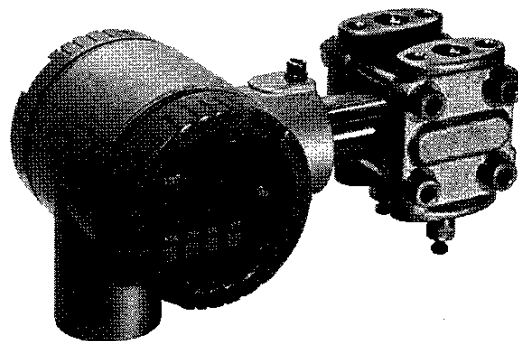


# OPTICAL DIFFERENTIAL PRESSURE/ FLOW TRANSMITTER

The model FFK 2 Optical Differential Pressure/Flow Transmitter is a precision, electrostatic capacitance type instrument used for measuring differential pressures and flow rates of various fluids. The transmission unit incorporates a micro-processor for digital signal processing to attain highly accurate measurements.

A fiber optic cable used for the signal transmission line forms an optical field instrumentation system together with an optical star coupler and a master station.

An 6mm dia. optical fiber cable is connected to the instrument.



## SPECIFICATIONS

### Functional specifications

Fluids measured: Liquid, gas or steam

Measuring range and operating pressure:

Type	Operating pressure [MPa] [kgf/cm <sup>2</sup> ]	Span [kPa] (mmH <sub>2</sub> O)	Range limits [kPa] (mmH <sub>2</sub> O)	
			Lower range limit	Upper range limit
FFKS11	-0.1 to +3.2 (-1.0 to +32.6)	0.1...1 (or 10...100)	-1 (-100)	1 (100)
FFKS12		0.6...6 (or 60...600)	-6 (-600)	6 (600)
FFKS23	-0.1 to +10 (-1.0 to +102)	3.2...32 (or 320...3200)	-32 (-3200)	32 (3200)
FFKS24		6.4...64 (or 640...6400)	-64 (-6400)	64 (6400)
FFKS25		13...130 (or 1300...13000)	-130 (-13000)	130 (13000)
FFKS26		50...500 (or 5000...50000)	-50 (-50000)	50 (50000)
FFKS33	-0.1 to +16 (-1.0 to +163.2)	3.2...32 (or 320...3200)	-32 (-3200)	32 (3200)
FFKS34		6.4...64 (or 640...6400)	-64 (-6400)	64 (6400)
FFKS35		13...130 (or 1300...13000)	-130 (-13000)	130 (13000)
FFKS36		50...500 (or 5000...50000)	-500 (-50000)	500 (50000)
FFKS38		300...3000 (or 30000...300000)	-3000 (-300000)	3000 (300000)
FFKS43	-1.0 to +42 (-1.0 to +428.3)	3.2...32 (or 320...3200)	-32 (-3200)	32 (3200)
FFKS44		6.4...64 (or 640...6400)	-64 (-6400)	64 (6400)
FFKS45		13...130 (or 1300...13000)	-130 (-13000)	130 (13000)
FFKS46		50...500 (or 5000...50000)	-500 (-50000)	500 (50000)
FFKS47		200...2000 (or 20000...200000)	-2000 (-200000)	2000 (200000)

Process pressure limit:

For details, refer to Fig.1 on page 3

Fill-fluid	Code	Process temperature [*°C]	Allowable pressure limit
Silicon oil(*1)	Y,G,N	-40 to +120°C	2.7kPa abs (20.3mmHg abs)
Fluorolube oil	W,A,D	-20 to +80°C	0kPa (0kgf/cm <sup>2</sup> )
Silicon oil	R	-15 to +120°C	2.7kPa abs (20.3mmHg abs)

Note: \*

(1) In case of FFK38 or FFK47, use under allowable pressure is not allowed (Codes Y, G, N). When using under allowable pressure, specify code R.

