SIEVERS®

800 Series Total Organic Carbon Analyzer

Operation and Maintenance Manual

Minimum Firmware Version:

TOC Firmware Versions 3.52 (CAS) with or without
DataPro™ Autosampler Software, or

TOC Firmware Versions 3.62 (CAS) with
DataGuard™ and with or without DataPro Autosampler Software, or

TOC Firmware Versions 3.15 (CMS), or
TOC Firmware Versions 2.12 (CTB) Turbo*, or*
TOC Firmware Version 2.11 (CBI)

Instrument Business Group

6060 Spine Road
Boulder, CO 80301 USA
phone 800.255.6964 • 303.444.2009 • fax 303.444.9543
www.IonicsInstruments.com

DLM 30007-08 Rev. A

Identification Records

Default Administrator Password: IIBG

Record the instrument's serial number as it appears on the identification label located on the left side panel of the instrument:

Instrument's serial number _____

Record the date of receipt and installation of the instrument; this is the warranty start date:

Date of receipt/installation of the instrument _____

Revision History

New editions are complete revisions of the manual and incorporate all previous update pages and write-in instructions. This manual will be revised as necessary. Revisions can be in the form of new editions, update pages, or write-in instructions.

Revision A and B	On-Line Software Versions 0.10 – 1.17 ..... July 1992
Revision C	On-Line Software Version 2.0 and updates; Autosampler Firmware Versions 20 – 30 ..... July 1993
Revision D and E	On-Line Software Version 2.0 and updates; Autosampler Firmware Versions 20 – 30 ..... September 1994
Revision F	Firmware Version 3.00 (AS or MS) and updates ..... May 1995
Revision G	Firmware Version 3.06 (AS or MS) and updates; RAM Card PC Software Version 3.08RC and updates; Autosampler PC Software Version 3.07PC and updates ..... August 1995
Revision H	Appendices B and C updates ..... March 1996
Revision J	Appendices B and C updates ..... January 1997
DLM 30007-01 Rev. A	TUV rating; Firmware 3.13CAS, 3.12CMS, 2.0CTB, 3.11PRA ..... July 1998
DLM 30007-02 Rev. A	Year 2000 Readiness ..... January 1999
DLM 30007-03 Rev. A	New DI Loop Maintenance ..... June 1999
DLM 30007-04 Rev. A	Firm/Software Versions 3.20CAS, 2.11CTB and 3.20PRA ..... April 2000
DLM 30007-05 Rev. A	Firm/Software Versions 3.30CAS, 2.12CTB 2.11CBI ..... March 2001
DLM 30007-06 Rev. A	Firm/Software Versions 3.50CAS, 3.60CAS ..... May 2003
DLM 30007-06 Rev. B	Formatting Adjustments ..... July 2003
DLM 30007-07 Rev. A	Firm/Software Version 3.51CAS ..... July 2003
DLM 30007-08 Rev. A	Firm/Software Version 3.52CAS, 3.62CAS ..... October 2004

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The analyzer described in this manual is covered by one or more patents issued to and owned or pending by Ionics Instrument Business Group.

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Standard Limited Warranty

Ionics Instrument Business Group warrants its products (Sievers™, Ionics™, and Leakwise™) for defects in materials and workmanship. Ionics Instrument Business Group will, at its option, repair or replace instrument components that prove to be defective with new or remanufactured components (i.e., equivalent to new). The warranty set forth is exclusive and no other warranty, whether written or oral, is expressed or implied.

Warranty Term

The Ionics Instrument Business Group warranty term is thirteen (13) months ex-works, or twelve (12) months from installation or start up by Ionics Instruments certified service personnel. In no event shall the standard limited warranty coverage extend beyond thirteen (13) months from original shipment date.

Warranty Service

Warranty Service is provided to customers through telephone support (1-800-255-6964 or 1-888-245-2595), Monday - Friday, from 8:00 a.m. to 5:00 p.m. (Mountain Time), excluding all company and legal holidays. Telephone support is provided for troubleshooting and determination of parts to be shipped from Ionics Instrument Business Group to the customer in order to return the product to operation. If telephone support is not effective, the product may be returned to Ionics Instrument for repair or replacement. In some instances, suitable instruments may be available for short duration loan or lease.

Ionics Instrument Business Group warrants that any **labor services** provided shall conform to the reasonable standards of technical competency and performance effective at the time of delivery. All service interventions are to be reviewed and authorized as correct and complete at the completion of the service by a customer representative, or designate. Ionics Instrument Business Group warrants these services for 30 days after the authorization and will correct any qualifying deficiency in labor provided that the labor service deficiency is exactly related to the originating event. No other remedy, other than the provision of labor services, may be applicable.

Repair components (parts and materials), but not consumables, provided in the course of a repair, or purchased individually, are warranted for 90 days ex-works for materials and workmanship. In no event will the incorporation of a warranted repair component into an instrument extend the whole instrument's warranty beyond its original term.

Consumables (e.g., dilution standards, verification solutions, reagents, and UV lamps, etc.) are warranted to the extent of their stated shelf life, provided these items are maintained within the stated environmental limitations. Warranty claims for consumables, reagents, and verification standards are limited to the replacement of the defective items, prorated from the time of claim to the expiration of shelf life.

Shipping

A Repair Authorization Number (RA) must be obtained from the Technical Support Group before any product can be returned to the factory. Ionics Instrument Business Group will pay freight charges, exclusive of any taxes and duties, for replacement or repaired products shipped to the customer site. Customers shall pay freight charges, including all taxes and duties, for all products returning to Ionics Instruments. Any product returned to the factory without an RA number will be returned to the customer.

Limiting Conditions

The foregoing warranty shall not apply to defects resulting from improper or inadequate installation, maintenance, adjustment, calibration, or operation by customer. Installation, maintenance, adjustment, calibration, or operation must be performed in accordance with instructions stated in the Operation and Maintenance Manual. Usage of non-recommended maintenance materials may void a warranty claim.

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The remedies provided herein are the customer's sole and exclusive remedies. In no event shall Ionics Instrument Business Group be liable for direct, indirect, special, incidental or consequential damages (including loss of profits) whether based on contract, tort, or any other legal theory. The Operation and Maintenance Manual is believed to be accurate at the time of publication and no responsibility is taken for any errors that may be present. In no event shall Ionics Instrument Business Group be liable for incidental or consequential damages in connection with or arising from the use of the manual and its accompanying related materials. Warranty is valid only for the original purchaser on the Ionics Instruments quote or invoice. This Limited Warranty is not transferable from the original purchaser to any other party without the express written consent from Ionics Instrument Business Group. **Ionics Instrument Business Group specifically disclaims the implied warranties of merchantability and fitness for a particular purpose.**

Declaration of Conformity

We,

Sievers Instruments, Inc.

declare under our responsibility that the

Sievers Instruments, Inc.
TOC 820 Analyzer

Manufactured at Sievers Instruments, Inc. manufacturing sites or other designated manufacturing locations:

Manufacturer's Name:	**Sievers Instruments, Inc.**
Manufacturer's Address:	6060 Spine Road Boulder, CO 80301-3323 USA

is in conformity with the protection requirements of the following Council Directives:

89/336/EEC: Electromagnetic Compatibility Directive
73/23/EEC: Low Voltage Directive

based upon compliance testing of the product and compliance of the product with the following harmonized standards:

EN 55011 : 1991
EN 50082-1 : 1992
EN 61010-1:1993

Boulder, Colorado, USA	
(Place of issue)	(Signature)
July 24, 1998	Misha Plam
(Date)	(Full Name)
	President
	(Position)

Declaration of Conformity

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1 INTRODUCTION

The Sievers 800 Series Total Organic Carbon (TOC) Analyzer from Ionics Instruments (U.S. Patent No. 5,132,094) is a high-sensitivity analyzer used to measure the concentration of total organic carbon (TOC), total inorganic carbon (TIC), and total carbon (TC = TOC+ TIC) in all water samples. The 800 designation is for 120V systems, 810 is for 100 V systems and 820 designation is for 230V systems (generically referred to as a Sievers 800 TOC Analyzer).

The analyzer is based on the oxidation of organic compounds to form carbon dioxide using UV radiation and a chemical oxidizing agent (ammonium persulfate). Carbon dioxide is measured using a sensitive and selective membrane-based conductometric detection technique as described by Carlson (R. M. Carlson, "Method and Apparatus for the Determination of Volatile Electrolytes", U.S. Patent No. 4,209,299, licensed by Ionics Instruments) For each TOC measurement, the concentration of inorganic carbon species (CO_2, HCO_3^-, and CO_3^{-2}) is determined and, after oxidation of the organic compounds, the total carbon content of the sample is measured. The concentration of the organic compounds is then calculated from the difference between total carbon and total inorganic carbon concentrations

(TOC=TC–TIC).

The analyzer can be used to monitor water samples ranging from high-purity water containing < 0.5 parts per billion carbon to water samples containing up to 50 parts per million TOC. The analyzer is easy to operate, with extremely low maintenance, and no special training or chemical knowledge required for preparing reagents. The analyzer is calibrated at the factory, with the calibration stable for approximately one year. Recalibration and validation can be easily performed at the user's site.

NOTE

Throughout this manual, the term Sievers 800 TOC Analyzer refers to all models (800/810/820) of the analyzer.

Warnings – English

⚠ WARNING

Any operation requiring access to the inside of the equipment could result in injury. To avoid potentially dangerous shock, disconnect from power supply before opening the equipment.

⚠ WARNING

For continued protection against fire hazard, replace fuse with same type and rating.

WARNING

This symbol, ⚠ on the instrument indicates that the user should refer to the manual for operating instructions.

WARNING

This is a Safety Class I product. It must be wired to a mains supply with a protective earthing ground incorporated into the power cord. Any interruption of the protective conductor, inside or outside the equipment, is likely to make the instrument dangerous. Intentional interruption is prohibited.

WARNING

If this instrument is used in a manner not specified by Ionics Instruments Business Group USA, the protection provided by the instrument may be impaired.

⚠ WARNING

Disposal of RAM card Lithium batteries must follow local environmental regulations.

Warnings – Español

⚠ATENCION
Cualquier operación que requiera acceso al interior del equipo, puede causar una lesión. Para evitar peligros potenciales, desconectarlo de la alimentación a red antes de abrir el equipo.

⚠ATENCION
Para protección contínua contra el peligro de fuego, sustituir el fusible por uno del mismo tipo y características.

ATENCION
Este símbolo, ⚠ en el instrumento indica que el usuario debería referirse al manual para instrucciones de funcionamiento.

ATENCION
Esto es un producto con clase I de seguridad. Debe conectarse a una red que disponga de tierra protectora en el cable de red. Cualquier interrupción del conductor protector, dentro o fuera del equipo, puede ser peligroso. Se prohibe la interrupción intencionada.

ATENCION
Si este instrumento se usa de una forma no especificada por Ionics Instruments Business Group, USA, puede desactivarse la protección suministrada por el instrumento.

⚠ATENCION
Las pilas de litio de la RAM card deshechadas deben seguir las regulaciones medioambientales locales.

Warnings – Francais

⚠ATTENTION
Chaque opération à l'intérieur de l'appareil, peut causer du préjudice. Afin d'éviter un shock qui pourrait être dangereux, disconnectez l'appareil du réseau avant de l'ouvrir.

⚠ATTENTION
Afin de protéger l'appareil continuellement contre l'incendie, échangez le fusible par un fusible du même type et valeur.

ATTENTION
Le symbol, ⚠ indique que l'utilisateur doit consulter le manuel d'instructions.

ATTENTION
Ceci est un produit de Classe de sécurité I. L'instrument doit être branché sur l'alimentation secteur par un fil de secteur prévu d'une prise de masse. Chaque interruption du conducteur protégeant, à l'intérieur ou á l'extérieur de l'appareil peut rendre l'instrument dangereux. Interruption intentionnelle est interdite.

ATTENTION
Si l'instrument n'est pas utilisé suivant les instructions de Ionics Instruments Business Group, USA, les dispositions de sécurité de l'appareil ne sont plus valables.

⚠ATTENTION
Les batteries RAM card Lithium doivent être déposés suivant les régulations d'environnement locales.

Warnings – Deutsch

⚠WARNHINWEIS
Vor dem Öffnen des Gerätes Netzstecker ziehen!

⚠WARNHINWEIS
Für kontinuierlichen Schutz gegen Brandgefahr dürfen bei Sicherungswechsel nur Sicherungen der gleichen Stärke verwendet werden!

WARNHINWEIS
Dieses Symbol ⚠auf dem Gerät weist darauf hin, dass der Anwender zuerst das entsprechende Kapitel in der Bedienungsanleitung lesen sollte.

WARNHINWEIS
Dies ist ein Gerät der Sicherheitsklasse I und darf nur mit einem Netzkabel mit Schutzleiter betrieben werden. Jede Unterbrechung des Schutzleiters außerhalb oder innerhalb des Gerätes kann das Gerät elektrisch gefährlich machen. Absichtliches Unterbrechen des Schutzleiters ist ausdrücklich verboten.

WARNHINWEIS
Wenn das Gerät nicht wie durch die Firma Ionics Instruments Business Group, USA, vorgeschrieben und im Handbuch beschrieben betrieben wird, können die im Gerät eingebauten Schutzvorrichtungen beeinträchtigt werden.

⚠WARNHINWEIS
Die Entsorgung der Lithium-Batterie in der RAM-Karte darf nur nach den geltenden Umweltschutzregeln erfolgen.

Warnings – Italiano

⚠ATTENZIONE

Qualsiasi intervento debba essere effettuato sullo strumento può essere potenzialmente pericoloso a causa della corrente elettrica. Il cavo di alimentazione deve essere staccato dallo strumento prima della sua apertura.

⚠ATTENZIONE

Per la protezione da rischi da incendio in seguito a corto circuito, sostituire I fusibili di protezione con quelli dello stesso tipo e caratteristiche.

ATTENZIONE

Il simbolo, ⚠ sullo strumento avverte l'utilizzatore di consultare il Manuale di Istruzioni alla sezione specifica.

ATTENZIONE

Questo strumento è conforme alle specifiche per I prodotti in Classe I - Il cavo di alimentazione dalla rete deve essere munito di "terra". Qualsiasi interruzione del cavo di terra all'interno ed all'esterno dello strumento potrebbe risultare pericolòsa. Sono proibite interruzioni intenzionali.

ATTENZIONE

Se questo strumento viene utilizzato in maniera non conforme alle specifiche di Ionics Instruments Business Group USA, le protezioni di cui esso è dotato potrebbero essere alterate.

⚠ATTENZION

Le batterie al Litio sulla RAM card, quando sono esaurite, devono essere gettate secondo le regolamentazioni vigenti localmente.

Warnings – Dutch

⚠OPGELET

Iedere handeling binnenin het toestel kan beschadiging veroorzaken. Om iedere mogelijk gevaarlijke shock te vermijden moet de aansluiting met het net verbroken worden, vóór het openen van het toestel.

⚠OPGELET

Voor een continue bescherming tegen brandgevaar, vervang de zekering door een zekering van hetzelfde type en waarde.

OPGELET

Het symbool, ⚠ geeft aan dat de gebruiker de instructies in de handleiding moet raadplegen.

OPGELET

Dit is een produkt van veiligheidsklasse I. Het toestel moet aangesloten worden op het net via een geaard netsnoer. Bij onderbreking van de beschermende geleider, aan de binnenzijde of aan de buitenzijde van het toestel, kan gebruik het toestel gevaarlijk maken. Opzettelijke onderbreking is verboden.

OPGELET

Indien het toestel niet gebruikt wordt volgens de richtlijnen van Ionics Instruments Business Group, USA gelden de veiligheidsvoorzieningen niet meer.

⚠OPGELET

RAM kaart Lithium batterijen dienen volgens de lokale afvalwetgeving verwijderd te worden.

WARNING

For on-line applications, an in-line particle filter must be installed on the sample inlet line to prevent damage to the instrument. If the water sample to be monitored contains high levels of suspended solids, then the in-line filter must be replaced on a regular basis.

WARNING

Do not run the instrument with the sample inlet line capped off as this can result in false TOC readings and possible damage to the instrument.

WARNING

Hazardous chemical reagents (ammonium persulfate and phosphoric acid) are used in the instrument. The waste stream from the instrument is acidic and must be disposed of properly. Consult your state and local regulations.

WARNING

Do not adjust the pressure regulator on the sample inlet system. The pressure is preset to 5 psi. Changing the inlet pressure can damage the analyzer and void the warranty. Do not let the inlet pressure exceed 5 psi.

WARNING

Always stop TOC measurements before turning off or unplugging the instrument. Turning off the instrument while it is writing to the RAM card may damage the card.

WARNING

Make sure the DI Reservoir is full, particularly when running samples with high TOC or high salt concentrations. Always "clean-up" the instrument by running low TOC DI water after running high TOC or salt samples.

WARNING

This is a Class A product. In a domestic environment, this product may cause electromagnetic interference in which case the user may be required to take adequate measures to correct the interference.

WARNING

For performance within specifications on ozonated water systems, an Ozone Destruct Kit must be purchased from Ionics Instruments and installed according to instructions.

WARNING

The UV lamp contains mercury and may be considered hazardous material in your local area. Dispose of the UV lamp in accordance with Federal, state, or local government regulations.

WARNING

Installation of the UV lamp requires access to the inside of the instrument. To avoid potentially dangerous shock, disconnect the power cord before opening the instrument's top panel.

WARNING

Should the UV lamp become broken or damaged it should be handled in accordance with your organization's toxic waste handling procedure and disposed of in accordance with Federal, state, or local government regulations.

2 SYSTEM SPECIFICATIONS

Detection limit.....0.05 ppb TOC

On-Line TOC Precision.....± 3% of Total Carbon value

On-Line TOC Accuracy.....± 3% of TC value (TC > 100 ppb)

Interferences.....Insensitive to halogenated hydrocarbon interference

Linear range.....0.05 – 50,000 ppb TOC

Analysis Time.....6 minutes

Sample Temperature.....1 to 100°C

Ambient Temperature.....10 to 40°C

Sample Pressure.....Up to 100 psi

Sample Flow Rate……30 to 220 mL/min

Internal Sample Flow Rate.....0.35mL/minute

Maximum Relative Humidity.....80% at 31°C; 50% at 40°C

Maximum Altitude.....up to 3,048m

Calibration Stability.....Typically stable for 12 months

Chemical Reagents.....Prepackaged, 3-month supply

Outputs.....0–10 V and 4–20 mA, RS-232, parallel printer port, alarms

Power requirements

Model 800	120 V, 150 watts, 60 Hz
Model 810	100 V, 150 watts, 50/60 Hz
Model 820	230 V(±10%), 150 watts, 50/60 Hz

Installation/Overvoltage Category.....II

Pollution Degree.....II

Display.....Back-lit, 3 significant digits

Size .....57 cm x 37 cm x 15 cm

Weight .....13.6 kg

3 SYSTEM DESCRIPTION

The Sievers 800 TOC Analyzer consists of nine major components:

- Sample inlet system and sample pump
- Chemical reagent reservoirs
- Chemical reagent syringe pumps
- Stream splitter
- Oxidation reactor
- CO_2 sensors consisting of:

    Deionized water loop

    Membrane module

    Conductivity and temperature-measurement cell

- Microprocessor controller and electronics
- On-board data storage
- Data outputs

Figure 3-1 shows a generalized schematic of the analyzer.

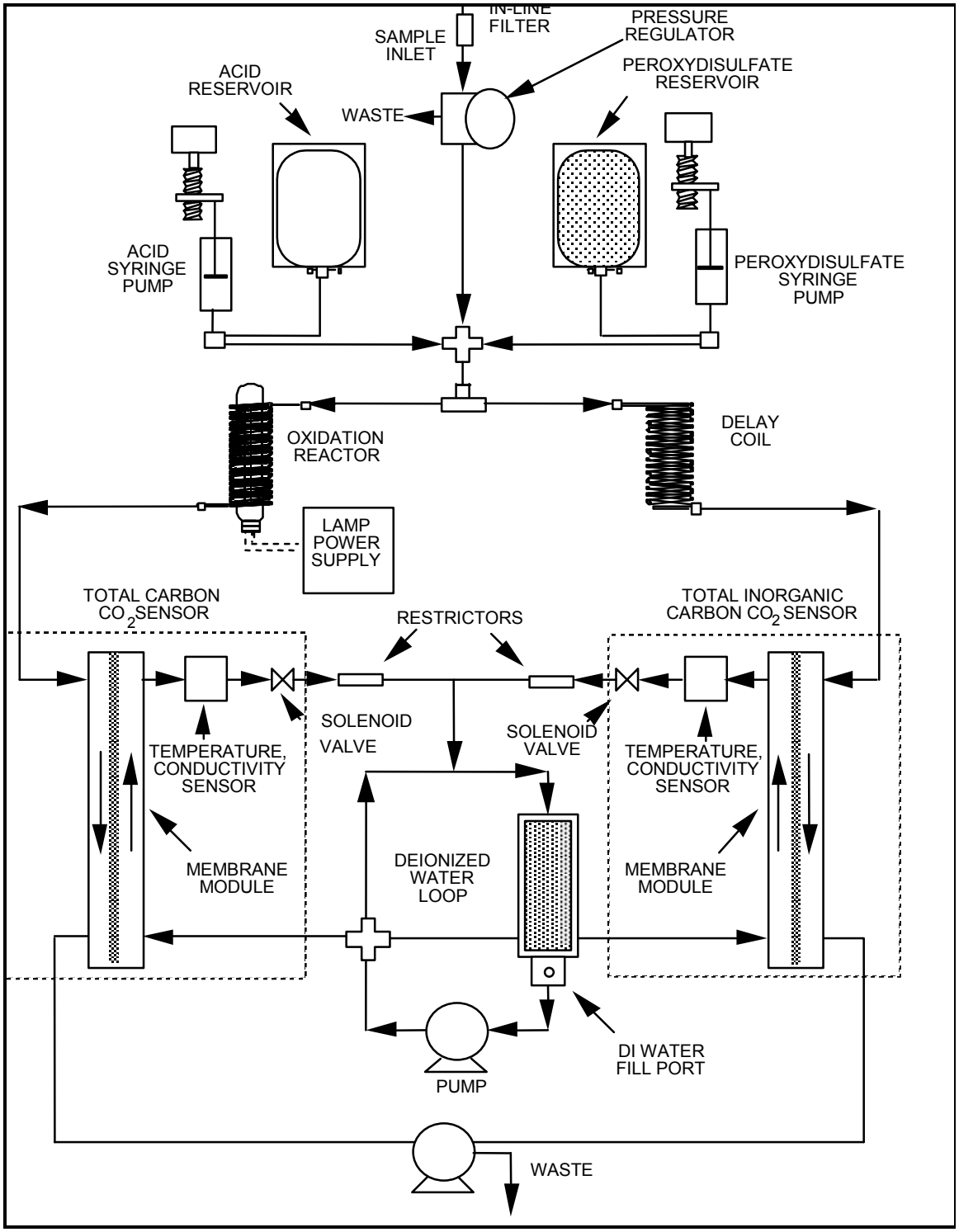


FIGURE 3-1: Analyzer Schematic

A brief description of the major components of the analyzer follows.

Sample Inlet Systems and Sample Pump

On-Line Sampling from Pressurized Source

Water from a high-pressure line (> 5 psig) is introduced into the analyzer using a sample inlet system. The system consists of:

- two lengths of 1/4" OD PFA tubing
- a 60-µm stainless steel in-line filter
- an in-line pressure regulator
- a sample interface box that includes:
    - a pressure gauge
    - back-pressure orifice
    - a sample inlet line to the analyzer
    - a sample outlet.

The temperature of the water to the inlet system can range from 1-100° C. The flow rate of water through the inlet system can range from 30-220 mL/minute. The in-line pressure regulator reduces the pressure of the water to 3-7 psig (5 psig at 25 °C). Water is drawn into the analyzer by a sample pump at a flow rate of approximately 0.35 mL/min. A pressure > 5 psig will be indicated by the gauge for water samples at temperatures < 25 °C (lower pressure for water > 25 °C). The inlet system can also be used for water samples at pressures below 5 psig as long as the flow through the inlet system is at least 30 mL/min. For most applications, the waste stream from the analyzer is mixed with the effluent from the sample inlet system and discharged to a drain.

Grab Sampling

The analyzer can also be used to sample directly from a sample bottle or other non-pressurized container for the analysis of grab samples, standards, and other off-line operations. The samples should be filtered (60 µm or finer) to prevent clogging of the analyzer by particles in the sample. The inlet line from the sample inlet system is a 1/16" OD Teflon® tubing and the sample pump

draws the sample into the analyzer at a flow rate of about 0.35 mL/min. The waste is removed through a second 1/16" OD Teflon tube to a waste container. The 1/16" OD Teflon tubes are found in the accessories kit.

Calibration Valve

The analyzer can also be equipped with a two-position switching valve. Installed at the inlet to the analyzer, this valve allows switching between on-line and container sampling without removing any tubing. The valve does not contaminate the sample, even for low-level TOC measurements.

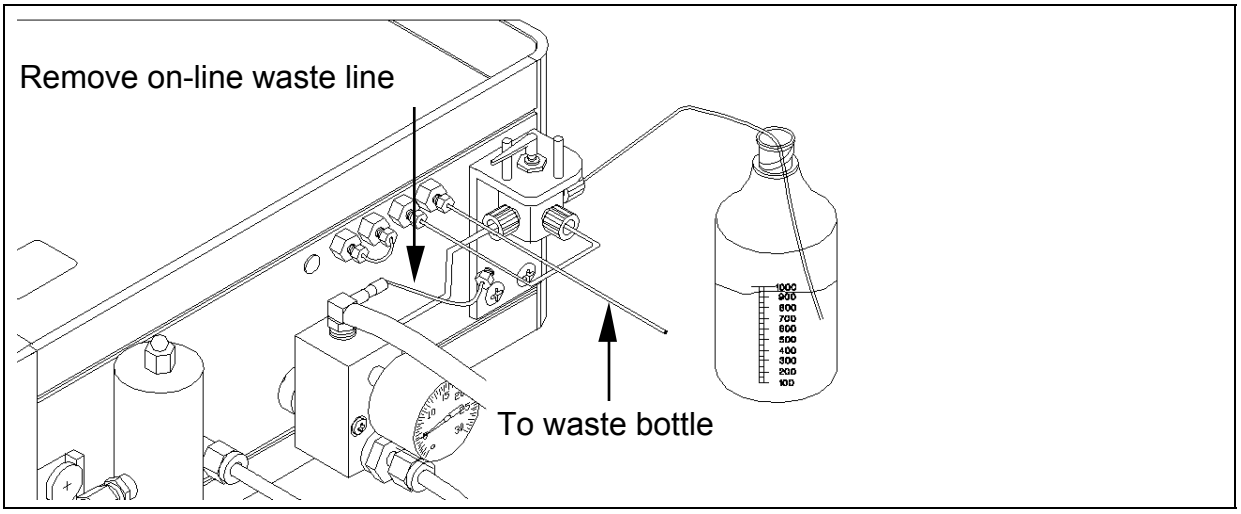


Figure 3-2: View of Calibration Valve

Chemical Reagent Reservoirs

Two chemical reagents are used in the analyzer: 6M phosphoric acid (H_3PO_4) and 15% ammonium persulfate ($(NH_4)_2S_2O_8$). A supply of these reagents for approximately three months of continuous operation is stored in sealed containers in the analyzer. The reagents are prepared using low-TOC, deionized water under controlled conditions. The reagents are then packaged to eliminate possible contamination of the sample by organic compounds. When exhausted, the reagent supplies are simply replaced.

The oxidizing reagent – ammonium persulfate – is inherently unstable, slowly decomposing to form sulfate ion and oxygen. The reagent is stored in a micro-porous Teflon bag container to permit the oxygen to diffuse from solution. The decomposition of the persulfate limits the useful lifetime of this reagent to three months, regardless of the volume of reagent consumed by operating the analyzer. Although the volume for the phosphoric acid reagent is sufficient for three months under typical operating conditions, the shelf life is one year.

The analyzer's firmware keeps track of the volume of both reagents consumed and the age of the persulfate solution. Warning messages indicate when new reservoirs must be installed.

Chemical Reagent Syringe Pumps

The reagents are added to the sample stream using microprocessor-controlled syringe pumps. The capacity of each syringe is 0.5 mL.

Typically, phosphoric acid is added at a flow rate of 0.2 – 1.5 µL/minute, dependent upon initial sample pH and TOC concentration, to reduce the pH of the sample stream to pH <2.

For water samples containing up to 5ppm TOC, 0.75µL/min is a suitable flow rate for persulfate oxidizer. For samples containing higher levels of TOC (up to 50 ppm), the oxidizer flow rate may be increased to 4.5 µL/min. or higher.

Stream Splitter

After the addition of the chemical reagents, the sample stream is split into two equal flows. One stream passes through a delay coil and into a CO_2 sensor, which measures the concentration of total inorganic carbon (TIC), or simply "IC". The other stream passes through the oxidation reactor that photochemically oxidizes organic compounds to form CO_2, and into a CO_2 sensor that measures the concentration of total carbon (TC). As total carbon is the sum of organic and inorganic carbon, the concentration of total organic carbon is computed as the difference between the total and inorganic carbon (TOC = TC–TIC).

Oxidation Reactor

The analyzer oxidizes organic compounds to CO_2 using the chemical oxidizing agent ammonium persulfate, and UV radiation. The oxidation reactor is a spiral quartz tube wrapped around an UV lamp. The lamp emits light at 184 and 254 nanometers, resulting in the formation of powerful chemical oxidizing agents from the photolysis of water and persulfate:

$$H_2O + hn\ (184\ nm) \rightarrow OH\cdot + H\cdot \qquad (1)$$

$$S_2O_8^{-2} + hn\ (254\ nm) \rightarrow 2\ SO_4\cdot^- \qquad (2)$$

$$SO_4\cdot^- + H_2O \rightarrow HSO_4^- + OH\cdot \qquad (3)$$

Hydroxyl radical (OH·) will completely oxidize organic compounds to form carbon dioxide:

$$\text{Organic Compounds} + OH\cdot \rightarrow CO_2 + H_2O \qquad (4)$$

When low levels of organic compounds (< 1 ppm) are present in the sample, complete oxidation can usually be achieved by hydroxyl radicals produced from the photolysis of water, without the addition of persulfate.

The lifetime of the UV lamp is approximately 6 months of operation and a warning message will indicate when it is time to replace the lamp.

CO_2 Sensors

Two membrane-based conductometric CO_2 sensors, a TC and an IC, are used in the analyzer. One DI water source serves both sensors and each CO_2 sensor consists of a membrane module, and a conductivity and temperature measurement cell. The IC sensor measures the concentration of CO_2 in the sample (without oxidation). The TC sensor measures the combined concentration of CO_2 initially in the sample and CO_2 produced by the oxidation of organic compounds.

DI Water Loop

Deionized water for both CO_2 sensors is continuously generated using a circulating pump and a mixed-bed ion exchange resin. When used for the monitoring of low salt samples containing < 10 ppm total carbon, the lifetime of the resin bed is approximately 5 years. The level of the DI water in the reservoir (~150 mL) can be viewed through a window and refilled as needed.

The conductivity of the DI water is determined by the Conductivity and Temperature Measurement Cell, which monitors the ion exchange resin. When the resin is depleted, the entire DI water loop and pump assembly is removed and the resin is replaced.

Membrane Module

The membrane module consists of a gas-permeable membrane that separates the spiral flow channel containing the sample stream from a matching channel containing deionized water. The membrane is permeable to CO_2 (and other gases) but impermeable to ions and organic compounds. The sample stream flows continuously through the membrane module, while a solenoid valve controls the flow of DI water through the membrane module.

Conductivity and Temperature Measurement Cell

The conductivity and temperature measurement cell is located at the outlet of the deionized water channel from the membrane module. A thermistor measures the temperature of the DI water stream as it leaves the conductivity cell. Conductivity is measured using a bipolar-pulsed technique and the conductivity electronics are calibrated by measuring a precision resistor prior to each analysis cycle. The conductivity sensors and thermistors have NIST-traceable calibrations.

Microprocessor Controller and Electronics

All operations of the analyzer are controlled by a 32-bit microprocessor. Nine electronic boards are contained in the analyzer:

Two power supply boards
Two conductivity and temperature-measurement headboards,
Main microprocessor/memoryI/O board (which includes the printer output and RAM card)
Analog to digital board
Syringe pump control board
Display and keypad board

On-board Data Storage

The date, time, TOC, IC, acid flow rate, oxidizer flow rate, and conductivity temperatures are stored on the Ram Card after each TOC measurement. The standard RAM card included in the analyzer has 512K capacity, which can store ~102 days of continuous measurements. Once the RAM card is full, the analyzer's firmware notifies the user that it is overwriting data. Larger-capacity RAM cards are available (up to 2048K or ~400 days) and new RAM cards can be installed if archiving data on the cards.

Please note, these RAM cards are battery-operated; when the battery is depleted the stored data will be lost. The battery is not depleted when the RAM card is in an operating TOC analyzer. When the card is removed or the analyzer is turned off the battery will start to deplete. The battery in a 512K card lasts about 2 years and the battery in a 2048K card lasts ~1 year in storage, outside the analyzer.

To download the information to a PC for further processing, analysis, and data storage, remove the RAM card from the analyzer and read the data with a RAM card reader and the RAMReader program. RAMReader produces a file that can be used with Lotus 1-2-3, Excel, and other spreadsheet programs. Error messages and calibration constants are stored in nonvolatile memory in

the analyzer. Refer to the *RAM CARDS, CARD READER, and RAMReader SOFTWARE* chapter for further information.

Data Outputs

The analyzer has four output ports: an RS-232 output, two analog outputs (4-20 mA, and 0-1V or 0-10V), and a parallel printer port. Data can be downloaded from the analyzer via the RS-232 port to a PC using communication software.

CO_2 Sensor Measurement Cycle

The concentrations of CO_2 in the TC and IC sample streams are independently measured during a 6-minute cycle. At the beginning of each measurement cycle, a fresh pulse of DI water is introduced into the membrane module, and then the DI water flow is stopped when the solenoid valve closes. The acidified sample stream flows continuously through the sample side of the membrane module. At a pH < 2, bicarbonate and carbonate ions are converted to carbonic acid (H_2CO_3), which readily dissociates to aqueous carbon dioxide ($CO_{2(aq)}$) and water. Carbon dioxide in the sample stream diffuses across the membrane into the deionized water chamber and ionizes to form bicarbonate (HCO_3^-) and hydronium ions (H_3O^+). After 5 minutes, the concentration of $CO_{2(aq)}$ in the deionized water approaches equilibrium with the concentration of $CO_{2(aq)}$ in the flowing sample stream.

After equilibrium has been established, the solenoid valve opens to introduce fresh DI water into the chamber and sweep the $CO_{2(aq)}$, H_3O^+, and HCO_3^- into the Conductivity and Temperature Measurement Cell. The solenoid valve then closes and the next measurement cycle commences.

The increase in conductivity of the deionized water is proportional to the concentration of $CO_{2(aq)}$ in the deionized water stream, which is proportional to the concentration of $CO_{2(aq)}$ (and total carbon or inorganic carbon) in the sample stream. From the measurement of total carbon and total inorganic carbon concentrations, the TOC is computed as the difference.

Major Accessories and Configurations Available for the Analyzer

IC Removal Module

For water samples containing high levels of inorganic carbon (IC) compared to the TOC levels such as some municipal water systems, groundwater supplies, and RO permeates, improved accuracy in TOC measurements can be achieved by removing most of the IC prior to TOC measurement. The Sievers IC Removal Module consists of a vacuum degassing module, a vacuum pump, and an activated carbon and soda lime trap. In operation, the water sample is introduced into the analyzer, acid, and if necessary persulfate oxidizer, is added to the sample as usual. Then the stream is directed through the vacuum-degassing module. Carbon dioxide produced from the reaction of bicarbonate and carbonate with acid is removed from the sample stream by the vacuum. The sample is then directed by the stream splitter for measurement of IC and TC. Approximately 99% of the IC is removed at concentrations up to 25 ppm. The activated carbon/soda lime trap prevents contamination of the sample stream from organic compounds and CO_2 in the atmosphere.

Typically, if the TOC is 10% or less of the IC concentration, the Sievers Inorganic Carbon Removal Module will be required. For example, if the IC is 1 ppm, then use the IC Removal Module if the TOC is 100 ppb or less for accurate TOC measurements. The analyzer will calculate the TOC/IC ratio for each measurement and if this ratio is less than 0.1, a warning message will be displayed on the LCD screen and written to the Error Stack.

Autosampler

The TOC Autosampler System consists of:

- Autosampler
- Computer with Sievers DataPro Autosampler Software
- Sievers 800 Series TOC Analyzer
- Printer (optional)

The computer, in conjunction with the DataPro software, allows control of the analyzer and the autosampler. The autosampler has a capacity for 26 samples (plus 1 clean-up sample) using 29 x 81mm screw-capped 40 mL sample vials with Teflon-lined septa or 71 samples (plus 1 clean-up sample) using 16 x 125 mm screw-capped 17 or 18 mL vials with Teflon-lined septa. A stainless steel needle is used to transfer samples from the sample vials into the analyzer. Results are displayed and stored on the computer via the software, stored on the analyzer's internal RAM card, and may be printed.

DataPro consists of three main parts: the Protocol File Editor, the Result Viewer, and the Message Area. Use the Protocol File Editor to create or edit the sampling sequence and to store the protocol file on the hard drive. Use the Results File Viewer to review and print the results from previous analyses. Watch the Message Area for status information while running the program and the analyzer.

Multistream

A single analyzer can be used to measure different water streams using the Multi-stream Sample Inlet System. The system consists of a programmable stream sampler for 4 sample streams and TOC analyzer firmware for controlling the sampler and reagent flow rates. The stream selector valve is housed in an environmental rated enclosure equipped with a controller and LEDs indicating display. A 5-way stainless steel ball valve is used to select the sample streams.

Using the firmware in the TOC, it is possible to set the measurement conditions for each sample stream, select the sampling order, set alarm levels for individual streams and the duration for TOC, TC and IC measurements for the different streams. The TOC analyzer will calculate and report averages and standard deviations for TOC, TC, and IC for each stream. The controller also has a manual override that permits the user to select a single sample stream for measurements.

The TOC analyzer can also be disconnected from the stream selector for continuous monitoring of a single sample stream, measurement of grab samples or calibration of the analyzer.

Three multi-stream systems are available: a 120V system for the Model 800, a 100V system for the Model 810 and a 230V system for the Model 820.

Turbo

Turbo Sampling Mode is an option on the analyzer achieved through specific firmware. Analyzers configured with this option are designated as the "Turbo" version of the model number (e.g., 800 Turbo analyzer). This mode is useful for monitoring recycle or reclaim water in semiconductor facilities where rapid response is of primary concern. When operated in the Turbo mode, the analyzer responds to a step change with an initial response in 3 minutes and 90% of final value in 3.5 minutes. Results are reported every 3 to 4 seconds.

Flow Switch and Binary Input Module

For on-line applications that experience intermittent water flow, the Flow Switch along with the Binary Input Module allow the analyzer to be turned on and off when water flow starts and stops. Ionics Instruments has tested the flow switch for functionality and ease-of-installation. Flow Switches must be used with a prefilter, and water must flow from below the analyzer before proceeding horizontally to the analyzer. The Flow Switch will not operate with the Multistream.

Ozone Destruct Kit

This kit is designed to easily replace the analyzer's existing sample line with ozone destruct tubing. Once installed the tubing will eliminate up to 800ppm of ozone from ozonated water systems for five years of operation.

Environmental Enclosure

Two Sievers enclosures are offered: the Protective Enclosure and the Environmental Enclosure. These enclosures protect the analyzer in corrosive, or extreme temperature environments:

- The Protective Enclosure provides protection for the analyzer from dripping splashing hazards present in industrial process environments. The cooling fan and filters provide for safe and reliable operation of the analyzer.
- The Environmental Enclosure is used for safe operation of the analyzer in low or high temperature environments. It is the same design as the Protective Enclosure with the addition of a heating/cooling system to maintain the optimal operation temperature for the analyzer.

Front Panel Displays and Controls

Operate the analyzer using the front panel display and the four buttons, as shown below:

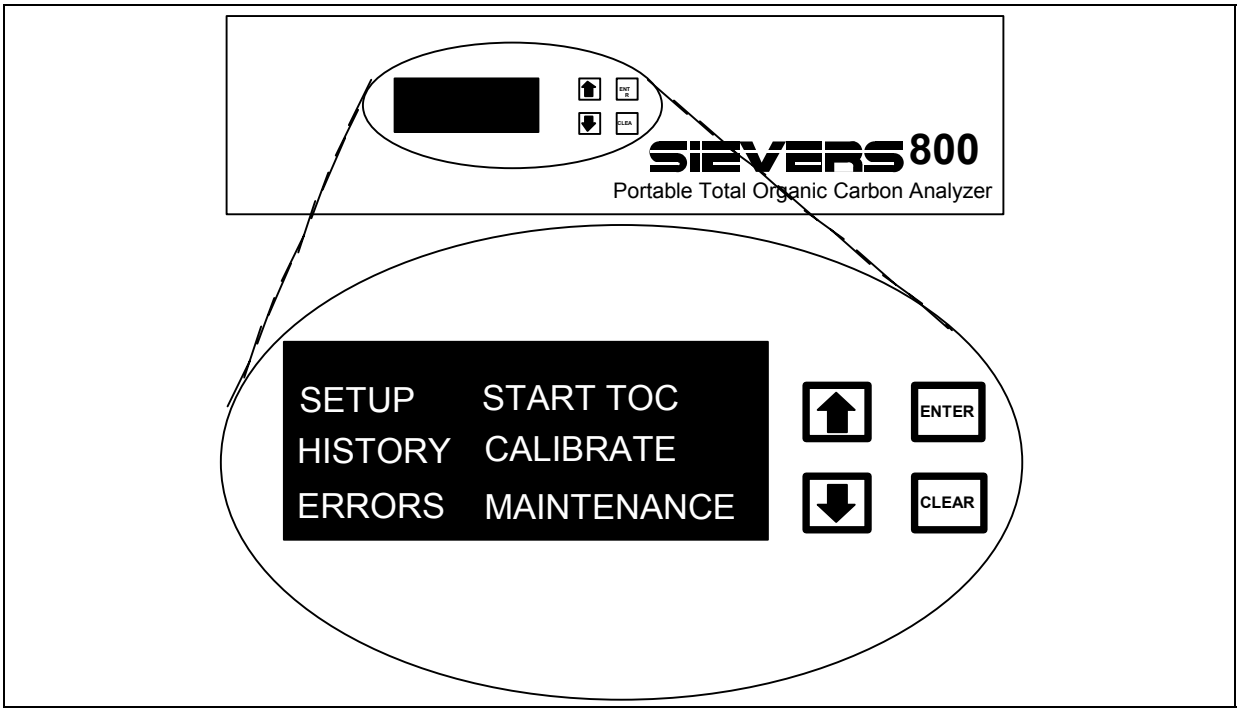


FIGURE 3-3: Front Panel

The control buttons are the up ↑ and down ↓ arrows, ENTER, and CLEAR.

Use ↑ and ↓ to move the cursor when selecting menus and when entering set points and operating codes.

For set points, the options are the numbers 0 – 9, the minus sign (-), the decimal point (.), the exponent (E), and a blank or space ( ).

↑ starts with zero (0) and scrolls up through numbers.

↓ starts with the exponent (E), and scrolls down through the options.

The highlighted text or number indicates the position of the cursor in the menu. Use ENTER to switch to the selected menu and to store inputs. Use CLEAR to return to the previous menu and to clear incorrect entries.

The Operations chapter contains a more complete guide to menus and operation of the instrument.

4 INSTALLATION

Reading this manual will help familiarize you with both the analyzer design and function. If additional assistance is needed, contact Ionics Instruments at (800)255-6964. Installation and training by a qualified service technician can also be provided.

NOTE

ORIGINAL PACKING MATERIALS MUST BE SAVED! If for any reason the analyzer must be returned, it MUST be packed in the original carton to ensure that no damage occurs during shipment. There will be a charge if the analyzer must be repackaged for return shipment. Insure the analyzer for the return shipment.

WARNING

Hazardous chemical reagents (ammonium persulfate and phosphoric acid) are used in the analyzer. Before installing the reagents, please read the Material Safety Data Sheets (MSDS) contained in a pouch on the top of the reagent shipping box for proper handling precautions and spill or leak procedures.

Unpacking and Inspecting

Open the two shipping boxes and verify that they contain the following:

- Sievers 800 TOC Analyzer
- Literature and manual
- Accessory package containing:
  - 3 meters of sample inlet tubing with in-line filter
  - Spare pump tubing
  - (4) .6-meter lengths of 1/16"-OD Teflon tubing with 1/16" Valco nuts and ferrules for container sampling
  - 6 meters of 3/8" OD vinyl tubing for waste line
  - Spare plastic-barbed water fitting
  - 3/32" Allen wrench
  - 1/4" Open-end wrench
  - Water bottle
  - Analyzer power cord

pH paper
(2) Warm Packs *(DO NOT OPEN unless returning the analyzer to Ionics Instruments for repair during cold weather)*
Stainless steel Metric tubing converter (1/4 inch to 6mm tube) - 810 and 820 models only

- Acid Reagent Cartridge*
- Oxidizer Reagent Cartridge*

* Reagents are not installed; they are shipped in a separate box due to shipping regulations.

DO NOT START THE ANALYZER UNTIL THE REAGENTS HAVE BEEN INSTALLED. Follow the steps outlined in this chapter or in the Maintenance chapter.

If a major accessory (IC Removal Module, Autosampler, Flow Switch, Environmental Enclosure or Multistream, etc) has been ordered or shipped with the analyzer, please refer to their respective documentation for packing lists, unpacking instructions and installation procedures.

Collecting Additional Equipment

In addition, the following equipment will be needed to complete the installation; see Appendix B for CE Mark Specifications:

- a sampling port equipped with a shut-off valve
- a Swagelok adapter (with 1/4" nut and ferrules) from the sampling port for connection of the 1/4" OD Teflon sample inlet tubing
- Open-end wrenches (1/2", 9/16" and 3/4")
- Insulated wire (22-12 American Wire Gauge) for analog and alarm outputs (*optional*)
- a data acquisition system or analog recorder (0–10 V or 4–20 mA) (*optional*)
- Printer and cable (*optional*)
- IBM-compatible computer (required for Autosampler configuration; *optional for instrument operation in on-line or grab mode*)

Site Selection/Location

Place the analyzer on a clean, unobstructed surface approximately 56 cm deep by 76 cm wide that can support at least 14 kg in addition to existing equipment. For proper heat dissipation, ensure that an additional 16 cm is available at the rear and on both sides of the analyzer. For on-line sampling, the analyzer should be placed within 3 m of the sampling port to be tested. If using a printer, make sure that there is sufficient space for the printer and for connecting the printer to the analyzer. For container sampling, make sure there is sufficient space on the right-hand-side of the analyzer for containers.

Power Requirements

The 120 VAC version of the analyzer is powered from a standard 120 VAC (108 to 132 VAC, 60 Hz) grounded AC outlet. For 100 VAC versions, a standard 90-110 VAC, 50 or 60 Hz, grounded AC outlet is required. See Appendix A for instructions on selecting the frequency setting for 100 VAC analyzers. For 230 VAC versions of the analyzer, a standard 210 - 250 VAC, 50 Hz, grounded AC outlet is required. See Appendix B for instructions on verifying the frequency setting for 230 VAC analyzers.

Environmental Consideration

Operate the analyzer in an environment comfortable for human habitation with reasonably constant temperature and humidity. Avoid direct sunlight and extreme temperatures; operating at elevated temperatures (greater than 40 °C) prevents proper operation and operating at low temperatures (10 °C) could cause errors in the measurements.

Installing Sample Port

The analyzer can be used with any pressurized sample port (2 to 135 psig) and water samples ranging from 5°C to 100°C. Thoroughly flush the port before installing the sample inlet lines to remove any contamination.

Plumbing

Installing On-Line Sample Inlet System –

1. Install a Swagelok adapter in the sampling port to permit attachment of 1/4"-OD Teflon tubing and connect the tubing (end without filter) to the adapter.
2. Connect the 1/4" Teflon tubing with the in-line filter to the inlet of the pressure regulator.

WARNING
Operation of the analyzer without the in-line filter on the sample inlet line will damage the analyzer and void the warranty. To avoid damaging the analyzer, install the filter and replace as needed.

WARNING
Do not adjust the pressure regulator on the sample inlet system. The pressure has been preset to 5 psi and changing the inlet pressure can damage the analyzer and void the warranty.

WARNING
Do not run the analyzer with the sample inlet line capped off as this can result in loss of deionized water.

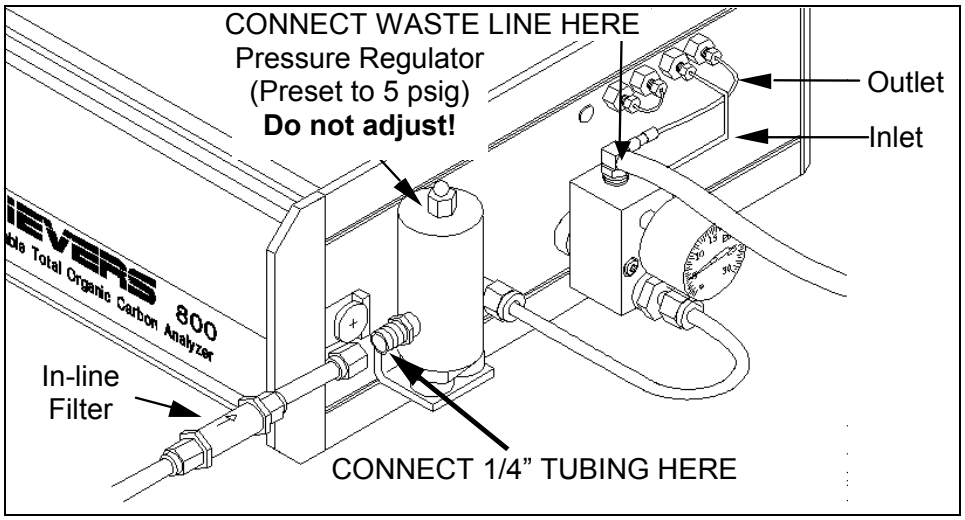


FIGURE 4-1: Sample Inlet Connections for On-Line Monitoring

3. Connect the 3/8" OD waste line tubing to the sampler by sliding the tubing over the barb fitting on the sampler outlet.

The analyzer is configured for on-line monitoring from a pressurized water source. **If experiencing less than 5 psi, DO NOT ADJUST THE REGULATOR.** Water flows of less than 5psi are acceptable. If experiencing a no flow condition, contact Ionics Instruments. The plumbing must be changed for sampling from containers or calibrating the analyzer.

WARNING
The waste stream from the analyzer is acidic and must be disposed of according to local regulations.

Installing Grab Sample Inlet System –

To change the plumbing from on-line to grab sample configuration:

1. Turn off the power switch on the left-hand side of the analyzer.
2. If the analyzer is connected to a pressurized water source, turn off the water at the sampling port.

3. Locate the 1/16" OD stainless steel tubing between the sample inlet system and the bulkhead fitting labeled INLET (see Figure 5-2).

4. Use a 1/4" wrench to loosen 1/16" Valco nut connected to the INLET bulkhead fitting. Remove the nut and tubing from the bulkhead fitting.

5. Carefully rotate the tubing away from the analyzer so that tubing is clear of the bulkhead fitting. There is no need to loosen or remove the nut from the sample inlet block.

NOTE

There is no need to remove the tubing from the sample inlet block. If the tubing must be removed, loosen the nut from the inlet block and carefully remove the tubing. A small ferrule is loosely held on the tubing and may come off when the tubing is removed from the inlet system. This ferrule must be on the tube, with the wide side of the ferrule facing into the inlet system when reinstalling the tubing for on-line measurements.

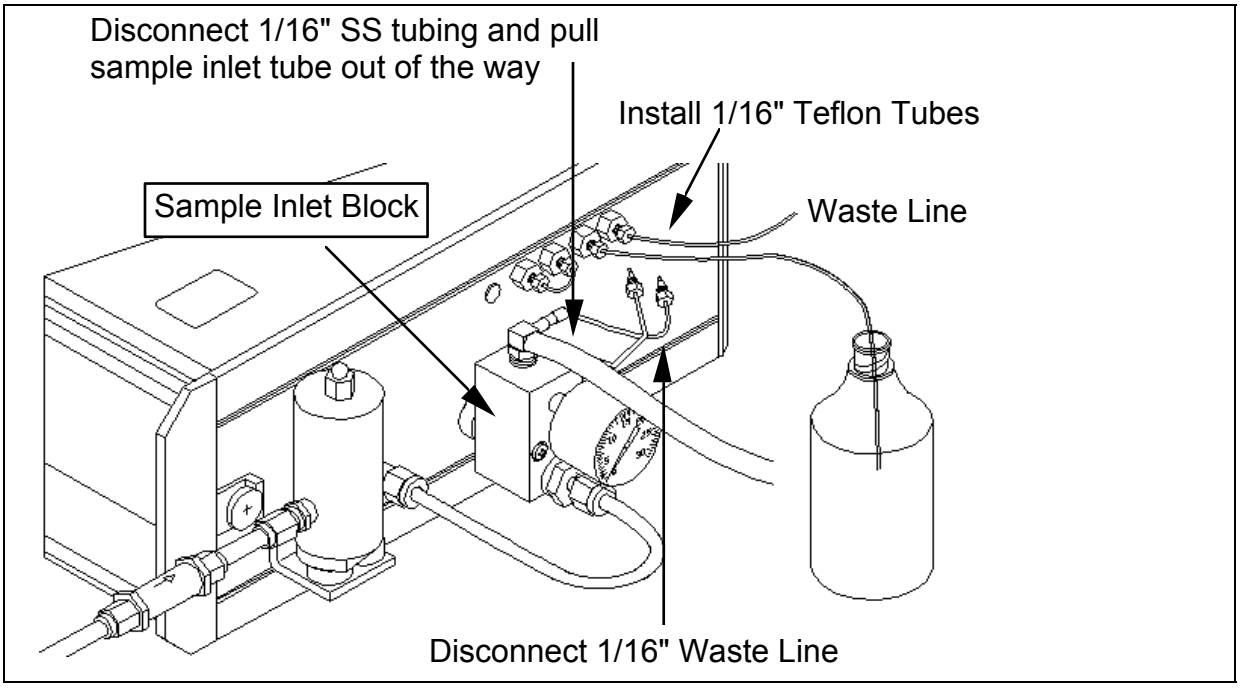


FIGURE 4-2: Connections for Grab Sampling

6. Locate the 1/16" Teflon tubing on the OUTLET of the analyzer.

7. Use a 1/4" wrench to loosen the Valco nut from the outlet bulkhead and remove the tubing. Disconnect the other end of the tubing from the rubber tubing on the sample inlet system. **This tubing will be needed for on-line sampling; place the tubing in a secure location.**

8. Locate the two 1/16" OD Teflon lines with Valco nuts and ferrules in the accessories kit that came with the analyzer.

9. Connect one of the 1/16" OD Teflon lines to the OUTLET bulkhead fitting and tighten finger-tight. Use a 1/4" wrench to secure the nut 1/8 of a turn past finger-tight**. Do not over tighten, the tubing will collapse and prevent flow!**

10. Connect the other 1/16" OD Teflon lines to the INLET bulkhead fitting and tighten finger-tight. Use a 1/4" wrench to secure the nut 1/8 of a turn past finger-tight. **Do not overtighten; the tubing will collapse and prevent flow!**

11. Place the Teflon tube from the OUTLET in a suitable waste container.

WARNING
The waste stream from the analyzer is acidic and must be disposed of according to local regulations.

