



Orion 8030cX

Silica Analyzer

Instruction Manual

Version C, Feb 2022

thermo
scientific

Before using the instrument, please read this Instruction Manual carefully!

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Chapter 1

Basic Information



This manual provides the operation, maintenance, troubleshooting and other contents of Thermo Scientific Orion 8030cX Silica Analyzer. Please read this manual completely before installing and operating this equipment. Users must strictly abide by relevant regulations to ensure the normal operation of the instrument. Additionally, relevant information can help users operate the product correctly and obtain accurate analysis results.





Safety Measures

The instrument complies with the safety design rules formulated by international regulatory agencies, and all safety warnings marked on the instrument must be observed when using it, otherwise personal injury or even threat to life may be caused. In order to ensure the protection provided by this instrument is not damaged, please do not install or operate this instrument in any way outside the scope listed in this manual.

- Please do not use the instrument in any environment not specified in this manual.
- Before maintenance and internal wiring of the instrument, the power supply must be disconnected.
- Do not operate the instrument with the door of the electronic cabinet open.
- Please wear personal protective equipment before changing reagents.
- Please refer to Table 1.1 for all safety labels details.

Table 1.1: Safety Precautions

Electric Shock and Fire Warning		This symbol, when noted on a product enclosure or barrier, indicates that a risk of electronic shock and/or electrocution exists.
Warning		<p>A series of chemicals are used in the instrument. Some of these substances have potential hazards. Proper precautions must be taken when handling these chemicals or solutions.</p> <p>Contact and inhalation of chemicals are dangerous.</p> <p>You must pay attention to the following points:</p> <ol style="list-style-type: none"> 1. Wear protective clothing (laboratory clothing). 2. Wear protective goggles/ face masks and protective gloves. 3. Work in a well-ventilated space. 4. Only glass or Teflon material is used when operating according to the steps in the instruction manual;

Warning		<p>5. After installation, ensure that all vent holes of used bottles are unblocked.</p> <p>6. Ensure that you have obeyed applicable specifications for accident prevention.</p> <p>7. Substances shall be disposed of in accordance with applicable local laws and regulations.</p>
Grounding Warning		This symbol, when noted on the product, identifies the location of the connection for Protective Earth (ground).
High Temperature		When the product is marked with this symbol, do not touch it to prevent from being burned.
Recycling Sign		Electric power equipment with this sign cannot be abandoned in the European public waste system after August 12, 2005. According to European local and national regulations (EU Directive 2012/19/EU), European power equipment users must now return used or abandoned equipment to the equipment producers for disposal without paying any fees.

Chapter 2

Product Overview

Brief Introduction of Application Fields

Thermo Scientific™ Orion™ 8030cX Silica Analyzer is designed to provide accurate on-line measurement of silica (i.e. reactive silicate, soluble silica/silicate). Its applications include:

Feedwater
Boiler water
RO permeate
Steam condensate
Demineralized water
Deionized water
Power plants, Semiconductor, and ultrapure water facilities, etc.

For applications not covered above or for some unconventional applications, please contact your local dealer or Thermo Fisher Scientific Inc.

Specifications

Table 2.1: Specifications of Orion 8030cX Silica Analyzer

Measuring performance	Range of measurement	0-5000 µg/L Auto-switching between two sub-ranges (0-1000 µg/L and 1000-5000 µg/L)
	Accuracy	≤ 1% or ±1 µg/L for 0-500 µg/L; ≤ 5% for 500-5000 µg/L
	Repeatability	± 0.6 µg/L or ± 1% of reading, whichever is greater
	Method	Heteropoly-molybdenum blue colorimetric method
	Measurement time	≤ 10min in Fast mode; ≤ 15min regular mode
	Detection Limit	0.5 µg/L*
Environment requirements	Operating temperature	5 - 45°C (41–113°F)
	Humidity	5% - 95% RH, non-condensing
Sampling condition	Sample flow	50-300mL/min
	Sample pressure	0.2 - 5 bar (2.9 - 72.5psi)
	Sample temperature	0 - 65°C (32–149°F), no ice present
	Water sample ports	Flow cell inlet OD (Outer Diameter) 8mm/ OD 6mm (1/4 inch)
Water sample requirements	Clean water	Clean water with no particles over 0.2µm; prefilter 7070FLT can be used if large particles exist

Instrument installation	Housing protection class	IP65
	Instrument size (WxHxD)	450 mmx791 mmx320 mm (17.7inx31.1inx12.6in)
	Transportation weight Instrument weight	41kg (90 lbs) 26.8kg (59.1 lbs)
Electronic parameters	Requirements for power supply	100–240VAC, 100W, 50/60Hz
Data and control	Analog output	Two (2) isolated 0/4-20 mA, Maximum load 900 Ω
	Dry contact output	Three (3) relays, 8 A @ 250 VAC
	Data communication	RS485, MODBUS RTU/TCP/IP, PROFIBUS (optional)
Regulator	Regulator Disclaimers	cTUVus, CE, UKCA, KC, RCM, FCC, ISED
Use life of the reagents at 15min measurement frequency	Reagent	100 days
Waste Volume	Chemical Waste per month (at 2hr measurement cycle)	1.87 L
	Chemical liquid waste Volume per analysis	< 5.5 mL

* Note: In order to ensure the best performance of the instrument, it is recommended that the instrument shall be installed in the analysis room within the temperature range of 20 °C \pm 10 °C. The LOD of 0.5 μ g/L was achieved at optimal lab test condition.

Instrument Size

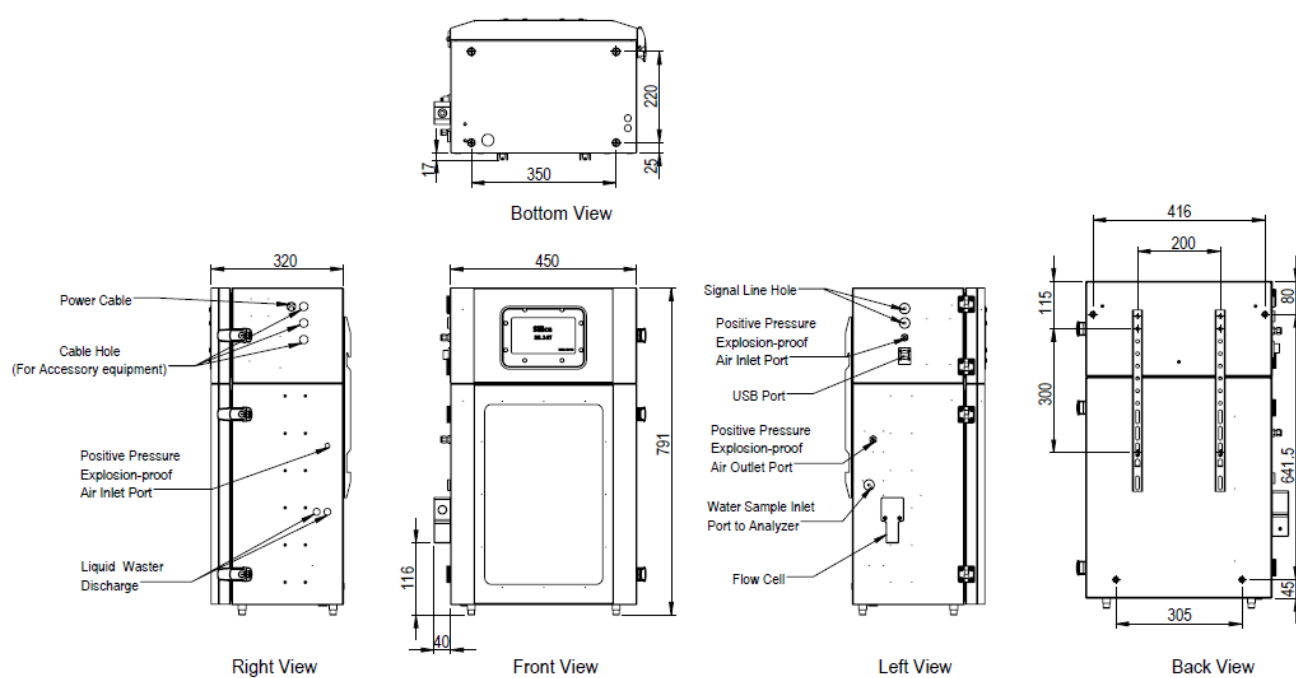
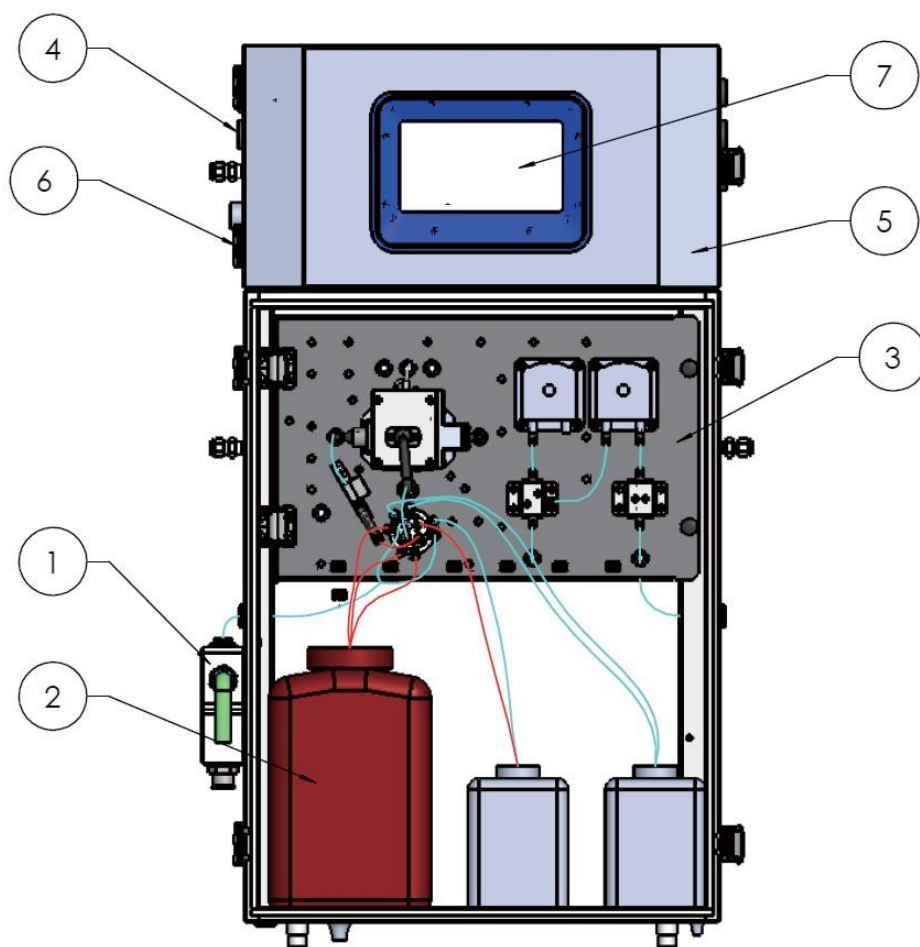


Figure 2.1: Size of 8030cX Silica Analyzer (Unit: mm)



1	Flow cell	5	Electronic Cabinet
2	Standards, Reagents, Clean Solution, Validation solution bottles	6	USB port
3	Fluidic panel	7	Touch screen
4	Signal line hole		

Figure 2.2: Main Interactive Interface of 8030cX Silica Analyzer

Fundamental Principles

Silica refers to the reactive silica in pure water, such as boiler feedwater, deionized water, steam condensate, and RO permeate used in power plants, boiler or ultrapure water applications. It is a very important indicator for detecting and controlling the corrosion or scaling on turbines, heat exchangers, and boilers. Online real-time measurement of silica enables safe, efficient operation, reduces maintenance, and replacement costs due to scaling. The online silica analyzer allows instantaneous or automated decision making, enabling removal or recycling of water with out-of-range silica concentration. Continuous silica monitoring provides rapid notification of RO breakdown or saturation of ion exchange resins, thus, ensuring maximizing system efficiency and minimizing downtime for repairs. Orion 8030cX Silica Analyzer can send alerts/alarms or data to warn the users at the onset of silica spikes, triggering corrective actions and reducing failure and issues downstream.

Orion 8030cX Silica Analyzer is based on the detection principle of the Heteropoly-molybdenum blue colorimetric method. In this process, silica reacts with molybdate in acidified condition to form siliconmolybdate yellow. This is an intermediate then reacts with reductant to generate siliconmolybdate blue. The absorbance of this blue complex at a specific wavelength is proportional to the silica content. After calibration, the silica concentration (unit: $\mu\text{g/L}$ or ppb) in the water sample can be reported.

Interferents such as phosphate (PO_4^{3-}) and arsenic (As) can cause significant false-positive errors. Therefore, the masking reagent R2 is added to prevent formation of intermediate reaction products which interfere with the molybdate method, thereby enabling more accurate results.

Below 30 mg/L , the phosphate (PO_4^{3-}) and arsenate (AsO_4^{3-}) ions will not interfere with silica test results. In standard boiler water, ultrapure water, ion exchange resin effluent, mixed-bed demineralizer effluent and RO permeate applications, the phosphate (PO_4^{3-}) and arsenate (AsO_4^{3-}) ions will not exceed the 30 mg/L threshold, so the results of 8030cX Silica Analyzer will be accurate without interference.

Orion 8030cX Silica Analyzer includes the following parts: the electronic control system and water sample analysis system.

The electronic control system includes the power supply module, circuit control system and user interface panel, and it has the functions of instrument power-on, self-test and fault alarm. Historical analysis data, alarm data, calibration and event log are stored in the instrument for one year or even more, which users can download via USB drive. The real-time data can also be transmitted to external equipment (PLC or DCS) through 0/4-20 mA output signals or RS485. The user can set the measurement time, measurement frequency, calibration, cleaning and validation frequency according to the site-specific requirements.

The water sample analysis system includes the water sampling flow cell, reagents delivery sub-system, reaction cell, and measurement and analysis module. The water sample and reagents are delivered by a newly designed fluidic sampling system to ensure a higher measurement accuracy. The instrument has implemented an accurate temperature control on the color reaction process to ensure the colorimetric reaction proceeds to completion. Optical background correction was implemented to reduce background interference. Pre-analysis and post-analysis rinses and cleaning procedure are built in each measurement to ensure accurate result without carry over effect or contamination.

Chapter 3

Installation

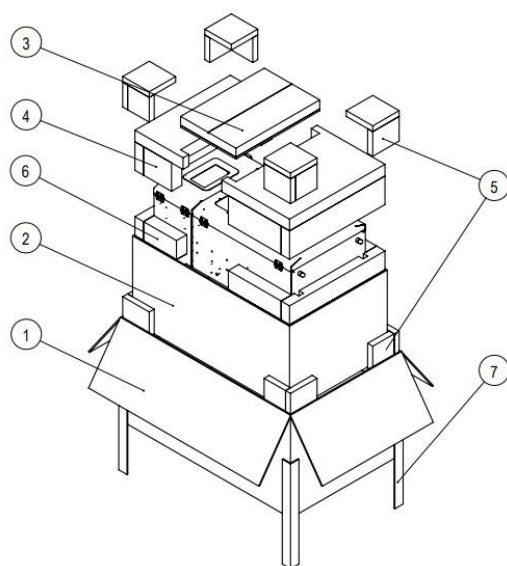
Unpacking Inspection

Orion 8030cX Silica Analyzer has been carefully tested and packaged before leaving the factory.

