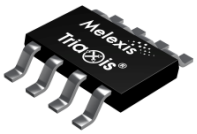
# MLX90380 - Triaxis® Resolver

Datasheet

## 1. Features and Benefits

- Triaxis® Hall Technology
- Sine and Cosine Analog Outputs
- Output Refresh Rate 4µs
- 3.3V and 5V Operating Supply Voltage
- Operating Temperature Range from -40°C to 150°C
- Selectable Magnetic Field Axis (X/Y - X/Z - Z/Y)
- Selectable Sensitivity Range (10mT … 70mT)
- End-of-Shaft / Through-Shaft Operation
- Ratiometric Outputs
- Programming Through the Connector
- RoHS Compliant Packages:
  - Single Die – SOIC-8
  - Dual Die Fully Redundant – TSSOP-16



*SOIC-8*



*TSSOP-16*

## 2. Application Examples

- Absolute Rotary Position Sensor
- Brushless Motor Control
  - Permanent Magnet Synchronous Motor
  - Brushless DC Motor (BLDC)
- Field-oriented Motor Control

## 3. Description

The MLX90380 is a monolithic contactless sensor IC sensitive to the flux density applied orthogonally and parallel to the IC surface.

High-speed dual analog outputs allow the MLX90380 to deliver accurate sine/cosine signals when used with a rotating permanent magnet.

With a wide range of operating temperature, supply voltage and magnetic flux density, the MLX90380 can resolve the angular position of a rotating axis over 360 degrees in many industrial and automotive applications.

Selectable magnetic axes ensure compatibility with end-of-shaft and through-shaft configurations.

Sensitivity and filter bandwidth can be programmed through the 4 application pins to optimally use the ADC input range of the companion MCU.

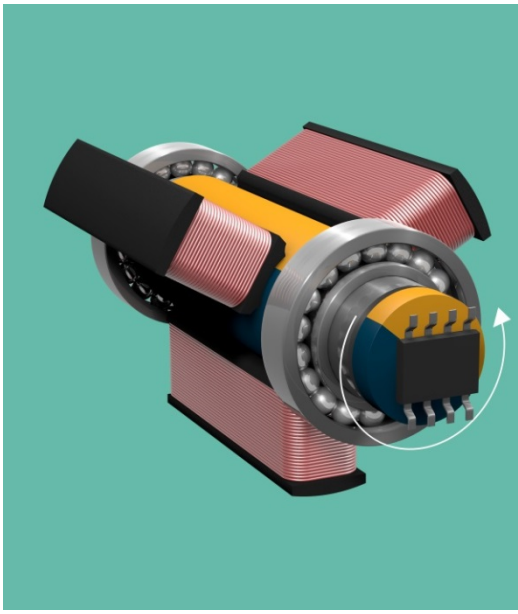


*Figure 1: End of Shaft*

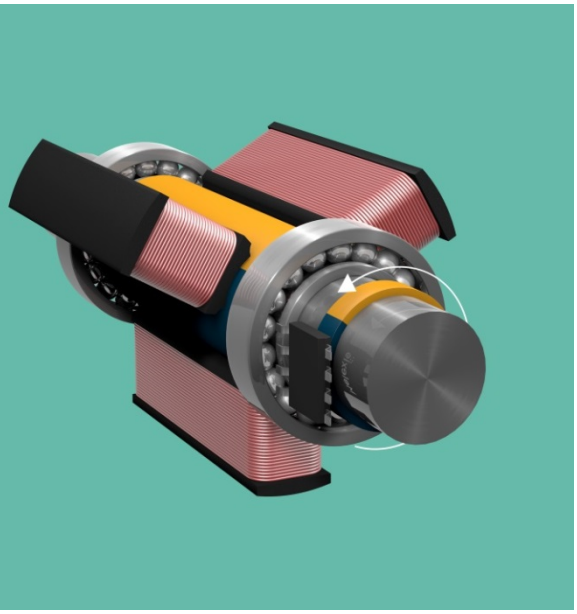


*Figure 2: Through Shaft*



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## 4. Ordering Information [1]

| Product Ordering Code | Temperature | Package | Option Code | Packing Form |
|---|---|---|---|---|
| MLX90380LDC-BAA-000-RE | -40°C to 150°C | SOIC-8 | BAA-000 | Reel |
| MLX90380LDC-BAA-100-RE | -40°C to 150°C | SOIC-8 | BAA-100 | Reel |
| MLX90380LDC-BAA-500-RE | -40°C to 150°C | SOIC-8 | BAA-500 | Reel |
| MLX90380LDC-BAB-000-RE | -40°C to 150°C | SOIC-8 | BAB-000 | Reel |
| MLX90380LDC-BAB-003-RE | -40°C to 150°C | SOIC-8 | BAB-003 | Reel |
| MLX90380LDC-BAB-005-RE | -40°C to 150°C | SOIC-8 | BAB-005 | Reel |
| MLX90380LDC-BAB-010-RE | -40°C to 150°C | SOIC-8 | BAB-010 | Reel |
| MLX90380LDC-BAB-023-RE | -40°C to 150°C | SOIC-8 | BAB-023 | Reel |
| MLX90380LDC-BAB-025-RE | -40°C to 150°C | SOIC-8 | BAB-025 | Reel |
| MLX90380LDC-BAB-043-RE | -40°C to 150°C | SOIC-8 | BAB-043 | Reel |
| MLX90380LDC-BAB-045-RE | -40°C to 150°C | SOIC-8 | BAB-045 | Reel |
| MLX90380LDC-BAB-100-RE | -40°C to 150°C | SOIC-8 | BAB-100 | Reel |
| MLX90380LDC-BAB-103-RE | -40°C to 150°C | SOIC-8 | BAB-103 | Reel |
| MLX90380LDC-BAB-105-RE | -40°C to 150°C | SOIC-8 | BAB-105 | Reel |
| MLX90380LDC-BAB-120-RE | -40°C to 150°C | SOIC-8 | BAB-120 | Reel |
| MLX90380LDC-BAB-123-RE | -40°C to 150°C | SOIC-8 | BAB-123 | Reel |
| MLX90380LDC-BAB-125-RE | -40°C to 150°C | SOIC-8 | BAB-125 | Reel |
| MLX90380LDC-BAB-140-RE | -40°C to 150°C | SOIC-8 | BAB-140 | Reel |
| MLX90380LDC-BAB-143-RE | -40°C to 150°C | SOIC-8 | BAB-143 | Reel |
| MLX90380LDC-BAB-145-RE | -40°C to 150°C | SOIC-8 | BAB-145 | Reel |
| MLX90380LDC-BAB-200-RE | -40°C to 150°C | SOIC-8 | BAB-200 | Reel |
| MLX90380LDC-BAB-305-RE | -40°C to 150°C | SOIC-8 | BAB-305 | Reel |
| MLX90380LDC-BAB-403-RE | -40°C to 150°C | SOIC-8 | BAB-403 | Reel |
| MLX90380LDC-BAB-506-RE | -40°C to 150°C | SOIC-8 | BAB-506 | Reel |
| MLX90380LDC-BAB-543-RE | -40°C to 150°C | SOIC-8 | BAB-543 | Reel |
| MLX90380LDC-BAC-000-RE | -40°C to 150°C | SOIC-8 | BAC-000 | Reel |

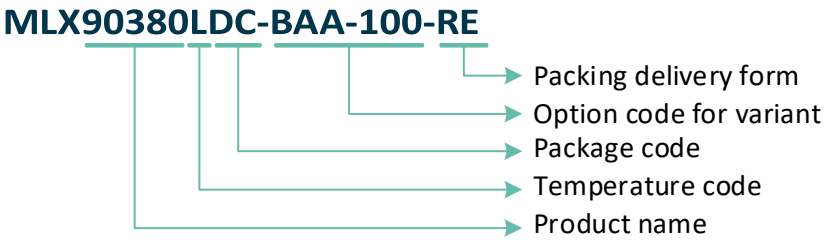
*[1] Other option codes and packing forms are available upon request. Every combination in Table 2 can be made pending on yearly volume. Please contact your sales representative to see what combinations are available.*



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| Product Ordering Code | Temperature | Package | Option Code | Packing Form |
|---|---|---|---|---|
| MLX90380LDC-BAC-100-RE | -40°C to 150°C | SOIC-8 | BAC-100 | Reel |
| MLX90380LDC-BAC-125-RE | -40°C to 150°C | SOIC-8 | BAC-125 | Reel |
| MLX90380LDC-BAC-524-RE | -40°C to 150°C | SOIC-8 | BAC-524 | Reel |
| MLX90380LDC-BAC-545-RE | -40°C to 150°C | SOIC-8 | BAC-545 | Reel |
| MLX90380LGO-BAA-000-RE | -40°C to 150°C | TSSOP-16 | BAA-000 | Reel |
| MLX90380LGO-BAA-100-RE | -40°C to 150°C | TSSOP-16 | BAA-100 | Reel |
| MLX90380LGO-BAB-003-RE | -40°C to 150°C | TSSOP-16 | BAB-003 | Reel |
| MLX90380LGO-BAB-005-RE | -40°C to 150°C | TSSOP-16 | BAB-005 | Reel |
| MLX90380LGO-BAB-015-RE | -40°C to 150°C | TSSOP-16 | BAB-015 | Reel |
| MLX90380LGO-BAB-023-RE | -40°C to 150°C | TSSOP-16 | BAB-023 | Reel |
| MLX90380LGO-BAB-025-RE | -40°C to 150°C | TSSOP-16 | BAB-025 | Reel |
| MLX90380LGO-BAB-043-RE | -40°C to 150°C | TSSOP-16 | BAB-043 | Reel |
| MLX90380LGO-BAB-045-RE | -40°C to 150°C | TSSOP-16 | BAB-045 | Reel |
| MLX90380LGO-BAB-100-RE | -40°C to 150°C | TSSOP-16 | BAB-100 | Reel |
| MLX90380LGO-BAB-103-RE | -40°C to 150°C | TSSOP-16 | BAB-103 | Reel |
| MLX90380LGO-BAB-105-RE | -40°C to 150°C | TSSOP-16 | BAB-105 | Reel |
| MLX90380LGO-BAB-123-RE | -40°C to 150°C | TSSOP-16 | BAB-123 | Reel |
| MLX90380LGO-BAB-125-RE | -40°C to 150°C | TSSOP-16 | BAB-125 | Reel |
| MLX90380LGO-BAB-143-RE | -40°C to 150°C | TSSOP-16 | BAB-143 | Reel |
| MLX90380LGO-BAB-145-RE | -40°C to 150°C | TSSOP-16 | BAB-145 | Reel |
| MLX90380LGO-BAB-400-RE | -40°C to 150°C | TSSOP-16 | BAB-400 | Reel |
| MLX90380LGO-BAC-000-RE | -40°C to 150°C | TSSOP-16 | BAC-000 | Reel |
| MLX90380LGO-BAC-100-RE | -40°C to 150°C | TSSOP-16 | BAC-100 | Reel |

*Table 1: Ordering Codes available. All option codes of Table 2 can be made.*





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# Legend:

| | |
|---|---|
| Temperature Code: | L: from -40°C to 150°C |
| Package Code: | DC: for SOIC-8 package<br>GO: for TSSOP-16 package (dual die) |
| Option Code: | BAx-123<br>**Sensitivity Temperature Coefficient:**<br>BAA-xxx: SmCo magnet<br>BAB-xxx: NdFeB magnet<br>BAC-xxx: Ferrite magnet<br>**Sensitivity:**<br>BAx-xx0: 40mT magnetic range[2]<br>BAx-xx1: 10mT magnetic range[2] for 3.3V operating supply voltage only<br>BAx-xx2: 20mT magnetic range[2]<br>BAx-xx3: 30mT magnetic range[2]<br>BAx-xx4: 50mT magnetic range[2]<br>BAx-xx5: 60mT magnetic range[2]<br>BAx-xx6: 70mT magnetic range[2]<br>BAx-xx7: 15mT magnetic range[2] for 5V operating supply voltage only<br>**Magnetic axis:**<br>BAx-x0x: X/Y magnetic axis – equal sensitivity[3]<br>BAx-x1x: X/Z magnetic axis – equal sensitivity[3]<br>BAx-x2x: Z/Y magnetic axis – equal sensitivity[3]<br>BAx-x3x: X/Z magnetic axis – sensitivity mismatch[4]<br>BAx-x4x: Z/Y magnetic axis – sensitivity mismatch[4]<br>**Operating voltage and Bandwidth:**<br>BAx-0xx: 3.3V operating supply voltage – low BW<br>BAx-1xx: 5V operating supply voltage – low BW<br>BAx-2xx: 3.3V operating supply voltage – medium BW<br>BAx-3xx: 5V operating supply voltage – medium BW<br>BAx-4xx: 3.3V operating supply voltage – high BW<br>BAx-5xx: 5V operating supply voltage – high BW |
| Packing Form: | RE: for Reel |
| Ordering Example: | MLX90380LDC-BAA-000-RE: SOIC-8 150, SmCo magnet, 3.3V operating supply voltage, Low bandwidth, X/Y magnetic axis, 40mT full scale magnetic range, Reel |

