

### Features and Benefits

- ❑ Wide operating voltage range : from 2.7V to 24V
- ❑ Chopper-stabilized amplifier stage
- ❑ Built-in negative temperature coefficient
- ❑ Reverse Supply Voltage Protection
- ❑ High ESD rating / Excellent EMC performance

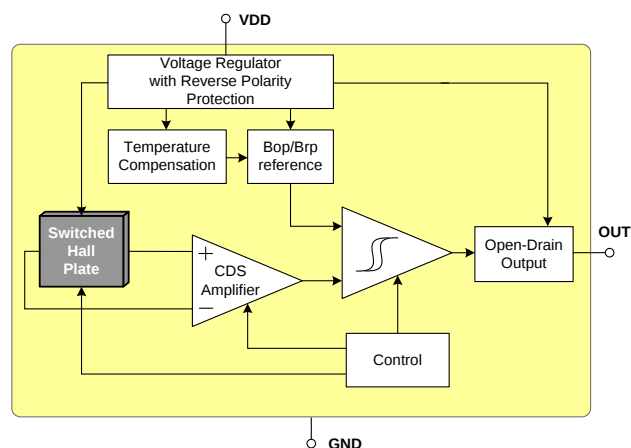
### Application Examples

- ❑ Consumer and Industrial
- ❑ Solid-state switch
- ❑ E-Bike
- ❑ Motorcycles
- ❑ 3-phase BLDC motor commutation

### Ordering Information

| Part No.               | Temperature Code   | Package Code | Comment                                                                   |
|------------------------|--------------------|--------------|---------------------------------------------------------------------------|
| MLX92215LUA-AAA-000-BU | L (-40°C to 150°C) | UA (TO92-3L) | $B_{OP}/B_{RP} = \pm 3\text{mT}$ , $TC = -1100\text{ ppm}/^\circ\text{C}$ |
| MLX92215LSE-AAA-000-RE | L (-40°C to 150°C) | SE (TSOT-23) | $B_{OP}/B_{RP} = \pm 3\text{mT}$ , $TC = -1100\text{ ppm}/^\circ\text{C}$ |

## 1 Functional Diagram



## 2 General Description

The Melexis MLX92215 is the second generation Hall-effect latch designed in mixed signal CMOS technology. The device integrates a voltage regulator, Hall sensor with advanced offset cancellation system and an open-drain

output driver, all in a single package. Based on the existing platform, the magnetic core is using an improved offset cancellation system allowing faster and more accurate processing while being temperature insensitive and stress independent. In addition is implemented a negative temperature coefficient to compensate the natural behaviour of magnets becoming weaker with rise in temperature.

The included voltage regulator operates from 2.7 to 24V, hence covering a wide range of applications. With the built-in reverse voltage protection, a serial resistor or diode on the supply line is not required so that even remote sensors can be specified for low voltage operation down to 2.7V while being reverse voltage tolerant.

With latching magnetic characteristics, the output is 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.

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### 3 Glossary of Terms

|                        |                                                                                                 |
|------------------------|-------------------------------------------------------------------------------------------------|
| MilliTesla (mT), Gauss | Units of magnetic flux density: 1mT = 10 Gauss                                                  |
| RoHS                   | Restriction of Hazardous Substances                                                             |
| TSOT                   | Thin Small Outline Transistor (TSOT package) – also referred with the Melexis package code “SE” |
| ESD                    | Electro-Static Discharge                                                                        |

