

### Features and Benefits

- Solid state thermopile sensor
- On-chip thermistor for ambient temperature compensation
- High reliability and long-term stability
- Low cost, small size



### Ordering Information

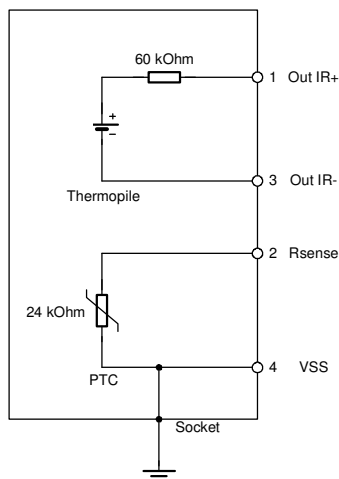
Part No	Ta	Suffix	Package code	Type	Description
MLX90247	E (-40C to +85C)		SF(TO-39)	DSA	Large aperture thermopile detector with on-chip PTC thermistor, floating thermopile outputs. 3.5mm aperture

**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.

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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.

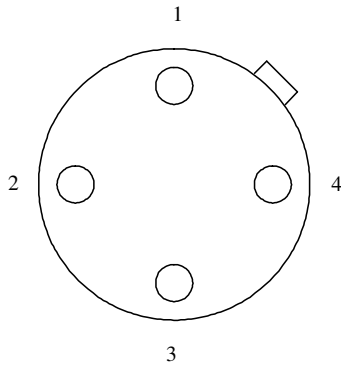
**PTC:** On-chip thermistor which resistance increases with rising temperature (Positive Thermal Coefficient)

**t<sub>bb</sub>:** Black body (object temperature)

**t<sub>a</sub>:** Ambient (die) temperature

### 4. Pin Definitions and Descriptions

TO-39 package - connections



Top view = pins down

Pin	Symbol	Description
1	Outlr+	Infrared Thermopile positive output
2	Rsens	Thermistor - ambient (die) temperature sensor
3	Outlr-	Infrared Thermopile negative output
4	Vss	Thermistor ground / case potential

### 5. MLX90247 Specifications

Operating temperature range: Ta = -40 to 85 °C unless otherwise noted

Parameter	Typical	Units	Condition
Sensitive Area	1.2 x 1.2	mm <sup>2</sup>	
Wavelength range	5.5 ... 15	µm	
DC membrane responsivity	12	V / W	Ta = 25°C Tbb = 60°C
Sensitivity (Alpha)	4.28 ±25% x10 <sup>-13</sup>	V/K <sup>4</sup>	Full FOV
Thermopile output voltage	46 ±25%	µV	Ta = 26°C Tbb = 27°C, Full FOV
Window aperture size	3.5	mm	
Field of view	88	Deg	50% thermopile signal
Spectral sensitivity	> 70	%	7.5µm < λ < 13.5µm
	< 1	%	0 < λ < 5µm
Thermopile Resistance	60	kΩ	Ta = 25°C
Noise	32	nV / √Hz	RMS, Ta = 25°C
NEP	2.6	nW / √Hz	RMS, Ta = 25°C
Time constant	30	ms	
Thermopile resistance tempco	0.1	% / °C	
PTC value R(25°C)	24 ±30%	kΩ	Ta = 25°C
PTC TC <sub>1</sub>	6500 ±20%	ppm/°C	
PTC TC <sub>2</sub>	16	ppm/°C <sup>2</sup>	
Withstand ESD voltage	+ 800	V	
	- 7000	V	

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

$$R(T) = R(25^{\circ}C) \left[ 1 + TC_1(T - 25^{\circ}C) + TC_2(T - 25^{\circ}C)^2 \right]$$

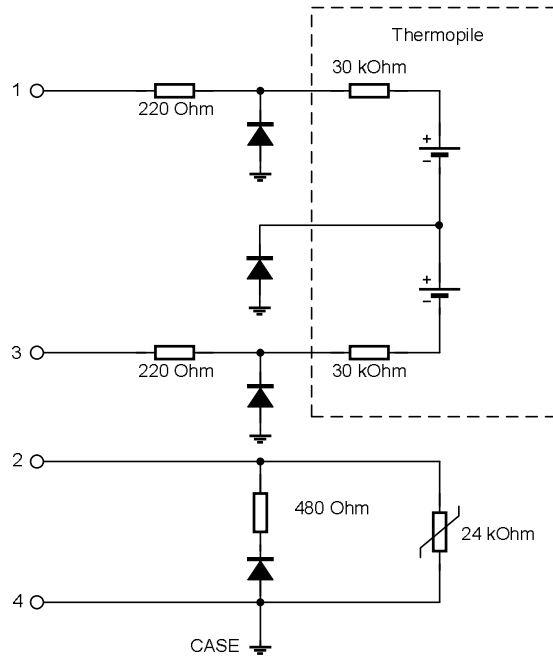
Thermopile output voltage is:

$$V_{ir} = \text{Alpha} \cdot [(T_o^4) - (T_a^4)]$$

where To is the measured object temperature, both To and Ta are in Kelvins

Note: 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.

