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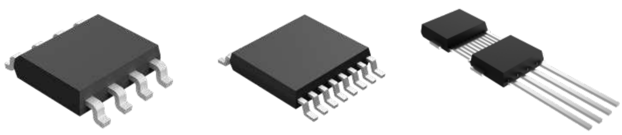
MLX90371 Triaxis® Position Processor

Datasheet

Features and Benefits

- Triaxis® Hall Technology
- On-Chip Signal Processing for Robust Absolute Position Sensing
- ISO26262 ASIL-B capable, Safety Element out-of-Context (SEooC)
- Programmable Measurement Range
- Programmable Linear Transfer Characteristic (Multi-points 4 or 8 points or Piece-Wise-Linear 16 or 32 segments)
- Selectable Analog (Ratiometric) or PWM Output
- 12 bit Resolution - 10 bit Thermal Accuracy
- 48 bit ID Number option
- Robustness against Stray-Field



SOIC-8 *TSSOP-16* *DMP-4*

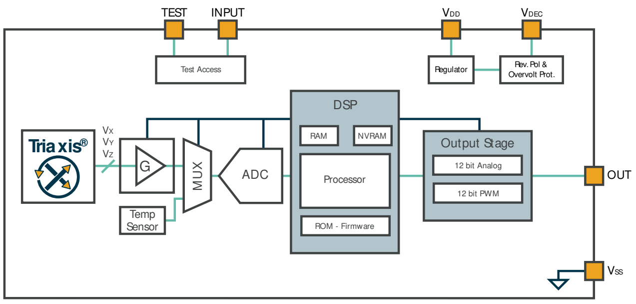
Application Examples

- Absolute Rotary Position Sensor
- Absolute Linear Position Sensor
- Pedal Position Sensor
- Throttle Position Sensor
- Ride Height Position Sensor
- Steering Wheel Position Sensor
- Float-Level Sensor
- Non-Contacting Potentiometer

Description

The MLX90371 is a monolithic sensor sensitive to the three components of the flux density applied to the IC (i.e. B_X, B_Y and B_Z). This allows the MLX90371 with the correct magnetic circuit to decode the absolute position of any magnet moving in its vicinity (e.g. rotary position from 0 to 360 Degrees or linear displacement, see Figure 2).

The MLX90371 reports a programmable ratiometric analog output signal compatible with any resistive potentiometer or programmable linear Hall sensor. Through programming, the MLX90371 can provide a digital PWM (Pulse Width Modulation) output characteristic.



Melexis
INSPIRED ENGINEERING

Ordering Information

Product	Temperature	Package	Option Code	Packing Form	Definition
MLX90371	G	DC	BCC-100	RE	Rotary Stray-Field Immune Mode
MLX90371	G	DC	BCC-200	RE	Linear Stray-Field Immune Mode
MLX90371	G	DC	BCC-300	RE	Standard / Legacy Mode
MLX90371	G	GO	BCC-100	RE	Rotary Stray-Field Immune Mode – Low-Field Variant
MLX90371	G	GO	BCC-200	RE	Linear Stray-Field Immune Mode
MLX90371	G	GO	BCC-300	RE	Standard / Legacy Mode
MLX90371	G	GO	BCC-500	RE	Rotary Stray-Field Immune Mode – High-Field Variant
MLX90371	G	VS	BCC-100	RE/RX	Rotary Stray-Field Immune Mode
MLX90371	G	VS	BCC-150	RE/RX	Rotary Stray-Field Immune Mode
MLX90371	G	VS	BCC-101	RE/RX	Rotary Stray-Field Immune Mode
MLX90371	G	VS	BCC-151	RE/RX	Rotary Stray-Field Immune Mode
MLX90371	G	VS	BCC-103	RE/RX	Rotary Stray-Field Immune Mode
MLX90371	G	VS	BCC-153	RE/RX	Rotary Stray-Field Immune Mode
MLX90371	G	VS	BCC-108	RE/RX	Rotary Stray-Field Immune Mode
MLX90371	G	VS	BCC-158	RE/RX	Rotary Stray-Field Immune Mode
MLX90371	G	VS	BCC-200	RE/RX	Linear Stray-Field Immune Mode
MLX90371	G	VS	BCC-250	RE/RX	Linear Stray-Field Immune Mode
MLX90371	G	VS	BCC-201	RE/RX	Linear Stray-Field Immune Mode
MLX90371	G	VS	BCC-251	RE/RX	Linear Stray-Field Immune Mode
MLX90371	G	VS	BCC-203	RE/RX	Linear Stray-Field Immune Mode
MLX90371	G	VS	BCC-253	RE/RX	Linear Stray-Field Immune Mode
MLX90371	G	VS	BCC-208	RE/RX	Linear Stray-Field Immune Mode
MLX90371	G	VS	BCC-258	RE/RX	Linear Stray-Field Immune Mode
MLX90371	G	VS	BCC-300	RE/RX	Standard / Legacy Mode
MLX90371	G	VS	BCC-350	RE/RX	Standard / Legacy Mode
MLX90371	G	VS	BCC-301	RE/RX	Standard / Legacy Mode

