16th Annual Meeting

Design and optimization of very high voltage magnetic transformer for aerospace applications

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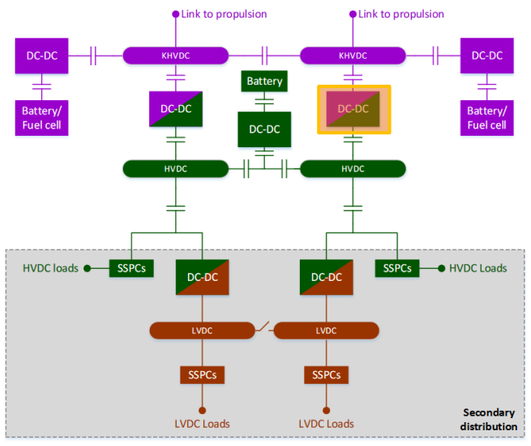
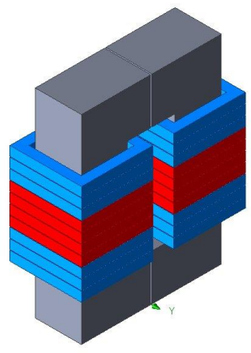
ABSTRACT

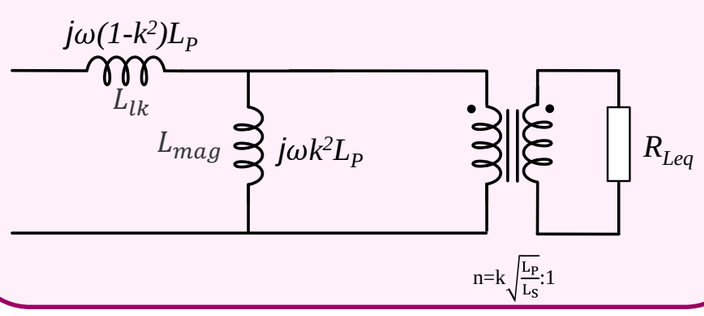
To achieve climate neutral air mobility by 2050 set by ACARE (Advisory Council for Aeronautics Research in Europe), requires the aviation industry to do a further step. In this context, HECATE (Hybrid ElectriC regional Aircraft distribution TEchnologies) project from Clean Aviation is born. CEI-UPM is working in the design and optimization of a magnetic component for the hybrid-electric propulsion system of the aircraft that is being designed by Collins Aerospace. Transfomer will be part of an isolated DC/DC converter in the KHVDC supply rail based on LLC and DAB converters.





TRANSFORMER SPECIFICATIONS

Parameters	Value
Power	100 – 300 kW
Frequency	25- 100 kHz
Primary voltage (square)	800 V
Primary current (senoidal)	150 - 300 A_{RMS}
Secondary current (senoidal)	200 - 400 A_{RMS}
Turns ratio	6:4
Lmag	20 – 40 µH
Llk	1 – 5 µH



ANN WITH E-TYPE CORE PROCESS

Training the ANN

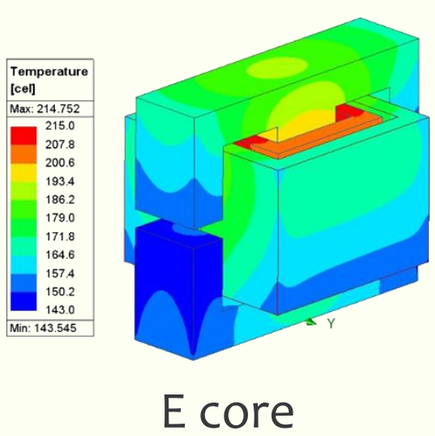
V,I,P → **Geometry** based on analytical equations → Magnetic ANN → Z matrix → **Power** obtained from analytical equations → Thermal ANN → Avg. Temp

Inputs: V, I, P
Outputs: Geometry, Z matrix, Power, Avg Temp.

