

FCX – AX SERIES LEVEL TRANSMITTER

DATA SHEET

FHE, FKE...3

The FCX-AX level transmitter accurately measures liquid level and transmits a proportional 4 to 20mA signal. The transmitter utilizes a unique micromachined capacitance silicon sensor with state-of-the-art microprocessor technology to provide exceptional performance and functionality.

FEATURES

- High accuracy**
0.2% accuracy for all calibrated spans is a standard feature for all models covering 3.2kPa{32mbar} range to 500kPa{5bar} high differential pressure range. 0.1% accuracy is available as option. Fuji's micro-capacitance silicon sensor assures this accuracy for all elevated or suppressed calibration ranges without additional adjustment.
- Minimum environmental influence**
The "Advanced Floating Cell" design which protects the pressure sensor against changes in temperature, static pressure, and overpressure substantially reduces total measurement error in actual field applications.
- Replaceable Communication Module**
Fuji micro-electronics manufacturing technology offers replaceable communication module that makes FCX-AX transmitter very unique in design. In case of change in communication protocol, all that needs to be done is just to replace the module and the transmitter gets upgraded to the new version.
- Fuji/HART bilingual communication module**
The communication module is "bilingual" to speak both Fuji proprietary protocol and HART. Any HART compatible devices can communicate with FCX-AX series transmitters.
- Application flexibility**
Various options that render the FCX-AX suitable for almost any process applications include:
 - Analog indicator at either the electronics side or terminal side
 - Full range of hazardous area approvals
 - Built-in RFI filter and lightning arrester
 - 4½ digits LCD meter
 - Stainless steel electronics housing
 - Wide selection of materials
 - High temperature, high vacuum service.
- Programmable output Linearization Function**
In addition to Linear and Square Root, output signal can be freely programmable.
(Up to 14 compensated points at approximation.)
(Available for amplifier unit from version 24 and FXW(HHC) version 5.3.)



- Burnout current flexibility (Under Scale: 3.2 to 3.8mA, Over Scale: 20.8 to 21.6mA)**
Burnout signal level is adjustable using Model FXW hand Held Communicator (HHC) to comply with NAMUR NE43. (Available for amplifier unit from version 24 and FXW (HHC) version 5.3.)
- Dry calibration without reference pressure**
Thanks to the best combination of unique construction of mechanical parts (Sensor unit) and high performance electronics circuit (Electronics unit), reliability of dry calibration without reference pressure is at equal level as wet calibration.

SPECIFICATIONS

Functional specifications

Type:
Model FHE: 4 to 20mA
Model FKE: 4 to 20mA with digital signal

Service: Liquid, gas, or vapour

Static pressure, span, and range limit:

Type	Static pressure	Span limit [kPa] {m bar}			Range limit [kPa] {m bar}
		Min.		Max.	
		FHE	FKE	FHE/FKE	
F□E□□3	Up to flange rating	3.2 {32}	0.32 {3.2}	32 {320}	+/- 32 {+/- 320}
F□E□□5		13 {130}	1.3 {13}	130 {1300}	+/- 130 {+/- 1300}
F□E□□6		50 {500}	5 {50}	500 {5000}	+/- 500 {+/- 5000}

Remark: To minimize environmental influence, span should be greater than 1/40 of the max. span in most applications.

- Lower limit of static pressure (vacuum limit) ;
Silicone fill sensor: See Fig . 1
Fluorinated fill sensor: 66kPa abs (500mmHg abs) at temperature below 60 °C.
- The maximum span of each sensor can be converted to different units using factors as below.
1MPa=10³kPa=10bar=10.19716kgf/cm²=145.0377psi
1kPa=10mbar=101.9716mmH₂O=4.01463inH₂O

Overrange limit: To maximum static pressure limit

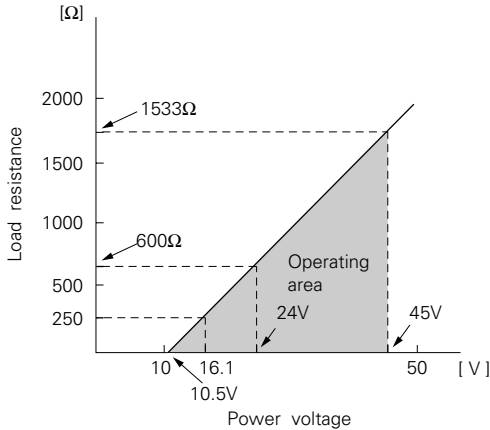
Output signal:

Model FHE: 4 to 20mA DC 2-wire, linear signal

Model FKE: 4 to 20mA DC with digital signal superimposed on the 4 to 20mA signal

Power supply: Transmitter operates on 10.5V to 45V DC at transmitter terminals.
10.5V to 32V DC for the units with optional arrester.