(2) Wetted process temperature in intrinsic safety ...-10 to +80°C

**Output:** Linear or square-root extraction output  
(optical digital output)

**Square-root extraction output:**

Low flow cut point: 7% (differential pressure 0.5%)

**Power supply:** Built-in lithium battery (expected life about 2 years)

**Setting:**

Item	Remote setting	Direct setting
Details	1. Measuring range 2. Damping(*1) 3. Read from, write in transmitter inside memory	1. Measuring range 2. Damping(*1)
Setter	By HHC(*2), MS(*2)	By indication unit

Notes :\*

(1) Damping 0.2 to 51.2sec

(2) HHC: Hand held communicator

MS: Master station

(see System block diagram on page 3)

**Zero elevation and suppression:**

From -100% to +90% of upper range limit

**Self-diagnosis:** Displayed on indication unit (option) and transmitted to master station.

Diagnosis item	HHC, MS	Indicating unit
Measuring range abnormal	○	○
Detecting unit failure	○	○
Battery voltage low	○	○
Battery voltage	○	-
Amplifier ambient temperature	○	-

**Explosion-proof:** JIS i3aG4. Safety barriers are not necessary.

**Ambient temperature:**

-30 to +70°C  
 (-10 to +60°C for intrinsic safety explosion-proof type)  
 (-10 to +60°C when filled with fluorolube oil)

**Storage temperature:**

-30 to +70°C

**Ambient humidity:**

0 to 95%RH

**Transmission:** Half-duplex bi-directional transmission with one-fiber system (6mm dia. cable)  
 Transmission distance: 1.2km max.  
 (free from noise effects and surge)

**Indication of measured value:**

-100 to 100% or actual value scale, LCD 4-digit

**Others:** Optical/electric converter is available with transmission distance is 4km max.

### Performance specifications

Max. span [kPa] (mmH <sub>2</sub> O)	Differential pressure		
	Low	Medium	High
1 (100) 6 (600)	32 (3200) 64 (6400) 130 (13000)	500 (50000) 2000 (200000) 3000 (300000)	
Accuracy rating (inclusive of linearity, hysteresis and repeatability) under reference conditions	For linear output of differential pressure		For square-root output
	Between 0 to 100% output (1/6) x max. span or more: ±0.1% (1/10) x max. span or more: ±0.2%		Between 50 and 100% output (1/6) x max. span or more: ±0.1% (1/10) x max. span or more: ±0.2% Between 20 and 50% output (1/6) x max. span or more: ±0.25% (1/10) x max. span or more: ±0.5% Between 10 and 20% output (1/6) x max. span or more: ±0.5% (1/10) x max. span or more: ±1.0%
Temperature effect (zero shift at max. span)	±0.5%/55°C between -30 and +70°C	±0.25%/55°C between -30 and +70°C	
Max. allowable over-pressure	Up to max. operating pressure		
Overrange effect (zero shift at excessive span)	±0.3% / 1, 3.2MPa {10.2, 32.6kgf/cm <sup>2</sup> }	±0.3%/10MPa {102kgf/cm <sup>2</sup> } ±0.3%/16MPa {163.2kgf/cm <sup>2</sup> } ±0.5%/42MPa {428.3kgf/cm <sup>2</sup> }	
	Double above value for other than material code W or V		
Static pressure effect (zero shift at max. span)	±0.2% / 1, 3.2MPa {10.2, 32.6kgf/cm <sup>2</sup> }	±0.1%/10MPa {102kgf/cm <sup>2</sup> }	
	Double above value for other than material code W or V		
(Span shift at max. span)	-0.2% / +0.2% / -0.1% / 3.2MPa {32.6kgf/cm <sup>2</sup> }	-0.2% / +0.2% / -0.1% / 10MPa {102kgf/cm <sup>2</sup> }	

**Inclination effect:**

0.12kPa {12mmH<sub>2</sub>O}/10°.  
 Double above value when 13th digit (treatment, filled fluid) is W, D or A.

