GF-KG Clamp-on Ultrasonic Flow Sensor

General Information

GF-KG ultrasonic clamp-on flow sensors are compact size and can measure flow and output results without external circuitry. The sensors can be directly clamped on flexible plastic tubing to accurately measure the liquid flow rate and detect air bubbles. The sensors are not in direct contact with the liquid in the tubing and will not contaminate the liquid. They are especially suitable for applications where strict hygiene is required, such as medical devices, bioprocessing, new energy, semiconductors, industrial automation, scientific research, and other fields.

Features:

- High precision and high stability
- Non-invasive measurement, no direct contact with liquid, hygienic safety
- Bi-directional measurement, can calculate fluid volume and detect air bubble
- Circuit embedded in the sensor and no external circuit required
- No blockage, no dead area, low fluid pressure loss
- Provide standard output methods to seamlessly integrate with customer systems
- Customized calibration of plastic tubing material, size, temperature and liquid type

Applications:

- Medical devices such as hemodialysis machines, organ transplantation system, heart-lung machine, blood pump, syringe pump
- Bioprocessing, such as single-use systems, fermenters, cell culture equipment, vaccine production, tangential flow filtration systems, liquid chromatographs, chromatography
- Fluid monitoring during new energy and semiconductor manufacturing, such as high purity water and corrosive chemicals
- Food & beverage processing, such as milk, juice, beer production
- Filling equipment, spraying equipment, cooling system, lubrication system
- Scientific experiment system
- Water treatment and wastewater treatment system

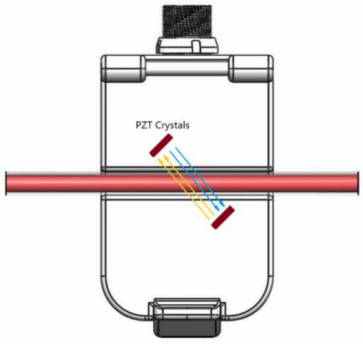
1. 1 Symbols and Abbreviations

Abbreviation	Description
EMC	Electromagnetic compatibility
PLC	Programmable logic controller
ID	Inner diameter
OD	Outer diameter
WT	Wall thickness
TTD	Transit-time difference

1. 2 Working Principle

The GF-KG clamp-on flow sensors can be clipped on flexible plastic and silicone tubing to measure liquid flow rate non-invasively. The sensors operate using the principle of ultrasonic transit-time difference technology, which is the most accurate method among some other approaches for non-invasive flow measurement solutions.

In the sensor, two piezoelectric (PZT) crystals transmit/receive ultrasonic waves alternatively in the downstream and upstream directions. The ultrasonic waves propagate through the liquid at an angle relative to the axis of the tubing, and the transit time in the upstream direction is always larger than that in the downstream direction. The time difference in both directions is proportional to the flow velocity, and with that information, the volume flow rate can be derived.



1. 3 Packing List

- One flow sensor with 8 pin receptacle (IP52) or with an integrated cable
- One 1. 5-meter-long sensor cable with 8 pin connector and flying wire (if the sensor has an integrated cable, then this item is not included)

Accessories (need to purchase separately):

- USB Data Converter
- Flow Senor Toolbox with display
- Flow Sensor Monitor
- 3-meter Flow Sensor Data Cable

2. Safety Precautions

Read the user manual carefully before using the flow sensor and accessories. Inspect the device for completeness and damage after first unpacking and keep them in an easily accessible safe place.

2. 1 Personnel Requirements

Personnel must be:

- Trained and qualified for the task
- Authorized by plant owner
- Familiar with any possible regulations
- Familiar and understanding of the instructions and associated documents
- Able to follow instructions and conditions mentioned

2. 2 Intended Purpose

The GF-KG clamp-on flow sensors are designed for non-invasive flow measurement of liquids. The measurement is based on the ultrasonic transit-time difference technology and the sensors are typically used in bioprocess, medical devices, new energy and industrial automation applications.

