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### BELLOWS

FORMED, WELDED BELLOWS HBL, WSL
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### **TERMS ON FLOW**

#### Reynolds number

A dimension-free value being represented by.

 $R = Vd/\nu$ .

(V: Uniform flow rate, d: A representative length of an object,  $\nu$ : Dynamic viscosity)

Flow conditions that have similar Reynolds numbers are considered hydrodynamic similarities.

#### Pressure loss

A pressure difference of a fluid before and behind a flow meter, this value shows the difficulty of fluid passage and it is also represented as Cv value.

### Dynamic viscosity

A value being represented by  $\nu = \mu / \rho$ .

( $\mu$ : Viscosity coefficient of fluid Unit (Pa • s). This value generally represents a viscosity value.  $\rho$ : Fluid density) Unit (mm<sup>2</sup>/s).

Same value as the former unit (cSt).

The performance (minimum measuring flow value) of vortex flow meters depends upon this dynamic viscosity.

#### Cavitation

Cavitation is defined as a solved gas or a vacuum bubble produced by the generation of a local low pressure on the secondary side of an obstacle in fluid flow. Since the breaking force of an impact produced when this bub-

### PRINCIPLE

Put a column or a flat plate on the flow perpendicularly as shown in the right figure, the bubbles generated from the rear side are alternately discharged from the right and left sides to form a vortex train zigzag in two rows.

This vortex train is called Karman vortex - well-known phenomenon in fluid dynamics.

Since this vortex is produced and discharged regularly and it is proportional to the flow rate, a KARUMAN ACE vortex flow meter counts the number of discharged vortexes to obtain the flow. This proportionality can be seen over a Reynolds number range of 3 X 10<sup>2</sup> to 5 X 10<sup>5</sup>.

In case of a cylindrical vortex generating body, the number of vortexes per unit time is represented by the following equation, assuming that generation frequency be f, flow rate be v, diameter of vortex generating body be d, and proportional constant be St (St is called Strouhal number).

 $f = St \cdot v/d$ 

The above equation shows that generation frequency f is primarily proportional to flow rate v.

ble disappears is very big and it causes the breakage of the generating body and detector in a vortex flow meter, we must pay attention to the maximum flow and secondary pressure.

#### Straight piping length

The length of straight piping before and behind a vortex flow meter required for adjusting the flow condition to a certain extent. This value is generally represented by a multiple of the diameter size.

### Two-phase flow

A status where a gas and a fluid are flowing while being clearly divided from each other in piping, this flow is apt to occur in horizontal piping, in particular. Since no vortex can be detected under this condition, it is need to bleeding by flowing the maximum flow water or other means.

### Pulsation

A status where a liquid flow changes in short cycles on the discharge side of a diaphragm pump or the like. Since the measuring value is not defined to cause an error indication when measuring an instantaneous flow value, mounting a damper or other countermeasures are necessary.



### **RELATED UNITS OF FLOW**

Flow

L/s	m³/h	m³/s	gal(UK)/m	gal(US)/m	ft³/h	ft³/s
1	3.6	0.001	13.19958995	15.85204756	127.1330094	0.035314725
0.2777777	1	0.000277777	3.333552764	4.403346544	35.31472483	0.009809646
1000	3600	1	13199.58995	15852.04756	127133.0094	35.31472483
0.0757599	0.272735745	0.000075752	1	1.20095	9.631587816	0.002675440
0.0630832	0.2271	0.000063077	0.832674	1	8.019974034	0.002227777
0.0078657	0.0283168	0.000007865	0.103825024	0.124688683	1	0.000277777
28.3168	101.94048	0.0283168	373.7700891	448.8792602	3600	1

#### Pressure

Pa	bar	kgf/cm <sup>2</sup>	atm	mH₂0	mHg	lbf/in <sup>2</sup>
1	0.00001	0.0000101972	0.000098692	0.000101972	0.0000075006	0.000145038
100000	1	1.019716213	0.986923267	10.19716213	0.750063755	14.50376808
98066.5	0.980665	1	0.967841105	10	0.735561273	14.22333772
101325	1.01325	1.033227453	1	10.33227453	0.7600021	14.69594301
9806.65	0.0980665	0.1	0.096784111	1	0.073556127	14.22333772
133322	1.33322	1.359506049	1.315785838	13.59506049	1	19.33671368
6894.76	0.0689476	0.070306986	0.068045991	0.703069856	0.051715096	1

### Viscosity

Pa·s	Р	cP	kgf • s/m²	gf • s/cm²	pdl • s/ft²
1 0.1 9.80665 98.0665 1.4881639	10 1 0.01 98.0665 980.665 14.881639	1000 100 1 9806.65 98066.5 1488.1639	100000/980665 10000/980665 100/980665 1 10 0.15175049	10000/980665 1000/980665 10/980665 0.1 1 0.015175049	0.67196897 0.067196897 0.00067196897 6.5897645 65.897645 1

### **Dynamic viscosity**

m²/s	St	cSt	m²/h	ft²/s	in²/s
1	10000	1000000	3600	10.763910	1550.0031
0.0001	1	100	0.36	0.001076391	0.15500031
0.000001	0.01	1	0.0036	0.0000107691	0.0015500031
1/3600	1/36000000	1000000/3.600	1	10.33227453	0.43055642
0.0980304	929.0304	92903.04	334.45094	1	144
0.00064516	6.4516	645.16	2.322576	1/144	1

### 

Dynamic viscosity is obtained by dividing viscosity by the density of a fluid under the viscosity condition,

and its conversion formula is as shown below.

Dynamic viscosity (m<sup>2</sup>/s) =  $\frac{Viscosity (Pa \cdot s)}{Density (kg/m<sup>3</sup>)}$ 

### Viscosity and dynamic viscosity of water

Pressure: 1atm = 101325Pa

Flessule. Ia	un = 101325Fa				(JIS Z 8803)
Temp. (°C)	Viscosity (Pa ⋅ s) (X10⁻₃)	Dynamic viscosity (m <sup>2</sup> /s) (X10 <sup>-6</sup> )	Temp. (°C)	Viscosity (Pa ⋅ s) (X10⁻³)	Dynamic viscosity (m²/s) (X10 <sup>-6</sup> )
0	1.792	1.792	40	0.653	0.658
5	1.520	1.520	50	0.548	0.554
10	1.307	1.307	60	0.467	0.475
15	1.138	1.139	70	0.404	0.413
20	1.002	1.0038	80	0.355	0.365
25	0.890	0.893	90	0.315	0.326
30	0.797	0.801	100	0.282	0.294

Quoted documents

[Chronological table of science, 1998] Extracted from Physics and chemistry sections, Maruzen (1993): National astronomical observatory.

### FEATURES

The Karman vortex flow meter is a highly durable and highly precise liquid flow meter/ flow sensor having a simple structure free of movable parts.

•Its body is made of resin or SUS (stainless steel).

This meter is applicable to ordinary water, pure water, ultra pure water, chemicals, and other various fluids.

Its low pressure loss design ensures stable measurement over an extensive flow range.

• Its pocket-free structure does not produce any particles so that it is also applicable to the UCT (ultra clean technology) field.

•Since the sensor output is frequency, the zero point does not fluctuate.

• Either 4 to 20mA. DC output type external power supply or a battery power supply type is selectable according to uses.

■Type QLK and Type WLK can switch the units of instantaneous values and integrated values. (Example: L/min → m³/h)

### Type SLK vortex flow meter and flow sensor

- All wetted portions are free of PFA O-ring and this type is the most suitable for clean uses.
- This device comprises a 3-wire system current output type for instantaneous flow and a pulse output type for integrating flow and instantaneous flow.
- The current output type is sub-divided into two types according to whether it is provided with an indicator or not.

### Type JLK and Type PLK vortex flow sensors

- Wetted portions are provided with a non-filled PPS O-ring to be applicable to pure water and various chemical liquids.
- A 2-wire system current output for instantaneous flow.

### Type VLK vortex flow sensor

- Wetted portions are provided with a SUS O-ring to be applicable to pure water and various chemical liquids.
- A 2-wire system current output for instantaneous flow.

				Wetted portion material Conn			Ou	tput			
Description items	Туре	Diameter	Measuring flow range					Dis	play		
			Ū	Main body	Vortex detector	O-ring		Instantaneo us flow	Integrating flow		
		05A	0.4 to 3.5								
		08A	1 to 10				Tubo	Brovidod/	Drovidod/		
5 to 6	SLK	10A	2 to 20	PFA	PFA	Not provided	tube	Not	Not		
		15A	4 to 40				* Finallock	provided	provided		
		20A	10 to 90								
		10A	4 to 25								
9 to 10	JLK	15A	8 to 50	JLK : PPS	JLK : PPS		JLK: Resin pipe				
		20A	12 to 80	PLK : PPS	PLK : PPS	FKM	PLK, QLK:	Drovidod/	Drovidod/		
11 to 12	PLK VLK	25A	20 to 130	QLK : PPS	QLK : PPS	EPDM	Resin pipe, Wafer	Resin pipe, Wafer	Resin pipe, '' Wafer	Not	Not
		32A	35 to 220	VLK : SUS	VLK : PEEK	others	VLK, WLK:	provided	provided		
13 to 15	QLK	40A	60 to 350	WLK : SUS	WLK : PEEK		Tapered male thread, Wafer				
	WLK	50A	90 to 550								
174-10	TLK	05A	0.5 to 5	PPS	DDC	EDDM	Tapered male	Provided/	Not		
17 to 18	ILK	10A	4 to 25	(glass fiber)	442	PPS	442	EPDM	thread	provided p	provided
16	шк	10A	5 to 25	9119	PPS		Tapered male	Not	Not		
		15A	8 to 50	505			thread	provided	provided		

### A TABLE FOR VORTEX FLOW METERS AND FLOW SENSORS

\* Final lock joint is produced by Kurashiki Boseki Co.

### Type WLK vortex flow meter and flow sensor

- Wetted portions are provided with a SUS O-ring to be applicable to pure water and various chemical liquids.
- This type comprises a battery-driven field display product for instantaneous flow and integrating flow and a 12 to 24V. DC 2-wire system current output type.
- This type can switch the displays of instantaneous values and integrating values display.

