Gyro Inclinometer

Vigor Technology

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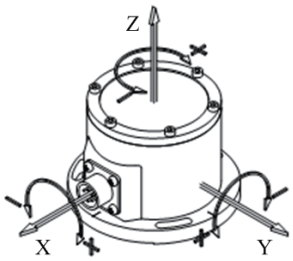
Features

- Gyro range:±100/±250/±400°/s
- Gyro In - run bias:±0.02°/s
- Gyro nonlinearity: 0.1%FS
- Gyro bandwidth: 50Hz
- Three axis angular rate & relative angle increment measurement
- Tilt range(X&Y axis): ±5° ~ ±60°
- Up to ±0.01° combined absolute accuracy

Descriptions

Gyro - inclinometer not only provide roll, pitch attitude angle in static, but also output relative roll, pitch &heading increment angle or angular rate in high dynamic test.
General inclinometer which based on accelerometer or electrolyte principle, will be affected much by additional axial acceleration and centripetal acceleration from rapid movement, and take measurement accuracy down. But gyroscope has good dynamic characteristics, not affected by acceleration, and output angular rate and relative angle increment under dynamic moving. In the low - frequency quasi - static conditions, the inclinometer will have accurate measurement, while gyroscope drift timely.
Based on good quasi - static characteristics of inclinometer and good dynamic characteristics of gyroscope, gyro - inclinometer combined gyroscope and inclinometer perfectly, to adapt to both dynamic and quas - static angle measurement.
Gryo - inclinometer have more choices as:
Single inclinometer +Z axes gyroscope with analog/digital output
Dual inclinometer +Z axes gyroscope with analog/digital output
Dual inclinometer +Y axes gyroscope with analog/digital output
Dual inclinometer +X/Y axes gyroscope with analog/digital output
Dual inclinometer +X/Y/Z axes gyroscope with analog/digital output
Also, Vigor may provide customized gyro's performance as demand



Gyro inclinometer has strong measuring ability:

- √ ±0.02%FS linearity and±0.005°Offset, higher zero accuracy with large measurement range
- √ Gyro bias stability ±0.02°/s & 50Hz bandwidth, has quick & accurate relative angle & angular rate measuring ability
- √ Relative angle & angle rate not affected by additional acceleration
- √ With static/dynamic angle measuring ability, suite to low/rapid platform leveling
- √ Combine with vibration module, realize FFT computations in-time, output vibration frequency and amplitude data directly, eliminate the influence of environment vibration
- √ Inclination axial and gyro axial have precisely aligned & calibrated, to ensure all measurement data simultaneous sampling in the same coordinate system
- √ Further confirmed that offset, repeatability, hysteresis, turn on repeatability etc. parameters which are important influence factors to unit total performance evaluation.
- √ Internal enhanced advanced intelligent algorithms drastically reduce cross-axis sensitivity, upgrades real tilt angle measuring accuracy, abandoned the traditional incomplete understanding for tilt angle measurement precision concept
- √ Greatly reduce measuring errors when the real tilt direction not consistent for unit's actual sensitive axis
- √ Short-circuit, transient voltage and transposition protection to adapt to industry environment
- √ User can set unit's all kinds of parameters and query factory data via digital interface.

Applications

Factory automation, Agricultural machinery, Construction machinery, Rail transportation, Road traffic, Robots, Vehicle system, Weapons platform, Satellite communication, Photoelectric platform, etc

