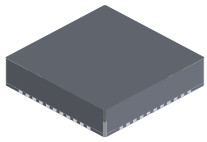
LIS2L02AQ

INERTIAL SENSOR: 2Axis - 2g/6g LINEAR ACCELEROMETER

PRODUCT PREVIEW

- 3V TO 5.25V SINGLE SUPPLY OPERATION
- THE SENSITIVITY IS ADJUSTED WITH A TOTAL ACCURACY OF ±10%
- 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



QFN-44
ORDERING NUMBER: LIS2L02AQ

DESCRIPTION

The LIS2L02AQ is a dual-axis linear accelerometer that includes a sensing element and an IC interface able to take the information from the sensing element and to provide an analog signal to the external world.

The sensing 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 sensors and actuators in silicon.

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

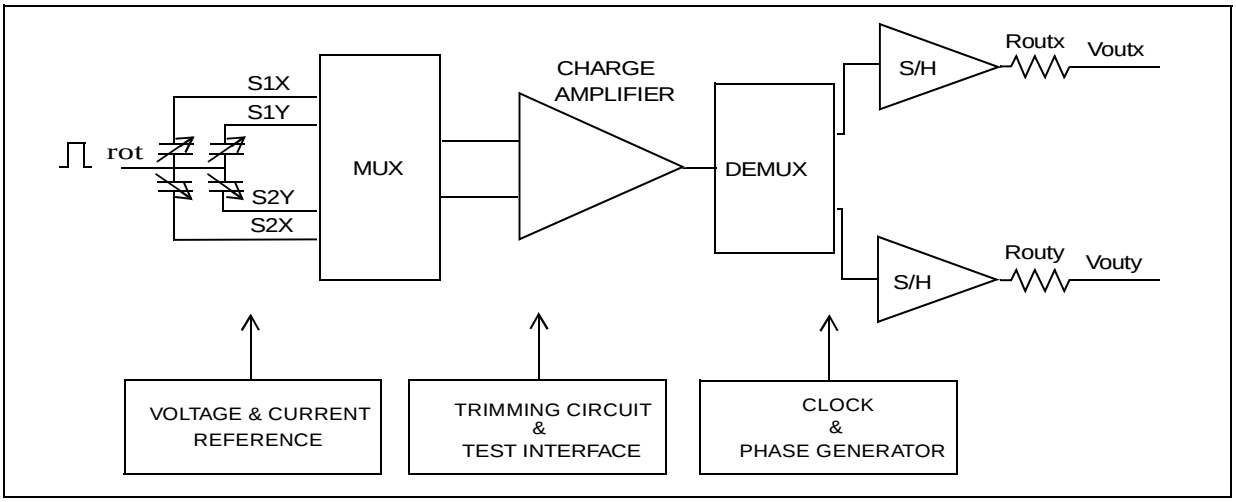
The LIS2L02AQ has a user selectable full scale of 2g, 6g and it is capable of measuring accelerations over a maximum bandwidth of 4.0 KHz for both the X and Y axis. The device bandwidth may be reduced by using external capacitances. A self-test capability allows the user to check the functioning of the system.

The LIS2L02AQ is available in plastic SMD package and it is specified over a temperature range extending from -40°C to +85°C.

The LIS2L02AQ belongs to a family of products suitable for a variety of applications:

- Antitheft systems
- Inertial navigation
- Virtual reality input devices
- Vibration Monitoring, recording and compensation
- Appliance control
- Robotics

