# LPMS-IG1W
# Hardware Manual ver. 1.0




LP-Research Inc.
https://www.lp-research.com

# Version History

| Date | Version | Details |
|---|---|---|
| 2024-06-28 | ver. 1.0 | - Initial release |

# 目录

# 1. Introduction

The LPMS-IG1W is a high-precision,high-stability wireless attitude sensor specially developed for the industrial IoT field.The embedded powerful processor integrates and processes data from gyroscope,accelerometer and magnetometer,and correcting and calculating according to our unique algorithm, ultimately provides the following high-precision data output:

- Raw data (acceleration,angular velocity,magnetic fields,etc.)
- Angle data (euler angles or quaternions)
- Calibration linear acceleration,angular velocity and temperature.

Specifically,the LPMS-IG1W is equipped with two gyroscopes:GyroI for low-speed ranges and GyroII for high-speed ranges.

Applicable scenarios:

GyroI is suitable for situatios **where high data accuracy is required and the detection range is not extensive.**

GyroII is suitable for situations **where moderate data accuracy is accetable and a larger detcetion range is needed.**

Main features:

- High precision and high stability
- Embedded wireless WIFI module and TCP/IP stack
- Wireless transmission frequency up to 250Hz
- Integrated 3-axis gyroscope,accelerometer and magnetometer sensors
- Choice of two gyroscope with different detection ranges(GyroI,GyroII)
- Real time output： raw data,euler angles,quaternions,linear acceleration and temperature
- Communication interface:WIFI/USB
- Supports IoT platfrom for data monitoring and allows setting of alarm thresholds[1]

Applocations:

- Mechanical equipment
- Unmanned
- Robotics
- IoT

**Note 1: The LPIoT monitoring platform needs to be used with an industrial PC and a router.**

# 2. System Overview

## 2.1 Sensor Structure

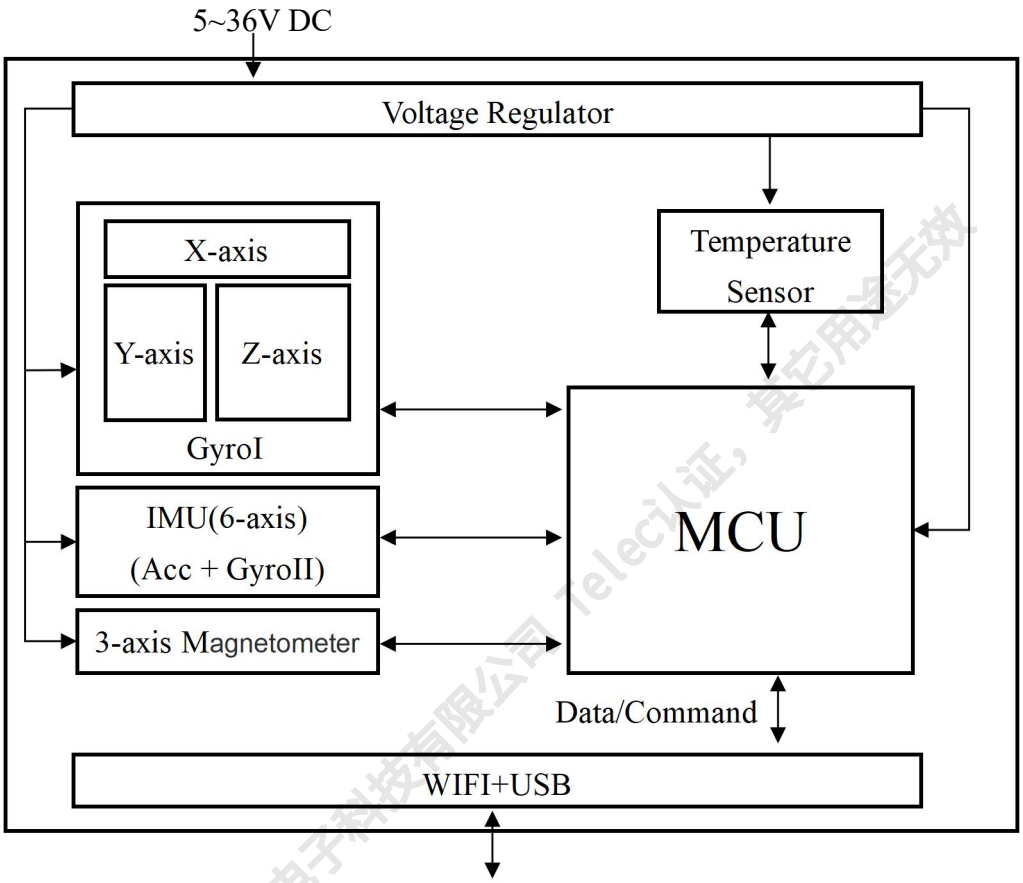


Fig.2.1. LPMS-IG1W sensor structure

## 2.2 Pin Out Configuration

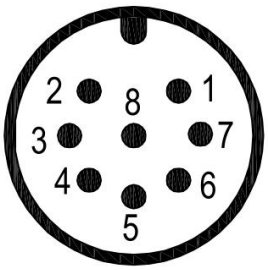


Fig.2.2. Sensor waterproof connector pin out(M12 8-pin-A-coded male connector)

Fig.2.2. LPMS-IG1W paired cables

Table 2-1. Connector pin out introduction

| Pin No. | Signal | Name | Remark | Paired Cable Color |
|---|---|---|---|---|
| 1 | Power | VIN | +5V~+36V DC | White |
| 2 | | GND | Ground | Brown |
| 3 | | RES | - | Green |
| 4 | | RES | - | Yellow |
| 5 | - | RES | - | Gray |
| 6 | USB | D- | - | Pink |
| 7 | | D+ | - | Blue |
| 8 | - | EN | Sensor enabled floating: enable; pulled to ground: disabled | Red |

Communication setting in default:

- USB: COM mode, 921600bps, 8N1

# 3. Coordinate System

The interpretation of the data output by LPMS-IG1W is related to the reference coordinate system used, so an introduction and explanation of various relevant coordinate systems are needed first.

The **Sensor coordinate system (S)** refers to the coordinate system of the LPMS-IG1W sensor, which is a right-handed orthogonal coordinate system, as marked on the sticker on the metal waterproof casing of the product.

The **Object coordinate system (O)** refers to the coordinate system of the object to which the LPMS-IG1W sensor is fixed. When **(S)** and **(O)** do not completely coincide, it is possible to align these two coordinate systems through software configuration. For specific operations, please refer to the relevant software manual.

The **global reference coordinate system (G)** can be divided into two different cases. While the orientation calculation is using all acceleration, gyroscope and magnetic data (sensor filter mode set at acc+gyr+mag), **(G)** system is defined as following:

- X positive when pointing to the magnetic north
- Y positive when pointing to the magnetic west
- Z positive when pointing up (gravity points vertically down with -1g)

While the orientation calculation is using only acceleration and gyroscope data (sensor filter mode set at acc+gyr), **(G)** system is defined as following:

- X positive aligned to ground plane horizontal projection of x axis of (S) when sensor powered on
- Y positive based on right-handed Cartesian coordinate definition
- Z positive when pointing up (gravity points vertically down with -1g)

# 4. Specification

## 4.1. Overall Parameters

| Name | Parameters | Condition | Value | | | Unit |
|---|---|---|---|---|---|---|
| | | | Min. | Typ. | Max. | |
| Performance Parameters | Wired communication frequency | | 5 | 100 | 500 | Hz |
| | Euler angle range | roll | -180 | | +180 | deg |
| | | pitch | -90 | | +90 | deg |
| | | yaw | -180 | | +180 | deg |
| | Angle resolution | | | 0.01 | | deg |
| WIFI parameters | WIFI protocol | | | IEEE 802.11b/g/n | | - |
| | WIFI working frequency band | | | 2.4 | | GHz |
| | WIFI communication distance | | | 10 | | m |
| | Wireless communication Standard | Supported protocols | | TCP/IP 或 MQTT | | |
| | Wireless output frequency[1] | | 5 | 100 | 250 | |
| Hardware parameters | Power consumption[2] | LPMS-IG1W | | 0.85 (0.07A@12V) | | W |
| | Power supply | | 5 | 12 | 36 | V |
| | Suggested input current[3] | | 150 | 500 | 1000 | mA |
| | Size | | | 51 x 45 x 24 | | mm |
| | Wight | | 110 | 115 | 118 | g |

