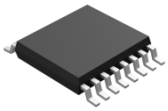
MLX90424

Integrated Wake-up Triaxis® Position Sensor IC
Datasheet

Features and Benefits

- On Chip Signal Processing for Robust Absolute Position Sensing
  - Triaxis® Hall Technology
  - Programmable Measurement Range
  - Programmable Linear Transfer Characteristic (12 to 16 Multi-points)
  - Selectable output modes
    - SENT (SAE J2716 APR2016)
    - PWM (Pulse Width Modulation)
  - Robustness against stray magnetic field up to 5mT (4kA/m) as per ISO 11452-8
  - 48 bit ID Number option
- Hall Effect switch
  - Less than 10µA average supply current in µ-Power Mode
  - Integrated self-diagnostic functions activating dedicated Safe Mode
  - Flexible magnetic thresholds and temperature coefficient
- ISO26262 SEooC ASIL READY
  - ASIL C for the Position sensing
  - ASIL B for the Switch sensing
- AEC-Q100 Qualified (Grade 0)
- Package, RoHS compliant
  - Triple Die - TSSOP-16



TSSOP-16

Application Examples

- Brake pedal stroke sensor
- Pedal Position Sensor
- Throttle Position Sensor
- Ride Height Position Sensor
- Absolute Linear Position Sensor
- Float-Level Sensor
- Non-Contacting Potentiometer
- Wake-up switch

Description

The MLX90424 is an integrated wake-up magnetic position sensor IC designed specifically for linear movement applications. It leverages the combined capabilities of three distinct dies: two MLX90423 Triaxis® Hall magnetic front ends and one MLX92292 Latch and Switch.

Like the MLX90423, the MLX90424 accurately detects the three components of magnetic flux density (Bx, By, Bz). This enables precise measurement of linear displacement, making it ideal for applications where non-contact position sensing is essential.

The incorporation of the MLX92292 Latch and Switch introduces a power-saving wake-up feature. This allows the system to remain in a low-power state until a magnetic field is detected, optimizing energy consumption.

The MLX90424 offers flexible output options, including PWM, and SENT frames encoded in a Secure Sensor format. This ensures compatibility with various systems and simplifies integration.

General Information

This document is an addendum to be used together with the MLX90423 Datasheet rev 001 dated June 2023 and the MLX92292 datasheet rev 018 dated August 2024 (section 8.1 for the Versions specific parameters). All values specified inside this document override the ones from the original datasheets. In absence of information, the data in the main datasheet shall be considered.

Ordering Information

Product	Temp. Code	Package Code	Option Code	Packing Form	Definition
MLX90424	L	GO	ACA-230	RE	Linear Strayfield Robust
MLX90424	L	GO	ACA-430	RE	Linear Legacy

Table 1 Ordering Codes

Temperature Code	L: from -40°C to 150°C
Package Code	GO: TSSOP-16 package (full redundancy dual die, see 8.1)
Option Code - Chip revision	**ACA-123: Chip Revision** ▪ ACA: MLX90424 production version
Option Code - Application	**ACA-123: 1-Application - Magnetic configuration** ▪ 2: Linear Strayfield Robust ▪ 4: Linear legacy
Option Code - SW configuration	**ACA-123: 2-SW configuration** ▪ 3: Pre-programmed SENT version (programmable to PWM)
Option Code – Trim & Form	**ACA-123: 3-DMP-4 Trim & Form configuration** ▪ 0: Standard straight leads.
Packing Form	RE: Tape & Reel ▪ GO: 4500 pcs/reel
Ordering Example:	MLX90424LGO-ACA-230-RE For a Linear Strayfield Robust SENT version in TSSOP-16 package, delivered in Reel of 4500pcs.

