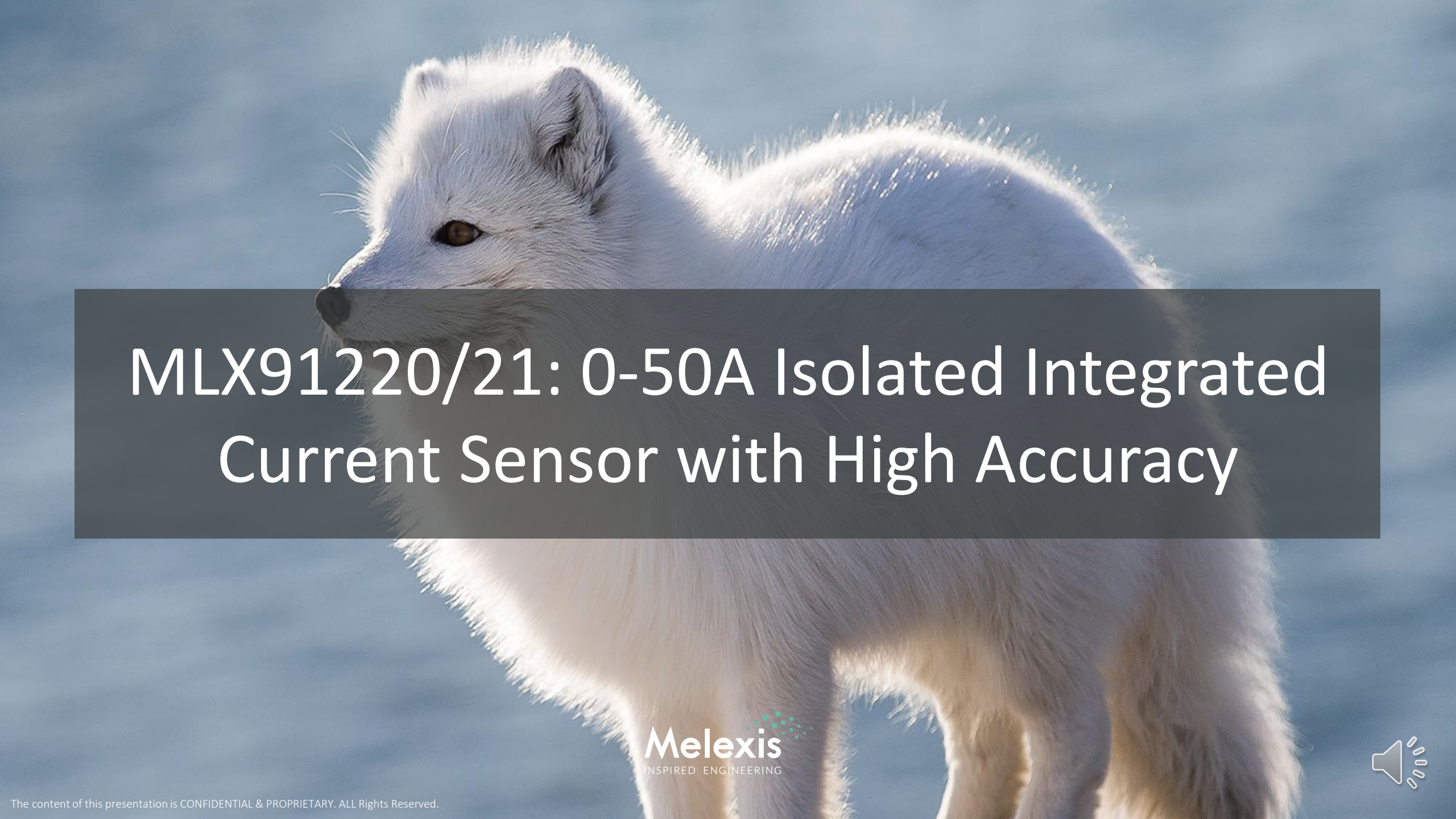




08th/Dec/2020

Dapeng Wu (dwu@melexis.com)



A close-up profile of an arctic fox with white fur and orange eyes, looking towards the left. The fox is standing on a snowy surface with a blue sky in the background.

MLX91220/21: 0-50A Isolated Integrated Current Sensor with High Accuracy



Content



1. Melexis Introduction

2. Integrated Current Sensor Applications

3. Melexis Integrated Current Sensor

4. Summary

1.Melexis Introduction

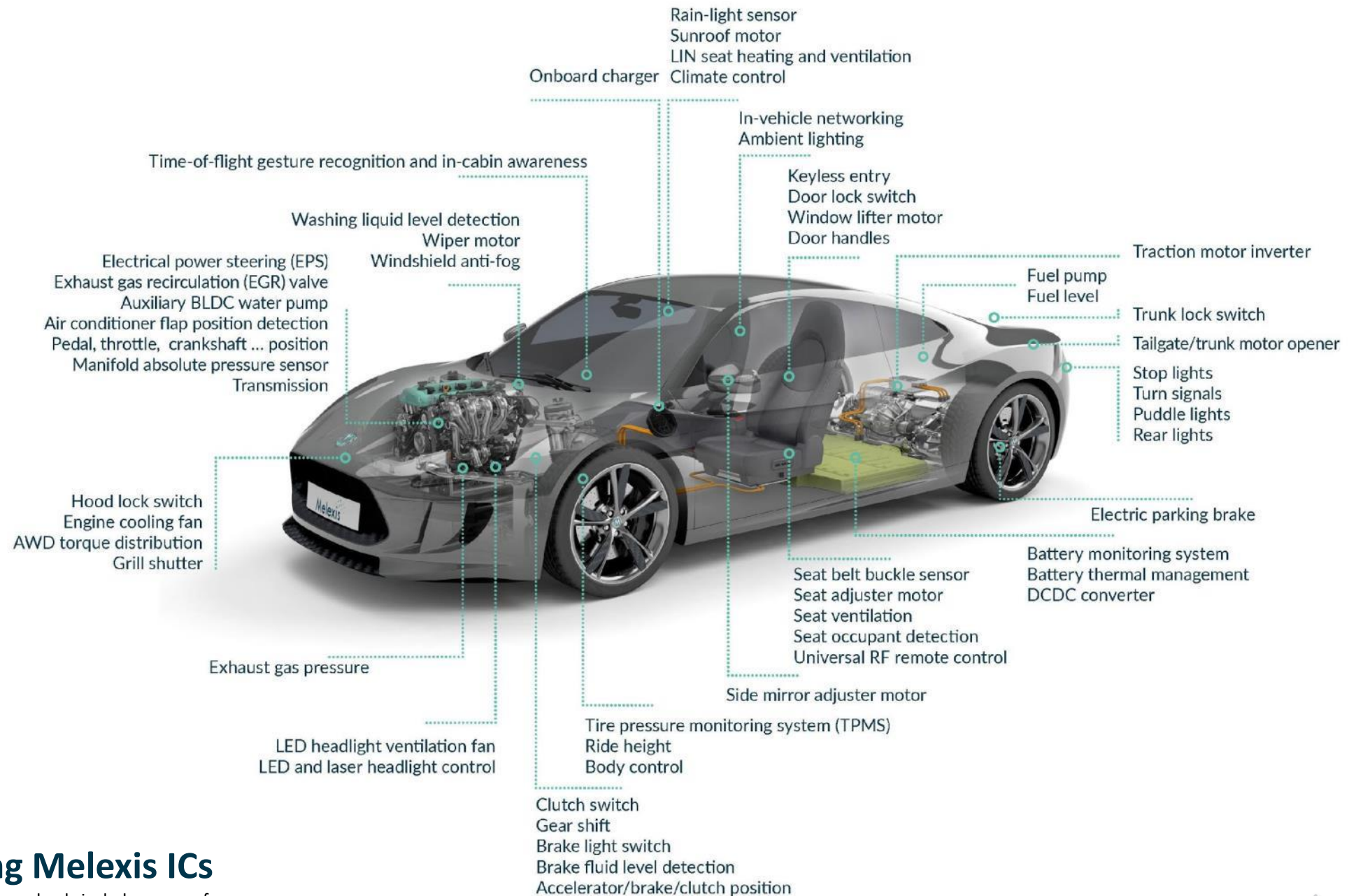
What do we do? And why?



