

General Specifications

Model FU24 Widebody type pH/ORP sensor

GS 12B06J03-03EN-P

A family of the wide body sensor is available for application in a wide variety of processes. The sensors share the same valuable features:

- Long life saturated Ag/AgCl reference system.
- PTFE reference diaphragm to prevent fouling and reduce measurement error.
- Double junction combined with ion-trap to prolong the life of the reference probe, even in chemically unfavorable environments.
- Integral Pt1000 element for accurate temperature measurements.
- Platinum ORP/LE electrode for accurate simultaneous pH and ORP measurements.
- Polymerized electrolyte to extend the sensors life time.
- Versatile in-line, immersion or off-line installation.

The FU24 is also made with a chemical resistant PPS 40GF body. It is particularly useful in harsh applications with fluctuating pressure and/or temperature. Process fluid may be moving in and out of the sensor under influence of frequent pressure and/or temperature fluctuations. This results in fast desalting and dilution of the reference electrolyte. This in turn will change the reference voltage and cause a drifting pH measurement.

By using the successful Yokogawa Bellow system integrated in the FU24 electrode, a strong pressure compensation mechanism is created. The build-in bellow ensures immediate interior pressure equalization to the outside pressure, making the sensor virtually insensitive to external pressure variations.

A slight overpressure caused by the bellow tension, prevents fluid ingress and maintains a positive ion flow out of the sensor. This feature is of particular interest in pure water applications.

The FU24 widebody type pH/ORP sensors are available with VP connector. This makes installation a lot easier. All sensors are delivered with a Quality Certificate.

In addition to our analogue sensors Yokogawa delivers a platform consisting of so called SMART sensors in combination with the SENCOM SMART adapter SA11. In the SENCOM platform digital functionality allows:

- Perform off-line calibration reducing process impact.
- Enable easier asset management
- Enable easier statistical process control
- Easier monitoring of extreme conditions during use.

For additional information about SENCOM and its benefits request you to check the applicable GS-document number GS 12A06S01-01Z1. This document is available from our website and through our regional offices.



1. General specifications FU24

- **1.1 Measuring elements**
 - : pH glass electrode
 - : Silver/Silver Chloride reference
 - : Solid Platinum electrode
 - : Pt1000 temperature sensor
- **1.2 Construction materials**

Wetted materials:

 - Body : PPS 40GF
 - Measuring Sensor : G-Glass
 - Earth Pin : Solid platinum
 - Reference Junction : Porous PTFE
 - O-ring : Viton
- **1.3 Functional specifications**
 - Isothermal point : pH 7
 - Glass impedance
 - Dome shape : nominal 200 M Ω
 - Flat Surface : nominal 750 M Ω
 - Reference system : Double junction, Ag/AgCl with saturated KCl, including Ag⁺ ion trap
 - Junction resistance : 1 to 15 k Ω
 - Temperature element : Pt1000 to IEC 751
 - Asymmetry potential : 8 \pm 15 mV
 - Linearity PH (Slope) : > 96 % (of theoretical value)

Note: The temperature sensor included in the FU24 is intended to provide indication and cell compensation.
The construction has not been tested to the pressure vessel standards required for plant temperature control.

- **1.4 Dynamic specifications**
 - Response time pH step (7 to 4) : < 15 sec for 90%
 - Response time temp step (10°C)
 - Dome shape : < 1 min for 90%
 - Flat Surface : < 4 min for 90%
 - Stabilization time (0.02 pH unit/10 s) : < 2 minutes

- **1.5 Operating range**

pH		: 0 to 14
Temperature	NPT	: -10 - 105 °C (14 - 221 °F)
	FSM	: 15 - 105 °C (59 - 212 °F)
Pressure		: (See Figure 1)
Conductivity		: > 10 μ S/cm

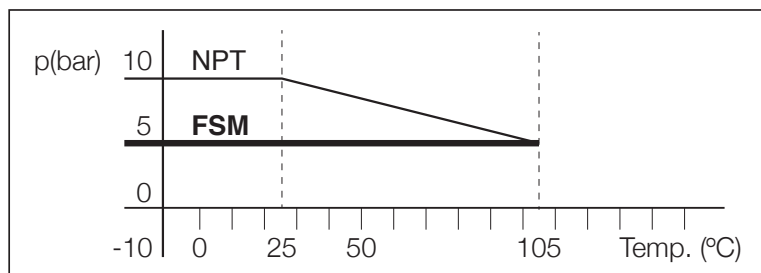


Figure 1: Pressure and temperature range for FU24

- **1.6 Environmental conditions**
 - Storage temp. : -15 to 50 °C (5 to 122 °F)
 - Ingress Protection : IP67

Note: The pH operating range at room temperature is 0-14 pH, but at high temperatures or range outside 2-12 pH the lifetime will be seriously shortened.

