

# LEVEL TRANSMITTERS

## DATA SHEET

**FKE...F**

The FCX-AII V5 level transmitter accurately measures liquid levels and transmits a proportional 4-20 mA output signal.

The transmitter uses an unique micro-capacitive silicon sensor in combination with a state-of-the-art digital signal processing to provide exceptional performances in terms of accuracy and stability.

## FEATURES

### 1. High accuracy

The Fuji Electric's micro-capacitive sensor provides in standard  $\pm 0.165\%$  accuracy for all elevated or suppressed calibration ranges without additional adjustments.

$\pm 0.1\%$  accuracy is available in option.

### 2. Minimum inventory and design

Electronics unit, local indicators and electronics housing are interchangeable among all FCX-AII V5 transmitters.

### 3. Minimum environmental influence

The Advanced Floating Cell technology provides a high immunity against temperature variations, static pressure and overpressure commonly found in the process industry and substantially reduces the overall measurement error.

### 4. HART/Fuji Electric communication protocols

FCX-AII V5 series of pressure transmitters can communicate using either the universal HART or the proprietary and faster Fuji Electric communication protocol.

By the use of Device Description files, HART compatible devices can communicate with any FCX-AII V5 transmitter.

### 5. Application flexibility

Various options are available to address most of the process industry applications, including :

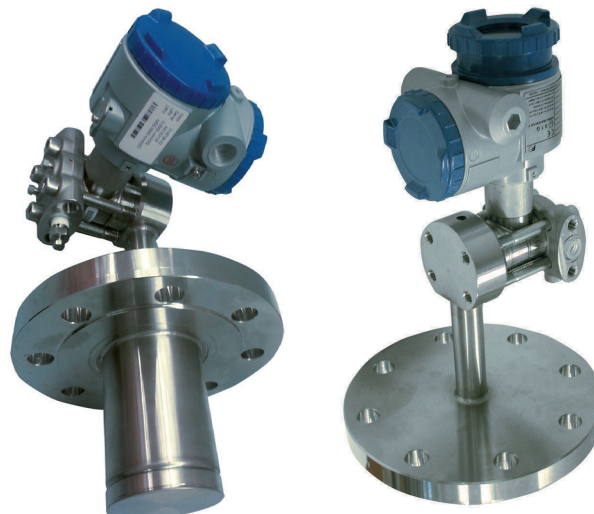
- Full range of hazardous area approvals
- Built-in RFI filter and lightning arrester
- Analog or 5-digits local display with engineering units
- Stainless steel electronics housing
- Wide selection of wetted part materials

### 6. Programmable Output Linearization Function

The output signal can be linearized using up to 14 point pairs.

### 7. Burnout current flexibility

The burnout current value can be adjusted in the ranges of [3.2 ; 4.0] and [20.0 ; 22.5] mA and can be compliant with NAMUR NE43 recommendations.



## SPECIFICATIONS

### Functional specifications

#### Type :

FKE : Smart, 4-20 mA + HART/Fuji Electric communication protocols

#### Service :

Liquid

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

Model	Static pressure	Span limits (mmWC)		Range limits (mmWC)
		Min.	Max.	
FKE□□2	Up to flange rating	10	600	$\pm 600$
FKE□□3		32	3200	$\pm 3200$
FKE□□5		130	13000	$\pm 13000$
FKE□□6		500	50000	$\pm 50000$
FKE□□8		3000	300000	$\pm 300000$

#### Remark :

To minimize environmental influence, span should be greater than 1/40 of the maximum 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 :

4-20 mA with digital signal superimposed on the analog signal.

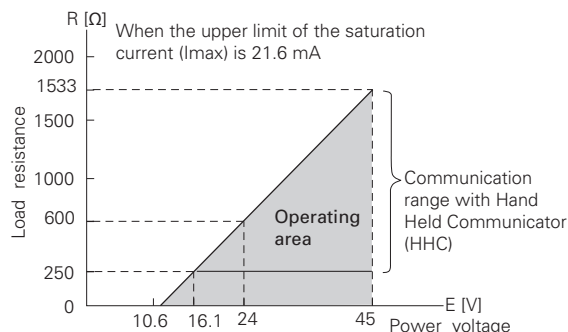
### Power supply :

10.5 to 45 V DC at transmitter terminals.

