Operator Manual

Anatel A1000 TOC Analyzer

HACH ULTRA™

EXCELLENCE IN PROCESS ANALYTICS

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Manual Overview

About This Manual

The information in this manual has been carefully checked and is believed to be accurate. However, Hach Ultra assumes no responsibility for any inaccuracies that may be contained in this manual. In no event will Hach Ultra be liable for direct, indirect, special, incidental, or consequential damages resulting from any defect or omission in this manual, even if advised of the possibility of such damages. In the interest of continued product development, Hach Ultra reserves the right to make improvements in this manual and the products it describes at any time, without notice or obligation.

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Safety Conventions

WARNING

A warning is used to indicate a condition which, if not met, could cause serious personal injury and/or death. Do not move beyond a warning until all conditions have been met.

CAUTION:

A caution is used to indicate a condition which, if not met, could cause damage to the equipment. Do not move beyond a caution until all conditions have been met.

Note:

A note is used to indicate important information or instructions that should be considered before operating the equipment.

General Safety Considerations

- All service procedures should be conducted by properly trained service personnel.
- Make sure the A1000 TOC Analyzer is properly installed and all hydraulic connections are correctly installed before operation. All safety guidelines should be observed.
- Follow all procedures in “Return Procedures” on page 155 before shipping a unit to a service center for repair or re-calibration.

WARNING

Use of controls or adjustments, or performance of procedures other than those specified herein may result in hazardous radiation exposure.

WARNING

Only factory certified personnel should perform service of the A1000*. Attempts by untrained personnel to disassemble, alter, modify or adjust the electronics and/or hydraulics may result in personal injury and damage to the* A1000*.*

WARNING

The A1000 contains high voltage electronics. Always physically disconnect power from the instrument before accessing electronic components in order to perform maintenance or repair operations.

WARNING

Replacement of the A1000 Sensor's onboard lithium battery presents a potential fire, explosion and burn hazard. Properly dispose of expired batteries—do not attempt to incinerate, recharge or disassemble.

WARNING

Hach Ultra cannot address all health and safety issues associated with using the Anatel A1000 TOC Analysis System. Inherent dangers include high voltage electronics and ultraviolet radiation. Reading the Operator Manual thoroughly before installing or operating the instrument is strongly recommended. If you have any questions regarding the A1000, contact Hach Ultra at 800-866-7889 or +1-541-472-6500.

CAUTION:

The UV lamp used for oxidation by the A1000 emits ultraviolet radiation and contains small amounts of mercury. When replacing it, dispose of the expired UV lamp in accordance with applicable local regulations. Hach Ultra does accept used lamps for proper Ultraviolet Radiation disposal. Contact Hach Ultra at 800-866-7889 or +1-541-472-6500 for more information.

CAUTION:

Avoid installations where the A1000 could be exposed to an acidic or caustic atmosphere, as may be present in a deionized water regeneration area or near acid waste sumps. Exposure will corrode the instrument's electronic circuity and damage analysis components. If it is to be placed in such an environment, it must be mounted in an enclosure which conforms to the instrument's operational specifications.

CAUTION:

Although the instrument's electronics and analysis modules are physically separated, the enclosure is rated only as splashproof and components are not completely protected against external conditions. Do not subject the A1000 to direct water streams or other adverse environmental elements.

This instrument has been tested and found to comply with EMC Directive 89/336/EEC and is in conformity with the relevant sections of the following EC standards and other normative documents:

Safety: LVD EN 61 010–1:1993 + A2:1995

EMC: CENELEC EN 50 081–2:1993, Class B†

- Conducted EN 55 011:1992, Class B, Group 1
- Radisted EN 55 011:1992, Class B, Group 1

CENELEC EN 50 082–2:1995

- IEC 801–2, EN 61 000–4–2; 4kV CD, 8kV AD
- IEC 801–4, EN 61 000–4–4; 2kV Signal Lines, 2kV Power Lines
- IEC 801–3, ENV 50 140, EN 61 000–4–3; 10V/m
- IEC 801–6, ENV 50 141, EN 61 000–4–5; 10V

† The product was tested in a typical configuration of the Anatel TOC Monitoring System.

The product herewith complies with the requirements of the Low Voltage Directive 73/23/EEC and the EMC Directive 89/336/EEC. The subject products were also tested by LGA Ref #EMC-295/2129 for certificate of conformity to EMC directive, and LGA GS Mark Certificate #9741007, conformity to LVD directive.

The CE Marking has been affixed on the devices according to the EU Directive 89/336/EEC.

The Anatel A1000 TOC Analyzer supports those parts of 21 CFR, Part 11 concerning the collection, retention, access and retrieval of data as electronic records. The instrument uses no electronic signature(s), thus those parts of the rule referring to electronic signature(s) are not applicable. Extensively documented and verifiable tests have been conducted to establish 21 CFR, Part 11 compliance.

The Anatel A1000 TOC Analysis System is comprised of a line of precision instruments which meet or exceed the following international requirements and standards of compliance:

The A1000 TOC Analyzer System is comprised of a line of precision instruments which meet or exceed the following international requirements and standards of compliance:

EN61010–1
Electrical Equipment for Laboratory Use,
Part 1: General Requirements

CAN/CSA–C22.2 No. 1010.1–92
Safety Requirements for Electrical Equipment for Measurement, Control and Laboratory Use, Part 1: General Requirements

Customer satisfaction through continuous quality improvements.

In addition, the following international symbols are found on the instruments

Standby
Reference Document: IEC 417–5009

Protective Earth Ground
Reference Document: IEC 417–5019

Warranty

Hach Ultra warrants that this instrument will be free of defects in materials and workmanship for a period of one (1) year from the shipping date. If any instrument covered under this warranty proves defective during this period, Hach Ultra will, at its option, either repair the defective product without charge for parts and labor, or provide an equivalent replacement in exchange for the defective product.

To obtain service under this warranty, the customer must notify the nearest Hach Ultra service support center on or before the expiration of the warranty period and follow their instructions for return of the defective instrument. The customer is responsible for all costs associated with packaging and transporting the defective unit to the service support center, and must prepay all shipping charges. Hach Ultra will pay for return shipping if the shipment is to a location within the same country as the service support center.

This warranty shall not apply to any defect failure or damage caused by improper use or maintenance or by inadequate maintenance or care. This warranty shall not apply to damage resulting from attempts by personnel other than Hach Ultra representatives, or factory-authorized and trained personnel, to install, repair or service the instrument; to damage resulting from improper use or connection to incompatible equipment; or to instruments that have been modified or integrated with other products when the effect of such modification or integration materially increases the time or difficulty of servicing the instrument.

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- Edition 1, January 1994, Anatel Corporation
- Edition 2, May 1994, Anatel Corporation
- Edition 3, September 1994, Anatel Corporation
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- Edition 7, May 2001, Anatel Corporation
- Edition 8, May 2006, Hach Ultra Analytics, Inc.
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Apparatus and products are manufactured and sold by Hach Ultra Analytics, Inc. under one or more of the following U.S. patents: 4,626,413; 4,666,680; 4,683,435; 4,868,127; 5,047,212; 5,260,633; 5,275,975; 5,334,940; 5,677,190 and equivalents in other countries where issued. Purchaser is granted a paid-up, non-exclusive license to practice under these patents for the useful life of this apparatus or product.

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1 Introduction

1.1 Overview

The Anatel A1000 TOC Analysis System is designed to provide high-purity water processing facilities with optimum flexibility, performance and networking capabilities in the monitoring of their critical processes. Properly installed and operated, the A1000 System offers accurate and repeatable results.

The Anatel A1000 TOC Analyzer offers new measurement and networking capabilities for even the most demanding ultrapure water applications. Some typical A1000 applications include organic contamination detection in semiconductor manufacturing, pharmaceutical and power generating plants as well as biochemical and laboratory analysis projects.

The A1000 offers an extensive temperature range while reducing the time necessary for sample analysis. It can integrate analytical Sensors with managing Controllers into a wide range of configurations, affording maximum flexibility for addressing virtually any process requirements.

