COMPARING DC/DC CONDUCTED EMI SIMULATION WITH MEASUREMENTS – PART 1

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Comparing DC/DC conducted EMI Simulation with Measurements – Part 1

Introduction

- Why we need a buck converter?
  - Customer needs a power supply
- Where is the buck converter used?
  - Everywhere
- Specification:
  - Input voltage = 12 V
  - Output voltage = 5 V
  - Output current = 1 A
  - f_{switch} = 1 MHz

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EMC overview

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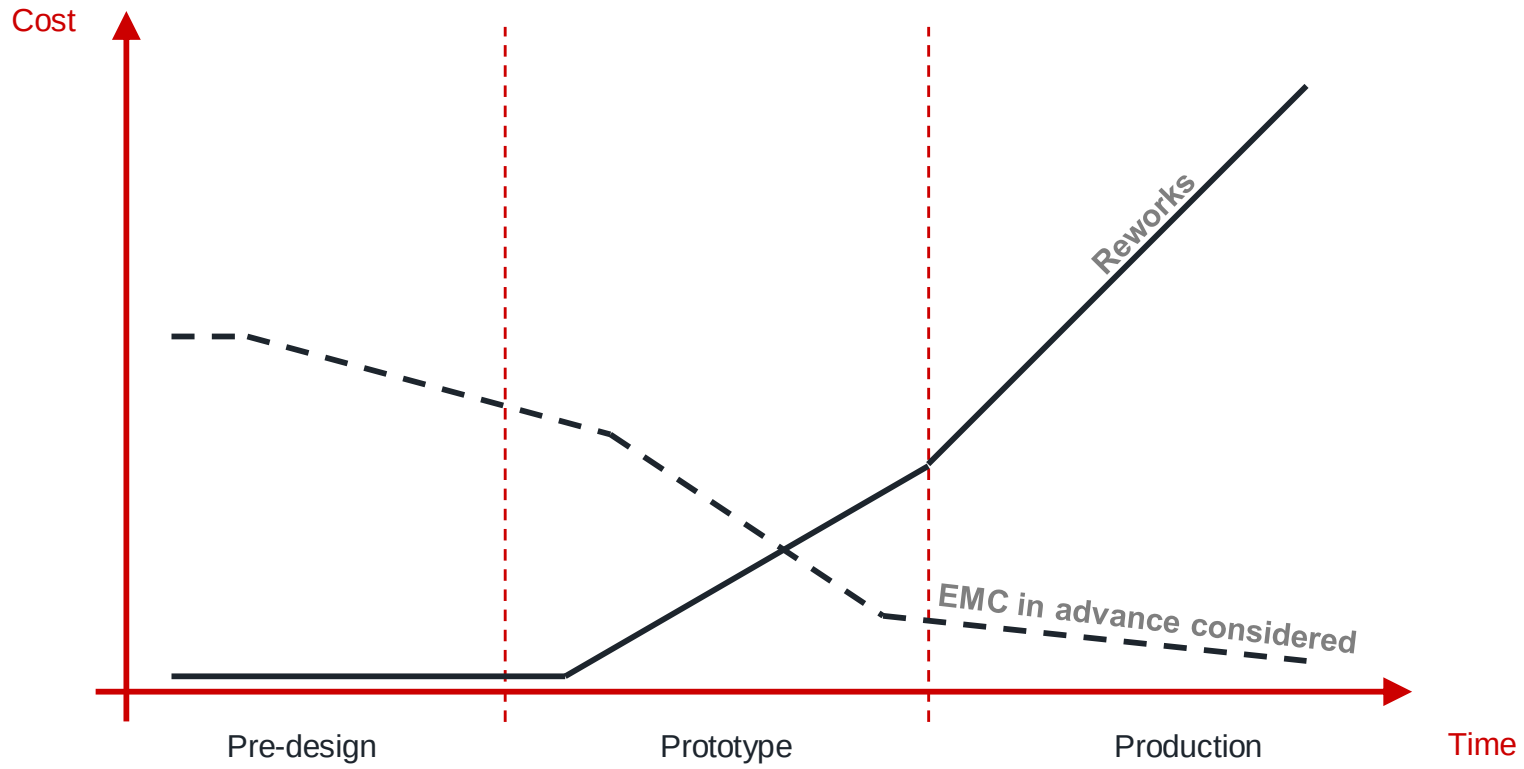
Importance of EMC

- Economical point of view:
  - Dependent on when EMC conformity is considered in a design phase



