

LEVEL TRANSMITTER

DATA SHEET

FKE...F

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

FEATURES

1. High accuracy

0.165% accuracy for all calibrated spans is a standard feature. The micro-capacitance silicon sensor assures this accuracy for all elevated or suppressed calibration ranges without additional adjustment.

0.1% accuracy is available as option

2. Minimum inventory and design

Electronics unit, local indicators and electronics housing are interchangeable among all FCX-All transmitters.

3. 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.

4. Fuji/HART® bilingual communications protocol

FCX-All series transmitter offers bilingual communications to speak both Fuji proprietary protocol and HART®. Any HART® compatible devices can communicate with FCX-All.

5. Application flexibility

Various options that render the FCX-All suitable for almost any process applications include:

- Full range of hazardous area approvals
- Built-in RFI filter and lightning arrester
- 5-digit LCD meter with engineering unit
- Stainless steel electronics housing
- Wide selection of materials

6. Programmable output Linearization Function

Output signal can be freely programmable.
(Up to 14 compensated points at approximation.)

7. Burnout current flexibility (Under Scale: 3.2 to 4.0 mA, Over Scale: 20.0 to 22.5 mA)

Burnout signal level is adjustable using Model FXW or Hand Held Communicator (HHC) to comply with NAMUR NE43.

8. 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:

FKE : Smart, 4-20 mA DC + Fuji/Hart® digital signal

Service :

Liquid, gas or vapour.

Static pressure, span, and range limit:

Type	Static pressure	Span limit (mmH ₂ O)		Range limit (mmH ₂ O)
		Min.	Max.	
FKE□□2	Up to flange rating	10	600	± 600
FKE□□3		32	3200	± 3200
FKE□□5		130	13000	± 13000
FKE□□6		500	50000	± 50000
FKE□□8		3000	300000	±300000

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: 66 kPa abs (500 mmHg abs) at temperature below 60 °C. See fig.2

Overrange limit:

To maximum static pressure limit

Output signal:

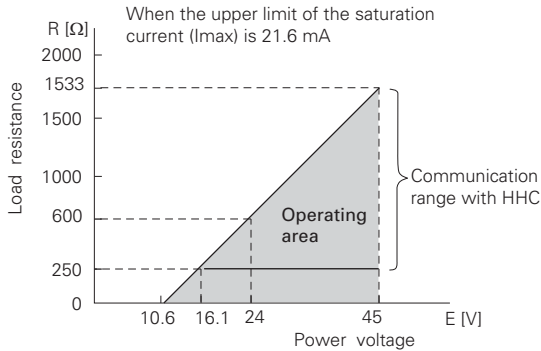
4 to 20 mA DC with digital signal superimposed on the analogic signal

Power supply:

Transmitter operates on 10.5 V to 45 V DC at transmitter terminals.

10.5 V to 32 V DC for the units with optional arrester.

Load limitations: see figure below



Note) The load resistance varies with the upper limit of the saturation current (I max)

$$R [\Omega] = \frac{E [V] - 10.5}{(I \text{ max [mA]} + 0.9) \times 10^{-3}}$$

Note: For communication with HHC⁽¹⁾, min. of 250Ω required.

