FG7005002

ANATEL PAT700 On-line Total Organic Carbon Analyzer

USER MANUAL

April 2010, Edition 4

mm/kt

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Chapter 1 Before You Begin

1.1 About this manual

This instruction manual explains how to install and operate the Anatel® PAT700 Total Organic Carbon Analyzer.

- This chapter provides an overview of the PAT700 analyzer; explains your responsibility for reading and following all instructions; explains safety procedures, cautions, and warnings, which must be adhered to at all times; defines terms that are used throughout this manual; and tells you how to contact customer service.
- Chapter 2 explains how to install the analyzer and explains RS-232 commands.
- Chapter 3 explains analyzer behavior at startup, how to sign on or sign off the analyzer, and how to use the home screen to read Total Organic Carbon (TOC), conductivity, and temperature.
- Chapter 4 explains how to use the various analyzer run modes and how to select the desired run mode.
- Chapter 5 explains how to use the setup dialog box to navigate and change analyzer settings.
- Chapter 6 explains how to use bottles in the bottle bay to run calibrations, validations, or system suitability tests; analyze samples from a bottle; install excursion bottles to capture samples when TOC measurements exceed alarm limits; or schedule tests to be run.
- Chapter 7 explains alarm indications and how to acknowledge alarms, and provides detailed listings and descriptions of all error codes.
- Chapter 8 explains how to perform tests on the system to verify it is operating correctly.
- Chapter 9 explains how to read, filter, and export historical sample data.
- Chapter 10 explains how to enter or change passwords that provide data security for the analyzer.
- Chapter 11 explains Modbus TCP/IP communications.
- Chapter 12 explains maintenance and troubleshooting procedures for the analyzer.
- Appendix A: provides specifications for the analyzer.
- Appendix B: is the CE attestation of conformity.
- Appendix C: explains the theory of operation.
- Appendix D: contains the analyzer default settings.

1.2 Anatel® PAT700 analyzer overview

The Anatel® PAT700 analyzer provides TOC analysis for pure and ultra-pure water processing. The PAT700 oxidizes a water sample to determine the TOC in the sample. The analyzer traps a sample in the analysis cell, exposes the sample to ultraviolet (UV) light, and monitors changes in temperature and conductivity until the sample has completely oxidized. Once full oxidation has occurred, the analyzer reports TOC, temperature, conductivity, the oxidation curve type, and TOC trend. The PAT700 incorporates the OASIS™ onboard, automated standards introduction system that simplifies analyzer performance testing using standards bottles tagged with RFID technology.

A touch-screen interface provides access to all analyzer functions. The user interface consists of a home screen from which all user operations initiate. The home screen displays the current status of the analyzer and analysis results based on the current run mode selection. The software can display data in a number of user-selected formats, including TOC, compensated and uncompensated conductivity, resistivity, and temperature in engineering units, with data logging and graphing of the data.

You may connect a USB flash drive to the analyzer and download the contents of the data buffer, audit trail, alarm log, bottle analysis reports, and analyzer configuration settings. You can interact with the analyzer remotely, including downloading data records, by querying the analyzer through an RS-232 communications port. You can communicate with the analyzer using Modbus® protocol via the Ethernet port. Printing may be done automatically or on demand through an RS-232 port to a serial printer.

The PAT700 allows for compliance to 21 CFR Part 11 with password protection and an audit trail of all user actions.

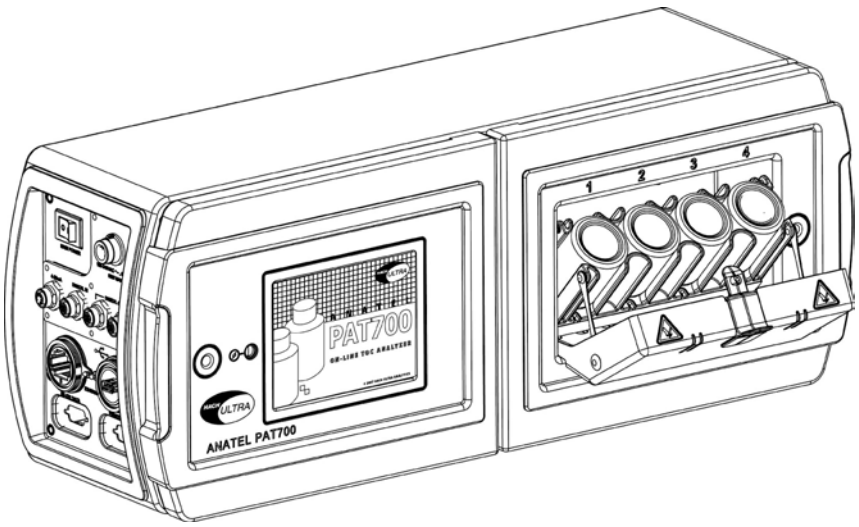


Figure 1-1 PAT700 with bottle bay open

1.3 RFID technology

The Anatel PAT700 on-line TOC analyzer Onboard Automated Standards Introduction System (OASIS™) employs Radio Frequency Identification (RFID) technology, a registered radio frequency device. The RFID system in the PAT700 operates over a very short distance to eliminate any interference with other wireless communications.

The term RFID describes a system that transmits data wirelessly using radio waves. An RFID system is comprised of a “tag” and a “reader/writer”. In the PAT700 analyzer, the tag is attached to the standards bottles used in calibrations (conductivity and TOC), validations, system suitability tests, and excursion mode. The RFID tag consists of a microchip attached to a radio antenna mounted on a substrate. The RFID tag is attached to the bottom of the standards bottle. The microchip contains data about the standard contained in the bottle. The PAT700 OASIS system contains four RFID reader/writers permanently mounted inside the analyzer that align with the bottle RFID tags when the bottles are fully loaded in the analyzer.

The reader/writer retrieves the data stored on the RFID tags located on the bottom of the standards bottles. The RFID reader/writers have antennas that emit radio waves and receive signals back from the tags on the standards bottles. The information provided from the tag includes the identity of the standard, the standard's concentration, date of expiration and other pertinent data.

The reader/writer takes the data received from the tag and passes the information in digital form to the PAT700 processor. The RFID system in the PAT700 can read and write to the RFID tags attached to the standards bottle. The writing feature allows the PAT700 to write data to the bottles showing that the bottle has been used and provides for writing of data for the exclusive excursion sampling feature.

The RFID system in the PAT700 does not require any user intervention to operate. The system operates automatically when bottle tests are performed. The system automatically turns on and off to read and write data only when necessary. When enabled, the radio frequency modulation emitted from the antennas is fixed at 13.56 Mhz. There are no user serviceable parts associated with the RFID system. The RFID reader/writer board assembly should only be serviced by a Hach certified service representative.

Since the RFID labels on the standards bottles contain the data necessary for each standard, the labels must not be removed from the bottle. Without the label, the RFID reader/writer has no data to read and will not operate as intended; however, bottles without labels can be run if the user manually enters data.

1.4 Reading and following instructions

You must comply with all instructions while you are installing, operating, or maintaining the analyzer. Failure to comply with the instructions violates standards of design, manufacture, and intended use of the analyzer. Hach disclaims all liability for the customer's failure to comply with the instructions.

- *Read instructions* — Read all instructions before installing or operating the product.
- *Retain instructions* — Retain the instructions for future reference.
- *Follow instructions* — Follow all installation, operating and maintenance instructions.
- *Heed warnings and cautions* — Adhere to all warnings and caution statements on the product and in these instructions.
- *Parts and accessories* — Install only those replacement parts and accessories that are recommended by Hach. Substitution of parts is hazardous.

1.5 Safety

- Read the *Anatel PAT700 TOC Analyzer Operator Manual* thoroughly before installing or operating the analyzer. Pay attention to all danger and caution statements. Failure to do so could result in serious injury to the operator or damage to the equipment.
- Although the analyzer is designed for rugged use, you should care for and maintain it as described in this manual. Following proper safety and handling instructions promotes accident free operation and prolongs product life.
- For any questions regarding the analyzer, phone Hach at 800.866.7889 or +1 541.472.6500.
- All service procedures should be conducted by properly trained service personnel.

- Follow all procedures in Return procedures, page 171, before shipping the analyzer to a service center for repair or recalibration.
- Make sure the analyzer is properly installed and all connections are correctly made before operating the analyzer. Adhere to all instructions provided in caution and warning statements.
- Any changes or modifications not expressly approved by Hach voids the user's warranty.
- 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 specified in this manual.

1.6 Hazard information

DANGER

Indicates a potentially or imminently hazardous situation which, if not avoided, will result in death or serious injury.

WARNING

Indicates a potentially or imminently hazardous situation which, if not avoided, could result in death or serious injury.

CAUTION

Indicates a potentially hazardous situation that may result in minor or moderate injury.

NOTE

Information that requires special emphasis.

1.7 FCC conformance

The PAT700 contains a registered Radio Frequency device (RFID)
FCC ID: VICPAT700TOC
IC: 6149-PT700TOC

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, you should try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna or the affected equipment.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or authorized service person for help.

Any changes or modifications not expressly approved by Hach could void the user's authority to operate the equipment.

1.8 EU directives

The PAT700 Total Organic Carbon Analyzer has been tested and found to be in conformity with the following EU directive:

- EMC Directive 2004/108/EC
- Low Voltage Directive 2006/95/EC

This instrument is in conformity with the relevant sections of the following EC technical standards and other normative documents:

- Safety: EN 61010-1
- EMC: EN 61326
  EN 55011
  EN 61000-3-2
  EN 61000-3-3
  EN 61000-4-2
  EN 61000-4-3
  EN 61000-4-4
  EN 61000-4-5
  EN 61000-4-6
  EN 61000-4-11

1.9 Precautionary labels

Read all labels and tags attached to the analyzer. Personal injury or damage to the instrument could occur if not observed. A symbol, if present on the analyzer, will reference a danger or caution statement in the manual.

This symbol, when on the product, references the instruction manual for operation and/or safety information.

Electrical equipment with this symbol may not be disposed of in European public disposal systems after 12 of August 2005. In conformity with local and national regulations (EU Directive 2002/96/EC), European electrical equipment users must now return old or end-of-life equipment to the producer for disposal at no charge to the user.

NOTE

For return for recycling, contact the equipment producer or supplier for instructions on how to return end-of-life equipment, producer-supplied electrical accessories, and all auxiliary items for proper disposal.

This symbol, when on a product enclosure or barrier, indicates that a risk of electrical shock and/or electrocution exists.

This symbol, when on the product, indicates the need for protective eye wear.

This symbol, when on the product, identifies the location of the connection for protective earth (ground).

This symbol, when on the product, identifies the location of a fuse or current limiting device.

This symbol, when on the product, indicates the presence of devices sensitive to electrostatic discharge (ESD) and indicates that care must be taken to prevent damage with the equipment.

This symbol, when on the product, indicates a puncture or pinch hazard. Keep hands and fingers clear.

This symbol, when on the product or a component of the product, indicates the presence of mercury. Components containing mercury must be removed and safely disposed of in accordance with applicable local, state, or federal law. Do not put these items into municipal waste.

1.10 Symbols and marks

The PAT700 Total Organic Carbon Analyzer complies with those parts of 21 CFR, Part 11 concerning the collection, retention, access and retrieval of data as electronic records. The instrument uses no electronic signature(s), thus those parts of the rule referring to electronic signature(s) are not applicable. Extensively documented and verifiable tests have been conducted to establish 21 CFR, Part 11 compliance.

The PAT700 Total Organic Carbon Analyzer is comprised of a line of precision instruments which meet or exceed the following international requirements and standards of compliance:

European Conformity Mark

When applied to a product, indicates that the product complies with all required directives and standards.

UL61010-1 and CAN/CSA C22.2 No. 61010-1

Safety Requirements for Electrical Equipment for Measurement, Control and Laboratory Use, Part 1: General Requirements.

ISO

Customer satisfaction through continuous quality improvements.

1.11 Patents

Apparatus and products are manufactured and sold by Hach under one or more of the following U.S. patents: 5,260,663 and 5,334,940 and equivalents in other countries where issued. Purchaser is granted a paid-up, non-exclusive license to practice under these patents for the useful life of this apparatus or product.

1.12 Definitions of terms

The following terms are used throughout this manual:

Conductivity. A measure of the ability to conduct current through water. Conductivity, very low with high-purity deionized water, is the reciprocal of resistivity and is measured in microsiemens per centimeter (µS/cm).

Megohm (M). A measurement of 1,000,000 ohms.

Microsiemens (µS). A unit of conductance in the metric system equivalent to one millionth of an ampere per volt (1 µS = 1 x 10^{-6} A/V).

Normalize. To make conform to a standard. In this case, the user performs calculations on the raw data to produce a result in a standard unit of measure.

Organic. A molecule that contains carbon but excludes carbonate CO_2, CO, CS_2, or cyanide-related compounds. Oxygen is very common in organics, and they almost always include hydrogen.

Oxidation. The loss of electrons by a chemical species, typically with oxygen. Organic carbon, for example, oxidizes to carbon dioxide and water.

Parts per billion (ppb). A term used to report trace chemical analyses. It refers to the concentration of the element or compound present within one billion parts of water. One microgram per liter (µg/L) is equal to 1 ppb).

Resistivity. Resistance, measured in megohmcentimeters (MΩ-cm), to the flow of electrical current through high-purity water. Resistivity is a means of continuously measuring the purity of the water and is the reciprocal of conductivity.

Temperature compensation. Conductivity and resistivity measurements normalized to 25 °C (77 °F) for reporting purposes. Normalized conductivity and resistivity measurements reflect the values that would be reported at a sample temperature of 25 °C (77 °F) using a model based on sodium chloride in water. Conductivity and resistivity of electric current in water depend on the temperature of the water. The lower the temperature, the lower the conductivity and the higher the resistivity.

Total organic carbon (TOC). A measurement of the organics present in water based on its carbon content. In high-purity water, TOC is measured in parts per billion (ppb). Total organic carbon is used interchangeably with total oxidizable carbon.

VGA. Video Graphics Adapter.

1.13 Customer service

For customer service:

- Voice: US: 1.970.663.9760 or 1.800.373.0531
EU: 41.22.594.6400
- FAX: US: 1.970.663.9761
EU: 41.22.594.6488
- Support hot line: US: 1.877.4 ANATEL (1.877.426.2835)
- Website: www.hach.com

Chapter 2 Installation

DANGER

Tasks involving installation of this equipment have fire, electrical, and pressure related hazards associated with them. These tasks must only be attempted by individuals trained and knowledgeable in the particular task and the associated hazards.

2.1 Installation requirements

The quick-connect version of the PAT700 has an IP46 enclosure surrounding the electronics portion of the analyzer. The conduit version of the PAT700 has a waterproof IP56 enclosure, that can withstand water jets, surrounding the electronics portion of the analyzer. The hydraulics portion of the analyzer is protected by a splash resistant enclosure, but does not carry an IP rating.

- Install the analyzer in a dry, dust-free environment.
- Install the analyzer in a properly ventilated location where the ambient air temperature is 10 to 40 °C (50 to 104 °F).
- The analyzer has 3/4-inch NPT conduit fittings or quick-connect fittings for wiring.

See Figure 2-1, page 11 for mounting dimensions. The analyzer weighs 30 lb (13.6 kg).

The analyzer ship kit includes the following parts:

- This instruction manual
- 5-foot (1.5 meter) PFA inlet tubing
- 10-foot (3 meter) polypropylene outlet tubing
- 5/16-inch T-handle Allen wrench
- Stylus
- Instrument screwdriver
- USB memory stick
- Graduated cylinder

For units with quick connect I/O fittings the following items are also included:

- Quick connect power cord
- Male 8-pin quick connect cord fitting
- Three male 5-pin quick connect cord fittings

2.2 Orientation and mounting

NOTE

Failure to mount the analyzer in an upright position can cause measurement error.

To ensure proper operation of the measurement cell, mount the analyzer in an upright position. See Figure 2-2*.*

- Secure the analyzer using the factory-supplied mounting bracket (see Figure 2-3, page 13). Use the mounting holes in the bracket to mount it to a flat, stable surface.
- Hook the analyzer onto the mounting bracket and latch it into place using the twist latches.
- An optional handle, attached to the analyzer, enables it to be moved from place to place.

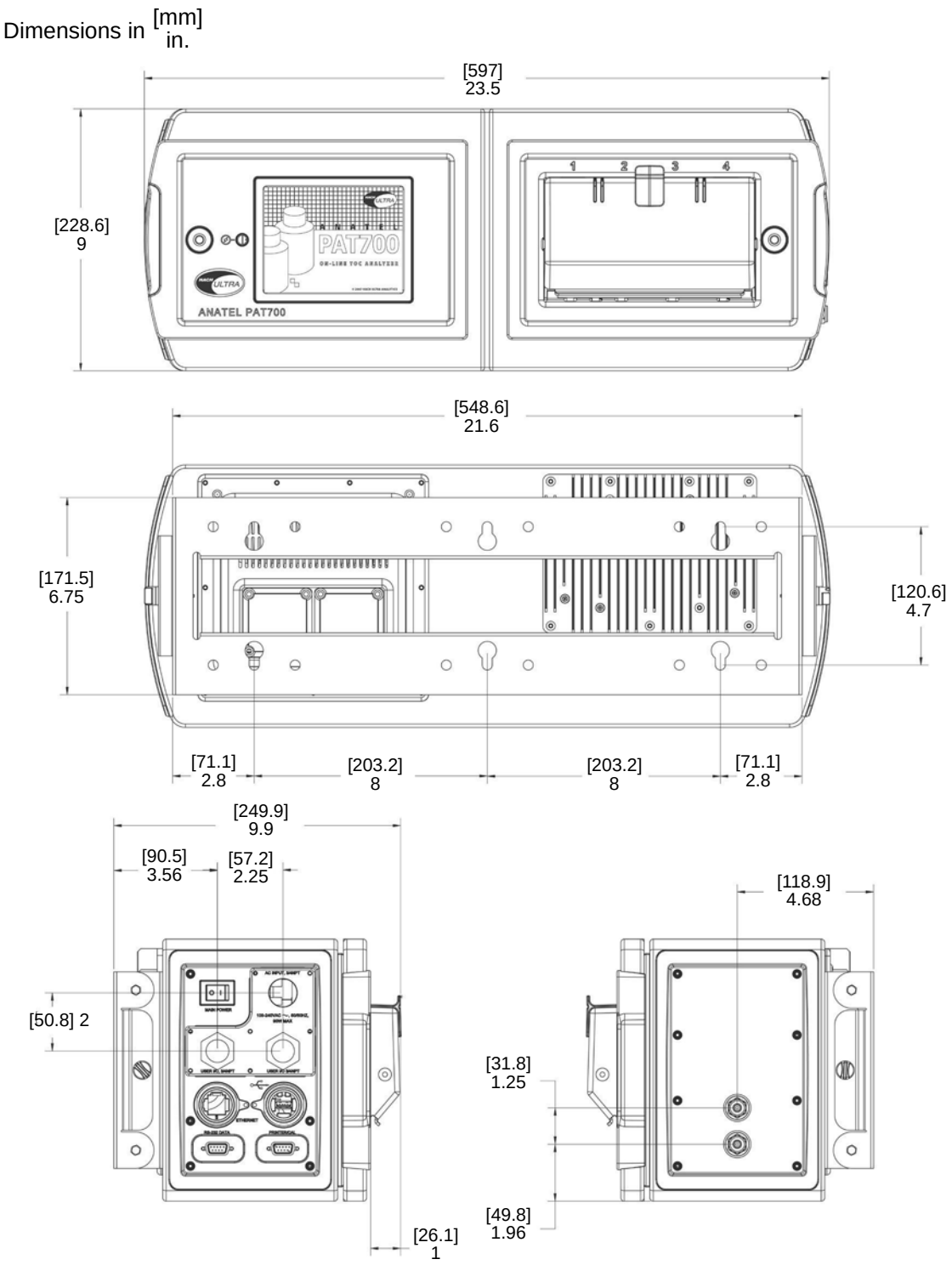


Figure 2-1 PAT700 mounting dimensions

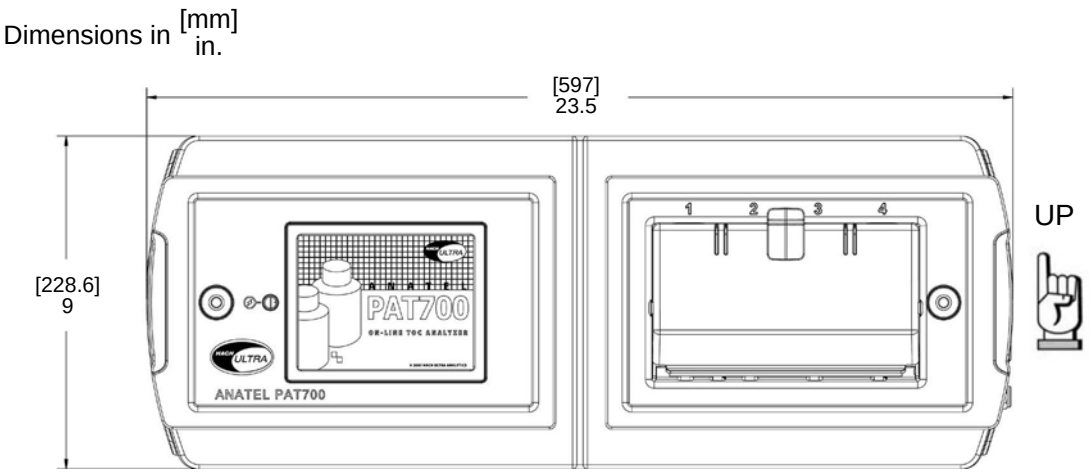


Figure 2-2 PAT700 analyzer orientation

Mounting general considerations

Follow these guidelines when installing the analyzer:

- Locate the analyzer where it is accessible for operation, service and calibration.
- Minimize the distance between the water system sample point and the analyzer to allow for representative sampling.
- Maintain sufficient space to allow access to the power switch, and the plumbing and electrical connections on the end panels.
- Locate the analyzer where the ambient temperature remains from 10 to 40 °C (50 to 104 °F).
- The mounting bracket is installed independently from the analyzer. Once mounted, the analyzer hooks on the mounting bracket and locks into place with twist latches.
- Mount the mounting bracket to a stable, flat surface or dual instrument poles.
- The front of the analyzer requires 12 inches (30.48 cm) of clearance to allow the doors to open completely.
- The analyzer is available with ¾-inch conduit openings or quick-connect fittings for power and I/O wiring. If conduit is used, install fittings that ensure a complete seal with the openings and are properly sealed to keep the analyzer electronics compartment watertight.

Mounting to a wall

Follow these guidelines and refer to Figure 2-1, Figure 2-2,and Figure 2-3 to mount the transmitter to a wall or other flat, rigid surface:

- Use 5/16-inch (8 mm) diameter screws or bolts and nuts to mount the analyzer to a wall or other flat, rigid surface. Use hardware that can withstand the process environment. Hach does not supply these screws, bolts, or nuts.
- To minimize stress on the analyzer mounting bracket, secure all mounting bolts to the same structure, which should be flat and should not vibrate or move excessively. Do not secure bolts to separate girders, beams, or wall studs that can move independently.

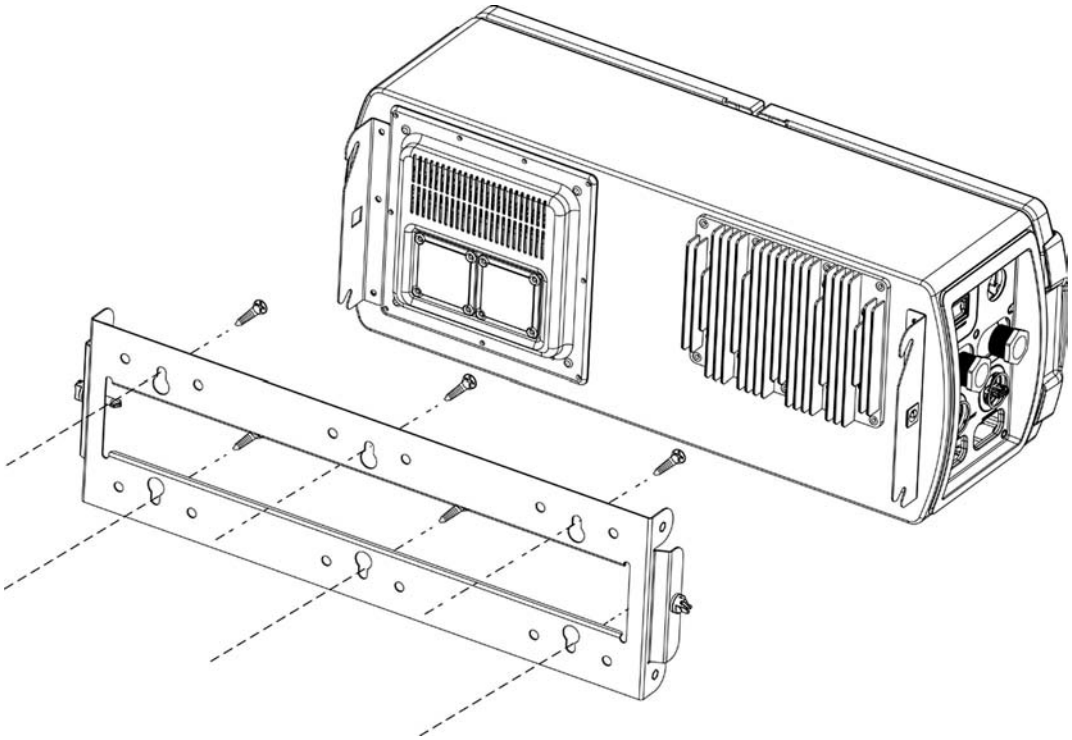


Figure 2-3 PAT700 wall mount

Mounting to dual instrument poles

Follow these guidelines and refer to Figure 2-1 and Figure 2-4 to mount the analyzer to instrument poles:

- Mount the analyzer mounting bracket to two instrument poles that are attached to a common surface. Do not secure to two instrument poles that could move independently.
- The instrument poles should extend at least 10 inches (254 mm) from a common rigid base and should be no larger than 2 inches (50.8 mm) in diameter.

- Use four 5/16-inch U-bolts, two for each 2-inch pipe, and eight matching nuts, to mount the analyzer mounting bracket to two rigid instrument poles. Use U-bolts and nuts that can withstand the process environment. Hach does not supply U-bolts or nuts.
- The U-bolts and nuts should not extend more then 0.60 inches (15 mm) from the inside of the mounting bracket to allow clearance for the analyzer.

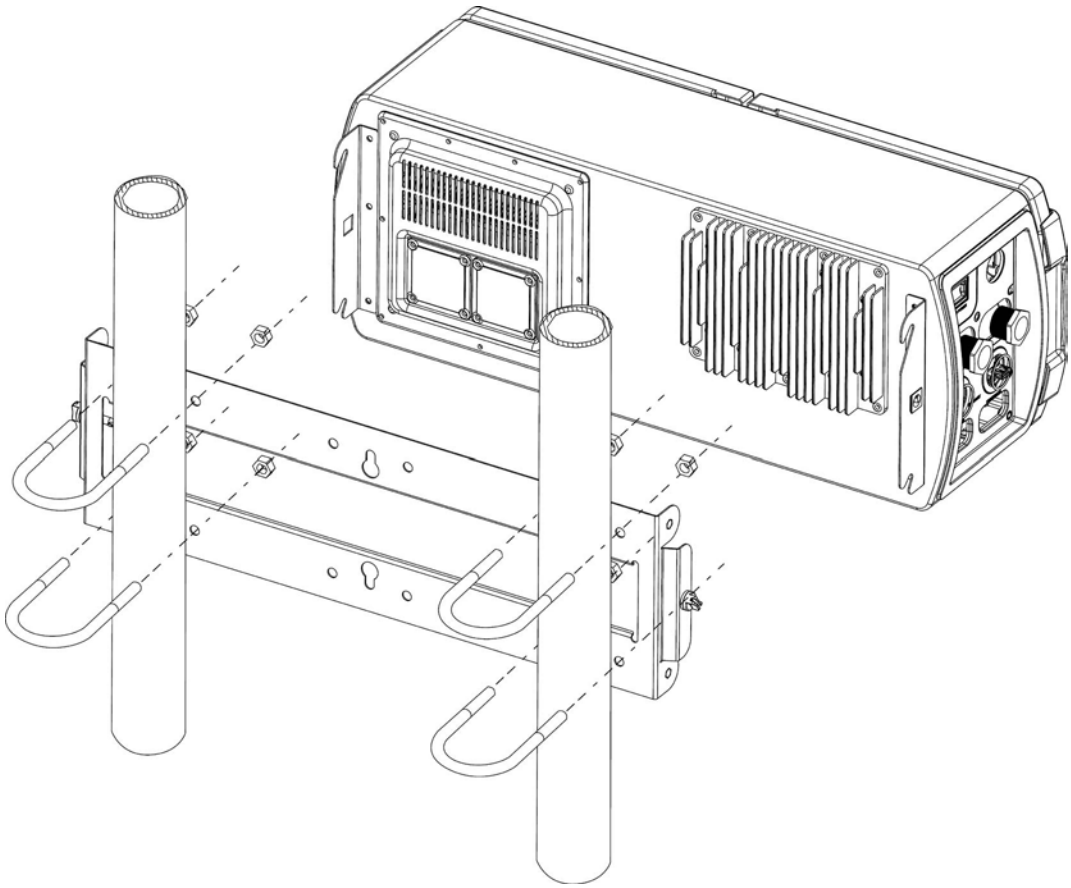


Figure 2-4 PAT700 instrument-pole mount

2.3 Plumbing connections

CAUTION

Potential eye and/or burn hazard! The water inlet can rupture if water pressure is too high. Sample inlet pressure must not exceed 100 psi (690 kPa).

NOTE

Improper plumbing connections to the analyzer can cause improper flow through the analyzer, resulting in measurement error.

Do not allow temperature or pressure to exceed the limits listed in Table 2-1. Install high grade 1/4” (OD) PTFE, FEP, PVDF, or 316 stainless steel tubing. Otherwise, install the factory-supplied 1/4” PFA (perfluoroalkoxy resin) inlet tubing and 1/4” OD polypropylene outlet tubing. Hach supplies 5 feet (1.5 meters) of PFA tubing and 10 feet (3 meters) of polypropylene tubing with the analyzer.

Install an appropriate air brake in the drain line between the instrument and the drain. The outlet drain tubing must be open to atmosphere at the drain.

Table 2-1 Maximum temperature and pressure limits for PFA tubing

Maximum water temperature	Maximum pressure
75 °C (167 °F)	90 psig (620 kPa)
85 °C (185 °F)	80 psig (550 kPa)
90 °C (194 °F)	70 psig (480 kPa)

Isolation valve

To enable manual isolation of the analyzer from input flow, connect the analyzer to the sample supply through a customer-supplied upstream isolation valve. See Figure 2-5.

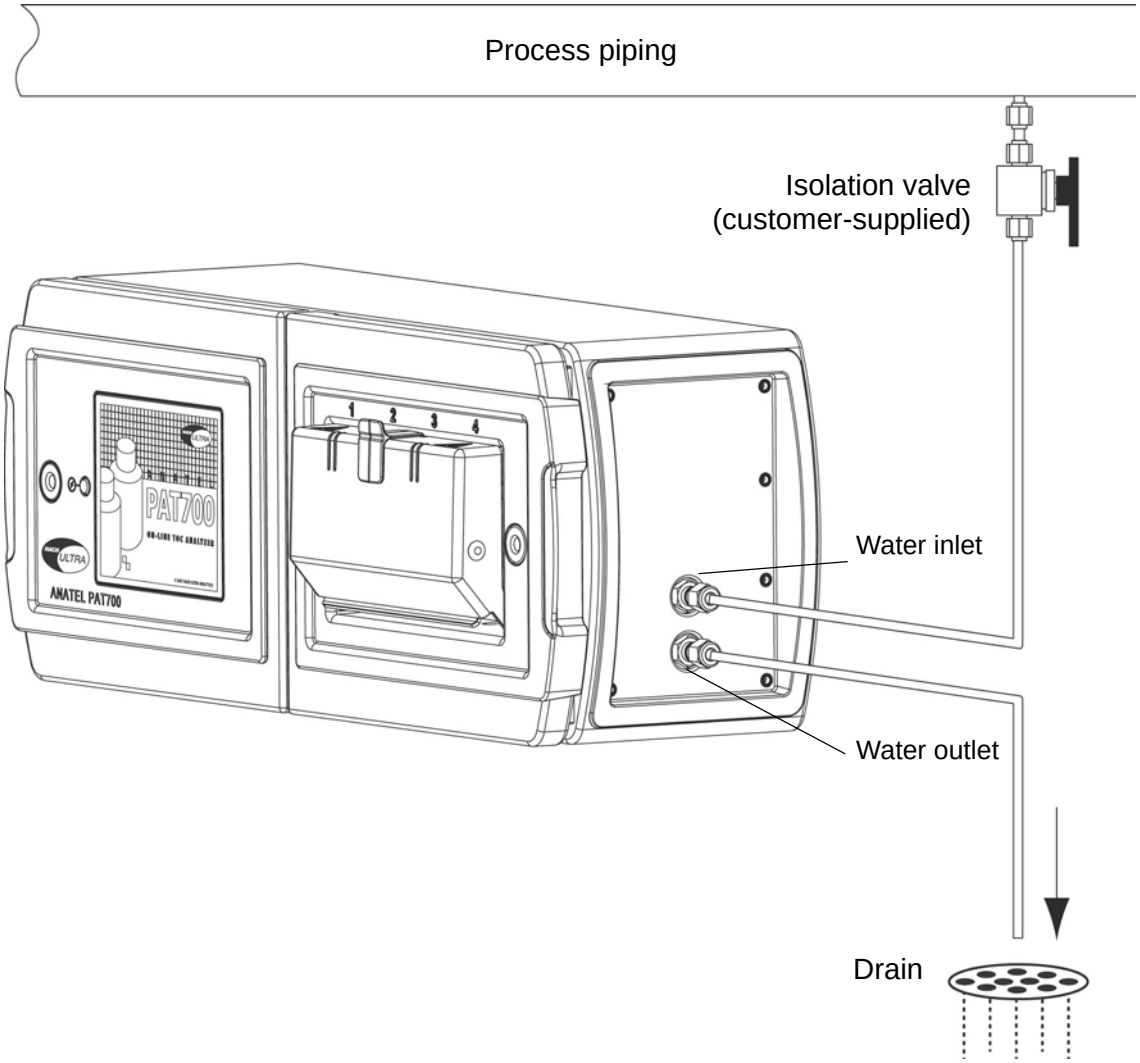


Figure 2-5 PAT700 connection to isolation valve

Water inlet and outlet

Tubing connects to the 1/4” inlet (WATER IN) and outlet (WATER OUT) 316 stainless steel compression fittings on the analyzer. See Figure 2-6. Installation requires a 7/16” wrench.

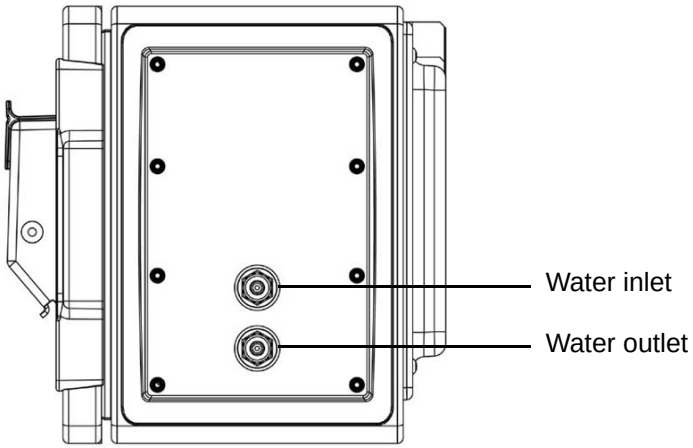


Figure 2-6 PAT700 water inlet and outlet connections

To connect plumbing to the 1/4” inlet (WATER IN) port, follow these steps:

1) To avoid introducing debris through the inlet plumbing, flush the isolation valve by opening and closing it fully several times.
2) Without crimping or damaging the tubing, push one end of the inlet tubing into the water inlet until it cannot be inserted any farther.
3) Without pulling on the tubing, hand-tighten the compression nut.
4) Mark the compression nut and the WATER IN connector as references for tightening the nut.
5) Tighten the compression nut 1-1/4 turns to secure the connection.

NOTE

Over tightening the compression nut can damage the ferrules, causing leaks that can result in measurement error or property damage.

After tightening the compression nut 1-1/4 turns, do not tighten it more than another 1/4 turn to seal the connection.

To connect plumbing to the 1/4” outlet (WATER OUT) port, follow these steps:

1) Attach the 10-foot long, 1/4” OD polypropylene drain tubing to the WATER OUT port of the analyzer.
2) Taking care not to crimp or damage the tubing, push one end of the tubing into the water outlet port until it cannot be inserted any farther.
3) Taking care not to pull on the tubing, hand-tighten the compression nut.
4) Mark both the compression nut and the WATER OUT connector as a reference for tightening the nut.
5) Tighten the compression nut 1-1/4 turns to secure the connection.
6) Leak test the connections by slowly opening the upstream isolation valve to introduce water into the analyzer. Pulse the valve several times by opening and closing it, then recheck the fittings.
7) If necessary, slowly tighten the compression fittings to stop any leaks.

2.4 Setting sample flow rate

The PAT700 is designed to operate with a supply flow rate in the range of 60-300 mL/min. A flow rate in this range ensures a sufficient flow for proper flushing of the analysis cell and protects the analyzers from damage due to excessive flow. Following proper installation of the sample inlet and outlet lines the analyzer flow rate can be verified and adjusted if necessary. Verify the flow rate by timing the amount of water collected from the outlet of the analyzer in the graduated cylinder supplied with the analyzer.

1) Access the run modes by touching the <<icon to open the sliding toolbar from the home screen.
2) Touch the Run Mode icon at the top of the sliding toolbar.
3) At the run mode dialog box, touch the radio button for "Standby". In standby mode the analyzer's sample valve will open and allow water to continuously flow through the analyzer without any analysis.
4) Measure the amount of water exiting the analyzer over a 15 second period using the graduated cylinder.
5) If the flow rate exceeds the analyzer's specification the rate can be adjusted using the flow control valve. See Figure 2-7.
6) Return the analyzer to the desired operating mode by selecting the appropriate radio button in the run mode dialog box.

The flow control valve is set to fully open when the unit is shipped from the factory. To reduce the flow through the analyzer turn the flow control clockwise until the desired flow rate is obtained.

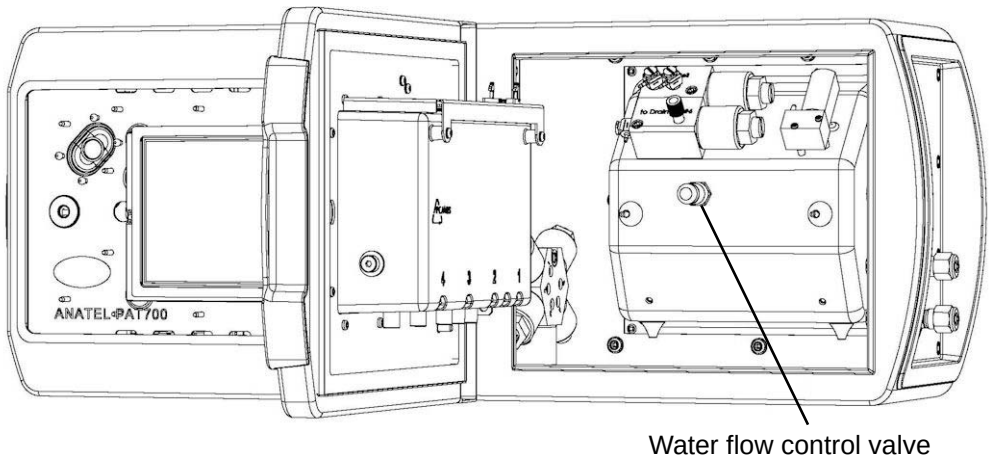


Figure 2-7 PAT700 water flow control valve location

2.5 Wiring connections for PAT700 with conduit openings

Refer to this section if the PAT700 has three 3/4-inch female NPT conduit openings.

- One opening accommodates power supply wiring.
- The other two openings accommodate 4-20 mA and/or discrete I/O wiring.
- Power supply and I/O wiring connects to terminals in the compartment behind the analyzer's display unit. Figure 2-9 illustrates power supply and I/O wiring terminals. To access the terminals:

1) Use a 5/16-inch Allen wrench to unlatch the door that contains the display.
2) Unlatch the door and swing it open on its hinges.

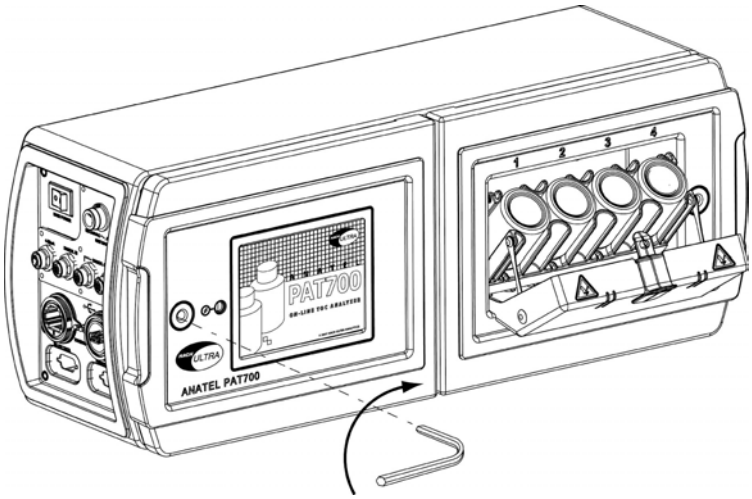


Figure 2-8 Using Allen wrench to access wiring connections

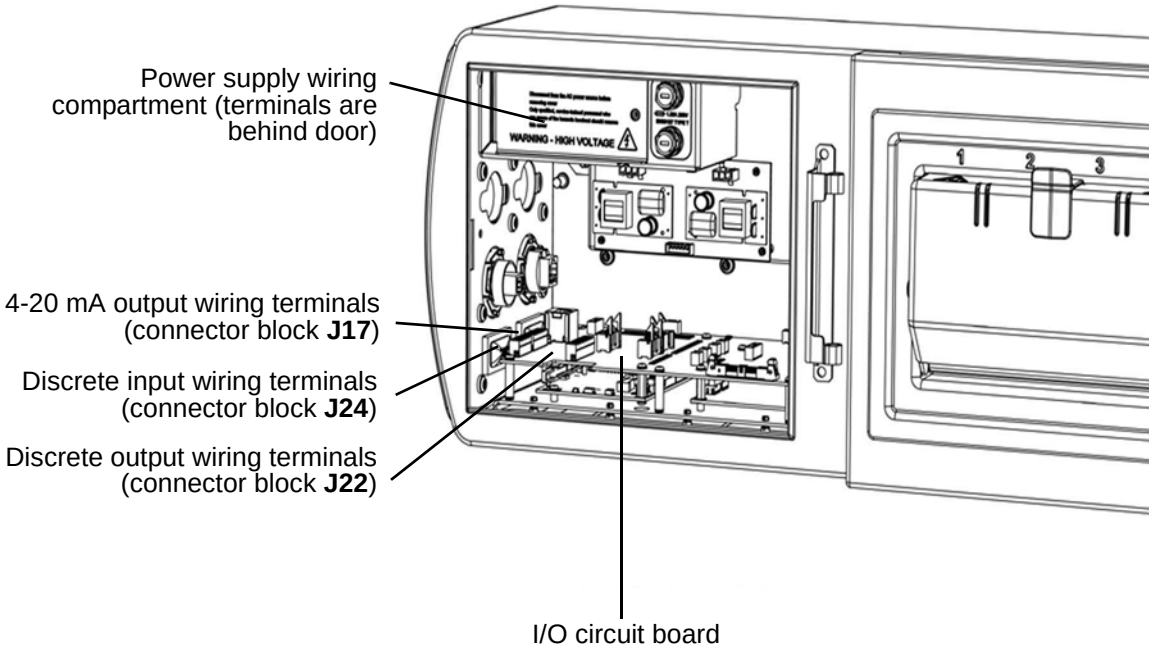


Figure 2-9 PAT700 power supply and I/O wiring terminals

Power supply wiring

WARNING

Potential property damage or electrical shock! Adhere to ground network requirements for the facility.

Figure 2-10 illustrates power supply wiring terminals.

Table 2-2 lists specifications for the power supply.

Select a wire style and gauge that meets local electrical codes. The power supply wiring connector accepts 10 to 14 AWG wiring. Wire type can be stranded or solid. Strip 3/8” (9.5 mm) of insulation from the ends of the wires and insert the stripped wire ends into the appropriate connector terminals. Secure the wire with the integral screw and tug firmly on each wire to make sure it is properly secured.

WARNING

Potential electrical shock! After power supply wiring has been installed, make sure the field wiring box cover is in place and the screw is tightened with a screwdriver to ensure that the cover is properly bonded to protective earth.