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

Note: For detailed information about SENCOM sensors refer to current edition of GS12B03J04.

● 1.7 Regulatory compliance above the tables

Item	Description, Approval, Certification
LVD	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
PED	EU Directive 2011/68/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)	EU Directive 2014/34/EU, ATEX approval: DEKRA 11ATEX0014 X, ~ 0344 0 II 1 G Ex ia IIC T3...T6 Ga Applied standards: EN IEC 60079-0, EN 60079-11
IECEX	IECEX approval: IECEX DEK 11.0064X, Ex ia IIC T3...T6 Ga Applied standards: IEC 60079-0, IEC 60079-11
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
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, ANSI/ISA 60079-0, ANSI/ISA 60079-11, ANSI/ISA 61010-1
NEPSI (China)	NEPSI approval: GYJ21.2891X, Ex ia IIC T3...T6 Ga, Applied standards: GB 3836.1, GB 3836.4, GB 3836.20
PESO (India)	PESO approval: PESO approval is based on ATEX approval DEKRA 11ATEX0014 X, iss. 2 – 29.11.2019 Equipment reference numbers: P512760/1 Applied standards: EN IEC 60079-0, EN 60079-11
TS (Taiwan)	TS approval: TS Safety Label is based on IECEX approval IECEX DEK 11.0064X Identification Number: TD04000C Applied standards: IEC 60079-0, IEC 60079-11
KCs (Korea)	Korea Ex certificates: Korea Ex certificate is based on IECEX approval IECEX DEK 11.0064X, iss. 1 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
EAC Ex (Russia)	EAC Ex certificate: RU C-NL.AA87.B.00754 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

