BW-IMU300 Series

Cost-effective

Inertial Measurement Unit

Technical Manual

V3.0

BW-IMU300
Cost-effective Inertial Measurement Unit

Introduction

BW-IMU300 is a high-precision inertial measurement unit that can measure the angular velocity and acceleration of a moving carrier. The data deviation is estimated by the 6-state Kalman filter with appropriate gain, which is suitable for inertial attitude measurement in motion or vibration state.

BW-IMU300 uses highly reliable MEMS accelerometers and gyroscopes, and it uses algorithms to ensure measurement accuracy. At the same time, the sealing design and strict production process ensure that the product can accurately measure movement parameters such as the angular velocity, acceleration and attitude of the carrier in harsh environments. Through various compensations such as nonlinear compensation, quadrature compensation, temperature compensation and drift compensation, the error source of BW-IMU300 can be greatly eliminated and the product accuracy level can be improved. It has a digital interface, which can be easily integrated into the user's system.

Feature

- Dynamic compensation, quadrature compensation
- Sampling frequency up to 500Hz
- RS232 /485/TTL Output optional
- Wide temperature range: -40℃~+85℃, Temperature compensation
- Small size: L60×W59×H29mm

Application

- Unmanned ships and underwater robots
- Construction machinery
- Stable platform
- AGV unmanned guided vehicle
- Heavy duty truck
- Unmanned drive
- Robots
- Unmanned aircrafts

Product Feature

Electrical index

Power supply	9-36V DC
Working current	30mA （40mA max）
Operating temperature	-40~85℃
Storage temperature	-55~100℃

Performance index

Gyro	Resolution	0.01°/sec
	Range	±400°/sec
	Bias stability at room temperature	< 1.5°/h （100s,1σ） < 15°/h （10s,1σ）
	Angle random walk coefficient	< 0.1 °/√h
	Bias repeatability	< 50 °/h （1σ）
	Scale factor non-linearity	≤100ppm （1σ）
	Scale factor repeatability	≤100ppm （1σ）
	Bandwidth	100Hz
Accelerometer	Range: X, Y, Z	±3.6g
	Resolution	0.01mg
	Add zero offset	0.15mg
	Bias stability	0.001mg （25℃， 100s， 1σ） 0.01mg （25℃， 10s，1σ）

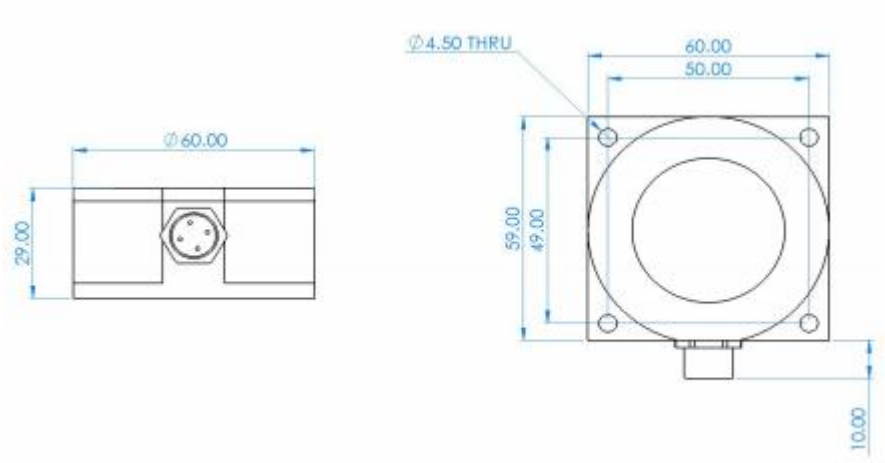
Resolution: The smallest change value of the measured value that the sensor can detect and distinguish within the measurement range.

