

3-Wire Hall Effect Latch

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

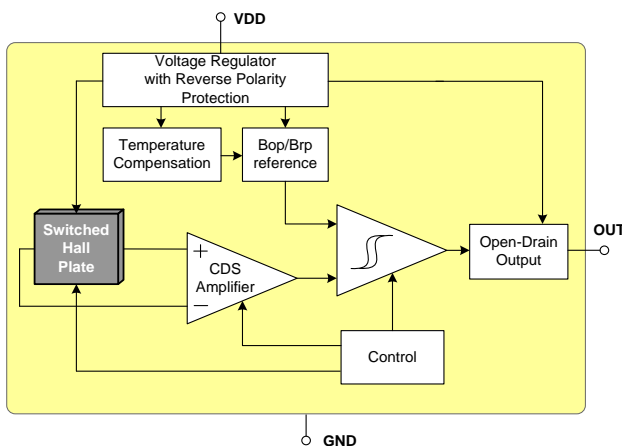
Applications

- 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)	$B_{OP}/B_{RP} = \pm 3mT$, $TC = -1100 \text{ ppm}/^\circ\text{C}$
MLX92215LSE-AAA-000-RE	L (-40°C to 150°C)	SE (TSOT-23)	$B_{OP}/B_{RP} = \pm 3mT$, $TC = -1100 \text{ ppm}/^\circ\text{C}$
MLX92215LSE-ACA-000-RE	L (-40°C to 150°C)	SE (TSOT-23)	Inverted output $B_{OP}/B_{RP} = \pm 3mT$, $TC = -2000 \text{ ppm}/^\circ\text{C}$

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 2.7V 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.

Contents

1. Functional Diagram	1
2. General Description.....	1
3. Glossary of Terms.....	3
4. Absolute Maximum Ratings.....	3
5. General Electrical Specifications.....	4
6. Magnetic Specifications.....	5
6.1. MLX92215LSE-AAA-000.....	5
6.2. MLX92215LUA-AAA-000.....	5
6.3. MLX92215LSE-ACA-000.....	5
7. Output Behaviour versus Magnetic Pole	6
7.1. South Pole Active	6
8. Performance Graphs	7
8.1. Magnetic parameters vs. TA	7
8.2. Magnetic parameters vs. VDD	7
8.3. VDSon vs. TA	7
8.4. VDSon vs. VDD	7
8.5. IDD vs. TA	7
8.6. IDD vs. VDD	7
8.7. IOFF vs. TA	8
8.8. IOFF vs. VOUT.....	8
8.9. SE Power Derating vs. TA.....	8
8.10. UA Power Derating vs. TA	8
9. Application Information.....	9
9.1. Typical Three-Wire Application Circuit.....	9
10. Standard information regarding manufacturability of Melexis products with different soldering processes.....	10
11. ESD Precautions	10
12. Packages.....	11
12.1. SE Package (TSOT-23)	11
12.2. UA (TO92 - 3L).....	12
13. Contact.....	13
14. Disclaimer.....	13

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 ^(1, 2)	V _{DD}	+27	V
Supply Voltage (Load dump) ^(1, 3)	V _{DD}	+32	V
Supply Current ^(1, 2, 4)	I _{DD}	+20	mA
Supply Current ^(1, 3, 4)	I _{DD}	+50	mA
Reverse Supply Voltage ^(1, 2)	V _{DDREV}	-24	V
Reverse Supply Voltage (Load dump) ^(1, 3)	V _{DDREV}	-30	V
Reverse Supply Current ^(1, 2, 5)	I _{DDREV}	-20	mA
Reverse Supply Current ^(1, 3, 5)	I _{DDREV}	-50	mA
Output Voltage ^(1, 2)	V _{OUT}	+27	V
Output Current ^(1, 2, 5)	I _{OUT}	+20	mA
Output Current ^(1, 3, 6)	I _{OUT}	+75	mA
Reverse Output Voltage ⁽¹⁾	V _{OUTREV}	-0.5	V
Reverse Output Current ^(1, 2)	I _{OUTREV}	-50	mA
Operating Temperature Range	T _A	-40 to +150	°C
Storage Temperature Range	T _S	-55 to +165	°C
Maximum Junction Temperature ⁽⁷⁾	T _J	+165	°C
ESD Sensitivity – HBM ⁽⁸⁾	-	4000	V
ESD Sensitivity – MM ⁽⁹⁾	-	500	V
ESD Sensitivity – CDM ⁽¹⁰⁾	-	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.

