

Magnetic Sensors

8-May-2018

Switch & Latch

Linear Hall

Triaxis® Hall <-Today's Topic

Current Sensors

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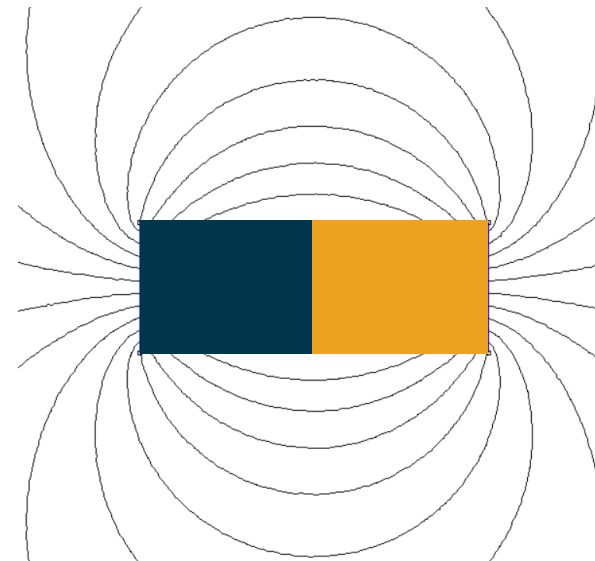
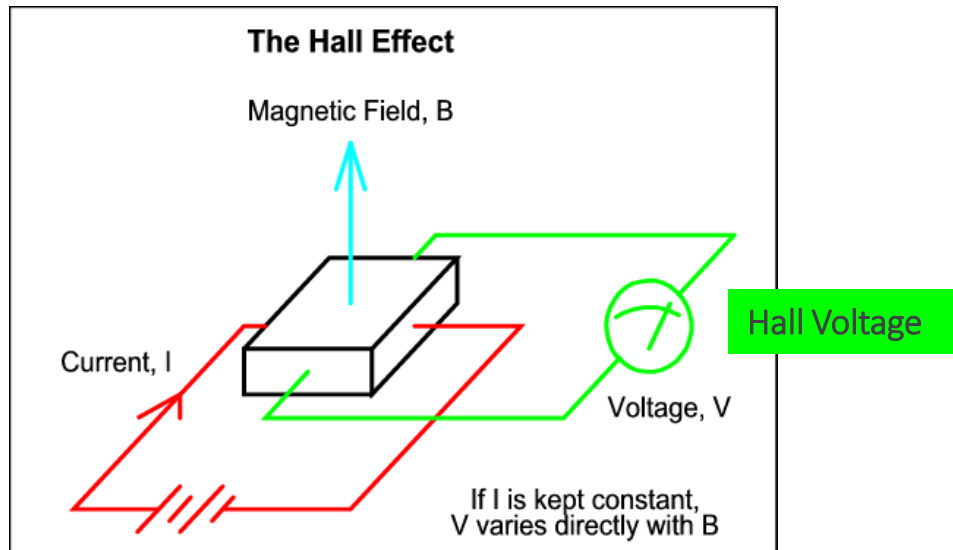


What Is Triaxis?

Magnetic Sensors

Hall Effect Principle

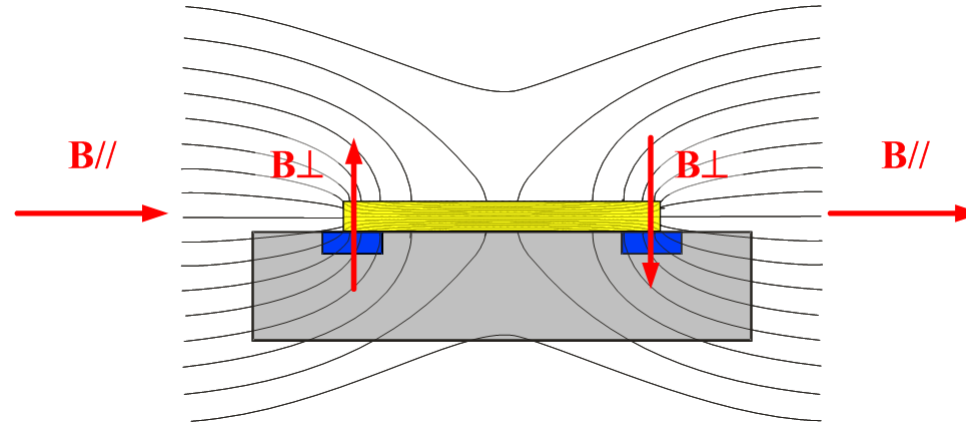
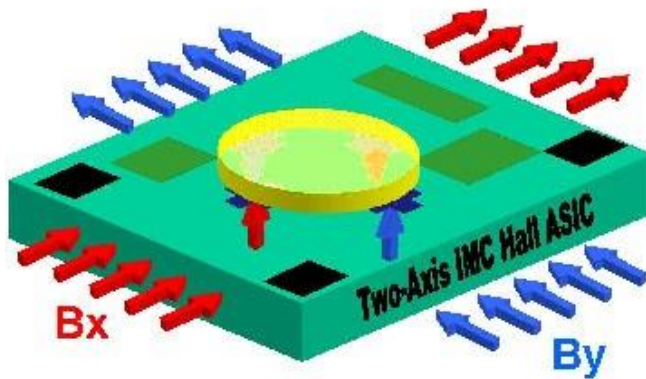
- ✓ Melexis magnetic sensors utilize the Hall Effect
 - ✓ Discovered in 1879 by Edwin Herbert Hall (1855-1938)
 - ✓ Effect results in a measured voltage proportional to the applied magnetic field
 - ✓ Magnetic field (flux density) measured in Tesla or Gauss



What is Triaxis?

IMC[®] Hall

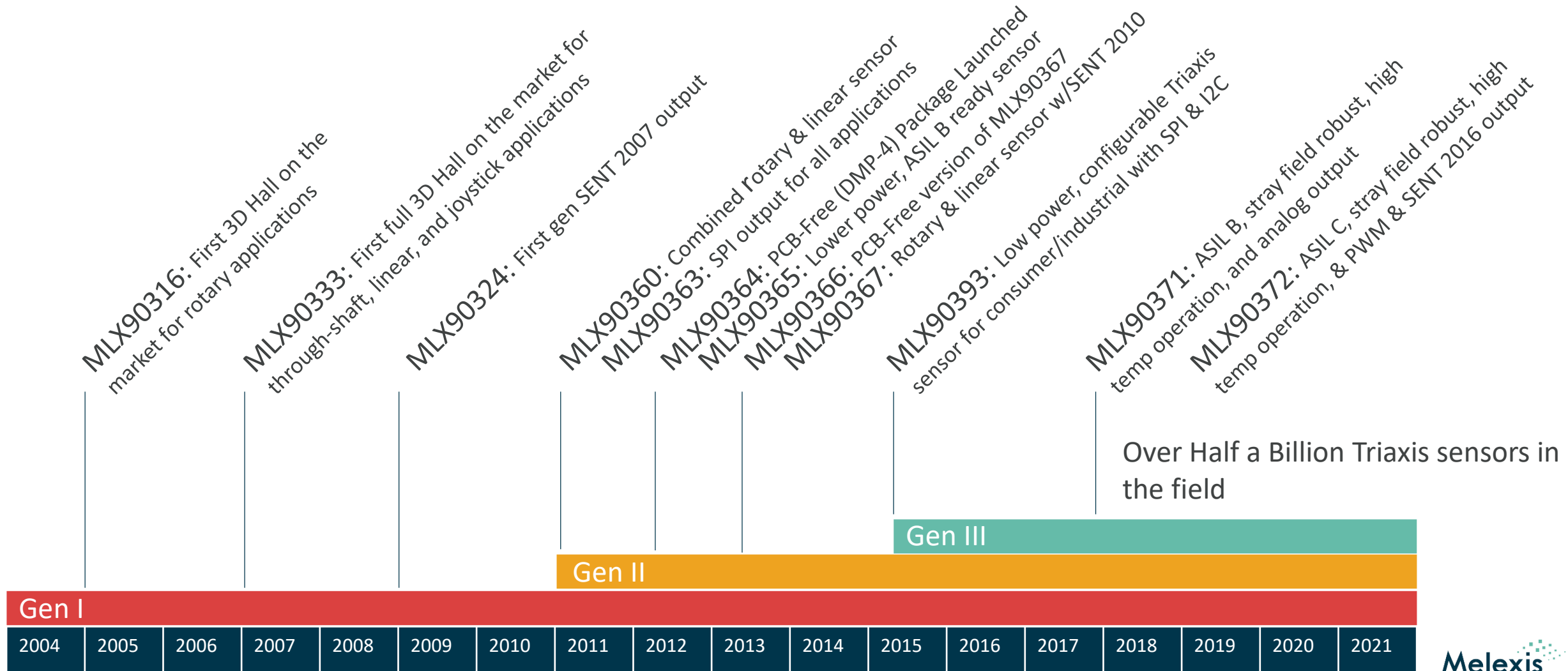
Integrated Magneto Concentrator + Planar Hall
(1 × IMC Disk) (2 × 2 plates)



