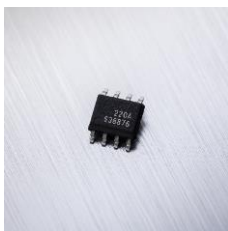


# MLX91221 Integrated Current Sensor IC

## Datasheet

### 1. Features and Benefits

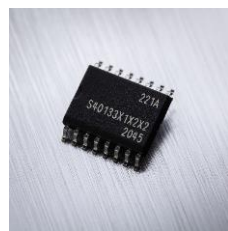
- Factory trimmed AC and DC current sensor
- Analog ratiometric or fixed output voltage
- Combining sensing element, signal conditioning & isolation in SOIC package
- No application programming required
- High speed sensing
  - DC to 300kHz bandwidth
  - 2 $\mu$ s response time
- Robust against external magnetic fields
- No magnetic hysteresis
- Double overcurrent detection (SOIC-16)
- Low ohmic losses of integrated conductor
  - 1.09m $\Omega$  SOIC-8 / 0.89m $\Omega$  SOIC-16
- SOIC-8 narrow body and SOIC-16 wide body package, RoHS compliant
- Lead free component, suitable for lead free soldering profile up to 260°C, MSL3
- Rated voltage isolation
  - 3550V<sub>RMS</sub> for SOIC-8
  - 5400V<sub>RMS</sub> for SOIC-16
- Suitable for Basic and Reinforced voltage isolation



SOIC-8



IEC/UL 62368-1:2014  
(2<sup>nd</sup> edition)



SOIC-16



### 2. Applications

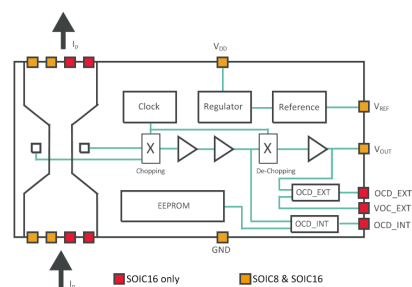
- AC and DC Chargers
- Electric Drives
- DCDC converters
- Solar
- Power Supplies
- Demand/Load control

### 3. Description

The MLX91221 is an Integrated Current Sensor that senses the current flowing through the low impedance leadframe of the SOIC package. By virtue of fixing the current conductor position with respect to the monolithic CMOS sensor, a fully integrated Hall-effect current sensor is obtained, that is factory calibrated.

Inside the package, the magnetic flux density generated by the current flow is sensed differentially by two sets of Hall plates. As a result the influence of external disturbing fields is minimized in the fast analog front-end. The residual signal is amplified to provide a high-speed linear analog output voltage.

The close proximity of the Hall plates to the current conductor ensures a high signal-to-noise ratio and an accurate signal over temperature. With this miniaturization, high voltage isolation ratings are still maintained between the primary and their opposing secondary side leads of the package.



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## 4. Ordering Information

Product Code	Package	Current Measurement Range	Output Type	Sensitivity	OCD level
MLX91221KDC-ABR-020-RE	SOIC8	20 A	Ratiometric	62.5 mV/A	
MLX91221KDC-ABF-025-RE	SOIC8	25 A	Fixed	50 mV/A	
MLX91221KDC-ABR-038-RE	SOIC8	38 A	Ratiometric	33.3 mV/A	
MLX91221KDC-ABF-050-RE	SOIC8	50 A	Fixed	25 mV/A	
MLX91221KDC-ABR-050-RE	SOIC8	50 A	Ratiometric	25 mV/A	
MLX91221KDF-ABF-010-RE	SOIC16	10 A	Fixed	120 mV/A	10.0 A
MLX91221KDF-ABF-020-RE	SOIC16	20 A	Fixed	62.5 mV/A	20.1 A
MLX91221KDF-ABR-020-RE	SOIC16	20 A	Ratiometric	62.5 mV/A	20.1 A
MLX91221KDF-ABF-120-RE	SOIC16	20 A	Fixed	62.5 mV/A	28.0 A
MLX91221KDF-ABF-025-RE	SOIC16	25 A	Fixed	50 mV/A	25.1 A
MLX91221KDF-ABR-050-RE	SOIC16	50 A	Ratiometric	25 mV/A	57.0 A
MLX91221KDF-ABF-050-RE	SOIC16	50 A	Fixed	25 mV/A	57.0 A
MLX91221KDF-ABF-075-RE	SOIC16	75 A	Fixed	16.67 mV/A	85.6 A

Table 1: Ordering information

## Legend:

Temperature Code:	K: from -40°C to 125°C ambient temperature
Package Code:	“DC” for SOIC-8 NB (Narrow Body – 150mils) package “DF” for SOIC-16 WB (Wide Body – 300mils) package
Option Code:	Axx-xxx: die version xBx-xxx: “B” for bipolar <sup>(1)</sup> and “U” for unipolar xxF-xxx: “F” for fixed mode output and “R” for ratiometric output xxx-0xx: “0” for default trimming xxx-x50: “50” for Full Scale current measurement (corresponding to 1.25V excursion from $V_{OQ}$ in bipolar case)
Packing Form:	“RE” for Reel
Ordering Example:	MLX91221KDC-ABF-050-RE

*Table 2: Legend*

- (1) Bipolar output indicates that the sensor provides a symmetrical output around the 0A point which is set at half the output voltage (50%  $V_{DD}$ ) in case of ratiometric mode, and  $V_{REF}$  equals 50% $V_{DD}$  in case of fixed mode. Both designs imply sensing of positive and negative currents.

Melexis is continuously expanding its product portfolio by adding new option codes to better meet the needs of our customer’s applications. This table is being updated frequently, please go to the [Melexis website](#) to download the latest version of this datasheet. For custom transfer characteristics, please contact your local Melexis Sales representative or distributor.

## 5. Functional Diagram

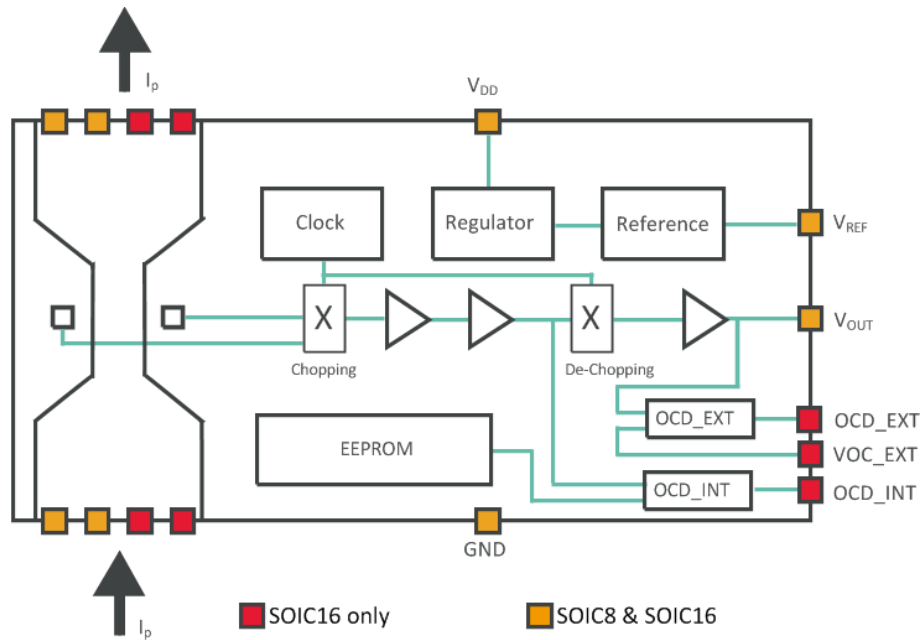


Figure 1: Functional Diagram for MLX91221

The sensor can be used in 2 different modes, depending on the application. Both modes rely on the output voltage of the sensor being proportional to the flow of current, but the difference resides in the signal reconstruction.

### 5.1. Ratiometric Mode

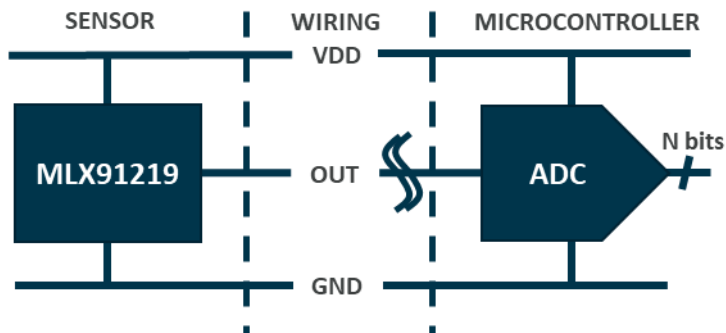


Figure 2: Schematic of ratiometric mode

No matter if the  $V_{DD}$  line is at 3.3V or deviating +/-5%, the ADC code for a given measured current will always be the same as the ADC is supplied by the same voltage as the sensor. The sensor has a sensitivity expressed in  $\%V_{DD}/A$ .

## 5.2. Differential or Fixed Mode<sup>(1)</sup>

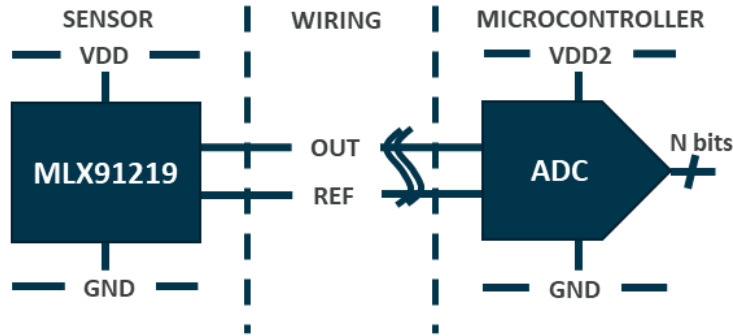


Figure 3: Schematic of fixed mode

In this particular case the ADC does not necessarily share the same supply voltage with the sensor. For this reason, the sensor is calibrated with an absolute sensitivity regardless of the actual supply voltage. The output signal can be reconstructed by taking the difference between the output and the reference voltage from the IC. The ADC gets these two signals as inputs for establishing the sensed current accurately, and is not influenced by the supply voltage differences between both sensor and microcontroller, if applicable.

