

# MLX92253 Datasheet

Dual Hall-Effect Latch with two Speed Outputs  
Datasheet

## 1. Features and Benefits

- Triaxis® Hall Technology
- Magnetic dual latch functionality
- Two independent signal tracks for reliable Speed-Speed sensing
- Vertical (Z) & Lateral (X) magnetic fields
- In quadrature outputs (90° phase shift) for pitch independent designs
- Output state feedback during start-up
- For microcontroller embedded designs
- Chopping frequency of 500 kHz
- Operating voltage range from 2.7V to 5.5V
- Operating temperature from -40°C to 150°C
- High ESD rating: 8kV (HBM)
- Under-Voltage Reset
- Industry standard TSOT23-5L package
- AEC-Q100 automotive qualification pending

## 2. Application Examples

- Linear speed & direction detection: window lifters and closures with anti-pinch features, power lift gates
- Rotation speed & direction detection: cadence sensor for e-bikes, fans, valves
- Angular position detection: knobs, jog wheels, DC motor indexing

## 3. Description

The MLX92253 is a Hall-effect dual latch designed in CMOS technology. The device integrates a voltage regulator, two Hall sensors with offset cancellation and two open-drain outputs in a single package.

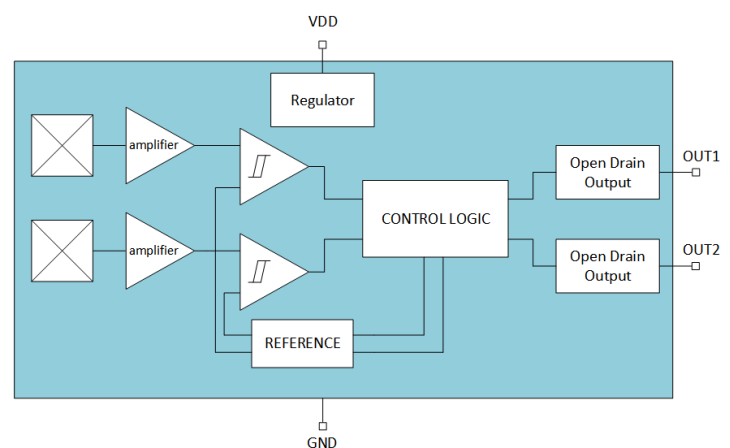
The two Hall sensors, one sensing the Z axis and one sensing the X axis, are integrated on the same

piece of silicon with two independent signal tracks and a common magnetic center. This ensures that the two speed outputs have a 90° phase shift regardless of magnet pole pitch, giving the customer more freedom in their magnetic design and faster reuse across multiple platforms.

Each speed output can be switched ON (LOW state) or OFF (HIGH state) by applying a sufficiently strong positive (South) or negative (North) magnetic field on one of the axes. OUT1 is sensitive to magnetic field on the Z axis, while OUT2 is sensitive to magnetic field on the X axis. Without magnetic field, the device will keep its last state.

The start-up feedback function can be used to turn the two outputs into inputs during Power-On. This function enables the customer to recover the last known state of the IC prior power-down in order to never miss a turn. The microcontroller should provide the necessary inputs at the starting point. This function is described in detail in chapter 10.2.

The MLX92253 is delivered in a green compliant 5-pin Thin Small Outline Transistor (TSOT) package for surface-mount applications.



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## 4. Ordering Information

Product	Temperature	Package	Option Code	Packing Form	Definition
MLX92253	L	SE	AAA-000	RE	Dual latch with two speed outputs

### Legend:

Temperature Code:	L: T <sub>a</sub> from -40°C to 150°C
Package Code:	SE: TSOT-5L package
Option Code:	MLX92253LSE-AAA-000-RE = Dual latch (ZX) with two speed outputs where OUT1 is corresponding to the B <sub>z</sub> magnetic field and OUT2 corresponding to the B <sub>x</sub> magnetic field.
Packing Form:	RE: REEL
Ordering Example:	MLX92253LSE-AAA-000-RE

Contact your sales representative for different product variants such as Pulse & Direction output types.

