
# SPECIFICATIONS

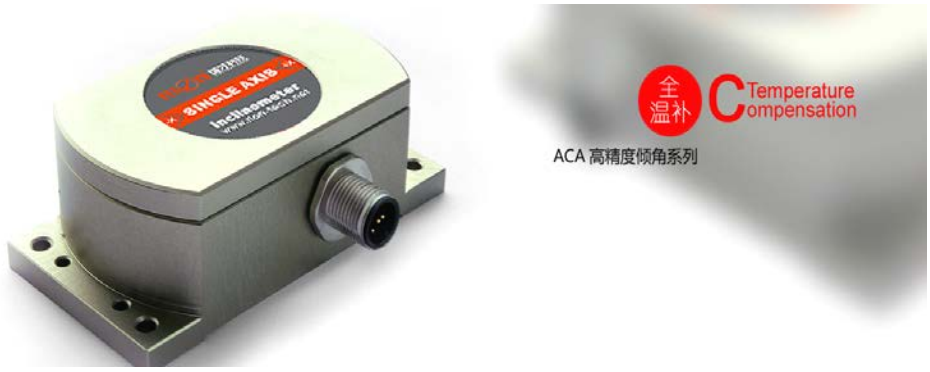
Item No.：ACA616T

Description: High Accuracy Digital Type Single-Axis Inclinometer with Full Temperature Compensation

## Production implementation standard reference

- Enterprise quality system standards: ISO9001: 2008 standard (certification number: 128101)
- 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
- 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.09
- Date:2014.4.16

# ACA616T-High Accuracy Digital Type Single-Axis Inclinometer with Full Temperature Compensation




## General Description

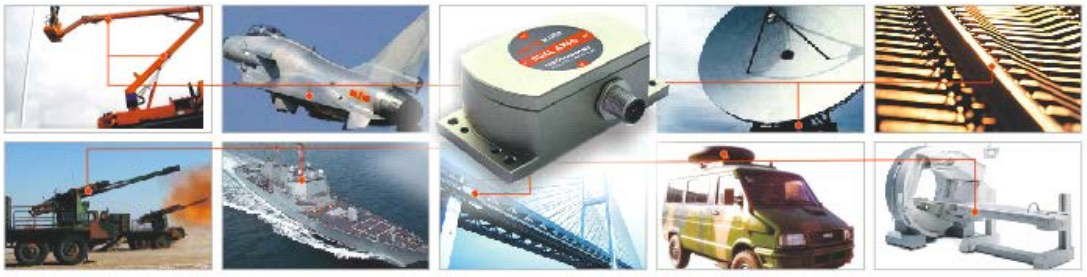
ACA616T is a full temperature compensation & high precision single-axis inclinometer which developed by Rion company based on high precision tilt angle platform ,the excellent temperature stability, can maintain higher measurement accuracy in a wide temperature range of -40-85 degrees environment, is more suitable for long-term monitoring and leveling of the field equipment. In addition the system built-in high-precision 24it A / D differential converter, meanwhile by 5 filtering algorithm, which can measure the output of the sensor tilt and pitch angle relative to the horizontal. The output interface RS485, RS232, TTL, PWM or CAN 2.0B optional.Non-contact installation features make ACA616T with superior system integration, Simply fix the sensor on the measured surface by screws , then can automatically calculate the object posture inclination, easy to use , no need to find the relative change two surfaces for mounting . With strong ability resistance to external electromagnetic interference and to withstand shock and vibration,in the domestic counterparts products with absolute competitive advantage, specialized in application in the industrial and military fields where the high-end user requirements.

## Features

- ●Single-Axis Inclinometer
- ●Accuracy: refer to the technical data
- ●Wide temperature working: -40～+85℃
- ●Highly anti-vibration performance >2000g
- ●Water-proof air-plug
- ●Measuring Range :±1～±90° optional
- ●Wide voltage input: 9～36V
- ●IP67 protection class
- ●High Resolution: 0.001°
- ●Size : 92×48×36mm
- ● Output mode RS232、RS485、RS422、TTL、CAN 2.0 are optional

## Application:

- ●Engineering vehicles automatic leveling
- ●Laser equipment position
- ●Underground drill posture navigation
- ●Precise machine tool level control
- ●Bridge & dam detection
- ●Medical facilities angle control
- ● Railway gauging rule , gauge equipment leveling
- ●Geological equipment inclined monitoring
- ●Directional satellite communications antenna pitching angle measurement



