e-Front runners

FFI SYSTEM

OPTICAL DIFFERENTIAL PRESSURE (FLOW) TRANSMITTER

DATA SHEET FFK···3

The Model FFK 3 Optical Differential Pressure (Flow) Transmitter measures differential pressures (flow rates) of various fluids accurately, converts them into optical digital signals and outputs them. This is an intelligent transmitter providing excellent performance and functions due to incorporation of electrostatic capacitance type silicon sensor and microprocessor.

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

FEATURES

1. **Resistive to noise and lightning**
   Optical signal ensures a reliable signal transmission, because it is not be affected by external noise and inductive lightning. Use of a nonmetallic optical (fiber) cable prevents propagation of inductive lightning through the cable, so a signal transmission immune to lightning can be realized.
2. **Reliability due to redundant configuration**
   Host system can be duplicated by using two optical cable trunk lines (between an optical star coupler and host system. This enhances reliability of users' systems.
3. **Intrinsic safety type explosion-proof**
   Each equipment with a built-in battery can be constructed so as to be an intrinsic safety type individually (intrinsic safety type barrier unnecessary).

SPECIFICATIONS

Functional specifications

Fluids measured: Liquid, gas or steam

Measuring range and operating pressure:

Type	Operating pressure [MPa]	Span [kPa]		Range limits [kPa]	
		Minimum value	Maximum value	Lower range limit	Upper range limit
FFK□11	–0.1 to +3.2	0.1	1	–1	1
FFK□22	–0.1 to +10	0.15	6	–6	6
FFK□23	–0.1 to +10	0.8	32	–32	32
FFK□25	–0.1 to +10	3.25	130	–130	130
FFK□26	–0.1 to +10	12.5	500	–500	500
FFK□33	–0.1 to +16	0.8	32	–32	32
FFK□35	–0.1 to +16	3.25	130	–130	130
FFK□36	–0.1 to +16	12.5	500	–500	500
FFK□38	–0.1 to +16	75	3000	–3000	3000
FFK□43	–0.1 to +42	0.8	32	–32	32
FFK□45	–0.1 to +42	3.25	130	–130	130
FFK□46	–0.1 to +42	12.5	500	–500	500
FFK□48	–0.1 to +30	75	3000	–3000	3000

Process temperature, Allowable pressure limit:
For details refer to Fig.1.

Fill-fluid	13th code digit	Process temperature (Note)	Allowable pressure limit
Silicon oil	Y, G, N	–40 to +120°C	2.7kPa abs
Fluorolube oil	W, A, D	–20 to +80°C	Atmospheric pressure
Silicon oil	R	–15 to +120°C	2.7kPa abs

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

Diagnosis item	Host system	Indication unit
Measuring range abnormal	○	○
Detecting unit failure	○	○
Amplifier abnormal	○	○
Battery voltage	○	—
Battery voltage low alarm	○	○

Remote control function:
See Table 1.

Output signal: Optical digital signal

Power supply: Built-in lithium battery (expected life: about 4 years)

Optical cable: Code set type,
silica fiber ... core/clad diameter
100/140 μm

Optical connector:
FC connector

Transmission distance:
1.5 km max. (when transmission loss of optical cable is 4 dB/km)

Damping: Variable from 0.2 to 32 sec (time constant)

Zero elevation and suppression:
Possible within ±100% of maximum span.

Explosion-proof: Intrinsic safety type, JIS ib IIC T3

Ambient temperature:
–30 to +70°C
–10 to +60°C for intrinsic safety explosion-proof type
–20 to +70°C when provided with indicator
–10 to +60°C when filled with fluorolube oil

