High-Precision TMR Angle Sensor XL463

Features

- Tunnel Magnetoresistance (TMR) Technology
- Wide Operating Voltage Range
- Sine/cosine differential output
- Full 360° In-Plane Rotation Sensing
- Large Air Gap Capability
- Temperature Grade 1: -40℃ to 125℃ Ambient Operating Temperature Range
- Device HBM ESD Classification Level Class3B
- SOP8 package

Applications

- Angular Position Measurement
- Rotational Position Measurement

General Description

The XL463 is a high-precision TMR angle sensor optimized for angle detection applications, featuring a wide operating voltage range and a wide temperature range. It integrates two sets of Wheatstone bridge structures internally, with each bridge consisting of four high-sensitivity tunnel magnetoresistance (TMR) elements. It converts angular signals from external magnetic field variations into sine and cosine voltage signals, enabling precise angle detection.

The output signal period corresponds to a full 360° rotation of the magnetic field vector within the sensing plane, independent of magnetic field strength. Featuring a maximum operating voltage of 5.5 V and an operating temperature range from -40° C to +125° C, it can be widely used in fields such as automotive electronics and industrial automation.

Typical application schematic

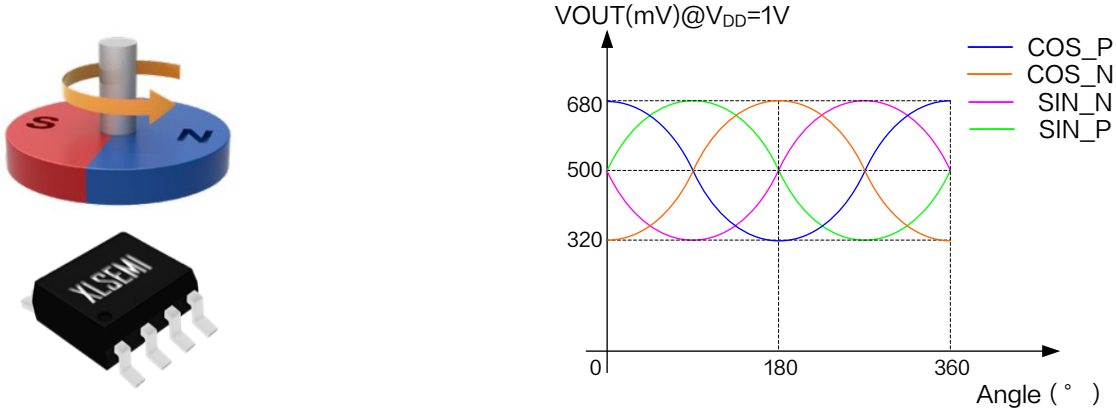


Figure1.XL463 Typical application diagram and output characteristic curve

Pin Configurations

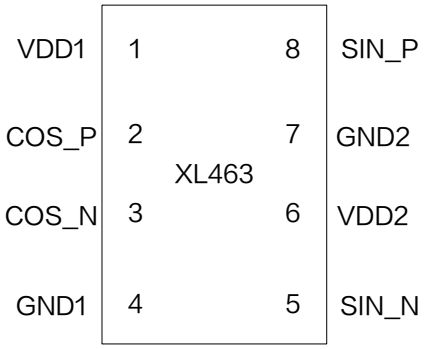


Figure2.Pin Configuration of XL463

Table 1.Pin Description

Pin Number	Pin Name	Description
1	VDD1	Channel 1 Power Supply Pin, supporting Wide DC Voltage Input up to 5.5V
2	COS_P	Channel 1 cosine differential output pin 1
3	COS_N	Channel 1 cosine differential output pin 2
4	GND1	Channel 1 Ground pin
5	SIN_N	Channel 2 sine differential output pin 2
6	VDD2	Channel 2 Power Supply Pin, supporting Wide DC Voltage Input up to 5.5V
7	GND2	Channel 2 Ground pin
8	SIN_P	Channel 2 sine differential output pin 1

Ordering Information

Order Information	Marking ID	Package Type	Eco Plan	Packing Type Supplied As
XL463	XL463	SOP8	RoHS & HF	4000 Units Per Reel