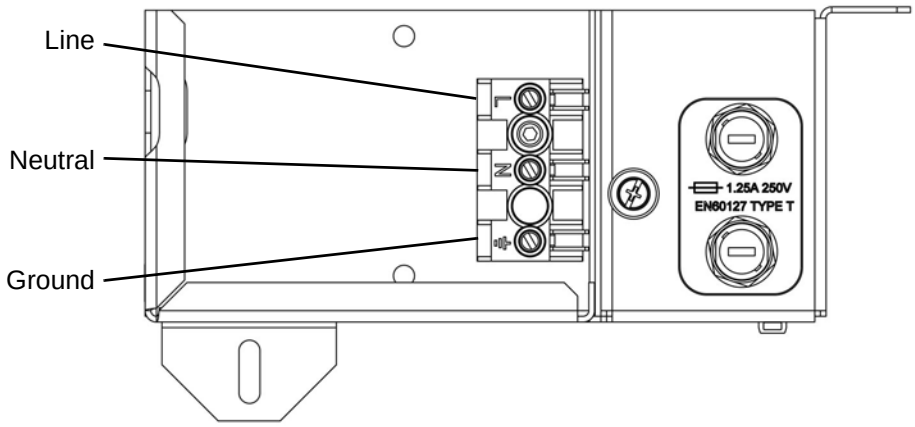


Figure 2-10 PAT700 power supply wiring terminals

Table 2-2 Power supply specifications

Description	Specification
Voltage input	100 to 230 VAC universal
Frequency	50 to 60 Hz
Power	65 W maximum, fused at 1.25 A

I/O wiring

The analyzer has three 4-20 mA outputs, two discrete inputs, and four discrete outputs. Connect wiring to the connector blocks located on the I/O circuit board.

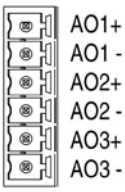
- The connector blocks are a 2-part assembly.
- The terminal block connector can be unplugged from the analyzer for easier installation of wiring.
- Install twisted-pair unshielded wiring, 18 to 14 AWG (1.0 to 2.5 mm^2).

4-20 mA outputs

The analyzer has three 4-20 mA outputs. Wiring connects to terminals on connector block J17, as listed in Table 2-3.

- Analog output 1 represents TOC (total organic carbon).
- Analog output 2 represents conductivity or resistivity (user selected).
- Analog output 3 represents temperature in °F or °C (user selected).

Table 2-3 J17 connector block: 4-20 mA output wiring terminal designations

J17 Block	Terminal	Description	Variable	Designation
	1	4-20 mA source output for analog output 1 (+)	TOC	AO1+
	2	4-20 mA sink output for analog output 1 (–)	TOC	AO1-
	3	4-20 mA source output for analog output 2 (+)	Conductivity or resistivity	AO2+
	4	4-20 mA sink output for analog output 2 (–)	Conductivity or resistivity	AO2-
	5	4-20 mA source output for analog output 3 (+)	Temperature	AO3+
	6	4-20 mA sink output for analog output 3 (–)	Temperature	AO3-

Discrete inputs

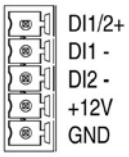
The analyzer has two discrete inputs, referred to as Digital Input 1 and Digital Input 2. Wiring connects to terminals on connector block J24, as listed in Table 2-4, page 22. Both inputs are optically isolated. The inputs are rated for 5 - 30VDC, 2 - 15mA. Terminals 4 and 5 of the discrete input terminal provides a 12 VDC output that can be used to drive each digital input. Both Digital input 1 and input 2 share a common positive power connection.

The default state for each input is a high state (no voltage applied across the input). High state is defined as no power applied across the input terminals. Low state is defined as power applied across the input terminals.

- **Digital input 1 initiates a TOC analysis.** When power is applied across pins 1 and 2 the analyzer input is changed from a high to low state. (When power is applied the optical input LED is powered and the input is activated.) An input trigger of at least 500 mSec (0.5 seconds) is required. When a high to low trigger is detected on the input the analyzer stops the current operation and runs a single TOC analysis. When the analysis is complete, the analyzer returns to the mode defined by digital input 2. During the TOC analysis, the analyzer ignores all subsequent triggers.
- **Digital input 2 controls the analyzer run mode.** If digital input 2 is not powered (High state) the analyzer is in TOC mode. If power is applied across pins 1 and 3 the analyzer input is changed from high to low and the analyzer will run in flow with conductivity mode.

The control required to activate digital inputs 1 and 2 can be configured by the user. For example, Digital Input 1 can be configured to trigger from the default change from high to low state or inverted to trigger from a change from low to high state. Refer to TOC, page 54 for instructions on inverting the operation of Digital Input 1 or Digital Input 2.

Table 2-4 J24 connector block: Discrete input wiring terminal designations

J24 Block	Terminal	Description	Variable	Designation
	1	Common connection for external sourcing (+)	Common	DI1/2+
	2	Digital input 1 voltage source return input (–)	Initiates TOC analysis	DI1–
	3	Digital input 2 voltage source return input (–)	Analyzer mode	DI2–
	4	• 12 VDC power supply + • Connect only if output device requires power supply	Output power supply	+12V
	5	• 12 VDC power supply – • Connect only if output device requires power supply	Output power supply	GND

The following two wiring diagrams Figure 2-11 and Figure 2-12 illustrate the digital input wiring:

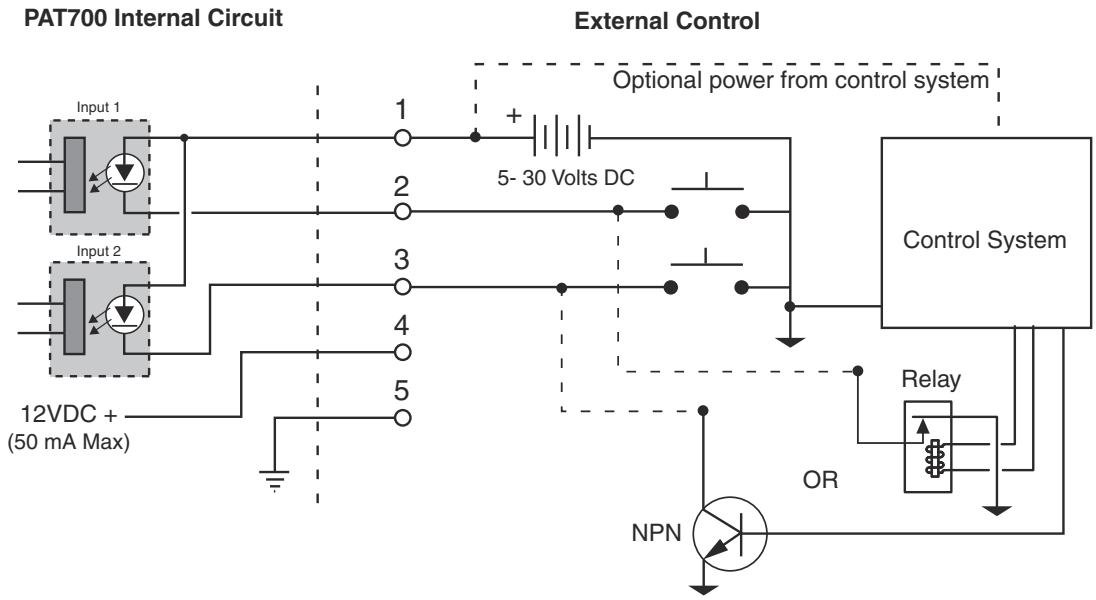


Figure 2-11 Digital input wiring external power - Isolated

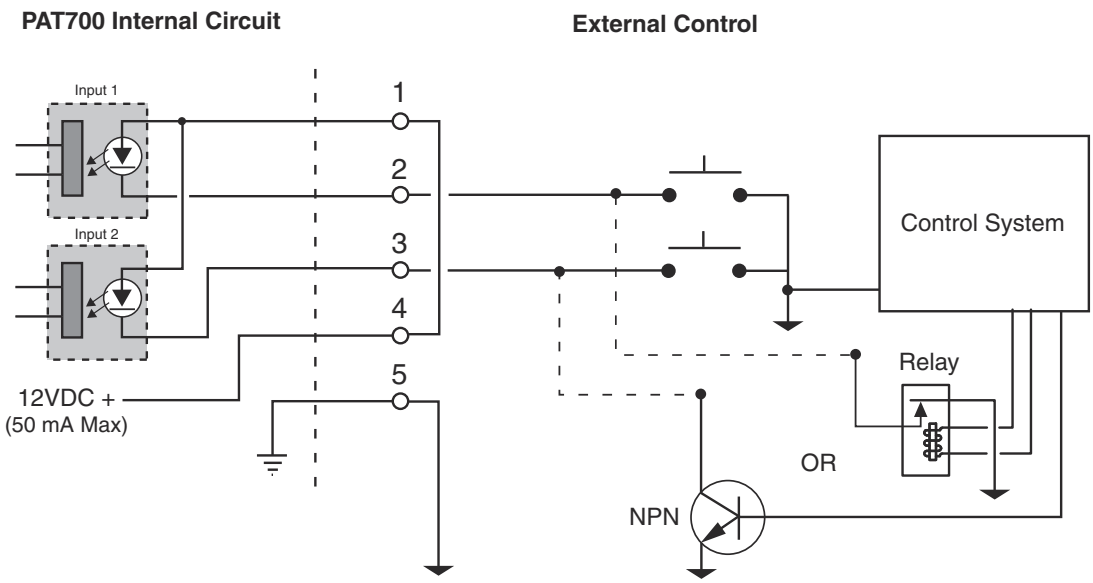


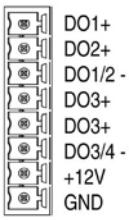
Figure 2-12 Digital input wiring internal power - Non-isolated

Discrete outputs

The analyzer has four discrete outputs. Wiring connects to terminals on connector block J22, as listed in Table 2-5.

- Discrete output 1 is a TOC alarm. The output reports the TOC level as above (low state) or below (high state) the user-specified alarm limit.
- Discrete output 2 is an uncompensated conductivity alarm. A low state indicates the conductivity level is above the alarm limit. A high state indicates the conductivity level is below the alarm limit.
- Discrete output 3 reports a warning or failure condition. A low state indicates an error condition exists. A high state indicates no error conditions exist.
- Discrete output 4 reports a TOC analysis start (by indicating the state of the sample inlet valve). A low state indicates the sample valve is closed. A high state indicates the sample valve is open.

Table 2-5 J22 connector block: Discrete output wiring terminal designations

J22 Block	Terminal	Description	Variable	Designation
	1	Digital output 1 (+)	TOC alarm	DO1+
	2	Digital output 2 (+)	Uncompensated conductivity alarm	DO2+
	3	Common return for discrete outputs 1 and 2 (–)	TOC alarm, uncompensated conductivity alarm	DO1/2–
	4	Digital output 3 (+)	Warning or failure	DO3+
	5	Digital output 4 (+)	TOC analysis start	DO4+
	6	Common return for discrete outputs 3 and 4 (–)	Warning or failure, TOC analysis start	DO3/4–
	7	• 12 VDC power supply + • Connect only if input device requires power supply	Input power supply	+12V
	8	• 12 VDC power supply – • Connect only if input device requires power supply	Input power supply	GND

2.6 Wiring connections for PAT700 with quick-connect fittings

Refer to this section if the PAT700 has five quick-connect fittings, as illustrated in Figure 2-13.

- One connector accommodates power supply wiring.
- The other four connectors accommodate 4-20 mA or discrete I/O wiring.
- The analyzer comes with factory-supplied mating connectors and a plug-in cord for power supply wiring.

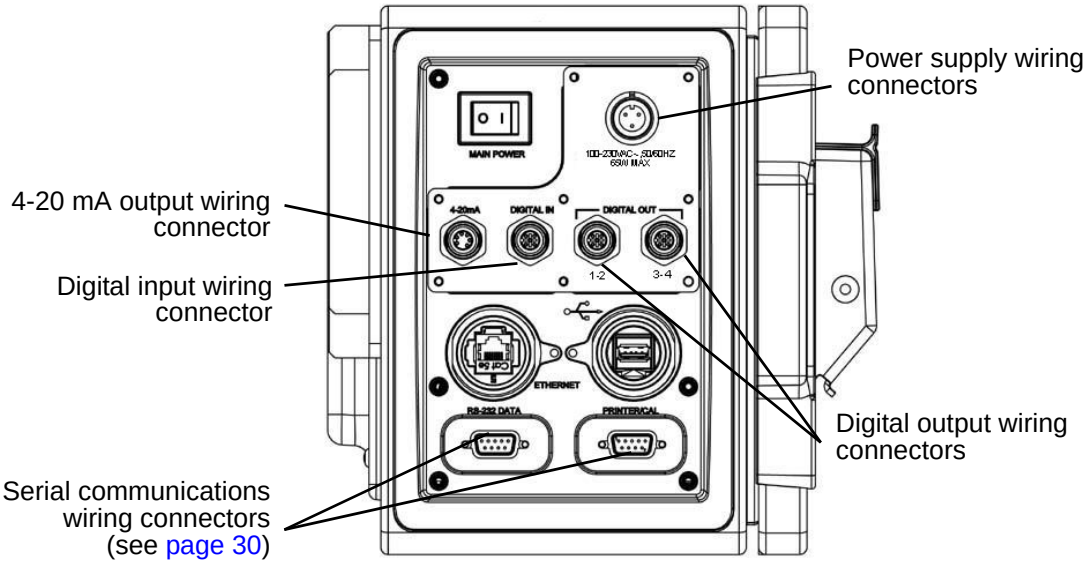


Figure 2-13 PAT700 power supply and I/O wiring terminals

Power supply wiring

WARNING

Potential property damage or electrical shock! Adhere to ground network requirements for the facility.

WARNING

After power supply wiring has been installed, make sure the field wiring box cover is in place and the screw is tightened with a screwdriver to ensure that the cover is properly bonded to protective earth.

Table 2-6 lists specifications for the power supply.

Table 2-6 Power supply specifications

Description	Specification
Voltage input	100 to 230 VAC universal
Frequency	50 to 60 Hz
Power	65 W maximum, fused at 1.25 A

I/O wiring

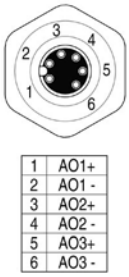
The analyzer has three 4-20 mA outputs, two discrete inputs, and four discrete outputs.

4-20 mA outputs

The analyzer has three 4-20 mA outputs, as listed in Table 2-7.

- Analog output 1 represents TOC (total organic carbon).
- Analog output 2 represents conductivity or resistivity (user selected).
- Analog output 3 represents temperature in °F or °C (user selected).

Table 2-7 4-20 mA output wiring terminal designations

Wiring connector	Terminal	Description	Variable	Designation
	1	4-20 mA source output for analog output 1 (+)	TOC	AO1+
	2	4-20 mA sink output for analog output 1 (–)	TOC	AO1–
	3	4-20 mA source output for analog output 2 (+)	Conductivity or resistivity	AO2+
	4	4-20 mA sink output for analog output 2 (–)	Conductivity or resistivity	AO2–
	5	4-20 mA source output for analog output 3 (+)	Temperature	AO3+
	6	4-20 mA sink output for analog output 3 (–)	Temperature	AO3–

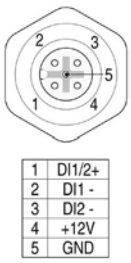
Discrete inputs

The analyzer has two discrete inputs, referred to as Digital Input 1 and Digital Input 2. Wiring connects to terminals as listed in Table 2-8, page 27. Both inputs are optically isolated. The inputs are rated for 5 - 30VDC, 2 - 15mA. Terminals 4 and 5 of the discrete input terminal provides a 12 VDC output that can be used to drive each digital input. Both Digital input 1 and input 2 share a common positive power connection.

The default state for each input is a high state (no voltage applied across the input). High state is defined as no power applied across the input terminals. Low state is defined as power applied across the input terminals.

- **Digital input 1 initiates a TOC analysis.** When power is applied across pins 1 and 2 the analyzer input is changed from a high to low state. (When power is applied the optical input LED is powered and the input is activated.) An input trigger of at least 500 mSec (0.5 seconds) is required. When a high to low trigger is detected on the input the analyzer stops the current operation and runs a single TOC analysis. When the analysis is complete, the analyzer returns to the mode defined by digital input 2. During the TOC analysis, the analyzer ignores all subsequent triggers.
- **Digital input 2 controls the analyzer run mode.** If digital input 2 is not powered (High state) the analyzer is in TOC mode. If power is applied across pins 1 and 3 the analyzer input is changed from high to low and the analyzer will run in flow with conductivity mode.
- The control required to activate digital inputs 1 and 2 can be configured by the user. For example, Digital Input 1 can be configured to trigger from the default change from high to low state or inverted to trigger from a change from low to high state. Refer to TOC, page 54 for instructions on inverting the operation of Digital Input 1 or Digital Input 2.

Table 2-8 Discrete input wiring terminal designations

Wiring connector	Terminal	Description	Variable	Designation
	1	Common connection for external sourcing (+)	Common	DI1/2+
	2	Digital input 1 voltage source return input (–)	Initiates TOC analysis	DI1–
	3	Digital input 2 voltage source return input (–)	Analyzer mode	DI2–
	4	• 12 VDC power supply + • Connect only if output device requires power supply	Output power supply	+12V
	5	• 12 VDC power supply – • Connect only if output device requires power supply	Output power supply	GND

The following two wiring diagrams Figure 2-14 and Figure 2-15 illustrate the digital input wiring:

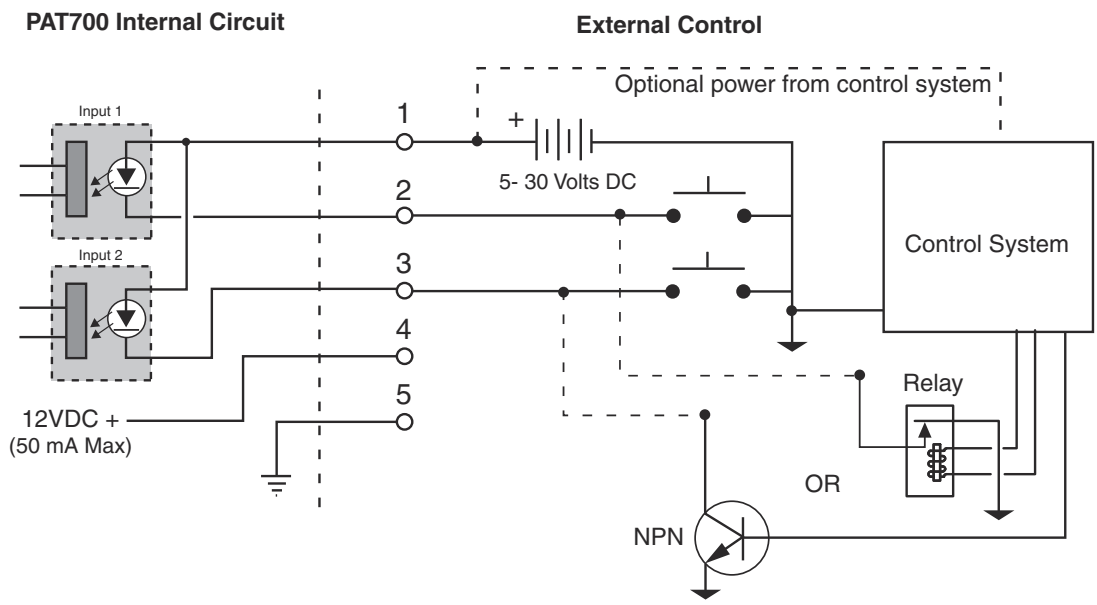


Figure 2-14 Digital input wiring external power - Isolated

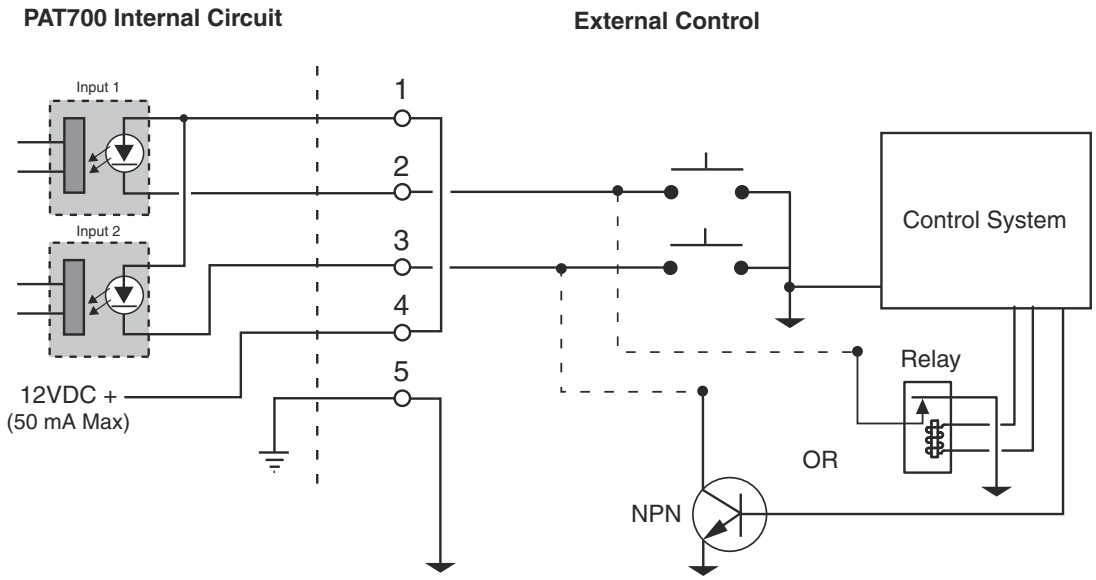


Figure 2-15 Digital input wiring internal power - Non-isolated

Discrete outputs

The analyzer has four discrete outputs, as listed in Table 2-9 and Table 2-10.

- Discrete output 1 is a TOC alarm. The output reports the TOC level as above (low state) or below (high state) the user-specified alarm limit.
- Discrete output 2 is an uncompensated conductivity alarm. A low state indicates the conductivity level is above the alarm limit. A high state indicates the conductivity level is below the alarm limit.
- Discrete output 3 reports a warning or failure condition. A low state indicates an error condition exists. A high state indicates no error conditions exist.
- Discrete output 4 reports a TOC analysis start (by indicating the state of the sample inlet valve). A low state indicates the sample valve is closed. A high state indicates the sample valve is open.

Table 2-9 Discrete outputs 1 and 2 wiring terminal designations

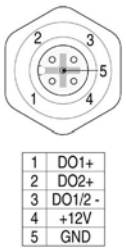
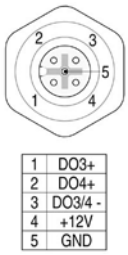
Wiring connector 1-2	Terminal	Description	Variable	Designation
	1	Digital output 1 (+)	TOC alarm	DO1+
	2	Digital output 2 (+)	Uncompensated conductivity alarm	DO2+
	3	Common return for discrete outputs 1 and 2 (–)	TOC alarm, uncompensated conductivity alarm	DO1/2–
	4	• 12 VDC power supply + • Connect only if input device requires power supply	Input power supply	+12V
	5	• 12 VDC power supply – • Connect only if input device requires power supply	Input power supply	GND

Table 2-10 Discrete outputs 3 and 4 wiring terminal designations

Wiring connector 3-4	Terminal	Description	Variable	Designation
	1	Digital output 3 (+)	Warning or failure	DO3+
	2	Digital output 4 (+)	TOC analysis start	DO4+
	3	Common return for discrete outputs 3 and 4 (–)	Warning or failure, TOC analysis start	DO3/4–
	4	• 12 VDC power supply + • Connect only if input device requires power supply	Input power supply	+12V
	5	• 12 VDC power supply – • Connect only if input device requires power supply	Input power supply	GND

2.7 Serial ports

The analyzer has the following serial ports:

- A female RS-232 serial port for data acquisition and control via a host computer.
- A male RS-232 serial port for connection to an external printer (9600 baud, 8 data bits, 1 stop bit, no parity).
- A USB port for data transfer via a memory stick.
- An Ethernet® 10/100 base-T interface port for communication via Modbus® protocol. For information about using Modbus protocol, see Modbus Protocol, page 143.
- All serial ports are internally wired. Table 2-11 lists specifications for serial communication.

Table 2-11 Serial communication specifications

Description	Specification
Female RS-232 data acquisition port	ASCII, 8 data bits, no parity, 1 stop bit, 9600 baud
Male RS-232 printer port	8 data bits, no parity, 1 stop bit, 9600 baud
USB host	Output to USB flash drive
Ethernet® interface	10/100 Mbits/sec., Modbus® TCP/IP

Figure 2-16 illustrates the RS-232 interface 9-pin connector.

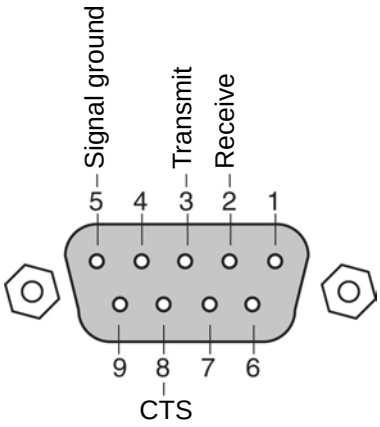


Figure 2-16 RS-232 interface 9-pin connector

2.8 RS-232 commands

Commands consist of 2-character, ASCII text mnemonics. Some commands require one or more arguments, each delimited by at least one space (ASCII 32, 20_{Hex}), following the command mnemonic. Each command string is terminated by a carriage return (ASCII 13, $0D_{Hex}$).

The analyzer responds to commands with an “OK>” prompt after the command has been processed. Data read and parameter read commands elicit a reply consisting of one or more numeric or text values delimited by at least one space and terminated by a carriage return, linefeed pair – “\r\n” (ASCII 13, 10; 0D, $0A_{Hex}$). Commands and replies use a free field format, in which the number of delimiting spaces and length of each argument or data field vary. If a command is rejected (for example, due to invalid syntax), the “OK>” prompt followed by a question mark (ASCII 63, $3F_{Hex}$) reply indicates the rejection.

Normally, the analyzer transmits only in response to a specific command. For unattended data collection, you can issue the “SA” command to make the analyzer transmit results.

You can combine multiple commands on a single line by separating them with a semicolon. The repeat command (an exclamation point followed by a repetition count, such as "!10") causes the previous valid command line to repeat for the specified number of times.

- To read current values for a parameter set command, enter the command without arguments.
- Every command must have a suffix with a carriage return.
- Send a carriage return without any command to see the "OK>" prompt.

Conventions

- f = Floating point number (such as 1.23, 1.23e3, –1.23, etc.)
- u = Unsigned integer from 0 to 65535
- s = ASCII text string
- YYYY mm DD = 4-digit year, month (where 1 = January and 12 = December), day of month (1 to 31)
- HH MM SS = Hours, minutes, seconds
- Any command that replies with temperature is in °C.

Setup

The PAT700 communicates at 9600 baud with no parity, 8 data bits, 1 stop bit. The analyzer supports full-duplex communication without hardware or software handshaking. The “BD” command can be used for temporarily increasing the baud rate to 115200 baud to reduce the time required for downloading the data log.

- “BDu” = Set baud rate, Where u: 0 = 9600 baud or 1 = 115200 baud
- “BD” = Get baud rate, returns 0 = 9600 baud or 1 = 115200 baud

Mode setup commands

Command	Mode	Analyzer activity
“MC”	Self-clean mode	Water flows through cell with UV lamp on.
“MD”	Automatic TOC mode	Continuous TOC analyses.
“MO”	Manual TOC mode	Performs one TOC analysis, then goes to idle mode.
“MP”	Conductivity mode	Water flows through cell with continuous conductivity measurement.
“MY”	Standby mode	Offline, water flows through cell.
“MZ”	Offline mode	Offline, all valves are shut.
“MR”	Master reset	Hardware reset, equivalent to cycling power.

Data read commands

“RD”	Read data	Read-only command produces last data. The format depends on the current mode.

The data normally are displayed only in response to the “RD” command. If the “SA” command is sent, data will be displayed at the end of each measurement. After the analyzer powers up, it initially responds with zeros in all data fields until the first valid reading is taken. For TOC data, the timestamp represents the time at which the unit finished sampling and began oxidation.

The data format can take either of two forms, depending on whether the sensor is in TOC mode or conductivity mode.

The analyzer produces new data every 15 seconds in conductivity mode or from 1 to 35 minutes in TOC mode. If the “RD command is used for polling, you can distinguish a new reading by comparing the current timestamp with the previous timestamp.

Example:

Read command: “RD”

TOC mode response:

“Date	Time	Mode	State	TOC alarm	Percentage	Trend
Resistance	Temperature	Curve type		Elapsed time”		
“07/25/2007	20:05:46	1	2	301	0%	-5.0
0.832	25.21	P1		310”		

Conductivity mode response:

“Date	Time	Mode	State	Resistance	Temperature”
“07/25/2007	20:07:36	7	1	18	24.28”

Where:

Mode	State
1 = Online TOC	0 = Idle
2 = Manual TOC	1 = Sampling
3 = Digital TOC	2 = Oxidizing
7 = Online conductivity	4 = Flushing
11 = Offline	
12 = StandBy	

"SA"	Read data	Read-only command enables automatic result printouts from the serial port, such as continuously streaming TOC data after every analysis or conductivity data every 15 seconds. The read format is same as "RD" command.

Data logger commands

"RE"	Read alarm log	Produces a list of alarms that occurred since power-up.

Example:

Read command: "RE"

Response:

Alarm time	Alarm code
"21:38:15	Code #27"
"21:44:40	Code #36"
"21:49:05	Code #36"
"…	
"…	

"ME"	Clear alarm log	Clears the alarm log list, also clears high TOC and conductivity alarms.
"LE"	Erase alarm and data log	Erases contents of alarm and data logs. Issue this command to reduce the size of the data log before taking a series of related measurements.
"LU"	Data log percentage	Produces the percentage (0 to 100) of the data log that has been used.

Example:

Read command: "LU"

Response: "7%"

"LP"	Read data log	If no arguments are given, the "LP" command displays the entire data log. If all 10 arguments are given, they specify a selected time span of data log records to be produced. The first five arguments specify the starting date/time, and the last five arguments specify the ending date/time. If the range is invalid or if no data records exist within the specified range, no data are printed.

Example:

Read command:

"LP" or "LP 2007 07 25 12 13 2007 07 25 16 00"

Read format:

"LP" or "LP YYYY mm DD HH MM YYYY mm DD HH MM"

Response:

```
"                ANATEL                    "
"              TOC Analyzer                "
"       Model  PAT700  S/N  0000           "
"         Sensor Name: Sensor              "
"         2007-07-26 21:36:23              "
"                                          "
"                                          "
"------------------------------------------"
"          2007-07-26 21:38:15             "
"Warning                                   "
"False conductivity                        "
"                                          "
"               2007-07-26                 "
"21:38:19                                  "
"Silenced Alarms                           "
"…"
"…"
"…"
```

"EL"	Dump error log	Dumps the internal application error log details

Example:

Read command: "EL"

Response:

```
"2007-06-12 15:35:09"
"System.Threading.ThreadAbortException: ThreadAbortException"
"at System.PInvoke.PAL.Console_printf_wsp()"
"at StdTextWriter.Write()"
"at System.IO.TextWriter.WriteLine()"
"at SyncTextWriter.WriteLine()"
"at System.Console.WriteLine()"
"at DIAMOND.SerialComm.LockSerialComm()"
"at DIAMOND.SerialComm.SendResponse()"
"at DIAMOND.SerialComm.SerialCommThreadProc()"
"…"
"…"
"…"
```

Parameter setup command

"SY"	Set/get system date and time	

Example:

Read command: "SY"

Response:

"7 25 2007 20 33 31"

Write format:

"SY mm DD YYYY HH MM SS"

"SY 7 30 2007 12 30 25"

"CA"	Disable automatic result printouts for serial port	Disables the automatic printout of results for the serial port.
"HR"	Set/get global settings	Sets or gets global settings. Compatible with or without user conductivity calibration slope parameter.

1. Flush time (HH:mm:SS)
2. Cycle time (HH:mm:SS)
3. TOC alarm limit (ppb)
4. Pump sampling (0 = Disabled, 1 = Enabled)
5. Sensor name (1 to 13 characters)
6. Idle mode (0 = No flow, 1 = Flow with conductivity, 2 = Flow without conductivity)
7. Always 0
8. Resistivity/conductivity units (0 = Mohm-cm, 1= μS/cm C, 2 = Mohm-cm U, 3 = μS U)
9. Always 0
10. TOC mode print strategy (0 = Continuous, 1 = Percent change, 2 = Disabled)
11. Conductivity print strategy (0 = Timed, 1 = Percent change, 2 = Disabled)
12. Active alarm type (0 = TOC only, 2 = TOC and uncompensated conductivity)
13. Analog output type (0 for 4-20 mA, 1 for 0-20 mA)
14. Analog output on error (0 = Minimum [2mA], 1 = Last output, 2 = Maximum [22mA])
15. TOC percent change between printouts (1-99)
16. Conductivity percent change between printouts (1-99)
17. Analog zero-scale TOC (ppb)
18. Analog full-scale TOC (ppb)
19. User TOC calibration slope
20. Digital control mode (0 = Disabled, 1 = Enabled)
21. Always 0 (data and audit Log)
22. User conductivity calibration slope

Example:

Read command: "HR"

Read format:

"HH:mm:SS HH:mm:SS u u u u s u u u u u u u u u u u u u
HH:mm:SS u u f u u u u u u f"

Response:

"00:01:00 00:00:00 50 0 1 1 Sensor 0 1 0 3 0 1 0 0 0 0 1 1
00:01:00 25 00 1.000 000 020 005 095 0 0 1.000"

Write format:

"HR HH:mm:SS HH:mm:SS u u u u s u u u u u u u u u u u u u
HH:mm:SS u u f u u u u u u f"

Write command:

"HR 00:01:00 00:00:00 50 0
1 1 Sensor 0 1 0 3 0 1 0 0 0 0 1 1
00:01:00 25 00 1.000 000 020 005 095 0 0 1.000"

"HH" Get number of times UV lamp is turned on, hours left, voltage and status of both UV lamps

Example:

Read command: "HH"

Response:

"UVLamp1: 4 4300 1.000000 Good"
"UVLamp2: 0 4300 1.000000 Good"

"HC" Set/get user-calibrated conductivity slope — Slope range should be between 0.9 and 1.1.

Example:

Read command: "HC"
Response: "1.000"
Write format: "HC f"
Write command: "HC 0.95"

"HT" Set/get user TOC slope — Slope range should be between 0.85 and 1.15.

Example:

Read command: "HT"
Response: "1.000"
Write format: "HT f"
Write command: "HT 1.05"

“PC” Show conductivity calibration history

Example:

Read command: “PC”

Response:

```
“        Conductivity Calibration”
“    Failed on 2007-08-16 06:27:13 PM”
“”
“Analyte        Replicates        Average”
“100 µS         000 000 000       000 ppb”
“”
“Slope Change = 2956.1 %”
“Slope Change Limits:”
“10% from previous calibration”
“5% from factory calibration”
“Calibration Rejected   “
“…”
“…”
```

“PS” Show system suitability history

Example:

Read command: “PS”

Response:

```
“        System Suitability Test”
“    Passed on 2007-08-13 12:54:04 PM”
“”
“Analyte        Replicates        Average”
“rW             014 008 009       010 ppb”
“500 rS         592 594 596       594 ppb”
‘500 rSS        523 572 596       563 ppb””
“”
“Limit response (rS-rW): 584 ppb”
“Suitability response (rSS-rW): 553 ppb”
“Response efficiency: 094%”
“Efficiency limit: 85% to 115%”
“…”
“…”
```

“PT” Show TOC calibration history

Example:

Read command: “PT”

Response:

```
“            TOC Calibration”
“    Failed on 2007-08-14 02:00:36 AM”
“”
“Analyte        Replicates        Average”
“Blank          245               245 ppb”
“”
“Correlation Coefficient = 0.0000”
“Calibration Rejected”
```

"PV" Show TOC validation history

Example:

Read command: "PV"

Response:

```
"              TOC Validation"
"     Passed on 2007-08-22 19:46:25"
""
"Analyte         Replicates        Average"
"Blank           023 023 023       023 ppb"
"500 std         512 512 512       512 ppb"
""
"500 ppb std Response = 489 ppb"
'500 ppb std Deviation = -2.2%"
""
"Deviation limit = 15%"
"Validation Accepted    "
```

Diagnostic commands

"RM" Get analyzer mode and state

Mode	State
0 = Offline	0 = Idle
1 = Online TOC	1 = Start sample
2 = Online conductivity	2= Calibrate
3 = Digital TOC	3 = Start flushing
4 = Manual TOC	4 = Flushing
5 = Manual bottle	5 = Wait 15 seconds
6 = Manual clean	6 = Reading TOC
7 = Manual diagnostic	8 = Analysis done
8 = Standby	9 = Initialization error
	10 = Error

Example:

Read command: "RM"

Read format: "Mode State"

Response: "0 0"

Chapter 3 Startup

3.1 Startup sequence

The analyzer goes through the following sequence on power up:

1) **Splash window:** The splash window appears at startup while the system launches the application.
2) **Verify lamp monitor:** After the system has initialized, it verifies that the lamp monitor works by turning on the main lamp and ensuring a voltage is returned.
3) **Sample bottle check:** The system checks to see if the bottles loaded in the bottle bay match the last known configuration. If the bottles contain RFID tags, the analyzer reads the tags and compares them against the information stored in the settings. If the RFID tag doesn't match what's stored in the settings, the settings are updated with the new information and a warning is generated. If the settings list a non-RFID tagged bottle in one of the bottle positions and an RFID tag cannot be detected in that position, the analyzer assumes the bottle is still present.
4) **Start sampling:** If the analyzer is configured for online TOC, it starts sampling after it has powered up.
5) **Print header:** After the system has started up, it prints a daily header.

3.2 Analyzer initialization

With the plumbing, input, outputs and power connections properly established, the ANATEL PAT700 can be initialized and placed into operation. Because the cleanliness of commercially available tubing varies (particularly stainless steel), it is suggested that the analyzer's flow path be thoroughly flushed. This is accomplished by placing the instrument in either on-line TOC mode or self-clean mode for several hours.

To initiate the PAT700 and place in self clean mode:

1) Open the isolation valve to initiate flow to the analyzer.
2) Turn on the analyzer. The analyzer will go through the sequence described above following power up.
3) To place the analyzer in self-clean mode, access the Run Mode screen by touching the << tab to open the sliding toolbar.
4) Touch the run mode icon at the top of the sliding tool bar.
5) At the Run Mode dialog box, touch the self-clean icon.
6) Refer to Self clean mode, page 51 to set the desired self-clean mode time. In self-clean mode the analyzer's UV lamp is turned on to oxidize any contaminants inside the analysis cell as sample water continuously flows through the analyzer to flush away impurities. Allow the analyzer to run in this state for at least 3-4 hours, or longer if the sample tubing is lengthy or if the sample point pressure is low.
7) With the analyzer sufficiently cleaned, on-line TOC analysis is initiated by selecting Online TOC in the Run Mode dialog box.

NOTE

To ensure accurate and representative results after installation or long-term storage, allow the instrument to complete several analyses before accepting the reported data as valid.

3.3 Logging on and off

The sign on and sign off icons enable you to sign on or sign off the analyzer. By default, security is disabled and the user cannot sign on. To enable security, see Security, page 69.

If you are signed on to the system, touching the sign off icon signs you off and changes the icon to the sign on icon.

If no one is signed on to the system, touching the sign on icon causes the sign on dialog box to appear. You then must enter your user ID and password. For more information about the user ID and password, see Chapter 10.

- If you are signed on remotely, you cannot be signed off locally.
- If you are signed on locally, you cannot be signed off by a remote user.

After you've signed on locally, the icon changes to the sign off icon. After you've signed on remotely, the icon changes to indicate that someone is logged on remotely.

Auto logoff

The analyzer logs the current user off after the user-defined period of time.

- If the analyzer is displaying the home screen, the icon in the sliding toolbar changes to the sign on icon.
- If the analyzer is displaying any dialog box other than the home screen, the sign on dialog box is displayed, requiring you to sign back on.

3.4 Home screen

The home screen provides an overview of the analysis results and provides access to the navigation menu bar. See Figure 3-1. The home screen includes:

- A sliding toolbar for navigation.
- A data section to view the last data readings, view a log of past data readings, or a graph of past data readings.
- A display of the current date and time.
- A display of the current sampling mode.
- A process animation.
- An OASIS bottle system status indicator in the lower left hand corner. (Touching this icon provides immediate access to the bottle mode dialog box.)
- UV lamp status indicators in the lower right hand corner. (Touching this icon provides immediate access to the diagnostics dialog box.)

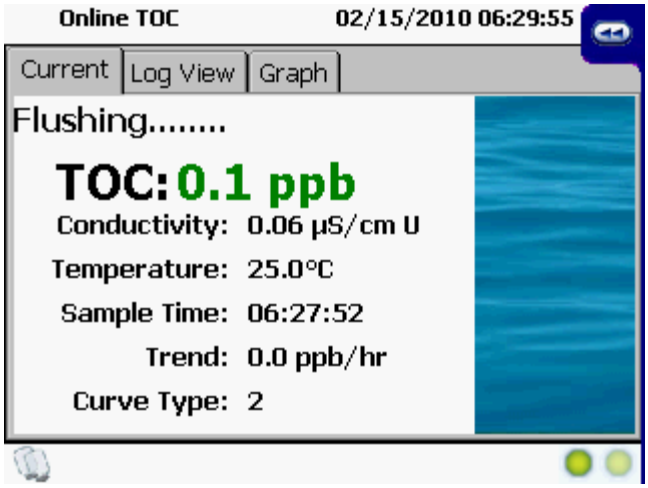


Figure 3-1 Home screen

Sliding toolbar

The sliding toolbar consists of icons that enable you to navigate through the analyzer menu structure or to access a single function. The toolbar is hidden most of the time. You may access the toolbar by touching the << tab in the upper right corner of the home screen. Touching the >> tab hides the toolbar again. If the sliding toolbar is open and an icon or the >> tab is *not* touched, the toolbar closes in 15 seconds.

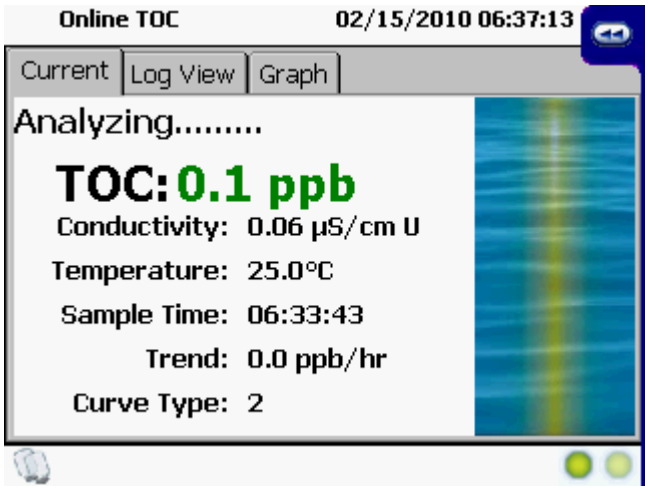


Figure 3-2 Home screen with sliding toolbar open

Run mode icon allows you to change the operating mode of the analyzer. Touching the icon takes you to the run mode dialog box without interrupting the current analysis.

Setup icon allows you to modify the settings of the analyzer. Touching the icon takes you to the setup dialog box, which contains navigation icons, without interrupting the current analysis.

Bottle mode icon allows you to enter bottle mode. Touching the icon takes you to the bottle mode dialog box without interrupting the current analysis.

Alarm icon allows you to review and acknowledge current or unacknowledged alarms. If no alarms are present, the icon is gray. Touching the icon takes you to the alarm review dialog box and displays all unacknowledged alarms without interrupting the current analysis.

Diagnostics icon allows you to check the health of the analyzer. Touching the icon takes you to the diagnostics dialog box without interrupting the current analysis.

Data review icon allows you to view the information from the log file. Touching the icon takes you to the data review dialog box without interrupting the current analysis.

Sign on or sign off icon allows you to sign onto the analyzer to modify or change the operation, or to sign off to prevent changes, without interrupting the current analysis. Sign on icon will be gray if security is disabled.

- If no user is signed on, the sign on icon is present. Touching the icon when no one is signed on causes the sign on dialog box to appear, so you may enter your user ID and password.
- If you are already signed on, the sign off icon is present. Touching the icon when you are signed on signs you off. While you are logged off, you have view-only access to all dialog boxes except security and the audit trail, but you can issue print commands.

3.5 Home screen data views

Home screen data views include current, log view, and graph tabs. You may switch from tab to tab without interrupting the current analysis.

Current tab

The current tab displays the last analysis values, depending on the selected analysis mode. In all modes except standby, offline, conductivity, and clean, the current tab displays the last readings for TOC, conductivity, temperature, curve type, trend, and the time of the last reading. The home screen also indicates the current state of the analysis in text and through process animation. See Figure 3-3.

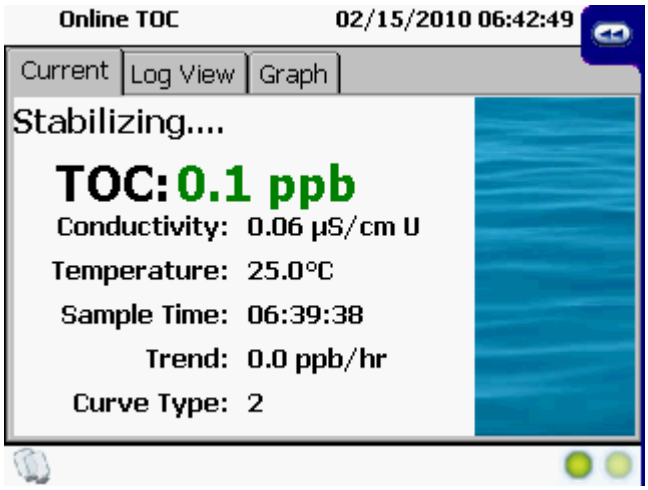


Figure 3-3 Home screen, current tab

Text field (left side of screen) includes the following variables:

- **Analysis state** is the current state (idle, flushing, stabilizing, analyzing, or reporting).
- **Run mode** is the selected mode of the analyzer. The choices for operation mode are online TOC, conductivity, standby, offline, self clean, and online manual TOC.
- **TOC** reading is in “TOC: X.X ppb” format. The range of values is 0.1 to 2500 ppb. If the value exceeds 2500, “Over limit” is displayed as “OL”.
- **Conductivity** is the last conductivity reading in “Conductivity: X.XX µS/cm” format for compensated conductivity and “Conductivity: X.XX µS/cm U” format for uncompensated conductivity. If resistivity is selected, it is displayed as “Resistivity: X.XX MΩ-cm C” for compensated resistivity. The home screen displays conductivity or resistivity, depending on the display units selected in the setup dialog box.