Load limitations: see figure below



Note: For communication with HHC (Model: FXW), min. of 250Ω required.

Hazardous locations: (Approval pending)

Authorities	Flameproof	Intrinsic safety	Type N Nonincendive
BASEEFA Factory Mutual	Ex ds IIC T5, T6 Class I II III Div. 1 Groups B thru. G	EEx ia IIC T4, T5 Class I II III Div. 1 Groups A thru. F	Ex N II T5 Class I II III Div. 2 Groups A thru. G
CSA	Class I II III Div. 1 Groups C thru. G	Class I II III Div. 1 Groups A thru. G	Class I II III Div. 2 Groups A thru. G
RIIS SAA	Ex ds IIB+H ₂ T4 Ex d II C T5, T6 IP 66/67	Ex ia II C T5, T6 IP 66/67	Ex n II C T5, T6 IP 66/67

Zero/span adjustment:

Model FHE: Zero is adjustable externally from the adjustment screw (UP and DOWN).

The adjustment screw can also function to adjust span when MODE SWITCH (located on the electronics unit) is in the span mode. INHIBIT mode to disable the adjustment screw is also available.

Model FKE: Zero and span are adjustable from the HHC. Zero is also adjustable externally from the adjustment screw.

Damping: Adjustable electrical damping.

Model FHE: The time constant is adjustable to 0, 0.3, 1.2, 4.8, or 19.2 seconds.

Model FKE: The time constant is adjustable between 0 to 38.4 seconds.

Zero elevation/suppression:

- 100% to + 100% of URL

Normal/reverse action:

Model FHE: Selectable by moving a jumper pin located on the electronics unit.

Model FKE: Selectable from HHC

Indication: Analog indicator or 4½-digit LCD meter, as specified.

Burnout direction: If self-diagnostic detect transmitter failure, the analog signal will be driven to either "Output Hold", "Output Overscale" or "Output Underscale" modes.

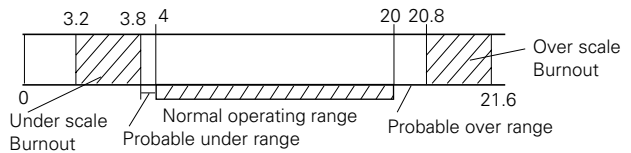
Model FHE: Unless otherwise specified in the order, the transmitter will be shipped in "Output Hold" mode.
(Output signal just before failure happens is maintained.)

Model FKE: Selectable from HHC

"Output Hold":
Output signal is hold as the value just before failure happens.

"Output Overscale":
Approx. 21.6mA
(Adjustable within the range 20.8mA to 21.6mA from HHC)

"Output Underscale":
Approx. 3.8mA
(Adjustable within the range 3.2mA to 3.8mA from HHC)



Loop-check output:

Model FHE: Transmitter can output constant signal of 4mA, 12mA, or 20mA if MODE SWITCH is set to the loop check mode.

Model FKE: Transmitter can be configured to provide constant signal 3.8mA through 21.6mA by HHC.

Temperature limit:

Ambient: - 40 to + 85°C

(- 20 to + 80°C for LCD indicator)

(- 40 to + 60°C for arrester option)

(- 10 to + 60°C for fluorinated oil fill transmitter)

For explosionproof units (flameproof or intrinsic safety), ambient temperature must be within the limits specified in each standard.

Process:

Fill fluid	Code in the 13th digit of "Code symbols"	Process temperature	Lower limit of static press
Fluorinated oil	W, A and D	-20 to 120°C	Atmospheric pressure
Silicone oil	H	-15 to 250°C	
	J	85 to 300°C	2.7kPa abs (20.3mmHg abs)
	Y and G	-40 to 120°C	
	S	-15 to 250°C	
	T	85 to 300°C	
	K	-15 to 150°C	0.13kPa abs (0.98mmHg abs)

Low pressure side contact liquid temperature on transmitter of Code H, J, S, T is 120°C or lower. Low pressure side contact liquid temperature of Code K is 85°C or lower

Storage: - 40 to + 90°C

Humidity limit: 0 to 100% RH

Communication: (Model FKE only)

With HHC (Model FXW, consult Data Sheet No. EDS8-47), following information can be remotely displayed or reconfigured.