### Physical specifications

**Material:** For details, refer to Code symbols

Material code	Process cover	Detecting unit		Operating (*2) pressure [MPa]			
		Seal diaphragm	Other wetted parts	3.2	10	16	42
W	SCS14	Hastelloy-C	SUS316	○	-	○	○
V(*)	SCS14	SUS316L	SUS316	○	-	○	○
H	SCS14	Hastelloy-C	Hastelloy-C	○	-	○	○
M	SCS14	Monel	Monel	-	-	○	○
T	SCS14	Tantalum	Tantalum	-	-	○	-
B	Hastelloy-C lining	Hastelloy-C	Hastelloy-C	-	○	-	-
L	Monel lining	Monel	Monel	-	○	-	-
U	Tantalum lining	Tantalum	Tantalum	-	○	-	-

Notes: \* (1) Except when 6th digit is 6, 7 or 8

(2) ○...available - ... unavailable

Fill-fluid..... Silicon oil

Casing bolt Chrome molybdenum steel

O-ring Viton

Amplifier case Aluminum alloy

**Finish:** Epoxy-polyurethane double coat, silver (blue for amplifier case cover)

**Environmental protection:**

Meets JIS C0920, immersion-proof (equivalent to IEC IP65 and NEMA4)

**External dimensions (H x W x D) and mass(weight) (without mounting plate):**

132 x 124 x 257mm, approx. 5kg

**Mounting method:**

Mounted on horizontal or vertical 50A (2B) pipe with U-bolt

**Cable and connection:**

Optical fiber cable per our specification (separately available).  
 Used with optical connector

**Process connection:**

Rc1/4 (PT1/4)

Oval flange thread 7/16-20UNF

### Optional specifications

**Indication unit:** 4-digit LCD unit

Setting unit (4 pushbutton switches)  
 (Operating temperature range: -20 to +70°C)

**Material:**

Stainless steel bolts, nuts  
 (SUS304 up to 10MPa {102kgf/cm<sup>2</sup>} of operating pressure  
 SUS630 up to 42MPa {428.3kgf/cm<sup>2</sup>}  
 Stainless steel fixture

**Oxygen oil-proof processing:**

Fluorolube oil filled, wetted parts degreased and cleaned. Available for material code "W" or "V".

**Fill-fluid:** Fluorolube oil

**Chlorine service:** Fluorolube oil filled (for material code H, T, B or U).

**NACE specification:**

H<sub>2</sub>S-proof treatment in accordance with NACE specifications (max. operating pressure 10MPa {102kgf/cm<sup>2</sup>})

**Acid/alkali-proof treatment:**

Depends on Code symbol of pipe fixture (stainless steel) and bolt/nut (stainless steel)

### Scope of delivery

Instrument body and pipe fixture (as specified)

## RELATED DEVICES

Master station (Data sheet No. EDS11-86, EDS11-121)  
 Optical/electric converter (Data sheet No. EDS9-45)  
 Optical star coupler (Data sheet No. EDS8-48)  
 Hand held communicator (Data sheet No. EDS8-44)  
 Connector assembly tool  
 Optical connector  
 Cable

## ORDERING INFORMATION

1. Process variable or use
2. Instrument name
3. Model type
4. Operating pressure and measuring range
5. Measuring unit material
6. Options
7. Others

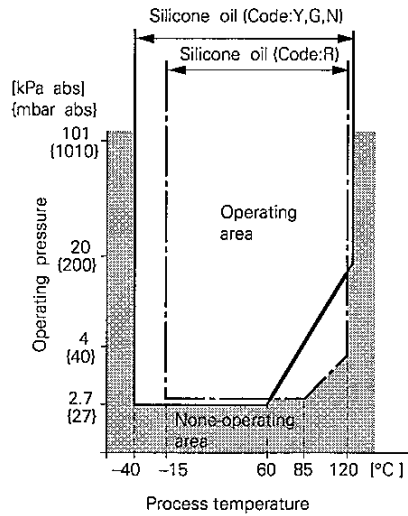
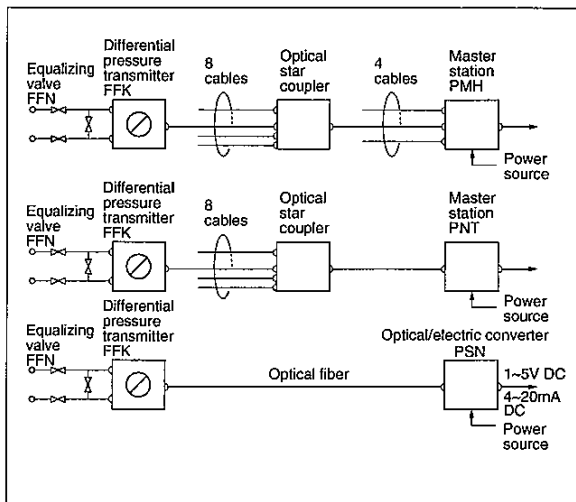