### Internal schematics



### 6. Absolute Maximum Ratings

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

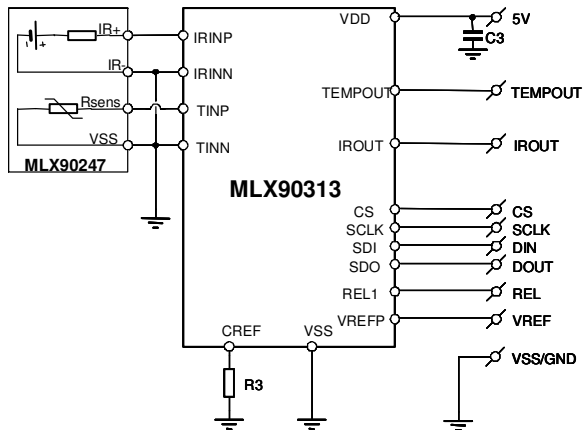
Exceeding the absolute maximum ratings may cause permanent damage. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

### 7. Unique features

- Fully CMOS compatible process
- High reliability
- Suitable for automotive applications
- Thermistor integrated in silicon edge of the sensor: closest possible sensing of sensor temperature

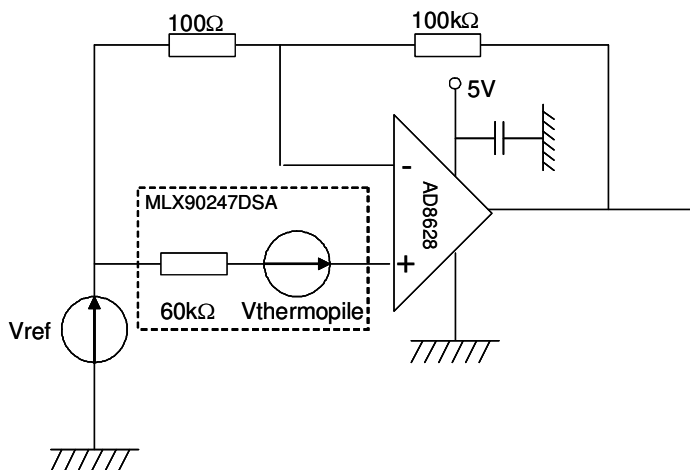
### 8. Applications information

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 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     R3 = 100kΩ  
 MLX90601KZA-CKD     C3 = 10μF  
 MLX90601KZA-CLA

The figure below shows a typical application with the AD8628 low-offset low-drift differential opamp from Analog Devices. The AD8628 has single voltage supply, and can only accept positive common mode input signals. Vref sets the output offset (output voltage when  $T_o = T_a$ ).



### 9. Reliability Information

Melexis Infrared sensors are sealed to withstand a fine and gross leak test according MIL 883 Method 1014 (Seal)/ JEDEC-STD-22 Test Method A 109 (Hermeticity).

For more information on manufacturability / solderability see quality page at our website:  
<http://www.melexis.com/>

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

### 10. ESD Precautions

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

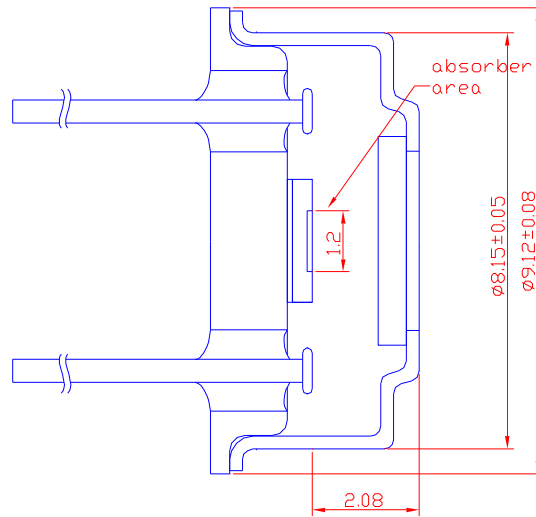
### 11. Package information

Housing specifications	
TO-39 specifications	
Metal cap	Welded
TO39 header	Au Plated
Filling gas	Nitrogen

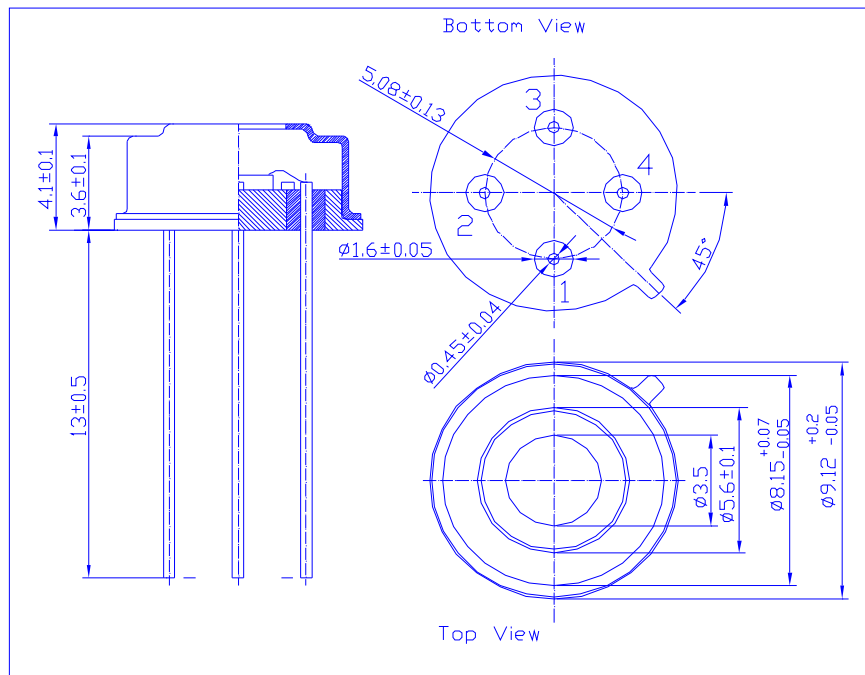
Marking			
Part No	Type	Package Code	Marking
MLX90247	DSA	SF(TO-39), 3,5mm	MLX90247B PTC FO XXXZZ

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**





### 12. Disclaimer

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