Development of Miniature Point of Load

(ARTES 5.2)

H. Löfgren
Presented by: A. Karlsson Schippers

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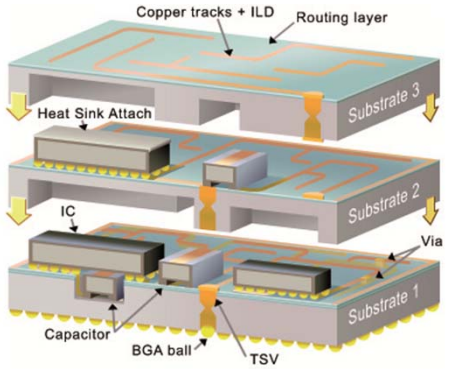
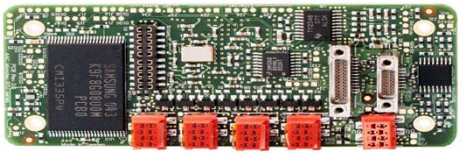
Agenda

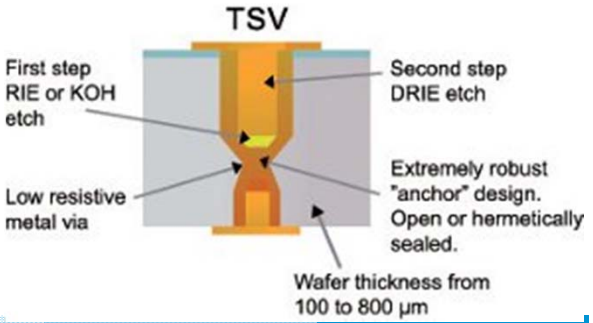
- Company introduction
- POL
- Goal and specification
- Manufacturing & packaging
- µCoil
- Outlook

ÅAC Microtec – capabilities

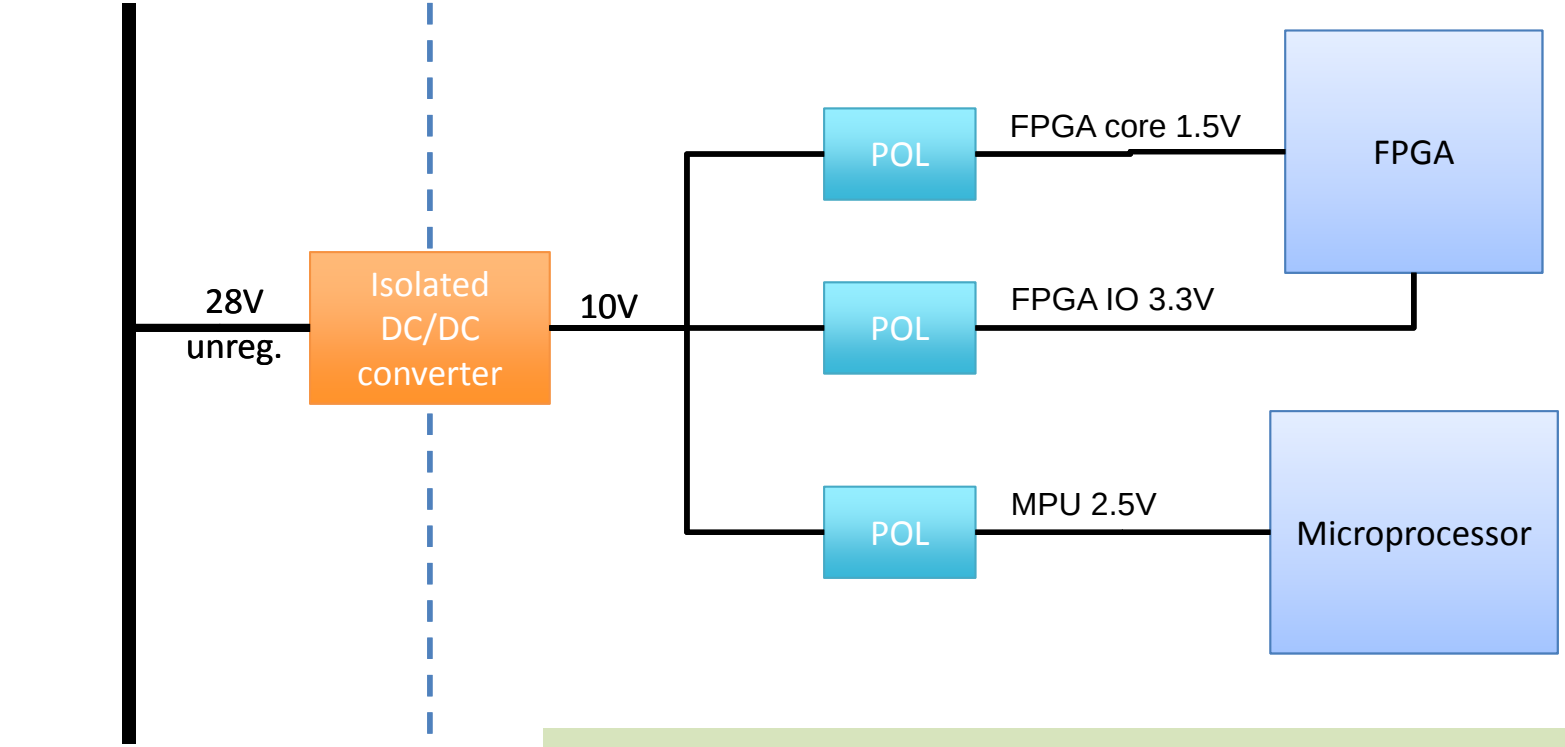
- Develops, manufactures and markets miniaturized and robust multifunctional electronics systems
  - Spin-off from Uppsala University, established in 2005
  - 27+ employees, revenue 2011: 4M€
  - Unique cooperation with US air force & NASA on satellites and space components
  - Clean-room (class 1000 with access to class 100)
- Specialist microelectronics services, e.g.
  - Thin Film production
  - Pulse electroplating (Cu, Ni, Au)
  - UBM chip preparation (ENIG/ENEPIG)
  - High-accuracy substrate stacking
- Example products:
  - PnP Space electronics
    - nRTU Processor PIC 16F84 (16 MIPS @ 16 MHz), 1 kB RAM
      - 32 x 32 x 7 mm, ~5 grams, 20 krad
    - µRTU OpenRISC1200 processor (24 MHz), 64 MB RAM
      - 70 x 30 x 10 mm, ~15 grams, 20 krad
  - ÅAC's XiVIA™ Through Silicon Via
    - Constriction
    - Easy manufacturing, mechanically strong, good electrical