### Type QLK vortex flow meter and flow sensor

- Wetted portions are provided with a non-filled PPS O-ring to be applicable to pure water and various chemical liquids.
- This type comprises battery-driven field display products for instantaneous flow and integrating flow and a 12 to 24V. DC 2-wire system current output type.
- This type can switch the displays of instantaneous values and integrating values display.

#### Type TLK vortex flow meter and flow sensor

- Wetted portions are provided with a glass fiber-filled PPS O-ring to be applicable to pure water and city water.
- These devices are designed as a 3-wire system current output type for instantaneous flow and they are subdivided into two types according to whether they are provided with an indicator or not.

### Type ILK flow sensor

- Wetted portions are provided with a SUS O-ring to be applicable to fluorine system thermal media. This flow sensor is designed for mass production.
- A two-wire system current output for instantaneous flow.

	Οι	utput			Connected electronic		
Current output		Alorm	Integral	Power supply	controller		
2-wire system	3-wire system	Aldini	pulse		Туре	Description items	
Not provided	Provided	Provided/ Not provided	Provided/ Not provided	12 to 24V. DC	ONE PNE	20 23	
Provided	Not provided	Not provided	Not provided	JLK: 12 to 24V. DC PLK, VLK: 24V. DC QLK, WLK: 12 to 24V. DC Dry battery	ONE PNE	20 23	
Not provided	Provided	Provided/ Not provided	Not provided	12 to 24V. DC			
Provided	Not provided	Not provided	Not provided	12 to 24V. DC			

## CURRENT OUTPUT TYPE VORTEX FLOW METER KARUMAN ACE

## Type **SLK**

- Karman vortex fluid flow meter of wetted part PFA.
- Highly durable and precise Karman vortex flow meter having a simple structure free of movable parts.
- Type SLK \* \* 33 is provided with LED display + current output + open collector output.

### **COMMON SPECIFICATIONS**

Power supply voltage : 12 to 24V. DC
Current consumption : Less than 100mA
Allowable working fluid temperature : 0 to 90°C
(Type SIK−053 : 0 to 60°C
Working ambient temperature : 0 to 50°C
Working ambient humidity : Less than 95%RH
Accuracy : ±2%FS
Responsibility : Approx. 1 second

**C E** mark applicable (available upon request) **UL** listed (available upon request)



Applicable fluids : Pure water, chemical liquids and other various fluids (On condition that these liquids do not corrode any material of main body)

### **SPECIFICATIONS**

		C	Catalog No.	Measurable	Kinematic	Max. Operating	Wt.		
Туре	Connection Size	Main Body Material	Output	Connection Style	Packing Material	(L/min)	(mm²/s)	Pressure (MPa)	(kg)
	05					0.4 to 3.5	1		0.22
	08		3	•		1 to 10	1.2 or less	] 1	0.26
	10	3	4 to 20mA open collector x 2 w/display	(Finallock)	llock) X (None)	2.5 (2) to 20	1.5 or less		0.20
	15					4 (3) to 40	2.5 or less	0.6	0.28
SI K-	20					10 (8) to 90	4 or less	0.5	0.36
OLI	05	(PFA)				0.4 to 3.5	1		0.23
	08		2	т		1 to 10	1.2 or less	] 1	0.07
10			4 to 20mA	(Tube)		2.5 (2) to 20	1.5 or less		0.27
15			(without display)	1y/ (1000)		4 (3) to 40	2.5 or less	0.6	0.30
	20					10 (8) to 90	4 or less	0.5	0.38

Numeric values in ( ) in the measuring flow range show those of water (1mm²/s at 25°C). 05 type is guaranteed only when dynamic viscosity of fluids is 1mm²/s.
Finallock joint is manufactured by Kurashiki Boseki Co., and nuts and phenol are attached to it.

**DESCRIPTION OF INDICATOR** 

### **OPERATION**



### **FLOW RATE**





Fluid temperature - Max. allowable working pressure



Since the main body is made of resin, the maximum operating pressure changes according to the fluid temperature and diameter.

Use the unit within the allowable working range shown in the left figure.

### DIMENSIONS



Catalog No.		Finallock joint Tube joint										
		SLK-										
Size (mm)	0533AX	0833AX	1033AX	1533AX	2033AX	0533TX	0833TX	1033TX	1533TX	2033TX		
A	85	10	0 130				230	-	280	300		
а	105	12	20	121	156	_	-	-	-	-		
b	57	5	9	61	70	57	5	9	61	70		
В	72	7	6	79	93	68	7	6	79	93		
С	30	3	0	30	40	30	30		30	40		
D	3/8	1.	/2	3/4	1	3/8	1.	/2	3/4	1		

## PULSE OUTPUT TYPE VORTEX FLOW METER KARUMAN ACE

## Type **SLK**

- · Karman vortex fluid flow meter of wetted part PFA.
- Highly durable and highly precise Karman vortex flow meter having a simple structure free of movable parts.
- Provide with LED display + pulse output + open collector output.

### **COMMON SPECIFICATIONS**

Power supply voltage : 12 to 24V. DC	
Current consumption : Lower than 100mA	
Allowable working fluid temperature : 0 to 90°C	
Working ambient temperature : 0 to 50°C	
Working ambient humidity : Lower than 95%RH	1
Accuracy : ±3%RD (Type SLK-0534: ±2%FS)	
Responsibility : Approx. 0.2 sec. (Switch output is approx. 1 sec.)	
Applicable fluids : Pure water, chemical liquids and other	various fluids



C E mark applicable (available upon request)

(On condition that these liquids do not corrode any material of main body)

### **SPECIFICATIONS**

		Catal	og No.			Measurable	Pulse Rate	Kinematic	Max. Operating	Wt.
Туре	Connection Size	Main Body Material	Output	Connection Style	Packing Material	(L/min) (mL/pulse)		(mm²/s)	<sup>2</sup> /s) Pressure (MPa)	
	05					0.5 to 3.5	0.1	1		0.22
	08		4	•		1 to 10	1	1.2 or less	1	0.06
-	10		NPN open collector pulse Pulse width:	(Finallock)	x	2.5 (2) to 20		1.5 or less		0.20
	15					4 (3) to 40	10	2.5 or less	0.6	0.28
SI K-	20	3				10 (8) to 90		4 or less	0.5	0.36
OEK	05 (PFA) 0.1ms and NPN open		(None)	0.5 to 3.5	0.1	1		0.23		
	08		collector	т		1 to 10	1	1.2 or less	1	0.27
	10		output,	(Tube)		2.5 (2) to 20		1.5 or less		0.27
	15		w/display	(1000)		4 (3) to 40	10	2.5 or less	0.6	0.30
	20					10 (8) to 90	10	4 or less	0.5	0.38

• Numeric values in ( ) in the measuring flow range show those of water (1mm²/s at 25°C). 05 type is guaranteed only when kinematic viscosity of fluids is 1mm²/s.

· Finallock joint is manufactured by Kurashiki Boseki Co., and nuts and phenol are attached to it.

· Pulse width 0.1ms or over.

### **OPERATION**



Open collector (transistor ON-OFF)

### WIRING DIAGRAM







### **FLOW RATE**



Fluid temperature - Max. operating pressure



Since the main body is made of resin, the max. operating pressure changes according to the liquid temperature. Use the unit within the allowable working range shown in the left figure.

### DIMENSIONS



Catalog No.		Finallock joint Tube joint										
		SLK-										
Size (mm)	0534AX	4AX 0834AX 1034AX 1534AX 2034AX 0534TX 0834TX 1034TX 1534TX										
A	85	10	100 130				230		280	300		
а	105	12	20	121	156	_	-		-	-		
b	57	5	9	61	70	57	59		61	70		
В	72	7	6	79	93	68	7	76		93		
С	30	3	0	30	40	30	30		30	40		
D	3/8	1.	/2	3/4	1	3/8	1/2		3/4	1		

## THIN VORTEX FLOW SENSOR KARUMAN ACE

## Type **JLK**

- Highly durable and highly precise Karman vortex liquid flow sensor (current output type) having a simple structure free of movable parts.
- Low pressure loss design ensures stable measurement over an extensive flow range.



### **COMMON SPECIFICATIONS**

Power supply voltage : 24V. DC Max. allowable pressure : 1MPa (at 25°C) Working ambient temperature : 0 to 50°C External output : 4 to 20mA Measuring accuracy : ±3%FS

### **SPECIFICATIONS**

		C	atalog No.		Measurable	Fluid			
Туре	Connection Size	Main Body Material	Output	Connection Style	Packing Material	(L/min)	Measurable Fluid	Kinematic Viscosity (mm <sup>2</sup> /s or less)	Temp. (°C)
	10			R(Tapered Male Thread) P (Pipe)	_	4 (3) to 25	Water · Warm Water	2	
	15	2	2		E (EPDM)	8 (7) to 50	Oil     Sea Water	3	*1
JLK–	20	(Non-filled)	4 to 20mA 2 lead	*P	(=: =:)	12 (9) to 80	of fluid	4	0 to 50 (0 to 90)
	25	PPS /	cables	(Pipe)	F (FKM)	20 (16) to 130	∫ Do not damage	5.5	, ,
	32				. ,	35 (30) to 220	( to the body )	6.5	

• Numeric values in ( ) in the measuring flow range show those of water (1mm²/s at 25°C).

\* The following joint specifications follow the sealing material only when the joint profile is "P".

Pody	Joint (recep	tacle) spec	ifications	Main	Recep-	Wt.
Бойу	Connection size	Material	Profile	body	tacle	(kg)
10	15 (1/2)			10	15	0.33
15	13 (1/2)	*1		15	15	0.32
15	20 (3/4)		S	15	20	0.33
20	20 (0/4)		(TS insertion)	20	20	0.43
20	OF (1)	(HT_PVC)		20	25	0.52
25	23(1)	(		25	25	0.51
32	32 (1-1/4)			32	32	0.62

 \* 1. Working fluid temperature changes according to materials. (PVC : 0 to 50°C, HT-PVC : 0 to 90°C)

### WIRING DIAGRAM



### **FLOW RATE**







Since the main body is made of resin, the maximum operating pressure depends upon the fluid temperature. Use this device within the above allowable working range.

