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Gyroscope Module 3-Axis L3G4200D (#27911)

The Gyroscope Module is a low power 3-Axis angular rate sensor with temperature data. The gyroscope shows the rate of change in rotation on its X,Y and Z axes. Temperature output data and raw measured angular rate is accessed from the selectable digital interface (I²C or SPI). The module is a small package design and has an easy to access SIP interface with a mounting hole for quick connectivity to your projects. The module is designed for use with a large variety of microcontrollers with different voltage requirements.

Features

- 3-Axis angular rate sensor (yaw, pitch, and roll)
- Supports I^{2}C and SPI communications
- Three selectable scales: 250/500/2000 degrees/sec (dps)
- High shock survivability
- Embedded temperature sensor -40 to +185 °F (-40 to + 85 °C)
- Embedded power-down and sleep mode
- 16 bit-rate value data output
- 8-bit temperature data output

Key Specifications

- Power Requirements: 2.7 to 6.5 VDC
- Communication Interface: I^{2}C (up to 400 kHz) or SPI (10 MHz; 4 & 3 wire)
- Operating temperature: -40 to +185 °F (-40 to +85 °C)
- Dimensions: 0.85 X 0.80 in (2.16 X 2.03 cm)

Application Ideas

- Gaming
- 3D motion control
- Virtual reality input devices
- Robotics
- UAV, IMU systems

Downloads & Resources

More resources, example code, the device schematic, and open-source hardware files are available from the 27911 product page at www.parallax.com.

Quick-Start Guide

The following is a very basic procedure to get started initializing and reading values from the Gyroscope Module. Example test code for the Propeller and Basic Stamp can be found on the 27911 product page at www.parallax.com.

This module's default communication setup is I²C. Use of SPI communication is configured by pulling the CS line low. See the datasheet for 3-wire and 4-wire SPI configuration and use.

1. With main power off, make the proper connections between the module and a microcontroller as shown below. The voltage connected to the VIN pin should be the same as the voltage powering the microcontroller communicating with the device.

2. Power on the device and load the BASIC Stamp or Propeller sample code provided on the 27911 product page.
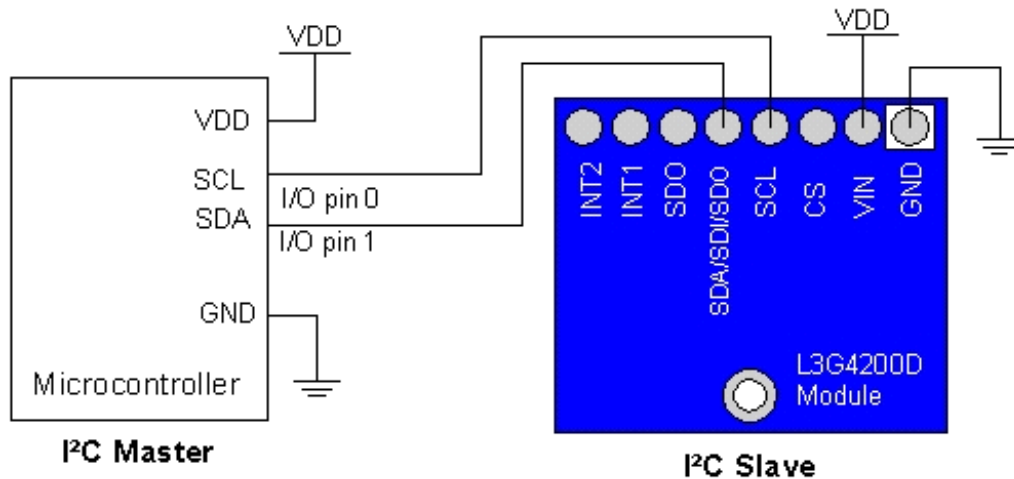
NOTE: The SDA pin is connected to a bi-directional level shifting IC, used to translate the lower I/O voltage of the L3G4200D to the possibly higher voltage used by an externally connected device. This particular level shifter has built-in pull-up resistors to each supply rail so it can be driven by open drain outputs for I²C; but can also be driven low/high for SPI protocol. The CLK and CS pins operate exclusively as inputs, so a simpler level shifting circuit with a resistor and Schottky diode is used. For the SDO pin another simple level shifting circuit is used along with a MOSFET and two resistors.