Multiple A1000 Sensors can be associated with a single C80 Controller to observe several process points or to monitor differential measurements at a single location. Alternatively, multiple Controllers can be networked to display readings at several different locations.

1.2 A1000 TOC Analysis System

The A1000 TOC Analysis System is comprised of the following components:

S10 Sensor	The S10 Sensor is the basic A1000 analysis device. Its 1-line by 16-character display visually reports the instrument's current TOC values. In conjunction with a C80 Controller, it can be networked with other Sensors to perform either individual or differential TOC measurements. Or, a single S10 Sensor can be linked to as many as eight C80 Controllers to offer data display and operational control from multiple remote sites.
S20P Sensor	The S20P combines a C80 controller with an integral 40-column thermal printer to provide total instrument portability with point-of-use reporting capabilities. The S20P Sensor is designed for maximum application flexibility within a facility by furnishing spot TOC measurements in addition to providing immediate hardcopy printouts.
C80 Controller	The C80 Controller is the control/display device for the A1000 System. The C80 allows operational and reporting parameters for as many as eight associated Sensors to be programmed independently. Its 4-line by 16-character display communicates such Sensor information as current TOC in ppb, trend, resistivity (or conductivity), temperature and operating mode. The alarm status of each active Sensor is reported via a corresponding Channel LED.
Printer	A stand-alone version of the thermal printer that is part of the S20P Sensor can be connected directly to any S10 Sensor to provide local printouts.

1.3 A1000 System Features

The Anatel A1000 TOC Analysis System offers several advantages in the monitoring of ultrapure water systems:

Fast Analysis Mode	Rapid analyses ensure that results are available as soon as possible and that all necessary data are recorded in order to capture even the briefest TOC excursions. The Sensor's patented measurement cell can provide accurate assessment of trace organics within a few minutes and results reported in as little as 2 minutes (depending on the water's TOC level) when operated in the "Fast Mode."
Differential TOC Measurement	Critical applications often demand the water immediately before and after the point-of-use be monitored in order to understand the process and maintain efficiency. The A1000 System is ideal for such measurements because it allows the data from two Sensors to be compared in real time to obtain prompt differential readings.
Hot Water Application	With an effective operating range of 0–100°C, the A1000 System can be incorporated directly into hot DI water processes, eliminating the need for heat exchangers to reduce the sample's temperature. Combined with a corresponding pressure range up to 100 psig, the A1000's on-line TOC measurements ensure optimum water quality management in otherwise difficult conditions.
Individual Alarm Monitoring	Single-point or differential TOC levels may be monitored for all connected Sensors and compared to user-defined alarm limits for each instrument. The user is alerted to any limit excursions by the C80 Controller which flashes its LCD display as well as the Sensor's corresponding LED. An audible beep may be enabled for additional warning.
Networking Capability	The ability to network as many as eight A1000 Sensors to a single C80 Controller provides timely readings of TOC levels even at the most distant and crucial areas of the water system. The C80 Controller can be mounted wherever convenient to make the TOC levels at several key locations immediately available on a single display. Analog, Digital I/O, Serial and 12 VDC Bias connections allow quick and easy connection to any external device to further enhance System capabilities.

A1000 Sensors require no reagents or gases to measure TOC; a patented analysis method measures the conductivity of the sample before and after its oxidation by ultraviolet (UV) light.

The water sample is isolated from the ambient environment to eliminate external contamination and the TOC concentration is determined using an algorithm that measures the change in the sample's conductivity. The change in conductivity is a direct function of the amount of organic carbon present and its oxidation to carbon dioxide (C02), allowing the TOC content of the sample water to be calculated.

The A1000 Sensors can accurately detect TOC levels between 0.05 and 9,999 parts per billion (ppb). The available water system pressure is then employed to rinse and fill the measurement cell prior to the next sample analysis.

The results of each sample analysis are digitally displayed on the front panel of the corresponding Sensor, and its supervisory C80 Controller, as a concentration of TOC in ppb. Additionally, resistivity (in M.–cm) or conductivity (in µS/cm) and sample temperature, uncompensated or corrected to 25°C, are measured and displayed on the associated C80 Controller. An assortment of A1000 system printouts are available.

An integral alarm scheme reports any abnormalities detected during Sensor operation. A TOC limit excursion is automatically output to a printer and logged for display on associated C80 Controllers.

The Sensors also perform ongoing TOC trend analyses to facilitate water quality management. Each instrument measures the change in TOC over the past hour and reports its directional trend. By further examining the exact TOC values on a printout, the user can determine if the trend is critical and then respond accordingly.

2 Instrument Installation

2.1 Overview

The A1000 TOC Analysis System is specifically designed to provide a flexible method of monitoring ultrapure water systems. The most basic A1000 configuration consists of a C80 Controller and S-10 Sensor. These two components are combined with a printer on the S20P to form a portable analysis System. Additional Sensors and Controllers can be integrated to create an A1000 Network (see “Network Installation” on page 33).

This configuration flexibility necessarily affects installation of the A1000 System. Each Sensor is furnished with an Installation Kit (P/N AS2013702) and must consider the following preparatory and installation routines:

Procedure	C80	S10	S20P
Inspection	X	X	X
Verification	X	X	X
System Time	X	-	X
Sensor Name	-	X	X
Mounting	X	X	-
Plumbing	-	X	X
External Communications	X	X	-
Auxiliary I/O	-	X	X
Power	X	X	X
Self-Cleaning	-	X	X

Note that these procedures are common to most, but not all, A1000 components. The C80 Controller, for example, is integral to the S20P Sensor and therefore does not require external communications connections. Conversely, a Sensor Name cannot be assigned to a stand-alone C80 Controller as it does not have a built-in Sensor.

2.2 Pre-Installation Procedures

Preliminary setup procedures should be conducted on the A1000 components prior to installing them on the water system to help assure their proper operation. Verification is also easier at this stage than when the components have been mounted and cabling has been run. The System pre-installation procedures are:

- Unpacking and visually inspecting the equipment.
- Powering it up to verify that all the components are operational.
- Setting up the System software by entering the System Time and naming the Sensor.

2.3 Unpacking and Inspection

Upon receiving the A1000 System, inspect the shipping container(s) for any signs of external damage before unpacking the components. Carefully remove the equipment, verify the enclosed packing list and check once again for obvious damage.

If damage is apparent, notify the freight carrier immediately. Claims must be filed by the customer. Also notify Hach Ultra of any such problems. Include the Serial Number of the damaged unit(s) and the purchase order number with all factory communications.

2.3.1 Operational Verification

The next pre-installation step is to establish communication connections between the C80 Controller and its associated S10 Sensor. These connections are internally wired on the S20P.

Note:
Additional twin-axial trunk cable, pre-wired with BNC plugs at each end, is available from Hach Ultra in 10-, 25-, 50-, 100-foot and custom lengths.

Each S-10 Sensor and C80 Controller is supplied with a 3-foot local cable, a twin BNC “tee” connector, and a passive terminator. The C80 Controller also includes a 10-foot trunk cable to facilitate communications connections.

To connect the Controller to its associated S10 Sensor:

1) Grasp the end of the 3-foot local cable attached to the C80 Controller and, noting the alignment of its internal pins, gently push it onto the middle coupling of the tee connector. Twist the cable onto the connector until it “locks” on the coupling.
2) Similarly fasten the S10 Sensor to its tee connector.
3) Link the two tees using the 10-foot section of twin-axial trunk cable provided.
4) Complete C80–S10 communications connections by placing a passive terminator on the open couplings at each end of the configuration. Proper termination is crucial for reliable communications.

