



USER'S MANUAL

DCM-20 INLINE OPTICAL BRIX MONITOR

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User's Manual

WARNING: If the unit 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 a 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.
- 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. 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 optical sensor in/from process piping.

High temperature

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

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 proximity.

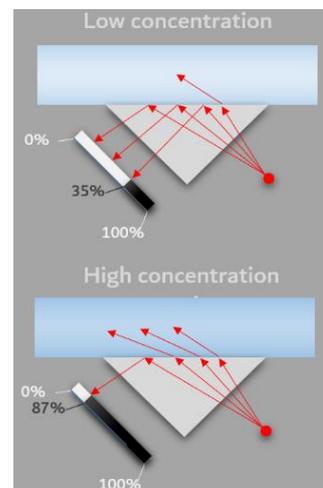
Introduction

DCM-20 inline optical Brix monitor provides real-time measurement in sanitary process applications. The liquid measurement technology is based on refractive index. The refractive index unit RIU is a physical measure of a liquid's dissolved material following the theory of Snell's law. KxS Technologies' refractometers are used in various industries and critical process systems for liquid concentration measurements of total dissolved solids.

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

The inline optical Brix monitor DCM-20 includes an integrated pT-1000 temperature element for process temperature measurement and simultaneous automatic temperature compensation of the Brix concentration measurement.

The instrument integration to process environments and control systems with industrial standard communication protocols is flexible with stand-alone Brix monitor setups, as well as optional modular connection units and external displays.



1. Connection

The inline optical Brix monitor 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.

1.1 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. 1).

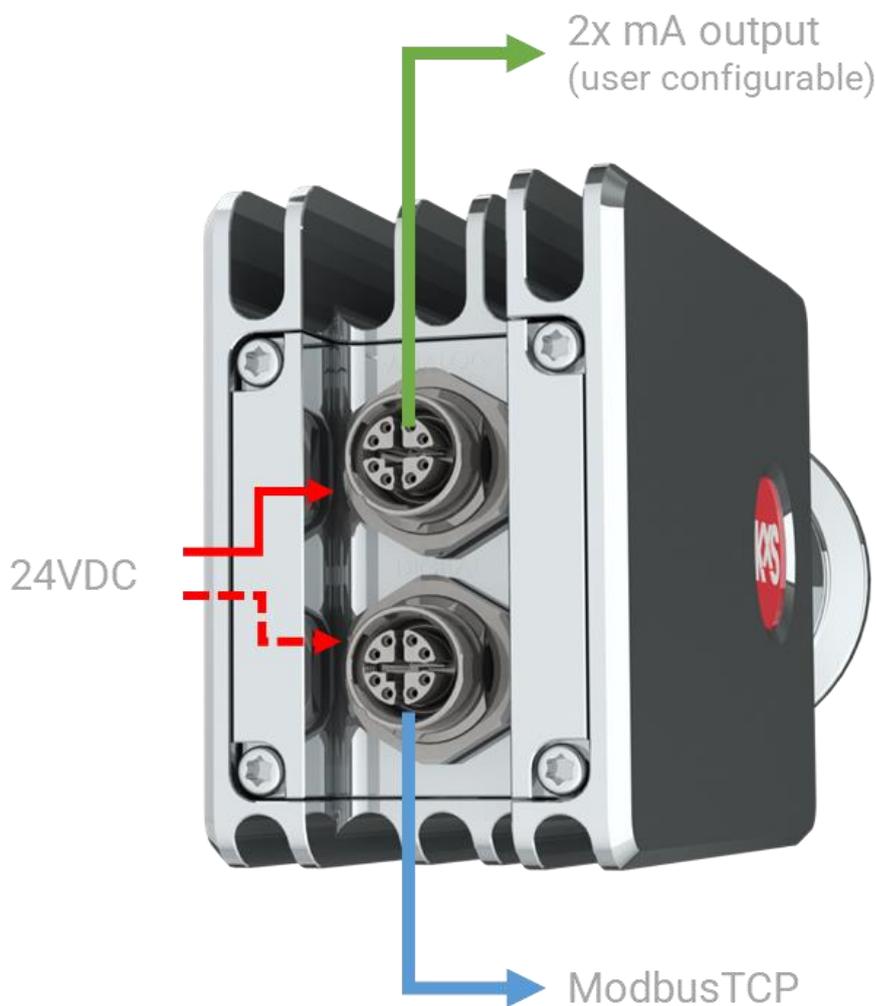


Figure 1 DCM-20 inline optical Brix monitor connectors

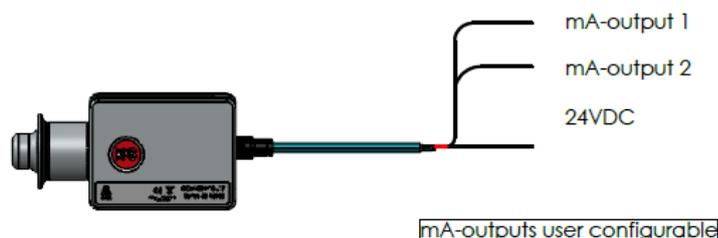
1.2 Sensor integration concept

Inline optical Brix monitor DCM-20 is 3-A and EHEDG certified. The stand-alone optical sensor is connected directly to 1.5" or larger process pipes. Single piece flow cells SPC are available for 1" or larger pipes. The SFC is with an optional optical window wash nozzle mount. Sensor mounting instructions found in section 2.

The sensor wetted parts are of stainless steel 316L EN 1.4435 according to industry standard surface roughness, sapphire optical window, and PTFE sealing. The sealing material is FDA approved and specified according to EU regulation for material in contact with food. The sensor head is of stainless steel 316.

The sensor cable connection is with one identical M12 cable model connected either to the sensor analog or digital shielded connector port. Both sensor connectors can receive 24VDC power input. Both sensor cables can be connected when the analog output is chosen, and the digital connector serves simultaneously as access to user interfaces. A connector not in use shall be plugged.

1. Analog only (see page 6)



2. Digital only (see page 7)



3. Analog and Digital (see page 8)

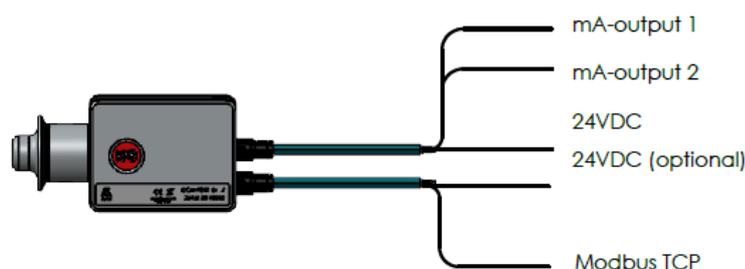


Figure 2 Inline Brix monitor DCM-20 operation concept. DWG No. 10125.

1.3 Cable connection with electrical modules

Regardless of analog or digital output port connection, one identical cable model serves both options. The shielded cable is with 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. 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. 3. 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 3 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 4 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. 4. 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.5) in Pin no. 1-4 according to the wiring schedule in Fig. 4. 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.

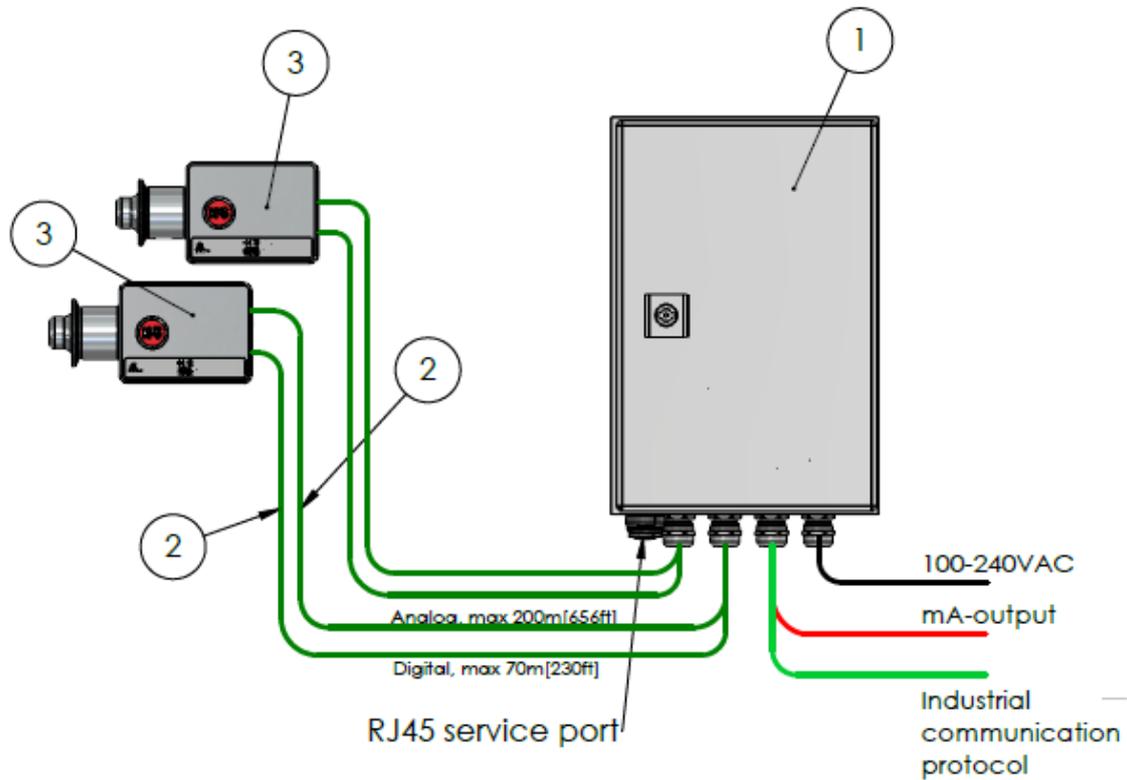


Figure 5 Power supply unit (Part No: SP-9400), industrial RJ-45 connector (Part No: SP-9310), Industrial Ethernet Switch with 4+1 ports (Part No: SP-9320), and Universally configurable limit value switch with 1x relay output (Part No: SP-9700).

The inline optical Brix monitor DCM-20 can be configured with high and low measurement alarms as described in section 4.4.3, as well as optical window wash system as described in section 3.3 and its user interface configuration in section 4.4.4. 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 optical window 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. See section 3.3 for optical window wash system configuration and section 4.4.4 for low and high alarm function configuration.

1.4 System drawing of DCM-20 and Modular Connection Unit

The system drawing of standard Brix monitor unit found in Fig. 6. The modular connection unit MCU consists of a set of control and converter modules. Each MCU can be mounted in a stainless-steel enclosure with IP66, NEMA 4x classification.



Item No.	Description	Qty
1	MCU Modular connection unit	1
2	SP-9000-... Sensor cable	1-4
3	DCM Digital Concentration Monitor	1-2

Figure 6 System drawing of inline optical Brix monitor DCM-20 and Modular Connection Unit MCU. DWG No. 10176.

1.5 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.

