MLX92235

3-wire µPower Low Voltage Hall Effect Switch/Omnipolar
Datasheet

1. Features and Benefits

- µPower operation
  - 0.9µA at 1.8V/11Hz
  - 1.2µA at 3.3V/11Hz
  - 1.2µA at 1.8V/22Hz
  - 1.6µA at 3.3V/22Hz
- Typical sleep current 0.65 µA at 1.8V
- Best in class min/max I_{DD} tolerances for a stable and predictable power budget
- Operating voltage range from 1.6V to 3.6V
- Push-pull or Open Drain output type
- No external components required
- Selectable Sleep time 0.6ms to 800ms
- Ambient temperature from -40°C to 105°C
- Chopper stabilized very sensitive Hall sensor
- Selectable magnetic thresholds and temperature coefficient
- Various magnetic functions: Unipolar, Omnipolar Switch
- Under-Voltage Reset protection
- Packages, RoHS compliant
  - TSOT-3L (SE) 2.8mm x 2.9mm

2. Application Examples

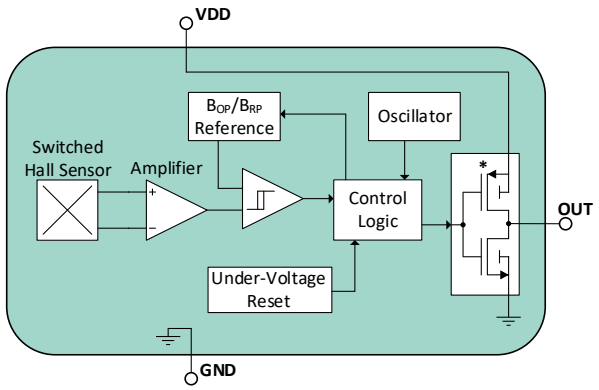
- Brake light/ wake-up switch
- E-Latch / e-door Handle
- Sunvisor / Vanity Mirror
- Button / HMI / Levers
- Seat positioning / folding
- Proximity sensor, Reed switch replacement, open/close detection

3. Description

The MLX92235 is a monolithic magnetic sensor IC utilizing a Hall Effect sensor technology.

It has an integrated logic for automatic Sleep/Awake sequencing enabling 1µA average current consumption without any action from the user (depending on the selected product). During the Awake state the chip is comparing the applied magnetic field to the predefined magnetic thresholds and updates its output accordingly. During Sleep state the OUT state remains unchanged regardless of the magnetic field. The OUT state will be refreshed during the next Awake period. The MLX92235 can be selected with various functions: magnetic thresholds, magnetic functions and sleep times.

The MLX92235 can be used as general replacement of reed switches having the advantage of solid-state reliability. The MLX92235 is suitable for battery-powered devices, lid open/close detection, wake-up switches and other low voltage applications where ultra-low current consumption is critical.



Push-pull output available on some versions

MLX92235 functional diagram Push-pull

Contents

4. Ordering Information

Product code	Output type	Sleep time (ms)	Magnetic function	Magnetic thresholds B_{OP}/B_{RP} (mT)
MLX92235RSE-AAC-001	Push-Pull	90	Unipolar Direct South Switch	4.0/2.5
MLX92235RSE-AAC-003	Push-Pull	45	Unipolar Direct South Switch	2.3/1.3
MLX92235RSE-AAC-101	Push-Pull	45	Omnipolar Direct Switch	±2.8/±1.8
MLX92235RSE-AAB-101	Open-Drain	90	Omnipolar Direct Switch	±3.0/±2.0

Legend:

All ordering codes are starting with MLX92235Rxx-AAy-zzz-RE followed by the ordering code details.

Temperature Code:	R = -40°C to 105°C
Package Code:	Rxx = SE: TSOT-3L
Option Code:	AAy = B: Open-Drain, C: Push-Pull
	zzz = 0zz: Unipolar switch, 1zz: Omnipolar switch
Packing Form:	RE = Reel
Ordering example:	MLX92235RSE-AAC-001-RE

5. Glossary of Terms

Gauss: G, Tesla: T	Units for the magnetic flux density: 1 mT = 10 G
TC	Temperature Coefficient of the magnetic threshold (in ppm/°C)
B_{OP}	Operating magnetic threshold
B_{RP}	Release magnetic threshold

6. Absolute Maximum Ratings

Parameter	Symbol	Value	Unit
Supply voltage(1)	V_{DD}	6	V
Supply current(1,2)	I_{DD}	10	mA
Reverse supply voltage(1)	V_{DDREV}	-0.5	V
Reverse supply current(1, 3)	I_{DDREV}	-10	mA
Open Drain Output voltage(1)	V_{OUTOD}	6	V
Push-Pull Output voltage(1)	V_{OUTPP}	V_{DD} + 0.5	V
Output current(1,2)	I_{OUT}	10	mA
Reverse Output voltage(1)	V_{OUTREV}	-0.5	V
Reverse Output current(1,2)	I_{OUTREV}	-10	mA
Maximum junction temperature	T_J	+125	°C
ESD – HBM(4)	-	3.5	kV
ESD – CDM(5)	-	500	V

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

[1] For maximum 1 hour
[2] Including the current through the protection device
[3] Current through the protection device
[4] Human Body Model according or ANSI/ESDA/JEDEC JS-001 standard
[5] Charged Device Model according or ANSI/ESDA/JEDEC JS-002 standard

