

PRODUCT MODBUS PROTOCOL

Note: Please read the following items carefully before use:

- 1) MODBUS protocol stipulates that it should be over 3.5 byte time between two data frame(Eg. Under 9600 baud rate, the time is $3.5 \times (1/9600) \times 11 = 0.004s$). This sensor increase the time to 10ms for a enough margin, so please set 10ms time interval at least between each data frame.
Host send command--10ms interval--slave response command--10ms time interval--host send command...
- 2) MODBUS protocol stipulates broadcast address--content relate to 0. This sensor also capable of receiving broadcast address content but without response. So broadcast address 0 could be used as(below is reference only):
 1. Set all the addresses of inclinometers mounted on BUS with this Model NO as one address.
 2. Set all the inclinometers mounted on BUS with this Model NO to be relative/absolute zero.
 3. Test all inclinometers mounted on BUS. Host inquires angle command by sending
- 3) 0 address to BUS, if the communication light flashes, then communication is in proper function.
- 4) for sake of system reliability, when set address and relative/absolute command, it should be send two times continuously, which means two successful sending with continuous responses by slave, that is no data frame between the two inquiries, or the command will be locked till power off. Set as below:
Send set address command--stand by for slave response set success command--send again set address command(no other command between)--stand by for slave response set success command--successful revision
After power-up, two set commands mentioned above could be only set once, if need reset, please set after power on again.
- 5) the communication light will flash once when proper communications accumulate to a certain times.

1. Data frames format:

RTU Mode : Communication Parameter:Baud rate 9600 bps.

Data frames:1 Start bit,8 datas,even parity check,1 stop bit.

2. Read angle data:(Modbus FUNC 03H.)

Host Computer Inquiry Command		Slave Computer Response	
Inclinometer Add	01H	Inclinometer Add	01H
FUNC	03H	FUNC	03H
Visit Register first Address	00H	Data Length	08H
	02H	Data word 1,high bits	50H
Data Length 4 bytes	00H	Data word 1,lower bits	46H
	04H	Data word 2,high bits	00H
CRC	E5C9H	Data word 2,lower bits	00H
		Data word 3,high bits	23H
		Data word 3,lower bits	20H
		Data word 4,high bits	00H
		Data word 4,lower bits	00H
		CRC	BD61H

Read the measured data command applicaton example

Host computer sending 01H 03H 00H 02H 00H 04H E5H C9H
Slave computer response

01H 03H 08H 50H 46H 00H 00H 23H 20H 00H 00H BDH 61H

Note:Slave computer response data domain of the frames is 50H,46H,00H,00H,23H,20H,00H,00H

The X axis is the 1-4th byte of the data field, the Y axis is the 5th-8th byte of the data field, and the low byte is first. The representation of the angle is the point number representation. One point corresponds to 0.01°, and 0.01×(point-offset) is the angle. If the measurement range is ±90°, the total number of points is 18000 points, so 0 corresponds to -90°, 18000 corresponds to +90°, 9000 corresponds to 0°.

Take the above data frame as an example: the angle conversion process is as follows:

- 1) Get the current angle points, the low byte is first, the X axis is 4650H, and the Y axis is 2023H.
- 2) Convert to decimal, X axis: 4650H → 180000, Y axis: 2023H → 8227.
- 3) Subtract the offset 9000 (note: this value is an amount related to the measurement range), X-axis: 18000-9000 = 9000, Y-axis: 8227-9000 = -773.
- 4) Get the final angle, X axis: $9000 \times 0.01 = 90.00^\circ$, Y axis: $-773 \times 0.01 = -7.73^\circ$.

Read the measured data command applicaton example

Host computer sending 01H 03H 00H 02H 00H 04H E5H C9H
Slave computer response

01H 03H 08H 00H 00H 00H 00H 23H 00H 00H 64H 1DH

Assuming that the sensor of this example has a measurement range of ±45 degrees, the total number of points is 9000 points. Therefore, 0 corresponds to -45°, 9000 corresponds to +45°, and 4500 corresponds to 0°. The angle conversion process is as follows:

- 1) Get the current angle points, the low byte is first, the X axis is 0000H, and the Y axis is 2300H.
- 2) Convert to decimal, X axis: 0000H → 0, Y axis: 2300H → 8960.
- 3) Subtract the offset 4500 (note: this value is an amount related to the measurement range), X-axis: 0-4500 = -4500, Y-axis: 8960-4500 = 4460.
- 4) Get the final angle, X-axis: $-4500 \times 0.01 = -45.00^\circ$, Y-axis: $4460 \times 0.01 = 44.60^\circ$.

