User Manual

Thermo Scientific Orion

2230XP Silica Analyzer

271539-001 • Revision B • March 2016

Thermo SCIENTIFIC

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SECTION 1

General Information

Safety Precautions

The Thermo Scientific™ Orion™ 2230XP Silica Analyzer has been designed with careful attention to safety. It complies with formal safety design rules established by international regulatory agencies. Observe all safety warnings marked on the instrument.

These warnings identify areas of potential hazard, which could result in personal injury, or loss of life.

To ensure that the protection provided by this equipment is not impaired, do not use or install this equipment in any manner other than that which is specified in this manual.

- Do not use this product for any purpose other than described in this manual.
- Disconnect power before servicing and prior to making any terminal connections within the Analyzer enclosure.
- Do not operate with the electronics enclosure door open.

Symbols Used in this Manual

 WARNING	**WARNING:** This symbol alerts the user about possible hazards that can cause serious damage to the instrument, and/or personal injury.
 CAUTION	**CAUTION:** This symbol alerts the user about possible faults from incorrect operation, which if ignored, could result in damage of the instrument.
	**HOT:** This symbol indicates that the marked area can be hot and should not be touched without care.
	**EARTH (Ground):** This symbol, when noted on the product, identifies the location of the connection for Protective Earth (ground).
NOTE:	Indicates important information that requires special attention.

Specifications

General	
Display	Graphic LCD 120 mm x 92 mm (4.7 in x 3.6 in)
Enclosure	Fluidics IP-65 (NEMA 4X); Electronics IP-52 (NEMA 12) rated for indoor installation
Dimensions (H x W x D)	698 mm x 406 mm x 162 mm (27 in x 16 in x 6 in)
Weight	16 kg (35 lb) without reagents
Mounting	Wall or panel mount
Measuring Method	Heteropoly-molybdenum blue
Measuring interval	15, 20, or 30 minutes (selectable settings and user programmable)

Electrical	
Power Requirements	110 watts. Automatic voltage recognition from 100 – 240 VAC, 110 w (VA), 50 – 60 Hz, Single Phase
Connection	Three wire terminal block (18 – 12 AwG) through a 19 mm (3/4-in) bulkhead on side of the electronics enclosure
Safety Class	I, protective grounding
Fuse Rating	250 VAC, 4 A (fast blow)
Relay Contacts	Four potential free relays with 250 VAC, 2A resistive contact ratings.
Outputs	Each relay may be configured separately to a list of programmable alarm functions
Inputs	Two-isolated analog outputs: 0/4-20mA, max. load 900 ohms

Environmental	
Storage Temperature Range	5 – 45°C (41 – 113°F)
Operating Temperature Range	5 – 45 °C (41 – 113°F)
Relative Humidity	90% at 40°C (104°F), non-condensing
Altitude	Up to 2000 m

Sample Requirements	
Inlet Pressure to Instrument	1 – 5 psig
Sample Flow Rate	50 – 1000 mL/min with < 100 microns particles size (user provides filter)
Sample Temperature	5 – 40°C (41 – 104°F)
Sample Fitting	6 mm (1/4-in) OD tubing
Drain Fitting	9.6 mm (3/8-in) OD tubing

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SECTION 2

Introduction

The Thermo Scientific Orion 2200 series analyzers are compact wet-chemistry analysis systems, designed for the continuous on-line analysis of water in several applications across many industries.

The Orion 2230XP Silica Analyzer uses the colorimetric detection method that relies on specific reagents that are added to the sample to produce a reacted color compound.

The intensity of the color determines the concentration in reference to a known reacted standard. The colored compound absorbs energy at a specific wavelength in accordance with the Beer-Lambert Law.

The instrument uses Light Emitting Diodes (LEDs) that emit light at a narrow bandwidth selected for the specific application.

The Silica analysis method uses the near infrared LED (NIR) at 810 nm.

Unpacking the Instrument

Remove the analyzer from its shipping carton and inspect it for damage. Verify that all the parts listed below in the startup kit detail are included.

If damage is evident or if the shipment is incomplete, please contact the Customer Service department. Do not destroy the shipping container during unpacking so that you can save it for possible future use.

NOTE:	The analyzer may be shipped with a translucent protective cover on the LCD. Carefully peel off this translucent layer and discard it.

 WARNING	**DO NOT APPLY ELECTRICAL POWER TO VISIBLY DAMAGED COMPONENTS, AS INJURY OR FURTHER EQUIPMENT DAMAGE MAY OCCUR .**

Startup Procedure

This section describes the necessary steps to begin using the 2230XP Silica Analyzer. Refer to Section 3 for instructions on mounting the analyzer, making the plumbing connections, and connecting electrical power. More details can be found in subsequent chapters.

Once the analyzer is securely mounted in a fixed location, wired to electrical power, wired to communications, (if necessary) and plumbed to process water, perform the following instrument Startup Procedure:

1. Power on instrument.
2. To allow longer lifetime of unit, the pump-head tubing are not fully engaged when the unit is shipped. Refer to *Plumbing Connections* Section.
   a. Reset tubes in pumps heads.
      Note: This step must be repeated for all four pump heads.
      i. Remove tape.
      ii. Slide tube retainer into place along keyway.
      iii. Install tubing cover by squeezing both sides, and sliding into grooves.

3. Install Reagents. Very carefully match reagent numbers and colors in their proper order. Refer to next page, *Installing the Reagents Section*.

NOTES:	It is recommended to wear latex gloves whenever handling or changing reagents.
	Turn the reagent cap clockwise while holding bottle vertical and level.
	Inspect the tubes to be sure none have been pinched.

4. Prime the tubing. Please repeat the following sequence 3 times. (See *Installing the Reagents Section*)
   a. Press *Menu*.
   b. Select *Services.*

c. Select *Prime Fluidics.*
d. Select *Prime All.*
Note: This procedure will run automatically and take approximately 10 minutes per cycle.

5. Refer to Section 4 for more details on startup and operation. Once the above 4 steps have been completed, (4. a, b, c, d) press *Stop*, *Select Run*. Allow the unit to operate overnight or for at least 12 hours, to become stabilized in the local environment.
6. For additional information on 2230XP Orion Silica Process Analyzer Operation, refer to Section 4.

Additional detail can be found in the following sections:
Section 4 - Instrument Operation
Section 5 - Analyzer Hardware Configuration and Calibration
Section 6 - Calibration of the Instrument for Measurement Analysis
Section 7 - Menu Overview
Section 8 - Terms Definition
Section 9 - Maintenance Schedule

Image: Reagent bottle numbers in proper order

General Product Description

This User Manual provides the information necessary to obtain the maximum benefits from the Orion 2230XP Silica Analyzer. All operating instructions, functional descriptions, illustrations, and other relevant information are contained in this manual. Descriptions of the system hardware and user-interface software (the control panel) are included, as is an overview of the analytical techniques employed in the analyzer. Step-by-step instructions guide you through all operating procedures and field programming.

The analyzer is designed for easy operation. Each analyzer in this family runs in a fully-automated mode for routine, day-to-day water analysis.

The need for operator interaction is minimal. Accordingly, the information required by the routine operator of this analyzer is modest, and that information is provided in *Section 4: Startup and Operation*, of this manual.

Important standard analyzer capabilities include:

- Sampling the process stream automatically.
- Calculating concentration of your sample and reporting it in units of concentration.
- Recalibrating automatically at preprogrammed intervals to compensate for any changes in captured sample volume, pump flow rates and reagent composition.
- Cleaning automatically (when programmed) at user-specified intervals to prevent precipitation build-up, coating of the optics or bacterial/fungal growth.

The analyzer brings colorimetric laboratory precision to the real world of unattended process analyzing. It is designed for long life under continuous, rigorous use.

The Orion 2200 series analyzers are designed for accommodating several applications. Each application requires a specific configuration in hardware and software that is set at the factory. The product as supplied will have a configuration sheet detailing the setup and the detailed tests and validation that were conducted at the factory. This analyzer model is intended to use for water analysis only.

User Interface

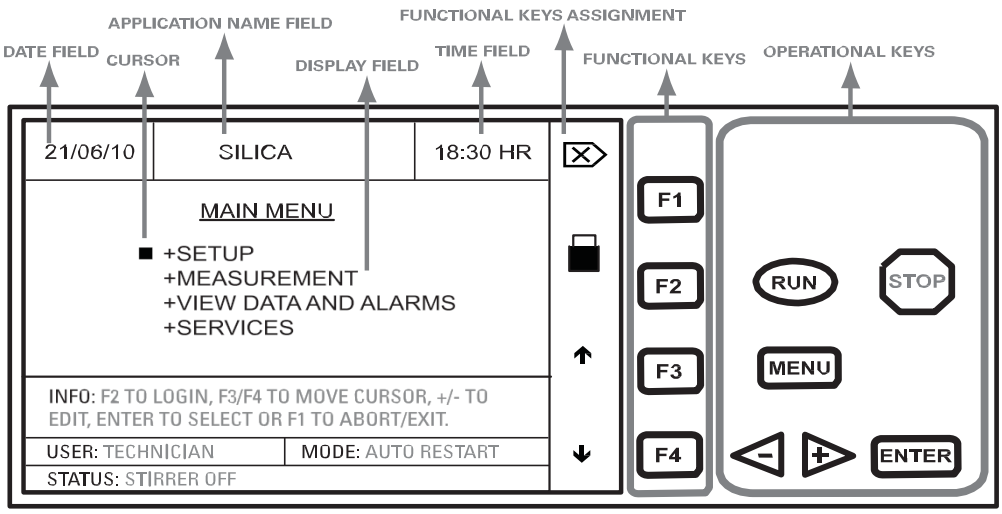
General Description

The user-interface consists of a keypad and a graphical LCD display. The keypad is located to the right of the display. The F1 F4 function keys (soft-keys) take on different meanings depending on the menu selection. The column on the left of the soft-keys labels the keys with their appropriate functions.

The RUN key starts the analysis and the STOP key stops the current functioning of the instrument. The + and - keys allow for navigation between pages. The ENTER key confirms selections made in the menus. Additional navigation is provided by the soft-keys (in appropriate menus), for left / right or up / down cursor movement.

The graphical LCD display shows the date, analysis label, time, navigational menus, information and help to the user, current user, instrument-working mode, current status of the instrument and the soft-key labels.

The MENU key is used to access the menus.



Display Fields

1. DATE FIELD shows the current date.
2. CURSOR indicates current selection.
3. INSTRUMENT NAME FIELD shows instrument nametag.
4. TIME FIELD shows present time.
5. DISPLAY FIELD shows menus / measurements.
6. INFO field shows information / instructions to navigate.
7. USER field shows current user name.
8. MODE field shows whether the instrument is working in Auto, Manual or Run mode.
9. STATUS field shows current working status of the instrument.
10. FUNCTIONAL KEYS ASSIGNMENT FIELD shows the functions allotted to the functional keys.
11. FUNCTION KEYS select functions.
12. OPERATIONAL KEYS are meant for operation of the instrument.

Symbols used

⌦	Escape (Cancel/Back)	■	Cursor
	Logged out (Locked)		Logged in
↑	Scroll Up	↓	Scroll Down
	Print		Delete
←	Scroll Left	→	Scroll right
☑	Accept	☒	Reject

Menus Display

A "+" before a menu item denotes that the item has multiple options.

The Up / Down Arrow keys scroll up or down through options and ENTER is used to view details of the options.

Pressing the MENU key displays the instrument's Main Menu. System parameters can be configured from the Main Menu.

NOTE:	The analyzer may be shipped with a translucent protective cover on the LCD. Carefully peel off this translucent layer and discard it.

Measurement Mode Display

In measurement mode, the instrument displays current and previous readings, units, date and time. The measurement results can be displayed as large size fonts or normal size fonts. "F1" key will toggle between large and normal fonts.

NOTE:	In AUTO mode, the user can navigate between different menus even though the instrument is performing a measurement or a calibration.

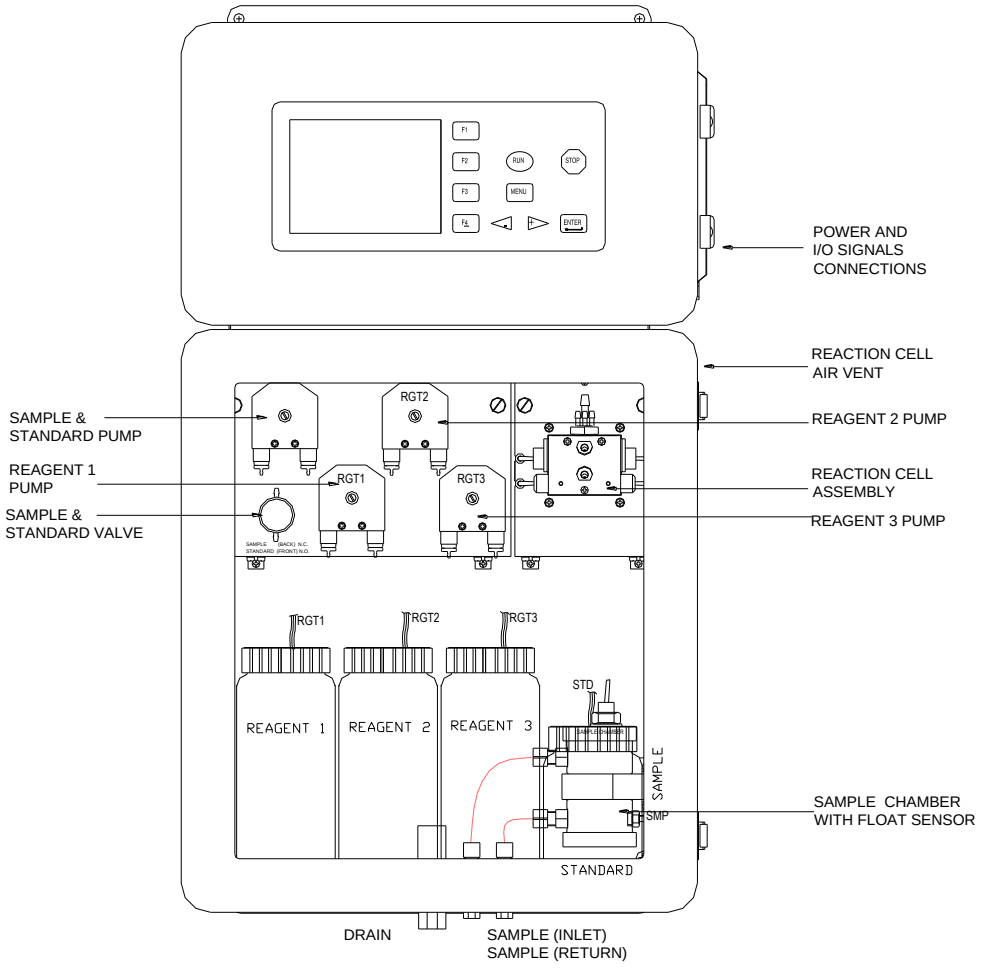


Figure 1: Orion 2230XP Silica Analyzer SiO_2 layout

 DANGER	**Handling chemical samples, standards, and reagents can be dangerous .** **Review the necessary Material Safety Data Sheets and become familiar with all safety procedures before handling any chemicals .**

 CAUTION	**REAGENT BOTTLES MUST BE KEPT TIGHTLY CLOSED.** Observe all health and safety procedures for handling chemicals. Wash any spillage with Distilled water. Allow enclosure to vent any trapped fumes before servicing. Air purge of enclosure is recommended . **EMPTY ALL REAGENTS BEFORE SHUTTING UNIT DOWN.**

Analysis Reaction Principle

The colorimetric method is based on the reaction of reagents with the sample to produce a color. This color is measured and compared to a standard color, which proportionally defines its concentration.

The color compound, which is the reacted mixture of the sample with the reagents, absorbs energy at a specific wavelength in accordance to Beer-Lambert Law.

Fluids Storage

Store all reagents and standards in a dark place at room temperature.

Calibration Standard

Standard part # 223020, the calibration standard required for this application is a 200 ppb solution. Each calibration cycle consumes approximately 50 mL. Each bottle contains enough standard solution for approximately 10 calibrations.

Reagents Required

Reagent Kit: 2230RE contains all 3 reagents.

The analyzer requires three reagents and one standard solution. All bottles are housed in the fluidics enclosure compartment.