Parameter	Ratiometric Mode	Differential or Fixed Mode
<b>Output Signal</b>	$V_{OUT} [\%V_{DD}]$  Example: output is 1.65V when supply is 3.3 V $\rightarrow$ output is then 50% $V_{DD}$ . If the supply ( $V_{DD}$ ) increases with 5% to 3.465 V the sensor output will (for the same measured input current) scale <b>ratiometrically</b> with the supply voltage, becoming 1.733 V which is a different voltage than when the supply was 3.3 V, but as a percentage (i.e. ratiometrically seen) it remains at the same level of 50% of $V_{DD}$ .	$V_{OUT} - V_{REF} [V]$  Example: output is 1.651 and $V_{REF}$ is 1.651V when supply is 3.3 V. When the supply voltage is increasing to 3.4 V due to supply system variation over temperature, the sensor will still maintain the same “fixed” output values $V_{OUT}$ and $V_{REF}$ .
<b>Offset</b>	$V_{OUT}[0A] = 50 [\%V_{DD}]$ (programmable)	$V_{REF} = 1.65 [V]$ (Melexis programmable) $V_{OUT}[0A] - V_{REF} = 0 [V]$
<b>Offset ratiometric</b>	Yes	No
<b>Sensitivity</b>	$[\%V_{DD}/A]^{(2)}$	[mV/A]
<b>Sensitivity ratiometric</b>	Yes	No
<b>Measured Current</b>	$\frac{(V_{OUT} - V_{OUT}[0A])}{Sensitivity}$	$\frac{(V_{OUT} - V_{REF})}{Sensitivity}$

Table 3: Parameters of differential and fixed modes

(1) More information can be found in Application Note AN91220\_ReferencePin on [www.melexis.com](http://www.melexis.com)

(2) The sensitivity in ratiometric mode is expressed as  $[\%V_{DD}/A]$ . However, for simplicity, in the datasheet the sensitivity will be always expressed in [mV/A]. For ratiometric devices, this corresponds to the sensitivity for  $V_{DD}=3.3V$ , depending on the settings of the sensor.

## 6. Glossary of Terms

Gauss (G), Tesla (T)	Units for the magnetic flux density - 1 mT = 10 G
TC	Temperature Coefficient (in ppm/°C)
NC	Not Connected
IP	Integrated Primary
ASP	Analog Signal Processing
DSP	Digital Signal Processing
AC	Alternate Current
DC	Direct Current
RAM	Random Access Memory
EMC	Electro-Magnetic Compatibility
FS	Full Scale
OCD	OverCurrent Detection

*Table 4: Glossary of Terms*



## 7. Pinout

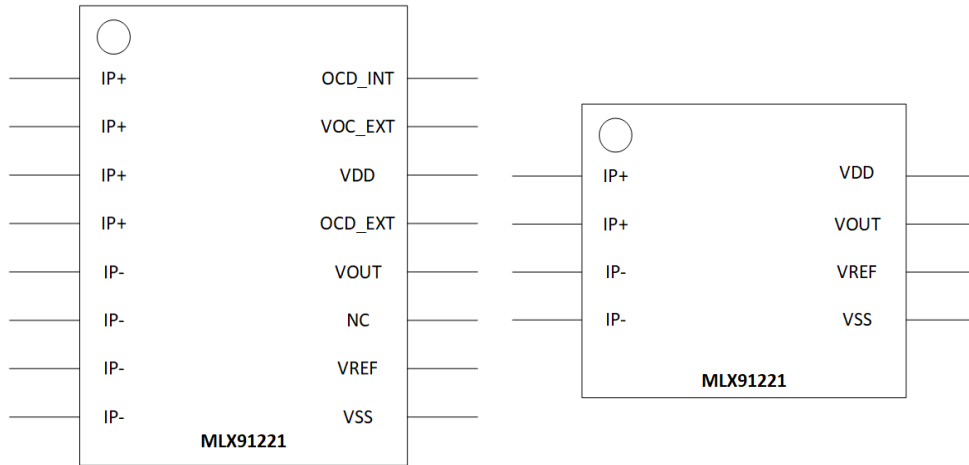


Figure 4: SOIC-16 and SOIC-8 pinouts

PIN	SOIC-8		SOIC-16	
	Pin	Function	Pin	Function
1	IP+	Primary Current Path Input	IP+	Primary Current Path Input
2				
3	IP-	Primary Current Path Output	IP-	Primary Current Path Output
4				
5	V <sub>SS</sub>	Ground Voltage		
6	V <sub>REF</sub>	Reference Voltage		
7	V <sub>OUT</sub>	Output Voltage		
8	V <sub>DD</sub>	Supply Voltage		
9			V <sub>SS</sub>	Ground Voltage
10			V <sub>REF</sub>	Reference Voltage
11			NC	Not connected
12			V <sub>OUT</sub>	Output Voltage
13			OCD <sub>EXT</sub>	External Overcurrent detection
14			V <sub>DD</sub>	Supply Voltage
15			VOC <sub>EXT</sub>	External Overcurrent threshold voltage
16			OCD <sub>INT</sub>	Internal Overcurrent Detection

Table 5: Pinout definition

For optimal EMC behavior, it is recommended to connect the unused pin (NC) to the Ground.

## 8. Absolute Maximum Ratings

Parameter	Value
Positive Supply Voltage (overvoltage)	+ 8 V
Positive Supply Voltage (maintaining application mode)	+ 6.5 V
Reverse Supply Voltage	- 0.3 V
Positive Pin Voltage <sup>(1)</sup>	VDD + 0.3 V
Output Sourcing Current	+ 25 mA
Reverse Pin Voltage <sup>(1)</sup>	- 0.3 V
Output Sinking Current	+50 mA
Operating Ambient Temperature Range, T <sub>A</sub>	- 40°C to + 125°C
Storage Temperature Range, T <sub>S</sub>	- 40°C to + 150°C
Maximum Junction Temperature, T <sub>J</sub> <sup>(2)</sup>	+ 165°C

*Table 6: Absolute maximum ratings*

(1) Except for V<sub>DD</sub> and V<sub>SS</sub>

(2) For more information on how the junction temperature relates to the applied current and ambient temperature range, please refer to section 10

## 9. MLX91221 General Electrical Specifications

DC Operating Parameters at  $V_{DD} = 3.3\text{ V}$  (unless otherwise specified) and for  $T_A$  as specified by the Temperature suffix (K).

Parameter	Symbol	Test Conditions	Min	Typ	Max	Units
Nominal Supply Voltage	$V_{DD}$		3.135	3.3	3.465	V
Supply Current	$I_{DD}$	Without RLOAD, in application mode		20	26	mA
$V_{out}$ output resistance	$R_{OUT}$	$V_{OUT} = 50\%V_{DD}$ , $I_{LOAD} = 10\text{ mA}$		1	5	$\Omega$
Voltage Reference Output Resistance	$R_{REF}$	$V_{REF} = 50\%V_{DD}$ , $I_{SINK} = 5\text{ mA}$ or $I_{SOURCE} = 0.2\text{ mA}$	120	200	333	$\Omega$
Output Capacitive Load	$C_{LOAD}$	Output amplifier stability is optimized for this typical value	0	4.7	6	nF
Common Mode Field Sensitivity <sup>(1)</sup>	CMFS	For SOIC16		0.4		mA/G
		For SOIC8		0.4		mA/G
Output Short Circuit Current	$I_{SHORT}$	Output shorted to $V_{DD}$ or $V_{SS}$ - Permanent			180	mA
Output Leakage current	$I_{LEAK}$	High impedance mode, $T_A = 125^\circ\text{C}$ , $T_J < 150^\circ\text{C}$		2	20	$\mu\text{A}$
Output Voltage Linear Swing	$V_{OUT\_LSW}$	$V_{DD} > 4.6\text{ V}$ for Fixed Mode versions	10		90	$\%V_{DD}$

*Table 7: General electrical specifications*

- (1) Common Mode Field Sensitivity expresses the sensor's susceptibility to a homogeneously applied field perpendicular to the package surface. The differential measurement cancels out such common mode magnetic fields, but due to the matching between both Hall plate clusters flanking the current conductor, this is not perfect. This parameter expresses the mA output error as a result of such 1 mT applied field. It has to be noted, that magnetic fields generated by nearby conductors are not homogenous but introduce gradients. More information in this regard can be found in Application Note AN91220\_ExternalFieldImmunity on [www.melexis.com](http://www.melexis.com)

## 10. MLX91221 General Current Specifications

DC Operating Parameters at  $V_{DD} = 3.3V$  (unless otherwise specified) and for  $T_A$  as specified by the Temperature suffix (K).

Parameter	Symbol	Test Conditions	Min	Typ	Max	Units
Electrical Resistance of the Primary Current Path	$R_{IP\_SOIC8}$	$T_A=25^\circ C$		1.09		m $\Omega$
	$R_{IP\_SOIC16}$			0.89		m $\Omega$
Measurement Range	$I_{P\_MAX}$	Option Code ABx-x10		10		A
		Option Code ABx-x20		20		A
		Option Code ABx-x25		25		A
		Option Code ABx-x38		38		A
		Option Code ABx-x50		50		A
		Option Code ABx-x75		75		A
Nominal Current	$I_{P\_NOM}$	Option Code ABx-x10		4		A
		Option Code ABx-x20		8		A
		Option Code ABx-x25		10		A
		Option Code ABx-x38		15		A
		Option Code ABx-x50		20		A
		Option Code ABx-x75		30		A
Linearity Error	NL	Current in range $I_{P\_NOM}$ , $T_A=25^\circ C$			$\pm 0.3$	%FS
	NL	Current in range $I_{P\_MAX}$ , $T_A=25^\circ C$			$\pm 0.6$	%FS
Current Capability <sup>(1)</sup>	$I_{P\_C85\_SOIC8}$	Continuous, $T_A=-40$ to $85^\circ C$			$\pm 25$	A
	$I_{P\_C25\_SOIC8}$	Continuous, $T_A=25^\circ C$			$\pm 40$	A
	$I_{P\_C85\_SOIC16}$	Continuous, $T_A=-40$ to $85^\circ C$			$\pm 30$	A
	$I_{P\_C25\_SOIC16}$	Continuous, $T_A=25^\circ C$			$\pm 45$	A

Table 8: General current specifications

- (1) Current capability based on the reference Melexis PCB made of 2x 105  $\mu m$  copper layer without any forced air or other form of cooling. Continuous or RMS current ranges in application are typically higher than this. More information can be found in Application Notes AN91220\_FuseCurrent Capability and AN91220\_ThermalManagement on [www.melexis.com](http://www.melexis.com).

