



TECHNICAL GUIDANCE

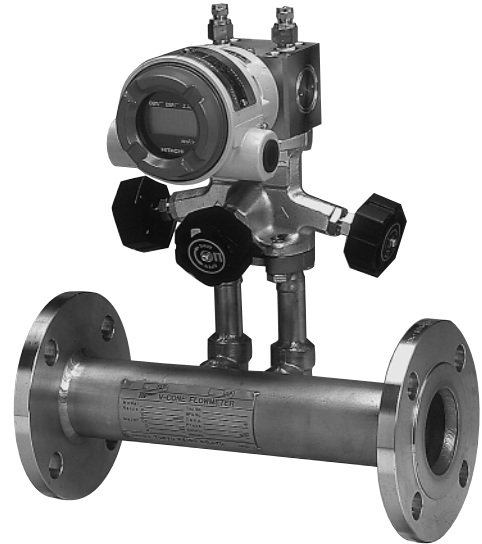
AUTOMATIC COMPENSATION TYPE TRANSMITTER MOUNTED
MASS FLOW MEASUREMENT OF STEAM AND GASES FREE
FROM PRESS. AND TEMP.CHANGES

VM series MASS V CONE FLOWMETER

GENERAL

VM series Mass V Cone Flowmeter is provided with newly developed automatic compensation type flow transmitter.

In addition to various unique features of V-Cone flowmeters, now direct mass flow measurement of saturated steam and various kind of gases free from changes of operating condition is available.



FEATURES

□ Easy Mass Flow Measurement

The newly developed flow transmitter with density compensation function outputs mass flow rate of steam and gases free from the changes of operating conditions.

(Additional temperature sensing element is required for gas mass flow measurement.)

□ Easy Installation and Wiring

All required devices are already mounted in one piece. Just by installing onto process piping and connecting 2 core cables, the system can be started. No additional cables for mass flow compensation is required.

□ Short straight runs

By the unique flow restriction theory, the required straight runs both for upstream and downstream are much shorter than those for traditional orifice plates. Effective for space and cost saving for plant construction.

□ Wide range ability

V-CONE sensor offers 14:1 range ability which is much wider than orifice and Vortex flowmeters.

□ Low permanent pressure loss

The signal stability of V-CONE is more stable than that of orifice plates. Thus, the required ΔP and permanent pressure loss are also much lower than orifice system. This saves total energy consumption in plants.

□ Durable against wear and sticking

V-CONE has "Self-Cleaning" capability because the fluid runs off from the beta edge of the Cone.

□ High anti-vibration capability

The mounted transmitter is guaranteed for 3G(0~150Hz) vibration. Tough applications which is not suitable for Vortex flowmeters are acceptable.

□ Optional unit for 3 different outputs available

By using Multi Functional Converter Type EDB500, 3 separate output of Mass flow rate, pressure and temperature is available.

RECOMMENDED APPLICATIONS

□ Saturated Steam flow measurement

Without any additional sensors, mass flow measurement free from change of operating pressure is conducted. The wide rangeability of V-Cone covers seasonal load variation.

□ Highly accurate consumption management of various kinds of gases

Gas flow can be measured free from change of operating pressure and temperature only by adding temperature sensing element. The mounted transmitter compensates the temp.factor and outputs mass flow rate directly.

STANDARD SPECIFICATION

Available sizes : 15mm(1/2")~300mm(12")
 Larger than 350mm on request
 Process connection : Flange connection
 JIS10K RF, ANSI#150
 Others on request

Material (Fluid contacting)
 Tube, V Cone, Bypass piping : 304SS
 Manifold, Transmitter : 316SS
 Transmitter diaphragm : Hastelloy C
 Gasket : Teflon

Sealing liquid for transmitter : Silicone oil

Measuring fluid : Saturated steam, gases

Temp., Press. range

Type of fluid		Steam	Gases
Fluid temp. (°C)	General purpose	~190	-40~120
	Ezxx-proof	~190	-20~120
Fluid press	kgf/cm ² G	~10	-0.5~9.9
	MPa	-0.98	-0.05~0.97

