TECHNOLOGY

HOLYKELL®

FLOWMETER

•DATASHEET•

1. Pressure Measurement 2. Level Measurement 3. Temperature Measurement
4. Flow Measurement 5. Display & Control Instruments

Gas Ultrasonic Flow Meter

Product Introduction

MGUF Gas ultrasonic flow meter is produced by advanced German technology. All its key components are imported from original equipment, featuring high reliability and long service life. It is a new type of precision measuring instrument with high precision and high reliability. It can be widely applied to gas flow measurement in urban gas, petroleum, chemical industry, electric power, metallurgy and other industries.

It adopts mono and multi-channel designs respectively, and the length of the pipe section of the mono ultrasonic flow meter can directly replace the current mainstream turbine flow meter in the market and has higher cost performance. Multi-channel ultrasonic flow meter adopts redundant design. Each channel can be measured separately. If one channel fails, other channels will continue to be measured reliably to improve the reliability of the system.

Product Features

Made with German Advanced Technology
Multiple options for mono and multi-channel measurements
Eddy Current and Asymmetric Flow Detection
Laminated shielding of electric and magnetic fields, high noise immunity
Zero drift automatic correction, accuracy is not affected by the environment

Measurement accuracy grade: 1.0
Ultra-wide range ratio 1:40
Ultra-low "zero" starting flow rate
The metering range can cover Roots meter and turbine meter.
Double backup lithium battery power supply
High precision temperature and pressure compensation, volume correction
Intelligent switch of various gas working conditions and standard temp. and pressure
Mass storage,saving data for one year
Intelligent fault detection, fault alarm
Maintenance-free, cleaning-free, long service life
The meter can be rotated 180 degrees to facilitate reading.

Working Principle

1. Basic Working Principle of Ultrasonic Flow Meter

Ultrasonic flow meter is based on the principle of measuring the relationship between the time of sound wave propagation in flowing medium and the flow rate. It is generally believed that the actual propagation speed of acoustic wave in fluid is determined by the propagation speed (C_f) of acoustic wave in the static state of the medium and the axial average velocity (V_m) of fluid
Component composition in the direction of sound wave propagation. As shown in fig. 1, the relationship between downstream and upstream propagation time and each quantity is:

$$t_{down} = t_{AB} = \frac{L}{(C_f + V_m \cos \emptyset)} \qquad t_{up} = t_{BA} = \frac{L}{(C_f - V_m \cos \emptyset)} \qquad (1)$$

In the formula:

t_{up} ———the time when the sound wave propagates countercurrently in the fluid;
t_{down} ———-the time when the sound wave propagates in the fluid along the current;
C_f ———the speed at which sound waves travel in fluids;
V_m———axial average velocity of fluid;
Ø ———channel angle;

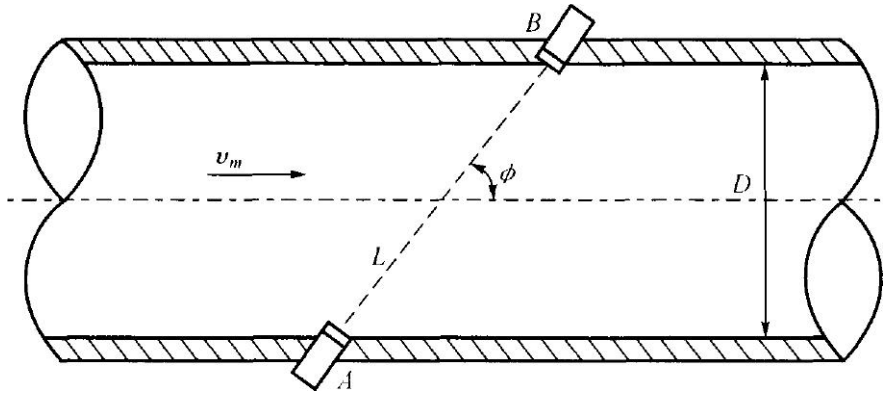

Fig. 1 general schematic diagram

Using equation (1), the expression of fluid flow rate can be obtained:

$$V_m = \frac{L}{2\cos\phi}\left(\frac{1}{t_{down}} - \frac{1}{t_{up}}\right) \qquad (2)$$