2. Dimensions FU24

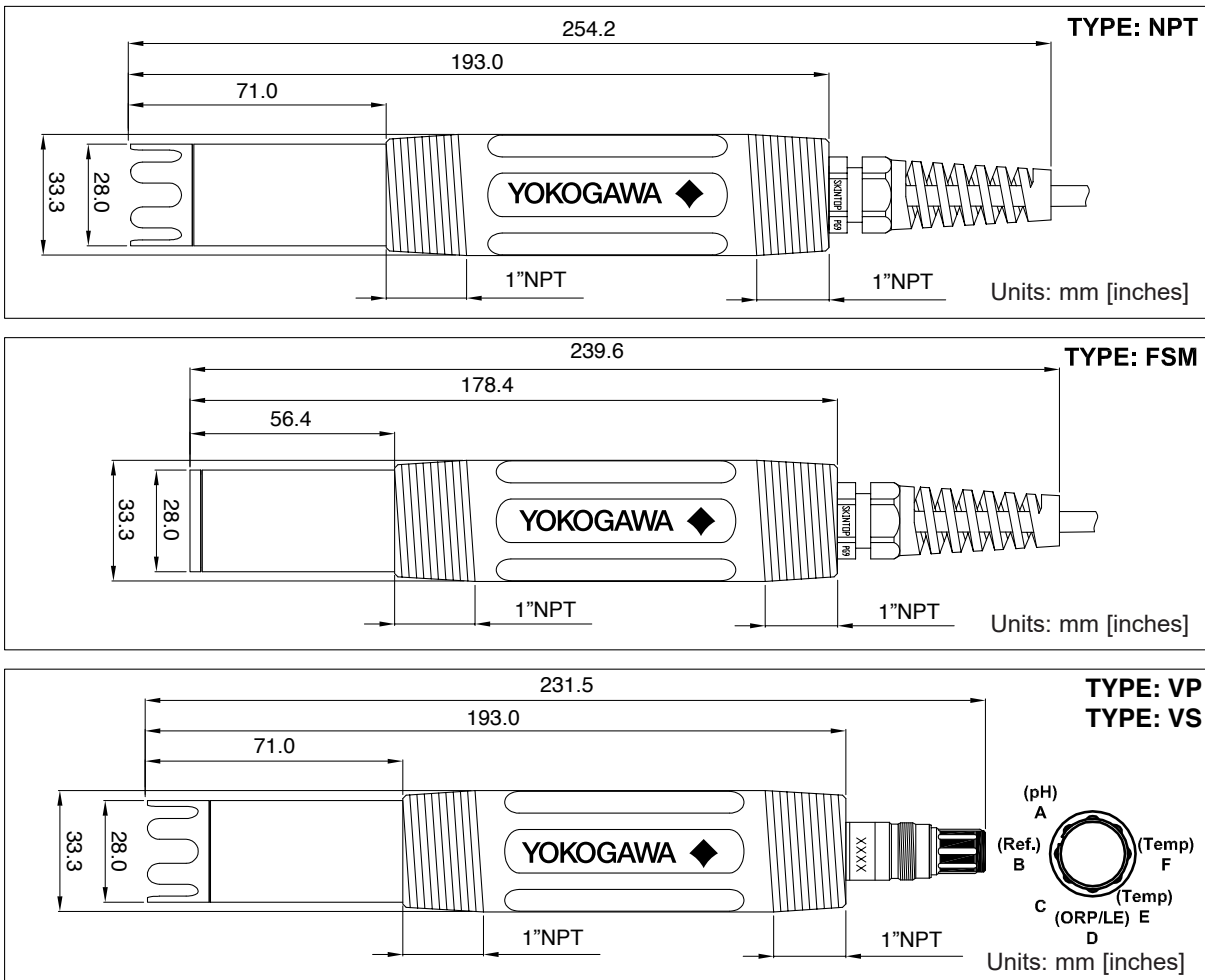


Figure 2: Dimensions of FU24

3. Model Codes & Parts

3.1 Table 1: Model Codes for FU24

Model Code	Suffix code	Description
FU24		Wide body sensor
Type	- VP - VS - 05 - 10	Variopin connector Variopin connector for SENCOM Fixed cable, 5 meters Fixed cable, 10 meters
Temp. Element	-T1	Pt1000
Model	-NPT -FSM	Dome shape model, heavy duty Flat surface model, self-cleaning

3.2 Table 3: Spare parts:

Spare part		Description
K1521JA	FU24	Holder for FU24(F) in FF20-S3* (SS) (1"NPT)
K1521JB		Holder for FU24(F) in FF20-F3* (PVDF) (1"NPT)
K1520BA	Buffer solutions	Buffer Solution pH4.01+6.87+9.18(3x0.5L)
K1520BB		Buffer Solution pH 1.68 (3x 0.5L)
K1520BC		Buffer Solution pH 4.01 (3x 0.5L)
K1520BD		Buffer Solution pH 6.87 (3x 0.5L)
K1520BE		Buffer Solution pH 9.18 (3x 0.5L)
WU10-V-D-XX	Connection cables for Suffix -05, -10, -VP	Variopin cable (XX = 02, 05, 10, 15 and 20m)
WU10-V-S-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-P1		SENCOM SMART adapter
WU11		Interconnection cable
IB100		Interface box

Adendum 1 - Installation of FU24

For optimum measurement results, the FU24 should be installed in a location that offers an acceptable representation of the process composition and DOES NOT exceed the specifications of the sensor. The FU24 is designed with 1" NPT threaded connections on both ends of the sensor to allow installation in a wide variety of applications.

Typical installation

The FU24 sensor is designed for versatile in-line, immersion or bypass loop installation. For best results the FU24 should be mounted with the process flow coming towards the sensor. The sensor can be mounted in all angles with respect to the horizontal plane (including Upside Down mounting).

Preparing the sensor for use

Remove the sensor from its shipping box and slide of the so-called 'wet pocket', the tube filled with solution to prevent drying out of the measuring elements during shipment or storage. Although on the Quality Inspection Certificate (QIC) all factory calibration data is stored, it is recommended to calibrate the sensor before first use. A general calibration procedure is described in Section 6 of this Instruction Manual.

Mounting the sensor

The simplest mounting is to use one of the 1" NPT threaded connection of the sensor. Apply Teflon tape to the appropriate threaded end, then install the sensor in the process. Tighten the sensor using a wrench on the sensor flats.

