

### Features and Benefits

- ❑ Low voltage supply : from 2.5V to 5.5V
- ❑ Chopper-stabilized amplifier stage
- ❑ Low power switch: 2.1mA
- ❑ Wide temperature range: -40°C to 150°C
- ❑ Automotive qualified: AEC-Q100
- ❑ Optimized ESD performance: 8kV
- ❑ Designed for standalone PCB applications
- ❑ Thin SOT23 3L Green Compliant package

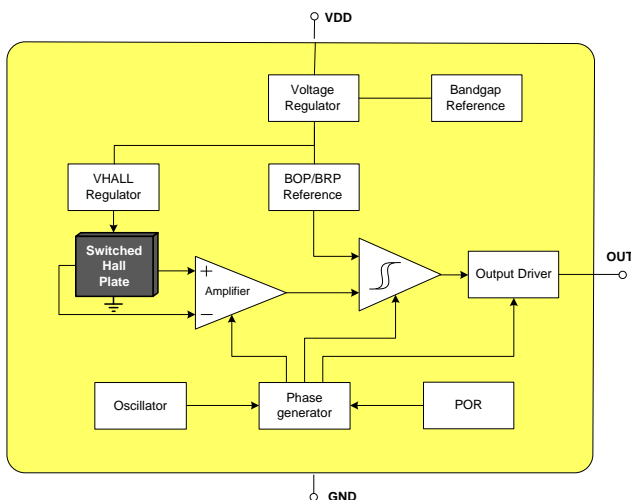
### Application Examples

- ❑ Automotive, Consumer and Industrial
- ❑ BLDC motor commutation
- ❑ Solid-state Latch
- ❑ Low power applications
- ❑ Index counting
- ❑ Electrical power steering

### Ordering Information

Part No.	Temperature Code	Package Code	Comment
MLX92212LSE-AAA-000-RE	L (-40°C to 150°C)	SE (TSOT-3L)	Very sensitive Latch
MLX92212LSE-ABA-000-RE	L (-40°C to 150°C)	SE (TSOT-3L)	Unipolar switch

## 1 Functional Diagram



## 2 General Description

The Melexis MLX92212 is a low voltage Hall-effect switch 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.

The device features a low voltage regulator with optimized performances targetting low power consumption at low voltage levels.

It is suitable for use in automotive applications thanks to its wide temperature range and extensive qualification according to automotive standards.

The MLX92212 is delivered in a Green compliant 3-pin Thin Small Outline Transistor (TSOT) for surface-mount process.



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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
BLDC	Brush-Less Direct-Current

### 4 Absolute Maximum Ratings

Parameter	Symbol	Value	Units
Supply Voltage	$V_{DD}$	-0.5 to 6	V
Supply Current <sup>(1)</sup>	$I_{DD}$	$\pm 20$	mA
Output Voltage	$V_{OUT}$	-0.5 to 6	V
Output Current <sup>(1)</sup>	$I_{OUT}$	$\pm 20$	mA
Operating Temperature Range	$T_A$	-40 to 150	°C
Storage Temperature Range	$T_S$	-50 to 165	°C
Maximum Junction Temperature	$T_J$	165	°C
ESD Sensitivity – HBM	-	8000 <sup>(2)</sup>	V
ESD Sensitivity – CDM	-	750	V

Table 1: Absolute maximum ratings

**Note 1:** Including current through the protection structure. Max Power dissipation should be also considered.

**Note 2:** Human Body Model according AEC-Q100-002 standard

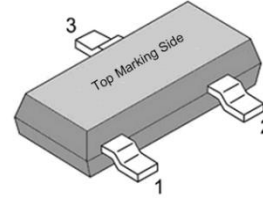
Exceeding the absolute maximum ratings may cause permanent damage. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.