The measured fluid flow rates **Vi (i=1,2,....k)** of a plurality of channels; The estimated value of the average flow rate **V** of the pipeline can be obtained by combining the mathematical functional relations, and the volume flow rate $\mathbf{q_v}$ can be obtained by multiplying the estimated value by the flow area A, as shown in Equation (3):

$$q_v = A\ \bar{V} \quad (3)$$

$$\bar{V} = (\ _1, \cdots, \ ) \quad (4)$$

Type: k ———Number of channels

2. Accurate Time of Flight Measurement Based on Echo Response

The key technology of ultrasonic flow meter is to accurately measure the flight time of acoustic wave in fluid, and the flight time consists of inherent delay **ε** (uncertainty) of sensor and flight time $\mathbf{t_0}$ in fluid, as shown in fig. 2.

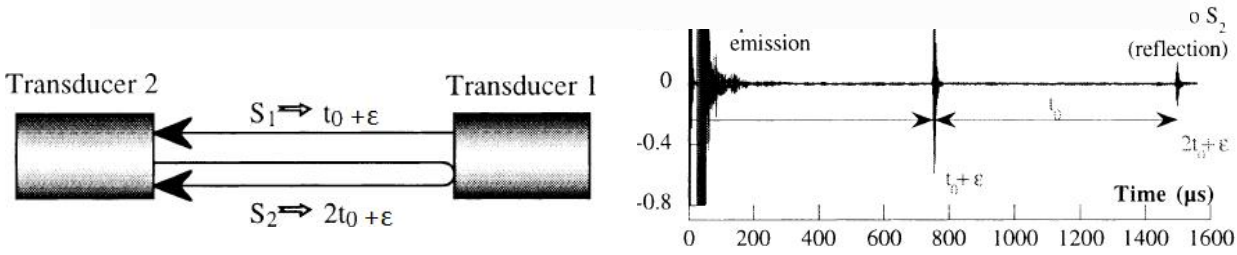

Fig. 2 schematic diagram based on echo response

That is , t1=t0 + ε t2=2 t0 + ε (5)

t0=t2 - t1 (6)

Therefore, the uncertain inherent delay **ε** of the sensor and the processing circuit is eliminated, and the flight time $\mathbf{t_0}$ of the acoustic wave in the fluid is accurately measured.

3. Multiplex Multi-channel Ultrasonic Flow Meter

The ultrasonic flow meter designed by multiplexing multi-channel has the characteristics of high noise resistance, capability of detecting eddy current and asymmetric flow, elimination of uncertain inherent delay of sensors and processing circuits, accurate measurement, etc. At the same time, the multiplexed channel can be used as redundant backup. Even if the individual sensors are damaged, the MGUF ultrasonic flow meter can still work normally, greatly improving the reliability of detection.

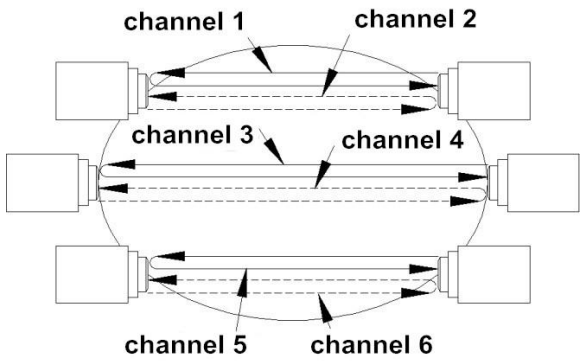

Fig. 3 schematic diagram of multiplex multi-channel

4. Working Principle of Volume Correction

Volume correction multi-channel signals sent by temperature, pressure and flow sensors are substituted into formula operation by microprocessor according to gaseous equation to realize real-time display and signal remote transmission.

