# TUF Ultrasonic Flow Meter

One. Overview

   series ultrasonic flow meter is designed on the theory of low voltage and time difference of multi pulse. It can be used to measure transmission time of ultrasound in forward stream and reverse stream, using the methods of high accurate and super stable double-balanced signal differential transmission and differential receive digital detection technology. Then calculate the speed of flow by time difference. It has the trait with high stability, low zero drift and high precision of measurement, wide measuring range and Strong ability of anti-jamming.

When the ultrasonic wave transmits in the liquid, the flow of the liquid will slightly change the transmitting time of ultrasound wave. The change of the transmitting time is proportional to the speed of the liquid. When the speed of the liquid is zero, the time of receiving sound wave of the two sensors is the same (the only way to measure zero speed). When the liquid flows, the transmitting time of sound wave in the forward stream is longer than that in the reverse stream. The equation is as follows:
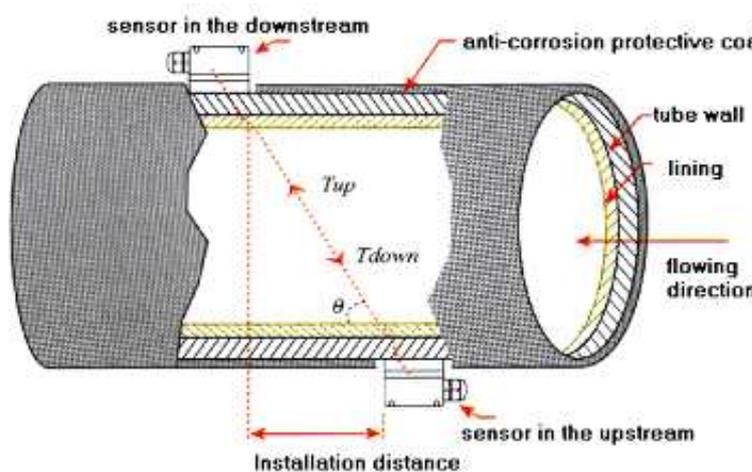
$$V = \frac{MD}{sin\,2\theta} \times \frac{\Delta T}{Tup \times Tdown}$$

V: speed of the flow

θ : the angle between Sound velocity and the direction of liquid flow

M : the straight transmitting times of sound beam in the liquid

D : inner diameter of the pipe

Tup : transmitting time of the sound beam in   positive direction

Tdowm : transmitting time of the sound beam in   reverse direction

$\triangle$T : Tup-Tdowm

Portable type Ultrasonic Flow Meter TUF-2000P

■ 고정밀도 Linearity≥0.5% Repeatable accuracy≥ 0.2% Measuring accuracy≥±1%, ■ Intact measuring Put the sensor of magnetic ultrasonic flow meter on the pipe wall, then it can finish the measurement of flow ■ large measuring range measure the flow from DN15 to DN6000mm with different sensors ■ support English menu Different types of flow meter can support English menu conveniently. ■ Rechargeable power source Built-in Ni-MH rechargeable battery with large capacity which can support flow meter to work lastly over 20 hours. ■ Built-in printer Besides printing the content on the screen in time, it can also print over 20 measuring results set ahead of time ■ built-in data recording machine upload over 20 results set ahead of time to computer or internet	 1. outside clip sensor with magnetism 2. menu in English 3. built-in printer 4. high strength aluminum protective box

Standard type	Model	Amount		Description
host	TUF-2000P	one		Volume: 225×180×67mm, working temperature: -20-60℃, measuring accuracy: ±1%
Middle sensor	TM-1	two		With magnetism, Volume: 64×35×32mm working temperature: -40-110℃ measuring range: DN50-DN1000mm
Special cable for ultrasound		two		Length: 5m, Used to connect sensor and host of ultrasonic flow meter
Power cable		one		Length:3m, used for recharging the host of ultrasonic flow meter or ACuse, measuring long time

| Thermal induction printing paper		Two volume		Length is 30m
Special coupling paste for ultrasound		one		Weight: 110g, Used for ultrasonic sensor and ultrasound transmission between pipe walls
tensioner		two		Length: 3m , Maximum pull force: 100Kg Used for Non-magnetic pipe bundled sensor
Rolling tape		one		Length: 3m Used to measure the circumference of pipe or the installation distance between two probes
Aluminum Alloy protective box		one		Volume: 415×315×100mm Suitable for use in the open air and harsh environment under petroleum drilling

