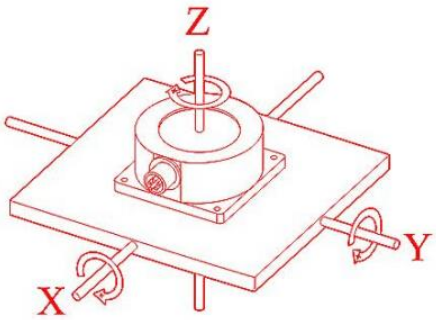
ATO

3D Gyroscope Sensor, Voltage Output User Manual

(Product Specification)

Model: ML720

Description: Voltage Type 3-Axis Gyroscope



Product Performance Indicators

Specification	Conditional	ML720-50	ML720-150	ML720-300	Unit
Range (Rotation Rate)		±50	±150	±300	°/S
Measuring Axial		X、Y、Z（optional）	X、Y、Z（optional）	X、Y、Z（optional）	
Capture Bandwidth		>2000	>2000	>2000	Hz
Resolution		±0.001	±0.001	±0.001	°/S
Nonlinear		0.1% of FS	0.1% of FS	0.1% of FS	
Temp Compensation	-45～85°	All temp zone	All temp zone	All temp zone	
Temp Drift		<±0.1	<±0.15	<±0.2	°/sec
Power-up Time		0.5	0.5	0.5	s
Output Signal	0~5V (0-10V optional), can be simultaneously RS232				
Bias Stability	5°/hr 1σ				
Average Trouble Free Operating Time	≥45000 hour/session				
Impact Resistant	20000g,2ms,1/2sine				
Anti Vibration	10grms、10～1000Hz				
Waterproof Level	IP67				
Cable	Standard 1.5 meter length, abrasion-resistant, oil-resistant, wide temperature, shielded cable 6*0.3mm2				
Weight	180g（Without box）				
Connector	6-pin aviation plug				
EMC	In accordance with EN6100 and GBT17626				

*** The performance parameters are listed as ±50°/S, ±150°/S, ±300°/S for reference only, for other measurement ranges, please refer to the most adjacent parameters.**

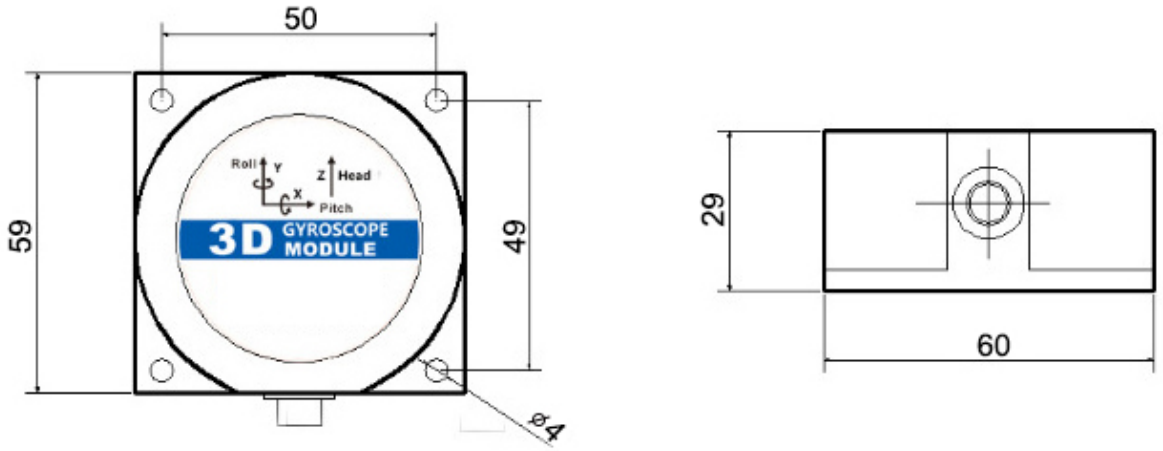
Electrical Specifications

Parameter	Conditional	Minimum Value	Typical Value	Maximum Value	Unit
Supply Voltage		9	12	36	V
Operating Current			35		mA
Output Load	Resistive	10			kΩ
	Capacitive			20	nF
Working Temperature		-40		+85	℃
Storage Temperature		-55		+100	℃

