



Melexis current sensors for charger and other current applications

Productline Magnetic current sensors

Part 1: The Melexis team to contact

Part 2: Current sensing applications

Part 3: Melexis Technology & Product

# Who to contact

## **Brenda Vanderheyden**

*Inside sales mastermind*

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*Technical support guru*

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Mobile: +32 471 66 87 58

Location: Tessenderlo

Country: Belgium



# Market Segmentation

## AUTOMOTIVE

**OBC, EVSE & DC FastCharge**  
(primary side / secondary side)

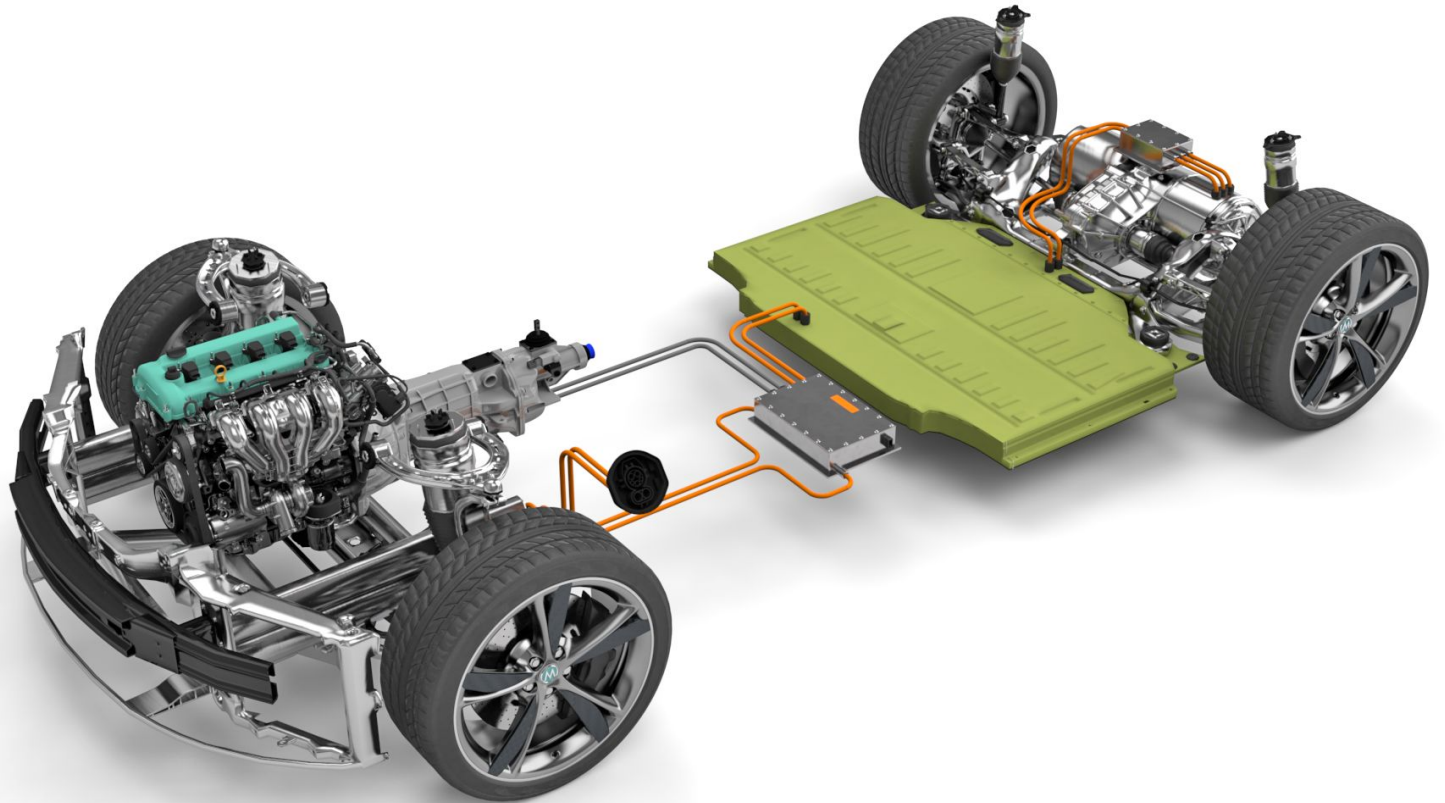
**PTC & HVAC**  
Battery & cabin heating/cooling

**BATTERY**  
(management, disconnect, pyro, contactor)

**DCDC**  
(24V/12V, 48V/12V, 400V/12V, ...)

**DRIVE**  
(inverter AC phase / DC link / boost)

**MONITORING**



# Market Segmentation

## INDUSTRY/CONSUMER

### DRIVES

(variable freq. ~, servo ~, ...)

### CHARGERS & MONITORING

(DC charging pile, AC Wallbox, In-Cable,...)

### POWER SUPPLIES

(uninterrupted ~, switch-mode ~,  
Telecom 4G/5G pad power mgmt,...)

### SOLAR & STORAGE

(input current, MPPT, string combiner,...)

### HOME APPLIANCES

(HVAC, washer, dryer, induction cooktop,  
rice cooker, blender, thermomix,...)



