A Novel Single-Stage Single-Phase Reconfigurable Inverter Topology for a Solar Powered Hybrid AC/DC Home

Introduction:

Current century has witnessed an unprecedented evolution and growth of renewable energy worldwide. There has been a substantial increase in the capacity and production of all renewable technologies and also growth in supporting policies. Between 2009 and 2013, solar photovoltaic (pvs) experienced the swiftest growth rate in added power capacity among all the renewable.

In particular, rooftop solar pv are gaining more popularity in distribution system due to reduction in cost of solar panel, appropriate government policies such as feed in tariffs promoting renewable energy utilization, modularity, less maintenance, etc. However, the intermittent nature of the renewable causes the significant stability and reliability issues in the distribution system. The restructuring of the electric supply industry has prompted the situation, where customer is a critical business player. To mitigate the uncertainty in solar PV generation, storage options such as battery system and fuel cells, etc., are introduced.
Existing system:

A novel solution to mitigate some of the harmonics related problems and efficiency issues by proposing a hybrid ac/dc home grid system. Conventional grid connected inverter uses high dc link voltage, which will be the peak magnitude of the line–line grid voltage. For this particular purpose, two stage conversions are required to boost up the dc voltage and to invert it. However, this will increase the cost, size, and loss of the system.

Transformer less inverter gained significant research interest such that Transformer less inverter has the advantage of low size and cost by avoiding the transformer but this will eliminate the galvanic isolation and inverter will become very sensitive to grid disturbances. The solar PV is limited by its inherent intermittency aspects and, hence, battery storage (assumed here) is required to supply the power when there are not enough solar radiations.

Hence, a three-phase topology of reconfigurable solar inverter for utility PV system with battery storage. This reconfigurable system is suitable to solar and wind farm applications. This topology is tested with a new algorithm and validated the results. Normally, every solar powered household have a battery system to provide a reliable supply system. These batteries are charged when connected to ac system or they need a separate converter to manage the charging operations when it connected to dc supply side

Dis-advantages

- Having a separate converter for battery’s power management system
- Increase the cost and size of the converter as well.

**Proposed system:**

The main contribution of this paper is to implement a single-phase single-stage solar converter called reconfigurable solar converter (RSC) in the solar powered hybrid ac/dc residential building with energy storage devices. The basic concept of the RSC is to use a single power conversion system to perform different operational modes such as solar PV to grid (Inverter operation, dc–ac), solar PV to battery/dc loads (dc–dc operation), battery to grid (dc–ac), battery/PV to grid (dc to ac) and Grid to battery (ac–dc) for solar PV systems with energy storage. This inverter is tested in a solar powered hybrid ac/dc home, which contains both ac and dc household loads.

Individual appliances are selected according to the harmonic contributions they are injecting to the distribution grid from a typical modern house. Apart from the aforementioned, other additional contributions are the electrical components and sensors are different and normal inductor only used for dc/dc operation. The variation in solar radiation is also considered.
and solar PV-battery operation is verified. The circulation current is mitigated due to operation of the switches in the topology for dc/dc operation.

**Advantages:**

- Utilize single conversion of ac power to dc,
- Improves the efficiency, reduces volume, and enhances the reliability.
- Reduce significant amount of harmonics in the residential feeders of the future smart grid.

**Applications:**

- Wind, fuel cells.
- Solar powered hybrid ac/dc home.

**Block Diagram:**

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Solar PV --> Reconfigurable solar converter (RSC) --> Transformer --> Load

Battery(Energy Storage) --> Reconfigurable solar converter (RSC) --> Transformer --> Load
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