7. General Electrical Specifications

Operating conditions V_{DD} = 1.6V to 3.6V, T_A = -40°C to 105°C (unless otherwise specified)

Electrical Parameter	Symbol	Condition	Min	Typ[1]	Max	Unit
Under Voltage Reset threshold	V_{UVR}		–	1.2	1.4	V
Awake Supply Current	I_{DD_AWK}	V_{DD} = 1.8V	–	1.7	2.1	mA
		V_{DD} = 3.3V	–	2.4	2.9	mA
Sleep Supply Current	I_{DD_SLP}	V_{DD} = 1.8V	–	0.65	1.3	µA
		V_{DD} = 3.3V	–	0.85	1.7	µA
Output-High voltage[3]	V_{OH}	I_{OUT} = -1mA	V_{DD} - 0.4	V_{DD} - 0.13	–	V
Output-Low voltage	V_{OL}	I_{OUT} = 1mA	–	0.1	0.3	V
Output turned-on resistance - NMOS	R_{ON_NMOS}	I_{OUT} = 1mA	–	100	300	Ω
Output turned-on resistance - PMOS[3]	R_{ON_PMOS}	I_{OUT} = -1mA	–	130	400	Ω
Open drain output leakage	I_{OFF}	V_{OUT} = 3.6V	–	–	1	µA
Output rise time[2,3]	t_R	C_{LOAD} = 50pF	–	0.1	–	µs
Output fall time[2]	t_F	C_{LOAD} = 50pF	–	0.1	–	µs
Power-On time[4,5,6]	t_{ON}	V_{DD} = 1.6V $\Delta V_{DD}/\Delta t \geq 2V/\mu s$	–	35	80	µs
Power-On state	–	Output state during t_{ON}	High			–
Awake time	t_{AWK}		10	14	18	µs
SE package thermal resistance	R_{THJA}	Single layer PCB, JEDEC standard test boards, still air (LFPM=0)	–	300	–	°C/W

[1] Unless otherwise specified the typical values are defined at T_A = +25°C and V_{DD} = 3.3V
[2] Guaranteed by design and verified by characterization, not production tested
[3] Only valid for versions with push-pull output type
[4] The Power-on time represents the time from reaching V_{DD} = 1.6V to the first refresh of the output state.
[5] Power-on slew rate is not critical for the proper device start-up
[6] For omnipolar devices one sleep time period has to be added on top of the t_{ON}

8. Version specific parameters

8.1. MLX92235RSE-AAC-001

Operating conditions V_{DD} = 3.3V, T_A = -40°C to 105°C (unless otherwise specified)

Parameter	Symbol	Condition	Min	Typ[1]	Max	Unit
Operating Point	B_{OP}		1.0	4.0	6.5	mT
Release Point	B_{RP}		0.3	2.5	4.8	mT
Hysteresis	B_{HYST}		1.0	1.5	2.2	mT
Active Pole			South			–
Magnetic Function			Direct Unipolar Switch			–
Output Type			Push-Pull			–
Sleep time	t_{SL}		65	90	110	ms
Average Supply Current	I_{DD_AVG}	V_{DD} = 1.8V	-	0.9	1.9	µA
		V_{DD} = 3.3V	-	1.2	2.4	µA
		V_{DD} = 3.6V	-	1.3	2.5	µA

8.2. MLX92235RSE-AAC-003

Operating conditions V_{DD} = 3.3V, T_A = -40°C to 105°C (unless otherwise specified)

Parameter	Symbol	Condition	Min	Typ[1]	Max	Unit
Operating Point	B_{OP}		0.5	2.3	4.3	mT
Release Point	B_{RP}		0.1	1.3	2.5	mT
Hysteresis	B_{HYST}		0.2	1.0	1.8	mT
Active Pole			South			–
Magnetic Function			Direct Unipolar Switch			–
Output Type			Push-Pull			–
Sleep time	t_{SL}		32	45	55	ms
Average Supply Current	I_{DD_AVG}	V_{DD} = 1.8V	-	1.2	2.3	µA
		V_{DD} = 3.3V	-	1.6	2.9	µA
		V_{DD} = 3.6V	-	1.7	3.0	µA

8.3. MLX92235RSE-AAC-101

Operating conditions V_{DD} = 3.3V, T_A = -40°C to 105°C (unless otherwise specified)

Parameter	Symbol	Condition	Min	Typ[1]	Max	Unit
Operating Point South Pole	B_{OP_SOUTH}		0.4	2.8	5.1	mT
Release Point South Pole	B_{RP_SOUTH}		0.1	1.8	4.0	mT
Operating Point North Pole	B_{OP_NORTH}		-5.1	-2.8	-0.4	mT
Release Point North Pole	B_{RP_NORTH}		-4.0	-1.8	-0.1	mT
Hysteresis	B_{HYST}		0.2	1.0	1.8	mT
Active Pole			South & North			–
Magnetic Function			Direct Omnipolar Switch			–
Output Type			Push-Pull			–
Sleep time [2]	t_{SL}		32	45	55	ms
Average Supply Current	I_{DD_AVG}	V_{DD} = 1.8V	-	1.2	2.3	µA
		V_{DD} = 3.3V	-	1.6	2.9	µA
		V_{DD} = 3.6V	-	1.7	3.0	µA

