Vigor Technology
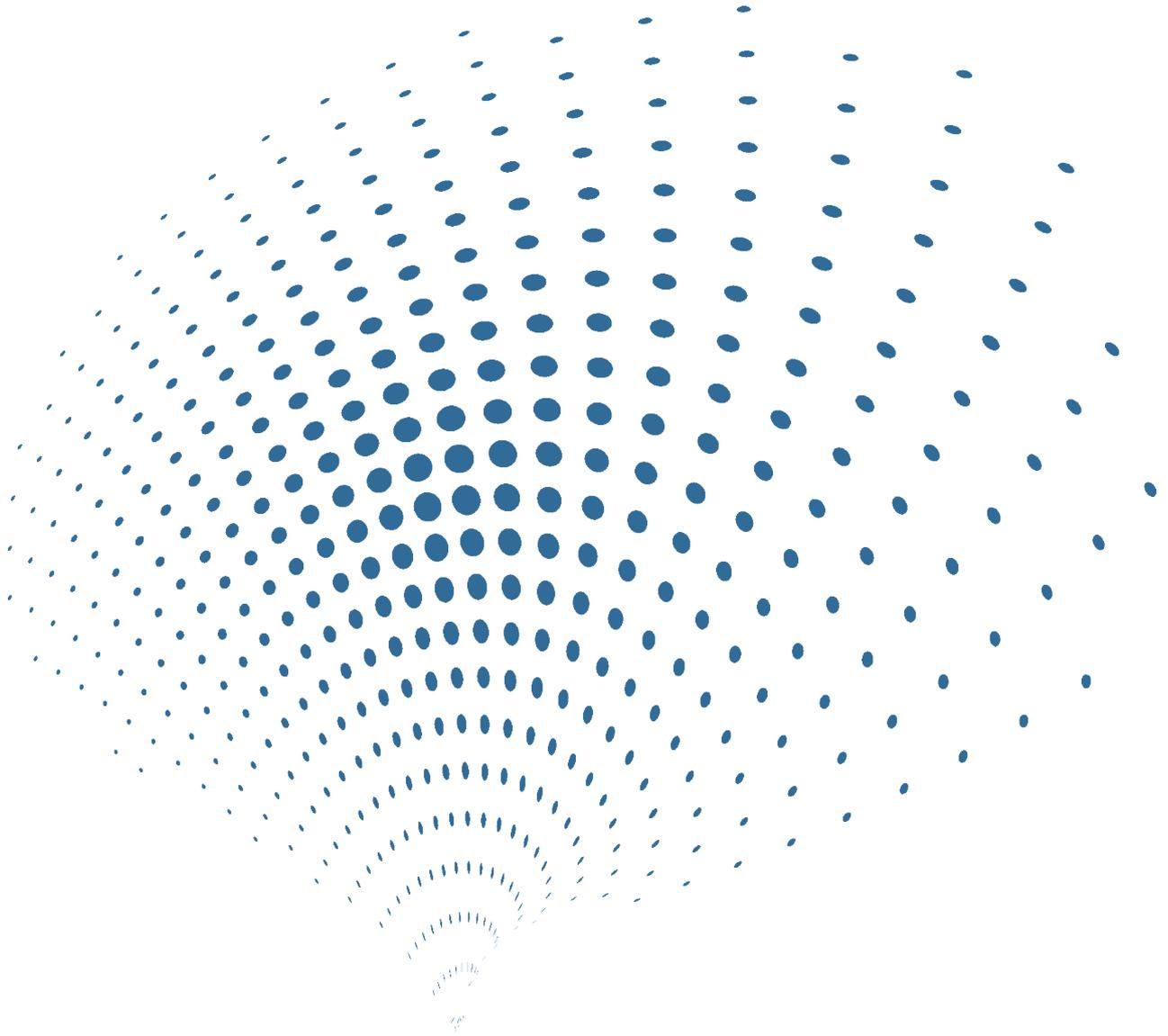
USB Inclinometer

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Features

- Reference with USB2.0 protocol
- P2P and compatible with any USB port
- USB bus power supply, no need external battery
- Patent tilt measuring technical, real high accuracy
- Provide multi-function PC software, easy to debug & acquire
- Intelligent AIS & data transmission control system.
- Support 1Mbp/s(optional 12Mb/s) transmission speed
- ±8KV electrostatic interface protection and anti-electromag-
  ction netism interference design
- Support Windows98/Windows2000/ Windows XP/ Vista/Win7/Linux system

