



# LIS2L01

## INERTIAL SENSOR: 2Axis/1g LINEAR ACCELEROMETER

PRODUCT PREVIEW

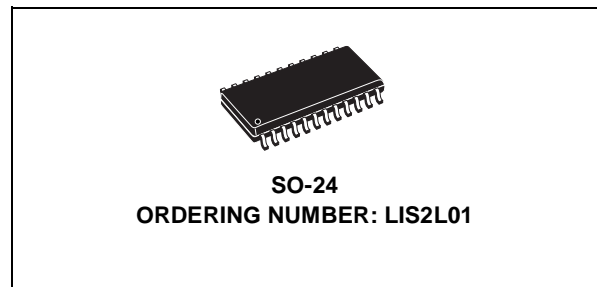
- THE SENSITIVITY IS ADJUSTED WITH A TOTAL ACCURACY OF  $\pm 2.5\%$
- INTERNAL TWO POLES LOW PASS SC FILTER WITH LINEAR OUTPUT, 30Hz BANDWIDTH
- THE OUTPUT VOLTAGE, OFFSET, SENSITIVITY AND TEST VOLTAGE ARE RATIOMETRIC TO THE SUPPLY VOLTAGE
- DEVICE SENSITIVITY IS ON-CHIP FACTORY TRIMMED
- EMBEDDED SELF TEST
- HIGH SHOCK SURVIVABILITY

### DESCRIPTION

The LIS2L01 is a dual channel accelerometer that includes a sensor elements and an IC interface able to take the information from the sensor and to provide an analog signal to the external world.

The sensor element, capable to detect the acceleration, is manufactured using a dedicated process called ThELMA (Thick Epi-Poly layer for Microactuators and Accelerometers) developed by ST to produce inertial sensor and actuator in silicon.

The IC interface instead is manufactured using a CMOS process that allow high level of integration to design a dedicated circuit which is trimmed to better match the sensor element characteristics.



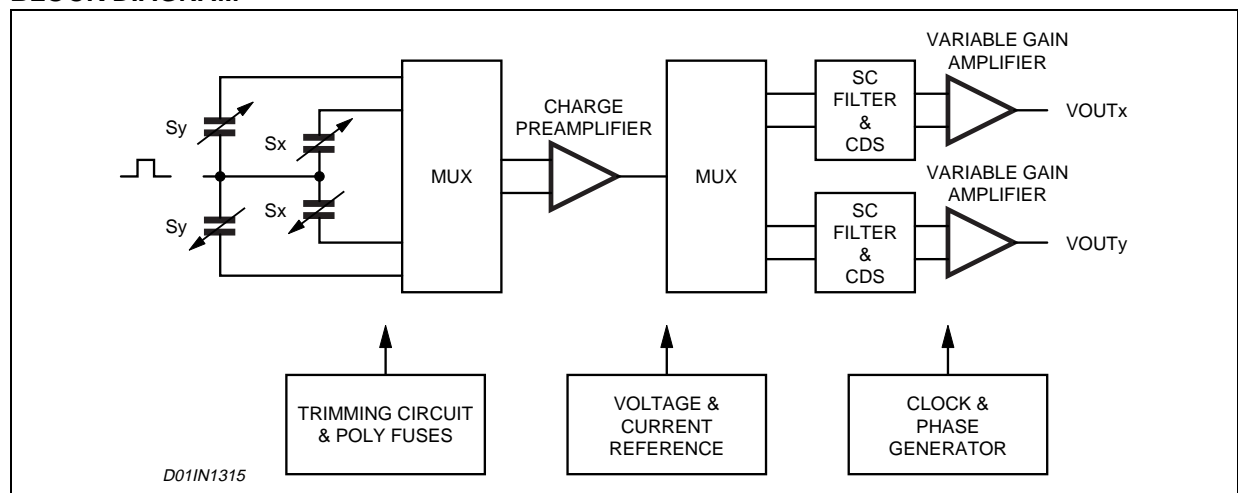
The LIS2L01 is capable of measuring acceleration in the range of  $\pm 1g$  with a bandwidth of 30Hz, set by a 2<sup>nd</sup> order low pass filter. A self-test capability verifies the system providing to the user a signal on a dedicated pin.

The LIS2L01 is available in plastic SMD package and it is specified over a temperature range from 0°C to +80°C.

