General Specifications

Model FU20-FTS and FU20-MTS
Differential pH/ORP sensor

GS 12B06J03-05EN-P

Overview

The FU20-FTS and FU20-MTS are successful developments in pH sensor technology, available from Yokogawa. This sensor has the measuring technology from the differential sensor and the ruggedness of the appreciated wide body FU20 design in one product.

Most pH sensors use silver/silver chloride reference cells with an open junction to the process. With the differential technology, the junction is not in direct contact with the process. For many applications, this is beneficial because you will not poison silver/silver chloride reference. In a wide range of applications, this solution has proven very effective and remains a cost-effective solution.

Lifetime of the conventional sensors is dependent on regular maintenance of the pH probes. Regular cleaning is required to eliminate reference poisoning. 70-80% of industrial users will fully benefit from using differential sensor technology in their high temperature and pressure applications.

Example applications:

- Electrolysis of brine in Chlorine manufacturing
- Flue gas desulphurization (scrubbers)
- Desalter in crude oil
- Quench tower
- Sugar, 1st and 2nd carbonation tower
- MgCl2 / CaCL production
- Pulp stock and stock water for Pulp and Paper
- Fermentation tank for bio-ethanol production

Features

In the differential pH measurement solution provided by Yokogawa below features deliver benefits in customers' applications:

- No junction
- No open connection from the process to the inside of the sensor
- No possibility of the poisoning reference element
- No use of diaphragm; hence no issues of plugging or coating of junction diaphragm
- No outflow of electrolytes, so no depletion issues
- NEW FU20-MTS optional with EPDM O-ring and FFKM sealing
- Any angle of installation, including upside down mounting for all VP/VS models

■ 1. General Specification FU20

This version encompasses the benefits of the cation reference into a PVDF rugged body with a ¾" NPT. The wide body sensor (26mm diameter) holds four separate measuring elements in one unbreakable and chemical resistant PVDF body. The FU20-FTS is targeted for those applications where the cation differential reference is the best solution but needs a more durable body than a 12mm glass.

1.1 Measuring elements

Sensor type	: Na glass electrode : pH glass electrode
Reference system	: Silver Chloride reference
Electrode type	: Solid Platinum electrode
Temperature sensor	: Pt1000 temperature sensor

1.2 Construction materials

Wetted parts

Sensor body	: PVDF - GF20
Earthing pin	: Solid Platinum
Measuring sensor membrane pH	: L-glass
Measuring sensor membrane pNa	: Na-glass
LE glass tube	: LF-44
O-ring	: FTS :Viton, Silicone : MTS :EPDM, FFKM
Body inert	: PVDF

1.3 Functional specifications (at 25°C)

Isothermal point	: pH 7, pNa 0 (pH 7 at 1 M NaCl)
Reference system	: Salt sensitive Ag/AgCl in 1M KCl
Glass impedance	: 400-1000 MΩ
Liquid outlet	: Non flow no junction
Temperature element	: Pt1000 to IEC 751
Asymmetry potential	: 0 ± 15 mV
Linearity PH (Slope)	: > 90 % in pH 2-12 with pH = pNa+2

Note: The temperature sensor included in the FU20-FTS-MTS is designed for process compensation and indication. It is NOT designed for process temperature control.

1.4 Dynamic specifications (at 25°C)

Response time pH step (7 to 4)	: t90 < 15 sec. (for 7 to 4 pH step)
Response time temp step (10°C)	: t90 < 120 sec. (for 10 °C step)
Stabilization time (0.02 pH unit/10 s)	: < 120 sec. (for 0.02 pH deviation during 10 sec.)

1.5 Operating range

pH	: 2 to 14
ORP	: -1500 to 1500 mV
Temperature	: 0°C to 105°C (32°F to 221°F)
Pressure	: At 25ºC and 105 ºC to a max. of 5 bar
Conductivity	: > 10 µS/cm

1.6 Environmental conditions

Storage temperature	: -10 to +50 ºC (14 to 122 ºF)
Ingress Protection	: IP67 (conform IEC 60529)

Note: The pH operating range at room temperature is 2-14 pH, but high temperatures will seriously shorten the lifetime outside the 2-12 pH range.

Note: The upper process temperature for the intrinsically safe version is limited by the ambient temperature (Tamb.) defined for each temperature class (T3, T4, T5 and T6)

Table 1: Regulatory compliance

Item	Description, Approval, Certification
LVD [1]	• ANSI/ISA 61010-1 • CAN/CSA C22.2 No. 61010-1
RoHS	EU Directive 2011/65/EU and Commission Delegated Directive (EU) 2015/863 amending Annex II, applying Annex IV as regards the application of the sensors, detectors, and electrodes per • EN-IEC 63000:2018
PED	EU Directive 2014/68/EU applying Article 4.3: Sound Engineering Practice.
WEEE	EU directive 2012/19/EU This sensor is intended to be sold and used only as a part of equipment which is excluded from the WEEE directive, such as large-scale stationary industrial tools, a large-scale fixed installation etc., and therefore it is in principle fully compliant with WEEE directive. The sensor should be disposed in accordance with applicable national legislations/regulations respectively.
ATEX (EU, UK)	ATEX approval (Issue No. 2): DEKRA 11ATEX0014 X ~ 0344 0 II 1 G Ex ia IIC T3…T6 Ga Applied standards: • EN IEC 60079-0 • EN 60079-11 For specific conditions of use, see certificate.
IECEx	IECEx approval (Issue No. 1): IECEx DEK 11.0064X Ex ia IIC T3…T6 Ga Applied standards: • IEC 60079-0 • IEC 60079-11 For specific conditions of use, see certificate.
FM (Canada)	FM approval Canada: FM20CA0062X IS SI CL I, DIV 1, GP ABCD, T3…T6 CL I, ZN 0, Ex ia IIC, T3…T6 Ga Control Drawing: D&E 2020-023-A51 Applied standards: • CAN/CSA-C22.2 No. 60079-0 • CAN/CSA-C22.2 No. 60079-11 • CAN/CSA-C22.2 No. 61010-1 For specific conditions of use, see certificate.
FM (United States)	FM approval United States: FM20US0123X IS CL I, DIV 1, GP ABCD, T3…T6 CL I, ZN 0, AEx ia IIC, T3…T6 Ga Control Drawing: D&E 2020-023-A50 Applied standards: • FM Class 3600 • FM Class 3610 • FM Class 3810 • ANSI/ISA 60079-0 • ANSI/ISA 60079-11 • ANSI/ISA 61010-1 For specific conditions of use, see certificate.
NEPSI (China)	NEPSI approval: GYJ21.2891X Ex ia IIC T3…T6 Ga Applied standards: • GB 3836.1 • GB 3836.4 • GB 3836.20 For specific conditions of use, see certificate.

