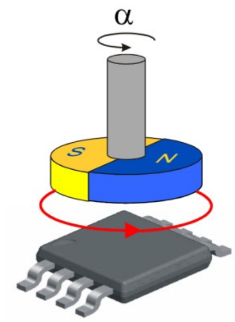
MLX91204

360 Degrees Hi-Speed Rotary Position Sensor (Sine/Cosine)

Features and Benefits

- Absolute Rotary Position Sensor IC
- Tria⊗is® Hall Technology
- Hi-Speed Operation
- Sine/Cosine Outputs
- Simple & Robust Magnetic Design
- Excellent Thermal Stability
- Very Low Hysteresis
- SOIC-8 Package (RoHS)



Applications

- Absolute Rotary Position Sensor
- BLDC Motor Position Sensor (for Commutation)
- Contactless potentiometers
- Contactless encoder

Ordering Code

Part No.	Temperature Code	Package Code	Option code	Packing Form
MLX91204	K	DC	ABA-001	RE
MLX91204	K	DC	ABA-002	RE
MLX91204	K	DC	ABA-003	RE
MLX91204	K	DC	ABA-001	TU
MLX91204	K	DC	ABA-002	TU
MLX91204	K	DC	ABA-003	TU

Legend:

Temperature Code: K for Temperature Range -40℃ to 125℃

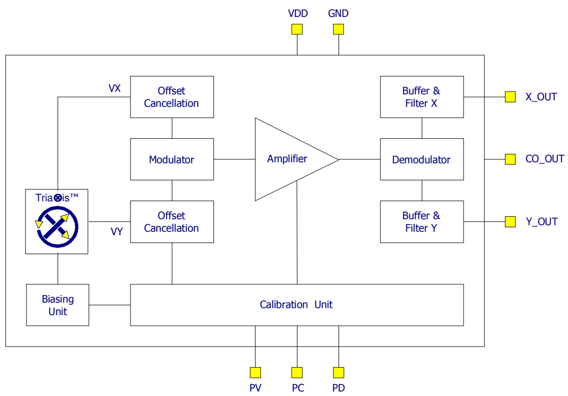
Package Code: DC for SOIC-8 Package

Option Code: Magnetic Sensitivity - See Section 7: parameter sensitivity=> test conditions; parameter Full scale magnetic field range=> test conditions

Packing Form: RE for Reel
TU for Tube

Ordering example: MLX91204KDC-ABA-001-RE

1 Functional Diagram



2 General Description

The Tria⊗is® rotary position sensor MLX91204 detects the absolute angular position of a small magnet that is positioned above the device surface.

The MLX91204 reports two analog, linear, orthogonal (quadrature) and ratiometric output voltages proportional to the applied magnetic flux density parallel to the chip surface (thanks to the Integrated Magneto Concentrator – IMC® – added on the top of the sensitive Hall elements).

The MLX91204 is ideally suited for hi-speed rotary position sensing in harsh automotive and industrial environments.

The angular position is computed off-chip from both sine and cosine signals.

Table of Contents

3 Glossary of Terms

- Gauss (G), Tesla (T): Magnetic flux density units where 1 mT = 10 G.
- Tria⊗is®: This technology refers to the Melexis Hall technology which allows the realization of Hall effect sensors able to sense the flux density along the 3 axis (i.e. X, Y & Z). In particular, it enables the realization of position sensors able to sense the magnetic flux density parallel to the IC surface and consequently the magnetic vector over 360 degrees.
- IMC: Integrated Magneto Concentrator. It concentrates the magnetic flux lines and bends them at the extremity under the planar Hall plates. Furthermore, it provides some magnetic gain factor.

4 Absolute Maximum Ratings

Parameter.	Units
Supply Voltage, V_{DD} (overvoltage)	+ 6 V
Reverse Voltage Protection	- 0.5 V
Operating Temperature Range TA	-40 to +125 Deg.C.
Storage Temperature Range, TS	-40 to +150 Deg.C.