Performances

Table 1 Specifications

Inclinometer 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 stability(1 year)		≤0.02°					
Measurement axis		1 or 2 axis					
Response time		0.3s(@t_{90})					
Refresh rate		5Hz(optional 10Hz or 20Hz)					
Response frequency		3Hz @-3dB					
Angular rate/different angle							
Measurement axis		1 axis(Z), 2 axis(X,Y), 3 axis(X,Y and Z)					
Measurement range		±100°/s,±250°/s,±400°/s					
In-Run bias stability		±0.02°/s					
bias		±0.03°/s					
Offset temperature drift		±0.004°/s/℃					
Sensitivity temperature drift coefficient		±0.004°/s /℃					
Nonlinearity		±0.1%					
Noise density		0.02°/√Hz @±100°/s range 0.03°/√Hz @±250°/s or ±400°/s range					
Bandwidth		50HZ					
Total specifications							
Misalignment		±0.1° (Inclinometer axial & gyro axial)					
Power supply		9~36VDC					
Output		RS232, RS422,CAN,0~5VDC					
Output parameter		Single/dual axis tilt angle data Single/dual/tri axis different angle data Single/dual/ tri axis different angular rate data inner temperature data(only for digital output)					
Functions (only for digital output)		set zero point, baud rate, local gravitational acceleration value, zero calibration, vibration suppression filter coefficients, ID address, refresh rate, etc					
Refresh rate		5Hz, 10Hz, 20Hz, 50Hz,100Hz(only for digital output)					
Power consumption		Average working current≤150mA(25℃&24VDC, double axis tilt, tri-axis gyroscopes))					
Operation temperature range		-40~85℃					
Storage temperature range		-40~85℃					
Insulation resistance		100MΩ					
MTBF		≥25000 h/times					
Shock		100g@11ms,three - axis, half - sine					
Vibration		8grms, 20~2000Hz					
Protection		IP65(optional IP67)					
Connecting		Military class connector					
Weight		450g(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

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

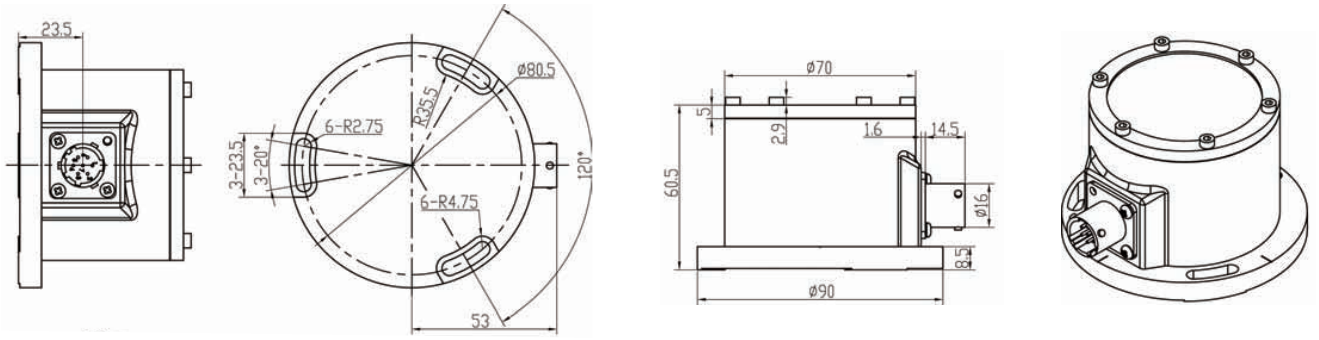
② The cross-axis sensitivity means the angle that the tilt sensor may be banked to the normal tilt direction of sensor. The cross-axis sensitivity (±0.1%FS) shows how much perpendicular acceleration or inclination is coupled to the inclinometer output signal. For example, for the single-axis inclinometer 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.

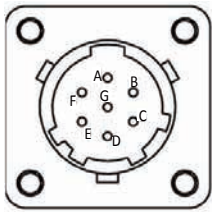
⑤ Offset turn on repeatability means the repeatability of the sensor in repeated by supply power on-off-on many times.

Dimensions (mm)



Picture 1 Housing with MIL class connector

Wiring



Picture2 MIL connector socket (View from outside)

Table 2 Pin definitions for analog and digital interface

Socket pin	Any combination of gyro - inclinometer Digital output			Single tilt +Z gyro	Dual tilt +Z gyros	Dual tilt +Y gyro	Dual tilt +X/Y gyro	Dual tilt +X/Y/Z gyro
	RS232	CAN	RS422	0~5VDC				
A	Power+	Power+	Power+	Power+	Power+	Power+	Power+	Power+
B	Power GND	Power GND	Power GND	Power GND	Power GND	Power GND	Power GND	Power GND
C	Signal GND	NC	Signal GND	Signal GND	Signal GND	Signal GND	Signal GND	Signal GND
D	NC	CAN-H	RS422-RXD+	Voutx-T	Voutx-T	Voutx-T	Voutx-T	Voutx-T
E	NC	CAN-L	RS422-RXD-	NC	Vouty-T	Vouty-T	Vouty-T	Vouty-T
F	RS232-TXD	NC	RS422-TXD+	Voutz-R	Voutz-R	NC	Voutx-R	Voutx-R
G	RS232-RXD	NC	RS422-TXD-	NC	NC	Vouty-R	Vouty-R	Vouty-R
H	——	——	——	——	——	——	——	Voutz-R
I	——	——	——	——	——	——	——	NC

