Vigor Technology

Core Sensing Technology

Static inclination measurement technology	INS+GPS/BD combined inertial navigation technology
Quasi-dynamic tilt measurement technology	Dynamic pure inertial north finder
Dynamic inclination measurement technology	Marine inertial compass technology
Accelerometer and real-time data processing technology	Image measurement technology
Wireless transmission and advanced bus transmission technology	Motion simulation and simulation technology
Remote communication and monitoring technology based on cloud technology	Mathematical modeling and simulation technology
Data acquisition equipment and post-processing software technology	Carrier dynamic testing and system integration technology

R&D Strength

; `cVU``A Uf_Yh`CdYfUh]cb `7UdUV]`]hm

Since 2001, Vigor Technology has focused on the inclination measurement field and sold a full range of self-developed inclination sensors worldwide. We can obtain effective industry experience and market dynamics in time, quickly grasp the application characteristics and development trends of various industries, and provide professional advice and efficient product solutions for our customers.

Dck YfZ ``8Yj Y`cda Ybh`D`UhZcfa

Vigor Technology has more than 40 patents, 100 sets of test equipments, 60 professional engineers, advanced product and project management platform, and talent resources advantages in Shanghai, Wuhan and Changsha.

DfcZYgg]cbU`HYW\b]W0`5V]`]hm

. Static tilt measurement products based on MEMS/force balance servo/electrolyte;
. No cumulative drift dynamic attitude measurement products based on Strapdown Technology;
. Combined inertial navigation system for measuring attitude, position and speed based on loose/tight coupling technology;
. Remote monitoring system based on cloud computing and storage attitude, location, speed, etc.

A YYh`8]ZZYfYbh`HYgh`GhUbXUfXg`UbX`E i U`]hm`GhUbXUfXg

Vigor Technology has independent understanding of reliability and quality systems, and can also strictly follow GB, GJB, MIL, ISO, IEC, DN and other test standards. The ability to implement the specification is reflected not only in the performance test, reliability test, and environmental test of the overall product, but also on the quality management system. For example, the specifications of special industries such as TS16949, PA-9000, BASEEFA, EECS, ANSI and NCSL are the direction that Vigor Technology continues to work hard and develop. In the security field, Vigor Technology can also provide customers with products that meet the requirements of ISO13849-1 and IEC61508/IEC61511.

HYW\b]W0`5W]`]Yj Ya Ybhg

Highest resolution: 0.01"	Highest nonlinearity: ±0.001%FS
Maximum horizontal axis sensitivity: 0.02%FS	Maximum stability: ±1"@12 months
Highest temperature drift coefficient: ±3"@-40~85℃	
Highest dynamic inclination measurement accuracy: ±10 "	Highest dynamic north seeking accuracy: ±0.005°
Maximum speed measurement accuracy: 0.01km/h	Maximum positioning accuracy: 2cm (dynamic), 2mm (static)

SST20 Low Cost Inclinometer

Features

- Low cost, high performance, suitable for batch application
- 50Hz refresh rate max, 10Hz response frequency max
- ±0.5% Cross-axis error, ±0.15° or ±0.07° accuracy
- Available to horizontal, vertical, headstand, etc installation
- Auto-correct installation error
- IP67 protection
- 9~36VDC supply, compatible to automotive application
- Survive to 1500g shock while operating
- OEM available, MIL/ EN/DIN/ISO/IEC testing standard upon request application

Descriptions

SST20 inclinometer is designed on the basis of Vigor's advanced tilt measurement technology, to meet the low cost requirement, high reliability and volume application, performs high performance-cost ratio.

SST20 adopts most universal & mass-produced components, die-cast aluminum alloy casing, universal high reliability M12-5pin industrial connector, full epoxy seal with IP67 protection, auto-test/calibration equipments which not only ensure delivery speed, also keep the consistency of goods.

Thanks for Vigor engineers, they adopt advanced technologies as:
- CAE/EDA simulation;
- Modal test for both housing and PCB to eliminate resonance due to vibration;
- Comprehensive performance & function test for component & firmware;
- Refer MIL/ EN/ ISO/IEC standards to enhance SST20 durability & reliability.

SST20 supports remote diagnosis without disassembling. MTBF more than 10 years per time and has good EMC ability.

SST20 can output RS232/RS485/CAN/CANopen and Voltage/Current signals. Better power management to meet with automotive /truck/vehicle application without regulated power.

OEM service is available with MIL qualified.

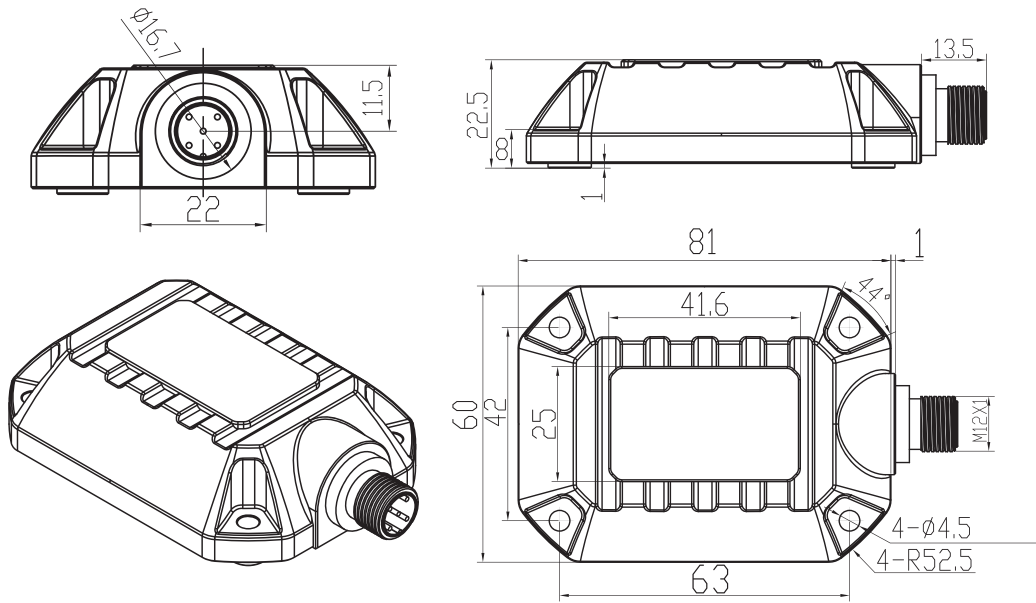## Applications

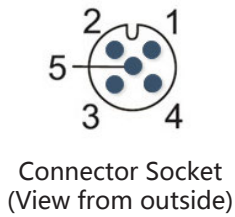|		
-Engineering machinery	-Automobile/truck/vehicle	-Shipping
-Solar/wind energy	-Radar/Antenna motion monitoring	-Civil engineering
-Landslide	-Communication/electric tower monitoring, etc	

Performances

Table1 Specifications

Range	±5°、±10°、±15°、±30°、±45°、±60°、±90°、0~360°(±180°@single axis)	
Accuracy	Digital output : ±0.07°@-15~50℃ Analog output : ±0.15°@-15~50℃	
Resolution	0.01°	
Cross-axis sensitivity	±0.5%FS	
Repeatability	±0.02°	±0.05°
Offset	±0.02°	±0.05°
Measurement axis	1 or 2 axis	
Bandwidth	3Hz, (10Hz max)	
Reponse time	0.3s@t90	
Refresh rate	5Hz , (50Hz max)	
Cold start warming time	60s	
Function	zeroing、baud rate、refresh rate、zero point correction、bandwidth、ID address	
Output	CAN2.0B：according to ISO11898-2 standard, twisted-pair output,5k~1Mbit/s baud rate, support 127 nodes, max cable length 10Km, built in high speed photoelectric isolator	
	CANOpen：according to DS301、DS303、DS305 standard，confirm to CiA 410 protocol standard, 5k~1Mbit/s baud rate support 127 nodes, max cable length 10Km, built in high speed photoelectric isolator	
	Voltage output : 0.5~4.5VDC ; output consumption 0.3Ω ; load impedance<100Ω	
	Current output: 4~20mA; output consumption 50MΩ; load impedance ＜400Ω	
	RS485 output: 9600bps（adjustable），8 data bits，1 start bit，1 stop bit，none parity	
Power supply	RS485/CAN/CANopen output : current consumption≤15mA@9~36VDC , no-load	
	Voltage/current output : current consumption≤25mA@9~36VDC , no-load	
Operation temperature	-40~85℃	
Storage temperature	-40~85℃	
EMC	According to EN610000 and GBT17626	
Insolation	≥100MΩ	
MTBF	10 years	
Shock	100g@11ms , three-axis , half-sine	
Vibration	8grms , 20~2000Hz	
Protection	IP67	
Connecting	M12-5Pin socket	
Weight	≤200g (without connector and cable)	

Dimensions（mm）

Wiring

Connector Socket
(View from outside)

Pin	Wire color	RS232	RS485	CAN	Current	Voltage
1	Red	Power+	Power+	Power+	Power+	Power+
2	Black	Power-	Power-	Power-	Power- & Signal GND	Power & Signal GND
3	Blue	TXD	A	CAN-H	Ix	Vx
4	Brown	RXD	B	CAN-L	Iy	Vy
5	Green	Signal GND	Signal GND	CAN-GND	Teach-in	Teach-in

Ordering

SST20

Axis	Accuracy	Range	Output

| Single axis — 01
Dual axis — 02 | ±0.15°—P1
±0.07°—P2 | ±5°—05
±10°—10
±15°—15
±30°—30
±45°—45
±60°—60
±90°—90
±180°—180
0~360°—360 | RS232—00
RS485—G1
CAN2.0B—G3
CANOpen—G4
0.5~4.5V—G20
4~20mA—G19 |
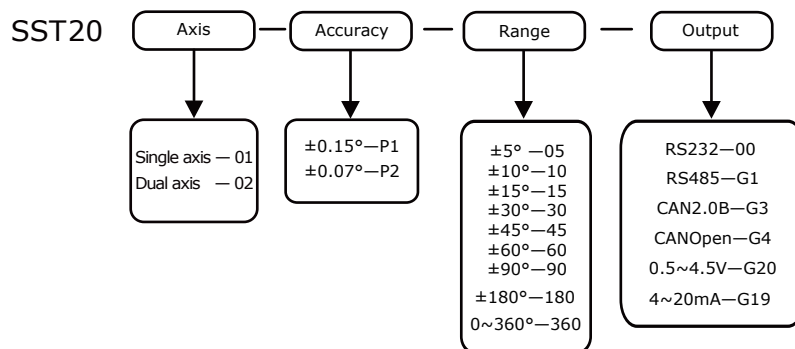
For example: if order a dual-axis SST20 inclinometer, range ±60°, ±0.07°accuracy, output CAN2.0B, the model should be chosen as : SST20-02-P2-60-G3

SST100 High-Reliability Inclinometer

Features

- High stability & performance-cost ratio
- Small size, light weight, easy to integrate
- Cross-axis sensitivity ≤ ±0.3%FS
- Full-seal, resistant to vibration and shock
- IP67 protection
- Reference nearly 50 industrial/military standards

Description

SST100 inclinometer is a high-reliability tilt angle measurement product for construction machinery industry application. This inclinometer adopts various technologies for improving reliability & stability, including full-sealing, enhanced PCBA design, optimized power management, enhanced resistance to shock & vibration, 30kg tensile cable, motion simulation of life testing, patented automatic test technology and precision machining of aluminum alloy.

SST100 inclinometer adopts low-g MEMS acceleration sensors with 2000g shock. Through non-linearity compensation, cross-axis sensitivity error compensation, filtering etc, it directly outputs analog signals proportional to the actual tilt angle, angle ASCII data, etc.

Applications

Mobile construction machinery, Factory automation, Solar equipment, Transportation machinery,Medical equipment, etc.

Referenced Standards

- GB/T 191 SJ 20873 General requirements for Inclinometer & levelmeter (China)
- GBT 18459 Methods for Calculating the Main static performance specifications for tansducers(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 Centrifuger(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)
- EN61000-4-11 Voltage dips &Voltage variations
- MIL-HDBD-338B
- ISO 5348 IDT
- MIL-STD-810F-501.4
- MIL-STD-810F-502.4
- MIL-STD-810F-503.4
- MIL-STD-810F-506.4
- MIL-STD-810F-510.4
- MIL-STD-810F-514.5
- MIL-STD-810F-516.5
- IEC60529 IP
- EN61000 -4-2 ESD
- EN61000-4-3 RS
- MIL-STD-810F-507.4
- EN61000-4-4 EFT
- EN61000-4-5 SURGE
- EN61000-4-6 CS
- EN61000-4-8 PFMF
- ISTA-2A

Performances

Table1 SST141/2,SST151/2,SST161/2 Inclinometer

Product type	SST141,SST142,SST151,SST152,SST161,SST162 with analog/digital output							
Measurement range	±5°	±10°	±15°	±30°	±45°	±60°	±90°	±180°
Accuracy(@25℃)	±0.1°							
Temperature drift coefficient /℃ @ -20~65℃	±0.004°			±0.005°			±0.009°	
Resolution	0.01°							
Repeatability	±0.02°							
Offset repeatability	±0.02°							
Offset	±0.02°							
Measurement axis	1 axis:SST141,SST151,SST161							
	2 axis:SST142,SST152,SST162							
Response time	0.3s @ t_{90}							
Cross-axis sensitivity	±0.3%FS							
Digital output for SST161,SST162	RS232(optional RS485、CAN、CANopen、J1939), Format: 9600bps(adjustable),8 data bits,1 start bit,1 stop bit,none parity							
Voltage output for SST141,SST142	0.5~4.5VDC Output Impedance:0.3Ω,load impedance:< 380Ω							
Current output for SST151,SST152	4~20mA Output Impedance:50MΩ,load impedance:< 380Ω							
Cold start warming time	60s							
Power supply	With digital/voltage output:9~36VDC,consumption≤20mA							
	With current output:16~36VDC,consumption≤40mA							
Power supply reject ratio	≥85dB							
Operation temperature range	-40~85℃							
Storage temperature range	-40~100℃							
EMC	According to GBT17626							
Insulation resistance	≥100MΩ							
MTBF	150000h/times							
Shock	100g@11ms,three-axis,half-sine							
Vibration	8grms,20~2000Hz							
Protection	IP67							
Housing	6061-T6 Aluminum alloy							
Connecting	Standard: Binder712 connector（optional: metal pigtail）							
Cable	7-wire shielded cable with tensile reinforcement, heavy duty up to 30Kg							
Weight	≤240g(without connector and cable)							

Wiring
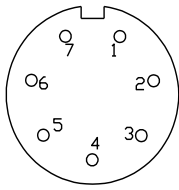
Picture 1 Binder712 socket
(View from outside)
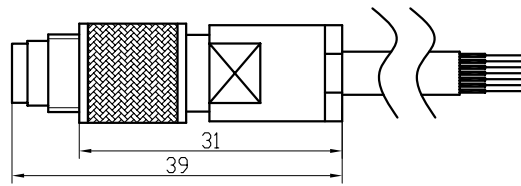

Picture 2 Binder712 plug and cable

Table 2 Analog/digital output wiring

Binder712 pin	Pigtail wire color	Output							
		SST151	SST152	SST141	SST142	SST161	SST162	Option	
		4~20mA		0.5~4.5VDC		RS232		RS485	CAN
1	Red	Power+	Power+	Power+	Power+	Power+	Power+	Power+	Power+
2	Black	Power -	Power -	Power -	Power -	Power -	Power -	Power -	Power -
3	Green	Signal GND	Signal GND	Signal GND	Signal GND	Signal GND	Signal GND	Signal GND	Signal GND
4	Yellow	Iout	Ioutx	Vout	Voutx	NC	NC	NC	CAN-H
5	White	NC	Iouty	NC	Vouty	NC	NC	NC	CAN-L
6	Blue	NC	NC	NC	NC	RS232-TXD	RS232-TXD	RS485-A	NC
7	Brown	NC	NC	NC	NC	RS232-RXD	RS232-RXD	RS485-B	NC