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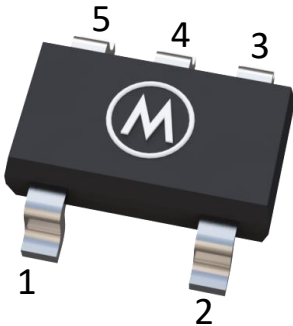
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## 5. Glossary of Terms

Term	Definition
Gauss (G), Tesla (T)	Units for the magnetic flux density – 1 mT = 10 G
TC	Temperature Coefficient (in ppm/°C)
B <sub>OP</sub>	Operating magnetic threshold
B <sub>RP</sub>	Release magnetic threshold
HBM	Human Body Model

## 6. Pin Definitions and Descriptions

### 6.1. Pin definition for TSOT-5L (SE) package



Pin №	Name	Description
1	OUT1	Open-drain output 1/Feedback input (Z)
2	OUT2	Open-drain output 2/Feedback input (X)
3	VDD	Supply pin
4	GND	Ground pin
5	GND	Ground pin

*Both GND pins (4 and 5) should be connected to ground*

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## 7. Absolute Maximum Ratings

<i>Parameter</i>	<i>Symbol</i>	<i>Value</i>	<i>Unit</i>
Supply voltage	$V_{DD}$	7	V
Supply current <sup>(1,2,3)</sup>	$I_{DD}$	20	mA
Reverse supply voltage	$V_{DDREV}$	-0.5	V
Reverse supply current <sup>(1,2,3)</sup>	$I_{DDREV}$	-20	mA
Output voltage	$V_{OUT}$	7	V
Reverse output voltage	$V_{OUTREV}$	-0.5	V
Reverse output current <sup>(1,2,3)</sup>	$I_{OUTREV}$	-20	mA
Maximum junction temperature	$T_J$	165	°C
ESD HBM <sup>(4)</sup>	-	8	kV

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

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<sup>1</sup> For a maximum of 500ms

<sup>2</sup> Including current through the protection device

<sup>3</sup> Maximum junction temperature should not be exceeded

<sup>4</sup> Human Body Model according AEC-Q100-002 standard

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## 8. General Electrical Specifications

Operating conditions  $T_A$  -40°C to 150°C (unless otherwise specified)

Electrical Parameter	Symbol	Min	Typ <sup>(1)</sup>	Max	Unit	Condition
Supply voltage	$V_{DD}$	2.7	-	5.5	V	
Supply current	$I_{DD}$	-	5	6.5	mA	
Power-on Reset voltage	$V_{POR}$	-	2.5	2.6	V	
Power-on Time <sup>(2)</sup>	$t_{PON}$	-	20	40	$\mu s$	$V_{DD} = 5V$ , $dV_{DD}/dt > 2V/\mu s$
Power-on state	-	High			-	Output state during $T_{PON}$
Output leakage current	$I_{OFF}$	-	0.01	5	$\mu A$	$B < B_{RP}$ , $V_{OUT} = 5.5V$
Output saturation voltage	$V_{OUTS}$	-	0.3	0.6	V	$I_{OUT} = 10mA$
Output short-circuit current	$I_{SC}$	15	-	40	mA	
Output rise/fall time <sup>(3,4)</sup>	$T_R/T_F$	0.15	0.3	0.5	$\mu s$	$V_{DD} = 5V$ , $V_{PU} = 5V$ , $R_{PU} = 1k\Omega$ , $C_L = 50pF$
Chopping frequency	$F_{CHOP}$	-	500	-	kHz	
Output refresh period	$T_{PER}$	-	4	6	$\mu s$	
Output jitter (p-p value) <sup>(3)</sup>	$T_{jitter}$	-	5	-	$\mu s$	Over 1000 successive switching events @10kHz triangle wave, $B_{PEAK} \geq 30mT$
Maximum switching frequency <sup>(5)</sup>	$F_{SW}$	40	66	-	kHz	$B \geq 10mT$ triangle wave magnetic field
Feedback input HIGH voltage <sup>(6)</sup>	$V_{IH}$	1.8	-	-	V	
Feedback input LOW voltage <sup>(6)</sup>	$V_{IL}$	-	-	0.8	V	
SE package thermal resistance	$R_{THJA}$	-	300	-	$^{\circ}C/W$	

