Catalogue

1.Product Profile

1.1 Technical Specifications

attitude accuracy	Roll/Pitch :<0.2° rms
bowhead accuracy	<0.3° rms
heading accuracy	<0.3° rms
Update Rate	1-200hz adjustable
Gyro range	±500°/s
Bias instability of a gyroscope	4deg/h @1σ
Accelerometer range	±6g
Accelerometer zero bias stability	0.04mg @1σ
Horizontal positioning accuracy (single point)	< 1.5m rms
Vertical positioning accuracy (single point)	< 2.5m rms
Horizontal positioning accuracy (RTK)	0.8cm+1ppm rms
Vertical Positioning accuracy (RTK)	1.5cm+1ppm rms
Speed accuracy (single point)	0.02 m/s
Speed Accuracy (RTK)	0.02 m/s
Cold start time	< 30s
Hot start time	≤2s

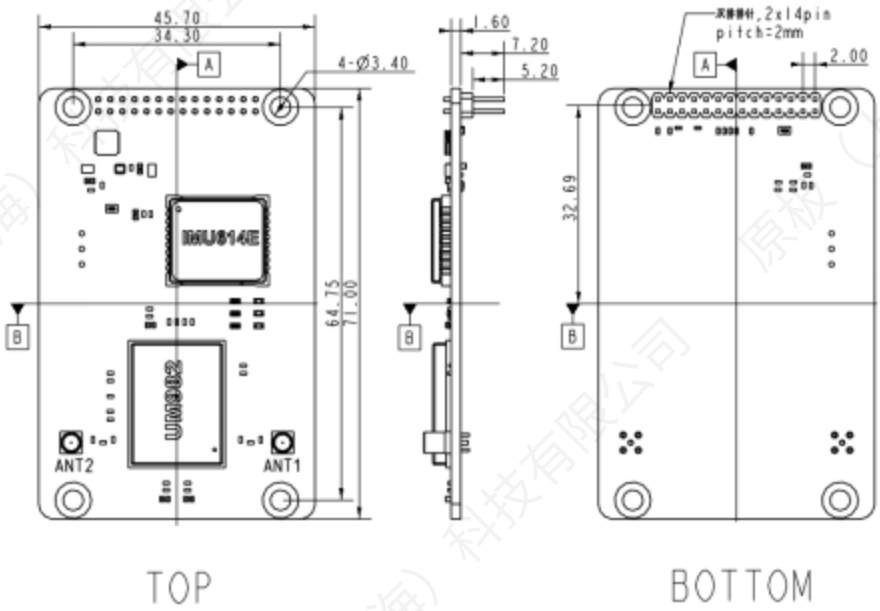
1.2 Board Overview

Customized development is made for the navigation scene, which can output the heading and heading based on true north at the same time, and output high-precision attitude Angle. FS982-SA integration and Core Star full system full frequency point high-precision positioning and orientation module UM982, integrated with the original pole self-developed high-precision IMU, built-in multi-model intelligent position fusion algorithm.

2. Hardware composition

2.1 Mechanical Dimensions

Figure 1 Mechanical dimensions (unit: mm)



2.2 Connector and PIN pin definition

In addition to ANT1 and ANT2 MMCX interfaces, FS982-SA provides the following 28pin Cvilux double-row pins, pin spacing: 2.0mm; Pin length: 3.9mm; Seat thickness: 2.0mm.