10.5 to 32 V DC with the optional arrester.

Refer to hazardous location table for specific limitations.

**Load limitations :** see figure below



Note 1 : The load resistance varies with the upper limit of the saturation current [ $I_{max}$ ]

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

Note 2 : For communication with HHC (FXW model), a minimum load of 250  $\Omega$  is required.

### Hazardous locations : (see Table below)

Marking (Digit 10 =)	Protection type
ATEX	Intrinsic Safety "i"
	Ex II 1G/D
	Ex ia IIC T4 Ga (-40°C ≤ Ta ≤ +70°C)
	Ex ia IIC T5 Ga (-40°C ≤ Ta ≤ +50°C)
	Ex ia IIIC T135°C Da (-40°C ≤ Ta ≤ +70°C)
	Ex ia IIIC T100°C Da (-40°C ≤ Ta ≤ +50°C)
	IP 66/67
	Electrical Parameters :
	Ui ≤ 28 Vdc, Ii ≤ 94,3 mA, Pi ≤ 0,66 W
	Ci = 26nF(1) / 36 nF(2), Li = 0.6 mH(3) / 0.7mH(4)
	Flameproof Enclosure "d"
	Ex II 2G/D
	Ex d IIC T5 Gb (-40°C ≤ Ta ≤ +85°C)
	Ex d IIC T6 Gb (-40°C ≤ Ta ≤ +65°C)
	Ex tb IIIC T100°C Db (-40°C ≤ Ta ≤ +85°C)
	Ex tb IIIC T85°C Db (-40°C ≤ Ta ≤ +65°C)
	45 Vdc max
	Increased Safety "e"
	Ex II 3G/D
	Ex ec IIC T5 Gc (-40°C ≤ Ta ≤ +70°C)
	Ex tc IIIC T100°C Dc (-40°C ≤ Ta ≤ +70°C)
	45 Vdc max
	(M) Combination (K) + (X)
IECEx	Intrinsic Safety "i"
	Ex ia IIC T4 Ga (-40°C ≤ Ta ≤ +70°C)
	Ex ia IIC T5 Ga (-40°C ≤ Ta ≤ +50°C)
	Ex ia IIIC T135°C Da (-40°C ≤ Ta ≤ +70°C)
	Ex ia IIIC T100°C Da (-40°C ≤ Ta ≤ +50°C)
	IP 66/67
	Electrical Parameters :
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	Flameproof Enclosure "d":
	Ex d IIC T5 Gb (-40°C ≤ Ta ≤ +85°C)
	Ex d IIC T6 Gb (-40°C ≤ Ta ≤ +65°C)
	Ex tb IIIC T100°C Db (-40°C ≤ Ta ≤ +85°C)
	Ex tb IIIC T85°C Db (-40°C ≤ Ta ≤ +65°C)
	45 Vdc max
	Increased Safety "e"
	Ex ec IIC T5 Gc (-40°C ≤ Ta ≤ +70°C)
	Ex tc IIIC T100°C Dc (-40°C ≤ Ta ≤ +70°C)
	45 Vdc max
	(N) Combination (T) + (R)

cCSAus	(J)	Intrinsic safety / Non Incendive / Class 1 Division 2
		IS Class I Division 1, Groups ABCD Ex ia
		Class II Groups EFG; Class III
		NI Class I Division 2, Groups ABCD
		(Per control drawing TC522873)
		Class I Division 2, Groups ABCD
		T4 (-40°C ≤ Ta ≤ +70°C)
		T5 (-40°C ≤ Ta ≤ +50°C)
		Vmax = 28 Vdc, Imax = 94.3 mA, Pmax ≤ 0.66 W
	Ci = 26nF(1) / 36 nF(2), Li = 0.6 mH(3) / 0.7mH(4)	
	(E)	Explosion proof
		XP Class I Division 1, Groups CD
		Class II Groups EFG; Class III
		T5 (-40°C ≤ Ta ≤ +85°C)
		T6 (-40°C ≤ Ta ≤ +65°C)
	(L)	Vmax = 42.4 Vdc
Combination (J) + (E)		
ATEX	(VV)	Combination (K) + (X) + (T) + (R) + (J) + (E)
IECEx		
cCSAus		

(1) Without optional arrester

(2) With optional arrester

(3) Without analog indicator

(4) With analog indicator

### Configuration :

Configuration of the FCX-AII V5 series of pressure transmitters can be carried out by either using a Hand Held Terminal (ie. Fuji Electric FXW or third party HART terminal) or the 3 push-buttons optional indicator.