Item	Description, Approval, Certification
PESO (India)	PESO approval (Issue No. 2): DEKRA 11ATEX0014 X PESO approval is based on ATEX approval Equipment reference numbers: P512760/1 Applied standards: • EN IEC 60079-0 • EN 60079-11 For specific conditions of use, see certificate.
TS (Taiwan)	TS approval: IECEx DEK 11.0064X TS Safety Label is based on IECEx approval Identification Number: TD04000C Applied standards: • IEC 60079-0 • IEC 60079-11 For specific conditions of use, see certificate.
KCs (Korea)	Korea Ex certificates (Issue No. 1): IECEx DEK 11.0064X Korea Ex certificate is based on IECEx approval and applicable for the following models: FU20-VP-CG: 21-KA4BO-0416X FU20-VS-CG: 21-KA4BO-0417X FU20-**-CG: 21-KA4BO-0418X Applied standards: • IEC 60079-0 • IEC 60079-11 • KS C IEC 60079-14 For specific conditions of use, see certificate.
EAS Ex (Russia)	EAC Ex certificate: RU C-NL.AA87.B.00229/19 0Ex ia IIC T6…T3 Ga X Applied standards: • GOST 31610.0 (IEC 60079-0) • GOST 31610.11 (IEC 60079-11) • GOST IEC 60079-14 For specific conditions of use, see certificate.
Regulatory Standards	
Remarks: 1. EU Directive 2011/68/EU applying: Article 4.3: Sound Engineering Practice Warning: Damaging the screw thread of the sensor might influence the maximum process pressure. 2. EU Directive 2011/65/EU and Commission Delegated Directive (EU) 2015/863 amending Annex II, applying Annex IV as regards the application of the sensors, detectors and electrodes per EN-IEC 63000: 2018 3. EU directive 2012/19/EU This sensor is intended to be sold and used only as a part of equipment which is excluded from the WEEE directive, such as large-scale stationary industrial tools, a large-scale fixed installation etc., and therefore it is in principle fully compliant with WEEE directive.The sensor should be disposed in accordance with applicable national legislations/regulations respectively. 4. Low Voltage as per ANSI/ISA 61010-1:2012 and CAN/CSA C22.2 No. 61010-1:2012 (R2017)	

■ 2. Dimensions

Units in mm [inch]

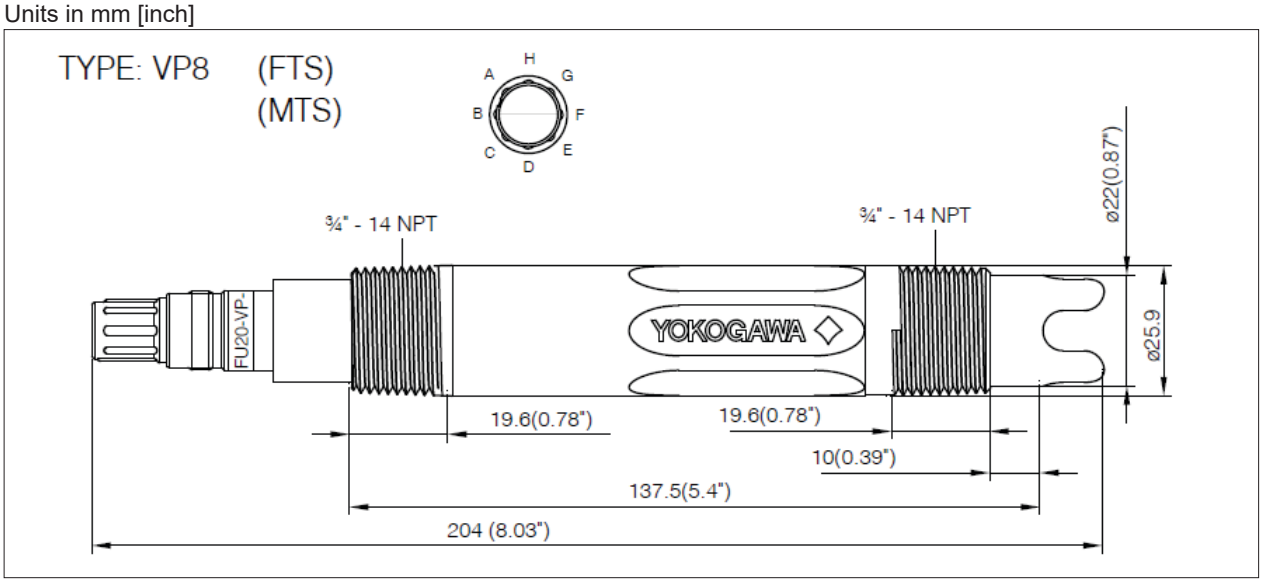


Figure 1: Dimensions FU20-FTS

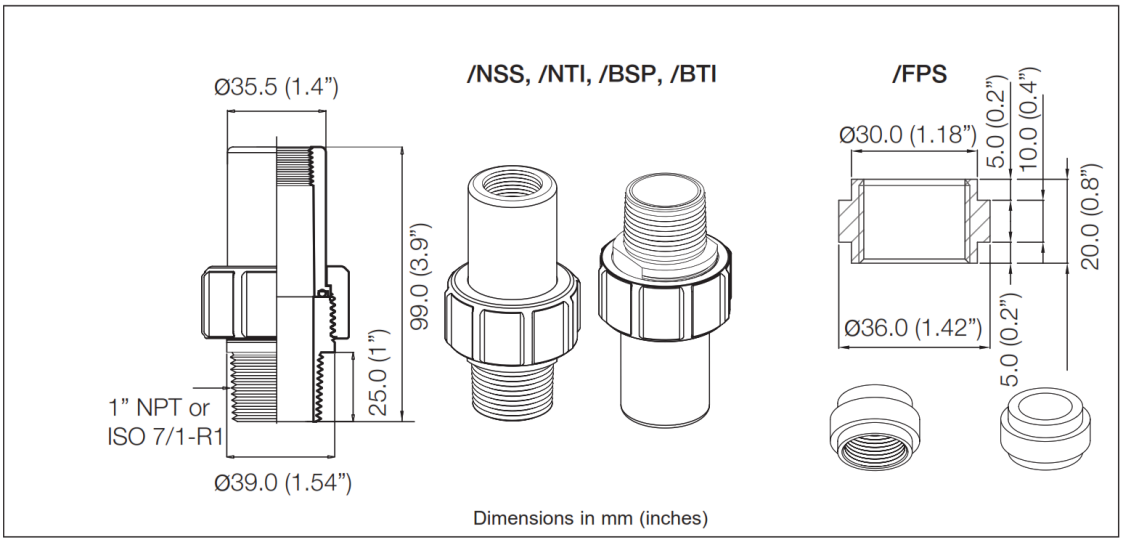


Figure 2: Dimensions 1" FU20-FTS/MTS adapter Stainless Steel & Titanium and FU20-FTS/MTS adapter for FF40, FS40 and FD40 fittings

■ 3. Model Codes & Parts

Table 2: Model & Suffix codes FU20

Model	Suffix Code	Option code	Description		
FU20			Wide Body sensor		
Connection	-VP		No Cable; VarioPin connector, not available for MTS		
	-VS		No Cable; VarioPin connector with ID-chip		
Temperature Sensor	-CG		Pt1000, IS for KCs		
	-T1		Pt1000, IS for ATEX/IECEx/FM-US/FM-CAN/NEPSI/PESO/TS/EACEx		
Model	-FTS		PVDF body / Tapered Thread / Salt Sensitive membrane / Silicone and FKM (Viton) sealing		
	-MTS		PVDF body / Tapered Thread / Salt Sensitive membrane / FFKM and EPDM sealing		
Options			Material	Process Connection	Part No.
		/FPS	PPO	Adapter F*40 from	K1523DD
		/NSS	SS316	1” NPT	K1547PK
		/NTI	Titanium	1” NPT	K1547PM
		/BSS	SS316	1” BSP	K1547PL
		/BTI	Titanium	1” BSP	K1547PN
		/HCNF	Complete Hastelloy cleaning system		K1547PJ

