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
- TSOT-3L Green Compliant package

Application Examples

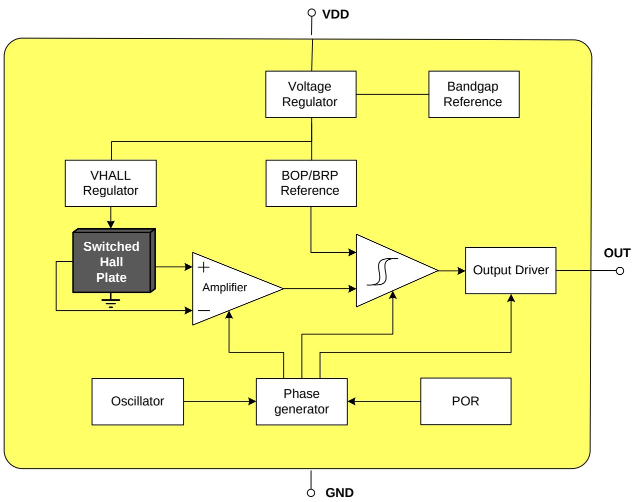
- Automotive, Consumer and Industrial
- BLDC motor commutation
- Solid-state Latch
- Low power applications
- Index counting
- Electrical power steering

Ordering Information

Product Code	Temperature Code	Package Code	Option code	Packing form code
MLX92212	L	SE	AAA-000	RE
MLX92212	L	SE	ABA-000	RE
MLX92212	L	SE	ACA-000	RE
MLX92212	L	SE	ADA-000	RE

Legend:
Temperature code: L (-40 to 150°C)
Package Code: SE = TSOT-3L
Packing Form: RE = Reel
Ordering code AAA = Very sensitive latch: Bop/Brp = 2mT/-2mT
ABA = Unipolar switch: Bop/Brp = 12.2mT/10.5mT
ACA = Unipolar switch: Bop/Brp = 10.1mT/8.3mT
ADA = Unipolar switch: Bop/Brp = 3mT/1.9mT
Ordering Example: MLX92212LSE-AAA-000-RE

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 targeting 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-3L) 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 [1]	I_{DD}	± 20	mA
Output Voltage	V_{OUT}	-0.5 to 6	V
Output Current [1]	I_{OUT}	± 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[2]	V
ESD Sensitivity – CDM	-	750	V

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

[1] *Including current through the protection structure. Max Power dissipation should be also considered.*
[2] *Human Body Model according AEC-Q100-002 standard*

5. General Electrical Specifications

DC Operating Parameters T_A = -40 to 150°C, V_{DD} = 2.5V to 5.5V (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_{DSON}	I_{OUT} = 5mA, B > B_{OP}			0.5	V
Output Leakage Current	I_{OFF}	B < B_{RP}, V_{OUT} = 5.5V		0.01	10	µA
Output Current Limit	I_{CL}	V_{OUT} = 2V, B > B_{OP}	10	16		mA
Output Rise Time [1]	t_r	R_L = 1kΩ, C_L = 50pF		0.25		µs
Output Fall Time [1]	t_f	R_L = 1kΩ, C_L = 50pF		0.25		µs
Power-On Time [2]	t_{PON}	dV_{DD}/dt > 2V/µs		38	70	µs
Power-On Reset Voltage [3]	V_{POR}			1.95	2.1	V
Power-On State	-			High		-
Maximum Switching Frequency [1]	F_{SW}	B≥±40mT and square wave magnetic field	10			KHz
SE Package Thermal Resistance	R_{TH}	Single layer (1S) Jedec board		300		°C/W

[1] *Guaranteed by design and verified by characterization, not production tested*
[2] *The Power-On time represents the time from reaching VDD = 2.5V to the first refresh of the output.*
[3] *If VDD drops below VPOR the output is reset to High state.*