### 4 Absolute Maximum Ratings

| Parameter                                            | Symbol              | Value       | Units |
|------------------------------------------------------|---------------------|-------------|-------|
| Supply Voltage <sup>(1, 2)</sup>                     | V <sub>DD</sub>     | +27         | V     |
| Supply Voltage (Load dump) <sup>(1, 3)</sup>         | V <sub>DD</sub>     | +32         | V     |
| Supply Current <sup>(1, 2, 4)</sup>                  | I <sub>DD</sub>     | +20         | mA    |
| Supply Current <sup>(1, 3, 4)</sup>                  | I <sub>DD</sub>     | +50         | mA    |
| Reverse Supply Voltage <sup>(1, 2)</sup>             | V <sub>DDREV</sub>  | -24         | V     |
| Reverse Supply Voltage (Load dump) <sup>(1, 3)</sup> | V <sub>DDREV</sub>  | -30         | V     |
| Reverse Supply Current <sup>(1, 2, 5)</sup>          | I <sub>DDREV</sub>  | -20         | mA    |
| Reverse Supply Current <sup>(1, 3, 5)</sup>          | I <sub>DDREV</sub>  | -50         | mA    |
| Output Voltage <sup>(1, 2)</sup>                     | V <sub>OUT</sub>    | +27         | V     |
| Output Current <sup>(1, 2, 5)</sup>                  | I <sub>OUT</sub>    | +20         | mA    |
| Output Current <sup>(1, 3, 6)</sup>                  | I <sub>OUT</sub>    | +75         | mA    |
| Reverse Output Voltage <sup>(1)</sup>                | V <sub>OUTREV</sub> | -0.5        | V     |
| Reverse Output Current <sup>(1, 2)</sup>             | I <sub>OUTREV</sub> | -50         | mA    |
| Operating Temperature Range                          | T <sub>A</sub>      | -40 to +150 | °C    |
| Storage Temperature Range                            | T <sub>S</sub>      | -55 to +165 | °C    |
| Maximum Junction Temperature <sup>(7)</sup>          | T <sub>J</sub>      | +165        | °C    |
| ESD Sensitivity – HBM <sup>(8)</sup>                 | -                   | 4000        | V     |
| ESD Sensitivity – MM <sup>(9)</sup>                  | -                   | 500         | V     |
| ESD Sensitivity – CDM <sup>(10)</sup>                | -                   | 1000        | V     |
| Magnetic Flux Density                                | B                   | Unlimited   | mT    |

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> The maximum junction temperature should not be exceeded

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

<sup>3</sup> For maximum 0.5 s

<sup>4</sup> Including current through protection device

<sup>5</sup> Through protection device

<sup>6</sup> For V<sub>OUT</sub> ≤ 27V.

<sup>7</sup> For 1000 hours.

<sup>8</sup> Human Model according AEC-Q100-002 standard

<sup>9</sup> Machine Model according AEC-Q100-003 standard

<sup>10</sup> Charged Device Model according AEC-Q100-011 standard

### 5 General Electrical Specifications

DC Operating Parameters  $T_A = -40^{\circ}\text{C}$  to  $150^{\circ}\text{C}$ ,  $V_{DD} = 2.7\text{V}$  to  $24\text{V}$  (unless otherwise specified)