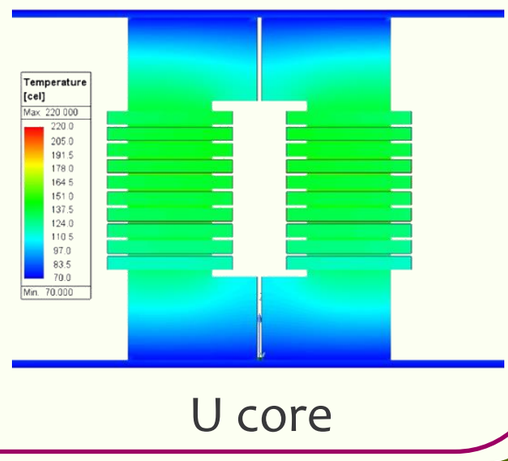
Using the ANN

Geometry → Magnetic ANN → Z matrix

Geometry, Power → Thermal ANN → Avg. Temp



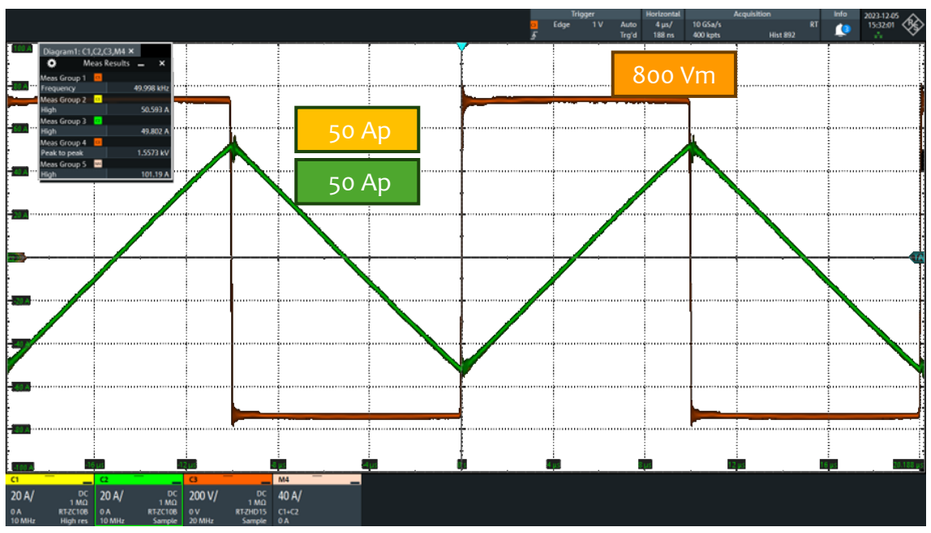
E core



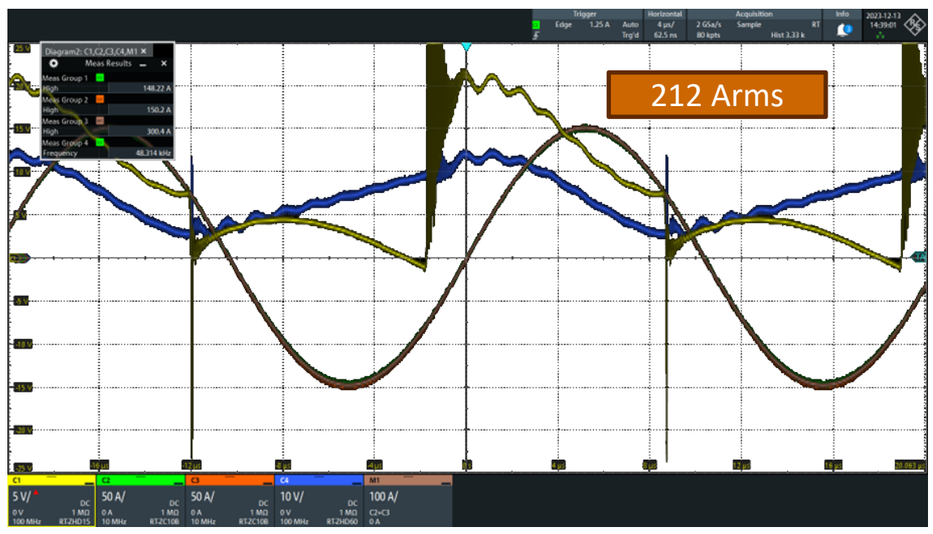
U core

Experimental results

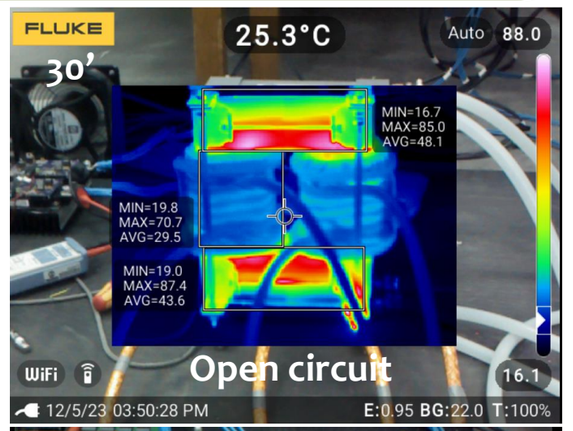
Open circuit test (core losses)

