Presentation

A Novel Contact-less Current Sensor for HEV/EV and Renewable Energy **Applications**

ROR-MLX

"Contact-less" Current Sensing

Melexis markets a patented Hall technology under the brand 'Triaxis™'. This technology enables the realization of cutting-edge contactless magnetic position sensors. Triaxis™ ICs are designed in rotary, linear and 3D-joystick position sensor.

Conventional Hall

Current Conductor

Tria⊗is Hall

CMOS HALL IC with IMC, Packaged in SO-8

Measures the field generated by the current

 Open Loop Current Sensor Vout Conventional Hall Element

Tria⊗is => IMC integrated magnetic concentrator



Conventional Current Sensors

Open Loop Current Sensor

Air gap: $B \approx I * \mu_0 / l_0$

Vout = S * B

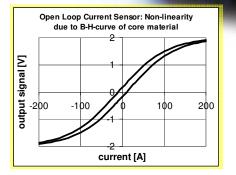
Features

- AC/DC; BW < 10- 50 kHz

- Accuracy <3-5% error

- Material non linearity

- Temperature drift



Soft Ferromagnetic Core

Conventional Hall Plate

Vout

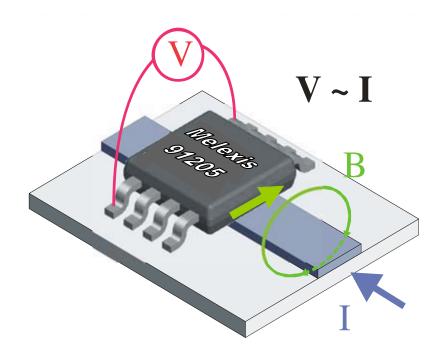
Current Conductor

Accuracy is limited by the ferromagnetic core i.e. hysteresis!

Small things make a big difference.

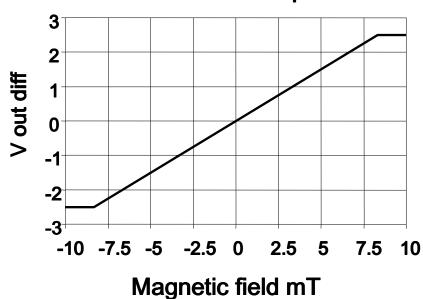


Current Sensor MLX91205



$$B \approx \frac{\mu_0}{2\pi r} *I amps$$

Differential output



Contact-less, low-cost, open-loop, SO-8

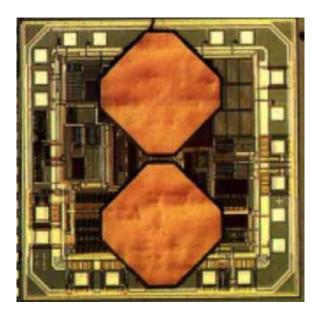
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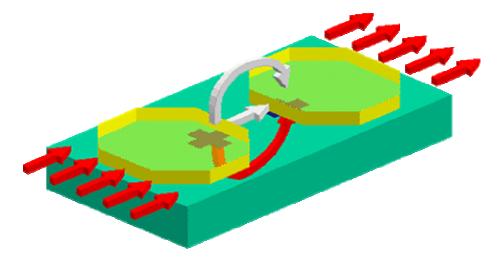
THE Current Senso

MLX91205

IMC = Integrated Magnetic Concentrator



Photograph of ASIC with attached twin IMC



The IMC transforms a lateral field locally into a vertical field



We structure Integrated
Magnetic Concentrators (IMC)
made of soft ferromagnetic
material on the chip surface !

And they
come out
here

Then the flux lines go in here

Part of the flux lines pass through the chip underneath the gap





Benefits of the IMC Technology

sensitive <u>parallel</u> with chip surface

- easier mounting of sensor for many applications
- new opportunities for combining sensor and current lead

locally increased flux density (magnetic gain)

- higher output signal
- ► lower field equivalent offset
- ► lower field equivalent noise

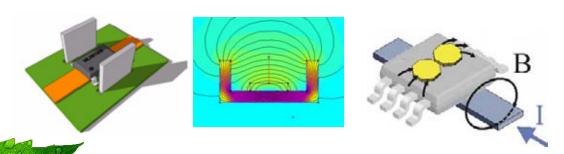
IMC boosts the performance of CMOS-Hall-Sensors

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- contact less -> voltage isolation from conductor to any level and good thermal isolation.
- > small dimension SO-8, standard assembling technique on pcb
- high bandwidth 100kHz, very fast response time!
- high modularity (adapt sensor to conductor i.e. shield)
- IMC give magnetic gain -> higher S/N; very low Br Hc
- small, robust and economical solution...

