EC-3823-R09 Series
3D High-Precision Electronic Compass

Technical Manual

V1.0

FEATURES

- Tri-Axial Accelerometer Tri-Axial Magnetometer
- Static Measurement Accuracy of Up to ±1°
- Bias Tracking Algorithm Eliminates Drift
- High Accuracy, Low Cost
- Wide Temperature Range: −40℃ ~+85℃
- Size: 23×31×8.5 (mm)
  0.906×1.22×0.335 (inch)
- With Hard and Soft Magnetism and Tilt Angle Compensation
- Standard TTL Output Interface

APPLICATIONS

- Satellite Tracking
- Petroleum Geological Well Surveys
- Optical Rangefinders
- GPS-Assisted Navigation
- Personal Equipment
- Marine Surveys
- Underwater Navigation
- Night Vision Devices

DESCRIPTION

The EC-3823-R09 high accuracy electronic compass is composed of a highly reliable and interference resistant industrial grade microcontroller and a high accuracy magnetic sensor and driver chip. It also integrates AIT Sensing's patented hard and soft magnetic calibration algorithms and uses a three-axis accelerometer to compensate for tilt angle, enabling it to provide accurate heading data even in extremely harsh environments. The product outputs highly accurate attitude information in real time through an optimized extended Kalman filter algorithm.

The EC-3823-R09 is specifically designed to improve the static measurement accuracy of magnetic compasses, maintaining a high level of accuracy against fixed disturbances. The EC-3823-R09 can be customized to meet customer requirements and can be easily and quickly integrated into a wide range of products.

SPECIFICATIONS

Table 1.

Parameter		Min.	Typ.	Max.	Unit/Note
Power Supply Voltage			5		VDC
Operating Current			70		mA
Operating Temperature Range		−40		70	℃
Storage Temperature Range		−55		85	℃
Azimuth	Measurement Range	0		360	°
	Accuracy	after spatial calibration≤±1°(RMS) (inclination range −45° ~ 45°)			
	Resolution		0.01		°
	Repeatability		0.5		° (RMS)
Pitch	Measurement Range	−45		45	°
	Accuracy	≤0.5°(RMS)			

Parameter		Min.	Typ.	Max.	Unit/Note
	Resolution		0.01		°
	Repeatability		0.2		° (RMS)
Roll	Measurement Range	−90		90	°
	Accuracy	≤±0.5°(RMS)			
	Resolution		0.01		°
	Repeatability		0.2		° (RMS)
Environment	Baud Rate	2400 ~ 115200 (default 9600)			

*Resolution: the smallest change in the measured value that the sensor can detect and distinguish within the measurement range.

*Accuracy: the root mean square error of multiple (≥16) measurements of the actual angle and the measured angle of the sensor.

ELECTRICAL INTERFACE

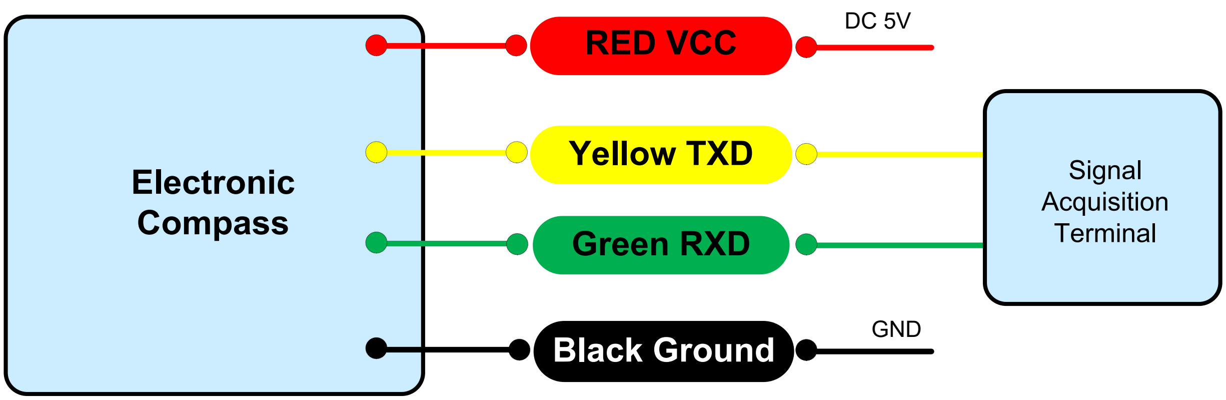

Figure 1. TTL Wiring Diagram

CALIBRATION METHOD

12 O'CLOCK METHOD

1.1. Calibration steps

1. Open the serial port and set it to send in HEX and receive in HEX.
2. Place the sensor at a pitch angle of 0°, a roll angle of 0°, and a heading angle pointing to the north, and use this direction as the reference direction. If you do not know where the north is, you can use any direction as the reference direction. Keep the sensor still and send the start calibration command 77 05 00 BA XX YY, XX can be input in the range of 01, 02, and 03. The default mode is 02. If 02 does not work

well, select 01. If 01 can calibrate successfully but the accuracy is slightly poor, select 03 for a try. This mode represents different calibration algorithm selections, optimized for different situations. When the magnetic environment is good, select 02 for calibration, and consider 01 for large magnetic inclinations. The sensor returns 77 05 00 BA 0 0 BF, start the calibration mode.