**Melexis**  
INSPIRED ENGINEERING

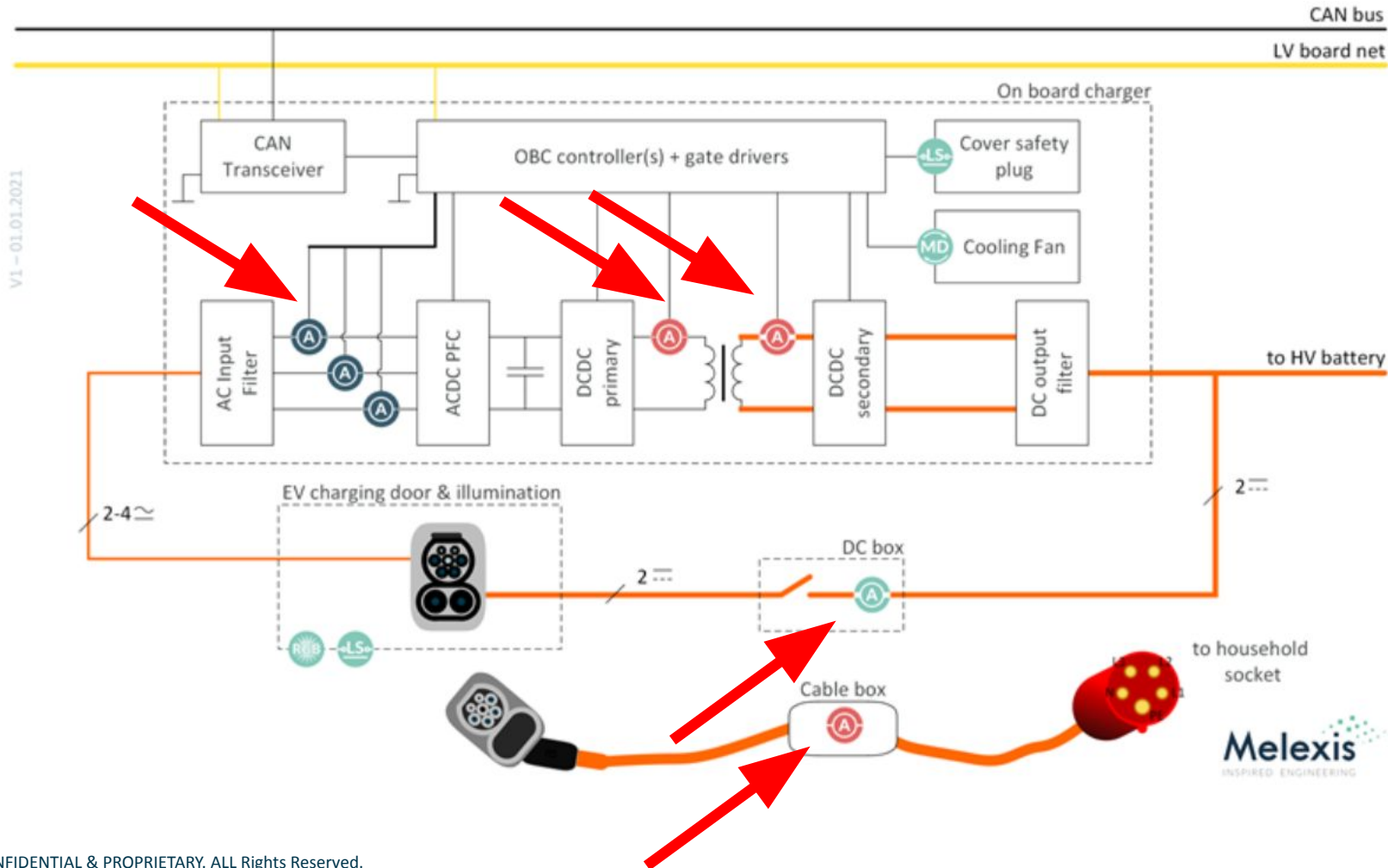


Application overview

**Melexis**  
INSPIRED ENGINEERING

# Current sensing applications

## System overview – example of multiplication factor

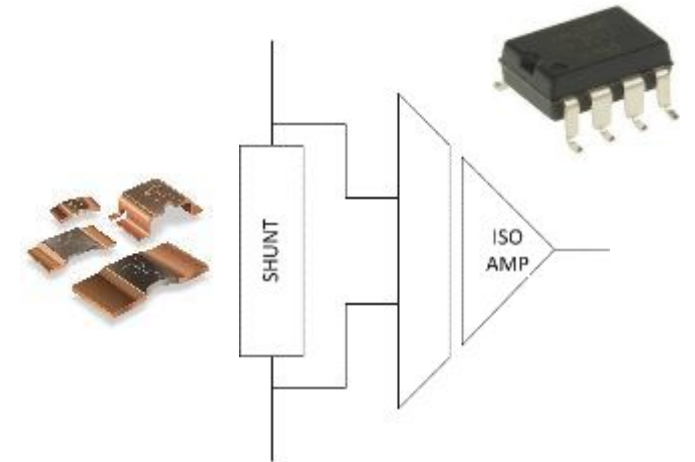


See this on  
our interactive  
website view

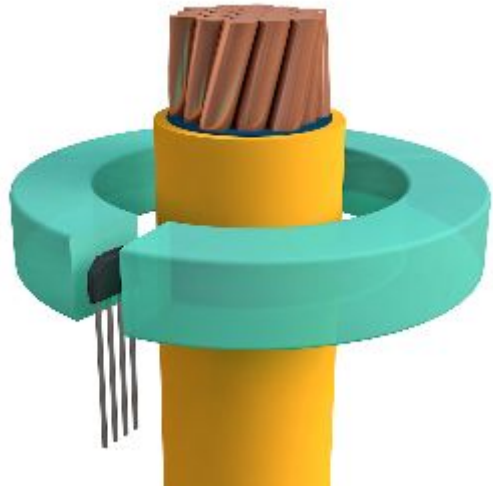
# Competing technologies

## Resistive direct measurement

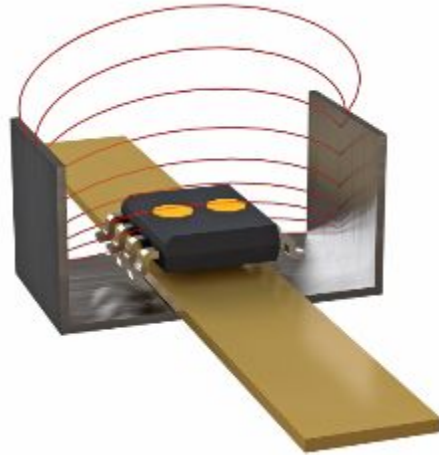
- Requires inline resistive element
  - Heat dissipation
  - Power loss
- Requires additional circuit for signal processing
  - Bulky
  - BOM Cost
- Requires cooling for increasing power demands
  - Bulky
  - Cost
  - Power loss



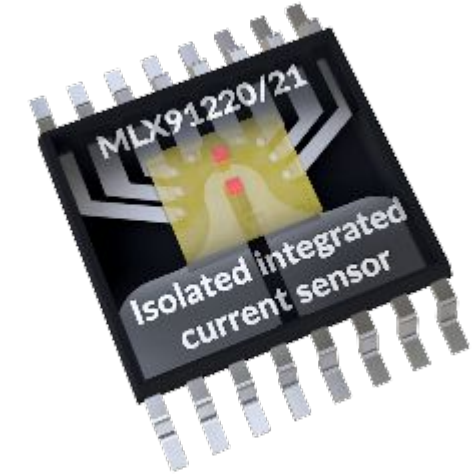
# Melexis Technologies



Conventional Hall  
“Core-based”



IMC-Hall®  
“Shield-based”



Plug & Power  
“Gradiometric”

External Primary (up to >2000A)