*Table 2: Order code Description*

*[2] The magnetic range is the in-plane (X or Y) flux density, that results in a ±40%VDD output swing with a $V_{OQ}$ of 50%VDD with $T_A$=25°C, $V_{DD}$=$V_{DDNOM}$*

*[3] Magnetic axis for: two pole magnet end of shaft / on axis and multi-pole magnet off-axis / through-shaft application.*

*[4] Magnetic axis for: two pole magnet off-axis / through-shaft application. The magnetic flux norm for the Z axis is double the magnetic flux norm for the X or Y axis: Bxy/Bz = 50%.*



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## 5. Functional Diagram

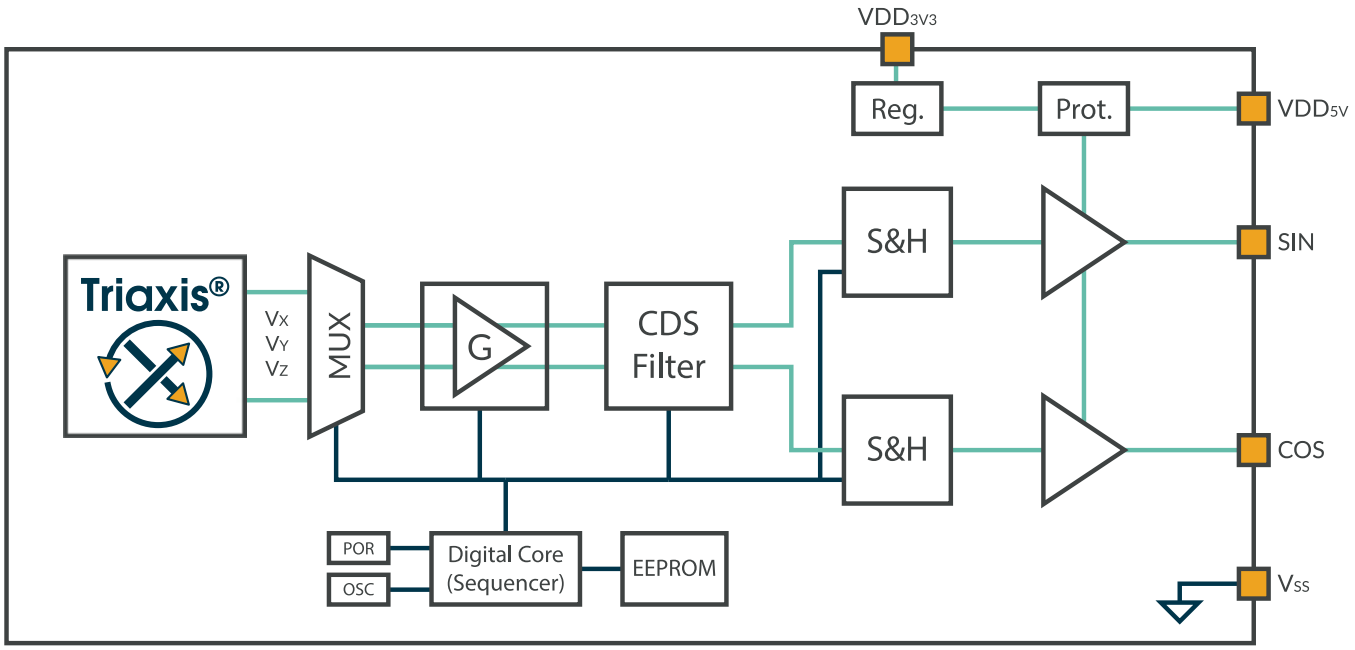



*Figure 3: Functional Diagram*

## 6. Glossary of Terms

| | |
|---|---|
| Gauss (G), Tesla (T) | Units for the magnetic flux density – 1 mT = 10 G |
| TC | Temperature Coefficient (in ppm/°C.) |
| NC | Not Connected |
| EMC | Electro-Magnetic Compatibility |

*Table 3: Glossary of Terms*


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# 7. Detailed General Description

The MLX90380 is a monolithic sensor IC sensitive to the flux density applied orthogonally and parallel to the IC surface. High-speed dual analog outputs allow the MLX90380 to deliver accurate, contact-less, true 360Deg. sine/cosine signals when used with a rotating permanent magnet.

$OUT_1$ and $OUT_2$ output voltages are proportional to the applied magnetic field along 2 axes. Those 2 axes are specified by the option code. For example, option code BAA-000 is a chip where $B_X$ and $B_Y$ components of the magnetic field are such that $OUT_1=Voq_1+S_1\times B_x$ and $OUT_2=Voq_2+S_2\times B_Y$.

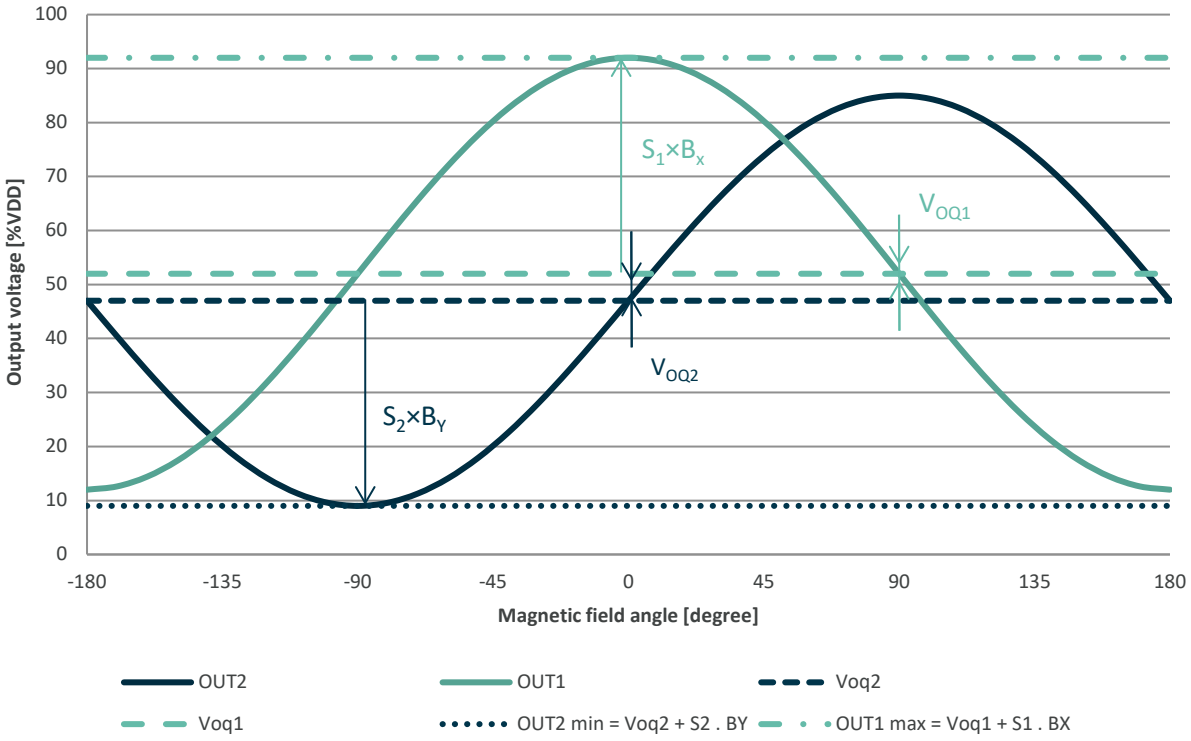



*Figure 4: Output characteristics*

Customers can order pre-programmed devices. End of line calibration is optional to achieve higher position accuracy.


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# 8. Intrinsic Magnetic Axis

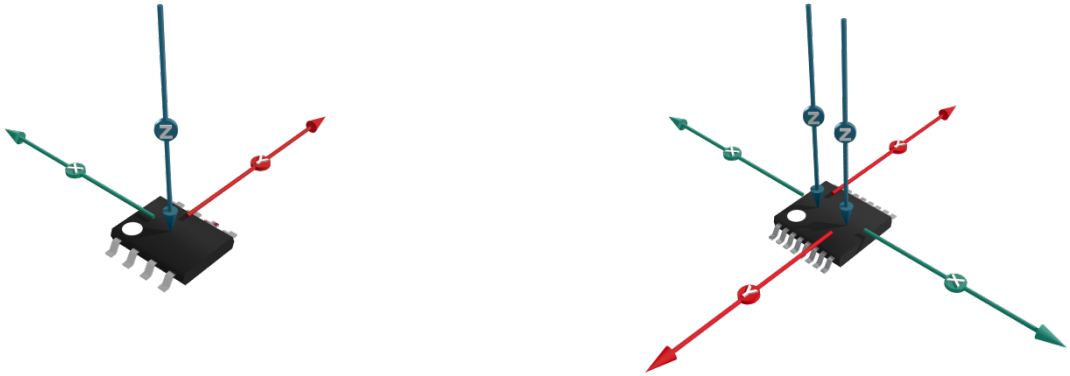


*Figure 5: Axis configuration*

Figure 5 gives the axis convention. Thus, take for example an IC in Z/Y configuration. Then, OUT1 will give Bz & OUT2 will give By.

The following sections list a detailed explanation of the intrinsic axis. It explains clock wise and counter clock wise behavior of the angle calculation.

CW – Clockwise turn: The magnet needs to turn in the CW direction to get a positive slope of the angle calculated by ATAN.

CCW – Counterclockwise turn: The magnet needs to turn in the CCW direction to get a positive slope of the angle calculated by ATAN.

The CW - CCW rotation direction can be modified by changing the COS / SIN assignment to SIN / COS with an angle correction of 90 Deg.

$$\alpha = ATAN\left(\frac{SIN}{COS}\right)$$

The convention of preprogrammed parts is such that OUT2 is seen as SIN and OUT1 as COS.