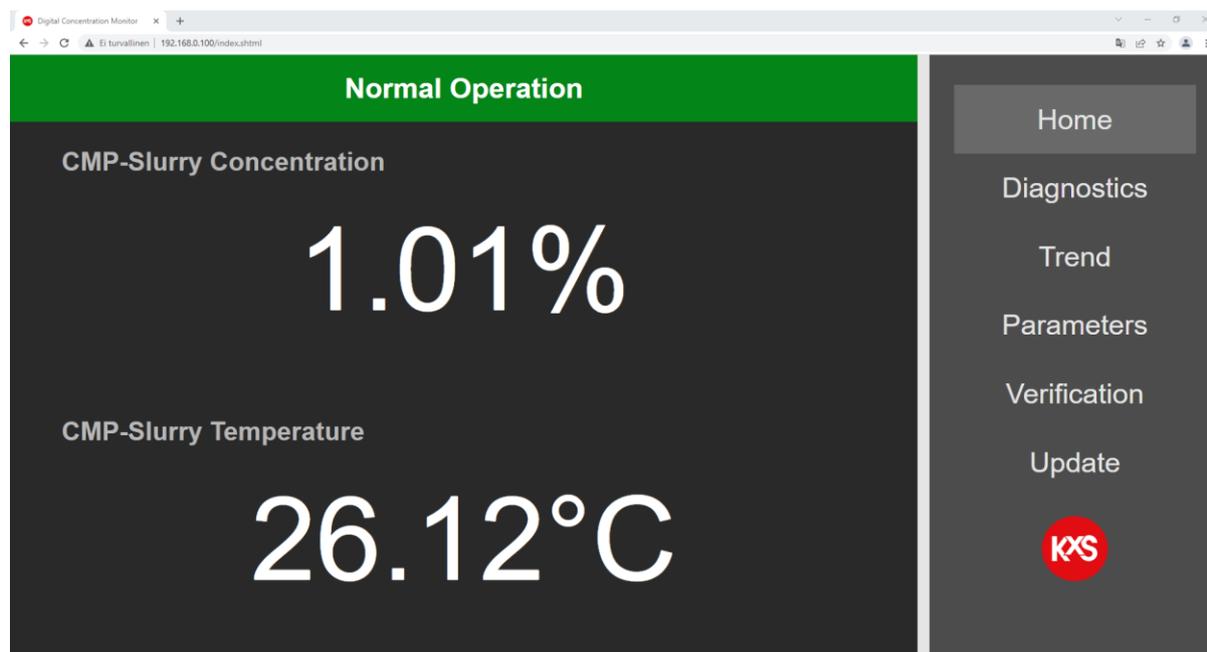


Figure 7 Sensor homepage of user interface on a computer web browser or external display SP-9500/SP-9520.

1.5.1 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.

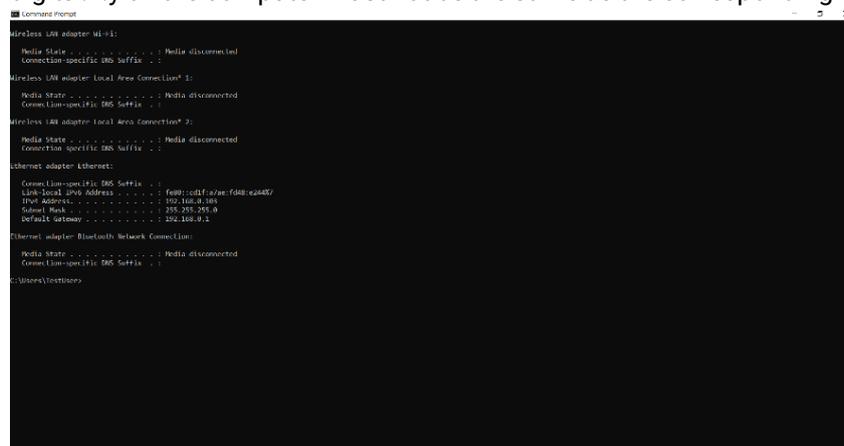
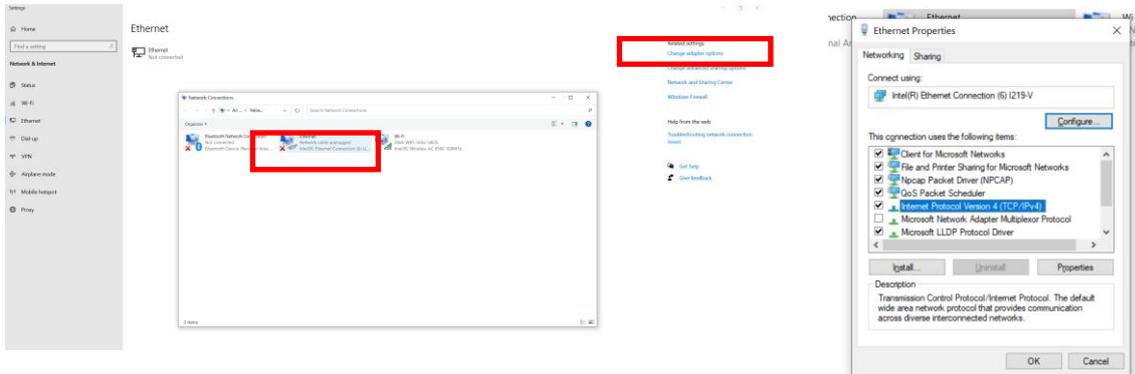
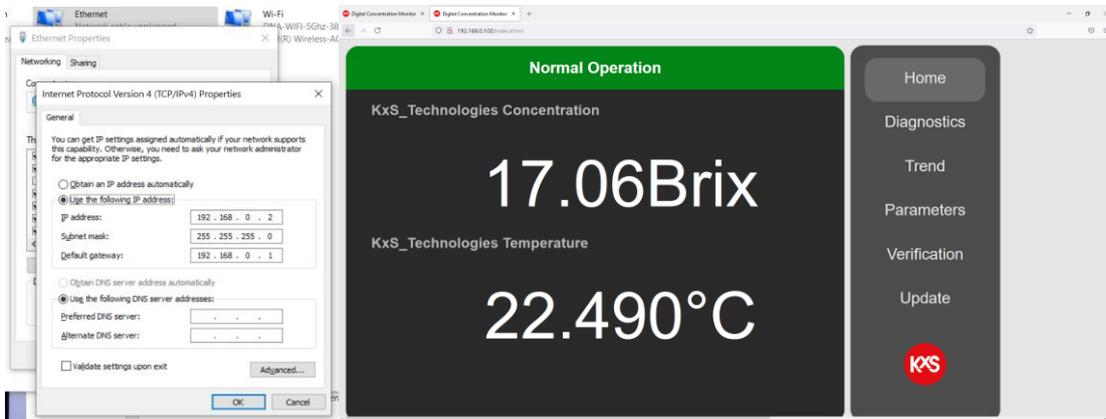


Figure 8 Command prompt on computer for IP address verification.

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.



1.5.2 External display setup

An external industrial display is available with a 7" multi touch panel mount design, or 15" all protected cover 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 9. When the display is powered up, opt for the configuration page during display start-up.



Figure 9 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.x.y where x.y is any other ending than the corresponding for the sensor .10.20. Subnet Mask 255.255.255.0. Confirm by pressing \checkmark .



Figure 10 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 \checkmark . The settings are applied by pressing the Restart button seen in Fig 11.



Figure 11 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.

1.5.3 Mobile device setup

A mobile device with a USB-C port can be connected for accessing 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. 12, 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).

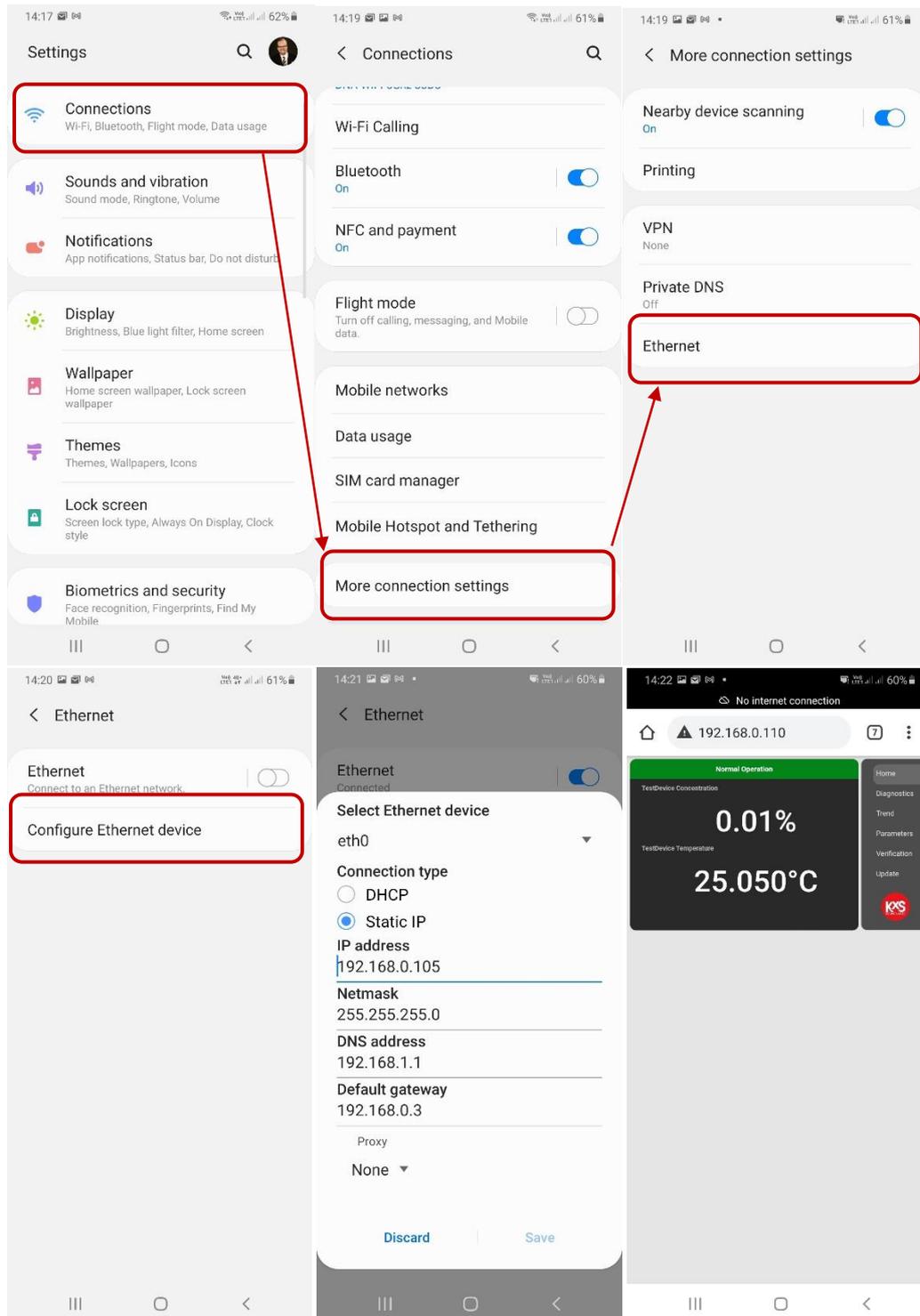


Figure 12 Mobile device setting path for IP configuration and access of sensor user interface homepage.

2. Inline Brix monitor DCM-20 mounting

The inline optical Brix monitor DCM-20 can be mounted straight into process pipe sizes of 1.5" or larger. For 1" or smaller pipe sizes and optical window wash nozzle connections, the sensor is mounted with flow cells designed by KxS Technologies. The DCM-20 and flow cells are Clean in Place CIP compatible.