Open the inner and outer packing and check the product and accessories according to the Packing Checklist. If any components are missing or damaged, please contact Thermo Fisher or its representative office immediately.

Open the outer package and take out the foam supports at the corners of the inner package.

Open the inner packing and check the product and accessories according to the Packing checklist.



1	Outer Box	5	Corner Foam Blocks
2	Inner Box	6	Bottom Foam Insert
3	Accessories Box	7	Box Reinforcement Sleeves
4	Upper Foam Insert		

Requirements for Instrument Installation

Basic Requirements for Instrument Installation

Instructions for instrument handling:



CAUTION: When equipment exceeding 40 lbs. should be lifted with the help of two persons or follow any heavy lifting policies your employer in place.

- It is recommended that two people work together to lift and handle the instrument.
- In the process of lifting the instrument, the instrument door should not be used as the lifting point, otherwise the door and sealing elements could become damaged.

Selection of Installation Location

Please refer to the specifications for the temperature and relative humidity requirements of the installation environment.

It is recommended to install the instrument in a shed, protective case, or analysis room to avoid extreme weather and freezing reagents. For the best results, it is recommended to install the silica analyzer at temperatures of 10-30°C and maximum humidity < 95% (no condensation) room.

Orion 8030cX Silica Analyzer has reached IP65 protection level and can be installed outdoors. However, the installation location of the instrument cannot be flooded, frozen, or overheating due to direct sunlight. If the ambient temperature drops below freezing point, the reagent solutions may freeze and stop analysis.

In the cold climate, it is recommended that the silica analyzer be installed in a non-freezing indoor environment.

Select the installation location as close as possible to the water sample source, which can reduce the sample delay as much as possible. To ensure real-time analysis of online sample, sample water needs to be pumped into the flow cell of the silica analyzer at above 50ml/min and at a pressure over 0.2 Bar (3 psi).

The installation location should be free from irritating or corrosive gases.

The installation of the instrument shall comply with the following requirements:

The instrument can be mounted on the wall with the hanging rack or mounting screws through the four holes on its back panel for operation. The instrument can be placed on a table top as well. No matter which installation method is adopted, it is suggested to fasten the instrument with screws. After installation, the instrument shall not move freely in the process of operation.

Ensure that the selected wall on which the instrument is to be installed can support at least 4 times the weight of the instrument (about 30 Kg).

Enough space should be reserved on the right side of the instrument to facilitate door opening and wiring.

Enough space should also be reserved on the left side and the bottom of the instrument to facilitate tubing connection and wiring.

The instrument should be installed at a position with suitable height. It is suggested that the screen shall be level with the operator's level of eyesight.

Remaining level is required for the installation of the instrument, and it is recommended to use a levelling tool to ensure proper installation.

Note:

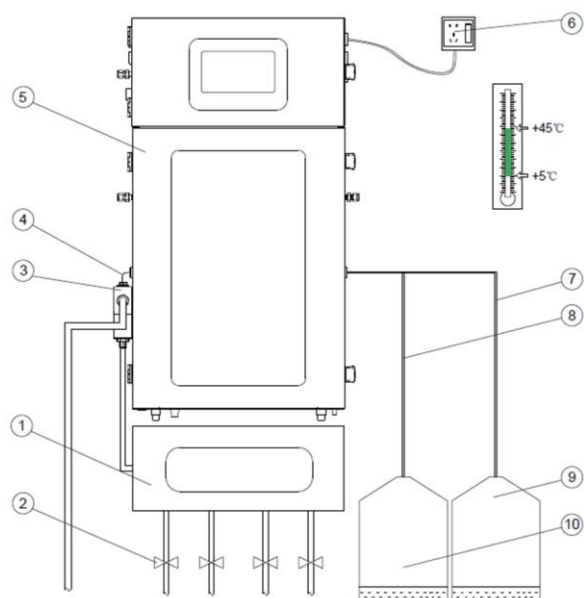
- During installation and operation, when the instrument door and internal fluid passage mounting panel are opened, it is necessary to pay attention to the risk that the instrument may

topple if it is not properly fastened.

- Note: During installation, especially when installing external cables, do not discard the rubber seal covers on the side of the instrument. External cables need to pass through these rubber seal covers to enable the IP65 protection. Otherwise, IP65 protection will be compromised.

for your wastewater facility to handle or meet your discharge regulation.

On-site instrument installation



1	Sequencer (optional)	6	Power supply socket
2	Regulation Valves	7	Liquid clean waste tubing
3	Flow cell	8	Liquid chemical waste tubing
4	Sampling tube	9	Liquid clean waste tank
5	8030cX Silica Analyzer	10	Liquid chemical waste tank

Figure 3.1: On-site Installation of Silica Analyzer

Note:

If you need to separate chemical waste from clean rinse wastewater, this analyzer needs to be equipped with two liquid waste tanks, one for chemical waste and the other for harmless cleaning waste. Be sure to properly label the corresponding tubing and tank.

Liquid chemical wastes should be properly disposed according to relevant waste handling requirement.

Due to the very limited quantity of chemical waste, it is possible that it is okay to discharge the chemical waste to drain. Please check to ensure the limited waste is okay

Mounting Methods of the Instrument

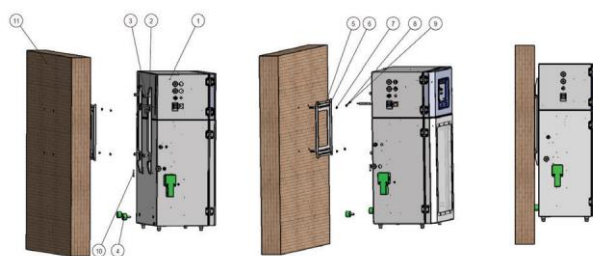
Before Installation, select a suitable wall for installing expansion screws, the wall surface has enough load capacity (at least 4 times weight of the instrument is required). If the instrument is damaged because it is not mounted firmly, Thermo Fisher will not assume any responsibility.

Option 1: Method of Rack Mounting

First step: As shown in Figure 3.2 below, take out the two aluminum alloy strip hanging racks (item 2) provided in the package. And use M6*16 bolt to fix the racks into the instrument. Also, to keep the instrument vertical and level, install the 2 pegs (Item 4) to the back bottom side of the analyzer cabinet,

Second step: mount the aluminum alloy rectangular bracket (item 5) on the wall with 6 pcs expansion screws, tightened by nuts/plain washer and spring washer. In addition, use Loctite glue on the connection points of the hanging rack if you like to secure it more.

Third step: hang the instrument onto the aluminum alloy rectangular bracket on the wall. The long hanging racks on the analyzer sit tight on the rectangular bracket on the wall to secure the instrument. And use the M4*30 2 pcs support screw to fix the racks. Also, adjust the pegs length to keep the instrument vertical and level.

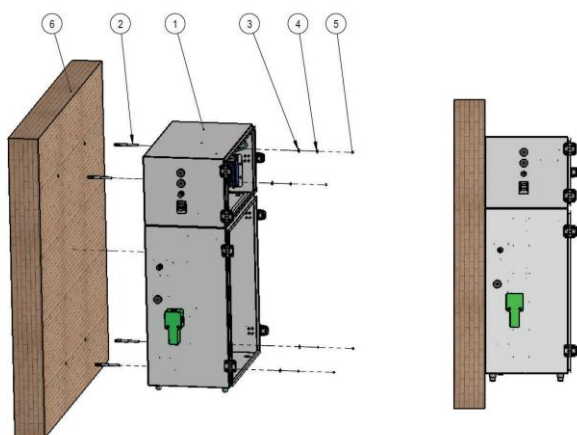


1	8030cX Silica Analyzer	7	Expansion Nut (6pcs)
2	Fix Bracket (2pcs)	8	Expansion Plain Washer (6pcs)
3	M8*16 Bolt (4pcs)	9	Expansion Spring Washer(6pcs)
4	Rubber Pegs (2pcs)	10	M4*30 Support Screw (2pcs)
5	Fixed rectangular bracket to Wall	11	Installation Wall
6	Expansion Screw (4pcs)		

Figure 3.2: Rack Mounting of 8030cX Silica Analyzer

Option 2: Used the Expansion Bolts to Fix the Instrument

the other is 6 mm OD or ¼ inch OD (7). (Figure 3.4)



1	8030cX Silica Analyzer	4	Expansion Spring Washer(4pcs)
2	M6*80 Expansion Screw (4pcs)	5	Expansion Nut (4pcs)
3	Expansion Plain Washer (4pcs)	6	Installation Wall

Figure 3.3: Expansion Bolts to Fix the Instrument

Before Installation, first step opens the front door to remove the black rubber cover from the rivet nut.

Second step based on Figure 3.3, drill the hole on the wall with diameter 8mm, and install the expansion screw.

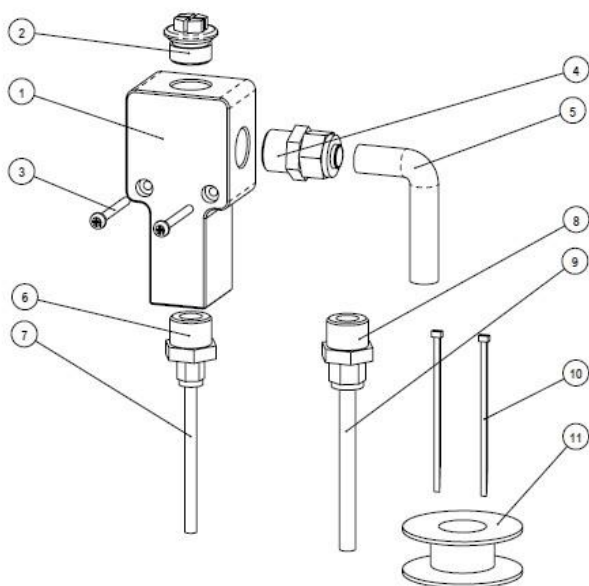
Third step install the instrument by fastening M6*80 Expansion Screws to the wall and fixing by the expansion nut /plain washer/ spring washer in front of the instrument as shown in Figure 3.3 above.

Option 3: Place the silica analyzer on a fixed table top. This is often used in a temporary setting. Ensure the table is sturdy and not moving.

Flow Cell

The flow cell is mounted on the left lower side of the instrument for water sample collection.

The components of the flow cell are shown in Figure 3.4. The flow cell is provided with the analyzer. There are two options of sample inlet tubing: one is 8 mm OD (9), and



Item No.	Name	Quantity	Specification
1	Flow cell body	1	
2	Flow cell upper cover	1	
3	Pan head screw	2	M4x40, stainless steel
4	Large Straight joint	1	G1/2 external thread to ID 12 mm OD 16 mm plastic tubing
5	Large Overflow tubing to drain	1	Plastic ID 12 mm OD 16 mm, length 1m
6	Small Straight joint	1	G1/2 external thread to ID 4 mm OD 6 mm plastic tubing
7	Small Sample inlet tubing	1	Plastic ID 4 mm OD 6 mm, length 0.2 m
8	Middle Straight joint	1	G1/2 external thread to ID 6 mm OD 8 mm plastic tubing
9	Middle Sample inlet tubing	1	Plastic ID 6 mm OD 8 mm, length 0.2 m
10	Cable tie	2	
11	PTFE tape	Several	

Figure 3.4: Flow Cell Components

Note: PTFE tape shall be wrapped around the thread for sealing and preventing water sample leaking, at least 4 rounds recommended.

The entire flow cell is mounted on the outside cabinet wall of the 8030cX Silica Analyzer with two M4 x 40 mm screws, as shown in Figure 3.4.

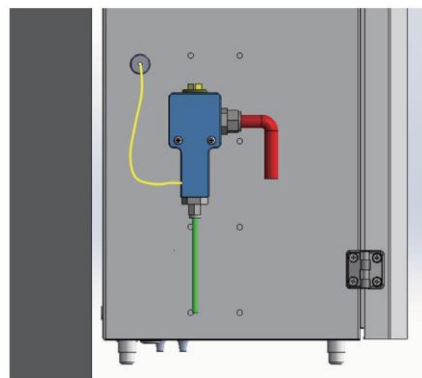


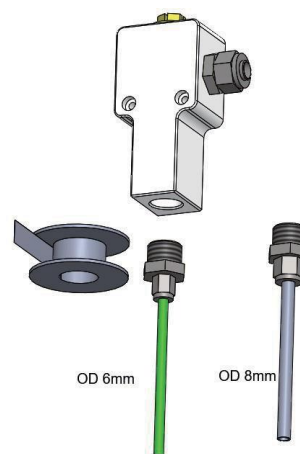
Figure 3.5: Flow Cell Installation Position

Note:

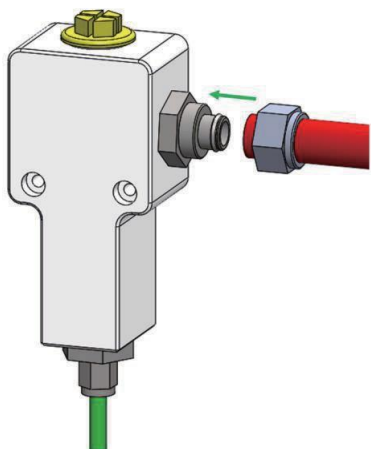
- The inlet port in Flow cell is connected to the common port in the sequencer (if used) and the pressure or flow speed is often adjusted by a valve to meet the requirements (seen in the table 2.1).

Description of flow cell installation steps:

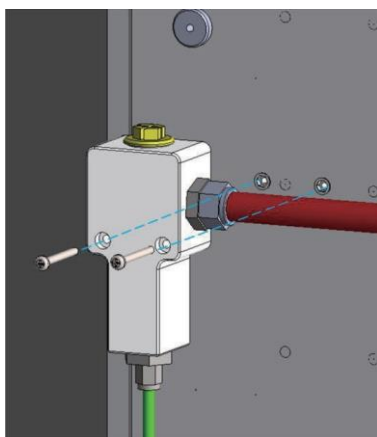
- Check the outer diameter of sampling tube (6mm or 8mm OD), and choose the right-size straight joint, then connect it to the flow cell (if the sampling tube's OD (Outer Diameter) is 6mm, choose the small straight joint, otherwise use the middle straight joint), PTFE tape is recommended to wrap around the thread before connecting.



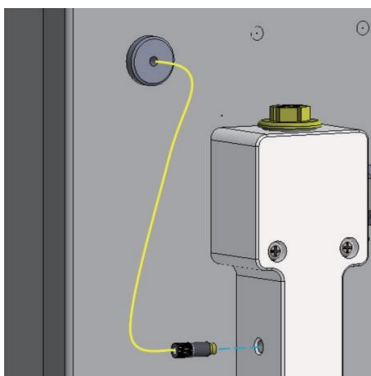
2. Loosen the nut on the large straight joint, then insert the larger overflow tubing (16 mm OD), which sends sample overflow to drain. Tighten the nut to make sure the tubing fastened.



