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DC-DC Boost Converter for Battery Charging Application

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Abstract Boost converter designed to improve output voltage with the use of coupled inductor and capacitor, two switch boost converter is connected in series with parallel to supply voltage. And output of converter is consists of two diodes and two output capacitor with load resistance. Turns ratio is 1:2 in between input and output circuit, capacitor voltage will be improved through the use of coupled inductor.

I. INTRODUCTION

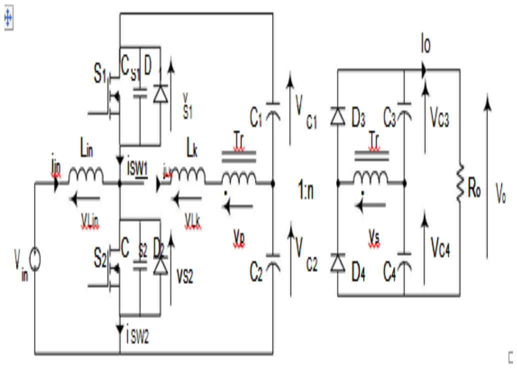

Fig.1. Step up dc-dc converter

The proposed converter consist of two MOSFET switches connected in series with parallel to supply voltage, coupled inductor connected in between capacitor and switches. Two diodes coneected in series and parallel to capacitor with output resistance it will act as load.Above circuit used as a boost converter for step up the input
Voltage, output obtained from above converter is twice the input Voltage.

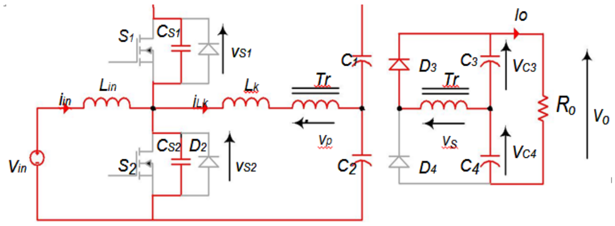

Fig.2. Mode 1 circuit

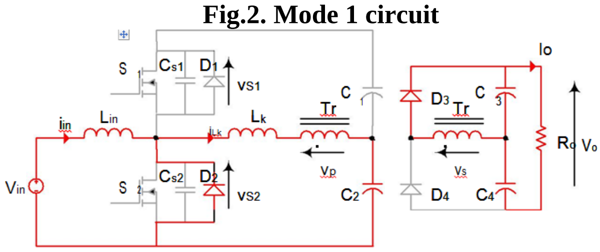

Fig.3. Mode 2 circuit

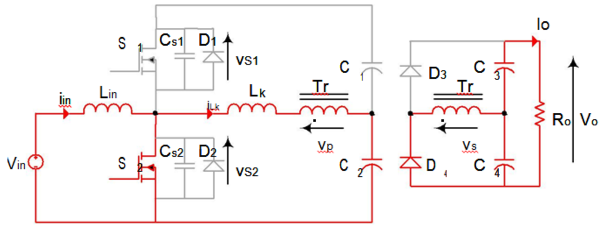

Fig.4. Mode 3 circuit

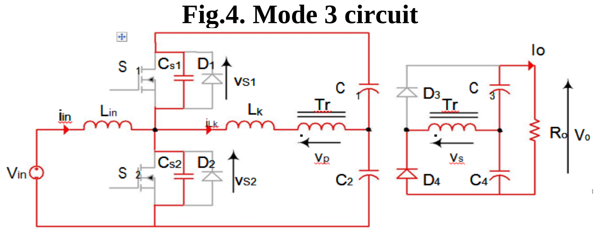

Fig.5. Mode 4 circuit

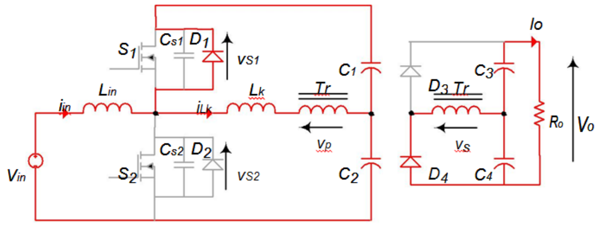

Fig.6. Mode 5 circuit

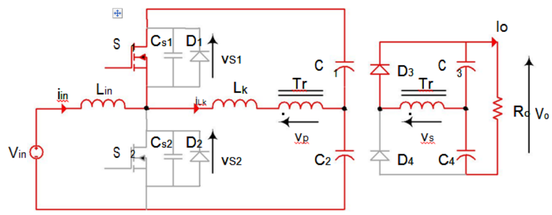

Fig.7. Mode 6 circuit

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II. SIMULATION AND EXPERIMENTAL RESULTS

The component values obtained from the design section of previous chapter are used for simulation of 400 W, 200 V output 50 kHz boost integrated HF isolated half-bridge dc-dc converter with an input voltage of 40 to 80 V.