For proper operation: Ensure that the reagents are correctly installed, the analyzer tubing is correctly routed in the pumps, and that the analyzer drain tube is connected to an atmospheric drain. All of the reagents and standard vent tubes need to exhaust to the outside of the enclosure, to minimize the trapping of any vapors inside the enclosure.

1. Connect sample to the analyzer and ensure that it is flowing through the sample chamber by observing the flow from the sample return line.
2. Turn the power ON to the instrument. After the booting sequence (this may take several minutes), press STOP and then MENU key:
3. Select SERVICES MENU option and then PRIME FLUIDICS ➔AUTO PRIME ➔ ENTER

The instrument will go through a priming sequence of all the available solution to the analyzer. Follow the startup procedure described in Section 4. You may repeat the AUTO PRIME sequence as necessary to purge out any trapped bubbles in the lines.

Reagent Consumption

The Silica analysis requires three reagents. The reagent usage depends on the frequency of analysis. Typically 0.20 mL of each reagent is used per analysis cycle.

Based on 4 analyses per hour, the 1 Liter reagents should last approximately 45 days.

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SECTION 3

Installation Environmental Considerations

The instrument is designed for general-duty, indoor installations. The electronics enclosure environmental rating is NEMA 12 and the Fluidics enclosure is a NEMA 4X fiberglass with a clear door window.

The Orion 2230XP Silica Analyzer should be installed in a well-ventilated location, with ambient temperature between 5°C and 45°C (41° to 113°F); and relative humidity not to exceed 90% at 40°C. The area must be free from dust, corrosive gases, vibration and shocks; sheltered from direct sunlight, and shielded from dripping water. Power should be instrument grade with over voltage protection, and a provision for disconnecting power.

Mounting the Instrument

The instrument case is designed for wall or panel mounting.

- Use four #10 screws or equivalent for proper support.
- Refer to Figure 2 and Figure 3 for dimensions (in mm and inches).
- Make sure that the wall that you choose can support the weight of the instrument (approximately 20 kg or 44 lbs.) See Figure 2.
- Locate the instrument as close to the sampling point as practical to ensure complete purging of the sample line during each cycle.
- Allow approximately 50 cm (20 in.) of clearance at the left side for door swing. Also allow enough clearance on the right side for wiring conduit.
- Locate the analyzer height such that the display is at eye-level height for an operator, allowing also for appropriate sample and drain connections.

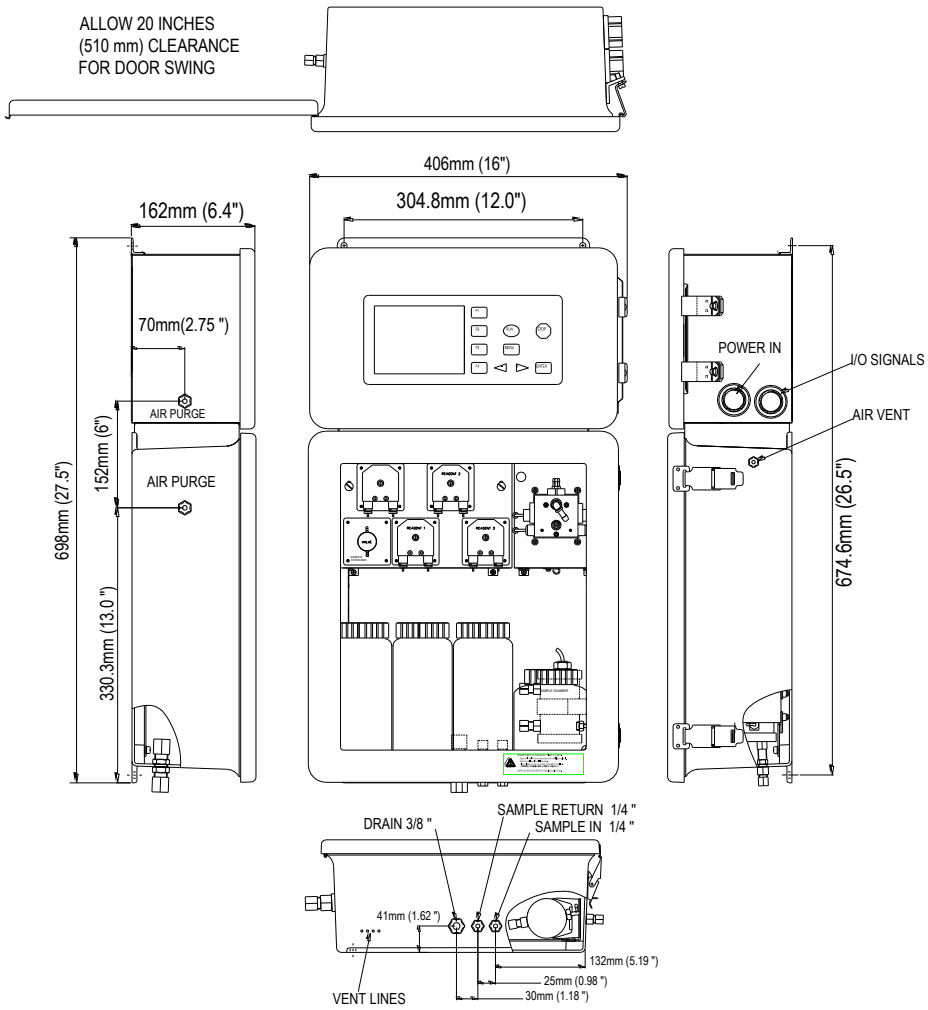


Figure 2: Mounting dimensions

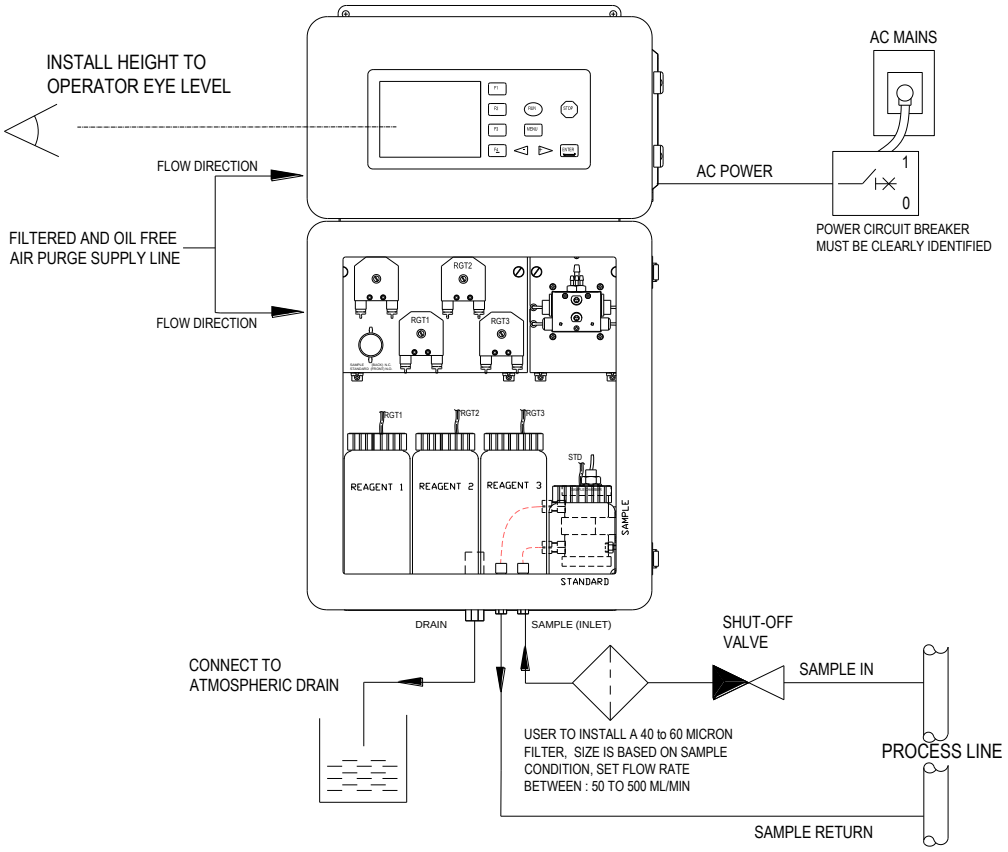


Figure 3: Typical external plumbing connections

NOTES:	1. It is recommended that you install an external sample shut off valve to allow control while accessing or service to the sample chamber. 2. Air purging of upper and lower enclosures is recommended. 3. Each analyzer MUST have its own drain tube vented to atmosphere. 4. The installation of a power circuit breaker is highly recommended.

Plumbing Connections

Sample inlet, sample return and drain connections are made on the bottom side of the instrument. The sample inlet and sample return fittings on the bottom of analyzer require ¼-in OD (6 mm OD) flexible tubing. The drain fitting at the bottom of the analyzer requires ⅜ -in OD (9.6 mm OD) flexible tubing. The air purge inlets require ¼-in OD tubing. The air purge supply must be filtered externally and free of oil and any other particulates.

DANGER	The ⅜ -in (9.6 mm) **DRAIN MUST BE VENTED TO ATMOSPHERE.** The sample drain contains analysis wastes, which include both sample and chemical reagents. Please check with local authorities concerning proper disposal of waste from this product.

NOTES:	The enclosure drain produces no waste under normal use. However, in the event of spills or leaks, some waste may be produced. The analyzer is shipped with all of the internal tubing attached. Before starting up the instrument, verify that the tubing lines are secured.

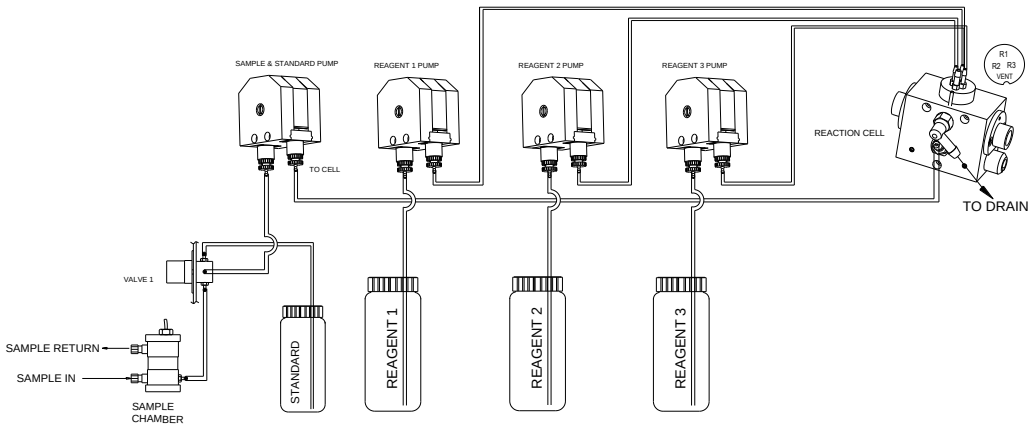


Figure 4: Internal tubing and tube routing interconnections

Installing Peristaltic Pump Head Tubing

Press the STOP key.

Disengage the U shape pressure plate of the pump head assembly by pressing with two fingers and gently move upside as shown in Figure 6. Slide the tube fitting retainers at each side as shown in Figure 5.

Replace the old tube by sliding off the barbed fitting. If necessary, clean the pump rollers.

Lubricate the tubing with a pea-sized quantity of silicone oil.

Fit the new tube and replace in the pressure plate. Note that the pressure plate sides must click properly in the pump head assembly and align on both sides.

Repeat above steps for all pumps.

You can test the pump under Diagnostics menu for proper operation:

MENU ➔ SERVICES ➔ DIAGNOSTICS ➔ PUMPS & STIRRER

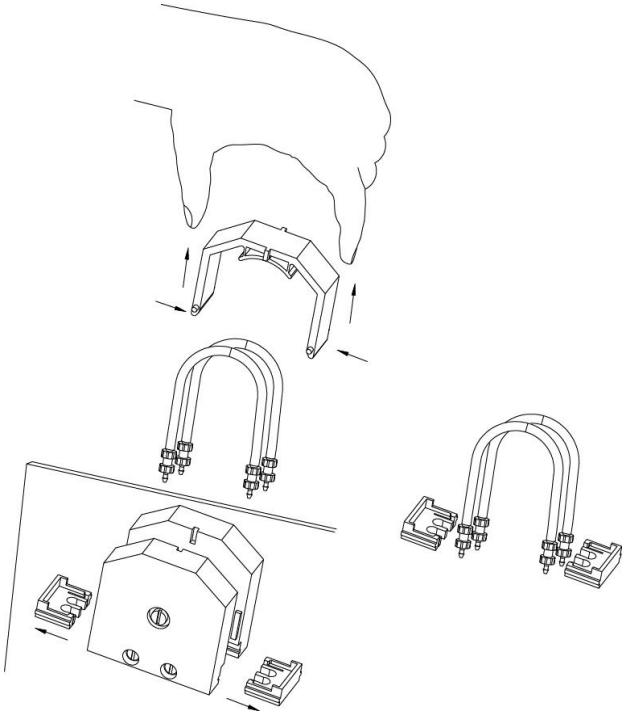


Figure 5: Installing peristaltic pump head tubing - (Dual channel)

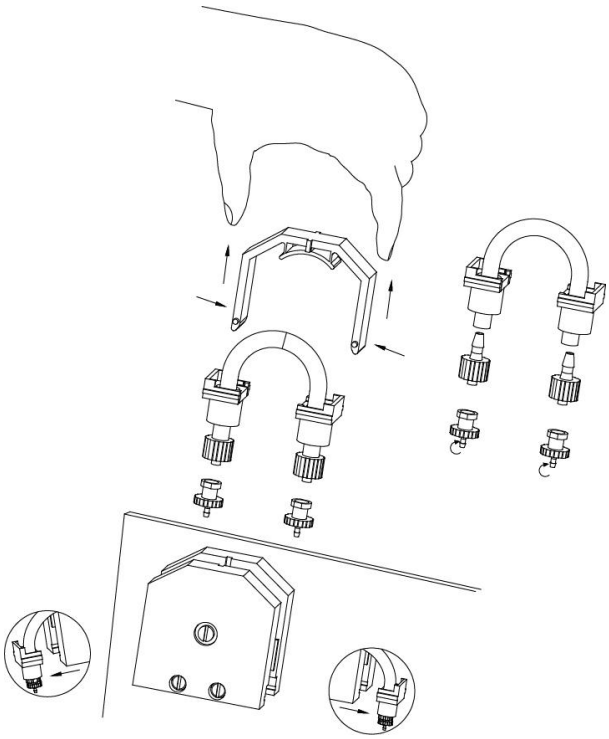


Figure 6: Installing peristaltic pump head tubing - (Single channel)

Installing the Reagents

The analyzer reagents startup kit contains all the necessary reagents for the specific application. The reagents and calibration standards are supplied in ready-to-use bottles that can be replaced directly onto the cap assemblies.

Follow the markings to install each solution into the respective feed line in the analyzer.

Connecting Power to the Analyzer

CAUTION	Operational Safety and General Precaution

Only trained technical personnel should perform installation, electrical wiring and maintenance of this product. Proper handling is required to avoid ESD (Electrical Static Discharge), as the internal electronic components on the circuit boards can be damaged by static electricity. It is recommended that before touching any electronic components, (such as printed circuit cards and the components on them) you should discharge static electricity from your body. This can be accomplished by touching an earth-grounded metal surface such as the chassis of an instrument, metal conduit, or pipe.

The analyzer is equipped with a three terminal power connector strip located in the electronics enclosure as shown in Figure 8.

IT IS HIGHLY RECOMMENDED THAT PROVISIONS FOR AN EXTERNAL CUSTOMER-SUPPLIED POWER SWITCH OR BREAKER BOX (WITH COMPLETE CB SPECIFICATION), CLEARLY MARKED FOR THE ANALYZER AND WITHIN REACH OF THE USER, BE PROVIDED TO ALLOW REMOVING POWER DURING SERVICE.

The analyzer has been designed to be hard-wired with provisions for the AC power lines to be routed in conduit pipes connecting to the ¾" FNPT hubs located on the left side of the electronics enclosure. See Figure 7.

When using line cords, use only certified power cords of 3 core, min 0.75 mm^2 / 18AWG, min. temperature of 75°C, H05VV-F.