Mechanical Index

Connector	Metal joint（Cable 1.5m)
Protection level	IP67
Shell material	Magnesium aluminum alloy anodizing
Installation	Four M4 screws

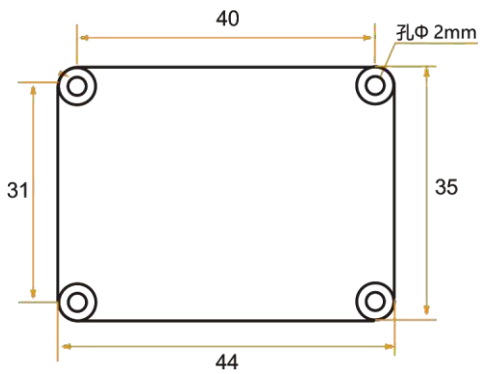
Package product size

Product size：L60*W59*H29（mm）



PCB size

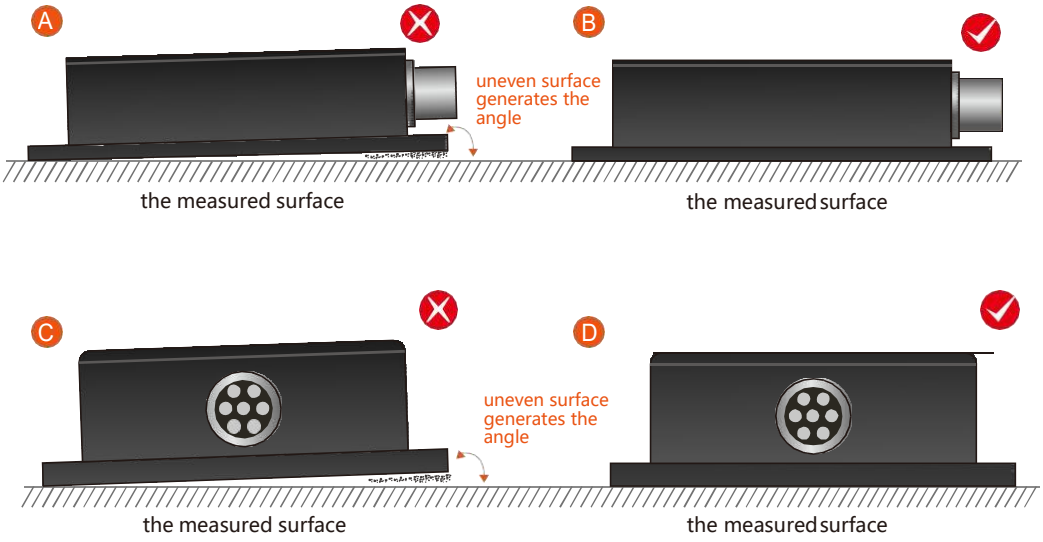
Product size：L44*W35*H11（mm） The length and width may have an error of ±1mm, please refer to the actual product



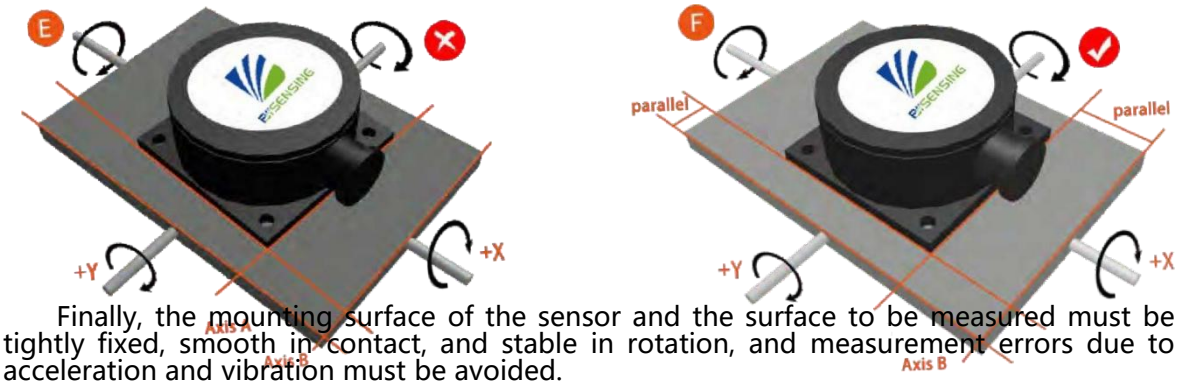
Installation

The correct installation method can avoid measurement errors. When installing the sensor, please do the following:

First of all, make sure that the sensor mounting surface is completely close to the measured surface, and the measured surface should be as level as possible, and there should be no included angles as shown in Figure A and Figure C. The correct installation method is shown in Figure B and Figure D.



