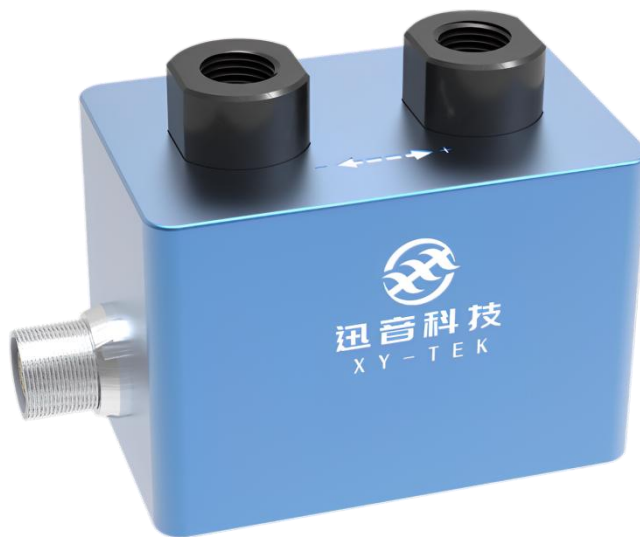




TGU Series Ultrasonic In-line Flow Sensor User Manual



User Manual (V1.6)

XY-TEK

July. 2025

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TGU Series Ultrasonic In-line Flow Sensor

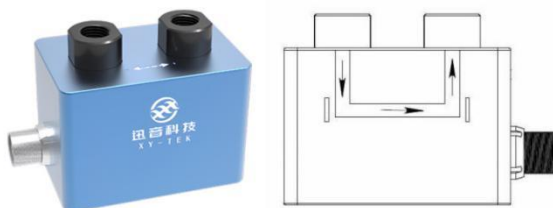
1. INTRODUCTION

XY-TEK is a technology-driven enterprise specializing in the R&D, production, and sales of ultrasonic flow sensors. We are committed to providing accurate and reliable flow sensors for liquid transmission tubing in medical devices, biopharmaceuticals, new energy, and industrial equipment, enhancing the automation, informatization, and intelligence of liquid flow measurement.

XY-TEK **TGU series in-line ultrasonic flow sensor** is compact and can output results without external circuitry. The sensors can be integrated into flow lines to measure very low flow rates with high precision. The sensors are based on the ultrasonic transit-time difference method, and they can be configured as flow switches, or be used for bubble detection and dosing/filling processes.

Product Features

- High accuracy and high stability
- The minimum flow rate can be measured at 1mL/min
- Bi-directional measurement, can calculate fluid volume and detect air bubble
- Circuit embedded in the sensor and no external circuit required
- Provide standard output methods to seamlessly integrate with customer systems
- Independent of liquid color or conductivity



Applications

- Medical Devices: Cooling systems, irrigation systems
- Biopharmaceuticals: Chromatography, upstream and downstream feed, filtration
- Industrial Automation: Filling equipment, spray coating equipment, cooling systems, lubrication systems, water treatment and wastewater treatment systems
- Scientific Research: Scientific experimental systems

1.1 Symbols and Abbreviations

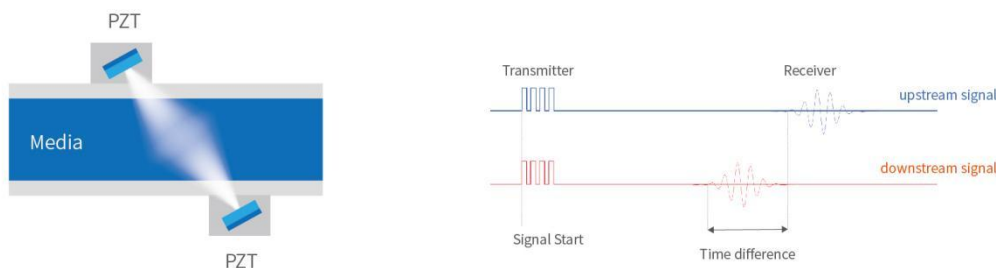
Symbols	Description
	Warning! This safety symbol precedes critical information that must be strictly followed to prevent injury or fatal hazards.
 Attention	Attention! This safety symbol precedes operational guidelines that must be strictly followed to prevent equipment damage or adverse.

