

# SST300

## DATASHEET

### Features

- Highest combined absolute accuracy, achieve max  $\pm 0.01^\circ$  @  $25^\circ\text{C}$  ;
- Absolute accuracy combined with absolute linearity, cross axis sensitivity error, offset, repeatability, hysteresis error
- Banking tilt up to  $60^\circ$ , the cross axis sensitivity error less than 0.1%
- Offset less than  $\pm 0.005^\circ$
- Provide installation deviation data of input axis misalignment, to realize more accurate installation and higher actual measuring accuracy
- Adjustable vibration suppression while sensor running
- Full range of temperature compensation accuracy(optional):  $\pm 0.05^\circ$  @  $-40^\circ\text{C} \sim +85^\circ\text{C}$
- Various output interfaces
- RoHS approved
- EMC certified



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# SST300

## Carried Standard

- GB/T 191 SJ 20873 General requirements for Inclinometer & levelmeter (China)
- GBT 18459 Methods for Calculating the Main static performance specifications for transducers(China)
- JJF 1059 Evaluation and Express of Uncertainty in Measurement(China)
- JJF 1094 Evaluation of the Characteristics of Measuring Instruments(China)
- JJF 1116 Calibration Specification for Linear Accelerometer used precision Centrifuge(China)
- QJ 2318 The test method of gyro & accelerometer(China)
- GJB 2786A General Requirements for Military Software Development(China)
- GJB 2884 General Specification for Three-axis angular motion simulator(China)
- MIL-HDBD-338B                    - MIL-STD-810F-506.4                    - IEC60529 IP                    - EN61000-4-6 CS
- ISO 5348 IDT                    - MIL-STD-810F-507.4                    - EN61000 -4-2 ESD                    - EN61000-4-8 PFMF
- MIL-STD-810F-501.4                    - MIL-STD-810F-510.4                    - EN61000-4-3 RS                    - EN61000-4-11 Voltage dips
- MIL-STD-810F-502.4                    - MIL-STD-810F-514.5                    - EN61000-4-4 EFT                    &Voltage variations
- MIL-STD-810F-503.4                    - MIL-STD-810F-516.5                    - EN61000-4-5 SURGE                    - ISTA-2A

## Description

SST300 series inclinometers are excellent tilt sensors which not only have an outstanding performance index, but also have the simulation and process with advanced EDA and CAE technologies including reliability design, strict process control, structure design, components/materials collection and heat treatment, heat flow analysis, finite element analysis and so on, to achieve high reliability and stability.

Each inclinometer should be performed with Vigor's patented automatic testing technologies without more manual operations and unpredictable random errors occupied. Not only the general accuracy test, but also the temperature drift compensation, nonlinear correction, cross-axis sensitivity error correction, and/or orthogonal error correction, input-axis misalignment compensation, vertical-axis misalignment of compensation, as well as life test, was made to reduce the additional error caused by filed installation, then realize to installed-to-forgot and acquire accurate data.

SST300 series inclinometer employs MEMS accelerometer principle, and combines with exclusive vibration suppression techniques to realize adjustment anytime while sensor running.

## Applications

- Vessel
- Precision instruments
- Security detection
- Civil engineering
- Military project
- Platform leveling
- Drilling machines
- Hydraulic leveling

# SST300

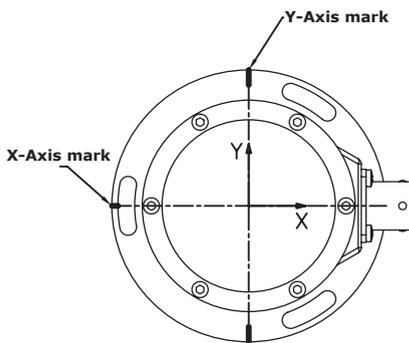
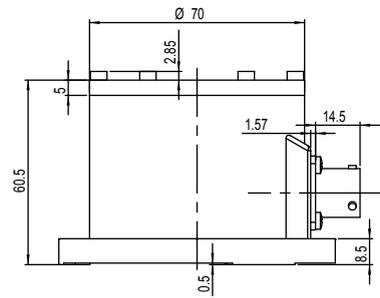
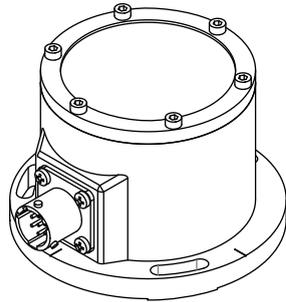
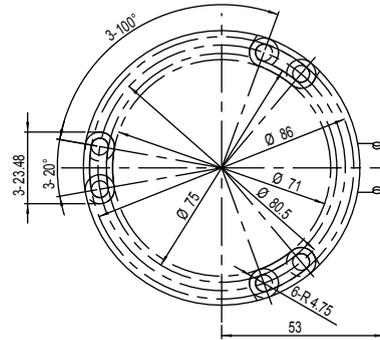
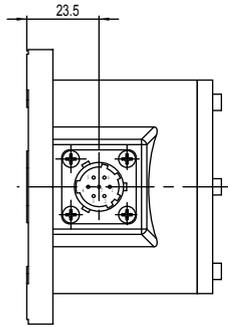
## Performances

