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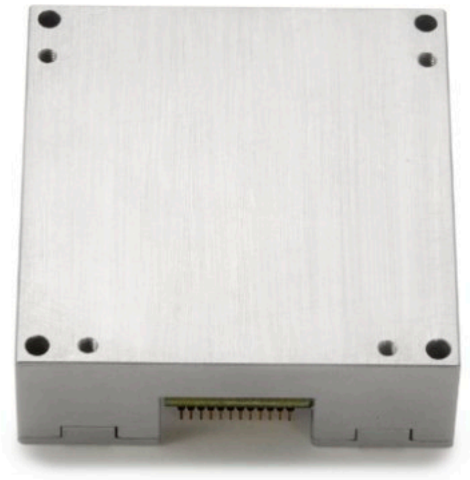
BS-IC24-M-D6EC

MEMS inertial measurement unit

EX2.900.063SM



This instruction manual is the main basis for the operation of the BS-IC24-M-D6EC multi-degree of freedom inertial measurement unit.

This instruction manual is mainly based on the "Multi-degree of freedom inertial measurement unit technical agreement" and "Inertial measurement unit and three-axis gyro combination technical conditions".

1 Product functions and related technical parameters

1.1 Composition and function

The 1BS-IC24-M-D6EC multi-degree-of-freedom inertial measurement unit is a complete inertial system with a built-in three-axis gyroscope, a three-axis accelerometer, a three-axis magnetometer and a pressure sensor for measuring the three-axis angle of the carrier parameters such as rate, acceleration, three-axis magnetic field, air pressure, etc., output data after error compensation (including temperature compensation, installation misalignment angle compensation, nonlinear compensation, etc.) according to the communication protocol through SPI or URA T.

1.2 The main technical parameters

Table 1-1 Technical parameters

parameter		Test Conditions	Minimum value	Typical value	Maximum	unit
Gyro	Dynamic measuring range	Configurable (maximum ± 1000)	±300	±450	±1000	°/s
	Zero bias instability	Allan variance, better than		5		°/h
	Zero bias stability	1s smooth, rms, better than		30		°/h
	Zero bias over the full temperature range	-40 °C ~ 85 °C, 10s smooth, rms		0.03		°/s
	Random walk	1б		0.26		°/√h
	Zero bias repeatability	1б		100		°/h
	Output noise	No filtering, rms		0.135		°/s
	Scale factor repeatability	1б		0.1		%
	Scale factor nonlinearity	FS=450 °/s		0.01		%FS

parameter		Test Conditions	Minimum value	Typical value	Maximum	unit
	Bandwidth (-3dB)			330		Hz
	Cross coupling			0.1		%
Accelerometer	Dynamic measuring range	Configurable (maximum ± 40)	±18	±20	±40	g
	Zero bias stability	Allan variance		0.07		mg
	Zero bias over the full temperature range	-40 ℃ ~ 85 ℃, 10s smooth, rms		5		mg
	Random walk	1б		0.029		m/s/√h
	Zero bias repeatability	1б		16		mg
	Output noise	No filtering, rms		1		mg
	Scale factor repeatability	1б		0.1		%
	Scale factor nonlinearity	FS=10g		0.1		%FS
	Bandwidth (-3dB)			330		Hz
	Cross coupling			0.1		%
Magnetometer	Dynamic measuring range			±2.5		gauss
	Sensitivity			0.1		mgauss/LSB
	Nonlinearity			0.5		%FS
Barometer	Pressure range		300		1100	mbar
	Sensitivity			6.1×10^{-7}		mbar/LSB
	Total error			4.5		mbar
	Relative error			2.5		mbar
	Nonlinearity			0.1		%FS
Communication Interface	1 way spi	Input clock frequency			15	MHz
	1 way uart	Baud rate	9.6	614.4	921.6	kbps
Electrical character	Voltage	DC		3.3 (or 5) ± 10%		V
	Power consumption			0.6	1	W

parameter		Test Conditions	Minimum value	Typical value	Maximum	unit
istics	Ripple	P-P			100	mV
	weight			48±2		g
Use environment	Operating temperature	Scalable	-40		85	℃
	storage temperature		-55		85	℃
	vibration			10~2000Hz，6.06g		
	Shock			5000g，0.1ms		

2 Structural features and electrical connections

The outline of BS-IC24-M-D6EC multi-degree of freedom inertial measurement unit is shown in Figure 2-1.