¹ The maximum junction temperature should not be exceeded

² For maximum 1 hour

³ For maximum 0.5 s

⁴ Including current through protection device

⁵ Through protection device

⁶ For V_{OUT} ≤ 27V

⁷ For 1000 hours

⁸ Human Model according AEC-Q100-002 standard

⁹ Machine Model according AEC-Q100-003 standard

¹⁰ Charged Device Model according AEC-Q100-011 standard

5. General Electrical Specifications

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

Parameter	Symbol	Test Conditions	Min	Typ ⁽¹⁾	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}	$V_{OUT} = 12\text{V}$, $V_{DD} = 12\text{V}$, $B < Brp$		0.1	10	μA
Output Saturation Voltage	V_{DSON}	$B > B_{OP}$, $V_{DD} = 3.8$ to 18V , $I_{OUT} = 20\text{mA}$		0.2	0.5	V
Output Rise Time ⁽²⁾ (R_{PU} dependent)	t_R	$V_{DD} = 12\text{V}$, V_{PU} ⁽³⁾ = 5V , $R_{PU} = 1\text{k}\Omega$ $C_{LOAD} = 50\text{pF}$ to GND	0.1	0.3	1	μs
Output Fall Time ⁽²⁾ (On-chip controlled)	t_F	$V_{DD} = 12\text{V}$, $V_{PU} = 5\text{V}$, $R_{PU} = 1\text{k}\Omega$ $C_{LOAD} = 50\text{pF}$ to GND	0.1	0.3	1	μs
Chopping Frequency	f_{CHOP}			340		kHz
Output Refresh Period ⁽²⁾	t_{PER}			6		μs
Delay time ^(2,4)	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		μs
Output Jitter (p-p) ^(2,5)	t_{JITTER}	Over 1000 successive switching events @1kHz, square wave with $B \geq 30\text{mT}$, $t_{RISE} = t_{FALL} \leq 100\mu\text{s}$		± 3		μs
Maximum Switching Frequency ^(2,6)	f_{SW}	$B \geq 30\text{mT}$ and square wave magnetic field	30	50		kHz
Power-On Time ^(7,8)	t_{ON}	$V_{DD} = 5\text{V}$, $dV_{DD}/dt > 2\text{V}/\mu\text{s}$		16	35	μs
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

¹ Typical values are defined at $T_A = +25^{\circ}\text{C}$ and $V_{DD} = 12\text{V}$

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

³ R_{PU} and V_{PU} are respectively the external pull-up resistor and pull-up power supply

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

⁵ Output jitter is the unpredictable deviation of the Delay time

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

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

⁸ 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 B_{OP} (mT)			Release Point B_{RP} (mT)			TC (ppm/ $^\circ C$)	Active Pole
	Min	Typ ⁽¹⁾	Max	Min	Typ ⁽¹⁾	Max		
$T_J = -40^\circ C$	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 B_{OP} (mT)			Release Point B_{RP} (mT)			TC (ppm/ $^\circ C$)	Active Pole
	Min	Typ ⁽¹⁾	Max	Min	Typ ⁽¹⁾	Max		
$T_J = -40^\circ C$	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		

6.3. MLX92215LSE-ACA-000

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

Test Condition	Operating Point B_{OP} (mT)			Release Point B_{RP} (mT)			TC (ppm/ $^\circ C$)	Active Pole
	Min	Typ ⁽¹⁾	Max	Min	Typ ⁽¹⁾	Max		
$T_J = -40^\circ C$	1.2	3.2	5.5	-5.5	-3.2	-1.2	-2000	North Pole
$T_J = 25^\circ C$	1.0	2.8	4.7	-4.7	-2.8	-1.0		
$T_J = 150^\circ C$	0.5	2.1	4.2	-4.2	-2.1	-0.5		

