

## Dual Hall Effect Latch with two Speed Outputs

### 1. Features and Benefits

- Operating Voltage from 2.7V to 5.5V
- Two Integrated Hall plates for Direction Detection
- Latching Magnetic Characteristics
- Feedback loop during power-on

### 2. Application Examples

- Windows lifter with Anti-Pinch feature
- Rotation speed & direction detection
- Linear speed & direction detection
- Angular position detection
- Power closures with Anti-Pinch features

### 3. Description

The Melexis MLX92255 is a second generation Hall-effect dual latch designed in mixed signal CMOS technology. The device integrates a voltage regulator, two Hall sensors with advanced offset cancellation system and two open-drain output drivers, all in a single package.

Two Hall plates are integrated on the same piece of silicon, thus using the high precision of the wafer fabrication process to ensure a fixed spacing of 1.45mm between the sensing elements.

With latching magnetic characteristics, both speed outputs (OUT1, OUT2) are turned low or high respectively with a sufficiently strong South or North pole facing the package top side. When removing the magnetic field, the device keeps its previous state.

During Startup communication with the IC is possible to load the previous state into the registers of our IC. This will then be used as a starting point.

The MLX92255 is delivered in a Green compliant 5-pin Thin Small Outline Transistor (TSOT) for surface-mount process.

The block diagram is shown on Figure 1.

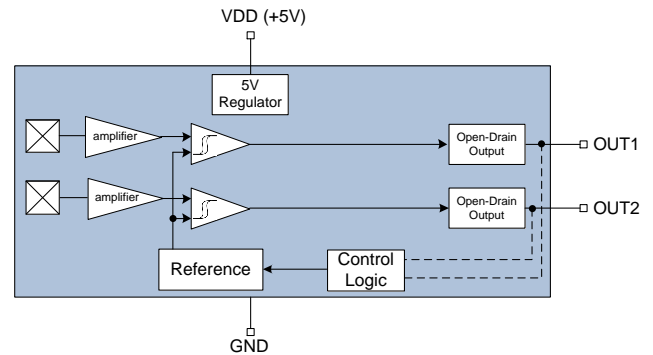


Figure 1

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## 4. Ordering Information

| Product     | Temperature | Package | Option Code | Packing Form | Definition                   |
|-------------|-------------|---------|-------------|--------------|------------------------------|
| MLX92255LSE | L           | SE      | AAA-001     | RE           | Sensitivity $\pm 3\text{mT}$ |

Table 1

## 5. Glossary of Terms

| Abbreviation         | Description   |
|----------------------|---|
| TC                   | Temperature Coefficient [ppm/°C]  |
| Gauss (G), Tesla (T) | Units for the magnetic flux density – 1 mT = 10 G   |
| RoHS                 | Restriction of Hazardous Substances   |
| TSOT                 | Thin Small Outline Transistor (TSOT package) – also referred with the Melexis package code “SE” |
| ESD                  | Electro-Static Discharge  |

Table 2

## 6. Pin Definitions and Descriptions

### 6.1. Pin Definition for TSOT-5L

| Pin No. | Name | Description                        |
|---------|------|------------------------------------|
| 1       | OUT1 | Start-up input/Open-Drain Output 1 |
| 2       | OUT2 | Start-up input/Open-Drain Output 2 |
| 3       | VDD  | Power Supply                       |
| 4       | GND  | Ground pin                         |
| 5       | GND  | Ground pin                         |

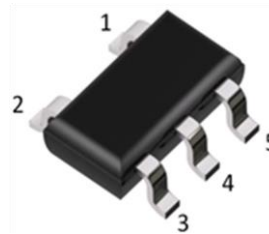


Table 3

## 7. Absolute Maximum Ratings

| Parameter                            | Symbol    | Min. | Typ. | Max.      | Unit |
|--------------------------------------|-----------|------|------|-----------|------|
| Supply Voltage                       | $V_{DD}$  | -0.5 |      | 6         | V    |
| Supply Current <sup>(1)</sup>        | $I_{DD}$  | -20  |      | 20        | mA   |
| Output Voltage                       | $V_{OUT}$ | -0.5 |      | 6         | V    |
| Output Current <sup>(1)</sup>        | $I_{OUT}$ | -20  |      | 20        | mA   |
| Operating Temperature Range          | $T_A$     | -40  |      | 150       | °C   |
| Maximum Junction Temperature         | $T_J$     |      |      | 165       | °C   |
| ESD Sensitivity – HBM <sup>(2)</sup> | -         |      |      | 8         | kV   |
| ESD Sensitivity – CDM <sup>(3)</sup> | -         |      |      | 1000      | V    |
| Magnetic Flux Density                | B         |      |      | Unlimited | mT   |

Table 4

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

<sup>1</sup> Including current through the protection structure. Max Power dissipation should be also considered