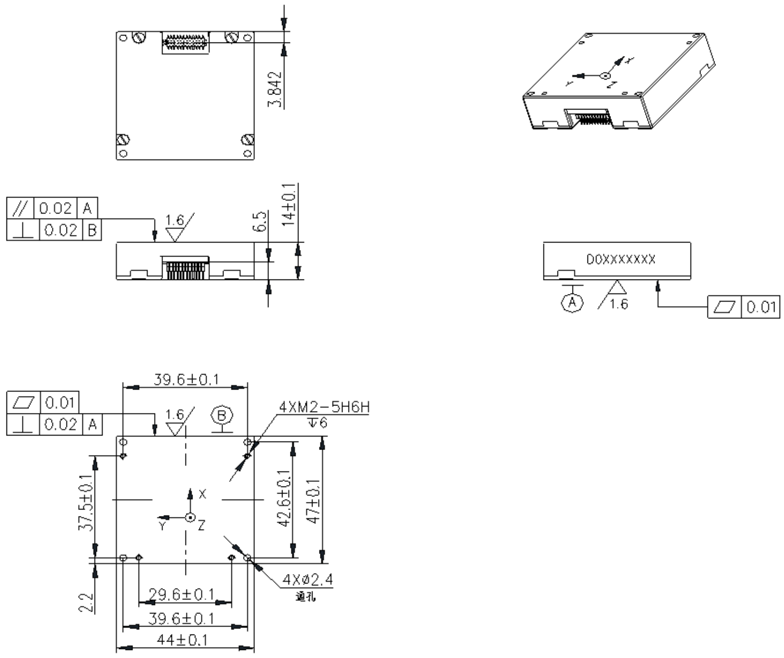


Figure 2-1 Product outline drawing

In the picture, " BS-IC24-M-D6EC" is the product code, and "D0xxxxxx" is the product number.

The product is installed through 4 Φ2.4 through holes, and 4 M2 screws (plus elastic pads and flat pads) are used for installation. When the connector is installed, the plug should be connected to the socket.○,A、 ○,BIs the installation datum.

It is recommended that the flatness of the mounting surface opposite to the reference surface is not greater than 0.02mm, the perpendicularity is not greater than

0.04mm, and the surface roughness is not greater than 0.8μm.

The connector type of the product and the external connection is FTMH-112-02-H-DH, and the docking connector of the product is Samtec P / N CLM-112-02-GDA. For the contact configuration diagram of the product, see 2-, 2 and the contact definition table 2-1.

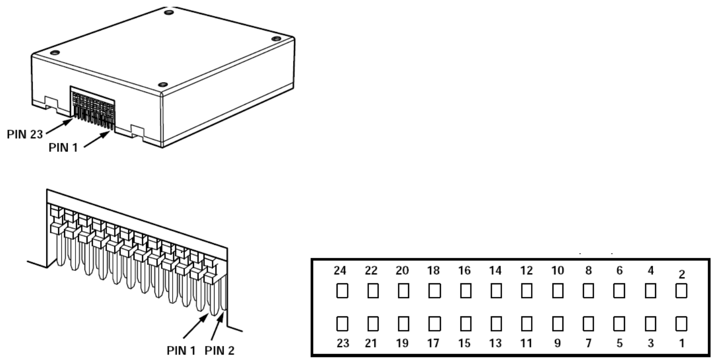


Figure 2-2 Product contact configuration diagram

Table 2-1 Product contact allocation

Pin number	name	Types of	description
10，11，12	VDD	power supply	
13，14，15	GND	power supply	
7	DIO1	input Output	Universal IO, configurable
9	DIO2	input Output	
1	DIO3	input Output	
2	DIO4	input Output	
3	SPI-CLK	input Output	SPI slave mode
4	SPI-MISO	input Output	
5	SPI-MOSI	input Output	
6	SPI-/CS	input Output	
19	UART-TXD	Output	UART, baud rate can be configured, the default is 614400bps
21	UART-RXD	Input	
18	CAN-T	Output	CAN protocol, TTL (+ 3.3v) level
20	CAN-R	Input	

8	RST	Input	Reset
23	VDDRTC	power supply	
other	NC	spare	Factory reserved

3 Spatial coordinate system

3.1 Right-hand rule principle one

The product contains three axial spatial coordinate systems, namely X, Y and Z, as shown in Figure 3-1.

