

# DIFFERENTIAL PRESSURE (FLOW) TRANSMITTER

DATA SHEET

FHC...4

The FCX-AIIe differential pressure (flow) transmitter accurately measures differential pressure, liquid level, gauge pressure or flow rate and transmits a proportional 4 to 20mA signal. The transmitter utilizes a unique micromachined capacitance silicon sensor with state-of-the-art microprocessor technology to provide exceptional performance and functionality.

## FEATURES

- High accuracy  $\pm 0.1\%$**   
0.1% accuracy is a standard feature.  
Fuji's micro-capacitance silicon sensor assures this accuracy for all elevated or suppressed calibration ranges without additional adjustment.
- 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.
- Fuji/HART® bilingual communications protocol**  
FCX-AIIe series transmitter offers bilingual communications to speak both Fuji proprietary protocol and HART®. Any HART® compatible devices can communicate with FCX-AIIe.
- Application flexibility**  
Various options that render the FCX-AIIe suitable for almost any process applications include.
  - Analog indicator at either the electronics side or terminal side
  - Full range of hazardous area approvals
  - Built-in RFI filter and lightning arrester
  - 5-digit LCD meter with engineering unit
- Programmable output Linearization Function**  
In addition to Linear and Square Root, output signal can be freely programmable.  
(Up to 14 compensated points at approximation.)
- 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) and high performance electronics circuit (Electronics unit), reliability of dry calibration without reference pressure is at equal level as wet calibration.



## SPECIFICATIONS

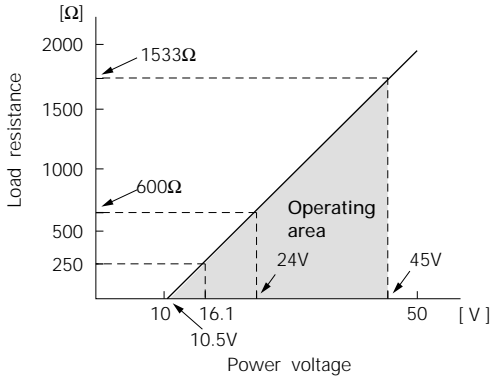
### Functional specifications

Service: Liquid, gas, or vapour  
Static pressure, span, and range limit:

Type	Static pressure [MPa] {bar}	Span limit [kPa] {m bar}		Range limit [kPa] {m bar}
		Min.	Max.	
FHC□33	-0.1 to + 16 {-1 to + 160}	1.06 { 10.6 }	32 { 320 }	+/- 32 { +/- 320 }
FHC□35	-0.1 to + 16 {-1 to + 160}	4.33 { 43.3 }	130 { 1300 }	+/- 130 { +/- 1300 }
FHC□36	-0.1 to + 16 {-1 to + 160}	16.66 {166.6}	500 { 5000 }	+/- 500 { +/- 5000 }

- Lower limit of static pressure (vacuum limit) ;  
Silicone fill sensor: See Fig. 1  
Fluorinated fill sensor: 66kPa abs (500mmHg abs) at temperature below 60°C
  - The maximum span of each sensor can be converted to different units using factors as below.  
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
- Over range 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
- 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 HHC<sup>(1)</sup> (Model: FXW), min. of 250 Ω required.

**Hazardous locations: (Approval pending)**

Authorities	Flameproof	Intrinsic safety	Type n Nonincendive
ATEX	Ex II 2 G and D - EExd IIC T5/T6	Ex II 1 G and D - EExia IIC T4/T5	Ex II 3 G and D - EExn IIC T4/T5
Factory Mutual	Class I II III Div. 1 Groups B thru. G	Class I II III Div. 1 Groups A thru. F	Class I II III Div. 2 Groups A thru. G
CSA	Class I II III Div. 1 Groups C thru. G	Class I II III Div. 1 Groups A thru. G	Class I II III Div. 2 Groups A thru. G
RIIS	Ex do IIB+H <sub>2</sub> T4	—	—

**Zero/span adjustment:**

Zero and span are adjustable from the HHC<sup>(1)</sup>. Zero is also adjustable externally from the adjustment screw.