Note:

1. Voutx - T means X axes voltage output of tilt;
Voutz - R means Z axes voltage output of angular rate;
2. Only <Dual tilt +X/Y/Z axis gyro> adopt 9-pin connector, others adopt 7-pin connector
3. For digital output, housing, see Picture 2 as standard; but for 0~5VDC output, please ask Vigor when order.

Ordering

SST3 — Axis — Range — G20 — F4 — 00 — Cable/plug — Temp.drift

- Axis: Single axis — 01; Dual axis — 02
- Range: ±5° — 05; ±10° — 60; ±15° — 15; ±30° — 30; ±45° — 45; ±60° — 60
- G20: RS232 — 00; Others: see table 3
- F4
- 00
- Cable/plug: None — 00; Others: see table 3
- Temp.drift: 25℃ — 00; Others: see table 3

For example, if order one Gyro-inclinometer, with tilt range ±60°, dual axis, absolute tilt accuracy±0.08°, -20~60℃ tilt temperature compensated accuracy ±0.02°, X & Y axis gyroscope(X axis range ±100°/s, Y axis range±250°/s), 2m cable with plug, 0~5VDC output, the final model should be chosen as :
SST302 - 60 - G20 - F4 - 00 - C1 - D3(gyroscopes with X axis range ±100°/s, Y axis range ±250°/s)
Other options (see Table 4) :
Magnetic base——order number SST003-01 - 01

Accessories & Options

Table 3 Accessories

Item	Order Code	Accessories name	Function
Output interface	00	RS232	Directly angle output Data format: Baud rate:115200(adjustable), 8 data bits, 1 start bit, 1 stop bit, none parity Refresh rate:5Hz, optional: 10Hz, 20Hz
	G2	RS422	Isolated, Compatible with half-duplex or full-duplex communication; ±15kV ESD protection Compatible with ANSI/TIA/EIA-485-A-98 & ISO8482:1987(E) Comply with UL1577---2500V rms for 1min ; Transmission rate up to 500 kbps, support max 256pcs node High common mode transient suppression ability>25kV/us ; Support Modbus-RTU, sensor supply HEX or ASCII communication
	G3	CAN	Compliance with ISO/DIS 11898, twisted-pair output Support CAN2.0A, CAN2.0B protocol Build-in high-speed photo isolators Support 15 baud rates from 5k to 1000Kbps Transmission distance: 10km Max
	G20	0~5VDC	Linearity:0.02%FS max Output impedance 100Ω, output current ±10mA max
Cable/Plug	C1	Standard Cable with plug	Military class connector(meet MIL-C-26482) Standard 2M cable, IP67 protection, heavy duty up to 30kg
	C4	Armoured cables	Increase cable mechanical strength, anti-erosion and anti-jamming capability
	C6	Standard plug	According to MIL-C-26482,IP67 protection
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°
	D9	Temperature drift	Temperature compensation range -40~85℃, accuracy ±0.05°@≤±30°
	D10	Temperature drift	Temperature compensation range -40~85℃, accuracy ±0.05°@>±30°

Table 4 Options

Item	P/N	Option name	Function
Installation tools	SST003-01-01	Magnetic base	50kg suction, permanent magnet, stainless steel materials
	SST003-01-04	Adjustable base with micrometer screw	Three-points adjustment, resolution 0.001mm, stainless steel materials
Power	SST003-09-02	The portable rechargeable lithium battery packs	Output 24VDC, Continuous work 24 hours , IP65, rechargeable
Test report	SST003-11-02	Absolute linearity	Average 21 points of full range
	SST003-11-03	Test report for Allowed Installation misalignment	Axis migration test report for vertical and horizontal axis of inclinometer,3 angles
	SST003-11-04	Test report for response time and hysteresis	The report for time response curve/ data and hysteresis characteristics
	SST003-11-05	Test report for vibration	According to inclinometer's standard vibration characteristic

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