<sup>1</sup> Typical values are given for  $T_A = 25^{\circ}C$  and  $V_{DD} = 5V$

<sup>2</sup> Measured from the moment  $V_{DD} = 2.7V$  until the first update of the outputs

<sup>3</sup> Guaranteed by design and verified during characterization, not production tested

<sup>4</sup> Measured between  $0.1 \cdot V_{PU}$  and  $0.9 \cdot V_{PU}$  where  $V_{PU}$  is the pull-up voltage and  $R_{PU}$  is the pull-up resistance

<sup>5</sup> The maximum frequency of the applied magnetic field which is detected without loss of pulses

<sup>6</sup> Only valid during start-up

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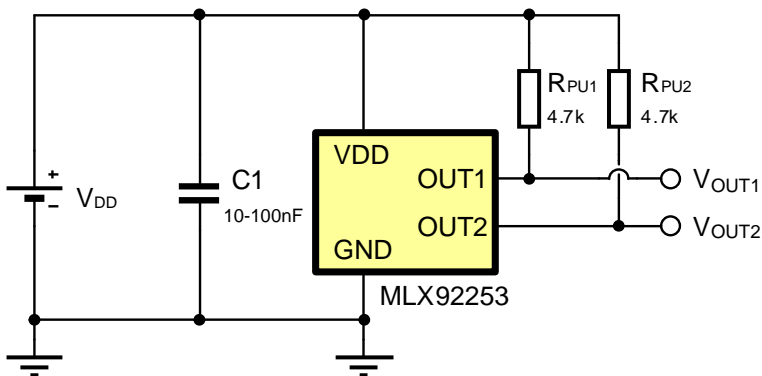
## 9. Magnetic Specification

Operating conditions  $V_{DD}$  2.7V to 5.5V,  $T_A$  -40°C to 150°C (unless otherwise specified)

Parameter	Symbol	Min	Typ <sup>(1)</sup>	Max	Unit	Condition
Operating point	$B_{OP}$	0.2	1.5	2.8	mT	
Release point	$B_{RP}$	-2.8	-1.5	-0.2	mT	
Temperature coefficient <sup>(2,3)</sup>	TC	-	0	-	ppm/°C	
Symmetry <sup>(3)</sup>	$B_{sym}$	-1.7	-	1.7	mT	$B_{opz} + B_{rpz}$ , $B_{opx} + B_{rpx}$
Operating point Symmetry <sup>(3)</sup>	$B_{sym\_op}$	-1.7	-	1.7	mT	$B_{opz} - B_{opx}$
Release point Symmetry <sup>(3)</sup>	$B_{sym\_rp}$	-1.7	-	1.7	mT	$B_{rpz} - B_{rpx}$

## 10. Detailed Description

### 10.1. Application schematic



**Note:**

For proper operation a 10-100nF bypass capacitor should be connected between the supply and ground as close to the VDD and GND pins as possible.

<sup>1</sup> Typical values are given for  $T_A = 25^\circ\text{C}$  and  $V_{DD} = 5\text{V}$

<sup>2</sup> The temperature coefficient is calculated using the following formula:

$$TC = \frac{B_{T_2} - B_{T_1}}{B_{25^\circ\text{C}} \times (T_2 - T_1)} \times 10^6 \left[ \frac{\text{ppm}}{^\circ\text{C}} \right], \text{ Where } T_1 = -40^\circ\text{C} \text{ and } T_2 = 150^\circ\text{C}$$

<sup>3</sup> Guaranteed by design and verified during characterization, not production tested

## 10.2. Start-up feedback

The start-up feedback turns the outputs of the device into inputs during the power-on time. After  $t_{PON}$  has elapsed the chip will use the externally provided states of the outputs to configure the references of the comparators for each channel. After  $t_{PON}$  the state of each output will depend on the applied field on each axis. If the applied field is not sufficiently strong to trigger a switch, the outputs will remain in the states that were externally provided during start-up.