2.1 Sensor mounting

The recommended sensor mounting position is either in a vertical or horizontal process pipe section. When a horizontal process pipe section is chosen, the sensor head is recommended in horizontal orientation, i.e. not on top nor below the process pipe.

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

The recommended sensor mounting location is such where the sensor is accessible for maintenance and cable connection for user interface access. The standard sensor connection is with 1.5" sanitary tri-clamp (DWG No. 10119) with option for a 2.5" sanitary tri-clamp connection, Varinline® Type N DIN 11850, DN40-150 (DWG No. 10097) or Sandvik L-clamp 1.25" ISO42.2 (DWG No. 10124).

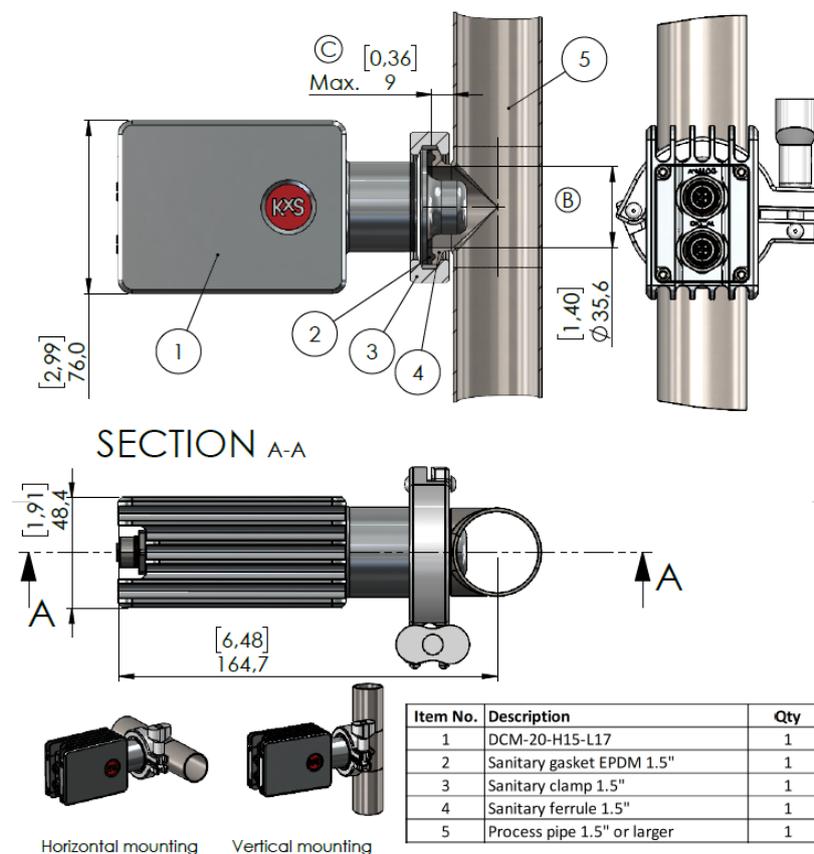


Figure 13 Inline optical Brix monitor mounted directly in 1.5" or larger pipe sizes with a sanitary tri-clamp connection. DWG No. 10119.

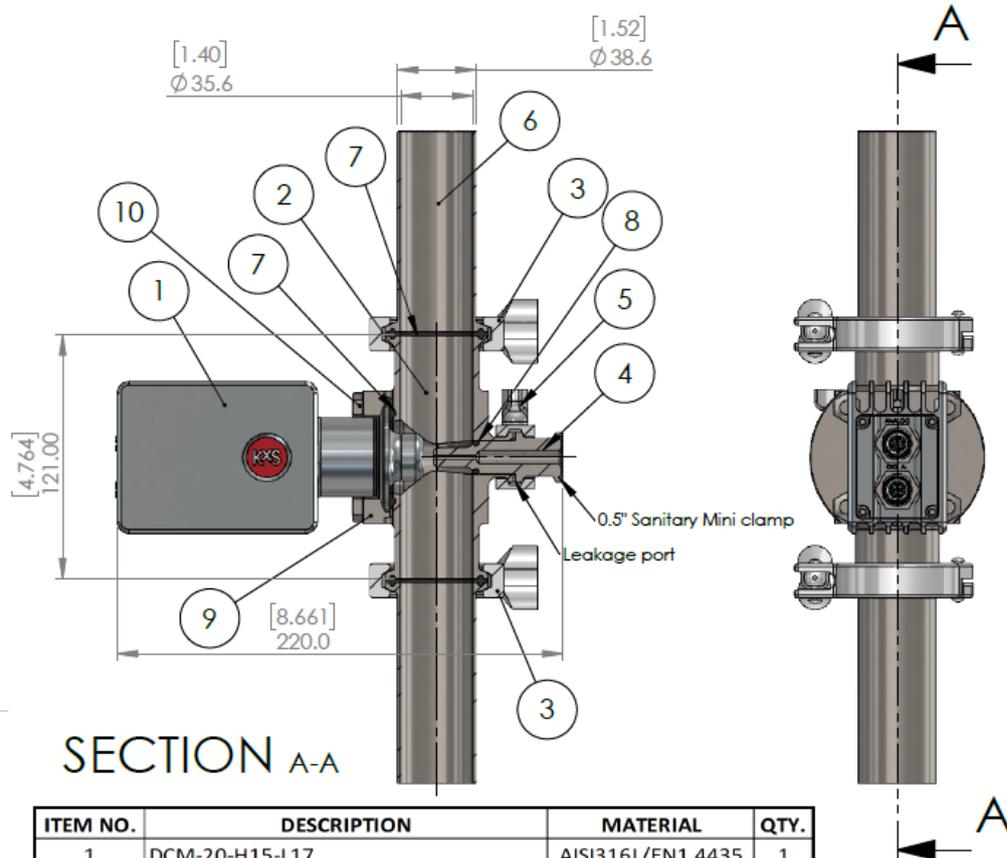
2.2 Flow cell mounting

Single piece flow cells SFC are designed for 1", 1.5", 2", 2.5", 3" and 4" pipe sizes. The SFC is mounted with corresponding sanitary tri-clamp connections to the process pipe. DCM-20 inline optical Brix monitor is mounted with a 1.5" sanitary half-flange to the SFC. When a single piece flow cell SFC is chosen, the recommended mounting orientation is in a vertical pipe. The SFC dimensions allow self-draining of fluid when in vertical position.

When a single-piece flow cell SFC is used in a horizontal pipe, the flow cell should be installed in a minimum 3 degree angle to allow liquid to be drained. The smallest 1" SFC flow cell should be mounted in a vertical line or in at least a 45 degree angle.

Note: The single-piece flow cell is designed with no welding joints.

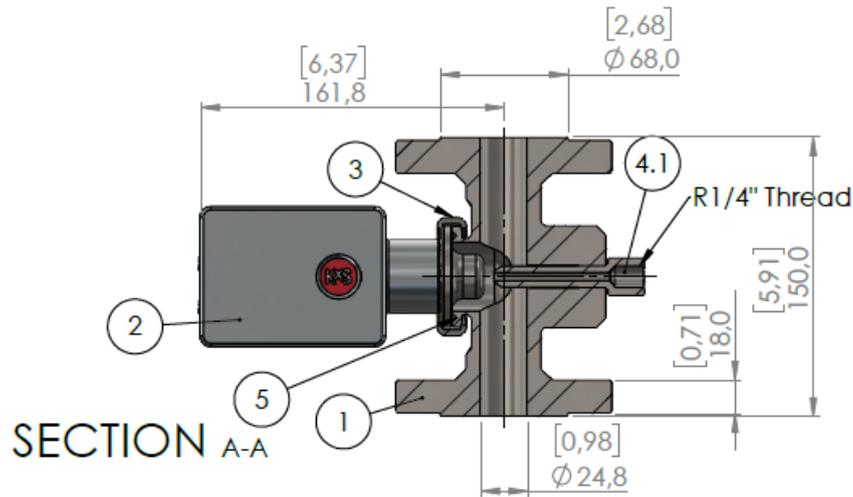
Note: The SFC is chosen when a sanitary high-pressure clamp for process pressures up to 55 bar (800psi) is required.



ITEM NO.	DESCRIPTION	MATERIAL	QTY.
1	DCM-20-H15-L17	AISI316L/EN1.4435	1
2	SFC-H15-HPF-H15-NC	AISI316L/EN1.4435	1
3	1.5" Sanitary clamp	AISI304	2
4	Wash nozzle		1
4.1	SFCN-15-P High pressure water nozzle	AISI316L/EN1.4435	
4.2	SFCN-15-S Steam Nozzle	AISI316L/EN1.4435	
5	Miniclamp	AISI304	1
6	Process piping		1
7	1.5" Sanitary clamp gasket	EPDM	3
8	O-ring 11x3	EPDM	1
9	Sanitary half flange 1.5"	AISI304	2
10	Bolt M8x20	A2	4

Figure 14 Sensor mounting in single-piece flow cell with optional wash nozzle. DWG No. 10288.

In installations without sanitary requirements, a flange connected flow cell GFC with wash nozzle connection is available where the sensor is connected to the flow cell with 42.4 PN40 Sandvik L-coupling.



ITEM NO.	PART NUMBER	DESCRIPTION	QTY.
1	10133	Flange Flow cell DN25 PN40 Single Piece	1
2	10032	DCM-20-K42-L17	1
3	Sandvik L clamp	42.4 PN40	1
4		Wash nozzle for FFC	1
4.1	10132	Flange flow cell steam nozzle	
4.2		Flange flow cell high pressure water nozzle	
5	O-ring	4x40 NBR	1

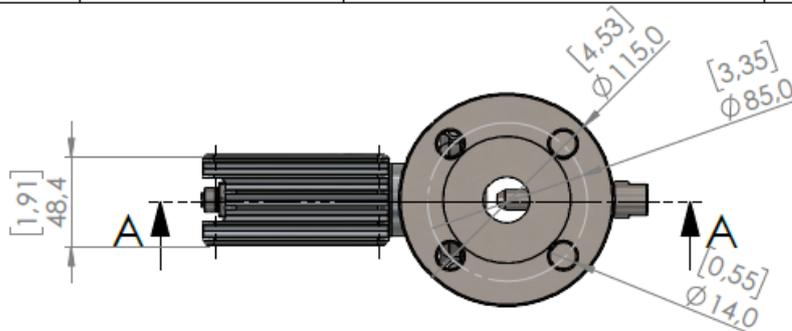


Figure 15. Flange Flow cell. DWG No. 10134.

2.3 Optical window wash nozzle mounting

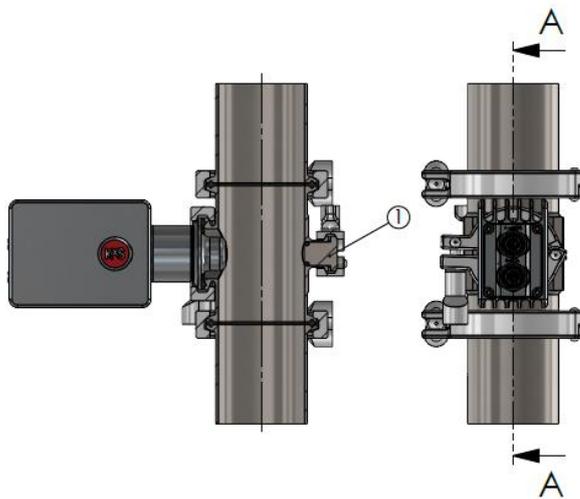
The wash medium needs to be specified with either steam or high-pressure water to determine the wash nozzle model. The wash nozzle is connected to the single-piece flow cell SFC through a sanitary mini clamp connection on the opposite side of the sensor.

