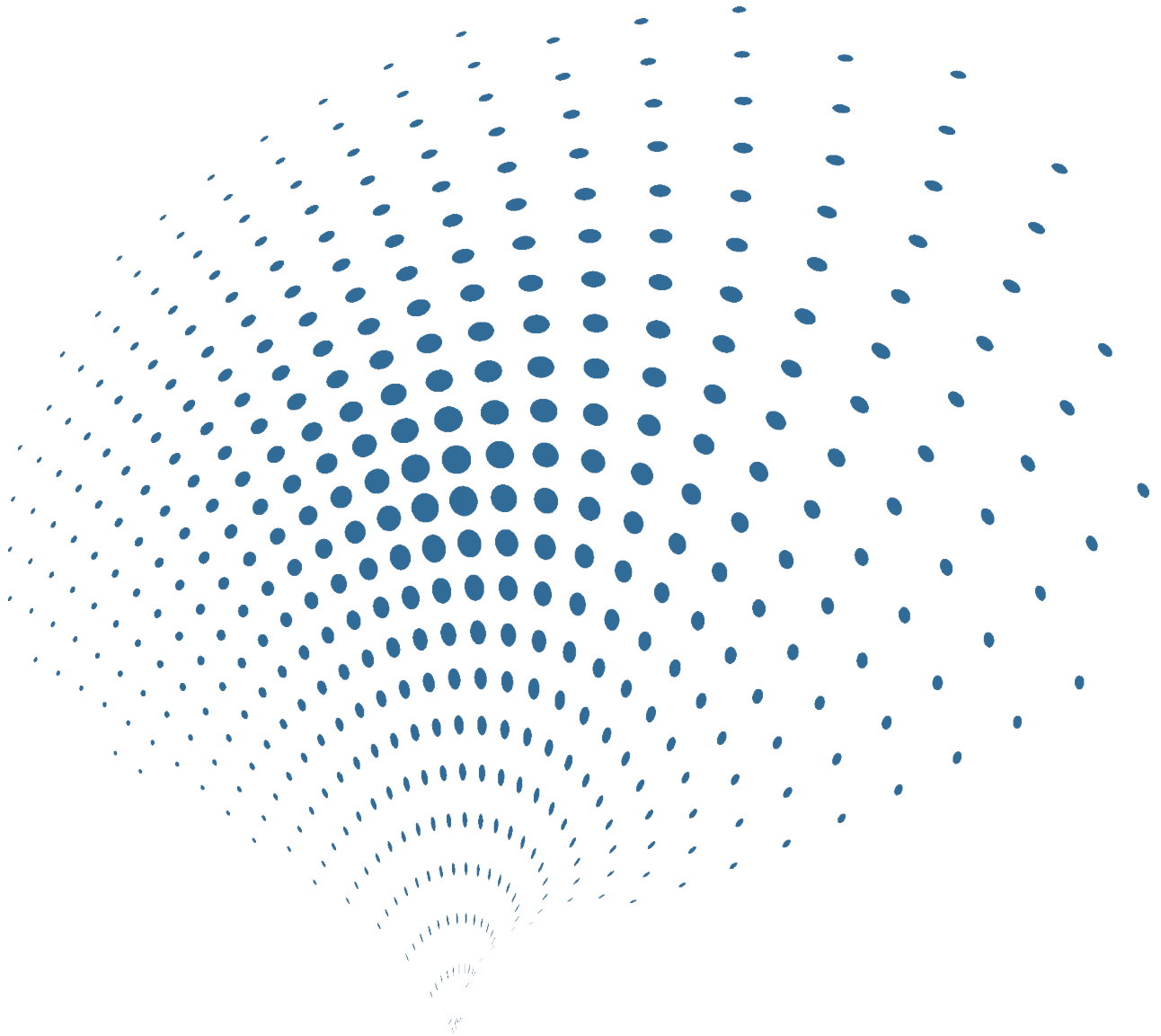




Vigor Technology



## **Ethernet Inclinometer**

# Ethernet Inclinator

## Features

- 10/100M self-adaptive Ethernet Interface
- Support ATUO MDI/MDIX, allowing crossover cable connection or straight-through cable connection
- Selectable Baud rate between 1200bps and 115200 bps
- Selectable working modes, such as TCP Server, TCP Client,
- UDP, Real COM driver; also, in these modes, most of the parameters, such as Multicasting address, working port, destination port, destination IP, and port number are configurable by user
- Build-in WEB server, allowing users to download their configuration webpage easily
- Auto reconnection after a network break, ensure the reliable TCP connection for the whole network
- Support DNS, can achieve a communication using the domain name
- Provide flexible framing modes to satisfy different framing requirements by user
- TCP modes supports multi connections, specific data sending after password verifying, allowing up to 4 user to manage a single inclinometer embedded device at a same time