The power safety ground must be provided for proper operation.

BEFORE MAKING ANY CONNECTIONS:

- Make sure that the wires are not powered before connecting to the instrument.
- Disconnect any power previously connected to the relays.
- Connect the Phase Hot or L (line), Earth and Neutral to the terminal block. Note the location of the fuse.
- Insert the wire into the terminal connector and make sure to tighten the screw.
- Route signal connections to the back hub, and power connections separately to the front hub.
- All connections must conform to local safety standards.

Figure 7: Electrical wiring ports

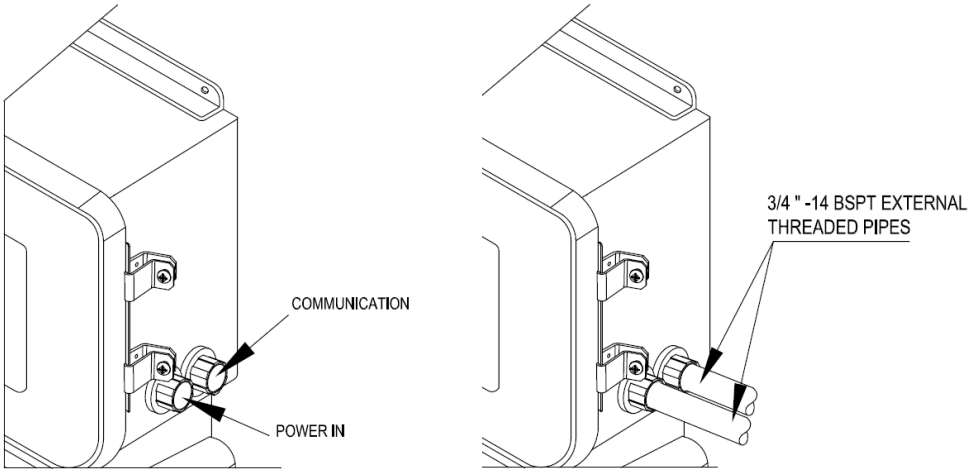
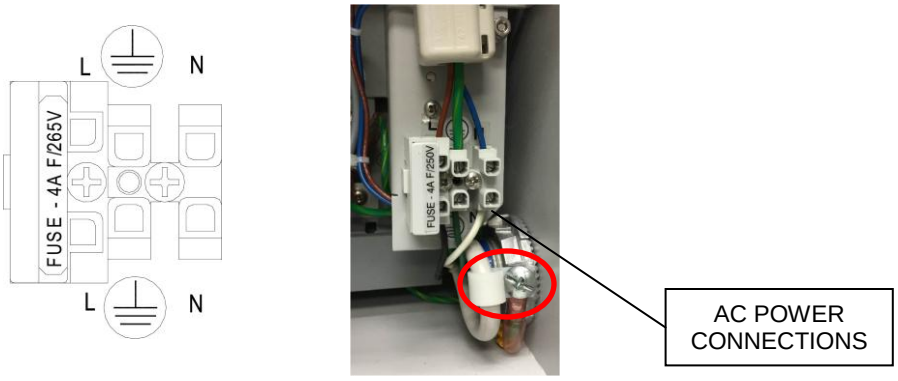


Table 1: AC power terminal wire connections

Analyzer Terminal Destination	North America Wire Color	European Wire Color
HOT or L (Line)	black	brown
Protective Earth Ground (PG)	green	green with yellow tracer
Neutral (n)	white	blue

Figure 8: AC power connections



NOTES:	When using a UL/CSA approved power cord, loop cord through clip retainer as shown in Figure 8 for proper strain relief.

CAUTION	**The analyzer is intended for use only with single-phase power.** The analyzer is not equipped with a power switch, therefore a circuit breaking device such as a circuit breaker should conform to local safety standards and must be fitted before the final installation. The circuit breaker must be in close proximity to the analyzer and within reach of the user, and must be marked clearly as the disconnection device for the analyzer. **ALL CONDUCTORS NEED TO HAVE MINIMUM INSULATION RATING OF 75°C**.

Analog Outputs Connections

The analyzer is equipped with two isolated analog outputs. The analog outputs can be programmed to be any one of the following: 0-20 mA or 4-20 mA or reverse acting i.e. 20 – 0 mA or 20 – 4 mA. The range is also programmable and can be scaled according to application needs.

The outputs have a common isolation from the main system and can drive up to a 900 Ohms load.

Please refer to Figure 9 (page 25), and Table 2 (page 27), for signal terminal connection detail.

Alarm Connections

The analyzer has five level sensor inputs that accept a dry contact closure signal to indicate the state of the level sensors. Input 5 is typically assigned for sample. The analyzer is equipped with four relays that have voltage-free contacts. Two contacts: Normally Open (NO) and Normally Closed (NC) with a Common (C). The relay contacts are rated for use at a maximum of 240 V and 2A.

The terminal connectors accept wire gauge up to 14AWG.

The terminal strip is located at the bottom of the electronics cabinet (Figure 9).

Table 2 shows the connector order and terminal designation.

- Make sure no power is supplied to the instrument.
- Strip the insulation on each wire back ¼-in.
- Insert the wire ends through the uppermost opening below the terminal screw and make sure that the stripped wire ends are in the terminal, tighten the connector screws.

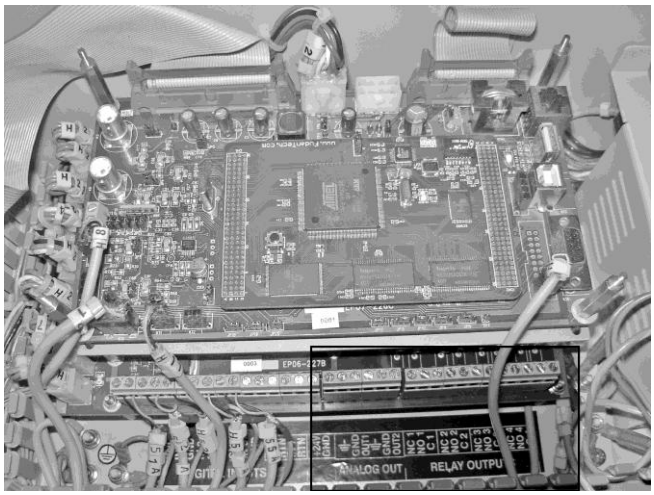


Figure 9: Terminal strips for analog and relay outputs

- RELAY contacts are rated at: 250V, 2A AC 500W (non-inductive load).
- All inputs (except IN 6 & 7) must be connected to POTENTIAL FREE contacts.

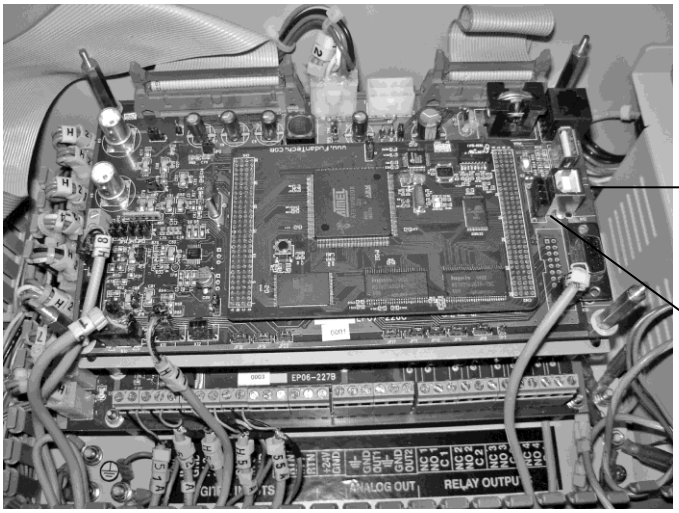


Figure 10: Communication ports

Table 2: Main terminal strip pin assignments

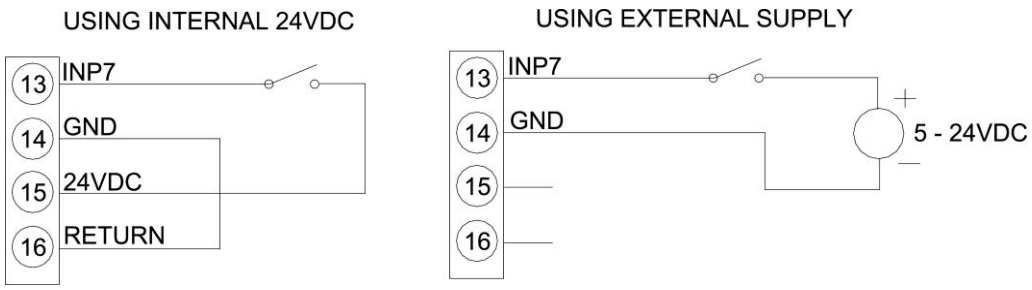
Terminal Number	Designation	Function
1	in1	Digital input 1 Live (Level sensor 1 live)
2	GnD	Digital input 1 ground (Level sensor 1 ground)
3	in2	Digital input 2 live (Level sensor 2 live)
4	GnD	Digital input 2 ground (Level sensor 2 ground)
5	in3	Digital input 3 live (Level sensor 3 live)
6	GnD	Digital input 3 ground (Level sensor 3 ground)
7	in4	Digital input 4 live (Level sensor 4 live)
8	GnD	Digital input 4 ground (Level sensor 4 ground)
9	in5	Digital input 5 live (Level sensor 5 live)
10	GnD	Digital input 5 ground (Level sensor 5 ground)
11	in6	Digital input 6 live (External 1 control)
12	rTn	Digital input 6 return (External 1 control return)
13	in7	Digital input 7 live (External 2 control)
14	rTn	Digital input 7 return (External 2 control return)
15	+24V	24V DC live (limited to 20 mA source)
16	GnD	24V DC ground
17	Earth Ground	System earth ground
18	GnD	Analog output 1 ground
19	OUT1	Analog output 1 (900 Ohms Max)
20	Earth Ground	System earth ground
21	GnD	Analog output 2 ground
22	OUT2	Analog output 2 (900 Ohms max)
23	nC1	Normally closed contact relay 1
24	nO1	Normally open contact relay 1
25	C1	Common contact relay 1
26	nC2	Normally closed contact relay 2
27	nO2	Normally open contact relay 2
28	C2	Common contact relay 2
29	nC3	Normally closed contact relay 3
30	nO3	Normally open contact relay 3
31	C3	Common contact relay 3
32	nC4	Normally closed contact relay 4
33	nO4	Normally open contact relay 4
34	C4	Common contact relay 4

Inputs Signal Connections

The two inputs are assigned for external control commands. Inputs 6 and 7 require a DC voltage between 5 and 24 Volts to activate. A 24V supply is available from the main terminal strip pins 15 and 16 that can be used for activating the external control inputs.

Digital CONTROL inputs:

Pin	**Signal**
11	Digital input 6 live
12	Digital input 6 return
13	Digital input 7 live
14	Digital input 7 return
15	+24V DC live
16	24V DC ground



Input 6 is assigned by default to RUN/STOP function with Close/Open of a dry contact.

Input 7 is left unassigned by default.

Dry contact = voltage free contact.

The functionality along with the state of the enabling signal is programmable by the user.

Communication Signal Connections

The analyzer has two communication connectors located at the right side in the upper cabinet. See Figure 10. For connecting to them, use the communication conduit hub port on the right side of the instrument for wire entry.

4

SECTION 4

Startup and Operation

Each Orion 2230XP Silica Analyzer gets thoroughly wet-tested and calibrated at the factory, so the system is ready to begin analyzing sample streams. The results of this activity are recorded in a Quality Control Report shipped to you with the analyzer.

Since the elapsed time between factory calibration and your startup process is unpredictable, it is important that you calibrate the analyzer again before you place it in service for the first time.

Please refer to Section 4.6 for additional instructions on calibrating the analyzer. The reported result of a calibration is a number that the analyzer uses to determine the sample concentration. The particular value of this number is not important, but it should be within ± 5% of the corresponding value in the Quality Control Report. If so, you can be confident that all subsystems of your analyzer are working properly.

Before proceeding, please make sure of the following:

- The reagent bottles 1, 2, and 3 are full and properly connected.
- The 200 ppb Si calibration standard (1/2 L bottle) is full with the standard and properly connected.
- The drain and sample lines are connected. Verify the sample is flowing into the sample chamber located at the bottom right side of the fluidics enclosure.
- The lines are primed and there are no trapped air bubbles in any of the lines.

To prime the lines:
MENU ➔ SERVICES ➔ PRIME FLUIDICS ➔AUTO PRIME ALL

Repeat auto prime as necessary to purge all the air from the lines. When done proceed to calibrate:
MENU ➔ MEASUREMENT ➔ CALIBRATE ➔ CALIBRATE STANDARD [ENTER]

NOTE:	It is highly recommended to allow the 2230XP Silica Analyzer to complete its measurement cycle rather than using the STOP key. If the STOP key is pressed before a measurement cycle is complete, it is highly recommended to perform both the AUTO PRIME ALL and CLEAN sequences described in Section 4.

The result of the calibration will be displayed as follows:

STANDARD	:	200 ppb
ABSORBANCE	:	0.200
SLOPE	:	+1000.00
INTERCEPT	:	-2.0

Refer to *Theory of Measurement Section* for a detailed explanation about the slope and intercept. The absorbance value found corresponds to the standard concentration used. If the calibration absorbance value is within ± 5% of your system QC report, then the system is operating properly and ready for running sample analysis. If the data is different, repeat the calibration cycle before proceeding further.

Executing a manual calibration

If the result is outside the user specified tolerance (default 5%), the Analyzer will warn the user to avoid storing the wrong calibration data. The user may then ACCEPT or REJECT the calibration result. Note user accepted manual calibration will become the REFERENCE calibration data.

The Analyzer will use the REFERENCE calibration data when checking for the acceptable tolerance limits in BOTH manual and auto cal cycles.

In Auto- Calibration mode

The system will run a second calibration cycle if the first calibration result was outside the user specified tolerance. If the second calibration result is still outside the specified tolerance limits, the Analyzer will continue to use the previously stored calibration and will flash the “CHK CAL” message in the Info section of the LCD screen.

The “CHK CAL” message can be cleared by resetting the fault alarm under:

VIEW DATA AND ALARMS → REVIEW/RESET ALARMS

Or a by running a manual calibration.

Placing the Analyzer into Service

Your analyzer is now ready for routine operation. To place the analyzer into routine service, press the control panel RUN key.

The analyzer typically runs unattended, analyzing sample streams and calibrating itself at regular intervals. All relevant parameters were programmed at the factory based upon your application. Consequently, the analyzer is fully prepared for routine operation once you complete these startup procedures.

A qualified and authorized user can change many of the operating parameters through the password-protected “Technician Level” menu as detailed in the USER INTERFACE menu.

Validating a Calibration Standard

You can check the analyzer’s calibration accuracy at any time using the validation function. Validation consists of running a single measurement cycle and reporting the result in concentration. This reported result can then be compared to the expected value, which is the known concentration of the validation solution, to determine the accuracy of system calibration.

The advantage of using this function over the Run Analysis function is that prior knowledge of the concentration allows for validating the accuracy of the analyzer, without affecting the data reporting to your control center or device.

NOTES:	**Running a validation is identical to running an analysis:** although the results are printed they are not stored, alarm conditions are not tested, and the analog outputs are not updated. It is highly recommended to allow the 2230XP Silica Analyzer to complete its measurement cycle rather than using the STOP key. If the STOP key is pressed before a measurement cycle is complete, it is highly recommended to perform both the AUTO PRIME ALL and CLEAN sequences described in Section 4.

Running an Analysis (Analyze Once)

Although the analyzer is usually set up to analyze sample streams on a regular schedule, you may wish to execute an analysis on command to obtain an immediate result. This function allows you to run single or multiple analyses on a sample without requiring that the automatic mode be initiated. The analyzer then runs the specified number of analyses, tests for alarm conditions, exercises the analog outputs, and prints the results exactly as if it were in the automatic mode.

To run multiple analyses (more than one) set the number of repeats in ANALYSIS menu:

Press MENU ➔ SETUP ➔ (+) to go to page 2 ➔ ANALYSIS PARAMETERS ➔ ENTER ➔ select NO. OF REPEATS

Instrument Operation Modes

1 SAMPLE ANALYSIS
2 CALIBRATION

The instrument also operates cleaning and post wash cycles, along with a priming function useful for startup and priming feed tubing lines to the reaction-measuring cell.