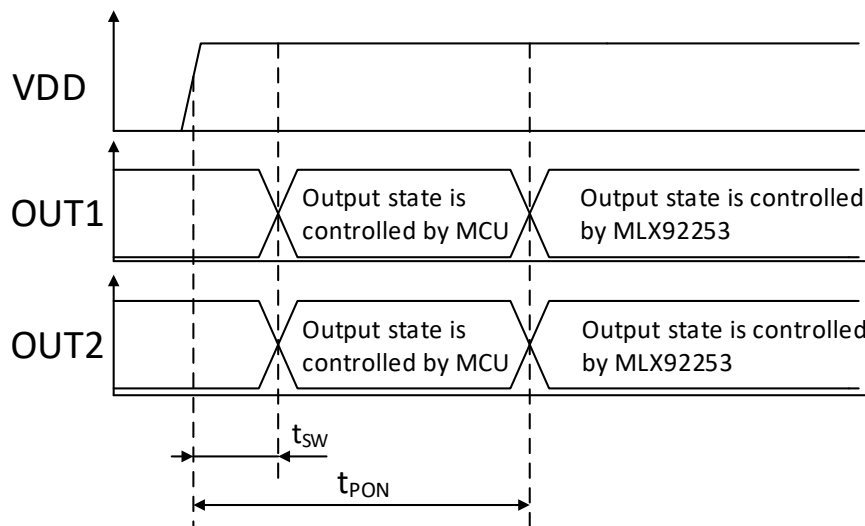


Figure 3

Shown in *Figure 3* is a timing diagram of a typical start-up procedure. Where  $t_{SW}$  is the time from providing power to the chip to providing valid start-up state on the output pins,  $t_{PON}$  is the time from the moment  $V_{DD} = V_{POR}$  until the first update of the output state. The duration of  $t_{SW}$  should not exceed 5 $\mu$ s, exceeding this time could lead to unsuccessful configuration of the device.  $t_{SW}$  can be 0 $\mu$ s or even have a negative value. Therefore, the state of the outputs can be provided to the chip simultaneously with the VDD or even before applying the VDD. The start-up state should be provided for the full duration of  $t_{PON}$ . For more information about  $t_{PON}$  refer the chapter “8. General electrical specifications”.

