

Ethernet Inclinator



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Ethernet Inclinometer

Features

- 10/100M, Ethernet interface self-adaption
- AUTO MDI/MDIX available, use either cross-ruling or parallel cable
- Baud rate is adjustable in 300bps~230.4Kbps
- Kinds of operating model, TCP Server, TCP Client, UDP and Real COM driver, etc
- Built-in WEB server
- Disconnect automatically after detach GSM
- Support DNS, satisfy the communication needs by domain name
- Flexible points frame setting
- Up to 4 users to operate the module
- Single or multiple computer communication is available
- Advanced safety mechanism, up to 8pcs IP certification or section
- Remote configuration is available

Description

Ethernet inclinometer which based on experienced SST300 integrated 10/100M self-adaption TCP/IP protocol, user can easily build high performance measurement network. Up to 230.4Kbps baud rate with TCP Server, TCP Client, UDP and Real COM driver etc. operating models, support with four connections and domain access functions.

Via SST003-05-14 option(see table 3.2), end user can build Ethernet network of tilt measurement system himself without more supports. Also user can choice SST003-05-15 option(see table 3.2), may transfer Ethernet network into Internet to access/setup from/for inclinometer remotely

Operation mode

TCP Server Mode

Ethernet inclinometer is always waiting for the connection from TCP Client, rather than connects to other devices actively. Once the connection is built up, the bi-direction data transmission can be carried out.

TCP Client Mode

Ethernet inclinometer will actively connect to the destination TCP server. If it fails, the module will continually try to establish the connection to the TCP server according to the setting condition. Bi-direction data transmission will be carried out once connected.

Real COM Mode

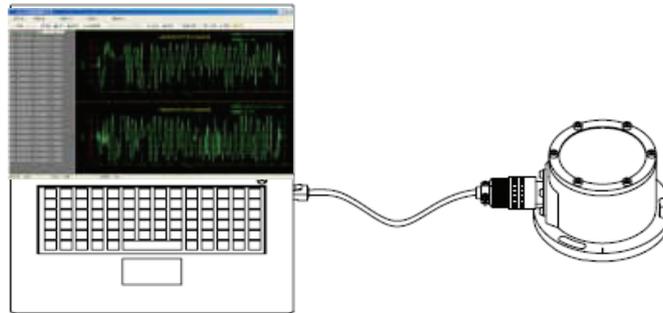
Ethernet inclinometer is actually working at TCP Server Mode. A servicer operated in the upper computer will actively build up a connection to SST300 Ethernet inclinometer, and increase a serial port on PC, that's the output serial port of SST300 inclinometer.

UDP mode

Ethernet inclinometer 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.

Point to point connection

Your Ethernet inclinometer can directly connect with any TCP/IP interface like as PC or laptop or mobile termination device. You may only need to supply power to inclinometer and with P/N SST003-04-09 option of PC application software.



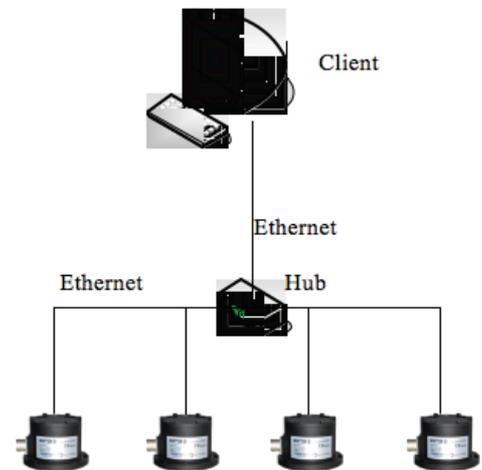
Picture 1 point to point connection

Ethernet network configuration

With 4pcs of Ethernet inclinometer and industrial Ethernet Switch device (P/N SST003-05-14, see table 3.2), a Ethernet network is easily built within short time.

