MEMS Inertial Measurement Unit V 1.01.

# BS-IC207-M-D6EC

## Product characteristics

- Gyroscope measuring range: 500 °/s optional
- 2 °/H gyroscope bias stability (Allan variance)
- Acceleration range: 16g
- Zero bias stability (Allan variance) for acceleration of 0.1 mg

## Field of application

UAVNavigation

Vehicle & Robot Navigation

AUV &ROV

## 1. Product overview

The BS-IC207-M-D6ECis an inertial measurement unit (IMU) based on micromachining technology (MEMS) with built-in high-performance MEMS gyroscope and MEMS accelerometer, which outputs 3 angular velocities and 3 accelerations. The utility model has the advantages of high reliability and strong environmental adaptability. By matching different software, the product can be widely used in intelligent driving, tactical and industrial UAV, intelligent ammunition, seeker, mobile communication, mapping, stable platform and other fields.

## 2. Product features

**1) Three-axis digital gyroscope:**

A) ± 500°/s dynamic measuring range;

B) Zero bias stability: 10 °/H (GJB, 10s), 2.0 °/H (ALLAN);

**2) Triaxial digital accelerometer:**

A) ± 16 G dynamic measuring range;

B) Zero-bias stability: 0.5 mg (GJB, 10s), 0.1 mg (ALLAN);

3) High reliability: MTBF > 20000h;

4) Guaranteed accuracy within the full temperature range (-40 ℃ ~ 80 ℃): built-in high-performance temperature calibration and compensation algorithm;

5) Suitable for working under strong vibration conditions

6) Interface 1-way RS422

## 3. Product indicators

| Parameter | | Test conditions | Minim | Typical | Maxi | Unit |
|---|---|---|---|---|---|---|
| Peg-top | Dynamic | | | | 500 | °/s |
| | Zero bias stability | Allan variance | | 2.0 | | °/h |
| | | 10 s average (-40 ℃ ~ + 80 ℃, constant temperature) | | 10 | | °/h |
| | Zero bias | Zero bias range | | ±0.5 | | °/s |
| | | Zero bias variation over full temperature | | ±0.5 | | °/s |
| | Scale factor | Scale factor accuracy | | 0.3 | | % |
| | | Scale factor | | 0.02 | | %FS |
| | Bandwidth | | | 200 | | Hz |

| Parameter | | Test conditions | Minim | Typical | Maxi | Unit |
|---|---|---|---|---|---|---|
| Accelerometer | Dynamic | | | 16 | | g |
| | Zero bias stability | Allan variance | | 0.1 | | mg |
| | | 10 s average (-40 ℃ ~ + 80 ℃, constant temperature) | | 0.5 | | mg |
| | Zero bias | Zero bias range | | 2 | | mg |
| | | Zero-bias change in full temperature range, | | 2 | | mg |
| | Scale factor | Scale factor accuracy | | 0.3 | | % |
| | | Scale factor | | 0.02 | | %FS |
| | Bandwidth | | | 200 | | Hz |
| Communication interface | 1-way SPI | Baud rate | | | 15 | MHz |
| | UART | Baud rate | | 230.4 | | Kbps |
| | Sampling frequency | SPI | | 1000 | | Hz |
| | | UART | | 200 | 1000 | Hz |
| Electrical characterist | Voltage | | | 3.3 | | V |
| | Power | | | | 1.0 | W |
| | Ripple | P-P | | | 100 | mV |
| Structural | Size | | | 24×24×12 | | mm |
| | Weight | | | 40 | | g |
| Use environment | Operating | | -40 | | 80 | ℃ |
| | Storage | | -45 | | 85 | ℃ |
| | Vibration | | | 20~2000Hz, 6.06g | | |
| | Impact | | | 1000g, 0.5 ms | | |
| Reliability | MTBF | | | 20000 | | h |
| | Continuous | | | 120 | | h |
| Calculate the zero deviation of the whole temperature change | | | | | | |

