MICROINFINITY

User Manual Rev1.1

CruizCore® XG1350
Digital Gyroscope

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1. Introduction

The CruizCore® XG1350 is a fully self-contained MEMS digital gyroscope and accelerometer based on the CruizCore® R1 Series platform. Compared with the R1 Series, the XG1350 was designed with convenient packaging and communication interfaces to allow its use as a standalone sensor(see Figure 1). It provide USB, the output and baud rate are adjustable for the customers' convenience. The XG1350 includes a MEMS gyroscope, 3axis accelerometer, internal voltage regulation, data acquisition and signal processing circuitry, communication interfaces and a RISC microprocessor running our patented error correcting algorithm. Because it uses MEMS sensors, it has the advantage of being light weight, small size and consuming low power. The XG1350 is packaged in a hard case for increasing protection against external impact. The XG1350 uses an adaptive reduced order Kalman filter to stabilized angular rates and heading angles, virtually eliminating the most common errors (i.e. bias drift, scale factor, temperature effects). The XG1350 has a 50Hz bandwidth and can precisely measure angular rates up to ± 100 deg/sec, it can also measure rates up to ± 150 deg/sec with lesser accuracy. The start-up time is less than one second, which is used to compute bias parameters; it does not require further calibration thereafter. The XG1350 is the best single axis rate measuring solution for navigation applications.

The CruizCore® XG1350 has the following features:

- Ultra low bias drift
- High resolution and accuracy
- Outstanding scale factor linearity
- Fast start-up
- Fully self-contained
- Digital output (USB)
- Low power consumption
- Low cost
- Roughed and compact package
- User friendly monitoring and testing program

Figure 1: CruizCore® XG1350.

NOTICE: We recommend extensive testing of this product before using it in a final application. Specifically, this product should be tested in the same environmental conditions that it is intended to be used. Furthermore, we strongly recommend caution when using our product in sensitive applications that can cause injures, death or property damage due to the wrong operation of this product, which may be caused by unexpected environmental changes such as temperature, shock, excessive and continuous vibration, etc. These applications include but are not limited to:

- **Aircraft equipment**

- **Air vehicles**

- **Aerospace equipment**

- **Underwater vehicles**

- **Medical equipment**

- **Transportation equipment**

- **Disaster prevention/crime prevention equipment**

- **Applications which require especially high reliability and accuracy**

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2. Hardware Description

2.1. System Description

The CruizCore® XG1350 is compact, light, low-power consuming digital gyroscope and accelerometer. It uses a MEMS rate and acceleration sensor. It has internal power regulation to minimize the power noises. The input voltage range of 4.75 V to 5.25 V is acceptable for power supply.

2.2. Part List Included with this Kit

The CruizCore® XG1350 is a full developer's kit intended to facilitate testing and understanding the CruizCore® R1 Series. Therefore it includes all the necessary cables and software needed for that purpose. The list of materials included with this kit is shown in Figure 2 and described in Table 1:
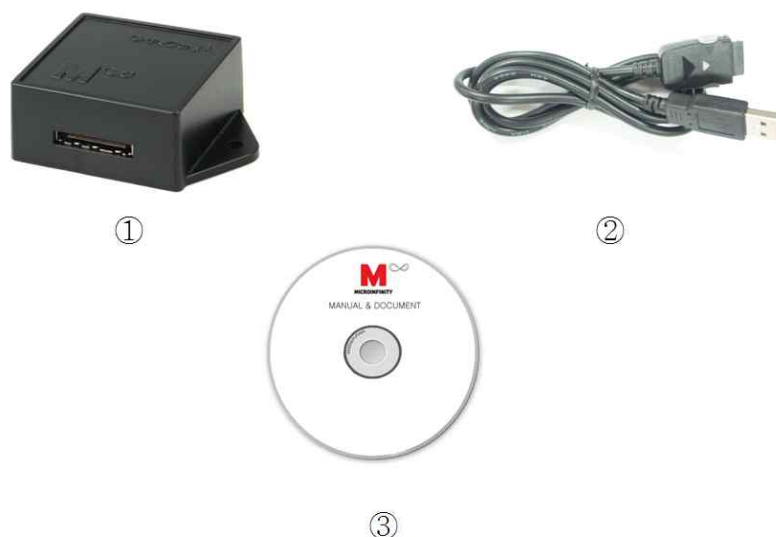

Figure 2: CruizCore® XG1350 part list.

Table 1: CruizCore® XG1350 part list description.

Item Number	Description
1	CruizCore® XG1350
2	USB cable
3	CD-ROM (includes User Manual and sensor testing program)

2.3. Cable Pin-out

For convenience, the CruizCore® XG1350 can communicate with external devices using two different interfaces: USB and RS232 ports.