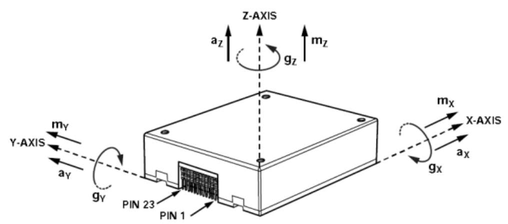


Figure 3-1 Product space coordinate system

The installation of the product must match the axis of the coordinate system, otherwise the measured angular velocity data is inaccurate. Following the "Right Hand Rule 1", you can quickly assign and determine the axis of the coordinate system. Extend your right hand and spread your thumb and index finger With the middle finger, the direction of the thumb is the X axis, the direction of the index finger is the Y axis, and the direction of the middle finger is the Z axis, as shown in Figure 3-2.

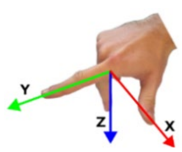


Figure 3-2 Right-hand rule principle one

3.2 Right-hand rule principle two

The three-degree of freedom gyroscope in the inertial group can measure the angular velocity in three directions. Following the 'right hand rule principle two', you can quickly determine the angular velocity direction of the axis of rotation of the coordinate axis. The direction is the axial direction, and the direction in which the other four fingers are bent is the direction of the angular velocity of the axial rotation of the thumb, as shown in Figure 3-3.

Figure 3-3 Right-hand rule principle two

4 Communication interface

4.1 SPI communication

The IMU communication uses a 4-wire SPI standard interface, the product's internal data refresh frequency is up to 2.4KHz, and the communication baud rate is up to 15Mbps.

4.1.1 Timing specifications

Unless otherwise stated, TC = 25 ° c, VDD = 3.3 v.

Table 4-1 Product timing requirements

parameter	Explanation	Normal mode			unit
		Minimum value	Typical value	Maximum	
f_{SCLK}	Serial clock	0.01		15	MHz
t_{STALL}	Stall period between data	20			μs
t_{CLS}	Serial clock low period	31			ns
t_{CHS}	Serial clock high period	31			ns
t_{CS}	Chip select to clock edge	32			ns
t_{DAV}	DOUT valid time after SCLK edge			10	ns
t_{DSU}	DIN settling time before the rising edge of SCLK	2			ns
t_{DHD}	DIN hold time after rising edge of SCLK	2			ns
t_{DR}, t_{DF}	DOUT rise / fall time, _load 100 pF		3	8	ns
t_{DSOE}	CS set to valid data output	0		11	ns

t_{HD}	SCLK edge to data output is invalid	0			ns
t_{SFS}	The last SCLK edge to CS is deasserted	32			ns
t_{DSHI}	CS is de-asserted to data output high impedance state	0		9	ns

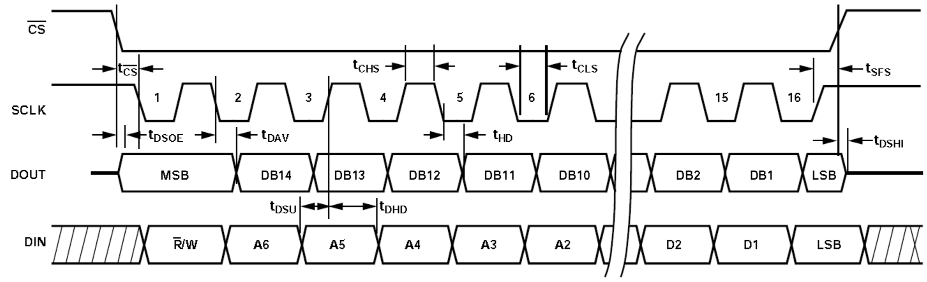


Figure 4-1 Timing diagram

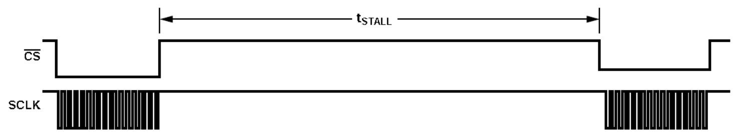


Figure 4-2 Stop time and data rate

4.1.2 Data register address mapping

The user register memory map data definition is shown in Table 4-2.

