Rion Technology MCA416 Modbus Output Type Inclinometer Instruction Manual

Contents

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PRODUCT MODBUS PROTOCOL

Note: Please read the following items carefully before use:

1. Data frames format: RTU Mode Communication Parameter:
   - Baud rate 9600 bps.
   - Data frames: 1 Start bit, 8 data bits, even parity check, 1
     stop bit.
2. Read angle data: (Modbus FUNC 03H.)

Product Usage Instructions:

1. To read angle data, use the Modbus FUNC 03H command:
   - Host Computer Inquiry Command: Inclinometer Add 01H, FUNC 03H, Access register first address 00H
     10H, Word nonzero 00H, is relative ZERO, word ZERO is absolute ZERO.
   - Slave Computer Response: Access register first address 00H 10H, Word nonzero 00H, is relative ZERO,
     word ZERO is absolute ZERO, Visit Register first Address Data Length 4 bytes, CRC 00H 02H 00H
     04H E5C9H.
2. To set the inclinometer address, use the Modbus FUNC 06H
   command:
   - Host computer sending: Inclinometer Add FUNC Access register first address Inclinometer New Add
     CRC.
   - Slave computer response: Inclinometer Add FUNC Access register first address Inclinometer New Add
     CRC.
3. To set the sensor communication character format:
   - Host computer sending: Set sensor communication character
     command.
   - Slave computer response: Read the measured data command application example.
4. To set the inclinometer relative/absolute ZERO, use the Modbus
   FUNC 06H command:
   - Setting relative/absolute ZERO command.
   - Slave Computer Response: Inclinometer Add 01H, FUNC 06H, Inclinometer Add.

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×(1/9600)×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
    4. address to BUS, if the communication light flashes, then communication is in proper function.
    5. for sake of system reliability, when set address and relative/absolutive 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.
    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

Inclinometer Add	01H
FUNC	03H
Visit Register first Address	00H
	02H
Data Length 4 bytes	00H
	04H
CRC	E5C9H

Slave Computer Response

Inclinometer Add	01H
FUNC	03H
Data Length	08H
Data word 1,high bits	50H
Data word 1,lower bits	46H
Data word 2,high bits	00H
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

X Axis Data spans Data word 1–2. Y Axis Data spans Data word 3–4.

Read the measured data command applicaton example
Host computer sending 01H 03 H00H 02H 00H 04HE5H C9H

Slave computer response
01H03H 08H50H 46H 00H 00H 23H 20H 00H 00H BDH 61H

Note: Slave computer response data domain of the frames is50H,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 + 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 × 0.01 = 90.00°, Y axis: -773 × 0.01 = -7.73°.

Read the measured data command application example
Host computer sending 01H 03 H00H 02H 00H 04HE5H C9H

Slave computer response
01H03H 08H00H 00H00H 00H00H 23H00H 00H64H 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: -450×0.01 = -45.00°, Y-axis: 4460×0.01 = 44.60°.

Setting inclinometer relative/absolute ZERO:Modbus FUNC 06H

Setting relative/absolute ZERO command

- Inclinometer Add   01H
- FUNC   06H

Slave Computer Response

- Inclinometer Add   01H
- FUNC   06H
- Access register   00H
- first address   10H
- Word nonzero   00H
- word ZERO   FFH/00H
- is absolute ZERO   Relative/Absolute
- CRC   C84FH/880FH

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

Read the measured data command application example

- **Host computer sending** 01 H 0 6 H00 H 11 H00 H 04 HD8H 0CH
- **Slave computer response** 01 H0 6 H00 H11 H00 H04 HD8H0CH

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 OOFFH) the output is relative ZERO. On contrary if zero(will change the fiveth and sixth bytes to 00H), then is absolute ZERO, the last two bytes is CRC checksum

Setting inclinometer address:

Set sensor communication character

- Inclinometer Add   01H
- FUNC   06H
- Access register   00H

- first address   11H
- Inclinometer   00H
- New Add   04H
- CRC   D80C

Slave computer response

- Inclinometer Add   01H
- FUNC   06H
- Access register   00H
- first address   11H
- Inclinometer   00H
- New Add   04H
- CRC   D80C

Read the measured data command applicaton example

- **Host computer sending** 01 H 0 6 H 00 H 11 H00 H 04 H D8H 0CH
- **Slave computer response** 01 H0 6 H00 H11 H00 H04 HD8H0CH

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.