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

5 Pinout and Function

Pin #	Pin Name	Function
1	CO_OUT	Output Common (V_{DD}/2)
2	PC	Factory programming pin. Connect to V_{DD}
3	V_{DD}	Supply Voltage (+)
4	Y_OUT	Analog Output Y
5	X_OUT	Analog Output X
6	PD	Factory programming pin. Connect to GND
7	PV	Factory programming pin. Connect to V_{DD}
8	GND	Ground

6 MLX91204 General Electrical Specification

DC Operating Parameters T_A = -40 Deg.C. to +125 Deg.C., V_{DD} = 5.0 V (unless otherwise specified)

Parameter	Symbol	Test Conditions	Min	Typ	Max	Units
Nominal Supply Voltage	V_{DD}		4.5	5	5.5	V
Supply Current	I_{DD}	I_{OUT} = 0 mA		16.5	19	mA
Common Output	CO_OUT	Referring to V_{DD}/2, unloaded	- 2	0	2	%V_{DD}
Output Current CO_OUT and X_OUT and Y_OUT	I_{OUT}	Drop is typically 80mV/mA	- 1		1	mA
Output Load Resistance	R_L		5			kΩ
Output Load Capacitance	C_L				1000	pF
Start-up cycle	$t_{STARTUP}$			150	200	µs

7 MLX91204 Sensor Specification

DC Operating Parameters T_A = -40 Deg.C. to 125 Deg.C., V_{DD} = 5.0 V, differential output (unless otherwise specified)

Parameter	Symbol	Test Conditions	Min	Typ	Max	Units
Offset Voltage	V_{OQ}	T_A = 25 Deg.C. – B = 0 mT X_OUT & Y_OUT	-10	0	10	mV
Offset Temperature Drift	$\Delta V_{OQ}/\Delta T$	B = 0mT – X_OUT & Y_OUT (1)	-0.10	0	+0.10	mV/Deg.C.
Sensitivity	S	T = 25 Deg.C. Option Code : ABA-001	16	25	34	V/T
		T = 25 Deg.C. Option Code : ABA-002	32	50	68	V/T
		T = 25 Deg.C. Option Code : ABA-003	64	100	136	V/T
Sensitivity Temperature Drift	$\Delta S/[S\Delta T]$	(1)	-0.08	-0.05	-0.01	%/Deg.C.
Sensitivity Mismatch	S_{XY}	$S_{XY} = S_X/S_Y$	-3	0	3	%
Sensitivity Mismatch Temperature Drift	$\Delta(S_{XY})/\Delta T$	(1)	-0.012	0	0.012	%/Deg.C.
Phase Mismatch	$\angle S_X - \angle S_Y$		-1	0	1	Degree
Hysteresis	H_{YST}	(1)	-20	±8	20	µT
Full Scale Magnetic Field Range (± 2 V Output Swing)	B_{FS}	Option Code: ABA-001			58.8	mT
		Option Code: ABA-002			29.4	mT
		Option Code: ABA-003			14.7	mT
Max. Output Voltage Swing	V_{OUTMAX}	B > B_{FS} – X_OUT &Y_OUT I_{OUT} = 0 mA	0.25		4.75	V
Angular Speed	ω	2 poles magnet			100k	RPM
Bandwidth (-3dB) DC to	BW	R_L > 1 MΩ – C_L < 10 pF		15		kHz
Spectral Noise Density	ΔB_{NOISE}				750	nT/Hz½

(1) Characterized

From the previous table and the ageing data, the intrinsic angular linearity error (in Degree) can be derived from the individual contributions as it follows:

Test Conditions	Parameters	Output Swing		Unit
		± 1 V	± 2 V	
Room Temperature (T_A = 25 Deg.C.)	Offset	± 0.8	± 0.4	Degree
	Sensitivity Mismatch	± 0.84	± 0.84	Degree
	Phase Mismatch	± 1	± 1	Degree
	Total	**± 2.64**	**± 2.24**	**Degree**
Temperature Range (T_A = -40 … 125 Deg.C.)	Offset	± 0.8	± 0.4	Degree
	Sensitivity Mismatch	± 0.34	± 0.34	Degree
	Phase Mismatch	± 0.12	± 0.12	Degree
	Total	**± 1.26**	**± 0.86**	**Degree**
Lifetime/Ageing (HTOL 1000 hours – 5.0 V – 150 Deg.C.)	Offset	± 0.8	± 0.4	Degree
	Sensitivity Mismatch	± 0.1	± 0.1	Degree
	Phase Mismatch	± 0.1	± 0.1	Degree
	Total	**± 1.00**	**± 0.60**	**Degree**
Overall Linearity Error	**Excl. Ageing**	**± 3.90**	**± 3.10**	**Degree**
	Incl. Ageing	**± 4.90**	**± 3.70**	**Degree**

The intrinsic linearity error refers only to the linearity error associated to the MLX91204. The linearity error associated to the magnetic and mechanical (off-axis, excentricity) design is not included and should be considered as an additional contribution.