[1] Unless otherwise specified the typical values are defined at T_A = +25˚C and V_{DD} = 3.3V
[2] The total update rate for omnipolar devices is twice the defined sleep time

8.4. MLX92235RSE-AAB-101

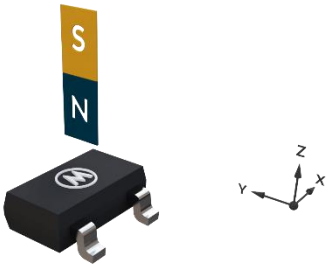
Operating conditions V_{DD} = 3.3V, T_A = -40°C to 105°C (unless otherwise specified)

Parameter	Symbol	Condition	Min	Typ[1]	Max	Unit
Operating Point South Pole	B_{OP_SOUTH}		0.8	3.0	5.0	mT
Release Point South Pole	B_{RP_SOUTH}		0.4	2.0	4.0	mT
Operating Point North Pole	B_{OP_NORTH}		-5.0	-3.0	-0.8	mT
Release Point North Pole	B_{RP_NORTH}		-4.0	-2.0	-0.4	mT
Hysteresis	B_{HYST}		0.2	1.0	1.8	mT
Active Pole			South & North			–
Magnetic Function			Direct Omnipolar Switch			–
Output Type			Open-Drain			–
Sleep time [2]	t_{SL}		65	90	110	ms
Average Supply Current	I_{DD_AVG}	V_{DD} = 1.8V	-	0.9	1.9	µA
		V_{DD} = 3.3V	-	1.2	2.4	µA
		V_{DD} = 3.6V	-	1.3	2.5	µA

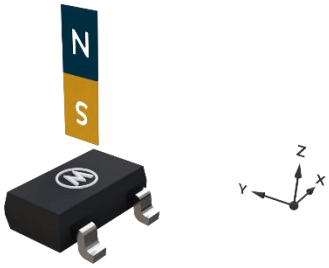
[1] Unless otherwise specified the typical values are defined at T_A = +25˚C and V_{DD} = 3.3V
[2] The total update rate for omnipolar devices is twice the defined sleep time