Amb.Temp. : General purpose : -20~80°C
 Ex-proof : -20~60°C

Storage temp. : -40~80°C, 5~100%RH

Flow direction : Horizontal
 (Left to Right or Right to Left)

Range ability : Std.10 : 1
 (Accuracy guaranteed)

Accuracy : ± 2.0%F.S
 Repeatability : ± 0.2%

Required straight runs :

Piping condition	Upstream	Downstream
Elbows, reducers	Min. 0D	Min. 3D
Valves, other fitting	Min. 2D	Min. 5D

D: Nominal size of V Cone flowmeter

Power source : DC11.4~50.4V

Output : DC4~20mA (2 wire)

Mass flow rate output

Max. load : 600 Ω (at DC24V)

Temp.input signal : Pt (Jpt) 100 Ω, 3 wire

(Required for gas flow temp.compensation)

Flow rate indication : 4-1/2 digit LCD digital indication

Compensation equation

(1) For gas flow measurement

$$Q_M = Q_B \times \sqrt{\frac{(273.15 + T_B)}{(273.15 + T_1)} \times \frac{P_1}{P_B}}$$

(2) For saturated steam flow measurement

$$Q_M = Q_B \times \sqrt{\frac{P_1}{P_B}}$$

Q_M : Compensated mass flow rate
 Q_B : Mass flow rate at design condition
 T₁ : Actual gas temp. (°C)
 T_B : Design temp. (°C)
 P₁ : Actual press. (kgf/cm² abs)
 P_B : Design press. (kgf/cm² abs)
 ρ₁ : Steam density at operating press. (kg/m³)
 ρ_B : Steam density at design condition (kg/m³)

Enclosure : JISC0920, Water tight
 (Equivalent to IP67)

Explosion proof : JIS Exds IIC T4

Cable entry : 2X G1/2

Pressure tight cable fitting type SXBM-16B manufactured by Shimada Electric it to be used for ex-proof version for cable connection.

Painting

Transmitter cover : Blue

Transmitter housing : Gray

MODEL CODE

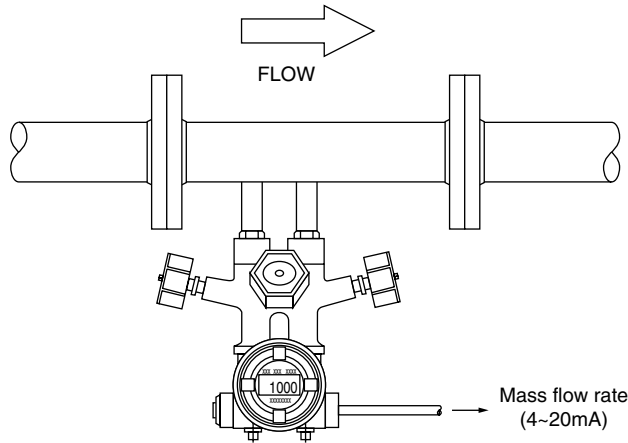
										Description			
Construction			VM	-							General use		
	EP	-	VM								Ex-proof		
Combination *1				-	5						V cone sensor + transmitter		
				-	6						V cone sensor + transmitter (Degrease treatment)		
				-	7						V cone sensor + 3 way manifold + transmitter		
				-	8						V cone sensor + 3 way manifold + transmitter (Degrease treatment)		
Measuring fluid										3	Gases		
										4	Saturated Steam		
Process connection											1	JIS10K RF flange	
											2	ANSI#150 flange	
Flow direction											6	Left to Right (Horizontal)	
											7	Right to Left (Horizontal)	
Size				-	01							15mm	1/2"
				-	02							20mm	3/4"
				-	03							25mm	1"
				-	04							40mm	1 1/2"
				-	05							50mm	2"
				-	06							65mm	2 1/2"
				-	08							80mm	3"
				-	10							100mm	4"
				-	13							125mm	5"
				-	15							150mm	6"
				-	20							200mm	8"
				-	25							250mm	10"
			-	30							300mm	12"	
β-Ratio *2				-	85							β=0.85	
				-	75							β=0.75	
				-	65							β=0.65	
				-	55							β=0.55	
				-	45							β=0.45	

NB : *1 Zero adjustment and maintenance of transmitter are not possible during operation in case type 5 and 6 are selected.

