

# BS-FU100-300-D3EC

## Triaxial Fiber Optic Gyroscope

### 1 Overview

This document specifies the requirements and methods for the use and maintenance of BS-FU100-300-D3EC three-axis fiber optic gyroscope (product for short).

### 2 Product introduction

#### 2.1 Working principle, function and scope of application of the product

##### 2.1.1 How it works

This product is an inertial angular velocity sensor based on optical Sagnac effect, which is used to measure the rotation angular velocity of the carrier along the sensitive axis. The digital closed-loop detection circuit is adopted to extract the optical path difference of the clockwise and counterclockwise propagation light caused by the external physical angular velocity and sensed by the three-axis sensing meter head, meanwhile, the optical path difference signal is converted into a voltage signal to carry out the modulation and demodulation of the signal, and the closed-loop feedback and control are realized to achieve the purpose of real-time angular velocity signal detection.

##### 2.1.2 Function

The product consists of an optical sensing meter unit and a circuit box, and provides three-axis angular increment information and internal temperature information externally.

##### 2.1.3 Scope of application

The products are mainly suitable for applications such as strapdown inertial navigation/inertial measurement system, positioning and orientation system and high-precision control platform.

### 2.2 Composition

The main components of the product are as follows:

- a) The circuit box part comprises an erbium-doped fiber light source, a signal detection and control circuit, a fiber coupler and a photoelectric detector;
- b) The sensing meter head part comprises an optical fiber ring and a Y-waveguide;
- c) And correspond structural parts and shield cover of that gyroscope.

### 2.3 Appearance and installation dimension

- a) Overall dimensions

Overall dimension of circuit box (mm):  $60 \pm 0.1 \times 60 \pm 0.1 \times 28.0 \pm 0.1$  (length  $\times$  width  $\times$  height);

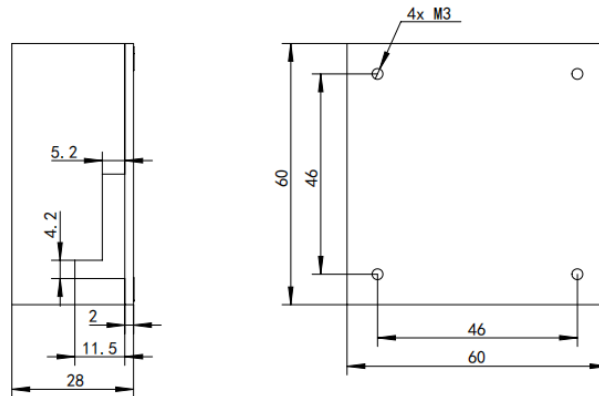
Dimension of the sensor head (mm):  $\Phi 100 \pm 0.1 \times 23.1 \pm 0.1$ ;

- b) Installation dimensions

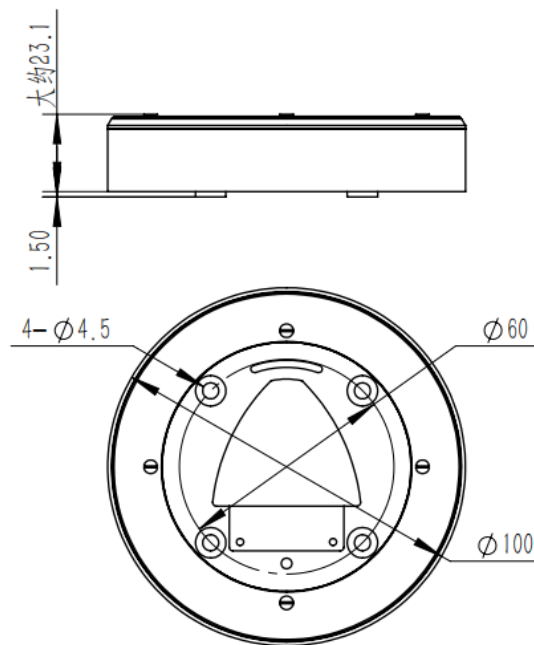
Installation dimension of circuit box (mm):  $46 \pm 0.1 \times 46 \pm 0.1$  (length  $\times$  width), M3  $\times$  4;

Installation dimension of sensor head (mm):  $\Phi 60 \pm 0.1$ ,  $\Phi 4.5 \times 4$ ;

Specific as Figure 1As shown.



(a) Circuit box part



(B) Sensing head section

Figure 1 Outline and Installation Diagram of BS-FU100-300-D3EC Fiber Optic Gyroscope

## 2.4 Weight

Total product weight < 1250 G.

## 2.5 Main performance parameters

The main performance parameters of the product are detailed in Table 1.