Table 4-2 User register memory map data

name	R/W	PAGE_ID	address	default	Register description
PAGE_ID	R/W	0x00	0x00	0x00	Page identification
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 gyro output, low word
Y_GYRO_OUT	R	0x00	0x16	N/A	Y axis gyro 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-order 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
X_MAGN_OUT	R	0x00	0x28	N/A	x-axis magnetometer output, high word

Y_MAGN_OUT	R	0x00	0x2A	N/A	Y axis magnetometer output, high word
Z_MAGN_OUT	R	0x00	0x2C	N/A	Z axis magnetometer output, high word
BAROM_LOW	R	0x00	0x2E	N/A	Barometer output, low word
BAROM_OUT	R	0x00	0x30	N/A	Barometer output, high word

4.1.3 SPI communication and configuration

A single register read operation requires two 16-bit SPI cycles. In the first cycle, use the bit allocation function in Figure 4-3 to request to read the contents of a register; in the second cycle, the register content is output through DOUT. The first bit of the DIN command is 0, and then the high or low address of the register. The last 8 bits are irrelevant bits, but the SPI requires a full 16 SCLK to receive the request. Figure 5 shows two consecutive register read operations, first DIN = 0x1A00, request the contents of the Z_GYRO_OUT register, then DIN = 0x1800, request the contents of the Z_GYRO_LOW register

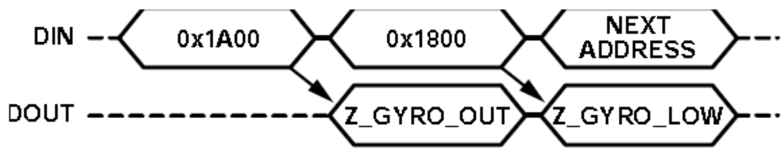


Figure 4-3 SPI read operation example

4.2 UART communication

4.2.1 Data communication protocol

The serial communication protocol is 1 start bit, 8 data bits, 1 stop bit, no parity, baud rate: selectable between 9600 ~ 614400bps (default 614400).

4.2.2 Data frame composition format

The data frame format specified in this article is as follows.

Table 4-3 Common format of data frame

Frame header	Command word	Data length	Data content	check
0x5A,0x5A	1 byte	1 byte	N bytes	1 byte

Command word: 1 byte, range 0x00 ~ 0xFF;

Data length: 1 byte, length of data content, range 0 ~ 250;

Data content: The data content is valid data in the instruction, and the length is specified by the data length;

XOR checkout: XOR sum of all bytes of frame header, command word, data length, data content.

4.2.3 Data instructions

4.2.3.1 Get data command (1-400Hz)

This command is a response type command, which is sent to the product by the host computer.After the product is correctly received, the data is returned.The commands are shown in Table 4-4.

Table 4-4 Get data instruction

Data Frame	Byte number	data	unit	type of data	Remarks
Frame header	0	0x5a			
	1	0x5a			
Command word	2	0x02			
Data length	3	0x00			
Data content		no			
End of frame	4	Checksum			XOR of 0 to 3 bytes

Example: Send the data acquisition instruction to the product:

【0x5a】【0x5a】【0x02】【0x00】【0x02】。

After the product is received, the data is returned.For the format content, see 3.2.3.4.

4.2.3.2 Get status command

This command is a response type command, which is sent to the product by the host computer.After the product is correctly received, it returns to the current state.The command format is shown in Table 4-5.

Table 4-5 Get status command

Data Frame	Byte number	data	unit	type of data	Remarks
Frame header	0	0x5a			
	1	0x5a			
Command word	2	0x03			
Data length	3	0x00			
Data content		no			
End of frame	4	Checksum			XOR of 0 to 3 bytes

Example: Send IMU50 to get status command:

【0x5a】【0x5a】【0x03】【0x00】【0x03】。

After receiving the product, it returns to the current state. For the format, see 4.2.3.5.

4.2.3.3 Baud rate setting

The command is sent to the product by the host computer, and the product immediately responds whether the reception is accurate. The command format is shown in Table 4-6.

Table 4-6 Baud rate setting instructions

Data Frame	Byte number	data	unit	type of data	Remarks
Frame header	0	0x5a			
	1	0x5a			
Command word	2	0x06			
Data length	3	0x01			
Data content	4	0x00：9600 bps 0x01：19200 bps 0x02：38400 bps 0x03：57600 bps			

		0x04：115200 bps 0x05：230400 bps 0x06：460800 bps 0x07：614400 bps			
End of frame	5	Checksum			XOR of 0 to 4 bytes

Example: Send a command to the product to set the baud rate to 9600.

【0x5a】【0x5a】【0x06】【0x01】【0x00】【0x07】。

After the product receives the command to set the baud rate, it immediately returns the response command and writes the configuration to the Flash.The next time the product is powered on again, it is the current configuration baud rate.