3. Use two M4x40 screws to attach the flow cell on the left side of 8030cX silica analyzer.



4. Screw the fittings in the sampling tube of Silica analyzer into the left side of flow cell.



5. Insert the end of the overflow drain tube to the correct drain location, secure the tubing if needed to prevent slip off.

Optional Sample Inlet Filter

If the sample source is ultrapure water, no filter is needed. If sample source is not ultrapure water or it may contain large particles (e.g. startup of a power plant could release rusty particles to boiler feedwater), then a pre-filter with ~200 um pore size is needed. Thermo Fisher provides a prefilter Y-strainer with part # 7070FLT. This filter contains two adaptors that connect the 1/2" NTP thread on Y-strainer to 6mm (or 1/4") OD tubing.

To install, put Teflon tape on the thread size of the adaptors. Screw in one adaptor to one end of the Y-strainer. Then, loose the nut (cap) on the other side of the adaptor. Push in 6mm (or 1/4") OD soft tubing to the adaptor hole and tighten the nut (cap). The other side of the soft tubing goes to the inlet of the flow cell (in step 1 of flow cell installation above). Then, connects the other side of the Y-strainer to the source water through 1/2" NTP thread or a 6mm (1/4") OD tubing with the adaptor on. Mount the Y-strainer on a wall or fixture with cable ties.

After installation, the water sample filtered by the prefilter goes to the flow cell as shown in the graph below from left to right.



Connecting source water to Y-strainer to adaptor, 6mm (or ¼") OD soft tubing, and flow cell. The water sample filtered by the prefilter goes to the flow cell.

Electronic Connection

Basic Electronic System

The basic electronic system includes the following components:

- Main control board (MCB)
- Single board computer (SBC)
- Power module

Main Control Board

The main control board is mounted on the back wall of the electric cabinet at the top of the 8030cX Silica Analyzer. It is located behind the LCD screen in the electronic cabinet. It is connected to the single board computer via RS485 and performs the functions required by silica applications.

Additionally, the main control board also includes external interfaces, including two 0/4-20 mA output interfaces, two digital input interfaces, three relay control interfaces and two analog input interfaces. Please refer to Figure 3.6 for the main interfaces.

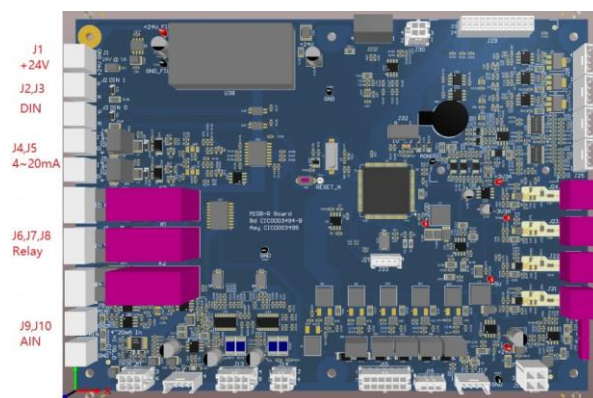


Figure 3.6: Main Interfaces of Main Control Board

Components of Single Board Computer

The single board computer is installed behind the LCD screen on the electronic cabinet at the top of 8030cX Silica Analyzer, which is convenient for user operation. It consists of a core board, an expansion board and a display screen. The single board computer supports the touch control function. The single board computer is connected to the main control board via RS485 cable. Please refer to Figure 3.7 for detail of single board computer.

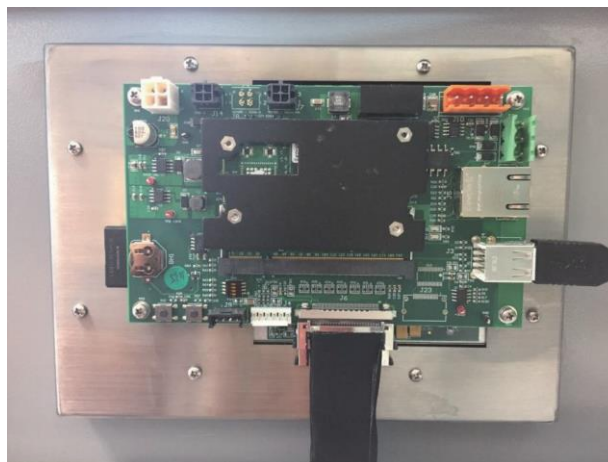


Figure 3.7: Single Board Computer

Switch-type Power Module

The switch-type power module of main AC power is provided with 24V output voltage by a power module and installed inside the upper electronic chamber. Please refer to Figure 3.8 for Switch-type power module of main AC power.

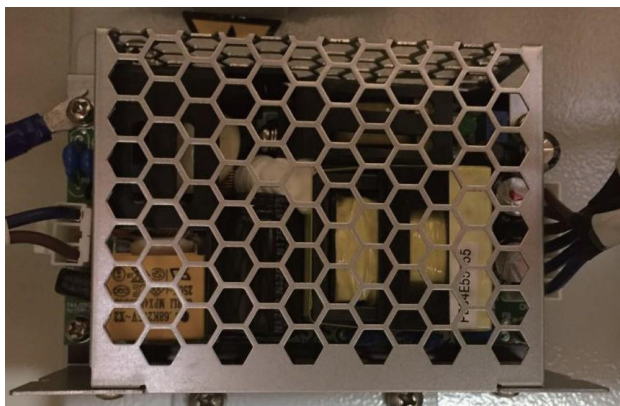


Figure 3.8: Switch-type Power Module of Main AC Power

Safety Wiring:

- Only trained or authorized operators are allowed to carry out electronic wiring and maintenance. Proper protection is required when working near electronically sensitive devices to avoid electrostatic discharge, otherwise the electronic components inside the circuit board may be damaged.
- It is recommended to release static electricity on an operators' body before touching any electronic components (such as the PCB board and its subcomponents).

Notes before Wiring:

- Make sure the power cord is not powered before connecting the power supply to the instrument; Turn off the power supply before connecting to any relay.
- Connect the live wire, neutral wire and ground wire to the power supply terminal in the instrument electronic box and pay attention to the position of the fuse.

- Insert the wire into the corresponding wiring terminal and tighten the screw.
- The signal wire passes through the threading conduit on the left, and the power cord passes through the threading conduit on the right.
- All connections must be conformed to local safety standards.

Notes during Wiring:

- Make sure that the instrument is not powered when wiring.
- Strip off a 6 mm insulation layer from each cable.
- Insert the stripped metal wire into the wiring terminal and tighten the screw. The maximum torque for tightening the screw shall not exceed 0.6 Nm, meanwhile the maximum pulling force shall not exceed 20N.
- The isolation design is applied to the external RS485 and 0/4-20 mA interfaces.
- Maximum switching capacity of relay contacts: 250V AC/8A (resistive load).



Warning!

The instrument is not equipped with a power switch, so the power switch with the functions similar as that of a breaker should comply with local safety standards and must be prepared before final installation.

The circuit breaker should be as close to the instrument as possible and convenient to be controlled by the operator. When the instrument is powered off, there must be a clear and explicit indication.

All conductors need to have a temperature resistance of at least 75°C.

Do not power on the instrument until all preparation work (including reagent installation, water sample access, etc.) is completed!

Connection of Power Cord

- The instrument is equipped with power wiring terminals in the electronic box (see Figure 3.9 and Table 3.1).
- It is strongly suggested that the user shall install an external power switch or a circuit breaker (with GFCI protection) for the instrument to facilitate the operator to control. In addition, the instrument must be powered off during maintenance operations such as reagent replacement.
- The instrument power cord is designed to be a hard connection and is led in through the threaded conduit on the right side of the case (see Figure 3.10).
- The power cord shall be a certified 3-core wire, with a minimum of 0.75 mm² /18 AWG, and the temperature resistance shall not be less than 75°C. The instrument power supply must be grounded.

Table 3.1: Wiring Mode of AC Power Supply

Wire Terminals	Color of Wire	
Line (L)	Brown	Black
Ground (G)	Yellow green	Green
Neutral (N)	Blue	White



Figure 3.9: Wiring of AC Power Supply



Figure 3.10: Power Cord Access Port

Communication Connection

0/4-20 mA analog signal wiring

The instrument provides two 0/4-20 mA analog signal outputs through the main control board, which can drive a load of up to 900 Ω . J4 and J5 are 0/4-20 mA analog signal wiring terminals (see Figure 3.12), and Table 3.2 provides the description of corresponding functions.

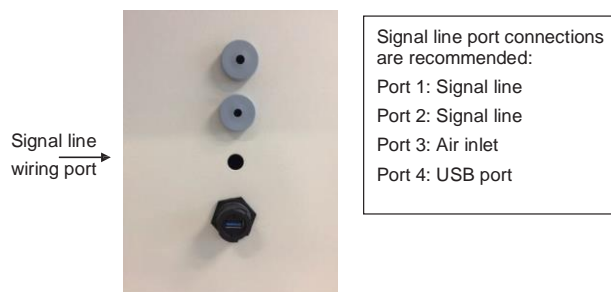


Figure 3.11: Signal Wiring

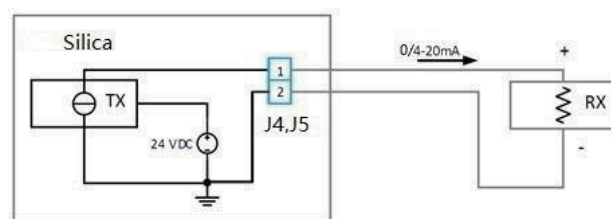


Figure 3.12: 0/4-20 mA Current Loop Link

Table 3.2: J4 and J5 Wiring Terminals

Con- nector	Termin- al No.	Name	Description
J4	1	AO+ (O)	2# analog output+ (max. load of 900 Ohm)
	2	AO- (I)	2# analog output-
J5	1	AO+ (O)	1# analog output+ (max. load of 900 Ohm)
	2	AO- (I)	1# analog output-

Alarm Signal/Relay Wiring

The instrument provides three relays, J6, J7 and J8 (see Figure 3.6), without voltage contacts through the main control board. Three contacts: normally open (NO), normally closed (NC) and common terminal (COM). The maximum rated capacity of relay contacts is 250V AC, 8A. The maximum acceptable cable size for the wiring terminals is 14AWG. Table 3.3 describes J6, J7 and J8 wiring terminals and corresponding functions.

Table 3.3: J6, J7 and J8 Wiring Terminals

Con- nector	Termin- al No.	Name	Description
J6	1	NC	3# Relay NC Contact
	2	COM	3# Relay COM
	3	NO	3# Relay NO Contact
J7	1	NC	2# Relay NC Contact
	2	COM	2# Relay COM
	3	NO	2# Relay NO Contact
J8	1	NC	1# Relay NC Contact
	2	COM	1# Relay COM
	3	NO	1# Relay NO Contact

Digital Signal Input Wiring

Two digital input interfaces on the main control board are used for the external trigger control. Pin 1 and pin 2 of J2 and J3 are inputs. Either external power input or internal power of the instrument can be used. If external power input is used, the external power supply shall be 5~24V DC. If the internal power of the instrument is used,

pin 1 and pin 2 of J1 provide a 24V DC power supply. Please refer to Figure 3.13 for specific digital power access. Please refer to Table 3.4 for digital signal input wiring.

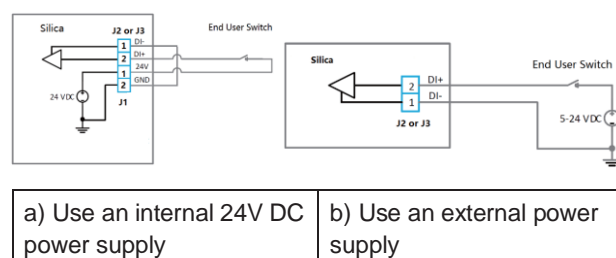


Figure 3.13: Digital Power Access

Table 3.4: J2 and J3 Digital Signal Input Wiring

Con- nector	Termin- al No.	Name	Description
J2	1	DI-(N)	2# input digital signal -
	2	DI+(P)	2# input digital signal +
J3	1	DI-(N)	1# input digital signal -
	2	DI+(P)	1# input digital signal +

RS485 Communication Output Interface

The instrument provides an RS485 communication output interface (See Figure 3.14) at the upper left of the electronic cabinet through the single board computer, the default baud rate is 115200. Please refer to Figure 3.15 and Table 3.5 for signal wiring.

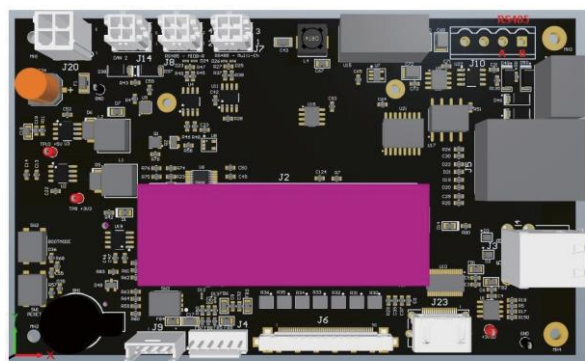


Figure 3.14 RS485 Communication output interface

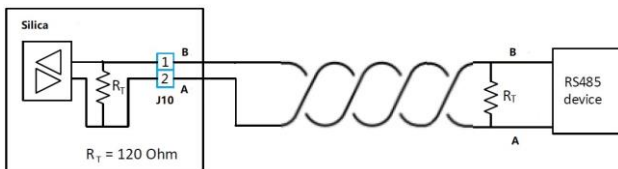


Figure 3.15: RS485 Communication Signal Wiring

Table 3.5: RS485 Communication Signal Output Interface

Connector	Terminal No.	Name	Description
J10	1	B	RS485-B
	2	A	RS485-A

The RS485 interface can provide the electrostatic discharge (ESD) protection stipulated by the International Electrotechnical Commission (IEC), but has no lightning protection design. When using the twisted pair cables with impedance matching with the RS485 termination resistor (typically 120 Ohms), the interface typically has a maximum bus length of 1200 m. The actual maximum bus length depends on the signal rate, cable characteristics and environmental conditions. For example, RS485 communication code requires the twisted pair connection. If parallel lines are used, the maximum bus length will be shortened accordingly. Recommended RS485 cables include:

- a) 6453 Alpha wire.
- b) 3106A Belden.

Knotting of External Wiring

All external wiring shall be knotted near the rubber sealing cover in the cabinet, otherwise the cables will be pulled, which would cause damage to the wiring terminals on the circuit board.

Installation of Liquid Leakage Alarm

The liquid leakage alarm sensor should be installed at the bottom of the instrument. Once liquid leakage is detected, the instrument would immediately give an alarm and stop operation to prevent accidental leakage from corrosion damage to the instrument or other safety issues.

The liquid leakage sensor is connected to the main control board through a connector. When the leakage liquid level exceeds the warning position, the liquid leakage alarm sensor would give out an alarm signal. And for the sake of safety, the instrument would automatically stop measuring. Only when the error is corrected and the sensor recovers to be dry again, can the measurement operation be restarted. Please dispose liquid and waste after wiping properly according to local regulations.

