CONTENTS

RK-100 Thermal Mass Flow meter

1. Brief Introduction to its Applications

The advanced technique of FTD Automation Instruments has been introduced to produce this flow meter measuring gas mass flow. Traditional flow meters need to adopt temperature and pressure compensation for measurement of fluid mass flow, whereas this flow meter can directly measure fluid mass flow without requiring temperature and pressure compensation. Its conspicuous features are as follows: direct trade settlement, no movable components, small pressure loss, wide range ratio, high accuracy, high reliability, simple installation and convenient operation. It is extensively used in the industries such as petroleum, chemical industry, medical industry, heat power plant and environmental protection etc.

2. Typical Applications

Flow measurement of gas in industrial pipelines
Flow measurement of air during gas combustion
Flow measurement of flue gas out of chimneys
Flow measurement of waterfall gas during water treatment
Flow measurement of gas and compressed air during production of cement, cigarette and glass
Flow measurement of natural gas, coal gas, liquefied gas, flare gas and hydrogen gas etc.
Flow measurement of trapped gas in steelworks

3. Operating Principle

The thermal gas mass flow meter employs thermal diffusion principle. The thermal diffusion technique is that of excellent performance and high reliability under severe conditions. The typical sensing elements include two thermal resistances (platina RTD); one is a velocity sensor and the other is a temperature sensor for automatic compensation for gas temperature variation. When the two RTDs are placed in medium, the velocity sensor is heated to a constant difference in temperature above ambient temperature, and the temperature sensor is used to respond to the medium temperature. If gas velocity increases, the heat quantity transmitted to the medium from the sensor will increase, so there is a need for more supply of power, whereas the power for electronic elements to heat RTD is corresponding with mass flow to a certain extent.

4. Data

Accuracy	±1% reading; ±0.5% full range
Repeatability	±0.5% of full range
Turn down ratio	Normal 100:1; it is decided by calibrated flow range
Upper Limit of Range	80 Nm/s (air,20℃,101.33kPa)
Lower Limit of Range	0.05Nm/s (air,20℃,101.33kPa)
Size	Ø6~ Ø6000
Pressure Range	Negative Pressure, 0~1.0MPa,0~1.6MPa,0~2.0MPa,0~3.0MPa
Medium Temperature	-20~60℃， 60~100℃， 100~150℃， 150~200℃， 200~300℃
Medium	All kinds pure gas or mixed gas with fixed percentage, gas with dust, sand or moisture, corrosive gas
Sensor Diameter	Ø3(standard), Ø4
Sensor Material	316SST,hastelloy,titanium
Probe Stem Diameter	Ø19(standard), Ø16, Ø12
Probe Stem Material	316SST,hastelloy,
Power supply	24VDC/400mA or 220VAC/2W
Output	4-20mA DC, max load 1000Ω;RS485
Display	LED; four digits instantaneous flow , eight digits totalized flow
Correction	16 non-linearity correction
Type	Remote type: transmitter + flow totalizer Integral type: transmitter with integral totalzier
Connection type	In-line type and plug-in type
Alarm	1-2 relay output,3A/220VAC,3A/30VAC,settable
Protection level	IP65
Explosive proof	Ia IICT65,ExdII CT4
Lifetime	5 years

5. Dimension

RK100 Thermal mass flow meter dimension shown as following:

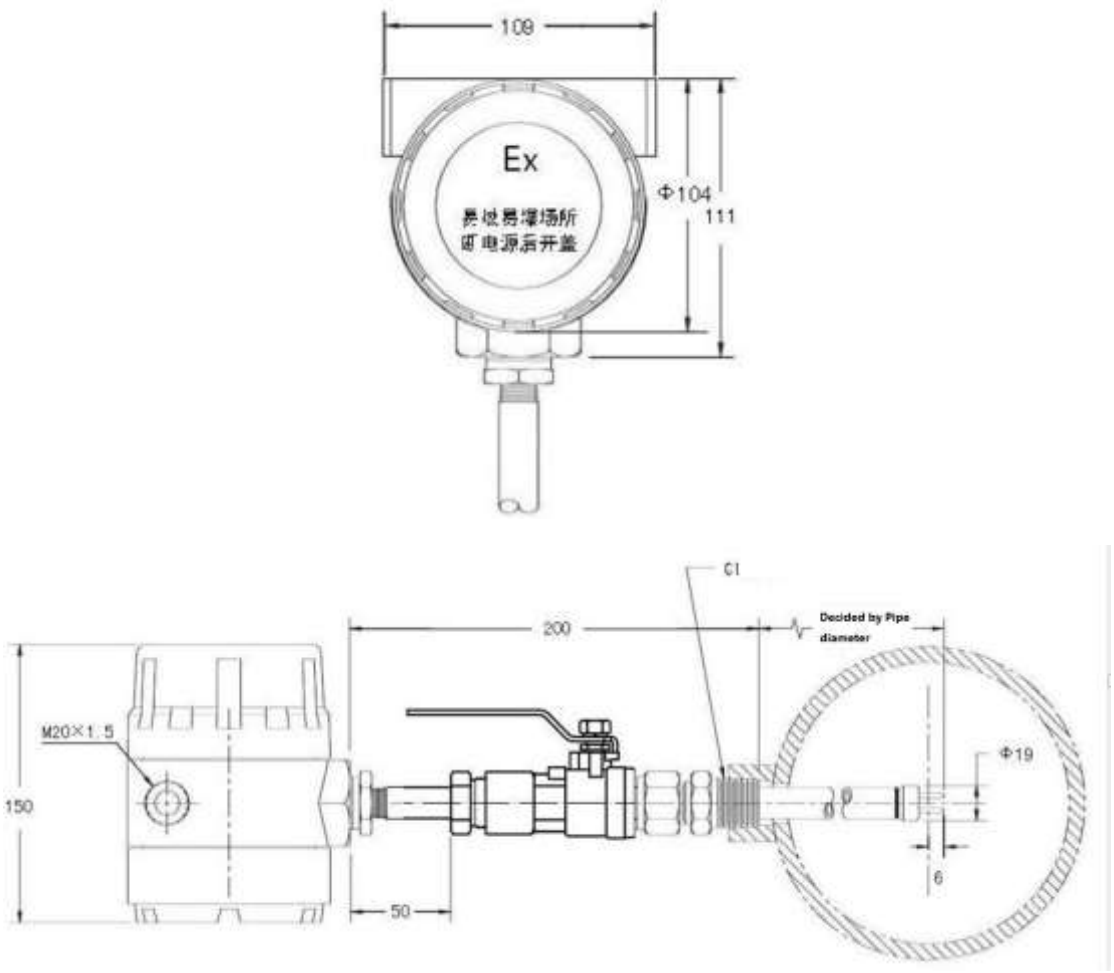

Figure 1: Dimension of Thermal Mass Flow meter

6. Model Selection Guideline

6.1 Flow range and Flow meter size selection

1. Table Reference
Table1: Air mass flow range selection table
Table2: Four kinds common gas calibrated range selection table
Table3: Common gas upper limit
All flow meters are calibrated before leaving factory, the upper limit of flow range will be indicated on the name plate of flow meter.

2. Lower and upper limit of the flow range
1) Lower limit: the thermal mass flow meter is sensitive to low flow, it can detect 0.05 m/s flow rate, so in normal condition, lower limit can be ignored.
2) Upper limit: It is normally decided by process design; the flow meter upper limit is more than 20% of design limit.

3) Mixed gas measurement: For mixed gas, the ender user should provide standard density and mole ratio (different gas percentage of the mix gas). The measuring range is decided by our factory. It is normally calibrated by air or nitrogen, and then corrected by meter conversion coefficient.

3. Statement

The flow range is limited by equipment, please get confirmation from factory before purchasing.