Product	Temperature	Package	Option Code	Packing Form	Definition
MLX90371	G	VS	BCC-351	RE/RX	Standard / Legacy Mode
MLX90371	G	VS	BCC-303	RE/RX	Standard / Legacy Mode
MLX90371	G	VS	BCC-353	RE/RX	Standard / Legacy Mode
MLX90371	G	VS	BCC-308	RE/RX	Standard / Legacy Mode
MLX90371	G	VS	BCC-358	RE/RX	Standard / Legacy Mode

Legend:

Temperature Code:	G: from -40°C to 160°C
Package Code:	“DC” for SOIC-8 package “GO” for TSSOP-16 package (dual die) “VS” for DMP-4 package (dual mold, PCB-less)
Option Code:	BCC-xxx: die Version xxx-**123**: **1**: Application – Magnetic configuration ▪ 1: Rotary Stray-Field Immune mode – Low-Field Variant ▪ 2: Linear Stray-Field Immune mode ▪ 3: Standard / Legacy mode (legacy backwards comparable to previous generation) ▪ 5: Rotary Stray-Field Immune mode – High-Field Variant **2**: Configuration for DMP package ▪ 0: 100nF output capacitor ▪ 5: 10nF output capacitor **3**: Trim-and-Form for DMP-4 ▪ 0: Standard straight leads. See section 18.3.1 ▪ 1: Trim-and-Form STD1 2.54. See section 18.3.2 (not recommended for new designs, prefer STD4 2.54) ▪ 3: Trim-and-Form STD2 2.54. See section 18.3.3 ▪ 8: Trim-and-Form STD4 2.54. See section 18.3.4
Packing Form:	-RE : Tape & Reel ▪ VS:2500 pcs/reel ▪ DC:3000 pcs/reel ▪ GO:4500 pcs/reel -RX : Tape & Reel, similar to RE with parts face-down (VS package only)
Ordering Example:	“MLX90371GDC-BCC-100-RE” For a Rotary Stray-Field Immune mode variant1 application in SOIC-8 package, delivered in Reel.

