Modeling and Design Optimization of Distributed Transformers for Renewable Energy Application

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Introduction

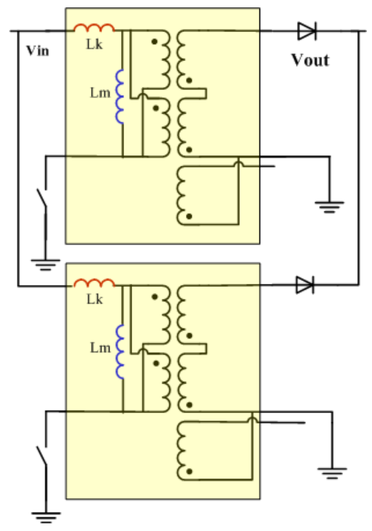
In this poster, a high efficiency, low profile design of distributed transformers (DT) for renewable energy application is presented.

The proposed DTs fully integrated into the dual-flyback converter maximize the DC/DC stage efficiency in whole load conditions.

The developed DTs with the built-in current sensing transformer allows the converter works in boundary conduction mode (BCM) or discontinues conduction mode (DCM) due to the variable nature of solar power with zero current switching (ZCS).

Various techniques are also taken to minimize the winding loss of the DTs.

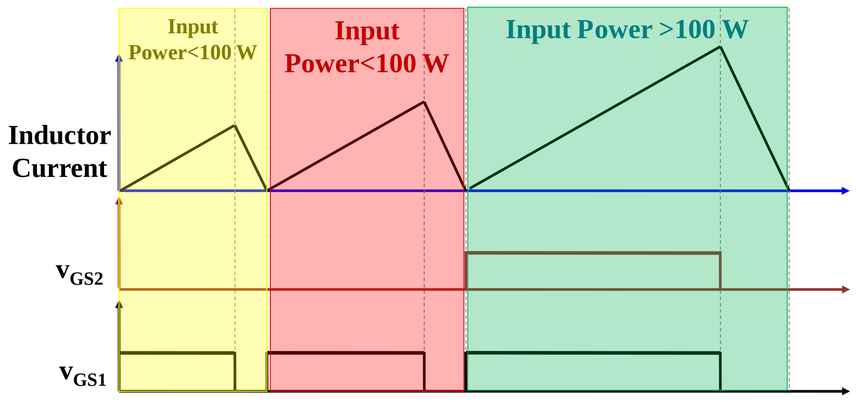
Distributed Transformer Schematics



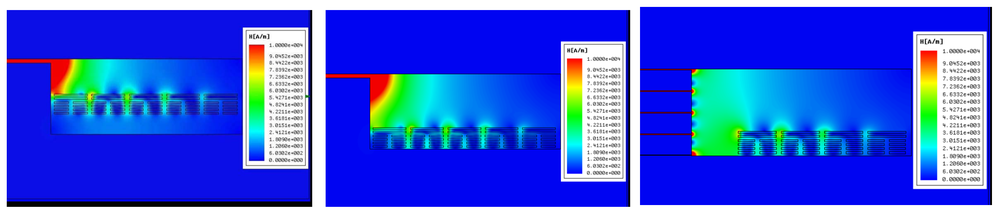
Switching frequency: 60 – 200 kHz
Input current ripple: 16 A
Turns ratio: 1:6
Primary winding: 6 turns in parallel
Secondary winding: 18 turns in series
Magnetizing inductance: 26 uH

