VG127C

Cost-effective Dynamic Inclinometer

Technical Manual




Introduction

The VG127C dynamic tilt sensor product is a cost-effective inertial measurement equipment that can measure the attitude parameters (roll and pitch) information of the moving carrier. The attitude deviation is estimated by the 6-state Kalman filter with appropriate gain, which is suitable for inclination measurement under motion or vibration.

VG127C uses high-quality and reliable MEMS accelerometers and gyroscopes, and uses algorithms to ensure measurement accuracy. At the same time, the sealing design and strict process ensure that the product can accurately measure the roll angle and pitch angle attitude parameters of the carrier in harsh environments . Through various compensations such as nonlinear compensation, quadrature compensation, temperature compensation and drift compensation, the error caused by interference can be greatly eliminated and the product accuracy level can be improved. VG127C has a digital interface, which can be easily integrated into the user's system.

Features

- Dynamic accuracy: 1°
- Static accuracy: 0.01°
- Nonlinear orthogonal compensation
- Special offset tracking algorithm eliminates the drift
- RS232/RS485/TTL/Modbus interface output optional
- Operating temperature: -40°C~+85°C
- High performance Kalman filter algorithm
- Small size: L60 × W59× H29(mm)

Applications

- Underwater unmanned boat
- Turbine sloshing monitoring
- Stable platform
- Large ships
- Photoelectric Pod
- Autonomous driving
- Special vehicles
- Unmanned aerial vehicle

Specifications

Electrical Specifications

Power supply	9-35VDC
Operating current	30mA (Max 40mA)
Operating temperature	-40℃~+85℃
Store temperature	-55℃~+100℃

Performance Specifications

Attitude parameter	Dynamic accuracy	1°
	Static accuracy	0.01°
	Resolution	0.005°
	Tilt range	Pitch ± 90º, Roll ±180º
Physical characteristics	Size	L60 × W59× H29 (mm)
	Weight (including cable)	280g
	Weight (including package)	360g
Interface characteristics	Start delay	<50ms
	Maximum output frequency	200Hz
	Serial communication rate	2400 to 115200 baud rate
	Digital output format	Binary high performance protocol
MTBF	≥100000 hours/time	
Electromagnetic compatibility	According to GBT17626	
Insulation resistance	≥100 MΩ	
Impact resistance	2000g, 0.5ms, 3 times / axis	

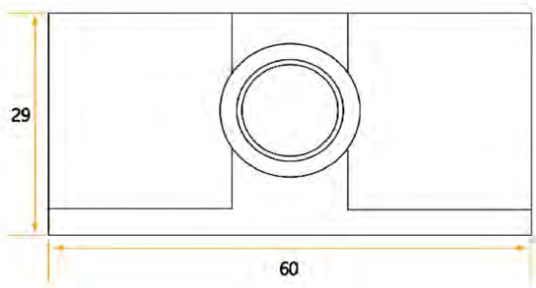
Resolution: The measured minimum change value that the sensor can detect and resolve within the measurement range.
Accuracy: The error between the actual angle and the Root mean square(RMS) of the measured angle of the sensor (≥16 times).

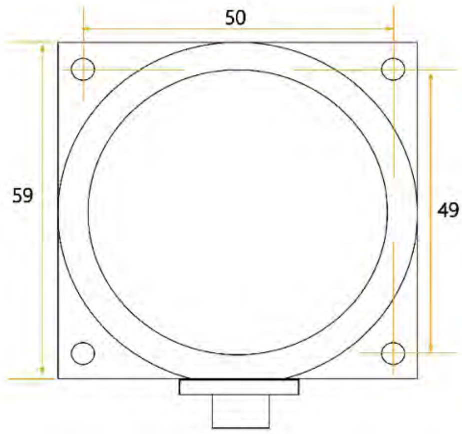
Mechanical Characteristic

Connector	Metal connector
Protection level	IP67
Shell material	Magnesium alloy anodizing
Installation	Four M4 screws

