

SUNSTAR商斯达实业集团是集研发、生产、工程、销售、代理经销、技术咨询、信息服务等为一体的高科技企业，是专业高科技电子产品生产厂家，是具有10多年历史的专业电子元器件供应商，是中国最早和最大的仓储式连锁规模经营大型综合电子零部件代理分销商之一，是一家专业代理和分销世界各大品牌IC芯片和电子元器件的连锁经营综合性国际公司。在香港、北京、深圳、上海、西安、成都等全国主要电子市场设有直属分公司和产品展示展销窗口门市部专卖店及代理分销商，已在全国范围内建成强大统一的供货和代理分销网络。我们专业代理经销、开发生产电子元器件、集成电路、传感器、微波光电元器件、工控机/DOC/DOM电子盘、专用电路、单片机开发、MCU/DSP/ARM/FPGA软件硬件、二极管、三极管、模块等，是您可靠的一站式现货配套供应商、方案提供商、部件功能模块开发配套商。专业以现代信息产业（计算机、通讯及传感器）三大支柱之一的传感器为主营业务，专业经营各类传感器的代理、销售生产、网络信息、科技图书资料及配套产品设计、工程开发。我们的专业网站——**中国传感器科技信息网（全球传感器数据库）www.SENSOR-IC.COM** 服务于全球高科技生产商及贸易商，为企业科技产品开发提供技术交流平台。欢迎各厂商互通有无、交换信息、交换链接、发布寻求代理信息。欢迎国外高科技传感器、变送器、执行器、自动控制产品厂商介绍产品到**中国**，共同开拓市场。本网站是关于各种传感器-变送器-仪器仪表及工业自动化大型专业网站，深入到工业控制、系统工程计 测量、自动化、安防报警、消费电子等众多领域，把最新的传感器-变送器-仪器仪表买卖信息，最新技术供求，最新采购商，行业动态，发展方向，最新的技术应用和市场资讯及时的传递给广大科技开发、科学研究、产品设计人员。本网站已成功为石油、化工、电力、医药、生物、航空、航天、国防、能源、冶金、电子、工业、农业、交通、汽车、矿山、煤炭、纺织、信息、通信、IT、安防、环保、印刷、科研、气象、仪器仪表等领域从事科学研究、产品设计、开发、生产制造的科技人员、管理人员、和采购人员提供满意服务。**我公司专业生产、代理、经销、销售各种传感器、变送器、敏感元器件、开关、执行器、仪器仪表、自动化控制系统：专门从事设计、生产、销售各种传感器、变送器、各种测控仪表、热工仪表、现场控制器、计算机控制系统、数据采集系统、各类环境监控系统、专用控制系统应用软件以及嵌入式系统开发及应用等工作。如热敏电阻、压敏电阻、温度传感器、温度变送器、湿度传感器、湿度变送器、气体传感器、气体变送器、压力传感器、压力变送、称重传感器、物（液）位传感器、物（液）位变送器、流量传感器、流量变送器、电流（压）传感器、溶氧传感器、霍尔传感器、图像传感器、超声波传感器、位移传感器、速度传感器、加速度传感器、扭距传感器、红外传感器、紫外传感器、火焰传感器、激光传感器、振动传感器、轴角传感器、光电传感器、接近传感器、干簧管传感器、继电器传感器、微型电泵、磁敏（阻）传感器、压力开关、接近开关、光电开关、色标传感器、光纤传感器、齿轮测速传感器、时间继电器、计数器、计米器、温控仪、固态继电器、调压模块、电磁铁、电压表、电流表等特殊传感器。同时承接传感器应用电路、产品设计和自动化工程项目。**

欢迎索取免费详细资料、设计指南和光盘；产品凡多，未能尽录，欢迎来电查询。

更多产品请看本公司产品专用销售网站：

商斯达中国传感器科技信息网：<http://www.sensor-ic.com/>

商斯达工控安防网：<http://www.pc-ps.net/>

商斯达电子元器件网：<http://www.sunstare.com/>

商斯达微波光电产品网：[HTTP://www.rfoe.net/](http://www.rfoe.net/)