4.2.3.4 Data output

This command is issued by the product to the host computer, which is the response after the host computer sends a request to obtain data.The high byte of data transmission is first, and the command format is shown in Table 4-7.

Table 4-7 Data output instructions

Data Frame	Byte number	data	unit	type of data	Remarks
Frame header	0	0x5a			
	1	0x5a			
Command word	2	0x02			
Data length	3	0x28			
Data content	4~7	X-axis gyro	°/s	float	
	8~11	Y-axis gyro	°/s	float	
	12~15	Z-axis gyro	°/s	float	
	16~19	X-axis plus table	g	float	
	20~23	Y-axis plus table	g	float	
	24~27	Z-axis plus table	g	float	

	28~29	Heading	mil	short	LSB: 0.1mil
	30~31	Pitch angle	mil	short	LSB: 0.1mil
	32~33	Roll angle	mil	short	LSB: 0.1mil
	34~35	temperature	℃	short	LSB: 0.1℃
	36~37	Barometer	mbar	short	LSB: 0.04mbar
	38~39	X-axis magnetometer	mgauss	short	LSB: 0.1mgauss
	40~41	Y-axis magnetometer	mgauss	short	LSB: 0.1mgauss
	42~43	Z-axis magnetometer	mgauss	short	LSB: 0.1mgauss
End of frame	44	check			XOR and

4.2.3.5 Status information output

This command is issued by the product to the host computer, which is the response after the host computer sends the request to obtain the status.The command format is shown in Table 4-8.

Table 4-8 Status information output instructions

Data Frame	Byte number	data	unit	type of data	Remarks
Frame header	0	0x5a			
	1	0x5a			
Command word	2	0x03			
Data length	3	0x0c			
	4~7	Identification Number		int	
	8~9	Lever arm size X	0.1m	Short	0.1m
	10~11	Lever arm size Y	0.1m	Short	0.1m
	12~13	Lever arm size Z	0.1m	Short	0.1m
	14	Status indicator			

		Bit0: 0 Heading angle binding succeeded, 1 heading angle binding failed Bit1: 0 The pitch binding is successful, 1 pitch binding fails Bit2: 0 Rolling angle binding is successful, 1 Rolling angle binding fails Bit3: 0 X lever arm binding is successful, 1X lever arm binding fails Bit4: 0 Y-arm binding is successful, 1Y-arm binding fails Bit5: 0 Z-arm binding is successful, 1Z-arm binding fails Bit6: 0 Current magnetic calibration succeeds, 1 Current magnetic calibration fails Bit7: reserved			
error code	15	1: fault; 0: normal			
End of frame	16	check			XOR and

4.2.3.6 Baud rate setting response command

After receiving the baud rate setting command from the host computer, the product immediately returns the response command, see Table 4-9 for details.

Table 4-9 Baud rate setting response command

Data Frame	Byte number	data	unit	type of data	Remarks
Frame header	0	0x5a			
	1	0x5a			
Command word	2	0x06			
Data length	3	0x01			

Data content	4	0x00：9600 bps 0x01：19200 bps 0x02：38400 bps 0x03：57600 bps 0x04：115200 bps 0x05：230400 bps 0x06：460800 bps 0x07：614400 bps			
End of frame	5	Checksum			XOR of 0 to 4 bytes

After the product sends a return command, the new baud rate will take effect immediately, and the configuration will be written to Flash. The next time the product is powered on again, it will be the current configuration baud rate.

5 SPI data register

After the BS-IC24-M-D6EC startup process, the PAGE_ID register value is 0x0000, and page 0 is set as the valid page for SPI access. Page 0 includes output data and product identification registers.

5.1 Inertial sensor data format

The output data registers of the gyroscope, accelerometer, angle change, speed change, and barometer use a 32-bit two's complement format. Each output uses two registers to support this resolution. Figure 5-1 illustrates by example The role of various inertial measurements. In this example, X_GYRO_Out is the most significant word (upper 16 bits) and X_GYRO_Low is the least significant word (lower 16 bits). In many cases, only the most significant word register can provide sufficient resolution Rate to reflect key performance indicators.

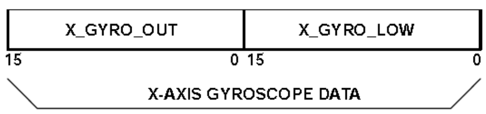


Figure 5-1 Gyro data output example

5.2 Gyroscope

The main registers used for gyroscope measurements use the X_GYRO_Out format (see Table 5-1, Table 5-2, and Table 5-3). When processing the data in these registers, use the 16-bit twos complement data format. Table 5-4 gives An example of X_GYRO_Out digital encoding is given.

