Theme 6 Passives

## Manchester University
Monday 7th April 2014

Partners and Researchers

- Bristol (Phil Mellor)
  - PDRA Team: Dr Rafal Wrobel and Nick Simpson
  - PhD: Andrew Hopkins
- Manchester (Andy Forsyth)
  - PDRA: Dr Tom Ki working on converters area
  - PhD: Yiren Wang
- Sheffield (Dave Stone)
  - PhD: Dave Hewitt , reported under design tools

Bristol PDRA activities

- Comparison of two experimental techniques:
  - Full loss measurement
  - Impedance analyser

Direct measurement of loss

Impedance analyser
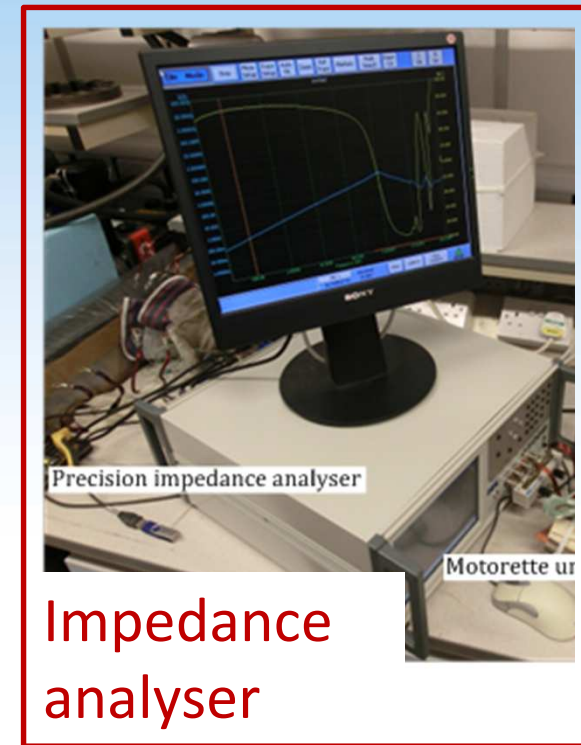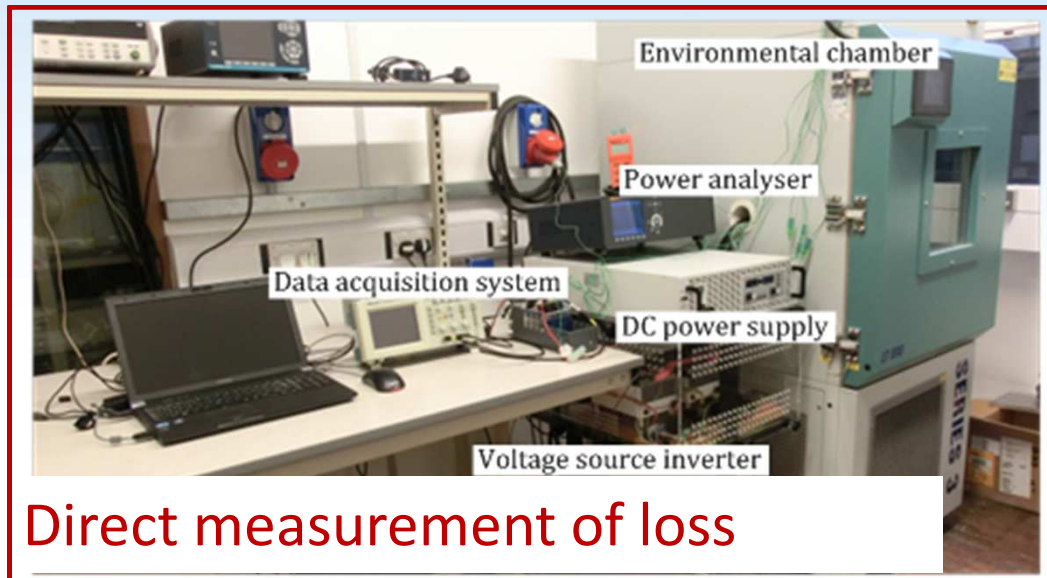
Bristol PDRA activities