Table 1: Air mass flow range selection table

DN (mm)	Min (kg/h)	Normal (kg/h)	Max (kg/h)
25	0-1.14	0-78	0-204
40	0-2.92	0-194	0-525
50	0-4.57	0-310	0-822
80	0-11.7	0-775	0-2106
100	0-18.3	0-1292	0-3291
150	0-41.1	0-2584	0-7404
200	0-73.1	0-5168	0-13613
250	0-114	0-7752	0-20564
300	0-165	0-11162	0-29613
400	0-292	0-19845	0-52645
500	0-457	0-31008	0-82257
600	0-658	0-44652	0-118450
700	0-896	0-60775	0-161224
800	0-1170	0-79380	0-210578
900	0-1481	0-100465	0-266513
1000	0-1828	0-124032	0-329028
1200	0-2632	0-178606	0-473801
1500	0-4113	0-279072	0-740314
2000	0-7312	0-496128	0-1316113

Table2：Four kinds common gas calibrated range selection table

DN(mm)	Air	(N2)	(O2)	(H2)
25	60	60	60	28
40	150	150	150	70
50	240	240	240	112
80	600	600	600	282
100	1000	1000	1000	470
150	2000	2000	2000	940
200	4000	4000	4000	1880
250	6000	6000	6000	2820
300	8640	8640	8640	4060
400	15360	15360	15360	7219
500	24000	24000	24000	11280

600	34560	34560	34560	16243
700	47040	47040	47040	22108
800	61440	61440	61440	28876
900	77760	77760	77760	77807
1000	96000	96000	96000	45120
1200	138240	138240	138240	64972
1500	216000	216000	216000	101520
2000	384000	384000	384000	180480

Note: The flow unit in above table is Nm3/h, corresponding flow rate is 34m/s,when in application, it can expand to 50m/s

Table3: Common gas upper limit (Nm3/h)

DN (mm)	Argon (Ar)	Helium (He)	Natural Gas	Methane Gas	LPG	City Gas	Chlorine Gas
25	82	37	58	51	84	44	109
40	207	94	147	129	211	111	273
50	331	151	235	206	339	177	436
80	828	378	588	516	847	444	1092
100	1380	630	980	860	1143	740	1820
150	2760	1260	1960	1720	2826	1480	3640
200	5520	2520	3920	3440	5652	2960	7280
250	8280	3780	5880	5160	8478	4440	10920
300	11923	5443	8467	7430	12208	6393	15724
400	21196	9676	15052	13209	21703	11366	27955
500	33120	15120	23520	20640	33912	17760	43680
600	47692	21772	33868	29721	48833	25574	62899
700	64915	29635	46099	40454	66467	34809	85612
800	84787	38707	60211	52838	86814	45465	111820
900	107308	48988	76204	66873	109874	57542	141523
1000	132480	60480	94080	82560	135648	71040	174720
1200	190771	87091	135475	118886	195333	102297	251596
1500	298080	136080	211680	185760	305208	159840	393120
2000	529920	241920	376320	330240	542592	284160	698880

Standard state: temperature 0 ℃, Pressure 1.01325×105Pa (absolute pressure)

Flow unit option: kg/h,t/h,Nm3/h,Nkm3/h.

6.2 Installation types

1. Recommendation:

When the pipeline ≤Ø100, in-line type is recommended.

When the pipeline ＞Ø100,plug-in type is recommended.

2. If the field pipes have been installed,, no installation flanges available, plug-in type can be selected. Please specify when ordering.

6.3 Types

1. Compact type:
The sensor, transmitter, display are integral, Power supply can be 220VAC or 24VDC. The display unit can display instantaneous flow and totalized flow, set alarm point and output 4-20mA.

Figure2: Compact Type

2.Remote type
The sensor, transmitter, and display are not integral. The display unit can display instantaneous flow and totalized flow, set alarm point and output 4-20mA. The two parts are connected by three wires, so the transmitters are 3 wire type.

Figure3: Remote Type

6.4 Output Type

1. Linear output:The analog output from compact type is standard 4-20mA linear output;
While the analogy output from remote type transmitter is with poor linearity, the output from display unit of remote type mass flow meter is standard linear 4-20mA signal.