Table 3: Spare parts FU20

Spare part		Description
K1523DD	FU20	/FPS Adapter for FF40, FS40 and FD40 fittings (PPO)
K1547PK		/NSS 1” NPT, Stainless Steel adapter (Viton O-ring)
K1547PL		/BSS ISO 7/1-R1, Stainless Steel adapter (Viton O-ring)
K1547PM		/NTI 1” NPT, Titanium adapter (Viton O-ring)
K1547PN		/BTI ISO 7/1-R1, Titanium adapter (Viton O-ring)
K1500FR		Viton O-rings 29.82*2.62 (5 pcs) for 1” adapter
K1500FS		EPDM O-rings 29.82*2.62 (5 pcs) for 1” adapter
K1500FT		Silicone O-rings 29.82*2.62 (5 pcs) for 1” adapter
K1526RF		Protection CAP/WET-POCKET FU20 (10 PCS)
K1547PJ	Cleaning system for FU20	Hastelloy cleaning system (HCNF)
K1547PG		Hastelloy nozzle and mounting set (HCNF)
K1547PH		Nylon tube (10 metre) and tube mounting set for chemical cleaning system
K1520BF	Buffer solutions	Buffer solution pH 4/7/9 + pNa 0 (500 ml each), ionic strength 1 mol NaCl
K1520BH		Buffer solution pH 4 + pNa 0 (3 x 500 ml), ionic strength 1 mol NaCl
K1520BJ		Buffer solution pH 7 + pNa 0 (3 x 500 ml), ionic strength 1 mol NaCl
K1520BK		Buffer solution pH 9 + pNa 0 (3 x 500 ml), ionic strength 1 mol NaCl
WU10-V-S-XX	Connection cables for Suffix -03, -05,-10, -20, -VP, -VS	Variopin cable (XX = 02, 05, 10, 15 and 20m)
WU10-V-D-XX		Variopin cable (XX = 02, 05, 10, 15 and 20m)
WE10-H-D-XX		Extension cable for SENCOM SMART ADAPTER SA11
BA11	Connection equipment for Suffix -VS	Active Junction box
SA11-P2		SENCOM SMART adapter
WU11		Interconnection cable
IB100		Interface box
K1522PS	Part K1522PS Protection sleeve	Protection sleeve for 3/4” NPT sensor

Addendum 1: Typical installation

The differential FU20 sensor can be implemented in process applications using either:

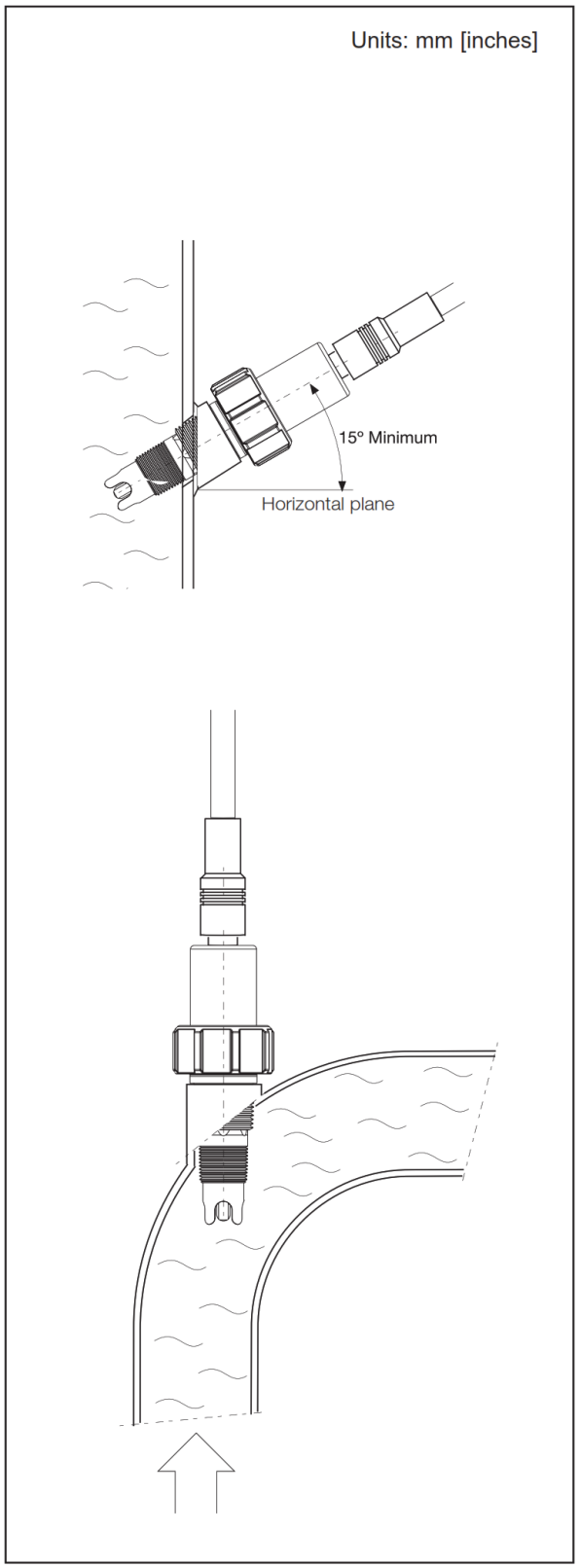


Figure 3: Direct process connection using the ¾"NPT thread using available adapters.