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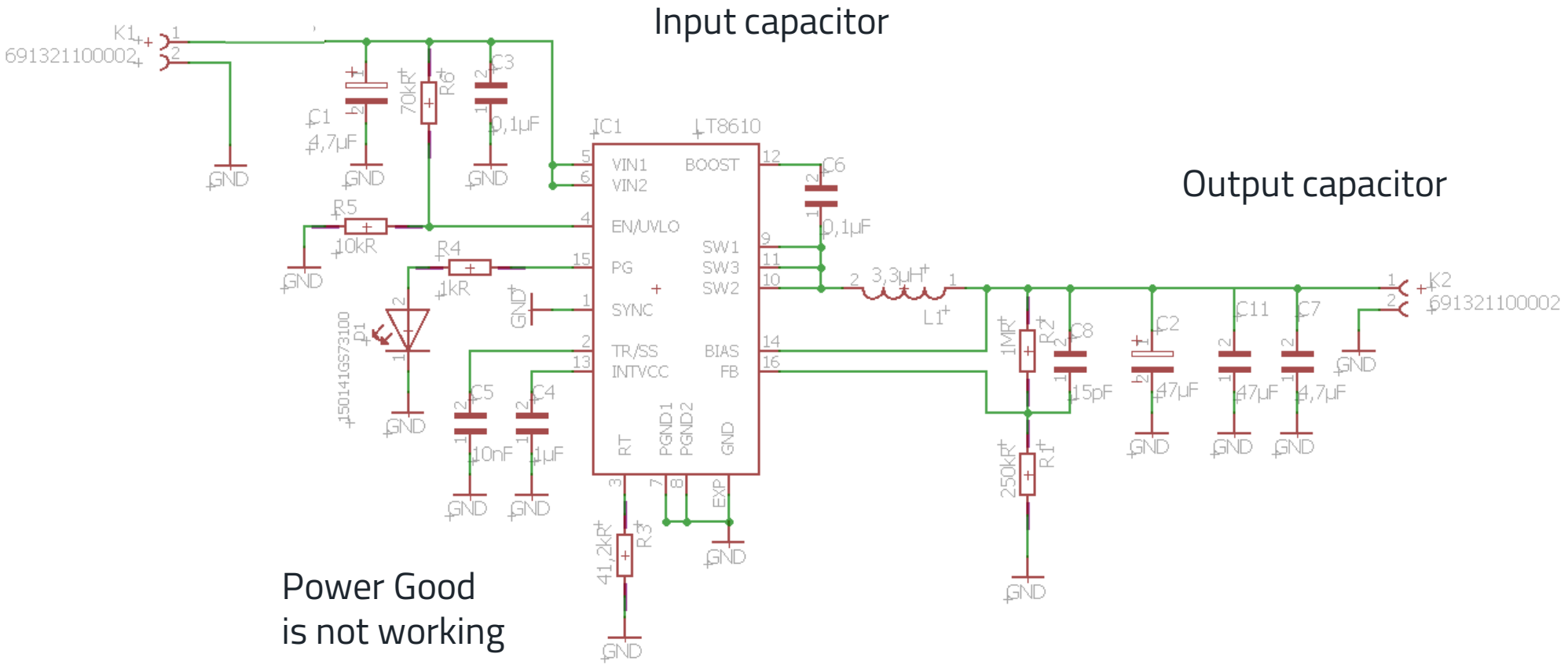
Schematic and layout



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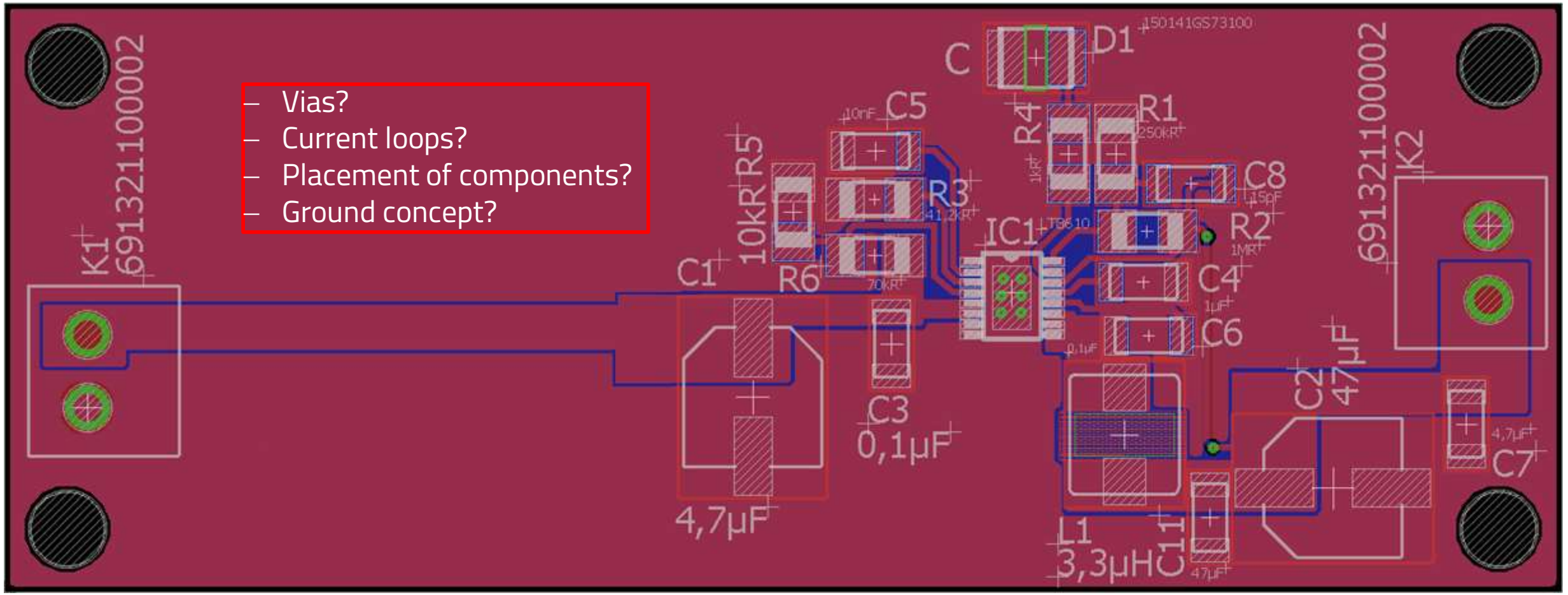

