

MLX91210 Integrated Current Sensor IC

Datasheet

Features and Benefits

- Factory trimmed AC and DC current sensor
- Analog ratiometric output voltage
- Combining sensing element, signal conditioning & isolation in small footprint and low profile SOIC package
- No application programming required
- High speed sensing
 - DC to 100kHz bandwidth
 - 5μs response time
- Robust against external magnetic fields
- No magnetic hysteresis
- Low ohmic losses of integrated conductor
 - 0.8mΩ SOIC-8 / 0.7mΩ 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
 - 2.1kV_{RMS} for SOIC-8
 - 2.5kV_{RMS} for SOIC-16



SOIC-8



SOIC-16



IEC60950-1:2005
+ Am 1:2009 & 2:2013

N/A



IEC60950-1:2005
+ Am 1:2009 & 2:2013



Applications

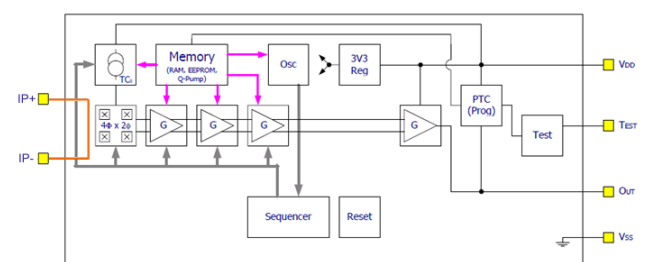
- Household/Appliance Smart Metering
- Electric Motor Control
- Demand Response Load Control
- Servers / Motherboard monitoring
- Switched Mode Power Supplies

Description

The MLX91210 is an Integrated Current Sensor that senses the current flowing through the leadframe of the SOIC package. The current conductor exhibits low power dissipation (0.7 - 0.8mΩ). 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 originating from the dense power electronics surrounding the IC 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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1. Ordering Information

Product Code	Temperature Code	Package Code	Option Code	Packing Form Code
MLX91210	K	DC	CAS-101	RE
MLX91210	K	DC	CAS-102	RE
MLX91210	K	DF	CAS-101	RE
MLX91210	K	DF	CAS-102	RE

Legend:

Temperature Code:	K: from -40°C to 125°C
Package Code:	“DC” for SOIC-8 NB (Narrow Body) package “DF” for SOIC-16 WB (Wide Body) package
Option Code:	CAS-xxx: die version xxx-101: Bipolar current sensor // 0A at 50%Vdd // nominal 80mV/A or ±25A full scale xxx-102: Bipolar current sensor // 0A at 50%Vdd // nominal 40mV/A or ±50A full scale
Packing Form:	“RE” for Reel
Ordering Example:	MLX91210KDC-CAS-101-RE

Table 1 – Legend

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.