In summary, there is no need for any external hardware to operate.

Calibration

Each L3G4200D is factory tested and trimmed for zero-rate level and sensitivity. So, for most common applications, no further calibration is required. For details on the calibration, please reference page 31 of Gyro_app_Note1.pdf on the product page.

Device Information

Complete device information for the L3G4200D can be found in the manufacturer's datasheet, which is available for download from the 27911 product page at www.parallax.com

Pin Definitions and Ratings

Pin	Name	Type	Function
1	GND	G	0V Supply, Ground Pin
2	VIN	P	Supply Voltage from +2.7 – +6.5VDC
3	CS	I	SPI enable (Default is I²C enabled) I²C/SPI mode selection (1: I²C communication enabled; 0: SPI communication mode / I2C disabled)
4	SCL	I	I²C & SPI serial clock (SCL)
5	SDA/SDI/SDO	IO	I²C serial data (SDA) SPI serial data input (SDI) 3-wire interface serial data output (SDO)
6	SDO	O	SPI serial data output (SDO) I²C least significant bit of the device address (SA0)
7	INT1	O	Programmable interrupt, see datasheet for more details
8	INT2	O	Data ready/FIFO interrupt, see datasheet for more details

Pin Type: P = Power, G = Ground, I = Input, O = Output
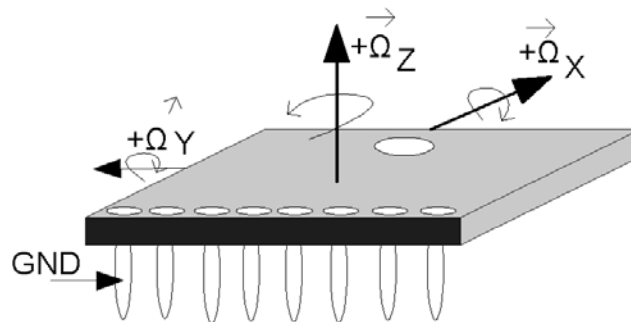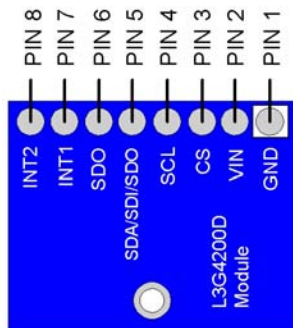
Module Dimensions
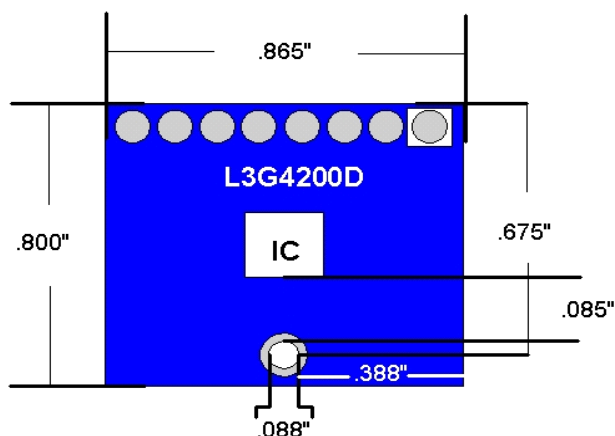
L3G4200D Mechanical Characteristics

