

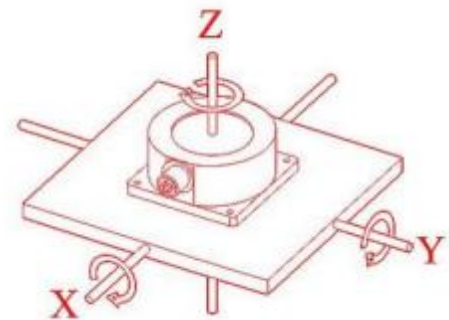
3D Gyroscope Sensor, Analog Output User Manual



(Product Specification)

Model: ML7200

Description: Analog Output 3-Axis Gyroscope



Product Performance Indicators

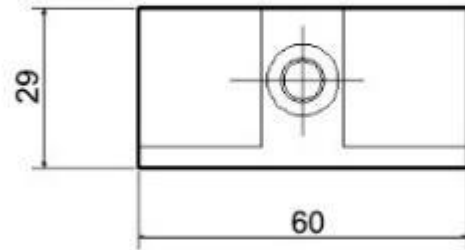
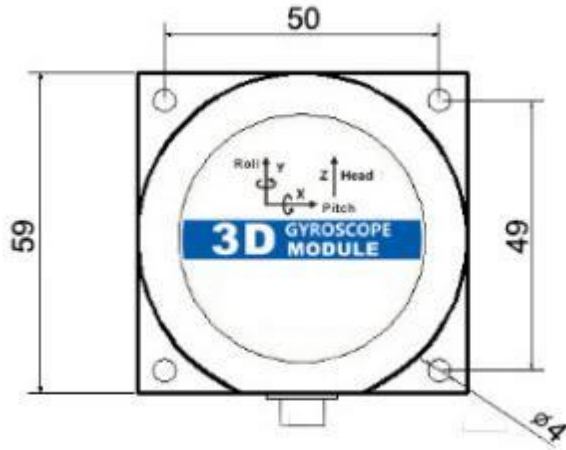
Parameters	ML7200-1-A	ML7200-1-B	ML7200-1-C
Measurement Axis	X、Y、Z (optional)	X、Y、Z (optional)	X、Y、Z (optional)
Acquisition Band Width	>1000Hz	>1000Hz	>1000Hz
Resolution	±0.1°/S	±0.1°/S	±0.1°/S
Non-linearity	0.1% of FS	0.1% of FS	0.1% of FS
Temperature Compensation	All temp zone: -45 ~ 85°	All temp zone: -45 ~ 85°	All temp zone: -45 ~ 85°
Temperature Drift	<±0.2°/sec indoor temp	<±0.2°/sec indoor temp	<±0.2°/sec indoor temp
Power-on Start-up Time	0.5s	0.5s	0.5s
Operating Voltage	9~36V		
Operating Current	50mA		
Output Signal	0~5V、0~10V、0~20mA、4~20mA (optional)		
MTBF	≥45000 hour/session		
Operating Time	20000g, 2ms, 1/2sine		
Anti-shock	10grms、10 ~ 1000Hz		
Anti-vibration	IP67		
Waterproof Grade	Standard 1.5 meters length, wear-resistant, oil-resistant, wide temperature, shielded cable 6*0.3mm ²		
Cable	180g (excluding box)		
Weight	6-pin aviation plug		
Connector	1000		

Electrical Specifications

Parameter	Condition	Minimum Value	Typical Value	Maximum Value	Unit
Supply Voltage		9	12	36	V
Working Current			35		mA
Output Load	Voltage Output	Resistive	0	500	kΩ
	Current Output	Resistive	10		kΩ
		Capacitive			20
Working Temperature		-40		+85	°C
Storage Temperature		-55		+100	°C

Mechanical Features

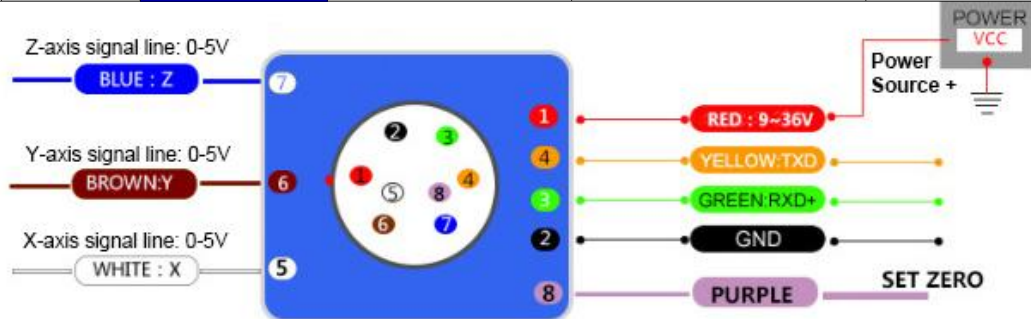
Connector	Lead wire (1.5m)
Protection Class	IP67
Housing Material	Aluminum alloy with matte oxidation
Mounting	Four M4 screws