Mechanical Features

Connectors	Lead wire (1.5m)
Protection Cass	IP67
Shell Material	Aluminum alloy sandblasted oxidation
Installation	Four M4 screws

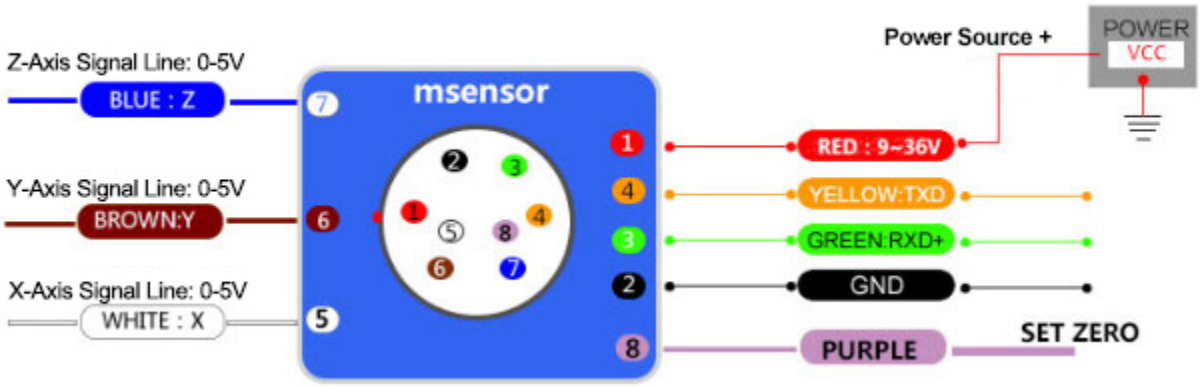
Product Dimension Drawing



Size: 60*59*29MM (L*W*H)