Table 1 – Ordering information legend

Contents

1. Functional Diagram

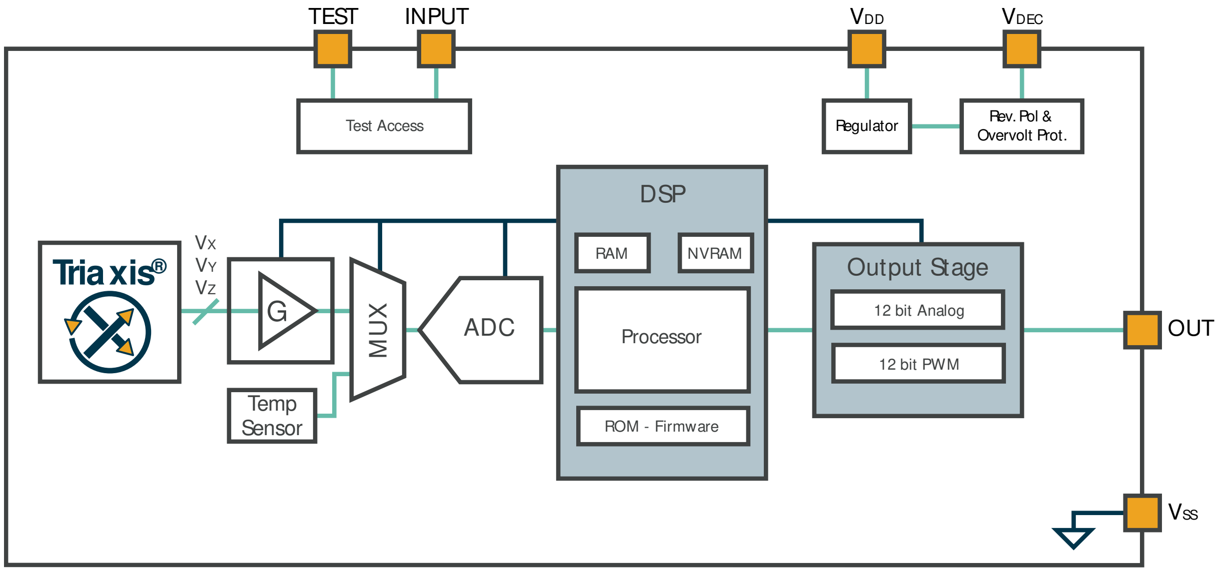


Figure 1 – MLX90371 Block Diagram

2. Glossary of Terms

Term	Description	Term	Description
Gauss (G), Tesla (T)	Units for the magnetic flux density: 1 mT = 10 G	SEooC	Safety Element Out of Context
TC	Temperature Coefficient (in ppm/Deg.C.)	FIR	Finite Impulse Response
PWM	Pulse Width Modulation	DCT	Diagnostic Cycle Time
%DC	Duty Cycle of the output signal. i.e. T_{ON} /(T_{ON} + T_{OFF})	PWL	Piece Wise Linear
ADC	Analog-to-Digital Converter	IWD	Intelligent Watchdog
DAC	Digital-to-Analog Converter	AWD	Absolute Watchdog
LSB	Least Significant Bit	CPU	Central Processing Unit
MSB	Most Significant Bit	POR	Power On Reset
DNL	Differential Non-Linearity	SW	Software
INL	Integral Non-Linearity	HW	Hardware
ASP	Analog Signal Processing	ECC	Error-Correcting Code
DSP	Digital Signal Processing	ROM	Read-only Memory
EMC	Electro-Magnetic Compatibility	RAM	Random-access Memory
DMP	Dual Mold Package	NVRAM	Non-volatile Random-access Memory
DP	Discontinuity Point	AoU	Assumptions of Use
EoL	End of Life	IMC	Integrated Magnetic Concentrator

Table 2 – Glossary of Terms

3. Pin Definitions

3.1. Pin Definition for SOIC-8 package

Pin #	Name	Description
1	VDD	Supply
2	Test Input	For test
3	Test	For test
4	Not Used	
5	OUT	Output
6	VSS_D	Ground
7	VDEC	Decoupling pin (on-chip regulator)
8	VSS_A	Ground

Table 3 – SOIC-8 Pin Definitions and Descriptions

For optimal EMC behavior, it is recommended to connect the unused pins (Not Used and Test) to the Ground (see section 15.1).

3.2. Pin Definition for TSSOP-16 package

Pin #	Name	Description
1	V_{DEC1}	Decoupling pin
2	V_{SSA1}	Ground
3	V_{DD1}	Supply
4	$Test\ Input_1$	For test
5	$Test_2$	For test
6	OUT2	Output
7	$Not\ Used_2$	
8	V_{SSD2}	Ground
9	V_{DEC2}	Decoupling pin
10	V_{SSA2}	Ground
11	V_{DD2}	Supply
12	$Test\ Input_2$	For test
13	$Test_1$	For test
14	$Not\ Used_1$	
15	OUT1	Output
16	V_{SSD1}	Ground

Table 4 – TSSOP-16 Pin Definitions and Descriptions

For optimal EMC behavior, it is recommended to connect the unused pins (Not Used and Test) to the Ground (see section 15.2).

3.3. Pin Definition for DMP-4 package

Pin #	Name	Description
1	VSS	Ground
2	VDD	Supply
3	OUT	Output
4	VSS	Ground

Table 5 – DMP-4 Pin Definitions and Descriptions

4. Absolute Maximum Ratings

Parameter	Symbol	Min.	Typ.	Max.	Unit	Condition
Supply Voltage	VDD			28 45	V	<48h <1min
Reverse Voltage Protection	VDD_{REV}	-14			V	At Room Temperature; <48h
Positive Output Voltage	VOUT			18	V	<48h
Output Current	IOUT	-30		30	mA	-1.5V< VOUT <40V
Reverse Output Voltage	$VOUT_{REV}$	-0.3			V	<48h
Operating Temperature	T_{AMB}	-40		+160	°C	Refer to the qualification profile
Junction Temperature	T_{JUNC}			+175	°C	
Storage Temperature	T_{ST}	-55		+170	°C	Refer to the qualification profile
Magnetic Flux Density		-1		1	T	

Table 6 – Absolute Maximum Ratings

Exceeding the absolute maximum ratings may cause permanent damage. Exposure to absolute maximum-rated conditions for extended periods may affect device reliability.

5. Isolation Specification

Only valid for the package code GO, i.e. TSSOP-16 package (dual die).

Parameter	Symbol	Min.	Typ.	Max.	Unit	Condition
Isolation Resistance		4	-	-	MΩ	Between dice

Table 7 – Isolation Specification

6. General Electrical Specifications

General electrical specifications are valid for temperature range: -40 - 160 Deg.C, supply voltage range: 4.5 - 5.5V unless otherwise noted.

Electrical Parameter	Symbol	Min.	Typ.	Max.	Unit	Condition
Supply Voltage	VDD	4.5	5	5.5	V	
Supply Current [1]	IDD	7	10	12	mA	Rotary Stray-Field Immune mode, Linear Stray-Field Immune mode, no resistive load at OUT PIN (OUT1 and OUT2 for TSSOP-16 package)
Supply Current [1]	IDD	6	9	10	mA	Standard/Legacy mode, no resistive load at OUT PIN (OUT1 and OUT2 for TSSOP-16 package)
Start-up Level (rising)		3.95	4.1	4.25	V	
Start-up Hysteresis		100	200	300	mV	
PTC Entry Level [2](rising)		6.2	6.5	6.8	V	
PTC Entry Level Hysteresis		400	500	600	mV	
Output Short Circuit Current	I_{short}	-25 10		-10 25	mA	VOUT = 0 V VOUT = 5 V or 18 V
Output Load	R_L	5 2	10 10	∞ ∞	kΩ	Analog mode Digital (PWM) mode
Analog Saturation Output Level	VsatA_lo		0.5 3.5	1 5	%VDD	Pull-up load $R_L \geq 10$ kΩ to 5 V Pull-up load $R_L \geq 5$ kΩ to 18 V
	VsatA_hi	96 97.5	97 98		%VDD	Pull-down load $R_L \geq 5$ kΩ Pull-down load $R_L \geq 10$ kΩ
Digital (PWM) Output Level	VsatD_lo		0.5 3.5 2.5	1 5 4	%VDD	Pull-up load $R_L \geq 10$ kΩ to 5 V Pull-up load $R_L \geq 5$ kΩ to 18 V Pull-up load $R_L \geq 2$kΩ to 5 V
	VsatD_hi	85 96 97.5	90 97 98		%VDD	Pull-down load $R_L \geq 2$ kΩ Pull-down load $R_L \geq 5$ kΩ Pull-down load $R_L \geq 10$ kΩ