### 5 Pin Definitions and Descriptions

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

Table 2: SE Package pinout



### 6 General Electrical Specifications

DC Operating Parameters  $T_A = -40$  to  $150^\circ\text{C}$ ,  $V_{DD} = 2.5\text{V}$  to  $5.5\text{V}$  (unless otherwise specified)

Parameter	Symbol	Test Conditions	Min	Typ	Max	Units
Supply Voltage	$V_{DD}$	Operating	2.5		5.5	V
Supply Current	$I_{DD}$		1.3	2.1	3.2	mA
Output Saturation Voltage	$V_{DS(on)}$	$I_{OUT} = 5\text{mA}$ , $B > B_{OP}$			0.5	V
Output Leakage Current	$I_{OFF}$	$B < B_{RP}$ , $V_{OUT} = 5.5\text{V}$		0.01	10	$\mu\text{A}$
Output Rise Time <sup>(1)</sup>	$t_r$	$R_L = 1\text{k}\Omega$ , $C_L = 50\text{pF}$		0.25		$\mu\text{s}$
Output Fall Time <sup>(1)</sup>	$t_f$	$R_L = 1\text{k}\Omega$ , $C_L = 50\text{pF}$		0.25		$\mu\text{s}$
Power-On Time <sup>(2)</sup>	$t_{PON}$	$dV_{DD}/dt > 2\text{V}/\mu\text{s}$		38	70	$\mu\text{s}$
Power-On Reset Voltage <sup>(3)</sup>	$V_{POR}$			1.95	2.1	V
Power-On State	-		High			-
Maximum Switching Frequency <sup>(1)</sup>	$F_{SW}$	$B \geq \pm 40\text{mT}$ and square wave magnetic field	10			KHz
SE Package Thermal Resistance	$R_{TH}$	Single layer (1S) Jedec board		300		$^\circ\text{C}/\text{W}$

Table 3: Electrical specifications

<sup>1</sup> Guaranteed by design and verified by characterization, not production tested.

<sup>2</sup> The Power-On time represents the time from reaching  $V_{DD} = 2.5\text{V}$  to the first refresh of the output.

<sup>3</sup> If  $V_{DD}$  drops below  $V_{POR}$  the output is reset to High state.



## 7 Magnetic Specification

### 7.1 MLX92212LSE-AAA-000-RE

DC Operating Parameters  $T_A = -40$  upto  $150^\circ\text{C}$ ,  $V_{DD} = 2.5\text{V}$  to  $5.5\text{V}$  (unless otherwise specified)

Parameter	Symbol	Test Conditions	Min	Typ	Max	Units
Operating Point	$B_{OP}$	$T_A = -40^\circ\text{C}$	0.6	2.1	3.8	mT
		$T_A = 25^\circ\text{C}$	0.6	2.0	3.8	mT
		$T_A = 150^\circ\text{C}$	0.6	1.9	3.8	mT
Release Point	$B_{RP}$	$T_A = -40^\circ\text{C}$	-3.8	-2.1	-0.6	mT
		$T_A = 25^\circ\text{C}$	-3.8	-2.0	-0.6	mT
		$T_A = 150^\circ\text{C}$	-3.8	-1.9	-0.6	mT
Hysteresis	$B_{HYST}$	$T_A = -40^\circ\text{C}$	1.7	4.2	6.8	mT
		$T_A = 25^\circ\text{C}$	1.7	4	6.8	mT
		$T_A = 150^\circ\text{C}$	1.7	3.8	6.8	mT

Table 4: Magnetic specifications

### 7.2 MLX92212LSE-ABA-000-RE

DC Operating Parameters,  $T_A = -40$  upto  $150^\circ\text{C}$ ,  $V_{DD} = 2.5\text{V}$  to  $5.5\text{V}$  (unless otherwise specified)

Parameter	Symbol	Test Conditions	Min	Typ	Max	Units
Operating Point	$B_{OP}$	$T_A = -40^\circ\text{C}$	9.2	12.7	16.6	mT
		$T_A = 25^\circ\text{C}$	9.4	12.2	15.4	mT
		$T_A = 85^\circ\text{C}$	9.2	12.3	15.4	mT
		$T_A = 125^\circ\text{C}$	8.8	12.4	16.0	mT
		$T_A = 150^\circ\text{C}$	8.2	12.5	16.8	mT
Release Point	$B_{RP}$	$T_A = -40^\circ\text{C}$	7.6	11	14.4	mT
		$T_A = 25^\circ\text{C}$	7.8	10.5	13.4	mT
		$T_A = 85^\circ\text{C}$	7.8	10.6	13.4	mT
		$T_A = 125^\circ\text{C}$	7.4	10.7	13.9	mT
		$T_A = 150^\circ\text{C}$	6.8	10.8	14.8	mT