2. Functional Diagram

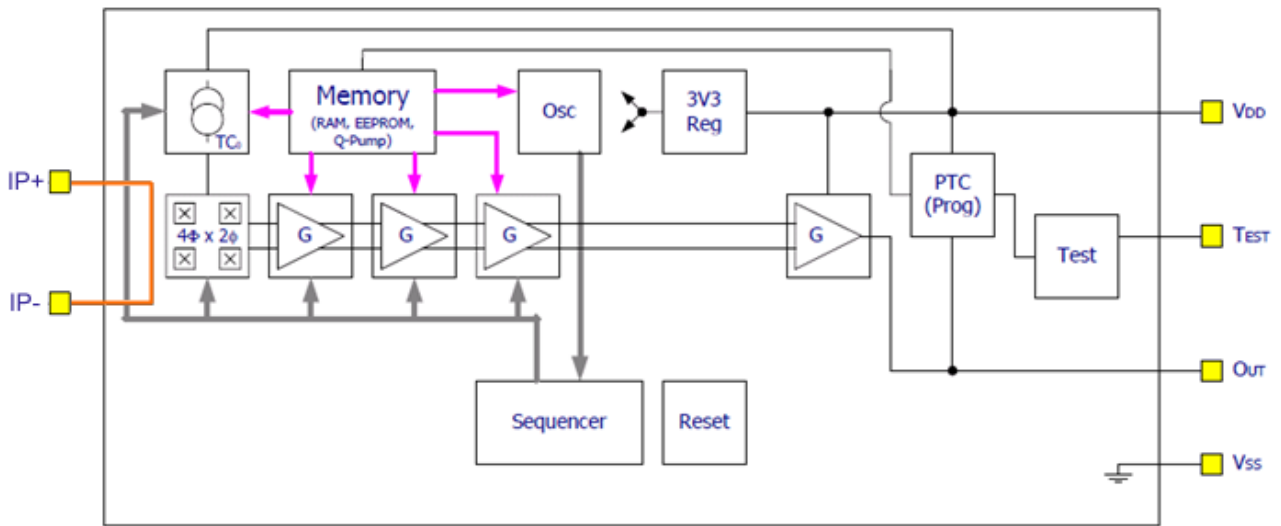


Figure 1 – Functional Diagram for MLX91210

3. 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

Table 2 – Glossary of Terms

4. Pinout

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		
4				
5	VSS	Ground Voltage	IP-	Primary Current Path Output
6	TEST	Digital Factory Test		
7	OUT	Output Voltage		
8	VDD	Supply Voltage		
9			VSS	Ground Voltage
10			VSS	Ground Voltage
11			TEST	Digital Factory Test
12			OUT	Output Voltage
13			NC	Not connected
14			VDD	Supply Voltage
15			NC	Not connected
16			NC	Not connected

For optimal EMC behavior, it is recommended to connect the unused pins (NC and TEST) to the Ground (see section 12).

5. Absolute Maximum Ratings

Parameter	Value
Positive Supply Voltage (overvoltage)	+ 10 V
Reverse Supply Voltage	- 0.3 V
Positive Output Voltage	+ 10 V
Positive Output Current	+ 70 mA
Reverse Output Voltage	- 0.3 V
Reverse Output Current	- 50 mA
Operating Ambient Temperature Range, T_A	- 40°C to + 125°C
Storage Temperature Range, T_S	- 55°C to + 165°C
Maximum Junction Temperature, T_J	+ 165°C

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

For more information on how the junction temperature relates to the applied current and ambient temperature range, please refer to section 7.

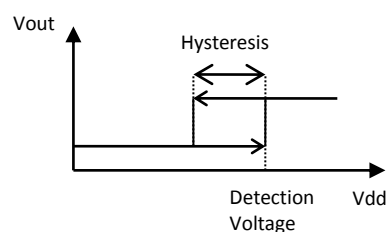
6. MLX91210 Electrical Specification

DC Operating Parameters at $V_{DD} = 5V$ (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}		4.5	5	5.5	V
Supply Current	I_{DD}	Without R _{LOAD} , in application mode	7	12	14	mA
DC Load Current	I_{OUT}	R _{LOAD} in range [6kΩ, 100kΩ]	-2		2	mA
Maximum Output Current (driving capability)	I_{MAX}	V _{OUT} can cover 3%V _{DD} to 97%V _{DD} span	-2		2	mA
Output Resistance	R _{OUT}	V _{OUT} = 50%V _{DD} , R _{LOAD} = 10kΩ		1	5	Ω
Output Capacitive Load	C _{LOAD}	Output amplifier stability is optimized for this typical value		10		nF
Output Resistive Load	R _{LOAD_PU} R _{LOAD_PD}	Output resistive load for high linearity (pull-up or pull-down)	6			kΩ
Output Short Circuit Current	I_{SHORT}	Output shorted to V _{DD} or V _{SS} - Permanent	35		180	mA
Output Leakage current	I_{LEAK}	High impedance mode ^(Error! Bookmark not defined.) , $T_A=150^{\circ}C$	0.5	1.5	20	μA
Output Voltage Linear Swing	V _{OUT_LSW}	Pull-down or pull-up ≥ 10 kΩ	10		90	%V _{DD}
High-impedance Mode Levels	V _{OUT_HIZ_PU}	R _{LOAD_PU} ≤ 25kΩ, $T_A \leq 125^{\circ}C$	95			%V _{DD}
	V _{OUT_HIZ_PD}	R _{LOAD_PD} ≤ 25kΩ, $T_A \leq 125^{\circ}C$			5	%V _{DD}
Under-Voltage Detection	V _{DD_UVL}	Detected Voltage (Low to High)	3.15	3.3	3.45	V
	V _{DD_UVH}	Hysteresis ⁽²⁾	0.25	0.3	0.4	V
Over-Voltage Detection	V _{DD_OVL}	Low to High Voltage	6.7		7.6	V
	V _{DD_OVH}	Hysteresis ⁽²⁾	0.05		0.7	V
Ratiometry Fault Detection	V _{RATIO_L}	Low to High Voltage	4		4.4	V
	V _{RATIO_H}	Low to High Voltage	0.05		0.5	V

(1) According to Table 3 of Section 11.