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°
Subroutine parameter	Absolute linearity (least- squares fitting)	±0.06%FS	±0.03%FS	±0.03%FS	±0.03%FS	±0.02%FS	±0.02%FS
	Cross-axis sensitivity error <sup>②</sup>	±0.1%FS					
	Offset <sup>③</sup>	±0.005°				±0.008°	
	Repeatability	±0.0025°					
	Hysteresis	±0.0025°					
Input axis misalignment <sup>④</sup>		±4.0°	±3.0°	±2.5°	±1.5°	±1.2°	±1.2°
Sensitivity temp. 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 <sup>⑥</sup> (1 year)		≤0.02°					
Measurement axes		1 axes or 2 axis					
Temperature sensor		Range: -50~125 °C , Accuracy:±1 °C					
Output		RS232 (Optional 25 types, please refer to accessories table)					
RS232 output format		ASCII, Baud rate:115200, 8 data bits,1 start bit,1 stop bit, none parity					
Cold start warming time		60s					
Response time <sup>⑦</sup>		0.3s (@t <sub>90</sub> )					
Refresh rate(digital output)		5Hz (Optional 10Hz,20Hz)					
Response frequency <sup>⑧</sup> (analog output)		3Hz @-3dB					
Power supply		9~36VDC					
Power consumption		Average working current≤50mA; average power≤1.5W (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 survival		100g@11ms, three-axis (Half Sinusoid)					
Anti-vibration		8grms, 20 ~ 2000Hz					
Protection		IP65 (Optional IP67)					
Connector		Military class connector (MIL-C-26482)					
Weight		420g (without connector and cables)					

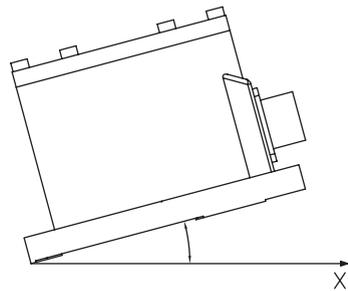
- ① Combined absolute accuracy means the compositive value of sensor's absolute linearity , repeatability, hysteresis, offset and cross-axis sensitivity error. (in room temperature condition) as
- $$\Delta = \pm \sqrt{\text{absolute linearity}^2 + \text{repeatability}^2 + \text{hysteresis}^2 + \text{offset}^2 + \text{cross-axis sensitivity error}^2}$$
- ② The cross-axis sensitivity error means the angle that the tilt sensor may be banked to the normal tilt direction of sensor. The cross-axis sensitivity ( $\pm 0.1\%FS$ ) shows how much perpendicular acceleration or inclination is coupled to the inclinometer output signal. For example, for the single-axis inclinometer with range  $\pm 30^\circ$  (assuming the X-axis as measured tilt direction), when there is a  $10^\circ$  tilt angle perpendicular to the X-axis direction (the actual measuring angle is no change, example as  $+8.505^\circ$ ), the output signal will generate additional error for this  $10^\circ$  tilt angle, this error is called as cross-axis sensitivity error. SST300's cross-axis sensitivity is  $0.1\%FS$ , the extra error is  $0.1\% \times 30^\circ = 0.03^\circ$  (max) , then real output angle should be  $+(8.505^\circ \pm 0.03^\circ)$ . 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 Input axis misalignment means during the installation, the allowable 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  $20^\circ C$ .
- ⑦ The response time refers to the angle sensor in a step change (such as the angle changes from  $-10^\circ$  to  $+10^\circ$  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
- ⑧ Response frequency is for the limitation of the dynamic measurement range, when the dynamic measurement exceeds 3 Hz, because of centripetal force, the output occupied additional random error , this error is difficult to define.