Table 5: Magnetic specifications

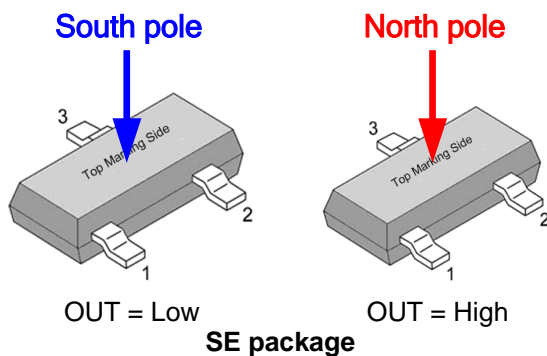


## 8 Output behaviour versus Magnetic Field

### 8.1 Latch sensor: MLX92212LSE-AAA-000

Parameter	Test Conditions	OUT
South pole	$B > B_{OP}$	Low
North pole	$B < B_{RP}$	High

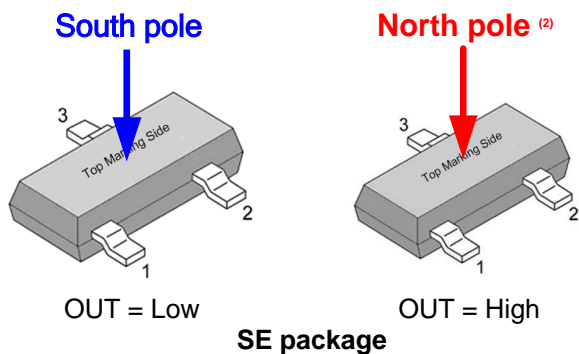
Table 6: Output behaviour versus magnetic pole <sup>(1)</sup>



### 8.2 Switch sensor: MLX92212LSE-ABA-000

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

Table 7: Output behaviour versus magnetic pole <sup>(1)</sup>



<sup>1</sup> Magnetic pole facing the branded / top side of the package

<sup>2</sup> North pole or absence of field or South field lower than  $B_{RP}$



## 9 Detailed General Description

Based on mixed signal CMOS technology, Melexis MLX92212LSE-AAA-000 is a Hall-effect device with very high magnetic sensitivity. Melexis MLX92212LSE-ABA-000 is a Hall-effect device with a low hysteresis covering higher magnetic fields. Both versions are allowing the use of generic magnets, weak magnets or larger air gap.

The chopper-stabilized amplifier uses switched capacitor techniques to suppress the offset generally observed with Hall sensors and amplifiers. The CMOS technology makes this advanced technique possible and contributes to smaller chip size and lower current consumption than bipolar technology. The small chip size is also an important factor to minimize the effect of physical stress.

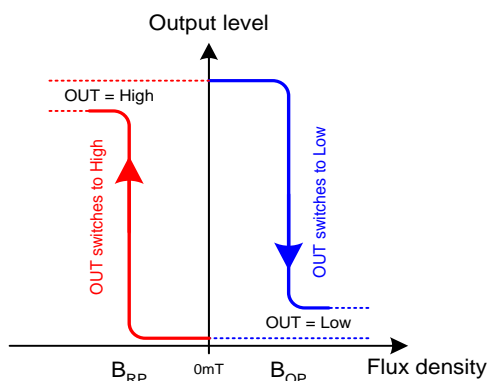
This combination results in more stable magnetic characteristics and enables faster and more precise design.

The operating voltage from 2.5V to 5.5V, low current consumption and large choice of operating temperature range according to "L" specification make this device suitable for automotive, industrial and consumer low voltage applications.

The output signal is open-drain type. Such output allows simple connectivity with TTL or CMOS logic by using a pull-up resistor tied between a pull-up voltage and the device output

## 10 Latching characteristic

The MLX92212-AAA exhibits magnetic latching characteristics.

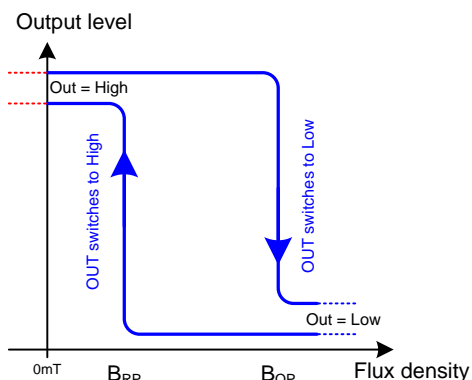


*Latch characteristic*

Typically, the device behaves as a latch with symmetric operating and release switching points ( $B_{OP} = |B_{RP}|$ ). This means magnetic fields with equivalent strength and opposite direction drive the output high and low.