Thanks to the IMC, the flux density parallel (horizontal) to the IC surface is *converted* into orthogonal (vertical) components suitable for the planar Hall plates

A History of Innovation

From 2004 Onwards...



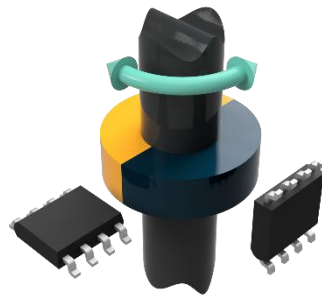
Why Use Triaxis Sensors?

Triaxis[®] Position Sensors

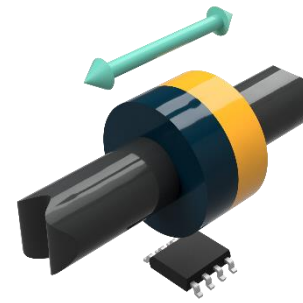
Bring Application Flexibility...



Rotary
On-Axis



Rotary
Off-Axis



Linear

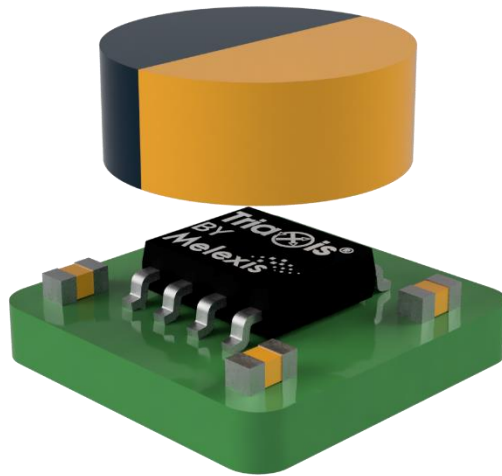


Joystick

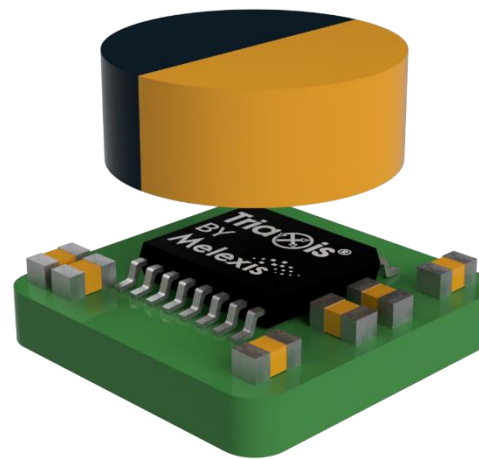
Triaxis® Position Sensors

Bring High Integration – PCB mounted applications

- ✓ All the Triaxis sensors are available in industry-standard PCB surface mount packages
 - ✓ Single Die: SOIC-8
 - ✓ Fully Redundant Dual Die: TSSOP-16