We create innovative
micro-electronic solutions
for the best imaginable future



11 chips in every new car



Applications containing Melexis ICs

Disclaimer: Please note this list is not exhaustive and only includes some of the most common applications containing Melexis ICs.



Melexis supplies > 1.2 billion ICs worldwide in 2019



- Magnetic position sensors
- Inductive position sensors
- Current sensors
- Latch & switch
- Embedded drivers
- Smart drivers
- Pressure sensors
- Tire monitoring sensors
- Temperature sensors
- Optical sensors
- Sensor interfaces
- Embedded lighting



Over 1500 people on 3 continents



Sales & Applications

Belgium – Ieper, Tessenderlo
Greater China – Shanghai, Shenzhen
France – Grasse, Paris
Germany – Erfurt, Dresden
Japan – Yokohama
USA – Nashua, Detroit, San Jose
South Korea – Seoul
Switzerland - Bevaix



Manufacturing

Belgium – Ieper
Bulgaria – Sofia
France – Corbeil-Essonnes
Germany – Erfurt
Malaysia – Kuching



Research & Development

Belgium – Ieper, Tessenderlo
Philippines – Manila
Bulgaria – Sofia
Switzerland - Bevaix
France – Grasse, Paris
Ukraine – Kiev
Germany – Erfurt, Dresden, Düsseldorf
USA - Nashua



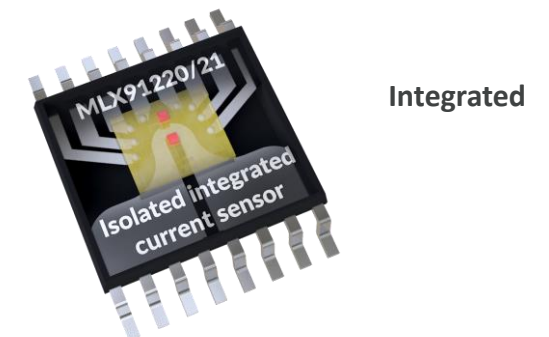
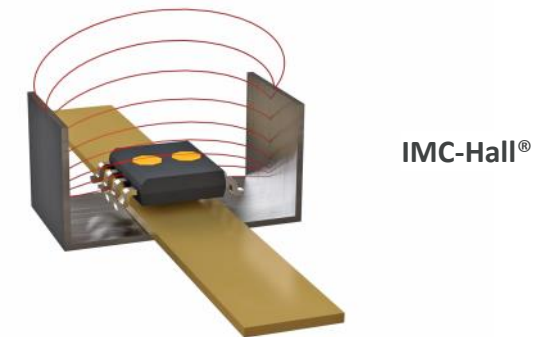
Current sensors

➤ Broad portfolio for many applications

- Battery monitoring & DC link
- Traction inverter phase monitoring
- On-board charger
- DCDC converter
- Industry (motor control, solar, power supplies, ...)

➤ Unique areas of expertise

- Temperature and lifetime stability
- Advanced magnetic design
- AC performance (di/dt)
- Miniaturized mechanical design → IMC
- Extensive simulation capabilities



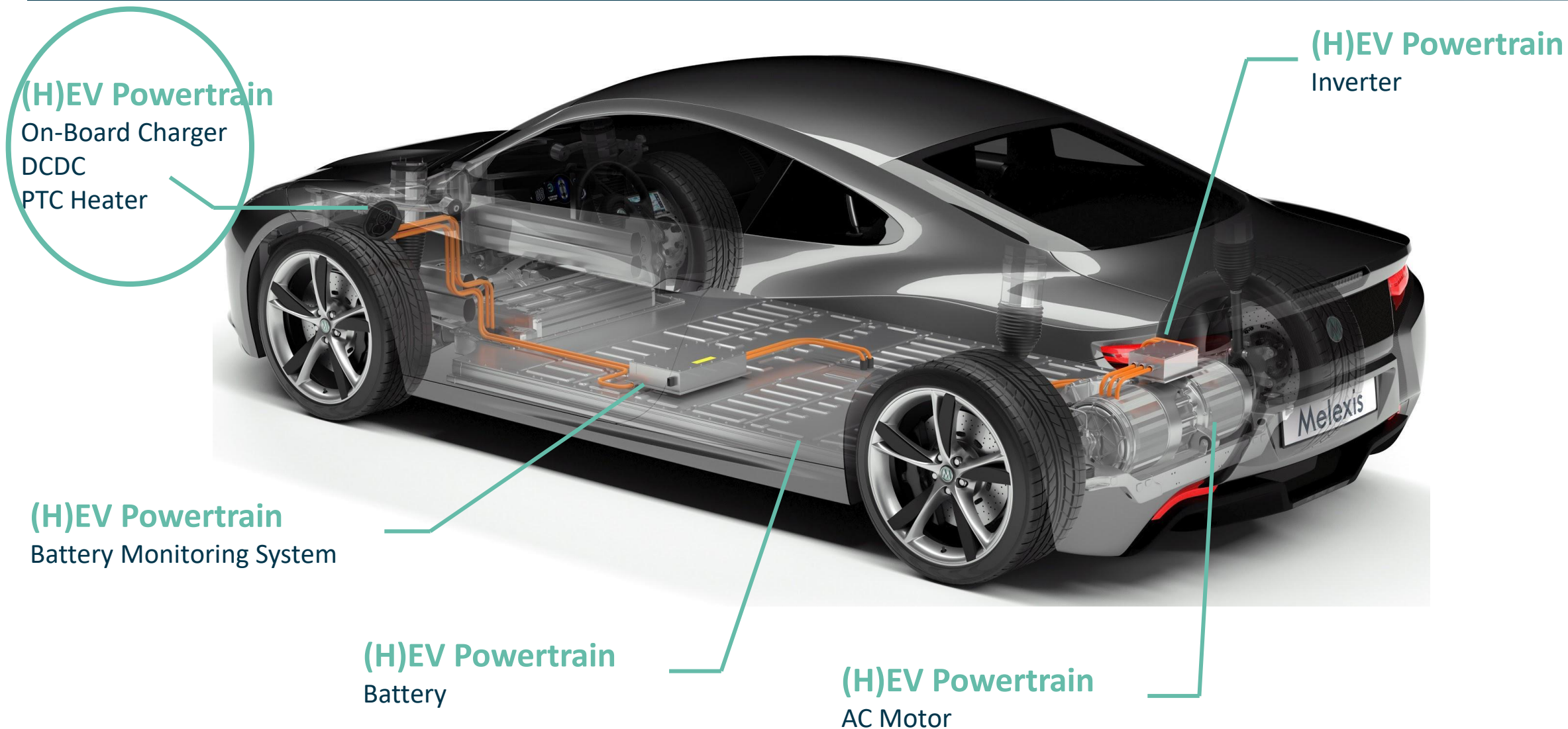
2. Integrated Current sensor Applications



