

# MLX92223LUA-AAA

2-Wire Hall Effect Latch with Resistive Output Characteristic

## 1. Features and Benefits

- Emulates 392Ω resistor
- Wide operating voltage range: from 3.8V to 16V
- Reverse supply voltage protection
- Advanced thermal management with current limit and thermal protection
- Integrated decoupling capacitor for PCB less designs.

## 2. Application Examples

- Automotive, Consumer and Industrial
- Seat positioning
- Seat Motor

## 3. Ordering Information

| Product Code | Temperature Code | Package Code | Option Code | Packing Form Code |
|--------------|------------------|--------------|-------------|-------------------|
| MLX92223     | L                | UA           | AAA-1xx     | BU                |

### Legend:

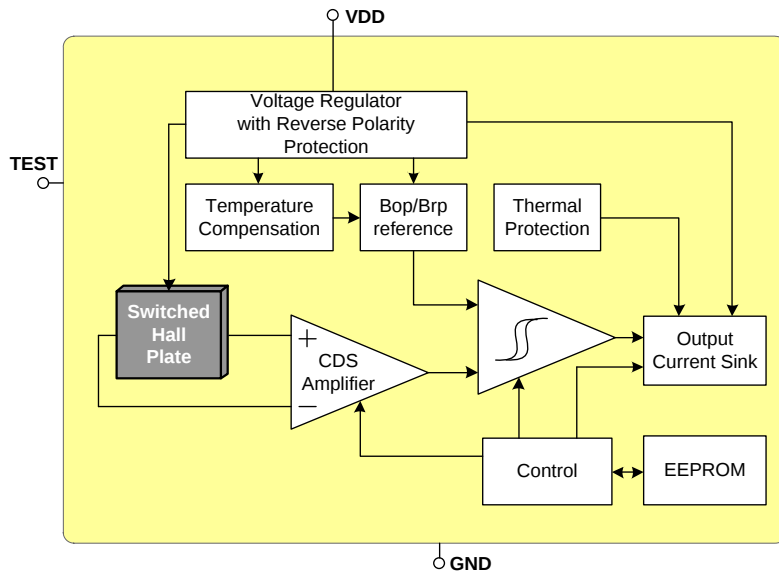
Temperature Code: L (-40°C to 150°C)  
Package Code: UA = T092-3L  
Option Code: AAA-1xx = 2 wire hall effect Latch with integrated capacitor

Packing Form: BU = Bulk | RE = Reel | CA = Ammopack delivery  
Ordering example: MLX92223LUA-AAA-1xx-BU

# MLX92223LUA-AAA

2-Wire Hall Effect Latch with Resistive Output Characteristic

## 4. Functional Diagram



## 5. General Description

The Melexis MLX92223 is based on the Melexis Hall-effect switch latest platform, designed in mixed signal submicron CMOS technology.

The device integrates a voltage regulator, Hall sensor, current sink-configured output driver and integrated capacitor all in a single package.

The MLX92223 magnetic core is using an advanced offset cancellation system. In addition a pre-programmable temperature coefficient is implemented to compensate the natural behavior of certain types of magnets becoming weaker at high temperature.

The included voltage regulator operates from 3.8 to 16V, hence covering a wide range of applications. With the built-in reverse voltage protection, a series diode on the supply line is not required so that even remote sensors can be specified for low voltage operation down to 3.8V while being reverse voltage tolerant.

Advanced thermal management with current limit above  $V_{DD} = 16.8V$  is implemented. The on-chip thermal protection switches the supply current below  $I_{PROT}$  if the junction temperature increases above the protection threshold  $T_{PROT}$ . It will automatically recover once the temperature decreases below  $T_{REL}$ .

The MLX92223 is delivered in a Green and RoHS compliant Plastic Single-in-Line (TO-92 flat) for through-hole mount and with integrated capacitor for PCB-less design.