Package size

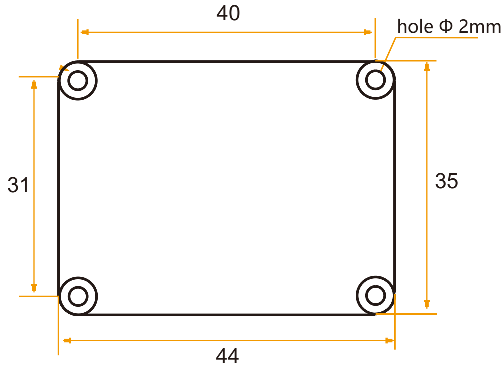
Product Size: L60× W59× H29mm





PCB size

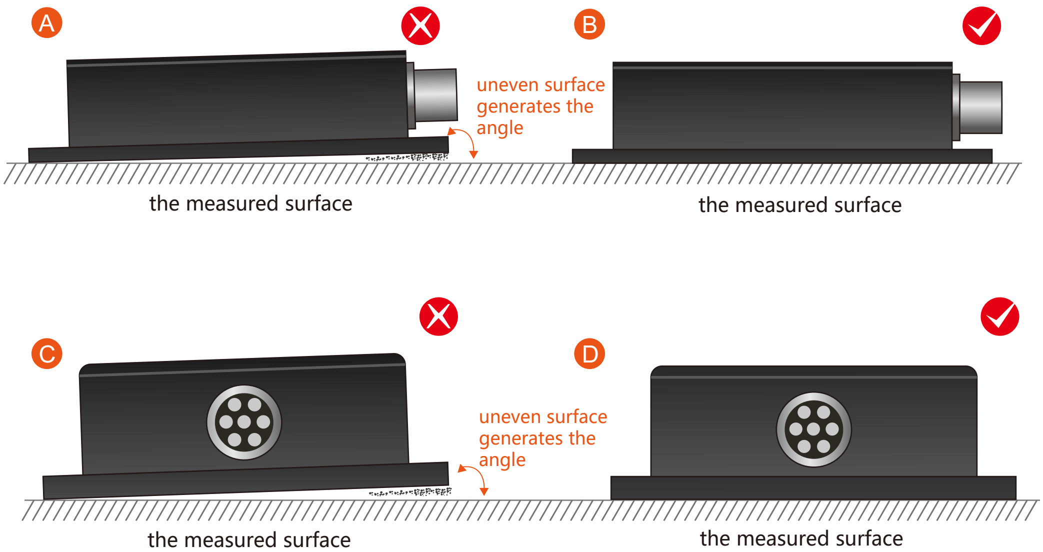
PCB Size: L44*W35*H11mm, ±1mm error for lengh and width dimensions, please refer to actual size



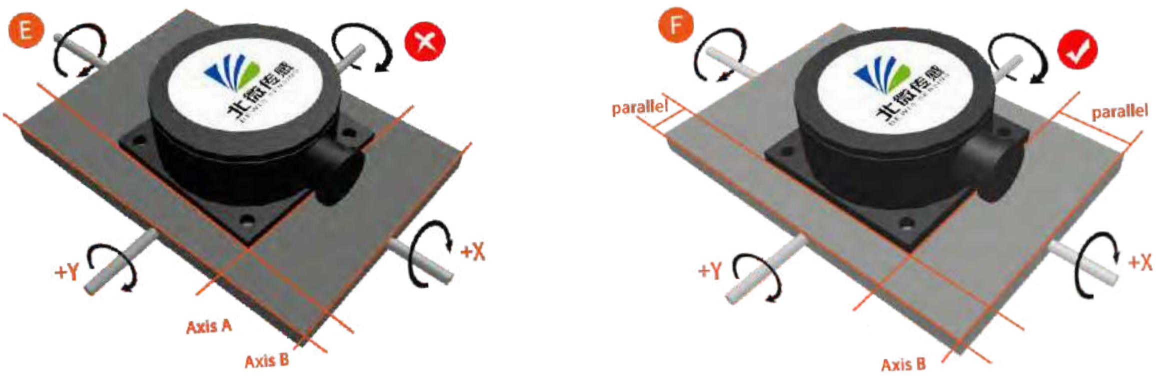
Installation direction

The correct installation method can avoid measurement error. The following points should be made when installing the sensor:

First of all, to ensure that the sensor mounting surface and the measured surface completely close, the measured surface should be as horizontal as possible, can not have the angle shown in Figure A and Figure C, the correct installation is shown in Figure B and Figure D.