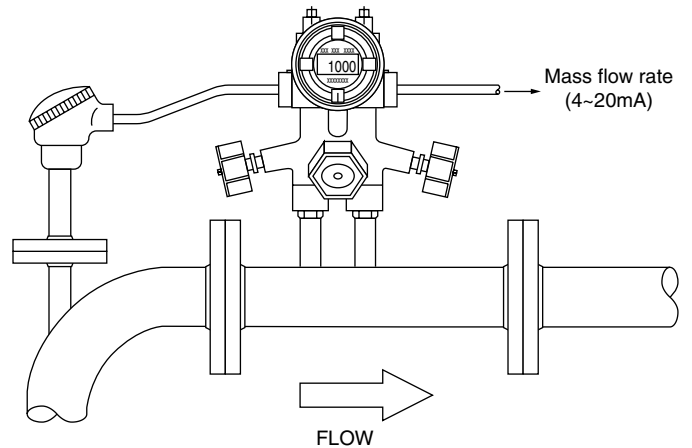
*2 Most suitable β-Ratio will be selected by Tokyo Keiso.

EXAMPLES OF APPLICATION

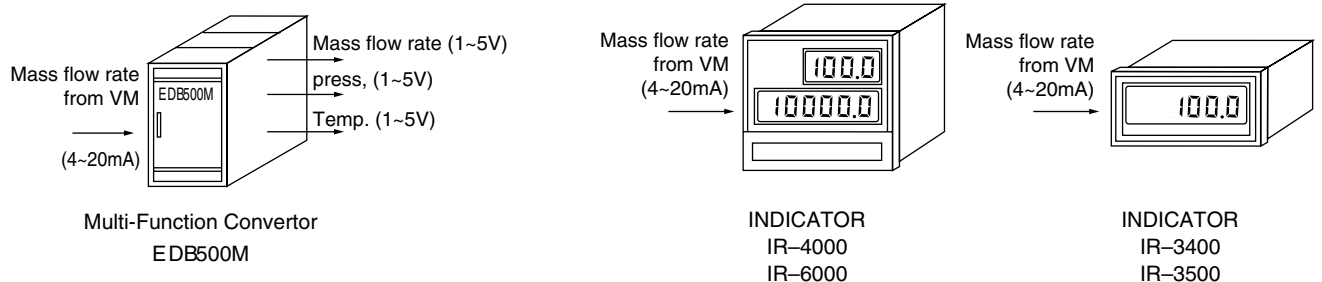
● For Saturated Steam Flow Measurement



● For Gas Flow Measurement



● Separate output of Mass flow, Temp. and Press

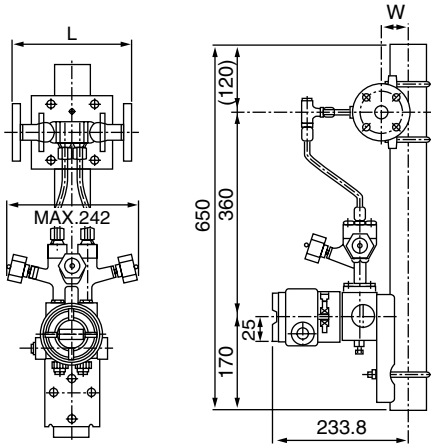


DIMENSIONS

● FOR SATURATED STEAM FLOW MEASUREMENT

◆ Fig. a : 15mm (1/2") ~ 40mm (1-1/2")

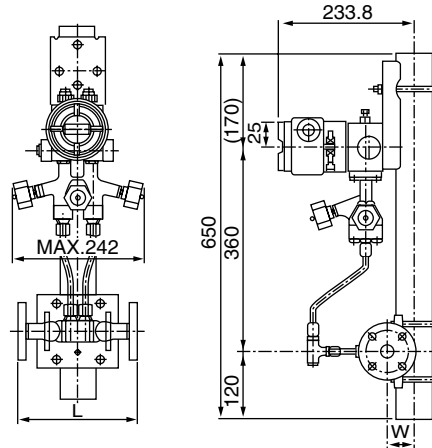
Flow direction : Left to Right or Right to Left