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

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

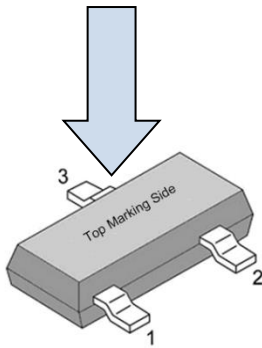
7. Output Behavior versus Magnetic Pole

7.1. South Pole Active

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

Parameter	Test Conditions	OUT
South pole	$B > B_{OP}$	Low (V_{D5on})
North pole	$B < B_{RP}$	High (V_{PU}) ⁽¹⁾

Table 2: Output behavior versus magnetic pole⁽²⁾

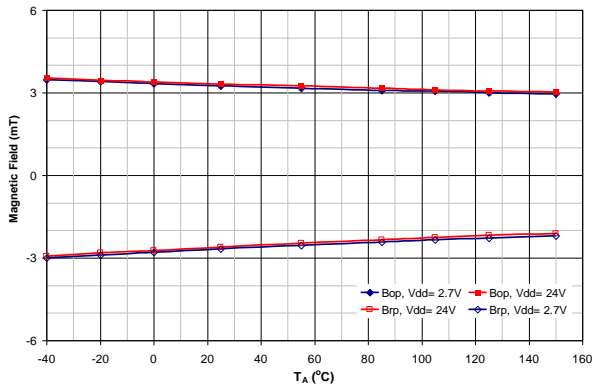


¹ Default Output state during power-up

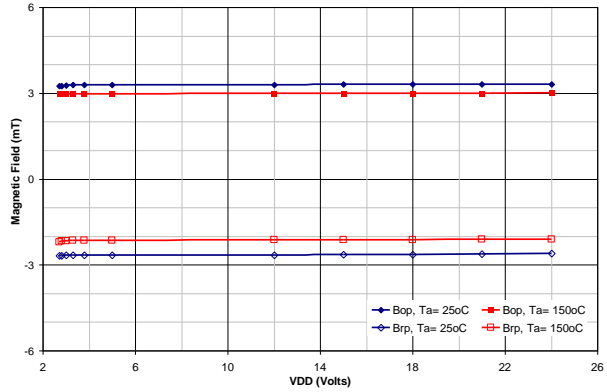
² Magnetic pole facing the branded/top side of the package

