

PWM Inclinometer



Vigor Technology

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Features

- Both PWM & RS 232 outputs
- High anti-noise capacity
- IP67 protection
- EMI/ESD suppression circuit
- Available directly drive valve with 1A PWM



Descriptions

PWM inclinometer is based on Vigor patent tilt measurement technology and combined with PWM module with high anti-jamming capability. It focused to hash industry environment. Not only meet to critical null repeatability, also with real high combined accuracy that performs high accuracy data of any angle point. It directly drive hydraulic proportional valve with 1A current, also can offer integrated system including sensor, controlling and driving that drive multiple hydraulic proportional valves, realize for automatic leveling fastly and easily.

PWM inclinometer adopts the PWM pulse width modulation output interface, a linear proportional relationship between the tilt values and duty cycle of PWM wave, has strong anti-interference ability.

PWM inclinometer has strong measuring ability:

- ✓ $\pm 0.02\%$ FS linearity
- ✓ $\pm 0.005^\circ$ Offset
- ✓ Combine with gyro module, realize static/dynamic angle measuring for low/rapid leveling
- ✓ Combine with vibration module, realize FFT computations in-time, output vibration frequency and amplitude data directly, eliminate the influence of environment vibration
- ✓ 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, 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 sensitive axis
- ✓ Performs with short-circuit, transient voltage and transposition protection to adapt to industry environment

User can set unit's all kinds of parameters via RS232 interface, such as setup zero point, baud rate, local gravitational acceleration value, zero calibration, vibration suppression filter coefficients, ID address, refresh rate and query factory data.

Applications

Factory automation, Instrumentation, Agriculture, Engineering machinery, Medical equipment, Security, Rail traffic

RS	CAN	CANopen	EtherCAT	DeviceNet	Profi-bus	HART	Ethernet	USB
Zigbee	Wi-Fi	GPRS	CDMA	SSI	PWM	Vibration-wire	Switch	Analog

Performances

Table 1 Specifications

Measurement range		±5°	±10°	±15°	±30°	±45°	±60°
Combined absolute accuracy ^① (@25°C)		±0.01°	±0.015°	±0.02°	±0.04°	±0.06°	±0.08°
Accuracy 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°					
Allowed installation misalignment ^④		±4.0°	±3.0°	±2.5°	±1.5°	±1.2°	±1.2°
Input-axis mislignment		≤±0.1°					
Sensitivity temperature drift coefficient(max.)		≤100ppm/°C	≤50ppm/°C				
Offset temperature drift coefficient(max.)		≤0.003°/°C					
Offset turn on repeatability ^⑤		±0.008°					
Resolution		0.0025°					
Long-term stability(1 year)		≤0.02°					
Measurement axis		1 or 2 axis					
Temperature sensor		Range: -50~125°C, Accuracy: ±1°C					
Output		PWM output Output frequency: 1000Hz Duty cycle: 20%~80%					
Cold start warming time		60s					
Response time		0.3s(@t ₉₀)					
Response frequency		3Hz @-3dB					
Power supply		9~36VDC					
Power consumption		Average working current≤200mA(25°C&24VDC)					
Operation temperature range		-40~85°C					
Storage temperature range		-60~100°C					
Insulation resistance		100MΩ					
MTBF		≥25000 h/times					
Shock		100g@11ms, three-axis, half-sine					
Vibration		8grms, 20~2000Hz					
Protection		IP67					
Connecting		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

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

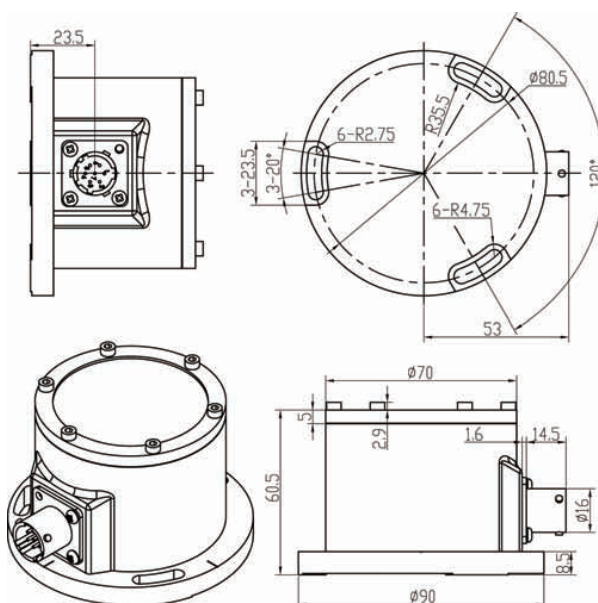
② The cross-axis sensitivity means the angle that the tilt sensor may be banked to the inclinometer output signal. The cross-axis sensitivity (±0.1%FS) shows how much perpendicular acceleration or inclination is coupled to the inclinometer output signal. For example, for the single-axis inclinometer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

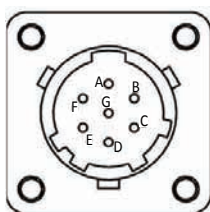
⑤ Offset turn on repeatability means the repeatability of the sensor in repeated by supply power on-off-on many times.

