Introduction to the IMU module

- This product is a high-performance three-dimensional motion attitude measurement system based on MEMS technology. It contains three-axis gyroscope, three-axis accelerometer, three-axis electronic compass motion sensor and barometer. By integrating various high-performance sensors and using the self-developed attitude dynamics core algorithm engine, combined with the high dynamic Kalman filter fusion algorithm, we can provide customers with high-precision, high-dynamic, real-time compensated three-axis attitude angles. Flexible configuration options to meet different application scenarios.
- The leading sensor fusion algorithm based on the Kalman filtering principle and with independent intellectual property rights can provide data with an update rate of up to 200Hz in real time, so as to meet various high-precision application requirements and achieve accurate motion capture and attitude estimation. The product integrates the self-developed high-precision calibration and calibration algorithm to improve the measurement accuracy of the product.
- At the same time, it provides the PC host computer software, operating instructions, development manual and development code required by users, so that the research and development time for various needs is minimized.

1. The front of the module
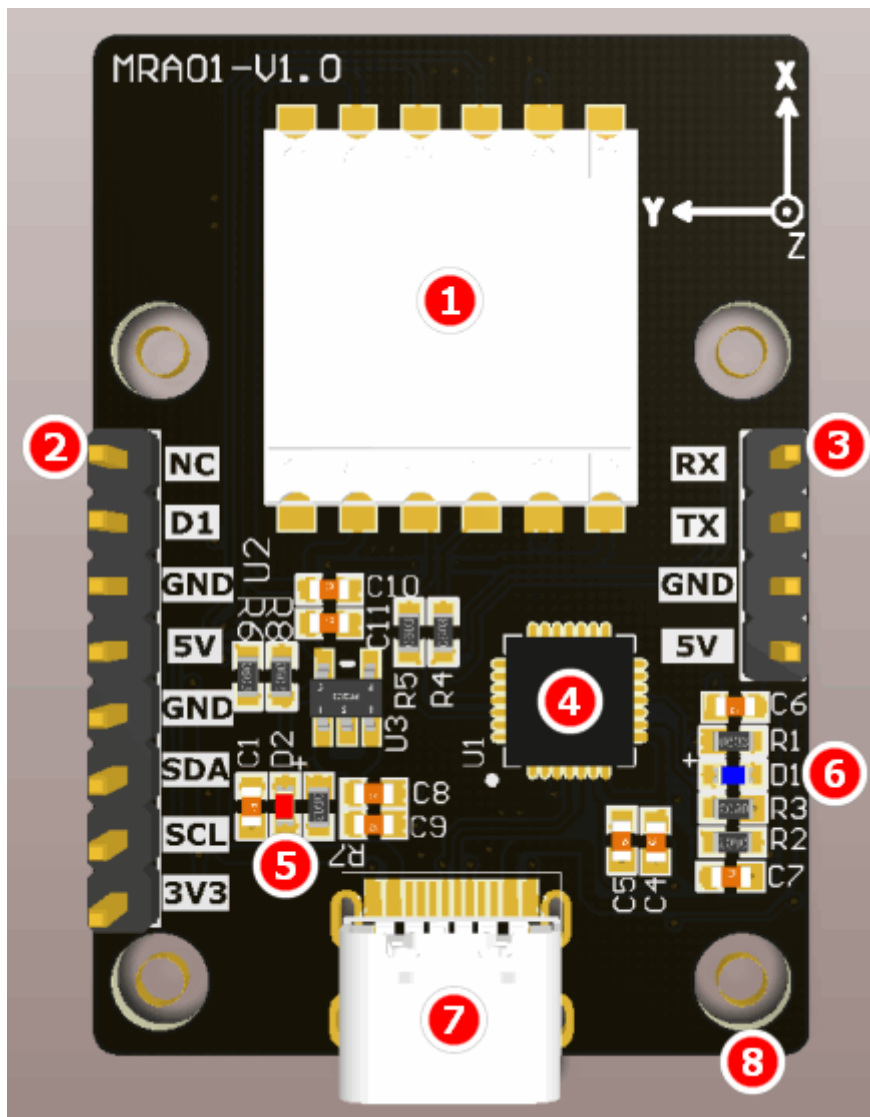
①The core module of the IMU module: All calculated poses are completed through this core module.

②External pin: can be connected to GPS module or I2C device.

③Serial port pin: output TTL signal, can communicate with STM32 and other microcontrollers.

④CP2102 chip: USB to serial port function.

⑤D2 indicator: module status indicator, the module is always on under normal conditions.

⑥D1 indicator: CP2102 status indicator, the USB is on during communication, and off when idle.

⑦Type-C interface: Connect to the serial port of the module and use it as a communication interface.

