Smart Sensor User Guide

UnU

Version

Version	Date Modified	Contents	Editor
V1.5.1	02. 23. 2023	• Add compressed air and brush cleaning device details • Change terminal block description	SC Choi Usman
V1.5.0	01. 13. 2023	• Add Maintenance details • Add Calibration procedure	SC Choi Usman
V1.4.0	07. 19. 2022	• Menu Modifications	SC Choi Usman
V1.3.0	11. 01. 2021	• Add safety-related information • Add product installation information	SH Jang
V1.2.2	08. 02. 2021	• Add New menu and change smart sensor picture	SC Choi
V1.2.1	12. 17. 2020	• Add communication protocol	SC Choi
V1.2	11. 30. 2020	• Add Modbus protocol	SH Jang
V1.1	07. 17. 2020	• Add new menu and sensor picture	SC Choi
V1.0	10. 30. 2019	• First written	SH Jang

Handling Precautions

[Warning Signs]

This instruction manual warns the user of hazardous situations and risks of personal injury or property damage through the following warning signs.

⚠ **DANGER:** Indicates a condition of imminent danger, which, if not prevent, will result in death or serious injury.

⚠ **WARNING:** Indicates a potentially dangerous condition, which, if not prevent, may result in death or serious injury.

⚠ **CAUTION:** Indicates a potentially dangerous condition, which, if not prevent, may result in minor or minor injury.

⚠ **(Used without text) Indicates safety-related messages.**

NOTE: Indicates actions that do not result in personal injury, which may result in property damage if not prevent.

⚠ CAUTION

1. The Smart Sensor operates with AC 110~240V, so be careful during work.
2. When operating the device while the power is applied, safety gear must be worn, and in particular, do not cirectly touch the device with wet hands.
3. When manipulating the power supply of the indicator, do not work with conductive objects(drivers, knoves, scissors, etc.), and check that the pro-mary power is OFF.

⚠ CAUTION

1. It emits very strong ultraviolet rays during operation.
2. Do not look directly into the emitter while it is in operation as UV light sources can harm your eyes.
3. Be sure to wear protective glasses when checking the light source.
4. Avoid prolonged exposure to skin or other tissues.
5. Keep out of reach of children.

UnU's Smart sensor is a device that measures the water quality of sewage and wastewater by an optical method. It does not use any chemicals and can measure water quality in real time. Before installing the smart sensor, please thoroughly grasp the following. Since the measure-ment component is operated in an immersed condition, if the smart sensor is examined while in operation, human and material damage may occur due to electric shock, therefore please check it in a safe state.

1. Installation Condition

1.1 Indoor use: a protective case must be manufactured and attached inside to use.

1.2 Altitudes: 2,000m or less

1.3 Ambient temperature: 5~40°C (When used outdoors, the temperature control device inside the protective case should be designed to be within the appropriate temperature range)

1.4 The maximum relative humidity should be 80% for temperatures below 31°C, which declines linearly from an ambient temperature of 40°C to a relative humidity of 50%.

1.5 Main supply voltage fluctuations Nominal voltage must be less than ±10%

1.6 Transient overvoltage should be below the overvoltage category II.

1.7 Temporary overvoltage from main supply equipment[1].

1.8 The degree of pollution in the intended condition (in most cases, the degree of pollution is 2[2].)

[1] This refers to a phenomenon in which a voltage higher than the original line voltage is supplied. This is especially referred to when the line voltage is higher than the rated voltage for a long time (usually more than 1 second), and a phenomenon that accounts for a large proportion as a cause of product lifespan shortening.

[2] Non-conductive contamination occurs, but it is expected to occasionally cause temporary conductivity due to dew condensation.

2. Installation

2.1 Requirements for Installation method and location

(a) The place where the indicator is attached must have a structure that can withstand wind pressure, rainfall, and heavy snow, and install it where it is not directly exposed to direct sunlight or rainfall.

(b) The flowrate at the place where the smart sensor (measuring part) is immersed is less than 3m/s and is installed in a place where no fine air droplets or turbulence occur.

(c) If you want to install under the same conditions as (b), a water tank with a structure that can remove air bubbles should be installed.

(d) Select a place where the measuring part of smart sensor is not exposed to direct sunlight, and if it is unavoidable, a cover and a shading film that can block the light should be installed to protect the measuring part from direct sunlight.

2.2 Guidelines for protective grounding

(a) The grounding pin connects the grounding wire to the indicator's power terminal, and if there is no separate grounding wire at the location where the power is supplied, a grounding rod should be installed to ground it.

2.3 Guidelines for connecting indicator, measuring, and cleaning parts.

(a) Power and grounding wires are firmly fixed to the power terminal block of the indicator and applied a force to check the connection status.

(b) When connecting the indicator to the measuring part, connect a wire of the same colour as the cable indicated on the indicator and apply force to check the connection.

(c) The waterproof connection of the measurement section and the brush cleaner features a notch, which determines the direction of coupling. Attach the right-hand screw in the tightening direction and ensure that it is properly connected with the screw thread. If the bonding condition is poor, the waterproof ability is lost, and flaws in the product may arise as a result of a short circuit.

(d) Check the communication method and switch the setting switch to the appropriate method when connecting a communication line to transmit measurement water quality data to the outside. TXD and RXD (TX+, TX-) written on the indication are based on the indication, therefore proceed with caution.

(e) Connect after validating the polarity indicated on the measurement component since analogue output has polarity. A maximum load resistance of 400 ohms may be connected.

2.4 Guidelines for power connection

(a) Supply wiring requirements

- The smart sensor’s maximum power consumption is within 10W, but when used with a compressed air cleaning part (device), the maximum power consumption is 100W, thus wiring must be done with a wire 0.75Sq or larger.

(b) Circuit breaker capacity

- Use an Electric Leakage Breaker (ELB), and the breaking current should be 6A.

3. Operation

⚠ **CAUTION: Read all safety precautions and related instructions.**

3.1 Instructions for potentially toxic or hazardous substances that may be released from the Smart Sensor

- The measuring part of smart sensor is a device that measures by emitting and measuring light of multiple wavelengths of ultraviolet and infrared wavelengths. Because it emits strong ultraviolet rays to measure pollutants, care must be taken not to expose it to the skin.
- Do not look directly at the light source that emits ultraviolet rays. Protective glasses with UV protection must be worn if verification is required.
- Since prolonged exposure to skin and other body can cause serious damage, inspect the light source while wearing gloves and work clothes that extend down to the wrist.

4. Smart Sensor Maintenance

4.1 Repairing and disassembling indicator and sensor (measuring part) units of smart sensors other than manufacturer engineers may cause serious problems with the device. Be sure to contact the manufacturer and request repairs to the manufacturer's engineer.

4.2 If it is impossible to visit the manufacturer office, disconnect the wiring according to the engineer's instructions with the entire power of the smart sensor turned off, and then put it in the protective case provided at the time of delivery and deliver it to the manufacturer.

Contents

1. System Configuration

1.1. Configuration

The Smart Sensor measures the concentration of organic substances, Total-Nitrogen (T-N) and Total-Phosphorus (T-P) in real time using multi-wavelength ultraviolet and infrared rays, and simultaneously measures the several types of water quality parameters with one sensor without using chemicals.

SMART SENSOR SPECIFICATIONS

Smart Sensor				Model: UV-06, UV-07		
Measurement Method	Multi-wavelength absorptiometry			**Measurement Target**	Wastewater, Raw water, and Treated water	
Measurement Period	All items within 1 second			**Measurement Error**	Within ± 5.0 % (Standard solution)	
Installation Type	Immersion, water tank type			**Cleaning Device**	Compressed air and brush	
IP Rating	IP68			**Correction Factor**	Automatic correction of measured values according to changes in water temperature	
Power	DC 24V, Max. 2.5W			**Material**	PEEK, STS316, POM	
Size (Unit: mm)	**UV-06**	5mm	Outer diameter ø60	Length (excluding water proof connector)	296mm	
		10mm			301mm	
		40mm			331mm	
	UV-07	5mm	Outer diameter ø51	Length (excluding water proof connector)	257.8mm	
		10mm			262.8mm	
		40mm			292.8mm	

Indicator Specifications

Indicator	
Display	LCD. 4 Line 20 Character
Power	AC 100~230V, 5W or less
Material	Body: ABS, Cover: Transparent PC
Input Method	8 Keys
Contact Oputput	Dry Contact (Compressed air cleaning device and cleaning signal)
Output Method	Analog DC 4~20 mA 2CH (Selectable), Serial: RS-232C or RS-485

Note

- The menu composition and specifications of UnU's Smart Sensor User Manual may differ depending on the Smart Sensor model and Indicator type

Measuring Range of Water Quality Parameters

Items	Measuring Range (Based on Standard Solution)						
	OPL : 5mm		OPL : 10mm		OPL : 40mm		Note
TOC *, **, ***	0 ~ 200	mg/L	0 ~ 100	mg/L	0 ~ 20	mg/L	Base type (Basic measurement items)
EC *, **, ***	0 ~ 1,000	µS/cm	0 ~ 1000	µS/cm	0 ~ 1000	µS/cm	
Temperature *, **, ***	0 ~ 45	°C	0 ~ 45	°C	0 ~ 45	°C	
DOC	0 ~ 200	mg/L	0 ~ 100	mg/L	0 ~ 20	mg/L	Option (Additional items)
TBOD	0 ~ 350	mg/L	0 ~ 175	mg/L	0 ~ 40	mg/L	
$SBOD_{Cr}$	0 ~ 350	mg/L	0 ~ 175	mg/L	0 ~ 40	mg/L	
$TCOD_{Cr}$	0 ~ 400	mg/L	0 ~ 200	mg/L	0 ~ 50	mg/L	
$SCOD_{Mn}$	0 ~ 400	mg/L	0 ~ 200	mg/L	0 ~ 50	mg/L	
$TCOD_{Mn}$	0 ~ 150	mg/L	0 ~ 75	mg/L	0 ~ 20	mg/L	
SCOD	0 ~ 150	mg/L	0 ~ 75	mg/L	0 ~ 20	mg/L	
TSS *, **	0 ~ 1,200	mg/L	0 ~ 600	mg/L	0 ~ 150	mg/L	
T-N *, **	0 ~ 100	mg/L	0 ~ 100	mg/L	0 ~ 50	mg/L	
NH_4^+-N	0 ~ 100	mg/L	0 ~ 100	mg/L	0 ~ 50	mg/L	
NO_x-N	0 ~ 60	mg/L	0 ~ 40	mg/L	0 ~ 20	mg/L	
T-P *, **	0 ~ 50	mg/L	0 ~ 50	mg/L	0 ~ 10	mg/L	
PO_4-P	0 ~ 50	mg/L	0 ~ 50	mg/L	0 ~ 10	mg/L	

Note

* Indication of excellent procurement product certification items (TOC, T-N, T-P, TSS, EC, water temperature)

** Indication of innovative product (KIP) certification items (TOC, T-N, T-P, TSS, EC, water temperature)

***Indicates new product (NEP) certification items (TOC, EC, water temperature)

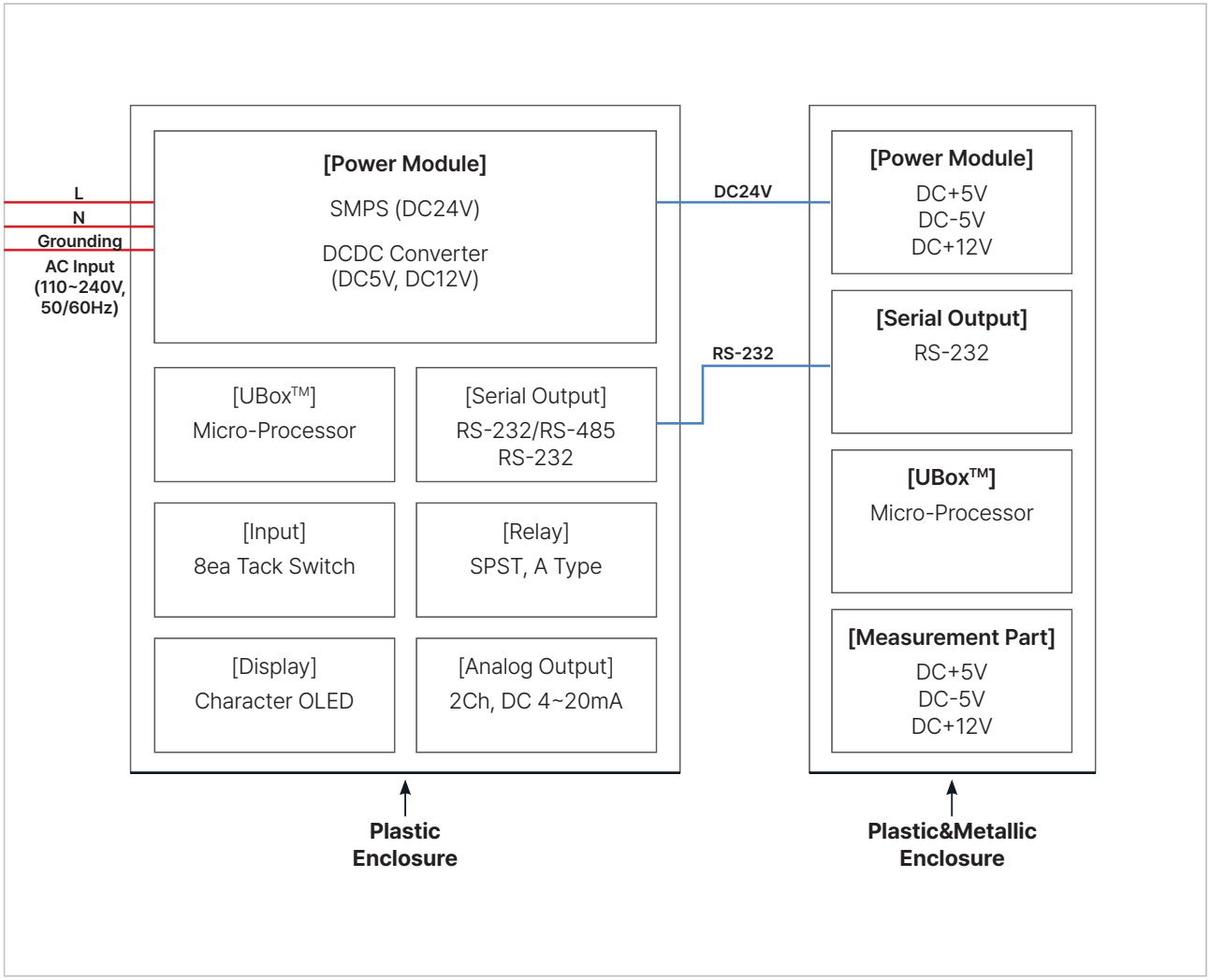
- Salt concentration in water may affect T-N, T-P measurement accuracy.
- Items can be used optionally, and prices may vary depending on the number and type of metrics.
- Since smart sensors use an indirect measurement method using optical principles, the measurement items are 'e' is added as in TOCe (equivalent), but for convenience, 'e' meaning equivalent is omitted.
- Excellent procurement, innovative product, and new product (NEP) certification is limited to the UV-06 model.
- OPL 2mm applies only to UV-07, and only compressed air cleaning devices can be used as cleaning devices.
- Dissolved water quality items must be checked after consultation with the manufacturer to determine whether they can be measured.