Chapter 4

System Startup

Do not power on the instrument before completing the preparation of reagents, water samples, standard solutions, validation solution, and cleaning solution.

Reagents Preparation



Warning!

Exposure to and inhalation of chemicals could be hazardous. Only trained and qualified personnel can perform the work described in this section of the Instruction Manual.



Warning!

Since some of the reagents are corrosive, it is recommended to order Thermo Fisher approved reagents, which can not only avoid personal injury and environmental pollution, but also ensure accurate measurement and good calibration results.

For the sake of safety, please observe the following rules:

- Please wear personal protective equipment (PPE) provided together with the instrument.
- Ensure that all bottles are ventilated after installation.

- Ensure compliance with applicable local accident prevention laws and regulations.
- Properly dispose of all chemicals and obey applicable local laws and regulations.

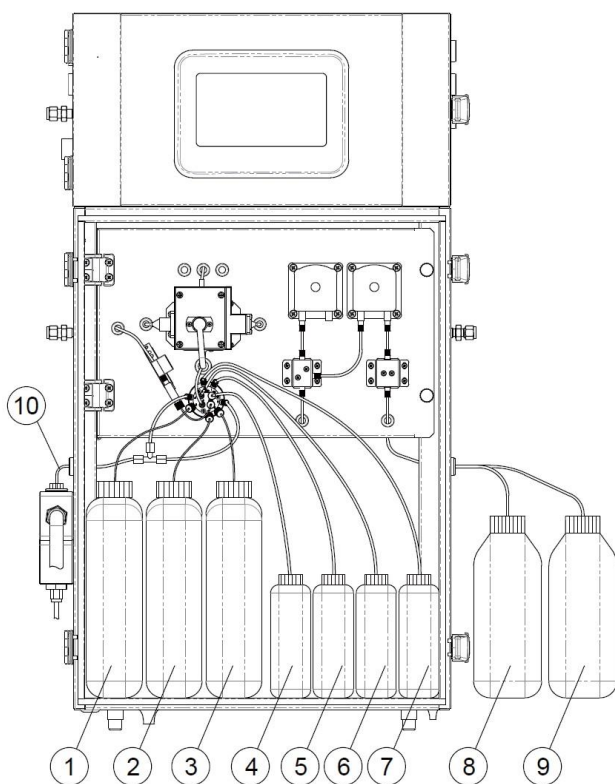
Tubing Connection

Installation of Reagent Bottles and Tubing Connection

This instrument is equipped with a total of 3 reagents (Reagent 1, Reagent 2 and Reagent 3), a maximum of 2 standard solutions, one validation solution and one cleaning solution. It is recommended to purchase them directly from Thermo Fisher (www.thermofisher.com).

Please refer to Figure 4.1 for the installation of reagents, standard solutions, validation solution, and cleaning solution.

Refer to Table 4.1 for the port position of electronic rotary valve (ERV) inside the instrument and its tubing connection information.



1	Reagent 1 bottle	6	Standard solution 1 bottle
2	Reagent 2 bottle	7	Standard solution 2 bottle
3	Reagent 3 bottle	8	Clean waste bottle/tank
4	Validation solution bottle	9	Chemical waste bottle/tank
5	Deep clean solution bottle	10	Sampling tube

Figure 4.1 Reagents, Standard Samples, and Cleaning Solutions Installation

Table 4.1: Electronic rotary valve (ERV) Port and its Port Connection

Installation Direction of Electronic Rotary Valve (ERV) and Port Connection	Port No.	Description	Remark
	Port 1	Cleaning Solution	To cleaning solution bottle
	Port 2	Standard Sample 2	To standard sample bottle 2
	Port 3	Standard Sample 1	To standard sample bottle 1
	Port 4	Water Sample 1	To water sample tube Tee
	Port 5	Reagent 3	To reagent bottle 3
	Port 6	Reaction/Measurement cell	To Reaction/Measurement cell
	Port 7	Reagent 1	To reagent bottle 1
	Port 8	Reagent 2	To reagent bottle 2
	Port 9	Water Sample 2	To water sample tube Tee
	Port 10	Validation	To validation bottle
	Intermediate Port (CTR)	Common port	To the buffer ring

Note:

- Only trained and qualified personnel can perform reagent-related operations.
- Different sample delivery tubing must be correctly inserted into the corresponding reagent bottles and standard solution bottles.
- Ensure the sample injection tubing reaches the bottom of the bottle.
- After installation, ensure that all vent holes of the bottles are unblocked.

- The length of main tubing R1, R2 and R3 should be controlled within a certain range, and it is suggested not to exceed 1.0 meter.
- Detailed instruction on installation of tubing into reagent bottles.

For the installation of the reagent bottles and standard solution bottles, it is recommended to follow the process shown below.

1. Take the guide tube assembly out of the random accessory bag and pull out the guide tube from the inverted hook joint.



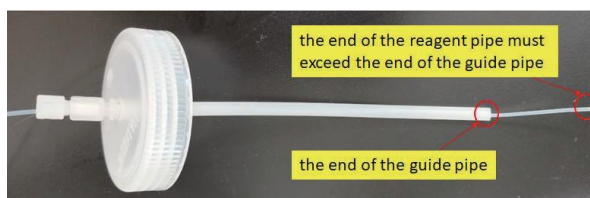
2. Remove the cap of a reagent/solution bottle and use a tool to drill a round hole with a diameter of about 4 mm. The tool can be a power drill, a screwdriver, or a knife, etc. If caps will open holes are ordered, you can use these pre-drilled caps.



3. Insert the inverted hook joint into the opening of the bottle cap, and then insert the guide tube into the inverted hook joint to connect them together.



4. Insert the small reagent/solution tube attached to the analyzer into the guide tube, the end of the small reagent/solution tube must exceed the end of the guide tube by a few centimeters so the small reagent/solution tube inlet is close to the bottom of the solution bottle. Then, lock the inverted cone connector at the top of the bottle cap, so that the small reagent/solution tube is firmly fixed on the bottle cap. This tube assembly fixes the small reagent/solution tube inlet to the bottom of the solution bottle.



5. Place the newly assembled bottle cap on the reagent bottle and tighten it.



Connections of Water Sample, Standard solutions, Validation solution and Cleaning Solution Tubing

Please refer to Figure 4.1 and Table 4.1 for the connections of the water sample tubing, standard solutions tubing, validation solution and cleaning solution tubing.

After the water sample tube is led out from the rubber stopper at the lower left side of the instrument, it is connected to the sample port in the flow cell. Please refer to Chapter 3 "Flow Cell" for specific operations.

Installation of Clean Waste Tank, Chemical Waste Tank, or Drain Connections

Please refer to Figure 4.1 regarding waste tubing.

The instrument has two liquid waste tubing for discharging spent chemical and sample. Waste can either be collected or discharged to the drain/waste system, depending on site requirements. If waste is collected, the chemical waste tube should be connected to a designated hazardous chemical waste tank, and the non-hazardous clean waste tube should be connected to a designated clean waste tank. It is recommended that the waste tubing is secured to the lid of the waste tank to prevent chemical spills.

If waste is to be discharged to the drain/waste system, route the waste tubing as appropriate to the drain/waste system. Ensure the tubing is secured to the drain to prevent chemical spills.

Main steps of waste tubing installation:

- a) Insert each tubing line through each of the two rubber sealing covers at the lower right of the instrument cabinet.
- b) Adjust and cut the waste tubing outside the instrument to a suitable length (according to the specific position of the liquid waste tanks), secure the tubing on the lid of the waste tank and extend it into the waste tanks.

Note:

- Only trained and qualified personnel can carry out waste related operations.
- It is recommended to dispose the waste tanks at least once a month.
- Liquid waste tubing shall not be immersed below the level of liquid waste to avoid potential backflow of wastes; It is recommended to install waste tanks at a lower position than the outlet of drain tubing from the analyzer to avoid backflow.
- The waste tubing goes directly down from the instrument to the waste tanks without bending, twisting or pinching, otherwise it will lead to

difficulties in discharge of wastes, which will affect the performance of the instrument.

- The waste tank must be clearly marked and managed in accordance with local laws and regulations.

Instrument Startup

After the installation of reagents, water sample, standards, validation and tubing are completed, power on the instrument. Users can choose to view the status of the instrument, set the parameters of the instrument, choose the maintenance mode, or conduct analysis and calibration.

If the automatic initialization option of the system has been set as "ON", the instrument will be initialized automatically after starting up. Auto-initialization checks instrument status, valve position, fluid levels and drains any remaining fluid in the system. Please wait patiently for the completion of automatic initialization.

It is recommended that the user shall set the automatic initialization option as "ON". Such setting ensures that after the power-off and restart of the instrument, the automatic initialization operation is performed before automatic measurement to avoid errors.

Solution Prime

Before beginning analysis after installation, it is recommended to prime all sample and reagent tubing. The main purpose of priming is to remove air from the reagent and water sample lines by filling the tubing with fresh sample and reagents, ensuring proper analysis. It is recommended to prime 3 mL of sample to prevent "lack of sample". The reagents and standard solutions only need prime of ~1mL. Priming can be used to see whether your bottle tube assembly is correct with tube inlet near bottom of reagent/standard. If it shows lack of sample during prime, it means that the tube end is not inserted to the primed solution.

Users have eight options when priming: the water sample, standard 1, standard 2, reagent 1, reagent 2, reagent 3, validation, and cleaning solution.

The reagents, standard, and cleaning solution will self-prime during analysis under default settings.

Chapter 5

System Running

Menu Interface Tree

The operation interface of Orion 8030cX Silica Analyzer is simple and easy to understand. The menu structure is as follows:

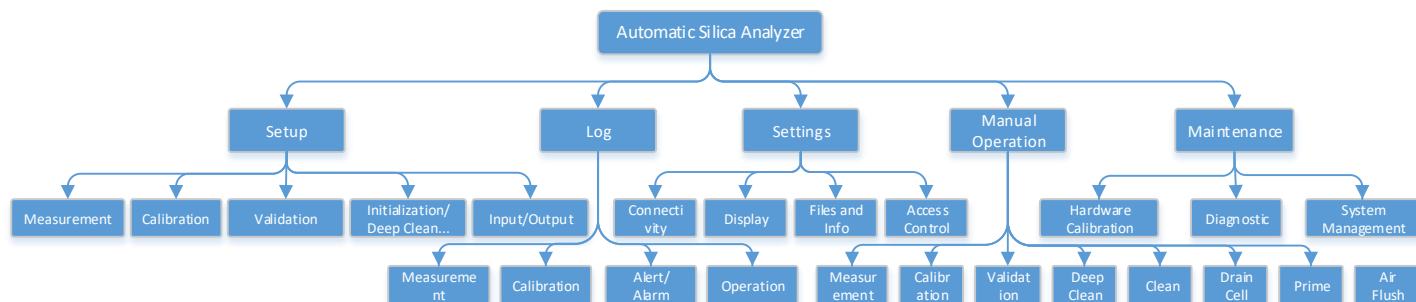


Figure 5.1: Menu Interface Tree of Orion 8030cX Silica Analyzer

Main Interface

The analyzer main interface includes the navigation bar, instrument name, time, date, instrument status icon, user login, real-time running status, measurement parameters and measurement result, progress bar, last measurement and calibration date/time, Start/Stop button and other information.

Navigation Bar: Navigation bar is used to quickly access specific pages. The navigation bar includes return, main interface, Setup, Log, Settings, Manual Operation and Maintenance. Clicking a corresponding icon, you will enter the corresponding page. Among them, the return icon is only valid when it is not on the main interface and is used to return to the previous menu level of the current UI location. The main interface icon quickly returns to the main interface from any page. The navigation bar would appear in each page. From the main interface, you can click middle of the navigation bar to hide the navigation bar. After that, click to return to the state with the navigation bar, shown in Figure 5.2.

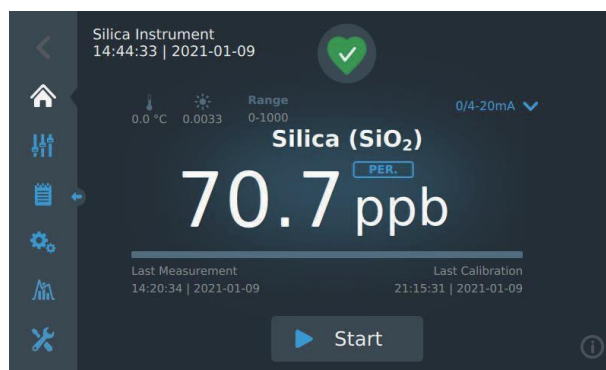


Figure 5.2: Menu Display in 8030cX Silica Analyzer

Equipment Name, Time and Date: The equipment name is used to indicate the name of the current equipment. Time/Date displays the current time/date.

Equipment Status: The equipment status is used to indicate the status of the equipment. Under normal conditions, the equipment status identification is green heart icon . When there is an alert or alarm, the identification changes to another form, such as Red or Yellow with an exclamation mark, shown in Figure 5.3 and Figure 5.4

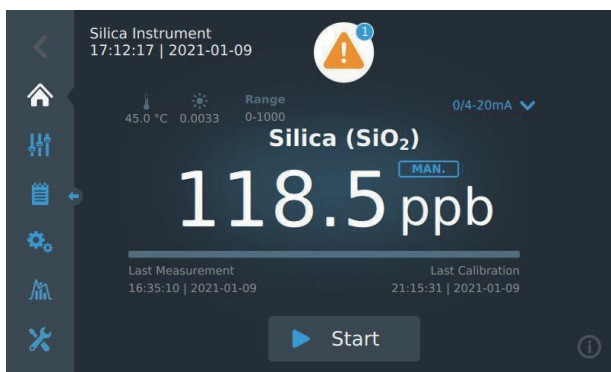


Figure 5.3: Main Interface of Orion 8030cX Silica Analyzer in Case of Alerts

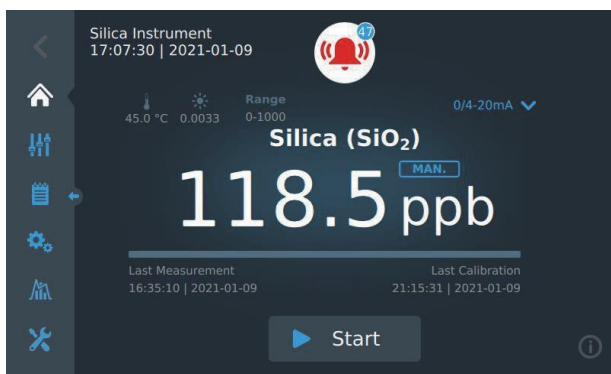


Figure 5.4: Main Interface of Orion 8030cX Silica Analyzer in Case of Alarms

Real-time running status: Some real time information is displayed, such as the currently reaction temperature, real time, absorbance measured, and currently measurement range.

Progress Bar: The progress bar is used to indicate the progress of the current operation. The current operation process is also displayed here.

Last Measurement and Calibration Date/Time: It is used to display the last measurement time and the last calibration time. It is recommended to conduct manual or auto-calibration at least once a month. Ideally auto-calibration should be performed once a week.