12. Place the Teflon tube from the INLET in the sample container making sure that the end of the tubing is immersed in the sample.

13. Follow the instructions in the Operations Chapter to select the Grab Sample Mode and proceed with measurements.

If using the analyzer for a large number of grab samples, consider using the Autosampler system, available from Ionics Instruments.

Electrical

Installing the Recorder, Alarm, and Printer Cables - Wiring

The output connectors are located on the left-hand side of the analyzer (see Figures 4-4 & 4-5). The long green connector is a terminal strip for the analog and alarm outputs. The parallel printer output is the 25-pin female connector and the 9-pin female is the RS-232 computer output.

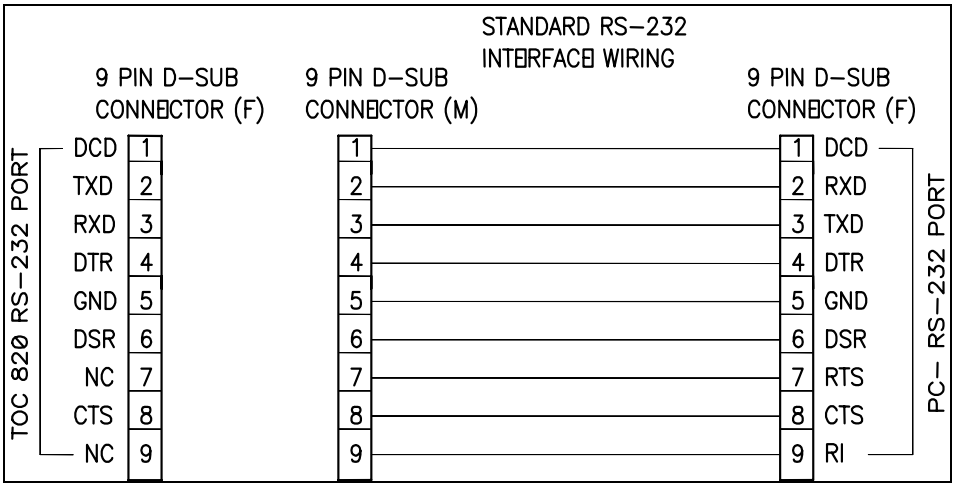


FIGURE 4-3: TOC STANDARD RS-232 9 Pin D-sub

The 15-pin auxiliary port connector is used for the autosampler option. See Appendix B for CE Mark Specifications. The AUX AC connector carries the line voltage and is used to power accessories for the analyzer.

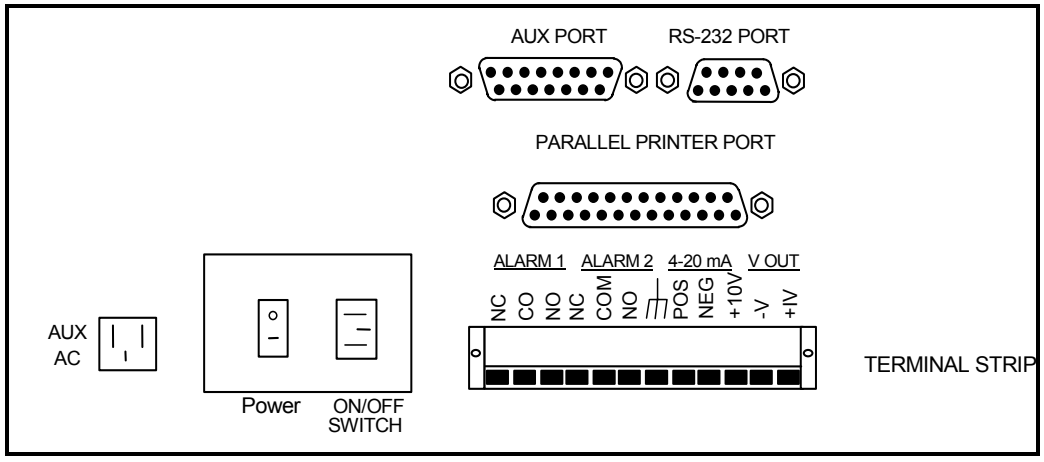


FIGURE 4-4: Output Connectors for the 800/810 Analyzer

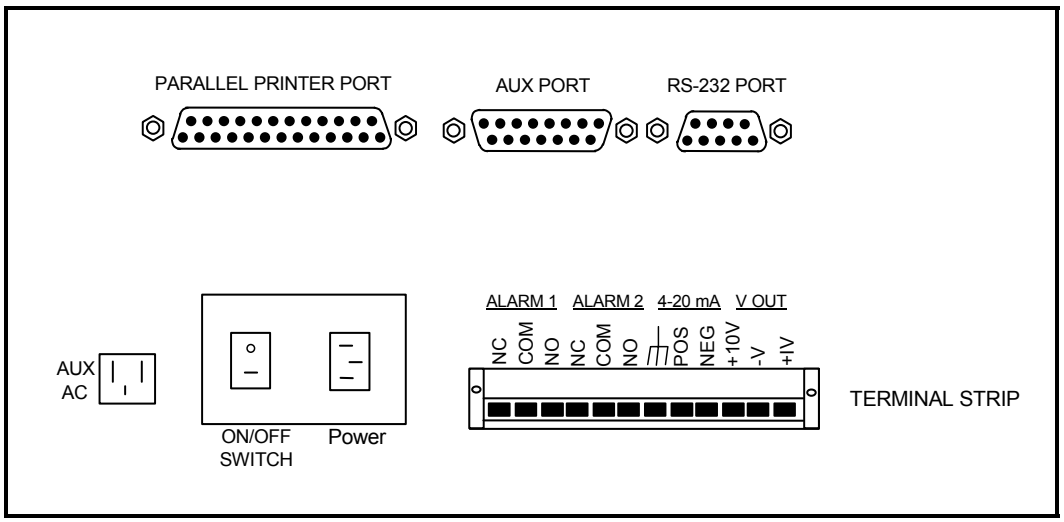


FIGURE 4-5: Output Connectors for the 820 TOC Analyzer

Recorder and Alarm Outputs

The data from the analyzer can be recorded using a 4–20 mA or 0–10 V recorder, and two alarms can be used. The recorder and alarm outputs are selected from the terminal strip and must be configured as described in this chapter. The outputs of the terminal strip are in Table 1. Only one recorder output (4-20 mA, 0-1 V or 0-10 V) could be used at a time. The output is calibrated and set for 4-20 mA when shipped. The position of a jumper in the analyzer must be changed to select the 0-1 V recorder output.

The maximum load for the 4-20 mA port is 400 ohms and it has a 12 V loop supply with a compliance to 10 V. The interface to the data collection system should be either a differential input or an otherwise isolated input. The 4-20 mA circuit return is to the system circuit ground and it should not have a large common mode voltage applied to it. The maximum load for the alarm ports is 1A, 30 VDC or 0.5 A, 125VAC.

Table 1. Analog Outputs on Terminal Strip

Pin Number (from left)	Output
1	Alarm 0 (NC*)
2	Alarm 0 (Common)
3	Alarm 0 (NO**)
4	Alarm 1 (NC*)
5	Alarm 1 (Common)
6	Alarm 1 (NO**)
7	Not used
8	4–20 mA (+ Output)
9	4–20 mA (- Output)
10	Voltage Output (+10 or +1 V)***
11	Voltage Output (Ground)
12	Not Used

* NC - normally closed
** NO - normally open
*** Voltage range selected by jumper

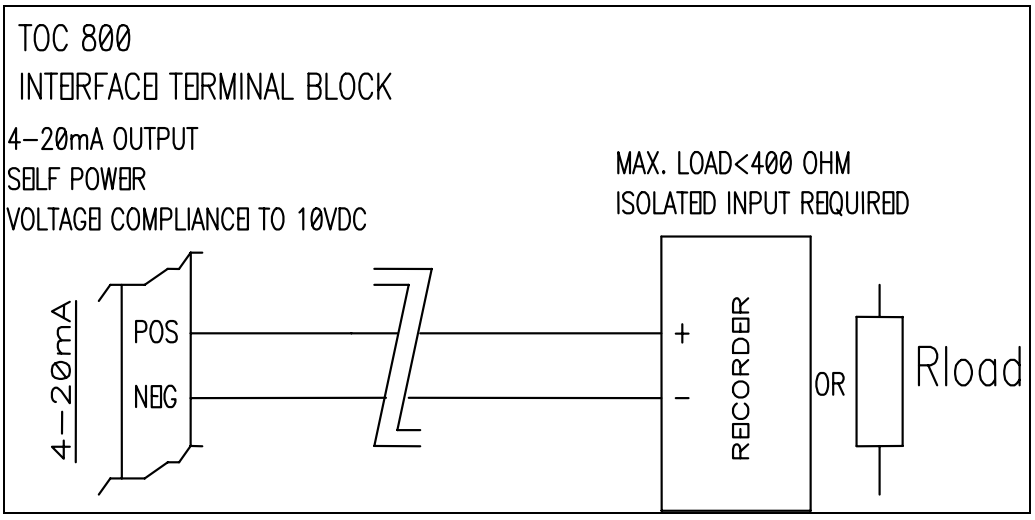


FIGURE 4-6: Typical 4-20 mA Output Wiring Diagram

Turn off the main power to the analyzer before connecting the alarm and recorder outputs. Connect the appropriate wires to the recorder or alarm, and then connect the wires to the terminal strip.

Printer Cable

The analyzer has a 25-pin parallel (Centronics) printer port for the direct output of results to a printer. Connect the proper cable for the printer, optional, to the printer port (see Figures 4-4 or 4-5) and secure with screws. The cable is a standard computer-printer cable and can be found at local computer stores. The printer must be IBM compatible or Epson FX 850 compatible. See Appendix B for CE Mark Specifications.

Installing Reagent Cartridges

The oxidizer and acid reagents have been shipped from Ionics Instruments in specific packaging. Carefully read the attached MSDS sheets prior to opening packaging. Within the packaging are two reagent cartridges. Each reagent cartridge is identified with bright yellow labels that indicate which cartridge contains Ammonium Persulfate and which cartridge contains Phosphoric Acid.

Warning
Installation of the reagents requires access to the inside of the analyzer. To avoid potentially dangerous shock, disconnect the power cord before opening the analyzer's top panel.

Warning
To avoid exposure to the chemical reagents, wear acid-resistant gloves, protective clothing, and safety goggles or a face shield when changing the reagent supplies.

WARNING
Reagent containers are for single-use only – do not refill. Refilling or reusing reagent containers will void all instrument and parts warranties and nullify any performance claims.

1. Turn off the main power switch and unplug the power cord.
2. Open the analyzer top panel by pushing back on the two black handles and lifting the panel upwards.

3. Locate the reagent supplies in a covered enclosure located at the front, right-hand side of the analyzer and open the top cover on the reagent enclosure by loosening the two screws located at the back of the reagent enclosure and removing the cover.

4. Locate the ACID supply line. It is labeled with the word ACID. At the end of this line there is brown knurled nut.

5. Inspect the ACID reagent cartridge. The Mininert valve must be in the closed position. Observe the labeling on the cartridge for proper positioning.

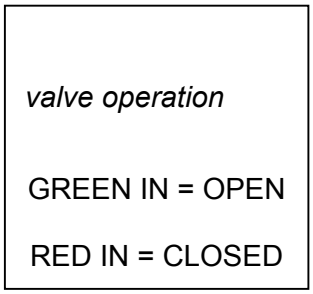


FIGURE 4-7: Label on Reagent Cartridges

WARNING
Acid may spill from the container if the valve is not in the closed position.

6. Align the ACID reagent cartridge with Mininert valve to the brown knurled nut. Once the cartridge is aligned with the brown knurled nut, turn the brown knurled nut clockwise while holding the reagent cartridge. Turning the nut rather than the cartridge will prevent the tubing from twisting. Tighten to finger tight. Do not overtighten the nut.

7. Open the Mininert valve on the ACID container by pressing on the green button to slide the Teflon bar fully inward. Reference the label on the container to verify direction.

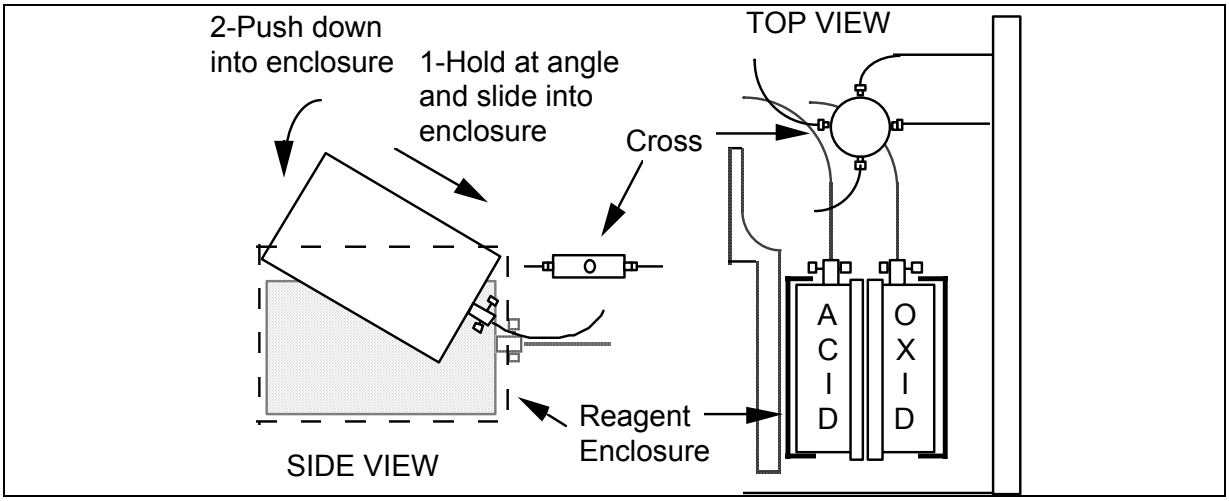


FIGURE 4-8: Installing Reagent Containers

8. Locate the OXIDIZER supply line. It is labeled with the word OXIDIZER. At the end of this line there is brown knurled nut.

9. Inspect the OXIDIZER reagent cartridge. The Mininert valve must be in the closed position. Observe the labeling on the cartridge for proper positioning.

WARNING
Oxidizer may spill from the container if the valve is not in the closed position.

10. Align the OXIDIZER reagent cartridge with Mininert valve to the brown knurled nut. Once the cartridge is aligned with the brown knurled nut, turn the brown knurled nut clockwise while holding reagent cartridge. Turning the nut rather than the cartridge will prevent the tubing from twisting. Tighten to fingertight. Do not overtighten the nut.

11. Open the Mininert valve on the OXIDIZER container by pressing on the green button to slide the Teflon bar fully inward. Reference the label on the container to verify direction.

12. Replace the reagent enclosure top cover and secure with the thumb screws.

13. The install date will be input to the analyzer's firmware. Record reagent install date for input once analyzer is operational.

NOTE

Instrument firmware with the DataGuard feature differ from the basic firmware in several ways. Access to most of the menus requires a password; some of the menus are different, and there are some additional menus. See the DataGuard Operation chapter for more information regarding the DataGuard feature.

Selecting the Sample Mode

The TOC analyzer can be operated in two sample modes: ON-LINE and GRAB. The on-line sampling mode is used for continuous monitoring from a pressurized sample stream using the on-line sample inlet system. The grab sampling mode is used for running standards or samples from bottles or containers. If the Multistream is installed, MULTISTREAM is a third mode; see the Multistream Manual for details. If the analyzer is being used with the autosampler system, the selected analyzer sample mode will be on-line. When using an autosampler, the DataPro Autosampler Software will place the analyzer in on-line mode and all instrument control and operation will be achieved through the software.

To turn the analyzer on, and select the sample mode, proceed as follows:

1. Connect the AC power cord to the left-hand side of analyzer (see Figures 4-4 and 4-5), and plug in the cord.

2. Turn the analyzer on using the main power switch. The analyzer should power up by displaying the Analyzer Identification Screen followed by the Main menu.

WARNING
The analyzer must be plugged into a grounded main outlet.

FIGURE 4-9: MAIN Menu

3. If the analyzer powers up in the TOC Measurement Mode, press ENTER to display the RunTime menu, use the arrows (↑ or ↓) to select STOP TOC and press ENTER to return to the MAIN menu. If the analyzer powers up with the message “Over 48 hours since last TOC. Do you wish to flush oxidizer?”, use the arrows (↑ or ↓) to select YES and press ENTER.

4. It is essential that the analyzer is connected to a water sample during the flush operations. The analyzer will automatically perform a reagent flush. During the reagent flush, the display will read “FLUSHING”. When the reagent flush is complete, the analyzer will return to the Main menu. Select SETUP and press ENTER.

5. With the SETUP option highlighted, press ENTER. The SETUP menu displays, the CLOCK function highlighted.

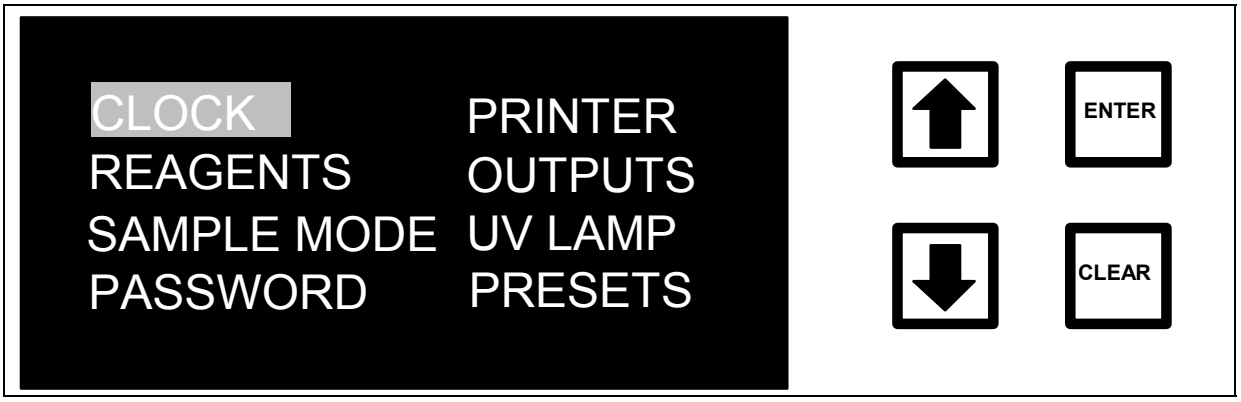


FIGURE 4-10: SETUP Menu

6. Use the arrows (↑ or ↓) to scroll to SAMPLE MODE.
7. Press ENTER to display the SAMPLE MODE screen:

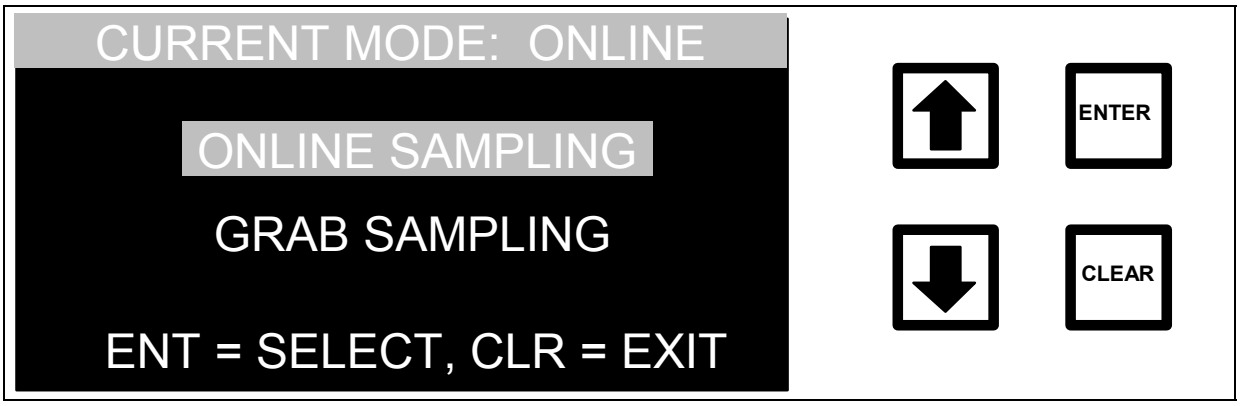


FIGURE 4-11: SAMPLE MODE Screen

8. The current setting of the sample mode is displayed along with the two options. If the sample mode is set to the correct option, press CLEAR to return to the Setup menu. To change the sample mode use the arrows (↑ or ↓) to select the desired mode and press ENTER. The display will change to indicate the new sampling mode. Press CLEAR to return to the SETUP menu.

Entering the Date and Time

1. From the Setup menu, use the arrows (↑ or ↓) to scroll to CLOCK and press ENTER to display the SET CLOCK screen:

FIGURE 4-12: SET CLOCK Screen

2. Use the arrows (↑ or ↓) to scroll to the correct month. Press ENTER.
3. Repeat this procedure to enter the day, year, and time. Press ENTER each time to save the entry. The date and time are now saved.
4. Press CLEAR to return to the MAIN menu.

> **NOTE**
> If CLEAR is pressed before setting all the times and dates, the clock will not be changed and the previous menu will be displayed.

Enter the Installation Dates for Reagents

After installing the reagents, the installation date must be entered. The UV lamp and pump tubing information has been entered at the factory.

To enter the installation dates from the MAIN menu:

1. Use the arrows (↑ or ↓) to scroll to MAINTENANCE.
2. Select the CONSUMABLES menu and press ENTER.

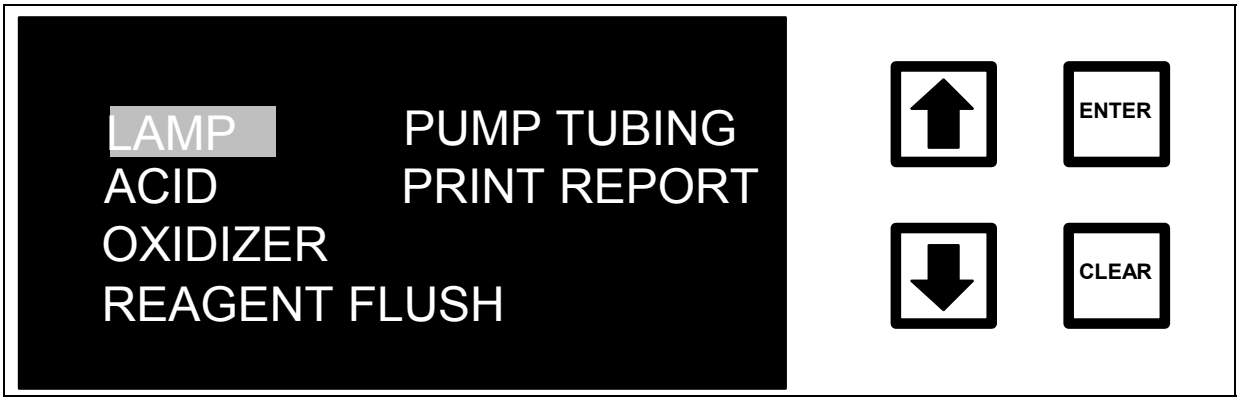


FIGURE 4-13: CONSUMABLES Menu

WARNING
The procedures described below reset timers and other key indicators used to keep track of the Acid, Oxidizer, UV Lamp, and Pump Tubing lifetimes. In these options, pressing ENTER zeroes the timers. Do not reset the timers unless the consumables are replaced. When viewing the status of the Acid, Oxidizer, UV Lamp, and Pump Tubing, press CLEAR to exit the menu without resetting the timers.

Oxidizer Reagent

To enter the installation date for the oxidizer reagent:

1. From the CONSUMABLES menu, use the arrows (↑ or ↓) to scroll to OXIDIZER. Press ENTER to display the OXIDIZER INSTALLATION menu.

FIGURE 4-14: OXIDIZER INSTALLATION Menu

2. With the INSTALL option highlighted, press ENTER to display the OXIDIZER Status and INSTALLATION screen:

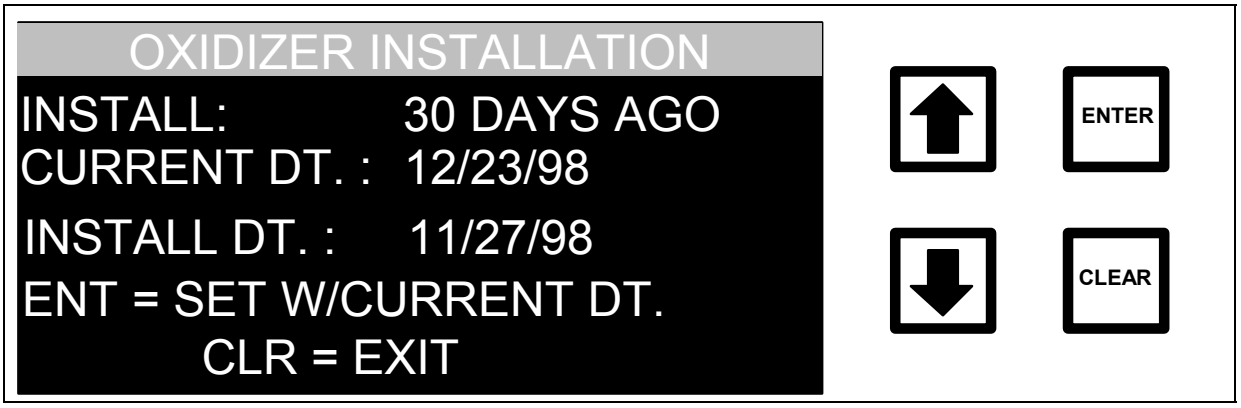


FIGURE 4-15: OXIDIZER Status and INSTALLATION Screen

The amount of oxidizer in the reservoir and the date when the oxidizer cartridge was installed (INSTALL DT.) is shown. The INSTALL date will be changed to the CURRENT date as described below.

3. To change the INSTALL date to today's date, press ENTER. The display will change back to the OXIDIZER Status and INSTALLATION screen with the new install date shown.

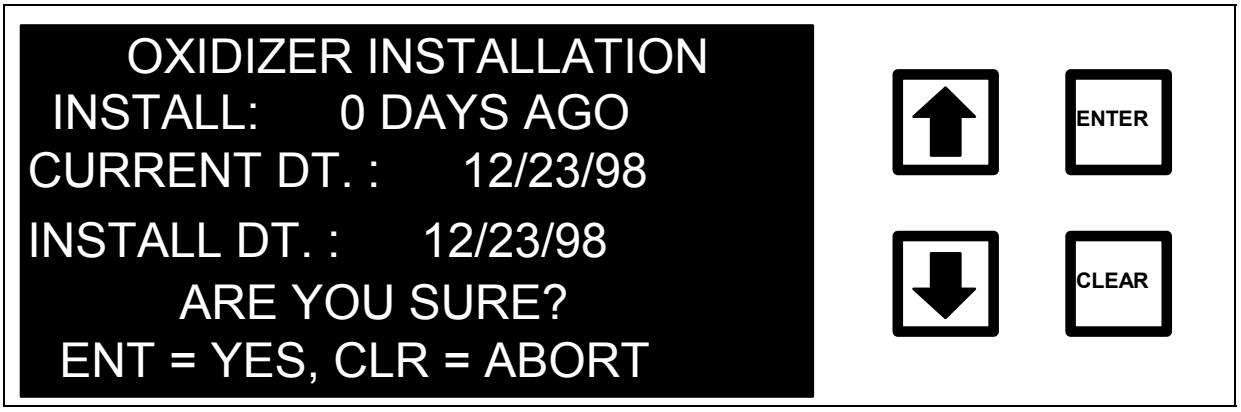


FIGURE 4-16: OXIDIZER Status and INSTALLATION Screen

The program asks for confirmation of the new install date. Press ENTER to store the new installation date and return to the OXIDIZER INSTALLATION screen. Press CLEAR to exit without changing the value.

4. Press CLEAR to return to the CONSUMABLES menu.

Acid Reagent

To enter the installation date for the Acid Reagent, select ACID from the CONSUMABLES menu.

1. From the Consumables menu, use the arrows (↑ or ↓) to scroll to ACID. Press ENTER to display the Acid Installation menu.
2. With the INSTALL option highlighted, press ENTER to display the Acid Status and Installation screen.
3. To change the INSTALL date to today's date, press ENTER twice.
4. Press CLEAR to return to the CONSUMABLES menu.
5. Press CLEAR again to return to the MAINTAINENCE menu.
6. Press CLEAR a final time to return to the MAIN menu.

Selecting Oxidizer and Acid Flow Rates

The analyzer can use the oxidizer to ensure complete oxidation of the organic compounds in the water samples. For most samples, the Preset Flow Rates or the flow rates listed in Table 2 can be selected to provide sufficient oxidizer for different TOC concentrations. However, investigate the optimum oxidizer flow rate for the particular water samples. A few guidelines are listed below that can be of assistance in selecting the best oxidizer flow rate.

For most water samples containing < 1 ppm TOC, only minimal oxidizer is required (flow rate =0.01 μL/min). Direct UV oxidation will convert the organic compounds to carbon dioxide. However, a small amount of acid (up to 0.75 μL/min.) must be added to any water sample, including low TOC deionized water. For basic samples, add sufficient acid to ensure that the pH of the waste stream is <2.

For water samples containing > 1 ppm TOC, the flow rate of persulfate oxidizer needs to be large enough to ensure complete oxidation, but problems may be encountered if the oxidizer flow rate is too high. When organic compounds are present in a water sample, the oxidizer will be consumed by the oxidation reactions. However, if a large excess of persulfate oxidizer is present, UV-promoted decomposition of persulfate will produce oxygen. The oxygen will collect as gas bubbles that can cause problems in the measurement. These problems may include “TOC spikes”, poor reproducibility, low, and possibly negative, TOC readings, and, in the worst case, enough gas bubbles may form to prevent sample from flowing through one or both measurement channels. One method for evaluating the effects of different oxidizer flow rates on the accuracy of the TOC measurements is to start with the Preset Oxidizer Flow representative of the water sample (Raw Water, Post GAC/RO, etc.) discussed later in this chapter, or the lowest flow rate listed in Table 2 and make 3-5 TOC measurements under these conditions. Increase the oxidizer flow rate by 0.5 to 1.0 μL/min. and make 3-5 TOC measurements under these conditions. If there is no change or a < 3% difference in the TOC measurements at the higher flow rates is being observed, then sufficient oxidizer was being added initially for complete oxidation of the organic compounds in the water sample.

If the TOC measurements at the higher oxidizer flow rate are more than 3% of the TOC values at the lower flow rate, then complete oxidation is not occurring. Increase the oxidizer flow rates. Increase the oxidizer flow rate by another 0.5 to 1.0 µL/min. and make 3-5 TOC measurements under these news conditions. Again, inspect the new TOC measurements and if the values show more than a 3% increase, continue increasing the oxidizer flow rate at 0.5 to 1.0 µL/min. increments until there is no increase or < 3% difference in the TOC values. While performing these tests, look for gas bubbles in the 1/16" Teflon analyzer outlet tube on the right hand side of the analyzer. If you see gases bubbles in this line, too much oxidizer has been added and therefore, decrease the oxidant flow rate. If increasing the oxidizer flow rate gives a lower TOC reading, then decrease the oxidizer flow rate. There is a small TOC background of ~1-2 ppb in the oxidizer reagent. The increase observed in the TOC measurements with and without oxidizer may be due to this background and not an increase in oxidation efficiency.

The upper range for the oxidizer flow rates listed in Table 2 are approximate values. If the water samples contain difficult to oxidize organic compounds or compounds with a high oxidant demand, it may be necessary to add more oxidizer than the upper flow rate listed for a particular TOC range. The important thing is not to add too much oxidizer if there is a presence of gas bubbles in the analyzer's outlet tube.

WARNING
Operation at oxidizer flow rates above 2 µL/min. with low TOC samples can result in excessive bubble formation and damage to the analyzer. Do not use oxidizer flow rate above 2 µL/min. for samples containing < 5 ppm TOC.

Solutions of persulfate are unstable and will decompose over time. As the persulfate oxidizer reagent ages, increase the flow rate of oxidizer in order to achieve complete oxidation.

The syringe-pump flow rates for the acid and oxidizer have been set at the factory to 0.75 µL/min. for the acid and 0.50 µL/min. for the oxidizer (Raw Water Preset flow rates). For most water samples, keep the acid flow rate set to 0.75 µL/min. Basic samples will require a higher acid flow rate to ensure

that the pH of the analyzer waste stream is <2. The flow rate for the oxidizer will depend on the levels of TOC in the samples and can be independently set for on-line sampling and grab sampling. The recommended reagent flow rates for different TOC concentrations are shown in Table 2.

Table 2. Recommended Reagent Flow Rates

Recommended Oxidizer Flow Rates	
TOC Concentration	Oxidizer Flow Rate
25-50 ppm	2.0 – 7.0 µL/min.
10-25 ppm	1.0 – 4.5 µL/min.
5 to 10 ppm	0.5 – 2.0 µL/min.
1-5 ppm	0.5 – 1.0 µL/min.
< 1 ppm	0.01 – 0.5 µL/min.

NOTE

If a specific application requires a broader TOC Concentration range, (from 0 to 5 ppm), it is acceptable to set the oxidizer flow rate from 0.01 – 1.0 µL/min.

Recommended Acid Flow Rates		
IC Concentration		With IC Removal Module
50 - 100 ppm	1.5 µL/min.	3.0 µL/min.
0-50 ppm	0.75 µL/min.	1.5 µL/min.
Deionized water	0.2 µL/min.	Not applicable
For all samples, verify pH of waste is ~2, adjust acid flow as necessary		

Preset Flow Rates

To simplify selection of acid and oxidizer flow rates for on-line monitoring water purification systems, preset values stored in the analyzer can be used. These flow rates are based upon the typical TOC concentration found in such samples. Preset flow rates are available for on-line mode only. Though the rates are applicable to grab mode, grab mode flow rates must be entered from the reagent menu as described in the Manual Grab/Flow Rates section that follows. Four preset flow rates are available; the corresponding acid and oxidizer flow rates are listed in Table 3.

Table 3. Preset Acid and Oxidizer Flow Rates

PRESET	Acid Flow Rate	Oxidizer Flow Rate
S1-Deionized Water	0.20 µL/min.	0 (Off)
S2-Post GAC/RO	0.40 µL/min.	0.20 µL/min.
S3-Raw Water	0.75 µL/min.	0.50 µL/min.
S4-25 ppm Standard	0.75 µL/min.	2.0 **or** 2.50 µL/min.

Preset S1 is used for TOC measurements in low TOC, deionized water.

Preset S2 is used for TOC measurements in low TOC water before deionization but after granular activated carbon (GAC) treatment and/or reverse osmosis (RO) treatment.

Preset S3 is for measurements in non-deionized water containing ≤5 ppm TOC (for example tap water).

Preset S4 is for measurements in non-deionized water containing ~25 ppm TOC and for calibration of the analyzer using a 25 ppm TOC standard.

To select one of the preset reagent flow rates from the SETUP menu:

1. Press the down arrow (🡻) to scroll to PRESETS and press ENTER. The PRESETS menu is displayed:

FIGURE 4-17: PRESETS Menu

2. Use the arrows (↑ or ↓) to scroll to the desired preset flow option and press ENTER. The preset flow screen is displayed, indicating the corresponding acid and oxidizer flow rates.

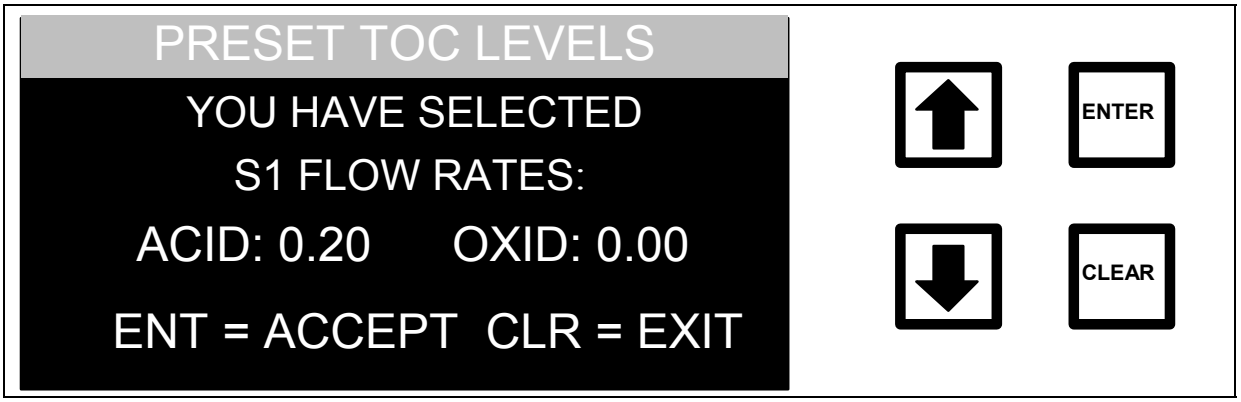


FIGURE 4-18: Presets Flows Screen

3. To change the flow rates to the displayed values, press ENTER, or press CLEAR to return to the PRESETS menu.
4. Press ENTER a second time when the instruments prompts for confirmation.
5. Press CLEAR to return to the SETUP menu.

If one of the preset flow rate options is selected, the name of the selected option will be displayed in the lower right-hand side of the TOC Measurement Display.

Manual/Grab Flow Rates

The preset flow rates are only for the on-line sampling mode. If one of the preset flow rates for on-line sampling is not selected, or if using the grab sampling mode, the acid and oxidizer flow rates must be set according to Table 2 as described below. If the preset flow rates for on-line sampling have been selected, proceed to the printer setup section.

To change the flow rates for on-line or grab sampling from the SETUP menu:

1. Press the down arrow (🡻) to scroll to REAGENTS. Press ENTER. The REAGENTS menu is displayed:

FIGURE 4-19: REAGENTS Menu

2. Use the arrows (🡹 or 🡻) to select on-line flow rates or grab flow rates, as applicable and press ENTER. The flow rates menu for that sampling mode will be displayed.

FIGURE 4-20: FLOW RATE Menu

3. Press ENTER to display the ACID FLOW RATE screen.

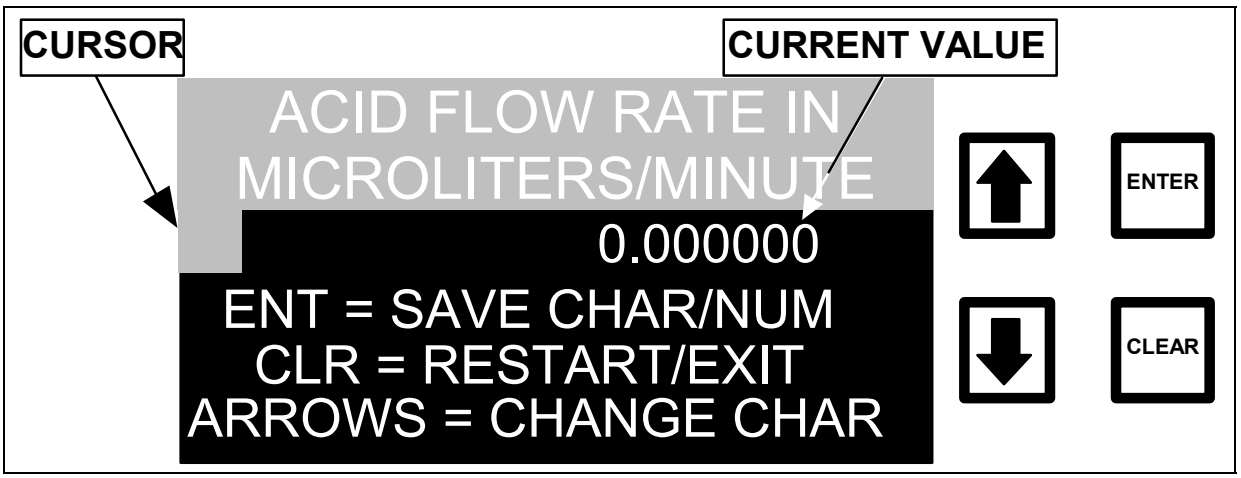


FIGURE 4-21: ACID FLOW RATE Screen

4. The current flow rate setting is shown toward the upper right-hand corner and the new flow rate will be entered at the cursor position. If a mistake has been made when entering the new values, press CLEAR to delete the entry. To exit the ACID FLOW RATE screen without changing the setting, press CLEAR twice.

5. Use the arrows (↑ or ↓) to scroll to the first digit of the new flow rate and press ENTER.

6. Use the arrows (↑ or ↓) to select the next digit and press ENTER.
7. Input the remaining digits.
8. To save the new acid flow rate, press ENTER.
9. The menu changes and the program prompts for confirmation. Press ENTER to save the new value. The new flow rate is then displayed. Confirm that the value is correct.

FIGURE 4-22: ACID FLOW RATE Confirmation Screen

10. Press CLEAR to return to the Flow Rate menu.

To change the oxidizer flow rate from the FLOW RATE menu:

1. Scroll to OXID FLOW RATE and press ENTER to display the OXIDIZER FLOW RATE menu.
2. Use the arrows (↑ or ↓) to scroll to the first digit of the new flow rate and press ENTER.
3. Enter the remaining digits.
4. To save the new oxidizer flow rate, press ENTER.
5. When the menu changes, press ENTER to save the new value. The new flow rate is then displayed. Confirm that the value is correct.

6. Press CLEAR three times to return to the SETUP menu.

The optimum oxidizer flow rate will depend on the TOC levels of the water samples and the types of organic compounds that are present. A more detailed discussion of setting oxidizer flow rates is in the Operations Chapter.

To set the flow rates for the other sampling mode (Grab or On-line), use the arrows (↑ or ↓) to select the appropriate option from the REAGENTS menu and press ENTER to display the FLOW RATES menu. Follow the procedures described above to set the acid and oxidizer flow rates for this sampling mode.

Setting Up a Password

The PASSWORD option in the SETUP menu allows password protection for the analyzer. Once a password is selected, it will need to be entered to recalibrate the analyzer, install consumables, or change the password. This password is independent of any passwords established via DataGuard. The analyzer is shipped with the password protection disabled. To select a password from the SETUP menu:

1. Use the arrows (↑ or ↓) to scroll to PASSWORD and press ENTER. The ENTER NEW password screen is displayed:

FIGURE 4-23: ENTER NEW PASSWORD Screen

2. The arrows (↑ or ↓) increment or decrement the character displayed. Exit from this menu, without storing the password, by pressing CLEAR.

3. Use the arrows (↑ or ↓) to select the first character in the password and press ENTER to save the first character. Delete the first character by pressing CLEAR before selecting and entering the next character.

4. Continue selecting the characters for the password, pressing ENTER after scrolling to the desired character.

5. After all of the characters have been entered, press ENTER again to store the password. The display indicates that the password has been set and will return to the SETUP menu.

WARNING
The password must be entered to recalibrate the analyzer, install consumables, or change the password. Choose a password that will be remembered and record the password and store it in a secure location for future reference.

Instructions for changing the password or disabling password protection are in the Operations chapter.

Entering Printer Setup

If a printer is connected to the printer port, the port must be configured to match the printer. If not using a printer, proceed to the next section.

Printer Columns

1. From the Setup menu, use the down arrow (↓) to scroll to PRINTER. Press ENTER.

For the configuration of the system, the PRINTER menu allows the selection of the number of columns for the printer (40 or 80) and the selection of how often the results are printed.

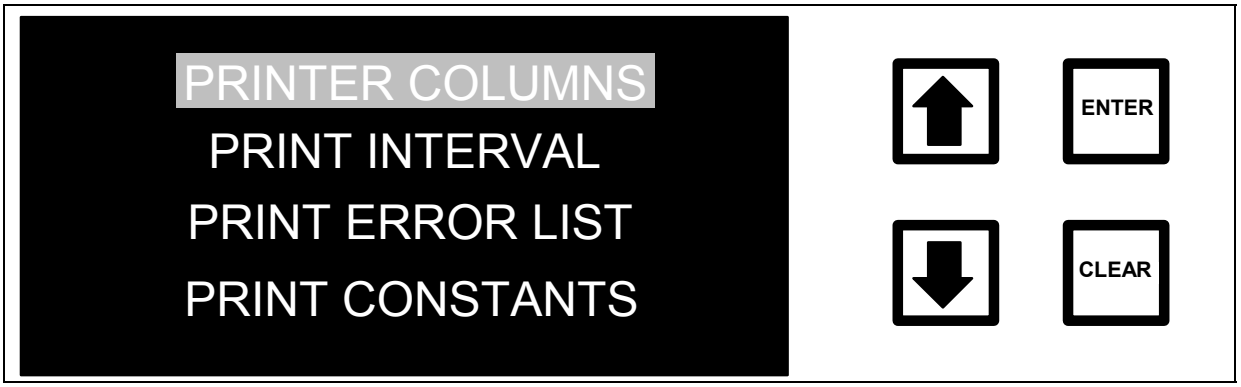


FIGURE 4-24: PRINTER Menu

2. To select the number of columns for the printer, scroll to PRINTER COLUMNS and press ENTER. The PRINTER COLUMN SETTING screen is displayed:

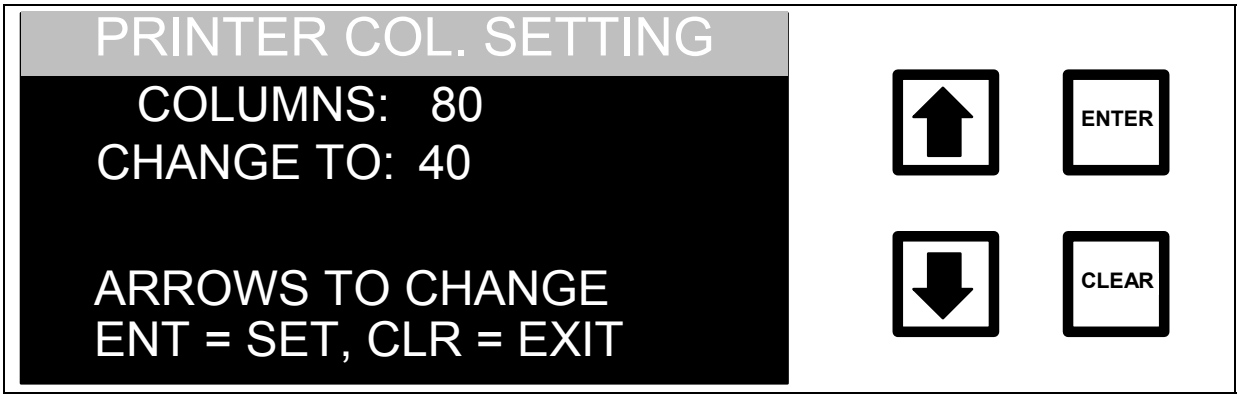


FIGURE 4-25: PRINTER COLUMN SETTING Screen

3. Use the arrows (↑ or ↓) to select the proper column setting (40 OR 80). Press ENTER.
4. Press CLEAR to return to the Printer menu.

Print Interval

The analyzer takes TOC measurements every 6 minutes. There is an option of printing the Time, TOC, TC, and IC results for every measurement or printing only the average value and standard deviation for TOC and IC for a selected interval. The options are:

- Print every sample;
- Print average value and standard deviation every hour;
- Print average value and standard deviation every two hours;
- Print average value and standard deviation every four hours;
- Print average value and standard deviation every eight hours.

To select the print interval from the PRINTER menu:

1. Scroll to PRINT INTERVAL and press ENTER. The PRINT INTERVAL screen is displayed.

FIGURE 4-26: PRINT INTERVAL Screen

2. Use the arrows (↑ or ↓) to select the desired interval. Press ENTER.
3. Press CLEAR twice to return to the SETUP menu.

Print Constants

Calibration constants, reagent flow rates, and other key parameters are stored in the battery-backed memory of the analyzer. Print a list of these parameters using the PRINT CONSTANTS option under the PRINTER SETUP menu. If the EEPROM (the analyzer firmware) needs upgrading, or in the unlikely event that these values are lost from memory, they may be reentered from the printout and then normal operations will resume. To list the constants, a printer must be connected to the analyzer and the printer must be turned ON.

To print the constants from the PRINTER menu, use the arrows (↑ or ↓) to scroll to PRINT CONSTANTS and press ENTER. A list of analyzer parameters will be printed and should be the same as the list included in the Quality Control Report shipped with the analyzer. **Store this list in a secure location and reprint the list when recalibrating the analyzer.**

Reagent Flush

Before using the analyzer, perform a reagent flush to remove any gas bubbles that may have formed in the reagent lines. **For the reagent flush, the analyzer must be connected to a low TOC, DI water supply (on-line sample mode) or a bottle of low TOC, DI water (grab sample mode).** The reagent flush will take about 20 minutes. To perform a reagent flush:

WARNING
Prior to operation, verify that the valves on the reagent containers are in the "open" position. The syringe pump may be damaged if the analyzer is operated with the valves in the "Closed" position.

WARNING
To avoid potentially dangerous shock, disconnect the power cord before opening the analyzer's top panel.

1. Turn the power to the analyzer off, open the top cover, and make sure the Mininert valves on the reagent containers are open (green button pushed in all the way).
2. Close the top cover, and turn the analyzer on.
3. From the MAIN menu, scroll to SETUP and press ENTER.
4. Scroll to REAGENTS and press ENTER.
5. Use the arrows (↑ or ↓) to scroll to REAGENT FLUSH and press ENTER. The REAGENT FLUSH menu is displayed:

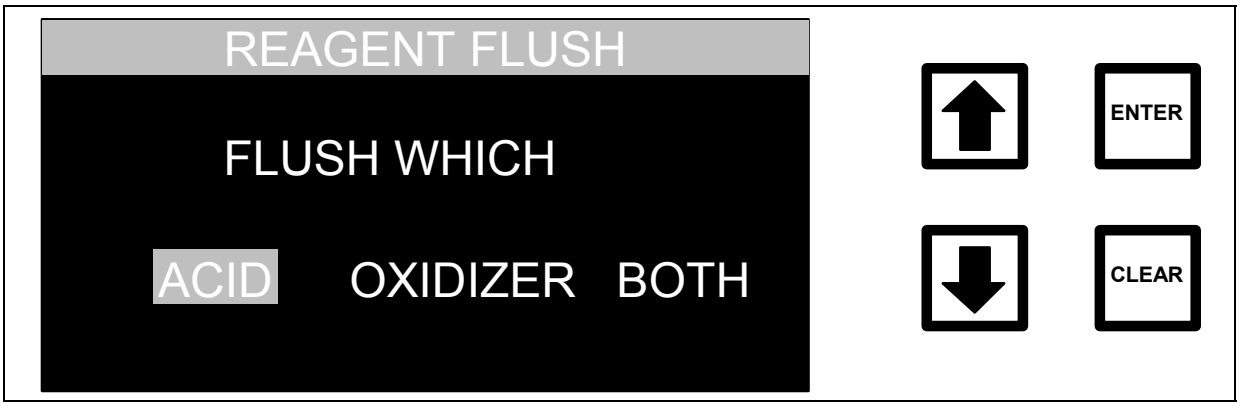


FIGURE 4-27: REAGENT FLUSH Menu

6. For on-line sampling, make sure that the analyzer is connected to a low TOC, DI water supply. For grab sampling, make sure the 1/16" Teflon inlet line is placed below the water level in a sample bottle containing low TOC, DI water.
7. Use the arrows (↑ or ↓) to scroll to BOTH and press ENTER. A warning message is displayed:

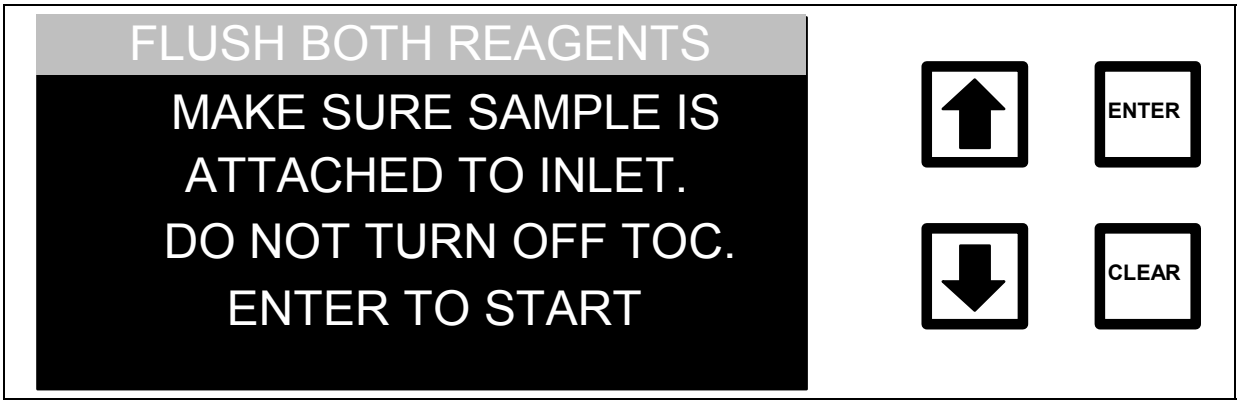


FIGURE 4-28: Reagent Flush Warning Message

WARNING
Do not turn off the power to the analyzer during the reagent flush.

8. Press ENTER to start the reagent flush.

During the reagent flush, the analyzer will:

- Empty and refill the syringes three times.
- Turn on the sample pump at twice normal speed.
- Run a “Fast Flush” for 8 minutes with reagents added at double the set flow rates.

After completion of the reagent flush, the analyzer will return to the REAGENTS menu.

If the analyzer has not been used for over 48 hours, the decomposition of persulfate can produce oxygen bubbles in the syringe pump and the reagent addition lines. To prevent bubbles from entering the sample stream and interfering in the TOC measurement, a reagent flush is used to remove the bubbles and fill the syringe with fresh reagent.

When the analyzer is turned on after more than 48 hours of inactivity, the following menu is displayed:

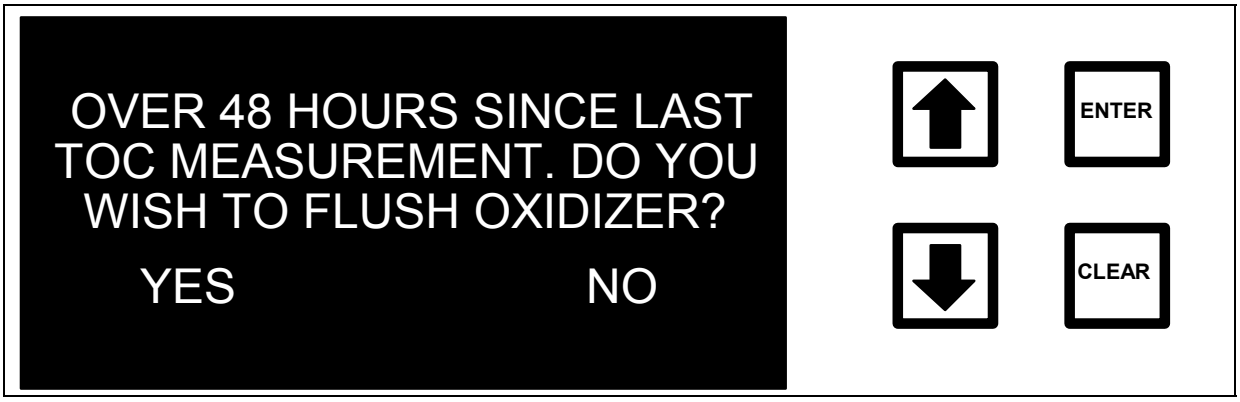


FIGURE 4-29: REAGENT FLUSH Menu

> ***CAUTION***
> Failure to connect sample water to the instrument either through Grab sample or On-Line will result in damage to the analyzer.