Main Screen Indicator Screen

Representation of Smart Sensor

The actual picture of the Smart Sensor (From left, 5mm, 10mm, 40mm and Smart Sensor picture with brush cleaning device combined)

System Configuration



1.2. Key Configuration and Description

Up Button

- Move menu
- Change settings

Back Button

- Move to submenu
- Cancel settings

Left Button

- Move menu
- Change setting value digits

Menu Button

- Enter the menu from the measurement screen

Right Button

- Move menu
- Change setting value digits
- Enter editing mode

Enter Button

- Enter menu
- Save change settings

Down Button

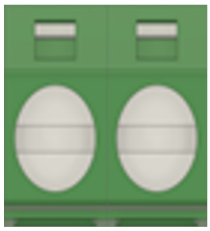
- Move menu
- Change settings

Main Button

- Move to measurement from menu list
- Change measurement screen page

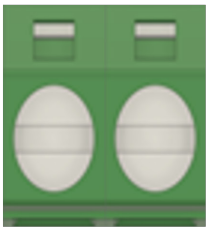
1.3. Terminal Block Description

AO1



A1+ GND

AO2

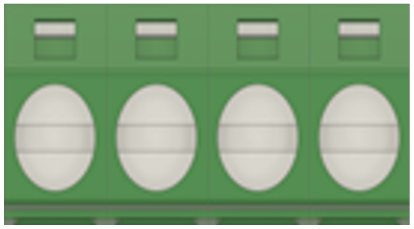


A2+ GND

EXTERNAL

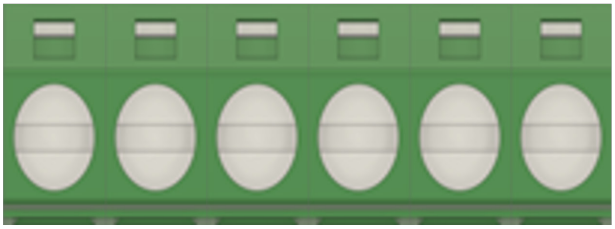
TXD(TX+) RXD(TX-) GND CTS RTS

SENSOR



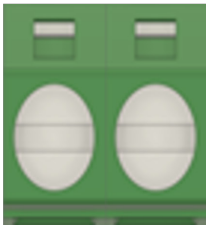
RED GREEN WHITE GREEN

MOTOR



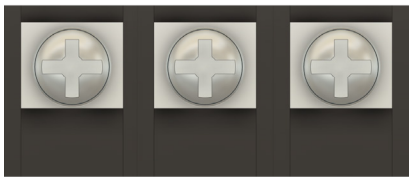
BLACK RED YELLOW SHIELD BLUE WHITE

RELAY



R1 R2

POWER

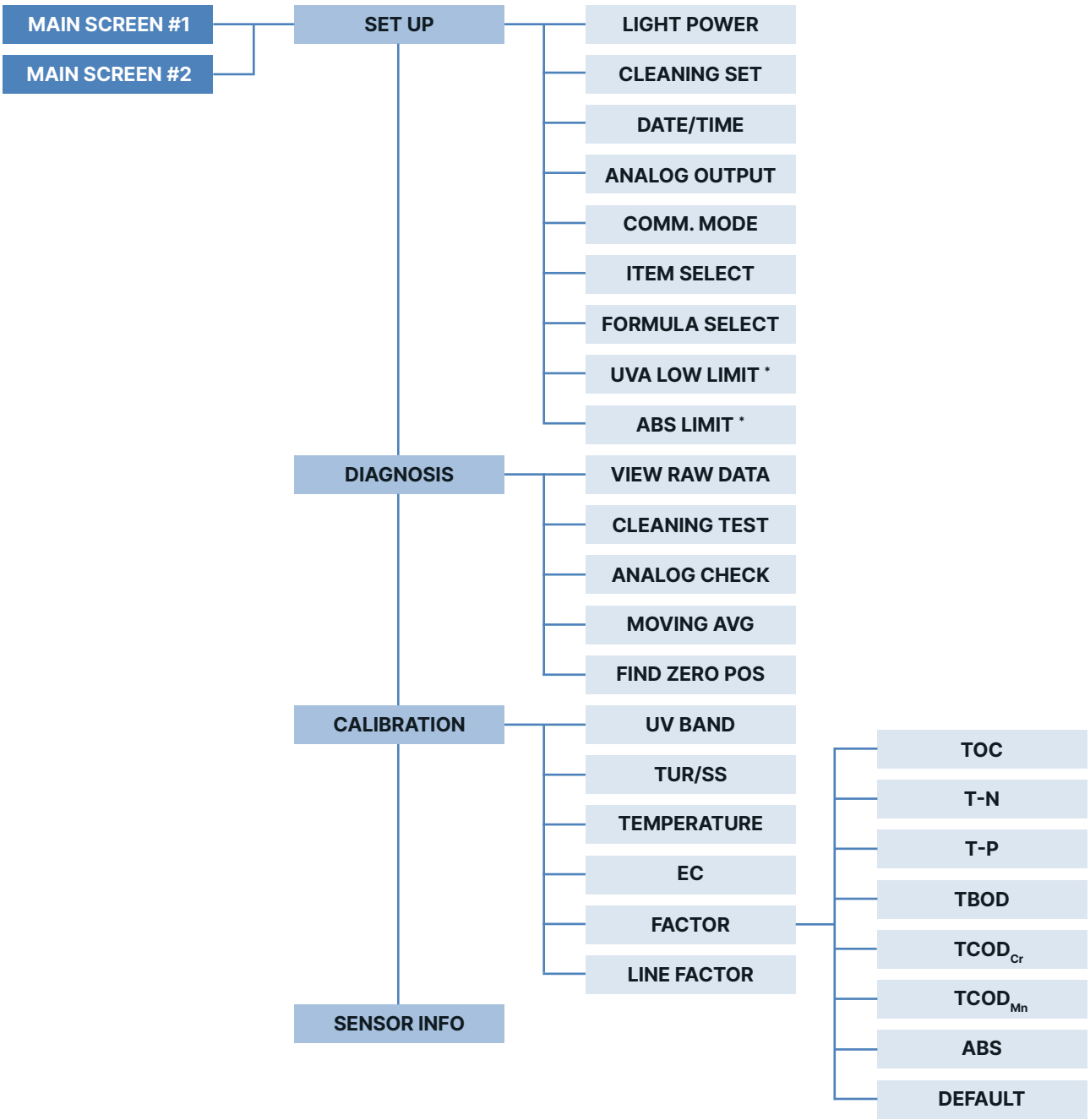


AC(L) AC(N)

- AO1, AO2 : Analog output terminal block
- EXTERNAL : External communication output terminal block
- SENSOR : Smart sensor dedicated terminal block
- MOTOR : Terminal block exclusively for brush cleaning devices
- RELAY : Compressed air cleaning device contact terminal block
- POWER : Smart sensor indicator power terminal block

2. Menu

2.1. Menu Configuration



Note

- Content displayed on the screen may vary depending on the smart sensor indicator version.

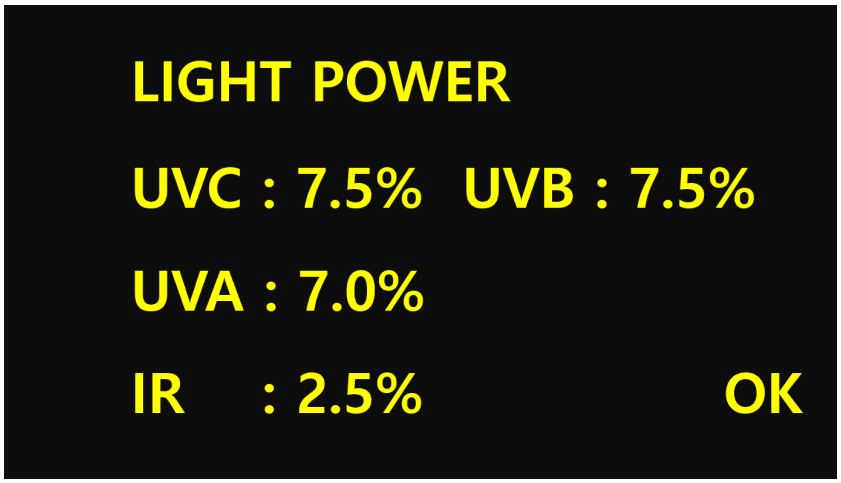
2.2. Menu Description

You may access the menu by pressing the MENU key on the measurement screen. Once accessing the menu screen, the desired set value may be checked and modified by combining seven keys, apart from the MENU key.

RIGHT key activates EDIT MODE, and then UP and DOWN keys are used to edit the value or setting, as well as RIGHT key to move the cursor.

2.2.1 Set Up

1. Light Power



This screen is to set the sensor LED brightness menu.

Since the LIGHT POWER is a unique factor of the sensor, all values are indicated as 0.0% if the sensor is not connected. Even if the value is modified in the absence of a sensor, the value is not saved. Since it is an important factor in the measured value, do not modify the value without confirmation from the manufacturer or operator.

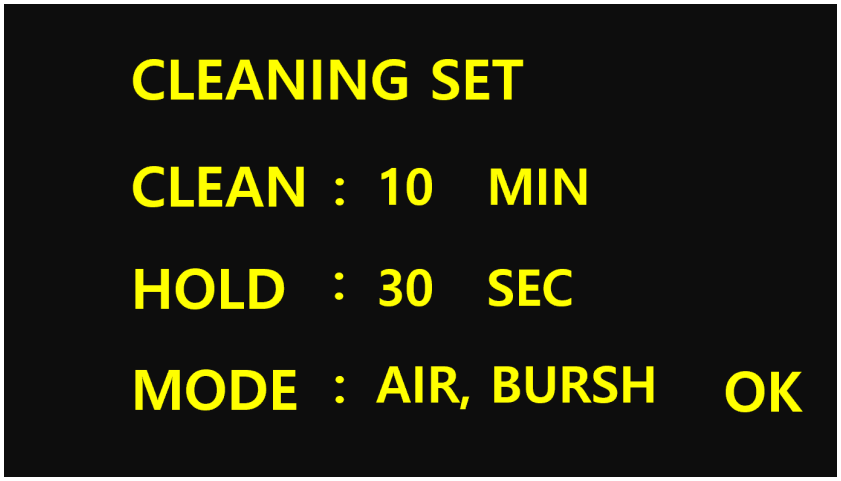
To set, use the RIGHT key, place the cursor in front of the value you want to modify, and then use the UP and DOWN keys to modify it to the desired value. You can quickly change the value by pressing the key for more than 3 seconds.

After changing to the desired value, move the cursor to OK and press the ENT key to transmit it to the sensor.

Note

- Content displayed on the screen may vary depending on the smart sensor indicator version.

2. Cleaning Set



This screen is a menu to set the Smart sensor cleaning cycle, the time to hold the measurement data after cleaning, and the cleaning mode.

The cleaning cycle (CLEAN) can be set in units of 5 MIN (minutes) from 0 MIN, and cleaning is not performed when set to 0 MIN. Data hold (HOLD) serves to hold the data for a certain period during the cleaning time. It can be set in units of 5 SEC (seconds) from 0 SEC, and it is recommended to set it for at least 30 SEC to see a more accurate value after cleaning.

There are three cleaning modes: AIR, BRUSH, AIR, and BRUSH depending on the type of washer. Set according to the type of cleaning mode you want to use.

Use the RIGHT key to move between menus and use the UP and DOWN keys to edit values. When the setting is complete with the desired value, press the ENT key to move the cursor to OK.

Since the time required for cleaning is 50 seconds, the total cleaning time setting is the sum of 50 seconds and the HOLD setting time. While the smart sensor is cleaning, `C` symbol is displayed in the lower right corner of the main screen of the indicator.

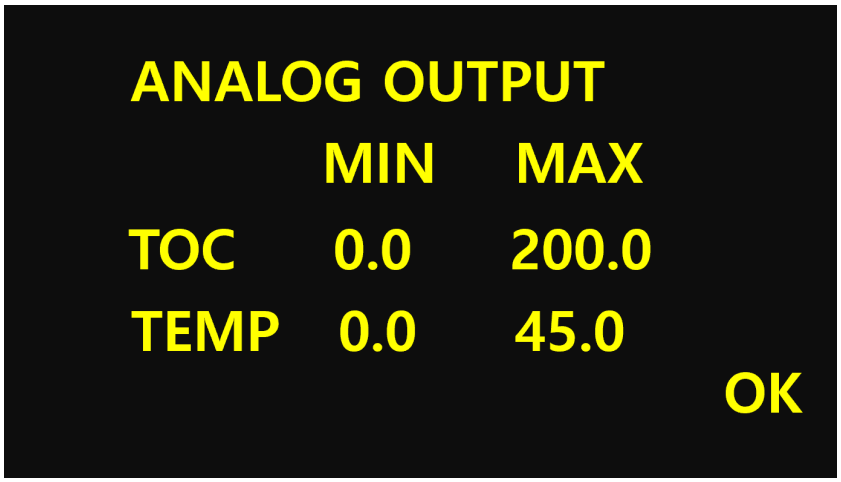
3. Date/Time

This screen is a menu to set the current time in the RTC (Real Time Clock) device mounted inside the indicator.

Although it is not a factor influencing the measurement of sensor, it is used to determine the cleaning cycle and to transmit

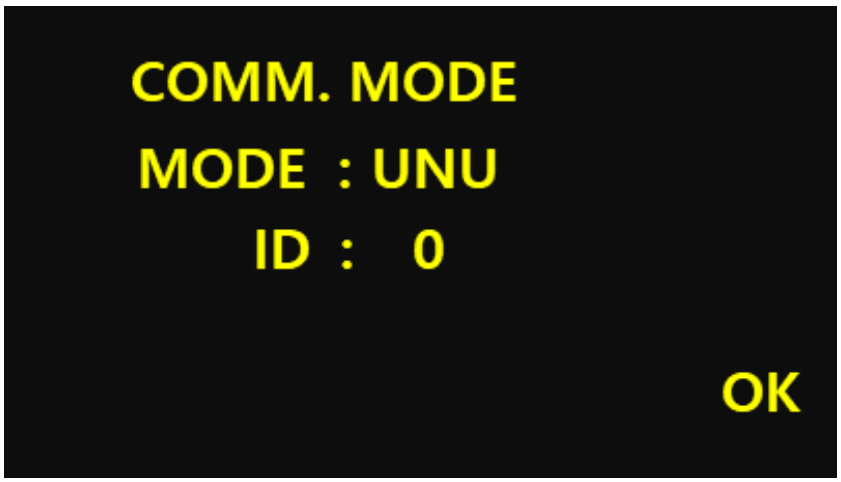
measurement values and other information through digital communication. The operator must check whether the indicator time is set to be the same as the current time, and if the set time differs greatly from the current time, it must be corrected. DATE sets the year, month, and day, and TIME sets hours, minutes, and seconds. Set the current date and time, and when the value setting is complete, move the cursor to OK and press the ENT key.
Time is calculated through the vibration of a crystal oscillator, and since the oscillator is sensitive to temperature changes, an RTC with a temperature compensation circuit built in is installed.

4. Analog Output



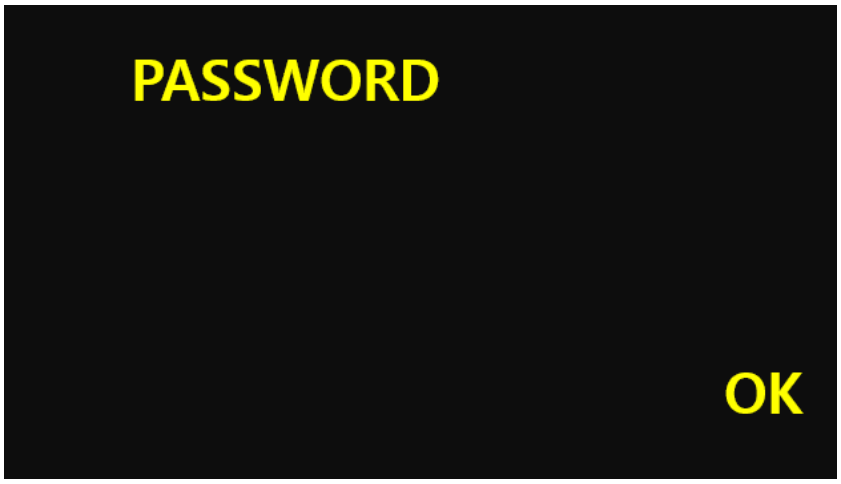
This screen is a menu to set analog output.
Two channels are set in one screen. Use the RIGHT key to move between menus and use the UP and DOWN keys to edit values. When the desired value setting is completed, move the cursor to OK and press the ENT key.
There are two channels that can be output as analog. After selecting the item to be output, set the RANGE (MIN, MAX) for each channel.

5. COMM. Mode



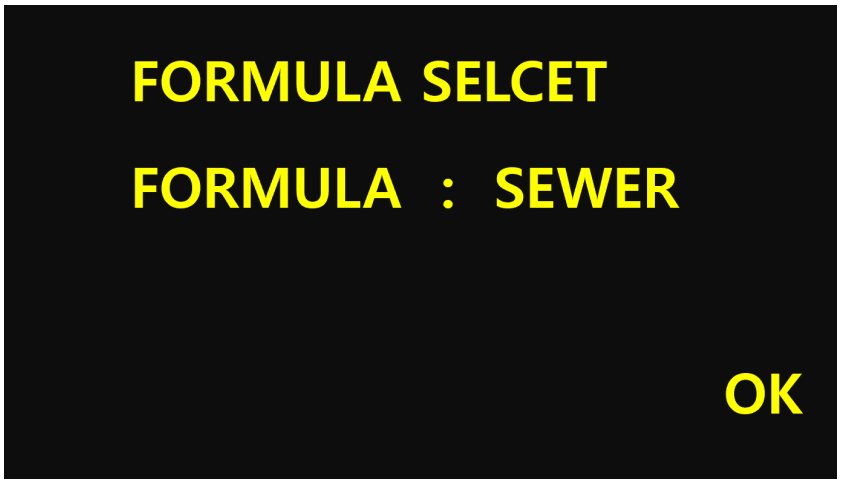
This screen is a menu to set the communication mode and equipment ID of the indicator.
It can be set in four modes: UNU, WCDMA, MODBUS, and EXTERNAL. Select the communication mode you want to use and when the setting is complete, move the cursor to OK and press the ENT key.
The equipment ID is used to set the equipment serial number when communicating with multiple instructions or when using MODBUS PROTOCOL. IDs can be set from 0 to 99. For descriptions of each communication mode, please refer to Chapter 3, Serial Communication.

6. Item Select



This screen is the manufacturer manager menu. It is not accessible other than manufacturer engineer.

7. Formula Select



This menu is for selecting the formula version of the value calculated in the indicator.
The default is the SEWER version, and the formula version is set according to the situation in the field. Before changing the formula version, you must obtain confirmation from the manufacturer or operator before making any changes.
After changing the formula version, you must enter the INFO menu to check whether the FORMULA version has changed.

