Catalogue

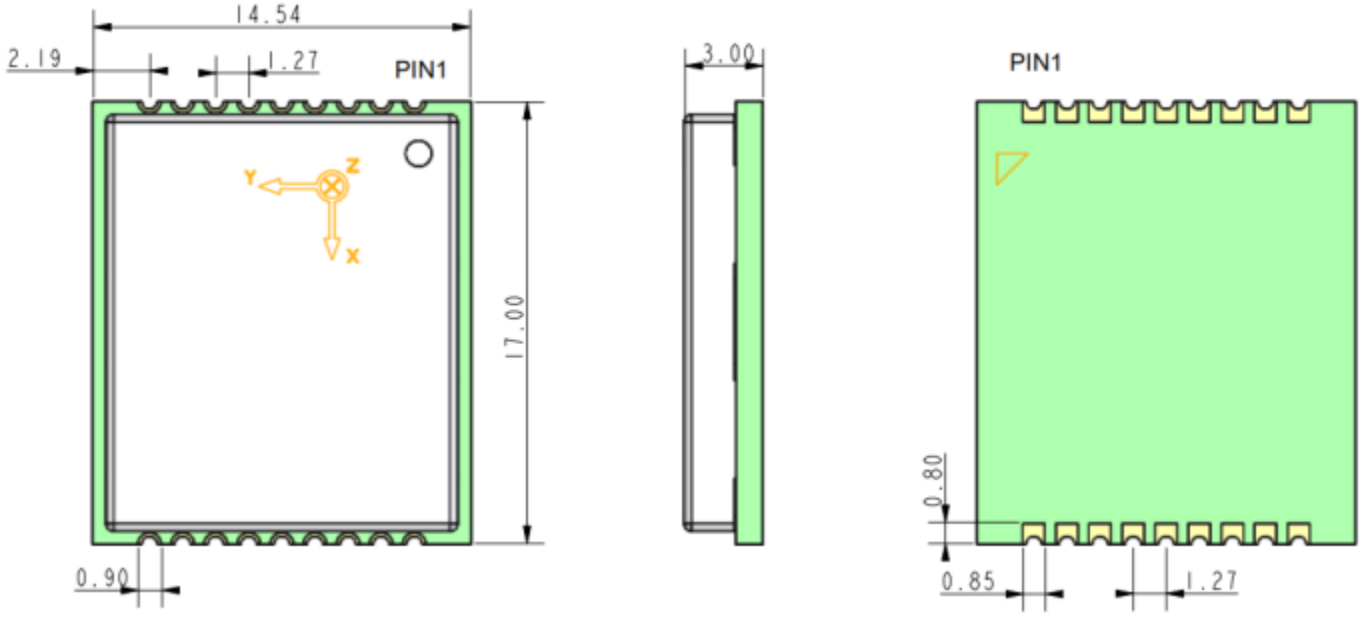
Summary

IMU614E-P inertial module can achieve low cost, high precision and anti-magnetic interference attitude measurement and orientation through data fusion algorithm of IMU and GNSS. Especially in the field of RTK oblique mapping, accurate and consistent oblique position correction can be achieved.

For surveying and mapping poles, it provides ±2.5cm measuring accuracy in the range of 0-30° inclination Angle, and has the function of correcting installation deviation Angle, which can be adapted to all kinds of centering poles.

