



V1.0

RTK INTEGRATED NAVIGATION SYSTEM
RION INS600
TECHNICAL MANUAL



PRODUCTION EXECUTION STANDARD REFERENCE

- Enterprise quality system standards: ISO9001: 2008 standard (certification number: 128101)
- The intellectual property management system meets the standards: GB/T 29490-2013 (Certificate No.: 18117IP1529R0S)
- High-tech enterprise (Certificate No.: GR201844204379)
- China National Intellectual Property Appearance Patent (Patent No.: ZL 201730609544.2)
- GJB 585A-1998 Inertia Technical Terminology
- Software Development Reference Standard: GJB 2786A-2009 General Requirements for Military Software Development
- Product environmental test standard: GJB150
- Electromagnetic anti-interference test standard: GB/T 17626
- Revision time: 2019-08-01
- Product functions, parameters, appearance, etc. will be adjusted with the upgrade of the technology. Please contact the sales before purchasing.

INS600 RTK INTEGRATED NAVIGATION SYSTEM

- ★ Gyro bias instability 10°/h (Allan Variance)
- ★ Accelerometer bias 1.7mg (within 4g range)



► INTRODUCTION

The INS600 series is a dual-antenna GPS/INS integrated navigation system built by RION. The dual-antenna differential positioning measurement unit (IMU) is precisely calibrated in the full temperature to meet the performance requirements in different environments. The multi-data Kalman filter fusion algorithm is realized by a built-in navigation computer, and outputs real-time accurate carrier posture, heading information, three-dimensional position and velocity information, and various inertial device information. The appearance is exquisite, the structure is small, the installation is convenient, the use is flexible, and the operation is more stable and reliable.

► FEATURE

- ★ Gyro bias instability 10°/h (Allan Variance)
- ★ Accelerometer bias 1.7mg (within 4g range)

► APPICATION

- ★ Precision farming
- ★ Surveying and mapping POS system
- ★ Industrial park unmanned vehicle
- ★ High-speed train measurement and control system
- ★ Car navigation & measurement & control system
- ★ Ocean and underwater mapping
- ★ Ship and ocean engineering
- ★ Flight control



► PARAMETERS

INS600

System	Roll/pitch (1σ)	0.2°	
	GPS loss-lock accuracy (vehicle-mounted CEP)	Position drift(1km or 3min)	0.2% , with odometer
		Heading drift (1min)	0.15°
Gyro	Measuring range	300°/s	
	Zero bias instability (Allen variance)	10°/h	
	Zero bias stability (1s smooth)	15°/h	
	Zero bias repeatability	15°/h	
	Full temperature zero bias	0.1°/s	
	Scale factor nonlinearity	200ppm	
	Scale factor repeatability	200ppm	
	Resolution	<0.01°/s	
	Acceleration sensitivity	<0.0028°/s/g , rms all direction	
	Angle random walk	0.15°/√hr	
	Bandwidth	200Hz	
	Delay	<2ms	
Accelerometer	Range	4g	
	Zero bias stability	0.2mg	
	Full temperature zero bias	1.7mg	
	Scale factor repeatability	200ppm	
	Resolution	0.1mg	
	Nonlinearity	0.1%	
	Bandwidth	200Hz	
Satellite Navigation Board	Position (CEP)	1.2m , 2cm+1ppm(RTK)	
	Speed (1σ)	0.03 m/s	
	Heading (1σ)	0.08° (base line 2m)	
	Frequency band	GPS L1 , L2 , L2C , Beidou B1 , B2	
Interface	Input voltage	12V	
	Working current	0.55A	
	Interface Type	10 core aviation plug	
Main engine	Size	155*120*55mm	
	Weight	708g	
Antenna	Size	152*152*62.2mm	
	Weight (single)	433.5g	
Data line	Size (length)	5M	
	Weight (single piece)	30g	

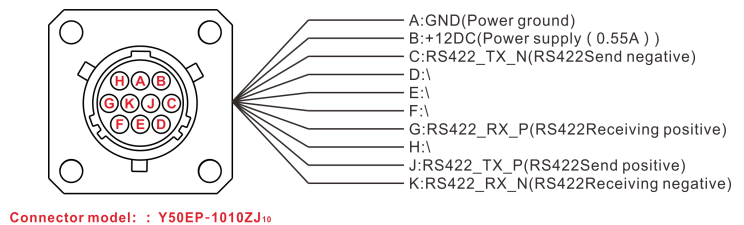
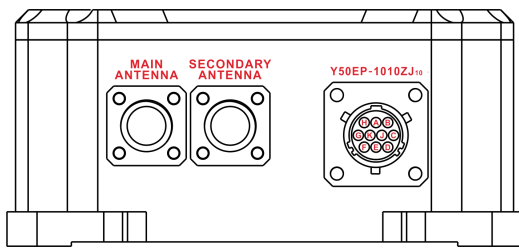
*Delivery qualification test index

1. Within $\pm 100^\circ/\text{s}$, the symmetry and nonlinearity are required to be <200ppm within $\pm 100^\circ/\text{s}$, test angular rate is 0, ± 0.1 , ± 0.2 , ± 0.5 , ± 1 , ± 2 , $\pm 5 \pm n \times 5$, $n = 1, 2, 3 \dots$
2. Measure $\pm 1g$ and full scale separately

○Inclinometer ○Digital compass ○Digital inclinometer ○Accelerometer ○Gyro ○North finder ○INS&IMU

► PIN DEFINITION

Pin	Definition	Description
A	GND	Power ground
B	+12VDC	Power + (0.55A)
C	RS422_TX_N	RS422 send-
D	\	\
E	\	\
F	\	\
G	RS422_RX_P	RS422 receive+
H	\	\
J	RS422_TX_P	RS422 send+
K	RS422_RX_N	RS422 receive-



► INSTALLATION INSTRUCTION

The power supply is 12~36V, the ripple (Vpp) is <50mV, and the maximum current output is 4A. If the power supply noise is large and the power supply line is long, please use a filter or an external voltage regulator.