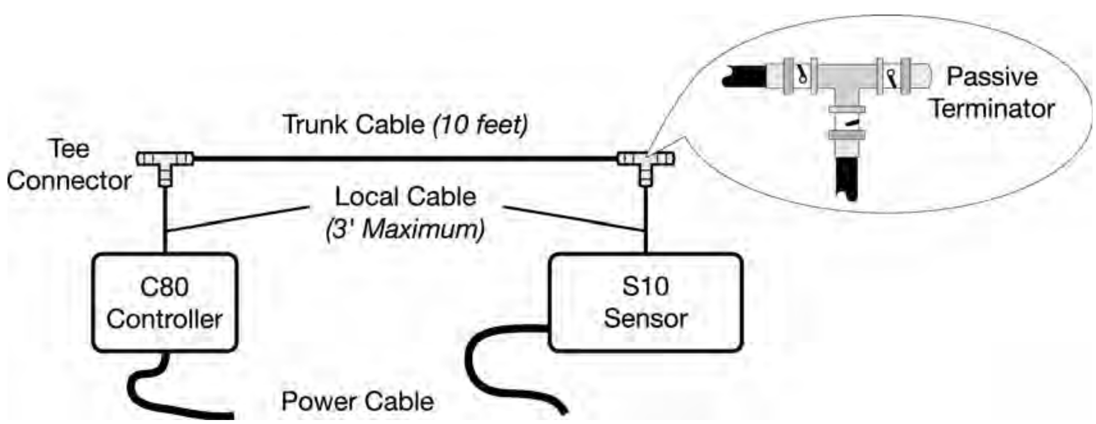

Fig 2-1 : Passive Terminator Location

5) Plug both components into an AC power source. A power cord is integral to A1000 Sensors; power is supplied to the C80 Controller through a 9 VDC wall mounted transformer that attaches similar to the communications connections.
6) Turn the S10 Sensor "ON." Verify the displays on both instruments illuminate and are functional.

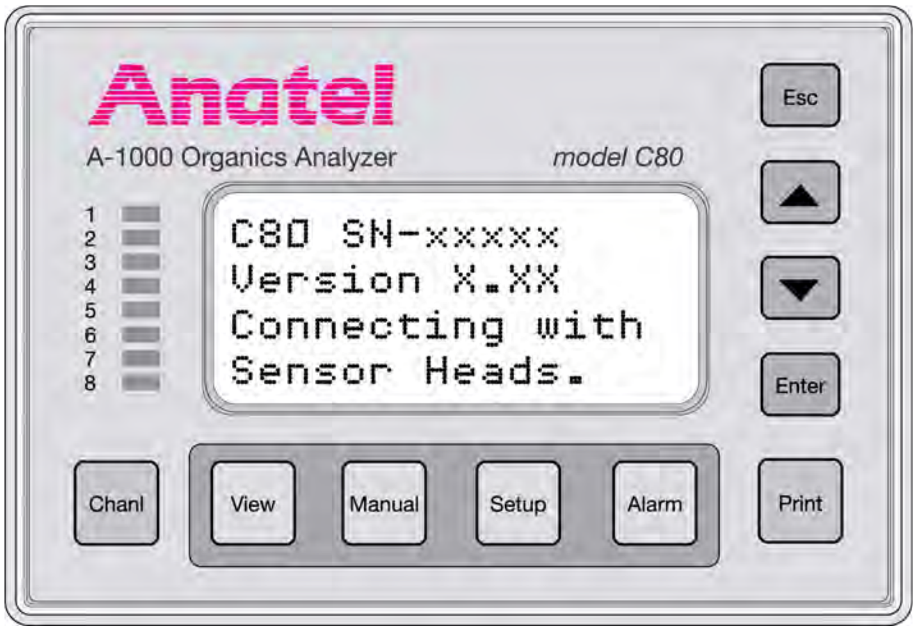

Fig 2-2 : C80 Logon Screen

The Controller display reports that it is establishing communications with the Sensor. If "Sensor Head not communicating" is displayed or either instrument fails to operate, check the connections. Contact Hach Ultra if these initial problems persist.

2.3.2 Software Setup

With communications established, you must define the System Time on the C80 Controller and give the S10 a Sensor Name. The same software programming should be performed on stand-alone S20P Sensors to assure that they are operating properly.

Note:
The following setup procedures are performed through the C80 Controller. Refer to "C80 Controller Setup" on page 39 *if necessary for a description of this control device and its keyboard interface.*

System Time

Each Sensor's onboard clock is set at the factory during testing, but it should be checked and altered if necessary to display local time. This global parameter synchronizes the timing of Sensors to their respective Controllers and, once set, should not have to be changed unless a Sensor's lithium battery is replaced.

To set the Controller's clock/calendar:

1) Press the **Setup Key** to display the **Setup Menu**.

	Sensor Setup:
▶	System Setup
	C80 Setup:

Fig 2-3 : Sensor Setup Selections

2) Use the **Up** and **Down Keys** to specify System Setup.
3) Press **Enter** to access its submenu.

▶	System Time:
	Network Test
	ID to SN Xfer:

Fig 2-4 : Sensor Time Selection

4) Specify **System Time** and press **Enter** to display that parameter screen. The programmed Date is displayed numerically in a month/day/year format; the Time in an hour:minute format. A block cursor begins flashing to highlight the month division of the date.

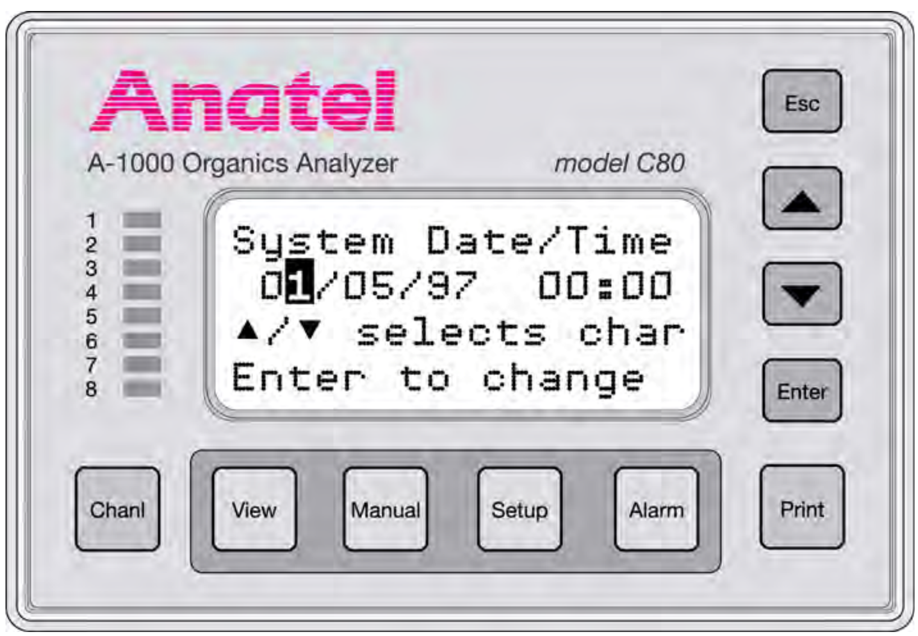

Fig 2-5 : System Time Screen

5) Use the **Up** and **Down Keys** to highlight the division of the Date/Time display that is to be changed.
6) Press **Enter** to enable the Controller’s Edit Mode. The flashing cursor becomes an underscore and the key functions change.

```
System Date/Time
07/31/06  00:00
Esc select char
▲/▼ to change
```

Fig 2-6 : Date/Time Setup Selections

7) Use the **Up** and **Down Keys** to scroll the digit to display the current month numerically.

```
System Date/Time
08/31/06  00:00
Esc select char
▲/▼ to change
```

Fig 2-7 : Date/Time Setup

8) Press **Esc** to retain the month setting and advance the block cursor to the day division of theclock/calendar setting.
9) Use the **Up** and **Down Keys** to scroll to the current day.
10) Press **Enter** to retain the day setting.
11) Repeat the editing process to set the year, then the hour and minute (in a 24-hour format).
12) With the System’s date and time properly set, press **Esc** twice to return to the System Setup Menu. The Controller transmits the new date and time to its associated Sensor. The Sensor’s report functions are now synchronized to this clock/calendar setting.

```
   Sensor Setup:
▶  System Setup
   C80 Setup:
```

Fig 2-8 : Sensor Setup Selections

Sensor Name

Default: Serial Number

The first step in setting up a Sensor is to name it so that it can be identified on displays and printouts. Up to 13 alphanumeric characters may be assigned to name the device. It is suggested that the instrument’s Sensor Name be chosen based on its location, its function or any other relevant designation.