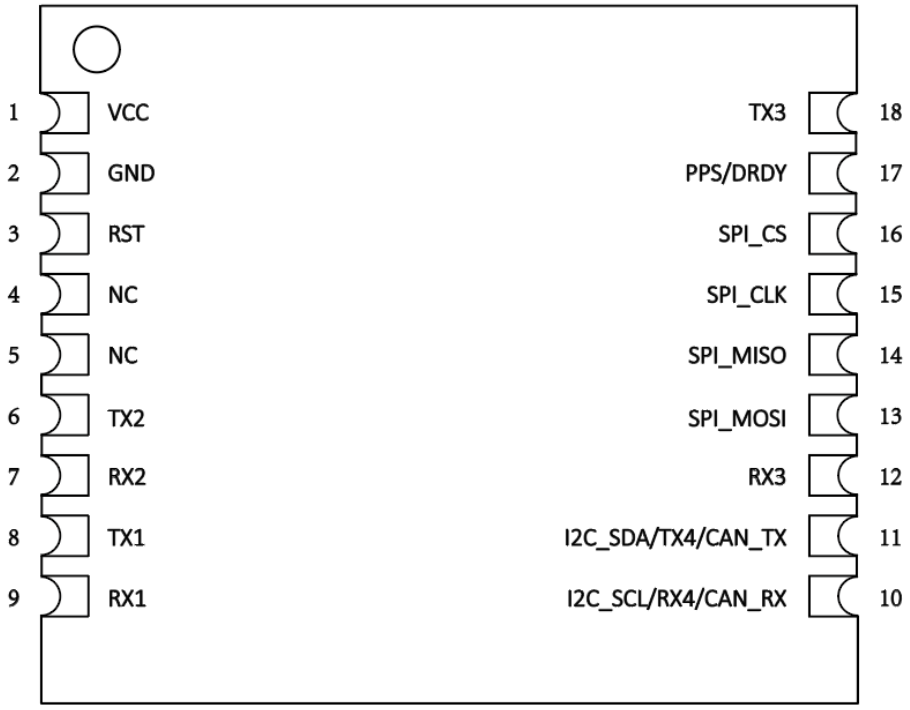
1. Configuration

Figure 1 Outline Structure And Dimensions（Units：mm）



2. Pin Description

Figure 2 Pin diagram

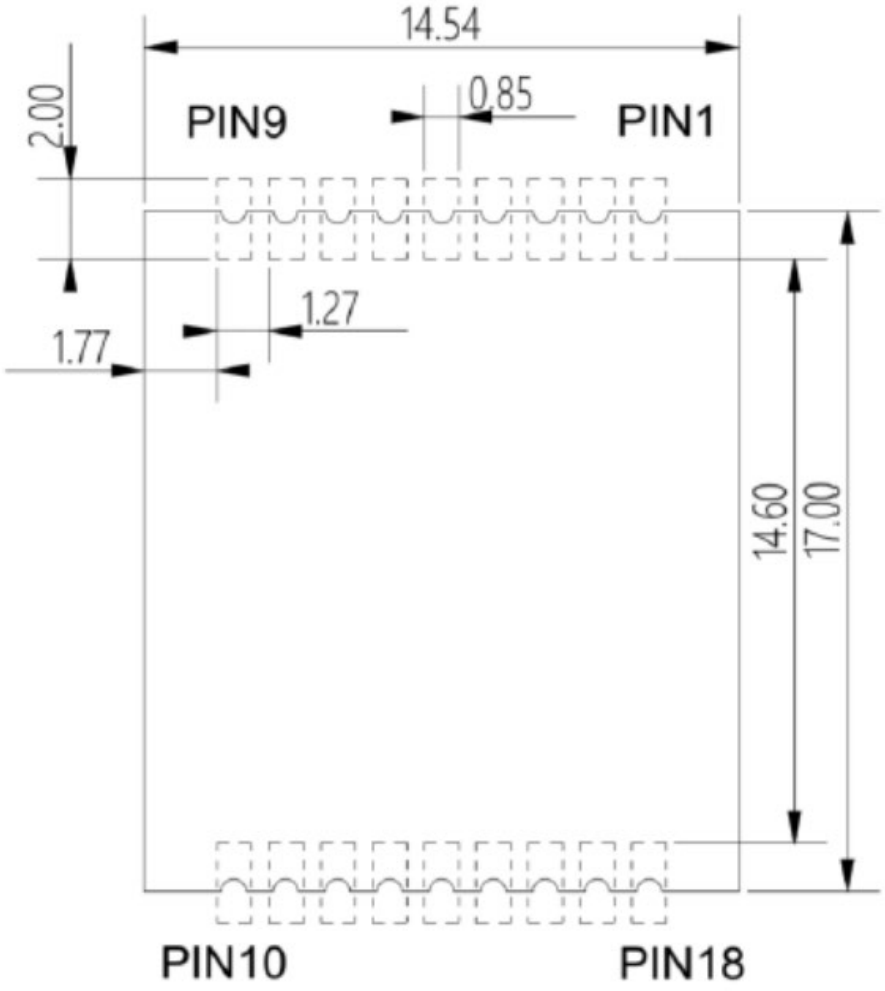


IMU614E-X Pin Layout (Top View)