Figure 2 Schematic diagram of the connector PIN

2.3 Pin function description

Table 1 Pin description

Pins	signal	Input/output	Description	Remarks
1	RSV	-	Reserved	-
2	RSV	-	Reserved	-
3	RSV	-	Reserved	-
4	RSV	-	Reserved	-
5	RSV	-	Reserved	-
6	VCC	Power	Power input	5VDC
7	RSV	-	Reserved	-
8	RXD2_IMU	I	IMU COM 2 Receives data (For firmware upgrade)	LVTTL level
9	RSV	-	Reserved	-
10	RSV	-	Reserved	-
11	RSV	-	Reserved	-
12	RSV	-	reserve	-
13	TXD2_IMU	O	IMU COM 2 Send (For firmware upgrade)	LVTTL level
14	GND	Power	Digital and Ground(GND)	
15	TXD1_IMU	O	IMU COM 1 Send (For user use)	LVTTL level
16	RXD1_IMU	I	IMU COM 1 Receives data (For user use)	LVTTL level
17	GND	Power	Digital and Ground (GND)	
18	TX2_982	O	982 COM 2 Send	LVTTL level
19	RX2_982	I	982 COM 2 Receives	LVTTL level
20	GND	Power	Digital and power ground	
21	RSV	-	Reserved	-
22	GND	Power	Digital and power ground	
23	PPS	O	Time synchronization signal	LVTTL level
24	RSV	-	Reserved	-
25	RSV	-	Reserved	-
26	CAN_TX	O		LVTTL level
27	RSV	-	Reserved	-
28	CAN_RX	I		LVTTL level

2.4 Electrical Characteristics

Table 2 Absolute Maximum Ratings

Parameter	Symbols	Minimum value	Maximum	Units
Voltage for Circuit to Circuit (VCC) (VCC)	Vcc	-0.3	5.5	V
Input Voltage (Vin)	Vin	-0.3	3.3	V
VCC maximum ripple	Vrpp	0	40	mV
Input Voltage (Vin) (all other pins except the above)	Vin	-0.3	3.6	V
Main antenna RF input power	ANT1_IN input power		±15	dBm
Input power from the antenna RF	ANT2_IN input power		±15	dBm
Maximum acceptable ESD stress level	VESD(HBM)		±2000V	V

2.5 Operating Conditions

Table 3 Operating conditions

Parameters	Symbols	Minimum value	Typical value	Maximum value	Units	Conditions
Supply voltage (VCC)		4.75	5	5.25	V	
Power-on impulse current	Iccp			10	A	Vcc=5V
Input pin low	Vin_low_1	-0.3		0.9	V	
Input pin high	Vin_high_1	2.4		3.6	V	
Output pin low	Vout_low	0		0.45	V	Iout=4mA
Output pin high	Vout_high	2.85		3.3	V	Iout=4mA
Optimum input gain	Gant	20		36	dB	
Power consumption	P		1.15		W	

2.6 Physical Characteristics

Table 4 Physical characteristics

Operating temperature	-40 ℃ ~ +85 ℃
Storage temperature	-55 ℃ ~ +95 ℃
Humidity	95% non-condensation

3. Hardware Integration Guide

3.1 Design Considerations

In order for FS982-SA to function properly, the following signals need to be properly connected:

- The module VCC has good monotony when powered on, and the starting level is lower than 0.4V, and the downstroke and ringing are guaranteed in the range of 5%VCC
- Use VCC pins to provide a reliable power supply and ground all GND pins of the board
- ANT1, ANT2 MMCX interface provides feed to the antenna, module antenna port, no antenna, using a multimeter test, that is, the voltage provided when no load is DC4.8~5.4V; When the module RF port is connected to the antenna, it can provide DC4.6V±0.2V antenna feed when the working current is 30~100mA at normal temperature. Pay attention to the line 50 ohm impedance matching
- Make sure that the IMU serial port 1 output, the user needs to use this serial port to receive IMU data.
- Make sure that the IMU serial port 2 is connected to the pad or connector. The user needs to use this serial port for firmware upgrade
- Ensure that the output of serial port 982 2, the user needs to use this serial port to receive positioning information data
- The board reset pin FRESET_N restores the factory Settings of the board, and RESETIN is a quick reset. Please connect it correctly to ensure that the board can be reset reliably

In order to obtain good performance, the design should also pay special attention to the following items:

- Power supply: Good performance requires stable and low ripple power supply guarantee. Ripple voltage peak peak value should not exceed 50mVpp. It is recommended to use a power chip with current output capacity greater than 2A to supply power to the board. In addition to using LDO to ensure pure power supply, it is also necessary to consider:

– Widen power cables or use split copper surfaces to transmit current
– Place the LDO as close to the LDO as possible
– Do not route power cables through high-power and high-inductive devices such as magnetic coils

- The UART port ensures that the signals and baud rates of the main device are consistent with those of the FS982-SA board
- The antenna line should be as short and smooth as possible, avoid sharp angles and pay attention to impedance matching
- Avoid running lines directly below FS982-SA
- Try to keep the board away from hot air currents

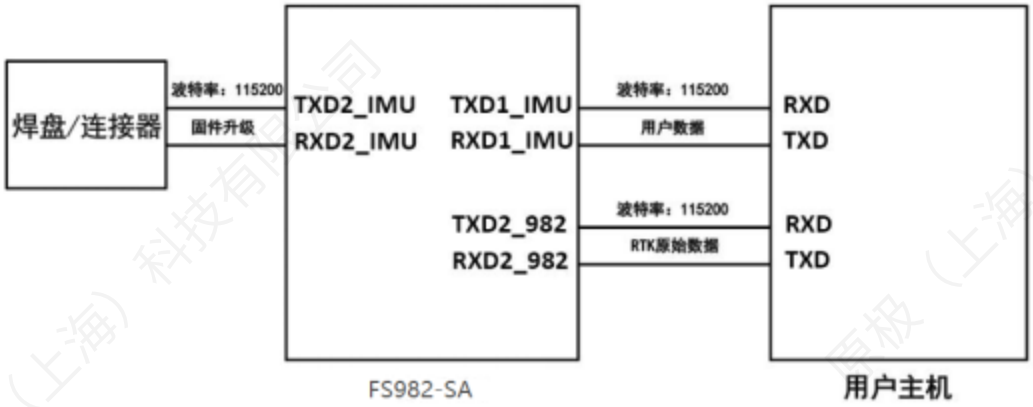
3.2 Precautions for pins

Table 5 Pin precautions

Features	Pins	I/O	Description	Remarks
Power Supply	VCC	Power supply	Power supply	Stable, pure and low ripple power supply, ripple voltage peak peak value should not exceed 50mVpp
	ANT1/ANT2	Power source	Antenna power	Active antennas provide power for the corresponding voltage. Module antenna port, no antenna, using a multimeter test, that is, when no load to provide voltage DC4.8~5.4V; When the module RF port is connected to the antenna, it can provide DC4.6V±0.2V antenna feed when the working current is 30~100mA at normal temperature.
	GND	Power supply	to	Ground all GND signals on the board, and it is best to use a large area of copper for grounding
UART	TXD1_IMU	O	IMU serial port 1 Send	Output from serial port 1 on the IMU, which needs to be connected to the user host
	RXD1_IMU	I	IMU serial port 1 Receive	
	TXD2_IMU	O	IMU serial port 2 Send (For firmware upgrade)	IMU serial port 2 Output, to be connected to pad or connector for firmware upgrade
	RXD2_IMU	I	IMU serial port 2 Receive (For firmware upgrade)	
	TXD2_982	O	982 Serial port 2 Send	982 Serial port 2 Output, needs to be connected to the user host
	RXD2_982	I	982 Serial port 2 Receive	

3.3 Hardware cable connection

Figure 3 Hardware cable connection



3.4 Antenna

FS982-SA board antenna input ANT1 and ANT2 MMCX interfaces to provide antenna feed, ANT1 and ANT2 antenna ports, no antenna, using a multimeter test, that is, the voltage provided when no load is DC4.8~5.4V; When the RF port of the module is connected to the antenna, it can provide DC4.6V±0.2V antenna feed when the working current is 30~100mA at normal temperature. When the FS982-SA board adopts active antenna, pay attention to the 50 ohm impedance matching between the antenna.

4. Connection and Setup

4.1 Static Protection

Many components on the FS982-SA board are susceptible to electrostatic damage, which will affect the IC circuit and other components. Take the following ESD preventive measures before opening the anti-static blister box:

- Electrostatic discharge (ESD) can damage the components. Operate the board on an ESD workbench while wearing an ESD wrist strap and using a conductive foam pad. If no ESD workbench is available, wear an ESD wrist strap and connect it to the metal part of the chassis for ESD protection
- Do not directly touch the components on the board when inserting and removing the board. Take out the board carefully to see if the components are loose or damaged.