What is a POL ?

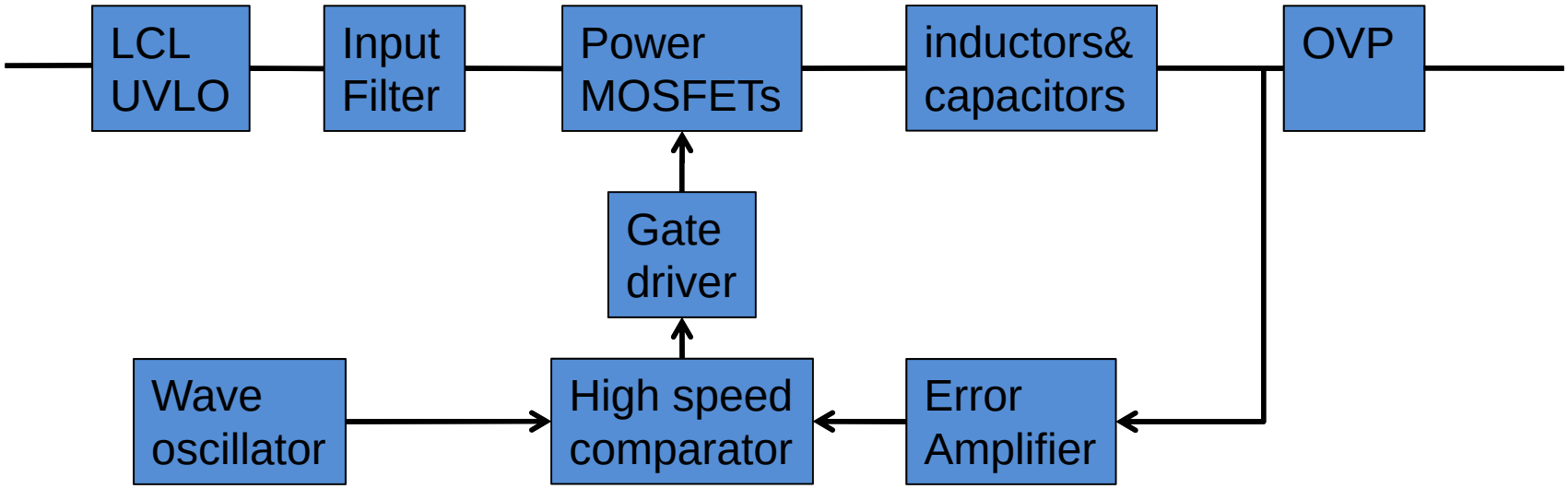


Advantages:

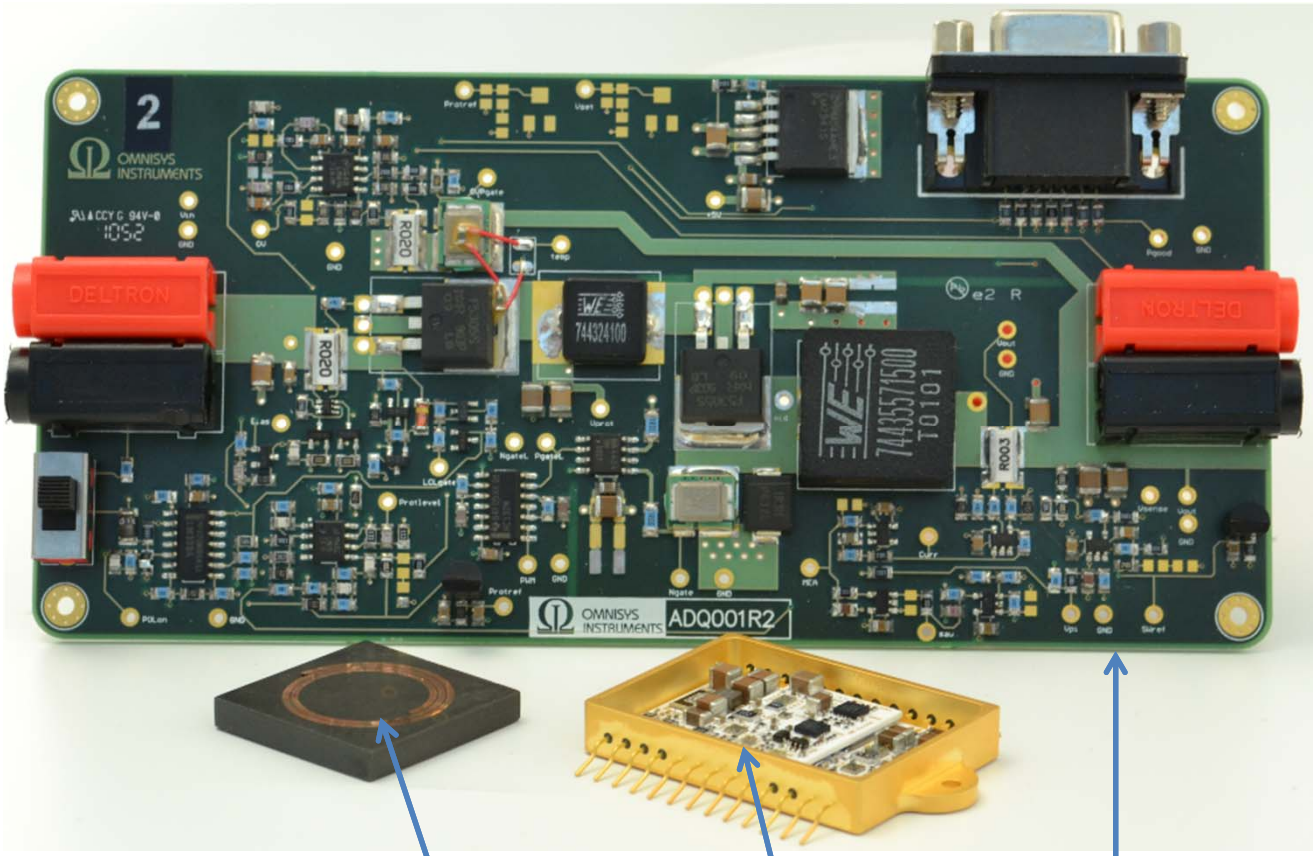
- Single output voltage from DC/DC conv.
  - Lighter DC/DC conv.
  - Higher efficiency
- POL close to power consumer
  - Better regulation and efficiency

Generic POL block diagram

(buck converter)



What do we want to achieve?