2.2.2 Diagnosis

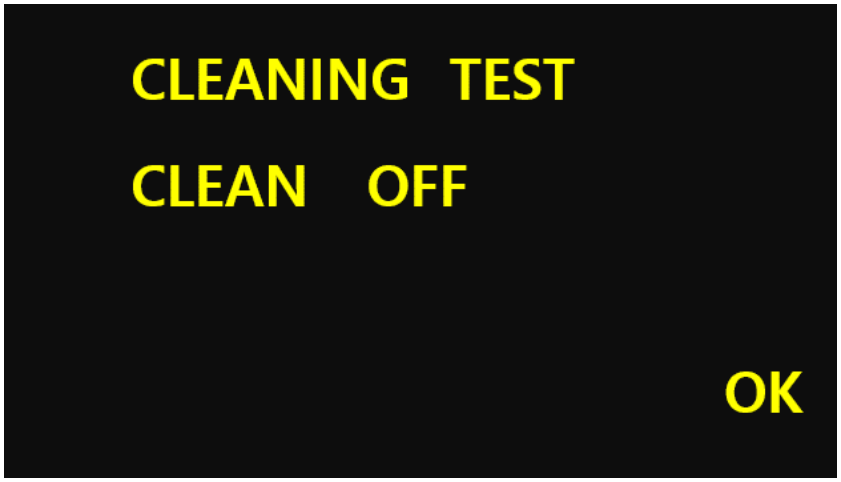
1. View Raw Data

This screen is a menu to view RAW data of UVC, UVA, and IR values. The amount of light irradiated from the light-emitting unit is quantified and quantified by the light-receiving unit, and the operation status of the light-emitting unit and the light-receiving unit can be checked.
This value cannot be modified, and if necessary, adjust the brightness of the light source in the LIGHT POWER menu, and you can see that the value is changed. The maximum value of RAW DATA is 65535.0, but if RAW DATA is larger than the set value in the UVBAND menu, the temperature of the sensor and the abnormality of the value of LIGHT POWER should be confirmed.

Note

- Content displayed on the screen may vary depending on the smart sensor indicator version.

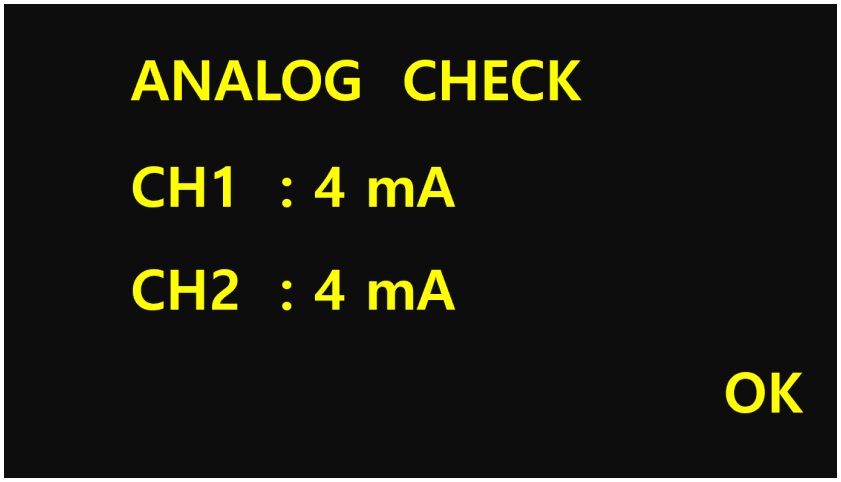
2. Cleaning Test



This screen is a menu to test the operation of the sensor cleaning.

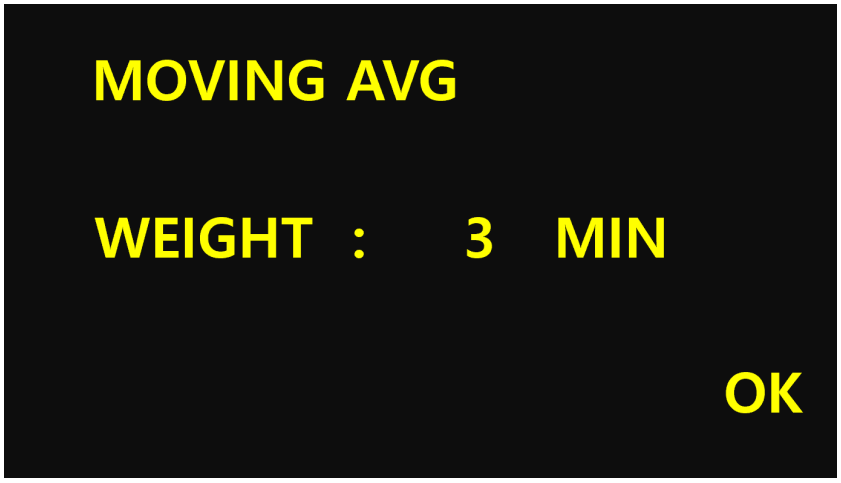
After moving the cursor by pressing the RIGHT key, set it from OFF to ON using the UP and DOWN keys. When the setting is completed, move the cursor to OK and press the ENT key to operate the cleaning mode.
Since this menu is executed in the same procedure as cleaning, the measured value is fixed, and a **C** symbol indicating cleaning is displayed on the main measurement screen.
In the case of a brush mode, the brush reciprocates the sensor measuring part 4 times, and in the case of an air compressor mode, when the blue light is set, fill the pressure of about 5 to 7 bar and clean with air.

3. Analog Check



This screen is a menu to test the analog output terminal.
In the case of output value, press the RIGHT key to adjust the number of channels to be tested with the UP and DOWN keys. When the adjustment is complete, the current corresponding to the set number is output. The number that can be set is 4 ~ 20mA and the value changes by ±2.
After both channels have completed the test and press the ESC key, it will automatically change to an analog output proportional to the measured value of the item set in the ANALOG OUTPUT menu.

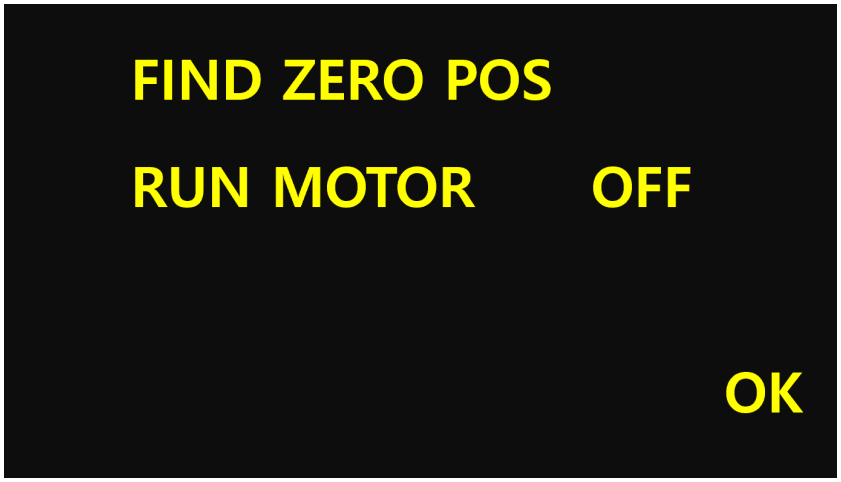
4. Moving Avg



This screen is a menu to set the moving average time for the measured value.

The default value is set to about 3 minutes, and the average time is changed when hunting for measured values is severe or when you want to check a slightly faster value change. If the average time is reduced to quickly confirm the change in the value, it may be difficult to obtain meaningful data.

5. Find Zero Pos



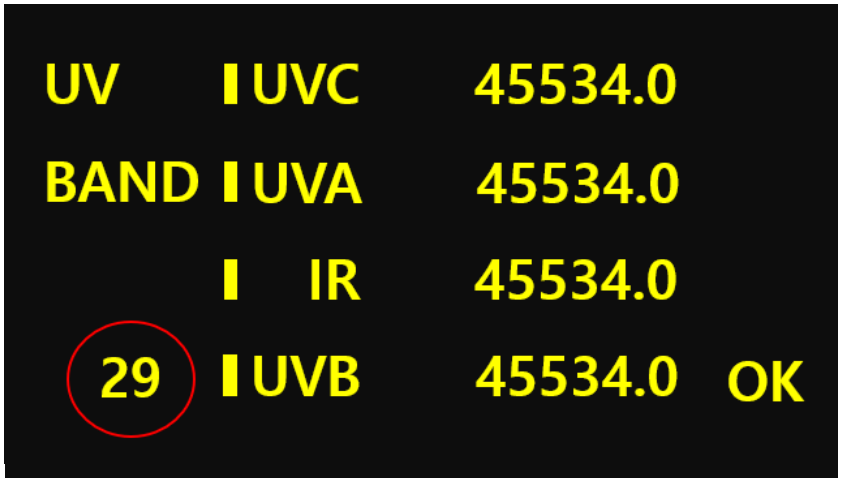
This screen is a menu to find the starting point of the brush cleaner. The first starting point of the brush cleaner is at a 45oC angle from the left looking at the sensor connector connection part.
If the brush swings from the other side, not the measuring part, or arbitrarily turn the brush upward to replace the brush, if you turn on the RUN MOTOR ON in the relevant menu after the cleaning time, it will return to the starting point.

2.2.3 Calibration

1. UV Band

This screen is a menu for setting the initial value of absorbance. It must be performed only when calibration is required.

If calibration is started by mistake, it cannot be stopped, so it can be stopped only when the power is turned off.
After washing the sensor sufficiently with ultrapure water for calibration, fill a beaker or barrel that does not transmit light with an amount of ultrapure water that can submerge the sensor body by 2/3.
Immerse the sensor in a beaker filled with ultrapure water, check whether air bubbles or suspended solids are well removed from the sensor measuring part, and wait for about 15 minutes until the transmitted light is stabilized. (Check the transmittance in the VIEW RAW DATA menu).
When the transmittance is stable, press the RIGHT key to move to OK and press the ENT key to perform calibration.



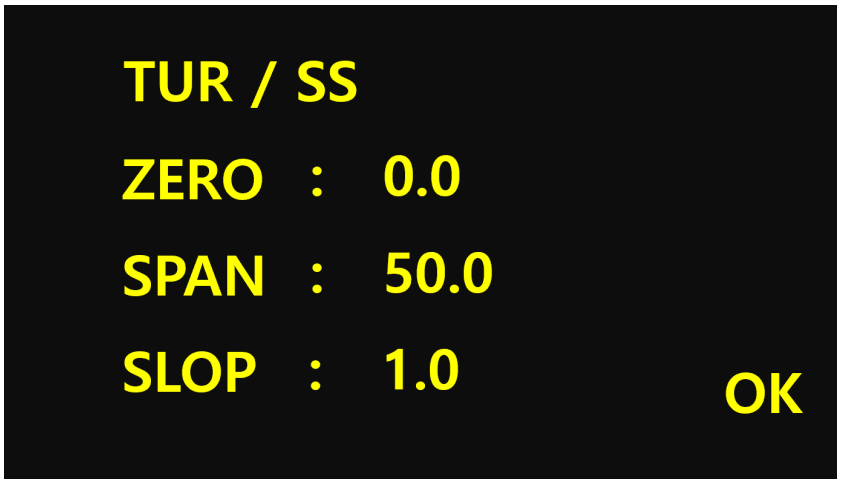
* Count starts when calibration is started, and calibration ends when it reaches 30

After the calibration process is normally performed, move from the main screen to the screen where you can check the absorbance and check if the four absorbances are displayed as 0.0000 ~ 0.0010 or less. (For the absorbance check screen, press the MAIN key on the main screen to move the screen)

Note

- For calibration, it is best to make the temperature of the ultrapure water and the measurement sample the same. If unavoidable, the calibration should be performed after keeping the temperature of the measurement sample and the ultrapure water as close as possible to obtain good results.
- Content displayed on the screen may vary depending on the smart sensor indicator version.

2. TUR/SS

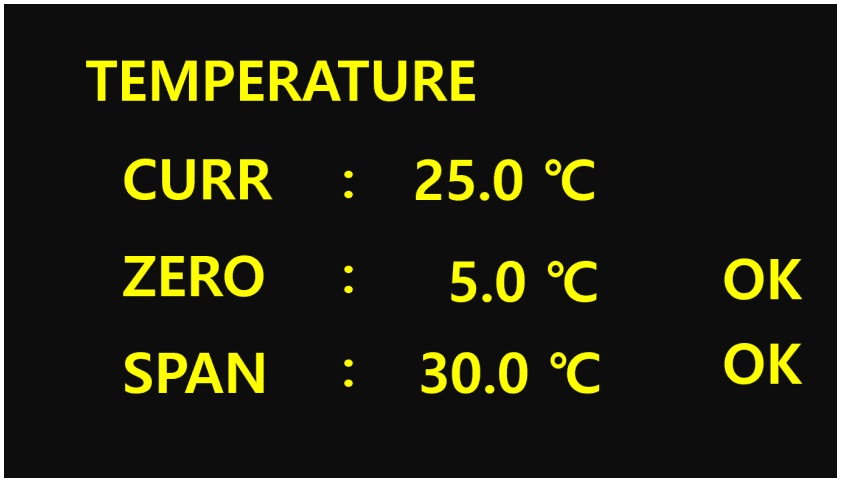


This screen is a menu to correct suspended solids (SS) and turbidity. ZERO is performed in ultrapure water and spanning over 90% of the measurement range is most effective to increase the reliability of the measurement water quality value. SLOP is to calibrate the calibration line obtained from ZERO and SPAN once more, and the measured value is multiplied by the value of SLOP to derive the measured value.

The factors in the TUR/SS menu are unique factors that the sensor has, so if the sensor is not connected, all values are written as 0.0. The value is not amended to the manufacturer or the operator without confirmation since being the important factor in the measured value.

It is recommended to perform correction with SLOP as much as possible, and to record the previous factor value when changing other factors to leave a calibration history.

3. Temperature



This screen is a menu to calibrate the water temperature. The water temperature of CURR displayed when entering the menu is the currently measured value. If you use the RIGHT key to enter the edit mode, the value is fixed and changes to the water temperature you want to calibrate using the UP and DOWN keys.

Calibration uses a two-point calibration method. This is a method of calibrating the current temperature using two points:

ZERO, which is a lower temperature than the current, and SPAN, which is a higher temperature than the current. In the case of ZERO, input the low value temperature measured with a thermometer, move it to OK in the ZERO line, and press the ENT key to apply immediately. The SPAN value is also the same.

4. Electrical Conductivity - EC

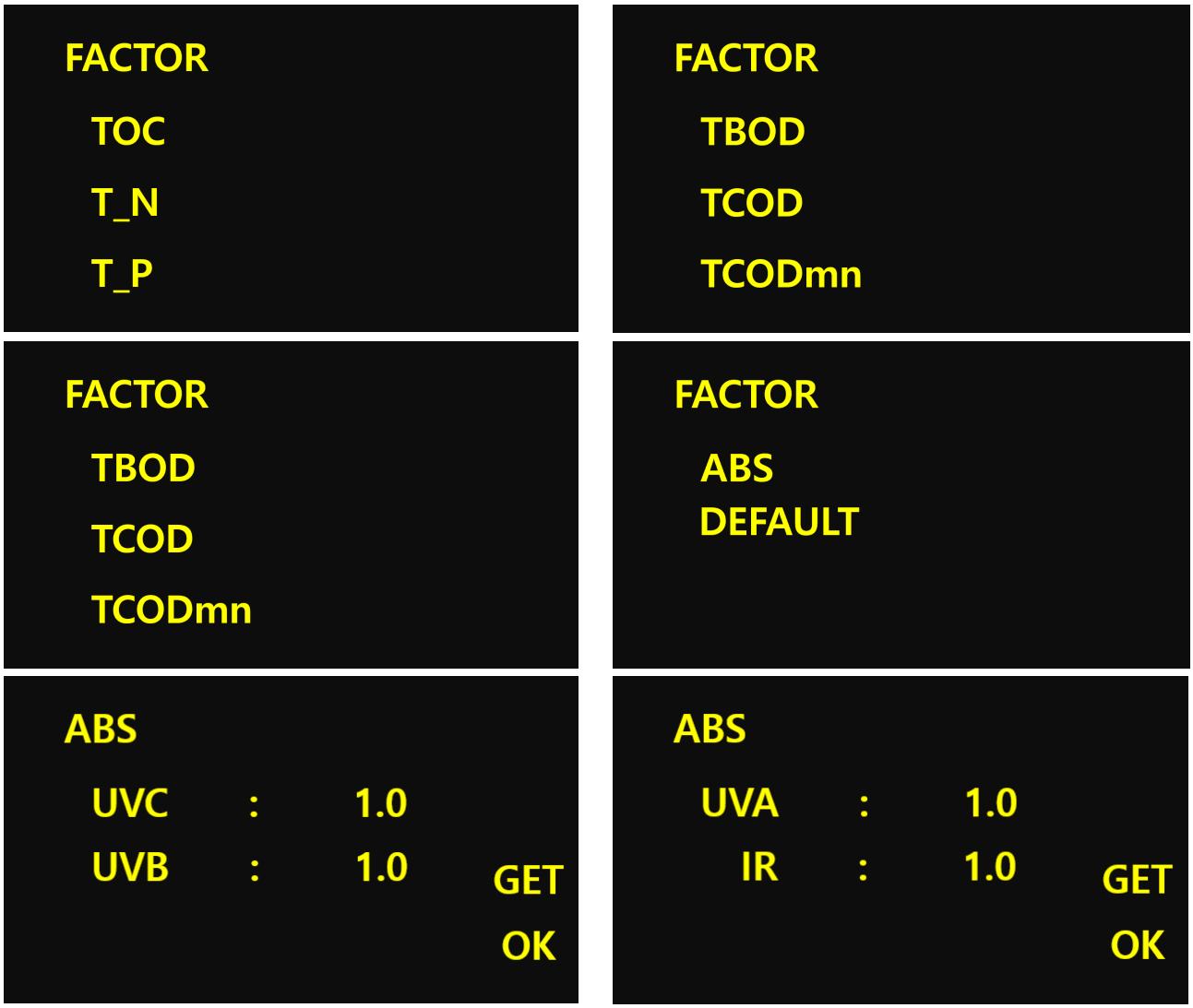
This screen is a menu for factors related to electrical conductivity and calibration. The electrical conductivity cell constant of this sensor is 1.70, and the temperature correction coefficient can be set to 2.2% when used in general water and sewage systems. In SLOP, the measured value is derived by multiplying the measured electrical conductivity by the value of SLOP. The factors in the EC menu are unique factors that the sensor has, so if the sensor is not connected, all values are written as 0.0. The value is not amended to the manufacturer or the operator without confirmation since being the important factor in the measured value.