Note: During Steam in Place SIP or Clean in Place CIP it is essential that optical window wash is activated multiple times during SIP/CIP-cycle to ensure a clean nozzle before next process sequence.

The nozzle can be removed by opening the sanitary mini clamp and pulling the nozzle out from the SFC flow cell. Sensor can also be removed by releasing the 1.5" sanitary tri-clamp.

When wash nozzle is not installed, a blind nozzle SP-10161 is mounted in the nozzle insert as shown in Fig. 16.

Note: Both wash nozzle and blind nozzle connections are 3A certified, while EHEDG certified installations are without nozzle connection in the SFC flow cell.



ITEM NO.	PART NUMBER	DESCRIPTION	QTY.
1	10161	Blind nozzle	1

Figure 16 Blind nozzle insert when wash nozzle not mounted. DWG No. 10164.

2.4 Wiring drawing of Modular Connection Unit system

The wiring drawing 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-98xx are available depending on required protocol conversion from Modbus TCP.

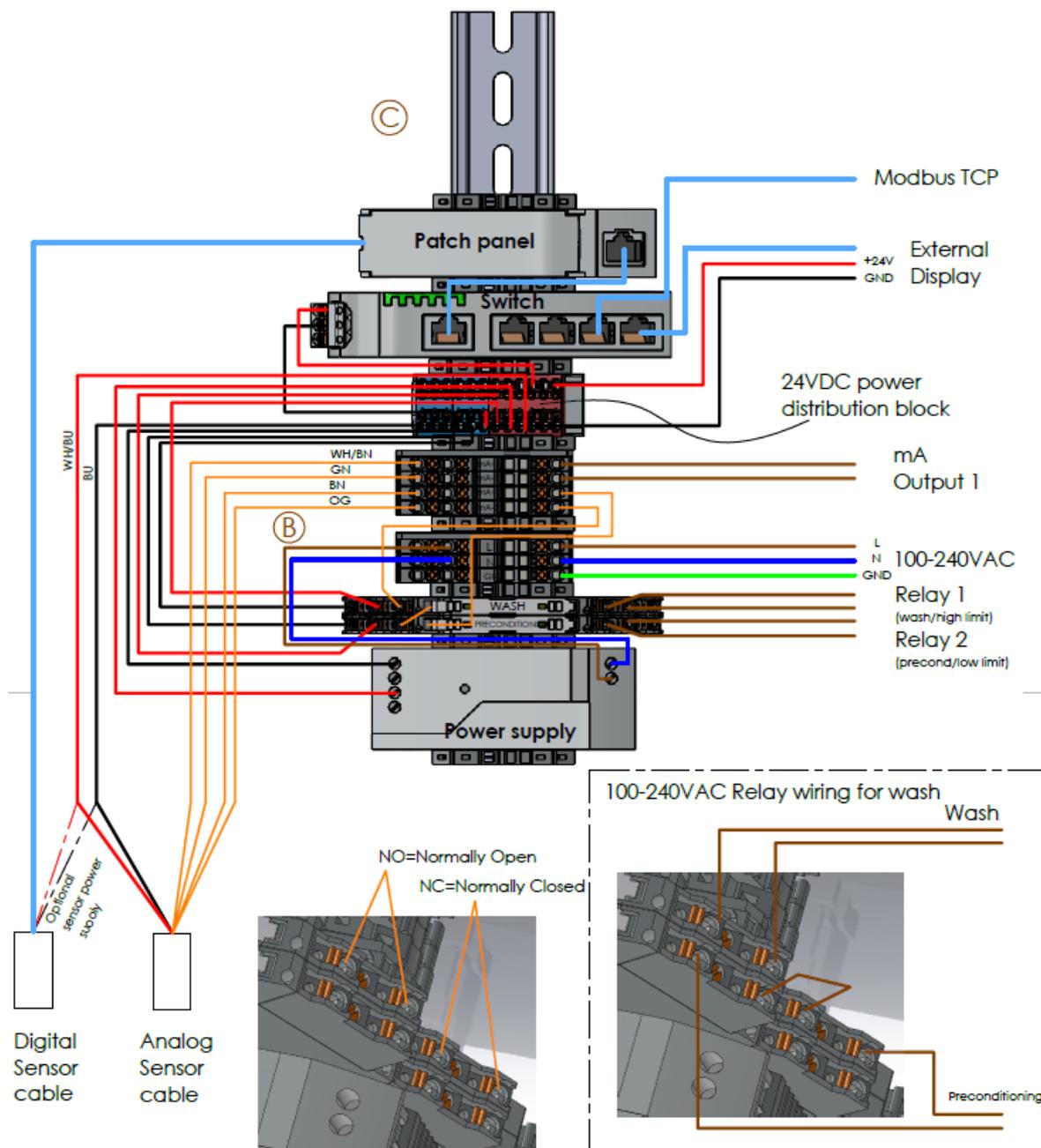


Figure 17 Wiring drawing of modules in MCU. DWG No. 10178.

3. Prism wash systems

Some applications in the food & beverage and chemical industries are known to cause fouling of the sensor optical window. Fouling is often caused by properties in the liquid. A typical measurement behavior in the event of optical window fouling is an upward trending Brix concentration measurement over time.

3.1 Sensor optical window wash

The inline optical Brix monitor DCM-20 can be equipped with a wash nozzle integrated in the Single-piece Flow Cell SFC for applications that requires an automatic wash of the optical window. The SFC design accommodates connections to process pipe sizes of 1", 1.5", 2", 2.5" and 3". The wash nozzles are designed for either high pressure water or steam.

3.1.1 High pressure water wash system

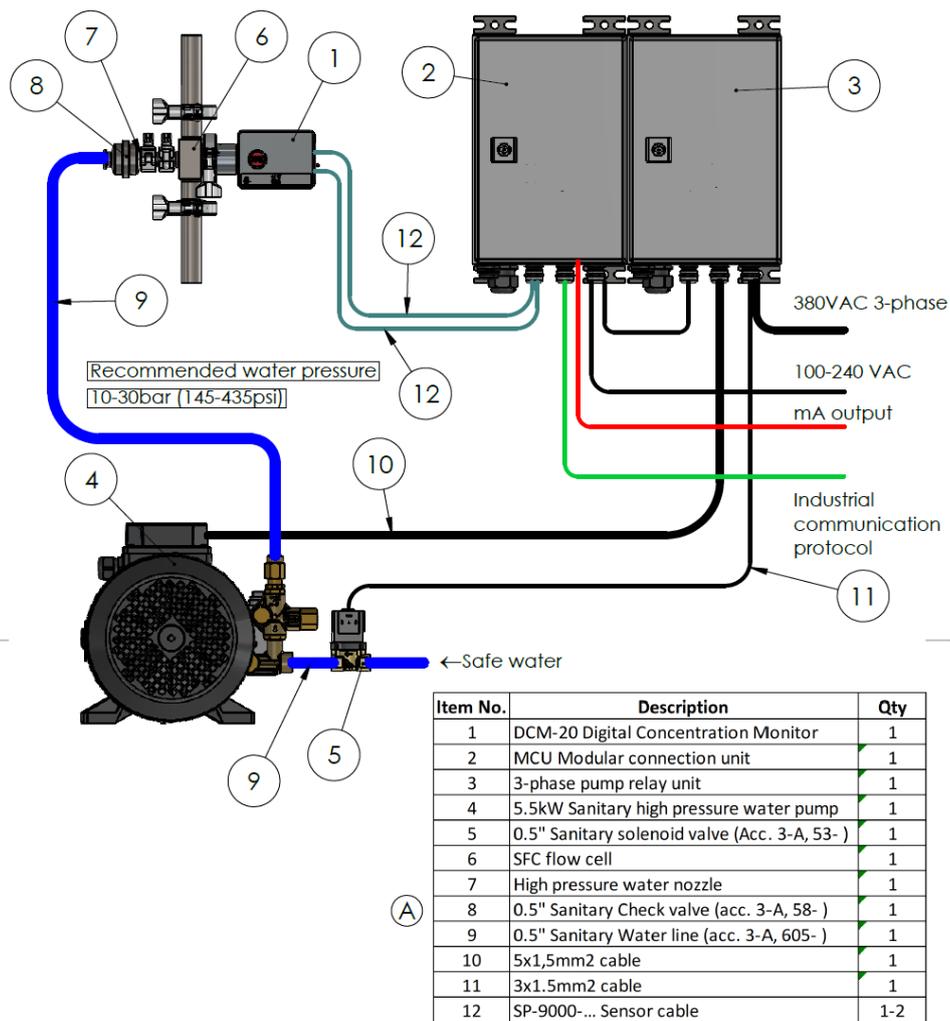
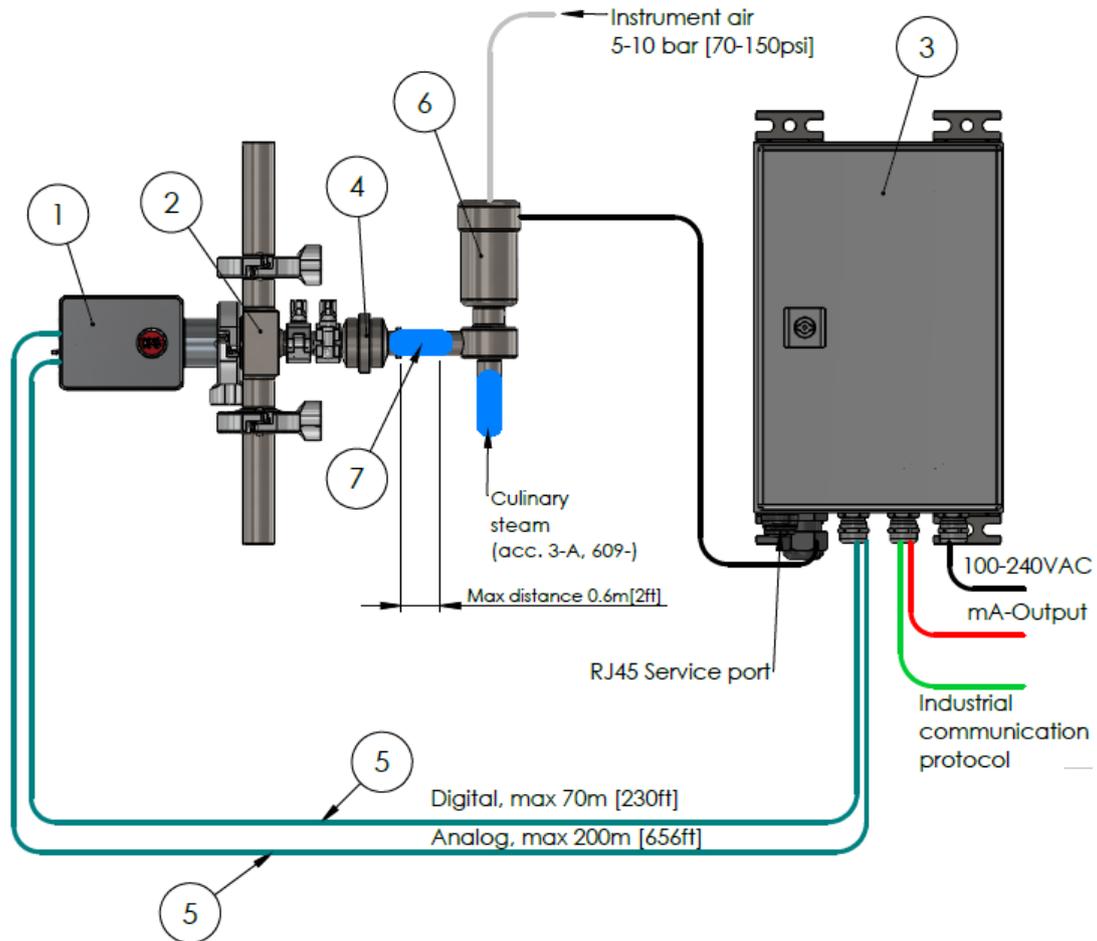


Figure 18 DCM-20 High pressure water system. DWG No. 10177.