商斯达消费电子产品网：<http://www.icasic.com/>

商斯达军工产品网：<http://www.junpinic.com/>

商斯达实业科技产品网：<http://www.sunstars.cn/>传感器销售热线：

地址：深圳市福田区福华路福庆街鸿图大厦1602室

电话：0755-83607652 83376489 83376549 83370250 83370251 82500323

传真：0755-83376182 (0) 13902971329 MSN: SUNS8888@hotmail.com

邮编：518033 E-mail: szss20@163.com QQ: 195847376

深圳赛格展销部：深圳华强北路赛格电子市场2583号 电话：0755-83665529

技术支持：0755-83394033 13501568376

FEATURES

- Complete rate gyroscope on a single chip
- Z-axis (yaw rate) response
- High vibration rejection over wide frequency
- 2000 g powered shock operation
- Self-test on digital command
- Temperature sensor output
- Precision voltage reference output
- Absolute rate output for precision applications
- 5 V single-supply operation
- Ultrasmall and light (< 0.15 cc, < 0.5 gram)

APPLICATIONS

- Vehicle chassis rollover sensing
- Inertial measurement units
- Platform stabilization

GENERAL DESCRIPTION

The ADXRS300 is a complete angular rate sensor (gyroscope) that uses Analog Devices' surface-micromachining process to make a functionally complete and low cost angular rate sensor integrated with all of the required electronics on one chip. The manufacturing technique for this device is the same high volume BIMOS process used for high reliability automotive airbag accelerometers.

The output signal, RATEOUT (1B, 2A), is a voltage proportional to angular rate about the axis normal to the top surface of the package (see Figure 3). A single external resistor can be used to lower the scale factor. An external capacitor is used to set the bandwidth. Other external capacitors are required for operation (see Figure 4).

A precision reference and a temperature output are also provided for compensation techniques. Two digital self-test inputs electromechanically excite the sensor to test proper operation of both sensors and the signal conditioning circuits. The ADXRS300 is available in a 7 mm × 7 mm × 3 mm BGA chip-scale package.

FUNCTIONAL BLOCK DIAGRAM

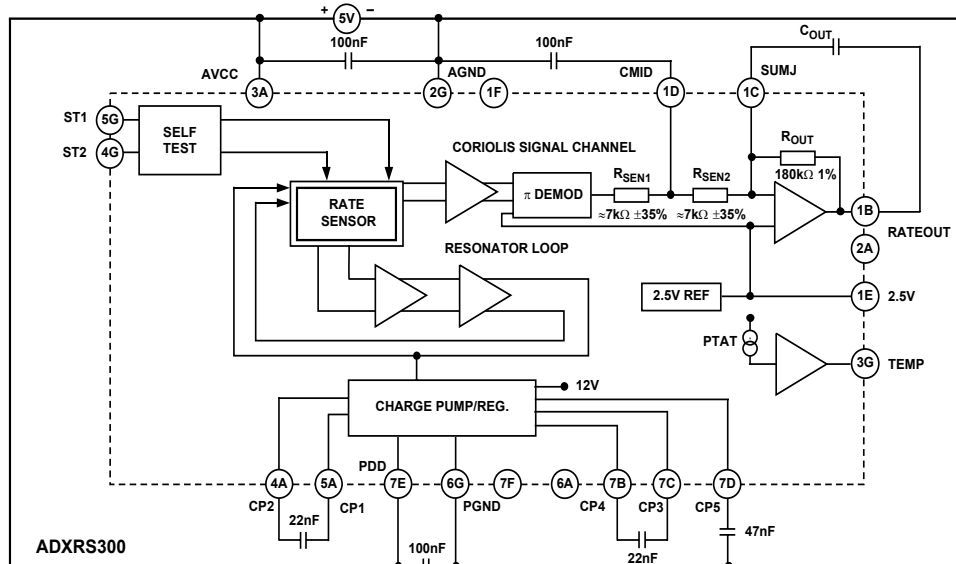


Figure 1.

Rev. A

Information furnished by Analog Devices is believed to be accurate and reliable. However, no responsibility is assumed by Analog Devices for its use, nor for any infringements of patents or other rights of third parties that may result from its use. Specifications subject to change without notice. No license is granted by implication or otherwise under any patent or patent rights of Analog Devices. Trademarks and registered trademarks are the property of their respective companies.