Internal Structure

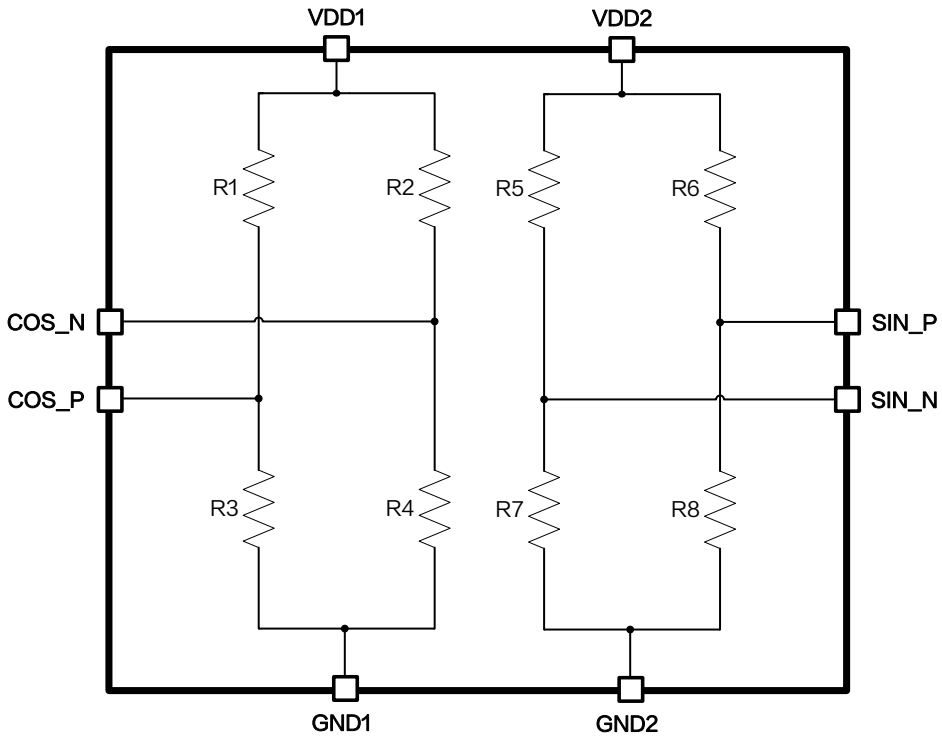


Figure3.Internal Structure Diagram of XL463

Absolute Maximum Ratings (Note 1)

Parameter	Symbol	Value	Unit
Input Pin Voltage	V_{DD}	−0.5 ~ 6	V
Thermal Resistance (SOP8) (Junction to Ambient, No Heatsink, Free Air)	R_{JA}	100	℃/W
Operating Temperature	T_A	−40 ~ 125	℃
Operating Junction Temperature	T_J	−40 ~ 155	℃
Storage Temperature	T_{STG}	−65 ~ 150	℃
Lead Temperature (Soldering, 10 sec)	T_{LEAD}	260	℃
ESD (HBM)	−	⩾8000	V

Note 1: Stresses greater than those listed under Maximum Ratings may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these or any other conditions above those indicated in the operation is not implied. Exposure to absolute maximum rating conditions for extended periods may affect reliability.

XL463 Electrical Characteristics

T_A = 25℃, V_{DD} = 1V, system parameters test circuit figure1, unless otherwise specified.

Parameters	Symbol	Test Condition	Min.	Typ.	Max.	Unit
Operation Voltage	V_{DD}	-	-	1	5.5	V
Zero-Field Resistance	R_0	B=0Gs VDD to GND	100	200	300	kΩ
Peak Voltage	V_{PEAK}	B=300Gs	-	350	-	mV/V
Midpoint Voltage	V_{Mid}	B=300Gs	450	500	550	mV/V
Bias Voltage	V_{OFFSET}	B=300Gs	-15	-	15	mV/V
Bridge Resistance Temperature Coefficient	TCR_B	-	-	-0.05	-	%/℃
Peak Voltage Temperature Coefficient	TCV_{PEAK}	-	-	-0.09	-	%/℃
Angle Error	△θ	T_A = -40℃~125℃ B=300Gs	-	0.9	-	deg
Phase Difference	-	B=300Gs	87	90	93	deg
Peak Synchronization Coefficient	k	B=300Gs	95	100	105	%

Note 2: The angle error is defined as the angle error from zero to the peak value.