3. Setting inclinometer relative/absolute ZERO:Modbus FUNC 06H

Setting relative/absolute ZERO command		Slave Computer Response	
Inclinometer Add	01H	Inclinometer Add	01H
FUNC	06H	FUNC	06H

Access register first address		Access register first address	
	00H		00H
	10H		10H
Word nonzero is relative ZERO, word ZERO is absolute ZERO	00H	Word nonzero is relative ZERO, word ZERO is absolute ZERO	00H
	FFH/00H Relative/Absolute		FFH/00H Relative/Absolute
CRC	C84FH/880FH	CRC	C84FH/880FH

Read the measured data command applicaton example

Host computer sending 01H 06H 00H 10H 00H FFH C8H 4FH
Slave computer response

01H 06H 00H 10H 00H FFH C8H 4FH

Note:0010 is register address,the register control inclinometer output is relative ZERO or absolute ZERO.If nonzero(As example as above,was written in 00FFH),the output is relative ZERO.On contrary if zero(will change the fifth and sixth bytes to 00H),then is absolute ZERO,the last two bytes is CRC checksum .

4. Setting inclinometer address:

Setting inclinometer add code command		Slave computer response	
Inclinometer Add	01H	Inclinometer Add	01H
FUNC	06H	FUNC	06H
Access register first address	00H	Access register first address	00H
	11H		11H
Inclinometer New Add	00H	Inclinometer New Add	00H
	04H		04H
CRC	D80C	CRC	D80C

Read the measured data command applicaton example

Host computer sending 01H 06H 00H 11H 00H 04H D8H 0CH
Slave computer response

01H 06H 00H 11H 00H 04H D8H 0CH

Note:0011H is register address,the register control inclinometer address.Above example,the inclinometer address is changed to 0004H, the last two bytes is CRC checksum.

5.Set the sensor communication character format:

Set sensor communication character		Slave Computer Response	
Inclinometer Add	01H	Inclinometer Add	01H
FUNC	06H	FUNC	06H
Access register first address	00H	Access register first address	00H
	09H		09H
Sensor change communication character format	00H	Sensor change communication character format	00H
	01/00H		01/00H
CRC	9800/59C8	CRC	9800/59C8

Set sensor communication character format

Host computer sending 01H 06H 00H 09H 00H 01H 98H 08H
Slave computer response

01H 06H 00H 09H 00H 01H 98H 08H

The above example sets the byte format to: 1 start bit + 8 data bits, no parity, + 1 stop bit; it will be valid after power-on. The factory default is 1 start bit + 8 data bits, even parity check + 1 stop bit;

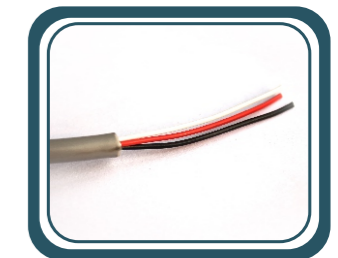
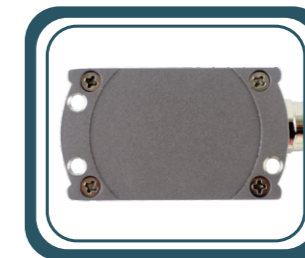
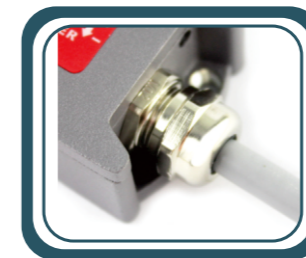
Note: 0009 is the register address, this register controls the character format of sensor communication,

000H: One start bit + 8 data bits, even parity +1 stop bit,

001H: one start bit + 8 data bits without parity +1 stop bit.



CE CERTIFICATION: ATSAZHE181129003
APPEARANCE PATENT : ZL 201830752891.5



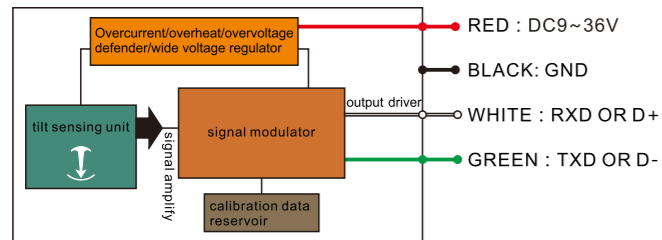
DESCRIPTION

MCA416&426M series inclinometer is a new low-cost full attitude tilt angle measurement product independently developed by RION. Adopting the latest anti-interference platform design, integrating new micro-mechanical sensing unit, wide temperature working performance, excellent anti-vibration performance, stable and reliable long-term work, and effective working life of up to 10 years. This product uses a non-contact principle to measure the tilt angle of an object, and calculates the real-time tilt angle by measuring the component produced by the earth's gravity through an internal capacitive micromechanical unit. The installation is simple and convenient, and it only needs to be fixed on the object to be tested, and does not need to fix the shaft and the rotating shaft. A variety of installation methods to meet customer measurement needs. It is an ideal accessory for engineering machinery, agricultural machinery, and other industrial equipment.