2. The display unit output 4-20mA, the flow range can be set manually. For example, the flow meter measuring range is 0~5000 Nm3/h, it output 4-20mA, the display unit can set 0-3000Nm3/,100~1500 Nm3/h… then output corresponding 4-20mA signal.

4. Cut off small flow. For some customers, cut-off small flow is required.

5. Output filter: when the gas is flowing in the pipeline, there are vibrations for some reason, the output figures on the display are fluttering, filter factor can be increased to decrease the fluttering.

6. Communication port: RS485 or alarm output

Customer needs to specify when ordering.

6.5 Measuring Unit and Flow Unit Conversion Table

1. Normal used mss flow unit: kg/h;
   Standard volume unit: Nm3/h

2. When the flow range is large, please select t/h or Nm3/h
   When the flow range is small, options are following:

Standard milliliter per minute: ml/min, symbol: SCCM

Standard liter per minute: L/min, symbol: SLM

Standard cubic meter per minute: Sm3/min

In industry, following units can be adapted.

			Symbol	Implication
Flow	Metric system	Volume	SCCM	Standard milliliter/ minute
			SLM	Standard liter /minute
			SL/min NL	Standard liter /minute
			SM3/min NCM	Standard cubic meter /minute
		Mass	kg/time	Kilogram/unit time
			TNS/time	Ton/time
	British System		SCF/time	Standard cubic foot/ time
			LB/time	Pound/ time
Flow rate			NM/time	Standard meter/ time
			SF/time	Standard feet/time
Conversion			1SCFM=28.316SL/min 1 Standard cubic foot =0.0283SM3/min	
Length Unit Conversion			1inch=25.4mm 1cm=0.394inch 1ft=30.5cm 1m=3.28ft	
Symbol: LB—pound kg——Kilogram TNS——Ton				

Table 4: Flow Unit Conversation Table

7. Installation Structure

7.1. Installation position

It is suggested that the installation of instruments should be far from bends, obstacles, reducers and magnet valves etc so as to ensure stable flow field. Straight pipes are required, the upstream length should be more than 10D, and the downstream length should be more than 5D.
Following are recommendations for special case:

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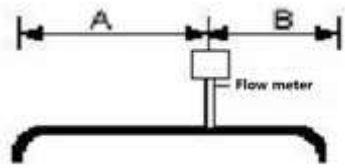
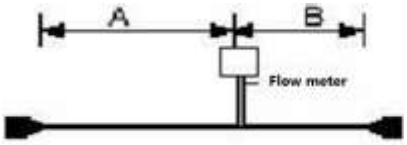
<td> 

1. one 90° bent or Tee pipe</td>
<td> 

4.Decrease the pipe line</td>
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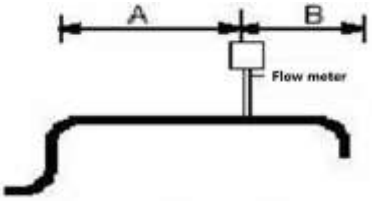
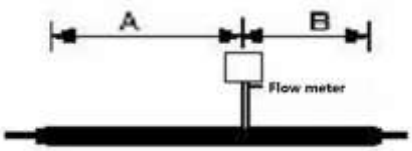
<td> 

2.Two 90° bents on the same plane</td>
<td> 

5.Expand the Pipeline</td>
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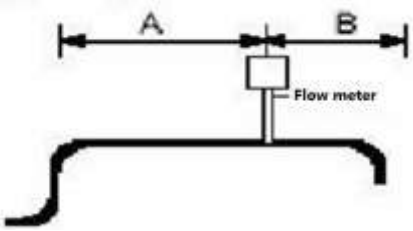
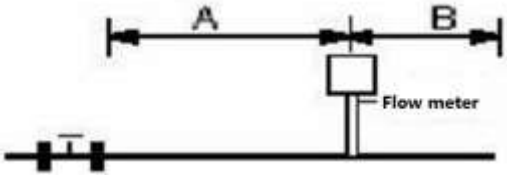
<td> 