**Damping:**

Adjustable from HHC. The time constant is adjustable between 0 to 32 seconds.

**Zero elevation/suppression:**

-100% to +100% of URL

**Normal/reverse action:**

Selectable from HHC<sup>(1)</sup>

**Indication:**

Analog indicator or 5-digit LCD meter, as specified.

**Burnout direction:** Selectable from HHC<sup>(1)</sup>

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

"Output Hold":

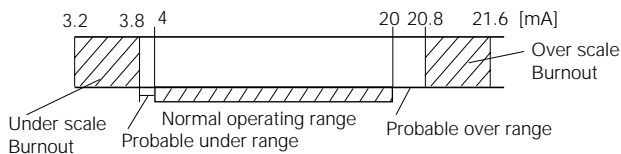
Output signal is hold as the value just before failure happens.

"Output Overscale":

Adjustable within the range 20.8mA to 21.6mA from HHC<sup>(1)</sup>

"Output Underscale":

Adjustable within the range 3.2mA to 3.8mA from HHC<sup>(1)</sup>



**Loop-check output:**

Transmitter can be configured to provide constant signal 3.8mA through 21.6mA by HHC<sup>(1)</sup>.

**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 filled transmitters)

For explosionproof units (flameproof or intrinsic safety), ambient temperature must be within the limits specified in each standard.

Process: -40 to +120°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<sup>(1)</sup> (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-□3), for FCX-A II.

Items	Display	Set
Tag No.	v	v
Model No.	v	v
Serial No.	v	—
Engineering unit	v	v
Range limit	v	—
Measuring range	v	v
Damping	v	v
Output mode	Linear	v
	Square root	v
Burnout direction	v	v
Calibration	v	v
Output adjust	—	v
Data	v	—
Self diagnoses	v	—
Printer	—	—
External switch lock	v	v
Transmitter display	v	v
Linearize	v	v
Rerange	v	v

**Programmable output linearization function:**

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

(Note) (1) HHC: Hand Held Communicator

## Performance specifications

Reference conditions, silicone oil fill, 316SS isolating diaphragms, 4 to 20mA analog output in linear mode.

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

For spans greater than 1/10 of URL:  $\pm 0.1\%$  of span  
For spans below 1/10 of URL:

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

**Stability:**  $\pm 0.2\%$  of upper range limit (URL) for 3 years.

**Temperature effect:**

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

Zero shift;

$$\pm \left( 0.1 + 0.025 \frac{\text{URL}}{\text{Span}} \right) \%$$

Total effect;

$$\pm \left( 0.125 + 0.025 \frac{\text{URL}}{\text{Span}} \right) \%$$

**Static pressure effect:**

Zero shift (% of URL);  
 $\pm 0.1\%/10\text{MPa}$  {100bar}

Span shift (% of calibration span);  
 $-0.2\%/10\text{MPa}$  {100bar}

**Overrange effect:**  $\pm 0.3\%/16\text{MPa}$  {160bar}

**Supply voltage effect:**

Less than 0.005% of calibrated span per 1V

**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 (6th digit in code symbols)	Time constant	Dead time
"3"	0.3 s	0.2 s
"5" and "6"	0.2 s	

**Mounting position effect:**

Zero shift, less than 0.12kPa {1.2m bar} for a 10° tilt in any plane.  
No effect on span.  
This error can be corrected by adjusting Zero.

**Dielectric strength:**

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

**Insulation resistance:**

More than 100M $\Omega$  at 500V DC.

**Turn-on time:** 4 sec.

**Internal resistance for external field indicator:**

12 $\Omega$  or less

**Low flow cut-off:** In the case of square root output mode, customer configurable for any point between 0 to 20% of output.