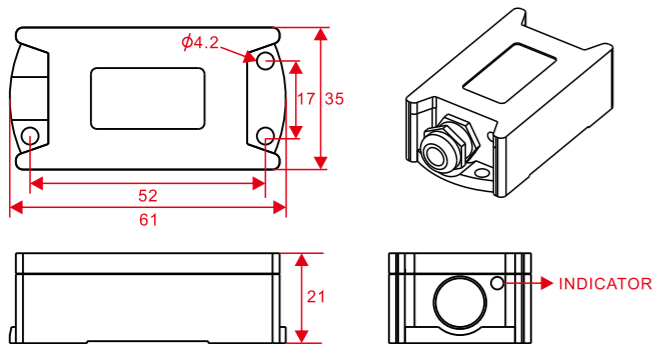
FEATURES

- Resolution: 0.1°
- Output: RS485 (MODBUS)
- Six installation methods
- Power supply: 9~36V
- Zero set function
- Work temperature: -40~+85°C
- IP67
- High anti-shock > 3500g

SYSTEM DIAGRAM



DIMENSION



Dimension : 61*35*21mm

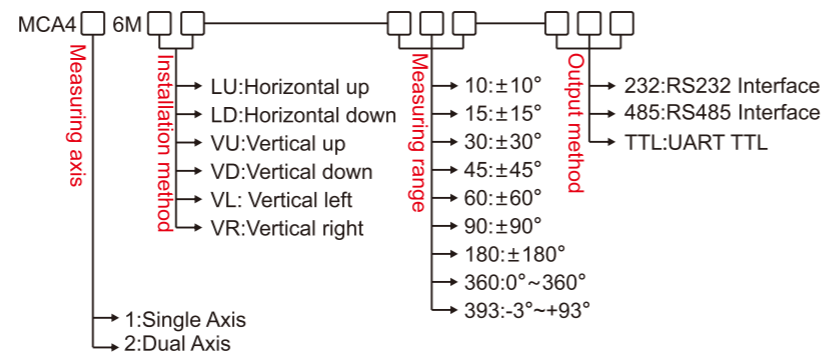
APPLICATION

- Agricultural machinery
- Lifting machinery
- Crane
- Aerial platform
- Solar tracking system
- Medical equipment
- Electric vehicle control

PARAMETERS

MCA416&426M	CONDITIONS	PARAMETER	UNIT
Resolution		0.1	°
Accuracy	25°C	±0.3	°
Response Time		0.05	S
Temperature Drift	-40 ~ 85°C	±0.5	°
Output Load		>500 ohm	
Working Time		50000 hours/time (no fault)	
Insulation Resistance		>100 ohm	
Anti-shock		10grms, 10~1000Hz	
Impact Resistance		100g@11ms, times/axis (half sinusoid)	
Weight		60g	
Certificate		CE ; APPEARANCE PATENT	
Production Standard		GB/T 191 SJ 20873-2003 tilt sensor, level sensor general specification	
Quality System		ISO9001:2015 standard (No.: 128101)	

ORDER GUIDE



E.g: MCA416M-LU-10: Indicates Single-axis, Horizontal Up Installation Method, ±10° Measuring range.