# SST300

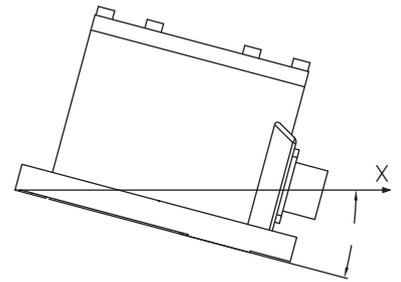
Outline (unit:mm)



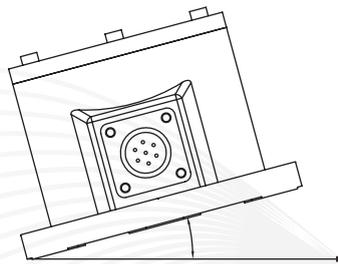
**Axial figure**



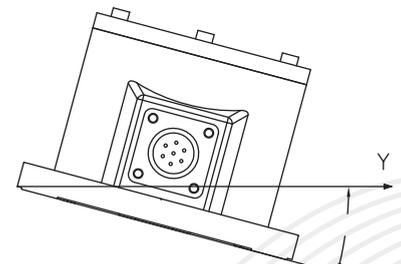
**X-axis positive angle**



**X-axis negative angle**



**Y-axis positive angle**

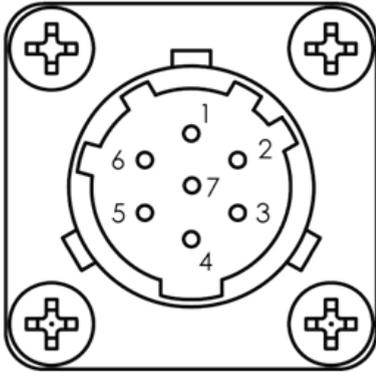


**Y-axis negative angle**

# SST300

## Plug Connector Allocation

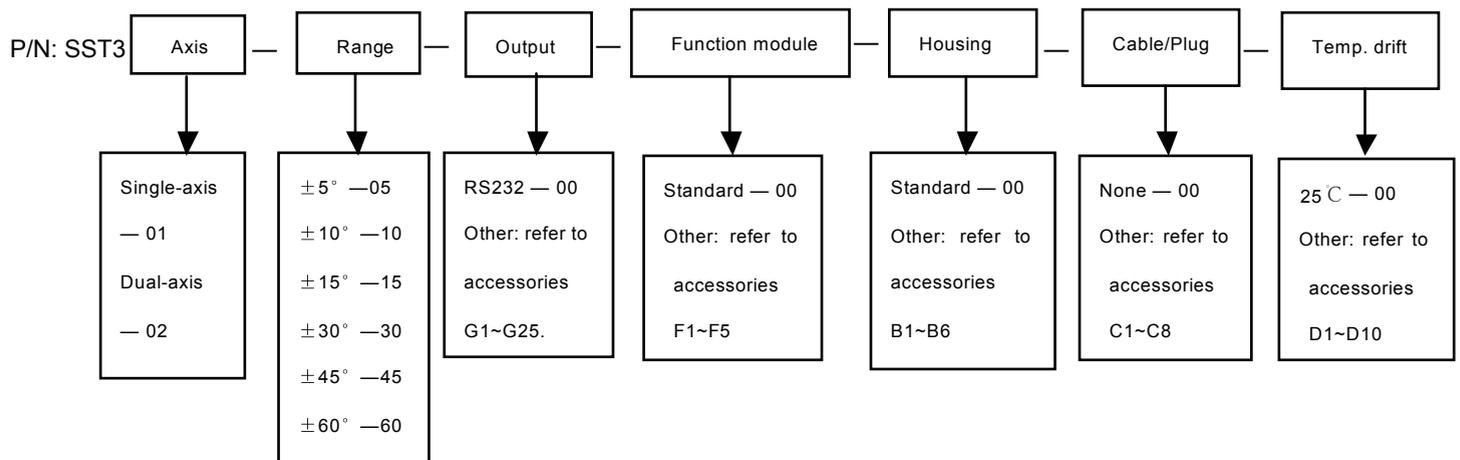
### Male plug (Front view of housing)



### Pin Definition

Pin	Signal (RS232)
1	Power+
2	Power-
3	Signal GND
4	NC
5	NC
6	RS232-TXD
7	RS232-RXD

### Ordering information



For example, if you order a dual-axis inclinometer, with range  $\pm 15^\circ$ , Output Zigbee wireless transmission, two meters cable with plug, vibration suppression function, anti-explosion housing, the model should be chosen as: SST302-15-G8-F5-B5-C1.