ADXRS300

TABLE OF CONTENTS

ADXRS300—Specifications	3	Using the ADXRS300 with a Supply-Ratiometric ADC	6
Absolute Maximum Ratings.....	4	Null Adjust	6
Rate Sensitive Axis.....	4	Self-Test Function	6
Theory of Operation	5	Continuous Self-Test.....	6
Supply and Common Considerations	5	Pin Configurations And Functional Descriptions	7
Setting Bandwidth	5	Outline Dimensions	8
Increasing Measurement Range	6		

REVISION HISTORY

Revision A

3/03—Data Sheet Changed from REV. 0 to REV. A

Edit to Figure 3.....5

ADXRS300—SPECIFICATIONS

Table 1. @T_A = 25°C, V_S = 5 V, Angular Rate = 0°/s, Bandwidth = 80 Hz (C_{OUT} = 0.01 μF), unless otherwise noted.

Parameter	Conditions	ADXRS300ABG			Unit
		Min ¹	Typ	Max ¹	
SENSITIVITY					
Dynamic Range ²	Clockwise Rotation Is Positive Output Full-Scale Range over Specifications Range	±300			°/s
Initial	@25°C	4.6	5	5.4	mV/°/s
Over Temperature ³	V _S = 4.75 V to 5.25 V	4.6	5	5.4	mV/°/s
Nonlinearity	Best Fit Straight Line		0.1		% of FS
NULL					
Initial Null		2.3	2.50	2.7	V
Over Temperature ³	V _S = 4.75 V to 5.25 V	2.3		2.7	V
Turn-On Time	Power on to ±½°/s of Final		35		ms
Linear Acceleration Effect	Any Axis		0.2		°/s/g
Voltage Sensitivity	V _{CC} = 4.75 V to 5.25 V		1		°/s/V
NOISE PERFORMANCE					
Rate Noise Density	@25°C		0.1		°/s/√Hz
FREQUENCY RESPONSE					
3 dB Bandwidth (User Selectable) ⁴	22 nF as Comp Cap (see Setting Bandwidth section)		40		Hz
Sensor Resonant Frequency			14		kHz
SELF-TEST INPUTS					
ST1 RATEOUT Response ⁵	ST1 Pin from Logic 0 to 1	-150	-270	-450	mV
ST2 RATEOUT Response ⁵	ST2 Pin from Logic 0 to 1	+150	+270	+450	mV
Logic 1 Input Voltage	Standard High Logic Level Definition	3.3			V
Logic 0 Input Voltage	Standard Low Logic Level Definition			1.7	V
Input Impedance	To Common		50		kΩ
TEMPERATURE SENSOR					
V _{OUT} at 298°K			2.50		V
Max Current Load on Pin	Source to Common			50	μA
Scale Factor	Proportional to Absolute Temperature		8.4		mV/°K
OUTPUT DRIVE CAPABILITY					
Output Voltage Swing	I _{OUT} = ±100 μA	0.25		V _S - 0.25	V
Capacitive Load Drive		1000			pF
2.5 V REFERENCE					
Voltage Value		2.45	2.5	2.55	V
Load Drive to Ground	Source		200		μA
Load Regulation	0 < I _{OUT} < 200 μA		5.0		mV/mA
Power Supply Rejection	4.75 V _S to 5.25 V _S		1.0		mV/V
Temperature Drift	Delta from 25°C		5.0		mV
POWER SUPPLY					
Operating Voltage Range		4.75	5.00	5.25	V
Quiescent Supply Current			6.0	8.0	mA
TEMPERATURE RANGE					
Specified Performance Grade A	Temperature Tested to Max and Min Specs.	-40		+85	°C

¹ All min and max specifications are guaranteed. Typical specifications are not tested or guaranteed.

² Dynamic range is the maximum full-scale measurement range possible, including output swing range, initial offset, sensitivity, offset drift, and sensitivity drift at 5 V supplies.

³ Specification refers to the maximum extent of this parameter as a worst-case value of T_{MIN} or T_{MAX}.

⁴ Frequency at which response is 3 dB down from dc response with specified compensation capacitor value. Internal pole forming resistor is 180 kΩ. See Setting Bandwidth section.