### DIMENSIONS



Unit : mm

	Connect	tion style	)	Pipe joint (JIS hard PVC pipe joint, etc.) receptacle TS				
	Size	(mm)		А	В	С	D	
	10		1/0	176	62.5	10	00.0	
	15		1/2	170	64.5	40	22.0	
			0/4	100	67	57	26.2	
Body	20	Joint	3/4	190	77	57	20.3	
	20		4	102	81	65	20.2	
	25		I	192	84	65	32.3	
	32		1-1/4	229	92	75	38.4	

## VORTEX FLOW SENSOR KARUMAN ACE

## Type **PLK, VLK**

- Highly durable and highly precise Karman vortex flow sensor (current output type) having a simple structure free of movable parts.
- Low pressure loss design ensures stable measurement over a wide flow range.
- Applicable even in a strong magnetic field. (Type VLK)

### **COMMON SPECIFICATIONS**

Power supply voltage : 24V. DC

Max. operating pressure : 1MPa (at 25°C)

Working ambient temperature : -10 to 70°C

(Lower than 50°C when the fluid temperature is higher than 70°C in case of VLK)

External output : 4 to 20mA

Measuring accuracy :  $\pm 3\%$ FS



Type PLK, VLK

### **SPECIFICATIONS**

		(	Catalog No.			Measurable		Fluid		\٨/+
Туре	Connection Size	Main Body Material	Output	Connection Style	Sealing Material	Flow Range (L/min)	Measurable Fluid	Kinematic viscosity (mm²/s or less)	Temp. (°C)	(kg)
	40	2 (Non-filled)		W		60 (50) to 350		9		0.64
PLK-	50	(PPS)		(Wafer)		90 (80) to 550		12		0.76
	10					4 (3) to 25	<ul><li>Water</li><li>Warm Water</li></ul>	2	]	0.66
	15		2	B		8 (7) to 50	<ul> <li>Oil</li> <li>Sea Water</li> </ul>	3		0.48
	20	6 (SUS316)	(4 to 20mA)	A (Tapered male) 12 (9) to 80 vinds of fluid	4	0 to 90	0.88			
VLK-	25		(2 lead cables)	( screw )	(FKM)	20 (16) to 130	Do not damage to	5.5	]	1.00
	32					35 (30) to 220		6.5	1 [	1.40
	40	5		W		60 (50) to 350	(	9		2.55
	50	(SUS304)		(Wafer)		90 (80) to 550		12	]	2.77

• PLK size applies to joint style W having a nominal diameter of 40 to 50.

• VLK size applies to joint style R having a nominal diameter of 10 to 32 and joint syyle W having a nominal diameter of 40 to 50.

• Numeric values in ( ) in the mesurable flow range show those in case of water (1mm<sup>2</sup>/s at 25°C).

### WIRING DIAGRAM



### **FLOW RATE**



Numeric values in ( ) show a current output value (mA).



Fluid Temp. (°C)

Since the body is made of resin, its maximum operating pressure depends upon the fluid temperature. Use this device within the above allowable working range.

### DIMENSIONS

### Type VLK





Connect	tion Size	Tapered male screw						
Size	(mm)	А	В	С	D			
	10	80	85	20	R3/8			
0	15	90	89	30	R1/2			
Onnice	20	120	98	40	R3/4			
ροπ	25	130	103	40	R1			
	32		108	45	R1-1/4			

### Type PLK-W · VLK-W





Connect	ion style		Wafer joint					
Size	(mm)	А	В	φC	φD			
Orifice	40	00	127	77	38			
port	50	90	141	92	48			

Unit : mm

## VORTEX FLOW METER KARUMAN ACE

## Type QLK, WLK

- Highly durable and highly precise Karman vortex flow meter having a simple structure free of movable parts.
- Low pressure loss design ensures stable measurement over a wide flow range.
- Applicable even in a strong magnetic field.
- This device comprises both battery drive system and external power supply system.



### **COMMON SPECIFICATIONS**

Power supply voltage : 3V. DC (Dry battery x 2) (No external output) 12V. to 24V. DC (An external output is provided)

Max. operating pressure : 1MPa (at 25°C)

Working ambient temperature : 0 to 50°C

Measuring accuracy :  $\pm 2\%$ FS

### **SPECIFICATIONS**

Catalog No.					Measurable		Fluid			
Туре	Connection Size	Main Body Material	Output	Connection Style	Sealing material	Flow Range (L/min)	Measurable Fluid	Kinematic Viscosity (mm²/s or less)	Temp. (°C)	vvt. (kg)
	10			P * 1(Pipe) R (Tapered male screw)		4 (3) to 25		2	*3	0.20
QLK-	15					8 (7) to 50		3	D	0.29
	20	2		P*1		12 (9) to 80		4	0 to 50	0.39
	25	(Non-filled)		(Pipe)		20 (16) to 130		5.5	(0 to 90)	0.48
	32	( FF3 /	0 (None)			35 (30) to 220	Water     Warm Water     Oil     Sea Water	6.5	R, W 0 to 90	1.40
	40	-	Battery drive	drive) (Wafer)	Е	60 (50) to 350		9		0.38
	50		2		(Wafer) (EPDN	(EPDM)	90 (80) to 550	Other various	12	
	10		4 to 20mA 2 lead cables	P	F (FKM)	4 (3) to 25	kinds of fluid Do not damage to the body	2		0.72
	15		External			8 (7) to 50		3	0 to 90	0.54
	20	6 (SUS316)	power supply	(Tapered male)		12 (9) to 80		4		0.94
WLK–	25			Screw /		20 (16) to 130		5.5		1.40
	32					35 (30) to 220		6.5		1.06
	40	5		W		60 (50) to 350		9		2.44
	50	(SUS304)		(Wafer)		90 (80) to550		12		2.96

\*1, \*2 Manufacturable only when the nominal diameter is 10 and connection sizes are 15(1/2), 15→15(1/2) · 20(3/4), 20→20(3/4) · 25(1), 25→25(1), 32→32(1-1/4). (in case of QLK-P joint)

 $\cdot$  Numeric values in ( ~ ) of the measurable flow range show those of water (1mm²/s at 25  $^\circ C$ ).

\* The following joint specifications follow the sealing material only when the connection style is "P".

Body	Connection specifications						
Douy	Connection size *2	Material	Style				
10	15 (1/2)	*3					
15	10 (1/2)	1					
	20 (3/4)	(PVC)	S				
20	20 (0/ 1)		(TS insertion)				
	25 (1)						
25	20(1)	(HI-PVC)					
32	32 (1-1/4)						

\*3 Working fluid temperature changes according to materials. (PVC:0 to 50°C, HT-PVC:0 to 90°C)

### WIRING DIAGRAM

**FLOW RATE** 





Numeric values in ( ) show the current output value (mA).



Fluid temperature - Max.operating pressure



Since the main body is made of resin, the maximum operating pressure depends upon the fluid temperature. Use this device within the above allowable working range.

### **DESCRIPTION OF INDICATOR**

Battery alarm indicator		Status indi	cator
(Replace the battery if this indicator starts fl	ickering.)	(It flickers at the sa	sequentially from the left to the right during measurement and it lights at 4 positions me time if the flow exceeds 110% of the maximum instantaneous flow.)
Mode indicator			
(Present mode can be checked for about 3 seconds.)			

### **MODE DISPLAY**

Each mode can be changed by mode key. The present mode is indicated in the mode indicator by flickering for about 3 seconds, and the mode can be changed by pressing the mode key during this time.

Instantaneous flow display mode



Indicates an instantaneous flow value.

Integrated flow display mode

Indicates an integrated flow value starting from turning on the power supply. (Total counter)

Batch processing mode of integrated flow

This indicator is reset to 0 if the mode switch is pressed continuously for 6 seconds.

### DIMENSIONS

### Type QLK





Taper male screw

Connect	ion style	Pipe connection						
Size (mm)		A B		С	D			
	10 *	176 (80)	94 (85)	48 (30)	22.3 (R1/2)			
	15	176	96	48	22.3			
0.5	15	100	100	57	00.0			
Orifice	00	190	110	57	20.3			
pon	20	100	113	<u>CE</u>	20.0			
	25	192	115	65	32.3			
	32	229	126	75	38.4			

\* ( ) shows the size of the taper male sorew.







Connection style		Taper male screw						
Size (mm)		А	A B C					
	10	80	85	20	R3/8			
Outline	15	90	89	30	R1/2			
Onnice	20	120	98	40	R3/4			
ροπ	25	130	103	40	R1			
	32	140	108	45	R1-1/4			

Type QLK · WLK

Connection style

Size (mm)

40

50

Orifice

port





Unit : mm

Ī		
φA	+ -	φB-
Ļ	10	

Center guide (for JIS 10K flange) Material: Aluminum

Part No.	φ A	<i>φ</i> B
VLK–PP01	77	90.5
VLK-PP02	92	105.5

**STANDARD ACCESSORY** 

• QLK size applies to nominal diameter 10 to 32 and connection style P or nominal diameter 40 to 50 and joint profile W. Also WLK size applies to nominal diameter 10 to 32 and connection style R or nominal diameter 40 to 50 and connection style W.

Wafer joint

φC

77

92

В

166

180

А

90

φD

38

48

### FOR GALDEN®, FLUORINERT® THIN VORTEX FLOW SENSOR KARUMAN ACE

Type **ILK** 

- This small vortex flow sensor applies to fluorine system thermal media and water such as Galden<sup>®</sup>, Fluorinert<sup>®</sup> etc., and its body is made of SUS304.
- Its low pressure loss design ensures stable measurement over a wide flow range.

### **COMMON SPECIFICATIONS**

### Power supply voltage : 12 to 24V. DC $\pm$ 10%

Material of wetted portions :

SUS304, non-filled PPS, EPDM

Working ambient temperature : 0 to 50°C

Accuracy :  $\pm$ 3%FS (Water at 20°C)

Applicable fluid : Galden<sup>®</sup>, Fluorinert<sup>®</sup> and water

Allowable working fluid temperature :

See the separate table.

