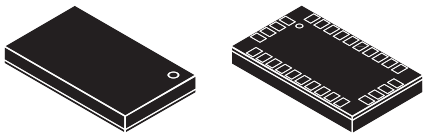
LYPR540AH

MEMS motion sensor: 3 axis analog output gyroscope

Preliminary data

Features

- Analog supply voltage 2.7 V to 3.6 V
- Wide extended operating temperature range (-40°C to 85°C)
- 3 indipendent angular rate channels
- ±400 dps and ±1600 dps full-scale
- High shock survivability
- Embedded self-test
- ECOPACK® RoHS and “Green” compliant (see *Section 5*)



LGA-28L (4.4x7.5x1.1 mm)

Application

- Motion and man machine interface
- Gaming and virtual reality input devices
- Fitness and wellness
- Pointing device and remote controllers
- Industrial and robotics
- Personal navigation devices

Description

The LYPR540AH is a three axis yaw, pitch and roll analog gyroscope featuring three separate analog output channels.

LYPR540AH provides amplified (±400 dps full scale) and not amplified (±1600 dps full scale) outputs for each sensible axis available at the same time through dedicated pins, and is capable of detecting rates with a -3 dB bandwidth up to 140 Hz.

ST 3 axis gyroscope family leverages on robust and mature manufacturing process already used for the production of hundreds milion micromachined accelerometers with excellent acceptance from the market.

Sensing element is manufactured using specialized micromachining processes, while the IC interfaces are realized using a CMOS technology that allows to design a dedicated circuit which is trimmed to better match the sensing element characteristics.

The LYPR540AH is available in plastic Land Grid Array (LGA) package. Several years ago ST pioneered successfully the usage of this package for accelerometers. Today ST has the widest manufacturing capability and strongest expertise in the world for production of sensors in plastic LGA package.

Table 1. Device summary

Order code	Temperature range [°C]	Package	Packing
LYPR540AH	-40 to +85	LGA-28L	Tray
LYPR540AHTR	-40 to +85	LGA-28L	Tape and reel

This is preliminary information on a new product now in development or undergoing evaluation. Details are subject to change without notice.

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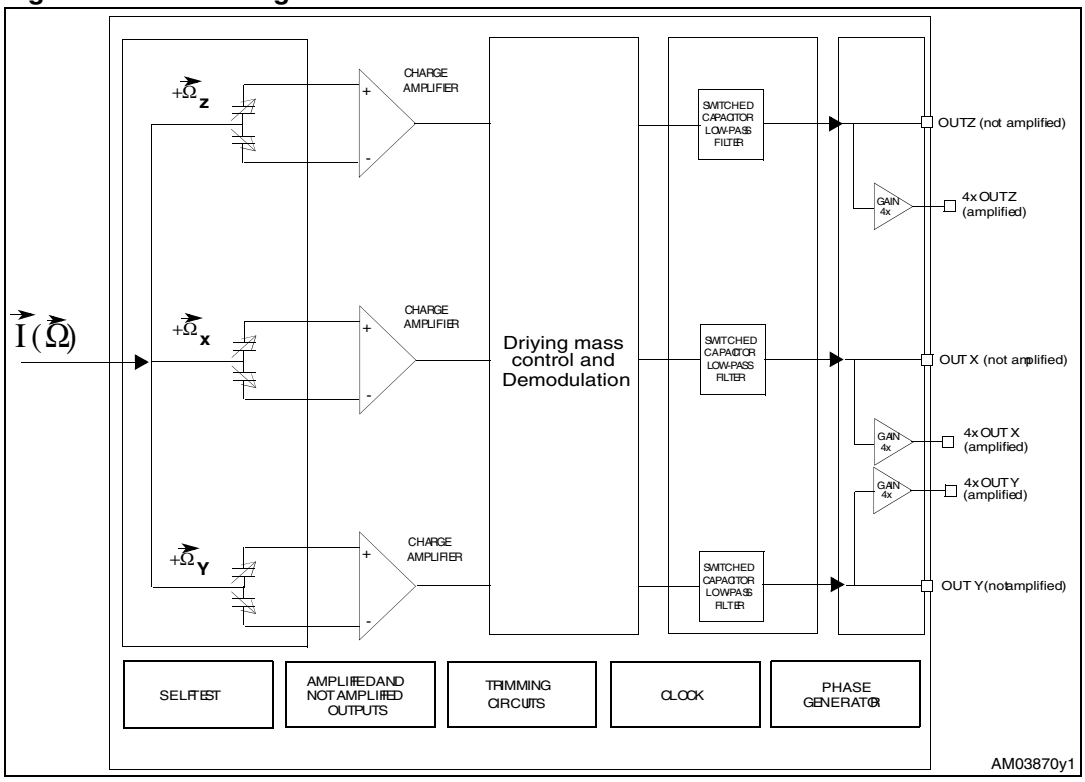
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1 Block diagram and pin description

