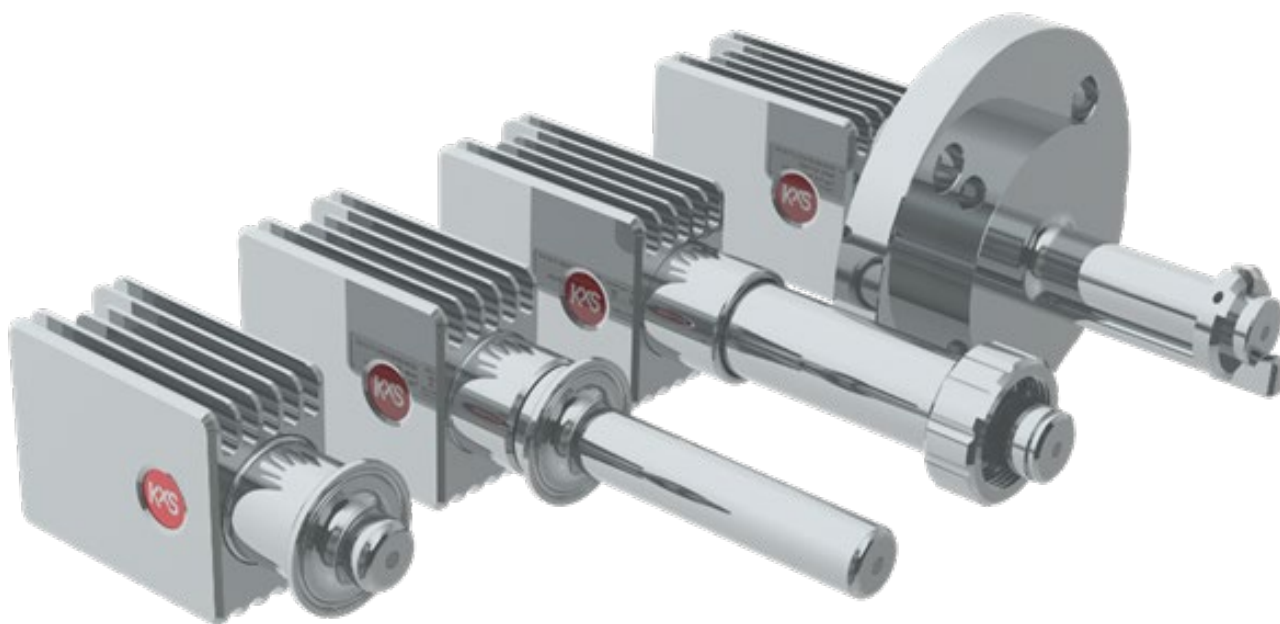




# **USER'S MANUAL**

## **DCM-20 PROCESS REFRACTOMETER**

# 1. Contents

|           |                                                                      |           |
|-----------|----------------------------------------------------------------------|-----------|
| <b>1.</b> | <b>Introduction .....</b>                                            | <b>0</b>  |
| 1.1       | DCM-20 Process Refractometer system.....                             | 0         |
| 1.2       | DCM-20 Process refractometer sensor models.....                      | 0         |
| 1.3       | Optional Modular Connection Unit MCU SP-8000.....                    | 2         |
| 1.4       | Display options for User Interface access .....                      | 3         |
| 1.4.1     | Computer or mobile device with display and RJ45 Ethernet cable ..... | 3         |
| 1.5       | Sensor M12 cable .....                                               | 4         |
| 1.6       | Measurement principle .....                                          | 5         |
| <b>2.</b> | <b>Connection .....</b>                                              | <b>6</b>  |
| 2.1       | Sensor connectors.....                                               | 6         |
| 2.2       | Sensor integration concept .....                                     | 7         |
| 2.3       | Cable connection with electrical modules .....                       | 9         |
| 2.4       | System drawing of DCM-20 and Modular Connection Unit MCU.....        | 11        |
| 2.5       | User interface .....                                                 | 11        |
| 2.5.1     | PC/Computer setup .....                                              | 12        |
| 2.5.2     | External display SP-9500 setup.....                                  | 13        |
| 2.5.3     | Access via wireless WiFi router.....                                 | 14        |
| 2.5.4     | Mobile device setup .....                                            | 15        |
| <b>3.</b> | <b>Installation .....</b>                                            | <b>17</b> |
| 3.1       | General installation principles.....                                 | 17        |
| 3.2       | Installation in high ambient and process temperatures.....           | 17        |
| 3.2.1     | Monitoring sensor temperature .....                                  | 17        |
| 3.2.2     | Improving sensor cooling .....                                       | 18        |
| 3.3       | Pipe installation specifics.....                                     | 19        |
| 3.4       | Compact sensor installation .....                                    | 20        |
| 3.5       | Long probe sensor installation .....                                 | 22        |
| 3.5.1     | Sensor installation in large pipes.....                              | 23        |
| 3.6       | Vessel installation specifics.....                                   | 24        |
| 3.6.1     | Sensor installation in bioreactors.....                              | 24        |
| 3.6.2     | Sensor installation in cookers.....                                  | 25        |
| 3.6.3     | Sensor installation in crystallizers and vacuum pans .....           | 27        |
| 3.7       | Wiring of Modular Connection Unit MCU.....                           | 28        |
| <b>4.</b> | <b>Prism wash systems.....</b>                                       | <b>30</b> |

|           |                                                                       |           |
|-----------|-----------------------------------------------------------------------|-----------|
| 4.1       | Prism wash alternatives.....                                          | 30        |
| 4.1.1     | Steam wash system.....                                                | 30        |
| 4.1.2     | Sanitary steam wash system (culinary steam) .....                     | 31        |
| 4.1.3     | High pressure water wash system.....                                  | 31        |
| 4.2       | Recommended wash settings.....                                        | 32        |
| 4.3       | Prism wash nozzle mounting.....                                       | 32        |
| 4.4       | Modular Connection Unit for Wash Systems.....                         | 33        |
| 4.5       | Mechanical washer for SFC Flow cell.....                              | 34        |
| <b>5.</b> | <b>Calibration and configuration .....</b>                            | <b>37</b> |
| 5.1       | User interface homepage .....                                         | 37        |
| 5.2       | Diagnostics .....                                                     | 38        |
| 5.3       | Trend plots.....                                                      | 38        |
| 5.4       | Parameters configuration.....                                         | 39        |
| 5.4.1     | User interface password.....                                          | 39        |
| 5.4.2     | Calibration parameters .....                                          | 40        |
| 5.5       | Instrument verification: Confirming ongoing performance .....         | 41        |
| 5.5.1     | R.I. verification: Setting up the system.....                         | 41        |
| 5.5.2     | R.I. verification: User interface password protection .....           | 44        |
| 5.5.3     | R.I. verification: Performing the verification procedure .....        | 44        |
| 5.6       | Output configuration and analog signal settings.....                  | 46        |
| 5.7       | Configuration of low and high alarms .....                            | 46        |
| 5.8       | Configuration of Prism wash .....                                     | 47        |
| 5.9       | Display.....                                                          | 48        |
| 5.10      | Software update .....                                                 | 49        |
| <b>6.</b> | <b>Digital Modbus TCP configuration .....</b>                         | <b>51</b> |
| <b>7.</b> | <b>DCM-20 refractometer in potentially explosive atmospheres.....</b> | <b>52</b> |
| 7.1       | Device marking.....                                                   | 52        |
| 7.2       | Safety instructions.....                                              | 52        |
| 7.3       | Installation.....                                                     | 53        |
| 7.3.1     | Sensor startup.....                                                   | 53        |
| 7.3.2     | Sensor removal/measurement window cleaning .....                      | 53        |
| 7.3.3     | Maintenance and repair of ATEX/IECEx refractometer .....              | 54        |
| 7.3.4     | Specific conditions of use.....                                       | 54        |
| 7.3.5     | Vibration.....                                                        | 54        |
| 7.4       | Sensor specifications.....                                            | 54        |

# User's Manual

**⚠ WARNING:** If the instrument is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

- The unit is intended for indoor/outdoor use, at an altitude of less than 3000m above sea level, within an temperature range of -20...65°C and a relative humidity range of 0% to 100% If the instrument is stored outside these ranges, it should be left to stand until it equilibrates to within the above limits.
- Do not operate the unit outside the rated power supply range specified 24VDC +/-10%.
- There are no user accessible or serviceable parts inside the unit. Do not remove or open the unit's casework. Maintenance and repair work may only be carried out by trained and authorized service personnel. Opening sensor casing may compromise measurement accuracy and reliability.
- Before using any cleaning or decontamination method except those recommended by the manufacturer, users should check with the manufacturer that the proposed method will not damage the equipment.
- Ensure the unit is only connected to an earthed supply.

## General safety considerations

This product has been tested for safety according to IEC 61010-1.

### Compliance:

- Safety: IEC/EN 61010-1:2010 + A1
- EMC: EN 61326-1 / EN 55011
- RoHS: 2011/65/EU
- CE: Conforms to EMC 2014/30/EU and RoHS 2011/65/EU

### Note the following precautions:

Use personal protection equipment PPE (protective eyewear, clothing, gloves) suitable for the process environment and liquid.

Be aware that the process liquid may transfer heat to the sensor head.

Remove the sensor from the process pipe before any maintenance or service actions are taken.

### Electrical safety

Only licensed or authorized personnel may install or connect electrical components. Follow local and state legislation and regulations.

DCM-20 overvoltage is category I and pollution degree 2.

### High pressure

Always ensure that the process piping and steam/hot water wash lines are un-pressurized and empty of liquid before mounting/removing the inline refractometer sensor in/from process piping.

### High temperature

In case of hot process liquid, also piping, process connections parts and DCM-20 sensor can be hot. Use Personal Protection Equipment PPE (protective eyewear, clothing, gloves) to avoid burns.

### Bright light source

When looking at bright light sources (e.g. LED), temporary reduction in visual acuity and afterimages can occur, leading to irritation, annoyance, visual impairment, and even accidents, depending on the situation. Avoid looking into the LED and optical measurement window in close proximity.

# 1. Introduction

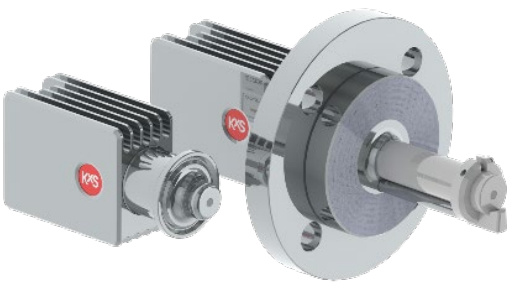
## 1.1 DCM-20 Process Refractometer system

The KxS Process Refractometer DCM-20 provides real-time concentration measurement in a wide range of industrial and hygienic process applications.

This document serves as the general user manual for all DCM-20 series refractometers except for DCM-20 PASVE®. For DCM-20 PASVE® specific installation, safety and user instructions, refer to the corresponding manual.

All KxS refractometers are intelligent, stand-alone instruments that integrate seamlessly into process automation systems through sensor cable with dual analog 4-20 mA or Modbus TCP outputs. Measurement, diagnostics, and configuration are managed via built-in digital connectivity – accessible through any web browser on a computer, tablet, or mobile device. Optional Modular connection unit MCU is also available for easy access and local monitoring (Figure 1).

*DCM-20 sensor*



*Sensor cable (digital/analog)*



*Modular connection unit MCU (optional)*



*Figure 1 DCM-20 process refractometer system components.*

## 1.2 DCM-20 Process refractometer sensor models

The KxS DCM-20 platform is designed to serve diverse industrial needs through specialized sensor and system configurations. Each model is purpose-built based on more than 40 years of refractometry expertise, ensuring optimal performance, reliability, and compliance with industry-specific requirements.

Compact sensor models fit directly or via flow cells in small pipelines. Probe models are designed to be installed directly in larger process pipes and vessels such as tanks, cookers, reactors, crystallizers, and pans.

All DCM-20 sensors are designed to withstand CIP (Clean-in-Place) and SIP (Sterilize-in-Place) cleaning procedures when installed according to the instructions in this manual.

- **KxS Process refractometer DCM-20 Ingold/Sanitary connection.**

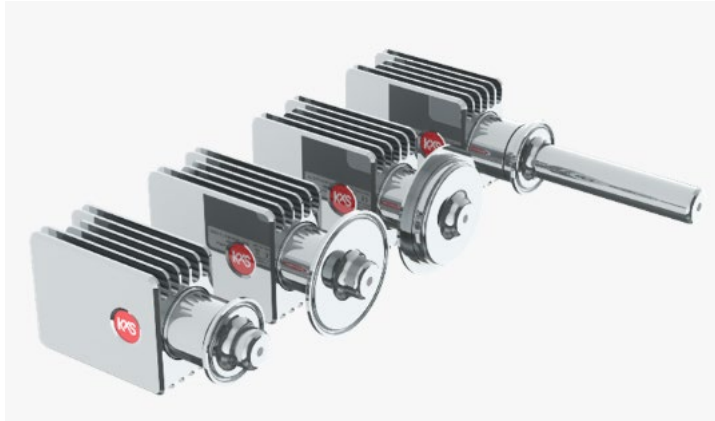
Designed for bioprocessing downstream operations, such as fermentation, and ultrafiltration (UF) systems. Compatible with 1" Ingold and Tri-Clamp sanitary process ports for pilot-scale and production bioreactors.



- **KxS Inline Brix refractometer DCM-20 for hygienic food, beverage and dairy processing**

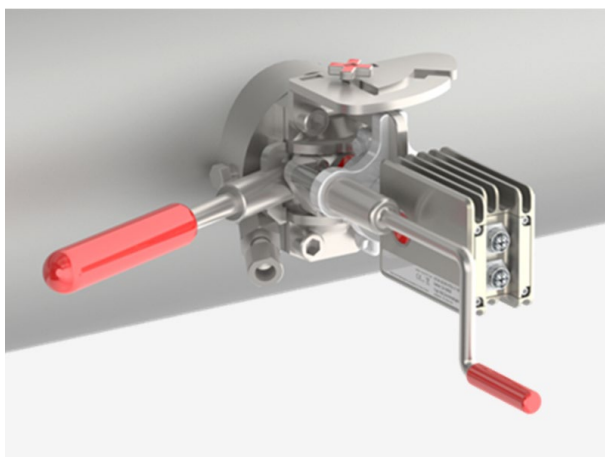
Designed for food, beverage, and dairy processes requiring hygienic design and compliance with the highest food-safety standards. These models, available with Tri-Clamp, Varinline, and APV tank bottom flange connections, carry 3-A Sanitary Standard 46-04 Symbol authorization.

When installed with the SFC flow cell (Tri-Clamp and Varinline connections), these models are also certified by the European Hygienic Engineering and Design Group (EHEDG).



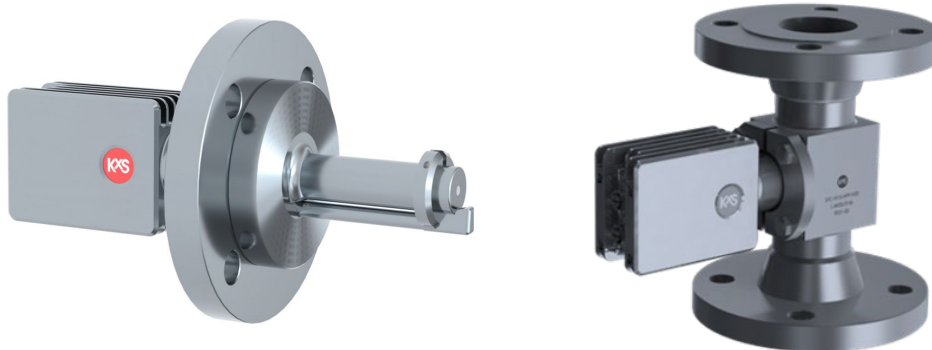
- **KxS Retractable refractometer DCM-20 PASVE®.**

Designed for kraft pulp and paper applications such as dry-solids measurement in black and green liquor. The PASVE® system enables safe insertion and removal of the sensor during full process pressure without process shutdown. This product model is covered by dedicated user manuals and safety documentation. Refer to [www.kxstechnologies.com](http://www.kxstechnologies.com) for DCM-20 PASVE® documentation for installation, operation, and safety instructions.



- **KxS Process refractometer DCM-20 with industrial process connections**

Designed for general purposes and heavy-duty chemical processing and other industrial processes and operations (e.g., sugar crystallization) across process pipelines, tanks, reactors, evaporators and crystallizers and vacuum pans. Process connection is directly in pipe and vessel via DIN, ANSI or JIS flange.



### 1.3 Optional Modular Connection Unit MCU SP-8000

The Modular Connection Unit (MCU) SP-8000 is optional component for the DCM-20 refractometer system.

The MCU SP-8000 connects with DCM-20 refractometer and facilitates direct, easy to use touch screen interface and displays measurement data and diagnostic information locally or to automation systems through analog 4-20 mA and digital Modbus TCP signals. If prism wash is required, the MCU also includes wash relays that activate the prism wash function at specified intervals.

The power and communication modules are mounted on a DIN rail.

The MCU is housed in stainless steel (1.4301/AISI 304) enclosure with protection rating of IP66 featuring additional top cover and touch screen splatter guard for enhanced protection against dirt, rain and harsh industrial environment in outdoor and factory conditions (see Fig. 2).

The MCU is delivered with mounting plates.

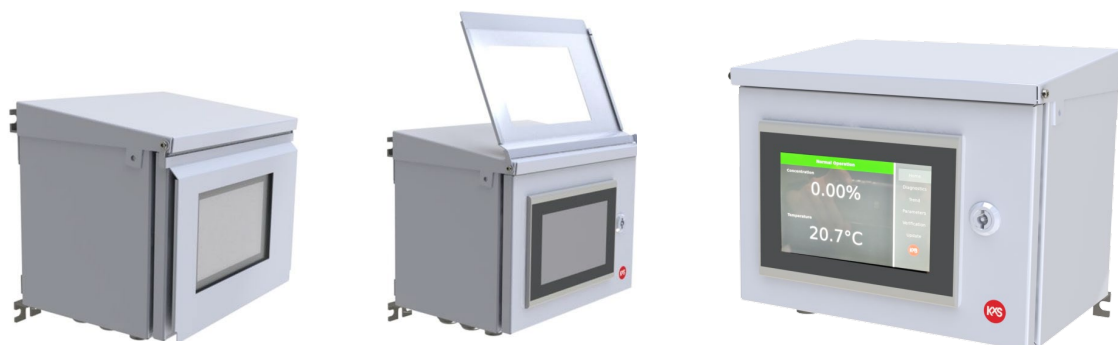


*Figure 2 MCU is housed in stainless steel (1.4301/AISI 304) enclosure featuring additional top cover and touch screen splatter guard).*

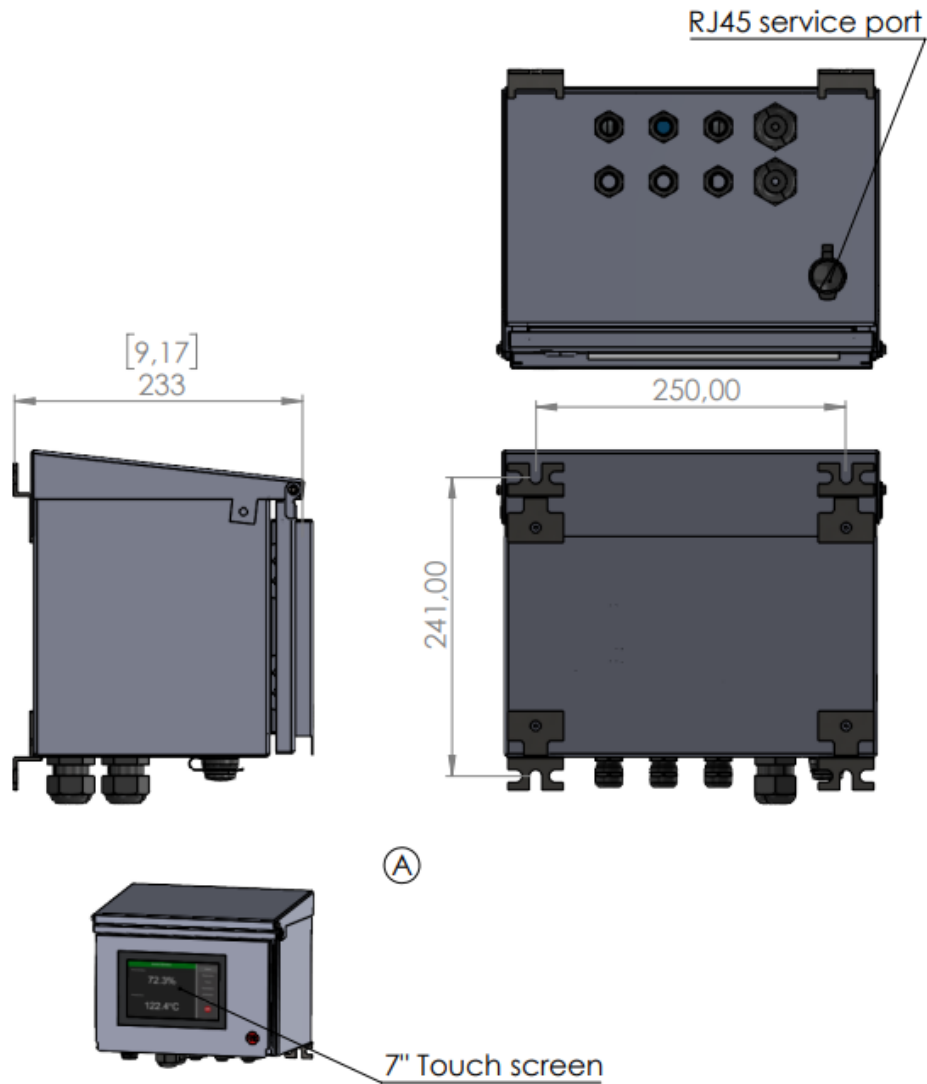


Figure 3 Dimensional drawing of Modular Connection Unit enclosure (Drawing 10528).

## 1.4 Display options for User Interface access

KxS Technologies offers options for user interface displays. The user interface features and functions are identical regardless of which option is chosen. Product certificates of modules and displays are available per third-party manufacturer.

### 1.4.1 Computer or mobile device with display and RJ45 Ethernet cable

The sensor cable is assembled to an RJ-45 connector according to the color coding given in Section 4.2 Sensor integration concept. The SP-9310 RJ-45 connector is with corresponding color coding of mode A. The cable is connected to computer's RJ-45 port, or USB-C port when a RJ-45 to USB-C adapter is used.