The LIS2L01 is a part of family products suitable for a variety of applications:

- Virtual reality input devices
- Computer hard disk drive protection
- Computer mouse and joysticks
- Vibration Monitoring, recording and compensation
- Appliance control
- Robotics

### BLOCK DIAGRAM

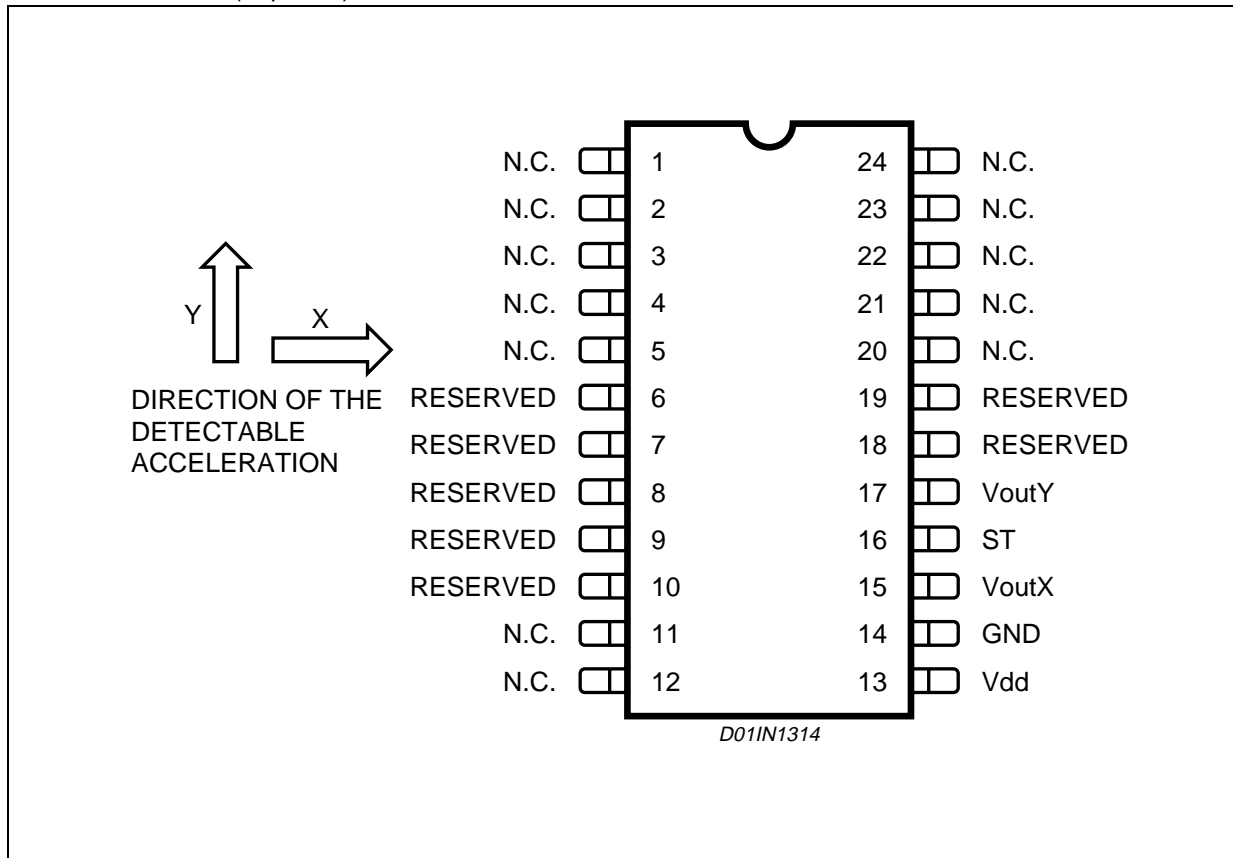


# LIS2L01

## PIN DESCRIPTION

N°	Pin	Function
1 to 5	NC	Internally not connected
6, 9, 10	Reserved	Leave unconnected or connect to GND
7, 8	Reserved	Leave unconnected or connect to Vdd
11, 12	NC	Internally not connected
13	Vdd	5V Supply
14	GND	0V Supply
15	VoutX	Voltage Output
16	ST	Self Test
17	VoutY	Voltage Output
18	Reserved	Leave unconnected or connect to GND
19	Reserved	Leave unconnected or connect to Vdd
20 to 24	NC	Internally not connected

## PIN CONNECTION (Top view)



**ELECTRICAL CHARACTERISTICS** (Temperature range 0°C to 80°C, supply voltage Vdd = 5V ±5%.)

Symbol	Parameter	Test Condition	Min.	Typ.	Max.	Unit
Vdd	Supply voltage		4.75	5	5.25	V
Idd	Supply current			10		mA
Voff	Zero-g level	T = 25°C ratiometric to Vdd	Vdd/2 - 0.1	Vdd/2	Vdd/2 + 0.1	V
Ar	Acceleration range		TBD	±1	TBD	g
So	Sensitivity ratiometric to Vdd	Vdd = 5V T = 25°C	1.8	2	2.2	V/g
fuc	Upper cutoff frequency low pass filter	-3dB/2 <sup>nd</sup> order filter	27	30	33	Hz
an	Equivalent noise acceleration	Bandwidth = 0.1...30Hz		1		mg
Vt	Self test output voltage Ratiometric to Vdd	T = 25°C @ 5V		TBD		V
Vst	Self test input Logic 1 voltage Logic 0 voltage		3.75 Vss		Vdd 1.25	V V
Cload	Capacitive load drive				100	pF
Rload	Resistive load output			50		kΩ