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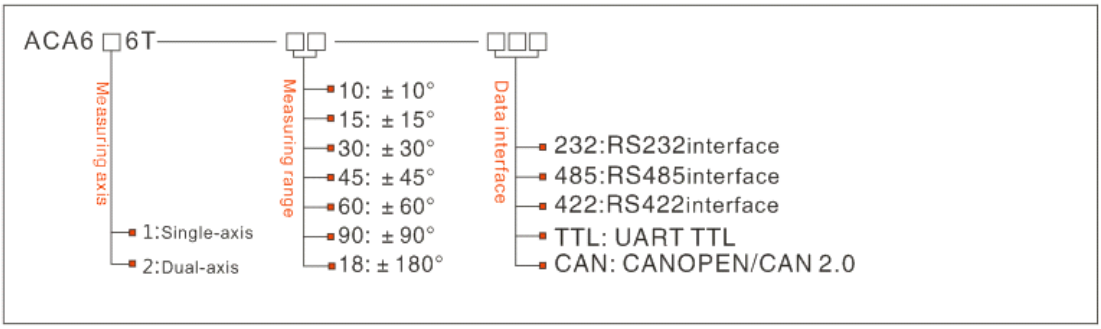
## Ordering information:




E.g：ACA616T-10-232：Single-axis/Standard /±10°Measuring range/RS232 output

## Technical Data

| Parameters | Conditions | ACA616T-10 | ACA616T-30 | ACA616T-60 | ACA616T-90 | unit |
|---|---|---|---|---|---|---|
| Measuring ran仪 | | ±10 | ±30 | ±60 | ±90 | ° |
| Measuring axis | | X | X | X | X | |
| Resolution | | 0.001 | 0.001 | 0.001 | 0.001 | ° |
| Absolute accuracy | | 0.003 | 0.01 | 0.02 | 0.03 | ° |
| Long term stability | | 0.01 | 0.02 | 0.03 | 0.04 | |
| Zero temperature coefficient | -40～85° | ±0.0008 | ±0.0008 | ±0.0008 | ±0.0008 | °/℃ |
| Sensitivity temperature coefficient | -40～85° | ≤50 | ≤50 | ≤50 | ≤100 | ppm/℃ |
| Power on time | | 0.5 | 0.5 | 0.5 | 0.5 | S |
| Response time | | 0.05 | 0.05 | 0.05 | 0.05 | S |
| Output rate | 5Hz、15Hz、35Hz、50Hz can be setting | | | | | |
| Output signal | RS232/RS485/RS422/TTL/CAN | | | | | |
| Electromagnetic compatibility | According to EN61000 and GBT17626 | | | | | |
| MTBF | ≥50000 hours/times | | | | | |
| Insulation Resistance | ≥100M | | | | | |
| Shockproof | 100g@11ms、Times/Axis(half sinusoid) | | | | | |
| Anti-vibration | 10grms、10～1000Hz | | | | | |
| Protection glass | IP67 | | | | | |
| Cables | Standard 1M length、wearproof、wide temperature、Shielded cables4*0.4mm2 air-plug connector | | | | | |
| Weight | 150g(without cable ) | | | | | |

* This Technical data only list ± 10 °, ± 30 °, ± 60 °, + 90 ° 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 |
| | customized | | Other voltage | | V |
| Working current | No-load | | 50 | | mA |
| Working temperature | | -40 | | +85 | ℃ |
| Store temperature | | -55 | | +100 | ℃ |

**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 cable with air-plug connector（customized）

○ Protection glass：IP67(air plug connector)

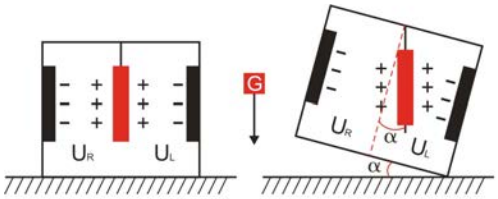
○ Enclosure material ：Aluminum Oxide

○ Installation ：4*M4 screws

2*3mm plug position(optional)