Storage temperature:
–40 to +80°C

Performance specifications

For linear output of differential pressure

	Low differential pressure	Medium differential pressure	High differential pressure
Max. span	1, 6kPa	32, 130kPa	500, 3000kPa
Accuracy rating (Note)	±0.1% when measuring span is 1/10 or more of maximum span. $\pm(0.05 + 0.005 \frac{\text{max. span}}{\text{measuring span}})$% when measuring span is less than 1/10 of maximum span.		
Abmient temperature effect URL: Max. span x: Measuring span	Zero shift: $\pm(0.125+0.2\frac{URL}{x})$% / 28°C Overall shift: $\pm(0.175+0.2\frac{URL}{x})$% / 28°C	Zero shift: $\pm(0.1+0.05\frac{URL}{x})$% / 28°C Overall shift: $\pm(0.15+0.05\frac{URL}{x})$% / 28°C	
	Twice as large as above when 7th digit (material) is other than V	3 times as large as above when 7th code (material) is other than V	
Overrange effect (zero shift at max. span)	±0.3% / 1MPa ±0.1% / 3.2MPa	±0.1% / 10MPa ±0.1% / 16MPa ±0.25% / 42MPa	
	Twice as large as above when 7th digit (material) is other than V		
Static pressure effect (zero shift at max. span)	±0.2% / 1MPa ±0.1% / 3.2MPa	±0.05% / 10MPa	
	Twice as large as above when 7th digit (material) is other than V		
(Span shift at measuring span)	$-0.2\%^{+0.2}_{-0.4}$ % / 3.2MPa	$-0.2\%^{+0.2}_{-0.4}$ % / 10MPa	

Note: Percent value with respect to measuring span (including linearity, hysteresis and repeatability in standard 23°C status)

For square-root output

	Low differential pressure	Medium differential pressure	High differential pressure
Max. span	1, 6kPa	32, 130kPa	500, 3000kPa
Accuracy rating (inclusive of linearity and hysteresis)	(Between 1 and 0.1) × max. span: ±0.1% for output 50 to 100% ±0.25% for output 20 to less than 50% ±0.5% for output 10 to less than 20% (Between 0.1 and 0.04) × max. span: For output 50 to 100%; $\pm1 \times (0.05 + 0.005 \frac{\text{max. span}}{\text{measuring span}})$% For output 20 to less than 50%; $\pm2.5 \times (0.05 + 0.005 \frac{\text{max. span}}{\text{measuring span}})$% For output 10 to less than 20%; $\pm5 \times (0.05 + 0.005 \frac{\text{max. span}}{\text{measuring span}})$%		
Low flow cutoff point	Flow rate value variable within 0 to 20% (default value: 7%)		
Ambient temperature effect (shift at 20% point) URL: Max. span x: Measuring span	$\pm2.5 \times (0.1 + 0.2 \times \frac{URL}{x})$% / 28°C	$\pm2.5 \times (0.1 + 0.05\frac{URL}{x})$% / 28°C	

Inclination effect:
0.12kPa/10°
Double above value when 13th digit (treatment, sealed liquid) is W, D, or A.

Measurement period:
0.2 sec

Response time:

Type	*Time constant [sec]	Dead time [sec]
FFK□11	0.8	About 0.2
FFK□22	0.5	
FFK□□3	0.3	
FFK□□ 5 ≀ 8	0.2	

Note: *Value at 23°C

Physical specifications

Material: For details, refer to Code symbols.

Material code	Process cover	Detecting unit		Operating pressure [MPa]			
		Seal diaphragm	Other wetted parts	3.2	10	16	42
V	SCS14	SUS316L	SUS316	○	○	○	○
J	SCS14	SUS316L·Gold-plated	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: ○...available, — ...unavailable

Environmental protection:
Meets JIS C0920 immersion-proof (equivalent to IEC IP67 or NEMA 6/6P).

Process connection:
Rc1/4 or 1/4-18NPT (whichever selected by code symbol)
Oval flange thread 7/16-20UNF

Optical cable connection:
G1/2 or 1/2-14NPT (whichever selected by code symbol)

Mounting method:
Mounted on 50A (2B) pipe with U-bolt or on a wall.

Finish: Epoxy-polyurethane double coat,
Color; Silver (blue for case cover).

External dimensions:
See OUTLINE DIAGRAM.

Mass: 5.3 to 5.5kg

Orientation of transmission unit:
Indicator unit turnable 90° upward/downward relative to detection unit.