Meanwhile some optional accessories:

4 channels hub - order number SST003-05-06

Fixed installation base - order number SST003-01-05

Zigbee LCD display with lithium battery - order number SST003-04-07

Complementary power combined with solar and wind energy - order number SST003-09-03

Field calibration equipment (accuracy  $\pm 30''$ ) - order number SST003-10-02

# SST300

## Accessories and Options

SST300 accessories				
Item	PN	Order No.	Accessories name	Function
Output interface	SST003-07-01	G1	RS485 output	Standard industrial ModBus protocol, can be connected to PLC
	SST003-07-02	G2	RS422 output	Standard industrial interface, can be connected to PLC
	SST003-07-03	G3	CAN output	Standard industrial interface, can be connected to PLC
	SST003-07-04	G4	CAN open output	Standard industrial interface, can be connected to PLC
	SST003-07-05	G5	EtherCAT output	Standard industrial interface, can be connected to PLC
	SST003-07-06	G6	DeviceNet output	Standard industrial interface, can be connected to PLC
	SST003-07-07	G7	Profi-bus output	Standard industrial interface, can be connected to PLC
	SST003-07-08	G8	HART interface	Standard industrial interface, can be connected to PLC
	SST003-07-09	G9	TCP/IP interface	Standard industrial TCP/IP interface
	SST003-07-10	G10	USB2.0 interface	Standard industrial USB interface
	SST003-07-11	G11	Zigbee interface	Standard industrial 2.4GHz interface
	SST003-07-12	G12	Wi-Fi interface	Standard industrial interface
	SST003-07-13	G13	GPRS interface	Standard industrial level
	SST003-07-14	G14	CDMA interface	Standard industrial level
	SST003-07-15	G15	SSI output	Standard encoder interface
	SST003-07-16	G16	PWM output	Standard industrial level
	SST003-07-17	G17	Vibration string type output	Standard civil engineering industry interface
	SST003-07-18	G18	Fiber Interface	Single/multimode fiber, industrial level
	SST003-07-19	G19	4~20mA output	Standard industrial level
	SST003-07-20	G20	0~5VDC output	Standard industrial level
	SST003-07-21	G21	-5~+5VDC output	Standard industrial level
	SST003-07-22	G22	0~10VDC output	Standard industrial level
	SST003-07-23	G23	-10~+10VDC output	Standard industrial level
	SST003-07-24	G24	mV output	Standard industrial level
	SST003-07-25	G25	Switch output	Emergency alarm can be set, 2 points/axis
Functional module (built-in)	SST003-06-01	F1	Single GPS module integrated	Single GPS antenna, positioning accuracy less 3m, gravity correction and time synchronization function
	SST003-06-02	F2	Dual GPS module integrated	Dual GPS antenna, allow the max baseline length is 5 m, measure the course, the accuracy + /-0.2 ° @ 5 m baseline, gravity correction and time synchronization function.
	SST003-06-03	F3	Electronic compass module integrated	Plane compass (accuracy±5°when the angle changed within 30 degrees; 0.5 degrees when levels)
	SST003-06-04	F4	Gyro module integrated	Measuring Z axis Angle rate; Measuring X, Y axis dynamic Angle rate
	SST003-06-05	F5	Vibration module integrated	Measuring Z axis vibration value (0 ~500 HZ); Resistance to vibration (for compensation)
Housing	SST003-02-01	B1	Transient high temperature isolation housing	Withstand impact temperature up to1200 °C within 5 minute duration
	SST003-02-02	B2	Underwater housing	3000m underwater application, with connector
	SST003-02-03	B3	Nuclear radiation resistance	Apply to nuclear power plants, Anti-radiation 10 <sup>7</sup> rads Gamma