Items	Display	Set
Tag No.	✓	✓
Model No.	✓	✓
Serial No.	✓	—
Engineering unit	✓	✓
Range limit	✓	—
Measuring range	✓	✓
Damping	✓	✓
Output mode	✓	✓
Burnout direction	✓	✓
Adjustment	✓	✓
Output adjust	—	✓
Data	✓	—
Self diagnoses	✓	—
Printer	—	—
External switch lock	✓	✓
Transmitter display (*)	✓	✓
Linearise (**)	✓	✓
Rerange (**)	✓	✓

(*) HHC's version must be more than 5.0 (or FXW □□□□1-□2), to use this function.
 (**) HHC's version must be more than 5.3, and Amplifier unit version 24.

Programmable output linearization function:

In smart version, output signal can be characterized with "14 points linear approximation function" from HHC.

Performance specifications

Accuracy rating: (including linearity, hysteresis, and repeatability)

(Standard)

For spans greater than 1/10 of URL: ±0.2% of span
 For spans below 1/10 of URL (Model FKE only):

$$\pm \left(0.1 + 0.1 \frac{0.1 \times \text{URL}}{\text{Span}} \right) \% \text{ of span}$$

(Option)

For span greater than 1/10 of URL: 0.1% of span
 For span below 1/10 of URL (Model FKE only):

$$\pm \left(0.05 + 0.05 \frac{0.1 \times \text{URL}}{\text{Span}} \right) \% \text{ of span}$$

Linearity: 0.1% of calibrated span

Stability: ±0.2% of upper range limit (URL) for 24 months

Temperature effect:

Effects per 28°C change between the limits of -40°C and +85°C

(Standard) Zero shift: ±0.35% of URL

Total effect: ±0.5% of URL

(Option) Zero shift: ±0.25% of URL

Total effect: ±0.275% of URL

Static pressure effect:

Zero shift: ±0.2% of URL for flange rating pressure

Span shift: -0.2% of calibrated span for flange rating pressure

Double the zero shift for material code (7th digit in "Code symbols") "H", "M", "T", "B", "L", "U", "P" and "R".

Overrange effect: Zero shift; ±0.3% of URL for flange rating pressure

Double the effects for material code "H", "M", "T", "B", "L", "U", "P" and "R".

Supply voltage effect:

Less than 0.05% of calibrated span per 10V

RFI effect:

Less than 0.2% of URL for the frequencies of 20 to 1000MHz and field strength 30 V/m when electronics covers on.

(Classification: 2-abc: 0.2% span per SAMA PMC 33.1)

Range code	Time constant	Dead time
"3"	0.55 s	approx. 0.3 s
"5" and "6"	0.3 s	

Step response: (without electrical damping)

Mounting position effect:

Zero shift, less than 0.3kPa(3m bar) for a 10° tilt in any plane. (No extension)

No effect on span.

This error can be corrected by adjusting zero.

(Double the effect for fluorinated fill sensors)

Dielectric strength:

500V AC, 50/60Hz 1 min., between circuit and earth.

Insulation resistance:

More than 100MΩ at 500V DC.

Turn-on time: 4 sec

Internal resistance for external field indicator:

12Ω or less

Physical specifications

Electrical connections:

G1/2, 1/2-14 NPT, Pg13.5, or M20 x 1.5 conduit, as specified.

Process connections:

LP side: 1/4-18 NPT or Rc1/4.
 HP side: ANSI, DIN, or JIS raised face flange. See OUTLINE DIAGRAM for detailed dimensions.
 Refer to "Code symbols"

Process-wetted parts material:

Material code (7th figure in "Code symbols")	LP side			HP side
	Process cover	Diaphragm	Wetted sensor body	Diaphragm & flange face
V	316 stainless steel (*2)	316L stainless steel	316 stainless steel	316L stainless steel
H	316 stainless steel (*2)	Hastelloy-C	Hastelloy-C lining	Hastelloy-C
M	316 stainless steel (*2)	Monel	Monel lining	Monel
T	316 stainless steel (*2)	Tantalum	Tantalum lining	Tantalum
B	Hastelloy-C lining	Hastelloy-C	Hastelloy-C lining	Hastelloy-C
L	Monel lining	Monel	Monel lining	Monel
U	Tantalum lining	Tantalum	Tantalum lining	Tantalum
P	316 stainless steel (*2)	Titanium	Titanium	Titanium
R	316 stainless steel (*2)	Zirconium	Zirconium	Zirconium