9. Detailed Description

9.1. Active magnetic pole definition



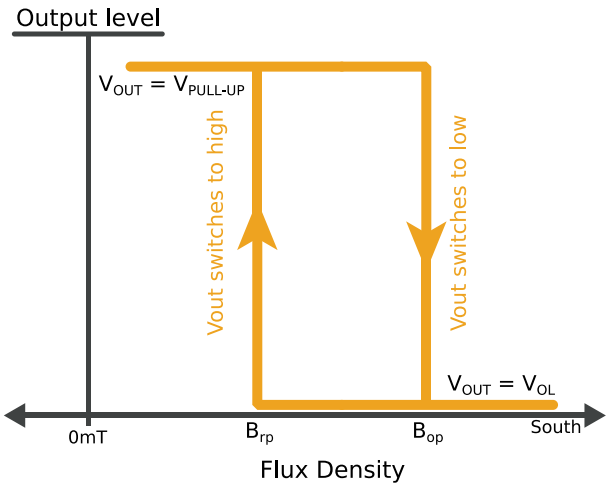
SE package – North pole active



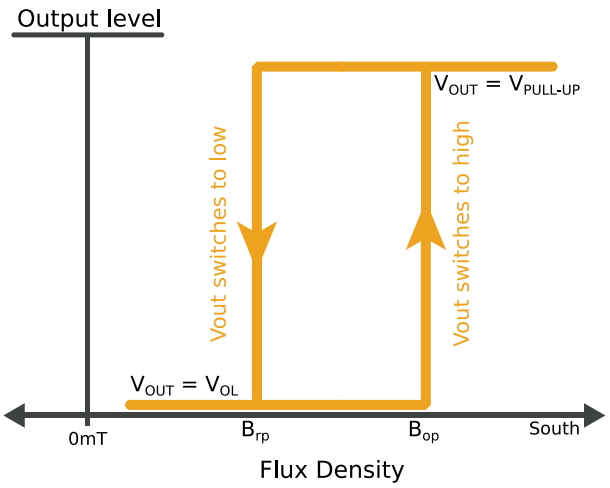
SE package – South pole active

10. Magnetic Behavior

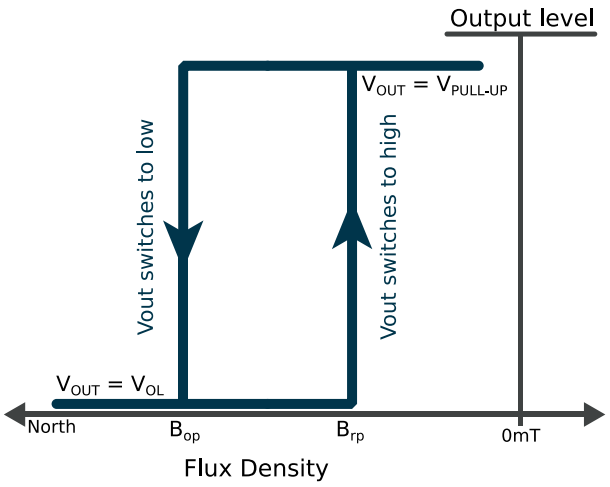
10.1. Unipolar Switch Sensor



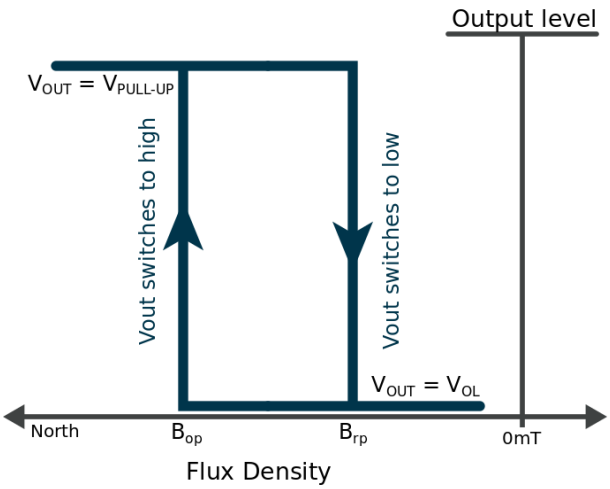
Direct South Pole Active Switch



Inverted South Pole Active Switch

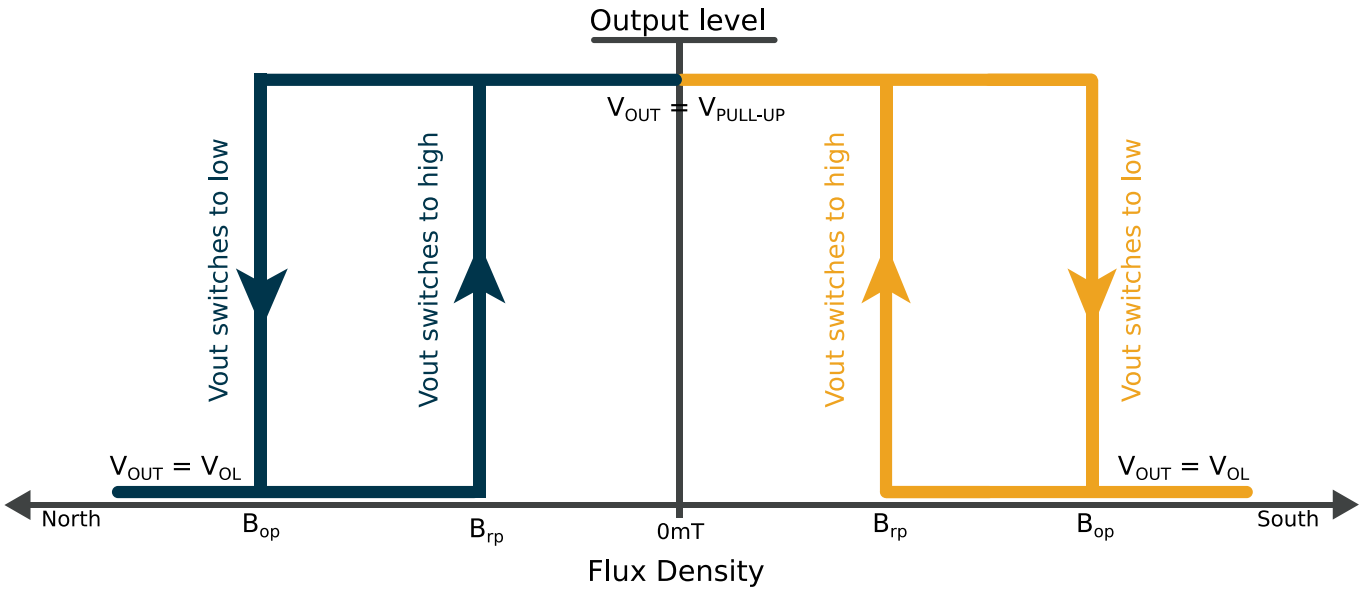


Direct North Pole Active Switch



Inverted North Pole Active Switch