## Physical specifications

**Electrical connections:**

G1/2, 1/2-14 NPT, Pg13.5, or M20  $\times$  1.5 conduit, as specified.

1 conduit only.

**Process connections:**

1/4-18 NPT or Rc1/4 on 54mm centers, as specified.

Meets DIN 19213.

**Process-wetted parts material:**

Material code (7th digit in Code symbols)	Process cover	Diaphragm	Wetted sensor body	Vent/drain
V	316 stainless steel(*1)	316L stainless steel	316 stainless steel	316 stainless steel

Notes: \* (1) SCS14 per JIS G 5121

Remark: Sensor O-rings: Viton O-ring and teflon gasket selectable.

**Non-wetted parts material:**

Electronics housing: Low copper die-cast aluminum alloy finished with epoxy/polyurethane double coating.

Bolts and nuts: Cr-Mo alloy (standard), 304 stainless steel or 630 stainless steel. Static pressure rating for code "3" with 304 stainless steel bolts is degraded to 10MPa.

Fill fluid: Silicone oil (standard) or fluorinated oil

Mounting bracket: 304 stainless steel

**Environmental protection:**

IEC IP67

**Mounting:**

On 60.5mm(JIS 50A) pipe using mounting bracket, direct wall mounting, or direct process mounting.

**Mass(weight):**

Transmitter approximately 4.4kg without options.

Add; 0.5kg for mounting bracket  
0.8kg for indicator option

**Optional features**

- Indicator:** A plug-in analog indicator (1.5% 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.
- Arrester:** A built-in arrester protects the electronics from lightning surges.  
Lightning surge immunity:  
4kV (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:** The fill fluid is fluorinated oil.
- 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 boundary parts comply with NACE MR-01-75. ASTM B7M or L7M bolts and 2HM nuts (Class II) are available.  
Static pressure rating for code "3" (16 MPa) is degraded to 10MPa.
- Optional tag plate:** An extra stainless steel tag with customer tag data is wired to the transmitter.

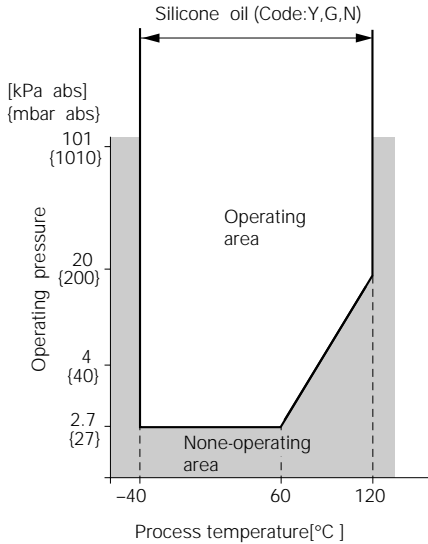


Fig. 1 Relation between process temperature and operating pressure

**ACCESSORIES**

- Oval flanges:** (Model FFP, refer to Data Sheet No. EDS6-10)  
Converts process connection to 1/2-14 NPT or to Rc1/2; in carbon steel or in 316 stainless steel.
- Equalizing valves:** (Model FFN, refer to Data Sheet No. EDS6-10)  
Available in Carbon steel or in 316 stainless steel and in pressure rating 16MPa or 42MPa.
- Hand-held communicator:** (Model FXW, refer to Data Sheet No. EDS 8-47)

**ORDERING INFORMATION**

When ordering this instrument, specify:

1. CODE SYMBOLS
2. Measuring range
3. Output orientation (burnout direction) when abnormality is occurred in the transmitter.  
Hold / Overscale (21.6mA) / Underscale (3.2mA)  
Unless otherwise specified, output hold function is supplied.
4. Output mode (linear or square root output)  
Unless otherwise specified, output mode is linear.
5. Indication method (indicated value and unit) in case of the actual scale (code D, H, P, S on 9th digit).
6. Tag No. (up to 26 alphanumeric characters), if required.