⑧Fixed copper column: used to install metal shell or install GPS module.

Pin function description

NC	Null
D1	Connect the data interface of the GPS module
GND	Ground
5V	5V

NC	Null
GND	Ground
SDA	I2C - Serial Data Line
SCL	I2C - Serial Clock Line
3V3	3.3V
RX	Serial port - data receiving pin
TX	Serial port - data transmission pin
GND	Ground
5V	5V

2. The back of the module
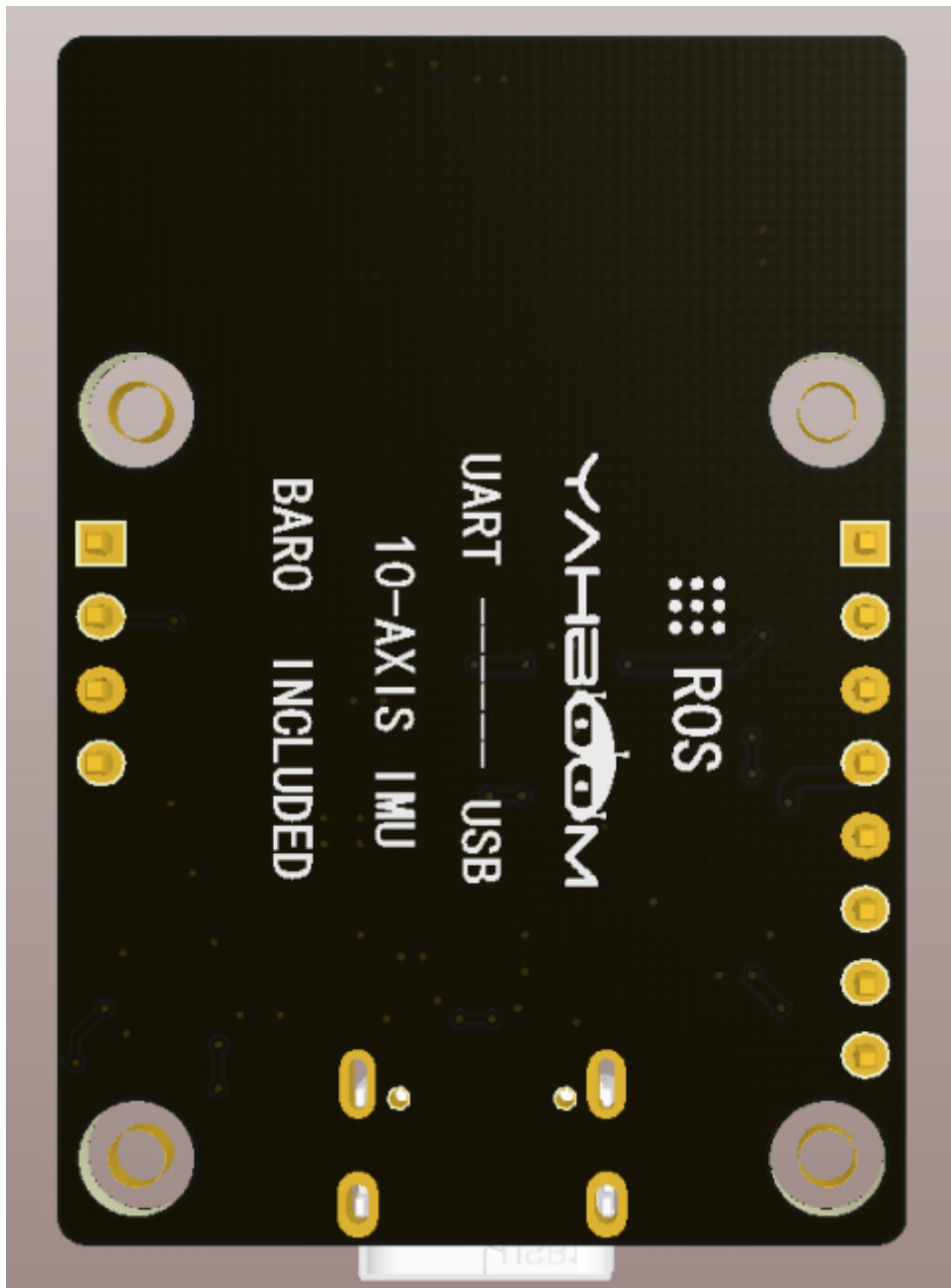
3. Version difference

The IMU module has a bare metal version and a metal shell version. The metal shell version has a shell installed at the factory. The bare metal version can be connected to a microcontroller such as STM32 through a serial port, or it can be connected to a Raspberry Pi through a USB data cable. After the metal case is installed, only USB communication can be used.