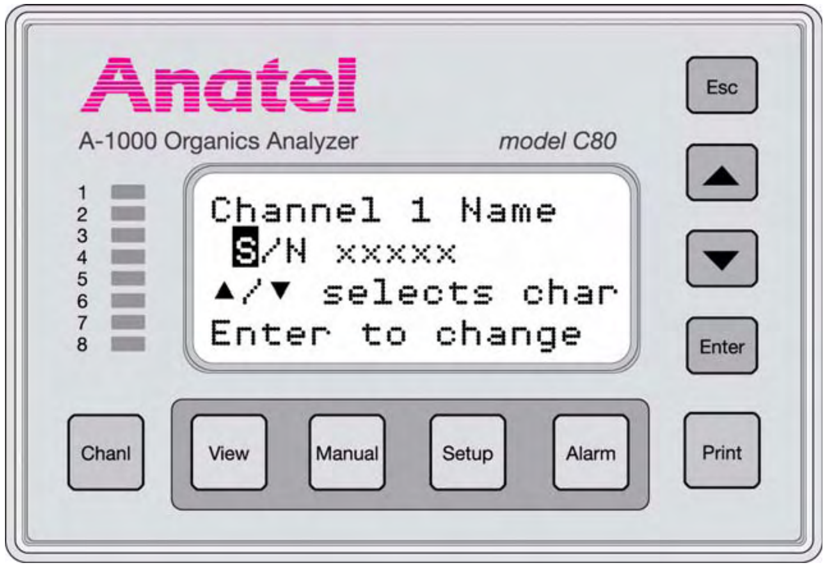

Fig 2-9 : Sensor Name Screen

To name a Sensor:

1) With Sensor Setup highlighted on the System Setup, press **Enter**.

Analysis Setup:
Display/Print:
▶ Sensor Name:
Diagnostics:

Fig 2-10 : System Setup Menu

2) Specify **Sensor Name** and press **Enter** to display that parameter screen. The first line of the display identifies the chosen Sensor by its Channel ID Number. The second line presents its default name, its Serial Number, with the block cursor flashing on the first character.

Channel 1 Name
S/N XXXXX
Esc select char
▲/▼ to change

Fig 2-11 : Sensor Name Setup

3) Use the **Up** and **Down Keys** to highlight the character that is to be changed.
4) Press **Enter** to enable the Controller's Edit Mode and the flashing block becomes an underscore.
5) Press the **Up** and **Down Keys** to step through the alphabet followed by numbers until the desired character is displayed.

6) Press **Enter** to save the new character and advance the cursor to the next.
7) Again scroll through the display using the **Up** and **Down Keys** until the desired character is displayed.
8) Press **Enter** to save the altered character.
9) Repeat the procedure until the desired Sensor Name has been entered into the display, then press **Esc** to exit the screen.

CAUTION:
It is possible for more than one Sensor to have the same Name. Duplicate Sensor Names may cause confusion when reviewing printed reports.

2.4 Hardware Installation

Once the A1000 components have been checked and setup, the System can be installed. Installation consists of:

- Mounting the components
- Providing the required plumbing, communications and power connections

2.4.1 Mounting

The C80 Controller and the S10 Sensor are the only A1000 System components that require stationary mounting. The Model S20P Sensor is designed to stand vertically on its feet, allowing this portable instrument to move to different locations easily and perform spot analyses. Therefore, it does not require stationary mounting.

C80 Controller

The C80 Controller can be positioned wherever it is convenient. The stand-alone unit is self-contained in an aluminum enclosure that is sealed against moisture and has splash-resistant I/O connections. The C80 Controller is secured in place with a steel mounting bracket. A 3/4” nut clamp accommodates the adjustable panel thickness, which can range in depth from 1/8” to 1/2” (3.17 mm to 12.70 mm).

Controller mounting dimensions are shown below.

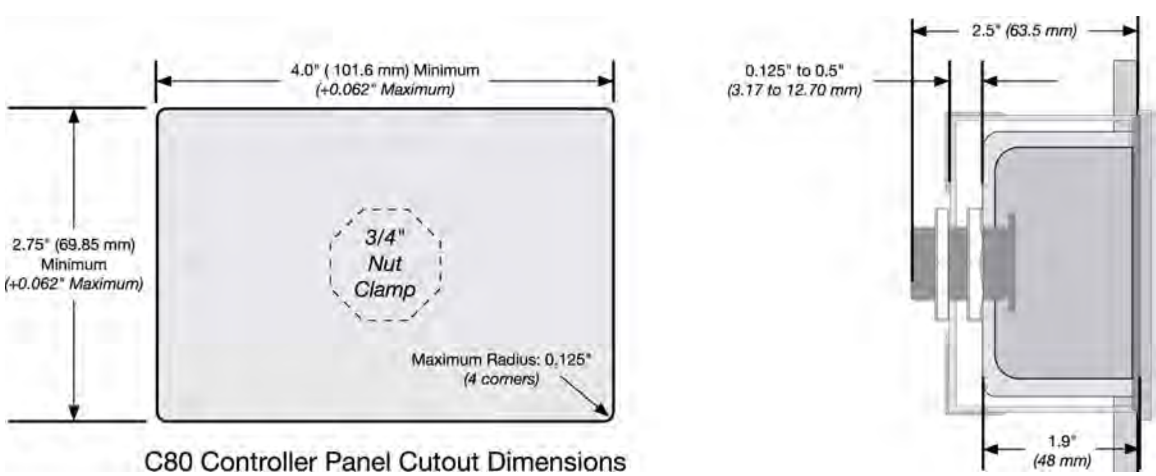

Fig 2-12 : C80 Controller Panel Cutout Dimensions

S10 Sensor

The S10 Sensor is designed to be a wall-mount unit. The instrument is splash-resistant, but it is not waterproof, and therefore should be installed in a dry and relatively dust-free environment. Do not allow the air flow through the intake and outlet filters located on the bottom of the Sensor to be obstructed or to not get wet. If mounting the S10 outside, place it inside of a water-tight enclosure and away from direct sunlight. The ambient air temperature should not exceed 40°C (104°F) wherever it is mounted.

Venting the enclosure may be necessary.

CAUTION:

Do not expose the A1000 Sensor to a caustic atmosphere, as may be The S10 Sensor is secured using two 1/4” mounting present in a DI regeneration area or near brackets located on the rear of the instrument in an acid waste sump; exposure will corrode electronic circuitry and damage analysis conjunction with two 1/4” tie-down tabs positioned components. If a Sensor must be installed along its bottom. The mounting dimensions for the in a hazardous area, it must be protected S10 Sensor are shown below. by a suitable enclosure which complies with all A1000 operating specifications.

A1000 Sensors combine the measurement cell, requisite electronics and power supply into a single compact package that is designed to be splash-proof and water-resistant. All Sensor cases are constructed of lightweight aluminum and the internal electronics are physically separated from the measurement cell to avoid potential water damage.