**Note 1: Wireless output frequency only supports a maximum of 250Hz, if the wired output frequency exceeds this value, it must be adjusted to below 250Hz before use.**
**Note 2: Tests are under room temperature +25℃, and the reference values might be changed under different operation conditions.**
**Note 3: When using high-power regulated power supply (such as the use of 48V to 24V output of high-power regulated power supply), the power supply turn on the moment may produce an instantaneous high current, this instantaneous current may exceed the maximum value of the sensor can withstand. Therefore, it is recommended that the use of high-power regulated power supply to the sensor power supply, step by step, that is, the sensor in the stabilization of the regulated source of power on, and then power supply connection.**

| | | | | | | |
|---|---|---|---|---|---|---|
| | Working temperature | | -20 | 20 | 80 | °C |
| | Waterproof level | | | IP67 | | |
| Gyro characteristics(BW=10Hz) | Bias stability | < 400 dps | | 4 | | deg/hr |
| | | > 400 dps | | 6 | | |
| | ARW | < 400 dps | | 0.12 | | deg/√hr |
| | | > 400 dps | | 0.24 | | |
| | Noise density | < 400 dps | | 0.002 | | dps/√Hz |
| | | > 400 dps | | 0.004 | | |
| | Root mean square of noise | < 400 dps (BW=10Hz) | | 0.01 | | dps |
| | | > 400 dps (BW=10Hz) | | 0.03 | | |
| | P-P noise | < 400 dps | | 0.05 | | dps |
| | | > 400 dps | | 0.15 | | |
| | Bandwidth | < 400 dps | | 10 | | Hz |
| | | > 400 dps | 5 | 10 | 92 | |
| Accelerometer characteristics(BW=10Hz) | Bias stability | | | 25 | | ug |
| | VRW | | | 0.045 | | m/s/√hr |
| | Root mean square of noise | | | 0.4 | | mg |
| | Noise density | | | 100 | | ug /√Hz |
| | Bandwidth | | 5 | 10 | 100 | Hz |

Table 4-1. Overall parameters

## 4.2. Gyroscope Parameters

| Parameters | Condition | Value | | | Unit |
|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | |
| Scale factor | 24bit | | 17920 | | LSB/dps |
| Initial scale factor tolerance | +25°C | -2 | | +2 | % |
| Scale factor change vs. temperature | | -3 | | +3 | % |
| Offset tolerance | +25°C | -1 | | +1 | dps |
| Offset change vs. temperature | | -1 | | +1 | dps |
| Measurement range | | -400 | | +400 | dps |
| non-linearity | +25°C | -0.5 | | +0.5 | %FS |
| Cross axis sensitivity | +25°C | -5 | | +5 | % |

Table 4-2. GyroI parameters

| Parameters | Condition | Value | | | Unit |
|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | |
| Scale factor | ±1000dps | | 32.8 | | LSB/dps |
| | ±2000dps | | 16.4 | | |
| Initial scale factor tolerance | +25°C | | ±1 | | % |
| Scale factor change vs. temperature | | | ±2 | | % |
| Offset tolerance | +25°C | | ±1 | | dps |
| Offset change vs. temperature | | | ±0.01 | | dps/°C |
| Measurement range | | | ±2000 | | dps |
| non-linearity | +25°C | | ±0.1 | | % |
| Cross axis sensitivity | | | ±1 | | % |

