

## 1 Features and Benefits

- Programmable parameters in application:
  - Wide magnetic Latch range:  $\pm 0.4\text{mT}$  to  $\pm 80\text{mT}$
  - Wide magnetic Switch range:  $\pm 1.5\text{mT}$  to  $\pm 66\text{mT}$
  - Programmable Hysteresis:  $1\text{mT}$  to  $36\text{mT}$
  - Programmable Active Pole: North or South
  - Programmable Output Behaviour: Direct or Inverted
  - Increased Traceability: 32 bits ID on chip
- Built-in Negative TC coefficient: 0 to  $-2000\text{ ppm}/^\circ\text{C}$
- Wide operating voltage range: from 2.7V to 24V
- Reverse Supply Voltage Protection
- Output Current Limit with Auto-Shutoff
- Under-Voltage Lockout Protection
- Thermal Protection
- Lateral Sensitivity option
- Dual die option

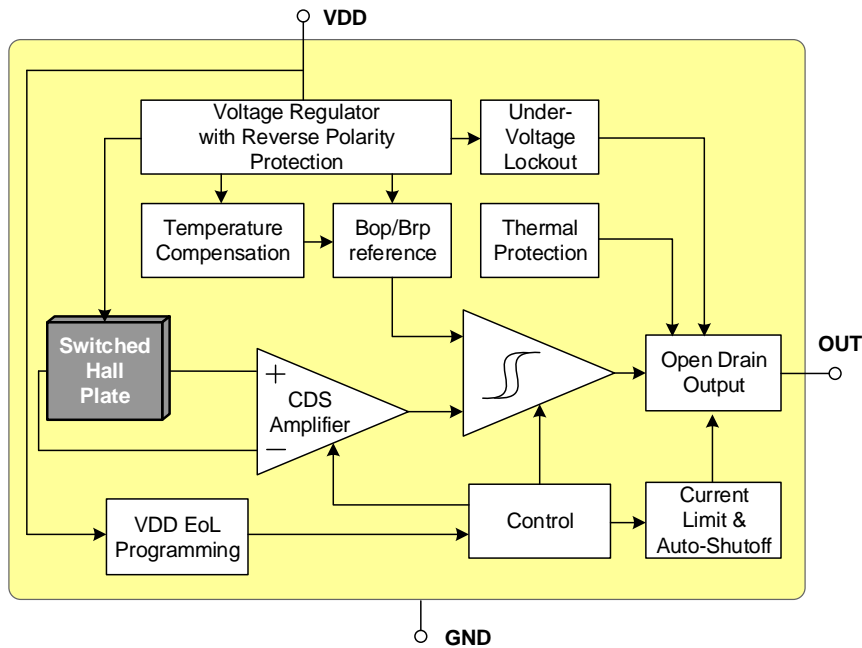
## 2 Application Examples

- Automotive, Consumer and Industrial
- Solid-state switch
- 3-phase BLDC motor commutation
- Wiper motor
- Window lifter
- Sunroof/Tailgate opener
- Seat motor adjuster
- Electrical power steering
- Brake Light switch

## 3 Ordering Information

Product Code	Temperature Code	Package Code	Comment
MLX92232LSE-AAA-000-RE	L (-40°C to 150°C)	SE (TSOT-3L)	3-wire Switch/Latch, TC=0 ppm/°C
MLX92232LUA-AAA-000-BU	L (-40°C to 150°C)	UA (TO92-3L)	3-wire Switch/Latch, TC=0 ppm/°C
MLX92232LVA-AAA-000-BU	L (-40°C to 150°C)	VA (SIP 4L)	Dual Die 3-wire Switch/Latch, TC=0 ppm/°C
MLX92232LSE-AAA-001-RE	L (-40°C to 150°C)	SE (TSOT-3L)	3-wire Switch/Latch, TC=-400 ppm/°C
MLX92232LUA-AAA-001-BU	L (-40°C to 150°C)	UA (TO92-3L)	3-wire Switch/Latch, TC=-400 ppm/°C
MLX92232LSE-AAA-002-RE	L (-40°C to 150°C)	SE (TSOT-3L)	3-wire Switch/Latch, TC=-1100 ppm/°C
MLX92232LUA-AAA-002-BU	L (-40°C to 150°C)	UA (TO92-3L)	3-wire Switch/Latch, TC=-1100 ppm/°C
MLX92232LSE-AAA-003-RE	L (-40°C to 150°C)	SE (TSOT-3L)	3-wire Switch/Latch, TC=-2000 ppm/°C
MLX92232LUA-AAA-003-BU	L (-40°C to 150°C)	UA (TO92-3L)	3-wire Switch/Latch, TC=-2000 ppm/°C
MLX92232LSE-AAA-200-RE	L (-40°C to 150°C)	SE (TSOT-3L)	3-wire Switch/Latch IMC version, TC=0 ppm/°C
MLX92232LSE-AAA-201-RE	L (-40°C to 150°C)	SE (TSOT-3L)	3-wire Switch/Latch IMC version, TC=-400 ppm/°C
MLX92232LSE-AAA-202-RE	L (-40°C to 150°C)	SE (TSOT-3L)	3-wire Switch/Latch IMC version, TC=-1100 ppm/°C
MLX92232LSE-AAA-203-RE	L (-40°C to 150°C)	SE (TSOT-3L)	3-wire Switch/Latch IMC version, TC=-2000 ppm/°C
MLX92232LUA-AAA-200-BU	L (-40°C to 150°C)	UA (TO92-3L)	3-wire Switch/Latch IMC version, TC=0 ppm/°C

## 4 Functional Diagram



## 5 General Description

The Melexis MLX92232 is the second generation programmable Hall-effect sensor 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.

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. In the event of a drop below the minimum supply voltage during operation, the under-voltage lock-out protection will automatically freeze the device, preventing the electrical perturbation to affect the magnetic measurement circuitry.

The open drain output is fully protected against short-circuit with a built-in current limit. An additional automatic output shut-off is activated in case of a prolonged short-circuit condition. A self-check is then periodically performed to switch back to normal operation if the short-circuit condition is released.

The on-chip thermal protection also switches off the output if the junction temperature increases above an abnormally high threshold. It will automatically recover once the temperature decreases below a safe value.

Furthermore the MLX92232 features a full set of programmable parameters that can be adjusted in the application in order to achieve the highest possible system accuracy by compensating the mechanical tolerances.

An Integrated Magnetic Concentrator option (IMC) has been added to sense the lateral field component. This is adding more flexibility in the module design. A dual die option is also available for applications that need a secondary output; these can be programmed independently from each other.