Descriptions

USB inclinometer is based on Vigor patent tilt measurement technology and combined with USB module, can be broadly used in various industry& lab test applications. Not only meet critical null repeatability, also suite to static/dynamic leveling with different modules in platform leveling application. With real high combined accuracy, this unit performs high accuracy data of any angle point while testing.

USB inclinometer compatible with USB2.0 standard, with data transmission control system. It uses USB bus for power supply but not the external battery. It adopts P2P working mode, with USB driver software, meanwhile Vigor provides much PC software (include driver software) for function setting, data acquisition & record.

USB inclinometer has strong measuring ability:

√ Combine with gyro module, realize static/dynamic angle measuring for 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

√ Combine with GPS module, realize data synchronization data acquisition and local position data in different installation places

√ 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, Upgrade 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 zero point, baud rate, local gravitational acceleration value, zero calibration, vibration suppression filter coefficients, ID address, refresh rate, etc.

C11 is USB2.0 standard cable, matched with standard USB port to get power and transmit data, max. transmission distance 15m.
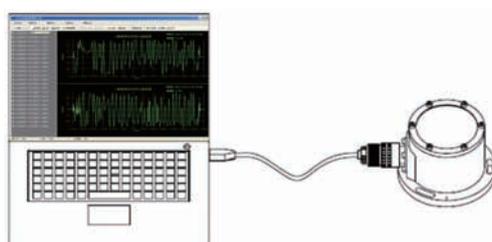
Picture 1 PC & USB Connection

(The dynamic library and source code disk will be enclosed with standard USB inclinometer, as well as 2 meter double shield USB wire.)

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 axis		1 or 2 axis					
Temperature sensor		Range, -50~125℃. Accuracy:±1℃					
Output		USB 2.0 output					
		High transmission speed up to 1Mb/s, highest 12Mb/s					
		Support standard USB2.0, compatible with USB 1.1					
		According to USB2.0 standard					
Cold start warming time		60s					
Response time⑦		0.3s(@t$_{90}$)					
Refresh rate(digital output)		5Hz (Optional 10Hz,20Hz)					
Power supply		USB power supply					
Power consumption		Average current ≤60mA					
Operation temperature range		-40~85℃					
Storage temperature range		-60~100℃					
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 (MIL-C-26482)					
Weight		400g (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 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℃.
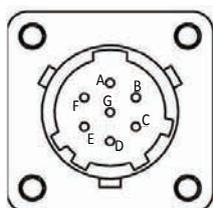
⑦ The response time refers to the angle sensor in a step change (such as the angle changes from -10 ° to +10 °within 5ms), the time required that output of the sensor achieved to the standard value of 90%. The index is different from the sensor set-up time

Dimensions （mm）
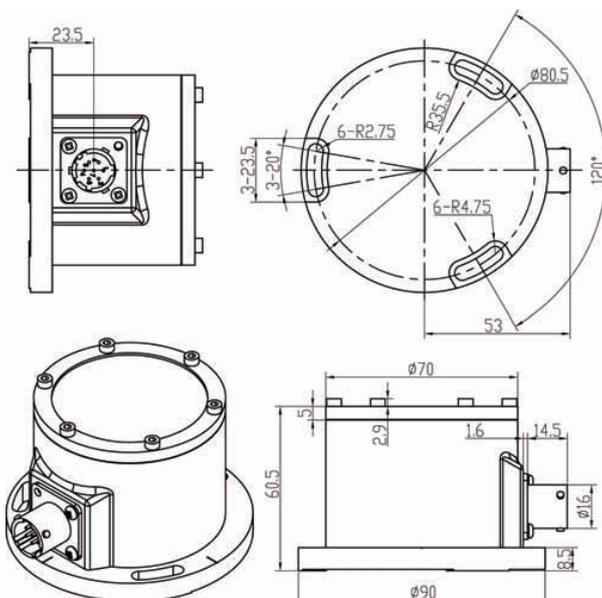
Picture 2 Housing with MIL class connector