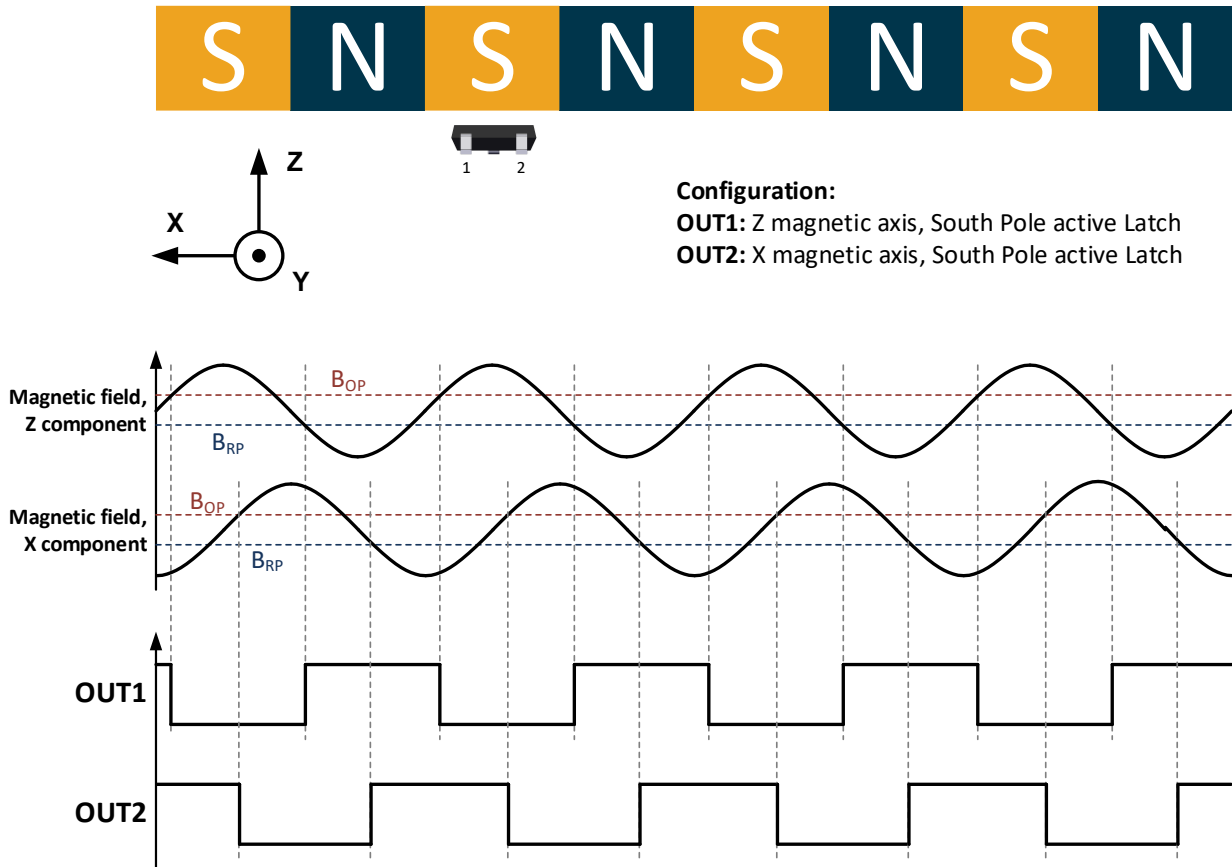


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## 10.3. Output function

Shown in the diagram below is the output behavior with respect to the position of a magnet. The direction of movement/rotation, the position (number of magnetic poles passed by) and speed can all be extracted from the two output signals.

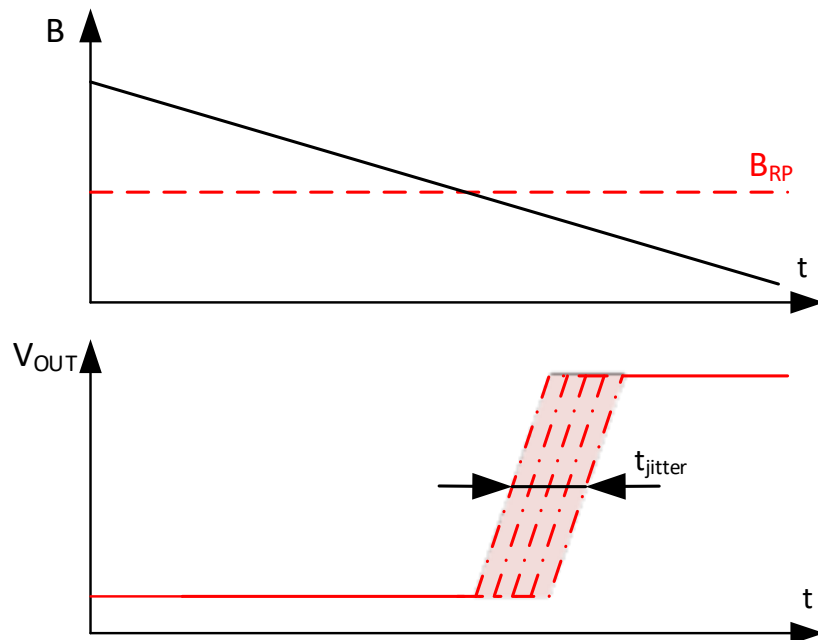


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## 10.4. Output jitter

Output jitter is measured over a period of 1000 consecutive switching events. A magnetic field with triangular form, switching frequency  $F = 10\text{kHz}$  and amplitude  $B_{\text{PEAK}} = \pm 30\text{mT}$  is applied. The parameter  $t_{\text{jitter}}$  is calculated as the difference between the maximum and minimum reaction times of the device.

