19.2 INVERTERS

19.2.1 General Characteristics of PV Inverters

Since the production cost of PV electricity is several times more expensive than conventional electric energy, conversion efficiency becomes predominant to the economics of the total PV system. As a consequence extremely high efficiency not only in the nominal power range but also under a part-load condition is a requirement for PV inverters in grid-connected as well as in stand-alone systems. Since some characteristics of both types of applications are different, they will be highlighted separately in the following chapter.

19.2.2 Inverters for Grid-connected Systems

This configuration consists mainly of the following components: the PV generator, the inverter, the safety devices and, in many cases, the electric meter as shown in Figure 19.15.

The actual power fed into the grid can be estimated by multiplying the actual power of the PV generator with the actual efficiency of the inverter if we neglect the losses in the safety device and in the meter. More important is the energy produced by the system after a certain period of time, for example, after one year of operation. In this case the mean efficiency of the inverter taking into account all load conditions throughout the year becomes important. As a first step the inverter must allow the PV generator to operate in the MPP by adjusting the corresponding operation voltage as shown in Figure 19.16.

Many inverters adjust this operation voltage continuously to the actual MPP. This operation is called maximum power point tracking (MPPT). The method most commonly used to perform the MPPT is to change the actual input voltage in such a way that maximum power is obtained (Figure 19.8). The effect of continuous MPPT is often overestimated. Simulation has shown that for grid-connected PV systems, CV operation leads only to losses between 1 and 2% when properly adjusted [1, 2].

For optimum use of the PV energy, MPPT and CV operation can be seen as equivalent. As a matter of their operation principle, single-phase inverters, which are most common in small-scale PV systems ($P \leq 5$ kW_P), lead to deviations from the MPP due to DC ripple, which is explained as follows: when injecting AC power into the grid, the feed-in current should be in phase with the grid's voltage, which means that the power factor equals one as shown in Figure 19.17.

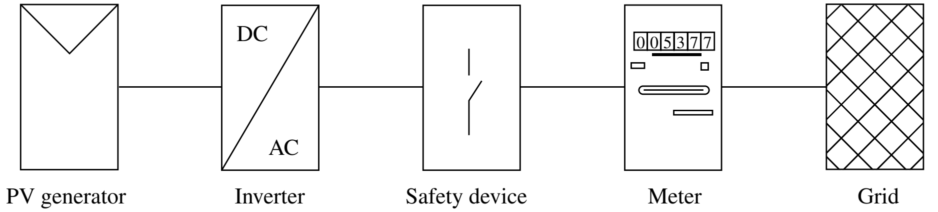

Figure 19.15 General structure of a grid-connected PV system