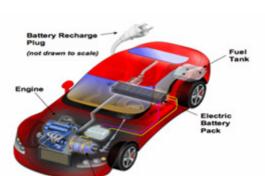


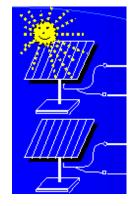
Melexis

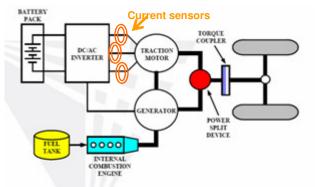
Microelectronic Integrated Systems

Market / Application

- Battery Current BMS, Battery Charger (HEV)
- > Inverter for HEV (traction motor control)
- Renewable Energy (Wind/Solar Power Converter) (Power Extractor, Battery Charger and Inverters)
- Power Supply for Telecommunication, Server,...







Typical Layout of a Combined Series-Parallel HEV Drive Train

Requirements: current range = 10 - 1000 Amps

Response time < 10 usec.,

Small, robust and economical

Small things make a big difference.



Current Sensor Automotive





DC-DC Power Converter 300V -> 14V, 120A





"Bus-Bar" Current Sensor for Battery Monitoring or Inverter Application

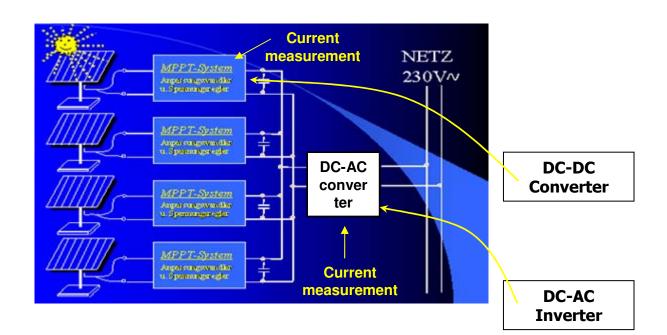




Solar Power Converter

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- Data Monitoring for renewable energy
- DC-DC and DC-AC converters in the range of 200W 2KW
- Solar power extractor charge controller

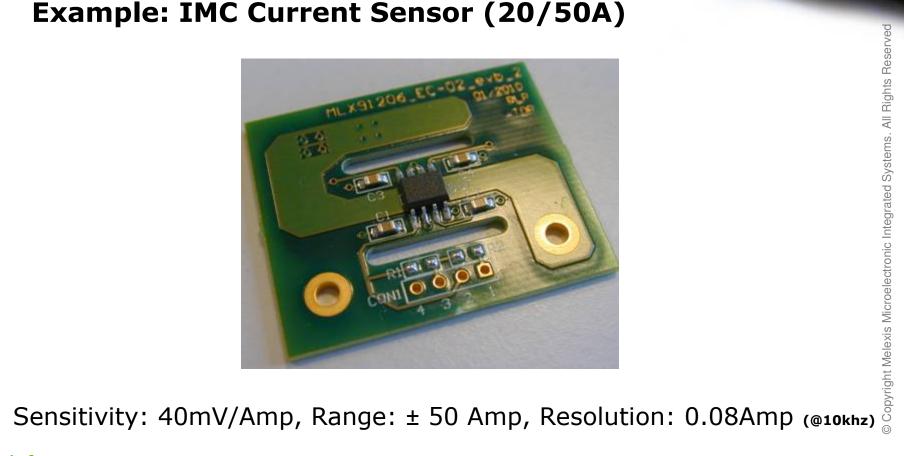




Melexis

Application: direct on PCB

Example: IMC Current Sensor (20/50A)