Sample Analysis and Validation

The SAMPLE ANALYSIS mode is similar to the calibration mode, with the exception that during calibration the instrument calculates the relevant parameters correlating to the standard concentrations used for calibration.

During sample analysis, the system relies on the CURRENT calibration parameters to calculate the sample concentration.

Each measurement cycle starts with flushing the reaction cell with fresh sample. An auto blank step makes sure that the background color of the sample is measured as a baseline. Typically, reagents are added to develop the color of the final compound, and the intensity of the color developed is measured and correlated to the sample concentration.

The validation cycle is similar to the measurement cycle except that the result is not reported on the analog loops and not stored in the sample analysis results data storage. The result of the validation analysis is displayed and printed on the RS-232 port. The validation cycle can be executed on any available solution standard or sample selected by the user in the validation setup parameters menu.

Calibration

The user may execute manual or set automatic calibration cycles at user defined intervals. In the auto mode the analyzer calibrates periodically and checks the validity of the calibration per the specified tolerance for the REFERENCE slope and offset parameters. New calibration data is only accepted if it is within the limits of the specified tolerance for the REFERENCE calibration parameters. The current column shows the current operating parameters that are used to calculate the sample concentration.

Cleaning

Automatic flushing of the reaction cell may be programmed.

The default setup for the analyzer uses the sample as the cleaning solution. A cleaning cycle can be performed by pressing:
STOP ➔ MENU ➔ MEASUREMENT ➔ CLEAN

This cycle helps maintain clean reaction cell.

NOTE:	To avoid damage and contamination to the reaction cell, use only cleaning solutions recommended by the factory.

Post Wash

Automatic post wash cycles are typically part of every measurement cycle. At the end of the analysis, the post wash cycle evacuates the reacted sample from the cell and cleans it to minimize coating and residue deposits in the cell. The post wash cycle settings can be accessed from the ANALYSIS PARAMETERS menu:
MENU ➔ SETUP ➔ (+) ANALYSIS PARAMETERS ➔ (+)

Please consult factory before modifying any of the parameters.

Priming

Priming of the instrument lines may be done as auto (all the solutions) or manually by selecting the specific reagent or standard. Priming fills the tubing, purges the lines of air, and prepares the analyzer for measurement mode.

The PRIME VOLUME in mL applies to all the listed solutions in the priming menu.

The Prime Volume may be specified as a (-) number; this allows the user to pump back the reagents inside the tubing back into the reagents containers allowing for safer service when replacement of the tubing is needed. User may select to pull back all or any one of the reagents or standard.

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SECTION 5

Analyzer Hardware Configuration and Calibration

Each analyzer is setup at the factory, and shipped ready to be commissioned for on-line analysis. This section describes the hardware setup in case maintenance or other post calibration adjustment after service is required.

The Orion 2230XP Silica Analyzer is based on colorimetric detection principles. The analyzer uses optical components that require initial setup at the factory and can be further tuned or re-calibrated by a trained technician.

This section describes the operation and calibration of the following assemblies: Optics, Heater, Pumps and Analog Outputs.

Optics Calibration

Orion 2230XP Silica Analyzer optics consists of a NIR LED light path and a photo-detector. The analyzer is capable of driving three LED and the intensity of each of the LED can be individually varied. The light path is preset in the reaction cell sample chamber. The photo detector receiving the light energy is connected to an amplifier with programmable gain. The output of the photo detector amplifier is digitized and measured in mV. Optics calibration in the analyzer is done in two stages. In the first stage, the level of stray light is recorded. The LED light source is switched off and the output of the photo detector is recorded. The second stage of calibration consists of adjusting the intensity of the LED and the gain of the photo detector amplifier to get an optimum level of output close to a fixed reference level. This is optimized for the specific LED and the results of the calibration are stored.

The reaction cell sample chamber must be clean and filled with de-ionized water for proper optics calibration cycle.

Optics Calibration Steps

For proper optics calibration the cell must be clean and filled with de-ionized water. Press the MENU key and navigate to CALIBRATE OPTICS:

MAIN MENU ➔ SERVICES ➔ HARDWARE SETUP ➔ CALBRATE OPTICS

The prompts remind the user to add de-ionized water in the reaction cell, and then allows them to proceed for optics calibration upon confirmation.

The optics calibration is an automated sequence that also detects fault conditions. Once a fault is detected, the sequence is aborted. For example, the optics calibration of stray light is aborted if the stray light measured is greater than the factory allowed set reference value. The optics calibration optimizes the light from the LED present in the system along with tuning the front-end detection to maximize the signal levels with de-ionized water in the cell. The system stores all the parameters for the application.

The calibration results are available for editing. From the MAIN MENU, follow the sequence:

MENU ➔ SERVICES ➔ HARDWARE SETUP ➔ EDIT CALIBRATED VALUES

The stray light measurement is listed as OPTICS DARK; the optimum light level is listed as OPTICS xREF for the LED specified in the MEASUREMENT METHOD.

Reaction Cell Temperature Calibration

In order to get consistent and repeatable measurements, the method is setup such that the reaction cell in the Orion 2230XP Silica Analyzer is heated to a specific set point (25°C). A heater element located on the back plate of the reaction cell controls the temperature. The temperature of the reaction cell is measured by a thermistor embedded in the reaction cell body. The temperature of the cell is displayed on the results screen.

NOTE:	Calibration is typically NOT required except in rare cases where the thermistor has been replaced and the default parameters are not functional.

The Orion 2230XP Silica Analyzer relies on a PID (Proportional, Integral, Derivative) algorithm setting to control and maintain the cell at the set point. The following procedure allows for tuning and calibrating of the thermistor in case it was replaced or required adjustment.

Heater Temperature Calibration:
MENU ➔ SERVICES ➔ HARDWARE SETUP ➔ CALBRATE THERMISTOR

Press F3 key to RESET thermistor calibration value to FACTORY DEFAULTS.

The operator is asked to read the temperature of the reaction using an external digital thermometer and enters the value. The unit will make appropriate correction if needed.

Editing the calibration results:
Upon successful completion of temperature calibration, the new calibrated temperature is available for further editing. From the MAIN MENU, follow the sequence:

MENU ➔ SERVICE ➔ HARDWARE SETUP ➔ EDIT CALIBRATED VALUES

Pumps Calibration

The Orion 2230XP Silica Analyzer uses peristaltic pumps to move fluids through the reaction cell. The pump tubing will require replacement periodically. Please refer to Chapter 9 for details.

The maximum rate of flow of the fluid is dependent on both the inner diameter of the tubing conveying the fluid and the rpm of the pump. The pumps are used to move the following fluids: sample, standard, and reagents.

WHEN REPLACING WITH SAME TYPE FACTORY TUBING, USER MAY BYPASS ANY CALIBRATION AND USE FACTORY DEFAULT VALUES. IF SUBSTITUTE TUBING IS USED, PUMP CALIBRATION IS REQUIRED TO INSURE ACCURATE DOSING.

Pumps Calibration Method

From the MAIN MENU, follow the sequence:

MENU ➔ SERVICES ➔ HARDWARE SETUP ➔ CALIBRATE PUMPS

Select the pump to be calibrated. The user is now asked to prime the pump with de-ionized water and to respond when ready. The pump calibration procedure is aborted if the user fails to confirm readiness to pump de-ionized water within 90 seconds.

The sequence starts with a priming step to allow fluid to purge the air from the tubing. The user may respond as soon as ready. The prime step will stop after 60 seconds. The next step prompt asks the user to be prepared to collect the water in a measuring cylinder. This step must

be allowed to complete and is timed at 60 seconds to allow the user to enter the volume collected in 60 seconds (or 1 minute). If the measured volume amount is not entered within 90 seconds the pump calibration procedure is aborted.

Upon successful completion of the pump calibration procedure, the user has the choice to calibrate the remaining pumps or to edit the calibrated values.

Analog Outputs Calibration

The analyzer has two isolated analog outputs. The outputs are rated 0/4-20mA with a maximum load of 900 ohms. They can be independently calibrated.

From the MAIN MENU, follow the sequence:

MENU ➔ SERVICES ➔ HARDWARE SETUP ➔ CALIBRATE ANALOG OUTPUTS

The user is asked to connect a 900 ohms resistor to each two analog outputs. The calibration requires the use of a current meter (0–100 mA range) placed in series with the output under test.

The user may select one output at a time for calibration. The calibration starts by adjusting the full scale to 20mA. The -/+ buttons are used to adjust the output to 20mA. The instrument waits for the user to confirm the calibration by pressing ENTER. If there is no user response within 90 seconds, the analog output procedure calibration is aborted.

Upon successful calibration of one of the analog outputs, the user has the choice of calibrating the second analog output.

The calibrated values for the analog outputs are not available for editing. For testing the calibrated outputs use:

MENU ➔ SERVICES ➔ DIAGNOSTICS ➔ ANALOG OUTPUT ➔ CHANNEL –1:

By pressing ENTER the user may select the signal level from the following settings:

0, 4, 10, 12, and 20 mA

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SECTION 6

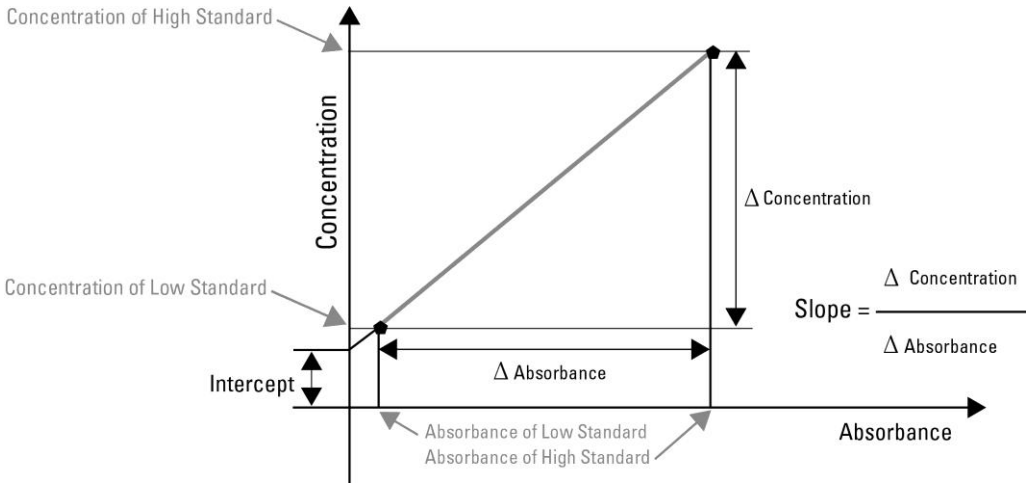
Calibration of the Instrument for Measurement Analysis

In the Analysis mode, the Orion 2230XP Silica Analyzer measures the absorbance of light through the sample, and compares the result with the absorbance of light through a standard solution of known concentration.

The Method of Analysis defines the detection wavelength for Silica. It is set at 810 nm.

Theory of Calibration

Using two known standards, one of low concentration and the other of high concentration, the absorbance for each concentration is measured and the slope and intercept are calculated from the calibration curve as shown below:



The Measured Absorbance is the result absorbance after subtracting the Blank Absorbance.

Methods of Calibration

Two methods of calibration are provided in the Orion 2230XP Silica Analyzer.

SINGLE POINT calibration uses high concentration standard alone, and BASE LINE calibration uses either very low or zero standards.

The base line calibration is provided to improve accuracy for low level measurements and trace analysis.

For setting up the calibration method, from the MAIN MENU, follow the sequence:
MAIN MENU ➔ SETUP ➔ CALIBRATION PARAMETERS

Set the MODE for SINGLE POINT or BASE LINE.

For Calibration, from the MAIN MENU, follow the sequence:
MAIN MENU ➔ MEASUREMENT ➔ CALIBRATE ➔ CALIBRATE STANDARD

Single Point Calibration

For single point calibration, typically the intercept value is zero. Therefore, Concentration = Slope x Absorbance.

The technician may modify the intercept value.

The analyzer uses a 200 ppb concentration standard solution for calibration. The absorbance of the standard solution is measured and the slope is calculated and stored upon user's confirmation.

Base Line Calibration

After calibrating using the single point, improved accuracy around the base or zero point may be further tuned by executing a base line calibration.

A low concentration solution is used and its absorbance is measured in the instrument. Only the intercept is recalculated as:
Intercept = Concentration (Low) – [Slope X Absorbance (Low)]. This is used along with the slope for single point calibration.

The calibration data is available for editing. From the MAIN MENU, follow the sequence:
MENU ➔ SETUP ➔ CALIBRATION PARAMETERS

The menu screen shows two columns labeled REFERENCE and CURRENT. The data in the current column is the active data being used for slope and intercept, and the data in the reference column is the data that the system relies on when comparing the new calibration result to check its allowed deviation per the specified limit specified for the tolerance value.

High Range Dilution-Factor Calibration

The analyzer uses a dilution method for measurement of high concentrations. The cycle is automatic and has been programmed at the factory. In most cases the factory default values are sufficient for the specified range of the product. For improved accuracy, the user may calibrate the dilution factor using a high concentration standard like a 3000 ppb. This calibration is only allowed in manual mode, with user prompts and confirmation required at the end of the cycle. Extended range calibration:
MENU ➔ SETUP ➔ (+) CALIBRATION PARAMETERS

Set the STANDARD CONC = 3000 ppb (for a 0 to 5000 ppb range). And execute a manual calibration:
MAIN MENU ➔ MEASUREMENT ➔ CALIBRATE ➔ CALIBRATE STANDARD

When the system detects a high absorbance level of the reacted solution, above the set limit, it initiates the dilution cycle using the standard.

At the end of the cycle the dilution factor is calculated based on the value of the standard used and the existing slope and intercept.

At the end of the calibration cycle the user is presented with the new calculated dilution factor to accept or reject. The default dilution factor is 9.0 (range 8 to 10). The range depends on the pump flow rate (pump #1) used to add the standard used for dilution dosing.

The user may edit the dilution factor in the ANALYSIS PARAMETERS menu:
MENU ➔ SETUP ➔ ANALYSIS PARAMETERS ➔ (+) (+) PAGE 3 OF 4 ➔ DILUTION PARAMETERS

Consult the factory before modifying the default dilution steps. Press (+) to access the dilution steps.

The automatic dilution cycle may be turned off using either a higher than expected AU limit:

ABS HIGH LIMIT = 5 AU or by de-selecting the dilution event
DILUTION EVENT = NOT ASSIGNED

During the analysis of high concentration samples, the system checks the final absorbance value of the reacted solution and if it exceeds the set limit (ABS HIGH LIMIT) it will execute the dilution steps and use the calibrated dilution factor to calculate the final concentration.

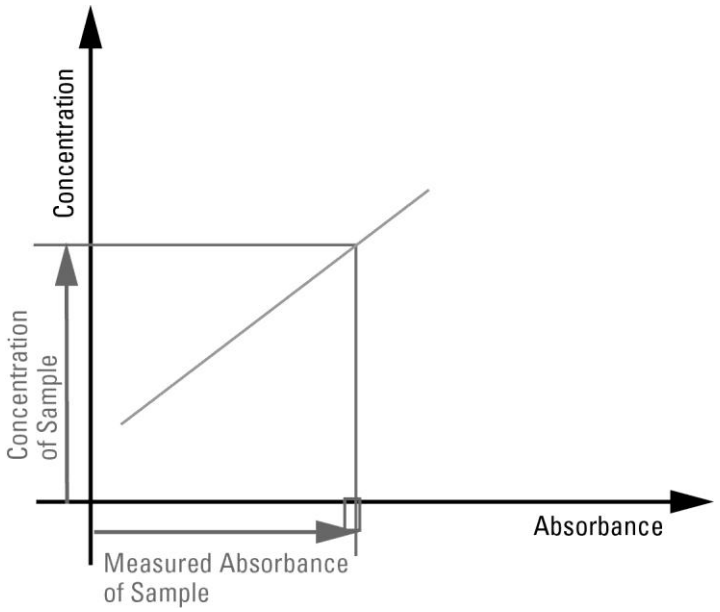
Theory of Measurement

Measurement in the Orion 2230XP Silica Analyzer is done by measuring the absorbance of a single wavelength of light through the sample, and comparing the result with the absorbance of the same wavelength of light through a standard solution of known concentration. If the two absorbencies match, then the sample concentration is equal to the standard solution.

