



## AHRS IMU Sensor | WTGAHRS1

*The Robust Acceleration, Angular velocity, Angle, Magnetic filed & Air Pressure & GPS Monitor Detector*

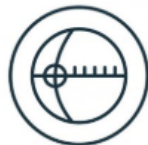
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*The WTGAHRS1 is a IMU sensor device, detecting acceleration, angular velocity, angle , magnetic filed , air pressure as well as GPS data. The robust housing and the small outline makes it perfectly suitable for industrial applications such as condition monitoring and predictive maintenance. Configuring the device enables the customer to address a broad variety of application by interpreting the sensor data by smart algorithms and Kalman filtering.*

### BUILT-IN SENSORS



Accelerometer



Gyroscope



Magnetometer



Barometer



GPS Module



## Tutorial Link

[Google Drive](#)

**Link to instructions DEMO:**

[WITMOTION Youtube Channel](#)

[WTGAHRS1 Playlist](#)

If you have technical problems or cannot find the information that you need in the provided documents, please contact our support team. Our engineering team is committed to providing the required support necessary to ensure that you are successful with the operation of our AHRS sensors.

## Contact

[Technical Support Contact Info](#)

## Application

- AGV Truck
- Platform Stability
- Auto Safety System
- 3D Virtual Reality
- Industrial Control
- Robot
- Car Navigation
- UAV
- Truck-mounted Satellite Antenna Equipment



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# 1 Overview

WTGAHRS1's scientific name is AHRS IMU sensor. A sensor measures 3-axis angle, angular velocity, acceleration, magnetic field, air pressure and GPS data. Its strength lies in the algorithm which can calculate three-axis angle accurately.

WTGAHRS1 is employed where the highest measurement accuracy is required. WTGAHRS1 offers several advantages over competing sensor:

- Heated for best data availability: new WITMOTION patented zero-bias automatic detection calibration algorithm outperforms traditional accelerometer sensor
- High precision Roll Pitch Yaw (X Y Z axis) Acceleration + Angular Velocity + Angle + Magnetic Field + Air Pressure + GPS data output
- Low cost of ownership: remote diagnostics and lifetime technical support by WITMOTION service team
- Developed tutorial: providing manual, datasheet, Demo video, PC software, mobile phone APP, and 51 serial, STM32, Arduino, and Matlab sample code, communication protocol
- WITMOTION sensors have been praised by thousands of engineers as a recommended attitude measurement solution



## 2 Features

- Built-in WT901B + GPS + BeiDou module, for detailed parameters, please refer to the instructions of WT901B.
- The default baud rate of this device is 9600 and could be changed.
- The interface of this product only leads to a serial port
- The module consists of a high precision gyroscope, accelerometer, geomagnetic field and barometer sensor. The product can solve the current real-time motion posture of the module quickly by using the high-performance microprocessor, advanced dynamic solutions and Kalman filter algorithm.
- The advanced digital filtering technology of this product can effectively reduce the measurement noise and improve the measurement accuracy.
- Maximum 200Hz data output rate. Output content can be arbitrarily selected, the output speed 0.2HZ~ 200HZ adjustable.

## 3 Specification

### 3.1 Parameter

Parameter	Specification
➤ Working Voltage	TTL:3.3V-5V
➤ Current	<40mA
➤ Size	61.2mm x 45.2mm X 27.8mm
➤ Data	Angle: X Y Z, 3-axis Acceleration: X Y Z, 3-axis Angular Velocity: X Y Z, 3-axis Magnetic Field : X Y Z, 3-axis Air Pressure : 1-Axis Positioning (longitude, latitude) Ground speed Number of satellites Time, Quaternion
➤ Output frequency	0.2Hz--200Hz
➤ Interface	Serial TTL level,
➤ Baud rate	9600(default, could be changed )

Measurement Range & Accuracy		
Sensor	Measurement Range	Accuracy/ Remark
➤ Acceleromet	X, Y, Z, 3-axis ±16g	Accuracy: 0.01g Resolution: 16bit Stability: 0.005g
➤ Gyroscope	X, Y, Z, 3-axis -±2000°/s	Resolution: 16bit Stability: 0.05°/s
➤ Magnetomet er	X, Y, Z, 3-axis ±4900μT	0.15μT/LSB typ. (16-bit) AK8963 Magnetometer Chip
➤ Angle/ Inclinometer	X, Y, Z, 3-axis X, Z-axis: ±180° Y ±90° (Y-axis 90° is singular point)	Accuracy:X, Y-axis: 0.05° Z-axis: 1° (after magnetic calibration)
➤ Barometer	1-axis	Accuracy : 1m
➤ GPS Module	Altitude :50000m Speed Velocity:50000m/s	Position Accuracy:2.5m Direction Accuracy :0.5°



## Accelerometer Parameters

Parameter	Condition	Typical Value
Range		$\pm 16 \text{ g}$
Resolution	$\pm 16\text{g}$	0.01 (g/LSB)
RMS noise	Bandwidth =100Hz	0.75~1mg-rms
Static zero drift	Placed horizontally	$\pm 20 \sim 40\text{mg}$
Temperature drift	$-40^{\circ} \text{ C} \sim +85^{\circ} \text{ C}$	$\pm 0.15\text{mg}/^{\circ}\text{C}$
Bandwidth		5~256Hz





## Gyroscope parameters

Parameter	Condition	Typical Value
Range		$\pm 2000^{\circ} /s$
Resolution	$\pm 2000^{\circ} /s$	$0.05 (^{\circ} /s) / (LSB)$
RMS noise	Bandwidth =100Hz	$0.028 \sim 0.07 (^{\circ} /s) -rms$
Static zero drift	Placed horizontally	$\pm 0.5 \sim 1^{\circ} /s$
Temperature drift	$-40^{\circ} C \sim +85^{\circ} C$	$\pm 0.005 \sim 0.015 (^{\circ} /s) / ^{\circ}C$
Bandwidth		$5 \sim 256Hz$