Set the sensor communication character format:

Set sensor communication character

- Inclinometer Add   01H
- FUNC   06H
- Access register   00H
- first address   09H
- Sensor change communication   00H
- character format   01/00H
- CRC   9800/59C8

Slave Computer Response

- Inclinometer Add   01H
- FUNC   06H
- Access register   00H
- first address   09H
- Sensor change communication   00H
- character format   01/00H
- CRC   9800/59C8

Set sensor communication character format

- **Host computer sending** 01 H 0 6 H 00 H 09 H00 H 01 H 98H 08H
- **Slave computer response** 01 H0 6 H00 H09 H00 H01 H98H08H

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.

Description

M C A 4 1 6 /4 2 6 M series tilt sensor is a new low cost tilt angle measurement product developed independently by RION. It adopts the latest ant interference platform design and integrates a new micromechanical sensing unit. It has wide working temperature, excellent antivibration and long-term stable and reliable performance. This product adopts the noncontact principle to measure the tilt angle. The internal capacitive micromechanical unit measures the component generated by the gravity of the earth to solve the real time tilt angle. The installation is simple and convenient. It only needs to be fixed on the object being measured and there is no need to find fixed shaft and rotating shaft. Variety of installation methods could meet customer different measurement needs. It is an ideal sensor for construction machinery vehicles, agricultural machinery, solar tracking and other industrial equipment's.

FEATURES

- Resolution:0.1°
- Six installation methods
- Zero set function
- IP67
- Output: RS485 (MODBUS)
- Power supply: 9~36V
- Work temperature:-40~+85℃
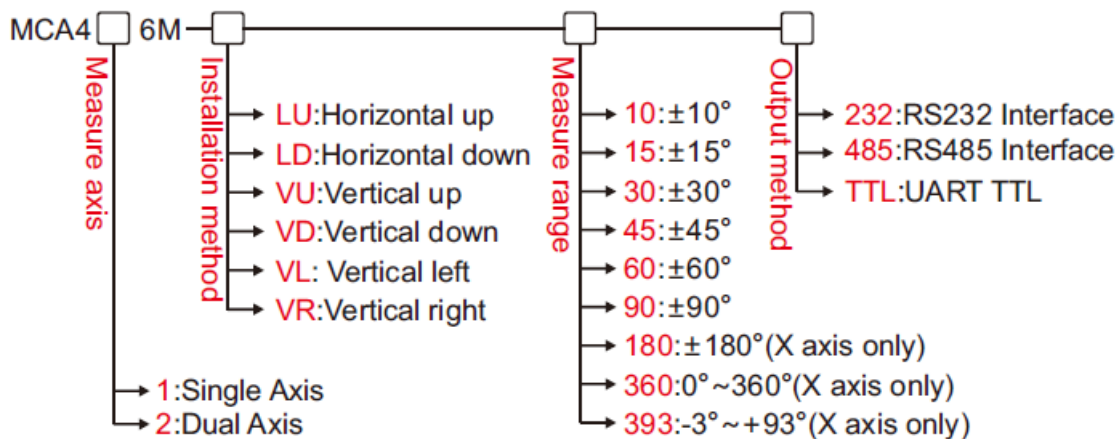- High anti-0shock>3500g