- **Temperature** is the last temperature reading in “Temperature: X.X °C” format or “Temperature: X.X °F” format, depending on the temperature units selected in the setup dialog box.
- **Sample time** is the time of the start of the last reading in the selected Time format.
- **Trend** is the TOC trend over the last hour in “Trend: +/-X.X ppb/hr” format.
- **Curve type** is the curve type for the last TOC reading in “Curve Type: X” format, where X can be one of four types (1, 2, 3, or 5). Curve types 1, 2 and 3 characterize the conductivity profile over time during oxidation and indicate typical water chemistry. Abrupt changes in the curve type can indicate a change in water chemistry. A 5 curve type is a change in conductivity indicative of the possible presence of organic acid. When a 5 curve type is experienced, the analyzer provides a Warning for possible organic acids.

Date and time (top of screen) displays the current date and time in ISO format. Depending on the current time format setting, the date and time is in 24-hour format (yyyy-mm-dd hh:mm:ss) or 12-hour format (yyyy-mm-dd hh:mm:ss AM/PM). The date and time are configured in the setup dialog box. The date display depends upon language selection.

Bottles icon (lower left corner of screen) displays the current state of the bottles in the bottle bay. There are three states for this indicator (no bottles loaded, bottles loaded, or bottles empty). Touching the icon takes you to the bottle mode dialog box.

Status indicator (lower right corner of screen) displays the status of the two UV lamps.

- Green indicates the UV lamp is good.
- Yellow indicates the UV lamp is marginal and should be replaced.
- Red indicates the UV lamp has failed and must be replaced.

Process animation (right side of screen) displays the current state of the analysis as an animated graphic. There are five possible states: water flowing through the cell, water not flowing through the cell, analyzing, new alarm condition, and acknowledged alarm condition. Analysis results are displayed until a new analysis is complete. The values for conductivity, temperature and time are the initial readings prior to the oxidation of the water sample.

Log view tab

The log view tab displays all analysis readings or events as they would appear on the printout. The display include all data, up to the last 72 hours, since the last power-up. See Figure 3-4.

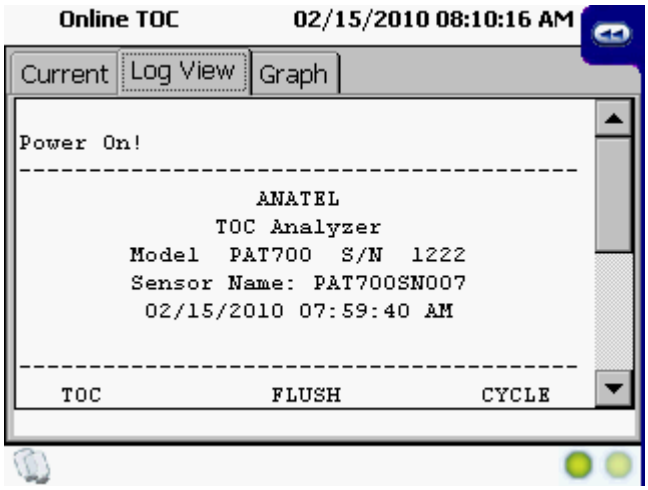


Figure 3-4 Home screen, log view tab

Graph tab

The graph tab displays the past three days of data values. In all modes except conductivity, the graph displays TOC values. In conductivity mode, the graph displays averaged conductivity values. These values are averaged over the last 30 minutes. See Figure 3-5.

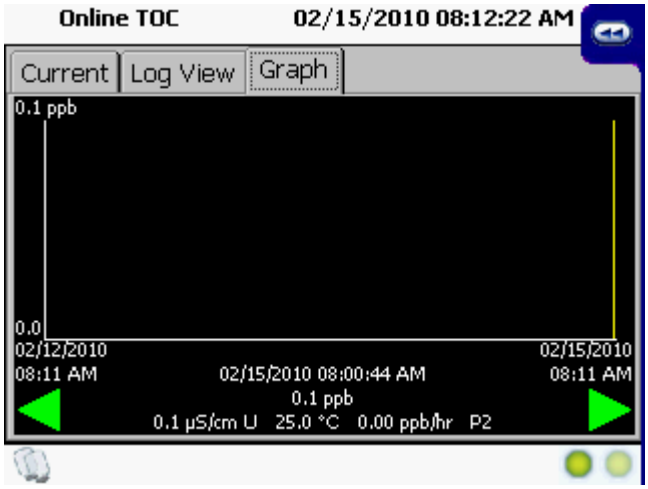


Figure 3-5 Home screen, graph tab

Scroll icons move the graph cursor one point to the left or right.

Data values text label displays the TOC value, conductivity, temperature, timestamp, trend, and curve type for the current cursor position.

Chapter 4 Run Modes

4.1 The analysis cycle

An analysis cycle is comprised of a flush of the analysis cell, oxidation, and idle time (if the cycle time is greater than the combined flush and oxidation time).

Oxidation time varies based on the amount of total organic carbon in the sample. Flush time is configurable and idle time varies to allow for varying analysis cycle time. See Figure 4-1.

Idle time occurs only after an online TOC analysis has been completed and only if the elapsed time has not exceeded the value for cycle time.

During idle time, the analyzer can operate in one of three ways: flow without conductivity, flow with conductivity, or no flow.

- When flow without conductivity is selected, the sample valve opens during idle, allowing continuous flow through the cell. No conductivity is reported.
- When flow with conductivity is selected, the sample valve opens during idle, allowing continuous flow through the cell. Conductivity of the water is reported.
- When no-flow is selected, the analyzer sample valve closes, stopping all flow through the sample cell during idle.

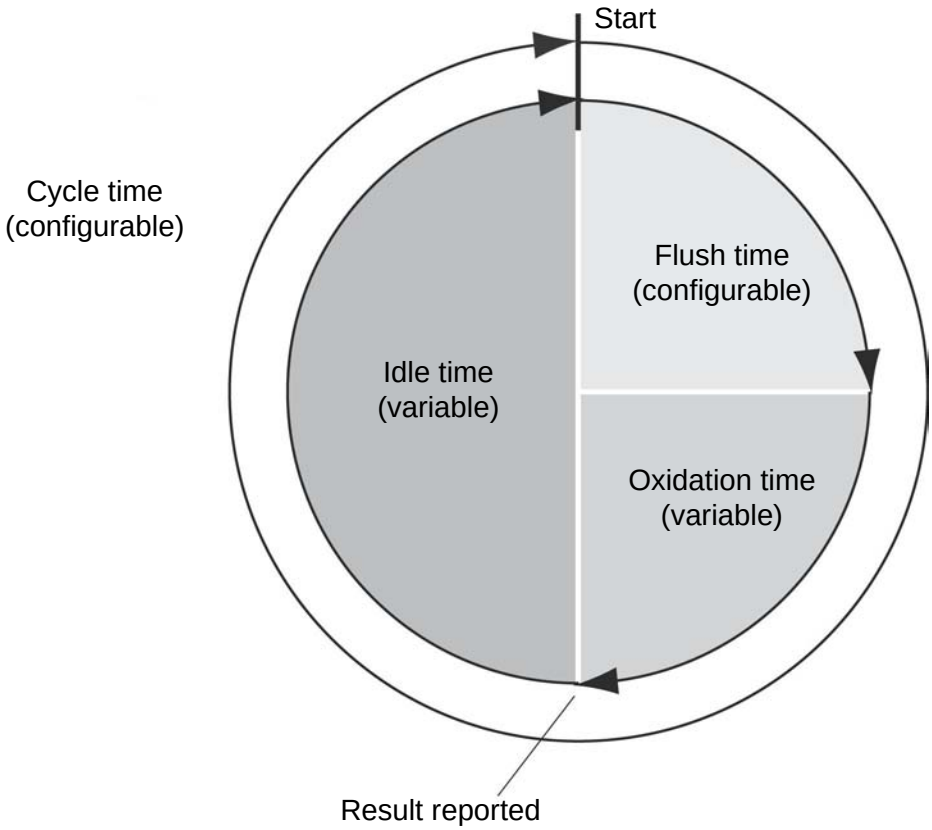


Figure 4-1 The TOC analysis cycle

4.2 Accessing run modes

To access run modes, follow these steps:

1) At the home screen, touch the << icon to open the sliding toolbar.
2) Touch the run mode icon.
3) At the run mode dialog box, touch the radio button that represents the desired run mode. See Figure 4-2.

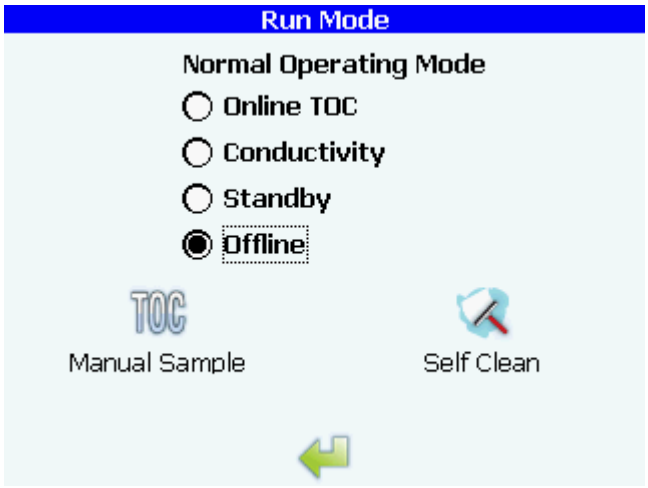


Figure 4-2 Run mode dialog box

NOTE

Normal operating modes do not apply when "Control with digital inputs" is selected in the TOC setup dialog box under the Digital Control tab. Refer to Digital control tab, page 56***.***

4.3 Online TOC mode

In online TOC mode, the home screen highlights the TOC reading, with conductivity, temperature, sample time, trend, and curve type displayed in smaller text. See Figure 4-3.

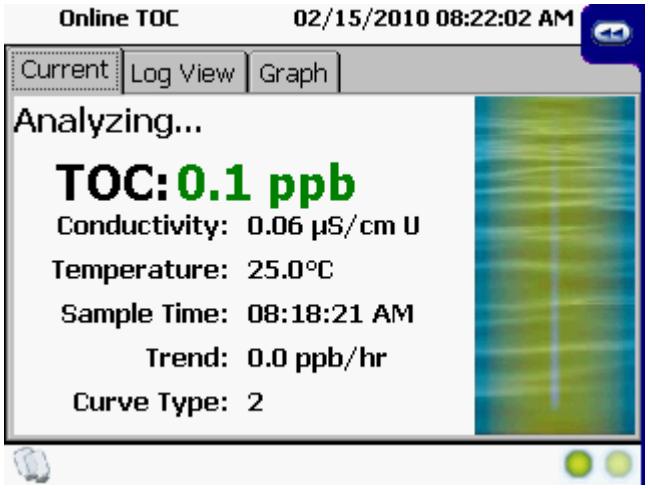


Figure 4-3 Home screen, current tab, online TOC mode

Sampling with pressure

CAUTION

Potential burst hazard! Do not exceed the maximum 100 psi (690k Pa) sample pressure ratings.

NOTE

Using the sample pump on a pressurized system could damage the pump. Do not use the sample pump on a pressurized system.

In online TOC mode, the cell valve opens to flush the cell.

- When flushing is completed, the cell's sample valve closes, the analysis begins, and initial conductivity and temperature readings are fed into the TOC algorithm. Conductivity is monitored until oxidation is complete.
- When oxidation is complete, the analyzer reports the results to the home screen, the data log, and the printer, based on the printer settings and if the printer is connected. The analyzer then checks to see if the elapsed time is greater than or equal to the value for cycle time in settings. If it is, the next online TOC analysis is started. Otherwise, the analyzer enters the idle mode.

Sampling from a zero pressure system

If you are sampling from a zero pressure system, you can enable the pump option to draw water into the cell. For instructions on setting up the pump option, see General tab, page 54.

4.4 Conductivity mode

In conductivity mode, the home screen displays conductivity and temperature readings. See Figure 4-4.

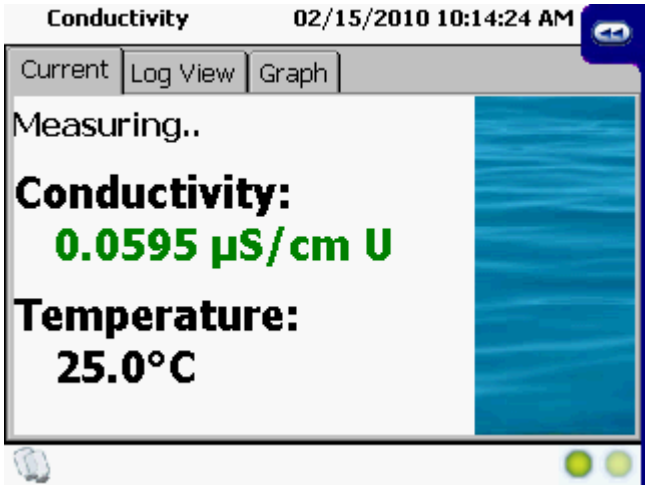


Figure 4-4 Home screen, current tab, conductivity mode

In conductivity mode, the analyzer starts by verifying that the UV lamp is off and the cell valve is open to flush the cell. The analyzer reports the current readings for conductivity and temperature every time a new value is available. The reported value is an average of the data over the last two seconds. The average reading is also sent to the printer, based on the printout settings, and to the data log. One data point is written to the log every 60 seconds.

4.5 Standby mode

In standby mode, the analyzer verifies that the lamp is off and the valves are open. You can terminate standby mode by switching to another mode.

Figure 4-5 Home screen in standby mode

4.6 Offline mode

In offline mode, the analyzer verifies that the lamp is off, the valves are closed, and flow through the analyzer has stopped. You can terminate offline mode by switching to another mode.

Figure 4-6 Home screen in offline mode

4.7 Manual TOC Sample

A TOC analysis can be performed manually by touching the TOC Manual Sample icon. Upon touching the TOC manual sample icon the analyzer will immediately stop its current operation and run one TOC analysis. Upon completion of the this analysis the analyzer will return to the mode currently selected under the run mode screen.

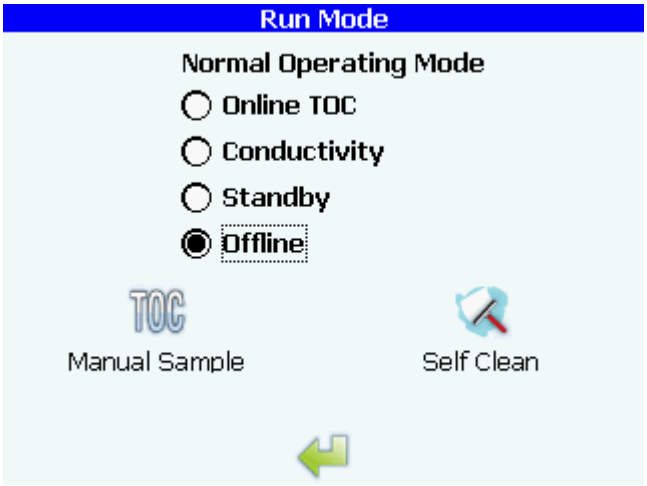


Figure 4-7 Run mode screen with manual sample

4.8 Self clean mode

To access self clean mode, touch the self clean icon to open the self clean setup dialog box.

Timed checkbox allows you to select timed or manual self cleaning.

Enter time text box allows you to enter the amount of time that will elapse during the timed self cleaning. If a checkmark is present in the timed checkbox, touch the enter time text box, then enter the desired amount of time for the self cleaning.

If a checkmark is not present in the timed checkbox, the self cleaning continues until it is stopped by the user.

Figure 4-8 Self clean setup dialog box

In manual self clean mode, the analyzer starts by setting the elapsed time to 0, opening the cell valve to flush the cell, and turning the lamp on. If timed self cleaning was selected, the dialog box displays the time remaining. Otherwise, the dialog box displays the elapsed time. Self cleaning stops if you touch the stop icon (red “X”) or if the analyzer is switched to another mode by schedule or by digital control.

Figure 4-9 Clean mode dialog box

Chapter 5 Setup

5.1 Accessing the setup dialog box

1) At the home screen, touch the << icon to open the sliding toolbar.
2) Touch the setup icon.

5.2 Setup dialog box

The setup dialog box allows you to navigate and change analyzer settings. Accessing this dialog box does not interrupt the current operation. See Figure 5-1.

Figure 5-1 Setup dialog box

Current analyzer configuration information can be exported from the setup dialog box using either the printer icon to print the information or the data export icon to export the information to a USB memory stick.

Printer icon prints the analyzer configuration data.

Export icon opens the export setting dialog box and allows export of configuration data to the USB port.

Return icon returns you to the main screen.

5.3 TOC

The TOC icon allows you to modify the settings for the TOC operating mode. Any changes are stored in the settings file and become the defaults.

General tab

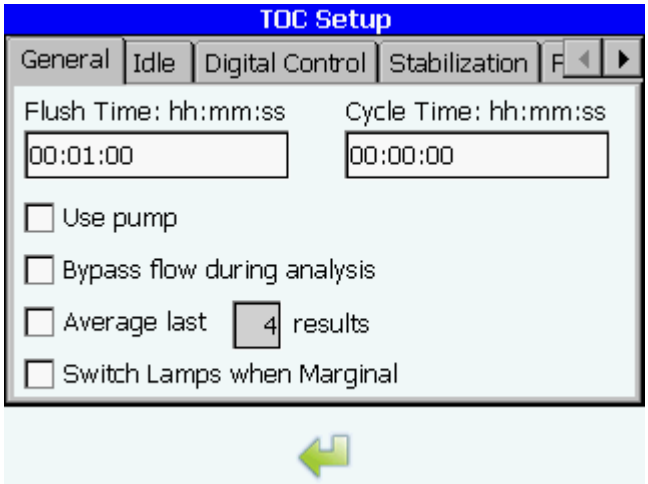


Figure 5-2 TOC setup dialog box, general tab

Flush time text box allows you to specify the amount of time to flush the cell prior to beginning a TOC analysis. You may specify a time in hh:mm:ss format between 00:00:00 and 23:59:59. The default value is 00:01:00.

Cycle time text box allows you to specify the minimum amount of time between automatic TOC analyses. Any value less than the actual elapsed time causes the next analysis to begin immediately. You may specify a time in hh:mm:ss format between 00:00:00 and 99:59:59. The default value is 00:00:00.

Use pump checkbox determines whether or not to use the pump for online sampling. You may enable or disable this option. If enabled, the analyzer turns the pump on any time water needs to be drawn from the online water source to the cell. If disabled, the analyzer does not use the pump for this action. Due to the potential risk of damage to the pump by using it with a positive pressure water source, enabling this option displays a message asking you to confirm this choice. The default setting for this option is disabled.

NOTE

Using the sample pump on a pressurized system could damage the pump. Do not use the pump on a pressurized system.

Bypass flow during analysis checkbox allows you to enable or disable bypass flow. Bypass flow enables continuous flow of sample water through the analyzer, bypassing the analysis cell, during TOC analysis. The bypass valve is open when the sample is captured and closed when the analysis is complete. If enabled, the bypass flow valve opens at the beginning of the flush. If disabled, this valve remains closed. The default setting is disabled.

Average last results checkbox averages the last X TOC analyses. The averaged value is displayed on the home screen and in the log view, logged to the data log, and sent to the printer based on the printer settings. The default value is disabled.

Switch lamps when marginal allows you to enable or disable switching of the UV lamps when one lamp reaches a marginal level of UV intensity. When this box is checked the analyzer will automatically switch to the alternate lamp when UV Detect diagnostics senses a marginal level of UV intensity on the operating lamp.

Return icon returns you to the setup dialog box and saves the changes. Any changes are noted in the audit trail. All changes take effect on the next change of state.

Idle tab

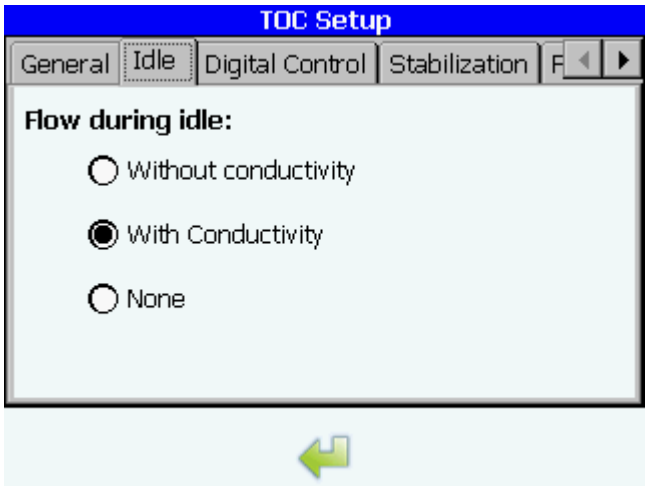


Figure 5-3 TOC dialog box, idle tab

Flow during idle radio buttons allows you to select the state that the analyzer should enter while waiting for the next analysis to begin if cycle time is greater than the time required for cell flush and oxidation. You may select without conductivity, with conductivity (default), or none.

- If without conductivity is selected, the sample valve opens during idle, allowing continuous flow through the cell. No conductivity is reported.
- If with conductivity is selected, the sample valve opens during idle, allowing continuous flow through the cell. Conductivity of the water is reported.
- If none, the analyzer sample valve closes, stopping all flow through the sample cell during idle.

Return icon returns you to the setup dialog box and saves the changes. Any changes are noted in the audit trail. All changes take effect on the next change of state.

Digital control tab

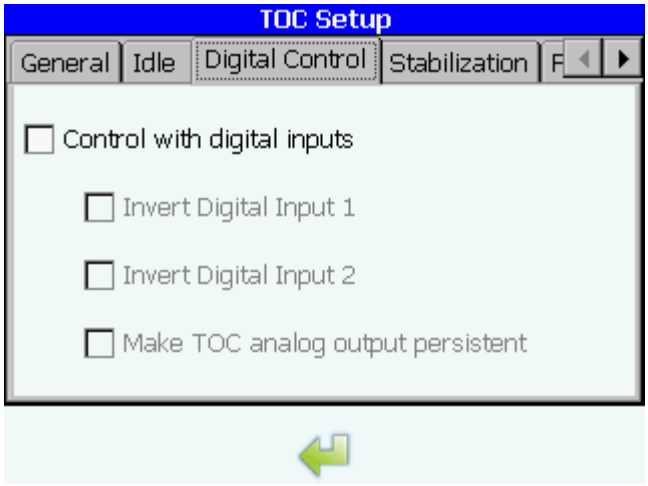


Figure 5-4 TOC dialog box, digital control tab

Control with digital inputs checkbox allows control of TOC analysis and operation mode through the use of the two digital inputs. The default setting is disabled. If enabled, the analyzer enters the mode defined by input 2 and TOC analysis can be initiated using input 1.

NOTE

When analyzer operation is selected for control by digital inputs the Normal Operating Modes in the Run Mode dialog box do not apply. All control is activated using the digital inputs.

The control required to activate digital inputs 1 and 2 can be configured by the user.

- In the default setting a high to low (applying power for at least 500 mSec) transition on digital 1 aborts the current operation and immediately runs a single TOC analysis. The analysis runs to completion regardless of whether subsequent trigger values are received.
- In the default setting, if digital input 2 is high (no power applied), the analyzer enters online TOC analysis mode. If digital input 2 is held low (power applied) the analyzer enters conductivity mode.

Invert Digital Input 1 changes the default state for control of digital input 1 from a high to low trigger to a low to high trigger. When Invert Digital Input 1 is selected, the analyzer stops the current operation and runs a single TOC analysis when a trigger is applied to the input by **removing** power across pins 1 and 2 for at least 500 mSec.

Invert Digital Input 2 changes the default state for control of digital input 2. When Invert Digital Input 2 is selected, the analyzer will be in TOC mode when power is supplied across pins 1 and 3 (low state). When power is not applied across pins 1 and 3 the analyzer runs in flow with conductivity mode.

Stabilization tab

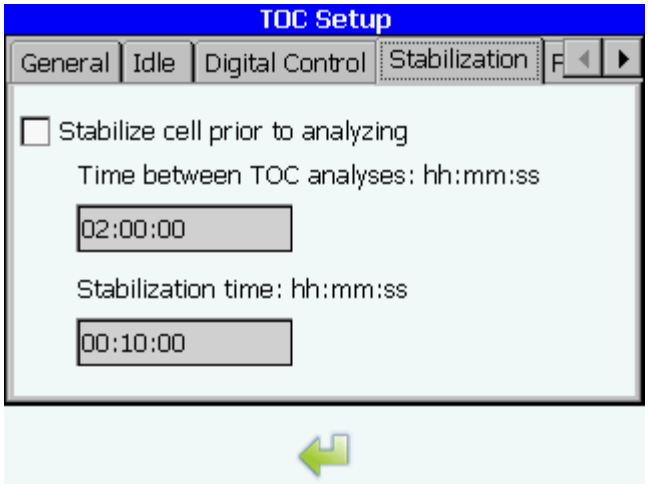


Figure 5-5 TOC dialog box, stabilization tab

When the analyzer switches to perform an on-line TOC analysis, after running the analyzer in continuous flow modes such as idle with conductivity, conductivity mode or standby for extend periods of time, a thermal stabilization and cleaning of the analysis cell can reduce the number of TOC analysis cycles necessary to produce stable results. An automatic stabilization process, along with its activation and duration criteria, can be enabled in the stabilization dialog box. The stabilization process involves trapping water in the cell and turning on the UV lamp to thermally stabilize and clean the cell.

Stabilize cell prior to analyzing check box allows you to enable automatic stabilization of the cell prior to performing a reportable TOC analysis.

Time between TOC analyses text box allows you to enter the minimum elapsed time between TOC analyses required to activate the automatic stabilization process. You may specify a time in hh:mm:ss format between 00:00:01 and 23:59:59. The default value is 02:00:00.

Stabilization time text box allows you to enter the amount of time to run the stabilization process. You may specify a time in hh:mm:ss format between 00:00:01 and 23:59:59. The default value is 00:10:00

P5 Curve

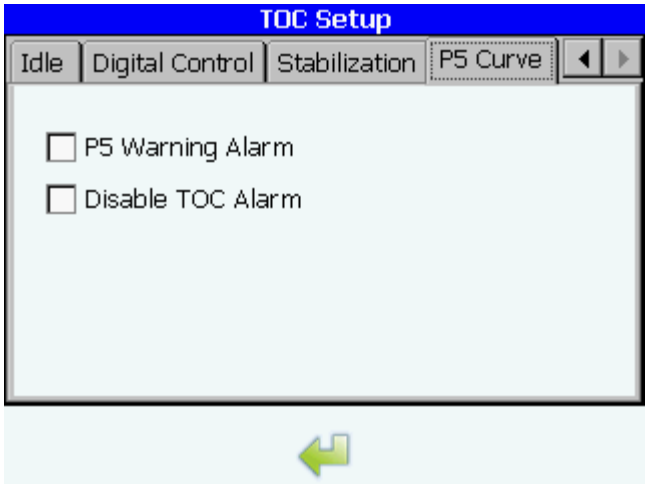


Figure 5-6 P-5 Curve dialog box

The user selectable P5 warning alarm and user selectable P5 TOC alarm functionality provide the user with complete control over how P5 events are handled. The system ships with the P5 Warning Alarm in the off state by default. TOC Setup also provides the option to Disable TOC Alarm when the analyzer reports a P5 state.

P5 Warning Alarm allows you to enable the P5 warning alarm. This feature will cause the instrument to alarm when a P5 condition is present. This is usually a sign of organic acids present in your water stream.

Disable TOC Alarm allows the user to disable the TOC alarm when a P5 condition is present. This feature allows the user to ignore TOC values above the set alarm limit when a P5 condition is present.

5.4 System

The system icon allows you to modify system settings for the analyzer.

General tab

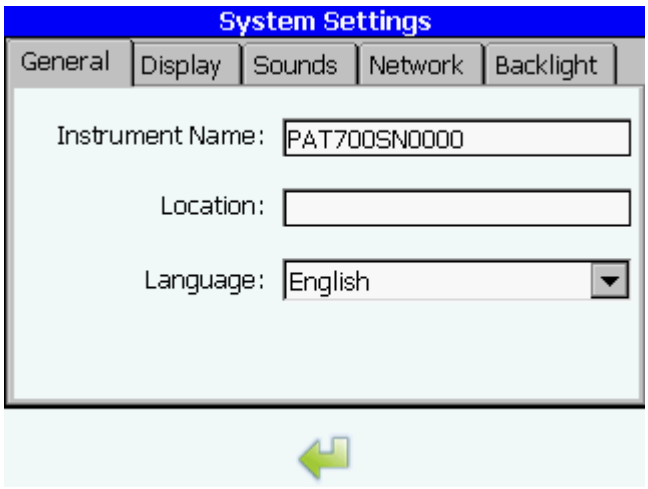


Figure 5-7 System settings dialog box, general tab

Instrument name text box allows you to specify the analyzer name used by the system. You may enter 1 to 13 alphanumeric or symbol characters. The default value is “PAT700 + Serial No.” Changing the instrument name will cause the system to reboot.

Instrument Location allows you to specify the location of the instrument.

Language drop down list box allows you to select the language to use for all your interfaces. You may currently select English.

- Selecting a different language changes the operating system setting in the registry. When the system is rebooted, the new setting takes effect. The default selection is English.
- For Japanese and Chinese translations, this control is disabled. In these cases, the appropriate language will be loaded at the factory.

Return icon returns you to the setup dialog box and saves the changes. Any changes are noted in the audit trail. All changes take effect on the next change of state.

Display tab

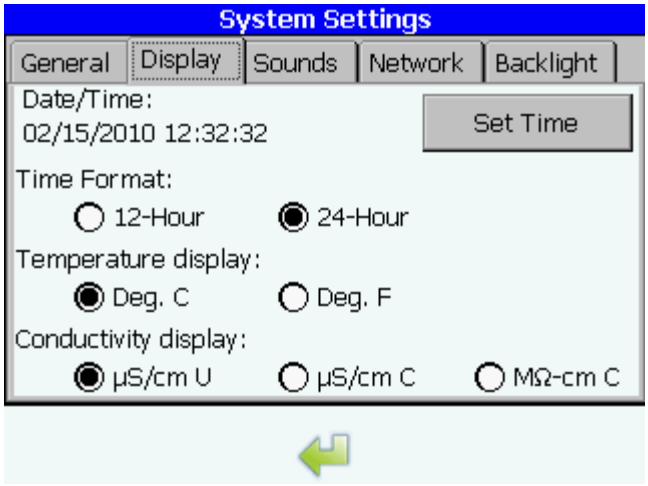


Figure 5-8 System settings dialog box, display tab

Set time icon allows you to specify the date and time to be used in the system. You may enter any valid date in “yyyy-mm-dd” format. You may enter any valid time in “hh:mm:ss” or “hh:mm:ss tt” format. The format used is based on the selected time format.

Time format radio buttons enable you to select the time format to be used in the system. You may select 12 or 24-hour format. Selecting one of the formats changes the value displayed in the time box. The default selection is 24-hour format.

Temperature display radio buttons enable you to select the format for displaying temperature values. You may select °C and °F. The default value is °C.

Conductivity display radio buttons enable you to select the format for displaying conductivity values. You may select uncompensated conductivity (µS/cm U), compensated conductivity (µS/cm C), or compensated resistivity (MΩ-cm C). The default value is uncompensated conductivity. If the conductivity alarm option has been selected, the conductivity display must be set to uncompensated conductivity (µS/cm U).

Return icon returns you to the setup dialog box and saves the changes. Any changes are noted in the audit trail. All changes take effect on the next change of state.

Sounds tab

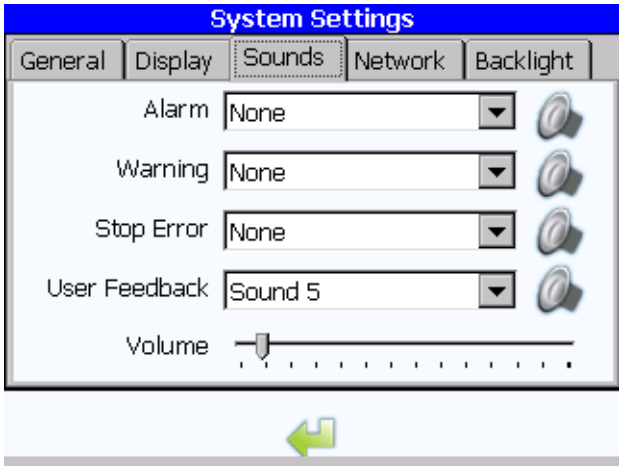


Figure 5-9 System settings dialog box, sounds tab

Alarm, warning, stop error, and user feedback list boxes enable you to select the system sounds to be associated with certain alarm types.

Test icons play the selected sound for the corresponding alarm.

Volume slider controls the level of the volume. Moving the slider to the right increases the volume and moving it to the left decreases the volume.

Return icon returns you to the setup dialog box and saves the changes. Any changes are noted in the audit trail. All changes take effect on the next change of state.

Network tab

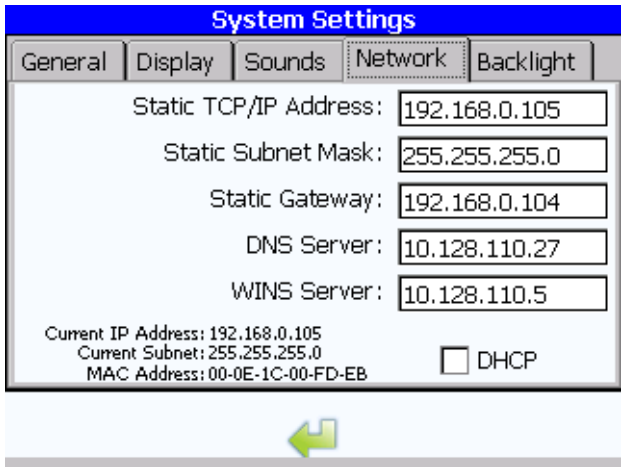


Figure 5-10 System settings dialog box, network tab

Static TCP/IP address text box sets the TCP/IP address for the analyzer. You may specify a value of 0 to 255 for each octet. The default value is 192.168.0.105.

Static subnet mask text box sets the subnet mask for the analyzer. You may specify a value of 0 to 255 for each octet. The default value is 255.255.255.0.

Static gateway text box sets the default gateway for the analyzer. You may specify a value of 0 to 255 for each octet. The default value is blank.

DNS server text box sets the DNS server address for the analyzer. You may specify a value of 0 to 255 for each octet. The default value is blank.

WINS server text box sets the WINS server address for the analyzer. You may specify a value of 0 to 255 for each octet. The default value is blank.

DHCP check box allows you to enable or disable DHCP. When enabled, the TCP/IP address, subnet mask, and default gateway entries are disabled. The default setting is enabled.

Return icon returns you to the setup dialog box and saves the changes. Any changes are noted in the audit trail. All changes take effect immediately.

Backlight tab

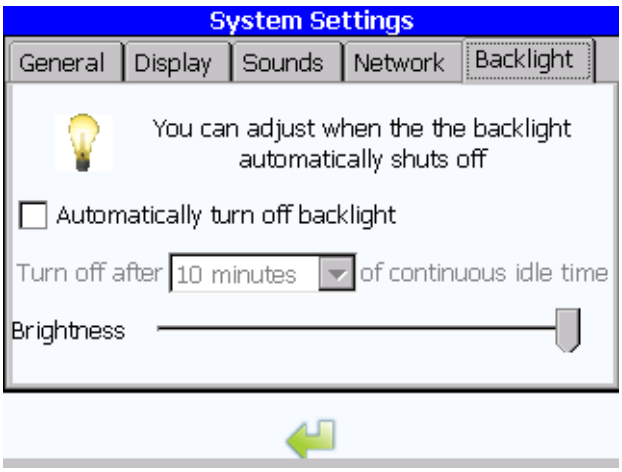


Figure 5-11 System settings dialog box, backlight tab

The display backlight can be automatically disabled after a specified period of time by selecting this option.

Automatically turn off backlight check box allows you to enable or disable automatic shutoff of the display backlight.

Turn off after X minutes of continuous idle time drop down list allows you to select the amount of idle time before the backlight is automatically turned off. You may select from 2, 5 10, 15, 30 minutes.

5.5 Alarms

The alarms icon allows you to enable or disable TOC and conductivity alarms for the system.

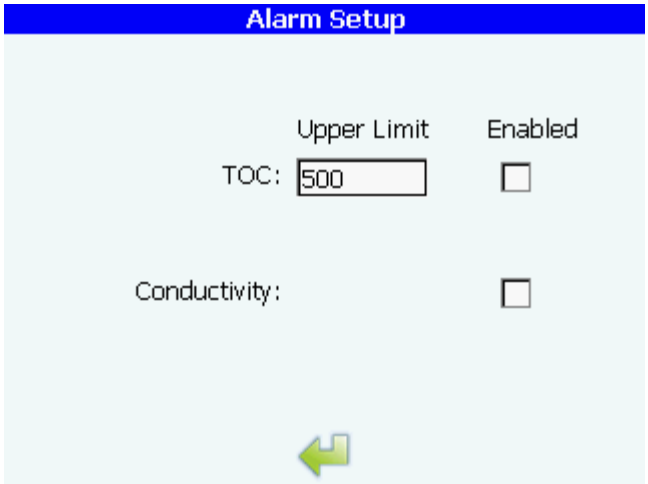


Figure 5-12 Alarm dialog box

TOC upper limit text box allows you to set the alarm upper limit for online TOC measurement. You may enter a value from 1 to 2500. The default value is 500. The value applies only to online TOC analysis, not to bottle tests or grab sample analysis.

TOC enabled checkbox allows you to enable or disable the online TOC alarm. If enabled, any online TOC reading that exceeds the alarm upper limit triggers a TOC alarm. If disabled, no TOC alarms are triggered. The default setting is enabled.

Conductivity enabled checkbox allows you to enable or disable the conductivity alarm. If enabled, any conductivity reading that exceeds the value in Table 5-1 for the current temperature triggers a conductivity alarm. If disabled, no conductivity alarms are triggered. The default setting is enabled.

Alarms are reported for conductivity excursions only in the uncompensated mode and require that uncompensated conductivity be selected.

NOTE

For proper operation of the conductivity alarm, uncompensated conductivity must be selected under the general tab of the System Setting dialog box. Refer to Display tab, page 60***.***

The actual (uncompensated) conductivity limits are in accordance with the specifications set forth in the method “<645> Water Conductivity” of the USP 25–NF 20 (January 2002).

Table 5-1 Conductivity alarm limits

Temperature (°C)	Uncompensated Conductivity (µS/cm)	Temperature (°C)	Uncompensated Conductivity (µS/cm)
0	0.6	55	2.1
5	0.8	60	2.2
10	0.9	65	2.4
15	1.0	70	2.5
20	1.1	75	2.7
25	1.3	80	2.7
30	1.4	85	2.7
35	1.5	90	2.7
40	1.7	95	2.9
45	1.8	100	3.1
50	1.9		

The actual sample water temperature is rounded downward to the nearest 5° to establish the conductivity limit, thereby assuring any potential excursions are detected early. For example, if the measured water temperature is 24.5 °C, the 20 °C limit is applied and an alarm is generated if the conductivity exceeds 1.1 µS/cm U.

To ensure agreement between all data outputs, TOC, conductivity, and temperature values are all rounded to match the analyzer’s accuracy for alarm limit checking, display, printouts, and any digital outputs.

Return icon returns you to the setup dialog box and saves the changes. Any changes are noted in the audit trail.

5.6 Analogs

The analogs icon allows you to configure the analog outputs for the system. The analyzer has analog outputs for TOC, conductivity, and temperature.

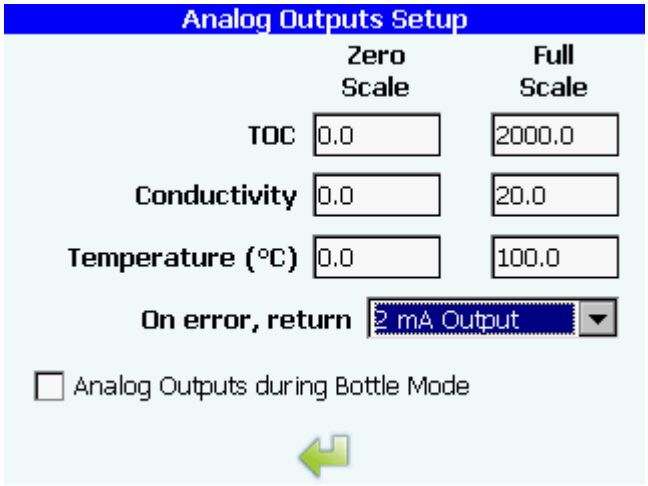


Figure 5-13 Analog outputs setup dialog box

TOC zero scale text box sets the TOC reading that corresponds to the lowest output for the selected range. You may enter a value from 0 (default) to 1999 ppb. The full scale value must be higher than the zero scale value.

TOC full scale text box sets the TOC reading that corresponds to the highest output for the selected range. You may enter a value from 1 to 2000 ppb (default). The full scale value must be higher than the zero scale value.

Conductivity zero scale text box sets the conductivity reading that corresponds to the lowest output for the selected range. You may enter a value from 0 (default) to 19 µS/cm. The full scale value must be higher than the zero scale value.

Conductivity full scale text box sets the conductivity reading that corresponds to the highest output for the selected range. You may enter a value from 1 to 20 µS/cm (default). The full scale value must be higher than the zero scale value.

Temperature zero scale text box sets the temperature reading that corresponds to the lowest output for the selected range. You may enter a value from 0 (default) to 99 °C. The full scale value must be higher than the zero scale value.

Temperature full scale text box sets the temperature reading that corresponds to the highest output for the selected range. You may enter a value from 1 to 100 °C (default). The full scale value must be higher than the zero scale value.

On error, return drop down list box determines the output that the analyzer produces when an alarm condition occurs. You may select 2 mA output (default), last output, or 22 mA output.

Analog outputs during Bottle Mode enables analog data output during bottle sampling mode.

Return icon returns you to the setup dialog box and saves any changes. Any changes are noted in the audit trail.

5.7 Printer

The printer icon allows you to configure the printer settings for the analyzer. You can independently configure the printing of analysis results and the frequency of printing for online TOC and conductivity modes.

Printer connection is made using the 9-pin D-subminiature serial port. The RS-232 interface communicates at 9600 baud, 8 data bits, 1 stop bit, no parity.

The printout report requires a 40-column printer.

- If the printer is purchased from Hach, the switches are preset at the factory.
- If a Seiko Instruments DPU-414 Type II thermal printer is installed, the electronic DIP switches must be set as listed in Table 5-2:

Table 5-2 Printer DIP switch settings

DIP Switch 1

Switch	Setting	Function
1	Off	Serial input
2	On	High print speed
3	On	Auto loading enabled
4	Off	Auto linefeed disabled
5	On	Enabled setting
6	Off	Print density
7	On	Print density
8	On	Print density

DIP Switch 2

Switch	Setting	Function
1	On	40-column printing
2	On	Backup font enabled
3	On	Normal characters
4	Off	Zero = Slash
5	On	International character set = USA
6	On	International character set = USA
7	On	International character set = USA
8	Off	International character set = USA

Table 5-2 Printer DIP switch settings

DIP Switch 3

Switch	Setting	Function
1	On	8 data bits
2	Off	Parity setting = Yes
3	On	Parity condition = Odd
4	Off	Flow control (X on/X off)
5	Off	9600 baud rate
6	On	9600 baud rate
7	On	9600 baud rate
8	On	9600 baud rate

To change the printer settings:

1) Turn the printer power switch OFF.
2) Restore power while pressing the ONLINE button. Release the button when a printout of the current settings begins.
3) Push the ONLINE button again. “DIP SW1” is printed, prompting you for changes to switches 1 through 8.
4) Enter the settings for DIP switch 1 by pressing ONLINE for ON (enabled) and FEED for OFF (disabled) for switches 1 through 8 in succession. The ONLINE LED illuminates to indicate an ON entry; the OFFLINE LED indicates an OFF entry. *Make sure to enter a setting for all eight switches.* The setup mode cannot be cancelled once initiated.
5) After all eight switches have been set, a printout prompts you whether to continue or repeat the procedure for DIP switches 1 through 3 or write the current settings to memory. After the settings have been saved, a printout is generated and the printer returns to normal operation. *Do not turn the printer off while it is saving settings.* Wait until “Dip SW setting complete!” is printed before shutting off power.

TOC tab

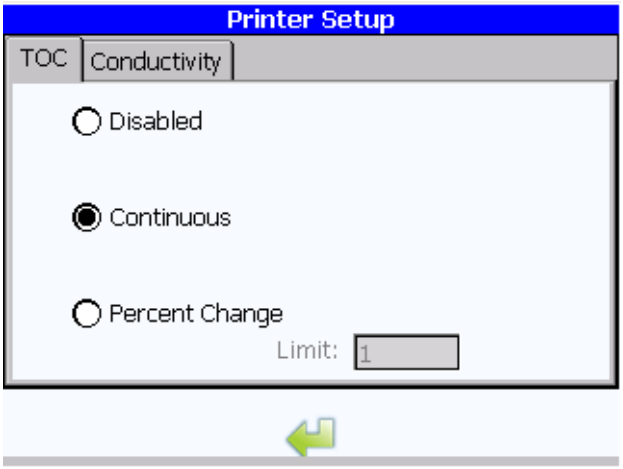


Figure 5-14 Printer dialog box, TOC tab

Disabled, continuous, and percent change radio buttons determine how often an online TOC reading will be printed. You may select disabled, continuous, or percent change.

