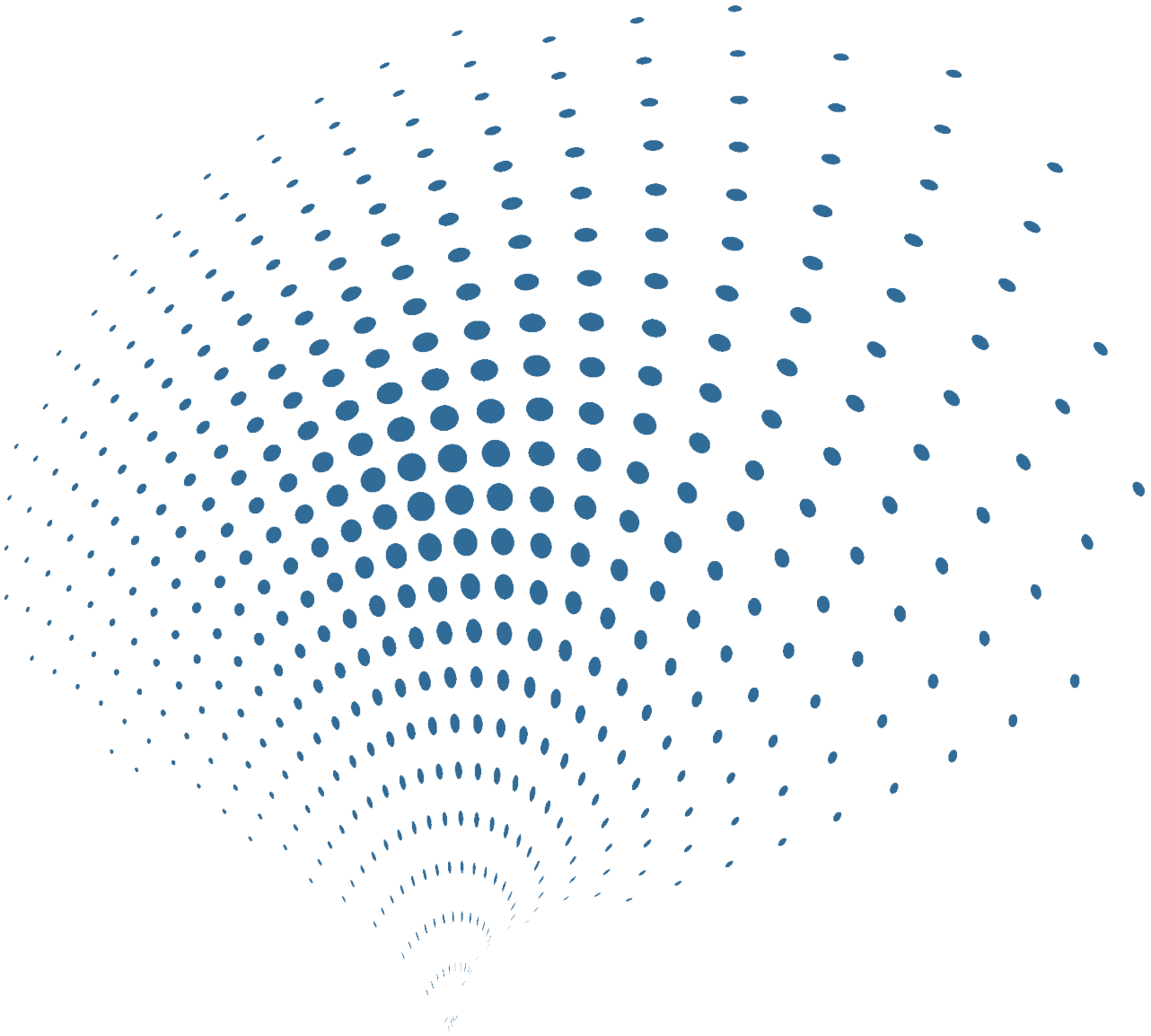
Vigor Technology



Submersible Inclinometer

Submersible Inclinometer

Features

- Max 3000m submersible depth
- Max combined absolute accuracy: ±0.01°
- Cross-axis sensitivity: ±0.1%FS
- Special underwater application connector
- Resistance to acid and alkali salt corrosion
- Reduce installation error via “Allowed installation misalignment”

Descriptions

Vigor's submersible inclinometer provides very high combined accuracy and real-time remote monitoring of tilt measurement for submerged structures or slow moving object. The submersible inclinometer is based on the high performance, high reliability and high stability of SST300 inclinometer. The PCB board of SST300 is installed in a strong waterproof housing and can work stably for a long period of max 3000m underwater.

The stainless steel shell of submersible inclinometer is machined and welded to meet high pressure performance. Sensor adopts special waterproof cable and submarine connector socket, which can be used stably in long-term underwater high-pressure environment.

