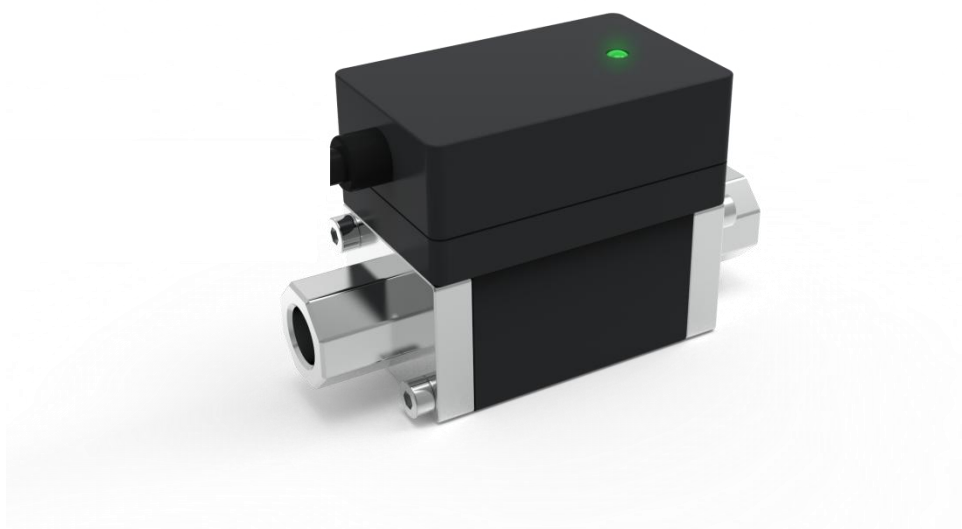




TPK Series Inline Ultrasonic Flow Sensor User Manual



User Manual (V1.0)

Shanghai Xunyun Technology Co., Ltd.

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1. INTRODUCTION

XY-TEK is a technology innovation enterprise specializing in the research, development, production, and sales of ultrasonic flow sensors. We are committed to providing accurate, stable, and reliable flow sensors for liquid flow rate measurement in medical devices, biopharmaceuticals, new energy, and industrial automation industry, helping enhance the automation, digitalization, and intelligence of liquid flow monitoring systems.

XY-TEK TPK series inline ultrasonic flow sensors feature a compact design, it can measure and output flow rate without external circuit systems. With no moving parts inside, TPD flow sensors has mechanical wear and no the measurement drift issues, ensuring stable and reliable flow rate measurement even during 24/7 continuous operation. At the same time, the TPK flow sensor generates negligible additional pressure loss to the measured liquid, making it suitable for applications with high requirements for system pressure and flow stability.

Product Features

- High accuracy and high stability
- Measure liquid flow in both directions, with bubble detection function
- The circuit is integrated inside the sensor, without the need for external computing and processing systems, compact in size
- No blockage, no steering, no dead corners, low fluid pressure loss
- Provide standard output methods for seamless integration with customer systems

Common applications

- New energy: liquid mixing ratio, coolant circulation system
- Semiconductors: Hybrid, Electroplating, Cooling Systems
- Industrial automation: spraying equipment, cooling system, lubrication system, liquid transfer system, water treatment and wastewater treatment system

1.1 Symbols and Abbreviations

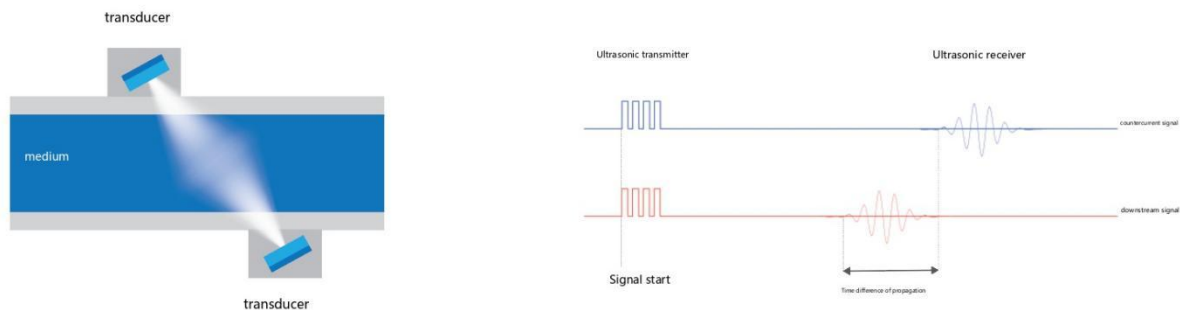
symbols and	description
	Warning! This safety symbol appears before important information that must be strictly followed to prevent injury and fatal danger.

