

# DIFFERENTIAL PRESSURE (FLOW) TRANSMITTER

## DATA SHEET

FKK, FDK...4

The FCX-CII differential pressure transmitter accurately measures differential pressure, liquid level or gauge pressure and transmits proportional 4 to 20mA signal.

The transmitter utilizes the unique micromachined capacitive silicon sensor with state-of-the-art micro-processor technology to provide exceptional performance and functionality.

## FEATURES

- High accuracy**  
 0.1% accuracy is the standard feature . Fuji's micro-capacitance silicon sensor assures this feature for all elevated or suppressed calibration ranges without additional adjustment.
- Minimum inventory**  
 Electronics unit, local indicators and electronics housing are interchangeable among all FCX-CII models. Process cover including bolts and nuts are common for all DP and flow transmitters.
- Fuji/HART™ bilingual communication protocol and FOUNDATION™ Fieldbus and Profibus™ compatibility**  
 FCX-CII series transmitter offers bilingual communication to speak both Fuji proprietary protocol and HART™. Any HART™ compatible devices can communicate with FCX-CII.  
 Further, by upgrading electronics FOUNDATION™ Fieldbus and Profibus™ are also available.
- Application flexibility**  
 Example features that render the FCX-CII suitable for almost any process applications includes :
  - Analog indicator at either the electronics side or terminal side
  - Full range of hazardous location approvals
  - Built-in RFI filter and lightning arrester
  - 5 digits LCD meter
- Programmable output Linearisation Function**  
 In addition to linear and square root, output signal is freely programmable.
- 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.
- Dry calibration without reference pressure**  
 Thanks to the best combination of unique construction of mechanical parts (Sensor unit), reliability of dry calibration without reference pressure is at equal level as wet calibration.



## SPECIFICATIONS

### Functional specifications

#### Type :

FKK : Smart, 4-20mA dc + Fuji/Hart™ digital signal  
 FDK : FOUNDATION™ Fieldbus & Profibus™

#### Service :

Liquid, gas or vapour

#### Static pressure, span and range limit :

Type	Static pressure (bar)	Span limit (mbar)		Range limit (mbar)
		Min.	Max.	
F□K□12	-1 to +32	3.75	60	±60
F□K□33	-1 to +140	20	320	±320
F□K□35	-1 to +140	81.25	1300	±1300
F□K□36	-1 to +140	312.5	5000	±5000
F□K□37	-1 to +140	1250	20000	±20000

Lower limit of static pressure (vacuum limit) is :

Silicone fill sensor : See Fig. 1

Fluorinated fill sensor : 66kPa abs (500mm Hg abs) at temperature below 80°C

The maximum span of each sensor can be converted to in different units using below factors.

1MPa=10<sup>3</sup>kPa=10bar=10.19716kgf/cm<sup>2</sup>=145.0377psi

1kPa=10mbar=101.9716mmH<sub>2</sub>O=4.01463inH<sub>2</sub>O

**Overrange limit :** To maximum static pressure limit.

#### Output signal :

4 to 20mA DC (linear or square root) with digital signal superimposed on the 4 to 20mA signal

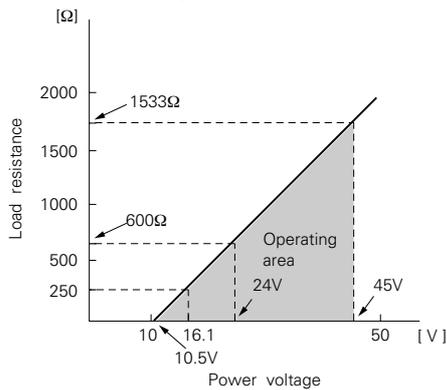
Digital signal based on FOUNDATION™ Fieldbus or Profibus™.

#### 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 FXW, min. of 250Ω required.

**Hazardous locations :**

Designed to meet international intrinsic safety and flameproof (explosionproof) standards. Please consult the code symbols some pages further on, to know the different types of approvals (digit 10). Consult FUJI for status.

**Zero/span adjustment :**

Zero and span are adjustable by hand held communicator in Hart™ or Fuji protocol. Local adjustment of zero and span are possible from outside screw on the electronic housing.

**Damping :** adjustable from HHC.

A damping of the output signal is possible between 0 and 32 sec with the hand held communicator HHC. Local adjustment possibilities with LCD indicator (refer to optional indicator).

**Zero elevation / suppression :**

Selectable with the hand held communicator (HHC) or from outside screw on the electronic housing.

**Normal / reverse action :**

Programmable with hand held communicator (HHC).