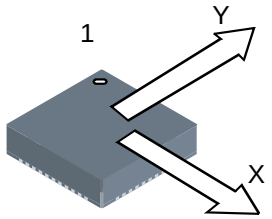
BLOCK DIAGRAM



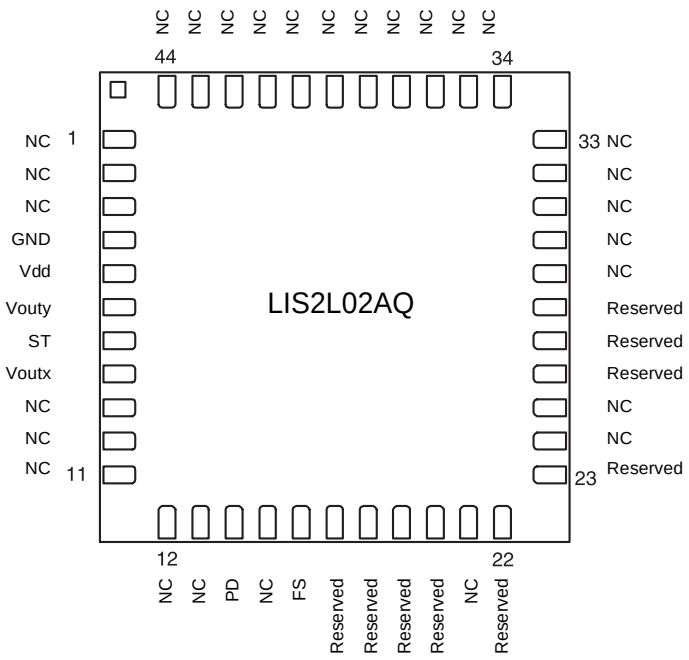
PIN DESCRIPTION

N°	Pin	Function
1 to 3	NC	Internally not connected
4	GND	0V supply
5	Vdd	Power supply
6	Vouty	Output Voltage
7	ST	Self Test (Logic 0: normal mode; Logic 1: Self-test)
8	Voutx	Output Voltage
9-13	NC	Internally not connected
14	PD	Power Down (Logic 0: normal mode; Logic 1: Power-Down mode)
15	NC	Internally not connected
16	FS	Full Scale selection (Logic 0: 2g Full-scale; Logic 1: 6g Full-scale)
17-18	Reserved	Leave unconnected
19	NC	Internally not connected
20	Reserved	Leave unconnected
21	NC	Internally not connected
22-23	Reserved	Leave unconnected
24-25	NC	Internally not connected
26	Reserved	Connect to Vdd or GND
27	Reserved	Leave unconnected or connect to Vdd
28	Reserved	Leave unconnected or connect to GND
29-44	NC	Internally not connected

PIN CONNECTION (Top view)



DIRECTION OF THE DETECTABLE ACCELERATIONS



ELECTRICAL CHARACTERISTCS (Temperature range -40°C to +85°C)

Symbol	Parameter	Test Condition	Min.	Typ.	Max.	Unit
V_{dd}	Supply voltage		3		5.25	V
I_{dd}	Supply current			1.0		mA
V_{off}	Zero-g level	T_{amb} = 25°C ratiometric to Vdd	V_{dd}/2-10%	V_{dd}/2	V_{dd}/2+10%	V
A_r	Acceleration range	0V on FS pin	±1.8	±2.0	±2.2	g
		V_{dd} on FS pin		±6.0		g
S_o	Sensitivity ratiometric to V_{dd}	T_{amb} = 25°C Full-scale = 2g	V_{dd}/5–10%	V_{dd}/5	V_{dd}/5+10%	V/g
		T_{amb} = 25°C Full-scale = 6g	V_{dd}/15–10%	V_{dd}/15	V_{dd}/15+10%	V/g
N_L	Non Linearity	Best fit straight line X, Y axis Full-scale = 2g		±0.3		%
f_{uc}	Sensing Element Resonant Frequency	X, Y axis		4.0		KHz
a_n	Acceleration noise density	V_{dd} = 5V Full-scale = 2g		50		$\mu g/\sqrt{Hz}$
V_t	Self test output voltage Ratiometric to Vdd	T_{amb} = 25°C @ 5V	100			mV
V_{st}	Self test input	Logic 0 level	0		0.8	V
		Logic 1 level	2.8		V_{dd}	V
R_{out}	Output impedance			100		kΩ
C_{load}	Capacitive load drive		320			pF