Note: DO NOT over tighten the sensor to prevent damage. The maximum applicable torque is 7.5 Nm

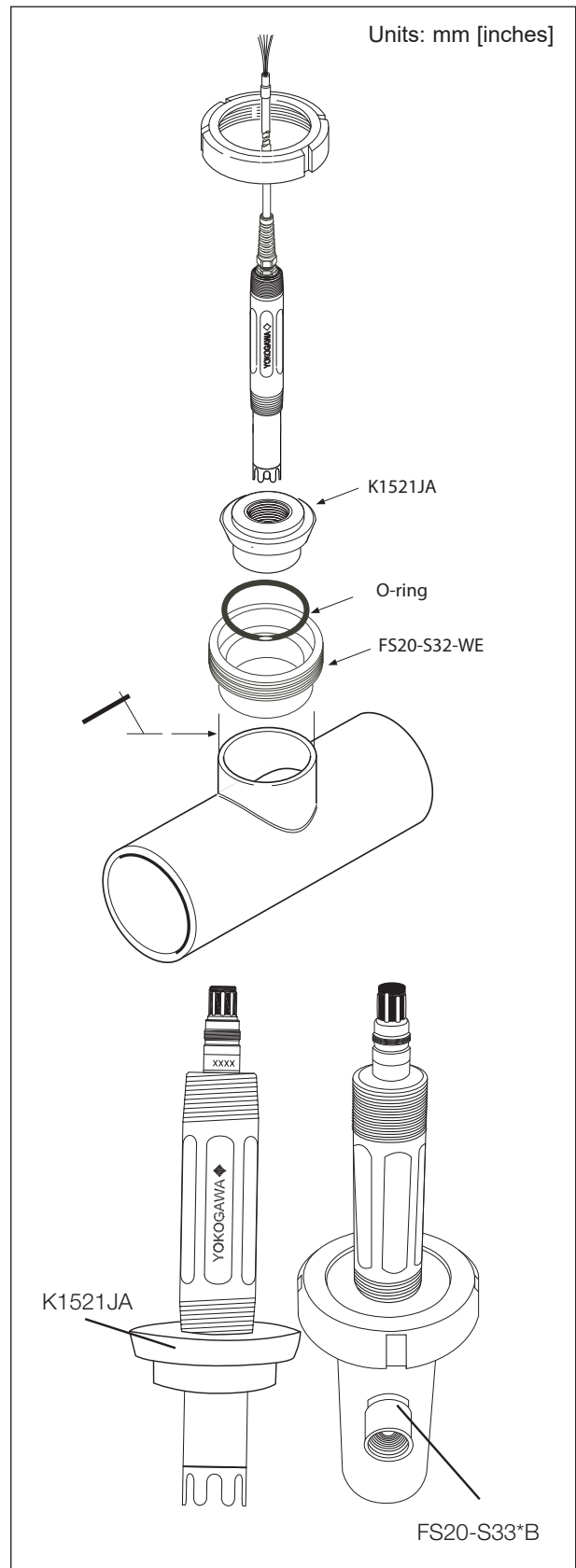


Figure 3: FS20 installation example for FU24

Adendum 2**Table 4:** Model codes

MS-code
FU24-05-T1-NPT
FU24-10-T1-NPT
FU24-VP-T1-NPT
FU24-VS-T1-NPT
FU24-05-T1-FSM
FU24-10-T1-FSM
FU24-VP-T1-FSM
FU24-VS-T1-FSM

Addendum 3: Control Drawings

FM-United States: FM Class 3600
FM Class 3610
FM Class 3810
ANSI/ISA 60079-0
ANSI/ISA 60079-11

Certificate no.*: 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

Electrical data: (See Note)
Specific conditions of use: See Control Drawing D&E 2020-023-A50

Note: Intrinsically safe, entity, for Class I, Division 1, Groups A, B, C and D; Class I, Zone 0, AEx ia IIC, Ga (entity) for hazardous (classified) locations when installed per control drawing D&E 2020-023-A50. Sensor input parameters:

$U_i = 18 \text{ V}$; $I_i = 170 \text{ mA}$; $P_i = 0.4 \text{ W}$;
 $L_i = 0.1 \text{ mH}$ (models with fixed cable) or $L_i = 0 \text{ mH}$ (VS/VP type);
 $C_i = 150 \text{ nF}$ (models with fixed cable) or $C_i = 0.4 \text{ nF}$ (VS type) or $C_i = 0 \text{ nF}$ (VP type).

Ambient temperature: $-40 \text{ }^\circ\text{C}$ to $+40 \text{ }^\circ\text{C}$ for temperature class T6,
 $-40 \text{ }^\circ\text{C}$ to $+55 \text{ }^\circ\text{C}$ for temperature class T4 and T5,
 $-40 \text{ }^\circ\text{C}$ to $+105 \text{ }^\circ\text{C}$ 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 sensor is not suitable anymore for intrinsically safe use.