SOIC-8 Package

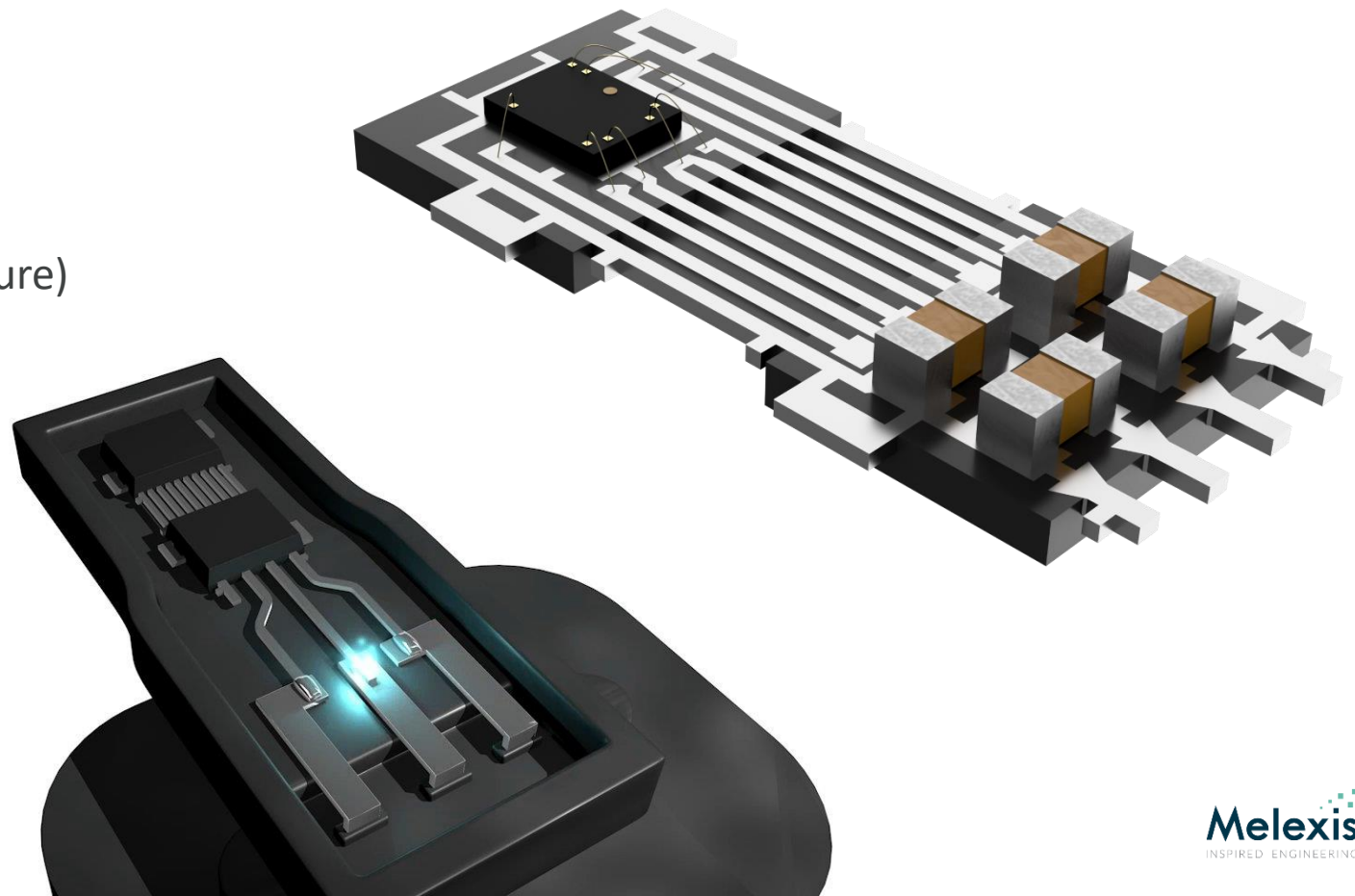


TSSOP-16 Package

Triaxis® Position Sensors

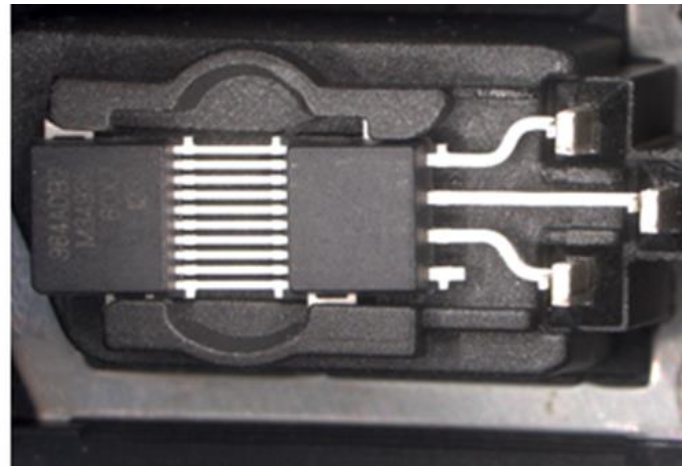
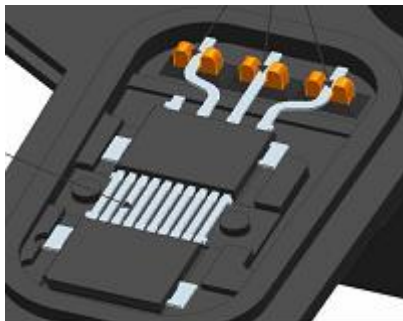
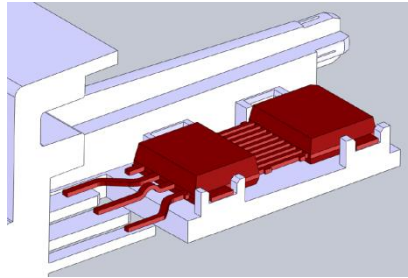
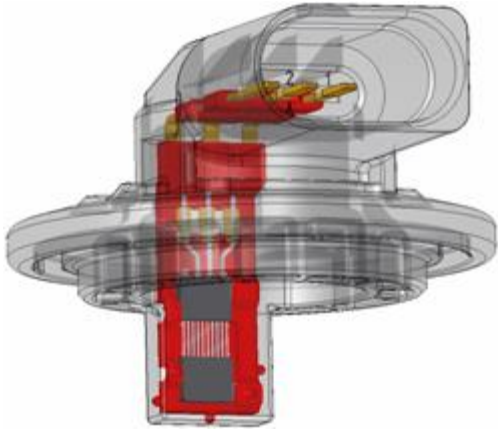
Bring High Integration – PCB-Less Packaging

- ✓ Highly Integrated Sensor Assembly: Dual Mold Package (DMP) featuring:
 - ✓ Triaxis® Position Sensing Die
 - ✓ Integrated EMC Capacitors
- ✓ Improved Robustness
 - ✓ Mechanical (mounting)
 - ✓ Electrical (ESD/EMC)
 - ✓ Environmental (vibrations, temperature)
- ✓ Small Size / Low Weight
- ✓ Increased Long-Term Reliability



Triaxis[®] Position Sensors

Bring High Integration – PCB-Less Packaging

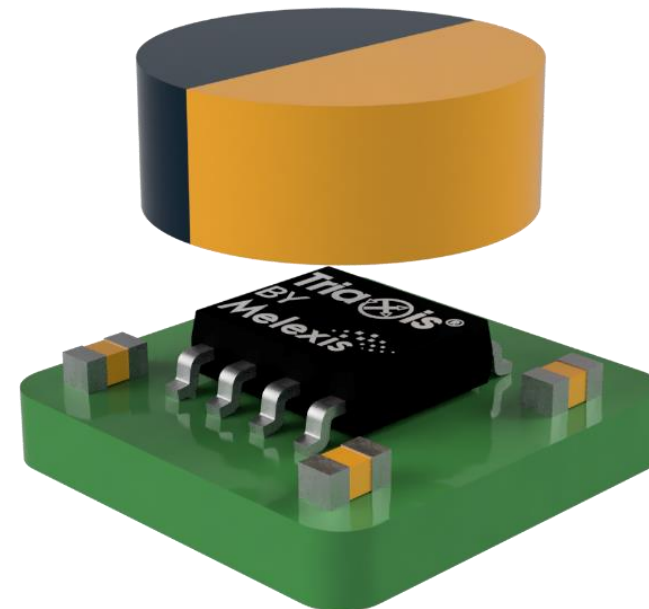


- ✓ Common Automotive Applications
 - ✓ Electric Throttle Body
 - ✓ Exhaust Gas Recirculation
 - ✓ Turbo Wastegate

Triaxis[®] Position Sensors

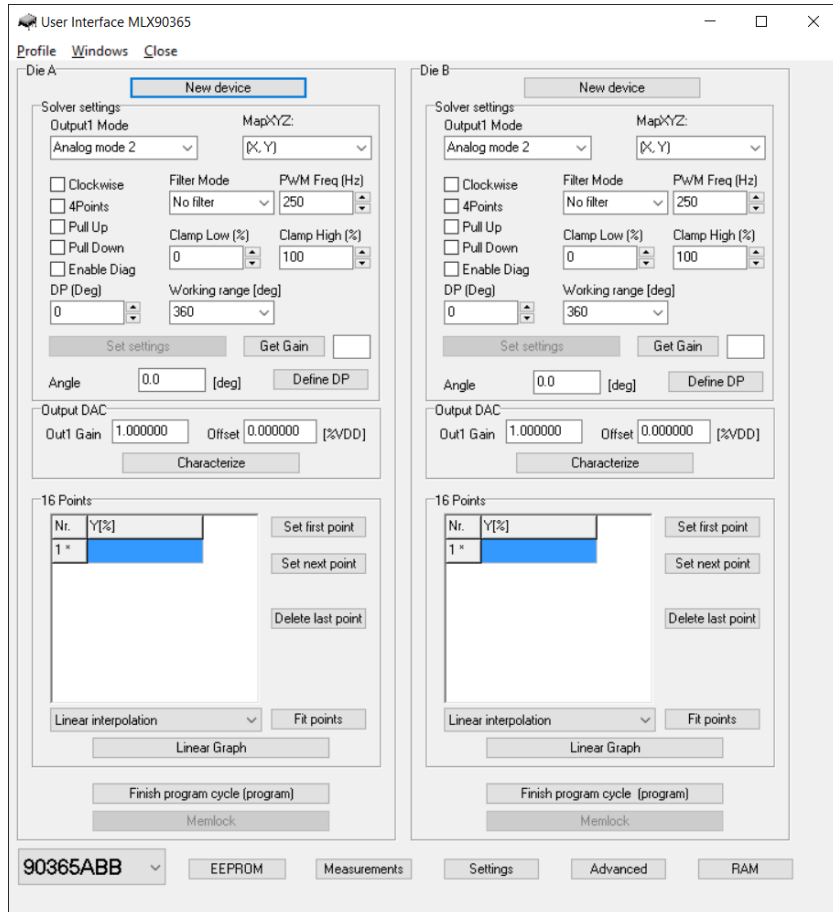
Bring High Reliability

- ✓ Triaxis sensors are non-contacting devices
 - ✓ “Seal-able” against liquid contamination
 - ✓ Insensitive to dirt or dust
 - ✓ Can operate through non-ferrous boundaries
 - ✓ Aluminum, Magnesium, ...
 - ✓ Plastic
 - ✓ Wood
 - ✓ Glass

