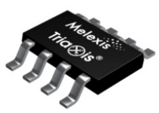
# MLX90340

Datasheet

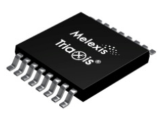
Melexis
INSPIRED ENGINEERING

## 1. Features and Benefits

- Triaxis® Hall Technology
- On Chip Signal Processing for Robust Absolute Position Sensing
- Programmable Measurement Range
- Programmable Linear Transfer Characteristic (Multi-points 4 or Piece-Wise-Linear 17)
- Selectable Analog (Ratiometric) or PWM Output
- 12 bit Resolution - 10 bit Thermal Accuracy
- 48 bit ID Number option
- Single Die – SOIC-8 Package RoHS Compliant
- Dual Die (Full Redundant) – TSSOP-16 Package RoHS Compliant



*SOIC-8*



*TSSOP-16*

## 2. Application Examples

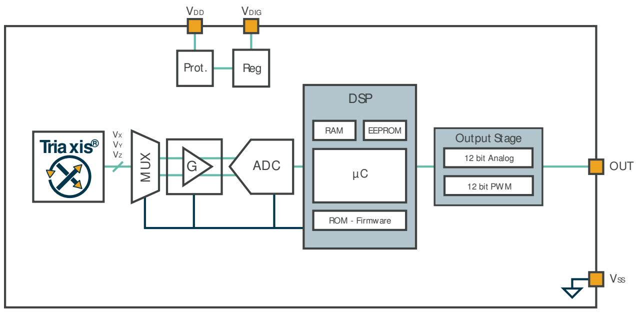
- Absolute Rotary Position Sensor
- Absolute Linear Position Sensor
- Non-Contacting Potentiometer

## 3. Description

The MLX90340 is a monolithic sensor IC sensitive to the flux density applied orthogonally and parallel to the IC surface.

The MLX90340 is sensitive to the three components of the flux density applied to the IC (i.e. Bx, By and Bz). This allows the MLX90340 with the correct magnetic circuit to decode the absolute position of any moving magnet (e.g. rotary position from 0 to 360 Degrees or linear displacement, stroke - Figure 2). It enables the design of novel generation of non-contacting position sensors that are frequently required for both heavy-duty and industrial applications.

The MLX90340 reports a programmable ratiometric analog output signal compatible with a programmable linear Hall sensor. Through programming, the MLX90340 provides also a digital PWM (Pulse Width Modulation) output characteristic.



# Contents

# 4. Ordering Information

| Product | Temp. code | Package code | Option Code | Packing Form | Definition |
|---|---|---|---|---|---|
| MLX90340 | L | GO | AAA-000 | RE | Standard version – Heavy-duty |
| MLX90340 | L | DC | AAA-000 | RE | Standard version – Heavy-duty |
| MLX90340 | E | GO | AAA-000 | RE | Standard version – Industrial |
| MLX90340 | E | DC | AAA-000 | RE | Standard version - Industrial |
| MLX90340 | E | DC | AAA-100 | RE | 90deg Pre-programmed analog - Industrial |
| MLX90340 | E | DC | AAA-200 | RE | 360deg Pre-programmed analog - Industrial |
| MLX90340 | E | DC | AAA-300 | RE | 180deg Pre-programmed analog - Industrial |
| MLX90340 | E | DC | AAA-400 | RE | 270deg Pre-programmed analog - Industrial |
| MLX90340 | S | DC | AAA-000 | RE | Standard version - Consumer |
| MLX90340 | S | DC | AAA-100 | RE | 90deg Pre-programmed analog - Consumer |
| MLX90340 | S | DC | AAA-200 | RE | 360deg Pre-programmed analog - Consumer |
| MLX90340 | S | DC | AAA-300 | RE | 180deg Pre-programmed analog - Consumer |
| MLX90340 | S | DC | AAA-400 | RE | 270deg Pre-programmed analog - Consumer |

## Legend:

| | |
|---|---|
| Temperature Code: | L: from -40°C to 150°C<br>E: from -40°C to 85°C<br>S: from -20°C to 85°C |
| Package Code: | "DC" for SOIC-8 package<br>"GO" for TSSOP-16 package (dual die) |
| Option Code: | AAA-xxx: die Version<br>xxx-**123**<br>**1**: Application<br>▪ 0: Standard version<br>▪ 1: Pre-programmed version in Analog output mode – Transfer function of 80%Vdd /90deg<br>▪ 2: Pre-programmed version in Analog output mode – Transfer function of 80%Vdd /360deg<br>▪ 3: Pre-programmed version in Analog output mode – Transfer function of 80%Vdd /180deg<br>▪ 4: Pre-programmed version in Analog output mode – Transfer function of 80%Vdd /270deg<br>**2**: N/A<br>**3**: N/A |
| Packing Form: | RE "for Reel", TU "for Tube", |
| Ordering Example: | "MLX90340EDC-AAA-000-RE"<br>For a Standard version from -40 to 85degC in SOIC-8 package, delivered in Reel. |

*Table 1: Ordering information Legend*

## 5. Functional Diagram

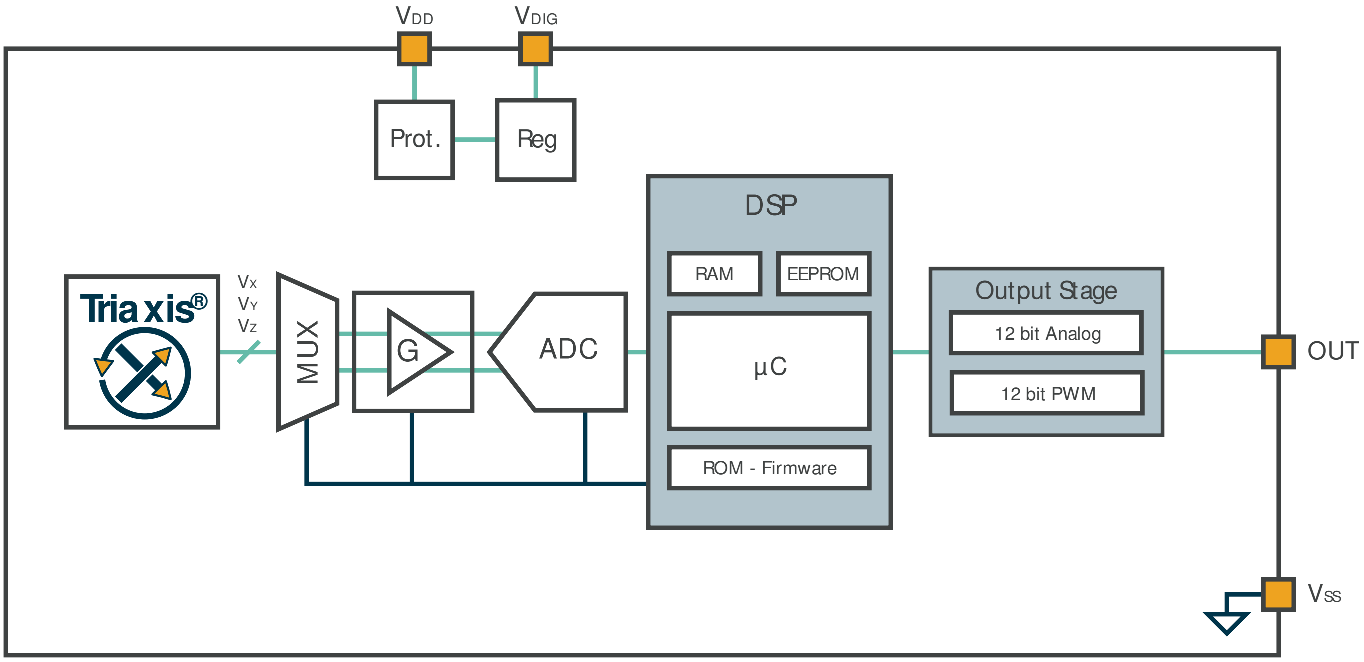



*Figure 1: Block diagram*

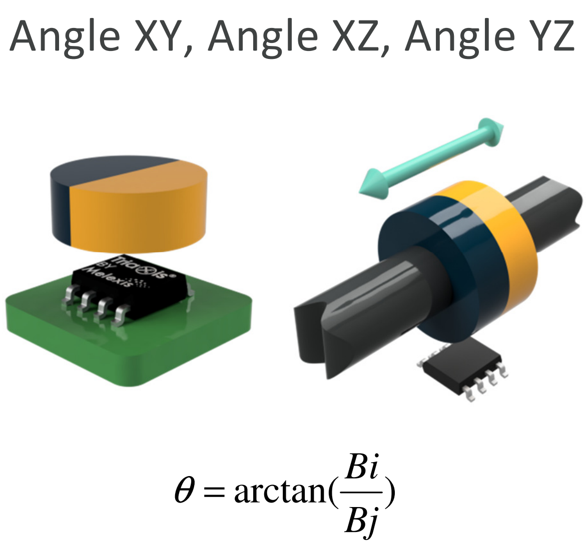



*Figure 2: Application examples*

# 6. Glossary of Terms

| **Gauss (G), Tesla (T)** | **Units for the magnetic flux density – 1 mT = 10 G** |
|---|---|
| **TC** | Temperature Coefficient (in ppm/Deg.C.) |
| **NC** | Not Connected |
| **PWM** | Pulse Width Modulation |
| **%DC** | Duty Cycle of the output signal i.e. TON /(TON + TOFF) |
| **ADC** | Analog-to-Digital Converter |
| **DAC** | Digital-to-Analog Converter |
| **LSB** | Least Significant Bit |
| **MSB** | Most Significant Bit |
| **DNL** | Differential Non-Linearity |
| **INL** | Integral Non-Linearity |
| **RISC** | Reduced Instruction Set Computer |
| **ASP** | Analog Signal Processing |
| **DSP** | Digital Signal Processing |
| **CoRDiC** | Coordinate Rotation Digital Computer (i.e. iterative rectangular-to-polar transform) |
| **EMC** | Electro-Magnetic Compatibility |
| **DLS** | Digital Low Speed |
| **DHS** | Digital High Speed |

*Table 2: Glossary*

# 7. Pin Definitions and Descriptions

## 7.1. Pin Definition for SOIC-8

| Pin # | Name | Description |
|---|---|---|
| 1 | $V_{DD}$ | Supply |
| 2 | Test Input | For test |
| 3 | Test | For test |
| 4 | Not Used | |
| 5 | OUT | Output |
| 6 | Test1 | Test pin |
| 7 | $V_{DIG}$ | 3.3V Regulator pin |
| 8 | Vss | Ground pin |

*Table 3: SOIC-8 Pinout*

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

## 7.2. Pin Definition for TSSOP-16

| Pin # | Name | Description |
|---|---|---|
| 1 | VDIG1 | 3.3V Regulator pin |
| 2 | VSS_1 | Ground Die 1 |
| 3 | VDD_1 | Supply Die1 |
| 4 | Test0_1 | For test |
| 5 | Test2_2 | For test |
| 6 | OUT2 | Output Die 2 |
| 7 | Not Used2 | |
| 8 | Test1_2 | For test |
| 9 | VDIG2 | 3.3V Regulator pin |
| 10 | VSS_2 | Ground Die 2 |
| 11 | VDD_2 | Supply Die 2 |
| 12 | Test0_2 | For test |
| 13 | Test2_1 | For test |
| 14 | Not Used1 | |
| 15 | OUT1 | Output |
| 16 | Test1_1 | For test |

*Table 4: TSSOP-16 Pinout*

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

# 8. Absolute Maximum Ratings

| Parameter | Symbol | Min. | Typ. | Max. | Unit | Condition |
|---|---|---|---|---|---|---|
| Supply Voltage | VDD | | | 24 | V | |
| Reverse Voltage Protection | VDD-REV | | | -12 | V | Independent of time, Breakdown at -14V |
| Positive Output Voltage | VOUT | | | 18 | V | Independent of time, Breakdown at 24V |
| Reverse Output Voltage | | | | -0.3 | V | |
| Operating Temperature | TAMB | -40 | | +150 | °C | |
| Junction Temperature | TJUNC | | | 160 | °C | |
| Storage Temperature | TST | -40 | | +150 | °C | |
| Magnetic Flux Density | | -1 | | 1 | T | |

*Table 5 – Maximum ratings*

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

# 9. Detailed General Description

As described on the block diagram the three vector components of the magnetic flux density (BX, BY and BZ) applied to the IC are sensed through the sensor front-end. The respective Hall signals (VX, VY and VZ) are generated at the Hall plates and amplified.