Integrated Primary  
(0-50A, 100A roadmap)



# Plug & Power Technology

**Melexis**  
INSPIRED ENGINEERING

Sensing IC

Secondary signal pins

Insulation barrier

Primary current path

Face down

MLX91220/21

Isolated integrated current sensor

- For AC & DC current measurement

ISOLATED INTEGRATED CURRENT SENSOR

MLX91220 (5 V)  
MLX91221 (3.3 V)

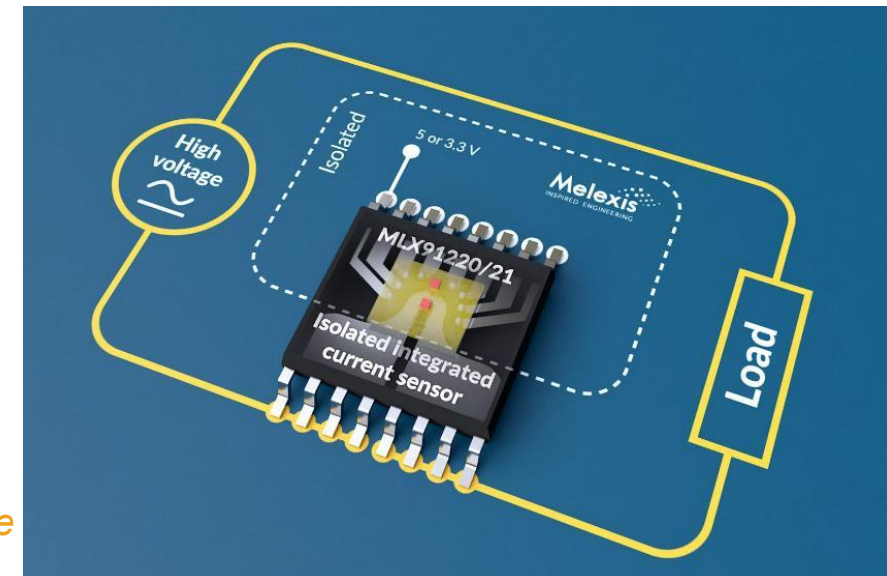
The diagram illustrates the internal structure of the MLX91220/21 sensor. It features a sensing IC mounted face down on a secondary signal pin array, which is separated from the primary current path by an insulation barrier. The primary current path is shown as a thick copper strip. The sensor is designed for AC and DC current measurement. Applications include EV charging stations and solar power systems. Two physical chips are shown: the MLX91220 (5V) and the MLX91221 (3.3V).