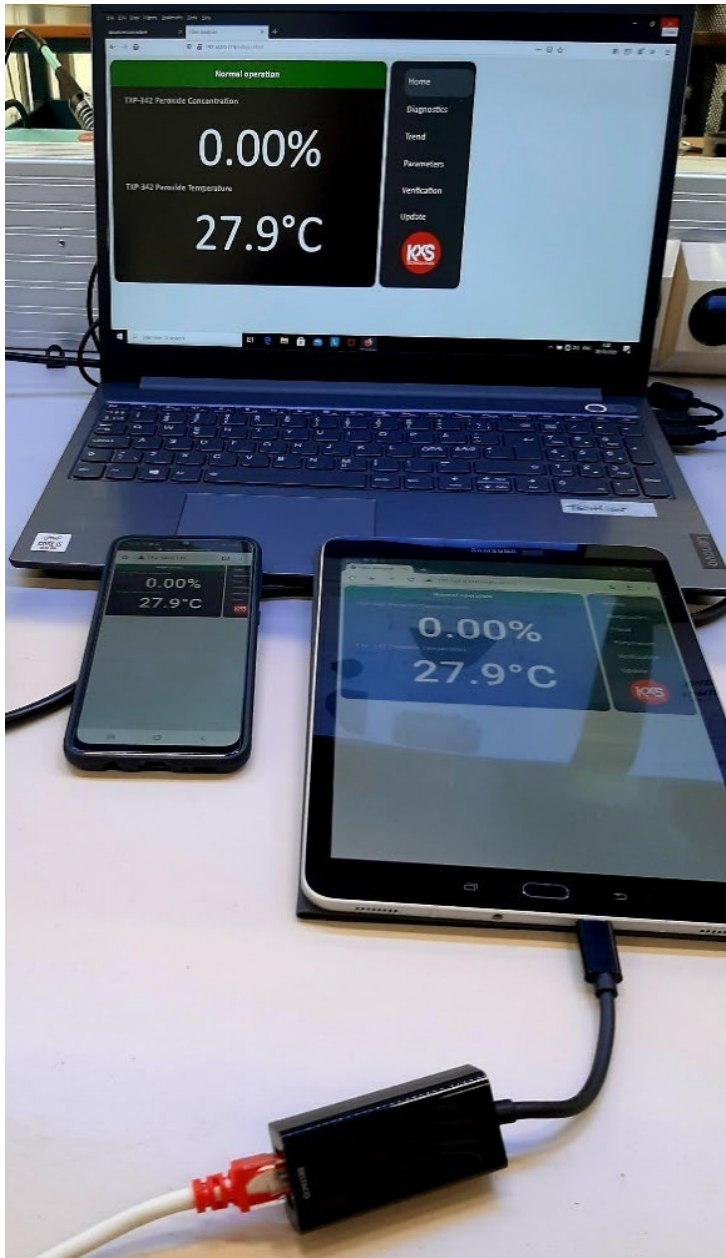


Figure 4 Computer or mobile device used as user interface.

## 1.5 Sensor M12 cable



Figure 5 Network cable with connector cover 10318 attached (Material 1.4404), Ethernet CAT6A (10 Gbps), CC-Link IE CAT6A (10 Gbps), 8-position halogen-free, shielded (Advanced Shielding Technology), Plug straight M12 / IP67, coding: X, on free cable end, coding: X.

## 1.6 Measurement principle

KxS DCM-20 employs the physical phenomenon of Refractive Index to define liquid concentration. Optical concentration measurement is based on Snell's law and the critical angle of total reflection to provide precise readings.

Light is emitted from an LED and directed towards the interface between the prism (optical window) and the liquid being measured. As the concentration of the liquid changes, specific angles of the light are totally reflected and partially reflected back, producing light and shadow interface that is captured by a digital camera sensing element (Fig. 6).

This interface is detected by light activated camera pixels and converted into refractive index (RI). The RI values can be directly used or further translated into any concentration units, such as percentage by weight. The DCM-20 includes an integrated pT-1000 temperature element for process temperature measurement and simultaneous automatic temperature compensation of the concentration measurement.

The sensor calibration is performed with NIST traceable standard refractive index liquids and a defined process at KxS Technologies' technology center.

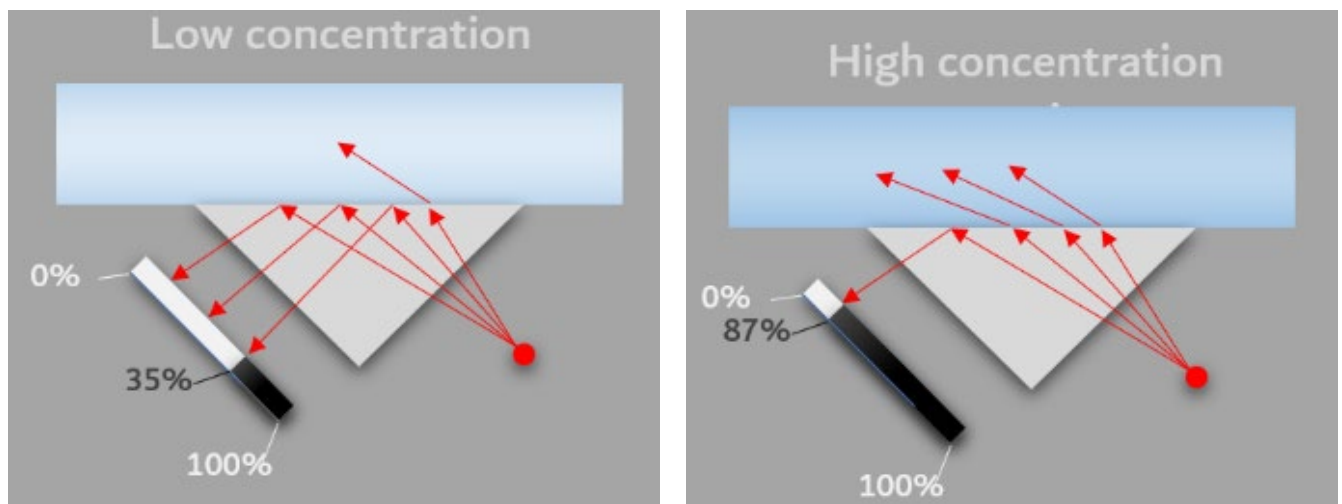


Figure 6 Optical refractive index measurement principle.

## 2. Connection

The DCM-20 operates with 24VDC input power supply. The communication signal is transferred through either an analog 4-20mA port, or a digital Modbus TCP port. Respective shielded connector port carries a 24VDC input power supply pinout. When the analog output port is chosen, the other digital port is used as a service channel for sensor parameter and diagnostics update in the user interface on a computer web browser, external display, or mobile device. All user interface options can be used simultaneously.

### 2.1 Sensor connectors

Two independent sensor connectors are available. Both shielded connectors are designed with 24VDC power supply pinouts. The analog port is designed with 2x 4-20mA pinouts. The digital port is designed for Modbus TCP communication output and user interface connection (Fig. 7).

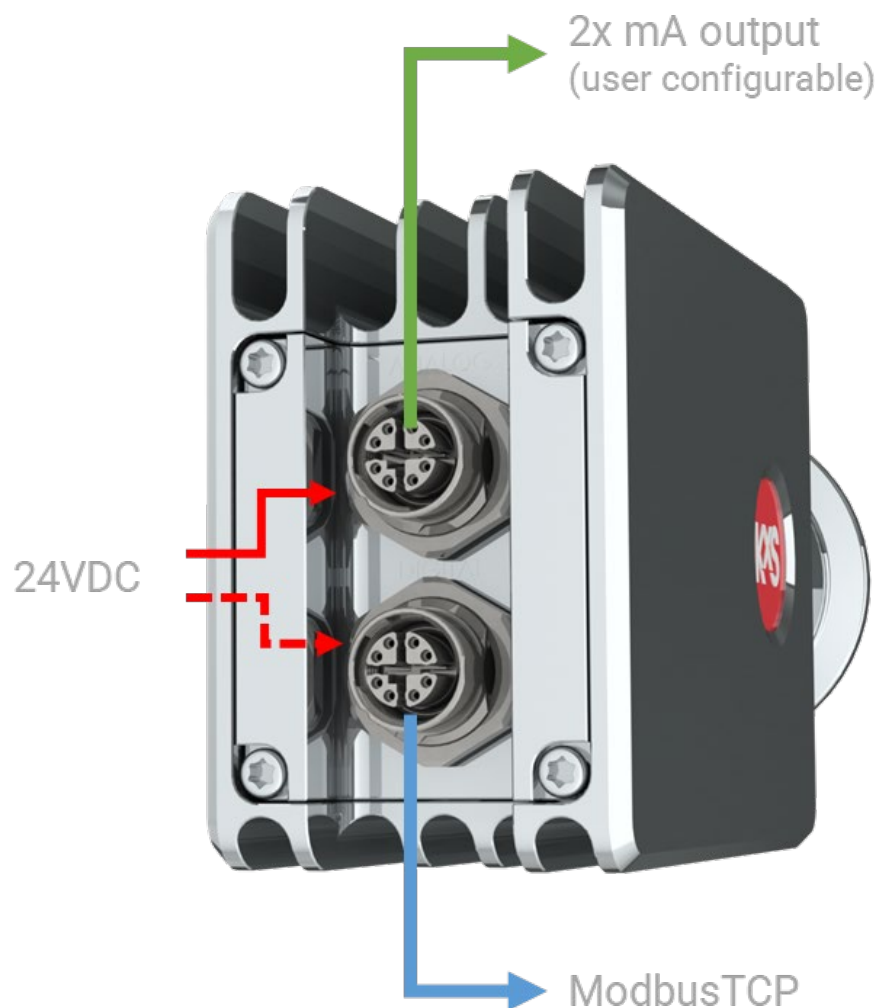


Figure 7 Process refractometer DCM-20 sensor connectors.

## 2.2 Sensor integration concept

The KxS Process Refractometer DCM-20 offers flexible system integration through M12 connector (8 pins, X-code), allowing easy adaptation to analog, digital, or combined operation modes.

Each sensor is equipped with two shielded connector ports:

- Analog connector – for 4–20 mA signal outputs and power input
- Digital connector – for Modbus TCP (Ethernet) communication and power input

Both connectors can supply power to the sensor. When operating in analog-only mode, connect the M12 cable to the “ANALOG” connector. When operating in digital-only mode, connect the cable to the “DIGITAL” connector. In combined mode, both connectors may be used simultaneously – analog outputs for process control signals and the digital interface for configuration, diagnostics, and data access.

 **Grounding note:**

When both cables are in use, connect the ground only through the digital cable at the system end to prevent ground loop interference.

Always cover any unused connector with the supplied sealing cap to maintain IP protection and prevent moisture ingress.

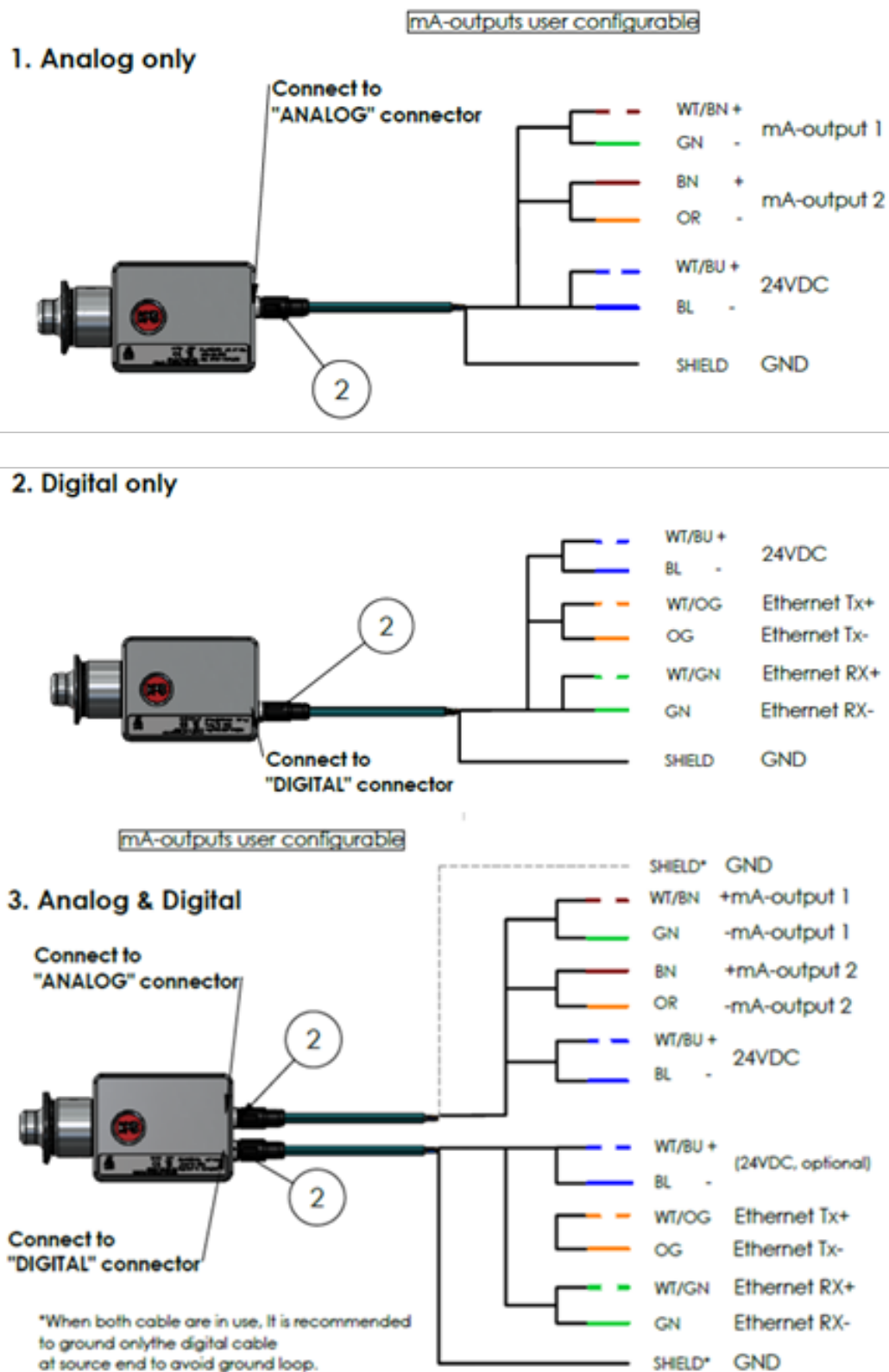


Figure 8 The DCM-20 operation concept. Drawing 10125.

## 2.3 Cable connection with electrical modules

Regardless of analog or digital output port connection, one identical cable model serves both options. The shielded cable has 24VDC power supply wires, Ethernet CAT 6A communication wires, and analog communications wires for 2x 4-20mA outputs.

The SP-9000 sensor cable provided is with a M12 SPEEDCON male connector (IEC 61076-2-109) attached to the corresponding sensor female connector. The twisted pair cable structure is according to 4x2xAWG26/7; S/FTP. The outer sheath material is polyurethane PUR water blue RAL 5021.

The cable end is free with 8 wires following given pinout schedules below.

When **sensor analog output** is chosen, the 8 free-end cable wires are connected to the power supply SP-9400 according to Fig. 9. leaving 4 wires for the 2x analog mA signal connection.

Analog connector (M12 X-code)

| Pin no. | Description    | Wire color |  |  |
|---------|----------------|------------|--|--|
| 1.      | Not connected  | WH/OG      |  |  |
| 2.      | Current out 2- | OG         |  |  |
| 3.      | Not connected  | WH/GN      |  |  |
| 4.      | Current out 1- | GN         |  |  |
| 5.      | Current out 1+ | WH/BN      |  |  |
| 6.      | Current out 2+ | BN         |  |  |
| 7.      | 24VDC+         | WH/BU      |  |  |
| 8.      | 24VDC-         | BU         |  |  |

Figure 9 Wiring pinout schedules for analog output connection

Digital connector (M12 X-code)

| Pin no. | Description   | Wire color |  |  |
|---------|---------------|------------|--|--|
| 1.      | Ethernet Tx+  | WH/OG      |  |  |
| 2.      | Ethernet Tx-  | OG         |  |  |
| 3.      | Ethernet Rx+  | WH/GN      |  |  |
| 4.      | Ethernet Rx-  | GN         |  |  |
| 5.      | Not connected | WH/BN      |  |  |
| 6.      | Not connected | BN         |  |  |
| 7.      | 24VDC+        | WH/BU      |  |  |
| 8.      | 24VDC-        | BU         |  |  |

Figure 10 Wiring pinout schedules for digital output connection

When **sensor digital output** is chosen, the 8 free-end cable wires are connected to the power supply SP-9400 and RJ-45 connector SP-9310 according to the pinout schedule in Fig. 10. The RJ-45 connector is connected to the industrial ethernet switch SP-9320 with 4+1 available ports. The industrial ethernet switch serves connection of industrial communication protocol converter modules, external displays, and WLAN modules. When the digital Modbus TCP signal is chosen, an additional module is available for conversion to other industrial protocols, for example Ethernet IP or ProfiNet. See separate third party user's manual for the industrial protocol converter modules.

When the analog output is chosen for measurement values, the digital channel is used for connecting to the user interface on a computer web browser or external display. When connecting the digital port, an identical second cable is connected to the sensor digital M12 connector port and the free-end wires are connected to the RJ-45 connector SP-9310 (Fig.9) in Pin no. 1-4 according to the wiring schedule in Fig. 8. The corresponding color coding is found on the RJ-45 connector SP-9310 with A coding. An assembled M12 cable with RJ-45 connector is available from KxS Technologies upon request.

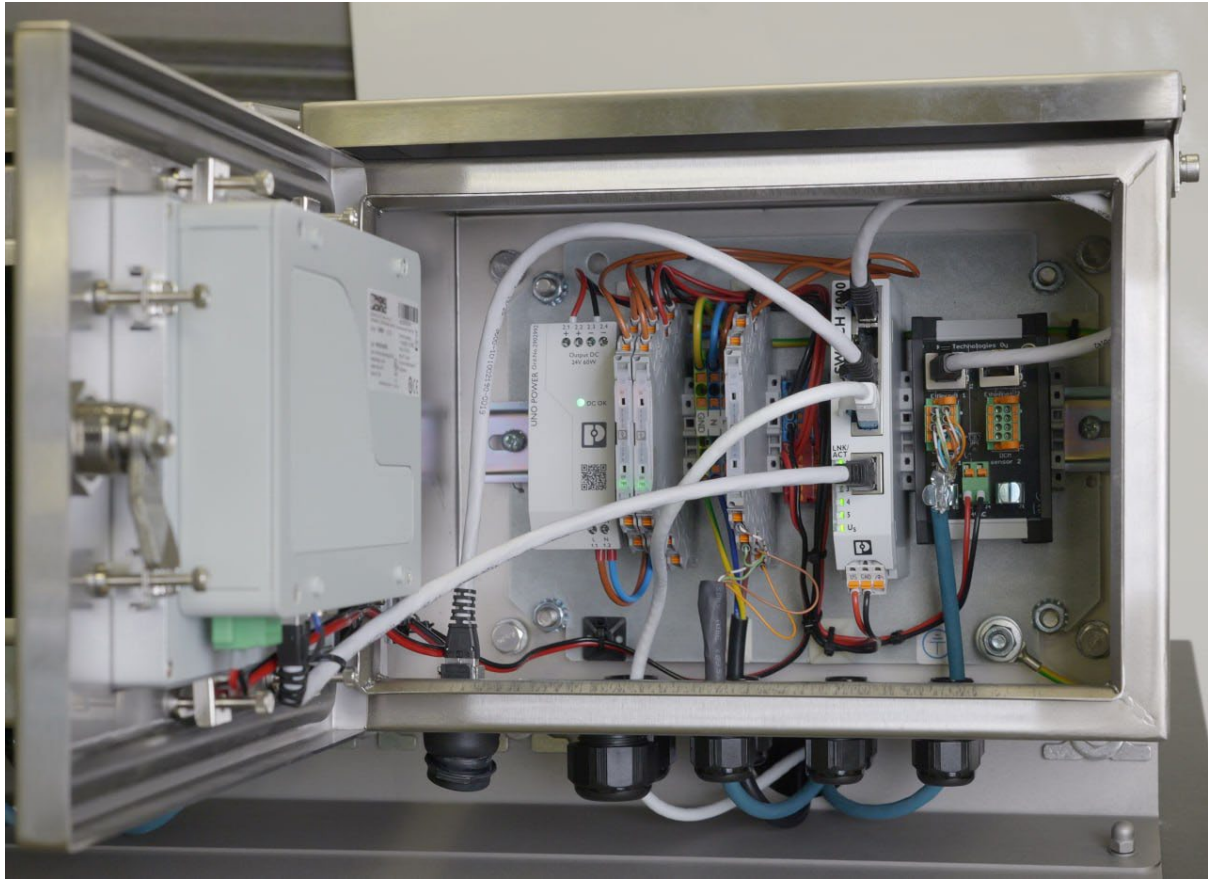


*Figure 11 Power supply unit (Part No: SP-9400), industrial RJ-45 connector (Part No: SP-9310), Industrial Ethernet Switch with 4+1 ports (Part No: SP-9320), and universally configurable limit value switch with 1x relay output (Part No: SP-9700).*

The Process refractometer DCM-20 can be configured with high and low measurement alarms, as well as prism wash system as and its user interface configuration. The universally configurable limit switch SP-9700 with 1 pcs changeover relay output and plug-in connection technology is used for monitoring analog limit values output from the sensor analog measurements. The limit values are configured with physical DIP switches with one relay per SP-9700 module.

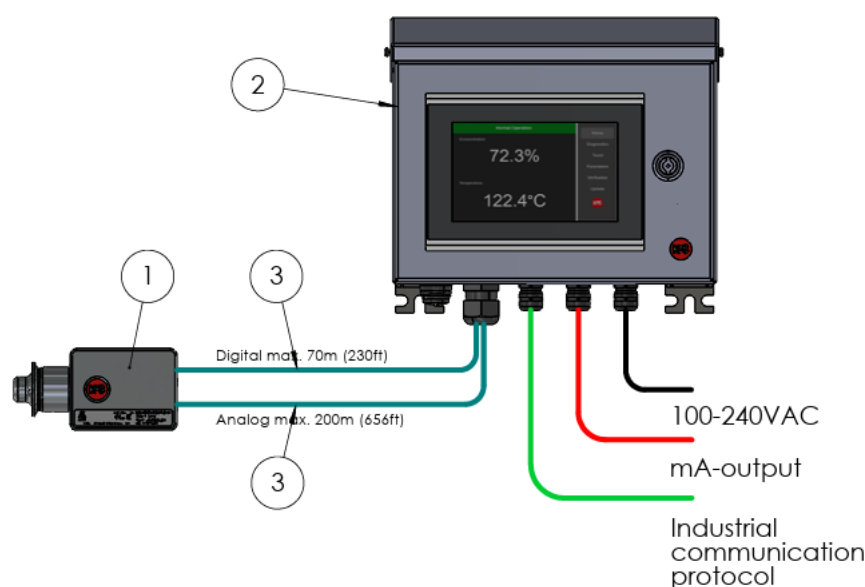
Two limit value switches are connected in serial when two relays for both low and high measurement alarms, or both precondition and wash functions for Prism wash systems are defined. The 10x physical DIP switches are activated or kept inactivated to follow a defined sensor analog mA limit behavior in the 4-20mA range.

## 2.4 System drawing of DCM-20 and Modular Connection Unit MCU

The typical DCM-20 system configuration is shown in Figure 12.

One DCM-20 Process Refractometer is connected to the Modular Connection Unit (MCU) using separate analog and digital sensor cables. The digital M12 connection provides 24 VDC power, Modbus TCP communication, and access to the sensor web-based user interface. The analog M12 connection provides 24 VDC power and two independent user-configurable 4–20 mA outputs for process control.

The Modular Connection Unit (MCU) integrates the required power supply, communication, control, and optional interface modules into a compact enclosure for field installation.



| ITEM NO. | DESCRIPTION                         | SUPPLY BY | QTY. |
|----------|-------------------------------------|-----------|------|
| 1        | DCM-20 Inline refractometer         | KxS       | 1    |
| 2        | Modular Connection Unit MCU         | KxS       | 1    |
| 3        | SP-9000 Sensor cable digital/analog | KxS       | 2    |

Figure 12 System drawing of Process refractometer DCM-20 and Modular Connection Unit MCU. Drawing 10896A.

