THE EFFECTIVENESS OF DIRECT APPLICATION OF THEORY ON STUDENTS' PROGRESS AND UNDERSTANDING

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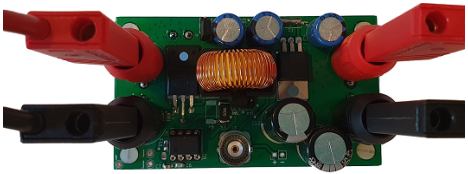
Introduction: Course contents

Effectiveness of direct application of theory on students practical simulation and measurement skills

- Lecture: Theory (How does it work?)
- Laboratory: Practice (See how it works!)

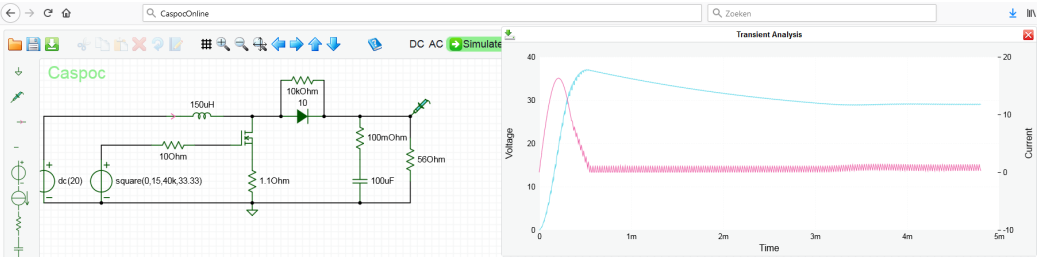


Introduction: Course outline

Course outline

- Introduction, smps versus linear power supplies, switching cell
- Buck and Boost converter
- Semiconductor
- Buck-Boost and Flyback
- Isolated converters like Forward and Pushpull and Full-bridge
- Magnetic components
- Control and PWM

Learn theory using online tools



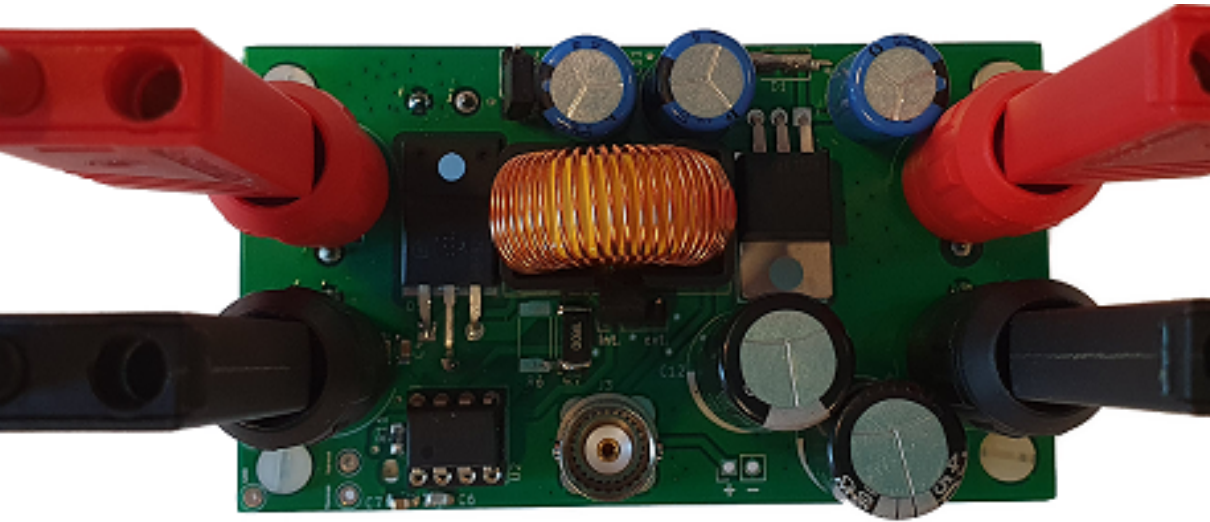
Online simulations using CASPOC Simulations Online