The analog signal processing is based on a fully differential analog chain featuring the classic offset cancellation technique (Hall plate 2-Phases spinning and chopper-stabilized amplifier).

The conditioned analog signals are converted through an ADC (15 bits) and provided to a DSP block for further processing. The DSP stage is based on a 16 bit RISC micro-controller whose primary function is the extraction of the position from two (out of three) raw signals (after so-called front-end compensation steps) through the following function:

$$\alpha = \angle\left(V_1, k \times V_2\right)$$

*Figure 3: Angular calculation formula*

where alpha is the magnetic angle <(B1, B2), V1 = Vx or Vy or Vz , V2 = Vx or Vy or Vz

The DSP functionality is governed by the micro-code (firmware – F/W) of the micro-controller which is stored into the ROM (mask programmable). In addition to the magnetic angle extraction, the F/W controls the whole analog chain, the output transfer characteristic, the output protocol, the programming/calibration and also the self-diagnostic modes.

The magnetic angular information is intrinsically self-compensated vs. flux density variations. This feature allows therefore an improved thermal accuracy vs position sensor based on conventional linear Hall sensors.

In addition to the improved thermal accuracy, the realized position sensor features excellent linearity performances taking into account typical manufacturing tolerances (e.g. relative placement between the Hall IC and the magnet).

Once the position (angular or linear stroke) information is computed, it is further conditioned (mapped) vs. the target transfer characteristic and it is provided at the output(s) as either a ratiometric analog output level through a 12 bit DAC followed by a buffer or a digital PWM output.

For instance, the analog output can be programmed for offset, gain and clamping to meet any rotary position sensor output transfer characteristic:

$$Vout(\alpha) = ClampLo \text{ for } \alpha \le \alpha min$$
$$Vout(\alpha) = Voffset + Gain \times \alpha \quad \text{for } \alpha min \le \alpha \le \alpha max$$
$$Vout(\alpha) = ClampHi \text{ for } \alpha \ge \alpha max$$

where Voffset, Gain, ClampLo and ClampHi are the main adjustable parameters for the end-user. The linear part of the transfer curve can be adjusted through a multi-point calibration: This back-end step consists into either up to 4 arbitrary points (5 segments + clamping levels) calibration or a Piece-Wise-Linear (PWL) output transfer characteristics - 17 equidistant points w/ programmable origin over 16 different angle ranges from 65 to 360 degrees.

The calibration parameters are stored in NVRAM featuring a Hamming Error Correction Coding (ECC).

The programming steps do not require any dedicated pins. The operation is done using the supply and output nodes of the IC. The programming of the ML90340 is handled at both engineering lab and production line levels by the Melexis Programming Unit PTC-04 with the dedicated DB90316 and software tools (DLL – User Interface).

# 10. General Electrical Specifications

DC Operating Parameters at $V_{DD}$ = 5V (unless otherwise specified) and for $T_A$ as specified by the Temperature suffix (S or E or L).

| Electrical Parameter | Symbol | Min. | Typ. | Max. | Unit | Condition |
|---|---|---|---|---|---|---|
| Supply Voltage | $V_{DD}$ | 4.5 | 5 | 5.5 | V | |
| Supply Current | | | 13.5 | 15 | mA | no resistive load at OUT PIN (OUT1 and OUT2 for TSSOP-16 package) |

| Electrical Parameter | Symbol | Min. | Typ. | Max. | Unit | Condition |
|---|---|---|---|---|---|---|
| Power-On reset ( rising ) | POR LH | 2.4 | 2.7 | 3 | V | Refer to internal voltage Vdig |
| Power-On reset Hysteresis | | | 400 | | mV | |
| ASP Start Rising Level | LT4VLH | 3.5 | | 4.1 | V | |
| ASP Start Hysteresis | LT4V Hyst | 0.1 | | 0.5 | V | |
| PTC Entry Rising Level | MT7V LH | 6.6 | | 7.2 | V | |
| PTC Entry Hysteresis | MT7V Hyst | 0.1 | | 0.4 | V | |
| Switch Off Rising Level | LT11V LH | 8.6 | | 14 | V | |
| Switch Off Hysteresis | LT11V Hyst | 0.1 | | 1 | V | |
| Output Load | RL | 1 | 10 | ∞ | kΩ | See Analog saturation |
| Output short circuit current | Ishort | | | 15 | mA | Vout to GND |
| | | | | 15 | mA | Vout to 5V |
| | | | | 18 | mA | Vout to 14V (Ta=25degC) |
| Analog Saturation Output level / Active Diagnostic output level | Vsat_lo / | | 0.5 | 2 | %Vdd | PU load RL ≥ 10 kΩ to 5 V |
| | Diag_lo | | 2 | 3 | %Vdd | PU load RL ≥ 1 kΩ to 5V |
| | Vsat_hi / | 94 | 96 | | %Vdd | PD load RL ≥ 5 kΩ |
| | Diag_hi | 96 | 98 | | %Vdd | PD load RL ≥ 10 kΩ |
| | | 97 | 97.5 | | %Vdd | PD load RL = 5 kΩ |
| Passive Diagnostic Output Level (Broken Vss /VDD) | BVSSPD | 0 | | 4 | %Vdd | Pull-down load $R_L$ ≤ 10 kΩ |
| | | 0 | | 10 | %Vdd | Pull-down load $R_L$ ≤ 25 kΩ |
| | BVSSPU | 99 | | 100 | %Vdd | Pull-up load $R_L$ ≥ 1kΩ |
| | BVDDPD | | 0 | 1 | %Vdd | Pull-down load $R_L$ ≥ 1kΩ |
| | BVDDPU | 96 | | 100 | %Vdd | Pull-down load $R_L$ ≤ 10 kΩ |
| Rdson | Rdson_lo | 15 | | 30 | | Rdson Low side |
| | Rdson_hi | 120 | | 300 | | Rdson High side |
| Clamping Output Level | Clamp_lo | 0 | | 100 | %Vdd | to be higher than Vsat_lo |
| | Clamp_hi | 0 | | 100 | %Vdd | to be lower than Vsat_hi |

*Table 6: MLX90340 Electrical specifications*

As an illustration of the previous table, the MLX90340 fits the typical classification of the output span described on Figure 4.

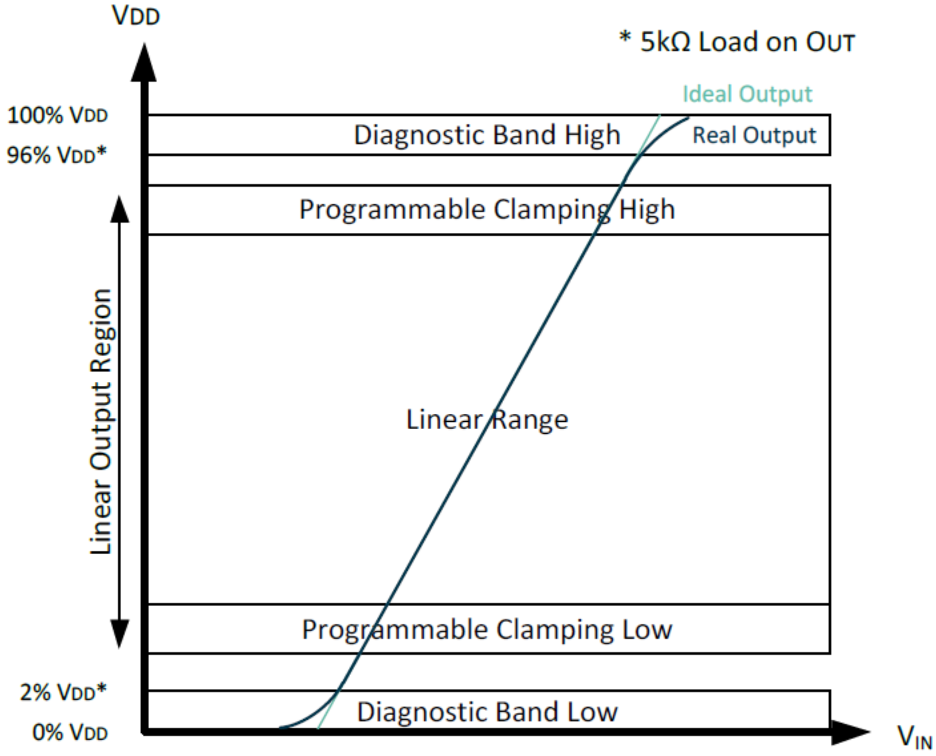



*Figure 4: Example of Output Span Classification for typical application.*

## 11. Isolation Specification

DC Operating Parameters at VDD = 5V (unless otherwise specified) and for $T_A$ as specified by the Temperature suffix (S or E or L). Only valid for the package code GO, i.e. dual die version.