This industrial Ethernet Switch device have many functions as:

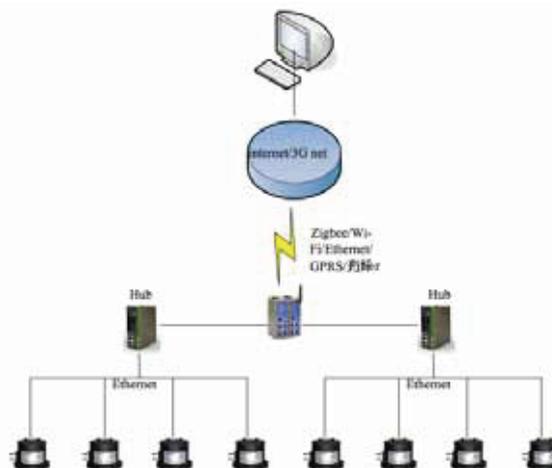
- Ultra-fast recovery of redundant ring protects critical networks
- Qos increases data determinism
- VLAN eases network planning
- SNMP inform enables reliable event management
- RMON provides efficient network monitoring and proactive management
- IGMP snooping and GMRP for filtering multicast traffic
- IEEE 802.1x enhance user authentication
- Broadcast storms filtering avoid network storm catastrophe



Picture 4 Ethernet network

Wireless Internet Network configuration

Based on Ethernet network, user easily to build meshed network of tilt measurement system via wireless router(P/N SST003-05-26, see table 3.2) of 3G,/GPRS/Wi-Fi etc. technologies, and LAN/WAN converter(P/N SST003-05-15, see table 3.2),to remotely access every inclinometer by internet network.



Picture 5 Remote access Network

Performances

Table 1 specifications

Measurement range		±5°	±10°	±15°	±30°	±45°	±60°
Combined absolute accuracy ^① (@25 °C)		±0.01°	±0.015°	±0.02°	±0.04°	±0.06°	±0.08°
Subroutine parameter	Absolute linearity (LSF,%FS)	±0.06	±0.03	±0.03	±0.03	±0.02	±0.02
	Cross-axis sensitivity ^②	±0.1%FS					
	Offset ^③	±0.005°				±0.008°	
	Repeatability	±0.0025°					
	Hysteresis	±0.0025°					
Input axis misalignment ^④		±4.0°	±3.0°	±2.5°	±1.5°	±1.2°	±1.2°
Sensitivity temperature drift coefficient(max.)		≤100ppm/°C		≤50ppm/°C			
Offset temperature drift coefficient(max.)		≤0.003%/ °C					
Offset turn on repeatability ^⑤		±0.008°					
Resolution		0.0025°					
Long-term stability(1 year)		≤0.02°					
Measurement axis		1 axis or 2 axis					
Temperature sensor		Range: -50~125°C ,Accuracy:±1°C					
Output		RS232 (optional 25 types, please refer to accessories)					
RS232 data format		115200 baud, 8 data bits, 1 start bit, 1 stop bit, none parity,ASCII					
Cold start warming time		60s					
Response time ^⑥		0.3s(@t ₉₀)					
Refresh rate(digital output)		5Hz(optional 10Hz,20Hz)					
Response frequency ^⑦ (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 h/times					
Shock		100g@11ms,three-axis, half- sine					
Vibration		8grms, 20~2000Hz					
Protection		IP67					
Connecting		Military class connector (MIL-C-26482)					
Weight		420g(without connector and cable)					

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

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

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 (±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 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.

