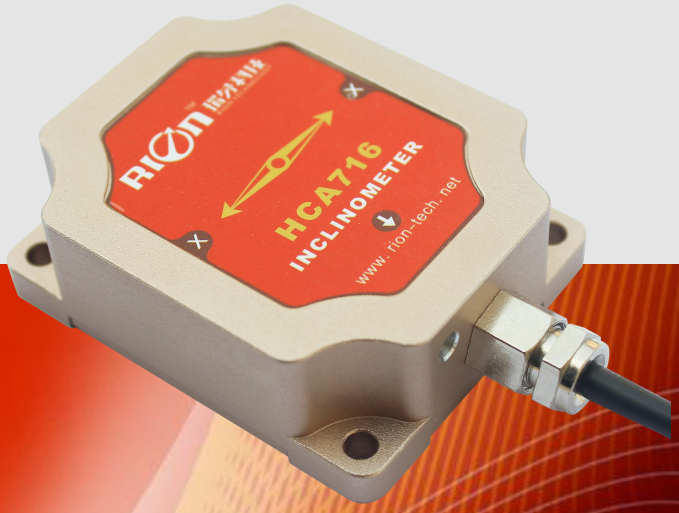

SPECIFICATIONS

Item No.：HCA716S/HCA726S

Desc.: Inclinometer (MODBUS RTU Protocol ）

Application：Solar photovoltaic power generation angle tracking system

Production implementation standard reference

- Enterprise quality system standards: ISO9001: 2008 standard (certification number: 128101)
- CE certification: AT011611741E FCC certification: AT011611742E
- Tilt sensor production standards: GB / T 191 SJ 20873-2003 inclinometer general specification of Level
- The Academy of metrology and quality inspection Calibrated in accordance to: JJF1119-2004 Electronic Level calibration Specification
- Gyro accelerometer test standard : QJ 2318-92 gyro accelerometer test method
- Software development reference standard: GJB 2786A-2009 military software development General requirements
- Product environmental testing standards: GJB150
- Electromagnetic anti-interference test standards: GB / T 17626
- Version:Ver.10
- Date: Feb 13th,2017

HCA716S/HCA726S Digital Ouput Dual axis Inclinometer

General Description

HCA716S/HCA726S is a small volume high accuracy inclinometer launched by RION company to the industrial field control , using RS485/RS232 Serial interface , MODBUS RTU standard protocol format .Built-in high-precision 24bit A /D differential converter, by 5 filtering algorithm, which can measure the angle of sensor output relative to the horizontal tilt and pitch tilt.The product integration of the latest technology to the main MEMS tilt unit, measuring range of +-180 degrees, full range accuracy of 0.01 degrees, can easily achieve biaxial and uniaxial inclination measurement .The products are truly industrial-grade products, reliable performance, scalability, and a variety of output options. The utility model is suitable for the control of the angle of the photovoltaic cell board, the orientation of the photovoltaic cell board, the measurement of the angle of various thermal power generation mirrors, and the large range high precision measurement of industrial sites.

Features:

- ●Single/dual Axis Inclinometer
- ●Accuracy: refer to the technical data
- ●Wide temperature working: -40～+85℃
- ●IP67 protection class
- ●Direct lead cable interface
- ●Output mode: MODBUS
- ●Measuring Range :±1～±90° optional
- ●Wide voltage input: 9～36V
- ●Resolution: 0.001°
- ●Highly anti-vibration performance >100g
- ●Small size : 54×44×18mm（customized）

Application:

- ●Satellite positioning Search
- ●engineering mechanical measurement of dip angle
- ●Radar detection of vehicle platform
- ●Gun Barrel angle measurement in early shooting
- ●Satellite communications vehicle posture detection
- ●Ship's navigation posture measurement
- ●Rail-mobile monitoring
- ●oil-well drilling equipment
- ●Underground drill posture navigation
- ●Based on the angle direction measurement
- ●Shield pipe jacking application
- ●Geological equipment inclined monitoring