⁵ Self-test response varies with temperature. Refer to the Self-Test Function section for details.

ADXRS300

ABSOLUTE MAXIMUM RATINGS

Table 2. ADXRS300 Absolute Maximum Ratings

Parameter	Rating
Acceleration (Any Axis, Unpowered, 0.5 ms)	2000 g
Acceleration (Any Axis, Powered, 0.5 ms)	2000 g
+V _s	-0.3 V to +6.0 V
Output Short-Circuit Duration (Any Pin to Common)	Indefinite
Operating Temperature Range	-55°C to +125°C
Storage Temperature	-65°C to +150°C

Stresses above those listed under the Absolute Maximum Ratings may cause permanent damage to the device. This is a stress rating only; functional operation of the device at these or any other conditions above those indicated in the operational section of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

Applications requiring more than 200 cycles to MIL-STD-883 Method 1010 Condition B (-55°C to +125°C) require underfill or other means to achieve this requirement.

Drops onto hard surfaces can cause shocks of greater than 2000 g and exceed the absolute maximum rating of the device. Care should be exercised in handling to avoid damage.

Rate Sensitive Axis

This is a Z-axis rate-sensing device that is also called a yaw-rate sensing device. It produces a positive going output voltage for clockwise rotation about the axis normal to the package top, i.e., clockwise when looking down at the package lid.

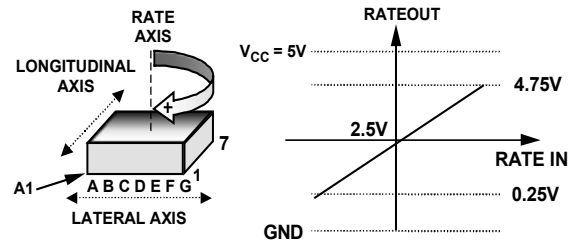


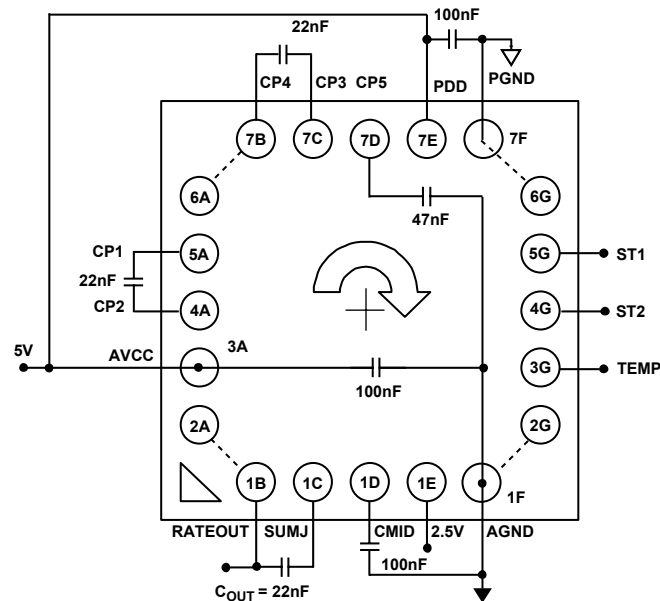
Figure 2. RATEOUT Signal Increases with Clockwise Rotation

THEORY OF OPERATION

The ADXRS300 operates on the principle of a resonator gyro. Two polysilicon sensing structures each contain a dither frame, which is electrostatically driven to resonance. This produces the necessary velocity element to produce a Coriolis force during angular rate. At two of the outer extremes of each frame, orthogonal to the dither motion, are movable fingers that are placed between fixed pickoff fingers to form a capacitive pickoff structure that senses Coriolis motion. The resulting signal is fed to a series of gain and demodulation stages that produce the electrical rate signal output. The dual-sensor design rejects external *g*-forces and vibration. Fabricating the sensor with the signal conditioning electronics preserves signal integrity in noisy environments.

The electrostatic resonator requires 14 V to 16 V for operation. Since only 5 V is typically available in most applications, a charge pump is included on-chip. If an external 14 V to 16 V supply is available, the two capacitors on CP1–CP4 can be omitted and this supply can be connected to CP5 (Pin 7D) with a 100 nF decoupling capacitor in place of the 47 nF.