Table 1 Pin Description

<table>
<tr><th>Pin No.</th><th>Pin Name</th><th>Pin Description</th></tr>
<tr><td>1</td><td>VCC</td><td>Power input, 2.8 ~ 3.3V input, 60mA, ripple no more than 40mv</td></tr>
<tr><td>2</td><td>GND</td><td>Power supply ground</td></tr>
<tr><td>3</td><td>RST</td><td>External hardware reset input, The internal pull-up (Used in SPI MODE)</td></tr>
<tr><td>4</td><td>NC</td><td>No Connect</td></tr>
<tr><td>5</td><td>NC</td><td>No Connect</td></tr>
<tr><td>6</td><td>TX2</td><td>Serial port 2 sending; Reserved Upgrade serial port (LVTTL) baud rate 115200</td></tr>
<tr><td>7</td><td>RX2</td><td>Serial port 2 receiving; Reserved Upgrade serial port (LVTTL) baud rate 115200.</td></tr>
<tr><td>8</td><td>TX1</td><td>Serial port 1 sending; Reserved Upgrade serial port (LVTTL) baud rate 115200</td></tr>
<tr><td>9</td><td>RX1</td><td>Serial port 1 receiving; Reserved Upgrade serial port (LVTTL) baud rate 115200.</td></tr>
<tr><td>10</td><td>CAN RX / RX4 / I2C_SCL</td><td>
<table>
<tr><th>Mode</th><th>Function</th><th>Description</th></tr>
<tr><td>1</td><td>CAN_RX</td><td>Receive data output; reads out data from the bus lines to the CAN controller.</td></tr>
<tr><td>2</td><td>RX4</td><td>Serial port 4 receiving</td></tr>
<tr><td>3</td><td>I2C_SCL</td><td>I2C serial clock</td></tr>
</table>
</td></tr>
<tr><td>11</td><td>CAN TX / TX4 / I2C_SDA</td><td>
<table>
<tr><th>Mode</th><th>Function</th><th>Description</th></tr>
<tr><td>1</td><td>CAN_TX</td><td>Transmit data input; reads in data from the CAN controller to the bus line drivers</td></tr>
<tr><td>2</td><td>TX4</td><td>Serial port 4 sending</td></tr>
<tr><td>3</td><td>I2C_SDA</td><td>I2C serial data</td></tr>
</table>
</td></tr>
<tr><td>12</td><td>RX3</td><td>Serial port 3 receiving; access RTK, baud rate 460800</td></tr>
<tr><td>13</td><td>SPI_MOSI</td><td>SPI serial data input</td></tr>
<tr><td>14</td><td>SPI_MISO</td><td>SPI serial data output</td></tr>
<tr><td>15</td><td>SPI_CLK</td><td>SPI serial clock</td></tr>
<tr><td>16</td><td>SPI_CS</td><td>SPI Chip select</td></tr>
<tr><td>17</td><td>PPS/DRDY</td><td>External synchronous sampling trigger signal. Can be used for Data Ready</td></tr>
<tr><td>18</td><td>TX3</td><td>Serial port 3 sending; access RTK, baud rate 460800</td></tr>
</table>

3. PCB Pad Dimension Drawing



PCB pad size drawing(Unit mm) Top View

4. Electrical Characteristics

Table 2 Electrical Characteristics

Parameter	Symbol	Interface Type	Min	Type	Max	Units
Power input	VCC		3.2	3.3	3.4	V
Power GND	GND					
Serial output	TX1	UART	0.3		VCC	V
Serial input	RX1	UART	0.3		VCC	V
Serial output	TX1	UART	0.3		VCC	V
Serial input	RX1	UART	0.3		VCC	V
Serial output	TX1	UART	0.3		VCC	V
Serial input	RX1	UART	0.3		VCC	V
Reserved pin	NC	IO	0.3		VCC	V
Electric current	I		50		150	mA
Temperature	T		-40		85	℃