[1] *For the dual die version, the current is multiplied by 2*
[2] *IC to be programmed at room temperature*

Electrical Parameter	Symbol	Min.	Typ.	Max.	Unit	Condition
Active Diagnostic Output Level	Diag_lo		0.5 3.5 2.5	1 5 4	%VDD	Pull-up load $R_L \geq 10$ kΩ to 5 V Pull-up load RL ≥ 5 kΩ to 18 V Pull-up load RL ≥ 2 kΩ to 5 V
	Diag_hi	85 96 97.5	90 97 98		%VDD	Pull-down load $R_L \geq 2$ kΩ Pull-down load $R_L \geq 5$ kΩ Pull-down load $R_L \geq 10$ kΩ
Passive Diagnostic Output Level (Broken-Wire Detection) [3]	BVSSPD	97.5 95	98 96		%VDD	Broken VSS & Pull-down load $R_L \geq 10$ kΩ Pull-down load $R_L \geq 5$ kΩ
	BVSSPU	99.5	100		%VDD	Broken VSS & Pull-up load $R_L \geq 5$ kΩ
Passive Diagnostic Output Level (Broken-Wire Detection) [3]	BVDDPD		0	0.5	%VDD	Broken VDD & Pull-down load $R_L \geq 5$ kΩ
	BVDDPU			2	%VDD	Broken VDD & Pull-up load $R_L \geq 5$ kΩ
Clamped Output Level [4]	Clamp	0		100	%VDD	Programmable

Table 8 – Electrical specifications

As an illustration of the previous table, the MLX90371 fits the typical classification of the output span described on the Figure 2.

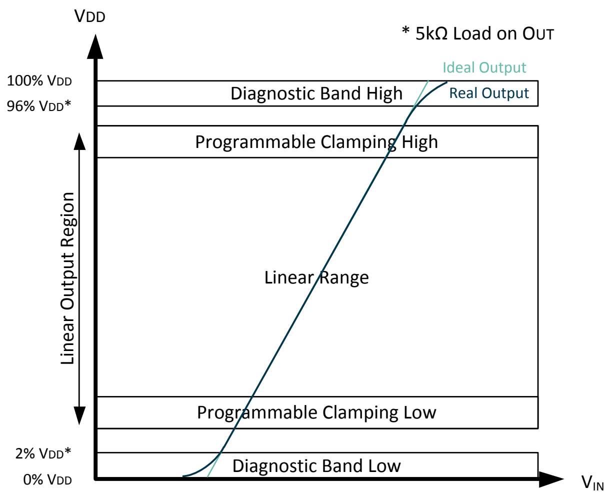


Figure 2 – Example of Output Span Classification for typical application.

[3] *For detailed information, see also section 14.1 Safety Mechanism*
[4] *Clamping levels need to be considered vs. the saturation of the output stage (see Analog Saturation Output level)*

7. Timing Specification

Timing conditions, including the variations of supply, temperature and aging, unless specified.

7.1. General Timing

Parameter	Symbol	Min.	Typ.	Max.	Unit	Condition
Main Clock Frequency	Ck	17.1	18	18.9	MHz	Including thermal drift and aging
Main Clock Frequency Thermal Drift	$\Delta^T Ck$	-3		3	% Ck	
Refresh Rate	τ_R			482	µs	
Latency Time	τ_L		440	462	µs	
Step Response Time [5]	τ_S	-	968 1474 2486 2486 5008	1127 1624 2617 2617 5099	µs	Filter=0 (FIR1) [6] Filter=1 (FIR11) Filter=2 (FIR1111) HYST=1/2 HYST=1/4

Table 9 – General Timing Specification

7.2. Latency Time Definition

The latency time is a suitable metric for the "delay" of the sensor in case of a slow ramp of the magnetic change, for instance, when the magnet has an angular frequency of 10 radians per second, i.e., 360 Deg. rotation within 100ms. A graphic illustration can be seen in Figure 3.