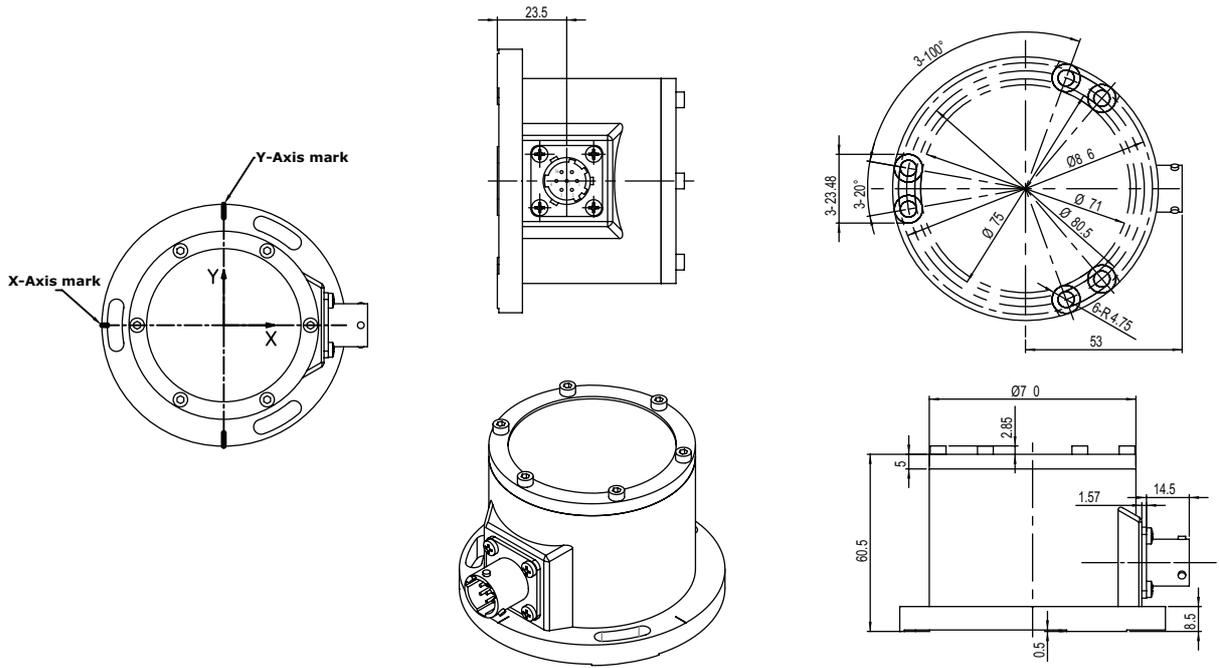
⑤ Offset turn on repeatability means the repeatability of the sensor in repeated by supply power on-off-on many times.

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°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

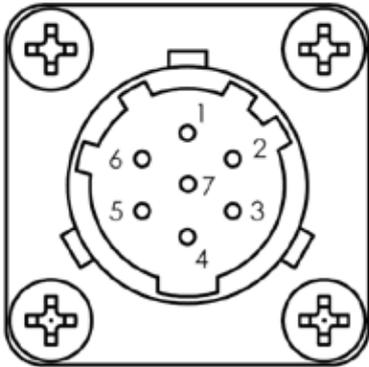
⑧ Response frequency is for the limitation of the dynamic measurement range, when the dynamic measurement exceeds 3 Hz, because of centripetal force, the output occupied additional random error,this error is difficult to define.

Dimensions (mm)



Picture 6 Ethernet Inclinometer mechanical draft

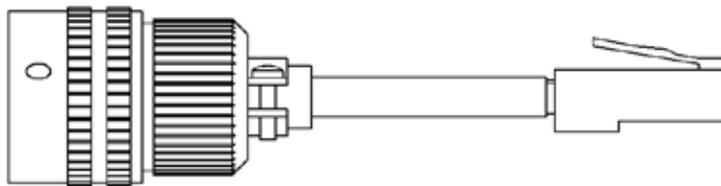
Wiring



Picture 7 MIL connector socket
(View from outside)

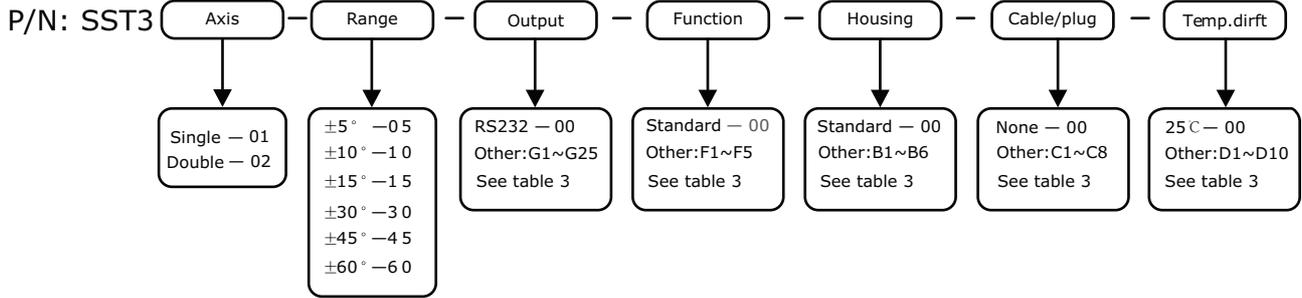
Table 2 MIL connector socket pin

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



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

Ordering information



For example, if order a dual-axis Ethernet inclinometer, with range $\pm 30^\circ$, room temperature accuracy $\pm 0.02^\circ$, $-20\sim 60^\circ\text{C}$ accuracy $\pm 0.02^\circ$, 2m cable with plug, vibration suppression function, the model should be chosen as: SST302-30-G9-F5 -00-C12-D3(2m).