Table1 Main performance parameters

Serial number	Test item	Unit	Technical requirements
1	Start time	s	3
2	Zero position	(°)/h	≤0.3
3	Zero bias stability at room temperature (constant temperature)	(°)/h	≤ 0.006 (10s smoothing) ≤ 0.002 (100s smooth)
4	Zero bias stability with temperature change (1 °C/min variable temperature, 100 s smooth)	(°)/h	≤0.008
5	Zero-bias repeatability	(°)/h	≤0.002
6	Zero bias sensitivity	(°)/h/Gs	≤0.003
7	Random walk coefficient	(°)/h <sup>1/2</sup>	≤0.0002
8	Scale factor nonlinearity	ppm	≤5
9	Scale factor asymmetry	ppm	≤2
10	Scale factor repeatability	ppm	≤5
11	Threshold	(°)/h	≤0.002
12	Resolution	(°)/h	≤0.002
13	Bandwidth	Hz	≥200
14	Operating temperature	°C	-45~+70
15	Storage temperature	°C	-55~+80
16	Dynamic range	(°)/s	±300
17	Supply voltage	V	+5
18	Normal temperature steady state power consumption	W	≤4.5
19	Full temperature steady state power consumption	W	≤8
20	Start the instantaneous current	A	<2

## 2.6 Mechanical and electrical interface relation

### 2.6.1 Power requirements

The product is powered by + 5V DC power supply. See Table 2 for power supply requirements. Table 2 BS-FU100-300-D3EC Triaxial Fiber Optic Gyroscope Combined Power Supply Requirements

Serial number	Name	Request
1	Power supply accuracy	±5%
2	Power ripple (Vpp)	≤50mV
3	Supply current	>2A

### 2.6.2 Electrical connection interface

The connector connecting the product to the outside is J30JZLN9ZKWA000. See Table 3 for the definition.

Table 3 Definition of J30JZLN9ZKWA000 Gyroscope Connector and Test Line Point

Core point number	Definition	Comment
1	+5V	Power supply input
2	GND	Power ground
3	Reserved	--
4	RXD+	Gyro differential sorting and correcting
5	TXD+	Gyro RS422 output positive
6	+5V	Power supply input
7	GND	Power ground
8	RXD-	Gyro differential gating negative
9	TXD-	Gyro RS422 output negative

Note: When connecting or contacting the product, anti-static measures shall be taken in accordance with GJB 1649-1993.

### 2.6.3 Communication protocol

Communication interface: RXD and TXD are RS422/485 differential communication interfaces. RXD is used to receive differential pulse (or square wave) synchronous gating signals, and TXD is used to output serial data signals.

Communication protocol: The frequency of the gating signal is not more than 1 kHz. The gyro latches the internal incremental angle data after receiving the falling gating signal, and starts to output the gyro data packet through the TXD within 1 μs. The transmission baud rate is 460.8 kbps. The data packet contains 23 bytes, and each byte has 1start bit, 8 data bits, and 1stop bit. There is no parity bit.

The angle increment information is the angle increment value of the gyroscope in the time between two gating signals, and the average value of the angular velocity of the gyroscope in a period of time is obtained by dividing the accumulated value of the angle increment in the period of time by the interval time.

The packet format is as follows:

Table 4 Data packet format of gyro combination

Byte sequence number	Content
1	99 (hexadecimal)
2	66 (hexadecimal)
3	Status word, normal value is FF (hexadecimal)
4	X Gyro delta 1, LSB
5	X Gyro delta 2
6	X Gyro delta 3
7	X-gyro delta 4, MSB
8	Y Gyro delta 1, LSB
9	Y Gyro delta 2
10	Y Gyro delta 3
11	Y Gyro delta 4, MSB
12	Z Gyro delta 1, LSB
13	Z Gyro delta 2
14	Z Gyro delta 3
15	Z gyro delta 4, MSB
16	Temperature Data 1, LSB
17	Temperature Data 1, MSB
18	Temperature Data2, LSB
19	Temperature Data 2, MSB
20	Temperature Data 3, LSB
21	Temperature Data 3, MSB
22	Frame number, plus one for each transmission, cycle count
23	Checksum, cumulative sum of bytes 3 to 22

The meaning of the status word is as follows:

Table 5 Data Format of Gyro Status Word

bit7	bit6	bit5	bit4	bit3	bit2	bit1	bit0
Reserved	Z-axis circuit control status	Y-axis circuit control status	X-axis circuit control status	Reserved	Z-axis optical path state	Y-axis optical path status	X-axis optical path status

Where the "Reserved" bit is always 1;

When the "circuit control status" bit is 1, it means that the gyro circuit control status is normal; when it is 0, it means that the control status is abnormal;

When the "light path status" bit is 1, it means that the gyro light path is working normally; when it is 0, it means that the gyro light path status is abnormal.

If any one of the above two status bits is always 0 during the use of the gyro, and there is an abnormality in the gyro data, the gyro should be repaired.