The USB Data Converter and the Flow Sensor Toolbox allow the sensor to communicate with a computer via a serial interface. They help users adjust sensor parameters to suit a specific application and help with troubleshooting. The USB Data Converter and the Flow Sensor

Toolbox can only be used for the above purposes, and the user must read and understand this guide and comply with all safety regulations before use.

All uses not related to the above purposes are not allowed and may damage the sensor.

2. 3 Workplace Conditions

Before using the device:

- Make sure temperature and pressure conditions are in check
- Make sure the device is installed correctly

The clamp-on flow sensor is not designed to be used:

- For gases
- With explosive liquids
- In an outdoor environment
- As a legal metrological control device

2. 4 Operational Conditions

While using the device make sure to:

- Be aware of risks of injury

- ❖ Operate device in proper conditions and environments
- ❖ Use device for its intended purpose
- ❖ Understand the user is responsible for operation and safety of device

2. 5 Product Safety

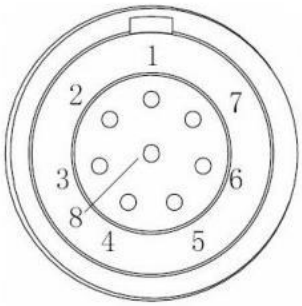
GF-KG flow sensors, Flow Viewer PC software, USB Data Converter, Flow Sensor Toolbox and other accessories comply with applicable safety regulations. The manufacturer has taken all possible measures to guarantee safe operation. The users need to make sure that these devices are installed and operated in a manner that doesn't impair safe use. All devices are factory tested and are delivered in a safe condition.

Note:

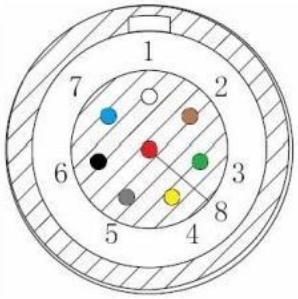
- ❖ Only the user who has read and fully understood this guide can modify the sensor parameters. Before modifying the sensor parameters, you need to back up the original sensor configuration.
- ❖ The housing of the USB Data Converter and Flow Sensor Toolbox may not be opened.
- ❖ The USB Data Converter and Flow Sensor Toolbox must be protected from moisture.

3. Sensor Specifications

3. 1 Sensor and Cable Connector



Female (Sensor)



Male(Cable)

3. 2 Cable Wire Assignment

Code	Pin Color	Function
1	White	GND
2	Brown	Voltage input(12-30VDC)
3	Green	Current output or voltage output
4	Yellow	RS485B
5	Grey	RS485A
6	Black	Frequency output (0-20KHz)
7	Blue	Digital output (NPN, PNP, PUSH-PULL)
8	Red	Digital input (Ground for 20ms)

