MAXL-OL-2015 Datasheet

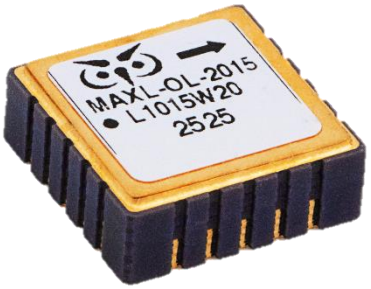
Part Number: 210114A15

The MAXL-OL-2015 is a state-of-the-art inertial sensor based on a unique MEMS device, providing high stability and low noise measurements. Offering a straightforward interface, the outputs are a differential analog voltage output proportional to acceleration and an analog temperature sensor output that can be used for thermal compensation. The output voltage range is ± 1.2 V.

A highly advanced device, the MAXL-OL-2015 provides a linear measurement up to a sensing range of ± 15 g, it operates from a single power supply voltage of 3.3 V with <13 mA current consumption.

Features

- **Sensing range ±15 g**
- **Single-axis sensing**
- **High resolution**
- **High bias and scale factor stability**
- **Low power consumption**
- **Hermetic packaging**
- **Low profile, Small Form Factor, LCC20 package**
- **Low weight**
- **RoHS compliant**



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1 Accelerometer Performance Specifications

Parameter	Units	Value
Input Range	g	±15
Bias		
Null Bias @ Room Temp.	mg (max)	50
Short Term Stability STD	µg (max)	250
Long Term Repeatability	mg (1σ)	2
Temperature Sensitivity	µg/^{o}C (1σ)	150
Temperature Residual Error	µg (1σ)	500
Scale Factor		
Scale Factor @ Room Temp.	mV/g	80±1
Short Term Stability STD	ppm (max)	200
Long Term Repeatability	ppm (1σ)	600
Temperature Sensitivity	ppm/^{o}C (1σ)	55
Temperature Residual Error	ppm(1σ)	200

Other		
Turn On to Turn On repeatability @ Room Temp.	mg (max)	0.5
SF Linearity Error	% of Input Acceleration (1σ) (2 point fit)	0.7
	% of Input Acceleration (IEEE method) (1σ)	0.2
Threshold	µg	50
Bandwidth (-3dB)	Hz	250 (1200) [t]
Equivalent Noise Density in Bandwidth*	µg/√Hz (max)	4

Table 1 Accelerometer Performance Specifications

* Evaluated in zero g position

[t] Special order required for adjusted Bandwidth. No degradation in other parameters.

2 Accelerometer Environmental Characteristics

The accelerometer was qualified according to the Table 2

Operating temperature range	-40°C to +85°C
Storage temperature range	-54°C to +90°C
Operational vibration	2.5g RMS, 20-2000Hz, each axis
Endurance vibration	7.7g RMS, 20-2000Hz, each axis
Operational shock	40g 11msec., saw tooth, 2 shocks each axis
Non-operational shock	75g 6msec., saw tooth, 2 shocks each axis
Multiple high shock	1500g 0.175msec., half sine
EDS sensitivity	Class 2 (MIL-STD-883-G), HBM 2kV

Table 2 Accelerometer Environmental Characteristics

3 Absolute Maximum Ratings

Stresses above those listed as “absolute maximum ratings” may cause permanent damage to the device. This is a stress rating only and functional operation of the device under these conditions is not implied. Exposure to maximum rating conditions for extended periods may affect device reliability.

Ratings	Unit	Maximum value
Supply voltage (VIN)	V	3.6
Electrostatic discharge protection	kV (HBM)	2
Soldering temperature (reflow)	°C	260

Table 3 Absolute Maximum Ratings

4 Packaging Information

The packaging is a standard LCC housing with a total of 20 pins. Sealing process is qualified at $5 \cdot 10^{-8}$ atm·cm^3/s (requirements MIL-STD-883-E). The precise dimensions are given in the Figure 1.The weight of the product is typically smaller than 0.7 grams.

