MLX90247 family

Discrete Infrared Thermopile Detectors

Features and Benefits

- Solid state thermopile sensor
- On-chip thermistor for ambient temperature compensation
- High reliability and long-term stability
- Very high ESD protection – 7 kV on all pins (only for MLX90247BAA and MLX90247BAL)
- Low cost, small size

Ordering Information

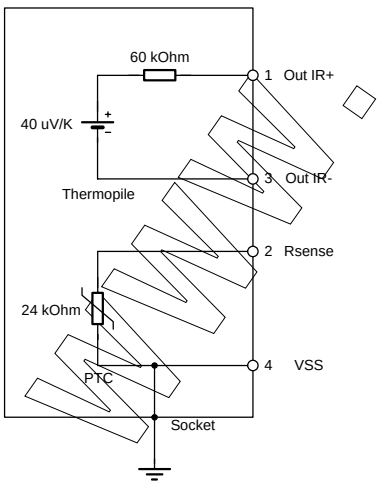
Part No	Suffix Ta	Package code	Type	Description
MLX90247	E (-40C to +85C)	SF(TO-39)	DSA	Large aperture (3.5mm) thermopile detector with on-chip PTC thermistor, floating thermopile outputs.
MLX90247	E (-40C to +85C)	SF(TO-39)	DSL	Small aperture (2.5mm) thermopile detector with on-chip PTC thermistor, floating thermopile outputs.
MLX90247	E (-40C to +85C)	SF(TO-39)	BAA	Large aperture (3.5mm) thermopile detector with on-chip PTC thermistor, floating thermopile outputs. Excellent ESD
MLX90247	E (-40C to +85C)	SF(TO-39)	BAL	Small aperture (2.5mm) thermopile detector with on-chip PTC thermistor, floating thermopile outputs. Excellent ESD

Notice: In case sensor is used in automotive applications, Melexis must be informed.

Applications

- Automotive contactless temperature sensing.
- IR thermometers
- Gas analysis equipment
- Occupancy detection

1. Functional Diagram



2. Description

At the heart of the MLX90247 thermopile sensors is a silicon die with a central micromachined membrane surrounded by a bulk silicon edge. The hot junctions of the thermopile are positioned near the center of the membrane and the cold junctions are located above the bulk silicon edge. Infrared irradiation of the low thermal conductivity membrane creates a temperature difference between the membrane and the surrounding bulk silicon. The resulting thermopile voltage is a function of the temperature difference between the object and the sensor. Measurement of the absolute temperature of the object is possible by relating the thermopile signal to the temperature of the sensor. The exact temperature of the sensor is measured by a PTC thermistor integrated in the bulk silicon edge. No supply voltage is needed for the thermopile.

The sensor and thermistor can be used independently of each other if desired, as the thermopile potential is floating.

The MLX90247DSL (BAL) sensor IC is similar to MLX90247DSA (BAA) but with smaller aperture, thus resulting in narrower field of view (FOV).

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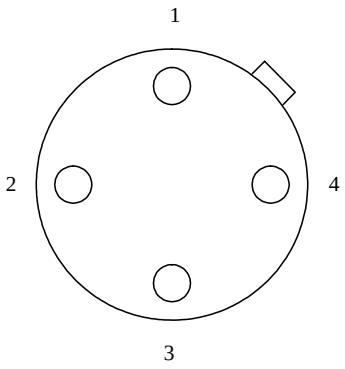
3. Glossary of Terms

IR: Infrared. Every object emits infrared radiation in relation to its temperature. This effect can be used to measure the temperature without the need for physical contact.

PTC: On-chip thermistor which resistance increases with rising temperature (Positive Thermal Coefficient)

4. Pin Definitions and Descriptions

TO-39 package - connections



Top view = pins down

Pin	Symbol	Description
1	OutIr+	Infrared Thermopile positive output
2	Rsens	Thermistor for sensor ambient temperature measurement
3	OutIr-	Infrared Thermopile negative output
4	Vss	Thermistor ground / case potential

5. MLX90247 Specifications

Operating temperature range: Ta = -40 to 125 °C unless otherwise noted

Parameter	Type	Typical	Units	Condition
Sensitive Area	All	1.2 x 1.2	mm^2	
DC membrane responsitivity	All	12	V / W	Tbb = 25°C
Sensitivity	DSA and BAA	46 ±25%	µV/°C	Full FOV
	DSL and BAL	34 ±25%	µV/°C	Full FOV
Window aperture size	DSA and BAA	3.5	mm	
	DSL and BAL	2.5	mm	
Field of view	DSA and BAA	100	deg	90% of energy
	DSL and BAL	85	deg	
Spectral sensitivity	All	> 70	%	7.5µm < λ < 13.5µm
		< 1	%	0 < λ < 5µm
Thermopile Resistance	All	60	kΩ	Ta = 25°C
Noise	All	32	nV / √Hz	RMS, Ta = 25°C