| Parameter                                                | Symbol       | Test Conditions                                                                                                                        | Min | Typ <sup>(1)</sup> | Max | Units                       |
|----------------------------------------------------------|--------------|----------------------------------------------------------------------------------------------------------------------------------------|-----|--------------------|-----|-----------------------------|
| Supply Voltage                                           | $V_{DD}$     | Operating                                                                                                                              | 2.7 | -                  | 24  | V                           |
| Supply Current                                           | $I_{DD}$     |                                                                                                                                        | 1.5 | 3.0                | 4.5 | mA                          |
| Reverse Supply Current                                   | $I_{DDREV}$  | $V_{DD} = -18\text{V}$                                                                                                                 |     |                    | 1   | mA                          |
| Output Leakage Current                                   | $I_{OFF}$    | $V_{OUT} = 12\text{V}$ , $V_{DD} = 12\text{V}$ , $B < B_{rp}$                                                                          |     | 0.1                | 10  | $\mu\text{A}$               |
| Output Saturation Voltage                                | $V_{DSon}$   | $B > B_{OP}$ , $V_{DD} = 3.8$ to $18\text{V}$ , $I_{OUT} = 20\text{mA}$                                                                |     | 0.2                | 0.5 | V                           |
| Output Rise Time <sup>(2)</sup><br>( $R_{PU}$ dependent) | $t_R$        | $V_{DD} = 12\text{V}$ , $V_{PU}^{(3)} = 5\text{V}$ , $R_{PU} = 1\text{k}\Omega$<br>$C_{LOAD} = 50\text{pF}$ to GND                     | 0.1 | 0.3                | 1   | $\mu\text{s}$               |
| Output Fall Time <sup>(2)</sup><br>(On-chip controlled)  | $t_F$        | $V_{DD} = 12\text{V}$ , $V_{PU} = 5\text{V}$ , $R_{PU} = 1\text{k}\Omega$<br>$C_{LOAD} = 50\text{pF}$ to GND                           | 0.1 | 0.3                | 1   | $\mu\text{s}$               |
| Chopping Frequency                                       | $f_{CHOP}$   |                                                                                                                                        |     | 340                |     | kHz                         |
| Output Refresh Period <sup>(2)</sup>                     | $t_{PER}$    |                                                                                                                                        |     | 6                  |     | $\mu\text{s}$               |
| Delay time <sup>(2,4)</sup>                              | $t_D$        | Average over 1000 successive switching events @10kHz, square wave with $B \geq 30\text{mT}$ , $t_{RISE} = t_{FALL} \leq 20\mu\text{s}$ |     | 6                  |     | $\mu\text{s}$               |
| Output Jitter (p-p) <sup>(2, 5)</sup>                    | $t_{JITTER}$ | Over 1000 successive switching events @1kHz, square wave with $B \geq 30\text{mT}$ , $t_{RISE} = t_{FALL} \leq 100\mu\text{s}$         |     | $\pm 3$            |     | $\mu\text{s}$               |
| Maximum Switching Frequency <sup>(2,6)</sup>             | $f_{SW}$     | $B \geq 30\text{mT}$ and square wave magnetic field                                                                                    | 30  | 50                 |     | kHz                         |
| Power-On Time <sup>(7,8)</sup>                           | $t_{ON}$     | $V_{DD} = 5\text{V}$ , $dV_{DD}/dt > 2\text{V}/\mu\text{s}$                                                                            |     | 16                 | 35  | $\mu\text{s}$               |
| SE Package Thermal Resistance                            | $R_{TH}$     | Single layer (1S) Jedec board                                                                                                          |     | 300                |     | $^{\circ}\text{C}/\text{W}$ |
| UA Package Thermal Resistance                            | $R_{TH}$     | Single layer (1S) Jedec board                                                                                                          |     | 200                |     | $^{\circ}\text{C}/\text{W}$ |

Table 1: Electrical specifications

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

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

<sup>3</sup>  $R_{PU}$  and  $V_{PU}$  are respectively the external pull-up resistor and pull-up power supply

<sup>4</sup> The Delay Time is the time from magnetic threshold reached to the start of the output switching

<sup>5</sup> Output jitter is the unpredictable deviation of the Delay time

<sup>6</sup> Maximum switching frequency corresponds to the maximum frequency of the applied magnetic field which is detected without loss of pulses

<sup>7</sup> The Power-On Time represents the time from reaching  $V_{DD} = V_{POR}$  to the first refresh of the output (first valid output state)

<sup>8</sup> Power-On Slew Rate is not critical for the proper device start-up

### 6 Magnetic Specifications

#### 6.1 MLX92215LSE-AAA-000

DC Operating Parameters  $V_{DD} = 3.8$  to  $24V$ ,  $T_a = -40^{\circ}C$  to  $150^{\circ}C$

| Test Condition       | Operating Point<br>$B_{OP}$ (mT) |                    |     | Release Point<br>$B_{RP}$ (mT) |                     |      | TC<br>(ppm/ $^{\circ}C$ ) | Active Pole |
|----------------------|----------------------------------|--------------------|-----|--------------------------------|---------------------|------|---------------------------|-------------|
|                      | Min                              | Typ <sup>(1)</sup> | Max | Min                            | Typ <sup>(10)</sup> | Max  | Typ <sup>(1)</sup>        |             |
| $T_J = -40^{\circ}C$ | 1                                | 3.2                | 5   | -5                             | -3.2                | -1   | -1100                     | South Pole  |
| $T_J = 25^{\circ}C$  | 1                                | 3                  | 5   | -5                             | -3.0                | -1   |                           |             |
| $T_J = 150^{\circ}C$ | 0.5                              | 2.6                | 5   | -5                             | -2.6                | -0.5 |                           |             |