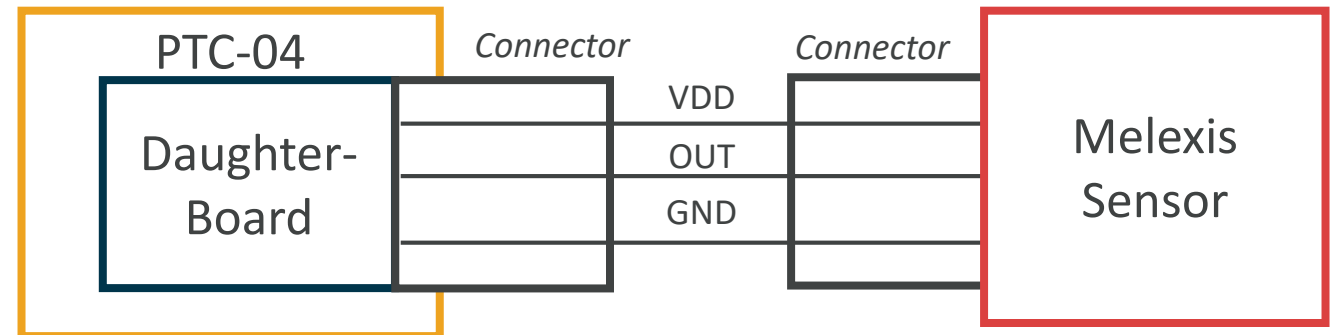


Triaxis[®] Position Sensors

Bring Easy Development and Production Via the PTC-04

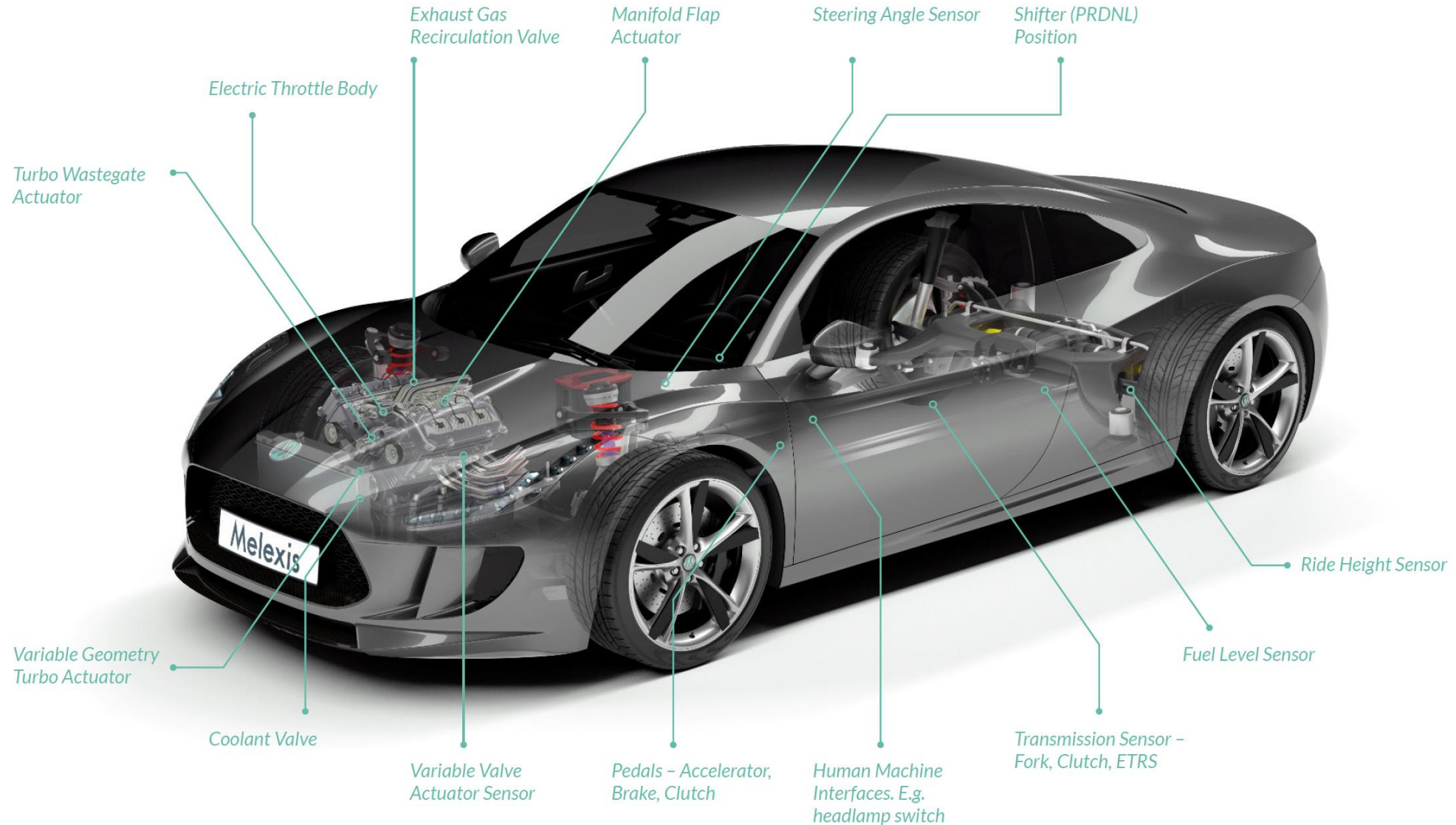


Interfaces via:
.Net (VB, C#)
Labview



Triaxis[®] Position Sensors

Selected Automotive Applications



Triaxis® Position Sensors

Generation I

Parameter		MLX90316 Rev. BCG	MLX90316 Rev. BDG	MLX90316 Rev. BCS	MLX90324 Rev. DBO	MLX90333 Rev. BCT
MOTION	Rotary	▪	▪	▪	▪	▪
	Linear					▪
	Joystick					▪
PACKAGE	SOIC-8	▪	▪	▪	▪	▪
	TSSOP-16	▪	▪	▪	▪	▪
OUTPUT	Analog	▪		▪ (2x)	▪	▪
	PWM	▪		▪ (2x)	▪	▪
	SENT				▪ (2007)	
	SPI	▪	▪			▪