## 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.

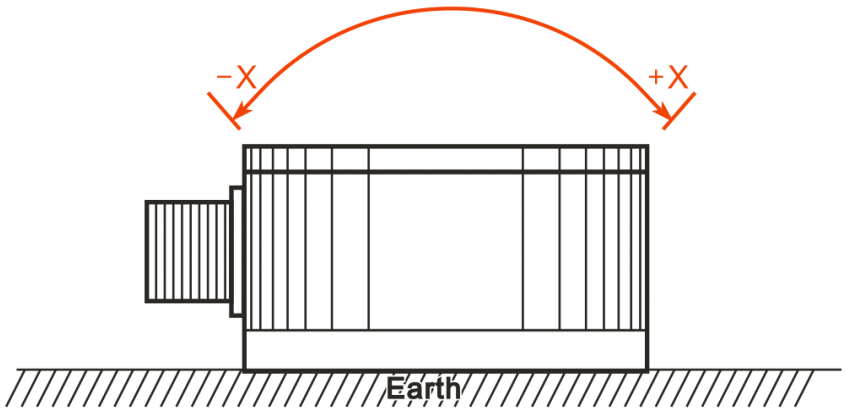



$U_R$, $U_L$Respectively is the pendulum left plate and the right plate corresponding to their respective voltage between theelectrodes, when the tilt sensor is tilted, $U_R$, $U_L$ Will change according to certain rules, so $f(U_R, U_L)$ On the inclination of α function:

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

## 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.

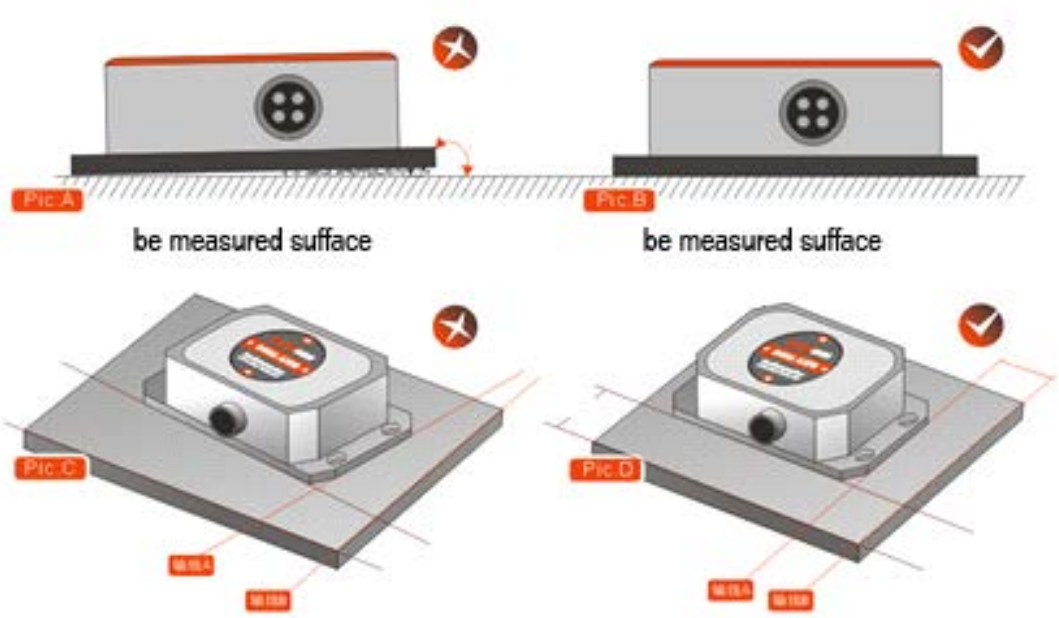



## Production installation notes :

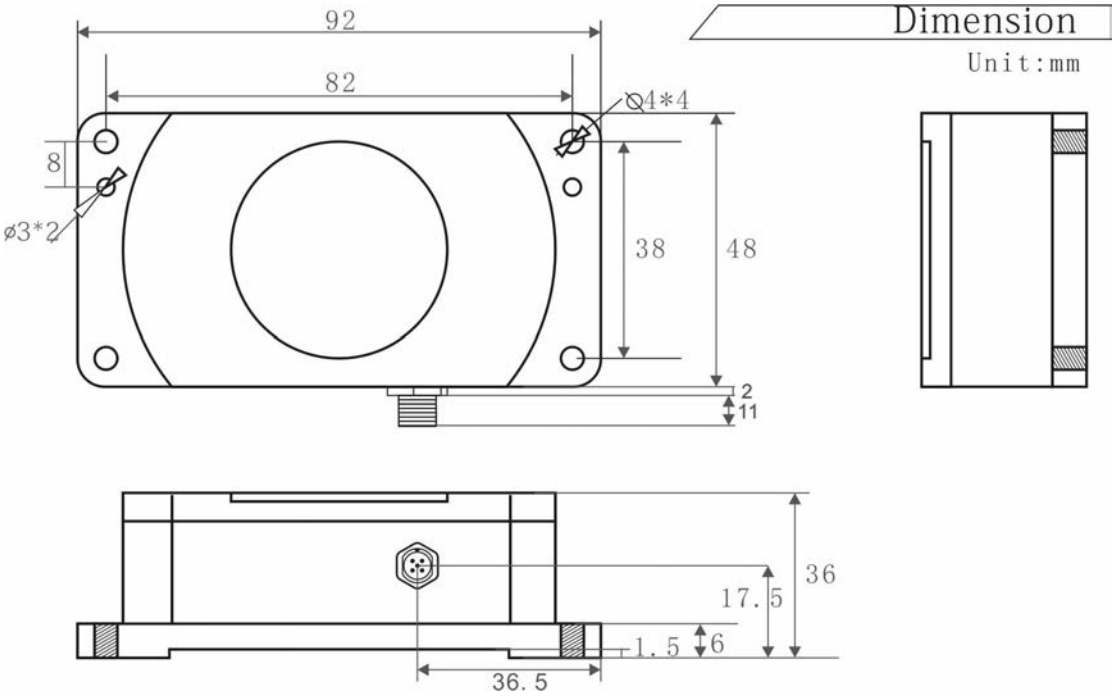
Please follow the correct way to install tilt sensor, incorrect installation can cause measurement errors, with particular attention to the "surface", "line"：

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




Size：L92×W48×H36mm

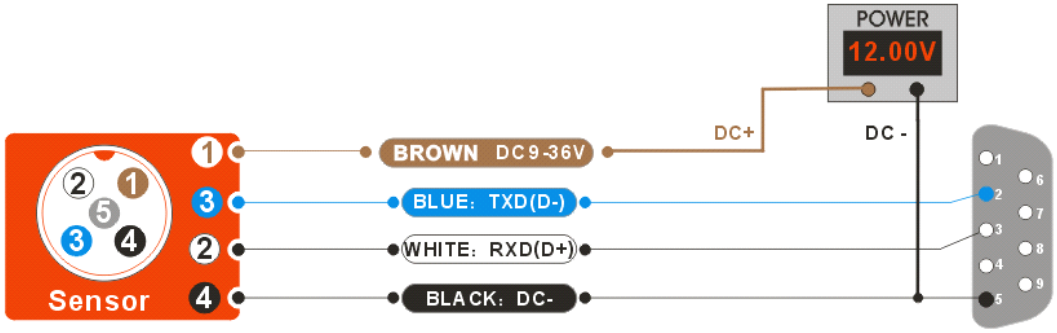
## Electrical Connection

### 1.RS232/RS485 Wiring

| Line color function | BLACK | WHITE | BLUE | BROWN | GRAY |
|---|---|---|---|---|---|
| | GND<br>Power Negative | RS232(RXD)<br>Or RS485(D+) | RS232(TXD)<br>Or RS485(D-) | Vcc 9～36V<br>Power supply positive | FACTORY<br>Use only |