To have the analyzer flush the oxidizer (duration ~20 minutes), use the arrows (↑ or ↓) to scroll to YES and press ENTER. The analyzer will empty and then fill the oxidizer syringe three times to remove any bubbles in the syringe and lines. When finished, the system will return to the Main menu.

To skip the oxidizer flush (not recommended), use the arrows (↑ or ↓) to scroll to NO and press ENTER.

Perform a reagent flush at any time by selecting the REAGENT FLUSH option under the REAGENTS menu.

This completes the installation. For best results, allow the analyzer to run overnight using low TOC, DI water with the acid and oxidizer flow rates set to the S3-Raw Water Presets to make sure that all bubbles have been removed from the analyzer. If sampling from a sample bottle, make sure that at least 250 mL of water so that it does not run dry overnight.

From the SETUP menu, press the down arrow (🡻) to scroll to OUTPUTS. Press ENTER. The OUTPUTS menu is displayed:

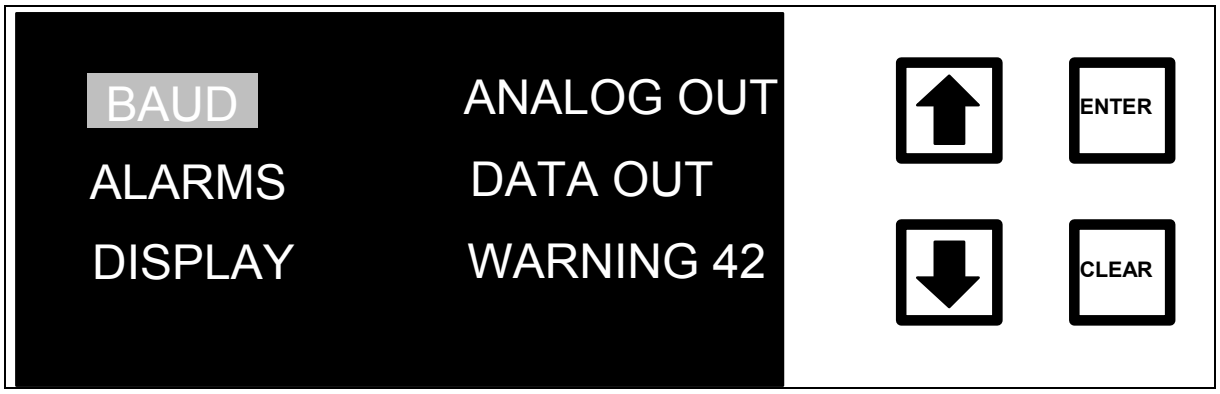


FIGURE 5-1: OUTPUTS Menu

To download data from the analyzer directly to a computer, you must set the BAUD rate for the RS-232 port and turn on the DATA OUT option.

Baud Rate

To set the baud rate:

1. From the OUTPUTS menu, use the arrows (🡹 or 🡻) to scroll to BAUD and press ENTER. The BAUD RATE SETTING screen is displayed:

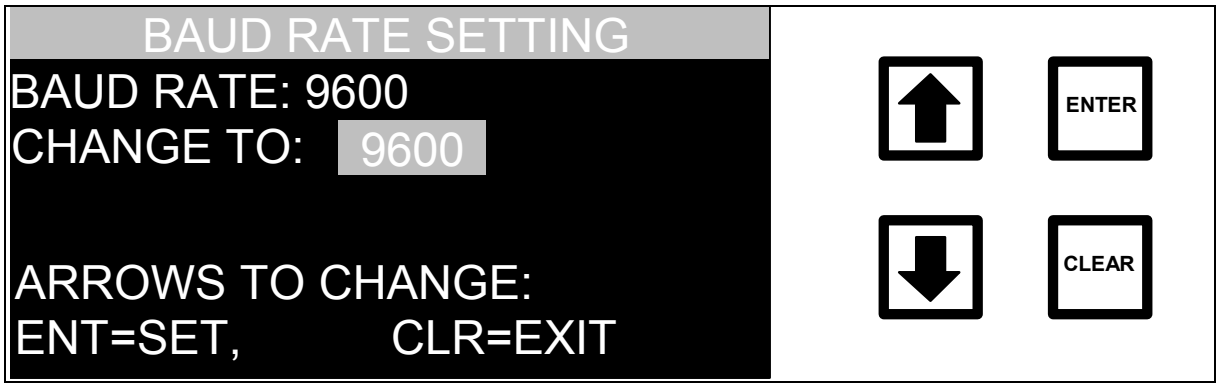


FIGURE 5-2: BAUD RATE SETTING Screen

2. Use the arrows (↑ or ↓) to select between 300, 1200, 2400, 4800, and 9600 baud. Select the value that matches the computer's serial-port baud rate (consult computer's manual). Set the serial port to: No Parity, 8 data bits, 1 stop bit.

3. Press CLEAR to return to the OUTPUTS menu.

RS-232 Data Out

To turn on the RS-232 port, scroll to DATA OUT and press ENTER. The SET DATA OUT STATE screen is displayed:

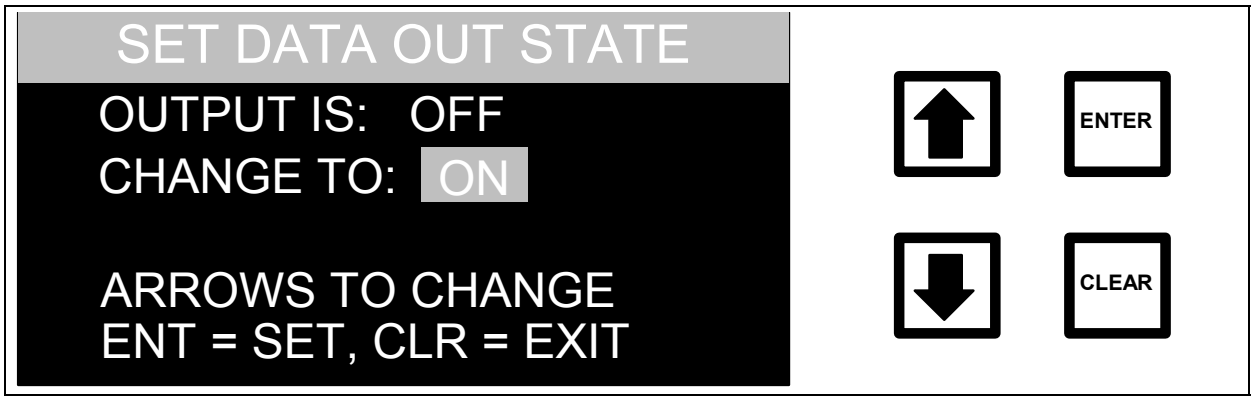


FIGURE 5-3: SET DATA OUT STATE Screen

To send data via the RS-232 port, set the data out state to ON.

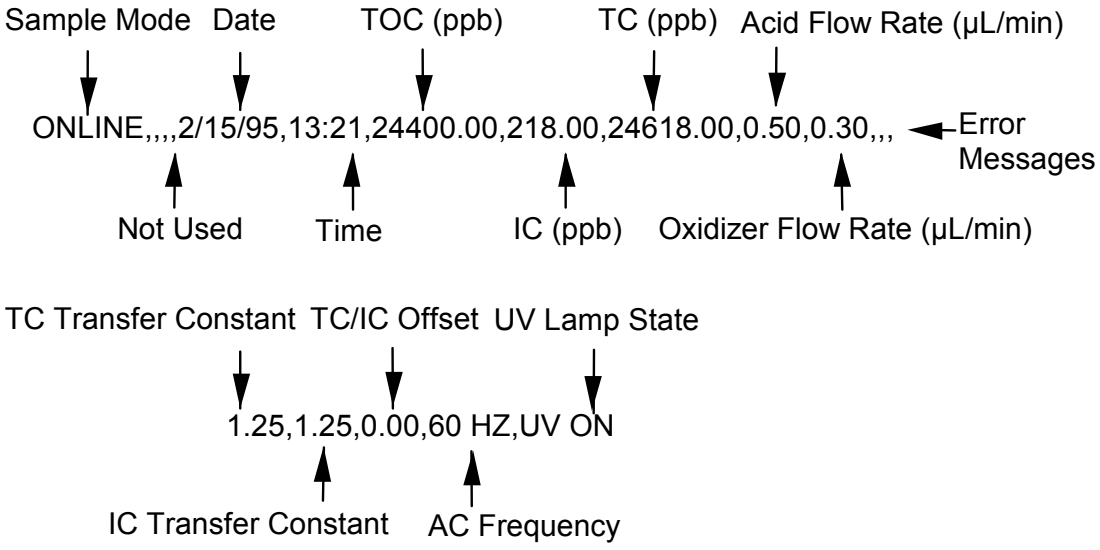
The data is output in an ASCII text string that is comma delimited and is sent after each TOC measurement. There are 13 fields in the following format:

Table 4. RS-232 Data Output Format

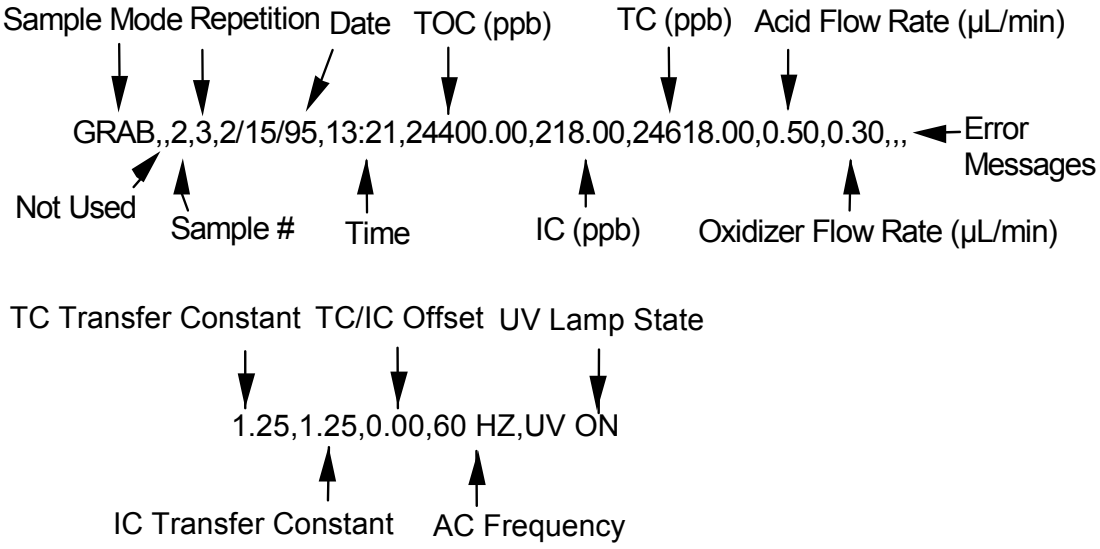
Field #	On-Line Sampling	Grab Sampling
#1: Sample Mode	ONLINE	GRAB
#2: Stream Number	–	–
#3: Sample Number	–	+
#4: Repetition Number	–	+
#5: Date (mm/dd/yy)	+	+
#6: Time (hh:mm 24 hour format)	+	+
#7: TOC in ppb	+	+
#8: IC in ppb	+	+
#9: TC in ppb	+	+
#10: Acid flow rate (µL/min)	+	+
#11: Oxidizer flow rate (µL/min)	+	+
#12: Error message #1 (if any)	–	–
#13: Error message #2 (if any)	–	–
#14: TC Transfer Constant	+	+
#15: IC Transfer Constant	+	+
#16: TC/IC Offset	+	+
#17: AC Frequency	+	+
#18: UV Lamp state	+	+

– Field not used unless there is an occurrence or set to the proper mode
\+ Field used in all occurrences

For example, the data stream for an on-line measurement will have the form:



The data stream for a grab sampling measurement will have the form:



To capture the data via the RS-232 port, you will need a dedicated PC and a serial port communications program (e.g., ProComm Plus, Delrina Technology, CrossTalk Communications, or Hyperterminal).

For long distance connections (up to 1000 feet, 305 meters), an RS-485 cable is recommended. Because of a specific electronic format of the analyzer, a jumper box and a converter are required for the installation of an RS-485. Install the components according to Figure 5-4.

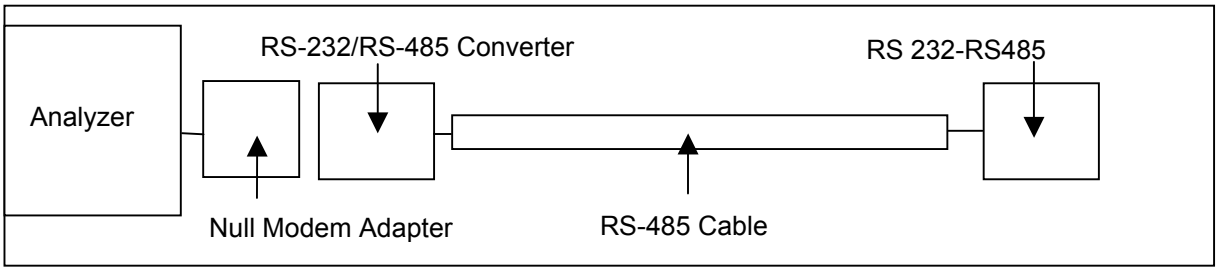


FIGURE 5-4: Setup For RS-485 Installation

Equipment such as RS-232 to RS-485 converters manufactured by B&B Electronics can be used for installation. Once installed in this configuration, RS-485 will convert data the same as described for RS-232.

Serial Commands

NOTE

Sending commands to the instrument via the RS-232 port requires a password. Refer to the DataGuard chapter for more information regarding the DataGuard feature.

If a PC is connected to the analyzer, start and stop TOC measurements and download the RAM card data using a communication program and a two-letter code.

Set the serial port to: No Parity, 8 data bits, 1 stop bit.

Action Desired	Command
To start the analyzer in the on-line mode	type **TB** and press ENTER
To stop TOC measurement:	type **TE** and press ENTER
To download data from the RAM card*	type **GD** and press ENTER

- Refer to *Downloading the RAM Card Data* for more information.

To start the TOC Analyzer in the ONLINE mode from the PC, type TB (or tb) and press ENTER. The analyzer will respond with a TB echo if the command was successfully executed. The TB command (TOC Begin will start the TOC measurement cycle using the settings for reagent flow rates output, etc. as they were when the analyzer was last stopped.

NOTE

The TB command can only be used in the on-line mode. The analyzer will respond with ER (error) if the system is in the Grab, Multistream, or Autosampler mode.

To stop the TOC Analyzer by typing TE and pressing ENTER. It will respond with a TE echo if the command was successfully executed. The TE command (TOC End) will stop the analyzer and change the display to the MAIN menu.

NOTE

The analyzer will respond with ER (error) if the system is in the Grab, Multistream, or Autosampler mode.

If an incorrect code has been entered, (e.g., TS instead of TB to start the TOC analysis) the analyzer will return BY (busy).

Alarms

The analyzer has two alarm outputs that can be set to trigger an alarm if the measured TOC, TC, or IC exceeds a set value or if a serious analyzer error occurs. The analyzer is shipped with both alarms OFF. If the alarms are connected to the analyzer, the alarm level must be set.

To set the alarms:

1. From the SETUP menu, scroll to OUTPUTS and press ENTER. From the Outputs menu, use the arrows (↑ or ↓) to scroll to ALARMS. Press ENTER. The Alarms menu is displayed:

FIGURE 5-5: ALARMS Menu

2. Use the arrows (↑ or ↓) to select Alarm #1 or #2.

3. Press ENTER to display the Alarm #1 set-point screen. There are seven alarm settings: TOC in ppb, TC in ppb, IC in ppb, Break In Attempt, Warnings or Errors, Errors Only, and Alarm Off.

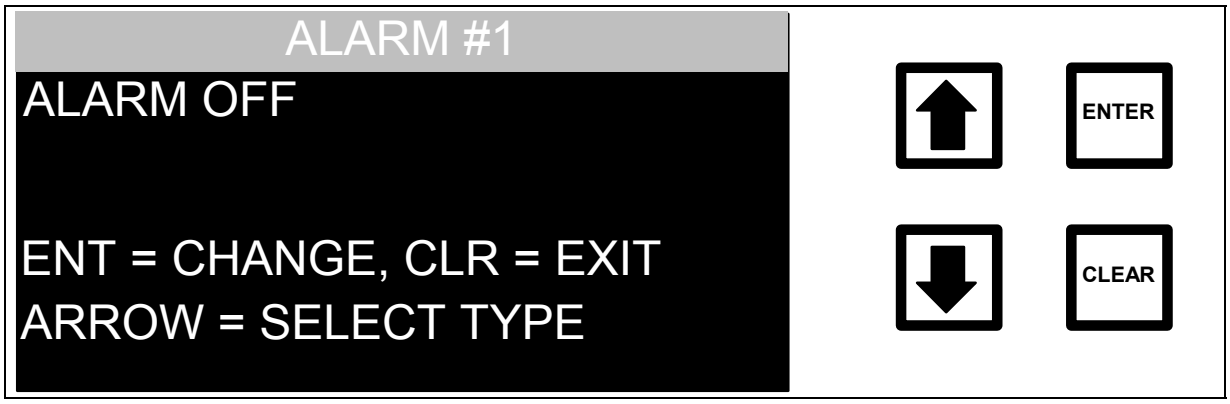


FIGURE 5-6: ALARM #1 Set-point Screen

4. Use the arrows (↑ or ↓) to select the alarm setting and press ENTER.

For example, to set the alarm to 1 ppm (1000 ppb) TOC, select TOC in ppb and press ENTER. The new menu is shown with the cursor on the left side of the display:

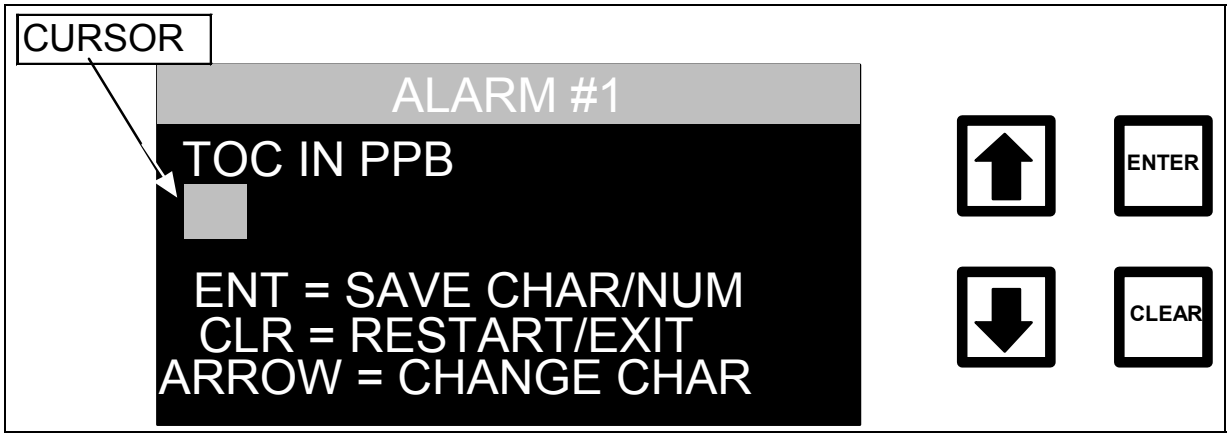


FIGURE 5-7: ALARM #1 Set-point Screen – *Example*

Use the arrows (↑ or ↓) to scroll to 1 and press ENTER. Use the arrows (↑ or ↓) to scroll to E (exponential) and press ENTER. Use the arrows (↑ or ↓) to scroll to 3 and press ENTER (Note: 1000 could have been entered instead of 1E3). Press ENTER. The menu changes and the program prompts for confirmation. Press ENTER to save the alarm level.

5. Press clear to return to the OUTPUTS menu.
6. If a second alarm is being used, follow the same procedure to set the level for ALARM #2. When finished, press CLEAR to return to the OUTPUTS menu.

Analog Outputs

Select the range for the two analog outputs (4–20 mA and 0–10 V) from the ANALOG OUT option of the OUTPUTS menu as follows:

1. Use the arrows (↑ or ↓) to scroll to ANALOG OUT and press ENTER. The Analog Output menu is displayed:

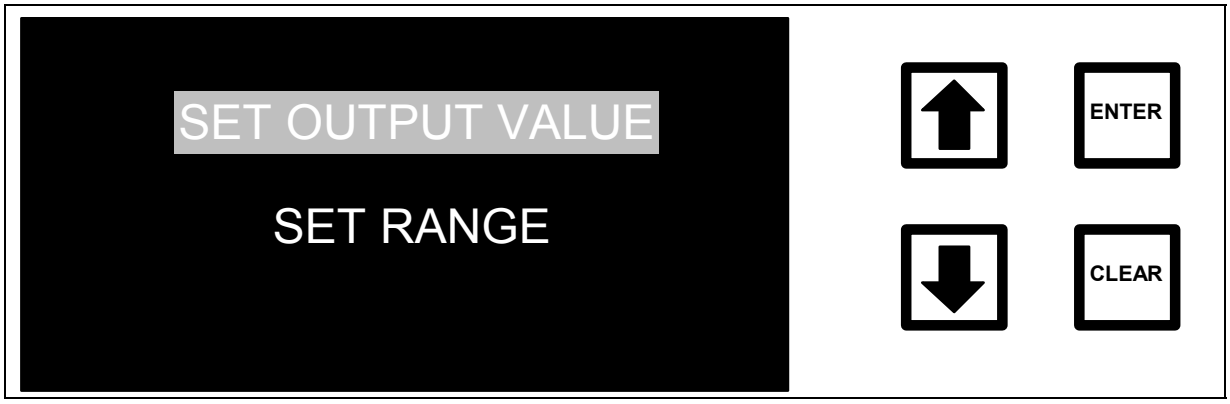


FIGURE 5-8: ANALOG OUTPUT Menu

2. With the SET OUTPUT VALUE option highlighted, press ENTER. The SET OUTPUT VALUE screen is displayed:

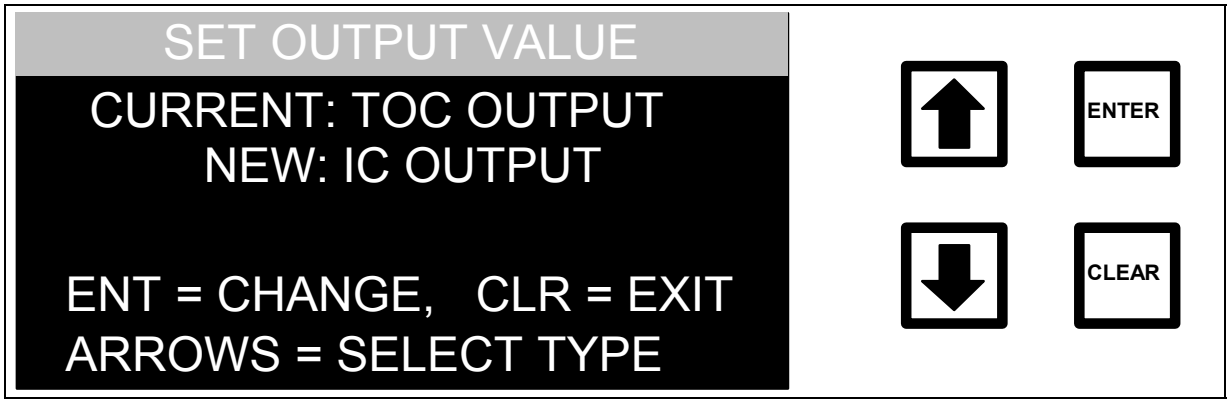


FIGURE 5-9: SET OUTPUT VALUE Screen

3. Use the arrows (↑ or ↓) to select the value to be sent to the analog output (TOC, TC or IC). Press ENTER. The current output will change to indicate the new analog output. The program will prompt for confirmation. Press ENTER to save, or press CLEAR to return to the ANALOG OUTPUT menu.
4. Use the arrows (↑ or ↓) to scroll to the SET RANGE option. Press ENTER. The ANALOG OUTPOUT RANGE (minimum value) screen is displayed:

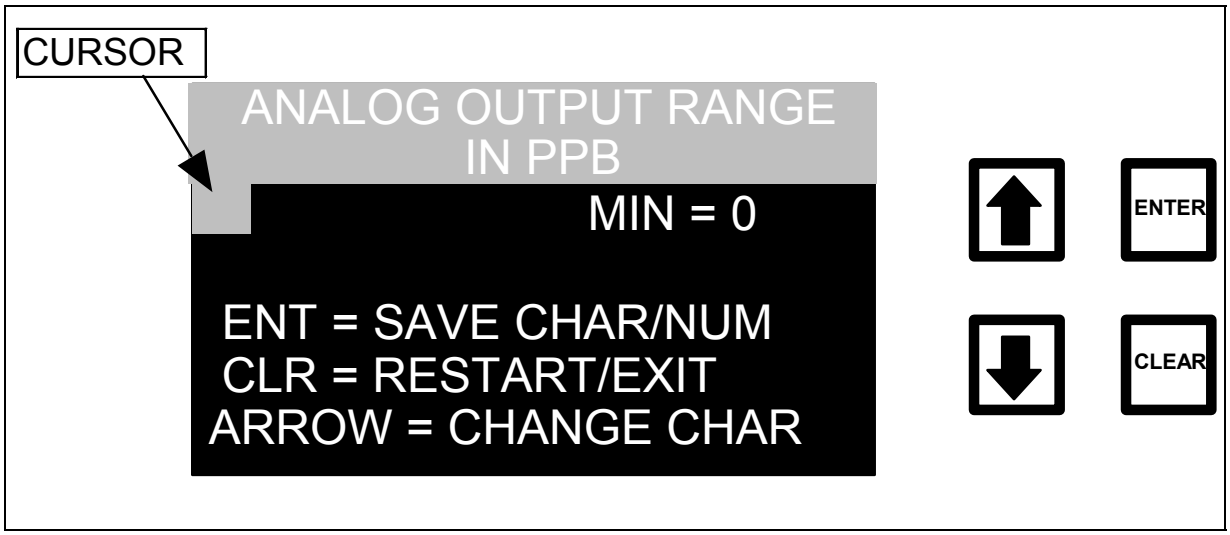


FIGURE 5-10: ANALOG OUTPUT RANGE Screen (Minimum Value)

5. Use the arrows (↑ or ↓) to select the minimum value (in ppb) for the recorder or device. Press ENTER to save each digit.

6. Press ENTER to store the minimum value. The display changes to allow selection of the maximum range; or press CLEAR twice to return to the ANALOG OUTPUT menu without saving.

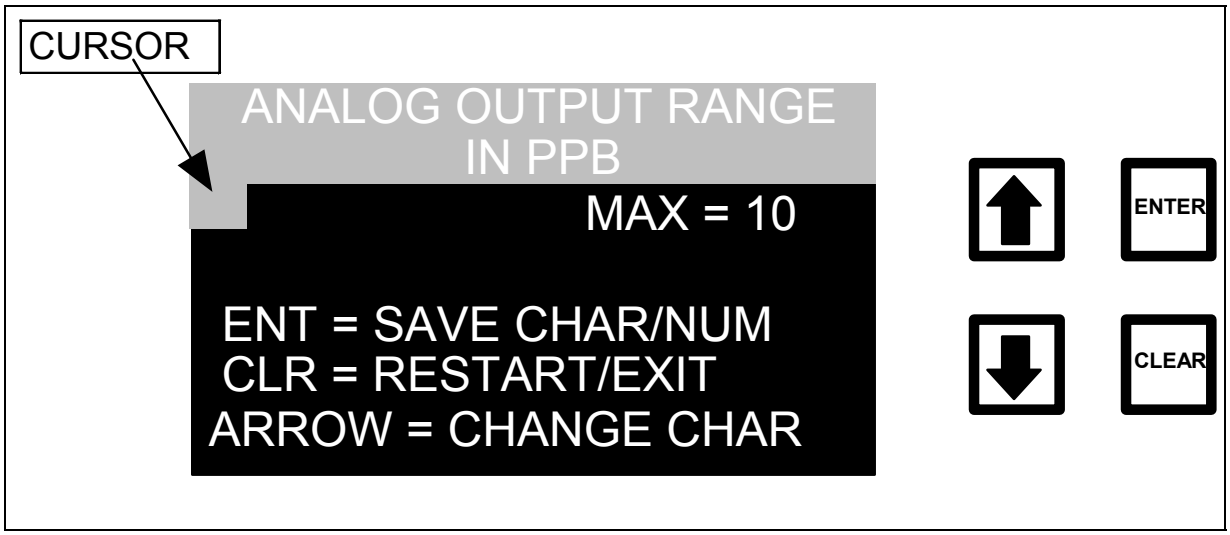


FIGURE 5-11: ANALOG OUTPUT RANGE Display (Maximum Value)

7. Use the arrows (↑ or ↓) to scroll to the maximum value (in ppb) for the recorder or device. Press ENTER to save each digit.

8. Press ENTER to store the maximum value and return to the ANALOG OUTPUT menu; or

9. Press CLEAR twice to return to the OUTPUTS menu without saving the new value.

Display

After each measurement, the analyzer will display a result in the Measurement screen. Using the DISPLAY option from the OUTPUT menu,

select to display TOC, IC, or TC (the factory default is TOC). All three measurements are stored on the RAM card and available in HISTORY.

The DISPLAY option affects the Measurement screen only. To change the display output:

1. Use the arrows (↑ or ↓) to scroll to DISPLAY. Press ENTER. The Set Display Mode screen is displayed:

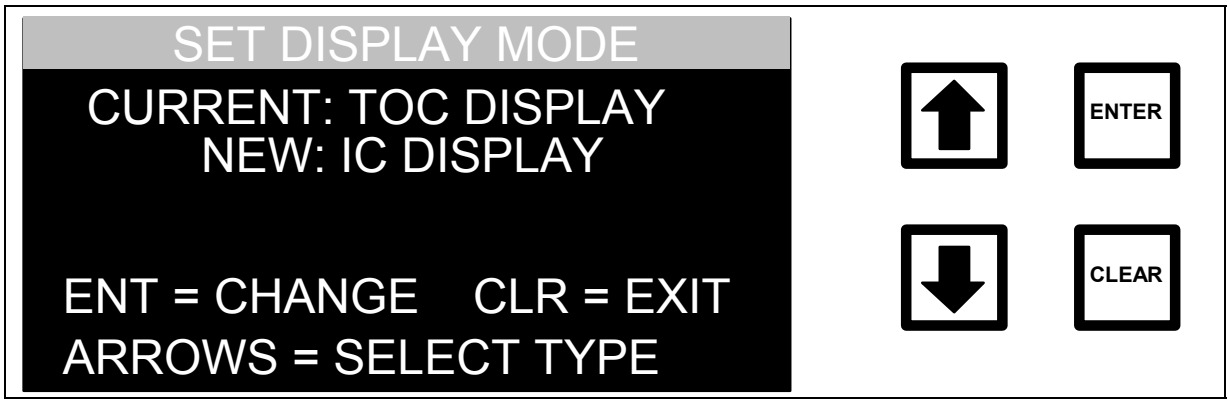


FIGURE 5-12: SET DISPLAY MODE Screen

2. Use the arrows (↑ or ↓) to select the measurement to be displayed (TOC, IC or TC). Press ENTER. The Current display will change to indicate the new display option and the program will prompt for confirmation. Press ENTER to return to the OUTPUTS menu.
3. Press CLEAR twice to return to the SETUP menu.

Warning 42

The accuracy of the TOC measurement is reduced when the TOC/IC ratio is ≤ 0.1; for improved accuracy, use the IC Removal Module to reduce the concentration of IC in the sample. After each measurement, the analyzer will calculate the TOC/IC ratio and if this value is less than or equal to 0.1, a

warning message, W42, will be displayed in the Measurement Display and written to the RAM card. Normally, this option is on to alert when there are low TOC/IC samples. However, for calibration or samples in which only IC is measured, this option may be turned off and no warning message will be indicated (errors will still be written to the RAM card). If applicable, turn off the low TOC/IC warning message:

1. From the OUTPUTS menu, use the arrows (↑ or ↓) to scroll to WARNING 42. Press ENTER. The WARNING 42 DISPLAY screen is displayed:

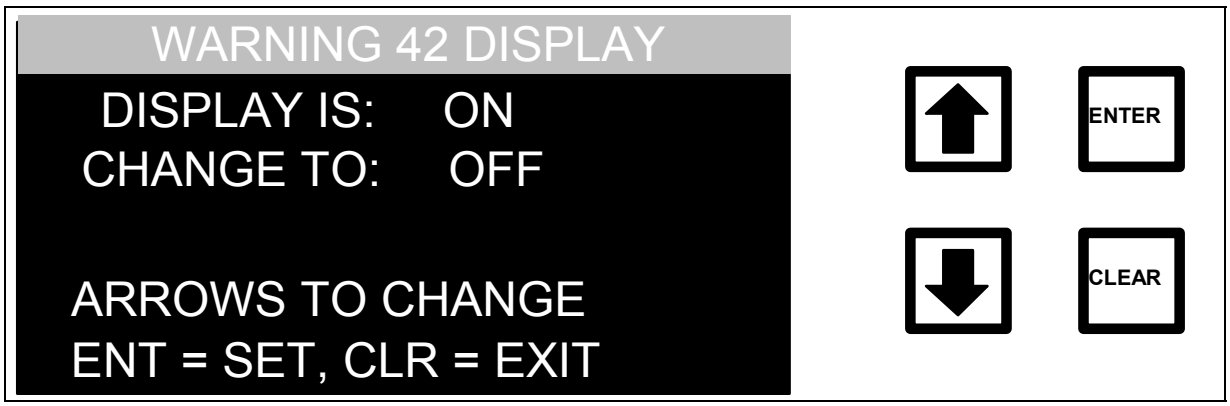


FIGURE 5-13: WARNING 42 DISPLAY Screen

2. Use the arrows (↑ or ↓) to select OFF and press ENTER.
3. Press CLEAR twice to return to the SETUP menu.

6 OPERATION AND DISPLAY MENUS

An overview of the menu structure is shown in Figure 6-1. To move down the menu tree, select the desired menu option with the arrows (↑ or ↓) and press ENTER. To move up the menu tree, press CLEAR.

For firmware versions with the DataGuard feature, refer to the DataGuard Operation chapter for additional information specific to that feature.

Menu Map

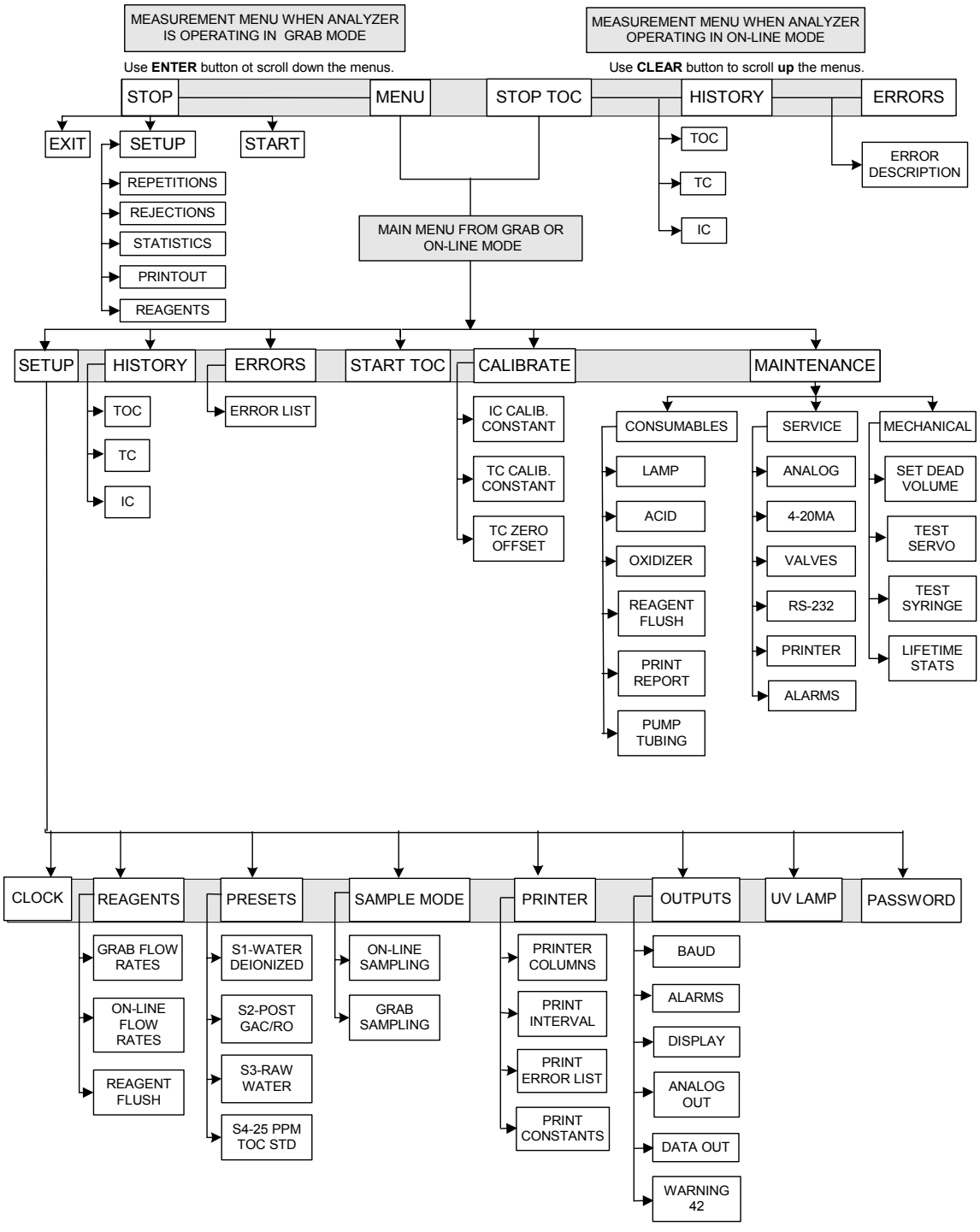


FIGURE 6-1: Map of Menu 3.52CAS

Main Menu

There are six options accessible from the MAIN menu:

- SETUP – set reagent flow rates; configure the printer, analog, and digital outputs; select the sampling mode; turn the UV lamp on or off; enter or change the password; and set the time and date.
- HISTORY – review TOC, TC, and IC data.
- ERRORS – review warning and error messages.
- START TOC –start the analyzer (the analyzer may also be started from the MAIN menu by pressing CLEAR).
- CALIBRATE – calibrate or verify calibration of the analyzer.
- MAINTENANCE – access the CONSUMABLES, SERVICE and MECHANICAL menus.

To select an option, scroll with the arrows (↑ or ↓) to highlight the desired option and press ENTER.

The SETUP menu options and procedures for entering values, configuring the output ports, and changing the reagent flow rates are described in the INSTALLATION chapter. The CONSUMABLES menu options and procedures for replacing the reagents, UV lamp, and pump tubing are in the MAINTENANCE chapter. The TROUBLESHOOTING chapter provides explanations and definitions for Warnings and Errors. The CALIBRATION chapter outlines procedures for calibrating the analyzer.

Power-Up and Initialization (On-Line Sampling)

When the main power switch is turned on and, if applicable, START TOC has been selected from the MAIN menu, the analyzer performs an initialization before the first TOC measurement. During initialization, the analyzer checks the status of the acid and oxidizer reservoirs and syringe pumps, and flushes

DI water through the membrane modules and conductivity cells. The syringe pumps refill if necessary, then flush the lines with fresh reagent and the first TOC measurement cycle commences.

The startup display shows the analysis status, starting with FLUSHING for the first 280 seconds (Figure 6-2), followed by ANALYZING for the remaining 504 seconds (Figure 6-3) of the first measurement. The total time for this two-step startup process is 784 seconds. The time remaining until the next reading is complete will count down in the upper right corner of the screen. If the reagent flow rates are at preset values, a description of that preset will be displayed in the lower right corner of the screen.

FIGURE 6-2: Startup Display - FLUSHING

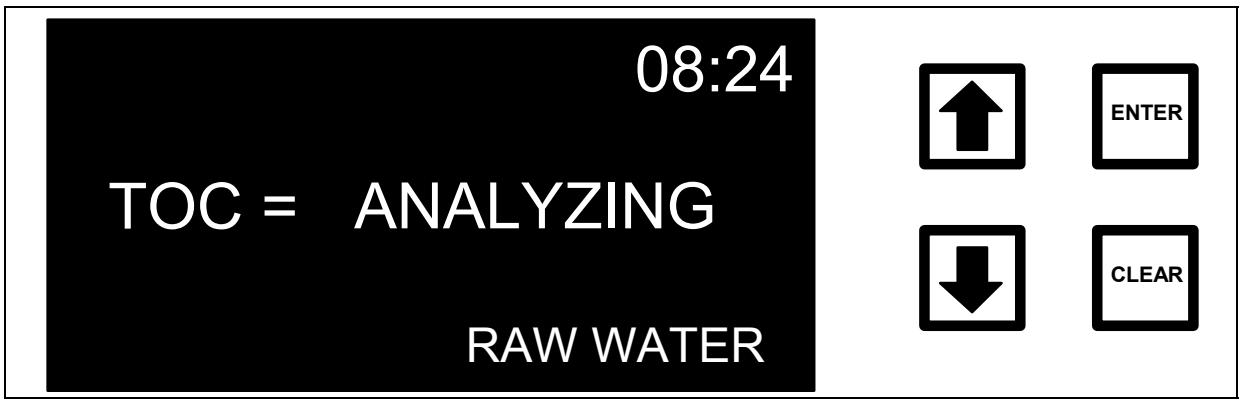


FIGURE 6-3: Startup Display - ANALYZING

When the TOC analysis begins, the first TOC measurement is performed on the water contained in the analyzer. The second measurement will be representative of the water from the sampling port. It may take six or more measurements to obtain an accurate reading when the analyzer is first installed. If the previous sample(s) were less than clean, the analyzer will need more measurements.

Measurement Display

FIGURE 6-4: Measurement Display

The principal display when the analyzer is operating is the Measurement Display. It shows the last value of TOC, TC or IC (selected in the SETUP/DISPLAY option) either in parts per billion (PPB), or parts per million (PPM). The time remaining until the next value is shown in the upper right

corner of the screen and warnings and error messages (if applicable) are shown in the upper left corner of the screen. If one of the Preset flow rate options is selected, the name of the option is shown in the lower right corner of the screen. Operating messages are shown in the lower left corner of the screen. A list of these operating messages and an explanation of the analyzer's action is in Table 5.

Table 5. Operating Messages

Message	Action
Refilling Acid*	The acid syringe is being refilled from the reservoir. Requires ~ 3 minutes to refill and 30 seconds for pressure equalization. The analyzer performs an initialization after each refill.
Refilling Oxidizer*	The oxidizer syringe is being refilled from the reservoir. Requires ~ 3 minutes to refill and 30 seconds for pressure equalization. The analyzer performs an initialization after each refill.

*The control buttons have delayed response while this message is being displayed.

RunTime Menu

While the analyzer is operating, view the TOC, TC, and IC data in the HISTORY option, review any warnings or error messages in the ERRORS stack, or stop TOC measurements with the STOP TOC option.

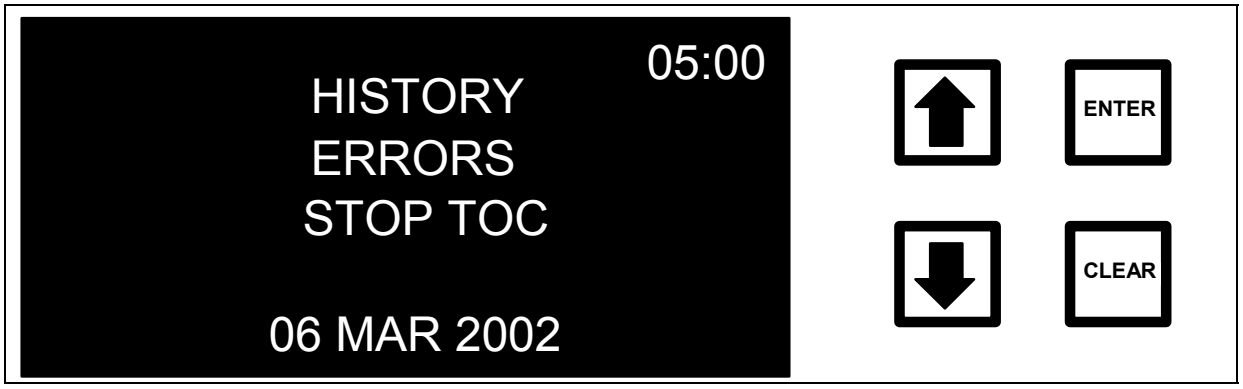


FIGURE 6-5: RunTime Menu

History

With the HISTORY option highlighted, press ENTER to display the last five TOC measurements.

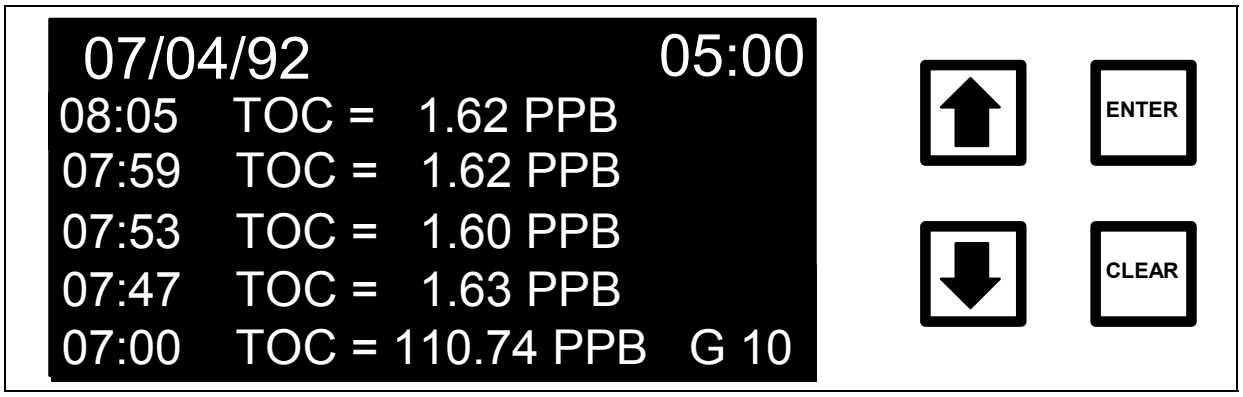


FIGURE 6-6: History TOC Display

In addition to the TOC data, the sample mode is displayed (G=grab, S=stream, T=autosampler and blank=on-line), and for grab and stream sampling, the sample number or stream number is shown. The time remaining until the next TOC measurement is displayed in the upper right-hand corner of the screen. As new TOC measurements are completed, the latest value is displayed at the top of the stack. Press the down arrow (🡻) to display the previous five TOC measurements. Press the up arrow (🡹) again to display the five latest TOC measurements.

Since the TOC measurements are stored and read from the RAM card, all of the data stored on the card may be reviewed. The processor is carrying out other functions associated with the TOC measurement, so TOC values are displayed at a slower rate than when the processor is inactive. Stopping the TOC measurements and using the HISTORY option from the MAIN menu provides a faster means for reviewing data.

There is a one minute time-out for the history display. If scrolling back to review earlier data, the display will reset to the most recent data after one minute without any keystrokes.

In addition to TOC values, total carbon (TC) and total inorganic carbon (IC) concentrations can also be displayed. To review the corresponding TC values from the TOC display, press ENTER:

FIGURE 6-7: History-TC Display

To review the corresponding IC values from the TC display, press ENTER:

FIGURE 6-8: History-IC Display

The arrows (↑ or ↓) can be used to scroll either the TC or IC displays. Pressing ENTER from the IC display will return to the TOC display and pressing CLEAR from the TOC, TC, or IC History will return to the RUNTIME menu.

Errors

With the ERRORS option highlighted, press ENTER to display the error list.

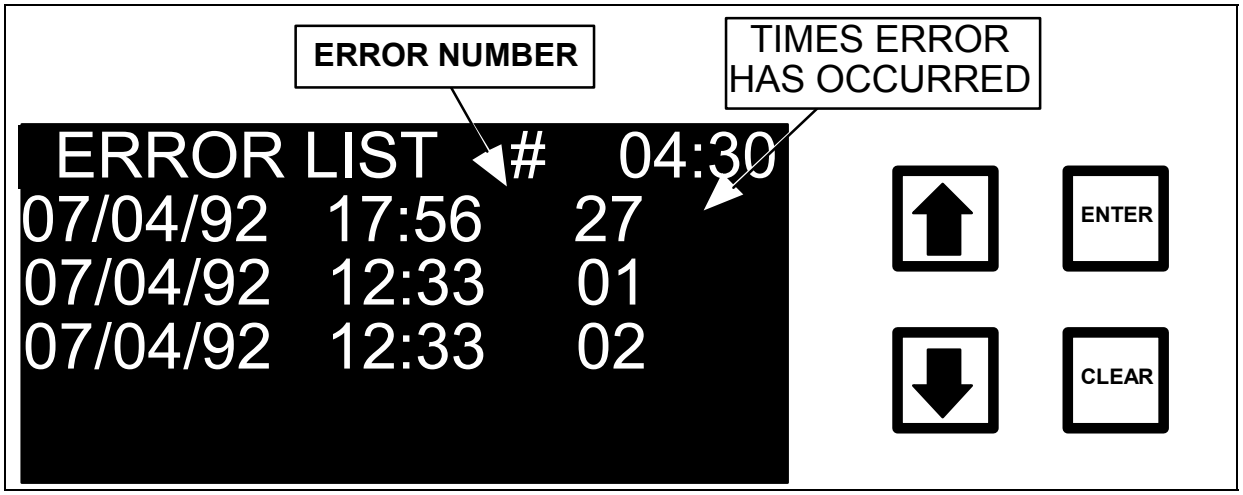


FIGURE 6-9: Error List

The date, time, error number, and number of times this error or warning has occurred is displayed. The time remaining until the next TOC measurement is also displayed in the upper right-hand corner of the screen. A complete discussion of warnings and errors along with remedies is found in the Troubleshooting chapter along with a list of warnings and error numbers (Table 10). The type of error can be displayed and, in some cases, actions to be taken from the Error List. To see what error has occurred, scroll to the desired error in the list and press ENTER.

FIGURE 6-10: Error Information Display

Return to the Error List by pressing any key and return to the RUNTIME menu by pressing CLEAR.

Stop TOC

NOTE

Always stop TOC measurements before turning off or unplugging the analyzer. Turning off the analyzer while data is being written to the RAM card may damage the RAM card.

With the STOP TOC option highlighted, press ENTER. Stopping the analyzer when in on-line mode will cause the MAIN menu to be displayed.

FIGURE 6-11: MAIN Menu

Viewing Consumables Status

From the MAIN menu, scroll to MAINTENANCE, press ENTER and then select CONSUMABLES and press ENTER.

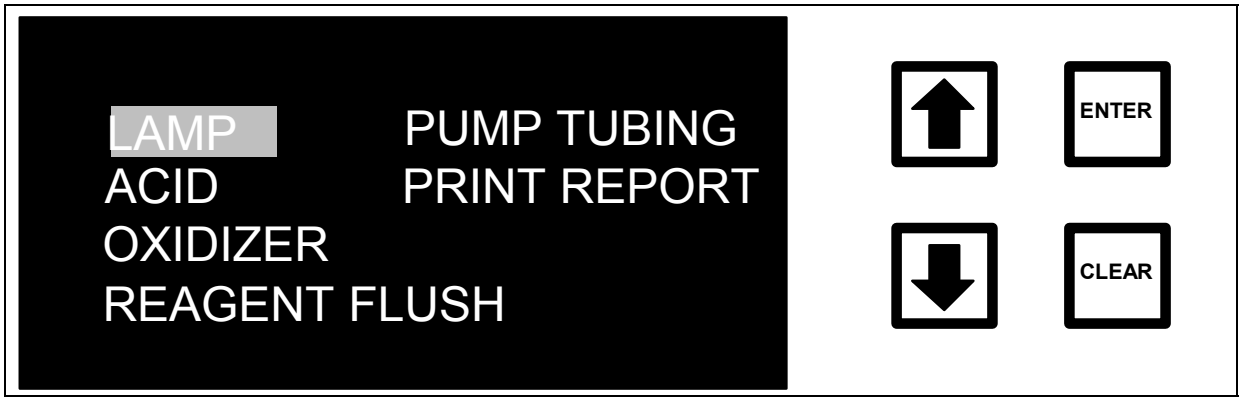


FIGURE 6-12: CONSUMABLES Menu

WARNING
The Consumables menu is also used to reset timers and other key indicators that keep track of the reagent supplies, lamp, and tubing lifetime. In these menus, ENTER resets the timers. CLEAR exits the menu without resetting the timers. Do not reset the timers unless replacing the consumables.

UV Lamp Status

View the status of the UV lamp, highlight LAMP and press ENTER. The LAMP INSTALLATION menu is displayed:

FIGURE 6-13: LAMP INSTALLATION Menu

Highlight INSTALL and press ENTER to display the status of the lamp:

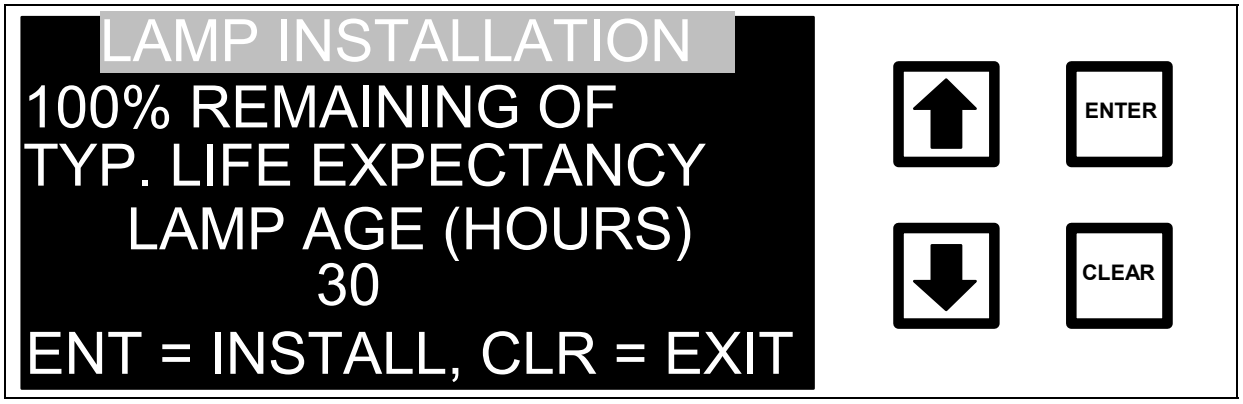


FIGURE 6-14: LAMP Status and INSTALLATION Screen

The screen shows the time the lamp has been on and the remaining lifetime. Press CLEAR to exit the menu without resetting the time. **Do not press ENTER or the timer will be reset!**

Follow the same steps to view the pump tubing status.