After the demodulation stage there is a single-pole low-pass filter consisting of an internal 7 kΩ resistor (R_{SEN1}) and an external user-supplied capacitor (CMID). A CMID capacitor of 100 nF sets a 400 Hz $\pm 35\%$ low-pass pole and is used to limit high frequency artifacts before final amplification. Bandwidth limit capacitor, C_{OUT} , sets the pass bandwidth (see Figure 4 and the Setting Bandwidth section).



NOTE THAT INNER ROWS/COLUMNS OF PINS HAVE BEEN OMITTED FOR CLARITY BUT SHOULD BE CONNECTED IN THE APPLICATION.

Figure 3. Example Application Circuit (Top View)

Supply and Common Considerations

Only power supplies used for supplying analog circuits are recommended for powering the ADXRS300. High frequency noise and transients associated with digital circuit supplies may have adverse effects on device operation.

Figure 3 shows the recommended connections for the ADXRS300 where both AVCC and PDD have a separate decoupling capacitor. These should be placed as close to their respective pins as possible before routing to the system analog supply. This will minimize the noise injected by the charge pump that uses the PDD supply.

It is also recommended to place the charge pump capacitors connected to the CP1–CP4 pins as close to the part as possible. These capacitors are used to produce the on-chip high voltage supply switched at the dither frequency at approximately 14 kHz. Care should be taken to ensure that there is no more than 50 pF of stray capacitance between CP1–CP4 and ground. Surface-mount chip capacitors are suitable as long as they are rated for over 15 V.

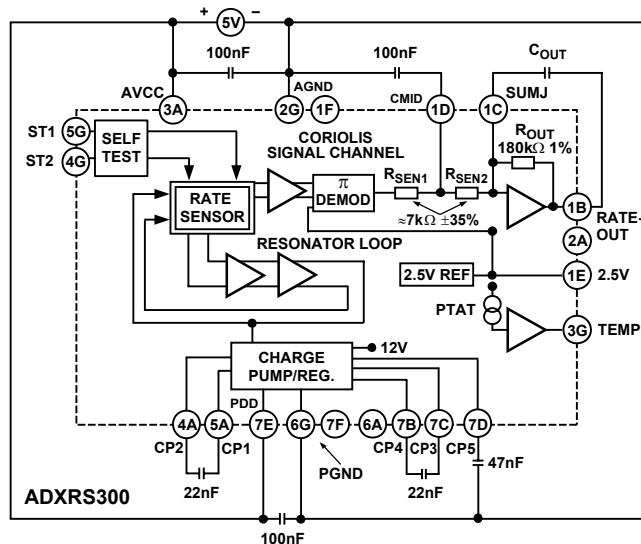


Figure 4. Block Diagram with External Components

Setting Bandwidth

External capacitors C_{MID} and C_{OUT} are used in combination with on-chip resistors to create two low-pass filters to limit the bandwidth of the ADXRS300's rate response. The -3 dB frequency set by R_{OUT} and C_{OUT} is

$$f_{OUT} = 1/(2 \times \pi \times R_{OUT} \times C_{OUT})$$

and can be well controlled since R_{OUT} has been trimmed during manufacturing to be $180 \text{ k}\Omega \pm 1\%$. Any external resistor applied

ADXRS300

between the RATEOUT (1B, 2A) and SUMJ (1C, 2C) pins will result in

$$R_{OUT} = (180 \text{ k}\Omega \times R_{EXT}) / (180 \text{ k}\Omega + R_{EXT})$$

The -3 dB frequency is set by RSEN (the parallel combination of R_{SEN1} and R_{SEN2}) at about 3.5 k Ω nominal; CMID is less well controlled since R_{SEN1} and R_{SEN2} have been used to trim the rate sensitivity during manufacturing and have a $\pm 35\%$ tolerance. Its primary purpose is to limit the high frequency demodulation artifacts from saturating the final amplifier stage. Thus, this pole of nominally 400 Hz @ 0.1 μ F need not be precise. Lower frequency is preferable, but its variability usually requires it to be about 10 times greater (in order to preserve phase integrity) than the well-controlled output pole. In general, both -3 dB filter frequencies should be set as low as possible to reduce the amplitude of these high frequency artifacts and to reduce the overall system noise.