It is recommended to perform correction with SLOP as much as possible, and to record the previous factor value when changing other factors to leave a calibration history. To change the temperature correction coefficient, refer to the table below and change the setting.

Temperature Correction Coefficient Cccording to Solution Type

Solution	%/°C
Ultrapure Water	4.55
SaltNaCl)	2.12
5% NaOH	1.72
Dilute Ammonia	1.88
10% HCl	1.32
5% Sulfuric Acid	0.98
Sugar Syrup	5.64

5. Factor



This screen is a menu to calibrate the measured values when measuring organic and inorganic materials. The initial value is set to 1, and it is used by changing the value according to the measurement sample. As it is a factor that affects the measured value of organic matter, if the value is changed by other than the manufacturer's engineer, the change history should be recorded.

The change of the factor value is performed through the correction of the measurement sample analysis result and the measurement value of the sensor in the water qulaity of field and if the original stored factor value is forgotten after arbitrarily changed, the cost of field calibration may be added. Items that can be set include TOC, TN, TP, TBOD, TCOD, TCODmn, and ABS. Except for ABS, the rest of the items are composed of SOLUBLE and TOTAL. Calibrate the dissolved materials and TOTAL concentrations for each water quality item are respectively corrected. ABS is a menu that calibrates absorbance UVC, UVA, and IR values. This menu are unique factors that the sensor has, so if the sensor is not connect–ed, all values are written as 0.0. The value is not amended to the manufacturer or the operator without confirmation since being the important factor in the measured value.

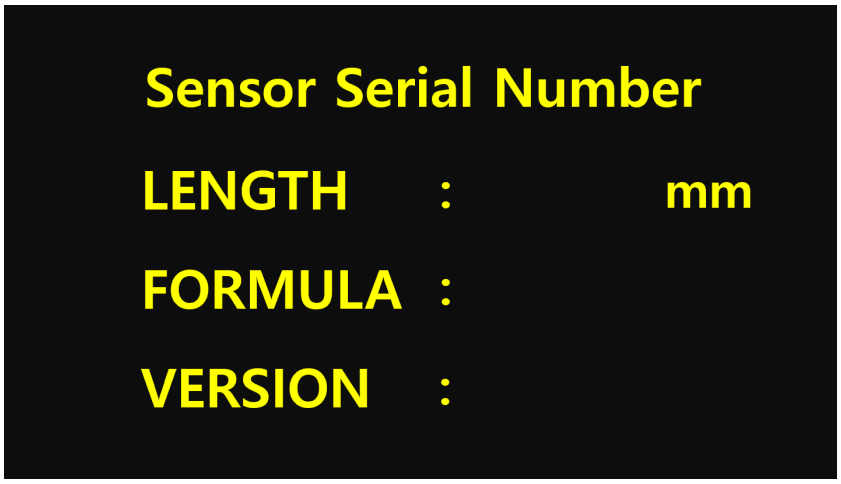
Note

- Content displayed on the screen may vary depending on the smart sensor indicator version.
- The DEFAULT menu initializes all factors except for the ABS factor to 1.

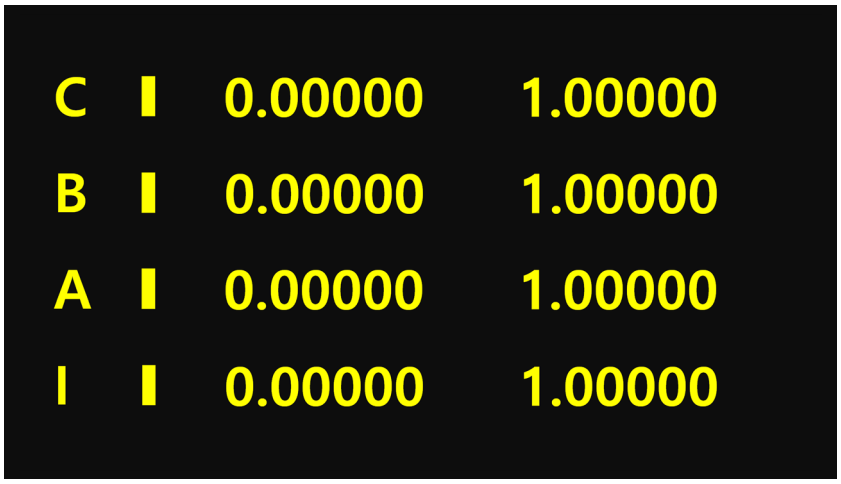
6. Line Factor

This screen displays the factors required to calculate the values of UVC, UVA, IR absorbance and EC, which is electrical conductivity. These values indicate the unique characteristics of the sensor, and if all factor values are set to 0, there is an error in the communication between the indicator and the sensor and you must contact the manufacturer.

2.2.4 Sensor Info



This screen is a menu that displays unique information about the sensor. The page of the screen can be changed by pressing the RIGHT and LEFT keys. Since they are unique information stored in the sensor, it cannot be modified.
The first screen (page) displays the sensor serial number, sensor optical path length, official information, and sensor version information. The serial number of the sensor has a different factor value for each sensor and is used to correct it.
The optical path length depends on the concentration of the sample to be measured, and this product is divided into three types: 5mm, 10mm, and 40mm. 5mm is used to measure raw wastewater, 10mm is used to measure secondary treated wastewater, and 40mm is used to measure final treatment wastewater or potable water. If a product that does not match the concentration to be measured is used, accurate measurement of concentrations higher than the upper limit or lower than the lower limit is impossible, which may cause many errors.
The official information displays the VERSION of the indicator, and if you change the setting in the FORMULA SELECT menu, the official information corresponding to the FORMULA is also changed. Since VERSION is a sensor program version, the unique factor uploaded by the sensor is different for each version.



The second page shows the unique factor that the sensor must calibrate the absorbance according to the temperature, and it is not possible to arbitrarily modify it. If the temperature correction coefficient is set as shown in the figure above, there is no correction coefficient or communication with the sensor is not possible.

Note

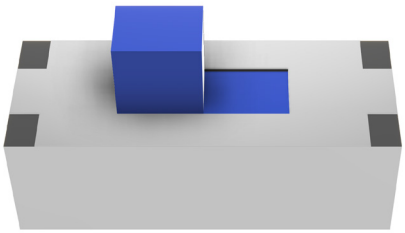
- Content displayed on the screen may vary depending on the smart sensor indicator version.

3. Serial Communication

3.1. Communication Specifications

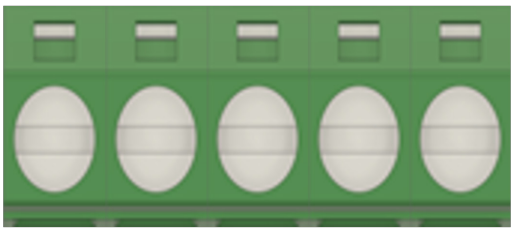
Item	Description
Communication Type	RS-232C or RS-485
Communication Speed	9600bps (Fixed)
Start Bit	1
Stop Bit	1
Data Bit	8
Panity	None
Handshaking	None
Type	Broadcasting

DIP SWITCH



RS-232 RS-485

EXTERNAL



TXD(TX+) RXD(TX-) GND CTS RTS

TXD is a port output from the indicator, so the receiving side (PC, etc.) must be connected to the RXD terminal. As it is a one-way communication (Broadcasting) method, it outputs at regular intervals even without a command such as a data request. The SERIAL output port communication standard may be set using SW at the lower left end of the terminal block. When both are set to the left, RS-232C can be used, and when set to the right, RS-485 can be used.

The item which is not selected in all communications modes transmits as hex 0xff.

3.2. Comm. Mode(Protocol)

3.2.1 UnU

UnU MODE is used when the indicator sends data to other UnU devices. Only the selected item displays the value, and for the unselected item, 'ff' of Char type is output. In the sensor data part, delimiters are separated by ','.

It is output in the order of
@ + digit + ! + sensor data + CR

e.g.

@162! 1.1408, 1.1384, 1.1193, 0.1493, 0.0000,2.0, 60.153, ff, 173.820, ff, 164.750, ff, 124.099, ff, 17.026,ff, 2.642,ff, 3.547, 0.100, 26.981, 1.1408,ff,ff

The output period is 1 second, and since it is a fixed value in the program code, to change this value, the program code must be modified.

3.2.2 WCDMA

WCDMA MODE is used when the indicator transmits data using a wireless communication terminal. The wireless communication terminal must be purchased separately and is built into the instruction unit.

It is output in the order of
@ + digit + ! + date (14 digits) + ! +
equipment serial number + data classification + ! +
group serial number + ! + sensor data

Item	Description
Digit	RS-232C or RS-485
Data Classification	D: Data, Use only 32-bit floating point
	M: String Type Massage - Error, Info, Warning, etc.
Group Serial Number	• Indicates the order of data • Used when sending multiple times due to long data Send only ASCII code numbers (starting from 0)
Equipment Serial Number	W: Transmission using WCDMA equipment
	M: Sent from the indicator

3.2.3 Modbus Communicaiton Specification

Item	Description
Station ID	0 (Default, 0 ~ 99 configurable)
Communication Type	RS-232C or RS-485
Communication Speed	9600bps (Fixed)
Start Bit	1
Stop Bit	1
Data Bit	8
Panity	None
Handshaking	None

3.3. Mapping List

V 1.0

Parameter	Adr.	Access	Min.	Max.	Unit	Weight
Absorbance UVC	30000	R	0	5.0000	-	10,000
Absorbance UVB	30001	R	0	5.0000	-	10,000
Absorbance UVA	30002	R	0	5.0000	-	10,000
Absorbance IR	30003	R	0	5.0000	-	10,000
Scatter IR	30004	R	0	65,535	-	1
Error Code	30005	R	-	-	-	
TOC	30006	R	0	200.0	mg/L	10
DOC	30007	R	0	200.0	mg/L	10
TBOD	30008	R	0	500.0	mg/L	10
SBOD	30009	R	0	500.0	mg/L	10
$TCOD_{Cr}$	30010	R	0	1500.0	mg/L	10
$SCOD_{Cr}$	30011	R	0	1500.0	mg/L	10
$TCOD_{Mn}$	30012	R	0	340.0	mg/L	10
$SCOD_{Mn}$	30013	R	0	340.0	mg/L	10
T-N	30014	R	0	100.0	mg/L	100
NH_4-N (NO_x-N)	30015	R	0	100.0	mg/L	100
T-P	30016	R	0	100.0	mg/L	100
PO_4-P	30017	R	0	100.0	mg/L	100
TSS (Turbidity)	30018	R	0	1200.0	mg/L	100
Conductivity	30019	R	0	1000.0	uS/cm	10
TEMP	30020	R	0	45.0	°C	10
UV254	30021	R	0	5.0000	-	10,000
Reserved.	30022	R	-	-	-	
Reserved.	30023	R	-	-	-	

V 2.0

Parameter	Adr.	Access	Min.	Max.	Unit	Weight
Absorbance UVC	30001	R	0	5.0000	-	10,000
Absorbance UVB	30002	R	0	5.0000	-	10,000
Absorbance UVA	30003	R	0	5.0000	-	10,000
Absorbance IR	30004	R	0	5.0000	-	10,000
scatter IR	30005	R	0	65,535	-	1
Reserved 1	30006	R	-	-	-	-
Reserved 2	30007	R	-	-	-	-
Reserved 3	30008	R	-	-	-	-
Reserved 4	30009	R	-	-	-	-
Reserved 5	30010	R	-	-	-	-
Error Code	30011	R	-	-	-	10
TOC	30012	R	0	200.0	mg/L	10
DOC	30013	R	0	200.0	mg/L	10
TBOD	30014	R	0	350.0	mg/L	10
SBOD	30015	R	0	350.0	mg/L	10
$TCOD_{Cr}$	30016	R	0	400.0	mg/L	10
$SCOD_{Cr}$	30017	R	0	400.0	mg/L	10
$TCOD_{Mn}$	30018	R	0	150.0	mg/L	10
$SCOD_{Mn}$	30019	R	0	150.0	mg/L	10
T-N	30020	R	0	100.0	mg/L	100
NH_4-N	30021	R	0	100.0	mg/L	100
T-P	30022	R	0	50.0	mg/L	100
PO_4-P	30023	R	0	50.0	mg/L	100
TSS	30024	R	0	1200.0	mg/L	10
Conductivity	30025	R	0	1000.0	uS/cm	10
TEMP	30026	R	0	45.0	°C	100
UV254	30027	R	0	5.0000	-	10,000
TDS	30028	R	0	1000.0	uS/cm	10
Turbidity	30029	R	0	20.0	NTU	1,000
NO_x-N	30030	R	0	100.0	mg/L	100
Reserved 6	30031	R	-	-	-	-
Reserved 7	30032	R	-	-	-	-
Reserved 8	30033	R	-	-	-	-
Reserved 9	30034	R	-	-	-	-
Reserved 10	30035	R	-	-	-	-

- Mapping List may differ depending on the smart sensor indicator version.
- Response in Reserved area is 0×00

Data transformation

The data is responded with the hex value multiplied by the weight for each requested item, and when received, it is converted into an integer using the hex2dec() function, and the weight of the corresponding parameter is divided and used.

e.g.

If the response to address 40012 is 0×04d2

40012 responses: 0×04d2 ⟹ 1234

40012 weights: 10

Measured value of 40012 address = $TCOD_{Mn}$ = 1234 / 10 = 123.4 mg/L

If there is no response to the request

- When the requested Station ID is different from the ID set in the indicator
- If the requested function code is not 0×04
- When the requested start address is greater than 40046
- When the address calculated by the combination of the requested start address and number is greater than 40046
- crc error

3.3.1 External

EXTERNAL MODE is used when the indicator transmits data to the outside by serial communication method.

It is output in the order of
@ + digit + ! + date (14 digits) + ! +
equipment serial number + data classification + ! +
group serial number + ! + sensor data

4. Sensor Cleaning

4.1. Air Compressor

Air Compressor

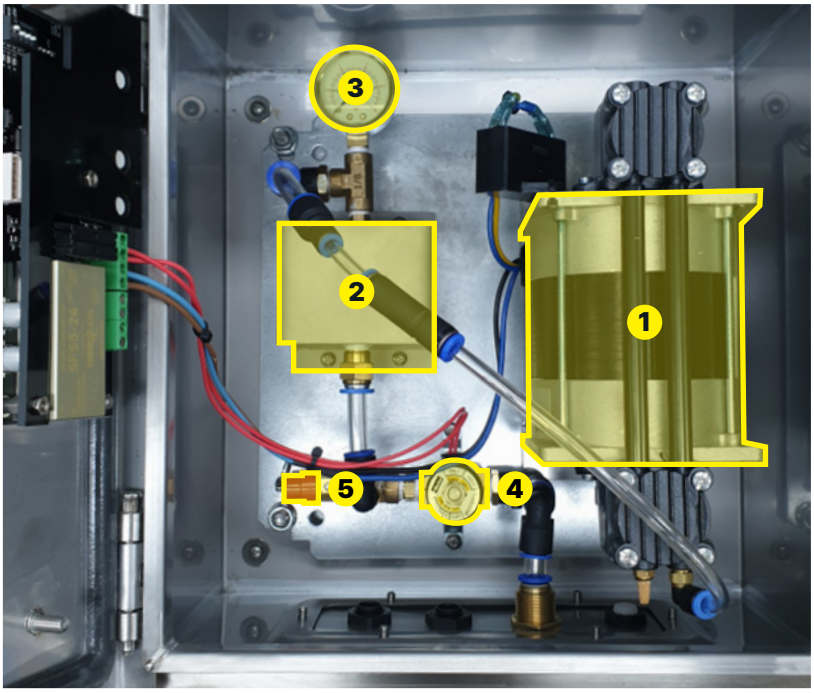
Air Compressor Nozzle Connection

The Air Compressor Cleaner operates by receiving a contact signal from the indicator. The pressure can be set according to the Dip SW and can be set up to 7 bar, but it is recommended to use 4 ~ 5 bar.

Item	Description
Status Check	3-color LED indicates pressure setting and operation status e.g.) Blue LED blinking means about 6 ~ 7bar status. • Blue : 6 ~ 7 bar • Green : 4 ~ 5 bar • Red : 3 ~ 4 bar
Pressure Setting	Combination of Dip SW in the compressed air controller
Operation Signal Input	DC24V pulse (period of a signals is 200ms or more)
Operating Temperature	0 ~ 45°C
Operating Voltage	AC220V, Max 80W in operation
Material and Size	300 × 300 × 200 mm (W x H x D), STS304 (Enclosure)

4.1.1 Air Compressor Cleaning Device Configuration

Inside the Air Compressor Cleaner



Air compressor sprays compressed air to clean the surface of the measuring part.