**Indicator :**

A plug-in analog indicator can be mounted on the electronics unit or the terminal block. The local LCD indicator (5 digits) is assembled on the electronics unit. Additional local adjustment facilities are possible by the integrated switches in the LCD indicator :

- "Local/comm" switch gives the possibilities to make local adjustments of zero/span, damping or to configure the transmitter with a hand held communicator.
- The "mode" switch with 7 positions gives local adjustment possibilities for zero/span, 4/20mA, enable or inhibit the local adjustments.
- Local damping adjustment is possible via the "damp" switch.

**Burnout direction:** Selected from HHC

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

**"Output Hold" :**

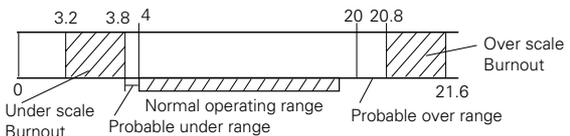
Output signal is hold as the value just before the failure happens.

**"Output Overscale" :** approx. 21,6 mA

Adjustable within the range 20,8 mA to 21,6 mA from the HHC.

**"Output Underscale" :** approx. 3,8 mA

Adjustable within the range 3,2 mA to 3,8 mA from the HHC.



**Loop-check output :**

Transmitter can be adjusted to generate a loop current of 4, 12 and 20 mA with the "Mode" switch in position 3, 4 or 5.

Transmitter can be configured by HHC to provide constant signal output between 3.8mA and 21.6mA.

**Temperature limit :**

**Ambient :**

- 40 to +85°C
  - (-20 to +80°C for LCD indicator)
  - (-40 to +60°C for arrester option)
  - (-20 to +80°C for fluorinated oil filled transmitters)
- For explosionproof units (flameproof or intrinsic safety), ambient temperature must be within the limits specified in each standard.

**Process :**

- 40 to +100°C for silicone fill sensor
- 20 to +80°C for fluorinated oil fill sensor

**Storage:**

- 40 to +90°C

**Humidity limit :** 0 to 100% RH

**Communication :**

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

Note : HHC's version must be more than 6.0 (or FXW □□□□1- A3)

Items	HART® PROTOCOL		FUJI PROTOCOL	
	Display	Set	Display	Set
Tag n°	Yes	Yes	Yes	Yes
Model n°	-	-	Yes	Yes
Serial n°	Yes	-	Yes	-
Engineering unit	Yes	Yes	Yes	Yes
Range limit	Yes	-	Yes	-
Measuring range	Yes	Yes	Yes	Yes
Damping	Yes	Yes	Yes	Yes
Output mode	Yes	-	Yes	-
Burnout direction	Yes	Yes	Yes	Yes
Adjustment	Yes	Yes	Yes	Yes
Output adjust	-	Yes	-	Yes
Data	Yes	-	Yes	-
Self diagnoses	Yes	-	Yes	-
Printer	-	-	-	-
External switch lock	Yes	Yes	Yes	Yes
Transmitter display	Yes	Yes	Yes	Yes
Linearise	-	-	Yes	Yes
Rerange	Yes	Yes	Yes	Yes

**Programmable output linearization function :**

Output signal can be characterized with "14 points linear approximation function" from HHC.

**Field Bus units :**

- Digital signal
- Transmission technique : according to IEC61158-2
- Power supply : 9VDC...32VDC
- Base current : 15 ±2mA
- Transmission rate : 31,25kbits/s
- Profibus-PA : version 3.0, DPVI version 2.0
- Foundation Fielbus : FF-890/891

## Performance specifications for linear output :

### Accuracy rating :

(including linearity, hysteresis, and repeatability)

For spans greater than 1/10 of URL :

±0.1% of span

For spans below 1/10 of URL :

± (0.05 + 0.05  $\frac{0.1 \times \text{URL}}{\text{span}}$ ) % of span

### Stability :

±0.2% of upper range limit (URL) for 3 years

### Temperature effect :

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

Range code (6th digit in Code symbols)	Zero shift	Total effect
"2"/ 60mbar max. span	±(0.25 $\frac{\text{URL}}{\text{span}}$ )% / 28°C	±(0.25+0.25 $\frac{\text{URL}}{\text{span}}$ )% / 28°C
"3"/ 320mbar max. span "5"/ 1,3bar max. span "6"/ 5bar max. span "7"/ 20bar max. span	±(0.1 $\frac{\text{URL}}{\text{span}}$ )% / 28°C	±(0.075+0.1 $\frac{\text{URL}}{\text{span}}$ )% / 28°C