Optional specifications

Indication unit: 5-digit LCD indication, % or real scale indication (as specified by code symbol)
Operating temperature range: –20 to +70°C

Oxygen oil-proof processing:
Fluorolube oil filled, wetted parts degreased and cleaned.

Chlorine service: Fluorolube oil filled

NACE specification:
H2S-proof treatment in accordance with NACE specifications.

Varies with material. Refer to CODE SYMBOLS.

Table 1 Remote Control Function
(Items readable and setting from hand-held communicator)

Item	Reading	Setting	Description
Maximum range	○	—	Maximum measuring range of equipment
Measuring range	○	○	Actual measuring range
Damping	○	○	Variable within 0.2 to 32 sec
Real scale indication	○	○	Indication in industrial value
Battery voltage	○	—	Battery voltage of equipment
Error indication	○	—	Errors of detection unit and amplifier
Measured value	○	—	Measured data
Adjustment	○	○	Zero and span adjustment

Note: For operation of the "3" type transmitter ("3" at the 8th digit of product code), a hand-held communicator is required to have a version 1.6 or higher, but a communicator before version 1.6 can be operated with memory data updated. (Refer to the instruction manual of transmitter.)

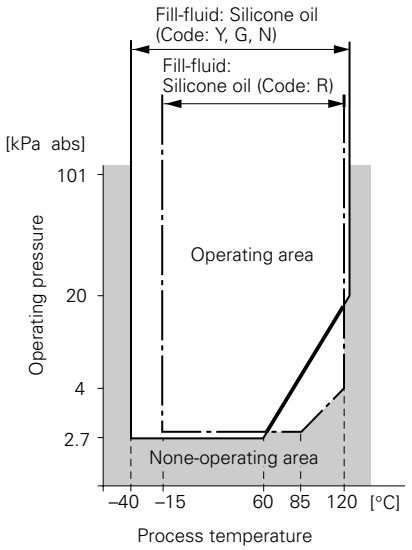
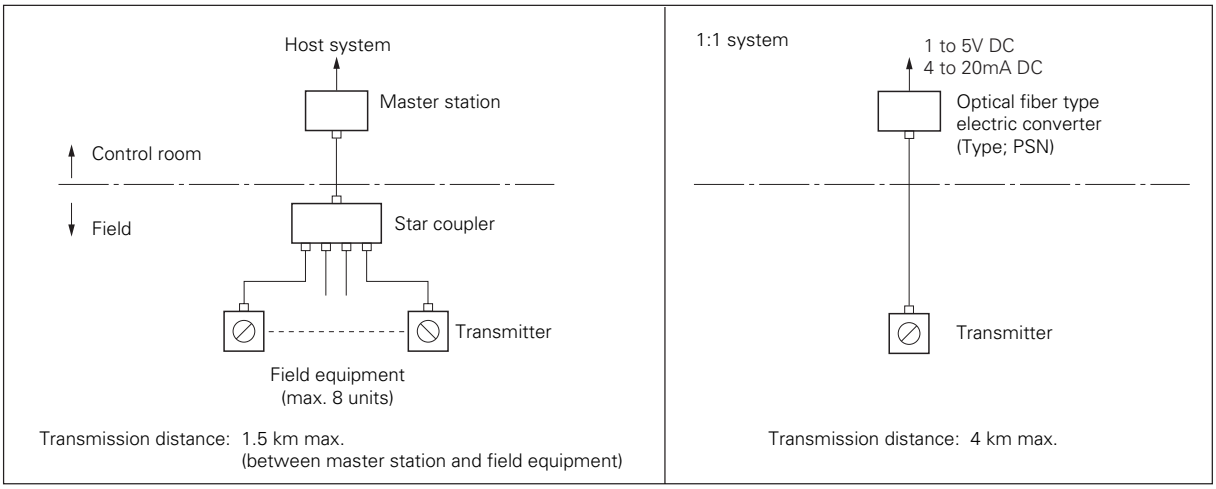
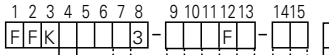


Fig. 1 Relation between process temperature and operating pressure

SYSTEM BLOCK DIAGRAM



CODE SYMBOLS



Description

Connection (4th digit)