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

*Table 7: Isolation*

# 12. Timing Specification

DC Operating Parameters at VDD = 5V (unless otherwise specified) and for $T_A$ as specified by the Temperature suffix (S or E or L).

| Parameter | Symbol | Min. | Typ. | Max. | Unit | Condition |
|---|---|---|---|---|---|---|
| Main Clock Frequency | Ck | 9.5 | 10 | 10.5 | MHz | |
| Main Clock Frequency Thermal Drift | | -10 | - | 10 | %Ck | Lifetime included |
| Refresh Rate | | | 400 | 440 | µs | |
| Latency | | | 400 | | µs | |
| Step Response Time | | | 800 | 1320 | µs | Filter=0 (FIR1) |
| | | | 1200 | 1760 | µs | Filter=1 (FIR11) |
| | | | 1600 | 2200 | µs | Filter=2 (FIR1111) |
| Watchdog | | | 4.58 | | ms | See Section 18 |
| Start-up Time | | | 7.5 | 10 | ms | excluding slew rate |
| Analog OUT Slew-rate | | | 37 | | V/ms | Mode1 |
| | | | 320 | | V/ms | Mode2 |

*Table 8: Timings specification*

## 12.1. 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 5.

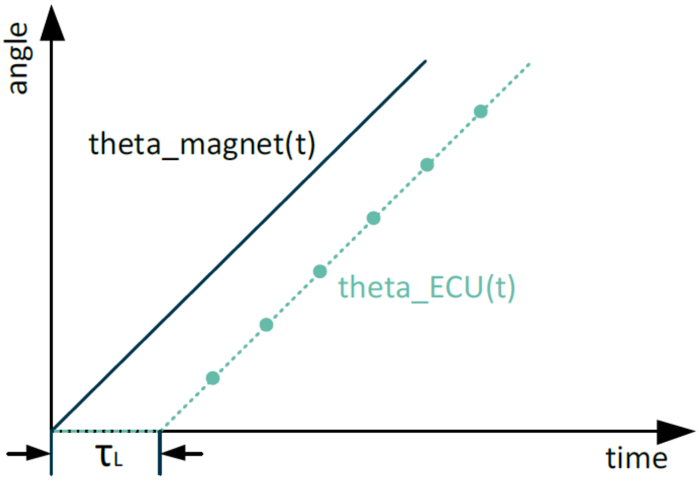



*Figure 5: Latency time defintion*

## 12.2. 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 Table 8.

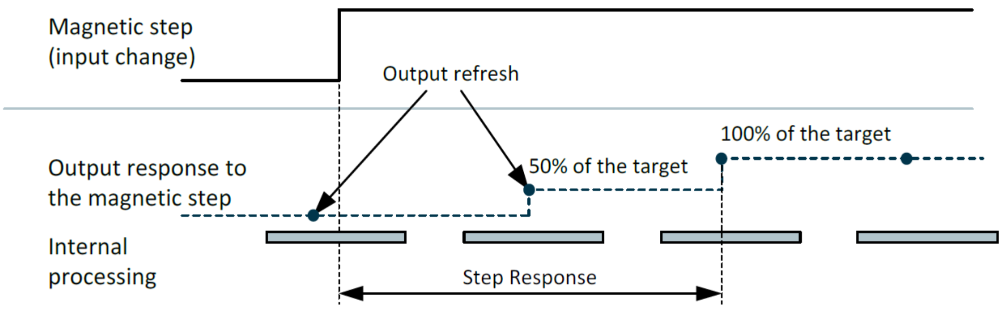



*Figure 6: Step Response time definition*

## 13. Accuracy

DC Operating Parameters at VDD = 5V (unless otherwise specified) and for TA as specified by the Temperature suffix (S or E or L).

| Parameter | Symbol | Min. | Typ. | Max. | Unit | Condition |
|---|---|---|---|---|---|---|
| XY – Intrinsic Linearity Error[1] | Le | -1 | | 1 | Deg. | TA=25degC |
| XZ (YZ) - Intrinsic Lin. Error[1] | Le | -20 | +/-2.5 | 20 | Deg. | TA=25degC |
| Analog Output Resolution | Rdac | <br>-4<br>0.05 | 0.025<br><br>1 | <br>4<br>3 | %Vdd/Lsb12<br>LSB12<br>LSB12 | |
| Output stage Noise | | | 0.05 | 0.075 | %Vdd | Output in clamping |
| ADC Resolution on the raw signals sine and cosine[2] | Radc | | 15 | | Bits | |
| Thermal Offset Drift #1 at the DSP input (excl. DAC and output stage) | Tofs1 | -0.35<br>-0.4<br>-0.55 | -<br>-<br>- | 0.35<br>0.4<br>0.55 | Deg.<br>Deg.<br>Deg. | Temperature Suffix S<br>Temperature Suffix E<br>Temperature Suffix L |
| Thermal Offset Drift #2 ( Output Stage Drift) | Tofs2 | -0.25 | | 0.25 | %Vdd | |
| Thermal Sensitivity Mismatch Drift | Tsmm | -0.1<br>-0.15<br>-0.2<br>-0.3<br>-0.4 | | 0.1<br>0.15<br>0.2<br>0.3<br>0.4 | Deg.<br>Deg.<br>Deg.<br>Deg.<br>Deg. | XY axis, Temp Suffix S<br>XY axis, Temp Suffix E<br>XY axis, Temp Suffix L<br>XZ axis, Temp Suffix S, E<br>XZ Axis, Temp Suffix L |
| Magnetic Angle phase error | | -0.3<br>-10 | | 0.3<br>10 | Deg.<br>Deg. | $T_A$ = 25°C – XY axis<br>$T_A$ = 25°C – XZ (YZ) axis |

[1] *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. The intrinsic Linearity Error for Magnetic angle XZ and YZ can be reduced through the programming of the k factor.*
[2] *16 bits corresponds to 15 bits + sign. Internal computation is performed using 16 bits.*

| Parameter | Symbol | Min. | Typ. | Max. | Unit | Condition |
|---|---|---|---|---|---|---|
| Ratiometry Error (Analog output only) | | -0.1<br>-1 | | 0.1<br>1 | %Vdd<br>%Vdd | 4.5V ≤ VDD ≤ 5.5V<br>LT4V ≤ VDD ≤ MT7V |
| Noise | | -0.125 | +/- 0.075 | 0.125 | Deg. | +/-3σ, No Filtering |

*Table 9: Accuracy specifications*

## 14. Magnetic Specification

| Parameter | Symbol | Min. | Typ. | Max. | Unit | Condition |
|---|---|---|---|---|---|---|
| Magnetic Flux Density | Bx, By<br>Bz | | | 70[(3)]<br>130 | mT<br>mT | $\sqrt{[B_X^2 + B_Y^2]}$ |
| Magnetic Field Norm | Norm | 20[(4)] | 40 | | mT | $\sqrt{[B_X^2 + B_Y^2 + (Bz/1.2)^2]}$ |
| IMC Gain in X and Y[(5)] | GainIMCxy | 1.2 | 1.4 | 1.8 | mT | |
| IMC Gain in Z | GainIMCz | 1.1 | | 1.3 | mT | |
| K factor | k | 1 | 1.2 | 1.5 | | GainIMCxy / GainIMCz |

*Table 10: Magnetic specifications*

[3] *Above 70 mT, the IMC starts saturating yielding to an increase of the linearity error.*
[4] *Below 20 mT, the performances slightly degrade due to a reduction of the signal-to-noise ratio, signal-to-offset ratio…*
[5] *This is the magnetic gain linked to the Integrated Magneto Concentrator structure. It applies to Bx and By and not to z. This is the overall variation. Within one lot, the part to part variation is typically ± 10% versus the average value of the IMC gain of that lot.*

## 15. CPU & Memory Specification

The DSP is based on a 16 bit RISC µController. This CPU provides 2.5 Mips while running at 10 MHz.

| Parameter | Symbol | Min. | Typ. | Max. | Unit | Condition |
|---|---|---|---|---|---|---|
| ROM | | | 7 | | kB | |
| RAM | | | 256 | | B | |
| EEPROM | | | 128 | | B | |

*Table 11: Memory specifications*

## 16. End-User Programmable Items

| Parameter | 000 | 200 | 100 | 300 | 400 | coding | Unit | Description |
|---|---|---|---|---|---|---|---|---|
| Output mode | 1 | 1 | 1 | 1 | 1 | 3 | bits | Define the output stage mode |
| DIAG | 0 | 0 | 0 | 0 | 0 | 1 | bits | Diagnostic mode (Low/Hi) |
| ADIAG | 0 | 0 | 0 | 0 | 0 | 1 | bits | Analog diagnostic option (Low/Hiz or HiZ/Hi) |
| MAPXYZ | MLX | MLX | MLX | MLX | MLX | 3 | bits | Mapping fields for output angle |
| CLAMP_HIGH | 50% | 10% | 10% | 10% | 10% | 16 | bits | Clamping High (50%) |
| CLAMP_LOW | 50% | 90% | 90% | 90% | 90% | 16 | bits | Clamping Low (50%) |
| FILTER | 0h | 1h | 1h | 1h | 1h | 2 | bits | Filter mode selection |
| k (SMISM) | MLX | MLX | MLX | MLX | MLX | 16 | bits | Sensitivity mismatch factor |
| GAINMIN | 00h | 00h | 00h | 00h | 00h | 8 | bits | Low threshold for virtual gain |
| GAINMAX | 29h | 29h | 29h | 29h | 29h | 8 | bits | High threshold for virtual gain |
| PWMPOL | 0 | N/A | N/A | N/A | N/A | 1 | bits | PWM polarity |
| PWMT | 1B58h | N/A | N/A | N/A | N/A | 16 | bits | PWM Frequency |
| DP | 0000h | 0000h | 0000h | 0000h | 0000h | 15 | bits | Discontinuity point |
| CW | 0h | 0h | 0h | 0h | 0h | 1 | bits | Enable Clock Wise direction |
| CUSTOMERID4 | 4 | 5 | 6 | 7 | 8 | 16 | bits | Customer identification reference |
| 4POINTS | 1h | 1h | 1h | 1h | 1h | 1 | bits | Selection of correction method 4pts or 16 segments |
| LNR_S0 | 0h | 0h | 0h | 0h | 0h | 16 | bits | 4pts – Initial Slope |
| LNR_A_X | 7FFFh | 0 | 0 | 0 | 0 | 16 | bits | 4pts – AX Coordinate |
| LNR_A_Y | 0 | 10% | 10% | 10% | 10% | 16 | bits | 4pts – AY Coordinate |
| LNR_A_S | 0 | 80%/ 360d | 80%/ 90d | 80%/ 180d | 80%/ 270d | 16 | bits | 4pts – AS Coordinate |
| LNR_B_X | FFFFh | FFFFh | FFFFh | FFFFh | FFFFh | 16 | bits | 4pts – BX Coordinate |
| LNR_B_Y | 0 | 0 | 0 | 0 | 0 | 16 | bits | 4pts – BY Coordinate |
| LNR_B_S | 0 | 0 | 0 | 0 | 0 | 16 | bits | 4pts – BS Coordinate |

| Parameter | 000 | 200 | 100 | 300 | 400 | coding | Unit | Description |
|---|---|---|---|---|---|---|---|---|
| LNR_C_X | FFFFh | FFFFh | FFFFh | FFFFh | FFFFh | 16 | bits | 4pts – CX Coordinate |
| LNR_C_Y | FFFFh | FFFFh | FFFFh | FFFFh | FFFFh | 16 | bits | 4pts – CY Coordinate |
| LNR_C_S | 0 | 0 | 0 | 0 | 0 | 16 | bits | 4pts – CS Coordinate |
| LNR_D_X | FFFFh | FFFFh | FFFFh | FFFFh | FFFFh | 16 | bits | 4pts – DX Coordinate |
| LNR_D_Y | FFFFh | FFFFh | FFFFh | FFFFh | FFFFh | 16 | bits | 4pts – DY Coordinate |
| LNR_D_S | 0 | 0 | 0 | 0 | 0 | 16 | bits | 4pts – DS Coordinate |
| WorkingRange | 0h | 0h | 0h | 0h | 0h | 4 | bits | 16pts – Output angle range |
| LNR_Y0/ CUSTOMERID1 | N/A | N/A | N/A | N/A | N/A | 16 | bits | 16pts – Y-coordinate point 0 / Cust. id reference |
| LNR_Y1/ CUSTOMERID2 | N/A | N/A | N/A | N/A | N/A | 16 | bits | 16pts – Y-coordinate point 1 / Cust. id reference |
| LNR_Y2/ CUSTOMERID3 | N/A | N/A | N/A | N/A | N/A | 16 | bits | 16pts – Y-coordinate point 2/ Cust. id reference |
| LNR_Yn | N/A | N/A | N/A | N/A | N/A | 16 | bits | 16pts – Y-coordinate point n |
| LNR_Y16 | N/A | N/A | N/A | N/A | N/A | 16 | bits | 16pts – Y-coordinate point 16 |
| HAMHOLE | 3131h | 0 | 0 | 0 | 0 | 16 | bits | Hamming code recovery |
| LOCK | 00h | 4Ch | 4Ch | 4Ch | 4Ch | 8 | bits | Lock byte |

*Table 12: End user NVRAM Parameters*

The values given in table 12 are the default EEPROM content for each of the MLX90340 versions.