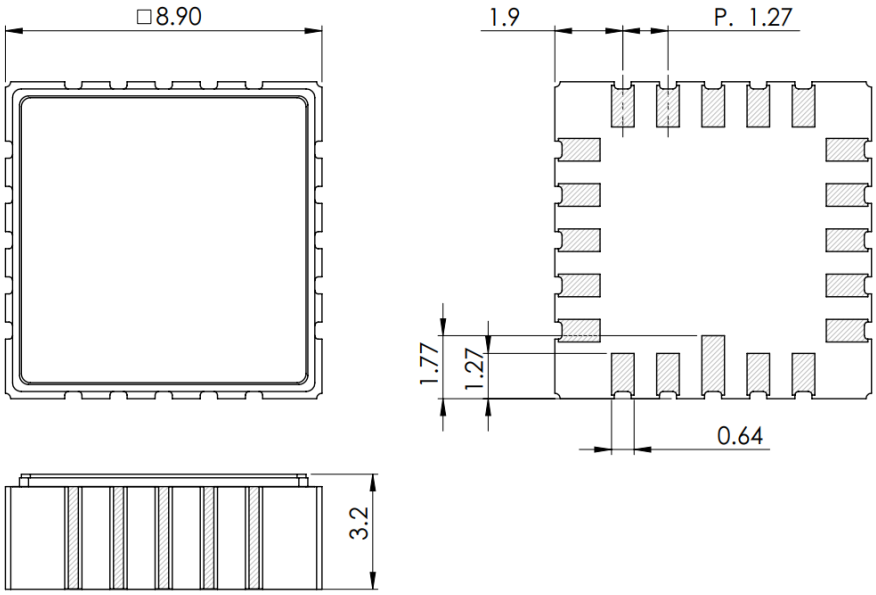

Figure 1 Package general dimensions bottom and side view

5 Physical Specifications

Packaging	LCC, 20 pin
Sealing	Hermetically sealed. Sealing process is qualified at $5 \cdot 10^{-8}$ atm·cm^3/s (requirements MIL-STD-883-E)
Weight	< 0.7 gram
Size	8.9 X 8.9 X 3.2 mm^3
Mounting	The bottom plane of the LCC is to be used as a reference plane for axis alignment. Any other way of fixing the sensor on the PCB may degrade the sensor's performance.

Table 4 Physical Specifications

6 Operational Principles

The MAXL-OL-2015 is a complete one axis acceleration measurement system with a measurement range of ± 15 g.

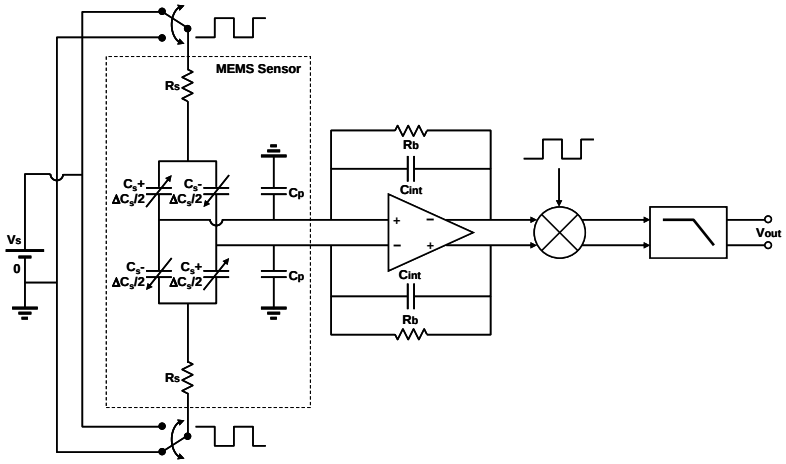

Figure 2 Simplified View of Sensor Operation

The main operation of the MAXL-OL-2015 accelerometer is measuring acceleration via capacitive sensing. There is a small proof mass suspended between the beams. When acceleration is applied to the sensor the proof mass deflects its position and the capacitance between the electrodes changes, resulting in a change of the output signal from the readout circuit.

The complete measurement chain of the MAXL-OL-2015 sensor is composed of a low-noise amplifier which converts the capacitive unbalancing of the MEMS sensor into an analog voltage and an independent analog 1st order low pass filter, which is responsible for reducing high level frequency noise. A simplified view of the sensor operation is shown in Figure 2.