1: Compression pump

2: Air tank

3: Pressure gauge

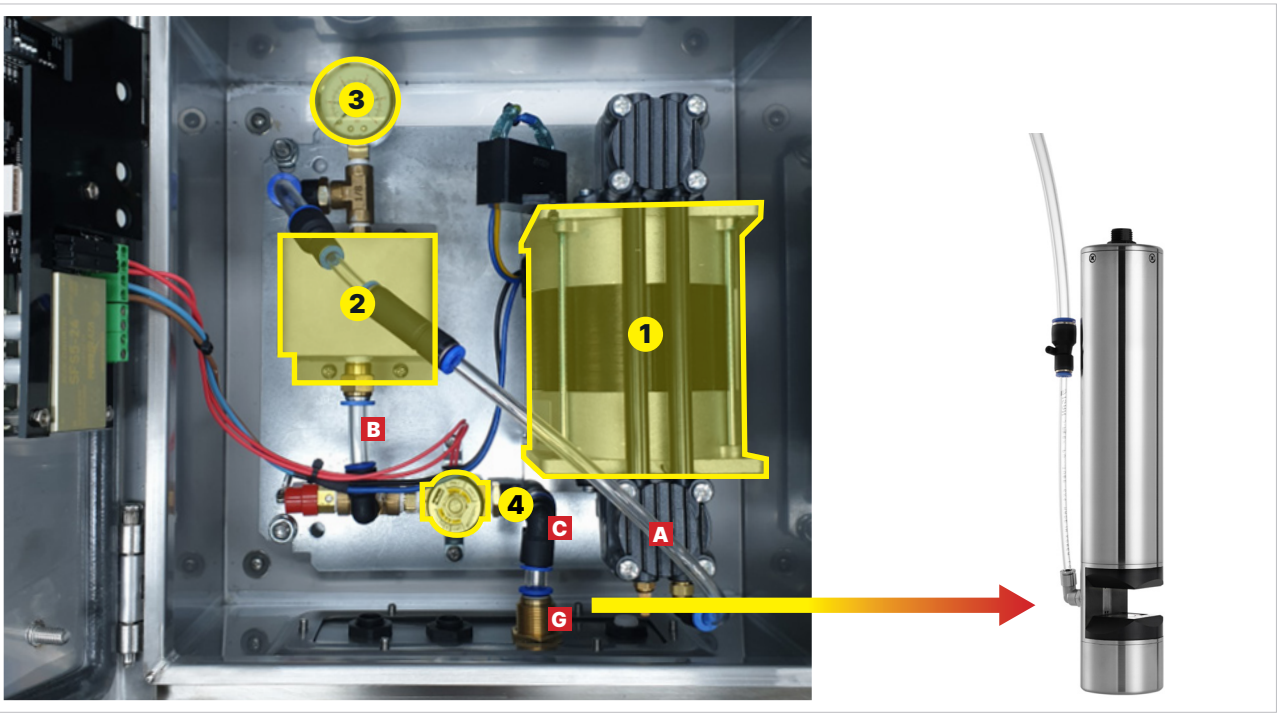
4: Electric valve

5: Relief valve

- The relief valve, is a safety valve, which controls or limit the compressed air to clean the surface of the measuring part.

4.1.2 The Operating Principle of the Air Compressor Cleaner

Inside the Air Compressor Cleaner



1. Give a contact signal to the cleaner through the P5 terminal block of the indicator or the TEST Tack SW inside the compressed air cleaner.
2. When the contact signal is received, No. 1 (yellow: compressed air pump) as shown in the picture of the Air Compressor Cleaner operates.
3. When No. 1 (yellow: compressed air pump) operates, air fills up in No. 2 (yellow: compressed air tank) through the A tube (red) connected to No.1 and No. 2.
4. As the pressure is filled in No. 2 (yellow: compressed air tank), the value of No. 3 (yellow : pressure gauge) increases.
5. When the predefined time limit is reached, proceed to activate the yellow valve marked as number 4. This action will initiate the release of pressure from the compressed air tank, denoted as yellow number 2, through the conduit identified as red number C. As the compressed air is discharged, it enters the measurement section of the smart sensor.

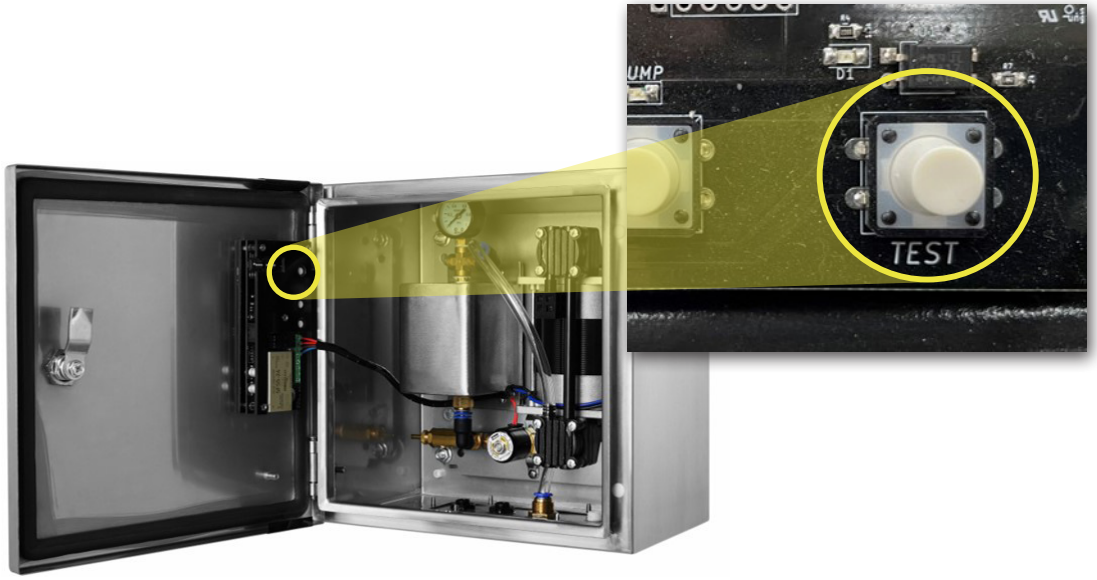
4.1.3 Air Compressor Cleaner Setting

Dip SW of the Air Compressor Cleaner

The controller as shown in the figure is built inside the Air Compressor Cleaner. The yellow circled part is the Dip SW that sets the pressure.

- When the HIGH SW is turned to the right, the pressure value is set to HIGH, and the LED blue blinked.
  The set pressure is 6 ~ 7 bar.
- When the MID SW is turned to the right, the pressure value is set to MID, and the LED green blinked
  The set pressure is 4 ~ 5 bar.
- When the LOW SW is turned to the right, the pressure value is set to LOW, and the LED red blinked.
  The set pressure is 3 ~ 4 bar.

4.1.4 Check the Air Compressor Cleaner



The controller is built inside the Air Compressor Cleaner as shown in the picture. The yellow circle is the Tack SW that can test the Air Compressor Cleaner. When the Test button is clicked, Air Compressor Cleaner starts immediately.

e.g.) Check the Air Pressor Guage after HIGH SW selection

- Top: HIGH SW selection
- Right: 6 ~ 7 bar pressor (0.6 ~ 0.7 kg/cm^2)

4.1.5 How to Connect a Compressed Air Cleaing Device

To connect the compressed air cleaning device, connect the 'CLEAN' terminal block on the controller board and the 'RE-LAY' terminal block on the indicator board within the compressed air cleaning device. (Refer to page 5 1.2 *terminal block description*)

- The power source of the compressed air cleaning device is connected to the terminal marked 'AC P'. The voltage used is AC220V and it operates at a maximum of 80W.
- The compressed air cleaning device operates by receiving a contact signal from the 'REALY' terminal block on the indicator unit, and connects a line from the 'REALY' terminal block on the indicator unit to the 'CLEAN' terminal on the controller board within the compressed air cleaning device.

4.2. Brush

Brush Cleaner (5mm)

Brush Cleaner (40mm)

The brush cleaner moves back and forth between the measuring parts to clean the smart sensor measuring part. As shown in the picture above, the first starting point is about 45° to 50° to the right when looking at the smart sensor from the front.

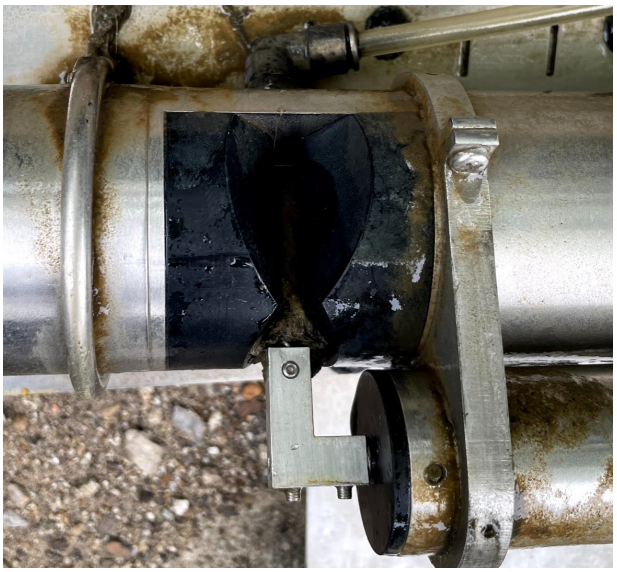
Item	Description
Status Check	When operating the Blush Cleaner, check whether the brush cleaner makes four round trips between the smart sensor measurement part and stops at the first starting point (refer to the 2.2.2 Diagnosis, 2) CLEANING TEST on the User Manual).
Operating Temperture	0 ~ 45°C
Operating Voltage	DC12V, Max 4.0W in operationvvvv
Meterial and Size	Diameter 34.0 mm, Length 170 mm, STS316, POM, Silicone
Brush Replacement Cycle	3months

4.2.1 Setting the Starting Point of Brush Cleaner

While gazing at the smart sensor from the front, the initial commencing point of the brush cleaner is roughly 45° to 50° to the right. However, if a foreign substance gets caught in the brush and the brush gets in between the measuring part of the smart sensor, the cleaning part does not work because a significant amount of foreign substance is adhered to the brush (brush contamination) or because the brush malfunctions by reciprocating only to parts other than the measuring part. If it occurs, wash, or replace the brush and return it to its original starting location for optimal cleaning impact.

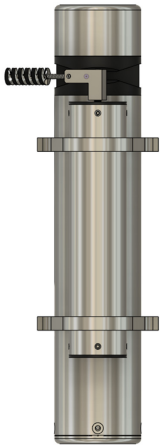
Brush Contamination and Gets in between the Measuring Part of Smart Sensor

[Brush contamination]

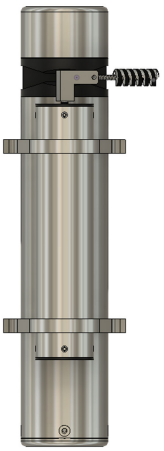


[The brush gets in between the measuring part of smart sensor]

Brush Cleaner Direction



[Brush Cleaner normal position]



[Incorrect Brush Cleaner position]

- **Contamination of foreign substances on the brush and brush getting caught in the measuring part**
  After removing foreign substances from the brush, go to indicator menu 2.2.2. DIAGNOSIS (under the 2) CLEANING TEST menu). During CLEAN ON operation, check whether there is reciprocating movement between measuring parts.

- **Incorrect brush direction**
  As shown in the picture above, when making a reciprocating motion with the first starting point wrong, the indicator menu 2.2.2. DIAGNOSIS → 5) When RUN MOTOR ON is activated in the FIND ZERO POS menu, it returns to the original position as shown in the picture above. If it moves briefly and stops during ON operation, run RUN MOTOR ON again.
  If the brush cleaning device returns to its original position, the indicator menu 2.2.2. DIAGNOSIS → 2) CLEANING TEST menu, turn on CLEAN ON and check whether there is a reciprocating motion 4 times between the measuring parts.

4.2.2 Replacement the Brush Cleaner

1. Indicator menu 2.2.1. SETUP, 2) In the CLEANING SET menu, set CLEAN TIME (cleaning cycle) to 0 MIN. (To prevent the brush from moving when replacing the brush).

2. Indicator menu 2.2.2. DIAGNOSIS, 2) In the CLEANING TEST menu, press and hold the DOWN key for about 5 seconds to rotate the brush cleaner clockwise. Release the DOWN key when the brush becomes vertical.

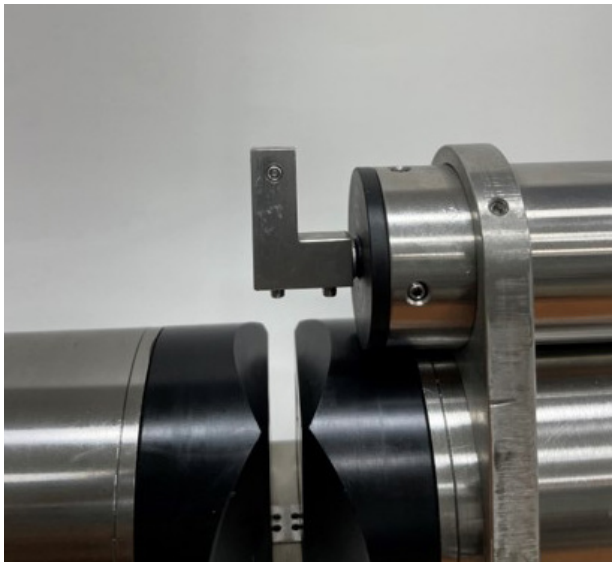
The Appearance of Brush Being Vertical

3. Loosen the screw that fixes the brush chuck and brush using a 6-angle ball driver (1.5 mm) (Same front and back).

4. Removing the brush used, and then recombining the extra brush.

Loosen the Screw Using a Screwdriver

Brush Removed from Brush Chuck

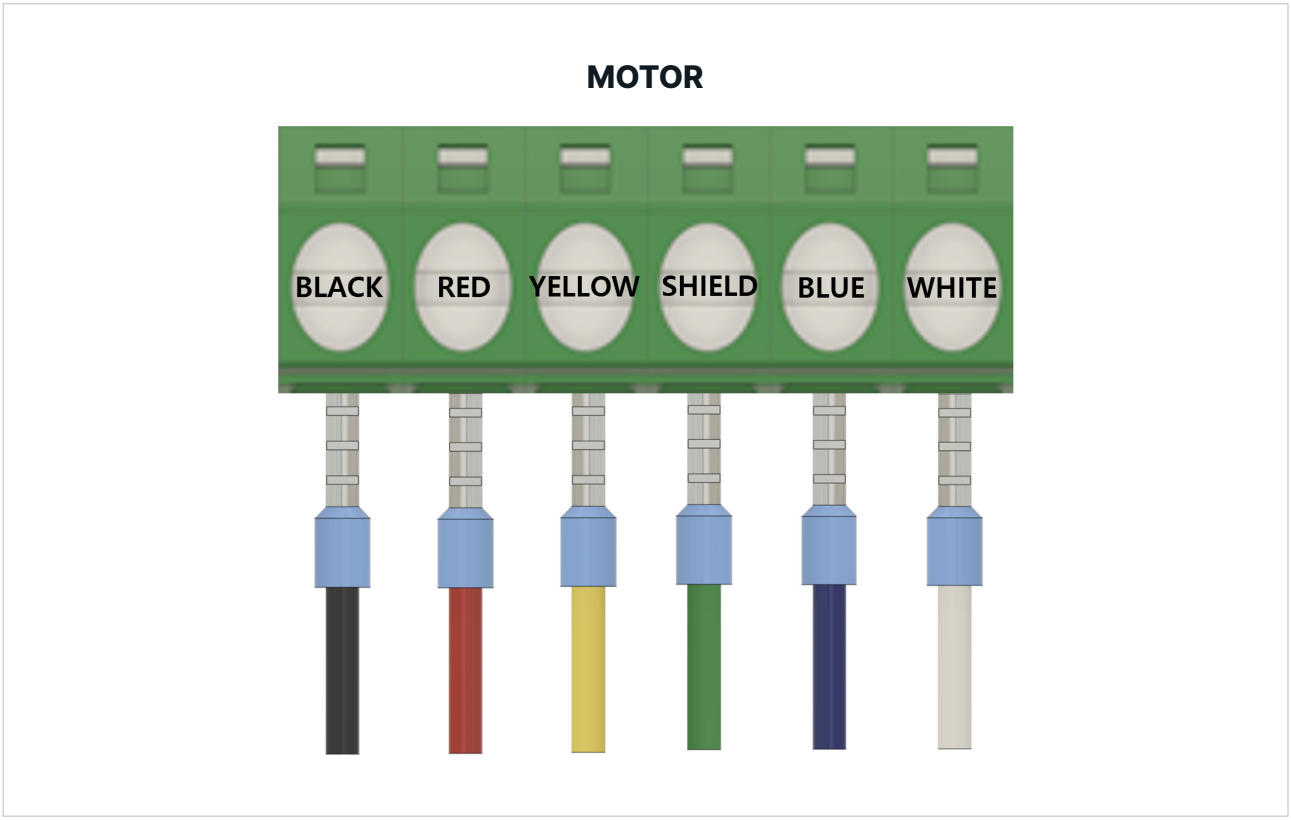


5. When the brush replacement is completed, turn on the RUN MOTOR function to check if it returns to the original position (refer to 2.2.2. DIAGNOSIS, 5) FIND ZERO POS on the User Manual).

6. When the brush has returned to its original position, check whether the brush is normally combined and reciprocated through the CLEAN ON function (refer to the 2.2.2 Diagnosis, 2) CLEANING TEST on the User Manual).