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## 8.1. X/Y magnetic axis

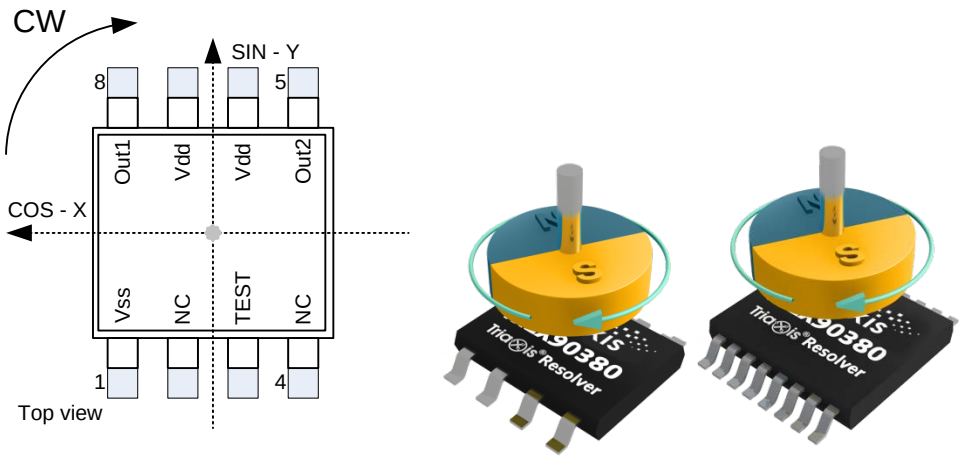



*Figure 6: X/Y Magnetic Axis*

## 8.2. X/Z magnetic axis

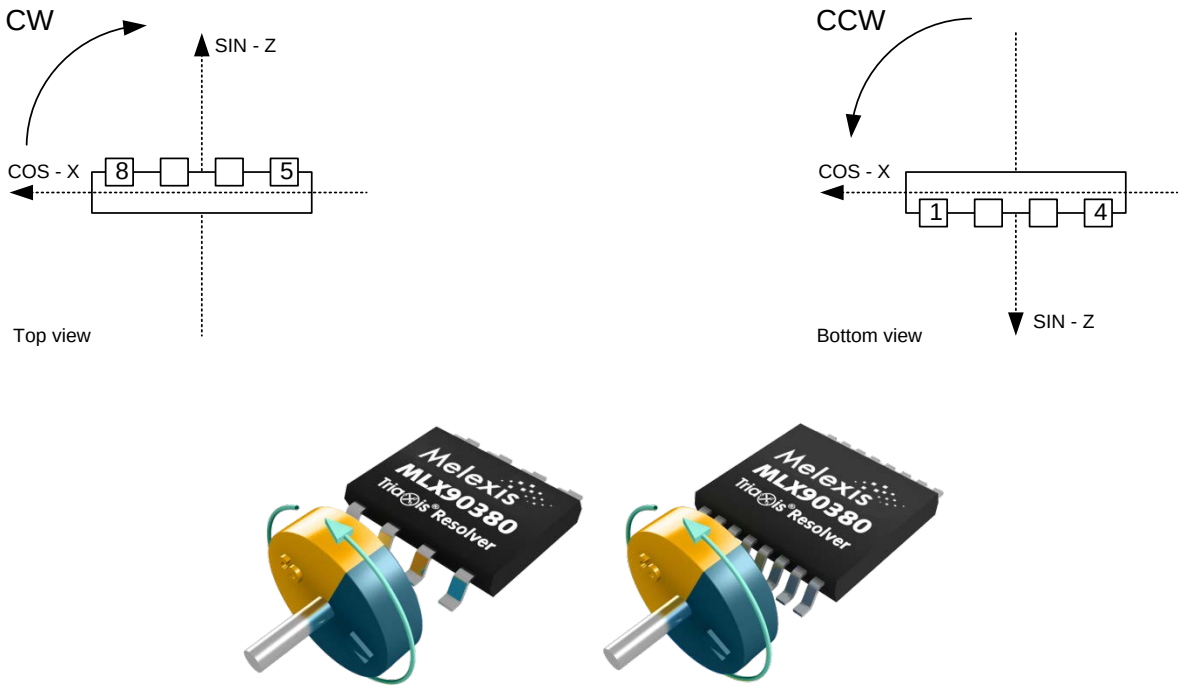



*Figure 7: X/Z Magnetic Axis*



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## 8.3. Z/Y magnetic axis

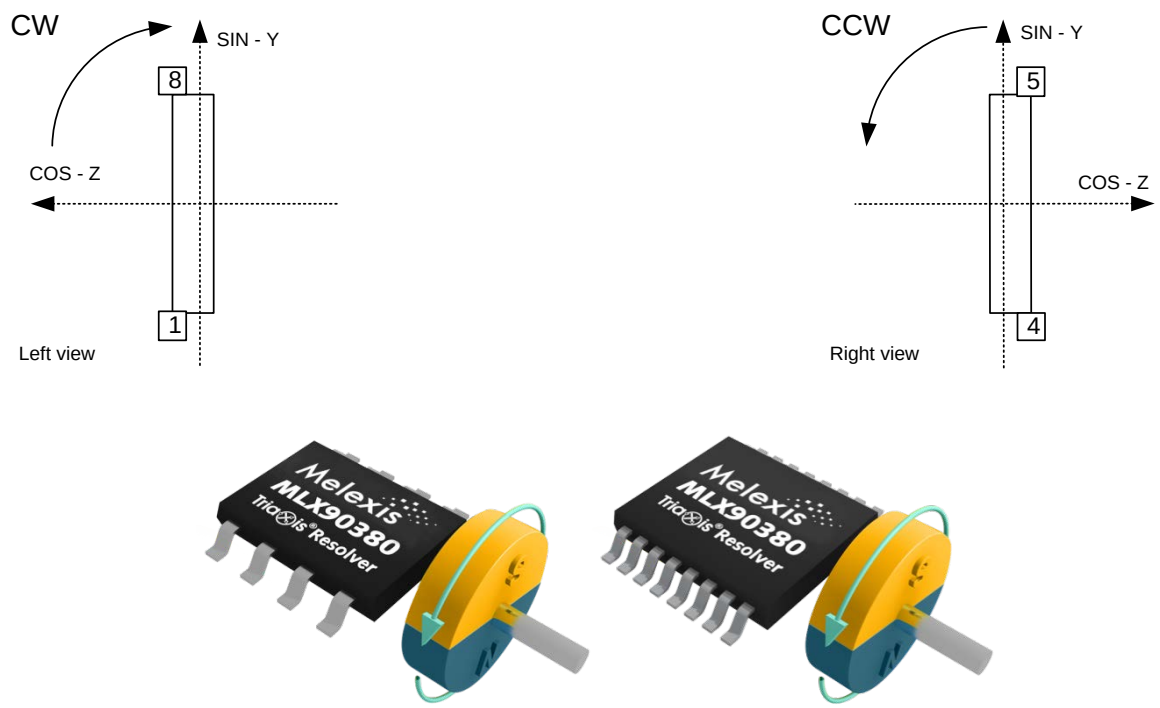



*Figure 8: Z/Y Magnetic Axis*

# 9. Pin Definitions and Descriptions

## 9.1. Pin Definition for SOIC-8

| Pin # | Name | Description |
|---|---|---|
| 1 | VSS | Supply Ground |
| 2 | NC | Not Used |
| 3 | TEST | Test Pin |
| 4 | NC | Not Used |
| 5 | OUT2 | Analog Output SIN |
| 6 | VDD5V | Supply 5V |
| 7 | VDD3V3 | Supply 3V3 |
| 8 | OUT1 | Analog Output COS |

*Table 4: Pin Definition SOIC-8*

For optimal EMC behavior connect the test pin and unused pins (Not Used) to the Ground.

Important: for 5V-mode applications, leave the VDD3V3 floating. Check the section 13 “Recommended Application Diagrams” for more details.


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## 9.2. Pin Definition for TSSOP-16

| Pin # | Name | Description |
|---|---|---|
| 1 | VSS_A | Supply Ground Die A |
| 2 | NC | Not Used |
| 3 | NC | Not Used |
| 4 | TEST_A | Test Pin Die A |
| 5 | OUT2_B | Analog Output SIN Die B |
| 6 | VDD5V_B | Supply 5V Die B |
| 7 | VDD3V3_B | Supply 3V3 Die B |
| 8 | OUT1_B | Analog Output COS Die B |
| 9 | VSS_B | Supply Ground Die B |
| 10 | NC | Not Used |
| 11 | TEST_B | Test Pin Die B |
| 12 | NC | Not Used |
| 13 | OUT2_A | Analog Output SIN Die A |
| 14 | VDD5V_A | Supply 5V Die A |
| 15 | VDD3V3_A | Supply 3V3 Die A |
| 16 | OUT1_A | Analog Output COS Die A |

*Table 5: Pin Definition TSSOP-16*

For optimal EMC behavior connect the test pin and unused pins (Not Used) to the Ground.

Important: for 5V applications, leave the VDD3V3 floating. Check the section “Recommended Application Diagrams” for more details.


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## 10. Absolute Maximum Ratings

| Parameter | Symbol | Min. | Max. | Unit | Condition |
|---|---|---|---|---|---|
| Supply Voltage (5V) | $V_{DD5V}$ | -16 | 24 | V | |
| Supply Voltage (3.3V) | $V_{DD3V3}$ | -0.3 | 7 | V | |
| Supply Current[5] | $I_{DD}$ | -10 | 10 | mA | Excluding external load on OUT1&2. |
| Negative Output Voltage | $V_{OUT}$ | -0.3 | - | V | |
| Positive Output Voltage (5V Application Diagram) | $V_{OUT}$ | - | 18 | V | |
| Positive Output Voltage (3.3V Application Diagram) | $V_{OUT}$ | - | 17 | V | |
| Output Current | $I_{OUT}$ | -20 | 20 | mA | |
| Operating Temperature Range | $T_A$ | -40 | 150 | °C | |
| Maximum Junction Temperature | $T_J$ | - | 165 | °C | |
| Storage Temperature Range | $T_S$ | -55 | 165 | °C | |
| ESD Sensitivity (Human Body Model) AEC-Q100-002 standard | $ESD_{HBM}$ | - | 2 | kV | Valid for SOIC-8.<br>TSSOP-16 cross die ESD limit is 1.5kV. |
| ESD Sensitivity (Charged Device Model) AEC-Q100-011 standard | $ESD_{CDM}$ | - | 500 | V | |
| Maximum Flux Density | B | -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.

## 11. General Electrical Specifications

Operating Characteristics, VDD=3.135V to 3.6V or VDD=4.5V to 5.5V (depending on the option code), $T_A$ = -40°C to 150°C (unless otherwise specified)

| Electrical Parameter | Symbol | Min. | Typ. | Max. | Unit | Condition |
|---|---|---|---|---|---|---|
| Supply Voltage (operating) | $V_{DD3V3}$ | 3.135 | 3.3 | 3.6 | V | SOIC-8 and TSSOP-16 packages |
| Supply Voltage (operating) | $V_{DD5V}$ | 4.5 | 5 | 5.5 | V | SOIC-8 and TSSOP-16 packages |
| Supply Current | $I_{DD}$ | 5<br>6 | -<br>- | 9<br>10 | mA<br>mA | Excluding external load on OUT1&2<br>3.135 ≤ VDD ≤ 3.6<br>4.5 ≤ VDD ≤ 5.5 |

[5] *Note IDD may exceed 10mA with a pull-down on OUT1&2.*



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| Electrical Parameter | Symbol | Min. | Typ. | Max. | Unit | Condition |
|---|---|---|---|---|---|---|
| Power On Reset Voltage Rising | $V_{POR_H}$ | 2.4<br>2.9 | 2.75<br>3.4 | 3<br>3.9 | V<br>V | OUT HiZ → operating mode<br>Application Diagram VDD3V3<br>Application Diagram VDD5V |
| Power On Reset Voltage Falling | $V_{POR_L}$ | 2.1<br>2.5 | 2.4<br>3.05 | 2.7<br>3.5 | V<br>V | Operating mode → OUT HiZ<br>Application Diagram VDD3V3<br>Application Diagram VDD5V |
| Programming Voltage (PTC) | MT7V | 6.1 | 6.5 | 7 | V | Rising Entry Level on VDD |
| Load Current Range | $I_{OUT}$ | -1 | - | 1 | mA | |
| Load Resistance Range[6] | $R_L$ | 10<br>5 | -<br>- | ∞<br>∞ | kΩ<br>kΩ | Connected between OUT and GND<br>Application Diagram VDD3V3<br>Application Diagram VDD5V |
| Load Capacitor Range | $C_L$ | 1.5 | 2.2 | 10 | ηF | Connected between OUT and GND |
| Output Voltage Range | $V_O$ | 5<br>10 | -<br>- | 95<br>90 | %VDD<br>%VDD | Linearity better than 1.5%<br>Linearity better than 0.5% |
| Output Resistance | $R_{OUT}$ | - | 25 | - | Ω | IOUT= ±1mA |
| Power-On Time[7] | $t_{ON}$ | - | - | 200 | µs | High bandwidth programming<br>$V_{POR_H} \leq V_{DD} \leq V_{DD5V_Max}$<br>$V_{POR_H} \leq V_{DD} \leq V_{DD3V3_Max}$ |
| Chopping Frequency | $F_{CHOP}$ | 0.9 | 1 | 1.1 | MHz | |
| Output Update Period | $T_S$ | - | 4 | - | µs | Each field component takes 2µs, measured sequentially |
| Output Noise Voltage[8] | $V_{nrms}$ | -<br>-<br>- | -<br>-<br>- | 3.1<br>4.6<br>10 | mV<br>mV<br>mV | RMS noise, B=0mT, VDD = typical value<br>S=1 %VDD/mT (50mV/mT at VDD=5V)<br>Low bandwidth programming<br>Medium bandwidth programming<br>High bandwidth programming |
| Nyquist Frequency | $F_{nyq}$ | - | 125 | - | kHz | |
| Tracking Delay[9] | | -<br>-<br>- | 12<br>29.5<br>74 | 17.5<br>38<br>85.5 | µs<br>µs<br>µs | High bandwidth<br>Medium bandwidth<br>Low bandwidth |

*Table 7 General Electrical Specifications*

*[6] A Pull down enables EEPROM error detection when the output goes in HiZ mode.*

*[7] Lower bandwidth programming increases the Power-On Time by the tracking delay (see footnote 9).*

*[8] Higher sensitivity programming may increase the output noise voltage.*

*[9] Tracking Delay is defined as the time delay between a rotating magnetic stimuli and the change on both outputs, SIN and COS. This delay includes the sample and hold filter which can be programmed by the customer according to the following equation: $Vo=Vi/n + nz^{-1} Vo/n$ with Bandwidth=1/(2πnTs) and n=1, 2, …, 16.*



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## 12. Magnetic Specifications [10]

Operating Characteristics, VDD=3.135V to 3.6V or VDD=4.5V to 5.5V (depending on the option code), $T_A$ = -40°C to 150°C (unless otherwise specified).