1.2 Working Principle

The XY-TEK TGU Series ultrasonic flow sensor connects to the customer's existing liquid pipeline via adapters, enabling precise measurement of the liquid flow rate within the pipe. This sensor utilizes advanced ultrasonic transit-time difference technology, delivering exceptional accuracy and reliability.

During measurement, two piezoelectric (PZT) crystals inside the sensor are positioned downstream and upstream, alternately sending and receiving ultrasonic signals. The ultrasonic waves propagate directly through the liquid in an opposing-beam configuration. The flow of the liquid affects the propagation of the

ultrasonic waves, causing the transit time in the upstream direction to always be longer than that in the downstream direction. By accurately analyzing the difference in transit time between these two directions, and based on its proportional relationship with the liquid flow velocity, the sensor can quickly and precisely calculate the volumetric flow rate, providing users with reliable and accurate flow data.



1.3 Packing List

Standard Item		Description
1	The Flow Sensor	
2	Flow Sensor Cable (Standard 1.5m)	
3	8-Pin Terminal	
Optional		Description
1	USB Data Converter	
2	Flow Display	
3	Double-ended cable for connecting sensor and display (standard 3.0m)	
4	USB 2.0 Printer Cable	

2. SPECIFICATIONS

2.1 Measurement Accuracy and Repeatability

Product Model	Flow Range	Measurement Accuracy ^[1]	Repeatability ^[2]
TGU012NS	Low flow: 0-10mL/min	±0.1mL/min	±0.1% F.S.
	High flow: 10-1000mL/min	±1% RD	±0.1% F.S.
TGU016NS	Low flow: 0-20mL/min	±0.2mL/min	±0.1% F.S.
	High flow: 20-2000mL/min	±1% RD	±0.1% F.S.
TGU024NS	Low flow: 0-50mL/min	±0.5mL/min	±0.1% F.S.
	High flow: 50-3000mL/min	±1% RD	±0.1% F.S.

[1] Measurement accuracy: RD denotes reading accuracy (Reading)

[2] Repeatability: F.S. denotes full scale

2.2 Calibration Conditions

Sensor calibration conditions: Liquid: Water (22° C ± 3° C)

2.3 Pipe Characteristics

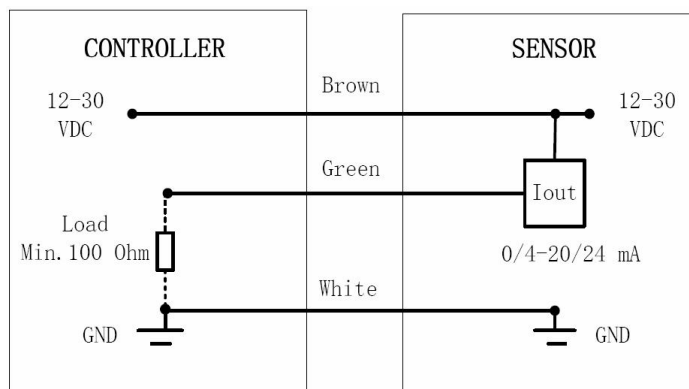
Product Model	Flow Range	Tube Connection
TGU012NS	0-1000 mL/min	1/8"NPT
TGU016NS	0-2000 mL/min	1/8"NPT
TGU024NS	0-3000 mL/min	1/8"NPT