	Process connection	Cable lead-in port
S	Rc1/4	G1/2
T	1/4-18NPT	1/2-14NPT

Operating pressure and measuring span (5th and 6th digits)

	Operating pressure range	Measuring span
1 1	–0.1 to +3.2 MPa	0.1.....1 kPa
2 2	–0.1 to +10 MPa	0.15..... 6 kPa
3 3	–0.1 to +16 MPa	0.8..... 32kPa
3 5		3.25..... 130kPa
3 6		12.5..... 500kPa
3 8		75..... 3000kPa
4 3	–0.1 to +42 MPa	0.8..... 32kPa
4 5		3.25..... 130kPa
4 6		12.5..... 500kPa
4 8	–0.1 to +30 MPa	75..... 3000kPa
2 3	–0.1 to +10 MPa	0.8..... 32kPa
2 5	For material codes B, L	3.25..... 130kPa
2 6	and U	12.5..... 500kPa

Material (7th digit)

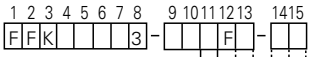
	Process cover	Seal diaphragm	Other wetted parts	Application (5th and 6th digits)
V	SCS14	SUS316L	SUS316	11,22,33,35,36,38, 43,45,46,48
J	SCS14	SUS316L·Gold-plated	SUS316	11,22,33,35,36,38, 43,45,46,48
H	SCS14	Hastelloy-C	Hastelloy-C	11,22,33,35,36,43, 45,46
M	SCS14	Monel	Monel	33,35,36,43,45,46
T	SCS14	Tantalum	Tantalum	33,35,36
B	Hastelloy-C lining	Hastelloy-C	Hastelloy-C	23,25,26
L	Monel lining	Monel	Monel	
U	Tantalum lining	Tantalum	Tantalum	

Indicator and output (9th digit)

	Indicator	Output
Y	Not provided	Linear
A	Not provided	Square-root extraction
L	Digital, % indication	Linear
P	Digital, real scale	Linear
Q	Digital, % indication	Square-root extraction
S	Digital, real scale	Square-root extraction

Explosion-proof (10th digit)

A	Non-explosion proof
G	Intrinsic safety, JIS



Description

Side vent/drain and fixture (11th digit)

	Side vent/drain	Mounting fixture	
A	None	None	
C	None	Yes (stainless steel)	
D	Yes	None	Cannot be specified when 7th digit is B, L or U.
F	Yes	Yes (stainless steel)	

Treatment and Fill-fluid (13th digit)

	Treatment	Fill-fluid
Y	None	Silicon oil
W	None	Fluorolube oil
G	Degreasing	Silicon oil
A	Oxygen oil-proof processing	Fluorolube oil ... Specifiable when 7th digit is V.
D	Chlorine service	Fluorolube oil ... Cannot be specified when 7th digit is V, M or L.
N	NACE specification	Fluorolube oil ... Cannot be specified when 7th digit is T or U.
R	None	Silicon oil (for vacuum)

O-ring material (for process cover)(14th digit)

