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Title of the Thesis : Design and Development of Novel MPPT (Maximum Power Point Tracker) for Solar Photovoltaic (PV) Energy Conversion System

ABSTRACT

Harnessing energy from Sun light has got tremendous attraction from the researchers in the last few decades. It is due to the fact that solar energy is considered as one of the reliable source of energy among all renewable energy sources. The other concern which leads to use of solar energy is climate change threats from emission of green-house gases. The whole civilized world has agreed that climate change threat is an issue and pose serious threats. Solar Photovoltaic (PV) is used to convert solar energy into unregulated electrical energy. Photovoltaic is made of semiconductor materials and has non-linear characteristics. Its output varies with ambient conditions mainly, with the change in solar irradiation and ambient temperature. Also, the conversion efficiency of solar PV is very low. Due to these factors, it becomes essential to extract maximum power from solar PV in all the ambient conditions. On the characteristic curve of solar PV a maximum power point is located and the operating point should be on either at maximum power point (MPP) or in the vicinity of it. A technique known as Maximum Power Point Tracking (MPPT) is developed by researchers to make MPP as operating point. Various types of MPPT techniques are proposed. Among all Perturb & Observe (P&O) MPPT technique is very acceptable due to its simplicity in control and reduce costs.

The main objective of this thesis work is to design and developed a novel Perturb & Observe MPPT technique which not only enhances the performance in terms of speed and steady state oscillations, but improves the reliability under change solar irradiation and load, for extracting the maximum power in solar PV system.

In this study two P&O MPPT techniques are proposed. One is adaptive P&O MPPT and other is normal P&O MPPT technique.

Three P&O MPPT is evaluated for its performance parameters i.e., the conventional P&O MPPT and two new designed and developed MPPT techniques. The proposed adaptive and normal P&O MPPT is evaluated for its performance mainly, convergence time, steady state oscillations, tracking factor, reliability under change solar irradiation and load conditions. The conventional P&O MPPT is evaluated for tracking factor and steady state oscillations. The evaluated convergence time for the conventional P&O MPPT is 2 sec and steady state oscillation is 3 Watt with R load. However, these two performance parameters for the adaptive proposed P&O MPPT is 0.1 sec and 1 Watt and for the normal proposed P&O MPPT is 0.16 sec and 1 Watt, respectively with R load. The tracking factor of both the proposed P&O MPPT is more than 95%. Furthermore, a new performance parameter named as MPP restoration factor due to the load variation is defined and evaluated. It is measured as 150 millisecond for the adaptive P&O MPPT and 200 millisecond for the normal P&O MPPT technique. These performance parameters of the proposed P&O MPPT techniques are compared with the conventional and with the previously proposed MPPT techniques. Both the proposed P&O MPPT techniques shows the significant improvements as compared to the previously proposed techniques.