SYSTEM DIAGRAM
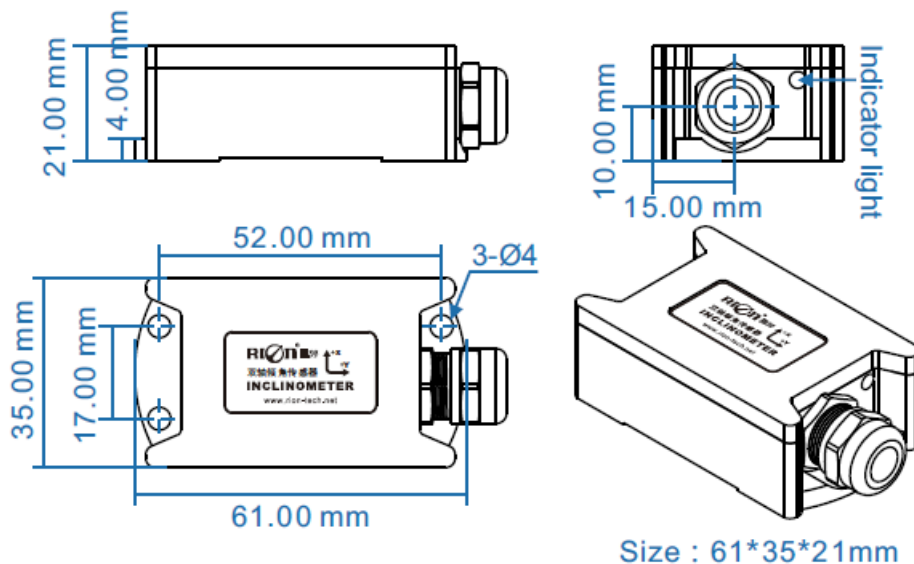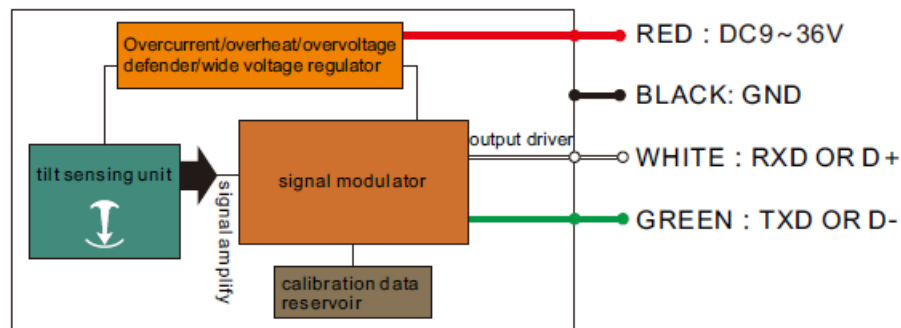
APPLICATION

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

PARAMETERS

MCA416M/426M	CONDITIONS	PARAMETER	UNIT
Resolution		0.1	°
Accuracy	25℃	±0.3	°
Response Time		0.05	S
Temperatu Re Drift	-40～85℃	±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,3 Axial Direction (Half Sinusoid)	
Weight		135g	
Certificate		CE ; APPEARANCE PATENT	
Quality System		GB/T19001-2016 idt ISO19001:2015 standard (Certificate No.: 128101)	

ORDER GUIDE

MCA4 ☐ 6M

Measure axis
- 1:Single Axis
- 2:Dual Axis

Installation method
- LU:Horizontal up
- LD:Horizontal down
- VU:Vertical up
- VD:Vertical down
- VL: Vertical left
- VR:Vertical right

Measure range
- 10:±10°
- 15:±15°
- 30:±30°
- 45:±45°
- 60:±60°
- 90:±90°
- 180:±180°(X axis only)
- 360:0°～360°(X axis only)
- 393:-3°～+93°(X axis only)

Output method
- 232:RS232 Interface
- 485:RS485 Interface
- TTL:UART TTL

E.g: MCA410T-LU-10: Indicates Single-axis, Horizontal Up Installation Method, ±10° Measure range,RS232 Interface.