- Coils made from copper and aluminium compared

k = 2.6W/m·K

Cu

k = 2.4W/m·K

Al

5 conductors in parallel
ø1.6mm 35 turns
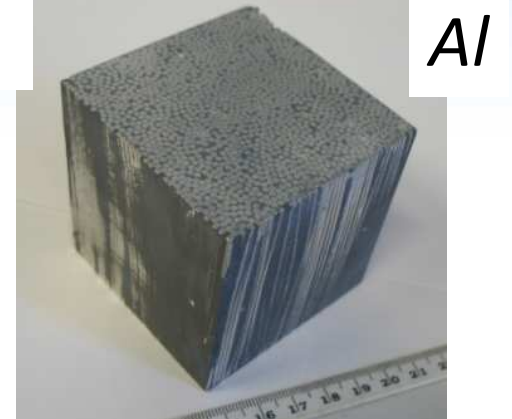
Bristol PDRA activities

- Loss trends using two methods would seem comparable
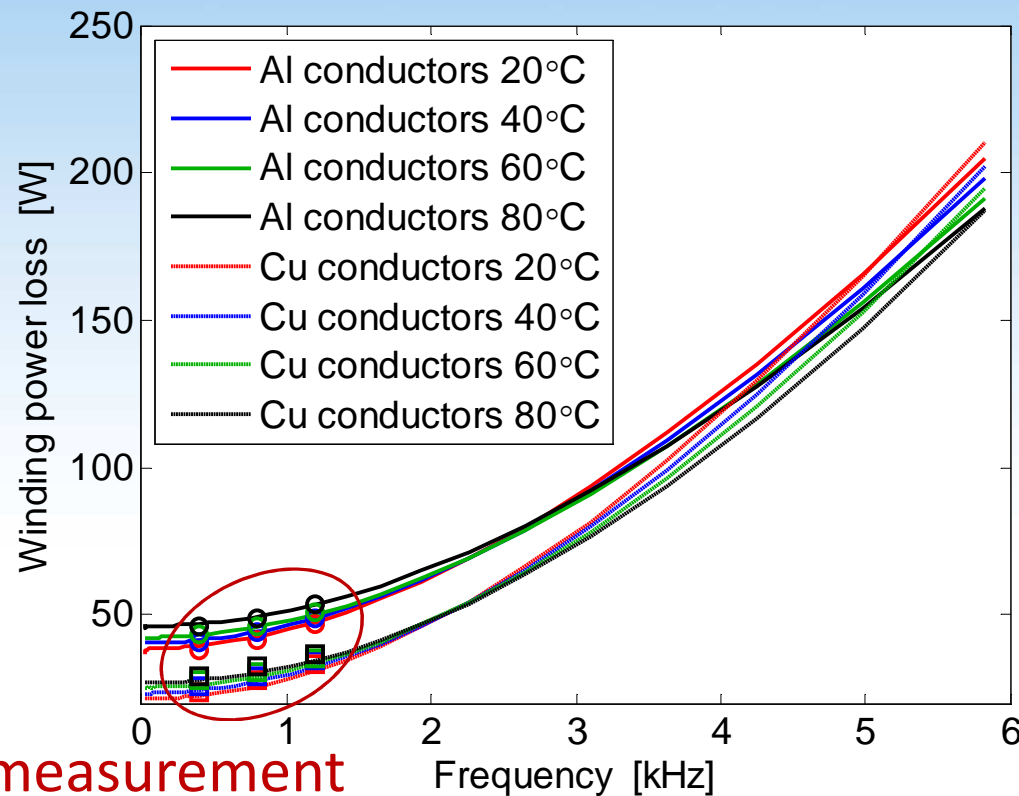
$I = 40A_{rms}$

Impedance measurement full line trends

Direct measurement

Bristol PDRA activities

- AC loss effects – Aluminium or Copper?