#### 6.2 MLX92215LUA-AAA-000

DC Operating Parameters  $V_{DD} = 3.8$  to  $24V$ ,  $T_a = -40^{\circ}C$  to  $150^{\circ}C$

| Test Condition       | Operating Point<br>$B_{OP}$ (mT) |                    |     | Release Point<br>$B_{RP}$ (mT) |                     |      | TC<br>(ppm/ $^{\circ}C$ ) | Active Pole |
|----------------------|----------------------------------|--------------------|-----|--------------------------------|---------------------|------|---------------------------|-------------|
|                      | Min                              | Typ <sup>(1)</sup> | Max | Min                            | Typ <sup>(10)</sup> | Max  | Typ <sup>(1)</sup>        |             |
| $T_J = -40^{\circ}C$ | 1                                | 3.2                | 5   | -5                             | -3.2                | -1   | -1100                     | South Pole  |
| $T_J = 25^{\circ}C$  | 1                                | 3                  | 5   | -5                             | -3.0                | -1   |                           |             |
| $T_J = 150^{\circ}C$ | 0.5                              | 2.6                | 5   | -5                             | -2.6                | -0.5 |                           |             |

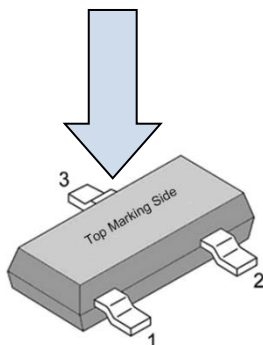
### 7 Output Behaviour versus Magnetic Pole

#### 7.1 South Pole Active

DC Operating Parameters  $T_A = -40^{\circ}C$  to  $150^{\circ}C$ ,  $V_{DD} = 2.7V$  to  $24V$  (unless otherwise specified)

| Parameter  | Test Conditions | OUT                              |
|------------|-----------------|----------------------------------|
| South pole | $B > B_{OP}$    | Low ( $V_{DSon}$ )               |
| North pole | $B < B_{RP}$    | High ( $V_{PU}$ ) <sup>(2)</sup> |

Table 2: Output behaviour versus magnetic pole<sup>(3)</sup>



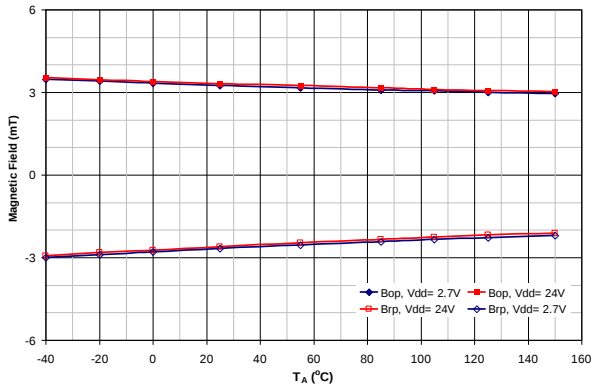
<sup>1</sup> Typical values are defined at  $T_A = +25^{\circ}C$  and  $V_{DD} = 12V$ , unless otherwise specified

<sup>2</sup> Default Output state during power-up

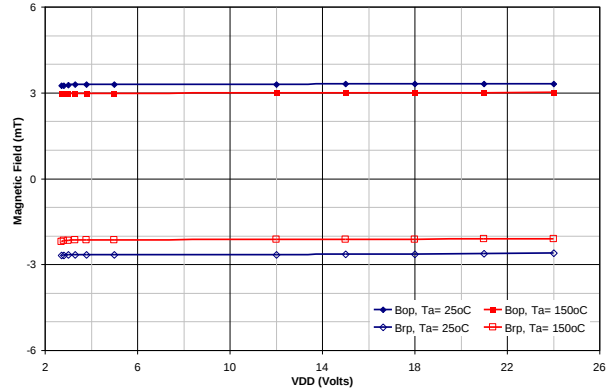
<sup>3</sup> Magnetic pole facing the branded/top side of the package