# MLX92232

End of Line programmable 3-Wire Hall Effect Latch/Switch

Datasheet



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## 6 Glossary of Terms

Tesla	Units for the magnetic flux density, 1 mT = 10 Gauss
TC	Temperature Coefficient in ppm/°C
IMC	Integrated Magnetic Concentrator
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	Value	Units
Supply Voltage <sup>(1, 2)</sup>	V <sub>DD</sub>	+27	V
Supply Voltage (Load Dump) <sup>(1, 4)</sup>	V <sub>DD</sub>	+32	V
Supply Current <sup>(1, 2, 3)</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 <sup>(1, 4)</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, 4, 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, 4, 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>	-100	mA
Maximum Junction Temperature <sup>(7)</sup>	T <sub>J</sub>	+165	°C
Storage Temperature Range	T <sub>S</sub>	-55 to +165	°C
ESD Sensitivity – HBM <sup>(8)</sup>	-	4000	V
ESD Sensitivity – CDM <sup>(9)</sup>	-	1000	V
Magnetic Flux Density	B	Unlimited	mT

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

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

<sup>3</sup> Including current through protection device

<sup>4</sup> For maximum 500ms

<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> Charged Device Model according AEC-Q100-011 standard

## 8 General Electrical Specifications

DC Operating Parameters  $V_{DD} = 2.7V$  to  $24V$ ,  $T_A = -40^{\circ}C$  to  $150^{\circ}C$  (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 <sup>(2)</sup>	$I_{DD}$		1.5	3.0	4.5	mA
Supply Current <sup>(3)</sup>	$I_{DD}$		3.0	6.0	9.0	mA
Reverse supply current	$I_{DDREV}$	$V_{DD} = -16V$	-1	-	-	mA
Output Saturation Voltage	$V_{DSON}$	$V_{DD} = 3.5$ to $24V$ , $I_{OUT} = 20mA$	-	0.3	0.5	V
Output Leakage	$I_{OFF}$	$V_{OUT} = 12V$ , $V_{DD} = 12V$	-	-	10	$\mu A$
Output Rise Time <sup>(4, 8)</sup> ( $R_{PU}$ dependent)	$t_R$	$R_{PU} = 1k\Omega$ , $V_{DD} = 12V$ , $V_{PU} = 5V$ $C_{LOAD} = 50pF$ to GND	0.1	0.3	1	$\mu s$
Output Fall Time <sup>(4, 8)</sup> (On-chip controlled)	$t_F$	$R_{PU} = 1k\Omega$ , $V_{DD} = 12V$ , $V_{PU} = 5V$ $C_{LOAD} = 50pF$ to GND	0.1	0.3	1	$\mu s$
Power-On Time <sup>(5, 6, 9)</sup>	$t_{ON}$	$V_{DD} = 5V$ , $dV_{DD}/dt > 2V/\mu s$	-	40	70	$\mu s$
Power-On Output State	-	$t < t_{ON}$		High ( $V_{PU}$ )		-
Output Current Limit	$I_{CL}$	$V_{DD} = 3.5$ to $24V$ , $V_{OUT} = 12V$	25	40	70	mA
Output ON Time under Current Limit conditions <sup>(10)</sup>	$t_{CLON}$	$V_{PU} = 12V$ , $R_{PU} = 100\Omega$	150	240		$\mu s$
Output OFF Time under Current Limit conditions <sup>(10)</sup>	$t_{CLOFF}$	$V_{PU} = 12V$ , $R_{PU} = 100\Omega$	-	3.5	-	ms
Chopping Frequency	$f_{CHOP}$		-	340	-	kHz
Refresh Period	$t_{PER}$		-	6	-	$\mu s$
Output Jitter (p-p) <sup>(4)</sup>	$t_{JITTER}$	Over 1000 successive switching events @10kHz triangle wave magnetic field, $B > \pm(B_{OPMAX} + 20mT)$	-	$\pm 3.2$	-	$\mu s$
Maximum Switching Frequency <sup>(4, 7)</sup>	$f_{SW}$	$B > \pm 3(B_{OPMAX} + 1mT)$ , triangle wave magnetic field	30	65	-	kHz
Under-voltage Lockout Threshold	$V_{UVL}$		-	-	2.7	V
Under-voltage Lockout Reaction time <sup>(4)</sup>	$t_{UVL}$		-	1	-	$\mu s$
Thermal Protection Threshold	$T_{PROT}$	Junction temperature	-	190 <sup>(11)</sup>	-	$^{\circ}C$
Thermal Protection Release	$T_{REL}$	Junction temperature	-	180 <sup>(11)</sup>	-	$^{\circ}C$
SE Package Thermal Resistance	$R_{THJA}$	Single layer PCB, JEDEC standard test boards		300		$^{\circ}C/W$
UA package Thermal Resistance	$R_{THJA}$	Single layer PCB, JEDEC standard test boards		200		$^{\circ}C/W$
VA package Thermal Resistance	$R_{THJA}$	Single layer PCB, JEDEC standard test boards		105		$^{\circ}C/W$

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

2 Valid for 92232LSE-AAA-xxx and 92232LUA-AAA-xxx versions

3 Valid for 92232LVA-AAA-xxx version

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

5 The Power-On Time represents the time from reaching  $V_{DD} = 2.7V$  to the first refresh of the output

6 Power-On Slew Rate is not critical for the proper device start-up.

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

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

9 Activated output with 1 mT overdrive

10 If the Output is in Current Limitation longer than  $t_{CLON}$  the Output is switched off in high-impedance state. The Output returns back in active state at next reaching of  $B_{OP}$  or after  $t_{CLOFF}$  time interval

11  $T_{PROT}$  and  $T_{REL}$  are the corresponding junction temperature values