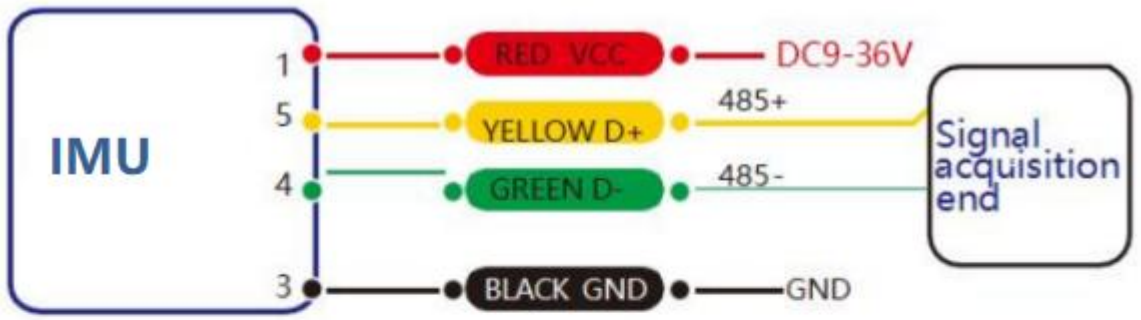
Secondly, the bottom line of the sensor and the axis of the measured object cannot have an angle as shown in Figure E. When installing, keep the bottom line of the sensor parallel or orthogonal to the axis of rotation of the measured object. This product can be installed horizontally or vertically (vertical installation needs to be customized), and the correct installation method is shown in Figure F.



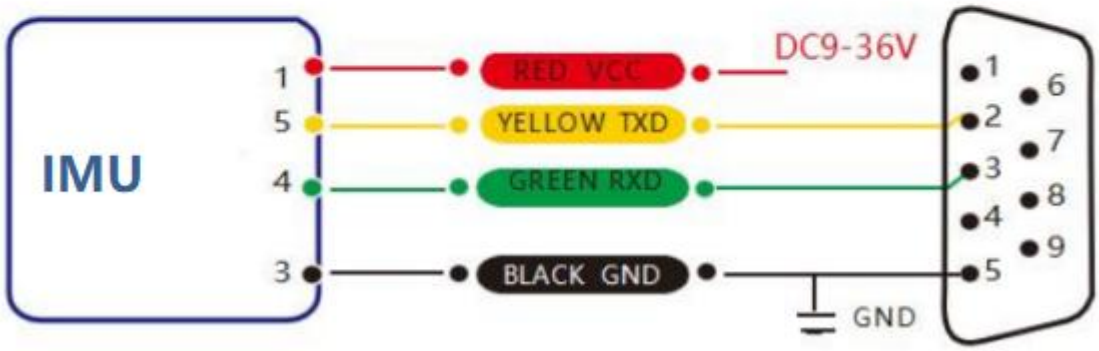
Finally, the mounting surface of the sensor and the surface to be measured must be tightly fixed, smooth in contact, and stable in rotation, and measurement errors due to acceleration and vibration must be avoided.