## 2.5 User interface

**Every sensor is delivered with the factory default IP address of 192.168.0.100.** The sensor user interface is accessed through the sensor digital port when connecting the sensor to a computer with a web browser, external display, or mobile device. The sensor digital output port carries the Modbus TCP signal and connects to the user interface with a standard RJ-45 connector. The factory set sensor IP address 192.168.0.100. is entered in the address field of a computer web browser, external display, or mobile device. The homepage offers access to measurement values and diagnostics, configuration of parameter, and verification of sensor calibrations. KxS Technologies recommends using Google Chrome or Microsoft Edge web browsers.

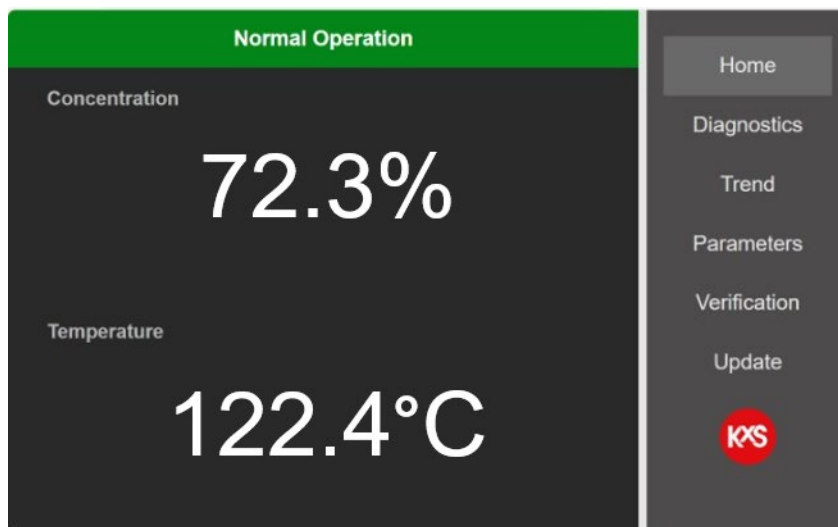


Figure 13 Sensor homepage of user interface on a computer web browser or external display SP-9500/SP-9520.

### 2.5.1 PC/Computer setup

Verify in the computer command prompt, (in Windows, press Start button and type *Command Prompt*) by typing *ipconfig*, that the computer IP address is set to the same 192.168.x.y network. The last two digits .x.y on the computer must not be the same as the corresponding for the sensor IP address .0.100.

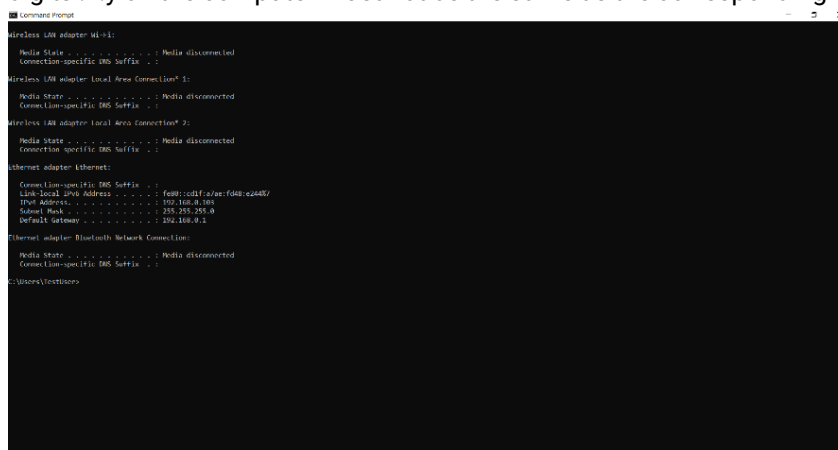
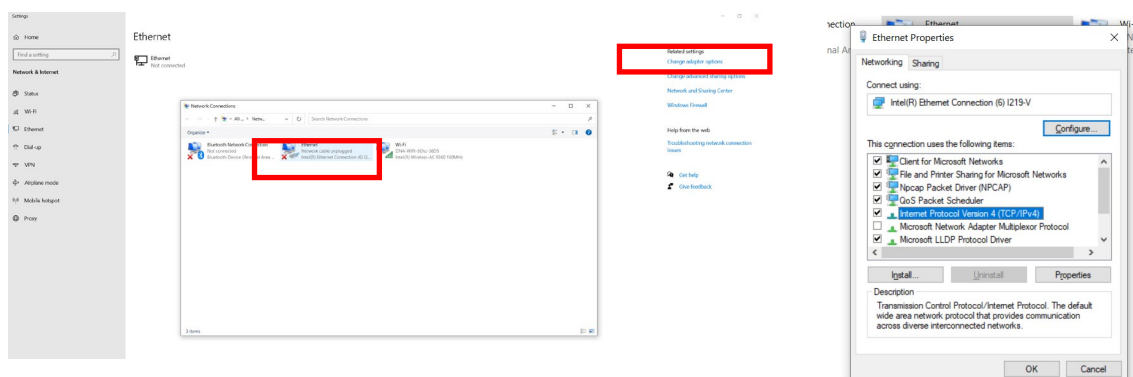
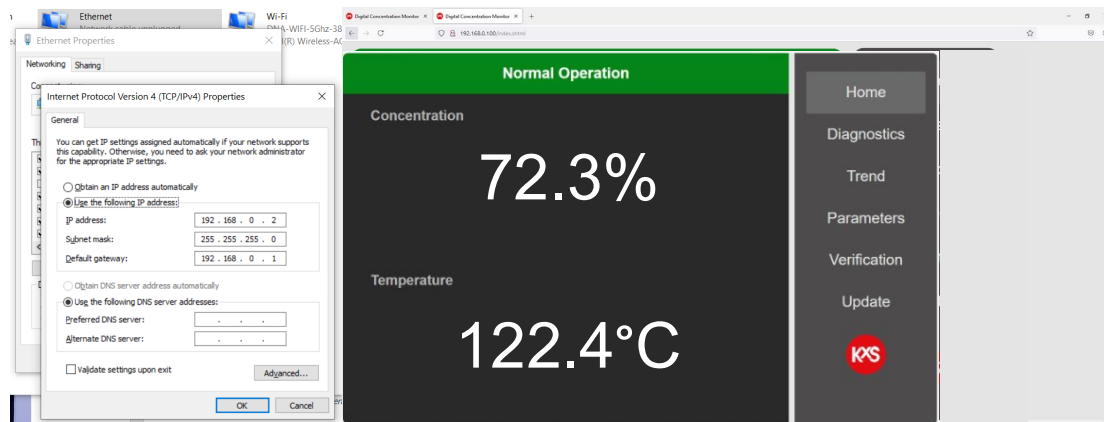


Figure 14 Command prompt on computer for IP address verification.

In the PC Start menu by typing Ethernet, the IP setting window is accessed. By going to *Change adapter settings*, a window will open where *Ethernet* is chosen. A new window for *Ethernet Properties* opens, where *Internet Protocol Version 4 (TCP/IPv4)* is double-clicked.



Unless the PC obtains the IP address automatically in the 192.168.x.y domain, the IP settings are changed to *Use the following IP address*. The PC IP address must not be the same as sensor default address. The PC IP address can be for example 192.168.0.2. Subnet mask: 255.255.255.0. Press OK, close, and open a web browser where the sensor IP address is entered in the address field.



### 2.5.2 External display SP-9500 setup

An external industrial display is available with a 7" multi touch panel mount design for user interface and measurement reading display purposes. The display is powered with 24VDC. The sensor Ethernet cable is connected to the display with a RJ-45 port shown in Fig 15-17. When the display is powered up, opt for the configuration page during display start-up.



Figure 15 Cable connections to the external display and activation of configuration page during power up.

To set up the display panel's IP address go to section *Network* and dial in settings as in Fig 10. Select Static IP. IP address with 192.168.0.y where y is any other ending than the corresponding for the sensor IP. Subnet Mask 255.255.255.0. Confirm by pressing ✓.

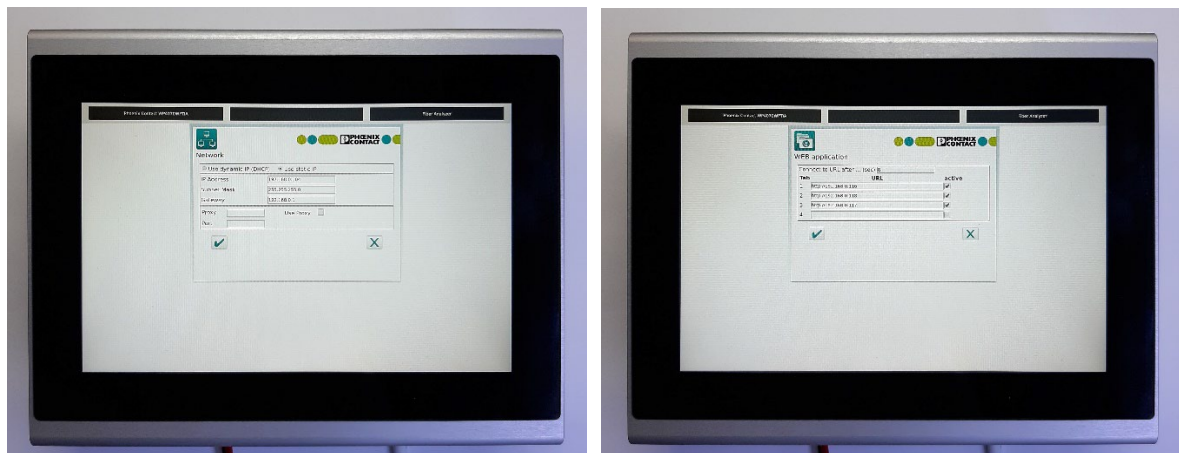


Figure 16 Display IP settings in section Network and connecting display to sensor IP in section Web application.

The touch panel unit can display four sensors by selecting respective sensor IP line 'active' in section *Web application* of the display user interface Fig 10. Confirm by pressing ✓. The settings are applied by pressing the Restart button seen in Fig 11.

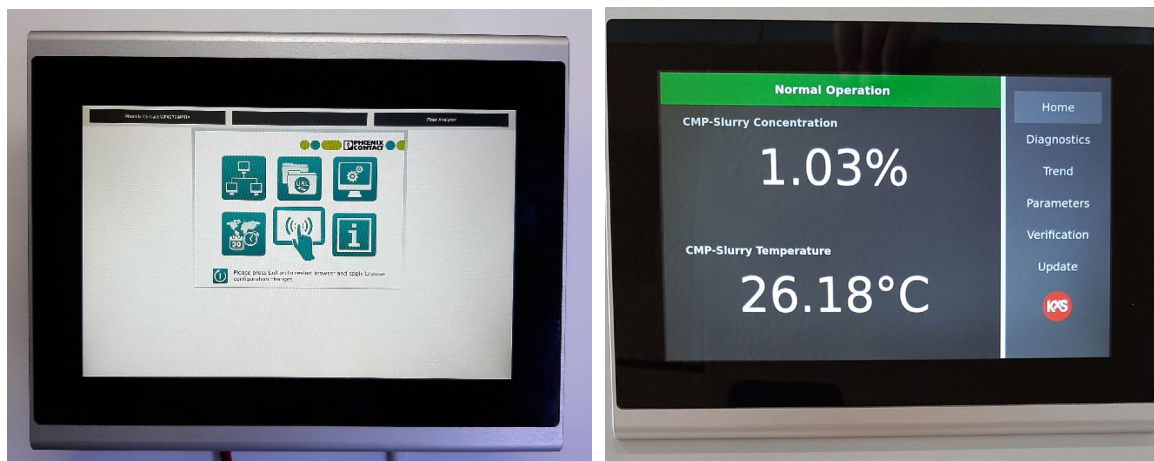


Figure 17 Restart the display by pressing the lower left button on the display to apply configuration settings and changes for activation of the sensor user interface homepage.

### 2.5.3 Access via wireless WiFi router

Wireless access to the KxS Process Refractometer DCM-20 can be established by connecting the sensor's Ethernet (digital) interface to a portable 4G/LTE WiFi router, such as the OLAX MT30 (see Fig. 18).



Figure 18 Example of a portable 4G/LTE WiFi router used for wireless access to the DCM-20 refractometer.

This arrangement provides wireless connectivity for viewing measurement data, diagnostics, and configuration through a standard web browser on a laptop, tablet, or mobile device.

The router offers built-in WiFi functionality and includes a Type-C charging port and an internal 4000 mAh battery (typical operating time up to approximately 8 hours, depending on usage). A LAN (Ethernet) port is provided for wired connections to the DCM-20.

#### Typical use cases

- Temporary or mobile access during commissioning and troubleshooting
- Wireless access where no plant Ethernet is available
- Local configuration access without modifying the control system network



*Figure 19 Portable 4G/LTE WiFi router connected to the DCM-20 refractometer for wireless access.*

#### 2.5.4 Mobile device setup

A mobile device with a USB-C port can be connected to access the user interface. An Ethernet cable from the industrial switch is connected through a standard RJ-45 to USB-C adapter. The USB-C connector is connected to the mobile device. The mobile device is set to Airplane mode. Following the mobile device *Settings* path from left to right in Fig. 20, allows access to the sensor user interface. When the settings are done, open a web browser and type the sensor IP address in the address field (default: 192.168.0.100).

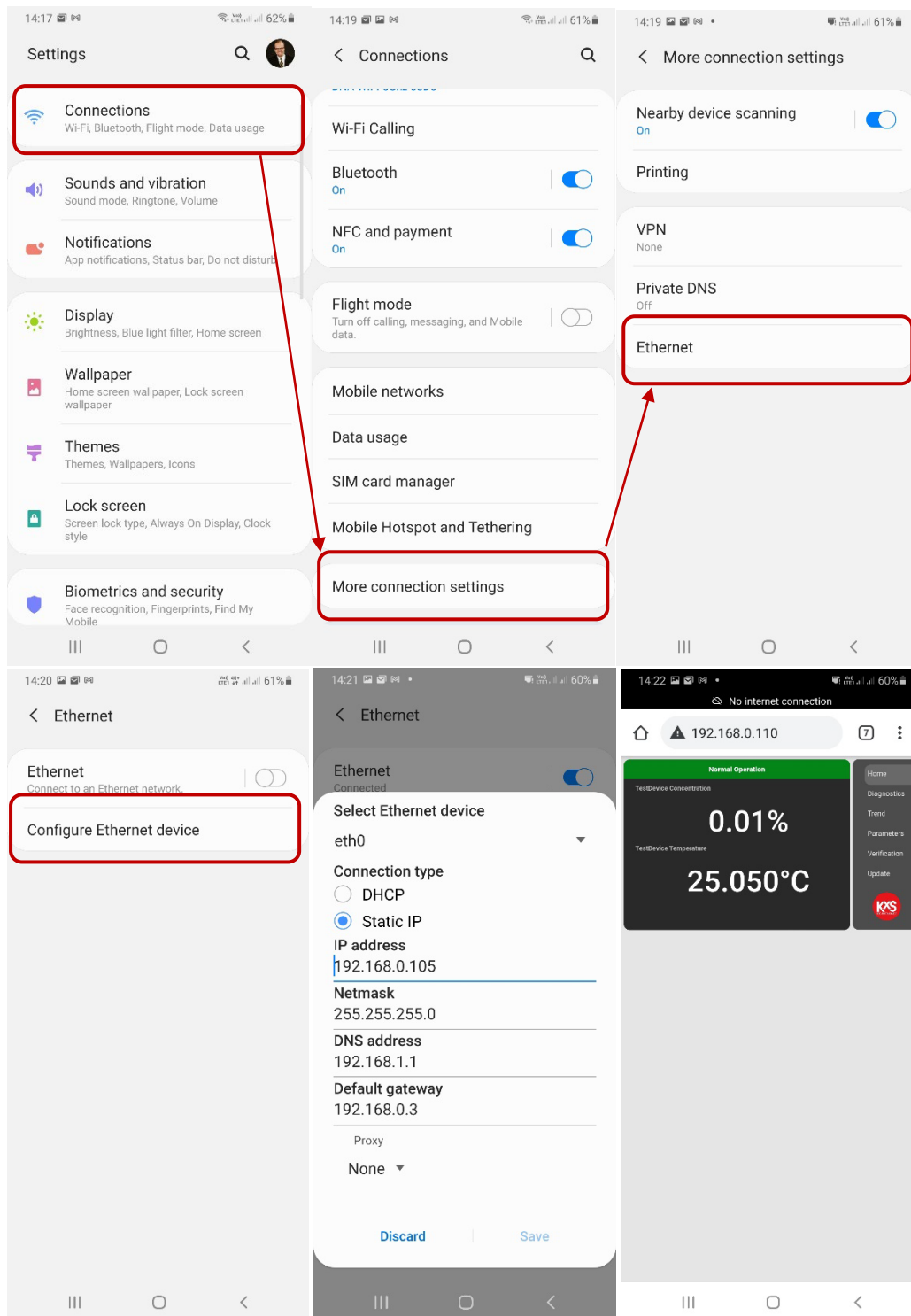


Figure 20 Mobile device setting path for IP configuration and access of sensor user interface homepage.

## 3. Installation

### 3.1 General installation principles

The DCM-20 is available in a range of purpose-built sensor models designed for different process conditions and industries. Compact sensor models are intended for direct installation or mounting via flow cells in small-diameter pipelines. Probe models are designed to be installed directly in larger process pipes and vessels, such as tanks, cookers, reactors, crystallizers, and pans.

The selected installation location should provide easy access for cable connection, inspection, maintenance, and service.

### 3.2 Installation in high ambient and process temperatures

The DCM-20 is designed for reliable operation in demanding industrial environments. However, additional sensor cooling may be required when the ambient or process temperature exceeds the recommended operating conditions.

Additional cooling is recommended when:

- the ambient temperature exceeds 65 °C (149 °F), or
- the process temperature exceeds 100 °C (212 °F) and the ambient temperature exceeds 45 °C (113 °F).

Refer to Figure 21 for the recommended operating limits.

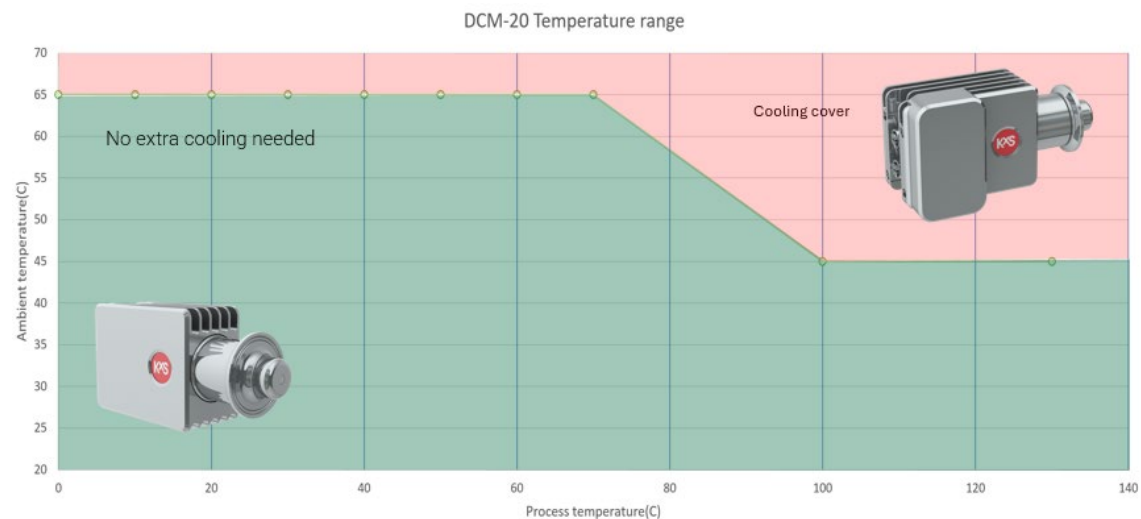


Figure 21 Evaluating high ambient and/or process temperature environments.

#### 3.2.1 Monitoring sensor temperature

You can read the camera card temperature value on Diagnostics page (see Fig 22).

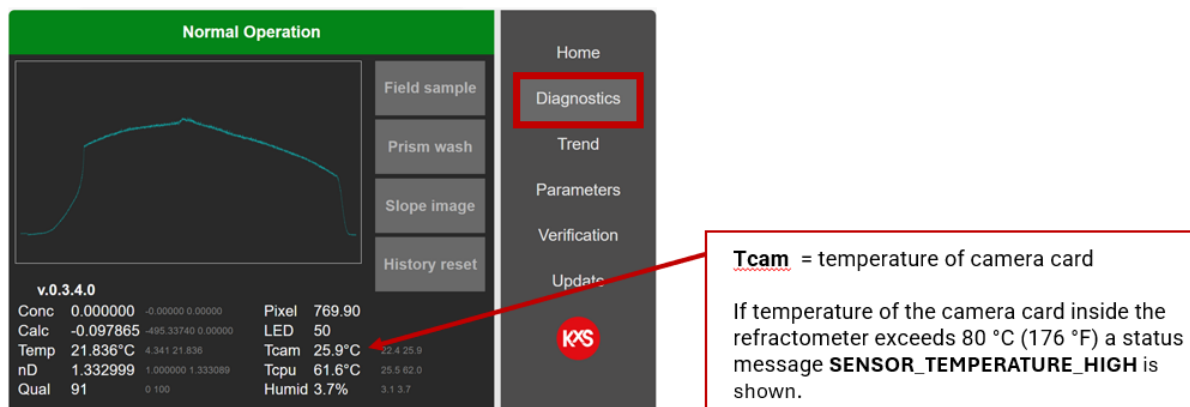


Figure 22 Diagnostics page shows diagnostic values, e.g. Tcam for temperature of camera card.

The internal temperature of the camera electronics (Tcam) can be monitored on the Diagnostics page of the DCM-20 user interface (Figure 22).

If the camera electronics temperature exceeds 80 °C (176 °F), the refractometer generates the status message: **SENSOR\_TEMPERATURE\_HIGH**.

The status message is displayed on both the Home page and the Diagnostics page of the web user interface. Diagnostic values and status messages can be viewed through: Web browser (computer, tablet or smartphone), Wireless WiFi connection (when available) and Modular Connection Unit (MCU).

See Section 2.5 for Modbus TCP communication.

### 3.2.2 Improving sensor cooling

If additional cooling is required, the following methods are recommended:

- Ensure unrestricted natural airflow around the sensor housing.
- Direct plant ventilation or clean compressed air towards the cooling fins.
- Install the optional sensor cooling cover

Sensor cooling cover clamps onto the side of sensor and is secured in place using two screws—without the need to open the sensor or compromise its tightness (see Fig 23). The cooling cover circulates cooling water around the sensor housing to prevent excessive heat build-up.



Figure 23 Cooling cover.

### 3.3 Pipe installation specifics

For pipe installation, always select straight section of the pipe. Secure at least 10 times the pipe diameter (D) of straight pipe before and after the installation point to achieve laminar flow and optimal sensor self-cleaning performance (see Fig. 24).

The recommended flow velocity is 1 m/s (3 ft/s), which corresponds to a flow rate of 70 liters per minute (LPM) in a 1.5" process pipe and 270 LPM in a 3" pipe.