## 9 Magnetic Specifications

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

Parameter	Symbol	Test Conditions	Min	Typ <sup>(1)</sup>	Max	Units
Latch Threshold Programming Range <sup>(2, 3)</sup>	$B_{LTH}$	$V_{DD}=12V, T_A=25^{\circ}C$	$\pm 0.4$		$\pm 80$	mT
Switch Operating Point Programming Range <sup>(3, 4)</sup>	$B_{OP}$	$V_{DD}=12V, T_A=25^{\circ}C$	$\pm 1.5$		$\pm 66$	mT
Proportional Hysteresis Ratio Programming <sup>(5, 6)</sup>	$HYS_{RATIO}$	$V_{DD}=12V, T_A=25^{\circ}C$	0.1		0.55	-
Fixed Hysteresis Value 0 <sup>(7, 8)</sup>	$B_{FHYS0}$		-	0	-	mT
Fixed Hysteresis Value 1 <sup>(7, 8)</sup>	$B_{FHYS1}$		-	1	-	mT
Fixed Hysteresis Value 2 <sup>(7, 8)</sup>	$B_{FHYS2}$		-	1.2	-	mT
Fixed Hysteresis Value 3 <sup>(7, 8)</sup>	$B_{FHYS3}$		-	1.4	-	mT
Fixed Hysteresis Value 4 <sup>(7, 8)</sup>	$B_{FHYS4}$		-	1.8	-	mT
Fixed Hysteresis Value 5 <sup>(7, 8)</sup>	$B_{FHYS5}$		-	2.2	-	mT
Latch Sensor Magnetic Offset <sup>(9)</sup>	$B_{OFFSET}$	$T_A=25^{\circ}C$	-0.5		0.5	mT
		$T_A=-40^{\circ}C$ to $150^{\circ}C$	-0.9		0.9	mT
Temperature Coefficient <sup>(10)</sup>	TC	Latch with: No IMC: $B_{OP}/B_{RP} = \pm 28mT$ IMC: $B_{OP}/B_{RP} = \pm 12mT$		0 -400 -1100 -2000		ppm/ $^{\circ}C$
Factory Programmed $B_{OP}$ , Switch <sup>(11)</sup>	$B_{OP}$	$V_{DD}=12V, T_A=25^{\circ}C$ , target 28mT	26	28	30	mT
Factory Programmed $B_{RP}$ , Switch <sup>(11)</sup>	$B_{RP}$	$V_{DD}=12V, T_A=25^{\circ}C$ , target 28mT, $HYS_{RATIO}=0.25$	19	21	23	mT
Factory Programmed $B_{OP}$ , Latch <sup>(12)</sup>	$B_{OP}$	$V_{DD}=12V, T_A=25^{\circ}C$ , target 12mT	10	12	14	mT
Factory Programmed $B_{RP}$ , Latch <sup>(12)</sup>	$B_{RP}$	$V_{DD}=12V, T_A=25^{\circ}C$ , target -12mT	-14	-12	-10	mT

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

2 For Latch sensor  $B_{LTH}=(B_{OP}-B_{RP})/2$ . The Latch programming step is typically between 0.7% and 1.5% of the programmed  $B_{LTH}$  value for  $|B_{LTH}|\geq 1.2mT$  and 0.018mT for  $|B_{LTH}|\leq 1.2mT$ .

3 Guaranteed by design and verified by characterization. The programming ranges for BLTH and BOP include some margin for process deviations.

4 For Switch sensor the  $B_{OP}$  programming step is typically between 0.7% and 1.5% of the programmed  $B_{OP}$  value for  $|B_{OP}|\geq 4.8mT$  and 0.072mT for  $|B_{OP}|\leq 4.8mT$ .

5 For Switch sensor with proportional hysteresis  $HYS_{RATIO}=B_{HYS}/B_{OP}$ . The  $HYS_{RATIO}$  programming step is 0.05.

6 The given min/max limits are typical values.

7 For Switch sensor with fixed hysteresis value

8 Guaranteed by design and verified by characterization.

9 For Latch sensor offset is defined as  $B_{OFFSET} = (B_{OP}+B_{RP})/2$ .

10 The temperature Coefficient is calculated using following formula:

$$TC = \frac{B_{XPTA2} - B_{XPTA1}}{B_{XPT25} * (T_{A2} - T_{A1})} * 10^6, ppm/^{\circ}C$$

where:

$T_{A1} = -40^{\circ}C, T_{A2} = 150^{\circ}C, T_{25} = 25^{\circ}C$

In case of magnetic Latch application:  $B_{XPTA1}, B_{XPTA2}$  OR  $B_{XPT25} = B_{OP}-B_{RP}$  at  $T_{A1}, T_{A2}$  OR  $T_{25}$

In case of magnetic Switch application:  $B_{XPTA1}, B_{XPTA2}$  OR  $B_{XPT25} = B_{OP}$  OR  $B_{RP}$  at  $T_{A1}, T_{A2}$  OR  $T_{25}$

11 Valid for 92232Lxx-AAA-0xx

12 Valid for 92232Lxx-AAA-2xx

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End of Line programmable 3-Wire Hall Effect Latch/Switch

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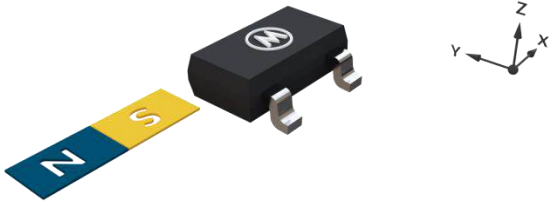
## 10 Programming parameters

Parameter	Symbol	Comments	Value	Units
B <sub>op</sub> programming resolution	B <sub>OPFINE</sub>	Fine programming of the threshold B <sub>op</sub> (switch) and B <sub>LTH</sub> (Latch)	7	Bit
B <sub>op</sub> sub-range	B <sub>OPRANGE</sub>	Selection of the appropriate switch sensor sub-range	2	Bit
B <sub>LTH</sub> sub-range	B <sub>OPRANGE</sub>	Selection of the appropriate latch sensor sub-range	3	Bit
Programming hysteresis	B <sub>HYST</sub>	Hysteresis can be fixed or proportional	4	Bit
Active Pole selection	B <sub>POLE</sub>	Part can be programmed for south or north magnetic pole active	1	Bit
Output polarity selection	P <sub>OLOUT</sub>	Selects direct or inverted output polarity	1	Bit
Switch/Latch function selection		Selects Latch or Switch sensor function	1	Bit
Melexis programmed ID	ID	A unique fixed ID implemented for device traceability, no overwriting allowed.	32	Bit

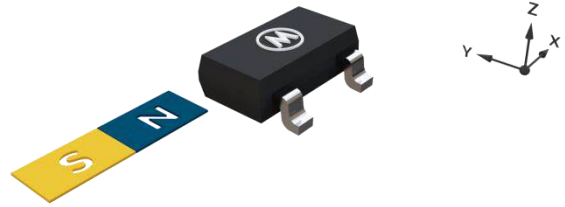
# MLX92232

End of Line programmable 3-Wire Hall Effect Latch/Switch

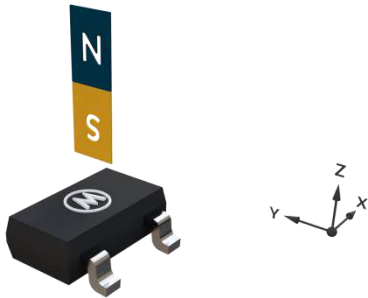
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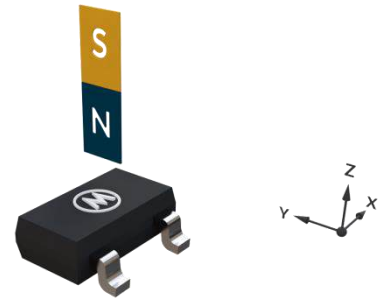
*South active pole (IMC version)*