Reagent Status

View the status of the reagent reservoirs from the CONSUMABLES menu by scrolling to ACID (or OXIDIZER) and pressing ENTER. The ACID INSTALLATION menu is displayed.

FIGURE 6-15: ACID INSTALLATION Menu

With the INSTALL option highlighted, press ENTER to view the acid status:

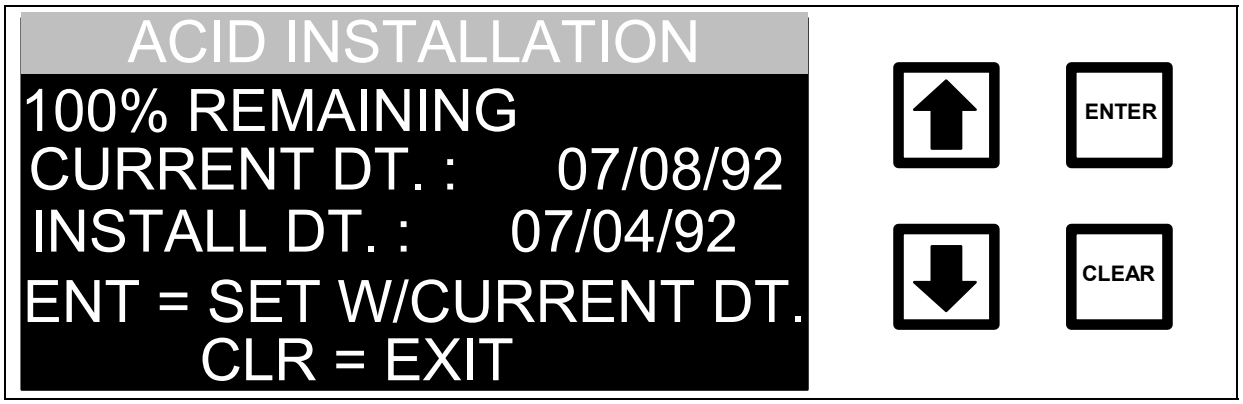


FIGURE 6-16: ACID Status and INSTALLATION Display

The amount of acid consumed is monitored by the microprocessor and the percentage remaining is displayed along with the date that the acid reservoir was installed. Press CLEAR to exit the menu without changing the install date.

For each consumable, there is a means for resetting the percentage left; for the oxidizer, the installation date may also be reset. These functions are used in the unlikely event that these values are lost from the battery-backed RAM or when a new EEPROM chip is installed. For example, the SET % LEFT option under the ACID INSTALLATION menu can be used to enter the amount of acid left so that the analyzer will know the volume of acid remaining in the reagent container. These options are only used for emergencies and the INSTALL option is used for setting the install dates when the consumables are replaced.

From the CONSUMABLES menu, print a report of the consumables status by pressing ENTER with the Print Report option highlighted. The PRINTING CONSUMABLES screen is displayed.

FIGURE 6-17: Consumables Report Screen

Fatal Error Display

An internal microprocessor monitors the analyzer's operation. If a serious problem is detected, the analyzer stops TOC measurements and displays a screen similar to that shown below:

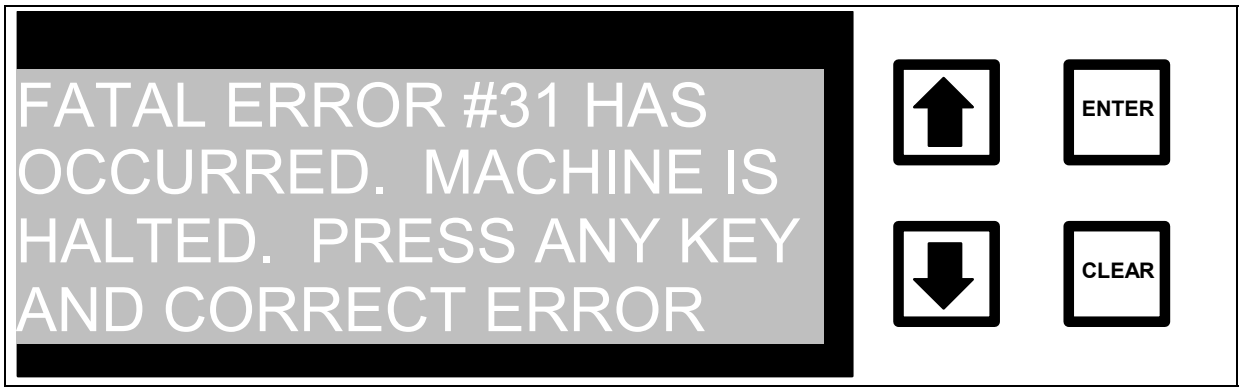


FIGURE 6-18: Fatal Error Display

Turning Off Power to the Analyzer

WARNING
Always stop TOC measurements before turning off or unplugging the analyzer. Turning off the analyzer while it is writing to the RAM Card may damage the card.

To turn the main power off when running on-line:

1. Press ENTER to display the RunTime menu.
2. Select STOP TOC.
3. Press ENTER. Once the MAIN menu is displayed, turn the power off.

To turn the main power off when running grab samples:

1. Use the arrows (↑ or ↓) to scroll to STOP in the Grab Sample menu.
2. Press ENTER.
3. When the Grab Sampling Idle menu is displayed, turn off the power.

To turn the main power off when running the autosampler:

1. Select Stop from the File menu of the DataPro Autosampler Program.
2. When the hourglass disappears, turn the power off.

Grab Sample Measurements

The analyzer can also be used for measurement of TOC, TC, and IC directly from sample bottles. In the Grab Sample mode, specify how many replicate measurements to make from a sample bottle and how many of these measurements are to be used in the calculation of average values and standard deviation or coefficient of variation (relative standard deviation).

WARNING
Make sure the DI Reservoir is full, particularly when running samples with high TOC's or high salt concentrations. If there is an air bubble in the reservoir, high levels of salts may contaminate the reservoir and deplete the resin. Always "clean-up" the analyzer by running low TOC DI water (at least three measurements) after running high TOC or salt samples.

If using the analyzer for on-line measurements, change the sample mode in the SETUP menu to GRAB SAMPLING and change the sample inlet plumbing. If running both on-line and grab samples, consider using the sample switching

valve, available through Ionics Instruments to eliminate the need to change the plumbing when switching between on-line and grab sampling.

Setting the Sample Mode to Grab Sampling

To set the sample mode to Grab Sampling from the MAIN menu:

1. Use the arrows (↑ or ↓) to scroll to SETUP and press ENTER. The SETUP menu is displayed, with the CLOCK function highlighted.

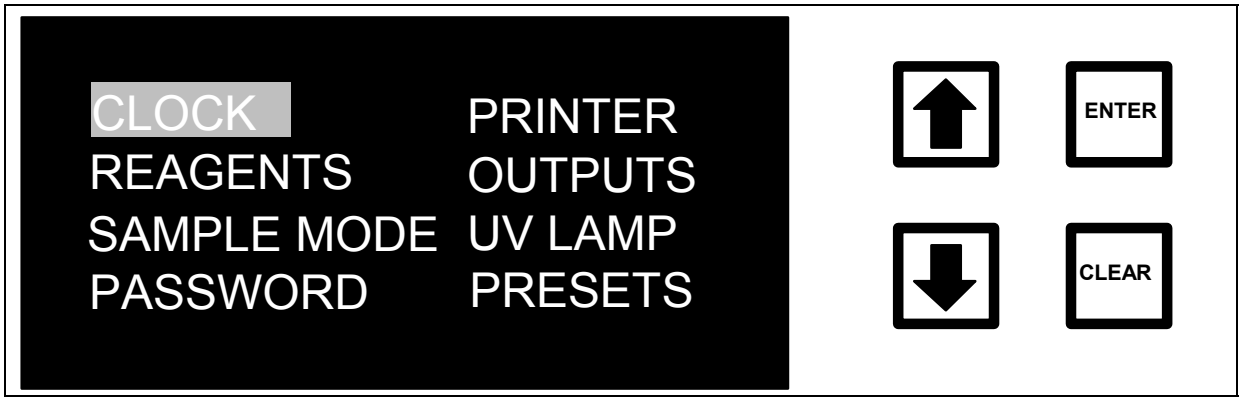


FIGURE 6-19: SETUP Menu

2. Use the arrows (↑ or ↓) to scroll to SAMPLE MODE. Press ENTER to display the SAMPLE MODE menu.

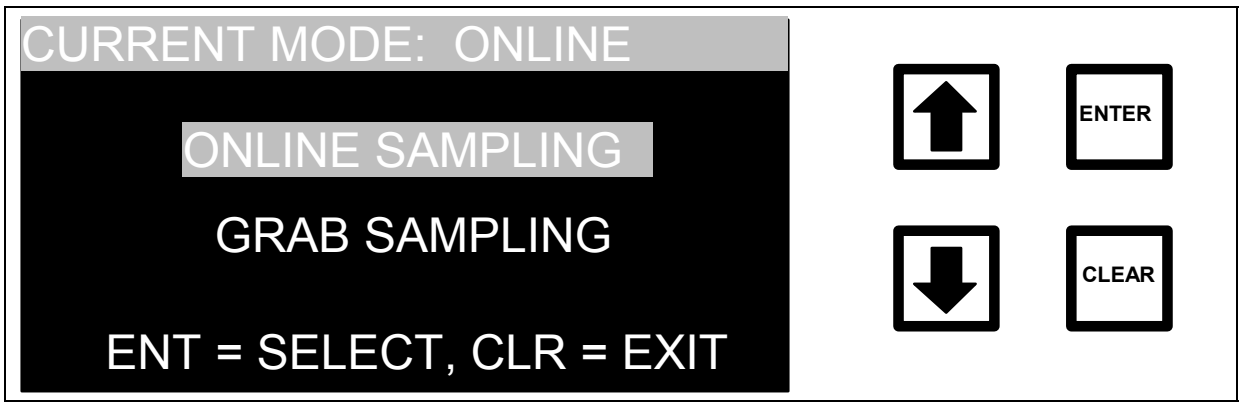


FIGURE 6-20: SAMPLE MODE Menu

3. The current setting of the sample mode is displayed along with the two options. If the sample mode is set to GRAB SAMPLING, press CLEAR to return to the Setup menu. To change the sample mode, use the arrows (↑ or ↓) to select GRAB SAMPLING.

4. Press ENTER. The display will change to indicate the new sampling mode. Press CLEAR to return to the SETUP menu.

Changing from On-line to Grab Sampling

The plumbing will need to be changed for sampling from containers or calibrating the analyzer. To change the plumbing, refer to the Installation Chapter of this manual.

Setting Up the Grab Sample Mode

After the sample mode has been set and the plumbing has been changed, the grab sample parameters need to be set.

1. From the Main menu, select START TOC. Press ENTER. The GRAB SAMPLE screen is displayed:

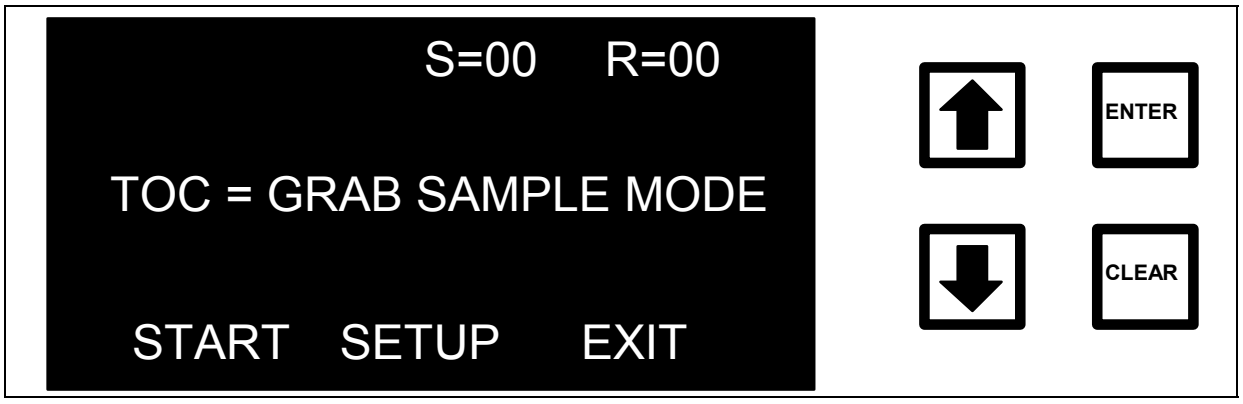


FIGURE 6-21: GRAB SAMPLE Screen

2. Use the arrows (↑ or ↓) to scroll to SETUP and press ENTER. The GRAB SAMPLE SETUP menu is displayed:

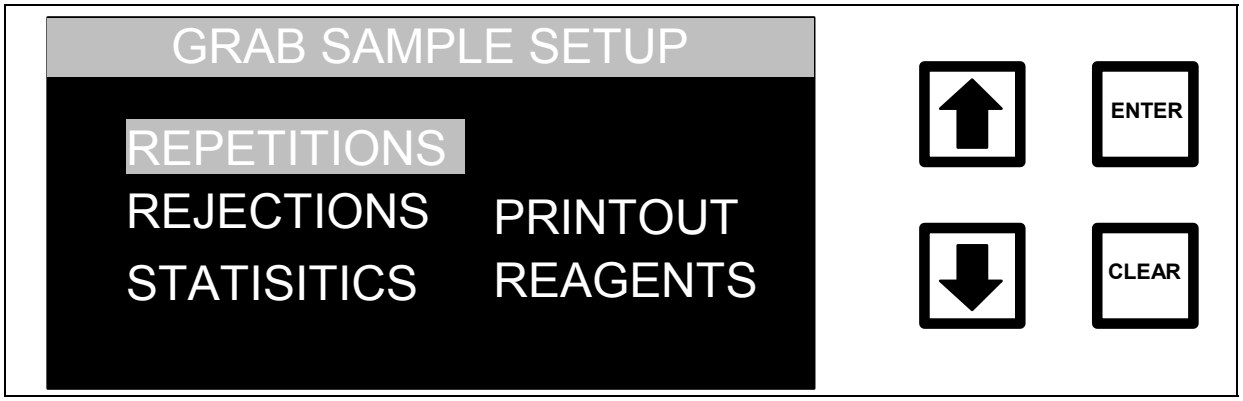


FIGURE 6-22: GRAB SAMPLE SETUP Menu

3. With the Repetitions option highlighted, press ENTER. The GRAB REPETITIONS screen is displayed:

FIGURE 6-23: GRAB REPETITIONS Screen

4. Use the arrows (↑ or ↓) to select the number of replicate TOC measurements (1-99) to be made on the sample and press ENTER to save the value.

   The analyzer uses a “fast flush” of the sample in which the speed of the sample pump and syringe pumps is doubled to fill the analyzer with the new sample. The pumps are then returned to the normal speeds and the first measurement performed. In most cases, this first measurement will be close to the actual TOC but may be outside of

the ± 3% repeatability of the analyzer. It is best to set the number of repetitions to 2 or more to ensure an accurate TOC value. Using four repetitions allows rejection of the first value and calculation of a standard deviation using the remaining three values.

5. Press CLEAR to return to the GRAB SAMPLE SETUP menu.
6. Use the arrows (↑ or ↓) to scroll to REJECTIONS and press ENTER. The GRAB REJECTIONS screen is displayed:

FIGURE 6-24: GRAB REJECTIONS Screen

The REJECTIONS option determines how many of the replicate measurements will be used in calculating average values and standard deviations. In most cases, reject the first measurement to yield a more accurate average value.

7. Use the arrows (↑ or ↓) to set the number of measurements to be rejected and press ENTER to save the value.
8. Press CLEAR to return to the GRAB SAMPLE SETUP menu.
9. Use the arrows (↑ or ↓) to scroll to STATISTICS and press ENTER. The STATISTICS DISPLAY TYPE screen is displayed:

FIGURE 6-25: STATISTICS DISPLAY TYPE Screen

After the analyzer has made the replicate measurements, the average value and sample standard deviation are computed, rejecting any measurements set in the REJECTIONS Option, and displayed on the LCD Display. The display may be set to show average value and the coefficient of variation (CV or relative standard deviation) or to show the average value and standard deviation (SD).

10. Use the arrows (↑ or ↓) to select AVE/CV or AVE/SD and press ENTER to save the setting.
11. Press CLEAR to return to the GRAB SAMPLE SETUP menu.
12. Use the arrows (↑ or ↓) to scroll to PRINTOUT and press ENTER. The GRAB PRINTOUT menu is displayed:

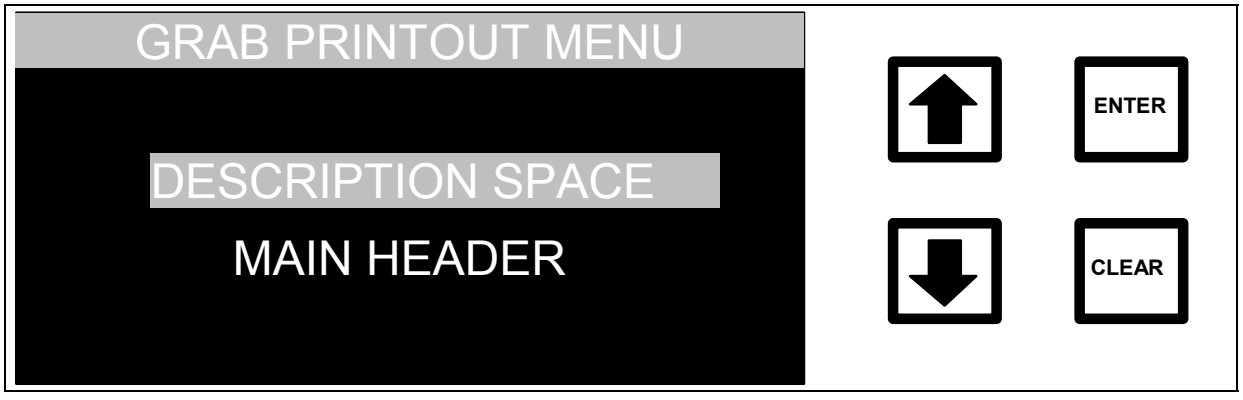


FIGURE 6-26: GRAB PRINTOUT Menu

The DESCRIPTION SPACE option will print several blank lines at the top of the printout so that sample information and other notes may be written on the printout.

The MAIN HEADER option will print the analyzer's serial number and firmware version, the date, and lines for entering the operator's name and sample information.

13. With the DESCRITION SPACE option highlighted, press ENTER. The GRAB DESCRIPTION SETTING screen is displayed:

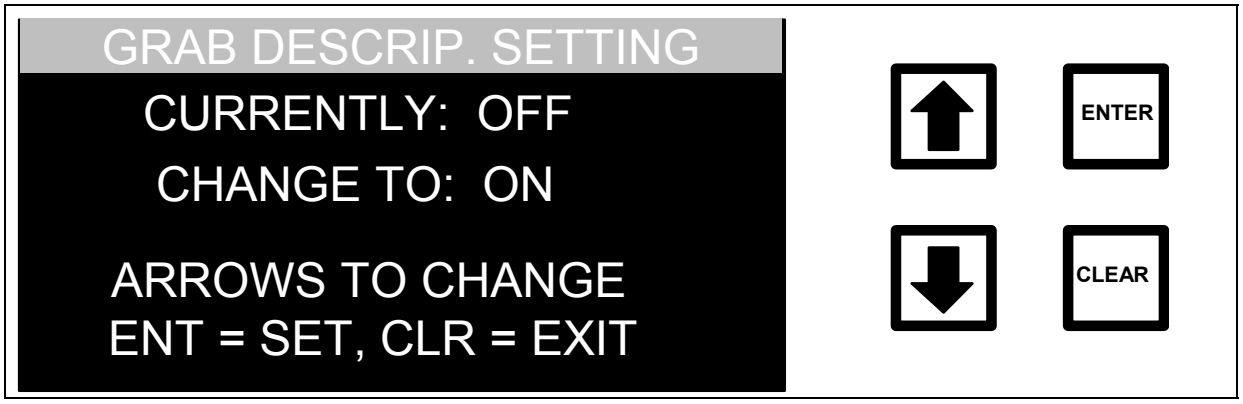


FIGURE 6-27: GRAB DESCRIPTION SETTING Screen

14. Use the arrows (↑ or ↓) to select the desired state (ON or OFF) and press ENTER to save the setting.
15. Press CLEAR to return to the GRAB PRINTOUT menu.
16. Use the arrows (↑ or ↓) to scroll to MAIN HEADER and press ENTER. The GRAB HEADER SETTING screen is displayed:

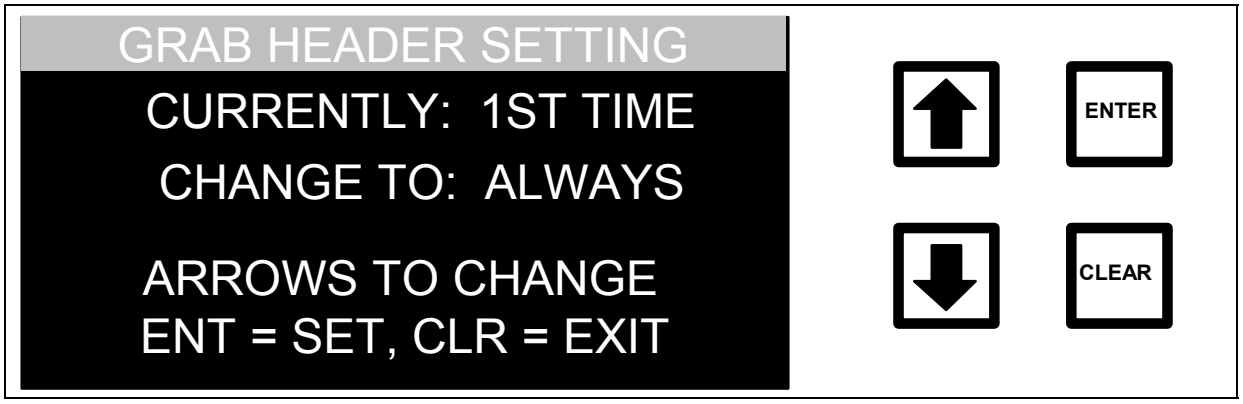


FIGURE 6-28: GRAB HEADER SETTING Screen

Options include 1ST TIME (prints the first grab sample of the day) or ALWAYS (prints for each grab sample).

17. Use the arrows (↑ or ↓) to select the desired option and press ENTER to save the setting.
18. Press CLEAR twice to return to the GRAB SAMPLE SETUP menu.

Running Grab Samples

1. Make sure the open end of the 1/16" sample line is below the liquid level in the sample bottle.
2. From the GRAB SAMPLING screen, use the arrows (↑ or ↓) to scroll to START and press ENTER. The display will change and the analyzer will start the "fast flush" of the sample.

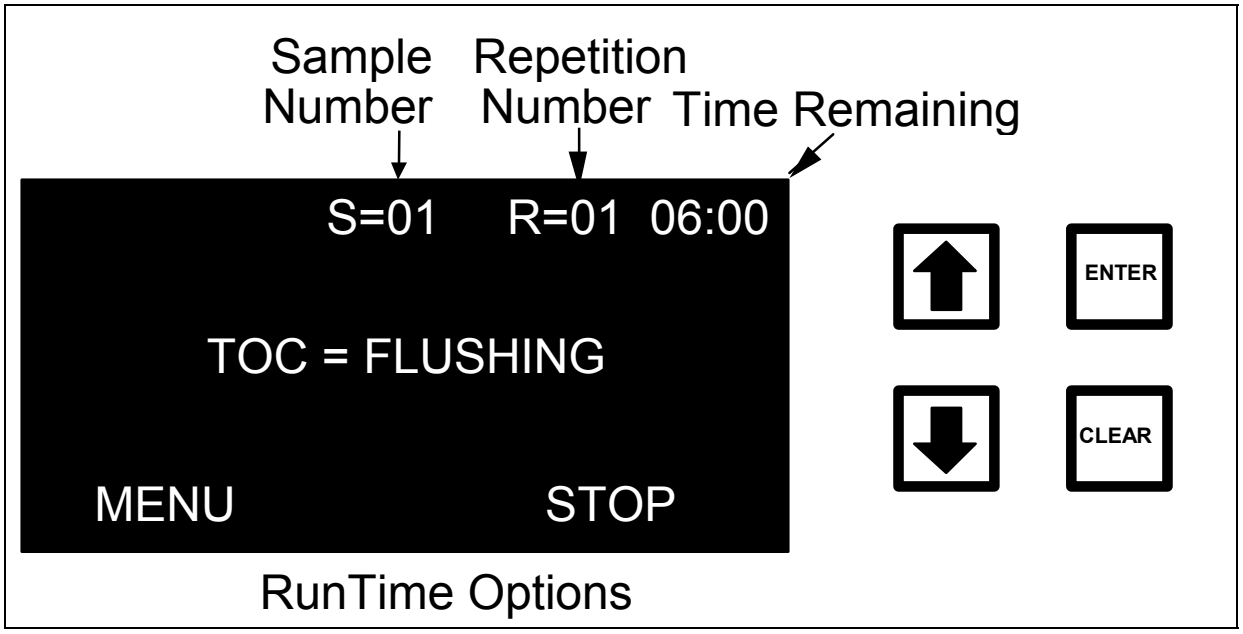


FIGURE 6-29: Grab Sampling Measurement Screen (*example*)

3. While the analyzer is running in the Grab Sample mode, use the arrows (↑ or ↓) to select from two menu options, MENU and STOP (the SETUP menu cannot be accessed while you are running). The MENU option allows viewing of the data stored on the RAM card from HISTORY and viewing of any warnings or error messages from ERRORS. Press CLEAR to return to the Grab Measurement screen.

4. Stop the Grab Sample measurements in one of two ways – select STOP TOC from the menu options or select STOP from the Grab Sample RunTime menu. Both options will return to the Grab Sample screen.

   As the measurements are completed, the last value is displayed and printed (if applicable), and the repetition number is increased. After all of the replicate measurements have been made, the display will change to indicate that it is done.

To ensure that the nuts have not been overtightened and collapsed the tubing, briefly remove the inlet Teflon tubing from the sample container. The sample pump should draw a small amount of air into the tubing. Replace the tubing in the sample container making sure that the end of the tubing is below the liquid

level. Observe the small air bubble being drawn into the analyzer and the liquid flowing out the outlet tubing.

If the air bubble is not drawn into the analyzer or if there is not liquid flowing out the outlet tubing, the tubing may be collapsed.

To check the tubing:

1. Turn off the main power on the analyzer.
2. Use a 1/4" wrench to remove the Teflon tubing from the bulkhead fitting.
3. Inspect the tubing in the region of the ferrule. If the ferrule has compressed the tubing completely closed, cut the tubing and install a new 1/16" Valco ferrule or replace the tubing. Replacement ferrules and tubing are available from Ionics Instruments.

Sampling from containers may result in loss of DI water from the internal reservoir. Check the DI water level frequently and refill the reservoir as needed. Instructions for checking and refilling the DI reservoir are given in the Maintenance chapter. **It is particularly important that the DI reservoir be filled before moving the analyzer.** An air bubble in the DI loop can become trapped in the circulation pump during transport, resulting in noisy operation and potentially damaging the pump.

Changing to or Returning to On-line Measurements

After the Grab Sample measurements have completed, return to on-line measurements from the RUNTIME menu.

1. Use the arrows (↑ or ↓) to scroll to STOP and press ENTER. The Grab Sample screen is displayed.
2. Use the arrows (↑ or ↓) to scroll to EXIT and press ENTER. The MAIN menu is displayed.

3. Use the arrows (↑ or ↓) to scroll to SETUP and press ENTER. Scroll to SAMPLE MODE and press ENTER.

4. Use the arrows (↑ or ↓) to change the sample mode to ONLINE and press ENTER to store the new sample mode. Press CLEAR twice to return to the MAIN menu.

5. Turn off the power switch on the left-hand side of the analyzer.

6. Locate the 1/16" OD Teflon tubing connected to the INLET and OUTLET bulkhead fittings (see Figure 6-22).

7. Use a 1/4" wrench to remove the Teflon tubes from the INLET and OUTLET fitting of the analyzer.

8. Rotate the 1/16" OD stainless steel tubing from the on-line sampling inlet block so that it is positioned near the INLET bulkhead fitting. Connect the tubing to the inlet bulkhead fitting with your fingers, then use the 1/4" wrench to tighten the nut 1/16 - 1/8 turn past finger-tight. **Do not overtighten; the tubing will collapse and prevent flow!**

9. Install the 1/16" OD Teflon outlet line by connecting the Valco nut to the OUTLET bulkhead fitting with your fingers, then use the 1/4" wrench to tight the nut 1/16 - 1/8 turn past finger tight. Do not over tighten, the tubing will collapse and prevent flow!

10. Connect the other end of the outlet line to the rubber tubing at the top of the sample inlet system.

11. If necessary, reinstall the 1/4" OD PFA tubing with the in-line filter to the inlet of the pressure regulator (see Figure 6-1). Thoroughly flush the sampling port to remove any contamination, and then connect the other end of the 1/4" OD PFA tubing to the port.

WARNING
Operation of the analyzer without the in-line filter on the sample inlet line will damage the analyzer and void the warranty. To avoid damaging the analyzer, install the filter and replace on a regular basis.

12. If necessary, connect the 3/8" OD waste line tubing to the sampler by sliding the tubing over the barb fitting on the sampler outlet.

13. Turn the main power switch on.

14. From the MAIN menu, select START TOC. Press ENTER.

The first two TOC measurements are performed on the water contained in the analyzer from the last measurement. The third measurement will be representative of the water from the system.

Changing the Password

After password protection has been enabled (as described in the Installation chapter), the password may be changed at any time. The password protection discussed here is independent of the password protection established via DataGuard; for further information regarding DataGuard passwords, please refer to the DataGuard Operation chapter.

To change the password:

1. Select SETUP from the MAIN menu and press ENTER.

2. Scroll to PASSWORD and press ENTER. The ENTER NEW PASSWORD screen is displayed:

FIGURE 6-30: ENTER NEW PASSWORD Screen

3. Enter the first letter of the current password by using the arrows (↑ or ↓) to scroll to the desired letter.

4. Press ENTER to input the first letter of the current password. If a mistake has been made, press CLEAR to delete first letter.
5. Use the arrows (↑ or ↓) to select the remaining letters, pressing ENTER to input each letter.
6. After all of the letters of the current password have been entered, press ENTER again to enter the password. The top line in the display should change to indicate that the correct password has been entered.

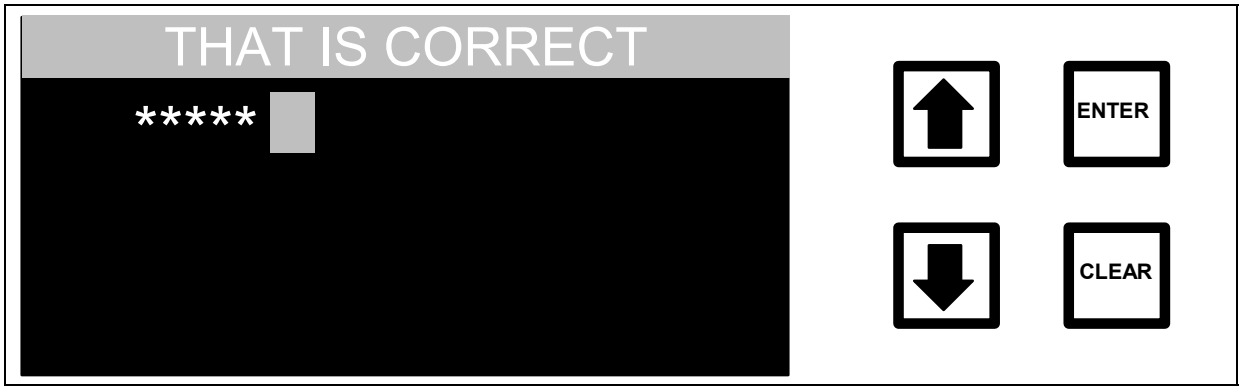


FIGURE 6-31: Correct Password Confirmation Screen

7. The display will then change to the ENTER NEW PASSWORD screen:

FIGURE 6-32: ENTER NEW PASSWORD Screen

8. Use the arrows (↑ or ↓) to highlight the first letter of the new password and press ENTER to save the character.
9. Continue selecting the characters for the password, pressing ENTER to select each character.
10. After all of the characters have been entered, press ENTER again to store the password. A message indicating the password has been set will appear.

WARNING
A password will need to be entered to recalibrate the analyzer, to change consumables, or to change the password. Choose a password that will be easy to remember, and record the password and store it in a secure location for future reference.

11. If an incorrect password has been entered in step 6, the INCORRECT PASSWORD screen will display:

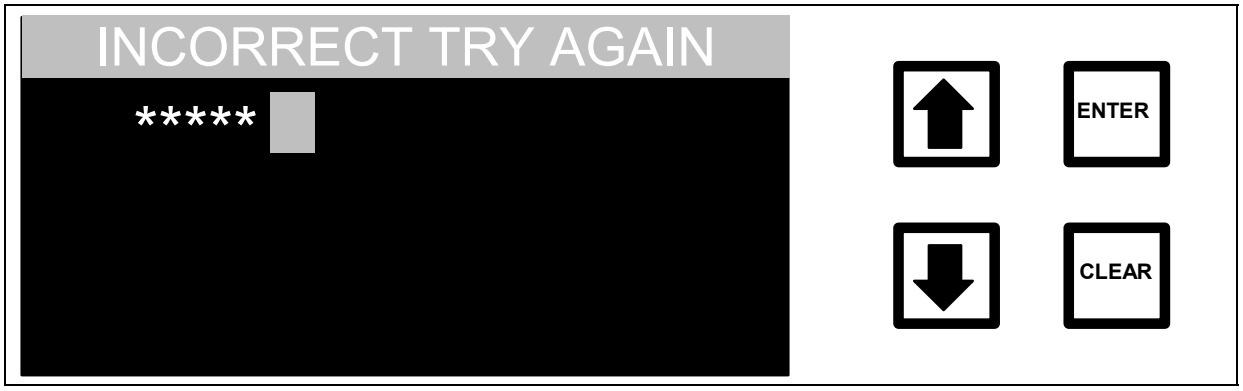


FIGURE 6-33: INCORRECT PASSWORD Screen

The display will change back to the ENTER NEW PASSWORD screen. Follow the procedures in steps 3-6 above to re-enter the current password.

If the password has been forgotten or for some other reason cannot be changed, contact Ionics Instruments for assistance.

Disabling Password Protection

After password protection has been enabled as described in the Installation chapter, the password protection can be disabled by selecting blanks for the password. To disable password protection:

1. Enter the current password.
2. When the ENTER NEW PASSWORD screen displays, leave the password field blank (don't enter any characters) and press ENTER.

The password protection is now disabled and the user will not be prompted to enter a password when changing consumables or recalibrating the analyzer.

To re-enable password protection, follow the same procedure for setting up a new password (refer to the Installation chapter).

Service Menu

The SERVICE menu provides a way to test the subsystems of the analyzer for proper operation. The subsystems that can be tested are the analog board, the 4-20mA outputs, the digital inputs, the RS-232 communication port, and the printer and the alarm outputs. Contact Ionics Technical Support for instructions about how to use these diagnostic tests and interpret the results. In addition to the diagnostic tests provided, you can manually perform an autozero operation from the SERVICE menu.

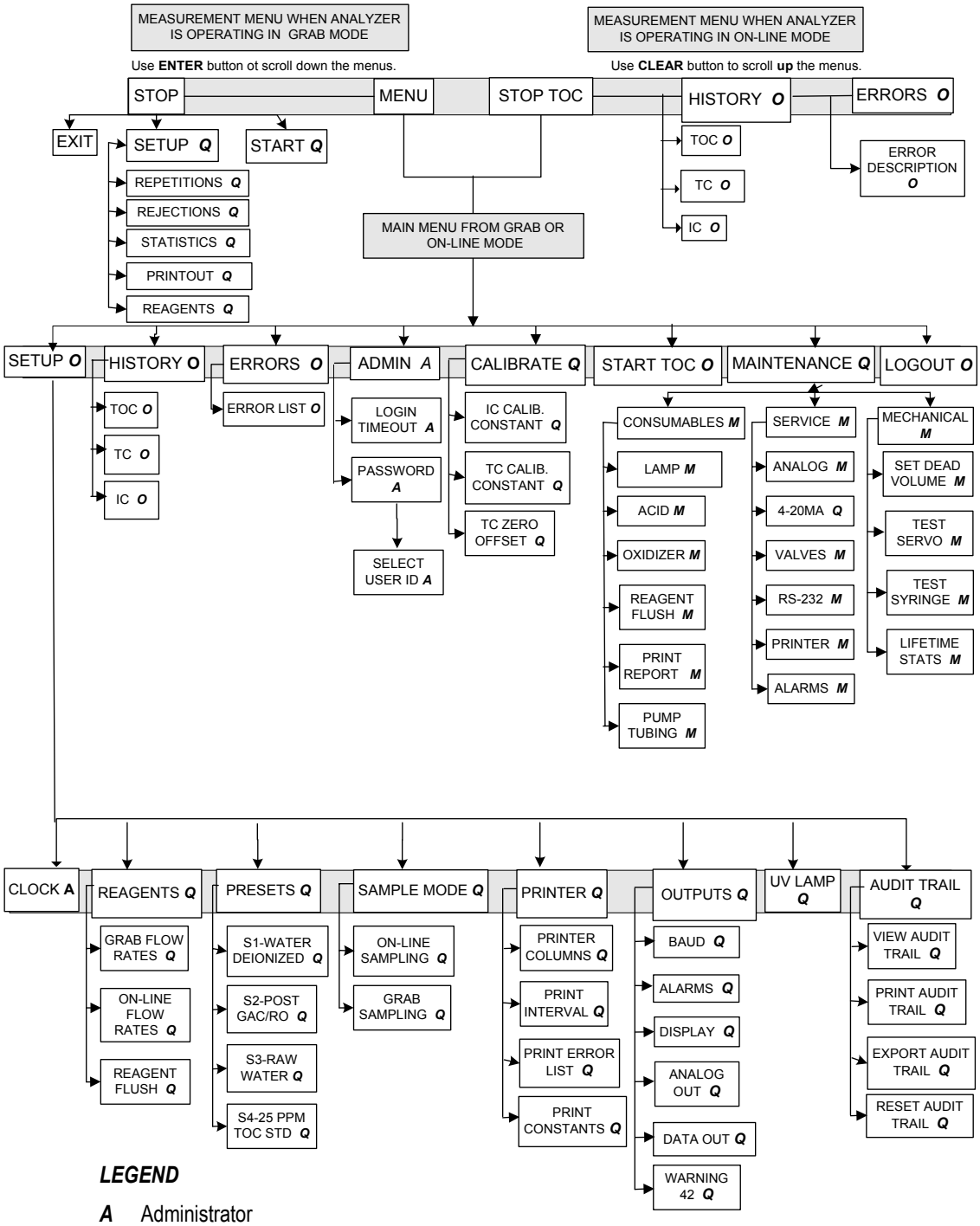
7 DATAGUARD OPERATION

This chapter describes how to operate firmware with the DataGuard feature. This chapter is a supplement to the Operation chapter, so only the differences will be covered here.

DataGuard is a firmware feature that provides support for 21 CFR Part 11. It provides access control to the instrument via password protection and maintains an audit trail of user operations. The default Administrator password can be found in the Identification Records.

An overview of the menu structure is shown in Figure 7-1. (The single letter shown following each menu option relates to the required level of access authority, as dictated by DataGuard and described in the key at the bottom of the page.) To move down the menu tree, select the desired menu option with the arrows (↑ or ↓) and press ENTER. To move up the menu tree, press CLEAR.

Menu Map



LEGEND

A Administrator

Q Quality Assurance

M Maintenance

O Operator

FIGURE 7-1: Map of Menu 3.62CAS

Main Menu

There are eight options in the MAIN menu:

- SETUP allows the user to set the reagent flow rates, configure the printer, analog, and digital outputs, select the sample mode, turn off the UV lamp, enter or change the password, set the time and date, and manage the audit trail.
- LOGOUT logs the user out of the instrument, requiring the next user to log in before operating the instrument.
- ADMIN provides tools for the administrator to manage user passwords and the automatic logout timer.
- HISTORY, ERRORS, START TOC, CALIBRATE, and MAINTENANCE are described in the OPERATION chapter.

Select an option by using the arrows (↑ or ↓) to scroll to and highlight the desired option and pressing ENTER.

RunTime Menu

The RunTime menu is accessible while the instrument is performing analysis. The menu selections are:

- HISTORY – to review the TOC, TC, and IC data.
- ERRORS – to review any warning or error messages.
- STOP TOC – to stop analyzer from taking TOC measurements.

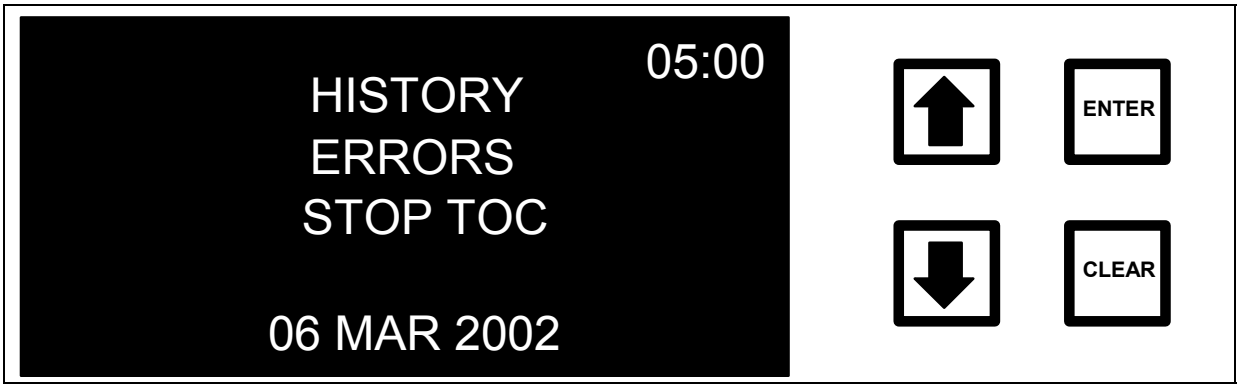


FIGURE 7-2: RunTime Menu

The operation of HISTORY and ERRORS is described in the OPERATION chapter.

Stop TOC Option

> **NOTE**
> Always stop TOC measurements before turning off or unplugging the analyzer. Turning off the analyzer while data is being written to the RAM card may damage the RAM card.

If the analyzer is in measurement mode, highlight the STOP TOC option and press ENTER. You will be prompted for a password:

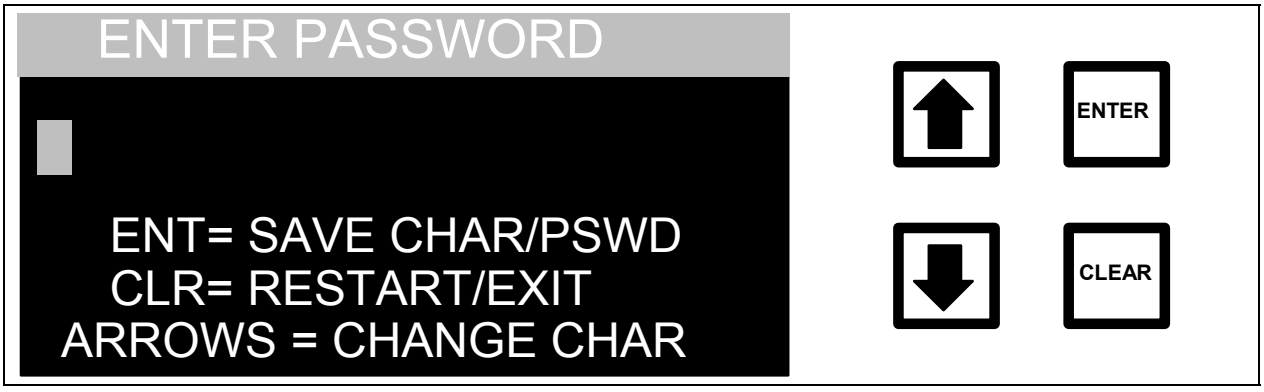


FIGURE 7-3: ENTER PASSWORD Screen

For more information about passwords with the DataGuard feature, refer to the password section in this chapter. After a valid password is entered, the MAIN menu displays:

FIGURE 7-4: MAIN Menu

Setup

All of the run parameters are accessed through the SETUP menu. To access the SETUP menu from the MAIN menu, use the arrows (↑ or ↓) to scroll to SETUP and press ENTER. The SETUP menu displays:

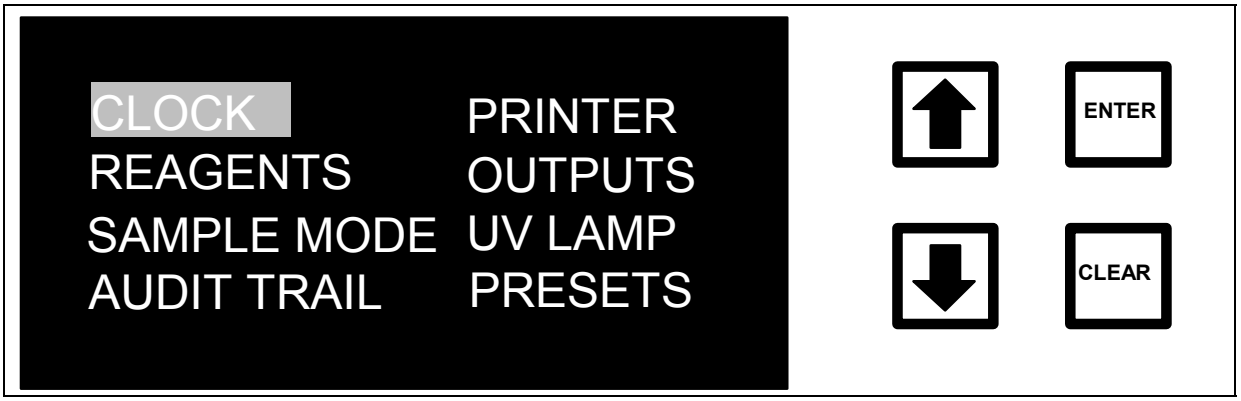


FIGURE 7-5: SETUP Menu

Refer to the Operations chapter for information about CLOCK, REAGENTS, SAMPLE MODE, PRINTER, OUTPUTS, UV LAMP, and PRESETS.

Admin

The ADMIN menu provides tools for managing access to the keypad interface of the instrument. Use the ADMIN option in the MAIN menu to change user passwords or adjust the logout timer.

Open the ADMIN menu from the MAIN menu by using the arrows (↑ or ↓) to scroll to ADMIN and pressing ENTER. The ADMIN menu displays:

FIGURE 7-6: ADMIN Menu

There are two options from the ADMIN menu:

- PASSWORD is used to change the passwords assigned to user IDs.
- LOGIN TIMEOUT sets how long the keypad interface goes unused before the instrument automatically logs the user out.

Select an option by using the arrows (↑ or ↓) to highlight the desired option, then press ENTER.

Password

Use the PASSWORD option in the ADMIN menu to manage passwords to control access to the analyzer. The analyzer supports four levels of access:

Operator, Maintenance, Quality Assurance, and Administration. There are several separate user IDs at each level, as shown in the following table:

Table 6. User IDs

Access Level	User ID
Operator	OPERATOR 01
Operator	OPERATOR 02
Operator	OPERATOR 03
Operator	OPERATOR 04
Operator	OPERATOR 05
Operator	OPERATOR 06
Operator	OPERATOR 07
Operator	OPERATOR 08
Operator	OPERATOR 09
Operator	OPERATOR 10
Maintenance	MAINT 01
Maintenance	MAINT 02
Maintenance	MAINT 03
Maintenance	MAINT 04
Quality Assurance	QUALITY 01
Quality Assurance	QUALITY 02
Quality Assurance	QUALITY 03
Quality Assurance	QUALITY 04
Administration	ADMIN 01
Administration	ADMIN 02

Each menu within the instrument requires a particular level of access. In order to access the menu system, the user is required to “log in” by entering a password:

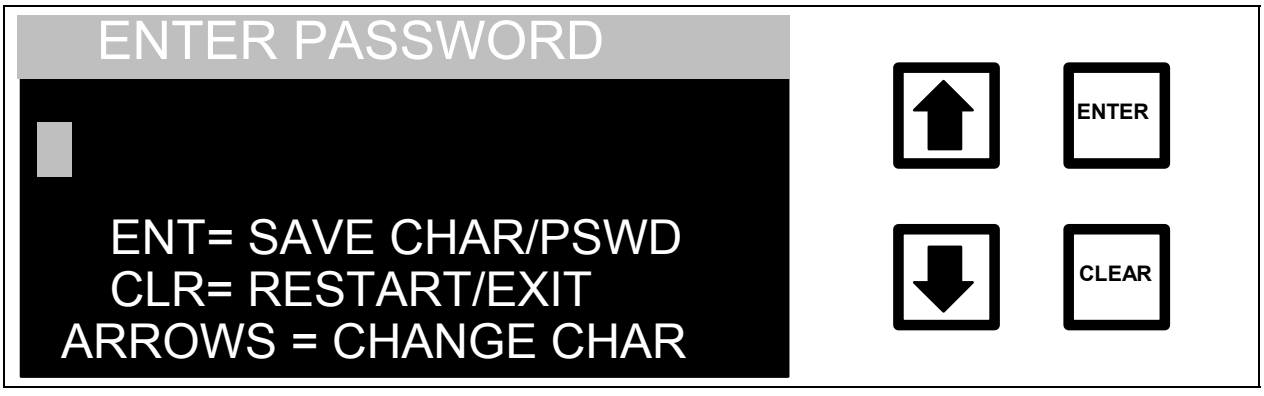


FIGURE 7-7: ENTER PASSWORD Screen

Entering a Password –

1. Enter the first letter of the password by using the arrows (↑ or ↓) to scroll to the desired letter.
2. Press ENTER to input the first letter of the password. If a mistake has been made, use CLEAR to delete the letter.
3. Use the arrows (↑ or ↓) to select the remaining letters of the current password, pressing ENTER to input each letter.
4. After all of the letters have been entered for the password, press ENTER again to enter the password.

If the entered password does not match any of the previously created passwords, the INCORRECT PASSWORD screen displays:

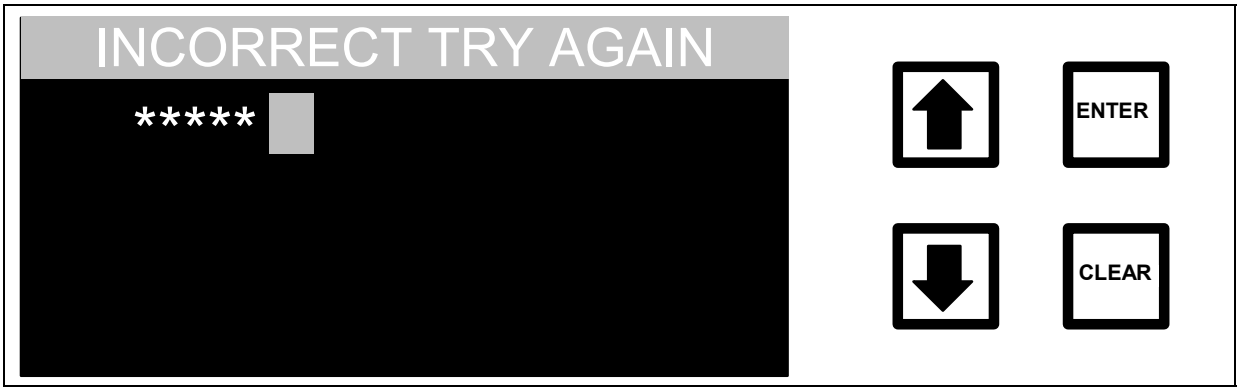


FIGURE 7-8: INCORRECT PASSWORD Screen

This screen displays for a few seconds before returning to the ENTER PASSWORD screen.

If the entered password matches any of the previously created passwords, a password confirmation screen displays:

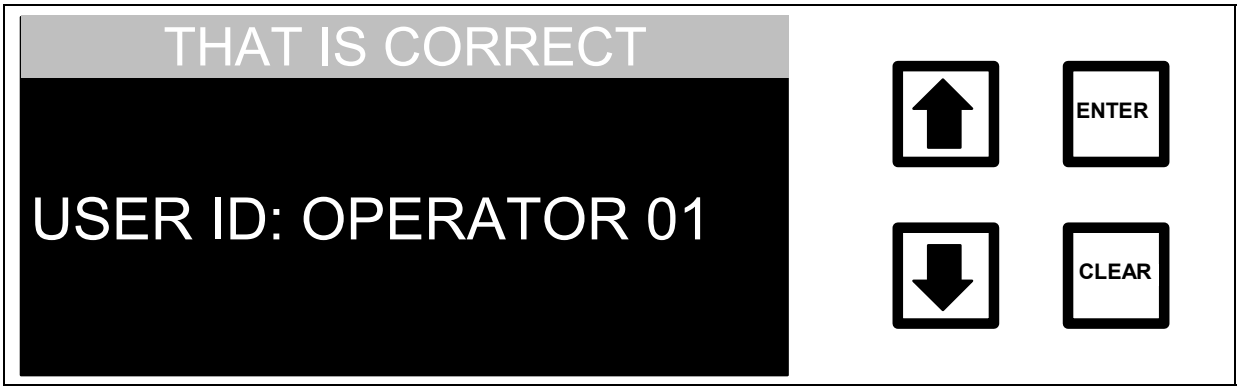


FIGURE 7-9: PASSWORD CONFIRMATION Screen

Passwords can be between one and eight characters in length. The analyzer is shipped with one Administrator-level password enabled (see Identification Records). This password should be changed in order to prevent unauthorized access to the instrument.

Setting a Password –

1. From the ADMIN menu, use the arrows (↑ or ↓) to scroll to PASSWORD and press ENTER. The SELECT USER ID screen displays:

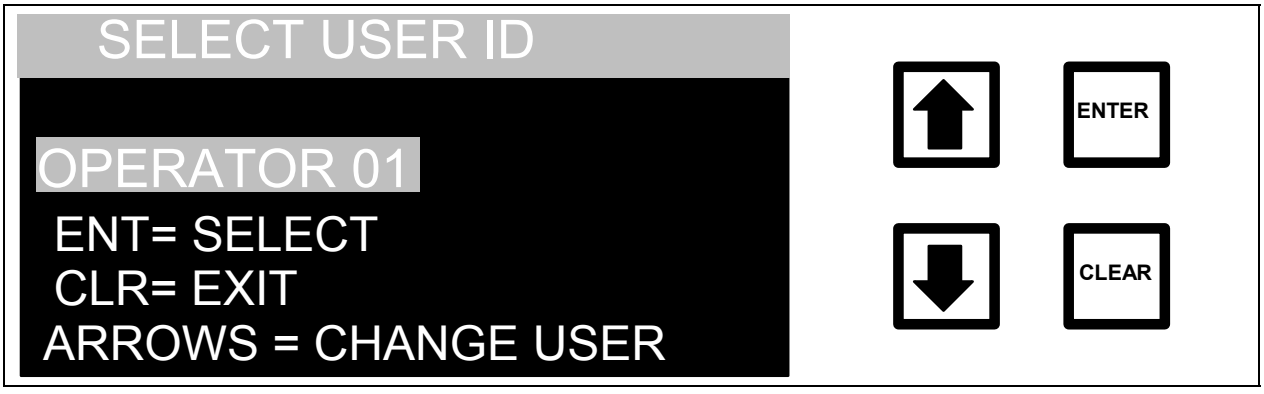


FIGURE 7-10: SELECT USER ID Screen

The arrows (↑ or ↓) scroll through the list of user IDs. To exit from this menu without selecting a user ID, press CLEAR.