3. Place the sensor according to the calibration point posture. After it stabilizes, send 77 04 00 BB BF. Return 77 05 00 BB XX YY. XX is the calibration point count and YY is the checksum. The calibration point count range is 0x00~0x0B. Each time a command is sent, it is considered as a sampling. The data is automatically increased by 1.
4. Send 77 04 00 BC C0 and return 77 05 00 BC XX YY, where XX is the result. If the calibration is successful, 00 is returned. If it fails, 0xFX is returned. If the lowest bit is 1, the magnetometer distribution is poor. If the second bit is 1, there is a problem with the acceleration alignment and there is jitter during calibration. If the third bit is 1, the calibration points are too close and do not meet the distribution conditions. If the calibration is successful, the calibration parameters will be saved. Do not power off at this time. Power off may cause the parameters to be erased. If erased, the device can only be returned to the factory. For example: If the calibration fails and the magnetometer distribution is poor and there is jitter during calibration, 77 05 00 BC F3 B4 is returned. If the calibration fails and the magnetometer distribution is poor and there is jitter during calibration, the calibration points are too close, 77 05 00 BC F7 B8 is returned.
5. Calibration Complete.

1.2. Calibration point scheme

1.2.1 Standard sampling method

Points	1	2	3	4	5	6	7	8	9	1 0	1 1	1 2
Pitch°	0	0	0	0	45	45	45	45	−45	−45	−45	−45
Roll°	0	0	0	0	−30	−30	30	30	30	30	−30	−30
Heading°	0	90	180	270	30	120	210	300	60	150	240	330

This solution can distribute the calibration points more evenly in space. It is the easiest and most accurate calibration solution tested so far.

1.2.2 Classic point collection method

Points	1	2	3	4	5	6	7	8	9	1 0	1 1	1 2
Pitch°	30	30	30	30	0	0	0	0	−30	−30	−30	−30
Roll°	30	30	−30	−30	0	0	0	0	−30	−30	3 0	30
Heading°	0	90	180	270	0	90	180	270	0	90	180	270

Because the headings are not staggered, this solution may have the problem of too small spacing between calibration points. The accuracy is slightly lower than the standard point collection method.

1.3 High-latitude reference point sampling method

Points	1	2	3	4	5	6	7	8	9	10	11	12
Pitch°	−75	−75	−75	−75	75	75	75	75	−30	−30	−30	−30

Roll°	−30	−30	30	30	30	30	−30	−30	0	0	0	0
Heading°	0	90	180	270	30	120	210	300	60	150	240	330

The core of this solution is to place the sensor in a horizontal state and point it in the direction of the calibration starting point, raise the pitch angle of the sensor to 75 degrees, -30 degrees, and -75 degrees, and then rotate the sensor around its Z axis in four directions. This solution is difficult to calibrate. It is recommended to only consider the value of the inclination angle, without considering the heading data. As long as the inclination angle is guaranteed, the next calibration point is rotated 90 degrees around the sensor's Z axis compared to the previous calibration point.

1.4 High latitude reference point sampling method 2

Points	1	2	3	4	5	6	7	8	9	10	11	12
Pitch°	0	0	0	0	75	75	75	75	−75	−75	−75	−75
Roll°	0		0	0	−45	−45	45	45	45	45	−45	−45
Heading°	0	90	180	270	30	120	210	300	60	150	240	330

DIMENSIONS

Outline Dimensions

Length and width may have ±1mm error, please refer to the actual product.

Top View	Side View
Side View	Unit: mm (inch)

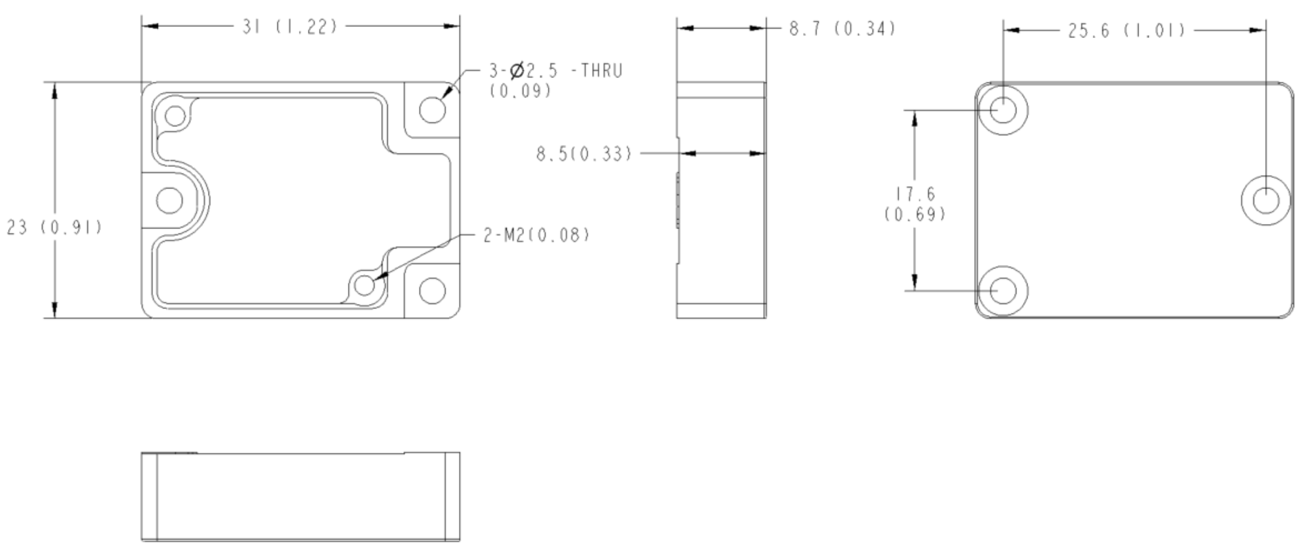

Figure 2. Outline Dimensions

EXECUTIVE STANDARD

- For static calibration of biaxial tilt sensors National standard (draft)
- GB/T 191 SJ 20873-2003 General Specification for Inclinometers and Leveler