INERTIAL NAVIGTION SYSTEM
BS-IU58-M-D6EC

▶ PRODUCT DESCRIPTION

Low cost integrated navigation system BS-IU58-M-D6EC is a kind of measurement equipment which based on MEMS technique. It is integrated with satellite navigation technology which can provide our user a very good performance at competitive price. It is widely used for navigation, control and dynamic measurements. Our system has many kinds of compensation techniques to guarantee measuring accuracy. We adopt rigorous production process to ensure our product can measure carrier angular movement and linear movement parameter under harsh environment.

▶ PRODUCT FEATURES

Applicability for various application。Adopt GPS /BD2 dual mode satellite navigation system, high tracking sensitivity, suitable for open area positioning navigation and complex environment such as street, jungle and so on.

Strong adaption ability. Silicon MEMS inside product, strong anti-vibration and anti-shock ability, -40℃～+60℃ full working temperature range.

Excellent Performance. Integrated navigation horizontal attitude 0.3 (（rms）, Positioning accuracy is better than 5 m

（rms）， velocity accuracy is better than 0.15m/s（rms ）， compact in size, light in weight.

Perfect user experience. Support RS -422, RS -232 multi-path serial port, output band width adjustable, output protocol adjustable, on-line upload program and parameter, wide range voltage power supply of 9V ~ 40V.

▶ APPLICATION

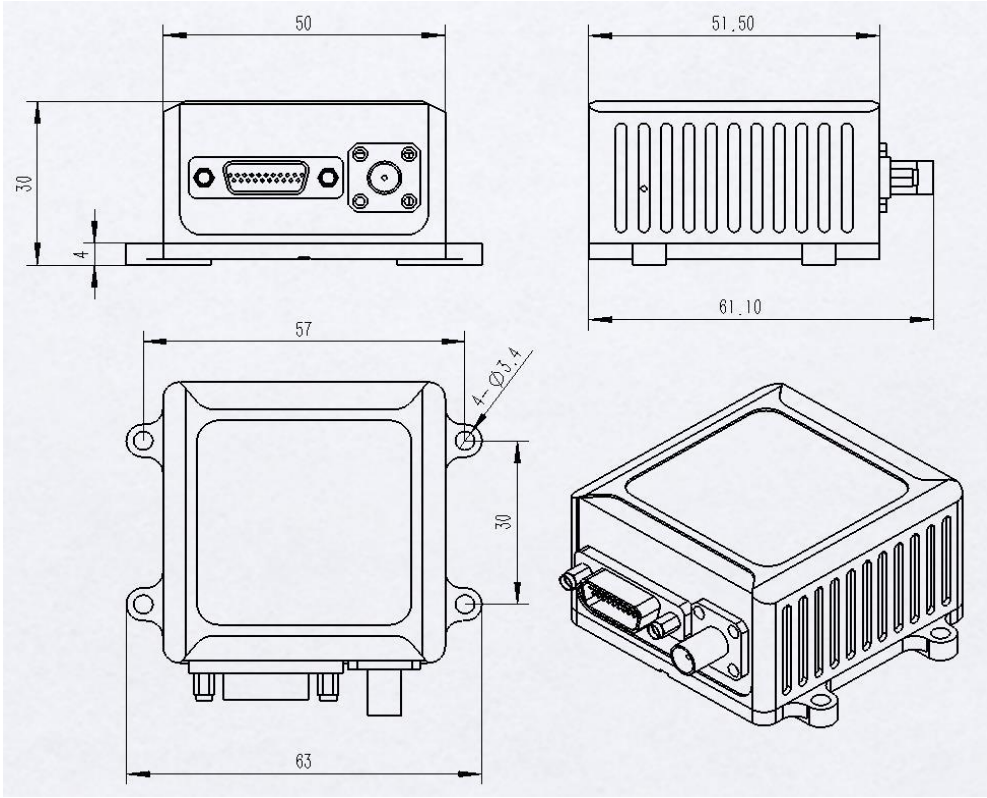
Vehicle navigation, mobile communication, aerial photography, crop protection in farming industry, weapon platform Electro-optical pod, UAV, Forest, territory detection, ship positioning and communication

