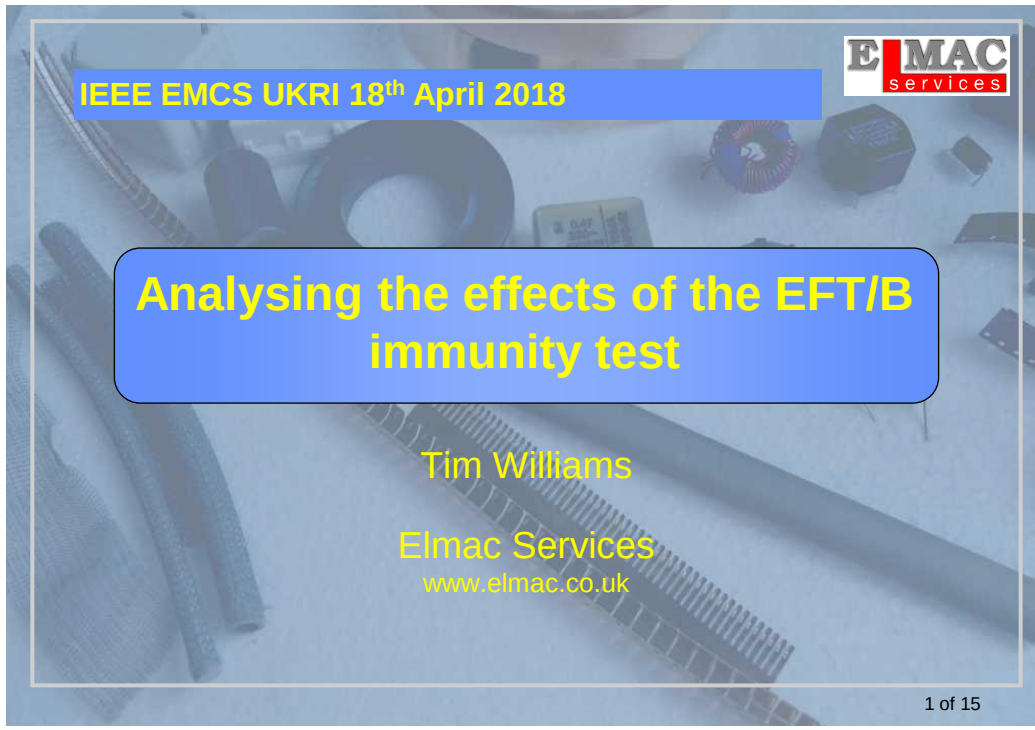

Outline

- The EFT/Burst test and its generator
- An experimental setup to determine coupling and its Spice model
- Some results of the experiment and comparing it to the model
- Another experimental setup, its model and results
- Conclusion and insights

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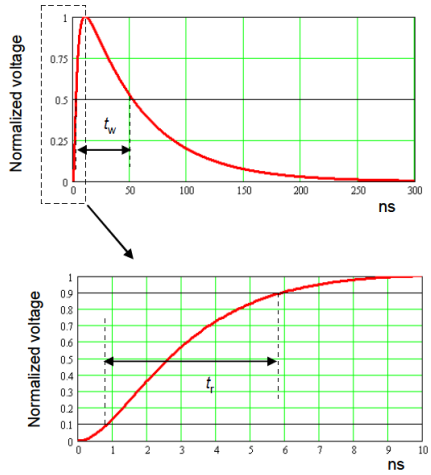
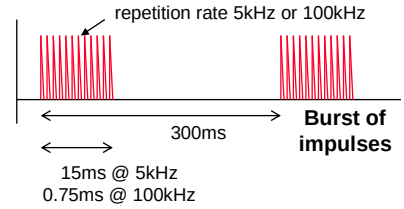
The IEC 61000-4-4 ideal waveform

A single pulse....



in a burst of 75 pulses



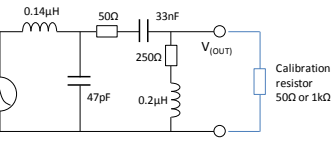
15ms @ 5kHz
0.75ms @ 100kHz

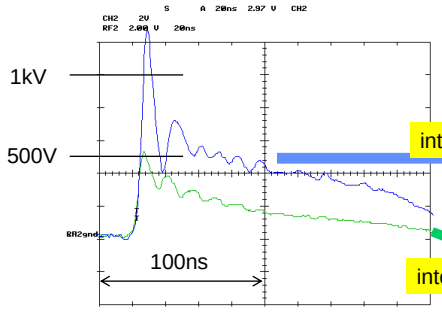
Tolerances:
- rise time t_r = (5 ± 1,5) ns
- Into 50 ohms:
- pulse width t_w = (50 ± 15) ns
- peak voltage, half indicated level ±10 %
- Into 1000 ohms:
- pulse width t_w = 50 ns, tolerance –15 ns to +100 ns
- peak voltage, 0.95 indicated level ± 20 %

