

# ***GPRS Inclinator***



Vigor Technology

# GPRS Inclinometer

## Features

- Industry GPRS interface
- Quad-Band 850/ 900/ 1800/ 1900 MHz Transmission worldwide
- Support PBCCH, CSD up to 14.4 kbps
- Support single/multi-center modes
- Support domain and IP address access center
- Embedded standard TCP/IP protocol stack
- Patented tilt measurement technology

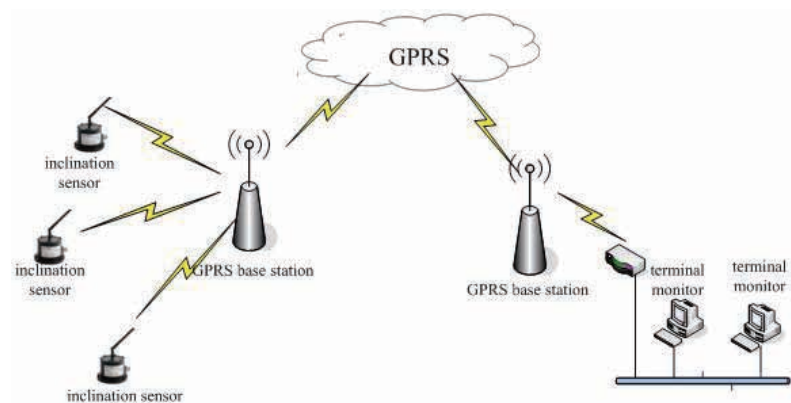


## Descriptions

GPRS inclinometer is developed based on Vigor patent tilt measurement technology and combined with GPRS wireless module, to meet with remote object monitoring and system maintenance requirements.

GPRS inclinometer has strong tilt 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
- ✓ 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 error, upgrade real tilt angle measuring accuracy, abandoned the traditional incomplete understanding for tilt angle measurement precision concept
- ✓ Patent error calculation and test calibration method, greatly upgrades real tilt angle measuring accuracy and reliability
- ✓ Greatly reduce measuring errors when the real tilt direction not consistent for unit's sensitive axis
- ✓ Short-circuit, transient voltage, 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.



Performances

Table 1 Specifications

|                                                 |                                     |                                                                                                                                           |           |        |         |        |        |
|-------------------------------------------------|-------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------|-----------|--------|---------|--------|--------|
| Measurement range                               |                                     | ±5°                                                                                                                                       | ±10°      | ±15°   | ±30°    | ±45°   | ±60°   |
| Combined absolute accuracy <sup>①</sup> (@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 <sup>②</sup> | ±0.1%FS                                                                                                                                   |           |        |         |        |        |
|                                                 | Offset <sup>③</sup>                 | ±0.005°                                                                                                                                   |           |        | ±0.008° |        |        |
|                                                 | Repeatability                       | ±0.0025°                                                                                                                                  |           |        |         |        |        |
|                                                 | Hysteresis                          | ±0.0025°                                                                                                                                  |           |        |         |        |        |
| Allowed installation misalignment <sup>④</sup>  |                                     | ±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 <sup>⑤</sup>       |                                     | ±0.008°                                                                                                                                   |           |        |         |        |        |
| Resolution                                      |                                     | 0.0025°                                                                                                                                   |           |        |         |        |        |
| Long-term stability(1 year)                     |                                     | ≤0.02°                                                                                                                                    |           |        |         |        |        |
| Measurement axis                                |                                     | 1 or 2 axis                                                                                                                               |           |        |         |        |        |
| Temperature sensor                              |                                     | Range：-50~125℃，Accuracy:±1℃                                                                                                               |           |        |         |        |        |
| Output                                          |                                     | GPRS class 10: max. 85.6 kbps(downlink)<br>support PBCCH and Coding schemes CS 1, 2, 3, 4<br>CSD up to 14.4 kbps, support USSD, PPP-stack |           |        |         |        |        |
| GPRS operating characteristics                  |                                     | Quad-band 850/ 900/ 1800/ 1900 MHz<br>GPRS multi-slot class 10/8                                                                          |           |        |         |        |        |
| Cold start warming time                         |                                     | 60s                                                                                                                                       |           |        |         |        |        |
| Response time                                   |                                     | 0.3s(@t <sub>90</sub> )                                                                                                                   |           |        |         |        |        |
| Refresh rate                                    |                                     | 5Hz, 10Hz, 20Hz                                                                                                                           |           |        |         |        |        |
| Response frequency (analog output)              |                                     | 3Hz @-3dB                                                                                                                                 |           |        |         |        |        |
| Power supply                                    |                                     | 9~36VDC                                                                                                                                   |           |        |         |        |        |
| Power consumption                               |                                     | Average working current≤200mA(25℃&24VDC)                                                                                                  |           |        |         |        |        |
| 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                                          |                                     | 420kg(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  

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

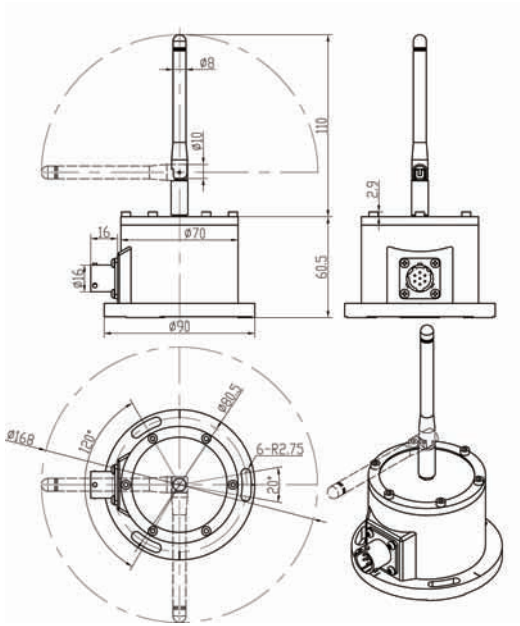
② The cross-axis sensitivity means the angle that the tilt sensor may be banked to the normal tilt direction of sensor. The cross-axis sensitivity (±0.1%FS) shows how much perpendicular acceleration or inclination is coupled to the inclinometer output signal. For example, for the single-axis inclinometer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

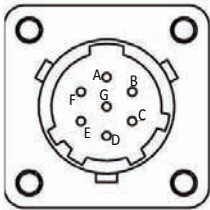
⑤ Offset turn on repeatability means the repeatability of the sensor in repeated by supply power on-off-on many times.