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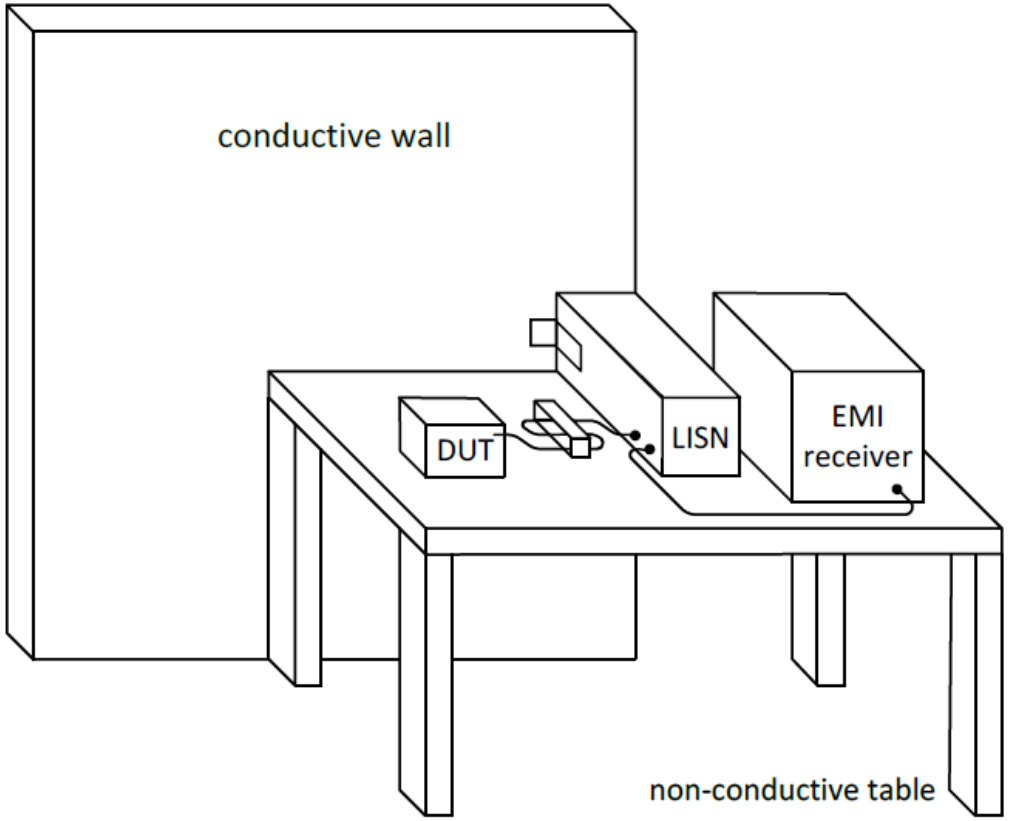
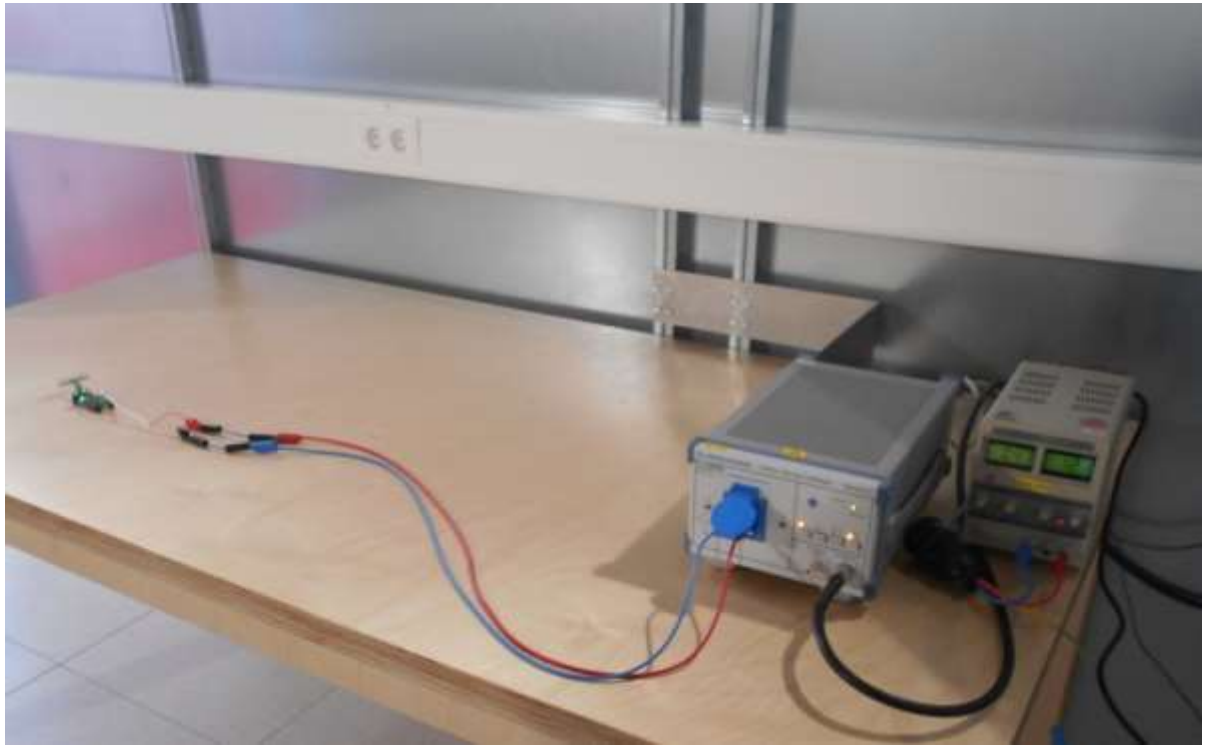
EMI measurement – conducted emission