Table 2 Ordering Codes Information

Contents

1. Pin Definitions and Descriptions for TSSOP-16 package

Pin #	Name	Description
1	$Test_{21}$	For Melexis factory test MLX90423 die1
2	OUT_1	Output MLX90423 die1
3	V_{DEC2}	Decoupling pin MLX90423 die2
4	V_{SS2}	Ground MLX90423 die2
5	V_{DD2}	Supply MLX90423 die2
6	$Test_{12}$	For Melexis factory test MLX90423 die2
7	OUT_{SW}	Output MLX92292 die3
8	V_{SSSW}	Ground MLX92292 die3
9	N.C	Not Connected
10	V_{DDSW}	Supply MLX92292 die3
11	$Test_{22}$	For Melexis factory test MLX90423 die2
12	OUT_2	Output MLX90423 die2
13	V_{DEC1}	Decoupling pin MLX90423 die1
14	V_{SS1}	Ground MLX90423 die1
15	V_{DD1}	Supply MLX90423 die1
16	$Test_{11}$	For Melexis factory test MLX90423 die1

Table 3 TSSOP-16 Pins definition and description

Test pins are internally grounded when in application mode. For optimal EMC behaviour always connect the Test and N.C. pins to the ground of the PCB.

2. Absolute Maximum Ratings

Parameter	Symbol	Min	Max	Unit	Condition
Storage Temperature	T_{ST}	-55	+170	°C	
ESD sensitivity – HBM	-	4		kV	Human Body Model according AEC-Q100-002 standard

Table 4 Absolute maximum ratings

Exceeding any of the absolute maximum ratings may cause permanent damage.

Exposure to absolute maximum ratings conditions for extended periods may affect device reliability.

3. Isolation Specification

Parameter	Symbol	Min	Typ	Max	Unit	Condition
Isolation Resistance	R_{isol}	4	-	-	MΩ	Between dice, measured between V_{SS1}, V_{SS2} and V_{SSSW} with +/-20V bias

Table 5 Isolation specification

4. General Electrical Specifications

Parameter	Symbol	Min	Typ	Max	Unit	Condition
PTC programming supply Voltage (switch)	-	3.8	5	32	V	35°C

Table 6 Supply System Electrical Specifications

5. Accuracy Specifications

5.1. Angular Noise in Linear stray field robust (-2xx order code)

Accuracy specifications are valid for temperature range [-40, 150] °C and supply voltage range [4.5, 5.5] V

Parameter	Symbol	Min	Typ	Max	Unit	Condition	
Angular Noise				0.50 0.55	Deg.	6mT/mm	35°C 85°C

Table 7 Linear stray field robust- Magnetic Performance

5.2. Angular Thermal Drift in Linear stray field robust (-2xx order code)

Accuracy specifications are valid for temperature range [-40, 150] °C and supply voltage range [4.5, 5.5] V

Parameter	Symbol	Min	Typ	Max	Unit	Condition		
XZ – Angular Thermal Drift	$\partial\theta_{TT\_XZ}$			2.4	Deg.	6mT/mm	150°C	B/dB=10

Table 8 Linear stray field robust- Magnetic Performance

The formula [1] provided as a design aid to help the integrator in estimating the angular drift for a given magnetic stroke, taking into account the magnetic field properties, and the sensor accuracy. Intermediate values for any B/dB can be calculated in the range between B/dB=2 and B/dB=10. The datasheet accuracy specification always takes precedence.

$$[1]\ \partial\theta_{TT\_XZ} = 0.4° + \frac{B}{dB}0.2°$$

Where the B/dB ratio represents the ratio of the flux density norm divided by the flux density gradient norm along a specified axis (see section 8.1.1 of the MLX90423 datasheet (see section General Information for the document's complete reference)).

5.3. Switch wake-up function – performances

DC Operating Parameters VDD = 3.0V to 18V, TA = -40°C to 150°C (unless otherwise specified).

Parameter	Symbol	Min	Typ	Max	Unit	Condition
Factory pre-programmed Operating Point	B_{OP} B_{RP}	13.8 12.9	15 14	16.2 15.1	mT mT	
Temperature Coefficient programming range [1]	T_C	-2400		0	ppm/°C	VDD =12V, with B_{OP} =15mT, B_{RP} = 14mT
Operating period			20		ms	