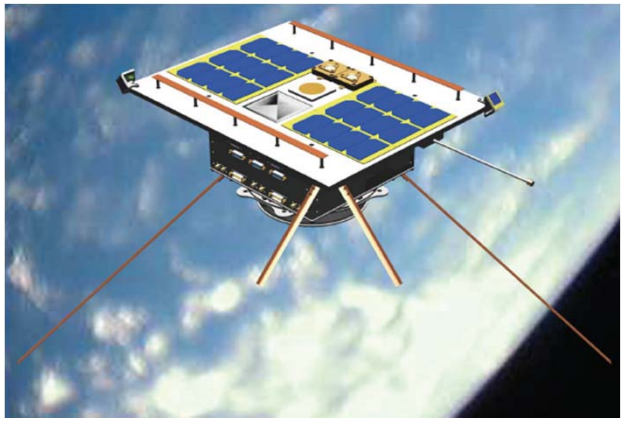
µCOIL
@ 20 A

µPOL

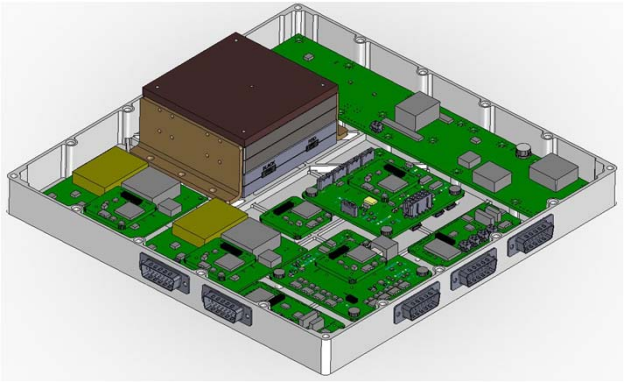
POL PCB Prototype

Background – National µPOL development

- Demonstration of ÅAC packaging technology
- Demonstration of ÅAC patent pending µCoil
- Radiation tolerant (30 kRAD) with up-screened ITAR free commercial components.
- Planned space qualification on QuadSat-PnP



- Reasons for new programme
  - Commercial quality components
  - Screening 30 krad
  - External coil
  - ESA compliant PA programme applied to new POL



µPOL summary data sheets

Summary Data Sheet µPOL

(existing component)

- Buck converter architecture
- Input voltage: 8 - 13 V
- Output voltage: 1.5 - 5 V (configurable)
- Max output current: 5 A
- Efficiency >85%
- Input current limiter
- Output overvoltage protection & current limiter
- Telemetry: On/off, power good

- Component radiation tolerance 30 kRad
- Operational temperature -40 C to +75 C
- Mass: 25g (excl. coil)
- Dimensions: 38 x 48 mm^2 (excl. coil)
- ITAR-free

Preliminary Data Sheet New µPOL

(Component under development)

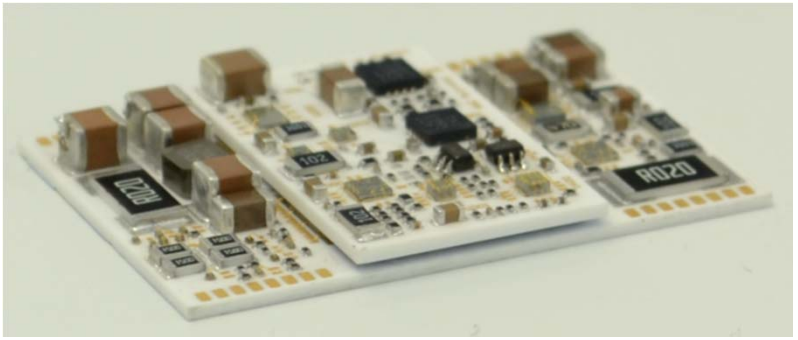
- Buck converter architecture
- Input voltage: 4.75 – 6.25 V
- Output voltage: 1.25 – 3.5 V (configurable)
- Max output current: 3.5 A
- Efficiency >88%
- Input current limiter
- Output overvoltage protection & current limiter
- Telemetry: On/off, power good

- Component radiation tolerance 50 kRad
- Operational temperature -40 C to +75 C
- Mass: <35g (incl. 2 coils)
- Dimensions: 52 x 27 x 6 mm^3 (incl. 2 coils)
- ITAR-free

µPOL devlopment

POL Development Models

- Electrical Model
  - PCB proving electrical performance
- Design Verification Electrical Model
  - Stacked LTCC, proving POL design on LTCC
- Advanced Package Electrical Model
  - Stacked LTCC with Rad hard components



Thermal Design

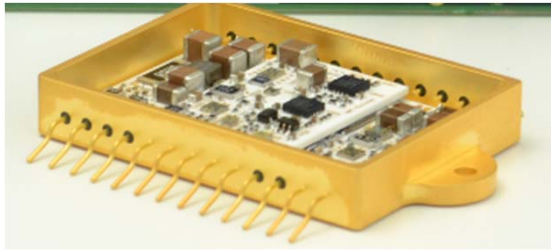
- LTCC material (thermal dissipation 3-5W/m-K)
- Thermal vias for increased thermal dissipation (up to 5 times)
- BGA stacking (2 LTCC substrates planned)
- Conductive adhesive in substrate/metal interface