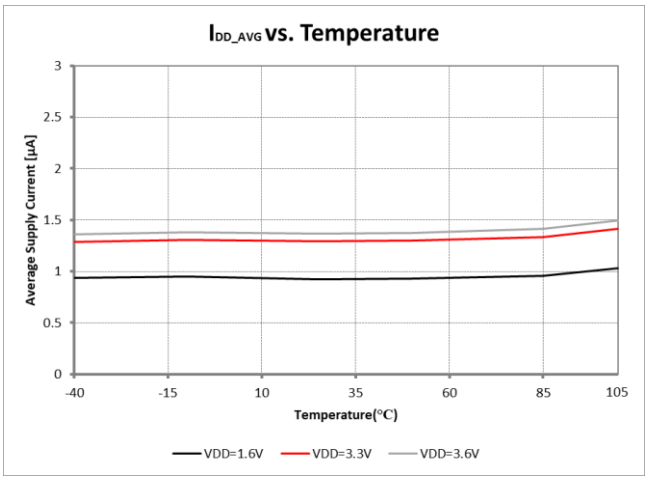
10.2. Omnipolar Switch Sensor



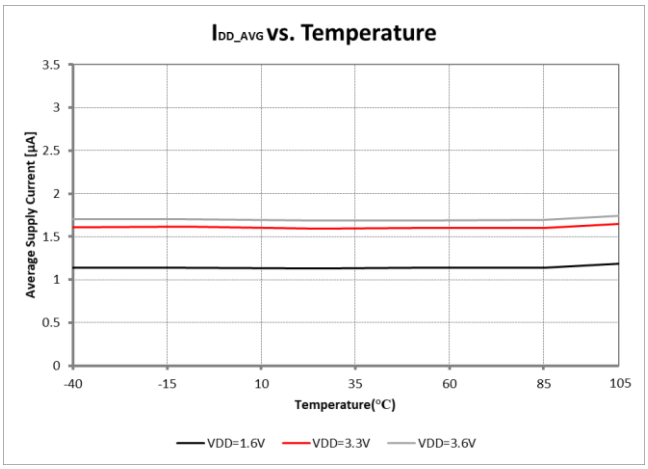
11. Performance graphs

11.1. I_{DD_AVG} vs. Temperature

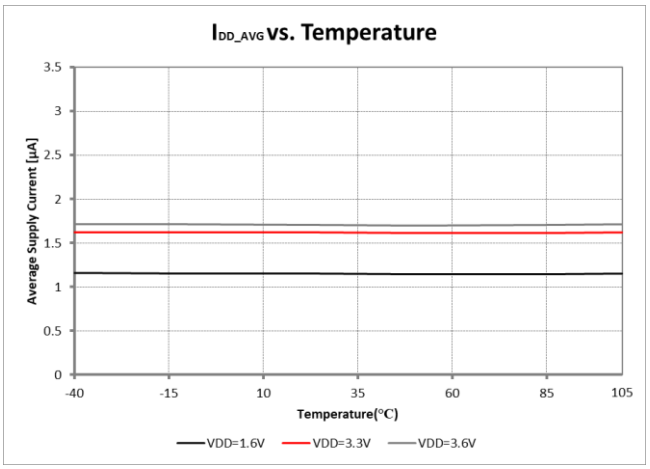
MLX92235RSE-AAC-001



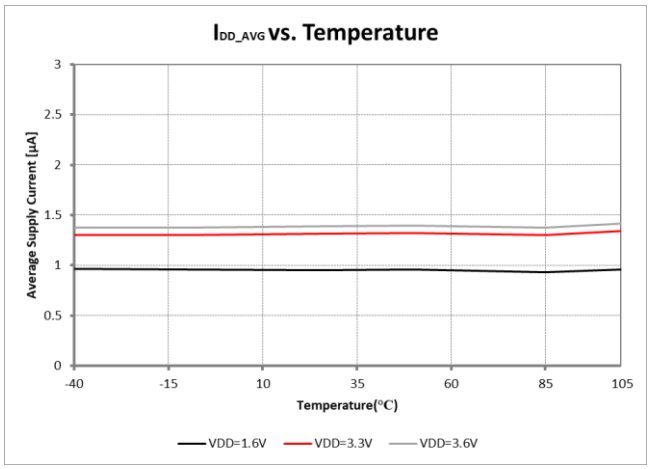
MLX92235RSE-AAC-003



MLX92235RSE-AAC-101

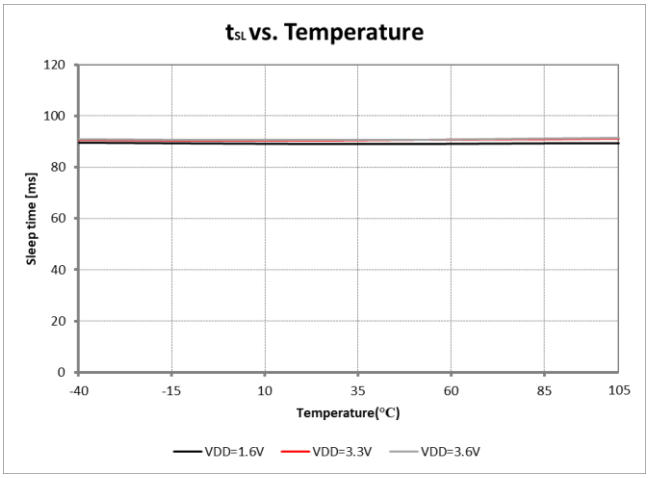


MLX92235RSE-AAB-101



11.2. T_{SL} vs. Temperature

MLX92235RSE-AAC-001



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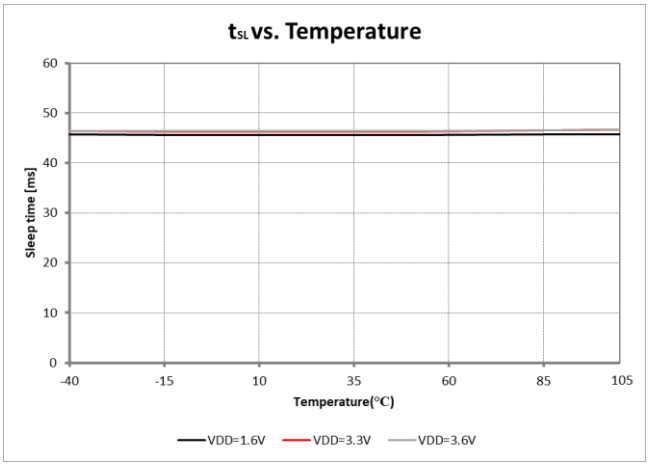