# 17. Description of End-User Programmable Items

## 17.1. Output mode

| Parameter | Value | Description |
|---|---|---|
| Analog Output Mode | 1 | Analog Rail to Rail – Coutmin= 47nF |
| | 2 | Analog Rail to Rail – Coutmin= 10nF |
| PWM Output Mode | 5 | Low Side (Open Drain NMOS) |
| | 7 | Push-Pull |

*Table 13: Output mode parameters*

### 17.1.1. Analog Output mode

The Analog Output Mode is a rail-to-rail and ratiometric output with a push-pull output stage configuration allows the use of a pull-up or pull-down resistor.
With respect to the application diagram described in section 19.1, Melexis recommendation is Analog Output Mode 1.

### 17.1.2. PWM Output mode

If PWM output mode is selected, the output signal is a digital signal with Pulse Width Modulation (PWM).

The PWM polarity is selected by the PWMPOL1 parameter:

- PWMPOL = 0 for a low level at 100%
- PWMPOL = 1 for a high level at 100%

The PWM frequency is selected by the PWMT parameter. The following table provides typical code for different target PWM frequency and for both low and high speed modes.

| PWM Frequency (Hz) | 100 | 200 | 500 | 1000 |
|---|---|---|---|---|
| PWM Frequency code (PWMT) | 50000 | 25000 | 10000 | 5000 |

*Table 14: PWMT to PWM Frequency Correspondance*

Notes:

A more accurate trimming can be performed to take into account initial tolerance of the main clock.

The PWM frequency is subjected to the same tolerances as the main clock (see $\Delta^{T}$Ck).

## 17.2. Output Transfer Characteristic

There are 2 different possibilities to define the transfer function (LNR):

- With 4 arbitrary points (defined on X and Y coordinates) and 5 slopes
- With 17 equidistant points for which only the Y coordinates are defined.

| Parameter | LNR type | Value | Unit |
|---|---|---|---|
| CLOCKWISE | Both | 0 → CounterClockWise<br>1 → ClockWise | LSB |
| DP | Both | 0 … 359.9999 | deg |
| LNR_A_X<br>LNR_B_X<br>LNR_C_X<br>LNR_D_X | Only 4 pts | 0 … 359.9999 | deg |
| LNR_A_Y<br>LNR_B_Y<br>LNR_C_Y<br>LNR_D_Y | Only 4 pts | 0 … 100 | % |
| LNR_S0<br>LNR_A_S<br>LNR_B_S | Only 4 pts | 0 … 17 | %/deg |
| LNR_C_S<br>LNR_D_S | Only 4 pts | -17 … 0 … 17 | %/deg |
| LNR_Y0<br>LNR_Y1<br>…<br>LNR_Y16 | Only 17 pts | -50 … + 150 | % |
| WorkingRange | Only 17 pts | 65.5 … 360 | Deg |
| CLAMP_LOW | Both | 0 … 100 | % |
| CLAMP_HIGH | Both | 0 … 100 | % |

*Table 15: Output transfer methods*

### 17.2.1. Enable Scaling Parameter

This parameter enables to scale LNR_x_Y from -50% - 150% according to the following formula

$(\text{Scaled Out})\%V_{DD} = 2 \times \text{Out}\%V_{DD} - 50\%$

### 17.2.2. Clockwise parameter

The CLOCKWISE parameter defines the magnet rotation direction.

- CCW is the defined by the 1-4-5-8 pin order direction for the SOIC-8 package and 1-8-9-16 pin order direction for the TSSOP-16 package.
- CW is defined by the reverse direction: 8-5-4-1 pin order direction for the SOIC-8 and 16-9-8-1 pin order direction for the TSSOP-16 package.

Refer to the drawing in the sensitive spot positioning sections (Section 22.3)

### 17.2.3. Discontinuity point (or Zero degree point)

The Discontinuity Point defines the 0° point on the circle. The discontinuity point places the origin at any location of the trigonometric circle. The DP is used as reference for all the angular measurements.

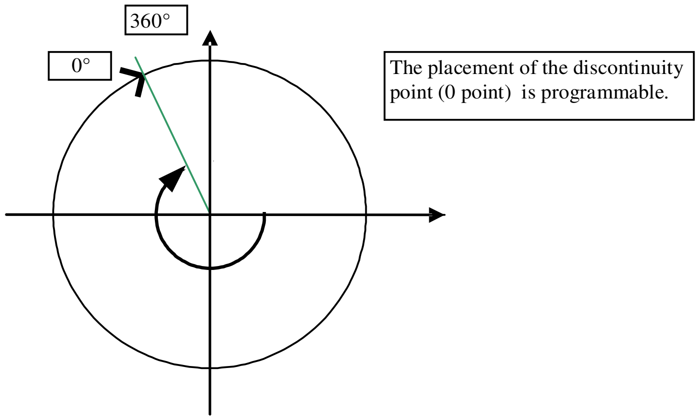



*Figure 7: Discontinuity Point Positioning*

### 17.2.4. 4-Pts LNR Parameters

The LNR parameters, together with the clamping values, fully define the relation (the transfer function) between the digital angle and the output signal.

The shape of the MLX90340 transfer function from the digital angle value to the output voltage is described by the drawing below. Six segments can be programmed but the clamping levels are necessarily flat.

Two, three, or even six calibration points are then available, reducing the overall non-linearity of the IC by almost an order of magnitude each time. Three or six calibration point will be preferred by customers looking for excellent non-linearity figures. Two-point calibrations will be preferred by customers looking for a cheaper calibration set-up and shorter calibration time.

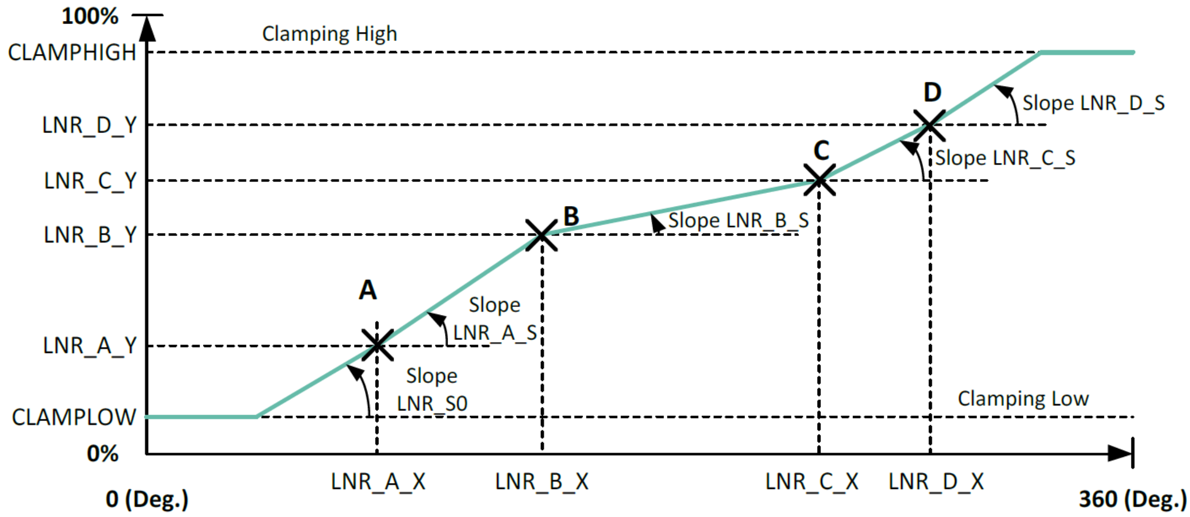



*Figure 8: 4 arbitratry points calibration method*

## 17.2.5. 17-Pts LNR Parameters

The LNR parameters, together with the clamping values, fully define the relation (the transfer function) between the digital angle and the output signal.

The shape of the MLX90340 transfer function from the digital angle value to the output voltage is described by the drawing below. In the 16-segments mode (or 17 pts), the output transfer characteristic is Piece-Wise-Linear (PWL).

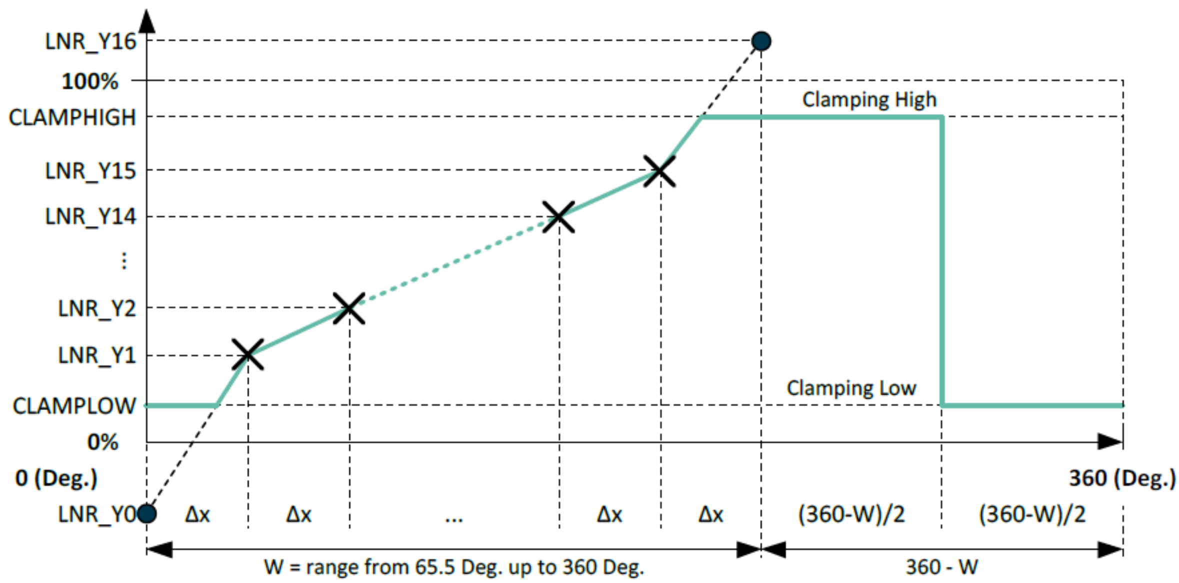



*Figure 9 – 16 segments calibration method*

All the Y-coordinates can be programmed from -50% up to +150% to allow clamping in the middle of one segment (like on the figure), but the output value is limited to CLAMPLOW and CLAMPHIGH values.

Between two consecutive points, the output characteristic is interpolated.

