AHRS IMU Sensor | WT61P

The Robust Acceleration, Angular velocity & Angle Detector

The WT61P is a IMU sensor device, detecting acceleration, angular velocity as well as angle. 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

Tutorial Link

Google Drive

Link to instructions DEMO:
WITMOTION Youtube Channel
WT61P 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

Contents

1 Overview

WT61P's scientific name is AHRS IMU sensor. A sensor measures 3-axis angle, angular velocity, acceleration. Its strength lies in the algorithm which can calculate three-axis angle accurately.

WT61P is employed where the highest measurement accuracy is required. WT61P 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 output

• Low cost of ownership: remote diagnostics and lifetime technical support by WITMOTION service team

•Developed tutorial: providing manual, datasheet, Demo video, free software for Windows computer, APP for Android smartphones , and sample code for MCU integration including 51 serial, STM32, Arduino, Matlab, Raspberry Pi,communication protocol for project

• WITMOTION sensors have been praised by thousands of engineers as a recommended attitude measurement solution

2 Features

- 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 and geomagnetic field 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	3.3V-5V
➢ Current	<25mA
➢ Size	15mm x 15mm X 2mm
➢ Data	Angle: X Y Z, 3-axis Acceleration: X Y Z, 3-axis Angular Velocity: X Y Z, 3-axis Time, Quaternion
➢ Output frequency	0.2Hz--200Hz
➢ Interface	Serial TTL level
➢ Baud rate	4800,9600(default),19200,38400,57600, 115200,230400

Measurement Range & Accuracy		
Sensor	Measurement Range	Accuracy/ Remark
➢ Accelerometer	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
➢ 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° (Angle of Z-axis will have accumulated error)

Accelerometer Parameters

Parameter	Condition	Typical Value
Range		±16g
Resolution	±16g	0.0005(g/LSB)
RMS noise	Bandwidth = 100Hz	0.75~1mg-rms
Static zero drift	Placed horizontally	±20~40mg
Temperature drift	- -40°C ~ +85°C	±0.15mg/℃
Bandwidth		5~256Hz

Gyro Parameters

Parameter	Condition	Typical Value
Range		±2000°/s
Resolution	±2000°/s	0.061(°/s)/(LSB)
RMS noise	Bandwidth = 100Hz	0.005(°/s)
Static zero drift	Placed horizontally	±0.5~1°/s
Temperature drift	- -40°C ~ +85°C	±0.005~0.015 (°/s)/℃
Bandwidth		5~256Hz

Magnetometer parameters

Parameter	Condition	Typical Value
Range		±2Gauss
Resolution	±2Gauss	0.0667mGauss/LSB

Pitch and roll angle parameters

Parameter	Condition	Typical Value
Range		XY:±180°; Y:±90°
Inclination accuracy		0.2°
Resolution	Placed horizontally	0.0055°
Temperature drift	-40°C ~ +85°C	±0.5~1°

Heading Angle Parameter

Parameter	Condition	Typical Value
Range		Z:±180°
Heading accuracy	6-axis algorithm, static	0.5° (Dynamic integral cumulative error exists)
Resolution	Placed horizontally	0.0055°

Module Parameters

Basic Parameters

Parameter	Condition	Minimum value	Default	Maximum value
Communication	UART	4800bps	9600bps	230400bps
	Hardware I2C			400K
	Analog I2C			100K
Output content		On-chip time, 3-axis acceleration, 3-axis angular velocity, 3-axis angle, quaternion, port status		
Output rate		0.2Hz	10Hz	200Hz
Start Time				1000ms
Operating temperature		-40℃		85℃
Storage temperature		-40℃		100℃
Shock proof				20000g

Electrical parameters

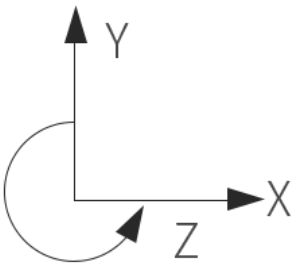
Parameter	Condition	Min	Default	Max
Supply voltage		3.3V	5V	5.5V
Working current	Work (5V) Sleep (5V)		8.43mA 9.91uA	

3.2 Size

Parameter	Specification	Tolerance	Comment
Length	15	±0.1	Unit: millimeter.
Width	15	±0.1	
Height	2	±0.1	
Weight	1	±0.1	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	Function
➢ VCC	3.3-5V input supply
➢ RX	Serial data input, TTL interface
➢ TX	Serial data output, TTL interface
➢ GND	Ground
➢ DO	Analog input, digital input and output, PWM
➢ D1	Analog input, digital input and output, PWM, connect GPS
➢ D2	Analog input, digital input and output, PWM
➢ D3	Analog input, digital input and output, PWM
➢ SDA	I2C signal line
➢ SCL	I2C clock line

5 Communication Protocol

Level: TTL level
Baud rate: 4800, 9600 (default), 19200 38400, 57600, 115200, 230400, stop bit and parity

Link to WITMOTION Protocol.

6 IIC Protocol

WT61P module can be fully accessed through IIC, the maximum IIC communication speed support 400khz, slave module address is 7bit, default address is 0x50, you can change the command through the serial port or the methods of IIC writing address ways. Many WT61P modules can be connect to IIC bus at the same time, The precondition is that the module has the different IIC address.