▶ SPECIFICATION

Integrated navigation performance parameter （ nominal value ）	
Heading accuracy （ Magnetism ）	1°(rms)
Heading accuracy（L1/B1Single-point)	0.5°(rms)
Heading accuracy without GPS	0.2°/min under good working condition 0.5°/min under harsh working condition
Attitude accuracy	0.3°(rms)
Gyro	
Capacity	±300 /s(Customizable)
Zero bias stability	10 /h （Room temperature， Allan variance ）
Nonlinearity	0.05%
Band width	50Hz~200Hz
Accelerometer	
Capacity	±2-±20g
Zero bias stability	≤5mg
Zero bias stability	≤5mg
Nonlinearity	0.05%
Receiver	
Working mode	BD2 B1 / GPS L1
Cold boot	60s
Warm boot	10s
Accuracy of position	5m(rms)
Speedaccuracy	0.15m/s(rms)
Electric / mechanical interface	
Power supply	9V~30V
Power	<2.5W
Starting time	3s
Communication interface	RS-422/RS-232/TTL
Refresh rate	100Hz～400Hz(IMU),100Hz

Physical dimension (not including mounting hole)	50mm×51.5mm×30mm
Installation dimension （ including installation hole)	63mm×61.1mm×30mm
Weight	<100g
Application environmen	
Working temperature	-40℃~80℃
Vibration	6.06g(rms)
Shock	9g/11ms; 1000g/1ms
Attitude accuracy	0.3 (rms)

▶ DIMENSION



Plug-in Node Configuration Diagram (Outside the Product)

▶ ASSEMBLING METHOD

1. Coordinate system Definition

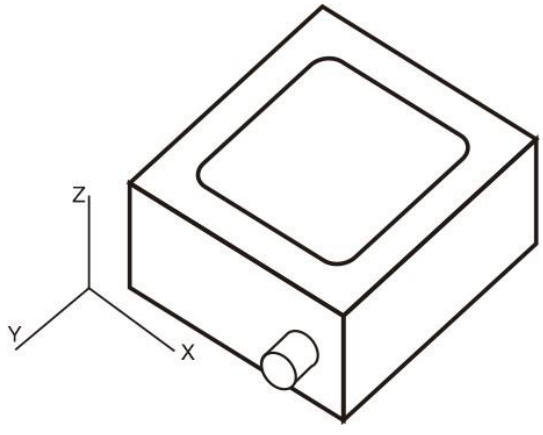


Diagram 1. Transducer Coordinate System

2. Mounting position

★ During measuring the three-dimensional motion of measuring object, the mounting position needs to be possibly near the center of measuring object. When the measuring object is not moving, the installation surface should be parallel with ground, at the same time, ensure " Y direction of arrow " will keep in line with direction of movement of the measuring object. After installation, it's recommended that the installation position should not be moved during use.

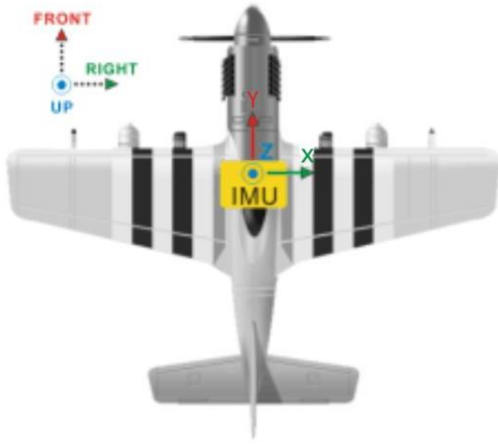
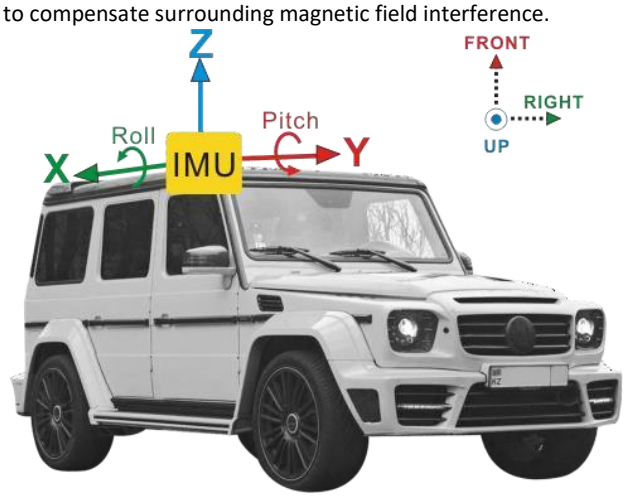


Diagram 2. integrated navigation scheme of installation on aircraft.