Fig. 1 Relation between process temperature and operating pressure

## SYSTEM BLOCK DIAGRAM



## CODE SYMBOLS

 1 2 3 4 5 6 7 8 - 9 10 11 12 13  
 F B K S | | | | 2 | | | |

		Description				
		Process cover				
		Process connection	Oval flange thread			
		Rc1/4	7/16-20UNF			
		Operating pressure range [MPa] (kgf/cm <sup>2</sup> )	Measuring span [kPa] (mmH <sub>2</sub> O)	Measuring unit material		
				Measuring chamber cover	Precess-wetted part	
					Seal diaphragm	Other wetted parts
11W		-0.1 to +3.2 {-1 to +32}	0.1...1 (10...100)	SCS14	Hastelloy-C	SUS316
11V				SCS14	SUS316L	SUS316
11H				SCS14	Hastelloy-C	Hastelloy-C
12W		0.6...6 (60...600)	SCS14	SCS14	Hastelloy-C	SUS316
12V				SCS14	SUS316L	SUS316
12H				SCS14	Hastelloy-C	Hastelloy-C
33W		-0.1 to +16 {-1 to +163.2}	3.2...32 (320...3200)	SCS14	Hastelloy-C	SUS316
33V				SCS14	SUS316L	SUS316
33H				SCS14	Hastelloy-C	Hastelloy-C
34W		6.4...64 (640...6400)	SCS14	SCS14	Monel	Monel
34V				SCS14	Tantalum	Tantalum
34H				SCS14	Hastelloy-C	SUS316
34M		13...130 (1300...13000)	SCS14	SCS14	SUS316L	SUS316
34H				SCS14	Hastelloy-C	Hastelloy-C
34M				SCS14	Monel	Monel
35W		300...3000 (30000...300000)	SCS14	SCS14	Tantalum	Tantalum
35V				SCS14	Hastelloy-C	SUS316
35H				SCS14	SUS316L	SUS316
35M		50...500 (5000...50000)	SCS14	SCS14	Hastelloy-C	Hastelloy-C
35T				SCS14	Monel	Monel
36W				SCS14	Tantalum	Tantalum
36H		200...2000 (20000...200000)	SCS14	SCS14	Hastelloy-C	SUS316
36M				SCS14	Hastelloy-C	Hastelloy-C
36T				SCS14	Monel	Monel
38W				SCS14	Tantalum	Tantalum
43W		-0.1 to +42 {-1 to +428.3}	3.2...32 (320...3200)	SCS14	Hastelloy-C	SUS316
43V				SCS14	SUS316L	SUS316
43H				SCS14	Hastelloy-C	Hastelloy-C
43M		6.4...64 (640...6400)	SCS14	SCS14	Monel	Monel
44W				SCS14	Hastelloy-C	SUS316
44V				SCS14	SUS316L	SUS316
44H		13...130 (1300...13000)	SCS14	SCS14	Hastelloy-C	Hastelloy-C
44M				SCS14	Monel	Monel
45W				SCS14	Hastelloy-C	SUS316
45V		50...500 (5000...50000)	SCS14	SCS14	SUS316L	SUS316
45H				SCS14	Hastelloy-C	Hastelloy-C
45M				SCS14	Monel	Monel
46W		200...2000 (20000...200000)	SCS14	SCS14	Hastelloy-C	SUS316
46V				SCS14	Hastelloy-C	Hastelloy-C
46M				SCS14	Monel	Monel
47W		-0.1 to +10 {-1 to +102}	3.2...32 (320...3200)	Hastelloy-C lining	Hastelloy-C	Hastelloy-C
23B				Monel lining	Monel	Monel
23L				Tantalum lining	Tantalum	Tantalum
23U		6.4...64 (640...6400)	SCS14	Hastelloy-C lining	Hastelloy-C	Hastelloy-C
24B				Monel lining	Monel	Monel
24U				Tantalum lining	Tantalum	Tantalum
24A		13...130 (1300...13000)	SCS14	Hastelloy-C lining	Hastelloy-C	Hastelloy-C
25B				Monel lining	Monel	Monel
25L				Tantalum lining	Tantalum	Tantalum
25U		50...500 (5000...50000)	SCS14	Hastelloy-C lining	Hastelloy-C	Hastelloy-C
26B				Monel lining	Monel	Monel
26L				Tantalum lining	Tantalum	Tantalum
26U						