2.4 Sensor Interface

Interface Type	Detailed Specifications
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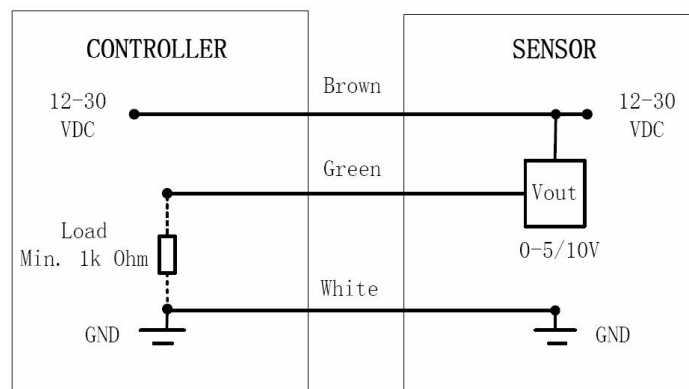
Current Output

Load to GND, and the minimum load is $100\ \Omega$. The maximum load depends on the operating voltage: 12V-250 Ω , 15V-500 Ω , 24V-1000 Ω , 30V-1200 Ω



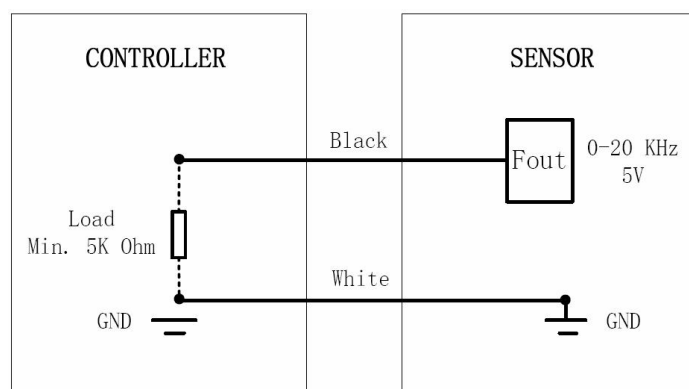
Voltage Output

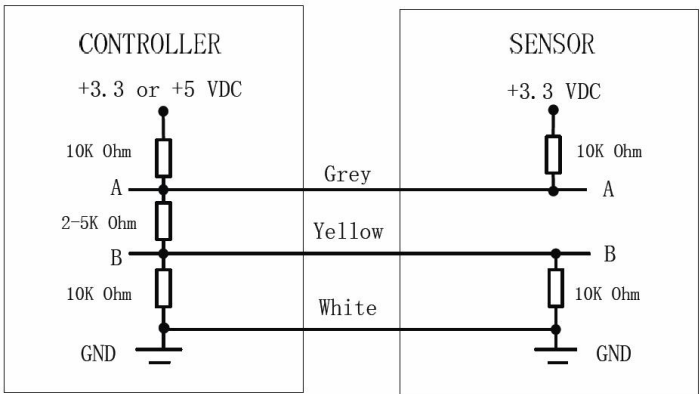
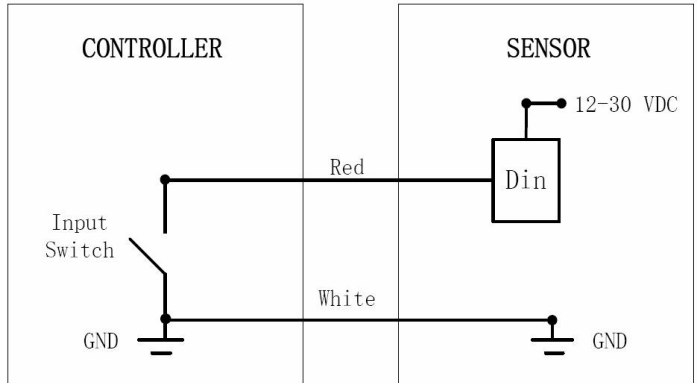
5V and 10V optional. The minimum load is 1000 Ω .