Removing the magnetic field ( $B \rightarrow 0$ ) keeps the output in its previous state. This latching property defines the device as a magnetic memory.

The MLX92212LSE-ABA exhibits magnetic switching characteristics.



*Unipolar switch characteristic*

The device is south pole active:

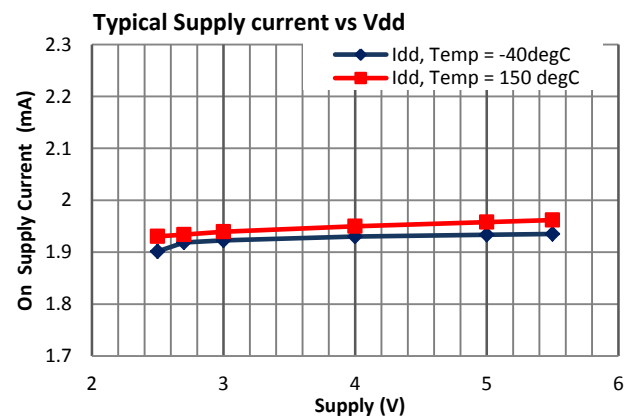
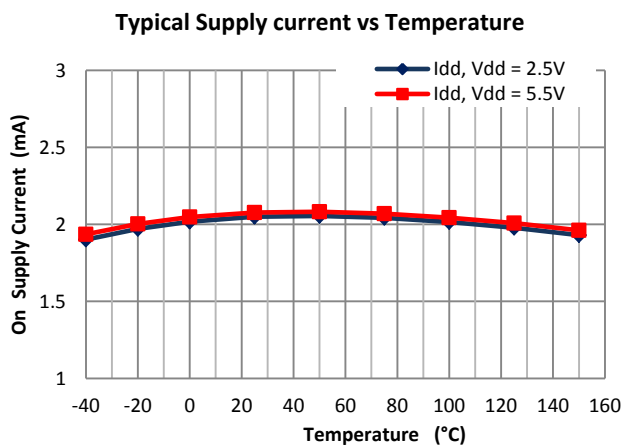
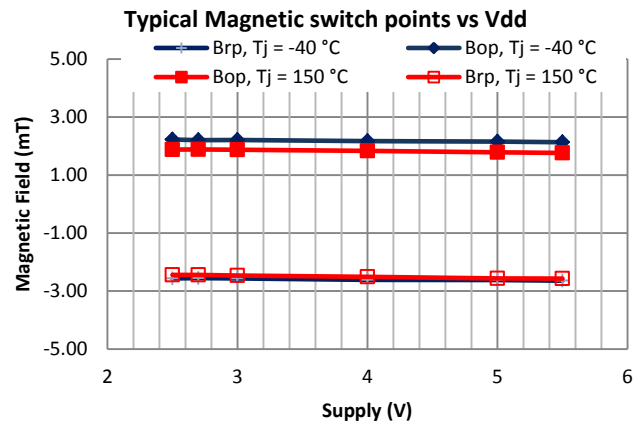
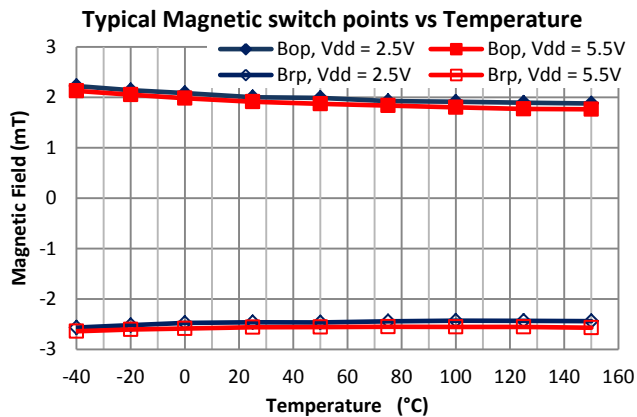
Applying a south magnetic pole greater than  $B_{OP}$  facing the branded side of the package switches the output low.

Removing the magnetic field ( $B \rightarrow 0$ ) switches the output high. The use of the opposite magnetic pole facing the branded side does not affect the output state.