* (1) Sensor O-rings: Viton or teflon selectable
 (2) SCS14 Per JIS G5121

Non-wetted parts material:

Electronics housing: Low copper die-cast aluminum alloy (standard), finished with polyester coating, or 316 stainless steel (SCS14 per JIS G5121), as specified.
 Bolts and nuts: Cr-Mo alloy (standard) or 304 stainless steel
 Fill fluid: Silicone oil (standard) or fluorinated oil (Daifloil)
 Mounting flange: Carbon steel or 304 stainless steel, as specified

Environmental protection:

IEC IP67 and NEMA 4X

Flange mounting: See drawings

Mass{weight}: Transmitter approximately 13kg without options.

- Add; 0.5kg for mounting bracket
- 0.8kg for indicator option
- 4.5kg for stainless steel housing option
- 1.0kg per 50mm extension of diaphragm

Optional features

Indicator: A plug-in analog indicator (1.5% accuracy) can be housed in the electronics compartment or in the terminal box of the housing.
 An optional 4 1/2 digits LCD meter is also available.

Arrester: A built-in arrester protects the electronics from lightning surges.

Lightning surge immunity: 4KV (1.2 x 50µs)

Oxygen service: Special cleaning procedures are followed throughout the process to maintain all process wetted parts oil-free. The fill fluid is fluorinated oil.

Chlorine service: Oil-free procedures as above. Includes fluorinated oil for fill.

Degreasing: Process-wetted parts are cleaned, but the fill fluid is standard silicone oil. Not for use on oxygen or chlorine measurement.

Vacuum service: Special silicone oil and filling procedure are applied. See below figure.

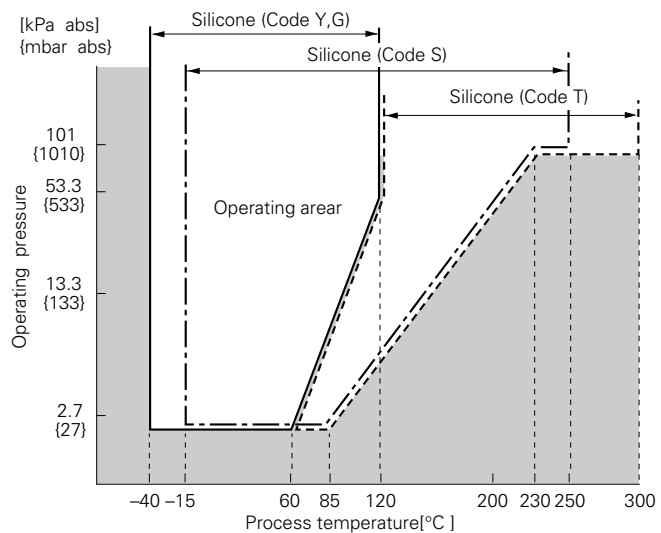


Fig. 1 Relation between process temperature and operating pressure

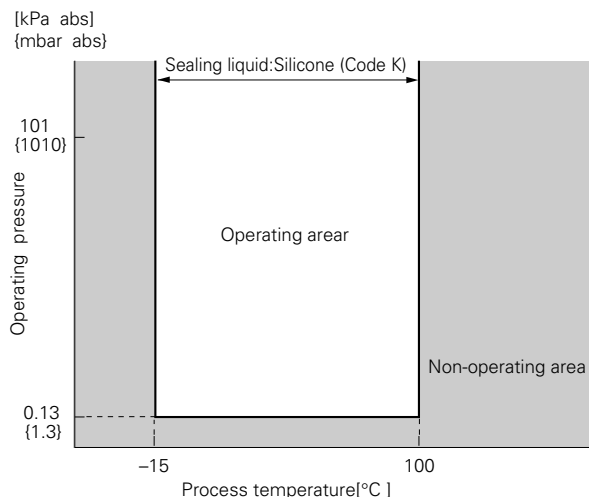


Fig. 2 Relation between process temperature and operating pressure

- Customer tag:** A stainless steel tag with customer tag data is wired to the transmitter.
- Coating of cell:** Cell's surface is finished with epoxy/polyurethane double coating.
Specify if environment is extremely corrosive.