Size: L60*W59*H29MM

Product Electrical Connection

6-Pin Socket Pin	7-Pin Socket Pin	Lead Wire Color	1-axis Gyro	2-axis Gyro	3-axis Gyro
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 analog signal	X-axis analog signal	X-axis analog signal
6	6	BROWN	NC	Y-axis analog signal	Y-axis analog signal
	7	BLUE	NC	NC	Z-axis analog signal



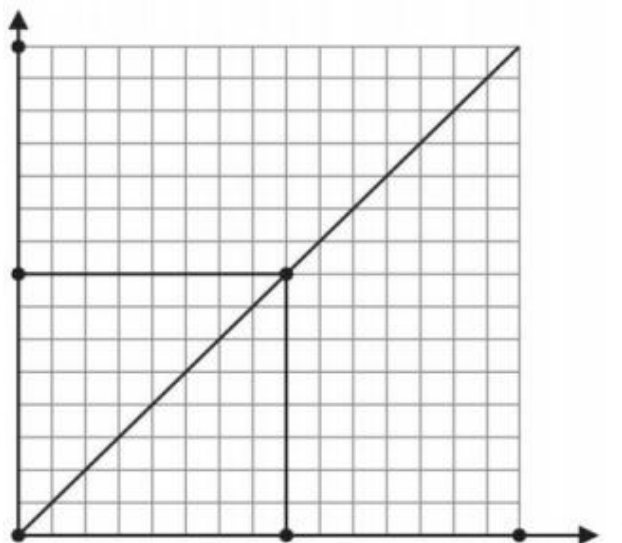
ML7200 outputs standard voltage 0~5V, 0~10V, standard current 4~20mA, 0~20mA corresponding to the minimum range and maximum range of angle measurement. When calculating the angle, just press the ratio to get the corresponding angle value: **Example:** ML7200-1-C (0~5V): Indicates Z-axis, 0~5V output voltage.

Max. range output voltage (5V)

Output Voltage (V)

Middle position output voltage (2.5V)

Min. range output voltage (0V)

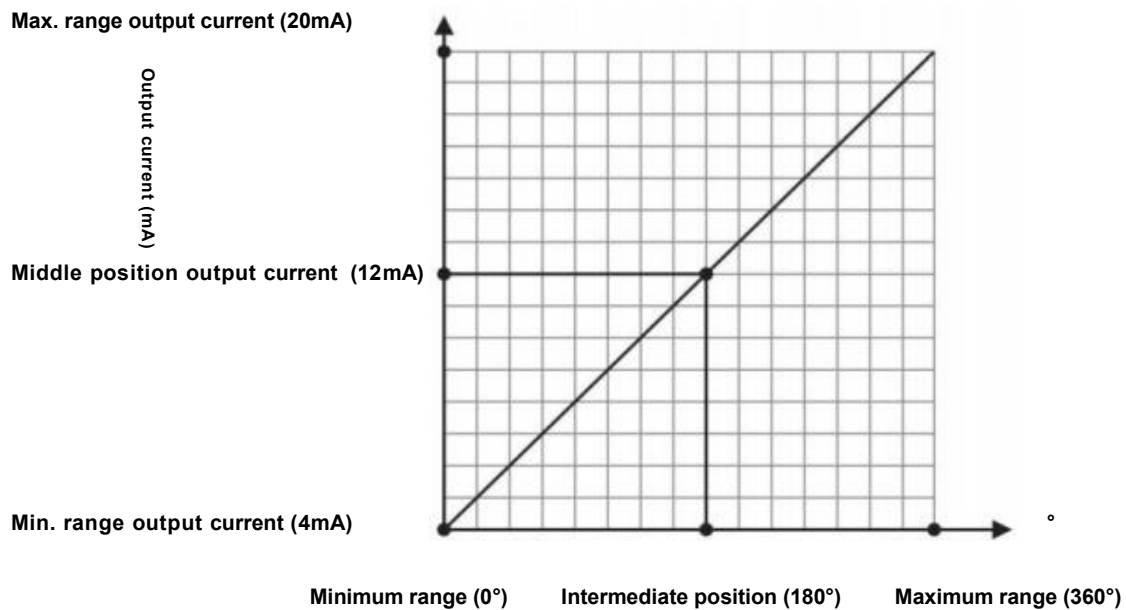


Minimum range (0°)