Original sequence of topics

Week	Lecture	Lab Topic	Lab-Assignment
1	Intro, switching Cell	I	**Online design tool: Basic Waveforms** 1) Choice of parameters (Uin, Uout, Iout, Fs, Cout) 2) Influence of the inductor L on the operation and (Uout and IL)
2	Buck and Boost Converter	II	**Online Simulation: Open loop, constant dutycycle** 1) Start-up overshoot 2) Variation of the load resistance
3	Semiconductor	III	**Online Simulation: Mosfet Switching Waveforms** 1) Influence of Rgate and Cgs in the gating circuit 2) Influence of Cgd 'miller' capacitance on the gating circuit 3) Switching loss due to Cds
4	Buck-Boost & Flyback	IV	**Online design tool: Power Inductor Design** 1) Selection of minimum core diameter and material 2) Calulation of the windings 3) Calculation of the losses (Rdc/Rac winding loss and core loss BF)
5	Isolated Converters	V	**PCB Assembly** 1) Placing all components except the the control IC. 2) Measurement of all voltage / current waveforms for constant dutycyle operation
6	Magnetic components	VI	**Ofline Simulation: Closed Loop, Control IC** 1) Simulating the behavior of the closed loop control based on the control IC, Gatedriver, Mosfet and the feedback loop components.
7	Control	VII	**Measurement: Closed loop waveforms** 1) Finalize the PCB with the control IC, measure all v, i and compare with simulation results. Examine the losses in the Mosfet, L and Cout using an infrared thermal camera

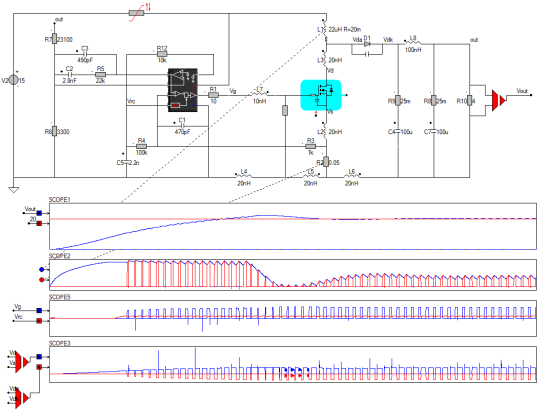
Original sequence of topics for lecture and lab assignments.

Typical study object



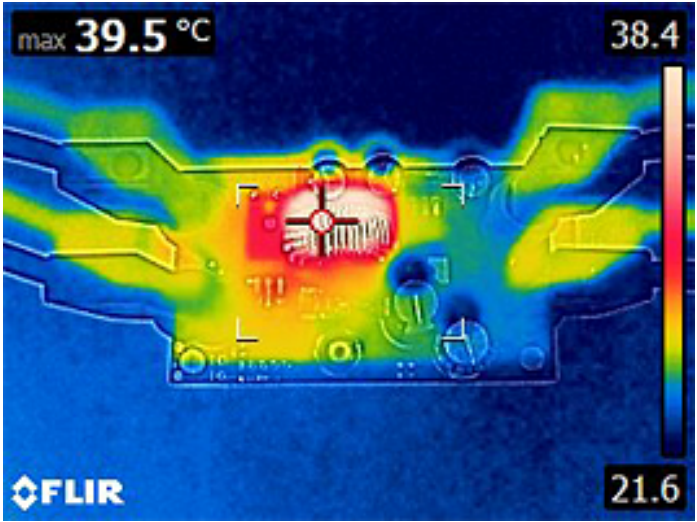
Boost PCB

Typical simulation



Simulation in Caspoc of a boost converter with parasitic components and current mode control ic.