 Attention	Attention! This safety symbol appears before critical operation information that must be strictly followed to prevent equipment damage or hazardous
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1.2 Working Principle

XY-TEK TPK series ultrasonic flow sensor can be connected to the existing liquid system through an adapter for accurate flow rate measurement within the tubing. The flow sensor uses advanced ultrasonic transit-time difference technology, providing excellent flow rate measurement accuracy and reliability.

During the measurement process, two piezoelectric (PZT) crystals inside the flow sensor are distributed downstream and upstream, alternately sending and receiving ultrasonic signals. The ultrasonic waves penetrate the tubing wall at a certain angle and propagate into the liquid. The liquid flow affects the propagation of the ultrasonic waves, ensuring that the ultrasonic transmission time in the counter-current direction is always greater than that in the downstream direction. The flow sensor, through precise analysis of the time difference in transmission between these two directions and based on its proportional relationship with the liquid flow rate, can quickly and accurately calculate the volumetric flow rate of the liquid, providing users with reliable and accurate flow data.



1.3 Packing List

Items	Detailed description
1	Flow Sensor
2	Flow Sensor Cable (standard 2m)
3	6-pin Terminal
Optional	Detailed description
1	USB Data Converter
2	USB 2.0 Printer Cable

2. TECHNICAL SPECIFICATIONS

2.1 Measurement Accuracy and Repeatability

Product model	Flow range	Measurement accuracy ^[1]	Repeatability ^{[2][3]}
TPK04M	Low flow rate: 0-0.25L/min	±5mL/min	±0.1% F.S.
	High flow rate: 0.25-5L/min	±2% RD	±0.1% F.S. F.S.

Remarks:

[1] Measurement accuracy: ±2% RD (Reading). During on-site testing, the same liquid type, temperature, and pressure as the factory calibration are required to achieve this measurement accuracy.

[2] Repeatability: ±0.1% FS (full scale). The repeatability needs to be achieved under stable liquid flow conditions. When there are pulsations or fluctuations in the liquid flow field, the repeatability will be affected.

2.2 Calibration Conditions

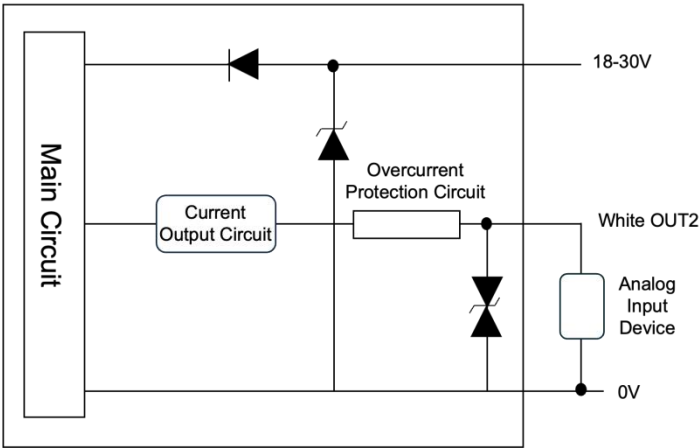
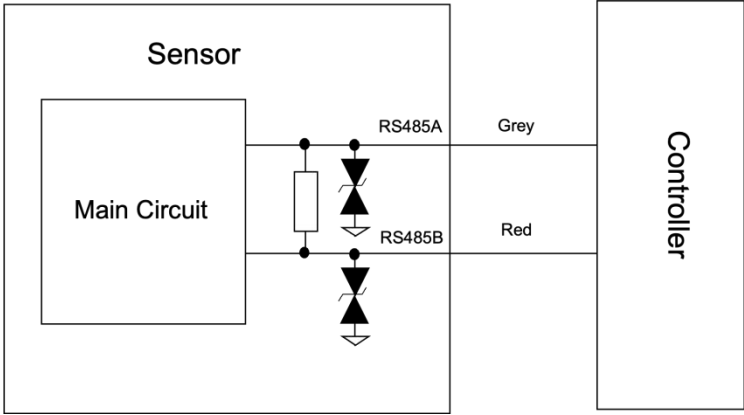
The flow sensor is calibrated at the factory according to the following standard conditions:

- Liquid: Water (22°C±3°C) (default)

2.3 Fluid Connectors

1/8 NPT internal thread (stainless steel)