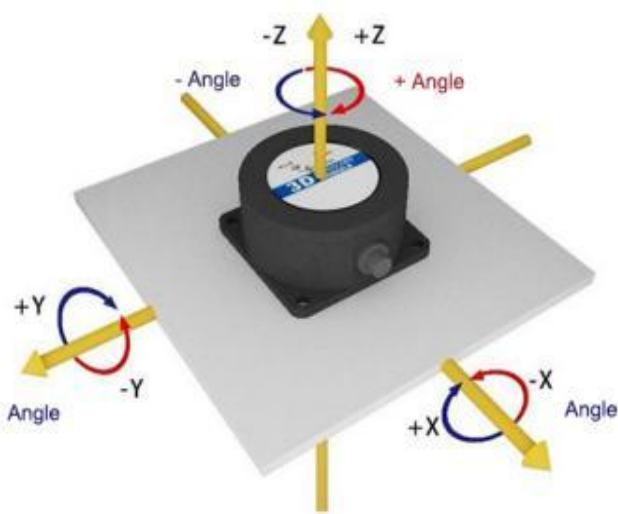
Intermediate position (180°)

Maximum range (360°)

Example: ML7200-1-C (4~20mA): Indicates Z-axis , 4~20mA output current



Measurement Installation



ML7200 is mainly used to measure the yaw angle of moving objects, this product is not affected by magnetic field interference, so it can measure the yaw angle normally in the magnetic field area, just set the zero-deviation angle you want to need, it can replace the function of the electronic compass, but not affected by magnetic field. The fastest rotational speed that can be measured by the tachometer is 300 degrees/second, please do not exceed this limit when using the tachometer, otherwise it will cause measurement overload, which will cause large integration error and lead to large output angle error. Now it is widely used in automobile, navigation, position control and attitude control of moving objects, and other occasions that need precise angle measurement!

Debugging Software

You can download the IMU gyro debugging software from the ATO website for initial angle debugging. If you wish to access the gyro sensor directly, you can do so through the gyro's communication protocol and the popular Serial Debugging Assistant, which makes it easy to integrate the sensor into your system.

Serial Port: Select the COM port corresponding to the device.

Address: Fill in the current address of the sensor, the factory default is 00.

Baud Rate: Select the current baud rate of the sensor, the factory default is 9600.

Monitor: Connect the serial port and click Start to collect data.

Setting: Set the functional parameters of the sensor.

If you wish to access the gyrometer directly, you can do so via the gyrometer's communication protocol, 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: 16 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 contents and length vary according to the command word.

Checksum: The sum of data length, address code, command word and data field without 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 Angle

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 the 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 angle value in compressed BCD code, S is the sign bit (0 positive, 1 negative), XXX is a two-bit integer value, and YY is a two-bit decimal value. Other axis data are the same as this. For example, 10 26 87 means -26.87°.

2.2 Read ROLL (Y) Axis Angle

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 Read HEADING (Z) Axis Angle

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 Read PITCH (X), ROLL (Y) and HEADING (Z) Axis Angles

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) angle values, which are compressed BCD code, and every three bytes are a group, e.g., the return command is 68 0D 00 84 10 26 80 00 33 65 03 13 71 66, in which Pitch is 10 26 80, Roll is 00 33 65, Heading is 03 13 71.

For the three bytes of each angle return value, the format is SX XX. YY, S is sign bit (0 positive, 1 negative) XXX is three integer values, YY is decimal value.

The corresponding three angle readings for this example are: -26.8°, 33.65°, 313.71°.

Example: The send and return commands to read all Pitch, Roll and Heading are as follows:

68 04 00 04 08



The checksum is the sum of all bytes in the command word excluding the first byte 0x68, and the outer checksum is the sum of modulo 255.

In this example $0x8=0x04+0x00+0x04$

Command code, 0x04 means read Pitch, Roll and Heading.