(2) According to the following diagram on the right :



7. MLX91210 Current Specification

DC Operating Parameters at $V_{DD} = 5V$ (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}	$T_A = 25^\circ C$		0.8		m Ω
	R_{IP_SOIC16}			0.7		
Nominal Range	IP_{NOM}	CAS-101 CAS-102		± 10 ± 20		A A
Measurement Range	IP_{MAX}	CAS-101 CAS-102		± 25 ± 50		A A
Linearity Error	NL	Current in range IP_{MAX} , $T_A = 25^\circ C$		± 0.5		%FS
Current Capability ⁽³⁾ (see also Figure 2 & Figure 3)	IP_{C85_SOIC8}	Continuous, $T_A = -40$ to $85^\circ C$			± 25	A
	IP_{C25_SOIC8}	Continuous, $T_A = 25^\circ C$			± 35	A
	IP_{T25_SOIC8}	Transient, 1ms pulse, $T_A = 25^\circ C$		± 100		A
	IP_{C85_SOIC16}	Continuous, $T_A = -40$ to $85^\circ C$			± 30	A
	IP_{C25_SOIC16}	Continuous, $T_A = 25^\circ C$			± 40	A
	IP_{T25_SOIC16}	Transient, 1ms pulse, $T_A = 25^\circ C$		± 100		A

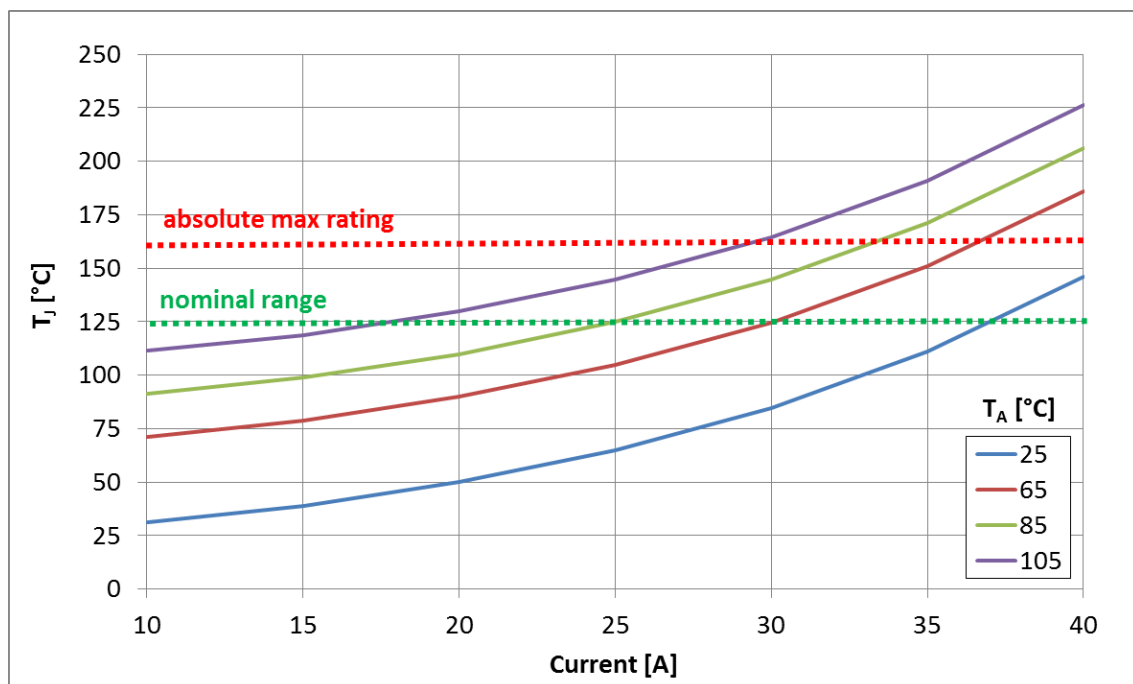


Figure 2 – Typical junction temperature [°C] on SOIC8 vs applied current [A] and ambient temperature [°C].