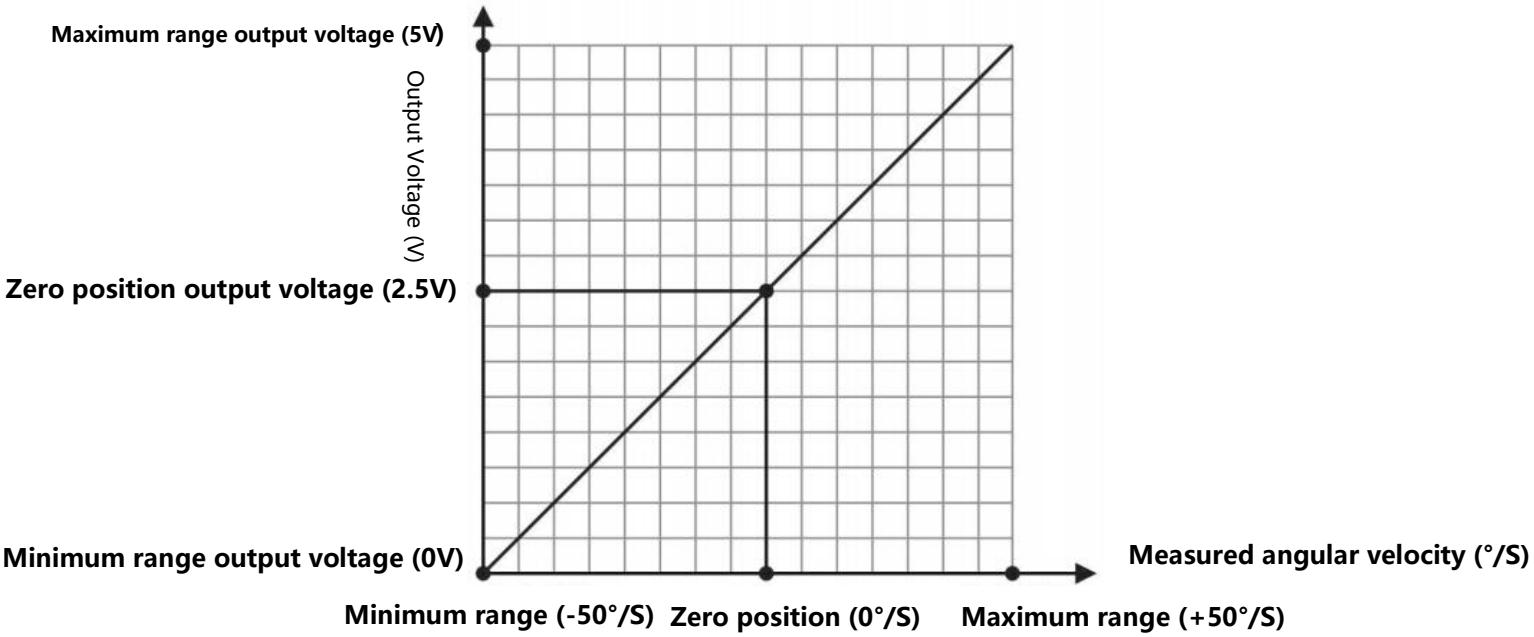
Product Electrical Connection

6-Pin Socket Pin	7-Pin Socket Pin	Lead Wire Color	Single Axis Gyroscope	2 Axis Gyroscope	2 Axis Gyroscope
1	1	RED	VCC	VCC	VCC
2	2	BLACK	GND	GND	GND
3	3	GREEN	RS232 (RX)	RS232 (RX)	RS232 (RX)
4	4	YELLOW	RS232 (TX)	RS232 (TX)	RS232 (TX)
5	5	WHITE	X-axis voltage signal	X-axis voltage signal	X-axis voltage signal
6	6	BROWN	NC	Y-axis voltage signal	Y-axis voltage signal
	7	BLUE	NC	NC	Z-axis voltage signal



ML720 outputs standard voltages of 0~5V and 0~10V, which correspond to the minimum and maximum ranges of angular velocity measurement. When calculating the angular velocity, just press the ratio to get the corresponding angular velocity value:

Example: ML720-1-C (0~5V) (0050): indicates ±50°/S measurement range, 0~5V output voltage



Typical Performance Chart

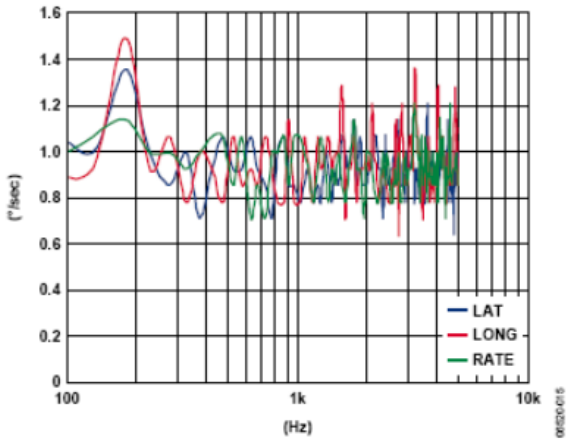


Figure 16. Typical Response to 10 g Sinusoidal Vibration (Sensor Bandwidth = 2 kHz)

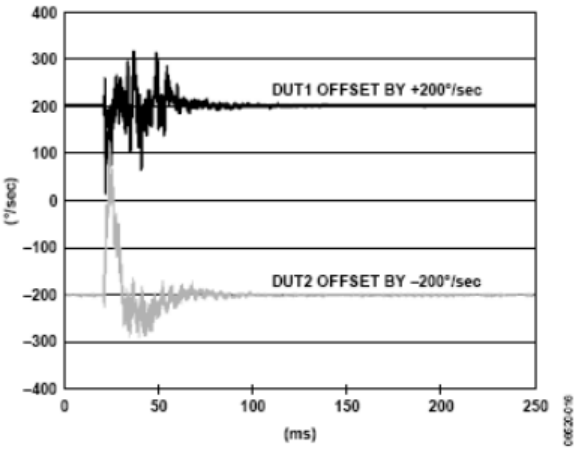


Figure 17. Typical High g (2500 g) Shock Response (Sensor Bandwidth = 40 Hz)