2. Use the arrows (↑ or ↓) to select the user ID for changing the password. To display the ENTER NEW PASSWORD screen, press ENTER when the desired user ID displays:

FIGURE 7-11: ENTER NEW PASSWORD Screen

3. Use the arrows (↑ or ↓) to select the first character. When the desired character displays, press ENTER.
4. ENTER each character in sequence as described in Step 3.
5. After entering the entire password, press ENTER to save the new password. The PASSWORD SET screen displays:

FIGURE 7-12: PASSWORD SET Screen

6. After the PASSWORD SET screen displays for a few seconds, the display will return to the SELECT USER ID screen.

Disabling a Password –

After a password has been defined, the password can be disabled by setting the password to be empty. This is accomplished by following the instructions in Setting a Password; when the ENTER NEW PASSWORD screen is displayed, press ENTER before selecting any characters. This sets the password to empty, disabling the password for the selected user ID.

Login Timeout

DataGuard minimizes the risk of unauthorized access by providing a logout mechanism. When a user has finished their activities on the analyzer, logging out prevents a second user from accessing the system under the first user's account. This feature is described in the Logout section of this chapter.

DataGuard also provides a timeout feature that automatically logs the user out after a period of inactivity with the keypad. If a user does not log out and leaves the system, the automatic logout feature will log the user out if the keypad is not used within a defined period of time. The LOGIN TIMEOUT menu allows the duration of this time period to be defined.

Setting the login timeout:

1. Select LOGIN TIMEOUT from the ADMIN menu and press ENTER. The LOGIN TIMEOUT screen displays:

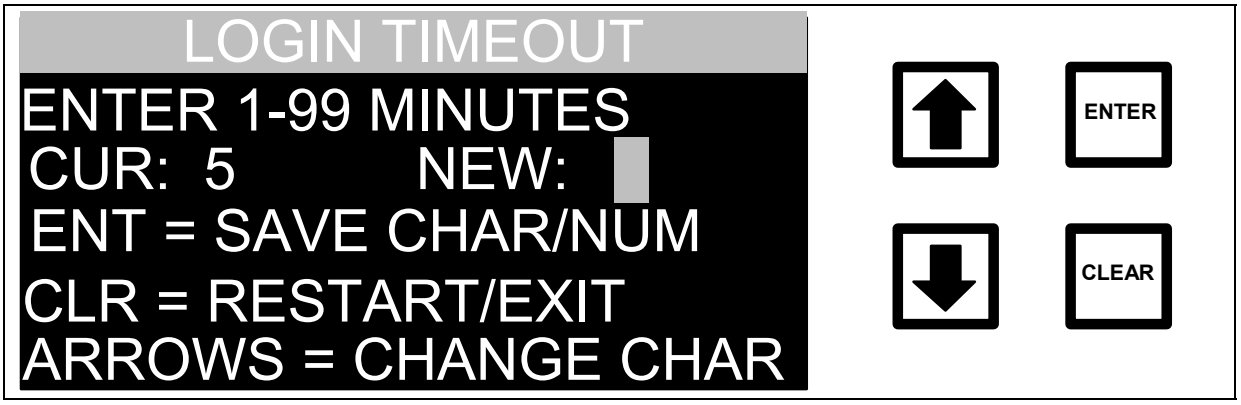


FIGURE 7-13: LOGIN TIMEOUT Screen

2. Use the arrows (↑ or ↓) to scroll through the numbers for each digit to be entered and press ENTER after each one to select. Pressing CLEAR returns to the previous digit.

3. When all of the digits have been entered, press ENTER again to set the login timeout.

When an automatic timeout occurs, the LOGIN HAS TIMED OUT screen displays when a user pushes any key:

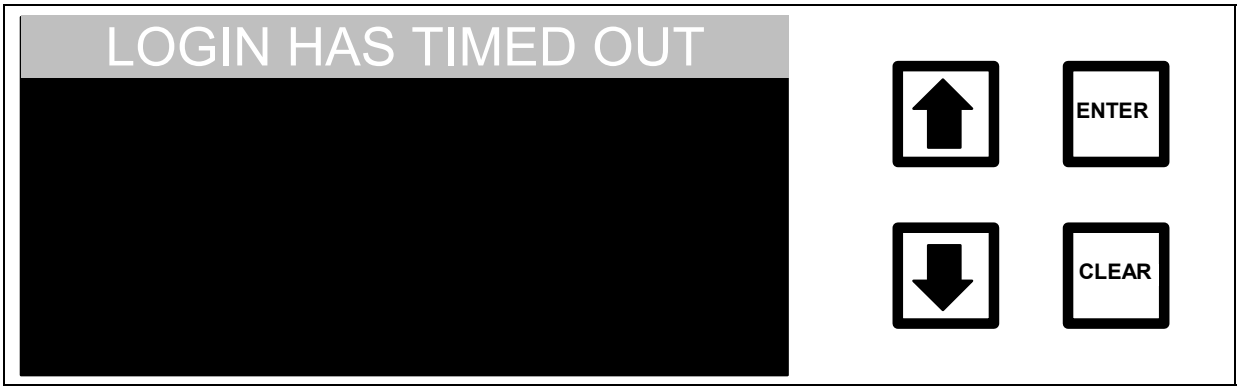


FIGURE 7-14: LOGIN HAS TIMED OUT Screen

After a few seconds, the ENTER PASSWORD screen displays. The user must re-enter a valid password in order to access the menu system.

Audit Trail

The DataGuard feature maintains an audit trail showing the history of activities performed on the instrument. Each audit trail entry contains an identification number, what operation was performed, when the operation was performed, and the ID of the user that performed the operation. Some entries also have the new value of a setting, if appropriate.

To manage the audit trail, scroll with the arrows (↑ or ↓) to highlight AUDIT TRAIL and press ENTER. The AUDIT TRAIL menu is displayed:

FIGURE 7-15: AUDIT TRAIL Menu

There are four options in the AUDIT TRAIL menu:

- VIEW AUDIT TRAIL shows the audit trail entries on the display.
- PRINT AUDIT TRAIL sends the entire audit trail to the printer, if a printer is available.
- EXPORT AUDIT TRAIL sends the entire audit trail to the RS-232 port.
- RESET AUDIT TRAIL is used to allow more audit trail entries after printing or exporting the audit trail.

Select an option by using the arrows (↑ or ↓) to highlight the desired option, then press ENTER.

The instrument can store approximately 200 entries. When the audit trail is almost full, a message will be displayed requesting that the audit trail be archived (either by printing or exporting). The audit trail should be reset after it has been archived; this will allow the instrument to store another 200 or so entries.

WARNING
Once the audit trail is full, the instrument will not allow any operations other than printing or exporting the audit trail; the audit trail should be archived as soon as the warning displays.

View Audit Trail

To view the current audit trail, use the arrows (↑ or ↓) to highlight VIEW AUDIT TRAIL, then press ENTER. The screen displays the most recent entry in the audit trail:

FIGURE 7-16: VIEW AUDIT TRAIL Screen

Use the arrows (↑ or ↓) to scroll to earlier or later entries. Press CLEAR to return to the AUDIT TRAIL menu.

Print Audit Trail

To print the current audit trail, use the arrows (↑ or ↓) to highlight PRINT AUDIT TRAIL, then press ENTER. The PRINTING AUDIT TRAIL screen displays:

FIGURE 7-17: PRINTING AUDIT TRAIL Screen

This screen will be cleared when printing is complete. To abort printing, press CLEAR. After the audit trail is printed or aborted, the AUDIT TRAIL menu displays.

Export Audit Trail

To export the current audit trail to the RS-232 port, use the arrows (↑ or ↓) to highlight EXPORT AUDIT TRAIL, then press ENTER. The EXPORTING AUDIT TRAIL screen displays:

FIGURE 7-18: EXPORTING AUDIT TRAIL Screen

This screen will be cleared when the entire audit trail has been sent to the RS-232 port. To abort the export process, press CLEAR.

Table 7 shows the fields of each audit trail entry.

Table 7. RS-232 Audit Trail Output Format

Field #	Field Contents	Format/Notes	Example
1	User ID	11 alpha-numeric characters (columns 1-11)	ADMIN 01
2	Entry ID Number	9 numeric characters (columns 13-21)	693090237
3	Date	dd MMM yyyy (columns 23-33)	17 OCT 2001
4	Time	hh:mm:ss (columns 35-42)	15:02:27
5	Operation	20 alpha-numeric characters (columns 44-63)	PASSWORD SET
6	Data	Alpha-numeric characters (columns 65-end of line)	QUALITY 01

After all of the audit trail entries have been exported, the instrument will send the characters “AT” to indicate that the audit trail is complete. After the audit trail is exported or aborted, the AUDIT TRAIL menu displays.

Reset Audit Trail

To reset the current audit trail, use the arrows (↑ or ↓) to highlight RESET AUDIT TRAIL, then press ENTER.

If the audit trail has not been archived, the RESET AUDIT TRAIL WARNING screen displays:

FIGURE 7-19: RESET AUDIT TRAIL WARNING Screen

If the audit trail has been archived, the RESET AUDIT TRAIL confirmation screen displays:

FIGURE 7-20: RESET AUDIT TRAIL Confirmation Screen

To reset the audit trail, press ENTER. To exit without resetting the audit trail, press CLEAR.

Logging Out

Log out after using the menu system to minimize the risk of unauthorized access by other users.

To logout, select LOGOUT from the MAIN menu. The LOGOUT COMPLETE screen displays:

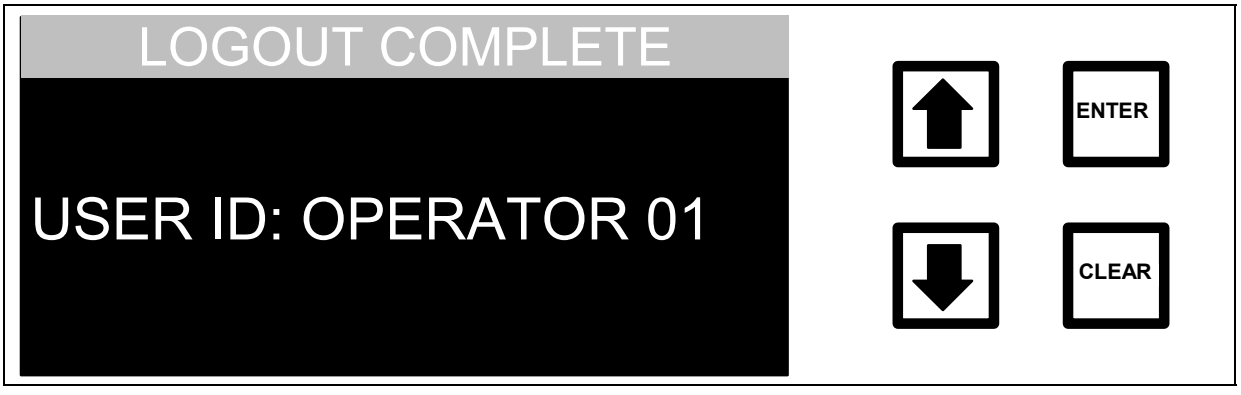


FIGURE 7-21: LOGOUT COMPLETE Screen

After a few seconds, the screen will clear and the analyzer will begin running analysis, as if the START TOC option had been selected. Further access to the menus will require a user to login.

8 MAINTENANCE

To ensure optimum performance of the analyzer, routinely replace the chemical reagents, in-line filter, UV lamp, and pump tubing. Chemical reagents, in-line filters, UV lamps, and pump tubing *must* be purchased from Ionics Instruments. Refer to Table 8 for the recommended maintenance schedule. TOCMAINT is the part number for a customizable kit of all maintenance items. When purchasing a kit the items will ship when the item is scheduled. The kit may be set up to the analyzer's maintenance schedule.

The replacement schedule for acid will depend on flow rates used and will be indicated by the microprocessor (see the Installation Chapter for reagent warning messages). A 3-year maintenance record log is provided for convenience to ensure that all required maintenance is performed when necessary.

Table 8. Replacement/Maintenance Schedule

Part Number	Description	Operating Life*
TOCMAINT	12 month kit	One year
HTF 94402	60 µm filter element	as needed**
APF 80025	Oxidizer reagent***	3 months
APF 80010	Acid reagent***	3 months
ATU 00646	Pump tubing*	12 months
ARE 00020	UV lamp*	6 months
	RAM card****	
	DI Water Reservoir	refill as needed
	Autosampler	check every 2 weeks
	On-Line	3 months

* Operating life is based on the total time the analyzer is making measurements.

** The lifetime of the in-line filter will depend on the levels of particles in your water samples. If the filter plugs frequently, contact Ionics Instruments for larger capacity filter devices.

*** Due to decomposition, the lifetime of the oxidizer is 3 months, whether the analyzer is in use or is idle. The lifetime of the acid reagent is one year.

**** The analyzer is equipped with a RAM card. There is an option of using the RAM card for long-term data storage and replacing the card when full. Additionally, the RAM card data may be copied to a permanent archival device (such as a hard drive or floppy disk). Once the copying is complete, the original RAM card may be reused. If the RAM card is reused, it does not need to be replaced as part of an ongoing maintenance program.

RAM cards in various sizes can be purchased from Ionics Instrument Business Group. Table 9 identifies the cards available and their respective capacities at continuous operation.

Table 9. Available RAM Cards and Storage Capacity

Part Number	RAM Card Size	Capacity (Days of Operation)	Battery Lifetime* (Years)
EMC 05120	512K	102.6	2
EMC 10240	1024K	205.4	1.5
EMC 20000	2048K	411.0	1

* An internal battery is used by the RAM cards to preserve the data when the card is removed from the analyzer. Battery lifetime is extended if the RAM card is in an operating unit. Lifetime varies with manufacturer. Some larger cards have rechargeable batteries to save data when changing main battery.

NOTE

For instrument firmware with the DataGuard feature, enter a Maintenance-level (or higher) password when prompted. Check with your system administrator for an appropriate password. See the DataGuard Operation chapter for more information regarding the DataGuard feature.

Replacing the In-line Filter

To prevent clogging, a filter is installed on the sample inlet line. The lifetime of the filter element will depend on the level of particles in the water samples. If monitoring the TOC of the feed water (prior to purification), the filter element will need to be replaced more often than if monitoring the water after purification. If the filter element clogs too frequently, contact Ionics Instruments to receive help in the selection of larger capacity filters. As the filter is used, the flow rate of water through the sample inlet system will decrease and can even stop. A simple way to determine if the filter element needs to be changed, is to periodically measure the flow rate of water out the waste line of the sample inlet system and replace the filter element when the flow rate starts to decrease. It is desirable to replace the filter element on a routine basis to prevent clogging the filter. For this procedure two 3/4" wrenches will be needed.

To replace the filter element:

1. Stop the analyzer by scrolling to STOP TOC in the RUNTIME menu and pressing ENTER.
2. Shut off the water to the sample inlet system at the sampling port.
3. Remove the filter by loosening the Swagelok nuts on the 1/4" Teflon tubing and disconnecting the tubing.
4. Position the 3/4" wrenches on the ends of the filter (see Figure 8-1). Loosen the adapter on the inlet side of the filter.
5. Unscrew the spring-loaded inlet adapter, taking care to not lose the spring.
6. Remove the old filter element from the body of the filter.
7. Insert a new filter element into the body of the filter, opened end first.

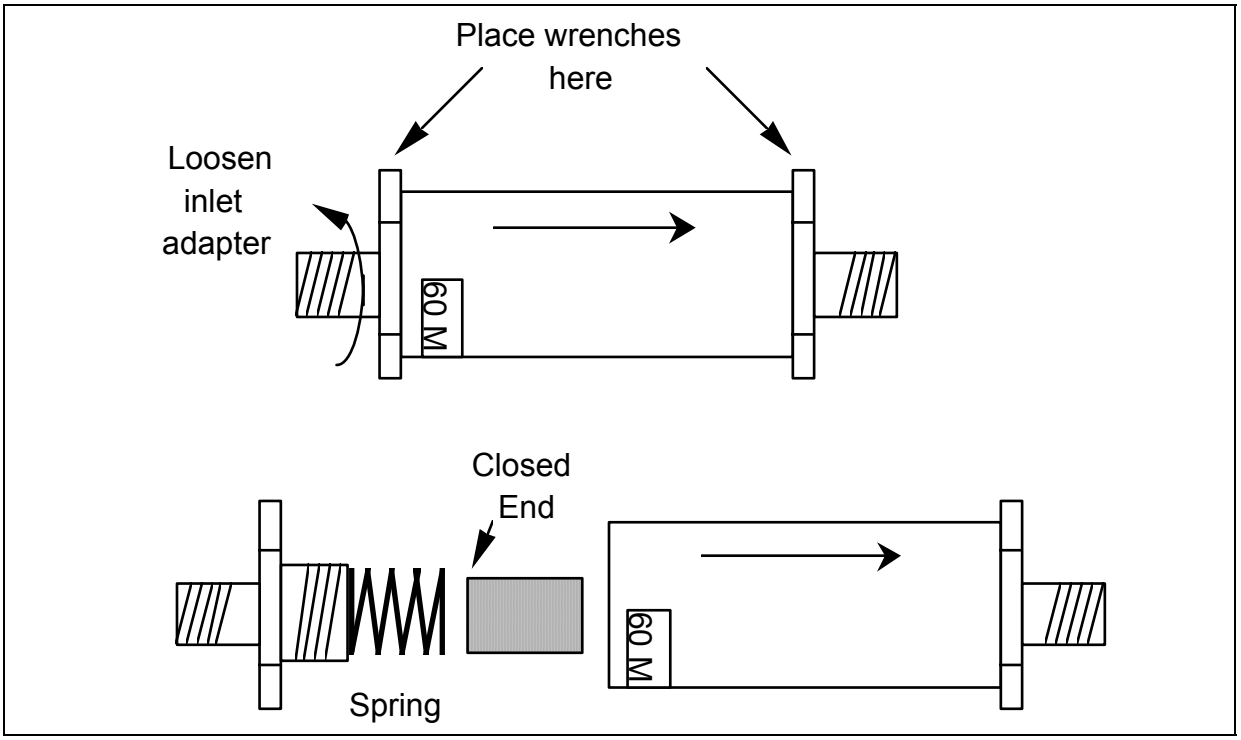


FIGURE 8-1: Replacing the In-Line Filter Element.

8. Replace the spring in the inlet adapter and screw the inlet adapter into the body of the filter.
9. Secure the inlet adapter by tightening ~ 1/4 turn past finger tight.

10. Reconnect the 1/4" Teflon tubing from the sampling port adapter to the inlet of the in-line filter. The in-line filter has arrows on the body of the filter that indicate the direction of flow through the filter. Tighten the nut 1/4 turn past finger tight.
11. Reconnect the 1/4" Teflon tubing to the outlet of the filter and tighten the nut 1/4 turn past finger tight.
12. Turn on the water supply at the sampling port prior to starting the analyzer.

Replacing the Reagents

The oxidizer and acid reagents *must* be purchased from Ionics Instruments to ensure product purity. The use of reagents from other sources or failure to replace the reagents on the prescribed replacement schedule will invalidate the warranty.

WARNING

Reagent containers are for single-use only – do not refill. Refilling or reusing reagent containers will void all instrument and parts warranties and nullify any performance claims.

WARNING

Installation of the reagents requires access to the inside of the analyzer. To avoid potentially dangerous shock, disconnect the power cord before opening the analyzer's top panel.

WARNING

To avoid exposure to the chemical reagents, wear acid-resistant gloves, protective clothing, and safety goggles or a face shield when changing the reagent supplies.

To replace the reagents:

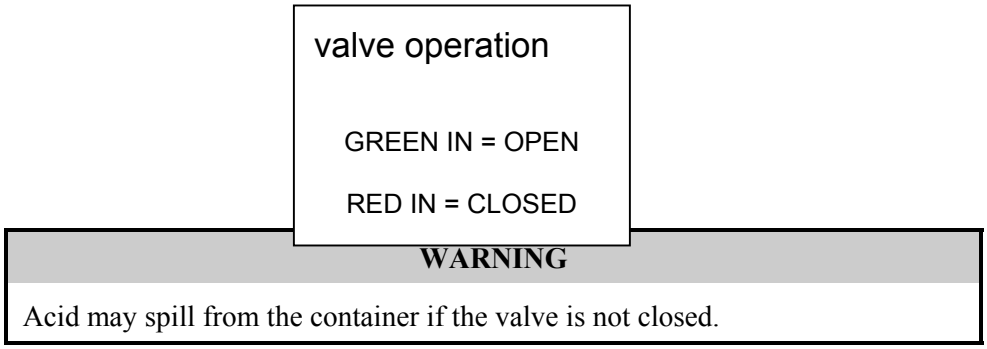
1. Turn the main power switch off and unplug the power cord.

2. Open the analyzer top panel by pushing back on the two black handles and lifting the panel upwards.

3. Locate the reagent supplies in the covered enclosure located at the front, right-hand side of the analyzer. Open the top cover on the reagent enclosure by loosening the two screws located at the back of the enclosure and removing the cover.

4. Locate the acid supply (container on the left-hand side). Remove the container from the enclosure by lifting up on the front of the container (the end opposite the Mininert valve) and pulling the container out of the enclosure while sliding the Mininert valve out from under the tubing and stainless steel cross.

5. Close the Mininert valve on the acid container by pressing on the red button to slide the stainless steel bar fully inward. Refer to the label on the reagent box for further clarification.



6. Disconnect the acid container from the inlet line. Lift the container from the holder and unscrew the container counterclockwise while holding the brown knurled nut. Turning the container rather than the nut will prevent the tubing from twisting.

7. Use DI water and a paper towel to remove any liquid or solids from the nut/ferrule, and connect the new acid reagent container to the ACID inlet line by carefully screwing the container and Mininert valve on the container clockwise onto the nut. Tighten fingertight. If the tubing did not twist when removing the container, turn the nut instead of turning container. Do not overtighten the nut.

8. Open the Mininert valve on the acid container by pressing on the green button to slide the Teflon bar fully inward. Reference the label on the container to verify direction.

9. Hold the acid container with the lid facing inward toward the oxidizer container (see Figure 8-2). Install the acid container on the left-hand side of the enclosure by holding the container at an angle with the Mininert valve pointing down, sliding the valve underneath the cross into the slot at the rear of the enclosure, then lowering the container into the enclosure.

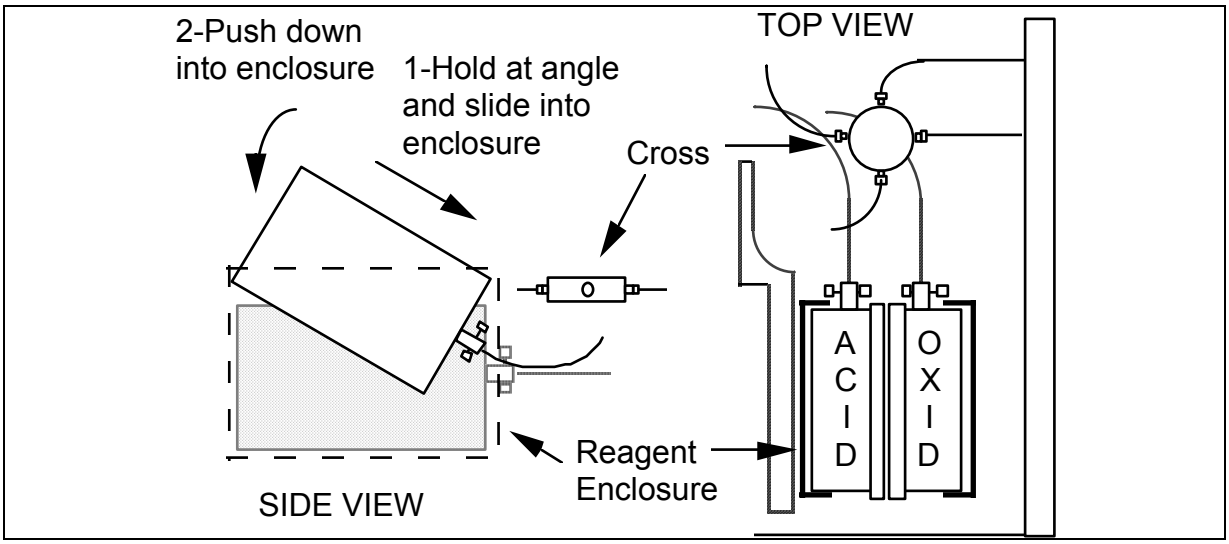


FIGURE 8-2: Installing Reagent Containers

10. Locate the OXIDIZER supply (container on the right-hand side) and remove the container from the enclosure by lifting up on the front of the reagent container (end opposite the Mininert valve), pulling the container out of the enclosure, while sliding the Mininert valve out from under the tubing and stainless steel cross.

11. Close the Mininert valve on the OXIDIZER container by pressing on the red button to slide the stainless steel bar fully inward.

WARNING
Oxidizer may spill from the container if the valve is not closed.

12. Disconnect the oxidizer container from the inlet line by grasping the container and the brown nut and unscrewing the nut counterclockwise while holding the container. Turning the nut rather than the container will prevent the tubing from twisting.
13. Use DI water and a paper towel to remove any liquid or solids from the nut/ferrule and connect the new OXIDIZER reagent container to the OXIDIZER inlet line by carefully screwing the container and Mininert valve clockwise onto the nut and tighten fingertight. Do not overtighten the nut.
14. Open the Mininert valve on the oxidizer container.
15. Install the oxidizer container on the right side of the enclosure with the valve facing the rear of the analyzer.

NOTE

The used reagent containers may still have a small volume of 6 M H_3PO_4 (ACID) or 15% $(NH_4)_2S_2O_8$ (OXIDIZER) inside and should be disposed of properly. Consult state and local regulations.

16. Replace the reagent enclosure top cover and secure with the thumb screws.
17. Record the installation date for the reagents in the service log.

If you need to replace the UV lamp, follow the procedures listed in the next section. Otherwise, close the top panel and restart the analyzer to enter the installation date for the reagents in the CONSUMABLES menu.

18. Plug in the power cord and turn the power switch on. The analyzer will start initialization.
19. Stop the analyzer by selecting STOP TOC.
20. Follow the procedures outlined later in this chapter to enter the installation date for the reagents in the CONSUMABLES menu.

NOTE

Reagent containers need to be disposed of according to local regulations. All reagent containers are shipped with Material Safety Data Sheets (MSDS). These sheets will provide instructions. Ionics Instruments will not accept containers for disposal.

Replacing the UV Lamp

The intensity of the UV lamp, particularly emission of short-wavelength radiation, decreases over time. Replace the lamp every six months.

WARNING

The UV lamp contains mercury and may be considered hazardous material in your local area. Dispose of the UV lamp in accordance with Federal, state, or local government regulations.

WARNING

Installation of the UV lamp requires access to the inside of the instrument. To avoid potentially dangerous shock, disconnect the power cord before opening the instrument's top panel.

WARNING

Should the UV lamp become broken or damaged it should be handled in accordance with your organization's toxic waste handling procedure and disposed of in accordance with Federal, state, or local government regulations.

NOTE

Included with the replacement UV lamp is a pair of cotton gloves to be worn during the installation to avoid leaving fingerprints on the quartz window of the lamp. Fingerprints will absorb UV radiation and decrease the performance of the oxidation reactor. Use methanol to remove any fingerprints before installing the new lamp.

For this procedure, you will need a 5/8" and an 11/16" open-end wrench.

To replace the UV lamp:

1. Turn off the main power switch and unplug the power cord.
2. Open the instrument top panel by pushing back on the two black latches and lifting the panel upward.
3. Locate the oxidation reactor (covered aluminum enclosure) located in the center of the instrument, with a brass nut at the back of the enclosure and a black wire with a black connector extending from the nut.
4. Carefully unplug the black power connector by pulling on both ends of the connector. Move the ribbon cables and wires away from the back of the oxidation reactor so that there are no obstructions for removing the lamp.
5. If the bulkhead nut (the nut next to the aluminum housing) cannot be loosened manually, hold it with a 5/8" wrench and use an 11/16" wrench to loosen the outer brass nut by turning the nut clockwise. Once the nut is loose, use fingers to finish loosening the nut.

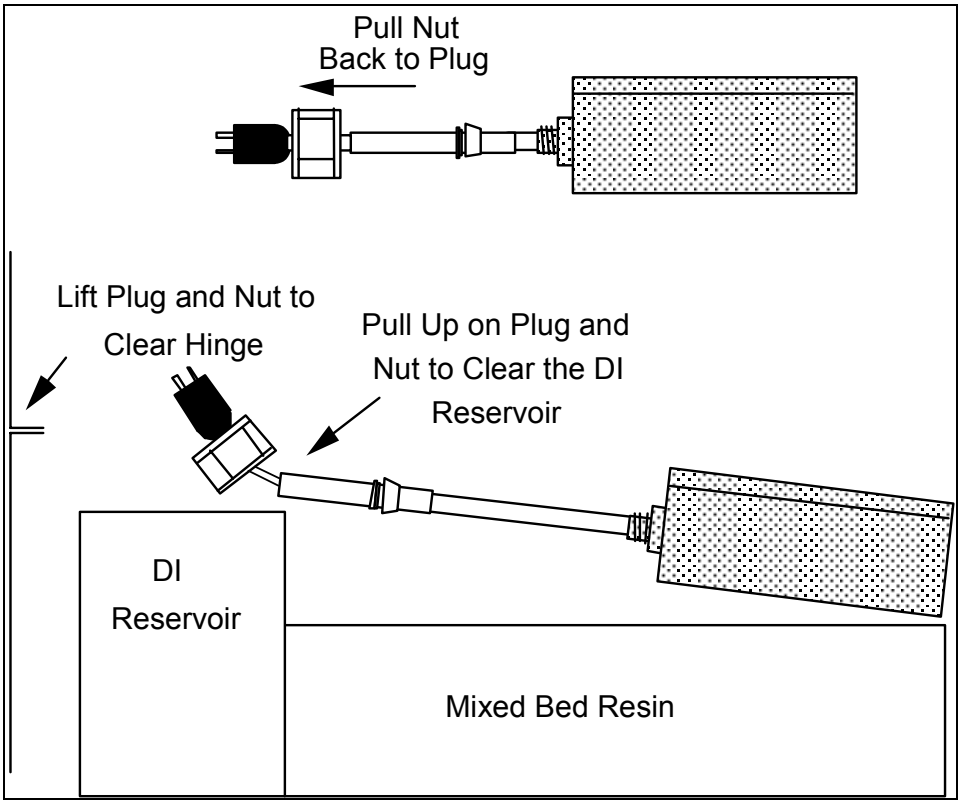


FIGURE 8-3: Lamp Removal

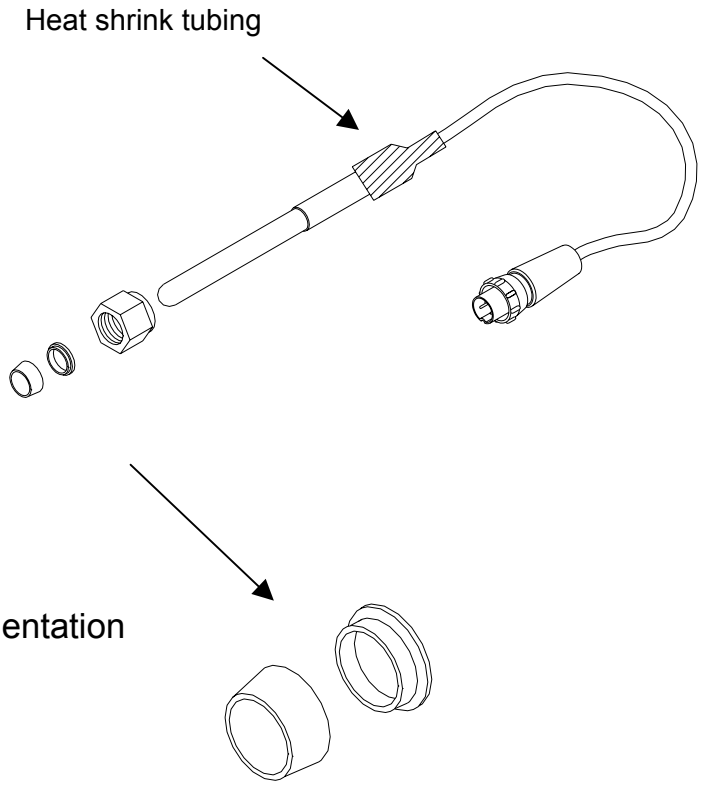
6. Pull nut from lamp body up onto lamp cord all the way back to the plug. This will help in removing the lamp from the enclosure.

7. Carefully pull the lamp out of the quartz coil and enclosure, being careful not to break the quartz coil. Pull the nut and plug past the top of the DI reservoir first, then carefully manipulate the lamp over the top of the reservoir. Lifting on the plug will help position the lamp so that it clears the top of the reservoir. Gently twisting the lamp back and forth will help to remove the lamp from the enclosure.

8. Pull the plug and nut away from the hinge on the top cover so that the cord and lamp will clear the hinge.

9. Put on the gloves supplied in the box. Remove the new lamp from the packet. Remove the nut and ferrules from the zip-top bag and slide them up the lamp housing until they are flush with the heat shrink tubing. Be careful when inserting the lamp into the instrument as the nut and ferrules

may slide off. Refer to the following illustration for proper orientation of the ferrules.



10. Carefully slide the lamp into the oxidation reactor enclosure.
11. While tightening the nut, make sure it stays flush with the heat shrink tubing. Tighten the nut finger-tight. Do NOT use a wrench.
12. Connect the lamp cord to the two-prong connector. One prong is larger than the other and the connector will fit only one way.
13. If the pump tubing needs to be replaced, follow the procedure in this chapter, otherwise close the top panel and restart the instrument.
14. Record the installation date for the lamp in the service log.
15. Plug in the main power cord and turn the power switch on. The instrument will start initialization.

16. Follow the procedures listed in this chapter to enter the installation date for the UV lamp in the CONSUMABLES menu. If the reagents have been changed, be sure to enter the installation date in the CONSUMABLES menu for the reagents.

17. After changing the UV lamp, perform a calibration verification using instructions in the Calibration chapter.

Replacing the Pump Tubing

The tubing for the sample pump loses elasticity over time and must be replaced once a year to ensure proper flow rates. The tubing must be purchased from Ionics Instruments; use of tubing from other sources or failure to replace the tubing on the prescribed replacement schedule will affect instrument functionality.

A 3/32" Allen wrench is supplied with the instrument to replace the pump tubing.

WARNING

Installation of the pump tubing requires access to the inside of the instrument. To avoid potentially dangerous shock, disconnect the power cord before opening the instrument's top panel.

WARNING

To avoid exposure to the acidified water in the tubing, wear acid resistant gloves, protective clothing, and safety goggles or a face shield, when changing the pump tubing.

To remove the old tubing:

1. Turn off the main power switch and unplug the power cord

2. Open the instrument top panel by pushing back on the two black catches and lifting the panel upwards.

3. Locate the sample pump and tubing support bracket located at the back, right-hand corner of the analyzer (see Figure 8-4). The support bracket is a plastic piece just to the left of the pump.

4. Remove wing nut in center of bracket and remove the piece.

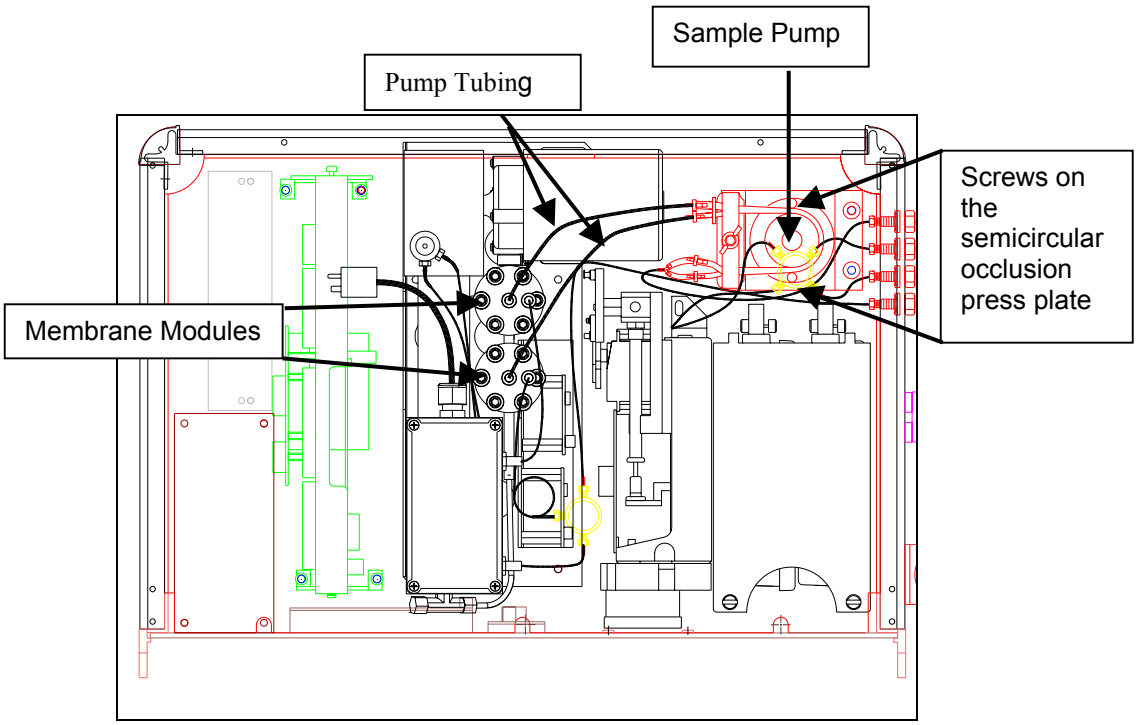


Figure 8-4: Pump Tubing and Components

5. Use a 3/32" Allen wrench to loosen both of the screws on the semicircular occlusion pressure plate on the right-hand side of the sample pump.

6. Remove the screw from the pressure plate closest to the front of the analyzer (see Figure 8-4) and swing the plate open to expose the tubing.

7. Locate the membrane modules (circular, stainless steel pieces with tubing extending out the top) located in the middle of the analyzer. The tubing to be replaced is connected to the membrane module, and runs behind the syringe pumps to the sample pump.

8. Grasp the membrane module and pull on the outlet tubing to disconnect. While holding the tubing up, remove the tubing from around the sample

pump, letting the fluid in the tubing drain out the instrument outlet. Leave the tubing connected to the outlet Y-fitting.

9. Repeat this process to disconnect the outlet tubing from the other membrane module, removing the tubing from the interior of the analyzer and letting the fluid in the tubing drain out the instrument outlet.

10. Disconnect the pump tubing from 1/16" stainless steel tubing attached to the bulkhead fitting and dispose of the old tubing.

12. Use a paper towel to cleanup any liquid that may have spilled inside the instrument.

To install the new tubing:

1. Remove the tubing from the shipping container. The tubing for the TC channel is the longer piece.
2. Connect the single end of the new tubing to the 1/16" stainless steel tubing attached to the bulkhead fitting.
3. Feed the tubing around the sample pump and behind the syringe pumps to the membrane modules.

IMPORTANT!

It is crucial that steps 4 and 5 are followed exactly. The shorter piece of tubing must be used on the IC membrane module and the longer piece of tubing must be used on the TC membrane module. Failure to do so will result in interference with the movement of the syringe pump armature.

4. Connect the SHORTER piece of tubing to the IC membrane modules (the one closest to the back of the analyzer).
5. Connect the *LONGER* piece of tubing to the TC membrane modules (the one closest to the front of the analyzer).
6. Position the tubing one on top of the other in the slots of the support bracket with the plastic collar just to the left of the bracket. Replace the top piece of the bracket, and secure with the wing nut. Do not pinch the tubing with the support bracket.

7. Place one Allen screw in the sample pump pressure plate. Firmly hold the pump with your thumb while squeezing the pressure plate with your fingers until the screw drops into position. Tighten the screw one turn, then insert the other screw and make sure it drops into position. With both screws in position, use the Allen wrench to secure the pressure plate, making sure the screws are tight.
8. Inspect the tubing to ensure it is not close to the servo (moving) mechanisms on the syringe pumps, repositioning the tubing if necessary.
9. Close the top panel.
10. Record the installation date for the pump tubing in the service log.
11. Plug in the main power cord and turn the power switch on. The analyzer will start initialization.
12. Stop the analyzer and follow the procedures listed below to enter the installation date for the pump tubing in the CONSUMABLES menu.

Entering the Installation Dates for Reagents, UV Lamp, and Pump Tubing

After changing the reagents, UV lamp, or pump tubing, you must enter the installation date. From the MAIN menu, scroll to MAINTENANCE and press ENTER.

1. Use the arrows (↑ or ↓) to scroll to CONSUMABLES and press ENTER to display the CONSUMABLES menu:

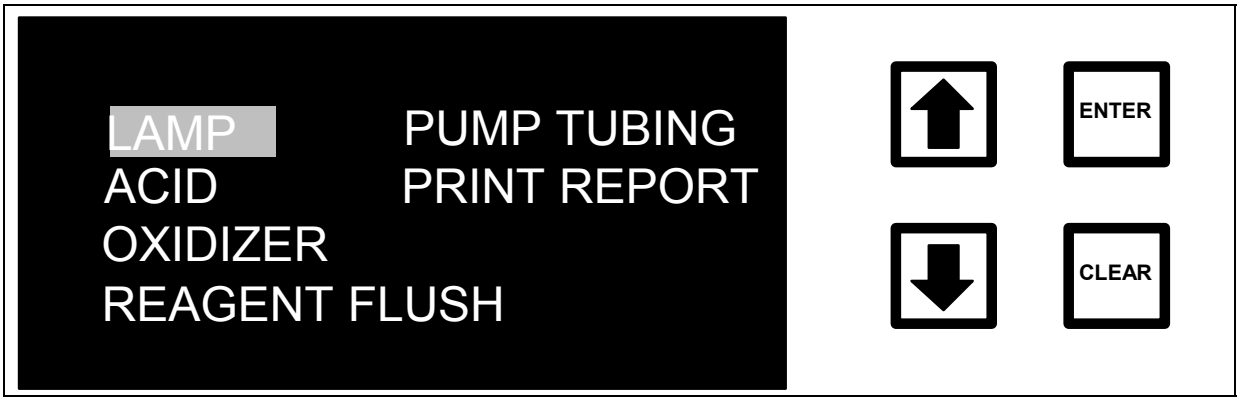


FIGURE 8-5: CONSUMABLES Menu

WARNING
The procedures described below reset timers and other key indicators used to keep track of the Reagents, UV Lamp, and Pump Tubing lifetimes. In these options, pressing ENTER zeroes the timers. Do not reset the times unless the consumables are replaced. When viewing the status of the Reagents, UV Lamp and Pump Tubing, press CLEAR to exit the menu without resetting the timers.

Oxidizer Reagent

To enter the installation date for the oxidizer reagent supply:

1. Use the arrows (↑ or ↓) to scroll to OXIDIZER. Press ENTER to display the OXIDIZER INSTALLATION menu:

FIGURE 8-6: OXIDIZER INSTALLATION Menu

2. With the INSTALL option highlighted, press ENTER to display the OXIDIZER Status and INSTALLATION screen:

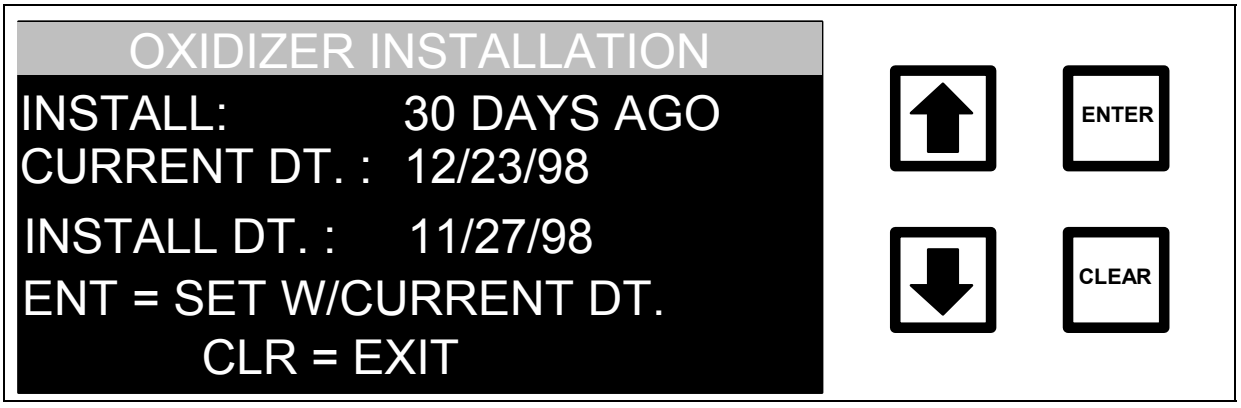


FIGURE 8-7: OXIDIZER Status and INSTALLATION Screen

The amount of oxidizer in the reservoir and the date when the oxidizer reservoir was installed (INSTALL DT) is shown. The install date will be changed to the current date as described below.

3. To change the INSTALL date to today's date, press ENTER.
4. If password protection is enabled, the ENTER PASSWORD screen is displayed; enter the password. Otherwise, go to step 5.

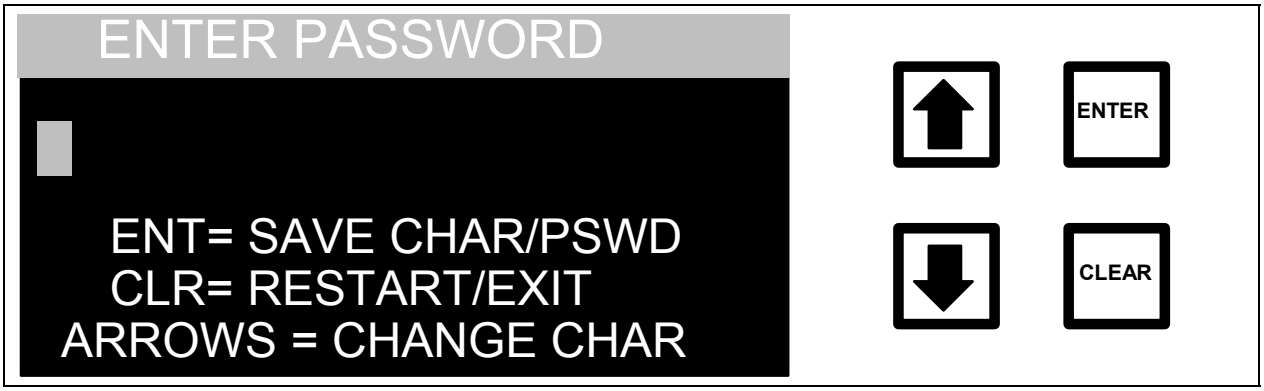


FIGURE 8-8: ENTER PASSWORD Screen

5. The display will change to the Oxidizer Status and Installation screen and display the new install date. The program prompts you to confirm the new install date. Press ENTER to store the new installation date and return to the OXIDIZER INSTALLATION screen. Press CLEAR to exit without changing the value.

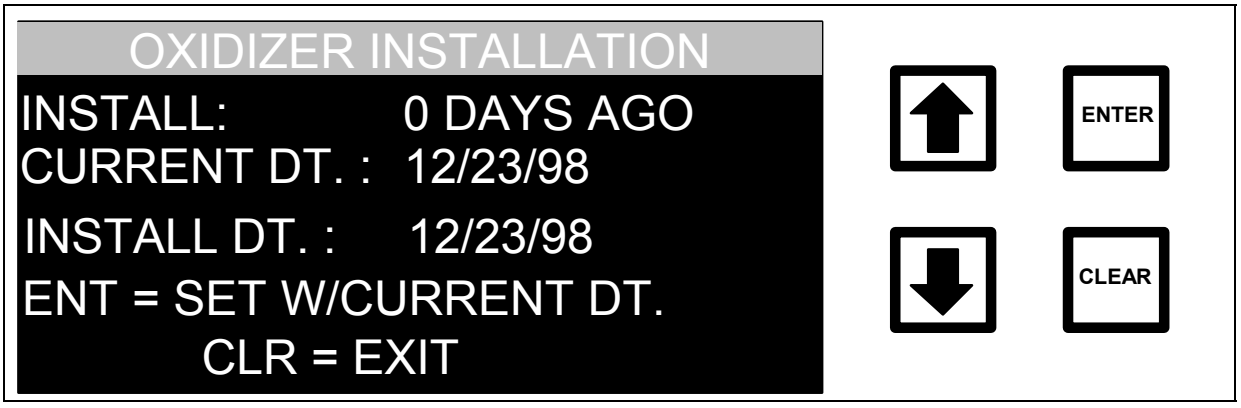


FIGURE 8-9: OXIDIZER Status and INSTALLATION Screen

6. To change the percent left, highlight SET % LEFT and press ENTER. Follow the on-screen instructions to change the percent left.
7. To change the installation date, highlight SET INSTALL DATE and press ENTER. Follow the on-screen instructions to change the oxidizer installation date.
8. Press CLEAR to return to the CONSUMABLES menu.

Acid Reagent

1. From the Consumables menu, use the arrows (↑ or ↓) to scroll to ACID. Press ENTER to display the ACID INSTALLATION menu:

FIGURE 8-10: ACID INSTALLATION Menu

2. With INSTALL highlighted, press ENTER to display the Acid Status and Installation screen.

3. To change the install date to today's date, press ENTER.
4. If password protection is enabled, the ENTER PASSWORD screen is displayed; input the password and press ENTER. Otherwise, go to step 5.
5. The display changes to the ACID Status and INSTALLATION screen and asks for confirmation of the new installation date. Press ENTER to store the new installation date and return to the ACID INSTALLATION menu. Press CLEAR at the ACID Status and INSTALLATION screen to exit without changing the value.
6. To change the percent left, highlight SET % LEFT and press ENTER. Follow the on-screen instructions to change the percent left.
7. Press CLEAR to return to the CONSUMABLES menu.

Lamp

The UV Lamp is monitored by a timer that counts down the hours from a beginning point of 4368 (182 days x 24 hours). The display will calculate the percentage of hours remaining. To reset the timer for the lamp:

1. With the LAMP option highlighted in the CONSUMABLES menu, press ENTER to display the LAMP INSTALLATION menu:

FIGURE 8-11: LAMP INSTALLATION Menu

2. With the INSTALL option highlighted, press ENTER to display the LAMP Status and INSTALLATION screen:

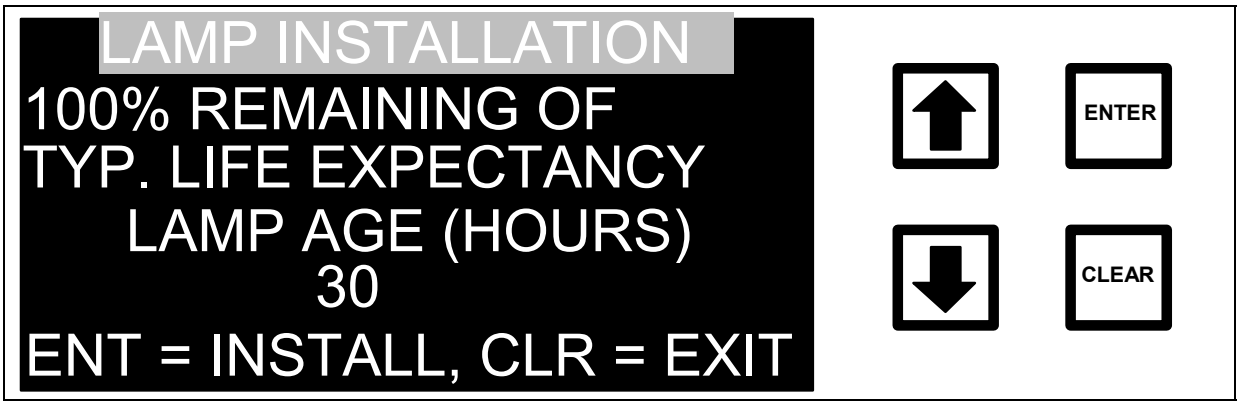


FIGURE 8-12: LAMP Status and INSTALLATION Screen

3. To reset the timer to zero, press ENTER.
4. If password protection is enabled, the ENTER Password screen is displayed; enter the password and press ENTER. Otherwise, go to step 5.
5. The display changes to the LAMP Status and INSTALLATION screen and prompts for confirmation. Press ENTER to reset the timer and return to the LAMP INSTALLATION menu. Press CLEAR to exit without changing the timer.
6. To change the percent left, highlight SET % LEFT and press ENTER. Follow the on-screen instructions to change the percent left.
7. Press CLEAR to return to the CONSUMABLES menu.

Pump Tubing

Pump Tubing is monitored by a timer that counts down the hours from a beginning point of 8760 (365 days x 24 hours). The display will calculate the percentage of hours remaining.

To reset the timer for the pump tubing from the CONSUMABLES menu:

1. With the PUMP TUBING option highlighted, press ENTER to display the tubing installation menu:

FIGURE 8-13: TUBING INSTALLATION Menu

2. With the INSTALL option highlighted, press ENTER to display the TUBING Status and INSTALLATION screen:

FIGURE 8-14: TUBING Status and INSTALLATION Screen

3. To set the timer to zero, press ENTER.
4. If password protection is enabled, the ENTER Password screen is displayed; enter the password and press ENTER. Otherwise, go to step 5.
5. The display changes to the TUBING Status and INSTALLATION screen and prompts for confirmation. Press ENTER to reset the timer and return to the TUBING INSTALLATION screen. Press CLEAR to exit without changing the timer.
6. To change the percent left, highlight SET % LEFT and press ENTER. Follow the on-screen instructions to change the percent left.
7. Press CLEAR to return to the CONSUMABLES menu.

Checking and Refilling the DI Water Reservoir

Water from the DI reservoir can be lost when using the analyzer with the autosampler or grab sampling. The level of the DI Water reservoir should be checked periodically and refilled as necessary. To check the level of DI water in the reservoir:

> **⚠ WARNING**
>
> Checking and refilling the DI water reservoir requires access to the inside of the analyzer. To avoid potentially dangerous shock, disconnect the power cord before opening the analyzer's top panel.

For this procedure, 10 to 20 mL of deionized water will be needed and the water bottle from the TOC accessories kit.

> ***CAUTION***
>
> The water used to replenish the DI Reservoir must be deionized from a pure source. This water may not be post-RO water!