5. Minimum Recommended Circuit

Figure 3 Minimum recommended circuit

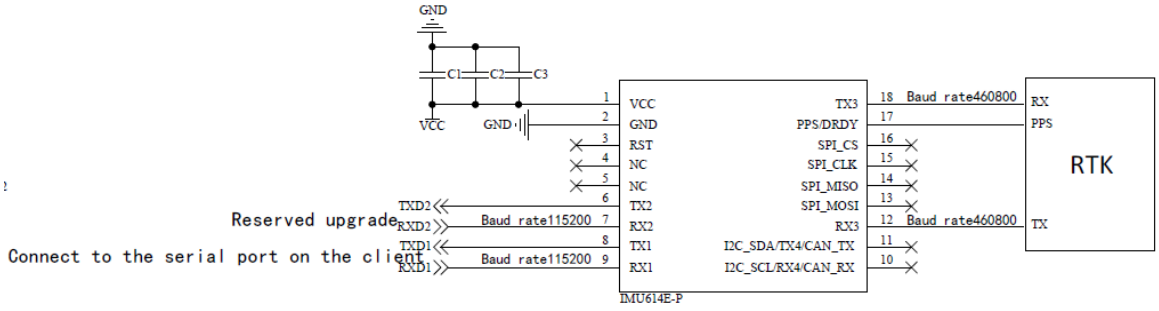


Table 3 Recommended BOM

No.	MPN	Description	Manufacture	Designator	Qty
1	CL10A106KP8NNNC	MLCC 10uF ±10% 10V X5R 0603	SAMSUNG	C1	1
2	CC0402KRX7R9BB104	MLCC 100nF ±10% 50V X7R 0402	YAGEO	C2	1
2	CL05C101JB5NNNC	MLCC 100pF ±5% 50V C0G 0402	SAMSUNG	C3	1

6. RTK Configuration Requirements

Baud rate 460800

PPS second pulse: 1S, rise triggered, aligned to UTC time. High level must not be higher than 5V

- If the RTK board supports Novatea binary protocol, you need to configure the board to output the following two instructions:

BESTPOSB 10hz

PSRVELB 10hz

Close other statements

- If the RTK board uses THE NMEA protocol, configure the board to output the following three commands:

GPGGA 10hz

GPRMC 10hz

GPGST 10hz

Close other statements

7. Output Protocol

Note:

- The frame message will not be output until the RTK data shown in Section 6 is accessed, with an output frequency of 10 Hz.
- The accumulative sum check removes the sum of all bytes of the check bits for this frame.
- Small end mode, send low bytes first.

Content	Type	Relative Position
Header 1：0 x AA	uint8	0
Header 2：0 x 55	uint8	1
Frame ID：0 x 0166	uint16	2
Frame length：0 x 0069	uint16	4
Rod Bottom Latitude-Degree	double	6
Base Longitude-Degree	double	14
Base elevation-M	double	22
Eastern distance of pole base relative to control point-meter	float	30
North Distance from Control Point to Bottom-meter	float	34
Sky Distance-Meter from Base to Control Point	float	38
Inclination-Degree	float	42
Precision Factor	float	46
Gyro x, y, z-axis deg/s Accelerometers x, y, z-axis G temperature	float*7	50
System Status	uint32	78
Current pole length - mm	uint16	82
Calibration accuracy	float	84
RTK Fixed Solution State	uint8	88
Number of RTK Stars	uint8	89
RTK differential delay	uint8	90
Reserve	int16*2	91
Reserve	float*4	95
Accumulation and Check	uint32	111

1 If the precision factor is less than 1.0, the tilt measurement accuracy is good. If the precision factor is 99.99, it indicates that the tilt measurement is not initialized or there are abnormal conditions (such as IMU overrange and RTK out of lock for a long time), and initialization is required.

2. If the calibration progress is -99 when the installation deviation calibration is not started, it means that the module has not been calibrated for the centering rod installation deviation.