XL463 Magnetic Characteristics

Parameters	Symbol	Test Condition	Min.	Typ.	Max.	Unit
Operating Magnetic Field	B	-	300	-	800	Gs

Output Characteristics

T_A = 25℃, V_{DD} = 1V, system parameters test circuit figure1, unless otherwise specified.

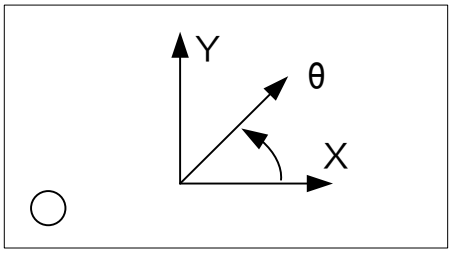


Figure4.XL463 Sensitivity Direction

The definition of the magnetic field angle is illustrated in Figure 4; as the magnetic field angle is continuously swept across the range of 0° to 360°, the output voltage of the XL463 exhibits a characteristic sinusoidal waveform, as shown in Figures 5 and 6.

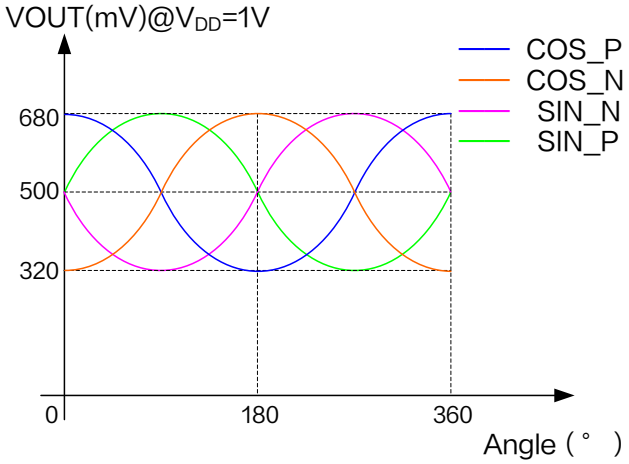


Figure5.XL463 Single-Period Single-Ended Output at V_{DD}=1V

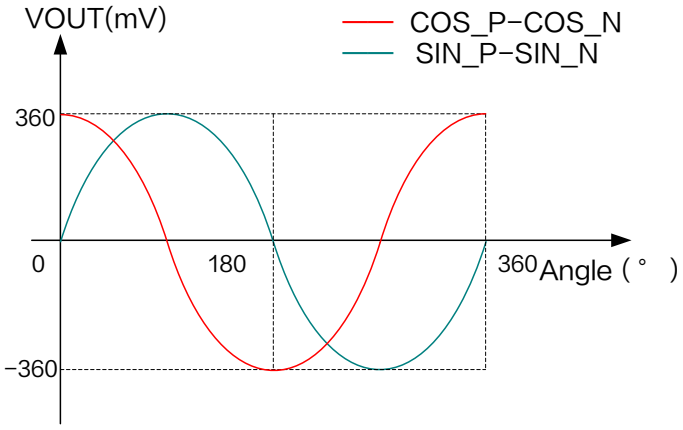


Figure6.XL463 Single-Period Differential Output at V_{DD}=1V

Parameter Definitions

Zero-Field Resistance

Resistance between the VDD and GND pins under zero magnetic field conditions.