For more information, please refer to the application note:

http://www.melexis.com/Assets/Magnet_Application_Note_MLX90316_5221.aspx

The total error can be reduced either statically (room temperature compensation) or dynamically (continuous compensation) through the off-chip signal processing performing the angular computation i.e. arctan(Y_{OUT}/X_{OUT}). The compensation is applied prior to computing the arctangent function: offset, gain and phase correction can be applied.

For more information, please refer to the application note:

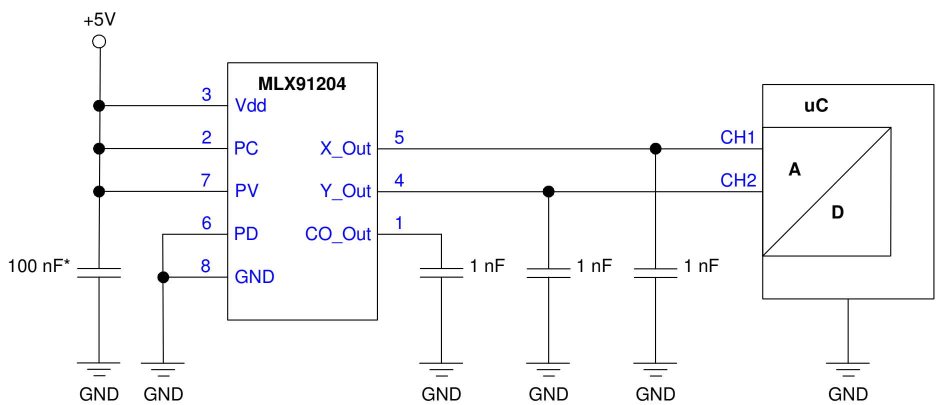
http://www.melexis.com/Assets/Front-End_Calibration_of_MLX90316_5252.aspx

8 Application Diagram

8.1 Single Ended Mode

The output voltages X = (X_OUT – GND) and Y = (Y_OUT – GND) are within 0.5V to 4.5V with an offset of 2.5V (VDD/2)

For reliable operation within the specifications the sensor must be connected as follows:

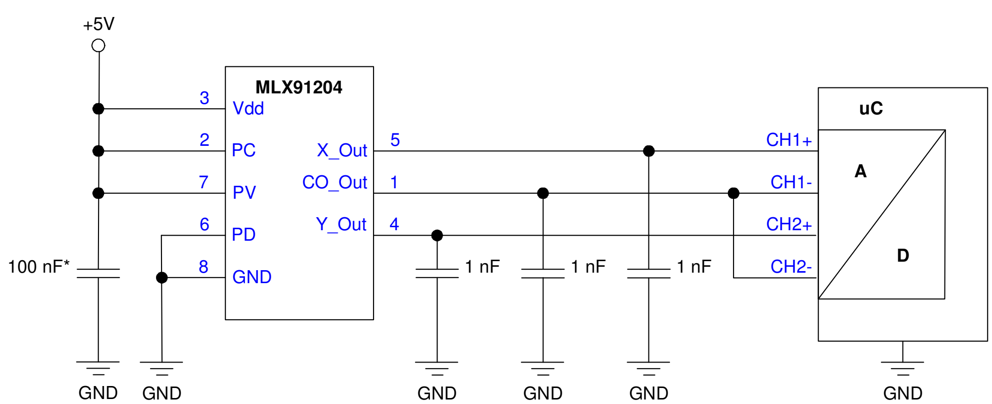


** if the supply voltage is disturbed by EMI it can be useful to place a second capacitor (100 pF ceramic) parallel to the 100nF capacitor.*

8.2 Differential Mode

The output voltages X = (X_OUT – CO_OUT) and Y = (Y_OUT – CO_OUT) are within ±2 V around "virtual ground" (i.e. CO_OUT = 2.5V = VDD/2)

For reliable operation within the specifications the sensor must be connected as follows:



** if the supply voltage is disturbed by EMI it can be useful to place a second capacitor (100pF ceramic) parallel to the 100 nF capacitor.*

9 Standard information regarding manufacturability of Melexis products with different soldering processes

Our products are classified and qualified regarding soldering technology, solderability and moisture sensitivity level according to following test methods:

Reflow Soldering SMD's (Surface Mount Devices)

IPC/JEDEC J-STD-020
Moisture/Reflow Sensitivity Classification for Nonhermetic Solid State Surface Mount Devices
(Classification reflow profiles according to table 5-2)
EIA/JEDEC JESD22-A113
Preconditioning of Nonhermetic Surface Mount Devices Prior to Reliability Testing
(Reflow profiles according to table 2)
Melexis Working Instruction 341901308