7 MAXL-OL-2015 Pin-Out

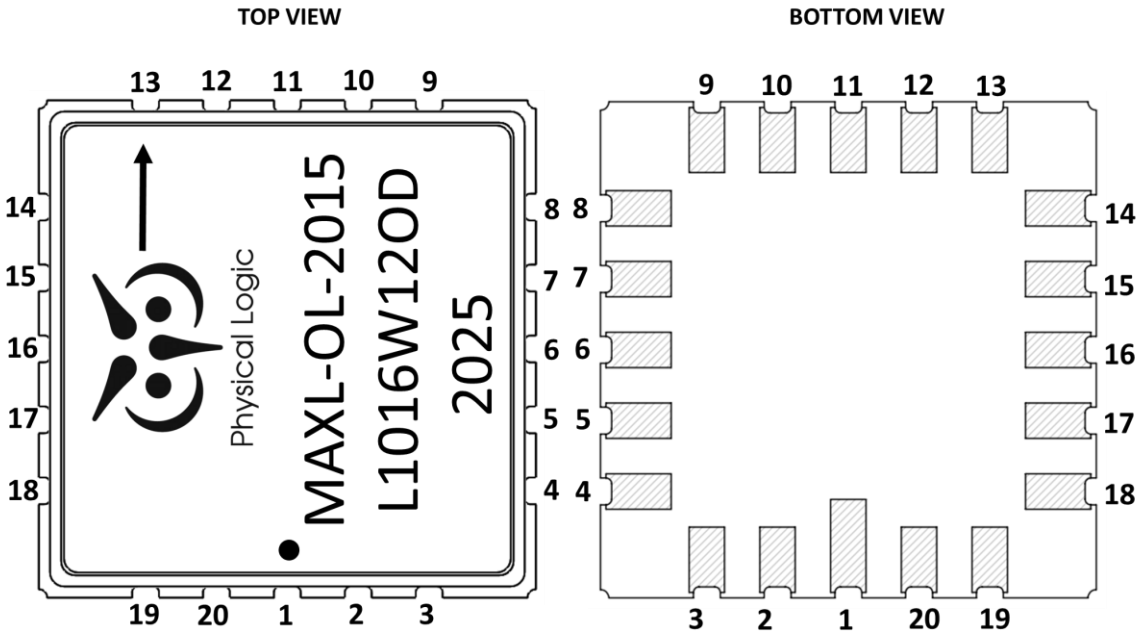

Figure 3 Pinout Description

8 Pin Configuration and Function Description

Pin#	Name	Type/direction	Function
1	NC	NC	
2	NC	NC	
3	NC	NC	
4	VIN	Power	Supply voltage 3.3V.
5	OUTN	Analog output	Negative analog output voltage of the accelerometer.
6	GND	-	GND for IO pads.
7	TEMP	Analog output	Analog output of the temperature sensor

Pin#	Name	Type/direction	Function
8	OUTP	Analog output	Positive analog output voltage of the accelerometer.
9	NC	NC	
10	NC	NC	
11	NC	NC	
12	NC	NC	
13	NC	NC	
14	NC	NC	
15	NC	NC	For internal use. Leave unconnected.
16	GND	-	For internal use. Connect to GND.
17	NC	NC	For internal use. Leave unconnected.
18	NC	NC	For internal use. Leave unconnected.
19	NC	NC	
20	NC	NC	

Table 5 Pin Description

9 MAXL-OL-2015 Typical Application

For the proper and stable MAXL-OL-2015 operation, we recommend connecting the accelerometer with the periphery shown in Figure 4.

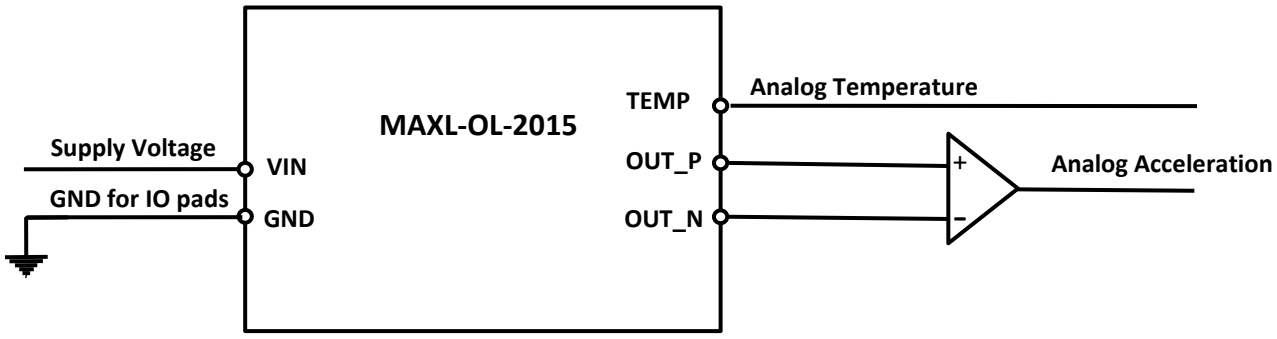

Figure 4 Typical Accelerometer Application

At power-up, there is an initialization time (about 50 msec) where spikes in the current and in the output voltage may appear. Then normal operation current stabilizes at about 13mA.