★ There is a three-axle magnetic sensor inside product, using it to measure magnetic intensity of surrounding environment when the object is not moving and there is no GPS signal. It will provide current heading information. Under such circumstance, if user wants to know heading information, the product should be exposed to terrestrial magnetic field and keep isolation from magnetic interfering field. The best way is to install product on iron and steel material (such as measuring vehicle), and keep away from magnetic interfering field. At the same time, doing magnetic field calibration to compensate surrounding magnetic field interference.



★ Diagram 2. integrated navigation scheme of installation on land vehicle During installation, integrated navigation and antenna fixed mode as following diagram, antenna needs to be installed vertically, right above the navigation direction or straight ahead.

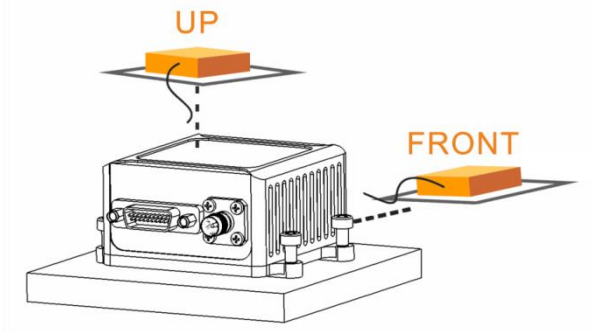


Diagram 4. integrated navigation and antenna scheme of installation Attention:

① In order to attain better performance, it is suggested that product needs power on and warm-up for fifteen minutes then turn off, power on again and remain measuring object stationary for 2 minutes then it is ready to use. During restart, the measuring object should keep still.
② User needs to proceed magnetic field calibration after finishing each installation or the magnetic field environment changed

▶ USER COMMUNICATION PROTOCOL

1. Data format

Baud rate 115200bps, 230400bps and 460800bps optional. Data bits 8-bite, stop bit 1 bit, no check bit. Little-Endian. Data updating frequency f=400 Hz. Power on default user mode, frame format 3， Baud rate 460800bps , land vehicle.

Notice： In order to guarantee data transmission integrality, suggest frame 3 use 460800 bps Baud rate, frame 2 use 230400/ 460800 bps Baud rate.

★ Frame format content

1. Frame format 1 ——Resolve data （ Attitude / Velocity / Position ）

Byte No.	Name	Byte	Zoom	Range	Unit	Description
1~2	Frame header	U,2				0xAA 51
3~4	Reserved					
5~8	AttAttitude	S,2*2	1e-2	±327.68	°	Ptich ±90° Roll ±180°
9~10		U,1*2		655.36		Yaw 0~360°
11	Scene and mode	U,1				Bit1~4--Working mode ALIGN = 1 INS = 2 AHRS= 3 VG= 4 Bit5~8--Working scene 1=land vehicle 2=in Doors 3=ship 4=fixed wing 5=rotor wing
12~13	Reserved					
14	Counting	U,1				
15	Verify	U,1				Cumulative sum of all word symbol before Check bit

2. Frame format 2 —— sensor data , resolve data （ attitude / velocity /position)

Byte No.	Name	Byte	Zoom	Range	Unit	Description
1~2	Frame header	U,2				0xAA 52
3	Reserved					

5~8	AttAttitude	S,2*2	1e-2	±327.68	°	Ptich ±90° Roll ±180°
9~10		U,1*2		655.36		Yaw 0~360°
11~19	VnVelocity	S,3*3	1e-4	±838.8608	m/s	Vel_E/N/U
20~30	PosPosition	S,2*4	1e-7	±214.7483648	°	Longitude Lon / latitude Lat，accuracy 0.01 m
		S,1*3	1e-2	±83886.08	m	Altitude
31	Scene and mode	U,1				Bit1~4--Working mode ALIGN = 1 INS = 2 AHRS= 3 VG= 4 Bit5~8--Working scene 1=land vehicle 2=in Doors 3=ship 4=fixed wing 5=rotor wing
32~33	Reserved					
34	Counting	U,1				
35	Verify	U,1				Cumulative sum of all word symbol before Check bit