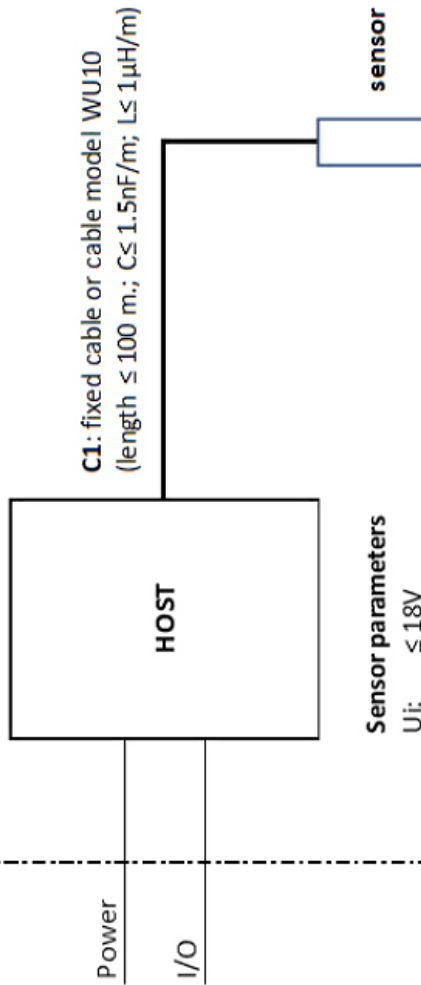
* Certification is subject to change, due to new regulations or changes in the product itself. When a certificate is updated, a new revision under the same certificate number is created with a new date.

FM-United States: FM20US0123X (effective from 03-2021)

Non-hazardous Location

Hazardous Location

IS CL I, DIV 1, GP ABCD T3 / T4 / T5 / T6
 CL I, ZN 0, AEx ia IIC, T3... T6 Ga
 Ta 105°C / 55°C / 55°C / 40°C



Sensor parameters

Ui: ≤ 18V

Ii: ≤ 170mA

Pi: ≤ 400mW

Ci: ≤ 0nF for sensor models with connector (without ID-chip)
 ≤ 0.4nF for sensor models with connector (including ID-chip)
 ≤ 150nF for sensor models with permanent cable

Remark:

Sensor Ci (in case of an integral cable the Ci includes the capacitance of the cable) shall not exceed the Co of the HOST.

Li: ≤ 0mH for sensor models with connector (without ID-chip)

≤ 0mH for sensor models with connector (including ID-chip)

≤ 0.1mH for sensor models with permanent cable

Remark:

Sensor Li (in case of an integral cable the Li includes the inductance of the cable) shall not exceed the Lo of the HOST.

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:
U_o= 18 V, I_o = 170 mA, P_o = 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.