3.1.2 Steam wash system



ITEM NO.	DESCRIPTION	QTY.
1	DCM-20-H15	1
2	Single Piece Flow cell with steam nozzle	1
3	Modular Connection Unit (MCU)	1
4	0.5" Sanitary check valve (acc. 3-A, 58-)	1
5	Sensor cable	1-2
6	0.5" Sanitary valve with solenoid valve (acc. 3-A, 53-)	1
7	0.5" Sanitary piping (acc. 3-A, 605-)	1

Figure 19 DCM-20 steam wash system. DWG No. 10168.

3.2 Recommended wash settings:

In limited demanding applications either high pressure water or steam wash medium is available for cleaning of the optical window. The recommended wash settings and times given in Fig. 20.

Wash system parameters setting in DCM-20					
	Maximum above process	Maximum total pressure	Wash time	Recovery time	Wash interval
High pressure water	30 bar above process pressure	70 bar	10 sec	20-30 sec	10-20 min
Steam	3 bar above process pressure	6 bar	3 sec	20-30 sec	20-30 min

Figure 20 Wash medium pressure and time settings.

3.3 Modular Connection Unit for Wash Systems

The optical window 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 21 DIP switch configuration



Figure 22 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. 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*.

4.1 User interface homepage

The sensor user interface is accessed as described in section 1.5. 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 optical window, *No Sample* when process pipe empty or no liquid on the optical window *Optical Window Wash* when the wash system is active as user defined.

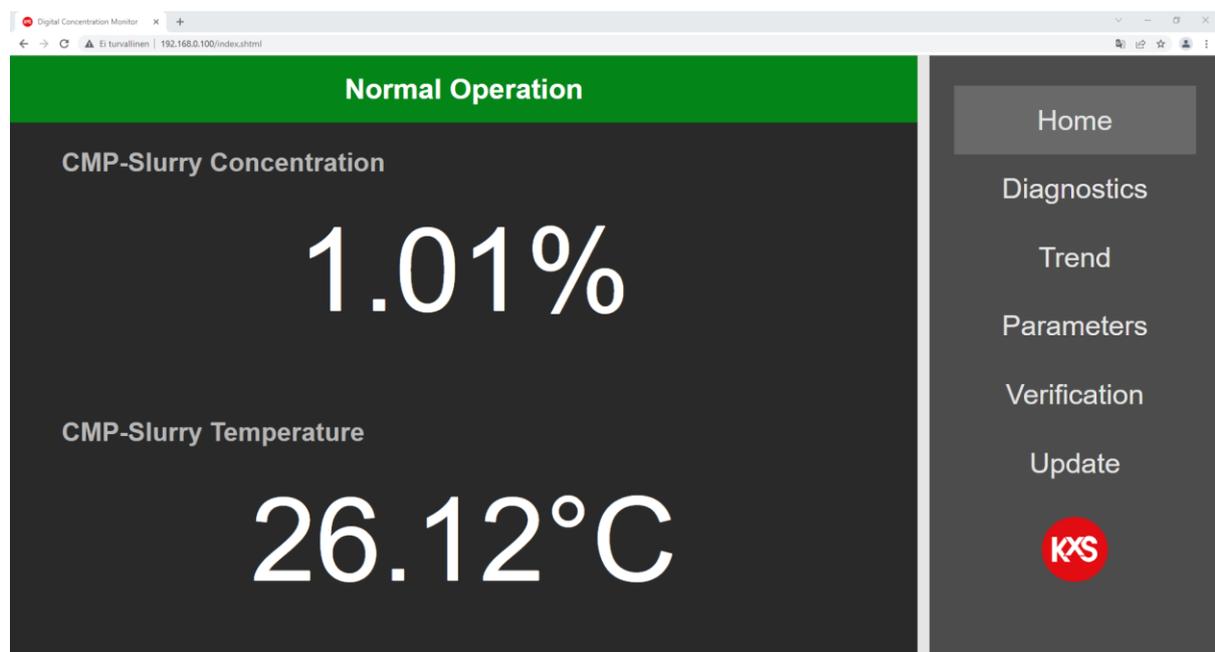


Figure 23 User interface homepage with real-time measurement values.

4.2 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 an optical window 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.

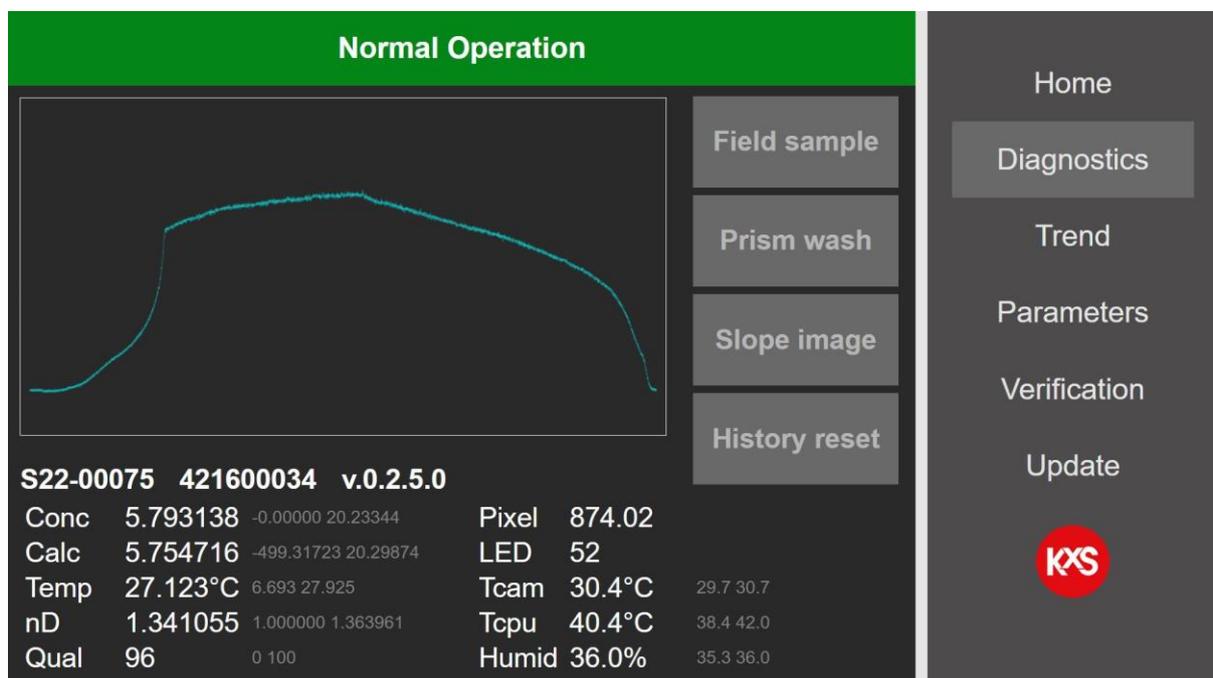


Figure 24 Diagnostics with optical image, measurements, and sensor internal diagnostics.

4.3 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 (Fig. 27). 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*.

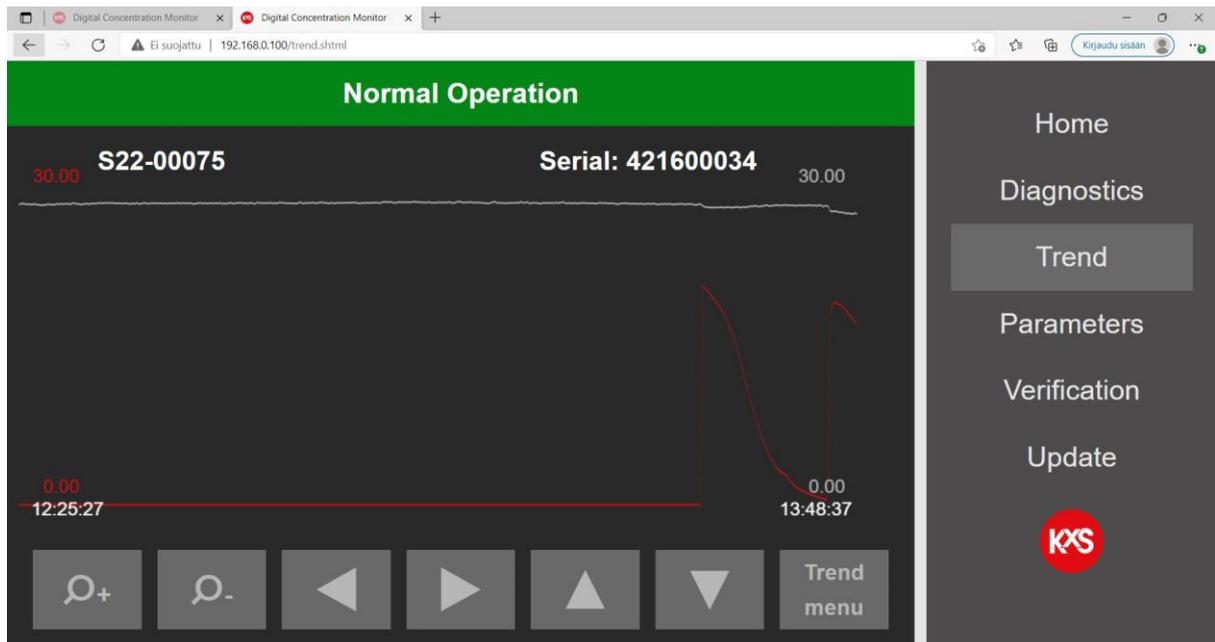


Figure 25 Continuous measurement trend.