Secondly, the bottom cable of the sensor and the axis of the measured object shouldn't generate the angle shown in E. When installing, the bottom cable of the sensor should be kept parallel or orthogonal to the rotation axis of the measured object. This product can be installed horizontally or vertically (vertical installation requires customization). The correct installation method is shown in Figure F.

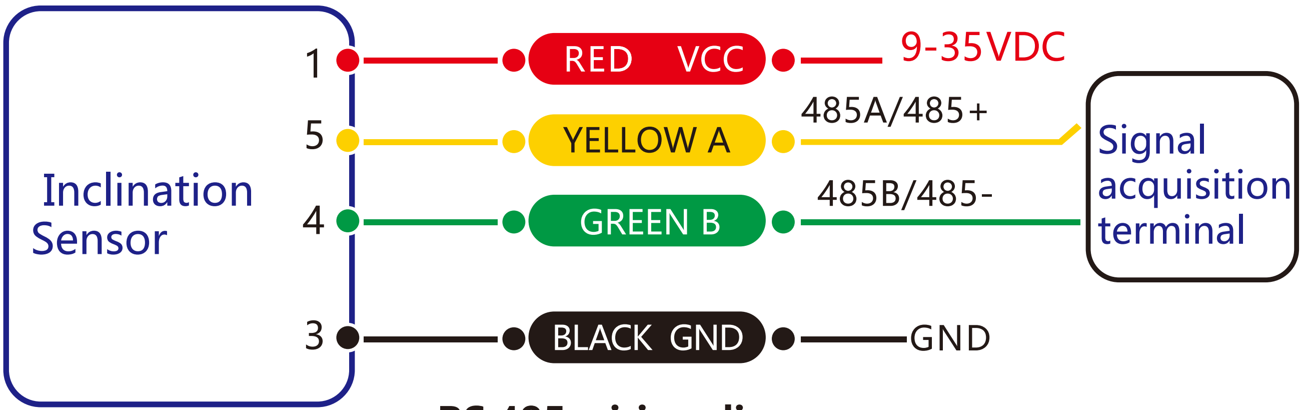


Finally, the installation surface of the sensor must be fixed with the measured surface tightly and smoothly, to avoid measurement error that may be caused by the acceleration and vibration.

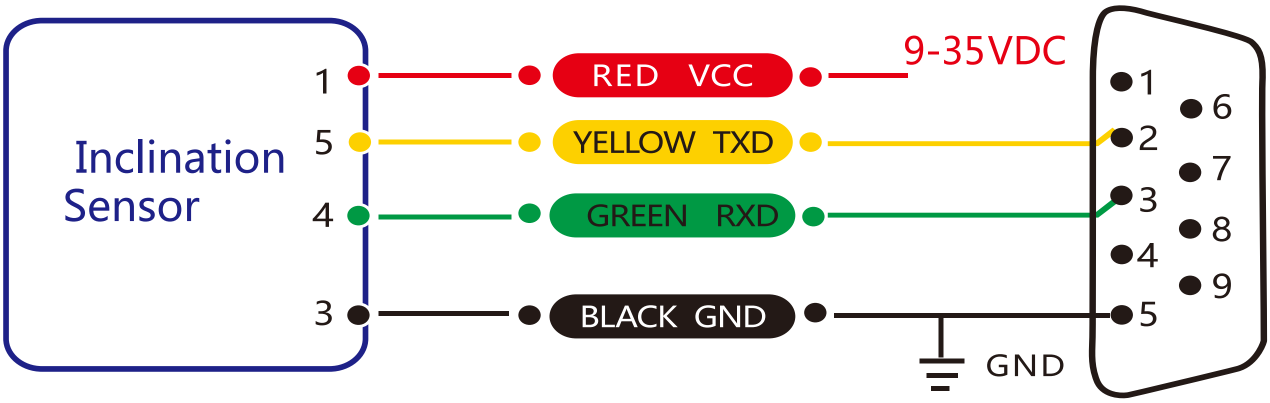
Electrical connections

Electrical interfaces

Cable color & function	RED	BLUE	BLACK	GREEN	YELLOW
	1	2	3	4	5
	VCC 9-35VDC	NC	GND	RXD (B、D-)	TXD (A、D+)



RS 485 wiring diagram



RS 232 wiring diagram

Debug software

You can download the serial debugging assistant directly on the official website (technical service -> download area), or you can use the more convenient and intuitive host computer software.