6. Magnetic Specification

6.1. MLX92212LSE-AAA-000-RE

DC Operating Parameters T_A = -40 °C up to 150 °C, V_{DD} = 2.5V to 5.5V (unless otherwise specified)

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
Operating Point	B_{OP}	T_A = -40°C	0.6	2.1	3.8	mT
		T_A = 25°C	0.6	**2.0**	3.8	
		T_A = 150°C	0.6	1.9	3.8	
Release Point	B_{RP}	T_A = -40°C	-3.8	-2.1	-0.6	mT
		T_A = 25°C	-3.8	**-2.0**	-0.6	
		T_A = 150°C	-3.8	-1.9	-0.6	
Hysteresis	B_{HYST}	T_A = -40°C	1.7	4.2	6.8	mT
		T_A = 25°C	1.7	4.0	6.8	
		T_A = 150°C	1.7	3.8	6.8	

6.2. MLX92212LSE-ABA-000-RE

DC Operating Parameters, T_A = -40 °C up to 150 °C, V_{DD} = 2.5V to 5.5V (unless otherwise specified)

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

6.3. MLX92212LSE-ACA-000-RE

DC Operating Parameters, T_A = -40 °C up to 150 °C, V_{DD} = 2.5V to 5.5V (unless otherwise specified)

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
Operating Point	B_{OP}	T_A = -40°C	7.8	11.5	15.1	mT
		T_A = 25°C	6.9	**10.1**	13.3	
		T_A = 150°C	5.3	7.6	9.9	
Release Point	B_{RP}	T_A = -40°C	5.9	9.3	12.7	mT
		T_A = 25°C	5.3	**8.3**	11.3	
		T_A = 150°C	4.2	6.6	9.0	
Temperature coefficient	TC			-2000[1]		ppm/˚C

6.4. MLX92212LSE-ADA-000-RE

DC Operating Parameters T_A = -40 °C up to 150 °C, V_{DD} = 2.5V to 5.5V (unless otherwise specified)

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
Operating Point	B_{OP}	T_A = -40°C	1.8	3.0	4.5	mT
		T_A = 25°C	1.8	**3.0**	4.5	
		T_A = 150°C	1.8	2.8	4.5	
Release Point	B_{RP}	T_A = -40°C	0.8	1.8	3.0	mT
		T_A = 25°C	0.8	**1.9**	3.0	
		T_A = 150°C	0.8	1.8	3.0	
Hysteresis	B_{HYST}	T_A = -40°C	0.5	1.2	2.0	mT
		T_A = 25°C	0.5	**1.1**	2.0	
		T_A = 150°C	0.5	1.0	2.0	

[1] *Temperature coefficient is calculated using the following formula:*

$$\frac{B_{OPT2} - B_{OPT1}}{B_{OPT1} \times (T_2 - T_1)} * 10^6, ppm/^oC\,; T_1 = 25^oC\,; T_2 = 150^oC$$

Value guaranteed by design and verified by characterization, not production tested.

7. Output behaviour versus Magnetic Field

7.1. Latch sensor

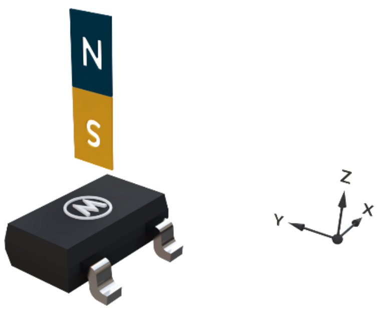
Valid for MLX92212LSE-AAA-000

Parameter [1]	Test Conditions	OUT
South pole	$B > B_{OP}$	Low
North pole	$B < B_{RP}$	High