## 11. MLX91221 Voltage Isolation Specifications

Parameter	Symbol	Test Conditions	Value	Units
Dielectric Strength Test Voltage <sup>(1)</sup> <sub>(2)</sub>	V <sub>ISO_SOIC8</sub>	IEC62368-1:2018	3550	V <sub>RMS</sub>
	V <sub>ISO_SOIC16</sub>		5400	V <sub>RMS</sub>
Impulse withstand voltage test	V <sub>IMPULSE_SOIC8</sub>	Test according to IEC61000-4-5, ±5 pulses at 2/minute, 1.2 µs (rise) / 50 µs (width)	4000	V <sub>pk</sub>
	V <sub>IMPULSE_SOIC16</sub>		6000	V <sub>pk</sub>
Clearance (primary to secondary)	D <sub>CL_SOIC8</sub>	Shortest distance through air	4	mm
	D <sub>CL_SOIC16</sub>		8.1	mm
Creepage (primary to secondary)	D <sub>CR_SOIC8</sub>	Shortest path along body	3.6	mm
	D <sub>CR_SOIC16</sub>		7.1	mm
Comparative tracking index	CTI		>600	
Material Group	-		I	
Working Voltage for Basic Isolation	V <sub>WV_SOIC8</sub>	IEC62368-1:2018 Based on Pollution degree 2, Material Group I	715	V <sub>RMS</sub>
	V <sub>WV_SOIC16</sub>		1415	V <sub>RMS</sub>
Working Voltage for Reinforced Isolation	V <sub>WV_SOIC8</sub>	IEC62368-1:2018 Based on Pollution degree 2, Material Group I	357	V <sub>RMS</sub>
	V <sub>WV_SOIC16</sub>		707	V <sub>RMS</sub>

*Table 9: Voltage isolation specifications*

- (1) Agency type tested, measured between IP (pin 1-4 on SOIC8, pin 1-8 on SOIC16) and Secondary side (pin 5-8 on SOIC8, pin 9-16 on SOIC16).
- (2) Melexis performs routine production-line tests, for all SOIC8 & SOIC16 devices produced.

## 12. MLX91221 Timing Specifications

DC Operating Parameters at  $V_{DD} = 3.3V$  (unless otherwise specified) and for  $T_A$  as specified by the Temperature suffix (K).

Parameter	Symbol	Test Conditions	Min	Typ	Max	Units
Step Response Time	$T_{RESP}$	Delay between the input signal reaching 90% and the output reaching 90% (see Figure 5)			2	$\mu s$
Bandwidth	BW	-3dB, $T_A = 25^\circ C$		300		kHz
Power on Delay <sup>(1)</sup>	$T_{POD}$	$V_{REF}$ capacitor = 47nF			0.6	ms

Table 10: Timing specifications

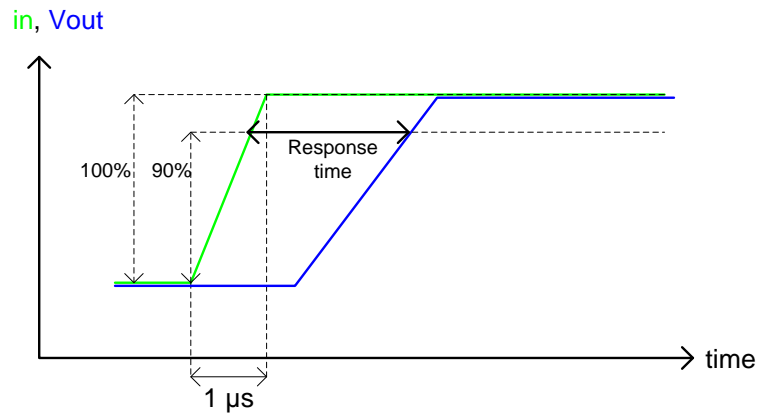


Figure 5: Response Time definition

(1) During the power on, the output follows a routine and is not valid (i.e. it is not related to magnetic field) for  $T_{POD}$ .

## 13. Diagnostics

It is possible to take advantage of diagnostic features, with the help of adding a pull-down resistor (see Section 16). If a failure event occurs, the measured output will be set to ground. This can be interpreted as failure by the microcontroller unit.

Error	Effect on Output
Calibration data CRC Error	Output stage in high-Z mode. A pull-down resistor to ground will result in output equal to ground.
VDD Under voltage Thresholds:	Output is pulled to GND with a 2kΩ resistance, until VDD is inside the specified ranges, depending if the device is powering on or off.
• Power-up: VDD < 2.8V	
• Power-down: VDD < 2.5V	
Broken OUT	Pull-down external resistor allows to measure a voltage equal to GND.

Table 11: Description of the diagnostic modes in MLX91221

## 14. MLX91221 Accuracy Specifications

### 14.1. Definitions

#### 14.1.1. Thermal Reference Drift

The thermal reference drift is the variation of the reference voltage ( $V_{REF}$ ) over temperature. It is expressed in ppm/°C.

$$\begin{aligned}
 + \Delta T_{VREF} &= \left( \frac{V_{ref}[125^{\circ}\text{C}]}{V_{ref}[35^{\circ}\text{C}]} - 1 \right) \cdot \frac{1}{(125 - 35)} \cdot 10^6 \\
 - \Delta T_{VREF} &= \left( \frac{V_{ref}[-40^{\circ}\text{C}]}{V_{ref}[35^{\circ}\text{C}]} - 1 \right) \cdot \frac{1}{(-40 - 35)} \cdot 10^6
 \end{aligned}$$

#### 14.1.2. Voltage Output Quiescent

$V_{OQ}$  corresponds to the difference between the measured and the ideal outputs when no current is flowing through the MLX91221 at  $T_A=25^{\circ}\text{C}$ .

$$V_{OQ} = V_{OUT}[0A]_{measured} - V_{OUT}[0A]_{ideal}$$

#### 14.1.3. Thermal Offset Drift

$\Delta T_{V_{OQ}}$  corresponds to variation of  $V_{OQ}$  in temperature.

#### 14.1.4. Sensitivity

The sensitivity is the ratio between the output of the MLX91221 and the input current.

For ratiometric devices, as the output will scale with the supply, sensitivity is expressed as [%V<sub>DD</sub>]/A. For simplicity, in the datasheet the sensitivity will be always expressed in mV/A. For ratiometric devices, this corresponds to the sensitivity for V<sub>DD</sub>=3.3V, depending on the settings of the sensor.

For fixed devices, the output does not vary with the V<sub>DD</sub>, sensitivity is thus expressed as mV/A.

#### 14.1.5. Linearity Error

The linearity error is the deviation of the output from the expected linear behaviour. To obtain the linearity error, the current is swept from -I<sub>PM</sub> to I<sub>PM</sub>. To decorrelate the thermal drift from the linearity error, the junction temperature should be fixed below 50°C.

$$NL = \frac{V_{out}[I] - BESTFIT(V_{out}[I])}{V_{out}[I_{PM}] - V_{out}[-I_{PM}]} \cdot 100 \text{ [%FS]}$$

#### 14.1.6. Ratiometry Offset and Sensitivity Error

##### Ratiometric Mode

In Ratiometric mode, V<sub>OUT</sub> and V<sub>REF</sub> are scaled with the supply voltage. V<sub>DDnom</sub> = 5V

Ratiometric V<sub>OQ</sub> Error:

$$\Delta R_{VOQ} = V_{OQ}[V_{DDnom}] - V_{OQ}[V_{DDnom} \pm 10\%] \cdot \frac{V_{DDnom}}{V_{DDnom} \pm 10\%} \text{ [mV]}$$

Ratiometric Sensitivity Error:

$$\Delta R_S = 100 \cdot \left(1 - \frac{S[V_{DDnom} \pm 10\%]}{S[V_{DDnom}]} \cdot \frac{V_{DDnom}}{V_{DDnom} \pm 10\%}\right) \text{ [%]}$$

##### Fixed Mode

In Fixed mode, V<sub>OUT</sub> and V<sub>REF</sub> are not scaled with the supply voltage. Ideally, they do not vary. V<sub>DDnom</sub> = 5V

Non-Ratiometric V<sub>OQ</sub> Error:

$$\Delta R_{VOQ} = V_{OQ}[V_{DDnom} \pm 10\%] - V_{OQ}[V_{DDnom}] \text{ [mV]}$$

Non-Ratiometric Sensitivity Error:

$$\Delta R_S = \left(\frac{S[V_{DDnom} \pm 10\%]}{S[V_{DDnom}]} - 1\right) \cdot 100 \text{ [%]}$$



## 14.2. MLX91221K Dx-ABF-010 Specifications

DC Operating Parameters at  $V_{DD} = 3.3V$  (unless otherwise specified), for  $T_A$  as specified by the Temperature suffix (K) and for  $T_j < 150\text{ }^\circ\text{C}$ .

Parameter	Symbol	Test Conditions	Min	Typ	Max	Units
Primary current	$I_{PM}$		-10		10	A
Voltage Reference	$V_{REF}$	$T_A=25^\circ\text{C}$	1.63	1.65	1.67	V
Thermal Reference Drift	$\Delta T_{VREF}$	Variation versus $25^\circ\text{C}$			$\pm 150$	ppm/ $^\circ\text{C}$
Voltage Output Quiescent	$V_{OQ}$	No current flowing through IP, $V_{OUT}-V_{REF}$ , $T_A=25^\circ\text{C}$ No resistive load on $V_{OUT}$ and $V_{REF}$	-7.5 -62.5		7.5 62.5	mV mA
Ratiometry Offset Error	$\Delta R_{VOQ}$	$T_A=25^\circ\text{C}$ and for $\pm 5\% V_{DD}$	-5		5	mV
Thermal Offset Drift	$\Delta T_{VOQ}$	Referred to $T_A=25^\circ\text{C}$ , IP = 0A		$\pm 5$ $\pm 41.7$	$\pm 10$ $\pm 83.4$	mV mA
Lifetime Offset Drift	$\Delta L_{VOQ}$			$\pm 2$		mV
Sensitivity	S	At $T_A=25^\circ\text{C}$ For $T_j < 50\text{ }^\circ\text{C}$	-1 118.8	120	1 121.2	%S mV/A
Ratiometry Sensitivity Error	$\Delta R_S$	$T_A=25^\circ\text{C}$ and for $\pm 5\% V_{DD}$	-0.6		0.6	%S
Thermal Sensitivity Drift	$\Delta T_S$	Current range $IP_{MAX}$		$\pm 1$	$\pm 1.5$	%S
Sensitivity Drift over lifetime	$\Delta L_S$			$\pm 1$	$\pm 2$	%S
Output Noise Spectral Density	$N_{SD}$	IP = 0 A, $T_A=25^\circ\text{C}$ within BW = 1 ... 100kHz		178		$\mu\text{A}/\sqrt{\text{Hz}}$
Output RMS Noise	$N_{RMS}$	IP = 0 A, $T_A=25^\circ\text{C}$ BW = 300kHz		115		$\text{mA}_{RMS}$
OCD <sub>INT</sub> Threshold Current <sup>(1)</sup>	$I_{OCD}$			10		A
OCD <sub>INT</sub> Accuracy <sup>(1)</sup>	$\epsilon_{IOCD}$	$T_A=25^\circ\text{C}$ $T_A=-40^\circ\text{C}$ to $85^\circ\text{C}$		9.7 17.6		%Threshold %Threshold
OCD <sub>EXT</sub> threshold error <sup>(1)</sup>	$\epsilon_{EOCD}$		-10		10	%FS

Table 12: MLX91221K Dx-ABF-010 specifications

(1) For SOIC16 version

### 14.3. MLX91221KDx-ABR-020 Specifications

DC Operating Parameters at  $V_{DD} = 3.3V$  (unless otherwise specified), for  $T_A$  as specified by the Temperature suffix (K) and for  $T_j < 150\text{ }^\circ\text{C}$ .