The actual generator output

The model

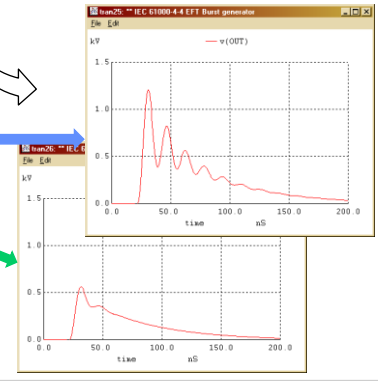
For 1kV output:
Transient voltage source, Spice model
EXP(0 1400 20ns 4ns 8ns 56ns)





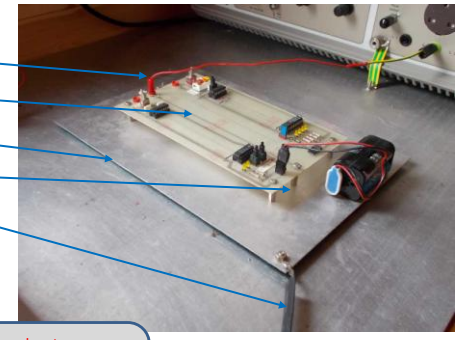
into 1kΩ

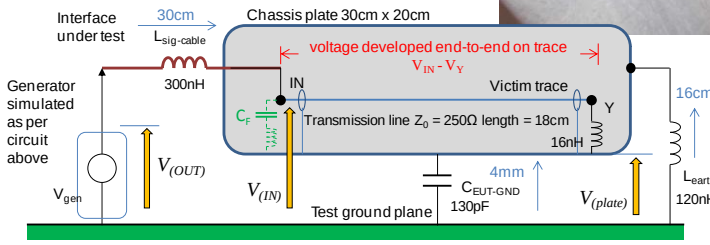
into 50Ω



Actual calibration waveform

The first experiment: trace over chassis





The model

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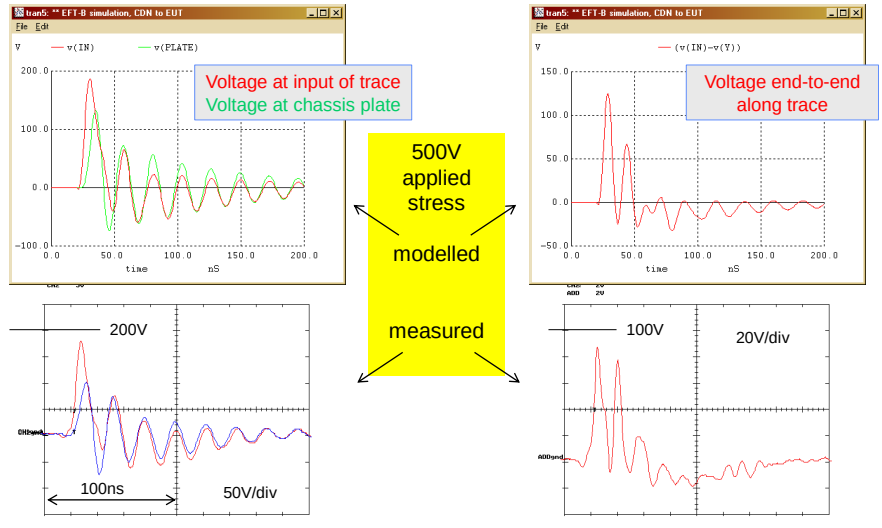
Comparison of model vs. actual waveforms