Gaseous equation: $$V_0 = V * \frac{(P_a + P_g)T_0}{P_0 T} * \frac{Z_n}{Z_g} = V * \frac{P}{P_0} * \frac{T_0}{T} * F_z^2 \quad (7)$$

Where, V_0 ——volume in standard state (m3)

V ——volume under working condition (m3)

$P=P_a+P_g$ ——absolute pressure (kPa) at pressure detection point of flow meter

P_a ——local atmospheric pressure (kPa)

P_g—— gauge pressure (kPa) at pressure detection point of flow meter

P_0 ——standard atmospheric pressure (101.325kPa)
T_0 —— absolute temperature in standard state (293.15K)
T ——absolute temperature (293.15+t)K of measured medium
t ——temperature of medium to be measured (℃)

$F_z=\sqrt{\frac{Zn}{Zg}}$ ——Gas compressibility factor

Z_n ——Gas Compression Coefficient in Standard State
Z_g ——Gas Compression Coefficient in Working State

Technical Performance Specification

1.Measurement Accuracy Grade

The accuracy level of measurement within the range is 1.0
0.1Qmax~ Qmax maximum permissible error: ±1.0%, repeatability: ±0.2%

2. Electrical Performance Indicators

2.1 Working power supply

- Internal power supply: 3.6V lithium battery (model ER34615), which displays the battery capacity in real time.
- External power supply: 5~24VDC, ripple ≤ 50mV, the system automatically switches external power supply, and the external power supply adopts DC-DC management mode. (Safety barrier shall be installed when using intrinsic safety function)

2.2 Overall power consumption

- Internal power supply: average power consumption ≤1.5mW, two lithium batteries can be used continuously for more than 6 years.
- external power supply: average power consumption ≤1W

2.3 Input Signal

- Flow signal: 200 KHz±10%, Vpp≥ 10mV
- Temperature signal: analog signal output by temperature sensor
- Pressure signal: analog signal output by pressure sensor

2.4 Output Signal

- Working condition pulse signal output (3-wire system) FOUT: pulse signal output high level ≥(V external-2V), low level ≤0.5V, drive current ≥20mA, transmission distance ≤ 50m, powered by external power supply.
- Ic card pulse signal output (two-wire system) IC _ out: CMOS level, output in pulse

signal string mode, normally low level. The pulse output format can be selected, and the volume flow represented by one pulse is set by the output pulse equivalent, namely 0.1m3、1m3、10m3； The level width is set by the output pulse width, which is 5ms, 50ms and 1000ms respectively, and is used together with the IC card controller. Transmission distance ≤ 5m, powered by internal power supply.

- Alarm signal output: the output mode is CMOS level output, which is low level in normal time and high level in alarm time.

1) battery undervoltage alarm output: when the battery voltage is lower than 3.2V, BAT_AL2 port outputs an alarm signal; When the battery voltage is lower than 3.1V, BAT_AL1 port outputs an alarm signal.

2) Over-flow Range Alarm Output HL: When the flow range exceeds the upper limit, HL outputs an alarm signal.

- 4~20mA standard analog signal output: 4 ~ 20mA analog signal corresponds to standard volume flow, range is set by upper and lower limits of standard temperature and pressure flow, lower limit corresponds to 4mA, and upper limit corresponds to 20mA. Transmission distance ≤ 200m, connection mode is two-wire system or three-wire system, and power supply voltage is 24VDC.
- Signal output of RS-485 interface: MODBUS protocol RTU mode, half duplex mode, baud rate 1200~9600 optional, see MODBUS communication protocol description for details. RS-485 communication can realize the following functions:

1) Directly connect with the upper computer, which can remotely transmit the temperature, pressure, standard volume flow and total volume of the measured medium, total volume of working conditions, relevant parameters of the instrument, fault codes, operation status and real-time data, etc.