8. Performance Graphs

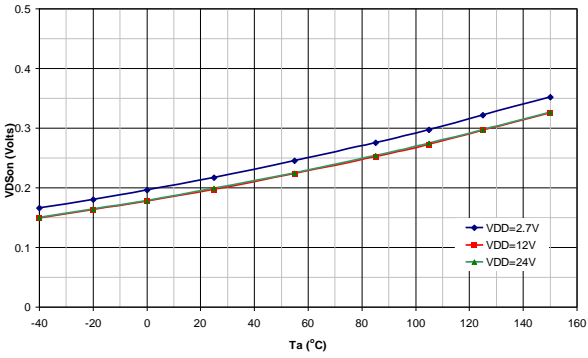
8.1. Magnetic parameters vs. T_A



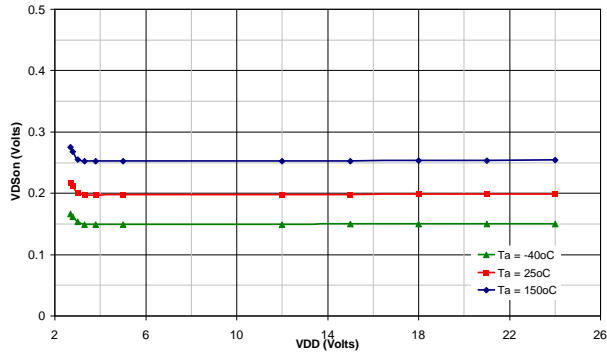
8.2. Magnetic parameters vs. V_{DD}



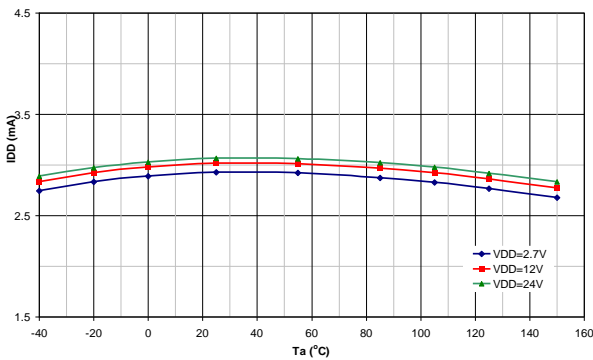
8.3. V_{Dson} vs. T_A



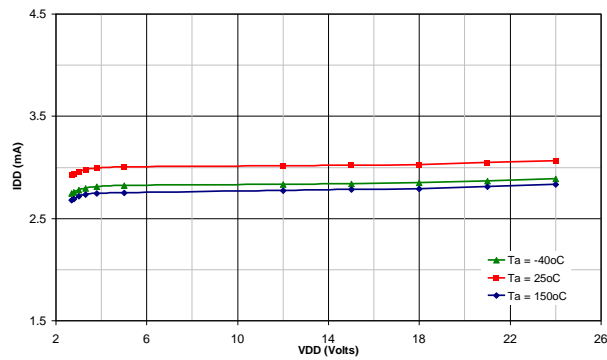
8.4. V_{Dson} vs. V_{DD}



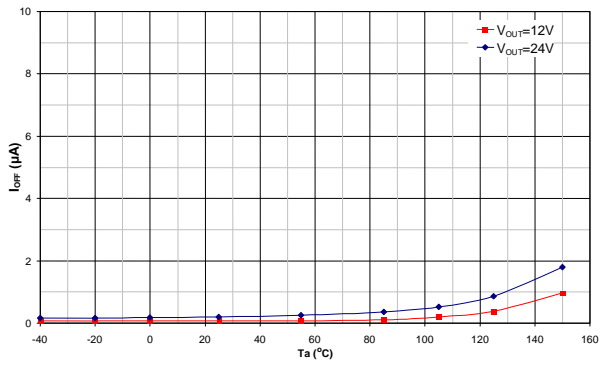
8.5. I_{DD} vs. T_A



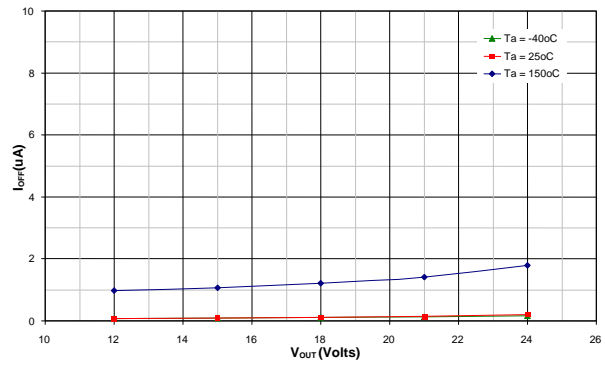
8.6. I_{DD} vs. V_{DD}



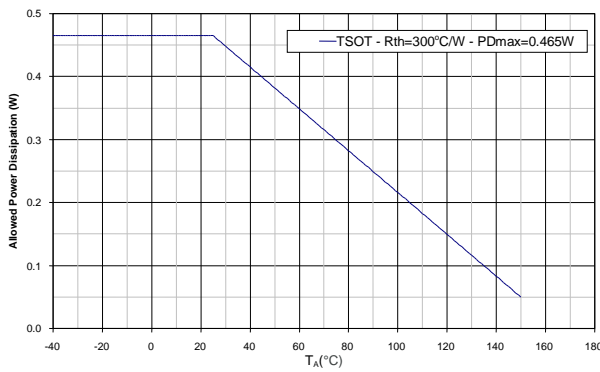
8.7. I_{OFF} vs. T_A



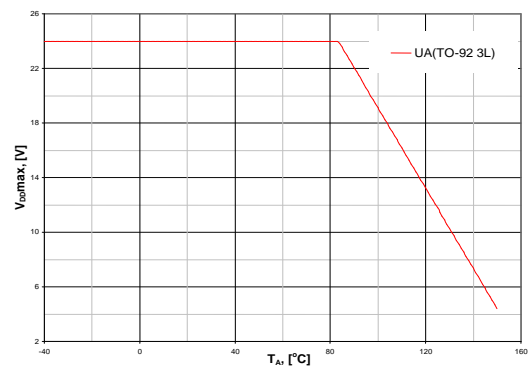
8.8. I_{OFF} vs. V_{OUT}