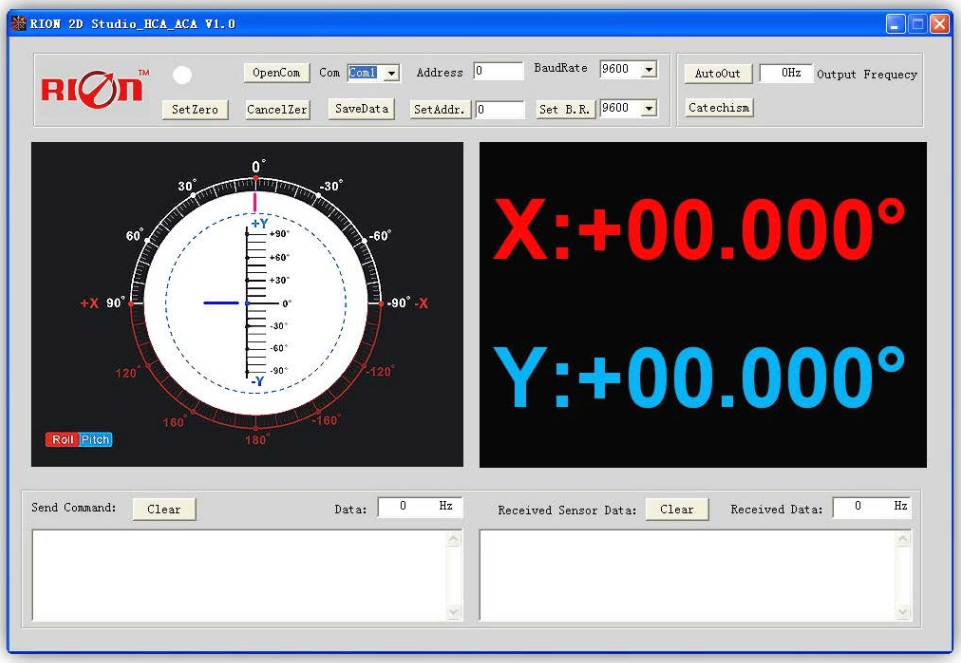
### 1.RS422 Wiring

| Line color function | RED | ORANGE | YELLOW | BLUE | PURPLE | BLACK |
|---|---|---|---|---|---|---|
| | DC9~36V | TXD+ | RXD- | RXD+ | TXD- | GND |



## RION serial port tester software

You can download the RION angle debugging software from RION's official website for the preliminary angle debugging, also you Can download public version of the serial port assistant software on line for using .




Open/Close： Open and close COM port;

Com: Select the the device corresponding to the COM port

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

Set Address: Set the sensor address code input box on the right to enter the desired address code, click Set Addr button

Save Data: Save the data, click here data can be synchronized Save angle data, the file is stored by default in the C: ---- COMDATA file

Set Zero: Set relative zero, the sensor current angle is 00.00 degrees

Cancel Zero: Unset the relative zero, to restore the sensor to the factory absolute zero;

Baud Rate: Select the sense baud rate , the factory default is 9600;

Set Baud Rate: Set the sensor baud rate, on the right of the selection box to select corresponding baud rate then click SetB.R. button;

Auto Output: Switch the sensor to automatically output mode, in the automatic output mode can be filled with different output frequency in Hz;

Catechism: The sensor switch to answer pattern, such as choosing the answer type, must input "send command "( command, please refer to the specification ) on the left of "Send Command" input box, but also can fill in the transmit frequency in the Send Data, the unit Hz;

Note: after install the RION's debugging software, if can not open, please operate by the following steps ( please appear to the administrator status to operate ):

1） Copy these three files mscomm.srg、mscomm32.ocx、mscomm32.dep from the folder to C:/Windows/system32 path below。

2） Click "Start" –"run" --regsvr32 mscomm32.ocx，You are prompted to install successful dialog。

## Product Protocol

### 1.DATA FRAME FORMAT：

（8 bits date，1 bit stop，No check，Default baud rate 9600）

| Identifier (1byte) | Date Length (1byte) | Address code (1byte) | Command word (1byte) | Date domain | Check sum (1byte) |
|---|---|---|---|---|---|
| 68 | | | | | |

Date format: hexadecimal

Identifier：Fixed68

Data length：From data length to check sum（including check sum）length

Address code：Accumulating module address，Default :00

Date domain will be changed according to the content and length of command word

Check sum：Data length、Address code、Command word and data domain sum,No carry.