Peak Voltage V_{PEAK}

$$V_{PEAK(COS\_P)}=\frac{V_{MAX(COS\_P)}-V_{MIN(COS\_P)}}{2\times V_{DD}}$$

$$V_{PEAK(COS\_N)}=\frac{V_{MAX(COS\_N)}-V_{MIN(COS\_N)}}{2\times V_{DD}}$$

$$V_{PEAK(SIN\_P)}=\frac{V_{MAX(SIN\_P)}-V_{MIN(SIN\_P)}}{2\times V_{DD}}$$

$$V_{PEAK(SIN\_N)}=\frac{V_{MAX(SIN\_N)}-V_{MIN(SIN\_N)}}{2\times V_{DD}}$$

$$V_{PEAK(COS)}=V_{PEAK(COS\_P)}+V_{PEAK(COS\_N)}$$

$$V_{PEAK(SIN)}=V_{PEAK(SIN\_P)}+V_{PEAK(SIN\_N)}$$

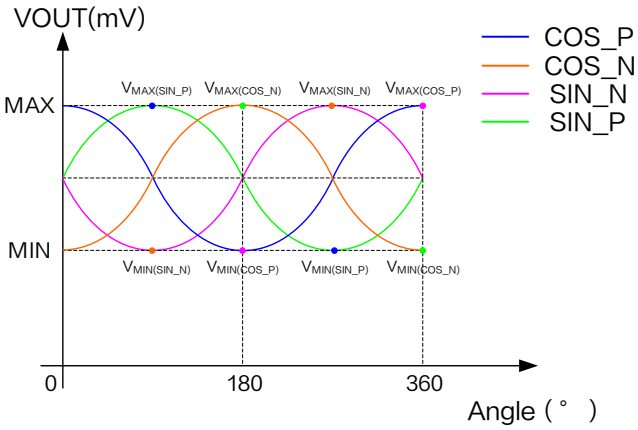


Figure7.Schematic Diagram of XL463 Parameter Definitions

Midpoint Voltage V_{Mid}

$$V_{Mid(COS\_P)}=\frac{V_{MAX(COS\_P)}+V_{MIN(COS\_P)}}{2\times V_{DD}} \qquad V_{Mid(COS\_N)}=\frac{V_{MAX(COS\_N)}+V_{MIN(COS\_N)}}{2\times V_{DD}}$$

$$V_{Mid(SIN\_P)}=\frac{V_{MAX(SIN\_P)}+V_{MIN(SIN\_P)}}{2\times V_{DD}} \qquad V_{Mid(SIN\_N)}=\frac{V_{MAX(SIN\_N)}+V_{MIN(SIN\_N)}}{2\times V_{DD}}$$

Bias Voltage V_{OFFSET}

$$V_{OFFSET(COS)}=V_{Mid(COS\_P)}-V_{Mid(COS\_N)} \qquad V_{OFFSET(SIN)}=V_{Mid(SIN\_P)}-V_{Mid(SIN\_N)}$$

Bridge Resistance Temperature Coefficient TCR_B

$$TCR_B=\frac{R_H-R_L}{R_N(T_H-T_L)}\times 100\%$$

R_H: Resistance at high temperature	R_L: Resistance at low temperature	R_N: Resistance at 25 ℃
T_H: High temperature	T_L: Low temperature	T_N: 25℃