• It outputs an instantaneous flow as a 2-wire system 4 to 20mA current.

(FOR MASS PRODUCTION)

• A simple structure free of movable parts, excellent durability, and high accuracy without any generation of particles.



### **SPECIFICATIONS**

Catalog No.	Connection	Measurable Flow Range (L/min)	Max.Operating Pressure (MPa)	Withstand Pre-ssure (MPa)	Output	Wt. (kg)
ILK-0101	R1/2	8 to 50	1.0	1.0	4 to 00m 4	0.43
ILK-0102	R3/8	5 to 25	1.0	1.8	4 to 20mA	0.40

### ALLOWABLE WORKING FLUID TEMPERATURE

	Catalog No.	ILK – 0101	ILK – 0102		
Applicable fluid		Fluid Temp. (°C)			
	HT – 110	-30 to 100	-20 to 100		
Galden®	HT – 135	-20 to 100	-5 to 100		
	HT – 200	20 to 100	30 to 100		
Eluoriport®	FC – 3283	-30 to 100	-20 to 100		
ridonnen	FC – 43	25 to 100	30 to 100		
Water (Freezing is	s not allowable)	0 to 100	0 to 100		

Galden<sup>®</sup> is a product of SOLVAY SOLEXIS. Fluorinert<sup>®</sup> is a product of Sumitomo 3M.



### DIMENSIONS

WIRING DIAGRAM



## VORTEX FLOW METER KARUMAN ACE

## Type **TLK**

- Karman vortex flow meter having PPS wetted portions.
- Highly durable and highly precise flow meter having a simple structure free of movable parts.
- An indicator-fitted type and an indicator-free type are available.

### **COMMON SPECIFICATIONS**

Power supply voltage : 12 to 24V. DC  $\pm$ 10%

Current consumption : Lower than 100mA

Max.operating pressure : 1MPa

Allowable working fluid temperature :

0 to 70°C (Type TLK-05)

0 to 90°C (Type TLK-10)

Working ambient temperature : 0 to 50°C

Working ambient humidity : Lower than 95%RH

Accuracy : ±3%FS

Responsibility : Approx. 1sec.

Applicable fluid : City water, pure water

### **SPECIFICATIONS**



	Catalog No.				Measurable Display		splay	Wt.	
Туре	Connection Size	Main Body Material	Output	Connection Style	Sealing material	Flow Range (L/min)	Instantaneous flow value	Switch output	(kg)
TI K_	05		2 ( 4 to 20mA, without display )	R (R3/8)	Е	0.5 to 5	7-segment	OUT1: Red LED	Approx.
TLK–	10	(GF30%)	4 to 20mA open collector x 2, with display	R (R1/2)	(EPDM)	4 to 25	LED 3 digits	OUT2: Green LED	Approx. 0.25

### **DESCRIPTION OF OPERATION**



### WIRING DIAGRAM

(Type TLK-\* \*22 has neither output 1 nor output 2.)



### DESCRIPTION OF DISPLAY



### **FLOW RATE**





Numeric values in ( ) show a current output value (mA).

Fluid temperature – Max. operating pressure



Since the body is made of resin, the maximum operating pressure depends upon the fluid temperature. Use this device within the left allowable working range.

### DIMENSIONS



	Size (mr	n)	А	В
	Orifice port	05	00	71
		10	80	74

Unit : mm

# The following electronic controllers are combined with our vortex flow sensors, resistivity meters, and other devices for remote instructions and monitoring.

### Type ONE general-purpose digital controller

- This current (4 to 20mA. DC) input panel-mount type controller has a 2-contact output.
- It is combined with type LK flow sensor, type RNE resistivity meter, conductivity meters, etc. for remove instructions and monitoring.

### Type PNE 6-channel general-purpose digital controller

- This current (4 to 20mA. DC) input panel-mount type controller has a 2-contact output being independent every channel.
- It has a scaling function every channel so that a vortex flow meter having a different diameter is connectable.
- Higher-limit and lower-limit alarm can be set every channel.

# **GENERAL-PURPOSE DIGITAL CONTROLLER**

## Type **ONE**

- General-purpose controller of current input (4 to 20mA. DC).
- Remote indications and monitoring can be done by combining with type LK series vortex flow sensor, type XSK pressure sensor, type RNE resistivity meter, conductivity meter, etc.

C E mark applicable (available upon request) UL listed (available upon request)



### **COMMON SPECIFICATIONS**

Control method : 2-position control

Power supply voltage : 24V. DC  $\pm 10\%$ 

Power consumption : Lower than 5W (excluding sensor)

Working ambient temperature : 0 to 50°C

Mounting method : Panel-mount type (DIN 48x48)

Protective structure : IP66 (panel)

## SPECIFICATIONS

Catalog No.	* Indicating and setting range (L/min)	* On-off difference setting range (L/min)	Flow indicator	Setting indicator	Contact type	Contact capacity	Wt. (kg)
ONE-2NI0-010	$\left(\begin{array}{c} 0 \text{ to } 9999\\ \left(\begin{array}{c} \text{Initial setting}\\ 0.0 \text{ to } 50.0 \end{array}\right) \end{array}\right)$	$\left(\begin{array}{c} 0.0 \text{ to } 999.9\\ \left(\begin{array}{c} \text{Initial setting}\\ 5.0 \end{array}\right) \end{array}\right)$	7-segment LED Green 4 digits	7-segment LED Orange 4 digits	SPST x 2	250V. AC 2A (cos φ =1)	0.17

\* In case of connection with type LK vortex flow sensor.

(Note) For connecting to a pressure sensor, a resistivity meter, or a conductivity meter, refer to the unit label as standard accessory.

### **DESCRIPTION OF FUNCTIONS**



### WIRING DIAGRAM



The left 4 patterns can be set to contact outputs 1 and 2. DIFF. is common to outputs 1 and 2.

### **MOUNTING SIZE**

Panel cutout size



### STANDARD ACCESSORIES

Unit seal
Fixing bracket



### DIMENSIONS





Unit : mm

# 6-CHANNEL GENERAL-PURPOSE DIGITAL CONTROLLER

## Type **PNE**

- A digital controller with a 6-channel 6-segment LED display.
- By connecting to our **KARUMAN ACE** vortex flowmeter, this instrument can be used as a flow controller.
- Either high-limit or low-limit alarm is selectable every channel to be able to issue an independent alarm.

### **COMMON SPECIFICATIONS**

Control method : 2-position control

Power	supply	voltage	:24V.	DC ±10%	
-------	--------	---------	-------	---------	--

Power consumption : Lower than 9VA (excluding sensor)

Input

Connected sensor units : 4 to 20mA. DC output sensor Max. 6 units Input range setting : Parameter setting every channel Display/setting accuracy :  $\pm$ 1%FS (excluding sensor)

Communication specification : Conforms to Compo Way/F Communication (manufactured by OMRON) procedure

Working ambient temperature : -10 to 50°C

Mounting method : Panel mount (DIN 48 x 96)



• Remote setting and remote monitoring of measuring data can be done.



### SPECIFICATIONS

Catalog No.	Display range (L/min)	Setting range (L/min)	On-off difference setting range (L/min)	Flow display	Contact type	Contact capacity	Wt. (kg)		
PNE-2DS1-C10	0 to 999 Decimal point position can be changed	High-limit setting: 3 to 996 (Initial value 3.00) Low-limit setting: 0 to 996 (Initial value 2.00)	0 to 333 (Initial value 0.04)	7-segment LED display green 3digits x 6	SPST x 6	* 24V. DC 0.5A (cos \u03c6 =1)	0.4		
* The total current flowing to common is lower than 1.5A									

### **DESCRIPTION OF OPERATION**



WIRING DIAGRAM



**MOUNTING SIZE** 





Unit : mm

### **STANDARD ACCESSORIES**

- Bracket : 2 pieces
- Mounting screw : 2 pieces (M3 x 12)
- Sensor harness (L=1.5m) x 6
- Power supply, contact output
- Communication harness (L=1.5m) 1 each





Bracket

### Resistivity of theoretically pure water

Temp. (°C)	Ultimate mole conductivity of hydrogen ions (S • cm <sup>2</sup> /mol)	Ultimate mole conductivity of hydroxide (S • cm²/mol)	Dissociation constant of water (pKw)	Density of water (g/cm³)	Resistivity (MΩ・cm)	Electric conductivity ( µ S/cm)
0	224.2	127.8	14.944	0.99987	84.2	0.01188
10	275.5	156.2	14.535	0.99973	42.9	0.02331
18	315.6	178.8	14.236	0.99859	26.6	0.03759
20	325.5	184.4	14.167	0.99823	23.8	0.04202
25	349.8	197.8	13.997	0.99707	18.25	0.05479
30	373.7	211.6	13.833	0.99567	14.1	0.07092
40	419.5	237.2	13.535	0.99224	8.98	0.11136
50	462.6	261.4	13.262	0.98807	5.98	0.16722
60	502.5	284.2	13.017	0.98324	4.17	0.23981
70	545.8	324.2	12.813	0.97781	3.00	0.33333
75	565.2	344.1	12.712	0.97489	2.56	0.39063
80	582.8	364.8	12.613	0.97183	2.20	0.45455
90	612.5	405.9	12.431	0.96534	1.67	0.59880
100	634	447	12.265	0.95838	1.31	0.76336
200	824	701	11.289	0.865	0.334	2.99401
300	894	821	11.406	0.712	0.413	2.42131

### $\textbf{Resistivity} \Longleftarrow \textbf{electric conductivity conversion formula}$

Since the resistivity and electric conductivity are a reciprocal number of each value, the conversion formula is given as follows.

Resistivity (M $\Omega$  · cm) =  $\frac{1}{\text{Electric conductivity (} \mu \text{ S/cm)}}$ 

### Temperature and resistivity of theoretically pure water



Reference [Science of extra pure water]: SIPEC.

# The following resistivity meters and conductivity meter are prepared for controlling the purity of ultra pure water, pure water, thermal media, etc.