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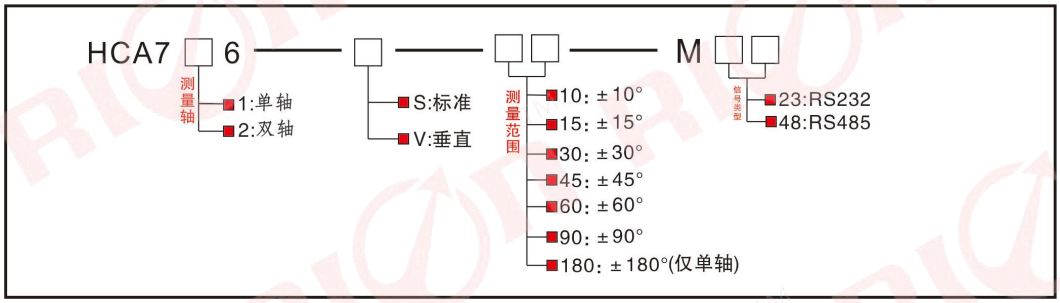
Ordering information:



E.g：HCA716S -10-M23 ：Single axis /Standard /±10° Meausring range /MODBUS/RS232 digital signal output type

Technical Data

Parameters	Conditions	HCA726S-15	HCA726S-45	HCA726S-60	HCA716V-180	Unit
Measuring range		±15	±45	±60	±180	°
Measuring axis		X,Y	X,Y	X,Y	Vertical X axis	
Resolution		0.001	0.001	0.003	0.005	°
Absolute accuracy	@25℃	±0.008	±0.01	±0.01	±0.01	° RMS
Long term stability		<0.02	<0.02	<0.02	<0.02	°
Zero temperature coefficient	-40～85°	±0.0005	±0.0005	±0.0005	±0.0005	°/℃
Sensitivity temperature coefficient	-40～85°	≤0.01	≤0.01	≤0.01	≤0.01	%/℃
Power on time		0.5	0.5	0.5	0.5	S
Response time		0.02	0.02	0.02	0.02	s
Response frequency	>20HZ					
Output signal	RS232 or RS485 (MODBUS RTU)					
EMC	According to EN61000 and GBT17626					
MTBF	≥50000 Hours/times					
Insulation Resistance	≥100M					
Shockproof	100g@11ms、3Times/Axis(half sinusoid))					
Anti-vibration	10grms、10～1000Hz					
Protection glass	IP67					
Cables	Standard 1M length、wearproof、grease proofing、wide temperature、Shielded cables 4*0.2mm2					
Weight	120g(without cable)					

*This Technical data only list ± 15 °, ± 45°, ± 60 °, ± 180 ° series for reference, other measuring range

please refer to the adjacent parameters .

Electronic Characteristics

Parameters	Conditions	Min	Standard	Max	Unit
Power supply	Standard	9	12、24	36	V
Working current	non-loaded		40		mA
Working temperature		-40		+85	℃
Store temperature		-40		+85	℃

Key words：

Resolution：Refers to the sensor in measuring range to detect and identify the smallest changed value.

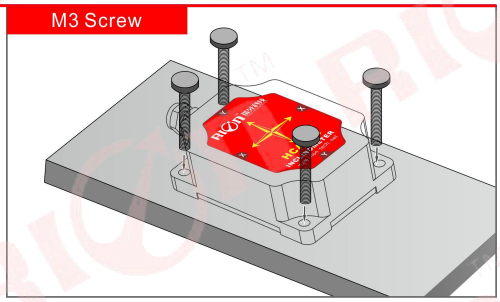
Absolute accuracy：Refers to in the normal temperature circumstances,the sensor absolute linearity, repeatability, hysteresis, zero deviation, and transverse error comprehensive error.

Long term stability : Refers to the sensors in normal temperature conditions, the deviation between the maximum and minimum values after a year's long time work.

Response time：Refers to the sensor in an angle change, the sensor output value reached the standard time required.

