

# *CANopen Inclinator*

CANopen



Vigor Technology

# CANopen Inclinometer

## Features

- Protocol stack follows CANopen documents: DS301, DS303, DS305 standard; and meets the Device profile CiA DSP-410
- Slave station configuration protocol
- Process Data Objects (TPDO and RPDO) and service Data objects (SDO server/SSDO)
- Emergency message object (Emergency ) and sync message object (Sync)
- Network configuration object (LSS slave station)
- Support baud rate 5Kbps~1Mbps
- Patented tilt measurement technology to realize real high accuracy



## Descriptions

CANopen inclinometer is based on Vigor patent tilt measurement technology and combined with CANOPEN module, which can directly connect with all kinds of PLC and DAE. It shortens system building & debug cycle, further reducing user's construction and maintenance costs.

CANopen inclinometer except meet CiA 410 standard, furthermore 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
- ✓ 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. upgrades real tilt angle measuring accuracy, abandoned the traditional incomplete understanding for tilt angle measurement precision concept
- ✓ Greatly reduce measuring errors when real tilt directions 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 via CANopen interface, and query factory data

CANopen inclinometer supports CANopen standard protocol, point to point or one point to multipoint communication method. Working model supports acknowledge model, continuous sending mode and parameter setting mode, which can directly connect with all kinds of PLC and DAE, realize online communication. CANopen transmitting speed is 5kbps~1Mbps. CANbus supports 127 nodes in single network which combines with a twisted-pair cable, maximum load line length is 10km, with longer communication distance by using of repeater.

C13 cable option is a  $120\Omega$  dedicated twisted-pair cable based on the characteristic impedance of CANopen specification. It includes proprietary 100% aluminum foil shield and 65% tinned copper braid shield, with maximum shielding effect. It is capable of carrying PLTC listed signal of UL NEC Type, installation flexibility. Meanwhile, in order to meet request of real on-site adjustment and display, Vigor provides specialized CANopen connector LED indicator, realize setting, alarm point setting, angle value displaying, etc.

## Applications

Factory automation, Instrument, Agriculture, Engineering machinery, Industrial network, Medical equipment, Building control, Railway

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

## Performances

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) <sup>⑥</sup>	≤0.02°						
Measurement axis	1 or 2 axis						
Temperature sensor	Range : -50~125°C , Accuracy: ±1°C						
Output	CANopen Protocol: DS301, 303, 305 Device sub-protocol CIA410						
Cold start warming time	60s						
Response time <sup>⑦</sup>	0.3s(@t <sub>90</sub> )						
Refresh rate(digital output)	5Hz(Optional 10Hz,20Hz)						
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						
EMC	According to EN 61000						
Insulation resistance	100MΩ						
MTBF	≥25000 hours						
Shock	100g@11ms , three-axis, half-sine						
Vibration	8grms, 20~2000Hz						
Protection	IP65(Optional IP67 )						
Connecting	Military class connector(MIL-C-26482)						
Weight	420g(without connector and cable)						

① Combined absolute accuracy means the composite 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.

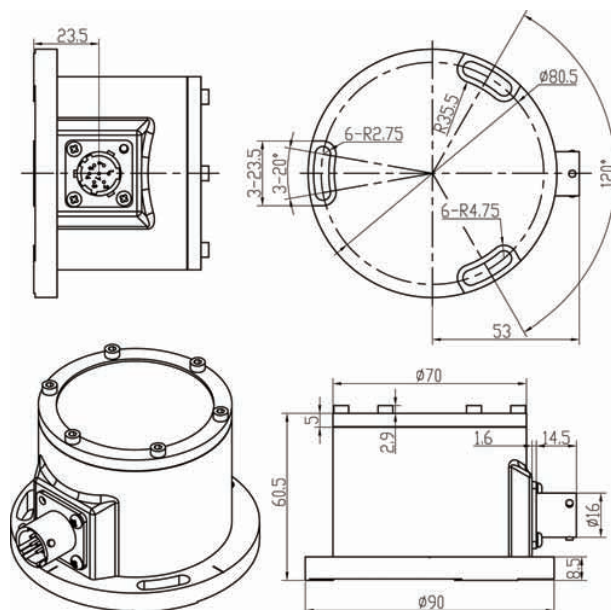
④ Allowed installation misalignment means during the installation, the allow able installation angle deviation between actual tilt direction and sensor's nature measurement direction. In general, when installed, SST300 sensor is required that the measured tilt direction keep parallel or coincident with 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.

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°C.