The parameter W determines the input range on which the 17 points (16 segments) are uniformly spread:

| W | Range | Δx | W | Range | Δx |
|---|---|---|---|---|---|
| 0 | 360.0deg | 22.5deg | 8 | 180.0deg | 11.3deg |
| 1 | 320.0deg | 20.0deg | 9 | 144.0deg | 9.0deg |
| 2 | 288.0deg | 18.0deg | 10 | 120.0deg | 7.5deg |
| 3 | 261.8deg | 16.4deg | 11 | 102.9deg | 6.4deg |
| 4 | 240.0deg | 15.0deg | 12 | 90.0deg | 5.6deg |
| 5 | 221.5deg | 13.8deg | 13 | 80.0deg | 5.0deg |
| 6 | 205.7deg | 12.9deg | 14 | 72.0deg | 4.5deg |
| 7 | 192.0deg | 12.0deg | 15 | 65.5deg | 4.1deg |

*Table 16: Working range*

Outside of the selected range, the output will remain in clamping levels.

### 17.2.6. CLAMPING Parameters

The clamping levels are two independent values to limit the output voltage range. The CLAMPLOW parameter adjusts the minimum output voltage level. The CLAMPHIGH parameter sets the maximum output voltage level. Both parameters have 16 bits of adjustment and are available for both LNR modes. In analog mode, the resolution will be limited by the D/A converter (12 bits) to 0.024%$V_{DD}$. In PWM mode, the resolution will be 0.024%$_{DC}$.

## 17.3. Identification

| Parameter | Value |
|---|---|
| MELEXISID1 | 0 … 65535 |
| MELEXISID2 | 0 … 65535 |
| MELEXISID3 | 0 … 65535 |
| CUSTOMERID1 | 0 … 65535 |
| CUSTOMERID2 | 0 … 65535 |
| CUSTOMERID3 | 0 … 65535 |
| CUSTOMERID4 | 0 … 65535 |

*Table 17: Identifications Parameters*

Identification number: 64 bits (4 words) freely useable by Customer for traceability purpose.

Those 64 bits are only available if the 4pts-LNR. For the 17-Pts LNR, the corresponding EEPROM area of CUSTOMERID1,2,3 are used by the LNR function.

## 17.4. Sensor Front-End

| Parameter | Value |
|---|---|
| MAPXYZ | 0 .. 5 |
| k (or SMISM) | 0 .. 65535 |
| GAINMIN<br>GAINMAX | 0 … 41 |

*Table 18: Front-end parameters*

### 17.4.1. MAPXYZ

The MAPXYZ parameter defines which fields are used to calculate the angle. The different possibilities are described in the tables below.

| MAPXYZ | Angle Definition |
|---|---|
| 0 | $\angle XY = \angle(k \cdot B_X, B_Y)$ |
| 1 | $\angle YX = \angle(B_X, k \cdot B_Y)$ |
| 2 | $\angle XZ = \angle(k \cdot B_X, B_Z)$ |
| 3 | $\angle ZX = \angle(B_X, k \cdot B_Z)$ |
| 4 | $\angle YZ = \angle(k \cdot B_Y, B_Z)$ |
| 5 | $\angle ZY = \angle(B_Y, k \cdot B_Z)$ |

*Table 19: Magnetic Mapping Parameters*

### 17.4.2. K parameter

The k parameter defines the sensitivity mismatch between the 2 selected axis used for the angular calculation. Its value is defined through an unsigned 16 bits value from 0.0 to 1.0. Typical values are between 0.5 and 1.

The MAPXYZ is defined in factory to be 0 or 1. For an end-user XY-application, don't overwrite this parameter.

### 17.4.3. GAINMIN and GAINMAX Parameters

GAINMIN and GAINMAX define the boundaries within the virtual gain setting is allowed to vary. Outside this range, the output is set in diagnostic mode.

## 17.5. Filter

| Parameter | Value |
|---|---|
| Filter | 0 … 2 |

*Table 20: Filtering value*

The MLX90340 includes the possibility to filter the angular value:

Low Pass FIR Filters controlled with the FILTER parameter

The MLX90340 features 2 FIR filter modes controlled with Filter = 1…2. Filter = 0 corresponds to no filtering. The transfer function is described below:

$$y_n = \frac{1}{\sum_{i=0}^{j} a_i} \sum_{i=0}^{j} a_i x_{n-i}$$

The filters characteristics are given in the following table:

| Filter No | 0 | 1 | 2 |
|---|---|---|---|
| j | 0 | 1 | 3 |
| Type | Disable | Finite Impulse Response | |
| Coefficients $a_i$ | 1 | 11 | 1111 |
| Title | No filter | ExtraLight | Light |
| 99% Response Time | 1 | 2 | 4 |
| Efficiency RMS (dB) | 0 | 3.0 | 6.0 |

*Table 21: Filtering characteristic*

## 17.6. Programmable Diagnostic Settings

| Parameter | Value |
|---|---|
| DIAG | 0 or 1 |
| ADIAG | 0 or 1 |
| HAMHOLE | 0 or 3131h |

*Table 22: Diagnostics control parameters*

### 17.6.1. Fixed-level diagnostic reporting

*In analog output mode*

DIAG and ADIAG parameters allow selecting all diagnostic modes:

| Mode | Type | Description |
|---|---|---|
| With pull-up<br>ADIAG = 0 | DIAG = 0<br>DIAG = 1 | Diagnostic Low<br>Diagnostic Hi (HiZ + pull-up) |
| With pull-down<br>ADIAG = 1 | DIAG = 0<br>DIAG = 1 | Diagnostic Low (HiZ + pull-down)<br>Diagnostic Hi |

*Table 23: Diagnostics control details in Analog modes*

| Mode | Type | Description |
|---|---|---|
| Open drain NMOS | DIAG = 0<br>DIAG = 1 | Diagnostic Low<br>Diagnostic Hi (HiZ + pull-up) |
| Push-pull output | DIAG = 0<br>DIAG = 1 | Diagnostic Low<br>Diagnostic Hi |

*Table 24: Diagnostics control details in PWM modes*

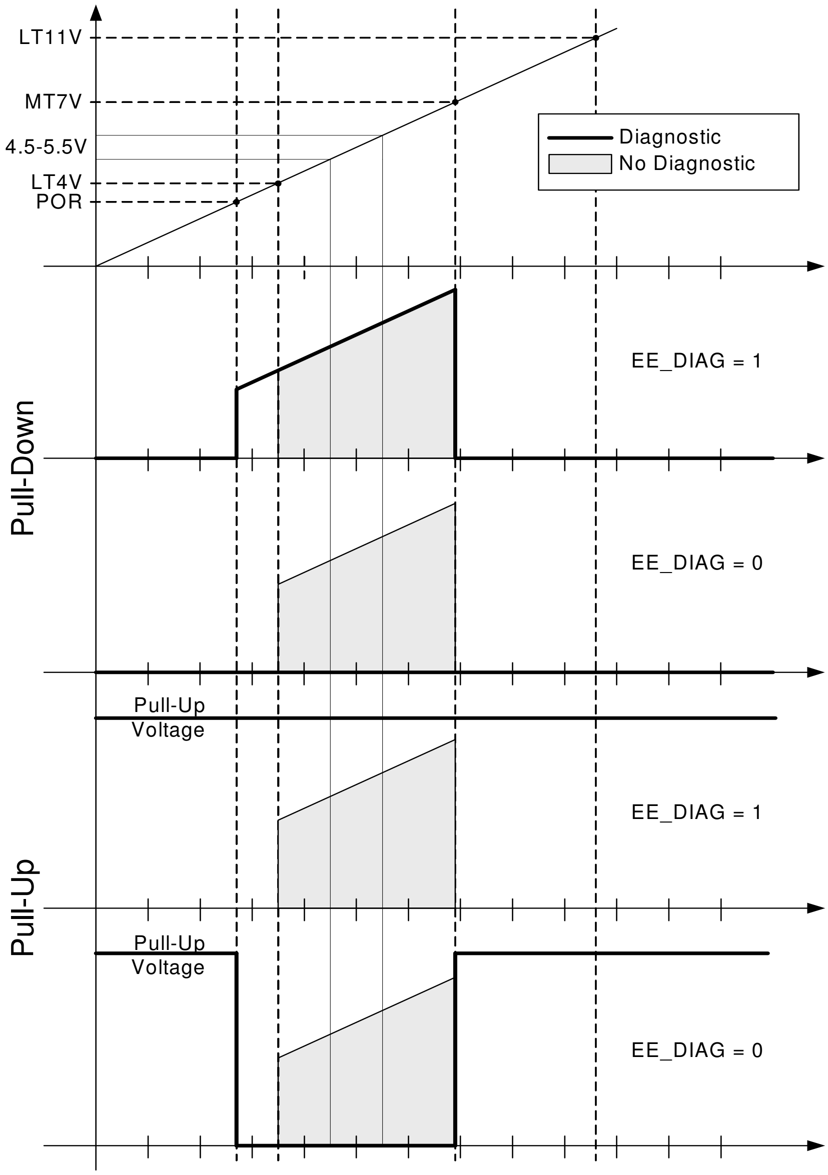



*Figure 10 - Output voltage in diagnostic modes over supply voltage*

### 17.6.2. HAMHOLE Parameter

The HAMHOLE parameter enables or disables the memory recovery based on Hamming codes in case of EEPROM CRC error. By default, the memory recovery and EEPROM CRC check are disabled (Hamhole=3131h). These two features are enabled automatically when locking the part (see paragraph 17.7).

## 17.7. Lock

The LOCK parameter locks all the parameters set by the user. Once the lock is enabled, it is not possible to change the EEPROM values anymore as PTC communication in writing mode is not available anymore.

Note that the lock bit should be set by the solver function “MemLock”.

### 17.8. EEPROM endurance

Although the EEPROM is used for Calibration Data Storage (similarly to an OTPROM), the MLX90340 embedded EEPROM is qualified to guarantee an endurance of minimum 1000 write cycles at 125˚C for (engineering/calibration purpose).

## 18. Self Diagnostic

The MLX90340 provides numerous self-diagnostic features. Those features increase the robustness of the IC functionality as it will prevent the IC to provide erroneous output signal in case of internal or external failure modes (“fail-safe”).

| | Action | Effects on OUT | Comments |
|---|---|---|---|
| ROM CRC Error at start up<br>(64 words including Intelligent Watch Dog - IWD) | CPU Reset [6] | Diagnostic low/high(19) | All the outputs are already in Diagnostic low/high - (start-up) |
| ROM CRC Error (Operation - Background task) | Enter Endless Loop:<br>- Progress (watchdog Acknowledge)<br>- Set Outputs in Diagnostic low/high | Immediate Diagnostic low//high(19) | |
| RAM Test Fail (Start up) | CPU Reset | Diagnostic low/ high (19) | All the outputs are already in Diagnostic low/high (start-up) |
| Calibration Data CRC Error<br>(Start-Up) | Hamming Code Recovery | | Start-Up Time is increased by 3 ms if successful recovery |
| Hamming Code Recovery Error<br>(Start-Up) | CPU Reset | Diagnostic low/high(19) | See section HAMHOLE |