● FOR GAS FLOW MEASUREMENT

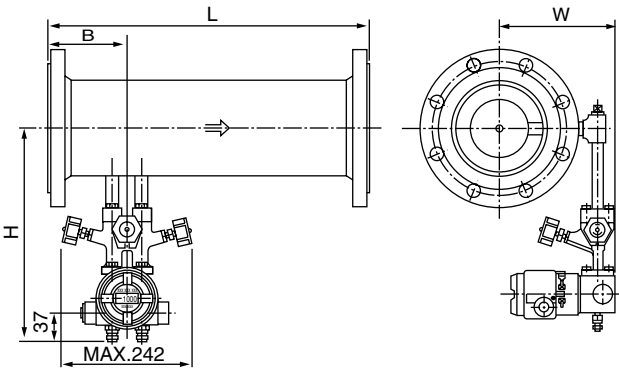
◆ Fig. b : 15mm (1/2") ~ 40mm (1-1/2")

Flow direction : Left to Right or Right to Left



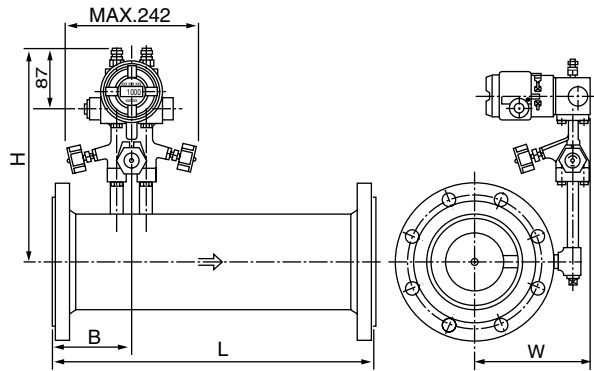
◆ Fig. c : 50mm (2") or larger

Flow direction : Left to Right



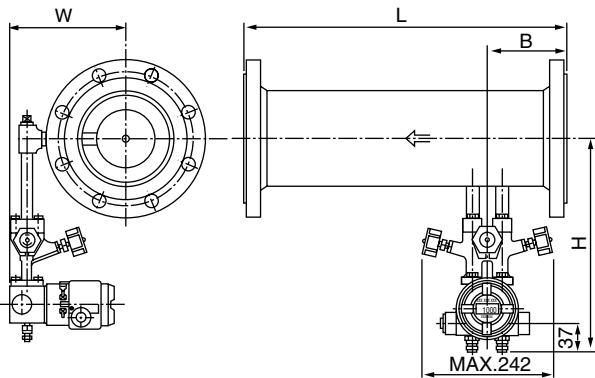
◆ Fig. e : 50mm (2") or larger

Flow direction : Right to Left



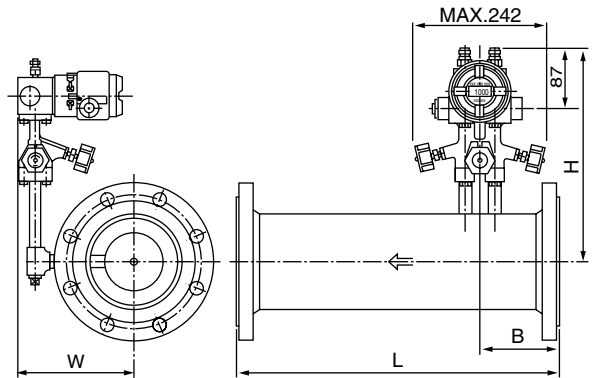
◆ Fig. d : 50mm (2") or larger

Flow direction : Left to Right



◆ Fig. f : 50mm (2") or larger

Flow direction : Right to Left



Size		L (mm)	B (mm)	W (mm)	H (mm)		Fig.
mm	inches				3 way manifold provided	3 way manifold NOT provided	
15	1/2	203	—	44	—	—	a,b
20	3/4	203	—	47	—	—	a,b
25	1	203	—	50	—	—	a,b
40	1 1/2	254	—	57	—	—	a,b
50	2	305	116	132	288	198	c~f
65	2 1/2	305	116	138	298	208	c~f
80	3	356	116	146	303	213	c~f
100	4	406	129	174	328	238	c~f
125	5	559	135	187	343	253	c~f
150	6	559	135	201	353	263	c~f
200	8	660	154	241	388	298	c~f
250	10	711	154	268	413	323	c~f
300	12	762	160	294	438	348	c~f

Note ● Fig. a~f show the VM flowmeters with 3way manifold

● Pressure tight cable fitting type SXBM-16B manufactured by Shimada Electric it to be used for ex-proof version for cable connection.