Start/Stop Button: The Start/Stop button is used to run or stop a measurement. When the instrument is idle, click the Start button to run a measurement.

While the instrument is running, click Stop and the instrument will abort and reset all components to their default status, then empty all solutions out of the instrument and put instrument back to idle. It will typically take 5-10 minutes to finish the aborting process.

Return

The return key of the navigation bar is used to return from the current page to the previous one. The main interface navigation bar is used to return to the main interface from any of sub-pages.

Setup

The Setup menu is used to configure parameters for Measurement, Calibration, Validation, Initialization, Deep-Clean, On-Demand Mode and Input/Output.

In Measurement Setup, the following operating parameters can be configured according to users' requirements: Mode (Manual/ Interval /Continuous), Range, Method, Auto Range, Reaction Time, Reaction Temperature, Clean Cycle, Pre-Mixing and Prime Volume.

Similarly, in Calibration setup, the calibration parameters can be set including Calibration Range, Calibration Standards' Concentration, Calibration Mode (Manual/Interval), Calibration Interval Time, Action When Fails (None/Stop), Calibration Points (Single/Double), Calibration Tolerance (Slope and Intercept).



The validation parameters can also be set using the Validation setup menu, including Mode (Manual/Interval), Tolerance Unit, Tolerance, Standard Conc. and Action When Fails (None/Stop).

Initialization, Deep-Clean and On-Demand features can be activated or deactivated for Auto Initialization, On-Demand Mode and Auto Deep Clean.

The Input/Output Setup is used to configure Relays, Digital Inputs, Analog Outputs and Modbus.

Measurement Setup

The Measurement Setup is used to configure analysis parameters such as Mode (Manual/ Interval /Continuous), Range, Method, Auto Range, Reaction Time, Reaction Temperature, Clean Cycle, Pre-Mixing and Prime Volume.

The Auto Range and Water Sample Pre-mixing can be enabled or disabled with a switch button. When it is set to Enable, the button will be highlighted with , as shown in the figure , thus their function is enabled, otherwise it is disabled.

Measurement Mode can be selected by Manual, Interval or Continuous. The detailed descriptions of Mode settings are listed in Table 5.1.

Prime Volume is set according to the sample tubing length. This function is used to rinse the sample tubing with the freshwater sample to ensure measurement accuracy. The prime volume can be calculated with the following Equation:

$$\text{Prime Volume, mL} = L_{\text{Sample Tubing}} / 50 + 0.2$$

Where:

$L_{\text{Sample Tubing}}$ is the length of sample tubing **in cm**.

For example, when the sample tubing length of 1/8" OD (Outer Diameter) is 50cm, the Prime Volume is 1.2mL ($50 \div 50 + 0.2$). The default value of the prime volume is set to 1.2mL.

Table 5.1: Definition of Analysis Parameters

Measurement Parameters	Sub-options	Definition of Parameter
Analysis mode	Manual	In Manual mode, the analysis is started only once when pressing [Start] each time. After the analysis is completed, the instrument returns to idle state.
	Interval	In Interval mode, the analysis is started continuously with an interval time, such as 1 hour, when pressing [Start]. The Start Time and Interval can be configured.
	Continuous	In Continuous mode, the analysis is started immediately and run continuously without any interval.
Analysis measurement range	Range 1	Is used to measure the water sample within the concentration range of 0µg/L~1000µg/L.
	Range 2	Is used to measure the water sample within the concentration range of 1000µg/L~5000µg/L.
Mode	Normal	The measurement cycle time is almost 15 min for each measurement, providing the highest degree of accuracy.
	Fast	The measurement cycle time is about 11 min for each measurement.
Auto Range	ON/OFF	Auto Range shift function can be set to ON or OFF. The Default is set to OFF.
Reaction Time	Seconds	The reaction time of chemical reaction for color developing in reaction/measurement cell can be set. The default is set to 290 seconds.
Reaction Temperature	°C	The temperature of reaction/measurement cell can be set. The default is set to 45°C.
Clean Cycle	Times of Cleaning	The clean times for cleaning reaction/measurement cell with samples is set. And the default is set to 1.
Water Sample Pre-mixing	ON/OFF	Water Sample Pre-mixing function can be set to ON or OFF to enable or disable the peristaltic pump 2 to flush air back to flow cell (or sample vial) and stir water samples to make sample homogeneous in flow cells. The Default is set to OFF.

Prime Volume	mL	The fresh sample is primed into the sample tubing with the volume of Prime Volume configured to rinse sample tubing. The Default is set to 1.2mL.
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Calibration Setup

Calibration Setup is used to configure calibration parameters including Calibration Range, Calibration

Mode, Calibration Points, Standard Concentration(s), Action When Fails and Calibration Tolerance (Slope and Intercept), shown in the Table 5.2.

Table 5.2: Definition of Calibration Parameters

Calibration Parameters	Sub-options	Definition of Parameter
Range	0–1000 µg/L	The Calibration Range of 0 µg/L~ 1000 µg/L is for low range; instrument is calibrated with the absorbance of long pathlength.
	1000–5000 µg/L	The Calibration Range of 1000 µg/L~ 5000 µg/L is for high range; instrument is calibrated with the absorbance of short pathlength.
Mode	Manual	The instrument is calibrated once when calibration is started.
	Interval	The instrument is calibrated automatically with an interval (such as 24 hours) when Calibration Mode of Interval is selected. The Interval default is set to 168 hours (1 week).
Calibration Point	/	Double or Single can be chosen. The default is set to Double – two point calibration.
Standard 1 Conc.	µg/L	The Silica Standard Concentration for standard 1 as silica is set. The default is set to 20 µg/L. If high range is selected, the default is set to 1000 µg/L.
Standard 2 Conc.	µg/L	Available when the Calibration Point is set to Double. The Silica Standard Concentration for standard 2 as silica is set. The default is set to 200 µg/L. If high range is selected, the default is set to 4000 µg/L.
Calibration Background	µg/L	Available when the Calibration Point is set to Single. The Default is set to 0 µg/L.
Action When Fail	/	None or Stop can be chosen. The default is set to None.
Slope Tolerance	%	The value is set to validate whether the current calibration is successful or not. The default is set 30%.
Intercept Tolerance		The value is set to validate whether the current calibration is successful or not. The default is set 30.

When configuring Calibration Setup for standard concentration, it is recommended to carefully check the actual concentration of the calibration solutions to ensure they correspond to the appropriate calibration range. Accurate measurement results can be obtained only when the calibration concentration settings are correct and the correct calibration solutions are used.

During the automatic range switching and automatic calibration, attention should be paid to the range of automatic calibration. The default automatic calibration is for the range 0-1000 µg/L with 20 µg/L and 200 µg/L standard solutions since this range (0-1000 µg/L) is most commonly used. The measurement error caused by the changes to environmental conditions and other conditions can be avoided through calibration. It is recommended to

conduct auto-calibration at least once a month. Ideally auto-calibration should be performed once a week. This setting can be adjusted under calibration mode: interval frequency. We recommend using default tolerance settings unless there is a special case where tolerance needs to be adjusted.

Validation Setup

Validation Setup is used to configure validation parameters including Validation Mode, Tolerance Unit, Calibration Tolerance, Standard Conc. and Action When Fails, shown in the Table 5.3.

Table 5.3: Definition of Validation Parameters

Validation Parameters	Sub-options	Definition of Parameter
Mode	Manual	The instrument is validated once when validation is started.
	Interval	The instrument is validated automatically with an interval (such as 24 hours) when Validation Mode of Interval is selected. The Interval default is set to 168 hours (1 week).
Tolerance Unit		% or µg/L can be chosen. The default is set to %.
Tolerance		The value is set to validate if the current calibration is successful or not. The default is set to 10.
Standard Conc.	µg/L	The Silica standard concentration for validation as silica is set. The default is set to 20µg/L. If high range is selected, the default is set to 1000µg/L.
Action When Fail		None, Stop or Calibrate can be chosen. The default is set to None.

When configuring Validation Setup for standard concentration, it is recommended to carefully check that the actual concentration of the validation solutions matches the corresponding Standard Conc. setting. Accurate validation results be obtained only under the conditions of correct validation concentration setting and use of the correct validation solution. It is recommended to run a validation after each calibration to validate the calibration is good. The Action when fail option allows user to choose to recalibrate or do nothing when validation results are out of tolerance range.

Initialization, Deep-Clean, On-Demand Mode Setup

Auto Deep Clean, Auto-initiation and On-demand Mode can be set up under Setup-Deep Clean.

Auto-Initialization: Auto-initialization checks instrument status, valve position, fluid levels and drains any remaining fluid in the system. Auto-Initialization can be set "ON" or "OFF". If the Auto-Initialization option has been set as "ON", the instrument will be initialized automatically after starting up. Please wait patiently for the automatic completion of initialization.

It is recommended that the user shall set the Automatic Initialization option as "ON". Such setting ensures that after the power-off and restart of the instrument, the automatic initialization operation is performed before automatic measurement to ensure measurement

accuracy.

On-Demand Mode: This mode should be activated when the instrument is in idle status for a long time (e.g. no measurement activity over one day). On-Demand mode moves liquids in tubing and flush the lines/ERV valve once a while to avoid precipitation and crystallization in the tubing and ERV valve to block the fluid passage. This mode helps to maintain optimal instrument performance.

Auto-Deep Clean: Auto-Deep Clean can be set "ON" or "OFF". If the Auto-Deep Clean has been set as "ON", the Deep Clean Interval can be set, the instrument will perform Auto-Deep Clean automatically with an interval (such as 1 day). The auto Deep Clean is only needed in rare situation. Default setting is Auto-Deep Clean off. After each deep clean, it is recommended to calibrate the instrument before measurement again to ensure accurate measurement.

Input/Output Setup

The Relays, Digital Inputs, Analog Outputs, and Modbus can be set through this page.

Relays: This menu is used to set up Relays and Pre/Post-Run. Relay is mainly used for external output, and Pre/Post-run is used for control of other peripheral equipment.

Relay Setup includes the On-Off setting and operating mode setting. When Relay Setup is “On” the available

operating modes include Alarm and Event. More details shown in table 5.4.

Table 5.4.1: Definition of Relays Setup

Relays Setup Parameters	Sub-options	Definition of Parameter
Relay Event Type	Off	Default setting is Off.
	Alarm	Relay will be On when the set Alarm type is triggered.
	Event	Relay will be On when the set Event type happens.

Table 5.4.2: Definition of Alarm

Alarm Setup Parameters	Sub-options	Definition of Parameter
Alarm Type	High	When measurement exceeds High threshold, relay will be On.
	Low	When measurement is below Low threshold, relay will be On.
	High + Low	When measurement exceeds High threshold or is below Low threshold, relay will be On.
High threshold	µg/L	The default is set 5000. It can be configured.
Low threshold	µg/L	The default is set to 0. It can be configured.
Delay	Seconds	Delay time to set relay on.

Table 5.4.3: Definition of Event

Event Setup Parameters	Sub-options	Definition of Parameter
Event Type	Measure	Relay will be On when measurement starts.
	Calibrate	Relay will be On when calibration starts.
	Validate	Relay will be On when validation starts.
	Clean	Relay will be On when cleaning starts.
	Deep Clean	Relay will be On when deep cleaning starts.
	Alarm	Relay will be On when alarms happen.
	Alert	Relay will be On when alerts happen.
	New Data Ready	Relay will be On when new measurement result is ready.
	Lack of Sample	Relay will be On when there is no sample water.
	Maintenance	Relay will be On when maintenance mode is ON.

Pre-run/Post-run Functions: According to different site applications, when an external equipment is required to run for a period before the Online Silica Analyzer begins analysis, the Pre-run function can be activated (e.g. in case that a water sample pre-treatment equipment is installed).

Similarly, when an external device needs to be triggered and started after the analyses of the 8030cX Silica Analyzer is completed, the Post-run function can be activated.

Pre-run: go to Setup-Input/Output Setup-Relays-Pre/Post Run page to set the pre-run command.

Post-run: go to Setup-Input/Output Setup-Relays-Pre/Post Run page to set post-run commands.

instrument.

Digital Inputs: digital signals can be wired into the analyzer as inputs, which are used to turn the functions ON/OFF with preset delay. Functions include Measurement, Deep Clean, Calibration, Validation and Abort or None. When they are set to the corresponding function, the corresponding function is started when there is an input. The Delay is used to set a specific time delay after input and then execute the corresponding function. This instrument provides two digital inputs, which can be configured separately.

Analog Outputs: The measurement data can be outputted to PLC or DCS via 0/4-20mA analog signal. They can be set to OFF or 4-20mA or 0-20mA. When set to 4-20mA, the corresponding values of Lower Limit for 4mA and Higher Limit for 20mA need to be set; when set to 0-20mA, the corresponding values of Lower Limit for 0mA and Higher Limit for 20mA need to be set. The lower and higher limits is set to the lower and upper limits of the measurement range by default. This instrument provides two analog outputs, which can be configured separately.

Modbus (RS485): Modbus R485 can be used to output data via digital signal. RS485 is used to set the station Address, Baud rate, Data bits, Stop bits and Parity.

Log

Log is used to query various records, including alert/ alarm log, measurement log, calibration log and operation log. Click each log to enter different log interfaces.

USB sticks supported: USB devices of fat32 file system. It is recommended to use standard USB devices of Thermo Fisher Scientific or USB devices of SanDisk and Kingston brands.

Alert/Alarm Log

Alert/Alarm logs are used for various alarms and alerts events occurring during the operation process of the instrument, including the time, date, event, status of event and alarm code. When checking alarm records, you can check based on time (including 1 week, 1 month, 3 months, 6 months, 1 year and all). Alarm records can be exported by authorized person only. When exporting, a USB storage device is required to be connected to the

Measurement Log

Measurement log is used to view and export measurement results, including the measurement time, date, and measurement details, etc. Click the detailed information of each measurement to view the measurement status, analysis time, concentration, sample absorbance, measuring range and other information. When checking measurement records, you can check based on time (including 1 week, 1 month, 3 months, 6 months, 1 year and all). Export measurement records by authorized person only. When exporting, a USB storage device needs to be connected to the instrument.

Calibration Log

Calibration log is used to view and export calibration results, including the time, date, and calibration information. Click each calibration information to view detailed recording parameters, including the calibration time, calibration range, slope, intercept, calibration points, standard calibration concentration, blank absorbance, cell temperature and concentration unit. When checking calibration records, you can check based on time (including 1 week, 1 month, 3 months, 6 months, 1 year and all). Export calibration logs by authorized person only. When exporting, a USB storage device is required to be connected to the instrument.

Operation Log

Operation log is used to view and export instrument operations. Relevant login and instrument operation records can be viewed. Export operation logs by authorized person only. When exporting, a USB storage device is required to be connected to the instrument.

Settings

Settings include the Connectivity, Display, Files and Info and Access Control. It is used to set up the connection and display-related options (including basic options such as Language, Time and Date, Unit Name, Temperature Unit, Concentration Unit and Measurement Type), while Files and Info provides the information of Instrument Model, Serial Number, MIDB Firmware version and

Application version. Access control is used in login interface, and is used for users with different permissions to log in.