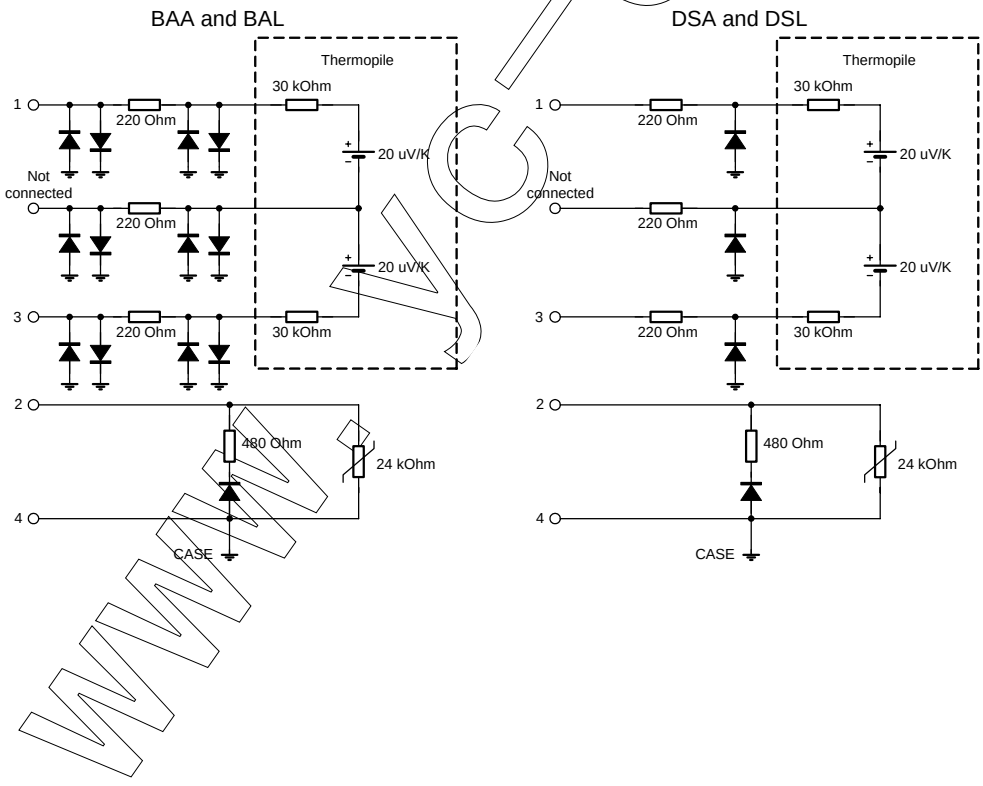
NEP	All	2.6	nW / √Hz	RMS, Ta = 25˚C
Time constant	All	30	ms	
Sensitivity TC	All	0.1	% / ˚C	
Thermistor value	All	24 ±30%	kΩ	Ta = 25˚C
Thermistor TC 1	All	6500 ±20%	ppm/˚C	
Thermistor TC 2	All	16	ppm/˚C²	typical
Withstand ESD voltage	DSA and DSL	700	V	
	BAA and BAL	7000	V	

NOTE: The thermistor resistance can be calculated using following expresion:

$$R(T) = R(25^oC)\left[1 + TC_1(T - 25^oC) + TC_2(T - 25^oC)^2\right]$$

Note:
Due to the strong ESD protection BAA and BAL versions can only be used with CM (Common Mode) = 0V for IR outputs. When measuring resistances with an ohm meter, please take care that the internal protection diodes, as indicated in the functional diagram below, are always reverse biased (DSA and DSL versions).

Internal schematics



Absolute Maximum Ratings

Parameter	Version		Units	Remark
Storage Temperature Range	All	-55 ÷150	°C	
Applied DC voltage	BAA and BAL DSA and DSL	-0.5 ÷ 0.5 -0.5 ÷ 12	V	Pins 1 and 3 to ground (pin4)
Applied DC voltage	BAA and BAL DSA and DSL	-0.5 ÷ 12 -0.5 ÷ 12	V	Pin 2 to ground (pin4)