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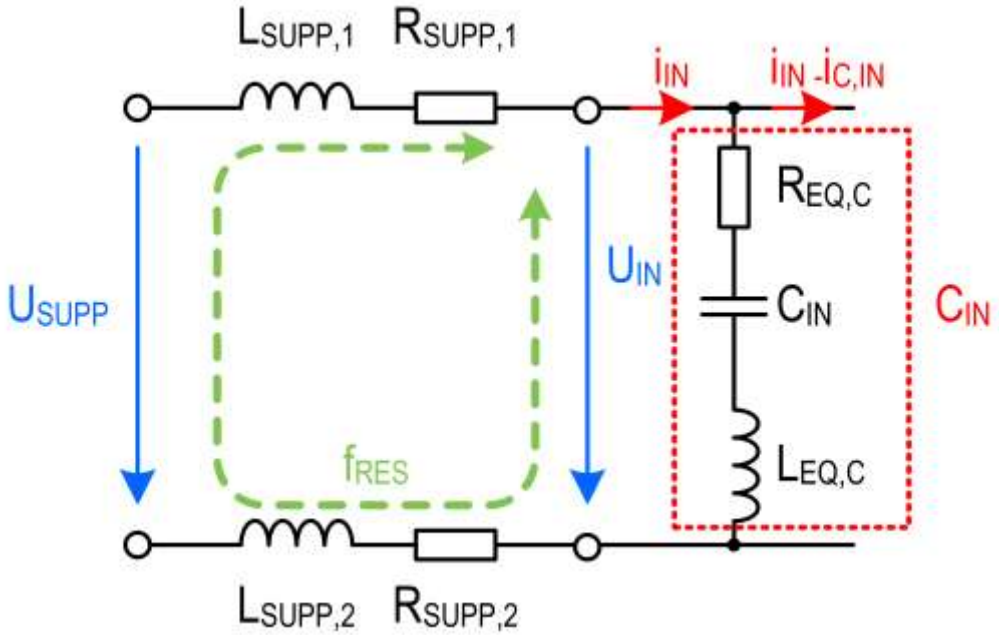
EMI measurement – conducted emission - root cause