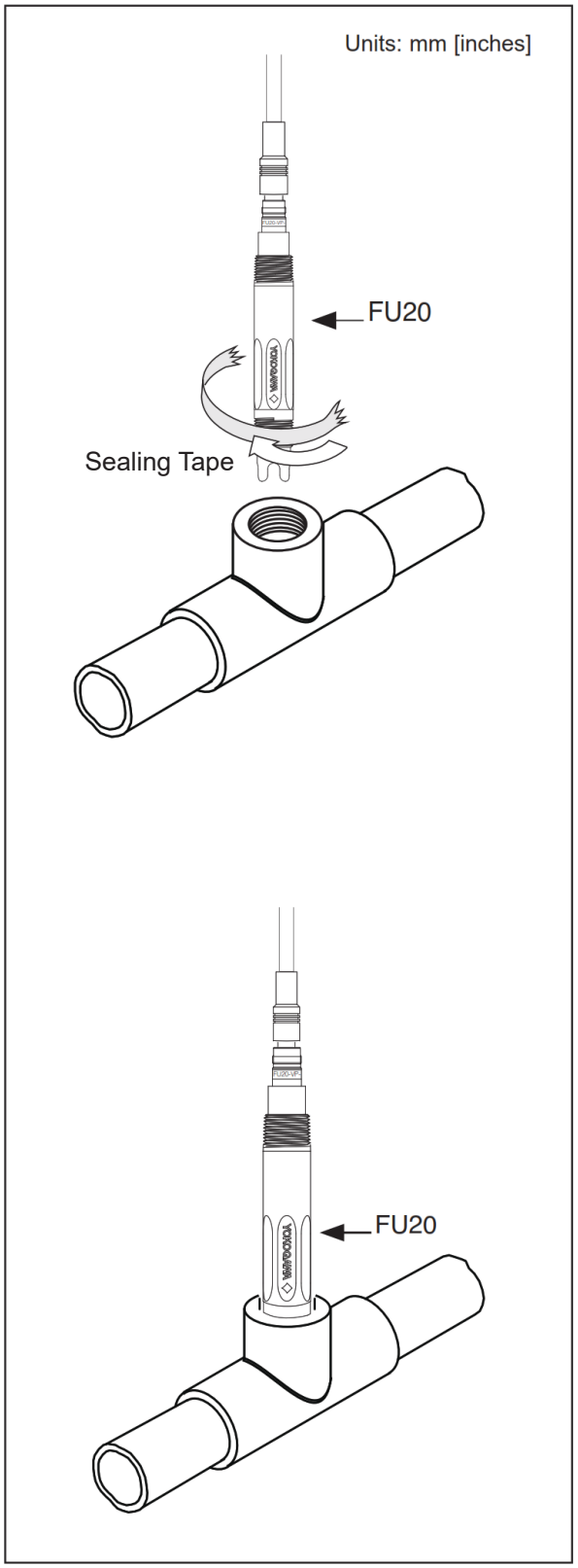


Figure 4: T-piece installation using 3/4" NPT Thread

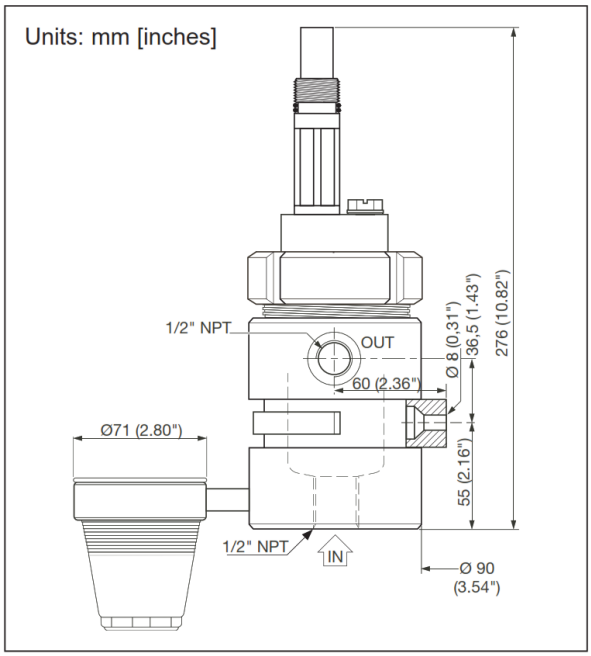


Figure 5: Installation example FU20-FTS/MTS in FF20 flow fitting PP/PVDF

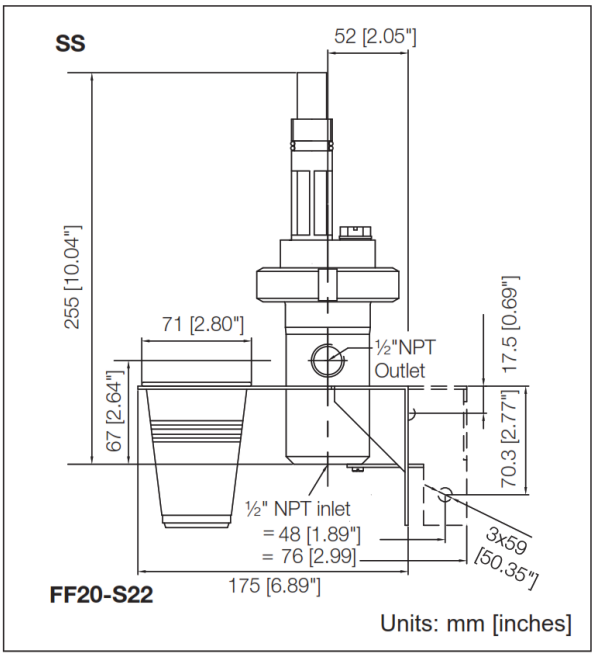


Figure 6: Installation example FU20-FTS/MTS in FF20-flow fitting SS

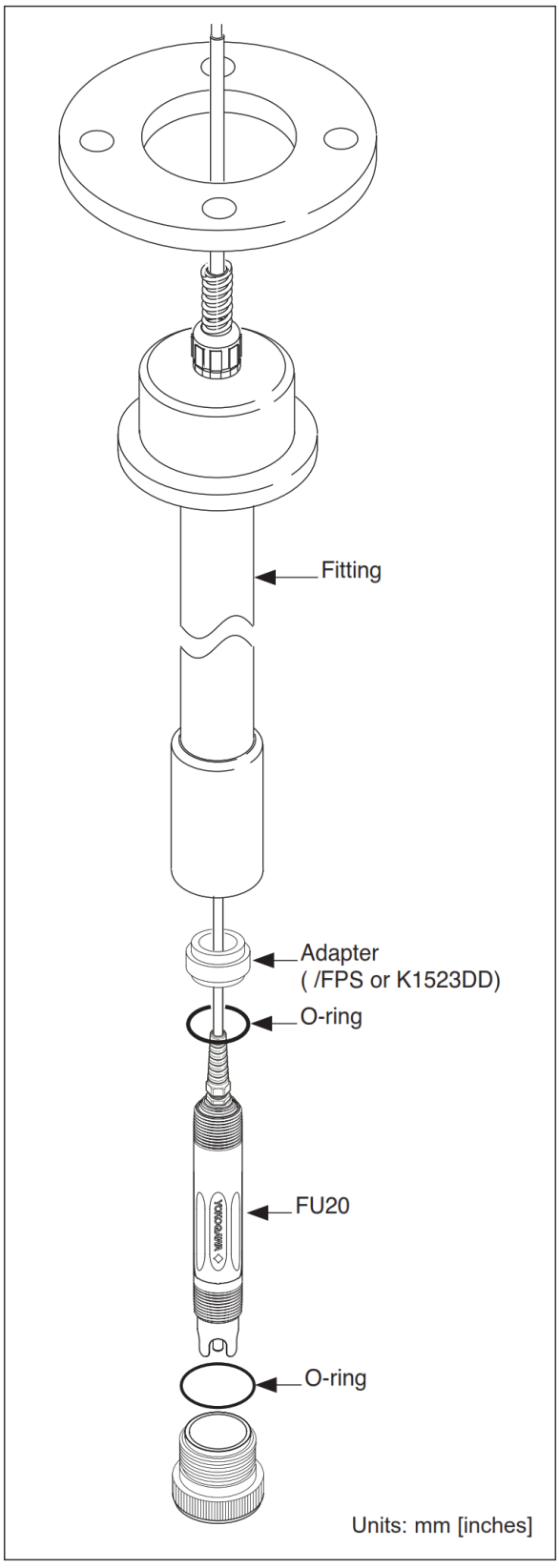


Figure 7: Installation example for the FD40

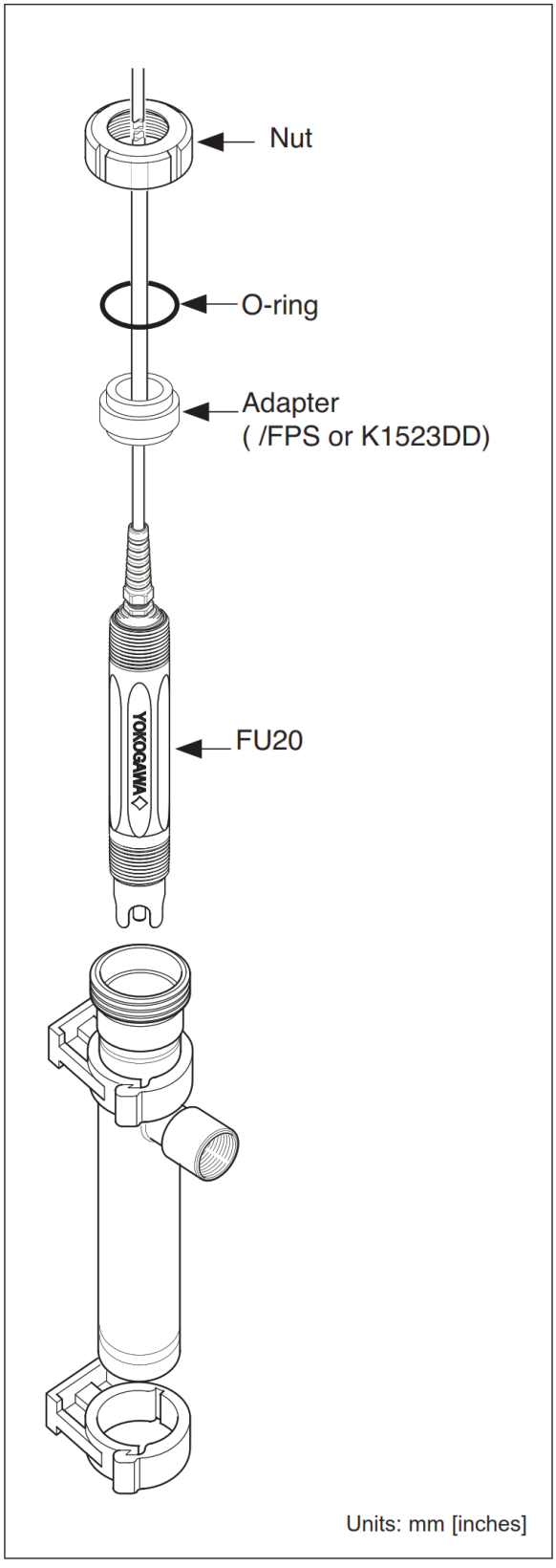


Figure 8: Installation example for the FF40