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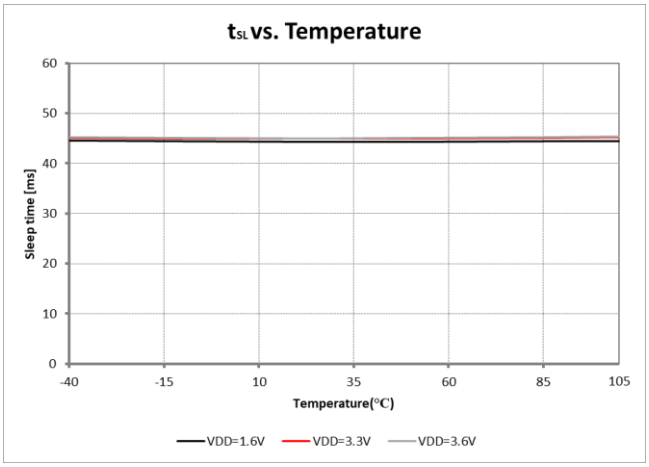

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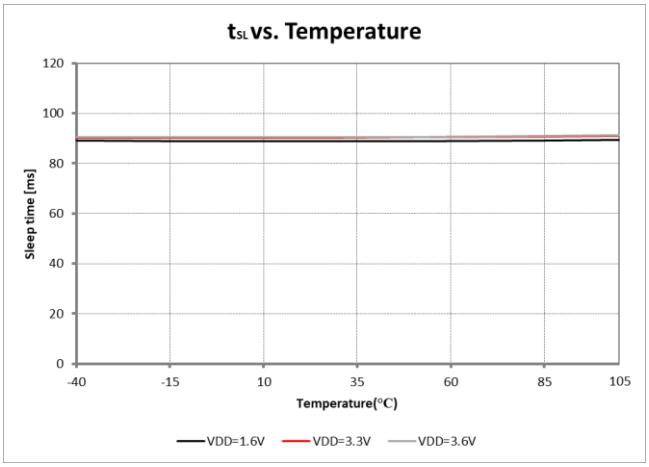
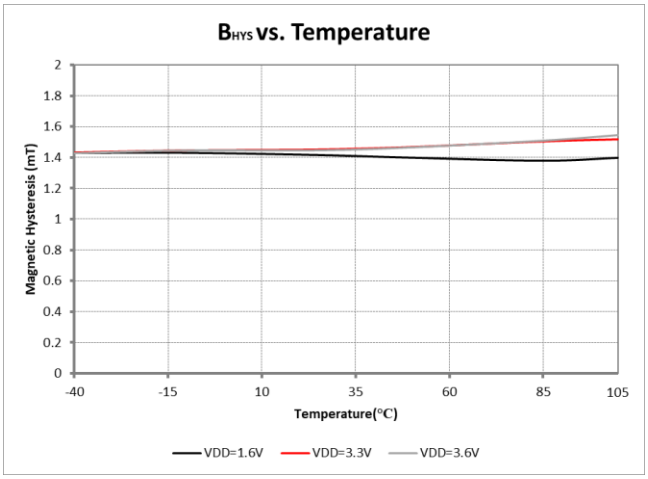
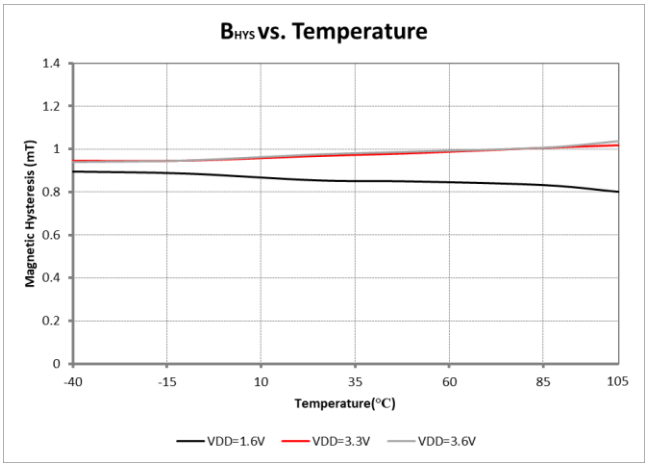