## 8 Performance Graphs

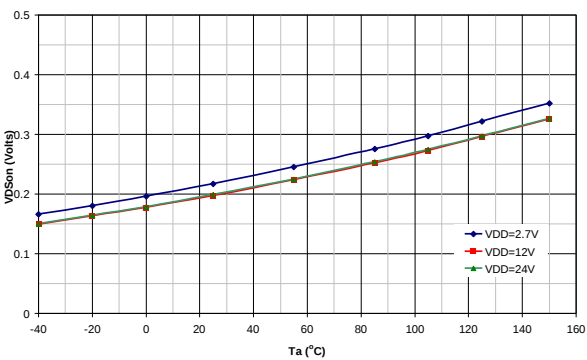
### 8.1 Magnetic parameters vs. $T_A$



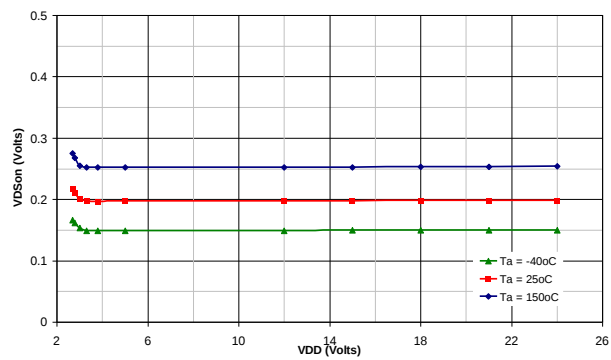
### 8.2 Magnetic parameters vs. $V_{DD}$