Triaxis® Position Sensors

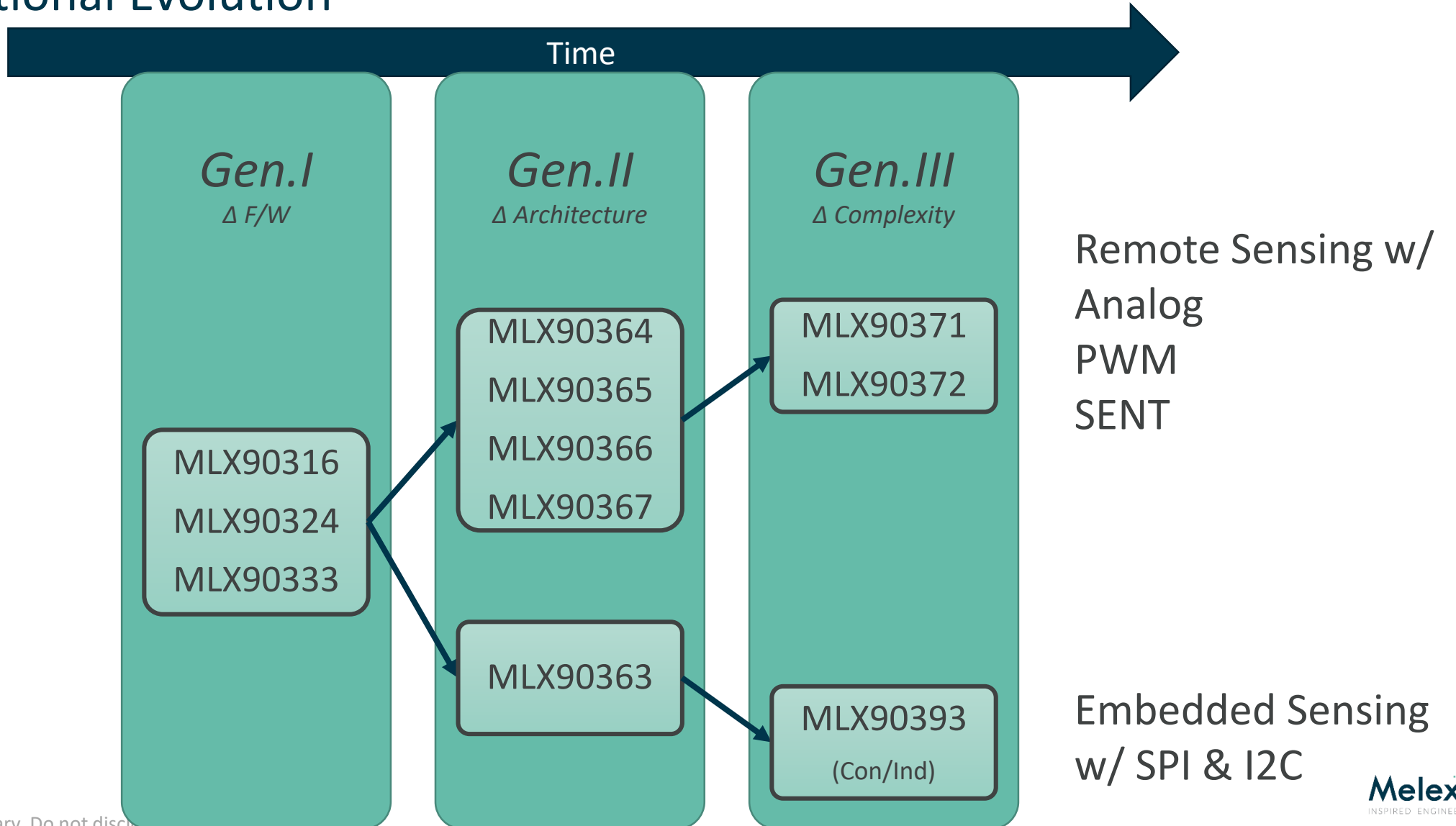
Generation II

Parameter		MLX90363 Rev. ABB	MLX90364 Rev. ADD	MLX90365 Rev. ABD	MLX90366 Rev. ADV/U	MLX90367 Rev. ABV/U
MOTION	Rotary	▪	▪	▪	▪	▪
	Linear	▪	▪	▪	▪	▪
	Joystick	▪				
PACKAGE	SOIC-8	▪		▪		▪
	TSSOP-16	▪		▪		▪
	DMP (PCB-less)		▪		▪	
OUTPUT	Analog		▪	▪		
	PWM		▪	▪		
	SENT				▪	▪
	SPI	▪				
ASIL	B (SEooC)	▪	▪	▪	▪	▪

Third Generation Triaxis

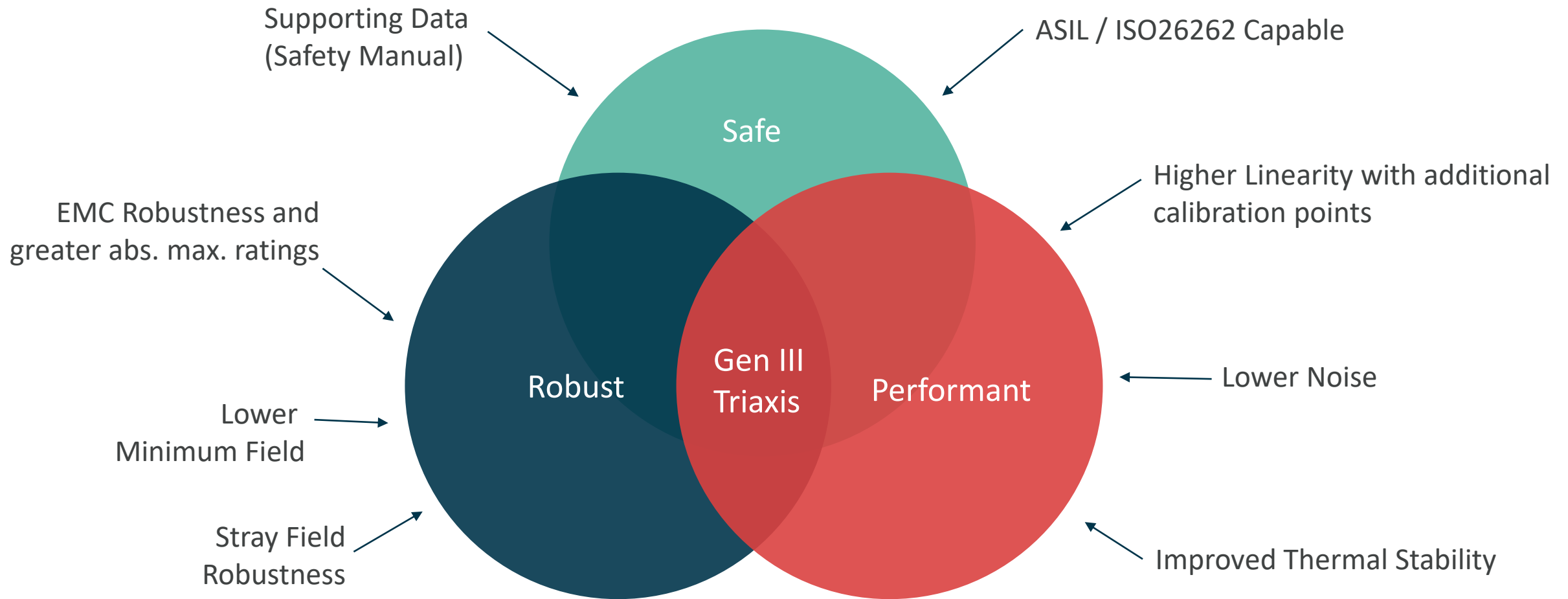
Triaxis Sensors

Generational Evolution



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Improvements in Generation III Devices