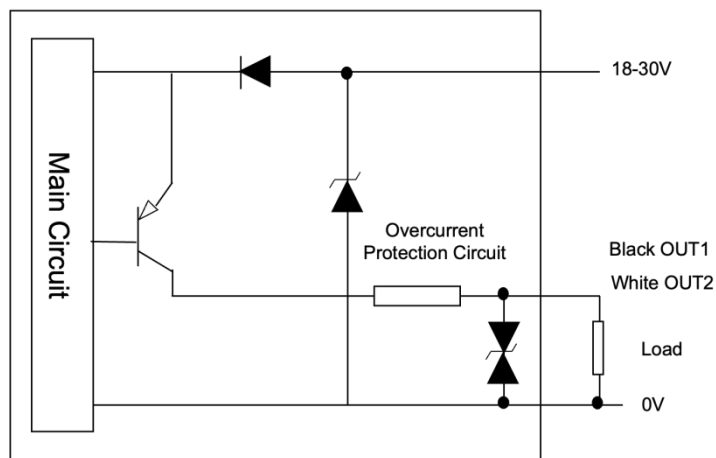
2.4 Flow Sensor Interface

Interface Type	Detailed Specifications
Current Output	3 current output modes are available: 4-20mA, 0-20mA, 0-24mA. For voltage conversion. The output can be grounded, and the load resistance is not greater than 600 Ω. 
RS485 interface	RS-485 bus operation: supports up to 12 sensors. 
Pulse Output	Pulse output, two modes: PNP, NPN

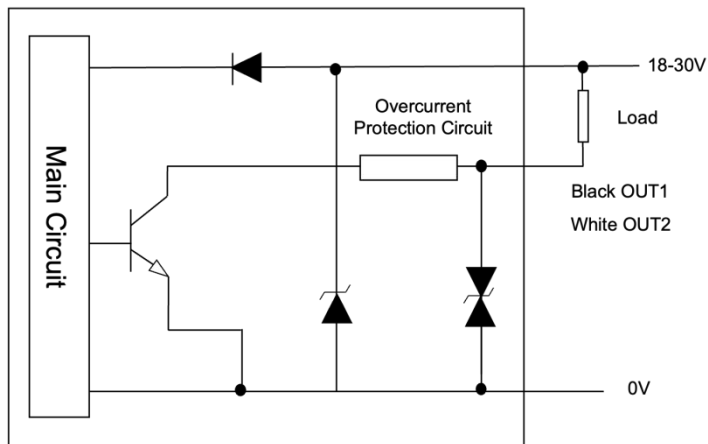
Maximum output current 100mA. Minimum load resistance is related to operating voltage.

Recommended: 12V-250 Ω , 15V-500 Ω , 24V-1000 Ω , 30V-1200 Ω

PNP (Default)

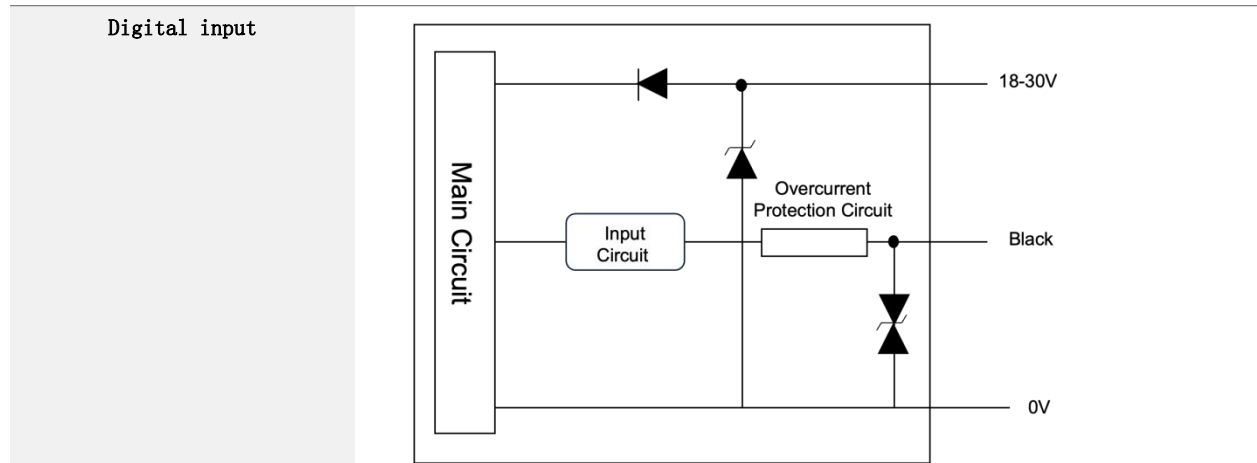


NPN (Optional)



Can be configured for zero point calibration, volume reset, start filling, etc.