ACCESSORIES

Oval flanges: (Model FFP, refer to Data Sheet No. EDS6-10)
Converts process connection to 1/2-14 NPT or to Rc1/2; in carbon steel or in 316 stainless steel.

Hand held communicator:
(Model FXW, refer to Data Sheet No. EDS 8-47)

Communication module: (Standard for model FKE)
By adding communication module, remote setting function becomes available for model FHE.

Remark: When the communication module is connected, the operation mode of external zero/span adjustment screw is limited to zero adjustment only.

The product conforms to the requirements of the Electromagnetic compatibility Directive 89/336/EEC as detailed within the technical construction file number TN510412. The applicable standards used to demonstrate compliance are :-

EMI (Emission) EN50081-1 : 1992

Test item	Frequency range	Basic standard
Applicable Electromagnetic Radiation Disturbance	30-1000MHz	EN55022 Class B

EMS (Immunity) EN50082-1 : 1992

No.	Test item	Test specification	Basic standard	Performance criteria
1	Electrostatic discharge	8kV (Air)	IEC 801-2:1984	B
2	Radio-frequency electromagnetic field.	27-500MHz 3V/m (Unmodulated)	IEC 801-3:1984	A
3	Fast transients common mode	0.5kV, 5/50 (Tr/Th) ns 5kHz Rep.	IEC 801-4:1988	B

"LVD - The transmitter is not covered by the requirements of the LVD standard."

CODE SYMBOLS

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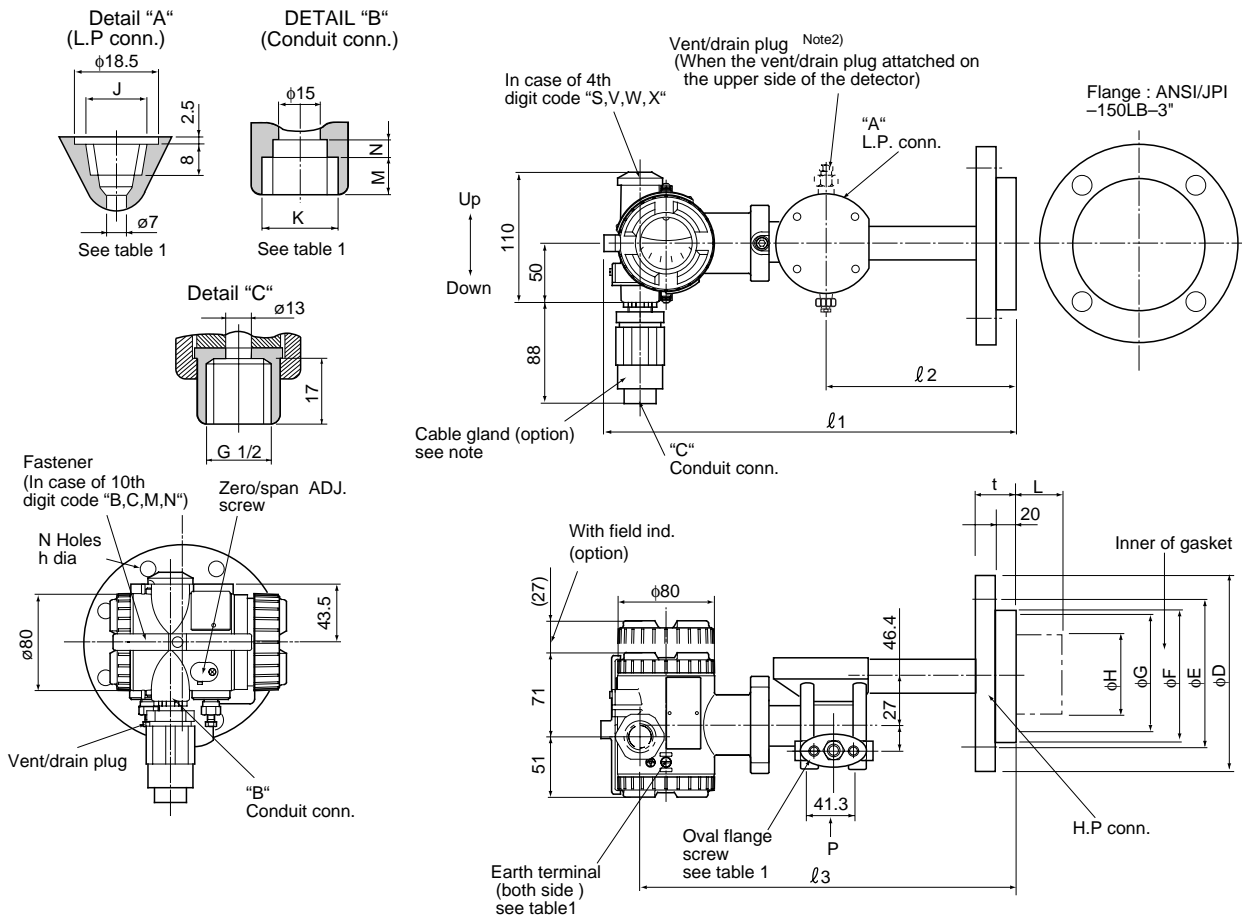
Notes: * (1) 100; 1 turn down is possible for model FKE, but should be used at a span greater than 1/40 of the maximum span for better performance.
 (2) In case of 6th digit code "6", LP side diaphragm is Hastelloy-C.
 (3) Material Code R; 6th digit code "6" is not available.