Electrical Connection

Wiring Definition					
Wiring color	RED	BLUE	BLACK	GREEN	YELLO
function	1	2	3	4	5
	VCC DC 9-36V	NC	GND	Receive RXD B、D-	Send TXD A、D+



RS 485 wiring diagram



RS 232 wiring diagram

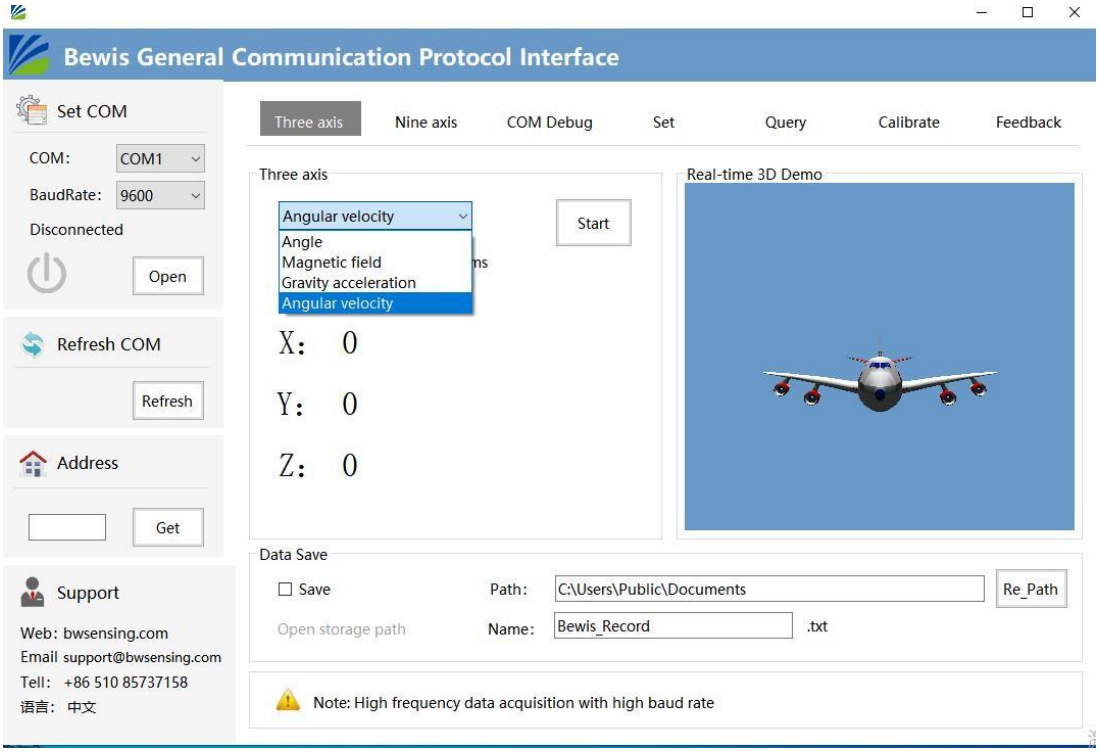
Debugging software

You can download the serial debugging assistant directly on the official website (Technical service -> download area), or you can use the more convenient and intuitive host computer software.

BW-IMU300 supporting serial port debugging software can connect the inclination sensor on the computer to display the angle. The software debugging interface is shown in the figure below. Using the tilt angle to debug the host computer, you can easily display the current X and Y directions, and you can also modify and set other parameters.

Steps for use:

① Connect the serial port hardware of the inclinometer correctly, and connect the power supply.
② Select computer serial port and baud rate and click connect serial port.
③ Click start button and the current inclination angle of the incliner in X and Y directions will be displayed on the screen.



Communication protocol

1 Data frame format: (8 data bits, 1 stop bit, no parity, default rate 9600)

Symbol (1 byte)	Data length (1 byte)	Address code (1 byte)	Command Word (1 byte)	Data field (X byte)	Checksum (1 byte)
0×77H					

Data format: hexadecimal number; Marker: fixed to 77;
Data length: length from data length to checksum (including data length and checksum);
Address code: the address of the acquisition module, the default is 00 Data field: according to the different contents and length of the command word change accordingly;
Checksum: the hexadecimal sum of data length, address code, command word and data field (if there is any rounding, only the last two are taken); Note: when the

2 Command Format:

2.1 Setting the communication rate Send command: 77 05 00 0B 02 12

Symbol (1 byte)	Data length (1 byte)	Address code (1 byte)	Command Word (1 byte)	Data field (1 byte)	Checksum (1 byte)
0×77	0×05		0x0B	XX	

Response command:

Symbol (1 byte)	Data length (1 byte)	Address code (1 byte)	Command Word (1 byte)	Data field (1 byte)	Checksum (1 byte)
0×77	0×05		0x8B	0x00: Success 0xFF: Failure	

Note: 0x00 means 2400, 0x01 means 4800, 0x02 means 9600, 0x03 means 19200, 0x04 means 115200, 0x05 means 38400, 0x06 means 57600, 0x07 means 460800, and the default value is 0x02:9600, and each time when changing the communication baud rate is successful, it will send back an answer command with the original baud rate. After each successful baud rate change, it will send back an answer command with the original baud rate, and then change the communication baud rate immediately. Note: If you need high frequency output, please set the baud rate to 115200 or 460800, and the modification of baud rate will take effect immediately without sending save command.

2.2 Set module address Send command: 77 05 00 0F 01 15

Symbol (1 byte)	Data length (1 byte)	Address code (1 byte)	Command Word (1 byte)	Data field (1 byte)	Checksum (1 byte)
0×77	0×05	Correct Address	0x0F	New address	

Response command:

Symbol (1 byte)	Data length (1 byte)	Address code (1 byte)	Command Word (1 byte)	Data field (1 byte)	Checksum (1 byte)
0×77	0x05	New address	0x8F	0x00: Success 0xFF: Failure	

Note: For example, the following command "77 05 00 0F 0A 1E" means to change the address of the product from hexadecimal address 00 to 0A.

2.3 Query current address Send command: 77 04 00 1F 23

Symbol (1 byte)	Data length (1 byte)	Address code (2 byte)	Command Word (1 byte)	Data field (0 byte)	Checksum (1 byte)
77	0x04	0x00	0x1F		0x23

Response command:

Symbol (1 byte)	Data length (1 byte)	Address code (1 byte)	Command Word (1 byte)	Data field (1 byte)	Checksum (1 byte)
0×77	0x05	Current address	0x1F	Current address	

Note: The query address command fixes this command.

2.4 Query the gravity acceleration G value Send command: 77 04 00 54 58

Symbol (1 byte)	Data length (1 byte)	Address code (1 byte)	Command Word (1 byte)	Data field (0 byte)	Checksum (1 byte)
0×77	0x04		0x54		

Response command:

Symbol (1 byte)	Data length (1 byte)	Address code (1 byte)	Command Word (1 byte)	Data field (9 byte)	Checksum (1 byte)
0×77	0x0D		0x54	3 groups SXXXYY	

Note: The data field is the size of g-value for pitch, roll, and Z-axis (vertical horizontal plane), which consists of 1 sign bit + 1 integer bit + 4 decimal places. If the return value is "77 0D 00 54 00 01 07 00 94 21 10 06 30 64", then it is 0.0107g, 0.9421g, -0.0630g respectively.

2.5 Query angular velocity Send command: 77 04 00 50 54

Symbol (1 byte)	Data length (1 byte)	Address code (1 byte)	Command Word (1 byte)	Data field (0 byte)	Checksum (1 byte)
0×77	0x04		0x50		

Response command:

Symbol (1 byte)	Data length (1 byte)	Address code (1 byte)	Command Word (1 byte)	Data field (9 byte)	Checksum (1 byte)
0x77	0x0D		0x50	3 groups SXXXYY	

Note: The data field is the magnitude of the pitch, roll and Z-axis (vertical horizontal) angular velocity and consists of 1 sign bit + 3 integer bits + 2 decimal places. For example, if the return value is "77 0D 00 50 10 93 76 12 98 87 00 14 03 BE", then the data field part is respectively:

Pitch axis angular velocity: -93.76°/s , Roll axis angular velocity: -298.87°/s , Z-axis angular velocity: +14.03°/s .