7. After checking the operation of the brush cleaner, the cleaning operation is periodically operated only when the CLEAN TIME (cleaning cycle) is changed to the initial set value (refer to 2.2.1. SETUP, 2) CLEANING SET on the User Manual).

4.2.3 Brush Cleaning Device Wiring Method

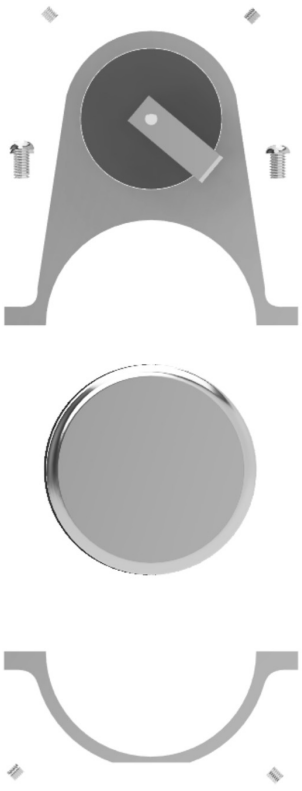


The brush cleaning device must use a cable dedicated to the brush cleaning device. The cable dedicated to the brush cleaning device consists of a total of 6 strands. As shown in the figure, the cable must be wired according to the colour indicated under the 'MOTOR' terminal block on the indicator.

- BLACK : CLEANING MOTOR +
- RED : CLEANING MOTOR -
- YELLOW : CLEANING +5V
- SHIELD : CLEANING GND
- BLUE : CLEANING ERR. POINT
- WHITE : CLEANING ZERO POINT

4.2.4 How to Combine the Brush Cleaning Device

The brush cleaning device is designed to be mounted on top of the smart sensor, and to combine the brush cleaning device and the smart sensor, a brush cleaning device bracket shaped is required.
The following are the names of the parts used to combine the brush cleaning device.



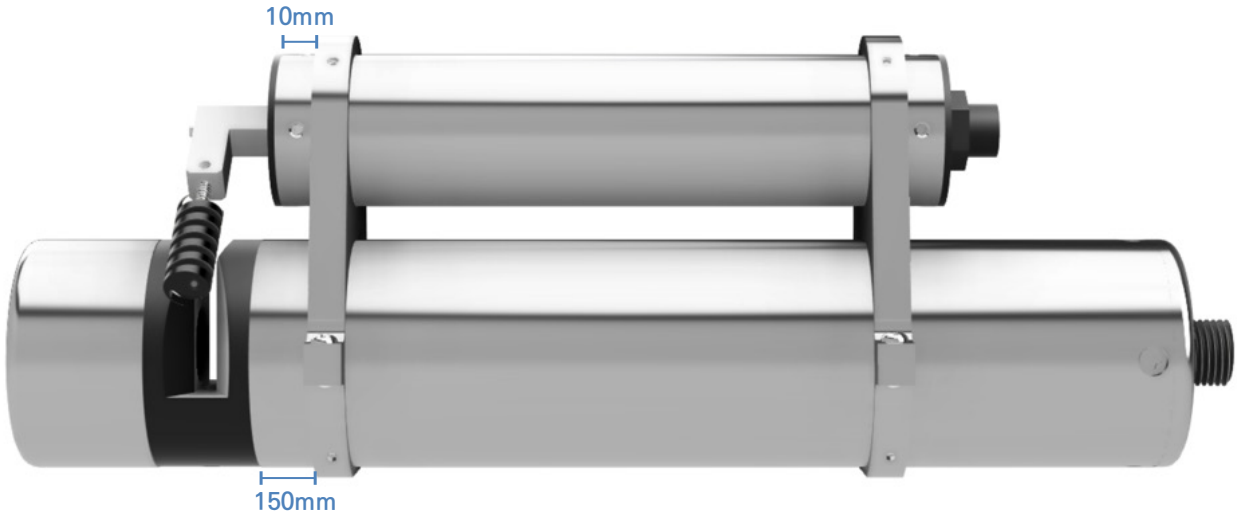
1 — Headless Bolt M3 L3

2 — Round Bolt M4 L6

3 — Brush Bracket (above)

4 — Brush Bracket (below)

5 — Headless Bolt M3 L3



1. How to attach the brush cleaning device to the brush bracket

- When fixing the brush cleaning device to the brush bracket, space the front and back to 10mm and then combine them

2. How to combine the brush bracket and smart sensor

- The correct position of the brush should be 45° downward to the right when viewed from the front of the brush cleaning device.
- The smart sensor is fixed to the brush bracket (below), and it is pre-tightened using a headless bolt M3 L3 so that it is flush with the brush bracket surface.
- Connect the top and bottom of the brush bracket using round bolts M4 L6.
- Place the brush bracket approximately 150mm away from the smart sensor body (based on OPL: 5mm), check whether the brush is located between the smart sensor measuring parts, and then fix it.
- Check the operation of the brush cleaning device by focusing on whether the brush moves well between measuring parts, whether there are any symptoms of jamming, and whether both window surfaces are properly cleaned.

Note

- The brush bracket fixing position varies depending on the smart sensor OPL, so it must be confirmed with the manufacturer.

5. Accessories

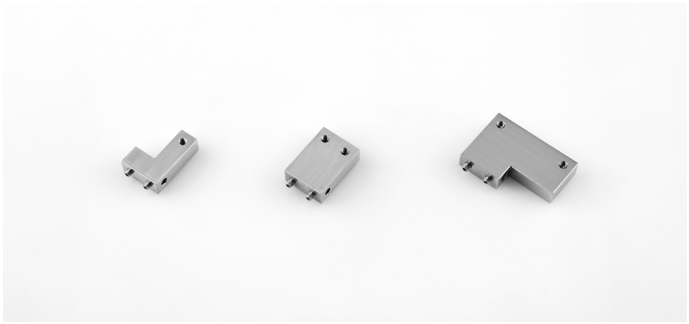
Cabel (Smart Sensor, Brush Cleaner), Air Compressor Tube

[Smart Sensor Cable SC-10]

[Brush Cleaner Cable BC-10]

[Air Compressor Tube CT-10]

Brush Cleaner Chuck, Smart Sensor Cleaning Tool



[Brush Cleaner Chuck, (5mm, 10mm, 40mm)]

[Smart sensor cleaning tool]

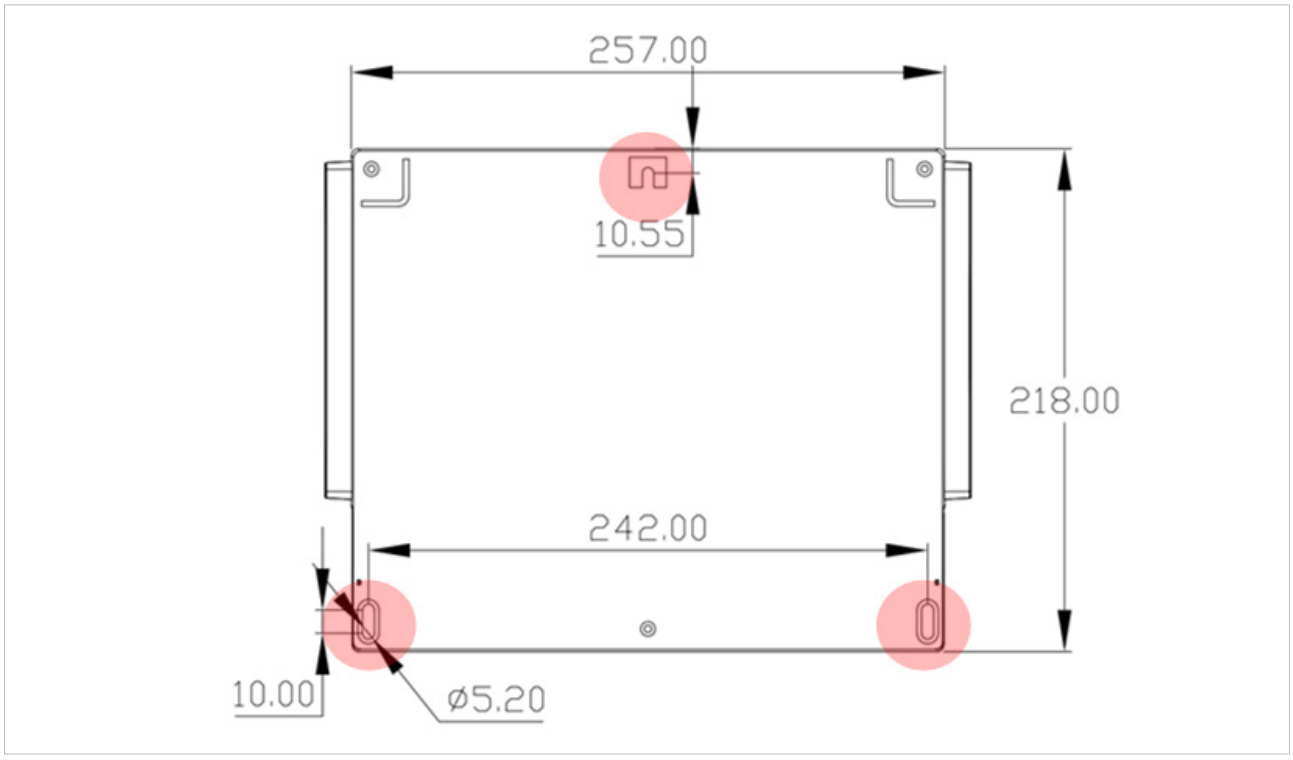
NOTE

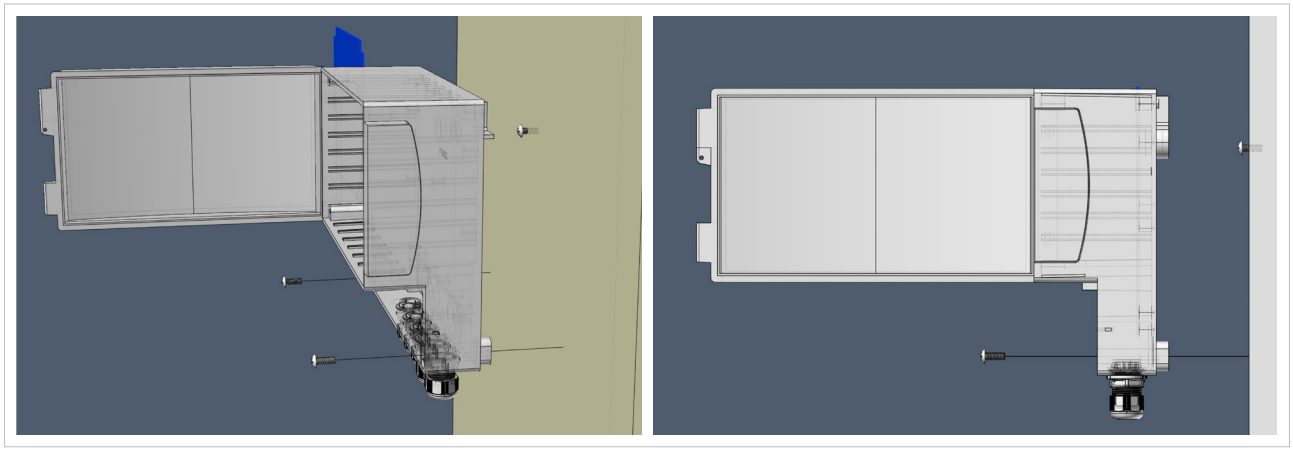
- Cables and Air Compressor tubes are basically provided of 10M but can be up to 30M if needed longer. However, a separate charge is added.

6. Installation

6.1. Indicator Installation

- The indicator is a wall mount type and is attached using round head screws or 3 Flat Head Screw.
- Use round head or flat Head Screw for the type of screw, and the size must be M4, and the length must be at least 12mm.
- Fastening position (rear side of the indicator)
- The red circle in the picture below is where the screw to fasten the indicator is combined.

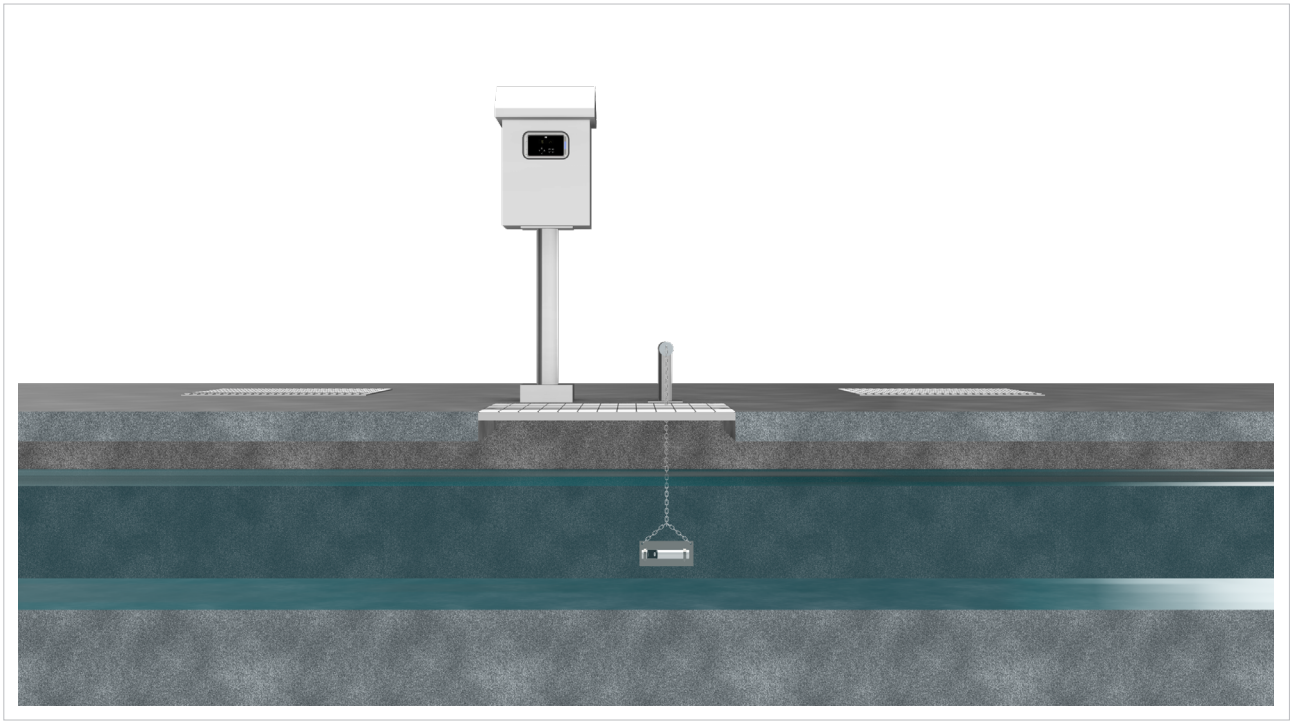




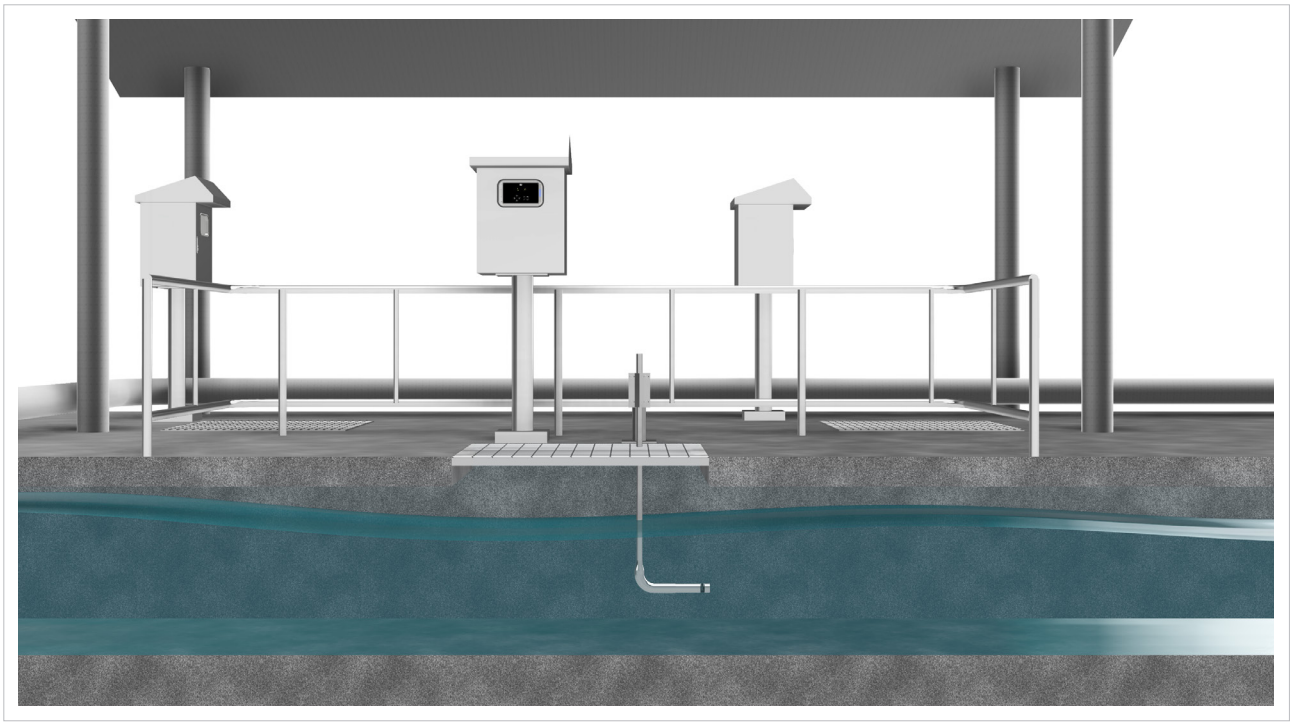
- Among the fixing bolts, the bolt fixed at the top should be fixed leaving 8mm from the wall.
- The bottom two bolts are fixed inside the case after hanging the indicator case on the top bolt.