1. INS600 is fixed on the carrier with M5 screws. The looseness during operation will affect the measurement accuracy.
2. Install as much as possible at the center of gravity of the carrier or near the center of gravity.
3. Try to avoid severe vibration, sudden temperature changes (such as installed near the engine), and use shock absorbers if necessary.
4. Align the INS600 axis with the carrier axis as much as possible.
5. Antenna installation Note: The main antenna is behind, the secondary antenna is in front, and the distance is 1.5-2.0 meters.

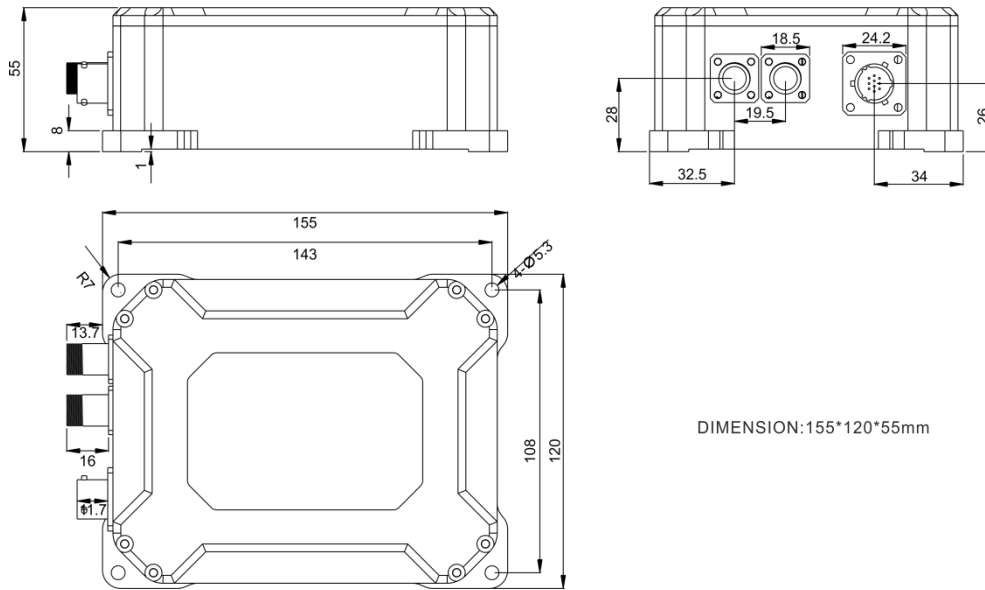
► INSTALLATION

The INS600 follows the NED coordinate system, it is right-handed system.

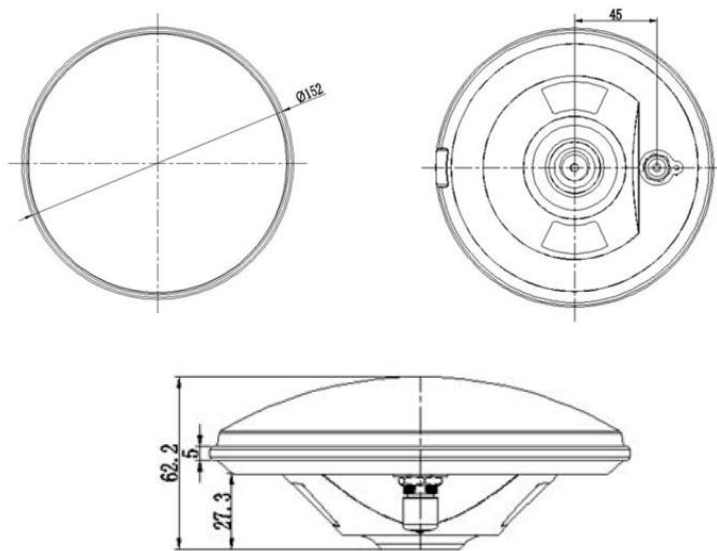
According to the rotation order of ZYX, when the positive direction of the X-axis is directed to the front of the carrier, the angle of rotation around the Z-axis is the heading angle, the angle of rotation around the Y-axis is the pitch angle, and the angle of rotation around the X-axis is the roll angle.



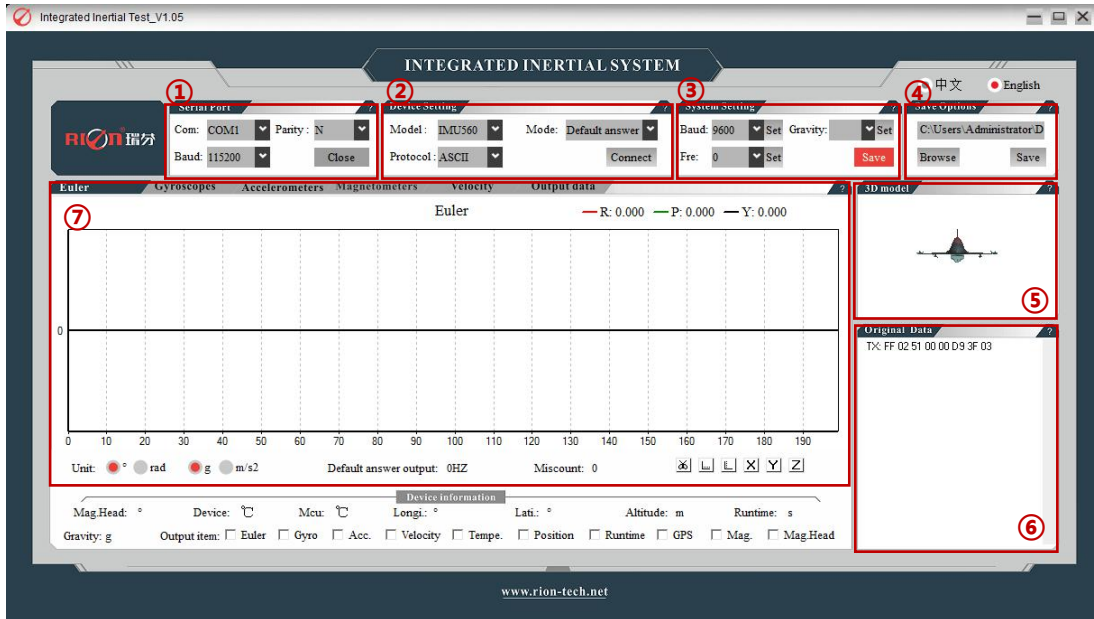
► DIMENSION



► ANTENNA DIMENSION



▶ UPPER COMPUTER SOFTWARE



The host computer interface mainly includes a serial port, a device setting, a system setting, a save option, a 3D model, and a raw data area (Original). DATA) and the main functional area. The prompt message moved to the column "?" is the description of each column, and the contents of each zone are introduced one by one below.