| Magnetic Parameter | Symbol | Min. | Typ. | Max. | Unit | Condition |
|---|---|---|---|---|---|---|
| Full Scale Magnetic Range (programmable) | $B_{fs}$ | 10 | - | 70 | mT | |
| Magnetic Flux Density | $B_z$ | - | - | 140 | mT | |
| Sensitivity[11] | S | -<br>-<br>-<br>-<br>-<br>-<br>-<br>- | 1[12]<br>4[12]<br>2[12]<br>1.33[12]<br>0.8[12]<br>0.66[12]<br>0.57[12]<br>2.66[12] | -<br>-<br>-<br>-<br>-<br>-<br>-<br>- | %VDD/mT<br>%VDD/mT<br>%VDD/mT<br>%VDD/mT<br>%VDD/mT<br>%VDD/mT<br>%VDD/mT<br>%VDD/mT | xx0: 40mT magnetic range<br>xx1: 10mT magnetic range[13]<br>xx2: 20mT magnetic range<br>xx3: 30mT magnetic range<br>xx4: 50mT magnetic range<br>xx5: 60mT magnetic range<br>xx6: 70mT magnetic range<br>xx7: 15mT magnetic range[14] |
| Sensitivity Accuracy | | -5<br>-8 | - | 5<br>8 | %<br>% | X/Y magnetic axis<br>Z magnetic axis<br>$T_A$=25°C, $V_{DD}$=$V_{DDNOM}$, S=1%VDD/mT |
| Sensitivity Temperature Coefficient[15] | TCS | | | | | First Order approximation |
| | | -<br>-<br>- | 350<br>1100<br>2000 | -<br>-<br>- | ppm/°C<br>ppm/°C<br>ppm/°C | SmCo<br>NdFeB<br>Ferrite |
| Sensitivity Temperature Coefficient Drift | $TCS_{drift}$ | -500 | - | 500 | ppm/°C | Temperature drift around programmed TCS |
| Sensitivity Ratiometry | | -2.5 | - | 2.5 | % / V | |
| Linearity | | -0.5<br>-0.5<br>-1.5<br>-1.5 | -<br>-<br>-<br>- | 0.5<br>0.5<br>1.5<br>1.5 | %<br>%<br>%<br>% | $V_{DD}$=5V, output voltage within [0.5V;4.5V]<br>$V_{DD}$=3.3V, output voltage within [0.33V;2.97V]<br>$V_{DD}$=5V, output voltage within [0.25V;4.75V]<br>$V_{DD}$=3.3V, output voltage in [0.165V;3.135V] |
| Sensitivity Mismatch | | -5<br>-<br>-5 | -<br>-20<br>- | 5<br>-<br>5 | %<br>%<br>% | X vs. Y, with/without gain adjustment<br>Z vs. X, Z vs. Y, without gain adjustment<br>Z vs. X, Z vs. Y, with gain adjustment |

*[10] Please refer to the User_Interface_description_MLX90380_PSF_sample.xls.pdf for customer programmable parameters.*

*[11] Sensitivity and associated magnetic full scale range are factory programmed (see Option Codes).*

*[12] For option code x3x and x4x the sensitivity for the Z axis is half of the sensitivity for the X or Y axis. The given figure is for the X or Y axis.*

*[13] for 3.3V operating supply voltage only*

*[14] for 5V operating supply voltage only*

*[15] See section 12.1 for second order behavior.*



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| Magnetic Parameter | Symbol | Min. | Typ. | Max. | Unit | Condition |
|---|---|---|---|---|---|---|
| Output Offset Level | $V_{OQ}$ | 47.5 | 50 | 52.5 | %VDD | B=0mT, $T_A$=25°C |
| Output Offset Temperature Drift[16] | | -1.5<br>-2.2 | 0<br>0 | 1.5<br>2.2 | %VDD<br>%VDD | $V_{DD}$=5V<br>$V_{DD}$=3.3V<br>B=0mT, S=1 %VDD/mT |
| Output Offset Ratiometry | | -2.5 | - | 2.5 | % | B=0mT<br>$(dV_{OQ} / V_{OQ}) - (dV_{DD} / V_{DD})$<br>$-10\% < dV_{DD}/V_{DD} < 10\%$ |
| Magnetic Angular Speed | | 0 | - | 25000 | rpm | |
| Signal Phase Shift | PHI | - | 1.8 | - | Degree | At 25000 rpm, high bandwidth programming |
| Output Update Rate | | - | 1.6 | - | Sample/ Degree | At 25000 rpm, high bandwidth programming |
| Total Angular Error without Correction[17] | | -10<br>-15 | - | 10<br>15 | Degree<br>Degree | T=25°C<br>-40°C ≤ T ≤ 150°C |
| Total Angular Error with Dynamic Compensation[18] | | -1 | - | 1 | Degree | |

*Table 8: Magnetic Specifications*

*[16] See section 12.2 for the full Output Offset Temperature Drift Characteristics*

*[17] Total angle error with an external homogeneous magnetic field stimulus. System design and manufacturing (magnet eccentricity and off-axis) may degrade the accuracy.*

*[18] This system error budget is explained in more detail in a separate application note. It is dependent on the magnetic system and the correction algorithm of the ECU. A very popular method to reduce total angle error is offset and amplitude correction (e.g. min/max COS/SIN scaling by the system ECU after one full magnet revolution).*
*The total angle error refers only to the linearity error associated to the MLX90380. The linearity error associated to the magnetic and mechanical (off-axis, eccentricity) design is not included and should be considered as an additional contribution. 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(OUT2/OUT1). The compensation is applied prior to computing the arctangent function: offset, gain and phase correction can be applied.*



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## 12.1. Sensitivity Temperature Coefficient Characteristic

The sensitivity temperature coefficient of the MLX90380 is a first order sensitivity compensation to counter the degrading of the magnets field strength over temperature. The TCS is foreseen with a target TCS of SmCo, NdFeB and Ferrite. The actual TCS of the sensor will show a small 2nd order on the target as illustrated in the figure below.

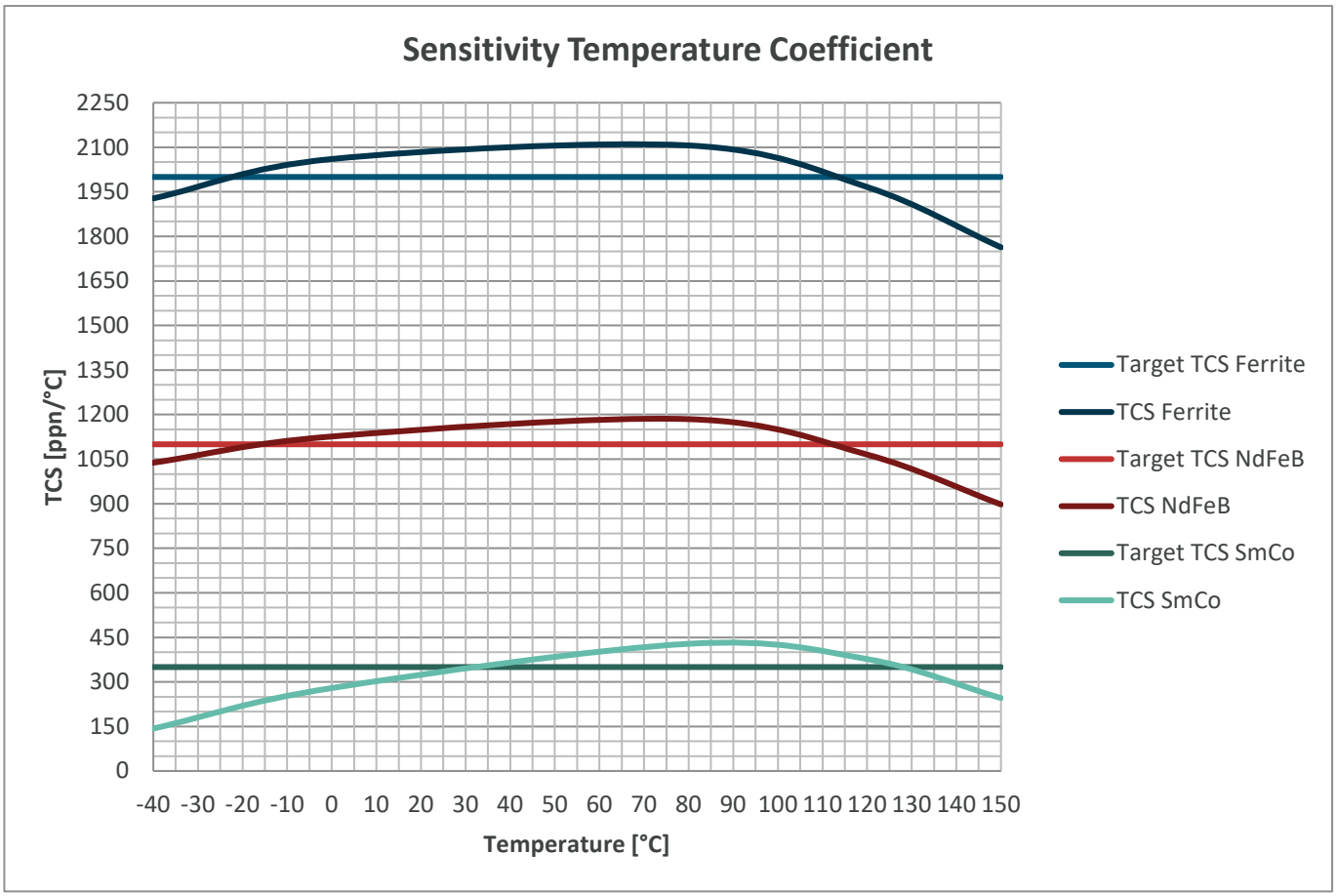


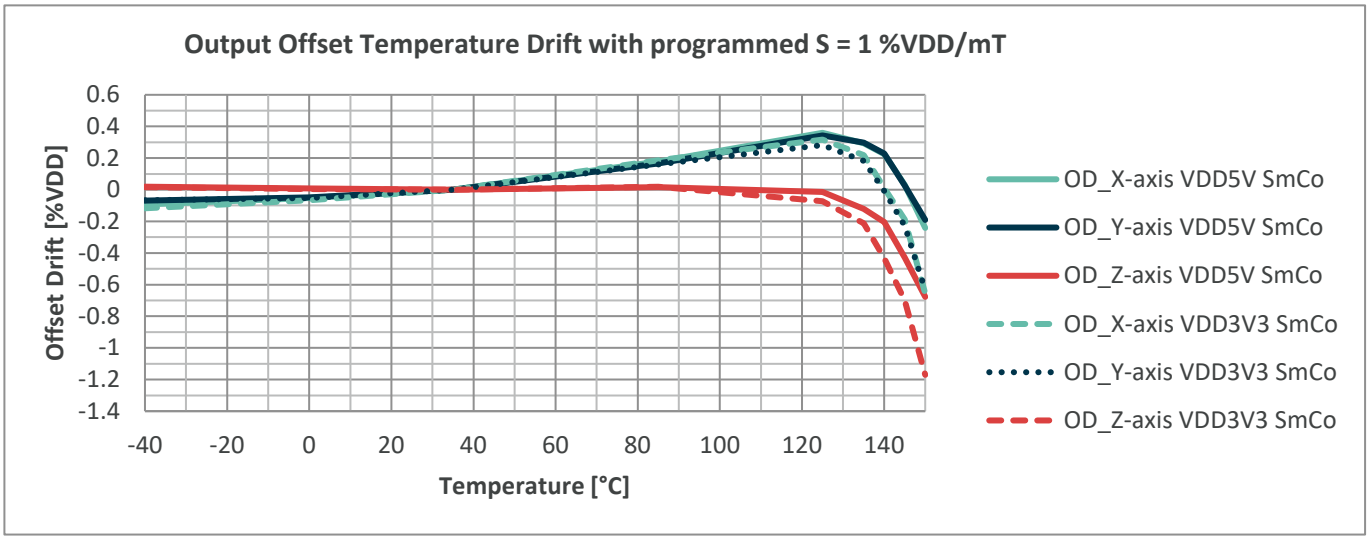

*Figure 9: Target TCS vs. 2nd order TCS*

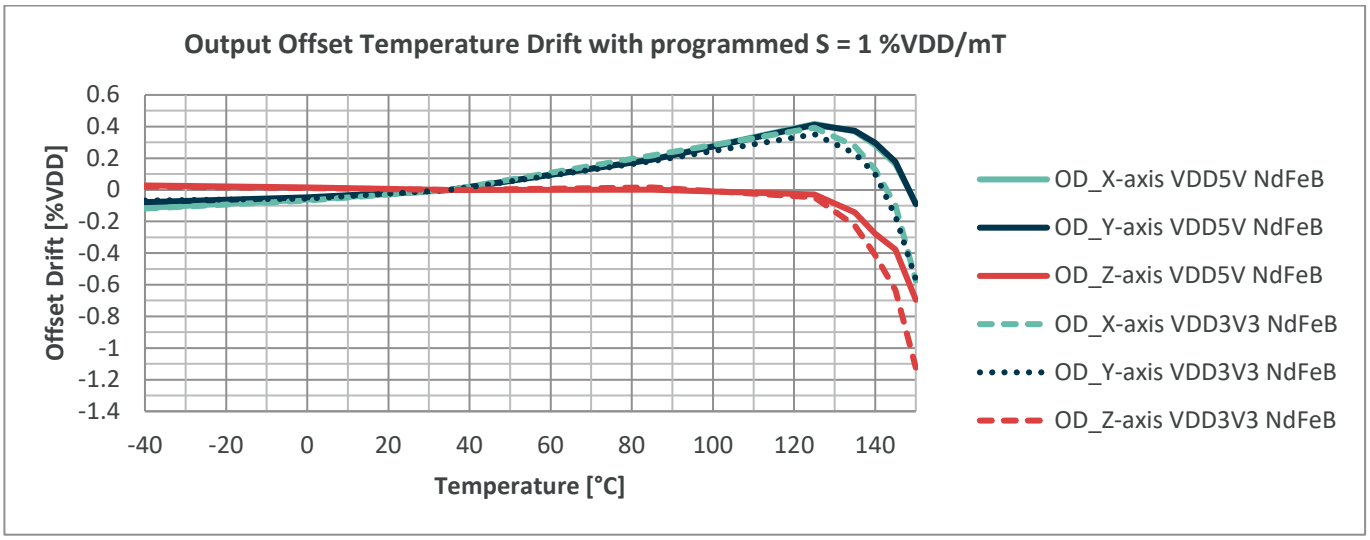
## 12.2. Output Offset Temperature Drift Characteristic

In the Magnetic Specifications, the Output Offset Temperature Drift of the MLX90380 is specified for B=0mT, VDD=VDDNOM, S=1 %VDD/mT -40°C ≤ T ≤ 150°C. The charts below list the Output Offset Temperature Drift characteristics for the full magnetic range.