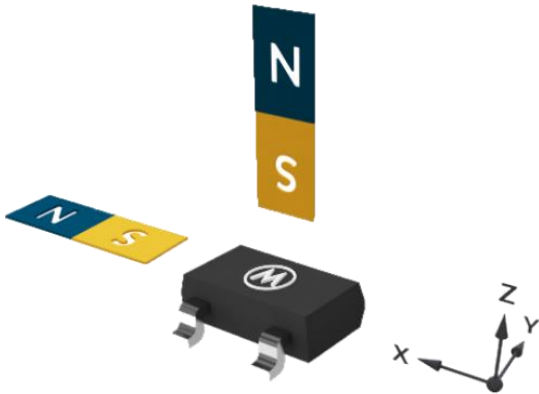


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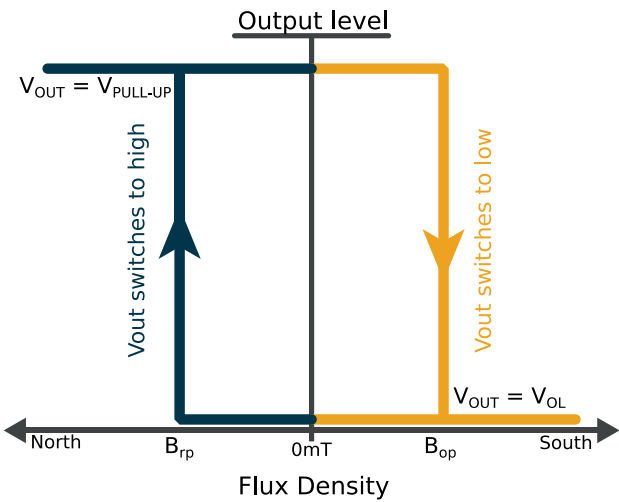
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## 11. Magnetic Behavior

### 11.1. Active magnetic pole definition



### 11.2. Output characteristics



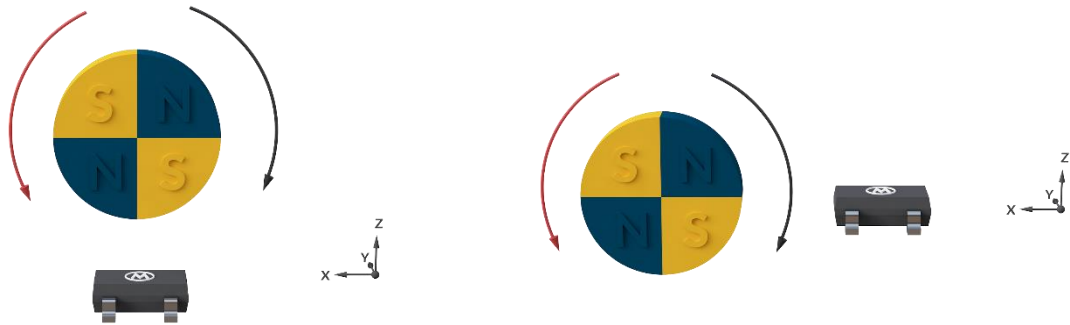
Magnetic Pole	Output state	Condition
South pole	LOW	$B > B_{OP}$
North pole	HIGH <sup>(1)</sup>	$B < B_{RP}$

<sup>1</sup> Default start-up state when the start-up feedback is not used.

