Zigbee Inclinometer

ZigBee™

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Vigor Technology

ZigBee Inclinometer

Features

- Performs IEEE802.15.4, frequency 2.4G ISM
- Support star networks and peer-to-peer network, more security
- Radio frequency passed by CE, FCC and other international certifications
- Low power consumption, support 100m or 1km distance
- Patent tilt measurement technology, to achieve true high accuracy

Descriptions

Zigbee inclinometer is based on Vigor's patent tilt measurement technology with Zigbee wireless module which with IEEE802.15.4 standard, to meet wild, unattended, hazardous and confined space applications for remote monitoring and maintenance requirements.

Zigbee inclinometer also has a highly flexible wireless network capability and strong tilt measurement capability:

√ ±0.02%FS linearity

√ ±0.005°Offset, realize higher accuracy for platform leveling

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

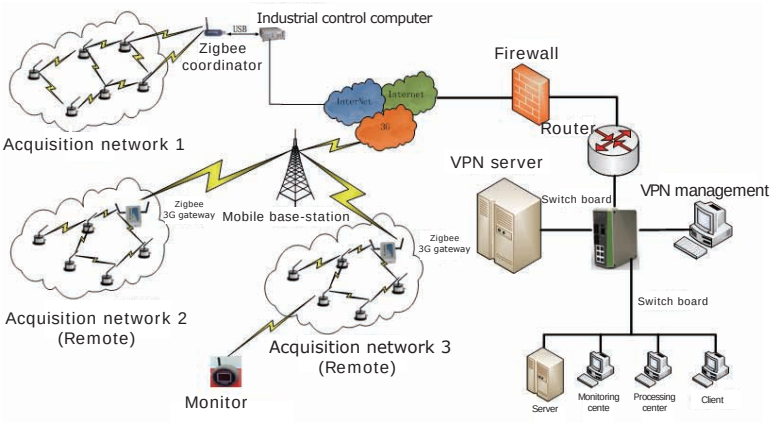
√ Combine with vibration module, realize FFT computations in-time, output vibration frequency and amplitude data directly, eliminate the influence of environment vibration

√ 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's sensitive axis

√ Performs with short-circuit, transient voltage, transposition protection to adapt to industry environment



Picture 1 Typical wireless monitoring system with Zigbee

Applications

Factory automation, Instrumentation, Agricultural machinery, Construction machinery, Industrial networks, medical equipment, Civil engineering, Internet of Things

Performances

Table 1 Specifications

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					
Cold start warming time		60s					
Response time		0.3s(@t90)					
Zigbee interface							
Transfer output power		2mW (+3 dBm), boost mode enable 1.25mW(+1dBm), boost mode off 10mW(+10dBm) request					
Indoor/city range		Up to 133 ft (40 M)					
Outdoor/RF sight distance		Up to 400 ft (120 M)					
RF data rate		250 Kbps					
Operation frequency		2.4 GHz					
Receiver sensitivity		- 96 dBm, boost mode enable - 95 dBm, boost mode off					
Spread spectrum type		16 DSSS					
Network topology		Mesh net, point-to-point protocol, and point to multipoint					
Address Option		PAN ID and addressing, cluster ID and terminal(optional)					
USA(FCC) certification		OUR-XBEE2					
Canada (IC) certification		4214A-XBEE2					
Europe (CE) certification		ETSI					
RoHS		Compatible					
General parameter							
Power supply		9~36VDC					
Debug interface		RS232					
Refresh rate		5Hz, 10Hz, 20Hz					
Power consumption		Average working current≤50mA(25℃&24VDC)					
Operation temperature range		-40~85℃					
Storage temperature range		-60~100℃					
Insulation resistance		100MΩ					
MTBF		≥25000h/tims					
Shock		100g@11ms , three-axis, half-sine					
Vibration		8grms, 20~2000Hz					
Protection		IP65(Optional IP67)					
Connecting		Military class connector(MIL-C-26482)					
Weight		450g(without cable and connector)					