- The symmetrical voltage at the input is a combination of the voltage drop of the supply lines and the voltage ripple on the input capacitor

$$u_{sup}(t) \approx i_{in}(t) \cdot R_{sup} + u_{in}(t) = i_{in}(t) \cdot R_{sup} + i_{C,in}(t) \cdot R_{eq,C} + u_{C,in}(t)$$

- The ESR and ESL of the capacitor should be as small as possible, so that the AC component does not have to be taken from the source



Possible differential mode resonance by L_{sup}, $L_{eq,C}$ and C_{in}

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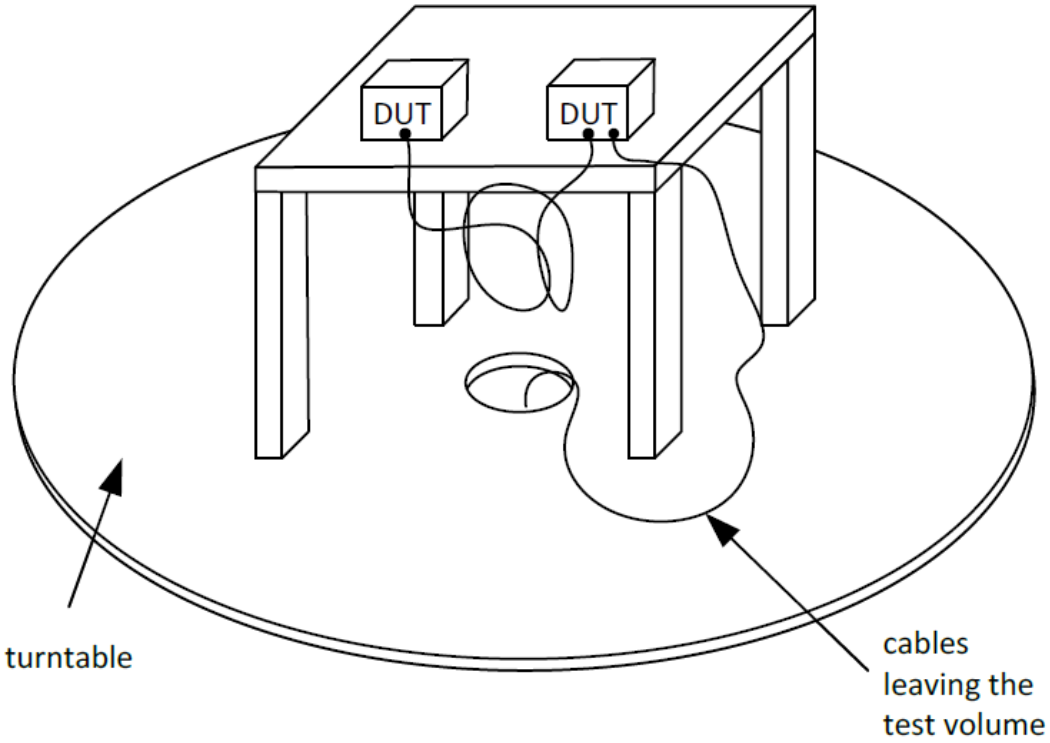
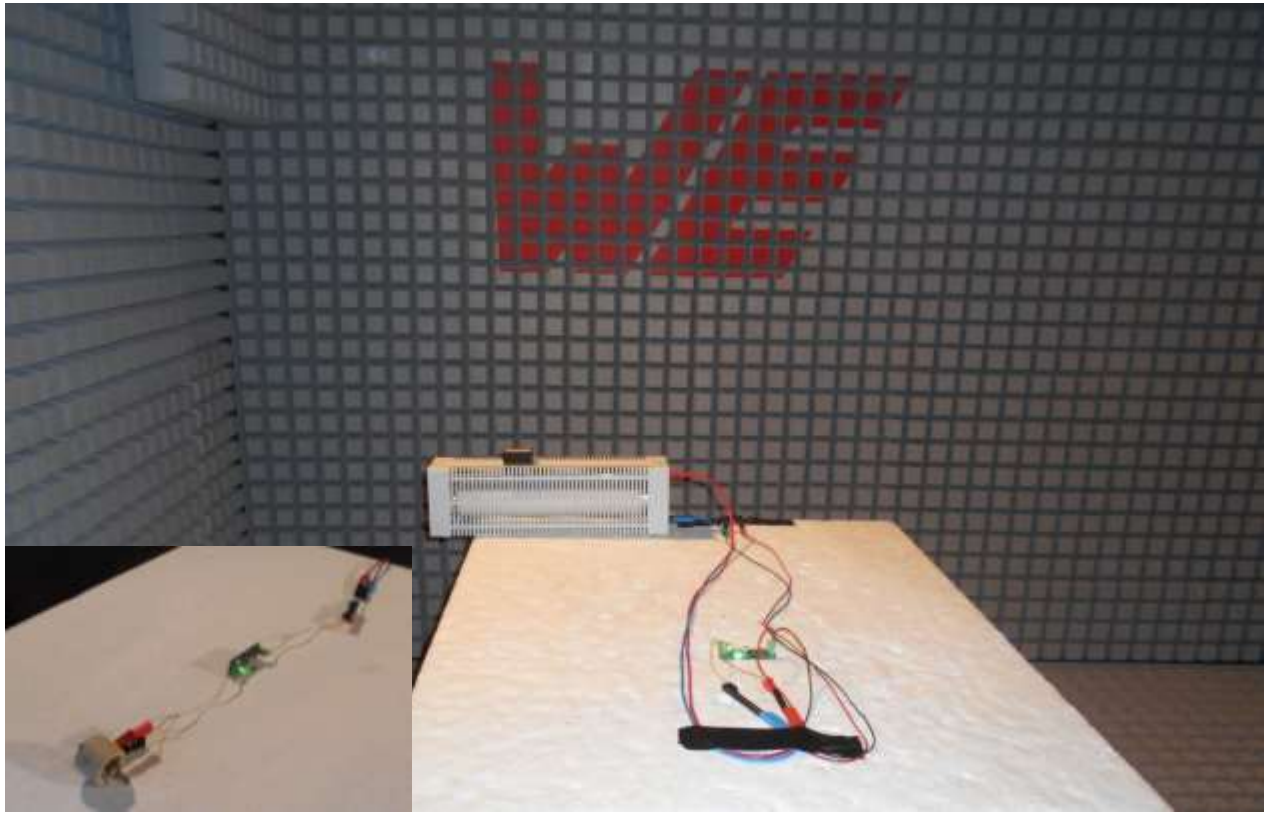
EMI measurement – radiated emission





