

Single-Phase String Inverter Systems Overview

Solutions

Single-phase string inverter systems convert the DC power generated by the photovoltaic (PV) panel arrays into the AC power fed into a 120 V / 220 V single-phase grid connection. The power rating typically ranges from 1kW to 10kW and is primarily used in residential market.

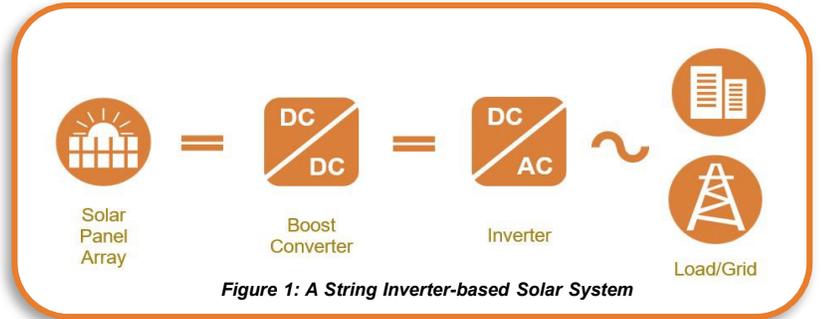


Figure 1: A String Inverter-based Solar System

System Overview

The system's main components handle the DC-AC conversion. Those components include the PV panels, the DC link capacitors, cables, DC-DC boost module, and inverter module. The DC-DC boost stages are often used between the PV strings and the DC link. These systems elevate the output voltage of the PV string to the DC link operating level and run the MPPT (Maximum Power Point Tracking) function, which maximizes the power generated by the PV strings in different environmental and sun irradiance conditions. When the PV string reaches the DC link operating voltage level, the DC-DC converter is bypassed (via a low VF diode) to maximize efficiency. To ensure reliability and cost optimization, single-phase string inverter systems are required to deliver high efficiency and to be compact in size.

Architecture and Technologies

The maximum bus voltage is under 600V for safety while size is important so that the inverter systems can be placed in houses. To be cost effective, single boost is a preferred topology in the DC-DC since it only requires a MOSFET and a diode. HERIC topologies are recommended in the DC-AC stage. Those topologies solve the leakage current issue that is frequently occurred with a transformer-less design.

Power integrated modules (PIMs), such as the H6.5 (3-level) featuring the 650 V Field Stop 4 (FS4) Trench IGBTs, simplify the design, reduce the efforts required for thermal dissipation as well as deliver power dense solutions. Inverters with medium voltage MOSFETs are also an option in some multilevel topologies. Galvanic isolation is often needed for the high-side switches and is used for the low-side. Dual-channel gate drivers offer simplified and compact solutions. Read "Optimizing Residential Solar Energy System for Efficiency, Reliability, and Cost" for more details.