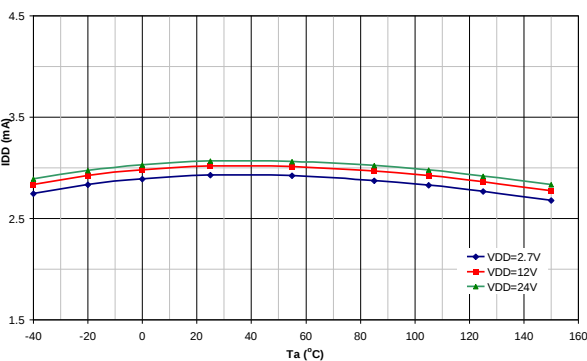
### 8.3 $V_{DSon}$ vs. $T_A$



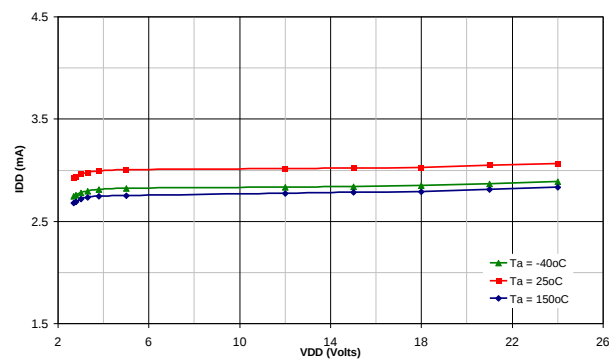
### 8.4 $V_{DSon}$ vs. $V_{DD}$



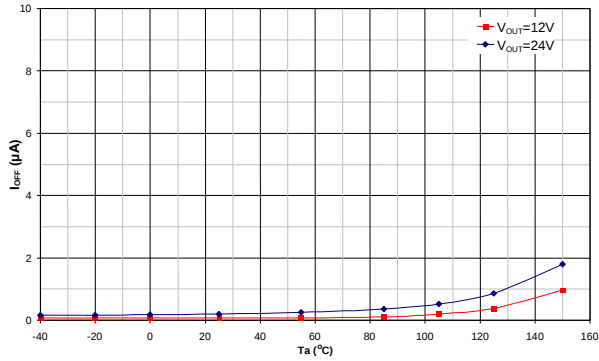
### 8.5 $I_{DD}$ vs. $T_A$



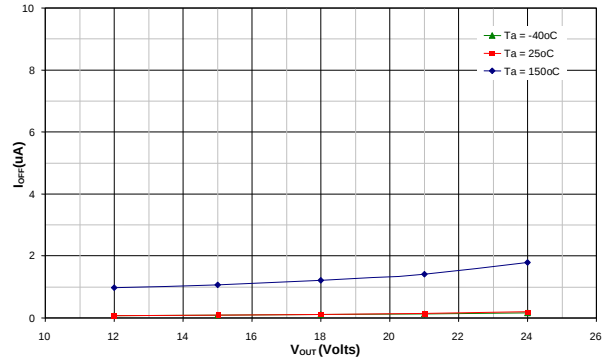
### 8.6 $I_{DD}$ vs. $V_{DD}$



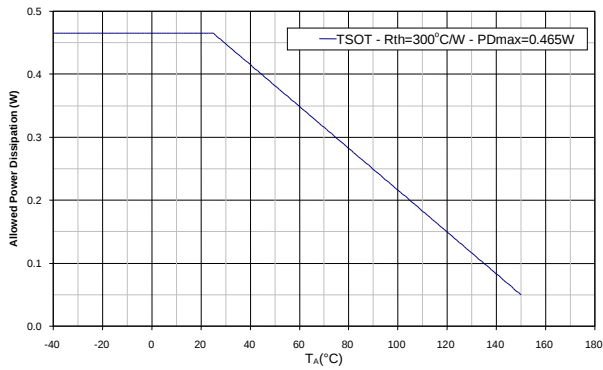
### 8.7 $I_{OFF}$ vs. $T_A$



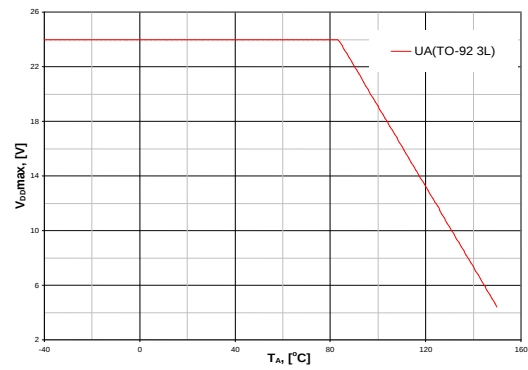
### 8.8 $I_{OFF}$ vs. $V_{OUT}$



### 8.9 SE Power Derating vs. $T_A$

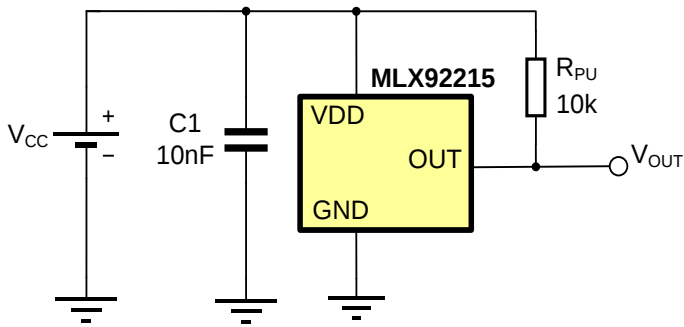


### 8.10 UA Power Derating vs. $T_A$



### 9 Application Information

#### 9.1 Typical Three-Wire Application Circuit



#### Notes:

1. For proper operation, a 10nF to 100nF bypass capacitor should be placed as close as possible to the  $V_{DD}$  and ground pin.
2. The pull-up resistor  $R_{PU}$  value should be chosen in to limit the current through the output pin below the maximum allowed continuous current for the device.
3. A capacitor connected to the output is not obligatory, because the output slope is generated internally.