3. Frame format 3—— sensor data , GPS sign , resolve data （ attitude / velocity /position)

Byte No.	Name	Byte	Zoom	Range	Unit	Description
1~2	Frame header	U,2				0xAA 53
3~4	Reserved word					
5~13	Gyro Gyro	S,3*3	1e-4	±838.8608	°/s	
14~22	Accelerometer	S,3*3	1e-5	±83.88608	g	
23~28	Magnetism Magn	S,3*2	1e-2	±327.68	uT	
29~31	Hbar	S,1*3	1e-2	±83886.08	m	Barometer
32	flag	U,1				Bit1 - Magnetism validity sign 1 - validity Bit2 - Air pressure validity sign 1 - validity Bit3 - GPS_existWhether have GPS info 0 - No GPS info 1 - Have GPS info Bit4 - GPSInfo validity sign 1 - validity Bit 5~8 zero fill
33~36	AttAttitude	S,2*2	1e-2	±327.68	°	Ptich ±90° Roll ±180°
37~38		U,1*2		655.36		Yaw 0~360°
39~47	VnVelocity	S,3*3	1e-4	±838.8608	m/s	Vel_E/N/U
48~58	PosPosition	S,2*4	1e-7	±214.7483648	°	Longitude Lon / latitude Lat，accuracy 0.01 m
		S,1*3	1e-2	±83886.08	m	Altitude
59	GPS_status	U,1				Bit1~4--GPSPosition location satellite numbers （ maximal 15) Bit5--GPSPositioning signGPS_flags[0] 1Valid Bit6~8--GPSPositioning TypeGPS_fixtype 0x00 = No Fix 0x01 = Dead Reckoning only（Dead reckoning）

						x02 = 2D-Fix 0x03 = 3D-Fix 0x04 = GNSS + dead reckoning combined 0x05 = Time only fix
60~61	GPS_PDop	U,2	1e-2			
62	Scene and mode	U,1				Bit1~4--Working mode ALIGN = 1 INS = 2 AHRS= 3 VG= 4 Bit5~8--Working scene 1=land vehicle 2=in Doors 3=ship 4=fixed wing 5=rotor wing
63~71	System reserved word					
72~73	Temperature	S,2	1e-2	±327.68	℃	
74	Counting	U,1				
75	Verify					Cumulative sum of all word symbol before Check bit

2. Parameter setting

When the product is power on, default state is " consecutive emit number ", if you want to set parameter you must dispatch " Stop output " Command first.Notice： After using the following command, product must be powered on and restart, it will autonomous switch to consecutive emit numeral state.

① Stop output

Stop output function is to switch default "consecutive emit number " mode to " parameter setting " state.

Dispatch： * PA blank space GS 01 blank space STOP enter

Return： * PA blank space GS 0 1 blank space STOP blank space 0 enter fail

* PA blank space GS 01 blank space STOP blank space 1 enter success

② Set Working Scene

Product needs to switch filter parameter according to different applicaiton scene. Working scene include land vehicle, in doors （ tilter ） , ship, fixed wing and rotor wing. Power on default mode is for land vehicle scene. Working scene switch is to make default "land vehicle scene " as current using scene.

Dispatch： * PA blank space GS 01 blank space SCENES blank space 1 enter

Return： * PA blank space GS 0 1 blank space SCENES blank space 0 enter fail

* PA blank space GS 01 blank space SCENES blank space 1 enter success

Remark： underscore character content 1-land vehicle , 2-in doors , 3-ship , 4- fixed wing and 5-rotor wing optional.

③ Set baud rate

Power on default Baud rate is 230400bps， you can switch Baud rate via dispatching different command.

Dispatch： * PA blank space GS 01 blank space BAUD blank space 1 enter

Return： * PA blank space GS 0 1 blank space BAUD blank space 0 enter fail

PA blank space GS 01 blank space BAUD blank space 1 enter success

Remark： underscore character content 1--115200 bps， 2--230400 bps，3--460800 bps optional .

④ Set frame format

Switch Frame format via dispatching different command, default Frame format 3 . Dispatch： * PA blank space GS 01 blank space FRAME 1 enter

Return： * PA blank space GS 0 1 blank space FRAME blank space 0 enter fail

PA blank space GS 01 blank space FRAME blank space 1 enter success

Remark： underscore character content FRAME 1 , FRAME2 and FRAME3 optional .