A third party HART hand held communicator can be used in combination with Fuji Electric FCX-AII V5 HART Device Description files (<https://fieldcommgroup.org>).

Functions	Fuji Electric FXW		Third party HART HHC		3 push buttons optional indicator	
	Display	Set	Display	Set	Display	Set
Tag Nb	✓	✓	✓	✓	✓	✓
Model Nb	✓	✓	✓	✓	✓	✓
Serial Nb & Software revision	✓	—	✓	—	✓	—
Engineering units	✓	✓	✓	✓	✓	✓
Upper Range Value	✓	—	✓	—	✓	—
Measuring Range	✓	✓	✓	✓	✓	✓
Damping	✓	✓	✓	✓	✓	✓
Output signal type	Linear	✓	✓	✓	✓	✓
	Square Root	✓	✓	✓	✓	✓
Burnout current	✓	✓	✓	✓	✓	✓
Calibration	✓	✓	✓	✓	✓	✓
Output Adjust	—	✓	—	✓	—	✓
Measuring Value	✓	—	✓	—	✓	—
Self Diagnosis	✓	—	✓	—	✓	—
Printer (option)	✓	—	—	—	—	—
External Adj Screw Lock	✓	✓	✓	✓	✓	✓
Transmitter Display	✓	✓	✓	✓	✓	✓
Linearization	—	—	✓	✓	✓	✓
Rerange	✓	✓	✓	✓	✓	✓
Saturation Current	✓	✓	✓	✓	✓	✓
Write Protect	✓	✓	✓	✓	✓	✓
History	✓	✓	✓	✓	✓	✓
	— Calibration History	✓	—	✓	—	✓
	— Ambient T° History	✓	—	✓	—	✓

Note 1 : The FXW firmware revision must be higher than 7.0 in order to address FCX-AII V5 "Saturation Current", "Write Protect" and "History" functions.

Note 2 : The "Linearization" function is not accessible through the 3 push-buttons optional indicator.

### Zero/span adjustment :

Zero and span are adjustable remotely with a Hand Held Communicator or locally with the external adjustment screw

### Damping :

The damping time constant can be adjusted within the range of [0.06 to 32] seconds

### Zero elevation/suppression :

±100% of URL

**Normal/reverse action :**

Selectable from the Hand Held Communicator

**Local indicator :**

One optional analog or 5-digits local indicator

**Burnout direction and saturation currents :**

If the self-diagnostic functions detect a transmitter failure, the burnout function will drive the output signal to either "Output Hold", "Output Overscale" or "Output Underscale" modes.

When "Output Hold" :

The output signal is held as the last value just before the failure happens.

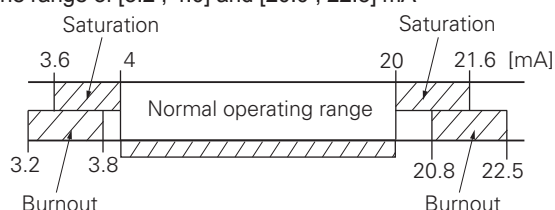
When "Output Overscale" :

The output signal is set within the range of [20.0 to 22.5] mA

When "Output Underscale" :

The output signal is set within the range of [3.2 to 4.0] mA

Both burnout and saturation current can be adjusted within the range of [3.2 ; 4.0] and [20.0 ; 22.5] mA

**Loop-check / fixed output currents :**

The transmitter can be configured to provide a constant output signal from 3.2 up to 22.5 mA

**Temperature limit :**

Ambient :

-40 to +85°C

-20 to +80°C (for LCD indicator)

-40 to +60°C (for arrester option)

Please refer to the hazardous locations table for ambient temperature limitations according to the standard and type of protection.

