3dm2010

3d module for measuring angular rates, integrated angle, and linear accelerations

Key Features

- Heading reference for robot-cleaner
- Angle & Angular rate output
- 3 axis acceleration output
- Ultra Low Bias Drift
- High Resolution and Accuracy
- Outstanding Scale Factor Linearity
- Fast Start-up
- Fully Self Contained
- UART Digital Output
- Low Power Consumption
- RoHS compliant
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Applications

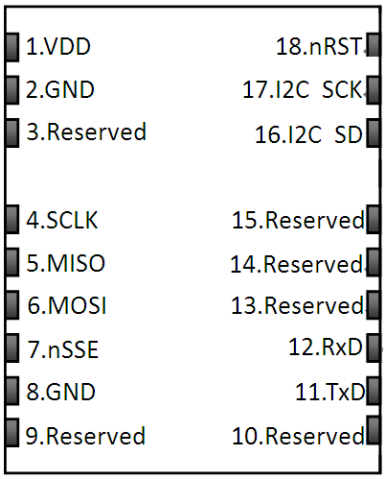
- Gesture recognition
- Robotics,
- Vehicles,
- Virtual Reality,
- Medical Devices,
- model airplane

Product Overview

The MiraMEMS 3dm2010 is a digital gyroscope and accelerometer used for measuring angular rates, heading angle (also known as orientation or yaw) and accelerations under dynamic conditions. It is a highly compact, light, and fully self-contained device. Internally the MiraMEMS 3dm2010 contains a MEMS gyroscope, 3 axis accelerometer, internal voltage regulator, signal processing circuitry, AD converter and a RISC microprocessor running our patented errorcorrecting algorithm. The MiraMEMS 3dm2010 uses an adaptive reduced order Kalman filter to reduce the errors that affect this type of sensors (i.e. bias drift, scale factor, asymmetry), as the result it produces very accurate stabilized angular rates and heading angle. The start-up time is less than 1 second, which is used to compute bias parameters; it does not require further calibration thereafter. The MiraMEMS 3dm2010 provides the best solution for low-cost but very accurate consumer robot applications.

Content

1 Pin description



Top View

Figure 1 Pin Connections

Table 1. Pin description

Pin#	Name	Function
1	VDD	Power supply
2	GND	0V supply
3	Reserved	Not connected
4	SCLK	SPI communication clock
5	MISO	SPI master input, slave output function
6	MOSI	SPI master input, slave output function
7	nSSEL	SPI slave select function
8	GND	0V supply
9	Reserved	Not connected
10	Reserved	Not connected
11	TxD	UART transmit data
12	RxD	UART receive data
13	Reserved	Not connected
14	Reserved	Not connected
15	Reserved	Not connected
16	I2C SDA	I2C data line
17	I2C SCK	I2C clock line
18	nRST	System reset input

2 Mechanical and electrical specifications

The MiraMEMS 3dm2010 is a fully self-contained MEMS digital gyroscope and accelerometer for measuring heading angle and acceleration under dynamic condition. The MiraMEMS 3dm2010 is the perfect substitute for high performance and highly reliable mechanical or optical gyroscopes used in robotics, stabilization, guidance and control systems. It is a highly compact with digital UART communication interfaces. The MiraMEMS 3dm2010 uses MEMS sensors resulting in low-cost and high reliability. The patented bias and scale-factor error estimation algorithm minimizes the bias drift and angle error due to the temperature variation.

2.1 Mechanical characteristics

Vdd =3.3 V, T = 25 °C unless otherwise noted (a)

a. The product is factory calibrated at 3.3 V. The operational power supply range is from 3V to 5.5 V.

Table 2. Mechanical characteristic

Parameter	Test conditions	Min	Type	Max	Unit
Angle & rate	Input Dynamic Range		±100		˚/sec(Continuous)
			±150		˚/sec(Instantaneous)
	Rate Noise (1σ@50Hz bandwidth)			0.1	˚/sec(Typical)
	Scale Factor Nonlinearity		0.5 %		
	Bandwidth		50		Hz
	Bias Drift			10	˚/hr
Acceleration	Input Dynamic Range		±2		g

2.2 Electrical characteristics

Vdd = 2.5 V, T = 25 °C unless otherwise noted.