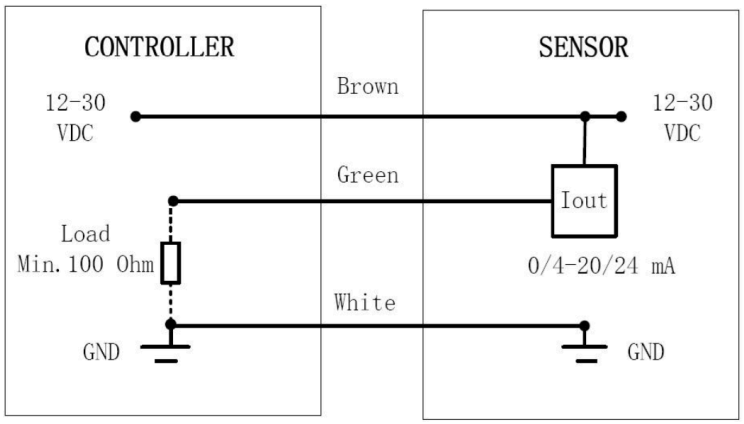
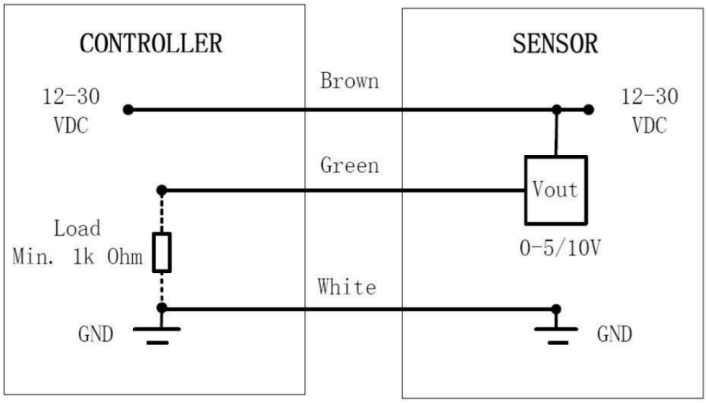
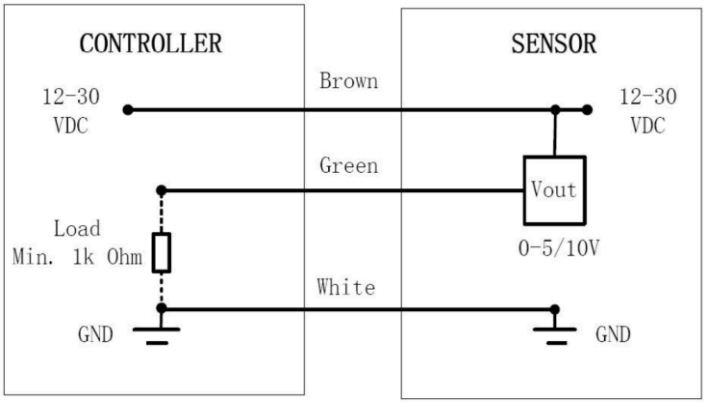
3. 3 Products and Tubing Sizes

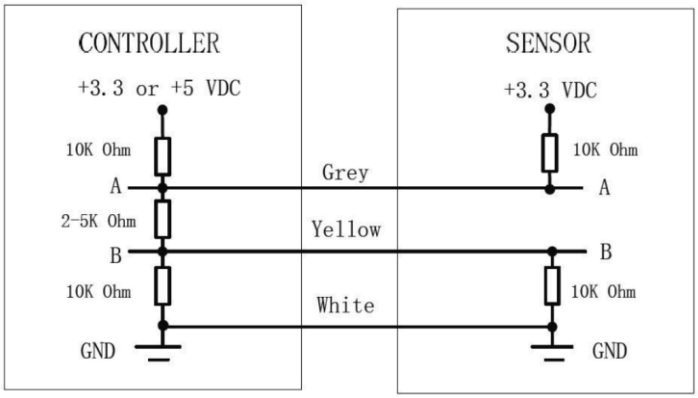
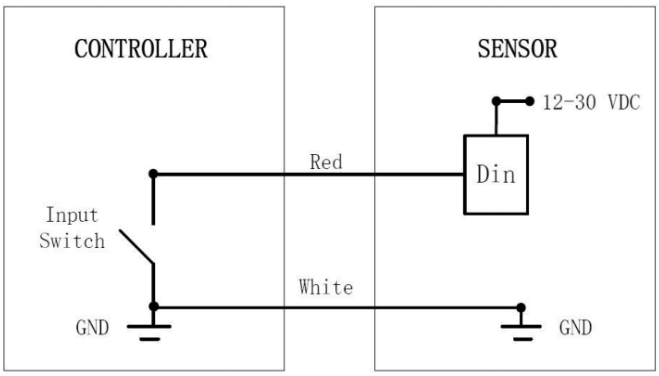
Sensor	Flow Range	Accuracy	Tubing OD	Tubing ID
KG-016N-S	500mL/min Max:2000mL/min	0-200mL/min:±4mL/min 200-2000mL/min:±2%	5/32"(4mm)	1/16"(1.6mm)
			4mm	2mm
KG-019N-S	800mL/min Max:4000mL/min	0-200mL/min:±4mL/min 200-4000mL/min:±2%	3/16"(4.8mm)	1/16"(1.6mm)
			5mm	3mm
KG-025N-S	1000mL/min Max:3000mL/min	0-200mL/min:±4mL/min 200-3000mL/min:±2%	1/4"(6.4mm)	1/8"(3.2mm)
			7mm	4mm
KG-032N-S	2000mL/min Max:6000mL/min	0-300mL/min:±9mL/min 300-6000mL/min:±3%	5/16"(7.9mm)	3/16"(4.8mm)
			8mm	5mm
KG-038N-S	3000mL/min Max:8000mL/min	0-500mL/min:±15mL/min 500-8000mL/min:±3%	3/8"(9.5mm)	1/4"(6.4mm)
			9mm	6mm
KG-044N-S	4000mL/min Max:9000mL/min	0-600mL/min:±18mL/min 600-9000mL/min:±3%	7/16"(11.1mm)	5/16"(7.9mm)
			11mm	8mm
KG-050N-S	5000mL/min Max:10000mL/min	0-700mL/min:±21mL/min 700-10000mL/min:±3%	1/2"(12.7mm)	3/8"(9.5mm)
			13mm	6mm
KG-056N-S	6000mL/min Max:12000mL/min	0-800mL/min:±24mL/min 800-12000mL/min:±3%	9/16"(14.3mm)	3/8"(9.5mm)
			14mm	10mm
KG-063N-S	8000mL/min Max:14000mL/min	0-900mL/min:±27mL/min 900-14000mL/min:±3%	5/8"(15.9mm)	3/8"(9.5mm)
			16mm	10mm
KG-075NS-	10000mL/min Max:20000mL/min	0-1200mL/min:±36mL/min 1200-18000mL/min:±3%	3/4"(19.1mm)	1/2"(12.7mm)
			19mm	14mm
KG-100N-S	25000mL/min Max:50000mL/min	0-2000mL/min:±60mL/min 2000-50000mL/min:±3%	1"(25.4mm)	3/4"(19.1mm)
			1"(25.4mm)	5/8"(15.9mm)