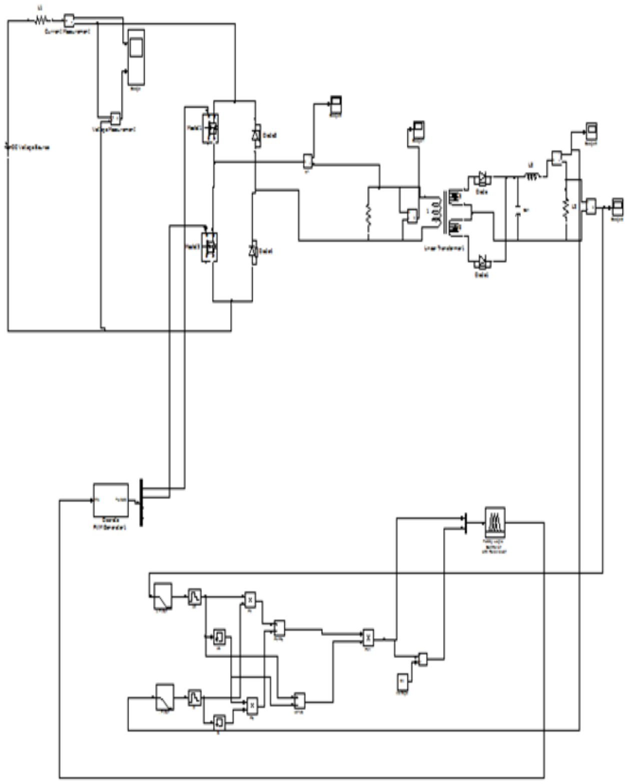


Fig.8. Simulation diagram.