11.3. B_{HYST} vs. Temperature

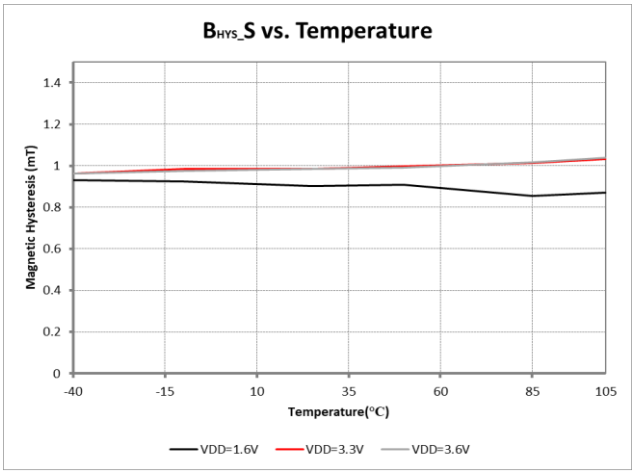
MLX92235RSE-AAC-001



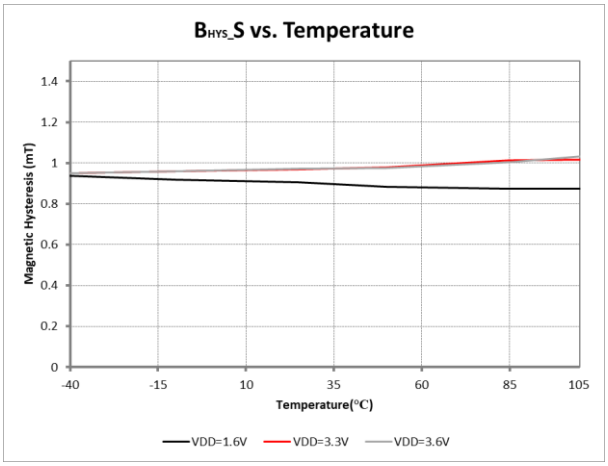
MLX92235RSE-AAC-003



MLX92235RSE-AAC-101

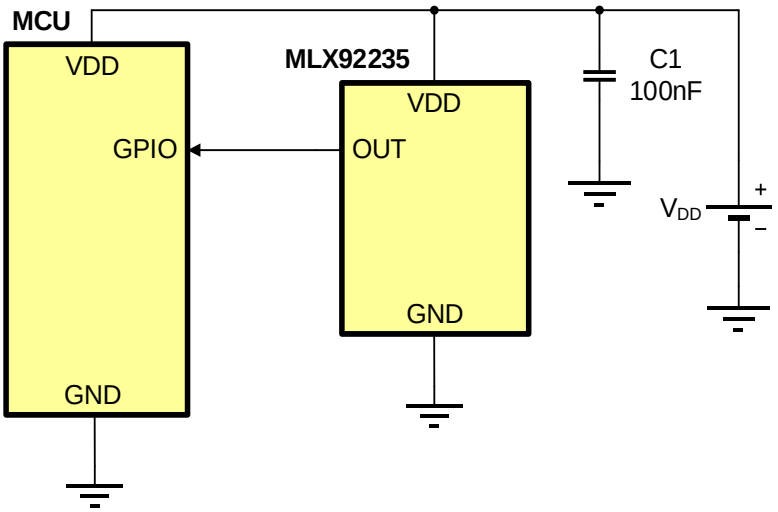


MLX92235RSE-AAB-101

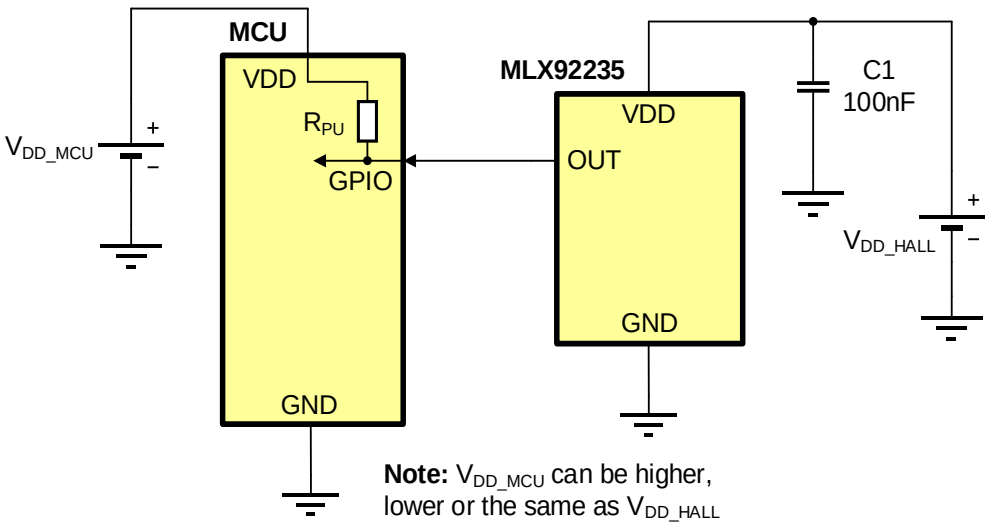


12. Typical application schematics

12.1. Push-Pull Output



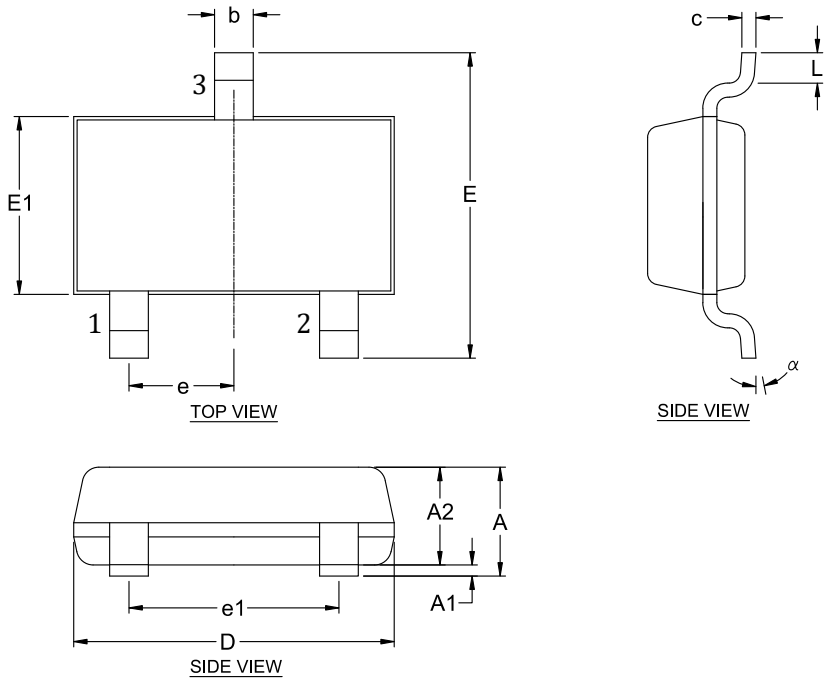
12.2. Open Drain Output



13. Package information

13.1. TSOT-3L (SE package)

13.1.1. TSOT-3L – Package dimensions

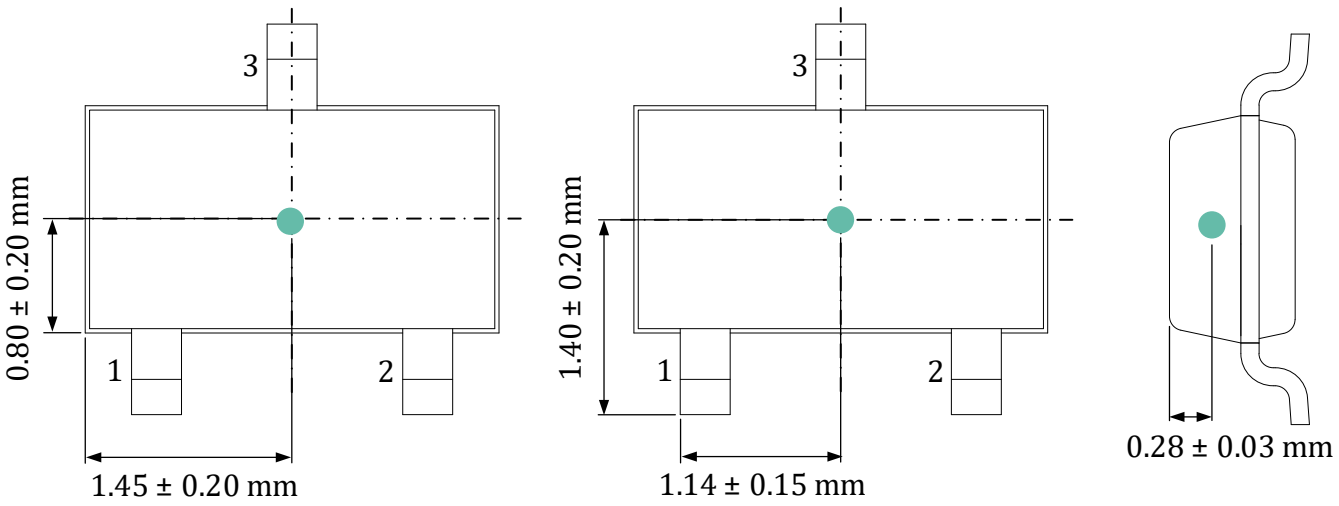


SYMBOL	MINIMUM	MAXIMUM
A	---	1.00
A1	0.025	0.10