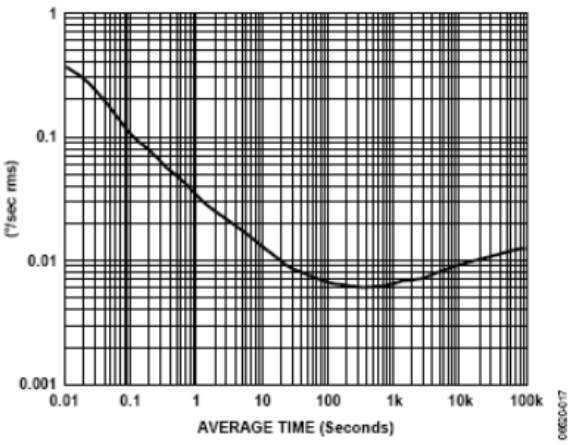


Figure 18. Typical Root Allan Deviation at 25°C vs. Averaging Time

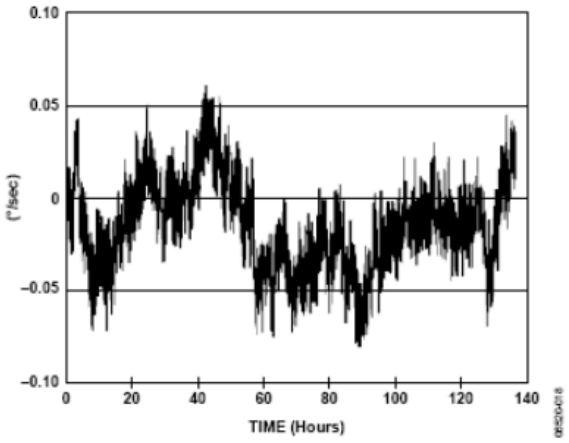


Figure 19. Typical Shift in 90 sec Null Averages Accumulated over 140 Hours

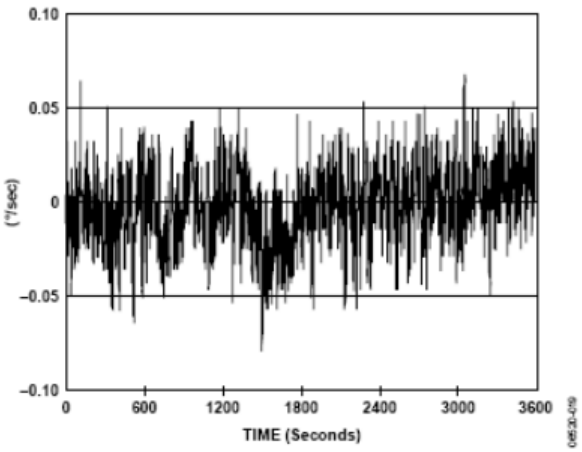


Figure 20. Typical Shift in Short Term Null (Bandwidth = 1 Hz)

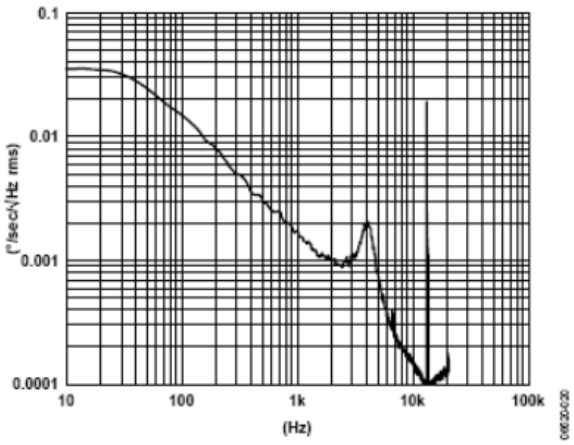
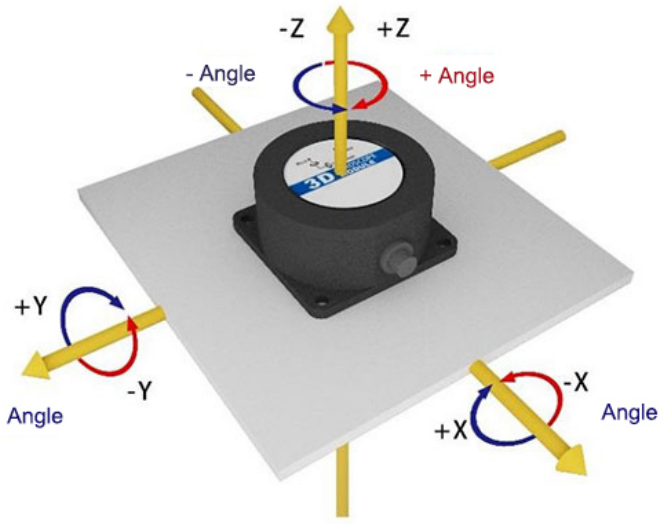