- Selecting disabled disables printing of online TOC readings.
- Selecting continuous (default) causes a TOC printout to occur at the end of each analysis cycle and disables the percent change text box.
- Selecting percent change causes a TOC printout to occur only when the change in online TOC readings between successive analyses exceeds the value specified in the percent change box and enables the percent change text box.

Limit text box allows you to enter the percentage change in online TOC readings that must occur between successive analyses before a printout occurs. You may select a value from 1 to 100%. The default value is 1.

Return icon returns you to the setup dialog box and saves the changes. Any changes are noted in the audit trail.

Conductivity tab

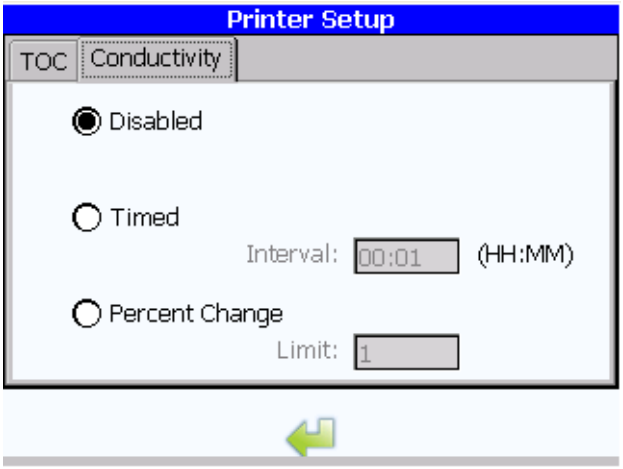


Figure 5-15 Printer dialog box, conductivity tab

Disabled, timed, and percent change radio buttons determine how often an online conductivity reading will be printed in conductivity mode. You may select disabled, timed, or percent change.

- Selecting disabled disables printing of online conductivity readings.
- Selecting timed causes a printout to occur at the interval specified in the interval text box and disables the percent change text box.
- Selecting percent change causes a printout to occur only when the change in conductivity between successive analyses exceeds the value specified in the percent change box. Selecting percent changes also disables the interval text box.

Interval text box allows you to determine how often a printout occurs in timed mode. You may enter a value from 1 minute to 24 hours. The default value is 1 minute.

Limit text box allows you to enter the percentage change in online conductivity readings that must occur between successive analyses before a printout occurs. You may select a value of 1 to 100%. The default value is 1%.

Return icon returns you to the setup dialog box and saves the changes. Any changes are noted in the audit trail.

5.8 Security

The security icon allows you to modify the security settings for the system. The security dialog box allows configuration of general security features, setting and modifying user accounts, and viewing of the audit trail.

General tab

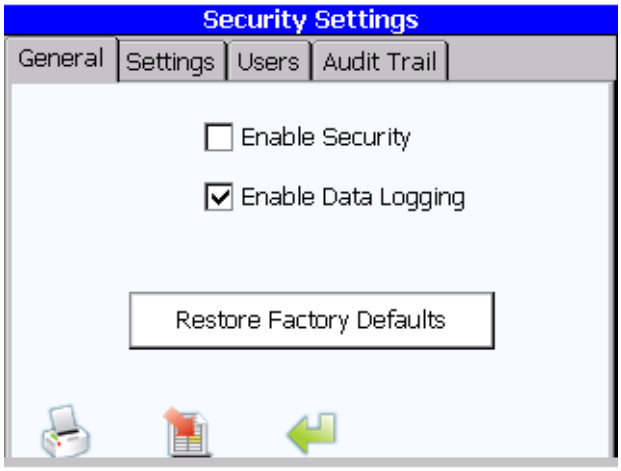


Figure 5-16 Security settings dialog box, general tab

Enable security checkbox allows you to enable or disable the analyzer's security system. When security is enabled, you are required to sign on prior to making changes in the analyzer, and only the administrator may access the security settings. When security is disabled, you are not required to sign on. Disabling the analyzer's security system disables the audit trail and all controls on this dialog box except the enable data logging checkbox. The default setting is disabled.

Enable data logging checkbox allows you to enable or disable data logging. When enabled, all data (up to 5000 records) are automatically stored in the analyzer's internal data buffer. When disabled, no data are saved. The default setting is enabled.

Restore Factory Defaults button will return the analyzer configuration settings to the factory defaults (see PAT700 Default Settings, page 183 for a list of the default values). When activated all valves are closed and the internal pump is turned off.

Printer icon prints the security settings.

Export icon opens the Export Settings and Oxidation files dialog box. See Figure 5-17.

Return icon returns you to the setup dialog box and saves the changes. Any changes are noted in the audit trail.

Figure 5-17 Export settings dialog box

Filename text box contains the filename for the exported data file, which includes all settings, the data log, and the alarm log. The default file name is mmddyyyyhhmmss (month, day, year, hour, minute, seconds) with the.txt extension.

Exporting record no: X bar graph indicator displays the progress of the export.

Export icon starts the export. Before the export begins, the analyzer verifies that there is data to export, that you have entered a valid file name, and that a USB flash drive is inserted into the analyzer's USB port. The file is written to a PAT700 directory in the root directory of the flash drive. If the file already exists, you are asked if you want to overwrite it.

Return icon returns you to the security dialog box.

Settings tab

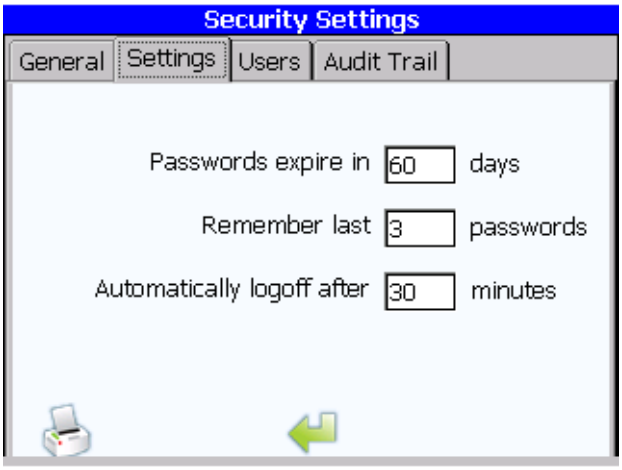


Figure 5-18 Security settings dialog box, settings tab

Passwords expire in text box allows you to set the number of days a user's password may be used before it must be changed. You may enter a value from 30 to 365 days. The default value is 60.

Remember last X passwords text box allows you to set the number of passwords to keep in memory to prevent a user from using an old password. You may enter a value from 0 to 5 passwords. The default value is 3.

Automatically logoff after X minutes text box allows you to set the number of minutes of inactivity before auto logoff. You may enter a value from 0 to 60 minutes. A setting of 0 disables auto logoff. The default value is 30.

Return icon returns you to the setup dialog box and saves the changes. Any changes are noted in the audit trail.

Users tab

The users tab allows you to add, edit, or delete users of the analyzer. Up to 10 users can be configured for the analyzer. Administrator and factory users cannot be deleted.

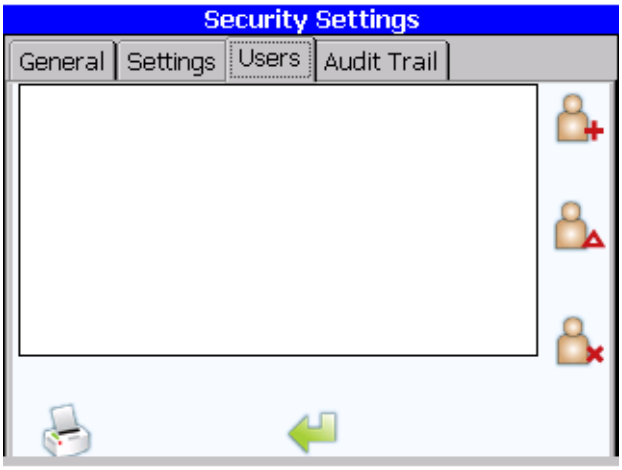


Figure 5-19 Security settings dialog box, users tab

Four different user types may access the system: guest, operator, administrator, and factory. Only operator users may be added or deleted from the system.

- **Guest.** This user type is any user who is not logged on to the system. This user may access most areas and view information but is not allowed to modify any settings or initiate any operations. Guests have no access to the security settings dialog box.
- **Operator.** This user type has full access to most dialog boxes. Operators have no access to the security settings dialog box and read-only access to the factory settings and the bottle mode settings.
- **Administrator.** This user type has full access to most dialog boxes. Administrators have read-only access to the factory dialog box. The default administrator entry has a user name of “Administrator”, a user ID of “Admin”, and a password of “123456”.
- **Factory.** This user type has full access to all dialog boxes.

User list box lists most users configured to use this analyzer. Administrator and factory users do not appear in the list. You may add up to 10 additional users to the list.

Add icon allows you to add a user to the system. Touching the icon opens the edit user dialog box.

Edit icon allows you to edit an existing user in the system. You must first select a user from the list. If no user is selected when this icon is touched, an error message appears. Otherwise, the edit user information dialog box appears. See Figure 5-20.

Delete icon allows you to delete an existing user from the system. You must first select a user from the list. If no user is selected when this icon is touched, an error message appears. Touching the icon with a user selected displays an “are you sure?” message. If you select “yes”, the selected user is deleted and an entry is made in the audit trail. If you touch “no”, you are returned to the security settings dialog box. The administrator and factory users may not be deleted.

Print security settings icon prints the user settings for all users except administrator and factory users.

Return icon returns you to the setup dialog box and saves the changes. Any changes are noted in the audit trail.

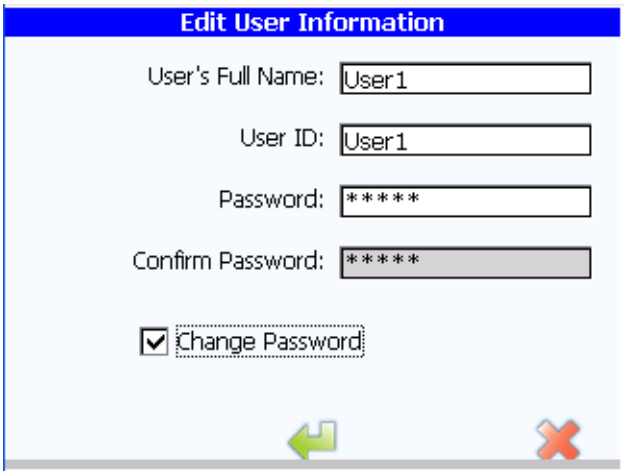


Figure 5-20 Edit user information dialog box

User's full name text box allows you to type from 5 to 20 alphanumeric or symbol characters. The default value is blank.

User ID text box allows you to type from 5 to 15 alphanumeric or symbol characters. The default value is blank.

Password text box allows you to type from 5 to 15 alphanumeric or symbol characters. The default value is blank.

Confirm password text box allows you to verify the new password. You may enter 5 to 15 alphanumeric or symbol characters. The field is case sensitive. The default value is blank. When you enter a character, only the * symbol appears for each key touch.

Change password checkbox forces the specified user to change his or her password at the next logon. The default setting for this option is disabled. Any time the password entry is modified, this option is enabled.

- If a change was made to the password, both passwords in the password and confirm password boxes must match. The new password may not be the same as any of the passwords in the password history list.
- A changed password triggers an entry in the audit trail but does not list the old or new password. The new password and date are added to the password history list.

Return icon returns you to the security settings dialog box and saves the changes. The ID and user name must be unique. Any changes are noted in the audit trail.

Cancel icon returns you to the security settings dialog box. All changes are discarded and no entries are made in the audit trail.

Audit trail tab

Only administrator and factory users can access the audit trail.

Any additions, modifications, or deletions to the analyzer configuration are noted by a keyword (added, modified, or deleted), the information affected, the old value (if applicable), the new value (if applicable), the full name of the user performing the operation, and the date and time of the change. System events such as logging in, exporting data, etc., are also noted in the audit log.

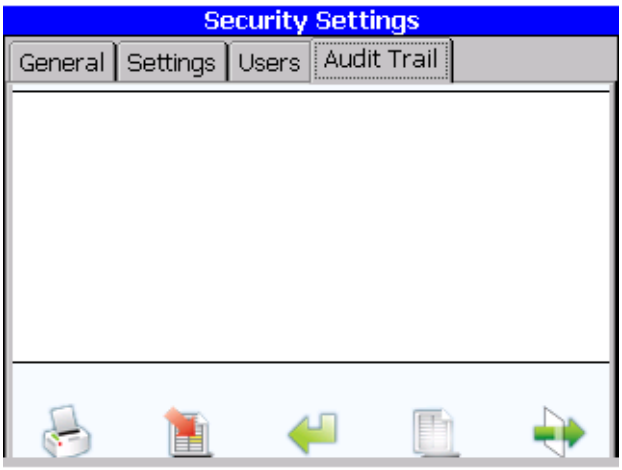


Figure 5-21 Security settings dialog box, audit trail tab

Audit trail display list box lists the filtered audit trail data.

- **Daily header** is displayed once per day preceding the first entry and at the change from one day to the next.
- **Entry header** is displayed at the beginning of each audit trail entry. It includes the time of the entry in long format (hh:mm:ss) and the name of the person associated with the entry. If the analyzer time is configured for 24-hour format, the AM/PM entry is blank.
- **Audit trail actions** follow the entry header. There are four types of entries possible for this section (data added, data modified, data deleted, or user action).
  - For the data added type, the keyword “Added” is displayed followed by the item name. The next line contains the keyword “New Value:” followed by the value name.
  - For the data modified type, the keyword “Modified” is displayed followed by one space and the item name. The next line contains the keyword “Old Value:” followed by the value name. The next line contains the keyword “New Value:” followed by the value name.
  - For the data deleted type, the keyword “Deleted” is displayed followed by two spaces and the item name. The next line contains the keyword “Old Value:” followed by the value name.
  - For action types, the action is displayed.

Print icon sends the filtered audit trail data to the printer.

Export icon opens the export audit trail dialog box. See Figure 5-22.

Clear data log icon allows you to clear the audit trail. Before you clear the data log, you must first answer “yes” when the clear datalog dialog box appears.

Filter icon opens the filter data dialog box. See Figure 5-23.

Return icon returns you to the setup dialog box and saves the changes. Any changes are noted in the audit trail.

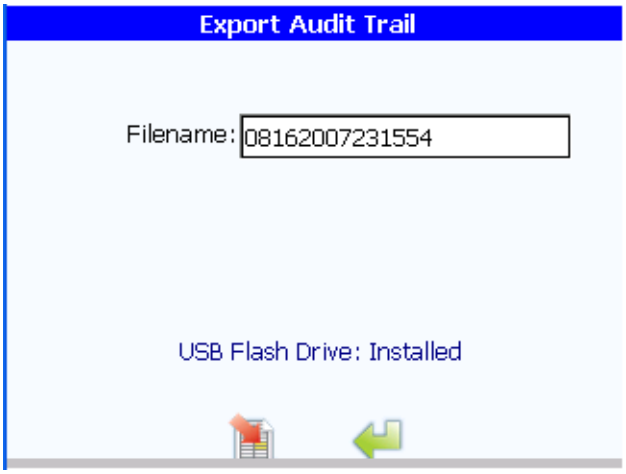


Figure 5-22 Export audit trail dialog box

The audit trail exports the entire audit trail in formatted clear text with a checksum to ensure data integrity.

Filename text box allows you to specify the filename for the exported data file. You may specify a 20-character file name. The default file name is mmddyyyyhhmmss (month, day, year, hour, minute, seconds) with the .txt extension.

Exporting record no: X thermometer displays the progress of the export.

Export icon starts the export. Before the export begins, the analyzer verifies that there is data to export, that you have entered a valid file name, and that a USB flash drive is inserted into the analyzer's USB port. The file is written to a PAT700 directory in the root directory of the flash drive. If the file already exists, you are asked if you want to overwrite it.

Return icon returns you to the audit trail dialog box.

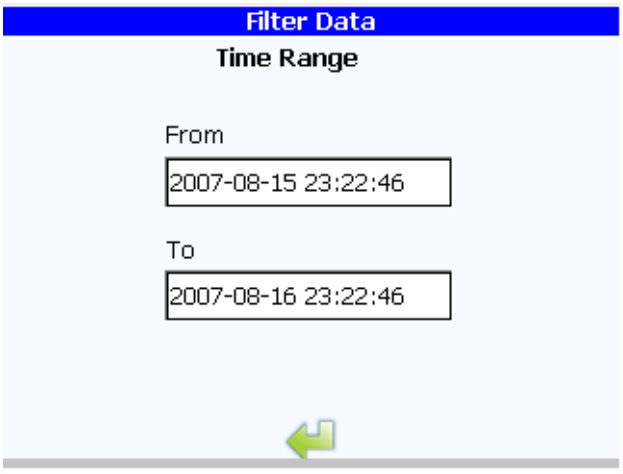


Figure 5-23 Filter data dialog box

From/to date and time range text box. Only audit trail entries that fall between the from and to date and time ranges are displayed in the audit trail display. Any valid date and time may be entered. The from date and time must be earlier than the to date and time. The default entries for these controls are the last 24 hours. These settings are not retained once you exit the security dialog box.

Return icon returns you to the setup dialog box and saves the changes. Any changes are noted in the audit trail.

5.9 Bottles

The bottles icon allows you to configure auto acceptance and test completion criteria for bottle mode operations.

TOC calibration tab

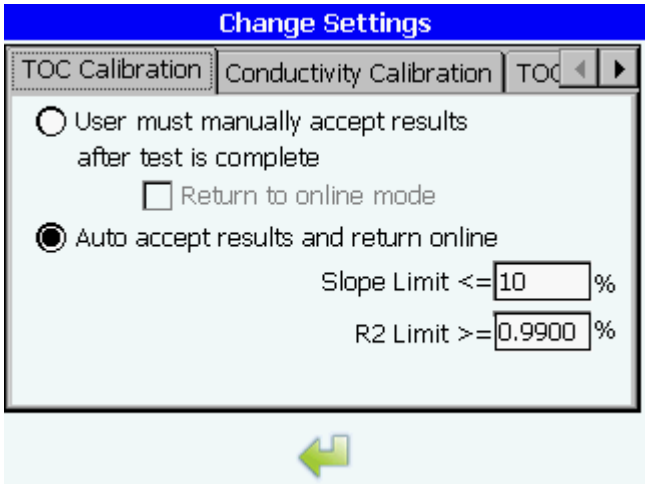


Figure 5-24 Bottle test setup dialog box, TOC calibration tab

User must manually accept results and auto accept results radio buttons determine whether the outcome of the test are manually or automatically accepted. You may select user must manually accept results (default) or auto accept results and return online.

- If user must manually accept results is selected, the results of the calibration will not be used until you accept them.
- If auto accept results and return online is selected, the slope and R^2 limit options are enabled. If the calibration is accepted, the new calibration factors are used.

Return to online mode checkbox tells the analyzer whether or not to return to online mode following the TOC calibration. You may enable or disable (default) this option. When enabled, the analyzer returns to online mode following the TOC calibration. When disabled, the analyzer stays at the bottle mode dialog box. All valves are closed, the pump is off, and the lamp is off.

Slope limit text box allows you to specify the acceptable limit of the slope for the calibration to pass. You may enter a value from 1 to 15%. The default value is 10%.

R2 limit text box allows you to specify the acceptable limit for the determination coefficient. You may enter a value from 0.9000 to 0.9999. The default value is 0.9900.

Return icon returns you to the setup dialog box and saves any changes. Any changes are noted in the audit trail.

Conductivity calibration tab

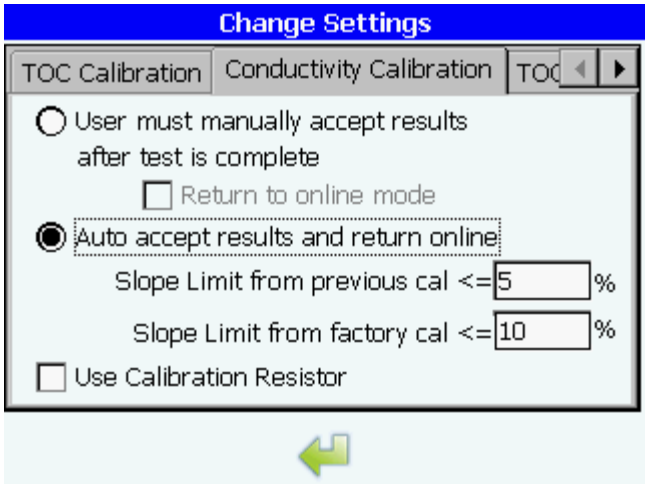


Figure 5-25 Bottle test setup dialog box, conductivity calibration tab

User must manually accept results and auto accept results radio buttons determine whether the outcome of the test are manually or automatically accepted. You may select user must manually accept results (default) or auto accept results and return online.

- If user must manually accept results is selected, the results of the calibration will not be used until you accept them.
- If auto accept results and return online is selected, the slope limit options are enabled. If the calibration is auto accepted, the new calibration factors are used.

Return to online mode checkbox tells the analyzer whether or not to return to online mode following the calibration. You may enable or disable (default) this option. When enabled, the analyzer returns to online mode following the calibration. When disabled, the analyzer stays at the bottle mode dialog box. All valves are closed, the pump is off, and the lamp is off.

Slope limit from previous cal text box allows you to specify the acceptable percent difference between the resulting gain factor and the current value. You may enter a value from 1 to 5%. The default value is 5%.

Slope limit from factory cal text box allows you to specify the acceptable percent difference between the resulting gain factor and the factory value. You may enter a value from 1 to 10%. The default value is 10%.

Use calibration resistor check box allows the use of the calibration check resistor during the conductivity calibration process. See Conductivity calibration, page 96.

Return icon returns you to the setup dialog box and saves any changes. Any changes are noted in the audit trail.

TOC validation tab

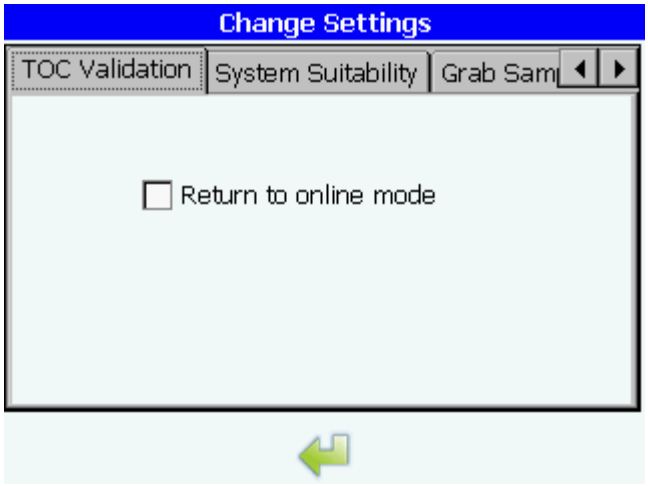


Figure 5-26 Bottle test setup dialog box, TOC validation tab

Return to online mode checkbox enables the analyzer to return to the online mode following the validation. You may enable or disable (default) this option. When enabled, the analyzer returns to online mode following the validation. When disabled, the analyzer stays at the bottle mode dialog box. All valves are closed, the pump is off, and the lamp is off.

Return icon returns you to the setup dialog box and saves any changes. Any changes are noted in the audit trail.

System suitability tab

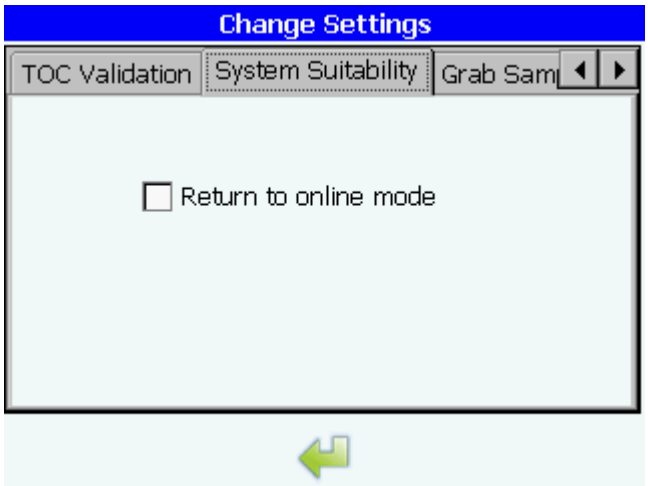


Figure 5-27 Bottle test setup dialog box, system suitability tab

Return to online mode checkbox enables the analyzer to return to the online mode following the system suitability test. You may enable or disable (default) this option. When enabled, the analyzer returns to online mode following the system suitability. When disabled,

the analyzer stays at the bottle mode dialog box. All valves are closed, the pump is off, and the lamp is off.

Return button returns you to the setup dialog box and saves any changes. Any changes will be noted in the audit trail.

Grab sample tab

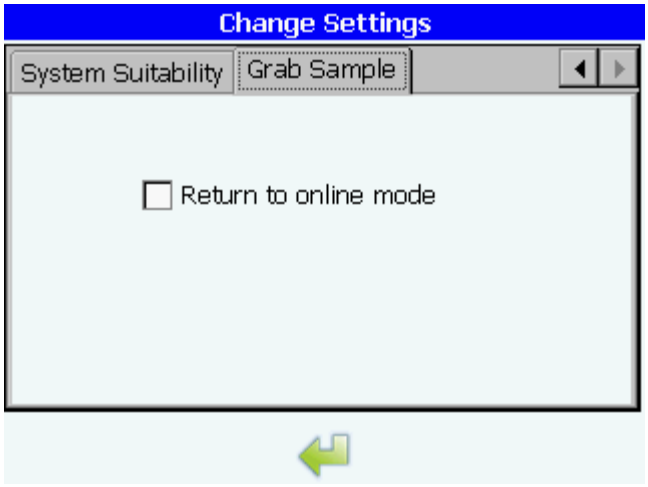


Figure 5-28 Grab sample dialog box

Return to online mode check box in the grab sample dialog enables the analyzer to return to the online mode following the analysis of one/multiple grab sample(s). When disabled, the analyzer stays at the grab sample mode dialog box. All valves are closed, the pump is off, and the lamp is off.

5.10 Password

The password icon allows you to change your password. For more information about the user ID and password, see Chapter 10. The password icon is highlighted and available when security is enabled. See Security, page 69.

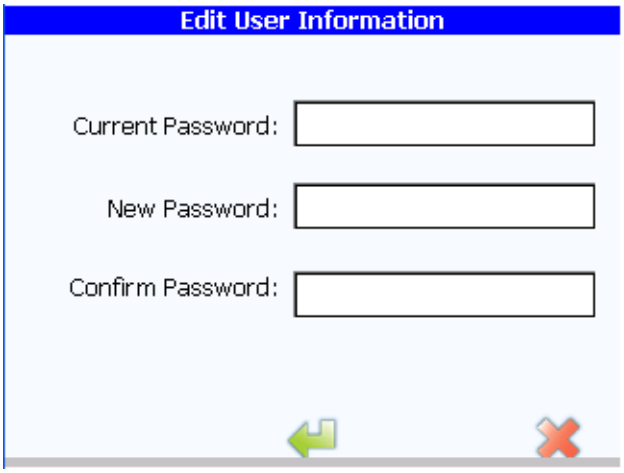


Figure 5-29 Change password dialog box

Current password allows you to type your current password. You may enter 5 to 15 alphanumeric or symbol characters.

New password allows you to type your new password. The new password may not be the same as any of the passwords in the password history list.

Confirm password allows you to retype your new password. Passwords in the password and confirm password boxes must match.

- You may enter 5 to 15 alphanumeric or symbol characters in each text box.
- All three text boxes are case sensitive.
- All default values are blank.
- When you enter a character, only the “*” symbol appears for each key touch.

OK icon returns you to the sign on dialog box and saves the changes. All changes are noted in the audit trail. None of the passwords appears.

Cancel icon returns you to the sign on dialog box. All changes are discarded and no entries are made in the audit trail.

5.11 Factory

The factory icon enables factory personnel to enter information that may not be changed by other users. Information on the factory dialog boxes can be viewed by any user but can be changed only by a factory user.

Entry into the factory dialog box for the purpose of changing the settings requires entry of the user ID and password. Touching the cancel icon enables read-only access to factory settings. See Chapter 10.

General tab

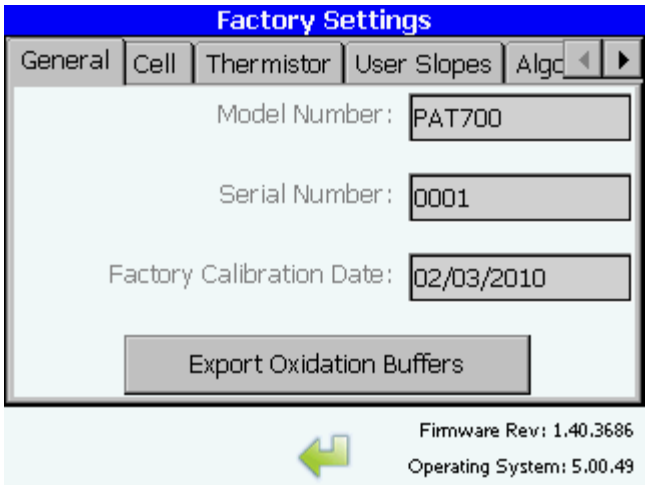


Figure 5-30 Factory settings dialog box, general tab

Model number text box displays the PAT700 model number.

Serial number text box displays the PAT700 serial number.

Factory calibration date text box displays the date of the last factory calibration in “yyyy-mm-dd” format. The date format will vary depending on the language selection.

Export oxidation buffers icon copies all oxidation buffers (up to five) to a connected USB flash drive. Before copying begins, the analyzer verifies that there is data to export and that a USB flash drive is inserted into the analyzer’s USB port.

Return icon returns you to the setup dialog box.

Cell tab

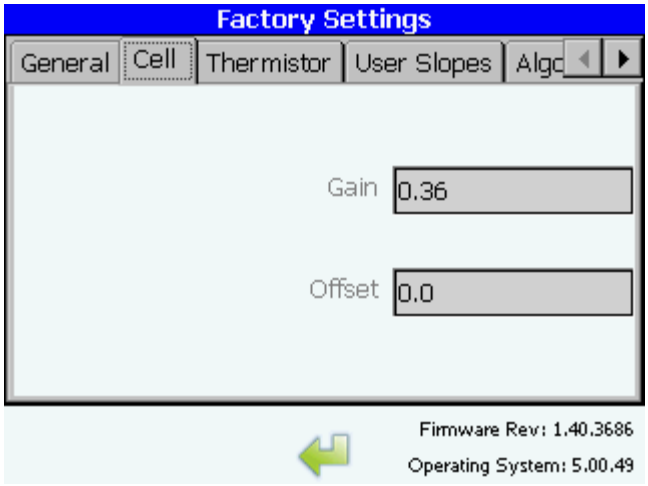


Figure 5-31 Factory settings dialog box, cell tab

Gain text box (read-only) allows you to view the cell gain factor.

Offset text box (read-only) allows you to view the cell offset value.

Return icon returns you to the setup dialog box and saves the changes. Any changes are noted in the audit trail.

Thermistor tab

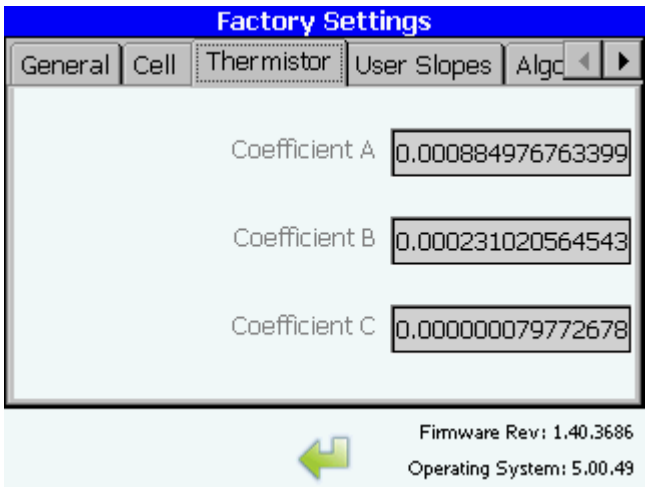


Figure 5-32 Factory settings dialog box, thermistor tab

The thermistor tab shows the read-only coefficient values for the thermistor.

Return icon returns you to the setup dialog box and saves the changes. Any changes are noted in the audit trail.

User slopes tab

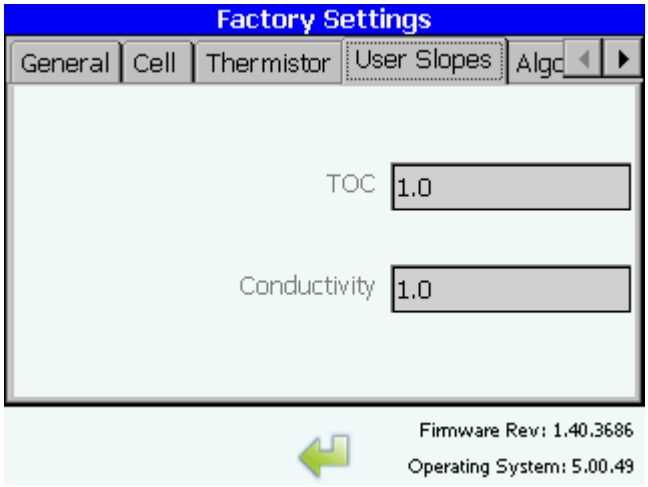


Figure 5-33 Factory settings dialog box, user slopes tab

TOC text box (read only) allows you to view the TOC calibration factor. This value is updated after a TOC calibration has been performed.

Conductivity text box (read only) allows you to view the conductivity calibration factor. This value is updated after a conductivity calibration has been performed.

Return icon returns you to the setup dialog box and saves the changes. Any changes are noted in the audit trail.

Algorithm tab

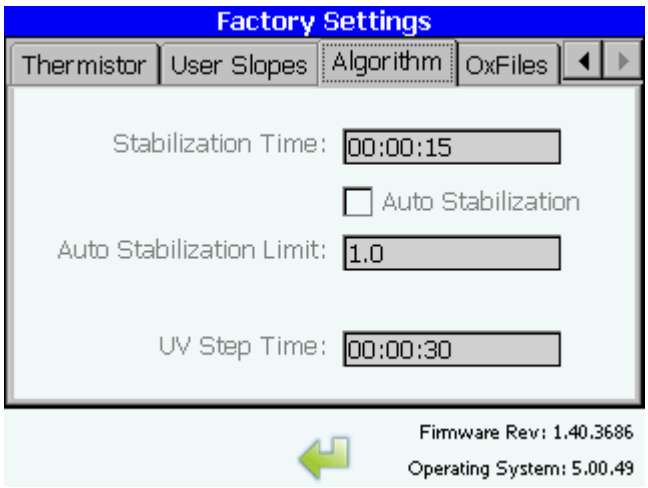


Figure 5-34 Factory settings dialog box, algorithm tab

The algorithm tab shows the algorithms used for stabilization time, auto stabilization limit, and UV step time. These are factory-set values that are read-only.

Return icon returns you to the setup dialog box.

OxFiles tab

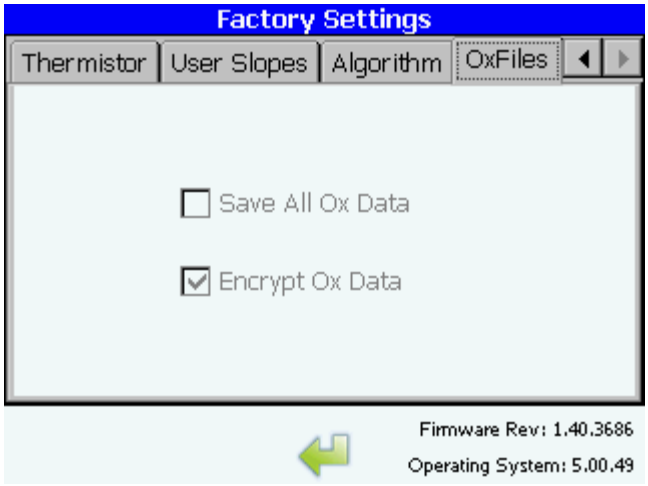


Figure 5-35 Factory settings dialog box, OxFiles tab

The OxFiles tab shows you whether OxFiles buffers are saved or encrypted. These are factory-set values that are read-only.

Return icon returns you to the setup dialog box.

Chapter 6 Bottle Mode

6.1 Calibration and validation

Bottle mode allows you to perform calibration, validation, and system suitability test procedures on the PAT700. Proper calibration of the analyzer is critical to maintaining optimum instrument performance. You may perform such functions automatically with the Onboard Automated Standards Introduction System (OASIS™) using the touch-screen interface. This method minimizes user intervention by using a prepackaged standards kit with RFID technology. You may run calibration, validation, and system suitability test procedures immediately or schedule them to run later.

This chapter provides *general* instructions on performing calibration and validation procedures. Refer to the specific Standard Operating Procedure (SOP) for detailed instructions.

- Calibration assures the accuracy of instrument's readings at regular intervals.The PAT700 is calibrated at the factory before shipment. You do not need to perform a TOC calibration before placing the analyzer into service.
- Validation ensures the accuracy of the calibration by challenging the calibration with the analysis of a known standard.
- Calibration and validation involve running analyses of one or more standards and blanks (protocols) to determine analyzer response.
- In bottle mode, the analog output retains the last online TOC, conductivity, and temperature values, and TOC and conductivity alarms are deactivated.

Four functions are available under bottle mode: run standards, grab sample, excursion mode, and unload bottles.

Onboard Automated Standards Introduction System (OASIS)

The PAT700 Onboard Automated Standards Introduction System (OASIS) is used for performing standards tests, grab sampling, and excursion sampling. Through the bottle mode, various bottle test functions can be selected. The OASIS system is automated through the use of RFID technology (see RFID technology, page 2). When standards bottles with RFID tags are installed in the system, the analyzer uses RFID technology to read and transmit data about the standards to the analyzer. This system eliminates the need for manual data entry.

Although equipped to perform automatically using RFID tagged standards, you may also use bottles without RFID tags by manually entering the standards data when prompted by the analyzer.

TOC calibration protocol

Select up to three levels (250, 500 and 750 ppb) of a sucrose standard. For maximum accuracy, the procedure allows up to three analysis replicates per standard.

TOC validation protocol

Perform a single-point or multi-point validation of the TOC calibration using up to three levels of sucrose validation standards.

Conductivity calibration protocol

Perform a conductivity calibration according to the guidelines established in USP Method <645>. The procedure uses an NIST-traceable calibrated resistor for determining meter accuracy and an NIST-traceable 100 µS/cm conductivity standard for cell constant verification.

System suitability protocol

Perform a system suitability test according to the guidelines established in USP Method <643> using prepackaged 500 ppb sucrose and 500 ppb 1,4-benzoquinone standards.

6.2 Accessing bottle mode

To access bottle mode, follow either of these procedures:

- Touch the << icon to open the sliding toolbar, then touch the bottles icon in the toolbar, or

- Touch the bottles icon in the lower left corner of the home screen.

NOTE

If security is enabled, you must be signed on the analyzer to access the bottle mode. Bottle tests can not be cancelled or accepted/rejected when security is enabled and a user is logged off the analyzer.

6.3 Bottle mode dialog box

The bottle mode dialog box allows you to perform procedures using the bottles in the bottle bay. You may run calibrations, validations, or system suitability tests, analyze samples from a bottle (grab sample), or install an excursion bottle to capture a sample when a TOC measurement exceeds an alarm limit, a conductivity alarm occurs, specific alarm conditions occurs, or manually. See Figure 6-1.

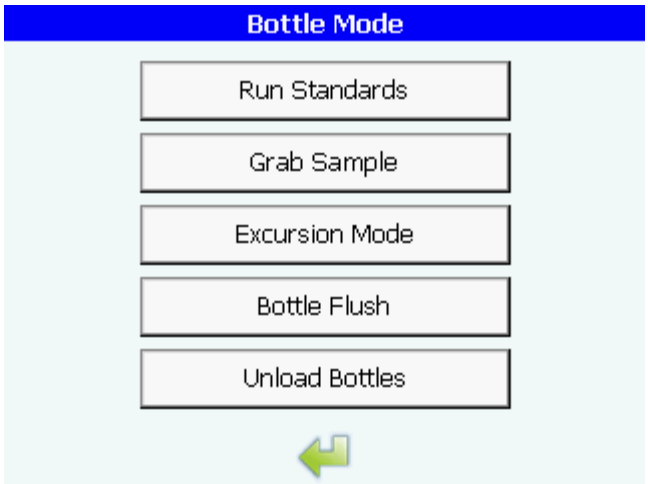


Figure 6-1 Bottle mode dialog box

Run standards button takes you to the run standards dialog box. See Run standards, page 87.

Grab sample button takes you to the grab sample load bottles dialog box. See Grab sample, page 104.

Excursion mode button takes you to the excursion mode dialog box. See Excursion mode, page 108.

Unload bottles button takes you to the unload/replace bottles dialog box. See Figure 6-12, page 95.

6.4 Run standards

The run standards dialog box allows you to select a standards test to run. See Figure 6-2.

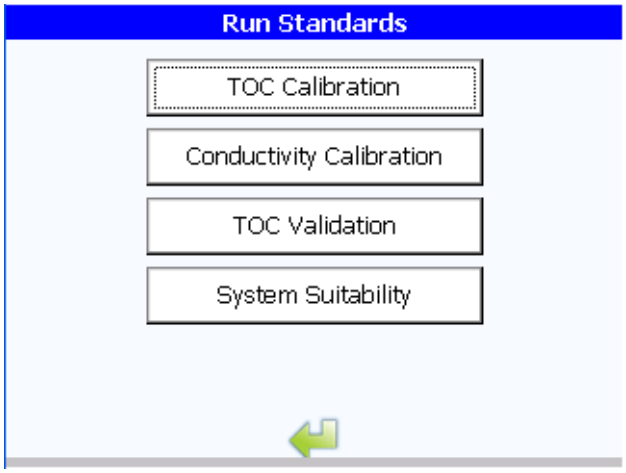


Figure 6-2 Run standards dialog box

TOC calibration button takes you to the TOC calibration setup dialog box.

Conductivity calibration button takes you to the conductivity calibration load bottles dialog box. See Conductivity calibration, page 96.

TOC validation button takes you to the TOC validation setup dialog box. See TOC validation, page 100.

System suitability button takes you to the system suitability load bottles dialog box. See System suitability test, page 102.

Return icon returns you to the bottle mode dialog box. See Bottle mode dialog box, page 86.

NOTE

Immediately following each test the standards bottles are backflushed and allowed to equilibrate to ambient pressure. DO NOT ATTEMPT TO REMOVE THE BOTTLES UNTIL THE BACKFLUSH AND PRESSURE EQUALIZATION IS COMPLETE.

6.5 TOC calibration

TOC calibration ensures the accuracy of the TOC values obtained by the analyzer. TOC values are determined by measuring the change in conductivity of a high-purity water sample as its organic compounds oxidize to carbon dioxide inside the analysis cell. The procedure subtracts the average of a series of background TOC measurements from the average of a series of user-selected standard measurements (in the form of sucrose). Linear regression is performed on the data, and the correlation coefficient (R^2) and percent slope change (% sc) are calculated and reported.

The recommended correlation coefficient, a user-accepted value (R^2), is 0.990 or greater. The calibration will be accepted if the R^2 value is 0.990 or greater and the percent slope change is within the specified ±15% limit.

TOC calibration setup

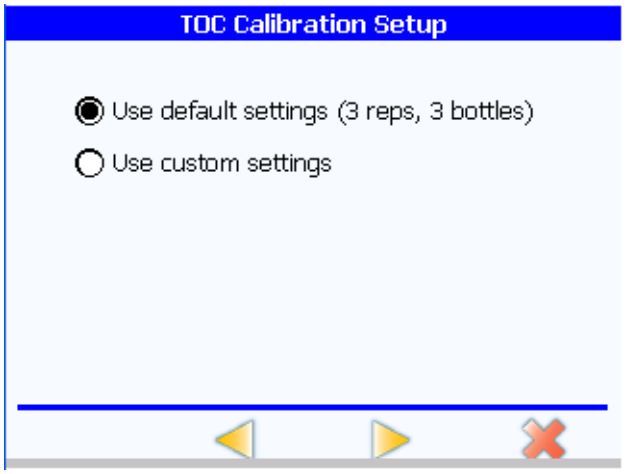


Figure 6-3 TOC calibration setup dialog box

Use default settings and use custom settings radio buttons enable you to select default settings or custom settings. The default selection is use default settings.

Back icon takes you back to the previous dialog box. All changes made to the TOC calibration are retained.

Forward icon takes you to the next dialog box.

- If you select default settings, the load bottles dialog box opens. See Figure 6-5.
- If you select custom settings, the custom setup dialog box opens. See Figure 6-4. If you select custom settings and then touch the back button, the analyzer uses the default settings.
- All changes made to the TOC calibration are retained.

Cancel icon returns you to the run standards dialog box. All changes made in any of the dialog boxes are lost.