Process :

	Code in the 13th digit of "Model 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)

## PERFORMANCE SPECIFICATIONS

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

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

Standard :

For spans > 1/10 of URL :

$\pm 0.165\%$  of span

For spans < 1/10 of URL :

$\pm (0.1 + 0.01 \times \frac{\text{URL}}{\text{Span}}) \% \text{ of span}$

Option

For spans > 1/10 of URL :

$\pm 0.1\%$  of span

For spans < 1/10 of URL :

$\pm (0.05 + 0.005 \times \frac{\text{URL}}{\text{Span}}) \% \text{ of span}$

**Stability :**

$\pm 0.2\%$  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) :

$\pm 0.3$  of URL

Zero shift (level kit only) :

+0.3 mbar / 28°C

Total effect (level kit and transmitter) :

$\pm 0.3\%$  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 :

$\pm 0.2\%$  of URL / 1MPa

Span shift :

$\pm 0.2\%$  of calibrated span / 1MPa

Double the effects for material code (7th digit in the model code) "H", "M", "T", "B", "P" and "R"

**Overrange effect :**

Zero shift :

$\pm 0.15\%$  of URL (160bar max)

Double the effects for material code (7th digit in the model code) "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 the URL for the frequencies from 20 up to 1000 MHz with an electrical field strength of 10 V/m and housing covers in place. (Classification : 2-abc : 0.2% of span according SAMA PMC 33.1).

**Response time :** (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 mmWC for a 10° tilt in any position (no extension). This error can be corrected by adjusting zero.

(Double the effect for fluorinated fill sensor).

No effect on span.

**Vibration effect :**

<  $\pm 0.25\%$  of span for spans greater than 1/10 of URL. Frequency 10 to 150 Hz, acceleration 39.2 m/sec<sup>2</sup>.

**Material fatigue :**

Please consult Fuji Electric.

**Dielectric strength:**

500 V AC, 50/60 Hz 1 min., between circuit and earth (except with the optional arrester).

**Insulation resistance :**

More than 100 MΩ at 500 V 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) 2014/68/EU**

According to Article 4.3

## PHYSICAL SPECIFICATIONS

### Conduit connections :

1/2-14 NPT, Pg13.5 or M20x1.5

### 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 model code)	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)

Filling 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 :

SS 316L

### Environmental protection :

IEC IP66/67 and Type 4X

### Flange mounting :

See drawings

### Mass {weight} :

Transmitter : 10.2 to 19.2 kg without options.

Add :

0.3 kg for indicator

0.5 kg for mounting bracket

2.0 kg for stainless steel housing (option)

1.0 kg per 50 mm extension of diaphragm

## ACCESSORIES

### Oval flange :

Converts process connection to 1/2-14 NPT

### Hand held communicator :

Model FXW, refer to datasheet EDS8-47

## OPTIONAL FEATURES

### Local indicator :

A plug-in analog indicator (2.5% accuracy) can be mounted into the electronics compartment or the terminal box of the housing.

An optional 5-digits indicator with engineering units is also available.

### Local configuration with the 3 push-buttons indicator :

A local configuration can be carried out with the optional 3 push-buttons 5-digits indicator.

### Arrester :

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

Lightning surge immunity :

$\pm 4$  kV ( $1.2 \times 50$   $\mu$ s)

### Oxygen service :

Special cleaning procedures are applied during the manufacturing process to maintain oil free all process wetted parts. The filling fluid is fluorinated oil.

### Chlorine service :

Same procedures and filling fluid as for oxygen service

### Degreasing :

Process-wetted parts are cleaned and the filling fluid is standard silicone oil.

Not for use with oxygen or chlorine presence.

### NACE specification :

Metallic materials for all pressure boundary parts comply with NACE MR 0175/ISO 15156.

SS 660 or SS 660/660 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 / fluorinated oil and filling procedure are applied. See Fig.1 and Fig.2 below

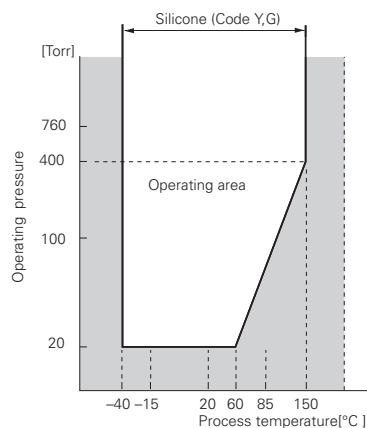


Fig.1  
Relation between process temperature  
and operating pressure (silicone oil)