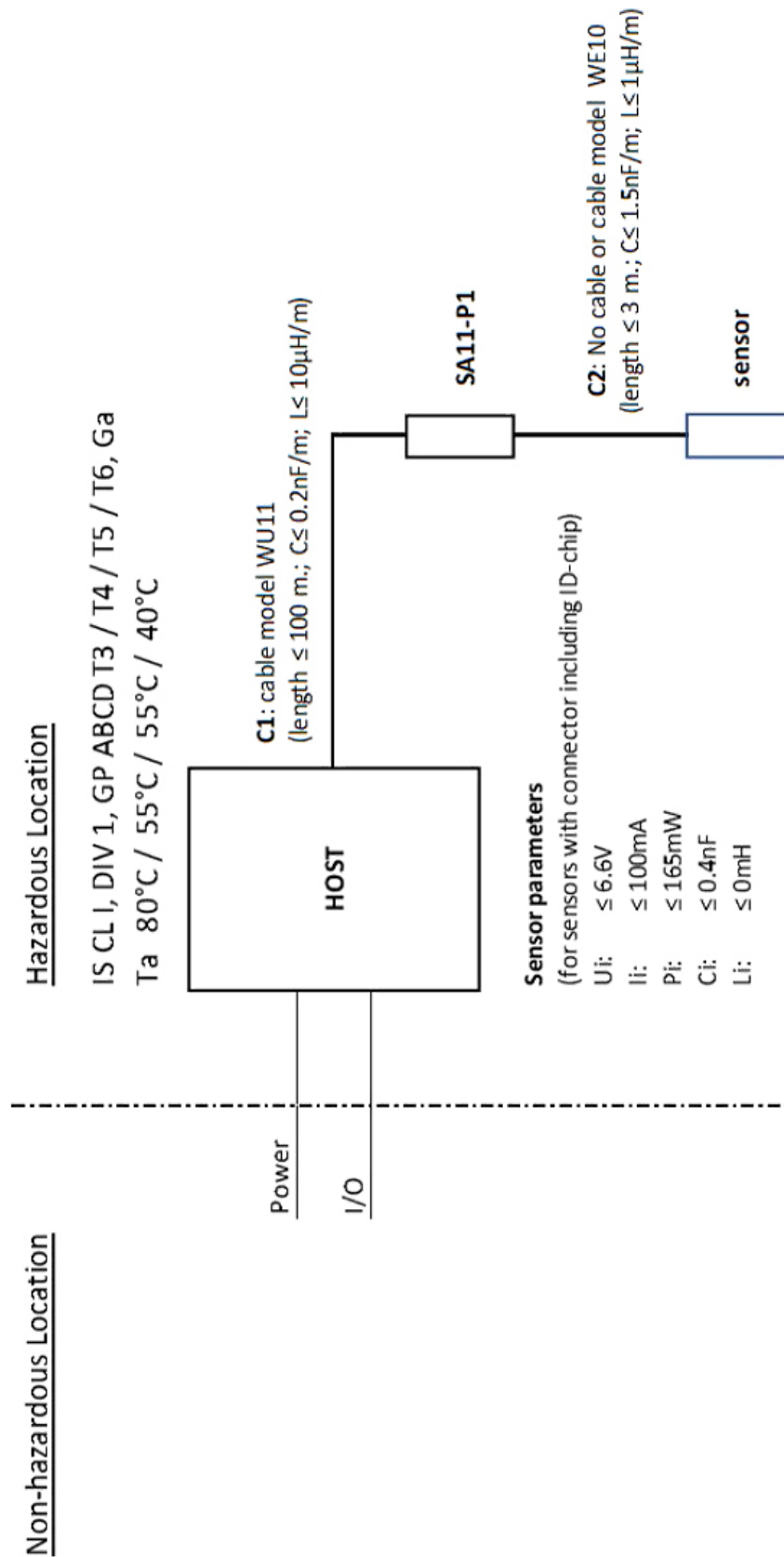
5. Sensor Model code:

Model	Suffix Codes	Option Codes
FU24	-ab -cd -efg	/ h

ab	Connection Type:	Two alphanumeric characters identifying the length of the permanent cable, each character from 0 to 9
		VS Connector with ID-chip VP Connector without ID-chip
cd	Temperature sensor + Region:	T1 Pt1000, IS for ATEX/IECEX, FM-US, FM-CAN
efg	Type:	NPT PPS body / Tapered Thread / Dome shaped FSM PPS body / Tapered Thread / Flat Surface
/ h	Option code:	Up to ten alphanumeric characters (A to Z, 0 to 9 or hyphen)

6. WARNING - POTENTIAL 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.



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:
 $U_o = 6.6 \text{ V}$, $I_o = 100 \text{ mA}$, $P_o = 165 \text{ mW}$.
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
FU24	-ab -cd -efg	/ h

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:	NPT PPS body / Tapered Thread / Dome shaped FSM PPS body / Tapered Thread / Flat Surface
/ h	Option code:	Up to ten alphanumeric characters (A to Z, 0 to 9 or hyphen)

6. WARNING - POTENTIAL 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.

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)
Specific conditions of use:	See Control Drawing D&E 2020-023-A51.

Note: 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: $U_i = 18 \text{ V}$; $I_i = 170 \text{ mA}$; $P_i = 0.4 \text{ W}$; $L_i = 0 \text{ mH}$ $C_i = 0.4 \text{ nF}$ (Suffix SC25V-B...with ID chip):

$C_i = 0 \text{ nF}$ (Suffix SC25V-A...without ID-chip)

Ambient temperature: $-40 \text{ }^\circ\text{C}$ to $+40 \text{ }^\circ\text{C}$ for temperature class T6, $-40 \text{ }^\circ\text{C}$ to $+55 \text{ }^\circ\text{C}$ for temperature class T4 and T5, $-40 \text{ }^\circ\text{C}$ to $+105 \text{ }^\circ\text{C}$ 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 sensor is not suitable anymore for intrinsically safe use.