Parameter	Symbol	Test Conditions	Min	Typ	Max	Units
Primary current	$I_{PM}$		-20		20	A
Voltage Output Quiescent	$V_{OQ}$	No current flowing through IP, $V_{OUT} = -V_{DD}/2$ , $T_A = 25^\circ\text{C}$ No resistive load on $V_{OUT}$ and $V_{REF}$	-7.5 -120		7.5 120	mV mA
Ratiometry Offset Error	$\Delta R_{VOQ}$	$T_A = 25^\circ\text{C}$ and for $\pm 5\% V_{DD}$	-7.5		7.5	mV
Thermal Offset Drift	$\Delta T_{VOQ}$	Referred to $T_A = 25^\circ\text{C}$ , $I_P = 0A$		$\pm 5$ $\pm 80$	$\pm 7.5$ $\pm 120$	mV mA
Lifetime Offset Drift	$\Delta L_{VOQ}$			$\pm 2$		mV
Sensitivity	S	At $T_A = 25^\circ\text{C}$ For $T_j < 50\text{ }^\circ\text{C}$	-1 61.8	62.5	1 63.2	%S mV/A
Ratiometry Sensitivity Error	$\Delta R_S$	$T_A = 25^\circ\text{C}$ and for $\pm 5\% V_{DD}$		$\pm 0.3$		%S
Thermal Sensitivity Drift	$\Delta T_S$	Current range $I_{P_{MAX}}$		$\pm 1$	$\pm 1.5$	%S
Sensitivity Drift over lifetime	$\Delta L_S$			$\pm 1$	$\pm 2$	%S
Output Noise Spectral Density	$N_{SD}$	$I_P = 0A$ , $T_A = 25^\circ\text{C}$ within $BW = 1 \dots 100\text{kHz}$		206		$\mu\text{A}/\sqrt{\text{Hz}}$
Output RMS Noise	$N_{RMS}$	$I_P = 0A$ , $T_A = 25^\circ\text{C}$ $BW = 300\text{kHz}$		136		$\text{mA}_{RMS}$
OCD <sub>INT</sub> Threshold Current <sup>(1)</sup>	$I_{OCD}$			20.1		A
OCD <sub>INT</sub> Accuracy <sup>(1)</sup>	$\epsilon_{IOCD}$	$T_A = 25^\circ\text{C}$ $T_A = -40^\circ\text{C}$ to $85^\circ\text{C}$		6 11		%Threshold %Threshold
OCD <sub>EXT</sub> threshold error <sup>(1)</sup>	$\epsilon_{EOCD}$		-10		10	%FS

Table 13: MLX91221KDx-ABR-020 specifications

(1) For SOIC16 version

## 14.4. MLX91221K Dx-ABF-020 Specifications

DC Operating Parameters at  $V_{DD} = 3.3V$  (unless otherwise specified), for  $T_A$  as specified by the Temperature suffix (K) and for  $T_j < 150\text{ }^\circ\text{C}$ .

Parameter	Symbol	Test Conditions	Min	Typ	Max	Units
Primary current	$I_{PM}$		-20		20	A
Voltage Reference	$V_{REF}$	$T_A=25^\circ\text{C}$	1.63	1.65	1.67	V
Thermal Reference Drift	$\Delta T_{VREF}$	Variation versus $25^\circ\text{C}$			$\pm 150$	ppm/ $^\circ\text{C}$
Voltage Output Quiescent	$V_{OQ}$	No current flowing through IP, $V_{OUT}-V_{REF}$ , $T_A=25^\circ\text{C}$ No resistive load on $V_{OUT}$ and $V_{REF}$	-7.5 -120		7.5 120	mV mA
Ratiometry Offset Error	$\Delta R_{VOQ}$	$T_A=25^\circ\text{C}$ and for $\pm 5\% V_{DD}$	-5		5	mV
Thermal Offset Drift	$\Delta T_{VOQ}$	Referred to $T_A=25^\circ\text{C}$ , IP = 0A		$\pm 5$ $\pm 80$	$\pm 7.5$ $\pm 120$	mV mA
Lifetime Offset Drift	$\Delta L_{VOQ}$			$\pm 2$		mV
Sensitivity	S	At $T_A=25^\circ\text{C}$ For $T_j < 50\text{ }^\circ\text{C}$	-1 61.8	62.5	1 63.2	%S mV/A
Ratiometry Sensitivity Error	$\Delta R_S$	$T_A=25^\circ\text{C}$ and for $\pm 5\% V_{DD}$	-0.6		0.6	%S
Thermal Sensitivity Drift	$\Delta T_S$	Current range $IP_{MAX}$		$\pm 1$	$\pm 1.5$	%S
Sensitivity Drift over lifetime	$\Delta L_S$			$\pm 1$	$\pm 2$	%S
Output Noise Spectral Density	$N_{SD}$	IP = 0 A, $T_A=25^\circ\text{C}$ within BW = 1 ... 100kHz		206		$\mu\text{A}/\sqrt{\text{Hz}}$
Output RMS Noise	$N_{RMS}$	IP = 0 A, $T_A=25^\circ\text{C}$ BW = 300kHz		136		$\text{mA}_{RMS}$
OCD <sub>INT</sub> Threshold Current <sup>(1)</sup>	$I_{OCD}$			20.1		A
OCD <sub>INT</sub> Accuracy <sup>(1)</sup>	$\epsilon_{IOCD}$	$T_A=25^\circ\text{C}$ $T_A=-40^\circ\text{C}$ to $85^\circ\text{C}$		6 11		%Threshold %Threshold
OCD <sub>EXT</sub> threshold error <sup>(1)</sup>	$\epsilon_{EOCD}$		-10		10	%FS

Table 14: MLX91221K Dx-ABF-020 specifications

(1) For SOIC16 version

## 14.5. MLX91221K Dx-ABF-120 Specifications

DC Operating Parameters at  $V_{DD} = 3.3V$  (unless otherwise specified), for  $T_A$  as specified by the Temperature suffix (K) and for  $T_j < 150\text{ }^\circ\text{C}$ .

Parameter	Symbol	Test Conditions	Min	Typ	Max	Units
Primary current	$I_{PM}$		-20		20	A
Voltage Reference	$V_{REF}$	$T_A=25^\circ\text{C}$	1.63	1.65	1.67	V
Thermal Reference Drift	$\Delta T_{VREF}$	Variation versus $25^\circ\text{C}$			$\pm 150$	ppm/ $^\circ\text{C}$
Voltage Output Quiescent	$V_{OQ}$	No current flowing through IP, $V_{OUT}-V_{REF}$ , $T_A=25^\circ\text{C}$ No resistive load on $V_{OUT}$ and $V_{REF}$	-7.5 -120		7.5 120	mV mA
Ratiometry Offset Error	$\Delta R_{VOQ}$	$T_A=25^\circ\text{C}$ and for $\pm 5\% V_{DD}$	-5		5	mV
Thermal Offset Drift	$\Delta T_{VOQ}$	Referred to $T_A=25^\circ\text{C}$ , IP = 0A		$\pm 5$ $\pm 80$	$\pm 7.5$ $\pm 120$	mV mA
Lifetime Offset Drift	$\Delta L_{VOQ}$			$\pm 2$		mV
Sensitivity	S	At $T_A=25^\circ\text{C}$ For $T_j < 50\text{ }^\circ\text{C}$	-1 61.8	62.5	1 63.2	%S mV/A
Ratiometry Sensitivity Error	$\Delta R_S$	$T_A=25^\circ\text{C}$ and for $\pm 5\% V_{DD}$	-0.6		0.6	%S
Thermal Sensitivity Drift	$\Delta T_S$	Current range $IP_{MAX}$		$\pm 1$	$\pm 1.5$	%S
Sensitivity Drift over lifetime	$\Delta L_S$			$\pm 1$	$\pm 2$	%S
Output Noise Spectral Density	$N_{SD}$	IP = 0 A, $T_A=25^\circ\text{C}$ within BW = 1 ... 100kHz		206		$\mu\text{A}/\sqrt{\text{Hz}}$
Output RMS Noise	$N_{RMS}$	IP = 0 A, $T_A=25^\circ\text{C}$ BW = 300kHz		136		$\text{mA}_{RMS}$
OCD <sub>INT</sub> Threshold Current <sup>(1)</sup>	$I_{OCD}$			28		A
OCD <sub>INT</sub> Accuracy <sup>(1)</sup>	$\epsilon_{IOCD}$	$T_A=25^\circ\text{C}$ $T_A=-40^\circ\text{C}$ to $85^\circ\text{C}$		6 11		%Threshold %Threshold
OCD <sub>EXT</sub> threshold error <sup>(1)</sup>	$\epsilon_{EOCD}$		-10		10	%FS

Table 15: MLX91221K Dx-ABF-120 specifications

(1) For SOIC16 version

## 14.6. MLX91221K Dx-ABF-025 Specifications

DC Operating Parameters at  $V_{DD} = 3.3V$  (unless otherwise specified), for  $T_A$  as specified by the Temperature suffix (K) and for  $T_j < 150\text{ }^\circ\text{C}$ .