1.1 Block diagram

Figure 1. Block diagram



1.2 Pin description

Figure 2. Pin connection

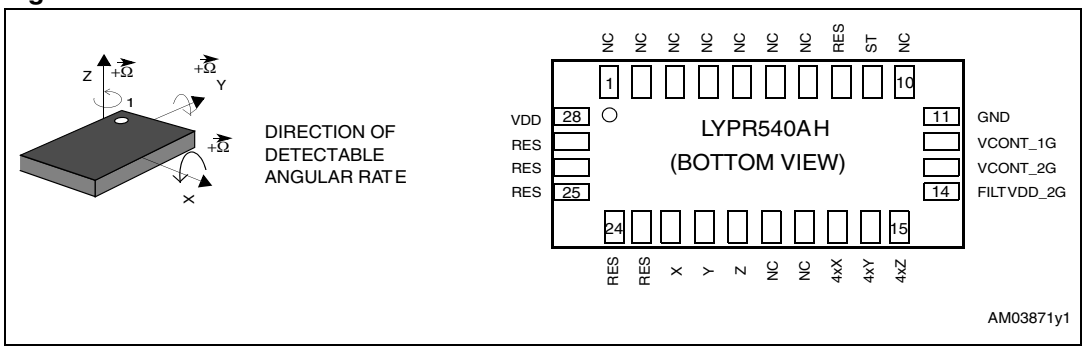


Table 2. Pin description

Pin#	Name	Function
1-7	NC	Internally not connected
8	Reserved	Connect to GND
9	ST	Self tets (logic 0: normal mode; logic 1: self test)
10	NC	Internally not connected
11	GND	0V supply voltage
12	VCONT_1G	PLL filter connection
13	VCONT_2G	PLL filter connection
14	FILTVDD_2G	PLL filter connection
15	4xZ	Z amplified output
16	4xY	Y amplified output
17	4xX	X amplified output
18	NC	Internally not connected
19	NC	Internally not connected
20	Z	Z not amplified output
21	Y	Y not amplified output
22	X	X not amplified output
23	Reserved	Connect to GND
24-27	Reserved	Connect to VDD
28	VDD	Power supply

2 Module specifications

2.1 Mechanical characteristics

Vdd = 3V, T = 25 °C unless otherwise noted[a]

Table 3. Mechanical characteristics

Symbol	Parameter	Test conditions	Min.	Typ.[1]	Max.	Unit
FS	Measurement range	Not amplified output (X,Y,Z)		±1600		dps
FSA		Amplified output (4xX,4xY,4xZ)		±400		
So	Sensitivity	Not amplified output (X,Y,Z)		0.8		mV/dps
SoA		Amplified output (4xX,4xY,4xZ)		3.2		
SoDr	Sensitivity change vs. temperature			0.07		%/°C
Voff	Zero-rate level			1.5		V
VoffDR	Zero rate level drift over temperature			0.08		dps/°C
NL	Non linearity[2]	Best fit straight line		±1		% FS
BW	Bandwidth[3]			140		Hz
Rn	Rate noise density			0.02		dps/√Hz
Top	Operating temperature range		-40		+85	°C

1. Typical specifications are not guaranteed.
2. Guaranteed by design.
3. The product is capable of measuring angular rates extending from DC to the selected BW.

a. The product is factory calibrated at 3 V. The operational power supply range is from 2.7 V to 3.6 V.