<sup>2</sup> Human Body Model according AEC-Q100-002 standard

<sup>3</sup> Charged Device Model according AEC-Q100-011 standard

## 8. General Electrical Specifications

DC Operating Parameters  $T_A = -40^{\circ}\text{C}$  to  $150^{\circ}\text{C}$ ,  $V_{DD} = 2.7\text{V}$  to  $5.5\text{V}$  (unless otherwise specified)

| Electrical Parameter                         | Symbol       | Min. | Typ. <sup>(1)</sup> | Max. | Unit                        | Condition  |
|--|--------------|------|---------------------|------|-----------------------------|--|
| Supply Voltage                               | $V_{DD}$     | 2.7  | -                   | 5.5  | V                           | Operating  |
| Supply Current                               | $I_{DD}$     | 3    | 5                   | 7    | mA                          |  |
| Output Leakage Current                       | $I_{OFF}$    |      | 0.001               | 5    | $\mu\text{A}$               | $V_{OUT} = 5.5\text{V}$ , $B < B_{RP}$   |
| Output Saturation Voltage                    | $V_{OUTS}$   |      | 0.15                | 0.4  | V                           | $B > B_{OP}$ , $I_{OUT} = 5\text{mA}$  |
| Output Rise/Fall Time <sup>(2,3)</sup>       | $t_R / t_F$  |      | 0.3                 |      | $\mu\text{s}$               | $V_{DD} = 5\text{V}$ , $V_{PU}$ <sup>(4)</sup> = 5V,<br>$R_{PU} = 1\text{k}\Omega$ , $C_L = 50\text{pF}$ |
| Chopping Frequency                           | $f_{CHOP}$   |      | 500                 |      | kHz                         |  |
| Output Refresh Period                        | $t_{PER}$    |      | 4                   | 6    | $\mu\text{s}$               |  |
| Output Jitter (p-p value) <sup>(2)</sup>     | $t_{JITTER}$ |      | 4.8                 |      | $\mu\text{s}$               | Over 1000 successive output switching events @10kHz triangle wave, $B_{PEAK} = 30\text{mT}$              |
| Maximum Switching Frequency <sup>(2,5)</sup> | $f_{SW}$     | 40   | 66                  |      | kHz                         | $\geq 10\text{mT}$ triangle wave magnetic field  |
| Power-On Reset Voltage <sup>(6)</sup>        | $V_{POR}$    |      | 2.5                 | 2.6  | V                           |  |
| Power-On Time <sup>(7)</sup>                 | $t_{PON}$    |      | 20                  | 40   | $\mu\text{s}$               | $V_{DD} = 5\text{V}$ , $dV_{DD}/dt > 2\text{V}/\mu\text{s}$  |
| Input High Voltage <sup>(8)</sup>            | $V_{IH}$     | 2.0  | -                   | 5.5  | V                           |  |
| Input Low Voltage <sup>(8)</sup>             | $V_{IL}$     | -    | -                   | 0.8  | V                           |  |
| SE Package Thermal Resistance                | $R_{THJA}$   |      | 300                 |      | $^{\circ}\text{C}/\text{W}$ | Single layer (1S) JEDEC board  |

Table 5

1 Typical values are defined at  $T_A = +25^{\circ}\text{C}$  and  $V_{DD} = 5\text{V}$

2 Guaranteed by design and verified by characterization, not production tested

3 Measured between  $0.1 \cdot V_{PU}$  and  $0.9 \cdot V_{PU}$

4  $R_{PU}$  and  $V_{PU}$  are respectively the external pull-up resistor and pull-up power supply

5 Maximum switching frequency corresponds to the maximum frequency of the applied magnetic field which is detected without loss of pulses

6 If  $V_{DD}$  drops below  $V_{POR}$  the output is reset to High state

7 The Power-On Time represents the time from reaching  $V_{DD} = 2.7\text{V}$  to the first refresh of the outputs

8 Applicable for OUT1 and OUT2 during start-up

## 9. Magnetic Specifications

### 9.1. MLX92255LSE-AA-001

DC Operating Parameters  $T_A = -40^{\circ}\text{C}$  to  $150^{\circ}\text{C}$ ,  $V_{DD} = 2.7\text{V}$  to  $5.5\text{V}$  (unless otherwise specified)