[5] *Also include the main clock variations. Typical: Output already reached 50% settling in a first step (482µs earlier). Maximum: Output already reached 90% settling in a first step (482µs earlier)*
[6] *See section 13.4 for details concerning Filter parameter*

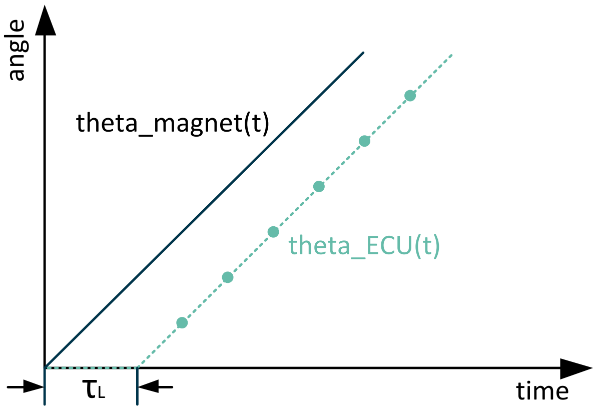


Figure 3 – Typical Latency illustration

7.3. Step Response Definition

The step response is a suitable metric for the "delay" of the sensor in case of an abrupt step in the magnetic change, considering 100% settling time without any DSP filter. Full settling is typically achieved in just two steps. The sensor is asynchronous with the magnetic step change: the 100% settling time will fall in a time window; worst case is given in the Table 9.

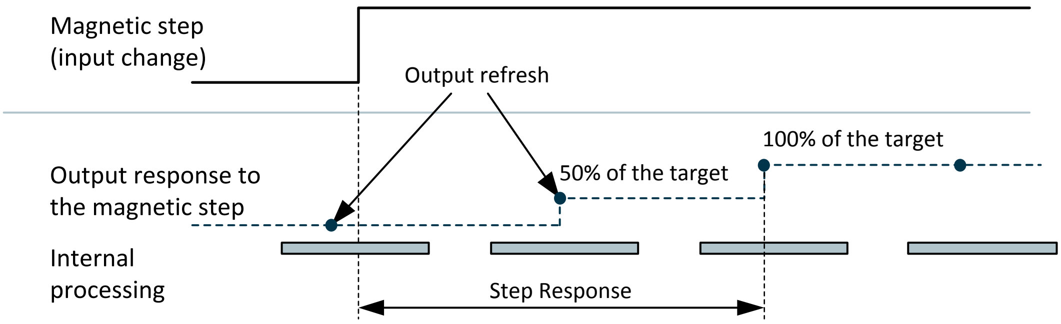


Figure 4 – Typical Step Response illustration

7.4. Analog timing

Parameter	Symbol	Min.	Typ.	Max.	Unit	Condition
Start-up Time	τ_{SU}			5	ms	Analog mode
Analog OUT Slew-rate	S_R		200		V/ms	no load, valid for both rising and falling edge
			120		V/ms	capacitor load C_L = 100 nF, valid for both rising and falling edge
			35		V/ms	capacitor load C_L = 330 nF, valid for both rising and falling edge

Table 10 – Analog timing specification

7.5. Digital (PWM) timing

Parameter	Symbol	Min.	Typ.	Max.	Unit	Condition
PWM Frequency	F_{PWM}	150		2000	Hz	Ck = 18MHz
PWM Frequency tolerance	ΔF_{PWM}	-5		5	$\%F_{PWM}$	Including thermal drift and aging
PWM Frequency Thermal Drift	$\Delta^T F_{PWM}$	-3		3	$\%F_{PWM}$	
Digital (PWM) output rise time		2		11	µs	Push-Pull, C_L = 4.7 nF, R_L = 4.7kΩ PU
Digital (PWM) output fall time		2		11	µs	Push-Pull, C_L = 4.7 nF, RL = 4.7kΩ PU
Start-up Time	τ_{SU}			5[7] 15[7]	ms	PWM mode @1kHz PMW mode @150Hz

Table 11 – Digital (PWM) timing specification

[7] *For PWM the start-up time is defined as the first edge of the first valid PWM cycle*

8. Magnetic Field Requirements

This section describes the magnetic field requirements in order to meet the performance described in section 9.1.

8.1. Rotary Stray-Field Immune Mode – Low-Field Variant

Parameter	Symbol	Min.	Typ.	Max.	Unit	Condition
Number of magnetic poles	N_P		4		-	End-of-shaft rotation
Magnetic Flux Density in X or Y	B_X, B_Y[(8)]			25[(9)]	mT	$\sqrt{B_X^2 + B_Y^2}$ this is NOT the useful signal
Magnetic Flux Density in Z	B_Z			100	mT	this is NOT the useful signal
Magnetic In-plane gradient of In-plane field component	$\frac{\Delta B_{XY}}{\Delta XY}$	3.8			mT/ mm	$\frac{1}{2}\sqrt{\left(\frac{dB_X}{dX} - \frac{dB_Y}{dY}\right)^2 + \left(\frac{dB_X}{dY} + \frac{dB_Y}{dX}\right)^2}$ min. value represents the minimum gradient available at worst-case condition: biggest airgap, biggest offaxis position, highest temperature See Figure 5 below
Magnet Temperature Coefficient	TCm	-2400		0	ppm/ Deg.C.	
Field Too Low Threshold[(10)]	B_{TH_LOW}	1	1.5	2	mT/ mm	corresponding to TCm=0
Field Too High Threshold[(10)]	B_{TH_HIGH}	70	100	130	mT/ mm	corresponding to TCm=0. Due to the saturation effect of the IMC, the FieldTooHigh monitor detects only defects in the sensors