⑤ Save Path

When using postion changed(longitude, latitude ,Altitude), user needs to set product initial position via upper computer interface, method as following:

① Automation : Plug in antenna, GPS will search satellite and confirm if the information is valid, postition information will fill GPS with longitude, latitude and Altitude information.

② Manually : User input local position information(longitude, latitude, altitude). Click " save " button, upper computer will sequencely dispatch 3 command to ARM.

1）Longitude default is 108.8919132 degree. Longitude range is -180 degree ~180 degree, east longitude is positive, west longitude is negative.

Dispatch： *PA blank space GS 01 blank space Lon enter + /-XXX.YYYYYYYEnter

Return： * PA blank space GS 0 1 blank space Lon blank space 0 enter fail

* PA blank space GS 01 blank space Lon blank space 1 enter success

Notice： underline integer bit is 3 bit， decimal place 7 bit. Like Longitude east longitude 115.416 degree underscore character is + 115.4160000.

2）Latitude default is 34.2489373 degree. Latitude range is -90 degree ~90 degree, north latitude is positive, south latitude is negative.

Dispatch： *PA blank space GS 01 blank space Lat enter + /-XX.YYYYYYYEnter

Return： * PA blank space GS 0 1 blank space Lat blank space 0 enter fail

* PA blank space GS 01 blank space Lat blank space 1 enter success

Notice： underline integer bit is 2 bit, decimal place 7 bit. Like latitude is north latitude 39.43 degree, underscore character bunch is + 39.4300000.

3）Altitude default is 404 meter .

Dispatch： *PA blank space GS 01 blank space h enter + /-XXXX.YYEnter

Return： * PA blank space GS 0 1 blank space h blank space 0 enter fail

* PA blank space GS 01 blank space h blank space 1 enter success

Notice： underline integer bit is 4 bit, decimal place 2 bit. If altitude is 450.7meter, then underscore character string is + 0450.70； if altitude is -123.91meter, underscore character string is -0123.91.

⑥ Recover to factory default settings

Recovery to factory default settings is to make everything into default mode. Such as working scene, Frame format , Baud rate ,magnetic declination ,magnetic field ,Calibration and Position （ latitude and longitude， Altitude）.

Dispatch： *PA blank space GS 01 blank space RESET enter

Return： * PA blank space GS 0 1 blank space RESET blank space 0 enter fail

* PA blank space GS 01 blank space RESET blank space 1 enter success

⑦ Set magnetic declination

Default magnetic declination is 0, magnetic north east is positive, west is negative.

Dispatch： * PA blank space GS 01 blank space MDEC blank space + /-XX .XX enterReturn： * PA blank space GS 0 1 blank space MDEC blank space 0 enter fail

* PA blank space GS 01 blank space MDEC blank space 1 enter success

Notice： If magnetic declination is -2.5 degree, underscore character string is -02.50; If magnetic declination is+1.5 degree, underscore character string is +01.50.

⑧ Magnetic field calibration

Magnetic sensor will suffer surrounding electromagnetic field disturb, this will make measuring value of XYZ axle offset and deformation. Magnetic field calibration is to compensate soft and hard magnetic interference via certain algorithm learning of surrounding magnetic field environment.Therefore, we suggest that user should proceed calibration after each installation or environmental modification.

During magnetic field calibration process, surrounding interfering material needs to rotate together with product, the relative position between them should remain stationary. Operator are prohibit to use mobile phone, magnetic card, unlocking key as well as metal or electronic equipment which might have influence on electromagnetic field.

Notice： magnetic field calibration will be valid only in limited interference range. Magnetic sensor range is about +/- 1Gauss, this is approximately to be twice of Northern Hemisphere geomagnetic field. If the magnetic field interference value exceed +/- 0.5Gauss, then the magnetic flow meter will in saturation state, which will have bad influence on compensation. If your calibration process shows failure, it means that the magnetic flow meter is in saturation state.

★ 2DCalibration

Notice： If the product can not move in 3 dimension, it can be calibrated in 2D method, we suggest that the inclination in real applicaiton should be less than 5 degree. 2 D Calibration can be completed via software interface or serial port command.

① Begin Calibration： before starting calibration process, dispatch

Dispatch： * PAblank space GS 01 blank space MCAL blank space START enter

Return： * PA blank space GS 0 1 blank space MCAL blank space START blank space 0 enter fail

* PA blank space GS 01 blank space MCAL blank space START blank space 1 enter success

② Stop Calibration: Begin Level rotate 2 circles, after rotation then dispatch.