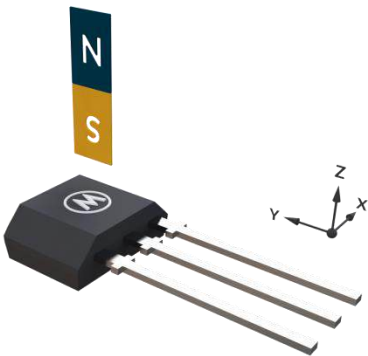
*North active pole (IMC version)*



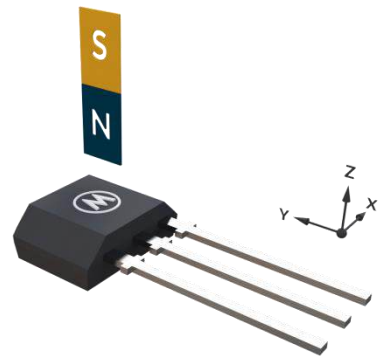
*South active pole*



*North active pole*



*South active pole*



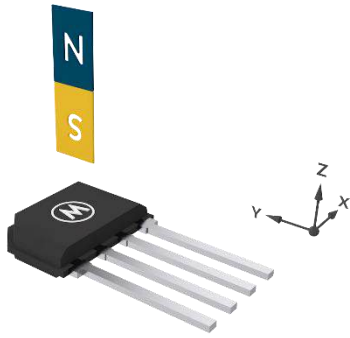
*North active pole*



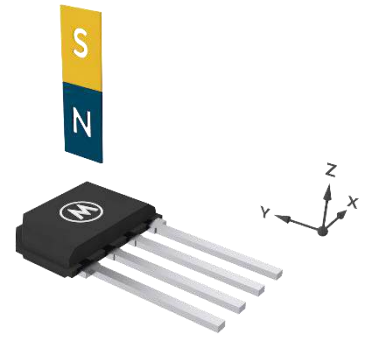
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## End of Line programmable 3-Wire Hall Effect Latch/Switch

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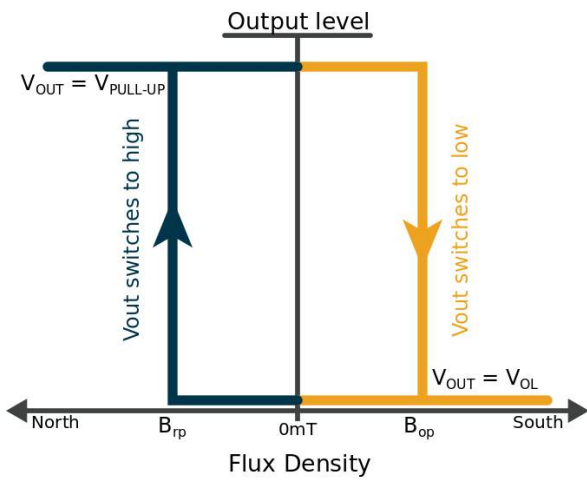


South pole active (VA package)

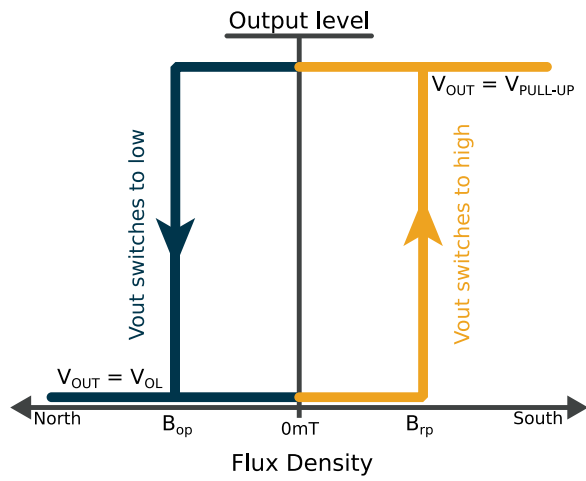


North pole active (VA package)