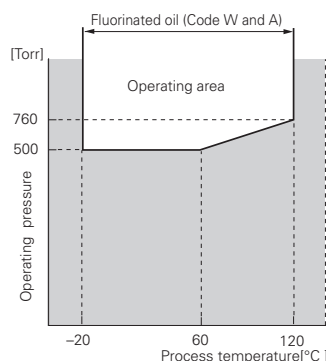
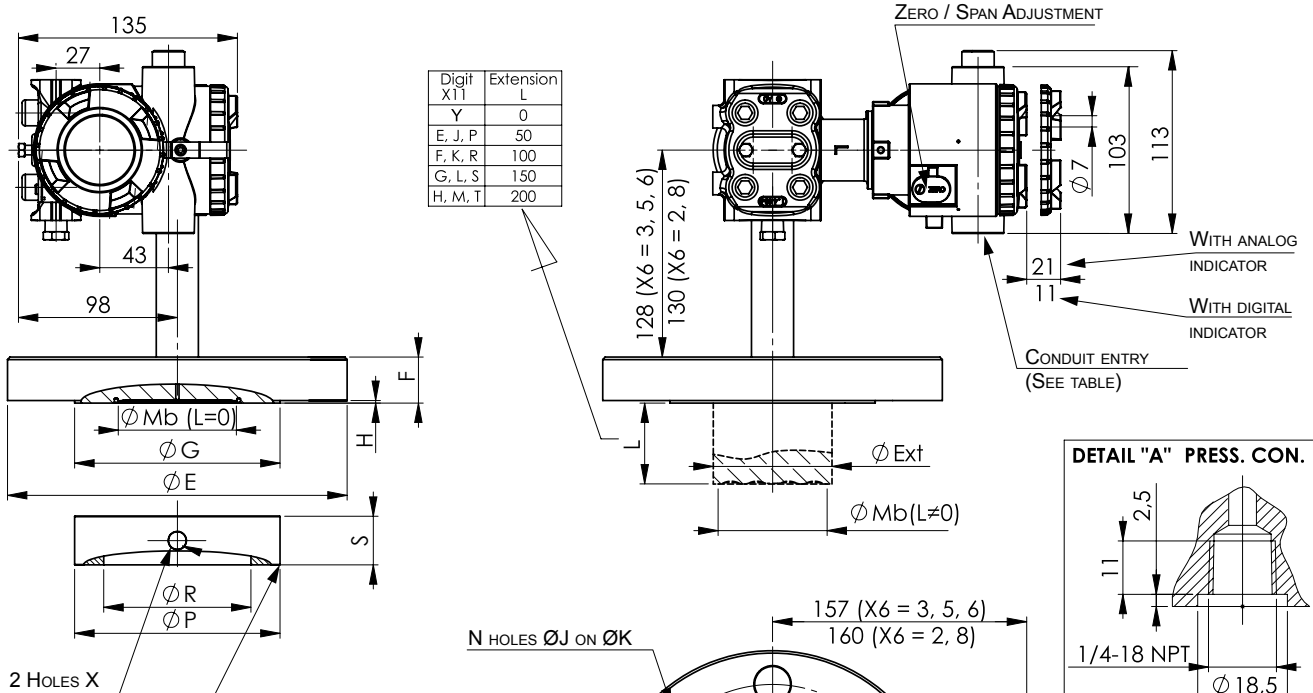


Fig.2  
Relation between process temperature  
and operating pressure (fluorinated oil)