Figure 21. Typical Noise Spectral Density (Bandwidth = 40 Hz)

Measurement Installation



ML720 is mainly used to measure the angular velocity sensor of moving objects, this product has a large working bandwidth, high resolution, small zero drift, high linearity, short start-up time, shock resistance, vibration resistance, low cost, etc. This product is an alternative to ordinary gyroscope. This gyroscope can measure the fastest speed of 1200 degrees / sec, please do not exceed this limit when using, otherwise it will cause measurement overload, which causes large integration error, resulting in large output angular velocity error.

The product has a high cost-effective, small products, the use of non-contact measurement, long-term work is stable and reliable. It has been widely used in automobile, marine, position control and attitude control of moving objects, and other occasions that require precise angle measurement!

Debugging Software

You can download the IMU gyro debugging software for preliminary angle debugging. If you wish to access the gyro sensor directly, you can do so through the gyro communication protocol and the mass version of the serial port debugging assistant, so that the sensor can be easily integrated into your system.

Serial Port: Select the COM port corresponding to the device.
Address: Fill in the current address code of the sensor, the factory default is 00 Baud rate: Select the current baud rate of the sensor, the factory default is 9600 Monitoring: Connect the serial port, click Start, data collection
Setting: Set the functional parameters of the sensor

If you wish to access the sensor directly, you can do so via the sensor's communication protocol so that the sensor can be easily integrated into your system.

1 . Data frame format: (8 data bits, 1 stop bit, no parity, default rate 9600)

Identifier	Data Length	Address Code	Order Word	Data Field	Checksum
(1byte)	(1byte)	(1byte)	(1byte)		(1byte)
0x68					

Data Format: Hexadecimal

Marker: Fixed to 0x68

Data Length: Length from data length to checksum (including checksum)

Address Code: Address of the acquisition module, default is 0x00.

Data Field: The content and length change according to the command word.

Checksum: The sum of data length, address code, command word and data field, not considering rounding (Note: When the command word or data field changes, the checksum will change. When you change the data field, please change the checksum accordingly.)

2. Command Format

2.1 Read PITCH(X) Axis (Angular Velocity)

Send command: 68 04 00 01 05

Identifier	Data Length	Address Code	Order Word	Data Field	Checksum
(1byte)	(1byte)	(1byte)	(1byte)	(0byte)	(1byte)
0x68			0x01		

Answer command:

Identifier	Data Length	Address Code	Order Word	Data Field	Checksum
(1byte)	(1byte)	(1byte)	(1byte)	(3byte)	(1byte)
0x68			0x81	SXXX.YY	

Note: The data field is a 3-byte return angular velocity value, compressed BCD code, S is the sign bit (0 positive, 1 negative), XXX is a two-digit integer value, YY is a two-digit decimal value. Other axis data are the same as this. For example, 10 26 87 means -26.87°/S.

2.2 Reading ROLL (Y) Axis (Angular Velocity)

Send command: 68 04 00 02 06

Identifier	Data Length	Address Code	Order Word	Data Field	Checksum
(1byte)	(1byte)	(1byte)	(1byte)	(0byte)	(1byte)
0x68			0x02		

Answer the command:

Identifier	Data Length	Address Code	Order Word	Data Field	Checksum
(1byte)	(1byte)	(1byte)	(1byte)	(3byte)	(1byte)
0x68			0x82	SXXX.YY	

2.3 Reading HEADING (Z) Axis (Angular Velocity)

Send command: 68 04 00 03 07

Identifier	Data Length	Address Code	Order Word	Data Field	Checksum
(1byte)	(1byte)	(1byte)	(1byte)	(0byte)	(1byte)
0x68			0x03		