Matched sensors	Model		Description	Measuring range	Temperature range
Small sensor	TS-1		With magnetism	DN15-DN100MM	-40-110℃
Middle sensor	TM-1		With magnetism	DN50-DN1000MM	-40-110℃
Large sensor	TL-1		With magnetism	DN300-DN6000MM	-40-110℃
High temperature small sensor	HTS-1			DN15-DN100MM	-40-160℃
High temperature middle sensor	HTM-1			DN50-DN1000MM	-40-160℃
Ultrasonic thickness measuring meter	TT100		Accurately measure the thickness of the pipe wall, improving the accuracy of the flow detection	1.2-225.0mm	±1%H±0.1mmH, it is the thickness of measured thing
Lengthened signal cable			Length is 10m×2	Suitable to the site where measured pipe is far from host.	

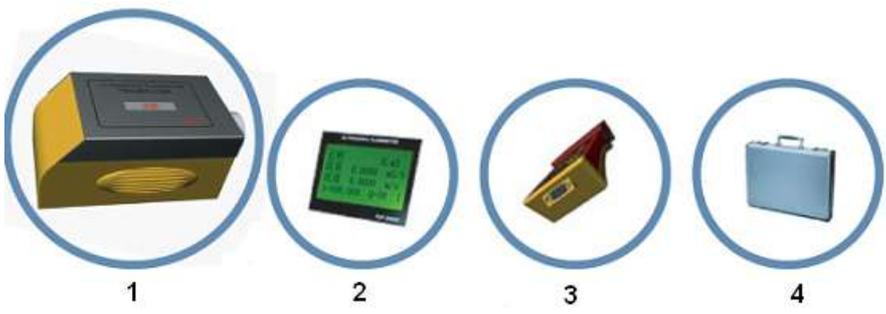|					
Lengthened tensioner			Length is 6m×2	It is suitable to fix sensor on the pipe which diameter is over 1000mm.	
Thermal induction printing paper			Length is 30m		

Basic Parameters

project	Functional parameters
Host	2×20 dot-matrix backlight type LCD. working temperature:-20-60℃ The output of the printer is 24 rows characters micro heat-variable printer 4×4+2 type touched keyboard, Data interface: RS-232
Sensor	1. standard TS-1 type, suitable pipe: DN15-100mm, flow temperature≤110 2. standard TM-1 type,suitable pipe:DN50-10000mm,flow temperature≤110℃ 3. standard TL-1 type, suitable pipe: DN300-6000mm,flowtemperature≤110℃
Medium measured	Water, sea water, industry polluted water, acid and alkali liquid, various kinds of oil, which can conduct ultrasound
Velocity range	0-±30m/s
Measuring accuracy	Better than±1%
Power supply	Ni-MH battery working lasting over 20 hours or AC 220V
power	2W
Recharge	Intelligent recharging type, directly connected with AC220V, stop and light green after recharged well.
Weight	Net weight 2.0(host)
Remarks	Matched with high-strength protective box, can work in the open air or harsh environment

The coding rules of Portable Type Ultrasonic Flow Meter

TUF-2000P
— 1.Standard TS-1 type
— 2.Standard TM-1 type
— 3.Standard TL-1 type
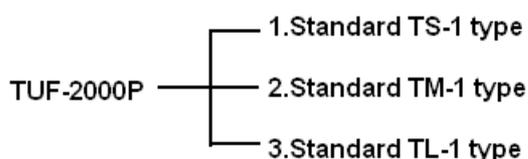
Example: TUF-2000P1
Explanation: Portable Ultrasonic Flow Meter, standard configuration, choose standard small sensor TS-1 type.

Hand-held ultrasonic flow meter TUF-2000H

■ high accuracy measuring
Accuracy: ±1%,
Linearity:0.5%
Repeatable accuracy: 0.2%

■ small volume and weight
Volume: 210×90×30mm
Weight: 0.5Kg

■ Intact measuring
Put the sensor of magnetic ultrasonic flow meter on the pipe wall, then it can finish the measurement of flow

■ large measuring range
measure the flow from DN15 to DN6000 mm with different sensors

■rechargeable
power supply
Built in Ni-MH rechargeable battery with large capacity can make flow meter work over 12 hours

■big LCD screen
It can display cumulative flow, instantaneous flow, flow velocity, working states in the same time