To facilitate the comparison, the analyzer is first calibrated with standards to determine the slope and intercept of the range of concentration it can analyze, and then the measurement of the unknown sample is interpolated along the calibration curve to calculate the unknown concentration.

i.e., Concentration = (Slope x Absorbance) + intercept. Where Slope and Intercept - Determined from Calibration. Absorbance - Calculated through measurement.

The two variables (Slope and Intercept) are available for editing in the calibration parameters menu screen



Mode of Measurement

The Orion 2230XP Silica Analyzer is designed to provide on-line process measurements, and has two modes of operation. The mode is always displayed at the bottom right, i.e., below the Info field and above the status field of the display.

The two modes of the instrument are AUTO restart mode (the instrument resumes auto analysis mode after 0.5 Hr of inactivity) and MANUAL restart mode. The instrument awaits the user to initiate the RUN or AUTO ANALYSIS mode by pressing the RUN key.

To change the instrument mode, from MAIN MENU follow the sequence:
MENU ➔ SETUP ➔ (+) ANALYSIS PARAMETERS ➔ MODE

The instrument has two special keys to start and stop the measurement. Pressing the RUN key starts the auto analysis immediately and analysis repeats at the rate of the time set in measurement frequency, which is selectable. During this mode, the instrument displays RUN MODE indicating that the instrument is running continuously.

To edit the measurement frequency, from the MAIN MENU follow the sequence:
MENU ➔ SETUP ➔ (+) ANALYSIS PARAMETERS ➔SAMPLE FREQUENCY

The STOP key aborts the measurement at any stage irrespective of the mode of the instrument.

NOTE:	RUN is not the mode of the instrument. It indicates that the instrument is performing measurement continuously, at the rate of measurement frequency.

Auto Restart Mode

The default mode of the instrument is auto restart. In this mode, if the instrument keypad is untouched (i.e. stays idle) for the period of auto restart idle time (default value of 30 minutes), then it automatically starts the measurement, the mode is displayed as RUN MODE and repeats the measurement as per the measurement frequency set in analysis parameters.

If the STOP key is pressed during this measurement, it aborts the measurement and will restart after the idle time countdown expires.

To stop the auto restart of the instrument the mode should be changed to manual restart:
MENU ➔ SETUP ➔ (+) ANALYSIS PARAMETERS ➔ MODE

Manual Restart Mode

This mode allows you to START the measurements manually.

To perform measurement on command from the MAIN MENU follow the sequence:
MENU ➔ MEASUREMENT ➔ ANALYZE ONCE

Pressing RUN key in this mode keeps the instrument in RUN MODE and pressing STOP key during measurement gets back to the MANUAL RESTART mode. In this mode, if the instrument is untouched for a period of the standby mode idle time (60 minutes default), it switches to standby mode.

During standby operation, all fluidics devices are shut down and the analyzer goes into a standby housekeeping mode in which the pumps are activated on an hourly basis to prevent tube pinching.

When manual restart mode is selected, the analyzer automatically goes into standby operation after one hour (60 minutes) of inactivity. Consult the factory should you require a different standby time out; for details, refer to Section 7.

NOTE:	Even though the instrument is running continuously and displays RUN MODE, to know the actual RESTART mode of the instrument from MAIN MENU follow the sequence: MENU ➔ SETUP ➔ (+) ANALYSIS PARAMETERS ➔ MODE

Measurement Cycle

The Orion 2230XP Silica Analyzer follows a sequence of steps or events for performing the analysis cycle. They are:

1. Cell Wash
2. Sample Capture
3. Optics Testing
4. Test Reaction Temperature (when enabled)
5. Adds Reagent 1 and 2
6. Blank Measurement
7. Adds Reagent 3
8. Collect Data and Output Result
9. Post Wash

Cell Wash

In cell wash the sample is pumped into the reaction cell. The user is allowed to edit the volume of the sample to be pumped by the parameter called CELL WASH VOLUME. To edit the cell wash volume, from the MAIN MENU follow the sequence:

MENU ➔ SETUP ➔ METHOD ➔ CELL WASH VOLUME

In cell wash volume, the positive volume is to pump the sample into the reaction cell, and the negative volume is to pull back an amount below the drain after the cell wash is completed.

During the cell wash, the stirrer is on and the info field (if enabled) shows the sample pumping progress with a progress bar, along with the volume pumped.

Sample Capture

In the sample capture step, the stirrer is switched off and fluid is allowed to settle for 5 seconds to drain any excess from the reaction cell overflow drain.

During the sample capture, the info field (if enabled) shows the 5 seconds countdown.

Optics Testing

In optics testing, the system checks the optical path and status of the LED source.

During this stage in the cycle, the info field (if enabled) shows the test optics progress bar which times out at a maximum period of 90 seconds.

NOTE:	Optics test may flag the following error messages: "TESTING OPTICS, PLEASE CHECK FOR OPTICS FAILURE" Optics test failed due to the non-functionality of the LED source or detector, measurement is aborted, and the info field will flash the error message. "TESTING OPTICS PLEASE CHECK FOR STRAY LIGHT" Stray light reading outside the allowed limits: will flash with a warning message. "TESTING OPTICS LOW SIGNAL LEVEL . . . CELL MAY BE COATED AND MAY REQUIRE CLEANING" If the test determines that the light energy reading is outside the allowed limits, the measurement is aborted. The cell may require cleaning, or you many need to re-calibrate the optics.

Checking Reaction Temperature

When reaction cell temperature control is enabled, at this stage in the cycle the reaction cell temperature is tested against the set point.

To enable or disable the REACTION TEMPERATURE CONTROL, from the MAIN MENU follow the sequence:
MENU ➔ SETUP ➔ METHOD ➔REACTION TEMPERATURE CONTROL

If reaction temperature control is enabled, then the temperature set point is editable. To edit the temperature set point, from the MAIN MENU follow the sequence:
MENU ➔ SETUP ➔ METHOD ➔ REACTION TEMPERATURE

The temperature stabilization is attained through PID control. Once it reaches the set point, it stays almost at the same temperature, until and unless the reaction temperature control is disabled or set point is altered.

This test is allowed a maximum of 240 seconds for the reaction cell to attain the set temperature. If it does not reach stability or set point in the allowed time, it will flag a warning message and proceed to the next step. The info field (if enabled) shows the temperature progress bar.

NOTE:	No variation in temperature for a period of 80 seconds aborts the measurement, and the info field will flash with the error message: "PLEASE CHECK FOR HEATER FAILURE". If the temperature is not stabilized within 200 seconds and below the set point, then the info field will flash with the warning message: "CHECKING THE REACTION TEMPERATURE. TEMPERATURE BELOW SET POINT". If the temperature is above the set point, then the info field will flash with the warning message: "CHECKING THE REACTION TEMPERATURE. TEMPERATURE ABOVE SET POINT".

Blank Measurement

In this event, a reading is recorded called BLANK ABSORBANCE.

The stability of the recorded reading depends on the specified stability criteria. You have the choice of editing the stability criteria. To do this from the MAIN MENU follow the sequence:
MENU ➔ SETUP ➔ ANALYSIS PARAMETERS ➔STABILITY CRITERIA

During this stage the info field (if enabled) shows the blank measurement progress bar with the BLANK ABSORBANCE reading in AU. (This is a relative value and NOT an absolute value.)

For the silica measurement, the event of blank measurement and its sequence in the measurement cycle is done before adding the third color developing reagent.

NOTE:	When unstable and not meeting the stability criteria, the info field will flash with the warning message "TAKING BLANK MEASUREMENT, UNSTABLE SIGNAL".

Add Reagents

In add reagent, the reagent(s) is pumped into the reaction cell. You are allowed to edit the volume of the reagent to be pumped by the parameter called REAGENT VOLUME.

To edit the reagent volume, from the MAIN MENU follow the sequence:
MAIN MENU ➔ SETUP ➔ METHOD ➔ (+) to go to page 2 ➔ REAGENT VOLUME (1, 2, 3)

In reagent volume, the positive volume is to pump the reagent in to the reaction cell, and the negative volume is to pump back any reagent drops in the pump delivery tube after the reagent addition is completed. After pumping the reagent, the stirrer is turned on for an editable period of time called STIR TIME to mix the reagent thoroughly with sample.

To edit the Reagent volume, from the MAIN MENU follow the sequence:
MAIN MENU ➔ SETUP ➔ METHOD ➔ (+) to go to page 2 ➔STIR TIME (1, 2, 3)

During the addition of reagent, the stirrer is on and the info field (if enabled) shows the reagent pumping progress, with a bar and the volume pumped. After adding the reagent, the countdown of stir time is also shown along with the absorbance of the sample mixture.

NOTE:	If the pump is not assigned to a reagent, it will abort the measurement and the info field will flash with the error message: “PUMP IS NOT ASSIGNED”.

Collect Data

In collect data, the final reading is recorded and the final absorbance is displayed at the end of the cycle.

The stability of the recorded reading depends on the specified stability criteria. You have the choice of editing the stability criteria. To do this from the MAIN MENU follow the sequence:
MENU ➔ SETUP ➔ ANALYSIS PARAMETERS ➔STABILITY CRITERIA

Now the concentration is calculated (as follows) and the current concentration is updated.

Concentration = (Slope x Absorbance) + Intercept

(Where slope and intercept are from the CURRENT calibrated values of the instrument for measurement.)

NOTE:	If unstable and doesn't meet the stability criteria, the info field will flash with the warning message “COLLECTING DATA, UNSTABLE SIGNAL”.

Post Wash

The programmable POST WASH is to wash the reaction cell after the measurement and evacuate any residue of the reaction mixed solution. This event is optional and can be disabled, or the reaction cell can be washed with selectable sources with editable volumes and stir times, with up to five programmable steps. To perform post wash after measurement, select ANALYSIS PARAMETERS for the POST WASH EVENT.

To set the post wash parameters from the MAIN MENU follow the sequence:
MAIN MENU ➔ SETUP ➔ ANALYSIS PARAMETERS ➔ (+) POST WASH EVENT ➔ POST WASH CYCLES

Measurement Data

The Orion 2230XP Silica Analyzer product stores measurement and calibration results for up to 31 days. The data for each sample analysis cycle or calibration may be retrieved under REVIEW RESULTS menu screen with the corresponding time stamp and other related operating parameters.

Sample analysis data stores the date, time, concentration, units, temperature, wavelength and status (Good or Fault) along with the faults for each measurement cycle.

Calibration data stores date, time, standard concentration, slope, intercept, temperature, wavelength and status.

The stored results are displayed with respect to the selectable period of time such as: Last 12 Hours, Last 1 Day, Last 2 Days, Last 3 Days, Last 1 week, Last 2 weeks, Last 3 weeks, Last 4 weeks, All, which is selected as DATA RANGE. To display the measurement results from the main menu follow the sequence:
MENU ➔ VIEW DATA AND ALARMS ➔REVIEW ANALYSIS RESULTS ➔ DISPLAY

NOTE:	Validation results are ONLY reported on the display and the RS-232 at the time of running the validation. Validation cycles are not stored and are not reported on the analog outputs.

Printing Results

The stored measurement results can be printed on to the Hyper Terminal (minicom in Linux) through the RS-232 port within the selected data range. The selected data range is applicable to displaying, printing and plotting of measurement results.

7

SECTION 7 Menu Overview

Explanations of the four major menu sections are described as follows:

Setup - For configuring the instrument's functionality and operational parameters, such as measurement range, measurement frequency, display contrast, date, time, and more.

Measurement - For performing the manual analysis, calibration, validation and cleaning cycles.

View Data and Alarms - For reviewing the collected data of up to the last 31 days in text and graphics mode, and for reviewing and resetting the various Alarms and Faults triggered during the latest cycle performed.

Services - For system administration, hardware setup, prime fluidics and diagnostics; and control of the various devices including LED, pumps, input level sensors, relays and analog outputs.

NOTE:	Press the STOP key to exit Auto RUN mode to access the Service Menu.

Setup Menu

Alarms Menu
Allows configuration of alarm parameters (type, value and hysteresis). Also allows assignment of individual alarms to faults.

Relays Mapping Menu
Allows mapping of multiple alarms to individual relays.

Analog Outputs Menu
Allows configuration of individual analog outputs.

Inputs Menu
Allows configuration of five internal inputs (for fluidics sensors) and two external inputs (for instrument control).

Display Parameters Menu
Allows configuration of display-related parameters.

Calibration Parameters Menu
Allows configuration of parameters for calibration. The menu shows two columns tagged as REFERENCE and CURRENT. The parameters listed under the REFERENCE column are set for validating auto calibrations repeats. The new calibration results are tested against the reference calibration parameters listed under the REFERENCE column. The CURRENT column shows the current operating parameters that are being used by the instrument when calculating the analysis measurement result. Calibrations are similar to analysis cycles and are on the method set in METHOD PARAMETERS menu.

Validation Parameters Menu
Allows configuration of parameters for validation, choice of validation source, and repetitions required.

Analysis Parameters Menu
Allows configuration of parameters for instrument mode, measurement frequency, measurement units, analysis label, cell wash and reagent flow rates, stability criteria and post wash events. Separate post wash events can be programmed for analysis, calibration, and validation cycles. All post wash cycles can be turned OFF when set to the “NOT ASSIGNED”.

Cleaner Parameters Menu
Allows configuration of the parameters for manual or periodic cleaning of the reaction cell.

Temperature Units Menu
Allows selection of units for displaying the temperature readings. Choice of Fahrenheit (°F) or Celsius (°C).

Method Parameters Menu
Allows configuration of the parameters for method and order of the events for analysis and calibration. Consult factory before modifying any parameter.

Date and Time Menu
Allows configuration of the date and time format and editing of the current date.

Daylight Saving
Allows configuration of the daylight saving for USA, Europe and custom settings. When daylight savings is enabled, the system will correct the time based on the settings shown below the selection.

Recovery After Power Failure Menu
Allows configuration of the instrument after power failure recovery.

Ethernet Parameters Menu
Allows configuration of Ethernet Parameters.

RS-232 Parameters Menu
Allows selection of the BAUD RATE for the RS-232 port. Default setting of 115200 Baud.

Language Menu
Allows configuration of the instrument's language. Current release is ENGLISH language. (Consult factory for other languages).

Measurement Menu

Analyze Once
Allows one manual analysis to be performed. Number of repeats (default = 1) can be edited in the ANALYSIS MENU. When performing a manual analysis, the user is restricted from navigating through other menus.

Calibrate
Allows manual calibration to be performed using standard solutions. The slope and intercept values obtained here may be edited in the CALIBRATION PARAMETERS menu. When performing a manual calibration, the user is restricted from navigating through other menus.

Validate
Allows manual validation of the instrument with a known sample or standard. When performing validation, the user is restricted from navigating through other menus.

Clean
Allows manual cleaning of the reaction cell. The parameters set for the manual clean are also used for auto clean. When performing manual cleaning, the user is restricted from navigating through other menus.

View Data and Alarms Menu

Review / Reset Alarms
Allows user to review and selectively reset the faults and alarms triggered during the latest Analysis/Calibration/Validation/Cleaning cycle performed.

Review Calibration Results
Allows the user to review and print the calibration results from the stored calibration database, using a selectable time scale. The database holds data from the last 31 days.

Review Analysis Results
Allows the user to review and print the analysis results from the stored analysis database, using a selectable time scale. The selected results can be displayed in text or graph modes. The database holds data from the last 31 days.

The view graph has the following operational keys:
F1 - Escape
F2 - Un-Zoom
F3 - Scroll Left
F4 - Scroll Right
ENTER - Zoom
- / + - Cursor Movement
MENU - No Action

Zoom works as (X hrs displayed)/4, around the cursor position. Un-zoom is the exact opposite of zoom.

Delete All Calibration Results
Allows the user to delete the entire calibration database after confirmation.

Delete All Analysis Results
Allows the user to delete the entire analysis database after confirmation.

NOTE:	To enter the Service menu, the instrument must be in manual mode. (Press STOP.)