Connectivity

Connectivity is used to configure Ethernet; either DHCP or Static IP can be selected. And an IP address is required if Static IP is selected.

Display

Display is used to set Language, Date, Time, Unit Name, Temperature Unit, Concentration Unit and Measurement Type. As required, the different languages and date or time need to set. After the Unit Name is set, the set unit name will be displayed on the main interface. the Celsius or Fahrenheit degree is for temperature unit. Concentration Unit includes $\mu\text{g/L}$ and ppb . Measurement Type includes Si , SiO_2 and SiO_3^{2-} .

Language: It is used to select the language displayed on the interface. English and Chinese are provided. Click "Save" and the instrument interface would switch to the selected language.

Date: Date format can be set to MM/DD/YYYY, DD/MM/YYYY and YYYY/MM/DD. When setting a month, date and year, just select the month, day and year. Click "Save" and instrument would switch to the setting date.

Time: Time format can be set to 12-hours system and 24-hours system. If the 12-hours system is selected, hour, minute, AM and PM are included; if the 24-hours system is selected, then hour and minute are included. Click "Save" and instrument would switch to the setting time.

Unit Name

It is used to set the name of the instrument. After the name is changed, the set name will display at the instrument name position on the main interface.

Temperature Unit

It is used to set the unit of temperature. °C and °F two options are provided. After the unit is changed, the set unit would display at the temperature unit position on the main interface.

Concentration Unit

It is used to set the unit of measurement results. µg/L or ppb can be selected. Click "Save" and instrument would switch to the setting unit.

Measurement Type

It is used to set the measurement type. Si, SiO₂ and SiO₃²⁻ can be selected. The default setting is SiO₂:

$$60 \mu\text{g/L SiO}_2 = 28 \mu\text{g/L Si} = 76 \mu\text{g/L SiO}_3^{2-}$$

Files and Info

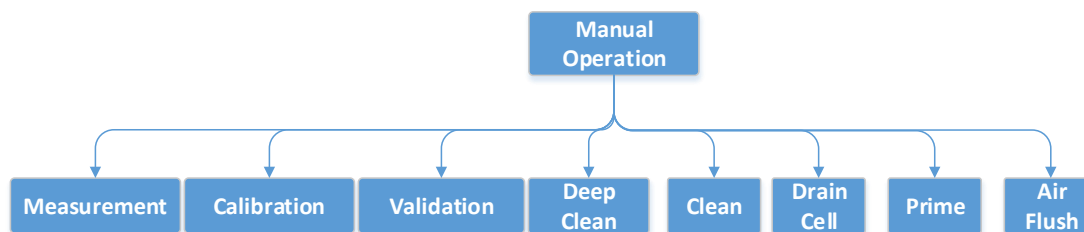
The Files and Info is used to display the Instrument Model, Serial Number, MIDB Firmware version and Application version.

Access Control

The Access Control interface can be used to set whether permission control is required or not. When selecting permission control, the instrument sets multi-level permissions and can distribute different permission passwords to different permission groups according to the needs of users.

Manual Operation

Orion 8030cX Silica Analyzer provides users with the following Manual Operation menus: Measurement, Calibration, Validation, Deep Clean, Clean operation, Drain Cell, Prime, and Air Flush.



Measurement

Click "Start" to run measurements according to the configured parameters. Relevant measurement parameters and measurement progress is displayed on this page. Before measurement, it is recommended to check the measurement parameters. If any modification is needed, enter the Setup-Measurement Setup menu to modify the parameters and enter the Manual Operation-Measurement page again after saving.

During measurement, the current operation can be aborted by clicking "Stop". It is not recommended to use the "Stop" function under this circumstance as pressing "Stop" will cause the instrument to fully flush the lines and rinse the flow cell.

Calibration

Click "Start" to implement manual calibration. Before calibration, it is recommended to check the Calibration Range, Points (Double - two point calibration or Single), Standard Concentrations, allowable deviation and calibration failure response mechanism. Default settings are recommended to begin with. If these parameters need to be modified, enter the Setup-Calibration Setup page to modify the parameters and enter the Manual Operation-Calibration interface again after saving.

During calibration, the current operation can be stopped by clicking "Stop", but the user is not recommended to use the "Stop" function under this circumstance.

As described above in the explanation of the Setup menus, if calibration points is set to Double (two point calibration), check to ensure that the calibration standards

being used match the concentration settings for Standard 1 Conc.(Default is 20 µg/L) and Standard 2 Conc. (Default is 200 µg/L). If calibration points is set to single, Standard 1 Conc. (Default is 20 µg/L) should be set, also Calibration Background should be set according to the background of reagent solutions, such as 3 µg/L (or use earlier double point calibration background - intercept). For the range of 1000~5000 µg/L, two-point calibration is strongly recommended to ensure measurement accuracy. Standard 1 Conc. should be set to 1000 µg/L, Standard 2 Conc. should be set to 4000 µg/L, and the corresponding standard bottles should be used.

After the instrument calibration is finished, the instrument will pop up a window to show calibration results. Click "Confirm" to complete the instrument calibration.

The calibration results of the instrument will be kept in calibration records. Users can enter the Log-Calibration Log page to view the calibration results.

Validation

Validation is used to verify the accuracy of the instrument. A validation solution with known concentration is used for verification. 20 µg/L silica standard is often used for validation for ultrapure water. Insert the validation tubing into the validation solution bottle, then click the "Start" button for validation.

When conducting the instrument verification, it is recommended that the validation solution shall be purchased from official channels.

If the validation fails (based on the Threshold settings), a new calibration is recommended. This action

can be performed automatically using the settings in Setup-Validation Setup menu. In the "Action When Fails" setting, select "Calibrate". After calibration, it is recommended to validate again.

Deep Clean

When dirty tubing or electronic rotary valve (ERV) is suspected as a source of measurement error, it is recommended to run the deep clean method. The special cleaning solution provided by Thermo Fisher is required for deep clean. It can remove silica deposit, bacteria, dirt, and surface fouling. Insert the corresponding tube into the deep cleaning solution, and then click the "Start" button to perform deep clean.

If deep clean needs to be stopped, click the "Stop" button, but this operation is not recommended. Thorough rinsing of the tubing to remove the deep clean solution is recommended prior to sample analysis. Therefore, it is recommended to let the instrument automatically finish the deep clean method to ensure sufficient rinsing of the tubing.

After deep clean is finished, it is recommended to calibrate the instrument with standard solutions. Otherwise, the instrument may perform poorly.

Clean

The clean function is built-in function as a house-keeping function reducing any prior residual when instrument is idle over 2 hours. When dirty reaction/measurement cell or electronic rotary valve (ERV) may affect measurement similar as that in Deep Clean, it is recommended to run clean cycle. The special cleaning solution provided by Thermo Fisher is required for clean. The clean function is a gentle cleaning procedure to remove light silica deposit and surface fouling, and it does not require calibration afterwards. Make sure that the corresponding tube is inserted into the cleaning solution, and then click the "Start" button to carry out clean.

If clean needs to be stopped, click the "Stop" button, but this operation is not recommended. Special cleaning solution are used for clean, which may have certain risks. Therefore, it is recommended to let the instrument automatically finish clean.

Drain Cell

Drain Cell is for emptying the reaction/measurement cell, it is recommended before long-time shut down, delivery or shipping.

Prime

Prime is for eliminating air in the tubing after replacing reagents, standard solutions and validation solution. The default Prime Volume is set to 1.2mL.

Air Flush

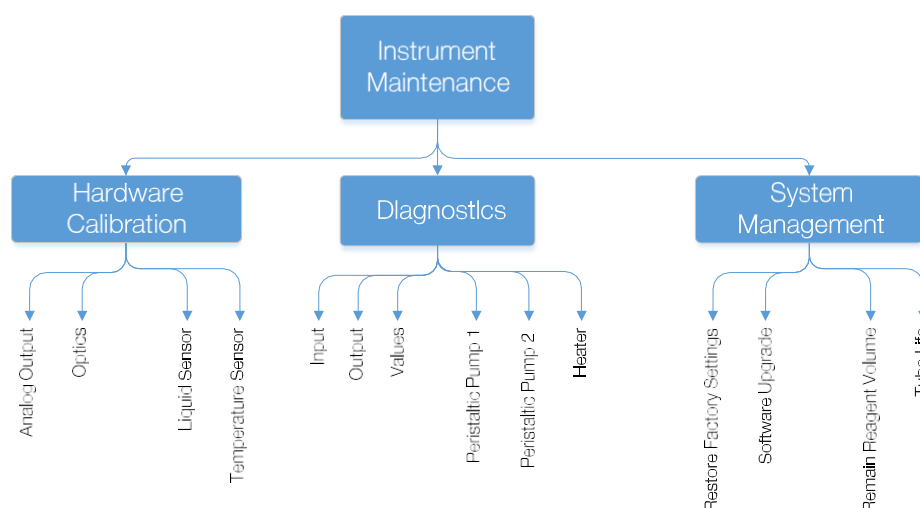
Air flush is for emptying the solutions in the tubing, it is recommended to flush All before long-time shut down, delivery or shipping.

Maintenance

Before entering the maintenance function, a certain permission is required.

When entering the maintenance interface and enabling the maintenance mode, the interface will prompt "Change the instrument to maintenance mode". Maintenance operations such as the Hardware Calibration, Diagnostics and System Management can only be carried out after entering the maintenance mode.

It is recommended to enter the maintenance mode only when the analyzer is in the idle state. If the analyzer is in the busy state, switching to Maintenance Mode will prompt waiting for current operation to complete.



Recommend switching to horizontal text and better resolution text. (Leave this to be done in formatting process)

Hardware Calibration

Hardware Calibration is used to calibrate the relevant hardware of the analyzer, including analog output calibration, optics calibration, liquid sensor calibration and temperature sensor calibration.

Optics Calibration: is used for the correction of light path. After the Analyzer has been running for a long time (half year), the light source and measuring cell may have slight changes. Through the optics calibration, the influence of these slight changes on measurement can be corrected. When performing the optics calibration, ensure that the volume of standard solution1 should be ≥ 10 mL. Click "Start" and the interface will show that "Calibrate optics calibration is in progress". After the optics calibration is finished, click "OK" and the system would pop up window with current and voltage values of LED calibration.

Click "Stop" to abort this process.

Liquid Sensor Calibration: is used to calibrate the liquid sensor to ensure accuracy of liquid volume measurement. After calibration, click "OK" and the system would give relevant parameters of liquid sensor.

Temperature sensor calibration is used to calibrate the reaction temperature. If there is a deviation in the reaction temperature, calibration of the temperature sensor can be conducted by a service technician. Accurately measure the temperature of the reaction/ measurement cell, then input the measured temperature and click "Save" to complete calibration of temperature sensor.

Analog Output Calibration: is used to calibrate analog outputs. For this operation, users need to connect the ammeter to measure current output, and use "-" and "+" to adjust current value to 20 mA.

Diagnostics

This section is used to diagnose the health and status of key components of the instrument. Instrument diagnosis includes valves diagnosis, peristaltic pump 1 diagnosis, peristaltic pump 2 diagnosis, heater diagnosis, input diagnosis and output diagnosis.

Valves: It is used to diagnose the electronic rotary valve (ERV) and two three-way valves (liquid valve and waste valve). For the ERV, the current position will be displayed, and the target position can be set. The three-way valve includes a left side and a right side, and the status position can be changed by switching. After the setting is finished, click "Execute", and the ERV and three-way valves will be switched according to the set positions.

Peristaltic Pump 1: It includes pump speed setting and pump rotation setting; the speed unit is rps (rotations per second). Click "Execute" to execute according to the set parameters.

Peristaltic Pump 2: It includes pump speed setting and pump rotation setting; the speed unit is rps. Click "Execute" to execute according to the set parameters.

Heater: It is used to control heating and read the current temperature of the reaction/measurement cell. When the heating device is turned off, the current temperature will gradually decrease. Be sure to turn on the switch of "Heater Enable" when exiting the heater diagnosis, so as to avoid abnormal measurement problem caused by switching off the heating device.

Input: Input diagnosis is used to diagnose the status of inputs. Through input diagnosis, the status of digital input 1 and digital input 2 can be seen to be On or Off, and the status of leakage sensor can be seen to be not detected and detected.

Output: Output diagnosis is used to diagnose analog outputs and relays. Set the analog output value, and then an external instrument can be used to test the corresponding current value at the same time to compare with the output, so as to judge whether the analog output is accurate. For a relay, it is to test whether it is On or Off, and then test the state of the relay, so as to know whether the relay performs according to the setting.

System Management

System management includes Restoring Factory Settings, Software Upgrade, Remain Reagent Volume and Tubing Life. Restoring Factory Settings is used to restore the original factory state, Software Upgrade is used to upgrade software, Remain Reagent Volume is used to display the current reagent volume and Tubing Life is used to display the remaining service life of the tubing.

Restoring Factory Settings: It is used to restore the original factory setting. When restoring factory settings, please note that once the recovery is implemented, all data and settings except the factory calibration curve will be deleted and the instrument will restart.

Software Upgrade: It is used for upgrading software. When the software is upgraded, insert a USB storage device containing the software package, and then click the "Upgrade" button, the system will upgrade automatically, and the instrument will restart automatically after the software upgrades.

Tubing Life: It is used to indicate the remaining service life of tubing.

Remain Reagent Volume: It is used to indicate the remaining volume of reagents.

Chapter 6

Regular Maintenance

The enclosure of Orion 8030cX Silica Analyzer has a security lock, which can only be unlocked by a key. After it is unlocked, you can replace reagents, and carry out related regular maintenance work. Please arrange a maintenance person to keep the key properly.

The enclosure of Orion 8030cX Silica Analyzer has a security lock, which can only be unlocked by a key. After it is unlocked, you can replace reagents, and carry out related regular maintenance work. Please arrange a maintenance person to keep the key properly.



Warning!

1. Only qualified service personnel that have passed the training can maintain the equipment!
- 2 Reagents in the instrument are corrosive!

General Maintenance

Regularly check whether reagents, cleaning solutions, standards, validation are insufficient, and check whether the liquid waste tank needs to be emptied and disposed.

Regularly check whether the flow cell needs to be cleaned.

Regularly check the whole system to see if there are any abnormal parts.

Regularly check all fluid path connections to see if there is leakage or corrosion.

Regularly check the circuit board and cables on the back of the flow path board for corrosion or damage.

Regular Maintenance

Table 6.1: Regular Maintenance

	Customer maintenance		Professional personnel maintenance
	Every four weeks	Every three months	Every six months
Cleaning the flow cell		√	
Deep cleaning the sample tubing, reaction/measurement cell	√		
Empty the chemical waste tank and put the waste tubing in place	√		
Replace with new reagents and new standard solutions		√	
Replace the liquid buffer ring			√
Replace with new cleaning solution		√	
Manually clean the reaction/measurement cell (if sediment or attached solids occurred in the reaction/measurement cell)			√
Replace pump tubes			√
Update all PTFE tubes and fitting			

Note:

1. After replacing the sample tubes, the prime volume of the water sample needs to be adjusted according to the length of the sample tubes.
2. After moving the sensor (including replacing the liquid buffer ring, repairing the electronic rotary valve (ERV), etc.), the liquid sensor needs to be recalibrated.
3. It is recommended to conduct autocalibration at least once a month (More accurate if auto-calibrated once a week; It can be set under calibration mode: interval frequency). The instrument automatically calibrate itself once its calibration frequency is set.