Copper dashed lines

Aluminium solid lines

Bristol PHD activities

- Continued circuit characterisation activities
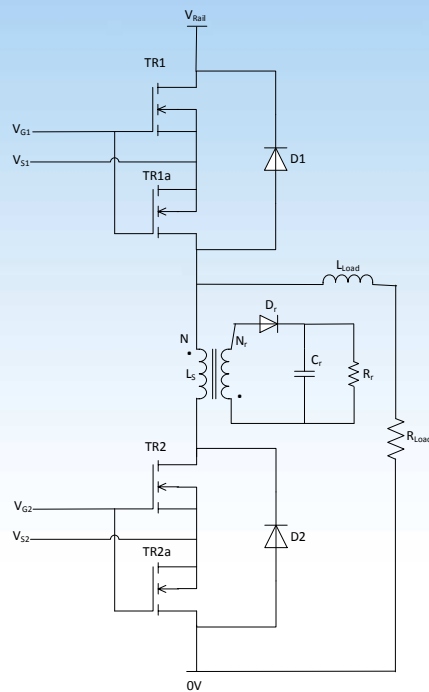
Test circuit
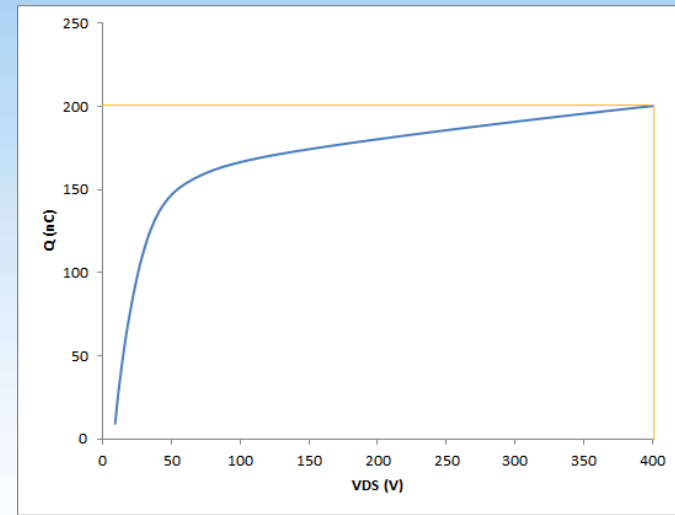
Measured Q-V characteristics

Calorimeter

- Calorimeter under construction to improve accuracy of component loss measurement