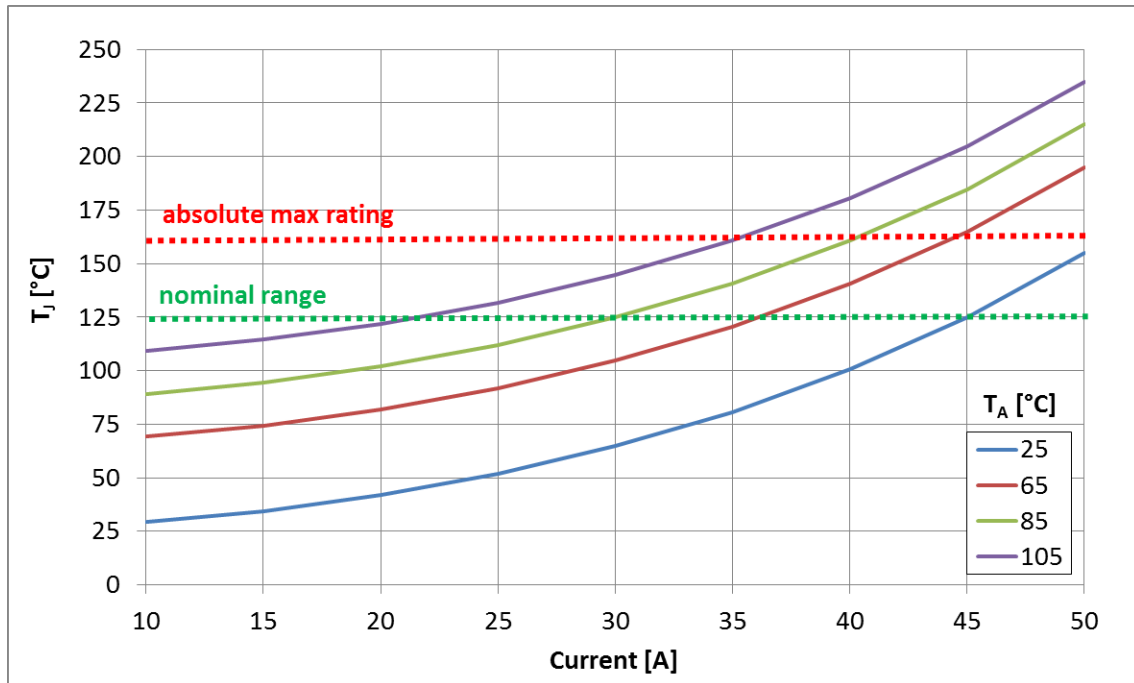


Figure 3 – Typical junction temperature [°C] on SOIC16 vs applied current [A] and ambient temperature [°C].

- (3) Current capability has been assessed on a Melexis evaluation board with 2oz of Copper on 2 layers. Please contact your local Melexis representative to get access to the MLX91210 application notes for PCB design and layout recommendations. Although the linear measurement range is wider, the steady-state DC current or RMS current should never exceed the specified current capability values for any option code.

8. MLX91210 Voltage Isolation Specification

Parameter	Symbol	Test Conditions	Rating	Units
Rated Isolation Voltage ⁽⁴⁾ IEC60950	V _{ISO_SOIC8}	IEC60950-1:2005	2100	V _{AC}
	V _{ISO_SOIC16}	+ Am 1:2009 + Am 2:2013	2500	
Rated Isolation Voltage ⁽⁴⁾ UL1577	V _{ISO2_SOIC16}	UL1577 ⁽⁵⁾	2500	V _{AC}
Working Voltage for Basic Isolation IEC60950	V _{WFSI_SOIC8}	IEC60950-1:2005	354	V _{DC} or
	V _{WFSI_SOIC16}	+ Am 1:2009 + Am 2:2013	390	V _{PEAK}

- (4) 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).
 (5) Melexis performs routine production-line tests with a test potential of 120% of the rated isolation voltage for 1s, according to UL1577 requirements, for all SOIC16 devices produced.

9. MLX91210 Timing Specification

DC Operating Parameters at $V_{DD} = 5V$ (unless otherwise specified) and for T_A as specified by the Temperature suffix (K).