2.2 Electrical characteristics

Vdd = 3 V, T = 25 °C unless otherwise noted

Table 4. Electrical characteristics

Symbol	Parameter	Test conditions	Min.	Typ.(1)	Max.	Unit
Vdd	Supply voltage		2.7	3	3.6	V
Idd	Supply current			10.8		mA
VST	Self-test input	Logic 0 level	0		0.2*Vdd	V
		Logic 1 level	0.8*Vdd		Vdd	
Top	Operating temperature range		-40		+85	°C

1. 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 (ST)	-0.3 to Vdd +0.3	V
A	Acceleration	3000 for 0.5 ms	*g*
		10000 for 0.1 ms	*g*
T_{STG}	Storage temperature range	-40 to +125	°C
ESD	Electrostatic discharge protection	2 (HBM)TBC	kV



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



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

3 Terminology

3.1 Sensitivity

An angular rate gyroscope is a device that produces a positive-going output voltage for counterclockwise rotation around the sensitive 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 time.

3.2 Zero-rate level

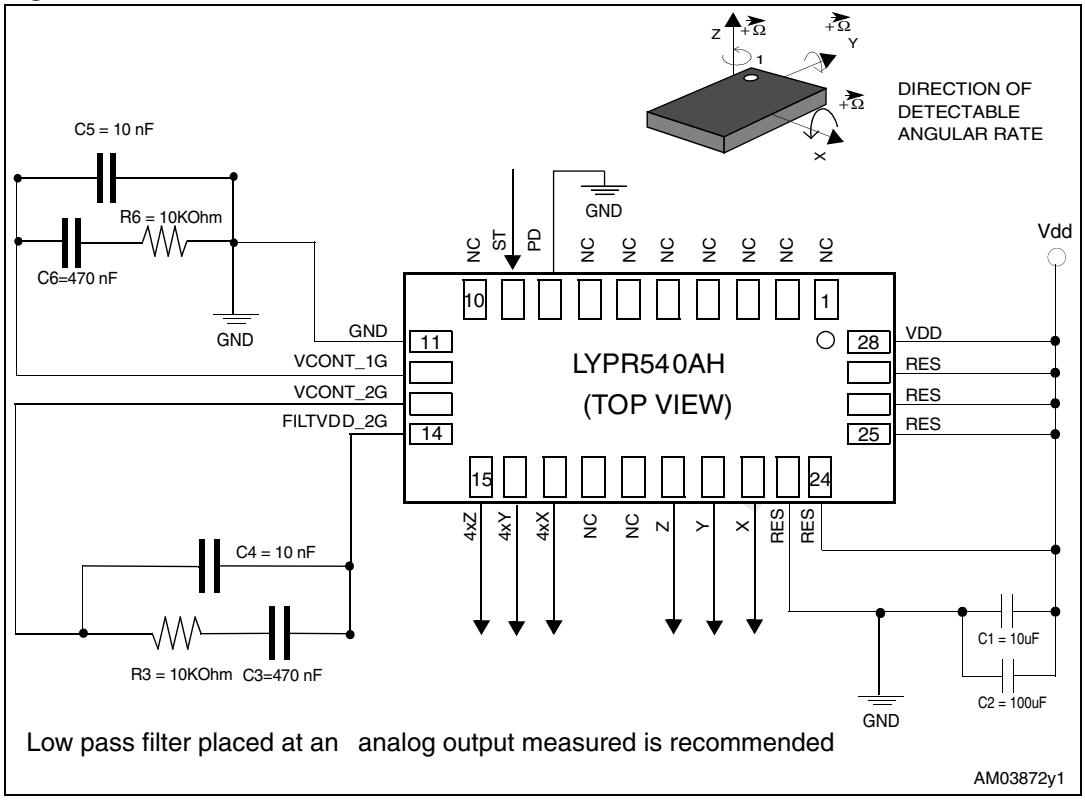
Zero-rate level describes the actual output signal if there is no angular rate present. The zero-rate level of precise MEMS sensors is, to some extent, a result of stress to the sensor and therefore zero-rate level can slightly change after mounting the sensor onto a printed circuit board or after exposing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

3.3 Self-test

Self-test allows testing the mechanical and electrical 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 angular velocity acting on the sensor and by the electrostatic test-force. If the output signals change within the amplitude specified then the mechanical element is working properly and the parameters of the interface chip are within the defined specification.