Dimensions (mm)
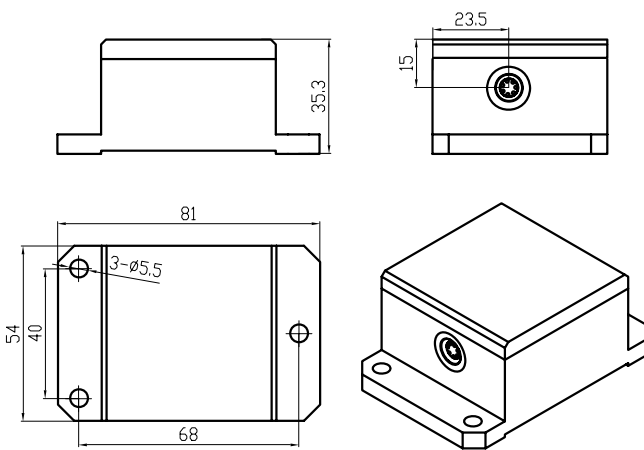
Picture 3 SST100 with Binder712 connector
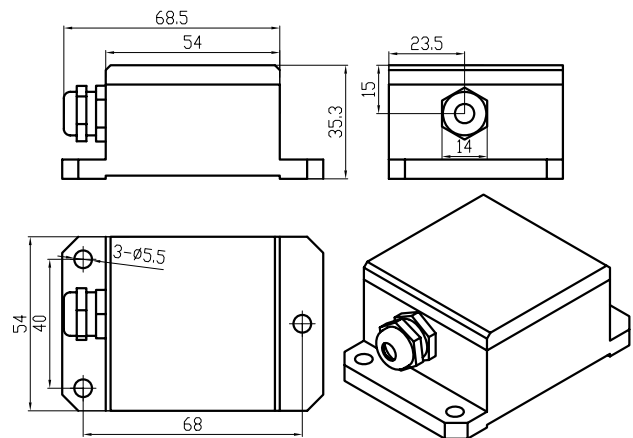
Picture 4 SST100 with metal pigtail

Ordering information

Model	Axis	Connector	Output	Range
SST141	1	Binder712(-C) ,optional Pigtail (-P)	0.5~4.5VDC	±5°,±10°, ±15°,±30°, ±45°,±60°, ±90°, ±180°
SST142	2	Binder712(-C) ,optional Pigtail (-P)	0.5~4.5VDC	
SST151	1	Binder712(-C) ,optional Pigtail (-P)	4~20mA	
SST152	2	Binder712(-C) ,optional Pigtail (-P)	4~20mA	
SST161	1	Binder712(-C) ,optional Pigtail (-P)	RS232(Optional RS485、CAN、CANopen、J1939)	
SST162	2	Binder712(-C) ,optional Pigtail (-P)	RS232(Optional RS485、CAN、CANopen、J1939)	

For example: if order a dual-axis SST162 inclinometer, range ±60°, binder712 connector, output RS485,the model should be chosen as: SST162-60-G1-C

SST300 High-Performance Inclinometer

Features

- Highest combined absolute accuracy ±0.01°@25℃
- Absolute accuracy combined with absolute linearity，cross-axis sensitivity，offset，repeatability，hysteresis
- Cross-axis sensitivity ≤±0.1%FS
- Offset ≤±0.005°
- Precise installation & higher actual accuracy
- Adjustable vibration suppression while running
- Temperature drift accuracy（optional）：±0.05°@-40~+85℃
- Various output interfaces
- Carried 50 industry & military standards
- Principle of MEMS accelerometer

Description

SST300 inclinometer is an excellent tilt device which not only has outstanding performance, but also has simulation & process with advanced EDA&CAE technologies including reliability design, strict process control, structure design, components/materials collection & heat treatment, heat flow analysis, finite element analysis and so on, to achieve high reliability and stability.

Each inclinometer is performed with Vigor's patented automatic testing technologies without manual operations and unpredictable random errors occupied. Not only general accuracy test, but also temperature drift compensation, nonlinear correction, cross-axis sensitivity error correction, and/or orthogonal error correction, input-axis misalignment compensation, vertical-axis misalignment compensation, as well as life test, are developed to reduce additional error caused by filed installation, and realize care-free installation and accurate data acquisition.

Applications

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

Carried Standards

- GB/T 191 SJ 20873 General requirements for Inclinometer & levelmeter (China)
- GBT 18459 Methods for Calculating the Main static performance specifications for tansducers(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 Centrifuger(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)
- EN61000-4-11 Voltage dips &Voltage variations

|		
- MIL-HDBD-338B	- MIL-STD-810F-510.4	- MIL-STD-810F-507.4
- ISO 5348 IDT	- MIL-STD-810F-514.5	- EN61000-4-4 EFT
- MIL-STD-810F-501.4	- MIL-STD-810F-516.5	- EN61000-4-5 SURGE
- MIL-STD-810F-502.4	- IEC60529 IP	- EN61000-4-6 CS
- MIL-STD-810F-503.4	- EN61000 -4-2 ESD	- EN61000-4-8 PFMF
- MIL-STD-810F-506.4	- EN61000-4-3 RS	- ISTA-2A

Performances

Table 1 Specification

Measurement range		±5°	±10°	±15°	±30°	±45°	±60°
Combined absolute accuracy[①](@25 ℃)		±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/℃	≤50ppm/℃				
Offset temperature drift coefficient (max.)		≤0.003°/ ℃					
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℃ ,Accuracy: ±1℃					
Output		RS232 (optional G1~G23, please refer to accessories)					
RS232 data format		115200 baud rate, 8 data bits, 1 start bit, 1 stop bit, none parity					
Cold start warming time		60s					
Response time[⑦]		0.3s(@t_{90})					
Refresh rate(digital output)		5Hz(optional 10Hz,20Hz)					
Response frequency[⑧] (analog output)		3Hz @-3dB					
Power supply		9~36VDC					
Power consumption		Average working current≤50mA, average power≤1.5W (25℃ &24VDC)					
Operation temperature range		-40~85℃					
Storage temperature range		-60~100℃					
EMC		According to EN 61000 and GBT17626					
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

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

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 measure ment 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℃ .

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 defin

Dimensions (mm)

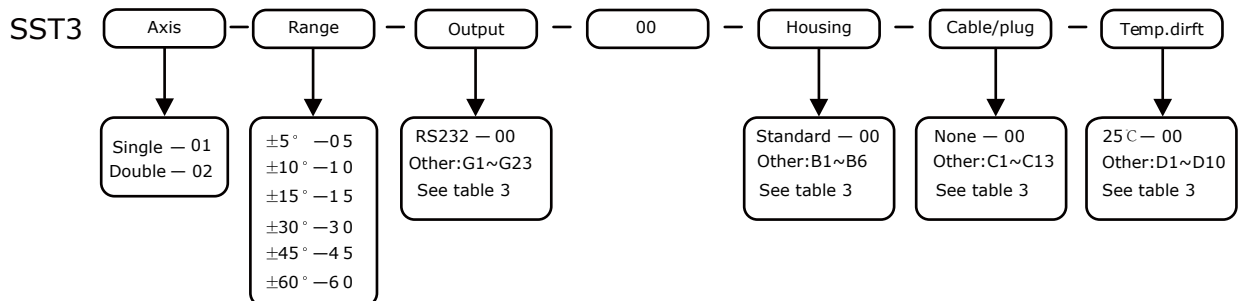Axial figur
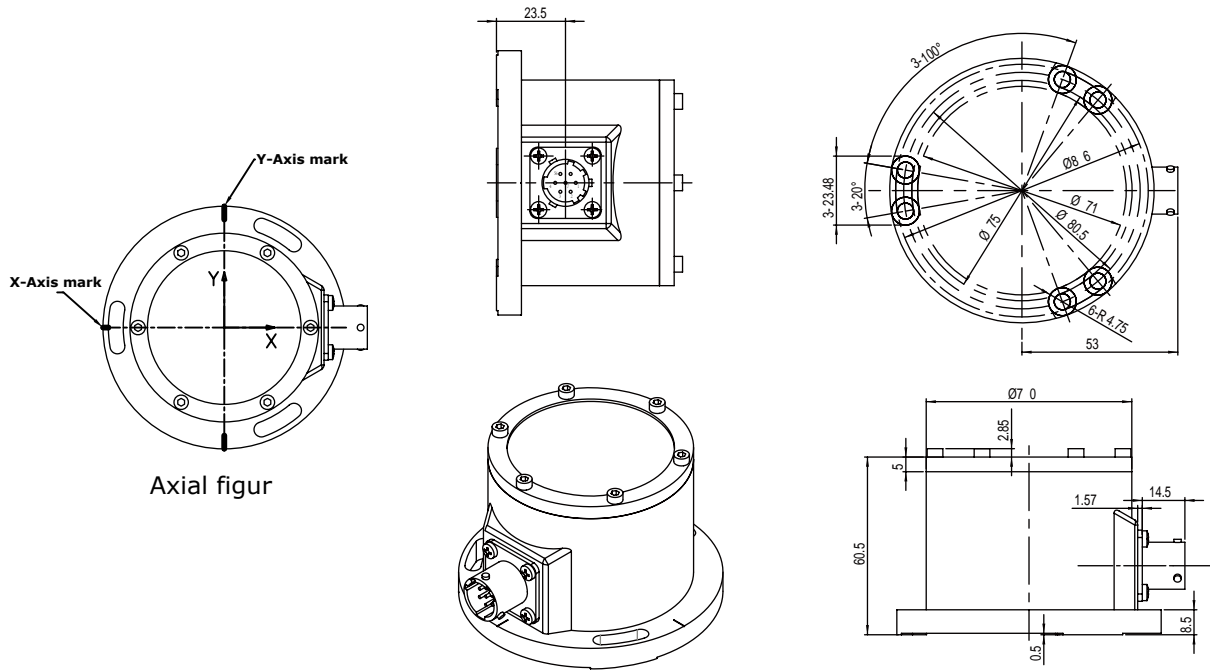
Picture 1 Housing with MIL class connector

Wiring
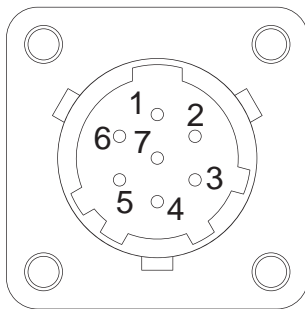
Picture 2 MIL connector socket
(View from outside)

Table 2 MIL connector socket pin definition

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

Ordering information

SST3 — Axis — Range — Output — 00 — Housing — Cable/plug — Temp.dirft

Axis	Range	Output	Housing	Cable/plug	Temp.dirft
Single — 01 Double — 02	±5°—05 ±10°—10 ±15°—15 ±30°—30 ±45°—45 ±60°—60	RS232 — 00 Other:G1~G23 See table 3	Standard — 00 Other:B1~B6 See table 3	None — 00 Other:C1~C13 See table 3	25℃— 00 Other:D1~D10 See table 3

For example, if order a dual-axis inclinometer, with range ±15°, ±0.02°accuracy@-20~60℃, output Wi-Fi wireless transmission, two meters cable with plug, the model should be chosen as: SST302-15-G12-00-00-C1-D3.

Accessories & Options

Table 3 Accessories

Item	Order Code	Accessories name	Function
Output interface	G1	RS485 output	Standard industrial ModBus protocol, can be connected to PLC
	G2	RS422 output	Standard industrial interface,can be connected to PLC
	G3	CAN output	Standard industrial interface, can be connected to PLC
	G4	CAN open output	Standard industrial interface, can be connected to PLC
	G7	Profi-bus output	Standard industrial interface, can be connected to PLC
	G9	TCP/IP interface	Standard industrial TCP/IP interface
	G10	USB2.0 interface	Standard industrial USB interface
	G12	Wi-Fi interface	Standard industrial interface
	G13	GPRS interface	Standard industrial level
	G19	4~20mA output	Standard industrial level
	G20	0~5VDC output	Standard industrial level
	G21	-5~+5VDC output	Standard industrial level
	G22	0~10VDC output	Standard industrial level
	G23	-10~+10VDC output	Standard industrial level
Housing	B1	Transient high temperature isolation housing	Withstand impact temperature up to 1200℃ within 5 minutes' duration
	B2	Underwater housing	5~3000m underwater application, with connector
	B3	Nuclear radiation resistance housing	Apply to nuclear power plants, Anti-radiation 10^7 rads Gamma
	B4	Beam type housing	Hard aluminum alloy, optional 1~3m length
	B5	Anti-explosion housing	According to ATEX Zone2 (Europe), Class I, Division 2(Canada & USA) dIIBT4,dIICT6,ibIIBT4,iaIIBT4,iaIICT6(China)
	B6	Constant temperature housing	Suitable for low temperature,5mins duration from -60 to +25℃

Cable/Plug	C1	Standard Cable with plug	Military class connector(meet MIL-C-26482),Standard 2M cable,IP67 protection, heavy duty up to 30kg
	C2	Tensile reinforced shield cable	Heavy duty up to 50kg
	C3	High temperature cable	Up to 250℃
	C4	Armor cover cable	Increasing mechanical strength, erosion and anti-interference ability.
	C5	Watertight cable with plug	3000m underwater with special plug
	C6	Standard plug	According to MIL-C-26482,IP67 protection
	C7	Compatible with Amphenol plug	Compatible with the standard of SST300 outlet, manufactured by Amphenol
	C8	Corners plug	90° corner,according to MIL-C-26482,IP67 protection
	C9	Explosion proof connectors and cables	For SST30X-XX-XXX-00-B5-C9-XX only
	C10	Pigtail connector	Only for beam tilt sensor SST301-XX-XXX-XX - B4-C10-XX
	C11	USB cable	For SST30X-XX-G10-00-00-C11-XX only, one end is MIL connector, the other end is USB port.
	C12	Ethernet cable	For SST30X-XX-G9-00-B5-C12-XX only, one end is MIL connector, the other end is RJ45
	C13	CAN/CANopen cable	Military class connector, standard 2M long, DB-9 interface at the other end, IP67 protection, anti 30KG pull
Temperature drift	D1	Temperature drift	Temperature compensation range is 0~60℃ , and temperature drift accuracy ±0.01°@≤±30°
	D2	Temperature drift	Temperature compensation range is 0~60℃ , and temperature drift accuracy ±0.01°@>±30°
	D3	Temperature drift	Temperature compensation range is -20~60℃ , and temperature drift accuracy ±0.02°@≤±30°
	D4	Temperature drift	Temperature compensation range is -20~60℃ , and temperature drift accuracy ±0.02°@>±30°
	D5	Temperature drift	Temperature compensation range is -30~60℃ , and temperature drift accuracy ±0.03°@≤±30°
	D6	Temperature drift	Temperature compensation range is -30~60℃ , and temperature drift accuracy ±0.03°@>±30°
	D7	Temperature drift	Temperature compensation range is -40~65℃ , and temperature drift accuracy ±0.05°@≤±30°
	D8	Temperature drift	Temperature compensation range is -40~65℃ , and temperature drift accuracy ±0.05°@>±30°
	D9	Temperature drift	Temperature compensation range is -40~85℃ , and temperature drift accuracy ±0.05°@≤±30°
	D10	Temperature drift	Temperature compensation range is -40~85℃ , and temperature drift accuracy ±0.05°@>±30°

Explosion-Proof Inclinometer

Features

- Real high accuracy & long-term stability, analog signal output
- Armored cable, Anti-pull, wear & corrosion resistance and so on
- EXdIICT6 explosion-proof
- IP66 protection
- Aluminum alloy shell, Low cost

Descriptions

Explosion-proof inclinometer is developed on the basis of Vigor's patented tilt technology and special EX protections, featuring real high accuracy and high safety & durability with robust casting aluminum, adopting professional connector/cable/protection/grounding etc.

Explosion-proof inclinometer has strong tilt measuring ability:

√ ±0.02%FS linearity
√ ±0.005°Offset
√ 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 error, upgrade real-tilt angle measuring accuracy, abandoned the traditional incomplete understanding for tilt angle measurement accuracy concept
√ Greatly reduce measuring errors when the real tilt direction not consistent for unit's sensitive axis
√ Short-circuit, transient voltage, overheat protection and transposition protection to adapt to industry environment

Applications

Level measurement in harsh environment (petroleum, chemical industry, natural gas, flammable and explosive), precision angle measurement, and industry & lab equipment leveling.

Attitude monitoring, angle measurement and alarming of the building and structures in gas explosion-proof zone 1 & 2 and dust explosion-proof zone 21 & 22.

Attitude monitoring in harsh environment, such as offshore drilling platform, large-inflammable and explosive storage, complex geology, dangerous vehicles and vessels. Also applied for monitoring the detection equipment in the dangerous area.

