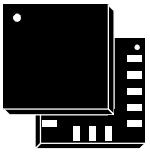
LPR530AL

MEMS motion sensor: pitch and roll ±300°/s analog output gyroscope

Preliminary Data

Features

- 2.7V to 3.6 V single supply operation
- ±300deg/sec FS range
- Two separated outputs for each axis simultaneosly available (4x gain)
- Low power consumption
- Embedded power-down
- Absolute analog rate output
- Integrated low-pass filters
- Embedded self-test
- High shock survivability
- Extended operating temperature range
- ECOPACK® RoHS and “Green” compliant (see *Section 5*)



LGA 16L (5x5x1.5mm)

Description

The LPR530AL is a low-power two-axis angular rate sensor. It includes a sensing element and an IC interface able to provide the measured angular rate to the external world through an analog output voltage.

The sensing element is manufactured using a dedicated micromachining process developed by ST to produce inertial sensors and actuators on silicon wafers.

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

The LPR530AL has a full scale of ±300 °/s and is capable of measuring rates with a -3 dB bandwidth up to 140Hz.

The LPR530AL is available in a plastic land grid array (LGA) package and can operate within a temperature range from -40 °C to +85 °C.

The LPR530AL belongs to a family of products suitable for a variety of applications, including:

- Motion control with MMI (man-machine interface)
- Pointing devices, remote and game controllers
- GPS navigation systems
- Appliances and robotics

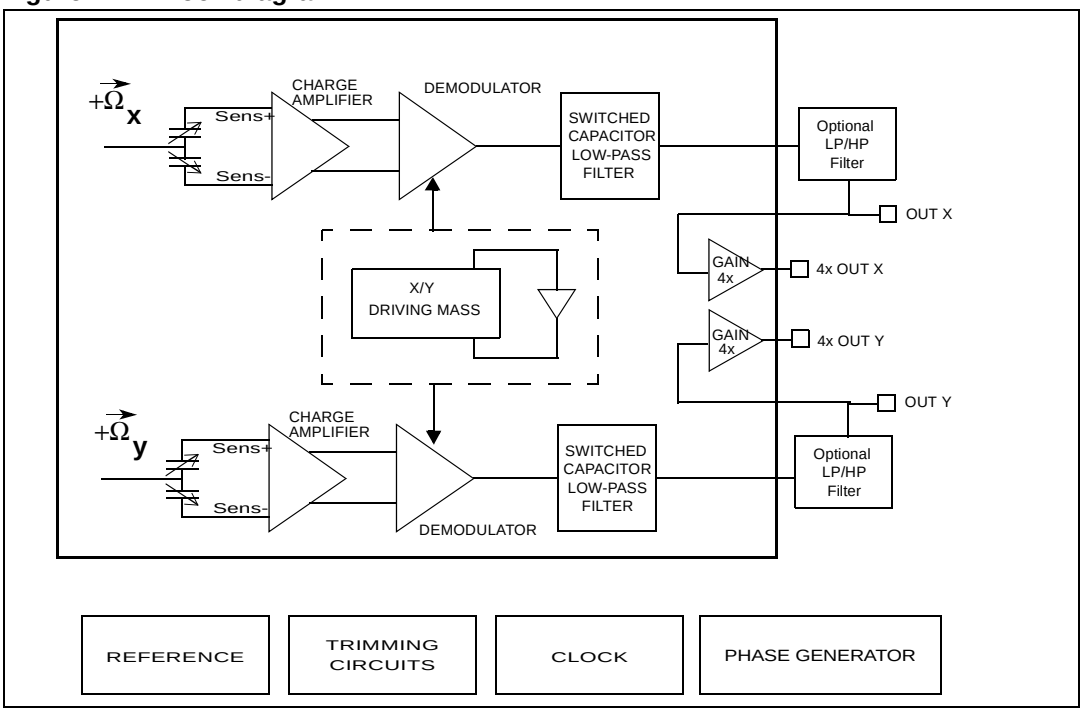
Table 1. Device summary

Order code	Temperature range (°C)	Package	Packing
LPR530AL	-40 to +85	LGA-16 (5x5x1.5)	Tray
LPR530ALTR	-40 to +85	LGA-16 (5x5x1.5)	Tape & Reel

Contents

1 Block diagram and pin description

Figure 1. Block diagram



The vibration of the structure is maintained by a drive circuitry in a feedback loop. The sensing signal is filtered and appears as an analog signal at the output.