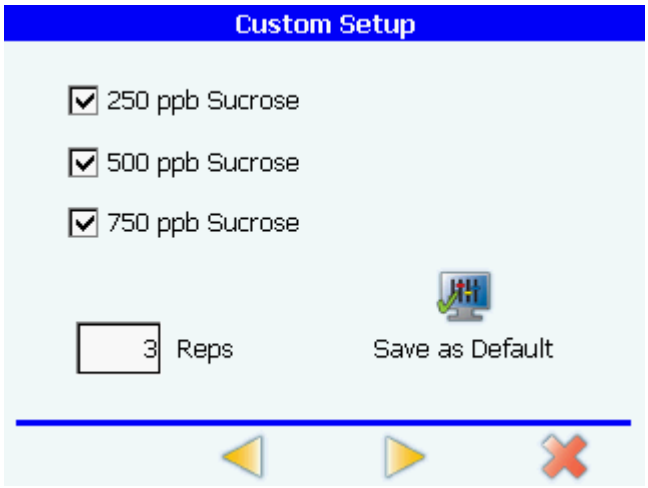


Figure 6-4 Custom setup dialog box

Bottle selection check boxes enable you to enable or disable the bottles to use in the test. The default setting is all three bottles checked. At least one bottle must be selected.

Reps text box allows you to specify the number of repetitions to perform on each bottle. You may enter a value from 1 to 3. The default setting is 3.

Save as default button saves the bottle selection and reps as the default setting.

Back icon returns you to the TOC calibration setup dialog box. All changes made to custom setup are retained.

Forward icon takes you to the load bottles dialog box. All changes made to the custom setup are retained. See Figure 6-5.

Cancel button takes you to the run standards dialog box. All changes made in any of the dialog boxes are lost.

TOC calibration procedure

CAUTION

Potential puncture hazard! Contact with the exposed needle could cause serious injury. Use extreme care when installing and removing the sample bottles.

1) Allow the TOC calibration standards to warm to room temperature.
2) At the home screen, touch the << icon to open the sliding toolbar, then touch the bottles icon in the toolbar, or touch the bottles icon in the lower left corner of the screen.
3) Touch the run standards button in the bottle mode dialog box. See Figure 6-1, page 86.
4) Touch the TOC calibration button in the run standards dialog box. See Figure 6-2, page 87.

5) To use default settings, touch the use default settings radio button in the TOC calibration setup dialog box. To run any other configuration, touch the use custom settings radio button, then define the desired configuration. (See Figure 6-4, page 89.) The following procedure relies on the recommended default setting.

6) Touch the forward icon. The OASIS door will unlock for five seconds. If the door is not opened within five seconds, the unlock icon can be used to unlock the door manually.

7) Install the standards bottles following the instructions as shown in the load bottles dialog box and ensuring that you place the standards bottles in the correct positions. See Figure 6-5. From left:
   - Bottle 1 = blank
   - Bottle 2 = 250 ppb sucrose
   - Bottle 3 = 500 ppb sucrose
   - Bottle 4 = 750 ppb sucrose

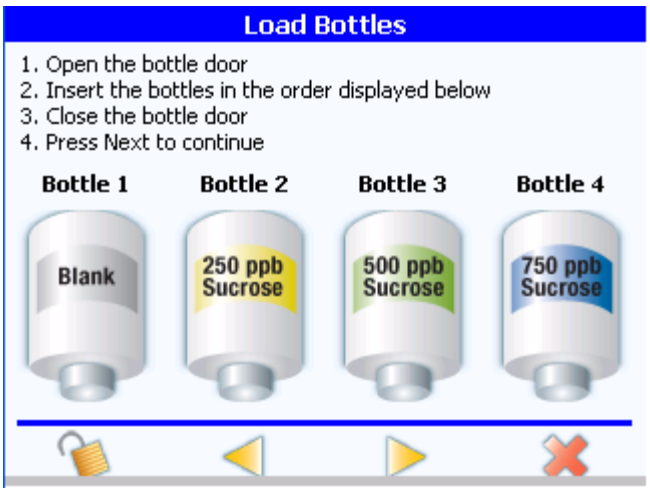


Figure 6-5 Load bottles dialog box, TOC calibration

   - **Bottle positions graphics** show you the order in which to install the bottles.
   - **Unlock icon** energizes the bottle bay door lock for five seconds, allowing you to open the door.
   - **Back icon** takes you to the run standards dialog box.
   - **Forward icon** takes you to the review test setup dialog box if RFID tagged bottles are being used (see Figure 6-6), or to the enter bottle information dialog box if bottles that are not RFID tagged are being used (see Figure 6-7).
   - **Cancel icon** returns you to the previous dialog box. All changes made in any of the dialog boxes are lost.

8) Close the bottle bay door.

9) Touch the forward icon. If bottles have been properly loaded and the RFID tags can be read, the review test setup dialog box appears. See Figure 6-6. If the bottles do not have RFID tags, the enter bottle information dialog box appears. See Figure 6-7.

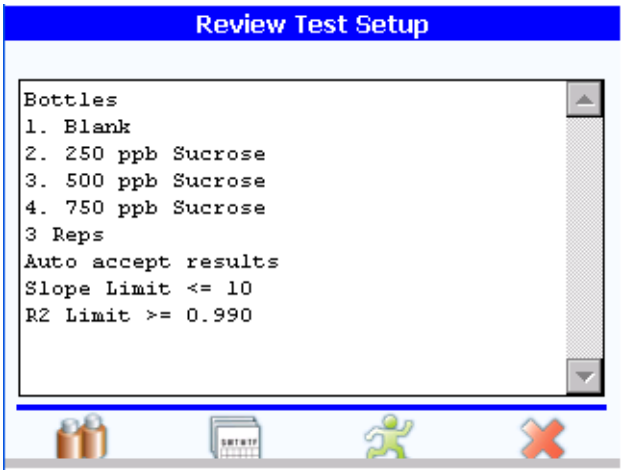


Figure 6-6 Review test setup dialog box

- **Test setup text** lists the bottles that are loaded, test completion actions, acceptance criteria, and, if applicable, schedule.
- **Bottles icon** takes you to the change settings dialog box, where you can change the acceptance limits and completion actions for each test. If you are not signed on as an administrator, you are prompted to enter the administrator user ID and password. Successfully entering this information displays the dialog box. The administrator logon is valid only while you are in that dialog box. An unsuccessful logon produces an error.
- **Schedule icon** takes you to the schedule test dialog box. See Figure 6-8.
- **Run now button** takes you to the run test dialog box. Figure 6-9.
- **Cancel icon** takes you to the unload/replace bottles dialog box. All changes made in any of the dialog boxes are lost.

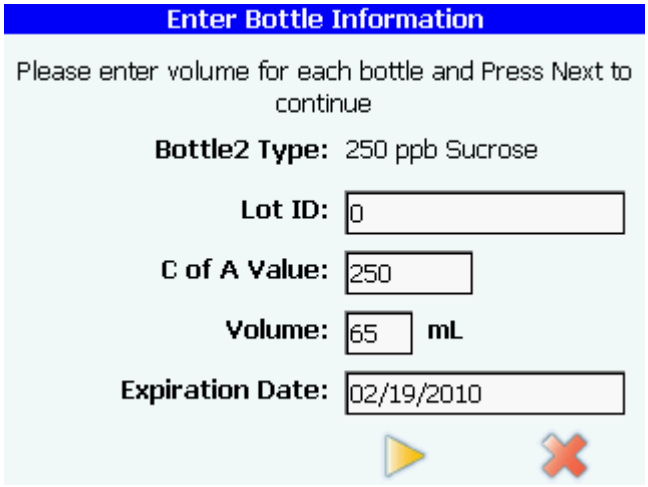


Figure 6-7 Enter bottle information dialog box

- **Lot ID text box** allows you to enter an identification code for the lot.

- **C of A value text box** allows you to enter the certified analysis value for the standard that is being used.
- **Volume text box** allows you to enter the volume of water, in mL, for the specified standards bottle.
- **Expiration date text box** allows you to enter an appropriate expiration date, in yyyy-mm-dd format, and time, in hh:mm:ss format, for the specified TOC calibration standard. The date time format will be language dependent.
- **Forward icon** takes you to the review test setup dialog box. See Figure 6-6.
- **Cancel icon** returns you to the load bottles dialog box.

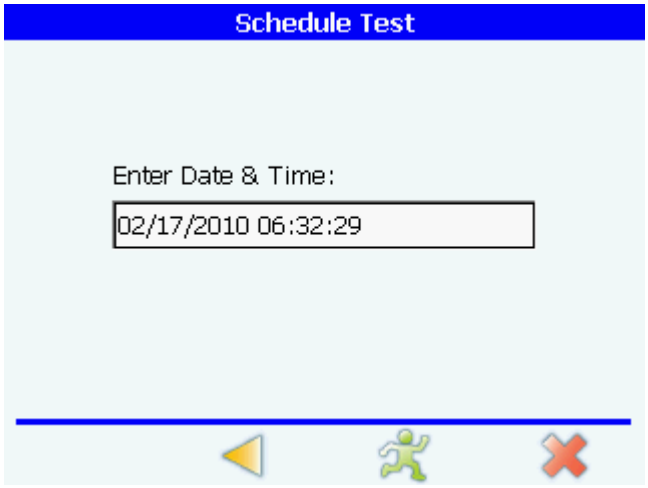


Figure 6-8 Schedule test dialog box

- **Date text box** allows you to enter the date the test will run. The default value is tomorrow's date. You may enter any valid date, in ISO "yyyy-mm-dd" format, that is within three days from the loading of the standards.
- **Time text box** allows you to enter the time the test will run. The default time is the current time. You may enter any valid time in hh:mm:ss format.
- **Back icon** takes you to the previous dialog box. All changes made in this dialog box are retained.
- **Run icon** takes you back to the home screen. All changes made in any of the dialog boxes are retained and the test is scheduled to run. Prior to exiting this dialog box, the analyzer verifies that the scheduled date and time is within three days of the current date and time. It also verifies that none of the bottles will expire prior to the scheduled date.

10) When the test running dialog box appears, the analyzer begins running the test. See Figure 6-9.

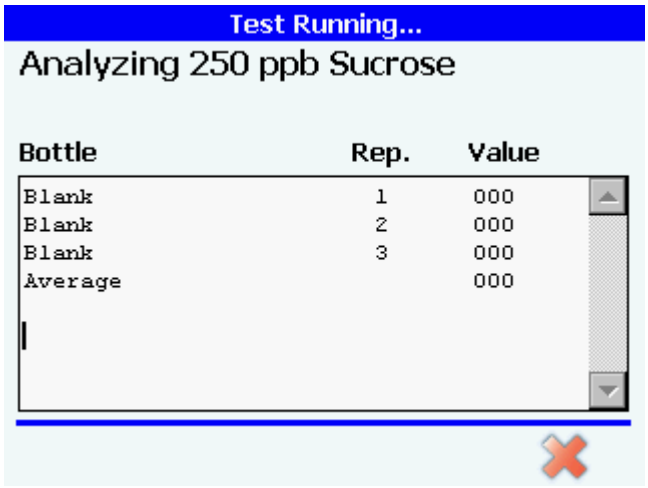


Figure 6-9 Test running dialog box

- After verifying the presence of the appropriate standards, the analyzer performs a temperature stabilization. After the temperature has stabilized, the blank and each standard is analyzed in the proper sequence.
- Once all the bottles have been analyzed, the analyzer compares the current results to the factory calibration. If the change in slope is greater than ±15%, the results are rejected.
- The dialog box displays the current status of the test and lists the results of each repetition and bottle as it is running.
- **Cancel icon** allows you to cancel the test while it is in progress. If you cancel the test, the analyzer turns off the pump and UV lamp, closes all valves, and notifies you that the test has been cancelled.
- When the calibration is completed, the test summary results box appears, with a message informing you that the bottles are being backflushed. See Figure 6-10

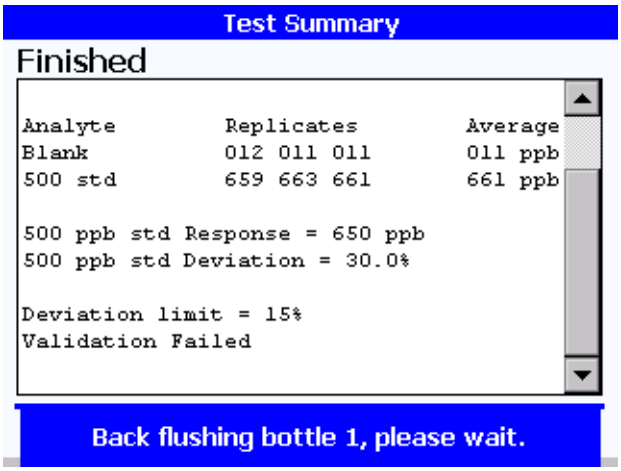


Figure 6-10 Test summary results box

NOTE

Immediately upon completion of the test the bottles are backflushed and allowed to equilibrate to ambient pressure. DO NOT ATTEMPT TO REMOVE THE BOTTLES UNTIL THE BACKFLUSH AND PRESSURE EQUALIZATION IS COMPLETE.

11) When the backflush and equalization is completed, the test summary dialog box appears, with the results of the calibration and a notification of whether the calibration failed or passed. The results also appear on the printout if a printer is attached. See Figure 6-11.

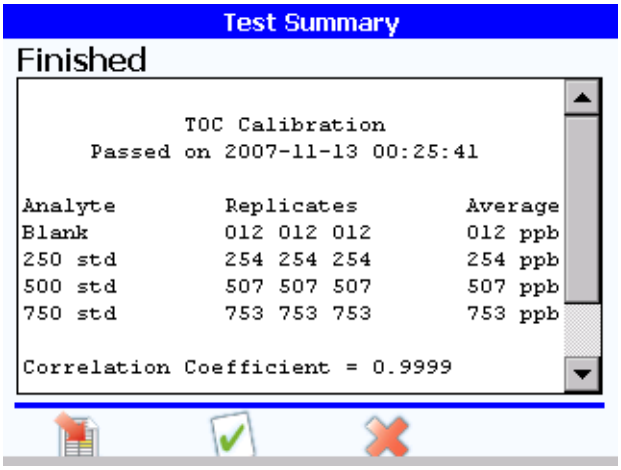


Figure 6-11 Test summary dialog box

- **Summary text** lists the results of the test. The results appear as they would appear on the printed report.
- **Export icon** takes you to the export dialog box, where you can save the results of the test to a USB flash drive.
- **Checkmark icon** accepts the calibration, if the values passed, and takes you to the unload/replace bottles dialog box.
- **Cancel icon** rejects the calibration results and takes you to a dialog box that asks if you want to rerun the test. If you touch the forward icon, the analyzer returns you to the beginning of the test. All previous data are discarded.
- **Auto accept.** If you have selected to auto accept the results and return online, the results are accepted and sent to the printer, and the analyzer returns to the home screen. If you have selected manually accept the results and return online, the analyzer returns to the home screen immediately following the completion of the test. If you have selected manually accept the results and remain offline, the test summary dialog box appears.

12) When the unload/replace bottles dialog box appears, follow the instructions for unloading or replacing bottles, then press the done icon. See Figure 6-12.

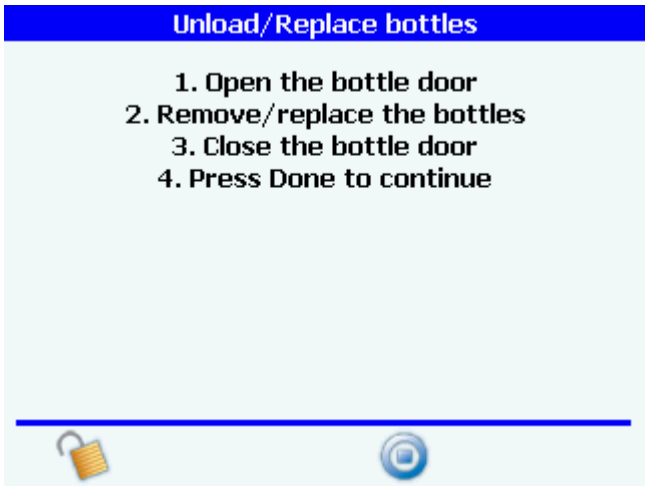


Figure 6-12 Unload/replace bottles dialog box

- **Unlock icon** energizes the bottle bay door lock for five seconds, allowing you to open the door.
- **Done icon** returns you to the bottle mode dialog box.

13) If the test failed or you have rejected the calibration, touch the cancel icon, then touch the checkmark icon to run the calibration again (see Figure 6-13) or the cancel icon to cancel the run.

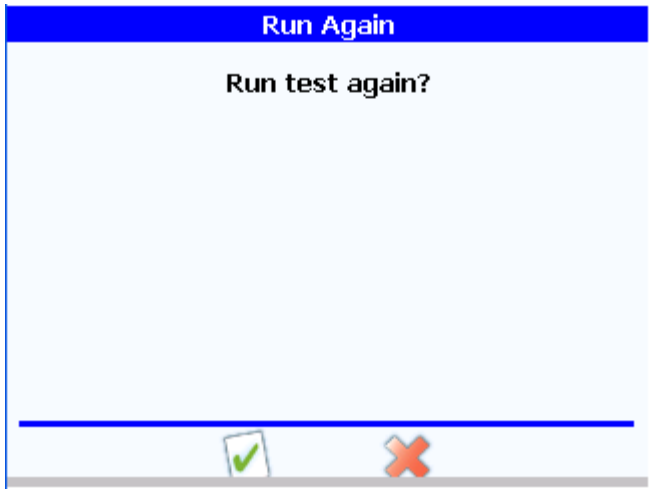


Figure 6-13 Run again dialog box

- **Checkmark icon** returns you to the beginning of the test. All previous data are discarded.
- **Cancel icon** takes you to the unload/replace bottles dialog box.

6.6 Conductivity calibration

CAUTION

Potential puncture hazard! Contact with the exposed needle could cause serious injury. Use extreme care when installing and removing the sample bottles.

Conductivity calibration ensures the accuracy of the conductivity values reported by the PAT700 TOC analyzer. A conductivity calibration consists of verifying the conductivity meter using a precision resistor. The cell constant is adjusted to the value of the conductivity standard, and therefore is always within ±2%. If the new calibration is greater than ±10% of the factory calibration or ±5% of the previous user calibration, the calibration is unacceptable and a new calibration is required.

NOTE

Immediately upon completion of the test the bottles are backflushed and allowed to equilibrate to ambient pressure. DO NOT ATTEMPT TO REMOVE THE BOTTLES UNTIL THE BACKFLUSH AND PRESSURE EQUALIZATION IS COMPLETE.

1) Allow the conductivity calibration standard to warm to room temperature.
2) At the home screen, touch the << icon to open the sliding toolbar.
3) Touch the setup icon.

4) Touch the bottles icon, then touch the conductivity calibration tab.

5) Make sure a checkmark appears in the use calibration resistor checkbox. If a checkmark is not present, touch the checkbox to enable use of the calibration resistor.
6) Press the return icon to return to the setup dialog box, then touch the return icon again to return to the home screen.

7) Touch the << icon to open the sliding toolbar, then touch the bottles icon in the toolbar, or touch the bottles icon in the lower left corner of the screen.
8) Touch the run standards button in the bottle mode dialog box. See Figure 6-1, page 86.
9) Touch the conductivity calibration button in the run standards dialog box. See Figure 6-2, page 87.
10) The OASIS door will unlock for five seconds. If the door is not opened within five seconds, the unlock icon can be used to unlock the door manually.

11) Install the standards bottle following the instructions as shown in the load bottles dialog box and ensuring that you place the standards bottle in the correct position. See Figure 6-14. From left:
   - Bottle 1 = empty
   - Bottle 2 = 100 µS potassium chloride conductivity test standard
   - Bottle 3 = empty
   - Bottle 4 = empty

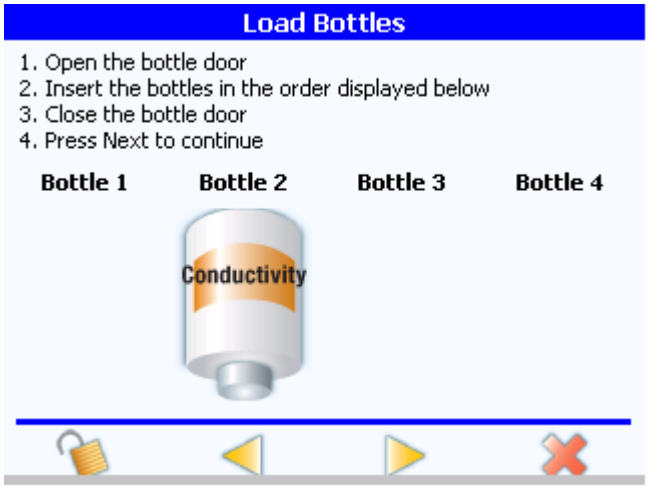


Figure 6-14 Load bottles dialog box, conductivity calibration

   - **Bottle positions graphics** show you the order in which to install the bottles.
   - **Unlock icon** energizes the bottle bay door lock for five seconds, allowing you to open the door.
   - **Back icon** takes you to the run standards dialog box.
   - **Forward icon** takes you to the review test options dialog box.
   - **Cancel icon** returns you to the previous dialog box. All changes made in any of the dialog boxes are lost.

12) Close the bottle bay door.

13) Touch the forward icon. If bottles have been properly loaded and the RFID tags can be read, the review test setup dialog box appears. See Figure 6-6, page 91. Otherwise, the enter bottle information dialog box appears. See Figure 6-7, page 91.

14) If the selection has been made to use the conductivity meter verification resistor, install the resistor onto the analyzer's 9-pin printer/calibration port, as illustrated in Figure 6-15.
   - If the calibration is being performed on a schedule, the conductivity meter test dialog box does not appear, and the calibration occurs automatically.
   - Otherwise, the conductivity meter test dialog box appears when the analyzer passes the conductivity meter test. See Figure 6-16.

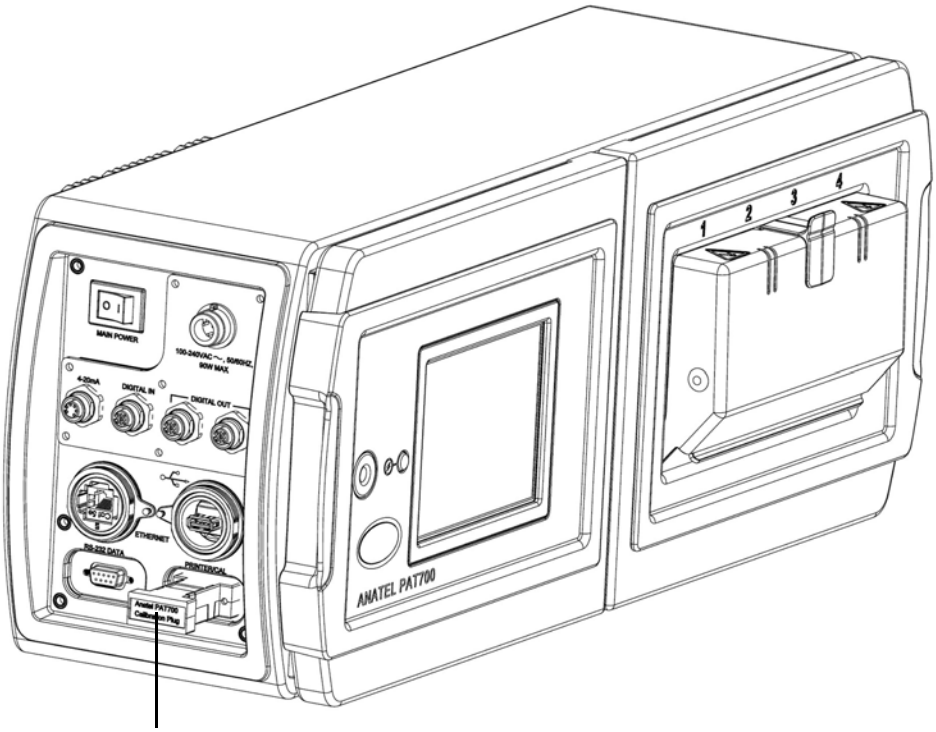


Figure 6-15 Verification resistor installed on printer/calibration port

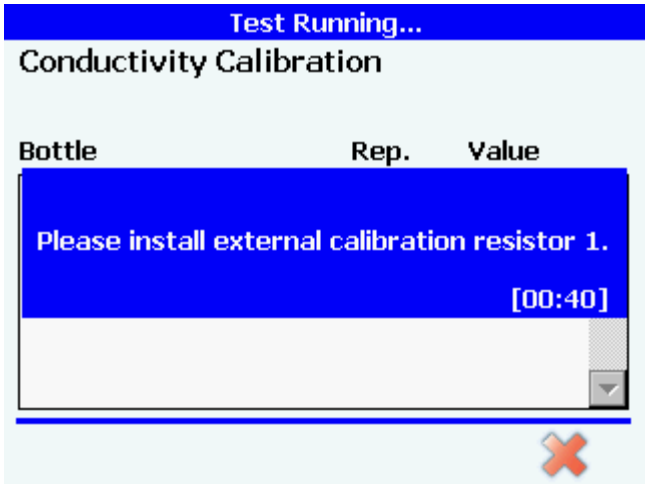


Figure 6-16 Conductivity meter test dialog box

- **Start test icon** reads the value of the resistor. The analyzer then converts this value to conductivity by taking the inverse of the resistance and multiplying it by the cell constant. This value is then compared to the expected value, assuming a 61.9 Kohm resistor. If the measured value is less than or equal to ±0.1 µS/cm of the expected value, the test passes and the forward icon is enabled. Otherwise, you are notified and must cancel the calibration.

- **Cancel icon** takes you to a dialog box that notifies you that the test has been cancelled. The next button on the cancellation dialog box takes you to the unload/replace bottles dialog box. All changes made in any of the dialog boxes are lost.

15) When the test running dialog box appears, the analyzer begins running the test.

- After verifying the presence of the calibration standard, the analyzer performs a temperature stabilization. After the temperature has stabilized, the conductivity standard is analyzed.
- The dialog box displays the current status of the test and lists the results of each repetition and the calibration standards bottle as it is running.

16) When the calibration is completed, the test summary dialog box appears, with the results of the calibration and a notification of whether the calibration failed or passed. The results also appear on the printout if a printer is attached. See Figure 6-17.

17) If the calibration fails, you may run the test again.

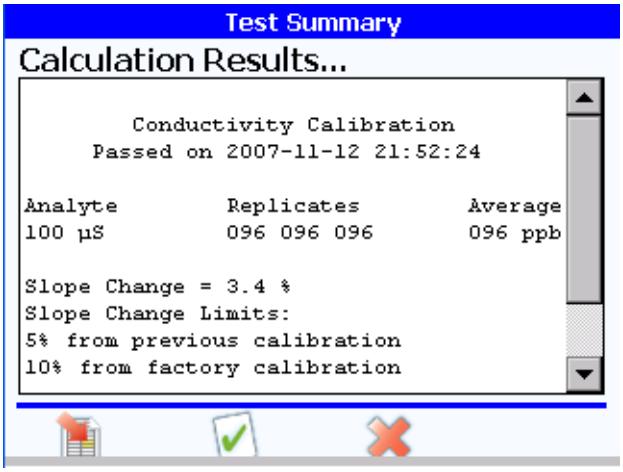


Figure 6-17 Test summary dialog box

- **Summary text** lists the results of the calibration. The results appear as they would appear on the printed report.
- **Export icon** takes you to the export dialog box, where you can save the results of the calibration to a USB flash drive.
- **Checkmark icon** accepts the calibration, if the values passed, and takes you to the unload/replace bottles dialog box.
- **Cancel icon** rejects the calibration results and takes you to a dialog box that asks if you want to rerun the test. If you wish to rerun the test, the analyzer returns you to the beginning of the test. All previous data are discarded.

NOTE

Immediately upon completion of the test the bottles are backflushed and allowed to equilibrate to ambient pressure. DO NOT ATTEMPT TO REMOVE THE BOTTLES UNTIL THE BACKFLUSH AND PRESSURE EQUALIZATION IS COMPLETE.

6.7 TOC validation

CAUTION

Potential puncture hazard! Contact with the exposed needle could cause serious injury. Use extreme care when installing and removing the sample bottles.

The principles and procedures for performing a TOC validation are essentially the same as those used for performing a calibration. Validation of the TOC calibration is accomplished by analyzing user-selected concentrations of sucrose validation standards. You can perform a validation using a single-point analysis or multi-point analysis. The instrument response for the validation standard must have a deviation of less than 15% of the calibrated response to be acceptable.

NOTE

Immediately upon completion of the test the bottles are backflushed and allowed to equilibrate to ambient pressure. DO NOT ATTEMPT TO REMOVE THE BOTTLES UNTIL THE BACKFLUSH AND PRESSURE EQUALIZATION IS COMPLETE.

1) Allow the TOC validation standards to warm to room temperature.
2) At the home screen, touch the << icon to open the sliding toolbar, then touch the bottles icon in the toolbar, or touch the bottles icon in the lower left corner of the screen.
3) Touch the run standards button in the bottle mode dialog box. See Figure 6-1, page 86.
4) Touch the TOC validation button in the run standards dialog box. See Figure 6-2, page 87.
5) To use default settings, touch the use default settings radio button in the TOC calibration setup dialog box. To run any other configuration, touch the use custom settings radio button, then define the desired configuration. (See Figure 6-4, page 89.) The following procedure relies on the recommended default setting.
6) Touch the forward icon. The OASIS door will unlock for five seconds. If the door is not opened within five seconds, the unlock icon can be used to unlock the door manually.
7) Install the standards bottles following the instructions as shown in the load bottles dialog box and ensuring that you place the standards bottles in the correct positions. See Figure 6-18. The default setting is a blank bottle and one standard of 500 ppb sucrose. You may perform multipoint validation by selecting the custom settings and defining the desired configuration. At least one bottle must be selected. From left:
   - Bottle 1 = blank
   - Bottle 2 = empty
   - Bottle 3 = 500 ppb sucrose
   - Bottle 4 = empty

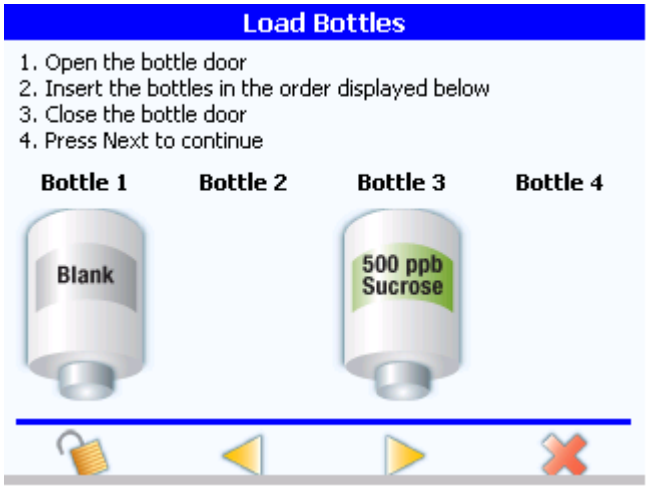


Figure 6-18 Load bottles dialog box, TOC validation

- **Bottle positions graphics** show you the order in which to install the bottles.
- **Unlock icon** energizes the bottle bay door lock for five seconds, allowing you to open the door.
- **Back icon** takes you to the previous dialog box.
- **Forward icon** takes you to the review test options dialog box.
- **Cancel icon** returns you to the run standards dialog box. All changes made in any of the dialog boxes are lost.

8) Close the bottle bay door.

9) Touch the forward icon. If bottles have been properly loaded and the RFID tags can be read, the review test setup dialog box appears. See Figure 6-6, page 91. Otherwise, the enter bottle information dialog box appears. See Figure 6-7, page 91.

10) When the test running dialog box appears, the analyzer begins running the test.
- After verifying the presence of the appropriate standards, the analyzer performs a temperature stabilization. Once the temperature has stabilized, the blank and standards bottles are analyzed in the proper sequence.
- Once all the bottles have been analyzed, the analyzer compares the current results to the standard calibration. If the average of each standard is within ±15% of the expected value, the validation is accepted. If any of the averaged values are greater than ±15% of the expected value, the validation is rejected.
- The dialog box displays the current status of the test and lists the results of each repetition and bottle as it is running.

11) When the validation is completed, the test summary dialog box appears, with the results of the validation and a notification of whether the validation failed or passed. The results also appear on the printout if a printer is attached. See Figure 6-11, page 94. Touching the forward icon takes you to the run again dialog box (Figure 6-13, page 95). If the test failed or you have rejected the calibration results, at the run again dialog box, touch the checkmark icon to run the validation again or the cancel icon to cancel the run.

NOTE

Immediately upon completion of the test the bottles are backflushed and allowed to equilibrate to ambient pressure. DO NOT ATTEMPT TO REMOVE THE BOTTLES UNTIL THE BACKFLUSH AND PRESSURE EQUALIZATION IS COMPLETE.

6.8 System suitability test

CAUTION

Potential puncture hazard! Contact with the exposed needle could cause serious injury. Use extreme care when installing and removing the sample bottles.

A system suitability test allows you to test analyzer measurements according to the guidelines established in USP Method <643> using 500 ppb sucrose and 500 ppb 1,4-benzoquinone standards.

NOTE

Immediately upon completion of the test the bottles are backflushed and allowed to equilibrate to ambient pressure. DO NOT ATTEMPT TO REMOVE THE BOTTLES UNTIL THE BACKFLUSH AND PRESSURE EQUALIZATION IS COMPLETE.

1) Allow the system suitability test standards to warm to room temperature.
2) At the home screen, touch the << icon to open the sliding toolbar, then touch the bottles icon in the toolbar, or touch the bottles icon in the lower left corner of the screen.
3) Touch the run standards button in the bottle mode dialog box. See Figure 6-1, page 86.
4) Touch the system suitability button in the run standards dialog box. See Figure 6-2, page 87.
5) Touch the forward icon. The OASIS door will unlock for five seconds. If the door is not opened within five seconds, the unlock icon can be used to unlock the door manually.
6) Install the standards bottles following the instructions as shown in the load bottles dialog box and ensuring that you place the standards bottles in the correct positions. See Figure 6-19. From left:
   - Bottle 1 = blank
   - Bottle 2 = empty
   - Bottle 3 = 500 ppb sucrose
   - Bottle 4 = 500 ppb benzoquinone

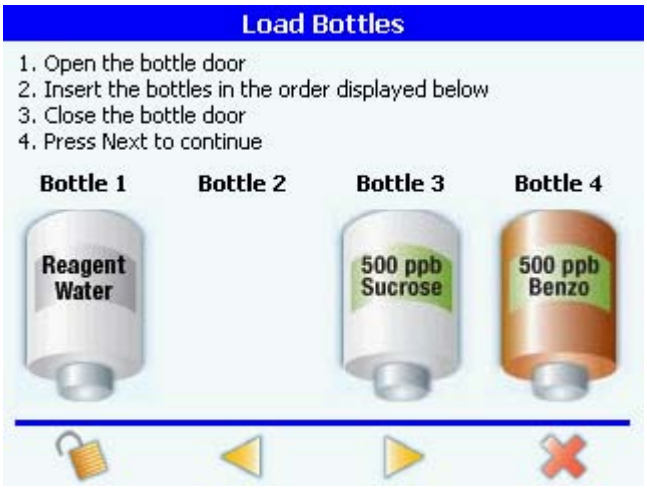


Figure 6-19 Load bottles dialog box, system suitability test

- **Bottle positions graphics** show you the order in which to install the bottles.
- **Unlock icon** energizes the bottle bay door lock for five seconds, allowing you to open the door.
- **Back icon** takes you to the run standards dialog box.
- **Forward icon** takes you to the review test options dialog box.
- **Cancel icon** returns you to the run standards dialog box. All changes made in any of the dialog boxes are lost.

7) Close the bottle bay door.

8) Touch the forward icon. If bottles have been properly loaded and the RFID tags can be read, the review test setup dialog box appears. See Figure 6-6, page 91. Otherwise, the enter bottle information dialog box appears. See Figure 6-7, page 91.

9) When the test running dialog box appears, the analyzer begins running the test.

- Three samples are drawn from each bottle. After all the repetitions are complete, the analyzer repeats the process for the rest of the bottles. All reported values must be normalized to 500 ppb using the following formula.

$$r_n = r_{raw}\left(\frac{500}{\text{C of A value}}\right)$$

- Once all the bottles have been analyzed, the analyzer compares the average reading of the sucrose standard to the average reading of the 1,4 benzoquinone. If the two values are within ±15% of each other, the test passes. The analyzer then displays the test summary dialog box. The following formulas are used to calculate the response efficiency.

$$r_e = 100 \times \left(\frac{SR}{LR}\right)$$

Where:

SR = *Suitability response of the analyzer defined as ($r_{ss} – r_w$).*

LR = *Limit response of the analyzer defined as ($r_s – r_w$).*

re = *Response efficiency of PAT700.*

r_w = *Average TOC response for the blank.*

r_s = *Average TOC response for the sucrose standard.*

r_{ss} = *Average TOC response for the benzoquinone standard.*

10) When the suitability test is completed, the test summary dialog box appears, with the results of the test and a notification of whether the test failed or passed. The results also appear on the printout if a printer is attached. See Figure 6-11, page 94. Touching the forward icon takes you to the run again dialog box (Figure 6-13, page 95). If the test failed or you have rejected the test results, at the run again dialog box, touch the checkmark icon to run the test again or the cancel icon to cancel the run.

NOTE

Immediately upon completion of the test the bottles are backflushed and allowed to equilibrate to ambient pressure. DO NOT ATTEMPT TO REMOVE THE BOTTLES UNTIL THE BACKFLUSH AND PRESSURE EQUALIZATION IS COMPLETE.

6.9 Grab sample

CAUTION

Potential puncture hazard! Contact with the exposed needle could cause serious injury. Use extreme care when installing and removing the sample bottles.

The grab sample function enables analysis of samples from various locations. Up to three repetitions from a single sample may be analyzed to arrive at an average value. Grab samples are run using a standard water sample bottle and do not require the use of an RFID tagged bottle.

1) At the home screen, touch the << icon to open the sliding toolbar, then touch the bottles icon in the toolbar, or touch the bottles icon in the lower left corner of the screen.
2) Touch the grab sample button in the bottle mode dialog box. See Figure 6-1, page 86.
3) The OASIS door will unlock for five seconds. If the door is not opened within five seconds, the unlock icon can be used to unlock the door manually.
4) Install the grab sample bottle following the instructions as shown in the load bottles dialog box and ensuring that you place the grab sample bottle in the correct position. See Figure 6-20. From left:
   - Bottle 1 = empty
   - Bottle 2 = sample bottle

- Bottle 3 = empty
- Bottle 4 = empty

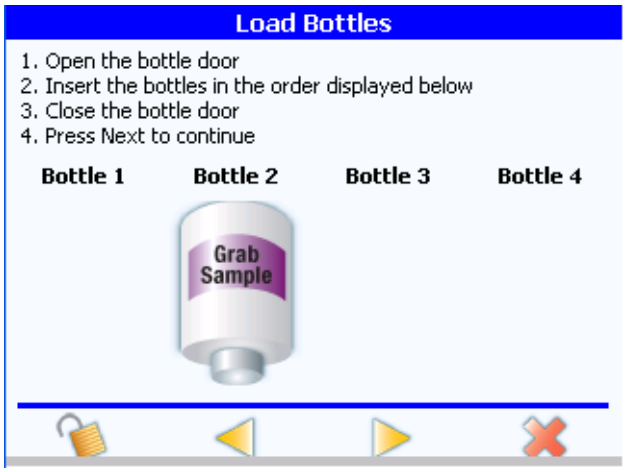


Figure 6-20 Load bottles dialog box, grab sample

- **Bottle positions graphics** show you where to install the bottle.
- **Unlock icon** energizes the bottle bay door lock for five seconds, allowing you to open the door.
- **Back icon** takes you to the bottle mode dialog box.
- **Forward icon** takes you to the grab sample setup dialog box.
- **Cancel icon** returns you to the previous dialog box. All changes made in any of the dialog boxes are lost.

5) Close the bottle bay door.

6) Touch the forward icon. The enter bottle information dialog box appears and allows you to enter information about the grab sample.

7) After entering the appropriate information about the grab sample, touch the forward icon. The grab sample setup dialog box appears. See Figure 6-21.

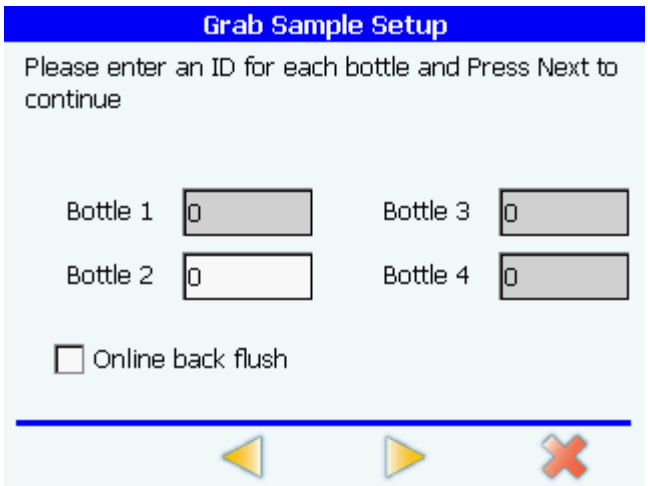


Figure 6-21 Grab sample setup dialog box

- **Reps text box** allows you to specify the number of repetitions to perform on the sample bottle. You may enter a value from 1 to 3. The default setting is 3.
- **Bottle ID text box** allows you to specify an identifier to be used in the data buffer and in reports. You may specify a 4-digit number. The default setting is 0.
- **Return to online mode after analysis check box** allows you to return to the home screen after the test is complete.
- **Schedule icon** takes you to the schedule test dialog box. See Figure 6-8. All changes made in this dialog box are retained.
- **Run now button** takes you to the run grab sample dialog box. See Figure 6-22. All changes made in this dialog box are retained.
- **Cancel icon** takes you to the unload/replace bottles dialog box. All changes made in any of the dialog boxes are lost.

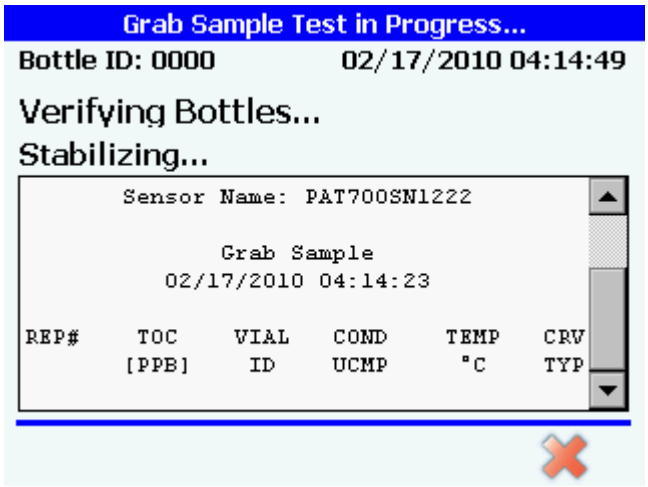


Figure 6-22 Grab sample test in progress dialog box

8) When the grab sample test in progress dialog box appears, the analyzer begins running the test.
   - Upon starting the grab sample, the analyzer performs a temperature stabilization. Once the temperature has stabilized, the sample bottle is analyzed.
   - **Cancel icon** takes you to the unload/replace bottles dialog box. All changes made in any of the dialog boxes are lost.
9) When the test is completed, the grab sample summary dialog box appears, with the results of the test. The results also appear on the printout if a printer is attached. See Figure 6-23.

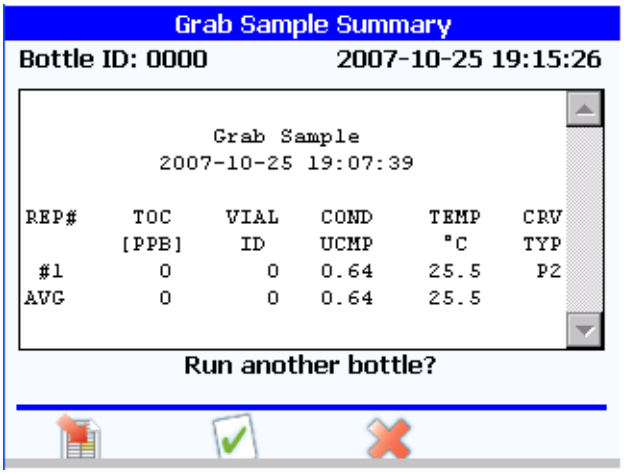


Figure 6-23 Grab sample summary dialog box

Export icon opens the export grab sample dialog box. See Figure 6-24. From there, you can export the grab sample summary to a USB flash drive

Run another bottle icon returns you to the load bottles dialog box.

Cancel icon takes you to the unload/replace bottles dialog box. See Figure 6-12, page 95.

Figure 6-24 Export grab sample dialog box

Filename text box allows you to specify the filename for the exported data file.

Exporting record no: X bar graph indicator displays the progress of the export.

Export icon starts the export. Before the export begins, the analyzer verifies that there is data to export, that you have entered a valid file name, and that a USB flash drive is inserted into the analyzer's USB port. The file is written to the root directory of the flash drive. If the file already exists, you are asked if you want to overwrite it.

Return icon returns you to the security dialog box.

6.10 Excursion mode

NOTE

Excursion mode requires the use of an RFID tagged excursion bottle. Excursion mode does not operate without an RFID tagged excursion bottle.

Excursion mode enables the analyzer to withdraw a sample from the water system when a predefined TOC level is exceeded or when alarm condition 35 or 36 occurs. An excursion sample can also be implemented manually. With excursion mode enabled and an empty excursion sample bottle loaded, a sample of the process system water is drawn immediately following the indication of the appropriate event. The water sample is then available for analysis to help determine the cause of the water system excursion. Excursion sample bottles must contain an RFID tag. The information from the excursion event is written to the bottle's RFID tag to ensure accurate information about the water sample.

Excursion with validation includes the use of a 500 ppb sucrose standard with the excursion sample bottle. The 500 ppb standard is used for verifying the performance of the analyzer immediately following the excursion event and sample. If excursion with validation is enabled, the analyzer draws a water sample, immediately following the analysis that indicated an excursion, followed by an analysis of the 500 ppb standard.