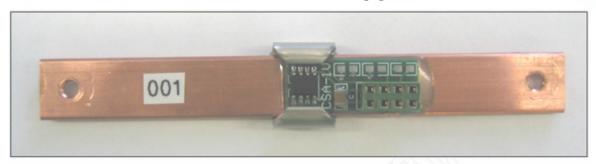


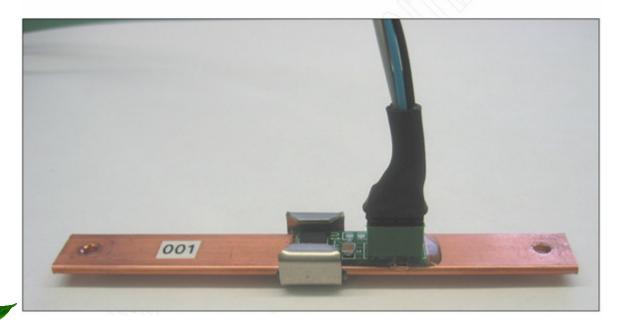




Application: Bus Bar +/-200A

Demonstrator for Inverter Application

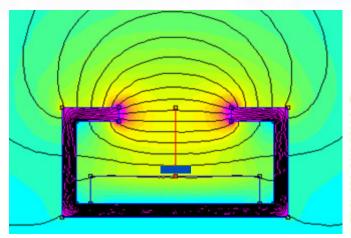




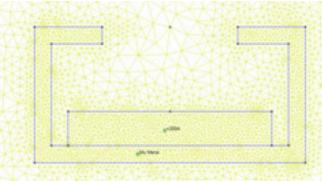
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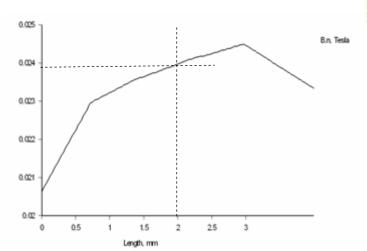
Application: Bus Bar +/-200A



2-D FEM Simulation





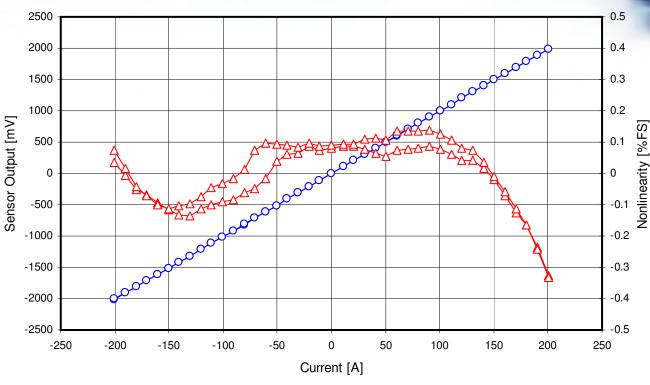


Name:	Demonstrator 200A
Number:	001
Chip:	91205HF(20/25mT)
Shield:	Closed U8mm, Mumetall
Busbar:	Copper, 100 x 12 x 2mm

Small things make a big difference.



Nonlinearity vs. Current



____ 91205HF [mV] ____ NL [%FS]

Sensitivity: 10.0 mV/A

Hysteresis: 2 mV => 0.2A => 0.1% F.S

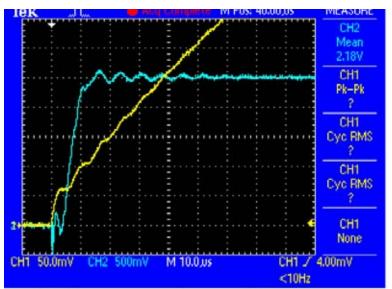
Nonlinearity: \pm 0.3% FS, FS = 200 A

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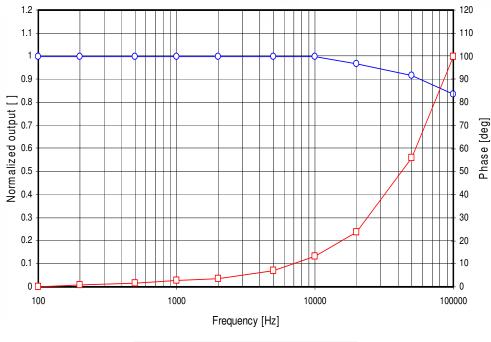
Application: Bus Bar +/-200A

Response Time



Right: response time < 10 usec.

Frequency Response



O—Normalised output [] —□—Phaseshift [deg]

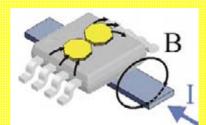
Response Time: < 10 usec. **Frequency range:** 50-100 kHz

Small things make a big difference.



IMC Current Sensor (IMC= integrated magnetic concentrator)

- Small size and low cost
- Simple construction
- High Bandwidth BW <100kHz
- Robust, Over current resistant
- High modularity by design
- Standard assembling technique on pcb
- non intrusive contact-less



Target Markets: Current Monitoring from few Amps to up to 1000 Amps on Bus Bar.

- Automotive (HEV, EV)
- Power Converter, Inverter, Motor Driver
- Battery Monitoring Sensor
- Over current protection, Electronic fuses,...

contact-less, small, robust and economical solution!

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