Answer the command:

Identifier	Data Length	Address Code	Order Word	Data Field	Checksum
(1byte)	(1byte)	(1byte)	(1byte)	(3byte)	(1byte)
0x68			0x83	SXXX.YY	

2.4 Reading PITCH (X), ROLL (Y), and HEADING (Z) Axis Angular Velocity

Send command: 68 04 00 04 08

Identifier	Data Length	Address Code	Order Word	Data Field	Checksum
(1byte)	(1byte)	(1byte)	(1byte)	(0byte)	(1byte)
0x68			0x04		

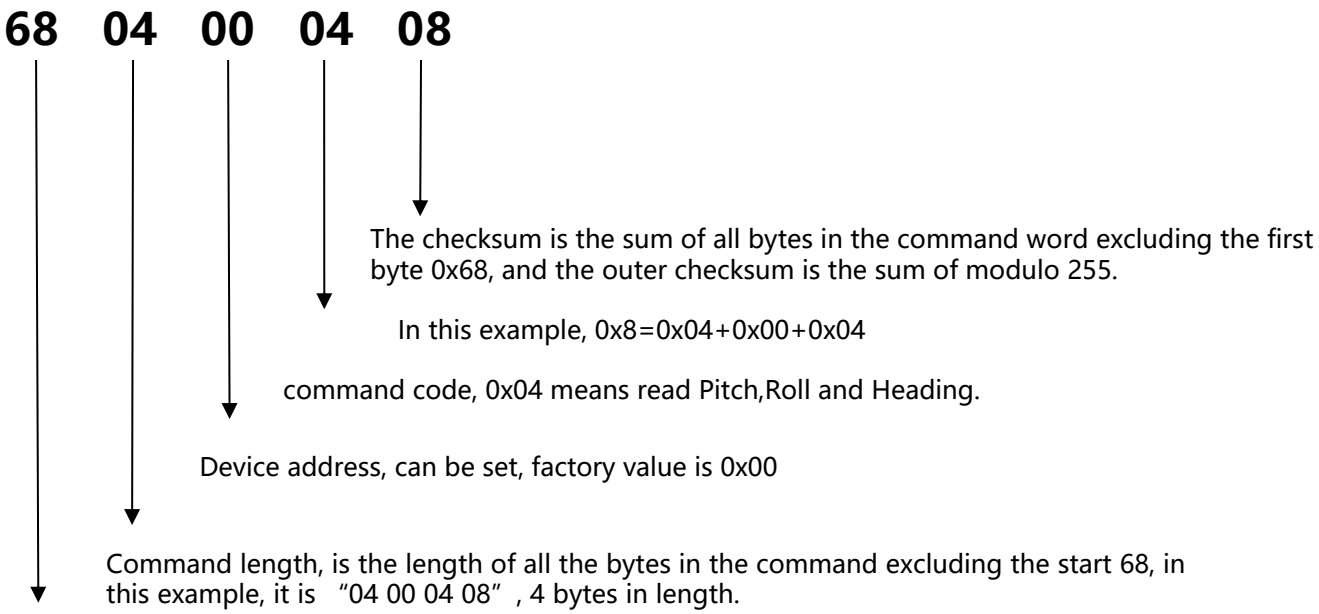
Answer the command:

Identifier	Data Length	Address Code	Order Word	Data Field	Checksum
(1byte)	(1byte)	(1byte)	(1byte)	(9byte)	(1byte)
0x68			0x84		

Note: * The data field contains 9 bytes for X-axis (Pitch), Y-axis (Roll) and Z-axis (Heading) angular velocity values, which are compressed BCD code, and every three bytes are a group, for example, the return command is 68 0D 00 84 10 26 80 00 33 65 03 13 71 66, in which the Pitch is 10 26 80, the Roll is 00 33 65, the Heading is 03 13 71. For the three bytes of each angular velocity return value, the format is SX XX. YY, S is the sign bit (0 positive, 1 negative) XXX is a three-digit integer value, and YY is a decimal value.