### Static pressure effect :

Static pressure code (5th digit in Code symbols)	Zero shift (% of URL)	Span shift (% of calibrated span)
"1" / 6kPa {60mbar} sensor	±0.4% / 3.2MPa{32bar}	±0.4% / 3.2MPa{32bar}
"3"	±0.2%/10MPa{100bar}	-0.2% <sup>+0.2</sup> <sub>-0.3</sub> / 10MPa{100bar}

### Overrange effect :

Static pressure code (5th digit in Code symbols)	Zero shift (% of URL)
"1"	±0.4% / 3.2MPa {32bar}
"3"	±0.4% / 14MPa {140bar}

### 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)

### Step response : (without electrical damping)

Range code	Time constant	Dead time
"2"	0.85 s	approx. 0.3 s
"3"	0.45 s	
"4" through "7"	0.2 s	

Response time = 5 x time constant + dead time

Time constant ( $\tau$ ) = 63 % output signal

Note : faster response time is available as option - Consult FUJI

### Mounting position effect :

Zero shift, less than 0.1kPa {1mbar} for a 10° tilt in any plane.

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

## Performance specifications for square root output :

### Accuracy rating :

Output	Span
	at (1 to 1/10) x URL
50 to 100%	±0.1 %
20 to 50%	±0.25 %
10 to 20%	±0.5 %

### For span below 1/10 of URL :

±(0.05 + 0.05 $\frac{0.1 \times \text{URL}}{\text{span}}$ )	OUTPUT 50 to 100%
±2.5 x (0.05 + 0.05 $\frac{0.1 \times \text{URL}}{\text{span}}$ )	OUTPUT 20 to 50%
±5 x (0.05 + 0.05 $\frac{0.1 \times \text{URL}}{\text{span}}$ )	OUTPUT 10 to 20%

### Temperature effect :

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

Range code	Shift at 20% output point
"2"	±(0.625 $\frac{\text{URL}}{\text{span}}$ )% / 28°C
"3" through "7"	±(0.25 $\frac{\text{URL}}{\text{span}}$ )% / 28°C

### Low flow cut-off :

Customer configurable for any point between 0 to 20% of output

## Physical specifications

### Electrical connections :

1/2"-14 NPT, Pg13.5 or M20 x 1.5

### Process connections :

Standard : 1/4"-18 NPT on 54mm centers meets DIN 19213.

Option : 1/2" NPT with oval flanges

### Process-wetted parts material :

Material code (7th digit in Code symbols)	Process cover	Diaphragm	Wetted sensor body	Vent/drain
V	316L SS	316L SS	316L SS	316 SS

### Remark :

Sensor gasket : viton o-rings or PTFE square section gasket.

### Non-wetted parts material :

Electronics housing :

Low copper die cast aluminum alloy (standard), finished with epoxy/polyurethane double coating.

Bolts and nuts :

Cr-Mo alloy (std), 316 stainless steel or 630 ss .

Static pressure rating for code "3" with 316 stainless steel bolts is limited at 10MPa (100bar).

Fill fluid :

Silicone oil (standard) or fluorinated oil

Mounting bracket :

304 stainless steel

### Environmental protection : IEC IP67 and NEMA 6/6P

### Mounting :

On 50mm (2") pipe using mounting bracket, direct wall mounting, or direct process mounting.

### Mass{weight} :

Transmitter approximately 3.4kg without options.

Add : 0.5kg for mounting bracket

0.8kg for indicator (option)

**Optional features**

**Indicator :**

A plug-in turnable analog indicator (1.5% accuracy) can be located in the electronics compartment or in the terminal box of the housing.  
An optional 5 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.

**Degreasing :**

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

**NACE specification :**

Metallic materials for all pressure boundary parts including 316SS bolts and nuts comply with NACE MR-01-75.

**Vacuum service :**

Special silicone oil and filling procedure are applied.

**ACCESSORIES**

**Oval flanges :**

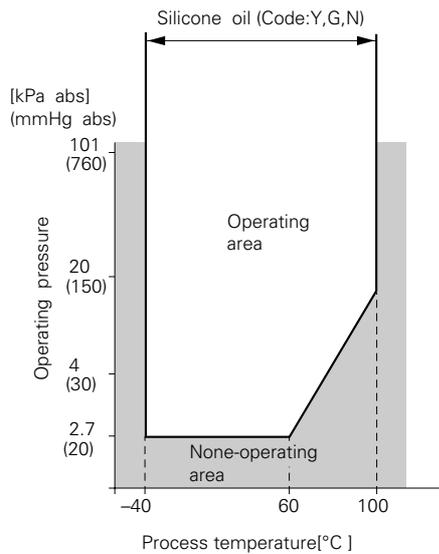
Converts process connection to 1/2"-14 NPT, material : 316L SS

**Three-valve manifold :**

Available in 316 stainless steel and pressure rating 14MPa (140bar).