2. Applications



2. Automotive applications



2.1 Connecting to the Grid



DC Fast Charge

- Made out of multiple 15 ... 30kW chargers
- 45 kW ... 300kW



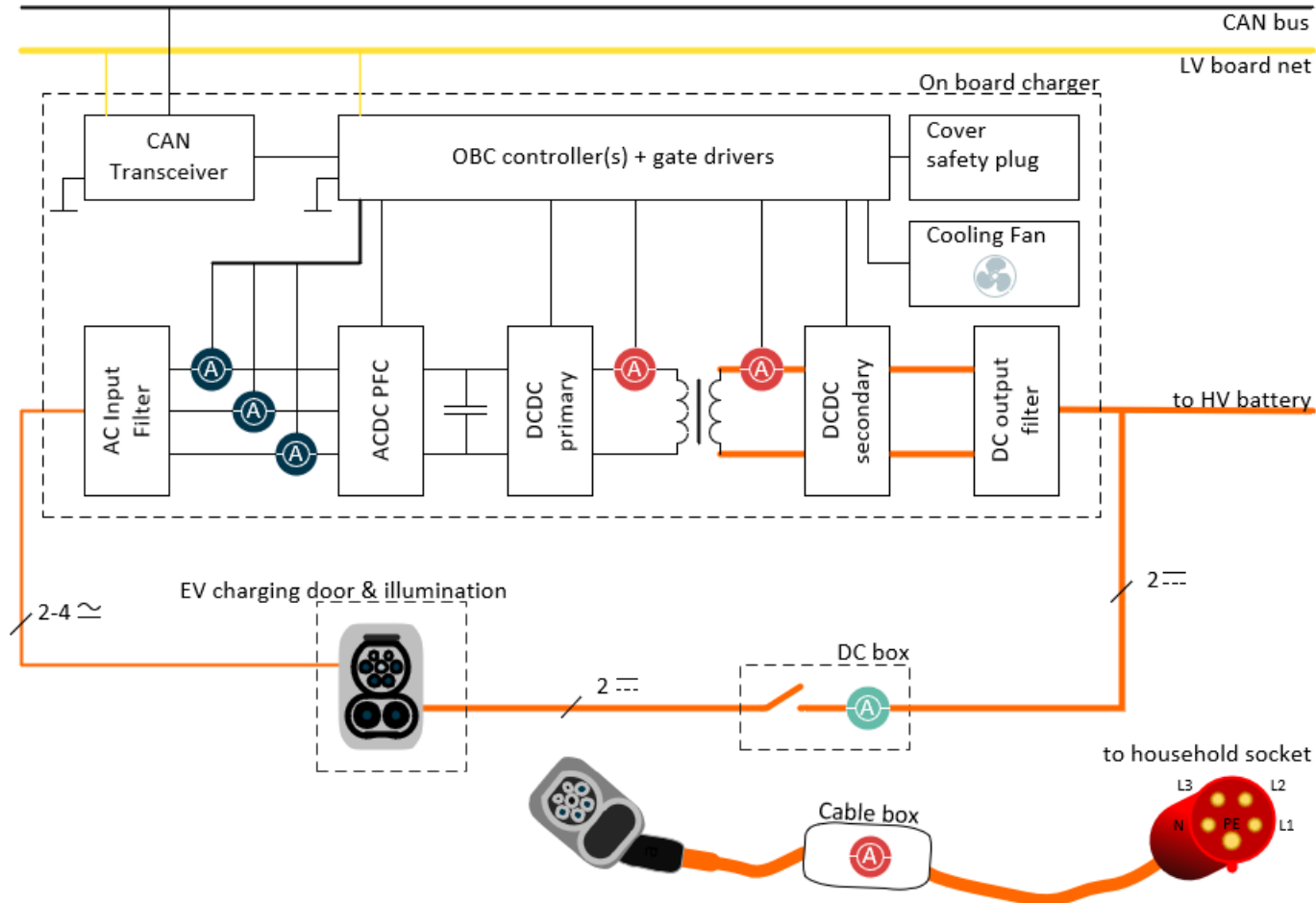
In-cable control box & charging gun

AC Wallbox

- 3.3kW ... 6.6KW (1-phase)
- 11kW ... 22kW (3-phase)



2.1 On-Board Charger (OBC)



Requirement:

- Isolation up to 3KV
- Accuracy 2% - 3% (extra case could be 1%);
- Response time: 3- 5us, bandwidth: 200-300KHz;
- Package: Compacted, SOIC16 is popular;
- Integrated hall (like 91220/21) is replacing SHUNT + Isolated AMP;

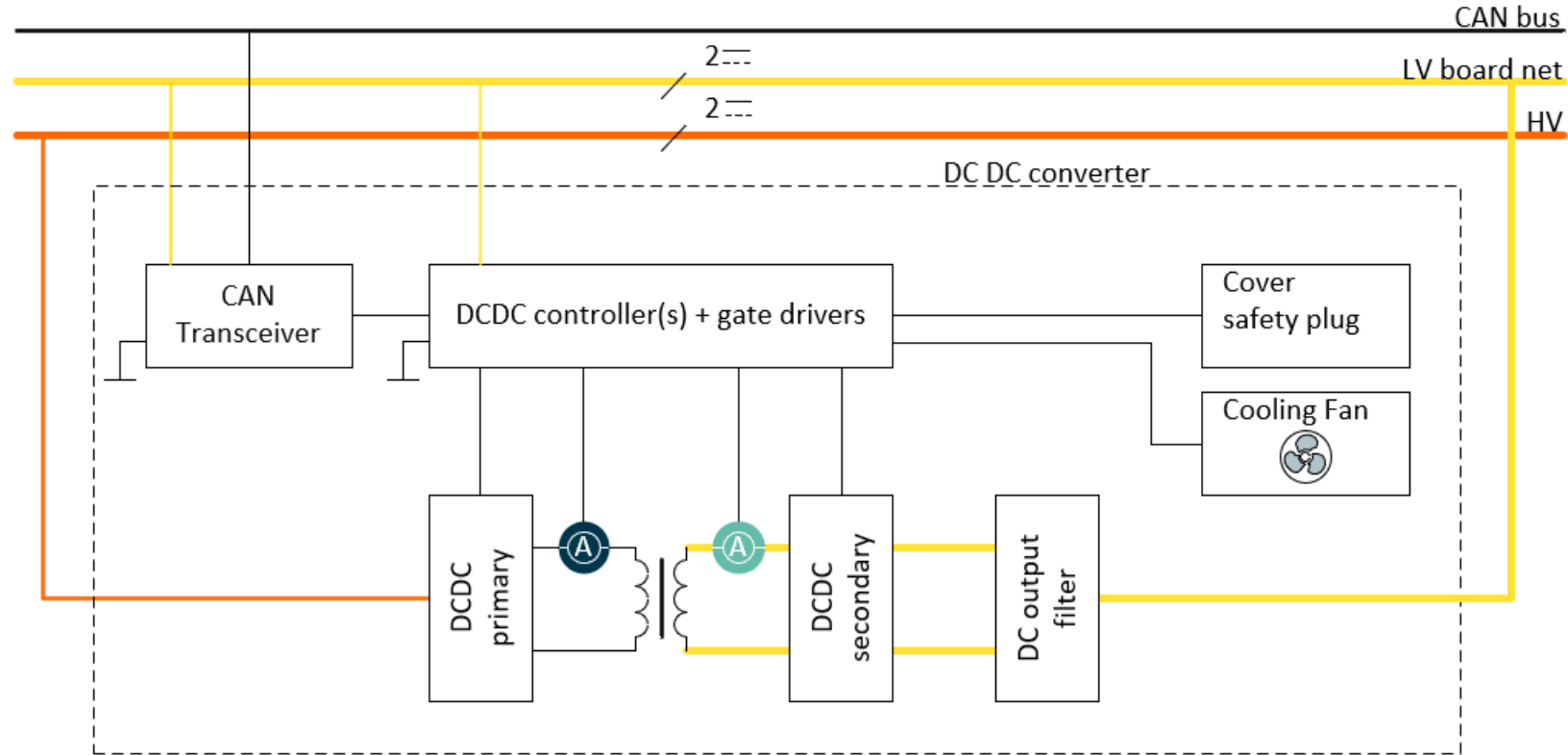
OBC from (AC Wallbox)