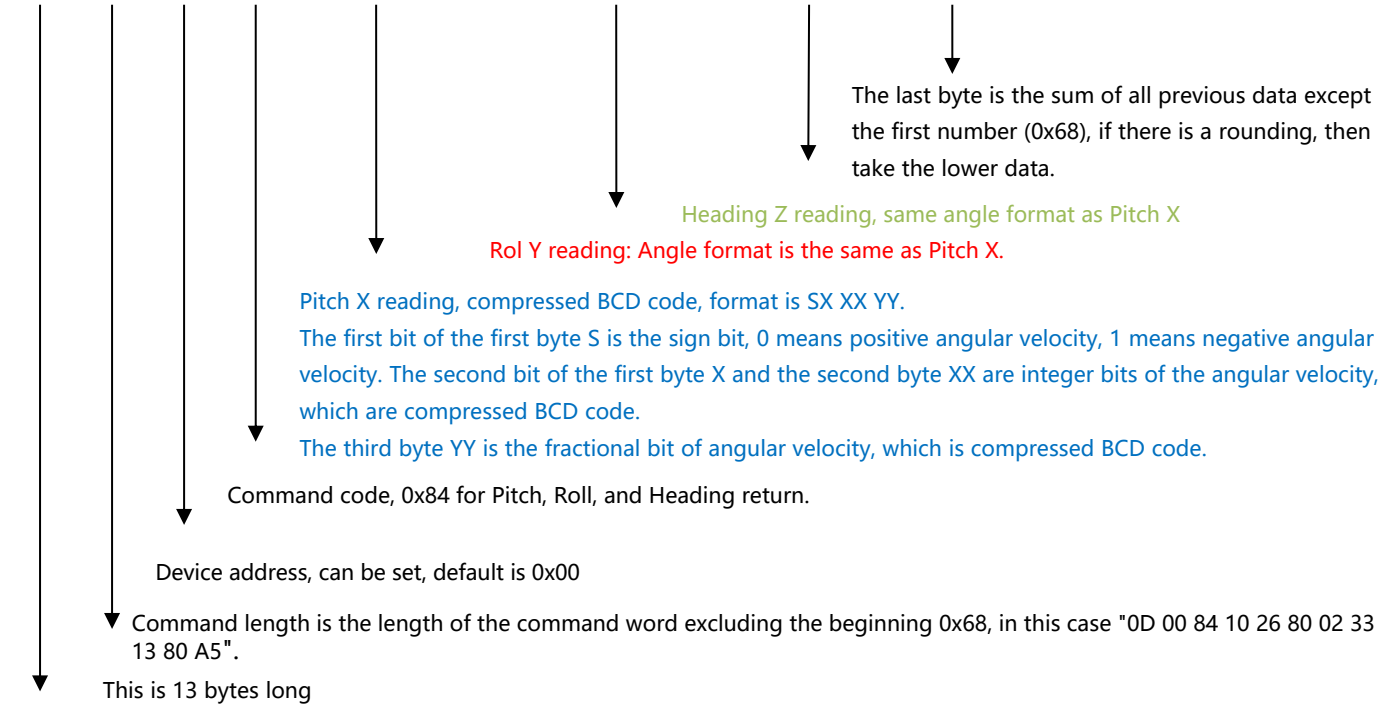
The corresponding three angular velocity readings for this example are: -26.8°/S, 33.65°/S, and 313.71°/S.

Example: The send and return commands for reading all **Pitch (X), Roll (Y) and Heading (Z) axes** are as follows:



The corresponding three angular velocity readings for this example are -26.8°/S， 33.65°/S， 313.71°/S

68 0D 00 84 10 26 80 00 33 65 03 13 71 66



2.5 Setting the Communication Rate

Send command: 68 05 00 0B 03 13

Identifier	Data Length	Address Code	Order Word	Data Field	Checksum
(1byte)	(1byte)	(1byte)	(1byte)	(1byte)	(1byte)
0x68			0x0B		

Answer the command:

Identifier	Data Length	Address Code	Order Word	Data Field	Checksum
(1byte)	(1byte)	(1byte)	(1byte)	(1byte)	(1byte)
0x68			0x8B	0x00: successful setup 0xFF: failure setup	

Note:* Baud rate: 0x00 means 2400; 0x01 means 4800; 0x02 means 9600; 0x03 means 19200; 0x04 means 115200; 0x05 means 14400; 0x06 means 38400; 0x07 means 57600, and **the default value is 0X02: 9600**, if you set the baud rate to 19200, the command is 68 05 00 0B 03 13, where 13 =05+ 00+ 0B+ 03, and so on when setting other baud rates. If the baud rate is set to 19200, the command is 68 05 00 0B 03 13, where 13=05+ 00+0B+0_, and so on when setting other baud rates.