1 FUNCTIONALITY

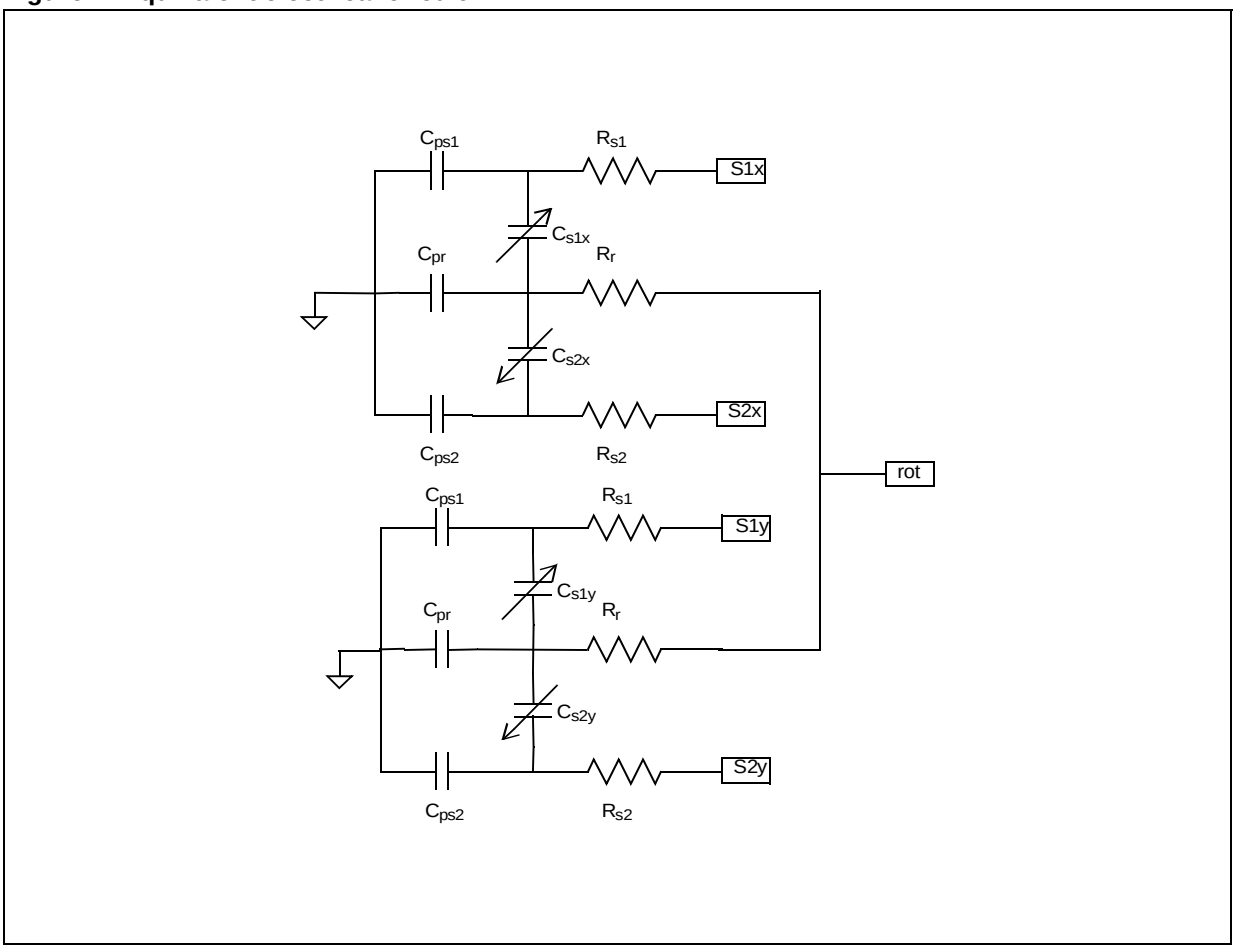
1.1 Sensing element

The THELMA process is utilized to create a surface micro-machined accelerometer. The technology allows to carry out suspended silicon structures which are attached to the substrate in a few points called anchors 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 of the sensing element to avoid blocking the moving parts during the molding phase.

The equivalent circuit for the sensing element 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 one to be compatible with the external world.

The first stage is a low-noise capacitive amplifier that implements a Correlated Double Sampling (CDS) at its output to cancel the offset and the 1/f noise. The produced signal is then sent to two different S&Hs, one for each channel, and made available to the outside.

The low noise input amplifier operates at 200 kHz while the two S&Hs operate at a sampling frequency of 66 kHz. This allows a large oversampling ratio, which leads to in-band noise reduction and to an accurate output waveform.

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

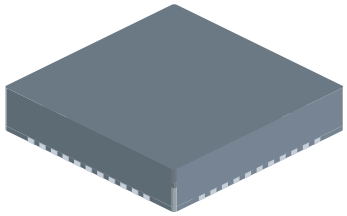
1.3 Factory calibration

The IC interface is factory calibrated to provide to the final user a device ready to operate. The parameters which are trimmed are: gain, offset, common mode and internal clock frequency.

The trimming values are stored inside the device by a poly-fuse structure. Any time the device is turned on, the memorized bits are downloaded into the registers to be employed during the normal operation. The poly-fuse approach allows the final user to utilize the device without any need for further calibration

DIM.	mm			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
A	1.70	1.80	1.90	0.067	0.071	0.075
A1	0.19		0.21	0.007		0.008
b	0.20	0.25	0.30	0.008	0.01	0.012
D		7.0			0.276	
E		7.0			0.276	
e		0.50			0.020	
J	5.04		5.24	0.198		0.206
K	5.04		5.24	0.198		0.206
L	0.38	0.48	0.58	0.015	0.019	0.023
P		45 REF			45 REF	

OUTLINE AND MECHANICAL DATA



QFN-44 (7x7x1.8mm)
Quad **F**lat **P**ackage **N**o lead