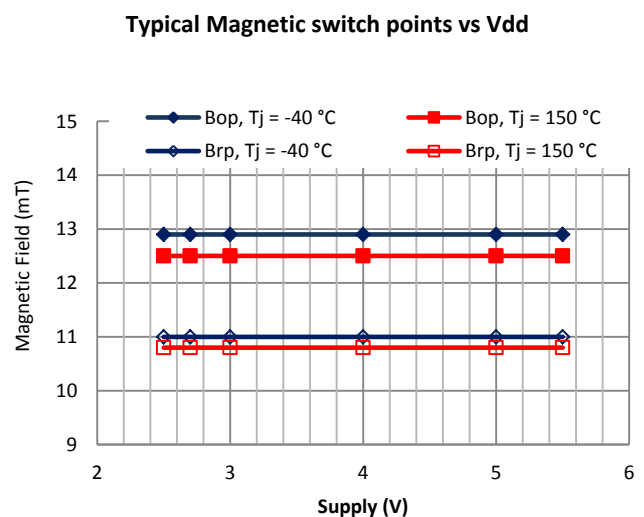
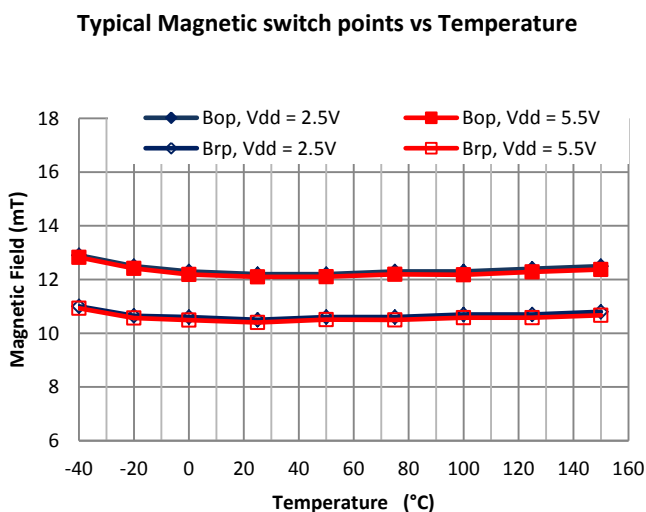


## 11 Performance graphs

### 11.1 MLX92212LSE -AAA-000



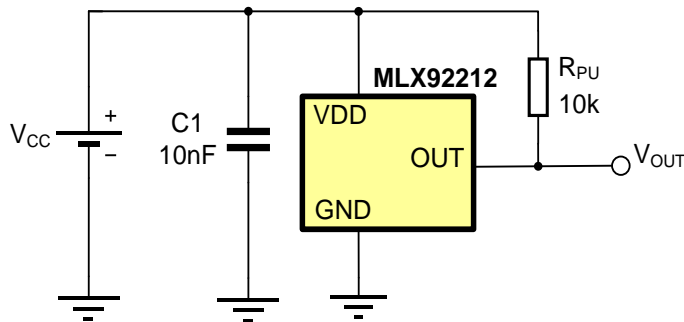
### 11.2 MLX92212LSE -ABA-000





## 12 Application Information

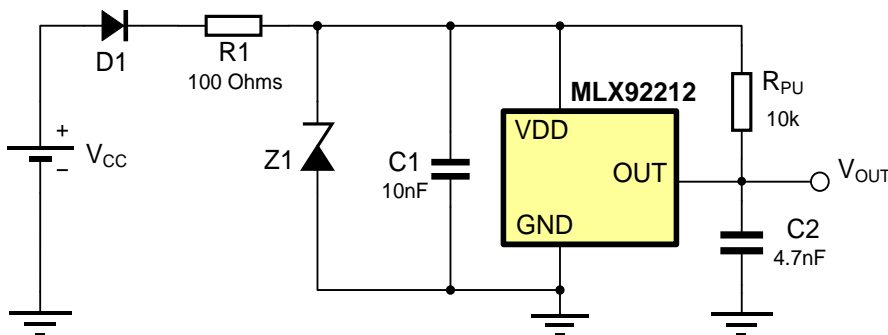
### 12.1 Typical Three-Wire Application Circuit



**Notes:**

1. For proper operation, a 10nF to 100nF bypass capacitor should be placed as close as possible to the V<sub>DD</sub> and ground pin.
2. A capacitor connected to the output is not obligatory, because the output slope is generated internally.

### 12.2 Automotive and Harsh, Noisy Environments Three-Wire Circuit



**Notes:**

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.
2. The device could tolerate negative voltage down to -0.5 V, so if negative transients over supply line V<sub>PEAK</sub> < -32V are expected, usage of the diode D1 is recommended. Otherwise only R1 is sufficient.