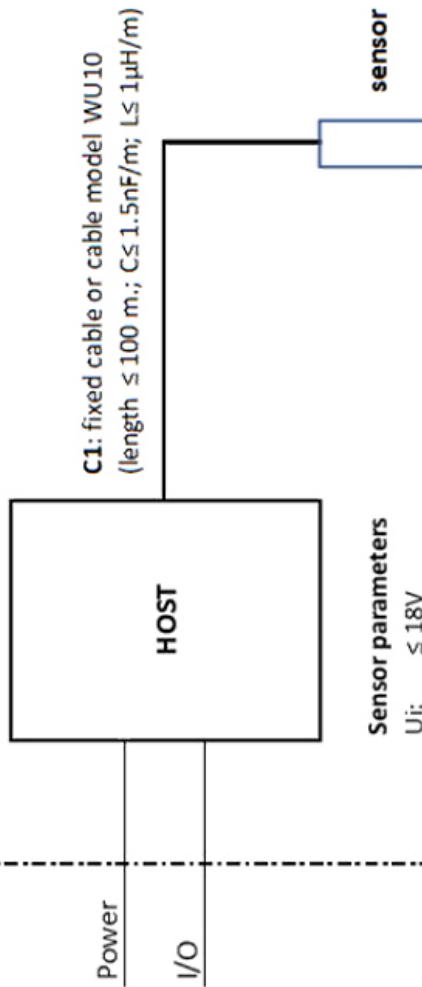
* Certification is subject to change, due to new regulations or changes in the product itself. When a certificate is updated, a new revision under the same certificate number is created with a new date.

FM-Canada: FM20CA0062X (effective from 03-2021)

Non-hazardous Location

Hazardous Location

IS, SI, CL I, DIV 1, GP ABCD T3 / T4 / T5 / T6
 CL I, ZN 0, Ex ia IIC, T3... T6 Ga
 Ta 105°C / 55°C / 55°C / 40°C



Sensor parameters

U_i: ≤ 18V

I_i: ≤ 170mA

P_i: ≤ 400mW

C_i: ≤ 0nF for sensor models with connector (without ID-chip)

≤ 0.4nF for sensor models with connector (including ID-chip)

≤ 150nF for sensor models with permanent cable

Remark:

Sensor C_i (in case of an integral cable the C_i includes the capacitance of the cable) shall not exceed the C_o of the HOST.

L_i: ≤ 0mH for sensor models with connector (without ID-chip)

≤ 0mH for sensor models with connector (including ID-chip)

≤ 0.1mH for sensor models with permanent cable

Remark:

Sensor L_i (in case of an integral cable the L_i includes the inductance of the cable) shall not exceed the L_o of the HOST.

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:
U_o= 18 V, I_o = 170 mA, P_o = 400mW.
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
FU24	-ab -cd -efg	/ h