# Plug and power benefits

One sensor, one package, small size and full solution

- Selectable sensitivity
- Fully factory calibrated
- 2x Integrated over current detection,
  - Internal (fast)
  - External (accurate)
- Ratiometric or fixed output selections

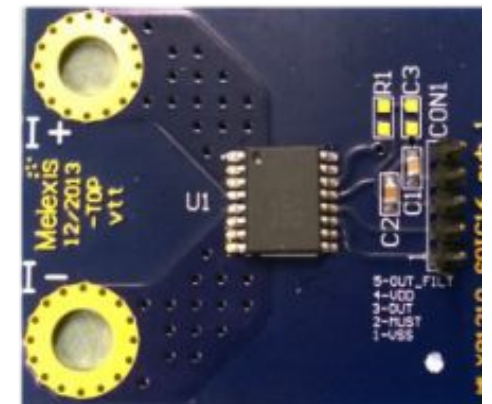
[Link to our website product info](#)



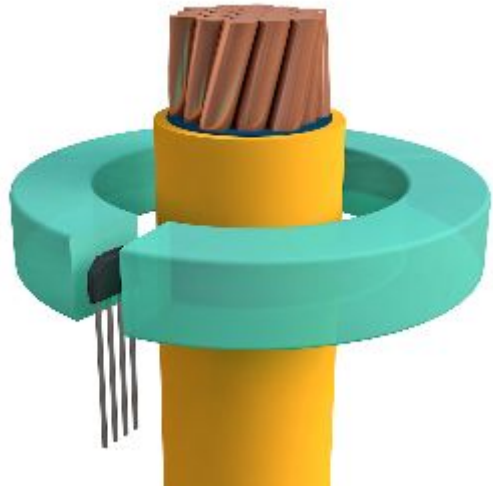
*Bringing a full current sensor inside a tiny semiconductor package...*

# Key take-aways: Integrated current sensors

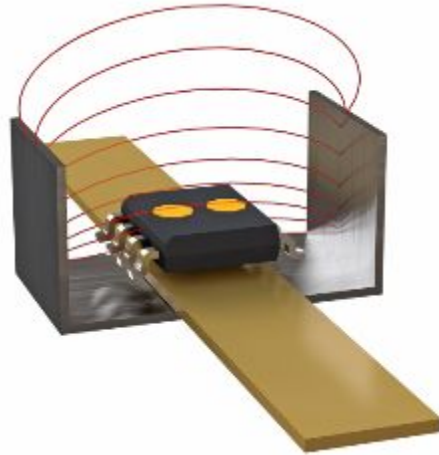
- Two types MLX91220 (5V); MLX91221 (3.3V)
- 0-75A currents, Isolated supply and sense circuits
- Dual OCD
- Measures unipolar currents or bipolar currents
- Main applications:
  - White goods
  - DC-DC converters
  - OBC (On board chargers)
  - Solar
- Evaluation kits available to get started ([Website link](#))



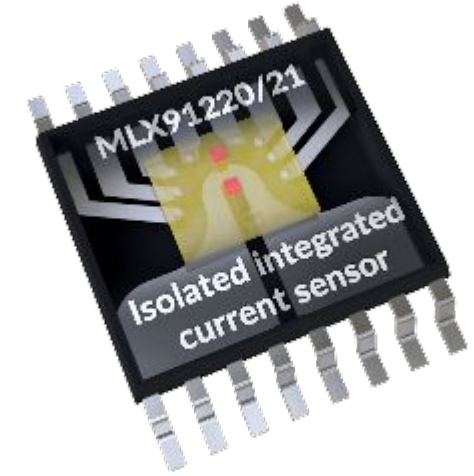
# Technologies



Conventional Hall  
“Core-based”



IMC-Hall®  
“Shield-based”

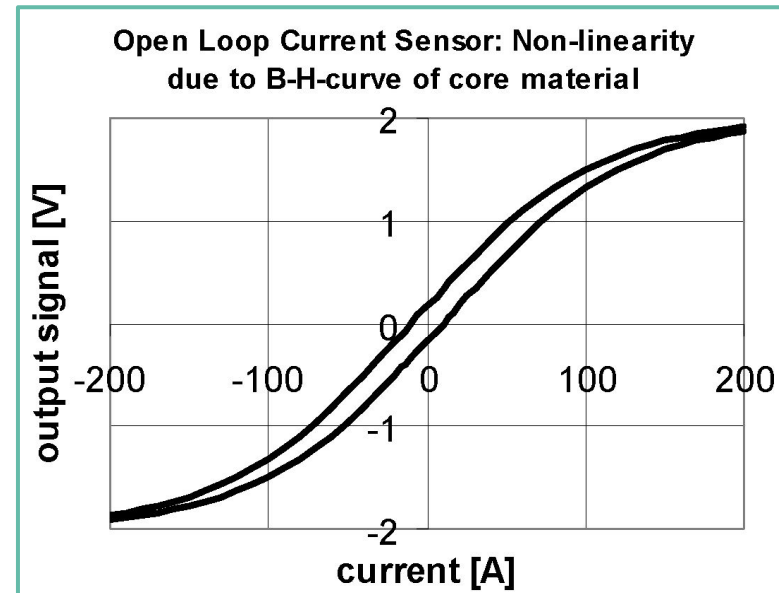
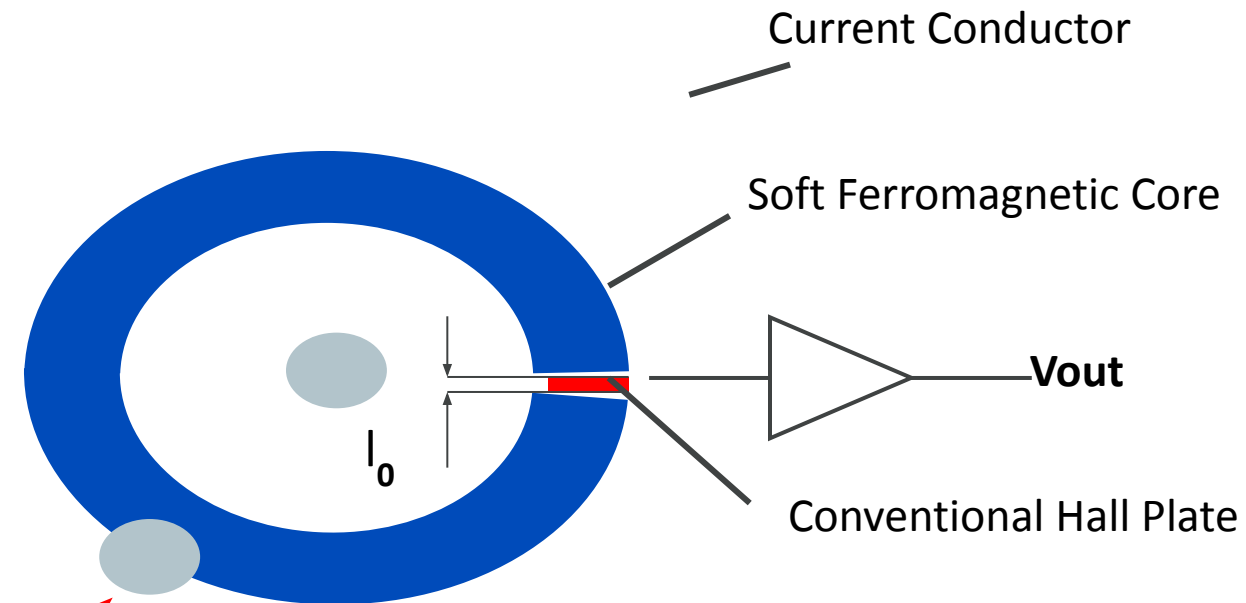