2) It can be used together with a special signal acquisition instrument and can form a remote data acquisition and monitoring system through GPRS/CDMA, Internet and telephone network. Data transmission is carried out through the network, the historical data and fault status of any flowmeter in the network are read, and relevant parameters of various flowmeters can be remotely set.

3) SCADA system and DCS system can be formed together with PLC and RTU.

- Real-time database: flowmeter has real-time data storage function, including:

1) the latest 2500 times of flow start-stop time and the corresponding standard cumulative flow value;

2) Cumulative flow value at a certain moment in the latest 100 months;

3) For the latest 5000 times of state data (including: time, temperature, pressure, instantaneous flow rate, working condition cumulative flow rate, standard cumulative flow rate, etc.), the recording time interval can be set, ranging from (1 min to 9999 min).

See the following table for the model specifications and basic parameters of flow meter:

MGUF Ultrasonic Flow Meter (Wide Range) Table 1

Diameter（mm）	Item	Initial flow(m3/h)	Flow range(m3/h)	Accuracy（m3/h）
25	MGUF-25	0.02	1~40	1%
32	MGUF-32	0.03	5-50	
40	MGUF-40	0.05	6~100	
50	MGUF-50	0.07	4~160	
80	MGUF-80	0.10	8-400	
100	MGUF-100	0.20	16~700	
150	MGUF-150	0.40	20~1400	
200	MGUF-200	0.50	36~2000	
250	MGUF-250	1	100-4000	
300	MGUF-300	1	100-6000	

3. Typical Characteristic Curve

Typical characteristic curve of flow meter is shown in fig. 4, y coordinate represents the basic error of the meter, and x coordinate represents the percentage of maximum flow.