Hazardous locations: See below

Authority (Digit 10 =)	Intrinsic safety																					
ATEX (K)	Ex II 1 G Ex ia IIC T5 (-40°C ≤ Ta ≤ +50 °C) Ex ia IIC T4 (-40°C ≤ Ta ≤ +70 °C) IP66/67 Entity Parameters: Ui ≤ 28 Vdc, Ii ≤ 94.3 mA, Pi ≤ 0.66 W Ci = 36 nF/26 nF for models with/without Arrester Li = 0.7 mH/0.6 mH for models with/without Analog Indicator																					
Factory Mutual (H)	Class I II III Div.1 Groups A, B, C, D, E, F, G T4 Entity Type 4X <table border="1"> <thead> <tr> <th colspan="2">Model code</th> <th>Tamb</th> </tr> <tr> <th>9th digit</th> <th>13th digit</th> <th></th> </tr> </thead> <tbody> <tr> <td>A,B,C,D,J</td> <td>Y,G,N</td> <td>-40°C to +85°C</td> </tr> <tr> <td>L,P,M,1,2,3</td> <td>Y,G,N</td> <td>-20°C to +80°C</td> </tr> <tr> <td>Q,S,N,4,5,6</td> <td>Y,G,N</td> <td>-20°C to +60°C</td> </tr> <tr> <td>E,F,G,H,K</td> <td>Y,G,N</td> <td>-40°C to +60°C</td> </tr> <tr> <td>-</td> <td>W,A,D</td> <td>-10°C to +60°C</td> </tr> </tbody> </table> Entity Parameters: Vmax=42.4V, Imax=113mA, Pi=1W, Ci=35.98nF, Li=0.694mH	Model code		Tamb	9th digit	13th digit		A,B,C,D,J	Y,G,N	-40°C to +85°C	L,P,M,1,2,3	Y,G,N	-20°C to +80°C	Q,S,N,4,5,6	Y,G,N	-20°C to +60°C	E,F,G,H,K	Y,G,N	-40°C to +60°C	-	W,A,D	-10°C to +60°C
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CSA (J)	Ex ia Class I, Groups A, B, C and D; Class II, Groups E,F and G; Class III Per drawing TC 522873 Temp. code T5 for Tamb max = +50°C Temp. code T4 for Tamb max = +70°C Entity Parameters: Vmax = 28 Vdc, Imax = 94.3 mA, Pmax = 0.66 W Ci = 36 nF/25 nF for models with/without Arrester Li = 0.7 mH/0.6 mH for models with/without Analog Indicator																					
IECEX (T)	Ex ia IIC T5 (-40°C ≤ Ta ≤ +50 °C) Ex ia IIC T4 (-40°C ≤ Ta ≤ +70 °C) IP66/67 Entity Parameters: Ui ≤ 28 Vdc, Ii ≤ 94.3 mA, Pi ≤ 0.66 W Ci = 36 nF/26 nF for models with/without Arrester Li = 0.7 mH/0.6 mH for models with/without Analog Indicator																					

Authority (Digit 10 =)	Type n Nonincendive																					
ATEX (P)	Ex II 3 G Ex nA II T5 (-40°C ≤ Ta ≤ +70 °C) IP66/67 Electrical ratings Model Without arrester: Ui ≤ 45 Vdc, 4-20 mA loop powered, Pi ≤ 1.0125 W Model With arrester: Ui ≤ 32 Vdc, 4-20 mA loop powered, Pi ≤ 1.0125 W Optional Analog indicator is not available for type "n"																					
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IECEX (Q)	Ex nA II T5 (-40°C ≤ Ta ≤ +70 °C) IP66/67 Electrical ratings Model Without arrester: Ui ≤ 45 Vdc, 4-20 mA loop powered, Pi ≤ 1.0125 W Model With arrester: Ui ≤ 32 Vdc, 4-20 mA loop powered, Pi ≤ 1.0125 W Optional Analog indicator is not available for type "n"																					
Authority	Flameproof																					
ATEX (X)	Ex II 2 GD Ex d IIC T6 (-40°C ≤ Ta ≤ +65 °C) Ex d IIC T5 (-40°C ≤ Ta ≤ +85 °C) Ex tD A21 IP66/67 T 85°C Ex tD A21 IP66/67 T 100°C Electrical ratings Model Without arrester: Ui ≤ 45 Vdc, 4-20 mA loop powered, Pi ≤ 1.0125 W Model With arrester: Ui ≤ 32 Vdc, 4-20 mA loop powered, Pi ≤ 1.0125 W																					
Factory Mutual (D)	Class I Div.1 Groups B, C, D T6 Type 4X Class II III Div.1 Groups E, F, G T6 Type 4X Tamb max = +60°C																					
CSA (E)	Class I, Groups C and D; Class II, Groups E,F and G ; Class III Maximum ambient temperature 85°C Maximum working pressure 50 Mpa Electrical ratings Model Without arrester: Ui ≤ 45 Vdc, 4-20 mA Model With arrester: Ui ≤ 32 Vdc, 4-20 mA Note: "Seal not required"																					
IECEX (R)	Ex d IIC T6 (-40°C ≤ Ta ≤ +65 °C) Ex d IIC T5 (-40°C ≤ Ta ≤ +85 °C) DIP A21 IP66/67 T 85°C DIP A21 IP66/67 T 100°C Electrical ratings Model Without arrester: Ui ≤ 45 Vdc, 4-20 mA loop powered, Pi ≤ 1.0125 W Model With arrester: Ui ≤ 32 Vdc, 4-20 mA loop powered, Pi ≤ 1.0125 W																					