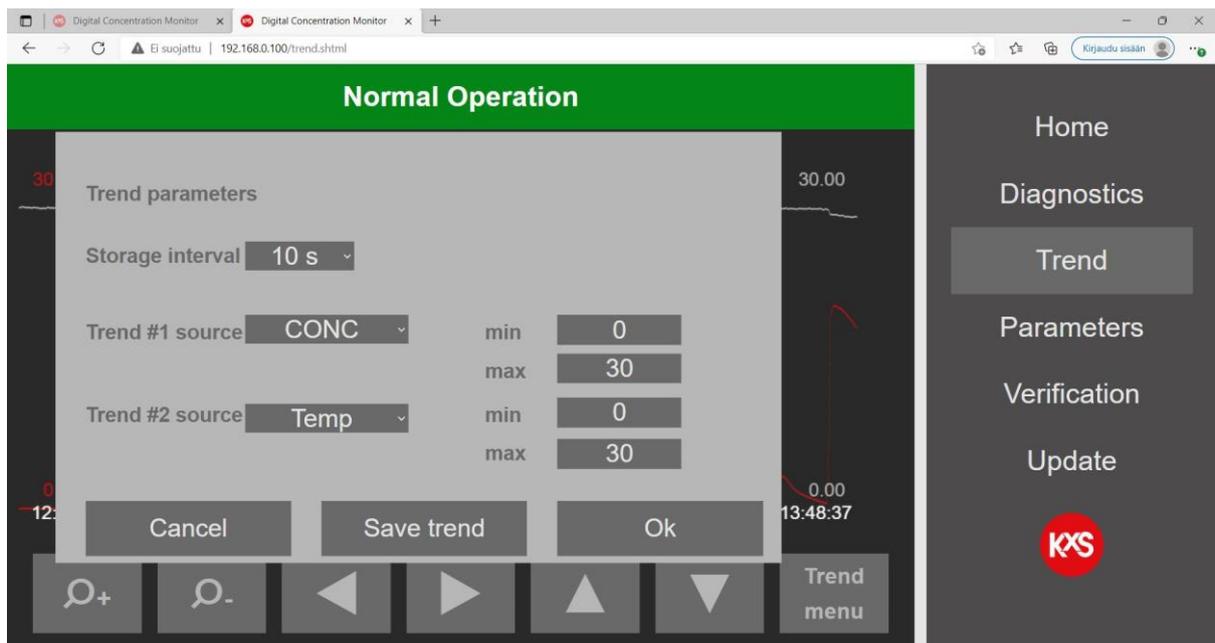


Figure 26 User selectable trend functions

4.4 Parameters configuration

4.4.1 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.

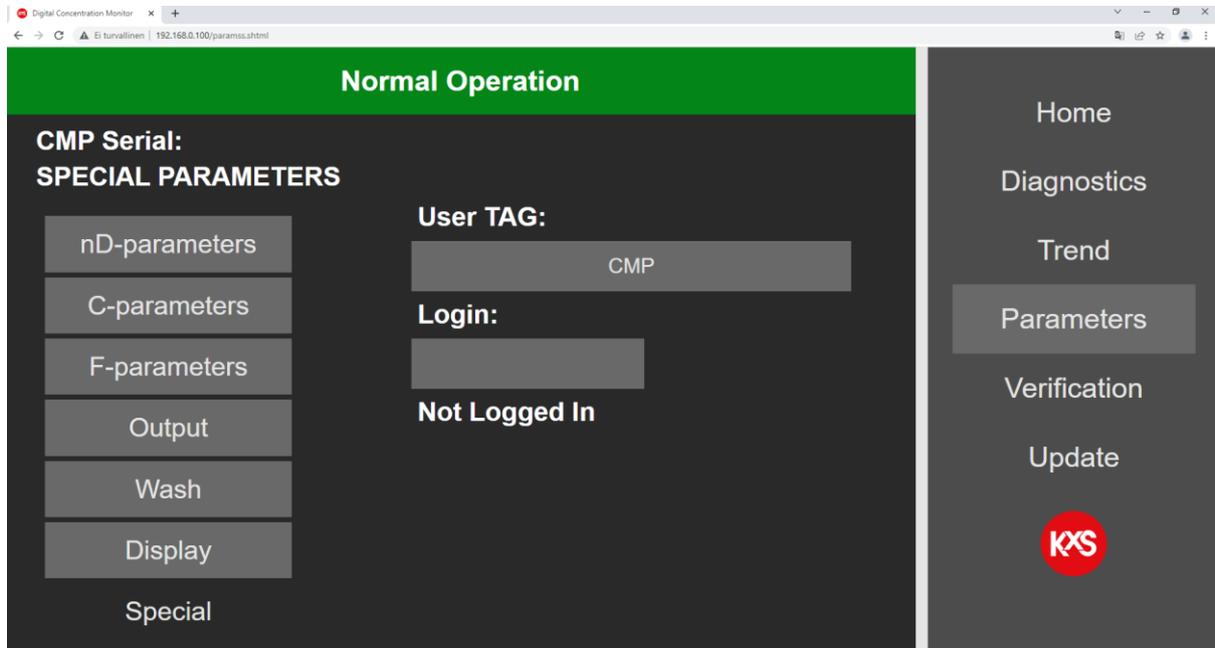


Figure 28 DCM Login with password

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

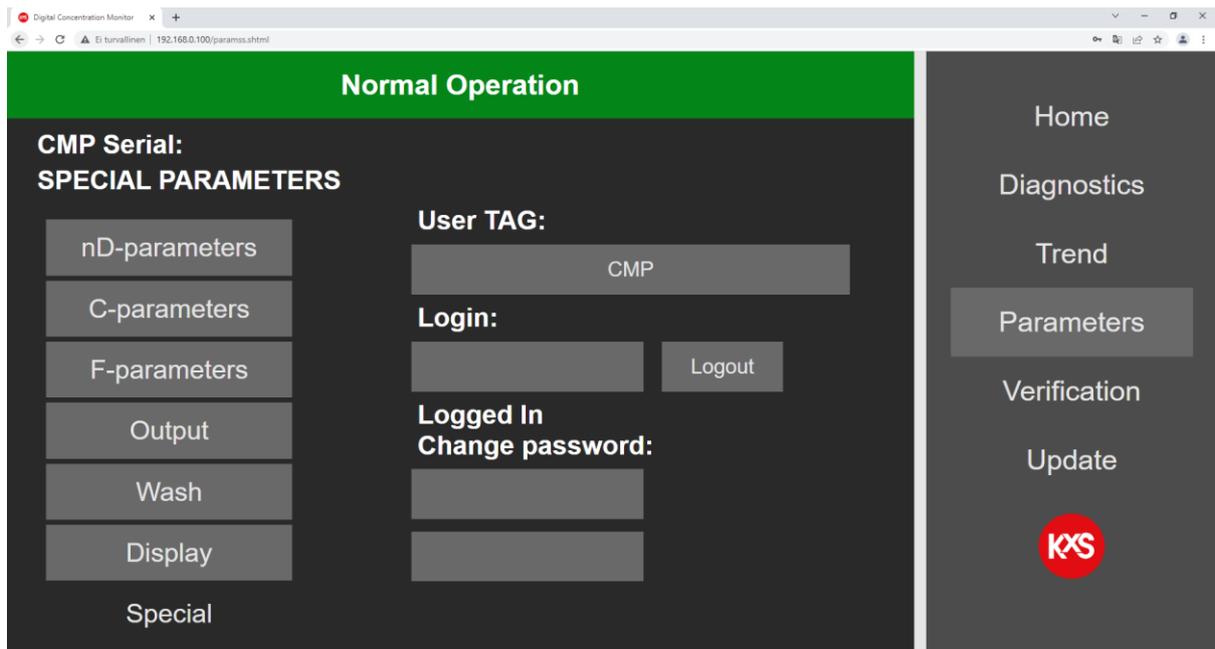


Figure 29 User selectable password

4.4.2 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 optical window). 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 1.000000E+00	C01 0.000000E+00	C02 0.000000E+00
C-parameters	C10 1.000000E+00	C11 0.000000E+00	C12 0.000000E+00
F-parameters	C20 0.000000E+00	C21 0.000000E+00	C22 0.000000E+00
Output	C30 0.000000E+00	W0 1.000000E+00	W1 0.000000E+00
Wash	W2 0.000000E+00	W3 0.000000E+00	Save
Display			
Special			

Navigation menu: Home, Diagnostics, Trend, Parameters, Verification, Update, KXS logo

Figure 30 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.

4.4.3 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 optical window, 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* as described in section 4.4.4

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.

The screenshot shows a web browser window with two tabs for 'Digital Concentration Monitor'. The address bar shows '192.168.0.100/paramsso.shtml'. The main content area has a green header 'Normal Operation' and displays the following information:

- Serial: S22-00075, Serial: 421600034
- Section: OUTPUT PARAMETERS
- Left sidebar menu: nD-parameters, C-parameters, F-parameters, Output, Wash, Display, Special.
- mA output 1: Function (CONC), Min (4mA) (0.000000), Max (20mA) (100.0000), Extras (...), Set button.
- mA output 2: Function (Temp), Min (4mA) (0.000000), Max (20mA) (100.0000), Extras (...), Set button.
- Damping: 10 (range 1...30)
- Ethernet IP Address: 192.168.0.100
- Right sidebar menu: Home, Diagnostics, Trend, Parameters, Verification, Update, and a KXS logo.

Figure 31 User configurable analog measurement output settings.

4.4.4 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.

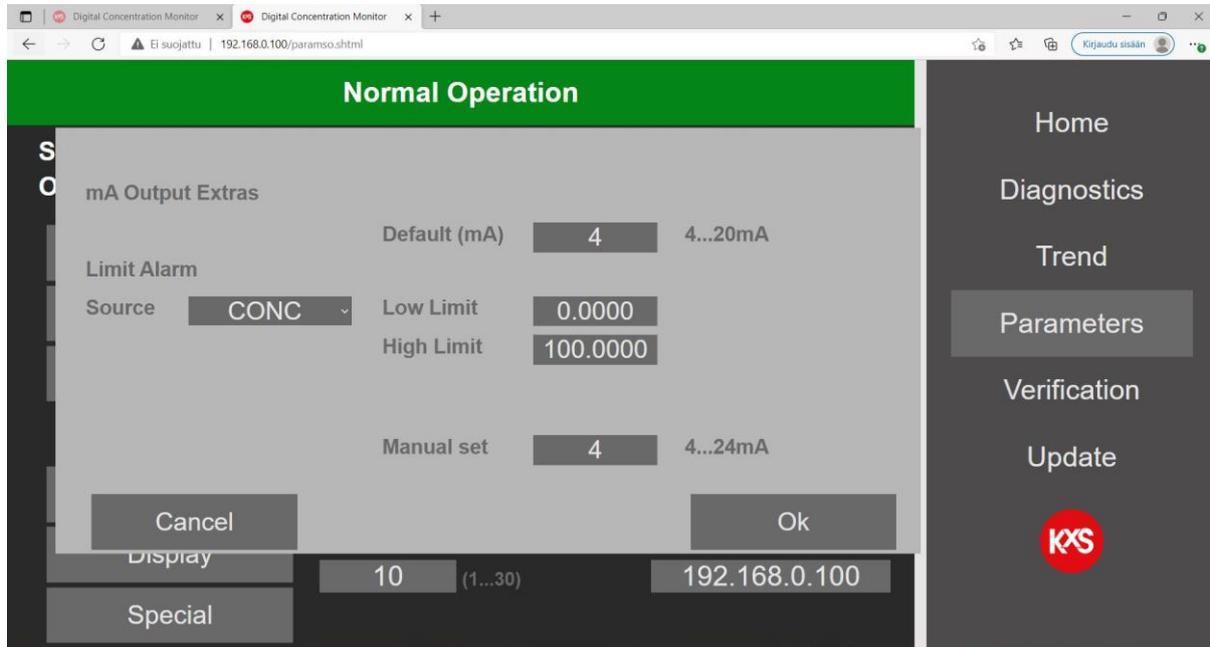


Figure 32 User selectable alarm limit function.