Core Material: 3C95
Core Shape: RM 14 Low-profile

Mode of Operation

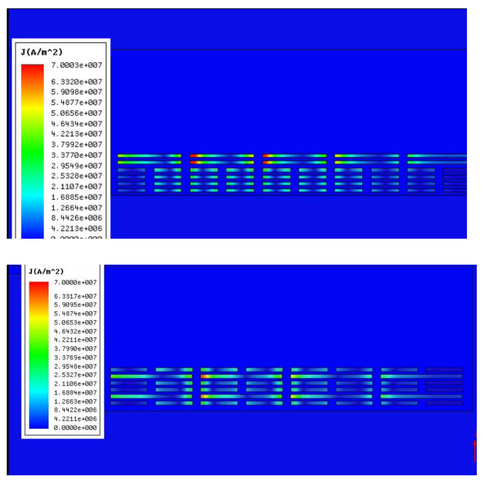


Maxwell Simulation Result 1



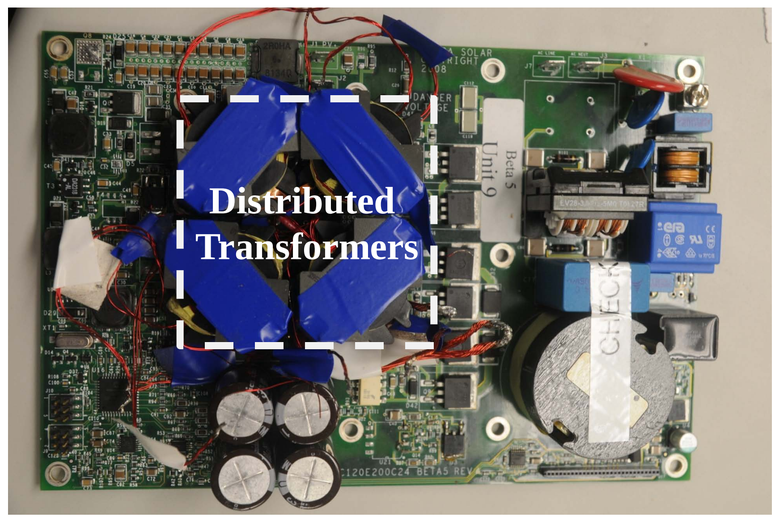
Magnetic field distribution of the transformer

Maxwell Simulation Result 2

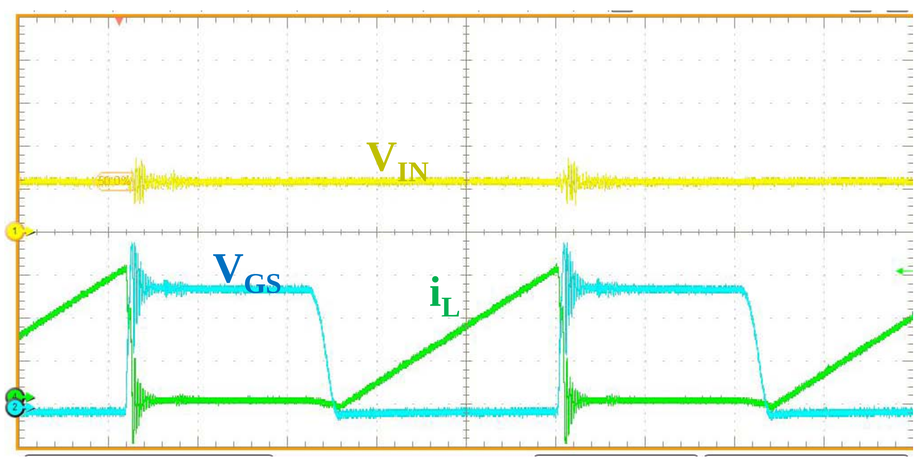


Eddy current distribution after interleaving.

Experiment Prototype

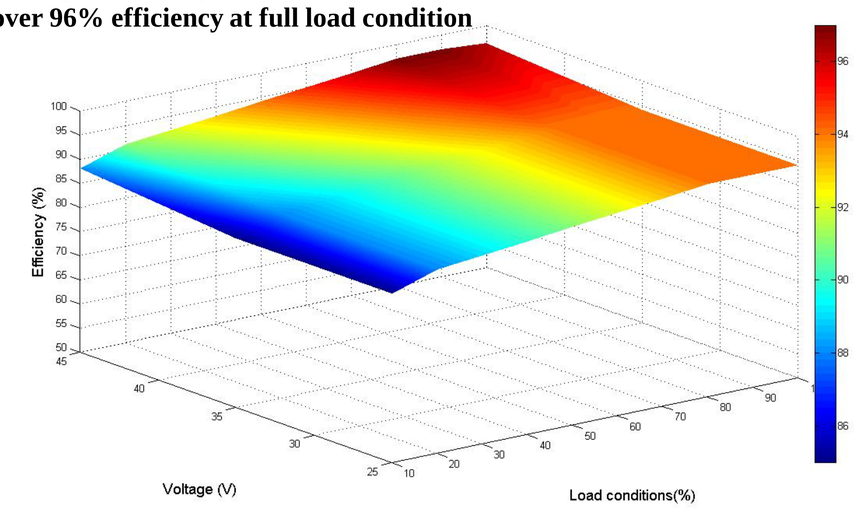


Current and Voltage Waveforms



3D Efficiency Plot

The experimental prototype employing the DTs achieves over 96% efficiency at full load condition



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