3. Two 90° bents on the different plane</td>
<td> 

6.After the valve</td>
</tr>
</table>

Table 5: Mass Flow meter Installation Pictures

Example	A-Upper stream straight Pipe	B-Down Stream Straight Pipe
1	15D	5D
2	20D	5D
3	40D	10D
4	15D	5D
5	30D	10D
6	40D	5D

2. If the straight pipes in the field can not be satisfied, gas rectifiers can be used.

3. When there are short straight pipes, bents or valves existed in the pipelines, please refer to the factory for more advices.

7.2 Plug-in installation

1. Insertin depth

The gas is flowing in the pipe; the gas velocity is different in different points of the pipe. The gas flow rate near the pipe wall is slower than that in the center of the pipe. Thermal mass flow meter actually is gas velocity sensor; the flow is equal to the sectional area of the pipe multiply the flow rate.

$Q=SV$

$S_1= \pi R^2$

$S_2=ab$

S=section area of the pipe
R=Radius of the round pipe
a,b=side length of square pipe
V=gas flow velocity
Q=mass flow

Thermal mass flow meter is measuring one point gas velocity of the pipeline; this point should be the average velocity point when applying the above formula. The sensor should be inserted to the average velocity point when installation.

2. According to the design standard, RK100 thermal mass flow meter should install as following:
When there is long enough straight pipes or the pipe diameter is＞Ø250,the sensor should be in the ¼ of the pipeline.
When the straight pipe is short or the pipe diameter≤Ø250, the sensor should be in the ½ of the pipeline.

3. Plug-in and take out

1) Open a Ø20 hole on the pipeline, weld a nipple base, the nipple will be provided by the manufacture.
2) Ball valve will be provided by the manufacture to avoid gas leaking.

7.3 In-Line Installation

In-line installation is the same as plug-in Installation.
Flange Dimension H(T)44-76-91 PN=1Mpa

Diameter	OD	Bolt Circle Diam	Bolt Diam.	Bolt Specifi.	Bolts No.	Flange Distance	
DN	D	K	L	RK	Nos	Factory H	Customization
10	90	60	14	M12	4	160	
15	95	65	14	M12	4	160	
20	105	75	14	M12	4	160	

25	115	85	14	M12	4	160	
32	140	100	18	M12	4	200	
40	150	110	18	M16	4	200	
50	165	125	18	M16	4	200	
65	185	145	18	M16	4	200	
80	200	160	18	M16	8	200	
100	220	180	18	M16	8	250	

Table 6.Flange Dimension

7.4 Cable Installation

1. In most cases, twisted pair cable can be used to supply power.
2.Sheild cable can also be used, for example 3×33/0.2 or RVVP. Core wire should be over Ø0.5.
3. The cable should be lower than instruments when connecting the cable to instruments to avoid water flowing into the flow meter.
4. For Ex-flow meter, Ex-flexible pipes should be used; the OD of the cable should match the ID of cable glands. Sealing gasket should be provided by the factory.

8. Electrical Connection

8.1 Compact type mass flow meter wiring

1) The housing can not connect to the internal circuit, but wiring.
2) The power supply can be switching power supply.