A	Viton
B	Teflon

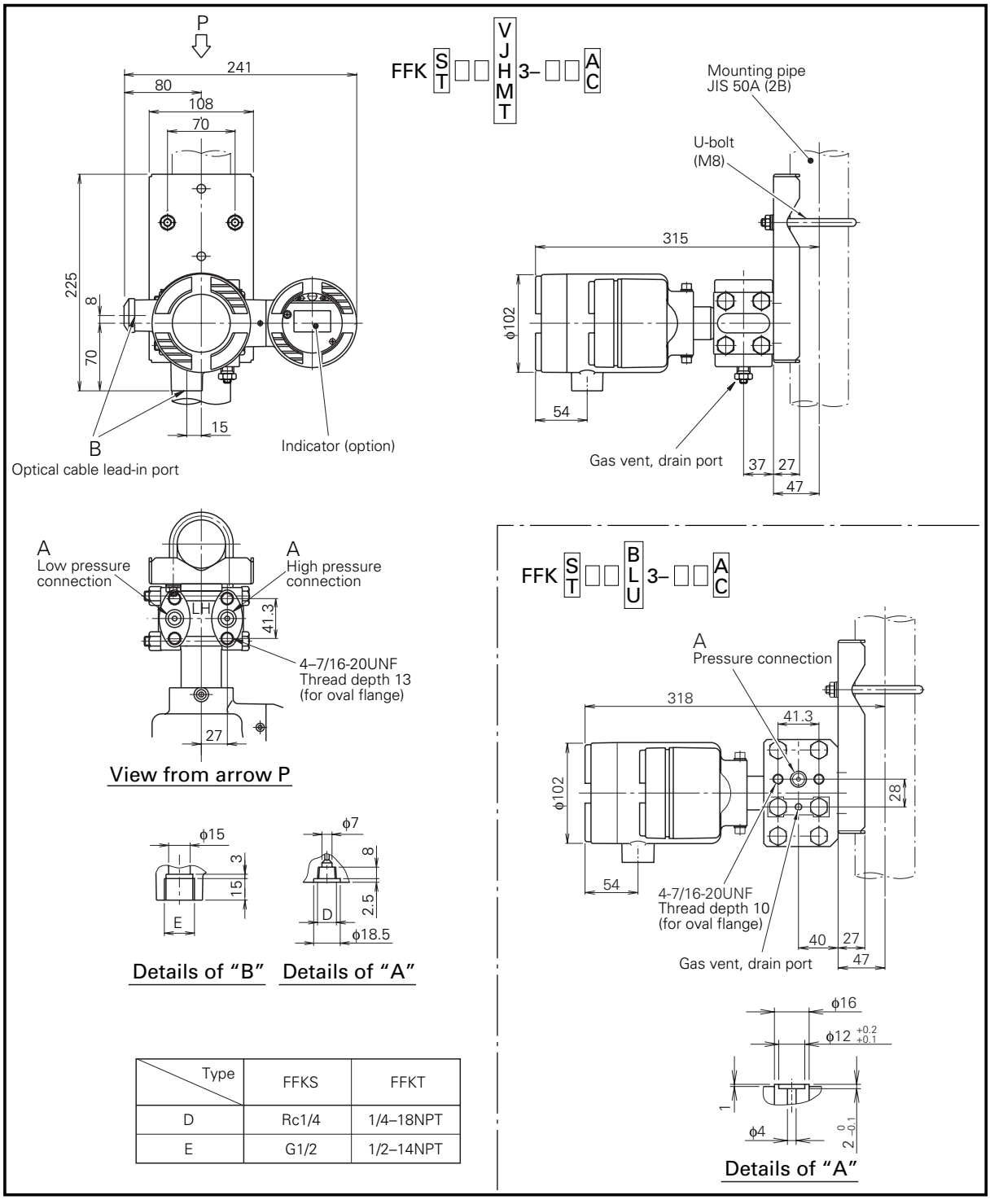
Bolt/nut (15th digit)

C	NACE bolt/nut (ASTM A193 B7M/A194 2HM)	Note 1
D	NACE bolt/nut (ASTM A320 L7M/A194 2HM)	Note 1
E	SUS304/SUS304 ... (For general use) ... Note 2	
F	SUS630/SUS304 ... Specify when 5th digit is 3 or 4.	

Note 1: Operating pressure is limited within 10 MPa.

Note 2: Specifiable when 5th digit is 1, 2 or 3.
However, operating pressure is limited within 10 MPa.

OUTLINE DIAGRAM (Unit : mm)



Type	FFKS	FFKT
D	Rc1/4	1/4–18NPT
E	G1/2	1/2–14NPT

SCOPE OF DELIVERY

Instrument body and pipe fixture (as specified)

ITEM TO BE PREPARED SEPARATELY

Oval flange: To be used as a flange of connecting pipe port.
For details, refer to the DATA SHEET of oval flange (EDS6-10).

Equalizing valve:
Refer to DATA SHEET (EDS6-10).

ORDERING INFORMATION

1. Model type
2. Measuring range
3. Indication scale for real scale specification
4. Others

⚠ Caution on Safety

*Before using this product, be sure to read its instruction manual in advance.

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