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
F	H	E					3							
F	K	E					3							

		Description		
Indicator and arrester				
	Indicator			Arrester
A	None			None
B	Analog, 0 to 100% linear scale			None
D	Analog, custom scale			None
J	Analog, double scale			None
E	None			Yes
F	Analog, 0 to 100% linear scale			Yes
H	Analog, custom scale			Yes
K	Analog, double scale			Yes
L	Digital, 0 to 100%			None
P	Digital, custom scale			None (Model FKE only)
Q	Digital, 0 to 100%			Yes
S	Digital, custom scale			Yes (Model FKE only)
Approvals for hazardous locations (Approval pending)				
A	None (for ordinary locations)			
B	JIS, Flameproof (Conduit seal)		(Available for 4th digit code "S")	
C	JIS, Flameproof (Cable gland seal)		(Available for 4th digit code "S")	
D	FM, Flameproof (or explosionproof)		(Available for 4th digit code "T")	
E	CSA, Flameproof (or explosionproof)		(Available for 4th digit code "T")	
M	BASEEFA, Flameproof (Conduit seal)			
N	BASEEFA, Flameproof (Cable gland seal) (Conduit connection G 1/2 only)			
H	FM, Intrinsic safety and nonincendive			
J	CSA, Intrinsic safety and nonincendive			
K	CENELEC, Intrinsic safety			
P	CENELEC, Intrinsic safety and BASEEFA, Type N			
R	SAA Flameproof (Conduit seal)(Available for 4th digit cord ("S,T,W))			
T	SAA Intrinsic safety (Available for 4th digit cord ("S,T,W))			
Q	SAA Type-N (non-sparking)(Available for 4th digit cord ("S,T,W))			
Diaphragm extension [mm]				
	<u>Extension [mm]</u>		<u>Applicable material code</u>	
Y	0		Any	
A	50	}	(7th digit code "V" only)	
B	100			
C	150			
D	200			
E	50	}	(7th digit code "H" or "B" only)	
F	100			
G	150			
H	200			
Stainless steel parts				
	Stainless steel tag plate	Stainless steel elec. housing	Coating of cell	
Y	None	None	None	
B	Yes	None	None	
C	None	Yes	None	
E	Yes	Yes	None	
M	None	None	Yes	
N	Yes	None	Yes	
P	None	Yes	Yes	
Q	Yes	Yes	Yes	
Special applications and fill fluid				
	Treatment		Fill fluid	
Y	None (standard)		Silicone oil	
W	None (standard)		Fluorinated oil	
G	Degreasing		Silicone oil	
A	Oxygen service		Fluorinated oil (7th digit code "V" only)	
D	Chlorine service		Fluorinated oil (7th digit code "H", "T", "B" and "U")	
H	High temp. 250°C	}	7th digit code "V"	(*1)
J	High temp. 300°C			
S	High temp. and vacuum (250°C)			
T	High temp. and vacuum (300°C)			
K	High temp. and high vacuum		Silicone oil	
O-ring and Teflon membrane				
	O-ring	Teflon membrane		
A	Viton	None		
B	Teflon	None		
C	Viton	Yes	(5th digit code "0", "2", "4", "6", "8", "A", "C", "E", "G", "J", and 11th digit code "Y")	
D	Teflon	Yes		
Bolt/nut				
A	Cr-Mo alloy hexagon socket head cap screw/carbon steel nut			
B	Cr-Mo alloy hexagon bolt/nut			
E	304 stainless steel/304 stainless steel (*2)			

Notes: * (1) Treatment; None
 (2) In case of tropical use, select a stainless bolts and nuts.