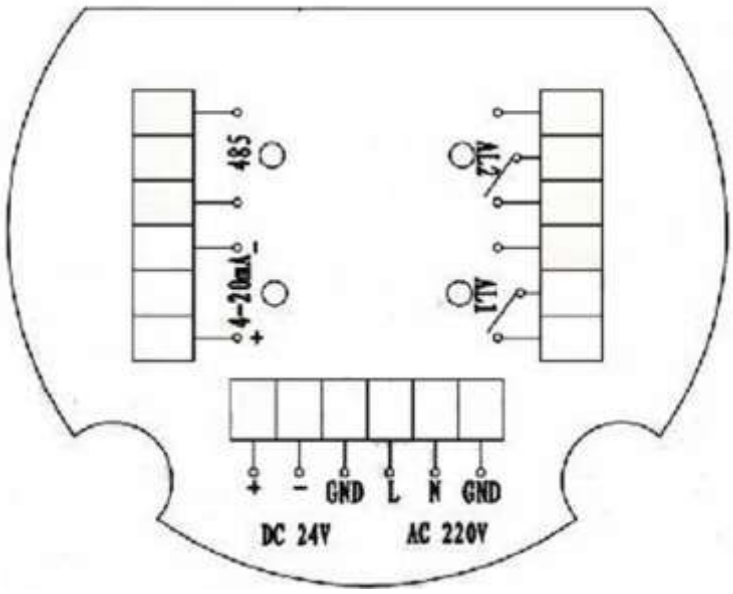


Figure 4: Compact Thermal Mass Flow meter Wiring

8.2 Remote Type Wiring

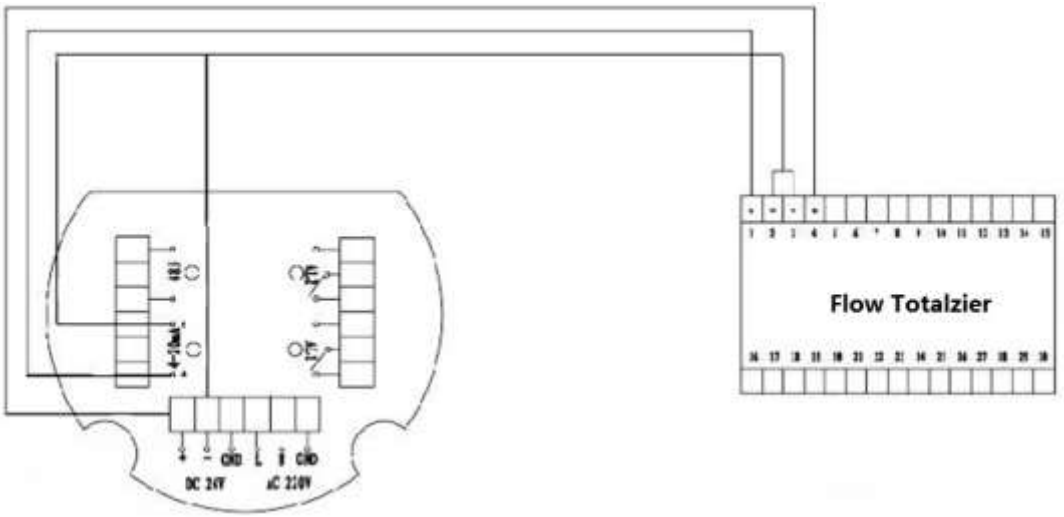


Figure 5: Remote Type Thermal Mass Flow meter Wiring

Red-Red	Power supply+
Black-Black	Power supply- & meter 4-20mA output negative(-)
White-White	meter 4-20mA output positive(+)

The remote type thermal mass flow meter is 3 wire system, two of them is for power supply , one for signal output.

9. Model Selection

RK100 Series Thermal Mass Flow meter

Item	**Code**	**Description**
Pipe size	DN	Ø6~ Ø6000
Structure	F	Remote Type
	I	Compact Type
	PI	Plug-in Type
	PL	In-line Type
Connection	C	Compression fitting
	T	Thread
	F	Flange
	W	Weld base
	B	Base + ball valve
Sensor Material	6	316
	F	PTFE coated
Explosive Proof	A0	NO
	A1	With Explosive Proof

Temperature	T0	-20~60 ℃
	T1	60-100℃
	T2	100-150℃
	T3	150-200℃
	T4	200-300℃
Pressure	P0	Negative Pressure
	P1	0-1.0Mpa
	P2	0-1.6Mpa
	P3	0-2.0Mpa
	P4	0-3.0Mpa
Power Supply	D	24VDC
	A	220VAC
	0	Other
Output	0	No output
	1	4-20mA
	2	RS485
Display	N	No display
	E	LED
	C	LCD

Table 7: Model Selection