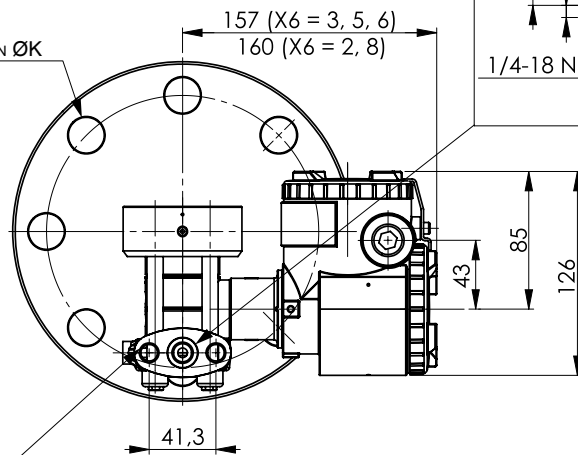
# MODEL CODE SYMBOLS

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	DESCRIPTION
F	K	E														Type
																Level - Smart, 4-20 mA + HART/Fuji Electric communication protocols
																Connections
																LP side connection
																Process
																Oval flange threading
																Conduit connection
																Enclosure type
																1/4 - 18 NPT
																7/16 - 20 UNF
																M20 x 1,5
																1/2 - 14 NPT
																Pg13,5
																M20 x 1,5
																Pg13,5
																1/4 - 18 NPT
																7/16 - 20 UNF
																G 1/2
																1/2 - 14 NPT
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																1/4 - 18 NPT
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																1/4 - 18 NPT

# OUTLINE DIAGRAM FOR SHORT DESIGN (unit : mm)



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



Code X=4	CONDUIT ENTRY		OVAL FLANGE SCREW G
	D	E	
R	M20x1.5	16	7/16-20 UNF
T	1/2-14NPT	16	7/16-20 UNF
V	Pg13.5	10,5	M10
W	M20x1.5	16	M10
X	Pg13.5	10,5	7/16-20 UNF

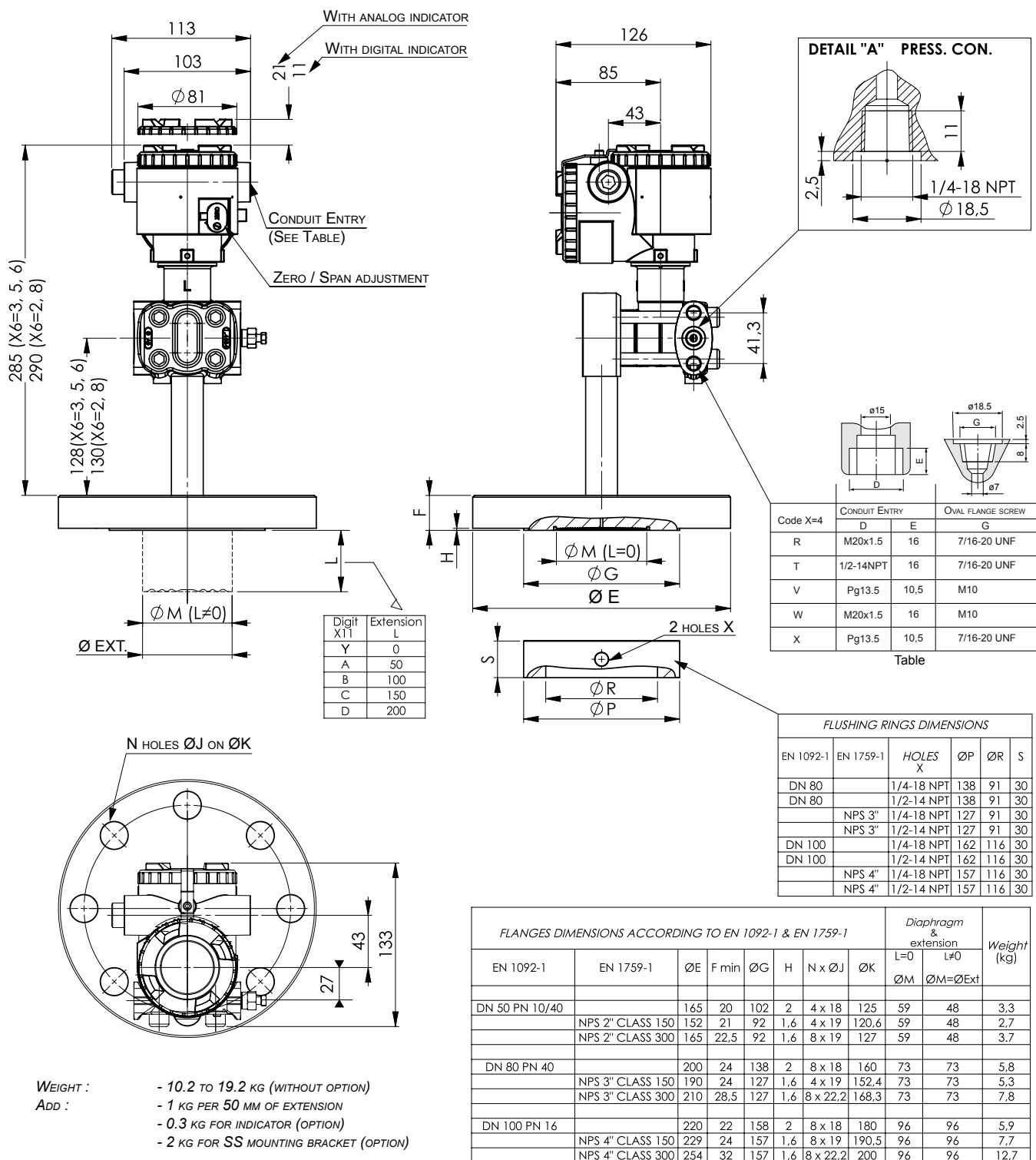
FLANGES DIMENSIONS ACCORDING TO EN 1092-1 & EN 1759-1										Diaphragm & extension	
EN 1092-1	EN 1759-1	ØE	F min	ØG	H	N x ØJ	ØK	Weight (kg)	Exotic material	l=0 (X11=Y) ØMb	l≠0 ØExt(ØMb)
DN50 PN40		165	20	102	2	4 x 18	125	3,3		59	48,3 (47)
	2" CLASS 150	152	21	92	1,6	4 x 19	120,6	2,7		59	48,3 (47)
	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 : - 10.2 TO 19.2 KG (WITHOUT OPTION)  
 ADD : - 1 KG PER 50 MM OF EXTENSION  
 - 0.3 KG FOR INDICATOR (OPTION)  
 - 2 KG FOR SS MOUNTING BRACKET (OPTION)