3. 4 Specifications

Item	Parameter
Liquid	Water, blood, drinks, oil, chemicals, paint, etc., without many solid particles
Accuracy	1. 5% plus zero offset
Calibration	22±3℃, water
Tubing material	PVC, Silicone, PFA, PTFE, PE, PUR, etc.

Housing material	Aluminum alloy
Input voltage	12-30 VDC
Current	Less than 20mA (no external load)
Connector	8 pin push-pull plug
Fluid temperature	0℃ -60℃
Storage temperature	-20℃-70℃
Shielding	Grounded
Input and output	1. RS485 output 2. Analog output: Current output 4-20mA, 0-20mA, 0-24mA Voltage output 0-5V, 0-10V 3. Frequency output:0-20KHz 4. Digital output: NPN, PNP, PUSH-PULL Digital input: Ground, lasts at least 20ms

Current output	Load to GND, and the minimum load is 100 Ohm. The maximum load depends on the operating voltage:12V-250 Ohm, 15V-500 Ohm, 24V-1000 Ohm, 30V-1200 Ohm 
Voltage output	5V and 10V optional. The minimum load is 1000 Ohm 
Frequency output	5V default (12-30V optional, contact manufacturer). The minimum load is 5000Ohm. 

RS485 interface	
RS485 bus operation	The sensor supports bus operation with a maximum of 12 subscribers. The default address is #4. The protocol is upon request.
Digital output	NPN, PNP, PUSH-PULL, can be configured as flow switch, air detection, dosing or pulse output mode. Maximum 100mA
Digital input	Can be configured as zero calibration, volume reset or start dosing. Switch-on time must be larger than 20ms 
Accessory	8 wire shielded cable, default length 1. 5m
Optional accessories	1. USB Data Converter: can connect a sensor to a PC 2. Flow Sensor Toolbox with display: can connect up to 3 sensors to a PC 3. Flow Sensor Monitor: can connect to a sensor with display, and extend the sensor cable out 4. Flow Sensor Data Cable, 3 meters, push-pull plugs at both ends, can connect a Flow Sensor Monitor and a sensor