The smallest 1" SFC flow cell should be mounted in a vertical line or in at least a 45-degree angle.

**⚠ WARNING:** Do not install sensor on the top or bottom of a horizontal pipe (see Fig. 24, Wrong way). **Measurement reliability is compromised.** Air pockets in partially filled pipes can significantly affect the reliability of refractometers installed on top.

- Position in process (good flow velocity, high temperature, full pipe)
- Install sensor air cooling fins pointing up (KxS logo horizontal).  
Air helps to cool down sensor electronics.
- Process connection tightened properly (clamp, flange)
- Free air flow around sensor cover to facilitate cooling of electronics

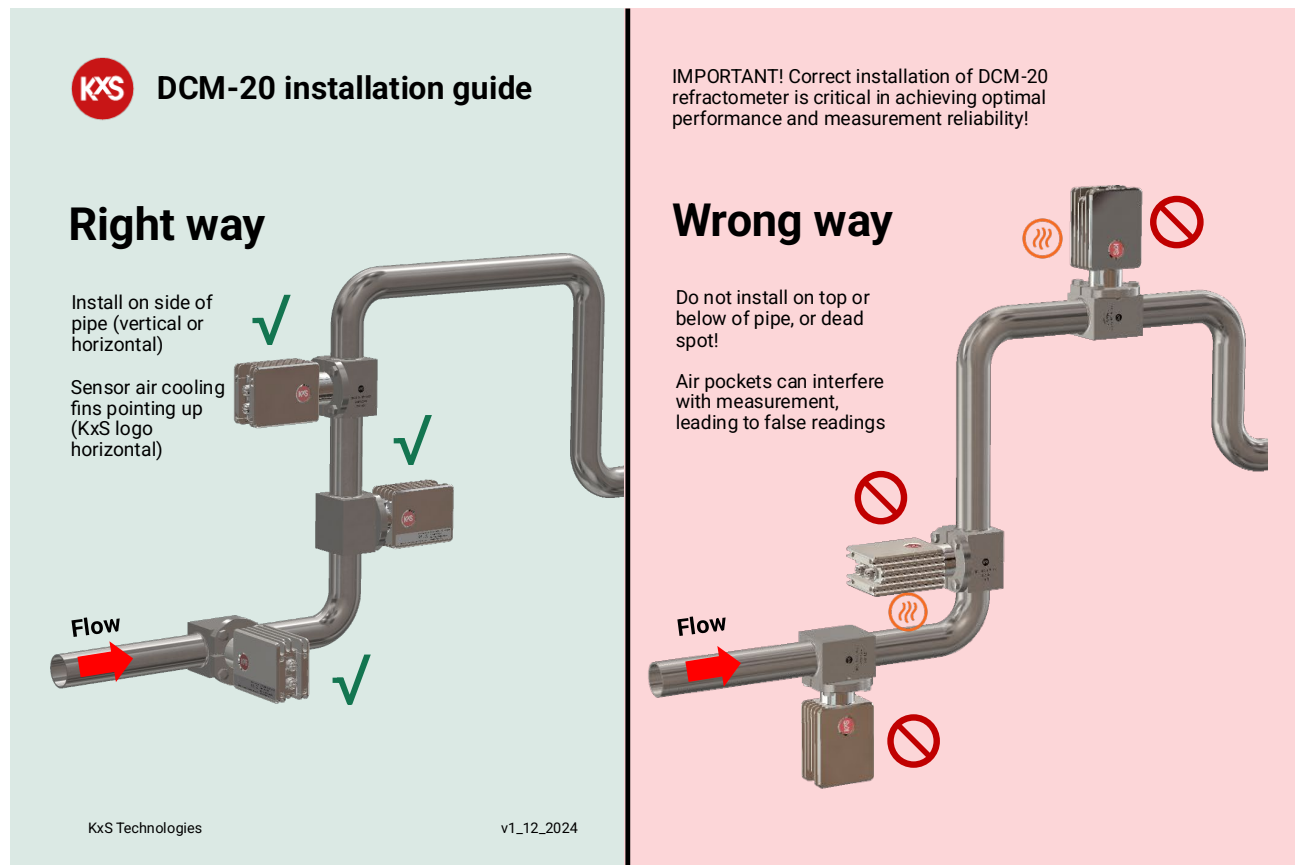


Figure 24 Sensor installation in process pipe: Right and wrong way.

**⚠ IMPORTANT: Horizontal** pipe installation: Position the sensor head in a lateral orientation (on the side of the pipe).

**⚠ IMPORTANT: Vertical** pipe installation: The flow must be directed upwards to maintain a full pipe during operation.

**⚠ IMPORTANT:** If the process pipe is subject to vibration, support the pipe. Excessive vibration may damage the refractometer.

### 3.4 Compact sensor installation

Single-piece flow cell SFC with Sanitary Tri-clamp clamp or flange ends makes compact sensor installation easy into straight pipelines. SFC flow cells are designed for 1", 1.5", 2", 2.5", 3", 4" and 6" pipe sizes (see Fig. 25). Straight pipe connection innovation offers significantly better flow velocity on measurement window compared to traditional elbow-mounted systems, and ease of mounting.



Figure 25 Single-piece flow cells with clamp or flange ends are scalable to different process line sizes.

DCM-20 refractometer sensor is mounted in SFC flow cell with 1.5" Sanitary high-pressure flange ISO 2852 (see Fig. 26). This mounting connection allows sensor to be installed in process pressures up to 55 bar (800psi) depending on flange rating.

**Note:** The single-piece flow cell is machined from one solid piece, and it has no weld joints.

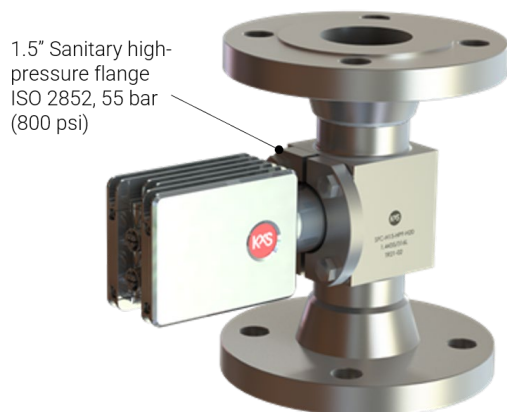


Figure 26 Sensor is installation in SFC flow cell 1.5" Sanitary high-pressure flange.

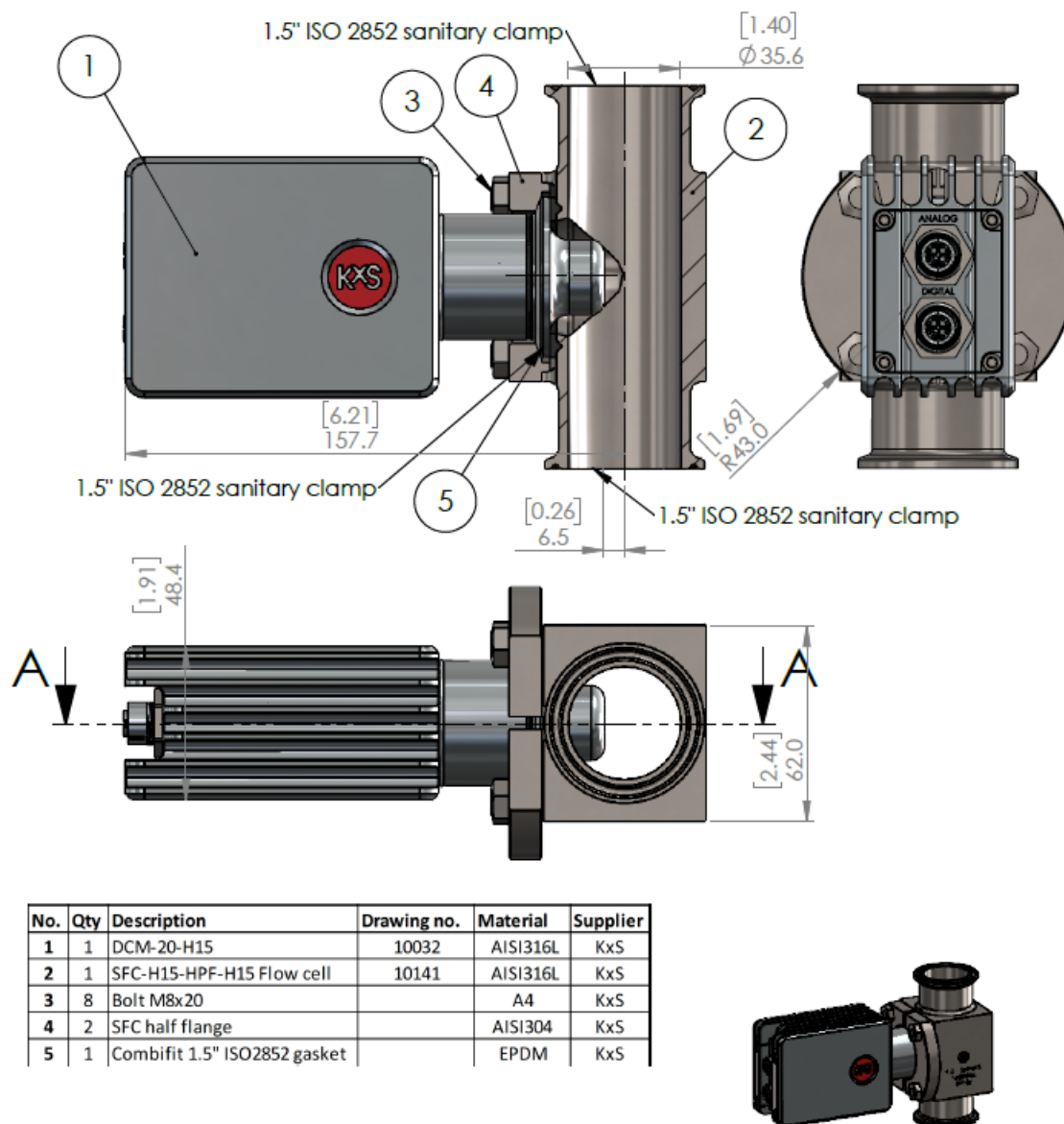


Figure 27 Sensor mounting in single-piece flow cell. DWG No. 10268.

Sensor installation is also available with 68 or 50 mm VARINLINE® coupling (see Fig. 28).



Figure 28 68 or 50 mm VARINLINE® connection.

For small pipeline sizes of 0.5" use pharma flow cell with mini-clamp (see Fig 29).



Figure 29 0.5" Pharma flow cell with mini clamp.

**⚠ IMPORTANT: Hygienic installations.** To secure proper self-drainage in hygienic single-piece horizontal installations with SFC flow cell, install sensor with inclination minimum of 2%. For SFC sizes of 1" ...1.5" install sensor in 30° inclination.

### 3.5 Long probe sensor installation

Long probe DCM-20 sensor models are typically installed in large process pipes and vessels using DIN, ANSI, JIS flange, Tank bottom flange, Sanitary Tri-clamp, or Ingold process connections.

The probe length and process connection shall be selected to suit the application, ensuring that the probe tip and prism are fully immersed to process liquid.

The long probe sensor with flange connection comes with

- Without wash nozzle connection
- With blind wash nozzle connection, allowing wash nozzle to be installed later if automatic prism washing becomes necessary.
- With integral wash nozzle

Fig 30 illustrates a flange-mounted long probe sensor with blind wash nozzle connection. Fig. 31 illustrates installation of a flange-mounted long probe sensor with wash nozzle.

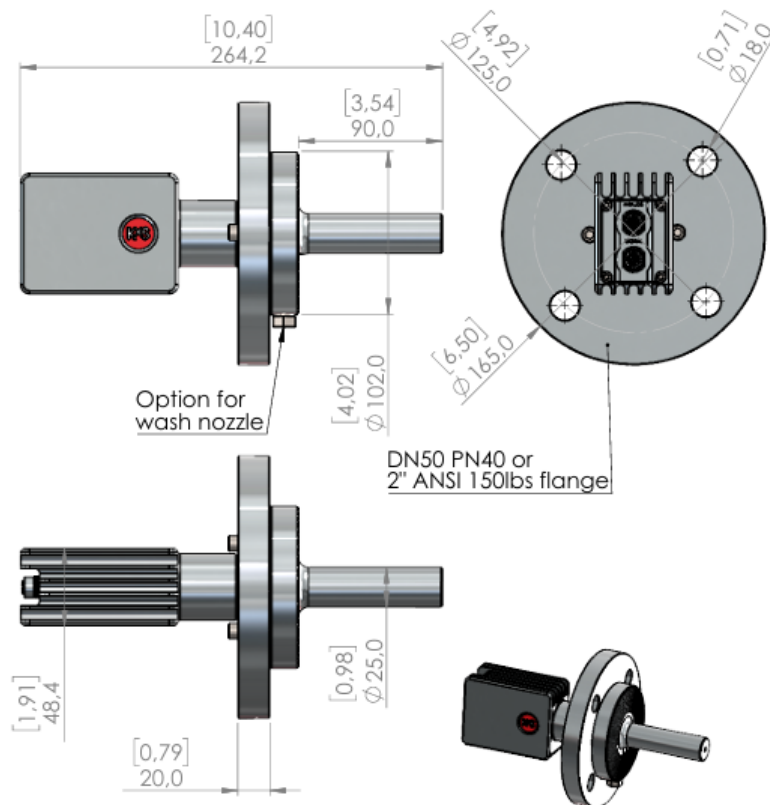


Figure 30 Long probe sensor with flange connection and blind wash nozzle connection. DWG No. 10657.

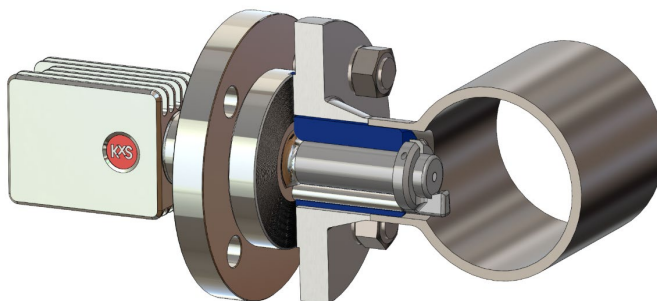


Figure 31 Installation of long probe sensor with flange connection and with wash nozzle.

### 3.5.1 Sensor installation in large pipes

For large pipe installation, refer also to Section 3.3 Pipe installation specifics. When installed via a flange, ensure that the sensor tip and prism extend fully into the process liquid and are continuously wetted during operation.

**⚠ IMPORTANT: Vibrating pipes.** Support the process piping where necessary to prevent excessive vibration from being transmitted to the sensor.

### 3.6 Vessel installation specifics

When the DCM-20 sensor is installed in a tank or vessel, correct mounting location and orientation are essential to ensure reliable measurement, proper cooling of sensor electronics, and long-term operational stability. The sensor shall be installed either on the side wall or at the bottom of the tank, in vertical or horizontal orientation, as illustrated in Figure 32.

- Install the sensor on the side or bottom of the tank (vertical or horizontal mounting orientation permitted)
- Ensure the sensor air-cooling fins are pointing upward (KxS logo in horizontal orientation)
- Install the sensor below the minimum liquid level, as low as practically possible

Correct installation ensures that the prism remains continuously wetted and that natural convection airflow supports sensor electronics cooling.

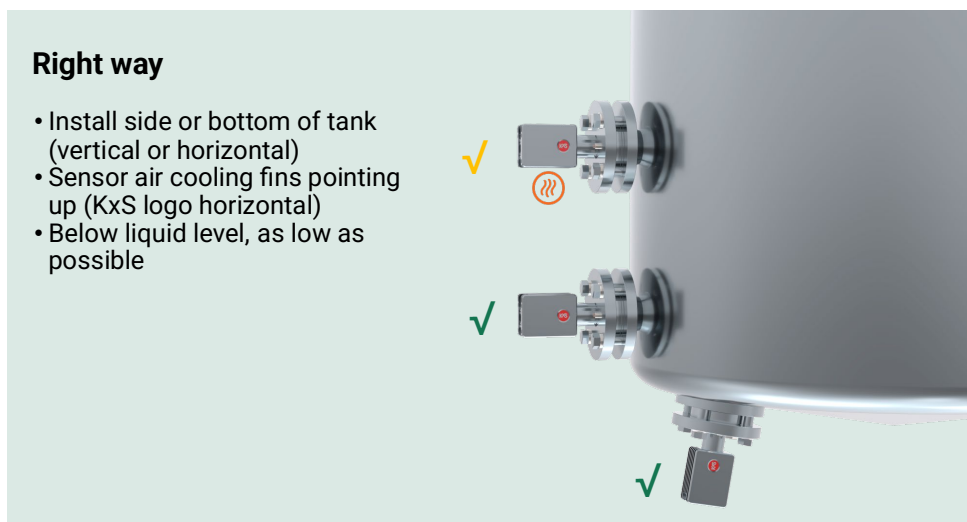


Figure 32 Sensor installation in tanks and vessels via flange connection.

#### 3.6.1 Sensor installation in bioreactors

In bioreactors, fermentation and other biological and biopharma tanks and vessels for maintaining stringent hygienic conditions, KxS Process refractometer with Ingold G1 ¼" 25mm (1") fitting can be used to install the refractometer directly in the standard Ingold port (Fig. 33).

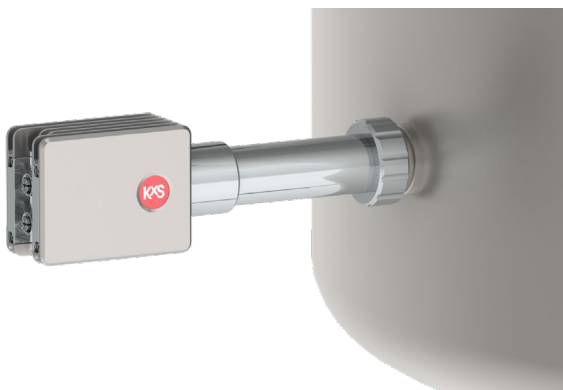


Figure 33 Refractometer sensor with 1" Ingold installed in bioreactor.

It uses a female threaded union nut (Fig. 34) on the holder to mate with a welding socket (Fig. 35) welded to the bioreactor, tank or vessel. The seal between the sensor holder and the socket is of high-quality EPDM O-ring on the holder body. The sensor insertion length is customizable.

The O-ring position for the holder should match the length of the socket. This creates a flush seal with the inner wall of the vessel and avoids any dead space where contamination might occur.

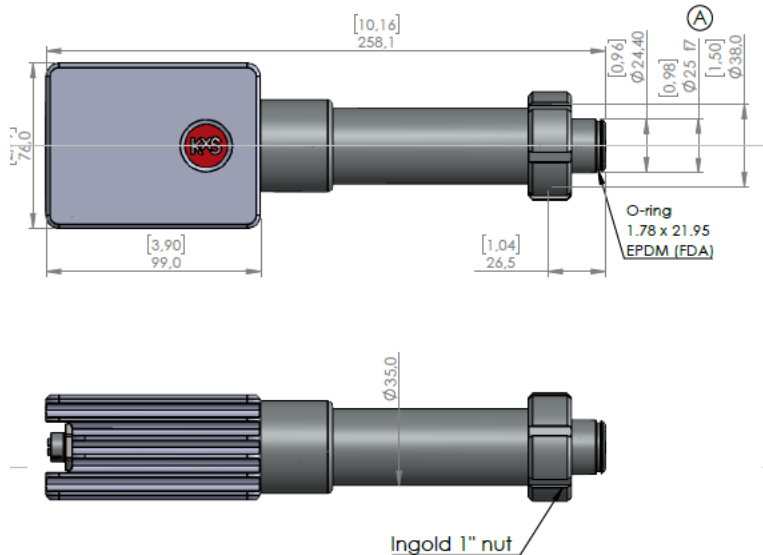


Figure 34 Sensor 1" Ingold connection for bioreactors.

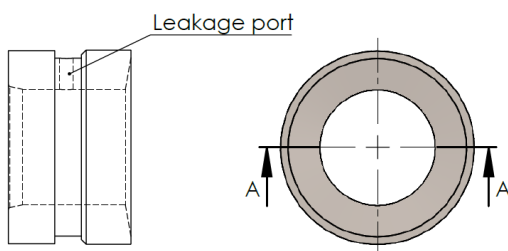


Figure 35 1" Ingold welding socket.

### 3.6.2 Sensor installation in cookers

For cooker applications such as jam, jelly, marmalade, and fruit preparations, the DCM-20 can be flush-mounted via APV tank bottom flange or inserted long probe sensor. The choice between them is determined by cooker design and mechanical constraints.

#### Installation in cookers with wall scrapers

If the cooker is equipped with wall scrapers, the flush-mounted APV tank bottom flange is the recommended and preferred solution (Fig. 36). The flush-mounted sensor is installed fully flush with the inner vessel wall, eliminating protrusions into the product space. The sensor body passes through the steam jacket, while the prism surface remains exposed to the circulating product. This configuration ensures: Mechanical safety, good hygienic design and reliable exposure to the liquid phase.

If the cooker uses both a mixer and wall scrapers, the flush-mounted option is recommended.