Table 9 Switch function - Magnetic Performance

[1] *The factory pre-programmed target TC value is -1100 ppm/°C.*

6. Recommended Application Diagrams

6.1. Wiring in TSSOP-16 Package

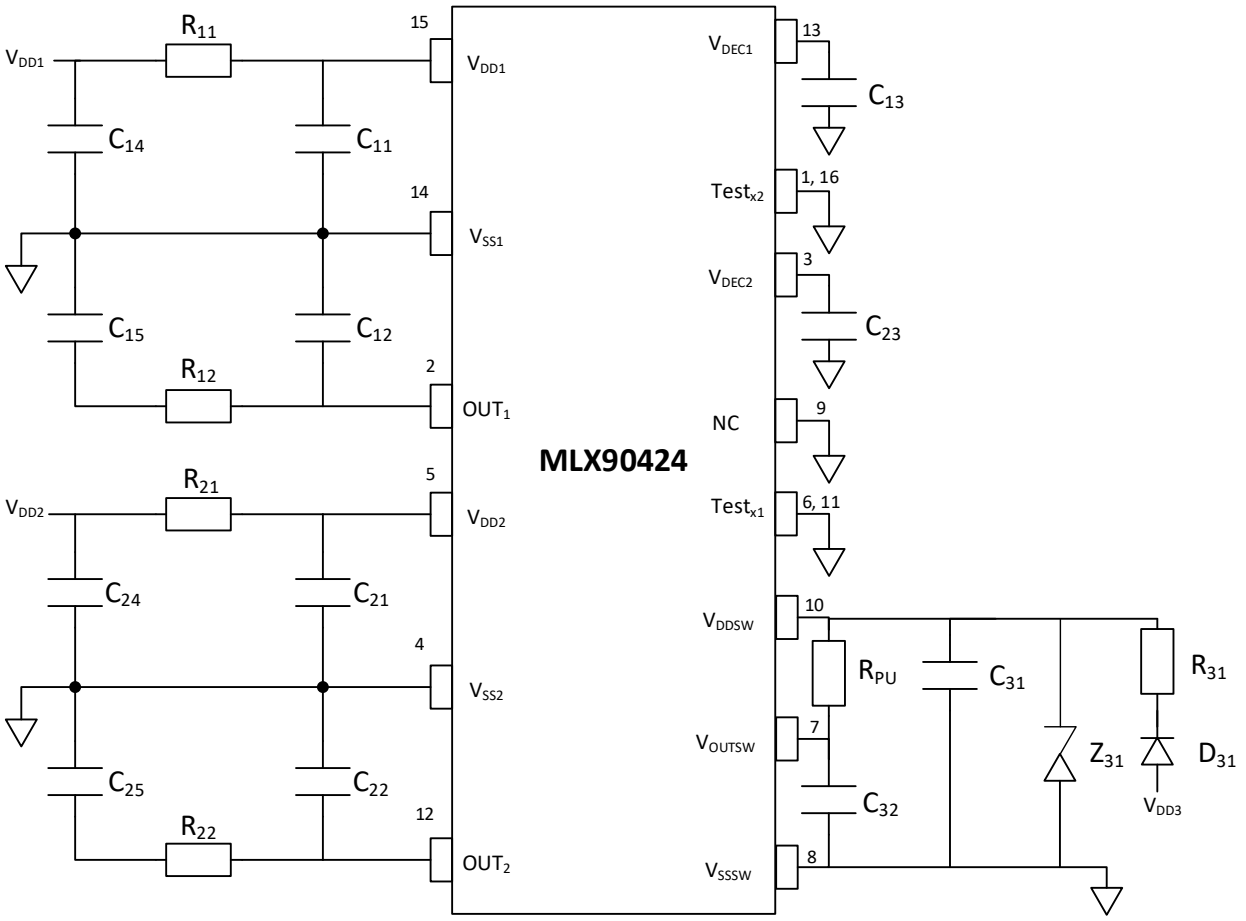


Figure 1 Recommended wiring for TSSOP-16 package

Component	min	Typ	Max	Unit	Remark
C_{11}, C_{21}	100	220	-	nF	Close to the IC
C_{12}, C_{22}	-	10	22	nF	PWM
(C_L)	-	10	22		SENT
C_{13}, C_{23}	100	100	220	nF	Close to the IC
C_{14}, C_{24}	-	-	1	nF	Close to the connector
C_{15}, C_{25}	-	-	1	nF	Close to the connector
R_{11}, R_{21}	-	0	10	Ω	
R_{12}, R_{22}	-	0 (2)	-	Ω	
C_{31}	10		100	nF	For proper operation the bypass capacitor C31 should be placed as close as possible to the VDD and GND pins
C_{32}		4.7		nF	A capacitor connected to the output will improve the EMC performance
R_{PU}		10		kΩ	
R_{31}		100 (3)		Ω	
D_{31}		(3)			
Z_{31}		(4)			