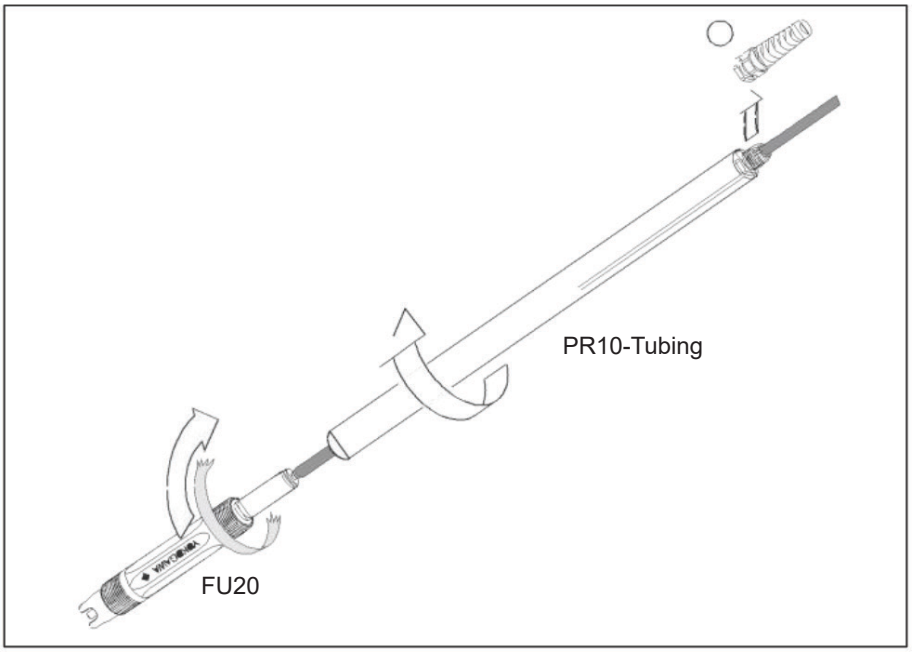


Figure 9: Installation in PR10 retractable fitting (For detailed information refer to the instruction manual coming with the retractable fitting)

Installation examples using the K1522PS protection sleeve

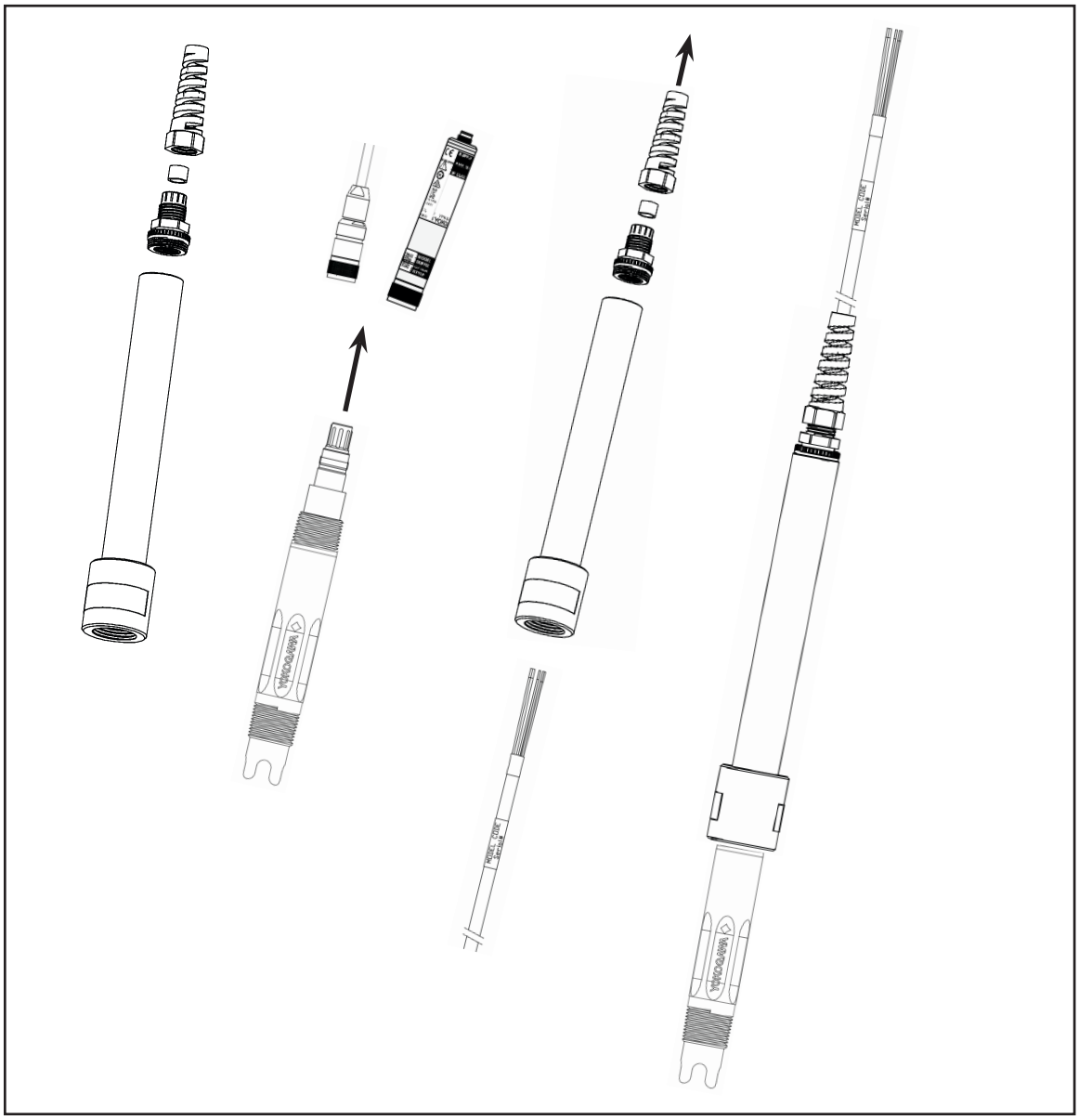


Figure 10: Installation using the protection sleeve K1522PS
Note: For details on installation FU20 sensor using protection sleeve please use instruction from SD 12A06K01-00EN-P