Touch the excursion mode button in the bottle mode dialog box. See Figure 6-1, page 86. The excursion mode dialog box appears, as illustrated in Figure 6-25.

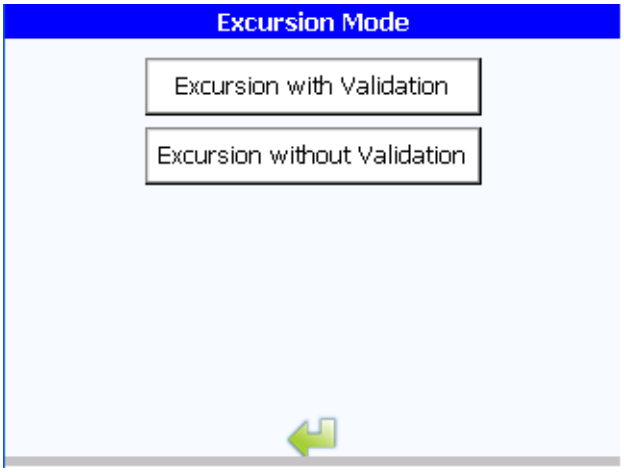


Figure 6-25 Excursion mode dialog box

- **Excursion with validation button** opens the excursion with validation load bottles dialog box. See Figure 6-26 and follow the instructions in Excursion with validation, below.
- **Excursion without validation** button tells the analyzer to run the excursion without validation and opens the excursion without validation load bottles dialog box. See Figure 6-30 and follow the instructions in Excursion without validation, page 111.
- **Return icon** returns you to the bottle mode dialog box.

Excursion with validation

CAUTION

Potential puncture hazard! Contact with the exposed needle could cause serious injury. Use extreme care when installing and removing the sample bottles.

1) Install the standards bottles following the instructions as shown in the load bottles dialog box and ensuring that you place the standards bottle in the correct position. See Figure 6-26. From left:
   - Bottle 1 = blank
   - Bottle 2 = empty
   - Bottle 3 = 500 ppb sucrose
   - Bottle 4 = excursion bottle

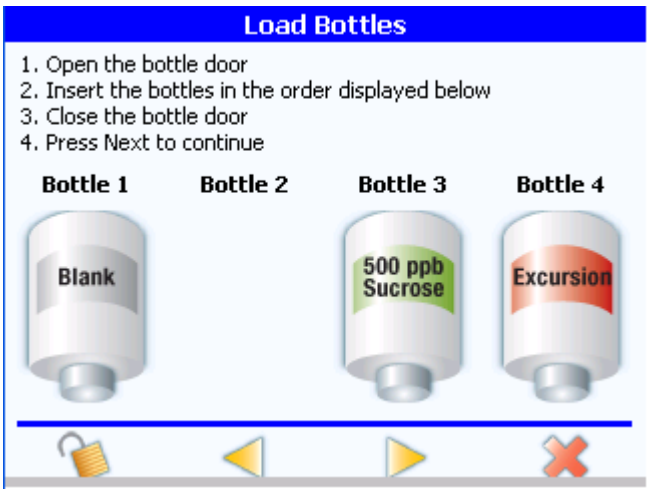


Figure 6-26 Excursion mode with validation, load bottles dialog box

   - **Bottle positions graphics** show you the order in which to install the bottles.
   - **Unlock icon** energizes the bottle bay door lock for five seconds, allowing you to open the door.
   - **Back icon** takes you to the excursion mode dialog box.
   - **Forward icon** takes you to the excursion mode setup dialog box.
   - **Cancel icon** returns you to the previous dialog box. All changes made in any of the dialog boxes are lost.
2) Close the bottle bay door.
3) Touch the forward icon. The excursion mode setup dialog box appears. See Figure 6-27.

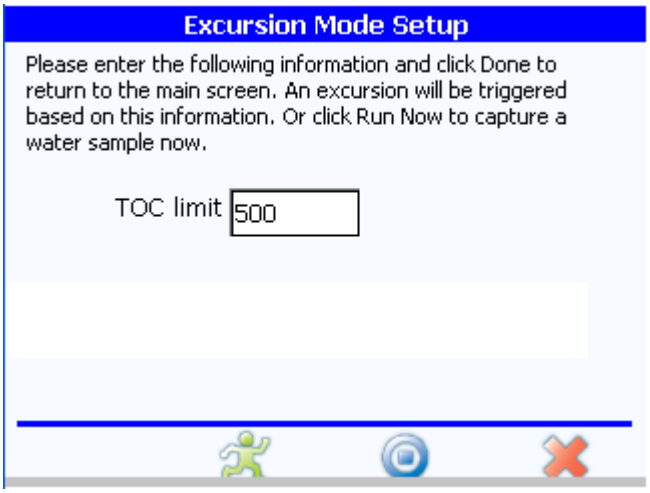


Figure 6-27 Excursion mode setup dialog box

- **TOC limit text box** allows you to enter a limit an online TOC analysis must reach before an excursion sample is captured. You may specify a value from 1 to 2000 ppb. The default setting is 500 ppb.
- **Run now icon** immediately draws a water sample from the online source into the excursion bottle and opens the bottle filling dialog box. See Figure 6-28.
- **Done icon** returns you to the home screen. When an excursion condition occurs, the analyzer performs an excursion sample capture. Following the excursion, the analyzer always returns to the home screen.
- **Cancel icon** returns you to the unload/replace bottles dialog box. All changes made in any of the dialog boxes are lost.

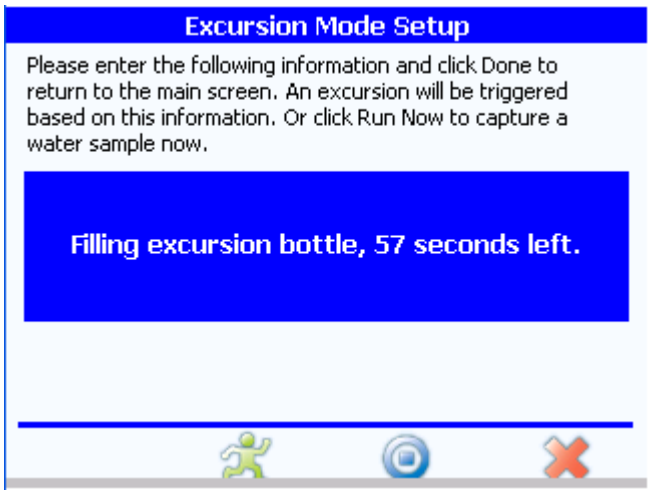


Figure 6-28 Bottle filling dialog box

4) When an excursion occurs, an excursion sample captured dialog box opens, and a validation occurs. See Figure 6-29.

- Following the excursion and validation, a validation results dialog box opens that contains the blank and 500 ppb sucrose data. The next arrow on the validation results dialog box takes you to the validation summary dialog box.
- The analyzer writes the date, time, TOC value, analyzer serial number, status, oxidation curve filename, conductivity, and temperature information to the RFID tag.

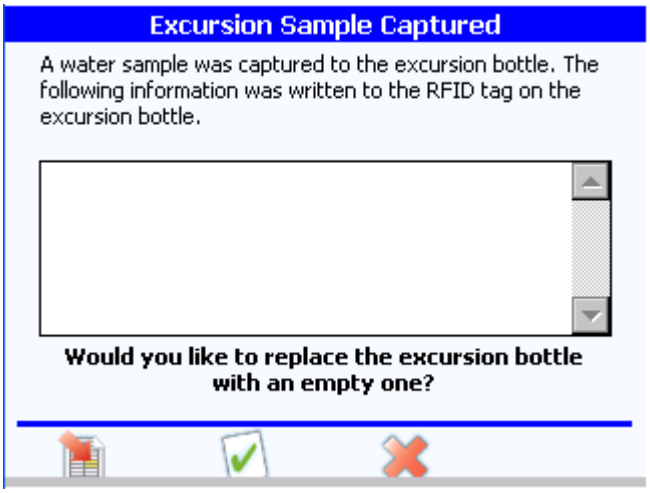


Figure 6-29 Excursion sample captured dialog box

The excursion sample dialog box displays the analyzer's serial number, the date and time of the excursion, the TOC value, and the oxidation curve filename.

Export icon opens the export sample dialog box. See Figure 6-24. From there, you can export the oxidation curve file to a USB flash drive.

Yes icon (containing checkmark) returns you to the load bottles dialog box.

Cancel icon takes you to the unload/replace bottles dialog box.

Excursion without validation

CAUTION

Potential puncture hazard! Contact with the exposed needle could cause serious injury. Use extreme care when installing and removing the sample bottles.

1) Install the standards bottles following the instructions as shown in the load bottles dialog box and ensuring that you place the standards bottle in the correct position. See Figure 6-30. From left:
   - Bottle 1 = empty
   - Bottle 2 = empty
   - Bottle 3 = empty
   - Bottle 4 = excursion bottle

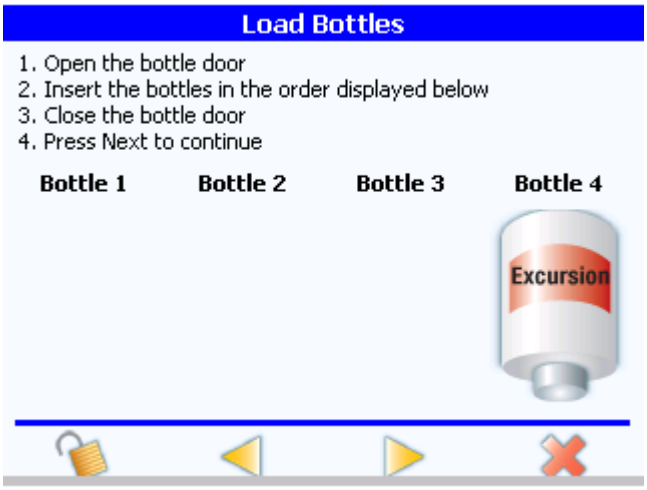


Figure 6-30 Excursion mode without validation dialog box

- **Bottle positions graphics** show you where to install the bottle.
- **Unlock icon** energizes the bottle bay door lock for five seconds, allowing you to open the door.
- **Back icon** takes you to the excursion mode dialog box.
- **Forward icon** takes you to the excursion mode setup dialog box.
- **Cancel icon** returns you to the previous dialog box. All changes made in any of the dialog boxes are lost.

2) Close the bottle bay door.

3) Touch the forward icon. The excursion mode setup dialog box appears. See Figure 6-31.

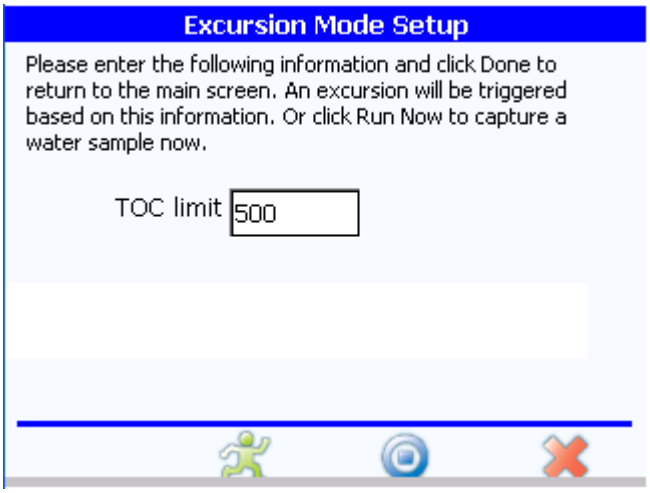


Figure 6-31 Excursion mode setup dialog box

- **TOC limit text box** allows you to enter a limit an online TOC analysis must reach before an excursion sample is captured. You may specify a value from 1 to 2000 ppb. The default setting is 500 ppb.

- **Run now icon** immediately draws a water sample from the online source into the excursion bottle and opens the bottle filling dialog box. See Figure 6-28. Once the bottle has been filled, the excursion captured dialog box appears. See Figure 6-29, page 111.
- **Done icon** returns you to the home screen. When an excursion condition occurs, the analyzer performs an excursion sample capture. Following the excursion, the analyzer always returns to the home screen.
- **Cancel icon** takes you to the unload/replace bottles dialog box. All changes made in any of the dialog boxes are lost.

6.11 Bottle flush mode

Bottle flush mode enables the user to flush the bottles with water from the user's water loop. When *Bottle Flush* is selected, the system will ask the user to load RFID tagged bottles into the bottle bay.

1) Open the bottle door.
2) Insert the bottles in the order displayed below.
3) Close the bottle door.
4) Press Next to continue.

Figure 6-32 Load bottle dialog box

Once the bottles have been loaded and the bottle bay has been closed, the system will read the RFID tags on the bottles to confirm which sample positions contain a bottle for cleaning.

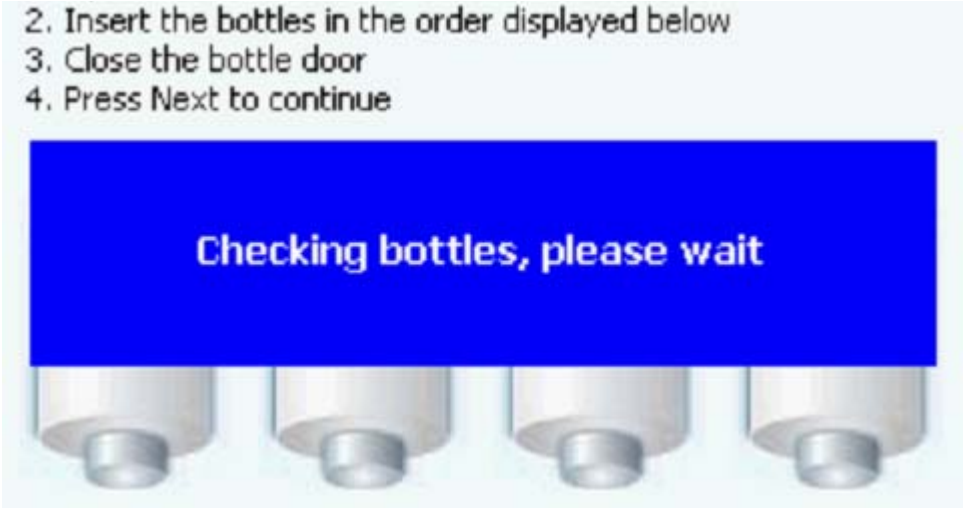


Figure 6-33 Checking bottles dialog box

The analyzer will start the bottle flushing cycle and indicate on the display which bottle is in the cleaning process.

Figure 6-34 Cleaning bottle dialog box

Chapter 7 Alarms

7.1 Alarm indication

The analyzer has two basic operational modes: on-line and bottle. On-line TOC and conductivity are the two primary on-line modes (although you can also select standby, off-line, manual, or self clean). In on-line TOC and conductivity modes, the home screen provides an on-screen animation indicating the general state of water flow through the analyzer. In on-line TOC, conductivity, or manual TOC modes, the animation area also serves as an alarm condition indicator. If an alarm occurs in an on-line mode, the following sequence of events occurs:

- When a TOC or conductivity alarm condition occurs, the home screen animation area flashes red, the displayed value of the variable causing the alarm also turns red, the PAT700 makes a sound (if a sound is programmed), the alarm icon is enabled, and the alarm condition is written to the data log and audit trail. See Figure 7-1.

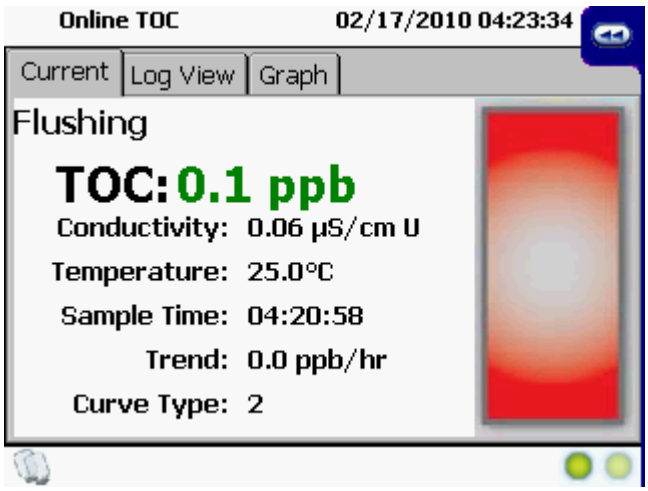


Figure 7-1 Online TOC mode, current tab, in alarm condition

- The animation area continues to flash red until a user acknowledges the alarm. See Alarm acknowledgement, page 116.
- If the alarm has been acknowledged and the user returns to the home screen, the animation area remains solid red until the analyzer completes a full cycle without any errors.
- Once a full cycle has occurred without any errors, the normal animation reappears.
- If on the next cycle the same or a new error occurs, the animation area again flashes red and must be acknowledged.
- As long as alarms exist in the alarm log, the alarm log is accessible.

7.2 Alarm acknowledgement

1) If an alarm occurs, at the home screen, touch the << icon to open the sliding toolbar.
2) Touch the alarms icon.

The alarm acknowledge dialog box allows you to view, acknowledge, or print current or past alarms that are visible in the alarm list. See Figure 7-2.

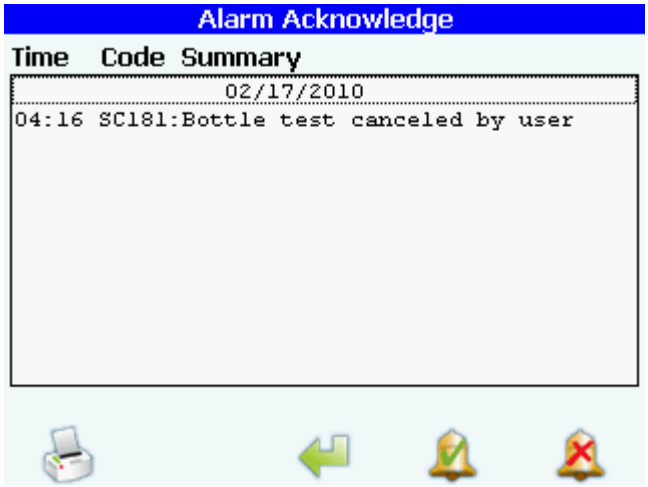


Figure 7-2 Alarm acknowledge dialog box

Alarm list box displays all unacknowledged alarms and alarms that have been acknowledged since the last time the alarm list was deleted. Each listing includes the alarm time, alarm code, and a brief alarm description in chronological order, from earliest to most recent.

Acknowledge alarm icon (bell with green checkmark) allows you to acknowledge any current alarm.

Delete alarms icon (bell with red “X”) deletes all alarms in the alarm list and clears the alarm log. If no user is logged on, the sign on dialog box appears.

Printer icon prints the alarm list.

Return icon returns you to the home screen.

7.3 Alarm details

Touching one of the alarms in the list produces the alarm details dialog box. See Figure 7-3.

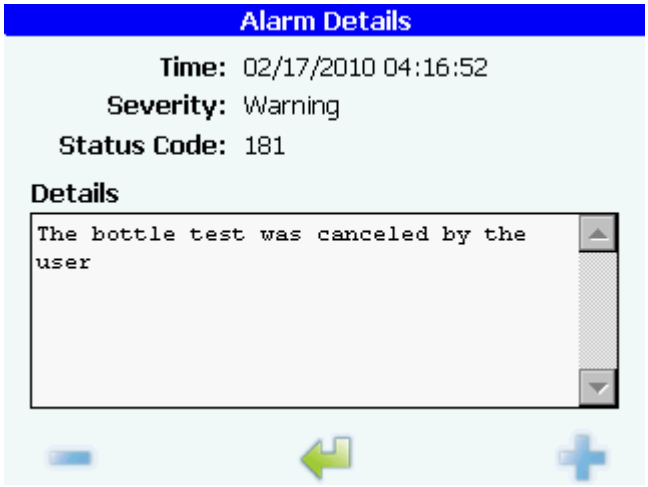


Figure 7-3 Alarm details dialog box

Alarm time text label indicates the time of the selected alarm.

Alarm severity text label indicates the severity of the type of the selected alarm.

Details list box lists a full text description for the selected alarm.

Next/previous icons (+ and –) move you to the next or previous alarm in the list.

Return icon returns you to the alarm acknowledge dialog box.

7.4 Alarm codes

Alarm codes, with user-initiated diagnostic tests, serve to isolate the source of the problem.The PAT700 constantly monitors its operation and measurement values for alarm conditions. Alarm conditions include error alarms, critical error alarms, warning alarms, and measurement alarms.

Error alarms

Errors occur any time one of the non-critical subsystems fail or a failure occurs from which the analyzer attempts to recover. The animation area flashes red to indicate an error condition is present. When an error condition is present, the analyzer attempts to recover and continue operating. See Table 7-1.

Table 7-1 Error alarm messages

Code	Message	Alarm condition
SC027	FalseConductivity	Measured conductivity is less than 0.
SC029	BadTocConvert	Temperature/Conductivity is out of bounds for TOC conversion.
SC035	LowOxidationRate	TOC is too low (out of range).
SC036	ChemicalInterference	• Negative TOC (out of range) • Potential presence of organic acids
SC037	LowTemperature	Temperature is out of range low.
SC038	HighTemperature	Temperature is out of range high.
SC039	LowResistance	Resistivity is out of range low.
SC040	HighResistance	Resistivity is out of range high.
SC112	UnableToStartPrinterModule	Analyzer can not start the printer module.
SC113	UnableToStartRs232Module	Analyzer can not start the RS-232 module.
SC116	UnableToReadDataLog	Analyzer can not read the data log.
SC117	UnableToWriteToDataLog	Analyzer can not write to the data log.
SC128	UvLampMonitorFailed	UV lamp monitor has failed.
SC151	LampExtinct	• Analyzer detects that the current lamp has failed. • Replace the UV lamp.
SC163	UnableToStopCurrentOperation	Analyzer can not stop its current operation.
SC164	UnknownError	Analyzer has experienced an unknown error.
SC167	WatchDogIoCard	I/O Card has stopped responding.
SC168	WatchDogTocAlgoithm	TOC algorithm has stopped responding.
SC169	WatchDogPrinter	Printer has stopped responding.
SC170	WatchDogRs232	RS-232 module has stopped responding.
SC177	Exception	An exception was thrown.
SC188	TOCOverLimit	TOC Over limit has occurred.

Critical error alarms

A critical error occurs any time the analyzer cannot function due to an error in the system. The error appears as a full-screen, flashing message. All operation ceases until the error condition has been corrected. The current analysis is aborted. Touching the screen provides access to the alarm acknowledge dialog box. See Table 7-2.

Table 7-2 Critical error alarm messages

Code	Message	Alarm condition
SC110	UnableToStartIoModule	Analyzer can not start the IO module.
SC111	UnableToStartTocModule	Analyzer can not start the IO module.
SC114	UnableToStartEthernetModule	Analyzer can not start the Ethernet module.
SC152	LampUnableToSwitch	Analyzer can not switch from one lamp to the other.
SC173	RangeTableFailedToLoad	RangeTable.txt file could not be loaded.
SC174	InstrumentTemperature	RangeTable.txt file could not be loaded.
SC175	BothLampsBad	• Both UV lamps have failed. • Replace both lamps as soon as possible.
SC176	NoCondTempReadings	• Analyzer can not measure conductivity and temperature. • Restart the analyzer. • If restarting does not resolve the error, phone customer service at 1–800–866–8854.
SC179	HardwareInitializationFailure	An error occurred during hardware initialization.

Warning alarms

A warning occurs any time one of the subsystems is not operating at a normal level. When a warning condition is present, a warning indicator appears on the display. Operation may continue with a warning condition present. When the warning condition has been corrected, the indicator disappears. See Table 7-3.

Table 7-3 Warning alarm messages

Code	Message	Alarm condition
SC100	IncorrectBottleLoadedinPosition1	• Incorrect bottle detected in position 1. • Analyzer can not perform bottle test operation.
SC101	IncorrectBottleLoadedinPosition2	• Incorrect bottle detected in position 2. • Analyzer can not perform bottle test operation.
SC102	IncorrectBottleLoadedinPosition3	• Incorrect bottle detected in position 3. • Analyzer can not perform the bottle test operation.
SC103	IncorrectBottleLoadedinPosition4	• Incorrect bottle detected in position 4. • Analyzer can not perform the bottle test operation.

Table 7-3 Warning alarm messages

Code	Message	Alarm condition
SC104	NotEnoughFluidinBottle1	• Not enough fluid in bottle 1 to complete the operation. • Check bottle 1 before starting operation. • Analyzer aborts operation and returns to its normal operating mode.
SC105	NotEnoughFluidinBottle2	• Not enough fluid in bottle 2 to complete the operation. • Check bottle 2 before starting operation. • Analyzer aborts operation and returns to its normal operating mode.
SC106	NotEnoughFluidinBottle3	• Not enough fluid in bottle 3 to complete the operation. • Check bottle 3 before starting operation. • Analyzer aborts operation and returns to its normal operating mode.
SC107	NotEnoughFluidinBottle4	• Not enough fluid in bottle 4 to complete the operation. • Check bottle 4 before starting operation. • Analyzer aborts operation and returns to its normal operating mode.
SC108	UnableToReadSettings	Some or all of the settings could not be read from the settings file.
SC109	UnableToWritetoSettings	Analyzer can not write to the settings file.
SC118	UnableToChangeLanguageSettings	Analyzer can not change the language settings.
SC119	UnableToReadLanguageSettings	Analyzer can not read the language settings
SC120	UnableToChangeEthernetSettings	Analyzer can not change the Ethernet settings.
SC121	UnableToReadEthernetSettings	Analyzer can not read the Ethernet settings.
SC122	UnableToPrintSystemSettings	Analyzer can not print the system settings.
SC125	UnableToStartLampTest	Analyzer can not start the lamp test.
SC126	UnableToStopLampTest	Analyzer can not stop the lamp test.
SC127	UvLampLifeExceeded	• Lamp hours of usage have been exceeded or the UV Detect™ output has dropped below the acceptable limit. • Lamp has been set to a status of marginal. • Replace the lamp.
SC129	UnableToReadInformationFromBottle	Analyzer can not read the information from the bottle.
SC130	UnableToWriteInformationToBottle	Analyzer can not write the information to the bottle.
SC132	UnableToStartPumpTest	Analyzer can not start the pump test.
SC133	UnableToStopPumpTest	Analyzer can not stop the pump test.
SC134	UnableToCalibratePump	Analyzer can not calibrate the pump.
SC135	UnableToExportDataLog	Analyzer can not export the data log.
SC136	UnableToExportAuditTrail	Analyzer can not export the audit trail.
SC137	UnableToAddUser	Analyzer can not add a user.
SC138	UnableToEditUser	Analyzer can not edit a user.
SC139	UnableToDeleteUser	Analyzer can not delete a user.

Table 7-3 Warning alarm messages

Code	Message	Alarm condition
SC141	UnableToAcknowledgeAlarms	Analyzer can not acknowledge alarm.
SC142	UnableToSilenceAlarms	Analyzer can not delete alarms.
SC143	UnableToStartSelfClean	Analyzer can not start the self clean.
SC144	UnableToStopSelfClean	Analyzer can not stop the self clean.
SC145	UnableToStartOnlineManualSample	Analyzer can not start the online manual sample.
SC147	UnableToRestoreFactoryDefaults	Analyzer can not restore the factory defaults.
SC150	UnableToPrintDataLog	Analyzer can not print the data log.
SC153	Bottle1MarkedAsUsed	• Bottle installed in location 1 is marked as used. • Replace bottle installed in location 1 with a valid standard.
SC154	Bottle2MarkedAsUsed	• Bottle installed in location 2 is marked as used. • Replace bottle installed in location 2 with a valid standard.
SC155	Bottle3MarkedAsUsed	• Bottle installed in location 3 is marked as used. • Replace bottle installed in location 3 with a valid standard.
SC156	Bottle4MarkedAsUsed	• Bottle installed in location 4 is marked as used. • Replace the bottle installed in location 4 with a valid standard.
SC160	ExcursionBottle4NotEmpty	• Excursion bottle 4 is not empty. • Remove excursion bottle 4 and replace with an empty bottle.
SC165	LampSwitch	• Analyzer has switched UV lamps because the current lamp was marginal or failed. • Replace the UV lamp.
SC172	RougeDetected	• One or more of your 500 ppb standards took longer than expected to oxidize. • Clean the cell.
SC178	ExcursionCaptured	• An excursion sample was captured in excursion bottle. • Remove the sample from the analyzer.
SC180	ConductivityMeterAlarm	Analyzer has not passed conductivity meter test.
SC181	BottleTestCancelled	Bottle test was cancelled by the user.
SC182	Bottle1Expired	Bottle installed in location 1 reached expiration date.
SC183	Bottle2Expired	Bottle installed in location 2 reached expiration date.
SC184	Bottle3Expired	Bottle installed in location 3 reached expiration date.
SC185	Bottle4Expired	Bottle installed in location 4 reached expiration date.
SC186	BottleTestCanceledExpiredStandard	Bottle test canceled due to an expired Standard bottle found in the Bottle bay.
SC187	ExcursionWithValChangedExpiredStandard	Excursion with Validation test canceled due to an expired Standard bottle found in the Bottle bay.

TOC alarms

A TOC or conductivity alarm occurs any time the measured TOC level or water conductivity exceeds the user set limit for each measure. See Table 7-4.

Table 7-4 TOC alarm messages

Code	Message	Alarm condition
SC161	TocAlarm	High TOC Alarm
SC162	ConductivityAlarm	Conductivity Alarm

Measurement alarms

A measurement alarm condition occurs any time the measured TOC exceeds the user-defined limit or conductivity exceeds the USP-defined alarm limit. When an alarm condition occurs, the corresponding data value turns red. If the value drops below the alarm limit, the value returns to its normal color.

Audible alarms

If a sound has been selected in the setup dialog box, when any of the above error types occurs, an audible alarm sounds. The audible alarm repeats until the alarm condition has been acknowledged. Each type of alarm (stop, warning, alarm) has its own sound. If multiple alarms are present, only the highest-level alarm sounds.

Chapter 8 Diagnostics

8.1 Accessing the diagnostics dialog box

- At the home screen, touch the << icon to open the sliding toolbar, then touch the diagnostics icon, or
- Touch the dual UV lamp status indicator in the lower right corner of the screen.

8.2 Diagnostics dialog box

The diagnostics dialog box provides access to lamp management, system tests, and calibration dates.

8.3 General tab

The general tab displays the operating status of lamps 1 and 2. See Figure 8-1.

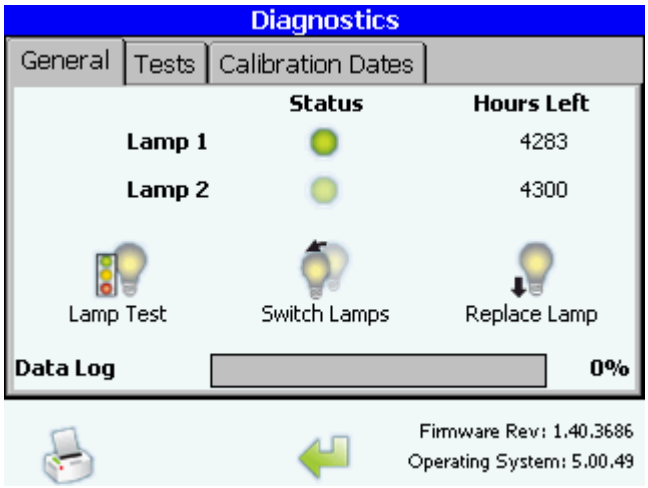


Figure 8-1 Diagnostics dialog box, general tab

Version information text label displays the firmware and operating system version information.

Status icon represents the status of each of lamp 1 and lamp 2. If a lamp is not currently in use, the icon is dimmed.

- **Good** (green) means the lamp has not reached 0 hours left and is producing a sufficient level of UV light based on the UV Detect™ diagnostics.
- **Marginal** (yellow) means the lamp has either reached 0 hours left or has been determined by UV Detect diagnostics to be producing a diminished level of UV light and that the lamp should be replaced.
- **Failed** (red) means the lamp has failed and is not longer producing sufficient UV light to perform full sample oxidation.
- **Not in use** (dimmed) means the lamp is not in use.

Hours left text label counts down the number of hours remaining for the UV lamp. You should replace the UV lamp after 4300 hours of operation.

Lamp test icon turns on each lamp for 180 seconds and tests the UV output level using the UV Detect diagnostics. See Figure 8-2. If you touch the lamp test icon, the current analysis operation stops, and you are asked if you want to continue. During the test, a message is displayed stating which lamp is being tested and how much time is left in the test. You may touch the stop icon (red “X”) to abort the test. Once the lamp test is over, the lamp information is updated and the analyzer returns to the diagnostics dialog box. Executing a lamp test triggers an entry in the audit trail.

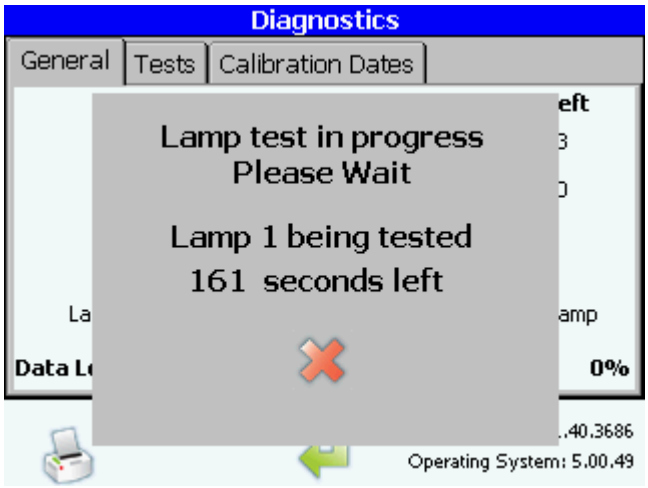


Figure 8-2 Lamp test progress dialog box

Switch lamps icon prompts you to switch from one lamp to the other. You are first notified that the current analysis is stopped and asked if you want to continue. If you touch the switch lamps icon, the analyzer begins using the other lamp. Executing this function triggers an entry in the audit trail.

- You may only switch from a good lamp to another good lamp, or from a marginal lamp to a good or marginal lamp.
- Using this logic, the switch lamps icon is enabled or disabled based on whether an appropriate lamp is available.

Replace lamp icon displays the UV lamp replacement dialog box. See PAT700 lamp replacement, page 125. The lamp replacement instructions can be sent to a printer, if connected, so that the instructions are available to review while the analyzer is powered down.

Return icon returns you to the diagnostics dialog box.

PAT700 lamp replacement

To replace a lamp, follow these steps:

1) Touch the replace lamp icon.
2) Select the lamp to be replaced.
3) Touch “Run Wizard” to run the lamp replacement wizard. Touch “Replace Now” to skip the replacement wizard. Touch “Print Instructions” to send the lamp replacement instructions to a printer, if connected. *Read the instructions completely* as you proceed with the lamp replacement.

- If you touch “Run Wizard”, the lamp replacement wizard provides step-by-step instructions for replacing the lamp. *Read the instructions completely* as you proceed with the lamp replacement.
- If you touch “Replace Now”, the display skips the replacement wizard and asks you to power down the analyzer. See Figure 8-3, then *carefully follow the procedure* described in Lamp replacement procedure, page 164.

Figure 8-3 Lamp replacement dialog box

8.4 Tests tab

The tests dialog box allows you to test the following analyzer functions: RS–232 output, digital I/O, 4-20 mA outputs, printer, plumbing systems, pump, and heat exchanger fan. See Figure 8-4.

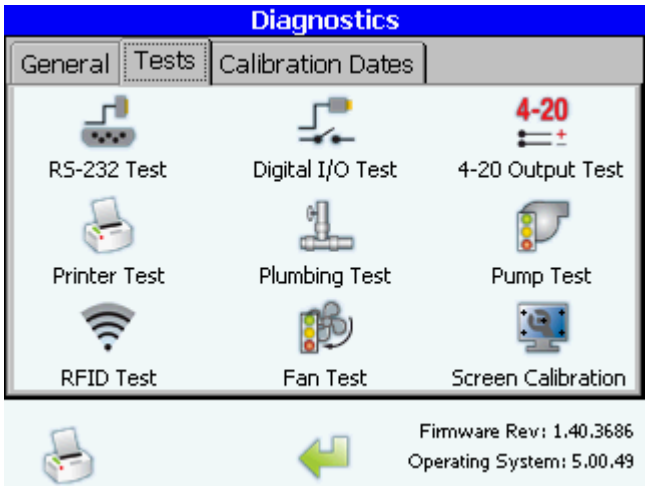


Figure 8-4 Diagnostics dialog box, test tab

RS-232 test

The RS-232 test icon allows you to test serial communication from the serial port by using the printer port as a return port. See Figure 8-5.

1) Disconnect the printer and RS-232 serial connections and connect a serial cable between the analyzer's serial ports (from one serial port to the other).
2) Press the start test icon.

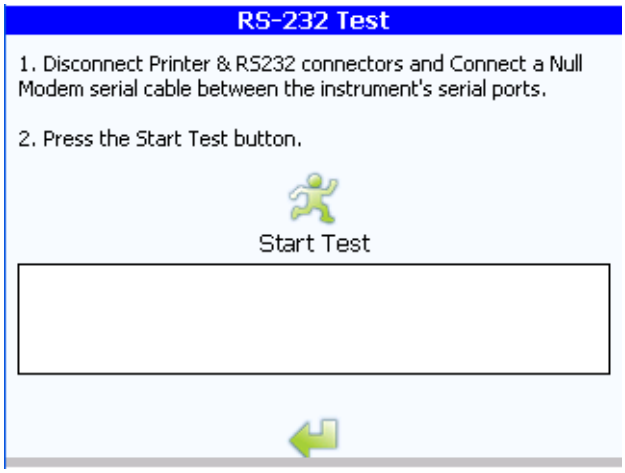


Figure 8-5 RS-232 test dialog box

Start test icon sends serial data out one serial port and reads the data on the other. If the read data matches the sent data, the test passes.

Return icon returns you to the diagnostics dialog box.

Digital I/O test

The digital I/O test icon allows you to test digital I/O communication. See Figure 8-6. Before you perform the digital I/O test, make sure I/O wiring is properly connected.

1) Connect the digital inputs to a system that is capable of sending a digital signal
2) Configure one digital input with a high signal and the other with a low signal.
3) Connect the digital outputs to a system that is capable of reading digital signals.
4) Press the start test icon.

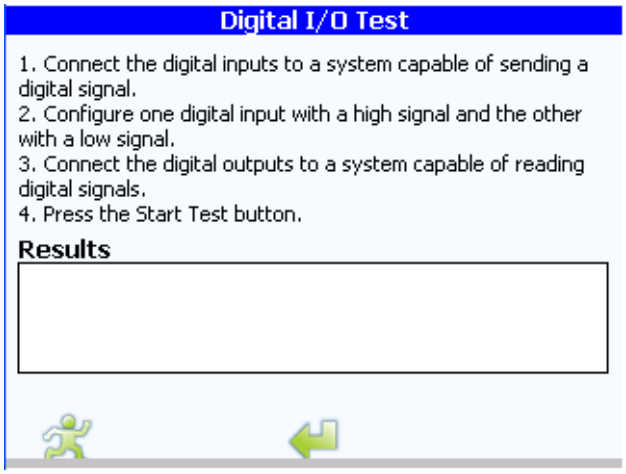


Figure 8-6 Digital I/O test dialog box

Start test icon sends send a digital signal out the specified digital output port and reads the signal on one of the digital input ports. If the read data matches the sent data, the test passes.

Return icon returns you to the diagnostics dialog box.

4-20 mA output test

The 4-20 mA output test icon allows you to test the 4-20 mA outputs. See Figure 8-7. To perform the test, you must connect a digital multimeter to the appropriate output to measure the voltage.

1) Connect a digital multimeter to one of the 4-20 mA outputs.
2) Press the corresponding output icon to start the test.

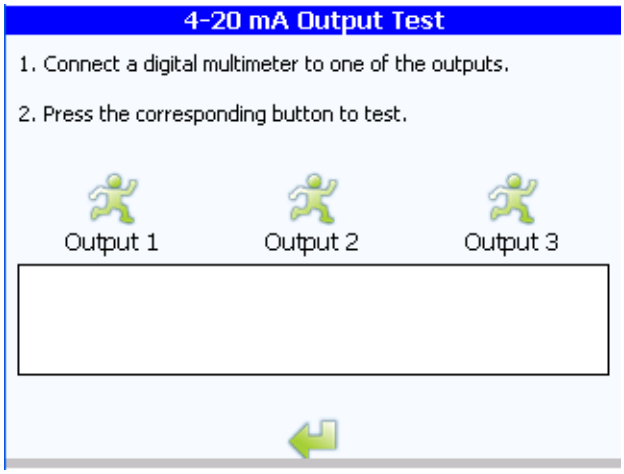


Figure 8-7 4-20 mA output test dialog box

Output 1, output 2, and output 3 icons have the same functionality for each output. Touching one of the icons sends a 4 mA signal from the appropriate output. The analyzer then sends a 20 mA signal from the same output. Each signal is held for three seconds.

Return icon returns you to the diagnostics dialog box.

Printer test

Touching the printer test icon sends a test printout to the printer. Before you perform the printer test, make sure the analyzer is properly connected to the printer.

Plumbing test

The plumbing test icon allows you to test the various analyzer plumbing systems. See Figure 8-8.

You are first notified that the current analysis is stopped and asked if you want to continue. In this dialog box, you may select preconfigured valve and pump combinations to test. Entering the plumbing test dialog box triggers an entry in the audit trail. See Figure 8-8.

Figure 8-8 Plumbing test dialog box

Flow path selection drop down list box allows you to select from 12 pre-configured valve and pump combinations. You may select none (default), bypass, flow through cell, flow through cell with pump, sample from bottle 1, sample from bottle 2, sample from bottle 3, sample from bottle 4, back flush through bottle 1, back flush through bottle 2, back flush through bottle 3, or back flush through bottle 4.

- **None.** Selecting this option turns off the pump and closes all the valves.
- **Bypass.** Selecting this option opens only the bypass valve.
- **Flow through cell.** Selecting this option opens only the cell valve.
- **Flow through cell with pump.** Selecting this option opens the cell valve, the pump valve, and turns on the pump.
- **Sample from bottle 1, bottle 2, bottle 3, or bottle 4.** Selecting this option opens the selected bottle valve, the pump valve, and turns on the pump.
- **Back flush through bottle 1, bottle 2, bottle 3, or bottle 4.** Selecting this option opens the selected bottle valve and the cell valve.
- **Return icon** returns you to the diagnostics dialog box.

Load bottles icon opens the select bottles to load dialog box. See Figure 8-9.

Unload bottles icon takes you to the unload/replace bottles dialog box. See Figure 8-11, page 131.

Figure 8-9 Select bottles to load dialog box, plumbing test

CAUTION

Potential puncture hazard! Contact with the exposed needle could cause serious injury. Use extreme care when installing and removing the sample bottles.

CAUTION

Potential burst hazard! Do not exceed the maximum 100 psi (690k Pa) sample pressure ratings.

1) After you've selected the bottles to load, install the grab samples bottles following the instructions as shown in the load bottles dialog box (Figure 8-10) and ensuring that you place the bottles in the correct positions.
2) Close the bottle bay door.

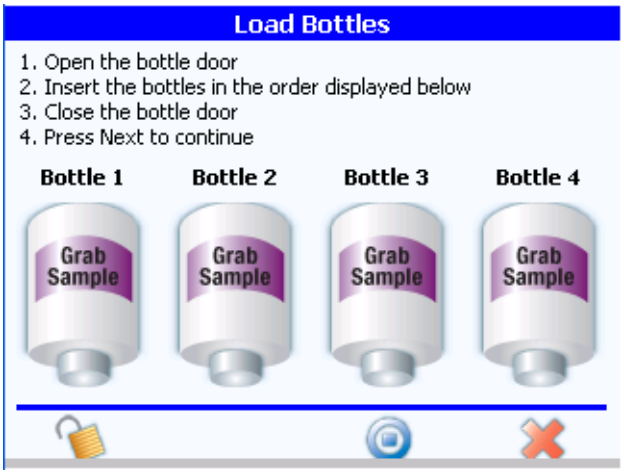


Figure 8-10 Load bottles dialog box, plumbing test

- **Bottle positions graphics** show you the order in which to install the bottles.
- **Unlock icon** energizes the bottle bay door lock for five seconds, allowing you to open the door.
- **Run test icon** runs the plumbing test.
- **Cancel icon** returns you to the previous dialog box. All changes made in any of the dialog boxes are lost.

3) After you've entered the correct bottle information, touch the run test icon, which returns you to the plumbing test dialog box. See Figure 8-8, page 129.

4) Select the desired test from the flow test selection drop down list box.

5) When the test is completed, touch the unload bottles icon. The unload/replace bottles dialog box appears. See Figure 8-11.

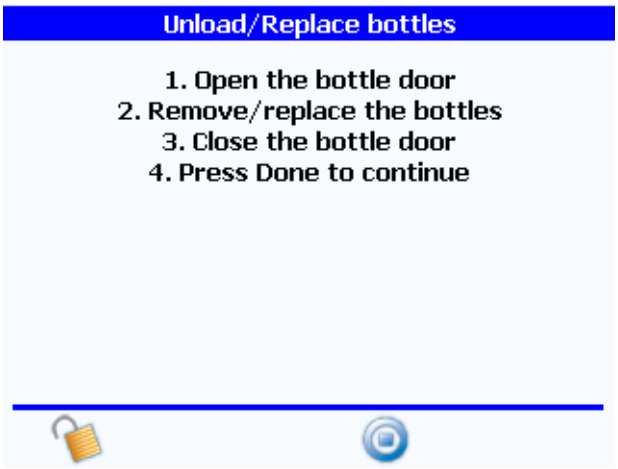


Figure 8-11 Unload/replace bottles dialog box

- **Unlock icon** energizes the bottle bay door lock for five seconds, allowing you to open the door.
- **Done icon** returns you to the plumbing test dialog box.