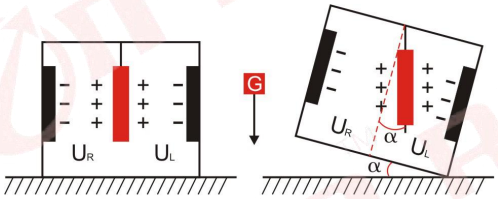
Mechanical Parameters

- Connectors：1m lead cable（customized）
- Protection glass：IP67
- Enclosure material ：Aluminum Oxide
- Installation ：4*M3 screws



Working Principle

Adopt the European import of core control unit, using the capacitive micro pendulum principle and the earth gravity principle, when the the inclination unit is tilted, the Earth's gravity on the corresponding pendulum will produce a component of gravity, corresponding to the electric capacity will change,, by enlarge the amount of electric capacity , filtering and after conversion then get the inclination.

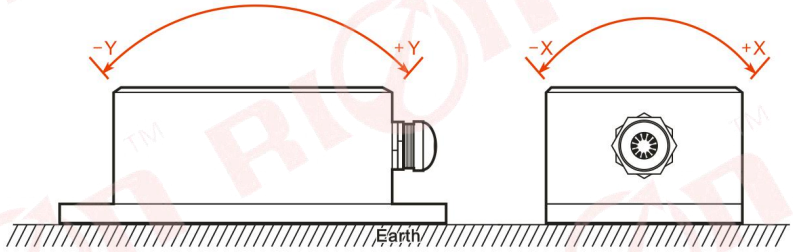


U_R, U_LRespectively is the pendulum left plate and the right plate corresponding to their respective voltage between theelectrodes, when the tilt sensor is tilted, U_R, U_L Will change according to certain rules, so $f(U_R, U_L)$ On the inclination of α function:

$$\alpha = (U_R, U_L)$$

Measuring Directions&Fix

The installation must guarantee the product bottom is parallel to measured face，and reduce the influence of dynamic and acceleration to the sensor. This product can be installed horizontally or mounted vertically (mounted vertically selection is only applicable to the single axis), for installation please refer to the following scheme.

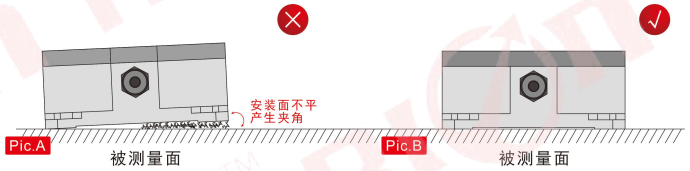


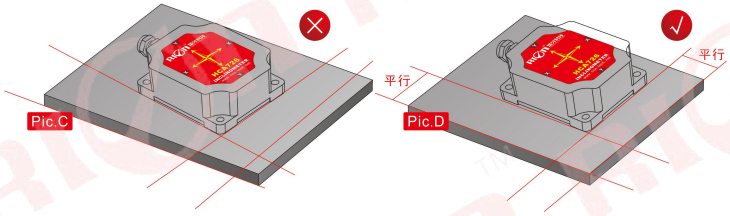
Production installation notes:

Please follow the correct way to install tilt sensor, incorrect installation can cause measurement errors, with particular attention to the "surface", "line"：

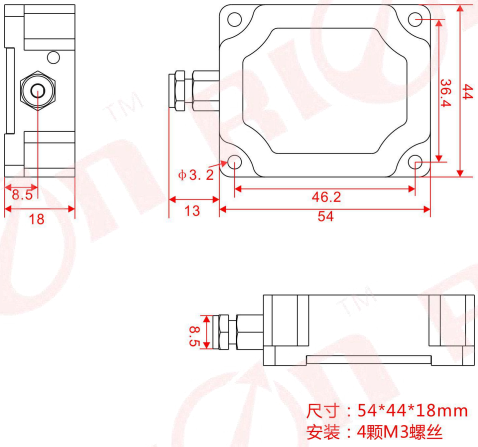
1）The Sensor mounting surface and the measured surface must be fixed closely, smoothly, stability,if mounting surface uneven likely to cause the sensor to measure the angle error. See Figure Pic.AB

