Melexis
Microelectronic Integrated Systems

MLX91205

IMC Current Sensor (Triaxis™ Technology)

Features and Benefits

- Triaxis™ Hall Technology
- Sensitive to a magnetic field parallel to the chip surface
- Very high sensitivity
- Linear output voltage proportional to a magnetic field
- Wideband: DC to 100kHz
- Short response time 8µs
- Low offset and offset drift
- Very low noise
- Isolated from current conductor
- Surface mount SOIC8 package

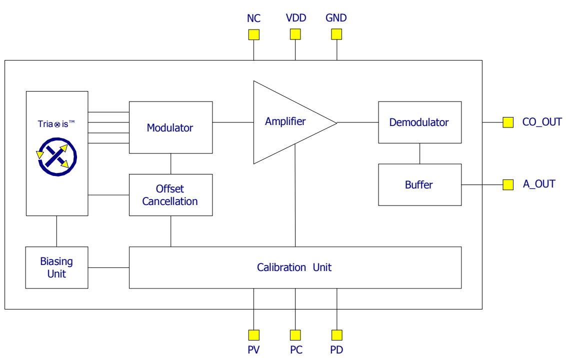
Applications Examples

- AC and/or DC contactless current measurement
- Wideband Magnetic Field Measurement
- Battery Management
- AC/DC Converters
- Motor Control
- Solar Power Converter (MPPT)
- Power Management

Ordering Information

Part No.	**Temperature Code**	**Package Code**	**Option code**
MLX91205KDC-LB	(-40℃ to 125℃)	DC (SOIC)	
MLX91205KDC-HB	(-40℃ to 125℃)	DC (SOIC)	

1 Functional diagram



2 General description

The new Triaxis™ current sensor MLX91205 is a single axis integrated magnetic sensor based on the Hall Effect. It produces an analog linear, ratio-metric output voltage proportional to the applied magnetic field parallel with the chip surface.

The circuit is fabricated using a standard CMOS process. The additional ferromagnetic layer (Triaxis™ or IMC™ = Integrated Magnetic Concentrator) that is added in a simple post-processing step, amplifies the magnetic field and concentrates it on the Hall elements. Therefore, the circuit features very high magnetic sensitivity, low offset, and low noise.

The MLX91205 is ideally suited for current sensing in automotive and industrial environments.

There are 2 different product versions available. The 91205HB features a linear magnetic field range of ±20mT and the 91205LB features a linear range of ±7.5mT.

HB refers to a high magnetic field, whereas LB refers to a low magnetic field range.

Table of Contents

3 Glossary of Terms

Gauss (G), Tesla (T): Magnetic flux density units where 1 mT = 10 G.

ADC: Analog-to-Digital Converter

TC: Sensitivity Temperature Coefficient (in ppm/Deg.C.).

Tria⊗is™ : The Tria⊗is™ technology refers to the Melexis Hall technology that is based on both planar and vertical (bulk & IMC) Hall plates. This technology allows the realization of Hall effect sensors able to sense the flux density along the 3 axis (i.e. X, Y & Z) as well as position sensors able to sense the magnetic vector over 360 degrees.

IMC: Integrated Magneto Concentrator. It concentrates the magnetic flux lines and bends them at the extremity under the planar Hall plate. Furthermore, it can provide some magnetic gain factor.

4 Maximum ratings

Parameter	Units
Supply Voltage, V_{DD} (overvoltage)	6V
Supply Voltage, V_{DD} (operating)	5.5V
Reverse Voltage Protection	0V
Operating Temperature Range, T_A	-40 to +125°C
Storage Temperature Range, T_S	-40 to +150°C

Table 1: Absolute maximum ratings

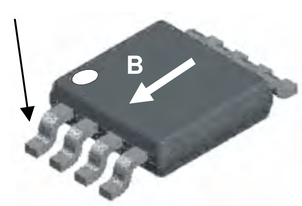
Exceeding the absolute maximum ratings may cause permanent damage. Exposure to absolute maximum rated conditions for extended periods may affect device reliability.