- 3.3kW ... 6.6KW (1-phase)
- 11kW ... 22kW (3-phase)



2.2 DC-DC

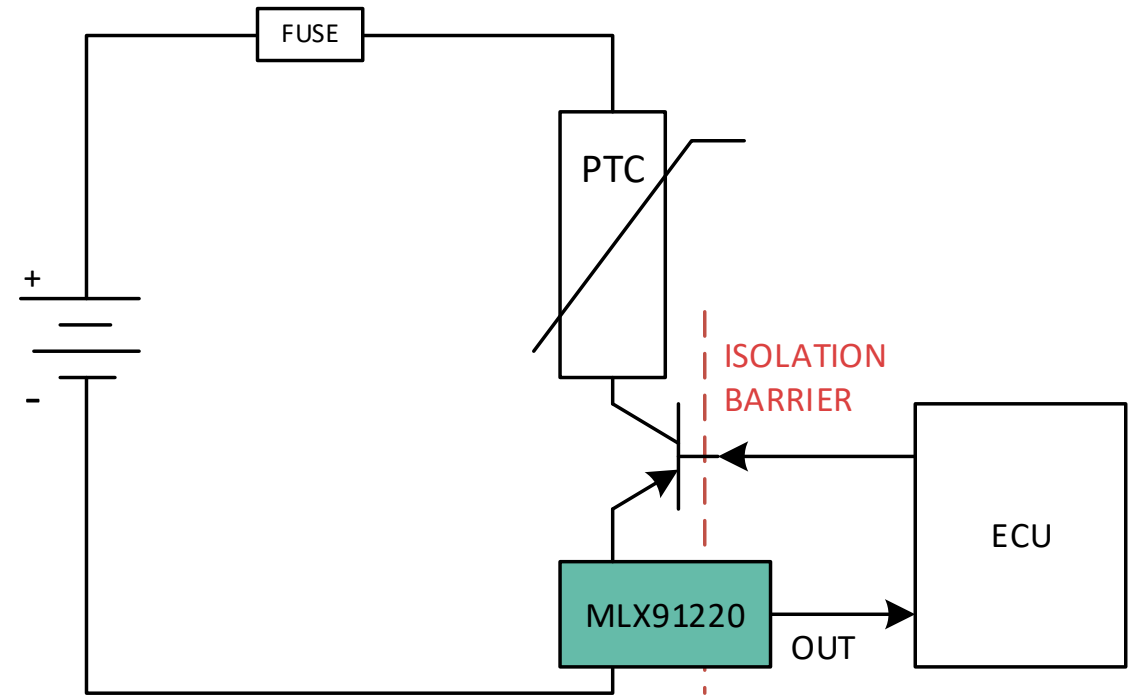
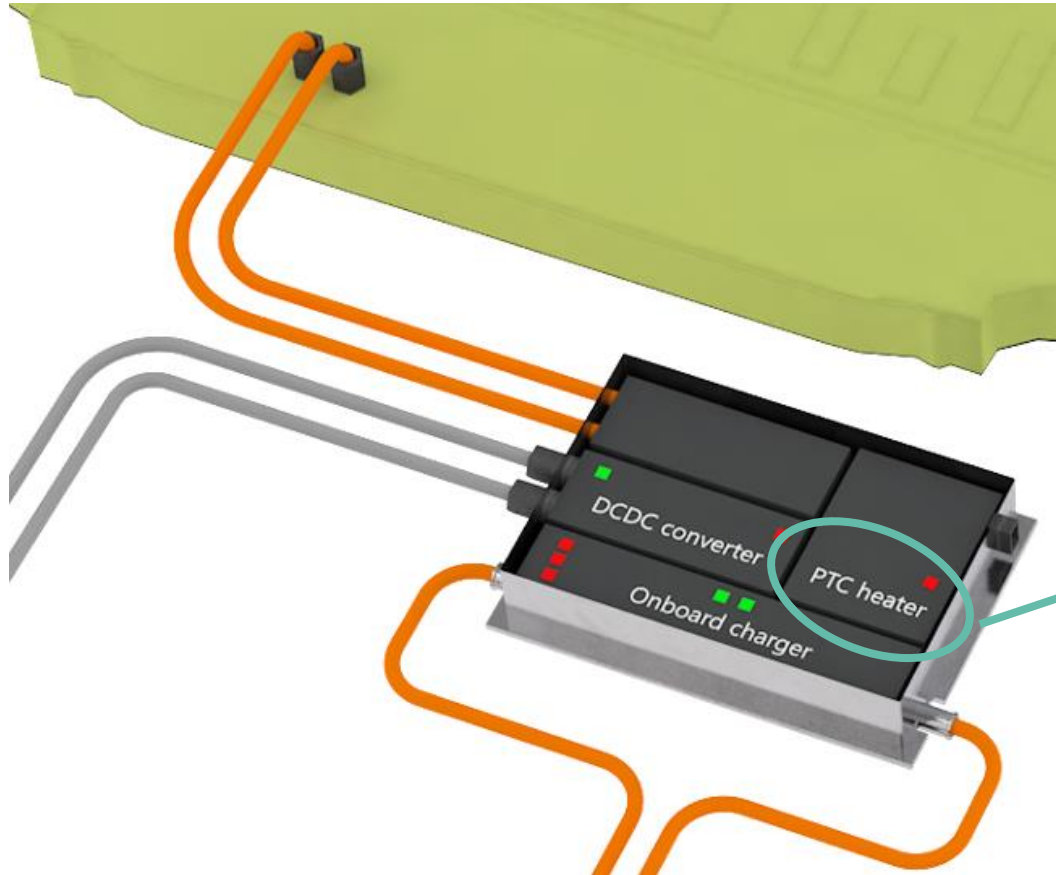
High Side (91220/1), Low side (IMC Solution)



- In case of 3.6KW DC-DC converter, for high-side, the current is around 10A rms (measurement range up to 50A).