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## 12.2.1. Output Offset Temperature Drift Characteristic



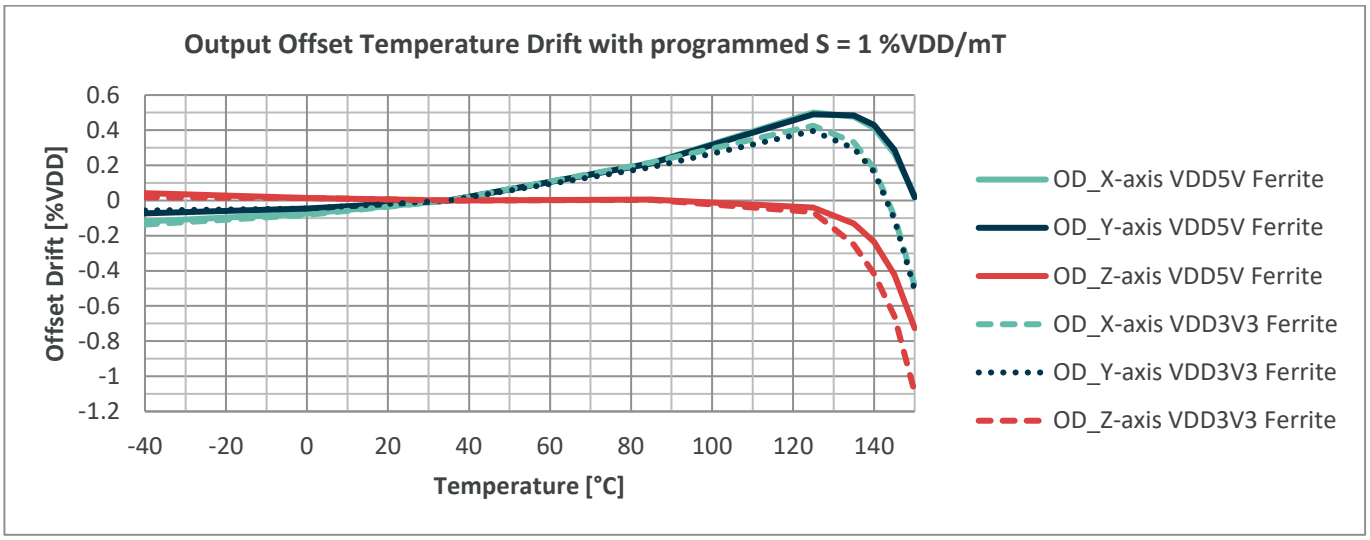
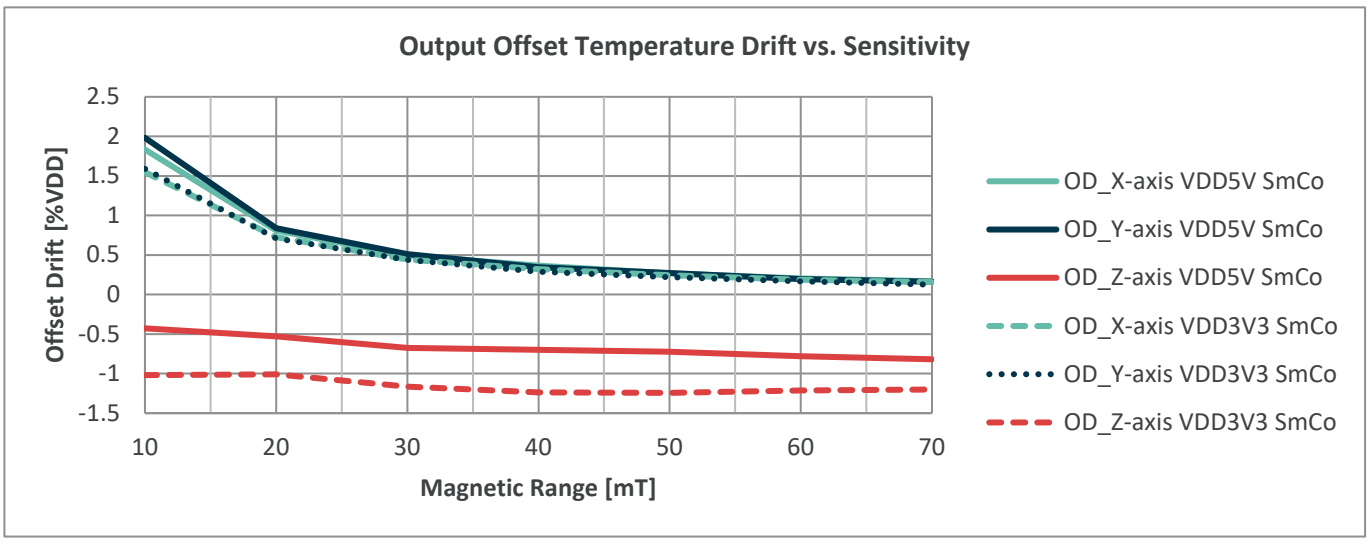
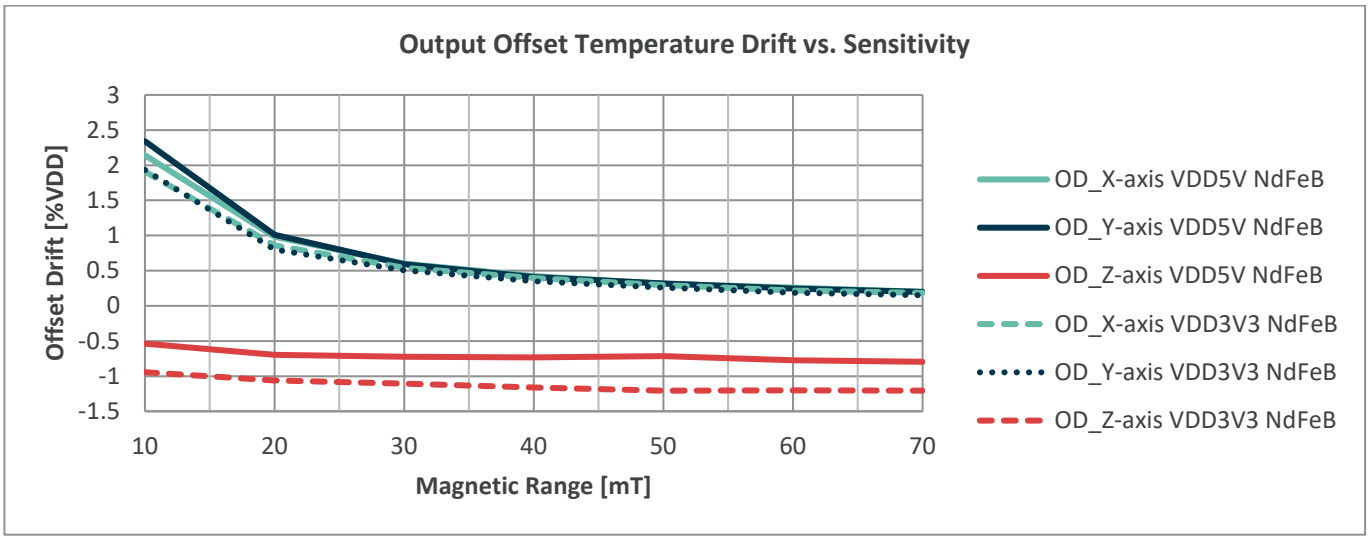




*Figure 10: Output Offset Temperature Drift per Magnet Type*


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## 12.2.2. Output Offset Temperature Drift Characteristic vs. Sensitivity



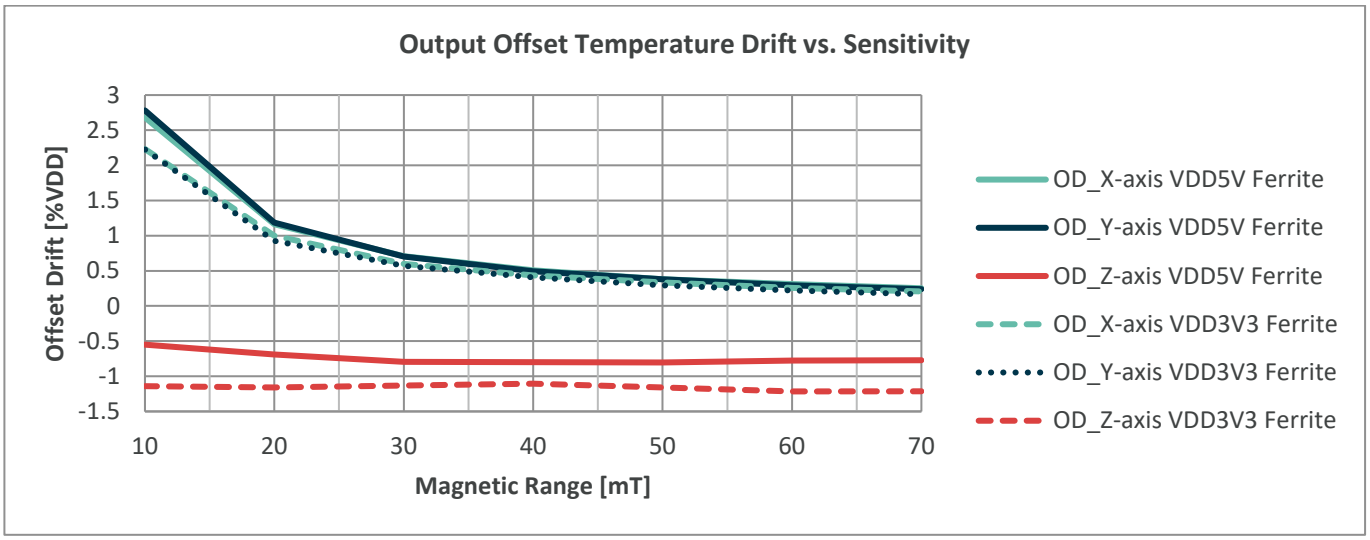




*Figure 11: Output Offset Temperature Drift vs Sensitive Range per Magnet Type*



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# 13. Recommended Application Diagrams