Zero/span adjustment:

Zero and span are adjustable from the HHC⁽¹⁾. Zero and span are also adjustable externally from the adjustment screw.

Damping:

Adjustable from HHC⁽¹⁾ or local adjustment unit with LCD display.

The time constant is adjustable between 0.12 to 32 sec.

Zero elevation/suppression:

-100% to + 100% of URL

Normal/reverse action:

Selectable from HHC⁽¹⁾

Indication:

Analog indicator or 5-digit LCD meter

Burnout direction: Selectable from HHC⁽¹⁾

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

"Output Hold":

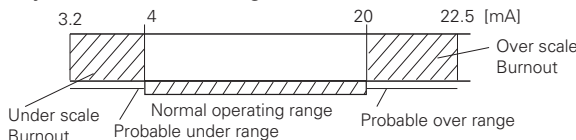
Output signal is hold as the value just before failure happens.

"Output Overscale":

Adjustable within the range 20.0 mA to 22.5 mA from HHC⁽¹⁾

"Output Underscale":

Adjustable within the range 3.2 mA to 4.0 mA from HHC⁽¹⁾



Output limits conforming to NAMUR NE43 by order

Loop-check output:

Transmitter can be configured to provide constant signal 3.2mA through 22.5 mA by HHC⁽¹⁾.

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:

	Code in the 13th digit of "Code symbols"	Process temperature	Lower limit of static pressure
Fluorinated oil	W, A	-20 to 120°C	Atmospheric
Silicone oil	Y and G	-40 to 150°C	20 torr

Note: For higher process temperature, please consult Fuji Electric.

Storage:

- 40 to + 90°C

Humidity limit:

- 0 to 100% RH (Relative Humidity)

Communication:

With HHC⁽¹⁾ (model FXW, consult DS_EDS8-47), following items can be remotely displayed or configured.

Note: HHC's version must be higher than 7.0 (or FXW □□□□1-□4), for FCX-All for supporting these items: "Saturate current", "Write protect", and "History".

Items	Protocole FUJI avec le FXW.		Protocole Hart®		Configuration par 3 boutons poussoir (affichage LCD)	
	Affich.	Régl.	Affich.	Régl.	Affich.	Régl.
N° de repère	v	v	v	v	v	v
N° de modèle	v	v	v	v	v	v
N° de série & version logiciel	v	—	v	—	v	—
Unités physiques	v	v	v	v	v	v
Limite de mesure maxi	v	—	v	—	v	—
Etendue de mesure	v	v	v	v	v	v

Amortissement	v	v	v	v	v	v
Type de signal de sortie	Linéaire	v	v	v	v	v
	Racine carrée	v	v	v	v	v
Valeurs de repli	v	v	v	v	v	v
Etalonnage	v	v	v	v	v	v
Générateur de courant	—	v	—	v	—	v
Valeurs de mesure	v	—	v	—	v	—
Auto diagnostic	v	—	v	—	v	—
Imprimante (option)	v	—	—	—	—	—
Vis de réglage externe	v	v	v	v	v	—
Affichage capteur	v	v	v	v	v	—
Linéarisation*	v	v	—	—	—	—
Reréglage de l'étendue de mesure	v	v	v	v	v	v
Saturation courant	v	v	v	v	v	v
Protection en écriture	v	v	v	v	v	v
Historique						
- Historique d'étalonnage	v	v	v	v	v	v
- Historique T° ambiante	v	—	v	—	v	—

(Note) (1) HHC: Hand Held Communicator

***Local configurator with LCD display (option):**

Local configurator with 3 push button and LCD display can support all items (Fuji Protocol list) except "Linearize" function.