Characterized @ Vdd = 3.0 V, T = 25 °C

Symbol	Parameter	Test condition	Typical	Units
FS	Measurement range	User-selectable	±250	dps
			±500	
			±2000	
So	Sensitivity	FS = 250 dps	8.75	Mdps/digit
		FS = 500 dps	17.50	
		FS = 2000 dps	70	
SoDr	Sensitivity change vs. temperature	From -40 °C to +85 °C	±2	%
DVoff	Digital zero-rate level	FS = 250 dps	±10	dps
		FS = 500 dps	±15	
		FS = 2000 dps	±75	
OffDr	Zero-rate level change vs. temperature	FS = 250 dps	±0.03	dps/°C
		FS = 500 dps	±0.04	
NL	Non linearity	Best fit straight line	0.2	% FS
DST	Self-test output change	FS = 250 dps	130	dps
		FS = 500 dps	200	
		FS = 2000 dps	530	
Rn	Rate noise density	BW = 50 Hz	0.03	dps/sqrt(Hz)
ODR	Digital output data rate		100/200/ 400/800	Hz

Data excerpt from the L3G4200D datasheet.

Communication Protocol

Note: details on the communication protocol and FIFO modes are taken from the L3G4200D datasheet. Please reference the datasheet for much more detailed explanations and configurations.

Communication Settings

You can select between I²C (2-wire) or SPI (3 or 4 wire) communication protocols; I²C is the default setting for this module. These serial interfaces are mapped onto the same pins.

I²C
The Gyroscope module I^{2}C is a bus slave. I²C communication is used to read and write to and from the Gyroscope's data registers.

The two signals need for I²C operation are the serial clock line (SCL) and the serial data line (SDA). The SDA line is bidirectional and used for sending and receiving the data to/from the interface.

SPI
The SPI is a bus slave. The SPI communication is used to read and write to and from the Gyroscope's data registers. The serial interface interacts with the external world through 4 wires: CS, SCL, SDI, and SDO (see Pin Definitions and Ratings for descriptions).

FIFO Modes

FIFO is an acronym for First In, First Out. It used to buffer data to help with flow of communication to devices.

There are 32 slots of FIFO data, for each of the three output channels: yaw, pitch, and roll (X,Y,Z). Each slot has 16 bits of data.

The great thing about having a FIFO is the host processor does not need to continuously poll data from the sensor. Instead, it can wake up only when needed and burst the significant data out from the FIFO. This buffer can work in five different modes.

There are five FIFO mode settings available; the default mode is "Bypass mode." To see how to access different modes, see FIFO_CTRL_REG and FIFO_SRC_REG in the datasheet posted to the 27911 product page at www.parallax.com.

Bypass Mode
In bypass mode, the FIFO is not operational and for this reason it remains empty.

FIFO Mode
In FIFO mode, data from the yaw, pitch, and roll channels are stored in the FIFO.

Stream Mode
In stream mode, data from yaw, pitch, and roll measurements are stored in the FIFO. The FIFO continues filling until full (32 slots of 16-bit data for yaw, pitch, and roll). When full, the FIFO discards the older data as the new data arrives.

Bypass-to-stream Mode
In bypass-to-stream mode, the FIFO starts operating in bypass mode, and once a trigger event occurs, the FIFO starts operating in stream mode.

Stream-to-FIFO Mode
In stream-to-FIFO mode, data from yaw, pitch, and roll measurements are stored in the FIFO. An interrupt can be enabled on pin INT2, setting the I2_WTM bit in CTRL_REG3, which is triggered when the FIFO is filled to the level specified in the WTM. The FIFO continues filling until full (32 slots of 16-bit data for yaw, pitch, and roll).

Example Code

Example code is available for download from the 27911 product page at www.parallax.com

BASIC Stamp 2
The L3G4200D_Gyroscope_Demo.bs2 program reads raw X,Y,Z values from the Gyroscope module using the default I²C interface, and displays the values in the BASIC Stamp Editor's Debug Terminal. The software is a free download from www.parallax.com/basicstampsoftware.

Propeller™ P8X32A
The L3G4200D_example_code.spin program reads raw X,Y,Z values from the Gyroscope module using the default I²C interface, and displays the values in a serial terminal. It calls FullDuplexSerial.spin, a library object of the Propeller Tool software, which is available from www.parallax.com/Propeller.

Revision History

Version 1.1: Corrected Type for pins 7 and 8 in Pin Definitions and Ratings table, page 3.

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