Plug & Power  
“Gradiometric”

External Primary (up to >2000A)

Integrated Primary  
(0-50A, 100A roadmap)

# Conventional Hall Technology



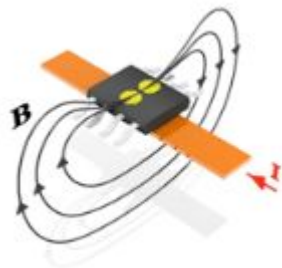
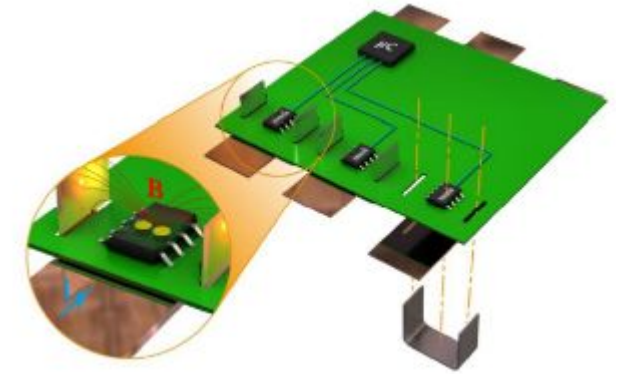
Current through the conductor generates a circular magnetic field, proportional to the current. Using a ferromagnetic core acting as concentrator, the field is amplified  more signal is obtained

Accuracy is mainly limited by the properties of the ferromagnetic core (saturation, hysteresis, frequency response, etc.)

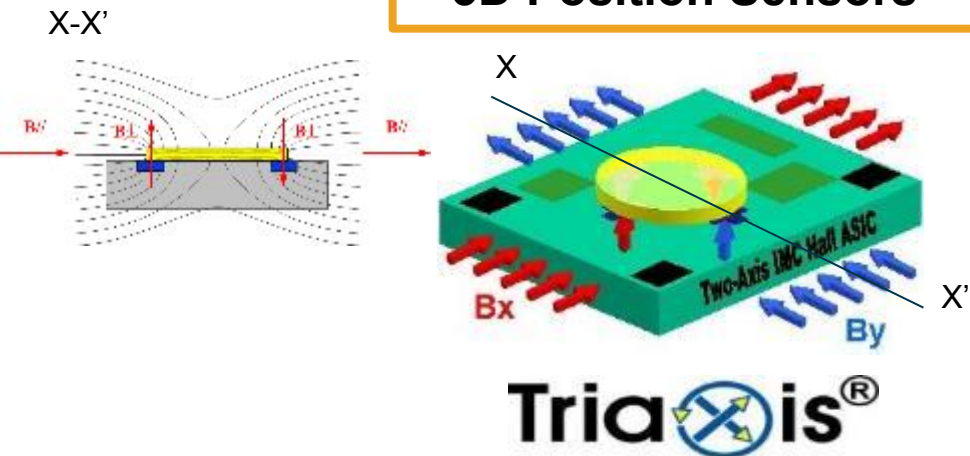
# IMC-Hall® Technology

Conventional Hall sensors can only measure vertical magnetic field

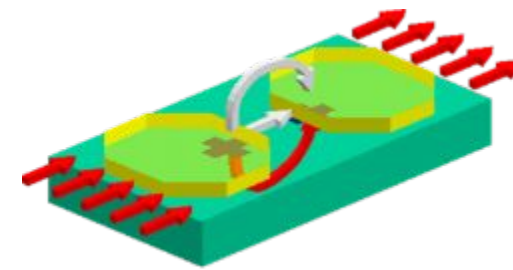
- IMC converts and amplifies the planar field into vertical components
- Current can be measured directly above a conductor
- Signal-to-noise ratio (SNR) is boosted by the IMC gain
- Solution requires very small footprint (no bulky core, only simple U shielding along 1 axis)
- AEC-Q100 qualified, adopted by nearly all TIER1s and OEMs in multi-million volumes