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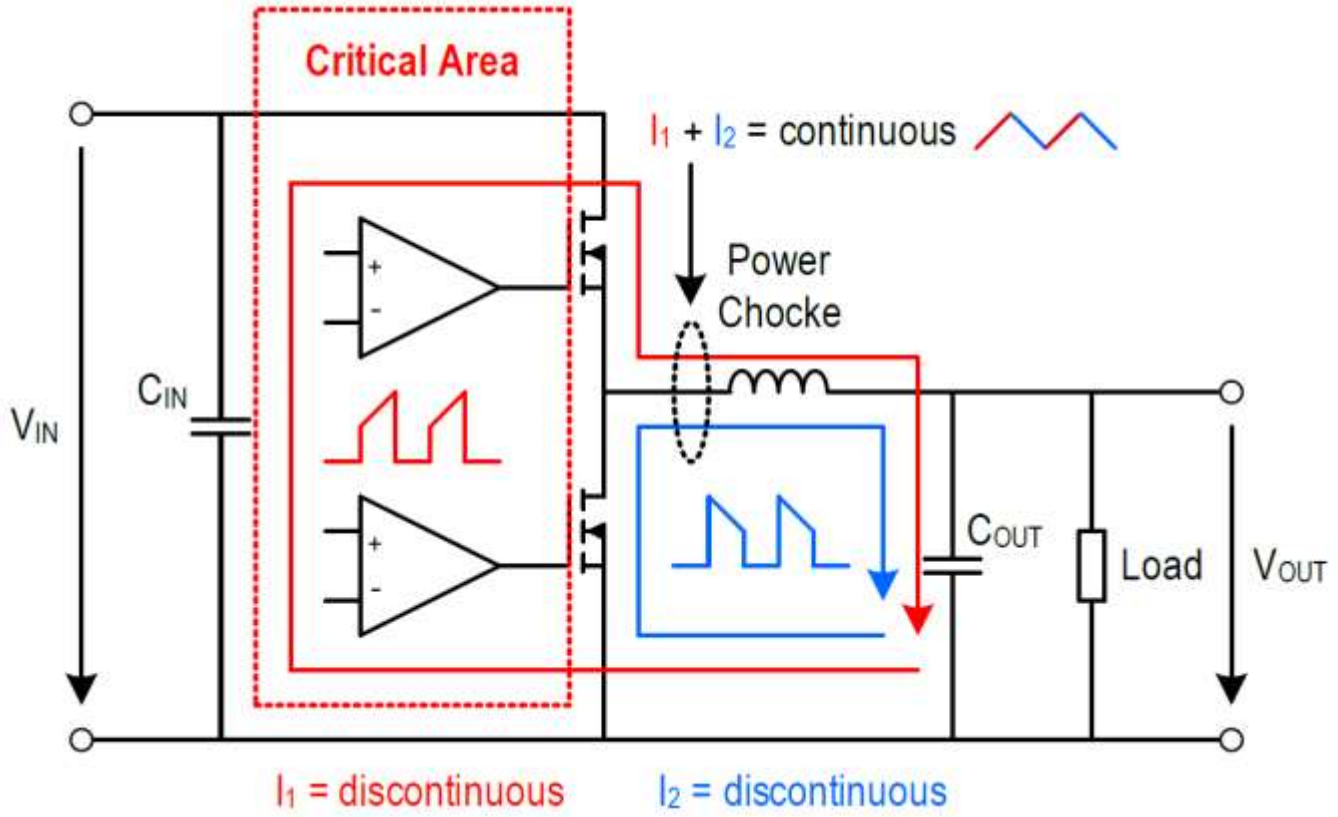
EMI measurement – radiated emission - root cause