- Supports single SST Inclinometer or multiple connections communication under UDP mode, allow multiple users to manage a same serial device at a same time
- Advanced security mechanisms, prevent illegal access from unauthorized visitors, provide IP verifying firewall, and up to 8 configurable IP or IP segment certifications
- Support remote configuration
- According to IEEE802.3af PoE Ethernet power supply requirement



## Descriptions

Ethernet inclination is a multi-functional tilt device developed by Vigor. It integrated TCP/IP protocol stack, which allows users to apply the network functions to their field conditions easily without knowing the complex knowledge on network or TCP/IP protocols.

Ethernet inclination contains a 10/100M self-adaptive Ethernet interface and Baud rate up to 230.4Kbps max. It provides different modes including TCP Server, TCP Client, UDP, Real COM driver, and etc.

Via SST003-05-14 option, multi-Ethernet inclinometers can easily build local network, meanwhile SST003-05-15 option can expand local network to wide area network (WAN) to realize remote data query and measurement function setting.

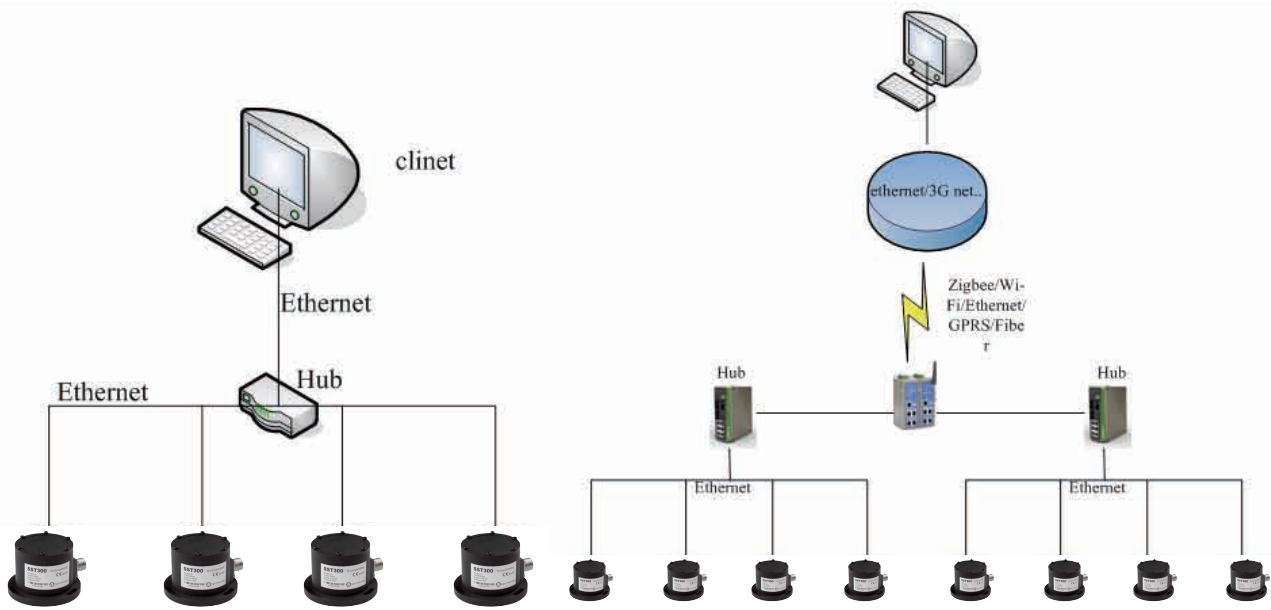
Ethernet inclinometer has strong measuring ability:

- ✓  $\pm 0.02\%$ FS linearity
- ✓  $\pm 0.005^\circ$  Offset
- ✓  $\pm 0.008^\circ$  offset turn on repeatability, meet kinds of temporary high accuracy measuring requirement
- ✓ Combine with gyro module, realize static/dynamic angle measuring for low/rapid leveling
- ✓ Combine with vibration module, realize FFT computations in-time, output vibration frequency and amplitude data directly, eliminate the influence of environment vibration
- ✓ Combine with GPS module, realize data synchronization data acquisition and local position data in different installation places
- ✓ Further confirmed that offset, repeatability, hysteresis, turn on repeatability etc. parameters which are important influence factors to unit total performance evaluation.
- ✓ Internal enhanced advanced intelligent algorithms drastically reduce cross-axis sensitivity, upgrades

real tilt angle measuring accuracy; abandoned the traditional incomplete understanding for tilt angle measurement precision concept

- ✓ Greatly reduce measuring errors when the real tilt directions not consistent for unit's actual sensitive axis
- ✓ Short-circuit, transient voltage and transposition protection to adapt to industry environment
- ✓ User can set zero point, baud rate, local gravitational acceleration value, zero calibration, vibration suppression filter coefficients, ID address, refresh rate, etc.

## Working Mode



Picture 1 Inclinometer measuring system (LAN)

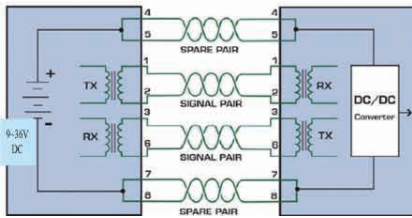
For TCP Server Mode, Ethernet inclination is always waiting for connection from TCP Client, rather than connects to other devices actively. Once connection built up, bi-direction data transmission can be carried out. For TCP Client Mode, Ethernet inclination will actively connect to destination TCP server. If it fails, the module will continually try to establish connection to TCP server according to connection condition of setting. When connection built up, bi-direction data transmission can be carried out.

For Real COM Mode, Ethernet inclination is actually working at TCP Server Mode. A background service program of upper layer machine will actively build up a connection to Ethernet inclination and increase a serial interface for Ethernet inclination on PC. Users can seamlessly upgrade their serial communication between PC and serial device via this mode.

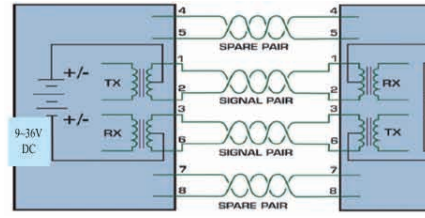
Different from the above mentioned modes, under UDP mode, Ethernet inclination will use UDP protocol for data transmission. UDP is a communication mode which is not base on connection and it does not guarantee the safe arrival of data to the destination; therefore, for the situation with high reliability requirement, an upper layer communication protocol should be used to guarantee the received data is correct; however, because the transmission method of UDP is very simple, it has lower communication overhead than TCP transmissions, so it has a faster communication rate than TCP mode; this make it more suitable for the real time transmission. In fact, for simple network environment and light communication load, UDP communication is hardly to have mistakes. Working in this mode, the role of the devices is equivalent, so there is no server and client.

Work with Ethernet PBX can build multi-nodes network. Remote host machine can query each inclinometer's information via router which connects to (wifi/zigbee/Ethernet/GPRS, etc.) ethernet network or other network (3G, GPRS).

POE(Ethernet power supply) according to 802.3af standard PI (Power interface: PSE/PD & cable), two modes of Alternative A(1,2,3,6 signal line) & Alternative B(4,5,7,8 free line), details as below:

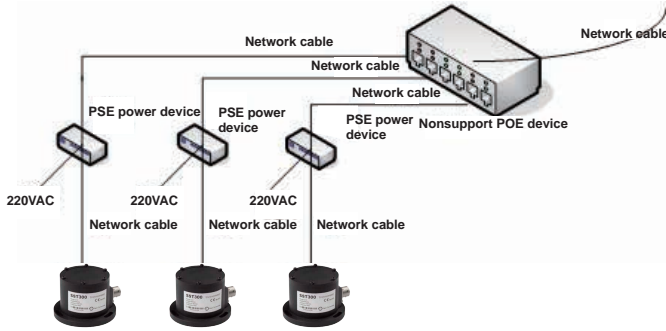


Picture 2 Power supply by free wire---B mode

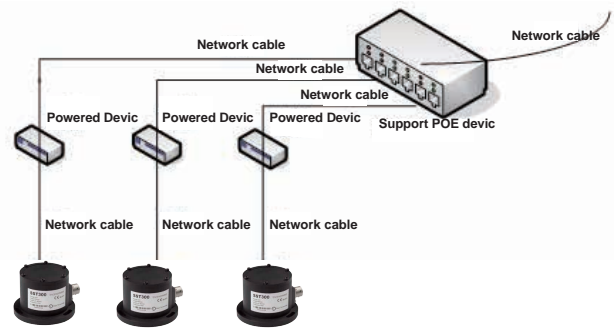


Picture 3 Power supply by signal wire---A mode

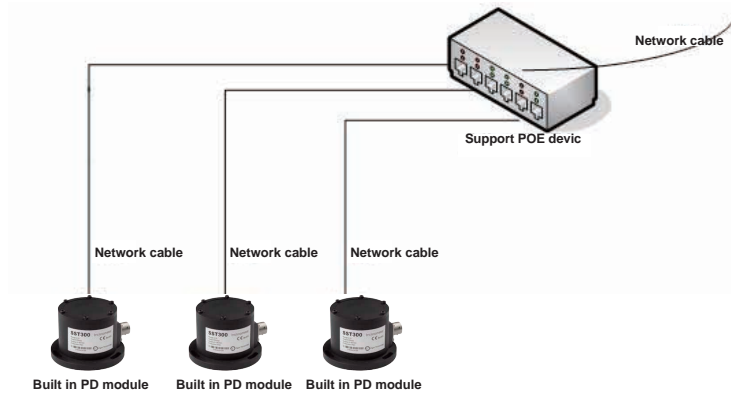
POE wiring:



Picture 4 Nonsupport POE Ethernet PSE power supply wiring method



Picture 5 Support POE Ethernet power supply wiring method (optional extra PD device)



Picture 6 Support POE Ethernet power supply wiring way (optional built in PD module)

# Performances

Table 1 Specifications

Measurement range	±5°	±10°	±15°	±30°	±45°	±60°	
Combined absolute accuracy <sup>①</sup> (@25°C)	±0.01°	±0.015°	±0.02°	±0.04°	±0.06°	±0.08°	
Accuracy subroutine parameter	Absolute linearity (LSF,%FS)	±0.06	±0.03	±0.03	±0.03	±0.02	±0.02
	Cross-axis sensitivity <sup>②</sup>	±0.1%FS					
	Offset <sup>③</sup>	±0.005°			±0.008°		
	Repeatability	±0.0025°					
	Hysteresis	±0.0025°					
Allowed installation misalignment <sup>④</sup>	±4.0°	±3.0°	±2.5°	±1.5°	±1.2°	±1.2°	
Input-axis mislignment	≤±0.1°						
Sensitivity temperature drift coefficient (max.)	≤100ppm/°C	≤50ppm/°C					
Offset temperature drift coefficient(max.)	≤0.003°/°C						
Offset turn on repeatability <sup>⑤</sup>	±0.008°						
Resolution	0.0025°						
Long-term stability(1 year) <sup>⑥</sup>	≤0.02°						
Measurement axis	1 axis or 2 axis						
Temperature sensor	Range : -50~125°C , Accuracy:±1°C						
Function	Set zero point, baud rate, local gravitational acceleration value, zero calibration, vibration suppression filter coefficients, ID address, refresh rate, etc						
Output	Ethernet(TCP/IP/UDP Protocol)						
Cold start warming time	60s						
Response time <sup>⑦</sup>	0.3s(@t <sub>90</sub> )						
Refresh rate(digital output)	5Hz(Optional 10Hz,20Hz)						
Power supply	9~36VDC						
Power consumption	Average working current≤200mA(25°C&24VDC)						
Operation temperature range	-40~85°C						
Storage temperature range	-60~100°C						
EMC	According to EN 61000						
Insulation resistance	100MΩ						
MTBF	≥25000 hours						
Shock	100g@11ms , three-axis, half-sine						
Vibration	8grms, 20~2000Hz						
Protection	IP65 ( Optional IP67 )						
Connecting	Military class connector(MIL-C-26482)						
Weight	420g ( without connector and cables )						

① Combined absolute accuracy means the composite value of sensor's absolute linearity, repeatability, hysteresis, offset and cross-axis sensitivity error. (in room temperature condition) as

$$\Delta = \pm \sqrt{\text{absolute linearity}^2 + \text{repeatability}^2 + \text{hysteresis}^2 + \text{offset}^2 + \text{cross-axis sensitivity}^2} \text{ error}^2$$