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Note: After setting the baud rate, the device will return the answer command with the original baud rate, after which the baud rate setting will take effect, and the host computer needs to change the baud rate accordingly in order to communicate with the device again.

2.6 Setting the Angular Velocity Output Mode

Send command: 68 05 00 0C 00 11

Identifier	Data Length	Address Code	Order Word	Data Field	Checksum
(1byte)	(1byte)	(1byte)	(1byte)	(1byte)	(1byte)
0x68			0x0C	0x00: question and answer style 0x01: 5Hz Data Rate 0x02: 15Hz Data Rate 0x03: 25Hz Data Rate 0x04: 35Hz Data Rate 0x05: 50Hz Data Rate	

*The default output mode is 00. If the device is in non-answer mode, there will be an idle time of 10s without sending data after each power restart, and after 10s, it will start to output data continuously.

Answer the command:

Identifier	Data Length	Address Code	Order Word	Data Field	Checksum
(1byte)	(1byte)	(1byte)	(1byte)	(1byte)	(1byte)
0x68			0x8C	0x00: successful setup 0xFF: failure setup	

Note: 5Hz Data Rate means that data is automatically output 5 times per second, and so on. When you use the product with RS485 interface, because the 485 interface works in half-duplex, the product may not be able to receive the incoming commands efficiently when the product automatically outputs data outward. In this case, you may need to repeat the command several times before the product receives it. Therefore, if you need to send commands to interact with the product during the use of the 485 interface product, it is recommended to set the product to work in the Q&A mode. In addition, when the product is set to Auto Output Mode, there will be no output for 10 seconds after the product is powered on, and then the product can effectively receive external setup commands.

2.7 Setting the Module Address

Send command: 68 05 00 0F 01 15

Identifier	Data Length	Address Code	Order Word	Data Field	Checksum
(1byte)	(1byte)	(1byte)	(1byte)	(1byte)	(1byte)
0x68			0x0F	XX module address	

Note: The default address of the sensor is 00

Answer the command:

Identifier	Data Length	Address Code	Order Word	Data Field	Checksum
(1byte)	(1byte)	(1byte)	(1byte)	(1byte)	(1byte)
0x68			0x8F	0x00: successful setup 0xFF: failure setup	

1. If multiple sensors are connected to a bus at the same time, such as RS485, each sensor needs to be set to a different address to achieve separate control and response speed.
2. If the new address is successfully changed, all subsequent commands and address codes in the response packet are changed to the changed new address code in order to take effect, otherwise the sensor will not respond to the command.
3. XX Module addresses range from 00 to EF.

2.8 Query Module Address

Send command: 68 04 00 1F

Identifier	Data Length	Address Code	Order Word	Data Field	Checksum
(1byte)	(1byte)	(1byte)	(1byte)	(0byte)	(0byte)
68	04	00	1F		

Note: The query module address does not take into account the parity bit

Answer the command:

Identifier	Data Length	Address Code	Order Word	Data Field	Checksum
(1byte)	(1byte)	(1byte)	(1byte)	(1byte)	(1byte)
0x68			0x1F		

2.9 update flash (save settings)

Send command: 68 04 00 0A 0E

Identifier	Data Length	Address Code	Order Word	Data Field	Checksum
(1byte)	(1byte)	(1byte)	(1byte)	(0byte)	(1byte)
0x68			0x0A		

Answer the command:

Identifier	Data Length	Address Code	Order Word	Data Field	Checksum
(1byte)	(1byte)	(1byte)	(1byte)	(1byte)	(1byte)
0x68			0x8A	0x00: successful setup 0xFF: failure setup	

*For various parameter settings, if you do not send the Save Settings command after the settings are completed, the settings will be lost after the power is turned off.