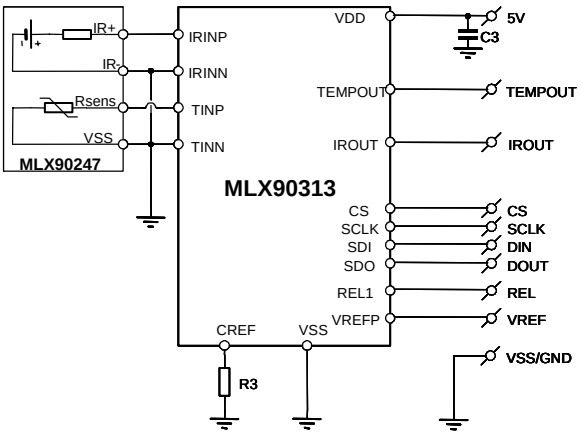
Exceeding the absolute maximum ratings may cause permanent damage. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

6. Unique features

- Fully CMOS compatible process
- High reliability
- Suitable for automotive applications
- Extremely high ESD resistance: 7 kV
- Thermistor integrated in silicon edge of the sensor: closest possible following of sensor temperature

7. Applications information

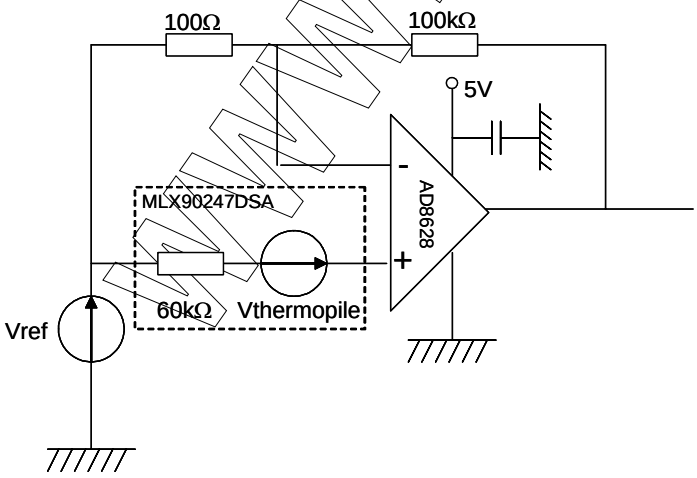
As shown in the internal schematics drawings in paragraph 5, the MLX90247BAA and BAL use a die with additional protection diodes for very high ESD performance. The configuration of the protection diodes is such that the MLX90247BAA and BAL can only be biased around ground potential.
The output voltage of the thermopile is positive when the object is at higher temperature than the sensor; it is negative when the object is at lower temperature than the sensor. As the output voltage can become positive as well as negative, the sensor has to be connected to a differential amplifier that can accept both positive and negative common mode input signals. The figure below shows a solution using the MLX90313 infrared sensor interface chip, which accepts common mode input voltages in the range [-0.1V;Vdd-3V]



MLX90601KZA-CKA
MLX90601KZA-CKD
MLX90601KZA-CLA

R3 = 100kΩ
C3 = 10µF

Using the MLX90247DSA or DSL, the ESD performance is lower, but there is the possibility to apply a non-zero bias voltage Vref to the thermopile. The figure below shows a typical application with the AD8628 low-offset low-drift differential opamp of Analog Devices. The AD8628 has single voltage supply, and can only accept positive common mode input signals. This application is not possible with the M:X90247BAA or BAL, as the BAA and BAL cannot be biased with Vref.



8. Reliability Information

Melexis Infrared sensors are sealed to withstand a fine and gross leak test according MIL883 Method 1014 (Seal) / JESD22-A109 (Hermeticity).

Please contact Melexis for specific information using MLX90247 sensors in automotive applications.

9. ESD Precautions

Electronic semiconductor products are sensitive to Electro Static Discharge (ESD).
Always observe Electro Static Discharge control procedures whenever handling semiconductor products.

10. Package information

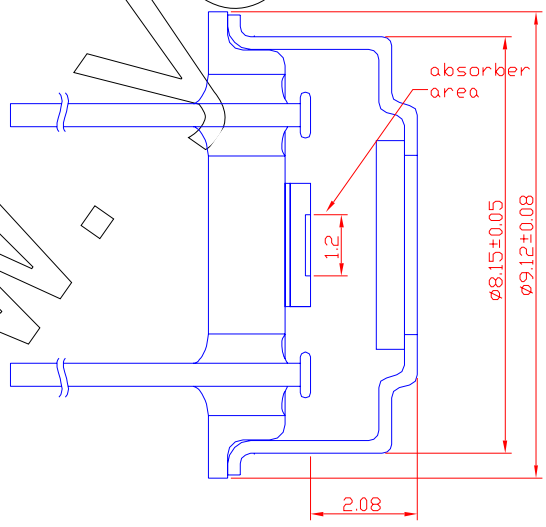
Housing specifications (TO39)	
Metal cap	Welded
TO39 header	Au plating
Filling gas	Nitrogen