### **3 Product installation and removal**

#### **3.1 Request**

The user shall be responsible for the installation and disassembly of the product. During this process, the product shall not be impacted, knocked or bumped, and the outer surface of the product shall not be machined. Pay attention to the wires and optical fiber sleeves between the gyroscope assemblies to prevent bending, squeezing, pulling and bumping at a small angle.

#### **3.2 Methods and procedures**

- A) The flatness of the surface used to fix the product shall be better than 0.02 mm;
- B) The connecting line between gyros shall be led out from the bottom of the sensing meter, and the position and direction of the outgoing line shall be noted during installation;
- C) The connecting line between gyros shall be bonded to the inertial navigation structure with easily detachable glue (such as 706B silica gel);
- D) It is recommended to add a spring washer for the installation of the sensing meter head, and the circuit box shall be installed on the back or an adapter plate shall be added.

#### **3.3 Inspection after installation**

Check whether each mounting screw meets the size of the mounting hole and whether it is firm.

### **4 Operating procedures**

#### **4.1 Inspection before use**

Check the appearance of the product for physical damage such as collision.

#### **4.2 Instructions for the use of the product**

- a) The product is installed on the carrier, and the cable is correctly connected according to the requirements of Table 3;
- b) The data connection is carried out according to the communication protocol of 2.6 3.

#### **4.3 Precautions**

In order to avoid damaging the performance and reducing the life of the a) three-axis fiber optic gyroscope, it is not appropriate to switch on and off the power frequently during the use of the gyroscope;

Check the power supply system before powering on the b) three-axis fiber optic gyroscope assembly to ensure that there is no short circuit between the electrical points of the power supply and between the gyroscope shell and the electrical points;

C) that if the product works abnormally, the manufacturer should be consulted, and it is forbidden to disassemble and repair it without authorization;

D) three-axis fiber optic gyroscope combination is a precision instrument, which should be handled with care during use and transportation;

The e) must ensure the correct connection of product input and output signal lines and power supply lines;

F) are required to take anti-static measures in the process of contacting products;

G) The optical devices in the three-axis fiber optic gyroscope assembly are susceptible to moisture. If conditions permit, it is recommended that the inertial navigation system should be airtight;

H) When the inertial navigation system is applied to occasions with high magnetic field requirements, it is recommended to add a layer of magnetic shield of 0.2 ~ 0.5 mm on the inner wall of the inertial navigation system;

I) The magnetic field intensity around the product location shall be less than 1 Gauss.

## 5 Maintenance and care

a) Before the product is loaded into the carrier, it is required to power on the product at least once every 6 months, and the power on time is 3600 s. It is not required to detect the electrical parameters of the product when the product is powered on;

b) After the product is loaded into the carrier, it is required to be powered on at least once a year for 3600s, and the electrical parameters of the product are not required to be detected when the product is powered on.

## 6 Common Faults and Troubleshooting

This product is in a sealed state and cannot be repaired on site after any failure of the user, and needs to be returned to the production unit for repair.

The following can only list some possible faults that are not related to the product itself, as shown in Table 6. If the product has other technical problems during use, please contact the product manufacturer.

Table 6 Common Faults and Troubleshooting

Serial number	Fault symptom	Cause analysis	Exclusion method
1	When the product is powered on, the	The product is not being	Check the power

	indication of + 5V ammeter is basically zero	powered or is providing too little current	supply and power supply circuit, and restore the power supply of the product
2	When the product is powered on, the + 5V ammeter indicates normally, but the computer acquisition program does not work.	Abnormal acquisition system of test equipment	Check the connection cable and equipment power supply
		Software program conflict	Restart the computer

## 7 Transportation and storage requirements

### 7.1 Shipping considerations

- Place the product in the direction shown in the packing box;
- Transportation by road, rail, air and water is permitted;
- During transportation, ensure that the packing box is fastened to the carrier and will not move.

### 7.2 Storage conditions, storage period and precautions

- The products placed in the packing box shall be stored in an air-conditioned warehouse under the standard atmospheric pressure, with the ambient temperature of  $25\text{ }^{\circ}\text{C} \pm 10\text{ }^{\circ}\text{C}$ , the relative humidity of 30% ~ 70%, and the surrounding magnetic field intensity of less than 10 Gauss;
- The storage life of the product is 15 years.

## 8 Unpacking notes

- Check the appearance of the outer package for physical damage such as collision;
- Check whether the product and supporting accessories are complete, see Table 7 for details;
- Electrostatic protection shall be carried out when the product is taken out.

Table7 Product delivery supporting list

Serial number	Name	Quantity
1	BS-FU100-300-D3EC Triaxial Fiber Optic Gyroscope Assembly	1
2	Gyro combined packing box	1
3	Test Report of Gyro Assembly	1
4	J30JZ/XN9TJCAL01 Connector	1
5	Certificate of conformity	1