1.1 Pin description

Figure 2. Pin connection

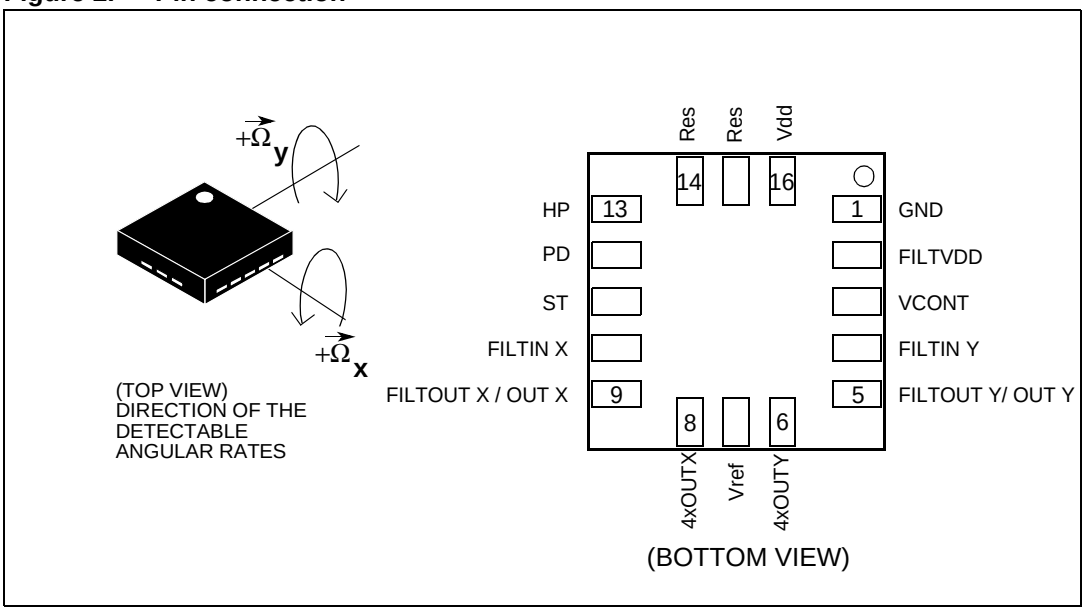


Table 2. Pin description

Pin #	Pin Name	Analog Function
1	GND	0V supply voltage
2	FILTVDD	PLL filter connection pin #2
3	VCONT	PLL filter connection pin #1
4	FILTIN Y	Y axis optional HP/LP filtering (input pad)
5	FILTOUT Y / OUT Y	Y axis optional HP/LP filtering (output pad) / not amplified output
6	4xOUTY	Y Rate signal output voltage (amplified)
7	Vref	Reference voltage
8	4xOUTX	X Rate signal output voltage (amplified)
9	FILTOUT X / OUT X	X axis optional HP/LP filtering (output pad) / not amplified output
10	FILTIN X	X axis optional HP/LP filtering (input pad)
11	ST	Self-test (logic 0: normal mode; logic 1: self-test)
12	PD	Power-down (logic 0: normal mode; logic 1: power-down mode)
13	HP	High pass filter reset (logic 0: normal operation mode; logic1: External High Pass filter is reset)
14	Res	Reserved. Connect to Vdd
15	Res	Reserved. Connect to Vdd
16	Vdd	Power supply

2 Mechanical and electrical specifications

2.1 Mechanical characteristics

Table 3. Mechanical characteristics @ Vdd = 3 V, T = 25 °C unless otherwise noted (1)

Symbol	Parameter	Test condition	Min.	Typ.(2)	Max.	Unit
FSA	Measurement range	4x OUT (amplified)		±300		°/s
FS		OUT (not amplified)		±1200		°/s
SoA	Sensitivity(3)	4x OUT (amplified)		3.33		mV/ °/s
So		OUT (not amplified)		0.83		mV/ °/s
SoDr	Sensitivity change vs temperature	Delta from 25°C		0.05		%/°C
Voff	Zero-rate level(3)			1.5		V
OffDr	Zero-rate level change Vs temperature	Delta from 25°C		0.15		(deg/sec)/ °C
NL	Non linearity	Best fit straight line		±1		% FS
BW	Bandwidth(4)			140		Hz
Rn	Rate noise density			0.035		°/s / $\sqrt{Hz}$
Fres	Sensing element resonant frequency			4.5		kHz
Top	Operating temperature range		-40		+85	°C

1. The product is factory calibrated at 3 V. The operational power supply range is specified in *Table 4*.
2. Typical specifications are not guaranteed
3. Sensitivity and Zero-rate Offset are not ratiometric to supply voltage
4. The product is capable of measuring angular rates extending from DC to the selected BW.