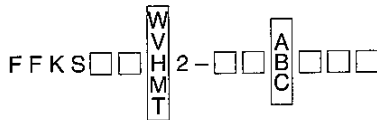
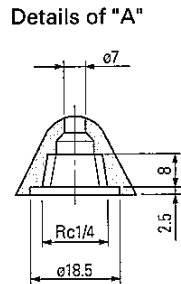
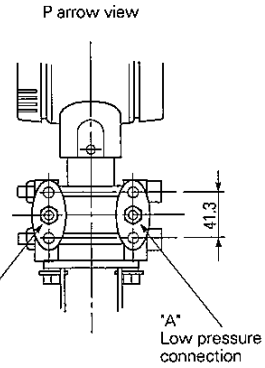
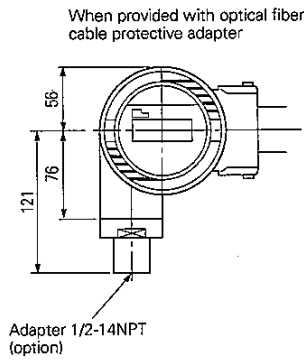
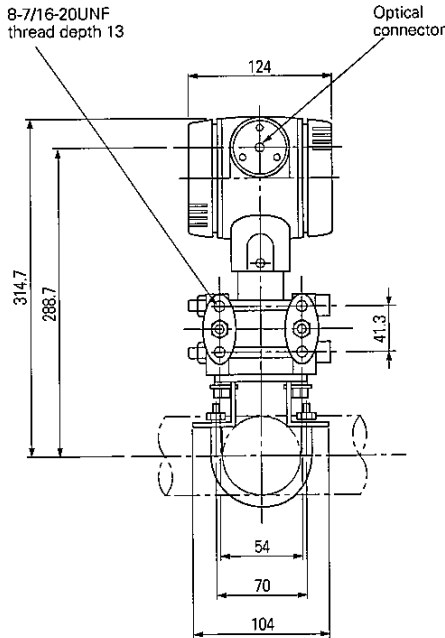
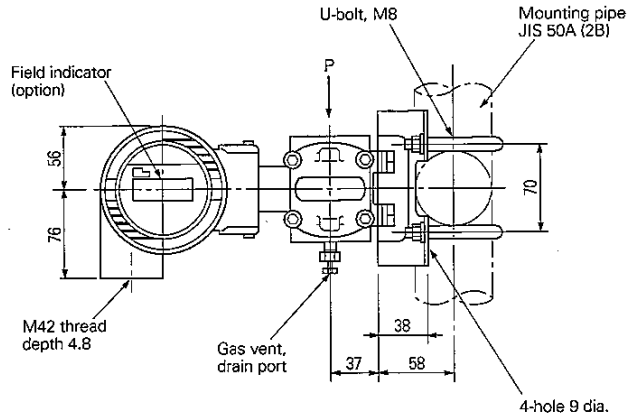
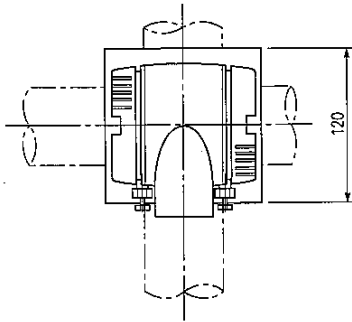
9 1011 1213