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## 11.3. Indexing magnet position



ZX configuration

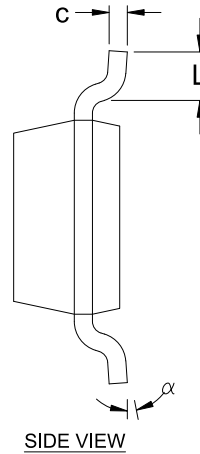
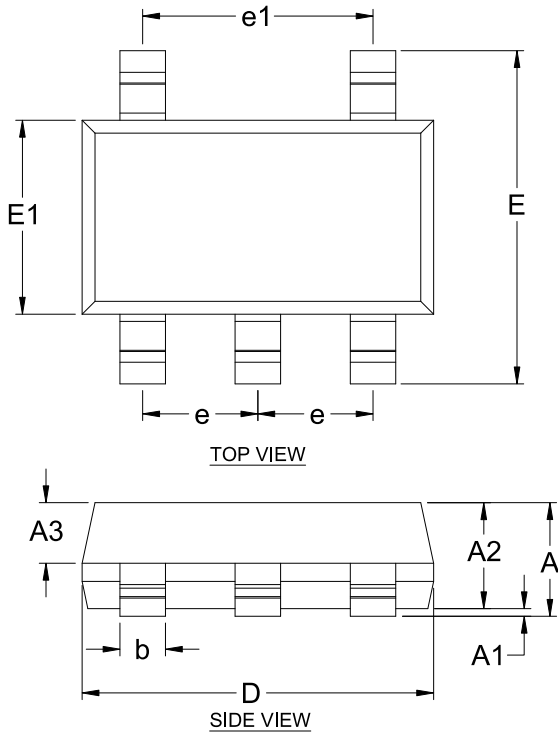
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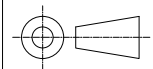
## 12. Package Information

### 12.1. TSOT-5L (SE Package)

#### 12.1.1. TSOT-5L – Package dimensions



SYMBOL	MINIMUM	MAXIMUM
A	---	1.00
A1	0.025	0.10
A2	0.85	0.90
A3	0.50 BSC	
D	2.80	3.00
E	2.60	3.00
E1	1.50	1.70
L	0.30	0.50
b	0.30	0.45
c	0.10	0.20
e	0.95 BSC	
e1	1.90 BSC	
$\alpha$	0°	8°



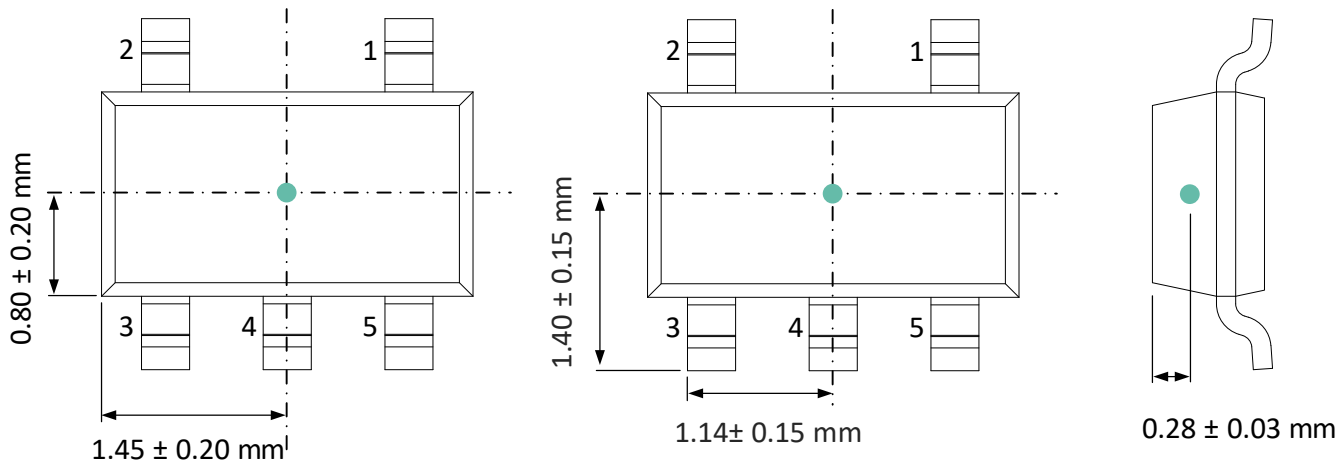
NOTE :

