

Solar America Board for Codes and Standards



PHOTOVOLTAIC SYSTEM GROUNDING

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Report Overview

This Solar America Board for Codes and Standards (Solar ABCs) report addresses the requirements for electrical grounding of photovoltaic (PV) systems in the United States. Solar ABCs, with support from the U.S. Department of Energy, commissioned this report to provide the PV industry with practical guidelines and procedures to ensure reliable PV system grounding as well as the ongoing safety of these systems.

The report explains what grounding is and defines different types of grounding. It also describes existing *National Electrical Code*[®] (*NEC*[®]) grounding requirements in some detail, explains the basics of grounding PV equipment and systems, and notes the U.S. organizations responsible for developing and publishing grounding and safety standards.

In addition, the report discusses grounding requirements for equipment such as microinverters and AC PV modules, and clarifies the differences between PV system and conventional electrical power systems (utility, generator, or battery sourced) grounding requirements. Finally, it includes an explanation of utility and *NEC* grounding requirements.

Why the Report Is Important

Grounding is a safety issue during the entire lifetime of a PV system, because modules can produce potentially dangerous currents and voltages even if the system is no longer fully functional.

The *NEC* establishes the legal installation requirements for PV (and other electrical) systems, and the requirements are somewhat complex. This report clarifies some of these complexities and suggests grounding configurations appropriate for PV systems.

Issues

PV systems have different grounding requirements than conventional electrical systems, and these differences are not fully addressed in existing hardware standards. As the power output of PV systems continues to increase with each new generation product, grounding is likely to become even more of an issue.

As PV system configurations evolve and new equipment comes on the market, equipment and system grounding protocols may also need to be updated. For example, microinverters and AC PV modules have different grounding requirements than other PV systems.

Key Findings

As PV systems age, grounding issues emerge that impact system safety. These issues include deteriorating electrical connections, inadequate grounding device design and installation, and non-code compliant system installations. In addition, many of the required ground-fault protection devices in use today do not detect all possible ground faults in PV systems, and fires and equipment damage have resulted from undetected ground faults.



A number of organizations are involved in the process of determining reliable grounding protocols for PV systems. Although the *NEC* does not specifically mandate that all equipment be certified/listed, it does require electrical inspectors to examine all electrical equipment for safety. Many local jurisdictions only allow the use of equipment certified/ listed through the U.S. Occupational Safety and Health Administration's Nationally Recognized Testing Laboratory Program, because they feel unqualified to examine uncertified/unlisted equipment for safety as the *NEC* requires. In addition, Underwriters Laboratories (UL) coordinates the development of many of the hardware safety standards that apply to PV systems. The *NEC* covers premises wiring up to the "service point," at which point the utility installation requirements, established by the *National Electrical Safety Code* and other Institute of Electrical and Electronic Engineers standards, begin.

The PV industry must work closely with these organizations as they shape the standards affecting grounding in PV systems. This diligence will reduce uncertainties for electrical inspectors as well as PV system installers and owners, and ensure that PV systems are safe throughout their long lifetimes. Revisions of the *NEC* and UL safety standards for the certification/listing of equipment are underway, and will help to address many of these issues.

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Download the full report:

www.solarabcs.org/systemgrounding

For more information, visit the Solar ABCs website:

www.solarabcs.org

About Solar America Board for Codes and Standards

The Solar America Board for Codes and Standards (Solar ABCs) is a collaborative effort among experts to formally gather and prioritize input from the broad spectrum of solar photovoltaic stakeholders including policy makers, manufacturers, installers, and consumers resulting in coordinated recommendations to codes and standards making bodies for existing and new solar technologies. The U.S. Department of Energy funds Solar ABCs as part of its commitment to facilitate widespread adoption of safe, reliable, and cost-effective solar technologies.

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