## 13.1. MLX90380 in SOIC-8 Package

### 13.1.1. Application Diagram VDD3V3

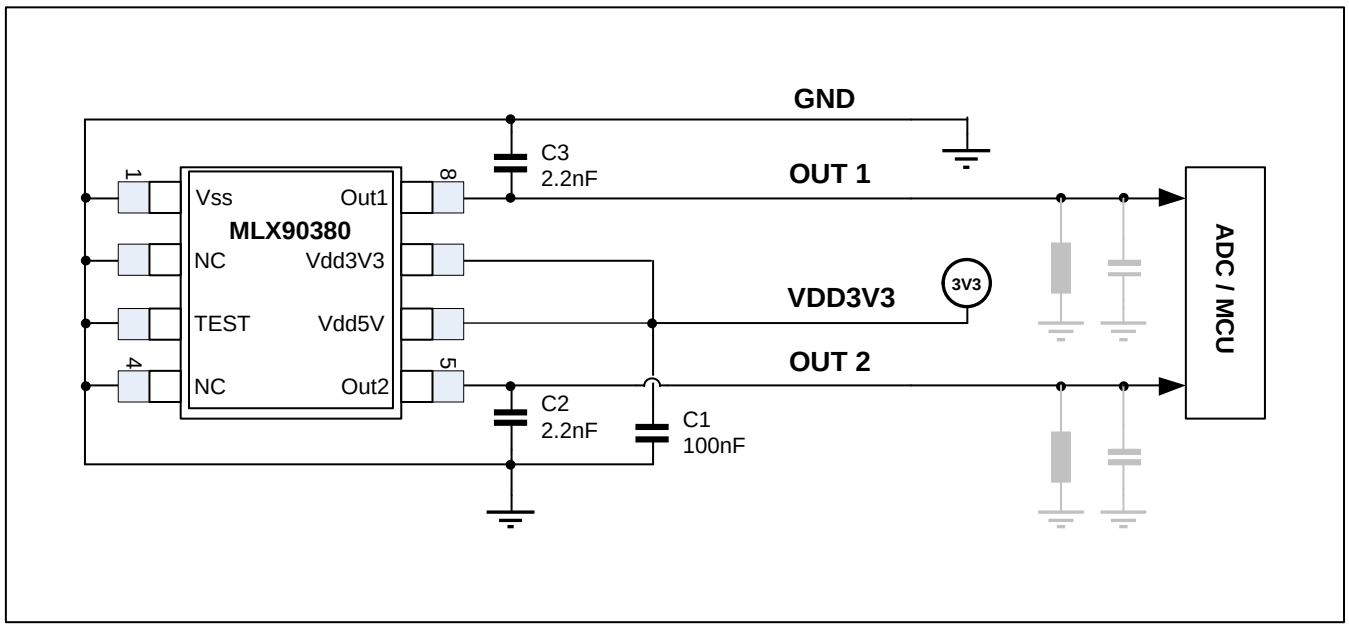



*Figure 12: Application Diagram VDD3V3*

### 13.1.2. Application Diagram VDD5V

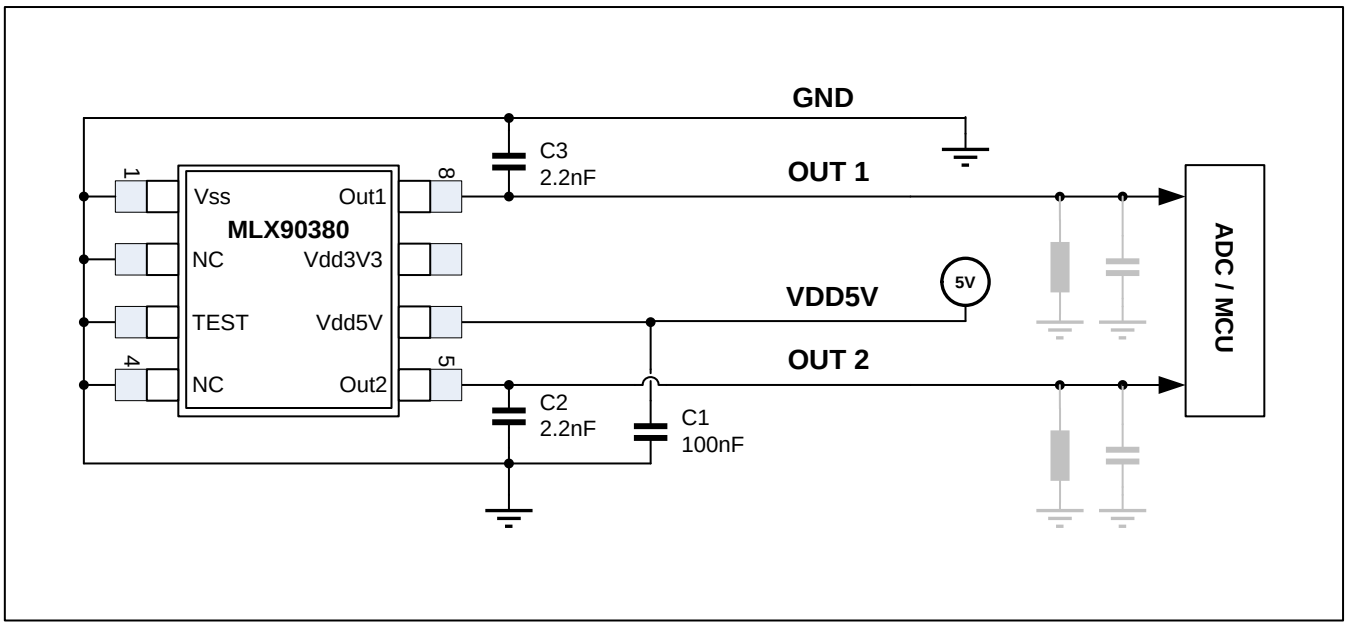



*Figure 13: Application Diagram VDD5V*



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## 13.2. MLX90380 in TSSOP-16 Package

### 13.2.1. Application Diagram VDD3V3

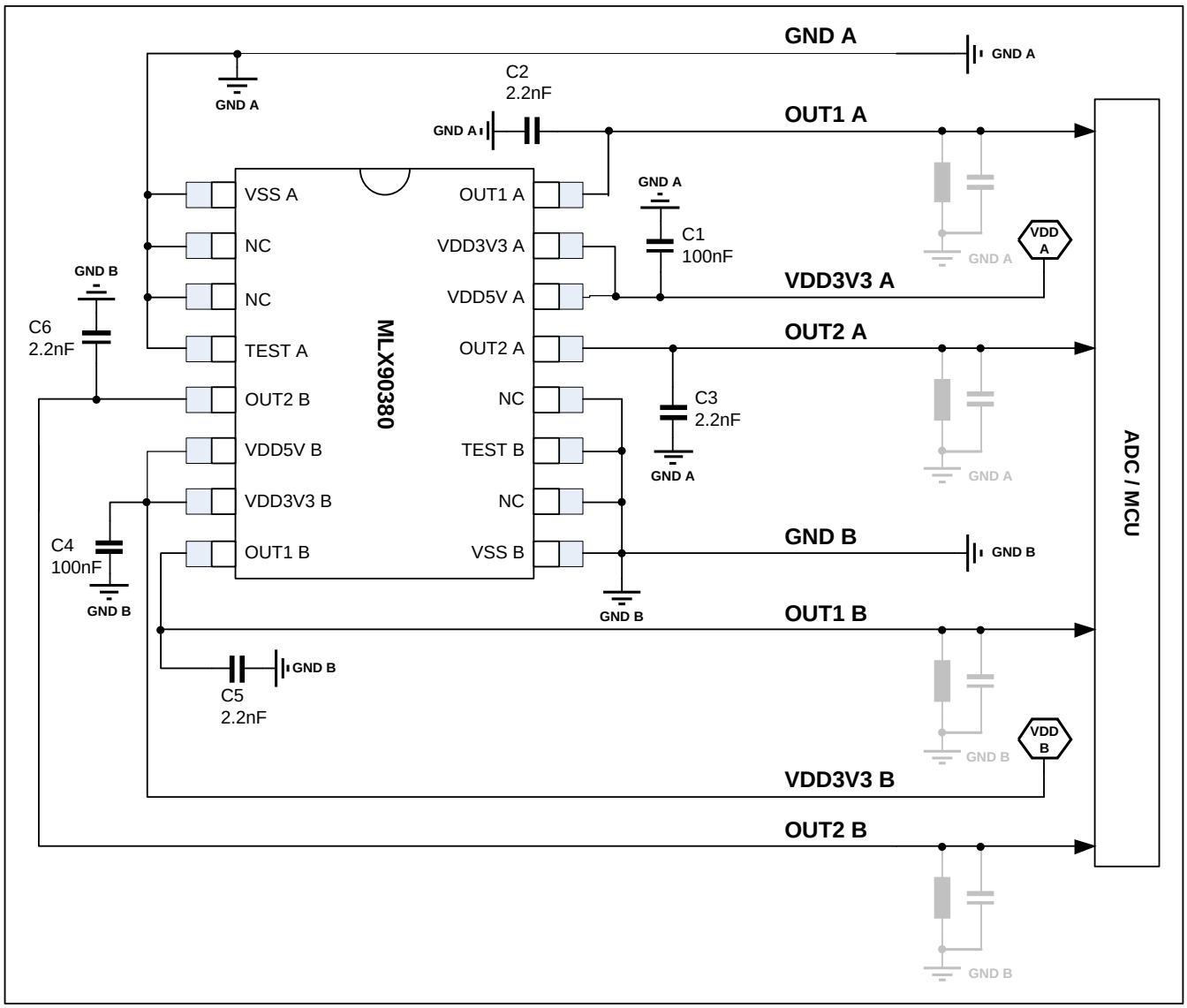



*Figure 14: Application Diagram VDD3V3*


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## 13.2.2. Application Diagram VDD5V