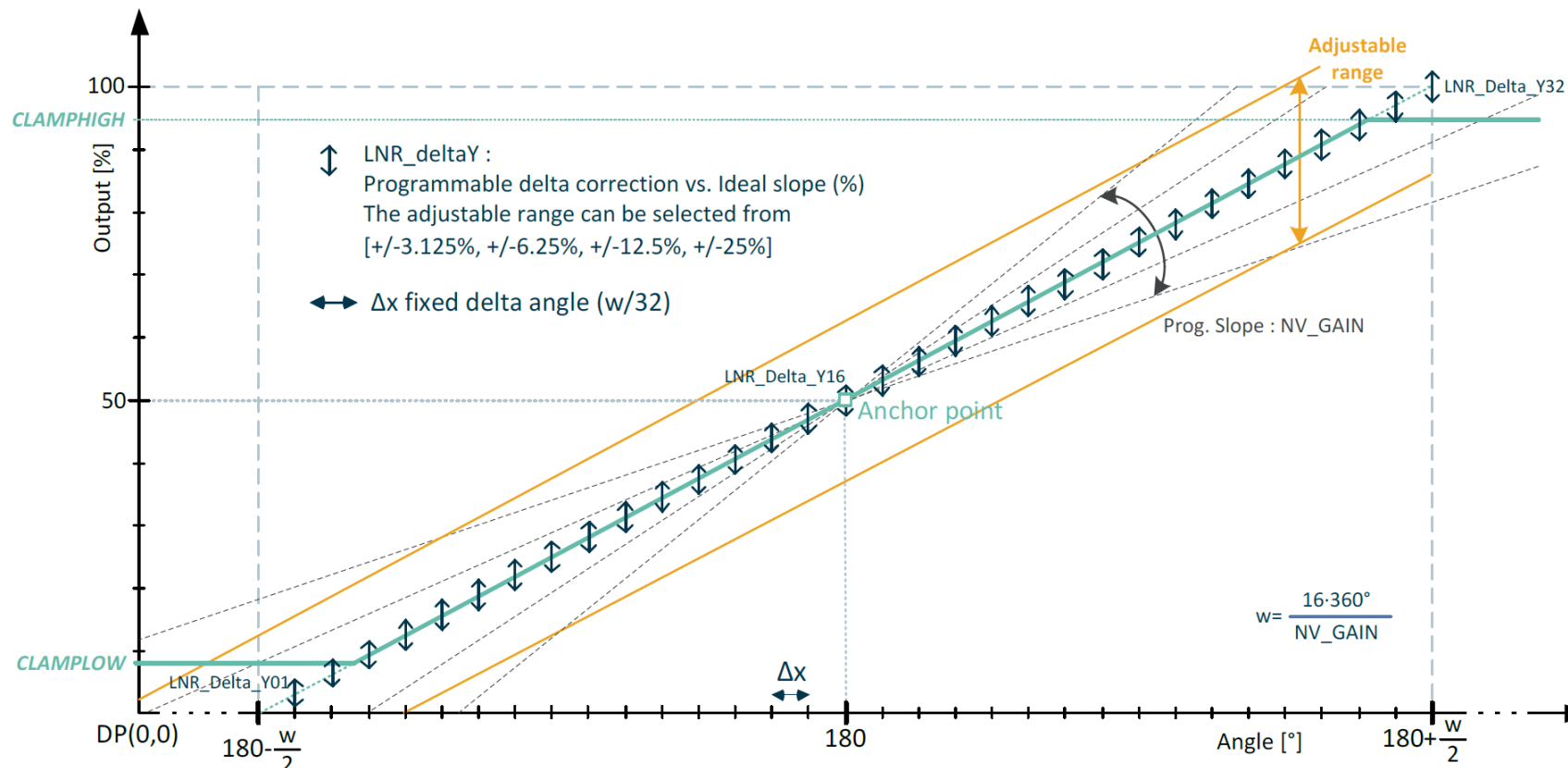


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Feature Improvements – All Modes, All Devices

✓ Enhanced Calibration

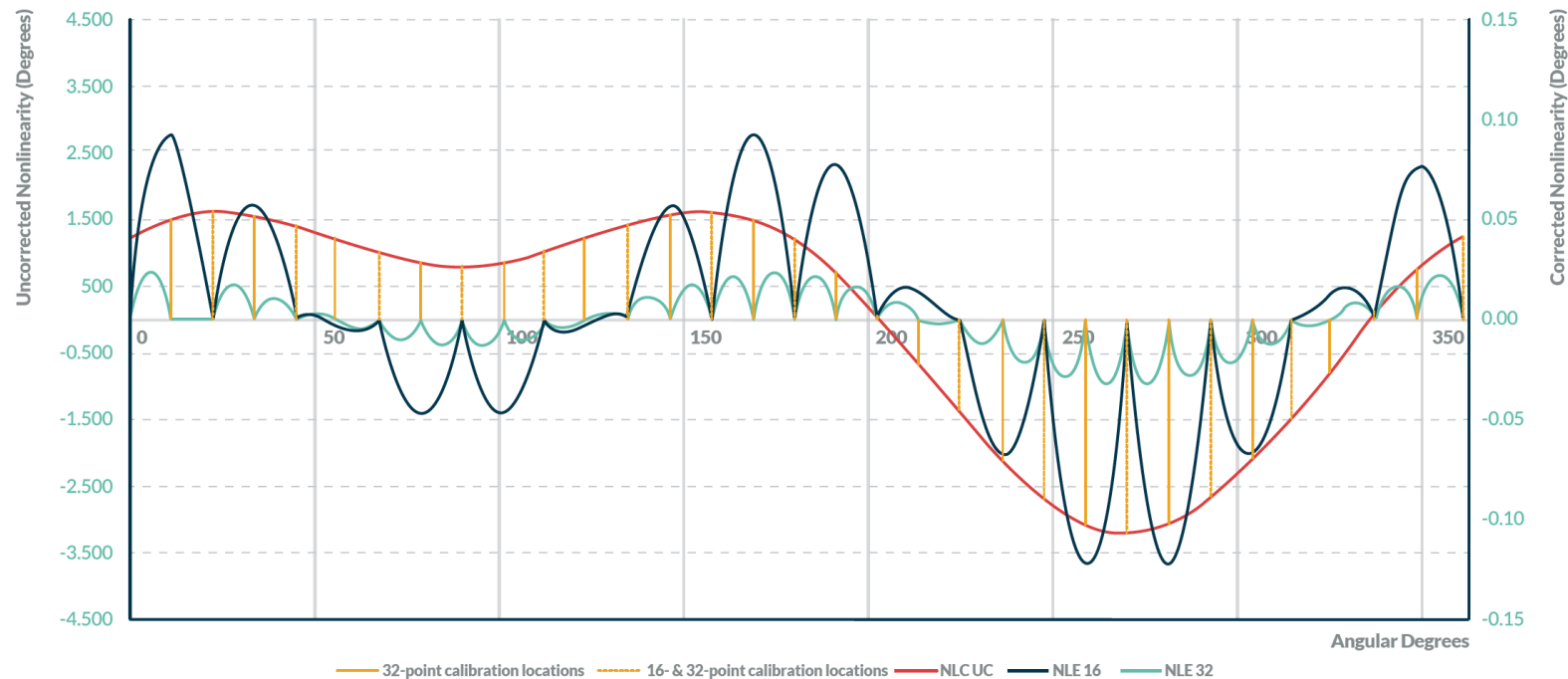
✓ 32 points on fixed grid or 8 arbitrary points



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Feature Improvements – All Modes, All Devices

- ✓ Enhanced Calibration with 32 Points
 - ✓ Allows for further reduction in nonlinearity errors vs 16 points



Simulation —
Real world results
may vary

Linearity improvement by 16-point and 32-point method found in Generation III Triaxis[®]