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## 6. Glossary of Terms

|       |                                                      |
|-------|------------------------------------------------------|
| Tesla | Units for the magnetic flux density, 1 mT = 10 Gauss |
| TC    | Temperature Coefficient , ppm/°C                     |
| NC    | Not Connected                                        |
| POR   | Power on Reset                                       |

## 7. 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.

| Parameter                                   | Symbol             | Conditions                                                                            | Value     | Units |
|---------------------------------------------|--------------------|---------------------------------------------------------------------------------------|-----------|-------|
| Supply Voltage <sup>(1, 2)</sup>            | V <sub>DD</sub>    |                                                                                       | +28       | V     |
| Battery Voltage <sup>(1, 6)</sup>           | V <sub>B</sub>     | 1 min, R <sub>S</sub> =182Ω±1%, T <sub>A</sub> =85°C,<br>B<B <sub>OP</sub>            | +24       | V     |
| Battery Voltage <sup>(1, 6)</sup>           | V <sub>B</sub>     | 1 min jump-start, R <sub>S</sub> =182Ω±1%,<br>T <sub>A</sub> =25°C, B<B <sub>OP</sub> | +26       | V     |
| Battery Voltage <sup>(1, 6)</sup>           | V <sub>B</sub>     | 0.5s load dump, R <sub>S</sub> =182Ω±1%,<br>T <sub>A</sub> =25°C, B<B <sub>OP</sub>   | +35       | V     |
| Reverse Supply Voltage <sup>(1, 2)</sup>    | V <sub>DDREV</sub> |                                                                                       | -24       | V     |
| Reverse Supply Voltage <sup>(1)</sup>       | V <sub>DDREV</sub> | For 500ms                                                                             | -30       | V     |
| Maximum Junction Temperature <sup>(3)</sup> | T <sub>J</sub>     |                                                                                       | +165      | °C    |
| ESD Sensitivity – HBM <sup>(4)</sup>        | -                  |                                                                                       | 8         | kV    |
| ESD Sensitivity – CDM <sup>(5)</sup>        | -                  |                                                                                       | 1000      | V     |
| ESD Sensitivity – System ESD <sup>(7)</sup> |                    |                                                                                       | 8         | kV    |
| Magnetic Flux Density                       | B                  |                                                                                       | Unlimited | mT    |

Table 1: Absolute maximum ratings

<sup>1</sup> The maximum junction temperature should not be exceeded

<sup>2</sup> For maximum 1 hour

<sup>3</sup> For 1000 hours.

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

<sup>5</sup> Charged Device Model according AEC-Q100-011 standard

<sup>6</sup> Refer to section "Typical Automotive Application Circuit"

<sup>7</sup> System level ESD, contact discharge VDD-GND (330Ω, 150pF)

## 8. General Electrical Specifications

Electrical Operating Parameters,  $V_{DD} = 3.8V$  to  $16V$ ,  $T_J = -40^{\circ}C$  to  $165^{\circ}C$  (unless otherwise specified)