5 Pin definitions and descriptions

Pin Number	Pin Name	Function
1	A_out	Analog Output
2	VDD	Supply
3	NC	
4	PV	Factory Programming Pin (default VDD)
5	GND	Supply Common
6	PD	Factory Programming Pin (default GND)
7	PC	Factory Programming Pin (default VDD)
8	CO_out	Common Output (VDD/2)

Table 2: Pin description MLX91205

Pin 1



Magnetic sensitive direction

6 MLX91205 General Electrical Specifications

DC Operating Parameters T_A = -40°C to +125°C, V_{DD} = 5.000V (unless otherwise specified)

Parameter	Symbol	Test Conditions	Min	Typ	Max	Units
Nominal Supply Voltage	Vdd		4.5	5	5.5	V
Supply Current	Idd	Iout=0mA		10	16	mA
Common Output	CO_Out	Referring to VDD/2	-50	VDD/2	+50	mV
Output Current	Iout		-1		1	mA
Output Load Resistance	Rload		5			kΩ
Output Load Capacitance	Cload			1000		pF
Start-up cycle	Ts			150		µs

Table 3: Electrical specifications

7 MLX91205 Sensor Specific Specifications

7.1 91205 LB: Low Field version 10mT (marking xxL)

DC Operating Parameters T_A = -40°C to 125°C, V_{DD} = 5.000V, differential output (i.e. Vout = A_out - CO_out), unloaded. Unless otherwise specified.

Parameter.	Symbol	Test Conditions	Min	Typ	Max	Units
Magnetic Sensitivity	S(1)	T=25°C, B = B_L	275	280	285	V/T
Magnetic Sensitivity over Temp.	S_T(1)	T= -40, 25, 125°C; See also below 10.2	260	280	300	V/T
Thermal Sensitivity Drift	TC	T= 25°C		<+/-200		ppm/°C
Offset Voltage	Voff	T= 25°C	-20	0	20	mV
Offset Voltage over Temperature	$Voff_T$	T= -40, 25, 125°C; See also below 10.1	-50	0	50	mV
Linear Magnetic Field Range	B_L		-7.5		7.5	mT
Fullscale Magnetic Field Range	B_{FS}			±10		mT
Non Linearity	NL	B<B_L		±0.5		%(2)
Hysteresis	Hyst	B<100mT		<±10		µT
Max. Output Voltage Swing	Vout,max	B>B_{FS}	5		95	%VDD
Response Time	tr			8		µs
Bandwidth (-3 dB) DC to	BW	R_{Load}>1MΩ; C_{Load}<10pF		100		kHz
Spectral Noise Density	ΔBnoise	f=10Hz to 10kHz		<125		nT/sqrt(Hz)

Table 4: Sensor specifications 10mT version (low-field version)

Note 1: Ratiometric (proportional to Vdd). The absolute accuracy on magnetic sensitivity trimming is +/- 2%.
Note 2: Deviation to a best fit straight line, related full linear input range, i.e. 15mT.

7.2 91205HB: High Field version 25mT (marking xxH)

DC Operating Parameters T_A = -40°C to 125°C, V_{DD} = 5.000V, differential output (i.e. Vout = A_out - CO_out), unloaded. Unless otherwise specified.

Parameter.	Symbol	Test Conditions	Min	Typ	Max	Units
Magnetic Sensitivity	S(1)	T=25°C, B = B_L	98.5	100	101.5	V/T
Magnetic Sensitivity over Temp.	S_T(1)	T= -40, 25, 125°C; See also below 10.2	93	100	107	V/T
Thermal Sensitivity Drift	TC	T= 25°C		<+/-200		ppm/°C
Offset Voltage	Voff	T= 25°C	-20	0	20	mV
Offset Voltage over Temperature	$Voff_T$	T= -40, 25, 125°C; See also below 10.1	-50	0	50	mV
Linear Magnetic Field Range	B_L		-20		20	mT
Fullscale Magnetic Field Range	B_{FS}			±25		mT
Non Linearity	NL	B<B_L		±0.5		%(2)
Hysteresis	Hyst	B<100mT		<±20		µT
Max. Output Voltage Swing	Vout,max	B>B_{FS}	5		95	%VDD
Response Time	Tr			8		µs
Bandwidth (-3 dB) DC to	BW	R_{Load}>1MΩ; C_{Load}<10pF		100		kHz
Spectral Noise Density	ΔBnoise	f=10Hz to 10kHz		<125		nT/sqrt(Hz)

Table 5: Sensor specifications 25mT version (high-field version)

Note 1: Ratiometric (proportional to Vdd). The absolute accuracy on magnetic sensitivity trimming is +/- 2%.
Note 2: Deviation to a best fit straight line, related full linear input range, i.e. 40mT.