A2	0.85	0.90
D	2.80	3.00
E	2.60	3.00
E1	1.50	1.70
L	0.30	0.50
b	0.30	0.45
c	0.10	0.20
e	0.95 BSC	
e1	1.90 BSC	
α	0°	8°

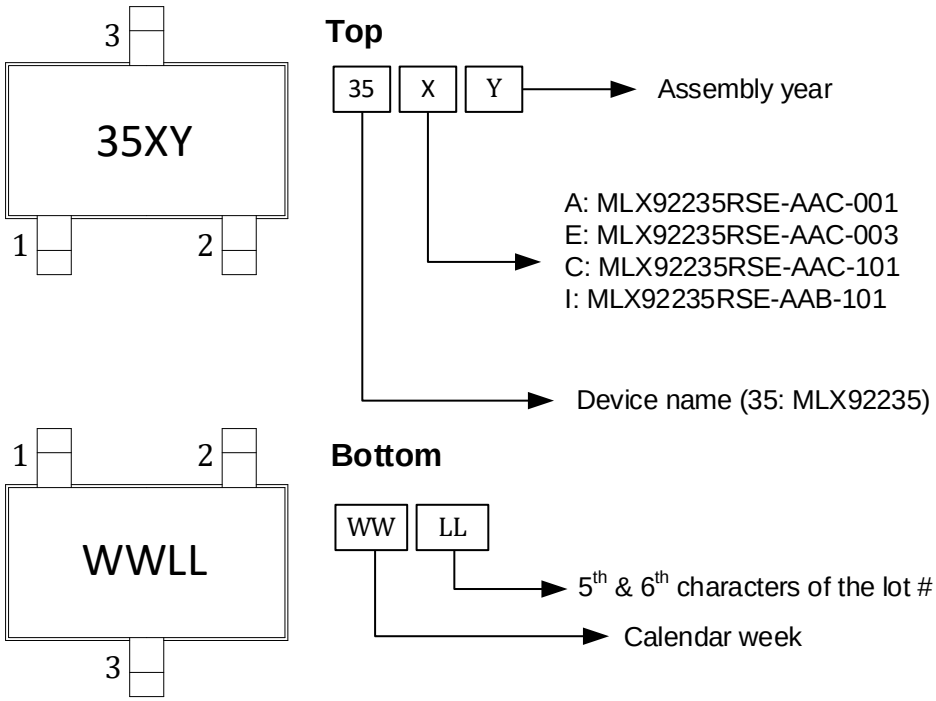
NOTE :

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/ Push-Pull
3	GND	Ground	Ground pin

14. IC handling and assembly

14.1. 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]

14.2. 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 [1]

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

14.3. 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*

15. Disclaimer

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