| Parameter                                  | Symbol       | Test Conditions                                                                                 | Min  | Typ <sup>(1)</sup> | Max  | Units         |
|--------------------------------------------|--------------|-------------------------------------------------------------------------------------------------|------|--------------------|------|---------------|
| OFF Supply Current                         | $I_{OFF}$    |                                                                                                 | 4.5  | -                  | 7.5  | mA            |
| ON Supply Current                          | $I_{ON}$     |                                                                                                 | -    | $I_{OFF} + I_R$    | -    | mA            |
| Proportional Supply Current Part           | $I_R$        | $V_{DD} = 3.8V$ to $16V$                                                                        | -10% | $V_{DD}/392\Omega$ | +10% | mA            |
|                                            |              | $V_{DD} > 16.8V$                                                                                | 36   | 43                 |      | mA            |
| Protection Supply Current                  | $I_{PROT}$   |                                                                                                 | -    | -                  | 1    | mA            |
| Reverse Supply Current                     | $I_{DDREV}$  | $V_{DD} = -16V$                                                                                 | -1   | -                  | -    | mA            |
| Supply Current Rise Time <sup>(2)</sup>    | $t_{R\,IDD}$ | $V_B = 12V$ , $R_S \leq 1\Omega$                                                                | 0.7  | 1.7                | 4    | $\mu s$       |
| Supply Current Fall Time <sup>(2)</sup>    | $t_{F\,IDD}$ | $V_B = 12V$ , $R_S \leq 1\Omega$                                                                | 0.4  | 1                  | 2.5  | $\mu s$       |
| Supply Voltage Rise Time <sup>(2)</sup>    | $t_{R\,VDD}$ | $V_B = 12V$ , $R_S = 182\Omega$ ,<br>$C_{bypass} = 68nF$                                        | -    | 27                 | -    | $\mu s$       |
| Supply Voltage Fall Time <sup>(2)</sup>    | $t_{F\,VDD}$ | $V_B = 12V$ , $R_S = 182\Omega$ ,<br>$C_{bypass} = 68nF$                                        | -    | 19                 | -    | $\mu s$       |
| Power-On Time <sup>(3, 4)</sup>            | $t_{ON}$     | $V_{DD} = 5V$ , $dV_{DD}/dt > 2V/\mu s$ ,<br>$B < B_{OP} - 1mT$                                 | -    | 40                 | 70   | $\mu s$       |
| Chopping Frequency                         | $f_{CHOP}$   |                                                                                                 | -    | 350                | -    | kHz           |
| Maximum Switching Frequency <sup>(2)</sup> | $f_{SW}$     | Triangular magnetic field with<br>$B_{pk-pk} \geq 10 \times B_{OP}$<br>$B_{OP} = -B_{RP} = 1mT$ | -    | 50                 | -    | kHz           |
| Integrated bypass capacitor                | $C_{BP}$     |                                                                                                 | -    | 68                 | -    | nF            |
| Thermal Protection Activation              | $T_{PROT}$   |                                                                                                 | -    | 190 <sup>(5)</sup> | -    | $^{\circ}C$   |
| Thermal Protection Release                 | $T_{REL}$    |                                                                                                 | -    | 180 <sup>(5)</sup> | -    | $^{\circ}C$   |
| UA Package Thermal Resistance              | $R_{THJA}$   |                                                                                                 | -    | 165                | -    | $^{\circ}C/W$ |

Table 2: General electrical parameters

<sup>1</sup> Typical values are defined at  $T_A = +25^{\circ}C$  and  $V_{DD} = 12V$ .

<sup>2</sup> Guaranteed by design and verified by characterization, not production tested.

<sup>3</sup> The Power-On Time represents the time from reaching  $V_{DD} = 3.8V$  to the first refresh of the supply current state.

<sup>4</sup> Power-On Slew Rate is not critical for the proper device start-up.

<sup>5</sup>  $T_{PROT}$  and  $T_{REL}$  are the corresponding junction temperature values.

## 9. Magnetic Specifications

### 9.1. MLX92223LUA-AAA-100

Magnetic Parameters,  $V_{DD} = 3.8V$  to  $16V$ ,  $T_J = -40^{\circ}C$  to  $165^{\circ}C$  (unless otherwise specified)

| Test Condition       | Operating Point<br>$B_{OP}$ (mT) |                    |     | Release Point<br>$B_{RP}$ (mT) |                    |     |
|----------------------|----------------------------------|--------------------|-----|--------------------------------|--------------------|-----|
|                      | Min                              | Typ <sup>(1)</sup> | Max | Min                            | Typ <sup>(1)</sup> | Max |
| $T_J = -40^{\circ}C$ | -16                              | -10                | -6  | 6                              | 10                 | 16  |
| $T_J = 25^{\circ}C$  | -14                              | -10                | -7  | 7                              | 10                 | 14  |
| $T_J = 150^{\circ}C$ | -16                              | -10                | -6  | 6                              | 10                 | 16  |