The grounding time must be greater than 20ms.



2.5 Electrical Specifications and Connections

Electrical Parameters	Detailed Specifications
Operating Voltage	18-30VDC
Current Consumption	24V power supply, current consumption <30mA without external load; With external load, current consumption >30mA, but not exceeding 100mA
Electrical Connection	6-pin cable (with flying wire at the end)

Cable color and function assignment

Male Connector (cable)	Core	Color	Function
	1	Brown	Voltage Input (18-30VDC)
	2	White	OUT2: Current Output
	3	Blue	Ground (GND)
	4	Black	N/A
	5	Gray	RS485A
	6	Red	RS485B

2.6 General Data

General Parameters	Detailed Specifications
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Measurement Principle	Ultrasonic time-of-flight method
Measurable Liquids	Water, chemical solutions, oil, glue, grinding fluid, etc. (excluding large solid particles and air bubbles)
Calibration	Manufacturer default calibration: 22°C±3°C (water)
Sensor Housing	Plastic
Liquid Temperature	0°C - 70°C
Ambient Temperature	0°C - 60°C
Storage Temperature	-20°C - 70°C
Operating Humidity	10% - 90% RH (non-condensing)
Protection Rating	IP65

2.7 Scope of Supply and Accessories

Name	Detailed Specifications
Scope of Supply	TPK Series Flow Sensor
	User Manual (Electronic Version)
	Factory Calibration Report
Required Accessories	6-core shielded cable (standard length 2m, optional 5m)
Optional Accessories	USB data converter (for connecting the sensor to the computer)
	Flow Viewer flow monitoring software
	USB 2.0 printer cable (for connecting the USB data converter to the computer)

2.8 Sensor Dimensions

Product Model	Product Dimensions (L x W x H)
TPK04M	N/A

3. SAFETY INSTRUCTIONS

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

- Upon initial unpacking, please check that the equipment is complete and undamaged, and store it properly
- Installation and subsequent operation must ensure that all environmental conditions meet the requirements in "2. Technical Specifications" of this manual
- If the flow sensor is not connected correctly as required, the user shall bear the relevant risks
- Do not drop the flow sensor to prevent breakage or damage, which may affect the measurement accuracy

3.1 Operators

Operators should meet the following conditions and strictly abide by the relevant regulations:

- (1) Qualified personnel who have been trained
- (2) Technicians authorized by the factory
- (3) Familiar with and understand the relevant operating procedures and documents

3.2 Applications

- (1) XYTEK TPK series in-line flow sensor is only used for liquid flow rate measurement
- (2) The USB data converter is used for serial communication between the sensor and the computer.

Combined with Flow Viewer flow monitoring software, it can assist users to adjust flow sensor parameters to suit

specific applications and troubleshooting

- (3) Do not use the flow sensor and data converter in situations unrelated to the above uses, otherwise it may cause damage to the equipment.

3.3 Workplace Conditions

Before using the flow sensor, ensure that:

- (1) The temperature and pressure conditions are in line with the sensor's operating conditions
- (2) The equipment is installed correctly and securely.

The flow sensor is not suitable for the following situations:

- (1) Gas flow measurement
- (2) Explosive liquid flow measurement
- (3) Outdoor environment
- (4) Metering control equipment for billing

3.4 Product Safety

Flow sensors, Flow Viewer software, USB data converter, and other accessories that XY-TEK provide all comply with applicable safety regulations. Users should ensure that the above devices are installed and

operated safely. All devices have undergone rigorous testing before leaving the factory to ensure safe use.

Note:

- Only users who have read and fully understood this user manual may modify the flow sensor parameters
- Before modifying the parameters, please be sure to back up the original configuration of the sensor
- Do not disassemble the internal structure of the flow sensor or USB data converter without authorization
- Ensure that the flow sensor and USB data converter are protected from humid environments.