**Dimensions (mm)**



Picture 1 Housing with MIL class connector

**Wiring**

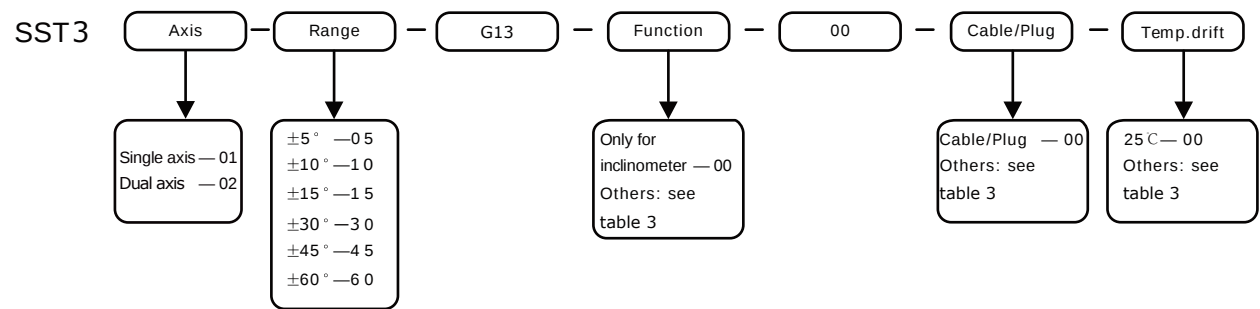


Picture2 MIL connector socket (View from outside)

Table2 Pin definition

| Pin | Function  |
|-----|-----------|
| A   | Power +   |
| B   | Power -   |
| C   | NC        |
| D   | NC        |
| E   | NC        |
| F   | RS232-TXD |
| G   | RS232-RXD |

**Ordering**



For example, if order a dual axis GPRS inclinometer, with range ±15°, room temperature accuracy ±0.02°, -20~60℃ accuracy ±0.02°, Output GPRS wireless transmission , 2 meters cable with plug, Vibration function module, the model should be chosen as: SST302-15-G13-F5 -00-C1-D3 (2m)

Other options (see table 4):

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

Magnetic base——order number SST003-01-01

Complementary power combined with solar and wind energy——SST003-09-03

Accuracy ±30"field calibration equipment——SST003-10-02

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<br>Local gravity acceleration automatic revision<br>Time pulse accuracy: 30ns RMS<br>Original data refresh rate: 4Hz<br>Speed accuracy: 0.1m/s<br>Receiver type: GPS L1 band, C/A code;<br>Higher positioning accuracy GPS available                                                     |
|                              | F3         | Compass module    | 2-Axis<br>Electronic compass technology<br>Heading measurement range: 0~360°<br>Heading accuracy: <±1.0°RMS<br>With hard magnetic compensation<br>Optional higher precision or three-dimensional compass module                                                                                                                     |
|                              | F4         | Gyro module       | ±100/250/400°/s, X/Y/Z axis dynamic angular rate<br>In-run bias: ±0.02°/s, Non-linearity: 0.1%FS<br>Bandwidth: 50Hz,Noise density : 0.02°/s/√Hz<br>Higher accuracy gyro module available                                                                                                                                            |
|                              | F5         | Vibration module  | Three-axis vibration detection, frequency response≤5 kHz<br>Range: 0g~±1g/ ±5g/ ±10g/ ±20g, adjustable<br>Sampling(real-time): 20.48 kSPS<br>Filter programmable, 11pcs set points<br>FFT, 512-point, real valued, all three-axis(x, y, z)<br>Storage: 14 FFT records on all three-axis(x, y, z)<br>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<br>Operating platform: windows XP, Windows 7<br>More information please see datasheet of this options                                                                 |
|                    | SST003-04-12-00 | iss8 software                                           | Collecting, preserving and monitoring data of 8pcs SST300 inclinometer max, can display each inclinometer data graph, parameters setting early warming and achieve multiple inclinometer networking<br>Based on windows |
| Power              | SST003-09-02    | The portable rechargeable lithium battery packs         | Input 220VAC,output 24VDC,output current 2A                                                                                                                                                                             |
|                    | SST003-09-03    | Complementary power combined with solar and wind energy | Solar and wind energy, Day & night working<br>Fan input power 0.6KW; solar input power 0.3KW<br>Battery rated voltage 24V;<br>AC output power 1KW, 220VAC<br>DC output: 24VDC@1A                                        |
| Test report        | SST003-11-03    | Test report for Allowed Installation misalignment       | Axis migration test report for vertical and horizontal axis of inclinometer,3 angles of point                                                                                                                           |



**Shanghai Vigor Technology Development Co., Ltd.**

No.289-4, Bisheng Road, Pudong New District Shanghai China 201204

Hotline. +86-400-0505-021

Tel. +86-21-5840-4921

Fax. +86-21-5835-4552

Email: [sales@vigordigital.com](mailto:sales@vigordigital.com)

Web: [www.vigordigital.com](http://www.vigordigital.com)