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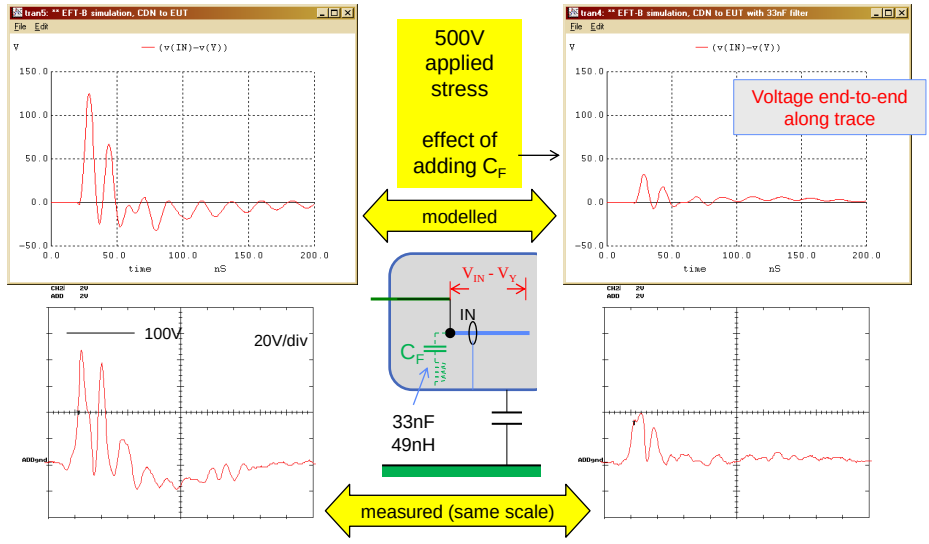
Comparison with/without filter capacitor



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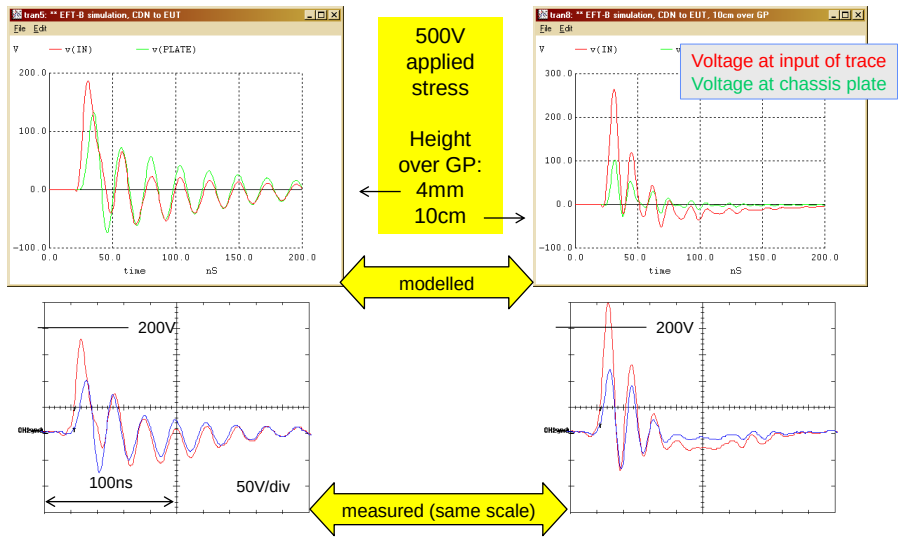
Comparison of height above test ground plane



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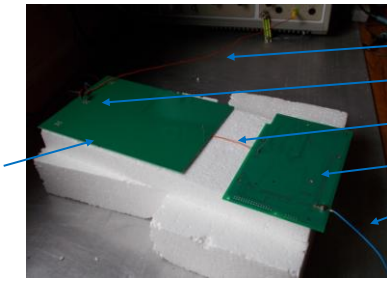
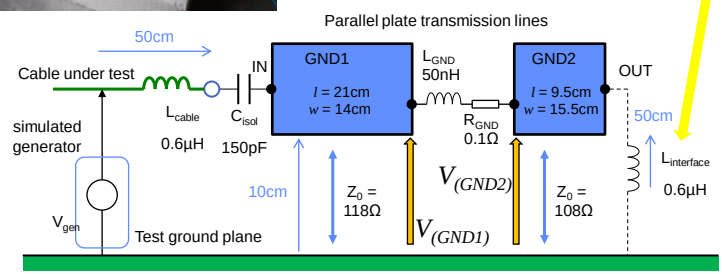
The second experiment: 2 boards, no chassis