2.3 PTC heater



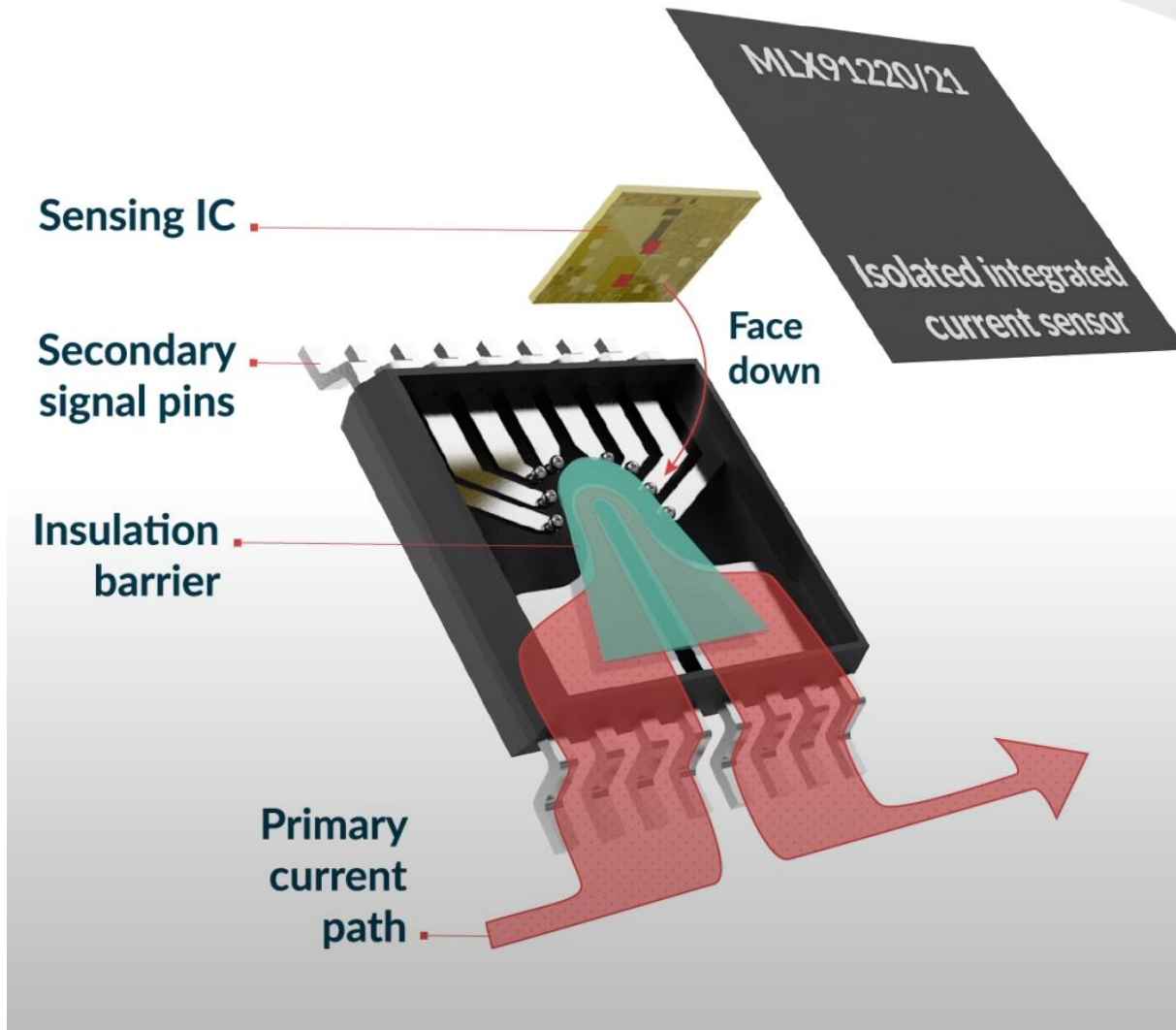
- 6-10KW with HV (400-800V) for in-cabin heating + battery pre-heating
- MLX91220/21 can be on high side (more diagnostics of system)



3. Melexis Integrated Current Sensor



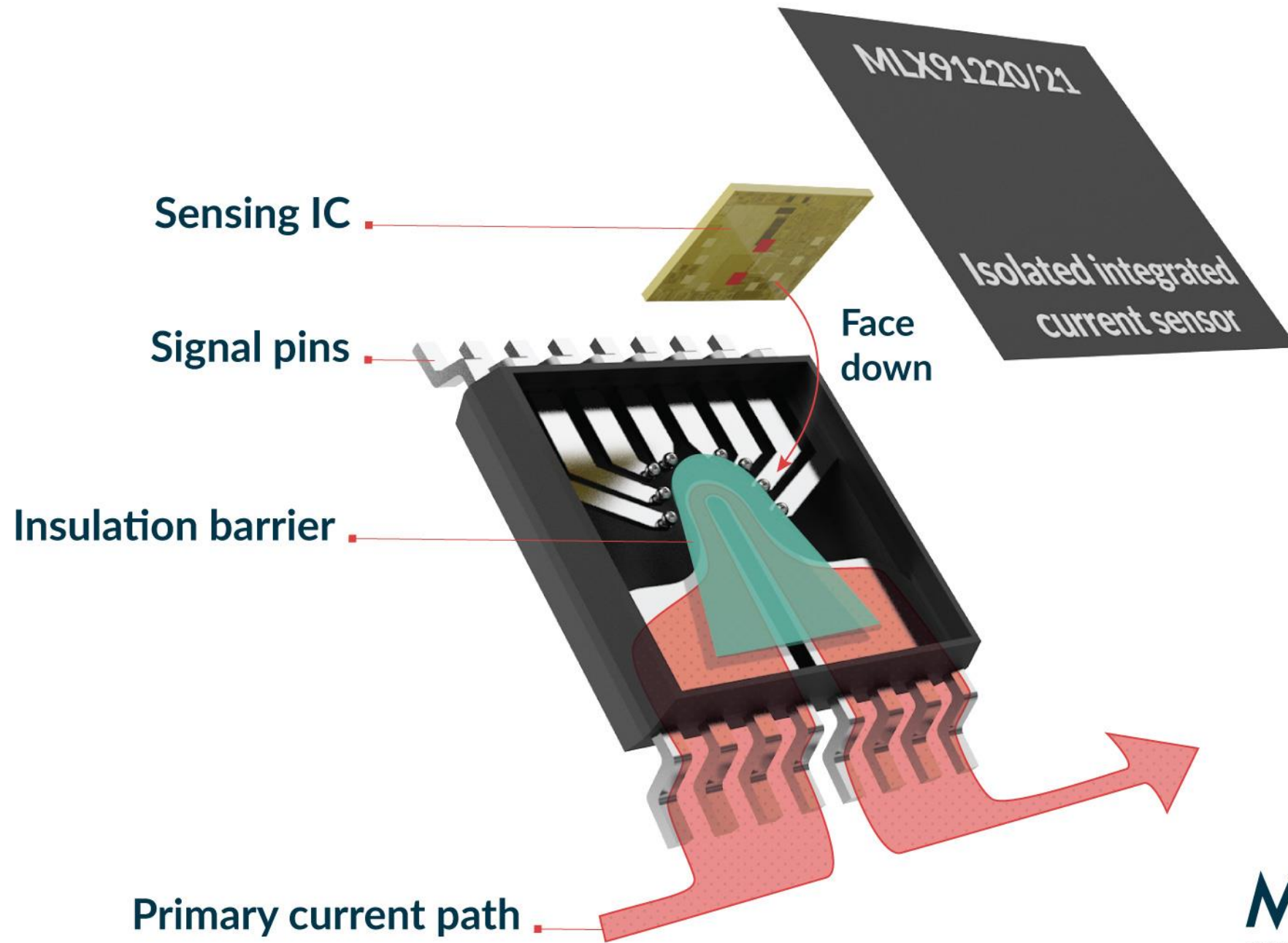
Introduction Video



**ISOLATED
INTEGRATED
CURRENT
SENSOR IC**
FOR AC & DC CURRENT
MEASUREMENT

MLX91220 (5 V)
MLX91221 (3.3 V)

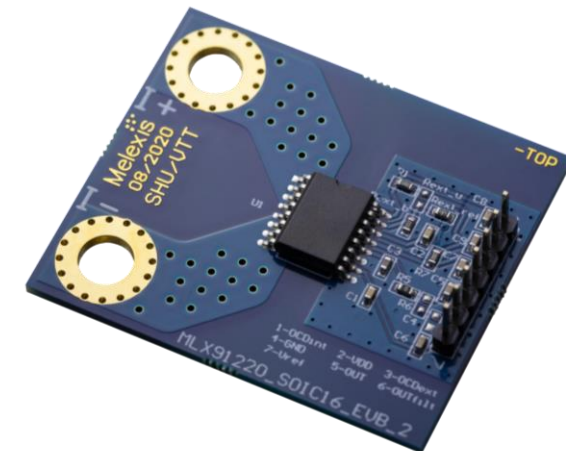
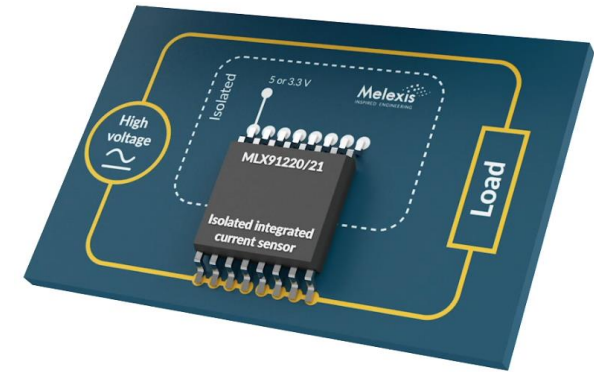