Performances

Table 1 Specifications

Measurement range		±5°	±10°	±15°	±30°	±45°	±60°
Combined absolute accuracy①(@25℃)		±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 sensitivity②	±0.1%FS					
	Offset③	±0.005°			±0.008°		
	Repeatability	±0.0025°					
	Hysteresis	±0.0025°					
Allowed installation misalignment④		±4.0°	±3.0°	±2.5°	±1.5°	±1.2°	±1.2°
Input-axis mislignment		≤±0.1°					
Sensitivity temperature drift coefficient(max.)		≤100ppm/℃	≤50ppm/ ℃				
Offset temperature drift coefficient(max.)		≤0.003°/ ℃					
Offset turn on repeatability⑤		±0.008°					
Resolution		0.0025°					
Long-term stability⑥		≤0.02°					
Measurement axes		Single & Dual axis					
Output		4~20mA, 0~5VDC, -5~+5VDC					
Cold start warming time		60s					
Response time⑦		0.3s@t90					
Refresh rate		5Hz, optional 10Hz, 20Hz					
Response frequency⑧		3Hz @-3dB					
Power supply		9~36VDC					
Power consumption		Average working current≤ 50mA, average power≤ 1.5W(25℃&24VDC)					
Operation temperature range		-40~55℃					
Storage temperature range		-60~100℃					
EMC		EN 61000					
Explosion-proof		EXdIICT6					
Insulation resistance		100MΩ					
MTBF		≥25000 hour/time					
Shock		100g@11ms, three-axis,half-sine					
Vibration		8grms, 20~2000Hz					
Protection		IP66					
Connecting		Explosion proof connector					
Cable		Armored cable, standard length 2m, Customized					
Weight		0.9Kg(without cable or connector)					

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
$\Delta=\pm \sqrt{absolute\ linearity^2+repeatability^2+hysteresis2+offset^2+cross-axis\ sensitivity^2\ error^2}$

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℃ .

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.
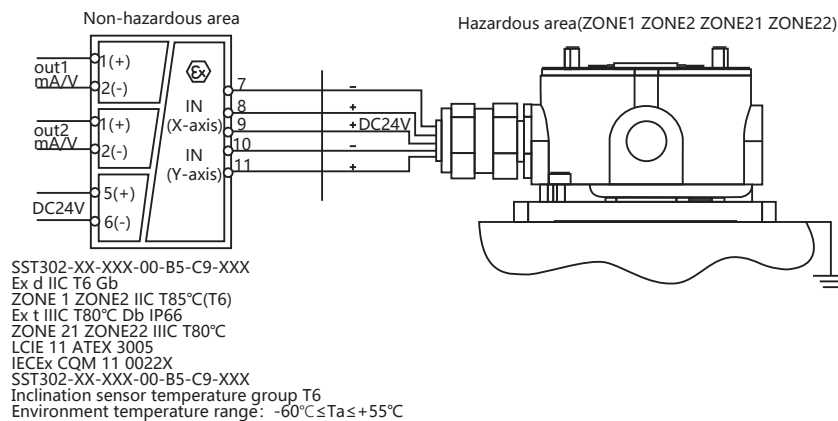
Dimensions （mm）
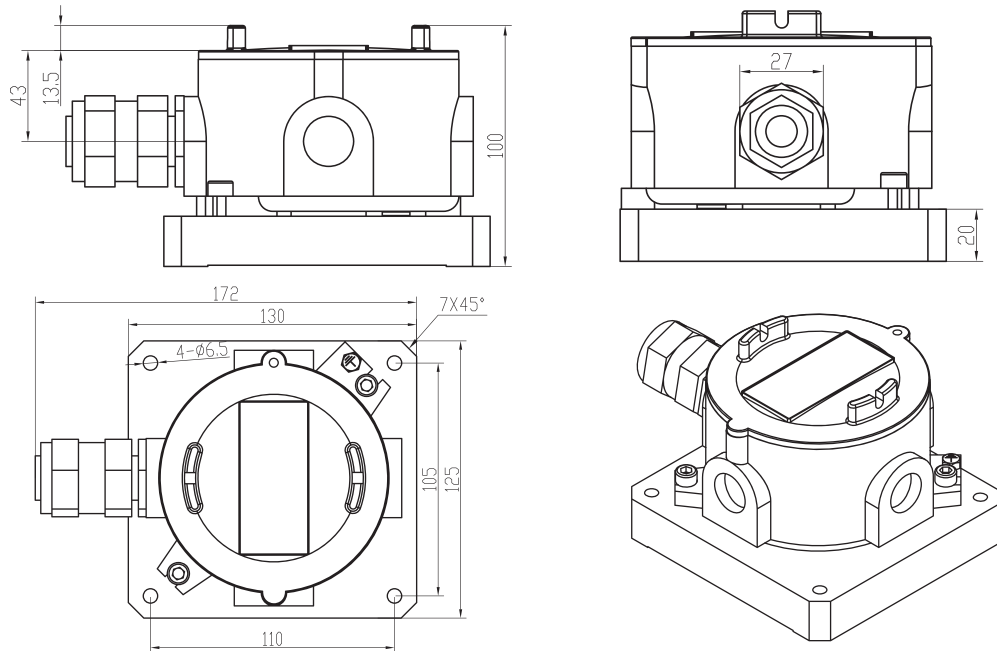
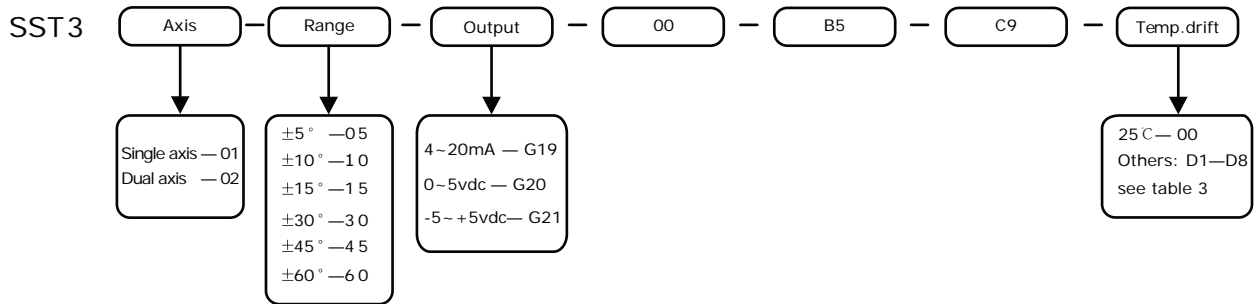Picture 1 Dimensions & Outline

Wiring

Table2 Pin definition

Wire Color	Single axis	Dual axis	Single axis	Dual axis
	Current output (G19)		Voltage output (G20, G21)	
Red	Power+	Power+	Power+	Power+
Black	Power-	Power-	Power-	Power-
Green	Signal GND	Signal GND	Signal GND	Signal GND
Yellow	Iout	Ioutx	Vout	Voutx
White	NC	Iouty	NC	Vouty
Blue	NC	NC	NC	NC
Brown	NC	NC	NC	NC

SST302-XX-XXX-00-B5-C9-XXX
Ex d IIC T6 Gb
ZONE 1 ZONE2 IIC T85℃(T6)
Ex t IIIC T80℃ Db IP66
ZONE 21 ZONE22 IIIC T80℃
LCIE 11 ATEX 3005
IECEx CQM 11 0022X
SST302-XX-XXX-00-B5-C9-XXX
Inclination sensor temperature group T6
Environment temperature range: -60℃≤Ta≤+55℃

Picture 2 Safety barrier & wiring diagram

Ordering

For example: If ordering an explosion-proof inclinometer, measurement range is ±5°, the accuracy is ±0.02° from -20~60℃ , 4~20mA output, 10m length cable, the model should be chosen as SST302-05-G19-00-B5-C9-D3（1 0m）

Options (see table 4):

Safety barrier -----Order No. is SST003-12-02, quantity: 1 pc.

Accessories & Options

Table 3 Accessories

Item	Order code	Accessories Name	Function
Output	G19	4~20mA	Output voltage proportional to tilt angle data Linearity: 0.02% FS Output impedance 39Ω, maximum load 625Ω
	G20	0~5VDC	Output voltage proportional to tilt angle data Linearity: 0.02% FS Output impedance: 100Ω, maximum output current: 10mA
	G21	-5~+5VDC	
Temperature drift	D1	Temperature drift	Temperature compensation range 0~60℃, accuracy ±0.01°@≤±30°
	D2	Temperature drift	Temperature compensation range 0~60℃, accuracy ±0.01°@>±30°
	D3	Temperature drift	Temperature compensation range -20~60℃, accuracy ±0.02°@≤±30°
	D4	Temperature drift	Temperature compensation range -20~60℃, accuracy ±0.02°@>±30°
	D5	Temperature drift	Temperature compensation range -30~60℃, accuracy ±0.03°@≤±30°
	D6	Temperature drift	Temperature compensation range -30~60℃, accuracy ±0.03°@>±30°
	D7	Temperature drift	Temperature compensation range -40~65℃, accuracy ±0.05°@≤±30°
	D8	Temperature drift	Temperature compensation range -40~65℃, accuracy ±0.05°@>±30°

Table 4 Options

Item	P/N	Option name	Function
Security products	SST003-12-02	Safety barrier(current input)	Ex-mark[Exia]IIC Certificate no.: CNEx11.0456 (China) 35mm rail power supply: 24V±10% DC, Input signal: 4~20mA, 0~20mA, input impedance≤250Ω, Output: voltage/current , RS-485, Switch output, Accuracy: 0.2%FS±1 bit Power supply (for inclinometer): 24VDC Insulating strength : 2500V, A.C: 1min Operating temperature: -40℃~85℃
Test report	SST003-11-01	Test report for cross-axis sensitivity	Test report under cross-axis 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 Alloewd Installation misalignment	Axis migration test report for vertical and horizontal axis of inclinometer,3 angles
	SST003-11-10	Test report for life simulation	Test report for zero position and full range under 7 days continuously power on
	SST003-11-13	Test report for salt spray	According to MIL standard (meet MIL810F 509.4)

Wi-Fi Inclinometer

Features

- Based on high performance SST300 inclinometer
- According to IEEE802.11b/g, Wi-Fi compatible
- High speed transmission and security
- 2.4G ISM band
- RF certificated by FCC, CE
- Operation temperature: -40~80℃
- Radio range up to 200m
- Customized wireless sensor network (WSN), 256 nodes max

Descriptions

SST300 Wi-Fi inclinometer integrated with experienced wireless Sensor Network(WSN) technology & patented tilt measurement technology, suitable for industrial remote tilt measurement system application, is a new economical and convenient sensor network product.

SST300 Wi-Fi inclinometer, perfectly combines industrial-grade products with commercial-grade terminal products, giving full play to their respective advantages. It has the following remarkable characteristics:

① High-accuracy SST300 inclinometer with advanced MEMS sensor technology to ensure maximum reliability even in the harshest environment.

② Adopt mature experienced Wi-Fi technology, to ensure accurate data remote transmission.

③ Support a variety of software operating platforms, whether fixed or mobile terminal devices.

④ Easy to connect mobile & fixed devices (with Wi-Fi interface) and build wireless network automatically, to realize data acquisition, storage, analysis and query.

⑤ With mobile terminal device (iPhone or iPad), surveyor & engineer can log & record data remotely while PLC system and control equipment running, especial to project monitoring, field equipment installing and debugging.

⑥ Easy to add & reduce amount of sensor or terminal equipment, can realize many sensor data queried by one device and one sensor datum queried by many devices simultaneously.

⑦ Lowest-cost to realize remote tilt measurement, data storage & analysis on your hand anytime & anywhere.

⑧ Through internet, data query in other cities comes true and it enables users to diagnose and set sensor remotely.

Applications

Civil engineering: Engineering surveyor collect data from engineering filed remotely, Remote bridge health monitoring & testing system, Tunneling or trenchless filed data survey remotely, Remote structural components monitoring

Industry equipment: Remote equipment attitude detection & monitoring while installing, debugging, controlling or in dangerous

Measurement/test: Remote detecting & monitoring lab device, Remote monitoring/test under dangerous or limited space

Performances

Table 1　Specifications

Measurement range		±5°	±10°	±15°	±30°	±45°	±60°
Combined absolute accuracy① (25 ℃)		±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 sensitivity②	±0.1%FS					
	Offset③	±0.005°				±0.008°	
	Repeatability	±0.0025°					
	Hysteresis	±0.0025°					
Allowed installation misalignment④		±4.0°	±3.0°	±2.5°	±1.5°	±1.2°	±1.2°
Input-axis mislignment		≤±0.1°					
Sensitivity temp. drift coefficient		≤100ppm/℃	≤50ppm/℃				
Offset temperature drift coefficient		≤0.003°/ ℃					
Offset turn on repeatability⑤		±0.008°					
Resolution		0.0025°					
Long-term stability⑥		≤0.02°					
Measurement axis		1 or 2 axis					
Temperature sensor		Range：-50~125℃, Accuracy: ±1℃					
Output		Wi-Fi(TCP/IP & UDP) Other output please refer to Table 4					
Cold start warming time		60s					
Response time⑦		0.3s (@t$_{90}$)					
Refresh rate(digital output)		5Hz (Optional 10Hz,20Hz)					
Response frequency⑧		3Hz @-3dB					
Power supply		9~36VDC					
Power consumption		Average current ≤ 300mA (25 ℃&24VDC)					
Operation temperature range		-40~80℃					
Storage temperature range		-60~100℃					
Insulation resistance		100MΩ					
MTBF		≥25000 hours / time					
Shock		100g@11ms, three-axis, half-sine					
Vibration		8grms, 20~2000Hz					
Protection		IP67					
Connecting		Military class connector (MIL-C-26482)					
Weight		350g (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

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

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℃ .

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.

Table 2 Wi-Fi communication specafication

|	
WLAN protocol	IEEE 802.11b/g, Wi-Fi compatible
Radio channel	802.11b: USA, Canada and Taiwan – 11 Most European Countries – 13 France – 4, Japan – 14 802.11g: USA and Canada – 11 Most European Countries – 13
Modulation system	DSSS, OFDM, DBPSK, DQPSK, CCK, 16-QAM, 64-QAM
Band	2.4G ISM
Transmission power	15dBm ±1.5dBm
Receiving sensitivity	802.11b : -91dBm 802.11g : -85dBm
Antenna interface	IPEX antenna connector
Wireless data transmission rate	802.11b: 1, 2, 5.5, 11Mbps 802.11g: 6, 9, 12, 18, 24, 36, 48, 54Mbps
Wireless network co-existence	Cell phone(GSM/DCS/WCDMA/UMTS/3G) co-existence
WLAN setting up	Support AP & Ad-Hoc
Encryption	Support WEP40 and WEP104 encryption (64/128 bit). Support OSI & Shared key model WPA/WPA2 PSK, AES and TKIP
Wireless Medium Access Control(MAC) protocol	CSMA/CA, with ACK
Reset to Network Connection	≤3s (WEP) , 6s (WPA)
Other function	Wi-Fi automatically recovery after dis-connection max transmission speed 60kb/s(send & receive simultaneously), 90kb/s(send or receive) DNS service Support protocol TCP and UDP Support TCP Server and Client Support UDP broadcast or uni-cast TCP Automatically connection after disconnection As TCP server, permit 3 clients connection Flexible configuration: HTML or PC software

Dimensions (mm)
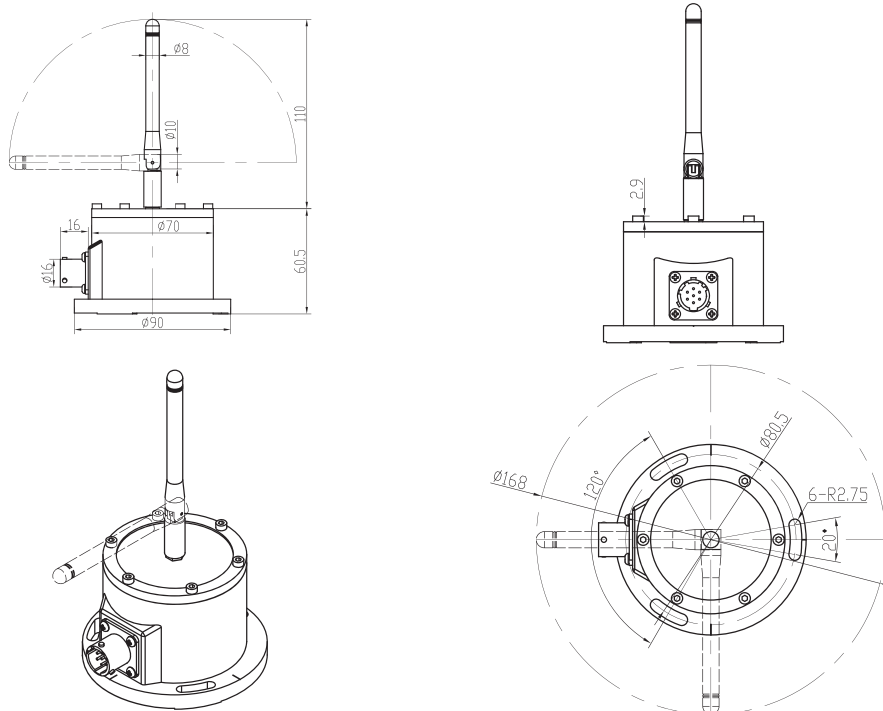
Picture 1 Dimensions(Wi-Fi Antenna adjusted to upright & rotary)
Note: For analog/digital output in parallel, the sensor height will chang, please ask Vigor for details.