Parameter	Symbol	Test Conditions	Min	Typ	Max	Units
Refresh rate	T_{RR}		0.8	1	2	μs
Step Response Time	T_{RESP}	Delay between the input signal reaching 90% and the output reaching 90% (see Figure 4)		5	6	μs
Bandwidth	BW	Min -3dB, $T_A = 25^\circ C$		100		kHz
Power on Delay ⁽⁶⁾	T_{POD}	$V_{OUT} = 100\%$ of FS, $R_{LOAD_PD} \leq 100k\Omega$			1	ms
Ratiometry Cut-off Frequency	F_{RATIO}			250		Hz

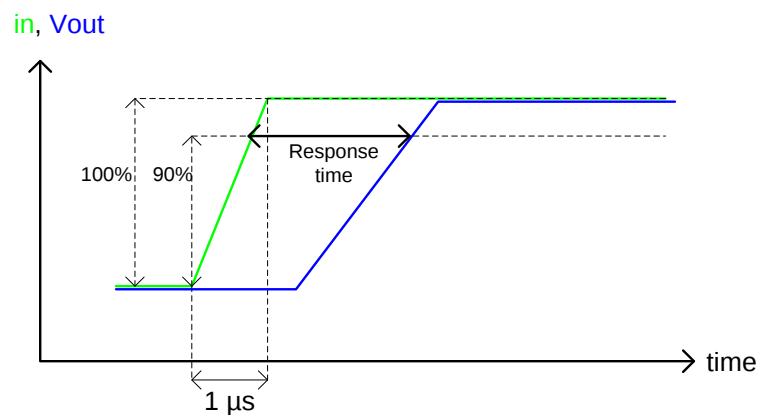


Figure 4 – Response Time definition

(6) During the Power-on delay, the output will remain within the 10% fault band at all time.

10. MLX91210 Accuracy Specification

DC Operating Parameters at $V_{DD} = 5V$ (unless otherwise specified) and for T_A as specified by the Temperature suffix (K).

Parameter	Symbol	Test Conditions	Min	Typ	Max	Units
Voltage Output Quiescent	V_{OQ}	No current flowing through IP $T_A=25^{\circ}C$	49.8	50	50.2	$\%V_{DD}$
Thermal Offset Drift	ΔT_{VOQ}	Referred to $T_A=25^{\circ}C$, IP = 0A Option Code : CAS-101 Option Code : CAS-102		± 0.06 ± 0.12	± 0.12 ± 0.25	A A
Sensitivity	S	At $T_A=25^{\circ}C$ Option Code : CAS-101 Option Code : CAS-102	78.4 39.2	80 40	81.6 40.8	mV/A mV/A
Thermal Sensitivity Drift	TC	Current range IP_{NOM}		± 1	± 1.5	$\%S$
RMS Output Noise ⁽⁷⁾	N_{RMS}	BW = 100kHz		0.15		A_{RMS}
Ratiometry Error Offset	ΔV_{OQ}	$V_{OQ} = 50\%V_{DD}$ $\Delta V_{DD} = \pm 10\%V_{DD}$			± 0.4	$\%V_{OQ}$
Ratiometry Error Sensitivity	ΔS	$\Delta V_{DD} = \pm 10\%V_{DD}$			± 0.4	$\% \text{ of } S$

(7) Further output filtering possible, see section 12.4.

11. MLX91210 Self Diagnostic

The sensor provides self-diagnostic features to detect internal memory errors and under-voltage. These features increase the robustness of the IC functionality as they prevent erroneous output signal in case of internal or external failure modes. This detection is guaranteed provided the measured signal does not exceed the Measurement Range IP_{MAX} as described in Section 7 or this excessive current is interpreted as a diagnostic as well.

Fault Mode	Action	Effect on Outputs	Remark
Calibration Data CRC Error	Fault mode	High Impedance mode	At power up and during normal operation
Power On Delay		High Impedance mode	1ms in high impedance followed by settling
Undervoltage Mode	IC is reset	High Impedance mode	300mV hysteresis (typical)
Overvoltage Detection	IC is reset	High Impedance mode	100mV hysteresis (typical)

Table 3 – Self Diagnostic Functionality

12. Recommended Application Diagrams

12.1. Resistor and Capacitor Values

Part	Description	Value	Unit
C1	Supply capacitor, EMI, ESD	100	nF
C2	Decoupling, EMI, ESD	10	nF
R1	Pull up or pull down resistor	6-100	kΩ