4.2 Power on and start

The FS982-SA supply voltage is 5V, the receiver starts to start after power-on, and is able to quickly establish communication.

5. Board LED indicator

The FS982-SA board is equipped with LED indicators to indicate the basic working status of the board:

Table 6 LED indicator lights on the board

NO.	Indicator light	Status	Instructions	Remarks
1	red	Steady on	The board system self-test fails	
		Perpetuate	Board self test passed	
2	green	Steady on	The board can be positioned	
		Immortal Disappears	The board cannot be positioned	
3	blue	Steady on	RTK fixed solution	
		Perquench	RTK Other positioning status or no positioning	

6. Composite navigation output protocol

Note:

- CRC check starts from the frame header, does not include CRC check bit itself, CRC check for all bytes of this frame, check calculation method and routine see appendix.
- The frame length is the total number of all data bytes except the frame header, frame ID, frame length and check bit.
- In small-endian mode, the low bytes are sent first.

The Content	Type	Relative position
Frame head 1:0 xAA	Uint8	0
Frame header 2:0x55	Uint8	1
Frame ID: 0x0166	Uint16	2
Frame length: 0x005E	Uint16	4
Seconds within a GPS week (ms)	Uint32	6
GPS Weekly count	Uint16	10

Latitude (degrees x 10000000)	Int32	12
Longitude (degrees x 10000000)	Int32	16
Height (mm)	Int32	20
Northbound speed (m/s)	Float	24
Eastbound velocity (m/s	Float	28
Ground velocity (m/s)	Float	32
Roll Angle (degree)	Float	36
Pitch Angle (degree)	Float	40
Heading Angle (degree)	Float	44
Dual antenna course (degrees)	Float	48
Track Angle (degree)	Float	52
Accelerometer X-axis (g)	Float	56
Accelerometer Y-axis (g)	Float	60
Accelerometer Z-axis (g)	Float	64
Gyroscope X axis (deg/s)	Float	68
Gyro Y-axis (deg/s)	Float	72
Gyro Z axis (deg/s)	Float	76
IMU Temperature (C)	Float	80
RTK positioning state (same as positioning state in GGA) 0: unpositioning 1: single point positioning 2: pseudo-distance differential positioning 4: fixed solution 5: floating point solution	Uint8	84
Number of satellites	Uint8	85
Differential time delay	Uint8	86
Dual antenna orientation status 50 indicates that the antenna is oriented . Others indicate that the antenna is not oriented	Uint8	87
Position precision factor (cm) Integrated Navigation is valid after initialization	Uint16	88
Status bits : bit0:1 indicates that the RTK data is valid; 0 indicates that the RTK data is invalid ; Bit1:1 indicates that the PPS signal is valid; 0 indicates that the PPS signal is invalid ; Bit2:1 indicates that the Integrated Navigation is initialized; 0 indicates that it is not initialized	Uint16	90
Reserved 1	Uint32	92
Reserved 2	Uint32	96
CRC check	Uint32	100

7. Parameter configuration

7.1 Configuring the rod arm

For example, configure the rod arm vector as X=1.2m, Y=0.2m, Z=-1.0m
Instruction: AT+CLUB_VECTOR=1.2,0.2,-1.0\r\n
Reply: GPS_POS_X = 1.2, GPS_POS_Y = 0.2, GPS_POS_Z = 1.0 / r/n
Description: The rod arm vector is the three-dimensional vector (X,Y,Z) of the phase center of the main antenna of RTK relative to the installation position of the IMU, in meters. Where,
If the RTK main antenna is positive on the X-axis of the IMU, it is positive, otherwise it is negative;
If the RTK main antenna is positive on the Y-axis of the IMU, it is positive, otherwise it is negative;
If the RTK main antenna is positive below the IMU, otherwise it is negative.
The coordinate system diagram is shown in Figure 4