Wiring
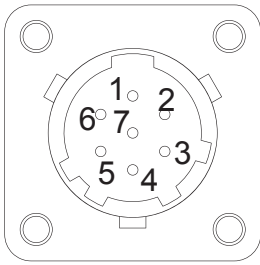
Picture 2 Connector socket
(View from outside)

Table 3 Connector definition

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

Table 4 Pin definitions for analog and digital interface(in parallel to Wi-Fi)

Pin	1 axis	2 axis	1 axis	2 axis	1 or 2 axis	1 or 2 axis	1 or 2 axis
	Current output(G19)		Voltage output(G20~G24)		RS232(00)	RS422(G2)	RS485(G1)
1	Power+	Power+	Power+	Power+	Power+	Power+	Power+
2	Power GND	Power GND	Power GND	Power GND	Power GND	Power GND	Power GND
3	Signal GND	Signal GND	Signal GND	Signal GND	Signal GND	Signal GND	Signal GND
4	Iout	Ioutx	Vout	Voutx	NC	RS422-RXD+	NC
5	NC	Iouty	NC	Vouty	NC	RS422-RXD-	NC
6	NC	NC	NC	NC	RS232—TXD	RS422-TXD+	RS485-A
7	NC	NC	NC	NC	RS232—RXD	RS422-TXD-	RS485-B

Note: The various output listed in this table need to be explained separately when ordering.
The output of standard products is only Wi-Fi output.

Ordering

For example, if order a dual-axis Wi-Fi inclinometer, with range ±15°, ±0.02° accuracy@-20~60℃ , the model should be chosen as: SST302-15-G12-00-00-C1-D3（2m）.

Accessories & Options

Table 5 Accessories

Cable/Plug	C1	Standard Cable with plug	Military class connector(meet MIL-C-26482),Standard 2M cable,IP67 protection, heavy duty up to 30kg
	C2	Tensile reinforced shield cable	Heavy duty up to 50kg
	C3	High temperature cable	Up to 250℃
	C4	Armor cover cable	Increasing mechanical strength, erosion and anti-interference ability.
	C5	Watertight cable with plug	3000m underwater with special plug
	C6	Standard plug	According to MIL-C-26482,IP67 protection
	C7	Compatible with Amphenol plug	Compatible with the standard of SST300 outlet, manufactured by Amphenol
	C8	Corners plug	90° corner,according to MIL-C-26482,IP67 protection
	C9	Explosion proof connectors and cables	For SST30X-XX-XXX-00-B5-C9-XX only
	C10	Pigtail connector	Only for beam tilt sensor SST301-XX-XXX-XX - B4-C10-XX
	C11	USB cable	For SST30X-XX-G10-00-00-C11-XX only, one end is MIL connector, the other end is USB port.
	C12	Ethernet cable	For SST30X-XX-G9-00-B5-C12-XX only, one end is MIL connector, the other end is RJ45
	C13	CAN/CANopen cable	Military class connector, standard 2M long, DB-9 interface at the other end, IP67 protection, anti 30KG pull
Temperature drift	D1	Temperature drift	Temperature compensation range is 0~60℃ , and temperature drift accuracy ±0.01°@≤±30°
	D2	Temperature drift	Temperature compensation range is 0~60℃ , and temperature drift accuracy ±0.01°@>±30°
	D3	Temperature drift	Temperature compensation range is -20~60℃ , and temperature drift accuracy ±0.02°@≤±30°
	D4	Temperature drift	Temperature compensation range is -20~60℃ , and temperature drift accuracy ±0.02°@>±30°
	D5	Temperature drift	Temperature compensation range is -30~60℃ , and temperature drift accuracy ±0.03°@≤±30°
	D6	Temperature drift	Temperature compensation range is -30~60℃ , and temperature drift accuracy ±0.03°@>±30°
	D7	Temperature drift	Temperature compensation range is -40~65℃ , and temperature drift accuracy ±0.05°@≤±30°
	D8	Temperature drift	Temperature compensation range is -40~65℃ , and temperature drift accuracy ±0.05°@>±30°
	D9	Temperature drift	Temperature compensation range is -40~85℃ , and temperature drift accuracy ±0.05°@≤±30°
	D10	Temperature drift	Temperature compensation range is -40~85℃ , and temperature drift accuracy ±0.05°@>±30°

SST400 High-Precision Inclinometer

Features

- Continuous output or command output
- Adjustable baud rate and output refresh rate
- Filter parameters can be set according to the field environment
- Accuracy up to ±20''@±5°~±30°range
- Optional max ±5″ accuracy
- Cross-axis sensitivity≤±0.2%FS
- ±9″offset repeatability
- Refer to about 50 industry & military standards
- Military class product available

Description

SST400 inclinometer is an intelligent renewed product with comprehensive improved functions & performances.

SST400 inclinometer has been strictly tested and combined with simulation & process with advanced EDA&CAE technologies including materials collection, heat treatment, finite element analysis, modal analysis & test (include shell, sensitive apparatus, PCB board and relationship between characters of each other).

SST400 inclinometer adopts Vigor's patented automatic testing technology, not only passed general test, correct and compensate to temperature drift/non-linearity/cross-axis sensitivity error/orthogonal error/ sensitive axis and so on, also made life test with different angular rate & angular acceleration impact and long time temperature cycle test for each product. More test programs, correction and compensation of parameters can be made as special request.

SST400 integrates MEMS accelerometer inside and combines with the proprietary vibration suppression technology. It can adjust the vibration suppression ability online according to the site conditions.

Applications

- Factory automation
- Precision instrument
- Vessel
- Engineering machinery
- Civil engineering
- Military project
- Aerospace, etc

Carried Standards

- 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 Centrifuger(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)
- EN61000-4-11 Voltage dips &Voltage variations

|		
- MIL-HDBD-338B	- MIL-STD-810F-510.4	- MIL-STD-810F-507.4
- ISO 5348 IDT	- MIL-STD-810F-514.5	- EN61000-4-4 EFT
- MIL-STD-810F-501.4	- MIL-STD-810F-516.5	- EN61000-4-5 SURGE
- MIL-STD-810F-502.4	- IEC60529 IP	- EN61000-4-6 CS
- MIL-STD-810F-503.4	- EN61000 -4-2 ESD	- EN61000-4-8 PFMF
- MIL-STD-810F-506.4	- EN61000-4-3 RS	- ISTA-2A

Performances

Table1 Specification

| Measurement range	±5°	±10°	±15°	±30°
Accuracy(@25℃)	±20″(optional max ±5″)			
Repeatability	±9″			
Resolution	2″			
Offset	±0.004°			
Response time	0.3s			
Offset temperature drift coefficient	≤0.0006°/ ℃ @ -20~65 ℃			
Sensitivity temperature drift coefficient	≤0.005%/ ℃ @ -20~65 ℃			
Temperature sensor	Range:-50~125℃ ,Accuracy: ±1℃			
Measurement axis	1axis or 2 axis			
Cross-axis sensitivity	±0.2%FS			
Output type	RS232 (optional RS422, RS485, CAN2.0, CANopen, Ethernet), 0~5VDC,4~20mA			
RS232 data format	115200bps(adjustable),8 data bits,1 start bit,1 stop bit, none parity			
Cold start warming time	60s			
Refresh rate	5Hz(optional 10Hz or 20Hz)			
Response frequency	3Hz@-3dB			
Power supply	9~36VDC			
Current consumption	≤100mA			
Power dissipation	Supply current≤50mA, power dissipation≤1.5W(25℃ &24VDC)			
Output impedance	Internal resistance of voltage output: 100Ω, sink/leakage current about 10mA Internal resistance of current output: 50MΩ, load :＜600Ω			
Power supply rejection ratio	＞85dB			
Operation temperature range	-40~85℃			
Storage temperature range	-60~100℃			
EMC	According to EN610000 and GBT17626			
Insulation resistance	100MΩ			
MTBF	≥25000h/time			
Shock	100g@11ms,three-axis,half-sine			
Vibration	8grms, 20~2000Hz			
Protection	IP67			
Housing	6061-T6 aluminum alloy			
Cable	7-wire shielded cable with tensile reinforcement			
Connecting	Binder712 connector(optional pigtail connector)			
Weight	≤500g(without connector and cable)			

Dimensions (mm)
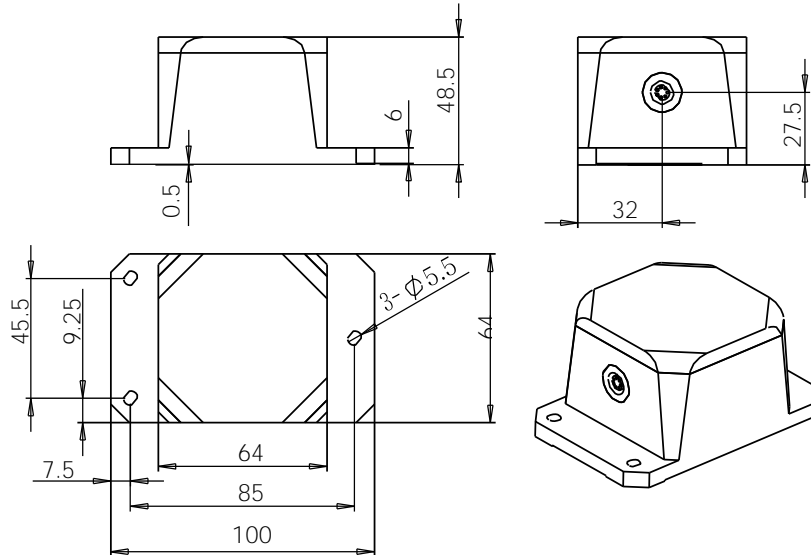
Picture1 Housing with Binder712 socket

Wiring
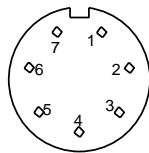
Picture 2 Binder712 socket
(View from outside)
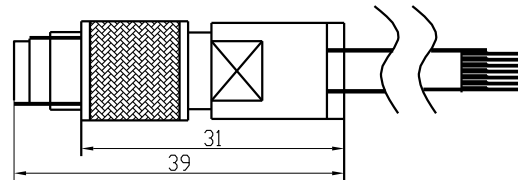
Picture 3 Binder712 plug and cable

Table 2 Binder712 wiring

Binder712 socket pin	Wire colour	Output					
		4~20mA	0~5VDC	RS232	RS485	RS422	CAN
1	Red	Power +	Power +	Power +	Power +	Power +	Power +
2	Black	Power -	Power -	Power -	Power -	Power-	Power-
3	Green	Signal GND	Signal GND	Signal GND	Signal GND	Signal GND	Signal GND
4	Yellow	Ioutx	Voutx	NC	NC	RS422-RXD+	CAN-H
5	White	Iouty	Vouty	NC	NC	RS422-RXD-	CAN-L
6	Blue	NC	NC	RS232-TXD	RS485-A	RS422-TXD+	NC
7	Brown	NC	NC	RS232-RXD	RS485-B	RS422-TXD-	NC

Ordering information

Table 3 Ordering product list

Model	Axis	Output type	Range
SST410	1	4~20mA	±5° ±10° ±15° ±30°
SST420	2	4~20mA	
SST430	1	0~5VDC	
SST440	2	0~5VDC	
SST450	1	RS232(optional RS485,RS422,CAN2.0,CANopen,Ethernet)	
SST460	2	RS232(optional RS485,RS422,CAN2.0,CANopen,Ethernet)	

SST500 Ultra High-Precision Inclinometer

Features

- Up to ±0.001° bias stability within 12 months
- Bias temperature drift achieve ±0.00057℃
- Optimization design based on CAE & EDA
- High reliability & flexibiliy
- Multi-functional management software
- Less than ±3″ bias
- Less than ± 1.5″ absolute linearity error
- Various land & aerospace application interfaces
- 3 classes: Industry class, Universal military class, High-quality military class
- Up to 15000 hours of MTBF
- Successfully applied to missile launch, radar, aerospace and other military projects
- Customized product available

Description

SST500 inclinometer is a revolutionary tilt measurement product, fully absorbs and learns from high precision military inertial navigation technology, precise fusion with machine-electric & inertial test technologies, applied to variety of high-class industrial & military applications.

SST500 inclinometer adopts inertial navigation grade servo accelerometer, with <0.1μg resolution, >25Hz frequency response, >120dB signal-noise ratio. Achieve ± 1.3″ accuracy at room temperature.

SST500 performs excellent dynamic characteristics, long-term stability, and environmental adaptability, experienced with various static & quasi-static long-term works under industrial & military harsh environment. Thanks Vigor's engineers for making complete modal testing for whole body & key components, to minimize interference from outside shock & vibration.

To maximize reliability of SST500 inclinometer, modeling analysis, regulated software & hardware reliability design, selected proven components directory, finite element analysis (thermal reliability analysis, structural reliability analysis) and FMEA, have been made to ensure the optimal performance and stability as well.
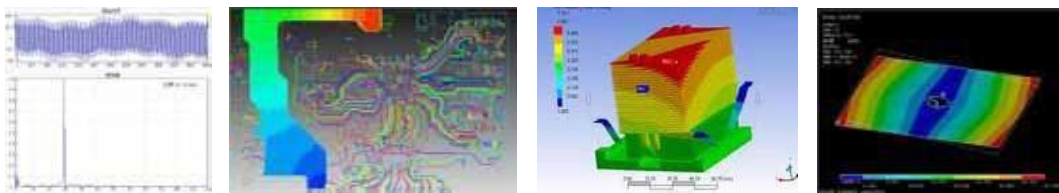
Applications

Military: missile launch, rocket launch, military radar, mobile communication equipment, fire control system, bunkers monitoring, flight test, laser/video equipment, navigation system, etc.

Civil: large-scale bridge, tunneling guidance equipment, space observations, precision machine tools, optical instrument, etc.