Table 4 – Resistor and Capacitor Values for Recommended Application Diagrams

12.2. Pull-down Diagnostic

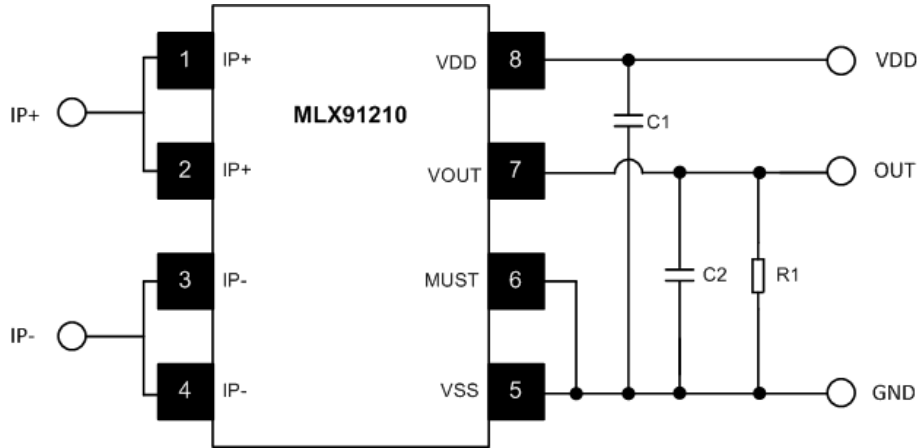


Figure 5 – Recommended wiring for the MLX91210 with pull-down diagnostic in SOIC-8 package

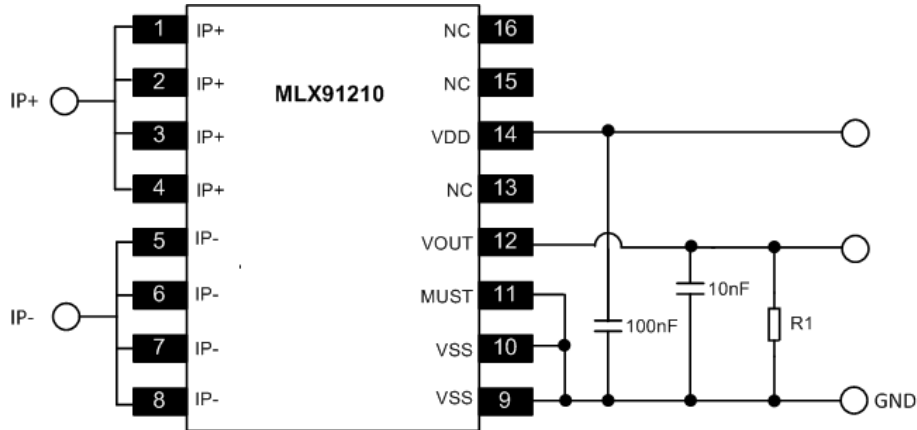


Figure 6 – Recommended wiring for the MLX91210 with pull-down diagnostic in SOIC-16 package

12.3. Pull-up Diagnostic

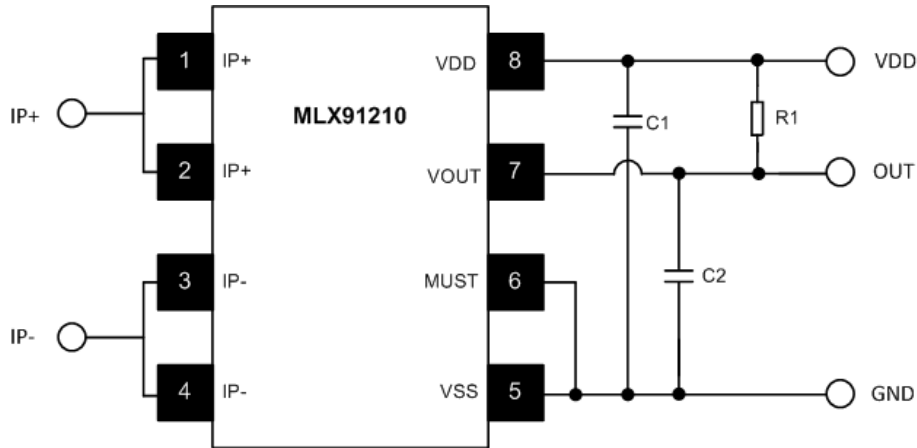


Figure 7 – Recommended wiring for the MLX91210 with pull-up diagnostic in SOIC-8 package

