



V1.3

HIGH ACCURACY DIGITAL INCLINOMETER
RION HCA516T/HCA526T
Technical Manual

HCA516T&526T HIGH ACCURACY DIGITAL INCLINOMETER



RODUCTION EXECUTION STANDARD REFERENCE

- Enterprise quality system standard: ISO9001: 2018 standard (certification number: 128101)
- CE certification: AT011611741E FCC certification: AT011611742E
- China National Intellectual Property Appearance Patent (Patent No. : ZL201830752890.0)
- Production standard of inclination sensor: SJ 20873-2003 General specification for inclinometer and level
- Gyro acceleration test standard: QJ 2318-92 gyro accelerometer test method
- Software development reference standard: GJB 2786A-2009
- Product environmental testing standard: GJB150
- Electromagnetic immunity test standard: GB / T 17626
- Revision date: 2020-3-1

Note: Product functions, parameters, appearance, etc. will be adjusted as the technology upgrades, please contact our pre-sales business to confirm when purchasing.

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► PRODUCT DESCRIPTION

HCA516T/HCA526T/HCA526T is a high accuracy inclinometer launched by RION company, inherit the stability of the SCA series, while the accuracy be effectively improved, and the temperature drift performance with much more excellence, in addition the system with built-in high-precision 16bit A / D differential converter, meanwhile through 5 filtering algorithm, which can measure the angle of sensor output relative to the horizontal tilt and pitch tilt. The output interface RS485 / RS232 / RS422 / TTL are optional.

Because of Built in ADI company's high precision digital temperature sensor that can correct the sensor temperature drift in accordance with the changes of the built-in temperature sensor(temperature output are optional), to ensure high repeatability of the product in the low-temperature and high-temperature environment. The output frequency response most up to 100Hz, for higher response frequency Division we can customize according to the user requests. The products are truly industrial-grade products, reliable performance, scalability. Suitable for a variety of harsh industrial control environment.

► FEATURES

- ★ Single/Dual-Axis Inclinometer
- ★ Wide voltage input: 9~36V
- ★ Resolution: 0.001°
- ★ IP67 protection class
- ★ Small size :90×50×34mm (customized)
- ★ Measuring Range :±1~±90° optional
- ★ Wide temperature working: -40~+85°C
- ★ Water-proof air-plug connector
- ★ Highly anti-vibration performance >2000g

► APPLICATION

- ★ Railway locomotive monitoring
- ★ Underground drilling rig attitude navigation
- ★ Oil drilling equipment
- ★ Radar vehicle platform detection
- ★ Various construction machinery inclination measurement
- ★ Geological equipment tilt monitoring
- ★ Direction measurement based on inclination
- ★ Ship navigation posture measurement
- ★ Shield pipe jacking application



○Inclinometer ○3D compass ○Digital inclinometer ○Accelerometer ○Gyro ○North finder ○INS&IMU

SINCE2008 · Inertial Attitude Measurement Manufacturer

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► TECHNICAL DATA

HCA516/526T	CONDITION	PARAMETERS				UNIT
Measuring range		±10	±30	±60	±90	°
Measuring axis		X / XY	X / XY	X / XY	X / XY	AXIS
Resolution		0.001	0.001	0.001	0.001	°
measurement accuracy	@25°C	0.005	0.01	0.02	0.05	°
Long temp. stability		0.01	0.02	0.05	0.08	°
Zero Temp.coefficient	-40 ~ 85°	±0.002	±0.002	±0.002	±0.002	°/°C
Sensitivity temp-coeffi	-40 ~ 85°	≤50	≤50	≤50	≤100	ppm/°C
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	5Hz、15Hz、35Hz、50Hz					
output signal	RS232/RS485/RS422/TTL/CAN/MODBUS					
EMC	According to EN61000 and GBT17626					
MTBF	≥50000hours/times					
Insulation Resistance	≥100MΩ					
Shockproof	100g@11ms、Triaxial (half sine wave)					
Anti-vibration	10grms、10 ~ 1000Hz					
Protection grade	IP67					
Cables	Standard 1 meter length, wear-resistant, wide temperature, shielded cable 4 * 0.4mm ² aviation connector					
Weight	190g(without cable)					

*This parameter only list ± 10 °, ± 30 °, ± 60 °, and ± 90 ° series for reference. For other measurement ranges, please refer to the nearest neighbor parameter.