Table 4-3. GyroII parameters

## 4.3. Accelerometer Parameters

| Parameters | Condition | Value | | | Unit |
|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | |
| Scale factor | 16bit, ±2g | | 16384 | | LSB/g |
| | 16bit, ±4g | | 8192 | | LSB/g |
| | 16bit, ±8g | | 4096 | | LSB/g |
| | 16bit, ±16g | | 2048 | | LSB/g |
| Initial scale factor tolerance | | | ±1 | | % |
| Scale factor change vs. temperature | | | ±1.5 | | % |
| Offset tolerance | | | ±40 | | mg |
| Offset change vs. temperature | X, Y | | ±0.5 | | mg/°C |
| | Z | | ±1 | | mg/°C |
| Measurement range | | | ±2 | | g |
| | | | ±4 | | g |
| | | | ±8 | | g |
| | | | ±16 | | g |
| non-linearity | +25°C | | ±0.3 | | % |
| Cross axis sensitivity | +25°C | | ±1 | | % |

Table 4-4. Accelerometer parameters

## 4.4. Magnetometer Parameters

| Parameters | Condition | Value | | | Unit |
|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | |
| Scale factor | 16bit, ±2G | | 12000 | | LSB/G |
| | 16bit, ±8G | | 3000 | | LSB/G |
| Scale factor change vs. temperature | | | 100 | | LSB/°C |
| Offset tolerance | | | ±10 | | mG |
| Measurement range | | -2 | | +2 | Gauss |
| | | -8 | | +8 | Gauss |
| non-linearity | ±2G | | 0.1 | | %FS |
| 磁滞 | ±2G, ±8G | | 0.3 | | %FS |
| Cross axis sensitivity | Cross field =1Gauss, ±2G | | 0.1 | | %/G |
| X-Y-Z orthogonality | | | 90±1 | | deg |