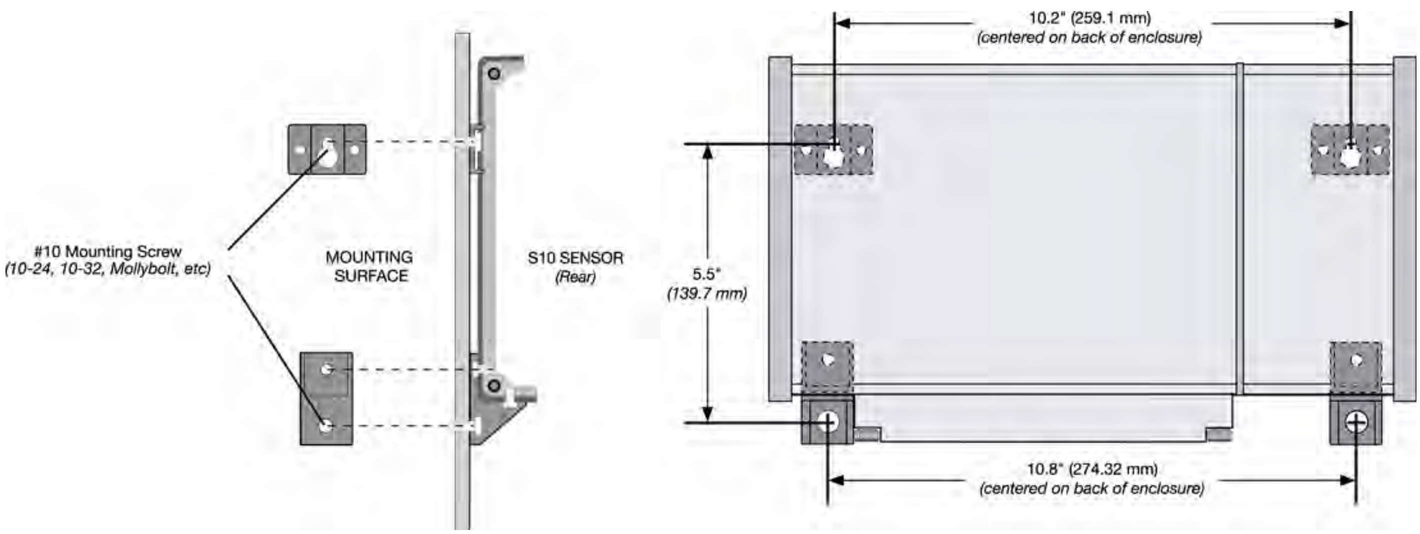

Fig 2-13 : S10 Mounting Template

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S20P Sensor

Orientation is important when locating the portable S20P Sensor. The instrument must be maintained in an upright position with the integral C80 Controller's front panel facing upwards. This precaution assures that the A1000's measurement cell is flushed completely between analysis cycles. A fresh sample, in turn, ensures more reliable and accurate analysis results.

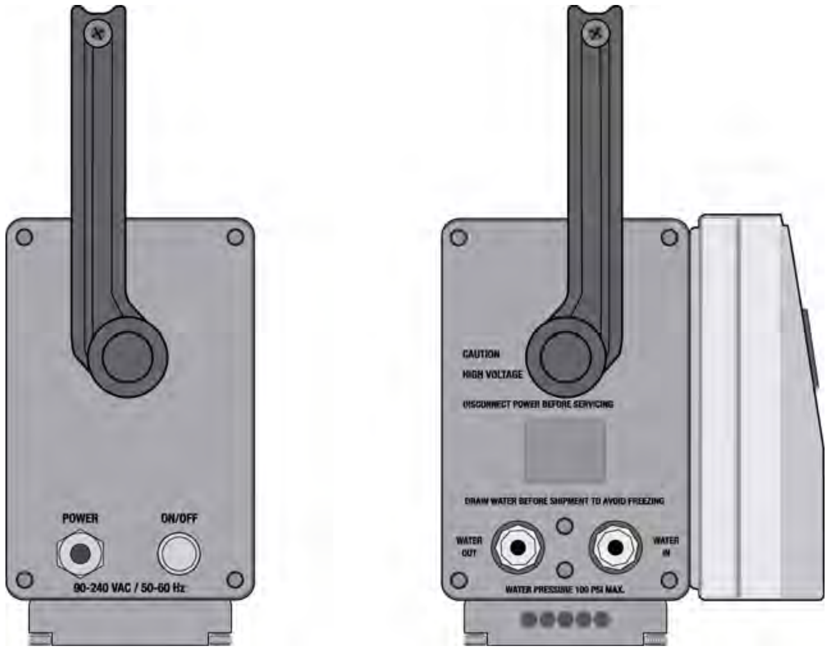

Fig 2-14 : Portable A1000 Mounting

The following plumbing, communications and Note: The term "Sensor" in the following installation instructions refers generally to power connections are identical for the Model S10, all A1000 Sensors.

2.4.2 Plumbing Connections

Sample inlet and outlet connections are made through two 1/4" 316 stainless steel compression fittings located at the Water I/O end of the Sensor enclosure. Plumbing the Sensor consists of making these two connections and optionally installing an upstream isolation valve to permit control of sample flow to the instrument.

Isolation Valve

A1000 Sensors should be connected to the sample supply through an upstream isolation valve in order to allow manual control of the input flow. The isolation valve must be supplied by the customer.

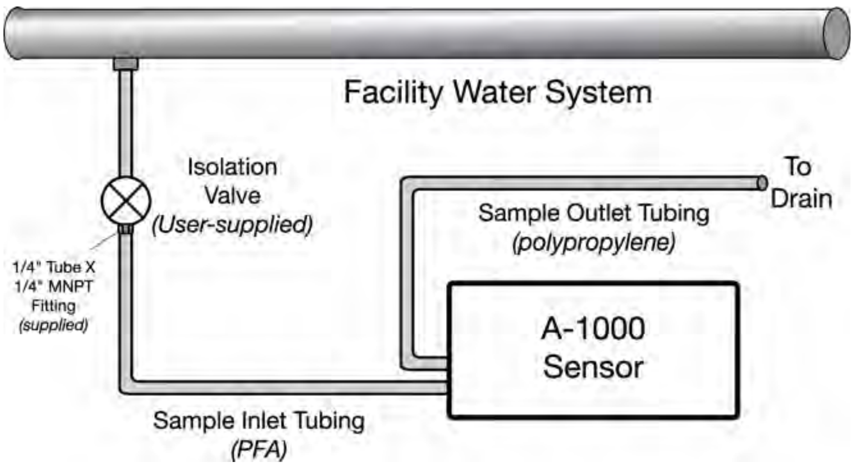

Fig 2-15 : Isolation Valve

Hach Ultra provides a 1/4” tube x 1/4” MNPT stainless steel compression fitting that can be inserted in the valve to assist in connection to the Sensor.

A 5-foot length of PFA sample tubing and a 10-foot length of polypropylene drain tubing are supplied with each Sensor. The suitability of any sample tube to the sample temperature and pressure should be determined prior to plumbing. The PFA tubing provided is not recommended for installations where:

- The water temperature exceeds 75°C (167°F) and the pressure exceeds 90 psig (620 kPa).
- The water temperature exceeds 85°C (185°F) and the pressure exceeds 80 psig (550 kPa).
- The water temperature exceeds 95°C (203°F) and pressure exceeds 70 psig (480 kPa).

Under these flow conditions, or in any application where the use of PFA is a concern, use of a high-grade sample tube is recommended.

A 3/4” and 9/16” wrench and are needed to install the tube fittings. Connections are made as follows:

1) Flush the (customer provided) isolation valve by opening and closing it fully several times before connecting the Sensor in order to avoid introducing debris through the inlet plumbing.
2) Push one end of the PFA inlet tubing into the rear of the compression nut located on the WATER IN port until it cannot be inserted any farther. Be careful not to crimp or damage the tubing.
3) Hand-tighten the compression nut taking care not to pull on the tubing.
4) Mark both the compression nut and the WATER IN connector as a reference for tightening the nut.

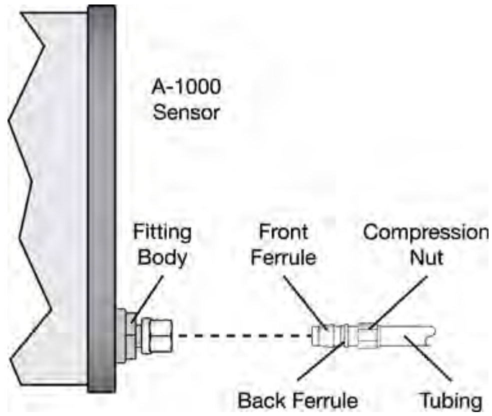

Fig 2-16 : Tubing Installation

5) Using the two wrenches, tighten the compression nut 1-1/4 turns to secure the connection.
6) Repeat step 2 through step 5 to connect the sample tubing to the (customer-supplied) isolation valve.