Dispatch： * PA blank space GS 01 blank space MCAL blank space END enter

Return： * PA blank space GS 0 1 blank space MCAL blank space 0 enter fail

* PA blank space GS 01 blank space MCAL blank space 1 blank space X:x.xx blank space Y:Y.yy enter success

Notice： Return calibration result 0.90 ~ 1 means calibration result is good, >1.1Or <0.9 means calibration result is bad.

③ Save calibration result： After calibration process, user will decide whether to save calibration result or not.

Dispatch： * PA blank space GS 01 blank space MCAL blank space SAVE enter

Return ： * PA blank space GS 0 1 blank space MCAL blank space SAVE blank space 0 enter fail

* PA blank space GS 01 blank space MCAL blank space SAVE blank space 1 enter success

④ Cleanout calibration result： user will decide whether to save calibration result or not.

Dispatch： * PA blank space GS 01 blank space MCAL blank space CLEAR enter

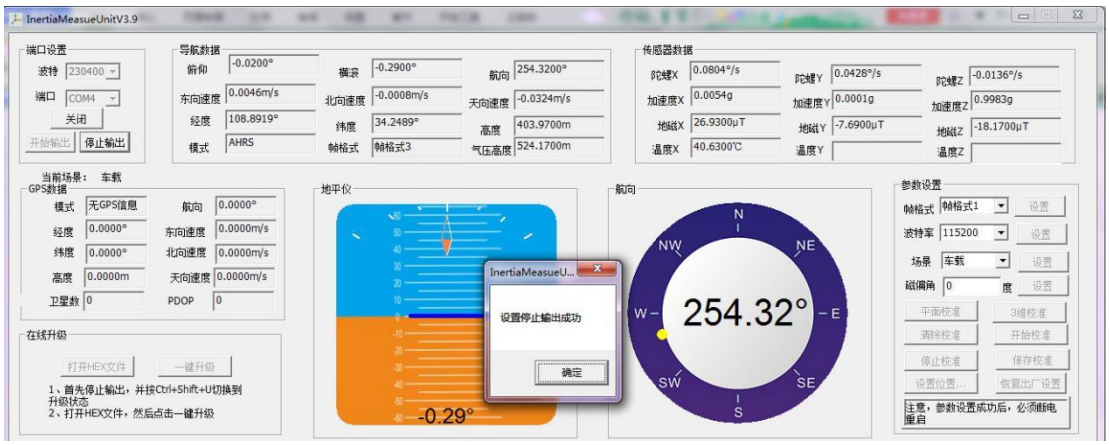
Return ： * PA blank space GS 0 1 blank space MCAL blank space CLEAR blank space 0 enter fail

* PA blank space GS 01 blank space MCAL blank space CLEAR blank space 1 enter success

★ 3DCalibration

Notice： In order to obtain better calibration accuracy, we suggest using 3D calibration via software interface.