10 Electrical Specifications

Supply voltage	3.3 ± 0.1 VDC
Output voltage range (OUTP-OUTN)	±1.2 VDC
Operation current consumption	<13 mA @ 3.3 VDC
Output impedance	8 kΩ
Load impedance	Min. 800 kΩ load at OUTP and OUTN
Load capacitance	Max. 0.7 nF load at OUTP and OUTN

Table 6 Electrical Specifications

11 Output signal conditioning

For proper data acquisition, the MAXL-OL-2015 can be connected directly to a differential ADC with > 800kΩ load impedance, for example the ADS126x Texas Instrument ADC can be used.

An alternative option is to use an ultra-low offset, drift and bias current operational amplifier before connecting to the ADC.

12 Temperature Sensor

The temperature sensor output of the MAXL-OL-2015 accelerometer reflects the sensor's junction temperature and provides a convenient temperature measurement for characterization, calibration and compensation. The output voltage of the temperature sensor behaves according to the following formula:

$$V = K(B + T)$$

Where K = Scale Factor, B = Bias, and T = measured temperature.

Symbol	Parameter	Units	Value
-	Range	°C	-45 to +85
K	Nominal Scale Factor	mV/°C	10.3
-	Nominal Scale Factor Accuracy	mV/°C	0.5
B	Nominal Bias	°C	70
-	Nominal Bias Accuracy	°C	2

Table 7 Temperature Sensor Specifications

13 Notes on parameters used in the datasheet

Bias [mg] – Accelerometer's output when no external acceleration is applied along its input axis.

Scale Factor [mV/g] – The ratio of the output change (given in millivolts) to a change of exactly one g in external acceleration along the input axis.

Short Term Stability (Δ Bias [µg] and Δ Scale Factor [ppm] STD) – STD of Bias and Scale Factor during 1 hour operation at room temperature.

Long Term Repeatability (Bias [mg] and Scale Factor [ppm]) – Deviation in accelerometer's bias and scale factor measured after applying following environment conditions:

- Short Term Stability
- Low temperature storage (-55°C)
- High temperature storage (+85°C)
- Turn-On / Turn-On repeatability
- 15 temperature cycles [-40°C, +85°C]
- Endurance vibration (20 – 2000 Hz)
- Shock (500g/0.25ms/6 directions)

Temperature Sensitivity (Bias [µg/^{o}C] and Scale Factor [ppm/^{o}C]) – Maximum value of bias or scale factor rate of change over -40°C, +85°C temperature range.

Temperature Residual Error (Bias [mg] and Scale Factor [ppm]) – Standard deviation of bias or scale factor error over -40°C, +85°C temperature range after applying a 3rd order polynomial compensation.

Scale Factor Linearity Error [% of input acceleration] (2 point fit) - Maximum deviation of accelerometer's output from a linear fit based on 0g and 1g output, given as a percentage of the input acceleration in full range.

Scale Factor Linearity Error [% of input acceleration] (IEEE method) - Maximum deviation of accelerometer's output from the best linear fit between 0g and maximum acceleration operating range. The deviation is expressed as a percentage of the full-scale output.

Bandwidth [Hz] – A range of frequency in which the gain of frequency response is higher than -3dB.

Equivalent Noise Density in band [µg/√Hz] – A criterion, calculated by dividing sensor's output RMS by square root of the bandwidth.

14 Quality

- Physical Logic is AS9100D ISO 9001:2015 certified
- MAXL-OL-2015 is qualified according to Mil-STD-810 G

Disclaimer

Physical Logic reserves the right to update the content of this datasheet without notice.

Physical Logic disclaims all liability related to use of the product in environments exceeding the specifications set forth in the datasheet.

Performance specification of MAXL-OL-2015 expressed in the datasheet has been validated at accelerometer level, performance at system level remains the customer's responsibility.