

Revision: October 24, 2012

Note: This document applies to REV A of the board.

## Overview

The PmodGYRO2 features the Analog Devices ADXRS453 High Performance, Digital Output Gyroscope that is ideal for systems in need of a gyroscope for high vibration environments.

## Functional Description

The PmodGYRO2 is a single-axis high performance gyroscope that utilizes a standard 6-pin connector and communicates via a Serial Peripheral Interface (SPI) bus.

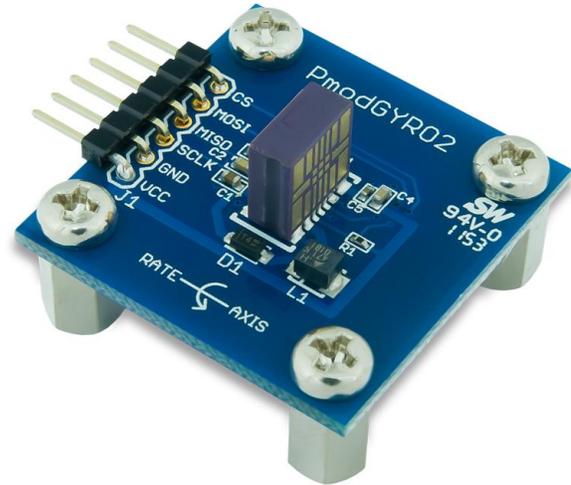
## Interface

The PmodGYRO2 interfaces with systems using standard SPI transmission protocol. (See table 1 for signal descriptions.) The module is set up for *Clock Phase = Clock Polarity = 0* or SPI mode 0. Users should drive SPI communication only to a maximum frequency of 8MHz.

This Analog Devices gyroscope utilizes a 32-bit Command/Response system to facilitate communication with user devices. System commands are sent to the Pmod during one 32-bit transmission sequence, and it returns a response during the next 32-bit transmission sequence. This message layout ensures that the very first module response is always 0x00000001. (See table 2 for details on bit definitions.)

When users assert chip select for each command, the PmodGyro2 begins latching rate data in case the command is a data request. The device then sends the data via the response in the next command sequence. The PmodGyro2 is capable of sending three different types of command packets and returning four different response packets. (See tables 3 and 4 for a breakdown of the allowed SPI commands and responses.)

Even though commands are 32-bits wide and the data part is 16-bits wide, each register in



Features include:

- Simple SPI interface
- $\pm 300^\circ/\text{sec}$  angular rate sensing
- Ultrahigh vibration rejection  $.01^\circ/\text{sec/g}$
- Excellent  $16^\circ/\text{hour}$  null bias stability
- Internal temperature compensation
- Continuous self-test

the device is only 8-bits wide. Due to the differences in widths, a read command will return the register requested and the next sequential register in the memory map. The same width ratio applies to a write command. **Users should address read and write commands to even registers only.** Users that desire access to an odd register must address commands to the previous (even) register.

For simple acquisition of data, users should issue an SPI Command in the Sensor Data Format. This will return an SPI Response in the Sensor Data Format on the next SPI transmission.

The ADXRS453 has a continuous self-test function that tests the complete electromechanical system and reports errors to the user. The ADXRS453 returns results to users via the FAULT register. The status of the PmodGYRO2 is included in most responses. The PmodGyro2 also prevents

temporary spikes in data from causing a failing status response by filtering raw data from the self-test before sending a pass/fail status. The module stores both the raw data and the filtered data in the HICSTx and LOCSTx registers. Users may access this data should they be concerned about these energy spikes.

The temperature sensor data is useful for temperature compensation of the rate data and is also directly available to the user. To get the temperature sensor data users must simply execute a read command of the TEMx registers from the device.

*Note: For more information on the GYRO2 module interface, see the ADXRS453 datasheet available online from Analog Devices at [www.analog.com](http://www.analog.com).*

**Table 1: Interface Connector Signal Description**

Connector J1		
Pin	Signal	Description
1	CS	Chip Select
2	MOSI	Master Out/Slave In
3	MISO	Master In/Slave Out
4	SCLK	Serial Clock
5	GND	Power Supply Ground
6	VCC	Power Supply (3.3v)

**Table 2: SPI Bit Definitions**

Bits	Description
SQ[2:0]	Sequence bits
SM[2:0]	Sensor module bits (always 0b000)
A[8:0]	Register address
D[15:0]	Data
P	Command odd parity
SPI	SPI command/response error
RE	Request Error
DU	Data Unavailable
ST[1:0]	Status Bits
P0	Response, odd parity, Bits[31:16]
P1	Response, odd parity, Bits[31:0]

**Table 3: SPI Commands**

Command	Bit																																
	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	
Sensor Data	SQ1	SQ0	1	SQ2																												CHK	P
Read	1	0	0	SM2	SM1	SM0	A8	A7	A6	A5	A4	A3	A2	A1	A0																		P
Write	0	1	0	SM2	SM1	SM0	A8	A7	A6	A5	A4	A3	A2	A1	A0	D15	D14	D13	D12	D11	D10	D9	D8	D7	D6	D5	D4	D3	D2	D1	D0	P	

**Table 4: SPI Responses**

Command	Bit																																
	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	
Sensor Data	SQ2	SQ1	SQ0	P0	ST1	ST0	D15	D14	D13	D12	D11	D10	D9	D8	D7	D6	D5	D4	D3	D2	D1	D0				PLL	Q	NVM	POR	PWR	CST	CHK	P1
Read	0	1	0	P0	1	1	1	0	SM2	SM1	SM0	D15	D14	D13	D12	D11	D10	D9	D8	D7	D6	D5	D4	D3	D2	D1	D0						P1
Write	0	0	1	P0	1	1	1	0	SM2	SM1	SM0	D15	D14	D13	D12	D11	D10	D9	D8	D7	D6	D5	D4	D3	D2	D1	D0						P1
R/W Error	0	0	0	P0	1	1	1	0	SM2	SM1	SM0	0	0	SPI	RE	DU																	P1