### 10.1 Latch Sensor

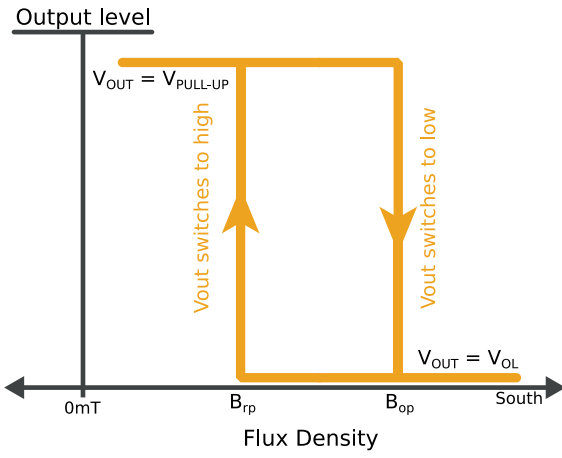


South Pole Active

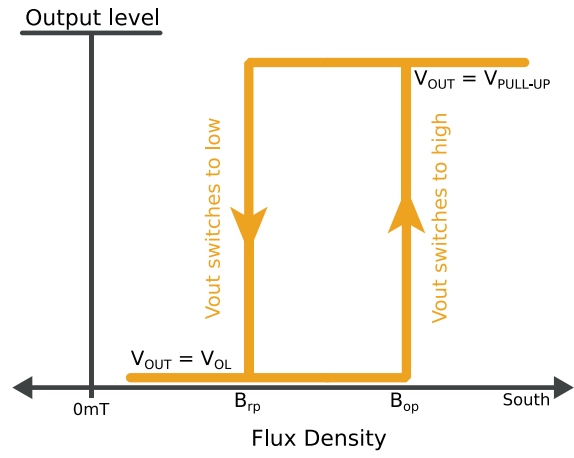


North Pole active

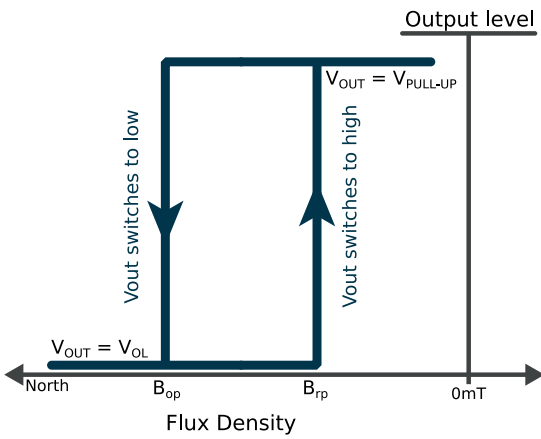
## 10.2 Switch Sensor



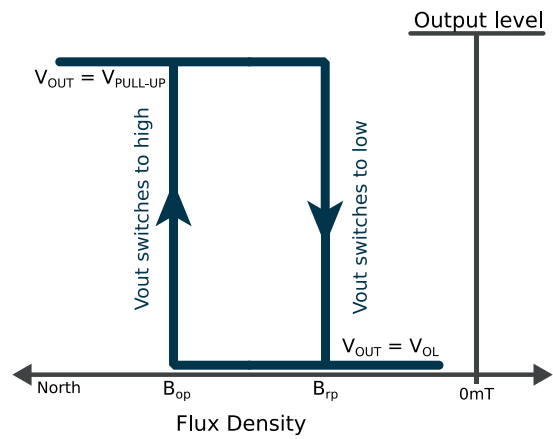
Direct South Active Pole



Inverted South Active Pole



Direct North Active Pole



Inverted North Active Pole

# MLX92232

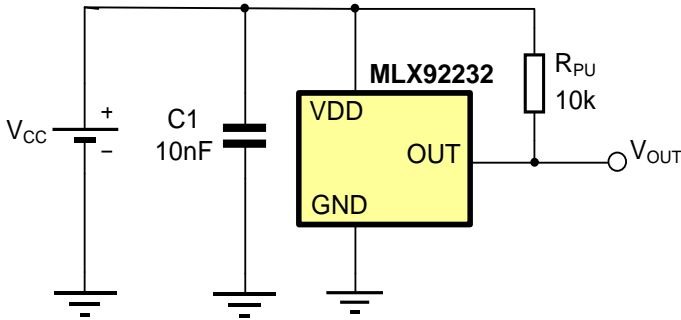
End of Line programmable 3-Wire Hall Effect Latch/Switch

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## 11 Application Information

### 11.1 Typical Three-Wire Application Circuit

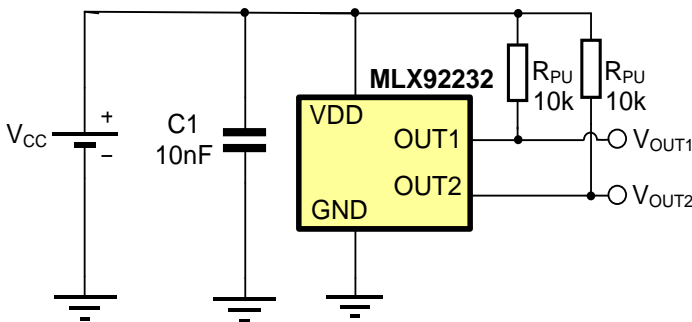
#### 11.1.1 92232LSE-AAA-xxx, 92232LUA-AAA-xxx



**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 pull-up resistor R<sub>PU</sub> 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 needed, because the output slope is generated internally.

#### 11.1.2 92232LVA-AAA-xxx

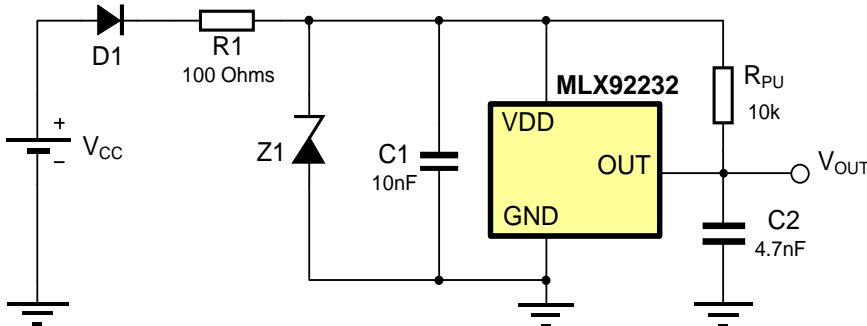


**Notes:**

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 pull-up resistors R<sub>PU</sub> values should be chosen in to limit the current through the output pin below the maximum allowed continuous current for the device.
3. A capacitors connected to the outputs are not needed, because the output slope is generated internally.

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

### 11.2.1 92232LSE-AAA-xxx, 92232LUA-AAA-xxx



#### Notes:

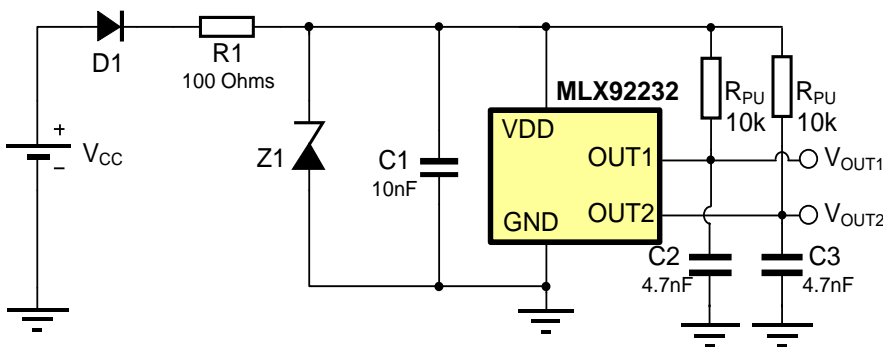
- For proper operation, a 10nF to 100nF bypass capacitor should be placed as close as possible to the V<sub>DD</sub> and ground pin.
- The device could tolerate negative voltage down to -24V, so if negative transients over supply line  $V_{PEAK} < -30V$  are expected, usage of the diode D1 is recommended. Otherwise only R1 is sufficient.

When selecting the resistor R1, three points are important:

- the resistor has to limit  $I_{DD}/I_{DDREV}$  to 50mA 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 ( $V_{DD} = V_{CC} - R1 \cdot I_{DD}$ )

- The device could tolerate positive supply voltage up to +27V (until the maximum power dissipation is not exceeded), so if positive transients over supply line with  $V_{PEAK} > 32V$  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.