IIC protocol module using the register address accessible way. The length of each address are 16bits, two bytes. The register address is defined in the following table:

RegAddr	Symbol	Meaning
0x00	SAVE	Save
0x01	CALSW	Calibration
0x02	RSW	Return data content
0x03	RATE	Return data Speed
0x04	BAUD	Baud rate
0x05	AXOFFSET	X axis Acceleration bias
0x06	AYOFFSET	Y axis Acceleration bias
0x07	AZOFFSET	Z axis Acceleration bias
0x08	GXOFFSET	X axis angular velocity bias
0x09	GYOFFSET	Y axis angular velocity bias
0x0a	GZOFFSET	Z axis angular velocity bias
0x1a	IICADDR	IIC address
0x1b	LEDOFF	Turn off LED
0x1c	GPSBAUD	GPS baud rate
0x30	MMYY	Month , Year
0x31	HHDD	Hour , Day
0x32	SSMM	Second , Minute
0x33	MS	Millisecond
0x34	AX	X axis Acceleration
0x35	AY	Y axis Acceleration
0x36	AZ	Z axis Acceleration
0x37	GX	X axis angular velocity
0x38	GY	Y axis angular velocity
0x39	GZ	Z axis angular velocity
0x3d	Roll	X axis Angle
0x3e	Pitch	Y axis Angle

0x3f	Yaw	Z axis Angle
0x40	TEMP	Temperature

6.1 IIC Write the Module

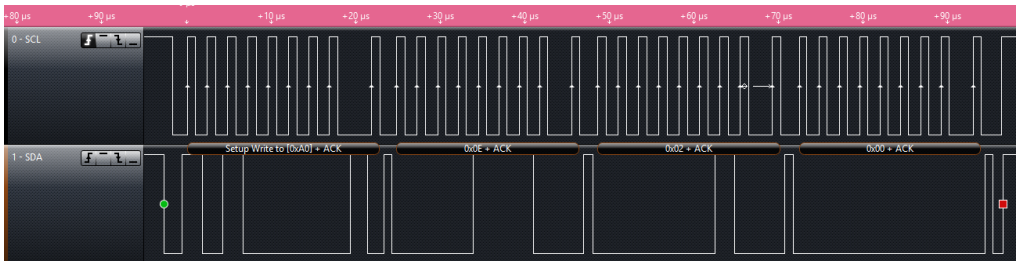
When IIC write the module, the format is as below:

IICAddr<<1	RegAddr	Data1L	Data1H	Data2L	Data2H	……

First IIC host sends a Start signal to WT61P module, then write IICAddr to register address and then write RegAddr, write the Data1L Data1H Data2L Data2H …. Sequentially, when the last data has been written, the host sends a stop signal to the module to release the IIC bus.

When finish writing the data, the register will be updated and module will execute the order.At the same time,the address of the module will add 1 automatically.The address Pointer will point to next address. So it can be written Continuously

For example:
Set D0 as Digital output high
RegAddr :0x0e DataL:0x02 DataH:0x00
Logic Analyzer captures waveforms as shown below:



Register set up by the module approach is consistent with the serial protocol, please refer 6.1

6.2 IIC Read the Module

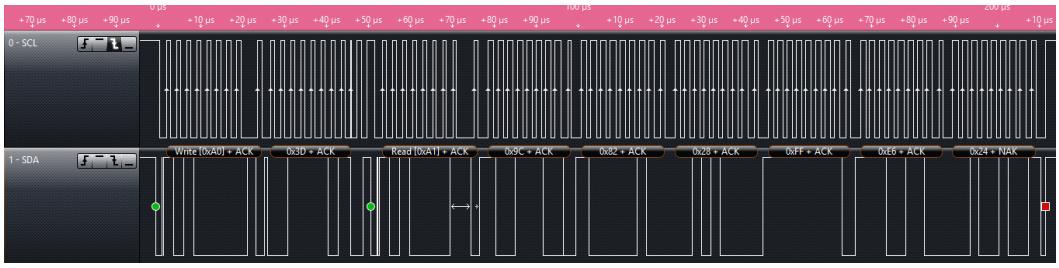
IIC read the module, the format is as follow

IICAddr<<1	RegAddr	(IICAddr<<1)|1	Data1L	Data1H	Data2L	Data2H	……

First IIC host sends a Start signal to WT61P module,then write IICAddr to register address, then IIC host sends a read signal(IICAddr<<1)|1) to WT61P module, if the IIC address is 0x50(default),then the host send 0xa0
Thereafter the module will export the data follow the rule: low byte first, high byte Sequentially. The host will make SDA bus low after receiving each byte, and sends a response signal to the module .After the specified number of data has been received completely, the host stop sending response signal back to the module, then the module will stop export data.The host send a stop signal to end this operation.

For example:

Read the Angle of the module,
RedAddr: 0x3d,read 6 bytes continuously, the logic analyzer captures waveforms as shown below:



Start reading out data from 0x3d,the data is 0x9C, 0x82,0x28,0xFF, 0xE6,0x24. That means X-axis angle is 0x829C, Y-axis angle is 0xFF28, Z-axis angle is 0x24E6. According to section 5.1.4 , X axis angle is -176.33 °, Y-axis angle is -1.19 °, Z-axis angle is 51.89 °