MAXIMUM ACCEPTABLE FLOW RATE BY SIZES

Table 1 : For Saturated Steam (UNIT OF PRESSURE ; G Gauge pressure)

Unit of Flow rate : kg/h

Fluid press. (Fluid temp.)		1kgf/cm ² 98kPa (120°C)	2kgf/cm ² 198kPa (133°C)	3kgf/cm ² 294kPa (143°C)	4kgf/cm ² 392kPa (151°C)	5kgf/cm ² 490kPa (158°C)	6kgf/cm ² 588kPa (164°C)	7kgf/cm ² 686kPa (170°C)	8kgf/cm ² 784kPa (175°C)	9kgf/cm ² 882kPa (179°C)	10kgf/cm ² 980kPa (183°C)
Size	15mm 1/2"	35	45	55	65	75	90	100	150	150	200
	20mm 3/4"	60	80	100	100	150	200	200	200	250	300
	25mm 1"	95	100	150	200	250	300	300	350	400	450
	40mm 1 1/2"	200	300	350	450	550	650	750	850	950	1000
	50mm 2"	350	500	600	800	950	1000	1500	1500	1500	1500
	65mm 2 1/2"	500	700	850	1000	1500	1500	2000	2000	2000	2500
	80mm 3"	800	1000	1500	1500	2000	2500	2500	3000	3500	3500
	100mm 4"	1500	2000	2500	3000	3500	4000	4500	5000	6000	6500
	125mm 5"	2000	3000	3500	4500	5500	6000	7000	8000	9000	10000
	150mm 6"	3000	4500	5500	7000	8000	9500	10000	10000	15000	15000
	200mm 8"	5500	7500	9000	10000	15000	15000	15000	20000	20000	25000
	250mm 10"	8500	10000	15000	15000	20000	25000	25000	30000	35000	40000
	300mm 12"	10000	15000	20000	25000	30000	35000	40000	45000	50000	55000

Table 2 : For Air (UNIT OF PRESSURE ; G Gauge pressure at 0°C)

Unit of Flow rate : Nm³/h

Fluide (Fluide temp.)		ATM.	1kgf/cm ² 98kPa	2kgf/cm ² 198kPa	3kgf/cm ² 294kPa	4kgf/cm ² 392kPa	5kgf/cm ² 490kPa	6kgf/cm ² 588kPa	7kgf/cm ² 686kPa	8kgf/cm ² 784kPa	9kgf/cm ² 882kPa	10kgf/cm ² 980kPa
Size	15mm 1/2"	30	35	40	60	70	80	100	150	150	150	200
	20mm 3/4"	40	60	75	100	150	150	200	200	250	300	300
	25mm 1"	70	90	150	200	250	250	300	350	400	450	500
	40mm 1 1/2"	100	200	300	400	500	650	850	900	1000	1000	1000
	50mm 2"	200	350	500	800	1000	1000	1500	1500	1500	2000	2000
	65mm 2 1/2"	250	500	800	1000	1500	1500	2000	2000	2500	2500	3000
	80mm 3"	450	800	1000	1500	2000	2500	3000	3000	3500	4000	4500
	100mm 4"	750	1500	2000	3000	4000	4500	5000	5500	6000	7000	8000
	125mm 5"	1000	2000	3000	4500	5500	6500	8000	8500	10000	10000	10000
	150mm 6"	1500	3000	5000	6500	8500	9500	10000	10000	15000	15000	15000
	200mm 8"	3000	5500	8000	10000	15000	15000	20000	20000	25000	25000	30000
	250mm 10"	4500	8500	10000	15000	20000	25000	30000	30000	40000	40000	45000
	300mm 12"	6500	10000	15000	20000	30000	35000	40000	45000	55000	60000	65000

NB : Above tables are for reference for size selection. Detailed sizing including rangeability and guaranteed accuracy range are calculated on request.