1. Turn the power switch off on the left-hand side of the analyzer and disconnect the power cord.
2. Open the analyzer top panel by pushing back on the two black latches and lifting the panel upward. The DI reservoir is the black plastic box with a valve and two fittings attached on top. The valve is located between the resin bed and the circulating pump at the back, center of the analyzer (see Figure 8-15).

When the reservoir is completely filled, the plastic box will have a uniform dark color. If an air bubble is present, the bubble will appear as a lighter colored (almost white) area in the plastic box. There is no need to refill the reservoir if the box appears to be a uniform dark color. If an air bubble is present, follow the steps listed below to add DI water to the reservoir.

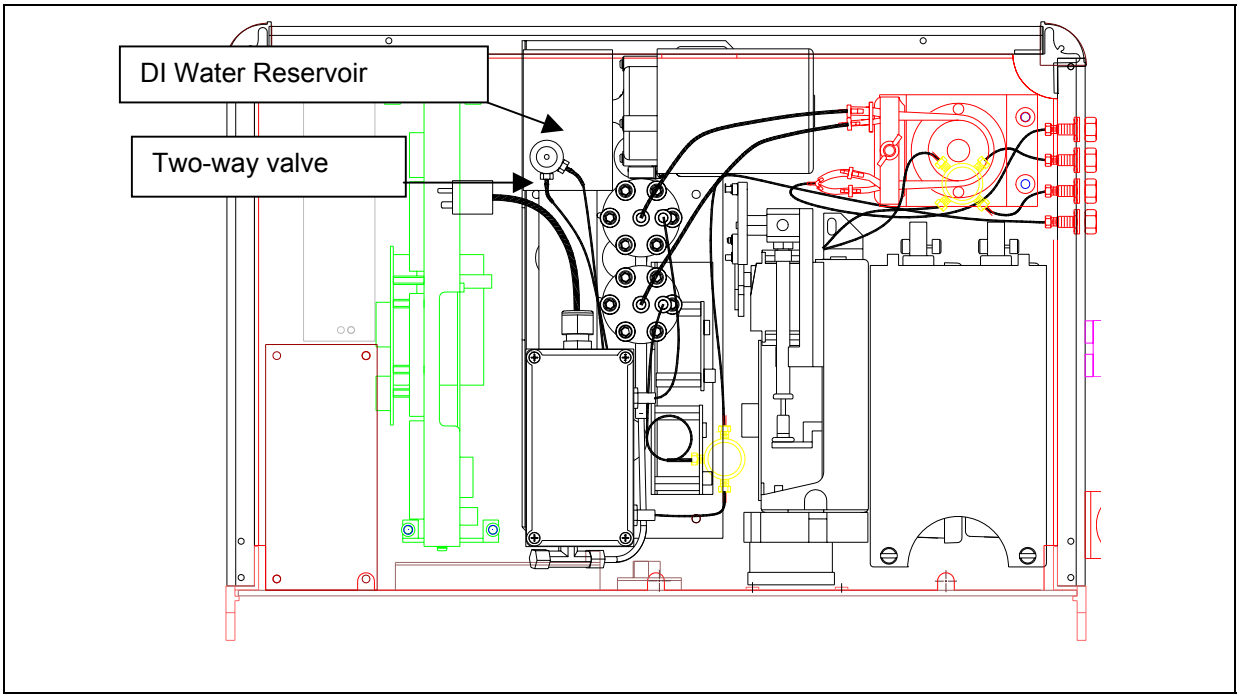


Figure 8-15: Location of DI Water Reservoir in TOC Analyzer

3. Remove the two-way check valve.
4. Fill the water bottle with DI water and use the water bottle to fill the DI water reservoir. Save the water bottle for future use.
5. Use your fingers to carefully replace the valve by gently pushing into place. Do not overtighten as the threads within the nut may be stripped.
6. Close the top cover panel, reconnect the power, and turn the power switch on.

Cleaning the Analyzer

If necessary, you may clean the external housing of the analyzer with a damp cloth using water or other non-abrasive cleaners. Turn off power to the instrument and disconnect from mains power prior to cleaning. Do not submerge the analyzer. Do not spray liquids directly on the analyzer. Wipe dry with a clean, soft cloth.

Sievers 800 TOC Analyzer 3-Year Maintenance and Service Records

Unit serial number _____ Date placed into operation _____

Maintenance Item	Period	Date	By	Notes
Oxidizer supply	3 months			
Acid supply	3 months			
UV Lamp	6 months			
Oxidizer supply	6 months			
Acid supply	6 months			
Oxidizer supply	9 months			
Acid supply	9 months			
Pump Tubing	12 months			
UV Lamp	12 months			
Oxidizer supply	12 months			
Acid supply	12 months			
Oxidizer supply	15 months			
Acid supply	15 months			
UV Lamp	18 months			
Oxidizer supply	18 months			
Acid supply	18 months			
Oxidizer supply	21 months			
Acid supply	21 months			
Pump Tubing	24 months			
UV Lamp	24 months			
Oxidizer supply	24 months			
Acid supply	24 months			
Oxidizer supply	27 months			
Acid supply	27 months			
UV Lamp	30 months			
Oxidizer supply	30 months			
Acid supply	30 months			
Oxidizer supply	33 months			
Acid supply	33 months			
Pump Tubing	36 months			
UV Lamp	36 months			
Oxidizer supply	36 months			
Acid supply	36 months			

ATTENTION!

If the analyzer is part of a system containing an Autosampler, please refer to the Autosampler Operation and Maintenance Manual for DataPro or DataPro/DataGuard and follow the calibration procedure found there.

The calibration procedure found here for the 800 Series is slightly different from the calibration procedure for the 800 Series using an autosampler. The autosampler procedure contains one extra equation because all the calibration standards are run at once and then adjustments are made to the calibration constants. This procedure runs the TC standard, makes an adjustment and then runs the IC standard, eliminating the need for the extra equation.

The analyzer was calibrated at the factory; calibration should be stable for at least one year. If the UV lamp is changed per the six month schedule, perform a verification of the calibration; re-calibration should not be necessary. Calibration constants are used to account for the recovery of CO_2 in the membrane module for the TC and IC channels. Another factor, the TC Zero Offset, is used to match the response of the TC and IC CO_2 sensors for low-TOC deionized water. The procedures described below allow for checking of the calibration and, if necessary, changing of the calibration values.

Calibration involves:

- Using low TOC, DI water to set the TC Zero Offset,
- Using a 25 ppm TC standard to set the recovery of CO_2 in the membrane module for the TC channel,
- Using a 25 ppm Na_2CO_3 standard to set the recovery of CO_2 for the IC channel and,
- Rechecking the TC and IC calibration by re-analyzing the standards.

A complete recalibration may be performed, or only recalibration of the TC Zero Offset or the TC and IC calibration constants. If desired, turn off the WARNING#42 option under SETUP→OUTPUTS to disable the low TOC/IC ratio warning during the calibration.

WARNING

Improper calibration of the analyzer will produce inaccurate results. Before calibrating the analyzer, carefully read the calibration procedure below. For questions regarding the calibration, contact Ionics Instruments.

NOTE

For on-line measurement of low TOC water (<10 ppb) there may be a need to recalibrate the TC Zero Offset during the first few months of operation. Check the offset after ~1 week, ~4 weeks and ~2 months of operation as described in this chapter.

NOTE

If the Oxidizer Reagent is more than 2 months old, it may be necessary to use a higher oxidizer flow rate than the 2.5 or 2.0 µL/min. flow rate selected with the S4-25 ppm Standard Preset.

NOTE

For instrument firmware with the DataGuard feature, enter a QA-level (or higher) password when prompted. Check with your system administrator for an appropriate password. See the DataGuard Operation chapter for more information regarding the DataGuard feature.

Supplies for TC and IC Standards

Ionics Instruments offers prepared standards:

STD 30001 25 mg/L Carbon as KHP TOC Calibration Standard (40mL vial)
STD 30002 25 mg/L Carbon as Na_2CO_3 IC Calibration Standard (40mL vial)
STD 30003 Reagent water (40mL vial)
STD 31001 Grab Mode Calibration Set (1-40mL Reagent Water, 2-40mL 25mg/L KHP, and 2-40mL 25mg/L Na_2CO_3)

Additional standards will be required if the calibration procedure is not successful initially and the procedure must be repeated.

To prepare calibration standards on site, refer to Appendix E.

TC Zero Offset

> **NOTE**
>
> The TC Zero Offset is *part of the calibration* procedure only if the analyzer is being used with water that is *less than 50ppb TOC*. If the analyzer is being used off-line or to analyze water that is *greater than 50ppb*, *do not perform this part* of the calibration procedure and proceed to TC calibration.

The TC zero offset corrects for minor differences in the response of the two CO_2 sensors. This adjustment is critical only for the determination of low-level TOC concentrations (< 50 ppb). Recalibration of this offset requires the TOC instrument to be connected on-line to a supply of low TOC, deionized water. Per Step 2 (8) below, if the instrument has been used for measurement of higher levels of TOC (TOC > 50 ppb), the instrument must run on-line for at least 6 hours, preferably overnight, to "clean" the instrument before adjusting the TC zero offset. If the instrument has been used for lower level TOC measurements (TOC < 50 ppb), it is not necessary to "clean" the instrument as part of the recalibration.

Prior to performing any calibration procedure, print the Constants List. From the SETUP menu, select PRINTER, then PRINT CONSTANTS. Retain this list for comparison after the calibration is finished.

To recalibrate the TC zero offset:

Step 1 – Connect Analyzer to Low TOC Water Supply:

If the analyzer has been used for sampling from containers or with the autosampler, follow the procedures below to set-up the analyzer for on-line measurements. If the analyzer has been running on-line, proceed to Step 2.

1. Set the SAMPLE MODE to on-line sampling in the SETUP menu.
2. Turn the analyzer off with the main power switch.
3. Disconnect both the 1/16"-OD Teflon tubes from the right side of the analyzer and reconnect the 1/16"-OD stainless-steel tubing from the sample inlet system to the analyzer inlet and the waste tube from the waste outlet to the 1/16" barb on the sample inlet system (see the

Operations chapter for more details on switching to on-line monitoring).

4. Connect the sample inlet system to a low TOC, deionized water supply.
5. Turn on the water supply.

Step 2 – Turn off the UV lamp and measure water:

1. Turn on the analyzer.
2. If necessary, stop the TOC measurement by going to the STOP TOC option in the RUNTIME menu and pressing ENTER. Once in the MAIN menu, select SETUP and press ENTER.
3. Scroll to the UV LAMP option and press ENTER to display the SET UV LAMP STATE screen:

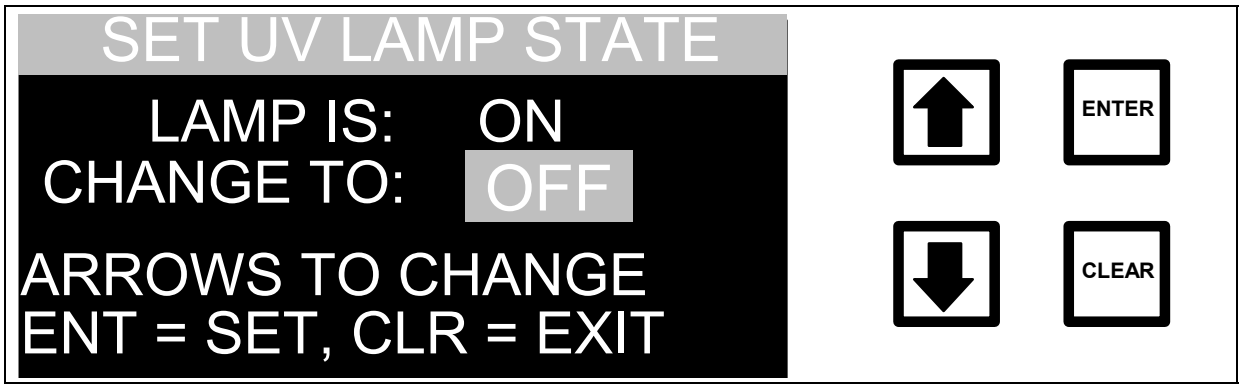


FIGURE 9-1: SET UV LAMP STATE Screen

4. Use the arrows (↑ or ↓) to select OFF and press ENTER to shut the lamp off.
5. Press CLEAR to return to the SETUP menu.
6. From the SETUP menu, select PRESETS. Highlight the S1-DI Water preset flow rates and press ENTER twice.
7. Press CLEAR three times to begin analysis.

8. If the instrument has been used for measuring higher levels of TOC (TOC> 50 ppb), make TOC measurements for at least 6 hours, preferably overnight. If the instrument has been used for lower level measurements (TOC < 50 ppb), make TOC measurements for at least 1 hour.

9. Stop the analyzer by pressing ENTER, scrolling to STOP TOC, and pressing ENTER again.

10. From the MAIN menu, select HISTORY and press ENTER.

11. Calculate and record the average value from the last five TOC measurements on the calibration worksheet.

12. Determine if the value is within the specified range of –0.1<TOC<+0.1 and record on the worksheet. If the value is within the range, there is no need to change the TC Zero Offset; proceed to Step Five. If the value is outside of the range, proceed with the TC Zero Offset procedure below.

Step 3 – Enter new TC Zero Offset:

1. Press CLEAR to return to the MAIN menu. Scroll to CALIBRATE and press ENTER.

2. Scroll to TC ZERO OFFSET and press ENTER to display the TC ZERO CORRECTION screen and the current value of the offset. Record the current offset value on the calibration worksheet.

3. Calculate the new TC Zero Offset using the formula:

   New TC ZERO OFFSET = (Initial TC OFFSET) – (Avg. TOC Value)

   Record the value on the calibration worksheet.

NOTE

The TC Zero Offset can be positive or negative. Be sure to include the sign when entering the new value.

4. Enter the new TC Zero Offset by scrolling to the first digit or the minus sign and pressing ENTER to save this entry. Press CLEAR if a mistake is made when entering the value. Scroll to the second digit or decimal point and press ENTER to save the entry. Continue this process until all of the values for the new TC Zero Offset are entered.

FIGURE 9-2: TC ZERO CORRECTION Screen

5. Pressing ENTER indicates entering the new TC Zero correction is complete.
6. If the password protection is enabled, the ENTER PASSWORD screen will be shown. If the password is not enabled, go to step 11.

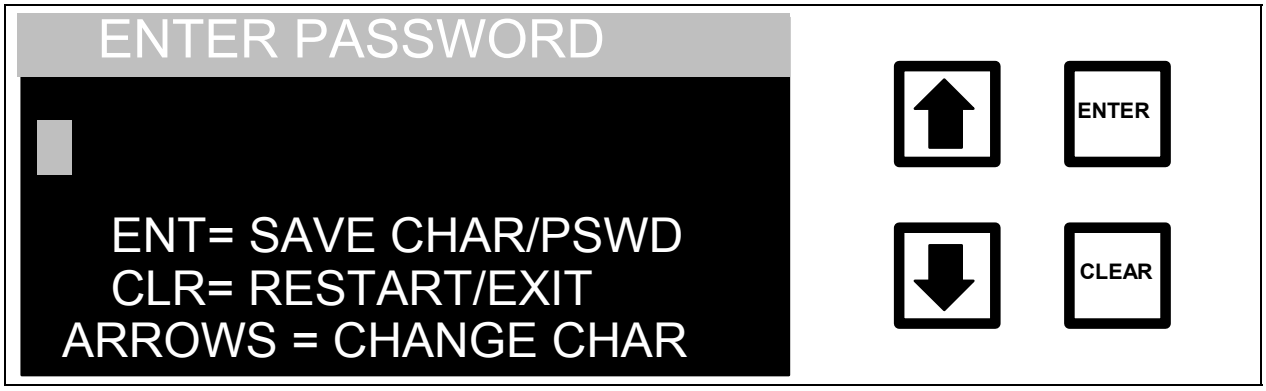


FIGURE 9-3: ENTER PASSWORD Screen

7. Enter the first letter of the password by using the arrows (↑ or ↓) to scroll to the desired letter.
8. Press ENTER to input the first letter of the password. Press CLEAR to delete the first letter if a mistake has been made.
9. Use the arrows (↑ or ↓) to select the remaining letters of the password, pressing ENTER to accept each letter.
10. After all letters have been entered for the password, press ENTER again to enter the password. The display will change, indicating the correct password has been input or that the password is incorrect and the password must be re-entered.
11. The display will show the TC Zero Correction screen with the new TC Zero Correction value displayed. The program prompts for confirmation that this value is to be used. Press ENTER to save the new TC Zero Offset or press CLEAR to exit without changing the value.

Step 4 – Check TC Zero setting:

Repeat Step 2 to perform several measurements with the UV Lamp off to check the new TC Zero setting.

After measurements are complete, determine if the average value is within the specified range of -0.1 < TOC < +0.1. If the average value falls within

this range, proceed to Step 5. If it does not fall within this range, repeat Steps 3 and 4.

Step 5 – Turn on UV lamp:

After the calibration values have been entered, **the UV lamp must be turned on before using the instrument.**

To turn on the lamp:

1. Press CLEAR to return to the MAIN menu, scroll to SETUP and press ENTER.
2. Scroll to UV LAMP and press ENTER.
4. Use the arrows (↑ or ↓) to change the state to ON, press ENTER to set the state and press CLEAR twice to return to the MAIN menu.

TC Calibration Constant

Use Ionics Instruments-prepared standards or prepare calibration standards on site according to the procedure in Appendix E.

Step 1 – Configure analyzer for standard measurements and measure reagent water blank:

1. Perform a REAGENT FLUSH as described in the Installation chapter. Select BOTH to flush both the ACID and the OXIDIZER reagent cartridges.
2. From the Main menu, scroll to SETUP and press ENTER.
3. Use the arrows (↑ or ↓) to scroll to OUTPUTS and press ENTER.
4. From the OUTPUTS menu, use the arrows (↑ or ↓) to scroll to DISPLAY and press ENTER.

5. From the SET DISPLAY MODE menu, use the arrows (↑ or ↓) to select TC DISPLAY and press ENTER to save this setting. The program will prompt for confirmation. Press ENTER and the OUTPUTS menu will appear. Press CLEAR once to return to the SETUP menu.

6. Ensure that the analyzer is in grab-sample mode. From the SETUP menu, select SAMPLE MODE and press ENTER. Using the arrows (↑ or ↓), scroll to GRAB SAMPLING and press ENTER. Press CLEAR twice to return to the MAIN menu.

7. Use the arrows (↑ or ↓) to scroll to START TOC and press ENTER. The GRAB SAMPLE menu is displayed.

8. Use the arrows (↑ or ↓) to scroll to SETUP and press ENTER. The GRAB SAMPLE SETUP menu is displayed.

9. Scroll to REPETITIONS and press ENTER.

10. Set the number of Repetitions to 10. Press ENTER to save the number. Press CLEAR to return to the GRAB SAMPLING SETUP menu.

11. Use the arrows (↑ or ↓) to scroll to REJECTIONS and press ENTER.

12. Set the number of Rejections to 7. Press ENTER to save the number. Press CLEAR to return to the GRAB SAMPLING SETUP menu.

13. Use the arrows (↑ or ↓) to scroll to REAGENTS and press ENTER.

14. Select the ACID FLOW RATE option and enter 0.75 μL/min. Press ENTER to save the number, and press ENTER again to confirm it. Press CLEAR to return to the REAGENTS menu. Use the arrows (↑ or ↓) to scroll to OXIDIZER FLOW RATE, and enter 0.01 μL/min. Press ENTER to save the number, and press ENTER again to confirm it. Press CLEAR twice to return to the GRAB SAMPLING SETUP menu.

15. Use the arrows (↑ or ↓) to scroll to STATISTICS, and press ENTER. Use the arrows (↑ or ↓) to toggle to the AVE/CV option and press ENTER to save the setting. Press CLEAR twice to return to the GRAB SAMPLING MODE menu.

16. Place the 1/16"-OD INLET Teflon tube in the flask or vial of Ionics Instruments-prepared standard labeled "Reagent Water Blank".

Make sure the end of the tubing is several inches below the liquid level.

17. From the GRAB SAMPLING menu, use the arrows (↑ or ↓) to scroll to START and press ENTER. The analyzer will make 10 measurements. When the measurements are finished, the average TC value and relative standard deviation for the last three TC measurements of the Reagent Water Blank will be displayed.

18. Record the average value from the last three TC measurements of the Reagent Water Blank on the Calibration Worksheet.

Step 2 – Measure the 25 mg/L Carbon as KHP TC/TOC Calibration Standard:

1. Record the concentration of the certified TC/TOC standard on the Calibration Worksheet. Add the average value obtained in Part One for the Reagent Water Blank to the certified TC/TOC Standard concentration to obtain the Adjusted Standard Concentration; record the value on the worksheet.

2. From the GRAB SAMPLING menu, scroll to SETUP and press ENTER.

3. Scroll to REAGENTS and press ENTER. Scroll to ACID FLOW RATE and press ENTER. Verify that the rate is set to 0.75 µL/min. Press CLEAR to return to the REAGENTS menu. Scroll to OXIDIZER FLOW RATE and press ENTER. Set the Oxidizer Flow Rate to 2.50 µL/min or 2.0 µL/min (to determine which value is correct for the analyzer, view the S4-25ppm TOC Standard PRESET by selecting PRESETS from the SETUP menu). Type in the appropriate rate, press ENTER to save the value, and press ENTER a second time to verify the value. Press CLEAR twice to return to the SETUP menu.

4. Under the REPETITIONS and REJECTIONS respectively, verify that the repetitions are set to 10 and the rejects are set to 7. Press CLEAR to return to the the GRAB SAMLING MODE Menu.

5. Place the 1/16"-OD INLET Teflon tube in the flask of site-prepared standard or in the vial of Ionics Instruments-prepared standard (labeled TOC Calibration Standard) that contains the TC standard. Make sure the end of the tubing is several inches below the liquid level.

6. From the GRAB SAMPLING menu, use the arrows (↑ or ↓) to scroll to START and press ENTER. The analyzer will make 10 measurements. When the measurements are finished, the average TC value and relative standard deviation for the last three TC measurements of the TC Calibration Standard will be displayed.

7. Record the average value from the last three TC measurements of the TC Calibration Standard, as shown on the measurement display, on the Calibration Worksheet.

The accuracy of the analyzer is ±3% of the TC concentration. For example, for the measurement of a 25.1 ppm TC standard (25 ppm KHP + 0.1 ppm TC background from water), the average TC values should fall between 24.3 and 25.9 ppm. Calculate the upper and lower limits of the adjusted standard concentrations. If the average value for the last three TC runs is within ±3% of the TC concentration of the TC standard, the TC channel of the analyzer is properly calibrated and no changes are necessary for the TC Calibration Constant. If the average value for the last three TC runs is not within ±3% of the TC concentration, recalibrate the CO_2 sensors as follows in Part Three.

Additionally, the CV (relative standard deviation) for the last three measurements should be less than 3%. If this value is greater than 3%, repeat the measurements with a new standard. The CV value appears on the analyzer's printout, or can be calculated as follows. Record the values on the Calibration Worksheet.

$$\text{Standard Deviation} = \sqrt{\frac{\sum (x-\bar{x})^2}{n-1}}$$

Σ = Sum of
x = Result
$\bar{x}$ = Average
n = Number of Measurements in a set

$$\text{Relative Standard Deviation (RSD)} = \frac{\text{Standard Deviation}}{\text{Average}} \times 100$$

NOTE

Save the site-prepared TC standard or use another Ionics Instruments-prepared vial for rechecking the calibration after the TC and IC channels have been calibrated.

NOTE

If the oxidizer reagent is more than 2 months old and there is a large difference (>10%) between the average TC values and the concentration of the TC standard, replace the oxidizer.

Step 3 – Enter the new TC Calibration Constant:

After the average TC values have been recorded:

1. From the GRAB SAMPLING menu, use the arrows (↑ or ↓) to scroll to EXIT, and press ENTER to display the MAIN menu.
2. Scroll to CALIBRATE.
3. Press ENTER to display the CALIBRATE menu.

FIGURE 9-4: CALIBRATION Menu

4. Scroll to TC CALIB. CONSTANT, and press ENTER. The current TC calibration constant is displayed. Record this value on the worksheet.

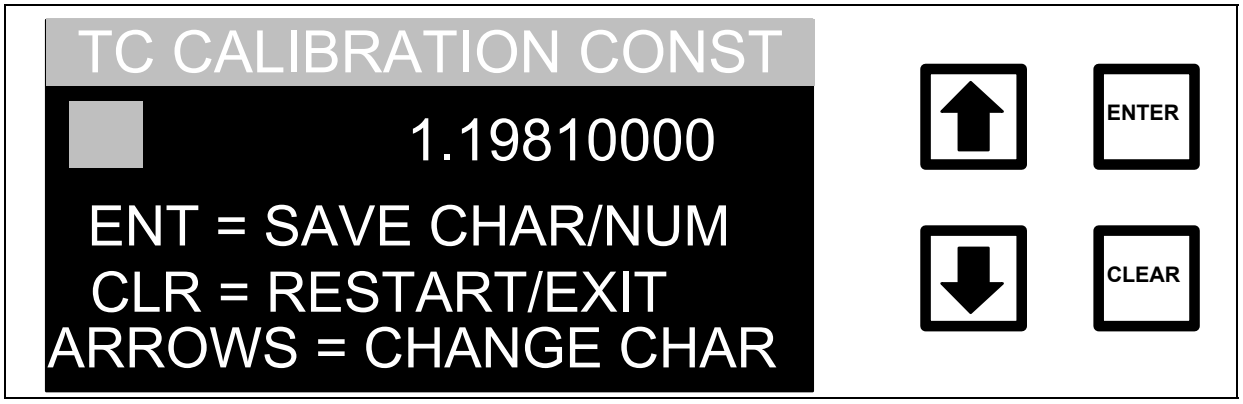


FIGURE 9-5: TC CALIBRATION CONSTANT Menu

5. Compute the new TC calibration constant using the formula:

$$\text{New TC CALIB. CONST.} = \left(\text{Initial TC CALIB. CONST.}\right) * \left(\frac{\text{Adjusted Standard Concentration}}{\text{Average TC value}}\right)$$

6. Scroll to the first digit of the new TC CALIBRATION CONST. and press ENTER to save this value. Press CLEAR to start again if a mistake has been made while entering.
7. Scroll to the decimal point and press ENTER.
8. Repeat this process to set and save the remaining values for the TC CALIBRATION CONST., pressing ENTER each time to store the value. Five significant figures (e.g., 1.2416) are used for the calibration constants.
9. Press ENTER to accept the new number .
10. If the password protection has been enabled, the ENTER PASSWORD Display will be shown. If password is not enabled, go to step 14.
11. Input the first letter of the password by using the arrows (↑ or ↓) to scroll to the desired letter.

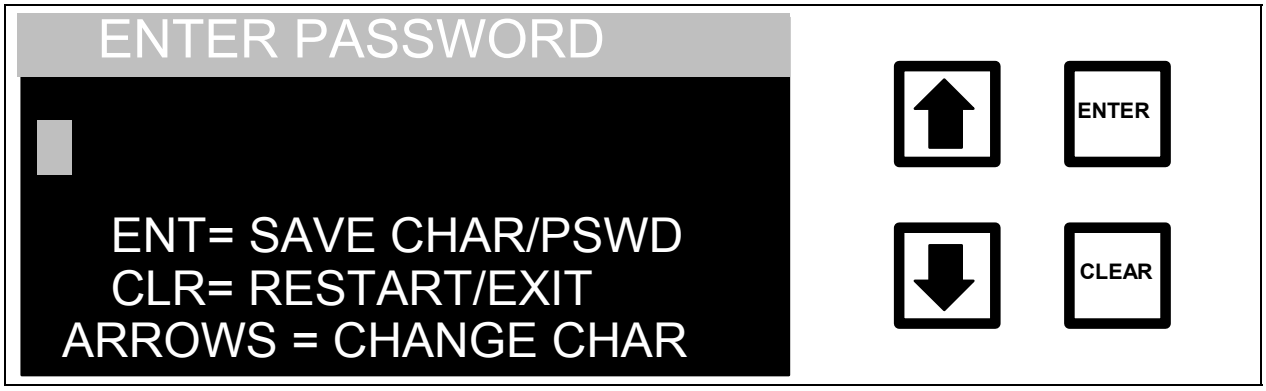


FIGURE 9-6: ENTER PASSWORD Display

12. Press ENTER to input the first letter of the password. Use the CLEAR Button to delete the first letter if a mistake has been made. Use the arrows (↑ or ↓) to select the remaining letters of the password, pressing ENTER to accept each letter.

13. After all of the letters have been entered, press ENTER again to enter the password. The display will change, indicating that the correct password has been entered or that the password is incorrect and needs to be re-entered.

14. The display will show the TC Calibration menu with the new TC Constant Correction value displayed. The display prompts for confirmation.

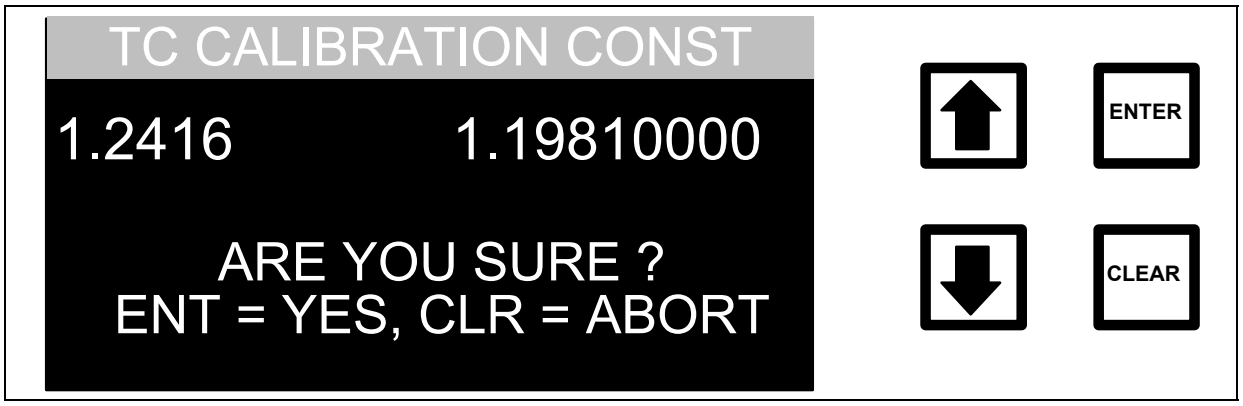


FIGURE 9-7: TC CALIBRATION Menu

15. Press ENTER. The new TC calibration constant is now stored and the Calibration menu is displayed. Record the new TC calibration and calibration constant in the calibration record and/or on the Calibration Worksheet.

IC Calibration Constant

After the TC channel has been calibrated, the IC channel is calibrated with a 25 ppm Na_2CO_3 standard using the TC channel to determine the actual concentration of the standard.

To prepare IC Calibration Standards on site, refer to Appendix E.

Step 1 – Configure the analyzer for standard measurements:

The IC Standard will have a TOC/IC ratio of < 0.1 and will cause the analyzer to display Warning #42. If desired, turn off the Warning #42 display option as described in the Installation chapter before analyzing the standard. This warning will be written to the Error Stack even if the Warning #42 is turned off.

1. From the Main menu, scroll to START TOC, and press ENTER to display the GRAB SAMPLING menu.
2. Scroll to SETUP and press ENTER.
3. From the GRAB SAMPLE SETUP menu, scroll to REAGENTS and press ENTER.
4. Scroll to ACID FLOW RATE and press ENTER.
5. Verify that the Acid Flow Rate is set to 0.75 µL/min. Press CLEAR to return to the REAGENTS menu.
6. Scroll to OXIDIZER FLOW RATE and press ENTER. Set the Oxidizer Flow Rate to 0.01 µL/min. Press ENTER to save the value, and press ENTER again to confirm the value. Press CLEAR twice to return to the SETUP menu.
7. Under the REPETITIONS and REJECTIONS respectively, verify that the repetitions are set to 10 and the rejects are set to 7.
8. Press CLEAR to return to the the GRAB SAMLING MODE Menu.

Step 2 – Measure the 25 mg/L Carbon as Na_2CO_3 IC Calibration Standard:

1. Place the 1/16" Teflon inlet tubing in the flask containing the site-prepared IC standard or in the Ionics Instruments-prepared standard labeled IC Calibration Standard. Make sure the end of the tubing is several inches below the liquid level.
2. From the GRAB SAMPLING menu, use the arrows (↑ or ↓) to scroll to START and press ENTER. The analyzer will make 10 measurements. When the measurements are finished, the average TC value and relative standard deviation for the last three TC measurements for the IC standard will be displayed. Record this average TC value on the Calibration Worksheet.

Additionally, the CV (relative standard deviation) for the last three TC measurements of the IC standard should be less than 3%. If this value is greater than 3%, repeat the measurements of the IC standard. The CV value appears on the analyzer's printout, or can be calculated as follows:

$$\text{Standard Deviation} = \sqrt{\frac{\sum (x - \bar{x})^2}{n-1}}$$

Σ = Sum of
x = Result
$\bar{x}$ = Average
n = Number of Measurements in a set

$$\text{Relative Standard Deviation (RSD)} = \frac{\text{Standard Deviation}}{\text{Average}} \times 100$$

Record the values on the Calibration Worksheet.

3. Use the arrows (↑ or ↓) to scroll to EXIT and press ENTER to display the Main menu.
4. Scroll to HISTORY and press ENTER.
5. From the TOC history display, press ENTER twice to display the IC values.
6. Calculate and record the average value from the last three IC measurements on the Calibration Worksheet.

7. Calculate the % difference between the average TC values and the average IC values for the IC standard via the calculation given below. Record the value on the Calibration Worksheet.

$$\% \text{ difference} = 100*(\text{Average TC} - \text{Average IC}) / \text{Average TC}$$

The accuracy of the analyzer is ±3% for TC; the TOC (TC-IC) on an IC standard should be –750 ppb to + 750 ppb based on a 25ppm solution. Per the above equation, if the percentage difference between the average TC and IC values is within ±3% of the TC value, the IC channel is properly calibrated, and there is no need to change the calibration constant. If the percentage difference is not within ±3%, determine the new IC channel constant as described below.

WARNING

If the TC channel has just been recalibrated, and there is a large difference (>10%) between the TC and IC values, it is possible that the TC channel calibration is incorrect due to incomplete oxidation of the TC/TOC standard. Repeat the TC calibration procedure using a new TC/TOC standard and a higher oxidizer flow rate before changing the IC calibration.

NOTE

Save the site-prepared IC standard or use another Ionics Instruments-prepared vial for rechecking the calibration.

Step 3 – Enter the new IC Calibration Constant:

After the average TC and IC values have been recorded:

1. Press CLEAR to return to the MAIN menu.
2. Scroll to CALIBRATE.
3. Press ENTER to display the CALIBRATION menu.

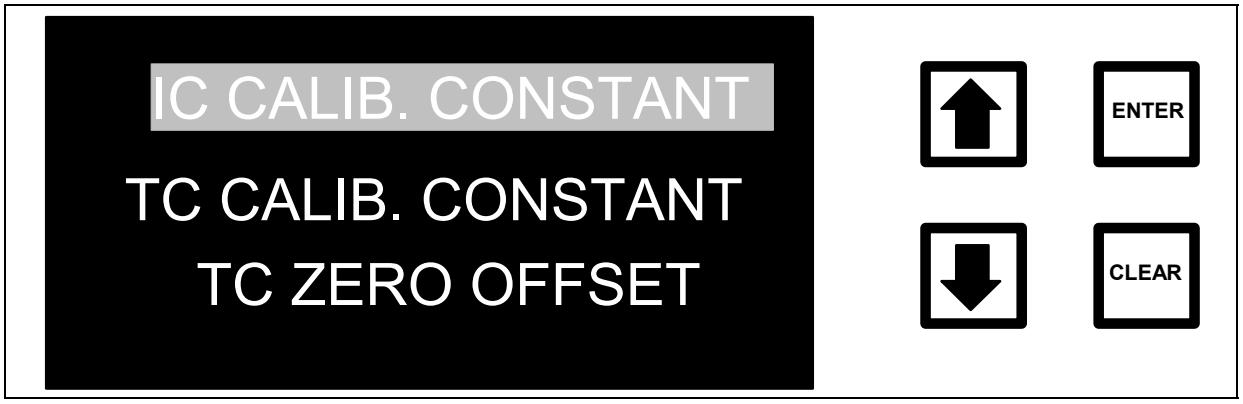


FIGURE 9-8: CALIBRATION Menu

4. Scroll to IC CALIB. CONSTANT and press ENTER. The current IC calibration constant is displayed. ENTER this value on the calibration worksheet.

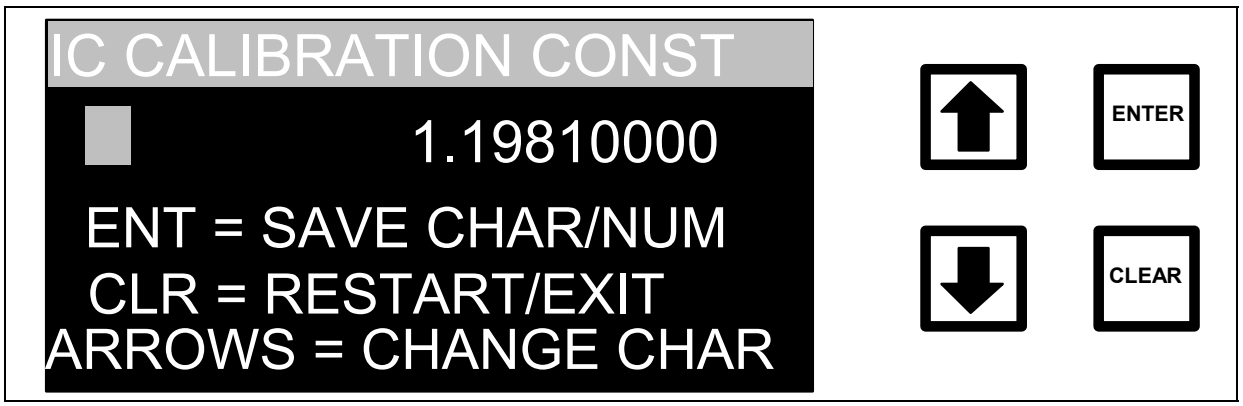


FIGURE 9-9: IC CALIBRATION CONSTANT Screen

5. Compute the new IC calibration constant using the formula:

$$\text{New IC CALIB. CONST.} = \left(\text{Initial IC CALIB. CONST.}\right) * \left(\frac{\text{Average TC values from last three runs}}{\text{Average IC value from last three runs}}\right)$$

6. Scroll to the first digit of the new IC CALIBRATION CONST. and press ENTER to save this value. Press CLEAR to start again if a mistake has been made.

7. Scroll to the decimal point and press ENTER.

8. Repeat this process to set and save the remaining values for the IC CALIBRATION CONST., pressing ENTER each time to store the value. Five significant figures (e.g., 1.2416) are used for the calibration constants.

9. Press ENTER to indicate that inputting the number has been finished for the new IC CALIBRATION CONST.

10. If the password protection has been enabled, the ENTER PASSWORD screen is displayed. Enter the password. Once the password is entered or if the password protection is disabled, the IC Calibration screen is displayed. The program prompts for confirmation.

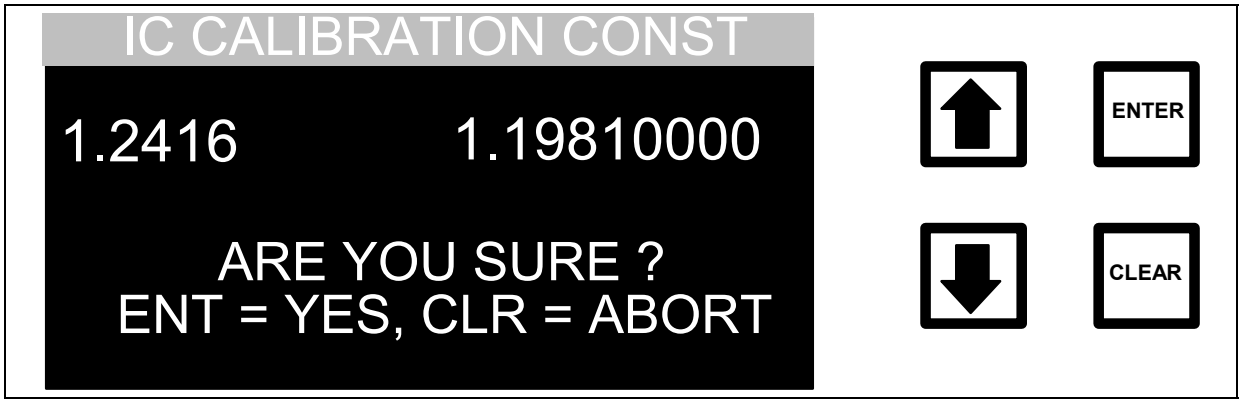


FIGURE 9-10: IC CALIBRATION CONSTANT Verification Screen

11. Press ENTER to confirm.

12. The new IC calibration constant is now stored and the Calibration menu is displayed. Press CLEAR to return to the MAIN menu. Record the new IC calibration and calibration constant in the calibration record and/or on the calibration worksheet.

TC and IC Calibration Verification

The next step in the calibration is to make sure the new calibration is correct.

Step 1 – Measure the TC Standard:

Follow the TC Calibration Constant procedure and record the values on the Verification Worksheet.

Step 2 – Measure the IC Standard:

Follow the IC Calibration Constant procedure and record the values on the Verification Worksheet.

This completes the calibration of the instrument. Use the following form to record the values of the new TC and IC Calibration Constants and the new TC Zero Offset. Print the list of constants from the SETUP/OUTPUTS/PRINTER menu. Reset the display to show TOC values under the SETUP/OUTPUTS/DISPLAY menu.

Calibration Values	
Date	
IC CALIB. CONSTANT	
TC CALIB. CONSTANT	
TC ZERO OFFSET	
Date	
IC CALIB. CONSTANT	
TC CALIB. CONSTANT	
TC ZERO OFFSET	
Date	
IC CALIB. CONSTANT	
TC CALIB. CONSTANT	
TC ZERO OFFSET	
Date	
IC CALIB. CONSTANT	
TC CALIB. CONSTANT	
TC ZERO OFFSET	
Date	
IC CALIB. CONSTANT	
TC CALIB. CONSTANT	
TC ZERO OFFSET	
Date	
IC CALIB. CONSTANT	
TC CALIB. CONSTANT	
TC ZERO OFFSET	

Calibration Worksheet

Name of Analyst_____ Date_____

Company Name_____

Analyzer Serial Number_____ Firmware Version_____

TC Zero Offset (only necessary for on-line analysis of water < 50 ppb)

Last Five TOC Measurements Average _____

Average within the range of –0.1<TOC<0.1? _____
If Yes, proceed to TC Calibration Procedure
If No, complete TC Zero Offset Procedure

Initial Offset _____

Initial Offset – Average TOC = New Offset _____

Verification TOC value _____

TC Calibration Constant

Blank TC (Average) _____

Certified TOC Concentration of standard _____

Adjusted Standard Concentration _____ + _____ = _____

Measured TC Reading (Average) _____

$$\text{Standard Deviation} = \sqrt{\frac{\sum (x-\bar{x})^2}{n-1}}$$

Σ = Sum of
x = Result
ξ = Average
n = Number of Measurements in a set

_____
Standard Deviation

$$\text{Relative Standard Deviation (RSD)} = \frac{\text{Standard Deviation}}{\text{Average}} \text{ x } 100$$

_____
Relative Standard Deviation (CV)

To Pass, measured TC value for the TC/TOC Standard must be within ±3% of the adjusted concentration of the standard and the CV value must be less than 3%.

☐ **Pass** ☐ **Fail**

Calculation of New TC Calibration Constant (if applicable)

Initial TC Calibration Constant _____

$$\text{New TC CALIB. CONST.} = \left(\text{Initial TC CALIB. CONST.}\right) * \left(\frac{\text{Standard TOC Conc. + Blank Average}}{\text{Average TC value from last three runs}}\right)$$

New TC Calibration Constant _____

IC Calibration Constant

Measured TC Reading (Average) _____

Standard Deviation

$$\text{Standard Deviation} = \sqrt{\frac{\sum (x-\bar{x})^2}{n-1}}$$

Σ = Sum of

x = Result

ξ = Average

n = Number of Measurements in a set

$$\text{Relative Standard Deviation (RSD)} = \frac{\text{Standard Deviation}}{\text{Average}} \text{ x } 100$$

_____

Relative Standard Deviation (CV)

To pass, the CV value for the measured TC of the IC Standard must be within ±3%.

☐ **Pass** ☐ **Fail**

IC Reading (Average) _____

% difference = 100*(Average TC - Average IC) / Average TC _____

To pass, the calculated % difference between TC and IC for the IC Standard must be within ± 3%.

☐ **Pass** ☐ **Fail**

Calculation of New IC Calibration Constant (if applicable)

Initial IC Calibration Constant _____

$$\text{New IC CALIB. CONST.} = \left(\text{Initial IC CALIB. CONST.}\right) * \left(\frac{\text{Average TC values from last three runs}}{\text{Average IC value from last three runs}}\right)$$

New IC Calibration Constant _____

Verification Worksheet

Name of Analyst_____ Date_____

Company Name_____

Analyzer Serial Number_____ Firmware Version_____

TC Calibration Constant

Blank TC (Average) _____

Certified TOC Concentration of standard _____

Adjusted Standard Concentration _____ + _____ = _____

Measured TC Reading (Average) _____

$$\text{Standard Deviation} = \sqrt{\frac{\sum (x-\bar{x})^2}{n-1}}$$

Σ = Sum of
x = Result
ξ = Average
n = Number of Measurements in a set

_____
Standard Deviation

$$\text{Relative Standard Deviation (RSD)} = \frac{\text{Standard Deviation}}{\text{Average}} \text{ x } 100$$

_____
Relative Standard Deviation (CV)

To Pass, the measured TC value for the TC/TOC Standard must be within ±3% of the adjusted concentration of the Standard and the CV value must be less than 3%.

☐ **Pass** ☐ **Fail**

Calculation of New TC Calibration Constant (if applicable)

Initial TC Calibration Constant _____

$$\text{New TC CALIB. CONST.} = \left(\text{Initial TC CALIB. CONST.}\right) * \left(\frac{\text{Standard TOC Conc. + Blank Average}}{\text{Average TC value from last three runs}}\right)$$

New TC Calibration Constant _____

IC Calibration Constant

Measured TC Reading (Average) _____

Standard Deviation _____

$$\text{Standard Deviation} = \sqrt{\frac{\sum (x-\bar{x})^2}{n-1}}$$

$\sum$ = Sum of

x = Result

ξ = Average

n = Number of Measurements in a set

$$\text{Relative Standard Deviation (RSD)} = \frac{\text{Standard Deviation}}{\text{Average}} \text{ x } 100$$

Relative Standard Deviation–(CV) _____

To pass, the CV value for the measured TC of the IC Standard must be within ±3%.

☐ **Pass** ☐ **Fail**

IC Reading (Average) _____

% difference = 100*(Average TC - Average IC) / Average TC _____

To pass, the calculated % difference of the IC and TC values for the IC Standard must be within ± 3%.

☐ **Pass** ☐ **Fail**

Calculation of New IC Calibration Constant (if applicable)

Initial IC Calibration Constant _____

$$\text{New IC CALIB. CONST.} = \left(\text{Initial IC CALIB. CONST.}\right) * \left(\frac{\text{Average TC values from last three runs}}{\text{Average IC value from last three runs}}\right)$$

New IC Calibration Constant _____

Checking the Error Stack

The first step in troubleshooting for erratic readings, poor reproducibility (> 3%), or other problems is to check the error stack to determine if any malfunctions have been detected. If the front-panel display is not illuminated and the analyzer is plugged in, proceed directly to the next section to check the main fuse. Otherwise, follow the procedure outlined below to review the error stack.

> **NOTE**
>
> For instrument firmware with the DataGuard feature, enter an Operator-level (or higher) password when prompted to view the error stack. A Maintenance-level (or higher) password is required for performing most diagnostic tests; a QA-level (or higher) password is required for performing the 4-20mA test. Check with your system administrator for an appropriate password. See the DataGuard Operation chapter for more information regarding the DataGuard feature.

An internal microprocessor monitors the analyzer's operation. If a problem is detected, an error or warning is displayed and recorded in the error stack.

Look at the error stack in two ways:

If the analyzer is operating and the TOC Measurement Display is shown:

1. Press ENTER to switch to the RUNTIME menu.
2. Scroll to STOP TOC and press ENTER.
3. Scroll to ERRORS and press ENTER.

If the analyzer is not operating, and the MAIN menu is displayed, scroll to ERRORS and press ENTER.

There are five different types of errors that are detected and recorded in the error stack:

- Reagent supplies, UV lamp, and pump tubing status,
- Operating temperature of the instrument,
- Problems with the DI water loop and conductivity sensors,
- Electronics and software problems,
- RAM card malfunctions or warnings.

A complete listing of possible error messages is given in Table 10. If no errors have occurred, selecting the error stack will display the message "NO ERRORS RECORDED".

There are two levels of messages:

- ERRORS are the most serious and generally will stop TOC measurements and may display a fatal error message. Corrective action must be taken before the analyzer can resume normal operation; however, pressing any key will restart the analyzer.

- WARNINGS will not stop TOC measurements, but these may indicate that corrective action is required to prevent analyzer shutdown or loss of data.

Table 10. Warnings and Error Messages

Message #	Error	Type
1	Temperature of cell 1 has exceeded 50 °C.	W
2	Temperature of cell 2 has exceeded 50 °C.	W
3	Temperature of cell 1 is less than 10 °C.	W
4	Temperature of cell 2 is less then 10 °C.	W
5	Invalid Temperature reading in cell 1.	E
6	Invalid Temperature reading in cell 2.	E
7	Conductivity range error in cell 1.	W
8	Conductivity range error in cell 2.	W
9	Invalid conductivity reading in cell 1.	E
10	Invalid conductivity reading in cell 2.	E
11	Mathematical calculation error has occurred.	W
12	Amount of available acid is < 10%.	W
13	Amount of available oxidizer is < 10%.	W
14	Age of oxidizer has exceeded the planned shelf life.	W
15	Age of UV lamp has exceeded the planned life expectancy.	W
16	Age of tubing has exceeded the planned life expectancy.	W
17	Error writing to the non-volatile memory.	W
18	A-to-D converter will not respond to start command.	W
19	A-to-D converter will not respond after initiated.	W
20	A-to-D input has exceeded maximum value in high range.	W
21	A-to-D input is less than minimum value in high range.	W
22	A-to-D input has exceeded maximum value in low range.	W
23	A-to-D input is less than minimum value in low range.	W
24	A-to-D readings are unstable in cell 1.	W
25	A-to-D readings are unstable in cell 2.	W
26	RAM card indicates that write protect switch is enabled, unable to write.	W
27	RAM card has been filled with data; old data will now be overwritten.	W
28	RAM card checksum error detected in index area, copy card immediately!	W
29	RAM card battery is low.	W
30	RAM card battery is dead.	W
31	RAM card is not present. Data will not be stored for upcoming runs.	W
32	Servo will not move to fill position.	E
33	Servo will not move to empty position.	E
34	Servo error in flag position sensing. Check cable and travel path.	E
35	Real Time Clock is set to an invalid or earlier time, or cannot write.	W
36	Printer indicates that it is out of paper.	W
37	Internal error detected.	E
38	One or both syringes require recalibration.	E
39	One or both syringes cannot be calibrated check cables and travel path.	E
40	RAM card appears to be unacceptable size for use with this TOC machine.	W
41	RAM card DOS format appears to have been corrupted or changed.	W
42	Ratio of TOC:IC is less than 0.1	W
43	Checksum error was detected in EEPROM	E
44	Break-in attempt. Five unsuccessful logins attempted	W

Corrective Actions

Actions to be taken if warnings and errors occur are outlined below. If you need further assistance, contact Ionics Instruments at 1-800-255-6964 or 303-444-2009.

Warnings 1-4: The analyzer is operating outside its allowable range of 10 °C to 40 °C. Change the ambient temperature or move the analyzer.

Errors 5-6: There is a bad thermistor or electronics problem. Contact Ionics Instruments for repairs.

Warnings 7-8: Either there is a gas bubble in the conductivity cells, the DI resin bed is exhausted and needs to be replaced, or there is an electronics problem. In some cases, refilling the DI reservoir and running the analyzer on-line or off-line, with the cap removed from the DI water reservoir will remove the bubble and eliminate the error message. Otherwise, contact Ionics Instruments.

Errors 9-10: There are problems with the conductivity electronics or cell or a gas bubble in the conductivity cells (see Warning 7).

Warning 11: Divide by zero error or other calculation error due to electronics problem, contact Ionics Instruments.

Warnings 12-16: Reagent supplies, lamp, or tubing needs to be replaced. Follow the procedures described in the Maintenance Chapter, for detailed instructions.

Warnings 17-25: There is a problem with the electronics or a gas bubble in the conductivity cells. In some cases, refilling the DI reservoir and running the analyzer on-line or off-line, with the cap removed from the DI water reservoir will remove the bubble and eliminate the error message. Otherwise, contact Ionics Instruments.

Warning 26: The write-protect tab on the top of the RAM card is in the protect position. Disconnect the AC power cord, open the top of the analyzer, and move the tab to the unprotected position (see Figure 11-2, the tab should be positioned away, towards the back of the analyzer).

Warning 27: The RAM card is full of TOC data which will be overwritten and data will be lost if the card is left in the analyzer. To archive data on the RAM card or have not downloaded the information, turn the analyzer off, remove the RAM card, and replace with a new card. To archive the data on the RAM card, but still download the data, turn the analyzer off, remove the card, download the data using the RAM card reader (see the RAM card chapter), and reinstall the card.

Warning 28: There is a checksum error. To avoid losing the data stored on the RAM card, disconnect the AC power cord, remove the card from the analyzer and download the data with the RAM card reader. Replace the RAM card, and if the error continues, contact Ionics Instruments.

Warnings 29-30: The RAM card battery is running low or is dead. The data stored on the card may be lost, if the card is removed from the analyzer, and wait before downloading the data. While the card is in the analyzer, use the RS-232 to download the data. the data may also be downloaded via a RAM card reader if the card is read immediately. the data has been collected, install a new battery in the card. The procedure for replacing the battery is in the Ram Card Chapter.

Warning 31: The RAM card is not in the analyzer and data will not be stored. Install a RAM card to store the data. The procedure for installing the card is in the Ram Card Chapter.

Errors 32-34: There is a problem with the servomotors used to refill the syringes or an electronics problem. Stop the analyzer, remove the AC power cord, and open the top of the analyzer. Check if there is an obstruction in the mechanism and, if there is, remove the obstruction. Check to make sure that the ribbon cable located to the left of the syringe pump PC board is plugged into the sockets. Check the two black connectors on the wiring to the syringe

pump labeled “Acid” and “Oxidizer”, and make sure the connectors are firmly in place. Otherwise, contact Ionics Instruments.

Warning 35: The clock has been set to a time earlier than the time of data written on the RAM card. For example, this error will occur when the clock is changed from daylight savings time to standard time. This error will be repeated until the clock catches up to the latest time/date written on the RAM card. If the time or date have not been changed, then there may be a problem with the clock. Reset the clock from the SETUP menu to the current date and time. If the problem persists, contact Ionics Instruments.