8.9. SE Power Derating vs. T_A

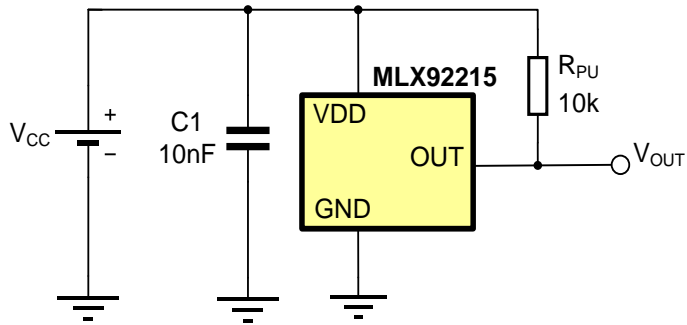


8.10. UA Power Derating vs. T_A



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 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 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>

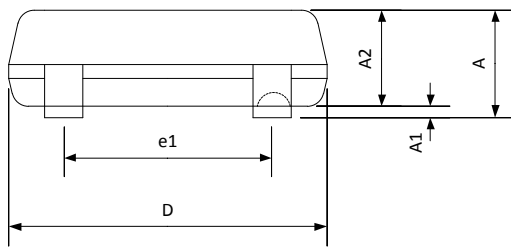
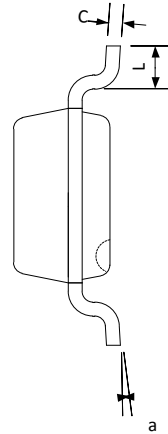
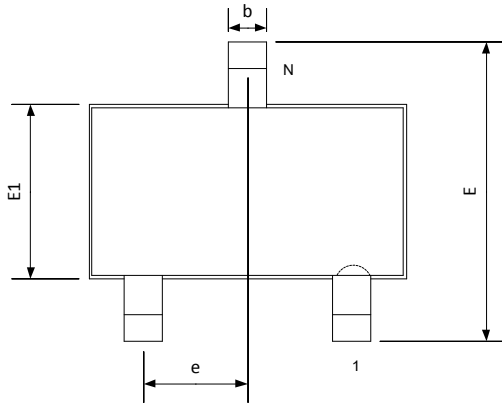
11. ESD Precautions

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



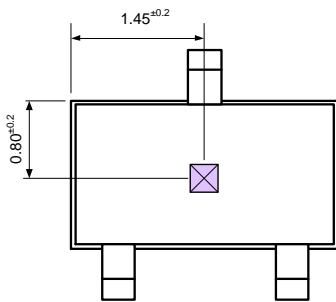
Notes:

1. 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.