Table 3. Electrical characteristics

Parameter	Test conditions	Min	Typ.	Max	Unit
Power Consumption				43	mW(@3.3V)
Input Voltage		3.2		5.5	V
Output Rate	Top=25℃, ODR=1kHz		100(10,25,50Hz Selectable)		Hz

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 4. Absolute maximum ratings

Parameter	Test conditions	Min	Max	Unit
Storage Temperature		-45	125	℃
Operating Temperature		-20	85	℃
ESD Rating	HMB,R=1.5k,C=100pF		±2	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.

2.4 Sensor start-up

The MiraMEMS 3dm2010 startup time is less than onesecond, it internally compensates for errors due to changes in temperature. However, sudden temperature changes shortly after powering-on the unit can cause static rate errors. If such temperature chances are expected, we recommend leaving the gyro stationary for about 4 seconds after startup.

WARNING: The MiraMEMS 3dm2010 must remain stationary during the startup time, failing to do so will introduce a constant drift in the output.

3 Software Description

3.1 Output Data Format

The MiraMEMS 3dm2010 provides rate, angle and acceleration outputs. The angle output is relative and can be affected by several conditions such as sampling rate variations, bandwidth limitation, dynamic range, alignment, and device mounting.

3.1.1 Integer Output Format

The MiraMEMS 3dm2010 provides rate, angle and acceleration outputs. The output format is described inTable5.

Table 5. data fields description

Output data	Byte	Comments
HEADER	1-2	Hex valueis: 0xAA00
INDEX	3	0x00~ 0xFF
ANGLE*	4-5	Provided in hundredths of deg. And normalized to±180 deg.
RATE*	6-7	Provided in hundredths of deg/sec
X-axis Acceleration	8-9	Provided in 1 mg resolution
Y-axis Acceleration	10-11	Provided in 1 mg resolution
Z-axis Acceleration	12-13	Provided in 1 mg resolution
RESERVED	14	
CHECKSUM*	15	Isequalto: index+ angle(LSB) + angle(MSB) +rate(LSB) +rate(MSB) + Xacc(LSB) +Xacc(MSB) +Yacc(LSB) + Yacc(MSB) +Zacc(LSB) +Zacc(MSB) + reserved

3.2 Input Command Format

3.2.1 INIT Field

Command start identifier. Must be '$MIA'.

3.2.2 FORMAT Field

Data output format. Floating point (F), integer (I), or ASCII (A) format (The floating point and ASCII formats are only available as an option).

3.2.3 BAUD RATE Field

The baud rate setting can be chosen from the following available options: 115200, 57600, 38400, 28800, 19200, 9600, and 4800. Notice that the baud rate is set before the data output rate, therefore a low baud rate can limit the maximum data output rate. For example, for 4800 baud rate the maximum data output rate is only 25Hz. Table 6 shows the maximum output rates for a given baud rate.

Table 6. Baud rate and maximum output rate

BAUD RATE	115200	57600	38400	28800	19200	9600	4800
MAX OUTPUTRATE	100Hz	100Hz	100Hz	100Hz	100Hz	50Hz	25Hz

3.2.4 OUTPUT RATE Field

Data output rate setting. This command determines data output rate, the following are the valid rates: 100Hz, 50Hz, 25Hz, and 10Hz.

3.2.5 TYPE Field

Data type setting. The rate and angle can be provided in 'Radian' (R) or 'Degree' (D) formats.

3.2.6 OUTPUT Field

Output setting ‘Y’ means all the data will be provided, and ‘N’ means none of the data will be provided.

3.2.7 FLASH Field

This command determines whether the setting is stored or not in flash memory. When the settings are stored in the flash memory, they will remain even after powering down the unit.

3.2.8 CHECK SUM Field

This is the sum of character after ‘$’ and before ‘*’, and it is represented in HEX value.

3.2.9 Software Reset

This command ‘$MIB, RESET* 87’ resets the device. There set command has its own identifier, which is different than the other available commands.

3.2.10 Default settings

Table 7 shows the factory default settings for the MiraMEMS 3dm2010, and Table 7 presents some examples of valid commands.