Dimensions (mm)



Picture 1 Housing with MIL class connector

Wiring

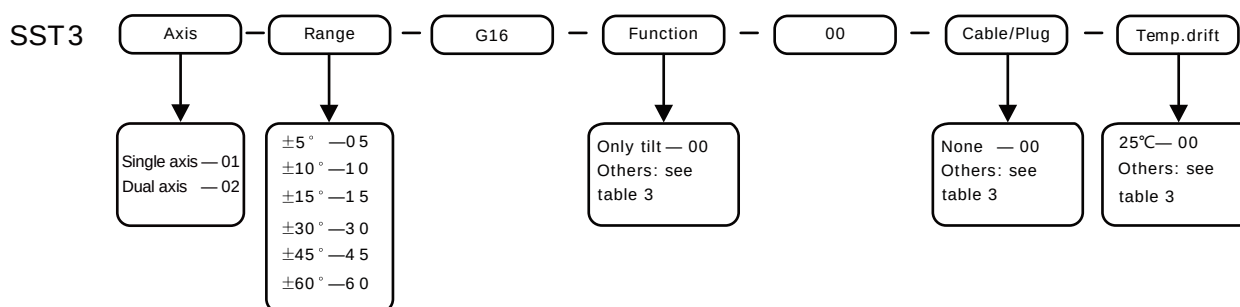


Picture2 MIL connector socket (View from outside)

Table2 Pin definition

Pin	Function
A	Power +
B	Power GND
C	Signal GND
D	PWM (X axis)
E	PWM (Y axis)
F	RS232-TXD
G	RS232-RXD

Ordering



For example, if order a dual axis PWM inclinometer, with range $\pm 15^\circ$, room temperature accuracy $\pm 0.02^\circ$, $-20 \sim 60^\circ\text{C}$ total drift accuracy $\pm 0.02^\circ$, 2 meters cable with plug, with X axis and Y axis gyro, the model should be chosen as: SST302-15-G16-F4 -00-C1-D3 (2m)

Other options (see table 4):

Magnetic base—order number SST003-01-01

Accessories & Options

Table 3 Accessories

Item	Order Code	Accessories name	Function
Functional model (built-in)	F4	Gyro module	±100/250/400°/s, X/Y/Z axis dynamic angular rate In-run bias: ±0.02°/s, Non-linearity: 0.1%FS Bandwidth: 50Hz,Noise density : 0.02°/s/√Hz Higher accuracy gyro module available
	F5	Vibration module	Three-axis vibration detection, frequency response≤5 kHz Range: 0g~±1g/ ±5g/ ±10g/ ±20g, adjustable Sampling(real-time): 20.48 kSPS Filter programmable, 11pcs set points FFT, 512-point, real valued, all three-axis(x, y, z) Storage: 14 FFT records on all three-axis(x, y, z) Alarm programmable, 6 spectrums
Plug/cable	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 is 0~60°C, accuracy ±0.01°@≤±30°
	D2	Temperature drift	Temperature compensation range is 0~60°C, accuracy ±0.01°@>±30°
	D3	Temperature drift	Temperature compensation range is -20~60°C, accuracy ±0.02°@≤±30°
	D4	Temperature drift	Temperature compensation range is -20~60°C, accuracy ±0.02°@>±30°
	D5	Temperature drift	Temperature compensation range is -30~60°C, accuracy ±0.03°@≤±30°
	D6	Temperature drift	Temperature compensation range is -30~60°C, accuracy ±0.03°@>±30°
	D7	Temperature drift	Temperature compensation range is -40~65°C, accuracy ±0.05°@≤±30°
	D8	Temperature drift	Temperature compensation range is -40~65°C, accuracy ±0.05°@>±30°
	D9	Temperature drift	Temperature compensation range is -40~85°C, accuracy ±0.05°@≤±30°
	D10	Temperature drift	Temperature compensation range is -40~85°C, accuracy ±0.05°@>±30°

Table 4 Options

Item	P/N	Options 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
Calibration equipment	SST003-10-04	Cross-axis test equipment	Mechanical, manual, accuracy ±30 ", measurement range ±15 °
	SST003-10-05	Adjustable field level platform	Mechanical, manual, 3kgs payload ,level accuracy ±10", adjustable range(X/Y) ±1°
Test report	SST003-11-01	Test report for cross-axis sensitivity	Test report under banking tilt, average 11 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
	SST003-11-04	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
	SST003-11-06	Test report for mechanical shock	According to inclinometer's standard shock characteristic

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