradiance than the array itself. This results in an unrealistically high Performance Factor.

If you are working on a large roof mounted system and you can’t find a ground level location with a good view of the sky, consider placing the tripod on the roof directly above the wall equipment. This usually provides an excellent view of the sky and satisfactory wireless communication down to the I-V Measurement Unit and PC.

Setting up SolSensor on a tripod

After you have selected a location that allows wireless communication to the rest of the equipment and provides SolSensor with the same view of the sky as the array itself, you will set up SolSensor on its tripod. Solmetric recommends the tripod hardware shown in **Figure 1**. This is the setup process.

1. Fully spread the tripod legs and securely ‘foot’ the tripod.
2. Install the leveling base on the tripod and securely fasten it in place. The leveling base greatly simplifies the setting of azimuth and tilt
3. Install the pan and tilt unit on the leveling base and securely fasten it in place. Use a true pan and tilt unit, not a ball and socket type of tripod head.

4. Mount SolSensor to the pan and tilt unit using the ¼-20 female threaded camera mount provided on the back of SolSensor. Tighten sufficiently that SolSensor's position is secure.
5. Level the leveling base using the built-in bubble level, and lock it in place.
6. Using your compass, adjust the **pan** so that the mount is oriented in the same direction as the PV modules are tilted, and lock down the pan setting. Be sure to keep your compass far enough away from any ferrous metals (for example in the tripod) so that the compass needle direction is not distorted.
7. While watching the tilt reading in the PVA software, adjust the pan and tilt unit's **tilt** until the SolSensor reports a tilt that matches the tilt of the PV modules.

Figure 1 Tripod mounting hardware recommended by Solmetric.

Once your tripod is set up in this manner, it's easy to move from location to location across the site:

1. Spread and foot the tripod
2. Level the **leveling base** using the built-in bubble level.
3. Adjust the **pan** control to the compass heading of the array.
4. While watching the tilt reading in the PVA software, adjust the **tilt** control to match the tilt of the PV modules.

These are the hardware components Solmetric recommends. If they are no longer available, select comparable components. Solmetric does not keep a current list of replacement components.

- **Tripod:** Vanguard ALTA PRO 263AT
- **Leveling base:** Sunwayfoto Tripod leveling base (DYH-90 or DYH-66x)
- **Pan and tilt unit:** SUNWAYFOTO DT-02 Tripod Fluid Panning Tilt Head

The Vanguard tripod comes with a height extension rod that is not actually required for this application but the excellent stability of this tripod is worth more than the additional cost of the extension.