Goodrich ISR Systems

Crista Sensor Head ICD

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1 General Description

1.1 Key Features

- Very small size (1.10 inches x 1.15 inches x 0.59 inches)
- Axis Rate and Acceleration Sensing
- Calibrated over full -40 C to 80 C temperature range
- 16 Bit Resolution Data Conversion
- SPI interface to 16 bit A/D and EEPROM with temperature calibration corrections data.
- OEM form factor for direct integration into end user applications.

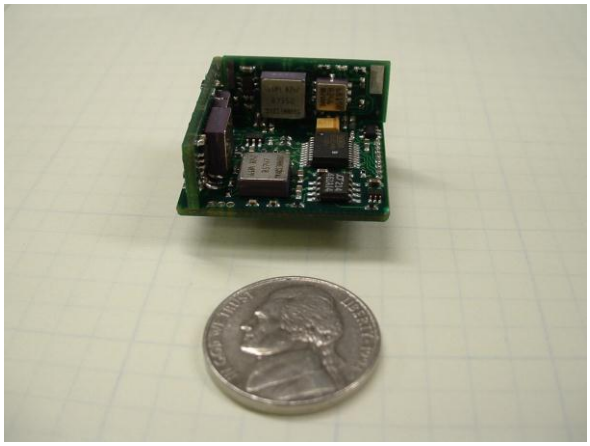

Figure 1 - Sensor Head

The Crista Sensor Head is a very small three axis inertial sensor package targeted for direct integration into end user application circuits. It provides high bandwidth (10 KHz – using 2 MHz SPI clock) raw measurements from Analog Devices ADXL 10g accelerometers and ADXRS MEMs 300 deg/sec rate sensors. Also included on the sensor head is an 8 channel, 16 bit, serial A to D converter; a 4.096V precision voltage reference; 8Kx8 serial EEPROM (used to store temperature calibration data); a 4:1 mux to facilitate 16 bit measurement of the gyro die temperatures and an on-board temperature sensor. A test input to gyros and accelerometers ICs causes diagnostic measured output shifts. The A/D and EEPROM are interfaced with a standard SPI bus.

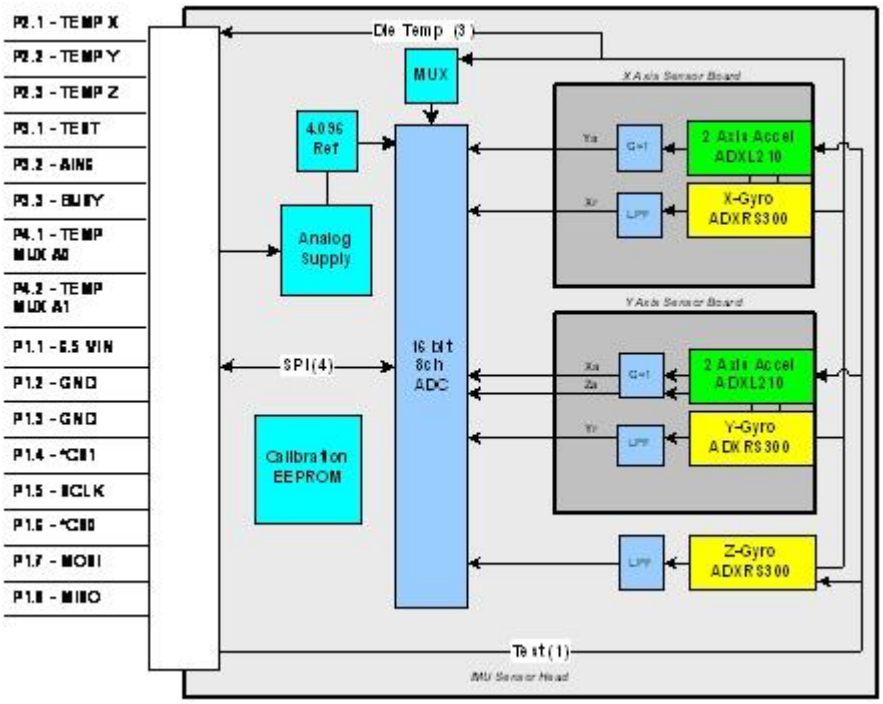

Figure 2 - Sensor Head Block Diagram

1.2 Crista IMU

The Sensor Head is also available integrated into the Crista IMU assembly that provides calibration corrected rate and acceleration readings over standard serial interfaces. The user can control data update rate and over-sample averaging of output data. A GPS PPS signal interface allows synchronization of IMU and GPS data.