2.3.1. USB Cable

The CruizCore® XG1350 USB connection is of type A (see Figure 3), the pin-out description is presented in Table 2.

Figure 3: Type A USB connector.

Table 2: USB connector type A pin-out.

Contact Number	Typical Wiring Color	Signal Name
1	Red	V_{BUS}(5V)
2	White	D-
3	Green	D+
4	Black	GND

2.4. Mounting Information (Coordinate System)

The CruizCore® XG1350 coordinate system has its sensitive axis perpendicular to the device flatter area (see Figure 4), therefore the gyro will show a positive angular rate (and angle increment) when its sensitive axis is rotated in the clock-wise direction (other coordinate systems are available as an option). Incorrect mounting can produce misalignment errors that have similar effect as scale factor errors, and therefore can be treated as such. If the error is significant we recommend re-calculating the scale factor using a single-axis rate table.

2.5. Sensor Start-up

The CruizCore® XG1350 startup time is less than one second, 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 1 second after startup.
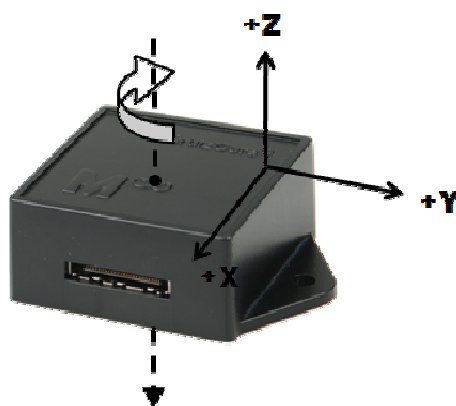

Figure 4: CruizCore® XG1350 coordinates system.

3. Software Description

3.1. Output Data Format

The CruizCore® XG1350 provides rate, angle and acceleration outputs. The information is packed in an 15 –byte data packet, which is transmitted to external devices at the specified baud rate. For more details about the output formatting, refer to the "CruizCore® R1 Series Technical Manual"

3.2. Monitoring Program

Microinfinity Co., Ltd. provides a monitoring program. For convenience, the program displays the parsed data in numerical and graphical forms and allows saving the data for subsequent analysis. The following explanation is based on the Monitoring Program version 1.0. This program has been tested under Microsoft Windows XP SP3.

3.2.1. Installation

The monitoring program is provided in the accompanying CD. The program can be installed using the Setup_XG1350MonitoringProgram.exe executable file. The installing and monitoring program requires the **.NET** framework 4.0 installed in the computer.

Caution: You must install ".net framework 4.0" before run this software.

We provided ".net framework 4.0" install file at this software install package or you can download at Microsoft homepage.
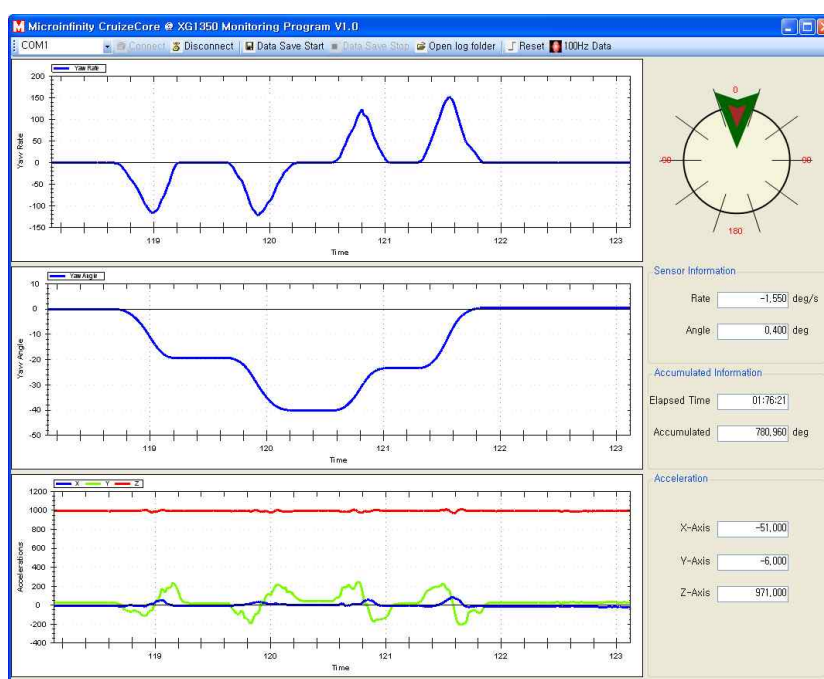

Figure 5: Program main window.

3.2.2. Main Window

The main window (see Figure) displays the information related to the CruizCore® XG1350 in five different formats or windows: rate, angle, acceleration, compass, and angle/acceleration data.