# CODE SYMBOLS

Digit	Description	Note	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	← Digit No. of code
4	<Connection> Process connection    Oval flange screw    Conduit connection		F	H	C					4								
	Rc1/4    7/16-20UNF    G1/2 (x1)						A											
	1/4-18NPT    7/16-20UNF    1/2-14NPT (x1)						B											
	1/4-18NPT    M10 (or M12)(*1)    Pg 13.5 (x1)	Note 1					C											
	1/4-18NPT    M10 (or M12)(*1)    M20x1.5 (x1)	Note 1					D											
	1/4-18NPT    7/16-20UNF    Pg 13.5 (x1)						E											
5, 6, 7	<Span and materials>																	
	Static pressure [MPa] {bar}    Span limit (*2) [kPa] {m bar}    Process cover    Diaphragm    Wetted cell body																	
	-0.1 to +16 (-1 to +160)    1.06...32 {10.6...320}    316 stainless steel    316L stainless steel    316 stainless steel																	33V
																		35V
																		36V
9	<Indicator and arrester> Indicator    Arrester																	
	None    None												A					
	Analog, 0 to 100% linear scale    None												B					
	Analog, 0 to 100% sq. root scale    None (*2)	Note 2											C					
	Analog, custom scale    None												D					
	Analog, double scale (Linear and sq. root)    None												J					
	None    Yes												E					
	Analog, 0 to 100% linear scale    Yes												F					
	Analog, 0 to 100% sq. root scale    Yes (*2)	Note 2											G					
	Analog, custom scale    Yes												H					
	Analog, double scale (Linear and sq. root)    Yes												K					
	Digital, 0 to 100%    None												L					
	Digital, custom scale    None												P					
	Digital 0 to 100% square root    None												M					
	Digital, 0 to 100%    Yes												Q					
	Digital, custom scale    Yes												N					
	Digital 0 to 100% square root    Yes												S					
10	<Approvals for hazardous locations (Approval pending)> None (for ordinary locations) RIS, Flameproof (Conduit seal) (Available for 4th digit code "A") RIS, Flameproof (Cable gland seal) (Available for 4th digit code "A") FM, Flameproof (or explosionproof) (Available for 4th digit code "B") CSA, Flameproof (or explosionproof) (Available for 4th digit code "B") ATEX, Flameproof FM, Intrinsic safety and Nonincendive CSA, Intrinsic safety and Nonincendive ATEX, Intrinsic safety ATEX, Type n													A				
														B				
														C				
														D				
														E				
														X				
														H				
														J				
														K				
														P				
11	<Vent/ drain and mounting bracket> Vent/drain    Mounting bracket																	
	Standard    None																	A
	Standard    Yes, stainless steel																	C
	Side    None																	D
	Side    Yes, stainless steel																	F
12	<Options> Extra SS tag plate    Stainless steel elec, housing    Coating of cell																	
	None    None    None																	Y
	Yes    None    None																	B
	None    Yes    None																	C
	Yes (*3)    Yes    None																	E
	None    None    Yes																	M
	Yes    None    Yes																	N
	None    Yes    Yes																	P
	Yes    Yes    Yes																	Q

Note 1: (\*1) The thread is M12, if 42MPa {420bar} static pressure is specified.