Programmable output linearization function:

Output signal can be characterized with "14 points linear approximation function" from HHC⁽¹⁾.

Performance specifications

Reference conditions, silicone oil fill, SS 316L isolating diaphragms, 4-20 mA analog output.

Accuracy rating:

(including linearity, hysteresis, and repeatability) (Standard)

For spans greater than 1/10 of URL:

±0.165% of span

For spans below 1/10 of URL:

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

(Option)

For span greater than 1/10 of URL:

0.1% of span

For span below 1/10 of URL:

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

Stability:

±0.2% of upper range limit (URL) for 10 years.

Temperature effect:

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

Zero shift (transmitter only): ±0,3 Of URL

Zero shift (level kit only): +0,3 mbar/28°C

Total effect (level kit and transmitter): ±0,3% Of URL

Note : The indicated values are for temperature compensation made on transmitter only, without level kit.

Zero shift is improved (2 to 3 times) by an additional temperature compensation of the complete level transmitter (level kit and transmitter)

Static pressure effect:

Zero shift: ±0.2% of URL / 1MPa
 Span shift: -0.2% of calibrated span / 1MPa
 Double the effects for material code (7th digit in codes symbols) "H", "M", "T", "B", "P" and "R"

Overrange effect:

Zero shift; ±0.15% of URL (160bar max)
 Double the effects for material code (7th digit in codes symbols) "H", "M", "T", "B", "P" and "R"

Supply voltage effect:

Less than 0.005% of calibrated span per 1 V

Update rate: 60 msec

RFI effect :

< 0,2% of URL for the frequencies of 20 to 1000 MHz and field strength of 10 V/m when electronic housing covers are on (Classification : 2-abc : 0,2% of span according SAMA PMC 33.1)

Response time: (at 63,3% of output signal without damping)

Range code	Time constant (at 23°C)	Dead time
"3"	550 msec	120 msec approx.
"5" to "8"	300 msec	

Response time = time constant + dead time

Mounting position effect:

Zero shift, less than 30 mmH₂O for a 10° tilt in any plane (no extension). This error can be corrected by adjusting zero. (Double the effect for fluorinated fill sensor).
 No effect on span.

Vibration effect:

< ±0,25% of span for spans greater than 1/10 of URL.
 Frequency 10 to 150 Hz, acceleration 39,2 m/sec².

Material fatigue: Please consult Fuji Electric.

Dielectric strength:

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

Insulation resistance:

More than 100MΩ at 500V DC.

Turn-on time: 4 seconds

Internal resistance for external field indicator:

12 Ω Max (connected to test terminal CK+ and CK-)

Pressure equipment directive (PED) 97/23/EC

According to Article 3.3

Physical specifications

Electrical connections:

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

Process connections:

LP side: Standard : 1/4-18 NPT
 Option : 1/2-14 NPT with oval flanges
 HP side: ANSI or DIN raised face flange.
 Raised face flange machining:
 Stockfinish - SS 316L diaphragm
 Smooth finish - Other diaphragm materials

Process-wetted parts material:

Material code (7th digit in "Code sym- bols")	LP side			HP side
	Process cover	Diaphragm	Wetted sensor body	Diaphragm & flange face
V	SS 316L	SS 316L	SS 316L	SS 316L
W	SS 316L	Hastelloy-C	SS 316L	Hastelloy-C
H	SS 316L	SS 316L	SS 316L	Hastelloy-C
M	SS 316L	SS 316L	SS 316L	Monel
T	SS 316L	SS 316L	SS 316L	Tantalum
A	SS 316L	SS 316L	SS 316L	SS 316L + FEP lining diaphragm
B	SS 316L	SS 316L	SS 316L	SS 316L + Gold coating
P	SS 316L	SS 316L	SS 316L	Titanium
R	SS 316L	SS 316L	SS 316L	Zirconium

Note: Gasket : Viton O-ring or PTFE/15% graphite square section gasket.