Carried Standards

- GB/T 191 SJ 20873 General requirements for Inclinometer & levelmeter (China)
- GBT 18459 Methods for Calculating the Main static performance specifications for tansducers(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 Centrifuger(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)
- EN61000-4-11 Voltage dips &Voltage variations

- MIL-HDBD-338B	- MIL-STD-810F-510.4	- MIL-STD-810F-507.4
- ISO 5348 IDT	- MIL-STD-810F-514.5	- EN61000-4-4 EFT
- MIL-STD-810F-501.4	- MIL-STD-810F-516.5	- EN61000-4-5 SURGE
- MIL-STD-810F-502.4	- IEC60529 IP	- EN61000-4-6 CS
- MIL-STD-810F-503.4	- EN61000 -4-2 ESD	- EN61000-4-8 PFMF
- MIL-STD-810F-506.4	- EN61000-4-3 RS	- ISTA-2A

Performances

Table 1 Specification

Measurement range		±1°	±5°	±10°	±15°	±30°	±45°	±60°
Absolute linearity error(@20℃)		±1.5″	±5″	±10″	±10″	±15″	±25″	±40″
Resolution		0.1″	0.2″	0.5″	0.5″	0.6″	1″	2″
Axis		Single/Double						
Bias repeatability	Industry class	±3.6″	±3.6″	±3.6″	±3.6″	±10″	±18″	±18″
	Universal military class	±3″						
	High-quality military class	±2″						
Bias stability	Industry level @ 6 months	±10″	±10″	±10″	±10″	±18″	±18″	±30″
	Universal military class @ 6 months	±3.6″						
	High-quality military class @ 12 months	±3.6″						
Bias	Industry class	±10″	±10″	±10″	±10″	±18″	±18″	±30″
	Universal military class	±8″						
	High-quality military class	±3.6″						
Bias temperature drift. /℃	Industry class @-20~65℃	±5″	±5″	±5″	±10″	±15″	±20″	±25″
	Universal military class @-40~85℃	±0.5″	±0.5″	±0.5″	±1″	±1″	±2″	±2″
	High-quality military class @-55~125℃	±0.5″	±0.5″	±0.5″	±1″	±1″	±2″	±2″
Sensitivity temperature drift ppm/℃	Industry class @-20~65℃	±35	±35	±40	±40	±50	±50	±60
	Universal military class @-40~85℃	±30	±20	±20	±10	±10	±10	±10
	High-quality military class @-55~125℃	±30	±20	±20	±10	±10	±10	±10
Cross-axis sensitivity	Industry class	±0.1%FS						
	Universal military class	±0.05%FS						
	High-quality military class	±0.02%FS						
Misalignment	Industry class	≤2mrad.						
	Universal military class	≤0.5mrad.						
	High-quality military class	≤0.05mrad.						
Response time	Industry class	0.3~1.0s(depends on requested accuracy)						
	Universal military class	0.1~1.0s(depends on requested accuracy)						
	High-quality military class	0.1~1.0s(depends on requested accuracy)						
Cold start warming time	Industry class	180s						
	Universal military class	120s						
	High-quality military class	60s						
Output	Industry class	Interface:RS232, RS485, update rate:5Hz, Format:9600bps(adjustable),8 data bits,1 start,1 stop, no parity, ASCII						
	Universal military class	Interface:RS422,update rate:10Hz,20Hz,50Hz, Format:9600bps(adjustable),8 data bits,1 start,1 stop, no parity, ASCII						
	High-quality military class	Interface:MIL-STD-1553B, ARINC429, IEEE1394, IBIS, or depend on request						
EMC	Industry class	According to EN61000 or GBT17626						
	Universal military class	GJB 151A or MIL STD-461						
	High-quality military class	GJB 151A,or MIL STD-461,or depend on request						

|		
MTBF	Industry class	≥5000h/times
	Universal military class	≥10000h/times
	High-quality military class	≥15000h/times
Power supply	Industry class	9~36VDC(unregulated),≤80mA@24VDC
	Universal military class	12~48VDC(unregulated),≤80mA@24VDC
	High-quality military class	12~48VDC(unregulated),consumption depends on request
Shock	Industry class	100g@11ms,3 axis,6directions,half-sine,1times/axis, total 6 times
	Universal military class	100g@11ms,3 axis,6directions,square wave,2times/axis, total 12 times
	High-quality military class	100g@11ms,3 axis,6directions,square wave,3times/axis, total 18 times
Vibration	Industry class	3grms, 20~2000Hz,random
	Universal military class	5grms, 20~2000Hz,random,1g,1oct/min,20~2000Hz,sine
	High-quality military class	6grms, 20~2000Hz,random,2g,1oct/min,20~2000Hz,sine
Rapid temperature change test	Industry class	-40~85℃ range,10℃ /min ratio
	Universal military class	-40~85℃ range,15℃ /min ratio
	High-quality military class	-60~125℃ range,15℃ /min ratio
Storage temperature test	Industry class	-40~85℃ range, 24h,according to GJB/MIL or depend on request
	Universal military class	-40~125℃ range, 2×24 h, according to GJB/MIL or depend on request
	High-quality military class	-60~125℃ range, 7×24 h, according to GJB/MIL or depend on request
Housing	Industry class	6061-T6 aluminum housing,316N base
	Universal military class	Full 316N,10 cycles of heat treatment
	High-quality military class	Full 316N,10 cycles of heat treatment,6months natural stress release, or depends on request
Connecting	Industry class	Military connector or metal pigtail with 2m shield 7-wire cable (heavy duty up to 30kg)
	Universal military class	Military full stainless steel connector, or full stainless steel pigtail with 2m shield 7-wire cable (heavy duty up to 50kg)
	High-quality military class	Military full stainless steel connector, or full stainless steel pigtail with 2m shield 7-wire cable (heavy duty up to 50kg)
Protection	Industry class	IP65
	Universal military class	IP67
	High-quality military class	Depends on request
Operation temperature range	Industry class	-40~85℃
	Universal military class	-40~85℃
	High-quality military class	-55~125℃
Storage temperature range	Industry class	-40~85℃
	Universal military class	-60~125℃
	High-quality military class	-60~125℃
Weight	Industry class	2Kg
	Universal military class	3Kg
	High-quality military class	Depends on request
Size	Industry class	105x65x64mm(without connector and pigtail)
	Universal military class	105x65x64mm(without connector and pigtail)
	High-quality military class	Depends on request
Temperature sensor (internal)	Industry class	Range -50~125℃ , accuracy ±1℃
	Universal military class	Range -50~125℃ , accuracy ±1℃
	High-quality military class	Range -60~125℃ , accuracy ±1.5℃

Dimensions (mm)
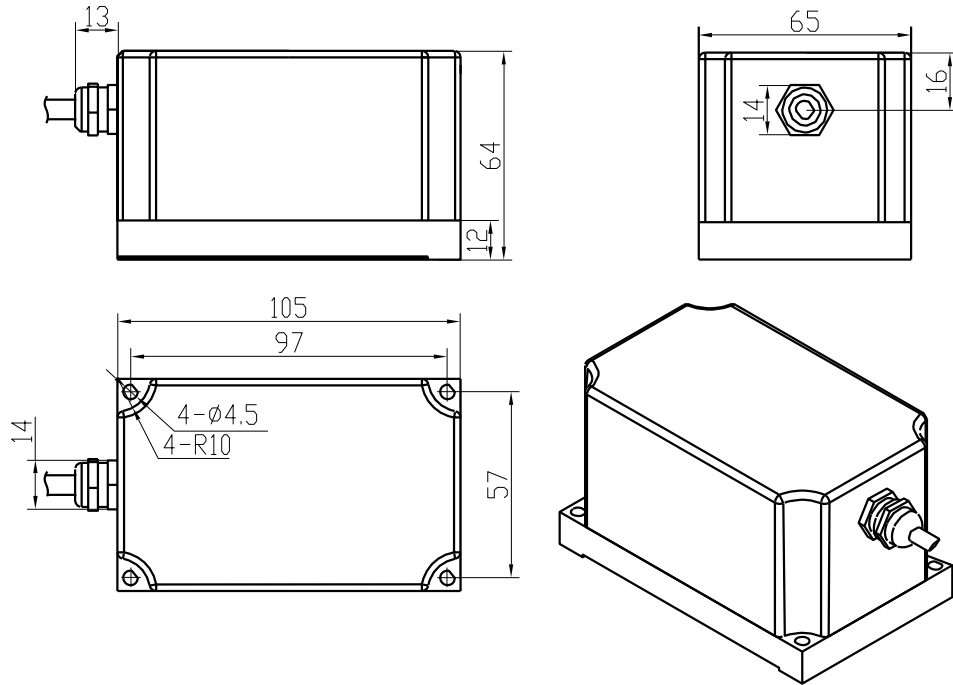
Picture 1 Mechanical draft
(Pigtail, suitable to industry class & universal military class)
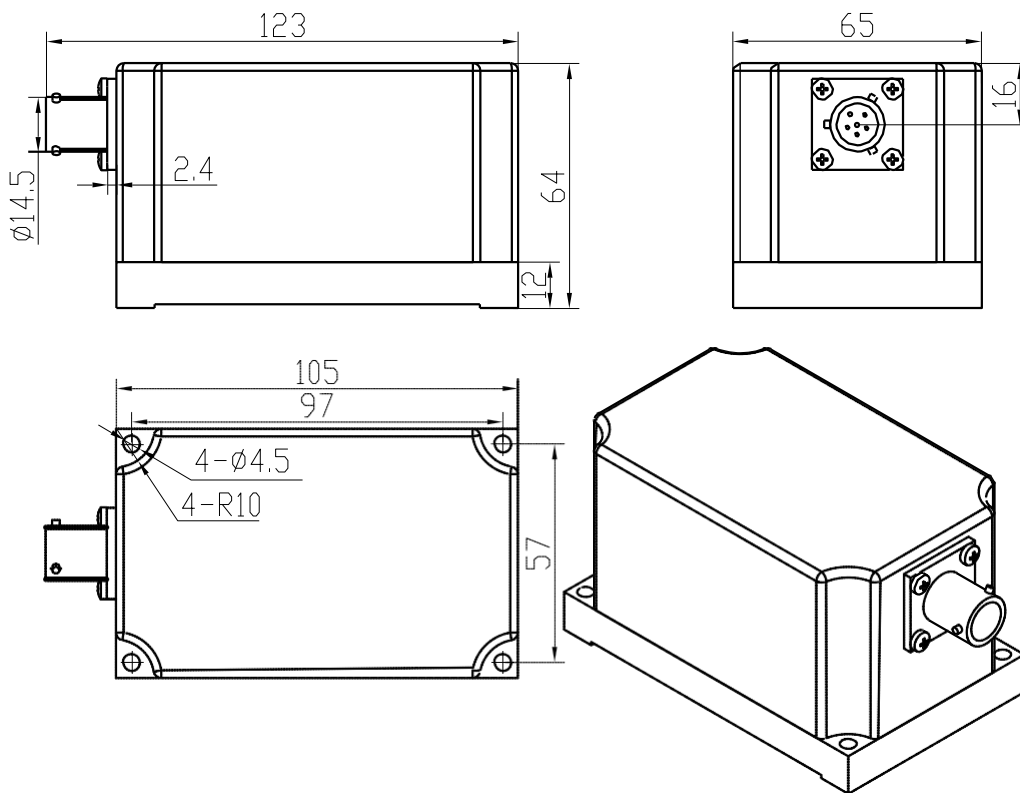
Picture 2 Mechanical draft
(Military connector, suitable to industry class & universal military class)
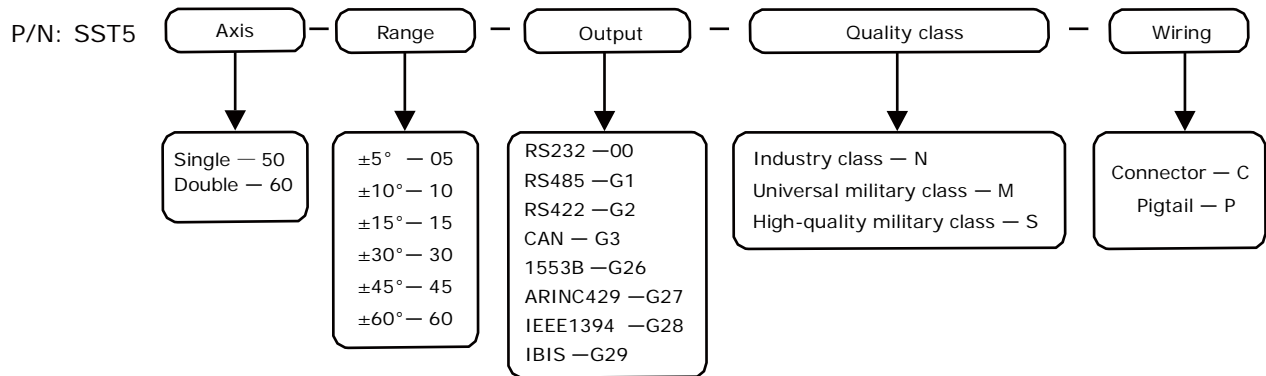
Wiring
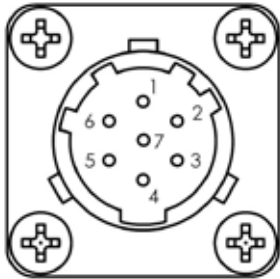
Picture 3 Connector socket
(view from outside)

Table 2 Wiring definition

Socket pin	Pigtail cable	Output(single or double axis)			
		RS232	RS485	RS422	CAN
1	Red	Power +	Power +	Power +	Power +
2	Black	Power -	Power -	Power -	Power -
3	Green	Signal GND	Signal GND	Signal GND	Signal GND
4	Yellow	NC	NC	RS422-RXD+	CAN-H
5	White	NC	NC	RS422-RXD-	CAN-L
6	Blue	RS232-TXD	RS485-A	RS422-TXD+	NC
7	Brown	RS232-RXD	RS485-B	RS422-TXD-	NC

Note: 1. Don't connect signal GND and Power GND together.
2. Other outputs on request.

Ordering information

P/N: SST5 — (Axis) — (Range) — (Output) — (Quality class) — (Wiring)

Axis
Single — 50
Double — 60

Range
±5° — 05
±10° — 10
±15° — 15
±30° — 30
±45° — 45
±60° — 60

Output
RS232 — 00
RS485 — G1
RS422 — G2
CAN — G3
1553B — G26
ARINC429 — G27
IEEE1394 — G28
IBIS — G29

Quality class
Industry class — N
Universal military class — M
High-quality military class — S

Wiring
Connector — C
Pigtail — P

SST2200 MEMS In-Place Inclinometer

Features

- Measurement range：±5°，±15°，±30°
- Resolution : ±0.002°
- Accuracy : max ±0.005°@25℃
- Direct watertight cable outgoing
- Flexible pitch configuration
- SUS304 stainless steel housing, wirerope connection
- Max pressure resistance 1MPa, long-term work underwater 100m
- MEMS, low cost, shock resistance

Descriptions

SST2200 in-place MEMS inclinometer, independently developed by Vigor, is a dual-axis transducer with RS485 signal output, housed inside a rugged tube, SST2200 is used for continuous and unattended measurements of lateral displacement of soil, rock and structures. The system mainly includes inclinometer group, data acquisition instrument, wireless/wired transmission system, data processing system, solar power supply system, etc. The inclinometer group is vertically installed in inclinometer tube of φ70-90 mm, which senses stratum changes synchronously, transmits the measured inclinometer data to data acquisition system, and then transmits the measured inclination data to data acquisition instrument by wireless or wired transmission for calculation and analysis, at last a depth-displacement curve is obtained.

Measuring principle

SST2200 consists of several MEMS inclinometers in series which are installed in the inclinometer tube, when the stratum is deformed and displaced, the inclinometer tube will deform synchronously, and the attitude of each inclinometer will change correspondingly, which is reflected in the change of inclination angle. As shown in the right figure, a inclinometer is installed at the specified depth of the inclinometer tube. The wheel-track of the inclinometer (the center of the upper and lower guide wheels) is L, the measured inclination angle changes to θ，According to the trigonometric function, the horizontal displacement variation of the two nodes is $S=L*\sin\theta$. When several inclinometers are connected in series, the total horizontal displacement variation can be obtained by taking the bottom node of the fixed inclinometers as the starting point and accumulating upward in turn: $S=S1+S2+...+Sn$
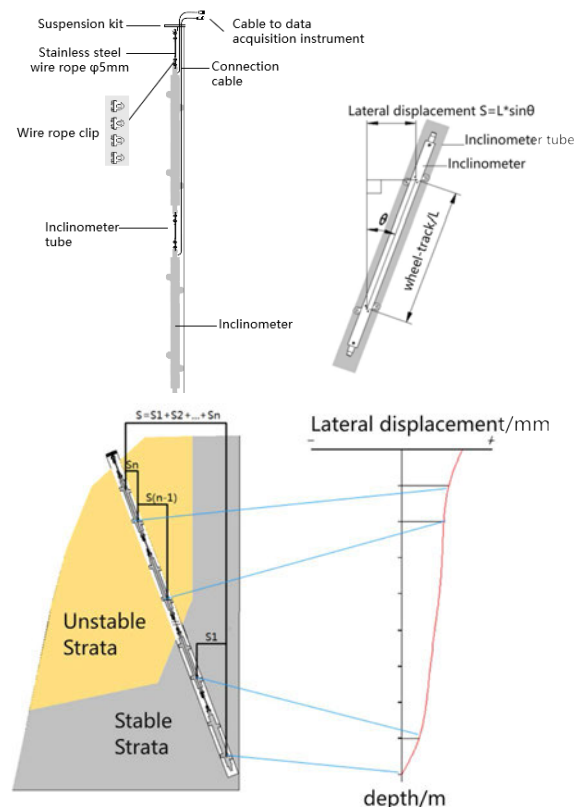
Applications

- Slope stability monitoring
- Soil displacement monitoring
- Monitoring of diaphragm wall
- Dam deformation monitoring
- Deflection monitoring of lateral loaded piles
- Foundation pit monitoring, etc.