Water I/O Tubing

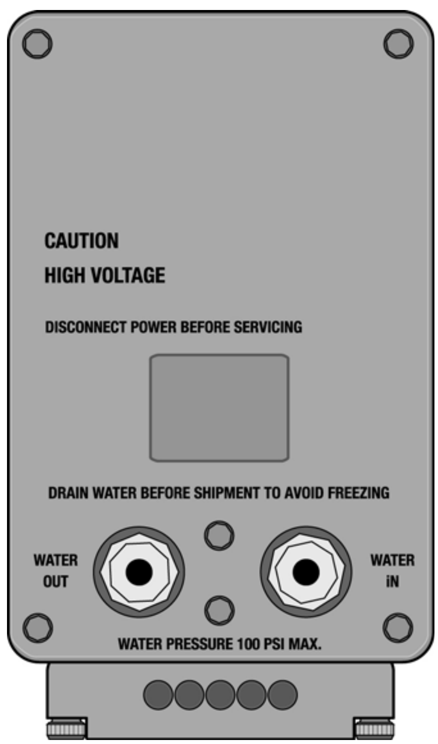

Fig 2-17 : Sensor Water I/O Connections

7) Repeat step 2 through step 5 to attach the 10-foot polypropylene drain tubing to the WATER OUT port. Run the open end to a suitable drain.
8) Leak test the connections by slowly opening the upstream isolation valve to introduce water into the instrument. Pulse the valve several times by opening and closing it, then recheck the fittings to stop any leaks.
9) If necessary, slowly tighten the compression fittings to stop any leaks.

CAUTION:
Over-tightening the fittings may permanently crush the ferrules.

Communications are established by making the necessary connections between an S10 Sensor and its associated C80 Controller. Because the Controller is an integral component on the S20P Sensor, communications are internal to this model.

The 3-foot local cables, twin BNC tee connectors, passive terminators and 10-foot trunk cable were all checked during the verification procedure and should only have to be reconnected in order to establish communications. The cable's twist-lock fittings facilitate the quick and easy connection and disconnection of any A1000 System component for installation, relocation or repair.

The C80–S10 interface must be configured as a single trunk line with local cabling no longer than three feet in length, although the trunk line can extend a total of 3000 feet (not including local cable drops). If electrical interference may be a problem, the interface cable should be installed in conduit which is free from other wiring or AC buses. Active (AC-powered) termination is required for trunk lines longer than 500 feet in order to control noise and help ensure a clean communications signal.

To establish interface communications between the C80 Controller and S10 Sensor:

1) Grasp the end of the 3-foot local cable attached to the C80 Controller and, noting the alignment of its internal pins, gently push it onto the middle coupling of the tee connector. Twist the cable onto the connector until it "locks" on the coupling.
2) Similarly fasten the S10 Sensor to its tee connector.
3) Link the two tee connectors using the section of trunk cable.
4) The passive terminators (P/N FG2005901) provided with each System component should be fastened to the open coupling at each end of the trunk cable.

2.4.3 Communications Connections

Note:
Trunk cabling longer than 500 feet require active termination. In these longer installations, an AC-powered terminator (PN FG2006501 – 120VAC, FG2006601 – 230VAC) must be connected to the open coupling at each end of the cable, then plugged into an appropriate AC source.

Auxiliary Inputs and Outputs

All of the Sensor's auxiliary input and output connections are made on its integral I/O Connector Block. This standardized Connector Block provides a consistent and flexible means of interfacing A1000 Sensors with a variety of other devices.

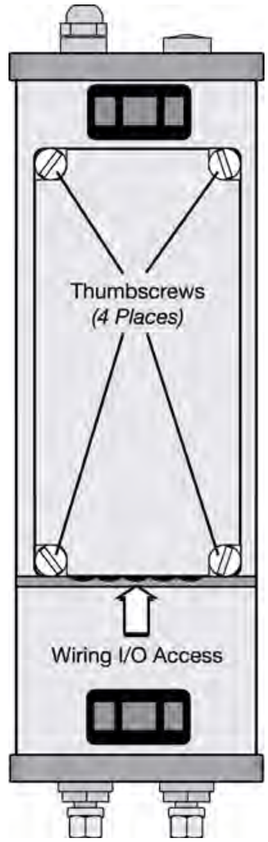

Fig 2-18 : A1000 Sensor, Bottom View

External wiring connections are made by removing the entire I/O Connector Block from the bottom of the Sensor and wiring each I/O cable to the appropriate screw terminals. The connector type and gender of the other end of the cable is determined by the auxiliary device to which it is attached.

I/O connections require a Phillips-head and a small flathead screwdriver and are made as follows:

1) Make sure the Sensor is turned OFF and disconnected from its power source.
2) Remove the I/O Connector Block from the bottom of the Sensor by loosening the four thumbscrews.

Note:
A medium flat blade screwdriver may be required.

3) Loosen and remove the two Phillips-head screws that secure the metal strain relief plate.
4) Feed the device wiring through one of the holes at the end of the I/O Connector Block cover and along the corresponding slot in the foam padding.

5) Make the connections to the appropriate terminals. Refer to the following sections for detailed information on the specific interface connections:
   - “Printer Output” on page 91
   - “Analog Outputs” on page 99
   - “Digital Inputs and Outputs” on page 117
   - “12 VDC Bias Output” on page 121
   - “Serial Communications” on page 123
6) Replace the metal strain relief plate.
7) Replace the I/O Connector Block on the bottom of the Sensor, taking care not to pinch any wires, and secure it in place by tightening the thumbscrews.

The I/O Connector Block offers these Sensor input and output connections.

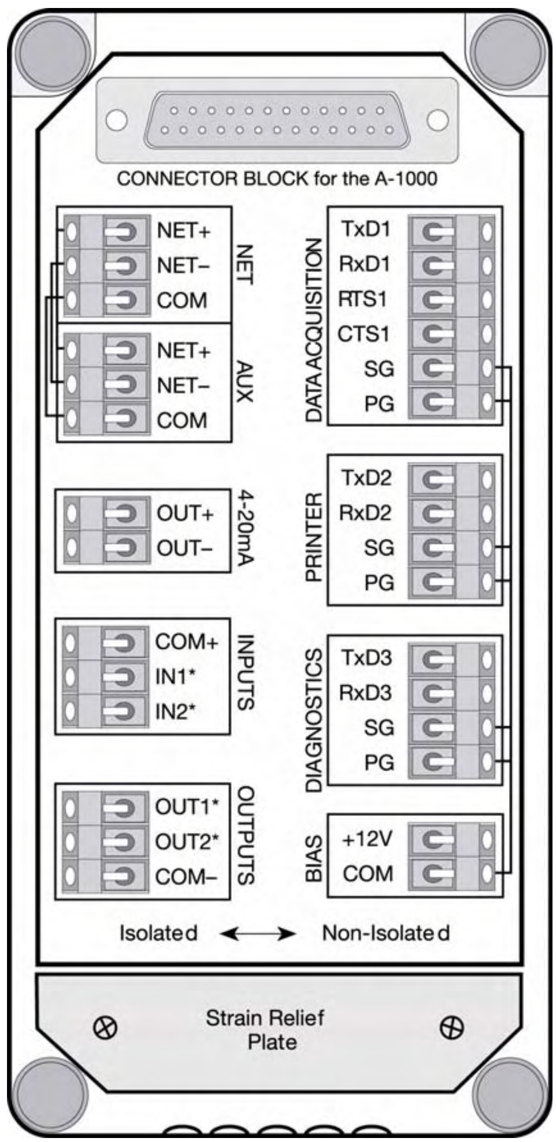

Fig 2-19 : A1000 Connector Block

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Table 2-1 : I/O Connector Block Input and Output Connections