Table 12 – Magnetic field requirements for rotary Stray-Field immune mode – Low-Field Variant

---

[8] *The condition must be fulfilled for at least one field B_X or B_Y*
[9] *Above this value, the IMC® starts saturating yielding to an increase of the linearity error*
[10] *Further details can be referred to section 11, see parameters "DIAG_FIELDTOOLOWTHRES" and "DIAG_FIELDTOOHIGHTHRES".*

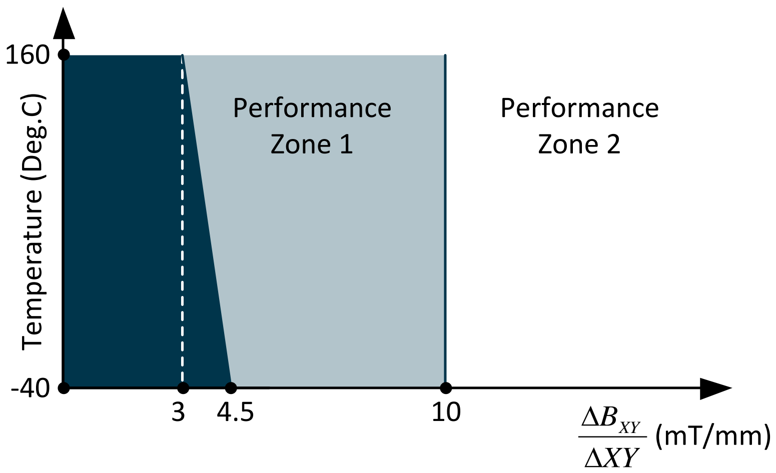


Figure 5 – Minimum useful signal definition for rotary Stray-Field immune mode – Low-Field Variant

8.2. Rotary Stray-Field Immune Mode – High-Field Variant

Parameter	Symbol	Min.	Typ.	Max.	Unit	Condition
Number of magnetic poles	N_P		4		-	End-of-shaft rotation
Magnetic Flux Density in X or Y	B_X, B_Y (8)			67 (9)	mT	$\sqrt{B_X^2 + B_Y^2}$ this is NOT the useful signal
Magnetic Flux Density in Z	B_Z			100	mT	this is NOT the useful signal
Magnetic In-plane gradient of In-plane field component	$\frac{\Delta B_{XY}}{\Delta XY}$	10		-	mT/ mm	$\frac{1}{2}\sqrt{\left(\frac{dB_X}{dX} - \frac{dB_Y}{dY}\right)^2 + \left(\frac{dB_X}{dY} + \frac{dB_Y}{dX}\right)^2}$ min. value represents the minimum gradient available at worst-case condition: biggest airgap, biggest offaxis position, highest temperature
Magnet Temperature Coefficient	TCm			0	ppm/ Deg.C.	
Field Too Low Threshold	B_{TH_LOW}	1	1.5	2	mT/ mm	corresponding to TCm=0
Field Too High Threshold	B_{TH_HIGH}	70	100	130	mT/ mm	corresponding to TCm=0. Due to the saturation effect of the IMC, the FieldTooHigh monitor detects only defects in the sensors

Table 13 – Magnetic field requirements for rotary Stray-Field immune mode – High-Field Variant

8.3. Linear Stray-Field Immune Mode

Parameter	Symbol	Min.	Typ.	Max.	Unit	Condition
Number of magnetic poles	N_P		2		-	Linear movement
Magnetic Flux Density in X	B_X			70[11]	mT	$B_Y \le 20mT$
Magnetic Flux Density in X-Y	B_X, B_Y[12]			70	mT	$\sqrt{B_X^2 + B_Y^2}$ to be used when $B_y > 20mT$
Magnetic Flux Density in Z	B_Z			100	mT	
Magnetic input gradient of X-Z field components	$\frac{\Delta B_{XZ}}{\Delta X}$	6[13]			mT/mm	$\sqrt{\left[\left(\frac{\Delta B_X}{\Delta X}\right)^2 + \left(\frac{1}{G_{IMC}}\frac{\Delta B_Z}{\Delta X}\right)^2\right]}$[14]
Distance between the two IMC®	ΔX		1.8		mm	
IMC gain	G_{IMC}		1.19			see[14]
Magnet Temperature Coefficient	TCm	-2400		0	ppm/Deg.C.	
Field Too Low Threshold[10]	B_{TH_LOW}	2	3	4	mT/mm	corresponding to TCm=0
Field Too High Threshold[10]	B_{TH_HIGH}	70	100	130	mT/mm	corresponding to TCm=0. Due to the saturation effect of the IMC, the FieldTooHigh monitor detects only defects in the sensors.