CONNECTION

-

Cable diameter : Ø5.5mm
Single core diameter : Ø1.3mm
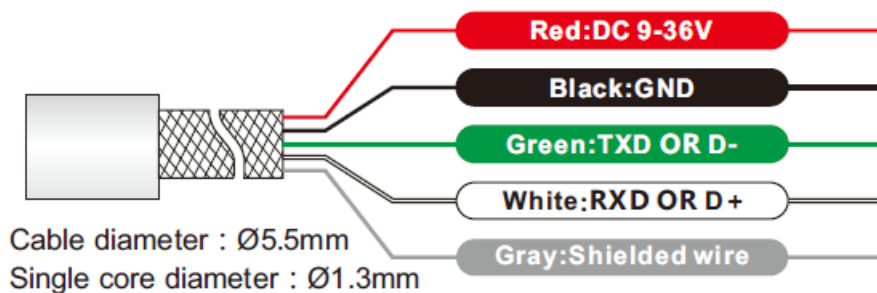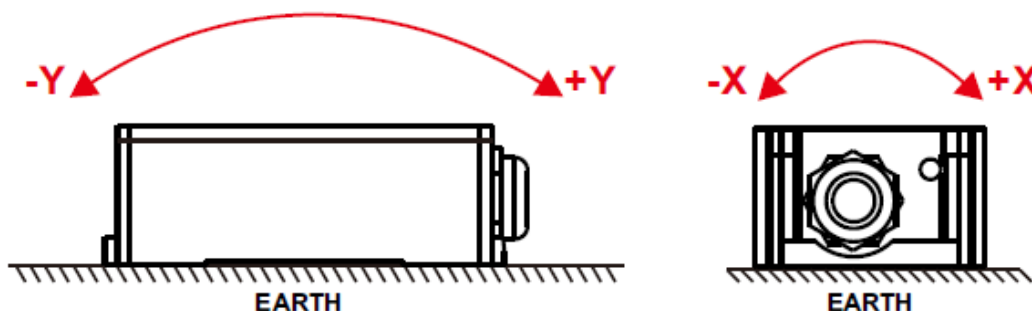
Cable diameter Ø5.5mm
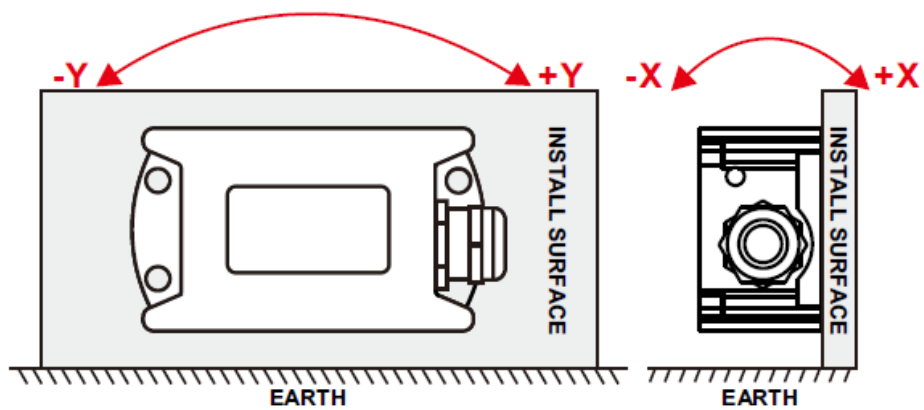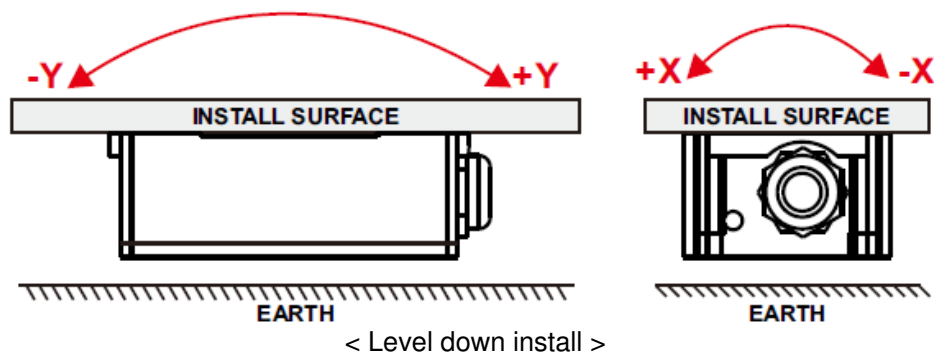- Single core diameter Ø1.3mm

