



In recent years, due to the growing concern over energy shortage and environmental pollution, the concepts of distributed generation (DG), and dc-ac based hybrid power systems have become progressively more popular with the decreasing costs of various clean renewable energy sources. Under small-scale power distribution system, such as house, commercial buildings, bi-directional single-phase PWM converters perform as key components to fulfill the following modes of operation.

1. Stand-alone inverter mode: when the grid is lost, the converter regulates the ac bus voltage and frequencies feeding the ac loads while the renewable energy sources or energy storage on the dc side to provide power. The ac side renewable energy resources would act as current sources.
2. Grid-tied inverter mode: when the grid is connected, the converter acts as a current source injecting or sinking power from the grid to balance the power flow between the dc and ac subsystems, while one of the dc resources regulates the dc bus voltage.
3. Grid-tied Rectifier mode: when the grid is present, the converter regulates the dc bus voltage to sustain the dc loads while all dc side energy sources operate as current sources.
4. Grid-tied charger mode: when the grid is present, the converter charges the energy storage elements, such as batteries.

By applying the modeling methodology of semi-conductor switches, the switching, average and small signal models of the converter are derived under different modes of operation