1 : Serial Port

Com : Select the COM port corresponding to the device;

Baud : Select the current baud rate of the device. The factory default is 115200;

Parity : Select the current calibration mode of the device;

Open : Open the set port ;

2 : Device Setting

Model : Select the connected device model ;

Protocol : Select the protocol used to connect the device ;

Mode : Data output mode ;

Connect : Confirm connection device ;

3 : System Setting

Baud: Set device baud rate ;

Fre. : Set device data output rate ;

Gravity : Set the gravity level ;

Save : Save Settings ;

4. Save Options

Path : indicate file path

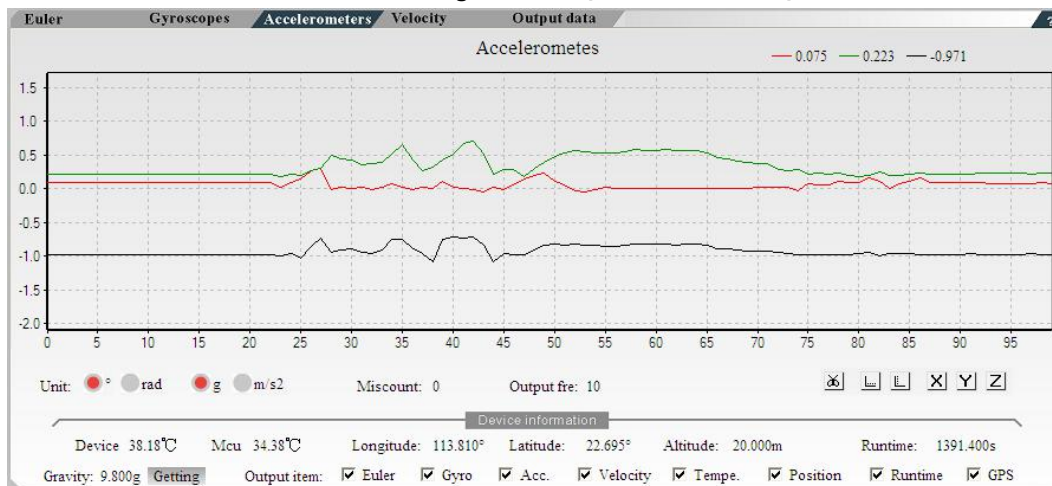
Browse : Select save file path ;

Save : Start saving data

5. 3D model 3D Dynamically display device poses.

6. Original DATA As shown in the figure above, the serial data printing function.

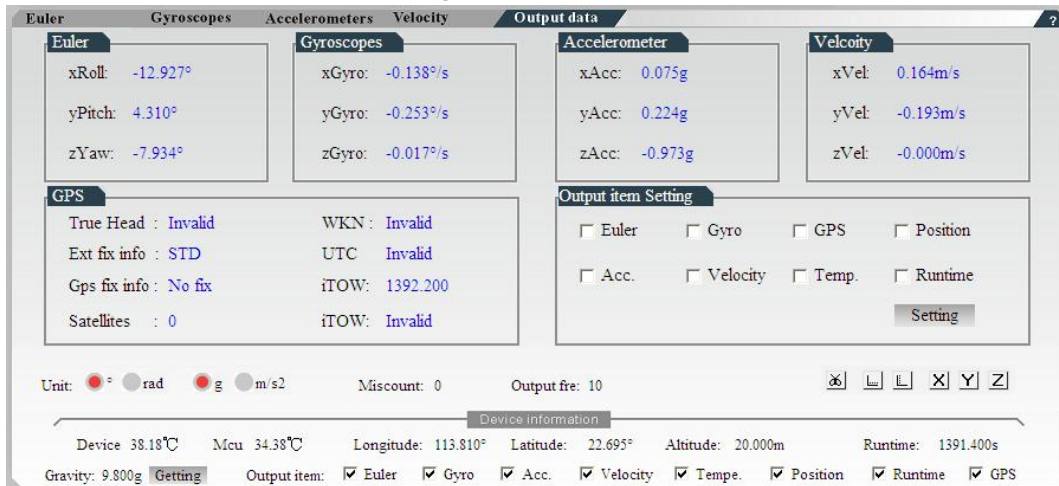
7. Main function area waveform drawing interface (Accelerometers)



Display real-time data waveform, the horizontal axis is the count value, the vertical axis is the data value, Click the left mouse button to zoom in to enlarge the drawing area, and right click to move the drawing area.

- a. The lower right toolbar will in turn be a screenshot, enable/disable the horizontal coordinate scale, enable/disable the ordinate scale, draw/close the X-axis data, draw/close the Y-axis data, and draw/close the Z-axis data.
- b. The lower left corner is the data unit switching, data output frequency and output error count;
- c. Below is the device information, which in turn is the device temperature, location information, time, gravity level and output data items. In the specified output mode, the customer selects the output here.

8. Main function area waveform drawing interface (Output DATA)



Software setting interface introduction steps

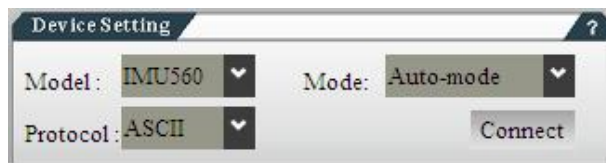
(1) First step setting: serial port settings

- ① After opening the software, select the corresponding port;
- ② Select the current calibration mode of the device (factory default is NONE)
- ③ Select the current baud rate of the device (factory default is 115200)
- ④ Click the Open button to open the port.