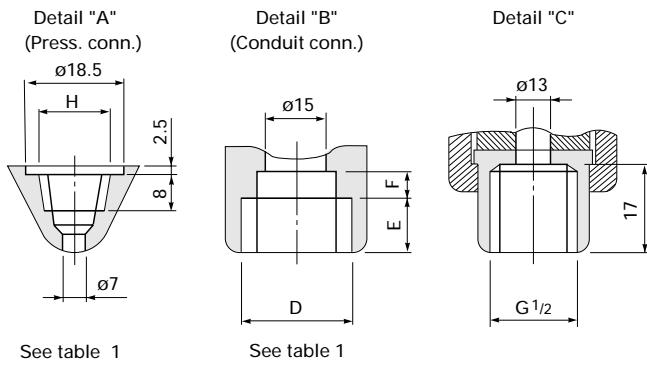
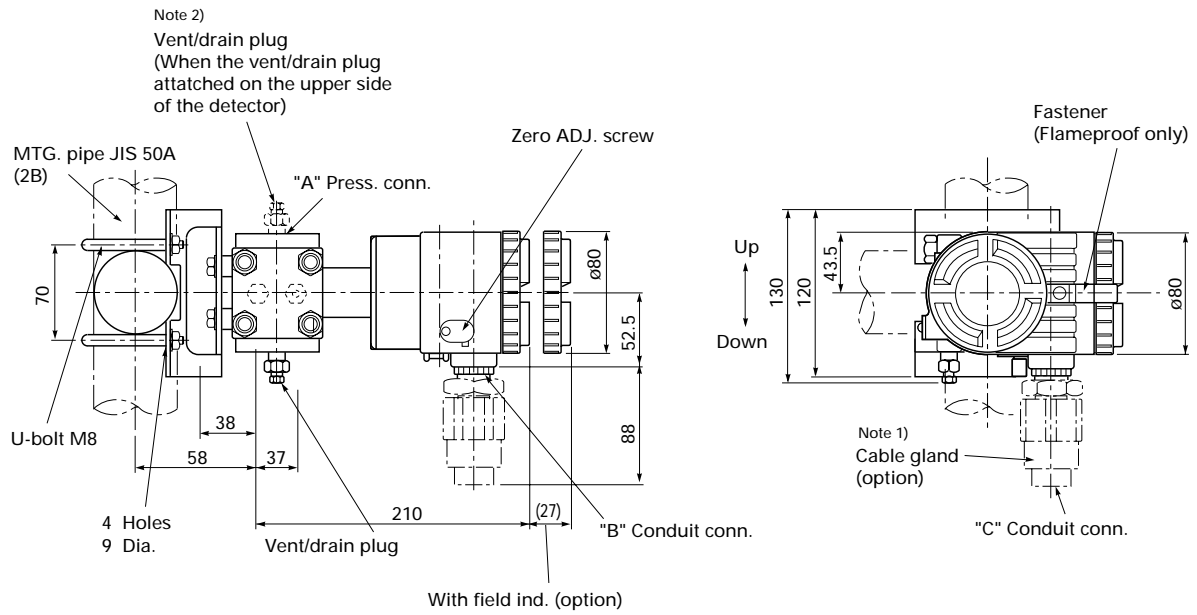
Note 2: (\*2) In case of square root output mode, square root scale is not available.

Note 3: (\*3) Customer tag number can be engraved on standard stainless steel name plate. If extra tag plate is required, select "Yes".

Digit	Description	Note	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	← Digit No. of code
13	<Special applications and fill fluid> Treatment      Fill fluid Standard        Silicone oil Degreasing     Silicone oil Oxygen service Fluorinated oil (7th digit code "V" only) NACE specification Silicone oil		F	H	C					4	-							
14	<Sensor O-ring / Gasket> Viton (O-ring) Teflon (gasket)																	A B
15	<Bolt/nut> (*6) Cr-Mo alloy hexagon socket head cap screw/carbon steel nut Cr-Mo alloy hexagon bolt/nut NACE bolt/nut (ASTM A193 B7M/A194 2HM) } (*4) NACE bolt/nut (ASTM A320 L7M/A194 2HM) } (*4) 304 stainless steel bolt/304 stainless steel nut (*5) 630 stainless steel bolt/304 stainless steel nut	Note 6   Note 4  Note 5																A B C D E F

Note 4: (\*4) Static pressure should be -0.1 to +10MPa(-1 to +100bar).  
 Note 5: (\*5) In case of stainless steel bolt, static pressure should be -0.1 to +10MPa (-1 to + 100bar).  
 Note 6: (\*6) In case of tropical use, select stainless bolts and nuts.