Mechanical Design

- Wire bonding & SMD (ECSS compatible)
- Nickel/Palladium/Gold metallization for high assembly reliability
- POL package is surface mounted

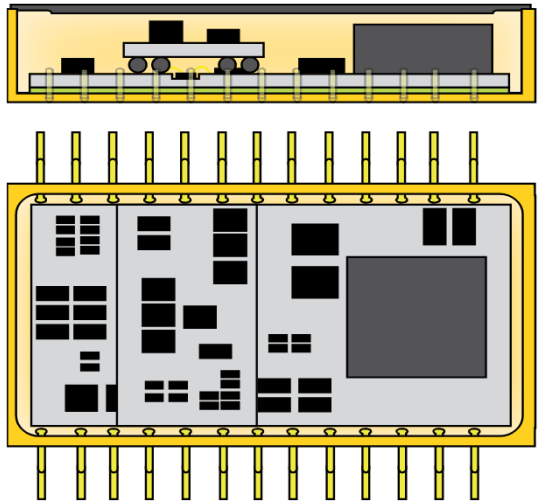
Previous generation µPOL

- Hermetic seam sealed package
- SCHOTT package
- Substrate wire bonded to package.
- External inductor
- Dimensions: 38 x 48 mm^2
- Mass: 25g



New µPOL

- Hermetic seam sealed packaging
- Surface Mount Device package
- Substrate wire bonded to package
- Includes 2 ÅAC µCoils
- Dimension: 52 x 27 x 6 mm^3
- Mass: <35g



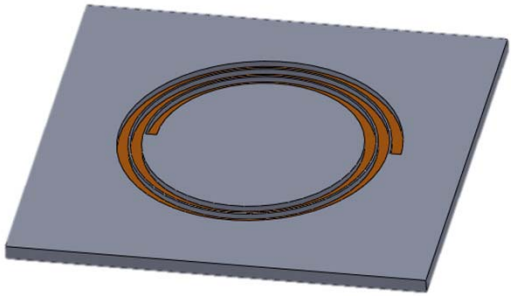
Note picture shows single µCoil

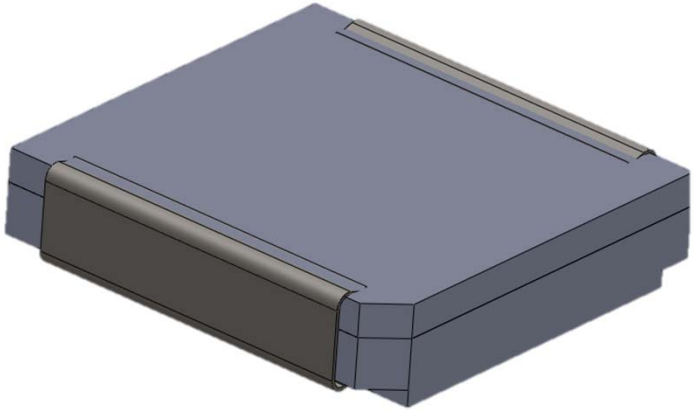
µCoil development

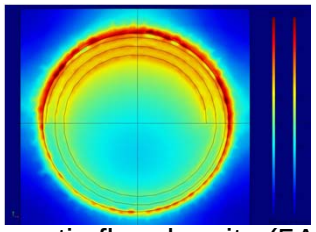
- Specification
  - Inductance ~5-10µH
  - Current saturation >10A
  - Dimensions13×13×3 mm^3

- Manufacturing

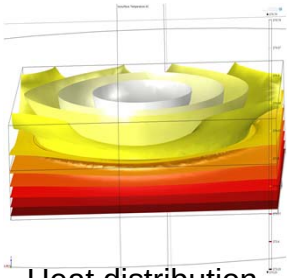
1. Ferrite milling; coil and vias + lid
2. Copper plating of coil, vias and pads
3. Ni/Au plating for solder pads
4. Grinding & Dicing
5. Lid assembly
6. Mounting (SMD)







Magnetic flux density (5A)



Heat distribution

Development programme

- Final design to be frozen at SRR. Two main design tracks are currently being pursued:
  - Discrete design
  - Monolithic design

- µCOIL developped in parallel with µPOL
  - Advanced 3D FEM simulations of µCoil have been performed
  - Compact µCOIL to be integrated with µPOL in single package.

- Planning
  - SRR - October 2012
  - PDR – March 2013
  - CDR – September 2013
  - FDR – March 2014
  - µPOL can be ordered – April 2014

Thank you !

Enjoy your lunch !