Table 10 Recommended Values for TSSOP-16 Package

[2] Normally external PI filters to improve EMC as recommended by the SENT standard are not needed. As the SENT product includes sophisticated SENT signal shaping. Extra PI filtering may bring the signal slopes out of the SENT specified range.
[3] If negative transients over supply line V_{PEAK}< -30V are expected, usage of the diode D_{31} is recommended. Otherwise only R_{31} is sufficient. When selecting the resistor R_{31}, three points are important:
- the resistor has to limit I_{DD}/I_{DDREV} to 40mA maximum
- the resistor has to withstand the power dissipated in both over voltage conditions (V_{R31} [2] /R_{31})
- the resulting device supply voltage V_{DD} has to be higher than V_{DD} min (V_{DDSW} = V_{DD3} – R_{31}.I_{DDSW})
[4] If positive transients over supply line with V_{PEAK}> 40V are expected, usage of Zener diode Z_{31} is recommended. The R_{31}-Z_{31} network should be sized to limit the voltage over the device below the maximum allowed.

7. Standard information for IC handling and assembly

7.1. Storage and handling of plastic encapsulated ICs

Plastic encapsulated ICs shall be stored and handled according to their MSL categorization level (specified in the packing label) as per J-STD-033.

Electronic semiconductor products are sensitive to Electro Static Discharge (ESD). The component assembly shall be handled in EPA (Electrostatic Protected Area) as per ANSI S20.20

For more information refer to Melexis *Guidelines for storage and handling of plastic encapsulated ICs* [5]

7.2. Assembly of encapsulated ICs

For Surface Mounted Devices (SMD, as defined according to JEDEC norms), the only applicable soldering method is reflow.

For Through Hole Devices (THD), the applicable soldering methods are reflow, wave, selective wave and robot point-to-point. THD lead pre-forming (cutting and/or bending) is applicable under strict compliance with Melexis *Guidelines for lead forming of SIP Hall Sensors* [5].

Melexis products soldering on PCB should be conducted according to the requirements of IPC/JEDEC and J-STD-001. Solder quality acceptance should follow the requirements of IPC-A-610.

For PCB-less assembly refer to the relevant application notes [5] or contact Melexis.

Electrical resistance welding or laser welding can be applied to Melexis products in THD and specific PCB-less packages following the *Guidelines for welding of PCB-less devices*[5].

Environmental protection of customer assembly with Melexis products for harsh media application, is applicable by means of coating, potting or overmolding considering restrictions listed in the relevant application notes [5]

For other specific process, contact Melexis via www.melexis.com/technical-inquiry

7.3. Environment and sustainability

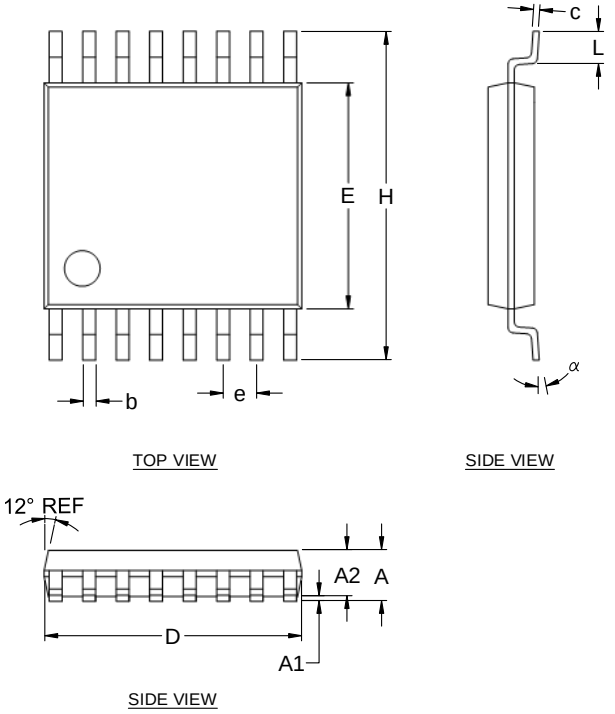
Melexis is contributing to global environmental conservation by promoting non-hazardous solutions. For more information on our environmental policy and declarations (RoHS, REACH…) visit www.melexis.com/environmental-forms-and-declarations