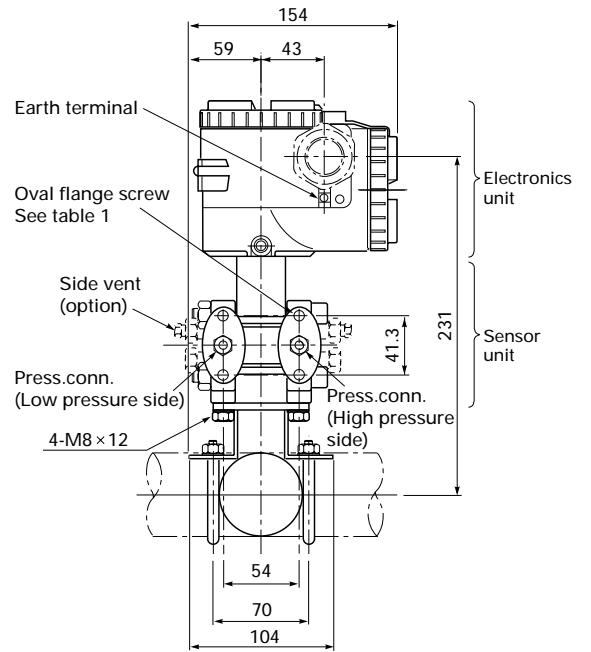
# OUTLINE DIAGRAM (Unit:mm)



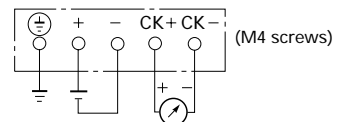
4th digit of the code symbols	Conduit conn.			Press. conn.	Oval flange screw
	D	E	F	H	
A	G $\frac{1}{2}$	17	8	Rc $\frac{1}{4}$	$\frac{1}{16}$ -20UNF Screw depth 15
B	1/2-14NPT	16	5	1/4-18NPT	$\frac{1}{16}$ -20UNF Screw depth 15
C	Pg13.5	8	4.5	1/4-18NPT	M10 Screw depth 15
D	M20 $\times$ 1.5	16	5	1/4-18NPT	M10 Screw depth 15
E	Pg13.5	8	4.5	1/4-18NPT	$\frac{1}{16}$ -20UNF Screw depth 15

Table 1

- Note 1) Cable gland is supplied in case of 10th digit code "C".  
 $\phi 11$  cable is suitable.
- Note 2) The pressure connector is located on the down side surface of the detector, when the vent /drain plug is attached on the upper side of the detector.



## CONNECTION DIAGRAM



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) EN50081-2 : 1993**

Test item	Frequency range	Basic standard
Applicable Electromagnetic Radiation Disturbance	30-1000MHz	EN55011 (1991) Class B

**EMI (Immunity) EN50082-2 : 1995**

Test item	Test specification	Basic standard	Performance criteria
Electrostatic discharge	8kV (Air)	EN61000-4-2 (1995)	B
Radio-frequency Electromagnetic Field Amplitude Modulated	80-1000MHz 10V/m (unmodulated) 80%AM	ENV50140 (1993)	A
Radio-frequency Electromagnetic Field Pulse Modulated	900MHz 10V/m (unmodulated) 50% Duty 200Hz (Rep. Freq.)	ENV50204 (IEC1000-4-3, 1995)	A
Radio-frequency Common Mode Amplitude Modulated	0.15-80MHz 10V/m (unmodulated) 80%AM 150Ω	ENV50141 (IEC1000-4-6, 1995)	A
Fast Transients Common mode	2kV 5ns/50ns (Tr/Th) 5kHz (Rep. Freq.)	EN61000-4-4 (IEC1000-4-4, 1995)	B

"LVD - The transmitter is not covered by the requirements of the LVD standard."

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