### Type RNE resistivity meter

- This device is combined with a low elution sensor having Hastelloy electrodes and teflon resin mounting threads to be the most suitable for controlling the purity of ultra pure water.
- It indicates a temperature together with resistivity.
- Resistivity can be measured precisely down to 0.05M Ω.cm.
- Its input, output, and sensor are isolated from each other to secure high reliability.
- A panel mounting type of DIN 96 x 48 size.

### Type RNE indicator-free resistivity meter

- This resistivity meter is combined with a sensor having electrodes made of Hastelloy or SUS 316L and it is the most suitable for controlling the purity of pure water, ultra pure water, and thermal media.
- It outputs analog signals of current (4 to 20mA. DC) and voltage (0 to 10V. DC) corresponding to measured resistance values.
- A model having control and alarm contact outputs and a model of analog outputs only are prepared.
- Temperature compensation (25°C) modl and temperature compensation-free modl are selectable by a switch on the rear panel.
- Its input, output, and sensor are isolated from each other to secure high reliability.
- DIN rail mounting type.

#### Type RNE indicator-free conductivity meter

- This meter is combined with a sensor having electrodes made of SUS316L, and it is the most suitable for controlling the purity of pure water and ordinary water.
- It outputs analog signals of current (4 to 20mA. DC) and voltage (0 to 10V. DC) corresponding to measured conductance values.
- Its input, output, and sensor are isolated from each other to secure high reliability.
- DIN rail mounting type.

# **RESISTIVITY METERS**

## Type RNE, ARK

- AC 2-electrode system resistivity meter having DIN 48 x 96 size indicator.
- Contact outputs are prepared for high-limit alarm and low-limit alarm respectively.

### **COMMON SPECIFICATIONS**

Power	supply	voltage	•	24V	DC
I OWEI	Suppry	vonaye	٠	24v.	50

Current consumptior	: Lower than 150mA
---------------------	--------------------

Accuracy : ±1%FS (repeated)

(With Sensor at 18MΩ ⋅ cm 25°C)

Display : Resistance 4 digits 7-segment LED (red) Temperature 4 digits 7-segment LED (green) Level and alarm indicating LED

Working ambient temperature : 0 to 45°C

### **CONTACT SPECIFICATIONS**

Contact type : SPST x 2

(Common to high-low limit common terminals)

Contact capacity: 30V. DC 2A ( $\cos\phi=1$ )

- Temperature can be confirmed together with resistivity.
- This sensor has excellent chemical liquid resistance and low elution.



Type RNE

Type ARK

SPECIFICATIONS
----------------

### Controller

Catalog No.	Measurable Range (MΩ • cm)	Alarm Output Setting Range (MΩ • cm)	Differential (fixed) (MΩ • cm)	Analog Output	Temp. Compensation Function	Temp. Compensation Range (Reference Temp. 25°C) (°C)	Connection Sensor	Wt. (kg)
RNE-2N100	0.05 to 20	0.05 to 20	0.2	4 to 20mA. DC	Provided	10 to 80	ARK-CATHR-***	0.38

#### Sensor

Catalog No.	Connection	Material	Cell Constant (cm <sup>-1</sup> )	Working temp. Range (°C)	Water- proofing	Fluid	Temp. Compensation	Max. Operating Pressure (MPa)	Lead Wire Length (m)	Wt. (kg)
ARK-CATHR-001	R3/4	Hastellov	0.05	0 to 90	* Equivalent	Pure	Broyidad	0.5	5	0.45
ARK-CATHR-002	(Fluororesin)	пазіеноў	0.05	0 10 80	to IP67	water	Flovided	0.5	10	0.75

· Don't screw the resin joint into any metallic portion.

\* Between main unit and lead wires.

### **DESCRIPTION OF OPERATION**



### WIRING DIAGRAM



Relay functions in the arrow direction when the resistivity increases.

### **DIMENSIONS**

#### Controller





### **MOUNTING SIZE**



Sensor



Туре	L (m)
ARK - CATHR - 001	5
ARK - CATHR - 002	10

### STANDARD ACCESSORY

#### Body fixing bracket x 2



# **RESISTIVITY METER**

## Type RNE, ARK

- AC 2-electrode system resistivity meter.
- Control and alarm contact outputs type is also prepared.

### **COMMON SPECIFICATIONS**

Power	supply	voltage	: 24V. DC

Current consumption : 140mA

Repeatability :  $\pm 2\%$ FS (With sensor at  $18M\Omega \cdot cm 25^{\circ}C$ )

Contact type : SPDT x 2

Contact capacity : 24V. DC 1A ( $\cos\phi=1$ )

Applicable fluids : Ultra pure water, various chemical liquids, thermal medium, etc.





SPECIFICATIONS

#### Controller

Catalog No.	Measurable Range (MΩ • cm)	Contact Output Setting Range (MΩ • cm)	Differential (fixed) (MΩ • cm)	Analog Output	Temp. Compensation Function	Temp. Compensation Range (Reference Temp. 25°C) (°C)	Connection Sensor	Wt. (kg)
RNE-2AE1	0 to 00	-	4 to 20m (Max.40		Provided/	0 to 95	ABK-**BB-***	0.25
RNE-2AF1	0 to 20	2 to 19.8	0.2	0 to 10V. DC (Min.2kΩ)	Not provided	0 10 95		0.20

#### Sensor

Catalog No.	Connection	Material	Cell constant (cm <sup>-1</sup> )	Working Temp. Range (°C)	Repeatability (% FS)	Temp. Compensation	Max.Operating Pressure (MPa)	Lead Wire Length (m)	Wt. (kg)
ARK-ATBR-001		Hastelloy		0 to 95		Browided	0.5	5	0.35
ARK-STBR-001	R3/4	0.01 20 to 05 ±1	+1	TTOVIDED					
ARK-SNBR-002		SUS316L	- 0.01	-30 10 95 -1		Not provided	1.0	3	0.3
ARK-BNBR-001				-5 to 125		Not provided			

\* For the external dimensions and standard accessories, refer to Page 35.

### WIRING DIAGRAM



### **DESCRIPTION OF OPERATION**



# **CONDUCTIVITY METER**

## Type RNE, ARK

- A small conductivity meter of AC 2-electrode system.
- A control output is provided to be freely settable for control and alarm.

### **COMMON SPECIFICATIONS**

Power supply voltage : 24V. DC

Current consumption : 150mA

Repeatability : ±2%FS (Sensor combination at 25°C)

Working ambient temperature : 0 to 50°C

### **CONTACT SPECIFICATIONS**

Contact type : SPST x 2

Contact capacity : 24V. DC 1A ( $\cos\phi=1$ )

• Input, output, and sensor are insulated to each other to secure high reliability.



Setting method : Set the voltage by the trimmer while reading the voltage value after connecting a voltmeter such as a circuit tester or the like across plus and minus terminals beside the setting trimmer. Setting voltage 0.6 to 10V. DC corresponds to set value 3.0 to 50 (30 to 500)  $\mu$ S/cm.

### **SPECIFICATIONS**

### Controller

Catalog No.	Measurable Range ( µ s/cm)	Contact Output Setting Range ( µ s/cm)	Differential (fixed) ( µ s/cm)	Analog Output	Temp. Compensation Function	Temp. Compensation Range (Reference Temp. 25°C) (°C)	Connection Sensor	Wt. (kg)	
RNE-2BF1	2.5 to 50	3.0 to 50	0.5	4 to 20mA. DC (Max.400 Ω)	Drovided	0 to 60	ARK_STCR_001	0.25	
RNE-2BF2	25 to 500	30 to 500	5	0 to 10V. DĆ (Min.2kΩ)	Provided	0.000	Anix-0100-001	0.25	

#### Sensor

Catalog No.	Connection	Material	Cell Constant (cm <sup>-1</sup> )	Working Temp. Range (°C)	Repeatability (% FS)	Fluid Used	Max. Operating Pressure (MPa)	Lead Wire Length (m)	Wt. (kg)
ARK-STCR-001	R3/4	SUS316L	0.1	0 to 60	±1	Pure water, ordinary water	1.0	3	0.24

\* For the external dimensions and standard accessories, refer to Page 35.

### WIRING DIAGRAM

-14 close

-(14) close

OFF: (3-(4) open

ON : 13 ON : 16-18 close

OFF:

18 open

18 open (16)

-18 close



2.5 or 25

0

High resistivity

 $(\mu S/cm)$ 

50 or 500

### DIMENSIONS

### Controller



### Sensor

For resistivity meter







Unit : mm

### **STANDARD ACCESSORIES**

#### Mounting plate



• Stopper (2 pieces)



### **REFRIGERATION TERMS**

- Pressure
- Absolute pressure
- = Gauge pressure + standard atmospheric pressure MPa (abs) MPa
- (Standard atmospheric pressure = 0.101325MPa)
- Vacuum ł
  - $P = 0.1013 \cdot \frac{n}{76}$ P: Absolute pressure MPa (abs)
    - h: Vacuum
    - (Mercury column) cmHg
- Power and calorie
- $1kW = 102kg \cdot m/sec = 860kcal/h$
- Refrigeration capacity In this catalogue, kW is used as nominal capacity indication.

- Coefficient of performance
  - $\varepsilon = \frac{Q_2}{A_W} = \frac{Q_2}{Q_1 Q_2} = \frac{273.15 + T_2}{T_1 T_2}$ 
    - ε : Coefficient of performance of refrigerator
  - Aw : Calorie equivalent to compression work kW
  - Q1 : Calorie being lost in condenser kW
  - Q2 : Refrigeration capacity (load) kW
  - T1 : Condensation temperature °C
  - T<sub>2</sub> : Evaporation temperature °C
- Refrigeration effect (Refrigeration capacity)  $q = i_2 i_1$ 
  - q : Refrigeration effect kJ/kg
  - i1 : Enthalpy of liquid just before expansion valve kJ/kg
  - i2 : Enthalpy of vapor coming out of evaporator kJ/kg
- Refrigerant circulation quantity G = 3,600 × Q/q
  - G : Refrigerant circulation quantity kg/h
  - Q : Refrigeration capacity kW
  - q : Refrigeration effect kJ/kg



- Water flow and water temperature difference
  - $Q = 1/60 \cdot \rho \cdot \alpha \cdot GW (t_1 t_2)$
  - Q : Refrigeration capacity kW
  - ρ : Specific gravity of water kg/m<sup>3</sup>
  - $\alpha$  : Specific heat of water J/K  $\cdot$  kg
  - Gw : Circulation water flow m³/min
  - $t_1$   $\ :$  Inlet temperature of water  $\ ^\circ C$
  - t2 : Outlet temperature of water  $\ ^{\circ}\text{C}$

### SATURATED VAPOUR PRESSURE (°C ↔ MPa (abs), °C ↔ kgf/cm<sup>2</sup> (abs))



### **REFRIGERATION UNITS**

The following description is quoted from JIS Z 8203. [International unit system (SI) and how to use it].