8 Detailed General Description

Melexis IMC current sensor MLX91205 is a single axis magnetic field sensor based on the Hall Effect. It is an integrated combination of a CMOS Hall circuit and a thin ferromagnetic concentrator. The CMOS circuit contains two pairs of Hall elements for its sensitivity direction parallel with the chip surface. The ferromagnetic concentrator amplifies the external magnetic field and concentrates it on the Hall elements.

The MLX91205 is ideally suited for current sensing in harsh automotive and industrial environments for both AC and DC currents. It produces an analog, linear, ratio-metric output voltage proportional to the applied magnetic field parallel with the chip surface.

The circuit is fabricated using a standard CMOS process and the ferromagnetic layer is added in a simple post-processing step. The monolithic device incorporates Hall elements, offset cancellation circuitry, current source, chopper stabilized amplification circuitry, parameter programming capability.
By dynamic offset cancellation any offset voltage caused by temperature variations, packaging stress or others is strongly reduced. As a result, the device has an extremely stable signal output, is immune to mechanical stress and is virtually immune to temperature cycling.

Therefore, the circuit features a wide application range and very high accuracy.

9 Unique Features

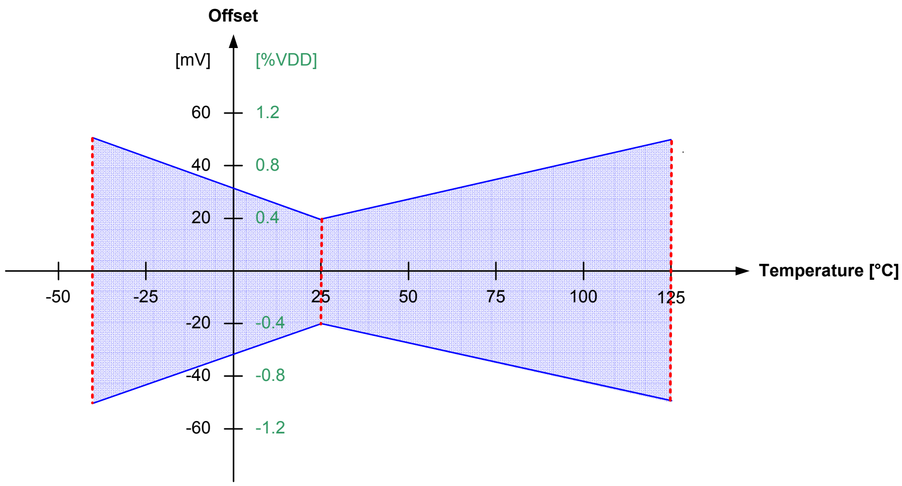
Different to other linear Hall sensors the MLX91205 measures the magnetic field parallel with the chip surface.
Therefore this sensor is ideally used as an open-loop current sensor for PCB mounting. It features small size application design and a simple construction for various current ranges.

Due to **short Response time** and **high Bandwidth** this sensor is suitable for high speed current measurement in a contactless, high current, high voltage setup.