(2) Step 2: Device Settings

- ① Select the device model;
 - ② Select the protocol used by the device;
 - ③ Click the Connect button device, if the operation is correct, you can see the data refresh.
 - ④ Set the product output mode according to the requirements, optional automatic, default output question and answer and specify output question and answer two modes.
- In the specified output mode, the customer data output selects the output by itself.



(3) Step 3: system settings

- user could set it as needed, there will be hint when set success.
- ① set baud rate ;
 - ② set according to local gravity level;
 - ③ set data output frequency, when it is auto mode, it is to set the auto output frequency, when in inquiry-response mode, it is set the inquiry frequency;
 - ④ click save to save settings.



○Inclinometer ○Digital compass ○Digital inclinometer ○Accelerometer ○Gyro ○North finder ○INS&IMU

(4) Step 4: save file

The file path is shown at the top. Click the Browse button to select the storage path. After selecting it, click Save to start saving the data, open the directory to find the product name + DATA + day CSV file, the content of the file is the protocol data and time.

**► Communication protocol****1. Communication frame format****1.1 communication frame format**

domain	Frame synchronous byte	Frame start byte	CMD Command domain	LEN length	DATAs data field	CRC	Frame end byte
number of bytes (byte)	1	1	1	2	0 to 504	2	1
explain	Sync. byte	Start of byte	Command	Length of the Datas	Datas	CRC	End of Tx byte
value	0xFF	0x02	-	-	-	-	0x03

Notes:

A. LEN data length domain includes the number of bytes of the data field (Ddatas). The MSB is in the front and the LSB is in the back. The length 0 indicates no data field. The longest data field is 504 bytes long, and the longest frame byte is 512 bytes.

B. The calculation of the CRC starts from the CMD command field, including the length field and the data field. The MSB is first and the LSB is after. The CRC is calculated as follows:

```
uint16 calcCRC(const uint8 *pBuffer, uint16 bufferSize)
{
    uint16 poly = 0x8408;
    uint16 crc = 0;
    uint8 carry;
    uint8 i_bits;
    uint16 j;

    for (j=0; j<bufferSize; j++)
    {
        crc = crc ^ pBuffer[j];
        for (i_bits=0; i_bits<8; i_bits++)
        {
            carry = crc & 1;
            crc = crc / 2;
            if (carry)
            {
                crc = crc^poly;
            }
        }
    }
    return crc;
}
```

1.2 Data format and endian

The data output of the device is small endian mode (such as integer, floating point type, both low byte first and high byte last).

○Inclinometer ○Digital compass ○Digital inclinometer ○Accelerometer ○Gyro ○North finder ○INS&IMU

1.3 Serial port default

The default baud rate of the serial port is 115200 bps, 1 start bit, 1 stop bit, no parity.

1.4 The default is continuous data item output, refer to 4.2.2.1.

2. Communication mode

The device has two communication modes: normal mode (question mode) and continuous mode (output data at a certain frequency). Normal mode (question-and-answer) operation can also be performed in continuous mode.

2.1 normal mode

In the normal mode, it adopts the question-and-answer mode, the user sends an inquiry or setting instruction to the device, and the device responds one-to-one to the inquiry or setting instruction. The device responds to the command response in two formats: response (CMD=ASK) and replies (CMD = RET). For details, refer to the command list in Chapter 4.

2.1.1 response

The response frame format is as follows:

domain	Frame sync byte	Frame start byte	CMD	LEN (MSB)	LEN (LSB)	DATA	CRC (MSB)	CRC (LSB)	Frame end byte
byte	1	1	1	1	1	1	1	1	1
Value	0xFF	0x02	IMU_A CK (0x01)	0x00	0x01	ERROR CODE	0xXX	0xXX	0x03

Response is the reply of the command, the error code reflect the execution of instruction, the error code below determines the response of the device to the inquiry command. The following is a list of error codes;

IMU_Error Code	Value	Description
IMU_NO_ERROR	0x00	The command has been executed correctly
IMU_ERROR	0x01	Command not executed correctly
IMU_INVALID_FRAME	0x04	Invalid command
IMU_INVALID_PARAMETER	0x09	Invalid parameter

Note: The error code constitutes the data field (DATA) of the frame.

2.1.2 Reply

The reply is a one-to-one response to the user command. The CMD and data fields of different query commands are different. Please refer to the command list in Chapter 4.

3. Output MASK and output BUFFER

3.1 Output MASK

The INS600 protocol uses output masks (uint32) to set the output data items and formats. Users can use or disable the following data items:

Valid mask	Description	sequence	Support	Mask value
IMU_OUPUT_QUATERNION	Four elements of the attitude angle	1	Not supported yet	0x00000001
IMU_OUTPUT_EULER	Attitude angle	2	support	0x00000002
IMU_OUTPUT_MATRIX	Attitude rotation matrix	3	Not supported yet	0x00000004
IMU_OUTPUT_GYROSCOPES	Calibrated triaxial angular	4	support	0x00000008
IMU_OUTPUT_ACCELEROMETERS	Calibrated three-axis acceleration	5	support	0x00000010
IMU_OUTPUT_MAGNETOMETERS	Calibrated three-axis magnetic field	6	Not supported yet	0x00000020
IMU_OUTPUT_TEMPERATURES	Calibrated temperature	7	support	0x00000040
IMU_OUTPUT_GYROSCOPES_RAW	Gyro original value	8	Not supported yet	0x00000080
IMU_OUTPUT_ACCELEROMETERS_RAW	Acceleration original value	9	Not supported yet	0x00000100
IMU_OUTPUT_MAGNETOMETERS_RAW	Original magnetic field value	10	Not supported yet	0x00000200
IMU_OUTPUT_TEMPERATURES_RAW	Original temperature value	11	Not supported yet	0x00000400
IMU_OUTPUT_TIME_SINCE_RESET	Time after reset	12	support	0x00000800
IMU_OUTPUT_DEVICE_STATUS	equipment status	13	Not supported yet	0x00001000
IMU_OUTPUT_GPS_POSITION	GPS Original location	14	Not supported yet	0x00002000
IMU_OUTPUT_GPS_NAVIGATION	GPS Original speed, heading	15	Not supported yet	0x00004000
IMU_OUTPUT_GPS_ACCURACY	GPS Original horizontal, vertical, heading accuracy	16	Not supported yet	0x00008000