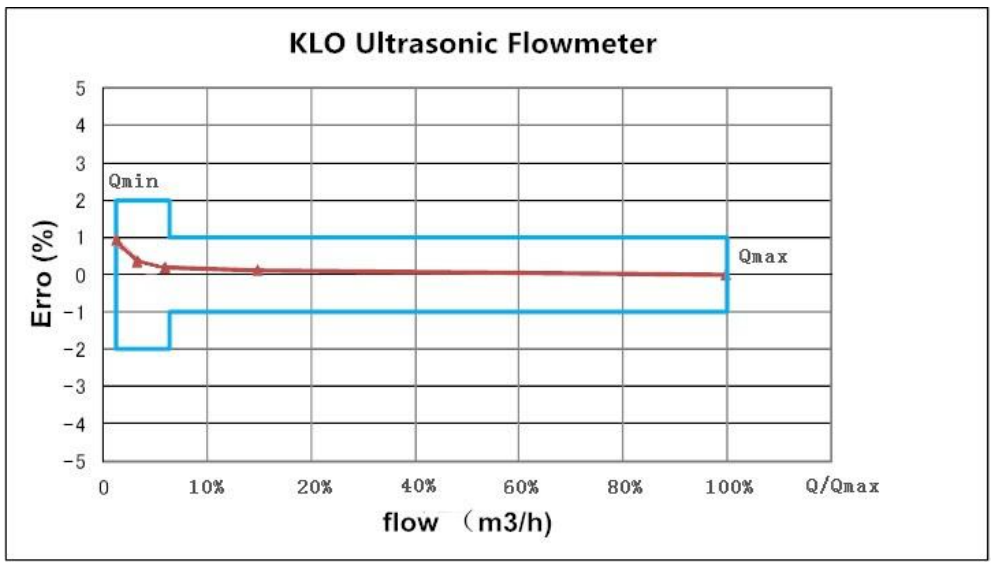

Fig. 4 typical characteristic curve

Overall Dimensions

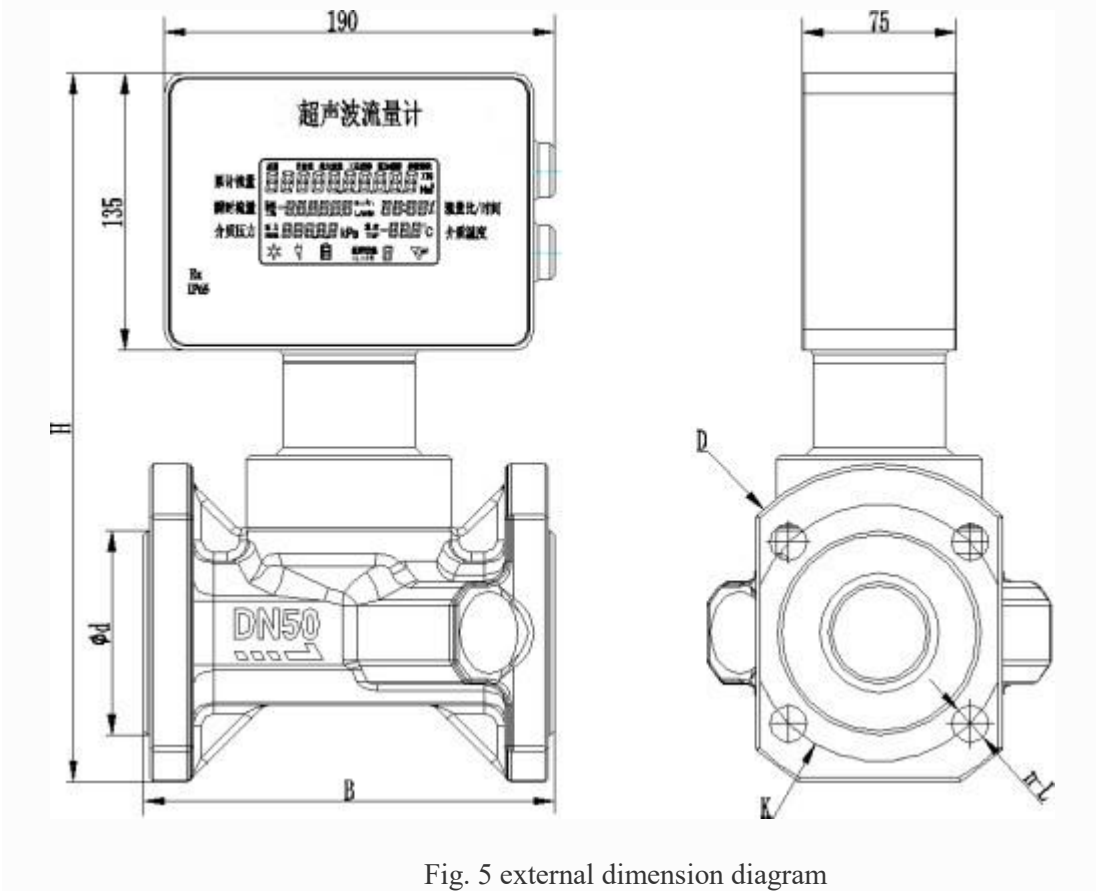

Fig. 5 external dimension diagram

Overall dimensions **Table 2**

Item	Diameter DN(mm)	B	1.6MPa				
			H	D	d	K	n-L
MGUF-25	25（1”）	200	325	115	65	85	4-⌀
MGUF-40	40（1 ”）	200	345	150	84	110	4-⌀
MGUF-50	50（2”）	200	365	165	99	125	4-⌀
MGUF-80	80（3”）	240	415	200	132	160	8-⌀
MGUF-100	100（4”）	300	435	220	156	180	8-⌀
MGUF-150	150（6”）	450	500	285	211	240	8-⌀
MGUF-200	200（8”）	600	540	340	266	295	12-⌀
MGUF-250	250(10”)	600	565	405	320	355	12-⌀ 6
MGUF-300	300(12”)	600	590	460	375	410	12-⌀ 6

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