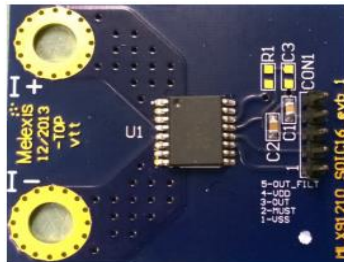
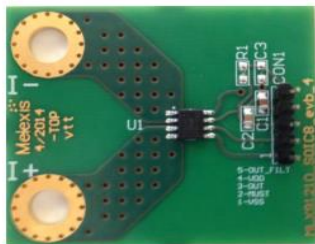
Product Overview

Integrated Primary

	91210 (EOL)	91220/21
	Gen.1	Gen.2
Supply Voltage	5V	5V/3.3V
Thermal sensitivity drift [%]	±1.5	±1.5
Thermal offset drift [mV]	±10	±7.5
Response Time [μs]	5	2
Bandwidth [kHz]	100	300
Isolation [kV]	B: 2.5	B: 2.4/ 4.8
OCD	No	Yes (INT & EXT)
Output	Analog	Analog
ASIL	(A)	(A)
Current Range [A]	50	50
Stray Field Immunity	Yes	Yes
Package	SOIC-8 /16	SOIC-8 / 16
Temp. range [°C]	-40-125	-40-125



Industry & AUTOMOTIVE

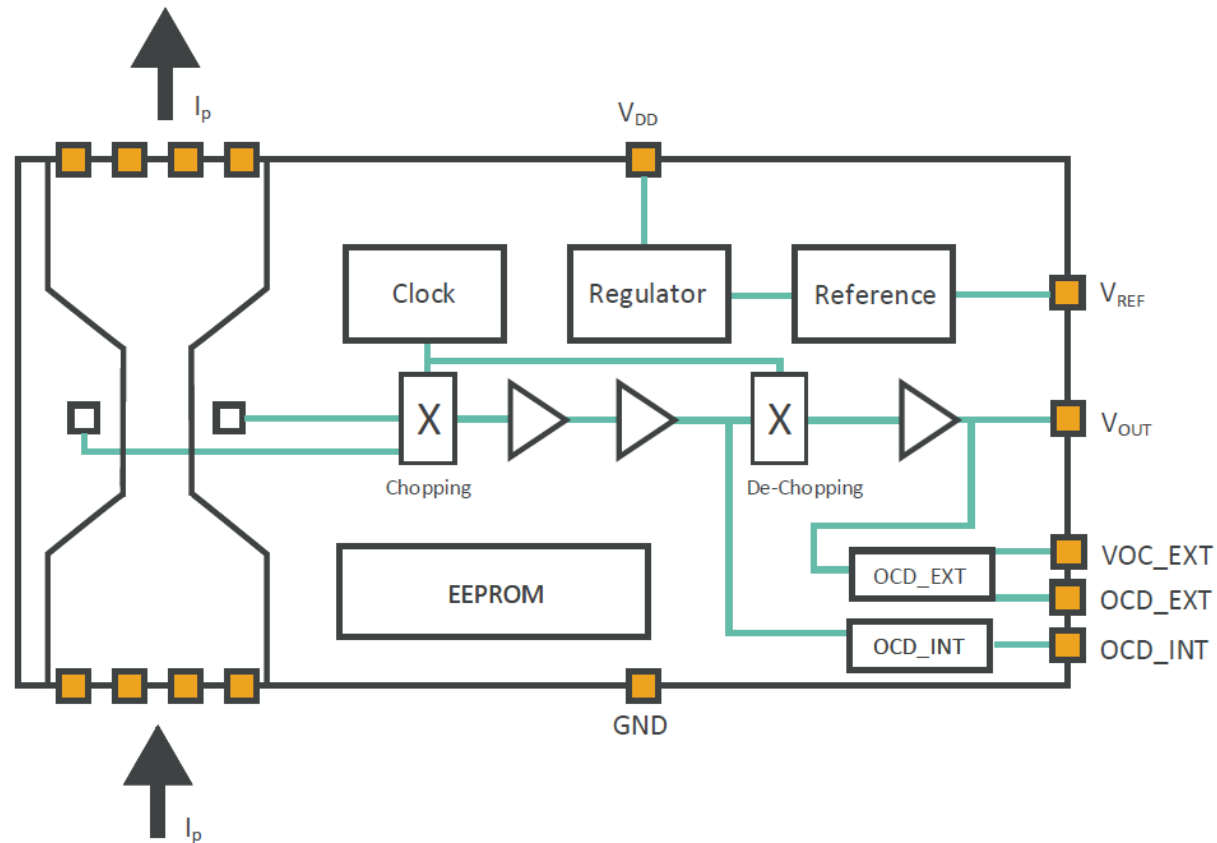


MLX91210



3. MLX91220/21 Block Diagram

SOIC-16 (SOIC-8 excludes OCD)