IMU_OUTPUT_GPS_INFO	GPS status (valid, number of stars, etc.)	17	support	0x00010000
IMU_OUTPUT_BARO_ALTITUDE	Barometric altitude reference user defined value	18	Not supported yet	0x00020000
IMU_OUTPUT_BARO_PRESSURE	Absolute air pressure (Pascal)	19	Not supported yet	0x00040000
IMU_OUTPUT_POSITION	Kalman filtered 3D position	20	support	0x00080000
IMU_OUTPUT_VELOCITY	Kalman filtered 3D speed	21	support	0x00100000
IMU_OUTPUT_ATTITUDE_ACCURACY	Kalman filter attitude accuracy	22	Not supported yet	0x00200000
IMU_OUTPUT_NAV_ACCURACY	Kalman filter position and velocity accuracy	23	Not supported yet	0x00400000
IMU_OUTPUT_GYRO_TEMPERATURES	Internal gyro sensor temperature after calibration	24	Not supported yet	0x00800000
IMU_OUTPUT_GYRO_TEMPERATURES_RAW	Internal gyro sensor original temperature	25	Not supported yet	0x01000000
IMU_OUTPUT_UTC_TIME_REFERENCE	UTC time	26	Not supported yet	0x02000000
IMU_OUTPUT_MAG_CALIB_DATA	Calibrated magnetometer	27	Not supported yet	0x04000000
IMU_OUTPUT_GPS_TRUE_HEADING	GPS original true heading	28	Not supported yet	0x08000000
IMU_OUTPUT_ODO_VELOCITY	Odometer original speed	29	Not supported yet	0x10000000
IMU_OUTPUT_DELTA_ANGLES	Incremental angle output	30	Not supported yet	0x20000000
IMU_OUTPUT_HEAVE	Enable sink output	31	Not supported yet	0x40000000

3.1.1 Attitude output

IMU_OUT_EULER

The attitude angles include Roll, Pitch and Yaw, represented by real32(float), 12 bytes, in units of radians.

Storage format:

Roll	Pitch	Yaw
------	-------	-----

3.1.2 Sensor output after calibration

IMU_OUTPUT_GYROSCOPES

The calibrated three-axis gyro angular rates Gx, Gy and Gz are represented by real32 (float), 12 bytes, in rad.S⁻¹ (radians/second).

Storage format:

Gx	Gy	Gz
----	----	----

IMU_OUTPUT_ACCELEROMETERS

The calibrated triaxial accelerations Ax, Ay and Az are represented by real32 (float), 12 bytes, in m.S⁻².

Storage format:

Gx	Gy	Gz
----	----	----

IMU_OUTPUT_TEMPERATURES

Acceleration or gyro built-in temperature sensor and temperature sensor measured temperature, expressed in real32 (float), 8 bytes, the unit is °C.

Storage format:

T0	T1
----	----

3.1.3 Related time output

IMU_OUTPUT_TIME_SINCE_RESET

This time output represents the time since reset to now, uint32 integer, 4 bytes, in mS.

Storage format:

time

3.1.4 GPS Status information output

IMU_OUT_GPS_INFO

This output mainly includes the following basic GPS status:

- * GPS week iTOW, uint32 integer, 4 bytes, unit ms;
- * GPS positioning information, uint8 integer, 1 byte;
- * GPS satellite number, the number of satellites used for navigation;

Storage format:

iTOW	RTKFlags	NumSV
------	----------	-------

GPSFlags: Includes the following signs, explained as follows:

digit	7	6	5	4	3	2	1	0
domain	Heading Flag	Velocity flag	POS flag	Time Status	RTK Quality Indicators			
description	0: Heading angle is not available. 1 heading angle is available.	0: Speed is not available; 1: speed is available;	0: Location is not available; 1: location is available;	0: GPS time is invalid 1: GPS time is valid	0: Fix not available or invalid 1: single point 4: RTK fixed ambiguity solution(RT2) 5: RTK floating ambiguity solution(RT20) other : not support			

3.1.5 Kalman Filtered compensated navigation output

- Inclinometer
- Digital compass
- Digital inclinometer
- Accelerometer
- Gyro
- North finder
- INS&IMU

IMU_OUTPUT_POSITION

3D position information WGS84 format: latitude high, expressed by real64 (double), 24 bytes, latitude and longitude units are degrees, height is m.

Storage format:

Lat.	Longi.	Alt.
------	--------	------

IMU_OUTPUT_VELOCITY

The 3D speed is output in the order of the reference system of INS600 (Northeast), expressed by real32 (float), 12 bytes, unit m.S-1.

Storage format:

Vx	Vy	Vz
----	----	----

3.2 Output BUFFER

According to the different values of the output masks(uint32)K, the INS600 will generate the corresponding output BUFFER. For example, the default output MASK is as follows:

IMU_OUTPUT_EULER|IMU_OUTPUT_GYROSCOPES|IMU_OUTPUT_ACCELEROMETERS|IMU_OUTPUT_TEMPERATURES|IMU_OUTPUT_TIME_SINCE_RESET|IMU_OUTPUT_GPS_INFO|IMU_OUTPUT_POSITION|IMU_OUTPUT_VELOCITY ; Then corresponding BUFFER output is as follows:

Name	Roll	Pitch	Yaw	Gx	Gy	Gz	Ax	Ay	Az
Size	4	4	4	4	4	4	4	4	4
(bytes)	12			12			12		

T0	T1	time	ITOW	GPSFlags	numSV	Lati	Longi	Alti
4	4	4	4	1	1	8	8	8
8		4	6			24		

VelN	VelE	VelD
4	4	4
12		

4. INS600 command list

4.1 Set command

4.1.1 general set

4.1.1.1 save set

4.1.1.1.1 set save command

* **IMU_SAVE_SETTINGS-----(0x24)**

Function: It is used to save all setting parameters to EEPROM and has power-down saving function.