3.2.3. Rate Window

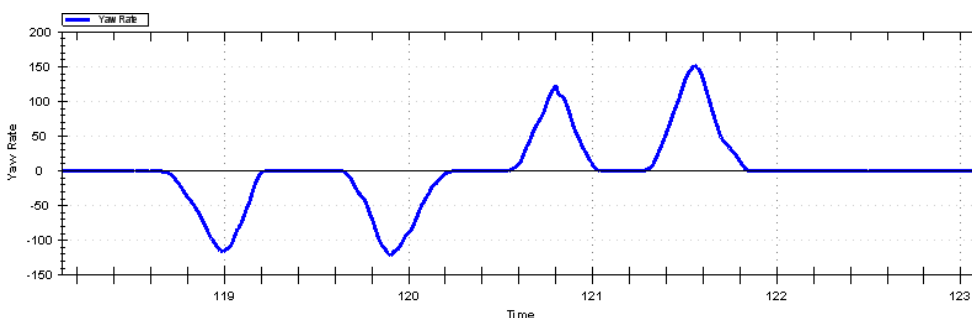This window shows the yaw rate of rotation data in graphic mode (see Figure 6).

Figure 6: Rate window.

3.2.4. Angle Window

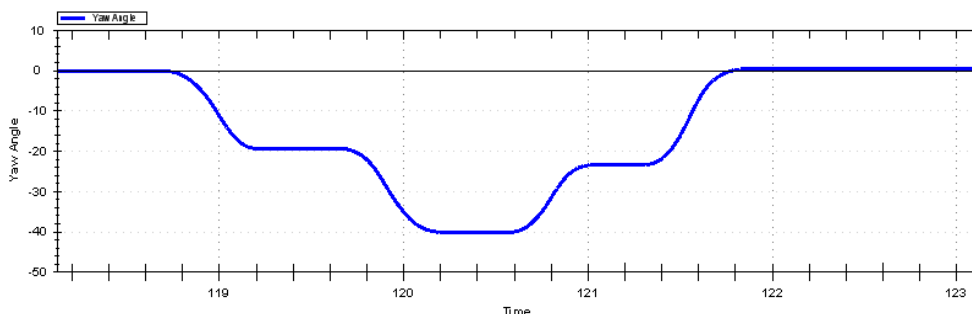This window shows the angle or integrated rate (see Figure 7).

Figure 7: Angle window.

3.2.5. Acceleration Window

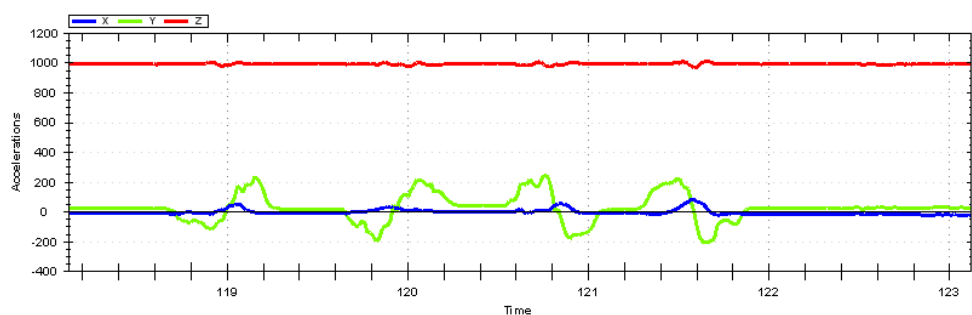This window shows acceleration data. (see Figure 8).

Figure 8: Acceleration window.

3.2.6. Compass Window

The compass window shows a simulated compass corresponding to the angle output provided by the CruizCore® XG1350 (see Figure 9).
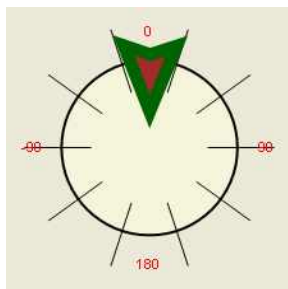
Figure 9: Compass window.

3.2.7. Data Window

The data window shows in numerical format the parsed sensor data and accumulated heading and acceleration data since the sensor was reset (see Figure 10).
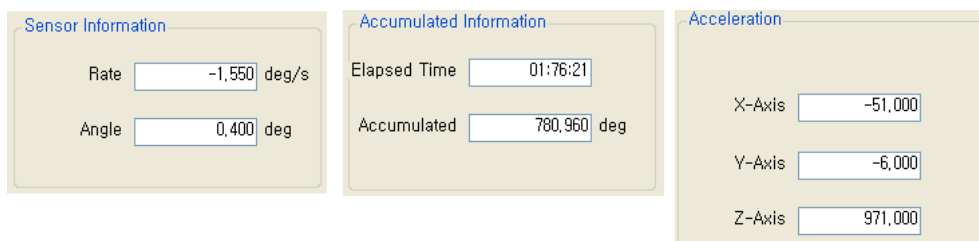
Figure 10: Data window.