**Hand-held communicator :**

(Model FXW, refer to Data Sheet No. EDS8-47)



See figure 1 below

**Fig.1**

**Relation between process temperature and operating pressure**

**Customer tag :**

A stainless steel tag with customer tag data is wired to the transmitter.

# CODE SYMBOLS

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	DESCRIPTION																																																															
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															<b>Approvals for hazardous locations (consult FUJI for availability)</b> None (standard) Flameproof housing ATEX $\text{Ex}$ II 2 GD - EEx d IIC T5/T6 Intrinsic safety ATEX $\text{Ex}$ II 1 GD - EEx ia IIC T4/T5 FM - Flameproof housing Class I, Division 1, Group B, C, D Dust ignitionproof Class II/III, Division 1, Group E, F, G - (elec. conn. code "T" only) FM - Intrinsic safety Class I, II, III, Division 1, Group A, B, C, D, E, F, G Nonincendive Class I, II, III, Division 2, Group A, B, C, D, F, G ATEX type "n" $\text{Ex}$ II 3 GD - EEx nL/nAL IIC T4/T5																																																															
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															<b>Side vent/drain &amp; mounting bracket</b> <table border="1"> <thead> <tr> <th>Side vent/drain</th><th>mounting bracket</th></tr> </thead> <tbody> <tr> <td>None</td><td>None</td></tr> <tr> <td>None</td><td>Yes, SS</td></tr> <tr> <td>Yes</td><td>None</td></tr> <tr> <td>Yes</td><td>Yes, SS</td></tr> </tbody> </table>	Side vent/drain	mounting bracket	None	None	None	Yes, SS	Yes	None	Yes	Yes, SS																																																					
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Y																																																																														
B																																																																														

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	<b>DESCRIPTION</b>	
															<b>Special applications &amp; fill fluid</b>	
															Treatment	Fill fluid
															None (std)	silicone oil
															Degreasing	silicone oil
															Oxygen serv.	fluorinated oil
															NACE	silicone oil
															<b>Process cover gasket</b>	
															- A Viton	
															- C PTFE square section gasket in SS flange (FEF design)	
															<b>Bolts/screws material</b>	
															A Cr-Mo (standard)	
															(*1) E SS 316/316 (bolt/nuts)	
															F SS 630/304 (bolt/nuts)	

- \*Notes :
- 1- Maximum static pressure 100 bar with 316/316 bolts/nuts (digit 15 code E)  
For static pressure >100 bar 630/304 bolts/nuts are required (digit 15 code F)
  - 2- Our stainless steel bolts/nuts are in conformity with the NACE requirements and can be used for NACE service.
  - 3- Process connection compatible for direct mounting on a pitot tube.

The product conforms to the requirements of the Electromagnetic Compatibility Directive 89/336/EEC as detailed within the technical construction file number TN513035. The applicable standards used to demonstrate compliance are :

**EMI (Emission) EN61326 : 1997**

Class A (std for Industrial Location)

Frequency range MHz	Limits	Reference Standard
3 to 230	40dB (µV/m) quasi peak measured at 10m distance	CISPR16-1 and CISPR16-2
230 to 1000	47dB (µV/m) quasi peak, measured at 10m distance	