## **10 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 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>

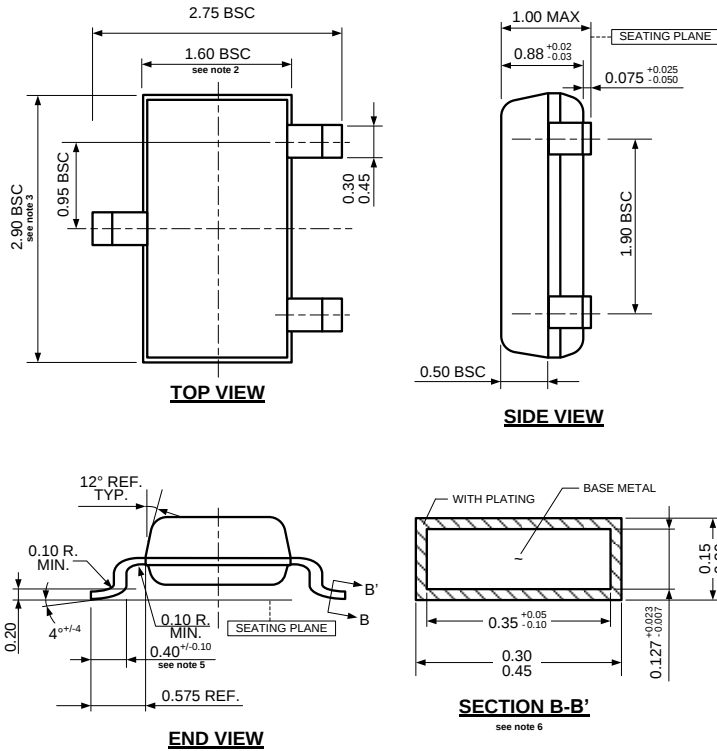
## **11 ESD Precautions**

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

### 12 Packages

#### 12.1 SE Package (TSOT-23)

##### Package Outline Drawing & Hall Plate Position



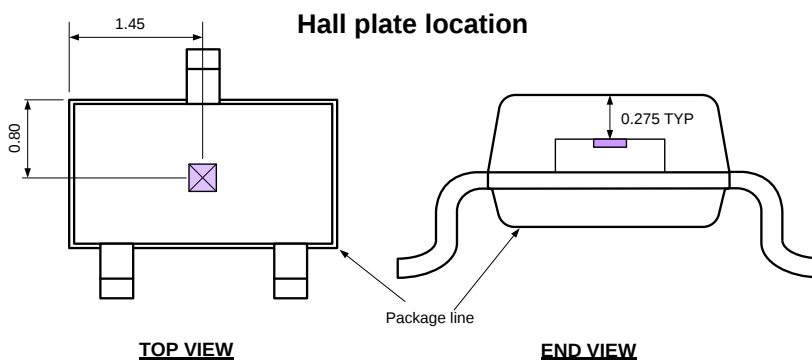
##### Notes:

1. All dimensions are in millimeters
2. Outermost plastic extreme width does not include mold flash or protrusions. Mold flash and protrusions shall not exceed 0.15mm per side.
3. Outermost plastic extreme length does not include mold flash or protrusions. Mold flash and protrusions shall not exceed 0.25mm per side.
4. The lead width dimension does not include dambar protrusion. Allowable dambar protrusion shall be 0.07mm total in excess of the lead width dimension at maximum material condition.
5. Dimension is the length of terminal for soldering to a substrate.
6. Dimension on SECTION B-B' applies to the flat section of the lead between 0.08mm and 0.15mm from the lead tip.
7. Formed lead shall be planar with respect to one another with 0.076mm at seating plane.

##### Marking:

Top side :11YY ; YY: Year (last 2 digits)

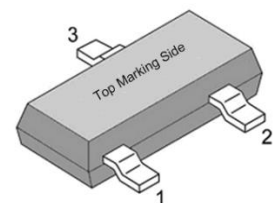
Bottom side: XXXX (XXXX: Lot Number (last 4 digits))



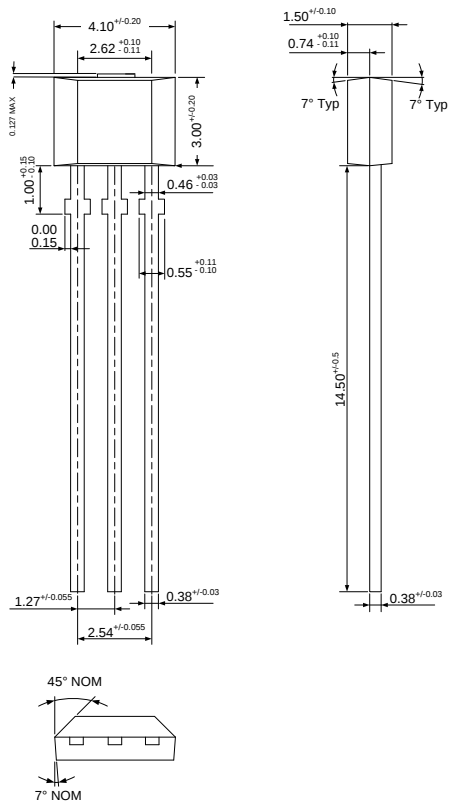
##### Notes:

1. All dimensions are in millimeters

| Pin № | Name | Type   | Function              |
|-------|------|--------|-----------------------|
| 1     | VDD  | Supply | Supply Voltage pin    |
| 2     | OUT  | Output | Open Drain output pin |
| 3     | GND  | Ground | Ground pin            |



## 12.1 UA (TO92 - 3L)



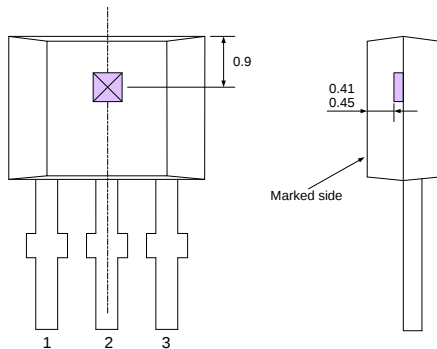
### Notes:

1. All dimensions are in millimeters
2. Package dimension exclusive molding flash.
3. The end flash shall not exceed 0.127 mm on the top side.

### Marking:

- 1<sup>st</sup> Line : xxx – last three digits from lot number  
2<sup>nd</sup> Line : yww  
y - last digit of year  
ww - calendar week

### Hall plate location



### Notes:

1. All dimensions are in millimeters

| Pin № | Name | Type   | Function             |
|-------|------|--------|----------------------|
| 1     | VDD  | Supply | Supply Voltage pin   |
| 2     | GND  | Ground | Ground pin           |
| 3     | TEST | I/O    | Analog & Digital I/O |

### 13 Disclaimer

Devices sold by Melexis are covered by the warranty and patent indemnification provisions appearing in its Term of Sale. Melexis makes no warranty, express, statutory, implied, or by description regarding the information set forth herein or regarding the freedom of the described devices from patent infringement. Melexis reserves the right to change specifications and prices at any time and without notice. Therefore, prior to designing this product into a system, it is necessary to check with Melexis for current information. This product is intended for use in normal commercial applications. Applications requiring extended temperature range, unusual environmental requirements, or high reliability applications, such as military, medical life-support or life-sustaining equipment are specifically not recommended without additional processing by Melexis for each application.

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ISO/TS 16949 and ISO14001 Certified

Компания «Life Electronics» занимается поставками электронных компонентов импортного и отечественного производства от производителей и со складов крупных дистрибьюторов Европы, Америки и Азии.

С конца 2013 года компания активно расширяет линейку поставок компонентов по направлению коаксиальный кабель, кварцевые генераторы и конденсаторы (керамические, пленочные, электролитические), за счёт заключения дистрибьюторских договоров

Мы предлагаем:

- Конкурентоспособные цены и скидки постоянным клиентам.
- Специальные условия для постоянных клиентов.
- Подбор аналогов.
- Поставку компонентов в любых объемах, удовлетворяющих вашим потребностям.
- Приемлемые сроки поставки, возможна ускоренная поставка.
- Доставку товара в любую точку России и стран СНГ.
- Комплексную поставку.
- Работу по проектам и поставку образцов.
- Формирование склада под заказчика.
- Сертификаты соответствия на поставляемую продукцию (по желанию клиента).
- Тестирование поставляемой продукции.
- Поставку компонентов, требующих военную и космическую приемку.
- Входной контроль качества.
- Наличие сертификата ISO.

В составе нашей компании организован Конструкторский отдел, призванный помогать разработчикам, и инженерам.

Конструкторский отдел помогает осуществить:

- Регистрацию проекта у производителя компонентов.
- Техническую поддержку проекта.
- Защиту от снятия компонента с производства.
- Оценку стоимости проекта по компонентам.
- Изготовление тестовой платы монтаж и пусконаладочные работы.



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