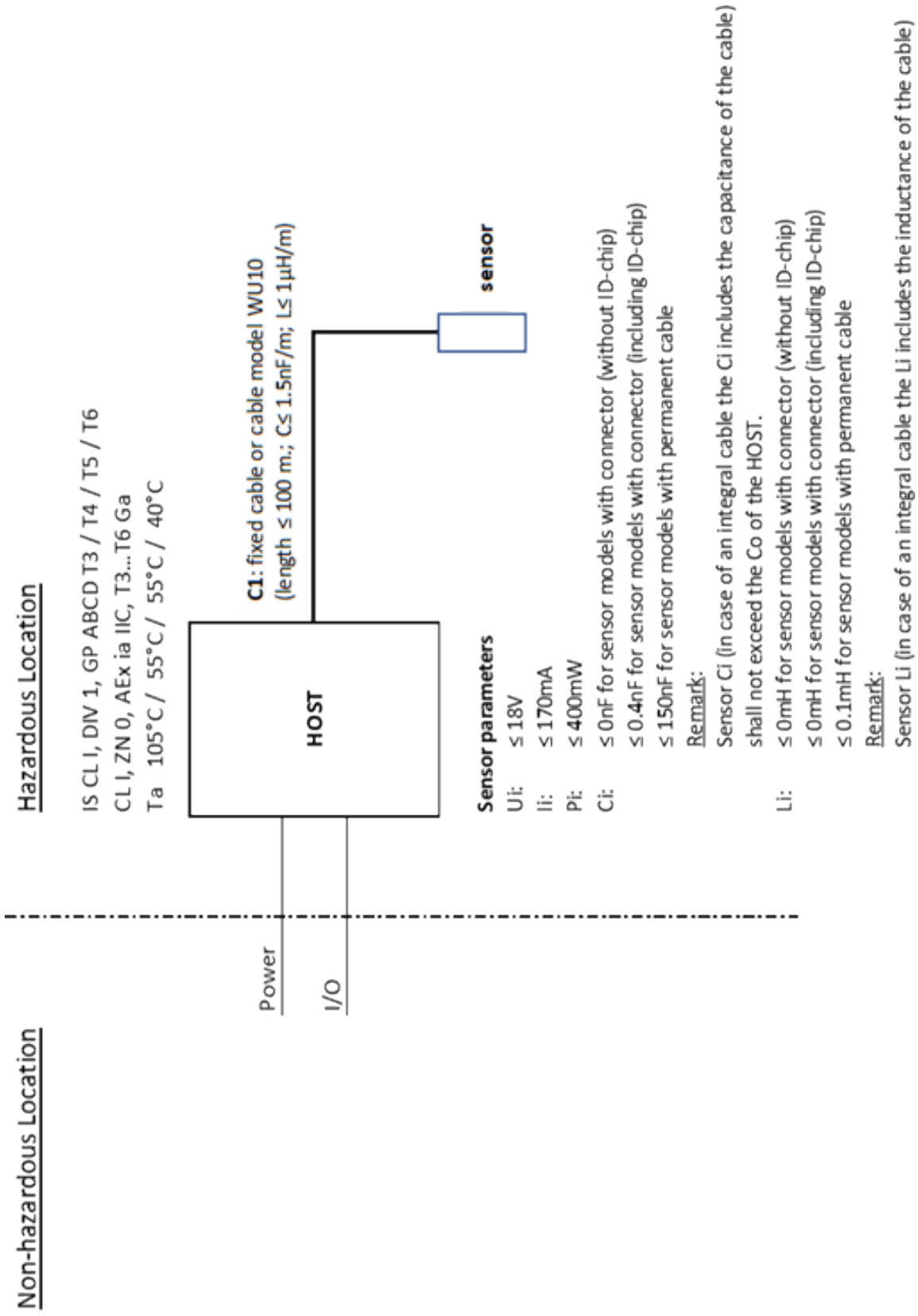
Addendum 2: Available models

Table 4: FU20 Differential pH Available models

Available Models
FU20-VP-T1-FTS
FU20-VS-T1-FTS
FU20-VS-T1-MTS

Addendum 3: Control Drawings

Control drawing: D&E 2020-023-A50 (part 1)



Remarks:

1. No revision to this drawing without prior approval of FM.
2. Installation must be in accordance with the National Electrical Code (ANSI/NFPA 70), ANSI/ISA-RP12.06.01, and relevant local codes.
3. The sensor shall be installed to a certified intrinsically safe HOST with the following maximum values: Uo= 18 V, Io = 170 mA, Po = 400 mW.
4. The sensor does not provide isolation from earth. Installers shall take necessary measures to prevent the possibility of sparking resulting from differing earth potentials between the sensors and interconnecting equipment. This can be realized for example by selecting interconnecting equipment which provides input-to-output and input-to-earth isolation up to 500 V rms.
5. Sensor Model code:

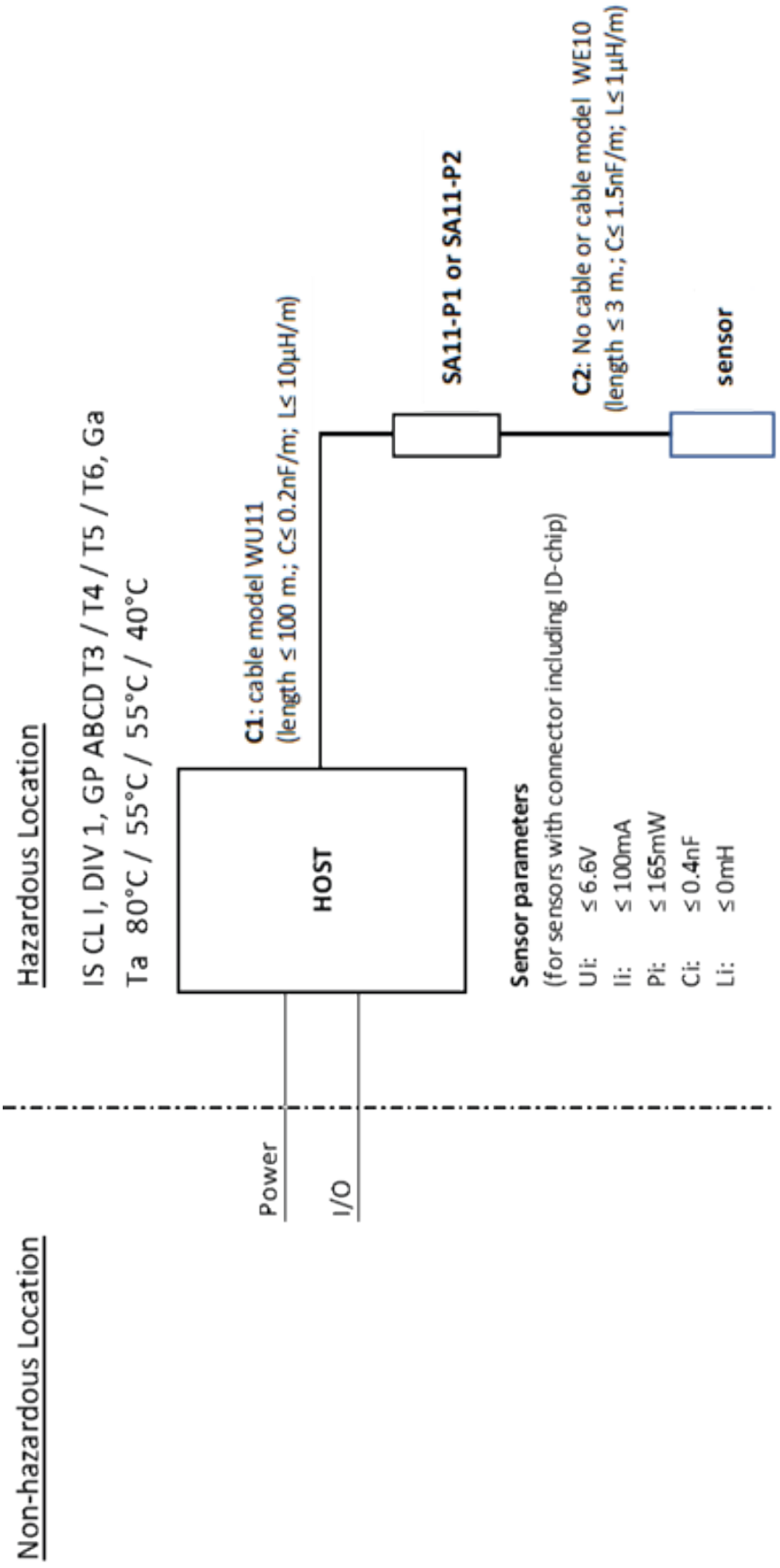
Model	Suffix Codes	Option Codes	
FU20	-ab-cd-efg	/h	
ab	Connection type:	Two alphanumeric characters identifying the length of the permanent cable, each character from 0 to 9	
		VP	Connector without ID-chip
		VS	Connector with ID-chip
cd	Temperature sensor + Region:	T1	Pt1000, IS for ATEX/IECEx, FM-US, FM-CAN
efg	Type:	FTS	PVDF body / Tapered Thread / Dome shaped / Sodium-ions sensitive membrane / Silicon&Viton sealing
		MTS	PVDF body / Tapered Thread / Dome shaped / Sodium-ions sensitive membrane / FFKM&EPDM sealings
		RTS	PPS body / Tapered Thread / Dome shaped / Sodium-ions sensitive membrane / Silicon&VITON sealings
h	Option code:	Up to ten alphanumeric characters	
		(A to Z, 0 to 9 or hyphen)	

6. WARNING - POTENTIONAL ELECTROSTATIC CHARGING HAZARD – SEE INSTRUCTIONS

- pH sensors containing accessible plastic parts and/or external conductive parts, must be installed and used in such a way, that dangers of ignition due to hazardous electrostatic charges cannot occur, especially in the case that the process medium is non-conductive.

