# MLX90819

**Relative Integrated Pressure Sensor Datasheet** 



### **1. Features and Benefits**

- Fully integrated IC: MEMS, analog front end, 16 bit microcontroller, analog back end, voltage regulators, SENT driver
- Ratiometric Analog and SENT outputs
- Automotive temperature (-40°C to 150°C)
- Automotive qualified beyond AECQ100
- Automotive diagnostic features (clamping levels, broken track diagnostics, multiple internal fault diagnostics)
- Glass pedestal for easy assembly and for back side exposed configuration for higher resistance to common automotive media
- High accuracy and robust EMC performance





### 2. Application Examples

- Mid pressure ranges (10..50bar)
- Automotive oil (engine, transmissions)
- Automotive HVAC
- Automotive fuel line
- Industrial applications

### **3. Description**

The MLX90819 is an integrated relative pressure sensor delivering a ratiometric analog or digital (using the SENT protocol) signal.

Use of an optimized architecture and a high density CMOS technology imparts the MLX90819 with best in class automotive EMC performance. A DSP based architecture using a 16bit microcontroller provides outstanding performance in terms of initial accuracy.

The MLX90819 is mounted on a glass pedestal to ease the assembly of the die at the customers being the ideal solution for back side exposed pressure sensor applications requiring high accuracy, high EMC robustness, miniaturization and compliance to harsh automotive environments (See application note 90819 Pressure Sensor Assembly Guidelines).



Figure 1: Block diagram



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# 4. Ordering Information

Product	Temperature	Package	Option Code	Packing Form	Definition
MLX90819	L (-40°C to 150°C)	UF	EBA-000	WB	10 to 35 bar range with electronic wafer map
MLX90819	L (-40°C to 150°C)	UF	EBB-000	WB	30 to 50 bar range with electronic wafer map

Table 1: Ordering information

# Legend:

Temperature Code:	L: from -40°C to 150°C
Package Code:	"UF" for saw wafer on foil
Option Code:	EBA-000: 10 to 35 bar application range with electronic wafer map EBB-000: 30 to 50 bar application range with electronic wafer map
Packing Form:	"WB" for wafer box
Ordering Example:	"MLX90819LUF-EBA-000-WB" For a sensor covering 10 to 35 bar pressure span in the application delivered as a saw wafer on foil with an electronic wafer map.



### 5. Functional Diagram

The pressure sensing element consists of a square diaphragm realized in the silicon chip by backside etching. The diaphragm reacts to a pressure difference between the top and bottom side of the diaphragm. The internal strain increases, in particular at the border of the diaphragm. Here, the piezo-resistive elements have been implanted into the silicon diaphragm, which act as a transducer.

The electronics front end amplifies the signal from the bridge, performs a coarse offset compensation and an ADC conversion. The DSP performs the compensations over temperature. Furthermore, the digital circuit provides some filtering, the possibility to linearize the pressure signal and also implements the clamping function. The analog back end consists of a 12 bit DAC and an output driver. This chip delivers an analog output proportional to the pressure or a SENT output compliant with SAE J2716 spec dated January 2010.

A broken wire detection block allows actively driving the output to one of the rails in case of a broken supply or ground connection. Extensive protection of the supply lines allows the MLX90819 to handle extreme overvoltage conditions and is immune to severe external disturbances. Several diagnostic functions (over-voltage, under-voltage, overpressure, under pressure detections) have been implemented on the 90819 and can be enabled by programming EEPROM settings. Figure 2 describes MLX90819 block diagram.



Figure 2: MLX90819 block diagram



### 6. Glossary of Terms

Bar	Pressure unit (1bar = 100kPa)
ADC	Analog to Digital Converter
DAC	Digital to Analog Converter
DSP	Digital Signal Processor
EMC	Electro Magnetic Compatibility
FSO	Full Span Output
SENT	Single Edge Nibble Transmission

Table 2: Glossary of terms

### 7. Bond Pads Location and Description

The positions of the bond pads are shown in Figure 3. The (X, Y) axes are depicted in blue; they represent the basis of the Cartesian coordinates of the bond pads center points.



The bond pad coordinates and their names and functional type are given in table 3.



Pin	Туре	Coordinates <sup>(1)</sup> X Y		Pad Opening X, Y		Pad Opening X, Y		Comment
VDD	Supply	470	2345	100	150			
ТХ	Output	612	2370	100	100	To be connected in SENT mode		
TEST	Input	86	1914	95	95	Do Not Connect		
SN	Output	80	325	80	120	Do Not Connect		
SP	Output	80	163	80	120	Do Not Connect		
GND	Ground	1070	91	150	100			
OUT	Output	1397	91	100	100	To be connected in Analog Mode		

#### Table 3: Bond pad coordinates

### 8. Absolute Maximum Ratings

Parameter	Symbol	Max.	Unit
Supply Voltage <sup>(2)</sup>	Vdd	+18	V
Reverse Supply Voltage <sup>(3)</sup>	Vddrev	-14	V
Positive Output Voltage <sup>(2)</sup>		+18	V
Reverse Output Voltage <sup>(2)</sup>		-0.5	V
Operating Temperature Range		-40 to 150	°C
Storage Temperature Range		-40 to 150	°C
Burst Pressure @ Room Temperature For EBA For EBB	P <sub>BURST</sub>	105 140	Bar
Proof Pressure @ Room Temperature For EBA For EBB	Pproof	70 105	Bar

#### Table 4: 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.

<sup>&</sup>lt;sup>1</sup> Coordinate of the center of the pad.