Service Menu

System Administration Menu
Allows access control to the instrument for up to six users and one technician, all with individual passwords.

Technician alone has the permission to add, delete and set access permission of any user. Each user can have access to edit their own user name and password.

Menus also allow technician to change factory settings (factory password required), printing options, instrument label, and to view instrument setup details.

Hardware Setup Menu
Allows technician to calibrate several hardware components of the analyzer.

Calibration results are editable by the technician.

Prime Fluidics Menu
Allows user to prime the fluidics lines of the analyzer.

Diagnostics Menu
Diagnostics provide a direct mechanism to individually test devices such as pumps, relays, optics and stirrer. Turn various pumps ON and OFF for testing or during adjustment. Maximum of two devices can be turned on at the same time. This function also provides a quick check of the optics subsystem.

System Administration Menu

Edit User Menu
Allows technician to edit user names, user passwords and user permissions, for measurement, calibration and validation. Allows user to edit his or her own user name and password.

Delete User Menu
Allows technician to delete a user from the users list.

Add User Menu
Allows technician to add a new user to the user's list. Up to six different users may be added.

Factory Settings Menu

Allows technician to restore factory defaults, update factory defaults and edit factory settings.

Instrument Details Menu

Allows viewing of instrument details:

- Software version
- Serial number
- Model number

Analysis Label Change Menu

Allows technician to edit the analysis label.

Printing Options Menu

Allows technician to print the system configuration, analysis parameters and method parameters. Also allows technician to enable/disable online printing. See Appendix A for the default analyzer parameters listing printouts.

Hardware Setup Menu

Calibrate Thermistor

Allows technician to calibrate the thermistor. Only required if the factory-installed thermistor has been serviced or replaced. To calibrate the thermistor, user is required to enter the reaction block temperature using an external reference thermometer.

Calibrate Pumps

Allows technician to calibrate the flow rate of the pumps.

Calibrate Optics

Allows technician to calibrate the optics.

Calibrate Analog Outputs

Allows technician to calibrate the two analog outputs.

Edit Calibrated Values

Allows technician to edit the calibrated results for fine-tuning.

Prime Fluidics Menu and New Reagents Blank

Auto Prime All
This menu runs an automatic priming sequence for all reagents, standards and sample based on the priming volume specified by the user.

Prime Input Source (Sample/Reagent/...)
Allows technician to selectively prime from the available list of devices.

Priming Volume
Allows technician to change the volume used for priming.

Press + to Navigate to NEXT Page
The new reagents blank is the ZERO intercept or offset. A user entry here will affect the zero calibration value of the calibration parameters.

Set NEW reagents BLANK
Allows the operator to set the BLANK value for the NEW reagents.This value is usually supplied with the new batch of reagents and its value may vary between 0 to -10. Default value is -1.0. PLEASE NOTE THE (-) SIGN.

Diagnostics Menu

Pumps and Stirrer
Allows technician to selectively check the functionality of the pumps and stirrer.

Inputs Status
Allows technician to check the status of the external inputs. Once a function has been assigned to a digital input, it disappears from the next menu of available functions for the next input.

External Control
The analyzer can be directed to initiate an analysis or calibration cycle or change operating mode under the command of an external controller using the digital input lines. A command on the digital input is represented by a contact closure (as the programmed EVENT) that occurs for more than 1 second. A new command received supersedes the previous command; in essence it will interrupt the previous command to execute the new command.

- Analyze once
- RUN/STOP
- Calibrate
- Validate (the source is defined in the validation menu)
- Not assigned

Validate Grab Sample
This function is the same as 'analyze once' except that the result data does not get sent to the analog output (4-20 mA), it is reported on the screen and the serial outputs.

Relays
Allows technician to selectively check the functionality of the four relays. The relay status is shown next to the selected relay. Pressing the ENTER key toggles the state of the relay. The relay initial status will be updated upon leaving this diagnostics menu.

Analog Output
Allows technician to selectively check the two analog outputs. Previous analog output setting will be updated upon leaving this diagnostics menu.

LED and Detector Control
Allows the technician to check the functionality of the optics system and its individual components. Also allows adjusting the detector preamp gain for the selected LED. Any new setting of the gain or of the intensity of the LED will override any previous optics calibration setting.

CONSULT FACTORY before overriding any setting.

This diagnostics menu allows direct reading of the mV level detected at the preamp and it shows the corresponding absorbance calculated. The internal electronics enclosure temperature and the reaction cell temperature are also displayed for reference.

Default and Lost or Forgotten Passwords

The default passwords are as follows:
Technician - 123***
User 1 - 111111 (6 ones)
User 6 - 666666 (6 sixes)

If a user password is forgotten, the technician can delete the user and then add the user back.

If the technician password is forgotten, call customer support: 1.800.225.1480.

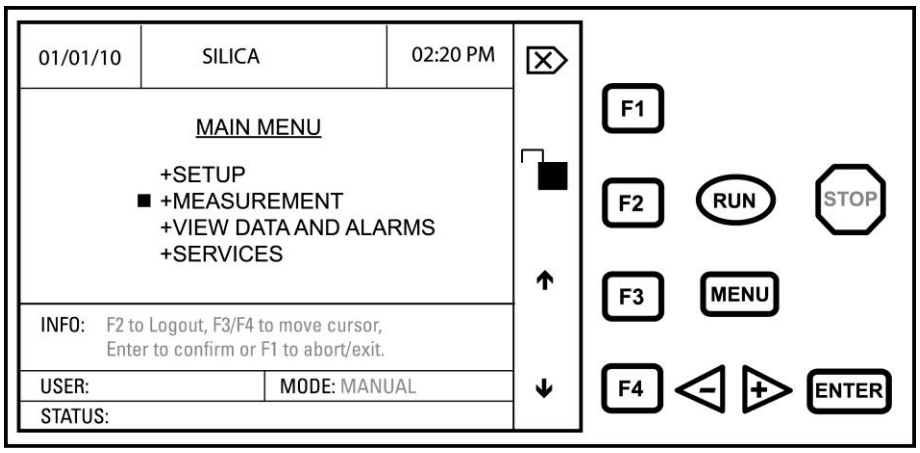


Figure 11: UNLOCK keypad

User Interface Tree

Menu			
Setup	**Measurement**	**View Data & Alarms**	**Services**
(+) Page 1	Analyze Once	Review / Reset Alarms	System Administration
Alarms	Calibrate	Review Calibration Results	Hardware Setup
Relays-Mapping	Validate	Review Analysis Results	Prime Fluidics
Analog Outputs	Clean	Delete All Calibration Results	Diagnostics
Inputs		Delete All Analysis Results	
Display Parameters			
Temperature Units			
(+) Page 2			
Analysis Parameters			
Validation Parameters			
Cleaner Parameters			
Calibration Parameters			
Method			
(+) Page 3			
Date & Time			
Daylight Saving			
Recovery After Power Failure			
Ethernet Parameters			
RS232 Parameters			
Language			

(+) Press + sign to go to next page

Menu			
Measurement	**View Data & Alarms**	**Services**	
Analyze Once	**Review / Reset Alarms**	**System Administration**	
Press Enter	Reset All Alarms Reset All Faults	Edit User	User name and Password
Calibrate	**Review Calibration Results**	Delete User	User Name X
Calibrate Standards	Display	Add User	Name, Password, Permission
Validate	Print	Factory Settings	Restore, Update, Edit **
Press Enter	Data Range Selection	Instrument Details	Software Version, Model and Serial Number
Clean	**Review Analysis Results**	Unit Label Change	
Press Enter	Display	Printing Options	Print System Configuration
	View Graph		Print Analysis Parameters
	Print		Print Method Parameters
	Data Range Selection		Print Cleaner Parameters
	Delete All Calibration Results		Online Print : Enable/Disable
	Delete All Analysis Results	**Hardware Setup**	
		Calibrate Thermistor **	
		Calibrate Pumps	Pump 1, 2, 3, 4
		Calibrate Optics	
		Calibrate Analog Outputs **	
		Edit Calibrated Values	
		Prime Fluidics	
		Auto Prime All	
		Prime Standard	
		Prime Reagent (1, 2, 3)	
		Prime Sample	
		Priming Volume (+/-)	
		Press (+) to go to page 2	New Reagents Blank
		Diagnostics	
		Pumps and Stirrer	
		Inputs Status	
		Relays	
		Analog Outputs	
		LED & Detector Control	** Consult Factory first

Menu				
Setup				
(+) Page 1		**(+) Page 2**		**(+) Page 3**
Alarms		**Analysis Parameters**		**Date & Time**
Display All		+ Page 1	(+) Page 2	**Daylight Saving**
Alarm 1 thru 7	Type, value, Hysterisis	Restart Mode	Post Wash Event	**Recovery after Power Failure**
Relays-Mapping		Measuring Frequency	Post Wash Cycles	Power Fail Duration
Analog Outputs		Measuring Units	Source, Volume, Stir Time	Power Fail Clean Cycle
Analog Output 1, 2	Type, Low, High	Ion Label		**Ethernet Parameters**
Inputs		No of Repeats	(+) Page 3 and (+) Page 4	IP Address
Level Sensors	Sensor 1 – 5	Stability Criteria	Dilution Parameters	Server IP
External Inputs	Input 1, 2	**Validation Parameters**		**RS232 Parameters**
Display Parameters		Validation Source		Baud Rate
Contrast		No of Repeats		**Language**
Back Light On time		**Cleaner Parameters**		
Display Help		Cleaner Source		
Display Info		Volume to Add		
Result Decimal Point		Clean Flow Rate		
Large Font Screen		Stir Time		
Temperature Units		Frequency		
Fahrenheit, Celsius		**Calibration Parameters**		
		Standard		
		Mode		
		Frequency		
		Slope		
		Intercept		
		Calibration Repeat Tolerance		
		Method		
		Cell Wash Volume		
		Reaction Cell Control		
		Reaction Cell Temperature		
		Wavelength		
		Blank Measurement	(+) Page 2	
			Reagent 1-3 and Stir Time	
			(+) Page 3	
			Cell Wash Flow rate	
			Reagent 1-3 flow rate	

(+) Press + sign to go to next page

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SECTION 8 Terms Definition

Terms	Description	Possible Values, Options
ALARM		
Type	Assigning a fault type to the alarm.	Low Limit, High Limit, Fluidics Fault, General Fault, not Assigned
Value	Boundary value for triggering an alarm, only for low limit and high limit type.	0 to XXXXX (XXXXX Value depends on precision selected in Setup ➔ Display parameters ➔ result Decimal Point)
Hysteresis	Value gap or difference before an event change.	0 to XXXXX (XXXXX Value depends on precision selected in Setup ➔ Display parameters ➔ result Decimal Point
RELAY	Up to FOUR spare relays available.	
MODE	Allows fault ON or OFF operation.	Normal or Fail Safe
ANALOG OUTPUT		
Type	Normal or reverse acting.	0 to 20, 4–20, 20-0 or 20–4
Low	Low concentration value.	
High	High concentration value.	
EXTERNAL INPUT		
Label	User programmable label.	
Event	Dry contact event.	Close/Open or Open/Close
Action	Selected function.	Analyze Once, Run/Stop, Calibrate, Validate, Not assigned
DISPLAY PARAMETERS		
Contrast	To adjust the display contrast.	120 to 200
Back Light On-Time	Screen saver time duration for backlight of display.	0 to 255 minutes, 0 for Continuously On

Terms	Description	Possible Values, Options
Display Help	Help message for the user to navigate between the menus.	Enabled, Disabled
Display Info	Message showing the status of the current cycle performing.	Enabled, Disabled
Results Decimal Point	Selectable precision to show the analysis result.	XXXX.X, XXX.XX, XX.XXX, X.XXX, XXXXX, Auto
Large Fonts Screen	To display the result with large fonts.	Enabled, Disabled
CALIBRATION PARAMETERS		
Standard	The concentration of the standard used for calibration.	0 to XXXXX (XXXXX Value depends on precision selected in Setup ➔ Display parameters ➔ result Decimal Point
Mode	Mode represents the calibration type.	Single-Point, Base-Line
Frequency	The time duration between two calibration cycles.	Every 6Hr, 12Hr, 24Hr, Sun, Mon, Tue, wed, Thu, Fri, Sat, Manual and Editable 0Hr to 99.99Hr
Start Time	Calibrations start time, except for manual and editable frequency.	Depends on Time format in Setup ➔ Time Menu
Slope	The CURRENT Slope value represents the coefficient that is multiplied by the absorbance to calculate the concentration of the sample +/- Intercept value.	
Intercept	Reference and current numbers based on the base line calibration cycle.	Default value of -1
Calibration Tolerance	Repeat tolerance tested during auto calibration cycles to accept or reject automatic calibrations.	Default value of +/- 5%
VALIDATION PARAMETERS		
Validation Source	Fluid source for validation.	Sample, Standard, Grab Sample, Not Assigned
Number of Repeats	Number of times that the validation is to be performed.	0 to 8
ANALYSIS PARAMETERS		
Mode	Instrument RESTART mode.	Auto Restart, Manual Restart
Measuring Frequency	In the RUN mode, the frequency is the time duration between two analysis cycles.	15, 30, 45 minutes, 1 hr, 0.20 hr are selectable and editable minutes range 00.00 to 99.99Hr
Measuring Units	Units for the analyzed sample.	Six characters long. Alphabets, numerals and special symbols are allowed.
Analysis Label		Six characters long. Alphabets, Numerals and +, - are allowed.
Cell Wash Flow Rate	The rate at which the sample is pumped to wash the cell.	Depends on the inner diameter of the pump tubing. It is derived from the calibration of pumps.

Terms	Description	Possible Values, Options
Reagent 1–3 Flow Rate	The rate at which the reagent is pumped to wash the cell.	Depends on the inner diameter of the pump tubing. It is derived from the calibration of pumps.
Stability Criteria	Defines the stability level of the data before accepting it. The stability criteria is a measure of stability of the absorbance level rate of 0.001 AU per sec as specified by the number 1 thru 10.	1 thru 10.
Post Wash Event	Washing the cell after completion of the event selected with the following source, volume and stir time.	Analysis, Calibration, Validation, Not Assigned.
Post Wash Cycle Source	Fluid for post washing the reaction cell.	Sample, Reagent, Cleaner, Standard
Post Wash Cycle Volume	The amount of fluid pumped for post washing.	-99.9 to +99.9 mL
Post Wash Cycle Stir Time	The amount of time the fluid is stirred for post washing the cell.	0 to 999 seconds
CLEANER PARAMETERS		
Cleaner Source	Fluid for cleaning the cell.	Sample, Reagent, Cleaner, Standard, Not Assigned
Volume to add	The amount pumped for cleaning.	0 to 255 mL
Clean Flow Rate	The rate at which the cleaner source is pumped to clean the cell.	Depends on the inner diameter of the pump tubing. It is derived from the calibration of pumps.
Stir Time	The amount of time the fluid is stirred for cleaning the cell.	0 to 999 seconds
Frequency	The time duration between two cleaning cycles.	Manual, Daily, Weekly, Monthly
Start Day/Date	For weekly cleaning the day of cleaning. For monthly cleaning the date of cleaning.	Day - Week days Date - Current month dates (1 to 31)
Start Time	The time to start the cleaning on the day or date selected.	00:00 hr to 23:59 hr
TEMPERATURE UNITS		
Units	Units of temperature.	Celsius, Fahrenheit
METHOD PARAMETERS		
Cell Wash Volume	The amount of sample pumped to wash the cell.	1 to 100 mL
Reaction Temperature Control	PID temperature control.	Enable, Disable
Reaction Temperature	The temperature set point.	0 to 60
Wavelength	The LED wavelength.	NIR3 810 nm
Blank Measurement	Allows the blank measurement in the analysis cycle.	Disable, Before Reagent1, Reagent2, Before Reagent3
Reagent Volume	The amount of reagent pumped in to the cell.	0 to 6.00 mL