2.2 Electrical characteristics

Table 4. Electrical characteristics @ Vdd =3 V, T=25 °C unless otherwise noted (1)

Symbol	Parameter	Test condition	Min.	Typ.(2)	Max.	Unit
Vdd	Supply voltage		2.7	3	3.6	V
Idd	Supply current	PD pin connected to GND		6.8		mA
IddPdn	Supply current in power-down mode	PD pin connected to Vdd		5		µA
VST	Self-test input	Logic 0 level	0		0.2*Vdd	V
		Logic 1 level	0.8*Vdd		Vdd	
VPD	Power-down input	Logic 0 level	0		0.2*Vdd	V
		Logic 1 level	0.8*Vdd		Vdd	
Top	Operating temperature range		-40		+85	°C

1. The product is factory calibrated at 3 V
2. Typical specifications are not guaranteed

2.3 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.

Table 5. Absolute maximum ratings

Symbol	Ratings	Maximum value	Unit
Vdd	Supply voltage	-0.3 to 6	V
Vin	Input voltage on any control pin (PD, ST)	-0.3 to Vdd +0.3	V
T_{STG}	Storage temperature range	-40 to +125	℃
ESD	Electrostatic discharge protection	2 (HBM)	kV

This is a mechanical shock sensitive device, improper handling can cause permanent damage to the part

This is an ESD sensitive device, improper handling can cause permanent damage to the part

3 Terminology

3.1 Sensitivity

An angular rate gyroscope is device that produces a positive-going output voltage for counterclockwise rotation around the sensible axis considered. Sensitivity describes the gain of the sensor and can be determined by applying a defined angular velocity to it. This value changes very little over temperature and also very little over time.

3.2 Zero-rate level

Zero-rate level describes the actual output signal if there is no angular rate present. For a 3 V powered sensor the absolute zero-rate output is ideally 1.5 V. Zero-rate level of precise MEMS sensors is, to some extent, a result of stress to the sensor and therefore zero-rate level can slightly change after mounting the sensor onto a printed circuit board or after exposing it to extensive mechanical stress. This value changes very little over temperature and also very little over time.

3.3 Self-test

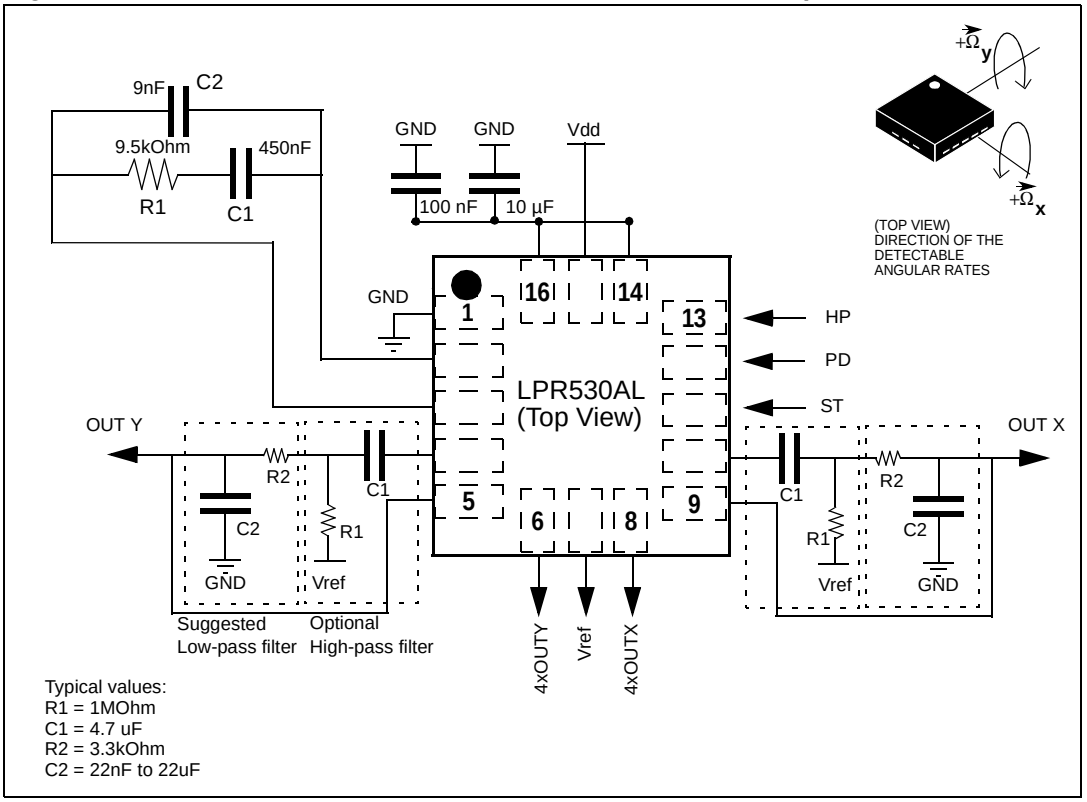
Self-test allows to test the mechanical and electric part of the sensor, allowing the seismic mass to be moved by means of an electrostatic test-force. The Self-test function is off when the ST pin is connected to GND. When the ST pin is tied to Vdd, an actuation force is applied to the sensor, emulating a definite Coriolis force. In this case the sensor output will exhibit a voltage change in its DC level which is also depending on the supply voltage. When ST is active, the device output level is given by the algebraic sum of the signals produced by the velocity acting on the sensor and by the electrostatic test-force. If the output signals change within the amplitude specified in *Table 3*, then the mechanical element is working properly and the parameters of the interface chip are within the defined specification.