6) If a test is chosen immediately, the analyzer asks if you wish to install a bottle. If yes is selected, the load bottles dialog box illustrates the appropriate port in which to install the bottle. The enter bottle information screen requires you to enter the bottle's volume. The next button then starts the test.

Pump test

The pump test icon allows you to test pumps. See Figure 8-12.

Before the pump test, you must place a 50 mL graduated cylinder at the analyzer's water outlet. No tubing should be used. A bottle must be installed in position 2 to enable the pump to be primed. When you touch the run icon, the analyzer pumps water for 30 seconds, then prompts you to input the volume pumped, as measured in the graduated cylinder. After you've input the volume, touch the return icon to accept the results or the cancel icon to reject them.

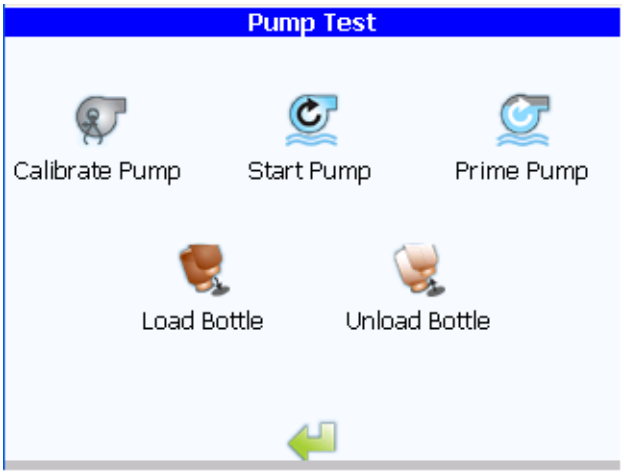


Figure 8-12 Pump test dialog box

Calibrate pump icon opens the calibrate pump dialog box. See Figure 8-13.

Start/stop pump icon starts and stops the pump. Touching the start pump icon opens the pump valve and the grab sample bottle valve, then starts the pump. The pump runs indefinitely until you press the stop pump icon. Both valves then close, and the pump stops.

Prime pump icon opens the pump valve and the grab sample valve, then starts the pump. The pump runs long enough to prime, then it stops. Both valves then close.

Load bottles icon opens the load bottles dialog box. See Figure 8-10, page 131.

Unload bottles icon takes you to the unload/replace bottles dialog box. See Figure 8-11, page 131.

Return icon returns you to the diagnostics dialog box.

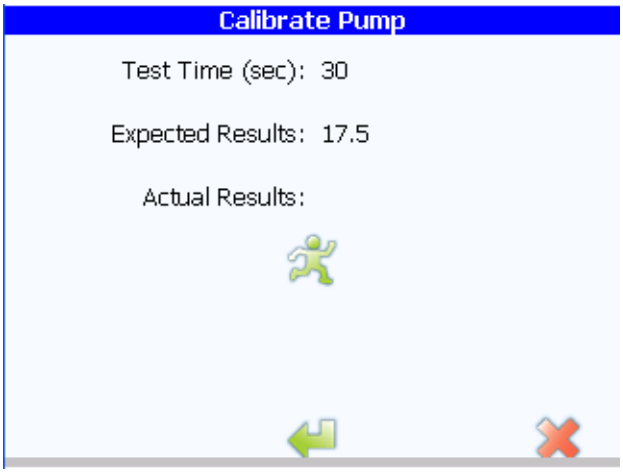


Figure 8-13 Pump calibration dialog box

Test time text box indicates the time in seconds that is used for the test and calibration functions. The test time is always 30 seconds.

Start test icon opens the pump valve and the grab sample valve, then starts the pump. The pump runs for 30 seconds, then the pump stops. Both valves then close.

Expected result text is the calculated amount of water that should be measured during the test. The formula for calculating this value appears below.

$$V = \frac{\text{Flow rate}}{\text{Test time}}$$

Where:

Flow rate=Target flow rate of the pump as entered in the actual results text box.

Test time=Value indicated in the test time text box.

Actual result text box is the actual amount of water that was measured during the test.

Return icon returns you to the diagnostics dialog box.

Cancel icon returns you to the pump test dialog box without saving the test results.

Fan test

The fan test icon allows you to test the analyzer's fans. The analyzer contains an internal online heat exchanger that activates to maintain proper water temperature to the analysis cell. Two fans cool the heat exchanger.

Touching the fan test icon opens the fan test dialog box, where you can cycle the fans on and off to ensure their proper operation. See Figure 8-14.

Figure 8-14 Fan test dialog box

RFID test

The RFID test icon allows you to test the RFID reader system.

To conduct this test you will need to install four standards bottles equipped with RFID tags. These bottle can be new or used standards bottles.

Open the OASIS system door and insert up to four standards bottles with RFID tags in each bottle location. Touching the start button will initiate a test of the RFID system. The system will automatically sense those locations where RFID tags are present. To verify failure of the system the unlock button can be used to open the OASIS door during the test. With the door open, and the bottles no longer positioned properly, the system will return a failed test.

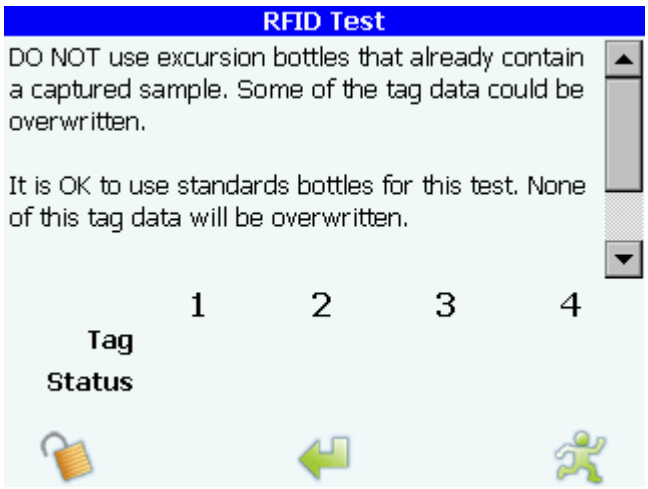


Figure 8-15 RFID test dialog box

Unlock icon energizes the bottle bay door lock for five seconds, allowing you to open the door.

Return icon returns you to the diagnostics dialog box.

Run icon initiates the RFID test.

8.5 Test tab

Screen calibration icon allows the user to calibrate the touch screen display. If the touch screen display does not allow accurate item selection, you can use calibrate the display to your touch. Select *Screen Calibration* and follow the touch screen wizard to calibrate.

8.6 Calibration dates tab

Use the calibration dates tab for viewing the last dates that TOC calibration, conductivity calibration, and system suitability test were performed.

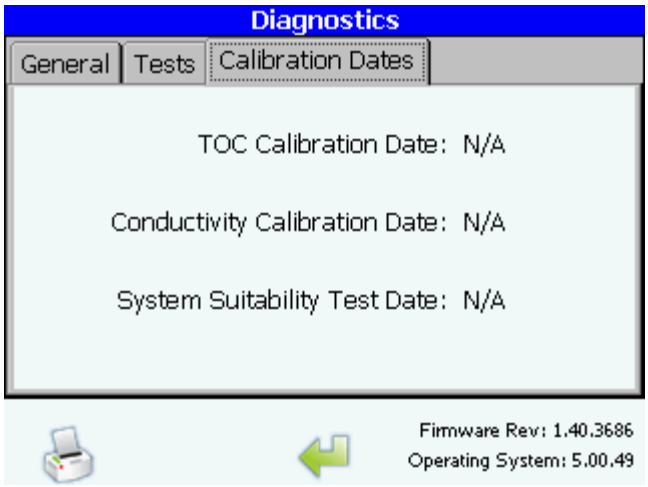


Figure 8-16 Diagnostics dialog box, calibration dates tab

TOC calibration date text box (read-only) updates when a TOC calibration has been run and accepted. The date appears in ISO “yyyy-mm-dd” format.

Conductivity calibration date text box (read-only) updates when a conductivity calibration has been run and accepted. The date appears in ISO “yyyy-mm-dd” format.

System suitability test date text box (read-only) updates when a system suitability test has been run and accepted. The date appears in ISO “yyyy-mm-dd” format.

Print icon prints all diagnostic information.

Return icon returns you to the home screen.

Chapter 9 Data Review

9.1 Accessing the data review dialog box

1) At the home screen, touch the << icon to open the sliding toolbar.
2) Touch the data review icon.

Access to the data review dialog box may be delayed while available data is transferred to the data log.

9.2 Data review dialog box

The data review dialog box is populated only when data logging is selected in the security settings dialog box. The data log will hold up to 5,000 records. The data log contains analysis results, alarms, bottle test results, and audit trail entries. Since the audit trail is stored in the data log each audit trail entry uses one of the 5,000 data log entries. The data log operates in a first in first out approach. Once the data log contains 5,000 entries the oldest entry is replaced with the newest entry. See Security, page 69.

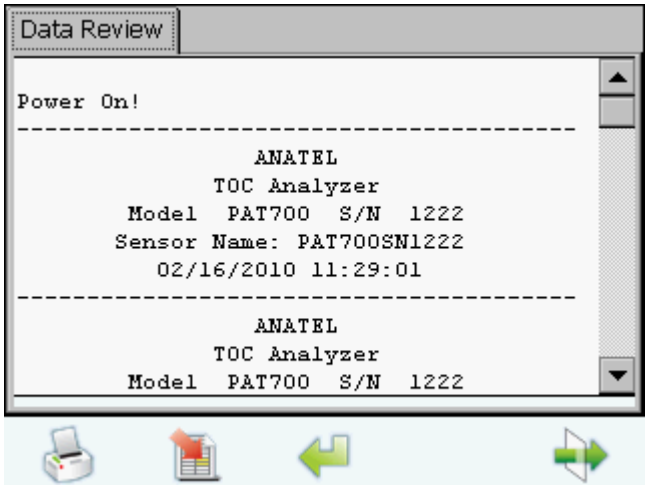


Figure 9-1 Data review dialog box

Data review window lists all the data in the data log. The data appear as they would on the printer. The data are filtered based on the settings in the filter dialog box. Data are displayed in chronological order from earliest to most recent. The list scrolls to display the earliest data.

Print icon sends the displayed data to the printer.

Export icon opens the export settings dialog box. See Export data, page 138.

Return icon returns you to the home screen.

Filter data icon opens the filter data dialog box. See Filter data, page 139.

9.3 Export data

Data are exported in formatted text. The export function sends data to the USB port. Due to driver constraints, the analyzer is not compatible with all USB flash drives. A compatible flash drive is shipped with the analyzer.

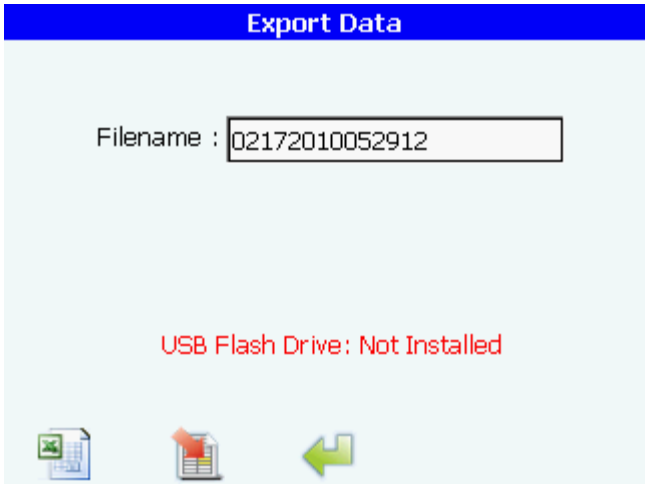


Figure 9-2 Export data dialog box

Filename text box allows you to specify the filename for the exported data file. You may specify a 20-character file name.

Exporting record no: X bar graph indicator displays the progress of the export.

Export icon starts the export. Before the export begins, the analyzer verifies that there is data to export, that you have entered a valid file name, and that a USB flash drive is inserted into the analyzer's USB port. The file is written to the root directory of the flash drive. If the file already exists, you are asked if you want to overwrite it.

Return icon returns you to the data review dialog box.

Export Excel icon exports data to the USB flash drive as an Excel file.

9.4 Filter data

Data filtering allows you to select the type and range of data to display, export or print. Data can be filtered by test type, date range, or special ranges.

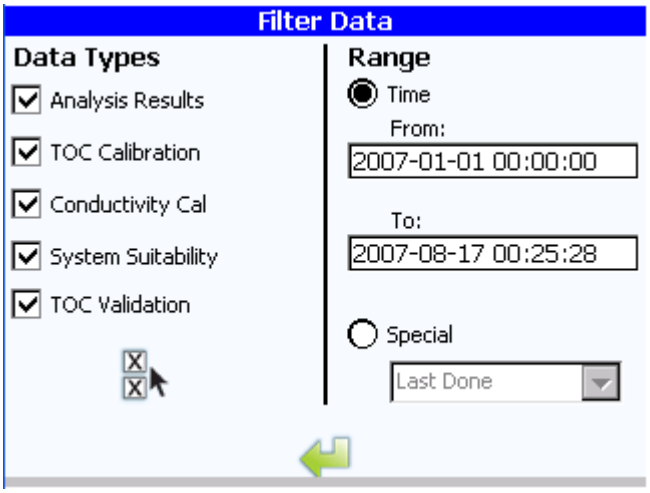


Figure 9-3 Filter data dialog box

Data types checkboxes determine what data are displayed in the data review dialog box. By default, all data types are selected.

Select all icon selects all the data types check boxes.

Range radio buttons enable you to determine how much data are displayed in the data review dialog box. You may select from time or special. Selecting time enables the from and to text boxes and disables the special drop down list box. Selecting special enables the special drop down list box and disables the from and to text boxes. The default selection is time.

Time from and time to text boxes enable you to define the from and to date and time. The default entries are the last 24 hours.

Special drop down list box allows you to filter data according to the last few entries of a certain type. Analysis results are deselected using this function. You may select last accepted, last done, or last five.

- Selecting last accepted causes the filter to include only the last accepted tests for the selected data types.
- Selecting last done causes the filter to include only the last completed tests for the selected data types.
- Selecting last five causes the filter to include only the last five completed tests for the selected data types.
- Selecting special causes the data to be sorted by data type first, then by time, from most recent to earliest. The data type will prefix each group of data. For example, “System Suitability” will prefix the system suitability group. A blank line separates each group.

Return icon returns you to the data review dialog box and resets the data filter according to the options chosen.

Chapter 10 Signing On and Off

If security is enabled, to access configuration and analyzer parameters, you must log on the system. Use the password dialog box to log on to the system.

Four different user types may access the system: guest, operator, administrator, and factory. Only operator users may be added or deleted from the system. Passwords can be assigned to an operator and administrator. Guest are those without passwords. The factory password is reserved for Hach service and support only.

- **Guest**. This user type is any user who does not have a password and can not log on to the system. This user may access most areas and view information but is not allowed to modify any settings or initiate any operations when security is enabled. Guests have no access to the security settings dialog box when security is enabled.
- **Operator**. This is a user who has been assigned a user name and password. This user type has full access to most dialog boxes. Operators have no access to the security settings dialog box and read-only access to the factory settings and the bottle mode settings.
- **Administrator**. This user type has a password and full access to most dialog boxes. Administrators have read-only access to the factory dialog box. The default administrator entry has a user name of “Administrator”, a user ID of “Admin”, and a password of “123456”.
- **Factory**. This user type has full access to all dialog boxes.

NOTE

For security reasons, the first time an administrator or newly created operator logs on to the system they will be required to change their password.

10.1 Accessing the password dialog box

1) At the home screen, touch the << icon to open the sliding toolbar.
2) Touch the sign on icon.

10.2 Password

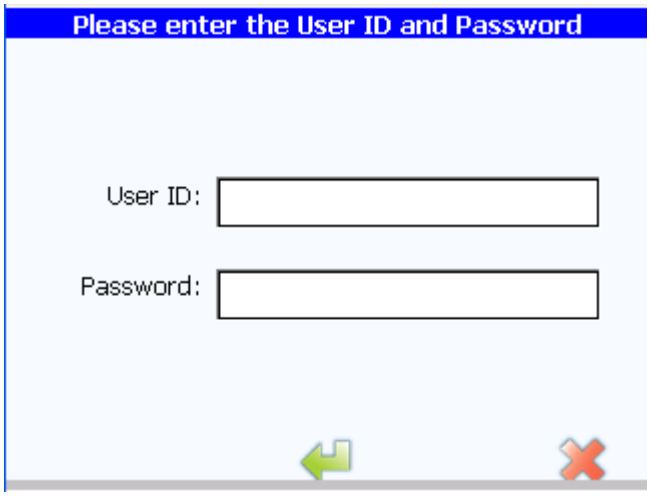


Figure 10-1 Password dialog box

User ID. Enter your user ID to log onto the analyzer.

Password. Enter your user password to log on the analyzer.

- If the entered user ID and password match existing entries in the user's list, you are signed on and returned to the home screen.
- If the entered user ID and password don't match existing entries in the user's list, an error message is displayed and you may try again.

OK icon returns you to the home screen.

Cancel icon returns you to the home screen. No entries are written to the audit trail.

10.3 Expired password

Upon successful sign on, the analyzer checks to see if the user's password has expired. If it has, you are prompted to change your password.

10.4 Backdoor password

If administrators or factory personnel forget their passwords, they may gain temporary access by using a backdoor password provided by Hach factory service. Upon successful sign on, the analyzer prompts the user to change the password.

Contact Hach service at 800.866.7889 to obtain a backdoor password for the analyzer. To obtain the password the factory will request the serial number and current date shown on the analyzer. Please have this information ready when calling to request a backdoor password.

Chapter 11 Modbus Protocol

11.1 Introduction

Modbus

This chapter provides a detailed explanation of the Modbus/TCP registers used by the Anatel PAT700 TOC Analyzer.

Please visit the Modbus Organization website at http://www.modbus.org for information regarding the latest Modbus and Modbus/TCP specifications. The Modbus Protocol is a messaging structure and it is used for master-slave/client-server communication between intelligent devices.

Modbus devices communicate using a master-slave (client-server) technique in which only one device (the master/client) can initiate transactions (called queries). The other devices (slaves/servers) respond by supplying the requested data to the master, or by taking the action requested in the query. A slave is any peripheral device (I/O transducer, valve, network drive, or other measuring device) which processes information and sends its output to the master using Modbus.

Modbus/TCP

The Modbus messaging structure is the application protocol that defines the transmission medium. TCP/IP refers to the Transmission Control Protocol and Internet Protocol, which provides the transmission medium for Modbus TCP/IP messaging.

Modbus/TCP uses TCP/IP and Ethernet to carry the data of the Modbus message structure between compatible devices. That is, Modbus/TCP combines a physical network (Ethernet), with a networking standard (TCP/IP), and a standard method of representing data (Modbus as the application protocol). Essentially, the Modbus/TCP message is simply a Modbus communication encapsulated in an Ethernet TCP/IP wrapper.

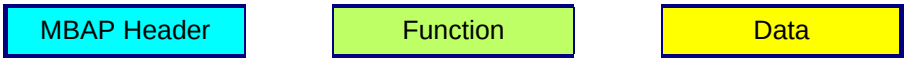
The Modbus/TCP protocol supports multiple types of data transactions, from reading single bits per transaction, to advanced object-oriented operations. However, to ensure the most compatible system available, the simplest function set is to be made available.

The Modbus/TCP has each transaction type classified in to conformation classes, to ensure consistency and interoperability. Class 0 is the simplest, and allows for reading and writing of multiple 16-bit registers. The Modbus/TCP feature of the Anatel PAT700 TOC Analyzers will support reading and writing of these 16-bit registers, which allows the Anatel PAT700 TOC Analyzers to establish a block of data which contains all the process variables, set points, alarms and input/output statuses that are to be made public to a Modbus/TCP client. This block of data is packaged so that it can be read in 16-bit chinks (or registers) at a time, regardless of the type of data within it. In the following sections, the formatting, storing and reading of this data are described.

11.2 Modbus/TCP Driver

Modbus Protocol

A typical Modbus/TCP frame consists of the following fields:



The **MBAP Header** (Modbus Application Protocol Header) consists of 7 bytes of information:

Transaction Identifier	2 bytes	It is used for transaction pairing i.e. identification of Request/ Response transaction. The Modbus/TCP server copies the transaction identifier of the request in to the response.
Protocol Identifier	2 bytes	It is used for intra-system multiplexing. The Modbus/TCP protocol is identified by the value 0.
Length	2 bytes	The length field is a byte count of the following fields, including the Unit Identifier.
Unit Identifier	1 byte	This field is used for intra-system routing purpose. It is typically used to communicate to a MODBUS or a MODBUS+ serial line slave through a gateway between an Ethernet TCP/IP network and a MODBUS serial line. This field is set by the MODBUS Client in the request and must be returned with the same value in the response by the server.

The **Function Code** field of a message contains 8 bits. Valid function codes are in the range of 1 - 255 decimal. The function code instructs the slave what kind of action to take. The Modbus/TCP feature only supports Function Codes: FC3 (Read Multiple Registers) and FC6 (Preset Single Register). The 125-register limitation is established for the Modbus/TCP standard to maintain consistency with original Modbus protocol standard, even though a TCP/ IP packet can support more data.

When a slave responds to the master, it uses the function code field to indicate either a normal response or that some type of error has occurred. For a normal response, the slave echoes the original function code. In an error condition, the slave echoes the original function code with its MSB set to logic 1.

The **Data** field is constructed using sets of two hexadecimal digits in the range of 00 to FF. According to the network's serial transmission mode, these digits can be made of a pair of ASCII characters or from one RTU character. The data field also contains additional information that the slave uses to execute the action defined by the function code. This can include internal addresses, quantity of items to be handled, etc.

The data field of a response from a slave to a master contains the data requested if no error occurs. If an error occurs, the field contains an exception code that the master uses to determine the next action to be taken. The data field can be nonexistent in certain types of messages.

Request

Function Code	1 byte	0x03
Starting Address	2 bytes	0x0000 to 0xFFFF
Quantity of Registers	2 bytes	1 to 125 (0x01 to 0x7D)

Response

Function Code	1 byte	0x03
Byte Count	1 byte	2 x N*
Register Values	N* x 2 bytes	

*N = quantity of registers

Error

Function Code	1 byte	0x83
Exception Code	1 byte	

Any other Function Code request will be returned with an error response indicating the Function Code is not supported, as well as a request for too much data or data at a register address that is not present.

TCP/IP Interface

The Modbus/TCP interface is attached to the TCP/IP stack that is implemented within the Anatel PAT700 TOC Analyzer, and will listen to all communications that come in on Modbus/TCP registered port 502.

The Modbus/TCP client uses the standard TCP methods for communicating with the driver, as established by the BSD socket interface: connect(), send(), receive() and close(). Only 1 Server connection is allowed at any time. If there is an active connection, any attempt at any more connections is ignored.

Once a connection has been established, it will be closed after 90 Seconds of inactivity.

Data Model

Modbus bases its data model on a series of tables that have individual characteristics. The four primary tables are:

Primary table	Address Range	Data type	Type of Access
Discrete Inputs	1000-1FFF	Single bit	Read-only
Coils	2000-2FFF	Single bit	Read-write
Input Registers	3000-3FFF	16-bits	Read-only
Holding Registers	4000-4FFF	16-bits	Read-write

There is no requirement for how the tables are implemented within the product, but the tables are distinctive because of the method that is used to access them within the protocol.

Since only FC3, FC6 and FC16 are supported in Anatel PAT700 TOC Analyzers, only the Holding Register-type table is required. To access each entry in to the Holding Register table, a starting address (0 indicates the first entry in the table) is required as well as the number of registers that are requested.

The data storage does not need to be consecutive; in fact, this implementation uses multiple blocks' within the Holding Register table to support future enhancements and additions to the data without changing the location of the data already present.

The Holding Register table is a large structure that contains smaller structures, each containing the specific types of data, and associated with a defined starting address offset for each type of data. The offset allows the driver to determine if the request needs to access data from the specific structure.

The data is stored within the table's local to the Modbus/TCP driver, which allows the driver to quickly access it during a request. The tables are indexed in to during a request using the starting address of the request and the defined offset for that structure.

For example, if the structure containing the headers has an defined offset of 0, and is 128 bytes long and a request for starting address 10 with a length of 5 words is received, the 20th through 29th byte within the table are sent to the client.

Once the data is stored within the local tables, the driver does not differentiate what is stored in them. **The Modbus/TCP client needs to know what data is stored in which register locations to be able to retrieve it, process it, and/or display it.**

Data Encoding

Modbus uses a 'big-endian' representation for addresses and data items. This means that when a numerical quantity larger than a single byte is transmitted, the MOST significant byte is sent first. The following sub-topics describe the different types of encoding and show how the data is encoded as it is within the Modbus/TCP packet. Most client drivers will extract the data from the packet in the correct format for use/display within the client environment.

Binary

A binary item is represented as a single bit within a data word. All binary data is packed in to 16-bit data words, which are accessed using FC3 therefore, a single register contains 16 bits of binary data, each having a specific meaning.

Example (Decimal value): 43,605

Value (Hex)	1st Register	2nd Register
0xAA55	0xAA	0x55
(101010100101)	(10101010)	(01010101)

16-bit Word (short)

A 16-bit word item is transmitted with the MOST significant byte first. FC3 reads 16-bit items at a time; therefore, each of these data items will fit within one register that is read.

Example (Decimal value): 4,660

Value (Hex)	1st Register	2nd Register
0x1234	0x12	0x34

32-bit Word (int)

A 32-bit word item is transmitted with the MOST significant byte first, then the next MOST significant, until all the bytes are transmitted. FC3 reads 16-bit items at a time; therefore, two registers are required to read each 32-bit data item.

Example (Decimal value): 305,419,896

	1st Register		2nd Register	
Value (Hex)	1st	2nd	1st	2nd
0x12345678	0x12	0x34	0x56	0x78

Double

A Double float value is 64-bits within the Anatel PAT700 TOC Analyzer. FC3 reads 16-bit items at a time; therefore, four registers are required to read each Double float data item.

NOTE

The Modbus/TCP protocol follows Little Endian - byte swap format while transmitting Double float data i.e. LSB byte should come first in a Register. The swapped data on Client side has to be converted back to original format to read the correct value.

Example (Double Float): 1.0

	1st Register		2nd Register		3rd Register		4th Register	
Value (Hex)	1st	2nd	1st	2nd	1st	2nd	1st	2nd
1.0 (as in memory) 0x0000000000000F03F	0x00	0x00	0x00	0x00	0x00	0x00	0xF0	0x3F

	1st Register		2nd Register		3rd Register		4th Register	
	2nd	1st	2nd	1st	2nd	1st	2nd	1st
1.0 (after swapping) 0x0000000000003FF0	0x00	0x00	0x00	0x00	0x00	0x00	0x3F	0xF0

Strings

A string is a group of 8-bit data items having a fixed length. The first character of a string is transmitted first, followed by the remaining characters. FC3 reads 16-bit items at a time; therefore, a single register contains two characters of the string. To simply string storage/ transfer, each string should be of an even-byte length.

Example (String): Hach

	1st Register		2nd Register		3rd Register		4th Register		5th Register	
Value (String)	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd
‘Hach’	0x48	0x61	0x63	0x68	0x55	0x6C	0x74	0x72	0x61	0x00

IP Address

An "IP Address" is transmitted similar to a 32-bit Word with the MOST significant byte first, then the next MOST significant, until all the bytes are transmitted. FC3 reads 16-bit items at a time; therefore, two registers are required to read each IP Address data item.

Example (Decimal): 192.168.0.1

	1st Register		2nd Register	
Value (Hex)	1st	2nd	1st	2nd
0xC0A80001	0xC0	0xA8	0x00	0x01

Date

The Date is transmitted similar to a 32-bit Word with the MOST significant byte first, then the next MOST significant, until all the bytes are transmitted. FC3 reads 16-bit items at a time; therefore, two registers are required to read each Date data item. Combine the two characters in the 1st Register to obtain the four digit year.

Example (Decimal): 2007-10-05 (Format in YYYY-MM-DD)

	1st Register		2nd Register	
Value (Hex)	1st	2nd	1st	2nd
0x07D70A05	0x07	0xD7	0x0A	0x05

Time (Format 1)

The Time is transmitted similar to a 32-bit Word with the MOST significant byte first, then the next MOST significant, until all the bytes are transmitted. FC3 reads 16-bit items at a time; therefore, two registers are required to read each Time data item. The Time is always in 24 Hours Format.

Example (Decimal): 00:15:46:25 (Format in DD:HH:MM:SS)

	1st Register		2nd Register	
Value (Hex)	1st	2nd	1st	2nd
0x000F2E19	0X00	0x0F	0x2E	0X19

Time (Format 2)

The Time is transmitted similar to a 32-bit Word with the MOST significant byte first, then the next MOST significant, until all the bytes are transmitted. FC3 reads 16-bit items at a time; therefore, two registers are required to read each Time data item. The Time is always in 24 Hours Format.

Example (Decimal): 46:25 (Format in HH:MM)

Value (Hex)	1st Register	2nd Register
0x2E19	0x2E	0x19

Date & Time

The Date and Time is transmitted similar to a 32-bit Word with the MOST significant byte first, then the next MOST significant, until all the bytes are transmitted. FC3 reads 16-bit items at a time; therefore, two registers are required to read each Date and Time data item. The Time is always in 24 Hours Format. Combine the two characters in the 1st Register and convert from Hex to Decimal to obtain the four digit year.

Example (Decimal): 2007-07-28 15:46:25 (Format in YYYY-MM-DD HH:MM:SS)

	1st Register		2nd Register		3rd Register		4th Register	
Value (Hex)	1st	2nd	1st	2nd	1st	2nd	1st	2nd
0x07D7071C0F2E1900	0x07	0xD7	0X07	0x1C	0x0F	0x2E	0x19	0x00

Data Dictionary

The following tables detail the Modbus addresses required to access each item of the public data.

Addressing (0 or 1 Based)

The addressing within the Modbus/TCP protocol (that is, the data within the physical packet) is 0-based, meaning the first element/item to be accessed is referenced by address 0. The Modbus standard for handling and displaying the data is 1-based; meaning the first element/ data item to be access is referenced by address 1.

Most client applications handle this by having the user enter the 1-based number, and then subtract 1 to revert to the 0-based addressing required at the protocol level.

Some client applications allow the user to enter the 0-based number, or a combination, depending on how it is configured.

The addresses defined within the following table are 1-based, as the majority of the client applications work with this method.

Identification Block

The Identification Block registers consists of basic information about the instrument. These registers are read-only and are updated by the instrument during the initial power-on sequence. In addition, these registers are only configurable at the factory and by qualified field service personnel.

NOTE

Use FC16 where '*' is indicated.

Identification Block			
Address	**Register Description**	**Access**	**Size (Words)**
0000	Manufacturer ID	R	15
0015	Model Number	R	10
0025	Serial Number	R	5
0030	Secondary ID	R	4
0034	Last Calibration Date	R	2
0036	Calibration Due Date	R	2
0038	Firmware Version	R	1
0039	Hardware Version	R	1
0040-0099	Future Expansion		

Address 0-14 (Manufacturer Identification) (Format: Strings)

Get the instrument's Manufacturer ID. The ID consists of 30 bytes of printable ASCII characters (0x20-0x7E). A register byte value of 0x00 or word value of 0x0000 indicates the end of the Manufacturer ID.

Address 15-24 (Model Number) (Format: Strings)

Get the model number. The model number consists of 20 bytes of printable ASCII characters (0x20-0x7E). A register byte value of 0x00 or word value of 0x0000 indicates the end of the model description.

Address 25-29 (Serial Number) (Format: Strings)

Get the instruments serial number. The serial number consists of 10 bytes of printable ASCII characters (0x20-0x7E).

NOTE

Anatel PAT700 currently supports only 4 digit Serial numbers. A register byte value of 0x00 or word value of 0x0000 indicates the end of the Serial Number.

Address 30-33 (Secondary ID)

Dummy - Place holder.

Address 34-35 (Last Calibration Date) (Format: Date)

Get the instrument's last date of factory or field calibration. The Date & Time range should be from 01-Jun-2006 to 01-Jan-2100.

Address 36-37 (Calibration Due Date) (Format: Date)

Get the instrument's calibration due date for service calibration. The Date & Time range should be from 01-Jun-2006 to 01-Jan-2100.

Address 38 (Firmware Version) (Format: 16 Bit Word)

Get the instrument's firmware version number. Reading a decimal value of 100 indicates firmware version 1.00.

NOTE

Only major and minor version is applicable.

Address 39 (Hardware Version) (Format: 16 Bit Word)

Get the instrument's hardware version number. Reading a decimal value of 101 indicates hardware version 1.01.

Address 40-99 - Expansion

Reserved for future expansion.

Configuration Block

The Configuration Data block comprises parameters that directly affect the sampling characteristics of the instrument. Any modifications to these registers will restart the current sample if a sample is active.

NOTE

Use FC16 where '*' is indicated.

Configuration Block			
Address	**Register Description**	**Access**	**Size (Words)**
0100	Instrument IP address	R	2
0102	Subnet Mask	R	2
0104	Gateway	R	2
0106	DNS Server	R	2
0108	WINS Server	R	2
0110	DHCP Flag	R	1
0111	Language identification code	R/W	1
0112	Mode of Operation	R/W	1
0113	Current State	R	1
0114	Cycle Time	R/W*	2
0116	Flush Time	R/W*	2
0118	Idle Mode	R/W	1
0119	Bypass flow	R/W	1
0120	Clean time mode	R/W	1
0121	Clean time	R/W*	2
0123	UTC Date and Time	R/W*	4
0127	UTC Time format	R/W	1
0128	Pump sampling	R/W	1
0129	Digital Control	R/W	1
0130	Temperature display unit	R/W	1
0131	Conductivity display unit	R/W	1
0132	Cell calibration gain	R	4
0136	Cell calibration offset	R	4
0140	User TOC Slope	R	4
0144	User Conductivity Slope	R	4
0148	Thermistor coefficient A	R	4

Configuration Block			
0152	Thermistor coefficient B	R	4
0156	Thermistor coefficient C	R	4
0160	TOC Print	R/W	1
0161	TOC Print Percent change	R/W	1
0162	Conductivity Print	R/W	1
0163	Conductivity Print Time	R/W*	2
0165	Conductivity Print Percent change	R/W	1
0166	TOC alarm	R/W	1
0167	TOC alarm limit	R/W	1
0168	Conductivity alarm (uncompensated only)	R/W	1
0169	Last alarm	R	1
0170	Total alarm count	R	1
0171	Alarm acknowledge	W	1
0172	Analog TOC Zero scale	R/W*	4
0176	Analog TOC Full scale	R/W*	4
0180	Analog Temp. Zero scale	R/W*	4
0184	Analog Temp. Full scale	R/W*	4
0188	Analog Cond. Zero scale	R/W*	4
0192	Analog Cond. Full scale	R/W*	4
0196	Analog Error output	R/W*	4
0221	UV Lamp 1 State	R/W*	4
0222	UV Lamp 2 State	R/W*	4
0223	UV Lamp 1 Hours Left	R	1
0224	UV Lamp 2 Hours Left	R	1
0225	UV Lamp Selected	R/W	1
0226	Last accepted TOC Calibration Date and Time	R	4
0230	Last accepted Conductivity Calibration Date and Time	R	4
0234	Last passed System Suitability Date and Time	R	4
0238-0299	Future Expansion		

Address 100-101 (Instrument IP Address) (Format: IP Address)

Get the instrument's IP Address (Manual / Auto DHCP). The IP Address consists of 4 bytes of binary characters (0x00-0xFF). Each 16-bit register contains two 8-bit characters.

Address 102-103 (Subnet Mask) (Format: IP Address)

Get the instrument's Subnet Mask (Manual / Auto DHCP). The Subnet Mask consists of 4 bytes of binary characters (0x00-0xFF). Each 16-bit register contains two 8-bit characters.

Address 104-105 (Gateway) (Format: IP Address)

Get the instrument's Gateway (Manual / Auto DHCP). The Gateway consists of 4 bytes of binary characters (0x00-0xFF). Each 16-bit register contains two 8-bit characters.

Address 106-107 (DNS Server) (Format: IP Address)

Get the instrument's DNS Server (Manual / Auto DHCP). The DNS Server consists of 4 bytes of binary characters (0x00-0xFF). Each 16-bit register contains two 8-bit characters.

Address 108-109 (WINS Server) (Format: IP Address)

Get the instrument's WINS Server (Manual / Auto DHCP). The WINS Server consists of 4 bytes of binary characters (0x00-0xFF). Each 16-bit register contains two 8-bit characters.

Address 110 (DHCP Flag) (Format: 16 Bit Word)

Get the value that states the instrument's TCP/IP connection type i.e. Either Manual or Auto DHCP. The DHCP Flag consists of 1 word which refers to 0 = Manual and 1 = Auto DHCP.

Address 111 (Language Identification code) (Format: 16 Bit Word)

Get / Set the value that states the instrument's language type. The Language identification code consists of 1 word which refers to 0 = English, (Future implementation: 1 = French, 2 = German, 3 = Italian, 4 = Spanish, 5 = Chinese Simplified and 6 = Japanese.)

Address 112 (Mode of Operation) (Format: 16 Bit Word)

Get / Set the instrument's Mode of Operation. The Mode of Operation consists of 1 word which refers to 0 = Offline, 1 = Online TOC, 2 = Online Conductivity, 3 = Digital TOC, 4 = Manual TOC, 5 = Manual Bottle, 6 = Manual Clean, 7 = Manual Diagnostics and 8 = Standby.

NOTE

Modes 5 = Manual Bottle and 7 = Manual Diagnostics can only be read and not set.

Address 113 (Current State) (Format: 16 Bit Word)

Get the value that refers to the instrument's current operational state. The Current State consists of 1 word which refers to 0 = Idle, 1 = Flushing, 2 = Analyzing, 3 = Clean, 4 = Standby, 5 = Offline, 6 = Error, 7 = Bottle mode and 8 = Diagnostic mode.

Address 114-115 (Cycle Time) (Format: Time 1)

Get / Set the instrument's Cycle Time. The Cycle Time consists of 2 words.

Address 116-117 (Flush Time) (Format: Time 1)

Get / Set the instrument's Flush Time. The Flush Time consists of 2 words.

Address 118 (Idle Mode) (Format: 16 Bit Word)

Get / Set the instrument's Idle Mode options. The Idle Mode consists of 1 word which refers to 0 = Flow without Conductivity, 1 = Flow with Conductivity and 2 = No Flow.

Address 119 (Bypass flow) (Format: 16 Bit Word)

Get / Set the instrument's Bypass flow flag. The Bypass flow consists of 1 word which refers to 0 = Disabled and 1 = Enabled.

Address 120 (Clean Time mode) (Format: 16 Bit Word)

Get / Set the instrument's Clean time mode flag. The Clean Time mode consists of 1 word which refers to 0 = Disabled and 1 = Enabled.

Address 121-122 (Clean Time) (Format: Time 1)

Get / Set the instrument's Clean Time. The Clean Time consists of 2 words.

Address 123-126 (UTC Date and Time) (Format: Date & Time)

Get / Set the instrument's UTC Date and Time. The Date and Time consists of 4 words.

Address 127 (UTC Time format) (Format: 16 Bit Word)

Get / Set the instrument's Time format. The Time format consists of 1 word which refers to 0 = 12 Hour Mode and 1 = 24 Hour Mode.

Address 128 (Pump sampling) (Format: 16 Bit Word)

Get / Set the instrument's Pump sampling flag. The Pump sampling consists of 1 word which refers to 0 = Disabled and 1 = Enabled.

Address 129 (Digital Control) (Format: 16 Bit Word)

Get / Set the instrument's Digital Control flag. The Digital Control consists of 1 word which refers to 0 = Disabled and 1 = Enabled.

Address 130 (Temperature display unit) (Format: 16 Bit Word)

Get / Set the instrument's Temperature display unit. The Temperature display unit consists of 1 word which refers to 0 = Fahrenheit and 1 = Celsius.

Address 131 (Conductivity display unit) (Format: 16 Bit Word)

Get / Set the instrument's Conductivity display unit. The Conductivity display unit consists of 1 word which refers to 0 = Un-Compensated Conductivity, 1 = Compensated Conductivity and 2 = Compensated Resistivity.

Address 132-135 (Cell calibration gain) (Format: Double Float)

Get the instrument's Cell calibration gain. The Cell calibration gain consists of 4 words and read as 64bit double float data.

Address 136-139 (Cell calibration offset) (Format: Double Float)

Get the instrument's Cell calibration offset. The Cell calibration gain consists of 4 words and read as 64bit double float data.

Address 140-143 (TOC slope) (Format: Double Float)

Get the instrument's TOC slope. The TOC slope consists of 4 words and read as 64bit double float data.

Address 144-147 (Conductivity slope) (Format: Double Float)

Get the instrument's Conductivity slope. The Conductivity slope consists of 4 words and read as 64bit double float data.

Address 148-151 (Thermistor coefficient A) (Format: Double Float)

Get the instrument's Thermistor coefficient A. The Thermistor coefficient A consists of 4 words and read as 64bit double float data.

Address 152-155(Thermistor coefficient B) (Format: Double Float)

Get / Set the instrument's Thermistor coefficient B. The Thermistor coefficient B consists of 4 words and read as 64bit double float data.

Address 156-159 (Thermistor coefficient C) (Format: Double Float)

Get the instrument's Thermistor coefficient C. The Thermistor coefficient C consists of 4 words and read as 64bit double float data.

Address 160 (TOC Print) (Format: 16 Bit Word)

Get / Set the instrument's TOC Print. The TOC Print consists of 1 word which refers to 0 = Disable, 1 = Continuous and 2 = % Change.

Address 161 (TOC Print Percentage change) (Format: 16 Bit Word)

Get / Set the instrument's TOC Print Percentage change. The TOC Print Percentage change consists of 1 word.

Address 162 (Conductivity Print) (Format: 16 Bit Word)

Get / Set the instrument's Conductivity Print. The Conductivity Print consists of 1 word which refers to 0 = Disable, 1 = Interval and 2 = % Change.

Address 163-164 (Conductivity Print time) (Format: Time 2)

Get / Set the instrument's Conductivity Print time. The Conductivity Print time consists of 2 words.

Address 165 (Conductivity Print Percentage change) (Format: 16 Bit Word)

Get / Set the instrument's Conductivity Print Percentage change. The Conductivity Print Percentage change consists of 1 word.

Address 166 (TOC Alarm) (Format: 16 Bit Word)

Get / Set the instrument's TOC Alarm. The TOC Alarm consists of 1 word which refers to 0 = Disable and 1 = Enable.

Address 167 (TOC Alarm limit) (Format: 16 Bit Word)

Get / Set the instrument's TOC Alarm limit. The TOC Alarm limit consists of 1 word.

Address 168 (Conductivity Alarm) (Format: 16 Bit Word)

Get / Set the instrument's Conductivity Alarm. The Conductivity Alarm consists of 1 word which refers to 0 = Disable and 1 = Enable.

Address 169 (Last Alarm) (Format: 16 Bit Word)

Get the instrument's last alarm code. The last alarm code consists of 1 word. Refer to Alarm codes, page 117.

Address 170 (Total alarm count) (Format: 16 Bit Word)

Get the instrument's Total alarm count. The Total alarm count consists of 1 word.

Address 171 (Alarm acknowledge) (Format: 16 Bit Word)

Set the instrument's Alarm acknowledge flag. The Alarm acknowledge consists of 1 word which refers to 1 = Acknowledge Active Alarms.

Address 172-175 (Analog TOC Zero scale) (Format: Double Float)

Get / Set the instrument's Analog TOC Zero scale. The Analog TOC Zero scale consists of 4 words and read as 64bit double float data.

Address 176-179 (Analog TOC Full scale) (Format: Double Float)

Get / Set the instrument's Analog TOC Full scale. The Analog TOC Full scale consists of 4 words and read as 64bit double float data.

Address 180-183 (Analog Temp. Zero scale) (Format: Double Float)

Get / Set the instrument's Analog Temp. Zero scale. The Analog Temp. Zero scale consists of 4 words and read as 64bit double float data.

Address 184-187 (Analog Temp. Full scale) (Format: Double Float)

Get / Set the instrument's Analog Temp. Full scale. The Analog Temp. Full scale consists of 4 words and read as 64bit double float data.

Address 188-191 (Analog Cond. Zero scale) (Format: Double Float)

Get / Set the instrument's Analog Cond. Zero scale. The Analog Cond. Zero scale consists of 4 words and read as 64bit double float data.

Address 192-195 (Analog Cond. Full scale) (Format: Double Float)

Get / Set the instrument's Analog Cond. Full scale. The Analog Cond. Full scale consists of 4 words and read as 64bit double float data.

Address 196 (Analog Error output) (Format: 16 Bit Word)

Get / Set the instrument's Analog Error output. The Analog Error output consists of 1 word which refers to 0 = Min (2ma), 1 = Last measured value and 2 = Max (22ma).

Address 221 (UV Lamp 1 State) (Format: 16 Bit Word)

Get the instrument's UV Lamp 1 state. The UV Lamp 1 state consists of 1 word which refers to 0 = Good, 1 = Marginal and 2 = Failed.

Address 222 (UV Lamp 2 State) (Format: 16 Bit Word)

Get the instrument's UV Lamp 2 state. The UV Lamp 2 state consists of 1 word which refers to 0 = Good, 1 = Marginal and 2 = Failed.