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 IP67, 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
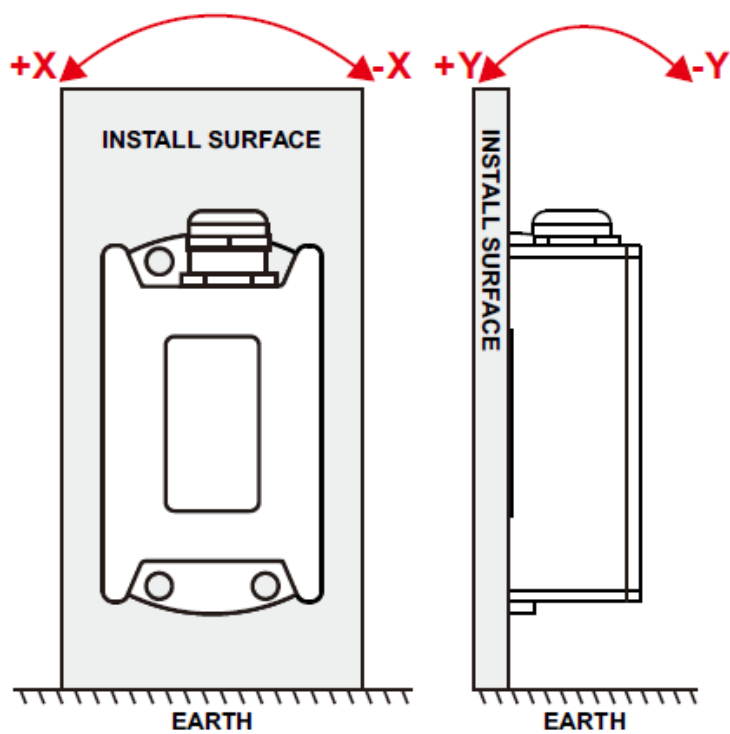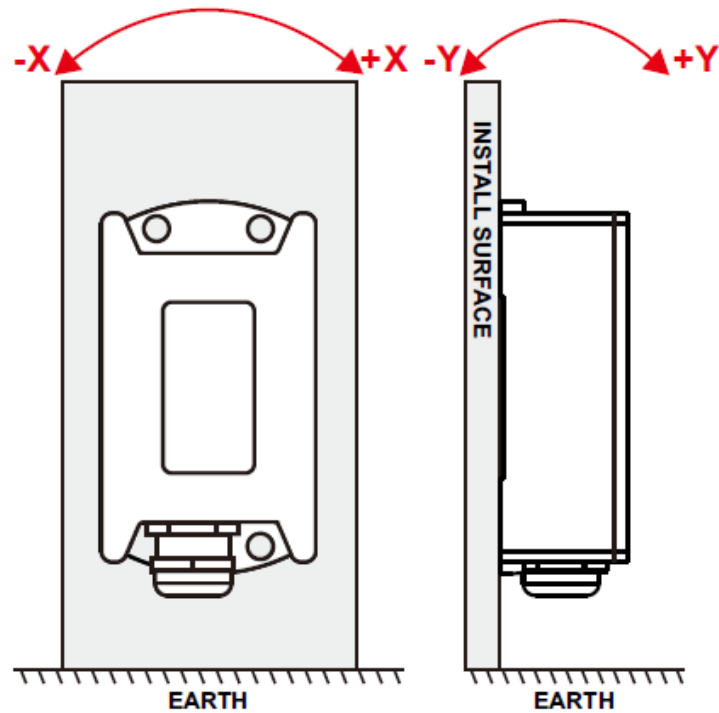
HORIZONTAL MEASUREMENT INSTALLATION DIRECTION

<Level up install>

-Y +Y +X -X

INSTALL SURFACE INSTALL SURFACE

EARTH EARTH

< Level down install >

-Y +Y -X +X

INSTALL SURFACE INSTALL SURFACE

EARTH EARTH

VERTICAL MEASUREMENT INSTALLATION DIRECTION

<Vertical Right Install>

+X -X +Y -Y

INSTALL SURFACE INSTALL SURFACE

EARTH EARTH

<Vertical down install>
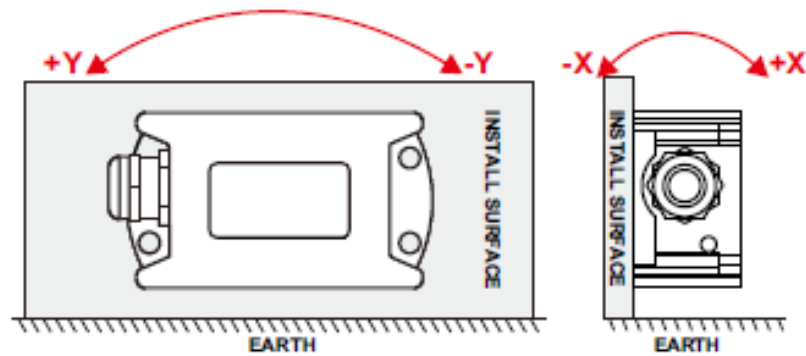
<Vertical up install>

<Vertical Left Install>

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

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Documents / Resources

 Rion Technology MCA416 Modbus Output Type Inclinometer [pdf] Instruction Manual
MCA416, MCA426M, MCA416 Modbus Output Type Inclinometer, Modbus Output Type Inclinometer, Output Type Inclinometer, Type Inclinometer, Inclinometer

References

- 🌐 [tech.net](#)
- 🌐 [SHENZHEN RION TECHNOLOGY CO., LTD](#)

Manuals+,