### 2、COMMAND word analysis

| Desc. | Meaning/Example | Description |
|---|---|---|
| ***0X04*** | **Meanwhile read angle command**<br>E.g: ***68 04 00 04 08*** | Data domain(0byte)<br>No Data domain command |
| ***0X84*** | sensor data response<br>Eg:<br>**68 0D 00 84 00 20 10 10 40 00 05 05 00 3B** | data field(9byte)<br>68 is prefix of data packets, fixed.<br>0D is data lenght, fixed.<br>00 is address code, revisable.<br>84 is command code, fixed.<br>**00 20 10** the three red bytes are the X axis returned angle value in compact BCD code. the high order **0** of first byte is sign bit(0: positive; 1: negative), **02** are two digit integer value, **010** are three decimal digit.<br>Other axis data analysis method is similar.<br>the angle is +02.010deg by analizing.<br>**10 40 00,** the three blue bytes are Y axis returned angle value, analysis method is similar to X axis<br>**05 05 00,** the three green bytes are internal temperature value, analysis method is similar to X axis.<br>**3B** check sum, hexadecimal sum of all data, exclude prefix 68,<br>if surpass one byte, pick low-order. |
| ***0X05*** | **Setting relative/absolute ZERO:**<br>Can set the current angle to Zero degree, relative measurement, can also be set to absolute ex-factory zero, power off save<br><br>E.g: ***68 05 00 05 00 0A*** | Data domain<br>（1byte）<br>00: absolute ZERO<br>01: relative ZERO |
| ***0X85*** | Sensor answer reply command<br>E.g: **68 05 00 85 00 8A** | Data domain（1byte）<br>Data domain in the number means the sensor response results |

| | | |
|---|---|---|
| | | 00 Setting successfully<br>FF Setting failure |
| ***0X0B*** | **Setting communication rate**<br>**E.g: *68 05 00 0B 03 13***<br>The command setting is effective after power off then restart<br>( power off with save function) | Data domain（1byte）<br>Baud rate：default :9600<br>00 means 2400<br>01 means 4800<br>02 means 9600<br>03 means 19200<br>04 means 38400<br>05 means 115200 |
| ***0X8B*** | Sensor answer reply command<br>E.G:**68 05 00 8B 90** | Data domain（1byte）<br>Data domain in the number means the sensor response results<br>00 Success FF Failure |
| ***0X0C*** | **Setting sensor output mode**<br>Response rule;<br>Need upper computer send reading angle command , the sensor answer<br>the corresponding angle<br>Automatic output rule:<br>The sensor with power on can Automatically output X angle , The output frequency base on what be setted，if you need output High frequency，please set baud rate as 115200 (Power off with save function)<br>E.g: ***68 05 00 0C 00 11*** | Data domain<br>（1byte）Factory default: 00<br>00 Answer reply mode<br>01 5Hz Automatical output mode<br>02 15Hz Automatical output mode<br>03 25Hz Automatical output mode<br>04 35Hz Automatical output mode<br>05 50Hz Automatical output mode |
| ***0X8C*** | The sensor answer reply command<br>E.g: **68 05 00 8C 00 91** | Data domain（1byte）<br>Data domain in the number means the sensor response results<br>00 Success FF Failure |
| ***0X0F*** | **Setting module address command**<br>The sensor default address is 00, 1, such as a plurality of sensor to be connected with a bus cable, e.g RS485.requires each sensor is set to a different address, in order to achieve control and response angle .<br>2, If successfully changed the new address, follow all of the commands and responding Packet address code has to switch to the new address code which already changed then to be effective, otherwise the sensor will | Data domain<br>（1byte）XX Module address<br>Address from 00 to EF range<br>Note: All products have a common address :FF, If forget the address what has been set during operation , can use FF address to operate the product can still normally respond |

| | | |
|---|---|---|
| | not respond to commands.(power off with save function)<br>E.g: ***68 05 00 0F 01 15***<br>Setting the address to 01<br>***68 05 FF 0F 00 13***<br>Use the common address to reset address to 00 | |
| ***0X8F*** | The sensor answer reply command<br>E.g: 68 05 00 8F 94 | Data domain（1byte），<br>Data domain in the number means the sensor response results<br>00 Success FF Failure |
| ***0X0D*** | **Query relative/absolute ZERO**<br>Used to query the sensor current ZERO mode is relative ZERO or absolute ZERO<br>E.g : **68 04 00 0D 11** | Data domain（0byte）<br>No data domain commands |
| ***0X8D*** | The sensor answer reply command<br>E.g:**68 05 00 8D 00 92** | Data domain (1byte），<br>Data domain in the number means the sensor response results<br>00 Absolute ZERO<br>01 Relative ZERO |

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

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