Wave Soldering SMD's (Surface Mount Devices) and THD's (Through Hole Devices)

- EN60749-20
  Resistance of plastic- encapsulated SMD's to combined effect of moisture and soldering heat
- EIA/JEDEC JESD22-B106 and EN60749-15
  Resistance to soldering temperature for through-hole mounted devices
- Melexis Working Instruction 341901309

Iron Soldering THD's (Through Hole Devices)

- EN60749-15
  Resistance to soldering temperature for through-hole mounted devices
- Melexis Working Instruction 341901309

Solderability SMD's (Surface Mount Devices) and THD's (Through Hole Devices)

- EIA/JEDEC JESD22-B102 and EN60749-21
  Solderability
- Melexis Working Instruction 3304312

For all soldering technologies deviating from above mentioned standard conditions (regarding peak temperature, temperature gradient, temperature profile etc) additional classification and qualification tests have to be agreed upon with Melexis.

The application of Wave Soldering for SMD's is allowed only after consulting Melexis regarding assurance of adhesive strength between device and board.

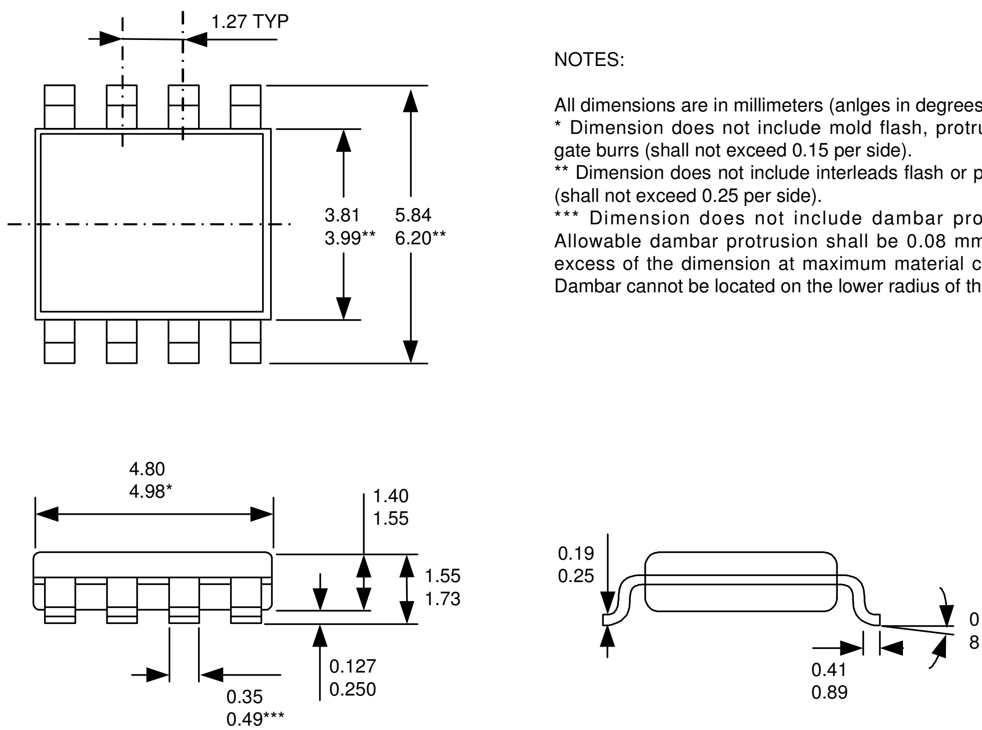
For more information on the lead free topic please see quality page at our website:
http://www.melexis.com/quality.aspx

10 ESD Precautions

Electronic semiconductor products are sensitive to Electro Static Discharge (ESD).
Always observe Electro Static Discharge control procedures whenever handling semiconductor products.