■ built-in data recording machine
Room is 24 KB, it can store 2000 lines of data

1. outside clip sensor with magnetism
2. display in big LCD screen
3. standard data interface
4. high strength aluminum protective box

Standard model	Model		Amount	Description
host	TUF-2000H		one	Volume: 210×90×30mm, working temperature: -20-60℃, measuring accuracy: ±1%
Middle sensor	TM-1		two	With magnetism, Volume: 64×35×32mm working temperature: -40-110℃

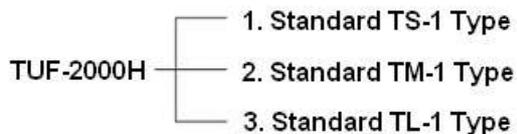|				measuring range: DN50-DN1000mm
Special cable for ultrasound			two	Length: 5m Used to connect sensor and host of ultrasonic flow meter
Data cable			one	Length: 1m Used to export the data stored in data record machine to computer
Power supply adapter			one	Length: 1m Used to recharge hand held flow meter
Special coupling paste for ultrasound			one	Weight: 110g Used for ultrasonic sensor and ultrasound transmission between pipe walls
tensioner			two	Length: 3m Maximum pull force: 100Kg Used for Non-magnetic pipe bundled sensor
Rolling tape			one	Length: 3m Used to measure the circumference of pipe or the installation distance between two probes
Manual book			one	
Aluminum Alloy protective box			one	Volume: 415×315×100mm

Matched sensors	Model	Picture	Description	Measuring range	Temperature range
Small sensor	TS-1		With magnetism	DN15-DN100MM	-40-110℃
Middle sensor	TM-1		With magnetism	DN50-DN1000MM	-40-110℃
Large sensor	TL-1		With magnetism	DN300-DN6000MM	-40-110℃
High temperature small sensor	HTS-1			DN15-DN100MM	-40-160℃
High temperature middle sensor	HTM-1			DN50-DN1000MM	-40-160℃
Ultrasonic thickness measuring meter	TT100		Accurately measure the thickness of the pipe wall, improving the accuracy of the flow detection	1.2-225.0mm	±1%H±0.1mmH, it is the thickness of measured thing
Lengthened signal cable			Length is 10m×2	Suitable to the site where measured pipe is far from host.	
Lengthened tensioner			Length is 6m×2	It is suitable to fix sensor on the pipe which diameter is over 1000mm.	

Basic Parameters

Project	Functional parameters
Linearity	0.5%
Repeatability	0.2%
Accuracy	±1% of the displayed value, flow velocity is bigger than 0.2m/s
Response time	Users can choose it between 0 to 999 seconds
Flow velocity range	±32m/s
Measuring diameter	15-6000mm
Measuring unit	Meter, inch, cubic meter, liter, cubic inch, American gallon, English gallon, oil drum, American liquid drum, English liquid drum, America million gallon, all these units are set by users.
Cumulative meter	7 digit positive and negative net cumulative meter
The kinds of liquid	Various types of medium in single and homogenous medium, which can conduct ultrasound.

Safety	Customers can lock the parameters. Unlock the parameters when they want to set them.
Display	4×16inEnglish.
Communication interface	RS-232, Baud rate 75-57600. It is compatible with Fujitsu ultrasonic flow meter or other related products according to the need from customers.
Sensors	Standard M1 type and other four optional types.
Sensor cable	The standard is 5m×2 and it can be lengthened to 10m×2.
Power supply	Three AAA built-in Ni-H battery, it can work successively for 12 hours after recharged every time, AC100-240V adapter.
Data recording	Built-in data recording machine can record data to 2000 lines.
Manual cumulative meter	7-digit, it can calibrate after the button is pressed.
Material of outer shell	flame retardant ABS
Size of outer shell	200×90×30mm
Weight of the host	500g(1.2Ibs) including battery