		Description		
<b>Transmission unit, field indicator</b>				
		Field indicator		Remarks
		Presence	Scale	
Y	---	---	---	Differential pressure output Square-root output
A	---	---	---	
L	---	Yes	0 to 100% digital indication	} Differential pressure output indication
P	---	Yes	Actual digital scale indication	
O	---	Yes	0 to 100% digital indication	} Square-root output indication
S	---	Yes	Actual digital scale indication	
<b>Explosion-proof</b>				
A	---	Non-explosion proof		
G	---	Intrinsic safety, JIS		
<b>Process connection</b>				
		Side vent/drain presence	Pipe fixture presence	
A	---	No	No	
B	---	No	Yes (steel)	
C	---	No	Yes (stainless)	
D	---	Yes	No	
E	---	Yes	Yes (steel)	
F	---	Yes	Yes (stainless)	
<b>Optional specification</b>				
		Stainless steel bolt/nut	Optical fiber cable protective adapter for 6mm dia. cable	Remarks
Y	---	x	x	
A	---	o	x	
B	---	x	o	} (*1)
C	---	o	o	
H	---	o	x	} (*2)
J	---	o	o	
Note: 9mm dia. optical fiber cable connecting type is also available as an option.				
		Treatment	Fill-fluid	
Y	---	No	Silicon oil	
W	---	No	Fluorolube oil	
G	---	Degreasing	Silicon oil	
A	---	Oxygen oil-proof processing	Fluorolube oil (W or V at 7th digit)	
D	---	Chlorine service	Fluorolube oil (H, T, B or U at 7th digit)	
N	---	NACE specification	Silicon oil (max. operating pressure 10MPa {102kgf/cm <sup>2</sup> })	
R	---	No	Silicon oil (for vacuum)	

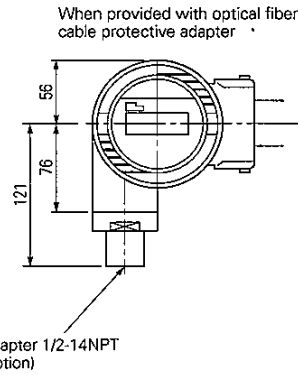
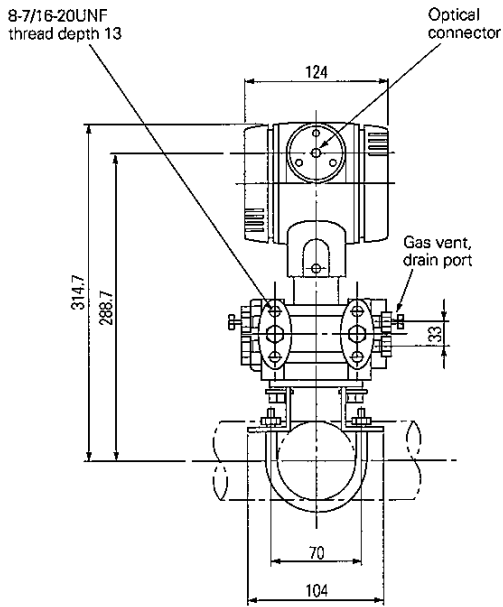
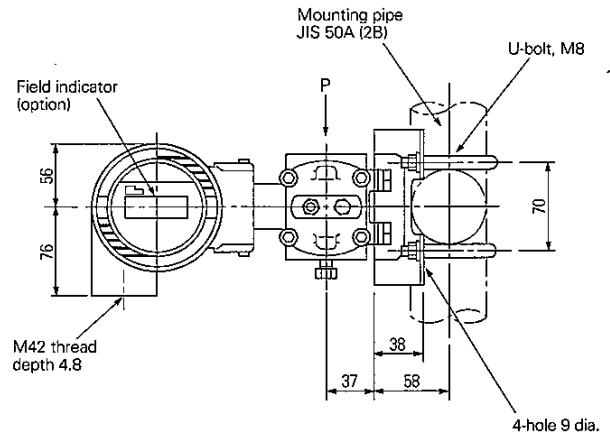
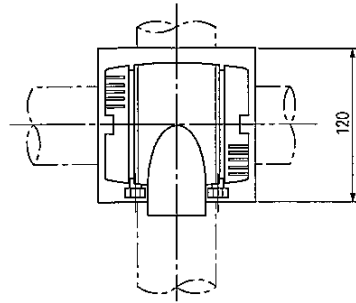
Notes:\*

- (1) Operating pressure is -0.1 to 10MPa (-1 to 102kgf/cm<sup>2</sup>) when 5th digit is "3".
- (2) Specify if operating pressure of -0.1 to 16MPa (-1 to 163.2kgf/cm<sup>2</sup>) is required when 5th digit is "3" (bolt material SUS 630).