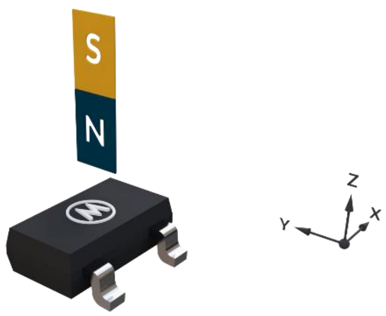
7.2. Switch sensor

Valid for: MLX92212LSE-ABA-000, MLX92212LSE-ACA-000 and MLX92212LSE-ADA-000

Parameter [1]	Test Conditions	OUT
South pole	$B > B_{OP}$	Low
North pole [2]	$B < B_{RP}$	High



OUT = Low



OUT = High

SE Package

[1] *Magnetic pole facing the branded / top side of the package*

[2] *North pole or absence of field or South field lower then Brp (ABA/ACA/ADA version)*

8. 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.

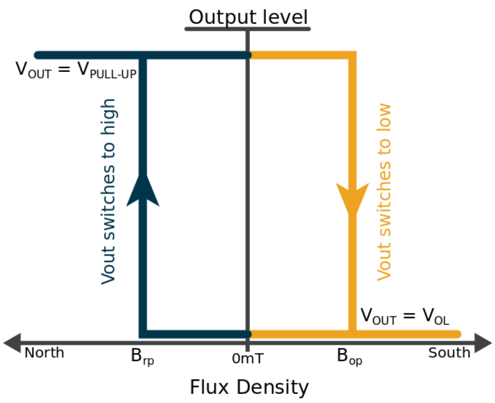
The chopper-stabilized amplifier uses switched capacitor techniques to suppress the offset generally observed with Hall sensors and amplifiers. The CMOS technology makes this advanced technique possible and contributes to smaller chip size and lower current consumption than bipolar technology. The small 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

9. Latch/Switch characteristics

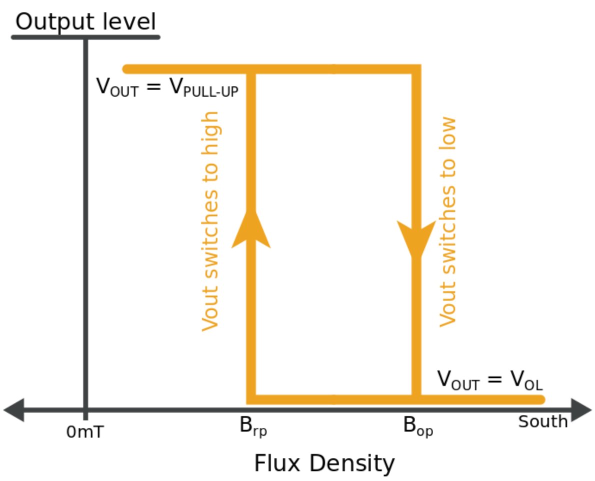
The MLX92212-AAA exhibits magnetic latching characteristics.



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→0) keeps the output in its previous state. This latching property defines the device as a magnetic memory.

The MLX92212LSE-ABA, MLX92212LSE-ACA-000 and MLX92212LSE-ADA-000 exhibits magnetic switching characteristics.