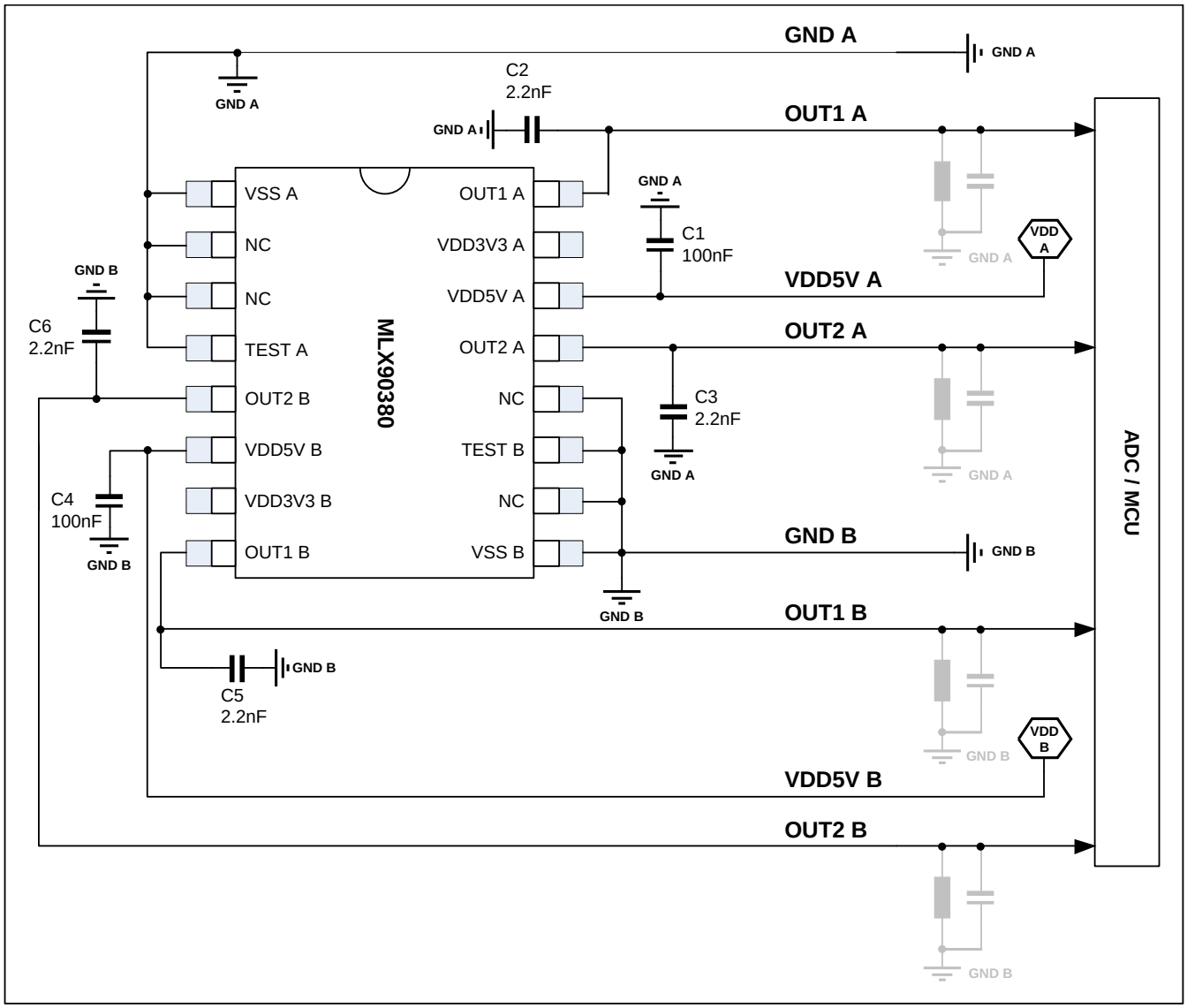



*Figure 15: Application Diagram VDD5V*



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# 14. Package Information

## 14.1. SOIC-8 Package Dimensions

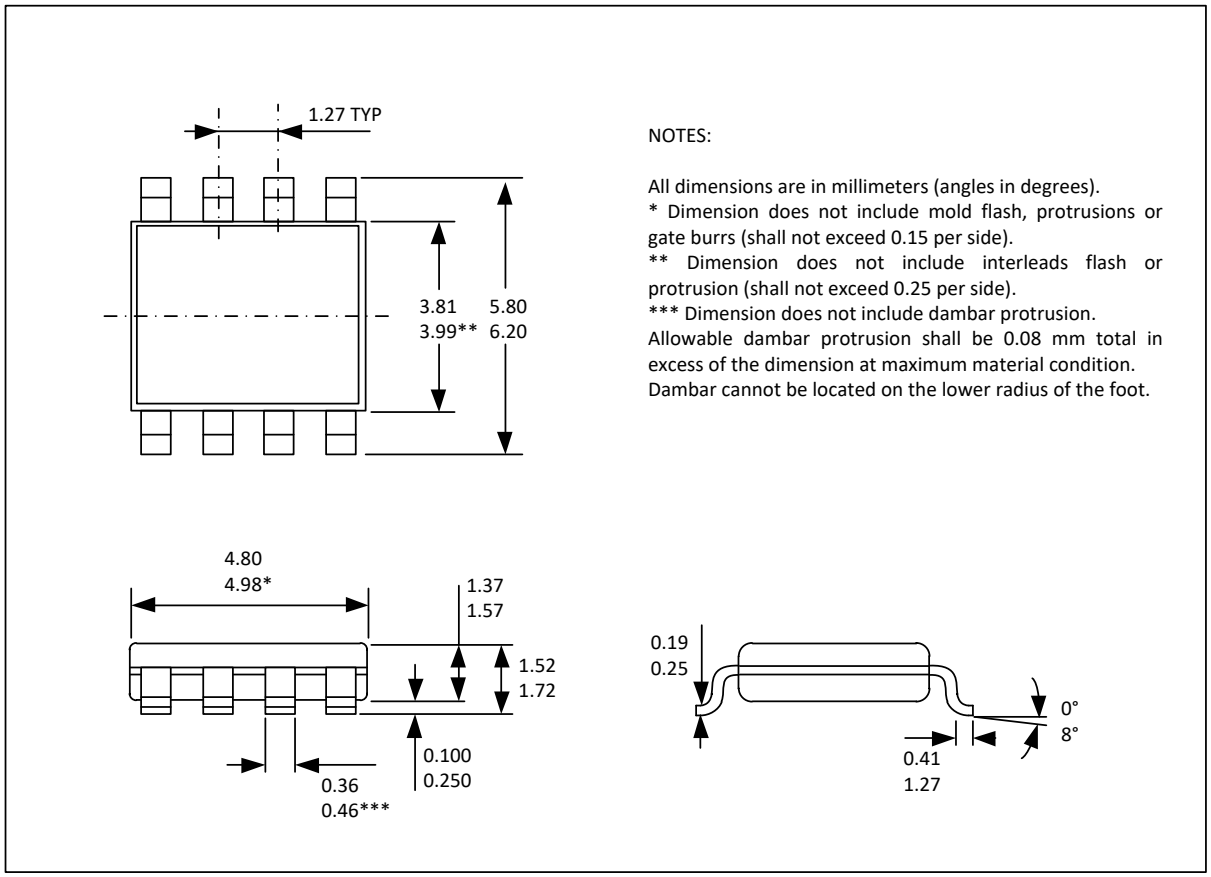



*Figure 16: SOIC-8 Package Dimensions*

## 14.2. SOIC-8 Pin out and Marking

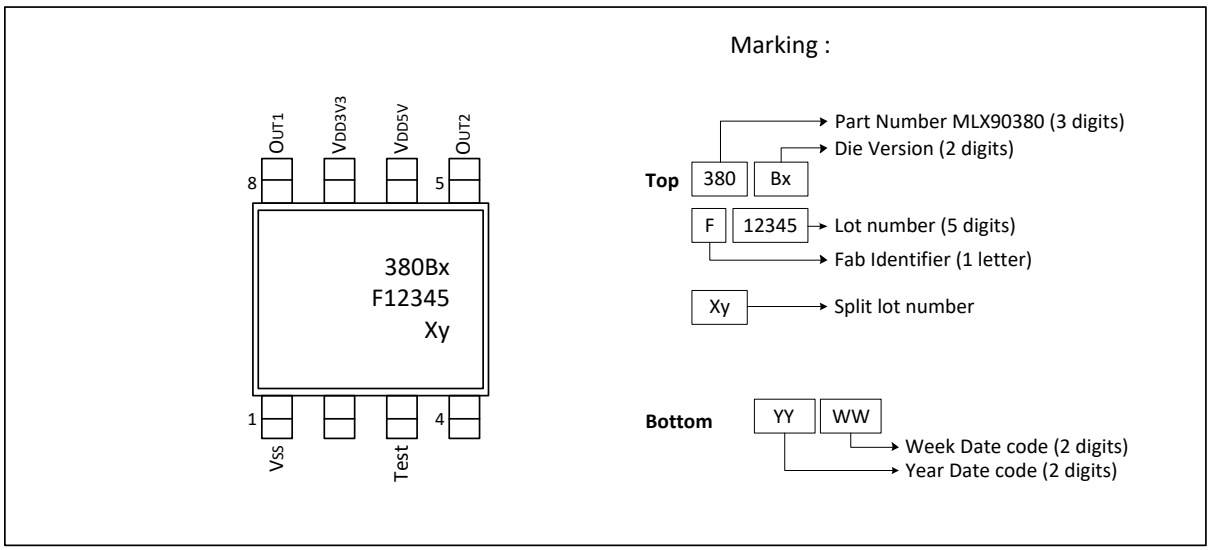



*Figure 17: SOIC-8 Pin out and Marking*


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## 14.3. SOIC-8 IMC Positioning

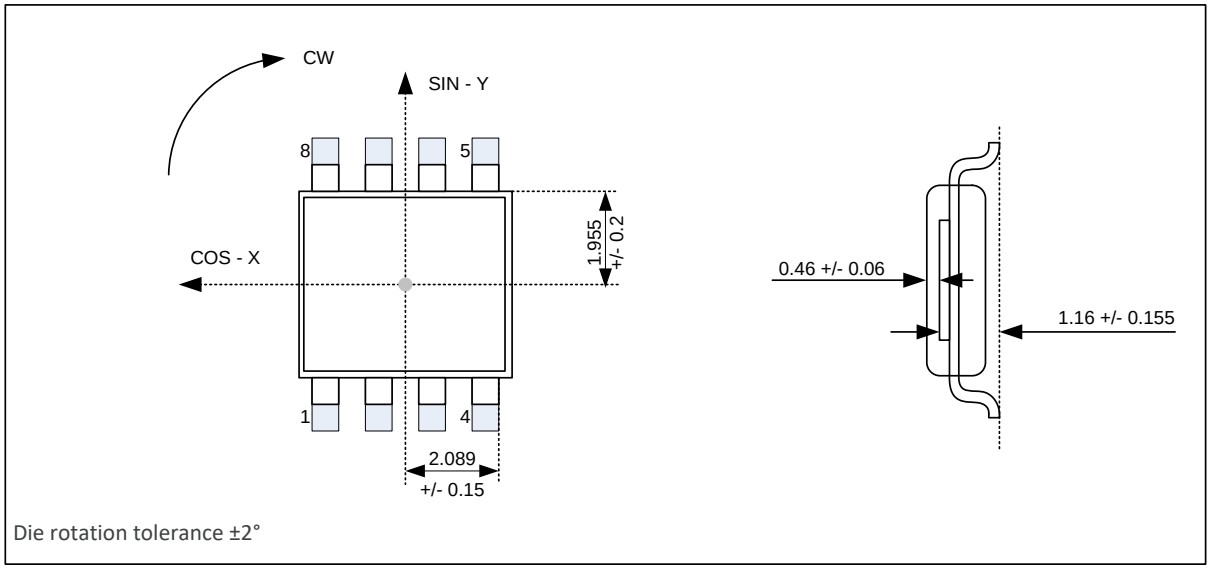



*Figure 18: SOIC-8 IMC positioning*

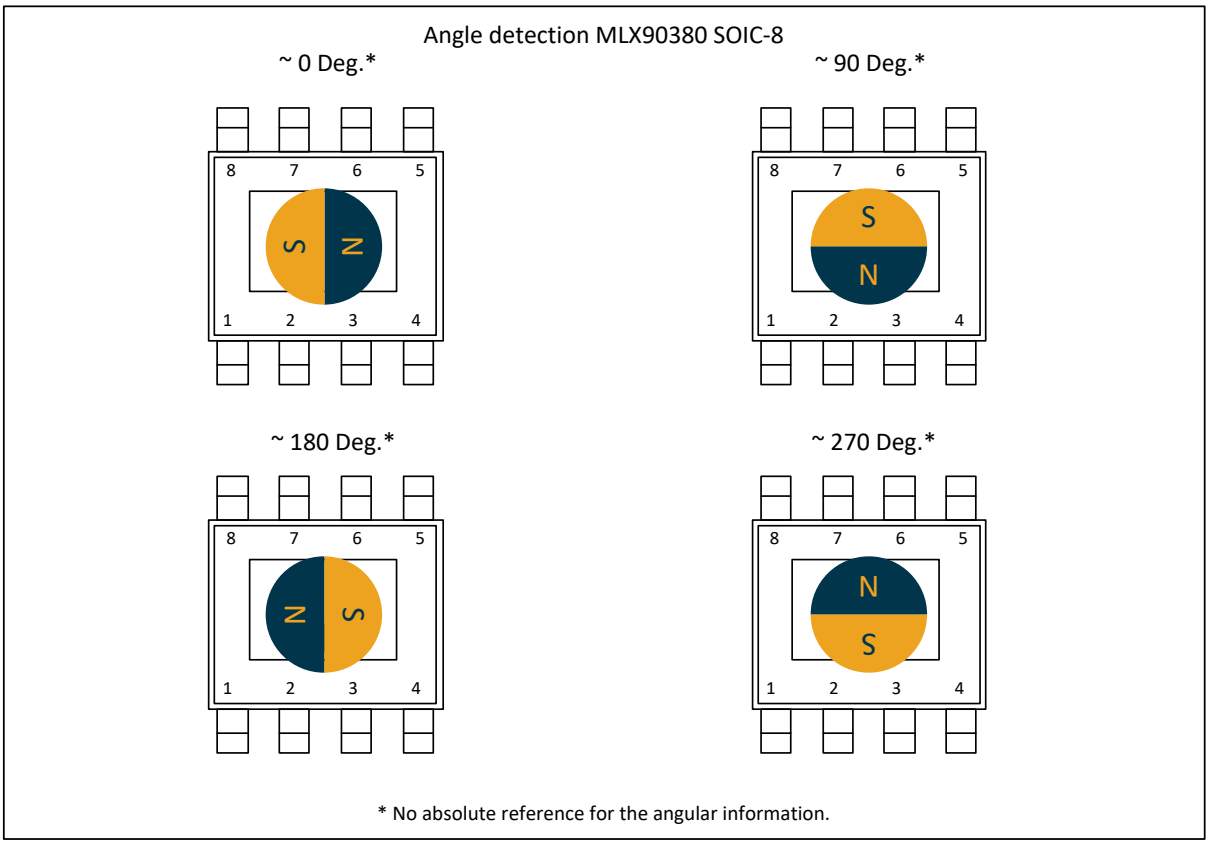
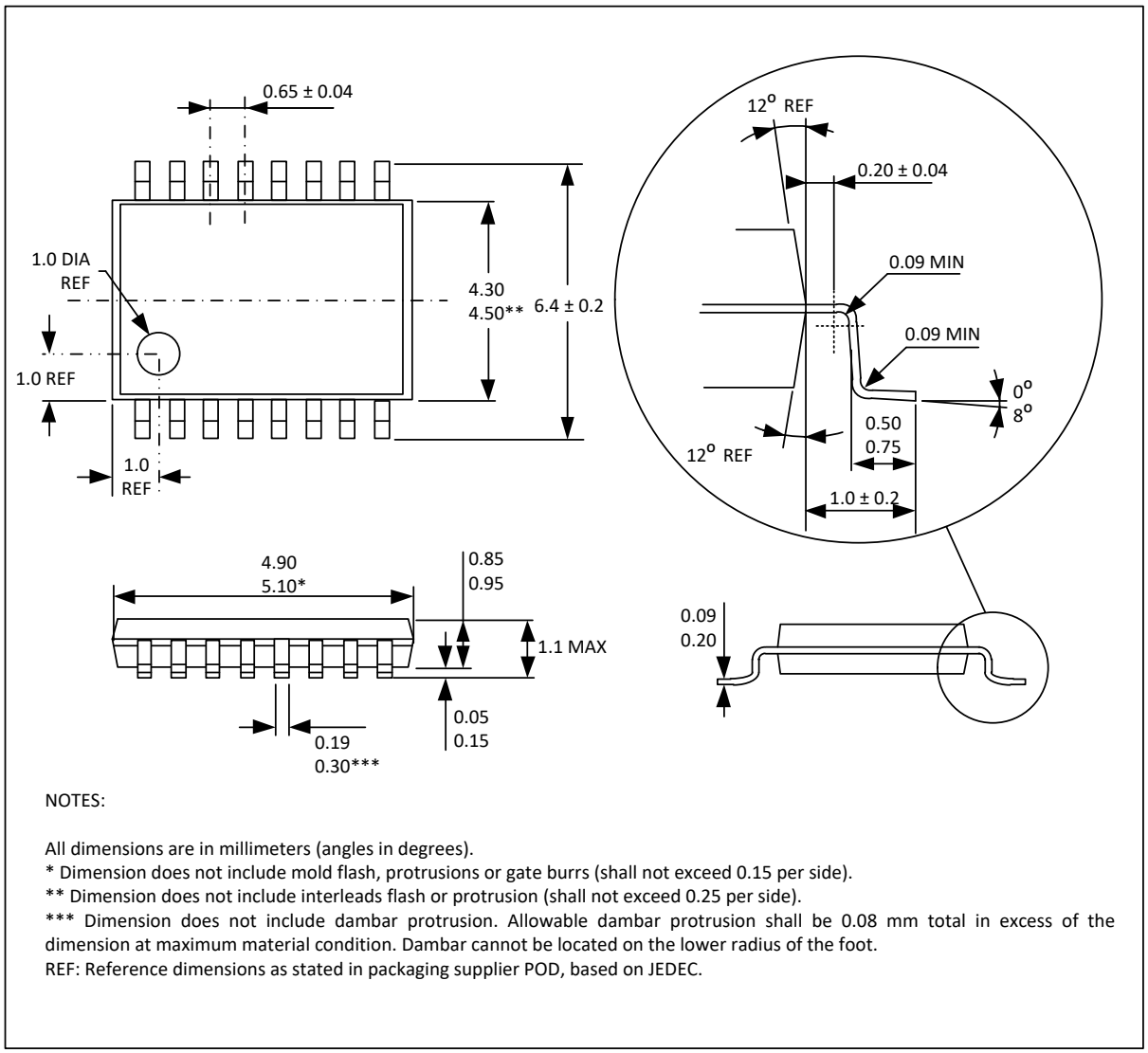