## 10. Magnetic Behavior

### 10.1. Latch Sensor

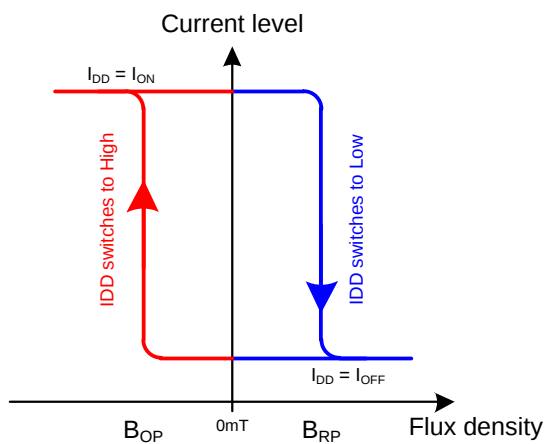
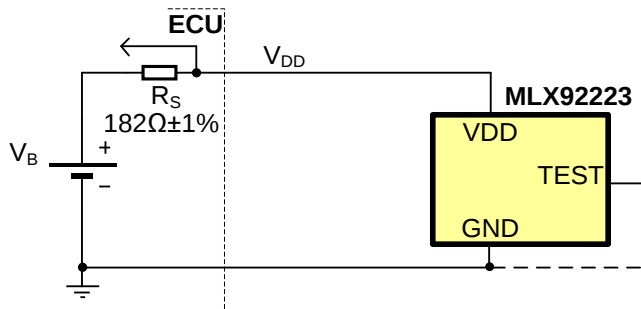


Fig.1 – North Pole Active

<sup>1</sup> Typical values are defined at  $T_A = +25^{\circ}C$  and  $V_{DD} = 12V$ .

## 11. Application Information

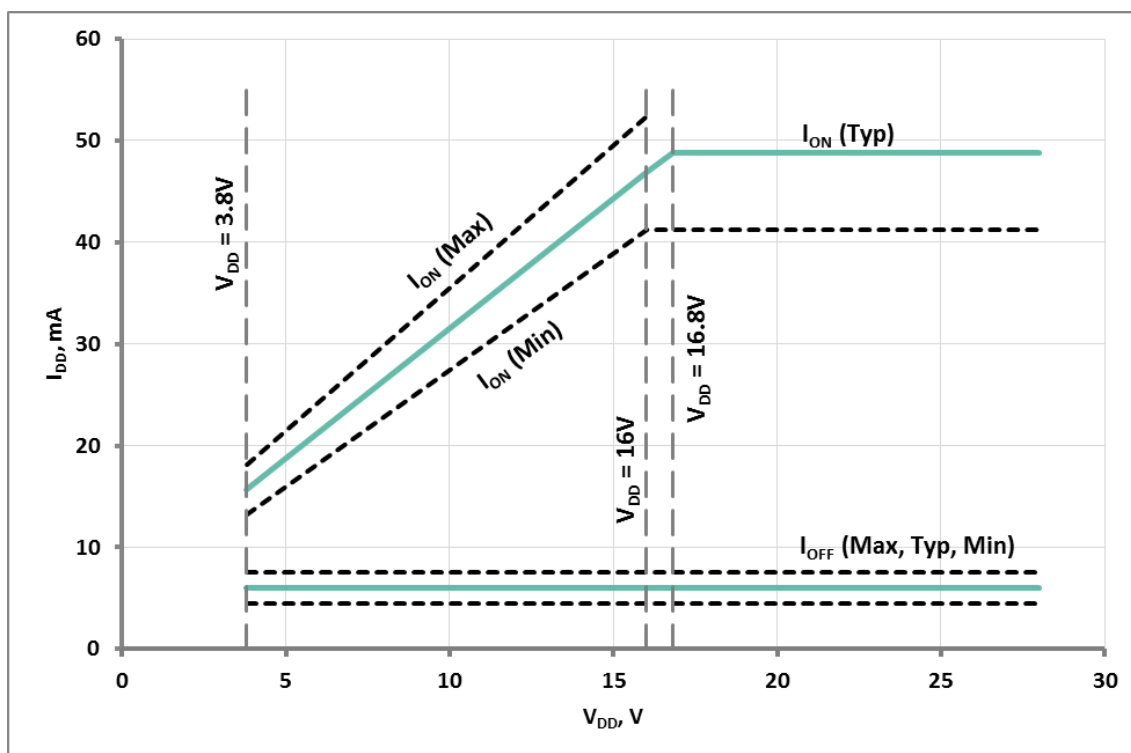
### 11.1. Typical Automotive Application Circuit