3.4 High Pass filter reset (HP)

LPR530AL integrates the possibility to reset the optional external high pass filter by applying high logic value to HP pad. This procedure ensures faster response expecially during overload conditions. Moreover, this operation is suggested each time the device is powered.

4 Application hints

Figure 3. LPR530AL electrical connections and external components values



Power supply decoupling capacitors (100 nF ceramic or polyester + 10 µF Aluminum) should be placed as near as possible to the device (common design practice).

The LPR530AL allows to band limit the output rate response through the use of an external low pass filter (suggested) and/or high pass filter (optional) in addition to the embedded low pass filter (f_t = 140Hz).

If external high pass or low pass filtering is not applied it is mandatory to short circuit respectively pad 4 to pad 5 and pad 9 to pad 10.

4xOUTX and 4xOUTY are respectively OUTX and OUTY amplified outputs lines, internally buffered to ensure low output impedence.

The LPR530AL IC includes a PLL (Phase Locked Loop) circuit to synchronize driving and sensing interfaces. Capacitors and resistors must be added at **FILTVDD** and **VCONT** pins (as shown in *Figure 3*) to implement a second-order low-pass filter.

4.1 Soldering information

The LGA package is compliant with the ECOPACK®, RoHS and “Green” standard.
It is qualified for soldering heat resistance according to JEDEC J-STD-020C.

Leave “Pin 1 Indicator” unconnected during soldering.

Land pattern and soldering recommendations are available at www.st.com/mems.

5 Package information

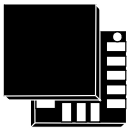
In order to meet environmental requirements, ST offers these devices in ECOPACK® packages. These packages have a lead-free second level interconnect. The category of second level interconnect is marked on the inner box label, in compliance with JEDEC Standard JESD97. The maximum ratings related to soldering conditions are also marked on the inner box label. ECOPACK® is an ST trademark.

ECOPACK® specifications are available at: www.st.com.

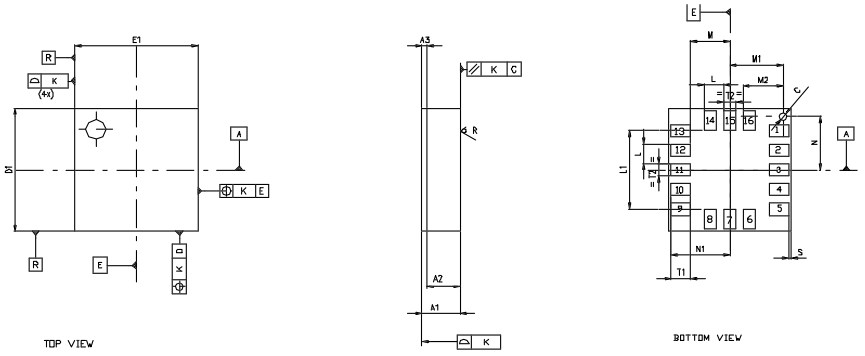
Figure 4. LGA-16: mechanical data and package dimensions

Ref.	Dimensions					
	mm			inch		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A1	1.46	1.5	1.6	0.057	0.059	0.063
A2			1.33			0.052
A3	0.16	0.2	0.24	0.006	0.008	0.009
C		0.3			0.012	
D1	4.85	5	5.15	0.191	0.197	0.203
E1	4.85	5	5.15	0.191	0.197	0.203
L		0.8			0.031	
L1		3.2			0.126	
M		1.6			0.062	
M1	2.15	2.175	2.20	0.085	0.086	0.087
M2		1.625			0.064	
N		2.175			0.086	
N1		2.4			0.094	
T1		0.8			0.031	
T2	0.475	0.5	0.525	0.019	0.020	0.021
R	1.2		1.6	0.047		0.063
S		0.1			0.004	
h		0.15			0.006	
k		0.05			0.002	
j		0.1			0.004	

Outline and mechanical data



LGA16 (5x5x1.6mm)
Land Grid Array Package



6 Revision history

Table 6. Document revision history

Date	Revision	Changes
24-Feb-09	0.1	Initial datasheet release

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