Table 14 – Magnetic field requirement for linear Stray-Field immune mode

---

[11] *Above 70 mT, the IMC® starts saturating yielding to an increase of the linearity error.*

[12] *The condition must be fulfilled for all combinations of Bx and By.*

[13] *Below 6 mT/mm, the performances degrade due to a reduction of the signal-to-noise ratio, signal-to-offset ratio.*

[14] *IMC has better performance for concentrating in-plane (x-y) field components, resulting in a better overall magnetic sensitivity. A correction factor, (IMC Gain XY / IMC Gain Z), called IMC gain has to be applied to the z field component to account for this difference.*

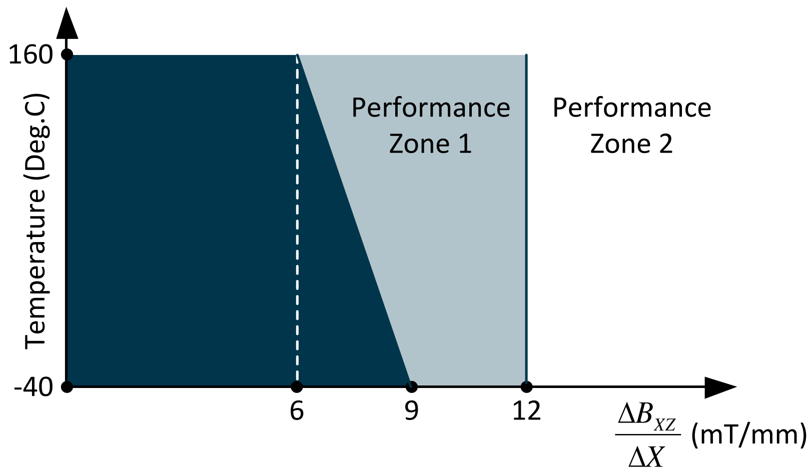


Figure 6 – Minimum useful signal definition for linear Stray-Field immune mode

8.4. Standard/Legacy Mode

Parameter	Symbol	Min.	Typ.	Max.	Unit	Condition
Number of magnetic poles	N_P		2		-	End of shaft rotation or Linear movement
Magnetic Flux Density in X or Y	B_X, B_Y[15]			70[16]	mT	$\sqrt{B_X^2 + B_Y^2}$
Magnetic Flux Density in Z	B_Z			100	mT	
Magnetic Flux	Norm	10[17]			mT	$\sqrt{B_X^2 + B_Y^2}$ (X-Y mode) $\sqrt{{B_X}^2 + \left(\frac{1}{G_{IMC}} B_Z\right)^2}$ (X-Z mode) $\sqrt{{B_Y}^2 + \left(\frac{1}{G_{IMC}} B_Z\right)^2}$ (Y-Z mode)
IMC gain	G_{IMC}		1.19			see[14]
Magnet Temperature Coefficient	TCm	-2400		0	ppm/ Deg.C	
Field Too Low Threshold[10]	B_{TH_LOW}	3.4	5	6.6	mT	corresponding to TCm=0
Field Too High Threshold[10]	B_{TH_HIGH}	70	100	130	mT	corresponding to TCm=0. Due to the saturation effect of the IMC, the FieldTooHigh monitor detects only defects in the sensors.

Table 15 – Magnetic field requirement for standard / legacy mode

---

[15] The condition must be fulfilled for at least one field B_X or B_Y
[16] Above 70 mT, the IMC® starts saturating yielding to an increase of the linearity error
[17] Below 10 mT the performances degrade due to a reduction of the signal-to-noise ratio, signal-to-offset ratio

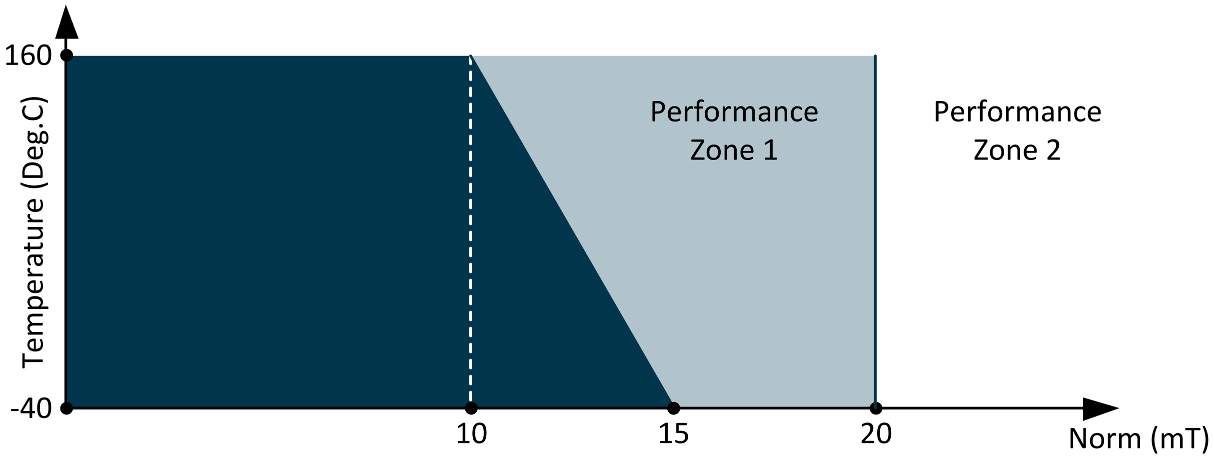


Figure 7 – Minimum useful signal definition for standard/legacy mode

9. Accuracy Specification

9.1. Magnetic Specification

9.1.1. Definition

This chapter defines several parameters, which will be used for the magnetic specification.