OUTLINE DIAGRAM (Unit:mm)



11th digit code	L (mm)	Mass.approx (kg)	l1	l2	l3
Y	0	9.5 to 13	355	150	325
A	50	10 to 17	349	144	319
B	100	10.5 to 17.5			
C	150	11 to 18			
D	200	11.5 to 18.5			

ϕD	ϕE	ϕF	ϕG	ϕH	t	N - ϕh	Flange
185	150	126	100	73	38	8-19	JIS-10K-80A
210	175	151	103	96	38	8-19	JIS-10K-100A
210	170	126	100	73	48	8-23	JIS-30K-80A
240	195	151	103	96	52	8-25	JIS-30K-100A
191	152.5	126	100	73	44	4-20	ANSI/JPI-150LB-3"
229	190.5	151	103	96	44	8-20	ANSI/JPI-150LB-4"
210	168	126	100	73	49	8-23	ANSI/JPI-300LB-3"
254	200	151	103	96	52	8-23	ANSI/JPI-300LB-4"
200	160	126	100	73	44	8-18	DIN PN40 DN80
220	180	151	103	96	40	8-18	DIN PN16 DN100

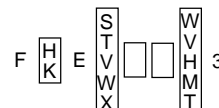
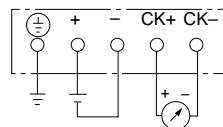
4th digit code	Conduit conn.			Press. conn. H	Oval flange screw	Earth terminal
	D	E	F			
S	G1/2	17	8	Rc1/4	7/16-20UNF Screw depth13	M4
T	1/2 -14NPT	16	5	1/4-18NPT	7/16-20UNF Screw depth13	No. 8-32UNC
V	Pg13.5	8	4.5	1/4-18NPT	M10 Screw depth13	M4
W	M20 x 1.5	16	5	1/4-18NPT	7M10 Screw depth13	M4
X	Pg13.5	8	4.5	1/4-18NPT	7/16-20UNF Screw depth13	M4