The coding rules of Hand-held Type Ultrasonic Flow Meter

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                  ┌─── 1. Standard TS-1 Type      Example: TUF-2000H1
TUF-2000H ────────┼─── 2. Standard TM-1 Type      Explanation: Hand-held Type Ultrasonic Flow
                  └─── 3. Standard TL-1 Type                   Meter,standard configuration, choose
                                                               standard small sensor TS-1 type.
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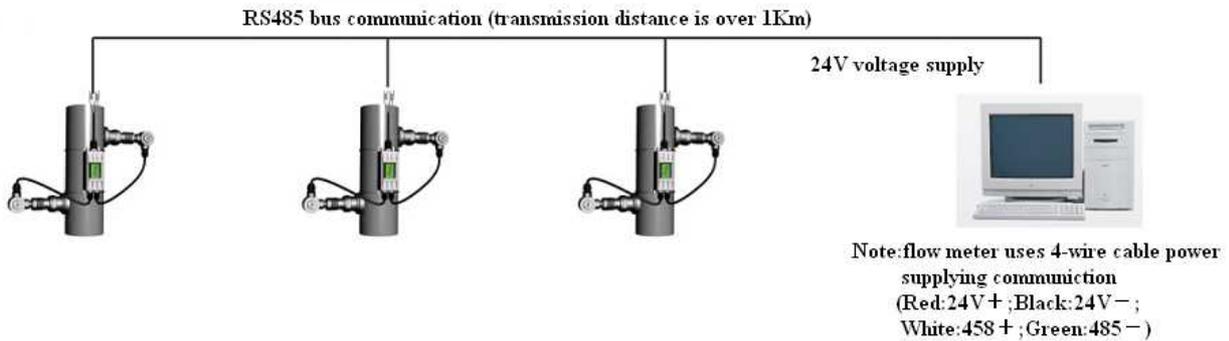
Fixed type Ultrasonic Flow Meter TUF-2000B   TUF-2000F

■ High accuracy measuring Linearity is better than 0.5%, repeatability is better than 0.2%, measuring accuracy is better ±1%	Basic type TUF-2000B · small volume with 120×40×25mm ·lowest price, can only manage flow measuring ·protective level IP68, with whole plastic water proof ·realizing local measurement, secondary remote transmission and parameter setting; network measuring
■ Large measuring range It can measure the pipes from DN15 to DN6000mm with sensors matched in different models	
■ High protective level The protective level of the first meter can reach IP68. it can work at 2 meters beneath water level	
■ Convenient operation Besides browsing the parameters on first meter with the help of magnetic bar, it can reset parameters or display	Functional type TUF-2000F
■ Multi-display The first meter has both the function of signal detecting and flow measuring. It can display the cumulative flow in circulation, flow velocity. Secondary meter can display more than 100 menus.	
■ Remote transmission and convenient network formation It uses RS-485 bus communication with ordinary cable. Transmitting distance can be reached over 1 kilometer and it can format the net conveniently in a short time. This kind of transmitting type has a strong ability in anti-noise. All the traits solve the problem from split ultrasonic flow meter which is high cost of special cable, bad quality in anti-noise and short transmitting distance, etc.	Besides the function of basic type, it has the additional function as follows: ·protective level IP68, it can work at 2 meters beneath water level ·3-channel 4-20mA analog input ·2-channel and 3-wire PT-100 resister signal input ·isolation RS232/RS485 output, 2-channel isolation OCT output ·1 channel isolation 4-20mA output(no power)

Composition Picture of Fixed Ultrasonic flow meter

RS485 bus communication (remote transmission over 1Km) Voltage supply:24V	**Hanging type TUF-2000FB** ·for hanging installation on the wall ·size: 178×165×55mm
	Dial fixing type TUF-2000FS ·for fixing of instrument dial ·aperture size: 152mm×76mm
	Explosion proof type TUF-2000FD ·explosion proof level DⅡBT4, for explosion proof site ·size:285×265×90nn

Picture of network measuring

RS485 bus communication (transmission distance is over 1Km)

24V voltage supply

Note:flow meter uses 4-wire cable power supplying communiction
(Red:24V＋;Black:24V－;
White:458＋;Green:485－)

The sensors that can be matched with fixed type Ultrasonic Flow Meter TUF-2000B   TUF-2000F

traits	Basic type	Functional type
Outside clip type ·safety with no need to cut off the flow, no pressure lose ·accuracy ±1% ·it is convenient to fix and maintain it, customers can fix it by themselves ·lowest price, no relationship with the measuring diameter ·suitable to good working environment	TUF-2000BNB	TUF-2000FNB
Plug-in type ·safety with no need to cut off the		

flow, no pressure lose ·accuracy ±1% ·customers can fix it with special aperture opening device after trained ·higher price, no relationship with the measuring diameter ·the quality of received signal is excellent and it can run stable and reliable in a long time	TUF-2000BNC	TUF-2000FNC
Standard pipe section type ·cut off the flow and uninstall pipe when fix it. no pressure lose ·accuracy ±0.5% ·cut off the flow when fix and maintain it, customers can fix it by themselves ·the bigger the measuring diameter is, the higher the price is ·high accuracy, excellent received signal, it can run stable and reliable in a long time	TUF-2000BNG	TUF-2000FNG