Table 7. Default settings

FIELD	DEFAUL TSETTING
FORMAT	I : integerformat
BAUDRATE	B,115200:115200bps
OUTPUT RATE	R,100 :100Hz
TYPE	D : Degree
OUTPUT	Y: all thedata valid
FLASH	N : No flashsaved

3.2.11 Example

Table 8. Command examples

Ex 1.	**SETTING**	Integer, 115200bps, 100Hz, Degree, Output enabled, Flash saved
	COMMAND	$MIA,I,B,115200,R,100,D,Y,Y*C4
Ex 2.	**SETTING**	Integer, 4800bps,10Hz, Radian, Output disabled, Flash saved
	COMMAND	$MIA,I,B,4800,R,10,R,N,Y*3A
Ex 3.	**SETTING**	Maintain current setting but only Output disabled, No flash saved
	COMMAND	$MIA,,,,,,,N,N*D3

4 Package information

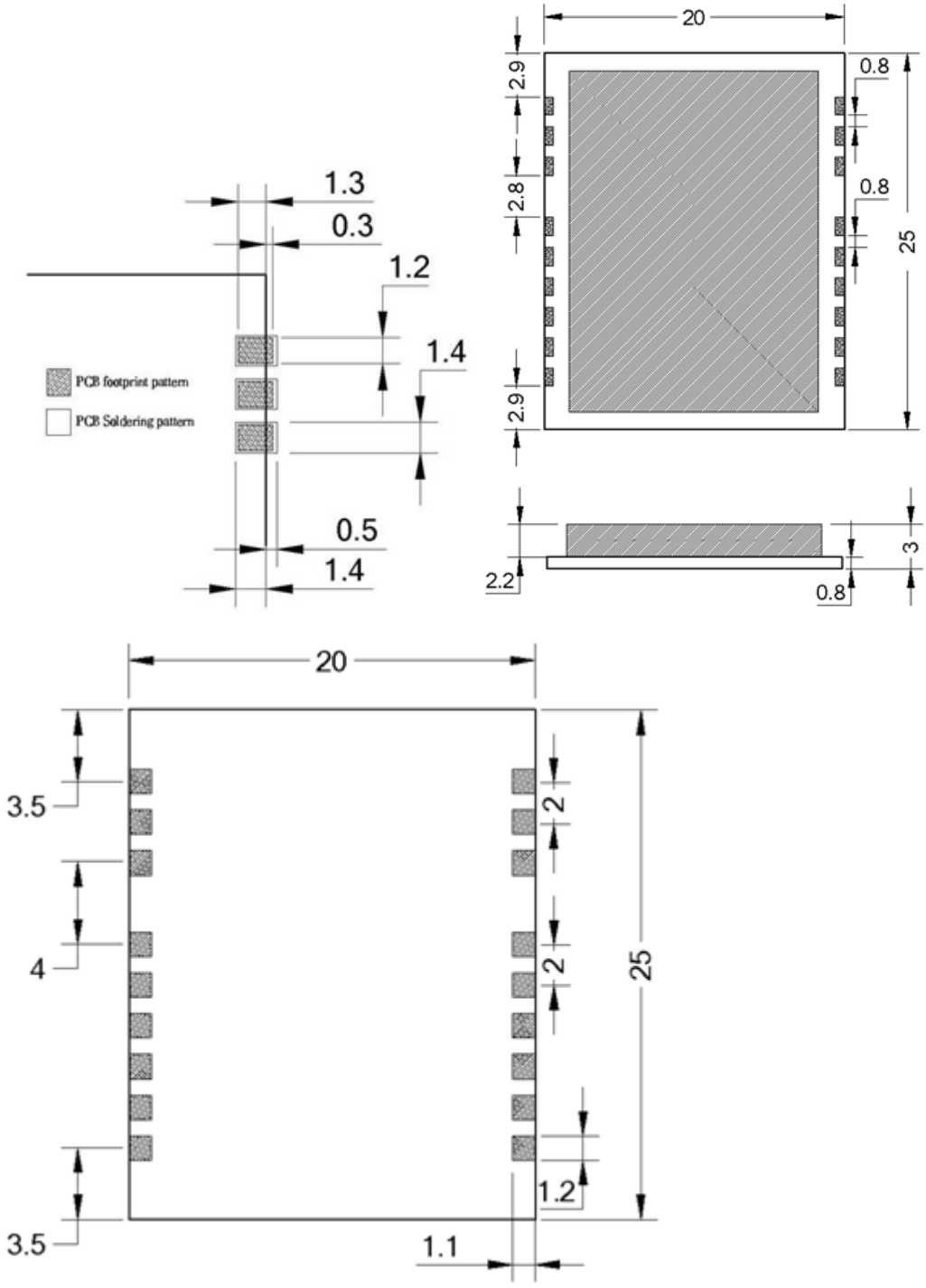


Figure 2 10 Pin LGA Mechanical data and package dimensions

5 Revision history

Table 9. Document revision history

Date	Revision	Changes
04-May-2014	1.0	Initial release