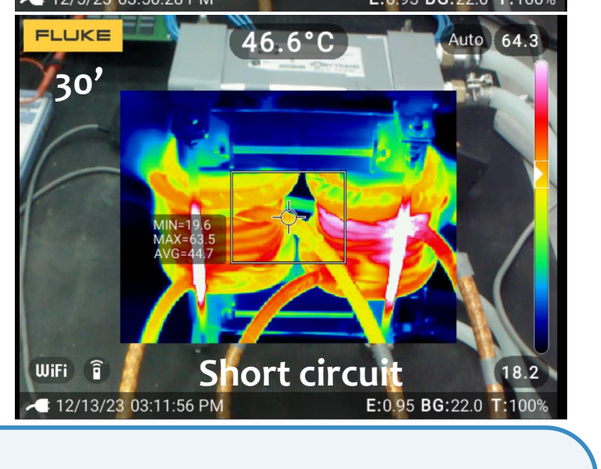


Short circuit test (winding losses)



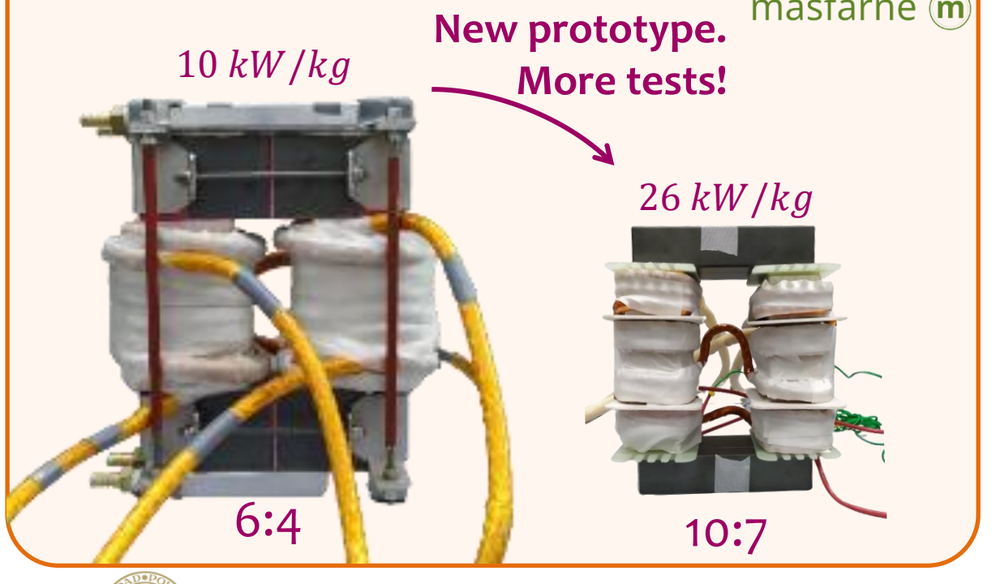
Excellent parallel windings . Identical current waveforms.





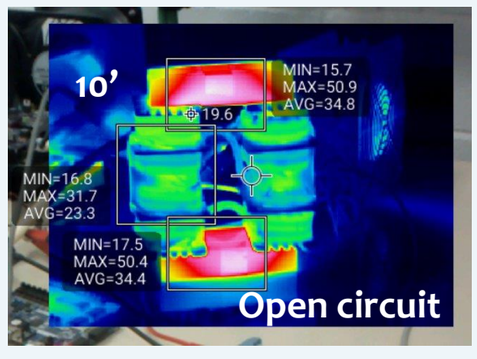
Future work

TORYTRANS masfarnē



Conclusions

- ANN is a useful tool but E core **not suitable for this application**.
- Finally, the prototype designed with FEM simulations **performed as expected**.
- Poor heat transfer between **ferrite tiles**. New prototype is built with **stacked U cores**.



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Project sponsored by Co-funded by the European Union

Project: HECATE
Ref. Number: 101101961

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