10 Performance Graphs

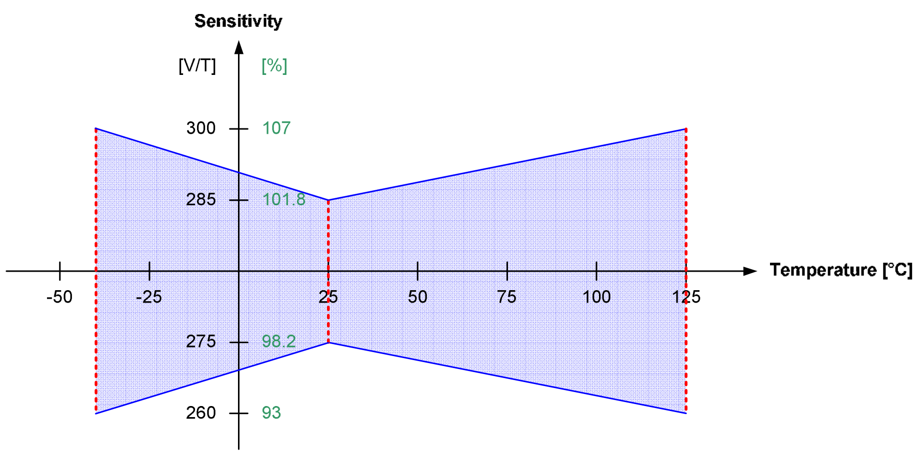
10.1 Offset over Temperature

The product is calibrated at room temperature and tested at -40°C, 25°C and +125°C. The Offset performance 0V ±20mV at room temperature and is 0V ±50mV over the temperature range from -40 to 125°C. The typical temperature drift is < 0mV/°C ± 0.3 mV/°C



10.2 Sensitivity over Temperature

The product is calibrated at room temperature and tested at -40°C, 25°C and +125°C. The Sensitivity performance for the low field version is 280V/T ±5 V/T at room temperature and 280V/T ±20 V/T over the temperature range from -40 to 125°C. Typical temperature drift is < 200 ppm/ °C.

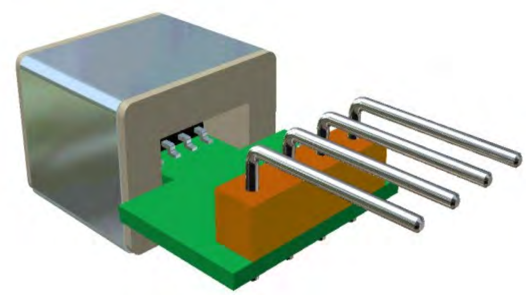


The corresponding sensitivity performance for the high field version is 100V/T ±1.5 V/T at room temperature and 100V/T ±7 V/T over the temperature range from -40 to 125°C.

11 Applications Information

11.1 Low current measurement up to ±2 A

Low currents can be measured with the MLX91205 by increasing the magnetic field via a coil around the sensor. The sensitivity (output voltage vs. current in coil) of the measurement will depend on the size of coil and number of turns. Additional sensitivity and increased immunity to external fields can be gained by adding a shield around the coil. The bobbin provides very high dielectric isolation making this a suitable solution for high voltage power supplies with relative low currents. The output should be scaled to obtain the maximum voltage for the highest current to be measured in order to obtain the best accuracy and resolution.



11.2 Medium current up to ±30 A

With a single conductor located on the PCB, currents in the range of up to 30 amps can be measured. The sizing of the PCB trace needs to take into account the current handling capability and the total power dissipation. The PCB trace needs to be thick enough and wide enough to handle the RMS current continuously.

The differential output voltage for this configuration can be approximated by the following equation:

Vout = typ. 35 - 40 mV/A * I

For a current level of 30 A, the output will be approximately 1050 mV.

11.3 High current measurement up to ±600 A

Another method of measuring high currents on PCB's is to use a large thick gauge copper trace capable of carrying the current on the opposite side of the PCB. The MLX91205 should be located near the centre of the trace, however because the trace is wide, the output is less sensitive to location on the PCB. This configuration also has less sensitivity due to the distance and width of the conductor.