6.2. Field Installation

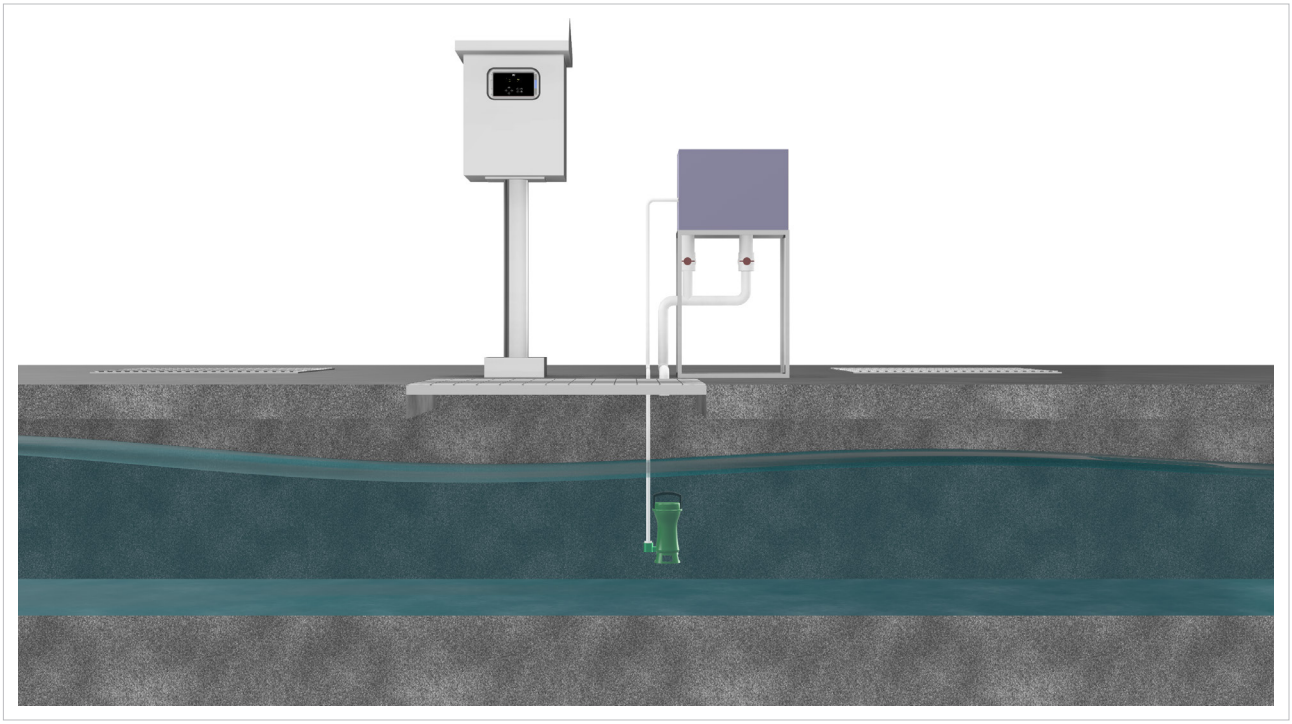
Chain Type Installation Diagram



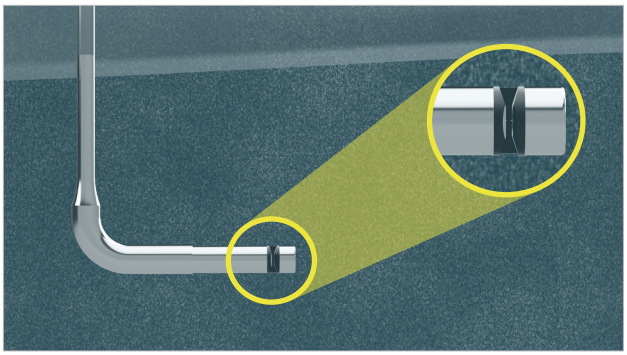
Rod Type Installation Diagram



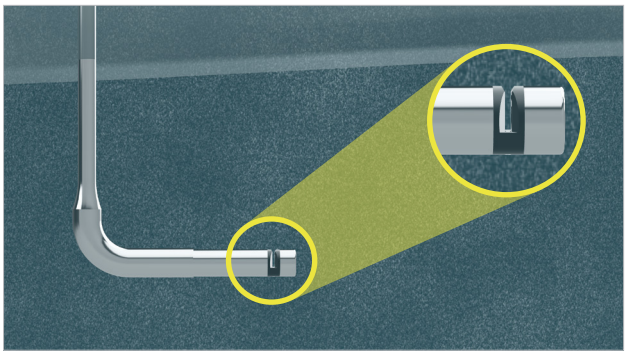
Reservoir Type Installation Diagram



- It is recommended to protect the instruction unit of the smart sensor by manufacturing a Local Indicating Panel (LIP).
- The open structure is applied where the upper part of the water sample to be measured is open, such as an open channel or a river. It should be measured under the condition of a flow rate of 0.5 m/s or less.
- When installing the smart sensor, install it so that it is level with the water surface.
- Determine the rod and chain type considering site conditions (flow speed, depth).
- To prevent foreign substances from accumulating on the floor of the smart sensor measuring unit, the measuring unit should not be installed in the direction toward the sky.
- Compressed air cleaning method is not used when installing the water tank type smart sensor.
- When designing a water tank, a structure that can remove fine air bubbles and foreign substances flowing into the water tank is required.
- It is not recommended to use water tanks that do not pass through a screen.
- If foreign matter accumulates inside the water tank, it will affect the measured value, so the water tank must be cleaned periodically.



[Correct]



[Incorrect]

7. Trouble Shooting Guide

7.1. Trouble Shooting

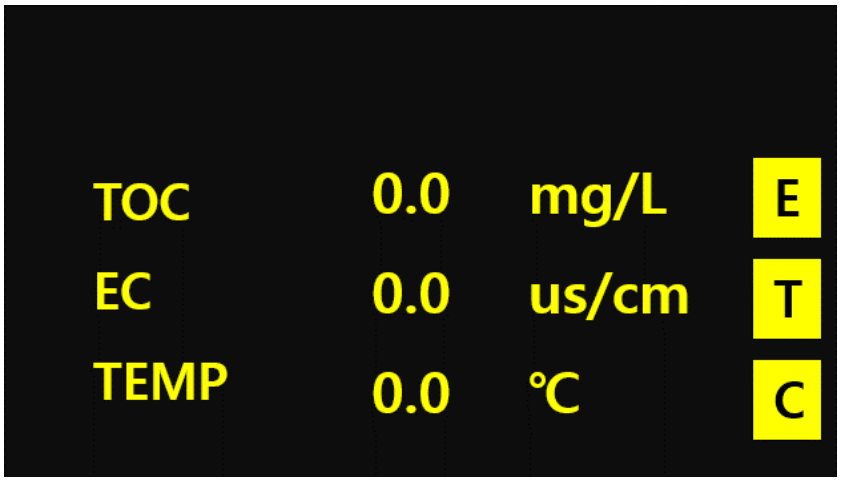
Symptom	Causes	Confirmation and Action
• Nothing is displayed on the screen • The screen is broken	• AC220V power not supplied • Backlight off • Operation program error	1. Check the part where the power is connected 2. If the backlight is off, the characters displayed on the screen may not be visible, so press any key 3. Restart the smart sensor system 4. If symptoms continue despite the above measures, contact the manufacturer
• T symbol appears on the screen • No data value change	• Sensor connection error or short sensor cable • Internal circuit failure	1. Restart the smart sensor system 2. Check the connection status of the sensor and the cable 3. Check that the cable is properly connected to the P3 terminal of the indicator 4. Check whether the sensor is short-circuited. (Continuity test and resistance test with a tester) 5. If symptoms continue despite the above measures, contact the manufacturer
• Brush cleaner continuously rotates in the same direction instead of reciprocating	• Defective cleaner motor • Short brush cable • Large amount of noise	1. Check that the cable is properly connected to the P4 terminal of the indicator 2. Restart the smart sensor system 3. If symptoms continue despite the above measures, contact the manufacturer
• Compressed air pressure does not rise. • Compressed air pressure does not drop. • Compressed air pressure is lower than set pressure	• Defective Air Compressor pump • Defective indicators contact point. • Clogged Air Compressor tube • Relief valve faulty	1. Check whether the indicator makes a sound (mechanical relay operation) of the contact 2. Check the air compressed injection port of the sensor for foreign substances 3. Check the inside of air compressed pump the air compressed cleaner 4. Check the relief valve on the lower left side of the inside of the air compressed cleaner
• No key input	• Operation program error • Defective key button	1. Restart the smart sensor system 2. If symptoms continue despite the above measures, contact the manufacturer

Symptom	Causes	Confirmation and Action
• The measured value outputs a value that exceeds the error range	• Contamination of sensor measurement part • Measurement factor setting error. • Temperature correction coefficient setting error. • Defective temperature measurement • Large amount of noise • Sensor error • Formula errors	1. Check the measuring part of the sensor. 2. Check if there are any foreign substances in the sensor measuring part or the brush cleaner. 3. Check if the sensor is submerged in water. 4. While cleaning the sensor, check the sensor appearance and connection status. 5. Restart the smart sensor system. 6. If symptoms continue despite the above measures, contact the manufacturer
Other	-	1. Check the symptoms and act by phone call to our engineer

7.2. Trouble Shooting Picture

7.2.1 Instructions od Screen

Code Displayed on the Main Screen of the Indicator



E The code E is displayed when the sensor is out of the water currently or the sensor measurement part is contaminated, and it is not provided accurate measurement value. The sensor is submerged in water, but when the corresponding indication occurs, the sensor is taken out and the measurement part is cleaned once.

T The code T is displayed when there is no communication between the sensor and the indicator. In such a case, reboot the power, and if the code continues to appear after the reboot, a faulty sensor cable or a defective connector inside the sensor should be suspected, and contact the manufacturer.

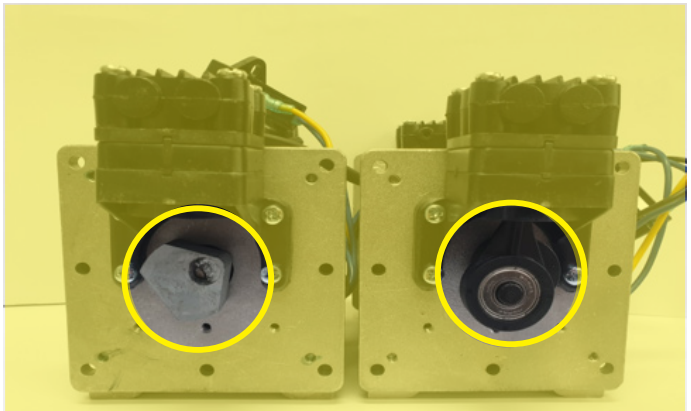
C The code C is displayed when cleaning. If the code continues to appear even after the cleaning time has passed, check the CLEAN time in the CLENAING SET menu and set the time again if it is set to 0 minutes. When the code is displayed, it is being cleaned, so when changing the CLEAN time, the CLEAN time is changed after the code disappears.

7.2.2 Air Compressor Cleaner

1. When the compressed air pressure does not rise

If the compressed air pressure does not rise, first check whether the connection of the tube (A) is missing or torn. If there is no abnormality after checking, check whether the air compressed pump inside the cleaner is normal.

AIR COMPRESSOR PUMP



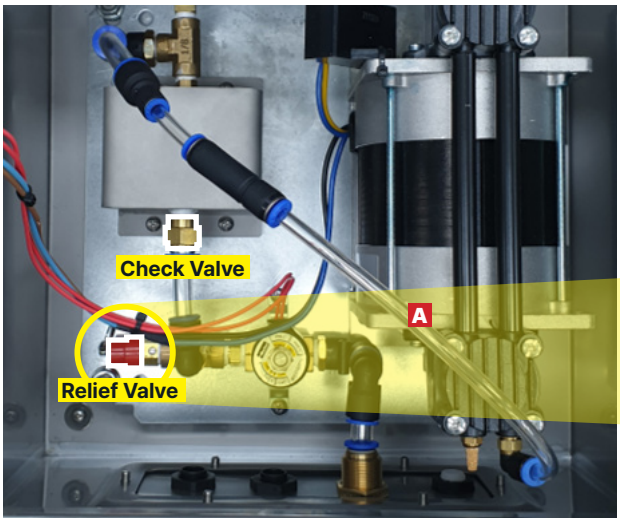
[Air Compressor Pump Error] [Air Compressor Pump Normal]

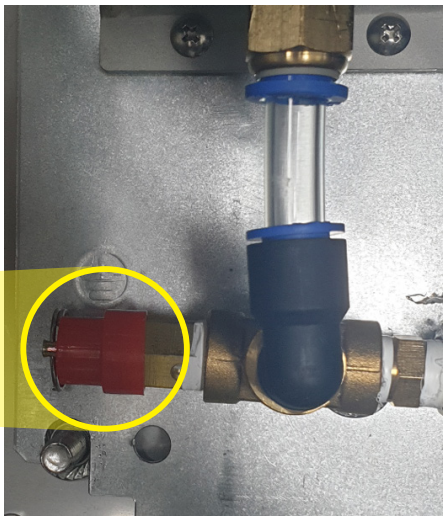
If the cables inside the air compressed cleaner are not arranged or the compressed air pump is overloaded, the drive shaft of the air compressed pump may be broken as shown in the red circle in the photo. If the drive shaft of the air compressed pump is broken, contact the manufacturer as it is one of the reasons that the compressed air pressure does not rise.

2. When the compressed air pressure is lower than the set pressure

If the compressed air pressure does not rise, first check whether the connection of the tube (A) is missing or torn. If there is no abnormality after checking, check whether the air compressed pump inside the cleaner is normal.

Relief Valve





The relief valve is one of the causes of failure of the compressed air cleaner when a pressure higher than a set pressure (Max 7 bar) occurs, so if it is higher than the set pressure, it opens the relief valve and releases the fluid to lower the pressure. If the compressed air cleaner is subjected to vibration or shock during operation, the relief valve may come off. If the relief valve is come out, the pressure is not generated in the air compressed tank, and the desired cleaning cannot be performed.

7.3. Support

Item	Description
Manufacturer	UnU inc.
Website	www.unu-inc.com
Email	unu@unu-inc.com
Business address	1004, 1005, Samsung IT Valley, 27, Digital-ro 33-gil Guro-gu, Seoul, Republic of Korea
Contact	(Tel) +82-2-2028 2145 (Fax) +82-2-6280-1373
Department	ICA Team

7.4. Defect Warranty

Manufacturer provides a one-year warranty on the equipment, which begins once the equipment is delivered to the customer.

The Warranty Extension are only available in 1 year increments, and additional costs will be incurred.

8. Maintenance

8.1. Smart Sensor

The inspection points for smart sensors are as follows.

- Check the smart sensor measurement unit
- Check the status of smart sensor cables
- Verify normal operation of the indicator unit

Before inspecting the smart sensor, the cleaning cycle of the automatic cleaning device must be changed to '0'Min before proceeding. (To prevent the automatic cleaning device from operating during the smart sensor inspection). ***However, after the inspection is completed, the cleaning cycle is set to the original value.**

For precise cleaning, turn the brush cleaning device in the opposite direction of the measuring area. To set the direction of the brush cleaning device, enter the CLEANING TEST menu in the DIAGNOSIS menu and press the DOWN KEY to manually operate the brush cleaning device (When you release the button, the brush cleaning device stops).

If the direction of the brush cleaning device is set in the opposite direction to the smart sensor measuring part, use a cleaning kit to clean the area between the measuring parts. Since the measuring part window of the smart sensor is made of sapphire, it can be cleaned using sandpaper depending on the degree of contamination of the measuring part.

Even after cleaning the smart sensor measuring part, if the raw data in the air does not fall within the range and an error in the measurement value occurs, the initial standard value of the smart sensor must be checked using ultrapure water. The raw data of the smart sensor can be checked in the VIEW RAW DATA menu in the DIAGNOSIS menu. The raw data range of smart sensors in the air is as shown in the table below.

Item	5mm	10mm	40mm
UVC	34,000~	30,000~	23,000~
UVB	-	-	-
UVA	34,000~	30,000~	25,000~
IR	35,000~	31,000~	34,000~

When checking raw data in the air after cleaning the smart sensor, the measured value may differ due to light coming from outside and moisture on the measuring unit window, so use wipes which specifically designed to gently clean liquid and dust and are great for instrumentation, surface, parts, and lens cleaning, to block external light and remove moisture.

Cables dedicated to smart sensors should not be installed in an excessively bent state. If the cable is damaged due to strain caused by structural malleability, it may affect the smart sensor, so replacement is recommended.

If the smart sensor indicator screen displays unknown characters or shows symptoms of screen cracking, damage to the indicator due to external shock or overvoltage is suspected, so contact the manufacturer.

Note

- Content displayed on the screen may vary depending on the smart sensor indicator version.