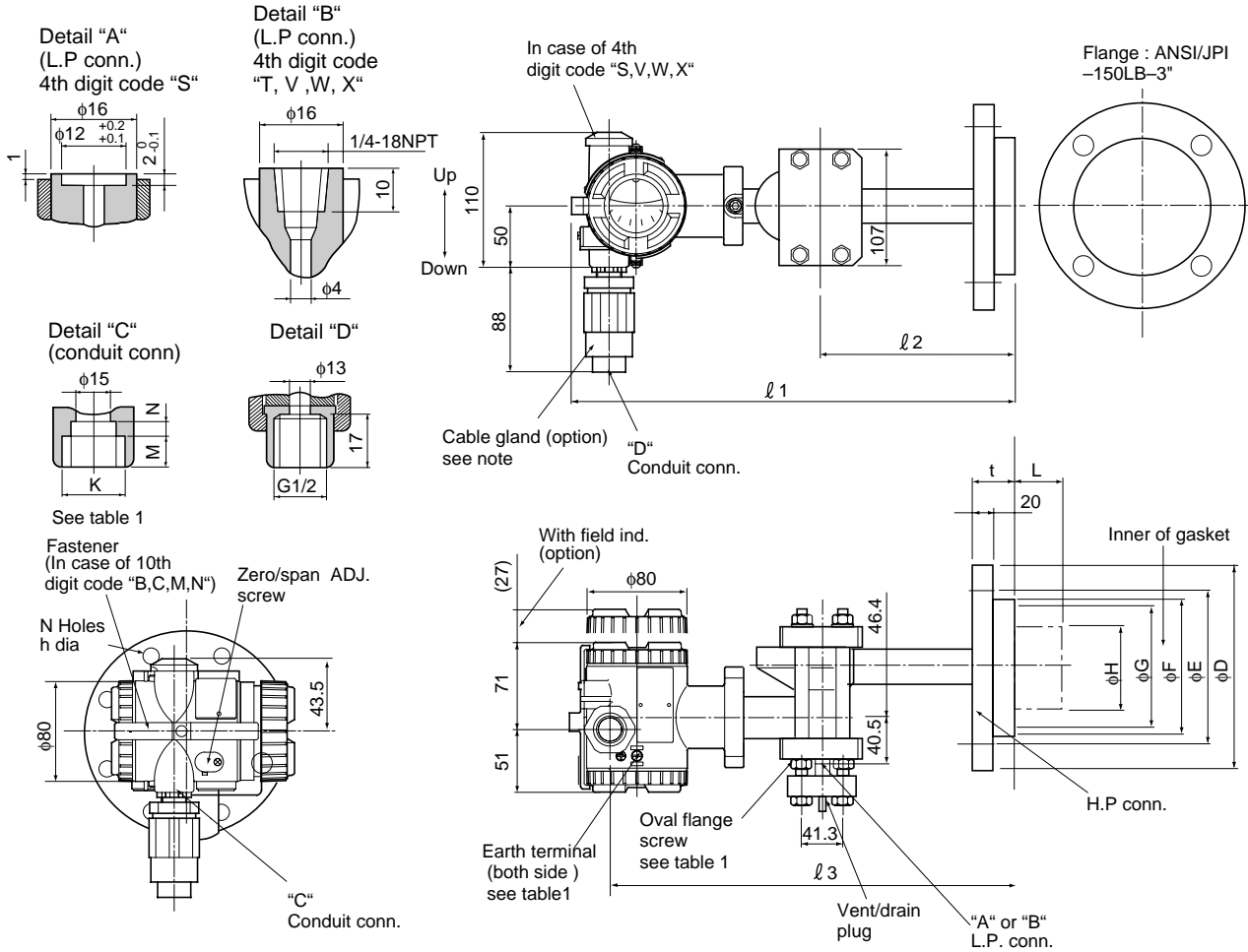
Table 1

Note1) : Cable gland is supplied in of flameproof packing type. $\phi 11$ cable is suitable.

Note2) : The pressure connention is loated on the down side surfaace of the detector, when the vent/dranplug is attached on the upper (when the 21th digit of the code symbols : C,E or D.)

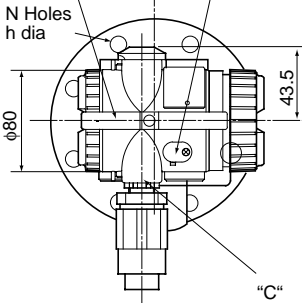
CONNECTION DIAGRAM





See table 1

Fastener
(In case of 10th digit code "B,C,M,N")
Zero/span ADJ. screw



"C"
Conduit conn.

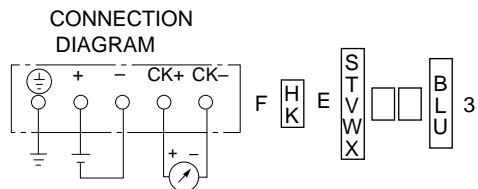
11th digit code	L (mm)	Mass. approx (kg)	l1	l2	l3
Y	0	9.5 to 13	323	150	325
A E	50	10 to 17	317	144	319
B F	100	10.5 to 17.5			
C G	150	11 to 18			
D H	200	11.5 to 18.5			

4th digit code	Conduit conn.			Press. conn.	Oval flange screw	Earth terminal
	D	E	F	H		
S	G1/2	17	8	Rc1/4	7/16-20UNF Screw depth13	M4
T	1/2 -14NPT	16	5	1/4-18NPT	7/16-20UNF Screw depth13	No. 8-32UNC
V	Pg13.5	8	4.5	1/4-18NPT	M10 Screw depth13	M4
W	M20 x 1.5	16	5	1/4-18NPT	7M10 Screw depth13	M4
X	Pg13.5	8	4.5	1/4-18NPT	7/16-20UNF Screw depth13	M4

φD	φE	φF	φG	φH	t	N-φh	Flange
185	150	126	100	73	38	8-19	JIS-10K-80A
210	175	151	103	96	38	8-19	JIS-10K-100A
210	170	126	100	73	48	8-23	JIS-30K-80A
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191	152.5	126	100	73	44	4-20	ANSI/JPI-150LB-3"
229	190.5	151	103	96	44	8-20	ANSI/JPI-150LB-4"
210	168	126	100	73	49	8-23	ANSI/JPI-300LB-3"
254	200	151	103	96	52	8-23	ANSI/JPI-300LB-4"
200	160	126	100	73	44	8-18	DIN PN40 DN80
220	180	151	103	96	40	8-18	DIN PN16 DN100

Note) : Cable gland is supplied in case of flameproof packing type.
φ11 cable is suitable.

Table 1



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