Parameter	Symbol	Test Conditions	Min	Typ	Max	Units
Primary current	$I_{PM}$		-25		25	A
Voltage Reference	$V_{REF}$	$T_A=25^\circ\text{C}$	1.63	1.65	1.67	V
Thermal Reference Drift	$\Delta T_{VREF}$	Variation versus $25^\circ\text{C}$			$\pm 150$	ppm/ $^\circ\text{C}$
Voltage Output Quiescent	$V_{OQ}$	No current flowing through IP, $V_{OUT}-V_{REF}$ , $T_A=25^\circ\text{C}$ No resistive load on $V_{OUT}$ and $V_{REF}$	-7.5 -150		7.5 150	mV mA
Ratiometry Offset Error	$\Delta R_{VOQ}$	$T_A=25^\circ\text{C}$ and for $\pm 5\% V_{DD}$	-5		5	mV
Thermal Offset Drift	$\Delta T_{VOQ}$	Referred to $T_A=25^\circ\text{C}$ , IP = 0A		$\pm 5$ $\pm 100$	$\pm 7.5$ $\pm 150$	mV mA
Lifetime Offset Drift	$\Delta L_{VOQ}$			$\pm 2$		mV
Sensitivity	S	At $T_A=25^\circ\text{C}$ For $T_j < 50\text{ }^\circ\text{C}$	-1 49.5	50	1 50.5	%S mV/A
Ratiometry Sensitivity Error	$\Delta R_S$	$T_A=25^\circ\text{C}$ and for $\pm 5\% V_{DD}$	-0.6		0.6	%S
Thermal Sensitivity Drift	$\Delta T_S$	Current range $IP_{MAX}$		$\pm 1$	$\pm 1.5$	%S
Sensitivity Drift over lifetime	$\Delta L_S$			$\pm 1$	$\pm 2$	%S
Output Noise Spectral Density	$N_{SD}$	IP = 0 A, $T_A=25^\circ\text{C}$ within BW = 1 ... 100kHz		202		$\mu\text{A}/\sqrt{\text{Hz}}$
Output RMS Noise	$N_{RMS}$	IP = 0 A, $T_A=25^\circ\text{C}$ BW = 300kHz		136		$\text{mA}_{RMS}$
OCD <sub>INT</sub> Threshold Current <sup>(1)</sup>	$I_{OCD}$			25.1		A
OCD <sub>INT</sub> Accuracy <sup>(1)</sup>	$\epsilon_{IOCD}$	$T_A=25^\circ\text{C}$ $T_A=-40^\circ\text{C}$ to $85^\circ\text{C}$		5.5 10.2		%Threshold %Threshold
OCD <sub>EXT</sub> threshold error <sup>(1)</sup>	$\epsilon_{EOCD}$		-10		10	%FS

Table 16: MLX91221K Dx-ABF-025 specifications

(1) For SOIC16 version

## 14.7. MLX91221KDx-ABR-038 Specifications

DC Operating Parameters at  $V_{DD} = 3.3V$  (unless otherwise specified), for  $T_A$  as specified by the Temperature suffix (K) and for  $T_j < 150\text{ }^\circ\text{C}$ .

Parameter	Symbol	Test Conditions	Min	Typ	Max	Units
Primary current	$I_{PM}$		-38		38	A
Voltage Output Quiescent	$V_{OQ}$	No current flowing through IP, $V_{OUT} = -V_{DD}/2$ , $T_A = 25^\circ\text{C}$ No resistive load on $V_{OUT}$ and $V_{REF}$	-7.5 -225		7.5 225	mV mA
Ratiometry Offset Error	$\Delta R_{VOQ}$	$T_A = 25^\circ\text{C}$ and for $\pm 5\% V_{DD}$	-7.5		7.5	mV
Thermal Offset Drift	$\Delta T_{VOQ}$	Referred to $T_A = 25^\circ\text{C}$ , $I_P = 0A$		$\pm 5$ $\pm 150$	$\pm 7.5$ $\pm 225$	mV mA
Lifetime Offset Drift	$\Delta L_{VOQ}$			$\pm 2$		mV
Sensitivity	S	At $T_A = 25^\circ\text{C}$ For $T_j < 50\text{ }^\circ\text{C}$	-1 33.0	33.3	1 33.6	%S mV/A
Ratiometry Sensitivity Error	$\Delta R_S$	$T_A = 25^\circ\text{C}$ and for $\pm 5\% V_{DD}$		$\pm 0.3$		%S
Thermal Sensitivity Drift	$\Delta T_S$	Current range $I_{P_{MAX}}$		$\pm 1$	$\pm 1.5$	%S
Sensitivity Drift over lifetime	$\Delta L_S$			$\pm 1$	$\pm 2$	%S
Output Noise Spectral Density	$N_{SD}$	$I_P = 0A$ , $T_A = 25^\circ\text{C}$ within $BW = 1 \dots 100\text{kHz}$		207		$\mu\text{A}/\sqrt{\text{Hz}}$
Output RMS Noise	$N_{RMS}$	$I_P = 0A$ , $T_A = 25^\circ\text{C}$ $BW = 300\text{kHz}$		140		$\text{mA}_{RMS}$
OCD <sub>INT</sub> Threshold Current <sup>(1)</sup>	$I_{OCD}$			42.8		A
OCD <sub>INT</sub> Accuracy <sup>(1)</sup>	$\epsilon_{IOCD}$	$T_A = 25^\circ\text{C}$ $T_A = -40^\circ\text{C}$ to $85^\circ\text{C}$		5 10		%Threshold %Threshold
OCD <sub>EXT</sub> threshold error <sup>(1)</sup>	$\epsilon_{EOCD}$		-10		10	%FS

Table 17: MLX91221KDx-ABR-038 specifications

(1) For SOIC16 version

## 14.8. MLX91221K Dx-ABF-050 Specifications

DC Operating Parameters at  $V_{DD} = 3.3V$  (unless otherwise specified), for  $T_A$  as specified by the Temperature suffix (K) and for  $T_j < 150\text{ }^\circ\text{C}$ .

Parameter	Symbol	Test Conditions	Min	Typ	Max	Units
Primary current	$I_{PM}$		-50		50	A
Voltage Reference	$V_{REF}$	$T_A=25^\circ\text{C}$	1.63	1.65	1.67	V
Thermal Reference Drift	$\Delta T_{VREF}$	Variation versus $25^\circ\text{C}$			$\pm 150$	ppm/ $^\circ\text{C}$
Voltage Output Quiescent	$V_{OQ}$	No current flowing through IP, $V_{OUT}-V_{REF}$ , $T_A=25^\circ\text{C}$ No resistive load on $V_{OUT}$ and $V_{REF}$	-7.5 -300		7.5 300	mV mA
Ratiometry Offset Error	$\Delta R_{VOQ}$	$T_A=25^\circ\text{C}$ and for $\pm 5\% V_{DD}$	-5		5	mV
Thermal Offset Drift	$\Delta T_{VOQ}$	Referred to $T_A=25^\circ\text{C}$ , IP = 0A		$\pm 5$ $\pm 200$	$\pm 7.5$ $\pm 300$	mV mA
Lifetime Offset Drift	$\Delta L_{VOQ}$			$\pm 2$		mV
Sensitivity	S	At $T_A=25^\circ\text{C}$ For $T_j < 50\text{ }^\circ\text{C}$	-1 24.75	25	1 25.25	%S mV/A
Ratiometry Sensitivity Error	$\Delta R_S$	$T_A=25^\circ\text{C}$ and for $\pm 5\% V_{DD}$	-0.6		0.6	%S
Thermal Sensitivity Drift	$\Delta T_S$	Current range $IP_{MAX}$		$\pm 1$	$\pm 1.5$	%S
Sensitivity Drift over lifetime	$\Delta L_S$			$\pm 1$	$\pm 2$	%S
Output Noise Spectral Density	$N_{SD}$	IP = 0 A, $T_A=25^\circ\text{C}$ within BW = 1 ... 100kHz		210		$\mu\text{A}/\sqrt{\text{Hz}}$
Output RMS Noise	$N_{RMS}$	IP = 0 A, $T_A=25^\circ\text{C}$ BW = 300kHz		143		$\text{mA}_{RMS}$
OCD <sub>INT</sub> Threshold Current <sup>(1)</sup>	$I_{OCD}$			57		A
OCD <sub>INT</sub> Accuracy <sup>(1)</sup>	$\epsilon_{IOCD}$	$T_A=25^\circ\text{C}$ $T_A=-40^\circ\text{C}$ to $85^\circ\text{C}$		4 6		%Threshold %Threshold
OCD <sub>EXT</sub> threshold error <sup>(1)</sup>	$\epsilon_{EOCD}$		-10		10	%FS

Table 18: MLX91221K Dx-ABF-050 specifications

(1) For SOIC16 version

## 14.9. MLX91221KDx-ABR-050 Specifications

DC Operating Parameters at  $V_{DD} = 3.3V$  (unless otherwise specified), for  $T_A$  as specified by the Temperature suffix (K) and for  $T_j < 150\text{ }^\circ\text{C}$ .