8.2. Measuring Tank

The inspection points of the smart sensor measurement tank are as follows.

- Check the flow rate flowing into the measurement tank.
- Check the accumulation of foreign substances and sludge in the bottom of the tank.
- Check the contamination level of the mesh net to capture fine bubbles and oil (when using a mesh net).

If the inflow line is blocked by sludge and foreign substances and the inflow rate is insufficient, the water in the measurement tank cannot circulate smoothly, causing errors in measured values.

When emptying the water into the measurement tank and cleaning it, the sludge and foreign matter on the wall of the measurement tank must be thoroughly cleaned using a large brush and water, and the sludge and foreign substances stuck between the smart sensor brackets must also be thoroughly cleaned. When refilling the measuring tank with water, the sludge on the wall falls off, causing an error in the measured value.

If the mesh network is clogged, the incoming water does not pass through the mesh network and overflows elsewhere, so continuous cleaning with water or replacement with a new mesh network is required.

8.3. Automatic Cleaning Device

The inspection points of the automatic cleaning device are as follows depending on the middle stream of the cleaning device.

8.3.1 Brush Cleaning Device

- Check for symptoms of brush bending.
- Check brush bristle wear.
- Check the direction of brush movement.
- When using the brush, make sure you are cleaning the measuring window well.
- Check the reciprocating movement of the brush cleaning device 4 times.

If the brush is damaged, it cannot be cleaned properly, so it must be replaced with a spare part. If the measuring window is not properly cleaned when the brush cleaning device is in operation, the brush cleaning device must be repositioned.

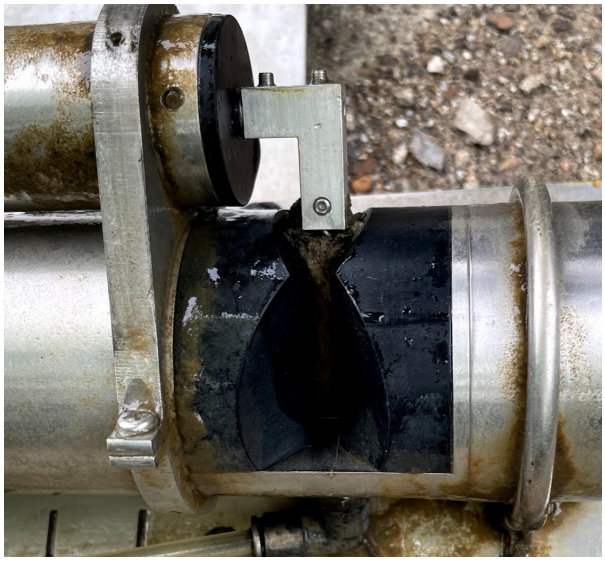
If the brush cleaning device cannot reciprocate four times, turns in one direction, or does not operate normally, it is necessary to inspect the cable dedicated to the brush cleaning device and the brush cleaning device.

Precautions when replacing the brush and the cable dedicated to the brush cleaning device include cleaning the window of the measuring unit well when the cleaning device is operating after replacing the brush, ensuring that there is no jamming of the measuring unit, and that the direction of the brush cleaning device is properly set.

When replacing a cable, disconnecting the cable connector from the connector on the smart sensor and brush cleaning device, be sure to remove enough moisture from the connector before disconnecting. After disconnecting the connector, be careful not to let moisture enter the male and female parts of the connector. When reconnecting, the connector must be sufficiently tightened.

Brush Cleaning Device Being Misaligned

Caught between Measuring Parts

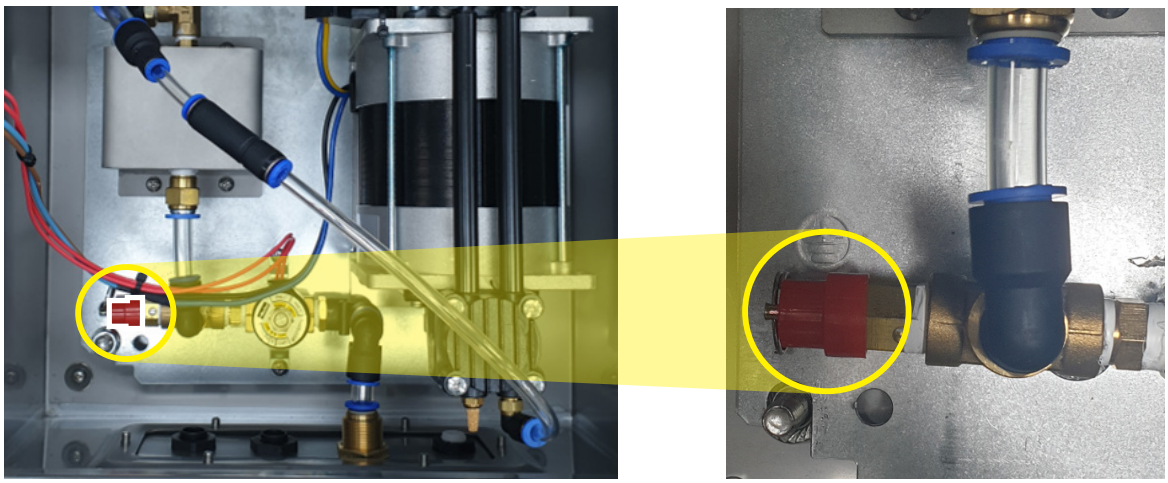


8.3.2 Compressed Air Cleaning Device

- Check whether the set pressure is properly reached.
- Check if the pump is operating normally and the air tank is full of pressure.
- Check the tube connected between the compressed air cleaning device and the smart sensor.
- Check whether the relief valve is coupled to prevent exceeding the standard pressure.

If the compressed air cleaning device does not reach the set pressure and the air tank is filled with sufficient pressure even when the pump operates, the pump needs to be inspected. If it is determined that sufficient air does not reach the smart sensor measuring part when compressed air is sprayed, the air tube should be checked. Even though the pressure exceeds about 6 to 7 bar reaches the air tank, if the pressure continues to increase or the valve is missing inside the compressed air cleaning device, the relief valve must be reattached.

Relief Valve in Cleaning Device



9. Smart Sensor Calibration

Before smart sensor calibration, the smart sensor must be cleaned, and in the case of the water tank type, the measuring water tank must also be cleaned precisely.
Water sample should be conducted after 30 minutes of smart sensor stabilization time after cleaning the smart sensor and cleaning the measurement tank prior to calibration (section 4 sensor cleaning).

9.1. Calibration by Item of Smart Sensor

The calibration process for each smart sensor item necessitates the collection of water analysis data at the same time and place as the measured value measured by the smart sensor in the field.

A total of 24 numerical analysis data is suggested at 1-hour intervals following the first sample for calibration of the smart sensor, however the minimum amount is 6 inflow and 4 discharge data at 1-hour intervals after the first sample.

The factor value for each item is calculated by comparing the number analysis data collected during sampling with the smart sensor measurement value. As average values, numerical analysis data and smart sensor measurement results are employed. Calculate and enter the value produced by dividing the overall average of the numerical analysis data and the total average of the smart sensor measurement values as a factor to get a factor.

$$Factor = \frac{\text{Average of all smart sensor measurements}}{\text{Average of all numerical analysis data}}$$

e.g.) When Factor is entered as 1.0

Time	TOC	
	Water Analysis Data	Smart Sensor Rreadings
10:00	54.0	27.0
11:00	56.0	28.0
12:00	58.0	29.0
13:00	52.0	26.0
14:00	51.0	25.5
15:00	50.0	25.0
Average	53.5	26.75

Total average of water analysis data: 53.5 mg/L
Overall average of smart sensor readings: 26.75 mg/L

When the aforementioned formula ['53.5' / '26.75' = '2'] is applied, the result value is '2', then go to the TOC menu in the Factor menu in the CALIBRATION menu and put '2' in the TOTAL column.

e.g.) Recalibrating after applying the factor

Time	TOC	
	Water Analysis in Data	Smart Sensor Redings
10:00	108.0	54.0
11:00	112.0	56.0
12:00	116.0	58.0
13:00	104.0	52.0
14:00	102.0	51.0
15:00	100.0	50.0
Average	107.0	53.5

Total average of water analysis data: 107.0 mg/L
Overall average of smart sensor readings: 53.5 mg/L

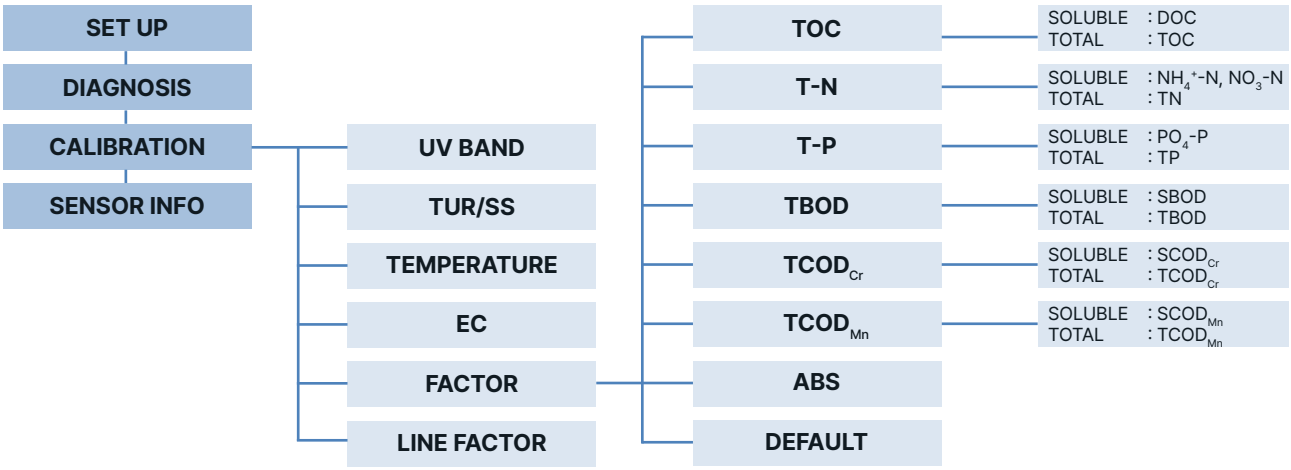
When applying the above formula, ['107.0' / '53.5' = '2'] results in '2', but if an existing factor is already included, [result value X existing factor] must be entered.

Factor = Result value X Existing factor

If the TOC Factor is '1', the value '26.75' comes out, and when the factor is calculated again by applying the above formula, you must do '2' X '2' to get the result value of '4'. ['26.75' X '4'] is required to display the value of '107.0'.

If each item is re-calibrated in the future, the previously inputted factor must be recorded, and if the original factor value is not left, the value may be incorrect. Before utilizing the factor calculation Excel file given by the manufacturer, consult with the manufacturer's engineer.

Factors are input in the FACTOR menu of the CALIBRATION menu on an item-by-item basis. TSS and EC factors, on the other hand, are inserted into the SLOPE values in the TUR, SS, and EC menus of the CALIBRATION menu. TOC, TN, TP, TBOD, TCOD, and $TCOD_{Mn}$ are among the menus in the FACTOR menu, and each menu is separated into SOLUTION and TOTAL. In the soluble part, enter DOC, SBOD, SCODcr, $SCOD_{Mn}$, NH_4^+-N, NO_3-N, and PO_4-P variables, and in the total part, enter TOC, TBOD, TCOD, $TCOD_{Mn}$, TN, and TP factors. (Unfortunately, measuring NH_4^+-N and NO_3-N simultaneously is not practicable).



9.2. Calibration Procedure

Smart sensor calibration procedures include zero calibration with ultrapure water and absorbance calibration using reference materials. We do not advocate zero calibration on-site without first contacting the manufacturer since zero calibration should be conducted after cleaning the smart sensor measurement unit and the complete smart sensor.

The absorbance correction technique uses a reference material to adjust the observed result. KHP and Formazine are the two kinds of reference materials used for calibration. KHP corrects UVC and UVB absorption, whereas Formazine corrects UVA and IR absorbance. Calibrations of smart sensors using standard materials are calibrations for factors of smart sensors, not calibrations of item measurement results.

KHP and Formazine, on the other hand, should not be used together for measuring standard chemicals. Fill the beaker with the standard material until the smart sensor measuring portion is immersed and check for bubbles or extraneous substances between the measuring parts. When measuring the standard material, the smart sensor's detected temperature must be comparable to the standard material's temperature to provide an accurate result, thus compare after around 20 to 30 minutes.

If the measured value varies from the standard value but is within the permissible range, go to the ABS option in the FACTOR menu in the CALIBRATION menu and recalculate the factor value for each item. To determine the factor, run [Standard value / Measured value] and input the result value. If the measured value is beyond the permitted range, use the Excel file given by the manufacturer or contact the manufacturer's engineer.

Reference Values for Each Concentration of Standard Chemicals

OPL	Concentration		UVC	UVB	UVA	IR
	KHP	Formazin				
5mm	90.0	540.0	1.3531	1.2162	2.7117	0.3279
10mm	45.0	260.0	0.6766	0.6081	1.3056	0.1579
40mm	10.0	20.0	0.1503	0.1351	0.1004	0.0121

Reference Values for Each Concentration of Standard Chemicals

OPL	Concentration		UVC	UVB	UVA	IR
	KHP	Formazin				
5mm	90.0	540.0	1.4884~1.2178	1.3378~1.0946	2.9829~2.4405	0.3606~0.2951
10mm	45.0	260.0	0.7442~0.6089	0.6689~0.5473	1.4362~1.1751	0.1736~0.1421
40mm	10.0	20.0	0.1654~0.1353	0.1486~0.1216	0.1105~0.0904	0.0134~0.0109

9.3. Method for Manufacturing Smart Sensor Reference Materials

9.3.1 KHP(Potassium Hydrogen Phthalate) Solution

The KHP solution is used as a smart sensor UVC and UVB absorbance calibration solution and is a standard solution for the "Water Pollution Process Test Standard ES04311.1 Total Organic Carbon" test technique.

1. Method for preparing KHP standard undiluted solution

KHP 1000mg-c/L standard stock solution is prepared by dissolving 2.125g in purified water to yield 1L after drying the KHP reagent at 105°C120°C for about 1 hour using the "ES04311.1 Total Organic Carbon Test Procedure" and then chilling in a desiccator.

2. Manufacturing method of standard solution for smart sensor calibration

After determining the calibration concentration for each OPL, as described in section 8.2 Calibration Procedure, prepare the standard solution for smart sensor calibration by diluting KHP 1000mg-c/L stock solution. Since the measuring component is properly immersed in around 500mL based on a 1L plastic beaker, it is advised to make with a capacity of 500mL to 1000mL.

Dilution

$$\begin{aligned}\text{Dilution factor} &= \text{Volume of solution after dilution} / \text{Volume of solution before dilution} \\ &= \text{Mass after dilution} / \text{Mass before dilution} \\ &= \text{Concentration before dilution} / \text{Concentration after dilution}\end{aligned}$$

If the concentration before dilution is 1000mg-c/L (the concentration of the standard stock solution) and the concentration after dilution is 10mg-c/L, 1000/10 = 100, then the dilution factor is 100 times. If the volume of the 10mg-c/L standard solution is 1000mL, the volume of solution before dilution (volume of standard stock solution needed for dilution) equals volume of solution/dilution factor, thus 1000mL/100=10mL. To prepare 10mg-c/L from a 1000mg-c/L standard stock solution, add purified water to 10mL of the standard stock solution to make 1L.

9.3.2 Formazine Solution

Formazine solution is a standard solution of the "Water Pollution Process Test Standard ES04313.1 Turbidity" test method and is used as a smart sensor UVA and IR absorbance calibration solution. Considering the measurement range of the smart sensor, it is prepared with 4000 NTU, which is higher than the 400 NTU of the test method and prepared by mixing hydrazine sulphate solution and hexamethylene tetraamine solution.

1. Preparation of hydrazine sulphate solution
   Add purified water to 5g of hydrazine sulphate to make 400mL
2. Preparation of hexamethylenetetramine solution
   Add purified water to 50g of hexamethylenetetramine to make 400mL.

3. Manufacture of Formazine standard stock solution
   In a 1L volumetric flask, blend 400mL of hydrazine sulphate solution and 400mL of hexamethylenetetramine solution, then add 1L of filtered water. After that, the two solutions are well mixed and kept at room temperature for 24 to 48 hours.

4. Manufacturing method of standard solution for smart sensor calibration
   The standard solution for smart sensor calibration is prepared by diluting the Formazine 4000NTU stock solution after determining the calibration concentration for each OPL. It is advised to manufacture with a capacity of 500mL to 1000mL since the measuring part is appropriately immersed in 500mL based on a 1L plastic beaker.

5. How to use Formazine solution
   In the case of Formazine solution, it should be used while stirring with a magnetic bar and a stirrer, or it should be used after thoroughly mixing and equally distributing the solution before measuring it.

10. Technical Certification

Item	Application Standard	Certificate No.	Date	Issuing Authority
New Product (NEP)	Real-time Optical TOC Analyzer for Wastewater	NEP-MOTIE-2021-125	09.29.2021	Ministry of Trade, Industry and Energy Republic of Korea
The Innovative Product	Real-time UV Sensor for Monitoring and Control of Wastewater Treatment Processes	2021 - 452	12.24.2021	Ministry of Environment, Republic of Korea
Designation of Excellent Product	Real-time UV Sensor for Monitoring and Control of Wastewater Treatment Processes	2022034	07.01.2022	Public Procurement Service, Republic of Korea

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