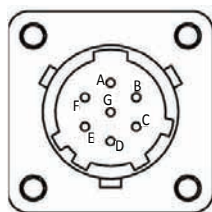
⑦ The response time refers to the angle sensor in a step change (such as the angle changes from -10° to +10° within 5ms), the time required that output of the sensor achieved to the standard value of 90%. The index is different from the sensor set-up time

## Dimensions (mm)

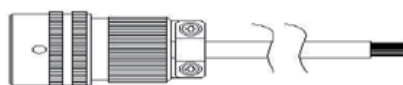


Picture 1 Housing with MIL class connector

## Wiring



Picture 2 MIL connector socket (View from outside)

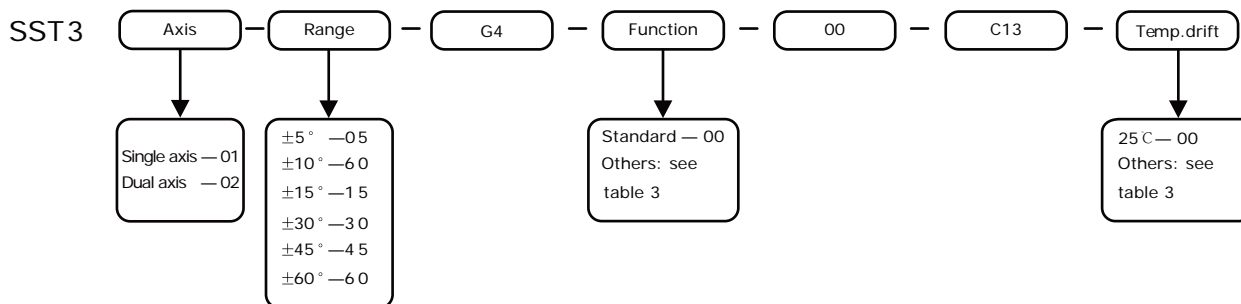


Picture 3 Cable/plug(C13)

Table2 CANopen pin definition

Pin	Color	Function
A	Red	Power+
B	Black	Power-
C	NC	NC
D	Blue	CANOPENH
E	White	CANOPENL
F	NC	NC
G	NC	NC

## Ordering



For example: if you order a dual-axis CANopen inclinometer, with range  $\pm 15^\circ$ , room temperature accuracy  $\pm 0.02^\circ$ ,  $-20$ – $60$  C accuracy  $\pm 0.02^\circ$ , CANopen output, 2m cable with plug, vibration suppression function, the model should be: SST302-15-G4-F5-00-C13-D3

Other options (see table 4):

CANopen indicator—order number SST003-04-19

## 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: <math>\pm 1.0^\circ\text{RMS}</math> With hard magnetic compensation Optional higher precision or three-dimensional compass module
	F4	Gyro module	$\pm 100/250/400^\circ/\text{s}$ , X/Y/Z axis dynamic angular rate In-run bias: $\pm 0.02^\circ/\text{s}$ , Non-linearity: 0.1%FS Bandwidth: 50Hz, Noise density : $0.02^\circ/\text{s}/\sqrt{\text{Hz}}$ Higher accuracy gyro module available
	F5	Vibration module	Three-axis vibration detection, frequency response $\leq 5\text{ kHz}$ Range: $0\text{g} \sim \pm 1\text{g} / \pm 5\text{g} / \pm 10\text{g} / \pm 20\text{g}$ , 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 $0 \sim 60^\circ\text{C}$ , accuracy $\pm 0.01^\circ @ \leq \pm 30^\circ$
	D2	Temperature drift	Temperature compensation range $0 \sim 60^\circ\text{C}$ , accuracy $\pm 0.01^\circ @ > \pm 30^\circ$
	D3	Temperature drift	Temperature compensation range $-20 \sim 60^\circ\text{C}$ , accuracy $\pm 0.02^\circ @ \leq \pm 30^\circ$
	D4	Temperature drift	Temperature compensation range $-20 \sim 60^\circ\text{C}$ , accuracy $\pm 0.02^\circ @ > \pm 30^\circ$
	D5	Temperature drift	Temperature compensation range $-30 \sim 60^\circ\text{C}$ , accuracy $\pm 0.03^\circ @ \leq \pm 30^\circ$
	D6	Temperature drift	Temperature compensation range $-30 \sim 60^\circ\text{C}$ , accuracy $\pm 0.03^\circ @ > \pm 30^\circ$
	D7	Temperature drift	Temperature compensation range $-40 \sim 65^\circ\text{C}$ , accuracy $\pm 0.05^\circ @ \leq \pm 30^\circ$
	D8	Temperature drift	Temperature compensation range $-40 \sim 65^\circ\text{C}$ , accuracy $\pm 0.05^\circ @ > \pm 30^\circ$
	D9	Temperature drift	Temperature compensation range $-40 \sim 85^\circ\text{C}$ , accuracy $\pm 0.05^\circ @ \leq \pm 30^\circ$
	D10	Temperature drift	Temperature compensation range $-40 \sim 85^\circ\text{C}$ , accuracy $\pm 0.05^\circ @ > \pm 30^\circ$

Table 4 Options

Item	P/N	Option name	Function
Indicator	SST003-04-19	CANopen indicator	Power supply: 10~35VDC Power consumption: 100mA @24VDC Communication protocol: DIN ISO 11898, CANopen(CIA DS301) Baud rate: 10~1000kb/s LED : 15 mm high; range - 99999~999999 Operation temperature: 0~+45°C Size: 96x48x120 mm

**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)