② The cross-axis sensitivity means the angle that the tilt sensor may be banked to the normal tilt direction of sensor. The cross-axis sensitivity (±0.1%FS) shows how much perpendicular acceleration or inclination is coupled to the inclinometer output signal. For example, for the single-axis inclinometer with range ±30° (assuming the X-axis as measured tilt direction), when there is a 10° tilt angle perpendicular to the X-axis direction (the actual measuring angle is no change, example as +8.505°), the output signal will generate additional error for this 10° tilt angle, this error is called as cross-axis sensitivity error. SST300's cross-axis sensitivity is 0.1%FS, the extra error is 0.1%×30°=0.03°(max), then real output angle should be +(8.505°±0.03°). In SST300 series, this error has been combined into the absolute accuracy

③ Offset means that when no angle input (such as the inclinometer is placed on an absolute level platform), output of sensor is not equal to zero, the actual output value is zero offset value.

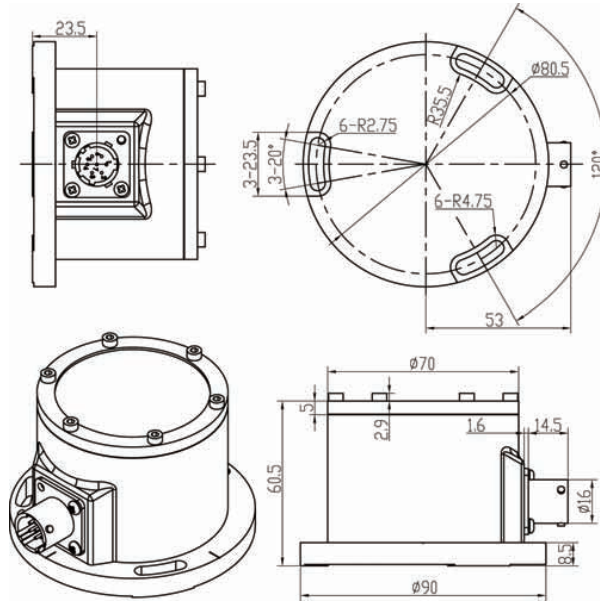
④ Allowed installation misalignment means during the installation, the allow able installation angle deviation between actual tilt direction and sensor's nature measurement direction. In general, when installed, SST300 sensor is required that the measured tilt direction keep parallel or coincident with sensor designated edge, this parameter can be allowed a certain deviation when sensor is installed and does not affect the measurement accuracy.

⑤ Offset turn on repeatability means the repeatability of the sensor in repeated by supply power on-off-on many times.

⑥ Long-term stability means the deviation between the statistics of the maximum and the minimum output value after a year of continuous power supply when the sensor is at 20°C.

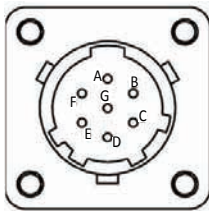
⑦ The response time refers to the angle sensor in a step change (such as the angle changes from -10° to +10° within 5ms), the time required that output of the sensor achieved to the standard value of 90%. The index is different from the sensor set-up time

## Dimensions (mm)



Picture 6 Housing with MIL class connector

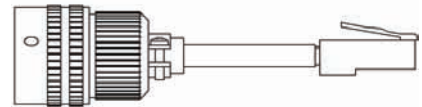
## Wiring



Picture 7 MIL connector socket (View from outside)

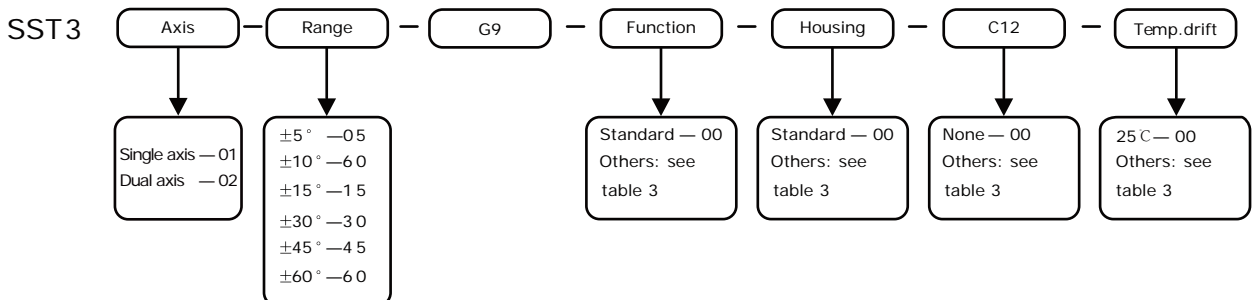
Table2 CAN pin definition

Pin	Signal
A	Power +
B	Power -
C	Shield GND
D	E-RXD+
E	E-RXD-
F	E-TXD+
G	E-TXD-



Picture 8 Standard cable and TCP/IP plug (C12)