Terms	Description	Possible Values, Options
Stir Time	The amount of time the fluid is stirred after pumping the reagent.	0 to 999 seconds
DATE		
Format	Selectable date format.	MM/DD/YY, YY/MM/DD, DD/MM/YY
Current Date	Present date, validated depending on the format.	Legible date
TIME		
Current Time	Present time.	Legible time depending on time format
Format	Selectable time format.	12 hr, 24 hr
RECOVERY AFTER POWER FAILURE		
Power Fail Duration	Recovery duration after power fail.	0 to 99.99 hr
Power Fail Clean Cycle	Performing clean cycle after recovering from power fail.	Enable, Disable
ETHERNET PARAMETERS		
IP Address	Instrument IP address.	Editable
Server IP		
Network ID		
RS-232 PARAMETERS		
Baud Rate	The rate at which the data is transferred through serial port.	115200 (default)
LANGUAGE		
Language	Language in the instrument.	English, other languages, consult factory
REVIEW / RESET ALARMS		
Reset All Alarms?	Resets all the raised alarms, which are shown below this option.	Reset All Alarms?
Reset All Faults?	Resets all the faults, which are shown below this option.	None
REVIEW CALIBRATION RESULTS		
Display	Displays the calibration results for the selected data range.	None
Print	Prints the Calibration results on to the PC for the selected data range.	None
Data Range	The time interval in which the calibration results are to be retrieved.	Last 12 hr, 1 Day, 2 Days, 3 Days, 1 Week, 2 Weeks, 3 weeks and All
REVIEW ANALYSIS RESULTS		
Display	Displays the analysis results for the selected data range.	None
View Graphs	Displays the Linear graph for the selected data range of Analysis records.	None
Print	Prints the analysis results on to the PC for the selected data range.	None
Data Range	The time interval in which the analysis results are to be retrieved.	Last 12 hr, 1 Day, 2 Days, 3 Days, 1 Week, 2 Weeks, 3 weeks and All

Terms	Description	Possible Values, Options
DELETE ALL CALIBRATION RESULTS	Deletes the entire calibration results database.	None
DELETE ALL ANALYSIS RESULTS	Deletes the entire analysis results database.	None
EDIT USER		
User Name	Change the user.	6 users and one technician are allowed
Password	Change the password of current user.	Six characters long A–Z, 0–9, * and space are allowed
Measure Permission	Change the measurement permission for the current user.	Enabled, Disabled
Calibrate Permission	Change the calibration permission for the current user.	Enabled, Disabled
Validate Permission	Change the validation permission for the current user.	Enabled, Disabled
DELETE USER		
User Name	Delete the current user displayed opposite this field.	All users can be deleted except technician
ADD USER		
User Name	Add a new user to the users list.	User name is 6 characters long and only 6 users are allowed
Password	Password of the new user entered.	6 characters long A–Z, 0–9 * and space are allowed
Measure Permission	Measurement permission for the new user.	Enabled, Disabled
Calibrate Permission	Calibration permission for the new user.	Enabled, Disabled
Validate Permission	Validation permission for the new user.	Enabled, Disabled
Factory Settings	Select this option to enter into factory setup.	None
INSTRUMENT DETAILS		
Software Version	The current running software version of the instrument.	None
Model Number	Model number of the instrument.	None
Serial Number	Serial number of the instrument.	None
UNIT LABEL CHANGE		
Label Name	Change the title of the instrument	Maximum 9 characters A–Z, 0–9, / , - , and space are allowed
PRINTING OPTIONS		
Print System Configuration	Prints all the system parameters.	None
Print Analysis Parameters	Prints only the analysis parameters.	None
Print Method Parameters	Prints only the method parameters.	None
Print Clean Parameters	Prints only the clean parameters.	None

Terms	Description	Possible Values, Options
Online Print	Prints the date, time and concentration after each analysis cycle.	Enabled, Disabled
EDIT CALIBRATED VALUES		
Pump1, Pump2, Pump3, Pump4	To change the flow rate of the pumps after their calibration.	0.10 to 60.00 mL
Optics Dark	The level detected as dark light level.	0 to 300 mV
Optics Xref	The level used as reference potential for light energy level.	0 to 2400.00 mV
PRIME FLUIDICS		
Priming Volume	The volume of the fluid selected for priming.	0 to 99.9 mL
PUMPS & STIRRER		
Pump1, Pump2, Pump3, Pump4	To check the functionality of pumps.	ON, OFF
Stirrer	To check the functionality of stirrer.	ON, OFF
RELAYS		
Relay1, Relay2, Relay3, Relay4	To check the functionality of relays.	ON, OFF
ANALOG OUTPUTS		
Channel1, Channel2	To test the functionality of analog outputs for different selectable currents.	0 mA, 4 mA, 10 mA, 12 mA, 20 mA
LED & ADC		
Select LED	To test the functionality of LED.	NIRx 810, None
Intensity	Intensity of the LED.	0% to 100%
Optics Amplifier Gain	Changing the gain of the amplifier.	0 to 255

9

SECTION 9

Maintenance Schedule

Maintenance Schedule Frequency	Conduct regular maintenance to ensure the analyzer performs properly.
Every week	Inspect in / out tubes, reagent bottle, and all tubes for fouling.
Every month	Inspect tubing and ensure that it is not blocked.
Every 6 months	Replace reagents if necessary.
Every 12 months	Replace Pump tubing. Use factory supplied maintenance kit. Inspect for any fouling of the reaction cell.

Changing Reagents

CAUTION	**Wear gloves or protective equipment your site may require when changing reagents .** Press the **STOP** key. Press the **MENU** key. Remove the cap from each bottle and change them over one by one. Do NOT re-use or re-fill old or existing bottles. Dispose of the used bottles and contents safely and according to local regulations. Tighten bottle caps and route the tubing properly making sure that it does not get pinched when placing the bottle in the enclosure. Press **MENU** key and select: SERVICES ➔ PRIME FLUIDICS ➔ AUTO PRIME Repeat AUTO PRIME if you notice air bubbles in the tubing. Each reagents kit comes with a REAGENT BLANK value. After changing the reagent you must enter the new value.

	Press (+) to go to next page and **ENTER** the value of the reagent blank offset which is detailed on the form that comes with the new reagents kit.

NOTE:	The reagent blank value has a (-) sign to it. **Default value** is -1.0

Installing Tubing Maintenance Kit

Changing the Instrument Tubing

It is recommended that the pump head tubing be replaced twice a year at a minimum, or as needed.

The six month maintenance kit (2230XPMK) contains completely assembled tubing sets.

To change the tubing proceed as follows: Press the STOP key.

To minimize contact with the reagents, it is highly recommended that you empty out the contents of the tubing using the PRIME back method as described below:

Press MENU and scroll down to SERVICES and then select PRIME FLUIDICS and then set the PRIMING VOLUME to - 5 mL. This step allows the user to pump back the reagents contents of the connecting tubing, including the peristaltic pump tubing.

Scroll up to each of the reagents and press ENTER to pump back the selected reagent fluid into its container. Repeat for each reagent (1, 2, 3 & 4).

Disconnect the tubing. Replace one a time to reduce the risk of errors in connection.

Replace the pump tubing as described in *Plumbing Connections Section*.

Replace with identical tubing from the maintenance kit by reversing the procedure. Apply silicone lubricant (supplied with the kit) to the pump rollers before re-installing the tubing.

NOTE:	**PRIME FLUIDICS** menu the (-) sign for the priming volume will be reset to (+) upon next menu entry.

SAMPLE/STANDARD
PUMP (larger tubing OD)

Reagents 1, 2 and 3 Pumps
(smaller tubing OD, all the same)

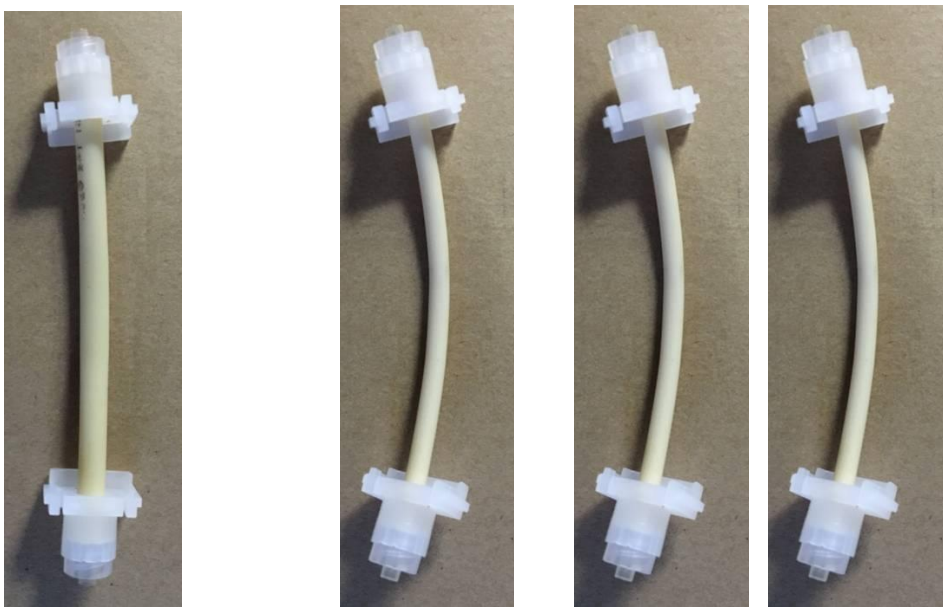
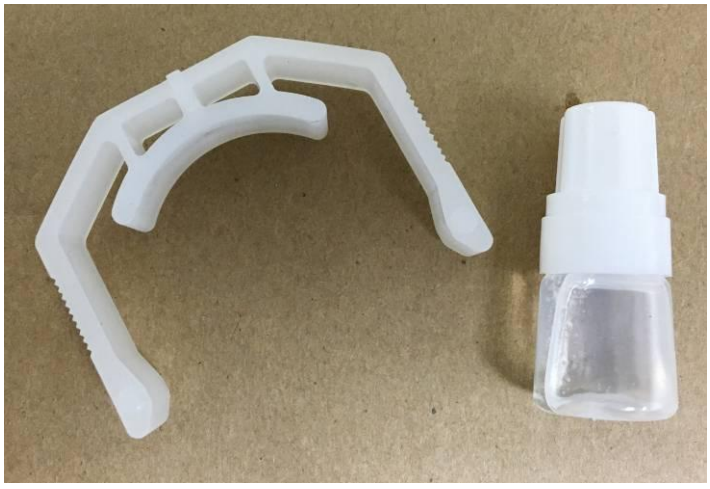


Figure 12: Maintenance kit assembly detail

Always use 2 drops of Silicone Oil on the platen before replacing on pump



Cleaning the Reaction Cell

Noisy or unstable readings may be caused by debris floating in the reaction cell or from deposits on the optical windows inside the reaction cell. Check the reaction cell and clean as needed. Make sure that the stir bar is clean and moving freely, all tubing is secured and in good condition.

CAUTION	**Always Wear Protective equipment** Press STOP →MENU →MEASUREMENT→ CLEAN (flush the reaction cell with sample) Press STOP →MENU → SERVICES → PRIME FLUIDICS Set PRIME VOLUME to – 5.0 ml and PRIME SAMPLE (note negative sign, this will empty out the cell). Remove reaction cell cap and deposit cleaning solution into the reaction cell, you can use a 10 ml syringe filled with 1N NaOH/EDTA mix (see preparation recipe A1 and A2) to fill the cell with cleaning solution and let it soak for about ½ hour. For a more thorough cleaning, swing the reaction cell down as shown in photos below and use a non-fiber swab with a bent tip, reach inside the reaction cell and wipe the side optical windows of the cell and the inner surfaces to dislodge and remove any deposits. Cleaning of the reaction cell should be performed monthly or as needed to remove any debris or deposits that may be created by the reacted solution or caused by the process sample. Deposits on the optical windows increase the surface tension attracting small air bubbles generated from the chemical reaction. Note that if the Analyzer is set for Auto-Restart you do NOT have to wait after leaving the cleaning solution in the reaction cell, the Analyzer will automatically start running after ½ hour. You may repeat the cleaning procedure as needed.

NOTE:	The reaction cell assembly can swing down to allow better access. Undo both thumb screws and swing down.

Preparing the Cleaning solution

Recipe A1 Cleaning Solution (for normal Cleaning Operation)

To prepare 1 liter of cleaning solution:

1. Dissolve 5 g of analytical grade sodium hydroxide pellets, NaOH, in approximately 600 ml of high purity water in a plastic container. Allow the solution to cool to ambient temperature.

2. Add to the solution 1 g analytical grade di-sodium EDTA and stir to dissolve.

3. Transfer the solution to a 1 liter measuring cylinder and make to the mark with more high purity water.

Mix well and store in a tightly sealed plastic bottle.

Recipe A2 Extra Strength Cleaning Solution (for troubleshooting and more intense Cleaning)

To prepare 1 liter of extra strength cleaning solution:

1. Dissolve 50 g of analytical grade sodium hydroxide pellets, NaOH, in approximately 600 ml of high purity water in a plastic container. Allow the solution to cool to ambient temperature.

2. Add to the solution 5 g analytical grade di-sodium EDTA and stir to dissolve.

3. Transfer the solution to a 1 liter measuring cylinder and make to the mark with more high purity water.

Mix well and store in a tightly sealed plastic bottle.

Cleaning the Sample Flow Chamber

It is recommended that you inspect the sample flow chamber at least once a year to check for any flow blockage, and to inspect the operation of the float level sensor. The sample chamber is located on the right lower corner of the fluidics enclosure.

The chamber can be removed for service and clean up.

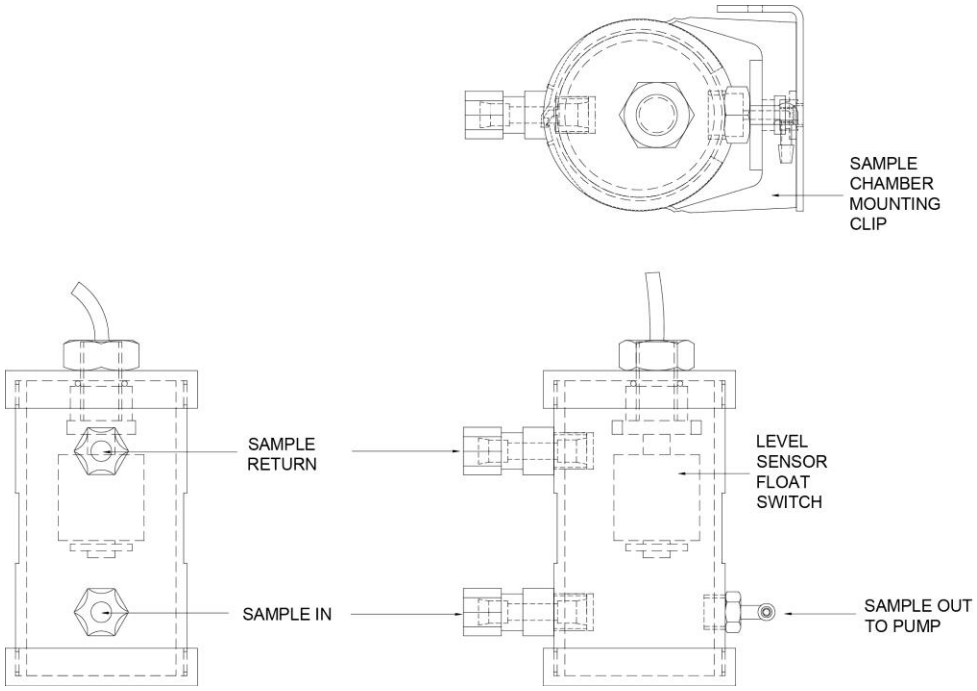


Figure 13: Sample chamber detail

Stand-By Mode and Extended Shutdown

To put the System in Stand-by mode, make sure to press the STOP key and check the DISPLAY field next to F4 to show MANUAL RESTART. If AUTO RESTART is selected, you need to set the mode to Manual:

MENU ➔ SETUP ➔ + ANALYSIS PARAMETERS ➔ MODE

The system will switch to Stand-By after 60 minutes of no keypad activity. In Stand-By, the analyzer will rotate the pumps periodically to avoid pinched tubing from sealing.

Extended Shutdown

To avoid clogging, flush the entire system with distilled water before shutdown. Disconnect and empty out the reagents bottles and flush the lines using FLUIDICS PRIME menu. Release the pressure on the peristaltic pump tubing.

Use the table below to diagnose and correct analyzer problems.