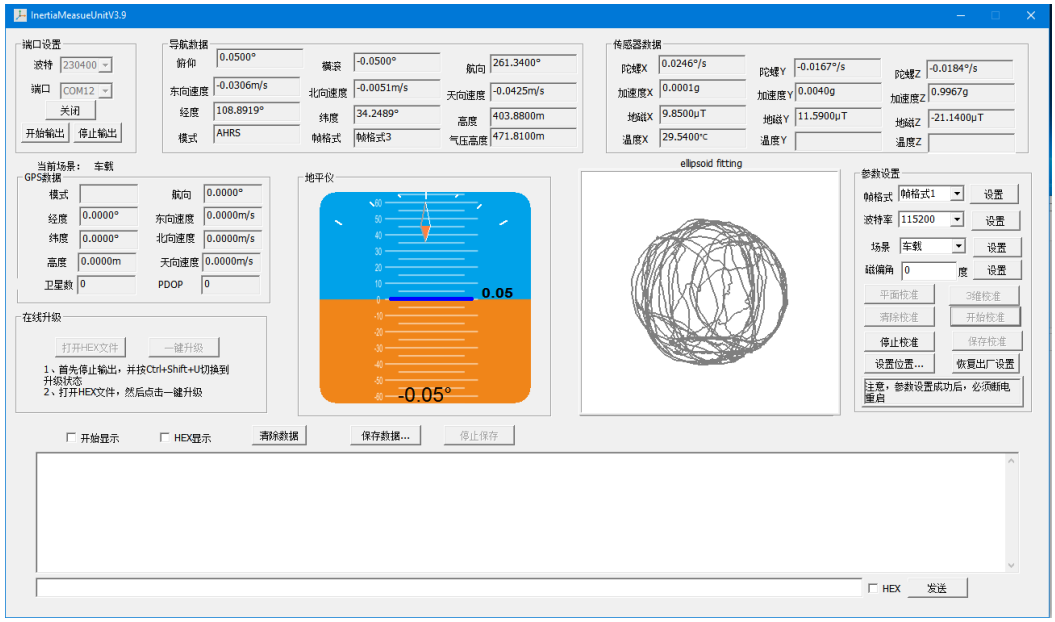
① Stop output



② Click 3D Calibration

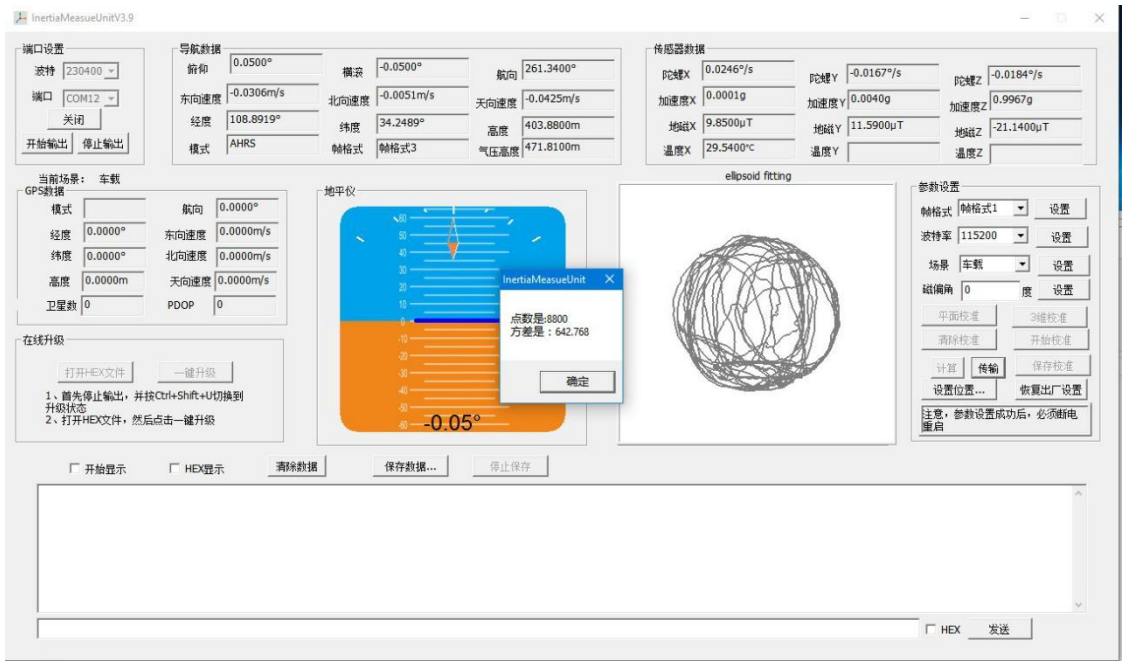
③ Click Cleanout Calibration

④ Begin Calibration， ellipsoid fitting

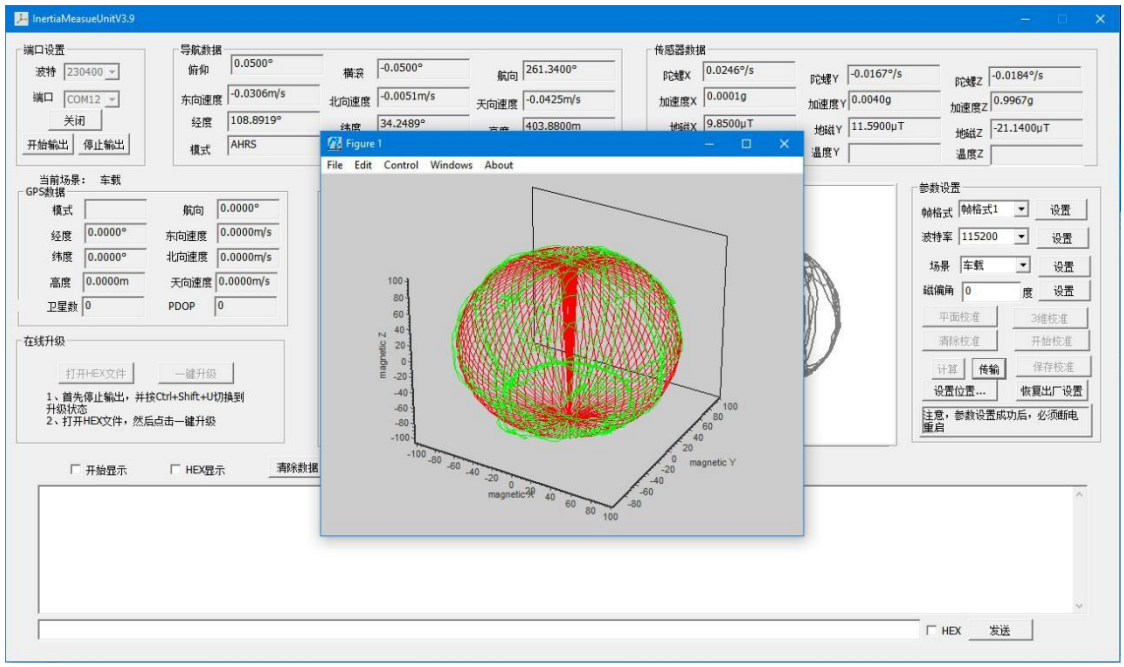


⑤ Click Stop Calibration, it will show calculation push-button, Click Calculation button, popup " ready for transmitting data " dialog box.

⑥ Click Transmission save data

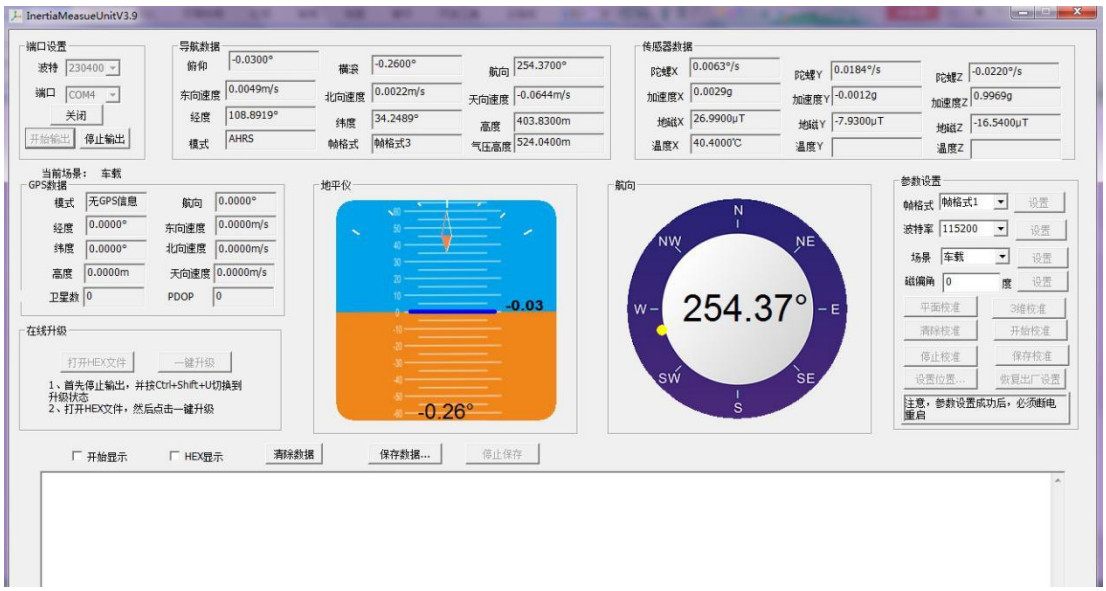


Click OK button, popup ellipsoid diagram .



More calibration point, smaller variance you will get. There will be more collection point attach at ellipsoid, which means the calibration result is good.

Testing software interface:



Operating instructions：

1）After power on, run operational testing interface, select practical serial port serial number and baud rate connection serial port.Click " Begin output " data will be displayed real-time.

2） Please click “stop” button and change “autosent data”to “magnetic parameter setting”before you set any parameter, after you make set then restart INS.