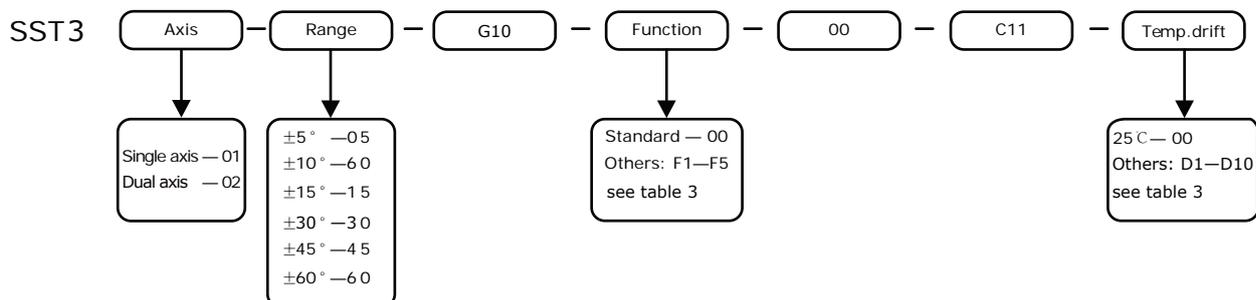# Wiring

Picture 3 MIL connector socket (View from outside)

Table 2 USB socket pin definition

Pin	Signal
A	VCC
B	GND
C	NC
D	NC
E	DATA-
F	DATA+
G	NC

Picture 4 Standard USB cable/plug(C11)

Ordering

SST3 — Axis — Range — G10 — Function — 00 — C11 — Temp.drift

Axis:
Single axis — 01
Dual axis — 02

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

Function:
Standard — 00
Others: F1—F5
see table 3

Temp.drift:
25℃— 00
Others: D1—D10
see table 3

For example, if order a dual-axis USB inclinometer, with range ±15°, the accuracy at room temperature is ±0.02°, same the range of -20~60℃, USB output, 2m shield cable, anti-vibration module, the model should be SST302-15-G10-F5 -00-C11-D3（2m, enclosed referred disk（dynamic library, source code and instruction)

Meanwhile some optional accessories (See table 4)

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

Magnetic base——order number SST003-01-01

Accessories & Options

Table 3 Accessories

Item	Order Code	Accessories name	Function
Functional module (built-in)	F1	GPS module	Positioning accuracy 2.5m CEP; 2.0m @ SBAS Local gravity acceleration automatic revision Time pulse accuracy: 30ns RMS, Original data refresh rate: 4Hz Speed accuracy: 0.1m/s, Receiver type: GPS L1 band, C/A code; Higher positioning accuracy GPS available
	F3	Compass module	2-Axis Electronic compass technology Heading measurement range: 0~360°, Heading accuracy: <±1.0°RMS With hard magnetic compensation Optional higher precision or three-dimensional compass module
	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
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
Software	SST003-04-09	PC application software	Setting function, Command function, Tool function Operating platform: windows XP, Windows 7 More information please see datasheet of this options
Power	SST003-09-02	Portable battery packs	Output 24VDC, Continuous work 24 hours , IP65, rechargeable
Test report	SST003-11-01	Test report for cross-axis sensitivity	Test report under banking tilt, average 11 points of full range
	SST003-11-02	Absolute linearity	Average 21 points of full range
	SST003-11-03	Test report for Alloewd Installations misalignment	Axis migration test report for vertical and horizontal axis of inclinometer,3 angles