[5] www.melexis.com/ic-handling-and-assembly

8. Package Information

8.1. TSSOP-16- Package

8.1.1. TSSOP-16- Package Dimensions



SYMBOL	MINIMUM	MAXIMUM
A	---	1.10
A1	0.05	0.15
A2	0.85	0.95
D	4.90	5.10
E	4.30	4.50
H	6.40 REF	
L	0.50	0.75
b	0.19	0.30
c	0.09	0.20
e	0.65 BSC	
α	0°	8°

NOTE :
1. ALL DIMENSIONS IN MILLIMETERS (mm) UNLESS OTHERWISE STATED.
2. DIMENSION D DOES NOT INCLUDE MOLD FLASH, PROTRUSIONS OR GATE BURRS OF MAX 0.15 mm PER SIDE.
3. DIMENSION E DOES NOT INCLUDE INTERLEADS FLASH OR PROTRUSIONS OF MAX 0.25 mm PER SIDE.
4. DIMENSION b DOES NOT INCLUDE DAMBAR PROTRUSION OF MAX 0.08 mm.

Figure 2 TSSOP-16 Package Outline Dimensions

8.1.2. TSSOP-16- Pinout and Marking

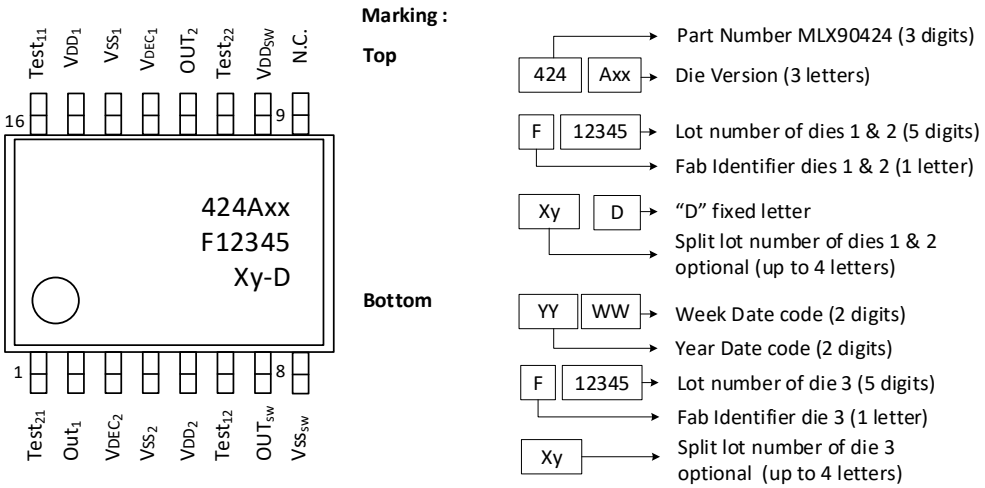


Figure 3 TSSOP-16 Package Pinout and Marking

8.1.3. TSSOP-16- Sensitive spot positioning

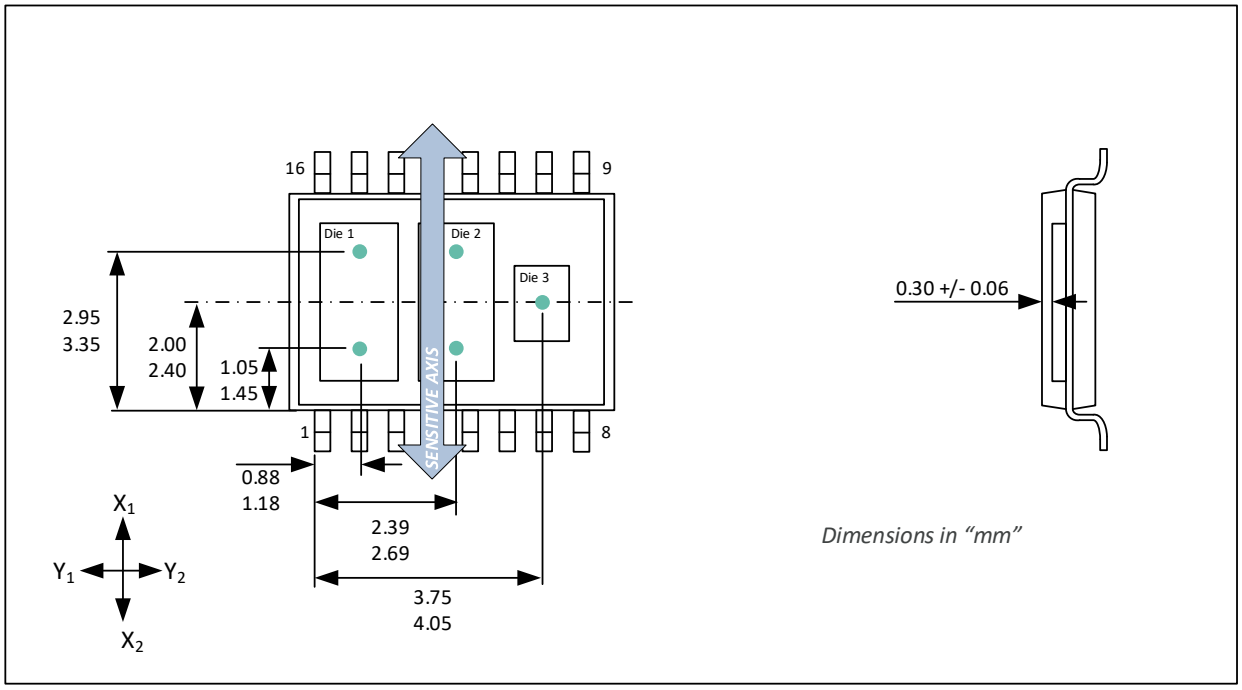