Connector	Function
DB-25 Connector Block	A DB-25 Connector Block provides connections between the A1000's internal electronics and the I/O Connector Block.
Isolated I/O Connections	These connections are optically isolated from ground and the Sensor's internal power to avoid potential electrical problems.
NET	Used for A1000 Network connections via the twin-axial BNC cable. The C80 Controller and the S-10 Sensor are supplied with a 3-foot length of local A-Net cable; cable for the S20P Sensor is provided in its installation kit.
AUX	Reserved for Hach Ultra Service Department use. 4-20mA furnishes a 4-20 or 0-20 mA output proportional tothe Sensor's TOC reading for external analog devices.
INPUTS	A digital connection allowing limited supervisorycontrol of the Sensor by a remote device or switch. Connectingto the "IN1*" terminal allows external initiation of a TOCanalysis cycle; "IN2*" determines whether the Sensor is in theAuto TOC or the Purge Mode.
OUTPUTS	Provides a corresponding digital output for devices such as a remote alarm indicator or a PLC (Programmable Logic Controller). Connecting to the "OUT1*" terminal reports on whether the Sensor's TOC level is above or below the userspecified limit; "OUT2*" reports whether its solenoid valve is opened or closed.
Non-Isolated I/O Connections	
DATA ACQUISITION	A bidirectional RS232C interface that permits the Sensor to interface with serial devices such as a host computer.
PRINTER	Outputs data to a local thermal or serial printer to generate hardcopy reports.
DIAGNOSTICS	A secondary RS232C port for reporting resistivity and temperature in a 4-20 mA format via an external DAC (Digital-to-Analog Conversion) Module. This interface also may be used by Hach Ultra Service Department personnel, eliminating the need to disconnect other wiring in order to perform field service procedures.
BIAS	Furnishes 12 VDC power for biasing digital inputs and outputs to drive external devices like the auxiliary External DAC Modules.

2.4.4 Power Connections

AC Power for each S10 and S20P Sensor is provided via its molded power cord. The integral cord plugs into a standard AC power source. The Sensor's internal electronics are self-adjusting to accommodate either a 110 VAC or 220 VAC supply. The C80 Controller receives its 9 VDC power through a Hach Ultra-supplied transformer that connects to a 120 VAC adapter. A 230 VAC version is also available.

2.5 Sensor Initialization

With the plumbing, communications and power connections properly established, the A1000 Sensor can be initialized and placed into operation. Because the cleanliness of commercially available tubing varies (particularly stainless steel), it is suggested that the Sensor's plumbing be thoroughly flushed. This is accomplished by placing the instrument in the Self-Clean Mode for several hours.

To initialize the Sensor:

1) Open the optional isolation valve to initiate flow to the Sensor.
2) Turn the Sensor and any attached printer "ON." The Sensor initially conducts a series of self-diagnostic routines, indicated by a flashing green Controller LED, to verify that it is operating properly. The LED flashes red while the Controller establishes communications with its associated Sensor.

The Controller reports if it is unable to establish communications with the Sensor and suggests checking the wiring connections. Once the Controller has established communications with the Sensor, any other faults detected during the power-up diagnostics may be examined by pressing the **Alarm Key**. Summaries of any errors are displayed and output to the printer (refer to "Troubleshooting" on page 143 for information on errors and their meanings).

When its self-diagnostics have been completed successfully, each Sensor begins an automatic analysis cycle based on factory default parameters.

3) Press the **Manual Key** in order to access the Sensor's Manual Menu.
4) Specify **Modes**, press **Enter** to display its submenu.
5) Specify **Special Modes** and press **Enter** to display the available options.
6) Use the **Up** and **Down Keys** to specify Clean.
7) Press **Enter** to place the instrument in its Self-Clean Mode of operation.

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

"CLEAN MODE" is displayed on the Controller's LCD for the Sensor. In this Mode, the Sensor's UV lamp is turned on to oxidize any contaminants inside its measurement cell and its solenoid valve is opened to flush away impurities. Allow the Sensor to run in this state for 3 to 4 hours, longer if the sample tube is lengthy or if the sample point is at low pressure, such as a gravity-feed tube.

Monitor the drain tube to verify that there is a sample flow of at least 120 mL/minute.

8) With the Sensor sufficiently cleaned, automatic TOC analysis can be initiated. Press the **Manual Key** to access its Manual Mode.
9) Specify **Modes** once again and press E.
10) Specify **Auto TOC** and press **Enter** to initiate automatic analysis based on the factory default parameter settings.
11) Press **Enter** to exit the screen.

3 Network Installation

3.1 General Information

As many as eight sensors and eight controllers can be networked together in any configuration to create a diverse combination of A1000 Systems. The controller in a single S20P, for example, can oversee as many as seven additional Sensors, or a single S10 Sensor may be linked to eight separate controllers. Regardless of the instrument combination, the Anet must consist of at least one C80 Controller and one S10 Sensor.

3.2 Software Setup

Each A1000 component must have its own unique address to identify it on the Network. Sensors are assigned Channel ID Numbers that correspond to the LEDs on the faceplate of their associated Controller. C80 Controllers are assigned Network addresses.

It is recommended these assignments be made during "Operational Verification" on page 18 before performing hardware installation of the Network. This process avoids conflicts and assures all of the components on the Network are uniquely identified and functioning properly.

3.2.1 ID to S/N Cross Reference

Default: Channel 1

The ID to Serial Number Cross-Reference associates each Sensor's Channel ID with its designated Serial Number. A Channel ID Number (1-8) is used to identify each Sensor for display and reporting purposes, as well as serving as its Network address. The attached Controller determines these ID–S/N relationships when it first scans the A-Net. These ID–SN assignments may be altered, but duplicate Channel IDs are not permitted on the Network.

To make Channel ID–Serial Number assignments:

1) With any Sensor specified, press the Setup Key to display its menu selections.

```
  Sensor Setup:
▶ System Setup
  C80 Setup:
```

Fig 3-1 : Sensor Setup Selections

2) Use the Up and Down Keys to specify System Setup.
3) Specify **ID to SN Xref** and press **Enter** to view its parameter screen. The Channel ID–Serial Number assignments are presented and Channel #1 flashes to indicate that it is the current selection.

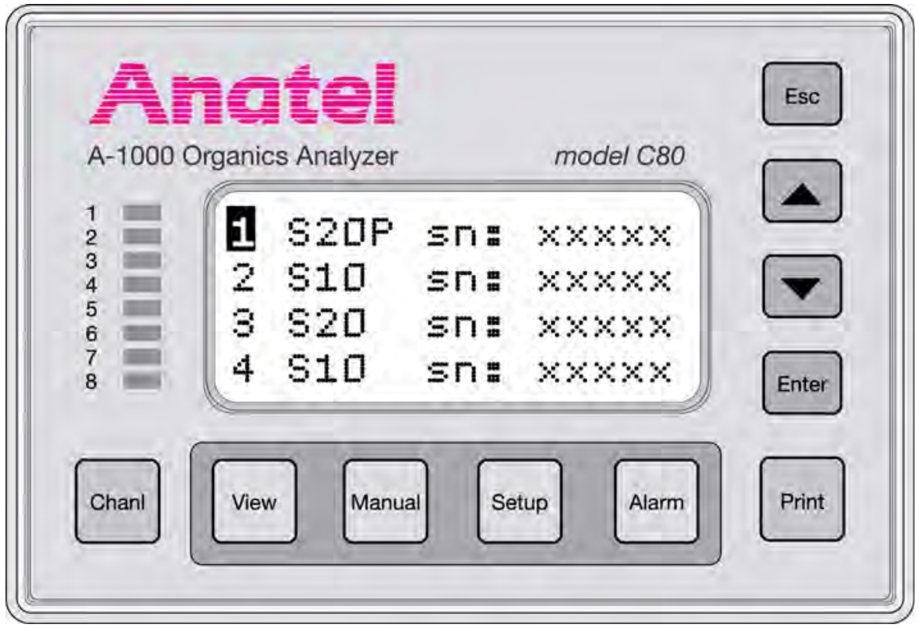

Fig 3-2 : ID to Serial Number Cross-Reference Screen

4) Accept this ID-S/N cross-reference, or press **Enter** to access the Controller’s Edit Mode. The flashing block cursor becomes an underscore.