1. ALL DIMENSIONS IN MILLIMETERS (mm) UNLESS OTHERWISE STATED.
2. DIMENSION D DOES NOT INCLUDE MOLD FLASH OR PROTRUSIONS OF MAX 0.15 mm PER SIDE.
3. DIMENSION E DOES NOT INCLUDE MOLD FLASH OR PROTRUSIONS OF MAX 0.25 mm PER SIDE.
4. DIMENSION b DOES NOT INCLUDE DAMBAR PROTRUSION OF MAX 0.07 mm.
5. DIMENSION L IS THE LENGTH OF THE TERMINAL FOR SOLDERING TO A SUBSTRATE.
6. FORMED LEAD SHALL BE PLANAR WITH RESPECT TO ONE ANOTHER WITH 0.076 mm SEATING PLANE.

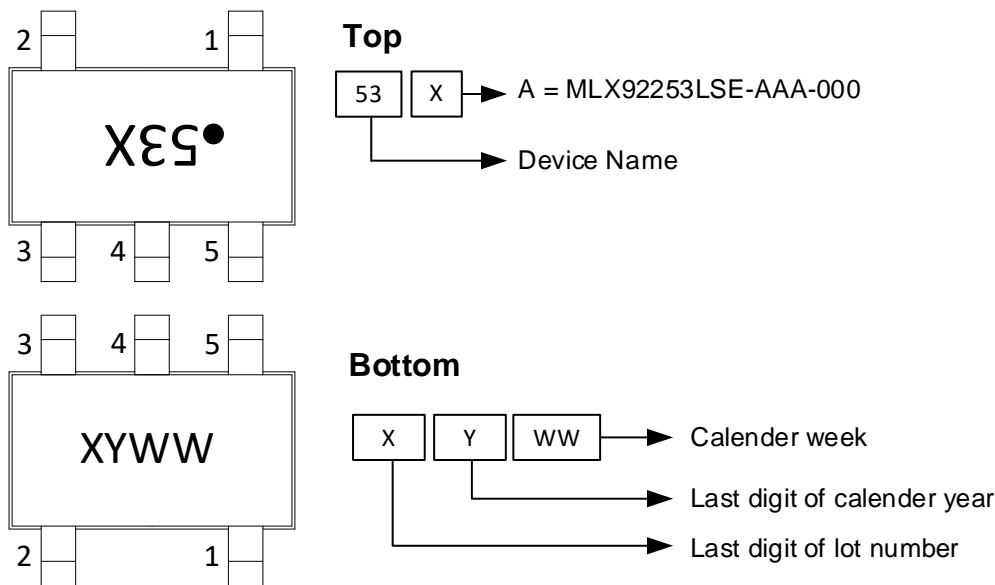
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## 12.2. TSOT-5L – Sensitive spot



### 12.2.1. TSOT-5L – Package marking



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## 13. Standard Information

### 13.1. Storage and handling of plastic encapsulated ICs

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

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

For more information refer to Melexis [\*Guidelines for storage and handling of plastic encapsulated ICs\*](#) <sup>(1)</sup>

### 13.2. Assembly of encapsulated ICs

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

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

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

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

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

Environmental protection of customer assembly with Melexis products for harsh media application, is applicable by means of coating, potting or overmolding considering restrictions listed in the relevant application notes <sup>(15)</sup>.

For other specific process, contact Melexis via [www.melexis.com/technical-inquiry](http://www.melexis.com/technical-inquiry)

### 13.3. Environment and sustainability

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

## 14. ESD Precautions

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

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<sup>1</sup> [www.melexis.com/ic-handling-and-assembly](http://www.melexis.com/ic-handling-and-assembly)

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## 15. Contact

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