When selecting the resistor R1, three points are important:

- the resistor has to limit I<sub>DD</sub>/I<sub>DDREV</sub> to 40mA maximum
- the resistor has to withstand the power dissipated in both over voltage conditions ( $V_{R1}^2/R1$ )
- the resulting device supply voltage V<sub>DD</sub> has to be higher than V<sub>DD</sub> min ( $V_{DD} = V_{CC} - R1 \cdot I_{DD}$ )

3. The device could tolerate positive supply voltage up to +6V (until the maximum power dissipation is not exceeded), so if positive transients over supply line with V<sub>PEAK</sub> > 6V are expected, usage a zener diode Z1 is recommended. The R1-Z1 network should be sized to limit the voltage over the device below the maximum allowed.



### **13 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 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](http://www.melexis.com/Quality_soldering.aspx)) as well as [trim&form recommendations](http://www.melexis.com/Assets/Trim-and-form-recommendations-5565.aspx) (<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>

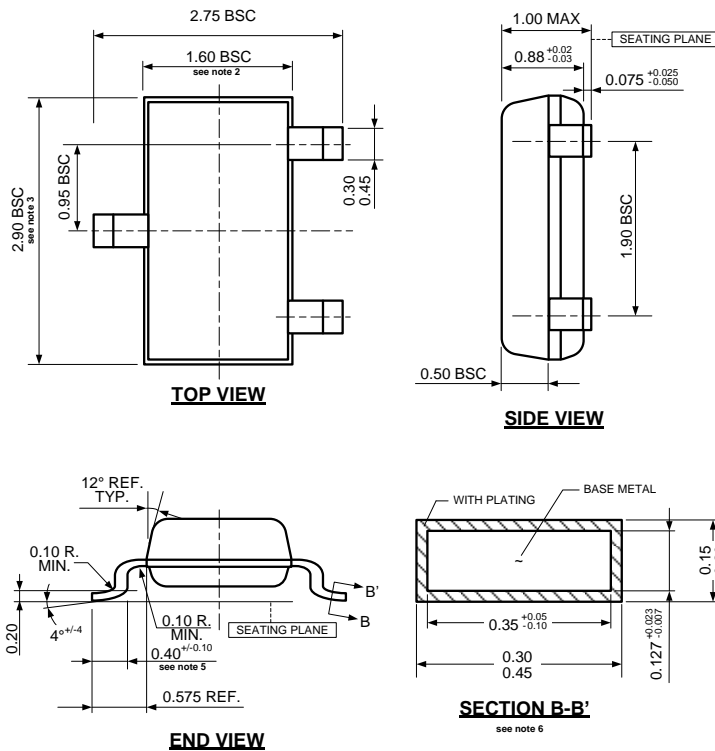
### **14 ESD Precautions**

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



### 15 Package Information

#### 15.1 SE (TSOT-3L) Package Information



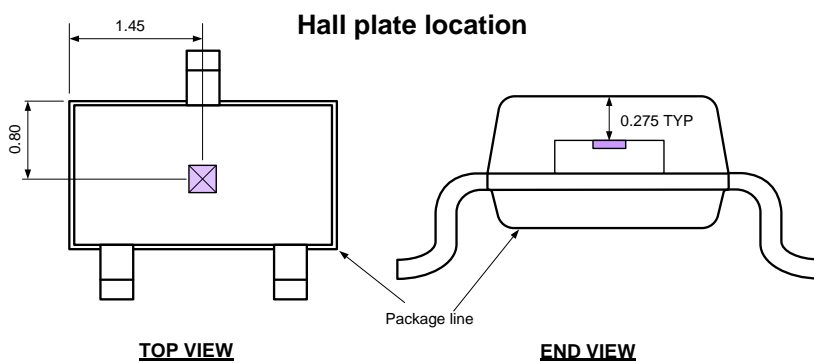
#### Notes:

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 : MLX92212LSE-AAA-000 = 12YY (YY = year code)  
MLX92212LSE-ABA-000 = 12BY (Y = year code )

Bottom side: LLLL= last 4 digits from lot#

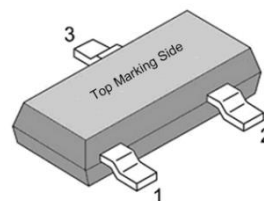


#### Notes:

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

Table 8:Package pinout





## **16 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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