### 11.2.2 92232LVA-AAA-xxx



#### Notes:

- 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.
- The device could tolerate negative voltage down to -24V, so if negative transients over supply line  $V_{PEAK} < -30V$  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 50mA 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 ( $V_{DD} = V_{CC} - R1 \cdot I_{DD}$ )

- The device could tolerate positive supply voltage up to +27V (until the maximum power dissipation is not exceeded), so if positive transients over supply line with  $V_{PEAK} > 32V$  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 regarding manufacturability of Melexis products

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>

## 13 ESD Precautions

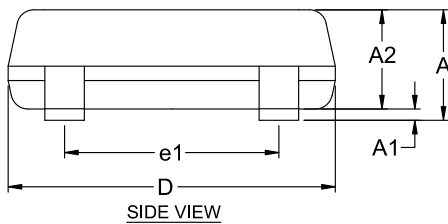
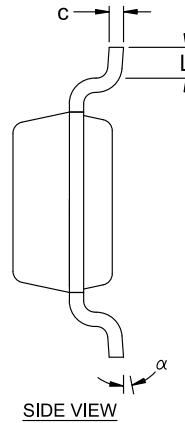
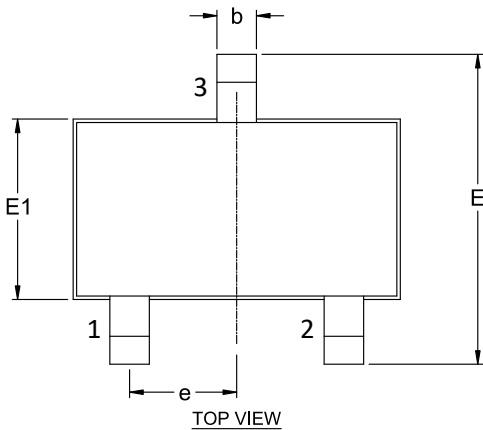
Electronic semiconductor products are sensitive to Electro Static Discharge (ESD).

Always observe Electro Static Discharge control procedures whenever handling semiconductor products.

## 14 Package Information

### 14.1 TSOT-3L (SE Package)

#### 14.1.1 TSOT-3L – Package dimensions

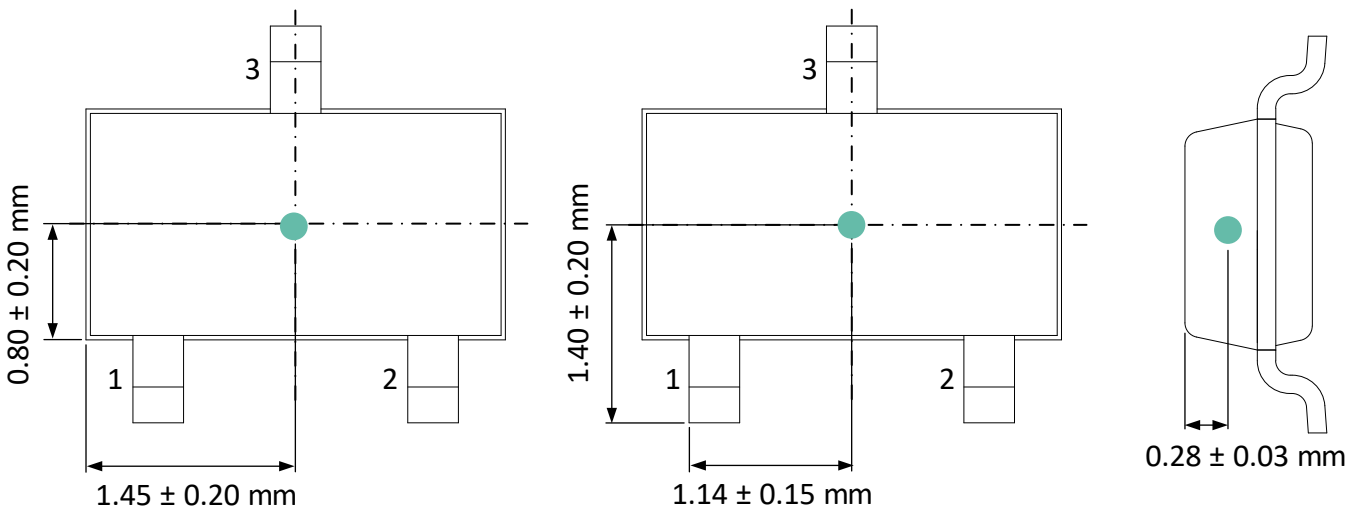


SYMBOL	MINIMUM	MAXIMUM
A	---	1.00
A1	0.025	0.10
A2	0.85	0.90
D	2.80	3.00
E	2.60	3.00
E1	1.50	1.70
L	0.30	0.50
b	0.30	0.45
c	0.10	0.20
e	0.95 BSC	
e1	1.90 BSC	
$\alpha$	0°	8°

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

#### 14.1.2 TSOT-3L – Sensitive spot

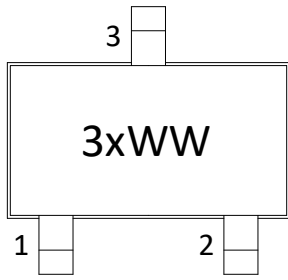


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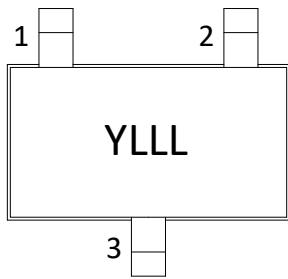
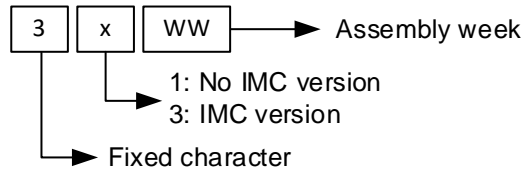
End of Line programmable 3-Wire Hall Effect Latch/Switch

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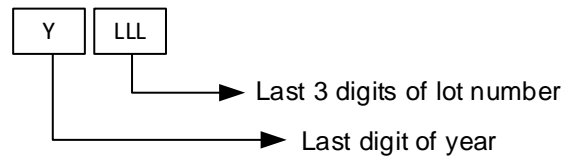
## 14.1.3 TSOT-3L – Package marking / Pin definition