Parameter	Symbol	Test Conditions	Min	Typ	Max	Units
Primary current	$I_{PM}$		-50		50	A
Voltage Output Quiescent	$V_{OQ}$	No current flowing through IP, $V_{OUT} = -V_{DD}/2$ , $T_A = 25^\circ\text{C}$ No resistive load on $V_{OUT}$ and $V_{REF}$	-7.5 -300		7.5 300	mV mA
Ratiometry Offset Error	$\Delta R_{VOQ}$	$T_A = 25^\circ\text{C}$ and for $\pm 5\% V_{DD}$	-7.5		7.5	mV
Thermal Offset Drift	$\Delta T_{VOQ}$	Referred to $T_A = 25^\circ\text{C}$ , $I_P = 0A$		$\pm 5$ $\pm 200$	$\pm 7.5$ $\pm 300$	mV mA
Lifetime Offset Drift	$\Delta L_{VOQ}$			$\pm 2$		mV
Sensitivity	S	At $T_A = 25^\circ\text{C}$ For $T_j < 50\text{ }^\circ\text{C}$	-1 24.75	25.0	1 25.25	%S mV/A
Ratiometry Sensitivity Error	$\Delta R_S$	$T_A = 25^\circ\text{C}$ and for $\pm 5\% V_{DD}$		$\pm 0.3$		%S
Thermal Sensitivity Drift	$\Delta T_S$	Current range $I_{P_{MAX}}$		$\pm 1$	$\pm 1.5$	%S
Sensitivity Drift over lifetime	$\Delta L_S$			$\pm 1$	$\pm 2$	%S
Output Noise Spectral Density	$N_{SD}$	$I_P = 0A$ , $T_A = 25^\circ\text{C}$ within $BW = 1 \dots 100\text{kHz}$		210		$\mu\text{A}/\sqrt{\text{Hz}}$
Output RMS Noise	$N_{RMS}$	$I_P = 0A$ , $T_A = 25^\circ\text{C}$ $BW = 300\text{kHz}$		143		$\text{mA}_{RMS}$
OCD <sub>INT</sub> Threshold Current <sup>(1)</sup>	$I_{OCD}$			57		A
OCD <sub>INT</sub> Accuracy <sup>(1)</sup>	$\epsilon_{IOCD}$	$T_A = 25^\circ\text{C}$ $T_A = -40^\circ\text{C}$ to $85^\circ\text{C}$		4 6		%Threshold %Threshold
OCD <sub>EXT</sub> threshold error <sup>(1)</sup>	$\epsilon_{EOCD}$		-10		10	%FS

Table 19: MLX91221KDx-ABR-050 specifications

(1) For SOIC16 version



## 14.10. MLX91221K Dx-ABF-075 Specifications

DC Operating Parameters at  $V_{DD} = 3.3V$  (unless otherwise specified), for  $T_A$  as specified by the Temperature suffix (K) and for  $T_j < 150\text{ }^\circ\text{C}$ .

Parameter	Symbol	Test Conditions	Min	Typ	Max	Units
Primary current	$I_{PM}$		-75		75	A
Voltage Reference	$V_{REF}$	$T_A=25^\circ\text{C}$	1.63	1.65	1.67	V
Thermal Reference Drift	$\Delta T_{VREF}$	Variation versus $25^\circ\text{C}$			$\pm 150$	ppm/ $^\circ\text{C}$
Voltage Output Quiescent	$V_{OQ}$	No current flowing through IP, $V_{OUT}-V_{REF}$ , $T_A=25^\circ\text{C}$ No resistive load on $V_{OUT}$ and $V_{REF}$	-7.5 -450		7.5 450	mV mA
Ratiometry Offset Error	$\Delta R_{VOQ}$	$T_A=25^\circ\text{C}$ and for $\pm 5\% V_{DD}$	-5		5	mV
Thermal Offset Drift	$\Delta T_{VOQ}$	Referred to $T_A=25^\circ\text{C}$ , IP = 0A		$\pm 5$ $\pm 300$	$\pm 7.5$ $\pm 450$	mV mA
Lifetime Offset Drift	$\Delta L_{VOQ}$			$\pm 2$		mV
Sensitivity	S	At $T_A=25^\circ\text{C}$ For $T_j < 50\text{ }^\circ\text{C}$	-1 16.5	16.67	1 16.8	%S mV/A
Ratiometry Sensitivity Error	$\Delta R_S$	$T_A=25^\circ\text{C}$ and for $\pm 5\% V_{DD}$	-0.6		0.6	%S
Thermal Sensitivity Drift	$\Delta T_S$	Current range $IP_{MAX}$		$\pm 1$	$\pm 1.5$	%S
Sensitivity Drift over lifetime	$\Delta L_S$			$\pm 1$	$\pm 2$	%S
Output Noise Spectral Density	$N_{SD}$	IP = 0 A, $T_A=25^\circ\text{C}$ within BW = 1 ... 100kHz		221		$\mu\text{A}/\sqrt{\text{Hz}}$
Output RMS Noise	$N_{RMS}$	IP = 0 A, $T_A=25^\circ\text{C}$ BW = 300kHz		149		$\text{mA}_{RMS}$
OCD <sub>INT</sub> Threshold Current <sup>(1)</sup>	$I_{OCD}$			85.6		A
OCD <sub>INT</sub> Accuracy <sup>(1)</sup>	$\epsilon_{IOCD}$	$T_A=25^\circ\text{C}$ $T_A=-40^\circ\text{C}$ to $85^\circ\text{C}$		4 6		%Threshold %Threshold
OCD <sub>EXT</sub> threshold error <sup>(1)</sup>	$\epsilon_{EOCD}$		-10		10	%FS

Table 20: MLX91221K Dx-ABF-075 specifications

(1) For SOIC16 version

## 15. MLX91221 Overcurrent Detection

### 15.1. General

The MLX91221 provides two OCD features that allow detecting overcurrent applied on the integrated sensor primary. In case of OCD detection, the  $OCD_{INT}$  or  $OCD_{EXT}$  is pulled to ground. During normal operation the OCD voltage remains at  $V_{DD}$ . This OCD feature is available for SOIC16 version only.

The two OCD functions are able to react to an overcurrent event within few us of response time. To avoid false alarm, the overcurrent has to be maintained at least  $1\mu s$  for the detection to occur. After detection by the sensor the output flag is maintained for  $10\mu s$  of dwell time. This allows the overcurrent to be easily detected at microcontroller level. More information can be found in Application Note AN91220\_OverCurrentDetection on [www.melexis.com](http://www.melexis.com)

The following table offers a comparison between  $OCD_{INT}$  and  $OCD_{EXT}$ :

	$OCD_{INT}$		$OCD_{EXT}$	
	Min	Max	Min	Max
Typical Application	Short-circuit detection		Out-of-range detection	
Overcurrent effect	$OCD_{INT}$ pin to $V_{SS}$		$OCD_{EXT}$ pin to $V_{SS}$	
Detection mode	Bidirectional		Unidirectional / bidirectional	
Accuracy	Lower		Higher	
Threshold trimming	EEPROM		Voltage divider on $VOC_{EXT}$	
Response time	$1.4\mu s$	$2.1\mu s$	$10\mu s$ typical	
Required Input holding time	$0.5\mu s$		$10\mu s$ minimum	
OCD output dwell time	$7\mu s$	$14\mu s$	$10\mu s$ typical	

*Table 21: Comparison between  $OCD_{INT}$  and  $OCD_{EXT}$  performances*

## 15.2. Electrical Specifications

DC Operating Parameters at  $V_{DD} = 3.3V$  (unless otherwise specified) and for  $T_A$  as specified by the Temperature suffix (K).

Parameter	Symbol	Test Conditions	Min	Typ	Max	Units
OCD_INT Internal ON Resistance	$R_{ON\_OCD\_INT}$	$I_{SINK} = 1 \text{ mA}$	60	90	150	$\Omega$
OCD_EXT Internal ON Resistance	$R_{ON\_OCD\_EXT}$	$I_{SINK} = 1 \text{ mA}$	160	190	280	$\Omega$
VOC_EXT Voltage Range <sup>(1)</sup>	VOC_EXT		0.3		1.2	V

Table 22:  $OCD_{INT}$  and  $OCD_{EXT}$  electrical specifications

## 15.3. Internal Overcurrent Detection Principle

The internal OCD takes fixed threshold voltage values predefined in the EEPROM and do not require any extra components. The  $OCD_{INT}$  implementation allows detecting overcurrent outside of the output measurement range of the sensor and is therefore suitable for large current peaks as occurring during short-circuit. If the theoretical sensor output overcomes the  $OCD_{INT}$  voltage threshold, the overcurrent event is flagged on  $OCD_{INT}$  pin. The default OCD threshold voltages are defined as follow, but other values can be set on request. The overcurrent threshold in ampere is deduced from the sensitivity of the sensor [mV/A] and the  $OCD_{INT}$  threshold voltage.

	Sensor configuration	Min.	Max.
$OCD_{INT}$ Threshold [% FS]	$V_{DD} = 3.3V / V_{REF} = 1.65V$	40.8	344

Table 23:  $OCD_{INT}$  factory programmable range

- (1) VOC\_ext defines the OCD\_ext threshold. In case of a ratiometric device, VOC\_ext should change with Vdd to avoid additional errors.

Sensor reference	Sensitivity [mV/A]	OCD <sub>INT</sub> Threshold Current [% FS]	OCD <sub>INT</sub> Threshold Current [A]
MLX91221KDF-ABF-010	120	100	10
MLX91221KDF-ABF-020	62.5	100.4	20.1
MLX91221KDF-ABx-120	62.5	140	28
MLX91221KDF-ABF-025	50	100.4	20.1
MLX91221KDF-ABR-038	33.3	112.6	42.8
MLX91221KDF-ABx-050	25	114	57
MLX91221KDF-ABF-075	16.7	114	85.6

Table 24: OCD<sub>INT</sub> threshold currents for SOIC-16 versions

## 15.4. External Overcurrent Detection Principle

The external OCD uses the voltage applied on VOC<sub>EXT</sub> pin as threshold voltage. This translates into an overcurrent threshold in ampere depending on the sensitivity of the sensor. A voltage divider on VOC<sub>EXT</sub> allows defining the threshold voltage in a custom way. Depending on the voltage divider configuration, the OCD<sub>EXT</sub> can be used either in bidirectional or unidirectional mode. The External OCD threshold is defined within the measurement range of the sensor output. This feature is then suitable for out-of-range detection where the OCD threshold remains close to the nominal current. It offers a better accuracy than OCD<sub>INT</sub> but the response is slower. The below table presents the unidirectional and bidirectional external OCD configurations. Please refer to section 12 for more details about the application diagram and the recommended resistances.

Bidirectional configuration	Unidirectional configuration
$VOC_{EXT} = V_{REF} * \frac{R_{ext_{bi}}}{R_{ext} + R_{ext_{bi}}}$ $VLocd = VOC_{EXT}$ $VHocd = 2 * V_{REF} - VLocd$	$VOC_{EXT} = V_{REF} + (V_{DD} - V_{REF}) * \frac{R_{ext}}{R_{ext} + R_{ext_{uni}}}$ $VHocd = VOC_{EXT}$

Table 25:  $OCD_{EXT}$ , bidirectional and unidirectional configurations

## 16. Recommended Application Diagrams

### 16.1. Resistor and Capacitor Values

Part	Description	Value	Unit
C <sub>1</sub>	Supply capacitor, EMI, ESD	47	nF
C <sub>2</sub>	Decoupling, EMI, ESD	47	nF
C <sub>3</sub>	Decoupling, EMI, ESD	4.7	nF
R <sub>EXT</sub> + R <sub>EXT_BI</sub> or R <sub>EXT</sub> + R <sub>EXT_UNI</sub>	External OCD Resistor	~200 <sup>(1)</sup>	kΩ
R <sub>EXT_BI</sub> or R <sub>EXT_UNI</sub>	External OCD Resistor	custom	-
R <sub>5</sub>	Pull-down resistance	>10	kΩ

Table 26: Resistor and Capacitor Values for Recommended Application Diagrams

(1) High impedance needed due to the current source/sink limitation of the V<sub>REF</sub> pin.