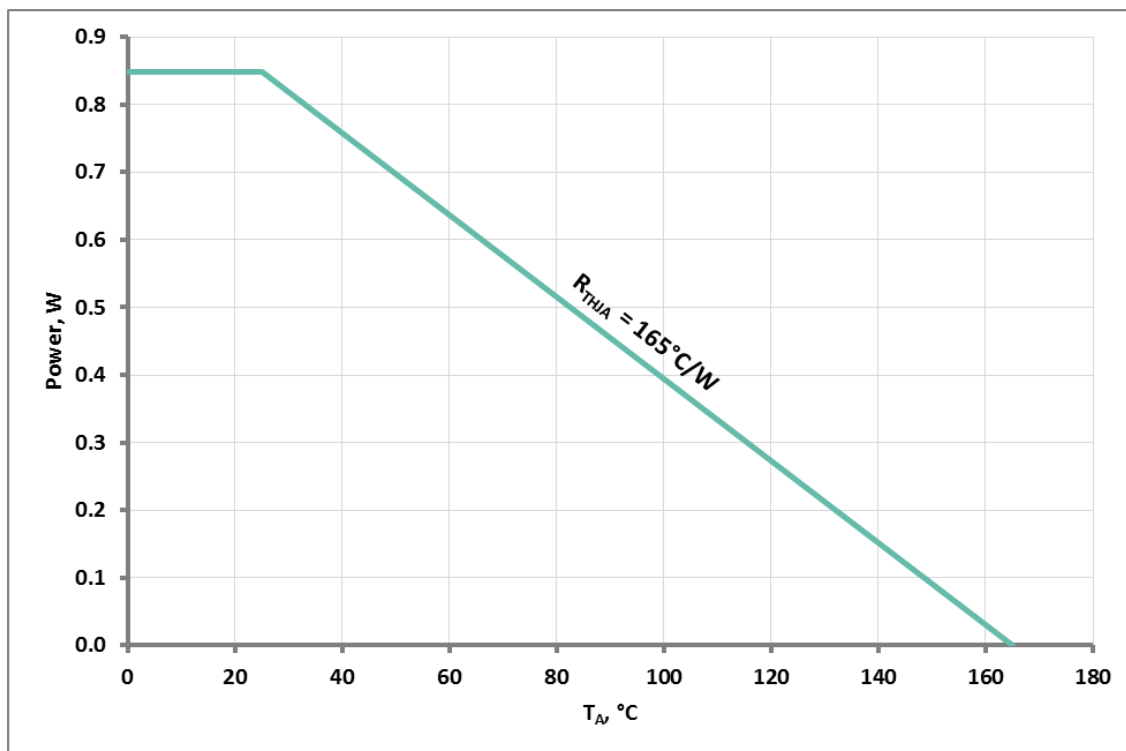
#### Notes:

1. For proper operation  $R_S$  should be equal or higher than  $50\Omega$ .
2. The TEST pin is to be connected to GND or left open.