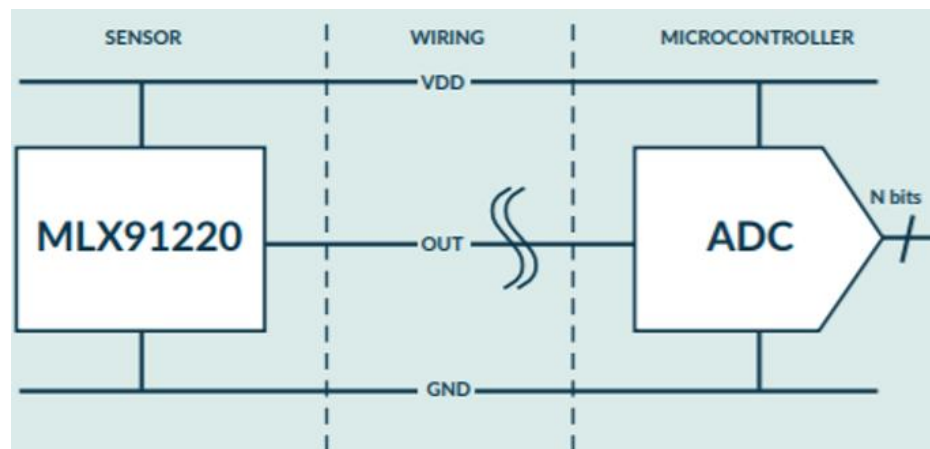


Robust against external magnetic field & Dual Over- Current Detection

3. MLX91220/21 Two Working Mode

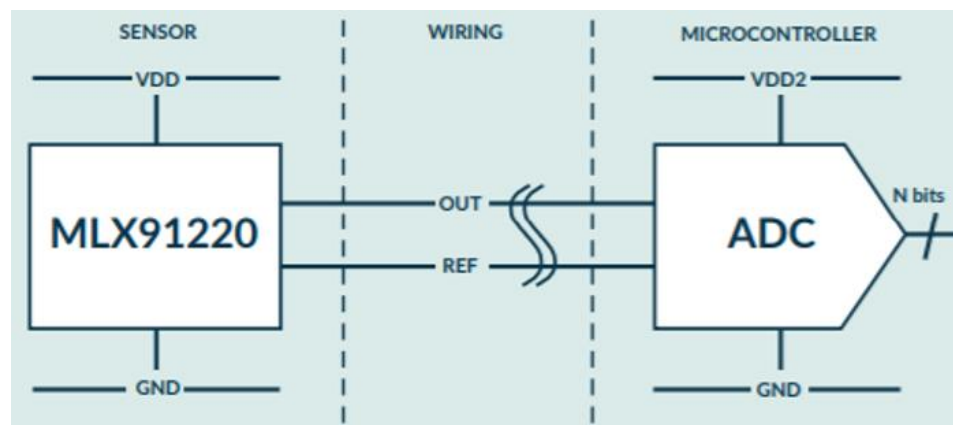
➤ **Ratiometric Mode**

- Sensitivity = $\%VDD/A$
- Offset = 50% VDD



➤ **Differential/Fixed**

- Sensitivity = mV/A
- Offset = 2.5V



3. MLX91220/21 Current Sensor Range

Capability Vs Measurement Range

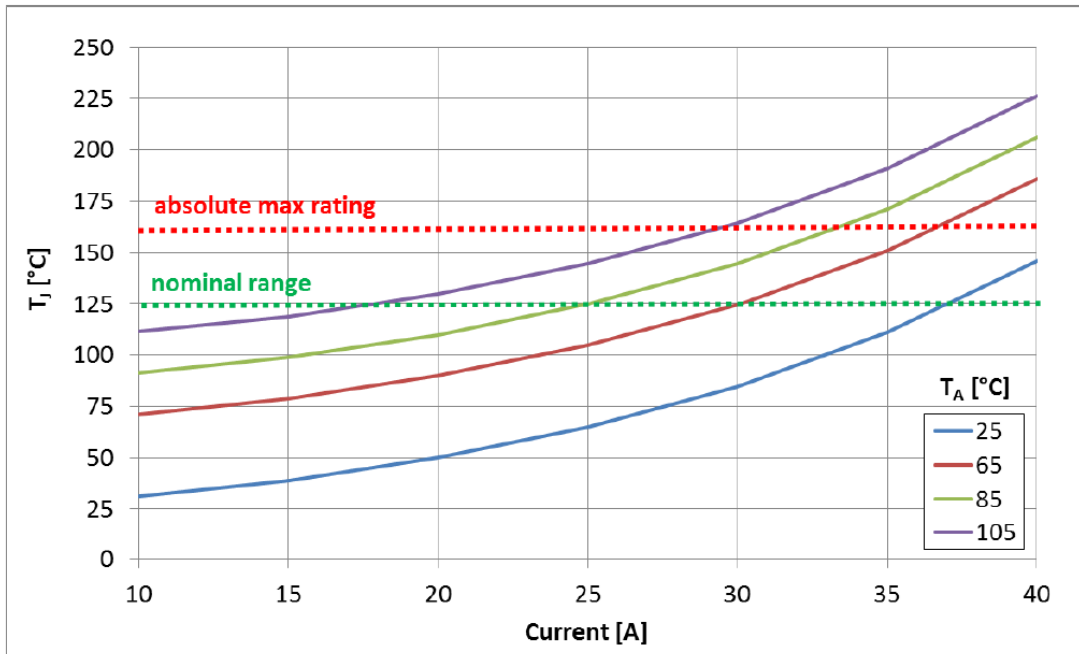


Figure 1 – Typical junction temperature [$^{\circ}\text{C}$] on SOIC8 vs applied current [A] and ambient temperature [$^{\circ}\text{C}$].

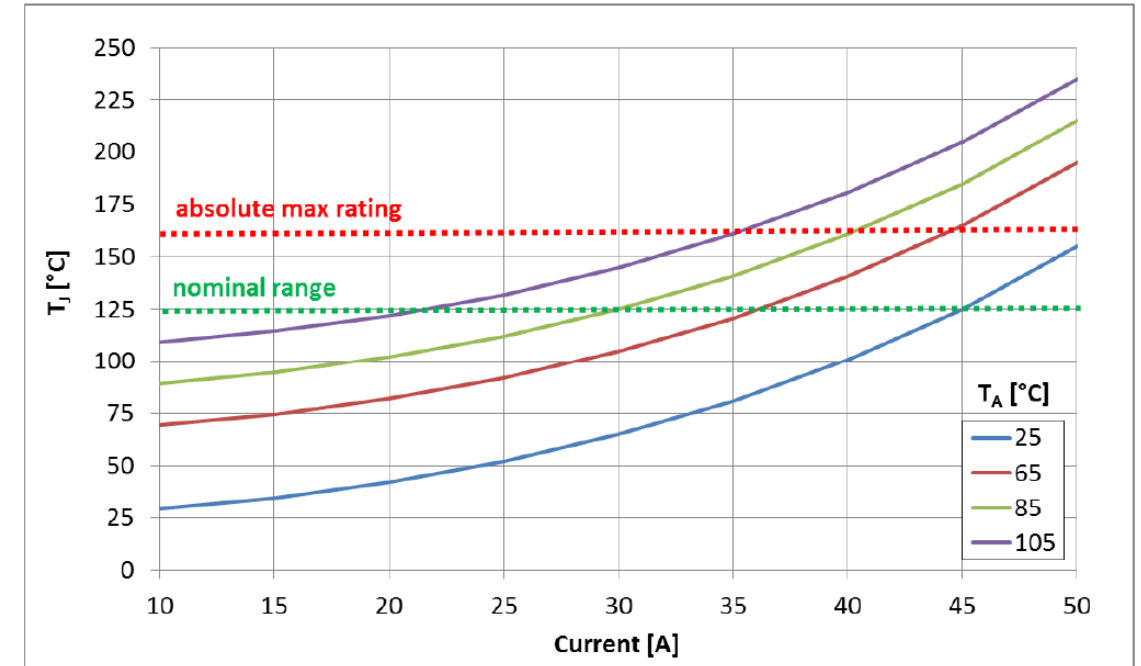


Figure 2 – Typical junction temperature [$^{\circ}\text{C}$] on SOIC16 vs applied current [A] and ambient temperature [$^{\circ}\text{C}$].



3. MLX91220/21 Isolation Spec

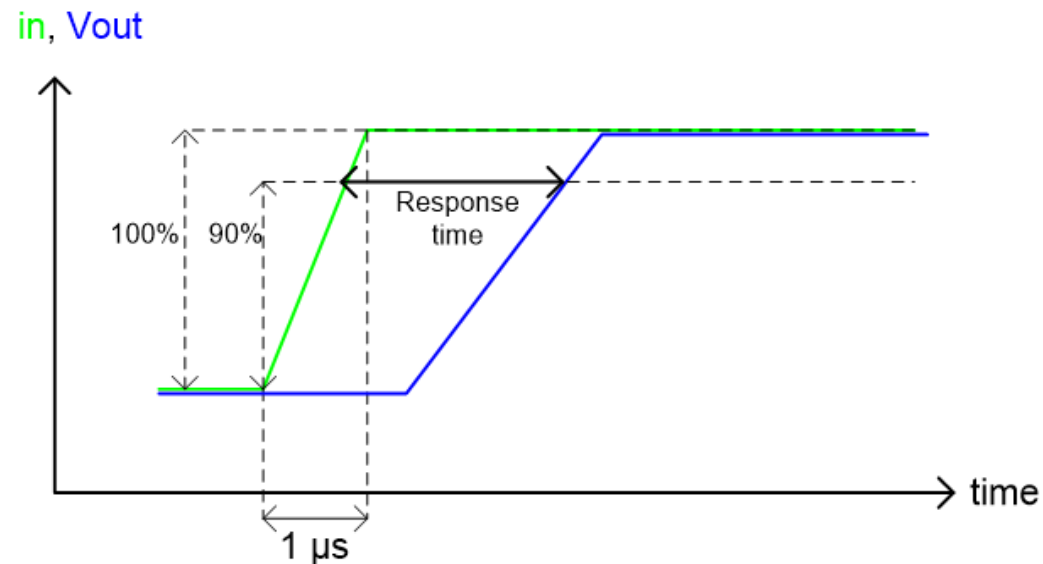
Parameter	Symbol	Test Conditions	Rating	Units
Dielectric Strength Test Voltage ⁽²⁾ ⁽³⁾	V _{ISO_SOIC8}	IEC 62368-1:2014 (second edition)	2400	V _{RMS}
	V _{ISO_SOIC16}		4800	
Working Voltage for Basic Isolation	V _{WV_SOIC8}	IEC 62368-1:2014 (second edition)	500	V _{RMS}
		Based on Pollution degree 2, material group II	707	V _{DC}
	V _{WV_SOIC16}		1000	V _{RMS}
		1414	V _{DC}	