- EMC view => a buck converter is much more critical at the input
- Discontinuous current consumption due to the fast switching processes
- An "LC filter" is already present at the output, which integrates the discontinuous current on the high side



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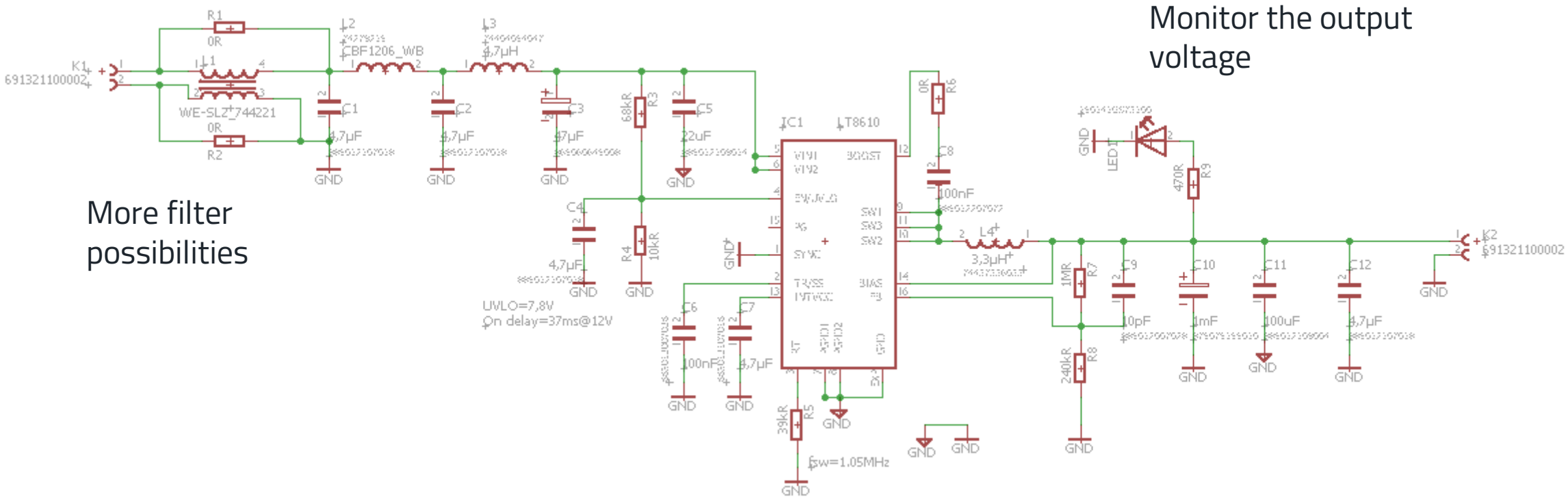
New design – schematic