Warning 36: The printer is out of paper and results cannot be printed. Install paper in the printer.

Error 37: This indicates a hardware or software error. Please note what actions were being performed when this error occurred, and contact Ionics Instruments.

Error 38: The full and empty positions of the syringe pumps have been recalibrated. This error is reported if the analyzer calibrates the syringes at times other than power-up. Unless this error occurs frequently, no action is required. If this error is frequent, Contact Ionics Instruments for instructions.

Error 39: The full and empty positions of the syringe pumps cannot be calibrated. Check to make sure that the ribbon cable located to the left of the syringe pump PC board is plugged into the sockets. Otherwise, contact Ionics Instruments.

Warnings 40-41: This indicates the RAM Card has been damaged or the format of the RAM card has been corrupted. Replace the card or follow the procedures in the Ram Card Chapter to reformat the card.

Warning 42: This indicates that the concentration of IC in the sample is large compared to the TOC, and the accuracy of the measurement will be reduced. Either use the on-line IC removal module for this sample for follow the

procedures in the Maintenance Chapter to remove the IC from the sample and re-measure.

Error 43: This indicates that the TOC program has been altered or erased. Contact Ionics Instruments for a new EEPROM.

Warning 44: A user failed to login to the instrument 5 consecutive times. This may indicate that the user has forgotten the password, or it may indicate an attempt to access the instrument without authorization.

If an ERROR is detected, a fatal error message will be displayed:

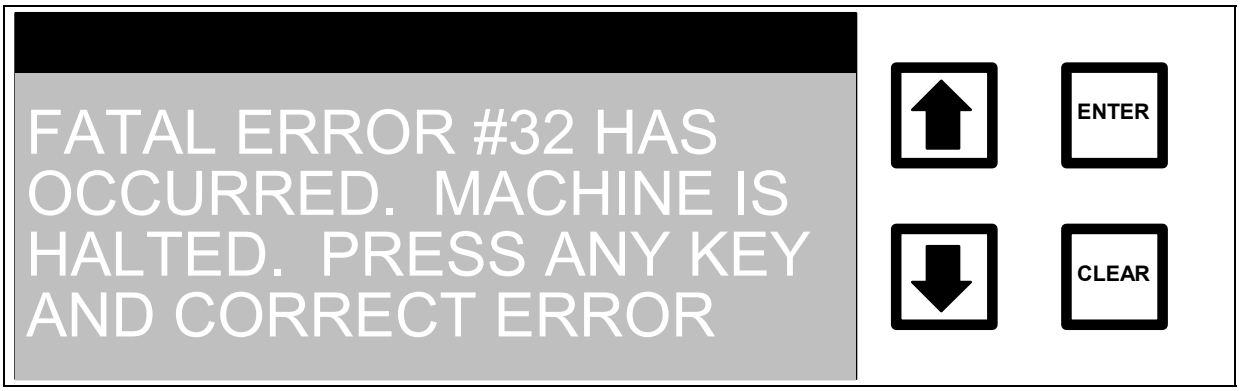


FIGURE 10-1: Fatal Error Screen

Correct the error before the analyzer will operate. If a fatal error occurs:

1. Record the error number, then press any key to clear the screen.
2. From the Main menu, scroll to ERRORS and press ENTER.
3. Scroll to the fatal error and press ENTER to display the Error Information screen.
4. Perform any actions suggested in the Error Information menu.
5. If necessary, contact Ionics Instruments at 1-800-255-6964 or 303-444-2009 for further instructions.

If the fatal error involves the servo mechanism for the syringe pumps, remove the AC power cord, open the top of the analyzer and check for obstructions in the mechanism. Check to make sure that the ribbon cable, located on the left-hand side of the syringe, is plugged into the socket. Remove any obstruction, reconnect the cable, and restart the analyzer.

Warnings do not stop the analyzer but will cause the warning number to be displayed on the RUNTIME screen.

FIGURE 10-2: TOC Measurement Screen with Error Messages

The numbers for the last two warnings are displayed in the upper left-hand corner of the screen. In this example, the acid and oxidant reagents need to be replaced soon. To get information on the warnings and corrective actions:

1. Press ENTER to switch to the RUNTIME menu.
2. Scroll to ERRORS and press ENTER.
3. Scroll to the desired error number and press ENTER.
4. Perform any actions suggested in the Error Information menu.

If the UV lamp is turned off, the error message "–UV" will be displayed in the upper left-hand corner of the screen. This warning is not written to the error stack and is only a reminder if the lamp has not been turned on after calibration of the TC zero offset.

After the error stack has been reviewed, the current warnings will no longer be displayed on the front panel. If additional errors or warnings occur, the new number(s) will be displayed.

Printing the Error Stack

To print the error stack from the MAIN menu:

1. Use the arrows (↑ or ↓) to scroll to SETUP and press ENTER. The SETUP menu is displayed.
2. Use the arrows (↑ or ↓) to scroll to PRINTER and press ENTER. The PRINTER SETUP menu is displayed:

FIGURE 10-3: PRINTER SETUP Menu

3. Make sure the printer is turned on, has paper, and is in the on-line mode.
4. Use the arrows (↑ or ↓) to scroll to PRINT ERROR LIST and press ENTER.

   The error list will be printed, showing the errors that have occurred, the time and date the error occurred, and the number of times this error was detected.

No Power to the Analyzer

If there are no characters on the front panel LED display and the fan does not work while the analyzer is plugged in, the problem is most likely a blown fuse. First check the power to the analyzer. Make sure the power cord is firmly seated at both ends. Make certain that there is power to the outlet at the wall or surge protector.

There are two fuses in the analyzer; a main power fuse and a power supply fuse.

To check the main fuse:

1. Unplug the power cord from the left-hand side of the analyzer.
2. Use a small screw driver to pry open the AC inlet adapter located on the left-hand side of the analyzer (see Figure 10-4).
3. Remove the fuse from the holder and replace, if necessary:

Analyzer Voltage	Replacement Fuse Type
100V, 120V	F 3.0A, 250 VAC, fast acting fuse (size 3AG)
230V*	T 1.25A, 250 VAC, Time-Lag fuse (size 5x20mm)

* 230V unit has a second fuse in place of the spare fuse; both fuses must be the same type and rating.

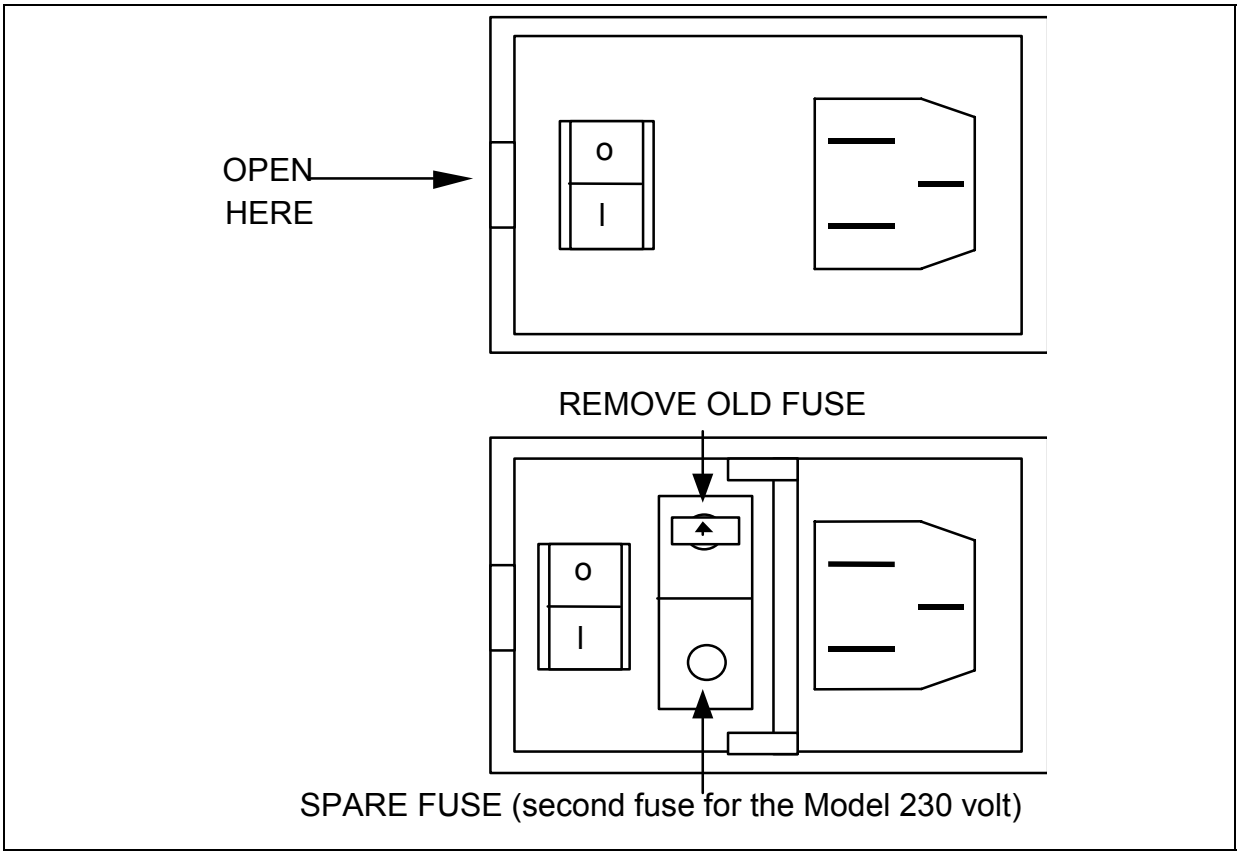


FIGURE 10-4: Main Fuse Holder

The power supply fuse is not accessible. If the main fuse is OK but there is still no power, contact Ionics Instruments.

No Flow Through the Analyzer

If the 60-µm stainless steel in-line filter (for on-line sampling) is clogged or the 1/16"-OD Teflon inlet or outlet lines (for grab sampling) are overtightened and have collapsed, or the sample sampling pump is not operating, then no sample will flow through the analyzer. While the analyzer is operating, open the top cover and make sure the sample pump is turning.

⚠ WARNING

To avoid potentially dangerous shock, do not touch anything inside the analyzer while observing the sample sampling pump.

If the pump is not turning and the analyzer is operating (Measurement menu or Grab Sampling RunTime menu is displayed), contact Ionics Instruments for instructions.

If the pump is turning, close the analyzer cover and follow the steps below to isolate the problem.

On-line Sampling

If there is no flow through analyzer, the 60 µm filter may be clogged and should be replaced. A clogged filter should cause the pressure of the sample stream to drop below 5 psi on the sample inlet pressure gauge.

The 1/16"-OD Teflon outlet tubing may also have been overtightened and has collapsed. To check the outlet tubing:

1. Turn off the power on the analyzer.
2. Use a 1/4" wrench to remove the Teflon tubing from the bulkhead fittings.
3. Inspect the tubing in the region of the ferrule. If the ferrule has compressed the tubing excessively or if it is completely closed, the tubing will need to be cut. Then install a new 1/16" Valco ferrule or replace the tubing. Replacement ferrules and tubing are available from Ionics Instruments.

Grab Sampling

The 1/16"-OD inlet line may be clogged or the inlet or outlet tubing may have been overtightened and has collapsed. To check the inlet tubing, make sure the analyzer is operating, then briefly remove the inlet Teflon tubing from the sample container. The sample pump should draw a small amount of air into the tubing. Replace the tubing in the sample container, making sure that the end of the tubing is below the liquid level. Observe the small air bubble being drawn into the analyzer. Observe the liquid flowing out the outlet tubing.

If air is not drawn into the analyzer or water is not flowing out of the analyzer, inspect the ends of the tubing as described above and replace the tubing if necessary.

The overall rate of flow through the inlet tubing should be the same as through the outlet tubing. (The outlet flow is usually more variable than the inlet flow because of its proximity to the sample pump.)

pH Of Sample Stream Is Too High

If the pH of the sample stream is not < 2, erratic readings and low TOC recovery may be observed. The first step is to increase the acid flow rate by 1-2 µL/min and determine if this eliminates the problem.

For non-deionized water, check the pH of the sample stream using the pH paper supplied with the analyzer. To check the pH of the stream, locate the sample outlet line on the right-hand side of the analyzer. If the outlet line is accessible, measure the pH as described below. If the outlet line is connected to the sample inlet block waste connection, the outlet line must be removed from the sample inlet block.

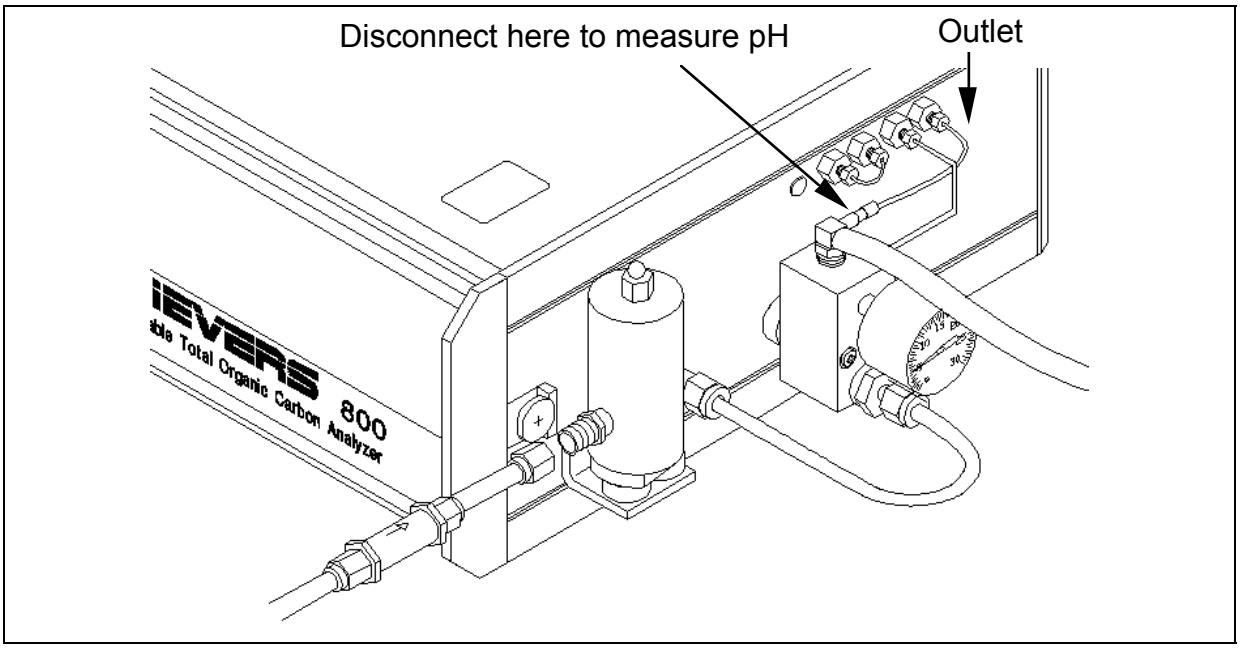


FIGURE 10-5: Outlet Tubing

Measure the pH (non-deionized water only)

With the sample stream flowing and the analyzer in the TOC Measurement mode, tear off a strip of pH paper and hold the paper in the sample outlet stream.

Compare the color of the paper with the pH color scale on the side of the pH paper container. If the pH is not < 2, not enough acid is being added to the sample stream. Possible reasons for high pH include:

- Acid flow rate is too low; check acid flow rate from the SETUP menu and increase flow rate if necessary.
- Acid reservoir is empty or low; check Error Stack, Error #12.
- Acid syringe is broken or not working; contact Ionics Instruments for instructions.
- Mininert valve on the acid reservoir is closed.

Oxidizer Flow Rate Too High

If the oxidizer flow rate is too high, the excess reagent will decompose and form oxygen bubbles in the analyzer and give erratic TOC measurements. In most cases, the gas bubbles can be seen in the outlet line. If readings are erratic and bubbles can be observed in the outlet line, decrease the oxidizer flow rate from the REAGENTS menu. This problem may occur just after the oxidizer reservoir has been changed and fresh oxidizer is in the analyzer. Some trial and error is required for adjusting the oxidizer flow rate. One procedure is to reduce the flow rate in 0.5 µL/min. increments, wait approximately 20 min and check whether the gas bubbles in the analyzer outlet line have disappeared. If the bubbles persist, decrease the oxidizer flow an additional 0.5 µL/min., repeating this procedure until readings are stable.

Oxidizer Flow Rate Too Low

For water samples containing > 1 ppm TOC, the oxidizer flow rate must be set to add enough reagent to completely oxidize the organic compounds. If the flow rate is too low, only partial oxidation will occur and low TOC values will be obtained. Check the oxidizer flow rate from the SETUP menu and the recommended oxidizer flow rates in Table 2 in the Installation chapter. If the flow rate is lower than the recommended flow rates, increase the oxidizer flow rate.

If the flow rate is set to the recommended value, the water sample may contain organic compounds that are particularly difficult to oxidize and may require additional persulfate oxidizer. Again, some trial and error is required to find the best oxidizer flow rate. Try increasing the flow rate by 0.5 µL/min. and monitor the TOC and check for gas bubbles in the analyzer outlet line. If the

measured TOC increases, then continue increasing the oxidizer flow rate until a steady TOC value is obtained and gas bubbles are not seen in the instrument outlet line.

DI Reservoir Too Low

If there is not enough water in the DI loop, erratic TOC readings can result. Follow the procedures in the Maintenance chapter to check the level of DI water in the reservoir and refill if necessary.

Gas Bubbles in Reagent Lines or Syringes

The presence of gas bubbles in the lines from the reagent containers to the syringe pumps and from the syringe pumps to the stainless steel cross can cause erratic TOC readings. Turn off the analyzer and disconnect the power cord. Open the top panel of the analyzer and inspect the 1/16" Teflon tubing from the syringes. If gas bubbles are observed in the lines or a large (greater than 30μL) gas bubble is in the syringe, perform a syringe flush. Select the REAGENT FLUSH option from the REAGENTS menu and flush both syringes.

Since the analyzer calculates TOC from the difference between total carbon and inorganic carbon, erratic readings or even negative values of TOC can be observed in water samples containing high levels of inorganic carbon. This is often the case for ground water samples, some municipal water supplies, and permeate from reverse osmosis systems.

The analyzer monitors the TOC/IC ratio. If this ratio is < 0.1, WARNING 42 will be shown on the LCD display and written to the error stack. If the response of the IC CO_2 sensor is greater than the response of the TC CO_2 sensor, the analyzer will report a negative TOC value.

Because the accuracy of the TOC measurement is ±3% of the TC measurement, the accuracy of TOC measurements will be less for water samples containing high levels of inorganic carbon.

To eliminate the problems encountered in TOC measurements of water samples containing high levels of IC, Ionics Instruments has an on-line IC Removal Module. The module is installed on the analyzer and uses a membrane-based system and vacuum to remove greater than 99% of the IC from the sample.

The IC removal module is the best method to eliminate problems with high levels of IC for both on-line monitoring and container sampling. If sampling from a container, remove the IC from the sample as follows:

1. Add a few drops of acid (6 M H_3PO_4) to the sample.
2. Use an N_2 or He purge gas to remove CO_2 from the sample.
3. After purging for 5-10 minutes, analyze the sample.

Acidifying the sample and purging may introduce organic impurities into the sample, so treat a sample of low TOC, deionized water in the same manner as a blank.

For more information on the IC removal module, contact Ionics Instruments.

Negative or Zero TOC Measurements

If using the analyzer for on-line measurement of low TOC water and getting zero or negative TOC readings, investigate the IC level of the water. If it is greater than 10 times the TOC value, refer to the previous discussion concerning IC concentration greater than TOC. If the reading appears to have drifted by 5 ppb (or 10 ppb at the most), recalibrate the TC Zero Offset. If the drift is greater than 10 ppb, check the TC and IC calibration before recalibrating the TC Zero. Follow the procedures in the Calibration chapter to calibrate the TC Zero Offset.

Before making any adjustments to your analyzer you should have eliminated potential operational problems with the instrument as the cause of the negative values you are experiencing. An improperly functioning instrument can yield negative results under some circumstances, and this possibility should be ruled out with the assistance of a Ionics Instrument Business Group Service Representative.

Examples of instrument conditions that could potentially lead to negative TOC values are:

- Depleted resin.
- Bubbles in the TC channel.
- Partial or complete channel blockage, resulting in low restriction in the TC or IC channels.
- High IC levels relative to those of TOC.

EFFECT of INORGANIC CARBON on INSTRUMENT ACCURACY

The Sievers 800 total organic carbon (TOC) analyzers determined TOC by measuring both the amount of total carbon (TC) and inorganic carbon (IC) in samples, and then calculating the difference [TOC= TC - IC]. The concentration of IC in samples is therefore an important consideration for obtaining accurate results. As stated in the 800 operation/maintenance manual (system specifications), the on-line accuracy of the 800 analyzer is ±3% of the total carbon value. The error in measurement then, is dictated by the total amount of carbon in the sample, of which the IC is a component. The off-line error of the 800 will be higher due to sample handling/preparation and exposure to air, and for those samples, an additional 2-3% error is expected based on data we have collected.

As an example, IC levels in municipal tap water often exceed 20 ppm. In such cases, the error would be ~1 ppm (from: (20,000 ppb) x (.05) = 1000 ppb). The 800 can indicate that the IC level is high relative to the TOC by illuminating "W42" on the display. Warning 42 notifies the user that the ratio of IC: TOC is greater than 10:1, and that the accuracy of the TOC measurements may be compromised. Since the accuracy error is directly proportional to the amount of IC in a sample, it is recommended that as much IC as possible be removed before analysis to obtain the most accurate results possible. One method that can be used to reduce IC levels is the acidification and mixing of the samples prior to sampling. Acidification reduces IC levels by liberating much of the dissolved CO_2 from the sample. This method is time consuming though, and can also introduce contamination into the sample from both the acid and additional handling. This procedure should not be performed unless materials and techniques can be ensured not to alter sample integrity.
Note: For samples with high IC, Ionics Instruments recommends the use of an inorganic carbon removal (ICR) module. The ICR accessory effectively removes CO_2 (IC) from samples without additional handling.

IMPORTANT FACTS

Negative TOC values are usually the result of measuring low levels of TOC with relatively high levels of IC, and can be statistically relevant results on a validated and properly functioning TOC analyzer, however, many customers find this undesirable. In an effort to mitigate this situation, the following procedure is designed to fine tune both the IC and TC channels of the analyzer.

In the case of off-line water samples, the TOC may be low, and the IC relatively high (off-line samples absorb carbon dioxide from the atmosphere). Off-line samples may equilibrate over a 250-400 ppb IC range. Depending on the extent to which samples have equilibrated with the atmosphere, there could be different levels of IC for the same water samples if they are analyzed at different times.

TC ZERO OFFSET

If it has been determined by an Ionics Instruments Service Representative to make an adjustment to the TC zero offset, perform the following:

Note: Be sure to record all TC zero offset adjustments and communicate the history to the Ionics Instruments Service Representative assisting you. If you have made more than two adjustments to the TC zero offset in the last six months, there may be underlying issues with your water system or analyzer. Please inform our representatives accordingly.

Modification of procedure in the TC Zero Offset section in Chapter 9:

1. Obtain a 1 L or larger flask (preferably a beaker to offer a large area of exposure to the air) and fill the container approximately half-full with low TOC water. Leave the sample open to the atmosphere overnight so that it may equilibrate with room CO_2 levels (200-400 ppb typically).
2. If necessary, loosely cover the mouth of the flask with parafilm (being careful to leave openings) to minimize organic contamination that may be present in the lab.
3. Turn the UV lamp off.

4. Set up the instrument for sample mode: On Line sampling.
5. Set reagent flows: Acid = 0.20 μL/min and Oxidizer = .01 μL/min.
6. Analyze the water sample prepared in Step 1 (usually done overnight).
7. Calculate the average value of the last 5 TOC measurements.
8. Calculate the new TC Zero Offset using the following equation:

New TC Zero Offset = (Initial TC Zero Offset) – (Avg. TOC value from step7)*

**Be sure to note the sign of the Average TOC value and input the value accordingly; it may be negative.*

9. Enter in the new TC Zero offset.**
10. Rerun with new offset for 1-2 hours. TOC should be close to zero PPB, if not repeat Steps 7-10.

***If the absolute values of the new TC Zero Offset is greater than 50 ppb, contact an Ionics Instruments Service Representative before inputting the new TC Zero Offset value.*

Diagnostic Testing

The analyzer has the ability to perform several diagnostics tests. These tests should only be run with the direction of an Ionics Instruments Service Technician.

To run a test, scroll to MAINTENANCE on the MAIN menu and press ENTER. Scroll to SERVICE and press ENTER. The following screen will display the tests:

FIGURE 10-6: SERVICE Menu

With the direction of an Ionics Instrument Service Technician, scroll to the designated test and press ENTER. The test will run quickly and provide the

Service Technician valuable information. These tests determine whether there is a valid electronic connection.

Syringe Pump

The analyzer has the ability to perform mechanical operations associated with the syringe pump replacement and repair. These repairs, replacements, and menu operations should only be run with the direction of an Ionics Instruments Service Technician.

Upon completion of a repair, scroll to MAINTENANCE on the MAIN menu and press ENTER. Scroll to MECHANICAL and press ENTER. The following screen will display the tests:

FIGURE 10-7: MECHANICAL Menu

The SET DEAD VOLUME option is only used after the replacement of the syringe pump or any of its components. TEST SERVO determines the functionality of the Servo Motor. TEST SYRINGE tests the syringe for reliability. LIFETIME STATS provides information for the Ionics Instruments Service Technician.

Returning the Analyzer to Ionics Instruments

In some instances, it will be necessary to return the analyzer to the factory for repairs. **Several precautions must be followed to ensure that the analyzer is not damaged during shipment.**

If the original shipping container has not been retained or heat packs are unavailable, contact Ionics Instruments at 1-800-255-6964 or 303-444-2009 to

order shipping supplies. *Under no circumstances should you try to pack the analyzer in anything other than the original shipping container.* A Return Authorization Number must be obtained from Ionics Instrument Business Group before shipping the analyzer.

WARNING
If the analyzer is returned in anything other than an Ionics Instruments shipping container, you will be charged for any damage that occurs during shipping.

Preparing the Analyzer for Return Shipment

1. Turn the analyzer on. If necessary, select STOP TOC and press ENTER.
2. From the MAIN menu, scroll to SETUP and press ENTER. Then scroll to REAGENTS ➔ ON-LINE FLOW RATES and press ENTER.
3. Set the acid flow rate to 0 by selecting ACID FLOW RATE, entering a flow rate of 0, and pressing ENTER three times. Press CLEAR to return to the FLOW RATES screen.
4. Set the oxidizer flow rate to 0 by selecting OXID FLOW RATE, entering a flow rate of 0 and pressing ENTER three times. Press CLEAR to return to the FLOW RATES screen.
5. Press CLEAR three times to return to the MAIN menu, scroll to START TOC, and press ENTER.
6. The analyzer will empty the Acid and Oxidizer syringes and display “Emptying Acid Syringe” and “Emptying Oxidizer Syringe” messages on the front panel display.
7. After the messages have been cleared and the clock indicating time to next measurement (upper right-hand corner of the screen) has started, stop analysis, and turn off power to the analyzer.
8. Disconnect the sample inlet tubing and the waste tubing from the right-hand-side of the analyzer.
9. Remove any printer, alarm, analog output, or computer cables and the power cord connected to the analyzer.
10. Remove the Acid and Oxidizer Reagent containers from the analyzer:

⚠ WARNING

Removing the reagents requires access to the inside of the analyzer. To avoid potentially dangerous shock, disconnect the power cord before opening the analyzer's top panel.

WARNING

To avoid exposure to the chemical reagents, wear acid-resistant gloves, protective clothing, and safety goggles or a face shield when removing the reagent supplies.

a. Open the analyzer top panel by pushing back on the two black handles and lifting the panel upwards.

b. Locate the reagents in the covered enclosure located at the front, right-hand side of the analyzer. Open the top cover on the enclosure by removing the two thumb-screws located at the back of the enclosure and lifting the cover.

c. Locate the acid supply (the container on the left-hand side) and remove it from the enclosure by lifting up on the front of the container (the end opposite the Mininert valve), pulling the container out of the enclosure while sliding the valve out from under the tubing and stainless steel cross.

d. Close the Mininert valve on the container by pressing on the red button to slide the stainless steel bar fully inward.

WARNING

Acid may spill from the container if you do not close the valve.

e. Disconnect the acid container from the inlet line by grasping the container and the brown nut and unscrewing the container counterclockwise while holding the brown knurled nut. Turning the container rather than the nut will prevent the tubing from twisting.

f. Locate the oxidizer supply (the container on the right-hand side) and remove it from the enclosure by lifting up on the front of the container (the end opposite the Mininert valve), pulling the container out of the enclosure while sliding the valve out from under the tubing and stainless steel cross.

g. Close the Mininert valve on the container by pressing on the red button to slide the stainless steel bar fully inward.

WARNING
Oxidizer may spill from the container if you do not close the valve.

h. Disconnect the oxidizer container from the inlet line by grasping the container and the brown nut and unscrewing the container counterclockwise while holding the brown knurled nut. Turning the container rather than the nut will prevent the tubing from twisting.

i. Store the reagent containers in a refrigerator.

j. Place a paper towel or Kimwipe around the acid and oxidant inlet line to absorb any liquid.

k. Replace the top cover on the reagent enclosure and secure with the two thumb-screws located at the back of the reagent enclosure. Close the analyzer top cover panel.

The analyzer is now ready for repackaging. To prevent the deionized water loop from freezing during shipment, two Warm Packs are included in the accessories kit that came with the analyzer. **Warm Packs must be used if returning the analyzer between September and May**. If Warm Packs are not available, please contact Ionics Instruments for replacement.

WARNING
Do not *under any circumstances* ship the analyzer from September to May without the warm packs. Failure to use the warm packs may damage the analyzer and you will be charged for any repairs.

Repackaging the Analyzer for Shipment

1. Activate two Warm Packs by opening the outer plastic package. Exposure to air will initiate the chemical reactions and supply heat for 20 hours.
2. Tape the ***activated*** Warm Packs to the inside of the plastic analyzer bag. Tape should be placed on the edges of the packs. Tape should not cover the center of the packs.
3. Insert the analyzer in the plastic analyzer bag containing the Warm Packs and secure with tape.
4. Install the white plastic analyzer supports on the front and back side of the analyzer. These supports have cut outs for the analyzer feet and handle and should fit securely on the analyzer. For the front panel, position the analyzer handle towards the top of the analyzer so that it fits in the cut-out on the plastic support.
5. Place the analyzer in the shipping box. Place the brown cardboard spacer on top of the analyzer and secure the box with packing tape. Use a marker to write the R.A. # in large letters on the top and sides of the box.
6. Ship the analyzer using an overnight courier (e.g., Federal Express or UPS).

Failure to use an overnight service between September and May will result in damage to the analyzer due to cold temperatures. The heat packs are only effective for twenty hours; therefore, overnight service is required to avoid damage to the analyzer.

Coordinate with an Ionics Instruments representative for international shipments to ensure quick passage through customs.

All of the data collected is stored on a RAM card. The data can be viewed either by using the HISTORY options from the RunTime menu while the analyzer is operating or by using the HISTORY option from the MAIN menu. The RAM card may be removed from the analyzer and the data downloaded to a PC using a RAM card reader device and the RAMReader software program.

To read the data stored on the RAM card, a RAM card reader device must be installed on the computer, and RAMReader software must be installed on the computer.

Installing the Card Reader Hardware

Follow the instructions supplied with the card reader for installation. Select the appropriate driver and follow the instructions. It is recommended to use an external card reader device instead of the incorporated PCMCIA slots on laptop computers.

NOTE

Data from the RAM card is transferred via one of the parallel printer ports. If both ports are being used or there is only one printer port, disconnect the printer cable in order to transfer data. For convenience, a printer switching box, available from computer stores, should be installed on the printer port in order to easily switch between the printer and the card reader.

Installing RAMReader Software

Ionics Instruments recommends using the RAMReader software program. Follow the instructions supplied with the program for installation. Instructions for installation on all Windows operating systems (except Windows NT) are included.

To order the RAMReader software program (part number ASW-80010), contact Ionics Instruments Customer Service at (800)255-6964.

Removing the RAM Card

1. Turn the instrument off and disconnect the power cord. If the instrument is running, first select STOP TOC (on-line mode) or STOP (measure sample mode) to stop the instrument.
2. Locate the RAM card (white with black trim) that extends out of the circuit board, to the left of the CO2 sensors (see Figure 11-1). Remove the RAM card by pulling it straight up out of the socket.

⚠ WARNING

Removing the RAM card requires access to the inside of the instrument. Disconnect the power cord before opening the instrument's top panel and removing the card. Removing the card with the power on will damage the instrument and invalidate the warranty.

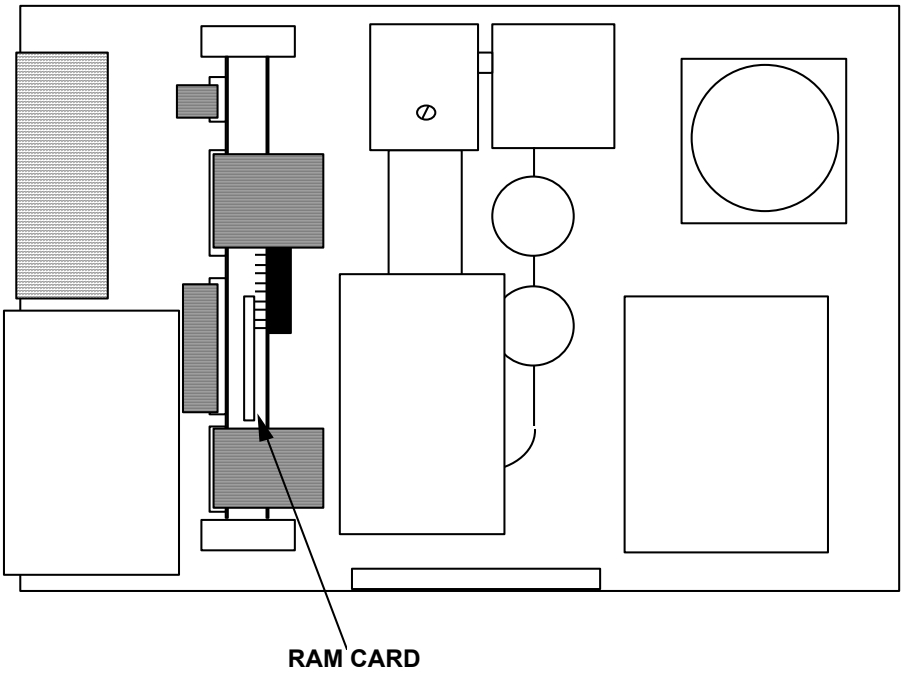


FIGURE 11-1: Location of RAM Card

3. Enable card write protection by following the instructions included with the RAM card. Slide the black tab towards the WP position. This will prevent writing on the card.

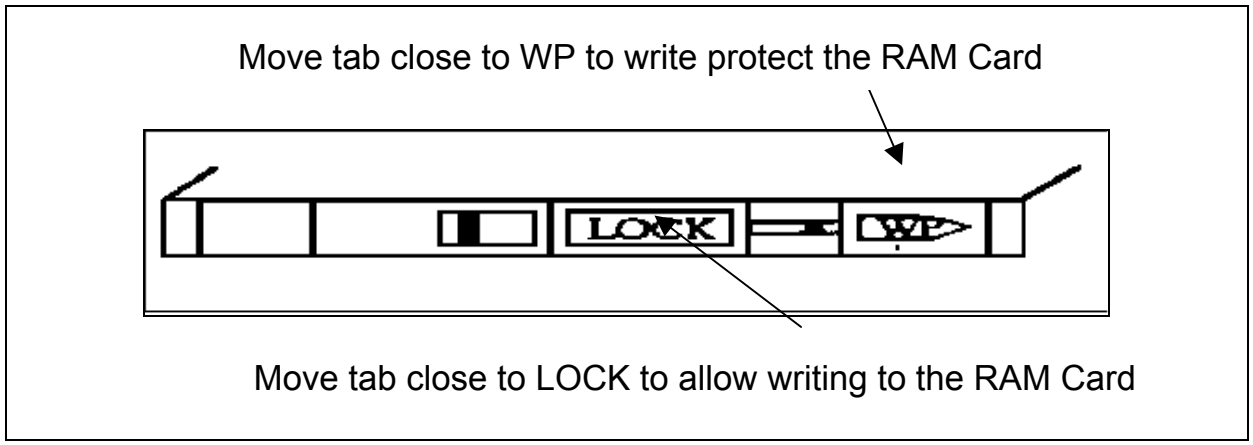


FIGURE 11-2: RAM Card Write protection position

Placing the RAM Card in the Card Reader Device

RAM cards supplied by Ionics Instruments have a label on one side of the card. Hold the card with the label facing down and insert the RAM card into the reader. In the proper orientation, the write protect switch on the card and the single tab groove will be located on the front, left-hand side of the card as it is inserted into the reader (see Figure 11-3). Press the card firmly into the reader. The pins slide into the card connector. If the card is installed upside-down, the pins will not be aligned, and the card will not be able to be pressed fully into the card reader.

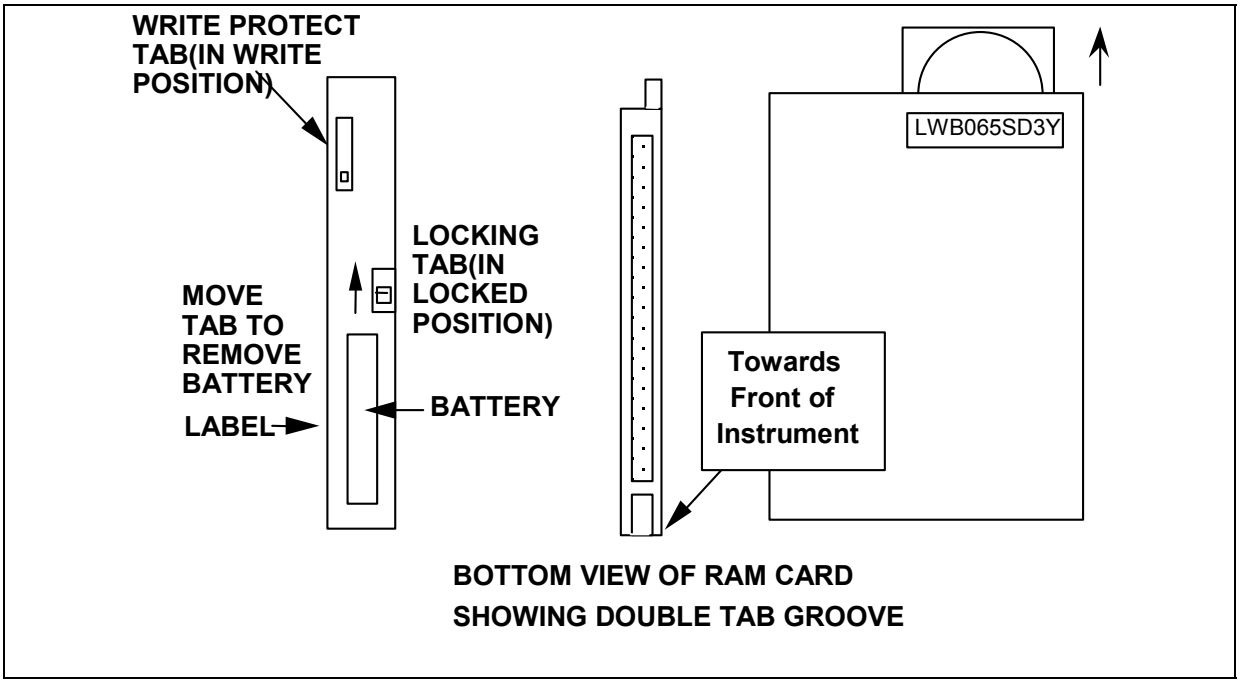


FIGURE 11-3: Replacing the RAM Card

Installing the RAM Card in the Analyzer

After the data has been downloaded from the card, the RAM card can be installed before restarting the analyzer. To install a card:

1. Disable card write protection by following the instructions included with the RAM card. To allow the card to be written to, slide the black tab to the LOCK position (see Figure 11-2).
2. Make sure the power to the analyzer is off and the power cord is disconnected.
3. Hold the card so that the double tab groove on the bottom of the card (see Figure 11-3) is facing towards the front of the analyzer. The label on the card will be facing to the left-hand side of the analyzer.
4. Locate the RAM card connector on the circuit board.
5. Gently push the card into place.
6. Close the top of the analyzer, reconnect the power cord, and turn the power switch on.

WARNING
RAM cards have a limited battery lifetime and data will be lost from the card when the battery expires. The battery is used whenever the card is removed from the analyzer. Consult Table 9 in the Maintenance Chapter for the approximate lifetimes of RAM card batteries. To avoid losing data, do not let the RAM card stand unplugged from the analyzer for an extended period.

RAM Card Battery Maintenance

When the RAM card is removed from the analyzer, an internal battery provides the power to maintain the data. As indicated in Table 9, the battery must be replaced to retain data on the card if the card is in the analyzer and the battery is low. Error Message #29 will be displayed at power up when it is time to change the battery. Replacement batteries should be available at local electronics stores.

To change the battery:

1. Follow the procedure described above for removing the RAM card from the analyzer.

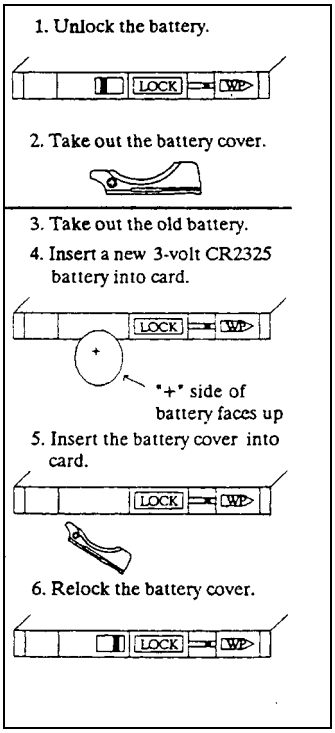


FIGURE 11-4: RAM Card Instruction Sheet

2. The Ram Card may be inserted into a powered up Ram Card Reader during this procedure. In this way the data will be retained, otherwise **the data will be lost when the battery is removed.**
3. Follow instructions that have been included with the RAM Card.
4. Follow the procedures listed above to reinstall the card in the analyzer.

NOTE

Some RAM cards do not have a locking tab for the battery, rather a small screw holds the battery in place. To replace the battery on these cards, remove the screw and lift the battery out of the card.

WARNING

Dispose of used battery according to local regulations.

Downloading the RAM Card Data

NOTE

Sending commands to the instrument via the RS-232 port requires a password. See the DataGuard Operation chapter for more information regarding the DataGuard feature.

To download the data from the RAM Card using the GD (get data) command. This command can be used in any sample mode (on-line, grab, or multistream). When GD is typed, (or gd) and enter is pressed, the system will scan the RAM card and respond with:

GDYYMMDD HH:MM YYMMDD HH:MM

(start date and time) (stop date and time)

where GD is the echo reply from the analyzer, the first date and time is for the first sample data on the card and the second date and time is for the last sample data on the card. For example, a reply to GD of:

GD950302 08:00 950808 13:30

indicates that the first data on the card is from March 2, 1995 at 8:00 AM and the last data is from August 8, 1995 at 1:30pm.

To download all or part of the data using the GD command using the same format. For example:

GD950701 00:00 950702 00:00

will retrieve all of the TOC data from midnight July 1 to midnight July 2, 1995.

The following format must be used:

GDYYMMDD (space) HH:MM (space) YYMMDD (space) HH:MM (enter)

The backspace or delete key cannot be used to correct mistakes. If a mistake is made, simply hit the enter key and retype the command. If the format is not correct, the analyzer will respond with IV (invalid command) or an ER (error).

For a valid command such as gd950808 13:37 950808 14:01, the analyzer will respond with:

CHANNEL NAMES:STRM NAME 1,STRM NAME 2,STRM NAME 3, STRM NAME 4, STRM NAME 5,STRM NAME 6,STRM NAME 7,STRM NAME 8

The first two line are a header that contain the stream names used in the multistream sampler. If not using the multistream samples, the header is not used.

The next line contain the first sample data. The format is:

YYMMDDHH:MM TOC(units) IC(units) (sample mode) (sample number)

The units are either B for ppb or M for ppm and the sample mode is blank for on-line, G for grab samples, T for tubes (autosampler), S for stream (multistream sampler) and F for Turbo mode.

95080813:27 22.8B 55.2B	-	On-Line
95080813:43 16.1B 37.1BG1	-	Grab
95080813:49 19.3B 45.1BG2	-	Grab
95080813:55 14.1B 30.9BT1	-	Tubes (autosampler)
95080814:01 12.1B 26.1BS1	-	Multistream (number one, in this case)
95080814:09 12.9M 29.3M F	-	Turbo

For this example, the first sample data is from August 8, 1995 at 1:37pm the TOC was 22.8 ppb and the IC was 55.2 ppb. The sample mode is blank, designating on-line measurements. Successive measurements are list on new lines.

An example of the reply for the grab sample mode is 95080813:43 19.3B 45.1BG1, where the G designates the grab sample mode and the 1 indicates that this was the second sample run this day.

Depending on the communication program, save the reply as a text file or copy the data to a text editor or spreadsheet program.

APPENDIX A – 810/810AS ANALYZER OPERATING FREQUENCY

The deionized water circulating pump in the analyzer is powered directly from the AC line supply. The speed of this pump is therefore dependent on the frequency of the AC power supply. The flow rate of DI water through the membrane module is determined by the speed of the pump, which, in turn affects the calibration of the analyzer. Since the frequency of the AC power supply can be 50 Hz or 60 Hz depending on the location, the firmware for the 810 and 810AS analyzers has been expanded to permit operation at either 50 or 60 Hz. The major difference in the software is two sets of calibration constants, one for 50Hz and one for 60 Hz. The analyzer was calibrated at the factory for the appropriate frequency or, in some cases, for both frequencies. The following discussion applies to dual frequency units.

> **NOTE**
>
> For instrument firmware with the DataGuard feature, enter a QA-level (or higher) password when prompted. Check with your system administrator for an appropriate password. See the DataGuard Operation chapter for more information regarding the DataGuard feature.

Selecting the Operating Frequency

The SETUP menu for the 810 and 810 AS analyzer contains an option (50/60 Hz) for selecting the operating frequency. To select the frequency:

1. Select SETUP from the MAIN menu.
2. Use the arrows (↑ or ↓) to scroll to 50/60 HZ and press ENTER.

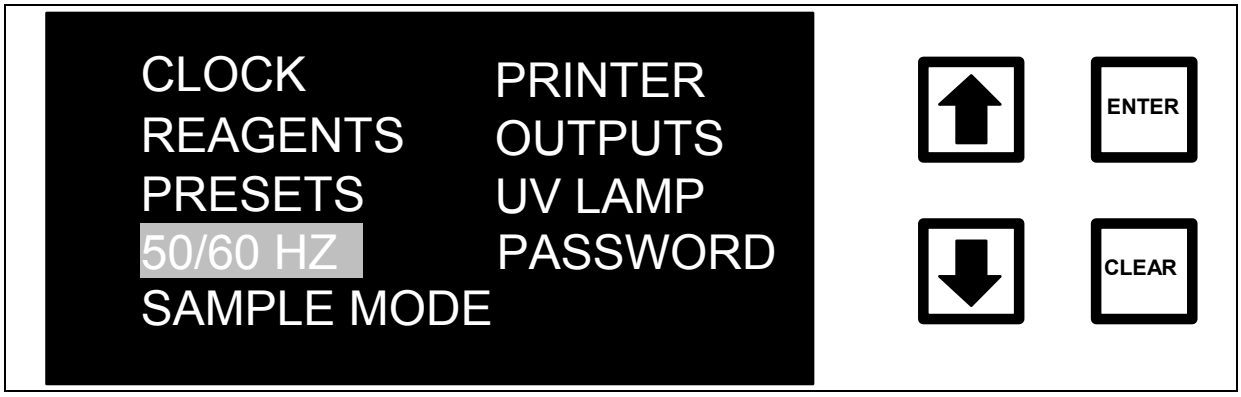


FIGURE A-1: Set-Up Menu for Sievers 810 TOC Analyzer

The OPERATING FREQUENCY menu is displayed showing the current set point.

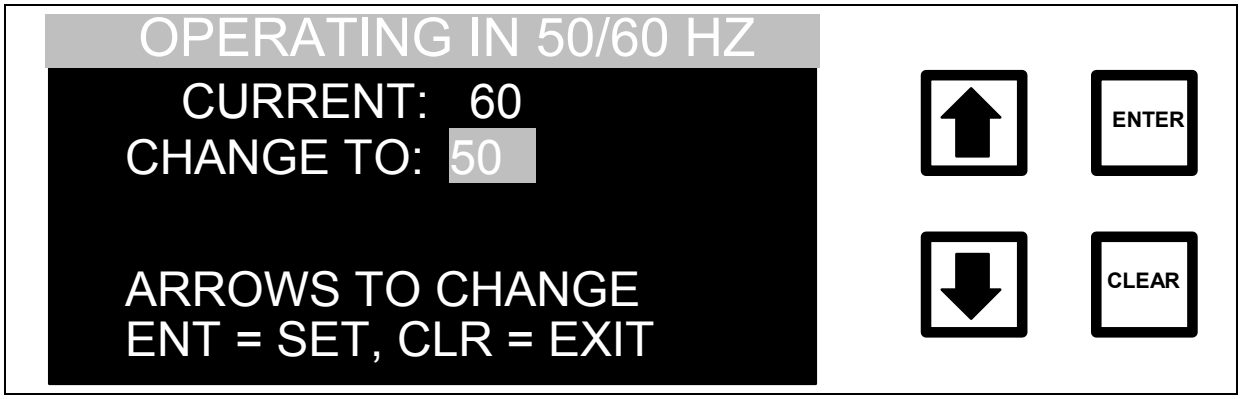


FIGURE A-2: Operating Frequency Menu for Model 810 TOC Analyzer

3. Use the arrows (↑ or ↓) to select the AC power supply frequency at the location.
4. Press ENTER to set the frequency, and then press CLEAR to return to the SETUP menu.

WARNING
The correct frequency must be selected for the AC power supply or the TOC measurements will be in error.

Selecting the frequency determines which set of calibration constants will be used for calculating TOC, TC, and IC.

Calibration

When the analyzer is being recalibrated, the calibration constants must be changed for the operating frequency. When CALIBRATE is selected from the

MAIN menu, the SELECT FREQUENCY CALIBRATION CONSTANTS menu is displayed.

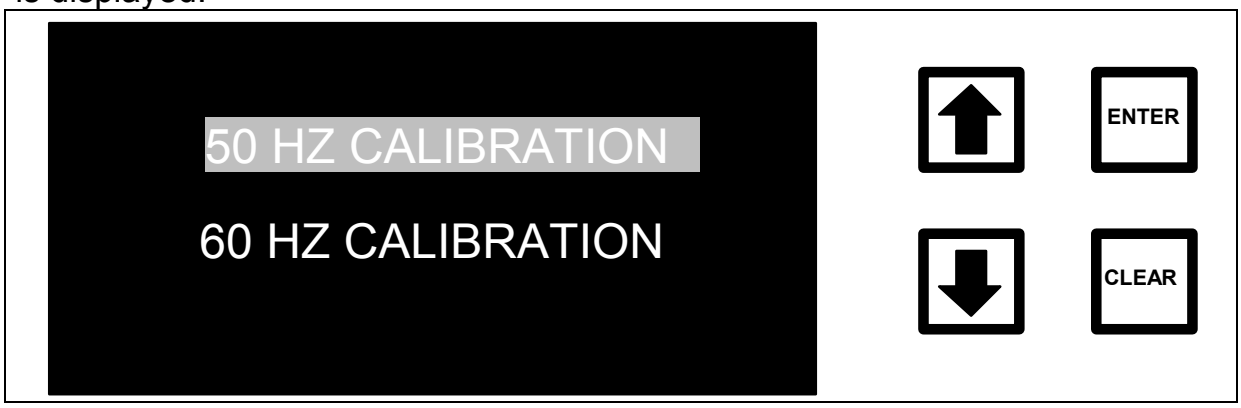


FIGURE A-3: Select Frequency Menu for Sievers 810 TOC Analyzer

Use the arrows (↑ or ↓) to select the calibration constants for the operating frequency and press ENTER. **The calibration constants must be selected for the operating frequency.** The CALIBRATION menu is then displayed. The procedures for calibrating the instrument are the same as described in the Calibration chapter. As a reminder that the calibration constants are dependent on the AC frequency, the CALIBRATION CONSTANT menu will display the frequency as shown in Figure A-4 for the TC Calibration Constant.

FIGURE A-4: TC Calibration Constant Menu for Sievers 810 TOC Analyzer

All other menus and operating procedures for the 810 and 810AS models are identical to the 800 and 800AS TOC analyzer.

APPENDIX B – 820/820AS ANALYZER OPERATING FREQUENCY

Checking the Operating Frequency

> **NOTE**
>
> For instrument firmware with the DataGuard feature, enter a QA-level (or higher) password when prompted. Check with your system administrator for an appropriate password. See the DataGuard Operation chapter for more information regarding the DataGuard feature.

The SETUP menu for the 820 and 820AS analyzer has an option (50/60 Hz) for selecting the operating frequency. Only one setting is used. Do not change the setting from the factory configuration.

To view and verify the frequency setting:

1. Select SETUP from the MAIN menu.
2. Use the arrows (↑ or ↓) to scroll to 50/60 Hz and press ENTER. The operating Frequency menu is displayed, showing the current set point:

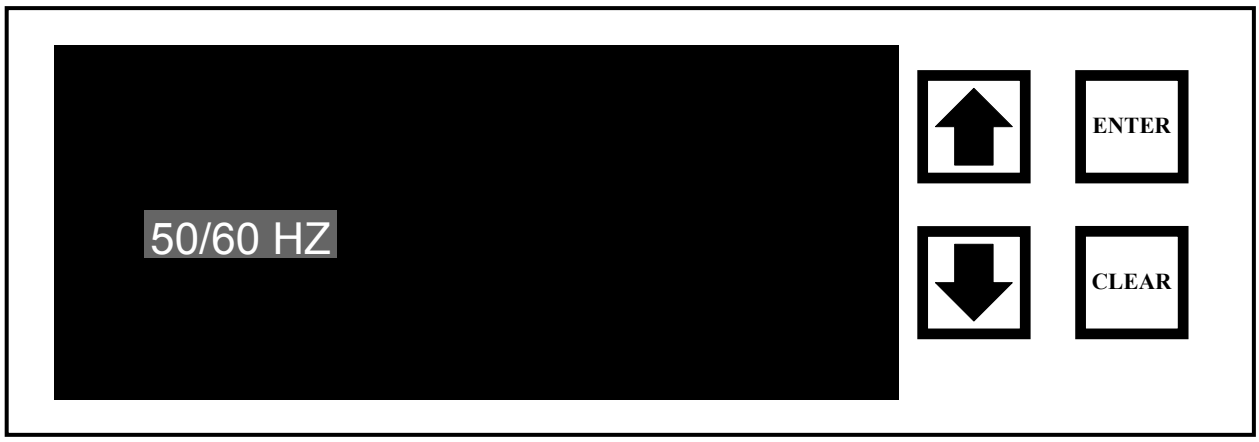


FIGURE B-1: SETUP Menu for Sievers 820 TOC Analyzer

3. Press CLEAR to return to the Setup menu.

WARNING
Only the factory configured frequency setting should be used for the 820/820AS analyzer. If the frequency setting is changed or the incorrect setting is selected, the TOC measurements will be in error.