[6] *CPU reset means*

1. Core Reset (same as Power-On-Reset). It induces a typical start up time.
2. Periphery Reset (same as Power-On-Reset)
3. Fault Flag/Status Lost

| | Action | Effects on OUT | Comments |
|---|---|---|---|
| Calibration Data CRC Error<br>(Operation - Background) | CPU Reset | Diagnostic low/high(19) | |
| ADC Clipping<br>(ADC Output is 0000h or 7FFFh) | Set Outputs in Diagnostic low/high Normal mode and CPU Reset If recovery | Immediate Diagnostic low/high(19) | |
| Norm Too Low<br>( < 25 % ) | Set Outputs in Diagnostic low/high Normal mode and CPU Reset If recovery | Immediate Diagnostic low/high(19) | If no magnet IC in Diag. mode. |
| Rough Offset Clipping<br>(RO is = 0d or = 127d) | Set Outputs in Diagnostic low/high Normal mode, with immediate recovery without CPU reset | Immediate Diagnostic low/high(19) | |
| Gain Clipping (Gain < GAINMIN or Gain > GAINMAX) | Set Outputs in Diagnostic low/high Normal mode, and CPU Reset If recovery | Immediate Diagnostic low/high(19) | See also Section GAINMIN and GAINMAX. |
| ADC Monitor (Analog to Digital Converter) | Set Outputs in Diagnostic low/high. Normal Mode with immediate recovery without CPU Reset | Immediate Diagnostic low/high(19) | ADC Inputs are Shorted and connected to Vref. ADC output is compared to a fixed value. |

| | Action | Effects on OUT | Comments |
|---|---|---|---|
| Undervoltage Mode | At Start-Up, wait Until VDD > LT4V.<br><br>During operation, CPU Reset after 3 ms debouncing. | - VDD < POR level<br>=> Output high impedance<br><br>- POR level < VDD < ~LT4V<br>=> Output in Diagnostic low/high[7]. | |
| Firmware Flow Error | CPU Reset | Immediate Diagnostic low/high[19] | Intelligent Watchdog (Observer) |
| Read/Write Access out of physical memory | CPU Reset | Immediate Diagnostic low/high[19] | 100% Hardware detection |
| Write Access to protected area (IO and RAM Words) | CPU Reset | Immediate Diagnostic low/high[19] | 100% Hardware detection |
| Unauthorized entry in "SYSTEM" Mode | CPU Reset | Immediate Diagnostic low/high[19] | 100% Hardware detection |
| VDD > MT7V | Set Output High Impedance (Analog) | Pull down resistive load => Diag. Low<br>Pull up resistive load => Diag. High | 100% Hardware detection |
| VDD > LT11V | IC is switched off (internal supply)<br>CPU Reset on recovery | Pull down resistive load => Diag. Low<br>Pull up resistive load => Diag. High | 100% Hardware detection |
| Broken VSS | CPU Reset on recovery | Pull down resistive load < 10kΩ => Diag. Low<br>Pull up resistive load (any value) => Diag. High | 100% Hardware detection |
| Broken VDD | CPU Reset on recovery | Pull down resistive load (any value) => Diag. Low<br><br>Pull up resistive load < 10kΩ => Diag. High | 100% Hardware detection |

[7] *The diagnostics can be selectable between Diagnostic Low/Diagnostic High by setting the bits EE_DIAG and EE_ADIAG (for analog modes only). See section Programmable Diagnostic Settings for the Diagnostic Output Level specifications.*

| | Action | Effects on OUT | Comments |
|---|---|---|---|
| Temperature Monitor | Set Outputs in Diagnostic low/high.<br>Normal Mode with immediate recovery without CPU Reset | Immediate Diagnostic low/high(19) | Temperature Sensor 1 is compared to temperature sensor 2 |

*Table 25: Diagnostics details*

# 19. Recommended Application Diagrams

## 19.1. MLX90340 in SOIC-8 Package

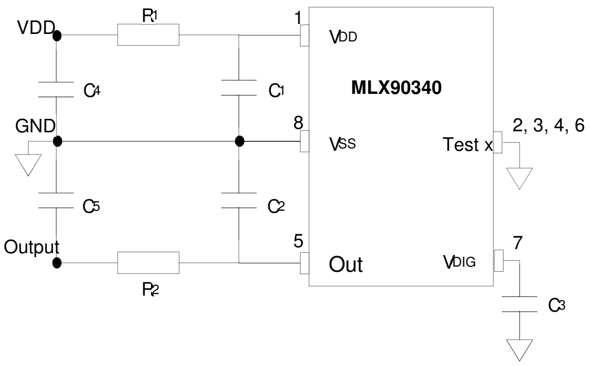



*Figure 11 –Recommended wiring for the MLX90340 in SOIC-8 package*

| Output | Compact PCB routing | | | EMC robust PCB routing | | | |
|---|---|---|---|---|---|---|---|
| Analog Output | Min | Typ. | Max | Min | Typ. | Max | Remarks |
| C1 | 100 nF | 100 nF | 1 uF | 47 nF | 100 nF | 1 uF | Close to the pin |
| C2 (20) | 47 nF | 100 nF | 330 nF | 47 nF | 100 nF | 330 nF | Close to the pin |
| C3 | 47 nF | 100 nF | 220 nF | 47 nF | 100 nF | 220 nF | Close to the pin |
| C4 | - | - | - | 500 pF | 1 nF | 10 nF | Connector Side |
| C5 | - | - | - | 500 pF | 1 nF | 10 nF | Connector Side |
| R1 | - | - | - | 0 Ω | 10 Ω | 33 Ω | Increased ratiometry error |
| R2 | - | - | - | 10 Ω | 50 Ω | 100 Ω | |

*Figure 12 – Analog Ouptut mode - Recommended capacitor/resistor values for the MLX90340 in SOIC-8 package*

| Output | Compact PCB routing | | | EMC robust PCB routing | | | |
|---|---|---|---|---|---|---|---|
| PWM Output | Min | Typ. | Max | Min | Typ. | Max | Remarks |
| C1 | 100 nF | 100 nF | 1 uF | 47 nF | 100 nF | 1 uF | Close to the pin |
| C2 | 2.2 nF | 4.7 nF | 22 nF | 2.2 nF | 4.7 nF | 22 nF | Close to the pin |
| C3 | 47 nF | 100 nF | 220 nF | 47 nF | 100 nF | 220 nF | Close to the pin |
| C4 | - | - | - | 500 pF | 1 nF | 10 nF | Connector Side |
| C5 | - | - | - | 500 pF | 1 nF | 2.2 nF | Connector Side |
| R1 | - | - | - | 0 Ω | 10 Ω | 33 Ω | Impacts the Voltage on VDD pin |
| R2 | - | - | - | 10 Ω | 50 Ω | 100 Ω | |

*Figure 13 – Analog Ouptut mode - Recommended capacitor/resistor values for the MLX90340 in SOIC-8 package*

## 19.2. MLX90340 in TSSOP-16 Package

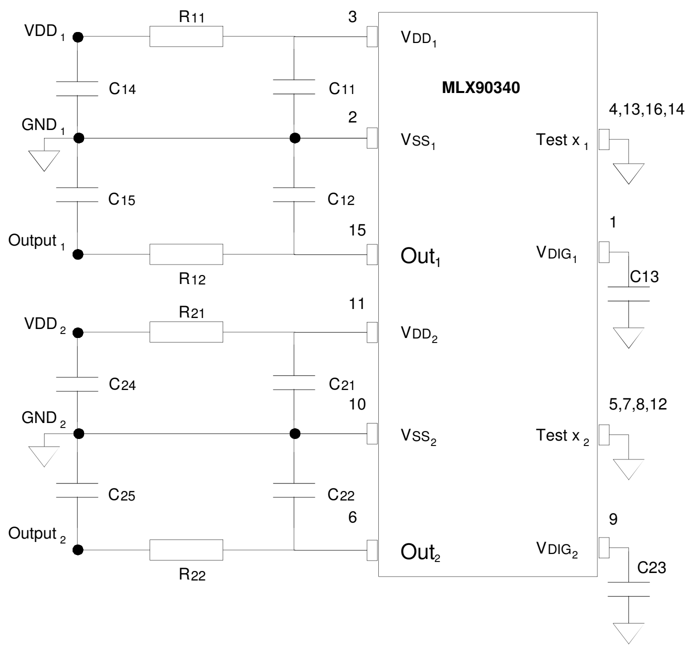



*Figure 14 –Recommended wiring for the MLX90340 in TSSOP16 package (dual die)*

| Output | Compact PCB routing | | | EMC robust PCB routing | | | |
|---|---|---|---|---|---|---|---|
| Analog Output | Min | Typ. | Max | Min | Typ. | Max | Remarks |
| C11, C21 | 100 nF | 100 nF | 1 uF | 47 nF | 100 nF | 1 uF | Close to the pin |
| C12, C22 | 47 nF | 100 nF | 330 nF | 47 nF | 100 nF | 330 nF | Close to the pin |
| C13, C23 | 47 nF | 100 nF | 220 nF | 47 nF | 100 nF | 220 nF | Close to the pin |
| C14, C24 | - | - | - | 500 pF | 1 nF | 10 nF | Connector Side |
| C15, C25 | - | - | - | 500 pF | 1 nF | 10 nF | Connector Side |
| R11, R21 | - | - | - | 0 Ω | 10 Ω | 33 Ω | Increased ratiometry error |
| R12, R22 | - | - | - | 10 Ω | 50 Ω | 100 Ω | |

| Output | Compact PCB routing | | | EMC robust PCB routing | | | |
|---|---|---|---|---|---|---|---|
| PWM Output | Min | Typ. | Max | Min | Typ. | Max | Remarks |
| C11, C21 | 100 nF | 100 nF | 1 uF | 47 nF | 100 nF | 1 uF | Close to the pin |
| C12, C22 | 22 nF | 4.7 nF | 22 nF | 2.2 nF | 4.7 nF | 22 nF | Close to the pin |
| C13, C23 | 47 nF | 100 nF | 220 nF | 47 nF | 100 nF | 220 nF | Close to the pin |
| C14, C24 | - | - | - | 500 pF | 1 nF | 10 nF | Connector Side |
| C15, C25 | - | - | - | 500 pF | 1 nF | 2.2 nF | Connector Side |
| R11, R21 | - | - | - | 0 Ω | 10 Ω | 33 Ω | Impacts the Voltage on VDD pin |
| R12, R22 | - | - | - | 10 Ω | 50 Ω | 100 Ω | |

# 20. 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 standards in place in Semiconductor industry.

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 ([http://www.melexis.com/en/quality-environment/soldering](http://www.melexis.com/en/quality-environment/soldering)).

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&forming recommendation application note: lead trimming and forming recommendations (http://www.melexis.com/en/documents/documentation/application-notes/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

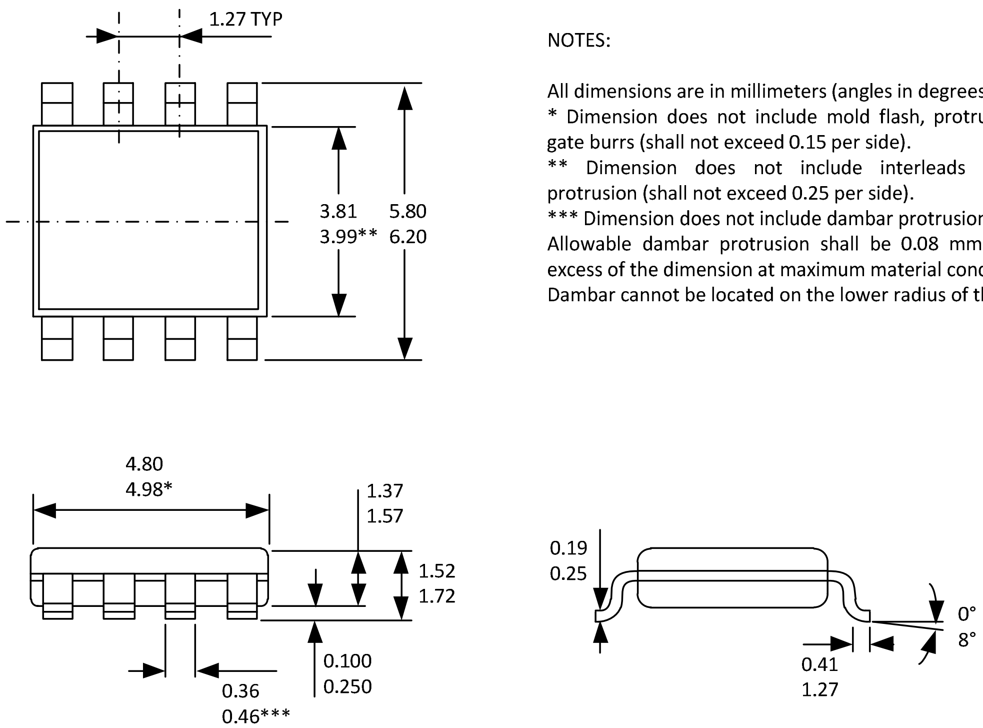
# 21. ESD Precautions

Electronic semiconductor products are sensitive to Electro Static Discharge (ESD).