Fill in the ORDERING FORM and contact Tokyo Keiso.

OPTIONAL UNITS

● Multi Functional Converter Type EDB500

Power source : AC/DC compatible AC100/110V ±10%,
50/60Hz, 3VA or DC24V ±10%, 0.1A

Input : DC4 ~ 20mA (Mass flow rate signal from
VM V Cone flowmeter)

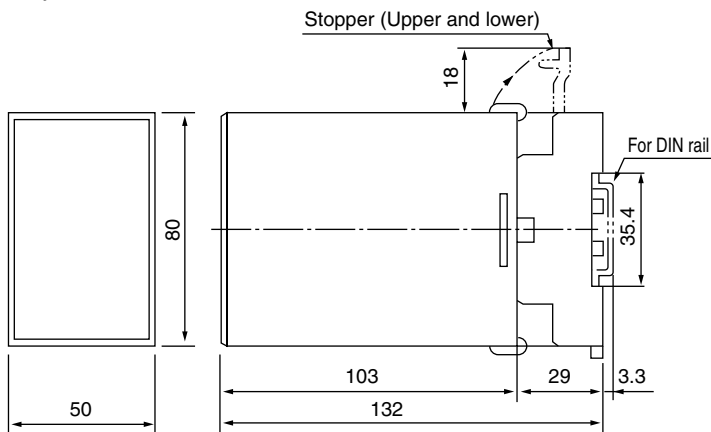
Output : Mass flow rate : DC1 ~ 5V
: Press. : DC1 ~ 5V
: Temp. : DC1 ~ 5V

Supply voltage for transmitter loop :
DC24 ~ 28V (Power switch provided)

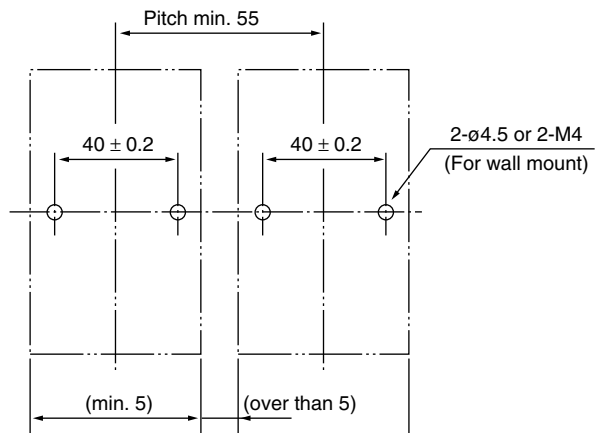


Dimension

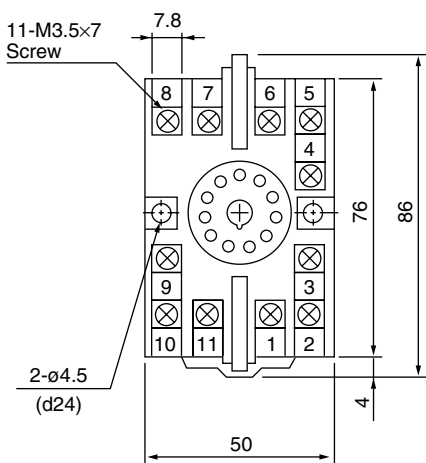
Body



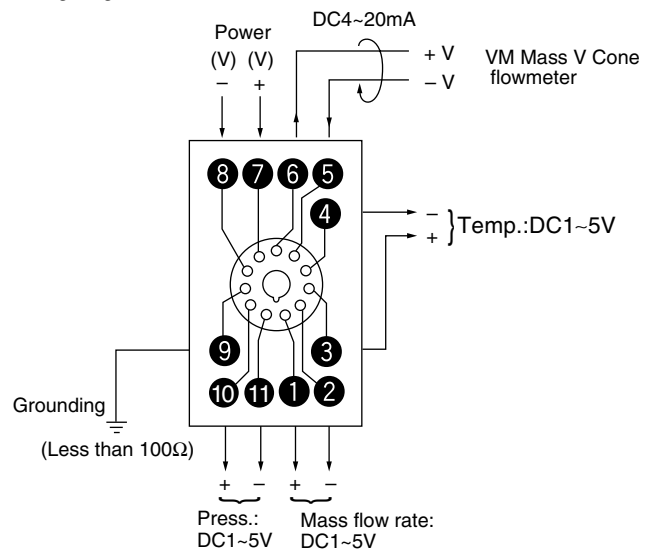
[Installation dimension]