The VG127C supporting serial port debugging software can connect the inclination sensor on the computer to display the angle. The software debugging interface is shown in the figure below. Using the tilt angle to debug the host computer, you can easily display the current X direction and Y direction tilt angle, and you can also modify and set other parameters.

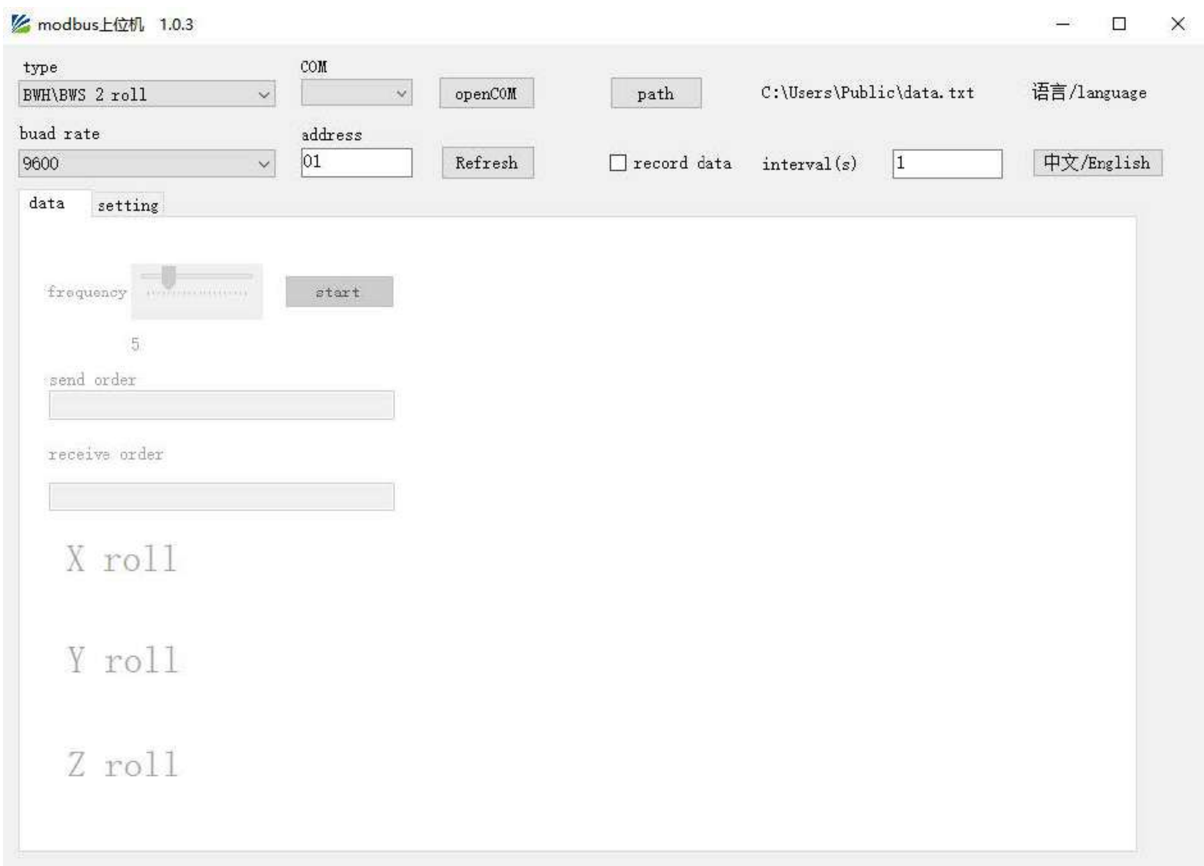
Software use steps:

① Connect the serial port hardware of the inclinometer correctly and connect the power supply.

② Select the correct device model (select azimuth series).

③ Select the computer serial port and baud rate and click to connect to the serial port.