Cleaning

This instrument supports two cleaning functions: Clean and Deep Clean.

Clean uses the special cleaning solution to clean the reaction/measurement cell, tubing and electric rotary valve (ERV). The necessary cleaning function has been integrated into the analysis process of the instrument. Additional cleaning can be performed manually by the user using the manual cleaning function. Cleaning is built-in to run automatically when the instrument has been idle for longer than two hours. Clean procedure removes residual contamination in the fluidic system when system is idle for over 2 hours. It can remove high concentrations of silica contamination from the sample delivery system or measurement cell.

The Deep Clean function uses the special cleaning solution (P/N: 8030CL) to thoroughly clean the tubes of the entire instrument and electronic rotary valve (ERV), thus killing bacteria and removing silica deposit and dirt in the tubes system. During long-term operation of the instrument, it is recommended that the user shall conduct a deep cleaning of the instrument pipeline system at least once a month and replace the cleaning solution once every 3 months. Deep Cleaning can also be used as a troubleshooting procedure. It is only recommended when the cell or tube is dirty. If the instrument does not provide correct reading after a few calibrations and validations, then deep cleaning can be used to clean the

fluidic system. After deep cleaning, an instrument calibration is needed to correct the instrument reading bias.

Liquid Leakage Maintenance

The instrument has the function of liquid leakage alarm to ensure the safety of the instrument.

If any liquid leaks to the bottom of the instrument, the system will give out an alarm. For the sake of safety, the instrument will automatically stop measuring. If the instrument sends a liquid leakage alarm, please follow the following steps:

Step 1: Power off the instrument.

Step 2: Please wear protective gloves, goggles and protective clothing.

Step 3: Remove the reagent bottles, standard solution bottle(s), cleaning solution bottle, validation solution bottle and other items from the instrument.

Step 4: Dry the tray and all liquid leakage.

Step 5: After confirming the leakage source and completing repair, switch on the power supply again to operate the instrument.

Long-term Shutdown

If a long-term shutdown is required (over a month), in order to prevent the crystallization of residues or sediment of other particulates in the instrument tubes, especially in the electronic rotary valve (ERV), which may block the tubes and cause the failure when restarting the instrument, please follow these steps to clean the system.

Step 1: Perform the manual cleaning procedure twice or more in succession.

Step 2: Execute the manual draining procedure, drain the residual liquid in the reaction/measurement cell.

Step 3: Insert all tubing (reagent 1, reagent 2, reagent 3, standard sample, water sample and cleaning solution) into DI water container.

Step 4: Perform the manual prime procedure twice or more in succession.

Step 5: Take all tubing (reagent 1, reagent 2, reagent 3, standard sample, water sample and cleaning solution) out from the DI water sample container and put them in the air.

Step 6: Perform the manual prime procedure twice or more in succession.

Step 7: Unplug the power supply of the instrument to turn off the instrument.

Long-term Idle

If the instrument is in idle status for a long time (running only once a day or even less), in order to prevent the crystallization of residues or sediment of other particulates in the instrument tubing and especially in the electronic rotary valve (ERV), which may block the fluidic path and cause failure when restarting the instrument. It is highly recommended to enable on-demand Mode when the instrument is only running once a day or less. The OnDemand Mode setting can be selected in the Setup menu under the Deep Clean option. It is also recommended in this case to enable the auto-initiation during startup. The clean function is built into the program to clean after the instrument is idle over 2 hours to ensure a clean start and accurate measurement.

Chapter 7

Common Errors and Troubleshooting Measures



Warning!

Only trained and qualified service personnel can maintain the equipment!

Reagents in the instrument are corrosive!

Alerts and alarms information will be displayed in the main interface's history records - alert and alarm information.

Table 7.1: Alerts Information and Troubleshooting Methods

No.	Alerts Information	Troubleshooting Methods
1	Photo diode output not stable (PTP> 10mV)	<ol style="list-style-type: none"> 1. Go to Maintenance-Hardware Calibration-Optics menu to calibrate optics. 2. If the alert persists after recalibration, please contact the service personnel to confirm the alert and repair it.
2	Heater not stabilized at setpoint (error>1°C)	<ol style="list-style-type: none"> 1. Stop measurements and enter Maintenance-Diagnostics-Heater menu to check the temperature of the reaction/measurement cell. The temperature change of the reaction/measurement cell should be within ± 1 °C. 2. If the temperature of the reaction/measurement cell still does not stabilize at the set point, please contact the service personnel to confirm the alert and repair it.
3	Analyzer Ambient temperature higher than 45°C	<ol style="list-style-type: none"> 1. Observe the ambient temperature, it should be within the range of 5°C~45°C; if the temperature exceeds the above range, please turn on the air conditioner or other equipment in your facility to adjust the indoor temperature to the set range, otherwise the working performance of the instrument will be affected and the hardware of the instrument could be damaged.
4	Analyzer Ambient temperature lower than 5°C	<ol style="list-style-type: none"> 1. Observe the ambient temperature, it should be within the range of 5°C~45°C; if the temperature exceeds the above range, please turn on the heater or other equipment to adjust the indoor temperature to the set range, otherwise the working performance of the instrument will be affected and the hardware of the instrument could be damaged.
5	Liquid Sensor output high (>0.3V)	<ol style="list-style-type: none"> 1. Go to Maintenance-Hardware Calibration-Liquid Sensor menu to calibrate liquid sensor. 2. Visually check whether the buffer ring (located behind the pump and measurement cell mounting board) is discolored or contaminated. If the tubing or liquid is discolored, use the deep clean function to clean the tubing. If discoloration persists after deep clean, it is recommended to replace the buffer ring tubing. 3. If the alert persists after these actions, please contact the service personnel to confirm the alert and repair it.

No.	Alerts Information	Troubleshooting Methods
6	EEPROM failed, default loaded	<ol style="list-style-type: none"> 1. Enter Hardware Calibration menu to perform calibration of Analog Output, Optics, and Liquid Sensor. 2. If the alert persists after calibration of all hardware, it may be a circuit board hardware failure or a software problem, please contact service personnel for maintenance or replacement.
100	Calibration curve too old	<ol style="list-style-type: none"> 1. Setup the corresponding measuring range, prepare standard solution(s) and recalibrate.
103	Reading exceeds upper range	<ol style="list-style-type: none"> 1. Enter Setup-Measurement Setup menu to change the range setting to the appropriate value for silica in your water sample.
104	Reading exceeds lower range	<ol style="list-style-type: none"> 1. Enter Setup-Measurement Setup menu to change the range setting to the appropriate value for silica in your water sample.
107	Analog output 1 exceed upper range	<ol style="list-style-type: none"> 1. Enter Setup-Input/Output Setup-Analog Outputs Setup menu to check whether the high limit of Output 1 is setup properly, the default value of high limit is 5000.
108	Analog output 1 exceed lower range	<ol style="list-style-type: none"> 1. Enter Setup-Input/Output Setup-Analog Outputs Setup menu to check whether the low limit of Output 1 is setup properly, the default value of low limit is 0.
109	Analog output 2 exceed upper range	<ol style="list-style-type: none"> 1. Enter Setup-Input/Output Setup-Analog Outputs Setup menu to check whether the high limit of Output 2 is setup properly, the default value of high limit is 5000.
110	Analog output 2 exceed lower range	<ol style="list-style-type: none"> 1. Enter Setup-Input/Output Setup-Analog Outputs Setup menu to check whether the low limit of Output 2 is setup properly, the default value of low limit is 0.
123	Relay 1 tripped for alarm	<ol style="list-style-type: none"> 1. Enter Setup-Input/Output Setup-Relays-Relay1 menu to check whether the Relay Event Type, Alarm Type (Low Threshold and High Threshold) are setup properly, the default Low Threshold is 0, the default High Threshold is 5000.
124	Relay 2 tripped for alarm	<ol style="list-style-type: none"> 1. Enter Setup-Input/Output Setup-Relays-Relay2 menu to check whether the Relay Event Type, Alarm Type (Low Threshold and High Threshold) are setup properly, the default Low Threshold is 0, the default High Threshold is 5000.
125	Relay 3 tripped for alarm	<ol style="list-style-type: none"> 1. Enter Setup-Input/Output Setup-Relays-Relay3 menu to check whether the Relay Event Type, Alarm Type (Low Threshold and High Threshold) are setup properly, the default Low Threshold is 0, the default High Threshold is 5000.

Note:

- For all the alerts information items listed in Table 7.1, it is unnecessary to eliminate the alert information by cutting off the power supply.
- It is recommended to identify the root cause of the problem, fix the problem and then restart the measurement operation. When initializing the next round of measurement, the system will reconfirm the relevant alerts information. If the problem is detected to have been eliminated, the alert notification(s) will automatically disappear.

Table 7.2: Alarms Information and Troubleshooting Methods

No.	Alarms Information	Troubleshooting Methods
1	Heater loses control	<ol style="list-style-type: none"> 1. Stop measurement and enter the Maintenance-Diagnostics-Heater menu to observe the temperature of the reaction/measurement cell. The temperature change of the reaction/measurement cell should be within $\pm 1^{\circ}\text{C}$. 2. If the temperature of the reaction/measurement cell changes greatly, please contact the service personnel to confirm the alarm and repair it.
2	Leakage detected	<ol style="list-style-type: none"> 1. Cut off the power supply of the instrument, visually check the tubes and connections for leaks. Determine the leakage source, and then carry out maintenance (see Chapter 6 for detailed information). 2. Possible causes of liquid leakage: <ol style="list-style-type: none"> a. Loose tubing connection. b. Cracks or holes in tubing. c. Cracks or holes in reagent bottles. d. Cracked reaction/measurement cell. e. Leak from external source getting into instrument enclosure
3	Peristaltic pump failed	<ol style="list-style-type: none"> 1. Visually check whether the two peristaltic pumps are damaged. 2. Check whether the electronic connection of two peristaltic pumps damaged or corroded. If there is any corrosion, it is necessary to power off the instrument and replace any corroded wiring connections. 3. Restart the instrument and check whether the two peristaltic pumps are working properly by using the diagnostic function of the instrument. If the alarm still occurs, please contact the service personnel to confirm the alarm and repair it.
4	ERV failed	<ol style="list-style-type: none"> 1. Visually check the electronic connections of the electronic rotary valve (ERV) control board and serial port communication adapter board at the rear of the electronic rotary valve (ERV) for corrosion. If there is any corrosion, it is necessary to power off, replace relevant parts and try again. 2. Visually inspect each liquid tubing line of the electronic rotary valve (ERV) for blockage or crystal residue, if any obstruction is observed, replace the obstructed tubing. 3. Operate the electronic rotary valve (ERV) with the system diagnostic function of the instrument, and check whether the feedback position of the electronic rotary valve (ERV) is correct. 4. Disconnect the power supply of the instrument, power on it again, and check whether the electronic rotary valve (ERV) works normally by using the diagnostic function of the instrument. If the alarm still occurs, please contact the service personnel to confirm the alarm and repair it.
5	Valve failed	<ol style="list-style-type: none"> 1. Visually check whether either of the two valves are damaged. 2. Check whether the electronic connections of two valves are damaged or corroded. If there is any corrosion, it is necessary to power off, replace relevant parts and try again. 3. Restart the machine and check whether the two valves are working properly by using the diagnostic function of the instrument. If the alarm still occurs, please contact the service personnel to confirm the alarm and repair it.

No.	Alarms Information	Troubleshooting Methods
7	LED0 calibration failed	<ol style="list-style-type: none"> 1. Shutdown the instrument, remove the LED0 and PD0, and observe whether there are obstructions, dirt, or debris in the light path. If obstructions are observed, use cotton swabs dipped in alcohol to clean the LED & PD. 2. Turn on the instrument and use the maintenance function of the instrument to run a deep clean procedure, which should remove interfering residues from the reaction/measurement cell. 3. Recalibrate the instrument. 4. After all the above steps have been performed, if the alarm still occurs, please contact the service personnel to confirm the alarm and repair it.
8	LED1 calibration failed	<ol style="list-style-type: none"> 1. Shut down the instrument, remove the LED1 and PD1, and observe whether there are obstructions, dirt, or debris in the light path. If obstructions are observed, use cotton swabs dipped in alcohol to clean the LED & PD. 2. Turn on the instrument and use the maintenance function of the instrument to run a deep clean procedure, which should remove interfering residues from the reaction/measurement cell. 3. Recalibrate the instrument. 4. After all the above steps have been performed, if the alarm still occurs, please contact the service personnel to confirm the alarm and repair it.
9	Cell temperature higher than setpoint +5°C	<ol style="list-style-type: none"> 1. When the instrument is not working, enter "Maintenance – Diagnostics – Heater" menu to observe the temperature of the reaction/measurement cell. The temperature of the reaction/measurement cell should be within the range of the set temperature $\pm 1^{\circ}\text{C}$. 2. If the temperature of the reaction/measurement cell deviates too much from the set temperature, the instrument may be failure, please contact the service personnel to confirm the alarm and repair it.
10	Cell temperature lower than setpoint -5°C	<ol style="list-style-type: none"> 1. Stop measurement and enter the Maintenance-Diagnostics-Heater menu to observe the temperature setting of the reaction/measurement cell. The temperature of the reaction/measurement cell should be within the range of the set temperature $\pm 1^{\circ}\text{C}$. 2. If the temperature of the reaction/measurement cell deviates too much from the set temperature, please contact the service personnel to confirm the alarm and repair it.
11	Liquid sensor calibration failed	<ol style="list-style-type: none"> 1. Ensure that the cable of the liquid sensor is securely connected. 2. Visually check whether the buffer ring (located behind the pump and measurement cell mounting board) discolored or contaminated. If the buffer ring tubing is contaminated, perform the deep cleaning function to clean the buffer ring. If the alarm persists, replace the buffer ring tubing with fresh tubing. 3. Re-calibrate liquid sensor. 4. If the alarm still occurs, please contact the service personnel to confirm the alarm and repair it.