Inductor Modelling & Design - UoMcr

- Use of amorphous metal cores

- Loss models have been established using FEA techniques, particularly eddy current loses in laminations around gaps
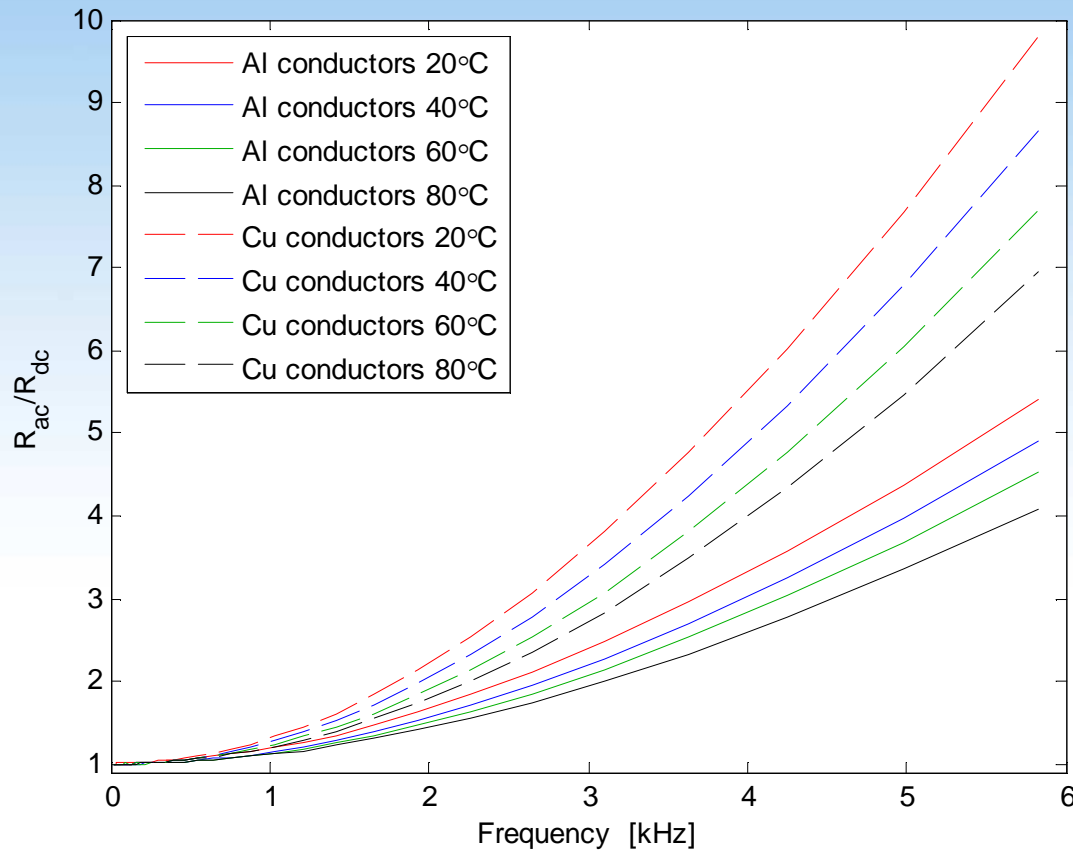
- Validation tests on loss modelling work ongoing. Research paper is in draft.

Potted inductor with embedded thermal sensors

Measurement Points	FEA [°C]	Measurement [°C]
CoG1	89.2	88
CoG2	84.7	85.5
CG1	84.4	80
CG2	74.2	71.2
TG1	84.1	80.2
TG2	74.2	71.7
Coil	69	67.2

Status of deliverables

	Deliverable	Due date	Status
D6.1	Benchmarking activities	30/06/12	Completed
D6.2	Improved loss model	30/09/12	Completed
D6.3a	Definition of USH PhD aims	30/06/12	Completed
D6.6	Sheffield Yr 1 PhD report	31/12/12	Completed
D6.7	Manchester Yr 1 PhD Report	31/12/12	Completed
D6.3	Winding properties data base	31/03/13	Completed
D6.4	Data base of core material properties	June 14 (Oct 13)	Joint report with MCR
D6.10	Manchester Yr 2 PhD Report	31/12/13	Completed
D6.11	Definition of UoB PhD aims	28/02/14	Completed
D6.8	Bristol Yr I PhD Report	June 14	
D6.9-	Prototype evaluation and models	June 14	