| Parameter                              | Symbol      | Min. | Typ. <sup>(1)</sup> | Max. | Unit                    | Condition   |
|--|-------------|------|---------------------|------|-------------------------|---|
| Operating Point                        | $B_{OP}$    | 0.5  | 3.0                 | 5.5  | mT                      |   |
| Release Point                          | $B_{RP}$    | -5.5 | -3.0                | -0.5 | mT                      |   |
| Hysteresis <sup>(2)</sup>              | $B_{HYST}$  | 3    | 6                   | 10   | mT                      | $T_A = -40^{\circ}\text{C}$ to $150^{\circ}\text{C}$                    |
|  |             | 4    | 6                   | 10   | mT                      | $T_A = -40^{\circ}\text{C}$ to $55^{\circ}\text{C}$                     |
| Magnetic Matching                      | $B_{MATCH}$ | -2   |                     | 2    | mT                      | $B_{OP1} - B_{OP2}$ or $B_{RP1} - B_{RP2}$ , $T_A = 25^{\circ}\text{C}$ |
|  |             | -3   |                     | 3    | mT                      | $B_{OP1} - B_{OP2}$ or $B_{RP1} - B_{RP2}$                              |
| Magnetic Offset                        | $B_{OFF}$   | -2   |                     | 2    | mT                      | $(B_{OP1} + B_{RP1}) / 2$ , $(B_{OP2} + B_{RP2}) / 2$                   |
| Temperature Coefficient <sup>(3)</sup> | TC          |      | -1800               |      | ppm/ $^{\circ}\text{C}$ |   |
| Hall Sensors Spacing                   | -           |      | 1.45                |      | mm                      |   |

Table 6

1 Typical values are defined at  $T_A = +25^{\circ}\text{C}$  and  $V_{DD} = 5\text{V}$

2 Guaranteed by design and verified by characterization, not production tested

3 Temperature coefficient value is guaranteed by design and verified by characterization and is calculated using the following formula:

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

## 10. Output Behavior versus Magnetic Pole

DC Operating Parameters  $T_A = -40^{\circ}\text{C}$  to  $150^{\circ}\text{C}$ ,  $V_{DD} = 2.7\text{V}$  to  $5.5\text{V}$  (unless otherwise specified)

| Parameter  | Output State        | Condition    |
|------------|---------------------|--------------|
| South pole | Low                 | $B > B_{OP}$ |
| North pole | High <sup>(1)</sup> | $B < B_{RP}$ |

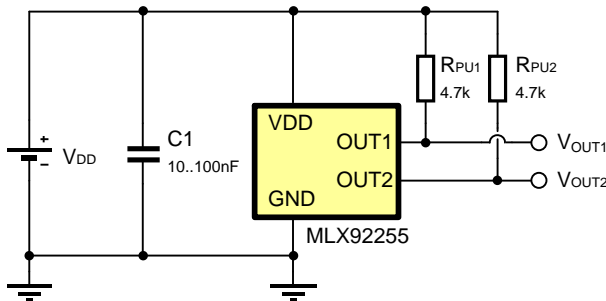
Table 7: Output behavior versus magnetic pole <sup>(2)</sup>

<sup>1</sup> Default output state during power-up

<sup>2</sup> Magnetic pole applied perpendicularly to Hall plate, facing the branded/top side of the package

## 11. Application Information

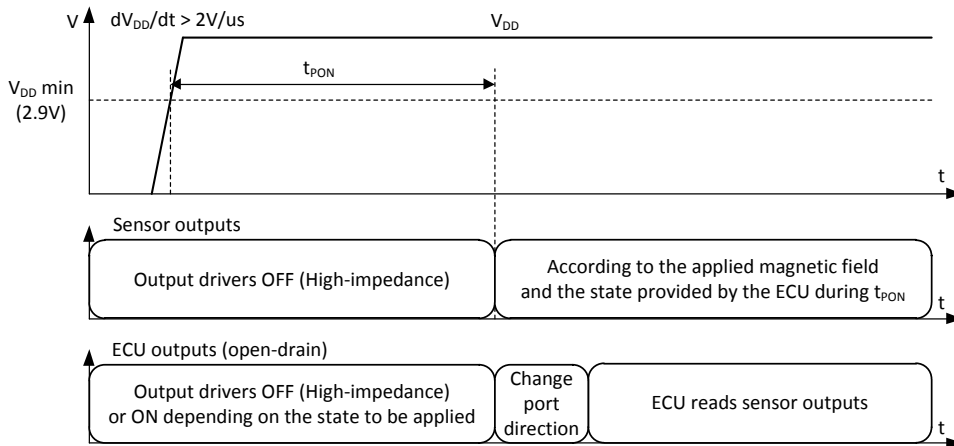
### 11.1. Default Application Schematic



**Note:**

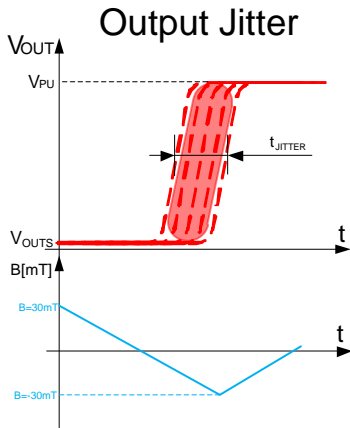
1. For proper operation, a 10nF to 100nF bypass capacitor should be placed as close as possible to the V<sub>DD</sub> and ground pin.