4. Product Features

- The module integrates high-precision gyroscopes, accelerometers, geomagnetic field sensors and barometers, and adopts high-performance microprocessors and advanced dynamic calculation and Kalman dynamic filtering algorithms, which can quickly solve the current real-time motion attitude of the module.

- Using advanced digital filtering technology can effectively reduce measurement noise and improve measurement accuracy.
- The module integrates an attitude solver and cooperates with the dynamic Kalman filter algorithm to accurately output the current attitude of the module in a dynamic environment. The attitude measurement accuracy is static 0.05 degrees, dynamic 0.1 degrees, extremely stable, and its performance is even better than some Professional inclinometer.
- The Z-axis heading angle is added to the filter fusion of the geomagnetic sensor, which solves the cumulative error caused by the drift of the gyroscope integral in the 6-axis algorithm, and can output the heading angle data stably for a long time. **Note: Due to the magnetic field detection, it needs to be calibrated before use, and it needs to be at least 20cm away from magnetic interference areas, electronic equipment, magnets, speakers and other hard magnetic objects.**
- The module has its own voltage stabilization circuit, the working voltage is 3.3~5V, and the pin level is compatible with 3.3V/5V embedded systems, which is easy to connect.
- Support serial port and IIC two kinds of digital interface. It is convenient for users to choose the best connection method. The serial port rate is adjustable from 4800 bps to 921600 bps, and the IIC interface supports full-speed 400K rate.
- Up to 200Hz data output rate. The output content can be freely selected, and the output rate can be adjusted from 0.2 to 200 Hz.
- 4 expansion ports are reserved, which can be configured as analog input, digital input, digital output and other functions respectively.
- With GPS connectivity. Accepts serial GPS data conforming to NMEA-0183 standard to form GPS-IMU integrated navigation unit.

5. Sensor parameter indicators

1. Accelerometer parameters

Parameter	Condition	Typical value
range		±16 g
Resolution	±16 g	0.0005 (g/LSB)
RMS noise	Bandwidth=100 Hz	0.75~1 mg-rms
static zero drift	horizontal	±20~40 mg
Warm drift	-40°C ~ +85°C	±0.15 mg/°C
bandwidth		5~256 Hz

2. Gyroscope parameters

Parameter	Condition	Typical value
range		±2000°/s
Resolution	±2000°/s	0.061(°/s)/(LSB)
RMS noise	Bandwidth=100Hz	0.028~0.07(°/s)-rms
static zero drift	horizontal	±0.5~1°/s

Parameter	Condition	Typical value
Warm drift	-40°C ~ +85°C	±0.005~0.015 (°/s)/℃
bandwidth		5~256Hz

3. Magnetometer parameters

Parameter	Condition	Typical value
range		±2 Gauss
Resolution	±2 Gauss	0.0667 mGauss/LSB

4. Barometer parameters

Parameter	condition	Typical value
range		300~1100 hPa
RMS noise	standard mode	0.5 Pa-RMS
Relative accuracy		±0.06 hPa

5. Pitch angle, roll angle parameters

Parameter	Condition	Typical value
range		X:±180°, Y:±90°
Inclination accuracy	static	0.1°
Inclination accuracy	dynamic	0.5°
Resolution	horizontal	0.0055°
Warm drift	-40°C ~ +85°C	±0.5~1°

6. Heading angle parameters

Parameter	Condition	Typical value
range		Z: ± 180 °
Heading accuracy	9-axis algorithm, magnetic field calibration, dynamic/static	1° (without magnetic field interference)[1]
Heading accuracy	6-axis algorithm, static	0.5° (Dynamic cumulative error) [2]
Resolution	horizontal	0.0055°

Note:

[1]Before use, please perform magnetic field calibration in the test environment to ensure that the sensor is familiar with the magnetic field in this environment. When calibrating, please stay away from magnetic interference

[2] In some vibration environments, there will be cumulative errors, and the specific errors cannot be estimated. The actual test shall prevail.

6. Module parameters

1. Basic parameters

Parameter	Remark
Serial communication interface	The default baud rate is 9600 bps, 4800 bps~921600 bps can be selected
I2C interface	Hardware I2C supports up to 400KHz, software I2C supports up to 100KHz
output content	On-chip time, 3-axis acceleration, 3-axis angular velocity, 3-axis magnetic field, 3-axis angle, quaternion, port state, air pressure, altitude
output rate	Default 10Hz, selectable 0.2Hz~200Hz
Start Time	1000ms
Operating temperature	-40℃~85℃
Storage temperature	-40℃~100℃
Shock proof	20kg (bare board)

2. Electrical parameters

Parameter	Condition	Numerical value
VCC supply voltage		3.3V/5V
Working current	5V	12mA
sleep current	5V	15uA