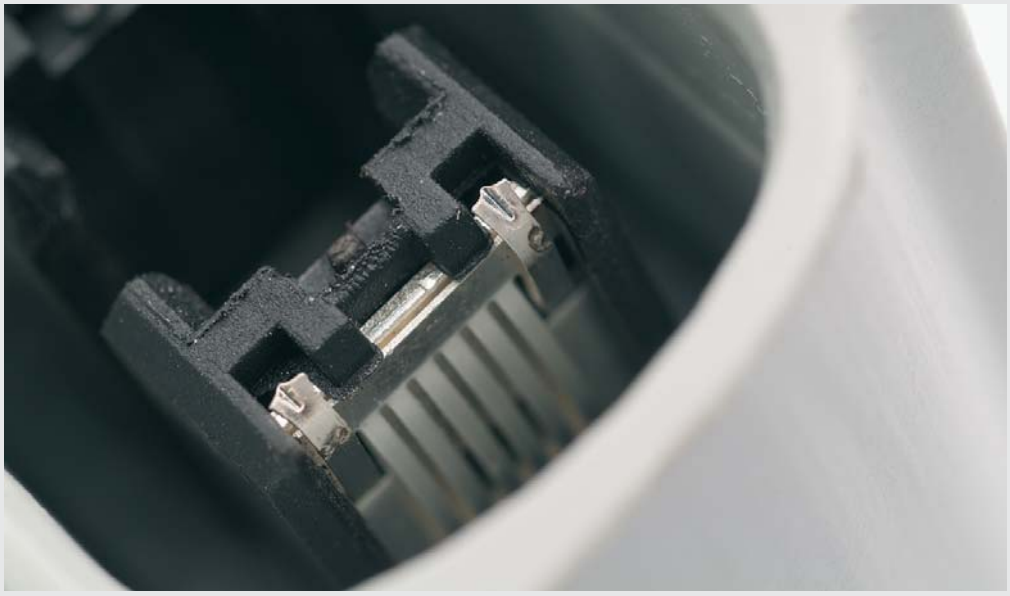
ESS – Electronic Solar Switch

SMA Presents the First Integrated DC Circuit Breaker

Summary

The new installation standard for solar power systems VDE 0100-712 was established in Germany on the 1st of June, 2006. It requires an additional circuit breaker to easily disconnect a solar inverter from the DC grid, and provide better protection for maintenance personnel.

With the Electronic Solar Switch (ESS), SMA is the first manufacturer to provide a DC load disconnecting switch integrated into the inverter, which is approved by the industrial trade association, and completely fulfills all requirements of the newly enforced standard. In contrast to external switches which often reduce the efficiency of the entire PV system, the ESS entails no losses whatsoever. Furthermore, no additional costs are incurred for installation and mounting. Accordingly, the ESS guarantees a very high level of operational safety for all installation and maintenance work, in a comfortable, low cost manner.



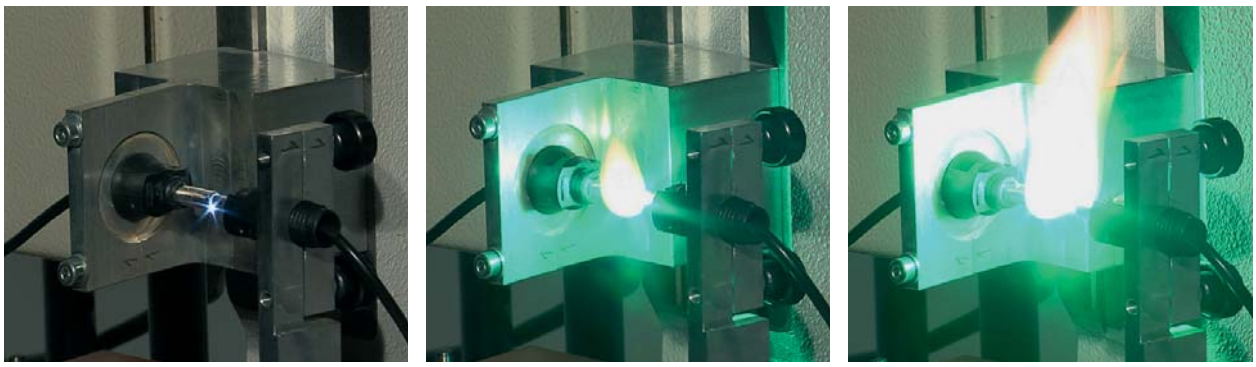
The Inverter: Centerpiece Between Two Energy Sources

Solar modules generate direct current. To enable the generated direct current to be used for normal household devices, an inverter must convert this direct current into alternating current.

In a solar power system, the inverter connects the generator (in this case the solar modules) to the public grid. It then forms the centerpiece between two different energy sources: the DC voltage grid on one side, and the AC voltage grid on the other. When installation or maintenance work is done, the inverter must be securely disconnected from both energy sources. The first step in disconnecting the device from the grid, is sufficiently well known, and is addressed by comprehensive measures employed in SMA products, such as the SMA grid guard® 2 technology (see Technology Brochure 1). However, the potential danger of PV modules as a direct current source is often underestimated.

Disconnection from the PV Generator

Arcing occurs if a current of electrically charged particles between the inverter socket and the PV generator plug heats the air and converts it into plasma.