Table 5-1 X_GYRO_OUT (page 0, base address = 0x12)

Bit	Explanation
[15:0]	X-axis gyroscope data; two's complement, ± 450 ° / sec range, 0 ° / sec = 0x0000, 1 LSB = 0.02 ° / sec

Table 5-2 Y_GYRO_OUT (page 0, base address = 0x16)

Bit	Explanation
[15:0]	Y-axis gyroscope data; two's complement, ± 450 ° / sec range, 0 ° / sec = 0x0000, 1 LSB = 0.02 ° / sec

Table 5-3 Z_GYRO_OUT (page 0, base address = 0x1A)

Bit	Explanation
[15:0]	Z-axis gyroscope data; two's complement, ± 450 ° / sec range, 0 ° / sec = 0x0000, 1 LSB = 0.02 ° / sec

Table 5-4 X_GYRO_OUT data format example

Spin rate	Decimal	Hex	Binary
+450°/sec	+22,500	0x57E4	0101 0111 1110 0100
+0.04/sec	+2	0x0002	0000 0000 0000 0010
+0.02°/sec	+1	0x0001	0000 0000 0000 0001
0°/sec	0	0x0000	0000 0000 0000 0000
−0.02°/sec	−1	0xFFFF	1111 1111 1111 1111
−0.04°/sec	−2	0xFFFE	1111 1111 1111 1110
−450°/sec	−22,500	0xA81C	1010 1000 0001 1100

Registers using the X_GYRO_Low naming format are used to improve the resolution of gyroscope measurements (see Table 5-5, Table 5-6, and Table 5-7). The weight of MSB is 0.01 ° / sec, and the weight of subsequent bits is the previous ½.

Table 5-5 X_GYRO_LOW (page 0, base address = 0x10)

Bit	Explanation
[15:0]	X-axis gyroscope data; additional resolution bits

Table 5-6 Y_GYRO_LOW (page 0, base address = 0x14)

Bit	Explanation
[15:0]	Y-axis gyroscope data; additional resolution bits

Table 5-7 Z_GYRO_LOW (page 0, base address = 0x18)

Bit	Explanation
[15:0]	Z-axis gyroscope data; additional resolution bits

5.3 Accelerometer

The main registers used for accelerometer measurement use the X_ACCL_OUT format (see Table 5-8, Table 5-9, and Table 5-10). When processing the data in these registers, use the 16-bit twos complement data format. An example of X_ACCL_OUT digital encoding is given.

Table 5-8 X_ACCL_OUT (page 0, base address = 0x1E)

Bit	Explanation
[15:0]	X-axis accelerometer data; two's complement, ± 18 g range, 0 g = 0x0000, 1 LSB = 0.8 mg

Table 5-9 Y_ACCL_OUT (page 0, base address = 0x22)

Bit	Explanation
[15:0]	Y-axis accelerometer data; two's complement, ± 18 g range, 0 g = 0x0000, 1 LSB = 0.8 mg

Table 5-10 Z_ACCL_OUT (page 0, base address = 0x26)

Bit	Explanation
[15:0]	Z-axis accelerometer data; two's complement, ± 18 g range, 0 g = 0x0000, 1 LSB = 0.8 mg

Table 5-11 Example of X_ACCL_OUT data format

Acceleration	Decimal	Hex	Binary
+18g	+22,500	0x57E4	0101 0111 1110 0100
+1.6mg	+2	0x0002	0000 0000 0000 0010
+0.8mg	+1	0x0001	0000 0000 0000 0001
0 mg	0	0x0000	0000 0000 0000 0000
−0.8mg	−1	0xFFFF	1111 1111 1111 1111
−1.6mg	−2	0xFFFE	1111 1111 1111 1110
−18g	−22,500	0xA81C	1010 1000 0001 1100

Registers using the X_ACCL_LOW naming format are used to improve the resolution of accelerometer measurements (see Table 5-12, Table 5-13, and Table 5-14). The weight of the MSB is 0.4 mg, and the weight of subsequent bits is 1/2 of the previous bit.