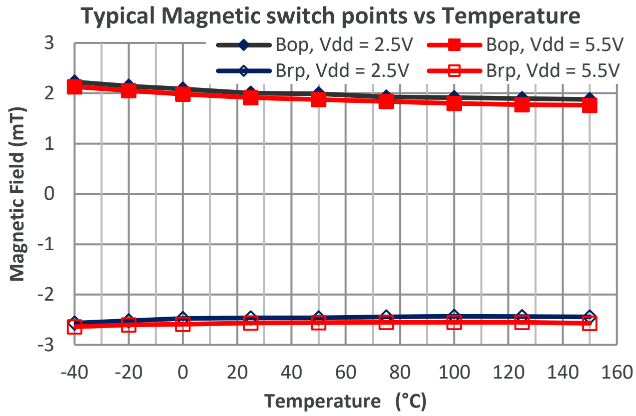


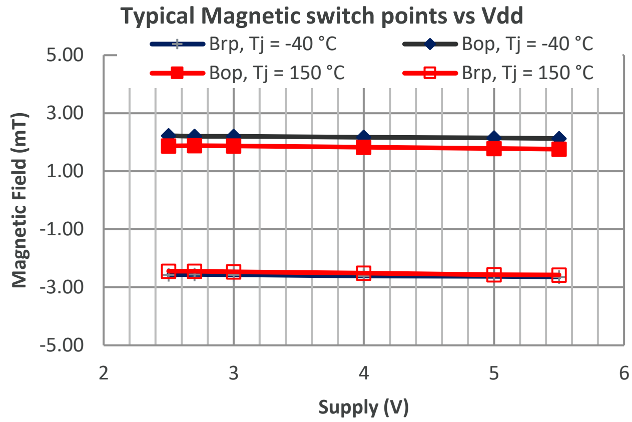
The device is south pole active:
Applying a south magnetic pole greater than B_{OP} facing the branded side of the package switches the output low.

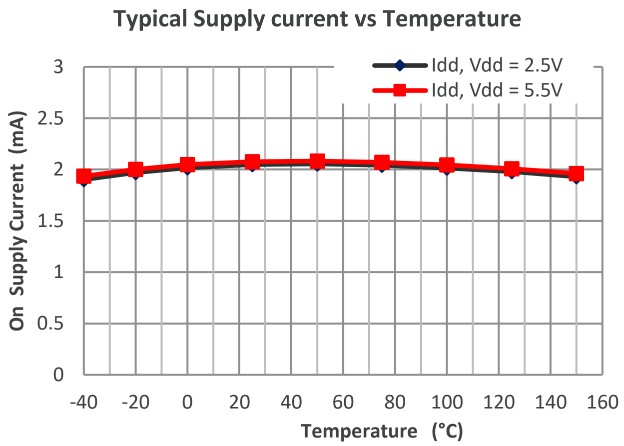
Removing the magnetic field (B→0) switches the output high. The use of the opposite magnetic pole facing the branded side does not affect the output state.