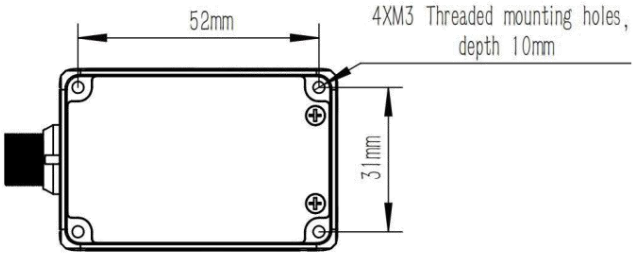
4. Sensor Setup and Operation

4. 1 Sensor and Tubing Installation

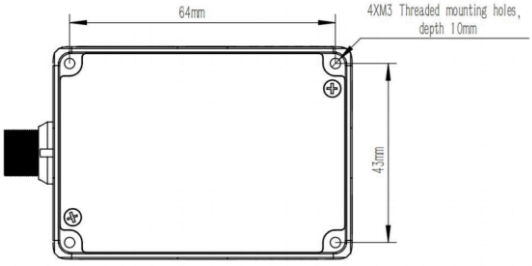
Sensor	L x W x H mm	Sensor	L x W x H mm
KG-016N-S	60x39x31. 4	KG-056N-S	60x39x40. 6
KG-019N-S	60x39x31. 4	KG-063N-S	60x39x39. 7
KG-025N-S	60x39x31. 4	KG-075NS	60x39x42. 4
KG-032N-S	60x39x37	KG-100NS	60x39x48. 8
KG-038N-S	60x39x34. 3	KG-125NS	72x40x54. 5
KG-044N-S	60x39x35. 6	KG-138NS	72x51x54. 9
KG-050N-S	60x39x37		

The sensor has four threaded inserts in the bottom, so it can be mounted on a flat panel, see below. The sensor can also be directly clamped on flexible tubing and hang freely.

The illustration below indicates the location of the four threaded inserts of sensors KG025N-S to KG100N-S.



The location of the threaded inserts of KG125N-S and KG138N-S (see below).



To install the tubing into the sensor, follow the procedures below:

- ❖ Open the sensor lid by pressing the spring-loaded lid lock.
- ❖ Insert the tubing into the measuring channel of the sensor.
- ❖ Close the lid gently until it locks.

To improve the accuracy of flow measurements, make sure:

- Tubing size and material match what were used in the factory calibration.
- The flow sensor is clamped on a straight section of tubing, preferably with 10 cm of straight section before and after the sensor. This helps reduce the flow recirculation and disturbance.
- The positive flow direction aligns with the arrow direction on the sensor lid.
- Apply a thin layer of grease or Vaseline to lubricate the tubing when possible.

4. 2 Electrical Connection

Refer to **Section 3.2** for wire assignment of the sensor cable. There are three scenarios for sensor electrical connection:

(1) The sensor needs to connect to a data acquisition device or PLC, and be powered by a 12-30 VDC voltage source:

- Turn off the power of the voltage source.
- Connect the white wire from the sensor cable to the ground and connect the brown wire to the 12-30 VDC voltage supply.
- Connect other output and input wires to the data acquisition device or PLC if necessary.
- Turn on the power of the voltage source.

(2)The sensor connects to a PC using the USB Data Converter:

- Connect the sensor to the USB Data Converter.
- Connect the USB Data Converter to the PC using the USB cable supplied. The PC
- supplies power to the USB Data Converter and the sensor.
- Connect the USB Data Converter to an external controller if necessary.

(3)The sensor connects to the Flow Sensor Tool Box and a PC:

- Connect the sensor to the Flow Sensor Toolbox.
- Connect the Flow Sensor Toolbox to the PC using the USB cable supplied. The PC supplies power to the Toolbox and the sensor.

Connect the Flow Sensor Toolbox to an external controller if necessary.