Typical measurement



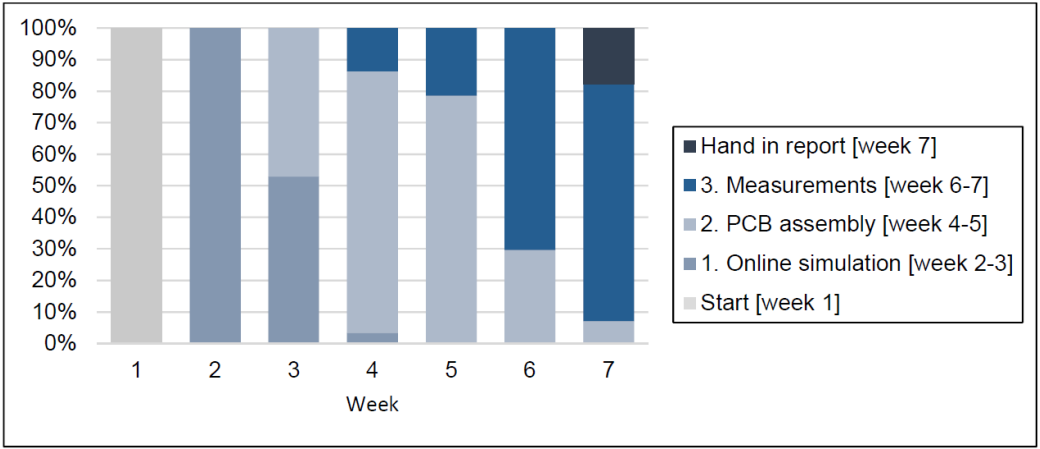
Boost Thermal image

Proposed outline

Week	Lecture	Lab Topic	Lab-Assignment
1	Intro, switching Cell	I	Online design tool:Basic Wave forms
2	Buck and Boost Converter	II	Online Simulation: Open loop, constant dutycycle
3	Buck-Boost & Flyback	V	PCB Assembly
4	Magnetic components	V IV	PCB Assembly (*see fig 3a*) Online design tool: Power Inductor Design
5	Semiconductor	III V	Online Simulation: Mosfet Switching Waveforms Measurement: Open loop waveforms
6	Control	VI	Ofline Simulation: Closed Loop, Control IC
7	Isolated Converters	VII	Measurement: Closed loop waveforms (*see fig.3b*)

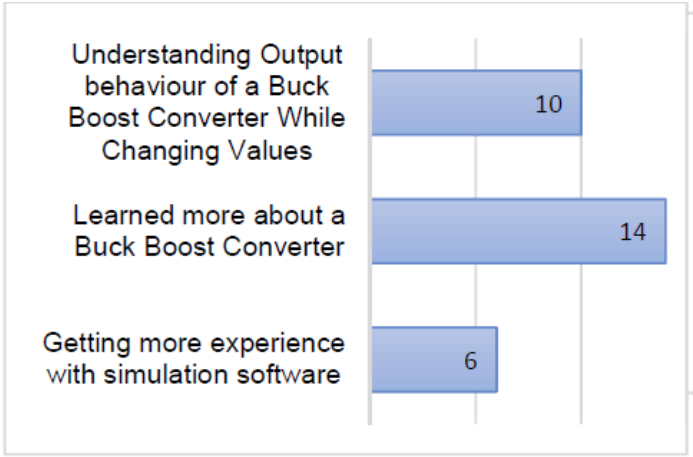
Synchronized sequence of topics for lectures and lab assignments

Progress



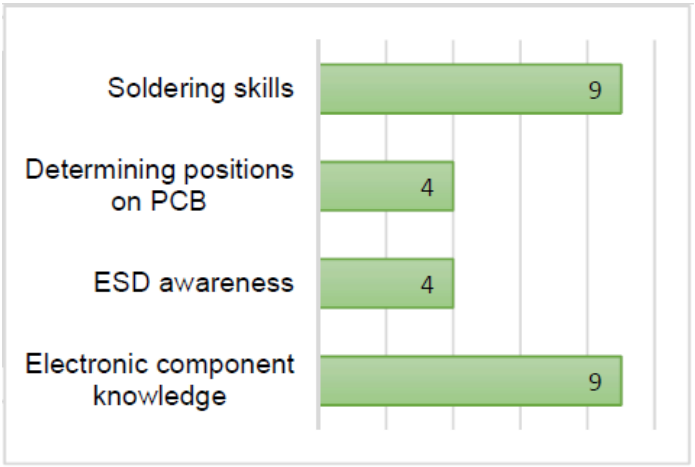
Students actual progress during the seven week lab practicals (N=31)

What students learn from the lab simulations



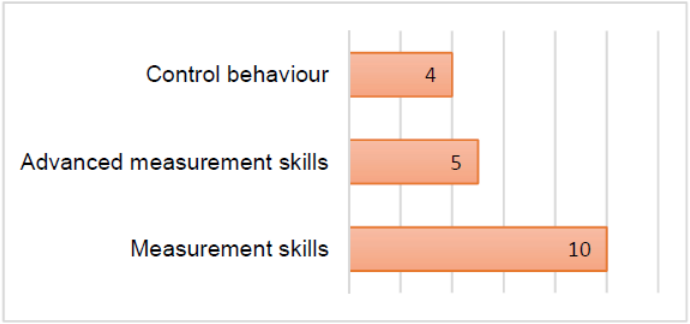
Simulations (n=30)

Assembly skills



PCB assembly (n=26)

Measurement skills



Measurements (n=19)

Conclusion

- Combining topics theory and practice
- Improve the understanding per topic with specific practice
- Student should see clearly the link between theory and practice

Thank you!
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