Always observe Electro Static Discharge control procedures whenever handling semiconductor products.

# 22. Package Information

## 22.1. SOIC-8 - 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.

*Figure 15*

## 22.2. SOIC-8 - Pinout and Marking

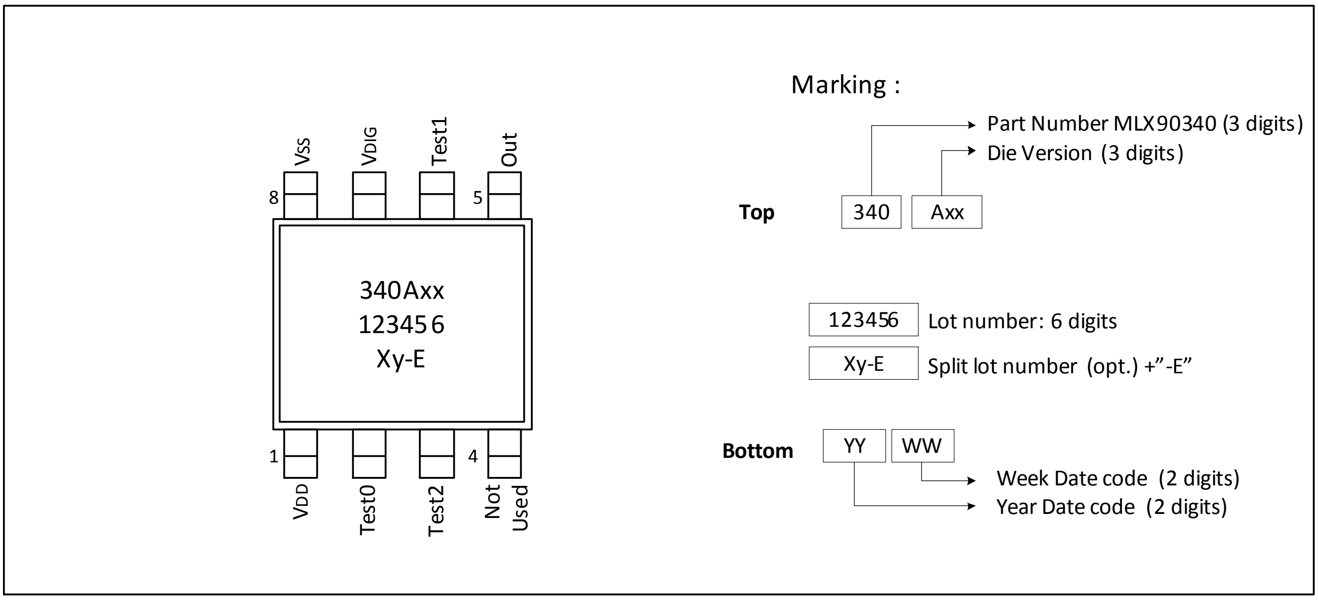



*Figure 16*

## 22.3. SOIC-8 - Sensitive spot Positioning

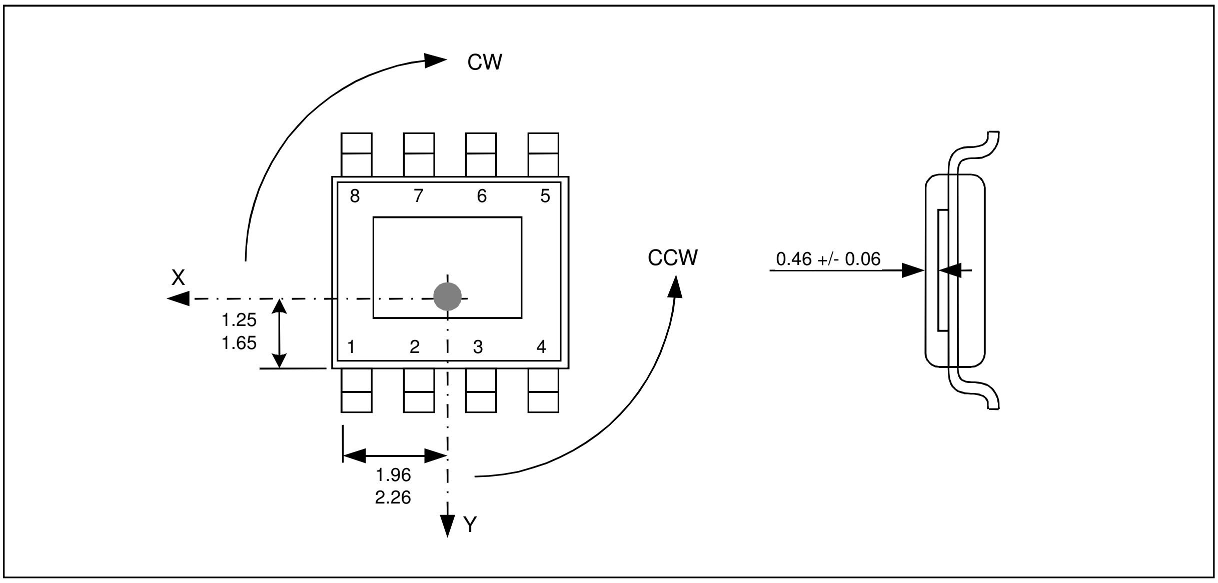



*Figure 17*

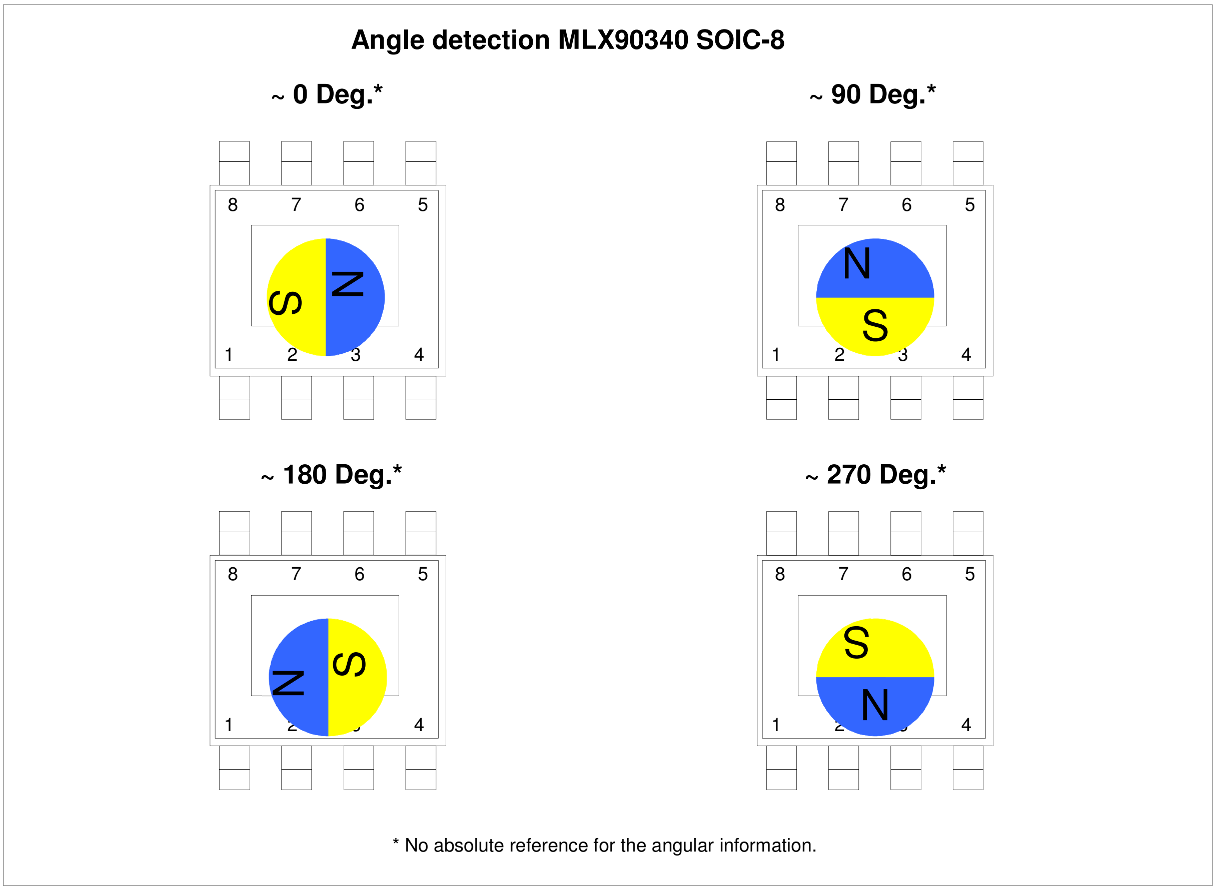
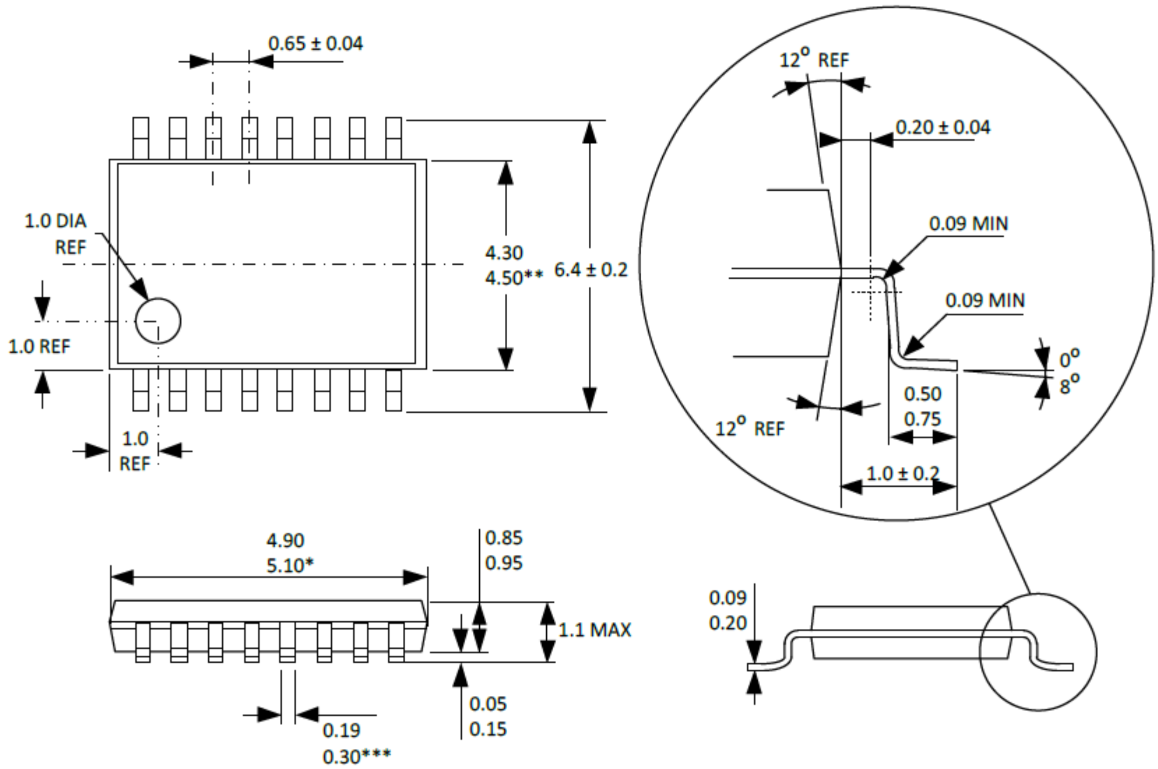



*Figure 18*

The MLX90340 is an absolute angular position sensor but the linearity error (See section 13) does not include the error linked to the absolute reference 0 Deg (which can be fixed in the application through the discontinuity point).