There is no data field, the frame format is as follows:

frame sync byte	frame start byte	CMD	LEN (MSB)	LEN (LSB)	DATA	CRC (MSB)	CRC (LSB)	frame end byte
1	1	1	1	1	0	1	1	1
0xFF	0x02	0x24	0x00	0x00	NULL	0xFF	0xFF	0x03

Reply:

IMU_ACK

oInclinometer oDigital compass oDigital inclinometer oAccelerometer oGyro oNorth finder oINS&IMU

frame sync byte	frame start byte	CMD	LEN (MSB)	LEN (LSB)	DATA	CRC (MSB)	CRC (LSB)	frame end byte
1	1	1	1	1	1	1	1	1
0xFF	0x02	0x01	0x00	0x01	ERROR_CODE	0xFF	0xFF	0x03

Remarks: ERROR CODE refers to 2.1.1 content;

4.1.2 output setting

4.1.2.1 default output MASK setting

4.1.2.1.1 set default output MASK

* IMU_SET_DEFAULT_OUTPUT_MASK-----(0x50)

Function: used to set the output MASK (output mask (uint32)), that is, the output data type (Buffer).

Note: If you do not have the power-down save function, you must execute the save settings command to save the power-down function.

The frame format is as follows:

frame sync byte	frame start byte	CMD	LEN (MSB)	LEN (LSB)	DATA	CRC (MSB)	CRC (LSB)	frame end byte
1	1	1	1	1	5	1	1	1
0xFF	0x02	0x50	0x00	0x05	as follows	0xFF	0xFF	0x03

Among them : DATA part

DATA	
Reserved. Leave to 0(bytes)	Default output mask(uint32)
1	4

Reply :

IMU_ACK

frame sync byte	frame start byte	CMD	LEN (MSB)	LEN (LSB)	DATA	CRC (MSB)	CRC (LSB)	frame end byte
1	1	1	1	1	1	1	1	1
0xFF	0x02	0x01	0x00	0x01	ERROR_CODE	0xFF	0xFF	0x03

4.1.2.1.2 Get the default output MASK

* IMU_GET_DEFAULT_OUTPUT_MASK-----(0x51)

Function: It is used to read the output MASK (output mask (uint32)), that is, to obtain the output data type (Buffer).

The frame format is as follows:

frame sync byte	frame start byte	CMD	LEN (MSB)	LEN (LSB)	DATA	CRC (MSB)	CRC (LSB)	frame end byte
1	1	1	1	1	0	1	1	1
0xFF	0x02	0x51	0x00	0x00	NULL	0xFF	0xFF	0x03

Reply:

○Inclinometer ○Digital compass ○Digital inclinometer ○Accelerometer ○Gyro ○North finder ○INS&IMU

*** IMU_RET_DEFAULT_OUTPUT_MASK-----(0x52)**

Function: return output mask;

The frame format is as follows:

frame sync byte	frame start byte	CMD	LEN (MSB)	LEN (LSB)	DATA	CRC (MSB)	CRC (LSB)	frame end byte
1	1	1	1	1	4	1	1	1
0xFF	0x02	0x52	0x00	0x04	as follows	0xFF	0xFF	0x03

Among them : DATA part

DATA
Default output mask(uint32)
4

4.1.2.2 Continuous mode

Used to query for continuous mode information, or to set continuous mode, mainly to set the output working mode.

Mode can be used in two ways as follows:

IMU_NORMAL_MODE (normal working mode or called question and answer mode): 0x00

IMU_CONTINUOUS_MODE (continuous output mode): 0x01

Among them CONTINUOUS_MODE (continuous output mode) has different Divider values, corresponding to the following different output frequencies:

Divider	OUT(Hz)
0	INVALID
1	200
2	100
4	50
8	25
10	20
20	10
40	5
200	1

Note: The default is IMU_CONTLNIOUS_MODE (continuous output mode) with a frequency of 200Hz.

4.1.2.2.1 Setting continuous mode

*** IMU_SET_CONTINUOUS_MODE-----(0x53)**

Function: set the output mode;

Note: If you do not have the power-down save function, you must execute the save settings command to save the power-down function.

The frame format is as follows:

frame sync byte	frame start byte	CMD	LEN (MSB)	LEN (LSB)	DATA	CRC (MSB)	CRC (LSB)	frame end byte
1	1	1	1	1	3	1	1	1
0xFF	0x02	0x53	0x00	0x03	as follows	0xFF	0xFF	0x03

Among them : DATA part

DATA		
Reserved. Leave to 0(bytes)	Mode	Divider
1	1	1

Reply:

IMU_ACK

frame sync byte	frame start byte	CMD	LEN (MSB)	LEN (LSB)	DATA	CRC (MSB)	CRC (LSB)	frame end byte
1	1	1	1	1	1	1	1	1
0xFF	0x02	0x01	0x00	0x01	ERROR_CODE	0xFF	0xFF	0x03

4.1.2.2.2 Get continuous mode

* **IMU_GET_CONTINUOUS_MODE-----(0x54)**

Function: used to read the current mode;

The frame format is as follows:

frame sync byte	frame start byte	CMD	LEN (MSB)	LEN (LSB)	DATA	CRC (MSB)	CRC (LSB)	frame end byte
1	1	1	1	1	0	1	1	1
0xFF	0x02	0x54	0x00	0x00	NULL	0xFF	0xFF	0x03

Reply:

* **IMU_RET_CONTINUOUS_MODE-----(0x55)**

Role: used to return Mode and Divider;

The frame format is as follows:

frame sync byte	frame start byte	CMD	LEN (MSB)	LEN (LSB)	DATA	CRC (MSB)	CRC (LSB)	frame end byte
1	1	1	1	1	2	1	1	1
0xFF	0x02	0x55	0x00	0x02	as follows	0xFF	0xFF	0x03

Among them: DATA part

DATA	
Mode(uint8)	Divider(uint8)
1	1

4.1.3 Protocol setting

4.1.3.1 Protocol mode

The main command is related to setting or reading the baud rate. The baud rate is a 32-bit integer. The valid values are as follows: 9600, 19200, 38400, 57600, 115200, 256000.