Non-wetted parts material:

Electronics housing:
 Low copper die-cast aluminum, finished with polyester coating (standard), or SS 316 as specified.
 Bolts and nuts:
 Cr-Mo alloy (standard) or SS 316(L)
 Fill fluid:
 Silicone oil (standard) for the measuring cell and level kit
 Silicone oil (standard) for the measuring cell and fluorinated oil (or specific oils upon request) for the level kit.
 Mounting flange:
 316L SS

Environmental protection:

IEC IP66/67 and NEMA 4X

Flange mounting:

See drawings

Mass {weight}:

Transmitter:
 Approx. 10.2 to 19.2 kg without options.
 Add; 0.3 kg for indicator
 0.5 kg for mounting bracket
 4.5 kg for stainless steel housing (option)
 1.0 kg per 50mm extension of diaphragm

ACCESSORIES

Oval flanges:

Converts process connection to 1/2-14 NPT

Hand held communicator:

(Model FXW, refer to datasheet (EDS8-47))

Optional features

Indicator:

A plug-in analog indicator (2.5% accuracy) can be housed in the electronics compartment or in the terminal box of the housing.
 An optional 5 digit LCD meter with engineering unit is also available.

Local configurator with LCD display:

An optional 5 digits LCD meter with 3 push buttons can support items as using communication with HHC.

Arrester:

A built-in arrester protects the electronics from lightning surges.
 Lightning surge immunity: 4 kV (1.2 × 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.

NACE specification:

Metallic materials for all pressure bound ary parts comply with NACE MR 0175/ISO 15156.
 SS 660 bolts and nuts comply with NACE MR 0175/ISO 15156.

Optional tag plate:

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

Vacuum service:

Special silicone oil and filling procedure are applied.
See Fig.1 and Fig.2 below

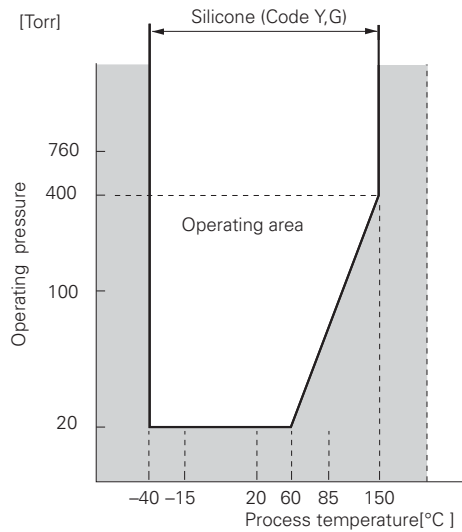


Fig. 1 Relation between process temperature and operating pressure

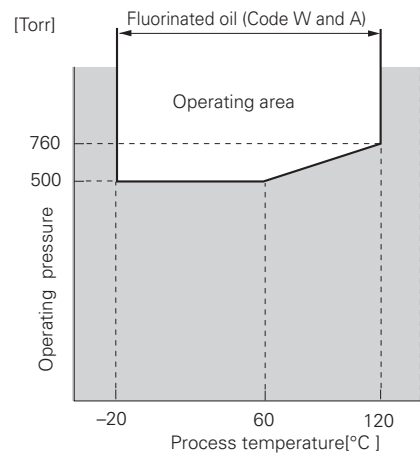


Fig. 2 Relation between process temperature and operating pressure

EMC Directive (2004/108/EC)

All models of **FCX** series transmitters type **FCX-AII** are in accordance with :