2.6 Setting the Output Angle Mode Send command: 77 05 00 0C 00 11

Symbol (1 byte)	Data length (1 byte)	Address code (1 byte)	Command Word (1 byte)	Data field (1 byte)	Checksum (1 byte)
0x77	0x05		0x0C	XX	

Response command:

Symbol (1 byte)	Data length (1 byte)	Address code (1 byte)	Command Word (1 byte)	Data field (1 byte)	Checksum (1 byte)
0x77	0x05		0x8C	0x00: Success 0xFF: Failure	

The data field XX sent is the automatic output frequency option: 00 for answer mode
01 for 5Hz automatic data output
02 for 10Hz auto output data
03 for 20Hz auto output data
04 indicates 25Hz auto output data
05 indicates 50Hz auto output data
06 indicates 100HZ auto output data
07Indicates 200HZ automatic data output
08 denotes 500HZ automatic data output
Note: The auto output data type parameter is determined by the data type selection command, and the default is to output angular velocity automatically.

2.7 Automatic output data type setting Send command: 77 05 00 56 00 5B

Symbol (1 byte)	Data length (1 byte)	Address code (1 byte)	Command Word (1 byte)	Data field (1 byte)	Checksum (1 byte)
0x77	0x05		0x56	XX	

Response command:

Symbol (1 byte)	Data length (1 byte)	Address code (1 byte)	Command Word (1 byte)	Data field (1 byte)	Checksum (1 byte)
0x77	0x05		0x56	00	

Note: Data field XX is the corresponding output data type, which needs to be carried out in automatic output mode: 0x00: when outputting automatically, the output parameter is 3-axis angular velocity data, and the output format refers to Command 2.5;
0x01: the output parameter is 3-axis acceleration data, refer to Command 2.4 for the output format;

0x02: When outputting automatically, the output parameter consists of three-axis angular velocity and acceleration, for example, the return value is "77 16 00 84 10 93 76 12 98 87 00 14 03 00 01
07 00 94 21 10 06 30 FE", then the data fields are: X-axis angular velocity: -93.76°/s, Y-axis angular velocity: -298.87°/s, Z-axis angular velocity:
+14.03°/s, X-axis acceleration: 0.0107g, Y-axis acceleration: 0.9421g, Z-axis acceleration: -0.0630g

2.8 Gyro calibration Send command: 77 04 00 52 56

Symbol (1 byte)	Data length (1 byte)	Address code (1 byte)	Command Word (1 byte)	Data field (0 byte)	Checksum (1 byte)
0x77	0x04		0x52		

Response command:

Symbol (1 byte)	Data length (1 byte)	Address code (1 byte)	Command Word (1 byte)	Data field (1 byte)	Checksum (1 byte)
0x77	0x05		0xA5	0x01	

Note: This command can be sent to correct the gyro zero bias when the sensor appears to be performing poorly in dynamic environments or when it reads a gyro angular velocity value that is not at zero while stationary. This command should only be used when the sensor is absolutely stationary to obtain the best calibration results.

2.9 Save settings Send command: 77 04 00 0A 0E

Symbol (1 byte)	Data length (1 byte)	Address code (1 byte)	Command Word (1 byte)	Data field (0 byte)	Checksum (1 byte)
0x77	0x04		0x0A		

Response command:

Symbol (1 byte)	Data length (1 byte)	Address code (1 byte)	Command Word (1 byte)	Data field (1 byte)	Checksum (1 byte)
0x77			0x8A	0x00: Setting success 0xFF: Setting failed	

Note: Setting the baud rate does not need to save the setting, all other setting items need to be sent to save the setting.

Order information

Product model	Communication mode	Package situation
BW-IMU300-485	RS485	IP67 Package /Metal joint
BW-IMU300-232	RS232	IP67 Package /Metal joint
BW-IMU300-TTL	TTL	IP67 Package /Metal joint

Executive standard

- National Standard (Draft) for Static Calibration Specification for Biaxial Inclination Sensors
- GB/T 191 SJ 20873-2003 General specification for inclinometer and level

BW-IMU300 Series

Cost-effective Inertial Measurement Unit

Wuxi Bewis Sensing Technology LLC

Add: Building 30, No.58 Xiuxi Road, Binhu District, Wuxi City, Jiangsu Province, China

Tel: +86 18921292620

Email: sales@bwsensing.com

Web: www.bwsensing.com