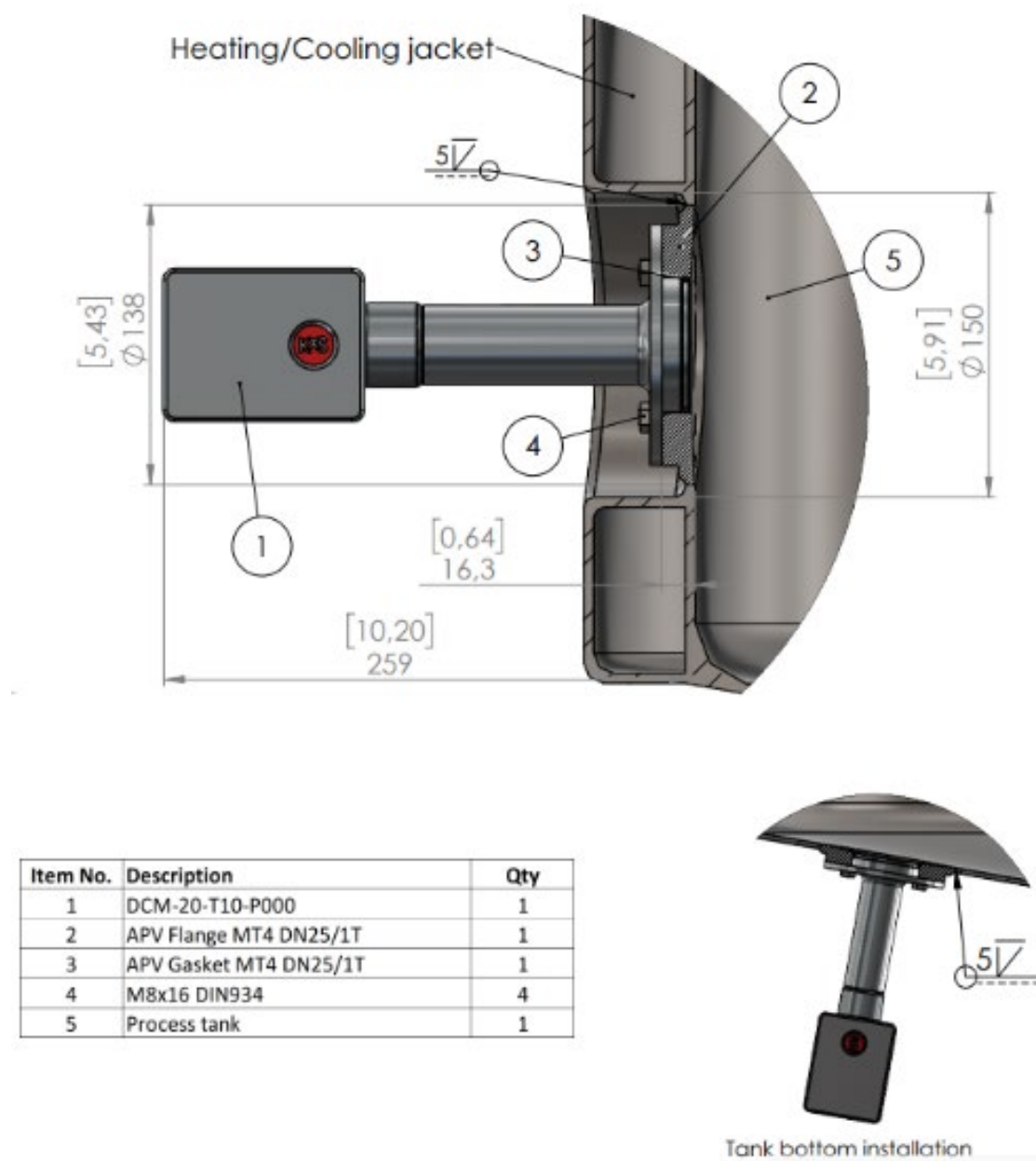
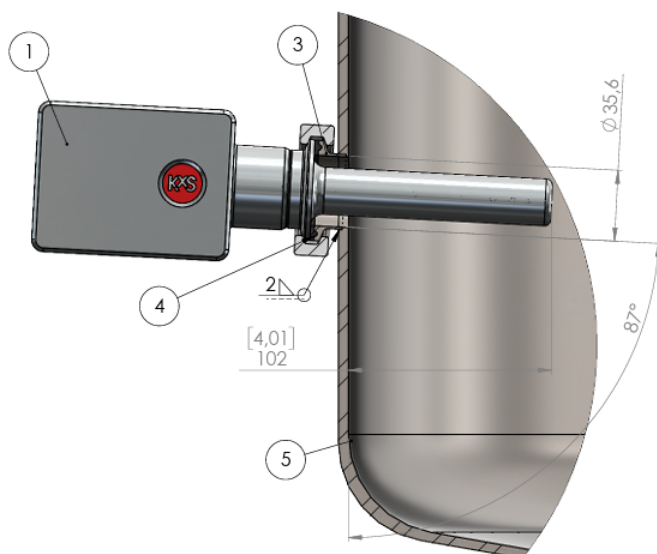


Figure 36 Sensor installation in vessel and cooker with heating/cooling jacket via APV Tank bottom flange. Drawing 10182.

## Installation in vessels and cookers with mixers

The inserted long probe can be used in cookers (Fig. 37):

- Without wall scrapers, or
- Where the mixer does not reach the vessel wall, and sufficient mechanical clearance can be ensured



| Part no | Description                | Qty | Drawing no. | Supplier |
|---------|----------------------------|-----|-------------|----------|
| 1       | DCM-20-H15-P120 sensor     | 1   | 10235       | KxS      |
| 2       | 1.5" Sanitary clamp        | 1   |             | KxS      |
| 3       | 1.5" Sanitary ferrule      | 1   |             | KxS      |
| 4       | 1.5" Sanitary gasket       | 1   |             | KxS      |
| 5       | Process tank/vessel/cooker | 1   |             | Customer |

(A)

Figure 37 Sensor installation in vessel, tank and cooker via Sanitary Tri-clamp. Drawing 10443.

### 3.6.3 Sensor installation in crystallizers and vacuum pans

For crystallizers and vacuum pan applications, it is recommended to use the DCM-20 long probe sensor with a flange connection and counter flange adapter. Typical installation locations are above the calandria, below the calandria, or in the bottom section of the vessel, as shown in Figure 38.

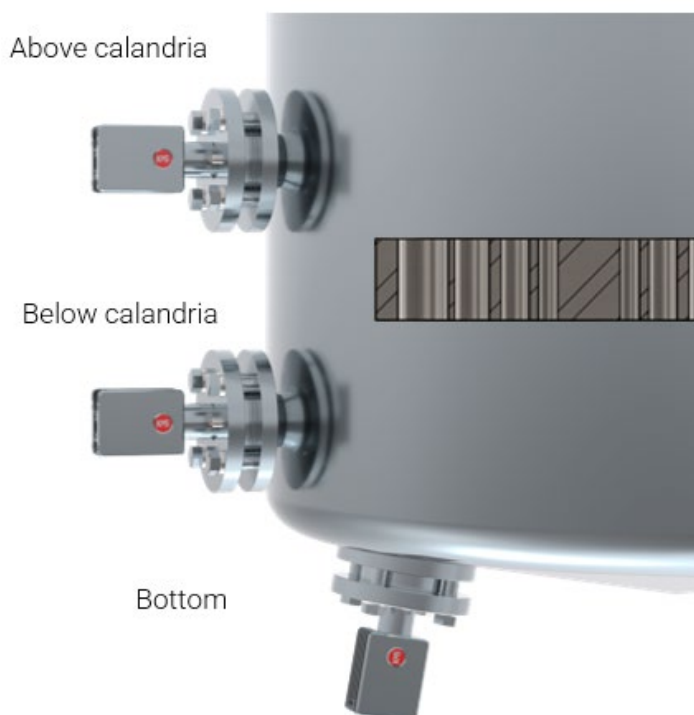


Figure 38 Recommended sensor installation locations in crystallizers and vacuum pans.

**⚠ IMPORTANT:** It is recommended to specify the flange-mounted sensor with a blind wash nozzle connection (see Figure 30) for all crystallizer applications. This allows an automatic prism wash nozzle to be installed later without replacing the sensor, should process conditions require it.

For low-purity boiling applications, where prism fouling is more likely to occur, installation of an automatic prism wash system is recommended (Figure 39).

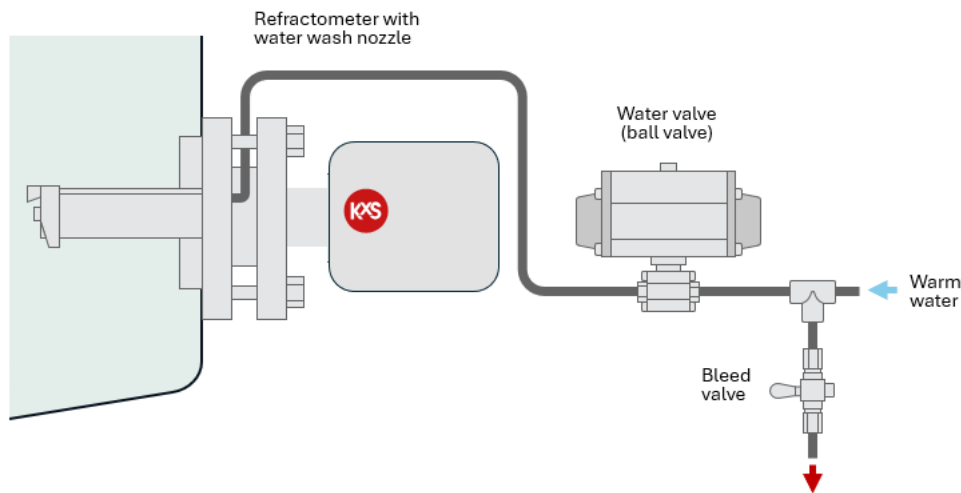


Figure 39 Prism wash installation in crystallizers and vacuum pans.

### 3.7 Wiring of Modular Connection Unit MCU

The wiring drawing (Fig 40) presents all standard modules for power supply, wiring, control, and optional converter modules.

Components listed from bottom to up: 60W power supply unit 110-240V in 24V out SP-9400, limit value switches with analog mA input and relay output SP-9700, wire connection unit for 100-240V input, analog signal wiring output unit, patch panel for digital communication 4 wire free-end connection SP-9330, wire connection unit for 24VDC input and output, industrial ethernet switch SP-9320.

Optional digital communication protocol converters SP-9860 (Profinet) and SP-9870 (Profibus) are available depending on required protocol conversion from Modbus TCP.

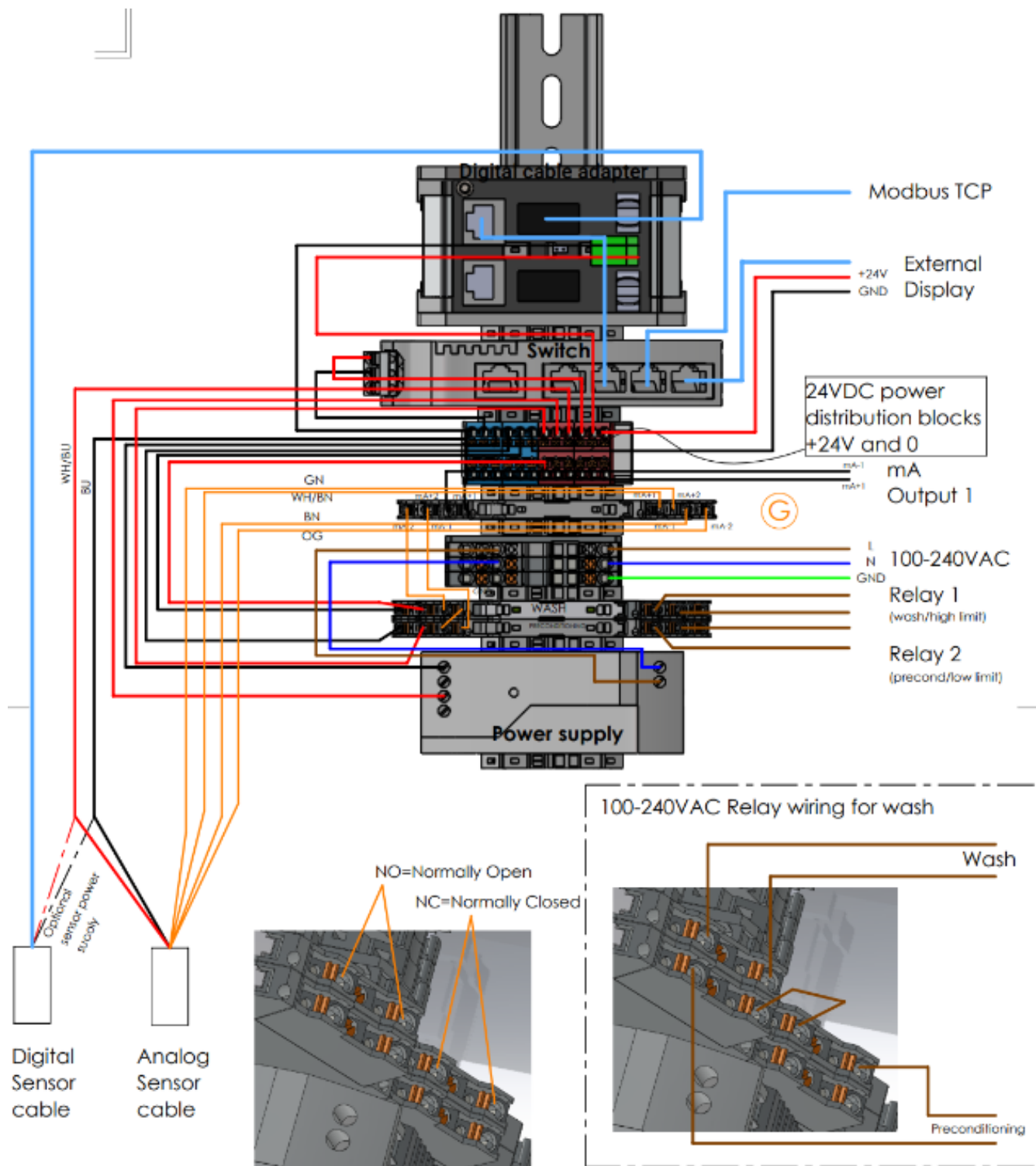


Figure 40 Wiring drawing of modules in MCU. DWG No. 10178.

## 4. Prism wash systems

### 4.1 Prism wash alternatives

Most DCM-20 refractometer applications rely on the natural self-cleaning effect of the process flow. When the sensor is installed at location with sufficient flow velocity, the process liquid continuously flows over the prism surface, preventing deposits from accumulating and maintaining reliable measurement without additional cleaning.

In some food, sugar, and chemical process applications, sticky or fouling components, impurities, or deposit-forming process conditions may cause deposits to accumulate on the prism. A typical indication of prism fouling is a gradual upward drift in the measured concentration value over time.

DCM-20 can be equipped with an automatic prism wash system or mechanical prism cleaning, depending on the application.

#### 4.1.1 Steam wash system

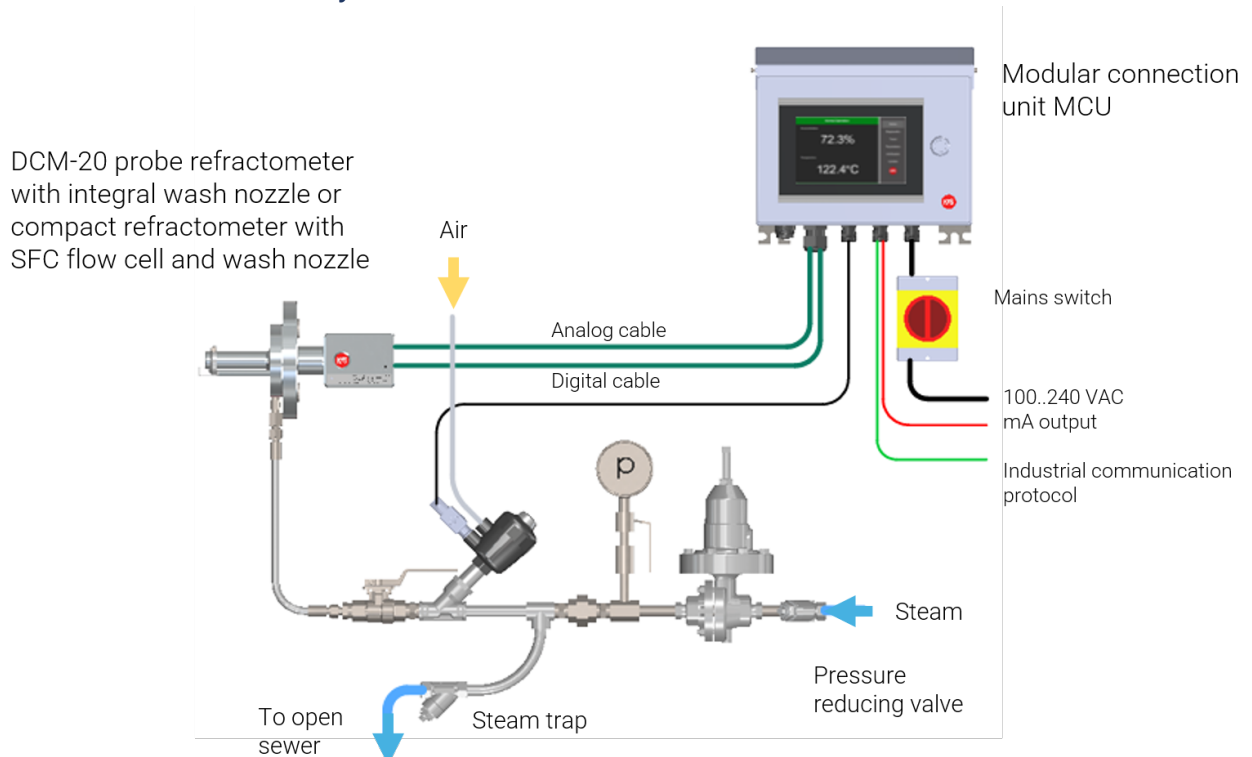


Figure 41 DCM-20 with steam wash system.

### 4.1.2 Sanitary steam wash system (culinary steam)

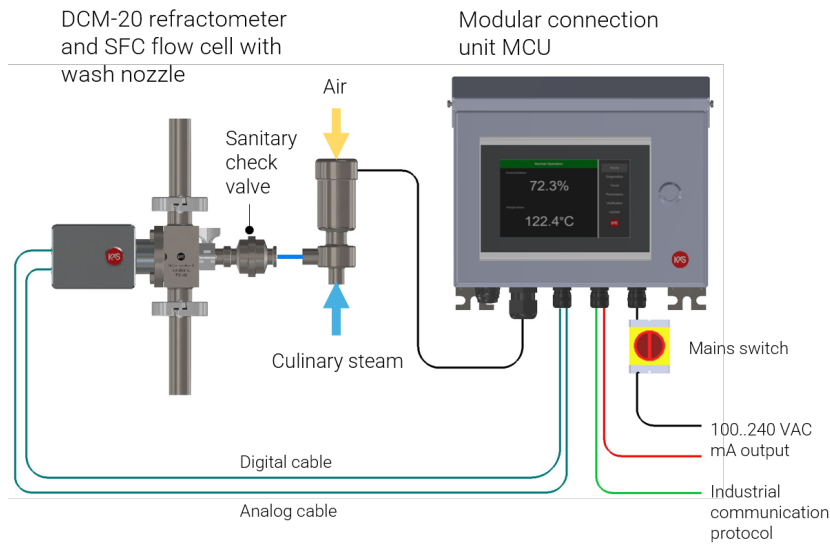


Figure 42 DCM-20 with sanitary steam wash system (culinary steam).

### 4.1.3 High pressure water wash system

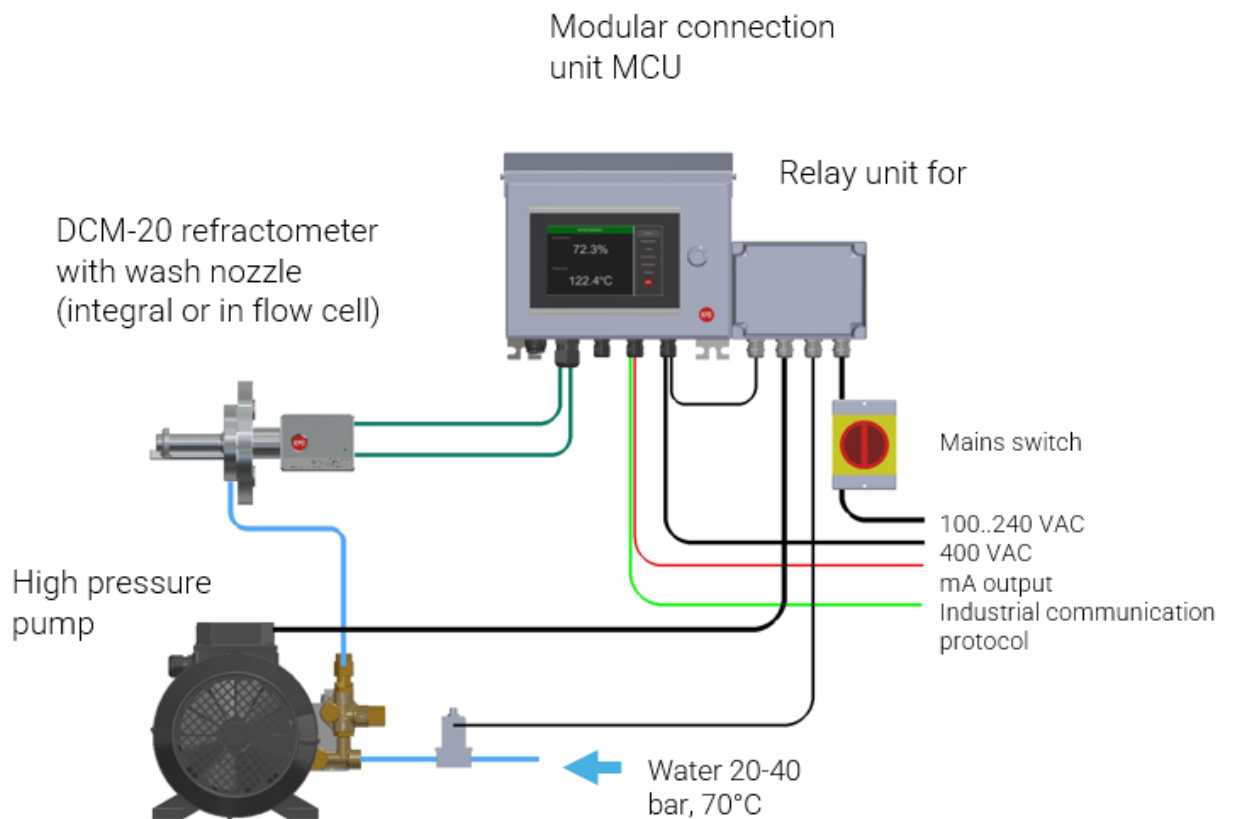


Figure 43 DCM-20 with high pressure water system.

## 4.2 Recommended wash settings

The recommended wash settings and times are given in Fig. 44.

**Note:** Excessively frequent washing or unnecessarily high wash pressure may shorten the service life of the prism. Use the minimum wash settings required to maintain a clean prism surface.

| Wash system parameters setting in DCM-20 |                                             |                          |           |               |               |
|------------------------------------------|---------------------------------------------|--------------------------|-----------|---------------|---------------|
|                                          | Maximum above process                       | Maximum total pressure   | Wash time | Recovery time | Wash interval |
| <b>High pressure water</b>               | 30 bar (435 psig) above process pressure    | 70 bar (1,015 psig)      | 10 sec    | 20-30 sec     | 10-20 min     |
| <b>Steam</b>                             | 4-5 bar (58-73 psig) above process pressure | 12-15 bar (174-218 psig) | 3 sec     | 20-30 sec     | 20-30 min     |

Figure 44 Wash medium pressure and time settings.

## 4.3 Prism wash nozzle mounting

For compact sensor installations using the Single-piece Flow Cell (SFC), an integrated prism wash nozzle is available for automatic prism cleaning. The SFC is available for process pipe sizes of 1", 1.5", 2", 2.5", 3", 4" and 6", and dedicated wash nozzle models are available for steam or high-pressure water applications.

The wash nozzle is mounted to the SFC flow cell through a sanitary mini-clamp connection located opposite the sensor (Figure 45).

The wash nozzle can be removed by opening the sanitary mini-clamp and withdrawing the nozzle from the SFC flow cell. The sensor itself can be removed independently by releasing the 1.5" sanitary Tri-Clamp connection.

When a wash nozzle is not installed, a blind nozzle insert (SP-10161) shall be fitted to close the nozzle connection (Figure 46).

**Note:** Both the wash nozzle and the blind nozzle insert comply with 3-A Sanitary Standard 46-04. EHEDG-certified installations are available only when the SFC flow cell is installed without a nozzle connection.

The wash medium needs to be specified with either steam or high-pressure water to determine the wash nozzle model. The wash nozzle is connected to the single-piece flow cell SFC through a sanitary mini clamp connection on the opposite side of the sensor (see Fig. 45).

For **long probe sensor models**, an **integral wash nozzle** is available for applications requiring automatic prism cleaning (Figure 47).

See Fig 31 for installation of long probe sensor in pipe with flange connection and integral wash nozzle.



Figure 45 Sensor installation in pipe with flange connection and integral wash nozzle. DWG No. 10522.