Increasing Measurement Range

The full-scale measurement range of the ADXRS300 can be increased by placing an external resistor between the RATEOUT (1B, 2A) and SUMJ (1C, 2C) pins, which would parallel the internal R_{OUT} resistor that is factory-trimmed to 180 k Ω . For example, a 330 k Ω external resistor will give ~50% increase in the full-scale range. This is effective for up to a 4 \times increase in the full-scale range (minimum value of the parallel resistor allowed is 45 k Ω). Beyond this amount of external sensitivity reduction, the internal circuitry headroom requirements prevent further increase in the linear full-scale output range. The drawbacks of modifying the full-scale range are the additional output null drift (as much as 2°/sec over temperature) and the readjustment of the initial null bias (see the Null Adjust section).

Using the ADXRS300 with a Supply-Ratiometric ADC

The ADXRS300's RATEOUT signal is nonratiometric, i.e., neither the null voltage nor the rate sensitivity is proportional to the supply. Rather they are nominally constant for dc supply changes within the 4.75 V to 5.25 V operating range. If the ADXRS300 is used with a supply-ratiometric ADC, the ADXRS300's 2.5 V output can be converted and used to make corrections in software for the supply variations.

Null Adjust

Null adjustment is possible by injecting a suitable current to SUMJ (1C, 2C). Adding a suitable resistor to either ground or to

the positive supply is a simple way of achieving this. The nominal 2.5 V null is for a symmetrical swing range at RATEOUT (1B, 2A). However, a nonsymmetrical output swing may be suitable in some applications. Note that if a resistor is connected to the positive supply, then supply disturbances may reflect some null instabilities. Digital supply noise should be avoided particularly in this case (see the Supply and Common Considerations section).

The resistor value to use is approximately

$$R_{NULL} = (2.5 \times 180,000) / (V_{NULL0} - V_{NULL1})$$

V_{NULL0} is the unadjusted zero rate output, and V_{NULL1} is the target null value. If the initial value is below the desired value, the resistor should terminate on common or ground. If it is above the desired value, the resistor should terminate on the 5 V supply. Values are typically in the 1 M Ω to 5 M Ω range.

If an external resistor is used across RATEOUT and SUMJ, then the parallel equivalent value is substituted into the above equation. Note that the resistor value is an estimate since it assumes $V_{CC} = 5.0$ V and $V_{SUMJ} = 2.5$ V.

Self-Test Function

The ADXRS300 includes a self-test feature that actuates each of the sensing structures and associated electronics in the same manner as if subjected to angular rate. It is activated by standard logic high levels applied to inputs ST1 (5F, 5G), ST2 (4F, 4G), or both. ST1 will cause a voltage at RATEOUT equivalent to typically -270 mV and ST2 will cause an opposite +270 mV change. The self-test response follows the viscosity temperature dependence of the package atmosphere, approximately 0.25%/°C.

Activating both ST1 and ST2 simultaneously is not damaging. Since ST1 and ST2 are not necessarily closely matched, actuating both simultaneously may result in an apparent null bias shift.

Continuous Self-Test

The one-chip integration of the ADXRS300 gives it higher reliability than is obtainable with any other high volume manufacturing method. Also, it is manufactured under a mature BiMOS process that has field-proven reliability. As an additional failure detection measure, power-on self-test can be performed. However, some applications may warrant continuous self-test while sensing rate. Application notes outlining continuous self-test techniques are also available on the Analog Devices website.

PIN CONFIGURATIONS AND FUNCTIONAL DESCRIPTIONS

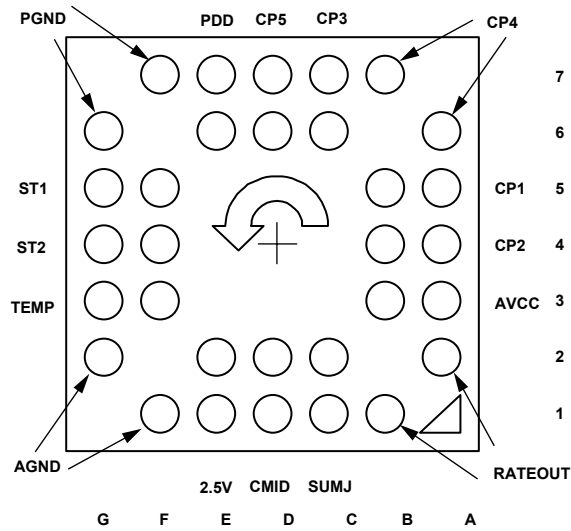


Figure 5. 32-Lead BGA (Bottom View)