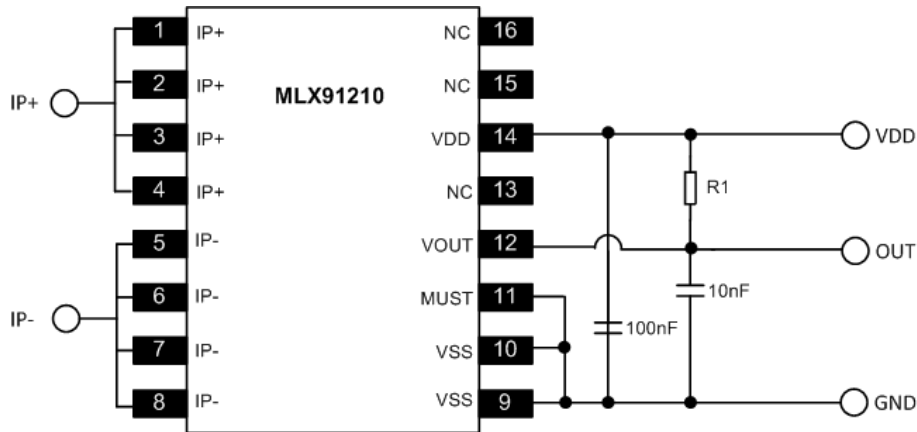


Figure 8 – Recommended wiring for the MLX91210 with pull-up diagnostic in SOIC-16 package

12.4. Optional RC filter

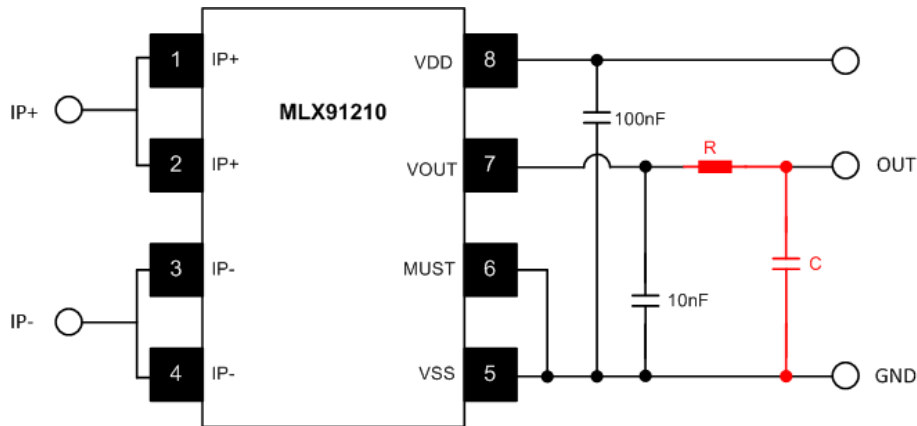


Figure 9 – Recommended Application Diagram with RC filter in SOIC-8 package

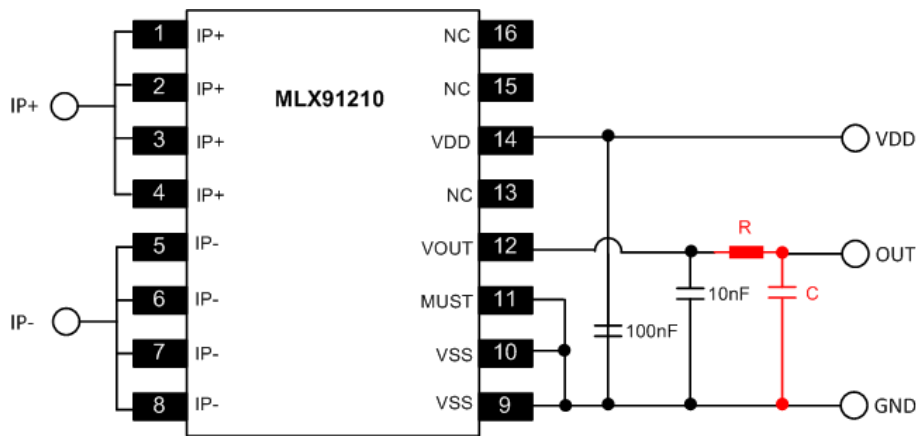


Figure 10 – Recommended Application Diagram with RC filter in SOIC-16 package

R [Ω]	C [nF]	Bandwidth [kHz]	Noise [A_{RMS}]
n.a.	n.a.	100	0.15
100	150	10	0.05
1000	150	1	0.02

Table 5 – Additional Filtering Information

13. 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>).