Performances

Measurement range	±5°	±15°	±30°
Accuracy	±0.005°@25℃		
	±0.01°@-20~65℃		
Resolution	0.002°		
Cross-axis sensitivity	±0.1%FS		
Repeatability	±0.002°		
Long-term stability	±0.01°@12 months		
Measurement axis	Dual-axis		
Output	RS485 ModBus		
Cold start warming time	60s		
Operation temperature	-40~85℃		
Storage temperature	-40~85℃		
Power supply	9-36VDC , current consumption≤50mA@24VDC(single inclinometer)		
MTBF	≥25000 h/times		
Shock	100g@11ms, three-axis, half-sine		
Vibration	8grms , 20~2000Hz		
Pressure resistance	1MPa(Max 100m underwater)		
Max connected sensors	25 @φ70mm tube		
Connection cable	Each inclinometer is connected to the data acquisition instrument independently by a 7-core 5mm tension-resistant 30Kg watertight cable		
Guide wheels	Stainless steel material, NSK high precision bearing, long service life		
Sealing performance	Double high hardness high pressure resistant seal ring @Shore hardness 90 degrees+Inside all-silicone seals		
Balance treatment	Make gravity center in geometric center, prolong the life of guide wheels and springs		
Safety factor of housing	≥5.65@25 inclinometers in series		
Interconnection between inclinometers	Stainless steel wire rope with customizable length		
Diameter of adapted inclinometer tube	φ70-90mm		
Housing	SUS304 stainless steel		
Packing	Aluminum alloy packing box : 1000X450X75 mm		
Weight	2Kg@single inclinometer(without cable and wire rope)		

Dimensions (mm)
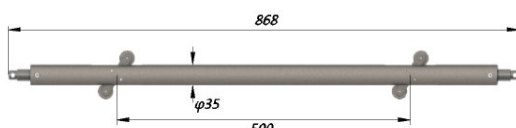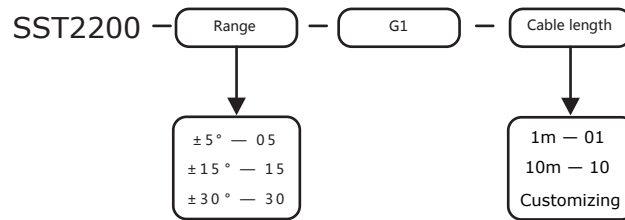
Size of single inclinometer
(without cable and wire rope)
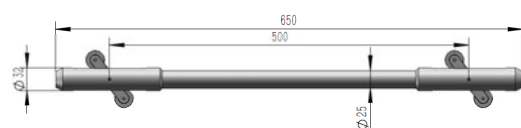
Size of preconditioner
(without cable and wire rope)

Wiring

Pin	Wire colour	RS485 output
1	Red	Power+
2	Black	Power-
3	Blue	RS485-A
4	Brown	RS485-B
5	Green	Signal GND

Ordering

SST2200 — [Range] — [G1] — [Cable length]

±5° — 05	1m — 01
±15° — 15	10m — 10
±30° — 30	Customizing

Optional list

Items	Quantity
Preconditioner	1 pcs
Connected cable	Depends on request
Solar Power Supply System	1 set
Data acquisition instrument	1 set
Cloud-based software	1 set
Installation accessories	1 set

# SST2202 Tilt Beam Sensor

Features

- High resolution, accuracy & stability
- Reliable long distance transmission, easy to set up
  measurement network on site
- U-Shaped openings in both ending, easy to connect sensors
- IP67 protection
- Alloyed & anodized aluminum shell, corrosion-resistant,
  wear-resistant, artistic

Descriptions

SST2202 tilt beam sensor is developed by Vigor Company based on patent inclination measurement technology for civil industry application, and it is specially designed for linear measurement. SST2202 is used to detect the angle change between two fixed points. The inclination sensor is installed in a rigid beam with a standard length of 1m (2m, 3M optional). When the beam is installed on the structure to be monitored, the angle change can be measured and converted into the displacement relative to the length of the beam. Many such beams can be connected in series for long distance and accurate monitoring of the linear changes of the dam, tunnel and excavation wall.
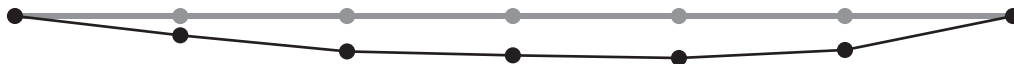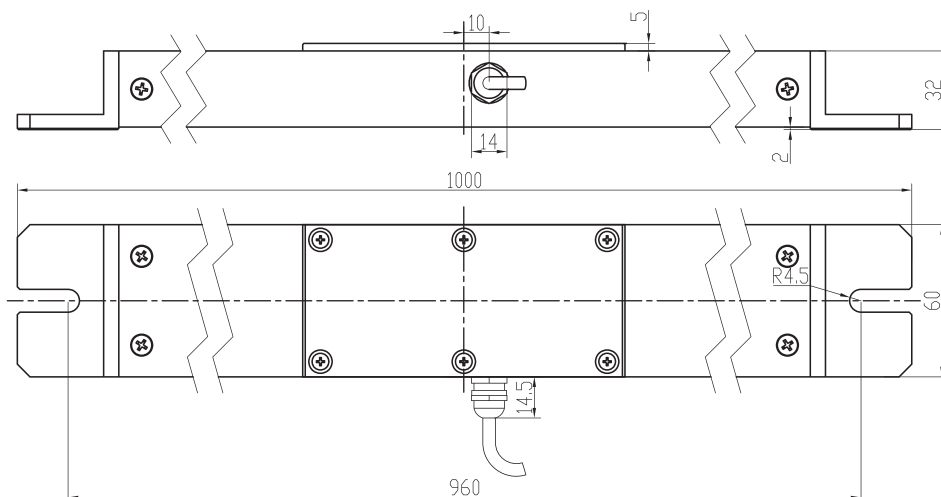
Picture 1 Level bending diagram

Applications

- Buildings and structures adjacent to deep excavation and series walls.
- Buildings and structures impacted by tunneling and mining.
- Subgrade treating, grouting & supporting structure.
- Oil tank monitoring
- Retaining wall monitoring
- Subside and collapse monitoring
- Rail subsidence monitoring, etc.

Dimensions (mm)

Performances

Table 1 Specifications

		±5°	±10°	±15°
Measurement range		±5°	±10°	±15°
Combined absolute accuracy[1](@25℃)		±0.01° (0.17mm/m)	±0.015°(0.26mm/m)	±0.02°(0.35mm/m)
Accuracy subroutine parameter	Absolute linearity (LSF,%FS)	±0.06	±0.03	±0.03
	Cross-axis sensitivity[2]	±0.1%FS		
	Offset[3]	±0.005°(0.1mm/m)		
	Repeatability	±0.0025°(0.05mm/m)		
	Hysteresis	±0.0025°(0.05mm/m)		
Allowed installation misalignment[4]		±4.0°	±3.0°	±2.5°
Input-axis mislignment		≤±0.1°		
Sensitivity temperature drift coefficient (max.)		≤100ppm/ ℃		
Offset temperature drift coefficient (max.)		≤0.003° (0.06mm/m)/ ℃		
Offset turn on repeatability[5]		±0.008°(0.15mm/m)		
Resolution		0.0025°(0.05mm/m)		
Long-term stability(1 year)[6]		≤0.02°(0.4mm/m)		
Measurement axis		1 axis		
Temperature sensor		Range：-50~125℃, Accuracy:±1℃		
Output		RS232(standard) ， Optional RS485, CAN2.0, Ethernet, Wi-Fi, 4~20mA, -5~5VDC		
RS232 output format		115200 baud, 8 data bits, 1 start bit, 1 stop bit, none parity		
Cold start warming time		60s		
Response time[7]		0.3s(@t_{90})		
Refresh rate		5Hz, optional 10Hz or 20Hz		
Response frequency[8]		3Hz @-3dB		
Power supply		9~36VDC		
Power consumption		Average working current≤50mA, average power≤1.5W (25℃&24VDC)		
Operation temperature range		-40~85℃		
Storage temperature range		-60~100℃		
EMC		According to EN 61000		
Insulation resistance		100MΩ		
MTBF		≥25000 hours		
Shock		100g@11ms, three-axis, half sine		
Vibration		8grms, 20~2000Hz		
Protection		IP67		
Connecting		Pigtail, 2m cable, other length available		
Weight		1.3Kg(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

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

[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 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℃.

[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.

Wiring

Table2 Cable definition

Wire color	RS232	RS485	CAN	Ethernet	Wi-Fi	4~20mA	-5~+5VDC
Red	Power+	Power+	Power+	Power+	Power+	Power+	Power+
Black	Power GND	Power GND	Power GND	Power GND	Power GND	Power GND	Power GND
Green	Signal GND	Signal GND	Signal GND	Signal GND	NC	Signal GND	Signal GND
Yellow	NC	NC	NC	E-RXD+	NC	Iout	Vout
White	NC	NC	NC	E-RXD-	NC	NC	NC
Blue	RS232—TXD	RS485—A	CAN-H	E-TXD+	NC	NC	NC
Brown	RS232—RXD	RS485—B	CAN-L	E-TXD-	NC	NC	NC

Ordering

SST2202 – (Range) – (Output)

Range:
±5°—05
±10°—10
±15°—15

Output:
RS232 — 00
Others: see table 4
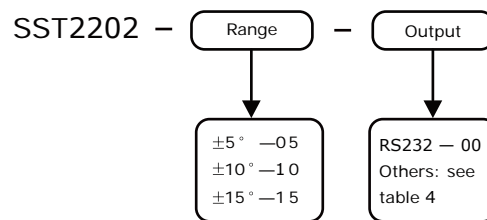
Angle conversion

Table3 Angle conversion table

	degrees	arc minutes	arc seconds	µradians	mm/meter	inches/ft.
1 degree=	1	60	3600	17453	17.453	0.2094
1 arc minute=	0.01667	1	60	290.9	0.2909	3.49×10^{-3}
1 arc second=	2.78×10^{-4}	0.01667	1	4.848	4.85×10^{-3}	5.82×10^{-5}
1 µradian=	5.73×10^{-5}	3.44×10^{-3}	0.2063	1	0.001	1.20×10^{-5}
1 mm/meter=	0.0573	3.436	206.3	1000	1	0.0120
1 inches/ft.=	4.775	286.5	17189	83333	83.33	1

Accessories & Options

Table 4 Accessories

Item	Order Code	Accessories name	Function
Output interface	00	RS232 output	Standard industrial interface
	G1	RS485 output	Standard industrial ModBus protocol
	G3	CAN output	Standard industrial interface
	G9	Ethernet interface	Standard industrial TCP/IP interface
	G12	Wi-Fi interface	Standard industrial interface
	G19	4~20mA output	Standard industrial level
	G21	-5~+5VDC output	Standard industrial level

SST810 Dynamic Inclinometer

Features

- No drift, dynamic tilt measuring
- Lowest cost, high performance
- Built in MEMS triaxial accelerometer and triaxial gyroscope
- Dynamic accuracy ±0.5°，optional ±1° or ±0.1°
- Highest refresh rate 400Hz
- Autonomous working, do not need any external auxiliary
- Mounted wherever needed

Descriptions

SST810 dynamic inclinometer is specially designed for motion application, which is an inertial product with highest 400Hz update rate.

The traditional inclinometer on the market is designed on accelerometer and electrolyte principles. In dynamic motion such as rapid movement vehicle and vessel, the measurement result will be affected by extra axial acceleration and centripetal acceleration, so that valid angle measurement data can't identify effectively, and accuracy is unable to guarantee. SST810 adopts advanced inertial navigation technology to exactly measure dynamic pitch/roll tilt angle for long time, without aiding of GPS.

Applications

- Ship
- Robot
- dynamic GPS assist
- Engineering machinery
- Weapon platform
- Power line monitoring, etc.
- Rail transportation
- Photoelectric platform
- Automotive
- Robot

Referenced Standards

- GB/T 191 SJ 20873 General requirements for Inclinometer & levelmeter (China)
- GBT 18459 Methods for Calculation 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 Centrifuger(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)
- EN61000-4-11 Voltage dips &Voltage variations

- MIL-HDBD-338B
- ISO 5348 IDT
- MIL-STD-810F-501.4
- MIL-STD-810F-502.4
- MIL-STD-810F-503.4
- MIL-STD-810F-506.4

- MIL-STD-810F-510.4
- MIL-STD-810F-514.5
- MIL-STD-810F-516.5
- IEC60529 IP
- EN61000 -4-2 ESD
- EN61000-4-3 RS

- MIL-STD-810F-507.4
- EN61000-4-4 EFT
- EN61000-4-5 SURGE
- EN61000-4-6 CS
- EN61000-4-8 PFMF
- ISTA-2A

Performances

Table 1 Specifications

Roll/pitch range	±180°/±90°
Resolution	0.05°(optional 1° or 0.01°)
Response frequency	DC~800Hz
Accuracy	≤±0.5°, dynamic(optional ≤±1° or ±0.1°)
	≤±0.05°, static (optional ≤±0.1° or ±0.01°)
Refresh data	Adjustable 0.5-50Hz, optional max 400Hz
Angular velocity range	≤±300°/s (max ≤2000°/s)
Acceleration range	≤±5g (max ≤±16g)
Power supply	9~36VDC
Power consumption	< 1W
Output interface	RS232, RS485, RS422, CAN2.0, CANopen, Ethernet
Output data	Roll & pitch angle data , optional triaxial acceleration and triaxial angular velocity data
Operation temperature range	-40~85℃
Storage temperature range	-40~85℃
MTBF	≥100000 h/times
Shock	1000g@1ms,three-axis, half- sine
Protection	IP67
Connecting	M12, 5-pin
Dimensions	81x54x28.5mm
Weight	240g (without connector and cable)

Dimensions (mm)
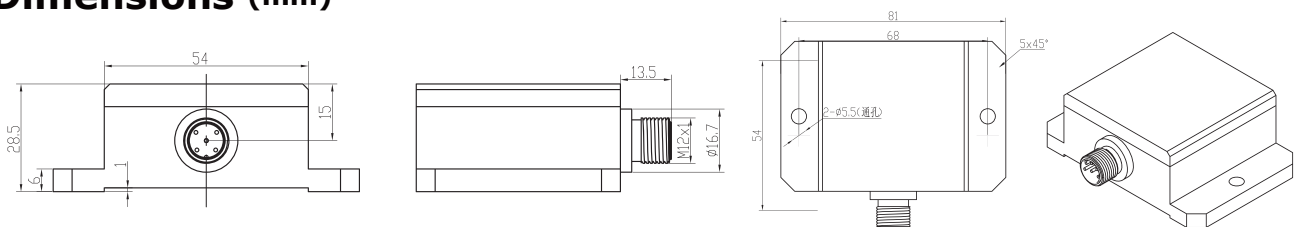
Wiring
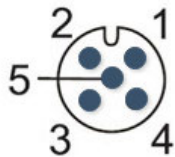
M12 connector socket
(Male head view from outside)

Pin	Wire color	RS232	RS485	CAN
1	Red	Power+	Power+	Power+
2	Black	Power-	Power-	Power-
3	Blue	TXD	A	CAN-H
4	Brown	RXD	B	CAN-L
5	Green	Signal GND	Signal GND	CAN-GND

Ordering

SST810 — Dynamic/Static accuracy — Update rate — Output

±1°/±0.1°—P1
±0.5°/±0.05°—P2
±0.1°/±0.01°—P3

50Hz — 00
100Hz — 01
200Hz — 02
400Hz — 03

RS232—00
RS485—G1
RS422—G2
CAN2.0—G3
CANopen—G4
Ethernet—G9
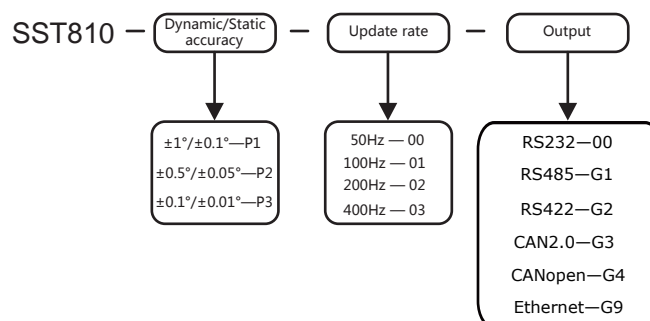
SSN57420 Laser Gyro Inertial Navigation System