<sup>&</sup>lt;sup>2</sup> No time limit or temperature limit for these over voltage conditions

<sup>&</sup>lt;sup>3</sup> Reverse Voltage Protection at -14V at 150 °C for maximum 1 hour. At Room Temperature that condition can apply for maximum 24 hours



### 9. General Electrical Specifications

DC operating parameters T = -40°C to 150°C,  $V_{DD}$  = 5V (unless otherwise specified)

Parameter	Symbol	Test Conditions	Min	Typ <sup>(4)</sup>	Max	Units
Nominal Supply Voltage	Vdd		4.5	5	5.5	V
Nominal Supply Current	I <sub>DD</sub>	No output load connected		7	8	mA
Analog Output Load (Resistive)	RLOAD	Pull-up or Pull-down	4.7			kΩ
Analog Output Load (Capacitive)	CLOAD		2.2		470	nF
SENT Output Load (Capacitive)	CLOAD				2.2	nF
SENT Output Load (C-R-C)					1.1nF + 220Ohm + 1.1nF	
	diag_lo	Pull-up ≥ 4.7kΩ Pull-down ≥ 4.7kΩ			3 3	%Vdd
Diagnostic Limits	diag_hi	Pull-up ≥ 4.7kΩ Pull-down ≥ 8kΩ	96 96			%Vdd
Clomping Lougle <sup>(5)</sup>	clamp_lo		0		25	%V <sub>DD</sub>
	clamp_hi		50		100	%V <sub>DD</sub>
Apples Seturation Output	vsat_lo	Pull-up ≥ 4.7kΩ Pull-down ≥ 4.7kΩ	0 0		3 3	%Vdd
Level	vsat_hi	Pull-up ≥ 4.7kΩ Pull-down ≥ 4.7kΩ Pull-down ≥ 10kΩ	97 96 97		100 100 100	%V <sub>DD</sub>
Power Up Time <sup>(6)</sup>					5.5	ms
Response Time(7) Analog Output					1	ms
Response Time SENT Output		3us tick time, pause pulse enabled		3	4	frames
Ratiometricity Error					0.2	$%V_{DD}$
Analog Output Noise(8)					2	mVrms
SENT Output Noise(8)					1.8	LSBrms
Internal Temperature	Тртат	0 hours	-5		5	ംറ
Error on SENT Output	I FIAI	Over life	-10		10	0

Table 5: General electrical specification

 $_{4}$ Typical values are defined at  $T_{A} = +25^{\circ}C$  and  $V_{DD} = 5V$ 

<sup>&</sup>lt;sup>5</sup> Programmable range with 8 bits resolution for the low clamping level and 9 bits resolution for the high clamping level (See application note 90819 Advanced Configuration Settings for detailed information)

<sup>&</sup>lt;sup>6</sup> Time from reaching the minimum allowed supply voltage of 4.5V till having the output within specification

<sup>&</sup>lt;sup>7</sup> Time needed for the output to react to a pressure change from 10% to 90% of its final value (pressure change corresponding to maximum a 4V output change) using default filter settings SSF=1, PFLT = 0 (See application note 90819 Advanced Configuration Settings for detailed information) <sup>8</sup> Bandwidth limited to 50kHz. Using default filter settings SSF = 1, PFLT = 0.



### **10. Pressure Accuracy Specifications**

DC operating parameters T = -40°C to 150°C, V<sub>DD</sub> = 5V (unless otherwise specified)

Parameter	Symbol	Test Conditions	Min	Max	Units
Non Linearity Error <sup>(9)</sup>		EBA Room Temperature 10 bar (2 point calibration) 35 bar (2 point calibration) EBB Room Temperature		0.1 0.2	%FSO
		30 bar (2 point calibration) 50 bar (2 point calibration)		0.1 0.2	%FSO
Hysteresis			-0.25	0.25	%FSO
Programmable Pressure Spans		EBA EBB	10 30	35 50	Bar
Overall Accuracy <sup>(10)</sup>			-2.5	2.5	%FSO

Table 6: Pressure accuracy specification

## **11. Application Information**

The MLX90819 only needs 2 capacitors in the application, a 47nF decoupling capacitor on the supply line and a 47nF load on the analog output pin. When the SENT output is used a 2.2nF capacitor is recommended. Consult Melexis to discuss the ideal application schematics depending on the EMC specs to be fulfilled.



Figure 4: MLX90819 application schematic - analog

<sup>10</sup> Indicative overall accuracy using ceramics prototype package and calibration in engineering setup of EBA at 20bar and EBB at 50bar.

<sup>&</sup>lt;sup>9</sup> Best Fit Non Linearity using ceramics prototype package.





Figure 5: MLX90819 application schematic - SENT

### **12.** Die Dimensions

The MLX90819 shall be delivered as bare die, on fully tested wafers. Each wafer is accompanied by a wafer map in order to discriminate between good and bad dies during customer assembly. The die dimensions (including scribe lane), membrane size are depicted in Figure 6. All dimensions are in mm.



Figure 6: Floorplan of a single die, including central position of membrane



### **13. Standard Information**

Our products are classified and qualified regarding soldering technology, solderability and moisture sensitivity level according to standards in place in Semiconductor industry.

For further details about test method references and for compliance verification of selected soldering method for product integration, Melexis recommends reviewing on our web site the General Guidelines <u>soldering</u> recommendation. For all soldering technologies deviating from the one mentioned in above document (regarding peak temperature, temperature gradient, temperature profile etc), additional classification and qualification tests have to be agreed upon with Melexis.

For package technology embedding trim and form post-delivery capability, Melexis recommends to consult the dedicated trim&form recommendation application note: <u>lead trimming and forming recommendations</u>

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### **14. ESD Precautions**

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



### **15. Contact**

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