- ⁽²⁾ Agency type tested, measured between IP (pin 1-4 on SOIC8, pin 1-8 on SOIC16) and Secondary side (pin 5-8 on SOIC8, pin 9-16 on SOIC16).
- ⁽³⁾ Melexis performs routine production-line tests, for all SOIC8 & SOIC16 devices produced.



3. MLX91220/21 Timing Spec

Parameter	Symbol	Test Conditions	Min	Typ	Max	Units
Step Response Time	T_{RESP}	Delay between the input signal reaching 90% and the output reaching 90% (see Figure 5)			2	μs
Bandwidth	BW	-3dB, $T_A = 25^\circ C$		300		kHz
Power on Delay ⁽⁵⁾	T_{POD}	V_{REF} capacitor = 47nF			0.6	ms



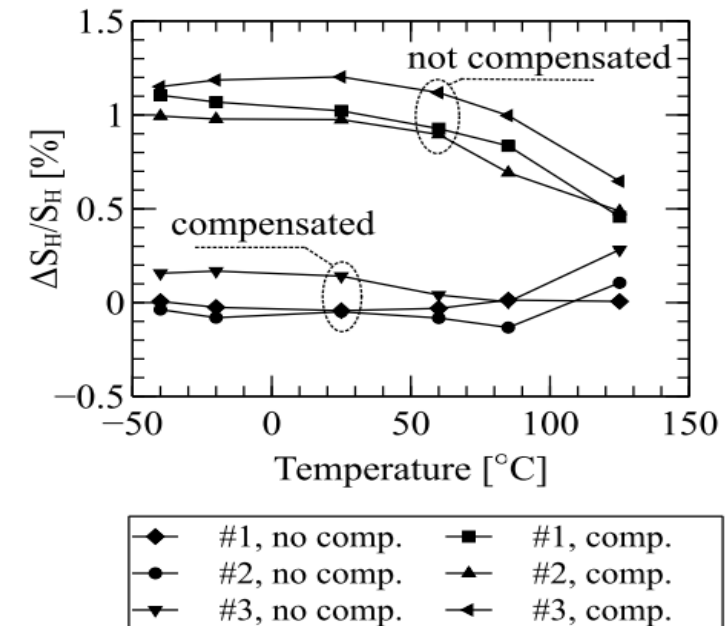
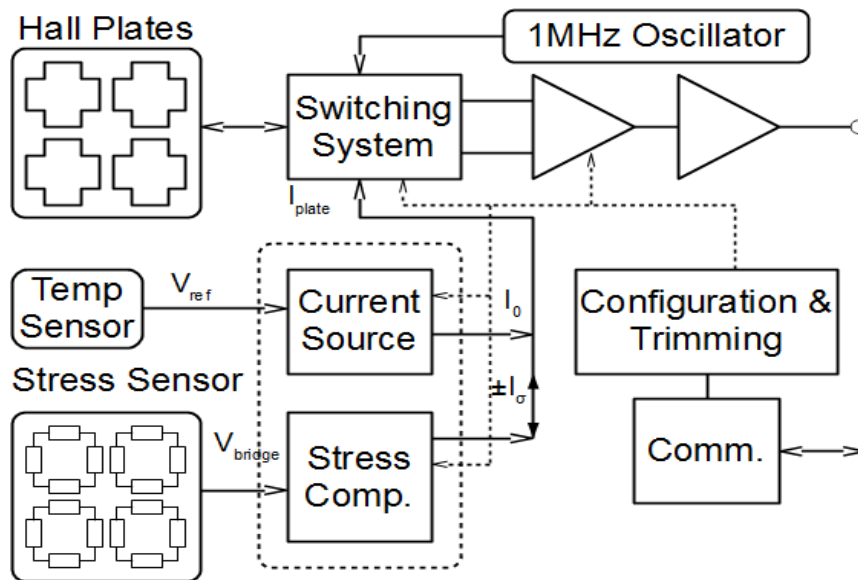
3. MLX91220/21 Dual Over-Current Detection

	OCD _{INT}		OCD _{EXT}	
	Min	Max	Min	Max
Typical Application	Short-circuit detection		Out-of-range detection	
Overcurrent effect	OCD _{INT} pin to V _{SS}		OCD _{EXT} pin to V _{SS}	
Detection mode	Bidirectional		Unidirectional / bidirectional	
Accuracy	Lower		Higher	
Threshold trimming	EEPROM		Voltage divider on VOC _{EXT}	
Response time	1.4μs	2.1μs	10μs typical	
Required Input holding time	1μs		10μs	
OCD output dwell time	7 μs	14 μs	10μs	



3. Stress Compensation

- Our most recent current sensors include a stress-compensation circuit to ensure optimal stability over lifetime.
- Stresses applied to the Hall sensing elements are automatically compensated by a change of the biasing current.
- With this technology, **lifetime sensitivity drift is below < 1%**



4. Summary



4. Summary

➤ Introduction on Melexis and Current Sensor

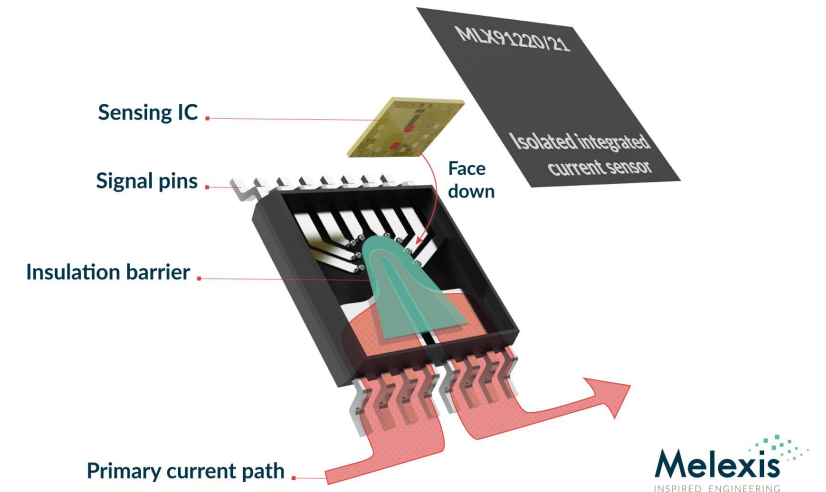
➤ Conventional, IMC, Integrated 91220/21

➤ Application System

- Automotive: OBC (incl. Charger gun), DCDC, PTC
- Industry: Solar, Pump Driver, Ups, HVAC, etc.

➤ 91220/21 Technical Spec

- Diagram (SFI), Current Capacity & Range, Voltage Isolation;
- BW & Response time, OCD_{INT} & OCD_{EXT} , Temp & Stress Compensation;





We engineer
the best imaginable future



Q&A