• For pressure, the gauge pressure is indicated by Pa and (abs) is added to the unit symbol in case of absolute pressure.

• The fundamental unit of temperature is K (Kelvin), but temperature is indicated by °C being used normally.

### Capacity

kJ/h	MJ/h	kW	kcal/h	US refrigeration ton (USRT)
1	1×10-³	2.77778×10 <sup>-₄</sup>	2.3889×10⁻¹	7.8998×10⁵
1×10 <sup>3</sup>	1	2.77778×10⁻¹	2.3889×10 <sup>2</sup>	7.8998×10 <sup>-₂</sup>
3.6×10³	3.6	1	8.6×10 <sup>2</sup>	2.8439×10⁻¹
4.18605	4.18605×10⁻₃	1.16279×10 <sup>-</sup> 3	1	3.3068×10-₄
1.26586×10⁴	1.26586×10	3.5163	3.024×10 <sup>3</sup>	1

#### Pressure

kPa	MPa	mmH₂O	kgf/cm <sup>2</sup>	mmHg
1	1×10-₃	1.01972×10 <sup>2</sup>	1.01972×10 <sup>-₂</sup>	7.50062
1×10 <sup>3</sup>	1	1.01972×10⁵	1.01972×10	7.50062×10 <sup>3</sup>
9.80665×10⁻₃	9.80665×10⁻⁰	1	1×10 <sup>-₄</sup>	7.35559×10 <sup>-₂</sup>
9.80665×10	9.80665×10⁻²	1×10⁴	1	7.35559×10 <sup>2</sup>
1.33322×10 <sup>-1</sup>	1.33322×10 <sup>-₄</sup>	1.35951×10	1.35951×10 <sup>_</sup>	1

### **CONVERSION TABLE**

Conversion method : A conversion value can be obtained by finding a converted value in I columns first, and then, reading its right (or left) column.

(Example) For converting MPa into kgf/cm<sup>2</sup> or converting kgf/cm<sup>2</sup> into MPa.

Example : 1kW ↔ 860kcal/h

Pressure conversion table (MPa ↔ kgf/cm<sup>2</sup>)

5MPa - 50,9860kgi/cm		5MPa	⇒	50,9860kgf/cm
----------------------	--	------	---	---------------

kgf/cm<sup>2</sup>

50.9860

t

5

				- I	Example :	1MPa ↔ 10	0.19	72kgf/cm <sup>2</sup>
MPa	t	kgf/cm <sup>2</sup>	MPa	t	kgf/cm <sup>2</sup>	MPa	t	kgf/cm <sup>2</sup>
0 0.0098067 0.0196113 0.0294200 0.0392266	0 0.1 0.2 0.3 0.4	0 1.01972 2.03944 3.05916 4.07888	0.0980665 0.1961330 0.2941995 0.3922660 0.4903325	1 2 3 4 5	10.1972 20.3944 30.5916 40.7888 50.9860	1.961330 2.941995 3.922660 4.903325 5.883990	20 30 40 50 60	203.944 305.916 407.888 509.860 611.832
0.0490333 0.0588399 0.0686466 0.0784532 0.0882599	0.5 0.6 0.7 0.8 0.9	5.09860 6.11832 7.13804 8.15776 9.17748	0.5883990 0.6864655 0.7845320 0.8825985 0.9806550	6 7 8 9 10	61.1832 71.3804 81.5776 91.7748 101.972	6.864655 7.845320 8.825985 9.806650	70 80 90 100	713.804 815.776 917.748 1019.72

Capacity conversion table (kW ↔ kcal/h)

kW	t	1000 kcal/h	kW	t	1000 kcal/h	kW	t	1000 kcal/h	kW	t	1000 kcal/h
0.166	0.1	0.086	1.162	1	0.86	11.62	10	8.6	116.2	100	86
0.232	0.2	0.172	2.325	2	1.72	23.25	20	17.2	232.5	200	172
0.348	0.3	0.258	3.488	3	2.58	34.88	30	25.8	348.8	300	258
0.465	0.4	0.344	4.651	4	3.44	46.51	40	34.4	465.1	400	344
0.581	0.5	0.430	5.813	5	4.33	58.13	50	43.3	581.3	500	433
0.697	0.6	0.516	6.976	6	5.16	69.76	60	51.6	697.6	600	516
0.813	0.7	0.602	8.139	7	6.02	81.39	70	60.2	813.9	700	602
0.930	0.8	0.688	9.302	8	6.88	93.02	80	68.8	930.2	800	688
1.046	0.9	0.774	10.46	9	7.74	104.6	90	77.4	104.6	900	774

In	mm	In	mm	In	mm	In	mm
1/8	3.18	1/32	0.79	1/64	0.40	33/64	13.10
1/4	6.35	3/32	2.38	3/64	1.19	35/64	13.89
3/8	9.53	5/32	3.97	5/64	1.98	37/64	14.68
1/2	12.70	7/32	5.56	7/64	2.78	39/64	15.48
5/8	15.88	9/32	7.14	9/64	3.57	41/64	16.72
3/4	19.05	11/32	8.73	11/64	4.39	43/64	17.07
7/8	22.23	13/32	10.32	13/64	5.16	45/64	17.86
1	25.40	15/32	11.91	15/64	5.95	47/64	18.65
1/16	1.59	17/32	13.49	17/64	6.75	49/64	19.45
3/16	4.76	19/32	15.08	19/64	7.54	51/64	20.24
5/16	7.94	21/32	16.67	21/64	8.33	53/64	21.04
7/16	11.11	23/32	18.26	23/64	9.13	55/64	21.83
9/16	14.29	25/32	19.84	25/64	9.92	57/64	22.62
11/16	17.46	27/32	21.43	27/64	10.72	59/64	23.42
13/16	20.64	29/32	23.02	29/64	11.51	61/64	24.21
15/16	23.81	31/32	24.61	31/64	12.30	63/64	25.00

Vacuum conversion tab	e (MPa ↔ MPa	a (abs) ↔ cmHgV	↔ kgf/cm² (abs))
-----------------------	--------------	-----------------	------------------

Example : -0.0667MPa ↔ 0.0347MPa (abs) ↔ 50cmHgV ↔ 0.3535kgf/cm<sup>2</sup> (abs)

MPa

0.4903325

Length conversion table (In ↔ mm)

5kgf/cm<sup>2</sup> → 0.4903325MPa

MPa	MPa (abs)	cmHg V	kgf/cm <sup>2</sup> (abs)	MPa	MPa (abs)	cmHg V	kgf/cm <sup>2</sup> (abs)	MPa	MPa (abs)	cmHg V	kgf/cm <sup>2</sup> (abs)	MPa	MPa (abs)	cmHg V	kgf/cm <sup>2</sup> (abs)
-0.1013	0	76	0	-0.0747	0.0267	56	0.2719	-0.0480	0.0533	36	0.5438	-0.0213	0.0800	16	0.8157
-0.0987	0.0027	74	0.0272	-0.0720	0.0293	54	0.2991	-0.0453	0.0560	34	0.5710	-0.0187	0.0827	14	0.8429
-0.0960	0.0053	72	0.0544	-0.0693	0.0320	52	0.3263	-0.0427	0.0587	32	0.5981	-0.0160	0.0853	12	0.8700
-0.0933	0.0080	70	0.0816	-0.0667	0.0347	50	0.3535	-0.0400	0.0613	30	0.6254	-0.0133	0.0880	10	0.8972
-0.0907	0.0107	68	0.1088	-0.0640	0.0373	48	0.3806	-0.0373	0.0640	28	0.6526	-0.0107	0.0907	8	0.9245
-0.0880	0.0133	66	0.1360	-0.0613	0.0400	46	0.4078	-0.0347	0.0667	26	0.6798	-0.0080	0.0933	6	0.9517
-0.0853	0.0160	64	0.1631	-0.0587	0.0427	44	0.4350	-0.0320	0.0693	24	0.7069	-0.0053	0.0960	4	0.9788
-0.0827	0.0187	62	0.1903	-0.0560	0.0453	42	0.4622	-0.0293	0.0720	22	0.7341	-0.0027	0.0987	2	1.0060
-0.0800	0.0213	60	0.2175	-0.0533	0.0480	40	0.4894	-0.0267	0.0747	20	0.7613	0	0.1013	0	1.0332
-0.0773	0.0240	58	0.2447	-0.0507	0.0507	38	0.5166	-0.0240	0.0773	18	0.7885				
0.0770	0.0240	50	0.2447	0.0007	0.0007	00	0.5100	0.0240	0.0770	10	0.7005				

### The following control devices are prepared for cooling system.

### Type YSK pressure sensor

- A voltage output type diffused semiconductor pressure sensor.
- Power voltage is 5V. DC or 12 to 24V. DC.
- A sensor equivalent to protective structure IP66 is also prepared.

### Type XSK pressure sensor

- A 2-wire current output type diffused semiconductor pressure sensor.
- A sensor equivalent to protective structure IP66 is also prepared.

### Type TNE temperature controller

- A small general-purpose, high-function digital temperature controller.
- Current output type and relay output type are available.
- A 2-contact output is provided for higher-limit/lower-limit alarm.

### Type LNE pulse converter

- This converter converts a current (4 to 20mA. DC) input into motor operated valve drive pulses.
- It can drive type EKV, PKV, BKV, and MKV motor operated valves.
- DIN rail mounting type.

### Type CFE digital pressure switch

- This electronic pressure switch can set a low pressure easily.
- A delay timer function is provided to prevent hunting effectively.
- A pressure display correction function and a forced turn-on function are provided.
- One-contact output.