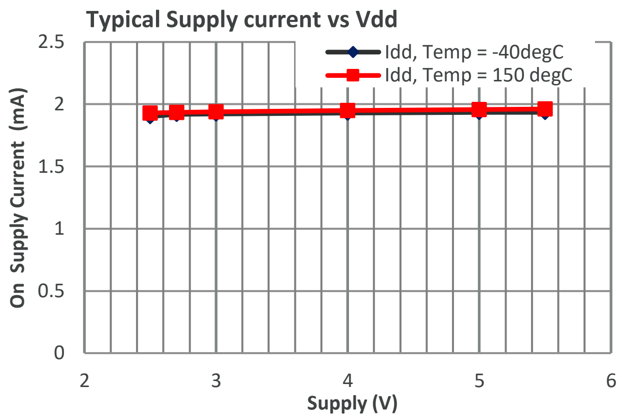
10. Performance graphs

10.1. MLX92212LSE -AAA-000

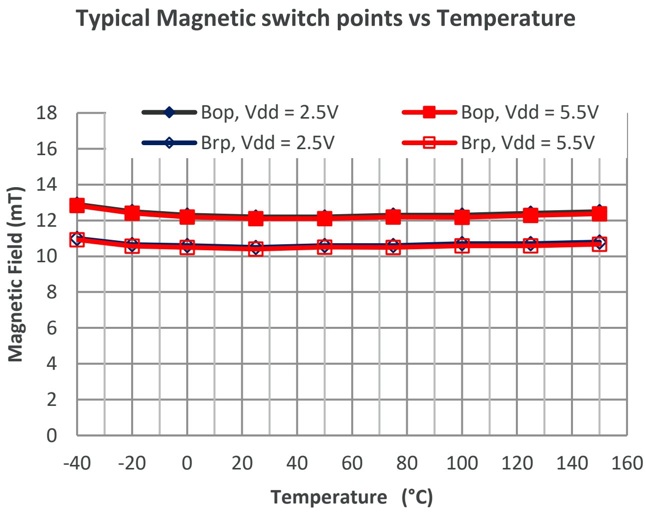


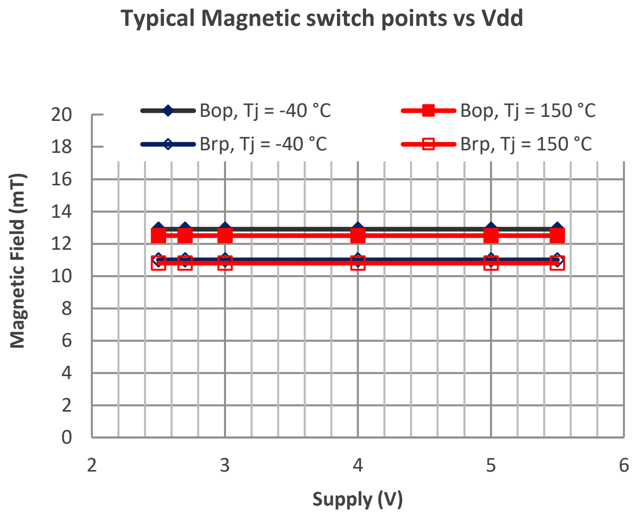




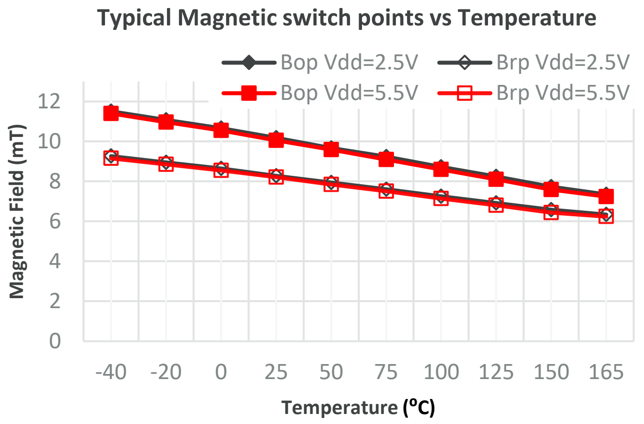


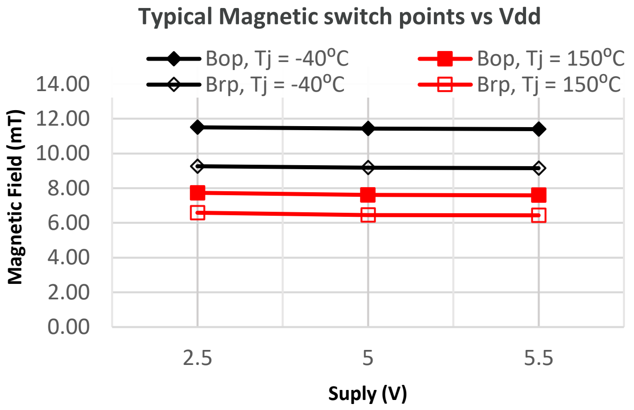
10.2. MLX92212LSE -ABA-000



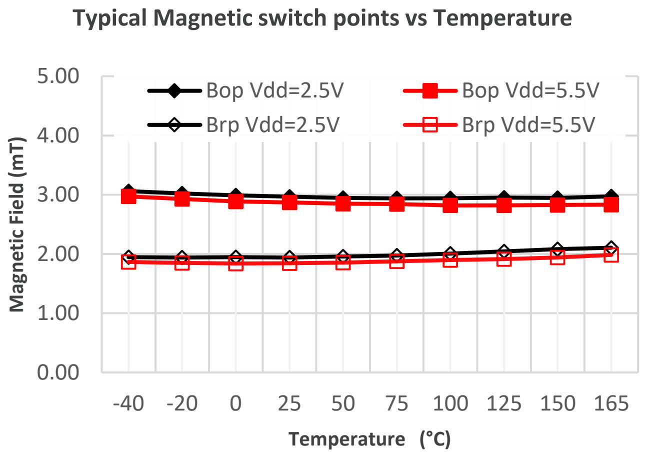


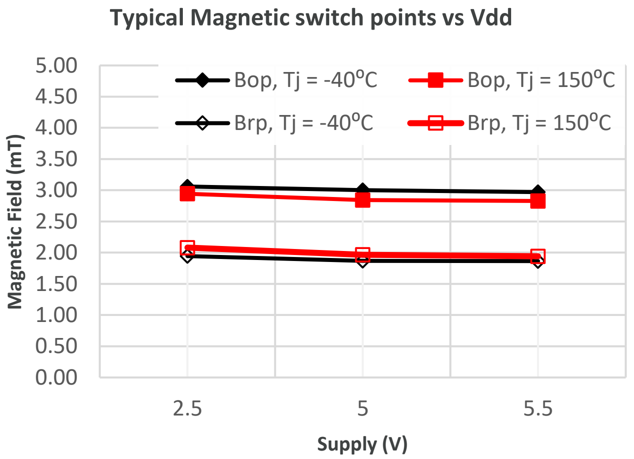
10.3. MLX92212LSE -ACA-000





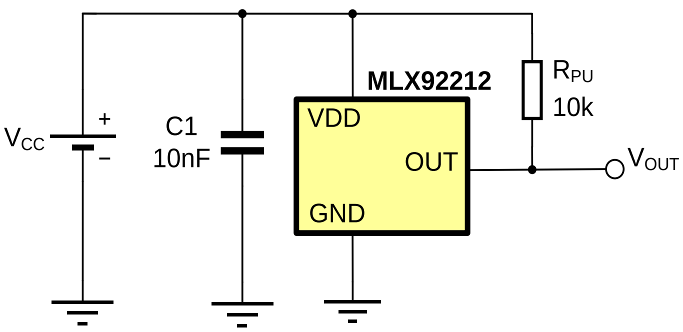
10.4. MLX92212LSE -ADA-000





11. Application Information

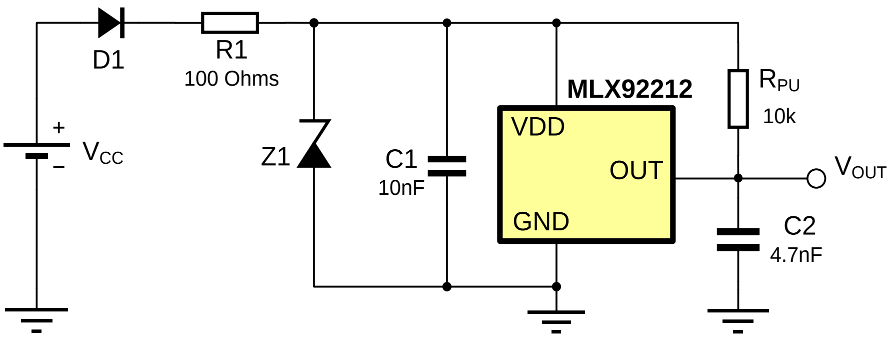
11.1. Typical Three-Wire Application Circuit



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. A capacitor connected to the output is not obligatory, because the output slope is generated internally.

11.2. 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_{DD} and ground pin.
2. The device could tolerate negative voltage down to -0.5 V, so if negative transients over supply line V_{PEAK}< -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_{DD}/I_{DDREV} 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_{DD} has to be higher than V_{DD} min ($V_{DD} = V_{CC} – R1.I_{DD}$)

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_{PEAK}> 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.

12. Standard information

12.1. 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* (1)

12.2. 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* (1).

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 (1) 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*(1).