Control drawings:

Control drawing: D&E 2020-023-A50 (part 2)



Remarks:

1. No revision to this drawing without prior approval of FM.
2. Installation must be in accordance with the National Electrical Code (ANSI/NFPA 70), ANSI/ISA-RP12.06.01, and relevant local codes.
3. The sensor shall be installed to a certified intrinsically safe Smart Adapter, model SA11-P2 with the following maximum values: Uo= 6.6 V, Io = 100 mA, Po = 165 mW.
4. The installers shall take necessary measures to prevent the possibility of sparking resulting from differing earth potentials between the sensors and interconnecting equipment. The sensor itself does not provide 500 V rms isolation from earth, the interconnecting equipment Model SA11-P2 Smart Adapter however provide this required isolation.
5. Sensor Model code:

Model	**Suffix Codes**	**Option Codes**	
FU20	-ab-cd-efg	/h	
ab	Connection type:	VS Connector with ID-chip	
cd	Temperature sensor + Region:	T1 Pt1000, IS for ATEX/IECEx, FM-US, FM-CAN	
efg	Type:	FTS	PVDF body / Tapered Thread / Dome shaped / Sodium-ions sensitive membrane / Silicon&Viton sealing
		MTS	PVDF body / Tapered Thread / Dome shaped / Sodium-ions sensitive membrane / FFKM&EPDM sealings
		RTS	PPS body / Tapered Thread / Dome shaped / Sodium-ions sensitive membrane / Silicon&VITON sealings
h	Option code:	Up to ten alphanumeric characters (A to Z, 0 to 9 or hyphen)	

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- pH sensors containing accessible plastic parts and/or external conductive parts, must be installed and used in such a way, that dangers of ignition due to hazardous electrostatic charges cannot occur, especially in the case that the process medium is non-conductive.

FM-Canada

Applying standards	: CAN/CSA-C22.2 No. 60079-0 CAN/CSA-C22.2 No. 60079-11
Certificate no.*	: FM20CA0062X IS CL I, DIV 1, GP ABCD, T3…T6 CL I, ZN 0, Ex ia IIC, T3…T6 Ga Control Drawing: D&E 2020-023-A51
Electrical data	: See Note 4.
Specific conditions of use	: See Control Drawing D&E 2020-023-A51.

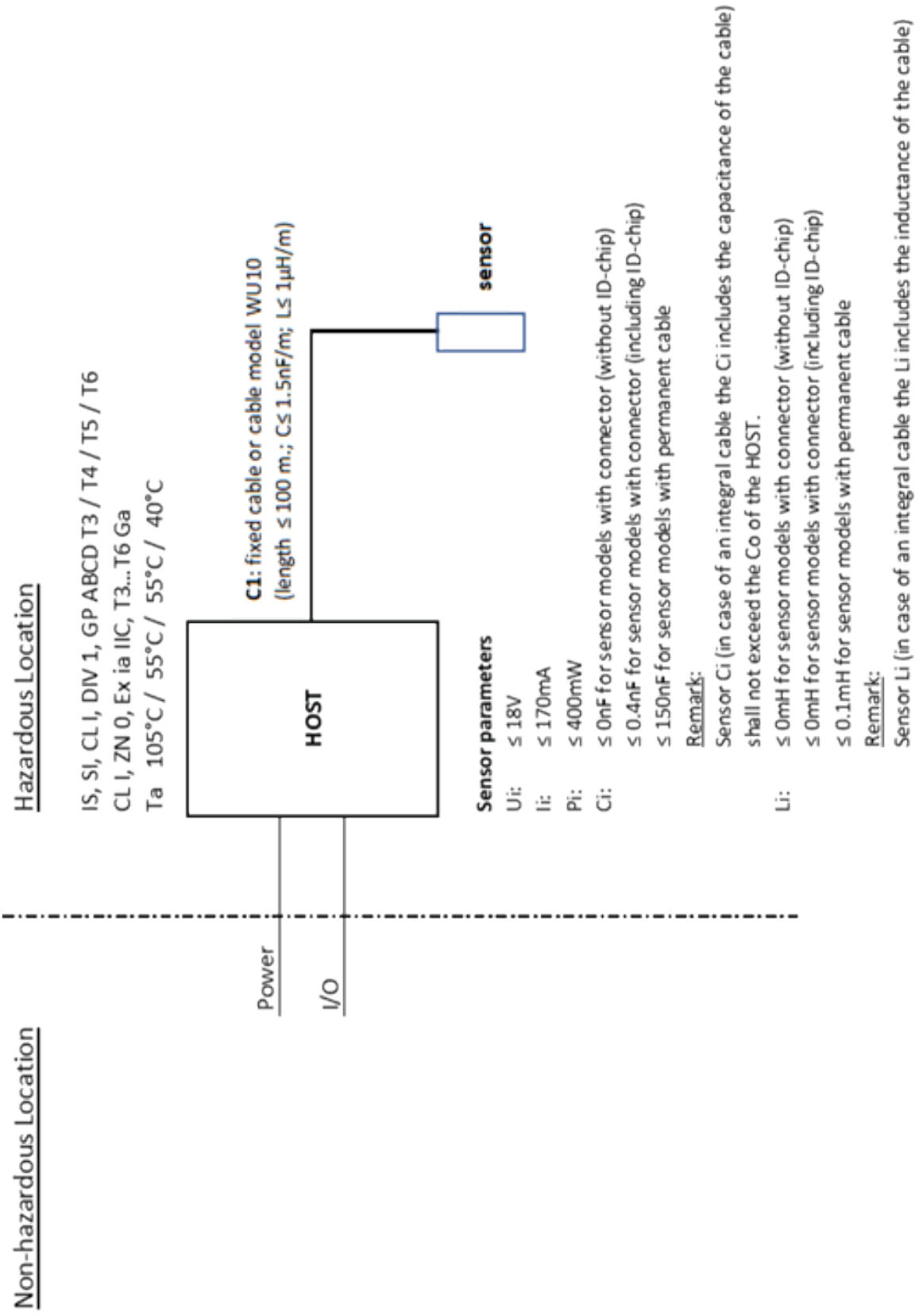
Note 4: Intrinsically safe, entity, for Class I, Division 1, Groups A, B, C and D;
Class I, Zone 0, Ex ia IIC, Ga (entity) for hazardous (classified) locations when installed per control drawing D&E 2020-023-A51.
Sensor input parameters:
Ui= 18V; Ii= 170 mA; Pi= 0.4 W;
Li= 0.1 mH (models with fixed cable) or Li= 0 mH (VS/VP type);
Ci= 150 nF (models with fixed cable) or
Ci= 0.4 nF (VS type) or Ci= 0 nF (VP type).

Ambient temperature:
-40 °C to +40 °C for temperature class T6,
-40 °C to +55 °C for temperature class T4 and T5,
-40 °C to +105 °C for temperature class T3.

When the sensor has been connected to non intrinsically safe equipment which exceeds the restrictions regarding the sensor input circuits, the sen sor is not suitable anymore for intrinsically safe use.