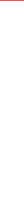
Device address, can be set, factory value is 0x00

Command length is the length of all the bytes in the command excluding the start 68, in this example, it is "04 00 04 08" , 4 bytes in length.

Command header, all send and return commands start with a fixed 0x68.

The corresponding three angle readings for this example are: **-26.8°**, **33.65°**, and **313.71°**.

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



The last byte is the sum of all previous data except the first number (0x68), if there is a rounding, take the lower data.

Heading reading, same angle format as Pitch

Roll readout: Same angle format as Pitch

Pitch reading, compressed BCD code, format SX XX YY:

First bit of the first byte S is the sign bit, 0 means positive angle, 1 means negative angle.

Second bit of the first byte X and the second byte XX are the integer bits of the angle, which is the compressed BCD code.

Third byte YY is the fractional digit of the angle, which is the compressed BCD code.

Command code, 0x84 for Pitch, Roll, and Heading return.

Device address, can be set, default is 0x00

Command length is the length of the command word excluding the beginning 0x68, in this example, " 0D 00 84 10 26 80 02 33 65 31 13 80 A5 " is 13 bytes long.

Command header, all send and return commands are fixed at 0x68.

2.5 HEADING (Z) Axis Angle Drift Elimination

Send command: 68 04 00 3E 42

Identifier	Data Length	Address Code	Order Word	Data Field	Checksum
(1byte)	(1byte)	(1byte)	(1byte)	(0byte)	(1byte)
0x68	04		0x3E		

Answer the command:

Identifier	Data Length	Address Code	Order Word	Data Field	Checksum
(1byte)	(1byte)	(1byte)	(1byte)	(1byte)	(1byte)
0x68	05		0x6E	0x00: successes 0xFF: fail	

*If the output angle value is drifting, use this command to eliminate it. The initial state of Z-axis is reset to zero, and the instrument must be set at a standstill when sending this command. It is prohibited to use this function when the instrument is rotating.

2.6 Set X, Y Axis Relative/Absolute Zero Points

Send command: 68 05 00 05 00 0A

Identifier	Data Length	Address Code	Order Word	Data Field	Checksum
(1byte)	(1byte)	(1byte)	(1byte)	(1byte)	(1byte)
0x68			0x05	0x00: Absolute 0 0x01: Relative 0	

Answer the command:

Identifier	Data Length	Address Code	Order Word	Data Field	Checksum
(1byte)	(1byte)	(1byte)	(1byte)	(1byte)	(1byte)
0x68			0x85	0x00: successes 0xFF: fail	

Note: If absolute zero is set, the measurement angle will be based on the factory-set zero point. If set to relative zero, the measurement angle is based on the current position as the zero reference. This function is the same as grounding the gray output line.

2.7 Query Relative/Absolute Zero

Send command: 68 04 00 0D 11

Identifier	Data Length	Address Code	Order Word	Data Field	Checksum
(1byte)	(1byte)	(1byte)	(1byte)	(0byte)	(1byte)
0x68			0x0D		

Answer the command:

Identifier	Data Length	Address Code	Order Word	Data Field	Checksum
(1byte)	(1byte)	(1byte)	(1byte)	(1byte)	(1byte)
0x68			0x8D	0x00: Absolute 0 0xFF: Relative 0	

2.8 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: successes 0xFF: fail	

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

2.9 Setting the Angle 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: Q&A 0x01: 5Hz Data Rate 0x02: 15Hz Data Rate 0x03: 25Hz Data Rate 0x04: 35Hz Data Rate 0x05: 50Hz Data Rate	

*Default output mode is 00, if the device is in non-answer mode, there will be an idle time of 10s after each power restart without transmitting data, 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: successes 0xFF: fail	

Note: 5Hz Data Rate means that the product automatically outputs data 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 it outputs data automatically. 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 while **using the 485 interface**, it is recommended that you set the product to work in **the Question and Answer 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.

2.10 Setting 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: successes 0xFF: fail	

1. If multiple sensors are connected to a bus at the same time, e.g. RS485, each sensor must be set to a different address to achieve separate control and response speeds.
2. If the new address is successfully changed, all subsequent commands and response packets must be changed to the new address to take effect, otherwise the sensor will not respond to the command.
3. The XX module addresses range from 00 to EF.

2.11 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		

2.12 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)	(1byte)	(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: successes 0xFF: fail	

*If the save setting command is not sent after the setting is completed, the settings will be lost when the power is turned off.