## 4. Electrical interface

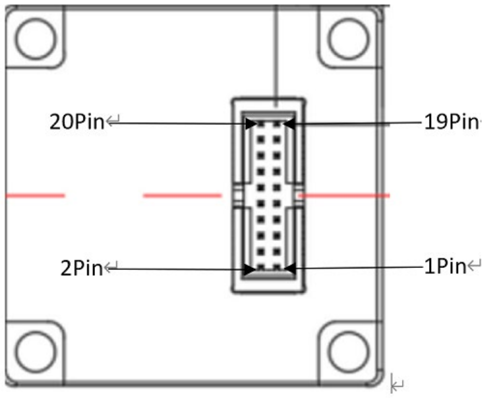


图1 Stitch indication

| PIN | Interface definition | Type | Description |
|---|---|---|---|
| 1 | SCLK | I | SPI Serial Clock. |
| 2 | DOUT | O | SPI Data Input. This pin clocks the input on the SCLK rising edge. |
| 3 | GND | S | Ground |
| 4 | GND | S | Ground |
| 5 | DIN | I | SPI Data Output. This pin clocks the output on the SCLK falling edge. |
| 6 | /CS | I | SPI Chip Select. |
| 7 | SOUT1 | O | COM1 UART Data Output |
| 8 | GND | S | Ground |
| 9 | SIN1 | I | COM1 UART Data Input |
| 10 | VCC | S | Power Supply 3.3V |
| 11 | VCC | S | Power Supply 3.3V |
| 12 | VCC | S | Power Supply 3.3V |
| 13 | DRDY (DIO2) | I/O | Data Ready (General Purpose I/O1) |
| 14 | DIO1 (EXT) | I/O | General Purpose I/O2 (External Trigger Input or External Counter Reset Input) |
| 15 | GND | S | Ground |
| 16 | /RST | I | Reset |
| 17 | NC | N/A | Do Not Connect |
| 18 | RTD | O | Run Time Diag Output |
| 19 | SOUT2/CAN+ | | COM2 or CAN |
| 20 | SIN2/CAN- | | |

Table 1: Stitch Definition Diagram

## 5. Fabric interface

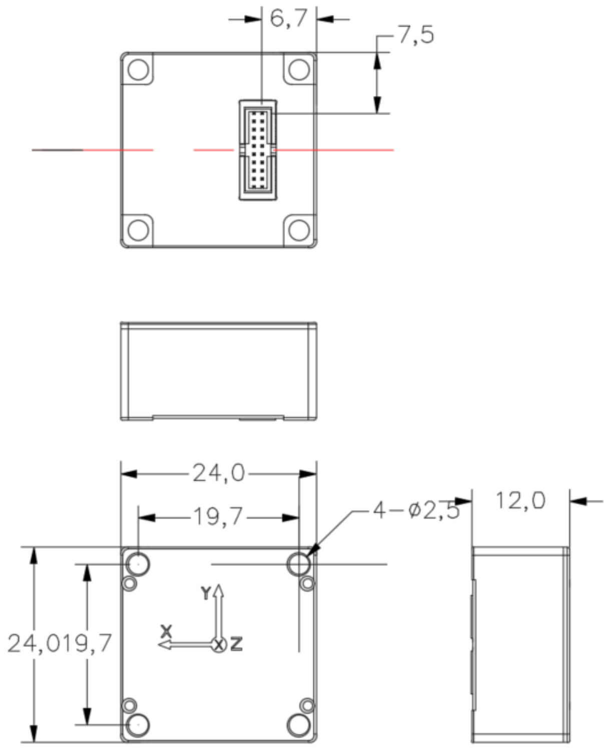


Fig. 2 Schematic Diagram of Structure Appearance

## 6. Instructions for use

**6.1 UART read-write data**

**Interface 6.2**

Default configuration: 230400bps, 8 data bits, 1stop bit, no parity;

**6.2.1 protocol format**

It is divided into protocol head, protocol body and protocol tail; 200 Hz; the coordinate axis is defined as the lower right front.