Work plan (UoB activities)
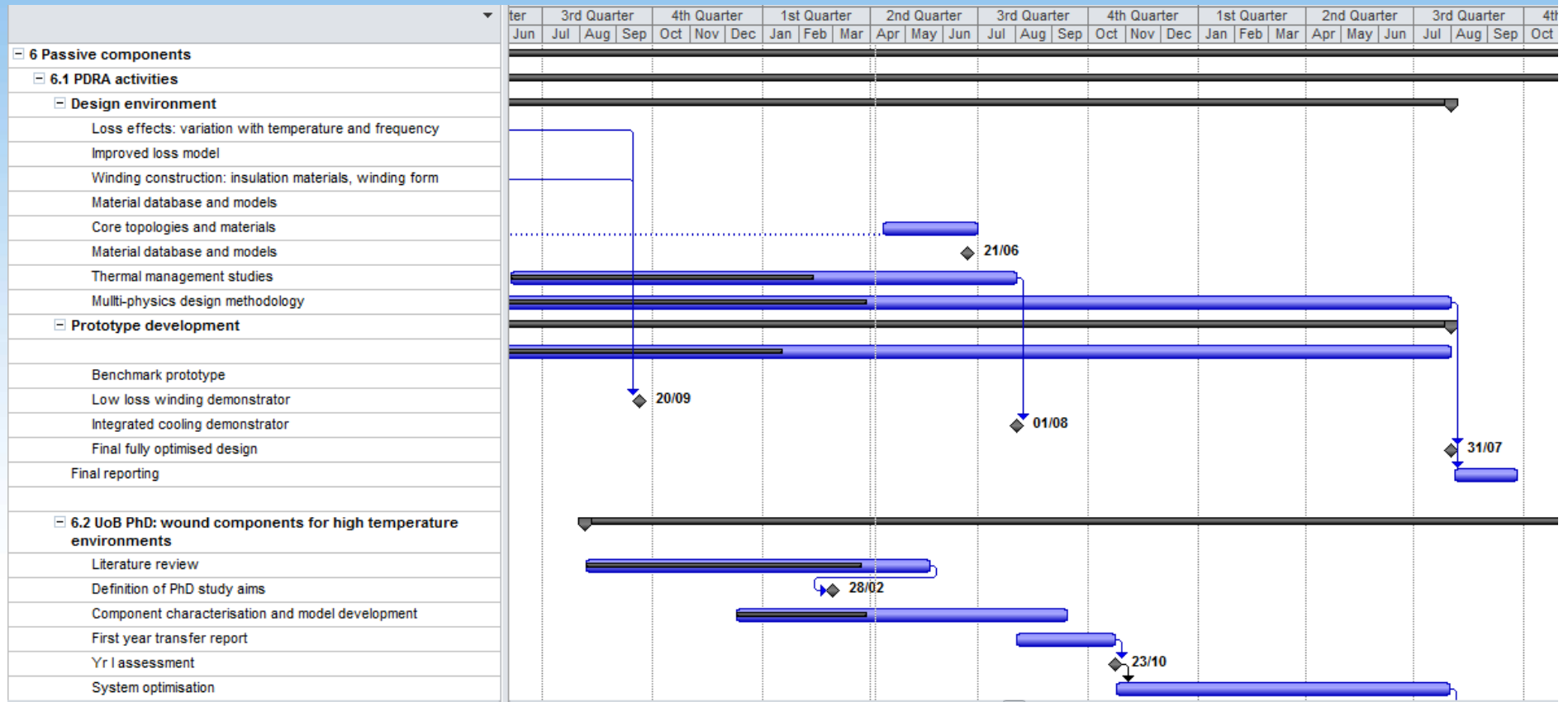
Work plan (UoMcr activities)

Task Name	2013				2014				
	ter	3rd Quarter	4th Quarter	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	1st Quarter	2nd Quarter
	Jun	Jul Aug Sep	Oct Nov Dec	Jan Feb Mar	Apr May Jun	Jul Aug Sep	Oct Nov Dec	Jan Feb Mar	Apr May Jun
6.4 UoMcr PhD: Improved nanocrystaline core materials									
Core loss characterisation & modelling									
First year report and review									
Yr I report published									
Nanocrystalline core modelling and design optimisation									
Design and fabrication of test component									
Component test, evaluation and refinement of techniques									
Second year report and review									
Techniques for integrated design of converter & magnetics									
Thesis writing and publication									

Next steps

- Bristol PDRA –Focus of AC effects for copper and aluminium windings. Demonstrate design tools to comparable designs of copper and aluminium filter inductors against the same specification

- Bristol PhD – Super-junction device loss characterisation through evaluation of a switching cell. Continue to gain practical understanding through experimentation, literature update. Improved accuracy test-bed for measuring losses

- Manchester PhD – Continue validation activities of modelling work on an amorphous cored gapped inductor in a DC-DC converter

- Manchester PDRA – Reporter under Converters theme

- Sheffield – Reported under Design Tools