④ Click Start and the tilt angle of the inclinometer in the X and Y directions will be displayed on the screen.



Protocol

1. Data Frame Format:

(8 data bits, 1 stop bit, No parity check, default baud rate 9600)

Identifier (1byte)	Function (1byte)	High address of register (1byte)	Low address of register (1byte)	High order of the number of registers (1byte)	Low order of the number of registers (1byte)	Checksum (2byte)
0x01	0x03 (read) 0x06 (write)	xx	xx	xx	xx	xxxx

Data format: hexadecimal
Address code: 01 by default (Note: the address cannot exceed FF)
Function code: 03 means read register, 06 means set register
Register address: the starting address of the register to be operated
Number of registers: the number of registers that need to be operated
CRC check: calculated by the host, no check is required when sending commands. (It is recommended to use CRC calculation software to obtain) Register data storage order:
X-axis angle: register 00 01
Y-axis angle: register 00 02
Three-axis acceleration: the register start address is 00 28, a total of 6 registers
Three-axis angular velocity: the register start address is 00 2E, a total of 6 registers
Quaternion: Register starting address 00 3A, a total of 8 registers
Product address: register 00 03
Zero point type: register 00 04

2 Command Format:

2.1 Read X-axis angle Command: 01 03 00 01 00 01 D5 CA

Address (1byte)	Function (1byte)	High address of register	Low address of register	High order of the number of registers	Low order of the number of registers	Checksum (2byte)
0x01	0x03	0x00	0x01	0x00	0x01	0xD5CA

Command response:

Address (1byte)	Function (1byte)	Byte (1byte)	Data high (1byte)	Data low (1byte)	Checksum (2byte)
0x01	0x03	0x02	xx	xx	xxxx

Note: Data is a hexadecimal number (PLC or configuration software uses a 16-bit register to read data directly in decimal). After conversion to decimal, the real data = (Data-20000)/100. If Data is 3D52, it is 15698 when converted to decimal, the real data = (15698-20000)/100=-43.02 degrees

2.2 Read Y axis angle Command: 01 03 00 02 00 01 25 CA

Address (1byte)	Function (1byte)	High address of register	Low address of register	High order of the number of registers	Low order of the number of registers	Checksum (2byte)
0x01	0x03	0x00	0x02	0x00	0x01	xxxx

Command response:

Address (1byte)	Function (1byte)	Byte (1byte)	Data high (1byte)	Data low (1byte)	Checksum (2byte)
0x01	0x03	0x02	xx	xx	xxxx

2.3 Read X, Y axis angle Command: 01 03 00 01 00 02 95 CB

Address (1byte)	Function (1byte)	High address of register	Low address of register	High order of the number of registers	Low order of the number of registers	Checksum (2byte)
0x01	0x03	0x00	0x01	0x00	0x02	xxxx

Command response:

Address (1byte)	Function (1byte)	Byte (1byte)	X axis angle (2byte)	Y axis angle (2byte)	......	Checksum (2byte)
0x01	0x03	0x04	xx xx	xx xx	......	xxxx

2.4 Set communication rate Command: 01 06 00 0B 00 02 79 C9

Address (1byte)	Function (1byte)	Function (1byte)	Function (1byte)	Data (2byte)	Checksum (2byte)
0x01	0x06	0x00	0x0B	0x0002	0x79 C9

Command response:

Address (1byte)	Function (1byte)	Function (1byte)	Function (1byte)	Data (2byte)	Checksum (2byte)
0x01	0x06	0x00	0x0B	0x0002	0x79 C9

Note: Data is 0x00 00 means 2400
0x00 01 means 4800
0x00 02 means 9600 (default value)
0x00 03 means 19200
0x00 04 means 115200

2.5 Set relative/absolute zero point Command: 01 06 00 0A 00 00 A9 C8

Address (1byte)	Function (1byte)	Function (1byte)	Function (1byte)	Data (2byte)	Checksum (2byte)
0x01	0x06	0x00	0x0A	0x0000: Absolute zero 0x0001: Relative zero	0xA9 C8

Command response:

Address (1byte)	Function (1byte)	Function (1byte)	Function (1byte)	Data (2byte)	Checksum (2byte)
0x01	0x06	0x00	0x0A	0x0000: Absolute zero 0x0001: Relative zero	0xA9 C8

Note: Absolute zero point: based on the factory-calibrated zero point;
Relative zero point: based on the zero point set at the current position.