Socket



Wiring diagram :



●Temperature sensor

Class	: Pt100 Ω(JIS CLASS B)
Material	: 304SS
Painting	: Silver
Rated current	: Less than 5mA
Housing material	: Aluminum diecasting
Cable entry	: G1/2

●Receiving instruments

a. IR-6000

Flow rate indication, Total flow indication, Reoutput of flow rate and scaled pulse, Alarm output Preset counting, Loop supply power source



b. IR-4000

Alternative indication of Flow rate and total flow, Reoutput of flow rate and scaled pulse, Alarm output Preset counting, Loop supply power source



c. IR-3500

Flow rate indication, Alarm output



d. IR-3400

Flow rate indication

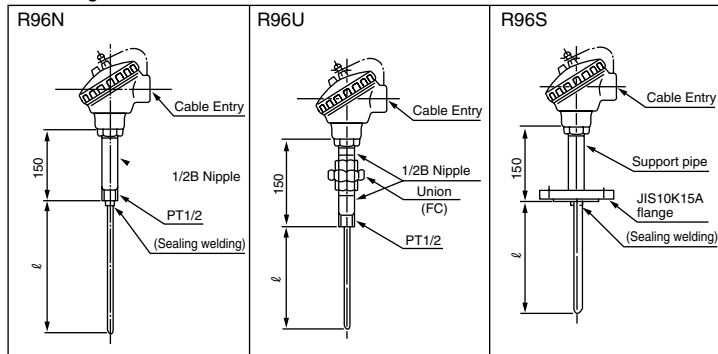


MODEL CODE

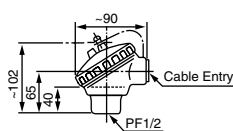
R96	*	-A	-**	L	*	*	*	100B	-*	Description
Installation	N									R1/2 Nipple
	U									R1/2 Nipple with union
	S									15A JIS10K Flange
Terminal box		-EL								General
		-GA								Ex-proof (d2G4)
Sheath dia.				D						ø3.2 (Single core only)
				E						ø4.8
				F						ø6.4
				G						ø8.0
Cable core							3			Single core
							6			Double core
Range						L				-200~+100°C
						M				0~+350°C
Insertion length								-R		mm unit

External dimensions :

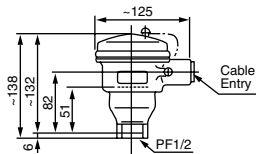
< Sensing unit >



< Terminal box >



General purpose



Ex-Proof

ORDERING FORM

The following to be specified for order/inquiry;

Name of customer	
Contact	

● Selection of model code

Refer to MODEL CODE for selection

VM -

● Process condition

Tag No. : _____
 Fluid Name : _____
 Design temp. : _____ °C
 Design press. : _____ kgf/cm²G kPa [gage] mmH₂O
 Design fluid Viscosity : _____ cP
 Design fluid density : _____ kg/m³
 Flow rate
 Operation : NOR. _____ MAX. _____ MIN. _____
 Full Scale : _____
 Unit of flow rate : kg/h t/h Nm³/h
 Sm³/h (Standard condition _____ °C, _____ kgf/cm²G)
 Press. compensation range _____ ~ _____
 Temp. compensation range _____ ~ _____
 Acceptable pressure loss MAX. _____ mmH₂O

● Options

Temp.sensor Not required
 To be prepared by customer
 Tokyo Keiso to supply (Model R96□-A-□□L□□□100B-)

Multi Functional Converter Type EDB500

Not required
 Tokyo Keiso to supply

● Other special instructions, if any; _____

* Specification subject to change without notice



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