2) The sensor axis and the measured axis must be parallel ,the two axes do not produce the angle as much as possible. See Figure Pic.CD





Dimension



尺寸：54*44*18mm
安装：4颗M3螺丝

Electrical Connection

Line color function	BLACK	WHITE	GREEN	RED
	GND Power Negative	RS485(D+) RS232(RXD)	RS485(D-) RS232(TXD)	Vcc 9～36V Power Positive

Product MODBUS Protocol

Please read the following items carefully before use:

1) Because of the MODBUS protocol stipulates between the two data frames should be at least more than 3.5 bytes of time (such as the baud rate of 9600, the time is 3.5 X (1/9600) X 11=0.004s). However, in order to leave enough margin, the sensor will be increased this time to 10ms, so please leave at least of the time interval between each data frame.
The master computer sends commands——10ms idle——slave computer reply command —— 10ms idel - The master computer sends commands.....

2) MODBUS protocol stipulates the broadcast address ----0 relevant content, the sensor can also accept the broadcast address content, but will not reply. Therefore, the broadcast address 0 can be used for the following purposes, for reference only.
1 All the sensors mounted on BUS are all set to an address.
2 All the sensors mounted on BUS are all set to relative / absolute zero.
3 Test all sensors mounted on BUS , that is, the master computer send 0 address to BUS for query angle command, communication lights can flicker that means the communication is normal.
3）In order to improve the reliability of the system, set the address command and set the absolute / relative command, set the baud rate, these three commands must be sent for two consecutive times will be valid. "Two consecutive send" refers to two times sent successfully (the slave machine reply every time) ,must be consecutive in two times, that's means the master compuetr can not insert other frames in the midele of two replies , otherwise, the command will be locked until the power off ,
setting process refer to below :
Send set address command —— waiting for the slave compueter to send command of successful commands - (no other commands) to send the set address command again - waiting for the successful settings from the slave computer to send the command - modify the success
4) After power up, the above two sets of commands can be set only once, if necessary, again need to re power.
5) when the normal communication accumulated to a certain number of times, the communication indicator will flash once.

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

Master Computer Inquiry Command ：		Slave Computer Response ：		
Inclinometer Address	01H	Inclinometer Address	01H	
FUNC	03H	FUNC	03H	
Visit Register first Address	00H	Data Length 8 bytes	08H	
	02H	Data word 1 upper 8 bits	50H	X Axis Data
Data Length 4 bytes	00H	Data word 1 Lower 8 bits	46H	
	04H	Data word 2 upper 8 bits	00H	
CRC	E5C9H	Data word 2 lower 8 bits	00H	
		Data word 3 upper 8 bits	23H	Y Axis Data
		Data word 3 lower 8 bits	20H	
		Data word 4 upper 8 bits	00H	
		Data word 4 lower 8 bits	00H	
		CRC	BD61H	

Read the measured data command applicaton example 1 ：								
Master computer sending	01 H	03 H	00 H	02 H	00 H	04 H	E5H	C9H
Slave computer response								
01H	03 H	08 H	50 H	46 H	00 H	00 H	23H	20 H	00 H	00 H	BD H	61H

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

X Axis is the 1-4 bytes of the data domain，Y Axis is the 5-8 bytes of the data domain，

Low byte in front. Angle representation method for point representation, a point corresponding to 0.001°, 0.001 x (points -offset) is the angle. If the measurement range is +-180°, a total point number is 360000. So the 0 corresponding to -180°, 360000 degrees corresponding to +180°, 180000 corresponding to 0 degree.

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

1) get the current point of view, note, low byte in the front, the X axis is 4650H, Y axis is 2023H.

2) convert to decimal, X axis: 4650H→18000, Y axis: 2023H→8227.

3) subtract the offset 180000 (Note: the value is related to the measurement range of a quantity), X axis: 18000-180000=-162000, Y axis: 8227-180000 = -171773.