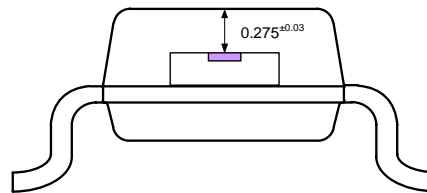
Marking:

Top side :15YY ; YY: Year (last 2 digits)

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



Hall plate location



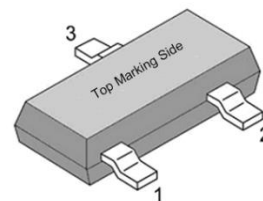
TOP VIEW

END VIEW

This table and all dimensions are in millimeters

N		A	A1	A2	D	E	E1	L	b	c	e	e1	α
3	min	—	0.025	0.85	2.80	2.60	1.50	0.30	0.30	0.10	0.95	1.90	0°
	max	1.00	0.10	0.90	3.00	3.00	1.70	0.50	0.45	0.20	BSC	BSC	8°

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



12.2. UA (TO92 - 3L)

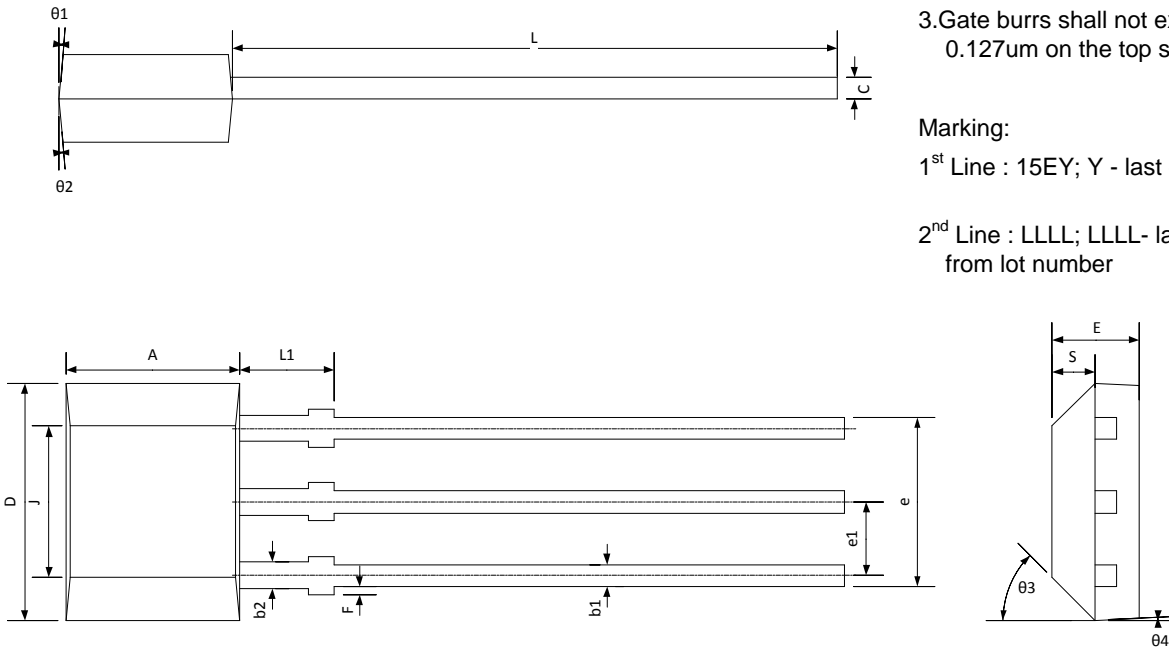
Notes:

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

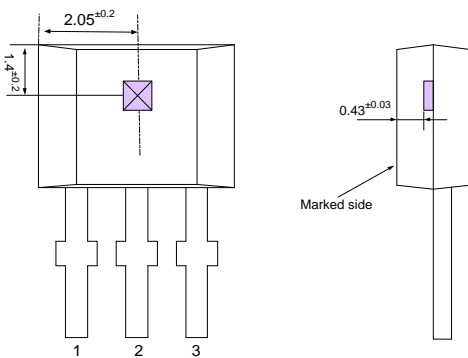
Marking:

1st Line : 15EY; Y - last digit of year

2nd Line : LLLL; LLLL- last four digits from lot number



Hall plate location



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

This table in mm

	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
	theta1	theta2	theta3	theta4									
min	7° REF	7° REF	45° REF	7° REF									
max													

13. Contact

For the latest version of this document, go to our website at www.melexis.com.

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

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	Email : sales_usa@melexis.com
Asia	Email : sales_asia@melexis.com

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