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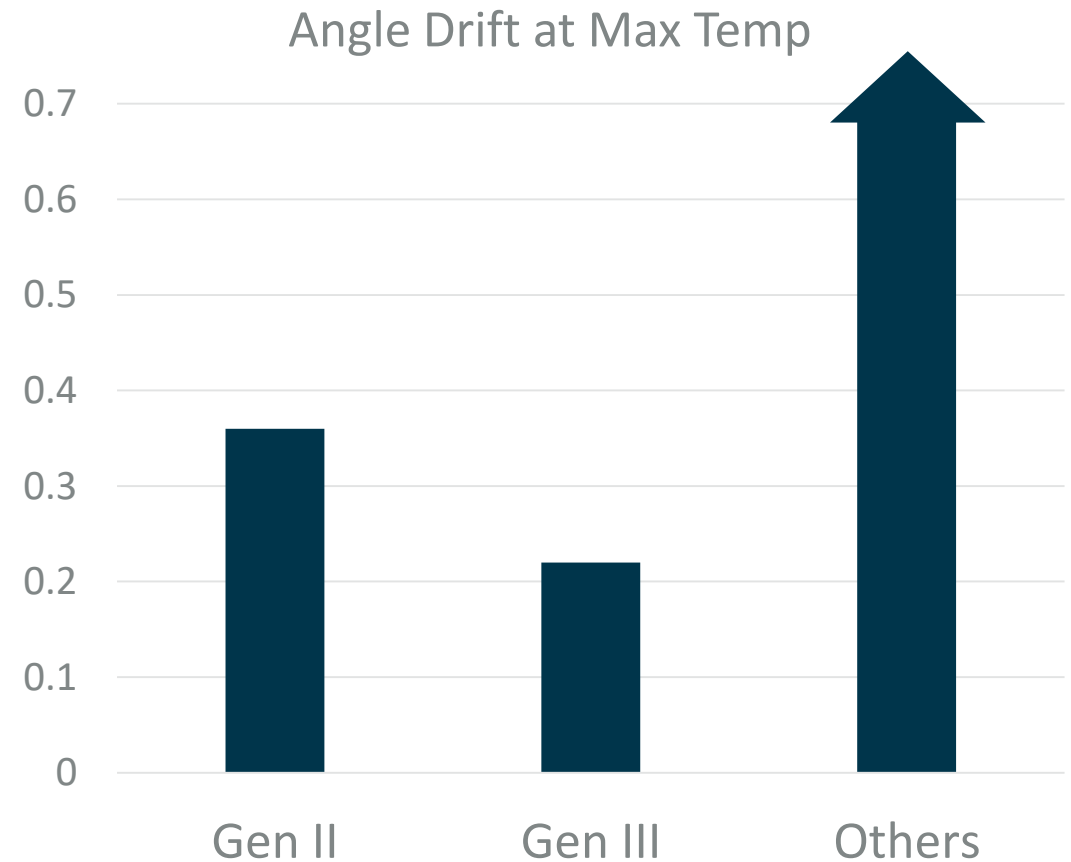
Generation III – Performance Improvements

- ✓ Lower Flux Density Requirement
 - ✓ 10mT vs 20mT of existing products. Allows for smaller or lower cost magnets reducing total system cost
- ✓ Higher Ambient Temperature
 - ✓ 160°C ambient with low degradation of performance (e.g. drift, noise) to allow customers to target high temp applications (e.g. engine compartment)

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Generation III – Performance Improvements

- ✓ Thermal Drift and Noise Substantially Improved over Gen II
- ✓ Additionally,
 - ✓ Gen III operates at a higher ambient temperature of 160°C
 - ✓ Or at a lower minimum field (10mT)



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How can we meet stray field requirements?

✓ Gen II (and others) Solution

- ✓ More Field
 - ✓ More Field
 - ✓ More Field
- ✓ R.O.T.: 1% of good field as stray field = 0.6 deg error
 - ✓ 4mT stray @ 20mT > 11° error
 - ✓ 4mT stray @ 120mT < 2° error
- ✓ Drawback: Bigger magnet or small airgap required

✓ Gen III Solution

- ✓ Ignore the stray field
- ✓ Available on MLX90371 and MLX90372
- ✓ Excellent for existing stray-field requirements from OEM's
- ✓ Utilizes a two or four-pole magnet (linear or rotary)



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Gen III – Stray Field Mode

✓ Stray Field Robustness

- ✓ Based on ISO11452-8 ($4000\text{A/m} = 5\text{mT}$) and current carrying conductor tests ($400\text{A}@25\text{mm} = 3.2\text{mT}$) to meet next-gen OEM requirements

✓ Gradient Measurement vs Homogenous Measurement

- ✓ 10mT/mm gradient field

✓ For on-axis rotation a new magnet is used

- ✓ 4-pole axially magnetized. (Contact MLX for an app note)

✓ For off-axis rotation or linear motion a 2-pole magnet can still be used (Contact MLX for an app note)



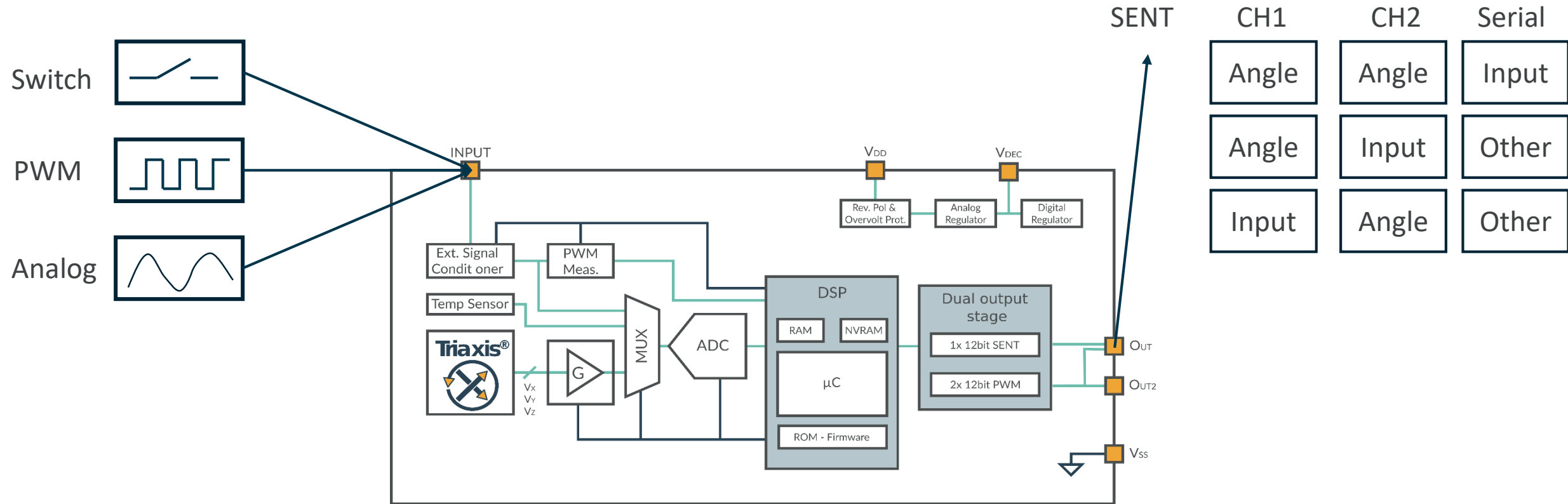
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Performance and Feature Improvements – All Modes