*Figure 19: Angular detection MLX90380 SOIC-8*



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## 14.4. TSSOP-16 Package Dimensions




NOTES:

All dimensions are in millimeters (angles 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.
REF: Reference dimensions as stated in packaging supplier POD, based on JEDEC.

*Figure 20: TSSOP-16 Package Dimensions*


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## 14.5. TSSOP-16 Pin out and Marking

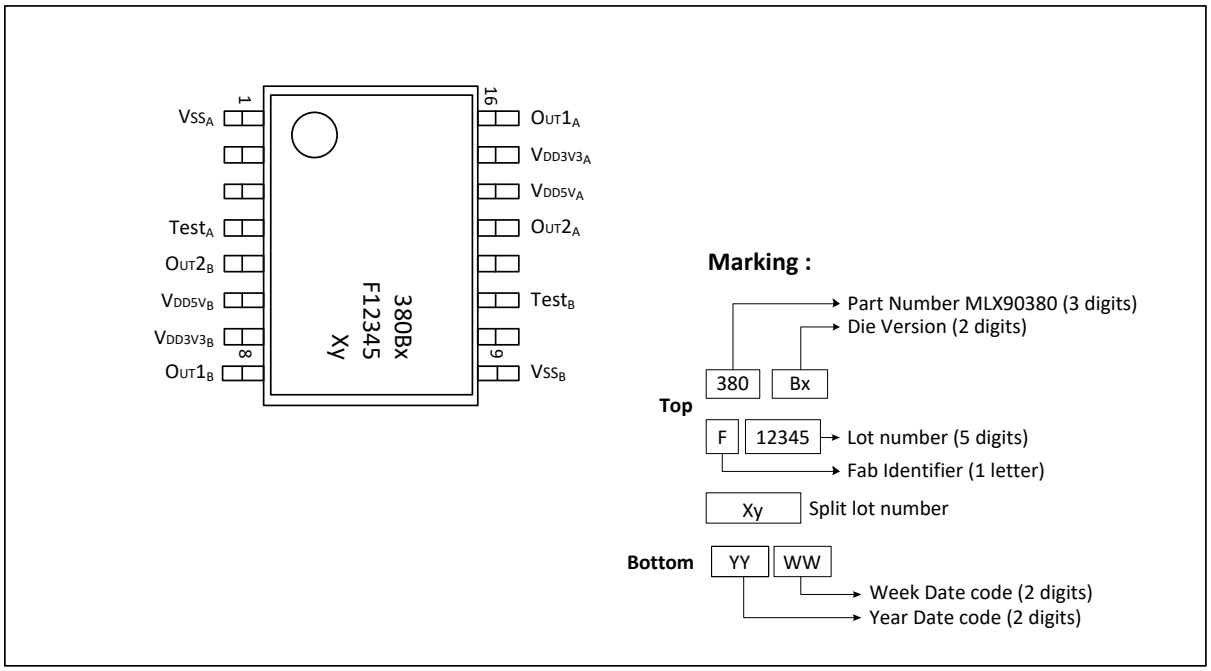



*Figure 21: TSSOP-16 Pin out and Marking*

## 14.6. TSSOP-16 IMC positioning

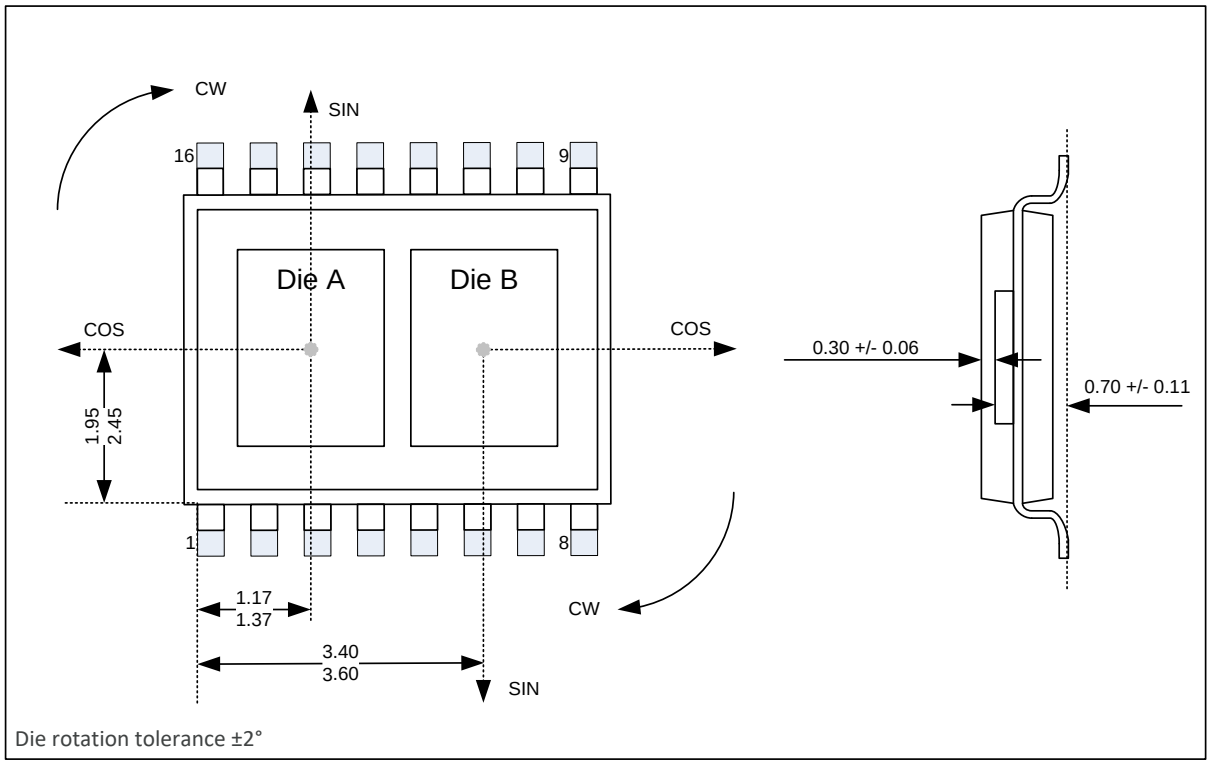



*Figure 22: TSSOP-16 IMC positioning*



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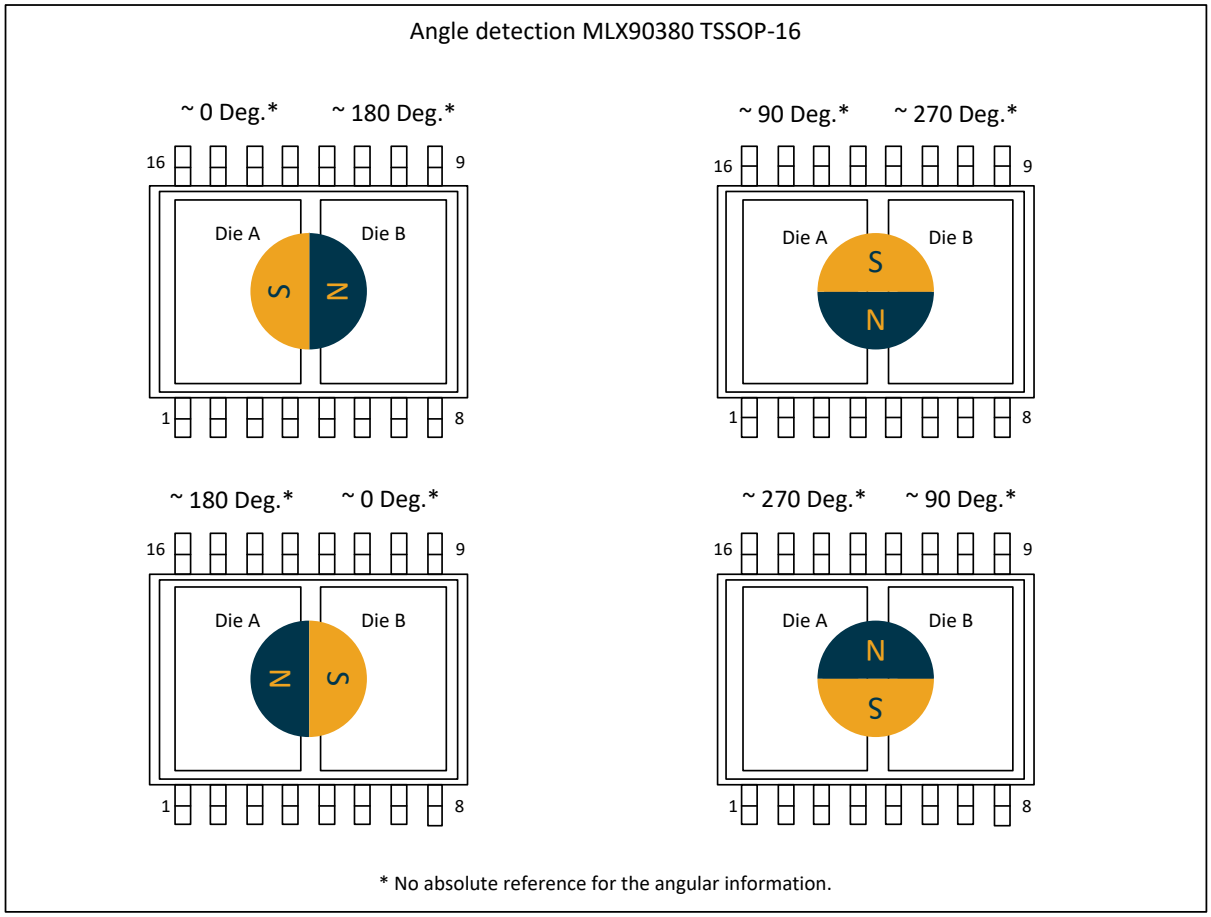



*Figure 23: Angular detection MLX90380 TSSOP-16*

As illustrated above the magnetic axis of die B in the package are shifted 180° towards the magnetic axis of die A. When a magnetic angle of ~0° is applied to die A, die B will report an angle of ~180°.


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For further details about test method references and for compliance verification of selected soldering method for product integration, Melexis recommends reviewing on our web site the General Guidelines soldering recommendation. For all soldering technologies deviating from the one mentioned in above document (regarding peak temperature, temperature gradient, temperature profile etc.), additional classification and qualification tests have to be agreed upon with Melexis.

For package technology embedding trim and form post-delivery capability, Melexis recommends consulting the dedicated trim&form recommendation application note: lead trimming and forming recommendations.

Melexis is contributing to global environmental conservation by promoting **lead free** solutions. For more information on qualifications of **RoHS** compliant products (RoHS = European directive on the Restriction Of the use of certain Hazardous Substances) please visit the quality page on our website: http://www.melexis.com/en/quality-environment.

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