**Top**



**Bottom**



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

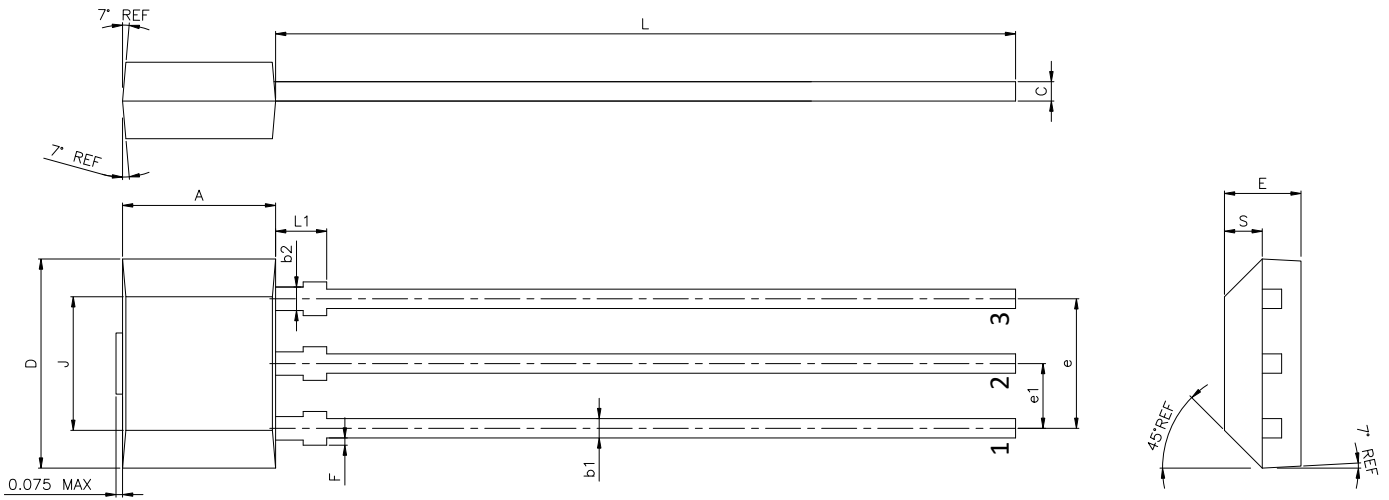
# MLX92232

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## 14.2 TO92-3L (UA Package)

### 14.2.1 TO92-3L – Package dimensions

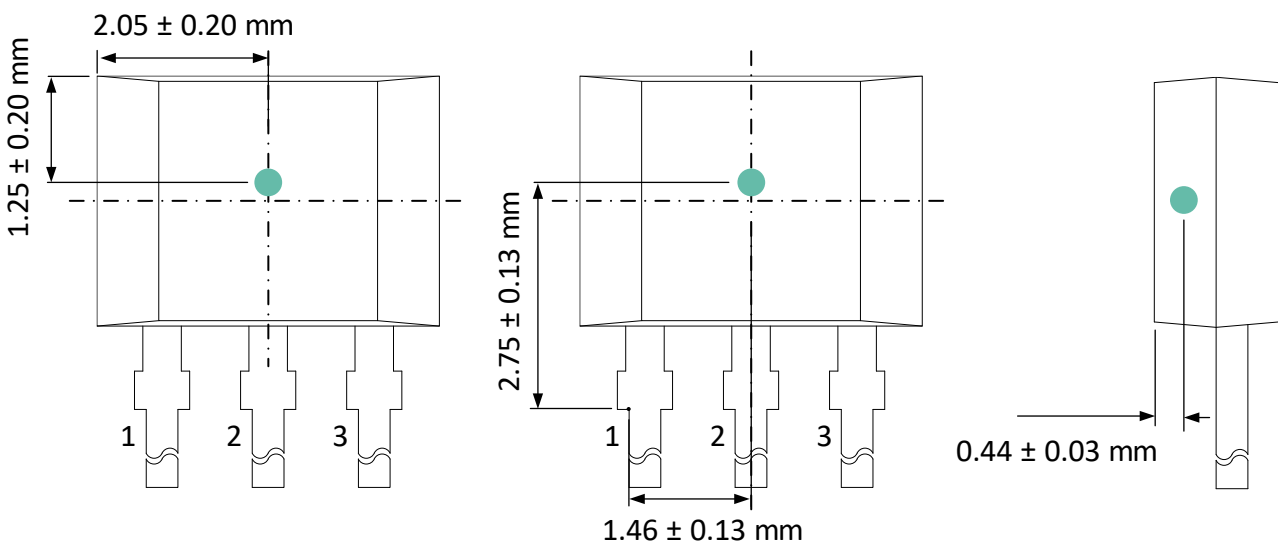


SYMBOL	MINIMUM	MAXIMUM
A	2.90	3.10
D	4.00	4.20
E	1.40	1.60
F	0.00	0.15
J	2.51	2.72
L	14.00	15.00
L1	0.90	1.10
S	0.63	0.84
b1	0.35	0.44
b2	0.43	0.52
c	0.35	0.44
e	2.51	2.57
e1	1.24	1.30

NOTES :

1. DIMENSIONS IN MILLIMETERS (mm) UNLESS NOTED OTHERWISE.
2. PACKAGE DIMENSIONS DO NOT INCLUDE MOLD FLASHES AND PROTRUSIONS.
3. DIMENSION A AND D DO NOT INCLUDE MOLD GATE AND SIDE FLASH (PROTRUSION) of MAXIMUM 0.127 mm PER SIDE.
4. THE LEADS MAY BE SLIGHTLY DEFORMED DURING TRANSPORTATION IF PACKED IN BULK (BAG), AFFECTING e1 DIMENSION. IT IS RECOMMENDED TO ORDER RADIAL TAPE (REEL OR AMMOPACK) IF SUCH DEFORMATION IS CRITICAL FOR THE LEAD FORMING PROCESS, EVEN IF MANUAL LOADING INTO THE TOOL IS FORESEEN.

### 14.2.2 TO92-3L – Sensitive spot



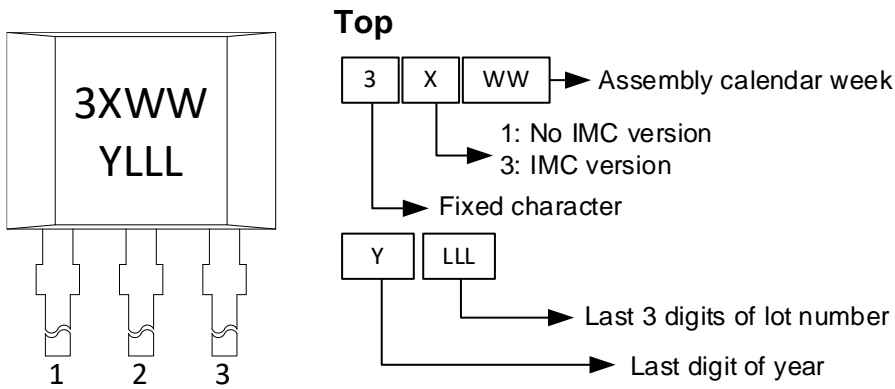


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## 14.2.3 TO92-3L – Package marking / Pin definition