## Magnetometer parameters

Parameter	Condition	Typical Value
Range		$\pm 2Gauss$
Resolution	$\pm 2Gauss$	$0.0667mGauss/LSB$

## Pitch and roll angle parameters

Parameter	Condition	Typical Value
Range		X: $\pm 180^\circ$
		Y: $\pm 90^\circ$
Inclination accuracy		0.2°
Resolution	Placed horizontally	0.0055°
Temperature drift	-40° C ~ +85° C	$\pm 0.5 \sim 1^\circ$

## Heading angle parameter

Parameter	Condition	Typical Value
Range		Z: $\pm 180^\circ$
Heading accuracy	9-axis algorithm, magnetic field calibration, dynamic/static	1° (without interference from magnetic field)
	6-axis algorithm, static	0.5° (Dynamic integral cumulative error exists)
Resolution	Placed horizontally	0.0055°

## GPS parameter

Index	Parameter
Signal Reception	BDS/GPS/QZSS/GLONASS
Cold Start TTFF	$\leq 32s$
Hot Start TTFF	$\leq 1s$
Recapture TTFF	$\leq 1s$
Cold Start Capture Sensitivity	-148dBm
Hot Start Capture Sensitivity	-156dBm
Recapture Sensitivity	-160dBm
Tracking Sensitivity	-162dBm
Positioning Precision	$< 2.5m$ (CEP50)
Speed Measurement Accuracy	$< 0.1m/s$ ( $1\sigma$ )
Positioning Update Rate	2Hz
Protocol	NMEA0183



Maximum Height	18000m
Maximum Speed	515m/s
Maximum Acceleration	4g



## Module parameters

### Basic parameters

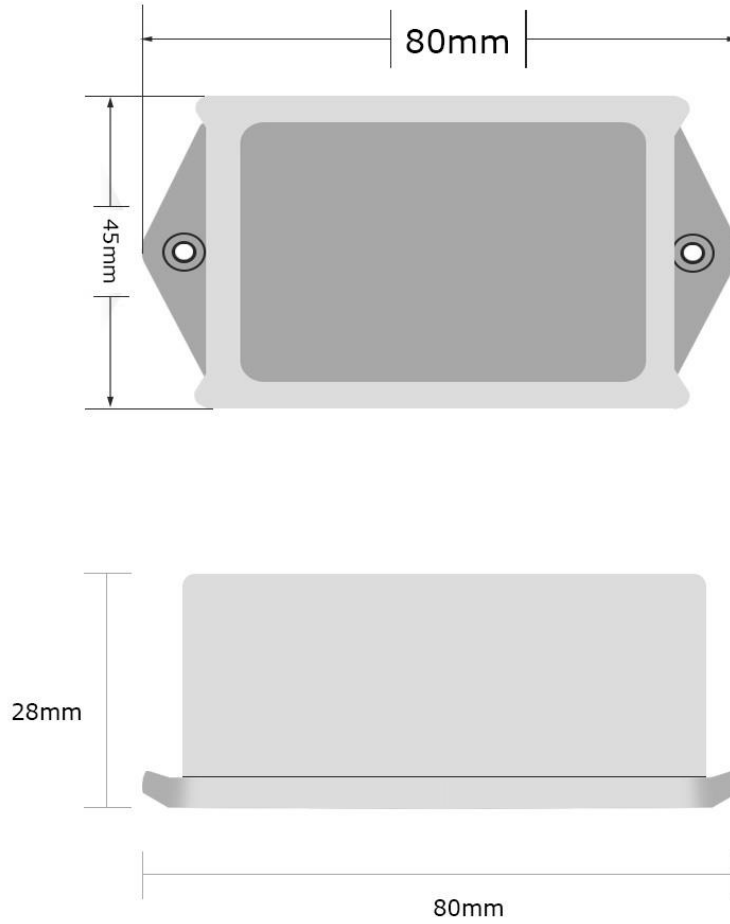
Parameter	Condition	Min	Default	Max
Interface	UART	4800bps	9600bps	230400bps
Output content		Time, acceleration, angular velocity, angle, magnetic field, port status, four elements, air pressure, altitude, latitude and longitude, ground speed		
Output rate		0.2Hz	10Hz	200Hz
Start time				1000ms
Operating temperature		-40°C		85°C
Storage temperature		-40°C		100°C
Shockproof				20000g



## Electrical parameters

Parameter	Condition	Min	Default	Max
Supply voltage		3.3V	5V	5.5V
Working current	Work (5V)		98mA	

### 3.2 Size



Parameter	Specification	Tolerance	Comment
Length	80	$\pm 0.1$	Unit: millimeter.
Width	45	$\pm 0.1$	
Height	28	$\pm 0.1$	
Weight	50	$\pm 1$	Unit: gram

### 3.3 Axial Direction

The coordinate system used for attitude angle settlement is the northeast sky coordinate system. Place the module in the positive direction, as shown in the figure below, direction right is the X-axis, the direction forward is the Y-axis, and direction upward is the Z-axis. Euler angle represents the rotation order of the coordinate system when the attitude is defined as Z-Y-X, that is, first turn around the Z-axis, then turn around the Y-axis, and then turn around the X-axis.





## 4 PIN Definition



PIN	Color	Function
➤ VCC	RED	Input Supply TTL :powered by 3.3-5V
➤ RX	GREEN	Serial data input RX connected with TX
➤ TX	YELLOW	Serial data output TX connected with RX
➤ GND	BLACK	Ground GND

## 5 Communication Protocol

[Link to WITMOTION protocol.](#)