## 22.4. TSSOP16 - 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 19*

## 22.5. TSSOP16 - Pinout and Marking

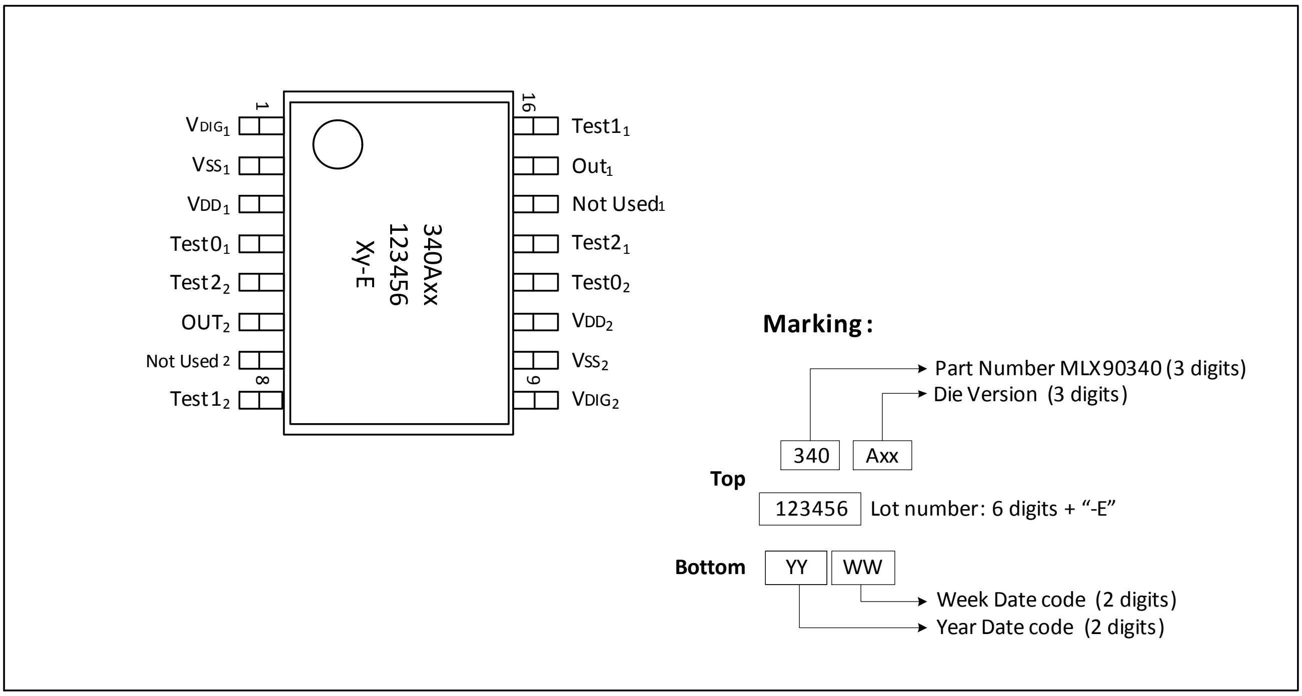



*Figure 20*

## 22.6. TSSOP16 - Sensitive spot Positioning

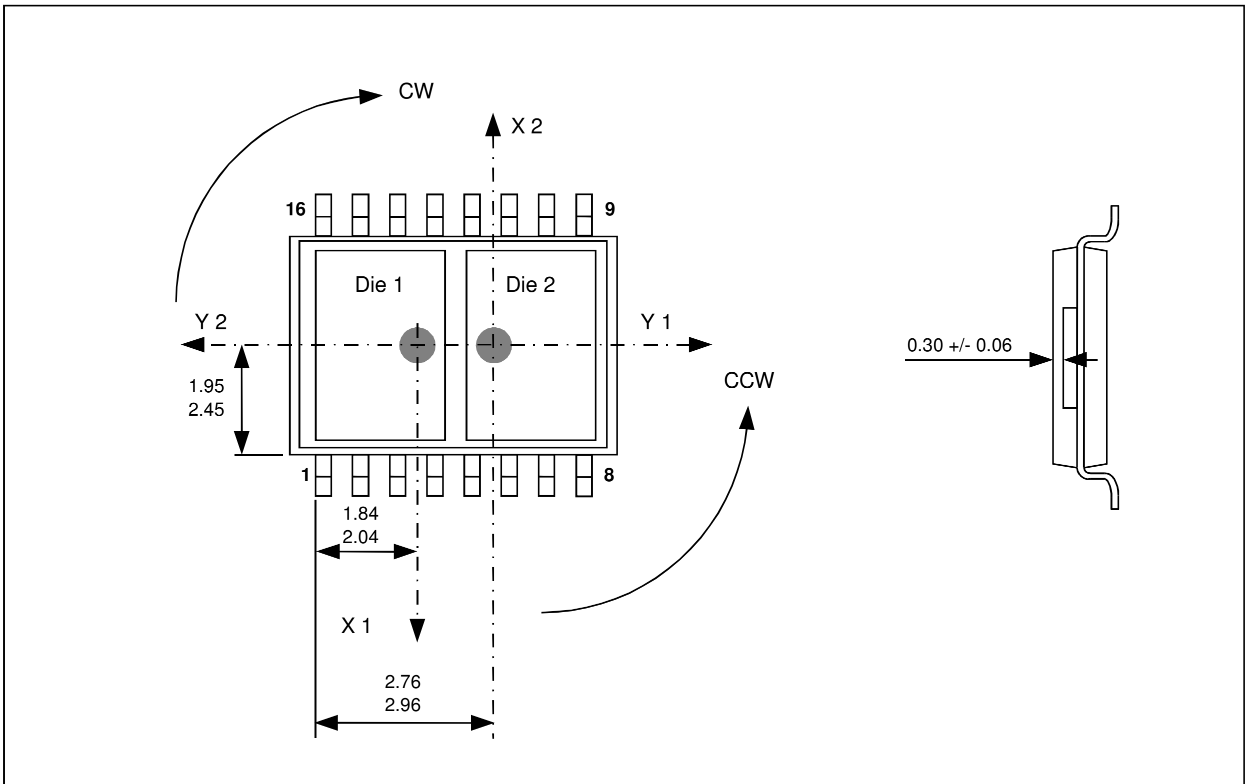



Figure 21

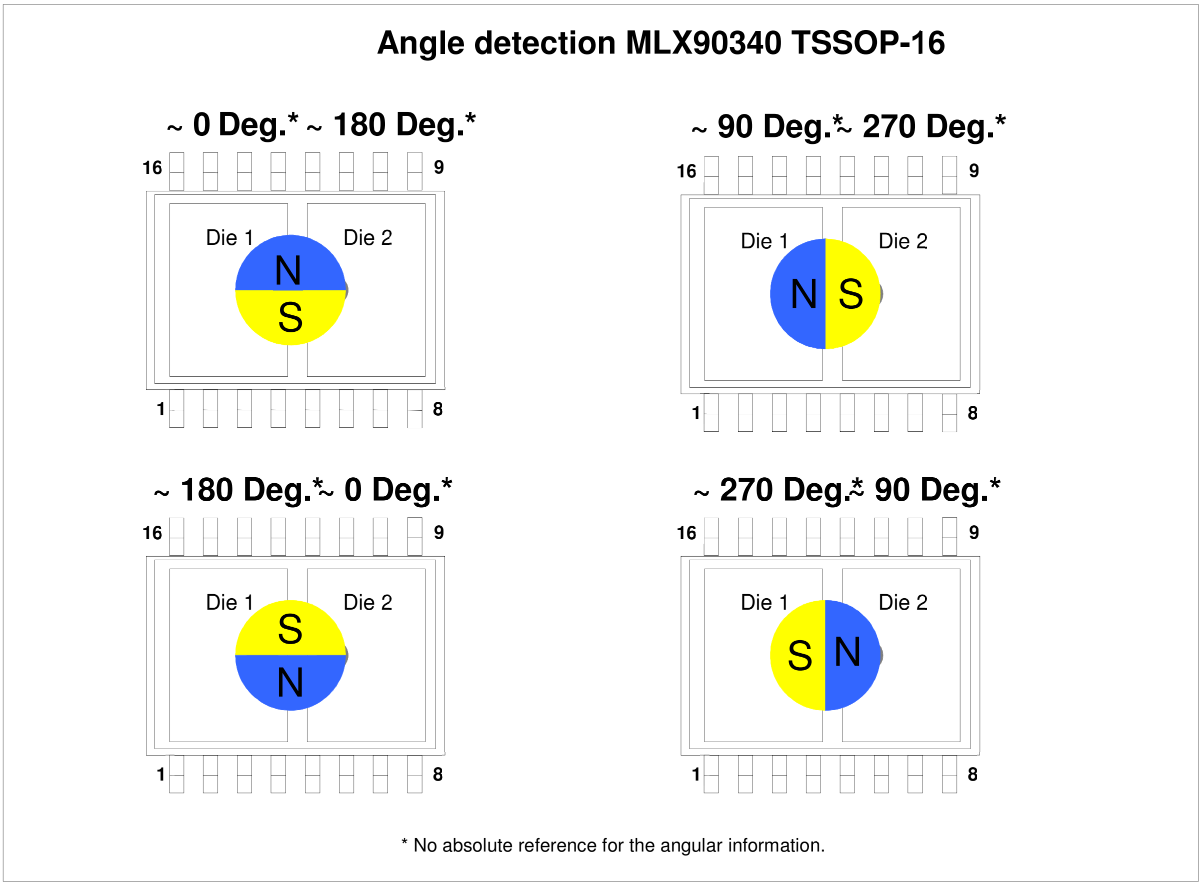



*Figure 22*

The MLX90340 is an absolute angular position sensor but the linearity error (See section 13) does not include the error linked to the absolute reference 0Deg (which can be fixed in the application through the discontinuity point).

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