Marking

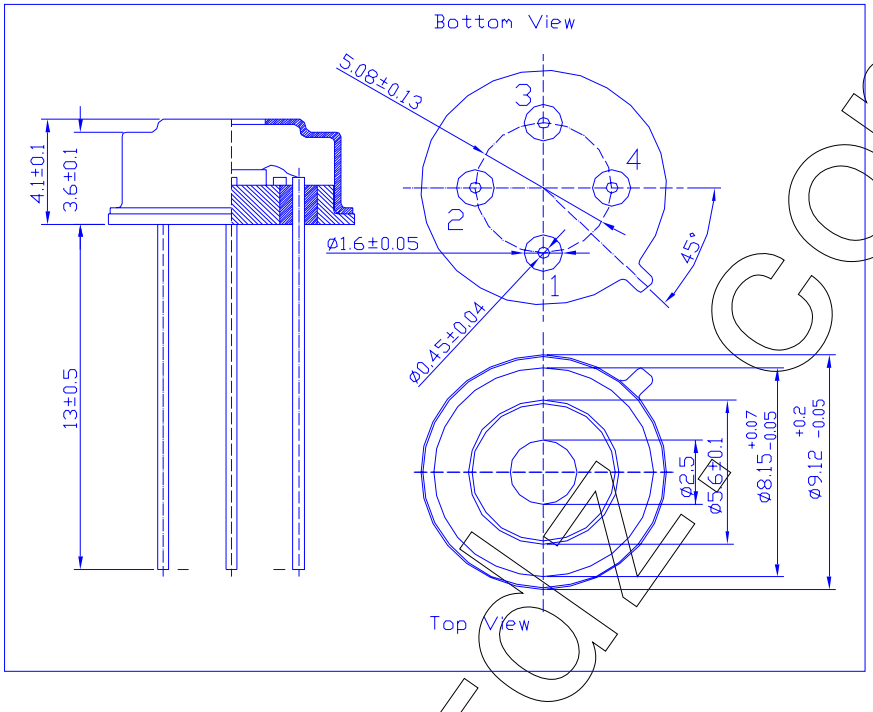
Part No	Type	Package Code	Marking
MLX90247	DSA	SF(TO-39), 3,5mm	MLX90247B PTC FO XXXZZ
MLX90247	DSL	SF(TO-39), 2,5mm	MLX90247H PTC FO XXXZZ
MLX90247	BAA	SF(TO-39), 3,5mm	MLX90247BAA YYWW
MLX90247	BAL	SF(TO-39), 2,5mm	MLX90247BAL YYWW

XXX- last digits of lot number
ZZ – wafer number
YYWW – date code with YY- year, WW- week of assembly

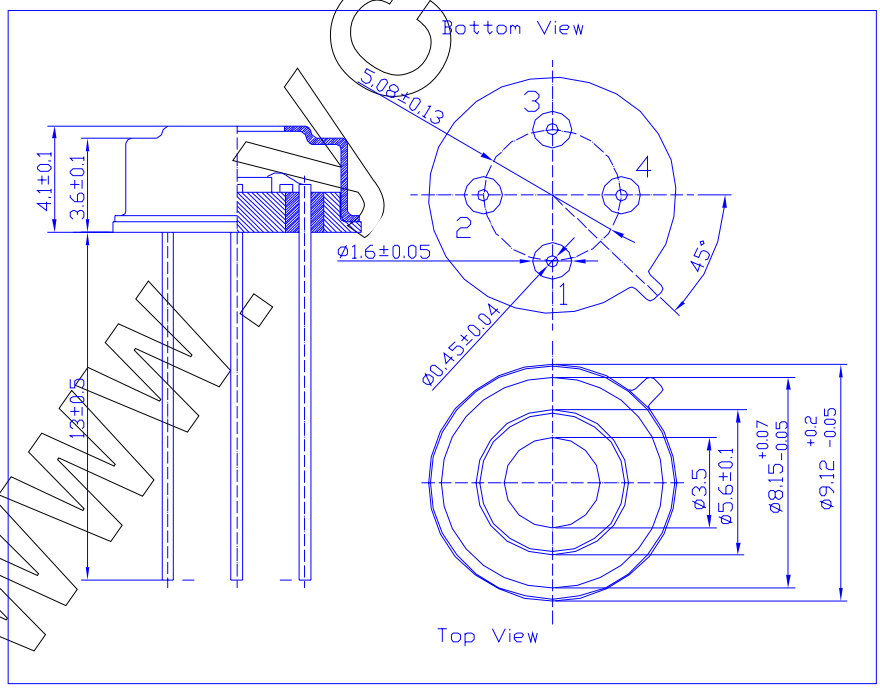
Position of membrane in housing



Package Outline



DSL and BAL



DSA and BAA

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