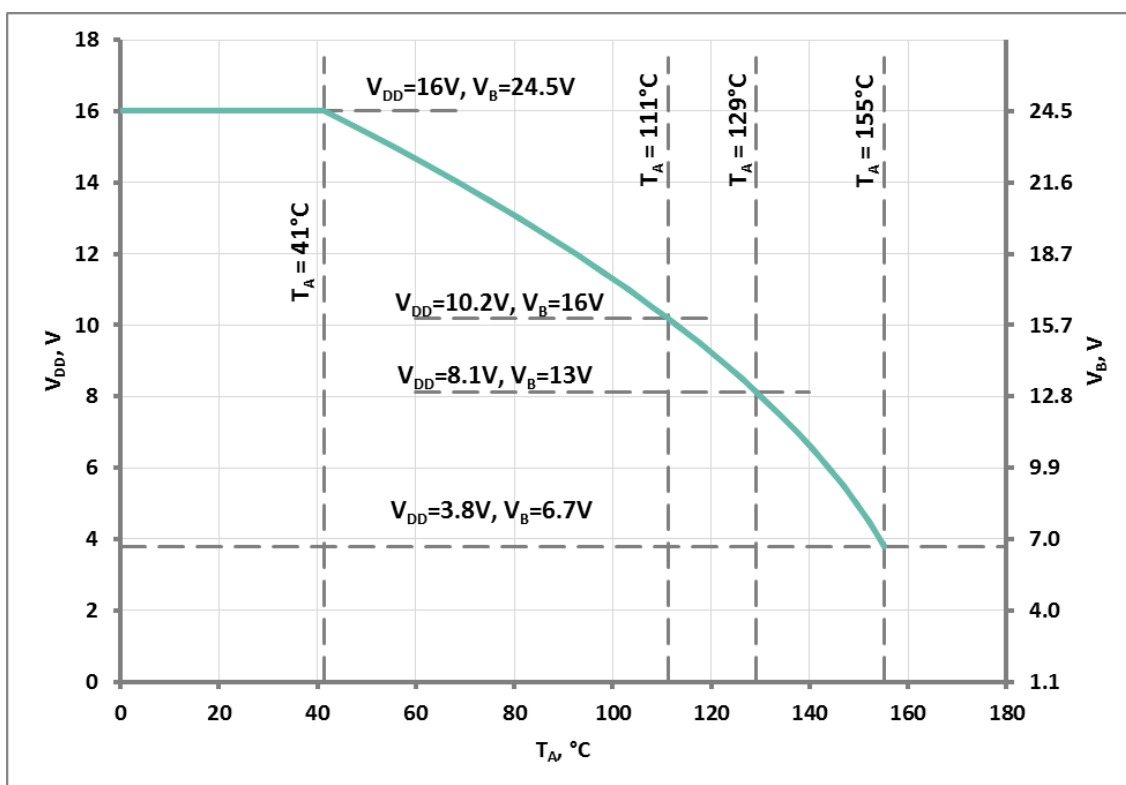
### 11.2. Supply Current Diagram



### 11.3. Power Dissipation Derating Curve



### 11.4. Voltage Derating Curve (valid for $R_S=182\Omega$ )



## 12. 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 following test methods:

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

- 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 Device)s and THD's (Through Hole Device)s

- 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 Device)s

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

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

- 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 recommends reviewing on our web site the General Guidelines soldering recommendation ([http://www.melexis.com/Quality\\_soldering.aspx](http://www.melexis.com/Quality_soldering.aspx)) as well as trim&form recommendations (<http://www.melexis.com/Assets/Trim-and-form-recommendations-5565.aspx>).