2.6 Query relative/absolute zero point Command: 01 03 00 05 00 01 94 0B

Address (1byte)	Function (1byte)	High address of register	Low address of register	High order of the number of registers	Low order of the number of registers	Checksum (1byte)
0x01	0x03	0x00	0x05	0x00	0x01	0x94 0B

Command response:

Address (1byte)	Function (1byte)	Byte (1byte)	Data high (1byte)	Data low (1byte)	Checksum (2byte)
0x01	0x03	0x02	xx	xx	xxxx

2.7 Set module address Command: 01 06 00 0D 00 03 58 08

Address (1byte)	Function (1byte)	Function (1byte)	Function (1byte)	Data (2byte)	Checksum (2byte)
0x01	0x06	0x00	0x0D	Module address	xxxx

Command response:

Address low (1byte)	Function (1byte)	Function (1byte)	Function (1byte)	Data (2byte)	Checksum (2byte)
Module address	0x06	0x00	0x0D	Module address	xxxx

2.8 Save Settings Command: 01 06 00 0F 00 00 B9 C9

Address (1byte)	Function (1byte)	Function (1byte)	Function (1byte)	Data (2byte)	Checksum (2byte)
0x01	0x06	0x00	0x0F	0x0000	0xB9 C9

Command response:

Address (1byte)	Function (1byte)	Function (1byte)	Function (1byte)	Data (2byte)	Checksum (2byte)
0x01	0x06	0x00	0x0F	0x0000	0xB9 C9

Note: For all the previous setting items, you need to send a save command after modification, otherwise, after power off, these settings will be restored to the state before the setting.

2.9 Read three-axis acceleration Command: 01 03 00 28 00 06 45 C0

Address (1byte)	Function (1byte)	High address of register	Low address of register	High order of the number of registers	Low order of the number of registers	Checksum (2byte)
0x01	0x03	0x00	0x28	0x00	0x06	0x45C0

Command response:

Address (1byte)	Function (1byte)	Byte (1byte)	X axis angle (4byte)	Y axis angle (4byte)	Z axis angle (4byte)	Checksum (2byte)
0x01	0x03	0x0C	X	Y	Z	CRC

Note: The Data of each axis is 32-bit single-precision floating-point type (4 bytes), with the low bit in the front and the high bit in the back.

2.10 Read three-axis angular velocity Command: 01 03 00 2E 00 06 A5 C1

Address (1byte)	Function (1byte)	High address of register	Low address of register	High order of the number of registers	Low order of the number of registers	Checksum (2byte)
0x01	0x03	0x00	0x2E	0x00	0x06	0xA5C1

Command response:

Address (1byte)	Function (1byte)	Byte (1byte)	X axis angle (4byte)	Y axis angle (4byte)	Z axis angle (4byte)	Checksum (2byte)
0x01	0x03	0x0C	X	Y	Z	CRC

Note: The Data of each axis is 32-bit single-precision floating-point type (4 bytes), with the low bit in the front and the high bit in the back.

2.11 Read quaternion Command: 01 03 00 3A 00 08 64 01

Address (1byte)	Function (1byte)	High address of register	Low address of register	High order of the number of registers	Low order of the number of registers	Checksum (2byte)
0x01	0x03	0x00	0x3A	0x00	0x08	xxxx

Command response:

Address (1byte)	Function (1byte)	Byte (1byte)	Data1 (4byte)	Data2 (4byte)	Data3 (4byte)	Data4 (4byte)	Checksum (2byte)
0x01	0x03	0x10	q1	q2	q3	q4	CRC

Note: The Data of each quaternion is a 32-bit single-precision floating-point type (4 bytes), with the low bit in the front and the high bit in the back.

Executive standard

- Enterprise Quality System Standard: ISO9001:2015 Standard (Certificate No.:23919Q10455ROS)
- CE certification (certificate number: M.2019.103.UY1151)
- RoHS (certificate number: G190930099)

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