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 (9)

For other specific process, contact Melexis via www.melexis.com/technical-inquiry

12.3. Environment and sustainability

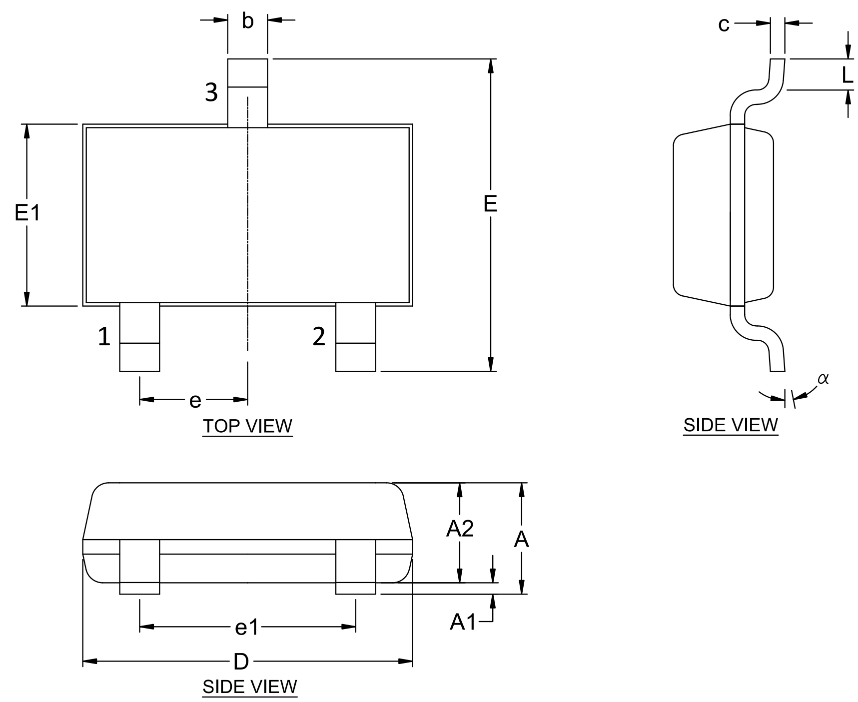
Melexis is contributing to global environmental conservation by promoting non-hazardous solutions. For more information on our environmental policy and declarations (RoHS, REACH…) visit www.melexis.com/environmental-forms-and-declarations