### Type BFE digital pressure switch

- This electronic pressure switch can set a low pressure easily.
- A delay timer function is provided to prevent hunting effectively.
- A pressure display correction function and a forced turn-on function are provided.
- A two-contact output type and a one-contact output plus analog (0.5 to 5V. DC) output type are prepared, and 2-contact output + rotation function are provided.

### Type RGE fan speed controller

- This controller is used to control the number of revolutions of the fan motor for air-cooled system condensers.
- Single-phase type and 3-phase type products are prepared.
- Various products are prepared according to the refrigerants used and drive motor currents.

# SEMICONDUCTOR PRESSURE SENSOR

## Type **YSK**

- A compact, lightweight, high-precision diffusion type semiconductor pressure sensor.
- Voltage output type.

### **COMMON SPECIFICATIONS**

#### Airtight pressure : 3.75MPa

Overall accuracy : ±3%FS
(including non-linearity, temperature characteristic,
hysteresis, and reproducibility)

Liquid temperature : -20 to 70°C

Working ambient temperature : -20 to 70°C

Current consumption : 10mA (Max.)

Connection material : C3604 (SUS is also applicable)

Protective structure : Automobile standards S2 rank (water-proofing standard) : Equivalent to IP66

(A : Except open collector type)

1300

Main body color : Black

# • Since this sensor adopts a double diaphragm structure which fully seals the wetted portions with stainless steel diaphragms, it is applicable to various fluids.



### SPECIFICATIONS

		Output volt	age DC (V)	Load resistance (k Ω)		۱۸/+				
Tupo	Power veltage	Cable treatment	Pressure range	Connection	Numbor	Power voltage		Power voltage		$(k\alpha)$
Type Tower voltage		Cable treatment	(MPa)	Connection	Number	12 to 24V. DC	5V. DC	12 to 24V. DC	5V. DC	(rg)
		A : Open connector	10 : (-0.065) to 1	В		(0.75) to 5	(0.3) to 3.5			
YSK-		C :Drip-proof connector	20 : 0 to 2	F				F	447	
	A : 10.5 10 200. DC B : 5V DC + 5%	E:Lead wire direct	30 : 0 to 3	I	-***			5 (Min)	(Min)	0.08
	D. 5V. DO - 570	connection type	35 : 0 to 3.5	M		1105	0.5 10 3.5	(10111.)	(10111.)	
		(Water-proof type)	50 : 0 to 5	(L)					1	

Absolute pressure type.

DIMENSIONS

1 atmospheric pressure (1013hPa) is specified as 0MPa.

• 5V. DC type output changes in proportion to the power voltage.

• Brackets and open type 1300mm and drip-proof type 1000mm lead wires (with connector) are attached to standard product.

• No bracket is attached to E type (where the lead wire is connected directly).

### **CONNECTION APPLICATION TABLE**

	Matorials	Catalog No.		
Connection	and others	Connection type	Number	
7/16 20UNE	C3604	в	-107	
7/10-2001NI	SUS304	В	-103	
R1/8MPT			-901	
R1/4MPT	C3604		-902	
R3/8MPT		М	-903	
R1/8MPT			-904	
R1/4MPT	SUS304		-905	
R3/8MPT			-906	
1/4 flare female	No pin	F	-911	
1/4 flare female	With pin	I	-912	
Copper pipe	φ 6.35	D	-931	

 For the capillary type, please send us an order of type YSK pressure sensor and the accessory on page 52 (Number –107 or –103).



### WIRING DIAGRAM



# **PRESSURE SENSOR**

## Type XSK

- A compact, lightweight, high-precision diffusion type semiconductor pressure sensor.
- Current output type.

### **COMMON SPECIFICATIONS**

Airtight pressure : 3.75MPa					
Overall accuracy : ±3%FS (including non-linearity, temperature characteristic, hysteresis, and reproducibility)					
Liquid temperature : -20 to 70°C					
Working ambient temperature : -20 to 70°C					
Connection material : C3604 (SUS is also applicable)					
Protective structure : Automobile standards S2 rank (water-proofing standard) Equivalent to IP66					

• Since this sensor adopts a double diaphragm structure which fully seals the wetted portions with stainless steel diaphragms, it is applicable to various fluids.



### **SPECIFICATIONS**

Catalog No.							Load	Main	Airtight	۱۸/+
Туре	Power voltage	Cable treatment	Pressure range (MPa)	Connection	Number	current DC (mA)	resistance (Ω)	body color	pressure (MPa)	(kg)
			10 : (-0.065) to 1	B	-***	2.93 to 20	03 to 20 100 (Max.) at 12V to 20 500 (Max.)	Blue 3.75		
<b>XSK</b> – A :10.5 to 28V. DC	C: Drip-proof	20 : 0 to 2	, I	* * *		3.75			0.09	
			30 : 0 to 3	(L)		4 10 20	at 24V	Black		

· Absolute pressure type.

1 atmospheric pressure (1013hPa) is specified as 0MPa.

Brackets 1000mm lead wire (with connector) is attached to standard product.

### **DIMENSIONS**



#### Unit : mm

#### **CONNECTION APPLICATION TABLE** Т Catalog No.

	Matoriale	Catalog No.		
Connection	and others	Connection type	Number	
	C3604	D	-107	
7/10-200NF	SUS304	Б	-103	
R1/8MPT			-201	
R1/4MPT	C3604		-202	
R3/8MPT		54	-203	
R1/8MPT		IVI	-204	
R1/4MPT	SUS304		-205	
R3/8MPT			-206	
1/4 flare female	No pin	F	-211	
1/4 flare female	With pin	I	-212	
Copper pipe	\$ 6.35	D	-231	

· For the capillary type, please send us an order of type XSK pressure sensor and the accessory on page 52 (Number -107 or -103).

### **WIRING DIAGRAM**



# **TEMPERATURE CONTROLLER**

## Type **TNE**

- A general-purpose high-function digital temperature controller.
- · High-precision temperature control has been realized by com-
- bining this controller with a platinum temperature sensor.
- Setting system by ▲▼ keys every digit.

### **COMMON SPECIFICATIONS**

Power supply voltage : 100 to 240V. AC  $\pm 10\%$  50/60Hz

Power consumption : Lower than 10VA

Working ambient temperature : 0 to 50°C

Temperature sensor : Type PEK-02 (Pt100Ω)

### **SPECIFICATIONS**





Catalog No.Control MethodTemp. Soluting Range (°C)Contact OutputAlarm OutputProcess Variables (PV)Set Values (SV)Control OutputWt (kgTNE-SNPR-N112-position* -100 to 180SPDT (cos \$\not =1)SPST x 2 (cos \$\not =1)7-segment (cos \$\not =1)Red LED, x 3Red LED, x 30.11	Temp Setting								
<b>TNE-SNPR-N11</b> 2-position* * -100 to 180SPDT 250V. AC 3A $(\cos \phi = 1)$ SPST x 2 250V. AC 2A $(\cos \phi = 1)$ SPST x 2 250V. AC 2A $(\cos \phi = 1)$ Red LED x 3Red LED x 3Red LED x 3Red LED x 3No	Catalog No.	Control Method	Range (°C)	Contact Output	Alarm Output	Process Variables (PV)	Set Values (SV)	Control Output	Wt. (kg)
TNE-SNPA-N11PID $-100 \text{ to 180}$ Current 4 to 20mA. DC $2500. \text{ AC 2A}$ ( $\cos \phi = 1$ )green LED, 4 digitsred LED, 4 digitsx 30.1	TNE-SNPR-N11	2-position	*	SPDT 250V. AC 3A (cos <i>φ</i> =1)	SPST x 2	7-segment green LED, 4 digits	7-segment red LED, 4 digits	Red LED	0.17
(Load resistance: Lower than 600 Ω)	TNE-SNPA-N11	PID	-100 to 180	Current 4 to 20mA. DC (Load resistance: Lower than 600 Ω)	$(\cos \phi = 1)$			х З	0.17

\* Initial setting value. This is the temperature range of the temperature sensor to be connected.

· Various sensors are prepared according to uses. Please contact us separately.

## **DESCRIPTION OF FUNCTIONS**



sv

48

Temp

48



**Reverse** action







### MOUNTING SIZE

#### Panel cutout size



**STANDARD** ACCESSORY

#### Fixing bracket



Unit · mm

- 🗆 🗇 Red

/Solderless

terminal

- CC Blue

### **OPTION PART**

DIMENSIONS

Standard temperature sensor PEK-02H001

Temperature range : -70 to 140°C Resistance value :  $100\,\Omega(0^{\circ}C)$  JIS C 1604 class A



# **PULSE CONVERTER**

## Type LNE, BKV, MKV

- This converter converts a current input into a drive pulse output of a motor valve.
- This unit can control type EKV, PKV, BKV, and MKV motor valves.
- This unit converts a 4 to 20mA.DC input into a 0 to 480 pulses or 0 to 656 pulses.







Type MKV

### **SPECIFICATIONS**

### Controller

Catalog No. – Power Voltage		Input		Output	Sampling Time	Working	Wt.
Catalog No.	i ower vonage	Signal	Start	(12V. DC)	(sec)	(°C)	(kg)
LNE-ZN20-010	24V. AC 50/60Hz or 24V. DC ±10%	4 to 20mA. DC	No-voltage contact	0 to 480 pulses (for type EKV,PKV, BKV) or 0 to 656 pulses (for type MKV)	0.1, 1, 5, 10 selectable	-10 to 50	0.25

### Motor Valve

Catalog No.	Port Size (mm)	Flow coefficient (Cv value)	Max. operating Pressure (MPa)	Fully Open-Close Pulses	Exciting Method	Coil Current Value (12V. DC mA/phase)	Wt. (kg)
BKV–555DS	5.5	0.67	3.0	0 to 480	1 to 2 phases	375 -	0.8
MKV-1606DS	16.0	3.0	3.0	0 to 656	1 10 2 phases		1.1

For EKV and PKV types, refer to page 43-45.

### **DESCRIPTION OF OPERATION**



Pulse increases or decreases as the input current value increases.