More information on Crista IMU assembly and the associated Serial Developers Kit are available on our web site.

1.3 Applicable Export Controls

The Crista Sensor Head is a controlled export device under Department of Commerce Export Administration Regulations (EAR), as a CCL Category 7A994 device, and source software falls under CCL Category 7D002 Prior to selling to foreign customers, Cloud Cap will require a end-use letter from the customer, and will ensure that applicable license requirements are followed. Likewise, customers are responsible for following Department of Commerce rules for re-export of these devices.

2 Specifications

Gyros

- Range: ±300 º /sec
- Scale Factor Error: < 3 º/sec at room ambient
  - (Nonlinearity from best fit straight line. Typically much better at lower rates)
- In-Run Bias Error:
  - Fixed temperature < 0.2 º/sec (unit warmed up)
  - Over temperature < 1.5 º/sec (0.6 º/sec for 'A' spec parts)
- Turn-on to Turn-on Bias < 0.75 º/sec
- Linear Acceleration Effects 0.2 º /sec / G typical ; 1.5 º /sec / G max uncorrected.
- Noise (1σ, no oversamples) < ± 0.7 º /sec
- Cross Axis Rate Error 5 % uncorrected (2.6 % uncorrected for 'A' spec parts) (effect of off axis rate)
- A/D Measurement Resolution: 0.0155 º /sec
- Converted data rate resolution 0.009 º /sec (max output rate = 300 º /sec)
- Bandwidth 2nd order filter, Fc = 100 Hz

Accelerometers

- Range: ±10 G
- Scale Factor Error: < 100 mg (0.98 m/s^2) at room ambient
  (Nonlinearity from best fit straight line. Typically much better at lower accelerations))

- In-Run Bias Error:
  - Fixed temperature < 25 mG (0.245 m/s^2)
  - Over temperature < 100 mG (0.980 m/s^2)

  (< 51 mG (0.500 m/s^2) for 'A' spec parts)
- Turn-on to Turn-on Bias < 30 mG (0.295 m/s^2)
- Noise (1σ, no oversamples) < ± 12 mG (0.120 m/s^2)

Cross Axis Error 5 % uncorrected (2.6 % uncorrected for 'A' spec parts)

(effect of off axis acceleration)

- A/D Measurement Resolution: 0.62 mG
- Converted data rate resolution 0.30 mG (max output rate = 10 G)
- Bandwidth Passive LPF, Fc = 50 Hz

Power

- Vin 5.5 – 8.5 V (sensor head)
- Iin (typ) 30ma @ 6.5 Volts (sensor head)

Environment

- Operating Temperature: -40C to +80C Calibrated Temperature Range
- Storage Temperature -60C to +100C
- Max Acceleration 500 G

3 Signal Descriptions

The sensor head has four connectors P1, P2, P3 and P4 that provide the electrical and the mechanical interface to the host circuit.