11 Package Information

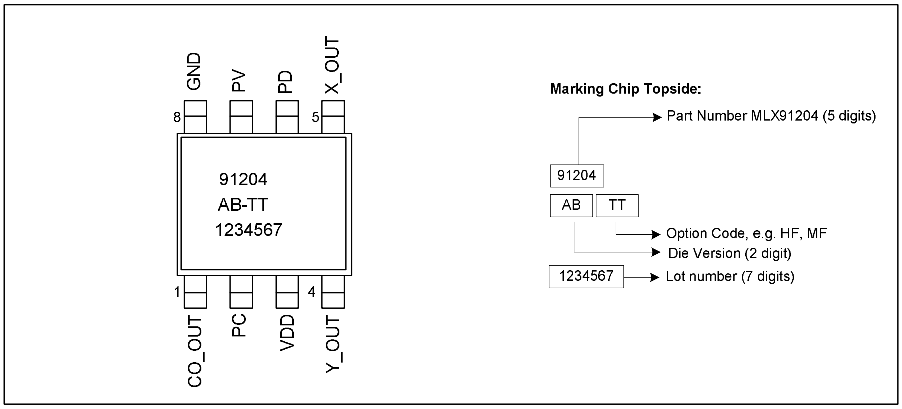
11.1 Package Dimensions

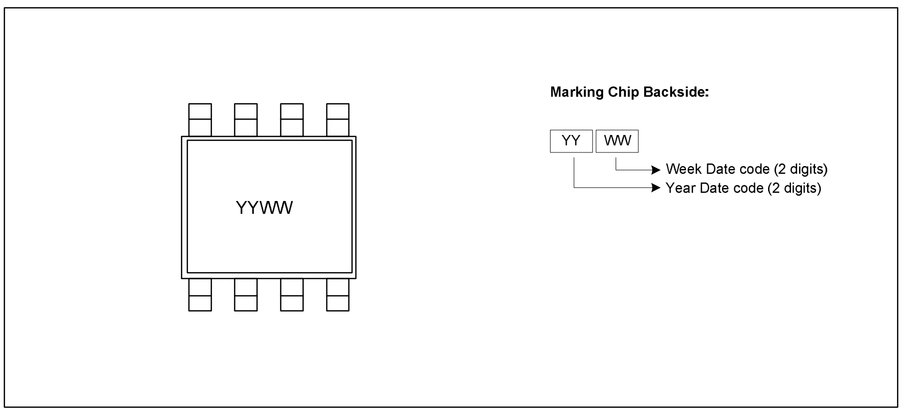


NOTES:

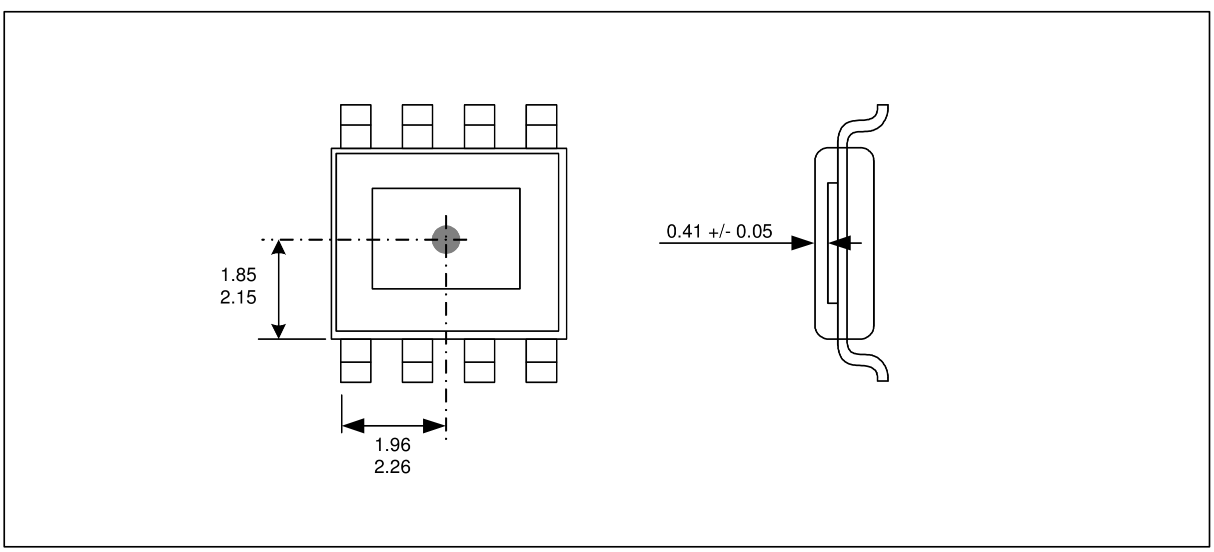
All dimensions are in millimeters (anlges in degrees).
* Dimension does not include mold flash, protrusions or gate burrs (shall not exceed 0.15 per side).
** Dimension does not include interleads flash or protrusion (shall not exceed 0.25 per side).
*** Dimension does not include dambar protrusion. Allowable dambar protrusion shall be 0.08 mm total in excess of the dimension at maximum material condition. Dambar cannot be located on the lower radius of the foot.

11.2 Pinout and Marking





11.3 Hall Plate Positioning



12 Disclaimer

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