### **WIRING DIAGRAM**



### SYSTEM CIRCUIT EXAMPLE



### **DIMENSIONS**

#### Controller



Туре	LI (M)
MKV–LK02N	2
MKV–LK05N	5
MKV–LK10N	10

# **DIGITAL PRESSURE SWITCH**

## Type **CFE**

- A fine low-pressure setting can easily be done by operating 3 push-button switches.
- A large easy-to-see LED indicator.
- A delay timer function is effective for preventing hunting.
- A pressure correction function and a forced turn-on function are provided.

C E mark applicable (available upon request) (200, 230V. AC type)

### **COMMON SPECIFICATIONS**

Contact capacity : 125/250V. AC 1A  $(\cos\phi=1)$  SPST Power consumption : Lower than 35VA On delay timer : 0 to 240sec. (step=1sec.) Fluid : Fluoro-carbon refrigerant, water, air Fluid temperature : -10 to 60°C Working ambient temperature : -10 to 60°C Display : Character height 14.3mm, red LED Connection : 1/4" male flare Protective structure : IP X 2



### **SPECIFICATIONS**

Catalog No.	Setting/Indicatio	Setting/Indication Range (MPa) Min. Max.		Calibration range (MPa)	Airtight Pressure (MPa)	Wt. (kg)
CFE-SC10B-001	-0.095	0.995	0.005	±0.03	0.75	
CFE-SC35B-001	0	3.5	0.02	±0.06	3.75	0.2
CFE-SC10B-101	–0.95 bar	9.95 bar	0.05 bar	±0.3 bar	27 E bor	0.3
CFE-SC35B-102	0 bar	35 bar	0.2 bar	±0.6 bar	37.5 Dai	

### WIRING DIAGRAM



Relay contacts show the power off condition. Arrow  $\uparrow\,$  shows the operating direction when pressure increases.

### **OPERATION**

### Delay timer operation pattern

#### During Set Low (LoC)





ON



Delay timer is reset if the pressure has become lower than the input pressure during delay timer operation.

### DIMENSIONS





### **STANDARD ACCESSORIES**

- 1/4" flare nut
- M4 x 8 screws, 4 pieces with spring washers
- Body mounting plate (Part No. Type SNS-AE01)



Unit : mm

### **OPTION PART**

#### Capillary assembly part



Туре	Size L (mm)			
SNS-AD01	1000			
SNS-AD02	1500			
SNS-AD03	2000			
SNS-AD06	1000, A pin is attached			
SNS-AD07	500			
SNS-AD10	500, A pin is attached			
SNS-AD12	1000, A pin is attached			

# **DIGITAL PRESSURE SWITCH**

## Type **BFE**

- A fine low-pressure setting can easily be done by operating 3 push-button switches.
- A large easy-to-see LED indicator.
- A delay timer function is effective for preventing hunting.
- A pressure correction function and a forced turn-on function are provided.
- 2-contact output product and analog output product are also available.



### **COMMON SPECIFICATIONS**

Contact capacity : 125/250V. AC 2A ( $\cos\phi=1$ )

Airtight pressure : 3.75MPa

Applicable fluid : Fluoro-carbon refrigerant, water, air

Fluid temperature : -10 to 60°C

Working ambient temperature : -10 to 60°C

Display : Character height 14.3mm, red LED

Connection : 1/4" Male flare

### **SPECIFICATIONS**

Catalog No.					Setting and	Setting and indicating	Delay timer	Pressure correction	Wt.
Туре	Output	Power supply	Pressure	Additional number	(MPa)	resolution (MPa)	(sec)	range (MPa)	(kg)
BFE-	S (2-contact output SPDT+SPST R (Rotation output SPDT+SPST A (Analog output SPDT+0.5 to 5V. DC)	A (200V.AC)	10B	-001	-0.095 to 0.995	0.005	0 to 200 (1-sec unit)	±0.03	0.37

### **WIRING DIAGRAM**



Relay contacts show the power off condition.

Arrow † shows the operating direction when pressure increases.

### **OPERATION**

### Delay timer function



Rotation function

The working rate of loads is averaged by alternately starting and stopping the loads connected to output 1 and output.

### DIMENSIONS



### **STANDARD ACCESSORIES**

- 1/4" flare nut
- M4 x 8 screws, 4 pieces with spring washers
- Body mounting plate (Part No. Type SNS–AE01)



Unit : mm

### **OPTION PART**

#### Capillary assembly part



Туре	Size L (mm)
SNS-AD01	1000
SNS-AD02	1500
SNS-AD03	2000
SNS-AD06	1000, A pin is attached
SNS-AD07	500
SNS-AD10	500, A pin is attached
SNS-AD12	1000, A pin is attached

# **CONDENSER FAN SPEED CONTROLLERS**

## Type **RGE**

- The most suitable for controlling the speed of a condenser fan of freezing and refrigeration condensing unit, package air conditioner and other units which are operated throughout a year.
- Keep condensing pressure constant in winter and intermediate seasons for stable operation.
- One of the following operation models is selectable when low speed. Minimum Speed Operation

Cut off Operation

- Excellent noise-resisting design.
- Protective device conforms to IP54.
- Applicable to the external forced operation switch.





State (available upon request)



Type RGE-Z1

Type RGE-Z3, RGE-X3

	*1 F.V.S. Setting (MPa)			*2 E.P.B.	Definements	Electrical		Function	Ambient	Opera-	Wt.
Catalog No.	Factory	Adjusting Range		(MPa)	Refrigerants	Ratnig		Function		tion	(kg)
	Set	Min.	Min. Max.				Ampere		(0)		
RGE-Z1N2-5	1.1	0.8	2.8	Fixed 0.4	R134a	Single phase 230V. AC 50Hz	0.2 to 4A	At approximately 45%, Cut Off or Minimum Speed function is selec- table with changeover switch. Default setting: Cut Off	–20 to 55	1	0.5
RGE-Z1N4-5	1.9				R22, R404A, R407C						
RGE-Z1N6-5	3.2	1.6	3.9	Fixed 0.8	R410A						
RGE-Z1P2-5	1.1	0.8	2.8	Fixed 0.4	R134a		0.2 to 6A				0.54
RGE-Z1P4-5	1.9				R22, R404A, R407C						
RGE-Z1P6-5	3.2	1.6	3.9	Fixed 0.8	R410A						
RGE-Z1Q2-5	1.1	0.8 2	20	Fixed 0.4	R134a		0.2 to 8A				0.58
RGE-Z1Q4-5	1.9		2.0		R22, R404A, R407C						
RGE-Z1Q6-5	3.2	1.6	3.9	Fixed 0.8	R410A						
RGE-Z1N2-6	1.1	0.0	0.0	Fixed 0.4	R134a	Single phase 230V. AC 60Hz	0.2 to 4A				0.5
RGE-Z1N4-6	1.9	0.0	2.0	FIXEU 0.4	R22, R404A, R407C						
RGE-Z1N6-6	3.2	1.6	3.9	Fixed 0.8	R410A						
RGE-Z1P2-6	1.1	0.0	20	Fixed 0.4	R134a		0.2 to 6A				0.54
RGE-Z1P4-6	1.9	0.0	2.0		R22, R404A, R407C						
RGE-Z1P6-6	3.2	1.6	3.9	Fixed 0.8	R410A						
RGE-Z1Q2-6	1.1	0.8 2.8	0.0	Fixed 0.4	R134a		0.2 to 8A				0.58
RGE-Z1Q4-6	1.9		2.0		R22, R404A, R407C						
RGE-Z1Q6-6	3.2	1.6	3.9	Fixed 0.8	R410A						
RGE-Z3R2-7	1.1	0.8	2.8	Fixed 0.4	R134a	Three phase 200 to 240V. AC 50/60Hz	- 0.2 to 5A	At approximately 35%, Cut Off or Minimum Speed function is selec- table with changeover switch.	-20 to 50	2	1.4
RGE-Z3R4-7	1.6				R22, R404A, R407C						
RGE-Z3R6-7	3.2	1.6	3.9	Fixed 0.8	R410A						
RGE-X3R2-7	1.1	0.8	2.0	Fixed 0.4	R134a	Three phase 380 to 415V.			-15 to 50		
RGE-X3R4-7	1.6		2.0		R22, R404A, R407C						
RGE-X3R6-7	3.2	1.6	3.9	Fixed 0.8	R410A	50/60Hz					

**SPECIFICATIONS** 

\*1 : The pressure at which the control delivers 95% output effective voltage (VRMS).

\*2 : Pressure width where effective voltage corresponds to the minimum speed or causes cut off operation

• Min. speed: Fan motor will be kept running at the specific value (V%) when pressure band increase more than E.P.B.

• Cut off: Fan motor will be stopped when pressure decrease to the specific value (V%) for R.M.S.

· For other pressure set values or min. speed/cut off set values, please contact us.

### **WIRING DIAGRAM**

Single-phase type





Use a forced operation switch with non-voltage contact signal.

#### **DESCRIPTION OF OPERATION**

2 Three-phase type



The operating characteristic may vary according to the voltage, frequency, and fan motor characteristics.

### **DIMENSIONS**







Three-phase type



## **BELLOWS**

## Type HBL & WSL



### Hydraulically–Formed Bellows Type HBL etc...

Hydraulically corrugated bellows made form a tin wall metal pipe. Material and specifications are selectable for applications. Match for mass production and quality are very stable.

Material example: Phosphor bronze, beryllium bronze, stainless steel, hastelloy, inconel, aluminum and etc ...



Welding Bellows	Type WSL etc

Bellows made from precision-made tin wall metal rings. Suitable for extremely precision use. Material is selectable for applications.

Material example : Stainless steel, monel metal, titanium, hastelloy, inconel, nickel and etc so on.



### Welding Bellows for vacuum use (S seris)

Welding bellows for low pressure and long stroke use. Main Characteristic : Using anticorrosion material SUS316L. Long stroke structure. With End Fittings for easy to install. Low price and fast delivery.



### Applications

Aerospace, marine, chemical, refrigeration, air conditioning, electric, construction, medical and other various kinds of industries. Bellows assembly parts that with fittings also can be provided.