CONNECTION

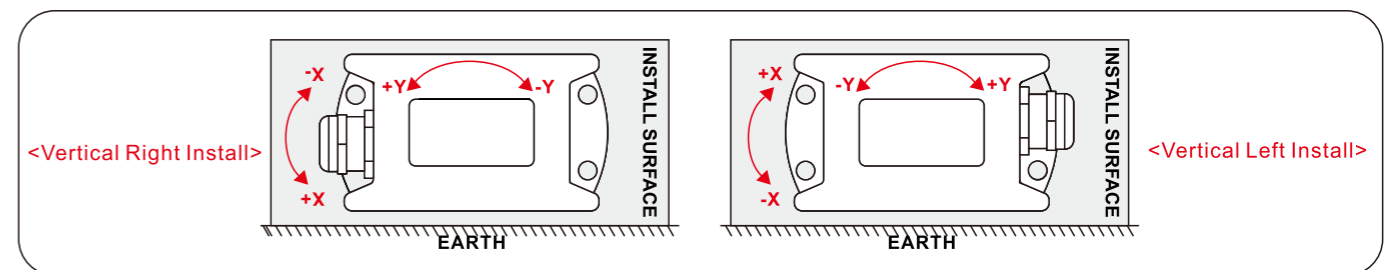
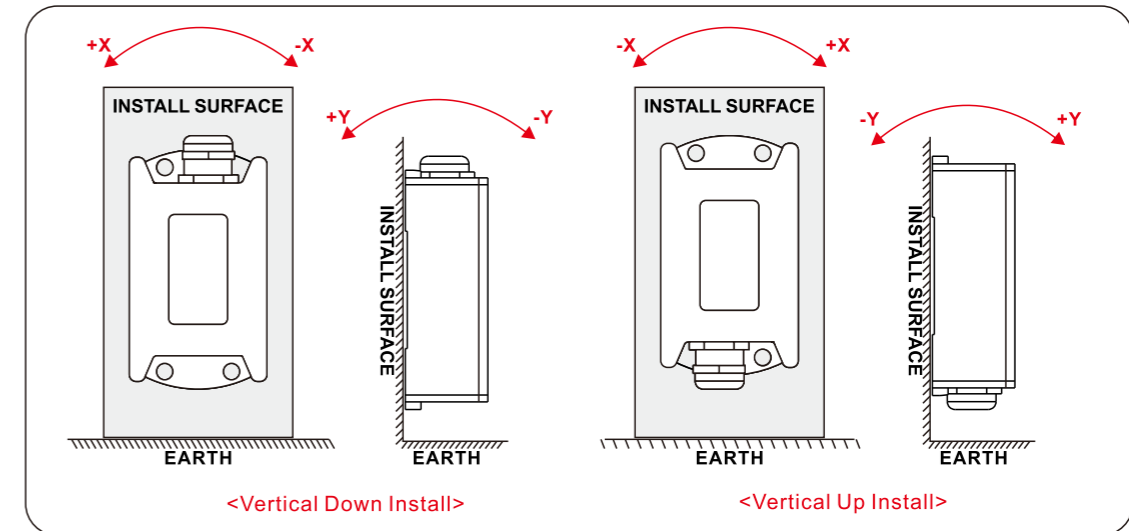
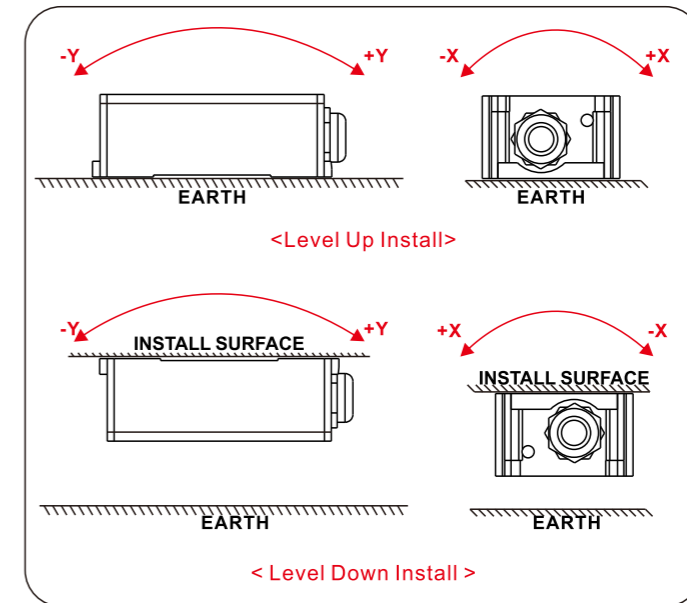


Cable diameter : φ5.5mm
Single core diameter : φ1.3mm

USAGE

- 1, the working principle is sensing gravity of earth, when installation, the sensing axis of the sensor should be parallel with the tilt axis of measured object to achieve the best accuracy. the install surface of the measured object must be flat, stable, contact close, error may be caused if the installation surface is not even.
- 2, any side of the six sides of the sensor could be as the installation side. After installation, set current position as zero position by the zero set function, (at the same time, the installation way is set as well, the set value is stored in reservoir of the sensor. After zero set, the sensor will work and regard the current position as zero position). set steps as below:
short circuit set line (grey) and GND (black) for 3 second above, the power indicator will shut off at the same time, unbind set line after power indicator flicker again, zero set finished, indicator will back to normally on status.
- 3, the protection class is Ip66, rain or water spray would not affect its proper work, please do not soak it under water for long time in case inner circuit would be damaged, damage caused by which is beyond warranty service
- 4, after installation, please do not short-circuit signal wire and power+ in case of damaging output circuit. the signal- and power- is shared by the same wire, so please connect acquisition signal- end to the power-.

INSTALLATION WAY



Remarks: The factory default installation is horizontal upward, the user can set the corresponding installation method according to needs, please refer to Article 2 of the operating instructions, and make the corresponding settings.