Peak Voltage Temperature Coefficient TCV_{PEAK}

$$TCV_{PEAK(COS\_P)}=\frac{V_{PEAKH(COS\_P)}-V_{PEAKL(COS\_P)}}{V_{PEAKN(COS\_P)}(T_H-T_L)}\times 100\%$$

$$TCV_{PEAK(COS\_N)}=\frac{V_{PEAKH(COS\_N)}-V_{PEAKL(COS\_N)}}{V_{PEAKN(COS\_N)}(T_H-T_L)}\times 100\%$$

$$TCV_{PEAK(SIN\_P)}=\frac{V_{PEAKH(SIN\_P)}-V_{PEAKL(SIN\_P)}}{V_{PEAKN(SIN\_P)}(T_H-T_L)}\times 100\%$$

$$TCV_{PEAK(SIN\_N)}=\frac{V_{PEAKH(SIN\_N)}-V_{PEAKL(SIN\_N)}}{V_{PEAKN(SIN\_N)}(T_H-T_L)}\times 100\%$$

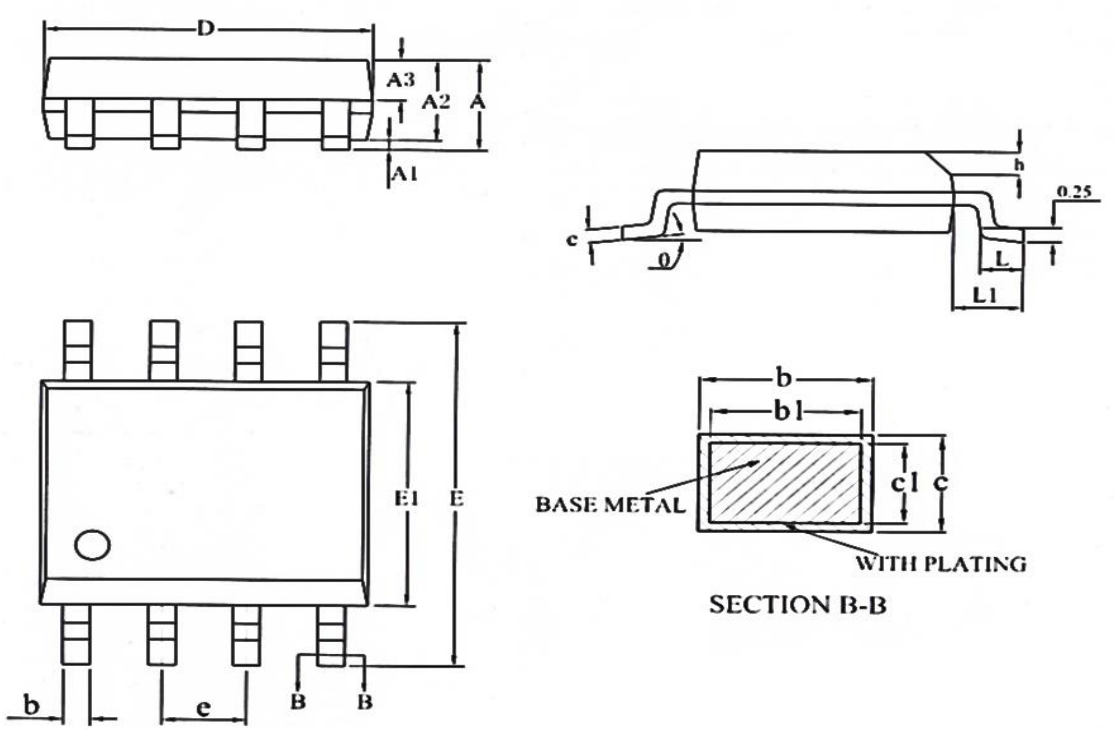
$V_{PEAKH(COS\_P)}$: Output value of COS_P at high temperature	$V_{PEAKL(COS\_P)}$: Output value of COS_P at low temperature	$V_{PEAKN(COS\_P)}$: Output value of COS_P at 25℃
$V_{PEAKH(COS\_N)}$: Output value of COS_N at high temperature	$V_{PEAKL(COS\_N)}$: Output value of COS_N at low temperature	$V_{PEAKN(COS\_N)}$: Output value of COS_N at 25℃
$V_{PEAKH(SIN\_P)}$: Output value of SIN_P at high temperature	$V_{PEAKL(SIN\_P)}$: Output value of SIN_P at low temperature	$V_{PEAKN(SIN\_P)}$: Output value of SIN_P at 25℃
$V_{PEAKH(SIN\_N)}$: Output value of SIN_N at high temperature	$V_{PEAKL(SIN\_N)}$: Output value of SIN_N at low temperature	$V_{PEAKN(SIN\_N)}$: Output value of SIN_N at 25℃
T_H: High temperature	T_L: Low temperature	T_N: 25℃

Peak Synchronization Coefficient k

$$k=\frac{V_{PEAK(COS)}}{V_{PEAK(SIN)}}\times 100\%$$

Package Information

SOP8



Symbol	Dimensions In Millimeters			Dimensions In Inches		
	Min.	Nom.	Max.	Min.	Nom.	Max.
A	1.35	1.55	1.75	0.053	0.061	0.069
A1	0.05	–	0.25	0.002	–	0.010
A2	1.25	1.40	1.65	0.049	0.055	0.065
A3	0.50	0.60	0.70	0.019	0.024	0.028
b	0.30	–	0.51	0.012	–	0.020
b1	0.29	0.41	0.48	0.011	0.016	0.018
c	0.17	–	0.25	0.007	–	0.010
c1	0.17	0.20	0.23	0.007	0.008	0.009
D	4.70	4.90	5.10	0.185	0.193	0.200
E	5.80	6.00	6.20	0.228	0.236	0.244
E1	3.80	3.90	4.00	0.150	0.154	0.157
e	1.14	1.27	1.40	0.045	0.050	0.055
h	0.25	–	0.50	0.010	–	0.020
L	0.45	–	0.80	0.017	–	0.031
L1	0.82	1.03	1.23	0.032	0.040	0.048
θ	0	–	8°	0	–	8°

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