Table 5-12 X_ACCL_LOW (page 0, base address = 0x1C)

Bit	Explanation

[15:0]	x-axis accelerometer data; additional resolution bits

Table 5-13 Y_ACCL_LOW (page 0, base address = 0x20)

Bit	Explanation
[15:0]	x-axis accelerometer data; additional resolution bits

Table 5-14 Z_ACCL_LOW (page 0, base address = 0x24)

Bit	Explanation
[15:0]	x-axis accelerometer data; additional resolution bits

5.4 Magnetometer

The main registers used for magnetometer measurement use the X_MAGN_OUT format. When processing the data in these registers, the 16-bit twos complement data format is used. Table 5-15, Table 5-16, and Table 5-17 give the number format of each register , Table 5-18 gives X_MAGN_OUT digital coding examples.

Table 5-15 X_MAGN_OUT (page 0, base address = 0x28)

Bit	Explanation
[15:0]	X-axis magnetometer data; two's complement, ± 3.2767 gauss range, 0 gauss = 0x0000, 1 LSB = 0.1 mgauss

Table 5-16 Y_MAGN_OUT (page 0, base address = 0x2A)

Bit	Explanation
[15:0]	Y-axis magnetometer data; two's complement, ± 3.2767 gauss range, 0 gauss = 0x0000, 1 LSB = 0.1 mgauss

Table 5-17 Z_MAGN_OUT (page 0, base address = 0x2C)

Bit	Explanation
[15:0]	Z-axis magnetometer data; two's complement, ± 3.2767 gauss range, 0 gauss = 0x0000, 1 LSB = 0.1 mgauss

Table 5-18 Example of X_MAGN_OUT data format

Magnetic field	Decimal	Hex	Binary
+3.2767 gauss	+32767	0x7FFF	0111 1111 1111 1111
+0.2 mgauss	+2	0x0002	0000 0000 0000 0010
+0.1 mgauss	+1	0x0001	0000 0000 0000 0001
0 gauss	0	0x0000	0000 0000 0000 0000
−0.1 mgauss	−1	0xFFFF	1111 1111 1111 1111
−0.2 mgauss	−2	0xFFFE	1111 1111 1111 1110
−3.2768 gauss	−32768	0x8000	1000 0000 0000 0000

5.5 Barometer

The BAROM_OUT register (see Table 5-19) and the BAROM_LOW register (see Table 5-20) are used to access barometric pressure data. These two registers together form a 32-bit two's complement format. Some applications can only use BAROM_OUT. If BAROM_LOW is required The higher resolution provided is the same as the gyro. The 16-bit twos complement data format is used when processing data from the BAROM_OUT register only. Table 5-21 provides the digital format of BAROM_OUT, table 5-21 An example of numeric encoding is given.

Table 5-19 BAROM_OUT (page 0, base address = 0x30)

Bit	Explanation
[15:0]	Air pressure; two's complement, ± 1.31 bar range, 0 bar = 0x0000, 40 μbar / LSB

Table 5-20 Barom_out data format example

Air pressure (bar)	Decimal	Hex	Binary
+0.00004 × (2^15− 1)	+32767	0x7FFF	0111 1111 1111 1111
+0.00008	+2	0x0002	0000 0000 0000 0010
+0.00004	+1	0x0001	0000 0000 0000 0001
0	0	0x0000	0000 0000 0000 0000
−0.00004	−1	0xFFFF	1111 1111 1111 1111
−0.00008	−2	0xFFFE	1111 1111 1111 1110
−0.00004 × (2^15 − 1)	−32768	0x8000	1000 0000 0000 0000

The BAROM_LOW register is used to improve the resolution of the barometric pressure measurement. The weight of the MSB is 20 _bar, and the weight of subsequent bits is 1/2 of the previous bit.

Table 5-21 BAROM_LOW (page 0, base address = 0x2E)

Bit	Explanation
[15:0]	Air pressure; additional resolution bits

5.6 Internal temperature

The TEMP_OUT register provides internal temperature measurement results for observing the relative temperature change inside the product (see Table 5-22). Table 5-23 gives an example of the digital encoding of TEMP_OUT. Note that this temperature is higher than the ambient temperature due to self-heating effects.