See Appendix A for additional details on menu selections when entering calibration constants.

CE Mark Compliance

To comply with CE mark standards, additional equipment needs to be collected for installation of an 820/820AS analyzer. This information is in addition to the information in the Installation chapter.

- Printer and cable (*optional*) – use CE mark or CISPR class “B” approved printer; printer cable must be properly shielded.
- IBM compatible computer (optional) – use CE mark or CISPR class “B” approved computer.
- RS-232 cable needs to be shielded.

Printer Cable

The 820/820AS analyzer has a 25-pin parallel (Centronics) printer port for the direct output of results to a printer. If a printer is to be used, connect the proper shielded cable for the printer to the printer port and secure with screws. The cable needs to be a shielded printer cable that can be found at computer stores. The printer must be CE marked and CISPR class “B” approved IBM compatible. The port must be configured as described.

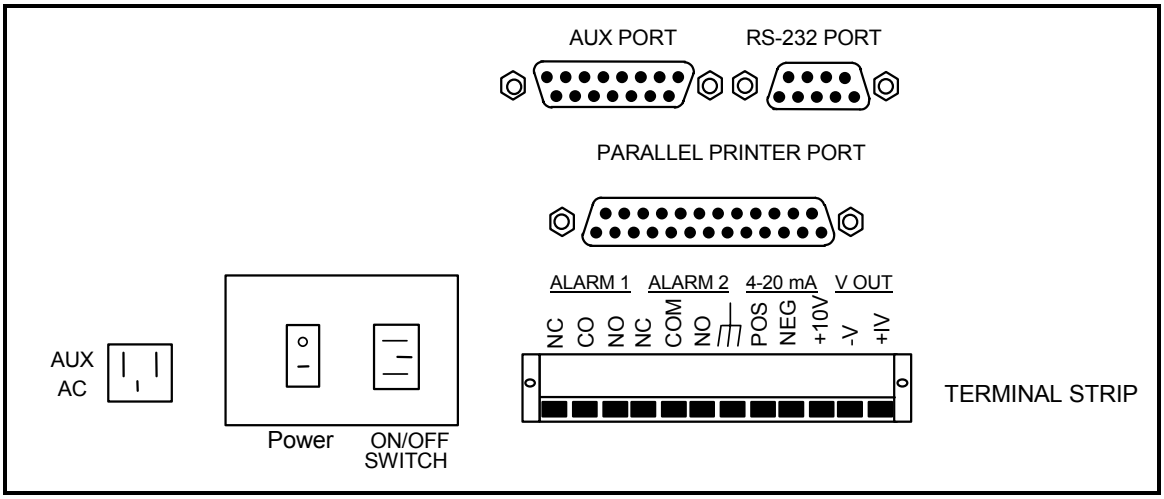


FIGURE B-2: Output Connectors Configuration*

* Pin 7 is changed from "not used" to "chassis ground" for the 820/820AS models.

Introduction

Turbo sampling mode is an option on a Sievers 800 Series TOC Analyzer that is achieved through specific firmware. Analyzers configured with this option are designated as the "Turbo" version of the model number. This mode is useful for monitoring recycle or reclaim water in semiconductor facilities where rapid response is of primary concern. When operated in the Turbo mode, the analyzer responds to a step change with an initial response in 3 minutes and 90% of the final value in 3.5 minutes. Results are reported every 3 to 4 seconds.

> **NOTE**
>
> During a reagent syringe refill, there is a 3 to 4 minute delay, during which no new data are available. Refills will occur approximately every 4 hours.

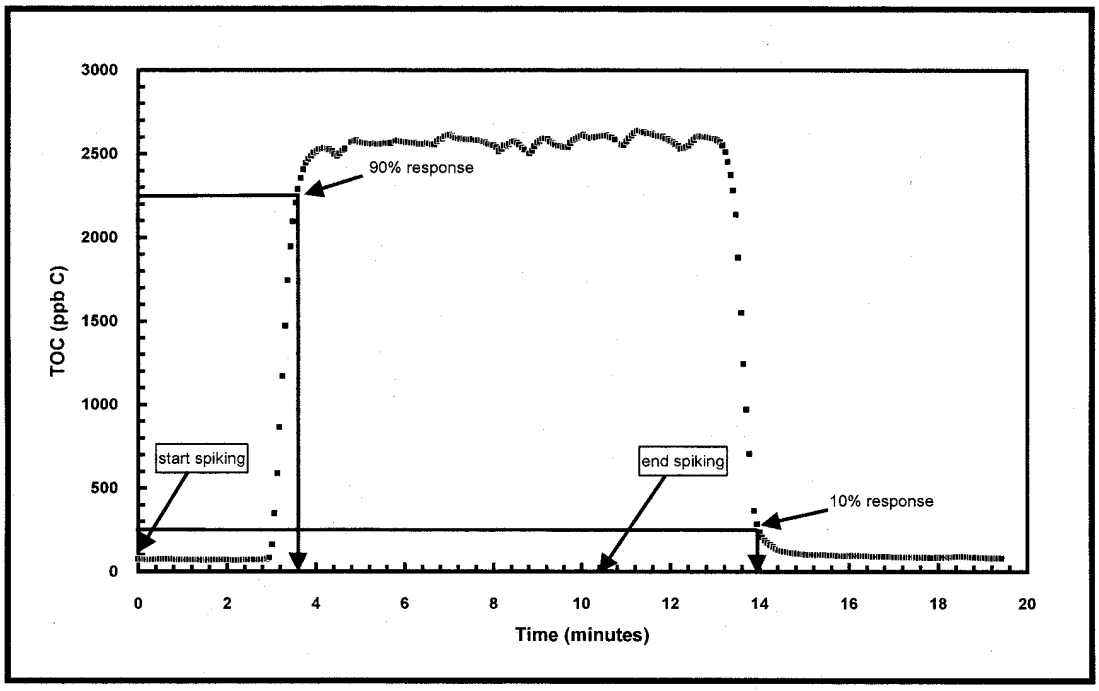


FIGURE C-1: *Step change response for 800/810/820 Turbo TOC Analyzer in TURBO mode.*

The working range of the analyzer in Turbo mode is 10 - 2500 ppb TOC. Data may be recorded from the front panel screen, the analog outputs, or from the RS-232 interface. **When in the Turbo mode, the printer interface is not functional.**

Setting Turbo Sampling Model

The SAMPLE MODE menu for a Sievers 800 Series Turbo analyzer contains an option to select fast sampling. To set TURBO SAMPLING mode:

1. Select SETUP from the MAIN menu.
2. Use the arrows (↑ or ↓) to scroll to SAMPLE MODE and press ENTER.
3. Use the arrows (↑ or ↓) to scroll to highlight TURBO SAMPLING.

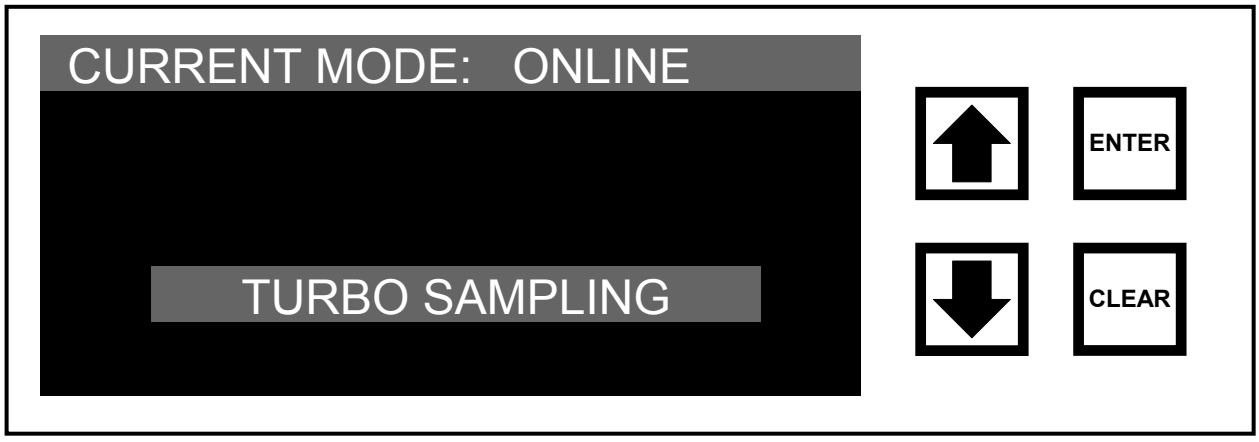


FIGURE C-2: SAMPLE MODE Menu

4. Press ENTER to change the current mode to TURBO.

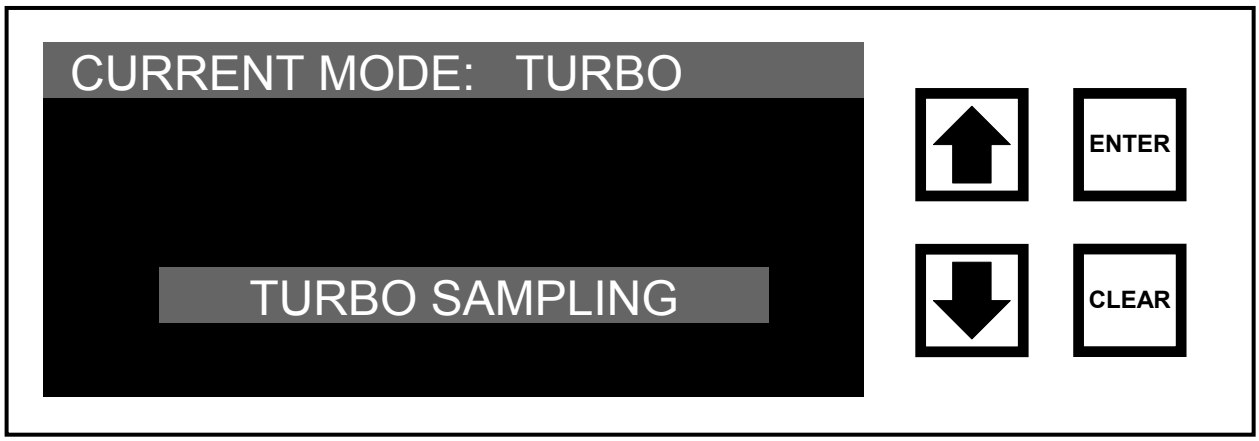


FIGURE C-3: SAMPLE MODE Menu – Turbo Analyzer (TURBO SAMPLING selected)

> **NOTE**
> Turbo sampling is only available in on-line mode.

Setting Reagent Flow Rates

> **NOTE**
> The reagent flow rates for Turbo mode are preset and should be only as follows:
>
> Acid = 2.0 µl/min
>
> Oxid = 0.5 µl/min
>
> These flow rates are optimized for operation from 10-2500 ppb TOC.

The REAGENTS menu for the Sievers 800 Series Turbo analyzer contains an option to select reagent flow rates for fast sampling.

To set TURBO flow rates:

1. Select SETUP from the MAIN menu.
2. Use the arrows (↑ or ↓) to scroll to REAGENTS and press ENTER.

3. Use the arrows (↑ or ↓) to scroll to and highlight TURBO FLOW RATES.

FIGURE C-4: REAGENTS MENU for 800 Series Turbo TOC Analyzer

4. Press ENTER to display the FLOW RATES menu:

FIGURE C-5: FLOW RATES Menu for 800 Series Turbo TOC Analyzer

ENTER flow rates as described in the INSTALLATION and OPERATION chapters.

Setting Alarms

Alarms may be activated to indicate that TOC measurement has been interrupted when syringes are being filled.

To activate this alarm setting:

1. From the SETUP menu, select OUTPUTS.
2. Select ALARMS.
3. Select RUN ALARM .
4. Select ON.

The alarm display will read TOC Active. An alarm will respond when the TOC measurements are interrupted.

Calibration in Turbo Sampling Mode

Calibration of Turbo mode is similar to calibration in the normal operating modes. Before attempting to calibrate the analyzer in TURBO SAMPLING MODE, review the Calibration chapter. Differences in the specific calibration procedures are provided below.

NOTE

The calibration constants for Turbo mode are separate from the constants for other modes and should not be interchanged.

Turbo Mode TC Zero Offset

NOTE

Because Turbo mode measurements are valid only over the range 10 – 2500 ppb TOC, it is not necessary to perform a zero offset calibration. Do not change the Turbo TC zero offset from the default value of 0.0.

To verify the TURBO TC ZERO OFFSET, access the TURBO TOC CALIB. menu. The CALIBRATE MODE menu for a Sievers 800 Series Turbo analyzer contains an option to select Turbo calibration values.

1. Select CALIBRATE from the MAIN menu.
2. Use the arrows (↑ or ↓) to scroll to TURBO TOC CALIB. and press ENTER.

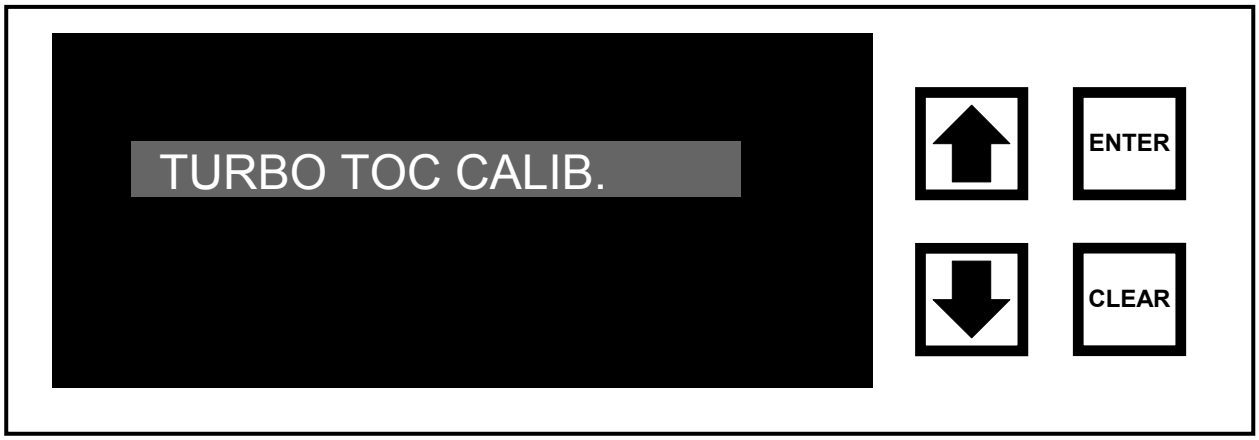


FIGURE C-6: CALIBRATE Menu for 800 Series Turbo TOC Analyzer

3. Use the arrows (↑ or ↓) to scroll to TC ZERO OFFSET and press ENTER.

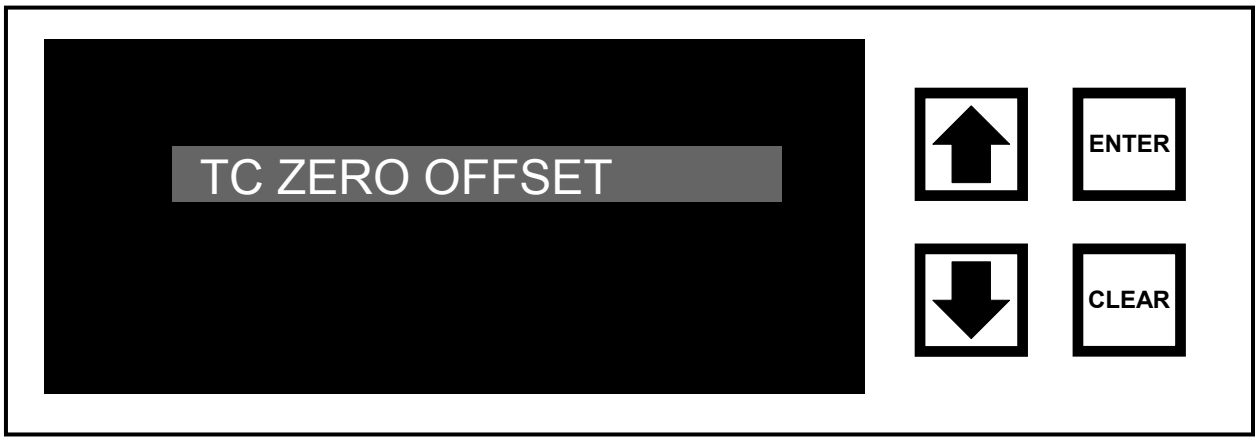


FIGURE C-7: CALIBRATE Menu for 800 Series Turbo TOC Analyzer

The TC ZERO OFFSET value will be displayed. Do not change the value from the default value of 0.0.

Turbo Mode TC Channel Calibration

NOTE

Turbo TOC sampling is available only in on-line mode. Configure the analyzer to sample from a container as explained in the Operation chapter but do not place the analyzer in grab sample mode to perform TC and IC channel calibrations.

Measure a flask of the water used to prepare standards as instructed in the calibration chapter. Once the readings have stabilized, stop the analyzer by pressing ENTER and selecting STOP TOC. Use HISTORY to view the data, then average the last five TC values to determine an accurate TC value for the water.

Prepare a nominal 2 ppm KHP standard instead of the 25 ppm standard indicated in the calibration chapter. This may easily be accomplished by preparing the stock solution in a 250 mL volumetric flask rather than the 100 mL flask indicated in the calibration chapter. This will produce a nominal 400 ppm stock when 0.212 grams of KHP are used to prepare the stock. Make the

dilute 2 ppm standard by transferring 5 mL of the 400 ppm stock with a calibrated pipette into a 1 L flask. Fill the flask to volume using water from the same source characterized earlier. Calculate the value of the dilute standard in the same way shown in the Calibration chapter.

Place the analyzer in turbo mode, then perform a TC channel calibration according to the instructions in the Calibration chapter. Use the preset flow rates of ACID = 2.0 and OXID = 0.5. Once the readings have stabilized, stop the analyzer by pressing ENTER and then selecting STOP TOC. Use HISTORY to view the data, then average the last five TC values to determine an accurate TC value for the 2 ppm standard.

If necessary, access the TURBO TC CALIB. CONSTANT by selecting TURBO TOC CALIB. from the CALIBRATE sub-menu, then choosing TC CALIB. CONSTANT. Calculate and enter the new TURBO TC CALIB. CONSTANT as instructed in the calibration chapter.

Turbo Mode IC Channel Calibration

Prepare a nominal 2 ppm Na_2CO_3 standard instead of the 25 ppm standard indicated in the Calibration chapter. This may easily be accomplished by preparing the stock solution in a 250 mL volumetric flask rather than a 100 mL flask. This will produce a nominal 200 ppm stock when 0.441 grams of Na_2CO_3 are used to prepare the stock. Make the dilute 2 ppm standard by transferring 10 mL of the 200 ppm stock with a calibrated pipette into a 1 L flask. Fill the flask to volume using water from the same source characterized earlier. Calculate the value of the dilute standard in the same way shown in the Calibration chapter.

Place the analyzer in Turbo mode, then perform an IC channel calibration according to the instructions in the calibration chapter. Use the preset flows of ACID = 2.0 and OXID = 0.5. Once the readings have stabilized, stop the analyzer by pressing ENTER, then selecting STOP TOC. Use HISTORY to view the data, then average the last five IC and TC values to determine accurate IC and TC values for the 2 ppm standard.

Access the TURBO IC CALIB. CONSTANT by selecting TURBO TOC CALIB. from the CALIBRATE sub-menu, then choosing IC CALIB. CONSTANT. Calculate and enter the new TURBO IC CALIB. CONSTANT as instructed in the calibration chapter.

Alarm Settings

Once in TURBO mode, from the SETUP menu select OUTPUTS, then select ALARMS. The settings are displayed as follows:

ALARM OFF
ALARM ON ERROR
TOC ABOVE
TC ABOVE
IC ABOVE
OFF LINE ALARM

Follow the directions in the Installation chapter for the setup and wiring of alarms.

Accuracy Specifications

When operated in Turbo mode, the analyzer has the following accuracy specifications:

@ 2.0 ppm ± 5%
@ 200 ppb ± 15%

Precision is ± 3% at all levels.

APPENDIX D – BINARY INPUT MODULE – FLOW SWITCH

This appendix describes the activities required to install the flow switch and firmware 2.11 CBI in all 800 series TOC analyzers.

The Turbo firmware 2.12 CTB or later has incorporated the INPUTS menu item. Follow these instructions except skip the firmware installation steps.

The materials and tools needed for this procedure are:

- 7/16” open-end or adjustable wrench
- ½” open-end wrench
- Flat head screwdriver
- Phillips head screwdriver
- Scriber
- Teflon tape

WARNINGS
A 60-micron filter must be used to ensure proper operation of the flow switch.
Do not overtighten any fitting.
Switch orientation should be no more than 15° from vertical alignment.
Do not install units near ferrous metals, magnets or electromagnetic fields.

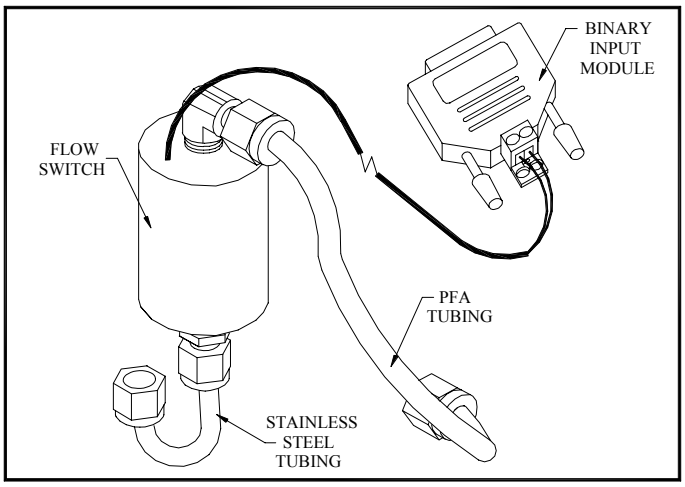


FIGURE D-1: Flow Switch Kit

Mechanical Installation

(Refer to Figures D-1 and D-2 for this procedure. Reference will depend on orientation of tubing from regulator.)

1. Remove the outlet PFA tube connector from the pressure regulator of the analyzer.
2. Detach the regulator from the analyzer by removing the two screws on the bottom of the mounting bracket, making sure not to lose the fiber spacers.
3. Remove the elbow from the outlet side of the regulator and clean the port and connector threads of any Teflon tape that remains. Reapply 4 wraps of Teflon tape to the elbow and screw the fitting back into the regulator ending with the tube fitting pointing down as shown.
4. Reinstall the regulator to the analyzer with the two screws making sure to use the fiber spacers.
5. Remove the PFA tube from the inlet of the sampling block.

6. Position the flow switch and secure the end of the stainless steel U-tube to the regulator outlet. Wires must point up to have a calibrated normally open switch.
7. Secure the PFA tube from the outlet of the switch to the inlet of the sampling block.
8. Connect the wires from the flow switch to the Binary Input Module, polarity is not important to the binary module.
9. Route the electrical cable as desired and plug the end into the AUX PORT on the opposite side of the analyzer.

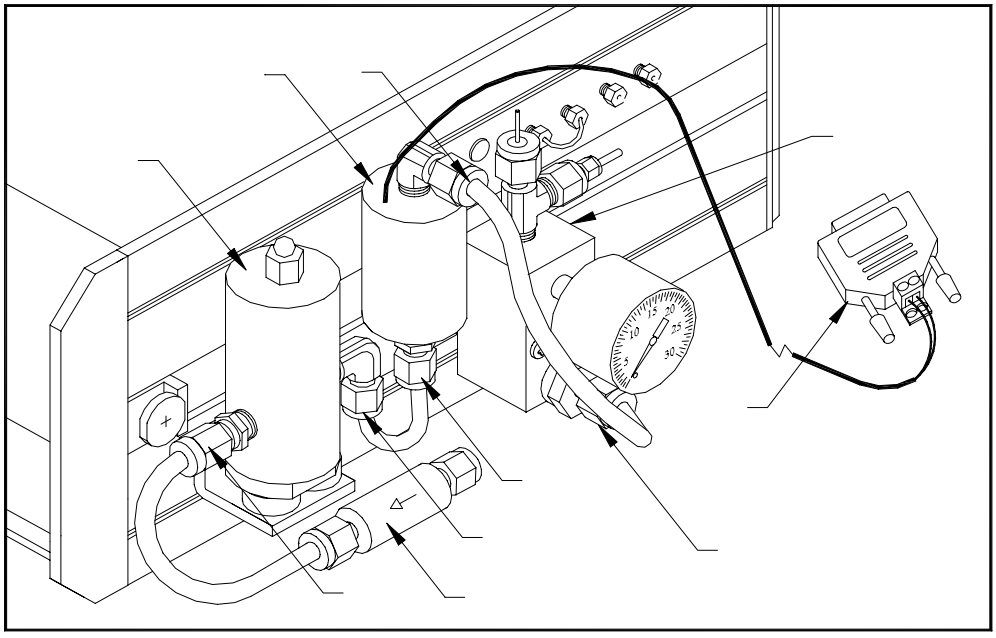


FIGURE D-2: Installed Flow Switch

Firmware Installation

Print the current memory constants:

1. Connect an IBM-compatible printer to the printer port of the TOC analyzer.
2. From the MAIN menu, choose SETUP.
3. From the SETUP menu, choose PRINTER.
4. From the PRINTER menu, choose PRINT CONSTANTS.
5. Once all the constants are printed press CLEAR twice to return to the MAIN menu.

Replacing the EEPROM Chip (IC chip)

1. Turn off the analyzer power and disconnect the power cord.
2. Lift the analyzer cover and locate the main electronic board.
3. Depending on the type of chip holder in the analyzer, different techniques are required to replace the existing EEPROM with the EEPROM labeled 2.11 CBI or later. Facing the analyzer's front panel, locate the IC socket on the left side of the main electronics board near the rear of the analyzer. If the chip socket has a metal lever at the top, it is a Zero Insertion Force socket. If the chip socket does not have a lever, it is a low profile type socket. Figure D-3 illustrates the low profile socket. Use the appropriate instruction below to replace the chip:

Replacing the IC Chip from an Zero Insertion Force-type Socket –

There is a small brass lever on the socket to secure the IC chip. It should be in the locked position (end of the lever close to the PC

board). To remove the existing chip, ground yourself by tap your hand to the metal surface on the analyzer. Hold the IC chip with one hand and unlock the socket with the other by pushing the end of the lever away from the PC board. Pull the existing IC chip straight out of the socket and set it aside in an ESD protected location.

To remove the upgrade IC chip from the packaging, tap your hand to the metal case of the analyzer again. Remove the new IC chip from ESD protected package.

To install the upgrade IC chip in the socket, locate the notch on the chip and ensure that the notch is pointed down. Align the pins to the socket openings and insert the IC chip in the socket. While pressing on the IC chip push the locking lever to the locked position (toward the PC board) to secure the IC chip in place.

IMPORTANT

Be sure the notch of the IC chip is pointed toward the bottom of the analyzer and that all the pins are engaged into the socket.

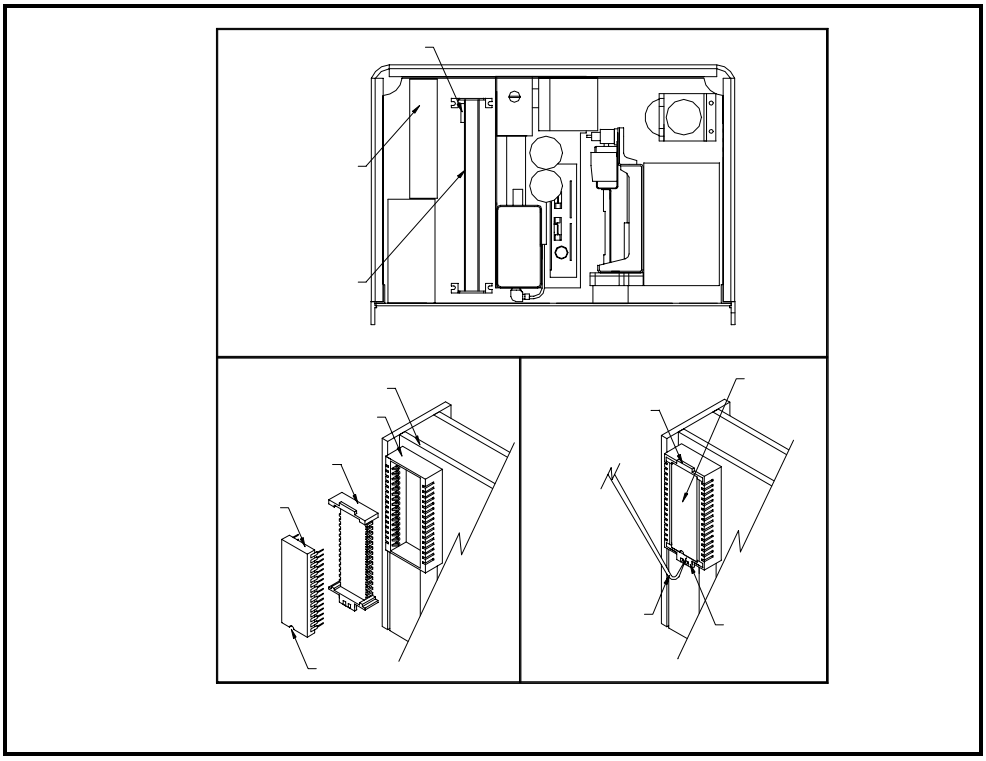


FIGURE D-3: Low Profile Socket Replacement

Replacing the IC Chip from a Low Profile-type Socket –

The IC socket consists of two parts – the main socket that is soldered to the PC board and the keyed carrier for holding the IC chip; refer to lower left corner of Figure D-3.

Note
The keyed carrier will only go in the socket in one direction.

To remove the existing chip, ground yourself by tapping your hand to the metal surface on the analyzer. Place the supplied tool at a right angle on the lower tab of the socket. Place your finger on the upper tab. Apply even force to pull the chip and carrier from the socket, see

lower right corner of Figure D-3. Be sure to pull the chip out straight so as not to damage the IC chip pins.

Once the chip is removed set it aside in an ESD-protected location with the chip and carrier still together; do not separate them.

To remove the upgrade IC chip from the packaging, tap your hand to the metal case of the analyzer again. Remove the upgrade IC chip from ESD protected package.

To install the upgrade IC chip into the carrier, note the location of the notch of the existing chip and remove it from the carrier. Replace it with the upgrade chip, ensuring that the orientation of the notch is the same.

Align the key of the assembly with the key position of the socket and gently press the IC chip and carrier assembly into the PC board socket until fully inserted. A fully inserted assembly will be flush with the socket housing on both sides.

IMPORTANT

Do not force the carrier into the socket. If it does not go into the socket ensure that the key is in the proper location and all the IC chip pins are not bent.

4. Once the IC chip is installed, replace the analyzer cover.
5. Reconnect the power cord to the analyzer and turn the power on.

Software Configuration

It is necessary to configure the binary inputs following a firmware upgrade. Follow these instructions to configure inputs and select proper polarity.

The purpose of the Binary/Digital Input Module is to send a binary/digital signal to the analyzer that will change to operating mode to a PAUSED state.

To **wire** the analyzer for binary/digital inputs:

1. Connect the flow switch to the provided terminal block on the Binary Switch Module located on the Auxiliary Port, which is on the left side of the analyzer.

2. Use a continuous closure contact system only. Applying voltage to the Binary Switch Module **may damage** the analyzer.

3. Use either opening in the Binary Switch Module. There is no polarity on the terminal block.

To **setup** the analyzer for binary/digital input:

1. From the MAIN menu, scroll with the arrows (↑ or ↓) to select SETUP and press ENTER.

FIGURE D-4: MAIN Menu

2. The SETUP menu is displayed:

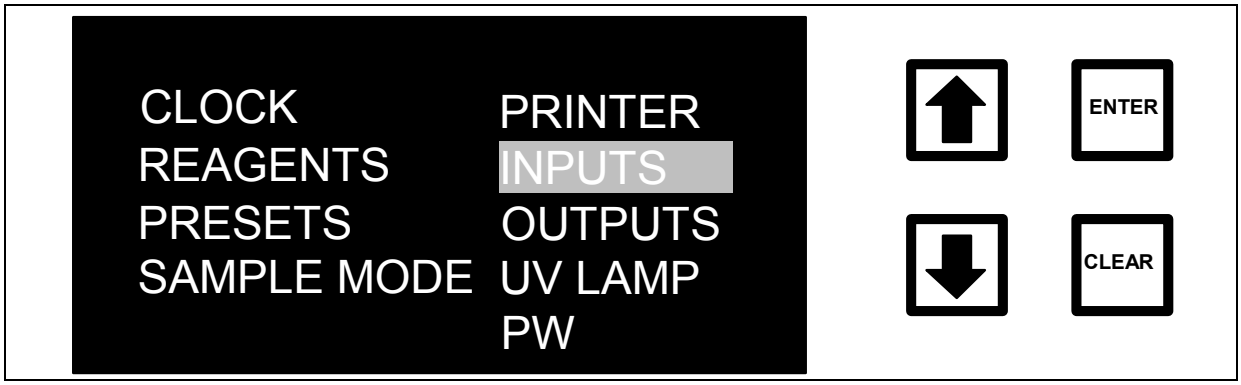


FIGURE D-5: SETUP Menu

3. Scroll with the arrows (↑ or ↓) to select INPUTS and press ENTER.

FIGURE D-6: INPUTS Screen

4. Select ENABLE/DISABLE and press ENTER.

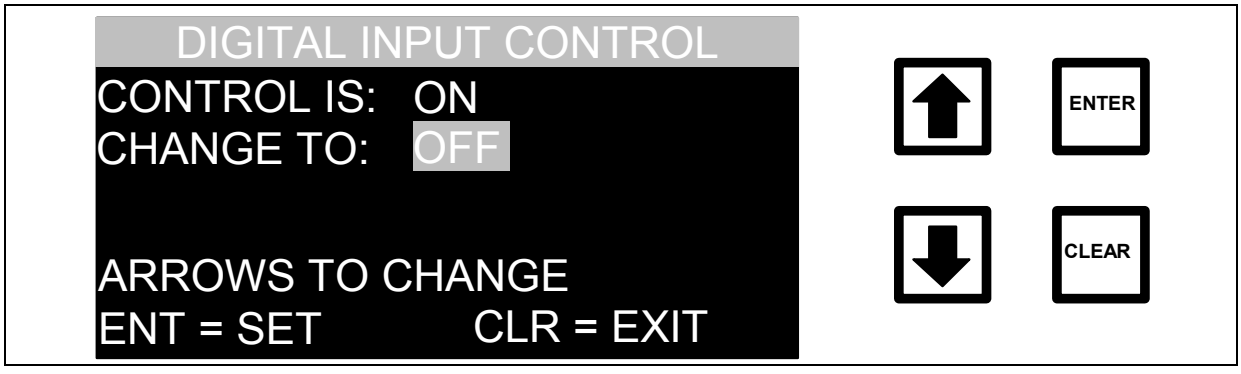


FIGURE D-7: DIGITAL INPUT CONTROL Screen

5. The digital input is either in a state of ON or OFF. To change this state, press the arrows (↑ or ↓) to toggle between the two choices. When the correct state is displayed, press ENTER to set it. **To allow input, the state must be ON**. Press CLEAR to return to the INPUTS screen.

FIGURE D-8: INPUTS Screen

6. Select SET POLARITY by using the arrows (↑ or ↓) and pressing ENTER. The DIGITAL INP. POLARITY screen is displayed:

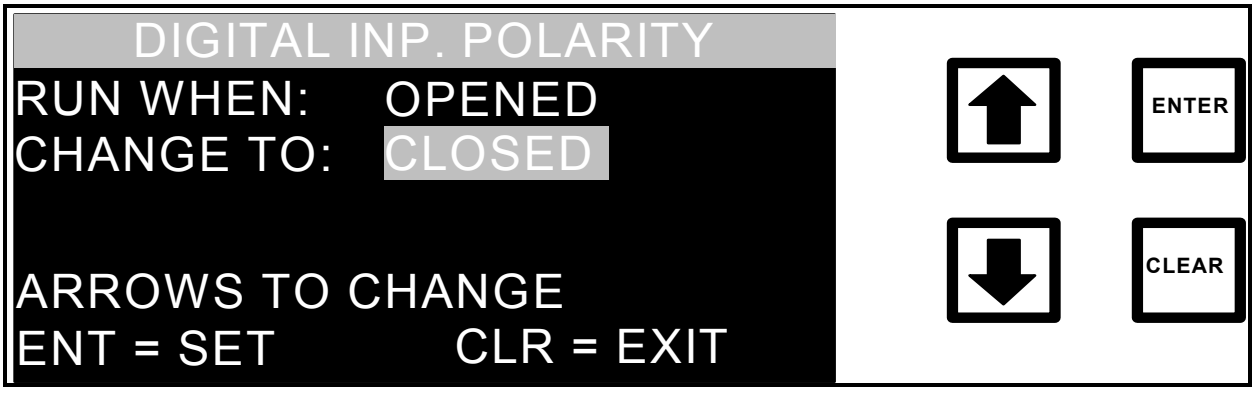


FIGURE D-9: DIGITAL INP. POLARITY Screen

7. The DIGITAL INP. POLARITY is either in an OPENED or CLOSED condition. To change this condition, press the arrows (↑ or ↓) to toggle between the two conditions. When the correct condition is displayed, press ENTER to set. **It is critical to have**

the polarity set to the same condition as the switch, whether it is normally open or closed. Press CLEAR to return to the INPUTS menu.

8. Press CLEAR to return to the MAIN menu.

The analyzer will function as described in this manual. When the switch is activated (no flow) and the binary/digital signal is received, the analyzer will convert to a PAUSED mode, noted on the MEASUREMENT DISPLAY screen. Analysis will automatically restart when the switch is deactivated (flow resumes).

APPENDIX E – CALIBRATION STANDARD PREPARATION

To prepare calibration standards on-site, the following equipment and supplies will be needed. Review the list and make sure all items are available.

- Anhydrous potassium hydrogen phthalate - KHP ($KHC_8H_4O_4$, A.C.S. Certified or Primary Standard Grade)
- Anhydrous sodium carbonate (Na_2CO_3, A.C.S. Certified or Primary Standard Grade)
- Low-TOC deionized water (less than 100 ppb TOC)*
- Analytical balance capable of weighing to ± 0.001 grams (± 1 mg)
- Two 100-mL volumetric flasks
- Two 1-L volumetric flasks
- A 25-mL volumetric pipet
- A 50-mL volumetric pipet
- A drying oven
- A desiccator for storing anhydrous reagents

* If a laboratory source of low TOC water is not available, most commercial "HLPC Grade" water has TOC < 100 ppb.

NOTE

The KHP and Na_2CO_3 need to be dried for 2-3 hours at 110 °C (230°F) before preparing the standard solutions.

NOTE

For instrument firmware with the DataGuard feature, enter a QA-level (or higher) password when prompted. Check with your system administrator for an appropriate password. See the DataGuard Operation chapter for more information regarding the DataGuard feature.

Preparing the TC Calibration Standard

Part 1 – Measure TC of Water Used for Preparing Standards

The TC of the standards will depend on the background TC of the water prepared for the standards; background must be accounted for for accurate calibration.

1. If the analyzer has been used for on-line measurements, shut off the water to the sample inlet system at the sampling port and follow the procedures in the Installation Chapter to change the sample mode from on-line to grab sampling and to change the sample inlet system to grab sampling.
2. Perform a REAGENT FLUSH as described in the Installation chapter. Select BOTH to flush the ACID and the OXIDIZER reagent cartridges.
3. From the MAIN menu, scroll to SETUP and press ENTER.
4. Use the arrows (↑ or ↓) to scroll to OUTPUTS and press ENTER.
5. From the OUTPUTS menu, use the arrows (↑ or ↓) to scroll to DISPLAY and press ENTER.
6. From the SET DISPLAY menu, use the arrows (↑ or ↓) to select TC and press ENTER to save this setting. Press CLEAR three times to return to the MAIN menu.
7. Use the arrows (↑ or ↓) to scroll to START TOC and press ENTER. The GRAB SAMPLE screen is displayed:

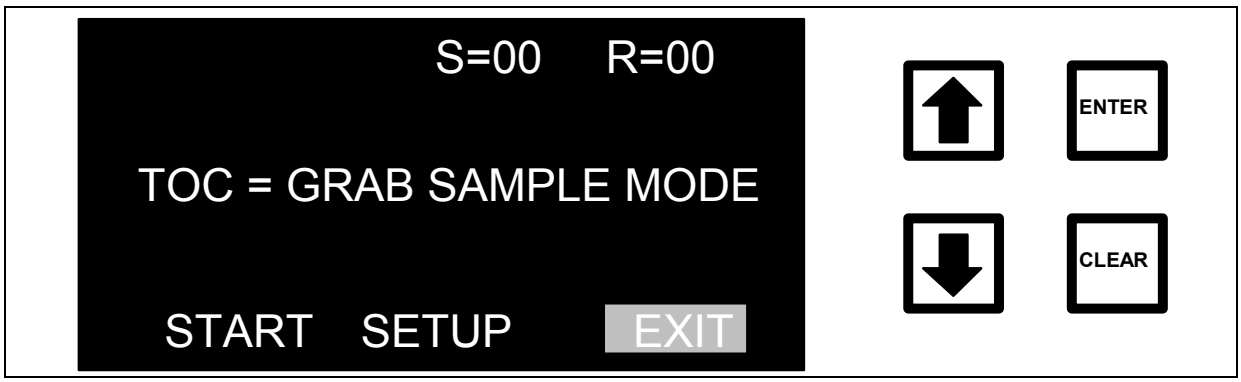


FIGURE D-1: GRAB SAMPLE Screen

8. Use the arrows (↑ or ↓) to scroll to SETUP and press ENTER. The GRAB SAMPLE SETUP menu is displayed:

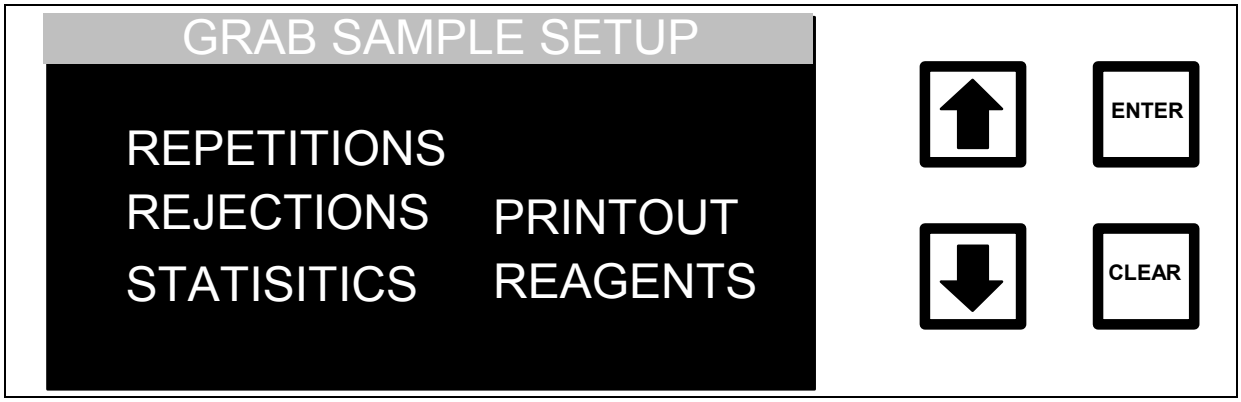


FIGURE D-2: GRAB SAMPLE SETUP Menu

9. From the Grab Sample Setup menu, scroll to Repetitions and press ENTER.
10. Set the number of Repetitions to 10 and press ENTER to save the number. Press CLEAR to return to the Grab Sampling Setup menu.
11. Use the arrows (↑ or ↓) to scroll to REJECTIONS and press ENTER.
12. Set the number of Rejections to 7 and press ENTER to save the number. Press CLEAR to return to the GRAB SAMPLE SETUP menu.
13. Use the arrows (↑ or ↓) to scroll to REAGENTS and press ENTER.
14. Select the ACID FLOW RATE option and enter 0.75 µL/min. Press ENTER to save the number, and press CLEAR to return to the Reagents menu.
15. Use the arrows (↑ or ↓) to scroll to Oxidizer Flow rate, and enter 0.75 µL/min. Press ENTER to save the number and press CLEAR twice to return to the Grab Sampling Setup menu.
16. Use the arrows (↑ or ↓) to scroll to STATISTICS and press ENTER.
17. Select the AVE/CV options and press ENTER to save the setting. Press CLEAR twice to return to the Grab Sampling menu.

18. If preparing standards on site, fill a 1-L volumetric flask with low TOC, DI water. If using Ionics Instruments-prepared standards, use a vial labeled Reagent Water. Place the 1/16"-OD INLET Teflon tube in the flask or vial, making sure the end of the tubing is several inches below the liquid level.

WARNING
Do not use a beaker for measuring the TC background of the water. Measure the water immediately after filling the flask. If the water is allowed to stand exposed to air for more than an hour, the water will absorb atmospheric CO_2 and record a high TC background.

19. From the Grab Sampling menu, use the arrows (↑ or ↓) to scroll to START and press ENTER.

20. The analyzer will make exactly 10 measurements. When the measurements are finished, the average TC value and relative standard deviation for the last three measurements will be shown on the LCD display.

21. Record the average value from the last three TC measurements as shown on the analyzer display. If the value displayed is in ppb, convert to ppm by dividing the ppb value by 1000.

Average TC value from last three runs (ppm C) _____

This background TC value will be added to the calculated concentration of the dilute TC standard in Part Three.

Part 2 – Prepare a Stock TC Standard

Place a small quantity (1-2 grams) of anhydrous potassium hydrogen phthalate in a beaker and dry in an oven at 110° C for 2-3 hours. Transfer the beaker to a desiccator and allow the sample to cool.

Weigh out approximately 0.212 grams of anhydrous potassium hydrogen phthalate (dried to a constant weight). Record the weight. Dissolve in a 100

mL volumetric flask with low TOC, DI water. Calculate and record the concentration of stock TC standard using the formula:

$$\text{Concentration of stock TC standard (ppm C)} = \frac{\text{Weight of } KHC_8H_4O_4 \text{ in grams} * 8 \text{ mol C} * 12.01 \text{ g C/mol} * 1000}{(0.1 \text{ L}) * (204.23 \text{ g/mol})}$$

Conc. of stock TC standard (ppm C) _____

Part 3 – Prepare a Dilute TC Standard

Use a volumetric pipette to transfer 25 mL of the stock TC standard to a 1 liter volumetric flask and dilute with low-TOC deionized water. Calculate and record the concentration of the dilute standard (~25 ppm C) using the formula:

$$TC_{ADJ.,TC} = (TC_{STC}) + (\text{TC of DI Water})$$

($TC_{ADJ.,TC}$: adjusted TC value; TC_{STC}: TC value of standard- calculated in step 2 or TOC value copied from the vial; TC of DI Water: TC value of water used to prepare standard in step 1 or TC value measured from the Reagent Water vial)

Conc. of dilute TC standard (ppm C) _____

Use the dilute TC standard immediately. The stock TC standard may be stored in a sealed dark bottle under refrigeration for 1 week.

Preparation of the IC Calibration Standard

Part 1 – Prepare a Stock IC Standard:

Place a small quantity (1-2 grams) of anhydrous Na_2CO_3 in a beaker and dry in an oven at 110° C (230°F) for 2-3 hours. Transfer the beaker to a desiccator and allow the sample to cool. If the bottle of anhydrous Na_2CO_3 is always stored in a desiccator, the drying may be omitted.

Weigh out 0.441 grams of anhydrous Na_2CO_3 (dried to a constant weight). Record the weight. Dissolve the Na_2CO_3 in a 100 mL volumetric flask with low

TOC deionized water. Calculate and record the concentration of the resulting stock IC standard (~500 ppm) using the formula below:

Concentration of stock IC standard = $\frac{\text{Weight of } Na_2CO_3 \text{ in grams} * 12.01 \text{ g C/mol} * 1000}{(0.1 \text{ L}) * (105.99 \text{ g/mol})}$

Conc. of stock IC standard (ppm C) _____

Part 2 – Prepare a Dilute IC Standard:

Use a volumetric pipette to transfer 50 mL of the stock IC standard to a 1 liter volumetric flask and dilute with low TOC, deionized water. Calculate and record the concentration of the dilute standard (~25 ppm C) using the formula:

Concentration of dilute IC standard = Conc. of stock IC standard * 0.05

Conc. of dilute IC standard (ppm C) _____

(If using Ionics Instruments-prepared standard, the concentration value is on the vial.)

WARNING
Measure the dilute IC standard immediately after preparation. If exposed to air for more than an hour, the standard will absorb atmospheric CO_2 and have a higher IC concentration than calculated.

Use the dilute IC standard immediately. The stock IC standard may be stored in a sealed, dark bottle under refrigeration for 1 week.

Proceed to Calibration chapter to perform Calibration procedure.

APPENDIX F – CONSUMABLES AND ACCESSORIES

To place an order, please contact Ionics Instruments Order Entry at 800-255-6964 or 303-444-2009 –

- East coast and Canada: ext. 129 or 226
- West coast and Puerto Rico: ext. 103 or 184

Refer to our Web site (www.IonicsInstruments.com) for the most current list.

Part Number	Description
Consumables	
ARE 00020	UV Lamp
ATU 00646	Pump tubing
HTF 94402	60 micron filter element
TOC MAINT	Consumables kit – 12 months (reagents, UV lamp, pump tubing)
APF 80010	Acid reagent
APF 80025	Persulfate reagent
Standards – Sets	
STD 31001	Calibration Standard Set, Grab Mode – includes one Calibration Blank (STD 30003), two TOC Calibration Standards (STD 30001) and two IC Calibration Standards (STD 30002).
STD 31002	Calibration Standard Set, Autosampler – includes four Calibration Blanks (STD 30003), four TOC Calibration Standards (STD 30001) and four IC Calibration Standards (STD 30002).
STD 31004	System Suitability Standard Set, Grab Mode – includes one Rw – Reagent Water Control (STD 30006), one Rs – Standard Solution (STD 30004) and one Rss - System Suitability Solution (STD 30008).
STD 31007	System Suitability Standard Set, Autosampler – includes two Rw – Reagent Water Controls (STD 30006), two Rs – Standard Solutions (STD 30004) and two Rss - System Suitability Solutions (STD 30008).
STD 31008	Low Concentration Precision Standard Set, Autosampler – includes two Rw- Reagent Water Control (STD 30006) and five Rs -Standard Solution (STD 30004).
STD 31009	High Concentration Precision Standard Set, Autosampler – includes two Calibration Blanks (STD 30003) and five TOC Calibration Standards (STD 30001).
STD 31012	Linearity Standard Set – includes one each 250 µg C/L, 500 µg C/L, 750 µg C/L as USP Sucrose and a Reagent Water Blank.
STD 31013	Low Level Precision Standard Set, Grab Mode – includes one Rw- Reagent Water Control (STD 30006) and one Rs -Standard Solution (STD 30004).
STD 38001	Validation Standards Set for Grab Mode – includes one Calibration Set (STD 31001), one System Suitability Set (STD 31004), one Linearity Set (STD 31012), one Rw- Reagent Water Control (STD 30006) and four Rs -Standard Solutions (STD 30004).
STD 38101	Validation Standards Set, Autosampler (low concentration) – includes one

Part Number	Description
	Calibration Set (STD 31002), one System Suitability Set (STD 31007), two Linearity Sets (STD 31012), two Rw- Reagent Water Controls (STD 30006) and two Rs -Standard Solutions (STD 30004), one Low Level Precision Set (STD 31008).
STD 38102	Validation Standards Set, Autosampler (high concentration) – includes one Calibration Set (STD 31002), one System Suitability Set (STD 31007), two Linearity Sets (STD 31012), two Rw- Reagent Water Controls (STD 30006) and two Rs -Standard Solutions (STD 30004), one High Level Precision Set (STD 31009).
Standards – Individual Vials	
STD 30001	TOC Calibration Standard – 25 mg/L Carbon as KHP (40mL vial)
STD 30002	IC Calibration Standard – 25 mg/L Carbon as Na2CO3 (40mL vial)
STD 30003	Calibration Blank – Reagent Water, 40 ml; use with STD 30001 or STD 30002
STD 30004	Rs - Standard Solution – 500 µg C/L as USP Sucrose, 40 ml
STD 30005	TOC Standard – 1.25 mg C/L as NIST Sucrose, 40 ml
STD 30006	Rw - Reagent Water Control Standard – Reagent Water, 40 ml; use with STD 30004 or STD 30008
STD 30007	TOC Standard Blank – Reagent Water , 40 ml; use with STD 30005
STD 30008	Rss - System Suitability Solution – 500 µg C/L as USP Benzoquinone, 40 ml
Firmware/Software	
ASK 31003	Upgrade, DataPro/DataGuard 2.07
ASK 30004	Upgrade, Multi-Stream, 3.15 CMS
ASK 30008	Upgrade, 3.52CAS
ASK 30009	Upgrade, Binary Input, 2.11 CBI
ASK 30010	Upgrade, 3.62CAS, 21 CFR
ASK 31001	Upgrade, 3.52CAS/DataPro 2.07
ASK 31004	Upgrade, 3.52CAS/DataPro/DataGuard 2.07
ASK 31005	Upgrade, DataPro 2.07
ASK 31007	Upgrade, 3.62CAS/DataPro 2.07
ASK 31008	Upgrade, 3.62CAS/DataPro/DataGuard 2.07
ASK 39000	Upgrade, Turbo, 2.12 CTB
SPM 00054	DataView
Accessories	
ARK 30001	Flow Switch
ASV 82650	Calibration Valve
ATP 08400	Binary Input Module
ASW 80010	RAMReader Software Program
ICR 89300	Inorganic Carbon Remover
PRD 32410	Environmental Enclosure, 120V
PRD 32420	Environmental Enclosure, 230V
PRD 32310	Protective Enclosure, 120V
PRD 32320	Protective Enclosure, 230V
PRD 31100	Autosampler, 100V (for Model 810)
PRD 31110	Autosampler, 120V (for Model 800)
PRD 31120	Autosampler, 230V (for Model 820)
PRD 38410	Multistream Sampler, 120V

Part Number	Description
PRD 38421	Multistream Sampler, 230V (for Model 820)
PRD 38422	Multistream Sampler, 230V (UK/Ireland)
PRD 38423	Multistream Sampler, 230V (Australia)
EMC 05120	RAM Card, 512K
EMC 10240	RAM Card, 1024K
EMC 20000	RAM Card, 2048K
DLM 31001	DataPro Autosampler Software Manual
DLM 31004	DataPro/DataGuard Autosampler Software Manual
DVL 30010	Validation Software Package – Volume I
DVL 30001	Validation Software Package – Volume II