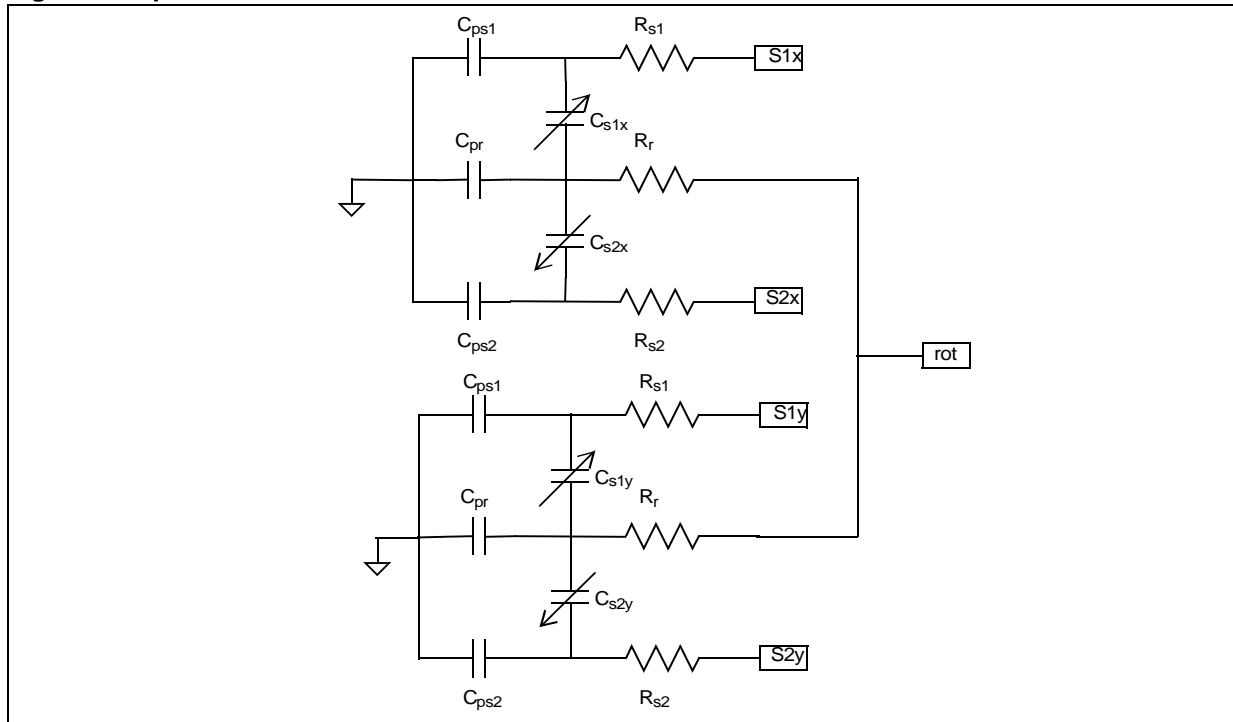
**1 FUNCTIONALITY****1.1 Sensor element**

The ThELMA process is utilized to create a surface micro-machined accelerometer. The technology allows carry out silicon structure on suspension, the structure are attached to the substrate in few points called anchor and free to move on a plane parallel to the substrate itself. To be compatible with the traditional packaging techniques a cap is placed on top the sensor element to avoid the molding goes between the elements making the sensor useless.

The equivalent circuit for the sensor is shown in the below figure; when a linear acceleration is applied, the proof mass displaces from its nominal position, causing an imbalance in the capacitive half-bridge. This imbalance is measured using charge integration in response to a voltage pulse applied to the sense capacitor.

The nominal value of the capacitors, at steady state, is few pF and when an acceleration is applied the maximum variation of the capacitive load is few tenth of pF.

Figure 1. Equivalent electrical circuit



## 1.2 IC Interface

The complete signal processing uses a fully differential structure, while the final stage converts the differential signal into a single-ended to be compatible with the external world.

The first stage is a low-noise capacitive amplifier that implements a Correlated Double Sampling (CDS) at the output to cancel the offset and the  $1/f$  noise.

The signal is processed through a 2<sup>nd</sup> order low pass filter in order to reject out of band noise, the filter cut off frequency is set to be 30Hz.

This filter is implemented using SC technique, which allows to realize a fully integrated system that avoid the use of any external component.

The low noise input amplifier operates at 100 kHz while the two SC filters operate at 50 kHz sampling frequency. This allows a large oversampling ratio, able to reduce in-band noise and to obtain an accurate output waveform. The signal at the output of the SC filter is sampled and held using a different clock to avoid that the filter output value during the CDS phase reaches the output pin.