Table 4-5. Magnetometer parameters

## 4.5. Allan Chart

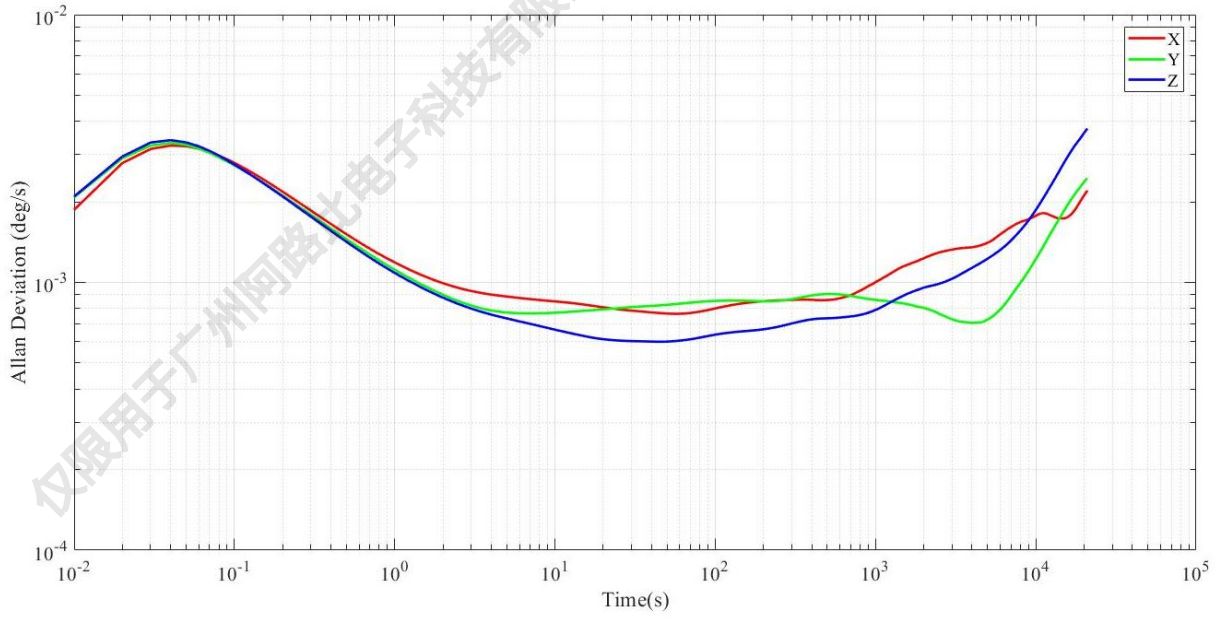


Fig.3.1. Gyrol Allan parameters

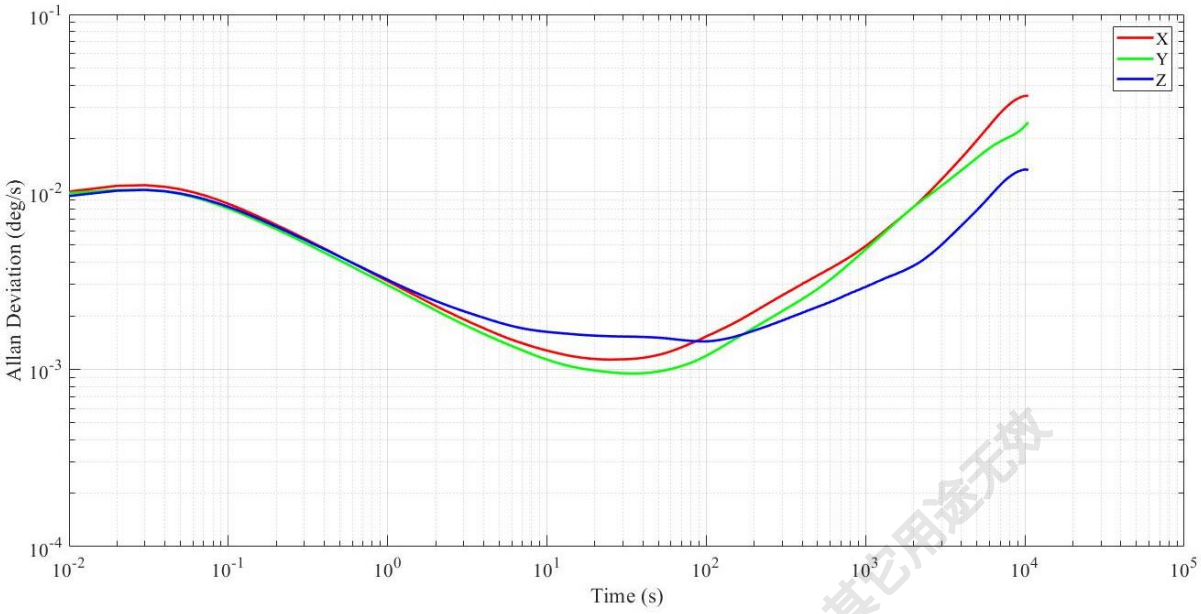


Fig.3.2. GyroII Allan parameters

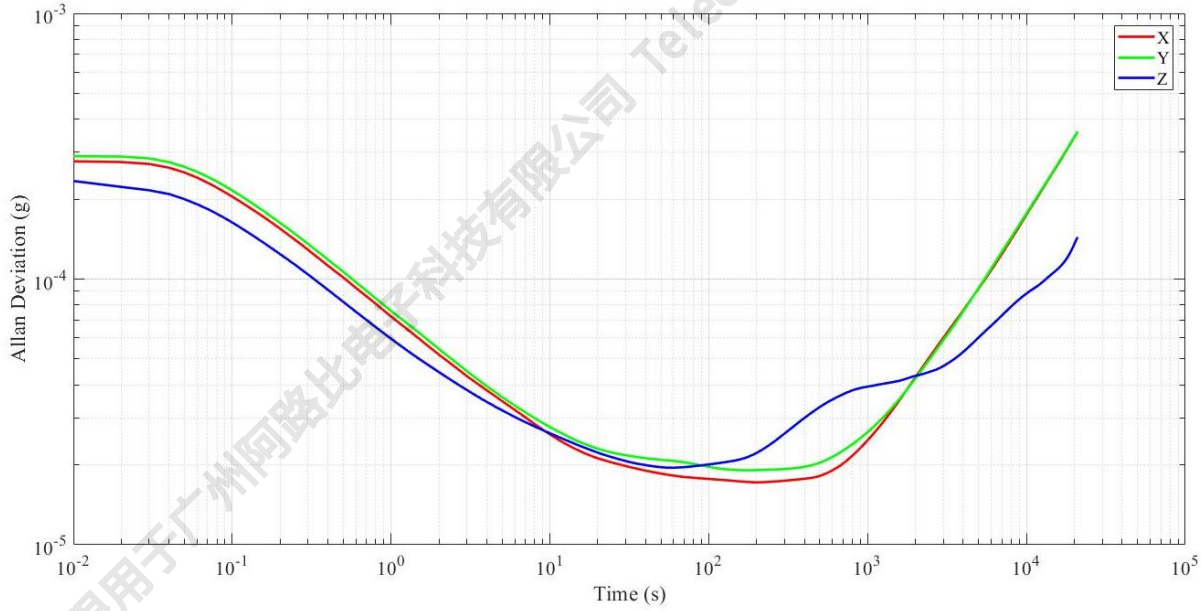


Fig.3.3. ACC Allan parameters

# 5. Mechanical Information

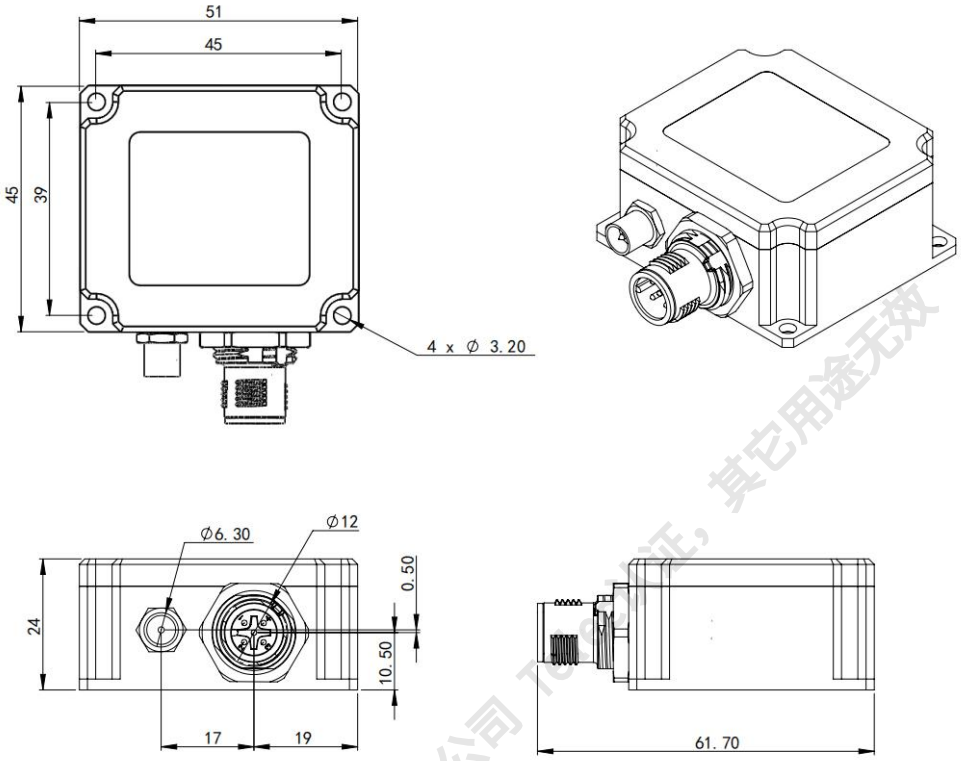


Fig.4.1. LPMS-IG1W dimension（unit:mm）

Federal Communications Commission (FCC) Statement
This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.
Note: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:
●Reorient or relocate the receiving antenna.
●Increase the separation between the equipment and receiver.
●Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
●Consult the dealer or an experienced radio/TV technician for help.
Warning: Changes or modifications made to this device not expressly approved by Xikaku Inc.
may void the FCC authorization to operate this device.
Note: The manufacturer is not responsible for any radio or TV interference caused by unauthorized modifications to this equipment. Such modifications could void the user's authority to operate the equipment.

RF exposure statement:
The transmitter must not be colocated or operated in conjunction with any other antenna or transmitter. This equipment complies with the FCC RF radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with a Minimum distance of 20cm between the radiator and any part of your body.