[1] www.melexis.com/ic-handling-and-assembly

13. Package Information

13.1. TSOT-3L (SE Package)

13.1.1. TSOT-3L – package dimensions

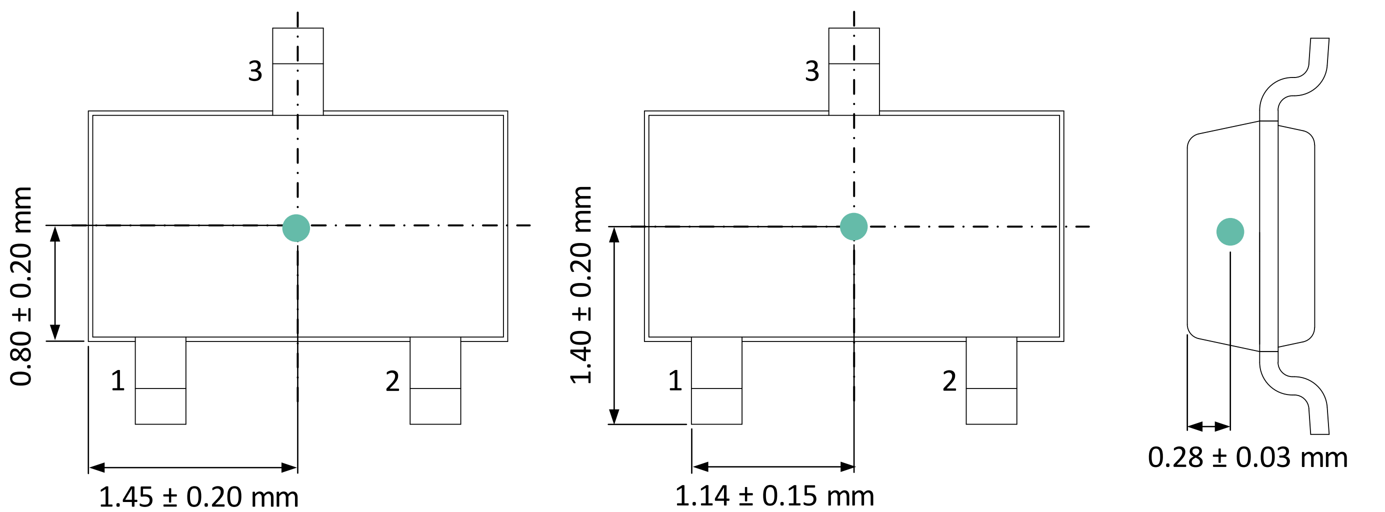


SYMBOL	MINIMUM	MAXIMUM
A	---	1.00
A1	0.025	0.10
A2	0.85	0.90
D	2.80	3.00
E	2.60	3.00
E1	1.50	1.70
L	0.30	0.50
b	0.30	0.45
c	0.10	0.20
e	0.95 BSC	
e1	1.90 BSC	
α	0°	8°

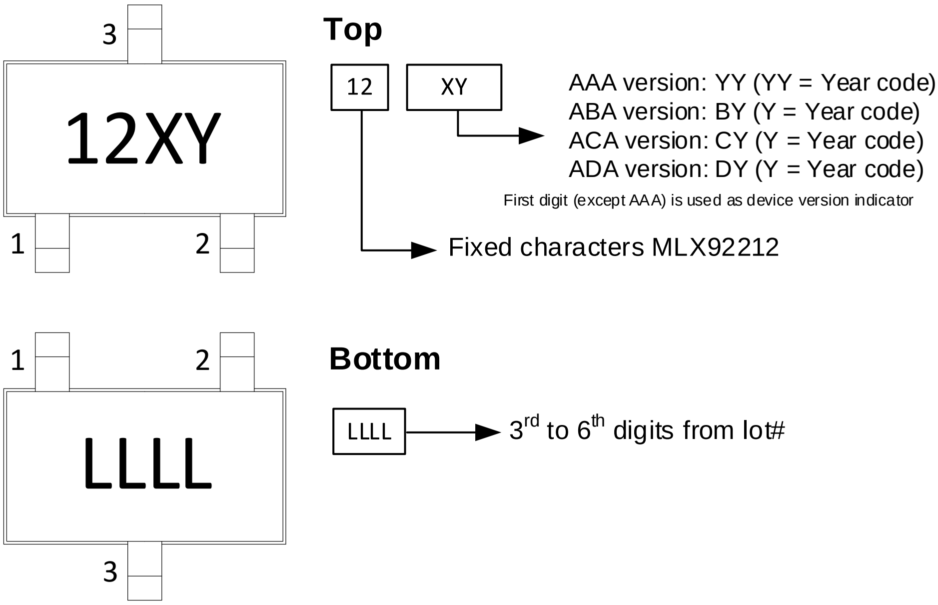
NOTE :

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 SUBTRATE.
6. FORMED LEAD SHALL BE PLANAR WITH RESPECT TO ONE ANOTHER WITH 0.076 mm SEATING PLANE.

13.1.2. TSOT-3L – Sensitive spot



13.1.3. TSOT-3L – Package marking / pin definition



Pin #	Name	Type	Function
1	VDD	Supply	Supply Voltage pin
2	OUT	Out	Open drain output pin
3	GND	Ground	Ground pin

14. Disclaimer

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3. defense related products, or other material for military use or for law enforcement;
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The previous versions of this document are repealed.

IATF 16949 and ISO 14001 Certified

For the latest revision of this document, visit https://www.melexis.com/en/product/MLX92212/Low-Voltage-Hall-Latch-Switch-Sensor

Happy to help you! www.melexis.com/contact