### 11.2. Start-up procedure





### 11.3. Output Jitter



## 12. Standard Information

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

### Reflow Soldering SMD's (Surface Mount Devices)

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

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

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

### Iron Soldering THD's (Through Hole Devices)

- EN60749-15  
Resistance to soldering temperature for through-hole mounted devices

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

- EIA/JEDEC JESD22-B102 and EN60749-21  
Solderability

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

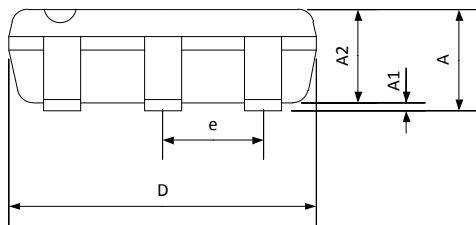
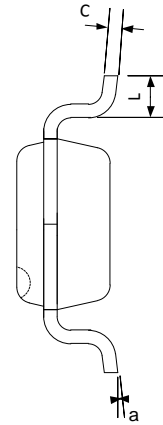
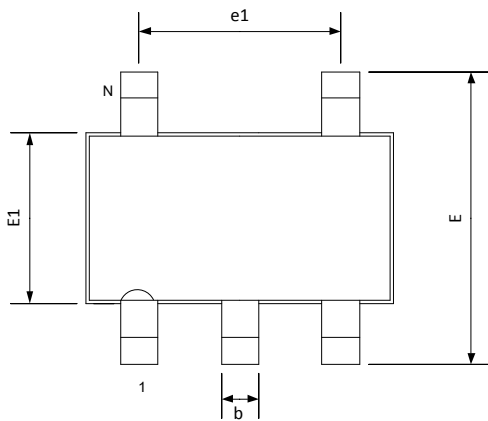
The application of Wave Soldering for SMD's is allowed only after consulting Melexis regarding assurance of adhesive strength between device and board.

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/quality.aspx>

## 13. ESD Precautions

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

## 14. SE Package Information



**Notes:**

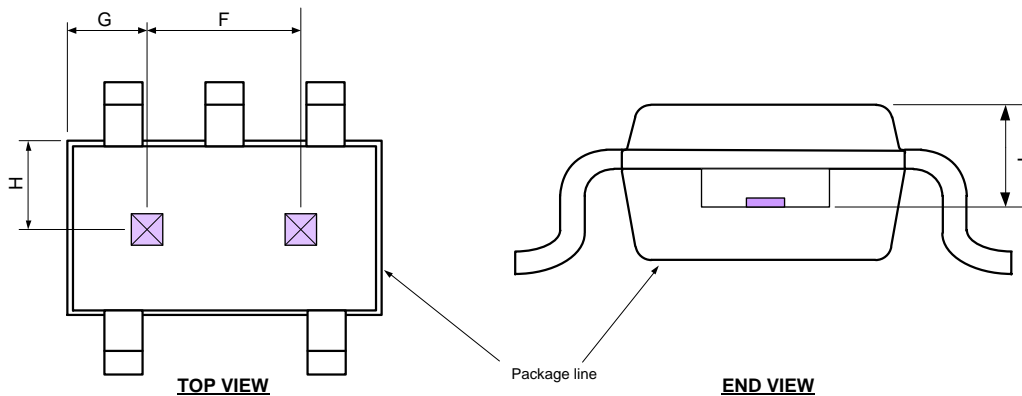
1. Dimension "D" and "E1" do not include mold flash or protrusions. Mold flash or protrusion shall not exceed 0.15mm on "D" and 0.25mm on "E" per side.
2. Dimension "b" does not include dambar protrusion.
3. This part is compliant with JEDEC specification MO-193. This part is full compliance to EIAJ specification SC-74.

**Marking:**

Top Side: ●55A – Name of the Device (MLX92255)

Bottom Side: xyww x = last digit of lot number  
y = last digit of year  
ww = week

**Hall plate location**



This table in mm

| N | A   | A1   | A2    | D    | E    | E1   | L    | b    | c    | e    | e1   | F    | G     | H   | I     | $\alpha$ |
|---|-----|------|-------|------|------|------|------|------|------|------|------|------|-------|-----|-------|----------|
| 5 | min | –    | 0.025 | 0.85 | 2.80 | 2.60 | 1.50 | 0.30 | 0.30 | 0.10 | 0.95 | 1.45 | 0.525 | 0.6 | 0.562 | 0°       |
|   | max | 1.00 | 0.10  | 0.90 | 3.00 | 3.00 | 1.70 | 0.50 | 0.45 | 0.20 | BSC  | 1.45 | 0.925 | 1   | 0.622 | 8°       |

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