## Ordering



For example, if order a dual-axis inclinometer with range  $\pm 30^\circ$ , room temperature accuracy  $\pm 0.02^\circ$ ,  $-20-60^\circ\text{C}$  drift accuracy  $\pm 0.02^\circ$ , output Ethernet, 25 meters cable with plug, vibration suppression function, the model should be chosen as: SST302-30-G9-F5-00-C12-D3 (25m)

Meanwhile some options (see table 4):

PC application software —order number SST003-04-09

Magnetic base—order number SST003-01-01

8 ports industry Ethernet switch —order number SST003-05-14

# Accessories & Options

Table 3 Accessories

Item	Order Code	Accessories name	Function
Functional module (built-in)	F1	GPS module	Positioning accuracy 2.5m CEP; 2.0m @ SBAS Local gravity acceleration automatic revision Time pulse accuracy: 30ns RMS Original data refresh rate: 4Hz Speed accuracy: 0.1m/s Receiver type: GPS L1 band, C/A code; Higher positioning accuracy GPS available
	F4	Gyro module	±100/250/400°/s, X/Y/Z axis dynamic angular rate In-run bias: ±0.02°/s, Non-linearity: 0.1%FS Bandwidth: 50Hz, Noise density : 0.02°/s/√Hz Higher accuracy gyro module available
	F5	Vibration module	Three-axis vibration detection, frequency response ≤5 kHz Range: 0g~±1g/ ±5g/ ±10g/ ±20g, adjustable Sampling(real-time): 20.48 kSPS Filter programmable, 11pcs set points FFT, 512-point, real valued, all three-axis(x, y, z) Storage: 14 FFT records on all three-axis(x, y, z) Alarm programmable, 6 spectrums
Temperature drift	D1	Temperature drift	Temperature compensation range 0~60°C, accuracy ±0.01°@≤±30°
	D2	Temperature drift	Temperature compensation range 0~60°C, accuracy ±0.01°@>±30°
	D3	Temperature drift	Temperature compensation range -20~60°C, accuracy ±0.02°@≤±30°
	D4	Temperature drift	Temperature compensation range -20~60°C, accuracy ±0.02°@>±30°
	D5	Temperature drift	Temperature compensation range -30~60°C, accuracy ±0.03°@≤±30°
	D6	Temperature drift	Temperature compensation range -30~60°C, accuracy ±0.03°@>±30°
	D7	Temperature drift	Temperature compensation range -40~65°C, accuracy ±0.05°@≤±30°
	D8	Temperature drift	Temperature compensation range -40~65°C, accuracy ±0.05°@>±30°
	D9	Temperature drift	Temperature compensation range -40~85°C, accuracy ±0.05°@≤±30°
	D10	Temperature drift	Temperature compensation range -40~85°C, accuracy ±0.05°@>±30°

Table 4 Options

Item	P/N	Option name	Function
Installation tools	SST003-01-01	Magnetic base	50kg suction, permanent magnet, stainless steel materials
	SST003-01-04	Adjustable base with micrometer screw	Three-points adjustment, resolution 0.001mm, stainless steel materials
Software	SST003-04-09	PC application software	Setting function, Command function, Tool function Operating platform: windows XP, Windows 7 More information please see datasheet at
Network access facility	SST003-05-14	8 ports industrial Ethernet switch	8 MB network, VLAN(IEEE802.1q) according to ITU-TG.8032 V2 Whole ring network failover time <5ms, support RSTP/STP IEEE 802.1x enhance user authentication
	SST003-05-15	LAN/WAN converter	According to ITU-TG-703/735/823 rate 10/100 Mbps, 100m distance, 1500V isolated full /half-duplex support VLAN long packets MAC address filter
Power	SST003-09-02	Portable battery packs	Output 24VDC, Continuous work 24 hours, IP65, rechargeable
Test report	SST003-11-01	Test report for cross-axis error	Accuracy test report under banking tilt, average 11 points of full range
	SST003-11-03	Test report for Allowed Installation misalignment	Axis migration test report for vertical and horizontal axis of inclinometer, 3 angles
	SST003-11-04	Test report for response time & hysteresis	The report for time response curve/ data and hysteresis characteristics

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