* Certification is subject to change, due to new regulations or changes in the product itself. When a certificate is updated, a new revision under the same certificate number is created with a new date.
- FM-Canada:
FM20CA0062X (effective from 03-2021)

Control drawing: D&E 2020-023-A51 (part 1)



Remarks:

1. No revision to this drawing without prior approval of FM.
2. Installation must be in accordance with the Canadian Electrical Code (CEC) CSA22.1, and relevant local codes.
3. The sensor shall be installed to a certified intrinsically safe HOST with the following maximum values: Uo= 18 V, Io = 170 mA, Po = 400 mW.
4. The sensor does not provide isolation from earth. Installers shall take necessary measures to prevent the possibility of sparking resulting from differing earth potentials between the sensors and interconnecting equipment. This can be realized for example by selecting interconnecting equipment which provides input-to-output and input-to-earth isolation up to 500 V rms.
5. Sensor Model code:

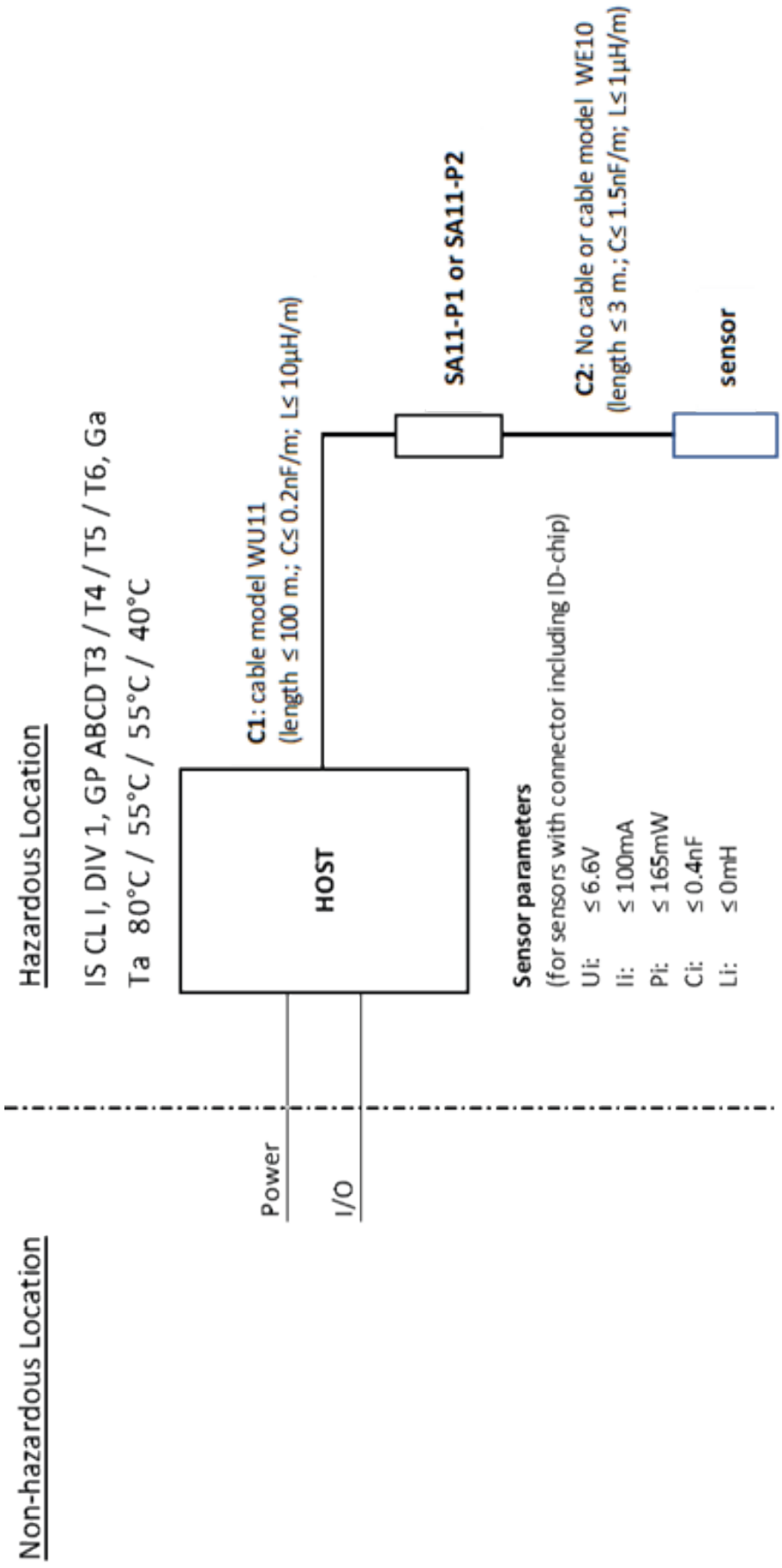
Model	Suffix Codes	Option Codes	
FU20	-ab-cd-efg	/h	
ab	Connection type:	Two alphanumeric characters identifying the length of the permanent cable, each character from 0 to 9	
		VP	Connector without ID-chip
		VS	Connector with ID-chip
cd	Temperature sensor + Region:	T1	Pt1000, IS for ATEX/IECEx, FM-US, FM-CAN
efg	Type:	FTS	PVDF body / Tapered Thread / Dome shaped / Sodium-ions sensitive membrane / Silicon&Viton sealing
		MTS	PVDF body / Tapered Thread / Dome shaped / Sodium-ions sensitive membrane / FFKM&EPDM sealings
		RTS	PPS body / Tapered Thread / Dome shaped / Sodium-ions sensitive membrane / Silicon&VITON sealings
h	Option code:	Up to ten alphanumeric characters (A to Z, 0 to 9 or hyphen)	

6. WARNING - POTENTIONAL ELECTROSTATIC CHARGING HAZARD – SEE INSTRUCTIONS

- pH sensors containing accessible plastic parts and/or external conductive parts, must be installed and used in such a way, that dangers of ignition due to hazardous electrostatic charges cannot occur, especially in the case that the process medium is non-conductive.

AVERTISSEMENT – DANGER POTENTIEL DE CHARGES ÉLECTROSTATIQUES – VOIR LES INSTRUCTIONS
Les sondes de pH contenant des pièces en plastique accessibles et / ou des pièces conductrices externes doivent être installées et utilisées de manière à éviter tout risque d'inflammation dû à des charges électrostatiques dangereuses, en particulier dans le cas où le fluide de procédé n'est pas conducteur.

Control drawing: D&E 2020-023-A51 (part 2)



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3. The sensor shall be installed to a certified intrinsically safe Smart Adapter, model SA11-P2 with the following maximum values: Uo= 6.6 V, Io = 100 mA, Po = 165 mW.
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ab	Connection type:	Two alphanumeric characters identifying the length of the permanent cable, each character from 0 to 9	
		VS	Connector with ID-chip
cd	Temperature sensor + Region:	T1	Pt1000, IS for ATEX/IECEx, FM-US, FM-CAN
efg	Type:	FTS	PVDF body / Tapered Thread / Dome shaped / Sodium-ions sensitive membrane / Silicon&Viton sealing
		MTS	PVDF body / Tapered Thread / Dome shaped / Sodium-ions sensitive membrane / FFKM&EPDM sealings
		RTS	PPS body / Tapered Thread / Dome shaped / Sodium-ions sensitive membrane / Silicon&VITON sealings
h	Option code:	Up to ten alphanumeric characters (A to Z, 0 to 9 or hyphen)	

6. WARNING - POTENTIONAL ELECTROSTATIC CHARGING HAZARD – SEE INSTRUCTIONS

- pH sensors containing accessible plastic parts and/or external conductive parts, must be installed and used in such a way, that dangers of ignition due to hazardous electrostatic charges cannot occur, especially in the case that the process medium is non-conductive.

AVERTISSEMENT – DANGER POTENTIEL DE CHARGES ÉLECTROSTATIQUES – VOIR LES INSTRUCTIONS
Les sondes de pH contenant des pièces en plastique accessibles et / ou des pièces conductrices externes doivent être installées et utilisées de manière à éviter tout risque d'inflammation dû à des charges électrostatiques dangereuses, en particulier dans le cas où le fluide de procédé n'est pas conducteur.

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