Table 1 - Signal Descriptions

Connector/Pin #	Signal Name	Type	Level	Signal Description
P1.1	DC IN	I		6.5 volts nominal (5.5 min, 9.0 max)
P1.2	GND	I/O		Ground
P1.3	GND	I/O		Ground
P1.4	*CS1	I	TTL	Active Low EEPROM Chip Select
P1.5	SLK	I	TTL	SPI serial clock
P1.6	*CS0	I	TTL	Active Low AtoD Chip Select
P1.7	MOSI	I	TTL	SPI Master Out Slave In
P1.8	MISO	O	TTL	SPI Master In Slave Out
P2.1	Temp - Rate Y	O	Analog	2.50 at 298 deg K -+ 8.4mv/deg K
P2.2	Temp - Rate X	O	Analog	2.50 at 298 deg K -+ 8.4mv/deg K

P2.3	Temp - Rate Z	O	Analog	2.50 at 298 deg K -+ 8.4mv/deg K
P3.1	Test	I	TTL	Active High Input for sensor self test
P3.2	Spare A/D - AIN6	I	Analog	0-4.096V user defined analog input to AtoD
P3.3	Busy	0	TTL	Active High output from ADS8344 AtoD
P4.1	Temp Mux A0	I		Mux control line for temperature A/D meas.
P4.2	Temp Mux A1	I		Mux control line for temperature A/D meas.
P4.3	Reserved			Reserved

3.1 DC IN

This input provides power to the onboard 5-volt linear regulator which powers all onboard circuits. The low dropout regulator will accept inputs from 5.5 to 8 volts but typically a 6.5 volts low switching noise supply is used.

3.2 Gnd

The two ground pins provide the return path for the power supply and digital I/O circuits.

3.3 CS1*

This pin is the active low chip select for the onboard serial EEPROM. A10k pull-up tied to the internal analog 5 volt rail was included so user's need not add one externally.

3.4 CS0*

This pin is the active low chip select for the onboard 8 channel serial A to D converter. A10k pull-up tied to the internal analog 5 volt rail was included so user's need not add one externally.

3.5 SCLK, MOSI, MISO

SPI serial clock, Master Out/Slave In and Master In/Slave Out signals used to transfer data to and from both the EEPROM and A to D converter. See the Texas Instruments ADS8344 and the Microchip 25LC640 data sheets for the specifics of each parts SPI interface.

3.6 Temp Mux Control

Two control lines determine which board temperature is selected for measurement at the 16 bit A/D. The multiplexer is an Analog Devices p/n ADG704. Selection is shown in the following table.

Table 2 - Temp Mux Control

Mux Select A1	Mux Select A0	Temperature Signal Routed to A/D input
0	0	Gyro X
0	1	Gyro Y
1	0	Gyro Z
1	1	Board Temperature Sensor

3.7 Temp X,Y,Z

Identical to signal inputs to the temperature select mux (see 3.6), these are passively buffered temperature outputs from the die of each rate gyro. The outputs are proportional to absolute temperature with an initial offset of 2.5 volts at 298 deg K with a scale factor of 8.4mv/degK. The outputs can only handle 50uA loading to ground. We have added a 1k series resistor between the output pin and the die to provide buffering. Leave temperature pins (P2.1 through P2.3) un-terminated if not using the analog temperature outputs.

3.8 A/D Inputs

The SPI interface 16 bit Texas Instruments ADS8344 A/D converter analog inputs are as shown in the following table.

Table 3 - A/D Inputs

A/D Input Signal	A/D Pin #	Sensor Head Signal to A/D
AIN 0	1	Negative Y axis Rate
AIN 1	2	X axis Rate
AIN 2	3	Z axis Rate
AIN 3	4	Y axis Acceleration
AIN 4	5	X axis Acceleration
AIN 5	6	Z axis Acceleration
AIN 6	7	Spare input – from P3-2
AIN 7	8	Temperature signal from MUX

4 Software Interface

See the associated Sensor Head Driver Source directory in the Sensor Head Dev Kit to help facilitate software interface to the IMU sensor head. For domestic customers (and export customers that go through export license process), associated hardware driver source code is made available in an as-is state to be of assistance in integration of the sensor head.

5 Electro-Mechanical Interface

There are four connectors that provide the electro-mechanical interface between the IMU sensor head and the application circuit board - P1, P2, P3 and P4. P1, P3 and P4 provide both mechanical as well as the electrical interface while the remaining 3-pin, P2, connector was added to provide additional mechanical connection and reserved interface lines. All three pins on the optional header P2 should be kept as no connects on the users interface. For the placement and spacing of the connectors please refer to paragraph 6.0 below.