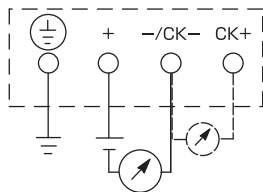
SPAN LIMIT														
Min.														
Max.														
FKE□□2	0,1 KPa (1 mbar)												6 KPa (60 mbar)	
FKE□□3	0,32 KPa (3,2 mbar)												32 KPa (320 mbar)	
FKE□□5	1,3 KPa (13 mbar)												130 KPa (1,3 bar)	
FKE□□6	5 KPa (50 mbar)												500 KPa (5 bar)	
FKE□□8	30 KPa (300 mbar)												3 MPa (30 bar)	



# OUTLINE DIAGRAM FOR LONG DESIGN (unit : mm)



## CONNECTION DIAGRAM



### ELECTROMAGNETIC COMPATIBILITY

All FCX-All series of pressure transmitters are in conformity with the provision of the EMC Directive 2014/30/EU on the harmonization of the laws of the Members States relating to electromagnetic compatibility.

All these models of pressure transmitters are in accordance with the following harmonized standards :

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

### Emission limits (according to EN 55011 / CISPR 11, Group 1 Class A)

Frequency range (MHz)	Limits	Basic standard
30 to 230	40 dB (μV/m) quasi peak, measured at 10 m distance	Passed
230 to 1000	47 dB (μV/m) quasi peak, measured at 10 m distance	

### Immunity

Phenomenon	Test value	Standard	Required Performance criteria	Result of criteria
Electrostatic Discharge	±4 kV (Contact) ±8 kV (Air)	EN/IEC 61000-4-2	<b>B</b>	<b>A</b>
Radiated, Electromagnetic Field	10 V/m (0.08 to 1.0 GHz) 3 V/m (1.4 to 2.0 GHz) 1 V/m (2.0 to 2.7 GHz)	EN/IEC 61000-4-3	<b>A</b>	<b>A</b>
Fast transients (burst)	2 kV (5/50 ns, 5 kHz)	EN/IEC 61000-4-4	<b>B</b>	<b>A</b>
Surge Transients	1 kV Line to line 2 kV Line to ground	EN/IEC 61000-4-5	<b>B</b>	<b>A</b>
Conducted RF Disturbances	3 Vrms (150 kHz to 80 MHz) 80% AM @ 1 kHz	EN/IEC 61000-4-6	<b>A</b>	<b>A</b>
Power Frequency Magnetic Field	30 A/m (50 Hz, 60 Hz)	EN/IEC 61000-4-8	<b>A</b>	<b>A</b>

Performance criteria (A & B): according to IEC 61326



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