| Agreement | Byte sequence number | Data | Unit | Data type | Remark |
|---|---|---|---|---|---|
| Protocol header | 0 | 0x5a | | | |
| | 1 | 0x5a | | | |
| Protocol body | 2~5 | X-axis gyro | °/s | float | |
| | 6~9 | Y-axis gyro | °/s | float | |
| | 10~13 | Z-axis gyro | °/s | float | |

| | | | | | |
|---|---|---|---|---|---|
| | 14~17 | X-axis plus table | g | float | |
| | 18~21 | Y-axis plus table | g | float | |
| | 22~25 | Z-axis plus table | g | float | |
| | 26~29 | Spare | | | |
| | 30~33 | Spare | | | |
| | 34~37 | Spare | | | |
| | 38~41 | Spare | | | |
| | 42~45 | Spare | | | |
| | 46~49 | Temperature | ℃ | float | |
| | 50~53 | Spare | | | |
| | 54~57 | Spare | | | |
| End of agreement | 58 | Checksum | | | Accumulate and sum 2 to 57 bytes, take the low byte |

Table 2: Serial port protocol table

**Read and write data from and to the 6.3 SPI**

The BS-IC207-M-D6EC is an autonomous sensor system that starts automatically when a valid power source is present. When the initialization process is complete, it begins sampling, processing, and loading the calibrated sensor data into the output registers, which is accessible through the SPI port. The SPI port is typically connected to a compatible port on an embedded processor. Four SPI signals support synchronous serial data transfer. In the factory default configuration, the DIO2 pin provides a data-ready signal that goes high when new data is available in the output data register.

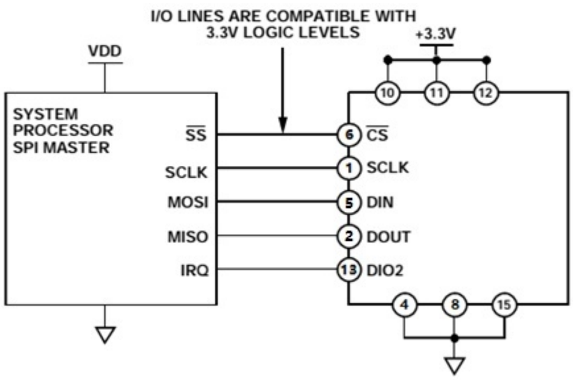


Figure 3 Schematic diagram of connection with external

equipment

### 6.3.1 Generic Host Processor SPI Settings

| Processor settings | Explain |
|---|---|
| Host | Slave |
| SCLK ≤ 15 MHz | Maximum serial clock ratio |
| SPI Mode 3 | CPOL = 1 (polar), CPHA = 1 (phase) |
| MSB first mode | Bit Order |
| 16-bit mode | Shift register/data length |

### 6.3.2 SPI communication

If the previous command is a read request, the SPI port supports full-duplex communication, and the external processor can write DIN while reading DOUT, as shown in the following figure.

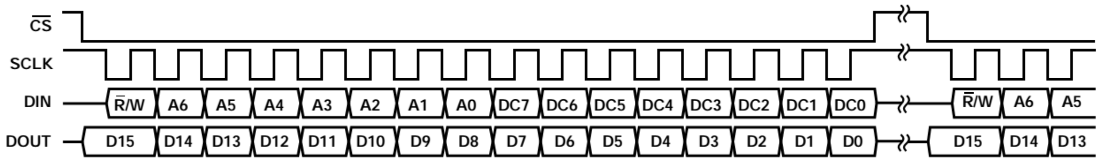


Figure 4 SPI Read and Write Timing

### 6.3.3 reads sensor data

The BS-IC207-M-D6EC automatically starts and activates Page 0 for data register access. After accessing any other page, write 0x00 to the PAGE _ ID register (DIN = 0x8000) to activate Page 0 in preparation for subsequent data accesses. A single register read requires two 16-bit SPI cycles. In the first cycle, a read of the contents of a register is requested using the bit assignment function in Figure 1; in the second cycle, the register contents are output on DOUT. The first bit of the DIN command is 0, followed by the high or low address of the register. The last eight bits are don't care, but the SPI requires a full 16 SCLKs to receive the request. The following figure shows two sequential register reads, one with DIN = 0x1A00 requesting the contents of the Z _ GYRO _ OUT register, and the other with DIN = 0x1800 requesting the contents of the Z _ GYRO _ LOW register.