No.	Alarms Information	Troubleshooting Methods
17	Lack of clean solution	<ol style="list-style-type: none"> 1. Check the liquid level in the cleaning solution bottle. 2. Ensure that the cleaning solution tubing is fully inserted and touches the bottom of the cleaning solution bottle. 3. Prime the cleaning solution and look to see if back flow occurs at the place where the cleaning solution tubing is connected to port 1 of the electronic rotary valve (ERV); if back flow is observed, the tubing connection needs to be tightened. 4. After all the above steps have been checked and the problem is solved, rerun the analysis procedure to see if the alarm has been eliminated. If the alarm still occurs, please contact the service personnel to confirm the fault and repair it.
18	Lack of standard 2	<ol style="list-style-type: none"> 1. Check the liquid level in the standard 2 sample bottle. 2. Ensure that the standard 2 sample tubing is fully inserted and touches the bottom of the standard 2 sample bottle. 3. Prime the standard 2 solution and look to see if back flow occurs at the place where the standard 2 solution tubing is connected to port 2 of the electronic rotary valve (ERV); if back flow is observed, the tubing connection needs to be tightened. 4. After all the above steps have been checked and the problem is solved, rerun the analysis procedure to see if the alarm has been eliminated. If the alarm still occurs, please contact the service personnel to confirm the alarm and repair it.
19	Lack of standard 1	<ol style="list-style-type: none"> 1. Check the liquid level in the standard 1 sample bottle. 2. Ensure that the standard 1 sample tubing is fully inserted and touches the bottom of the standard 1 sample bottle. 3. Prime the standard 1 solution and look to see if back flow occurs at the place where the standard 1 solution tubing is connected to port 3 of the electronic rotary valve (ERV); if back flow is observed, the tubing connection needs to be tightened. 4. After all the above steps have been checked and the problem is solved, rerun the analysis procedure to see if the alarm has been eliminated. If the alarm still occurs, please contact the service personnel to confirm the alarm and repair it.
20	Lack of sample 1	<ol style="list-style-type: none"> 1. Check whether the flow cell is full of water sample, and if there is a lack of water sample, check the external sample injection flow path. 2. Check whether the connection between sampling tube and flow cell is loose. 3. Check whether the connection of three-way valve to sampling tube and the port 4 and 9 of the electronic rotary valve (ERV) is loose, and whether there is any leakage; if so, tighten this connection terminal. 4. After all the above steps have been checked and the problem is solved, rerun the analysis procedure to see if the alarm has been eliminated. If the alarm still occurs, please contact the service personnel to confirm the alarm and repair it.

No.	Alarms Information	Troubleshooting Methods
21	Lack of reagent 3	<ol style="list-style-type: none"> 1. Check the liquid level in reagent 3. 2. Ensure that the tubing for reagent 3 is fully inserted and touches the bottom of the reagent bottle. 3. Prime reagent 3 solution and look to see if back flow occurs at the place where the reagent 3 solution tubing is connected to port 5 of the electronic rotary valve (ERV); if back flow is observed, the tubing connection needs to be tightened. 4. After all the above steps have been checked and the problem is solved, rerun the analysis procedure to see if the alarm has been eliminated. If the alarm still occurs, please contact the service personnel to confirm the alarm and repair it.
23	Lack of reagent 1	<ol style="list-style-type: none"> 1. Check the liquid level in reagent 1. 2. Ensure that the tubing for reagent 1 is fully inserted and touches the bottom of the reagent bottle. 3. Prime reagent 1 solution and look to see if back flow occurs at the place where the reagent 1 solution tubing is connected to port 7 of the electronic rotary valve (ERV); if back flow is observed, the tubing connection needs to be tightened. 4. After all the above steps have been checked and the problem is solved, rerun the analysis procedure to see if the alarm has been eliminated. If the alarm still occurs, please contact the service personnel to confirm the alarm and repair it.
24	Lack of reagent 2	<ol style="list-style-type: none"> 1. Check the liquid level in reagent 2. 2. Ensure that the tubing for reagent 2 is fully inserted and touches the bottom of the reagent bottle. 3. Prime reagent 2 solution and look to see if back flow occurs at the place where the reagent 2 solution tubing is connected to port 8 of the electronic rotary valve (ERV); if back flow is observed, the tubing connection needs to be tightened. 4. After all the above steps have been checked and the problem is solved, rerun the analysis procedure to see if the alarm has been eliminated. If the fault still occurs, please contact the service personnel to confirm the alarm and repair it.
25	Lack of sample 2	<ol style="list-style-type: none"> 1. Check whether the flow cell is full of water sample, and if there is a lack of water sample, check the external sample injection flow path. 2. Check whether the connection between sampling tube and flow cell is loose. 3. Check whether the connection port the connection of three-way valve to sampling tube and the port 9 and 4 the electronic rotary valve (ERV) is loose, and whether there is any leakage, if so, tighten this connection terminal. 4. After all the above steps have been checked and the problem is solved, rerun the analysis procedure to see if the alarm has been eliminated. If the alarm still occurs, please contact the service personnel to confirm the alarm and repair it.

No.	Alarms Information	Troubleshooting Methods
26	Lack of validation	<ol style="list-style-type: none"> 1 Check the liquid level in the validation solution. 2 Ensure that the tubing for the validation solution fully inserted and touches the bottom of the validation solution bottle. 3 Prime the validation solution and look to see if back flow occurs at the place where the validation solution tubing is connected to port 10 of the electronic rotary valve (ERV); if back flow is observed, the tubing connection needs to be tightened. 4 After all the above steps have been checked and the problem is solved, rerun the analysis procedure to see if the alarm has been eliminated. If the alarm still occurs, please contact the service personnel to confirm the alarm and repair it.
32	MIDB communication failed	<ol style="list-style-type: none"> 1. Check the cable connection between J20 of single board computer and J22 of main control board, whether the connection is loose, if so, tighten this connection terminal. 2. Disconnect the power supply of the instrument, power on it again, if the alarm still occurs, it may be a circuit board hardware failure or a software problem, please contact service personnel for maintenance or replacement.
33	Error detected in MIDB	<ol style="list-style-type: none"> 1. Disconnect the power supply of the instrument, power on it again, if the alarm still occurs, it may be a circuit board hardware failure or a software problem, please contact service personnel for maintenance or replacement.
100	Lost connection to ICS	<ol style="list-style-type: none"> 1. Disconnect the power supply of the instrument, power on it again to see if the alarm has been eliminated. If the fault still occurs, please contact the service personnel to confirm the fault and repair it.
101	MIDB communication failed (ICS)	<ol style="list-style-type: none"> 1. Disconnect the power supply of the instrument, power on it again, if the fault still occurs, it may be a circuit board hardware failure or a software problem, please contact service personnel for maintenance or replacement.
102	MIDB read/write failed (ICS)	<ol style="list-style-type: none"> 1. Disconnect the power supply of the instrument, power on it again, if the alarm still occurs, it may be a circuit board hardware failure or a software problem, please contact service personnel for maintenance or replacement.
103	Abnormal absorbance (ICS)	<ol style="list-style-type: none"> 1. Go to Maintenance-Hardware Calibration-Optics menu to calibrate optics. 2. If the alarm is still existing after recalibration, please contact the service personnel to confirm the alarm and repair it.
105	MIDB read timeout (ICS)	<ol style="list-style-type: none"> 1. Disconnect the power supply of the instrument, power on it again, if the alarm still occurs, it may be a circuit board hardware failure or a software problem, please contact service personnel for maintenance or replacement.
106	ICS is busy	<ol style="list-style-type: none"> 1. Disconnect the power supply of the instrument, power on it again, if the alarm still occurs, it may be a circuit board hardware failure or a software problem, please contact service personnel for maintenance or replacement.
190	Start procedure timeout	<ol style="list-style-type: none"> 1. Disconnect the power supply of the instrument, power on it again, if the alarm still occurs, it may be a circuit board hardware failure or a software problem, please contact service personnel for maintenance or replacement.
191	Procedure running timeout	<ol style="list-style-type: none"> 1. Disconnect the power supply of the instrument, power on it again, if the alarm still occurs, it may be a circuit board hardware failure or a software problem, please contact service personnel for maintenance or replacement.

No.	Alarms Information	Troubleshooting Methods
200	Calibration failed	<ol style="list-style-type: none"> 1. If calibration fails, enter Setup-Calibration Setup menu to check whether the Range, Tolerance, the Standard 1 Conc. and Standard 2 Conc. are setup properly. 2. Check that the correct standard sample 1 and sample 2 bottles are connected to the appropriate tubing. 3. After all the above steps have been checked, rerun the calibration procedure to see if the alarm has been eliminated. If the alarm still occurs, please contact the service personnel to confirm the fault and repair it.
201	Validate failed	<ol style="list-style-type: none"> 1. If validation fails, enter Setup-Validation Setup menu to check whether the Tolerance and Standard Conc. setup are properly. 2. Check that the correct validation solution bottle is connected to the appropriate tubing. 3. Recalibrate the instrument. 4. After all the above steps have been checked, rerun the validation procedure to see if the alarm has been eliminated. If the alarm still occurs, please contact the service personnel to confirm the alarm and repair it.
300	STA sync error	<ol style="list-style-type: none"> 1. Disconnect the power supply of the instrument, power on it again, if the alarm still occurs, it may be a circuit board hardware failure or a software problem, please contact service personnel for maintenance or replacement.
301	Illegal operation (STA)	<ol style="list-style-type: none"> 1. Disconnect the power supply of the instrument, power on it again, if the alarm still occurs, it may be a circuit board hardware failure or a software problem, please contact service personnel for maintenance or replacement.
302	Invalid argument (STA)	<ol style="list-style-type: none"> 1. Disconnect the power supply of the instrument, power on it again, if the alarm still occurs, it may be a circuit board hardware failure or a software problem, please contact service personnel for maintenance or replacement.
400	DB read failed	<ol style="list-style-type: none"> 1. Disconnect the power supply of the instrument, power on it again, if the alarm still occurs, it may be a circuit board hardware failure or a software problem, please contact service personnel for maintenance or replacement.
401	DB write failed	<ol style="list-style-type: none"> 1. Disconnect the power supply of the instrument, power on it again, if the alarm still occurs, it may be a circuit board hardware failure or a software problem, please contact service personnel for maintenance or replacement.
500	No upgrade files	<ol style="list-style-type: none"> 1. Check whether the USB stick has been saved the proper software files before software upgrading.
501	MD5 checksum failed on upgrade files	<ol style="list-style-type: none"> 1. Check whether the USB stick has been saved the proper software files before software upgrading.
999	Unknown error	<ol style="list-style-type: none"> 1. Please contact the service personnel to confirm the alarm and repair it.

Note:

- For all the alarms information items listed in Table 7.2, after eliminating the root cause of the problem, the power supply needs to be cut off, and the instrument needs to be restarted. Only after the relevant error prompt information disappears can the instrument be re-operated.

Chapter 8

Customer Service

Part List (Accessory)

Silica Analyzer

No.	Model Name	Part Number	Description
1	Orion™ 8030cX	8030cX	8030cX Silica Analyzer

The Silica analyzer includes a flow cell, but it does not include necessary reagents and standard solutions.

Accessory

No.	Model Name	Part Number	Description
1	N.A.	CIC0004250	Flow Cell, Silica
2	N.A.	8030MK	Maintenance Kit
3	N.A.	7070FLT	Sample filter for sample stream with particles over 200nm size

Silica Reagents, Standards and Cleaning solution

No.	Model Name	Part Number	Description
1	N.A.	8030REX	Silica Reagent Kit (Including R1, R2, R3)
2	N.A.	803002	Silica Standard Solution 20ug/L
3	N.A.	803020	Silica Standard Solution 200ug/L
4	N.A.	803030	Silica Standard Solution 1000ug/L
5	N.A.	803040	Silica Standard Solution 4000ug/L
6	N.A.	8030CL	8030cX Cleaning Solution

Compliance Precautions

This equipment could generate and radiate radio frequency energy. If not installed and used according to the Instruction Manual, it may cause interference to radio communication. This equipment has been tested in accordance with Part 15, Subpart J, of the FCC Rules and is deemed to meet the restrictions on Class A computing equipment and can provide reasonable interference protection for operation in a commercial environment. The operation of this equipment in residential areas may cause interference. Therefore, the user needs to take necessary measures to correct the interference at their own expense.

This digital equipment does not exceed the radio noise emission (Class A) limit for digital equipment specified in the Radio Interference Regulations of the Canadian Department of Communications.

Terms and Conditions

For products not listed in this warranty statement, please visit our website: www.thermo.com/water.

Dangerous Goods

Some materials are corrosive/oxidizing reagents specified by DOT and IATA and may require special marks and handling. In addition, the material is forbidden to mix with other products. The freighter may incur additional freight charges for handling/transporting these materials. Additional freight fees will be charged according to the conditions of FOB. Notify the manufacturer of the shipping instructions for these dangerous goods to reduce the relevant freight charges.

Replenishment Fee

Permission must be obtained before returning brand- new goods and excess inventory. Under the condition of no reordering, if any goods are approved for return due to ordering errors and receive corresponding refund, a replenishment fee of 25% of the product price shall be charged. The 25% replenishment fee for international customers will be paid according to the international price.

Only brand-new (in the box) goods can be returned within 30 days after the manufacturer's delivery. Used goods, 9 kinds of digital parts and discontinued items are not refundable.

Missing Shipment

The manufacturer must be informed of any goods or document discrepancy within 30 days of receiving the invoice. All confirmed claims for missing shipment will be settled by refund notices or new orders. Any claim for discrepancy in shipment made after 30 days since the date of invoice will not be accepted and the manufacturer will not provide any refund.

Force Majeure

The manufacturer shall not be liable for any failure or delay in fulfilling orders due to fire, flood, strike or other labor difficulties, natural disasters, acts of government authorities or buyers, riots, bans, shortage of fuel or energy, transportation accidents or delays, inability to obtain required labor, materials or manufacturer's facilities from general sources, or reasons beyond the manufacturer's control. In case of delay in fulfilling orders

due to any of the above reasons, the order delivery date or fulfillment completion time shall be reasonably extended for a period to cope with the impact of the delay.

Warranty

According to the operation restriction and maintenance procedures given in the User Guidelines, Thermo Scientific Orion process products are guaranteed to be free from material and process defects within 12 months since the date of installation or 18 months after delivery, whichever is earlier, when used under normal operating conditions or under the condition without the occurrence of any accident, change, misuse or abuse. This warranty is based on the premise that the consumables (all solutions) are stored in non-corrosive air at temperatures between 5°C and 45°C (41°F and 113°F) and within the storage life printed on the product.

In case of the occurrence of failure during the warranty period, the manufacturer or the authorized distributor selected by the manufacturer will repair or replace the unqualified product according to the above warranty terms or refund the purchase price of the product.

The warranty mentioned above is the only warranty certificate of Thermo Fisher Scientific Inc. for the product. All other forms of warranties, whether statutory, express or implied (including but not limited to implied warranty of product performance), or for other purposes and all warranties arising from trading habits or business practices, are not recognized by the company. The only solution enjoyed by the buyer is to repair or replace unqualified parts or refund the purchase price of the product. However, the manufacturer (including its contractors and suppliers) shall not be liable to the buyer or any person for special indirect, accidental or corresponding losses, regardless of the requirements in the contracts, torts (including negligence) or requirements arising from the supplied product.

Process products used in foreign nuclear facilities shall conform to the manufacturer's nuclear terms and conditions. If there is no copy of the nuclear terms and conditions, please contact the manufacturer.

Except for the terms of this warranty, any inconsistent statement and warranty made by any person (including authorized distributors, dealers, representatives and employees of the manufacturer) shall not be binding on the manufacturer, unless the written consent or signature of an official from the manufacturer has been gained.

Manufacturer: Thermo Fisher Scientific (Suzhou) Instruments Co., Ltd. Thermo Fisher Scientific

Address: No 555, Jinfeng Road, Suzhou, Jiangsu, China

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