Frequency Output

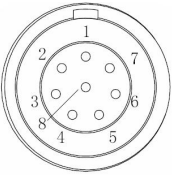
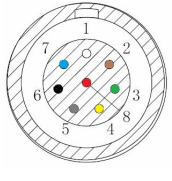
5V default (12-30V optional, contact manufacturer). The minimum load is 5000 Ω .



RS485 Interface	The sensor supports bus operation with maximum 12 subscribers.  The diagram shows the RS485 interface connection between a CONTROLLER and a SENSOR. The CONTROLLER side has a +3.3 or +5 VDC supply, a 10K Ohm pull-up resistor to terminal A, a 2-5K Ohm pull-up resistor to terminal B, and a 10K Ohm pull-up resistor to GND. The SENSOR side has a +3.3 VDC supply, a 10K Ohm pull-up resistor to terminal A, and a 10K Ohm pull-up resistor to GND. The wiring is as follows: Grey wire connects CONTROLLER A to SENSOR A; Yellow wire connects CONTROLLER B to SENSOR B; White wire connects CONTROLLER GND to SENSOR GND.
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.  The diagram shows the Digital Input connection between a CONTROLLER and a SENSOR. The CONTROLLER side has an Input Switch connected to a Red wire, which is connected to the Din terminal on the SENSOR. The White wire connects the CONTROLLER GND to the SENSOR GND. The SENSOR also has a 12-30 VDC supply connected to its Din terminal.

2.5 Electrical Specifications and Connections

Electrical Parameters	Detailed Specifications
Operating Voltage	18-30VDC
Current Consumption	≤ 20 mA (no external load)
Electrical Connection	8-pin push-pull connector

Sensor-to-Cable Connection	Pin	Wire Color	Function
 Female Sensor End	1	White	Ground
	2	Brown	Voltage Input (12 – 30 VDC)
	3	Green	Current Output or Voltage Output
	4	Yellow	RS485B
 Male Cable End	5	Gray	RS485A
	6	Black	Frequency Output (0 – 20 kHz)
	7	Blue	Digital Output (NPN, PNP, PUSH-PULL)
	8	Red	Digital Input (Ground 20 ms)

2.6 General Data

General Parameters	Detailed Specifications
Measurement Principle	Ultrasonic time-of-flight method
Measurable Liquids	Water or similar liquids
Fluid Connection	NPT female thread
Wetted Materials	Flow channel: PEEK, Seal: Viton
Calibration	Manufacturer default calibration: 22°C ± 3°C (water)
Sensor Housing	Aluminum alloy
Liquid Temperature	0°C - 90°C
Ambient Temperature	0°C - 60°C
Storage Temperature	-20°C - 70°C
Operating Humidity	10% - 90% RH (non-condensing)
Operating Pressure	0 - 1 MPa (consult factory for higher pressure)
Protection Rating	IP65
Installation	Thread mounting
Shielding	Cable ground

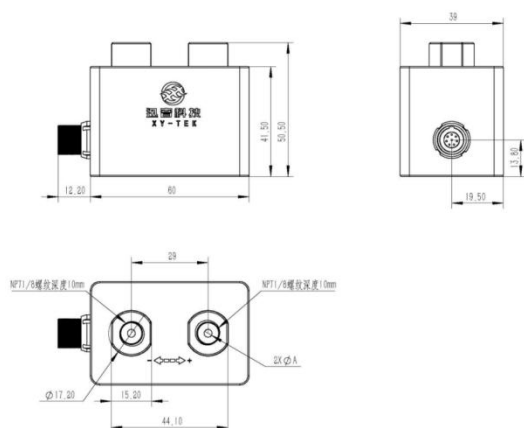
2.7 Scope of Supply and Accessories

Name	Detailed Specifications
Scope of Supply	TGU Series Flow Sensor
	User Manual (quick start guide)
	Factory Calibration Report
Required Accessories	8-core shielded cable (standard length 1.5m)
	Flow Viewer Software
Optional Accessories	USB data converter (for connecting the sensor to the computer)
	Flow display (supports one sensor)
	Data cable (3 m) with push-pull connectors at both ends (for connecting flow display and sensor)
	USB 2.0 printer cable (for connecting the USB data converter to the computer)