► ELECTRONIC CHARACTERISTICS

PARAMETERS	CONDITIONS	MIN	STANDARD	MAX	UNIT
Supply voltage	standard	9	12、24	36	V
	customizable		Other voltage		V
Working current	No load		50		mA
Operating temp.		-40		+85	°C
storage temp.		-55		+100	°C

KEY WORDS

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

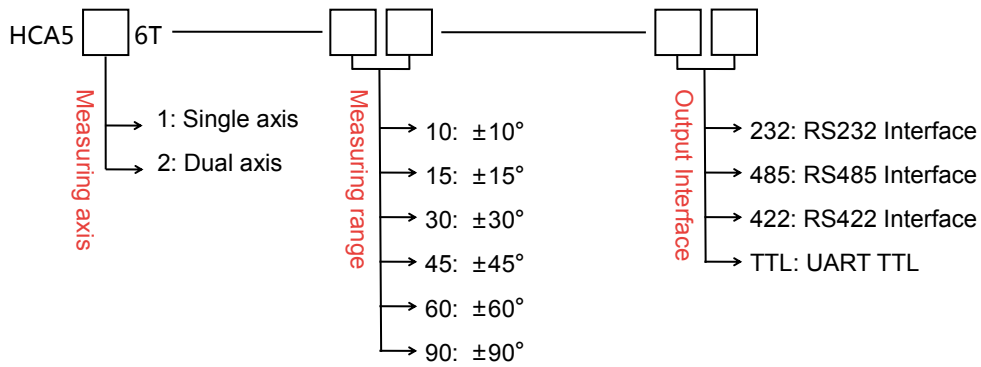
Absolute Accuracy : Refers to in the normal temperature circumstances,the sensor absolute linearity, repeatability, hysteresis, zero deviation, and transverse error comprehensive error.

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.

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► ORDERING INFORMATION



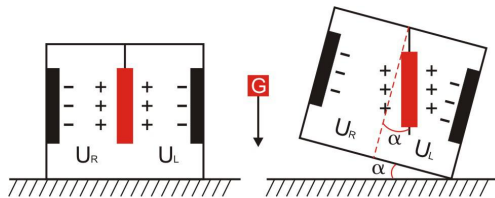
E.g:HCA526T-10-232: Dual axis/standard type/±10° measuring range/RS232 output.

► MECHANICAL PARAMETERS

- Connector: 1m Direct Leading Cable (Can Be Customized)
- Protection level: IP67
- Shell material: aluminum alloy shield oxidation
- Installation: Three M4 screws

► WORKING PRINCIPLE

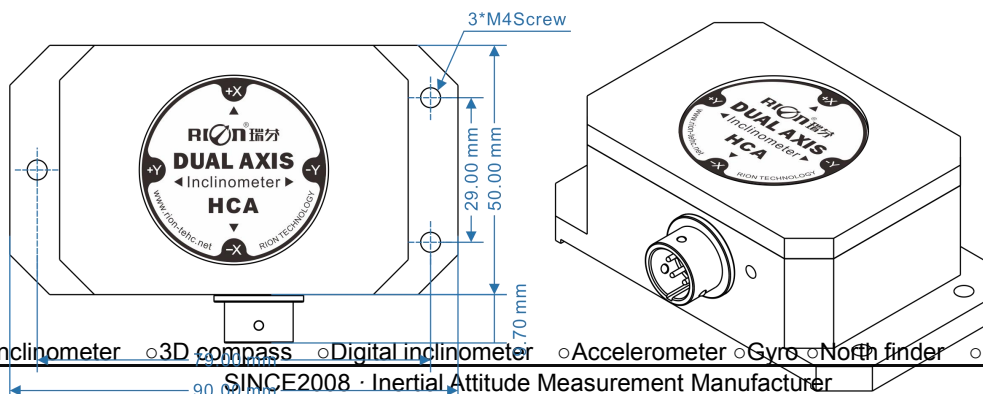
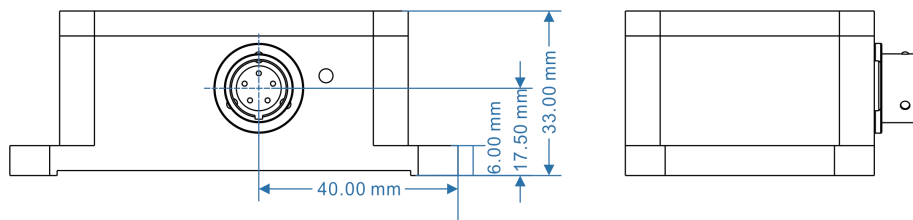
Adopt imported core control unit and apply the principle of capacitive micro-pendulum. Using the principle of earth's gravity, when the tilting unit tilts, the earth's gravity will produce a gravitational component on the corresponding pendulum, and the corresponding electric capacity will change. By amplifying and filtering the electric capacity, the inclination is obtained after conversion.