All the analog parameter (output offset voltage and sensitivity) are ratiometric to the supply voltage. Increasing or decreasing the supply voltage, the sensitivity and the offset will increase or decrease linearly. The feature provides the cancellation of the error related to the supply voltage in the analog to digital conversion chain.

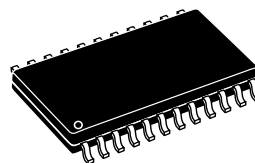
## 1.3 Factory calibration

In the IC interface different calibrations take place at factory level to provide to final user a device ready to be used, the trimmed parameters are: gain, offset and cut off frequency of the SC filter.

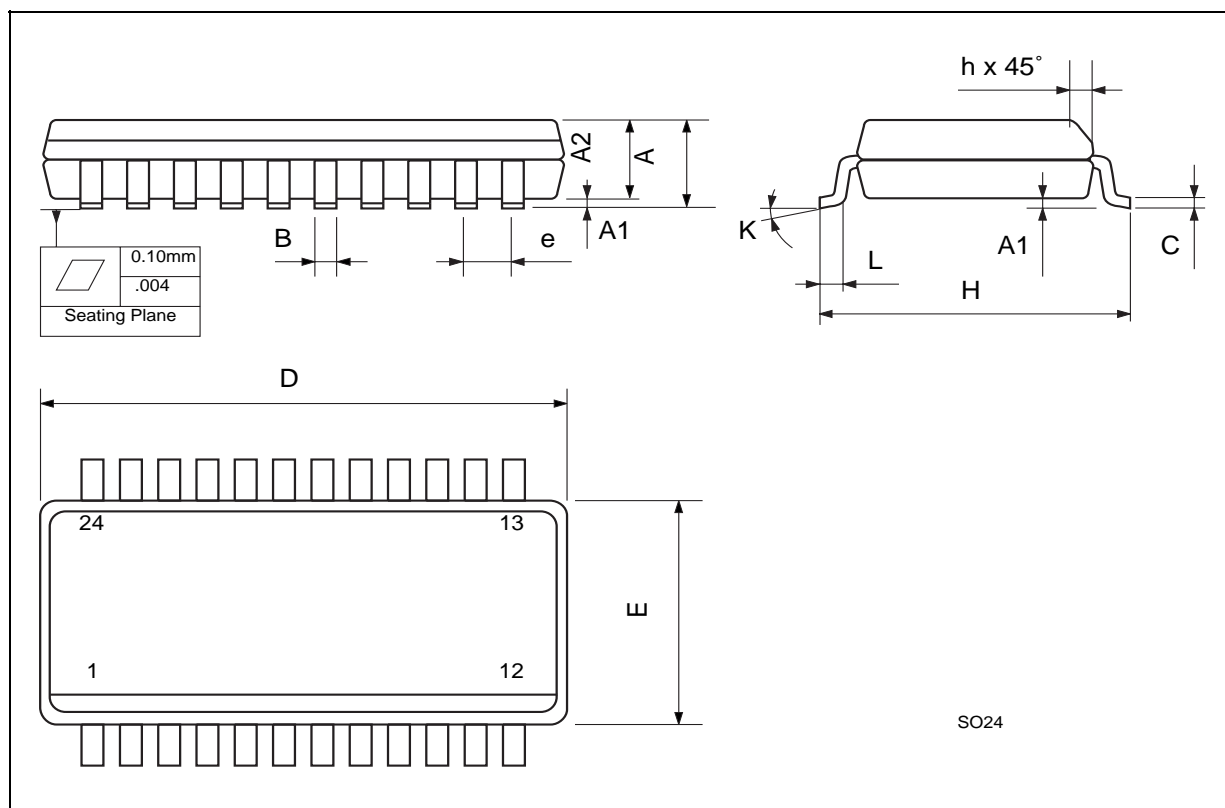
The trimmed value are stored in the device with a poly-fuse technique. Any time the device is turned on the memorized bits are loaded into the registers to be utilized during the normal operation. The poly-fuse approach allow the final user to use the device without any need for further calibration.

DIM.	mm			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
A	2.35		2.65	0.093		0.104
A1	0.10		0.30	0.004		0.012
A2			2.55			0.100
B	0.33		0.51	0.013		0.0200
C	0.23		0.32	0.009		0.013
D	15.20		15.60	0.598		0.614
E	7.40		7.60	0.291		0.299
e		1.27			0,050	
H	10.0		10.65	0.394		0.419
h	0.25		0.75	0.010		0.030
k	0° (min.), 8° (max.)					
L	0.40		1.27	0.016		0.050

## OUTLINE AND MECHANICAL DATA



### SO24



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