Laboratory test: arcing occurs as a PV generator plug connection is pulled out under load

With DC grids, not only the isolation of live components must be attended to during disconnection – an additional danger arises from breaking the electrical circuit. With an open circuit voltage of several hundred volts, and a short-circuit current of several amperes, most PV generators well meet the requirements for arcing. In contrast to alternating current, where the current flow changes its direction periodically thereby extinguishing any sparks automatically at the zero point, direct current remains constant and would therefore constantly provide any spark with "new feed".

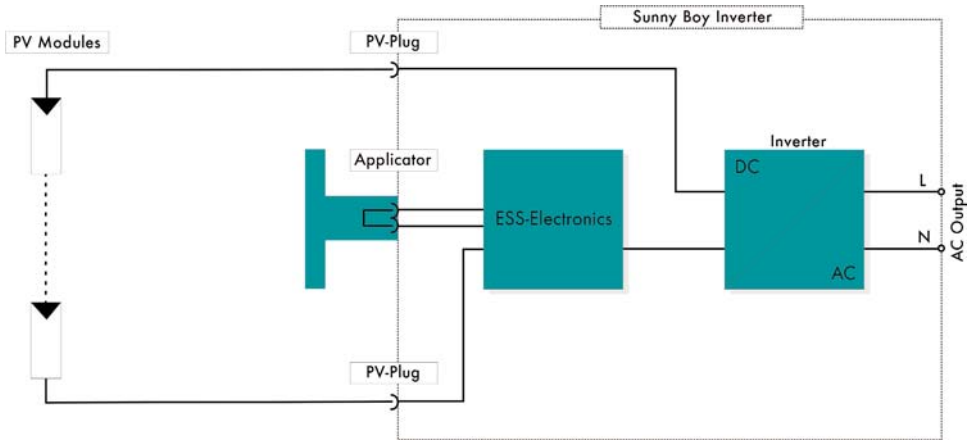
The Previously Common PV Plug Connectors Offer No Protection

The PV plug connectors presently in common use offer no protection against arcing, as they are only manipulated in load-free conditions. If the recommended connection and disconnection procedures are followed, most dangerous situations can indeed also be avoided with these components. However, if these rules are disregarded, or if a short circuit occurs on the input side of the inverter, there is a risk of arcing.

Therefore, a DC circuit breaker is obligatory according to IEC 60364-7-712, the internationally valid installation standard for PV systems. The DC circuit breaker is also standard in Germany in accordance with DIN VDE 0100-712 standard, established in June 2006.

ESS on a Sunny Boy SB 3800

Added Safety



Electronic Solar Switch - ESS in an inverter

An additional DC circuit breaker can, depending on the quality, significantly reduce the danger of arcing. The new standard provides no detailed specifications for the electrical properties of the DC circuit breaker, which means there is a great deal of freedom regarding the design of the load disconnector. However, each solution must meet certain basic requirements:

- load-switching capability throughout the entire operating range of the PV system,
- all-pole isolation of the PV generator,
- reliable functioning, especially in the event of a short circuit, and
- minimum power loss.

The Innovative Solution from SMA:
The Electronic Solar Switch

The objective of the developers at SMA was to meet all of the above requirements by developing a disconnection device which is easy to operate, contains a reliable automatic switch, and also has no influence on the efficiency of the PV system. A multitude of approaches were tested for potential, until gradually a completely new concept took shape.

With the Electronic Solar Switch (ESS), SMA is the first manufacturer to provide a DC circuit breaker integrated into the inverter. This integration of the disconnector into the inverter has a decisive advantage: it saves the considerable additional costs incurred in mounting and installing external DC circuit breaker. Furthermore, the ESS is completely independent of the inverter's electronics, and causes no loss during feed-in operation.

The Function of the ESS

"After a solid two years of intensive development work and comprehensive tests, we know that the Electronic Solar Switch provides additional safety which surpasses all other DC circuit breakers."

Stefan Buchhold, development engineer at SMA

Two-step disconnection procedure: 1. Pull ESS handle down. 2. Pull PV plug out. Finished.

The ESS consists of a grip handle, in which a jumper is integrated, and which completely covers all generator connections. To disconnect the generator from the inverter, the complete grip handle must first be pulled down. Only then can the plug connections be disconnected. As the grip handle is pulled, the current flow is simultaneously interrupted by means of the integrated jumper. An electrical switch is then activated which safely prevents the arc from fully forming, when the DC cable is pulled.

Maximum Protection

The ESS electronic function works under load, offering maximum protection in the event of faulty devices, or if an improper procedure is followed during disconnection of the electrical components in a solar power system. As the load disconnector completely covers the generator connections, it is securely prevented from being pulled if no DC disconnection has occurred.

This combination of mechanical and electronic design means that the disconnection cannot be forgotten, as might happen with common mechanical disconnectors. This inherent safety is what makes the ESS technology so revolutionary.

Implementation of ESS

Working on live components is prohibited. When establishing a voltage-free state, it is imperative that **the five safety rules**, as defined by the DIN VDE 0105 series of standards, be adhered to.

Implementation of the ESS requires no special plugs, and can occur in conjunction with the existing generator connections. Therefore, there is no need for any changes to the existing system configuration. The qualified installer simply needs to attach a plug cover with the integrated jumper before commissioning the system.

Available for All Sunny Boys and Sunny Mini Centrals

Whenever any work is done on the solar power system, ESS, the Electronic Solar Switch developed and patented by SMA, provides added safety beyond the standard requirements. In the future the ESS will be available for all Sunny Boys and Sunny Mini Centrals. In this way, the inventor of string technology continues setting new safety standards for solar inverters.

Literature:

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[2] DIN VDE 0100-712:2006
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Photos:
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