4 Application hints

Figure 3. LYPR540AH electrical connection



4.1 External capacitors

The device core is supplied through Vdd line. Power supply decoupling capacitors (C2=100 nF ceramic, C1=10 µF Al) should be placed as near as possible to the supply pin of the device (common design practice).

All the voltage and ground supplies must be present at the same time to have proper behavior of the IC (refer to *Figure 3*).

The LYPR540AH IC includes a PLL (phase-locked loop) circuit to synchronize driving and sensing interfaces. Capacitors and resistors must be added at the **FILTVDD_2G**, **VCONT_2G, VCONT_1G** pins (as shown in *Figure 3*) to implement a second-order low-pass filter.

4.2 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 recommendation are available at www.st.com/

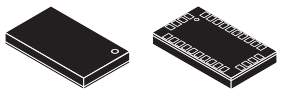
5 Package information

In order to meet environmental requirements, ST offers these devices in different grades of ECOPACK® packages, depending on their level of environmental compliance. ECOPACK® specifications, grade definitions and product status are available at: www.st.com. ECOPACK is an ST trademark

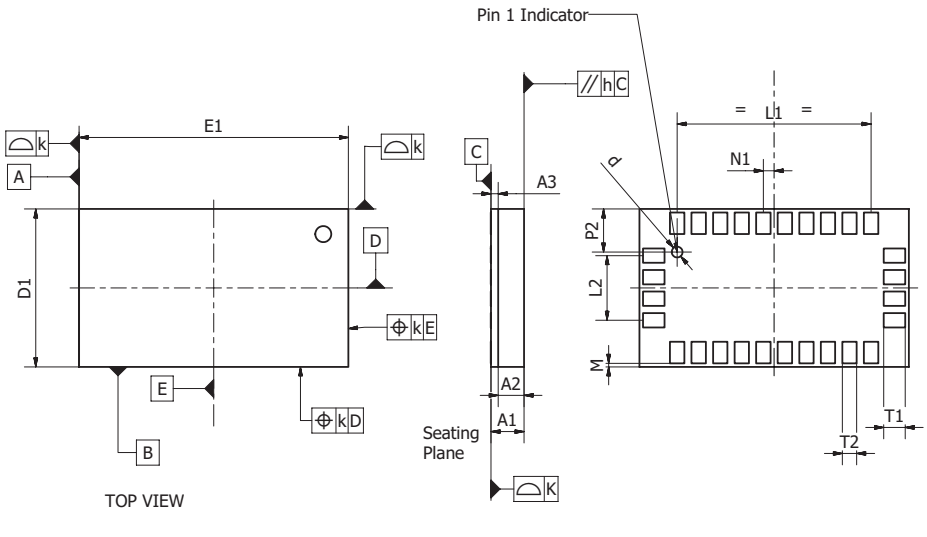
Figure 4. LGA-28L: mechanical data and package dimensions

Dim.	mm		
	Min.	Typ.	Max.
A1			1.1
A2		0.855	
A3		0.2	
D1	4.25	4.4	4.55
E1	7.25	7.5	7.55
N1		0.3	
L1		5.4	
L2		1.8	
P2		1.2	
T1		0.6	
T2		0.4	
M		0.1	
d		0.3	
k		0.05	
h		0.1	

Outline and mechanical data



LGA-28L (4.4x7.5x1.1mm)
Land Grid Array Package



6 Revision history

Table 6. Document revision history

Date	Revision	Changes
06-Nov-2009	1	Initial release.

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