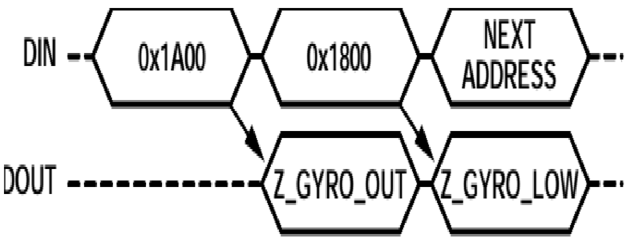


Figure 5. SPI Read Example

### 6.3.4 User Register Memory Map (N/A = Not Applicable)

Read a user register memory map with a delay of not less than 5 us inserted between the two data registers

| Name | R/W | PAGE_I | Address | Default | Register description |
|---|---|---|---|---|---|

|  |  | D |  |  |  |
|---|---|---|---|---|---|
| TEMP_OUT | R | 0x00 | 0x0E | N/A | Temperature |
| X_GYRO_LOW | R | 0x00 | 0x10 | N/A | X-axis gyroscope output, low word |
| X_GYRO_OUT | R | 0x00 | 0x12 | N/A | X-axis gyroscope output, high word |
| Y_GYRO_LOW | R | 0x00 | 0x14 | N/A | Y-axis gyroscope output, low word |
| Y_GYRO_OUT | R | 0x00 | 0x16 | N/A | Y-axis gyroscope output, high word |
| Z_GYRO_LOW | R | 0x00 | 0x18 | N/A | Z-axis gyroscope output, low word |
| Z_GYRO_OUT | R | 0x00 | 0x1A | N/A | Z-axis gyroscope output, high word |
| X_ACCL_LOW | R | 0x00 | 0x1C | N/A | X-axis accelerometer output, low word |
| X_ACCL_OUT | R | 0x00 | 0x1E | N/A | X-axis accelerometer output, high word |
| Y_ACCL_LOW | R | 0x00 | 0x20 | N/A | Y-axis accelerometer output, low word |
| Y_ACCL_OUT | R | 0x00 | 0x22 | N/A | Y-axis accelerometer output, high word |
| Z_ACCL_LOW | R | 0x00 | 0x24 | N/A | Z-axis accelerometer output, low word |
| Z_ACCL_OUT | R | 0x00 | 0x26 | N/A | Z-axis accelerometer output, high word |
| PROD_ID | R | 0x00 | 0x7E | 206 | Product identification (206) output |

### 6.3.5-Transformation formula

Current temperature = 25 + TEMP _ OUT * 0.00565.

X-axis gyro value = 0.02 * X _ GYRO _ OUT

Y-axis gyro value = 0.02 * Y _ GYRO _ OUT

Z-axis gyro value = 0.02 * Z _ GYRO _ OUT

X-axis accelerometer value = (long) (X _ ACCL _ OUT * 65536 + X _ ACCL _ LOW) * 0.00001220703125 * 0.001

Y-axis accelerometer value = (long) (Y _ ACCL _ OUT * 65536 + Y _ ACCL _ LOW) * 0.00001220703125 * 0.001

Z-axis accelerometer value = (long) (Z _ ACCL _ OUT * 65536 + Z _ ACCL _ LOW) * 0.00001220703125 * 0.001

## 7. Update the record

| Serial number | Version | Change the date | Before the change | After the change | Reason for the change | Changed by |
|---|---|---|---|---|---|---|
| 1 | 1.00 | 20220908 |  | New establishment | New establishment | Zzy |
| 2 | 1.01 | 20230117 |  | Compatible Of ADIS16135 SPI protocol | Customer needs | Asl |