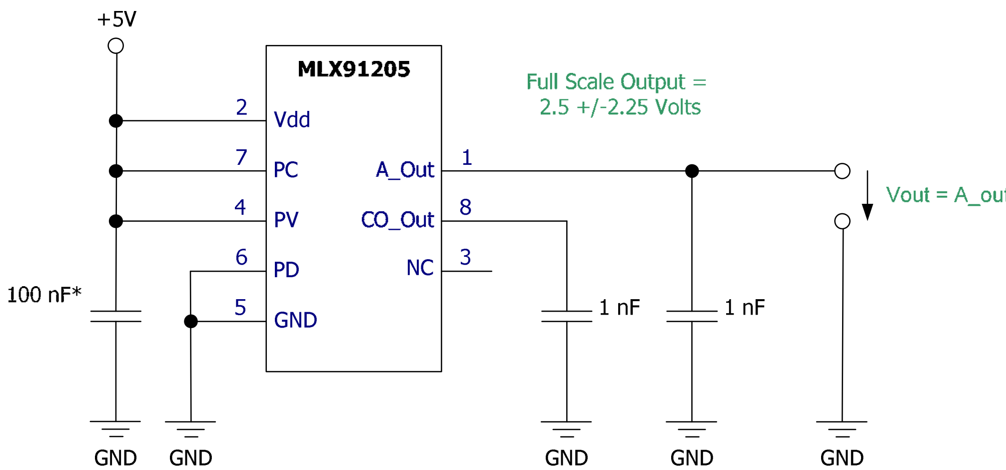
11.4 Customer Calibration with MCU

In many applications one measures the output voltage of the 91205 with a microcontroller. The current-sensor-system accuracy can be significantly increased by customer calibration of the system after assembling the 91205 in the application. By applying a known current i.e.100 Amperes, one can calibrate by means of the microcontroller the output voltage to the exact value i.e. 2.000V at 100 Amps. By doing so, the offset and sensitivity can be calibrated simply at a certain temperature.

12 Application Diagram

12.1 Direct Single Ended Output

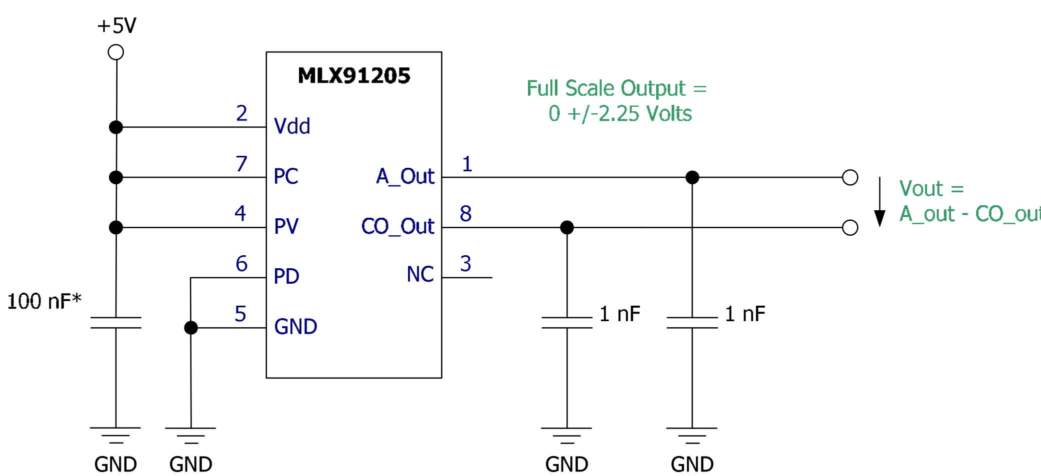
For reliable operation within the specifications the sensor must be connected as follows:



** if the supply voltage is disturbed by EMI it can be useful to place a second capacitor (100pF ceramic) parallel to the 100nF capacitor.*

12.2 Direct Differential Output

For reliable operation within the specifications the sensor must be connected as follows:



** if the supply voltage is disturbed by EMI it can be useful to place a second capacitor (100pF ceramic) parallel to the 100nF capacitor.*

13 Standard information regarding manufacturability of Melexis products with different soldering processes

Melexis devices are qualified using state-of-the-art practices in accordance with automotive and environmental requirements.

Through qualifications, various soldering techniques are considered; please refer to "Soldering recommendations for Melexis products" (http://www.melexis.com/Asset/Soldering_Application_Note_and_Recommendations_DownloadLink_5446.aspx) for more information.