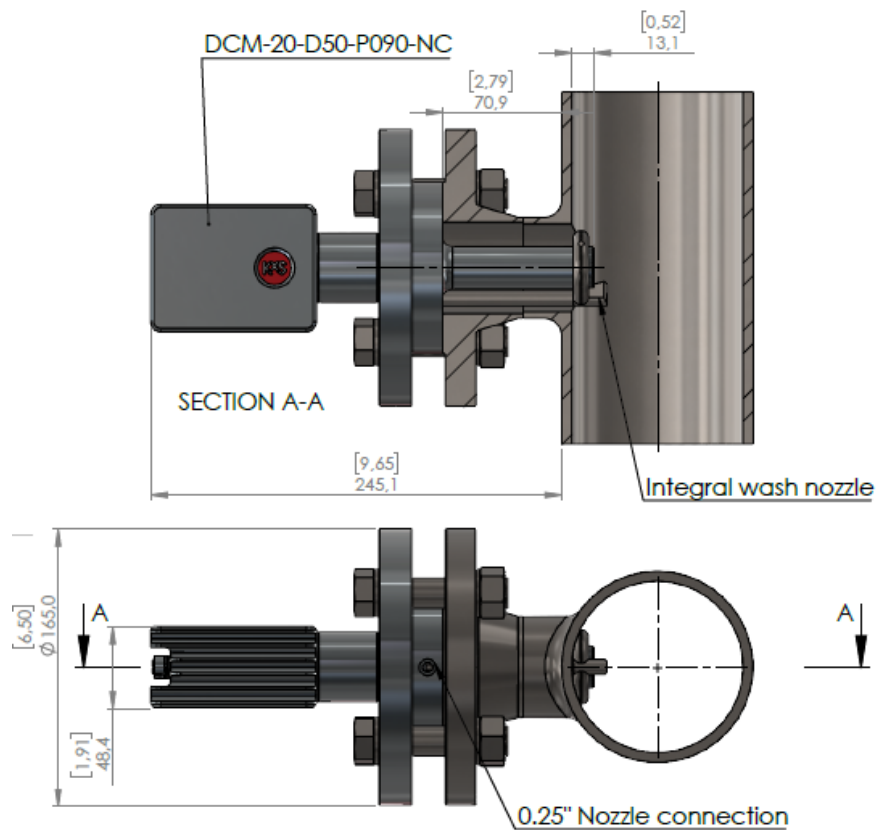


Figure 46 Sensor installation in pipe with flange connection and integral wash nozzle. DWG No. 10522.

#### 4.4 Modular Connection Unit for Wash Systems

The Prism wash is functional through one of the sensor analog 4-20mA outputs. The sensor mA wiring is connected to a Modular Connection Unit MCU for Wash Systems. The unit consists of two analog limit value switches SP-9700 and 24VDC power supply SP-9400 in a rail mounted stainless steel

enclosure assembly SP-8000 with IP66, NEMA 4X category. The wiring drawing presented in section 2.4 Fig.17 with all components included in the SP-8000 modular connection unit.

The limit value switches SP-9700 are configured with physical DIP switches to close or open the relay per user selection while the sensor wash function is active. The chosen DIP switch schedule with corresponding sensor analog mA output for precondition and wash activation is as follows:

**Precondition:** Module 1 DIP switches **5, 6, 0** activated 'ON' (4.8mA).

**Wash:** Module 2 DIP switches **3, 7, 0** activated 'ON' (6.8mA).

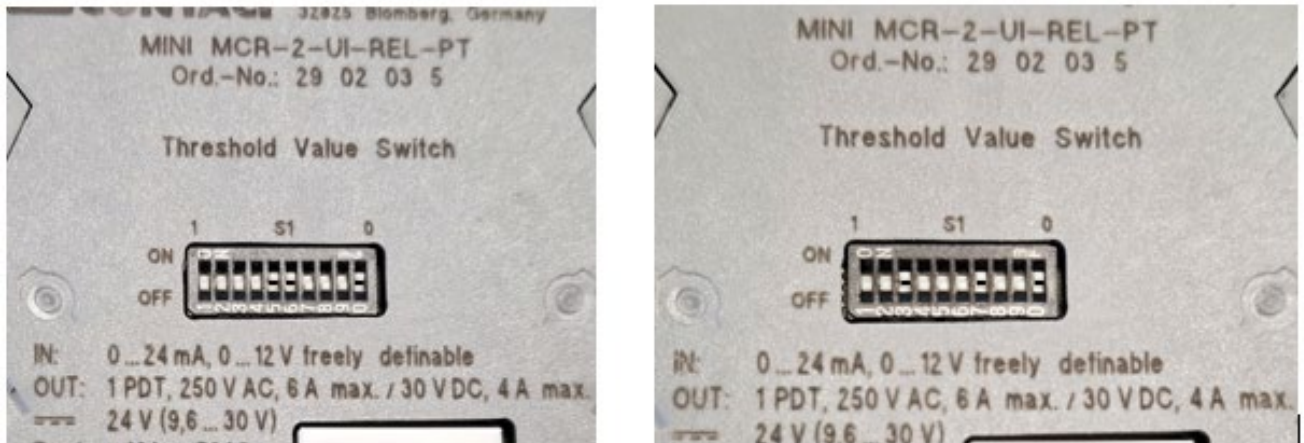


Figure 47 DIP switch configuration



Figure 48 Limit value switch with changeover relay output for monitoring analog limit values from the sensor output. The sensor wash is activated at a mA value that corresponds to the limit value switch schedule with DIP switches activated. The relay closes or opens per user selection.

## 4.5 Mechanical washer for SFC Flow cell

The DCM-20 can be equipped with a manual mechanical prism washer for applications where prism fouling occurs and cleaning with steam or high-pressure water is not suitable or available. This is a non-hygienic cleaning option designed for use with the Single-piece Flow Cell (SFC).

The mechanical washer is installed on the opposite side of the SFC flow cell from the refractometer sensor (see Fig. 50). It allows the sensor prism to be cleaned mechanically without removing the sensor from the process.

Note: The PTFE cleaning tip is designed to clean the prism without damaging its optical surface during normal operation. Inspect the cleaning tip periodically for wear and replace it when necessary.

**Note:** The required cleaning frequency depends on the application and the degree of prism fouling. **Monitor the sensor's Qual-number trend and measurement stability** to determine when mechanical cleaning is necessary.

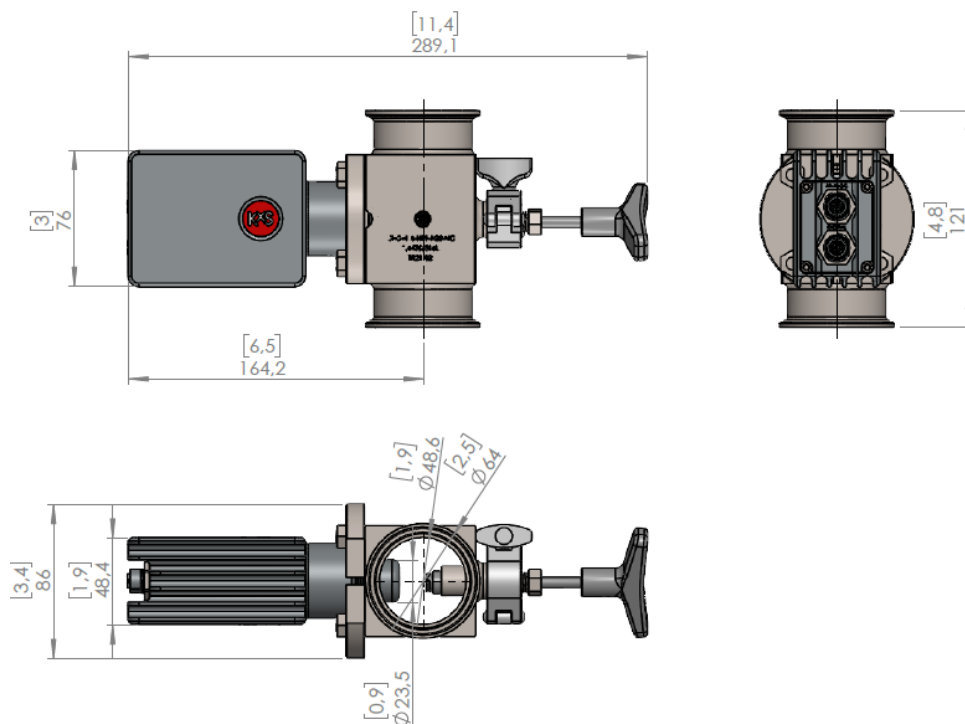


Figure 49 Mechanical washer installed in SFC-H15-HPF-H20-NC flow cell. Drawing 11016.

The washer consists of a stainless-steel assembly with a PTFE cleaning tip, an EPDM O-ring, and a manually operated handle (Fig. 51).

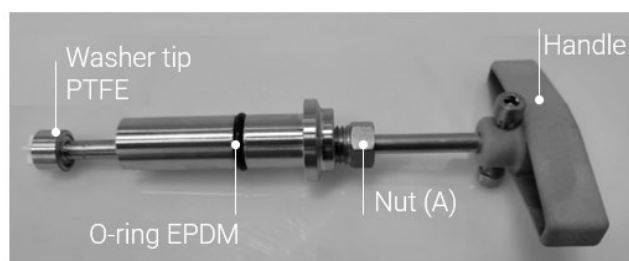


Figure 50 Mechanical washer components.

During cleaning, the PTFE tip is pressed gently against the sensor prism and rotated back and forth to remove fouling (Fig 52).

1. Gently push the washer handle towards the sensor until the PTFE cleaning tip contacts the prism.
2. While maintaining gentle contact, rotate the handle a few turns back and forth to clean the prism surface.
3. Pull the handle back to its original position after cleaning.

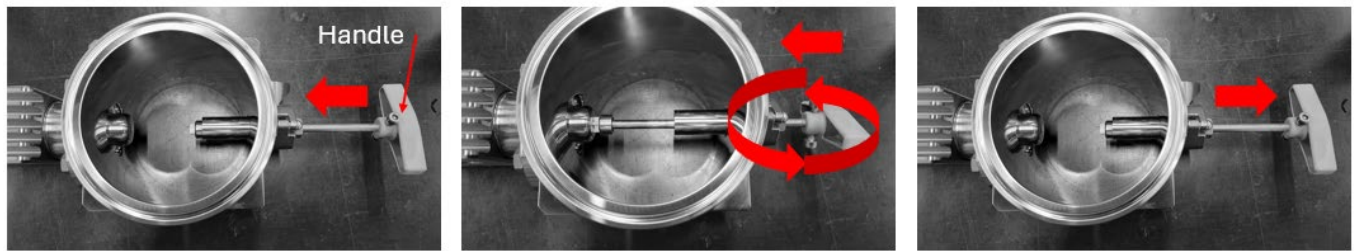


*Figure 51 Mechanical washer operating: push, rotate, and retract.*

## 5. Calibration and configuration

The inline optical Brix monitor DCM-20 is factory calibrated for refractive index units RIU according to NIST traceable procedures.

The DCM-20 is pre-calibrated for Brix according to ICUMSA references. The refractive index unit RIU and Temperature are used to convert the measurement to Brix. The factory Brix calibration is automatically temperature compensated.

Configuration and calibration parameter changes are defined in the user interface on a web browser on a computer, external display, or mobile device. Access to the user interfaces is described in section 1.5 *User Interface*.

### 5.1 User interface homepage

The homepage displays real time Brix concentration measurement values, process temperature, and sensor serial number. In addition, the sensor status is visible: *Normal Operation* when liquid is in contact with the Prism, *No Sample* when process pipe empty or no liquid on the Prism *Optical Window Wash* when the wash system is active as user defined.

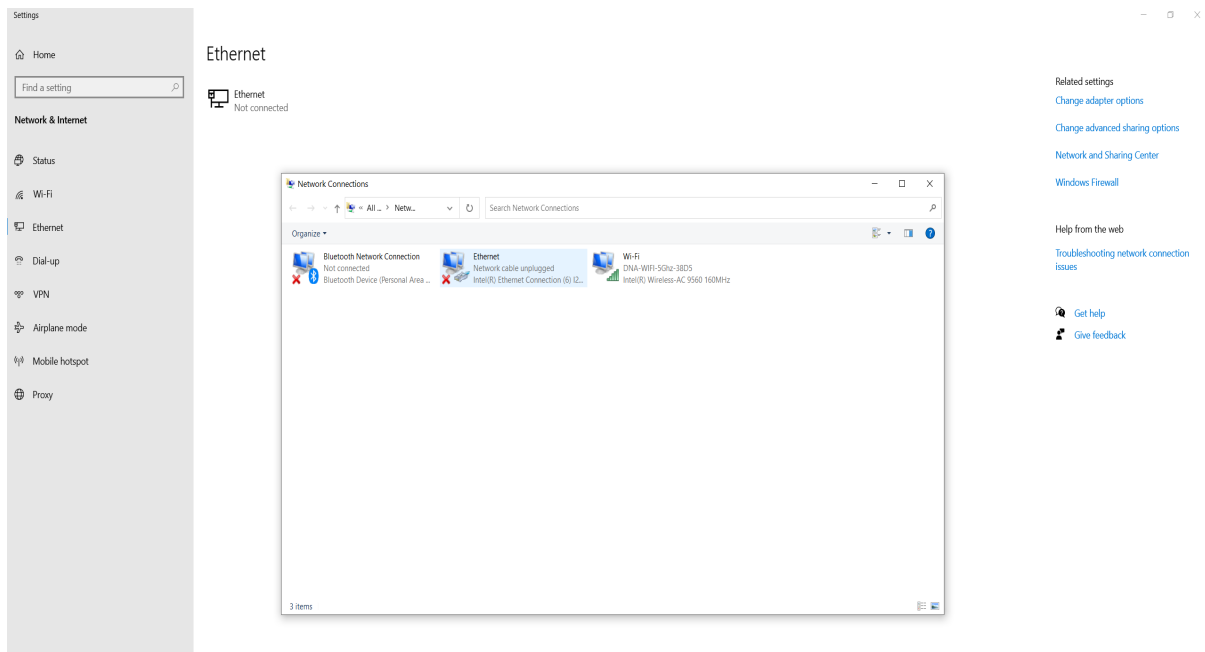


Figure 52 User interface homepage with real-time measurement values.

## 5.2 Diagnostics

The optical image, measurements, and sensor internal diagnostics are useful in analyzing the sensor performance and application functionality. During process troubleshooting the optical image is a key indicator of measurement quality.

The 'Field sample' button activates sampling of 10 measurement data points and calculates an average for display.

Prism wash activates Prism wash if one of the mA outputs have been configured for 'Wash' in section Parameters/Outputs

'Slope image' displays the slope of the optical image border line.

History reset resets the lowest and highest measurement values during the DCM sensor power session.

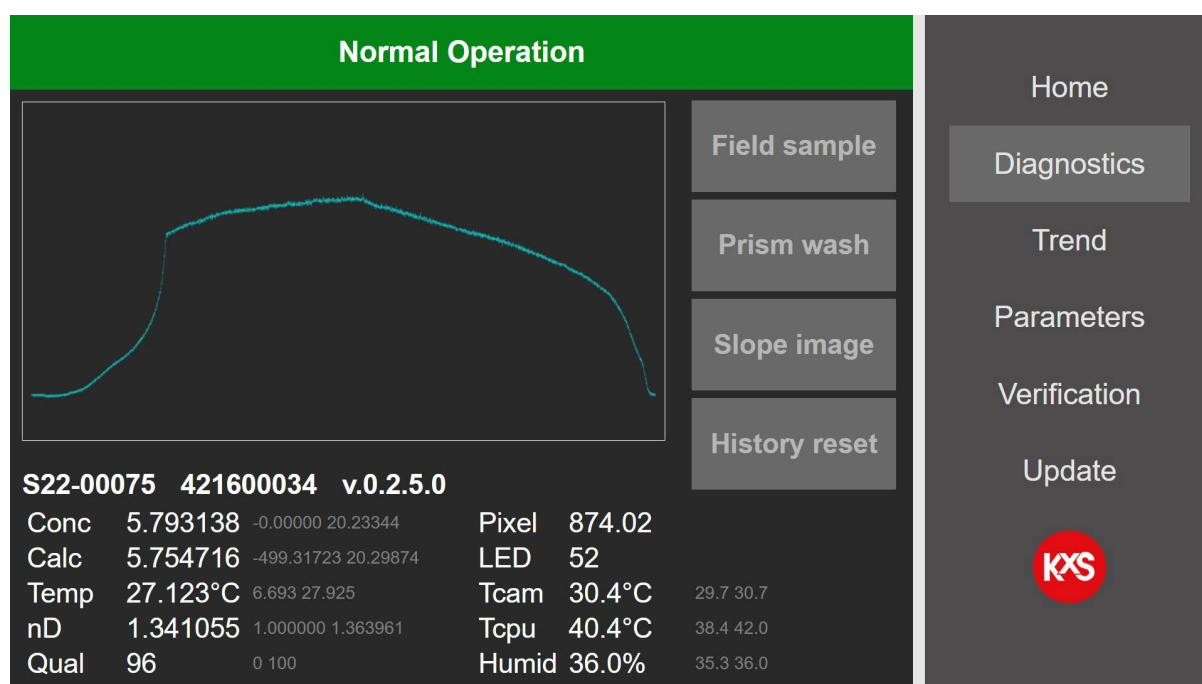


Figure 53 Diagnostics with optical image, measurements, and sensor internal diagnostics.

## 5.3 Trend plots

Realtime trends of user selected two measurement values (e.g., concentration and temperature) are available in page *Trend*. DCM-20 internal memory logs and stores 6000 measurement data points that can be saved in a txt file format. The storage interval is user selectable in the *Trend menu* to 1, 10 or 60 seconds. When the memory is full the log continues active while old measurement points are overwritten. The txt file is written to a folder on a computer when pressing *Save trend* in the *Trend menu*. The txt file is written to the selected folder according to computer settings. For example on a PC in folder *This PC/Downloads*.

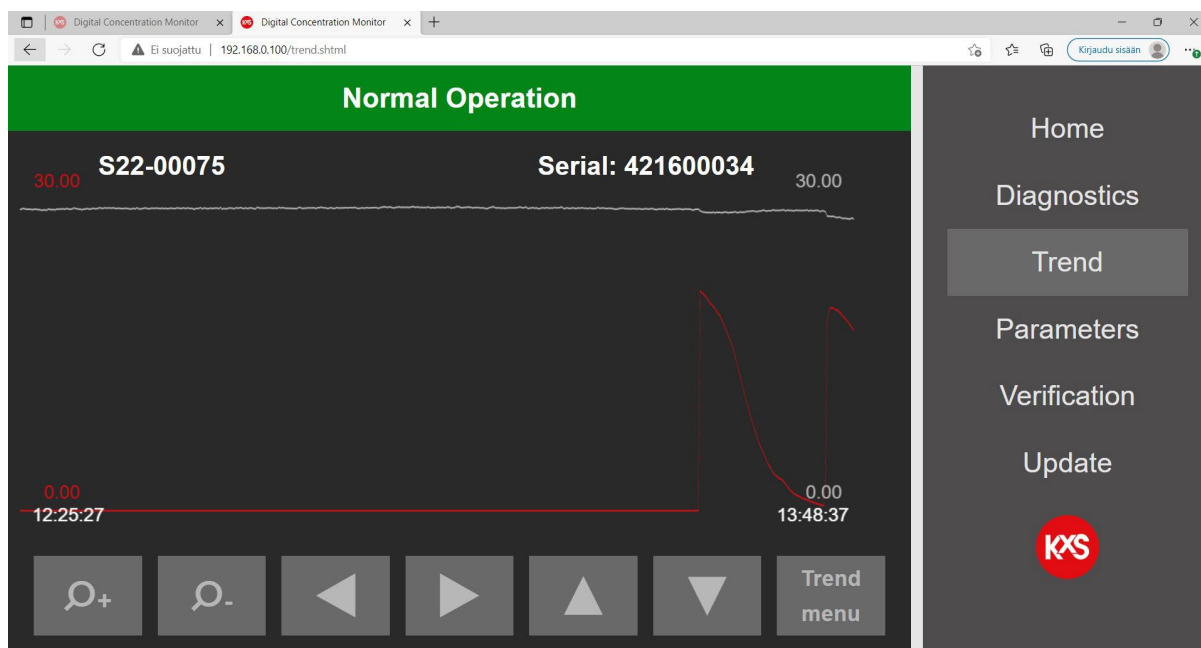


Figure 54 Continuous measurement trend.

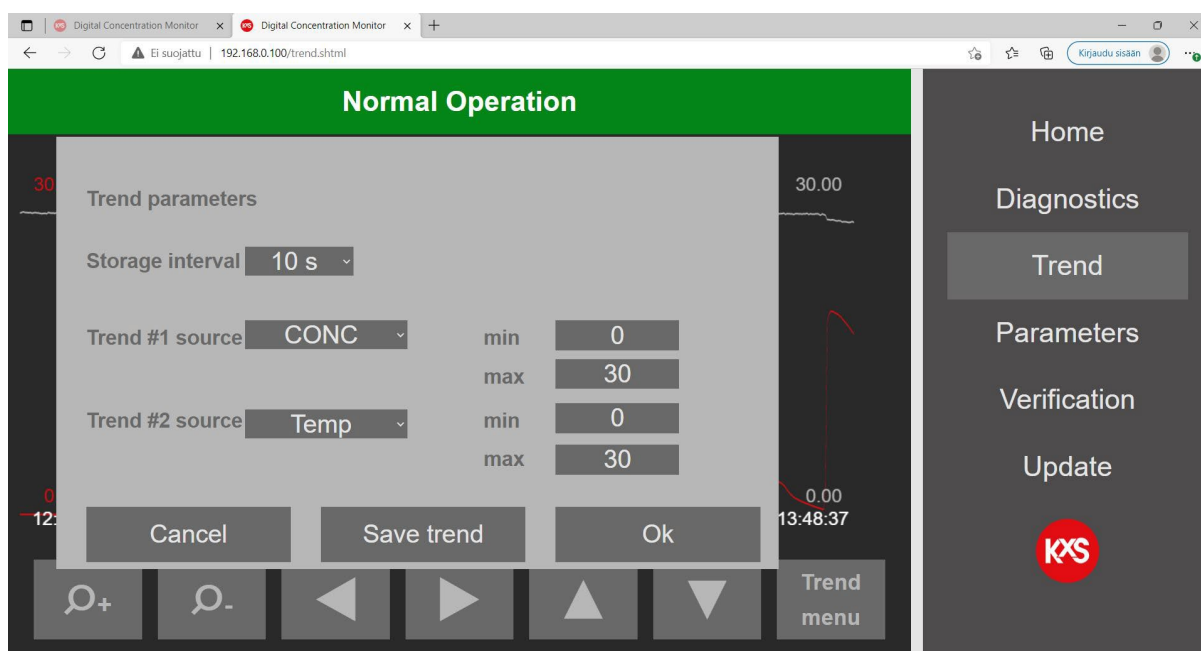


Figure 55 User selectable trend functions

## 5.4 Parameters configuration

### 5.4.1 User interface password

Operating and changing DCM settings and parameters is password protected. The password Login is found in the user interface section Parameters/Special. Please consult KxS Technologies or its authorized local partner for the default password.