3 If RTK has been located and PPS output is normal, the fixed solution state should be greater than 0.

8. Input Instructions

Note: Each instruction should be sent at least 10ms apart

8.1 Configure the RTK board protocol

- According to the principle, if the OUTPUT protocol of the RTK board card is Novatean binary:

Instructions： AT+GNSS_CARD=UNICORE\r\n

Answer： OK\r\n

If the input command is correctly received, the system status bit in the output protocol changes to 21.

- If the OUTPUT protocol of RTK board is NMEA:

Instructions： AT+GNSS_CARD=OEM\r\n

Answer： OK\r\n

If the input command is correctly received, the system status bit in the output protocol changes to 22.

8.2 Configure the front and rear sides of the IMU

If the input command is correctly received, the system status bit in the output protocol changes to 20.

- Virtual gateway If the IMU is installed on the front panel, the configuration command is:

Instructions： AT+INSTALL_ANGLE=0,0,0\r\n

Answer： OK\r\n

- If the IMU reverse patch is installed, the configuration instructions are as follows:

Instructions： AT+INSTALL_ANGLE=180,0,0\r\n

Answer： OK\r\n

8.3 Configure Rod Length

Note: The pole length is the distance from the phase center of the antenna to the pole bottom

For example, the configuration lever is 2.03 meters long

Instructions： AT+CLUB_VECTOR=0.0,0.0,2.03\r\n

Answer： LEN=2.03\r\n

If the input command is correctly received, the system status bit in the output protocol changes to 3.

8.4 Save Parameters

Instructions： AT+SAVE\r\n

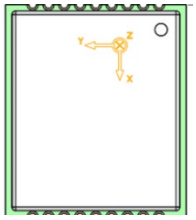
Answer： OK\r\n

If the input command is correctly received, the system status bit in the output protocol changes to 9.

8.5 Configure Arm Rod Vector

The arm rod vector is a three-dimensional vector (X, Y, Z) in meters of the phase center of the RTK antenna relative to the IMU installation position. Among,

- Positive if the RTK antenna is positively on the X-axis of the IMU, negative otherwise.
- Positive if the RTK antenna is positively on the Y-axis of the IMU, negative otherwise.
- If the RTK antenna is positive below the IMU, otherwise it is negative.



For example, configure arm rod vector to be (0.035, -0.05, -0.1)

Instructions: AT+LEVER_ARM=0.035, -0.05, -0.1\r\n

Answer: X=0.035, Y=-0.05, Z=-0.1\r\n

If the input command is correctly received, the system status bit in the output protocol changes to 5.

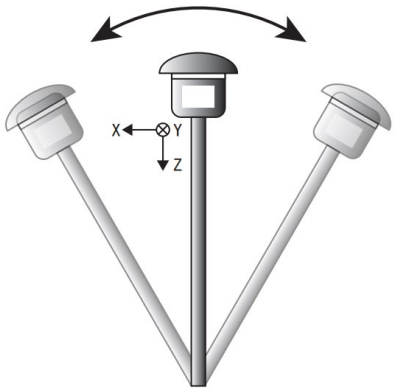
8.6 Initialization Of Skew Measurement

Note: There is no need to shake strictly according to the coordinate system, the diagram coordinates just rotate the diagram.

If the input command is correctly received, the system status bit in the output protocol changes to 1.

1. Send string "AT+START_INIT\r\n", swing the surveying rod back and forth as shown in Figure 4, lasting 5 seconds until the accuracy factor of the base position is less than 0.6.

Figure 4 Shake Diagram



2. Finish the initialization and begin the tilt measurement.
3. If a severe rotation, drop, impact or precision factor is greater than 1 during use, the initialization operation needs to be performed again.

8.7 Enable Installation of Deviation Angle Calibration

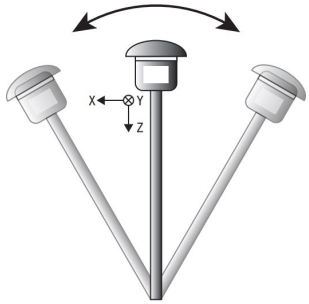
Note:

- After the module is installed, the installation deviation calibration process must be performed once.
- The installation deviation angle should be calibrated in an open scene.
- Insert the bottom tip of the pole into the hard surface to keep the position of the pole bottom unchanged throughout the process.
- Because RTK hosts are usually heavy, the calibration process should be as smooth as possible to prevent rod distortion from affecting the calibration accuracy.
- It is not necessary to calibrate the installation deviation angle each time unless the surveying rod has a severe impact, is deformed, or is reinstalled.
- There is no need to shake strictly according to the coordinate system, the diagrammed coordinates are just the rotation sequence diagram.