## 3D Position Sensors

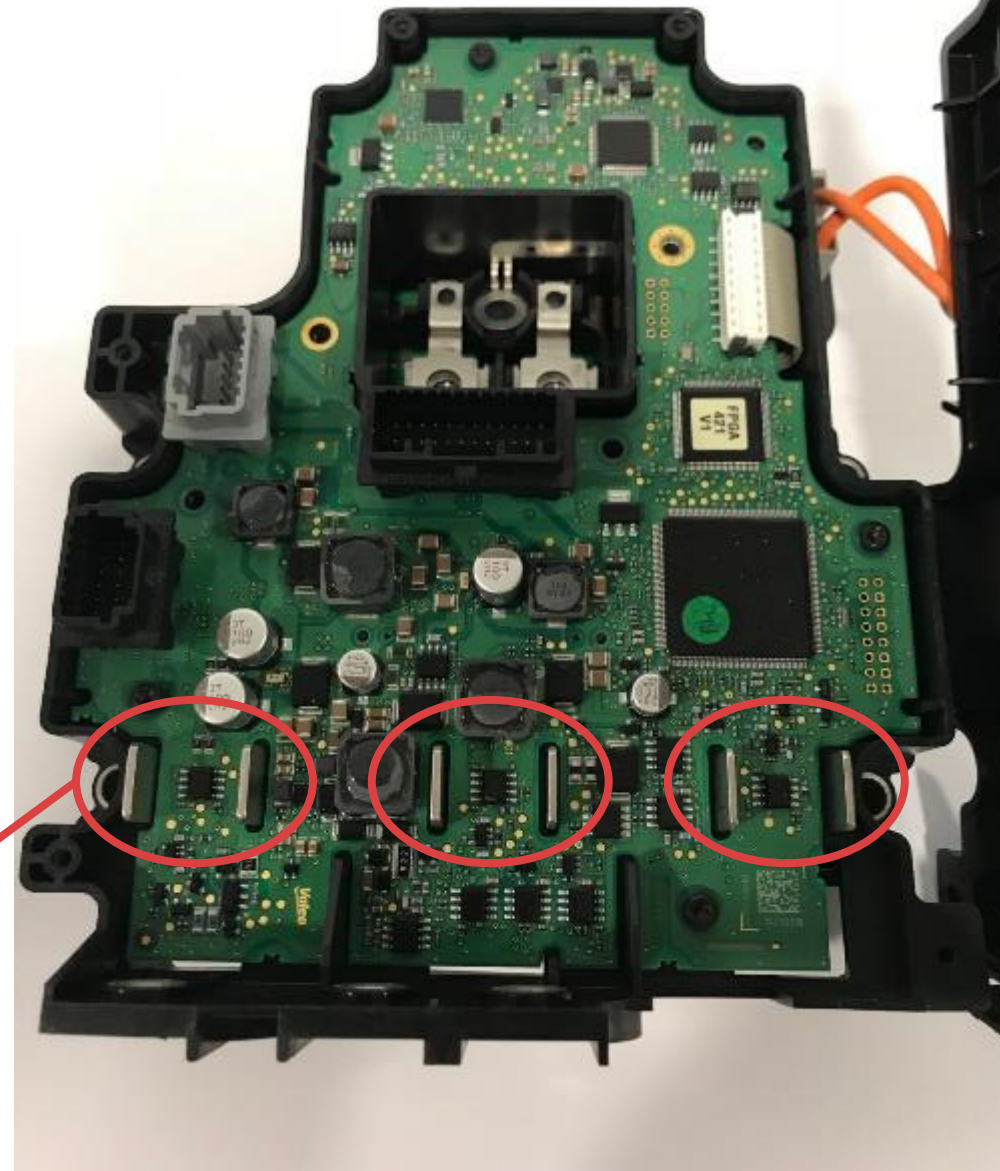
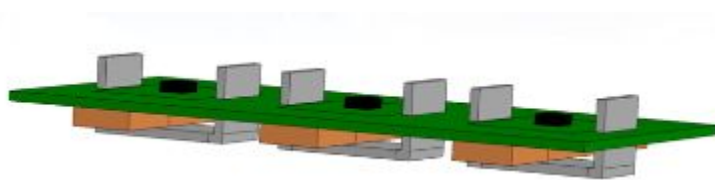