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

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

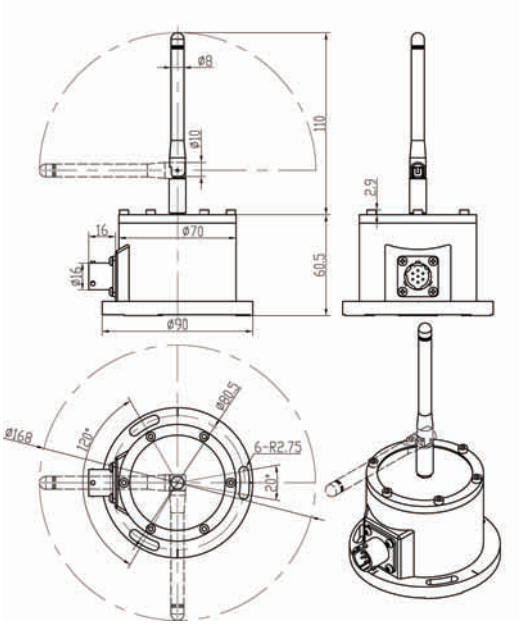
② The cross-axis sensitivity means the angle that the tilt sensor may be banked to the normal tilt direction of sensor. The cross-axis sensitivity (±0.1%FS) shows how much perpendicular acceleration or inclination is coupled to the inclinometer output signal. For example, for the single-axis inclinometer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

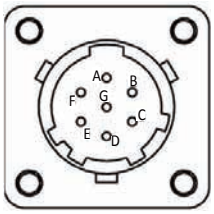
⑤ Offset turn on repeatability means the repeatability of the sensor in repeated by supply power on-off-on many times.

Dimensions (mm)



Picture 1 sing with MIL class connector

Wiring



Picture2 MIL connector socket (View from outside)

Table 2 Pin definition

Pin	Zigbee+RS232
A	Power+
B	Power GND
C	NC
D	NC
E	NC
F	RS232-TXD
G	RS232-RXD

Ordering

SST3 — Axis — Range — G11 — Function — 00 — C1 — Temp.drift

- Axis: Single axis — 01; Dual axis — 02
- Range: ±5° — 05; ±10° — 10; ±15° — 15; ±30° — 30; ±45° — 45; ±60° — 60
- Function: Only tilt — 00; Others: see table 3
- Temp.drift: 25℃— 00; Others: see table 3

For example, if order a dual-axis Zigbee inclinometer, with range ±15°, room temperature accuracy ±0.02°, -20~60℃ accuracy ±0.02°, output Zigbee interface,2 meters cable with plug, the model should be chosen as SST302-15-G11-00 -00-C1-D3（2m）

Meanwhile some options:（see table 4）

Zigbee monitor—— order number SST003-04-08

Zigbee-USB converter ——order number SST003-05-19

Zigbee wireless gateway——order number SST003-05-2

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	Plane compass technology Range: 0~360° Accuracy: <±1.0°RMS, Resolution: 0.01° Hard-iron compensation circuit Hgher accuracy or 3D compass module available
	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
Monitor	SST003-04-08	Zigbee monitor	Built-in lithium battery with 8 hours supply, single/dual axis, sound/light alarm, alarm point can be set up, 200m distance
Network access facility	SST003-05-15	LAN/WAN converter	According to ITU-T G-703 protocol and 10 Base-T comply with ITU-T G-735 and TU-T G-823 2.048Mbps rate, 2km distance,1500 V isolation Ethernet port rate 10,100 Mbps, Ethernet full/half-duplex mode, support VLAN MAC address filter: built in 10000 MAC ID
	SST003-05-19	Zigbee-USB converter	USB interface, support hot plug and port power supply Online configuration function, support sleep mode Support 128 bit AES Wireless data encryption Support 65536 nodes Compatible IEEE 802.15.4/ZigBee protocol 2.4 GHz ISM and 780M WPAN frequency range With 2dBi antenna, visual distance reach 300-1000 m Support point-to-point, star, tree and Mesh networks
	SST003-05-20	Zigbee wireless gateway	Visual distance reach 2000m Based on Web management, easy-to-use Support star, tree, chain and MESH network Up to 4-channel ZigBee Provide RS232, wired Ethernet, Wi-Fi and GPRS access Own RTC function, automatically synchronize Automatic CSMA-CA /address filtering/frame retransmission/confirm functions Safety certification, AES128 data encryption
Power	SST003-09-02	Portable battery packs	Output 24VDC,Continuous work 24 hours,IP65,rechargeable
	SST003-09-03	Complementary power combined with solar and wind energy	Solar and wind energy, Day & night working Wind input power 0.6KW; solar input power 0.3KW Battery rated voltage 24V; AC output power 1KW, 220VAC DC output: 24VDC@1A
Installation	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 material