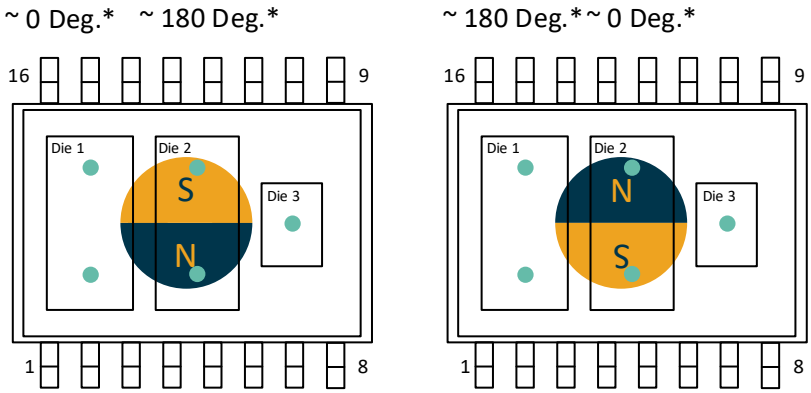


Figure 4 TSSOP-16 Package Sensitive Spot Position

8.1.4. TSSOP-16- Angle Detection



* No absolute reference for the angular information.

Figure 5 TSSOP-16 Package Angle Detection

The MLX90423 is an absolute angular position sensor but the linearity error does not include the error linked to the absolute reference 0 Deg. (which can be fixed in the application through the discontinuity point).

8.2. Package Thermal Performances

The Table 11 below describe the thermal behaviour of available packages following JEDEC EIA/JESD 51.X standard.

Package	Junction to case - θjc	Junction to ambient - θja (JEDEC 1s2p board)	Junction to ambient - θja (JEDEC 1s0p board)
TSSOP-16	27.6 K/W	99.1 K/W	137 K/W

Table 11 Standard Packages Thermal Performances

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