## Current Sensors



IMC-Hall®

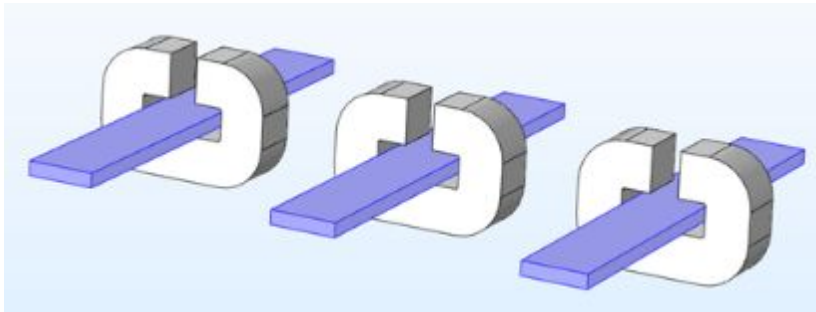
# High Current Inverters/Converters (100-2000A)



IMC-Hall®

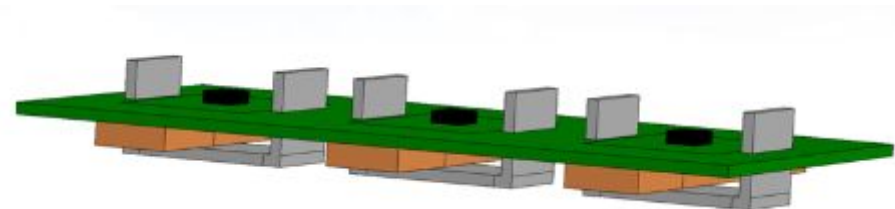
# Success Stories – Automotive

Tesla Model 3 (+S/X/Y), GM (Volt, Bolt), Volkswagen MEB & 48V, BMW PHEV, Hyundai Ioniq, BYD, Porsche, ...



**MLX91207/09/17/19**

Renault Zoé, FCA (Fiat Chrysler Automotive) HV & 48V, GM, Daimler, GAC, ...



**MLX91206/08/16/18**



# Industrial Current Sensing for Converters

[DCAC]

Variable Frequency Drives,  
electric motor control,  
eScooters/eBikes, ...



[DC or DCDC]

Solar Strings input current,  
combiner boxes, MPPT  
Converters



[ACDC or ACDCAC]

Power Supplies (UPS/SMPS) &  
Chargers



[DC or AC]

Demand/Load control DC or AC  
monitoring

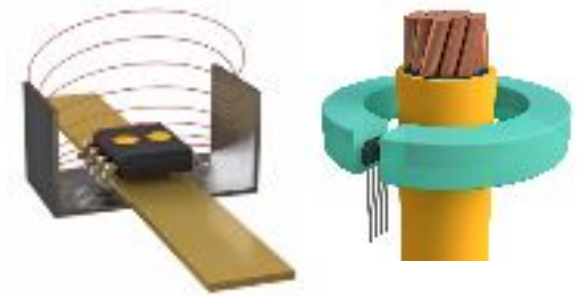


# Gen2 Portfolio

[Download Melexis selection guide](#)

[Website link](#) GEN2  
MLX91208/09

*Most cost-optimized – starting point*



[Website link](#) GEN2.5  
MLX91216/17

*Accuracy  
Broken Wire Diagnostics*

GEN2.75 [Website link](#)  
MLX91218/19

*SNR improvement 2.5x  
OverCurrent Detection  
3.3V capable (next to 5V)*

- Q3-2022
- Release of MLX91218
- Release of MLX91219

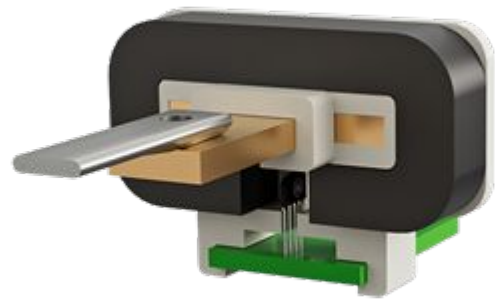
# Key take-aways: IMC Hall sensors

- Up to 2000A measuring range
- Dual OCD (Over Current Detection)
- 3.3V and 5V supply variants
- Measure unipolar and bipolar currents
  
- Newest additions:
  - **MLX91216ACX** - **X**tra high field 250 kHz IMC-Hall® current sensor with diagnostics ([link](#))
  - **MLX91218** (sneak peek) - 400kHz IMC-Hall® current sensor IC with dual overcurrent detection ([link](#))
  