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 in section 2.4, Fig. 17.

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).

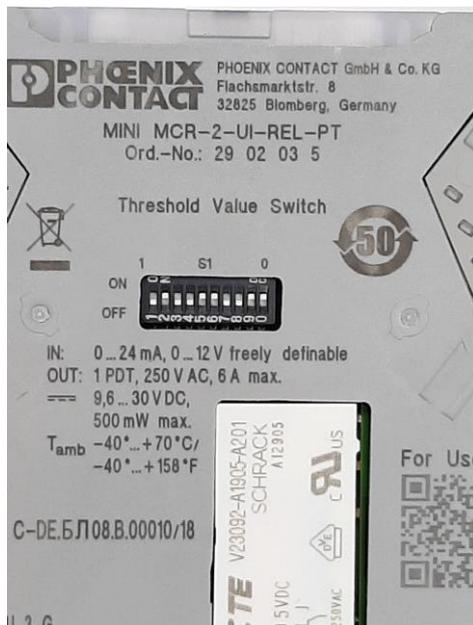


Figure 33 Physical DIP switch configuration for Low alarm functions. DIP switches 3, 5, 6, 9, 0 activated 'ON'

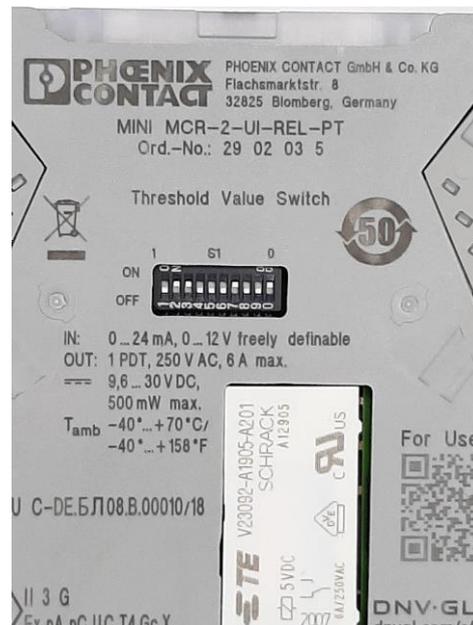


Figure 34 Physical DIP switch configuration for High alarms functions. DIP switches 3, 7, 0 activated 'ON'

4.4.5 Configuration of optical window wash

The optical window 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*.

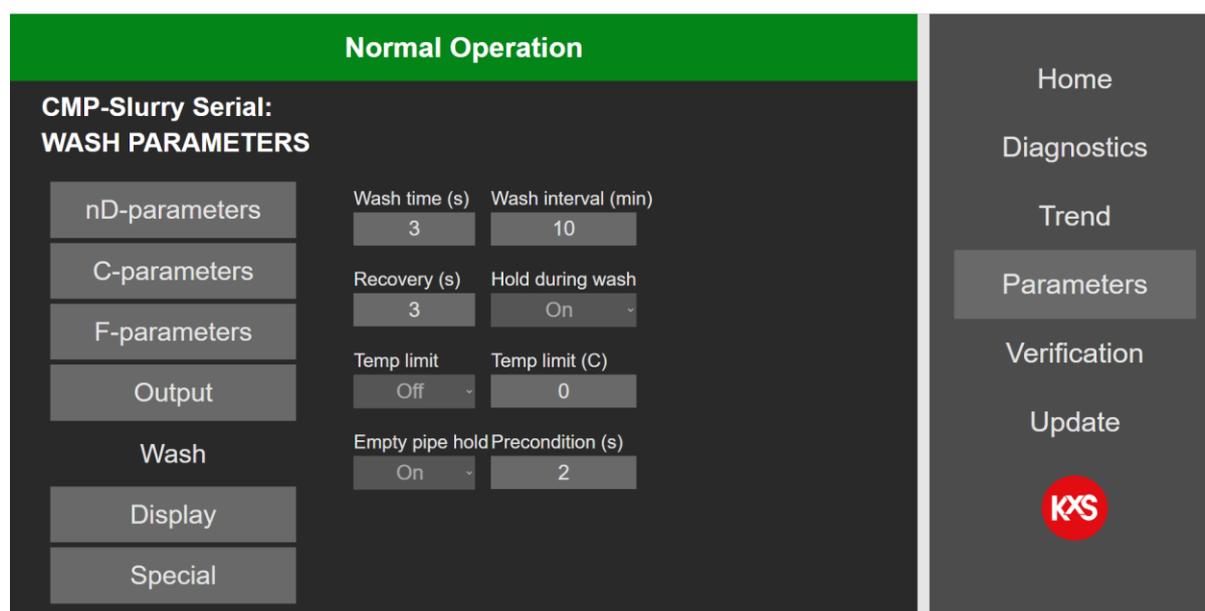


Figure 35 Optical window wash function and time settings.

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.

4.4.6 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.

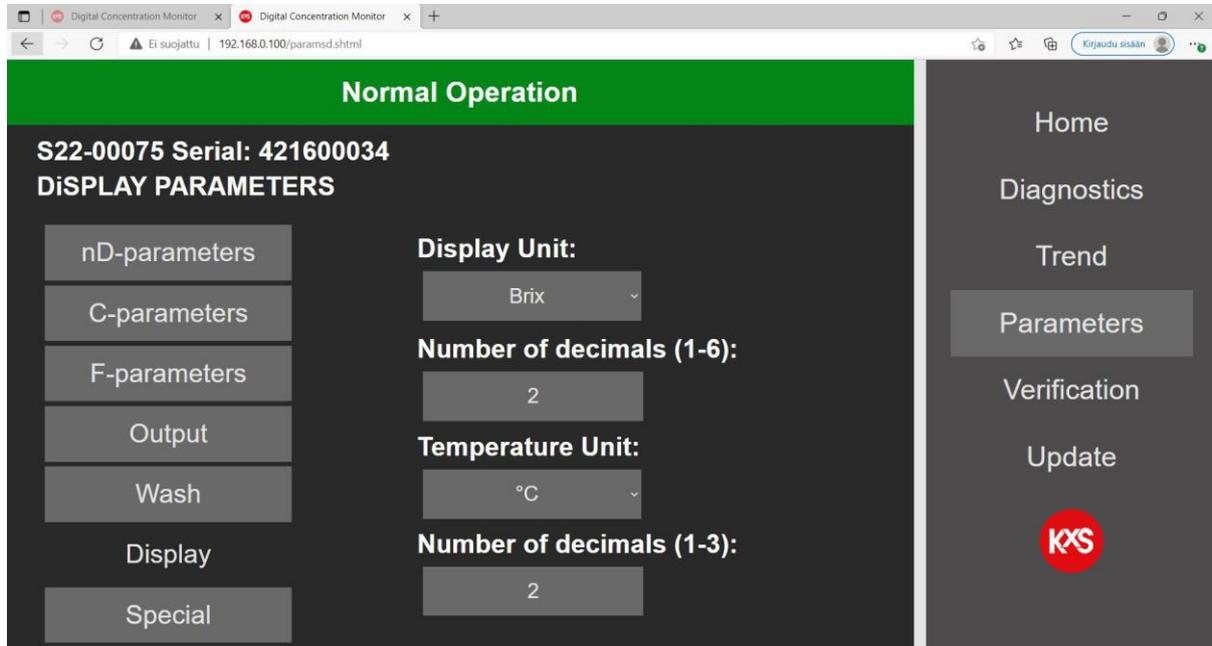


Figure 36 Displayed engineering units for concentration and temperature.

4.4.7 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'.

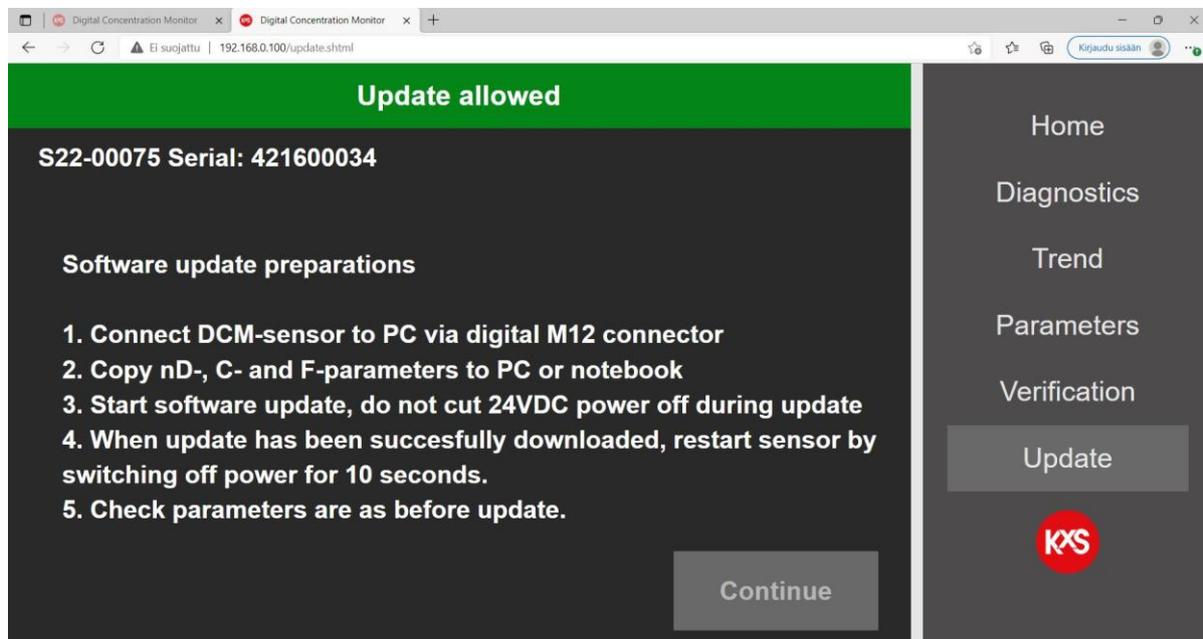


Figure 37 Guided sensor software procedure

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.

