

String Monitoring for Solar Panels Using DC Current Transducers



HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH

- Follow safe electrical work practices. See NFPA 70E in the USA, or applicable local codes.
- This equipment must only be installed and serviced by qualified electrical personnel.
- Read, understand and follow the instructions before installing this product.
- Turn off all power supplying equipment before working on or inside the equipment.
- Use a properly rated voltage sensing device to confirm power is off.
DO NOT DEPEND ON THIS PRODUCT FOR VOLTAGE INDICATION
- Only install this product on insulated conductors.

Failure to follow these instructions will result in death or serious injury.

The information provided herein is intended to supplement the knowledge required of an electrician trained in high voltage installations. There is no intent to foresee all possible variables in individual situations, nor to provide all training needed to perform these tasks. The installer is ultimately responsible to assure that a particular installation will be and remain safe and operable under the specific conditions encountered.

Introduction

A typical solar electrical system consists of many solar modules (or panels) connected into groups called “strings.” The energy generated by each string is channelled into a combiner box in the form of a DC load. The DC power from each combiner box in a large array is sent to an inverter, which converts the DC load to an AC load, suitable for standard building use. Figure 1 shows the layout of a basic solar array.

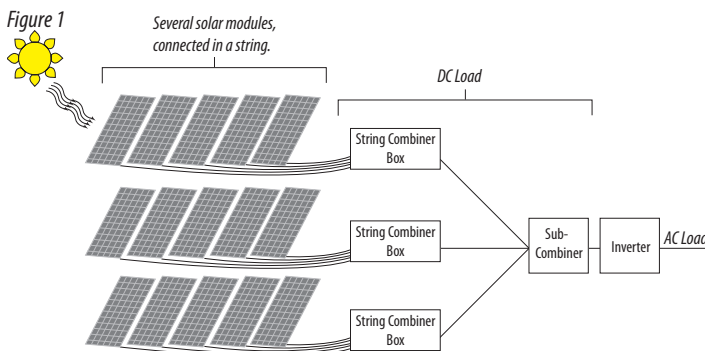


Figure 1



Several solar modules, connected in a string.

DC Load

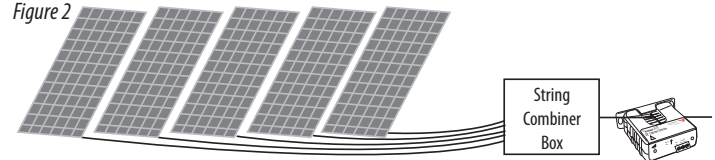
AC Load

String Monitoring

When an individual module is damaged, the load generated by that string drops, and the total AC output for the array drops correspondingly. Routine testing of strings to look for faulty modules is a costly and labor-intensive process. A far more efficient means of looking for system faults is to incorporate DC current monitoring in the array to continuously check each string for drops in amperage. DC current transducers (CTs) are wired to the control system and are capable of triggering an instantaneous alarm when a local load drop is detected.

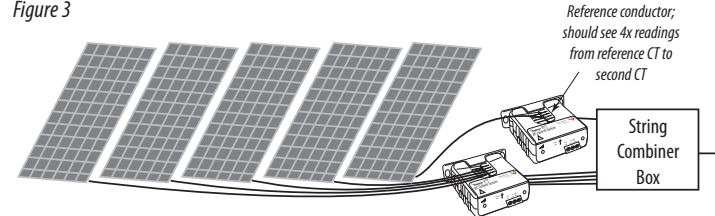
Figure 2 shows an appropriate monitoring technique for a basic solar array, in which all modules are of uniform size, and all strings consist of the same number of modules. The CTs are placed just after each combiner box in the circuit. The outputs from each transducer in the array should be similar. The average output value from one CT with the string functioning normally is used as a reference for all CTs. While all DC loads remain constant, no repairs are needed. However, a drop in the DC load in one CT triggers an alert to the building control system that the corresponding string needs maintenance.

Figure 2



In more complex arrays, modules of differing sizes may be used, or strings within the array may consist of different numbers of modules. The DC loads exiting the combiner boxes will not be uniform, so a new reference is needed. For these applications, CTs are placed before the combiner boxes, in pairs, with one CT in each pair used as the reference value for the second.

Figure 3



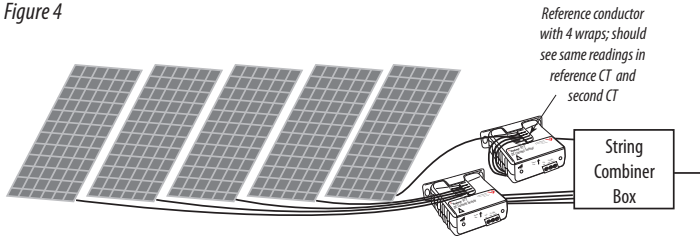
Reference conductor; should see 4x readings from reference CT to second CT

One CT monitors a single reference conductor, and the second CT monitors all other conductors collectively. The control system is programmed to compare the DC loads in this pair. The output from the reference CT is multiplied by the number of other conductors in the string; if the amperage outputs do not match, a repair alert is triggered.

* Note: Only five modules per string are shown in these illustrations. Typical strings contain 6-10 modules.

In a variation on this technique, shown in Figure 4, the reference conductor is wrapped around the reference CT. The number of wraps must equal the number of other conductors in the string. In this manner, no calculation is required. The amperage output from the reference CT is directly compared to the second CT.

Figure 4



String monitoring lowers costs for a solar array, both in time and labor. The DC current transducers allow the building controller to determine when action is required, and where the malfunction is located, with no need for expensive troubleshooting.