U_R , U_L respectively is the pendulum left plate and the right plate corresponding to their respective voltage between the electrodes, 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:

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

► DIMENSION



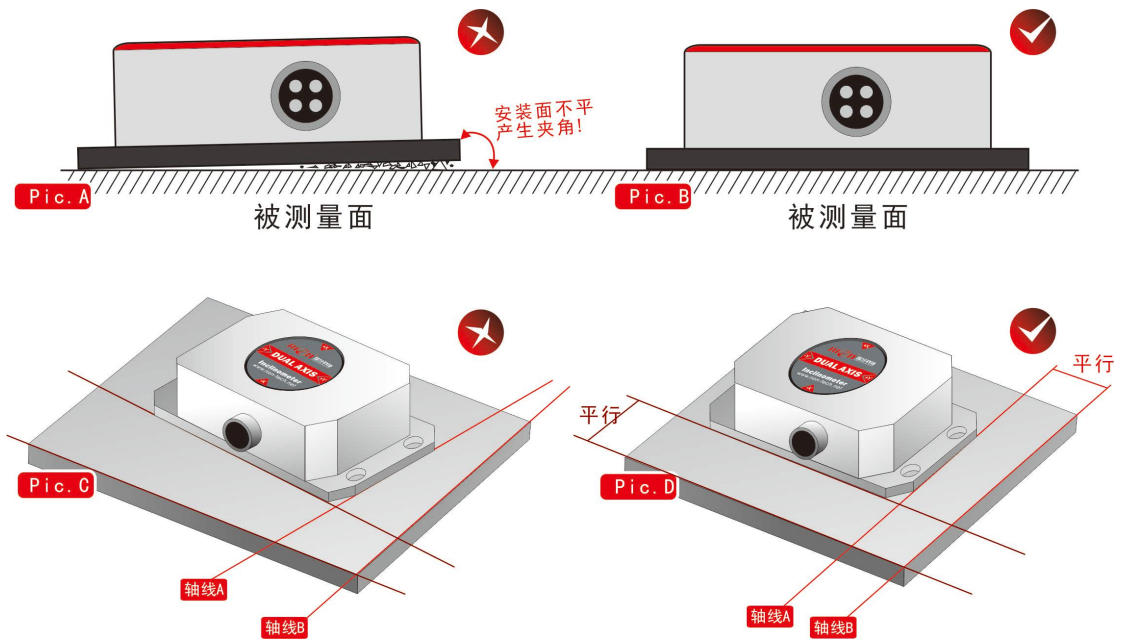
- Inclinometer
- 3D compass
- Digital inclinometer
- Accelerometer
- Gyrs
- North finder
- INS&IMU

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► PRODUCTION INSTALLATION NOTES

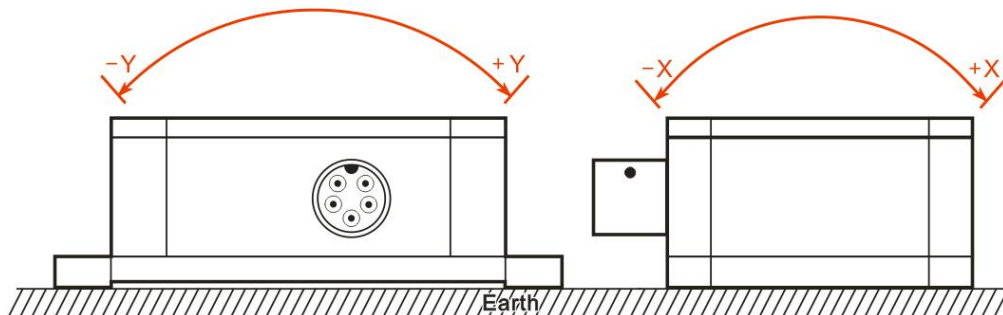
Please follow the correct way to install tilt sensor, incorrect installation can cause measurement errors, with particular attention to the "surface", "line"::

- 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.



► MEASURING DIRECTIONS

During installation, keep the sensor mounting surface parallel to the measured target surface, and reduce the influence of dynamics and acceleration on the sensor. This product can be installed horizontally or vertically (vertical installation selection is only applicable to single axis), please refer to the following diagram for the installation method:

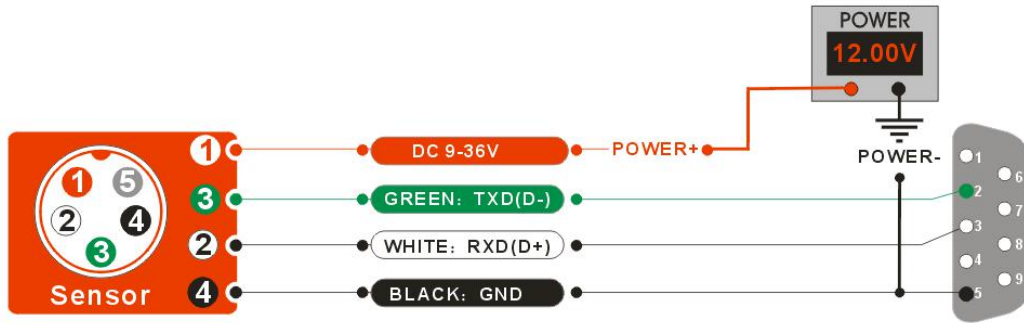


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▶ ELECTRICAL CONNECTION

1 : RS232/RS485 Wiring definition

CABLE COLOR INFORMATION	BLACK	WHITE	RED	GREEN
	GND Power negative	RS232/TTL(RXD) OR RS485(D+)	Vcc 9 ~ 36V Power supply positive	RS232/TTL(TXD) OR RS485(D-)



2 : RS422 Wiring definition

CABLE COLOR INFORMATION	RED	ORANGE	YELLOW	BLUE	PURPLE	BLACK
	DC9~36V	RXD+	RXD-	TXD+	TXD-	GND

► **RION PRODUCT COMMUNICATION PROTOCOL**

1. **DATA FRAME FORMAT** : (8 data bits, 1 stop bit, No check, default rate is 9600)

Identifier (1byte)	Date Length (1byte)	Address code (1byte)	Command Word (1byte)	Date domain	Check sum (1byte)
68					

Data 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**

Com mand word	Meaning/Example	Description
0X04	Meanwhile read angle command E.g: 68 04 00 04 08	Data domain(0byte) No Data domain command
0X84	Sensor response /answer E.g: 68 0D 00 84 00 20 10 10 40 00 05 05 00 1B	Data domain (9byte) AA AB BB CC DD EE EF FF AA AB BB : 3 characters indicate X axis CC CD DD : 3 characters indicate Y axis EE EF FF : 3 characters indicate temperature data The angle format is the same as the X-axis or Y-axis analysis method. In the example on the left, the angle is: X axis 02.010°, Y axis 00.000°, temperature: +50.50°. 00 20 10 : The red three bytes are the X-axis return angle value, which is the compressed BCD code. The high bit 0 of the first byte is the sign bit (0 is positive, 1 is negative), 02 is a two-digit integer value, 010 is three decimal places. The analysis method of other axis data is the same, and the angle is analyzed as +02.010°. 10 40 00 : The three blue bytes are the Y-axis return angle value, the analysis method is the same as the X-axis. 05 05 00 : The three green bytes are the internal temperature value of the product, and the analysis method is the same as the X-axis angle. CB : Checksum, the hexadecimal sum of all data, excluding prefix 68.
0X05	Setting relative/absolute ZERO: Can set the current angle to Zero degree for relative measurement,can also be set to absolute ex-factory zero,power	Data domain (1byte) 00 Absolute ZERO 01 Relative ZERO

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	off save. E.g: 68 05 00 05 00 0A	
0X85	Sensor response /answer command E.g: 68 05 00 85 00 8A	Data domain (1byte) The number in the data domain indicates the result of the sensor response 00 : Success FF : Failure
0X0B	Setting communication rate E.g: 68 05 00 0B 03 13 Note: It will take effect immediately after setting (but not saved to FLASH)	Data domain (1byte) Default : 9600 Baud rate : 00 means 2400 01 means 4800 02 means 9600 03 means 19200 04 means 38400 05 means 115200
0X8B	Sensor response /answer command E.g: 68 05 00 8B 90	Data domain (1byte) The number in the data domain indicates the result of the sensor response 00 : Success FF : Failure
0X0C	Setting sensor output mode Response rule; Need upper computer send reading angle command , the sensor answer the corresponding angle . Automatic output rule: The sensor with power on can Automatically output X,Y angle , output frequency 20Hz. (Power off with save function) E.g: 68 05 00 0C 00 11	Data domain (1byte) Factory default : 00 00 Answer reply mode 01 5Hz Auto output mode 02 15Hz Auto output mode 03 25Hz Auto output mode 04 35Hz Auto output mode 05 50Hz Auto output mode
0X8C	Sensor response /answer command E.g: 68 05 00 8C 00 91	Data domain (1byte) The number in the data domain indicates the result of the sensor response 00 : Success FF : Failure
0X0F	Setting module address command 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 .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	Data domain (1byte) XX Module address Address from 00 to EF range 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 Note: It will take effect immediately after setting (but not saved to FLASH)

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



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