The sensor head comes with **P1, P2, P3, and P4 stuffed with 1.27mm (0.050") center to center through hole connectors** which are intended for a **board to board spacing of 1.71mm (0.070").** The installed connectors come with a 2.4mm (0.095") solder tail. The bottom of the sensor head has one component that stands off 0.065" which defines the minimum keep-out height for board to board applications.

6 Mechanicals

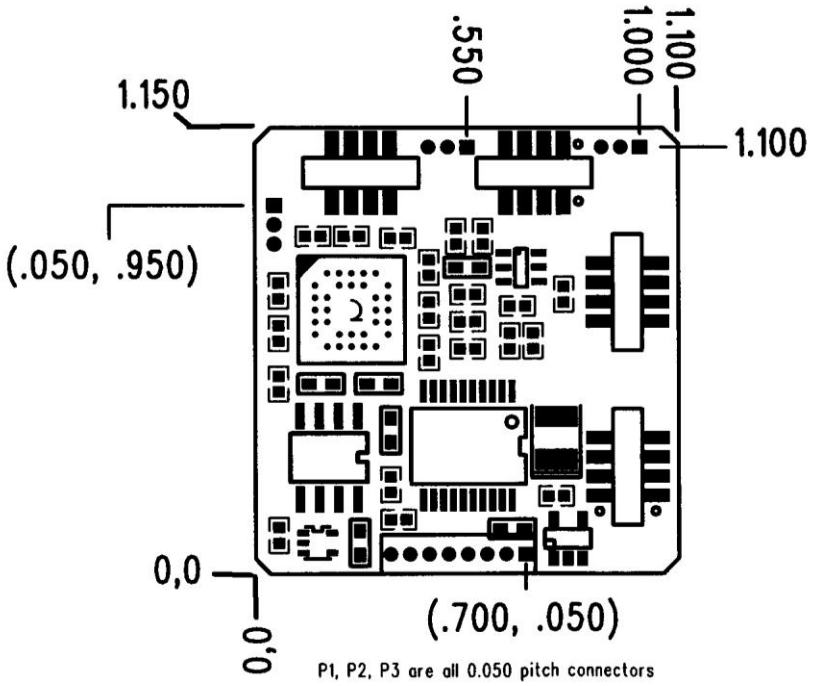

Figure 3 - Z Axis Board Dimensions and Interface Connector Placements

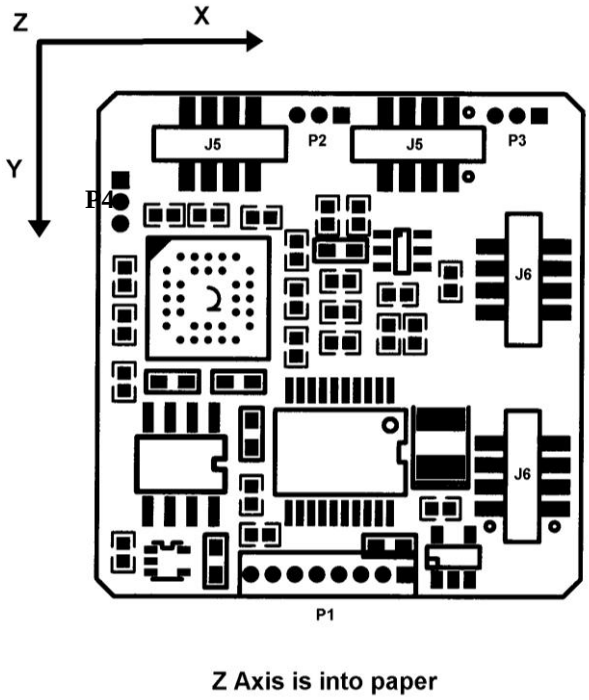

Figure 4 - Orientation of XYZ Axis