Small things make a big difference.
Melexis “Hall”

Low Cost Current Sensors

91205 / CSA-1V

ROR / September 2009
“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**
- Open Loop Current Sensor

**Triaxis Hall**
- CMOS HALL IC with IMC, Packaged in SO-8
- Measures the field generated by the current
- Small, robust, economical

**Triaxis** => IMC integrated magnetic concentrator

Small things make a big difference.
IMC Current Sensor

Current Sensor MLX91205

\[ B \approx \frac{\mu_0}{2\pi r} \times I \text{ amps} \]

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

Small things make a big difference.
Small things make a big difference.

**IMC Current Sensor**

**MLX91205**

**IMC = Integrated Magnetic Concentrator**

Photograph of ASIC with attached twin IMC

The IMC transforms a lateral field locally into a vertical field
IMC Current Sensor

IMC Hall Working Principle

Conventional Hall ASICs are made of CMOS integrated circuits containing lateral Hall elements at the surface.

Due to the nature of the Hall elements these sensors are only sensitive to a magnetic field perpendicular to the chip surface.

Small things make a big difference.
We structure Integrated Magnetic Concentrators (IMC) made of soft ferromagnetic material on the chip surface!

Then the flux lines go in here

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

Small things make a big difference.
IMC Current Sensor

Benefits of the IMC Technology

- sensitive parallel 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

Small things make a big difference.
### Application IMC Current Sensor
MLX91205-LB vs. MLX91205-HB

<table>
<thead>
<tr>
<th>Name</th>
<th>Package</th>
<th>IMC shape</th>
<th>Mag. Saturation</th>
<th>Sensitivity</th>
<th>IMC gain</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low field</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LB</td>
<td><img src="image1.png" alt="Image" /></td>
<td><img src="image2.png" alt="Image" /></td>
<td>10 mT</td>
<td>280 V/T</td>
<td>6</td>
</tr>
<tr>
<td>MLX 91205ABL</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High field</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HB</td>
<td><img src="image3.png" alt="Image" /></td>
<td><img src="image4.png" alt="Image" /></td>
<td>25 mT</td>
<td>100 V/T</td>
<td>3</td>
</tr>
<tr>
<td>MLX 91205ABH</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Legend:**
- **LB:** high sensitivity => lower currents

![Graph](image5.png)
Application IMC Current Sensor

Conductor below sensor (PCB mount)

Conductor above sensor
Bus bar

B \sim I

\rightarrow \text{no upper limit to the level of current to be measured because field range depends on current and the distance to sensor.}

Small things make a big difference.
IMC Current Sensor

Example: small currents +/- 5 A

Sensitivity: 160mV/Amp, Range: ± 5 Amp, Resolution: 0.01Amp

Small things make a big difference.
IMC Current Sensor

Example: medium current +/- 20.. +/- 50A

Sensitivity: 40mV/Amp, Range: ± 50 Amp, Resolution: 0.08Amp (@10kHz)

Small things make a big difference.
IMC Current Sensor

Conductor Loops to increase gain (10/20A)

Sensitivity 120mV/A, Range: ± 10..20A, Resolution: 0.03Amp (@10kHz)

Small things make a big difference.
IMC Current Sensor

Example: high currents +/-200..1000A

Sensitivity: 10mV/Amp, Range: ± 200 Amp, Resolution: 0.3 Amp (@10khz)

Small things make a big difference.
Shielding techniques

- To reduce the influence of external stray fields
- The shield guides the external flux lines around the sensor and it increases magnetic sensitivity by about 40-60%.

Shield:
- U-form or flat plate
- Permalloy/Mu-Metal or Si-Fe
- thickness 0.3-1 mm (depending on field strength)
- lower cost than Fe-Core

Small things make a big difference.
Small things make a big difference.

**IMC Current Sensor (differential)**

**Stray Field Compensation (differential measurement by using 2 sensors)**

Remark: The Sensors are only sensitive to a field along the x axis. Fields along the Y or Z axis does not generate an output signal on Sensor 1 or 2.
IMC Current Sensor

Performance 91205:

- Full-scale range: ... - 1000 Amps, depending on geometry
- Linearity: < 0.5%
- Freq. Range: DC-100 kHz
- Response time < 8 usec.
- Temp. drift of Offset: < +/- 1% for +/- 100°C
- Temp. drift of Sens.: <200ppm/°C

small, robust and economical!

Small things make a big difference.
IMC Current Sensor

Performance: very fast response time

Response time => 6-7 usec

Small things make a big difference.

one of the fastest linear hall sensors available!
USP and features of 91205

- 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!
- does not require slotted toroid (simple shield)
- high modularity (adapt sensor/conductor/shield)
- IMC give magnetic gain -> higher S/N; very low Br – Hc

application support:
application notes and design support offered by Melexis
Melexis Triaxis Current Sensors

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 ~ 5 to 100 Amps on PCB or up to 1000 Amps on Bus Bar.

- Automotive, Hybrid HEV, Electronic Vehicles EV
- Solar Power, Renewable Energy
- Power Converter, Inverter, Motor Driver
- Monitoring (Energy Data Acquisition)
- UPS, Power Supply, Power Tools

Small, robust and economical !!!
Small things make a big difference.
Small things make a big difference.

Contact: Robert Racz / ROR@melexis.com