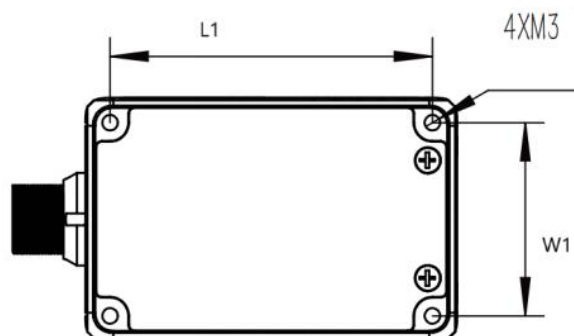
2.8 Sensor Dimensions

Model	Dimensions (L x W x H)	Mounting Hole	Mounting Hole Pitch L1	Mounting Hole Pitch W1
TGU012NS	60 x 39 x 50.5mm	M3 x 10mm	52mm	31mm
TGU016NS	60 x 39 x 50.5mm	M3 x 10mm	52mm	31mm
TGU024NS	60 x 39 x 50.5mm	M3 x 10mm	52mm	31mm

Sensor mounting method



Sensor external dimensions



There are four threaded mounting holes on the bottom of the sensor, which can be directly fixed onto a perforated flat plate.

3. SAFETY PRECAUTIONS

Before using the flow sensor and its accessories, please read this user manual carefully.

- Upon first opening the package, check the integrity of the device for any damage and store it safely.
- All environmental conditions must meet the specified requirements for installation and subsequent operation (see "4. Technical Specifications").
- The user will be responsible if the flow sensor is not connected correctly as required.
- Do not drop the flow sensor, as it may crack or become damaged, affecting measurement accuracy.

3.1 Operator Requirements

Operators must meet all the following conditions and comply with relevant regulations:

1. Trained and qualified personnel
2. Technicians authorized by the factory
3. Familiarity with and understanding of relevant regulations and documentation

3.2 Intend Usage

1. The in-line flow sensor from XY-TEK is designed solely for contact-type flow measurement of liquids.
2. The USB data converter allows the sensor to communicate with a computer via a serial interface. When used with the Flow Viewer flow monitoring software, it helps users adjust sensor parameters to fit specific applications and assists in troubleshooting.
3. All uses unrelated to the above purposes are prohibited, as they may damage the sensor and data converter.

3.3 Workplace Conditions

Before using the sensor equipment

1. Check temperature and pressure conditions to meet the sensor's operational requirements.
2. Ensure that the sensor and other equipment are installed correctly.

The flow sensor is not suitable for the following situations

1. Gas flow measurement
2. Measurement of explosive liquid flow
3. Metering equipment for billing purposes
4. Outdoor environments

3.4 Product Safety

The flow sensors, Flow Viewer software, USB data converters, and other accessories provided by XY-TEK comply with applicable safety regulations. Users must ensure that these hardware and software devices are installed and operated in a manner that does not compromise safety. All devices have been tested at the XY-TEK factory and are delivered in a safe condition.

Note: 

- Only users who have read and understood this guide may modify the sensor parameters.
- Before modifying the sensor parameters, users must back up the original sensor configuration.
- Do not disassemble the internal structure of the flow sensor and USB data converter.
- The flow sensor and USB data converter must be protected from moisture.

4. SENSOR USAGE

4.1 Sensor Wiring

There are typically two scenarios for connecting the sensor wires.