FIG. 4 Schematic diagram of coordinate system

7.2 Configuring the Output Integrated Navigation Data Flow

- If the output Integrated Navigation data stream is configured, the configuration instructions are:

Instruction: AT+SETNAV\r\n
Answer: OK\r\n

- If the configuration does not output, the configuration instruction is:

Instruction: AT+SETNO\r\n
Answer: OK\r\n

7.3 Configuring the position and Velocity projection point for Integrated Navigation Output

If the configuration outputs the result of the projection point set by the Integrated Navigation, the configuration instruction is:
Instruction: AT+PROJ_VECTOR=1.0,2.0,3.0\r\n
Answer: PROJ_VECTOR_X=1.0, PROJ_VECTOR_Y=2.0, PROJ_VECTOR_Z=3.0/r/n
Note: The default output of Integrated Navigation is the result of the projection point of the antenna phase center. If the result of other positions needs to be output, the lever arm vector of this position needs to be configured. The configuration method is the same as 7.1 lever arm configuration

7.4 Configuring the RTK double antenna installation Angle

If the RTK dual antenna installation Angle is 0 degrees, the configuration instructions are as follows:
Instruction: AT+RTK_ANGLE=0\r\n
Answer: ANGLE=0\r\n
The installation Angle is the Angle between the bow direction and the ray that the main antenna points to the secondary antenna, (the bow direction is rotated to the ray direction) clockwise is positive, counterclockwise is negative, and the Angle input range is -180°~180°
Note: After the configuration instruction is saved, power off and restart it to take effect; The distance between two antennas should be greater than 50cm

7.5 Configure the data output frequency

If the data output frequency is configured at 10hz, the configuration instructions are:
Instruction: AT+OUTRATE=10\r\n
Answer: OK\r\n

7.6 Configure the baud rate

Only the baud rate can be set to 115200 or 230400, and the default baud rate is 115200
If the baud rate of the IMU serial port is set to 230400, the configuration instructions are as follows:
Instruction: AT+BAUD=230400\r\n

Answer: BAUD=230400\r\n
Note: After the configuration instruction is saved, power off and restart will take effect

7.7 Print all configuration information

If all configured information is queried, the configuration command is as follows:
AT+CONFIG\r\n

7.8 Query the version number

AT+VERSION\r\n

7.9 Saving Parameter

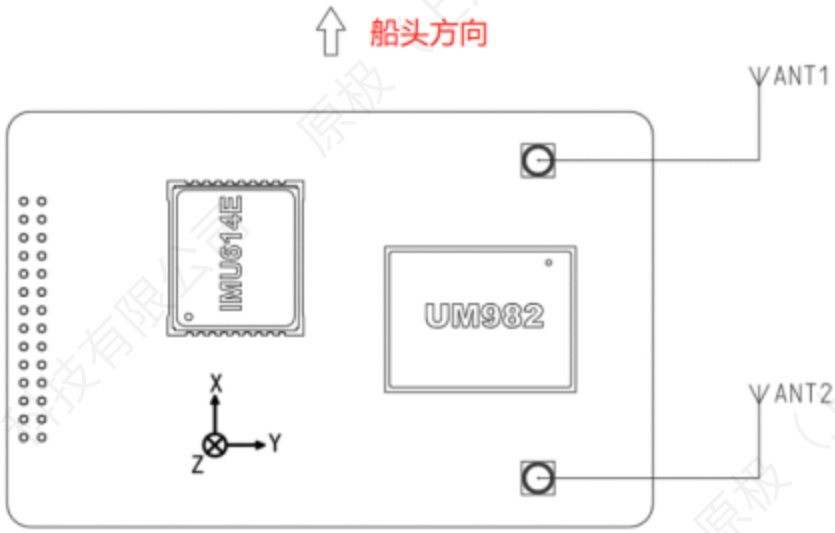
Instruction: AT+SAVE\r\n
Answer: OK\r\n

8. Example Usage

8.1 Equipment Installation

1. The module should be firmly fixed on a rigid plane to avoid being installed in a position with large vibration.
2. The orientation of module installation should maintain the relationship with the bow direction as shown in the figure below.
3. ANT1 is the RF connector for the primary antenna (positioning antenna) and ANT2 is the RF connector for the secondary antenna (directional antenna). The double antenna orientation result of the RTK board card is the Angle between the rays of the primary antenna pointing to the secondary antenna and the geographical true north direction.