14. 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 6 – Electrostatic Discharge Ratings

15. Package Information

15.1. SOIC-8 - Package Dimensions

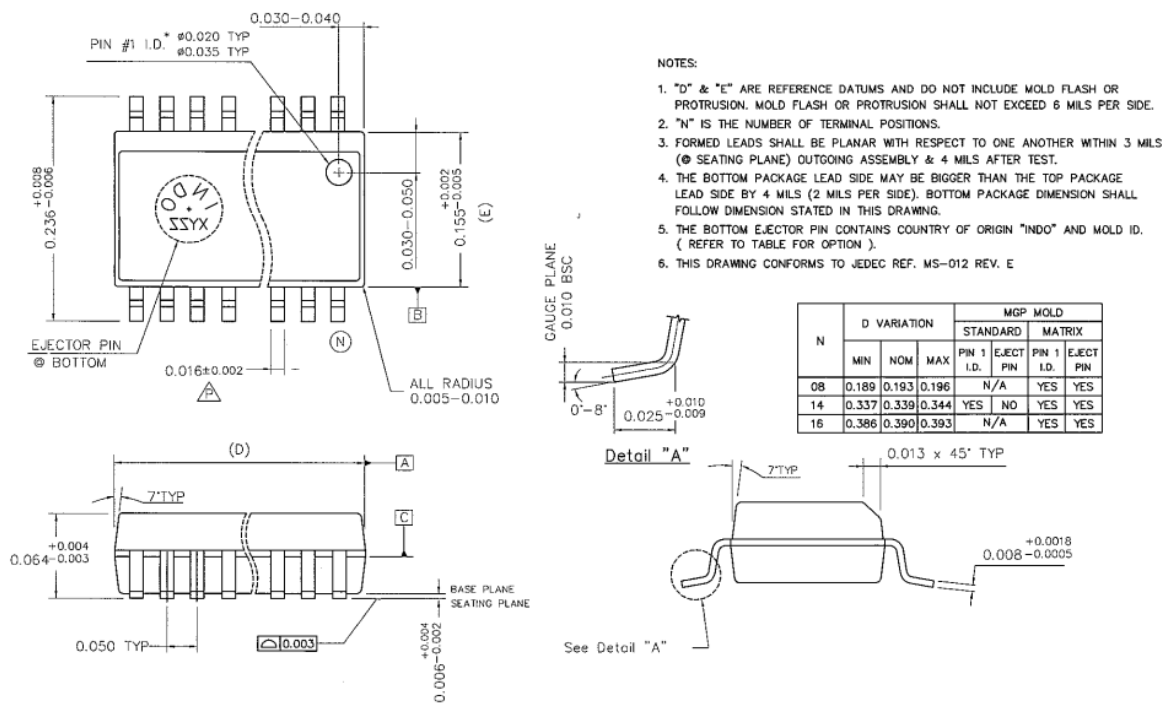


Figure 11 – SOIC8 Package Dimensions [mils]

16. Disclaimer

Devices sold by Melexis are covered by the warranty and patent indemnification provisions appearing in its Term of Sale. Melexis makes no warranty, express, statutory, implied, or by description regarding the information set forth herein or regarding the freedom of the described devices from patent infringement. Melexis reserves the right to change specifications and prices at any time and without notice. Therefore, prior to designing this product into a system, it is necessary to check with Melexis for current information. This product is intended for use in normal commercial applications. Applications requiring extended temperature range, unusual environmental requirements, or high reliability applications, such as military, medical life-support or life-sustaining equipment are specifically not recommended without additional processing by Melexis for each application.

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Or for additional information contact Melexis Direct:

Europe, Africa, Asia:

Phone: +32 1367 0495

E-mail: sales_europe@melexis.com

Americas:

Phone: +1 603 223 2362

E-mail: sales_usa@melexis.com

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