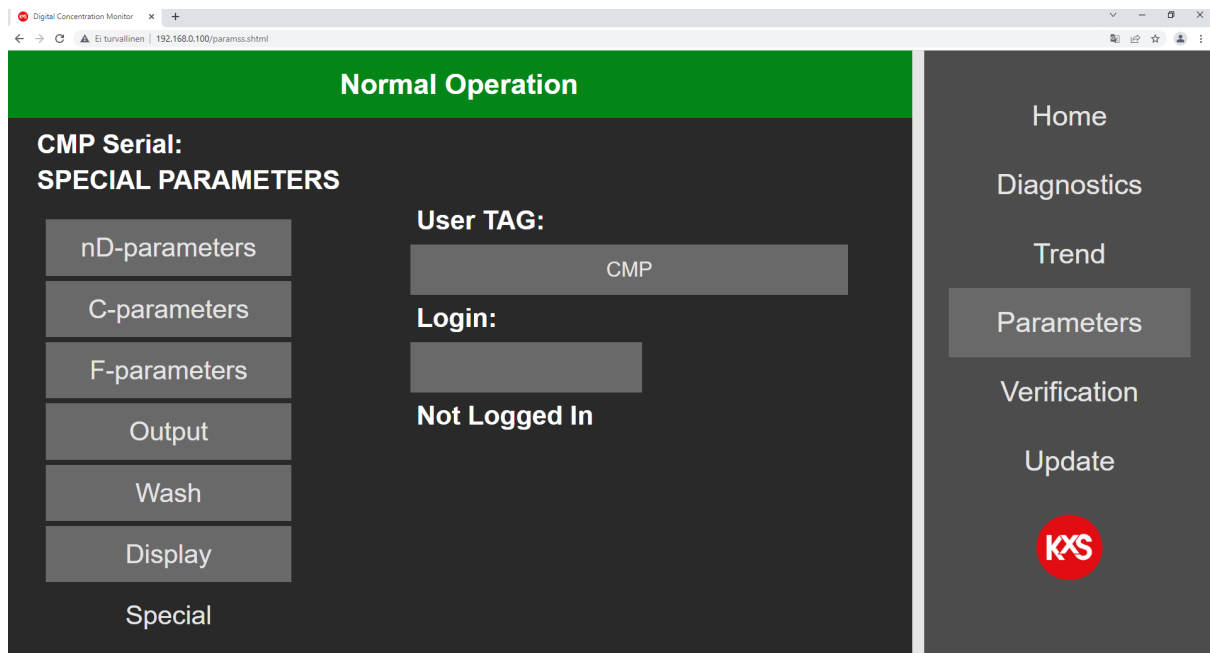


Figure 56 DCM Login with password

After the Login is activated, settings and parameters in the user interface can be changed. A user selected password can be configured.

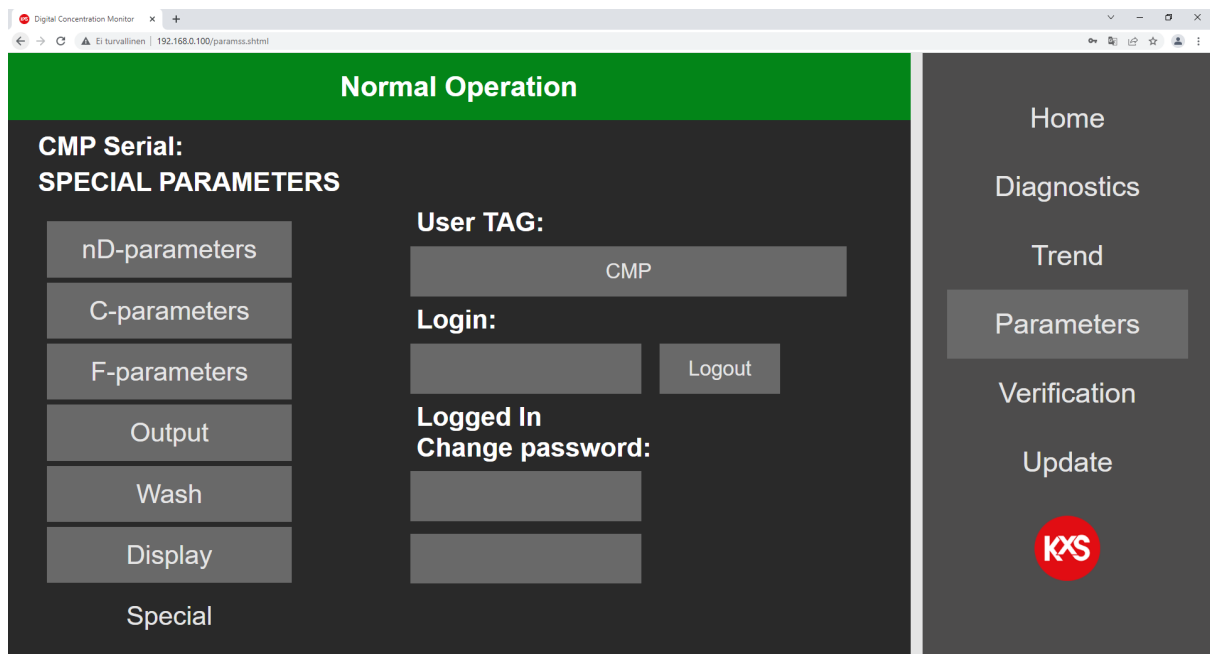


Figure 57 User selectable password

#### 5.4.2 Calibration parameters

In the user interface the mA configuration is found on page *Parameters* and *Output*. The mA-output is user configurable for Brix, Temp, diagnostics, and Wash (of Prism). The range of chosen measurement value is user configurable to correspond the analog 4-20mA range.

The sensor calibration is configured in three layers. Each layer is described by a second degree 3x3 matrix for both concentration and temperature dependency.

The factory camera pixel to refractive index unit RIU calibration is defined in page nD-parameters. The factory set a-parameters are sensor individual and must not be altered unless a sensor RIU calibration is performed.

The Chemical calibration RI to Brix/Conc% is set in page C-parameters. The 3x3 matrix describes the non-linear relationship of CONC vs RIU/Temp.

**Normal Operation**

**CMP-Slurry Serial:  
C PARAMETERS**

|               |                     |                     |                     |
|---------------|---------------------|---------------------|---------------------|
| nD-parameters | C00<br>1.000000E+00 | C01<br>0.000000E+00 | C02<br>0.000000E+00 |
| C-parameters  | C10<br>1.000000E+00 | C11<br>0.000000E+00 | C12<br>0.000000E+00 |
| F-parameters  | C20<br>0.000000E+00 | C21<br>0.000000E+00 | C22<br>0.000000E+00 |
| Output        | C30<br>0.000000E+00 | W0<br>1.000000E+00  | W1<br>0.000000E+00  |
| Wash          | W2<br>0.000000E+00  | W3<br>0.000000E+00  | Save                |
| Display       |                     |                     |                     |
| Special       |                     |                     |                     |

Home  
Diagnostics  
Trend  
Parameters  
Verification  
Update  
KXS

Figure 58 Sensor calibration parameter settings.

The parameter values C00-C30 are dialed by pressing respective cell. In the active cell a new parameter value is entered and confirmed by pressing Save.

Note! For Brix measurements the c-values are factory set and need no change. In the event the output Brix reading needs a field adjustment vs. reference measurement (laboratory), the sensor measurement is adjusted in page F-parameters with a bias adjustment. The Field adjustment matrix is defined in the F-parameters matrix.

## 5.5 Instrument verification: Confirming ongoing performance

DCM-20 refractometer does not require regular calibration due the optical refractive index measurement principle. However, periodic instrument verification is commonly required by quality management systems to ensure continued measurement accuracy and compliance with applicable quality standards.

The DCM-20 includes a built-in verification procedure, accessible through the sensor user interface. Instrument verification confirms that the refractometer remains within its specified accuracy limits and continues to perform reliably without requiring calibration adjustments.

The verification procedure provides documented evidence of measurement performance and supports ongoing compliance with internal quality requirements and applicable industry standards.

### 5.5.1 R.I. verification: Setting up the system

- Utility requirement: To be performed in a clean and dry environment under ambient room

temperature (20-25°C). Use Sample holder SP-10147, and RI verification liquid set SP-10147 (Cargille Laboratories, U.S.A. for R.I. 1.3300, 1.3700, 1.4200, 1.4700 and 1.5200)

- Check the R.I. liquids shelf life on each liquid bottle. Shelf life is given for an un-opened bottle, stored at room temperature and shielded from light. Once opened, the shelf life of liquids is half the remaining time.

- Place DCM-20 sensor onto Table stand for DCM-20 (SP-10158) and R.I. liquids (bottles closed) on table and let them settle 30-60 minutes to ambient temperature.

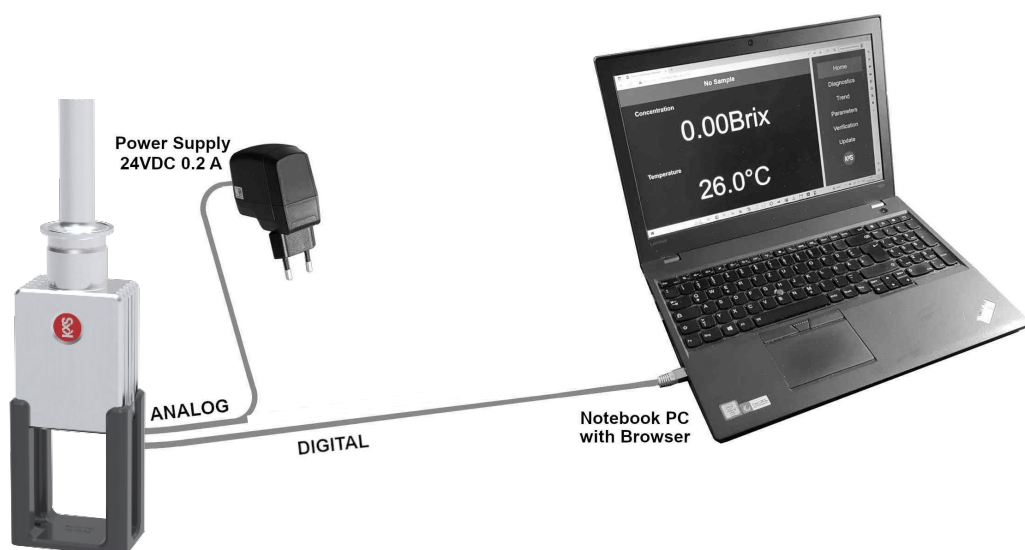


- Connect the M12-to-RJ45 Ethernet data cable to the sensor's M12 socket labeled "DIGITAL" for digital communication.

- *Only if 4–20 mA analog output is used:* Connect the M12-to-4–20 mA analog cable to the M12 socket labeled "ANALOG".

- Connect the 24 VDC power supply:

- Plug the low-voltage connector into the sensor's power input.
- Connect the power supply to the main power source.



- Confirm that the amber indicator light inside the prism is illuminated, confirming that the sensor is powered and active.

- For analog signal verification (if applicable):

- Connect the 4–20 mA output leads to a standard multimeter.
  - Black lead to the "COM" port
  - Red lead to the "mA" port
- Set the multimeter to "mA DC" mode to monitor the current output.

- Clean the sample holder using isopropyl alcohol (IPA) or suitable laboratory-grade ethanol. Dry the holder with a clean, lint-free paper tissue.

- Ensure that the gasket is clean, dry, and free of any residue.

- Check that the prism (area in the figure below) is clean and shiny, and free of streaks and contamination, and it displays a clear reflection without rainbow patterns/color (which may indicate a film or residue).



- Test status is "PASS" if no deposits or scratches are found.

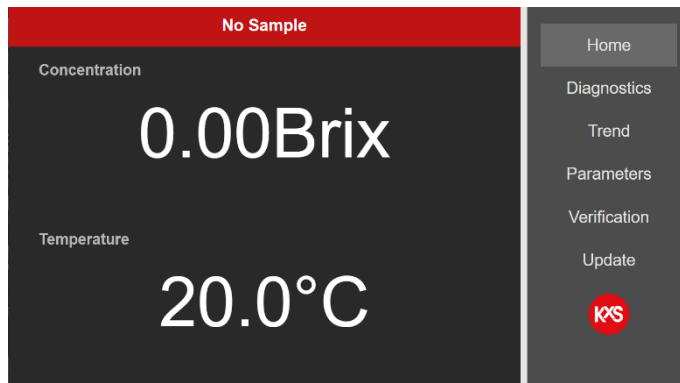
- Place the sample holder onto the DCM-20 sensor prism, ensuring proper alignment and full contact.



- Establish communication with sensor:

1. Connect the RJ45 Ethernet cable from the DCM-20 sensor to the PC.
2. Open a web browser on the PC.
3. Enter the sensor's IP address into the browser's address bar. The default IP address is printed on the serial number label of the sensor.
4. Ensure that the PC is on the same subnet as the sensor:
  - The first three segments of the IP address (e.g., 192.168.0.xxx) must match between the PC and the sensor for successful communication.

- You are now on the "Home" page of the instrument

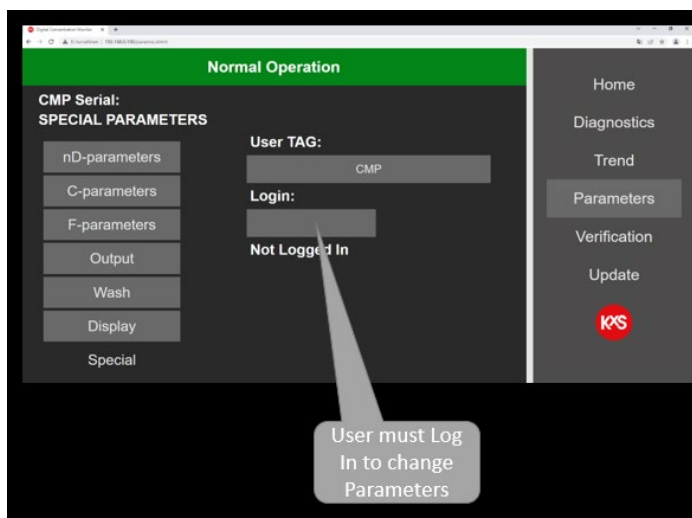


In case you encounter problems while establishing communication between PC and sensor, please refer to "PC/Computer setup" of the KxS DCM-20 User's Manual.

### 5.5.2 R.I. verification: User interface password protection

All parameters stored within the DCM-20 are password-protected and cannot be modified by the user without proper authorization. The user must log in to change the parameters. After the Login is activated, configuration and parameters in the user interface can be changed and a user selected password can be set.

**Note:** The factory default password is "KxSPass" allowing for a 5 minute session, and it is recommended to be changed upon IQ to maintain security and prevent unauthorized access.

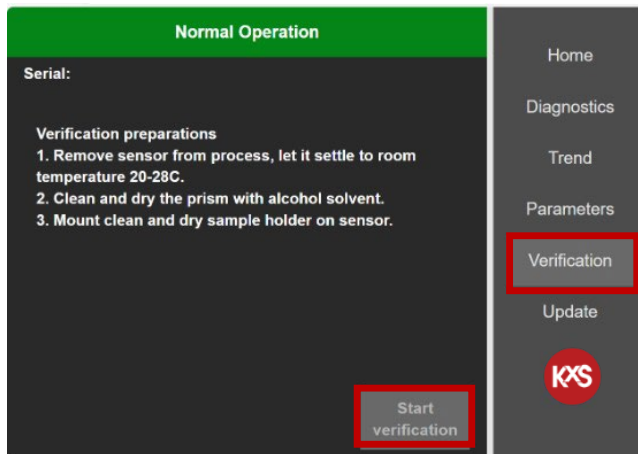


It is recommended that the system administrator updates the password in accordance with the site's data security policies and relevant regulatory requirements.

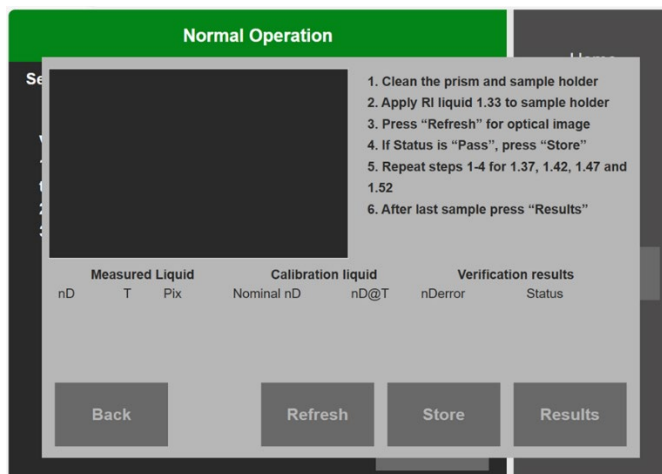
For instructions on configuring a new password, refer also to "User interface password" in the DCM-20 User Manual.

### 5.5.3 R.I. verification: Performing the verification procedure

- Go to the "Verification menu"



- Press "Start verification"
- Follow the menu guided instructions.



- Apply RI liquid 1.33 to the sample holder
  - Apply 3–5 drops of the liquid onto the measurement area.
  - The optimal liquid level is when the fluid just reaches the top of the O-ring.
  - Avoid touching the sample holder with R.I. liquid dropper to prevent contamination.
- Press "Refresh" for optical image
- If status is PASS, press "Store"
- Repeat steps 1-4 for 1.37, 1.42, 1.47 and 1.52
- After last sample press "Results"
- Verification results can be stored by pressing "Store"
- If any verification liquid results in "Fail", repeat for that specific RI liquid to ensure correct measurement and application.
- Export the verification results by one of the following methods:
  - Save the verification as a .txt file
  - Take a photo of the screen
  - Record the result in a text file for documentation and audit purposes

- Clean the sensor before returning it to the process line.
- Ensure that all RI liquid bottles are closed tightly and stored according to recommendations.

## 5.6 Output configuration and analog signal settings

The mA output function is found in the user interface section *Parameters/Output* . Two independent mA ports are available for user configuration. In the drop-down menu the selectable output functions are Concentration, Temperature, Quality of optical image, refractive index unit nD, diagnostics, automatic Wash functions of the Prism, and measurement low/high limit alarms.

The minimum and maximum measurement values are user selectable to correspond with the 4-20mA range. The selection is activated by pressing *Set*. The mA alarm limits are set in *Extras*.

The final CONC (concentration) output signal can be filter with a moving average function in *Damping*. The user selectable damping function is 0-30 sensor measurement points. In fast changing chemical process sequences the recommendation is to keep the Damping moderate 0-10 while in slow changing process a Damping 20-30 will smooth out the CONC measurement noise.

The existing sensor IP address is found in the lower right corner of the *Output* page.

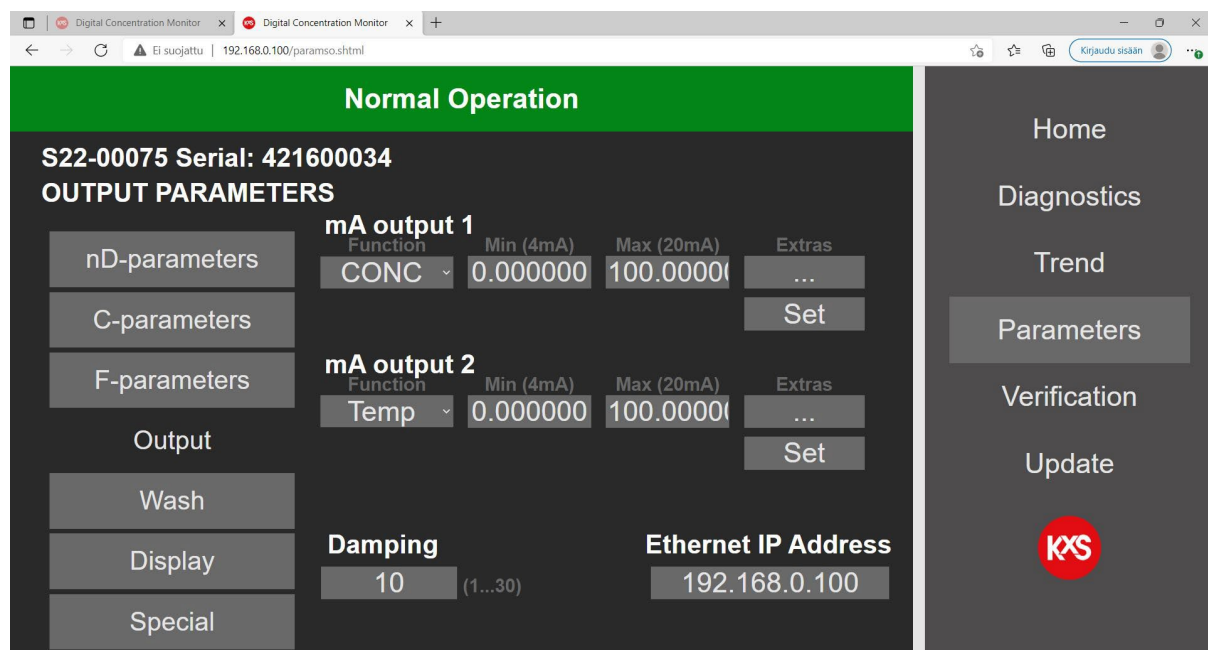


Figure 59 User configurable analog measurement output settings.

## 5.7 Configuration of low and high alarms

Low and high alarm limit values are user selectable for measurements or diagnostics. The alarm limit settings are configured in *Parameters/Output/Extras*.

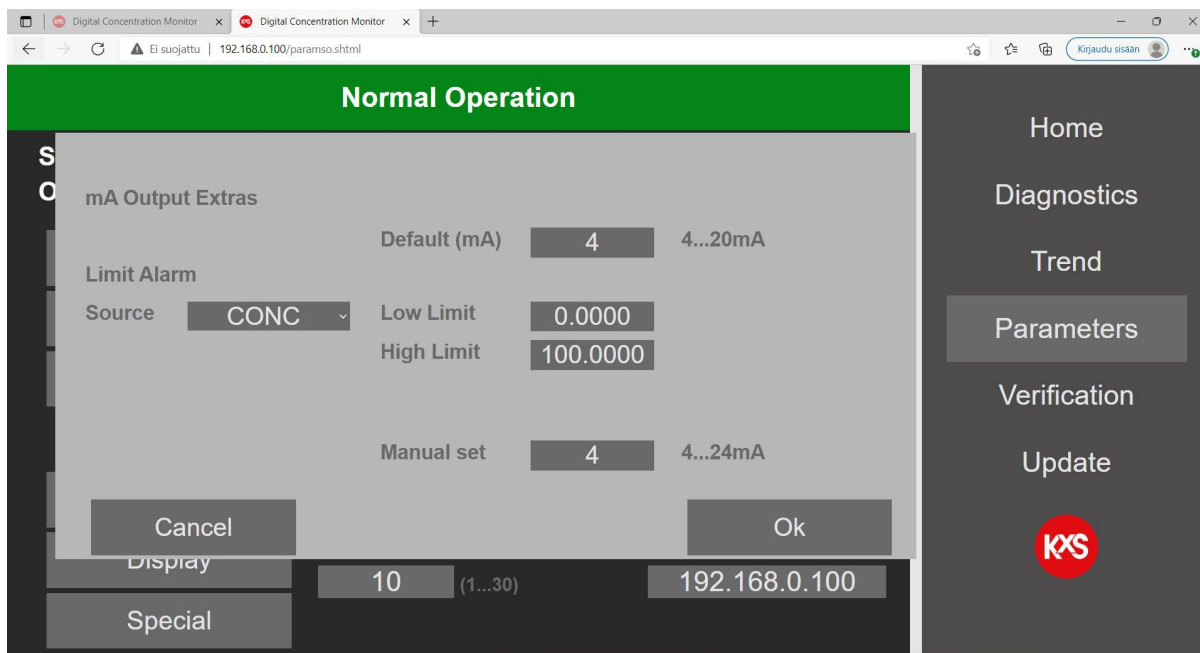


Figure 60 User selectable alarm limit function.