The model



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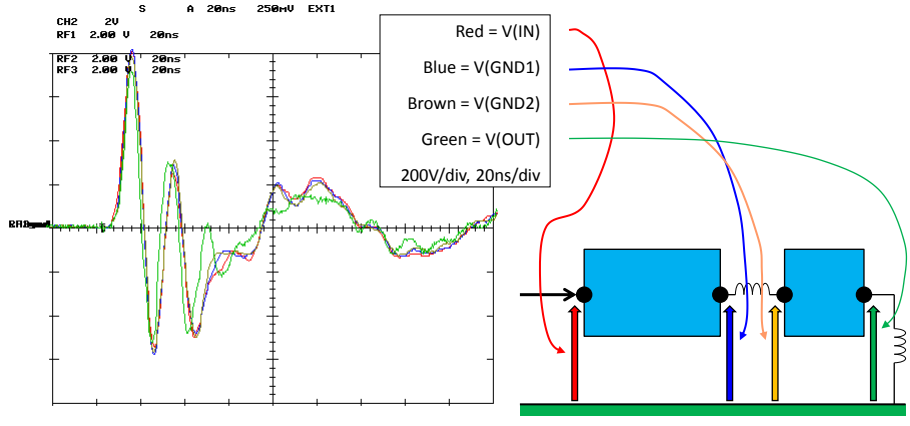
Example actual waveforms



+1kV stress, OUT interface grounded through 50 cm

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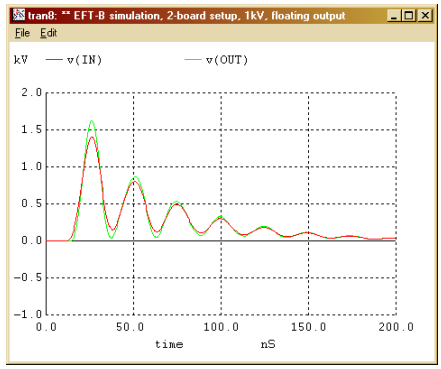
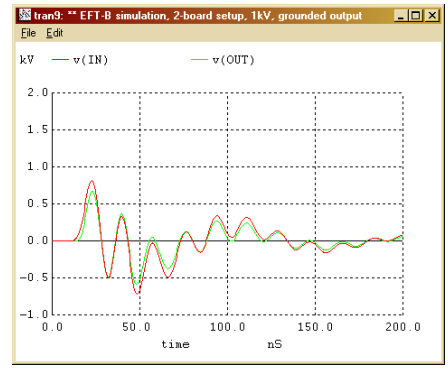
Model analysis – IN/OUT voltages





OUT interface: Floating

Grounded through 50 cm

+1kV stress, IN and OUT voltages

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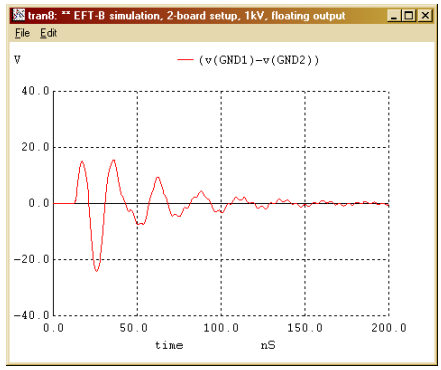
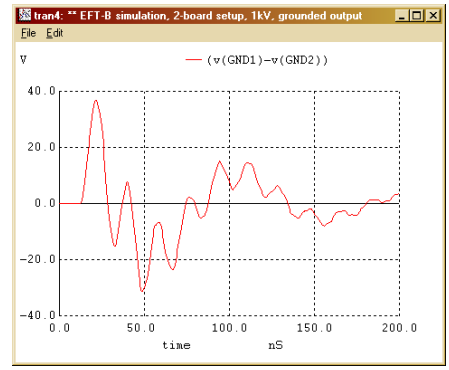
Model analysis – inter-board voltages





OUT interface: Floating

Grounded through 50 cm

+1kV stress, GND1 – GND2 voltages

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Conclusions and insights – the test

- The actual waveforms and levels on the EUT during an EFT/B test are nothing like the idealised stress:
  - they are modified by the parasitic impedances of the various structures, including the connecting cables and the presence and proximity of the test ground plane
  - they have a large and variable-frequency ringing component
- External interfaces other than the one being tested have a significant effect on the coupling, and must always be carefully controlled in the test plan

Conclusions and insights – modelling

- Consider the *electrical* behaviour of *mechanical* components:
  - not the circuit schematic, rather the structures and wires that are present as components themselves
  - draw up an equivalent circuit which shows their interconnections in the context of the external test setup
- Modelling this circuit can show the actual waveforms at critical points in the structure
- The model can evaluate options for improving immunity, as long as the parasitics are included

END

Thanks for your attention!

A more detailed description can be found at
www.elmac.co.uk/Papers.html