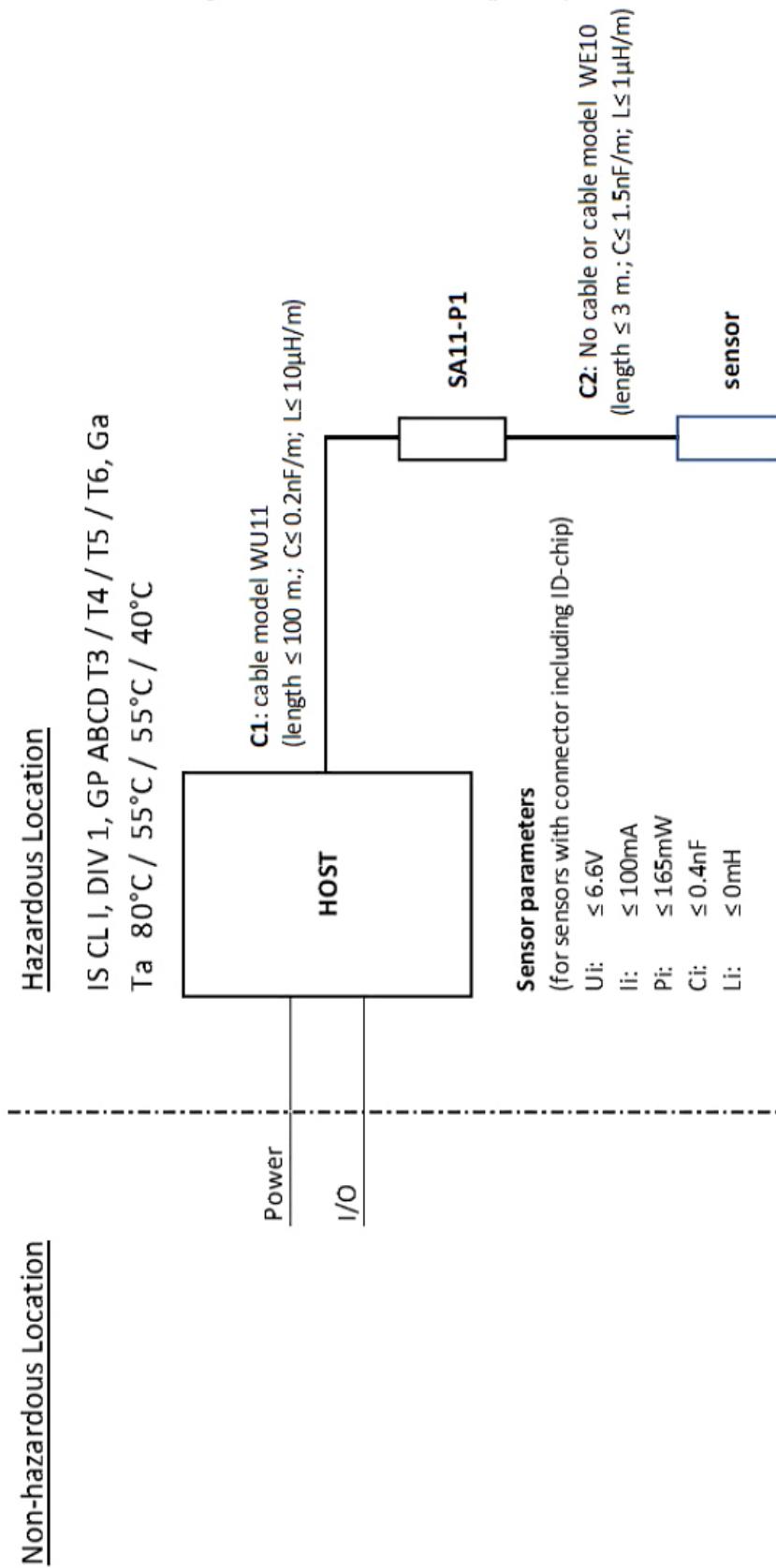
ab	Connection Type:	Two alphanumeric characters identifying the length of the permanent cable, each character from 0 to 9
		VS Connector with ID-chip VP Connector without ID-chip
cd	Temperature sensor + Region:	T1 Pt1000, IS for ATEX/IECEX, FM-US, FM-CAN
efg	Type:	NPT PPS body / Tapered Thread / Dome shaped FSM PPS body / Tapered Thread / Flat Surface
/ h	Option code:	Up to ten alphanumeric characters (A to Z, 0 to 9 or hyphen)

6. WARNING - POTENTIAL 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.

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.



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 Smart Adapter, model SA11-P1 with the following maximum values:
U_o= 6.6 V, I_o = 100 mA, P_o = 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-P1 Smart Adapter however provide this required isolation.

5. Sensor Model code:

Model	Suffix Codes	Option Codes
FU24	-ab -cd -efg	/ h

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:	NPT PPS body / Tapered Thread / Dome shaped FSM PPS body / Tapered Thread / Flat Surface
/ h	Option code:	Up to ten alphanumeric characters (A to Z, 0 to 9 or hyphen)

6. WARNING - POTENTIAL 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.

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.

YOKOGAWA ELECTRIC CORPORATION
World Headquarters
9-32, Nakacho 2-chome, Musashino-shi
Tokyo 180-8750
Japan
www.yokogawa.com

YOKOGAWA CORPORATION OF AMERICA
2 Dart Road
Newnan GA 30265
USA
www.yokogawa.com/us

YOKOGAWA PROCESS ANALYZERS EUROPE BV
Euroweg 2
3825 HD AMERSFOORT
The Netherlands
www.yokogawa.com/eu

YOKOGAWA ELECTRIC ASIA Pte. LTD.
5 Bedok South Road
Singapore 469270
Singapore
www.yokogawa.com/sg

YOKOGAWA CHINA CO. LTD.
Room 1801, Tower B, THE PLACE
No.100 Zunyi Road
Changning District, Shanghai, China
www.yokogawa.com/cn

YOKOGAWA MIDDLE EAST B.S.C.(c)
P.O. Box 10070, Manama
Building 577, Road 2516, Busaiten 225
Muharraq, Bahrain
www.yokogawa.com/bh

Yokogawa has an extensive sales and distribution network. Please refer to the European website (www.yokogawa.com/eu) to contact your nearest representative.



YOKOGAWA ◆