4. SENSOR USE

4.1 Flow Sensor Wiring Connection

The flow sensor cable connection usually has the following two situations:

(1) The flow sensor needs to be connected to the data acquisition device or PLC and powered by a separate power supply:

- Power off
- Ground the blue wire of the sensor cable and connect the brown wire to 12-30VDC (refer to “4.5 Electrical Specifications and Connections”)
- Connect other required output/input wires to the data acquisition device or PLC (refer to “4.5 Electrical Specifications and Connections”)
- Power on
- **Unused exposed wires should be cut off to avoid short circuits.**  Attention

(2) The flow sensor is connected to the computer through a USB data converter:

- Connect the flow sensor to the USB data converter
- Connect the USB data converter to the computer, the computer will power both the USB data converter and the flow sensor
- If needed, the USB data converter can be connected to an external controller (such as a data acquisition device or PLC)

Precautions

- Ensure the connector used is compatible with the measurement system
- Ensure the flow sensor connector is dry when powering on
- Avoid damaging the tubing system when installing the flow sensor
- Check if the plug and pins are damaged before connecting
- Do not use the flow sensor if any part of the sensor is damaged

4.2 Flow Sensor Installation

When integrating TPK series flow sensors into tubing systems, users should pay attention to:

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

4.3 Flow Sensor Operation

- Ensure the pipe is filled with the liquid to be measured when starting the measurement
- Ensure there are no air bubbles in the flow path and power on the sensor
- After powering on, the flow sensor will immediately begin flow rate measurement and output data

Before starting flow rate measurement Attention

- (1) Before each measurement, check the cable, connector, and pins for breakage or damage. If any damage is found, stop using the device immediately and contact XY-TEK after-sales service.
- (2) Ensure the liquid temperature is consistent with the flow sensor's factory calibration temperature.

4.4 Zero Point Calibration

Ensure the flow sensor is correctly connected to the liquid pipe and that the pipe is filled with liquid without air bubbles. Completely stop the liquid flow and perform zero-point calibration using the following method:

- Connect the flow sensor to the PLC device, send a command through 485, and start zero calibration.
- Connect the flow sensor to the USB data converter and start the zero-point calibration using the XY-TEK Flow Viewer software.

4.5 Sensor Adjustment and Calibration

To ensure flow rate measurement accuracy meets customer requirements, all flow sensors are parameter-set according to the application requirements provided by the customer before leaving the factory. XYTEK recommends that users calibrate the flow sensor regularly. Ideally, the interval between two calibrations should not exceed 24 months. In addition to factory calibration service, users can also perform calibration on-site. For detailed calibration procedures or technical support, please contact the XY-TEK after-sales service team at info@xy-tek.cn

4.6 Factors Affecting Measurement Accuracy

(1) Temperature

Temperature fluctuations can cause changes in the acoustic properties of the fluid. Therefore, it is necessary to ensure that the actual operating temperature of the sensor is consistent with the calibration temperature. The difference between the liquid temperature and the calibration temperature should be less than $\pm 5^{\circ}\text{C}$; if it is greater than $\pm 5^{\circ}\text{C}$, it is recommended to re-calibrate and adjust the correction coefficient.

(2) Liquid Type

The flow sensor is factory calibrated using water at $22^{\circ}\text{C} \pm 3^{\circ}\text{C}$ by default. The concentration of dissolved substances, bubbles, or solid particles in the liquid to be measured may affect the accuracy. If the actual measured liquid cannot be provided to the factory for calibration, water will be used for calibration, and the correction coefficient can be obtained through on-site calibration.

(3) Installation Location

To ensure optimal flow rate measurement accuracy, the flow sensor should be installed on a straight section of pipe. Large bends or sudden changes in direction may affect the distribution of the liquid flow field, increasing measurement uncertainty. It is recommended that the straight pipe length upstream of the sensor be at least 10 times the pipe inner diameter, and the straight pipe length downstream be at least 5 times the pipe inner diameter.

In some fluid filling pipelines with flow switch valves, it is not recommended to install the sensor after the valve, as the pipe section after the valve may be empty, causing the sensor to miss some flow rate during the next batch of liquid filling. The flow sensor should be installed on the side where the fluid pump generates positive pressure, or in a position where the pipeline is always filled with liquid, to avoid air bubbles affecting the measurement.

4.6 Flow Sensor Cleaning

When cleaning the sensor, ensure that the cleaning agent does not leak into the connector.

It is recommended to use a mild chemical cleaner and cotton swabs to wipe away dirt from the clamping area.



Attention

Precautions:

- The flow sensor must not be immersed in cleaning or disinfecting solutions.
- The flow sensor is not suitable for mechanical cleaning methods.
- The flow sensor must not be subjected to sterilization processes, especially steam sterilization or autoclaving.

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

Appendix: Update Log

Date	Modification Operation	Personnel	Version
2026/01/28	Initial Setup	HY.C	V1.0