Housing	SST003-02-04	B4	Beam type housing	Hard aluminum alloy, optional 1~3m length
	SST003-02-05	B5	Anti-explosion housing	According to ATEX Zone2 (Europe); Class I, Division 2(Canada & USA) dIIBT4、dIICT6、ibIIBT4、iaIIBT4、iaIICT6(China)
	SST003-02-06	B6	Constant temperature housing	Suitable for low temperature, 5mins duration from -60 to +25 C
Cable/Plug	SST003-03-01	C1	Standard Cable with plug	Military class connector (meet MIL-C-26482) , Standard 2M cable, IP67 protection, heavy duty up to 30kg
	SST003-03-02	C2	Tensile reinforced shield cable	Heavy duty up to 50kg
	SST003-03-03	C3	High temperature cable	Up to 250 C
	SST003-03-04	C4	Aarmor cover cable	Increasing mechanical strength, erosion and anti-interference ability.
	SST003-03-05	C5	Watertight cable with plug	3000m underwater with special plug
	SST003-03-06	C6	Standard configuration plug	According to MIL-C-26482, IP67 protection
	SST003-03-07	C7	Compatible with Amphenol plug	Compatible with the standard of SST300 outlet, manufactured by Amphenol
	SST003-03-08	C8	Corners plug	90° corner, according to MIL-C-26482, IP67protection
Temperature drift	SST003-00-01	D1	Temperature drift	Temperature compensation range is 0~60 C, and temp. drift accuracy $\pm 0.01^{\circ}$ @ $\leq \pm 30^{\circ}$
	SST003-00-02	D2	Temperature drift	Temperature compensation range is 0~60 C, and temp. drift accuracy $\pm 0.01^{\circ}$ @ $> \pm 30^{\circ}$
	SST003-00-03	D3	Temperature drift	Temperature compensation range is -20~60 C, and temp. drift accuracy $\pm 0.02^{\circ}$ @ $\leq \pm 30^{\circ}$
	SST003-00-04	D4	Temperature drift	Temperature compensation range is -20~60 C, and temp. drift accuracy $\pm 0.02^{\circ}$ @ $> \pm 30^{\circ}$
	SST003-00-05	D5	Temperature drift	Temperature compensation range is -30~60 C, and temp. drift accuracy $\pm 0.03^{\circ}$ @ $\leq \pm 30^{\circ}$
	SST003-00-06	D6	Temperature drift	Temperature compensation range is -30~60 C, and temp. drift accuracy $\pm 0.03^{\circ}$ @ $> \pm 30^{\circ}$
	SST003-00-07	D7	Temperature drift	Temperature compensation range is -40~65 C, and temp. drift accuracy $\pm 0.05^{\circ}$ @ $\leq \pm 30^{\circ}$
	SST003-00-08	D8	Temperature drift	Temperature compensation range is -40~65 C, and temp. drift accuracy $\pm 0.05^{\circ}$ @ $> \pm 30^{\circ}$
	SST003-00-09	D9	Temperature drift	Temperature compensation range is -40~85 C, and temp. drift accuracy $\pm 0.05^{\circ}$ @ $\leq \pm 30^{\circ}$
	SST003-00-10	D10	Temperature drift	Temperature compensation range is -40~85 C, and temp. drift accuracy $\pm 0.05^{\circ}$ @ $> \pm 30^{\circ}$

