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PHOTOVOLTAIC EMULATOR FOR SMART GRID TEST FACILTY

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Growth in installed photovoltaic (PV) systems in the past decade has increased and the trend will continue. Different types of photovoltaic panels are available for purchase in the market with different specifications by different manufacturers. It would be very costly to buy different types of PV panels for PV system testing at the research level or prototyping stage. A PV emulator, which is capable of replicating the characteristics of a PV panel, is very valuable in this regard. In literature it is possible to find PV emulators developed based on pilot PV cells and DC-DC converters which are capable of replicating complete characteristic curves. The proposed PV emulator is to be used in a prototype smart grid with the aim of studying the behaviour of smart grid having grid-connected PV systems. Typically grid-connected PV systems are coupled through voltage source inverters. The PV panel is connected to the input of the inverter through a power electronic converter or directly. Inverter feeds the maximum available power at given environmental conditions, *i.e.* irradiance and temperature, to the network. The controller of the inverter ensures the power reference to inverter to be delivered. In the proposed system, laboratory DC power supply is connected to the inverter input, and power reference to the controller of the inverter is provided by the microcontroller based PV emulator. The function of the microcontroller based PV emulator is to provide reference power which is the maximum available power corresponding to irradiance and temperature of a particular instant. Initially the specifications of the PV panel are fed into the microcontroller. Then, the irradiance and temperature profiles are fed into the PV emulator. The maximum power point tracking algorithm called voltage sweep method is inside the microcontroller which calculates the maximum power for the given conditions and delivers as the output. In order to validate the operation of the proposed PV emulator, a commercial photovoltaic (PV-UJ225GA6 MITSUBISHI) panel was connected to a variable resistive load and operated under varying irradiance and temperature conditions. The maximum power delivered to the load with the corresponding panel temperature and solar irradiance is measured. The results of the PV emulator in the microcontroller were obtained for the temperature and irradiance conditions. The results, *i.e.* maximum power delivered, obtained experimentally were compared with the PV emulator output. Thereby the operation of PV emulator was verified. The results showed good agreement between measured and estimated values. The proposed microcontroller based emulator can be used to generate the power reference to the grid-connected inverter.