4.1.3.1.1 Set protocol mode

* **IMU_SET_PROTOCOL_MODE-----(0x12)**

Function: used to set the communication baud rate; (default is 115200)

Note: If you do not have the power-down save function, you must execute the save settings command to

○Inclinometer ○Digital compass ○Digital inclinometer ○Accelerometer ○Gyro ○North finder ○INS&IMU

save the power-down function.

The frame format is as follows:

frame sync byte	frame start byte	CMD	LEN (MSB)	LEN (LSB)	DATA	CRC (MSB)	CRC (LSB)	frame end byte
1	1	1	1	1	5	1	1	1
0xFF	0x02	0x12	0x00	0x05	as follows	0xFF	0xFF	0x03

Among them: DATA part

DATA	
Reserved. Leave to 0(bytes)	Baud rate (uint32)
1	4

Reply:

IMU_ACK

frame sync byte	frame start byte	CMD	LEN (MSB)	LEN (LSB)	DATA	CRC (MSB)	CRC (LSB)	frame end byte
1	1	1	1	1	1	1	1	1
0xFF	0x02	0x01	0x00	0x01	ERROR_CODE	0xFF	0xFF	0x03

4.1.3.1.2 Acquisition protocol mode

* IMU_GET_PROTOCOL_MODE-----(0x13)

Role: used to obtain the communication baud rate;

The frame format is as follows:

frame sync byte	frame start byte	CMD	LEN (MSB)	LEN (LSB)	DATA	CRC (MSB)	CRC (LSB)	frame end byte
1	1	1	1	1	0	1	1	1
0xFF	0x02	0x13	0x00	0x00	NULL	0xFF	0xFF	0x03

Reply:

*IMU_RET_PROTOCOL_MODE-----(0x14)

Function: return the current baud rate;

The frame format is as follows:

frame sync byte	frame start byte	CMD	LEN (MSB)	LEN (LSB)	DATA	CRC (MSB)	CRC (LSB)	frame end byte
1	1	1	1	1	4	1	1	1
0xFF	0x02	0x14	0x00	0x04	as follows	0xFF	0xFF	0x03

Among them: DATA part

DATA
baud rate
4

4.1.3.2 Output mode

The main commands are related to the data format of the output. For example, the big endian or little-endian mode, the output is fixed point or floating-point number, etc., pay special attention: INS600 only supports small endian mode and floating-point number.

Different output modes are as follows, which can be combined or combined (Ored):

IMU_OUTPUT_MODE_DEFAULT 0x00

IMU_OUTPUT_MODE_BIG_ENDIAN 0x00

IMU_OUTPUT_MODE_LITTLE_ENDIAN 0x01 (default)

IMU_OUTPUT_MODE_FLOAT 0x00

IMU_OUTPUT_MODE_FIXED 0x02

4.1.3.2.1 Set the output format

* IMU_SET_OUT_MODE-----(0x15)

Note: INS600 does not support this command.

4.1.3.2.2 Obtaining the output format

* IMU_GET_OUTPUT_MODE-----(0x16)

Function: Read the format of the current output;

Note: If you do not have the power-down save function, you must execute the save settings command to save the power-down function.

The frame format is as follows:

frame sync byte	frame start byte	CMD	LEN (MSB)	LEN (LSB)	DATA	CRC (MSB)	CRC (LSB)	frame end byte
1	1	1	1	1	0	1	1	1
0xFF	0x02	0x16	0x00	0x00	NULL	0xFF	0xFF	0x03

Reply:

* IMU_RET_OUTPUT_MODE-----(0x17)

Function: return the current output format;

The frame format is as follows:

frame sync byte	frame start byte	CMD	LEN (MSB)	LEN (LSB)	DATA	CRC (MSB)	CRC (LSB)	frame end byte
1	1	1	1	1	1	1	1	1
0xFF	0x02	0x17	0x00	0x01	mode	0xFF	0xFF	0x03

4.1.4 GPS and navigation settings

4.1.4.1 gravity level configuration

These commands are mainly used to set or get the current gravity level. An invalid or inappropriate gravity level will cause the INS600 to make errors in speed and position calculation.

Gravity level unit $m.s^{-2}$, default value is $9.8m.s^{-2}$.

4.1.4.1.1 set gravity level

◦Inclinometer ◦Digital compass ◦Digital inclinometer ◦Accelerometer ◦Gyro ◦North finder ◦INS&IMU

*** IMU_SET_GRAVITY_MAGNITUDE----- (0xB1)**

Role: set the current gravity level;

Note: If you do not have the power-down save function, you must execute the save settings command to save the power-down function.

The frame format is as follows:

frame sync byte	frame start byte	CMD	LEN (MSB)	LEN (LSB)	DATA	CRC (MSB)	CRC (LSB)	frame end byte
1	1	1	1	1	5	1	1	1
0xFF	0x02	0xB1	0x00	0x05	as follows	0xFF	0xFF	0x03

Among them: DATA part

DATA	
Reserved. Leave to 0(bytes)	magnitude (real32)
1	4

Reply:

IMU_ACK

frame sync byte	frame start byte	CMD	LEN (MSB)	LEN (LSB)	DATA	CRC (MSB)	CRC (LSB)	frame end byte
1	1	1	1	1	1	1	1	1
0xFF	0x02	0x01	0x00	0x01	ERROR_CODE	0xFF	0xFF	0x03

4.1.4.1.2 get gravity level*** IMU_GET_GRAVITY_MAGNITUDE----- (0xB2)**

Function: Get the current gravity level;

The frame format is as follows:

frame sync byte	frame start byte	CMD	LEN (MSB)	LEN (LSB)	DATA	CRC (MSB)	CRC (LSB)	frame end byte
1	1	1	1	1	0	1	1	1
0xFF	0x02	0xB2	0x00	0x00	NULL	0xFF	0xFF	0x03

Reply:

*** IMU_RET_GRAVITY_MAGNITUDE----- (0xB3)**

Function: return the current gravity level;

The frame format is as follows:

frame sync byte	frame start byte	CMD	LEN (MSB)	LEN (LSB)	DATA	CRC (MSB)	CRC (LSB)	frame end byte
1	1	1	1	1	4	1	1	1
0xFF	0x02	0xB3	0x00	0x04	ERROR_CODE	0xFF	0xFF	0x03

Among them: DATA part

DATA
magnitude (real32)
4

4.2 Data output

4.2.1 Normal mode (question and answer)

The main instruction is used to get the data item output, and the reference output BUFFER part.