9.1.1.1. Intrinsic Linearity Error

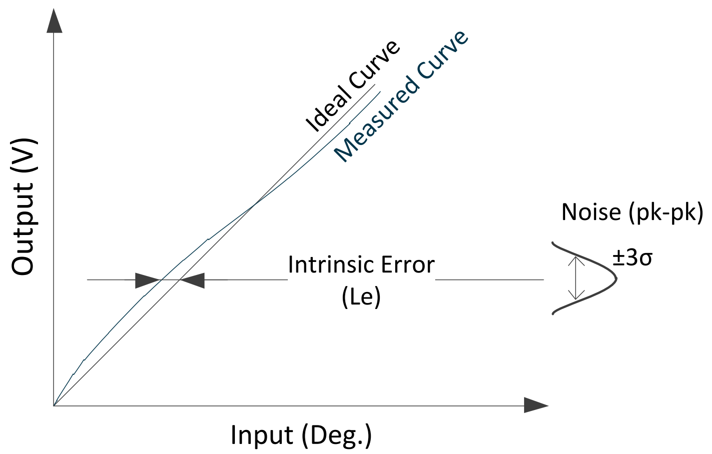


Figure 8 – Analog sensor accuracy definition

Figure 8 depicts the intrinsic linearity error in parts after Melexis factory calibration. The Intrinsic Linearity Error refers to the IC itself (offset, sensitivity mismatch, orthogonality) taking into account an ideal rotating field for BX and BY. Once associated to a practical magnetic construction and the associated mechanical and magnetic tolerances, the output linearity error increases. However, it can be improved with the multi-point end-user calibration.

This error is typically not critical in application because it is calibrated away.

9.1.1.2. Total Drift

After calibration, the output angle of the sensor might still change due to temperature change, aging, etc.. This is defined as the total drift θ_{T_DRIFT}:

$$\theta_{T\_DRIFT} = \theta(\theta_{IN}, T, t) - \theta(\theta_{IN}, T_{RT}, t_0)$$

where θ_{IN} is the input angle, T is the temperature, T_{RT} is the room temperature, t is the elapsed lifetime after calibration, t_0 is the start of the operating life (right after calibration). Note the total drift θ_{T_DRIFT} is always defined with respect to angle at room temperature T_{RT} during calibration. In this datasheet, T_{RT} is typically defined at 30 Deg.C, unless stated otherwise. The total drift is valid for all angles along the full mechanical stroke.

9.1.2. Rotary Stray-Field Immune Mode – Low-Field Variant

Before EoL calibration. General performances are valid for temperature range: -40 - 160 Deg.C, supply voltage range: 4.5 - 5.5V unless otherwise noted.

Parameter	Symbol	Min.	Typ.	Max.	Unit	Condition
XY - Intrinsic Linearity Error	Le_{XY}	-1		1	Deg.	
Noise [18]				0.4	Deg.	Filter= 0 (FIR1), in performance zone 2[19]
				0.7	Deg.	Filter= 0 (FIR1), in performance zone 1[19]
				0.5	Deg.	Filter= 1 (FIR11), in performance zone 1[19]
				0.35	Deg.	Filter= 2 (FIR1111), in performance zone 1[19]
XY - Total Drift	$\theta_{T\_DRIFT\_XY}$			0.85	Deg.	
Hysteresis			0.1		Deg.	
Output Stray Field Immunity	θ_{FF}			0.4	Deg.	In accordance of ISO 11452-8, at 30 Deg.C, with stray-field strength of 1000A/m from any direction Corresponding to 0.4% of 100 Deg. full stroke

Table 16 – Magnetic performances in Rotary Stray-Field Immune Mode – Low-Field Variant

9.1.3. Rotary Stray-Field Immune Mode – High-Field Variant

Before EoL calibration. General performances are valid for temperature range: -40 - 160 Deg.C, supply voltage range: 4.5 - 5.5V unless otherwise noted.

Parameter	Symbol	Min.	Typ.	Max.	Unit	Condition
XY - Intrinsic Linearity Error	Le_{XY}	-1		1	Deg.	
Noise [18]				0.5	Deg.	Filter= 0 (FIR1)
				0.35	Deg.	Filter= 1 (FIR11)
				0.25	Deg.	Filter= 2 (FIR1111)
XY - Total Drift	$\theta_{T\_DRIFT\_XY}$			0.67	Deg.	Full temperature range

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[18] *±3σ*

[19] *Referred to section 8.1 and Figure 5.*