Features

- Long-term dynamic measurement
- Initial alignment time $<$ 10 minutes
- Built-in triaxial quartz flexible accelerometer and triaxial laser gyroscope
- Yaw angle accuracy ±0.06°, Pitch/Roll accuracy ±0.02°
- Output refresh rate 50~1000Hz
- Full temperature compensation
- Output Yaw angle and Pitch/Roll angle data
- Working independently without any external auxiliary
- Able to work in 2m underwater for a long time, optional explosion-proof shell
- Optional external odometer, GNSS, ADCP/DVL, Depth gauge, rader, etc

Descriptions

SSN57420 laser gyroscope is a kind of high precision inertial measuring instrument which can independently measure Yaw angle, Pitch angle and Roll angle of carrier under arbitrary autonomous motion. After initial alignment, the Yaw angle measurement accuracy ±0.06°and attitude accuracy ±0.02° can be maintained for a long time without any external equipment. It is not affected by magnetic field, light and vibration. It can also work effectively for 2m underwater for a long time. SSN57420 built-in high-precision laser gyroscope and quartz flexible accelerometer, through a variety of error calibration and compensation technology, after initial alignment with Kalman filter technology and compass navigation algorithm, it can continuously provide Yaw angle and Pitch/Roll angle information that meet the performance requirements in real time.
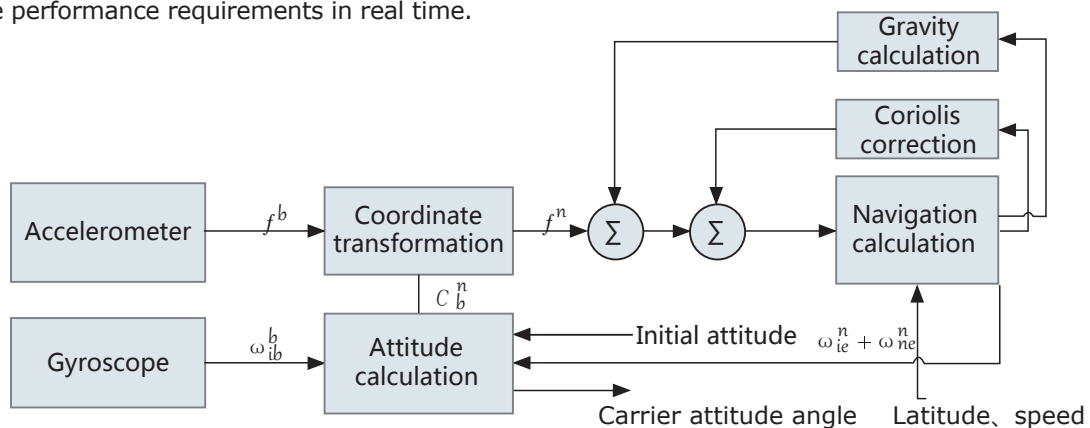
SSN57420 adopts electromagnetic shielding design, thermal balance design, vibration mode design, sealing design and strict manufacturing process to ensure that the system can adapt to harsh external environment.

Applications

-Shearer

-Coal digester

-TBM

-Ship navigation

-Pipe jacking machine

-Vehicle navigation, etc

-ROV

Performances

Yaw angle accuracy	≤0.06°secφ (Latitude < 70 degrees)	
Roll/Pitch angle accuracy	≤0.02°	
Yaw angle range	0 ~ 360°	
Roll/Pitch angle range	±180°/±90°	
Laser gyro	Angular rate range	±400°/s
	Zero bias repeatability	0.015°/h
	Scale factor nonlinearity	0.015°/h
	Zero bias stability	10ppm
Accelerometer	Acceleration range	±20g
	Zero bias stability	50ug
	Zero bias repeatability	50ug
	Scale factor nonlinearity	50ppm
Initial alignment time	≤10min	
Acceptable movement	Arbitrary autonomous motion	
Power	Voltage：24VDC±3VDC，current≤1.5A	
Operation temperature	-40 ~ +70℃	
Storage temperature	-55 ~ +85℃	
Shock	30g @ 6ms/50g @ 11ms	
Vibration	$0.04g^2$/Hz @ 20~2000Hz	
Protection	IP68，2m underwater	
Connector	Military connector	
Dimensions	242×198×190 mm	
Weight	≤8.8kg	
Output	RS232、RS422、CAN、Ethernet	
Output refresh rate	Optional 50~1000Hz	
Output data	Yaw、Roll、Pitch	

Dimensions (mm)
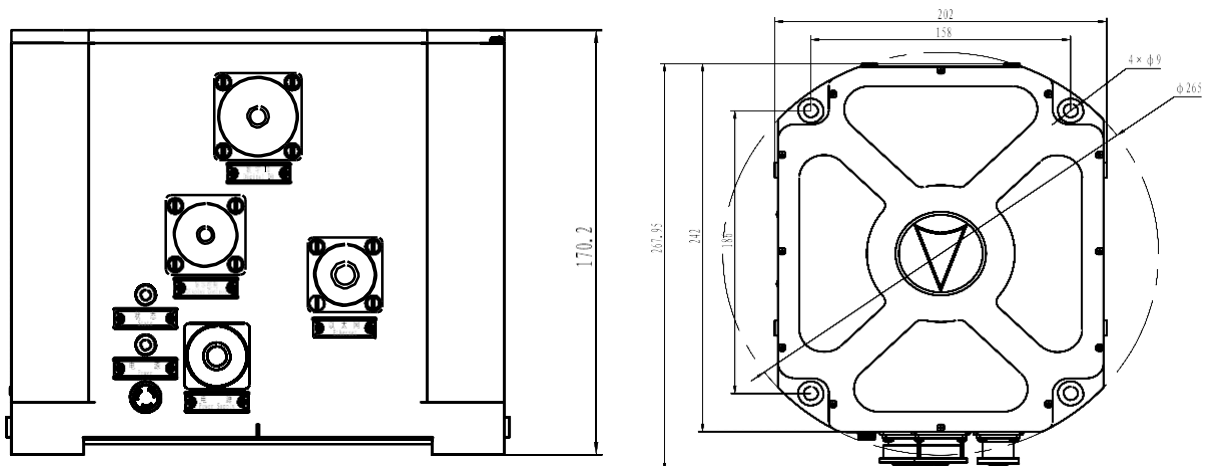
SSA100 Vibration Sensor

Features

- Real-time FFT analysis inside, output amplitude and frequency data
- MEMS acceleration sensor, single / double / three axis optional
- Max acceleration range ±16g, vibration frequency range 0~1.0kHz
- Cross-axis sensitivity ≤ ±1.5%FS, optional ±1%FS, ±0.5%FS, ±0.1%FS
- Non-linearity ≤ 0.5%FS
- Acceleration or vibration frequency alarm threshold can be set
- Built in high pass filter, optional low pass filter or bandpass filter

Descriptions

SSA100, built in on-line FFT analysis, directly outputs single/double/three axis vibration frequency and acceleration data via RS232/RS485/RS422/CAN2.0/CANopen/Ethernet. It can help you to understand and grasp the vibration condition of the measured object in real time and accurately, without the need of expensive data acquisition equipment and analysis software which are not suitable for the working environment on site. SSA100 has built-in high-speed processing chip, which can collect, process and analyze the original vibration acceleration signal and frequency signal in real time. The whole data processing process only needs 1 ms. At the same time, the cross-axis error sensitivity of SSA100 is less 1.5%FS, ≤1.0%FS, ≤0.5%FS and ≤0.1%FS are optional according to user's needs. SSA100 is a cost-effective vibration measurement product which has higher actual measurement accuracy than the same kind of vibration sensor (the cross-axis sensitivity error is generally about ±3%FS).

Applications

- Engineering machinery
- Radar/antenna motion monitoring
- Scientific research & teaching

- Automobile
- Factory automation
- Civil Engineering,etc

- Shipping
- Railway transportation

Performances

Table 1 Specifications

|		±1g	±2g	±4g	±8g	±16g
Acceleration measurement	Range	±1g	±2g	±4g	±8g	±16g
	Resolution	0.1mg	0.25mg	0.5mg	1mg	2mg
	Response frequency	0~1000Hz				
	Nonlinearity	<±0. 5%FS				
Vibration frequency measurement	Range : 0~1000Hz Accuracy : <±5% Resolution : 0.1Hz					
Cross-axis sensitivity	Default≤±1.5%FS , optional≤±1%FS、≤±0.5%FS、≤±0.1%FS					
Zero offset	±5mg@25℃ @±2g range , adjustable on site					
Offset temperature drift coefficient	±0.5mg/K					
Sensitivity temperature drift	±0.01%FS/K					
Measurement axis	1 or 2 or 3 axis					
Digital filter	Low pass filter : 10、20、40、75、150、300、600、1200 Hz, adjustable High pass filter : 1Hz, optional Bandpass filter : 0.2~300Hz, optional					
Output interface	RS232、RS485、RS422、CAN2.0、CANopen、Ethernet					
Output data	Acceleration & Vibration frequency					
Refresh rate	50~400Hz					
Power supply	24±5VDC , ≤200mA					
Operation temperature	-40～85℃					
Storage temperature	-40～85℃					
EMC	According GBT17626					
Insulation resistance	≥100MΩ					
MTBF	10 years					
Shock	1500g@1ms , three-axis , half-sine					
Vibration	4grms , 20～2000Hz , sine					
Protection	IP67					
Connecting	M12-8Pin socket					
Weight	≤150g (without connector and cable)					

Dimensions (mm)
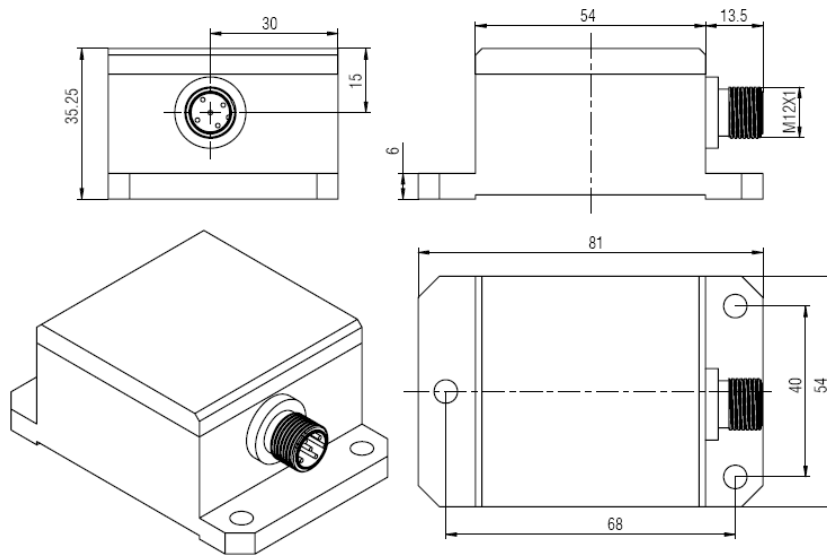
Picture1 SSA100 with M12 connector

Wiring

Table 2 Pin definition
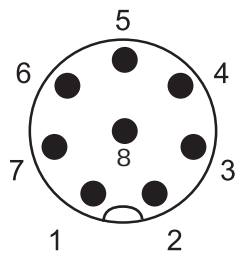
Picture2 M12 connector socket
(View from outside)

Pin	RS232	RS485	RS422	CAN	Ethernet
1	Power+	Power+	Power+	Power+	Power+
2	Power-	Power-	Power-	Power-	Power-
3	Signal GND	Signal GND	Signal GND	Signal GND	Signal GND
4	TXD	A	RXD+	CAN_H	RXD+
5	RXD	B	RXD-	CAN_L	RXD-
6	NC	NC	TXD+	NC	TXD+
7	NC	NC	TXD-	NC	TXD-
8	NC	NC	NC	NC	NC

Ordering

SSA10

Axis	Range	Cross-axis sensitivity	Output
Single — 1 Double — 2 Three — 3	±1g — 01 ±2g — 02 ±4g — 04 ±8g — 08 ±16g — 16 Customizing	±1.5% — 15 ±1.0% — 10 ±0.5% — 05 ±0.1% — 01	RS232—00 RS485—G1 RS422—G2 CAN2.0B—G3 CANopen—G4 Ethernet—G9
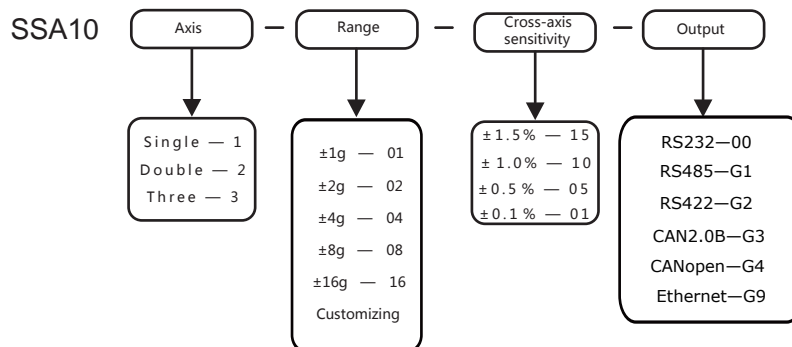
SSD200 Data Indicator

Features

- Compatible with SST series digital output inclinometer
- Built-in rechargeable lithium battery for 8h continuous
  operation - Power supply for connected sensor
- Single/dual axis angle display, optional alarm function
- Optional SD card, WiFi connection, voice alarm function, etc.
- IP65 Protection, multiple installation

Descriptions

SSD200 Data Indicator is a special display instrument for Vigor's SST series inclinometer. It can be compatible with all the SST series sensor with digital output to read inclination data, optional SD card to save data and voice alarm module as well as Wi-Fi wireless connection, and it is easy to install and use on site.

SSD200 based on high-performance ARM runs UCOSII real-time operating system and has built-in large capacity lithium batteries. It can directly supply power to connected sensor, even when the system is powered off, it can provide continuous power supply to sensors for a period of time. SSD200 has been tested and verified by EMC, environmental adaptability, sealing and other reliability tests before leaving the factory. It can be widely used in harsh field environment.

Applications

-Field environmental inclination measurement system

-Factory Automation Monitoring system

-Laboratory inclination testing system
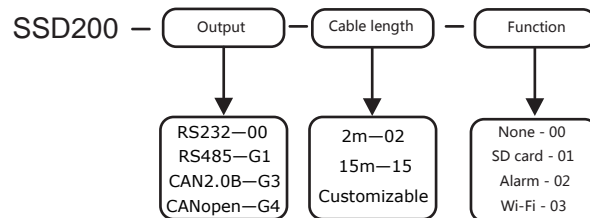
Dimensions(mm)
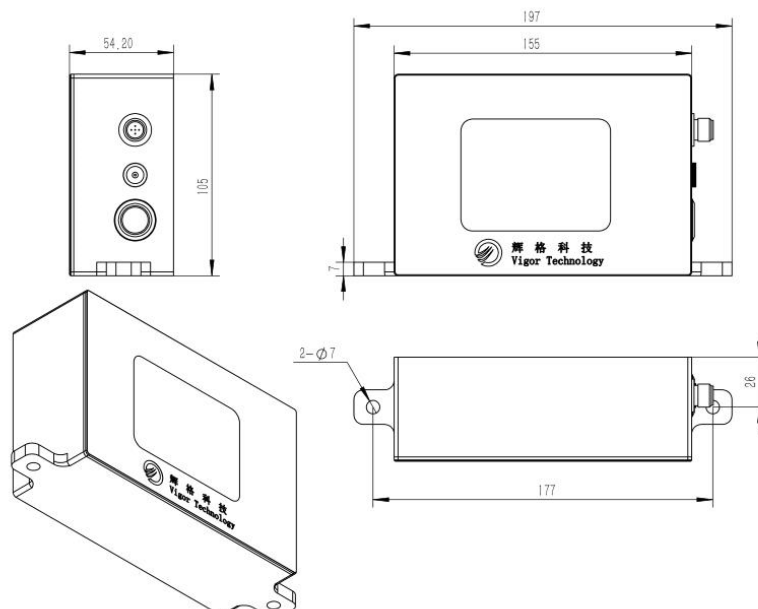
Performances

Table 1 Specifications

Connectible Sensors	SST series sensors with digital output（RS232、RS485、CAN2.0, etc）
Connection distance	≤50m
Battery life	＞8h
Function buttons	Zero setting and power switch
Charging voltage	9VDC
Power consumption	＜1W@No load
Status indication	Charge Indicator / Undervoltage Indicator
Power supply capability	24VDC@500mA
Protection	IP65
Operation temperature	-40℃~85℃
Storage temperature	-40℃~85℃
Operation humidity	5%~100%RH
Operation pressure	550~1060hPa
EMC	According GBT17626
MTBF	≥25000 h/times
Vibration	100g@11ms , three-axis（half-sine）
Shock	8grms, 20~2000Hz
Dimension	197mmX105mmX55mm
Weight	＜500g（without cable）
Optional functions	SD card（64GB）for data storage、Voice alarm function、Wi-Fi connection