Table 3. Pin Function Descriptions—32-LEAD BGA

Pin No.	Mnemonic	Description
6D, 7D	CP5	HV Filter Capacitor—47 nF
6A, 7B	CP4	Charge Pump Capacitor—22 nF
6C, 7C	CP3	
5A, 5B	CP1	Charge Pump Capacitor—22 nF
4A, 4B	CP2	
3A, 3B	AVCC	+ Analog Supply
1B, 2A	RATEOUT	Rate Signal Output
1C, 2C	SUMJ	Output Amp Summing Junction
1D, 2D	CMID	HF Filter Capacitor—100 nF
1E, 2E	2.5V	2.5 V Precision Reference
1F, 2G	AGND	Analog Supply Return
3F, 3G	TEMP	Temperature Voltage Output
4F, 4G	ST2	Self-Test for Sensor 2
5F, 5G	ST1	Self-Test for Sensor 1
6G, 7F	PGND	Charge Pump Supply Return
6E, 7E	PDD	+ Charge Pump Supply

ADXRS300

OUTLINE DIMENSIONS

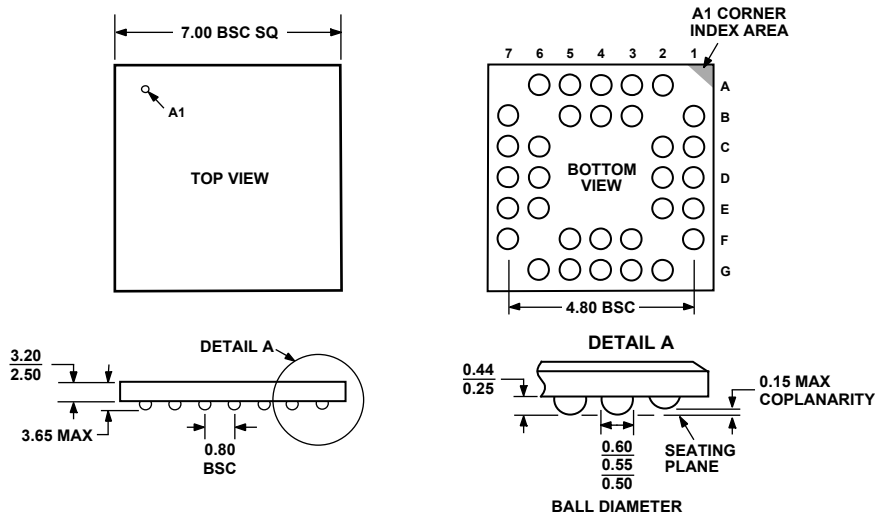


Figure 6. 32-Lead Chip Scale Ball Grid Array [CSPBGA]
(BC-32)
Dimensions shown in millimeters

ESD CAUTION

ESD (electrostatic discharge) sensitive device. Electrostatic charges as high as 4000 V readily accumulate on the human body and test equipment and can discharge without detection. Although this product features proprietary ESD protection circuitry, permanent damage may occur on devices subjected to high energy electrostatic discharges. Therefore, proper ESD precautions are recommended to avoid performance degradation or loss of functionality.



Ordering Guide

ADXRS300 Products	Temperature Package	Package Description	Package Outline
ADXRS300ABG	-40°C to +85°C	32-Lead BGA	BC-32
ADXRS300ABG-Reel	-40°C to +85°C	32-Lead BGA	BC-32

Copyright © Each Manufacturing Company.

All Datasheets cannot be modified without permission.

This datasheet has been download from :

www.AllDataSheet.com

100% Free DataSheet Search Site.

Free Download.

No Register.

Fast Search System.

www.AllDataSheet.com