### 16.2. SOIC8 Application Diagram

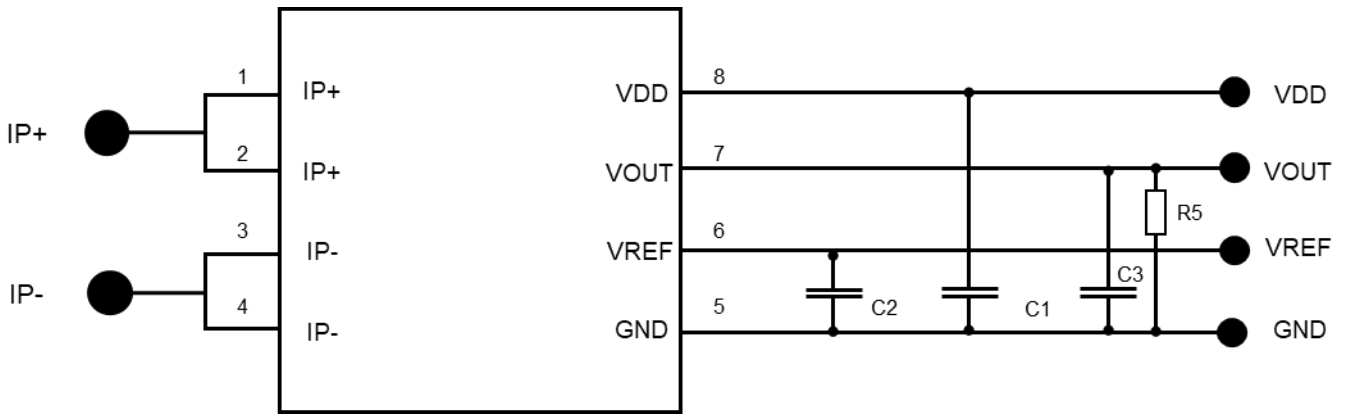


Figure 6: Recommended wiring for the MLX91221 in SOIC-8 package

### 16.3. SOIC16 Application Diagram

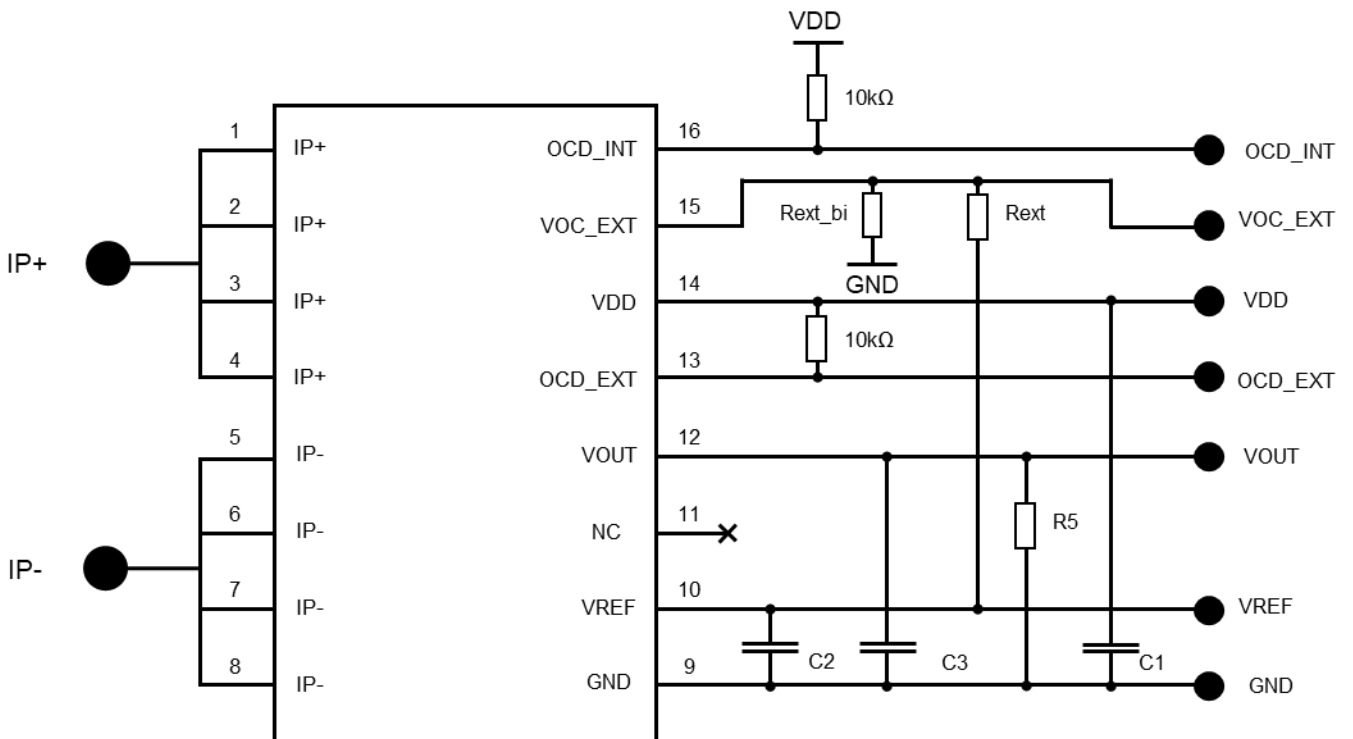


Figure 7: Recommended wiring for the MLX91221 with Bidirectional OCD<sub>EXT</sub>

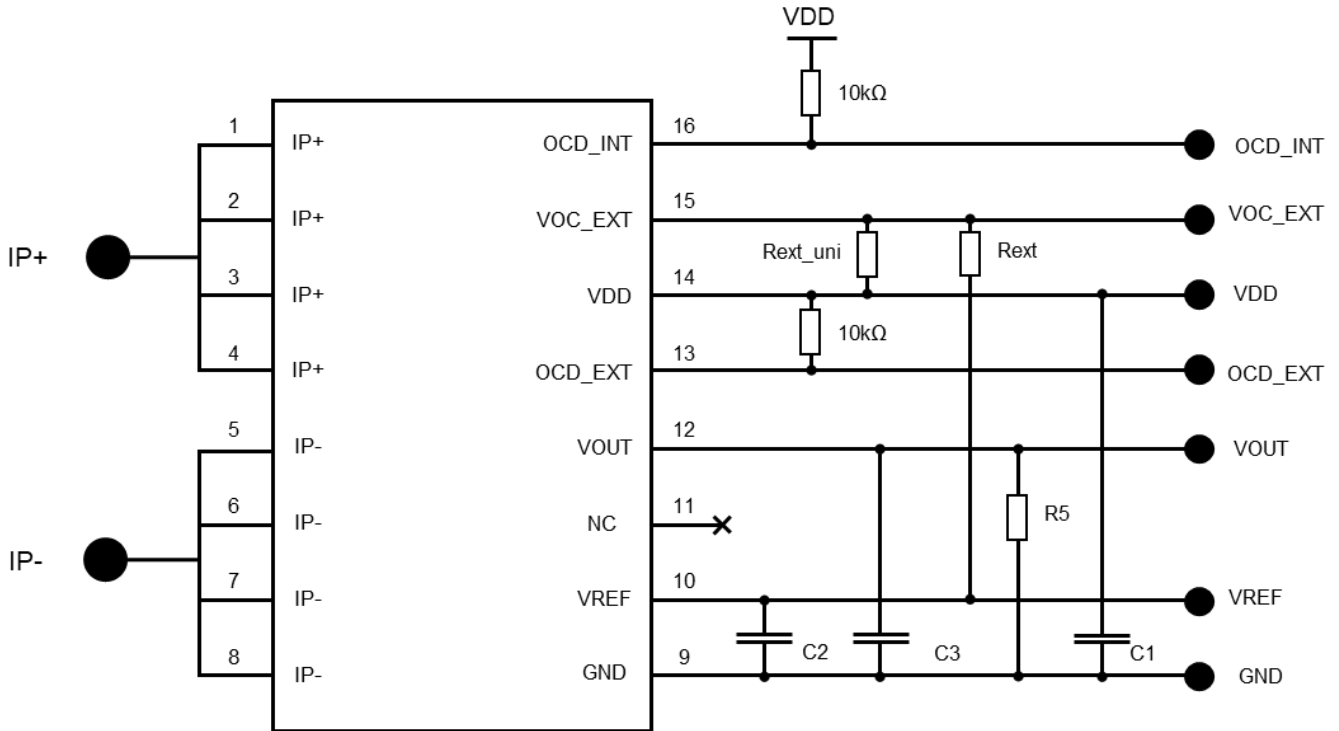


Figure 8: Recommended wiring for the MLX91221 with Unidirectional OCD<sub>EXT</sub>

### 16.3.1. OCD functions not used

In case of OCD functions are not needed (internal or external), OCD pins can be connected to GND. Moreover, when OCD<sub>ext</sub> is not needed, VOC<sub>ext</sub> pin should be connected to GND. Figure 9 shows the wiring configuration when both OCD functions are not needed.