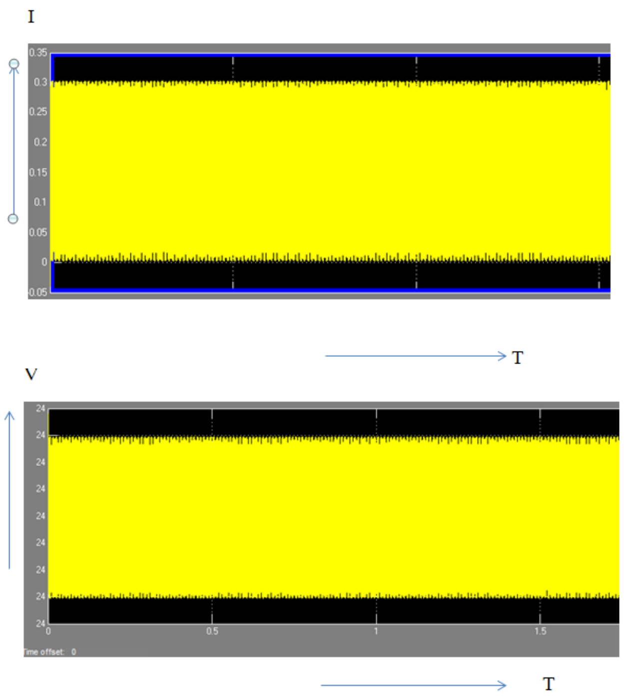


Fig.9. Simulated Input

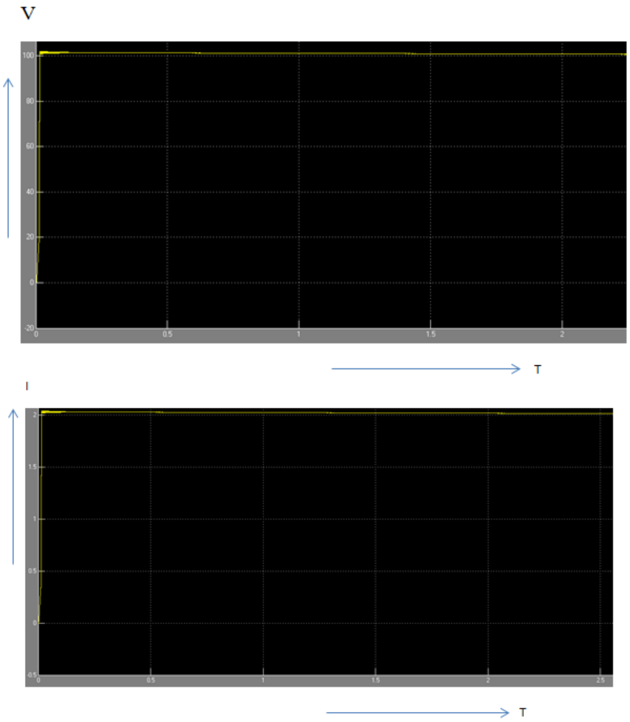
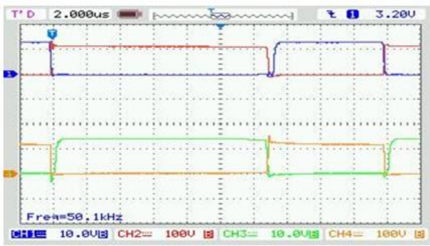
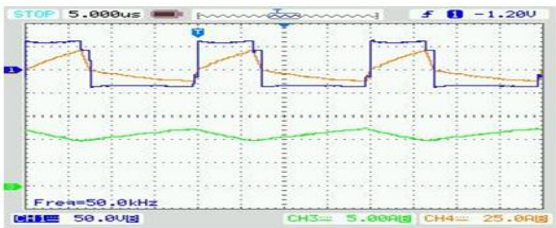


Fig.10. Simulated Output

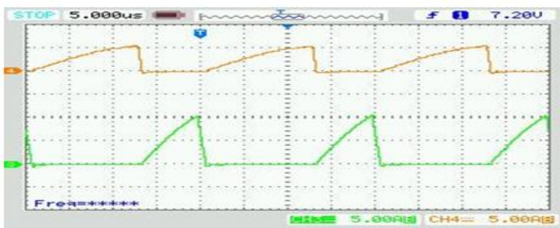
A 400 W 200 V output switching at 50 kHz converter designed in Chapter 2. In order to tolerate quite large ripple currents in C_1 and C_2 we had to use ten times the designed value for them. Also the turns ratio of transformer is higher for duty cycle loss. The converter was operated in open-loop control for 3 input voltages of V_{in} = 40 V, 60 V and 80 V and for 3 different loads (80 W, 200 W and 400 W).



(a) v_{gs1} (CH1-10V/div), v_{ds1} (CH2-100V/div), v_{gs2} (CH3-10V/div), v_{ds2} (CH4-100V/div)



(b) v_p (CH1-50V/div), i_{in} (CH3-5A/div), i_{LK} (CH4-25A/div)



(c) i_{D3} (CH3-5A/div), i_{D4} (CH4-5A/div)

Table shows the results of experiment for full load and various input voltages. Table Experimental results for full load and various input voltages

V_{IN}(V)	I_{IN}(A)	P_{IN}(W)	V_O(V)	I_O(A)	P_O(W)	P_{loss}(W)	Efficiency, η	Duty ratio, D
40.5	11.15	451	202	2	404	47	89.6%	0.64
60.7	7.37	447	202	2	404	43	90.4%	0.45
79.3	5.65	448	201	2	402	46	89.7%	0.33

V_{IN}(V)	I_{IN}(A)	P_{IN}(W)	V_O(V)	I_O(A)	P_O(W)	P_{loss}(W)	Efficiency, η	Duty ratio, D
40	5.35	214	201	1	201	13	93.9%	0.58
60	3.54	212	200	0.98	196	14	92.4%	0.4
80.2	2.7	216	201	1	201	15	93%	0.27

III. CONCLUSION

The comparison of theoretical, simulation and experimental results for V_{in} = 40 V and for V_{in} = 60V and V_{in} = 80V are given respectively. The differences between theoretical, simulation and experimental results are due to the fact that approximations were made in the theoretical analysis (i.e. neglecting magnetizing inductance of HF transformer, considering ideal diodes and switches and neglecting snubber effects) while in the simulation, losses were ignored. These losses include switching and conduction losses.

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