Ordering

SSD200 — [Output] — [Cable length] — [Function]

Output	Cable length	Function
RS232—00	2m—02	None - 00
RS485—G1	15m—15	SD card - 01
CAN2.0B—G3	Customizable	Alarm - 02
CANopen—G4		Wi-Fi - 03

For example, if order a SSD200 with RS485 output, SD card and 5m connection cable, the model should be chosen as：SSD200-G1-05-01.
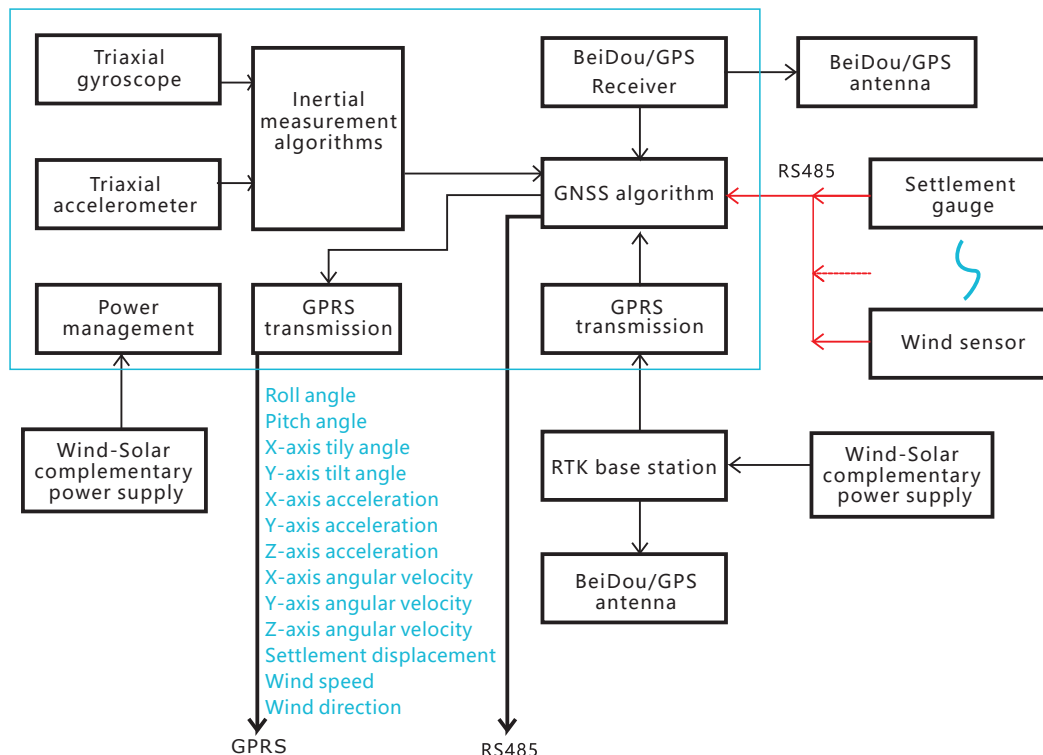
SSM0713 Tower Monitoring System

Features

- Achieve early warning, comprehensive dynamic recording in the process of danger occurrence, positioning and directional alarm function after danger occurrence.
- Measurement parameters：inclination angle、vertical settlement、triaxial acceleration、riaxial angular velocity，displacement meter、wind sensor、rain gauge and other sensors with RS485 output interface can be connected.
- Roll/Pitch angle range≤±30°，resolution 0.005°
- Acceleration range ±4g，bandwidth 500Hz，resolution 0.2mg
- angular velocity measurement range ±100°/s，resolution 0.01°/s
- GPS+BeiDou dual GNSS based on RTK
- Optional vibration frequency and amplitude output
- Optional wind-Solar complementary power supply
- Wi-Fi/GPRS output, optional RS485 ModBus output
- Lightning protection
- IP67 protection

Description

As a one-stop integrated measurement system, SSM0713 is an advanced monitoring system in the field of communication/power tower monitoring. It combines GNSS positioning technology, inertial measurement technology, wireless transmission technology, unattended monitoring technology, power supply technology and geotechnical monitoring technology, etc. It can monitor the top, body and base of the tower synchronously, and realize more advanced and early warning function and comprehensive warning ability.

Performances

General parameters	
Displacement measurement	Static accuracy: Plane accuracy：±2.5mm+1ppm Height accuracy：±5mm+1ppm RTK accuracy： Plane accuracy：±1cm+1ppm Height accuracy：±2cm+1ppm Code differential location accuracy：0.25~0.45m（CEP） Single location positioning accuracy：1.5m
Roll/Pitch angle measurement	Range：≤±30° Accuracy：±0.005° Resolution ：0.001° Temperature drift：0.0008°/℃
X/Y/Z Acceleration measurement	Range：±4g Resolution：0.2mg Bandwidth：500Hz
X/Y/Z Angular velocity measurement	Range：±100°/s Resolution：0.01°/s Bandwidth：100Hz
Vibration measurement	Vibration frequency,resolution: 0.1Hz Vibration acceleration,resolution: 1mg
Settlement Measurement	Range：200mm Resolution：0.05mm/m RS485 output
Lateral displacement monitoring(Optional)	Range：±30° Resolution：0.05mm/m RS485 output
Rain gauge (Optional)	Range：0.1~4mm/minute Accuracy：0.1mm/minute RS485 output
Wind sensor (Optional)	Wind speed：0~33m/s Accuracy：1m/s RS485 output
Data refresh rate	0.01~5Hz
Software	
Realization function	Alarm setting Communication port setting Data Sampling Parameter Con faignudr aTtriaonns ofef rS Seentstoinrsg and GNSS System Windows operation system

Input interface	
RS485	Format：baud rate 9600(adjustable),8 datas,1 Stop bit, No Parity
	Protocol：Modbus RTU,optional HEX or ASCII
Output interface	
RS485 （optional）	Format：baud rate 9600(adjustable),8 datas,1 Stop bit, No Parity
	Protocol：Modbus RTU,optional HEX or ASCII
GPRS	Built-in GPRS/CDMA communication module 900/1800MHz band,automatic landing 4G/GSM/CDMA
Electrical interface	
Power supply	Wind-Solar Complementary Power Supply , 12VDC, 15W
Power consumption	12VDC, 3W
Protection	Inverse polarity protection and overload protection
Mechanical part	
Protection	IP67
Dimension	200*180* 80mm@ SSM0713 data acquisition instrument
Weight	≤1.0kg
Environment	
Operation temperature	-40℃~85℃
Storage temperature	-40℃~85℃
EMC	EN 610000
Lightning protection	Common mode power supply 10KA,Signal 5KA Differential mode power supply 5KA,Signal 3KA
Insolation	>100MΩ
MTBF	10 years
Corrosion resistance	IEC 61701-2011
Radiation resistance	IEC 68-2-5
Shock	Resistance to 3m drop
System delivery list @ single tower	
1	RTK ground base station,1 set
2	SSM0713 data acquisition instrument, 1 set
3	Wind-Solar complementary power supply system （optional）
4	Monitoring software, 1 set
5	Installation accessories, 1 set
6	User manual

SSTsoftware Application Software

Features

- Compatible with SST series digital output sensor command protocol
- Support serial Port, USB, Ethernet, Wi-Fi and other communication modes
- Angle data and curves display
- Support automatic real-time storage of monitoring data/curves
- Support for exporting saved data to CSV format files
- Friendly, beautiful and humanized interface design
- Flexible system parameter setting
- Based on Windows7/Windows10@64 bit operating system
- Customizable multi-sensor centralized networking communication
- Customizable App software for Android or IOS mobile Phone/PAD

Descriptions

SSTsoftware PC application software is tailor-made for SST series inclinometer of Vigor, it is not only convenient for users to set inclinometer parameters, but also combined into an efficient online monitoring system with SST series inclinometer. This system can realize long-distance angle data measurement, transmission, acquisition and lightweight analysis in industrial field. It is a flexible and easy-to-use inclination measurement application software. SSTsoftware's advanced functions and features are as below:

√ Real-time displays the trend of inclination attitude change
√ Long-term data acquisition, monitoring, preservation and export function
√ Inclination data can be exported to CSV format file for third party analysis
√ Safe and reliable data preservation mechanism ensures that even in the case of sudden power failure, the collected data will not be lost
√ Sectionally save and export data at any time, which is convenient to extract and analyze the abnormal data
√ Compatible with all SST series inclinometer , supporting serial port, USB, Ethernet, Wi-Fi and other communication
√ Networking and remote inclination measurement can be realized with WI-FI and Ethernet inclinometer

Applications

Civil engineering : data monitoring of excavation or trenchless construction, data monitoring of structure attitude
Industrial equipment : data monitoring of equipment attitude , equipment installation and control process
Test and measurement : attitude data monitoring of experimental equipment, levelness, etc

Technical parameters

Table 1 Technical parameters

| SSTsoftware PC application software	
Compatible sensors	SST series inclinometer with digital output
Communication mode	Serial port communication, LAN communication, Wi-Fi communication, etc.
Operation system	Support Windows 7 or Windows 10@64 bit operation system
Operation envirenment	Microsoft .net Framework 4.5 Adobe PDF Reader (the latest version) Microsoft Office 2007 or higher
Hardware envirenment	CPU : 1.6GHz or higher , memory : 512MB Hard disk : minimum 1GB free space , actually depends on the size of storage data
Resolution	1024 x 768 or higher

Software menu
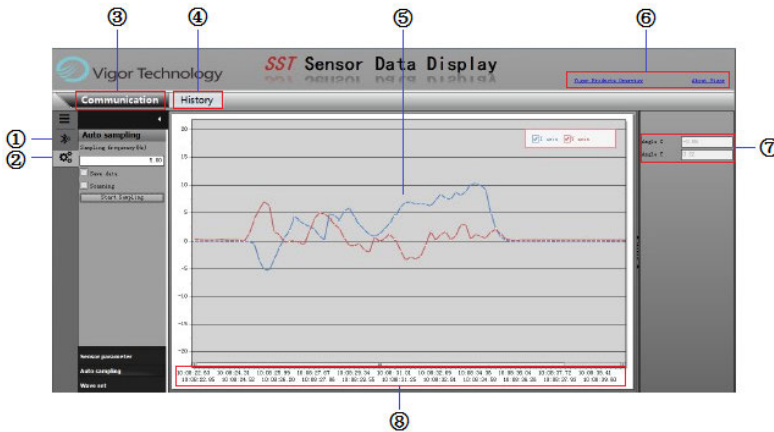
Table 2 Software menu

	Description
①	COM port, baud rate, parity check, data bit, stop bit, ID address, IP address settings, etc
②	Sensor parameter setting, angle data sampling setting, chart setting, etc.
③	Overview of communication parameters
④	Historical data and historical curve settings
⑤	X/Y axis angle real-time curve
⑥	Overview of SST Series sensors and Vigor website
⑦	X/Y axis angle real-time data
⑧	Rolling time corresponding to X/Y axis data

Main functions

Table 3 Main functions

Item	Description
Real-time display	Real-time inclination data display
	Real-time triaxial acceleration and triaxial angular velocity data display
	Real-time dynamic curve display
	Enlarged/reduced coordinate range, users can clearly see the data curve changes.
Data and curve playback	Custom time period to playback data curve
	When playback data, monitoring data at each time point follow the mouse cursor display
Data and curve save	Custom data and curves save, data will not be lost when power failure
Data export	Custom time period to export data to standard CSV format file
	Data save path customization, file automatically named by operation time
System setting	Communication parameter settings, such as serial port, baud rate, parity check, data bit, start bit, stop bit, ID address, IP address, etc.
	Sensor parameter setting, such as sensor series, single/double axis, protocol, etc.
	Other settings, such as sampling frequency, number of display points per screen, range of wave amplitude, etc.

Ordering

Table 4 Order information table

SST003-04-13-00	Based on windows platform
SST003-04-13-01(Need customization)	Based on iOS platform
SST003-04-13-02(Need customization)	Based on Andriod platform

SSH2310 Navigation Software

Features

- Communication with SSN series high precision gyroscope
- Continuous real-time Yaw angle and Roll/Pitch angle display
- Real-time positioning information and automatic conversion to horizontal displacement off the central line of tunnel
- Automatic acquisition of current mileage、real-time path display, and with idling recognition alarm function
- Rapid docking of total station positioning data, realize system calibration and accurate error calibration, ensure the accuracy of data in the whole tunneling
- Based on the design of underground working environment,reduce manual operation and improve the efficiency of software human-computer interaction

Descriptions

SSH2310 navigation software is a supporting software of Vigor's SSN series inertial navigation system. It is designed to meet the needs of high precision positioning and guidance of underground equipment when GNSS signal can not be received. The software can support the acquisition of real-time dynamic position and attitude information of underground excavation equipment, and use the position and attitude information to calculate the offset between equipment platform and target. At the same time, SSH2310 supports rapid docking with the total station data to calibrate system platform, correct accumulated errors, achieve accurate zeroing operation, and ensure the data accuracy in the whole excavation process.

Applications

High-precision positioning and navigation without GNSS signal in underground tunnels and mines.

Parameters

Connecting device	SSN Series Inertial Navigation System, Encoder, Radar	
Input information	Current longitude and latitude information, starting and ending coordinate information of target path	
Output information	Vehicle body current position and attitude information, displacement offset with preset path, offset alarm, etc.	
Operating system	32-bit or 64-bit Windows 7/8/10 system	
Operation tools	keyboard and mouse	
Hardware requirement	CPU	5th Gen Intel® CORE™ i5 or above
	Memory	2GB

Software Interface
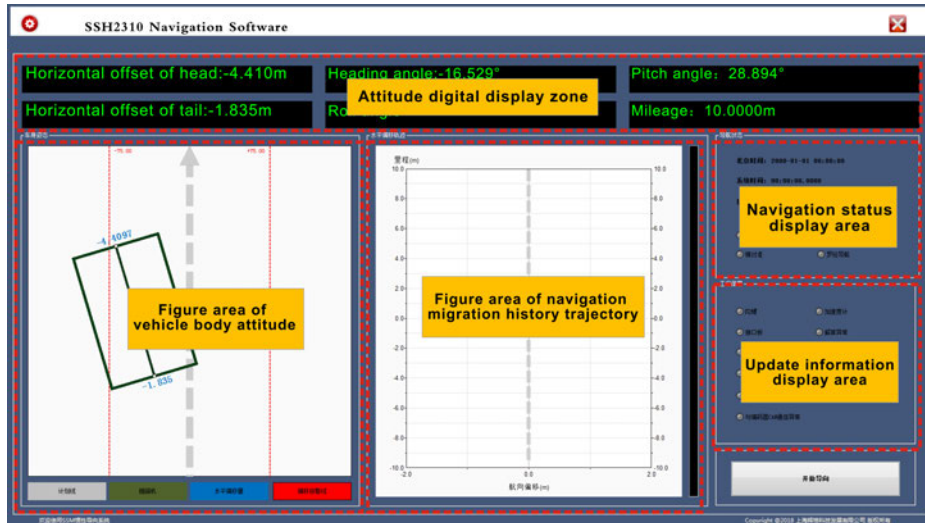
Operation

1,After connecting the inertial navigation system, encoder and radar, start the software and automatically initialize system.

2,Input the current longitude and latitude information and the coordinates of the starting and ending points of the target path, the system automatically runs, and calculates the current attitude and offset of vehicle body. No manual intervention is needed.

3,In order to eliminate accumulated errors, the total station should be used to calibrate the equipment during the off-duty period.

Main functions

Items	Description
Equipment calibration	As the accumulated error of encoder data, the equipment need to be corrected by using the tunnel/mine control points and total station during each work break. With the positioning data of total station, software automatically calculates the corrected values and completes the calibration.
Attitude display	Directtly display of current vehicle body attitude information
Offset calculation	By the target trajectory information, the offset can be calculated automatically and displayed by numerical and graphic methods.
Overrun alarm	Alarm when the calculated offset exceeds the preset value
Historical track	Recording and displaying the historical trajectory of the system according to the running condition of the equipment
Status display	Display system working condition, time, connection status, etc.
System calibration	Calibration of internal parameters of the system platform is realized with total station instrument. Data of total station are received, calibration information is automatically calculated and recorded.