For components normally soldered using Surface Mounted Device techniques (eg: Reflow process), Melexis has defined and qualified Moisture Sensitivity Level and Peak Temperature in accordance with the Jedec J-STD-020 standard. Delivered material is conditioned accordingly. Moisture Sensitivity Level and Peak Temperature information can be found on the label identifying the material.

In case you intend to use a reflow soldering process for through hole devices (Melexis' package codes: SA, UA, VA, VK, VM), please contact Melexis to verify your soldering process compatibility.

The application of Wave Soldering for SMD's is allowed only after consulting Melexis regarding assurance of adhesive strength between device and board.

Based on Melexis commitment to environmental responsibility, Europe legislations (Direction on the Restriction of the Use of Certain Hazardous substances, RoHS) and customer requests, Melexis has deployed Pb free leadfinish (typically Matte Tin) on all ASSP products.

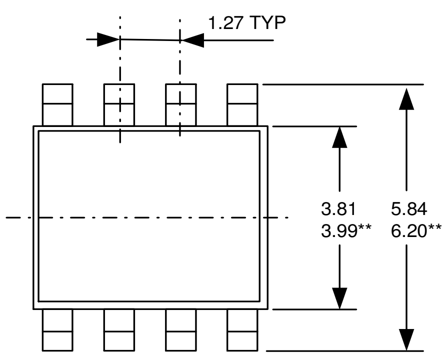
For through hole devices (Melexis' package codes: SA, UA, VA, VK, VM) Trim&Form, please refer to "Trim & Form recommendations for Melexis products" (http://www.melexis.com/Assets/Trim_and_form_recommendations_DownloadLink_5565.aspx) for more information.

14 ESD Precautions

Electronic semiconductor products are sensitive to Electro Static Discharge (ESD).
Always observe Electro Static Discharge control procedures whenever handling semiconductor products. A well designed (capacitors close to pins and low resistive ground layout) PCB layout will help to improve ESD robustness.