FIG. 5 Schematic diagram of antenna connection



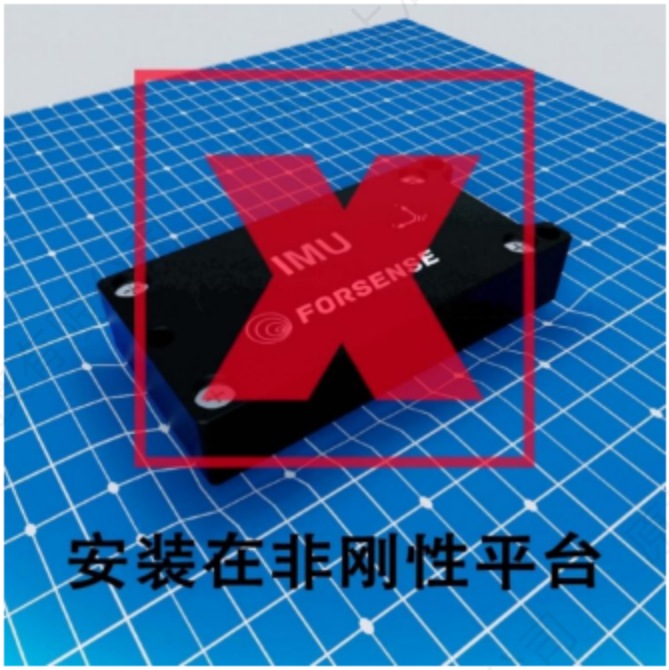
Since there is no coordinate system mark on the module, the installation direction can be confirmed according to the triangle shape mark on the IMU module, as shown in the following figure

Figure 6 Schematic diagram of coordinate system

The following installation methods are incorrect installation

1) Install on a non-rigid plane

Figure 7 Schematic diagram of installation error



2) IMU is not installed horizontally

Figure 8 Schematic diagram of the installation error

3) The IMU is suspended outside the vehicle

Figure 9 Installation error diagram

4) Fix by hand

Figure 10 Schematic diagram of the installation error

5) Install on the bracket

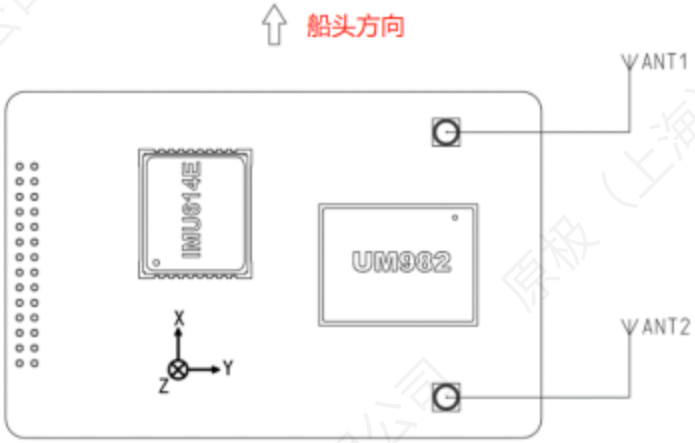
Figure 11 Installation error diagram

8.2 Setting Parameter for the rod arm

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

- If the RTK main antenna is positive on the X-axis of the IMU, it is positive, otherwise it is negative;
- If the RTK main antenna is positive on the Y-axis of the IMU, it is positive, otherwise it is negative.
- If the RTK main antenna is positive below the IMU, it is negative otherwise.

Figure 14 Three-dimensional vector of FS982-SA antenna (X, Y, Z)



8.3 Saving Parameter

After all configuration commands are configured, send the command "AT+SAVE\r\n" to save Parameter.