Address 223 (UV Lamp 1 Hours Left) (Format: 16 Bit Word)

Get the instrument's UV Lamp 1 Hours Left. The UV Lamp 1 Hours Left consists of 1 word.

Address 224 (UV Lamp 2 Hours Left) (Format: 16 Bit Word)

Get the instrument's UV Lamp 2 Hours Left. The UV Lamp 2 Hours Left consists of 1 word.

Address 225 (UV Lamp Selected) (Format: 16 Bit Word)

Get / Set the instrument's UV Lamp Selected. The UV Lamp Selected consists of 1 word which refers to 1 = Lamp1 and 2 = Lamp2.

Address 226-229 (Last accepted TOC Calibration Date and Time) (Format: Date & Time)

Get the instrument's Last run TOC Calibration Date and Time. The Last accepted TOC Calibration Date and Time consists of 4 words.

Address 230-233 (Last accepted Conductivity Calibration Date and Time) (Format: Date & Time)

Get the instrument's Last run Conductivity Calibration Date and Time. The Last accepted Conductivity Calibration Date and Time consists of 4 words.

Address 234-237 (Last passed System Suitability Date and Time) (Format: Date & Time)

Get the instrument's Last run System Suitability Date and Time. The Last passed System Suitability Date and Time consists of 4 words.

Address 238-299 - Expansion

Reserved for future expansion.

Last TOC Analysis Parameters Block

The Last TOC Analysis Parameters block comprises of parameters that are updated immediately after a successful TOC Analysis.

Last TOC Analysis Parameters Block			
Address	**Register Description**	**Access**	**Size (Words)**
0300	Final TOC	R	4
0304	Temperature	R	4
0308	Compensated Conductivity	R	4
0312	Uncompensated Conductivity	R	4
0316	Curve type	R	1
0317	TOC Analysis Timestamp	R	4
0321-0399	Future Expansion		

Address 300-303 (TOC) (Format: Double Float)

Get the instrument's Final TOC value. The Final TOC value consists of 4 words and read as 64bit double float data.

Address 304-307 (Temperature) (Format: Double Float)

Get the instrument's Temperature value. The Temperature value consists of 4 words and read as 64bit double float data.

Address 308-311 (Compensated Conductivity) (Format: Double Float)

Get the instrument's Compensated Conductivity value. The Compensated Conductivity value consists of 4 words and read as 64bit double float data.

Address 312-315 (Un-Compensated Conductivity) (Format: Double Float)

Get the instrument's Un-Compensated Conductivity value. The Un-Compensated Conductivity value consists of 4 words and read as 64bit double float data.

Address 316 (Curve Type) (Format: 16 Bit Word)

Get the instrument's Curve Type. The Curve Type value consists of 1 word.

Address 317-320 (TOC Analysis Timestamp) (Format: Date & Time)

Get the instrument's TOC Analysis Timestamp. The Timestamp value consists of 4 words.

Address 321-399 - Expansion

Reserved for future expansion.

User Security Block

The User Security block comprises of parameters that are essential to Logon or change security features in PAT700.

NOTE

Use FC16 where '*' is indicated.

User Security Block			
Address	**Register Description**	**Access**	**Size (Words)**
0400	User ID	W*	15
0415	Password	W*	10
0425	Logon / Logoff	R/W	1
0426	Security	R/W	1
0427	Data logging	R/W	1
0428-0499	Future Expansion		

Address 400-414 (User ID) (Format: Strings)

Set the instrument's User ID to login to PAT700. The ID consists of 15 bytes of Unicode characters.

NOTE

Authentication is not required to set the value for 'User ID'.

Address 415-424 (Password) (Format: Strings)

Set the instrument's Password to login to PAT700. The Password consists of 10 bytes of Unicode characters.

NOTE

Authentication is not required to set the value for 'User Password'.

Address 425 (Logon / Logoff) (Format: 16 Bit Word)

Get / Set the instrument's login flag. The Logon / Logoff consist of 1 word which refers to 0 = Logoff and 1=Logon.

NOTE

User ID and Password should be set first before enabling the Logon flag to successfully login to PAT700. Authentication is not required to set the value.

Address 426 (Security) (Format: 16 Bit Word)

Get / Set the instrument's Security flag. The Security consists of 1 word which refers to 0 = Disabled and 1 = Enabled.

Address 427 (Data logging) (Format: 16 Bit Word)

Get / Set the instrument's Data logging flag. The Data logging consists of 1 word which refers to 0 = Disabled and 1 = Enabled.

Address 428-499 - Expansion

Reserved for future expansion.

Error Codes

The following are the error codes used in PAT700 Modbus/TCP protocol.

Exception Code	Explanation
0x01	Illegal Function
0x02	Illegal Data address
0x03	Illegal Data value
0x04	Device Failure
0x08	Access Denied

Chapter 12 Maintenance and Troubleshooting

DANGER

Tasks involving maintenance and service of this equipment may have electrical shock, eye, and chemical hazards associated with them. These tasks must only be attempted by individuals trained and knowledgeable in the particular task and the hazards associated with it.

12.1 Maintenance

The PAT700 requires periodic maintenance to ensure the continued accuracy and reliable performance of the analyzer. UV lamps have a limited life and should be replaced every six months. The measurement cell should have a yearly calibration verification.

Maintenance procedures may be performed either by the user or by Hach customer service personnel. The most common maintenance procedure is UV lamp replacement. In most instances, you can perform the lamp replacement in the field (see PAT700 lamp replacement, page 125). If problems persist after performing maintenance or repair procedures, phone Hach at 800.866.7889 or +1 541.472.6500.

If you must return the PAT700 to the factory for maintenance or repair, obtain a Return Materials Authorization (RMA) number. Provide the model and serial numbers, and any additional relevant information. Ship the instrument(s) to Hach Company, Attn: RMA #xxxx.

NOTE

To clean the external surfaces of the analyzer, use only a damp cloth and mild cleaning detergent. Do not use solvents or other chemicals that may damage the housing components or display.

UV Detect technology

The PAT700 monitors the output of the UV lamp and produces an alarm if UV output indicates a failing lamp or if the lamp has failed completely and can no longer support proper oxidation. Code 127 indicates a failing lamp. Code 128 indicates a failed lamp.

Diminished lamp indications

When code 127 is produced, the analyzer UV lamp should be replaced as soon as possible. UV Detect generates code 127 when UV output from the lamp has reached a level that indicates a diminished lamp. At this level of UV output, the PAT700 switches lamp operation to the secondary UV lamp.

Failed lamp indications

When code 128 is produced, the analyzer lamp has failed and must be replaced. Code 128 indicates that the UV lamp has failed and no longer supports proper analyzer operation. If the UV lamp fails, the analyzer switches operation to the secondary UV lamp.

Under a code 128 condition, the lamp is no longer producing adequate levels of UV light to support proper sample oxidation.

Lamp replacement procedure

Replacement UV lamp part number: FG7001014.

To replace a lamp, follow these steps:

1) At the home screen, touch the << icon to open the sliding toolbar.
2) Touch the diagnostics icon or touch the dual UV lamp status indicator in the lower right corner of the screen.
3) Touch the replace lamp icon.
4) Select the lamp to be replaced.
5) Touch “Run Wizard” to run the lamp replacement wizard or “Replace Now” to skip the replacement wizard.

- The wizard provides step-by-step instructions for replacing the lamp. *Read the instructions completely.* You will be instructed to power down the analyzer and proceed with lamp replacement.
- If you touch “Replace Now”, the display skips the replacement wizard and warns of potential voltage and mercury dangers. Touching the forward icon takes you to a caution that describes how to handle the UV lamp. Touching the forward icon again takes you to a dialog box that asks you to power down the analyzer. See Figure 12-1, then proceed to Step 6, page 165.

Figure 12-1 Lamp replacement dialog box

WARNING

UV Lamp related shock, eye/skin, ozone gas and burn hazards are possible if the UV lamp is powered while outside the equipment lamp holder. Instrument power must always be disconnected before the lamp is removed from its holder and must always remain disconnected until the lamp is reinstalled and secured in the lamp holder. Allow 10-15 minutes for the lamp to cool before handling.

WARNING

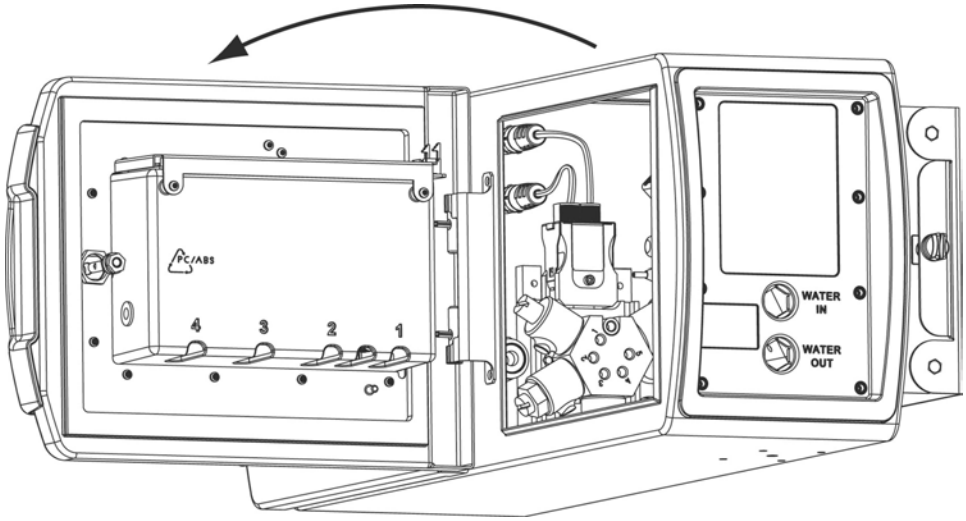
Chemical Hazard! The UV lamps contain mercury and mercury vapor. Handle lamps with care to avoid exposure. Cleanup of mercury should be in accordance with local, state, and federal guidelines. The mercury-containing UV lamps within this equipment must be disposed of accordance with local, state and federal law.

NOTE

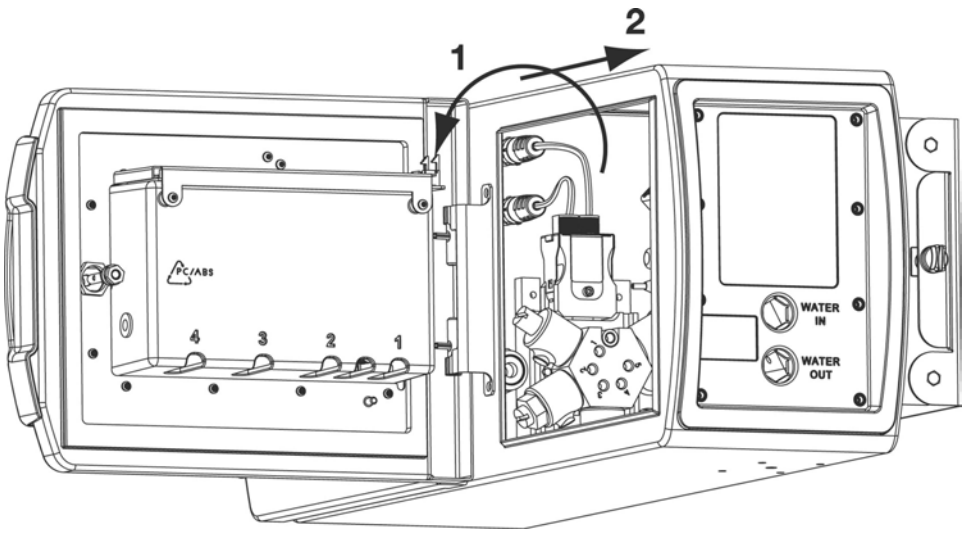
Leaving fingerprints on the lamp's glass surface can diminish UV output, resulting in measurement error.

- *Do not touch the UV lamp's glass surface during the lamp replacement procedure.*
- *Use isopropyl alcohol and a lint-free cloth to clean the glass.*

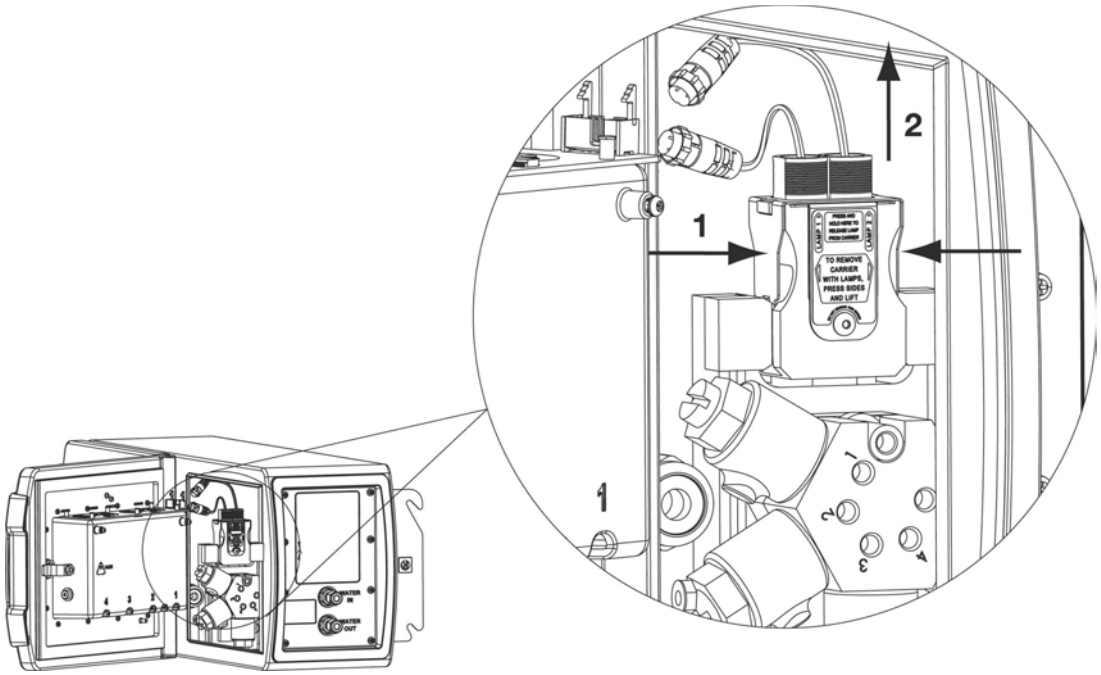
6) Open the right access door using a 5/32-inch hex key.



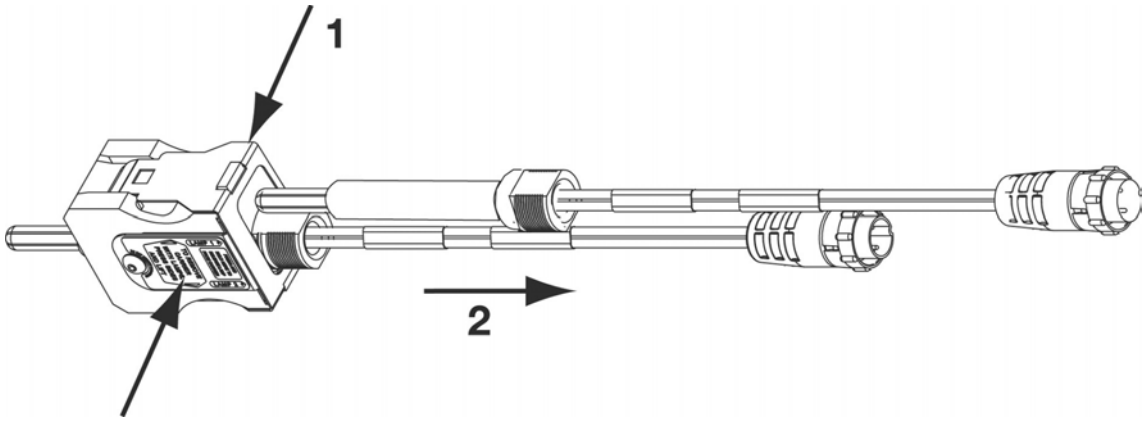
7) Locate the lamp power connectors in the front upper left corner of the compartment. Disconnect the lamp connectors by twisting both locking rings counter-clockwise and carefully unplugging both connectors.



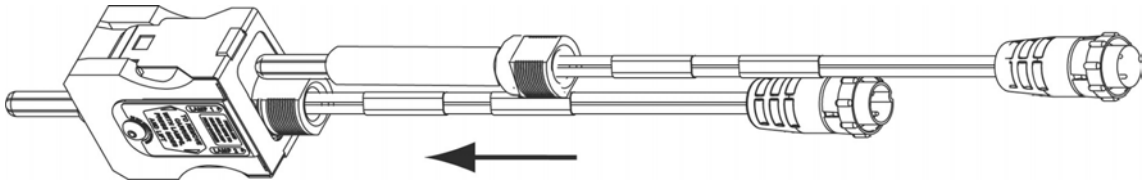
8) Grasp the lamp module on the right and left side and squeeze the module locking clips to release the module from the manifold assembly. Pull straight upward until the lamps clear the manifold.



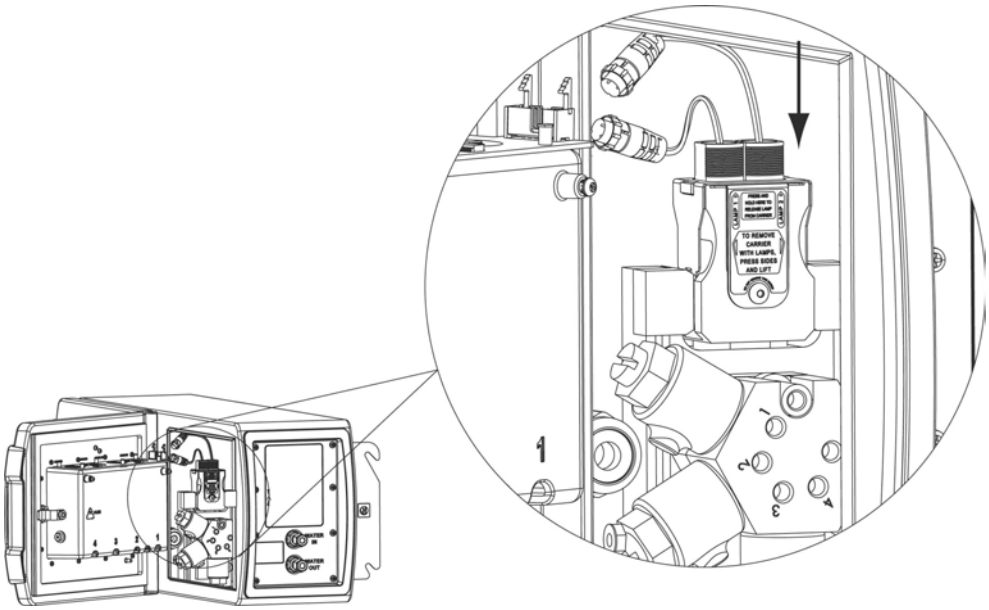
9) Press and hold the lamp retaining clip to release the UV lamp. While pressing the lamp retaining clip, carefully withdraw the lamp from the lamp holder. DO NOT touch the glass surfaces of the lamps.



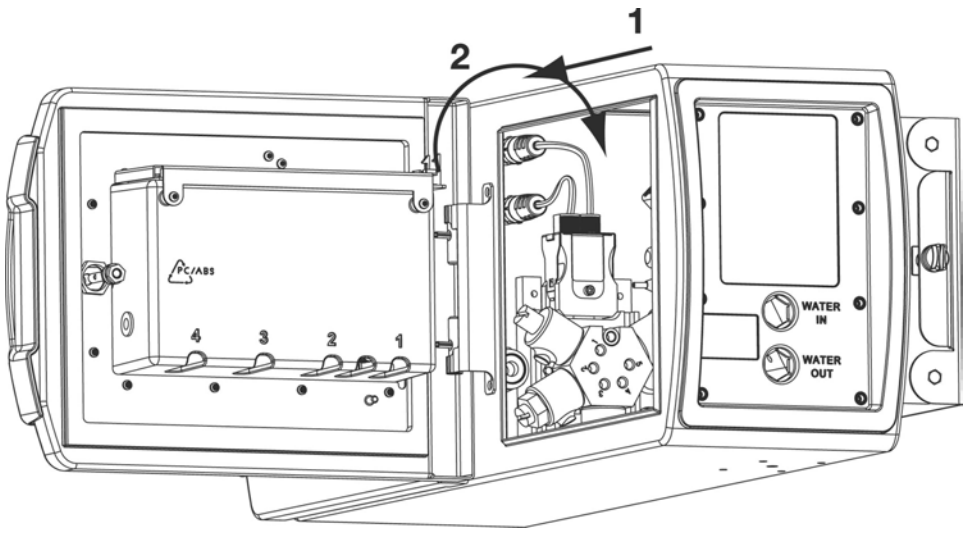
10) Holding the lamp by its metal sleeve, insert the new lamp into the lamp holder hole and clip into place. The lamp is self-aligning. Ensure that the lamp is locked in place by the lamp retaining clip.



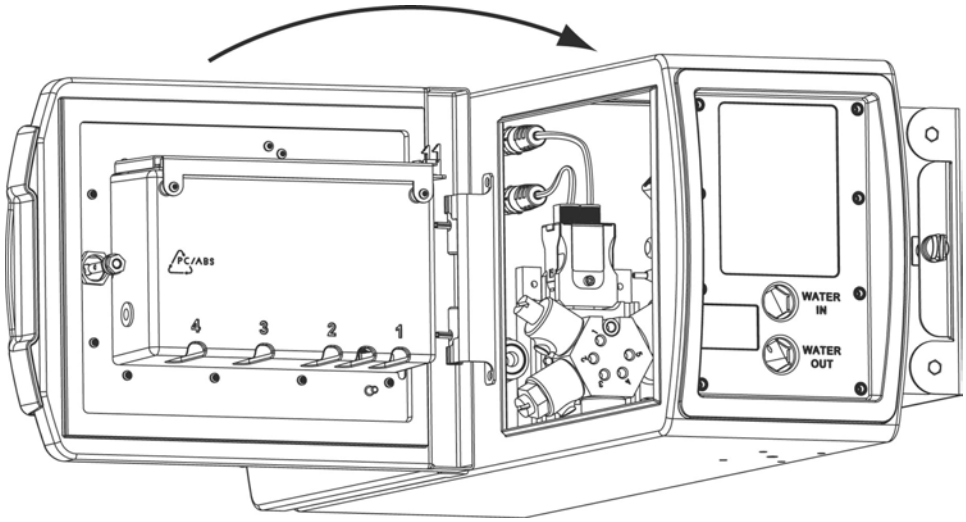
11) Reinsert the lamp module into the instrument by centering it over the manifold assembly and gently sliding the module down to the manifold until it locks into place.



12) Reconnect the lamp power connectors by carefully reinserting the connectors and locking them in place by twisting the locking rings clockwise.



13) Close and lock the door.



14) Restore power to the analyzer.

When the analyzer is powered on after the lamp replacement procedure, the analyzer performs a lamp test to make sure the replaced lamp is working.

Self clean mode

It is possible to contaminate the analyzer's measurement cell on any water system or after long-term storage or inactivity. This condition is indicated by suddenly changing or erratic TOC or resistivity readings. During self cleaning, the ultraviolet lamp oxidizes contaminants in the cell to alleviate such problems. The analyzer's sample valve opens to allow water to flow through the cell. The UV lamp turns on to oxidize any organic contaminants, which subsequently are flushed from the analyzer by the sample flow.

12.2 Water filter replacement

CAUTION

Burn and pressure hazard! Water is pressurized and may be hot (up to 95 °C [203 °F]). Protective eye wear is required while performing this task, and the sample line must first be depressurized before the water filter is disconnected.

The analyzer has an internal water filter, which can be replaced (replacement filter part number FG7001015). To replace the filter, follow these steps:

1) Disconnect power to the analyzer.
2) Use a 5/16-inch Allen wrench to unlatch the bottle bay door.
3) Unlatch the door and swing it open on its hinges. See Figure 12-2.

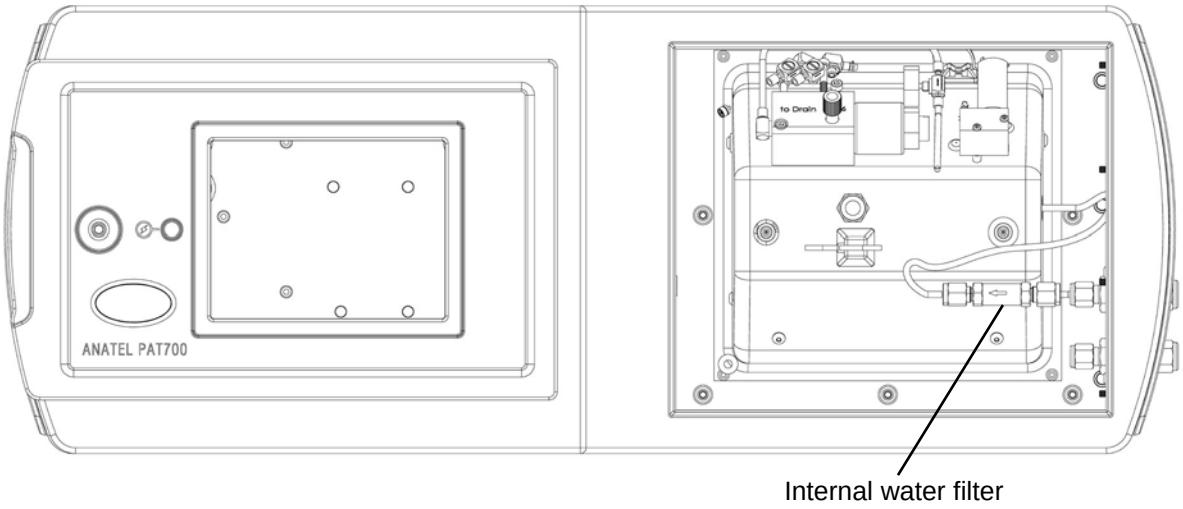


Figure 12-2 PAT700 with bottle bay door open to reveal internal water filter

4) Without crimping or damaging the tubing, loosen and remove the inlet tubing from the analyzer side of the inlet filter.
5) Loosen the compression nut from the end of the filter that connects to the water inlet connection.
6) Remove the filter.
7) Open the filter assembly and replace the internal filter.
8) Re-insert the filter into the water inlet fitting and hand-tighten the compression nut.
9) Reinstall the water inlet tubing on the analyzer side of the filter and tighten the compression nut 1-1/4 turns to secure the connection.
10) Close the bottle bay door.
11) Use the Allen wrench to latch the bottle bay door.
12) Restore power to the analyzer.

12.3 Troubleshooting

The PAT700 incorporates extended diagnostic and reporting facility to inform the user about the nature of a problem.

Alarm codes, with user-initiated diagnostic tests, serve to isolate the source of the problem.The PAT700 constantly monitors its operation and measurement values for alarm conditions. See Chapter 7.

Fuse replacement

The analyzer contains two 1.25 A, 250 V EN60127 type T fuses (see Figure 12-3). Fuse failure usually indicates an equipment problem that requires servicing.

To replace fuses, follow this procedure:

1) Shut off power to the analyzer.
2) Use a 5/16-inch Allen wrench to unlatch the door that contains the display.
3) Unlatch the door and swing it open on its hinges.
4) Twist the fuse holder out using a straight-blade screwdriver.
5) Replace the fuse.
6) Twist the fuse holder in using a straight-blade screwdriver.

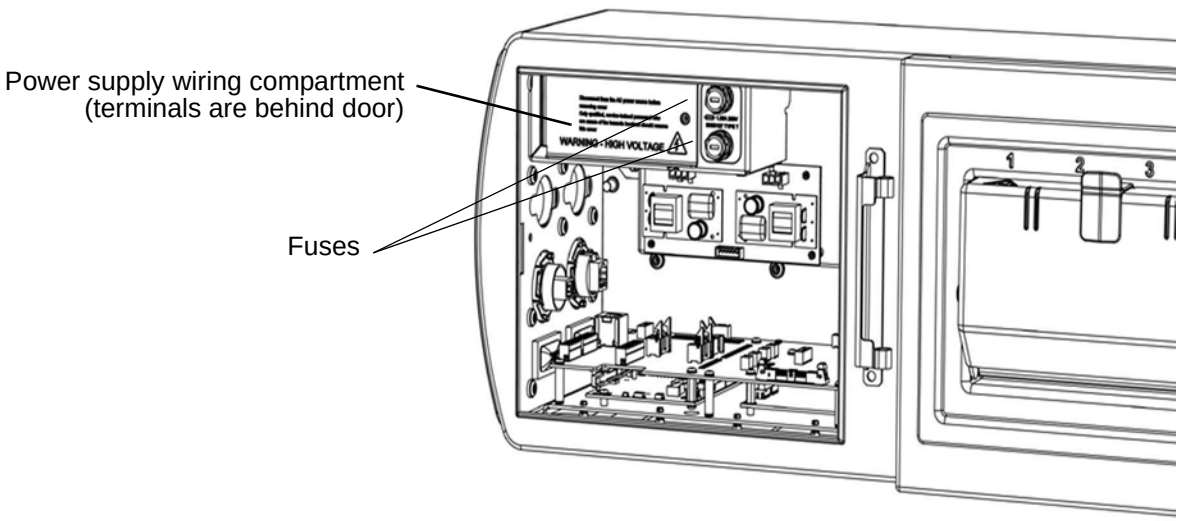


Figure 12-3 PAT700 EN60127 type T fuses

Technical support

Technical support engineers can provide high quality advice and recommendations for applications, product operation, measurement specifications, hardware and software, factory and customer site training.

Any questionable problems should be referred to Hach and the following information should be included in any correspondence with the factory:

- The instrument's serial number.
- Sample resistivity and temperature.
- Current and historical TOC data.
- Current and historical alarm codes.
- A setup printout.
- Process conductivity or resistivity and temperature.
- Current and historical calibration, validation and system suitability results.
- Any other significant changes in operating conditions.

If existing problems warrant equipment return, contact Hach Company at:

Hach
5600 Lindbergh Drive
Loveland, Colorado 80538

- U.S.A.Voice +1 541.472.6500
- Toll free: 1.800.866.8854 (USA/CA)
- FAX: 1.541.474.7414
  6:00 AM to 5:00 PM Pacific Time Monday through Friday
- Email: TechSupportGP@hachultra.com

Global Headquarters
Service Department
6, route de Compois, C.P. 212,
CH-1222 Vésenaz, Geneva, Switzerland

- Telephone: 41.22.594.6400
- FAX: 41.22.594.6488
- Website: www.hach.com

Return procedures

To return the Anatel PAT700 TOC Analyzer for service, first obtain a return material authorization number (RA#). The RA# is necessary for any analyzer that requires repair or calibration by an authorized service center. Include the RA# on the shipping label when the analyzer is returned.

While the RA# process is described in this section, for the most up-to-date RA# process information, including copies of all required forms, call Hach at 800.866.7889 or +1 541.472.6500.

CAUTION

Chemical hazard! Failure to dispose of hazardous waste by-products in accordance with applicable regulations can cause exposure to poisonous chemicals, resulting in severe environmental and property damage or personal injury. Adhere to applicable local, state, and federal regulations to ensure proper disposal of hazardous waste by-products.

NOTE

Failure to purge the analyzer of all liquid, remove all process materials, and thoroughly clean the analyzer before returning it to Hach Company can cause property damage or personal injury.

Before shipping the analyzer:

- *Purge the analyzer of all liquid.*
- *Remove all process materials and thoroughly clean the analyzer.*

Draining the analyzer

NOTE

Failure to purge all water from the analyzer when taking the instrument out of service can cause residual water to freeze and expand inside the analyzer, resulting in damage to the measurement cell.

To avoid damaging the measurement cell, purge all water from the analyzer before taking it out of service. Such damage is time consuming to repair and is not covered by the warranty.

Hach also offers service and extended warranty options to cover scheduled maintenance, calibration and repairs. If returning the analyzer to the factory is impractical, onsite maintenance and/or verification can be performed by a Hach technician, or a certified analyzer may be rented. Repairs are performed only at Hach service centers due to the specialized equipment and parts required.

For two reasons, you must drain the PAT700 of all water before removing the analyzer from its source:

- If the analyzer is removed from service for temporary or long term storage (longer than a month), any water remaining in the measurement cell is a medium for bacteria growth. Elements contained in the sample water will settle and adhere to the instrument components, causing contamination. The analyzer should self-clean for an extended period of time before reinstallation to ensure accurate and stable data.
- Draining the water out of the analyzer also prevents damage due to freezing. If the analyzer is stored or shipped in a cold environment, the water inside the analyzer expands and could severely damage sensitive components. Replacing these components is expensive and increases repair time as much as a week.

NOTE

Leaving water inside the analyzer if it is in a warehouse in the winter can cause freezing, and shipping the analyzer from a warm climate to a cold climate can expose the analyzer to temperature extremes en route, resulting in product damage.

To avoid damaging the analyzer:

- *Do not leave water inside the analyzer before putting it into storage.*
- *Do not expose the analyzer to temperature extremes.*

To purge the PAT700 of entrained water:

1) Remove the analyzer from service and disconnect it from the water system.
2) With the analyzer inlet and outlet water connections open to atmosphere, apply power to the analyzer.
3) In the TOC setup dialog box under the general tab, select “use pump”.
4) At the home screen, touch the << icon to open the sliding toolbar.
5) Touch the diagnostics icon.

6) Touch the tests tab, then touch the plumbing test icon.
7) Follow the procedure described in Plumbing test, page 128, to drain the water from the analyzer (flow through cell with pump and sample from all four bottles locations).
8) If necessary, repeat Step 4 through Step 7 until all water has drained from the analyzer.

Appendix A: Specifications

PAT700 specifications are subject to change without notice.

TOC specifications

Operating range	0.5 to 2,000 ppb as carbon
Conductivity Range for TOC	0.2 µS/cm for all waters, 1.0 µS/cm for all neutral waters, 5 µS/cm for water with CO_2 as the sole conductive species.
Display resolution	0.1 ppb
Accuracy	±1 ppb or 5%, whichever is greater
Repeatability	±0.3 ppb or ±1%, whichever is greater
Limit of detection	0.5 ppb

Conductivity and resistivity specifications

Conductivity range	0.05 to 150 µS/cm (@ 25 °C)
Conductivity display resolution	0.01 µS/cm
Conductivity accuracy	±1% over full range (uncompensated)
Resistivity range	0.2 to 18 MΩ-cm (@25 °C)
Resistivity display resolution	0.01 over full range
Available resistivity modes	Temperature compensated to 25 °C, or uncompensated

Temperature specifications

Ambient operating range	10 to 40° C (50 to 104 °F)
Display resolution	0.1 over full range
Measurement accuracy	±0.4°C
Sample water range	5 to 95 °C (41 to 203 °F)

Physical specifications

UV lamps	Two, with UV Detect technology
Interface/display	Color touch screen
Maximum altitude	4,000 m (13,125 ft)
User I/O wiring	Three 3/4-inch conduit openings or quick disconnect fittings
Standards system	Onboard, automated standards introduction system (OASIS)
Dimensions	59.7 cm wide x 22.9 cm deep x 25.4 cm high (23.5” wide x 9” deep x 10” high)
Weight	13.6 kg (30 lbs)
Sample inlet flow rate range	60 mL/min to 300 mL/min
Sample inlet pressure range	10 to 100 psi
Electronics enclosure rating	• IP56 conduit version • IP46 quick connect version
Humidity rating	5 to 95%
CE compliance	EN61010-1 and EN 61326
Safety rating	ETL, conforming to UL 61010-1 and CSA 22.2 No. 61010-1
Protection and overvoltage	Category II
Pollution degree	2, IEC 61010-1
Power input	100 to 230 ±10% VAC, 65 W, 50/60 Hz

Input/output specifications

Analog output specifications	
Analog outputs	Three, opto-isolated
Variables	TOC, conductivity, and temperature
Range	Configurable over 4-20 mA
Alarm level	Configurable: 2, 22, or last value
Discrete input specifications	
Discrete inputs	Two, opto-isolated
Input one	TOC analysis start
Input two	TOC/Flow with conductivity mode change
Discrete output specifications	
Discrete outputs	Four, opto-isolated
Output one	TOC alarm
Output two	Uncompensated conductivity alarm
Output three	Analyzer error
Output four	TOC analysis start indication
Serial output specifications	
Serial RS-232C output	ASCII format, 8 data bits, no parity, 1 stop bit, 9600 baud
Serial printer output	RS-232C interface, 8 data bits, no parity, 1 stop bit, 9600 baud
Compatibility	40-column serial printer
Ethernet output specifications	
Protocol	Modbus TCP/IP
Interface speed	10/100 Mbits/sec.
USB output specifications	
USB output	One, output to USB flash drive

Appendix B: CE Conformance

ATTESTATION OF CONFORMITY

CE

Presented To:

Hach Company

5600 Lindberg Dr. Loveland, CO 80538

For Product/Model:

Anatel TOC Analyzer
PAT 700

Was evaluated and confirmed to comply with:

EN 300 330 V1.5.1 (2006-04)

Leslie Bai
Director of Certification
SIEMIC, INC.
Accessing global markets

Reference Test Report No.:
SL07062104-HAC-001(R&TTE)

Page 1 of 1

Issue Date : 18 July 2007
Test House : SIEMIC Laboratories

Appendix C: Theory of Operation

The Anatel PAT700 on-line TOC analyzer provides TOC analysis for pure and ultra-pure water processing. The PAT700 oxidizes a water sample to determine the TOC in the sample. The analyzer traps a sample in the analysis cell, exposes the sample to ultraviolet (UV) light to oxidize a sample of water (photolysis), and monitors changes in temperature and conductivity until the sample has completely oxidized. Once full oxidation has occurred, the analyzer reports TOC.

Additionally, conductivity (in µS/cm) or resistivity (in MΩ-cm), uncompensated for temperature or corrected to 25°C, and sample temperature are measured then displayed along with the oxidation curve type, and TOC trend. The PAT700 incorporates an integral in-line filter, flow control valve and heat exchanger to ensure the proper water flow rate and temperature for accurate TOC analysis. An internal pump is available for sampling water from a supply with no pressure and to deliver standards to the analysis cell from the OASIS™.

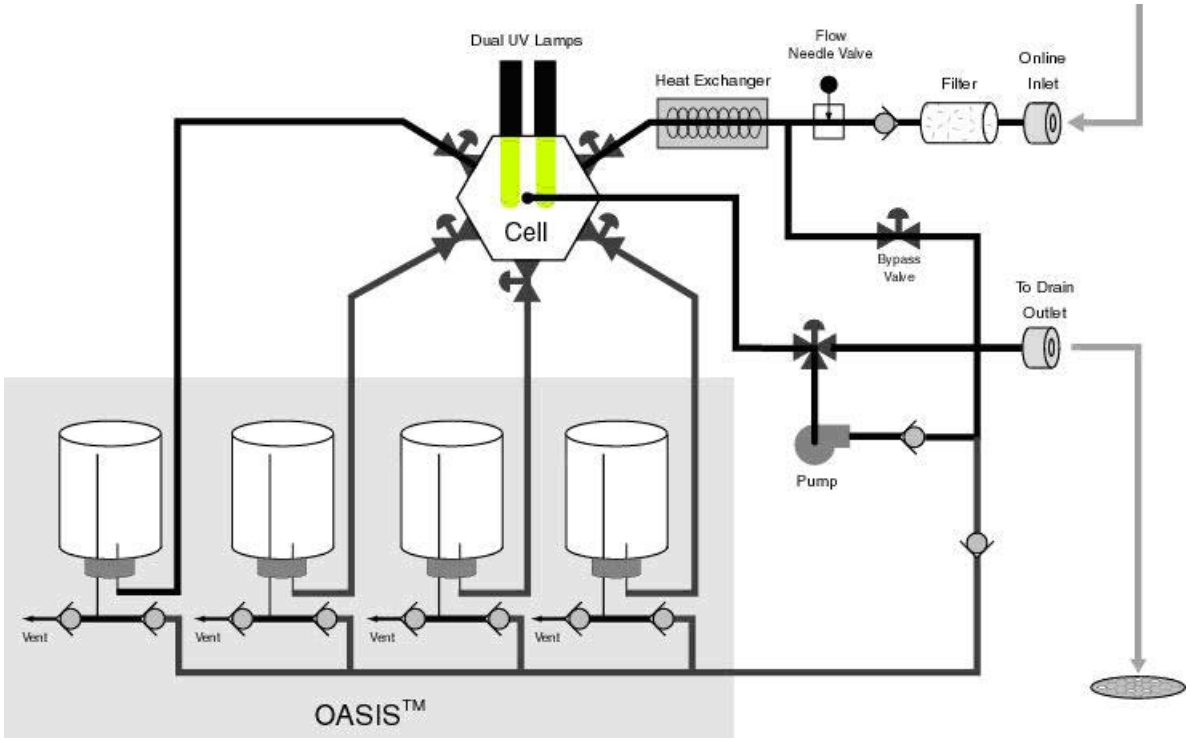


Figure C-1 PAT700 theory of operation

The PAT700 incorporates the OASIS™ onboard, automated standards introduction system that simplifies analyzer performance testing using standards bottles tagged with RFID technology. OASIS™ employs Radio Frequency Identification (RFID) technology, a registered radio frequency device. The RFID system in the PAT700 operates over a very short distance to eliminate any interference with other wireless communications. The term RFID describes a system that transmits data wirelessly using radio waves.

An RFID system is comprised of a "tag" and a "reader/writer". In the PAT700 analyzer, the tag is attached to the standards bottles used in calibrations (conductivity and TOC), validations, system suitability tests, and excursion mode. The RFID tag consists of a microchip attached

to a radio antenna mounted on a substrate. The RFID tag is attached to the bottom of the standards bottle. The microchip contains data about the standard contained in the bottle. The PAT700 OASIS system contains four RFID reader/writers permanently mounted inside the analyzer that align with the bottle RFID tags when the bottles are fully loaded in the analyzer.

The reader/writer retrieves the data stored on the RFID tags located on the bottom of the standards bottles. The RFID reader/writers have antennas that emit radio waves and receive signals back from the tags on the standards bottles. The information provided from the tag includes the identity of the standard, the standard's concentration, date of expiration and other pertinent data. The reader/writer takes the data received from the tag and passes the information in digital form to the PAT700 processor.

The RFID system in the PAT700 can read and write to the RFID tags attached to the standards bottle. The writing feature allows the PAT700 to write data to the bottles showing that the bottle has been used and provides for writing of data for the exclusive excursion sampling feature. The RFID system in the PAT700 does not require any user intervention to operate.

The system operates automatically when bottle tests are performed. The system automatically turns on and off to read and write data only when necessary. When enabled, the radio frequency modulation emitted from the antennas is fixed at 13.56 Mhz. Since the RFID labels on the standards bottles contain the data necessary for each standard, the labels must not be removed from the bottle. Without the label, the RFID reader/writer has no data to read and will not operate as intended; however, bottles without labels can be run if the user manually enters data.

A touch-screen interface provides access to all analyzer functions. The user interface consists of a home screen from which all user operations initiate. The home screen displays the current status of the analyzer and analysis results based on the current run mode selection. The software can display data in a number of user-selected formats, including TOC, compensated and uncompensated conductivity, resistivity, and temperature in engineering units, with data logging and graphing of the data.

You may connect a USB flash drive to the analyzer and download the contents of the data buffer, audit trail, alarm log, and bottle analysis reports. You can interact with the analyzer remotely, including downloading data records, by querying the analyzer through an RS-232 communications port. You can communicate with the analyzer using Modbus® protocol via the Ethernet port. Printing may be done automatically or on demand through an RS-232 port to a serial printer.

The PAT700 allows for compliance to 21 CFR Part 11 with password protection and an audit trail of all user actions.

Appendix D: PAT700 Default Settings

Table D-1 Default settings

TOC Setup	Default Setting
Flush time	1 minute
Cycle time	0
Use pump	Disabled
Bypass during analysis	Disabled
Average last results	Disabled
Flow during idle	With conductivity
Control with digital inputs	Disabled
Stabilization - Time between analysis	2 hours
Stabilization - Time	10 minutes

System Settings	Default Setting
Instrument name	PAT700Sensor
Language	English
Time format	24-hour
Temperature display	ºC
Conductivity display	Uncompensated Conductivity
Sounds	None
Static TCP/IP address	192.168.0.105
Static gateway	255.255.255.0
DNS server	Blank
WINS server	Blank
DHCP	Enabled

Alarm Setup	Default Setting
TOC upper limit	500 ppb
TOC enabled	Enabled
Conductivity alarm	Enabled

Analog Outputs Setup	Default Setting
TOC zero	Blank
TOC full scale	Blank
Conductivity zero	Blank
Conductivity full scale	Blank
Temperature zero	Blank
Temperature full scale	Blank
On error, return	Blank

Printer Setup	Default Setting
TOC print	Continuous
Conductivity print	Timed
Conductivity print interval	1 minute
Conductivity % change	1%

Security Settings	Default Setting
Enable security	Disabled
Enable data logging	Enabled
Password expires in # days	60
Remember last # passwords	3
Automatically log off after # minutes	30
Administrator user name	Administrator
Administrator ID	Admin
Administrator password	123456
User's full name	Blank
User ID	Blank
User password	Blank
Change password	Enabled

Bottles Change Settings	Default Setting
TOC calibration	
Manually accept results	Enabled
Return to on-line mode	Disabled
Slope limit	10%
R2 limit	0.99
Conductivity calibration	
Manually accept results	Enabled
Return to on-line mode	Disabled
Slope limit from previous	5%
Slope limit from factory calibration	10%
Use calibration resistor	Enabled
TOC validation	
Return to on-line mode	Disabled
System suitability	
Return to on-line mode	Disabled

Bottle Mode	Default Setting
TOC calibration setup	Use default settings
TOC calibration custom settings	All standards selected, 3 reps
Schedule bottle test	Current time