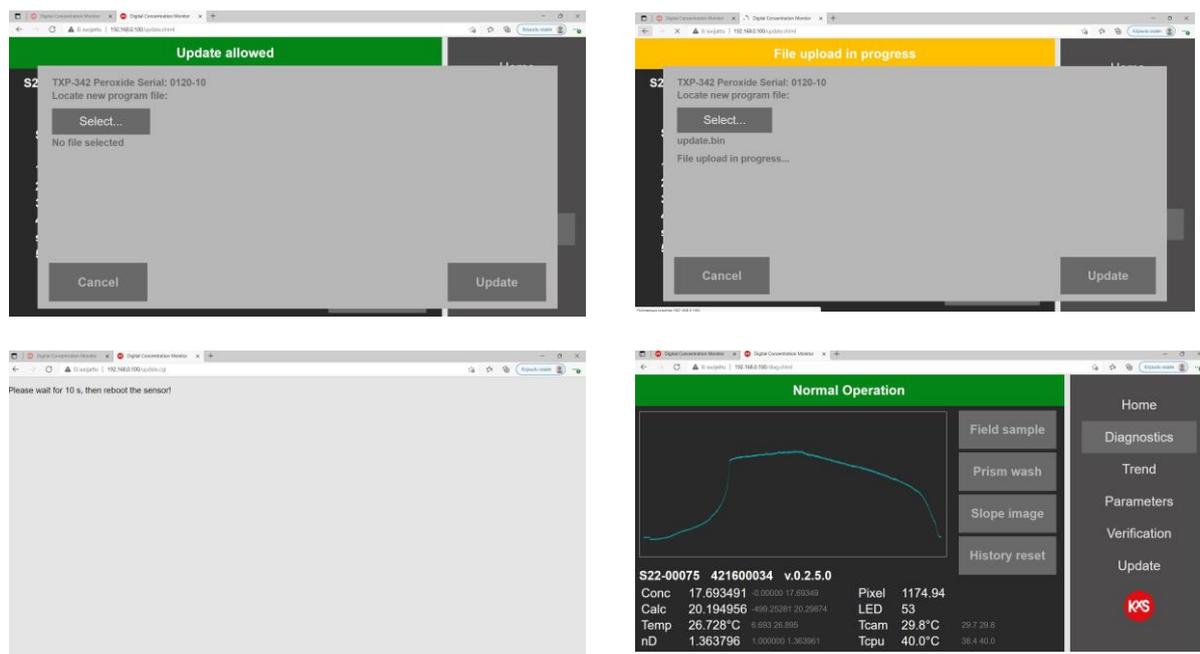


Figure 38 Sensor software update sequence

5. 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	30001	0	string32
LED	30017	16	ushort
RHsens (sensor relative humidity)	30019	18	float
nD (raw refractive index)	30021	20	float
CONC (final concentration value)	30023	22	float
Temp (process temperature)	30025	24	float
Tsens (sensor internal temperature)	30027	26	float
PIX (Pixel value)	30029	28	float
CALC (calculated concentration)	30031	30	float
Qual (Quality of optical image)	30033	32	float

6. Technical specifications of modules

6.1 Modular Connection Unit MCU Enclosure

The power and communication modules in the SP-8000 Modular Connection Unit MCU are with DIN rail mounting and optionally assembled in a stainless-steel enclosure with protection category IP66, NEMA 4X certified by the enclosure manufacturer.

Stainless steel compact enclosures 1.4301 (AISI 304) include mounting plates. The stainless steel door is all-round foamed in PU seal. Protection category IP 66. The enclosure manufacturer provides an EU Declaration of Conformity and UL Standard(s) for Safety.

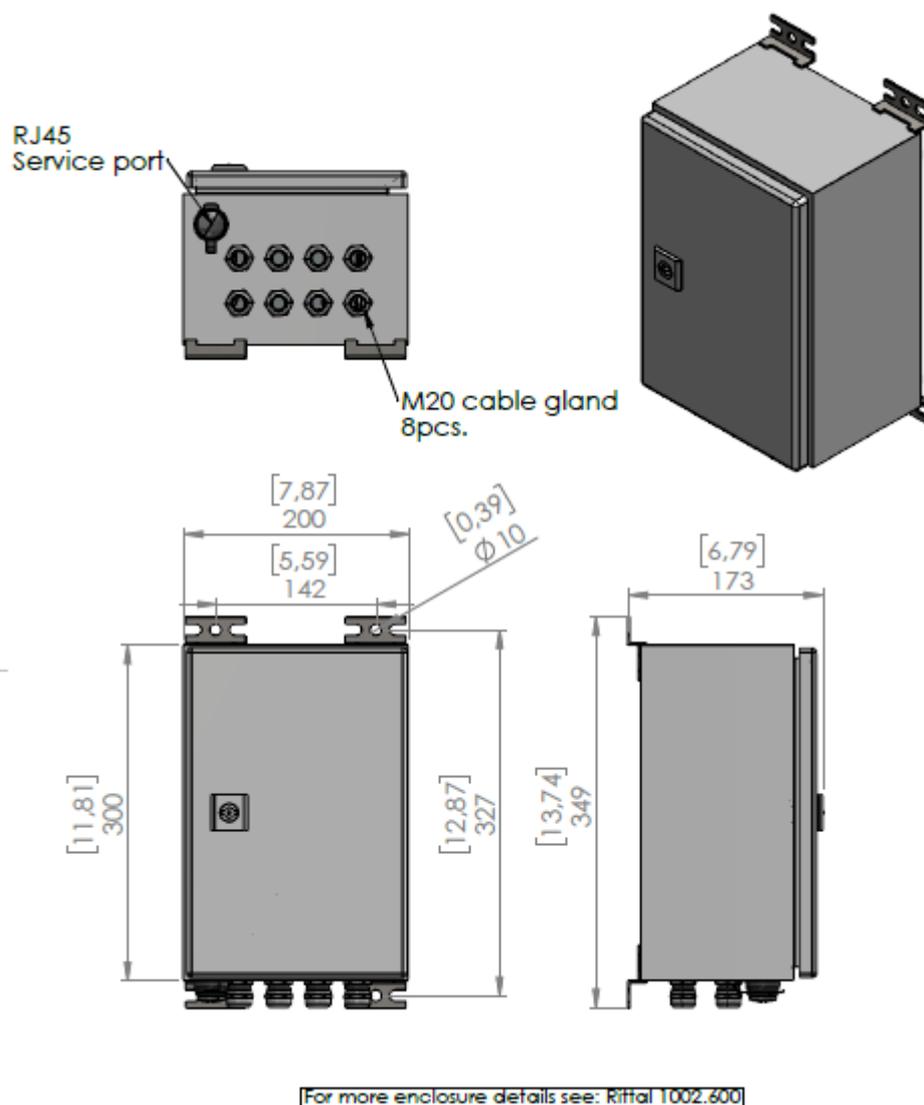


Figure 39 Dimensional drawing of Modular Connection Unit enclosure DWG No. 10179.

6.2 Display options for User Interface access

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

6.2.1 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 1.2 Fig.4. The SP-9310 RJ-45 connector is with corresponding color coding of mode A. The cable is connected to the computer RJ-45 port, or USB-C port when a RJ-45 to USB-C adapter is used. The sensor user interface is accessed as described in section 1.5.

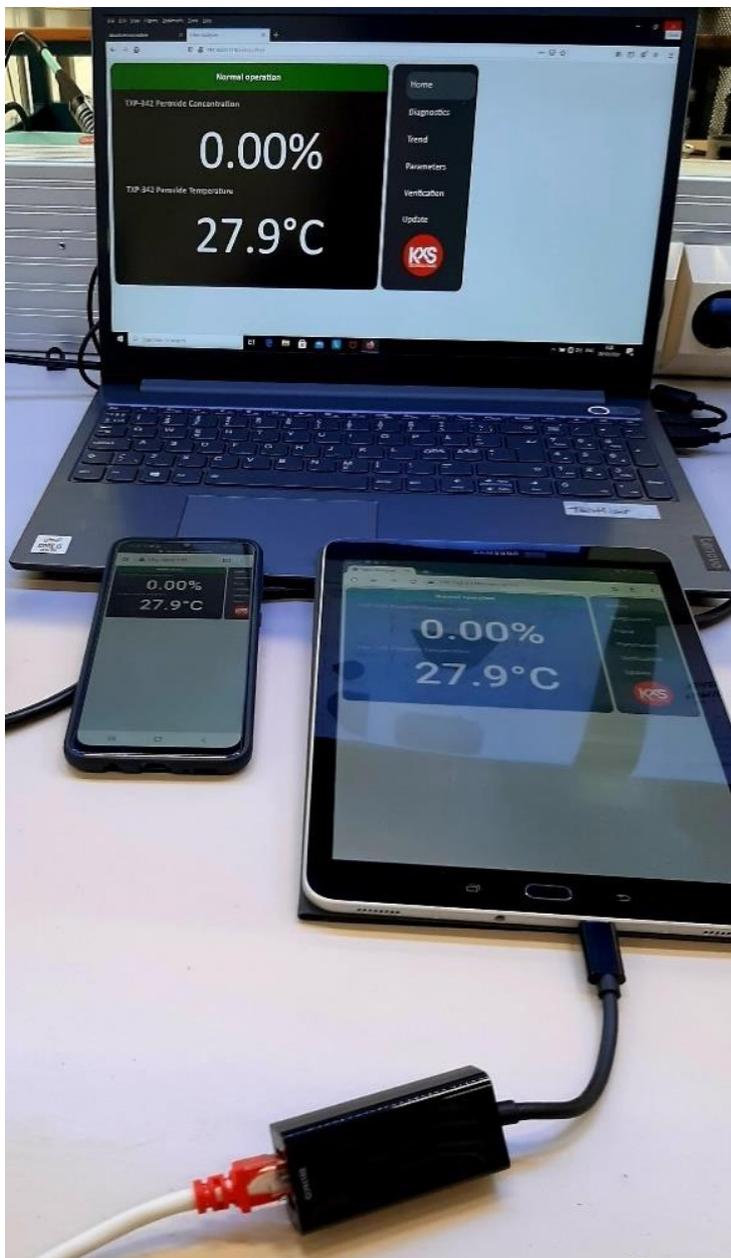


Figure 40 Computer or mobile device used as user interface.

6.2.2 WLAN for remote access with Computer or mobile device

The Modular Connection Unit MCU stainless steel enclosure can be equipped with a WLAN wireless module SP-9600 Fig. 17 for wireless connection to a computer or mobile device with corresponding WLAN features. The WLAN wireless module operates with 24VDC power input and holds an RJ-45 port for Ethernet cable connection from the Industrial Ethernet Switch SP-9320 placed inside the MCU enclosure.



Figure 41 WLAN access point, client with two internal antennas (MIMO) for single-hole mounting, IP54, WLAN 802.11 a, b, g, n, frequency: 2.4 GHz, 5 GHz (incl. DFS channels), connections: COMBICON 9 ... 32 V DC, RJ45: for LAN, web, http/https, Command Line Interface

6.2.3 Industrial touch panel display specifications

An external industrial display SP-9500 is available with a panel mount design and 7" touch display for user interface and measurement reading purposes with IP66 front protection category. The display is powered with 24VDC. The display with a RJ-45 port is used for the sensor Ethernet cable connection. The touch panel unit can display four sensors by selecting respective sensor URL line 'active' in settings of the display user interface.



Figure 42 Panel mount external 7" touch display with connectivity of 4 sensors. Touch panel with 17.8 cm/7" TFT-display (Projective-capacitive (PCAP)), IP66 Touch panel with 7.0-inch widescreen (16:9) VGA, PCAP display, Software: Qt Browser

6.2.4 Industrial Panel PC display with IP65 protection

When an enclosure for the display is required, an external industrial 15" display SP-9540 is available with a panel PC of IP65 protection category. The panel PC holds an RJ-45 port for Ethernet cable connection from the Industrial Ethernet Switch SP-9320. When display is powered up, opt for the configuration page during display start-up. On the display URL page set the sensor default IP address 192.168.0.100.



Figure 43 Full IP65 industrial PC with Intel® Pentium® N4200 processor and multi-touch capacitive full HD display. Designed for VESA, pole, or arm mounting.

6.3 Limit value switch specifications



Figure 44 Limit value switch. Universally configurable limit value switch with PDT relay output and plug-in connection technology for switching analog limit values. Configurable via DIP switch or software. Push-in connection technology, standard configuration.

6.4 Sensor M12 cable specification



Figure 45 Network cable, 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

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