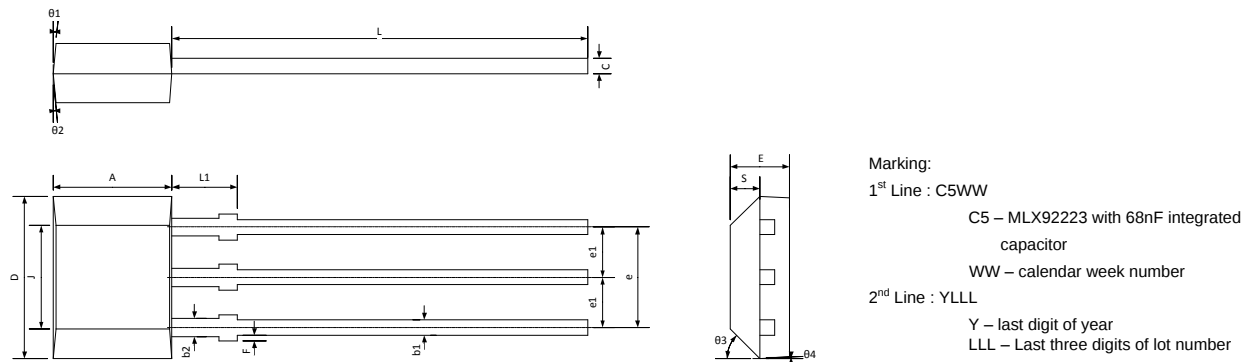
Melexis is contributing to global environmental conservation by promoting **lead free** solutions. For more information on qualifications of **RoHS** compliant products (RoHS = European directive on the Restriction Of the use of certain Hazardous Substances) please visit the quality page on our website:  
<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. Package Information

### 14.1. UA (TO92 - 3L) with integrated capacitor Package Information

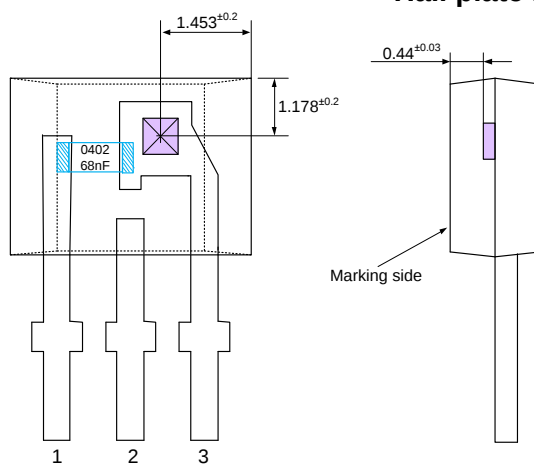


|     | A      | D      | E       | F      | J    | L    | L1   | S    | b1   | b2   | c    | e    | e1   |
|-----|--------|--------|---------|--------|------|------|------|------|------|------|------|------|------|
| min | 2.80   | 3.90   | 1.40    | 0.00   | 2.51 | 14.0 | 0.90 | 0.63 | 0.35 | 0.43 | 0.35 | 2.51 | 1.24 |
| max | 3.20   | 4.30   | 1.60    | 0.20   | 2.72 | 15.0 | 1.10 | 0.84 | 0.44 | 0.52 | 0.44 | 2.57 | 1.30 |
|     | θ1     | θ2     | θ3      | θ4     |      |      |      |      |      |      |      |      |      |
| min | 7° REF | 7° REF | 45° REF | 7° REF |      |      |      |      |      |      |      |      |      |
| max |        |        |         |        |      |      |      |      |      |      |      |      |      |

**Notes:**

1. All dimensions are in millimeters.
2. Mold flashes and protrusion are not included.
3. Gate burrs shall not exceed 0.127mm on the top side.

### Hall plate location



**Notes:**

1. All dimensions are in millimeters
2. Mold flashes and protrusion are not included.

| Pin № | Name | Type   | Function             |
|-------|------|--------|----------------------|
| 1     | VDD  | Supply | Supply Voltage pin   |
| 2     | TEST | I/O    | For Melexis use only |
| 3     | GND  | Ground | Ground pin           |

## 15. Contact

For the latest version of this document, go to our website at [www.melexis.com](http://www.melexis.com).

For additional information, please contact our Direct Sales team and get help for your specific needs:

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|----------------|----------------------------------|
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