Basic Parameters

Sensors can be matched		Basic model	Measuring range	Fluids temperature	Accuracy	Power	Input	Output	Communication protocol
Outside clip type	TS-1 (small)	TUF-2000BNB1	DN15-100mm	-30-90℃	±1%	The first instrument DC8-36V secondary instrument AC220V or	3-channel 4-20mA Analog input 2-channel and 3-wire PT100 resistance Signal input	separated RS232/ RS485 input OCT 4-20 mA	METER-bus Protocol MODBUS Protocol Fujitsu Expand protocol Simple
	TM-1 (middle)	TUF-2000BNB2	DN50-1000mm						
	TL-1 (large)	TUF-2000BNB3	DN300-6000mm						
High temperature outside clip type	TH2-1 (small)	TUF-2000BNB4	DN15-100mm	-30-160℃					
	THM-1 (middle)	TUF-2000BNB5	DN300-1000mm						
Plug-in type	TC-1 (standard)	TUF-2000BNC1	DN80-6000mm	-40-160℃					

	TLC-2 (lengthen)	TUF-2000BNC2			DC24V			water meter protocol
Pipe section type	Standard pipe section	TUF-2000BNG	DN15-1000mm	-40-160℃				

Fixed Split Ultrasonic Flow Meter   TUF-2000S

■High accuracy measuring Linearity is better than 0.5%, repeatability is better than 0.2%, measuring accuracy is better ±1%.	**Composition picture** Host computer Special cable for ultrasound Ultrasonic sensor
■ Large measuring range It can measure the pipes from DN15 to DN6000mm with sensors matched in different models.	
■ Support English menu The flow meters in different models can be operated in English menu conveniently and rapidly.	
■ High reliability It measures accuracy with low voltage and multi-pulse transmitting circuit, which advances its life and reliability	**Host computers that can be matched**
■ Strong ability of anti-noise It uses double balance signal differential transmitting and receiving circuit, which can effectively resist the noise from inverter, TV tower and high-voltage wire, etc.	
■ Strong memory ability Automatic record the cumulative flow in the last 64 days, last 64 months and last 5 years. Automatic record the power supply time, power cut time and flow of the last 64 times. Automatic judge	**Hanging type** **TUF-2000SB** ·used fo rhanging installation ·size: 178×165×55mm	**Dial fixing type** **TUF-2000SS** ·for fixing of instrument dial ·aperture size: 152mm×76mm	**Explosion proof type** **TUF-2000SD** ·explosion proof level DⅡBT4, for explosion proof site ·size: 285×265×90mm

whether working state of the cumulative flow of the last 64 days is normal or not.			

sensors those can be matche		Basic models	Measuring range	Temperature of flow medium	accuracy	power	input	output	Communication protocol
Outside clip-on type	TS-1 (Small model)	TUF-2000BNB1	DN15-100mm	-30-90℃	±1%	First meter DC8-36V Secondary meter AC220V or DC24V	3-channel 4-20mA analog input 2-channel and 3-wire PT100 resister signal input	Isolation RS232/RS485 input 2-channel isolation OCT output 1-channel isolation 4-20mA output (no power source)	METER-BUS protocol MODUS protocol Fujitsu expand protocol Simple water meter protocol
	TM-1 (Middle model)	TUF-2000BNB2	DN50-1000mm						
	TL-1 (large type)	TUF-3000BNB3	DN300-6000mm						
High temperature and clip-on type	TH2-1 (small type)	TUF-2000BNB4	DN15-100mm	-30-160℃					
	THM-1 (middle type)	TUF-2000BNB5	DN300-1000mm						
Plug-in type	TC-1 (standard plug-in)	TUF-2000BNC1	DN80-6000mm	-40-160℃					
	TLC-2 (lengthened plug-in)	TUF-2000BNC2							
Pipe section type	Standard pipe section type	TUF-2000BNG	DN15-1000mm	-40-160℃					