A Four-Switch Single-Stage Single-Phase Buck–Boost Inverter

Introduction:

Renewable energy sources such as solar photovoltaics (PV) and emphasis on storage systems such as fuel cell (FC) in the current energy scenario are faced with the ubiquitous challenge of conditioning the dc output into grid quality ac power. Inverter circuits, which execute this function, boost and invert the variable output dc voltages from these PV or FC devices to ac voltages with tightly controlled magnitude and frequency for interfacing with utility grid. PV inverter topologies, without any galvanic isolation, are due to their size and cost advantages.

However, these nonisolated inverters are associated with problems such as dc current injection to the grid and common mode leakage current (CMLC), the latter impairing PV panel life. Half or full Bridge inverters are the most common topologies employed for grid-connected PV systems, though these suffer from the problem of CMLC. This problem can be mollified by using bipolar pulse width modulation (PWM) technique. But this brings problems such as large grid current ripple, high harmonic content, and poor efficiency of the inverter.
Existing system:

The dc-based decoupling configurations incorporate the decoupling network in the dc side to provide the decoupled freewheeling path, examples being H5, H6. Solutions such as HERIC, on the other hand, include the decoupling network in the ac side to provide the decoupled freewheeling path. However, due to the presence of junction capacitance of switches, a high-frequency common mode voltage is generated. Moreover, there is a chance of high-frequency resonance during freewheeling mode.

A class of reported topologies share one common terminal between PV and grid which ensures zero CMLC. In, one such topology is proposed with buck–boost capability. But since it uses two input voltage sources for positive and negative halves of output voltage, this leads to underutilization of PV panel.

In differential connections of two buck–boost and boost converters were proposed. These converters have simple configuration with four active switches suitable for renewable energy application. However, hard switching of all the devices at high frequency reduces the efficiency and increases its affinity toward electromagnetic interference problems.

Dis-advantages:
- Increases the overall switch count,
- And greatly reduces power density and efficiency.

Proposed system:

A buck–boost single-phase inverter with only four switches, two inductors, and two capacitors is proposed. It also shares a common terminal between the input and output ports, which practically
eliminates CMLC problems and reduces the possibilities of consequent panel degradation. It is basically a combination of two dc–dc buck–boost converters operating sequentially to generate an ac voltage output.

Proposed single-phase buck–boost inverter in the stand-alone mode, which consists of two inductors ($l_1$, $l_2$), two capacitors ($c_1$, $c_2$), four Mosfets ($s_1$–$s_4$), and a power decoupling capacitor ($c_{in}$) to alleviate the low-frequency input current (2nd harmonic) of the inverter. The input is output dc stage of any renewable power source, for instance pv, whose voltage, $v_{in}$, varies over a wide range. Input dc and output ac stages have one common terminal, which alleviates the cmlc problem in the grid-connected applications.

**Advantages:**
- Excellent steady-state and transient performance.
- High-frequency pulse width modulation.

**Applications:**
- Grid applications.
Block Diagram:

- **Dc input** → **Buck-boost Inverter** → **Load**
  - **12VDC** → **Gate driver circuit**
  - **SVDC** → **Buffer circuit** → **Microcontroller circuit**