Simultaneously corresponding physical DIP switches are activated 'ON'. When both low and high alarms are used, 2x limit value switches SP-9700 are connected in serial per wiring drawing.

**Low alarm:** Module 1 DIP switches 3, 5, 6, 9, 0 activated 'ON' (5.2mA).

**High alarm:** Module 2 DIP switches 3, 7, 0 activated 'ON' (6.8mA).

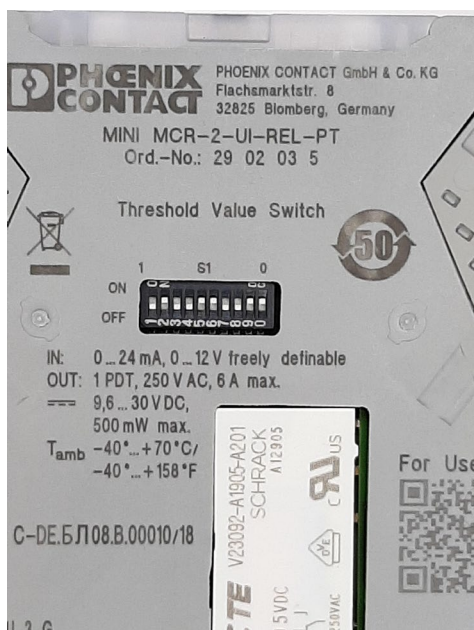


Figure 61 Physical DIP switch configuration for Low alarm functions. DIP switches 3, 5, 6, 9, 0 activated 'ON'

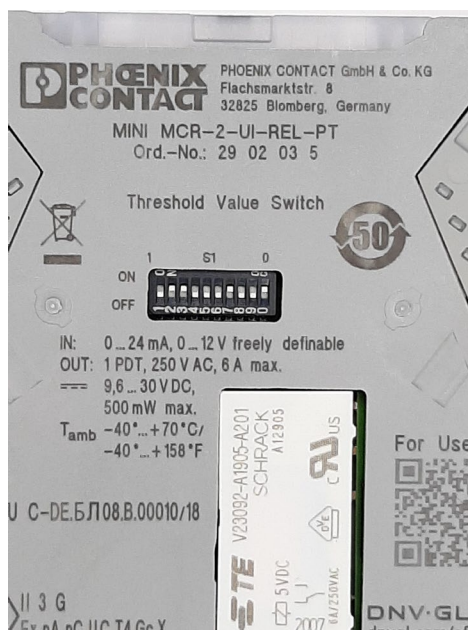


Figure 62 Physical DIP switch configuration for High alarms functions. DIP switches 3, 7, 0 activated 'ON'

## 5.8 Configuration of Prism wash

The Prism wash is functional through one of the sensor analog 4-20mA outputs. Wash times can be set in the user interface and controlled by external relay units.

The configuration of wash parameters is found in the user interface on page *Parameters* and *Outputs*. For the chosen mA output (1 or 2), *Function* opens a drop-down menu where *Wash* is selected and activated by pressing *Save & Exit*.

The wash cycle is configured on page *Parameters* and *Wash*. The user selectable wash time sets the time in seconds for an open wash relay. Recommended wash cycles depending on the wash medium is described in section 3.2 *Recommended wash settings*.

Figure 63 Prism wash function and time settings.

The recovery time describes the time in seconds between a closed wash cycle and activation of the CONC concentration output value. The CONC concentration output value can be put on hold during wash by selecting *On* in *Hold during wash*. With an activated *Hold during wash* the last CONC concentration output value is held when the wash cycle begins.

## 5.9 Display

User selectable engineering units in a drop-down menu are available for display of concentration and temperature. The number of displayed decimals of the final output CONC is user selectable 1-6.

**Note!** The displayed CONC engineering unit is not connected to the Chemical calibration parameters as described in 3.4.2. The sensor calibration is always correlated with the C-Parameters.

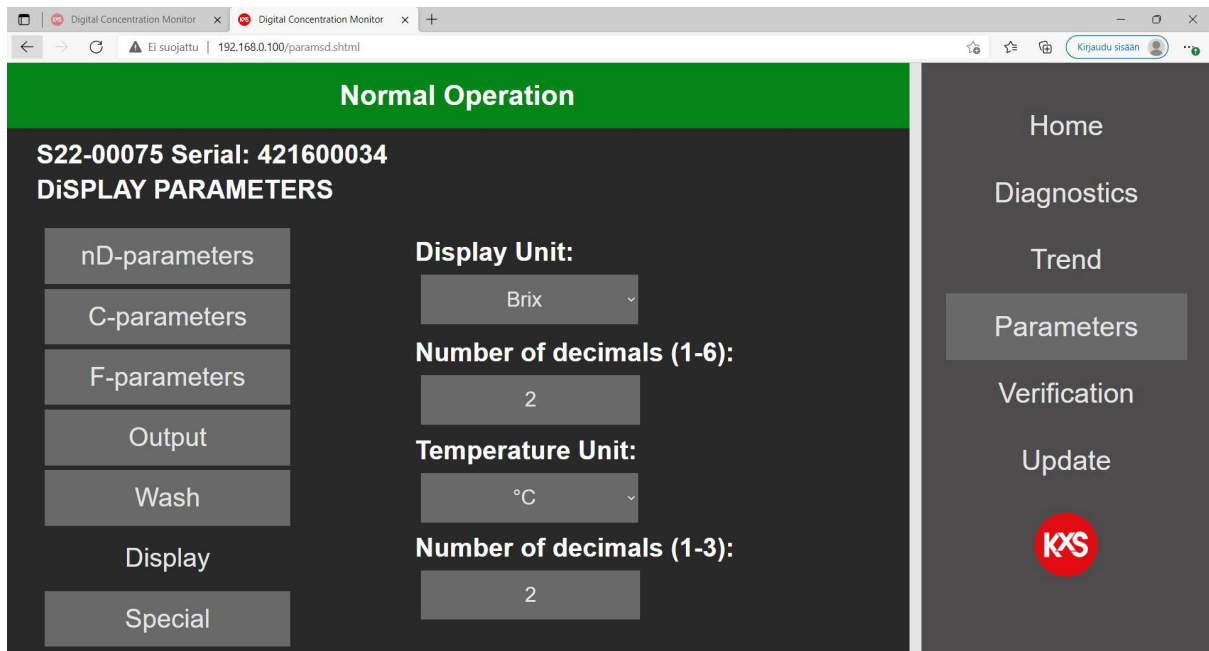


Figure 64 Displayed engineering units for concentration and temperature.

## 5.10 Software update

Sensor software is updated in the user interface in section Update. To access the sensor update function, the user interface Login must be activated. Login is activated in section Parameters/Special. Please consult KxS Technologies or its authorized distributor partner for login Password. A successful Login will allow a sensor software update function. The user interface status bar is indicated with 'Update allowed'.

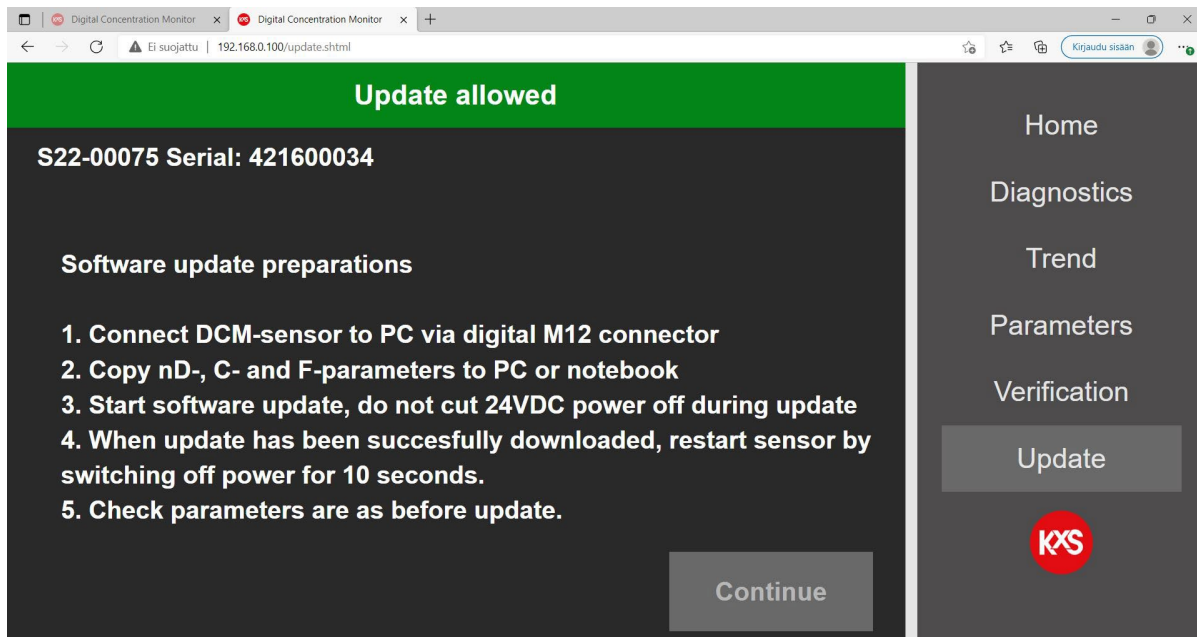


Figure 65 Guided sensor software procedure

The sensor software file is Selected and then activated by pressing 'Update'. The update progress is indicated in the status bar. During the update progress the user interface should not be operated nor power to the DCM-20 interrupted. Once the update is successful, there is an indication of allowing for 10 seconds prior to rebooting the sensor through a power cycle. The sensor software version is visible in page Diagnostics.

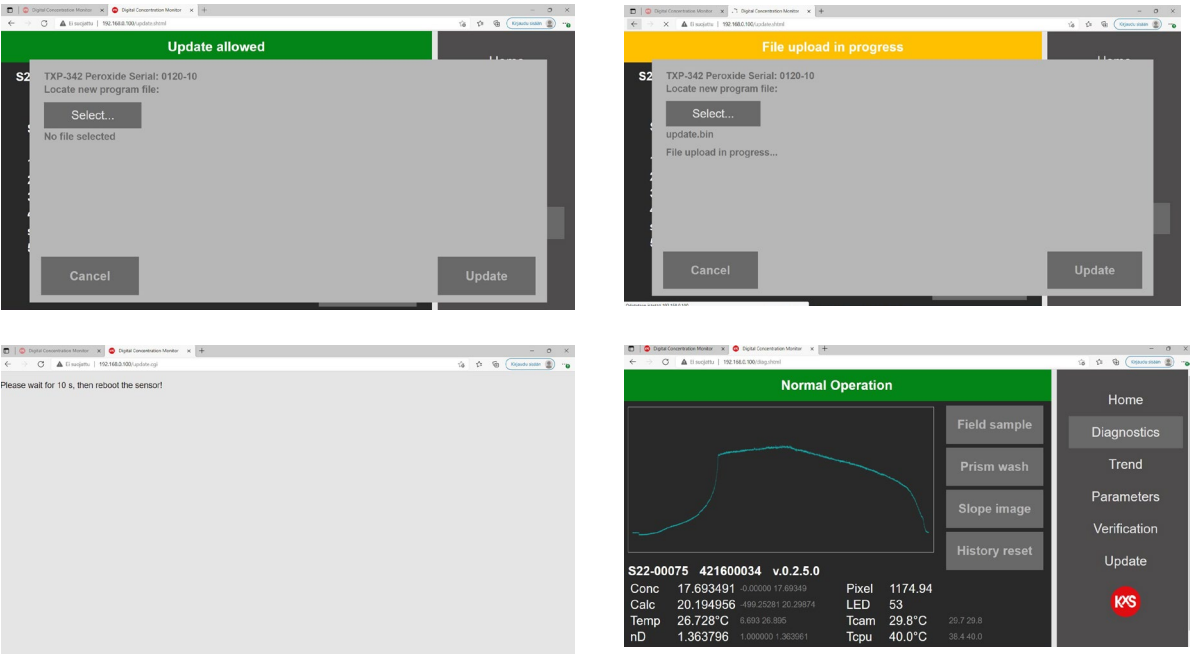


Figure 66 Sensor software update sequence

## 6. Digital Modbus TCP configuration

The DCM-20 digital output signal is designed with Ethernet communication in a Modbus TCP protocol. The protocol uses by default **Port 502** as local port in the server.

When configuring programmable logic controllers PLC, the DCM-20 measurement quantities are found in defined registers and addresses. The registers are defined in the Modbus Holding register with Function code 03. Sensor specific measurement quantities found in Register numbers and addresses as listed below:

| Measurement quantity                | Register number | Address | Data type      |
|-------------------------------------|-----------------|---------|----------------|
| Status                              | 40001           | 0       | string32       |
| LED                                 | 40017           | 16      | float          |
| RHsens (sensor relative humidity)   | 40019           | 18      | float          |
| nD (raw refractive index)           | 40021           | 20      | float          |
| CONC (final concentration value)    | 40023           | 22      | float          |
| Temp (process temperature)          | 40025           | 24      | float          |
| Tsens (sensor internal temperature) | 40027           | 26      | float          |
| PIX (Pixel value)                   | 40029           | 28      | float          |
| CALC (calculated concentration)     | 40031           | 30      | float          |
| Qual (Quality of optical image)     | 40033           | 32      | float          |
| ShortStatus                         | 40037           | 35      | unsigned short |

ShortStatus values:

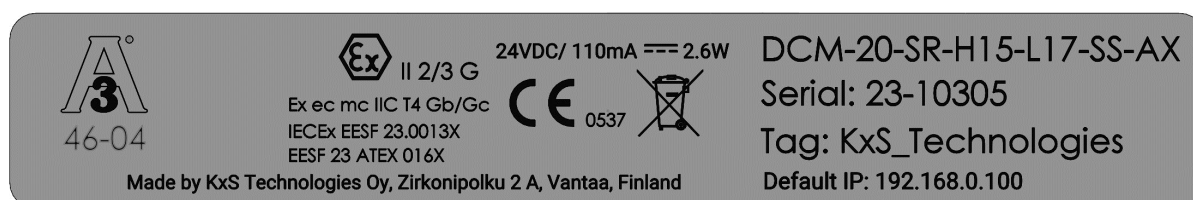
- 0: NORMAL\_OPERATION
- 1: NO\_SAMPLE
- 2: OVER\_RANGE
- 3: OVER\_RANGE\_PRISM\_COATED
- 4: NORMAL\_OPERATION\_LOW\_LIGHT
- 5: NORMAL\_OPERATION\_LOW\_QUAL
- 6: PRISM\_COATED
- 7: WASH\_PRECONDITION
- 8: WASH\_ACTIVE
- 9: WASH\_RECOVERY
- 10: WASH\_TEMP\_LIMIT
- 11: WASH\_EMPTY\_PIPE\_HOLD
- 12: SENSOR\_HUMIDITY\_HIGH
- 13: SENSOR\_TEMPERATURE\_HIGH

## 7. DCM-20 refractometer in potentially explosive atmospheres

The DCM-20...AX digital concentration monitor is certified by Eurofins Oy under the European ATEX directive 2014/34/EU for ATEX Ex II 2/3G and IECEx scheme for Ex ec mc IIC T4 Gb/Gc. The Type-examination Certificate number is EESF 23 ATEX 016X and the IECEx Certificate number is IECEx EESF 23.0013X . These certifications cover the following Ex standards: EN 60079-0:2017 / IEC 60079-15:2010.

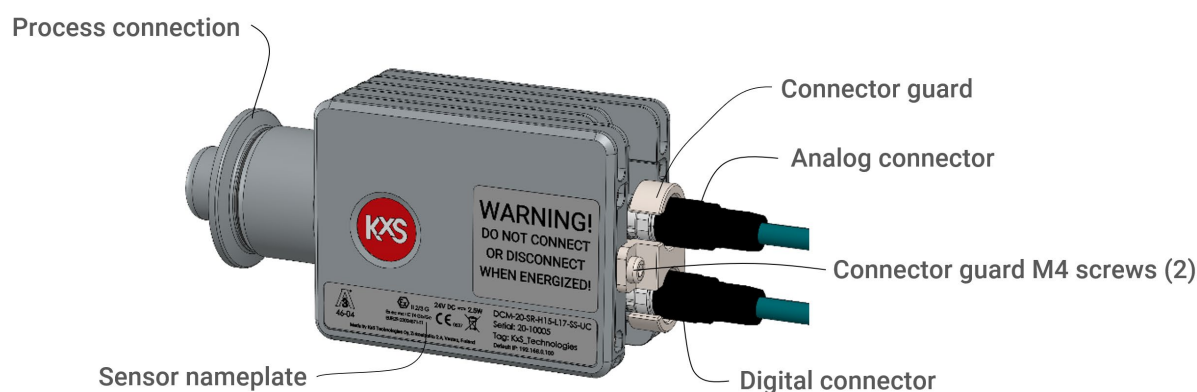
### 7.1 Device marking

The ATEX/IECEx approved DCM-20-...-AX sensors are identified by the product nameplate according to following picture:



### 7.2 Safety instructions

**⚠ WARNING – DO NOT CONNECT OR DISCONNECT WHEN ENERGIZED!** Switch OFF the system power before disconnecting sensor cable from sensor. After reconnecting sensor cable, the sensor power may be switched on again.



If the instrument show damage during transportation, return it to your nearest KxS Technologies authorized distributor for checkup before installation. A damaged instrument must not be installed in the process line.

Once per month check internal humidity from digital user interface. Accessing the user interface on a web browser. On page Diagnostics the Humidity should be below 50%.

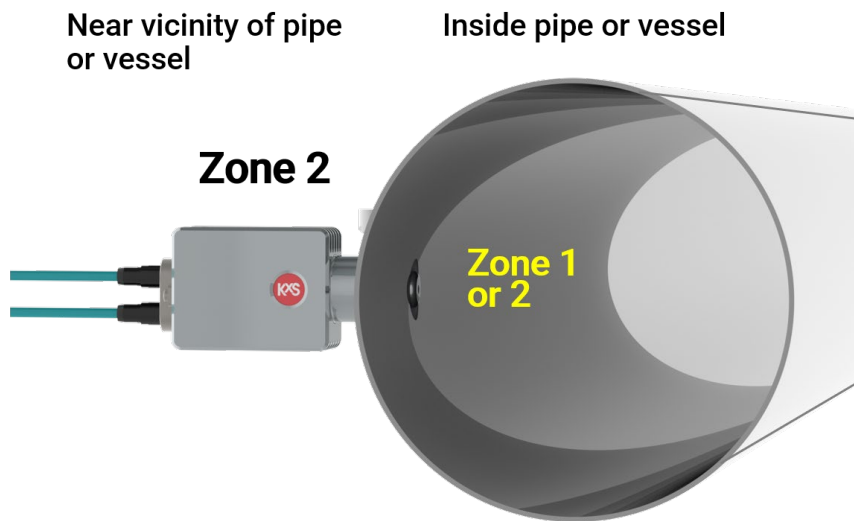
**IMPORTANT:** Tampering or replacing with other than original KxS Technologies components is not allowed because this may affect adversely the safe use of the system.

### 7.3 Installation

DCM-20-...-AX sensor can be installed in ATEX/IECEx Zone 2 classified areas where the process side of the sensor is classified for ATEX/IECEx Zone 1. The DCM-20-...-AX sensor can be installed in Zone 2 environment and Zone 2 process line/tank.



ATEX/IECEx approval  
II 2/3G Ex ec mc IIC T4 Gb/Gc



#### Tools for sensor start-up or removal

- Tx20 Torx screwdriver to remove cable connector guard.

#### 7.3.1 Sensor startup

1. Install sensor in process line or tank
2. Connect the cable(s) to sensor.
3. Install connector guard with two M4 screws
4. Connect cable(s) on the system side
5. Switch power 24VDC

#### 7.3.2 Sensor removal/measurement window cleaning

1. Switch off 24VDC from the system side of sensor cables
2. Remove connector guard with two M4 screws
3. Open sensor cable connectors
4. Remove sensor from process line or tank

### 7.3.3 Maintenance and repair of ATEX/IECEx refractometer

**⚠ WARNING:** Maintenance and repair of the DCM-20-...-AX that may affect explosion protection shall only be carried out by KxS Technologies personnel. Do not open, modify, or repair the sensor in the field.

KxS maintenance services may include inspection, preventive maintenance, functional testing, calibration, and replacement of worn or defective components. Only original KxS-approved parts and components shall be used where their characteristics may affect explosion protection.

If the refractometer is damaged, malfunctions, or shows signs that its explosion-protection integrity may have been compromised, remove the equipment from service and contact KxS Technologies.

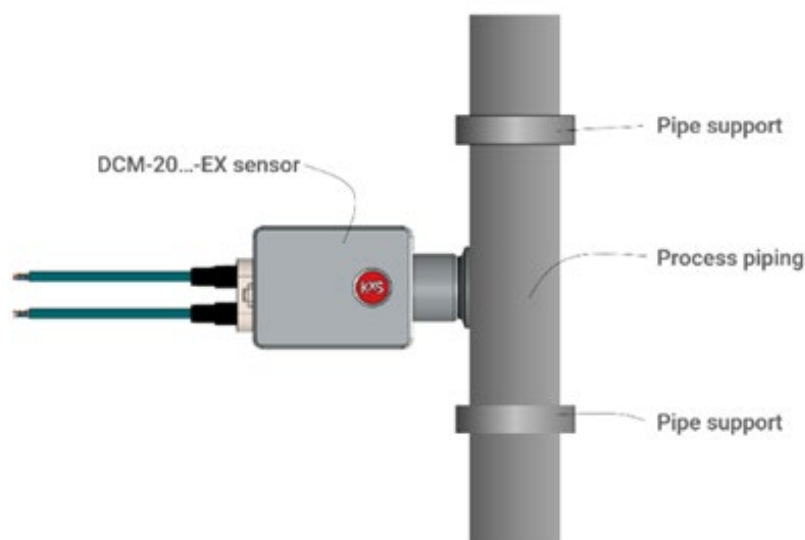
**⚠ WARNING:** Unauthorized modification or non-conforming repair may invalidate the equipment's ATEX/IECEx certification and compromise its explosion protection, creating a potential ignition hazard.

### 7.3.4 Specific conditions of use

- Do not carry the sensor on cable(s)!
- Do not use sensor as footstep when climbing!
- Do not use sensor without connector guards!
- In case there is any mechanical damage to sensor cover, prism, gasket, connector or connector cover, please consult KxS Technologies for further instructions.

### 7.3.5 Vibration

Process line and sensor vibration shall be eliminated by rigid piping/tank support before and after sensor installation point.



Wall thickness between sensor process side to electronic compartment is 1.5 mm stainless steel, Nickel, Hastelloy or Titanium. The DCM sensor sapphire prism (measurement window) thickness is 8 mm.

## 7.4 Sensor specifications

Maximum process pressure for DCM-20...AX sensor is 55bar(797psi) and temperature 130°C (266°F)

KxS Technologies Oy  
Polaris Business Park  
Capella Building, Vänrikinkuja 3  
FI-02600 Espoo FINLAND  
TEL. +358 50 343 7456  
info@kxstechnologies.com  
www.kxstechnologies.com

KxS Technologies LLC  
1400 Roaring Fork  
78641 Leander TX USA  
TEL: +1 480 390 2504  
info@kxstechnologies.com