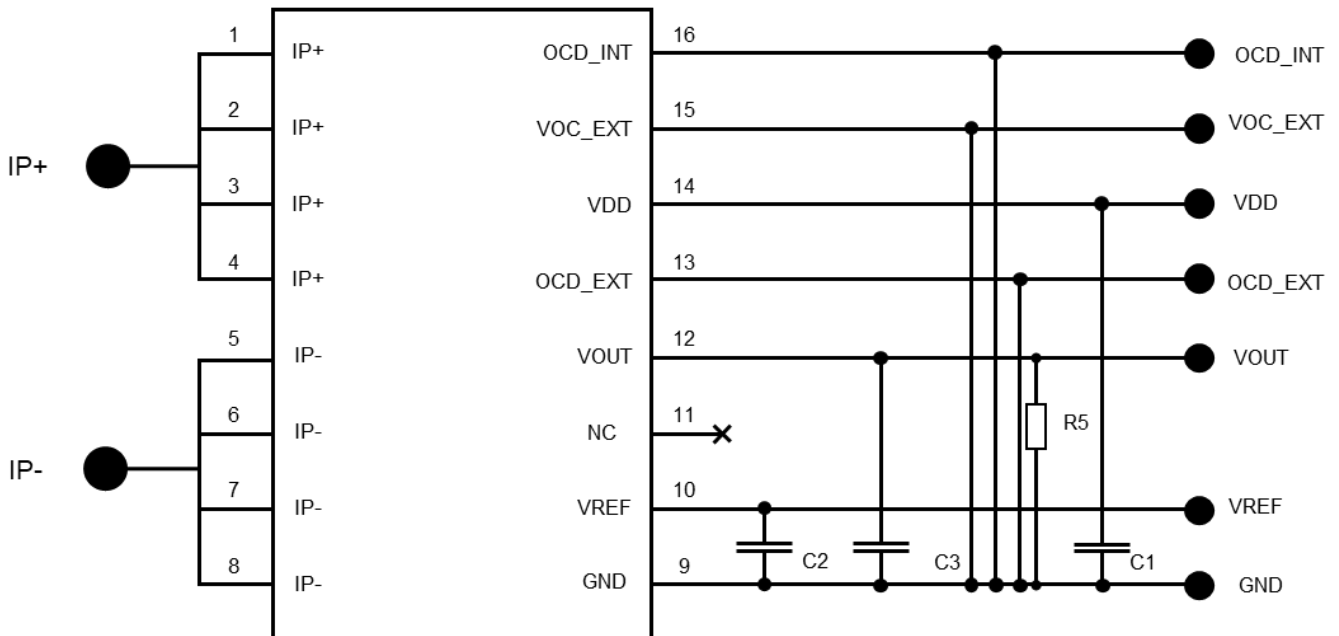


Figure 9: Example of wiring in case of both OCD functions not needed

## 17. Standard information regarding manufacturability 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 (<https://www.melexis.com/en/quality-environment/soldering>).



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 (<https://www.melexis.com/en/quality-environment>).

## 18. ESD Precautions

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

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



Parameter	Symbol	Test Method	Value	Unit
Human Body ESD Protection	$ESD_{HBM}$	AEC-Q100-002 Rev D	2	kV
Charged Device Model ESD Protection	$ESD_{CDM}$	AEC-Q100-011 Rev B	500	V

Table 27: Electrostatic Discharge Ratings

## 19. Package Information

### 19.1. SOIC-8 150mils- Package Dimensions

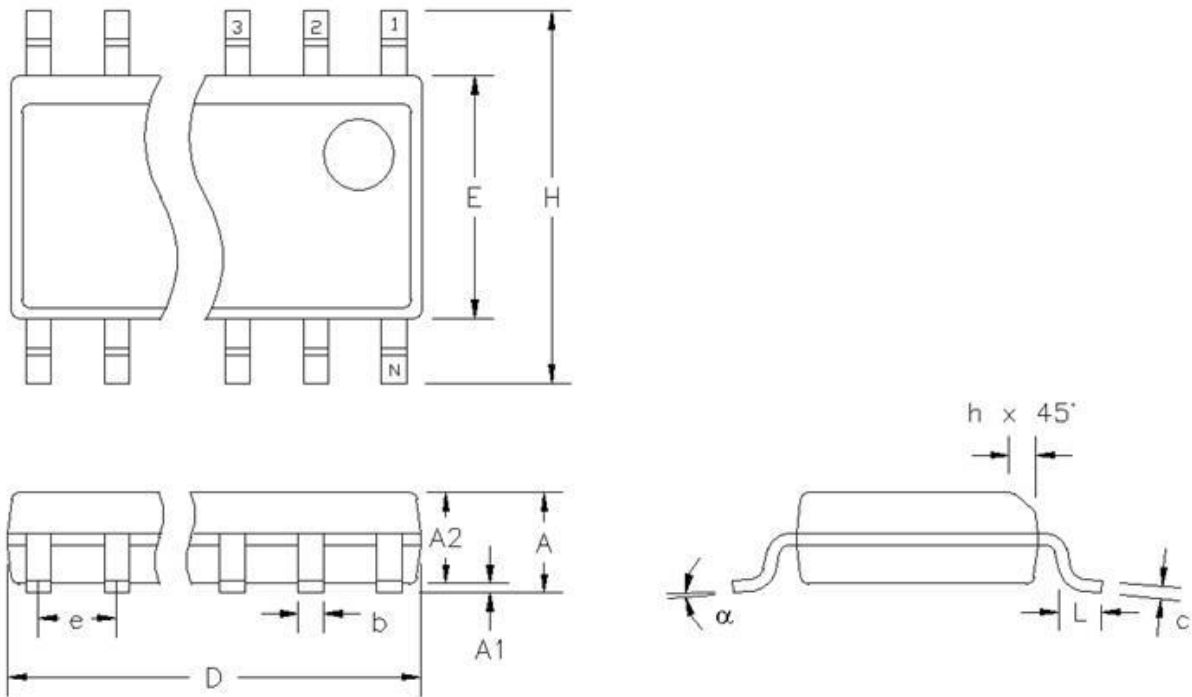


Figure 10: SOIC8 Package Dimensions

[mm]	A	A1	A2	D	E	H	L	b	c	e	h	⊘
min	1.52	0.10	1.37	4.80	3.81	5.80	0.41	0.35	0.19	1.27 BSC	0.25	0°
max	1.73	0.25	1.57	4.98	3.99	6.20	1.27	0.49	0.25		0.50	8°

[inch]	A	A1	A2	D	E	H	L	b	c	e	h	⊘
min	.060	.004	.054	.189	.150	.228	.016	.014	.008	.050 BSC	.010	0°
max	.068	.010	.062	.196	.157	.244	.050	.019	.010		.020	8°

Table 28: SOIC8 package dimensions in millimeters and inches

### 19.2. SOIC-16 300mils- Package Dimensions

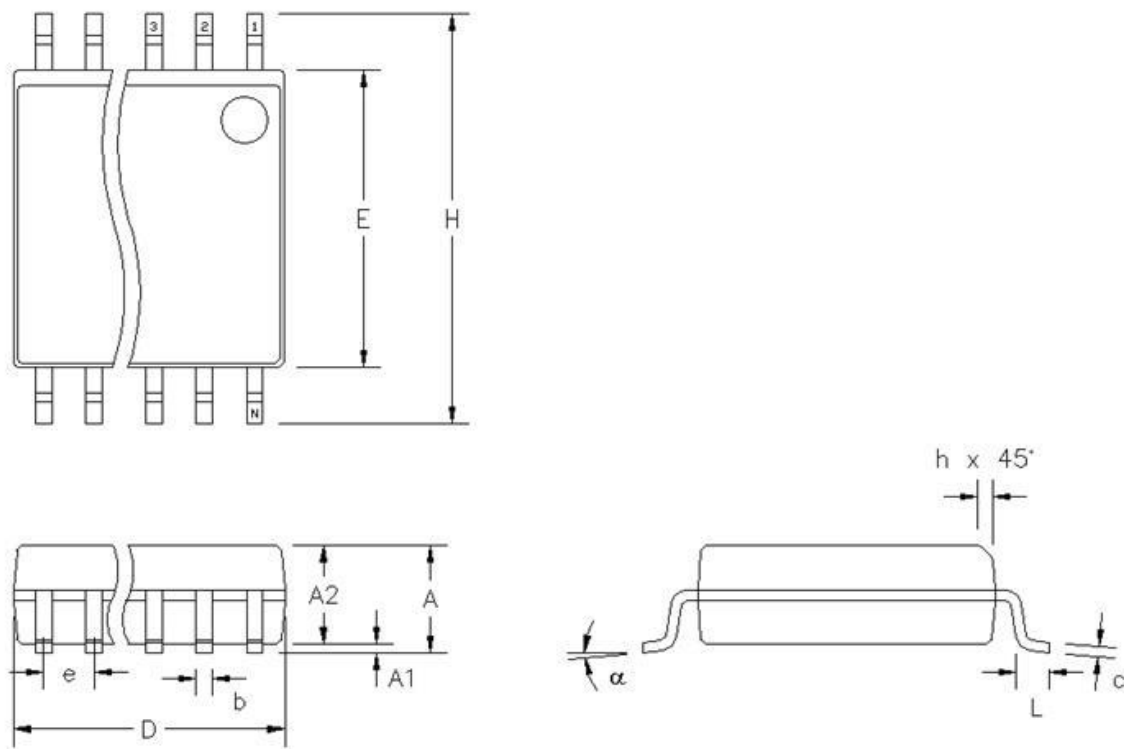


Figure 11: SOIC16 Package Dimensions

[mm]	A	A1	A2	D	E	H	L	b	c	e	h	⊘
min	2.44	0.10	2.24	10.11	7.40	10.11	0.51	0.35	0.23	1.27 BSC	0.25	0°
max	2.64	0.30	2.44	10.46	7.60	10.51	1.02	0.48	0.32		0.71	8°

[inch]	A	A1	A2	D	E	H	L	b	c	e	h	⊘
min	.096	.004	.088	.398	.291	.398	.020	.014	.009	.050	.010	0°
max	.104	.012	.096	.412	.299	.414	.040	.019	.013	BSC	.028	8°

*Table 29: SOIC16 package dimensions in millimeters and inches*

### 19.3. Packaging marks

SOIC-8	SOIC-16
<p><b>1. Top mark</b></p> <p>Line 1 (max 8 Char)          Line 2 (max 8 Char)          Line 3 (max 6 Char)</p> <p>↑ Pin 1  <u>Line 1:</u> Empty line  <u>Line 2:</u> Product specific marking  <u>Line 3:</u> First 6 characters of the lot number</p>	<p><b>1. Top mark</b></p> <p>Line 1 (max 12 Char)          Line 2 (max 12 Char)          Line 3 (max 12 Char)          Line 4 (max 12 Char)</p> <p>↑ Pin 1  <u>Line 1:</u> Product specific marking  <u>Line 2:</u> Empty line  <u>Line 3:</u> Lot number  <u>Line 4:</u> YY: Year, WW:week</p>
<p><b>2. Bottom mark</b></p> <p>Line 1 (max 8 Char)          Line 2 (max 8 Char)          Line 3 (max 6 Char)</p> <p><u>Line 2:</u> YY: Year, WW:week</p>	<p><b>2. Bottom mark</b></p>

Table 30: Package marking information

## 20. Contact

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

Europe, Africa	Email : sales_europe@melexis.com
Americas	Email : sales_usa@melexis.com
Asia	Email : sales_asia@melexis.com

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