1.Connecting the Sensor to Data Acquisition Equipment or PLC with a Separate Power Supply

- Disconnect the power supply.
- Ground the white wire of the sensor cable and connect the brown wire to 12-30Vdc (see "2.5 Electrical Specifications and Connections")
- Connect other necessary output and input wires to the data acquisition equipment or PLC (see "2.5 Electrical Specifications and Connections")
- Turn on the power supply.
- Cut off any unused exposed wires to avoid short circuits.  **Attention**

2.Connecting the Sensor to a Computer via USB Data Converter

- Connect the sensor to the USB data converter.
- Use the provided USB cable to connect the USB data converter to the computer, which will power both the USB data converter and the sensor.
- If necessary, connect the USB data converter to an external controller, such as data acquisition equipment or PLC.

Precautions

- Check and ensure that the connectors used are suitable and compatible with the measurement system.
- When inserting the wires, ensure that the flow sensor's connector is dry.

- When installing the flow sensor, be careful not to damage the functionality of the tubing system.
- Always inspect plugs and pins for damage before connecting the flow sensor.
- Do not use the flow sensor if any part of it is damaged.

4.2 Clamp the Sensor on the Tubing

To measure the flow rate properly, the TGU series flow sensor must be clamped onto the tubing.

- Ensure that the pipe adapters used correspond to the dimensions of the TGU series flow sensor.
- Air in the pipeline can cause measurement errors or interrupt the ultrasonic coupling.
- Make sure there is no dirt or residue in the flow path.
- If necessary, clean the TGU series flow sensor before connecting the adapter to the pipeline.

To install the sensor onto the tubing, please follow these steps.



Step 1:

Install the adapter onto the NPT female thread. Waterproof tape may be wrapped around the thread for sealing.



Step 2:

Connect the adapter to the liquid pipeline.



Step 3:

Allow the liquid in the pipeline to flow into the sensor and check whether the pipeline seal is intact.

4.3 Sensor Use

- Install the sensor and fill the tubing with the liquid to be measured.
- Ensure no bubbles in the tubing, and turn on the power.
- Once powered on, the sensor will immediately begin flow measurement and output data.

Before Measurement



Attention

(1) Before each measurement, check the cables, connectors, and pins for breaks or damage, as this may cause measurement errors. If any damage is found, contact our after-sales service for a replacement.

(2) Ensure that the medium temperature of your application is the same as the temperature at which the TGU sensor was adjusted and calibrated.

4.4 Zero Calibration

Ensure that the flow sensor is correctly clamped onto the exterior of the tubing, and the tubing is filled with liquid without any bubbles.

Completely stop the liquid flow, and perform the zero calibration using one of the following methods:

- Set the sensor's digital input to zero point calibration, and input a digital signal (ground for 20 ms) through the red wire of the sensor cable to initiate zero calibration.
- Connect the sensor to a USB data converter and use the XY-TEK Flow Viewer monitoring software to start the zero calibration.

4.5 Sensor Cleaning

For cleaning the sensor, we recommend using common cleaning agents or recommended disinfectants. To prevent stains and dirt from drying out, remove any dirt residue after each use.

Note: Attention

- Maximum liquid temperature: up to 100°C
- Sensor materials (PEEK, Viton®) are resistant to cleaning agents.

Shanghai Xunyun Technology Co., Ltd.

Address: Building 7, No. 410 Jinggu Road, Minhang District, Shanghai

Postcode: 200245

Tel: +86-21-33885752

Email: global@xy-tek.cn

Website: www.xy-tek.com



XY-TEK Linkedin XY-TEK Website

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The contents described in this manual are subject to change without notice

Appendix

Update Records

日期	修改操作	人员	版本
2020/05/02	Initial creation	L.L.	V1.0
2024/07/22	Added cover page, revised product image and dimensional drawing, added product model	CM.L.	V 1.1
2024/08/28	Changed flow channel material to PEEK	CM.L.	V1.2
2024/08/28	Added company profile, revised application areas and parameters	CM.L.	V1.3
2025/01/21	Overall document revision and update	CM.L.	V1.4
2025/05/08	Revised working principle, measurement repeatability, and pipe connection dimensions	CM.L.	V1.5
2025/07/31	Added description of ambient temperature, reading accuracy, and repeatability	HY.C.	V1.6