## SST300 Options

Item	PN.	Accessories name	Function
Display instrument	SST003-04-01	Remote single-axis inclination display instrument	LED display tilt angle data, range setup, sensor power supply, RS485 output, suitable for analog output single-axis inclinometer
	SST003-04-02	Remote dual-axis inclination display instrument	LED display tilt angle data, range setup, sensor power supply, RS485 output, suitable for analog output dual-axis inclinometer
	SST003-04-03	Remote single-axis inclination display & Control instrument	Alarm settings (2 points/axis), relay output, LED display, sensor power supply, RS485 output, suitable for analog output, single-axis inclinometer
	SST003-04-04	Remote dual-axis inclination display & Control instrument	alarm setting (2 points/axis), relay output, LED display, sensor power supply, RS485 output, suitable for analog output dual-axis tilt sensors
	SST003-04-05	LCD display	4 ½ LCD display, single/dual axis
	SST003-04-06	Zigbee LCD display	External power supply, with AC/DC regulator, single/dual axis, 200m distance
	SST003-04-07	Zigbee LCD display	Built-in lithium battery to 8 hours supply, single/dual axis; 200m distance
	SST003-04-08	Zigbee LCD display/alarm	Built-in lithium battery to 8 hours supply, single/dual axis; sound/light alarm, emergency alarm can be set up, 200m distance
	SST003-04-09	Application software with PC	Functions: serial port setting, control, diagnose, record, adjustable sampling, zero setting and zero recovery, adjustable vibration suppression filter parameters
	SST003-04-10	Application software	The same function as SST003-04-09, can run in iPhone、iPad
	SST003-04-11	Three-dimensional angle display、 measurement software	Can cooperate with inclinometer, which including compass, gyro, GPS, and also can run in iPhone, iPad, PC
	SST003-04-12	Display software with 8 channels	Can combined with SST003-04-09, each channel can achieve independence, can run in iPhone、 iPad、 PC
	SST003-04-13	Flatness measuring software	Measure and display the surface flatness of object, can run in iPhone、 iPad、 PC
	SST003-04-14	Verticality measuring software	Through multiple of sensors, to realize the whole object's vertical degree measurement and display, can run in iPhone、 iPad、 PC
Converter	SST003-05-01	RS232-USB converter	RS232 convert to USB2.0, external ,industrial-grade
	SST003-05-02	RS232-CAN converter	RS232 convert to CAN2.0B, external ,industrial-grade
	SST003-05-03	RS232-GPRS converter	RS232 convert to GPRS wireless transmission, external ,industrial-grade
	SST003-05-04	4 in1 USB converter	4pcs USB access, 1 USB output, external ,industrial-grade
	SST003-05-05	4 in 1 RS232 converter	4pcs RS232 access, 1 USB output, external ,industrial-grade
	SST003-05-06	4 channels hub	Suitable for concentrated power supply and wiring distribution, IP65 protection, glass fiber materials, industrial field application
	SST003-05-07	8 channels hub	Suitable for concentrated power supply and wiring distribution, IP65 protection, glass fiber materials, industrial field application
	SST003-05-08	8 channels analog/digital signal data collection box	16 or 24 bits acquisition module, work independently, USB interface, can be connected with PC, etc
Installation tools	SST003-01-01	Magnetic base	50kg suction, permanent magnet, stainless steel materials
	SST003-01-02	Adjustable base	Three-points adjustment, range ±3°, stainless steel materials
	SST003-01-03	Adjustable base with bubble	Three-points adjustment, range ±3°, bubble accuracy is ±20", stainless steel materials
	SST003-01-04	Adjustable base with micrometer screw	Three-points adjustment, resolution 0.001mm, stainless steel materials
	SST003-01-05	Fixed installation base	Three-points adjustment, stainless steel materials
	SST003-01-06	Alignment block	Positioning sensor's X/Y axis to align with actual tilt direction
Power	SST003-09-01	AC/DC power supply	Input 220VAC, output 24VDC, output current 2A
	SST003-09-02	The portable rechargeable lithium battery packs	Output 24VDC, Continuous work 24 hours, IP65, rechargeable
	SST003-09-03	Complementary power combined with solar and wind energy	solar and wind energy, output 24VDC@1A, Day & night working
Calibration equipment	SST003-10-01	Field calibration equipment	Mechanical, manual, accuracy ±20", measurement range ±5°, single axis
	SST003-10-02	Field calibration equipment	Mechanical, manual, accuracy ±30", measurement range ±30°, single axis
	SST003-10-03	High accuracy calibration equipment for lab	Manual, with LED display, accuracy ±5", resolution 0.5", measurement range±180°, single axis, weight 20 kg
	SST003-10-04	Cross-axis error test equipment	Mechanical, manual, accuracy ±30", measurement range ±15°

Calibration equipment	SST003-10-05	Adjustable field level platform	Mechanical, manual, 3kgs payload ,level accuracy $\pm 10''$ , adjustable range(X/Y) $\pm 1^\circ$
Test report	SST003-11-01	Test report for cross-axis error	Accuracy test report under banking tilt, average 11 points of full range
	SST003-11-02	Test report for absolute linearity	Average 21 points of full range
	SST003-11-03	Test report for Input axis misalignment	Axis migration test report for vertical and horizontal axis of inclinometer, 3 angles of point
	SST003-11-04	Test report for response time and hysteresis	The report for time response curve/ data and hysteresis characteristics
	SST003-11-05	Test report for vibration	According to sensor's standard vibration characteristic
	SST003-11-06	Test report for mechanical shock	According to sensor's standard shock characteristic
	SST003-11-07	Test report for temperature shock	Test report of characteristics change under 10 C /minute rate
	SST003-11-08	MTBF analysis report	MTBF Statistical analysis report
	SST003-11-09	FMEA analysis report	FMEA analysis report
	SST003-11-10	Test report for life simulation	Test report for zero position and full range under 7 days continuously power on
	SST003-11-11	Test report for high-low temperature storage	According to MIL standard (meet MIL810F 501.4 ,502.4)
	SST003-11-12	Test report by China National Shanghai Measurement institute	Average 5 points of full range
	SST003-11-13	Test report for salt spray	According to MIL standard(meet MIL810F 509.4)
SST003-11-14	Test report for IP protection	According to IEC standard	
SST003-11-13	EMC test report	According to EN6000	



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VT003-6005-SC5.1