4.2.1.1 Getting the default data item output

*** IMU_GET_DEFAULT_OUTPUT-----(0x56)**

Function: Get the current default output data item. The data item is set by the IMU_SET_DEFAULT_OUTPUT_MASK command (output masks(uint32)), and the reference output BUFFER part.

The frame format is as follows:

frame sync byte	frame start byte	CMD	LEN (MSB)	LEN (LSB)	DATA	CRC (MSB)	CRC (LSB)	frame end byte
1	1	1	1	1	0	1	1	1
0xFF	0x02	0x56	0x00	0x00	NULL	0xFF	0xFF	0x03

Reply:

***IMU_RET_DEFAULT_OUTPUT-----(0x57)**

Role: Returns the default data item output.

The frame format is as follows:

frame sync byte	frame start byte	CMD	LEN (MSB)	LEN (LSB)	DATA	CRC (MSB)	CRC (LSB)	frame end byte
1	1	1	1	1	98	1	1	1
0xFF	0x02	0x57	0x00	0x62	See below	0xFF	0xFF	0x03

Data part as follows (total length: 0x0062) :

Name	Roll	Pitch	Yaw	Gx	Gy	Gz	Ax	Ay	Az
Size	4	4	4	4	4	4	4	4	4
(bytes)	12			12			12		

T0	T1	time	iTOW	GPSFlags	numSV	Lati	Longi	Alti
4	4	4	4	1	1	8	8	8
8		4	6			32		

VelN	VelE	VelD
4	4	4
12		

4.2.1.2 Get the specific designated data item output

*** IMU_GET_SPECIFIC_OUTPUT-----(0x58)**

Function: Get a specially specified MASK data item.

The frame format is as follows:

frame sync byte	frame start byte	CMD	LEN (MSB)	LEN (LSB)	DATA	CRC (MSB)	CRC (LSB)	frame end byte
1	1	1	1	1	4	1	1	1
0xFF	0x02	0x58	0x00	0x04	as follows	0xFF	0xFF	0x03

Among them: DATA part

DATA
Output masks(uint32)
4

Reply:

*** IMU_RET_SPECIFIC_OUTPUT-----(0x59)**

Function: Returns the output of a specially designated data item.

The frame format is as follows:

frame sync byte	frame start byte	CMD	LEN (MSB)	LEN (LSB)	DATA	CRC (MSB)	CRC (LSB)	frame end byte
1	1	1	1	1	98	1	1	1
0xFF	0x02	0x59	0x00	0x5A	See below	0xFF	0xFF	0x03

Data part as follows (total length: 0x005A) :

Name	Roll	Pitch	Yaw	Gx	Gy	Gz	Ax	Ay	Az
Size	4	4	4	4	4	4	4	4	4
(bytes)	12			12			12		

T0	T1	time	iTOW	GPSFlags	numSV	Lati	Longi	Alti
4	4	4	4	1	1	8	8	8
8		4	6			24		

VelN	VelE	VelD
4	4	4
12		

Note: The above IMU_GET_DEFAULT_OUTPUT (0x56), IMU_GET_SPECIFIC_OUTPUT (0x58) reply RET data items, refer to Output masks (uint32) for the following corresponding BUFFER output:

IMU_OUTPUT_EULER|IMU_OUTPUT_GYROSCOPES|IMU_OUTPUT_ACCELEROMETERS|IMU_OUTPUT_TEMPERATURES|IMU_OUTPUT_TIME_SINCE_RESET|IMU_OUTPUT_GPS_INFO|IMU_OUTPUT_POSITION|IMU_OUTPUT_VELOCITY;

4.2.2 Continuous output mode

The continuous output mode is output according to the parameter set by IMU_SET_CONTINUOUS_MODE. After power-on, INS600 automatically outputs Output masks (uint32) related data items at a certain frequency.

4.2.2.1 Continuous data item output

*** IMU_CONTINUOUS_DEFAULT_OUTPUT-----(0x90)**

Function: The data item is continuously output.

frame sync byte	frame start byte	CMD	LEN (MSB)	LEN (LSB)	DATA	CRC (MSB)	CRC (LSB)	frame end byte
1	1	1	1	1	See below	1	1	1
0xFF	0x02	0x90	0x00	0x5A	See below	0xFF	0xFF	0x03

Data part as follows (total length: 0x005A) :

Name	Roll	Pitch	Yaw	Gx	Gy	Gz	Ax	Ay	Az
Size	4	4	4	4	4	4	4	4	4
(bytes)	12			12			12		

T0	T1	time	iTOW	GPSFlags	numSV	Lati	Longi	Alti
4	4	4	4	1	1	8	8	8
8		4	6			24		

VelN	VelE	VelD
4	4	4
12		

Remarks: Output masks (uint32) is the default BUFFER output below the default:

IMU_OUTPUT_EULER|IMU_OUTPUT_GYROSCOPES|IMU_OUTPUT_ACCELEROMETERS|IMU_OUTPUT_TEMPERATURES|IMU_OUTPUT_TIME_SINCE_RESET|IMU_OUTPUT_GPS_INFO|IMU_OUTPUT_POSITION|IMU_OUTPUT_VELOCITY;



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