If the input command is correctly received, the system status bit in the output protocol changes to 6.

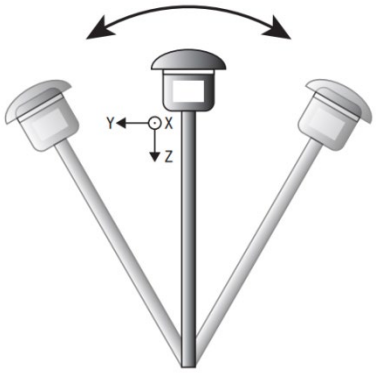
1. In an open and un-obstructing scene, the string "AT+INST_CALIB=3\r\n" was sent after RTK fixed solution. As shown in Figure 5, the mapping rod was swayed back and forth for about 10s until the calibration progress reached 25%

Figure 5 Shake Diagram



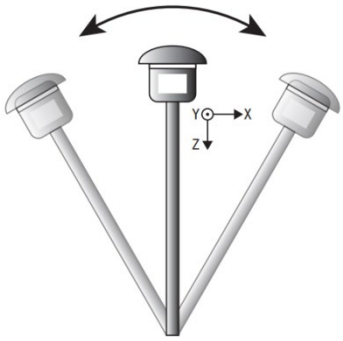
2. Rotate the rod 90 degrees, and swing the surveying rod back and forth for about 10s, as shown in Figure 6, until the calibration progress reaches 50%

Figure 6 Shake Diagram



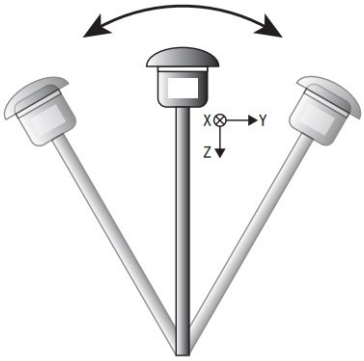
3. Continue to rotate the rod 90 degrees, as shown in Figure 7, swing the surveying rod around and around for at least 10 seconds, until the calibration progress reaches 75%

Figure 7 Shake Diagram



4. Continue to rotate the rod 90 degrees, swing the surveying rod around and around as shown in Figure 8 for at least 10 seconds, until the calibration progress reaches 100%.

Figure 8 Shake Diagram



5. Send the string "AT+SAVE\r\n" to save the parameters.

8.8 Request version Number

Instructions: AT+VERSION\r\n

Answer: VERSION=211209\r\n

If the input command is correctly received, the system status bit in the output protocol changes to 3.

9. Use Examples

9.1 For the first time to use

1. Configure the RTK card type:

If the board output supports novatea binary protocol, configure the RTK board to output BESTPOSB and PSRVELB two frames of 10Hz output, and send the string "AT+GNSS_CARD=UNICORE\r\n".

If the output of the board is NMEA, configure the RTK board to output three frames of GPGGA,GPRMC, and GPGST AT 10Hz and send the string AT+GNSS_CARD=OEM\ R \ N.

2. Configure the IMU installation orientation. If IMU reverse patch is installed, send string "AT+INSTALL_ANGLE=180,0,0\r\n"
3. Set the rod length. If the rod length is 2.03 meters, send the string "AT+CLUB_VECTOR=0.0,0.0,2.03\r\n".
4. Configure the lever vector. If the lever vector is (0.035,-0.05,-0.1) m, send the string "AT+LEVER_ARM=0.035,-0.05,-0.1\r\n
5. SAVE the parameter and send string "AT+SAVE\r\n"

Calibration of installation deviation Angle as shown in Section 8.7.

9.2 Routine use of

If the surveying rod is not replaced or obviously deformed or impacted, there is usually no need to re-calibrate the installation deviation Angle. Each power-on only requires initialization as shown in Section 8.5.