Other options (see table 3.2):

PC application software (PC)——order number SST003-04-09

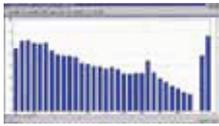
Magnetic base——order number SST003-01-01

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

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

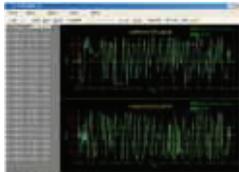
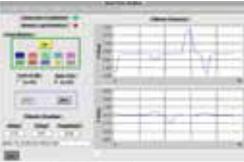
Field calibration equipment (accuracy $\pm 30''$) — order number SST003-10-02

Table 3.1 Accessories

	Item	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; GALILEO Open Service GLONASS FDMA SBAS: WAAS, EGNOS, MSAS Higher positioning accuracy GPS available
	F2	 GPS+Gyro module	Heading accuracy: $\leq 0.5^\circ\text{RMS}$ (including no GPS signals within 60s, no speedometer signal input), $\leq 0.3^\circ\text{RMS}$ (including Gasman speedometer signal input) Output refresh rate: 50~100Hz Cold start warming time: < 10S Positioning accuracy: $\leq \pm 3.0\text{m CEP}$ Output data: PPS, longitude and latitude, heading angle(relative to the arctic), Z axis angular rate data, X/Y acceleration data Angular rate measuring range: $\geq \pm 300^\circ/\text{s}$, Z axis, MEMS Acceleration measuring range: $\geq \pm 1.5\text{g}$, dual or three axis, MEMS
	F3	 Electronic compass	Adopt plane compass technology Range: $0\sim 360^\circ$ Heading accuracy: $< \pm 1.0^\circ\text{RMS}$ Resolution: 0.01° Hard magnetic compensation circuit Higher accuracy or 3D compass available
	F4	 Gyro module	X, Y, Z axis dynamic Angle rate Range: $\pm 100^\circ/\text{s}$, $\pm 250^\circ/\text{s}$, $\pm 400^\circ/\text{s}$ In-run bias accuracy: $\pm 0.02^\circ/\text{s}$ Non-linearity: 0.1%FS Sensitivity temperature drift accuracy: 0.5% $@ -40\sim +85^\circ\text{C}$ Bias temperature drift accuracy: $\pm 0.5^\circ/\text{s}$ $@ -40\sim +85^\circ\text{C}$ Bandwidth: 50Hz Noise density : $0.02^\circ/\text{s}/\sqrt{\text{Hz}}$ Higher accuracy gyro module available
	F5	 Vibration module	Three-axis vibration detection, frequency response $\leq 5\text{ kHz}$ Range: $0\text{ g}\sim \pm 1\text{ g}/ \pm 5\text{ g}/ \pm 10\text{ g}/ \pm 20\text{ g}$, adjustable Sampling time(real-time): 20.48 kSPS Filter programmable, 11pcs set points FFT, 512-point, real valued, all three-axis (x, y, z) Three windows: Rectangle, Hanning, Flat tope, adjustable FFT average value programmable, 255 max 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 , and temp. drift accuracy $\pm 0.01^\circ @ \leq \pm 30^\circ$
	D2	Temperature drift	Temperature compensation range 0~60°C , and temp. drift accuracy $\pm 0.01^\circ @ > \pm 30^\circ$
	D3	Temperature drift	Temperature compensation range -20~60°C , and temp. drift accuracy $\pm 0.02^\circ @ \leq \pm 30^\circ$
	D4	Temperature drift	Temperature compensation range -20~60°C , and temp. drift accuracy $\pm 0.02^\circ @ > \pm 30^\circ$
	D5	Temperature drift	Temperature compensation range -30~60°C , and temp. drift accuracy $\pm 0.03^\circ @ \leq \pm 30^\circ$
	D6	Temperature drift	Temperature compensation range -30~60°C , and temp. drift accuracy $\pm 0.03^\circ @ > \pm 30^\circ$
	D7	Temperature drift	Temperature compensation range -40~65°C , and temp. drift accuracy $\pm 0.05^\circ @ \leq \pm 30^\circ$
	D8	Temperature drift	Temperature compensation range -40~65°C , and temp. drift accuracy $\pm 0.05^\circ @ > \pm 30^\circ$
	D9	Temperature drift	Temperature compensation range -40~85°C , and temp. drift accuracy $\pm 0.05^\circ @ \leq \pm 30^\circ$
	D10	Temperature drift	Temperature compensation range -40~85°C , and temp. drift accuracy $\pm 0.05^\circ @ > \pm 30^\circ$