- ✓ ISO26262 -  **ASIL** | **READY**
BY MELEXIS
 - ✓ Supported via SEooC (Safety Element out of Context) approach
 - ✓ ASIL B – MLX90371
 - ✓ ASIL C – MLX90372
 - ✓ Safety Manuals available upon request
- ✓ Extended On Board Diagnostics Supporting ASIL Capability
- ✓ Gateway for External Sensor (Readout / Input)
 - ✓ PWM, NTC, or a switch can be read

Triaxis[®] Position Sensors

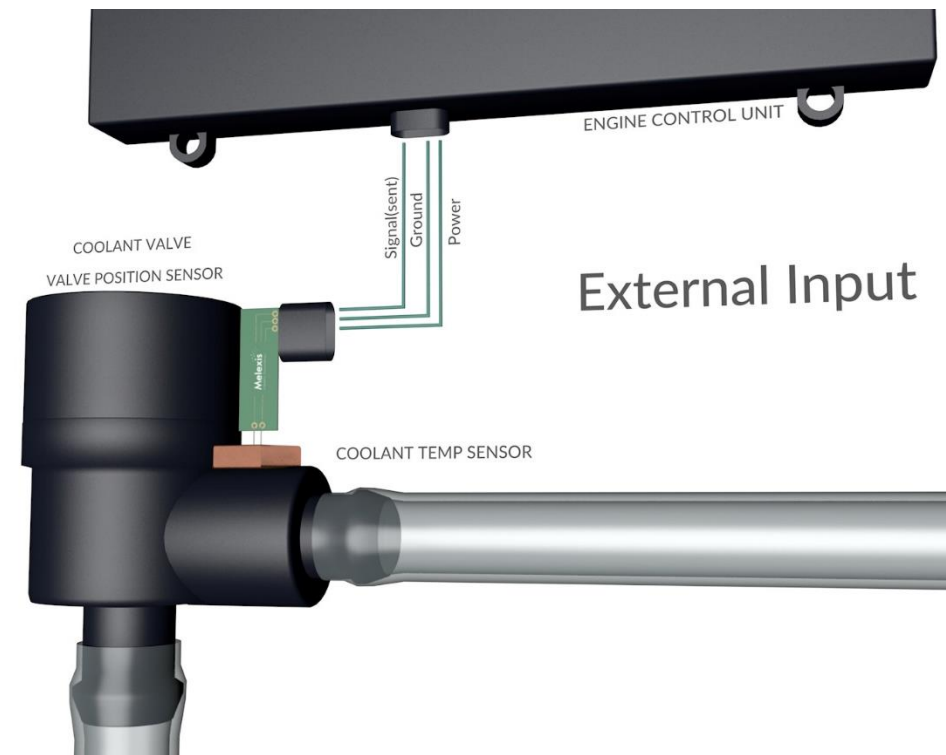
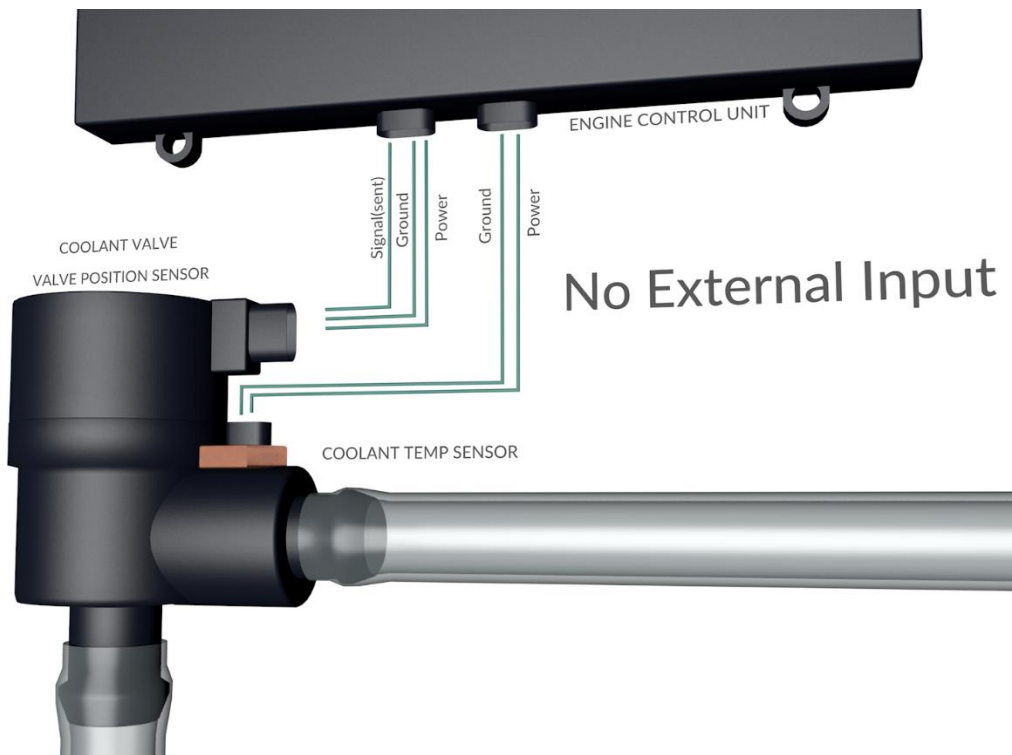
MLX90372: Input Pin for Expansion Capabilities



Triaxis[®] Position Sensors

MLX90372: Input Pin for Expansion Capabilities

- ✓ Input pin allows for reduction in wire count and harness complexity -> further integration & weight savings



Gen III Triaxis

Planned Family Members

Parameter		MLX90371	MLX90372
MOTION	Rotary	▪	▪
	Linear	▪	▪
	Joystick		
PACKAGE	SOIC-8	▪	▪
	TSSOP-16	▪	▪
	PCB-less (DMP-4)	▪	▪
OUTPUT	Analog	▪	
	PWM		▪
	SENT		▪
ASIL	B (SEooC)	▪	
	C (SEooC)		▪

More Coming Soon

26-March-2018

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Gen III Short Summary of Improvements – XY Nominal Mode

Metric (datasheet spec)	Gen II (e.g. MLX90367)	Gen III (e.g. MLX90372)
Output	SENT / PWM	SENT / PWM
Thermal Drift	20mT: +/-0.60 deg	10mT: +/-0.45 deg
Noise (max, 40mT)	0.2 deg	0.1 deg
Calibration Points	16 max	32 max
Input pin / Gateway	No	Yes
Abs Max Ratings / EMC	Vdd: -12V / +24V Vout: -0.3V / 18V	Vdd: -20V / +37V Vout: -14V / 28V

Gen III Short Summary of Improvements – Stray Field Immunity

Metric (datasheet spec)	Gen II (e.g. MLX90367)	Gen III (e.g. MLX90372)
4kA/m Stray Field	Substantial Deviation (>10deg)	No or minimal impact (<0.4 deg)

Tools and Samples

✓ Tools:

- ✓ Programming tool is the same PTC-04 as previous generations
- ✓ Using a new daughterboard (Hall06)
- ✓ Small EVB's (~25mm x 25mm) available with pre-programmed parts.
 - ✓ Custom options possible on request with additional lead time.
- ✓ Application notes for magnetic design available on request

✓ Samples:

- ✓ Available directly from Melexis for the immediate future
- ✓ Please contact your organizations sales contact or the email addresses below:
 - ✓ Sales_Europe@Melexis.com
 - ✓ Sales_USA@Melexis.com

An underwater scene with a deep blue background. Several sharks are visible, including two prominent hammerhead sharks in the foreground and middle ground. Numerous smaller fish are scattered throughout the water, creating a sense of a busy marine environment.

Thank You and Q&A