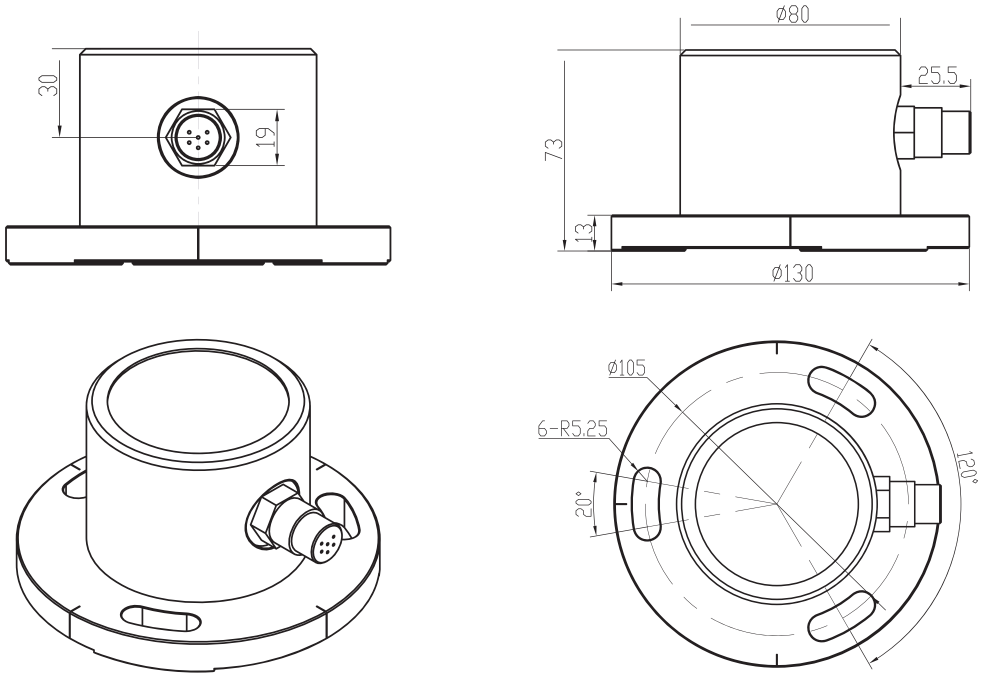
To solve the problem of installation error caused by underwater installation, sensor provide "Allowed installation misalignment" data to reduce installation error.

Submersible inclinometer can be directly mounted on a horizontal, vertical or inclined surface.

Applications

- Inclined concrete face rockfill dam
- Inclination monitoring of retaining wall
- Monitoring of offshore buildings and underwater pipelines
- Dam Bricks and Concrete Dams
- Piles and piers

Dimensions (mm)



Picture 1 Housing with connector

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					
	Offset ③	±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 stability(1 year)⑥		≤0.02°					
Measurement axis		1 or 2 axis					
Temperature sensor		Range: -50~125℃ ,Accuracy:±1℃					
Output		RS485, CAN					
RS485 data format		9600 baud(adjustable), 8 data bits, 1 start bit, 1 stop bit, none parity, ASCII					
Cold start warming time		60s					
Response time⑦		0.3s(@t_{90})					
Refresh rate(digital output)		5Hz(optional 10Hz,20Hz)					
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 h/times					
Shock		100g@11ms,three-axis, half- sine					
Vibration		8grms, 20~2000Hz					
Protection		Max 3000m underwater					
Connecting		3000m submarine class underwater special connector					
Weight		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

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

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

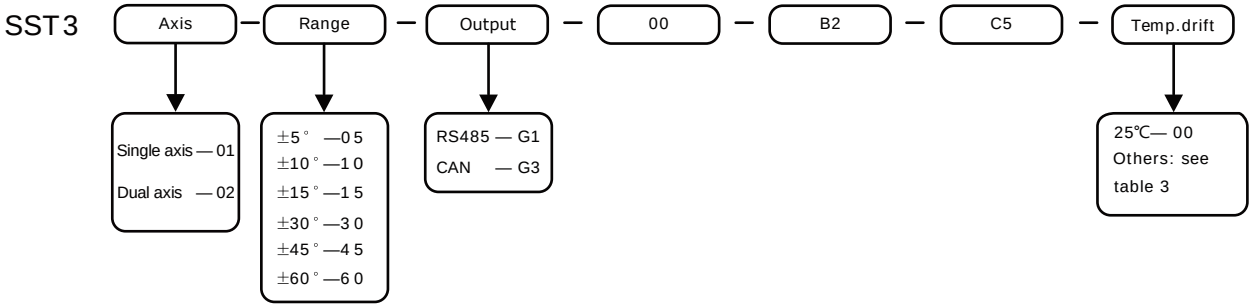
Wiring

Picture 2 Connector socket
(View from outside)

Table 2 Socket Pin definition

Pin	RS485 output	CAN
1	Power+	Power+
2	Power-	Power GND
3	Signal GND	Signal GND
4	NC	CAN-H
5	NC	CAN-L
6	RS485-A	NC
7	RS485-B	NC
8	NC	NC

Ordering



For example, if order a single axis inclinometer, with range ±15°, Output RS485, Watertight cable with plug, 3000m underwater housing (B2), the model should be chosen as: SST301-15-G1-00-B2-C5-00.

Accessories & Options

Table 3 Accessories

Item	Order Code	Accessories name	Function
Output	G1	RS485 output	Standard industrial ModBus protocol
	G3	CAN output	Standard industrial interface
Cable/Plug	C5	Watertight cable with plug	3000m underwater with special plug
Temperature drift	D1	Temperature drift	Temperature compensation range is 0~60℃, accuracy ±0.01°@≤±30°
	D2	Temperature drift	Temperature compensation range is 0~60℃, accuracy ±0.01°@>±30°

Table 4 Options

Item	P/N	Option name	Function
Test report	SST003-11-01	Test report for cross-axis snesitivity	Accuracy test report under the influence of cross-axis, average 11 points of full range
	SST003-11-03	Test report for Allowed Input axis misalignment	Axis migration test report for vertical and horizontal axis of inclinometer, 3 angles
	SST003-11-13	Test report for salt spray	According to MIL standard(meet MIL-810F 509.4)
	SST003-11-14	Test report for IP protection	According to IEC standard

Shanghai Vigor Technology Development Co., Ltd.

Tel:021-58404921 Fax:021-58354552 Website: www.vigordigital.com
Address: Room 102, Block 4, No. 289 of Bisheng Road, Shanghai, China