Table 3.2 Options

Item	P/N	Name	Function
Installation tools	SST003-01-01	Magnetic base	50kg suction, permanent magnet, stainless steel materials
	SST003-01-04	Adjustable base with micrometer	Three-points adjustment, resolution 0.001mm, stainless steel materials
	SST003-01-06	Alignment block	Positioning sensor's X\Y axis to align with actual tilt direction
Software	SST003-04-09	 PC application software(PC)	Setting: Serial interface communication settings, data save settings, data display settings, charts display settings, alarm settings Command: Zeros, filter factor, refresh rate, local gravity acceleration value, ID address, output method Tooling: Zero calibration, sensor software upgrades, data playback mode, real-time display mode, cursor display mode, sensor data Viewgraph: Status bar, tool bars, data area and chart area Operation: Windows XP, Windows 7 More information please refer to < SST003-04-09 datasheet>
	SST003-04-11-00	 iSS3 software	Communication distance: 200m max Settings : zero, range, sampling rate ,attitude measurement Three-dimensional data display Operation: Windows XP, Windows 7 More information please refer to < SST003-04-11-00 datasheet>
	SST003-04-12-00	 8 channels software	Can do data acquisition, save and monitor 8pcs SST300 inclinometer at one time Can show the angle changes graph, set the parameter of each inclinometer, alarm and multiple sensor net working Operation: Windows XP, Windows 7 More information please refer to < SST003-04-12-00 datasheet>
	SST003-04-13-00	 iSS2 flatness software	Communication distance 200m max Kinds of settings : zero, test range and sampling rate Output plane simulation chart Operation: Windows XP, Windows 7 More information please refer to < SST003-04-13-00 datasheet>

Network access facility	SST003-05-14	 8 ports industrial Ethernet switch	Passed IEC 61850-3 and IEEE 1613 EMC tests, operating temperature -40°C to +85°C Ultra-fast recovery of redundant ring protects critical networks Qos increases data determinism, VLAN eases network planning SNMP inform enables reliable event management RMON provides efficient network monitoring and proactive management IGMP snooping and GMRP for filtering multicast traffic IEEE 802.1x enhance user authentication Broadcast storms filtering avoid network storm catastrophe More information please refer to < SST003-05-14 datasheet>
	SST003-05-15	 LAN/WAN converter	According to ITU-T G-703 protocol and 10 Base-T Jitter transfer comply with ITU-T G-735, Jitter tolerance comply with ITU-T G-823 E1rate 2.048Mbps, 2km transmission distance, 1500 V electromagnetic isolation Ethernet network port rate 10 Mbps or 100 Mbps, 100 meters transmission distance Ethernet full-duplex/half-duplex working mode, support VLAN long packets MAC address filter: built in 10000 pieces MAC ID information More information please refer to < SST003-05-15 datasheet>
	SST003-05-26	 4-port Industrial Ethernet Router	DIN-rail mount 4-fixed Ethernet ports Ethernet WAN:ADSL/PPPoE/DHCP/Fixed IP Cellular backup to Ethernet WAN Support industrial bus protocols: Modbus TCP, Transparent TCP VPN:IPSec/PPTP/L2TP/GRE/SSL VPN Operation temperature range-25~70°C More information please refer to < SST003-05-26 datasheet>
Power	SST003-09-02	Portable rechargeable lithium battery packs	Output 24VDC, Continuous work 24 hours, IP65, rechargeable
Calibration equipment	SST003-10-02	Field calibration equipment	Mechanical, manual, accuracy $\pm 30''$, measurement range $\pm 30^\circ$, single axis
	SST003-10-03	High accuracy calibration equipment for lab	Manual, LED display, accuracy $\pm 5''$, resolution 0.5", measurement range $\pm 180^\circ$, single axis, weight 20 kg
	SST003-10-04	Cross-axis error test equipment	Mechanical, manual, accuracy $\pm 30''$, measurement range $\pm 15^\circ$
	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	Test report of characteristics change under 10°C / minute rate