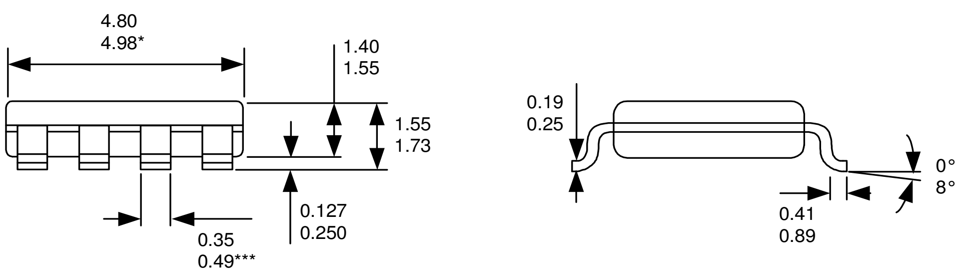
15 Package Information

15.1 Package Dimensions

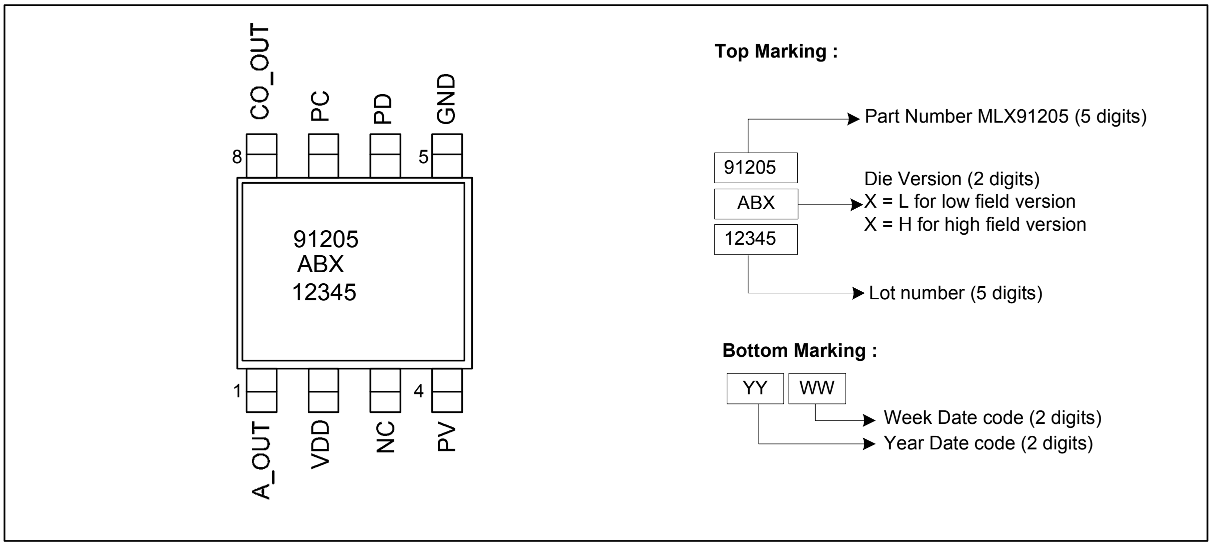


NOTES:

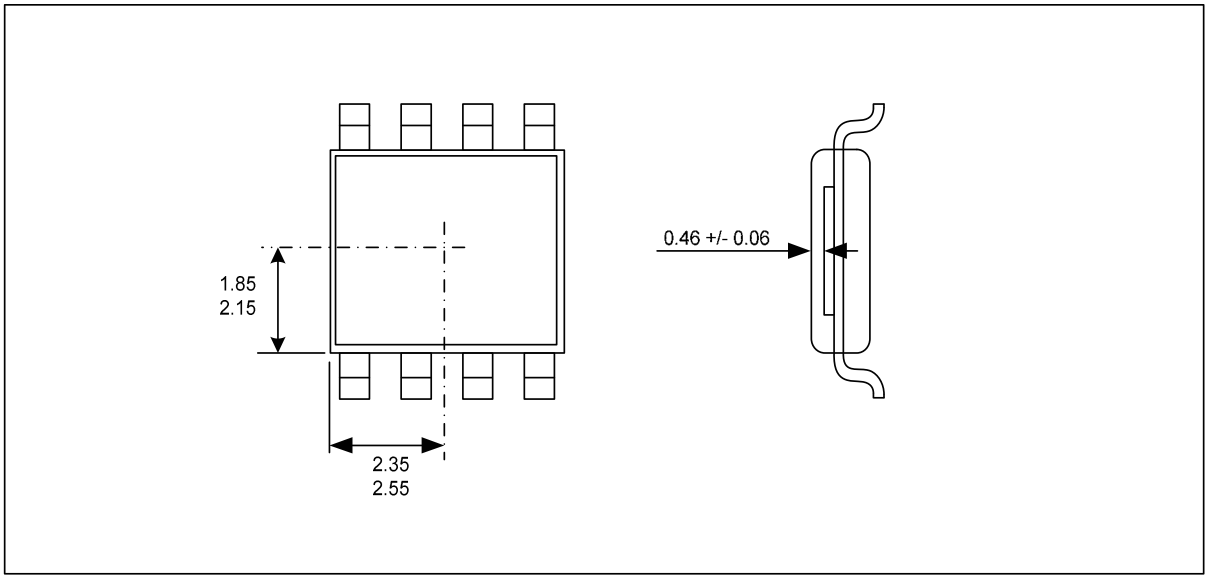
All dimensions are in millimeters (anlges in degrees).
* Dimension does not include mold flash, protrusions or gate burrs (shall not exceed 0.15 per side).
** Dimension does not include interleads flash or protrusion (shall not exceed 0.25 per side).
*** Dimension does not include dambar protrusion. Allowable dambar protrusion shall be 0.08 mm total in excess of the dimension at maximum material condition. Dambar cannot be located on the lower radius of the foot.



15.2 Pinout and marking



15.3 Hall plate positioning



16 Disclaimer

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Or for additional information contact Melexis Direct:

Europe, Africa, Asia:
Phone: +32 1367 0495
E-mail: sales_europe@melexis.com

America:
Phone: +1 603 223 2362
E-mail: sales_usa@melexis.com

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