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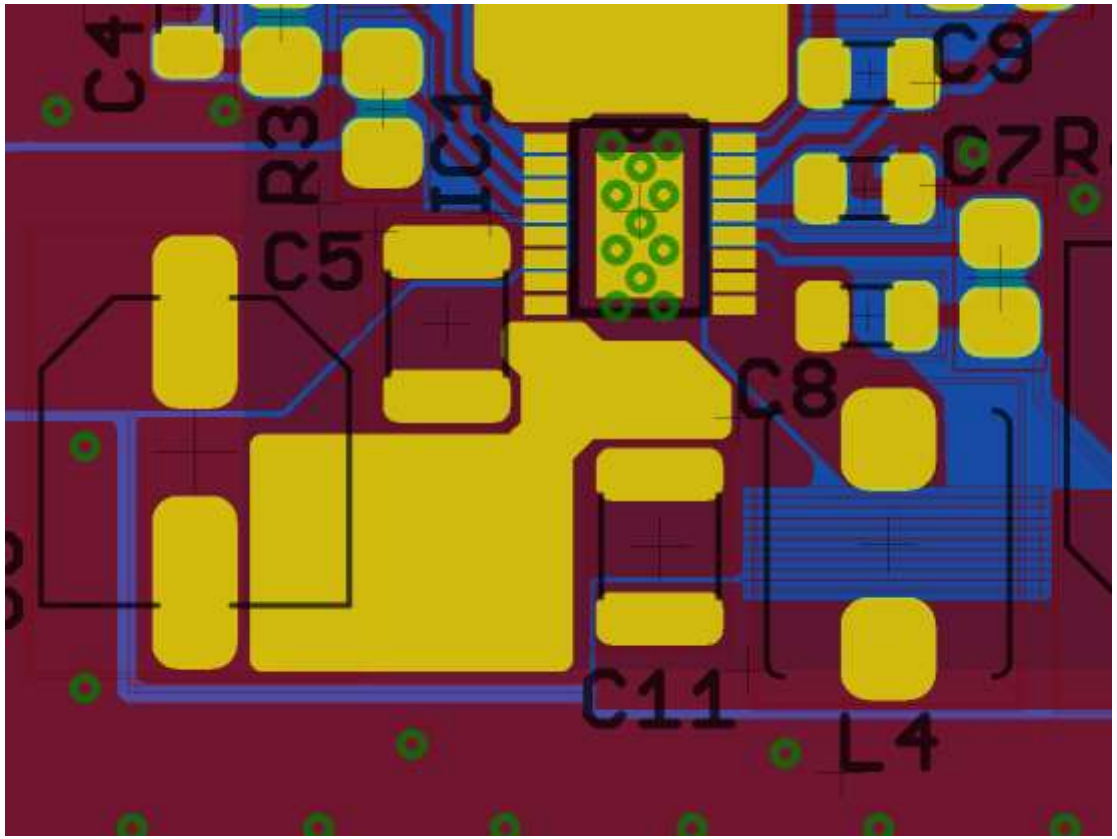
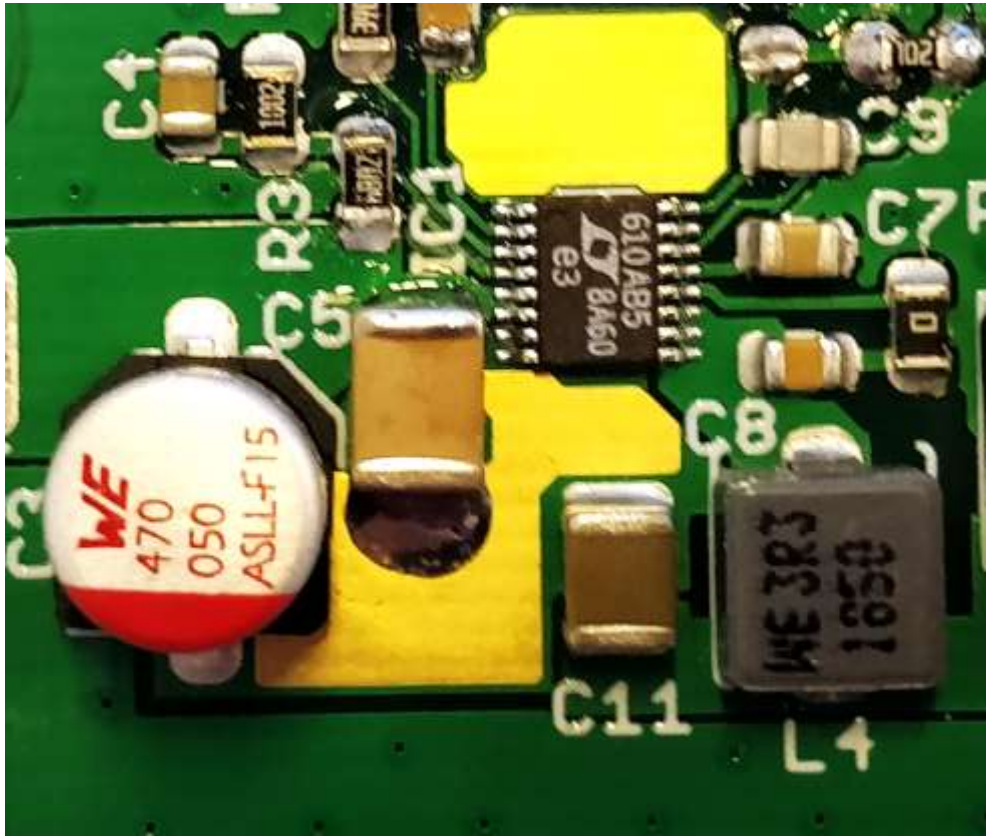
New design – layout

- Current loops: Keep it short





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New design – layout

- Good ground contact for capacitors and connectors