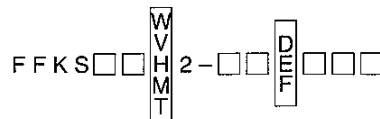
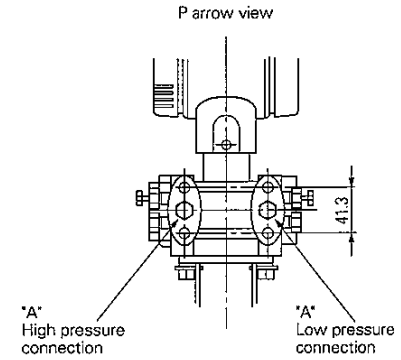
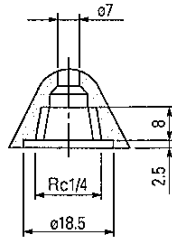
OUTLINE DIAGRAM (Unit:mm)



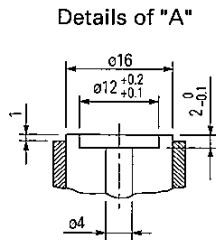
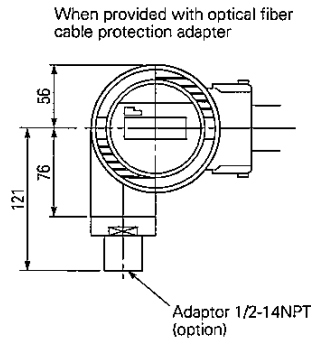
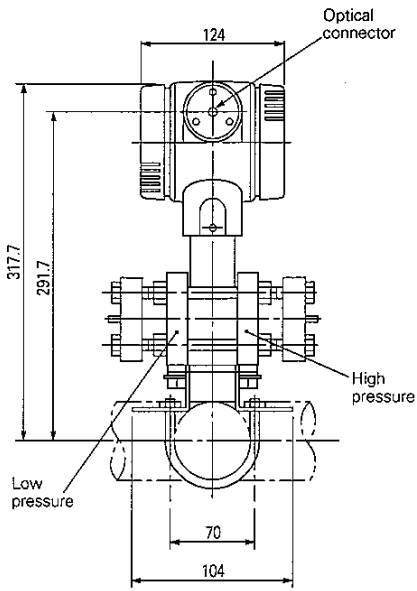
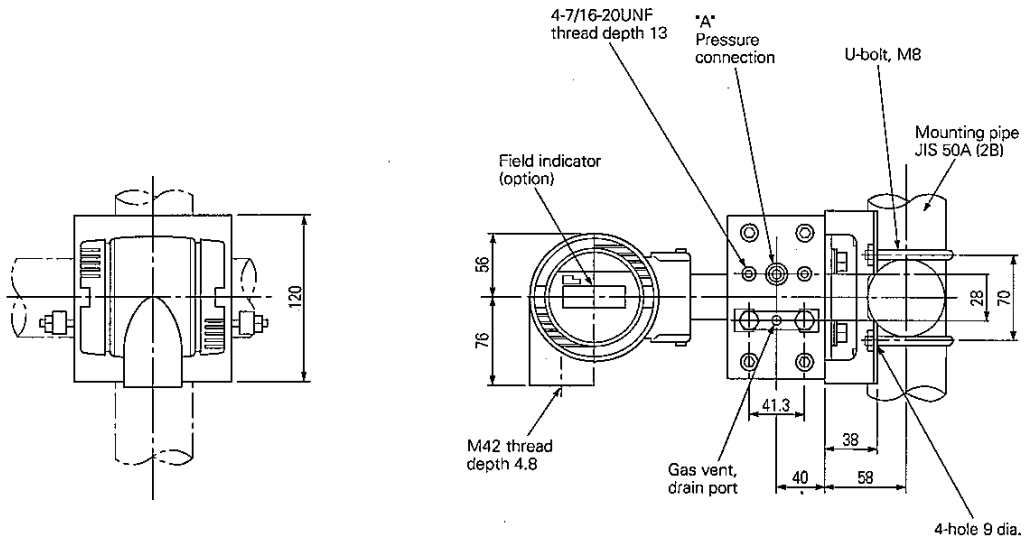
<When provided with side vent/drain>



Details of "A"



<For material code B, L, or U>



FFKS2 B L U

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