3.2.8. Icon Toolbar

The icon toolbar gives access to the most important features and functions of the monitoring program. The following is a brief description of each one. Some icon can be enabled or disabled as operating mode.

COM Port selection `COM1`

Allow selecting the serial port either if it is physical port (normally COM1 and COM2) or virtual COM port as the ones created by USB-serial converters.

Connect

Serial port connecting.

Disconnect

Serial port disconnecting.

Data Save start

All the Rate and Angle data will be saved.

Output data filename is Log_ current year-month-day-hour-minute-second.out in Log folder.

Example) Log_20110703084425.out

Data Save stop

Data save will be stopped.

Open log folder

Open the log folder in window explorer.

Reset

Sensor and accumulated information of CruizCore® XG1350 will be reset. After reset CruizCore® XG1350 is strongly needed in stationary state during initial alignment time.

4. System Characteristics

The following tables summarize the main characteristics of the CruizCore® XG1350. These specifications subject to change without notice and several parameters can be changed under customer request as an option.

4.1. Physical Characteristics

Table 3: CruizCore® XG1350 physical characteristics.

PARAMETER	VALUE			UNIT
	Min.	Typ.	Max.	
SIZE	35.9 × 35.9 × 17.0			mm
WEIGHT	15			g

4.2. Environmental Characteristics

Table 4: CruizCore® XG1350 environmental characteristics.

NO.	ITEMS	TEST CONDITION	TEST CRITERIA
1	High temperature storage	85°C x 120h	Refer to Table 5
2	Low temperature Storage	-40°C x 72h	Refer to Table 5
3	Temperature and Humidity cycling	25°C , 60%RH(4h) / 55°C , 95%RH(10h) /-30°C (2h) / 75°C (2h), 10cycles	Refer to Table 5
4	Thermal shock	-40°C ↔ 85°C 1hour at each temperature, 10cycles	Refer to Table 5
5	Drop	Free drop from 750mm height on a wooden board for 6 times	Refer to Table 5
6	Vibration	10Hz to 55Hz amplitude 0.75mm, 55Hz to 500Hz acceleration 98m/s2, 10Hz→500Hz→10Hz 15min/cycle, 6h(2h x 3directions)	Refer to Table 5
7	ESD	R(330Ω) C(150pF), Contact discharge, 5times	Refer to Table 5

* After each test, there should be no visible damage and the measured values shall be met Table 5.

Table 5: Judgment criteria of environment and mechanical test

ITEMS	UNITS	JUDGMENT CRITERIA
Angular error	degree	360±1.0deg. (CW rotation) 0±1.0deg. (CCW rotation)
ESD	voltage	1kV(operating), 2kV(destruct)

4.3. Electrical Characteristics

Table 6: CruizCore® XG1350 electrical characteristics.

PARAMETER	CONDITION	VALUE			UNIT
		Min.	Typ.	Max.	
INPUT VOLTAGE	OPERATING	4.75		5.25	V
	RECOMMENDED		5		V
CURRENT	@ 5 V		10		mA
POWER	@ 5 V		50		mW

CAUTION

ESD (electrostatic discharge) sensitive device. Electrostatic charges as high as 4000 V readily accumulate on the human body and test equipment and can discharge without detection. Permanent damage may occur on devices subjected to high-energy electrostatic discharges. Therefore, proper ESD precautions are recommended to avoid performance degradation or loss of functionality.

4.4. Performance Characteristics

Table 7: CruizCore® XG1350 performance characteristics.

PARAMETER		VALUE			UNIT
		Min.	Typ.	Max.	
BANDWIDTH	RATE	10		50	Hz
WARM-UP TIME	FAST WARM-UP		0.5		sec
	FULL ALIGNMENT[1]			5	min
ANGULAR RATE	CONTINUOUS*			± 100	deg/sec
	INSTANTANEOUS[2]			± 150	deg/sec
	RESOLUTION		0.01		deg/sec
	SCALE FACTOR ERROR		0.5	1	%
	BIAS DRIFT		< 10	50	deg/hr
ACCELERATION	MEASUREMENT RANGE		± 2		G
DATA RATE	ADJUSTABLE[3]		100		Hz

* The system must be installed in the correct position.
1. Full alignment: The total time that takes for full bias error calibration and temperature compensation. It is the worst case on condition that the temperature goes up suddenly without temperature compensation.
2. Prolonged time in this condition will introduce heading errors
3. Other data rate available as option.

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_____

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