- the harmonized standards:
 - EN 61326-1 : 2006 (Electrical equipment for measurement, control and laboratory use - EMC requirements).
 - EN 61326-2-3 : 2006 (Part 2-3 : Particular requirements - Test configuration, operational conditions and performance criteria for transducers with integrated or remote signal conditioning)

Emission limits : EN 61326-1 : 2006

Frequency range (MHz)	Limits	Basic standard
30 to 230	40 dB (µV/m) quasi peak, measured at 10 m distance	EN 55011 / CISPR 11 Group 1 Class A
230 to 1000	47 dB (µV/m) quasi peak, measured at 10 m distance	

Immunity requirements : EN 61326-1 : 2006 (Table 2)

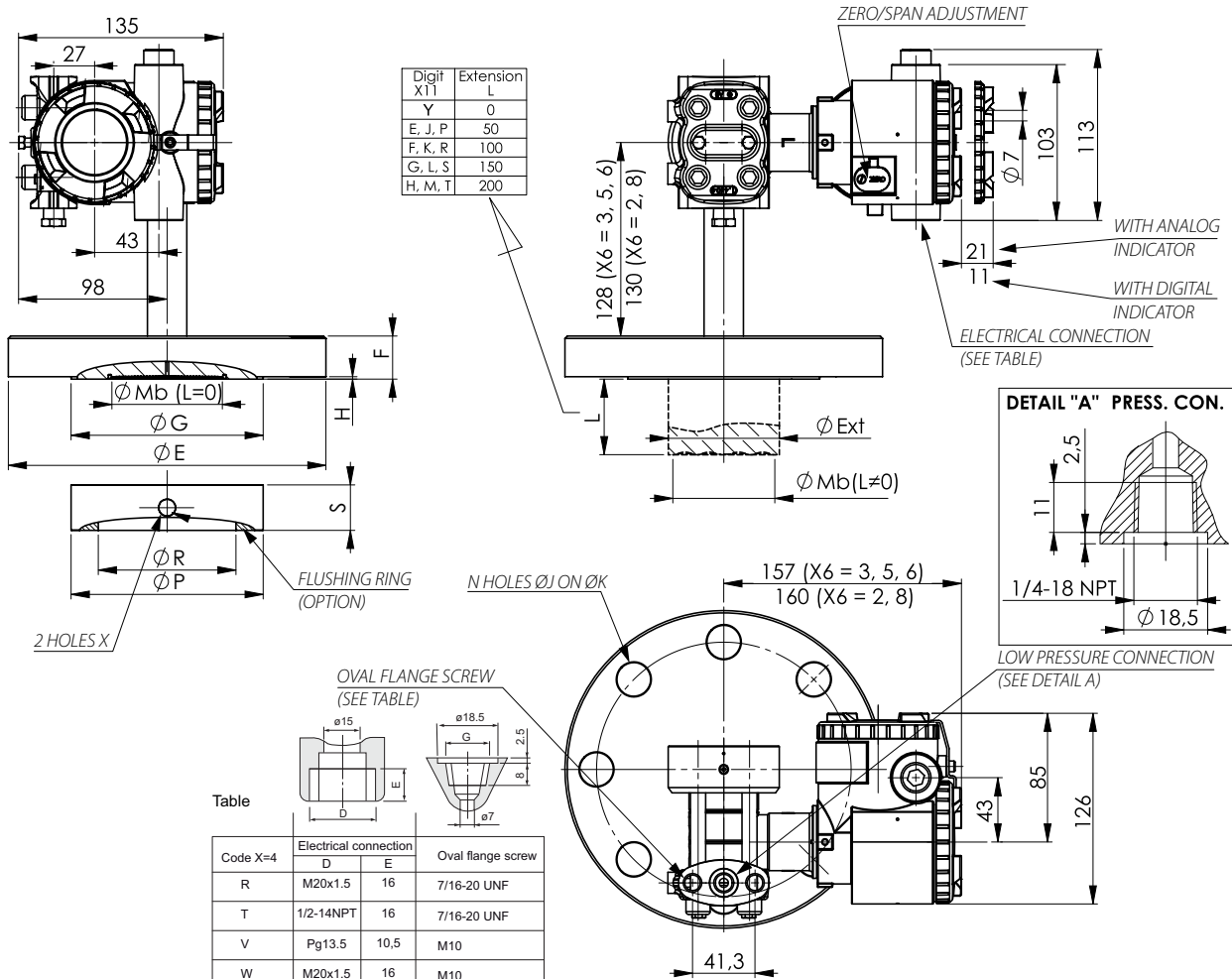
Phenomenon	Test value	Basic standard	Performance criteria
Electrostatic discharge (EDS)	4 kV (Contact) 8 kV (Air)	EN 61000-4-2 IEC 61000-4-2	B
Electromagnetic field	10V/m (80 to 1000 MHz) 3 V/m (1.4 to 2.0 GHz) 1 V/m (2.0 to 2.7 GHz)	EN 61000-4-3 IEC 61000-4-3	A
Rated power frequency Magnetic field	30 A/m	EN 61000-4-8 IEC 61000-4-8	A
Burst	2 kV (5/50 NS, 5 kHz)	EN 61000-4-4 IEC 61000-4-4	B
Surge	1 kV Line to line 2 kV Line to line	EN 61000-4-5 IEC61000-4-5	B
Conducted RF	3 V (150 kHz to 80 MHz)	EN 61000-4-6 IEC61000-4-6	A

