Integrated Magnetics

MagIC – Making magnetics disappear into IC's

Tyndall's Integrated Magnetics group are widely recognised as World Leaders in the area of Integrated Magnetic Passives for Power Supply on Chip technology. With over 100 man years of research effort in this field, the group has demonstrated multi-disciplinary skill set for Power Magnetics research which makes it unique within the European Power Electronics

landscape.

Integrated Magnetics Venn Diagram

Integrated Magnetics Venn Diagram

Over a period of 20 years, Tyndall's Integrated Magnetics group has demonstrated World beating results in the area of Integrated Magnetics for PCB and On-Silicon applications. In this period group has developed innovative solutions in all aspects of Power Magnetics research, including design, material & process development, micro-fabrication, electrical characterization, packaging and reliability. The group was the first to develop an optimization CAD tool for design of magnetic passive components on silicon, establish a magnetics processing platform for prototyping on-silicon magnetics and development of best-in class magnetic materials.

To date, the group have demonstrated highest efficiency for a micro-inductor (93%), highest efficiency micro-transformer (80%) and ultra-low loss high flux density soft magnetic materials (less than half ferrite power loss density). The team are presently co-ordinating the first EU-funded FP7 project on development of Power Supply on Chip technology (PowerSwipe) and are leading the Power Supply development Work Package in an IBM-led FP7 project, Carricool.

Coupled inductor with Power Management IC (PMIC) on Passive interpo

Coupled inductor with

Power Management IC (PMIC) on Passive interposer

Tyndall Coupled inductor device from PowerSwipe project

Tyndall Coupled inductor device from PowerSwipe project

Tyndall Magnetics - Key Achievements

- Highest efficiency (93%) demonstrated for micro-inductors. Demonstrated in converter ckts at 500mA up to 100MHz.
- Highest voltage gain, inductance density & efficiency (80%) for micro-transformers at 20 MHz.
- First CAD tool for power micro-inductors.
- First high frequency integrated power magnetics using pulsed reverse electroplated magnetic material.
- Co-ordinating the first EU funded project on PwrSoC, to establish an European supply chain.
- Patented technology on micro-inductor/transformer designs.

Tyndall Magnetics Profile

- 100+ Man years of effort
- €30M Investment over 20 years

Magnetic Materials

- Thin-film, sputtered/electroplated magnetic core

- Functional Integration in package, PCB, silicon

Power Magnetics Design

- Optimisation models validated
- Focus on eciency & footprint
- High frequency >100MHz
- High inductance density, Low DCR Novel topologies

Multidisciplinery Research Capability

- Design, Fabrication, Magnetic Materials, Wafer-level Test, Packaging/Integration, Reliability

Equipment

- SQUID (Superconducting quantum interference device) Magnetometer with variable temperature platform (1.4K-800K), Model – MPMS XL5; Quantum design, USA
- High Frequency Permeameter; Model – PMM 9G;Ryowa Electronics, Japan
- B-H Loop Tracer, Model – MESA 200 HF; SHB Instruments, USA
- Agilent E5071C Vector Network Analyzer/ Cascade Summit 9000 manual probe station
- Agilent E4294A precision impedance analyzer that covers a broad test-frequency range (40 Hz to 110 MHz)

Opportunities

- We are interested in research collaborations and commercialisation of our technology.

Contact enquiry (at) tyndall (dot) ie for all Business Development enquiries

---

Core Team

- Cian O'Mathuna
  MNS (Circuits and Systems) - MNS (Circuits and Systems) and Strategic Programs
  cian.omathuna (at) tyndall (dot) ie
- Santosh Kulkarni
  MNS (Circuits and Systems) - Magnetics on Silicon

+353-21-2346249
santosh.kulkarni (at) tyndall (dot) ie_unpublished
- Zoran Pavlovic
  MNS (Circuits and Systems) - Magnetics on Silicon
  +353 (0)21 2346003
  zoran.pavlovic (at) tyndall (dot) ie
- Xi Cao
  MNS (Circuits and Systems) - LSI (Integrated Biosensor Technologies)
  +353 (0)21 2346877
  xi.cao (at) tyndall (dot) ie_x_unpublished
- Paul McCloskey
  MNS (Circuits and Systems) - Magnetics on Silicon
  +353 (0)21 2346621
  paul.mccloskey (at) tyndall (dot) ie
- Satya Kubendran
  MNS (Circuits and Systems) - Magnetics on Silicon
  satya.kubendran (at) tyndall (dot) ie_unpublished
- Declan Jordan
  MNS (Circuits and Systems) - Magnetics on Silicon
  +353 (0)21 2346534
  declan.jordan (at) tyndall (dot) ie

Contact

- Cian O'Mathuna
  MNS (Circuits and Systems) - MNS (Circuits and Systems) and Strategic Programs
  cian.omathuna (at) tyndall (dot) ie
- Paul McCloskey
  MNS (Circuits and Systems) - Magnetics on Silicon
  +353 (0)21 2346621
  paul.mccloskey (at) tyndall (dot) ie

Related Publications

- High Efficiency on Si-Integrated Microtransformers for Isolated Power Conversion Applications
  IEEE Transactions on Power Electronics volume **30** issue **10** pages **5746 to 5754** (2015)
  Authors: Ningning Wang, Rais Miftakhutdinov, Santosh Kulkarni, Cian OMathuna

---

- Optimization of Coupled Stripline Microinductors in Power Supply on Chip Applications
  IEEE Transactions on Power Electronics volume **31** issue **8** pages **5805 to 5813** (2016)
  Authors: Ciaran Feeney, Ningning Wang, Santosh Kulkarni, Zoran Pavlovic, Cian O Mathuna, Maeve Duffy

---

- Low Loss Magnetic Thin Films for Off-Line Power Conversion
  IEEE Transactions on Magnetics volume **50** issue **4** pages **1 to 4** (2014)
- Authors: Santosh Kulkarni,

Advances in Planar Coil Processing for Improved Microinductor Performance
IEEE Transactions on Magnetics volume **50** issue **11** pages **1 to 4** (2014)
Authors: Ricky Anthony, Ningning Wang, Santosh Kulkarni, Cian O. Mathuna