Table 5-22 TEMP_OUT (page 0, base address = 0x0E) bit

Bit	Explanation
[15:0]	Temperature data; two's complement, 0.00565 ° C / LSB, 25 ° C = 0x0000

Table 5-23 temp_out data format example

temperature	Decimal	Hex	Binary
+85	+10,619	0x297B	0010 1001 0111 1011
+25 + 0.0113	+2	0x0002	0000 0000 0000 0010
+25 + 0.00565	+1	0x0001	0000 0000 0000 0001
+25	0	0x0000	0000 0000 0000 0000
+25 − 0.00565	−1	0xFFFF	1111 1111 1111 1111
+25 − 0.0113	−2	0xFFFE	1111 1111 1111 1110
−40	−11504	0xD310	1101 0011 0001 0000

6 Functional testing

6.1 Wiring method

If the user accesses the data through the SPI port, the connection diagram is shown in Figure 6-1.

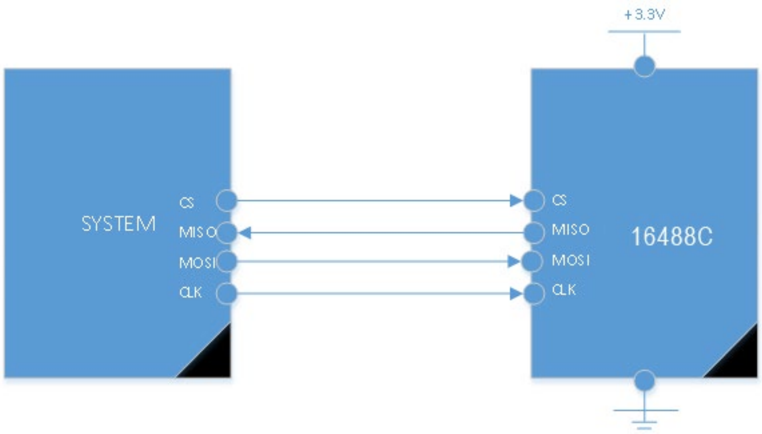


Figure 6-1

If the user can access the data through the UART port, see Figure 6-2 for the connection diagram.

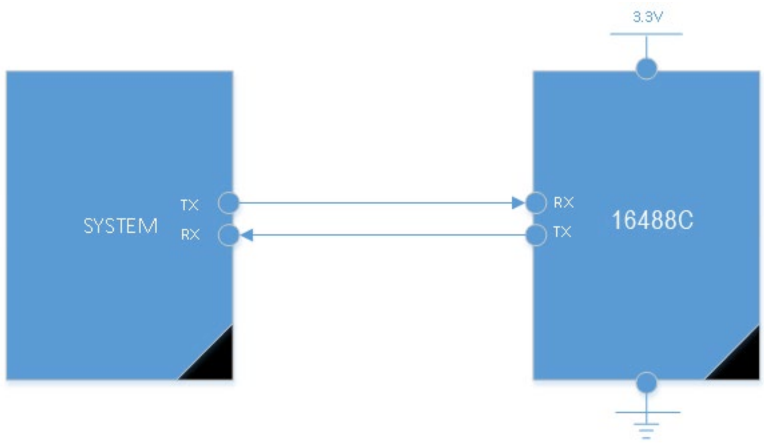


Figure 6-2

6.2 Functional test

The external MCU reads the register data of the BS-IC24-M-D6EC multi-freedom inertial measurement unit through SPI, calculates the parameters of the gyro, accelerometer, magnetic field, and air pressure according to the corresponding method, and verifies the function of the product through various data .

7 Installation and adjustment

The BS-IC24-M-D6EC three-axis gyro combination is installed through four Φ2.4 through holes and is installed with screws. When the connector is installed, the plug should correspond to each pin of the socket, and the product is fixed by screws.

It is recommended that the flatness of the mounting surface opposite to the reference surface is not greater than 0.02mm, the perpendicularity is not greater than 0.04mm, and the surface roughness is not greater than 0.8μm.

8 Operation and maintenance requirements

Before use, the installation position of the system must be checked to ensure correct installation. Carefully check the connection of each signal cable to ensure correct connection.

Before powering on, the values of the cable network contacts and the power supply should be checked, and the polarity of the power supply is prohibited to be reversed.

In use, the system mechanical ground should ensure good grounding.

This product contains precision instruments, and it is forbidden to knock or fall.

This product should be stored in a warehouse with a temperature of (15 ~ 35) ℃, a relative humidity of not more than 75%, and no acid, alkali, corrosive gas, and good ventilation.

Appendix A Packing list

BS-IC24-M-D6EC product matching table

Serial number	Name	Quantity	Unit	Remarks
1	BS-IC24-M-D6EC products	1	Station	
2	Product certification	1	Portion	
3	user's Guide	1	Portion	
4	Packing List	1	Portion	
5	Product box	1	Pc	