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 for short design (Unit:mm)



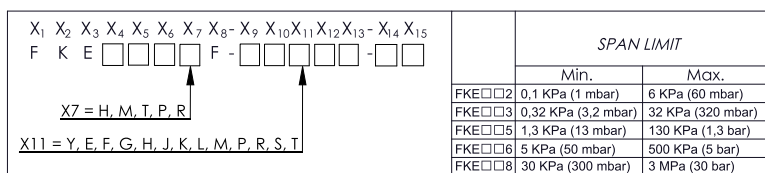
FLUSHING RINGS DIMENSIONS

EN 1092-1	EN 1759-1	HOLES X	ØP	ØR	S
DN 80		1/4-18 NPT	138	91	30
DN 80		1/2-14 NPT	138	91	30
	NPS 3"	1/4-18 NPT	127	91	30
	NPS 3"	1/2-14 NPT	127	91	30
DN 100		1/4-18 NPT	162	116	30
DN 100		1/2-14 NPT	162	116	30
	NPS 4"	1/4-18 NPT	157	116	30
	NPS 4"	1/2-14 NPT	157	116	30

FLANGES DIMENSIONS ACCORDING TO EN 1092-1 & EN 1759-1

EN 1092-1	EN 1759-1	ØE	F min	ØG	H	N x ØJ	ØK	Weight (kg)	Diaphragm & extension	
									L=0 (X11=Y) ØMb	L≠0 ØExt(ØMb)
DN50 PN40		165	20	102	2	4 x 18	125	3,3	59	48,3 (47)
	2" CLASS 150	152	21	92	1,6	4 x 19	120,6	2,7	59	48,3 (47)
	2" CLASS 300	165	22,5	92	1,6	8 x 19	127	3,7	59	48,3 (47)
DN80 PN40		200	24	138	2	8 x 18	160	5,8	89	76 (72)
	3" CLASS 150	190	24	127	1,6	4 x 19	152,4	5,3	89	76 (72)
	3" CLASS 300	210	28,5	127	1,6	8 x 22,2	168,3	7,8	89	76 (72)
DN100 PN16		220	22	158	2	8 x 18	180	5,9	89	94 (89)
	4" CLASS 150	229	24	157	1,6	8 x 19	190,5	7,7	89	94 (89)
	4" CLASS 300	254	32	157	1,6	8 x 22,2	200	12,7	89	94 (89)

Weight :
 4 kg (without option) Add :
 - Flange's weight (see table)
 - 1 kg per 50 mm of extension
 - 0,8 kg for indicator (option)
 - 2 kg for SS mounting bracket (option)



CONNECTION DIAGRAM