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

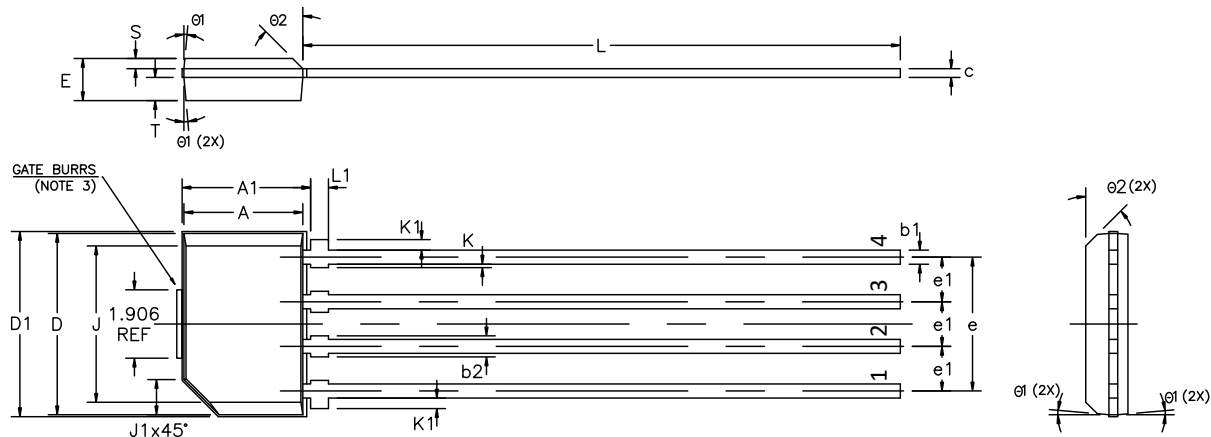
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## 14.3 VA Package

### 14.3.1 VA – Package dimensions

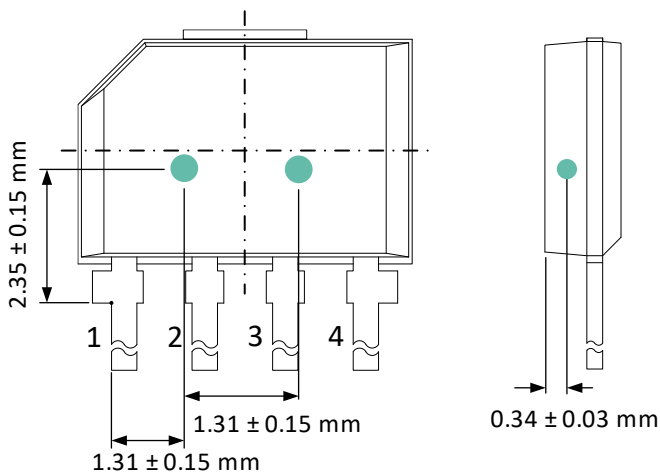


SYMBOLS	DIMENSIONS IN MILLIMETERS		
	MIN	NOM	MAX
A	3.30	3.38	3.46
A1	3.63	3.71	3.79
D	5.08	5.16	5.24
D1	5.33	5.38	5.43
E	1.10	---	1.20
J	4.10	4.30	4.50
J1	1.00 REF		
K	0.00	---	0.15
K1	0.25	0.30	0.35
L	17.5	18.0	18.5
L1	0.48	0.53	0.58
S	0.24	---	0.29
T	0.61	---	0.66
b1	0.35	---	0.48
b2	0.40	---	0.60
c	0.18	---	0.34
e	3.76	---	3.86
e1	1.22	1.27	1.32
$\phi 1$	5° REF		
$\phi 2$	45° REF		

Note:

1. DIMENSIONS "A" AND "D" DO NOT INCLUDE MOLD FLASH, PROTRUSIONS AND GATE BURRS.
2. DIMENSIONS "A1" DOES NOT INCLUDE GATE BURRS BUT INCLUDES MOLD FLASH AT BOTH ENDS.
3. MOLD GATE BURRS SHALL NOT EXCEED 0.15 mm MEASURED FROM EDGE OF MOLD FLASH (FLANGE).
4. DIMENSION "D1" INCLUDES MOLD FLASH AT BOTH ENDS.
5. LEAD PLATING; MATTE TIN PLATING THICKNESS 7.62 – 15.42  $\mu\text{m}$ .
6. THE LEADS MAY BE SLIGHTLY DEFORMED DURING TRANSPORTATION IF PACKED IN BULK (BAG), AFFECTING e1 DIMENSION. IT IS RECOMMENDED TO ORDER RADIAL TAPE (REEL OR AMMOPACK) IF SUCH DEFORMATION IS CRITICAL FOR THE LEAD FORMING PROCESS, EVEN IF MANUAL LOADING INTO THE TOOL IS FORESEEN.

### 14.3.2 VA – Sensitive Spot

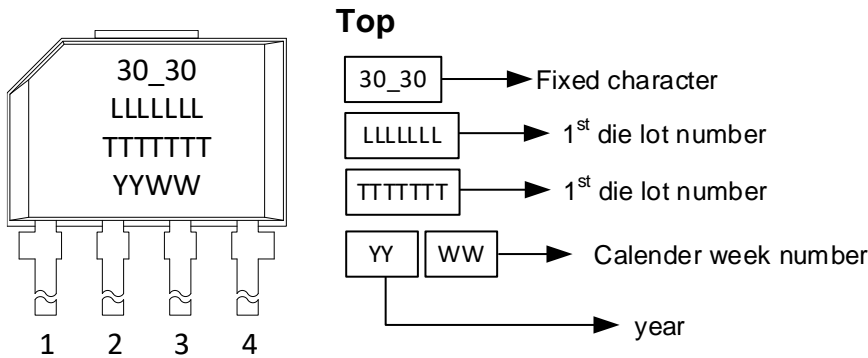


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## 14.3.3 VA – Package marking / Pin definition



Pin #	Name	Type	Function
1	OUT1	Out	Open drain output pin
2	VDD	Supply	Supply Voltage pin
3	GND	Ground	Ground pin
4	OUT2	Out	Open drain output pin

## 15 Contact

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

Europe, Africa	Telephone: +32 13 67 04 95
	Email : sales_europe@melexis.com
Americas	Telephone: +1 603 223 2362
	Email : sales_usa@melexis.com
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