- Main applications:
  - High currents AC/DC converters

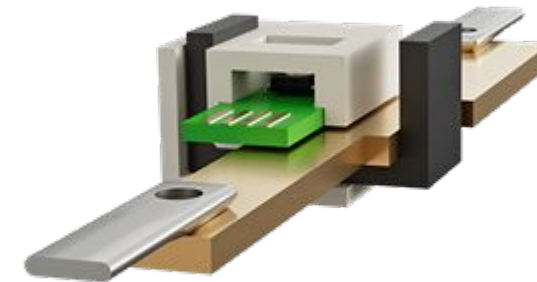
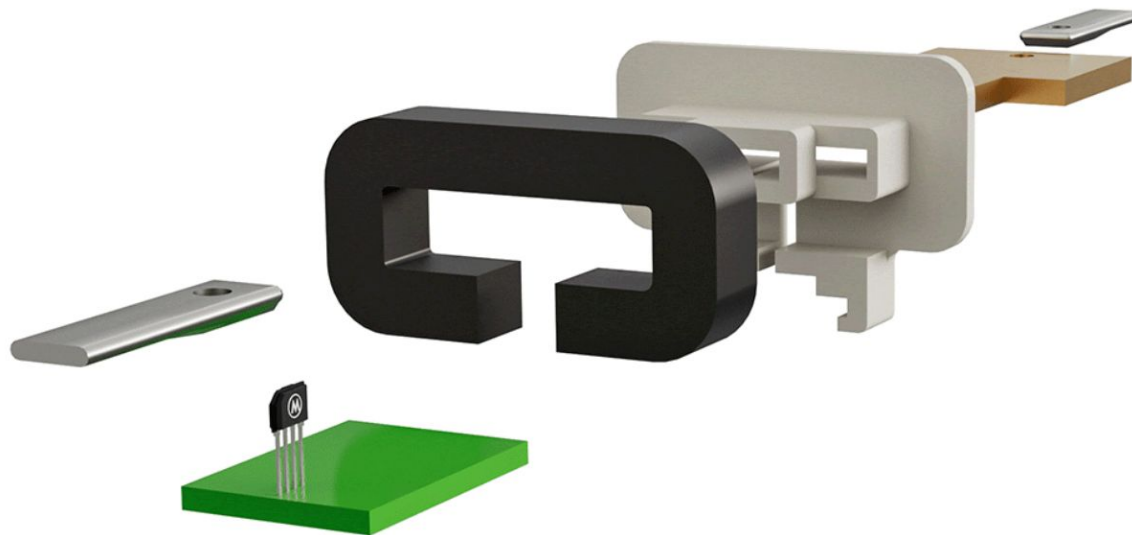
# Key take-aways: IMC Hall sensors

- Up to 2000A measuring range
- Dual OCD (Over Current Detection)
- 3.3V and 5V supply variants
- Measure unipolar and bipolar currents
  
- Newest additions:
  - MLX91219 - 400kHz Conventional Hall current sensor IC with dual overcurrent detection ([link](#))
  
- Main applications:
  - High currents AC/DC converters

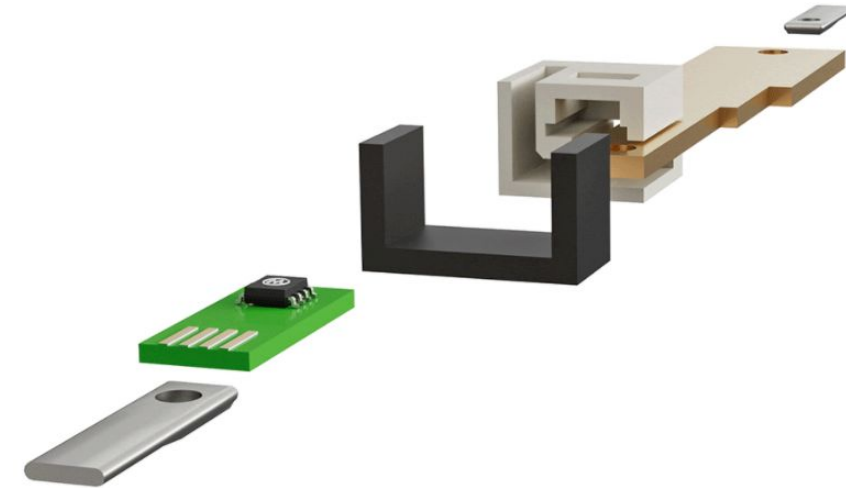
# DVK-Conventional-Hall vs DVK-IMC-Hall



[\(Product link\)](#)



[\(Product link\)](#)



Designing an external primary current sensor requires proper magnetic sensing understanding. Melexis supports its customers with application support in the form of guidelines ([www.melexis.com](http://www.melexis.com) □ core & shield geometries, design guideline, programming guide...) and magnetic simulation and support

# Supporting documentation on website

- **Reference pin**

Using the internal reference pin  
Forcing an external reference  
Interfacing the MLX91220 with a microcontroller  
Using same reference for several MLX91220

- **Overcurrent detections**

Internal overcurrent detection use cases  
External overcurrent detection use cases

- **Thermal Management**

Thermal performance of Melexis Evaluation Board  
PCB design guideline for better thermal management

- **External Field Immunity**

Surrounding current paths effect on the MLX91220

- **Fuse current capability**

Overcurrent and destructive current

# Final thoughts

Melexis Magnetic current sensors? Why?

## Plug and Power

- Easy / Small / 2x Overcurrent support / small BOM / least intrusive

## IMC Hall

- Medium to high current magnetic current measuring without the bulk of C-cores. 2x Overcurrent support. Scalable over 3 phase.

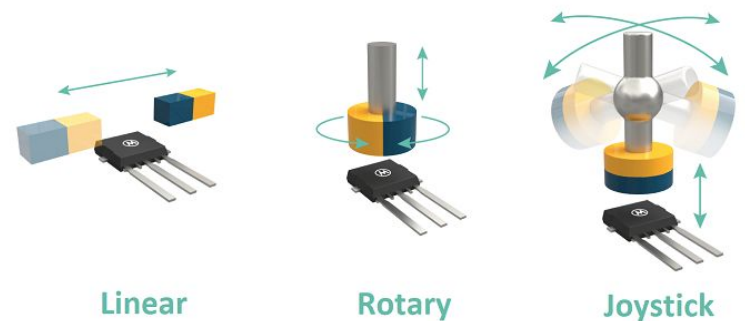
## Conventional Hall

- High current / non intrusive.

## Melexis

- Market leader supplier with automotive mindset.

Discover Melexis  
in position sensors





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