**EMS (Immunity) EN61326 : 1997**

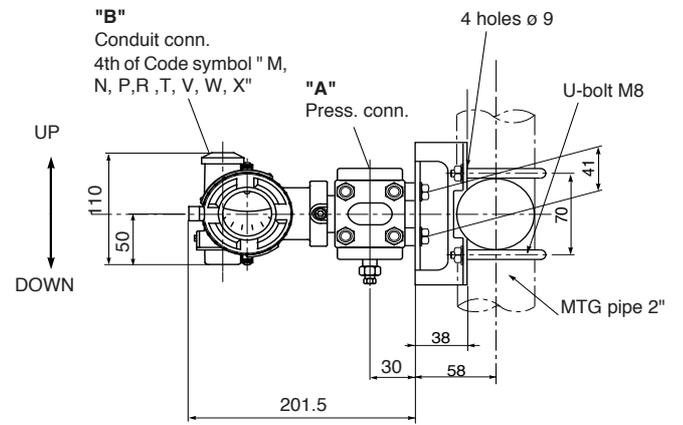
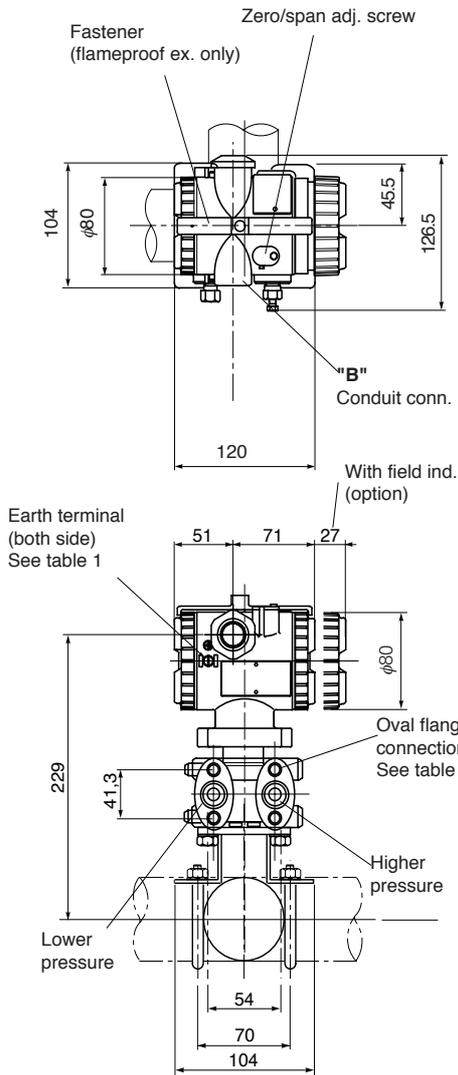
Annex A (std for Industrial Location)

Phenomenon	Test value	Basic Standard	Performance criteria
Electrostatic discharge	4kV (Contact) 8kV (Air)	IEC61000-4-2	B
Electromagnetic field	80 to 1000MHz 10V/m 80%AM (1kHz)	IEC61000-4-3	A
Rated power frequency magnetic field	30A/m 50Hz	IEC61000-4-8	A
Burst	2kV 5kHz	IEC61000-4-4	B
Surge	1.2µs/50µs 1kV (Line to line) 2kV (line to ground)	IEC61000-4-5	B
Conducted RF	0.15 to 80MHz 3V, 80%AM (1kHz)	IEC61000-4-6	A

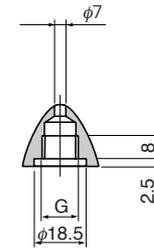
**Note) Definition of performance criteria**

- A : During testing, normal performance within the specification limits**
- B : During testing, temporary degradation, or loss of function or performance which is self-recovering.**

# OUTLINE DIAGRAM (Unit : mm)

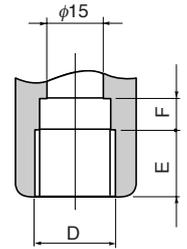


Details of "A"



See table 1

Details of "B"

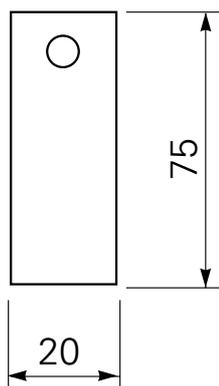


See table 1

4th of Code symbols	Conduit conn.			Press. conn.	Oval flange connection
	D	E	F	G	
M	M20 x 1.5	16	5	1/4-18NPT	M10
N	Pg13.5	8	4.5	1/4-18NPT	M10
P	1/2-14NPT	16	5	1/4-18NPT	M10
T	1/2-14NPT	16	5	1/4-18NPT	7/16-20UNF
V	Pg13.5	8	4.5	1/4-18NPT	M10 or M12
W	M20 x 1.5	16	5	1/4-18NPT	M10 or M12
X	Pg13.5	8	4.5	1/4-18NPT	7/16-20UNF
R	M20 x 1.5	16	5	1/4-18NPT	7/16-20UNF

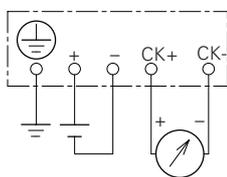
Table 1

Optional stainless steel tag

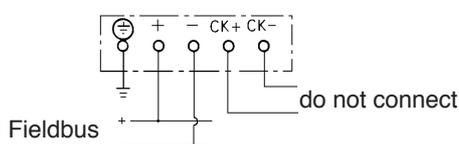


CONNECTION DIAGRAMS

FKK unit



FDK unit



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