4) Get the final angle, X axis：-162000×0.001= -162.000°，Y axis：-171773×0.001=-171.773°。

Read the measured data command applicaton example 2：												
Master computer sending				01 H	03 H	00 H	02 H	00 H	04 H	E5H	C9H	
Slave compueter response												
01H	03 H	08 H	00H	00 H	00 H	00 H	00H	23 H	00H	00 H	64 H	1DH

This example assumes that sensor measurement range is +-45 degrees, a total point number is 90000. So the 0 corresponding to -45°, 90000 degrees corresponding to +45°, 45000 corresponding to 45000 to 0°, the conversion process is as follows:

1) get the current point of view, note, low byte in the front, the X axis is 0000H, Y axis is 2300H.

2) convert to decimal, X axis:0000H→0, Y axis: 2300H→8960.

3) subtract the offset 45000 (Note: the value is related to the measurement range of a quantity), X axis: 0-45000=-45000, Y axis: 8960-45000 = -36040.

4) to get the final point of view, X axis: -45000 X 0.001=-45.00°, Y axis: -36040 X 0.001=36.040°..

3.Set sensor relative / absolute zero:

Modbus FUNC 06H

Set relative / absolute zero command：		Slave compueter response ：	
Sensor address	01H	Sensor address	01H
FUNC	06H	FUNC	06H
Access register First address	00H	Register address	00H
	10H		10H
If the word is nonzero, the relative zero is zero and zero is absolute zero	00 H	If the word is nonzero, the relative zero is zero and zero is absolute zero	00H
	FFH / 00H Relative / Absolute		FFH / 00H Relative / Absolute
CRC	C84FH/ 880FH	CRC	C84FH/ 880FH

Set ZERO command application example ：							
Master compueter sending	01 H	06 H	00 H	10 H	00 H	FFH	C8H	4FH
Slave compueter response								
01 H	06 H	00 H	10 H	00 H	FFH	C8 H	4FH

Note: 0010 is the register address, the register control sensor output is relative zero, or absolute zero. If nonzero (as in the example above, is written to 00FFH), the output is relative zero. On the contrary, if zero (fifth, = 00H), is the absolute zero. The last two bytes are CRC checksum

4.Set sensor address :

Set sensor address code command：		Slave compueter response ：	
Sensor add	01H	Sensor add	01H
FUNC	06H	FUNC	06H
ADD	00H	Register address	00H
	11H		11H
Sensor new address 04H	00 H	Sensor new address	00H
	04H		04H
CRC	D80C	CRC	D80C

Commands must be sent two times to be valid

Set sensor address command example ：							
Master computer sending	01 H	06 H	00 H	11 H	00 H	04H	D8H	0CH
Slave computer response								
01 H	06 H	00 H	11 H	00 H	04H	D8 H	0CH

Note: 0011H is the register address, which controls the sensor address. In the example above, the address of the sensor is changed to 0004H, and the last two bytes are CRC checksum.

5.Set sensor baudrate: (factory default 9600bps)

Sete sensor address code command ：		Slave computer response ：	
Sensor address	01H	Sensor address	01H
FUNC	06H	FUNC	06H
Add	00H	Register address	00H
	12H		12H
Sensor	00 H	Sensor baudrate	00H
	XX		XX

baudrate			
CRC	CRC LH	CRC	CRC LH

XX : A0H:4800 A1H:9600 A2H:19200 A3H:38400

Commands must be sent two times to be valid

Set sensor address command example：								
Master compueter sending	01 H	06 H	00 H	12 H	00 H	A2H	A8H	76H
Slave computer response								
01 H	06 H	00 H	12 H	00 H	A2H	A8 H	76H	

Note: 0012H is the register address, which controls the baud rate of the sensor. In the above example, the baud rate of the sensor is set to 19200, and the last two bytes are CRC checksum.

※More products information, please refer to the company's Website : www.rion-tech.net

(product specifications are to upgrade or change, without prior notice)

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