Table 3: Error messages

Messages	Cause	Solution
Login as Technician or Operator	User has not logged in, and trying to access restricted operations.	User has to login either as a Technician or Operator to access the restricted operations.
	User is logged in, but does not have adequate privileges to access the restricted operations.	User is not authorized to access the restricted operations.
Password mismatch, Enter to continue	Incorrect password has been entered.	Press “Enter” to cancel the wrong entry and enable re-entry of correct password. If password is lost consult factory for backdoor access code.
Measurement is in progress	Trying to perform measurement when it is already under way.	Wait for measurement to complete.
User programmable measuring frequency	Editing option of analysis frequency is selected.	Edit the analysis frequency.
User programmable calibration frequency	If same type of solution is assigned to two or more inputs.	Edit the calibration frequency.
Two or more inputs are of same type	If same type of solution is assigned to two or more input.	Reassign solution to inputs.
Error in date, press F1 to continue	Date entered is invalid.	Press F1 and re-enter valid date.
Error in hours, press F1 to continue	Hours entered is invalid.	Press F1 and re-enter valid hours.
More than 6 users are not allowed, delete a user to add further	Technician trying to add more than 6 users.	More than 6 users are not permitted at any time. To add a new user after 6, delete an existing user.
No records to delete.	User is trying to delete Calibration/Analysis records, when there are no records stored.	None.
Are you sure you want to delete all analysis results?	All analysis results? User is trying to delete all analysis records. (At least one analysis record is available in the database.)	None. Deleted records are not recoverable.
Are you sure you want to delete all calibration results?	User is trying to delete all calibration records. (At least one calibration record is available in the database.)	None. Deleted records are not recoverable.
No records to display	User is trying to display records, and no records are available in the selected data range.	None.

Messages	Cause	Solution
No records to print	User is trying to print records, and no records are available in the selected data range.	None.
Only one record to display	User is trying to view graph when only one analysis record is available in the database.	None.
Problem with memory allocation. Insufficient memory in the system or system is busy.	Do not try to repeatedly view the graph.	Try again after some duration or after performing one more measurement cycle.

Measurement/Calibration/Validation Messages

Messages	Cause	Solution
Reagent1 empty	Performing Analysis/ Calibration/ Validation with two or three Reagents and Reagent1 is exhausted.	Fill the empty Reagent1 bottle with Reagent1.
Reagent2 empty	Performing Analysis/ Calibration/ Validation with two or three Reagents and Reagent2 is exhausted.	Fill the empty Reagent2 bottle with Reagent2.
Reagent3 empty	Performing Analysis/ Calibration/ Validation with two or three Reagents and Reagent3 is exhausted.	Fill the empty reagent3 bottle with Reagent3.
Reagent1, Reagent2 are empty	Performing Analysis/ Calibration/ Validation with two or three Reagents and Reagent1 & 2 are exhausted.	Fill the empty Reagent1 & 2 bottles with Reagent1 & 2.
Standard empty	Performing single point or baseline calibration and the Standard is exhausted.	Fill the empty standard bottle with standard.
Low standard empty	Performing two-point calibration and the Low Standard is exhausted.	Fill the empty Low-Standard bottle with Low-Standard.
Hi standard empty	Performing two-point calibration and the Hi Standard is exhausted.	Fill the empty Hi-Standard bottle with Hi-Standard.
Two standards are empty	Performing two-point calibration and both standards are exhausted.	Fill the empty standard bottles with their respective standards.
Sample empty	Performing analysis with single sample and sample chamber is empty.	Check for Sample flow. Check for pipe blockages to sample chamber.
Testing optics, please check for optics failure	No light output from optics.	Run a Clean Cycle and try again. Inspect cell and clean, check for light detection under LED & DETECTOR CONTROL in Diagnostics menu.
Testing optics, low signal level . . . Cell may be coated and may require cleaning.	Low light output from Optics. Optical window of cell may be coated.	Run a Clean Cycle and try to clean the reaction cell with detergent.

Measurement/Calibration/Validation Messages		
Messages	**Cause**	**Solution**
Testing optics please check for stray light	External light is entering the cell.	Check if overflow cap on top of the reaction cell is loose.
Please check for heater failure	If heater is enabled in Method, and the Set point temperature is higher than ambient and Cell temperature differs from set point by ± 10ºC for 90 secs..	Try a different set point temperature. Call a service agent.
Checking the reaction temperature. Temperature below set point.	If the temperature is not able to reach the set point and is below the set point.	Re-calibrate the Thermistor. Try a different set point temperature. Call a service agent.
Checking the reaction temperature. Temperature above set point.	If the temperature is not able to reach the set point and is above the set point.	Re-calibrate the Thermistor. Try a different set point temperature. Call a service agent.
Taking blank measurement, unstable signal.	Unstable temperature, Cell may be coated, or may be due to Optics failure.	Perform Clean Cycle and Calibrate Optics and thermistor.
Collecting data, unstable signal	Unstable temperature or cell may be coated, or may be due to optics failure.	Perform Clean Cycle and calibrate optics and thermistor.

Calibrating Optics Messages		
Messages	**Cause**	**Solution**
Unstable signal, stray light is high please check.	Some external Light is entering in to the cell.	Check for possible external light entering areas on the reaction cell.
Optimum light level. Calibration is aborted.	Cell may be coated.	Perform Clean Cycle and then Calibrate Optics.

Calibrating Thermistor Messages		
Messages	**Cause**	**Solution**
Temperature below set point please check for hardware malfunction.	May be due to the connectors or the thermistor or heater malfunctioning.	Check for thermistor and heater connections, and calibrate them.
Temperature above set point please check for hardware malfunction.	May be due to the connectors or the thermistor or heater malfunctioning.	Check for thermistor and heater connections, and calibrate them.
Measured temperature differs widely from set temperature. Please check for hardware malfunction.	May be due to the connectors or the thermistor or heater malfunctioning.	Check for thermistor and heater connections, and calibrate if necessary.

Parts and Accessories

Catalog Number	Description
Maintenance and Service Items	
2230XPMK	Maintenance Kit for 2230XP
2230PA	Pump Head Tubing Covers (3 each)
2230PS	Power Supply Assy
2230FS	Power Fuses
2230PI	Air Purge Fittings
2230XPTK	Main Tubing Kit for 2230XP
2230BC	Empty Auto Cal Btl (Validation Sample Bottle)
2230SF	Fittings, Sample In, Sample Out and Drain
2230RC	Reagent Bottle Cap - includes fittings
2230SC	Standard Bottle Cap - includes fittings
Reagents and Standards	
2230RE	Reagents
223020	200 ppb Calibration Standard
223002	20 ppb Calibration Standard
223010	100 ppb Calibration Standard
223030	1000 ppb Calibration Standard

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SECTION 10

Standby and On-Demand Modes

Overview

As the power market has shifted from coal to gas plants, so have the power plant needs changed from base load to peaker plant operations. This shift has caused a need for analyzers to work from a continuous mode to an on-demand mode. Thermo Scientific identified this requirement as an enhancement feature and has introduced this into the new Orion 2230 Silica Analyzer.

The Orion 2230 is equipped with two modes of operations:

1- **AUTO RESTART** mode (default)
2- **MANUAL** mode

The mode of operation may be selected by the user by pressing the MENU key:

SET UP ➔ + (pg2) ➔ ANALYSIS PARAMETERS ➔ MODE

AUTO RESTART allows automatic restart of the sample measurement mode (same as pressing the RUN key) after 30 minutes wait/idle time. The unit will resume running analyses per the selected frequency (default 15 min).

In MANUAL mode, the system will wait for the operator command via keypad (RUN key) or external control to start/resume analyses per the selected measurement frequency. If no command is received, the system will switch to stand-by after 1 hour wait/idle time.

During automatic analysis, if the system detects a SAMPLE LOSS for more than one hour, it will switch to stand-by house-keeping. When the sample recovers, it will switch back to RUN mode after waiting for 1 minute to allow for fresh sample to flush the sample chamber.

STAND-BY: In stand-by the system will execute periodic house-keeping routines.

Every one hour, the fluids in reagents 1, 2, 3, standard and sample lines are moved back and forth. Every 6 hours, the system primes all the reagents lines with 1 mL each and then flushes the reaction cell with either 2.5 mL of standard or if sample is present, the system executes a clean cycle.

Fluids consumption while unit is left in Stand-by:

- 4 mL of each reagent per day
- 10 mL of standard** per day (with no sample). If sample is present, the system will run four clean cycles per day and will not consume any standard.

** Note that in stand-by mode, the standard is used only to flush the cell. Distilled water may be substituted instead of silica standard, or a time to refill the standard bottle if unit is kept in stand-by.

 CAUTION	**Make sure reagents and standard bottles have enough fluids to maintain wet lines when the analyzer is kept in stand-by.**

OPTIONAL MENU setting:
(Please consult factory before modifying default setup).

In Rev 3.46, an additional sub-menu selection for the Stand-by cleaner solution is provided. To access, press:

MENU ➔ SETUP ➔ + (pg 2) ➔ CLEANER PARAMETERS ➔ + (pg 2)

STDBY CLEANER SOURCE : SMP/STD (default)

STDBY CLEANER SOURCE	**SMP/STD:** (default) When selected, the system will use sample if present or in case of sample loss will revert to standard for the periodic flushing of the reaction cell. **SAMPLE:** The system will use sample only. In case of NO sample (sample loss) or sensor not assigned the daily priming and flush of the cell is NOT executed. The system will force a PRIME ALL sequence when analysis is resumed.

	STANDARD: System uses only the standard for flushing the cell in stand-by.

Factory Setup Recommendations When Operating In “ON-DEMAND” Mode

If the system is to be used “ON-DEMAND”, it is highly recommended to keep it powered and to keep sample flowing to eliminate algae growth in the lines over extended time. It is best to control the analyzer operation either directly via the keypad (RUN / STOP) keys or using a remote ON/OFF external control switch for controlling the analyzer.

The following describes how to setup the analyzer.

1 - Select the MANUAL mode: the analyzer will switch to stand-by after one hour of inactivity (after receiving the STOP command).

MENU ➔ SETUP ➔ + (pg 2) ➔ ANALYSIS PARAMETERS ➔ MODE

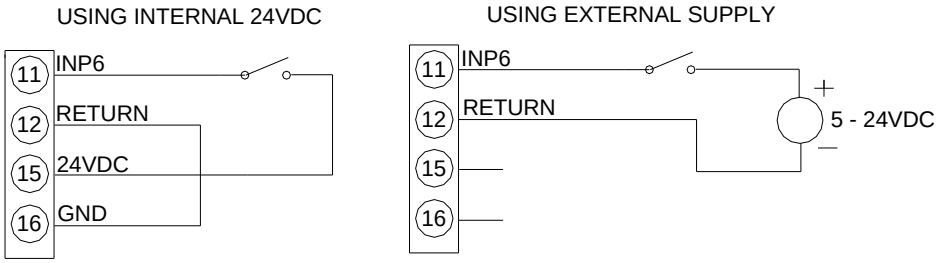
Select MANUAL mode.

2 - Program external control input 6:

MENU ➔ SETUP ➔ INPUTS ➔ EXTERNAL INPUTS ➔ INPUT 6

Press the down key to select ACTION: RUN / STOP

Refer to Manual *Inputs Signal Connections Section* for additional wiring details.



By using the ON/OFF external remote control switch the operator can turn ON analysis (RUN) when switch is flipped ON (closed contact) and stop analysis (STOP) with switch in the OFF position. When stopped, the unit will switch automatically to stand-by after one hour. In stand-by mode, the system will execute the necessary house-keeping to maintain a ready state.

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SECTION 11

Customer Services

Notice of Compliance

This analyzer may radiate radio frequency energy and may cause interference to radio communications if not installed and used properly in strict accordance with the manufacturer's instructions. This analyzer has been tested and found to comply with the limits for a Class A digital device pursuant to Subpart B of Part 15 of FCC Rules, which are designed to provide reasonable protection against such interference in a commercial environment. Operation of the analyzer in a residential area may cause interference, in which case the user, at his own expense, will be required to take whatever measures may be required to correct the interference.

This Class A digital apparatus complies with Canadian ICES-003. Cet appareil numérique de la classe A est conforme à la norme NMB-003 du Canada.

The Thermo Scientific Orion 2230XP Silica analyzer is CE and cTUVus certified, which includes testing to EMC and US and Canadian standards.

Warranty Information

Thermo Fisher Scientific warrants to the original purchaser of any new merchandise that all items will be free of defects in material and workmanship for the periods set forth below, when used under specified and normal operating conditions, in accordance with the operating limitation and procedures given in the instruction manuals, and when not subjected to accident, alteration, abuse or misuse of Thermo Fisher Scientific's products in unspecified applications, for unauthorized procedures, or with third-party products may void the warranty.

Thermo Scientific's instrument are warranted as follows:
All parts in contact with the sample for a period of ninety (90) days from the date of installation. Sample must be chemically compatible with parts ordered with the product. If parts are not compatible or if a question exists regarding compatibility, notify the factory before placing the product in service to maintain the warranty.

Parts not in contact with sample for a period of one (1) year from the date of shipment.

Peristaltic pump tubing for a period of thirty (30) days under normal operation.

The following user-serviceable parts are not warranted: Probes, O-rings.

THE WARRANTIES DESCRIBED ABOVE ARE EXCLUSIVE AND IN LIEU OF ALL OTHER WARRANTIES WHETHER STATUTORY, EXPRESSED OR IMPLIED. ALL OTHER WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE, AND ALL OTHER WARRANTIES ARISING FROM COURSE OF DEALING OR USAGE OF TRADE, EXCEPT TITLE, ARE HEREBY OVERRIDDEN AND EXCLUDED. NO LIABILITY SHALL ATTACH TO THERMO SCIENTIFIC EITHER IN CONTRACT OR IN TORT, FOR ANY PERSONAL INJURY, DEATH, DAMAGE TO PROPERTY, LOSS OF PROFITS, DAMAGES, COSTS, CHARGES, LIABILITIES OR EXPENSES, WHETHER DIRECT OR INDIRECT, CONSEQUENTIAL OR OTHERWISE, WHICH ARISE OUT OF OR IN CONJUNCTION WITH THE SALE OR USE OF THIS PRODUCT.

The customer's sole and exclusive remedy is the return of defective components or subassemblies to Thermo Fisher Scientific for repair or replacement or, at Thermo Fisher Scientific's option, refund of the purchase price.

For the most current warranty information, visit www.thermoscientific.com/water.

Warranty Shipments/ Returns/Adjustments

A warranty claim must be made promptly and must be received during the applicable warranty period by Thermo Fisher Scientific or your authorized Thermo Fisher Scientific distributor.

If it becomes necessary to return a product for repair and/or adjustment, prior authorization from Thermo Fisher Scientific or your Thermo Fisher Scientific- authorized distributor must be obtained. Instructions as to how and where these products should be shipped will be provided by Thermo Scientific or your Thermo Scientific-authorized distributor.

Any product or component returned for examination and/or warranty repair shall be sent to Thermo Fisher Scientific in MA, or any of their authorized representatives. All items must be returned at the customer's cost (freight prepaid), quoting a return authorization number that is available from the Service department. All products or components repaired or replaced under warranty will be returned to the customer at Thermo Fisher Scientific's cost using UPS (United Parcel Service) or an equivalent service.

In all cases, Thermo Fisher Scientific or your Thermo Fisher Scientific-authorized distributor has sole responsibility for determining the cause and nature of failure, and Thermo Fisher Scientific's or the distributor's determination with regard thereto shall be final.

All parts that are replaced under warranty will become the property of Thermo Fisher Scientific.

Consumables

Consumables can be ordered from Thermo Fisher Scientific or your Thermo Fisher Scientific-authorized distributor. Use only Thermo Fisher Scientific products or Thermo Fisher Scientific-approved products in your Thermo Scientific Analyzer. Thermo Fisher Scientific shall not be liable for damage to or malfunction of the system, which it deems was caused by the use of unauthorized materials.

Assistance

After troubleshooting all components of your measurement system, contact Technical Support. Within the United States call 1.800.225.1480 and outside the United States call 978.232.6000 or fax 978.232.6015.

In Europe, the Middle East and Africa, contact your local authorized dealer.

For the most current contact information, visit www.thermoscientific.com/water. For the latest application and technical resources for Thermo Scientific Orion products, visit www.thermoscientific.com/water

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