1	S20P SN: XXXXX
2	S10 SN: XXXXX
3	S20P SN: XXXXX
4	S10 SN: XXXXX

Fig 3-3 : Controller Edit Mode

5) Use the Up and Down Keys once again to select the Channel ID Number that corresponds to the associated Sensor’s Serial Number. Note that duplicate Channel IDs are permitted while in the Edit Mode, but they cannot be saved.
6) Press **Enter** to retain the new ID Number and advance the cursor to the next Sensor.
7) Repeat the procedure to reassign other Channel IDs as necessary. The Up and Down Keys are used to access other Channel IDs that are not presently visible in the display.
8) With all of the Channel ID–Serial Number crossreference assignments established, press **Esc**. A message is posted indicating that the Network will be reset in order to implement the changes. If duplicate Channel IDs exist, a message is displayed indicating this condition is not permitted and that the ID–S/N conflict must be resolved before the screen can be exited.
9) Press **Enter** to continue and the Controller resets the Network. The Channel LEDs and displays reflect the new ID to S/N assignments.

3.2.2 Controller Address

Note:
Default: Address 9

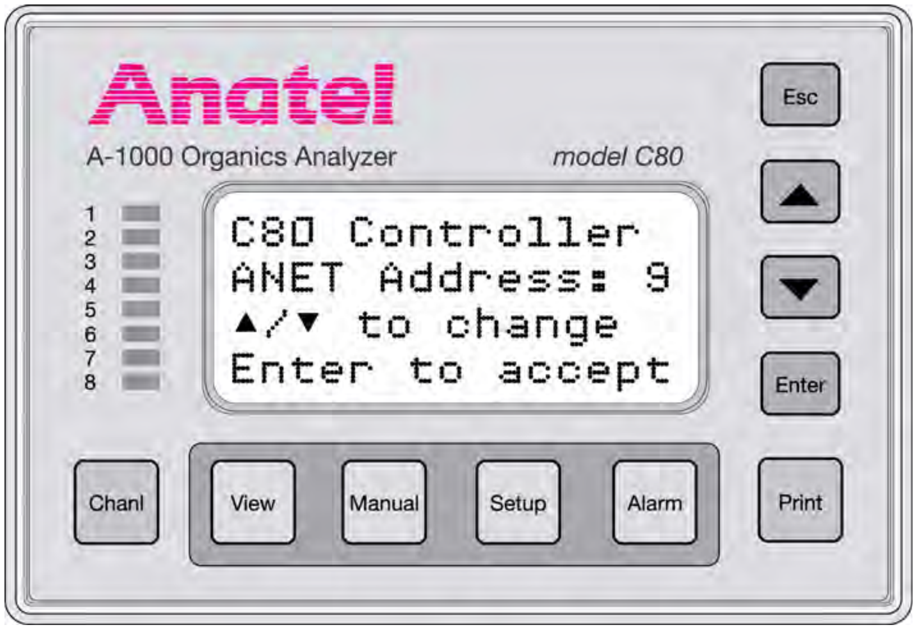

Fig 3-4 : Controller Address Screen

Like A1000 Sensors, each C80 Controller also must have its own unique address on the Network for identification and reporting functions. The Sensor address is pre-configured at the factory to a default of “9,” but may have to be changed in order to avoid a Network conflict.

To change the Controller’s A-Net address:

1) While holding the Setup Key down, cycle the Controller’s power by removing, then restoring, its power connection (on an S20P, simply turn the Sensor OFF and then back ON). The Controller displays its current address.
2) Use the Up and Down Keys in order to scroll the Controller’s A-Net Address to the desired setting (9–16).
3) Press **Enter** to retain the displayed setting and return to normal operation.

3.3 Network Setup

The A1000 Network is configured by making the necessary communications connections between multiple Sensors and their managing Controller(s) using the shielded twin-axial cabling. The cable’s BNC twist-lock fittings allow quick and easy connection and disconnection of any A1000 System component without disrupting overall Network operation.

The A-Net Network must be configured as a single trunk line with each A1000 component connected through an individual tee connector using a local cable no longer than 3 feet. The A-Net trunk line can extend a total of 3000 feet not including these local cable lengths. If the trunk line exceeds 500 feet, its cable should be installed in conduit which is free from other cables or AC buses to prevent the potential for electrical interference.

To establish A-Net communications:

1) Grasp the end of the 3-foot local cable attached to a C80 Controller and, noting the alignment of its internal pins, gently push it onto the middle coupling of the tee connector. Twist the cable onto the connector until it “locks” on the coupling.
2) Similarly fasten the local cable that extends from the other A1000 Network components to their respective tee connectors.
3) Link the various tee connectors using sections of twin-axial trunk cable.
4) Both ends of the Network must be terminated to control noise and help ensure a clean signal. The passive terminators (P/N FG 2005901) provided with each A1000 System component should be fastened to the open jack connector at each end of the A-Net Network with a total trunk length less than 500 feet.

Table 3-1 : Potential A-Net Configurations

C80 Controller	S10 Sensor	C80 & S10, S20P
8	8	0
0	0	8
0	0	0
1	1	7
:	:	:
:	:	:
• Maximum of eight C80 Controllers • Maximum of eight S10 Sensors		

Note:
It is recommended that once the Network communications have been established with all instruments, the System Time be again set as described in “System Time” on page 19*. The date and time are then broadcast to the connected Sensors, thereby assuring that all of the instruments on the Network are synchronized to the same clock setting.*

A-Net Networks longer than 500 feet require active termination. In these installations, an AC-powered terminator (P/N FG2006501: 120 VAC, 60 Hz; FG2006601: 230 VAC, 50 Hz) must be connected to the open coupling at each end of the Network and then plugged into an appropriate AC supply to ensure a clean signal. More Sensors may be added to an existing A-Net configuration by positioning them along the trunk line and then attaching them as described above using the twin-axial cable and the tee connector provided.

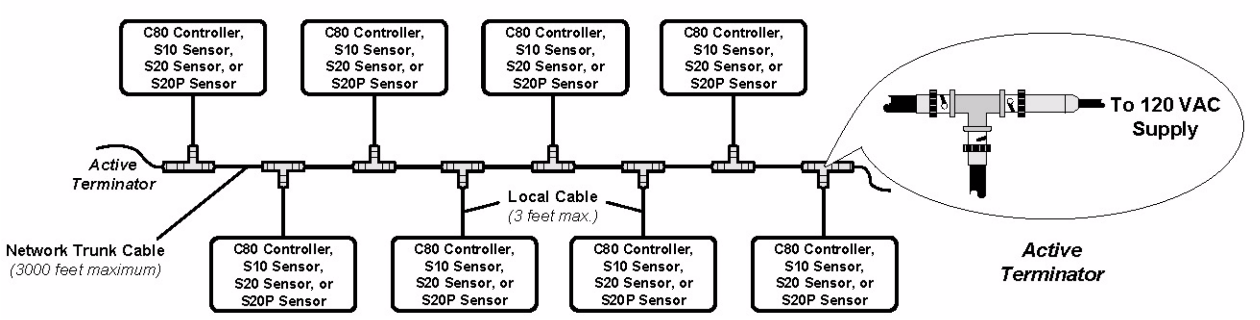

Fig 3-5 : A-Net Communications Connections

3.3.1 S20P Network Connections

The local cable must be attached to an S20P Sensor when connecting it to the network. This 3-foot communications cable is provided with each portable Sensor and can be found in its installation kit.

Network connections are made to the NET Port on the Sensor's I/O Connector Block as follows:

1) Turn the Sensor OFF and disconnect the power cord from its source.
2) Remove the I/O Connector Block from the bottom of the Sensor by loosening the four thumbscrews.
3) Loosen and remove the two Phillips-head screws that secure the metal strain relief plate.
4) Feed the interface wiring through one of the five holes at the end of the Connector Block cover and along the corresponding slot in the foam padding.
5) Make the necessary connections to the Sensor's NET port as shown in Figure 3-6.

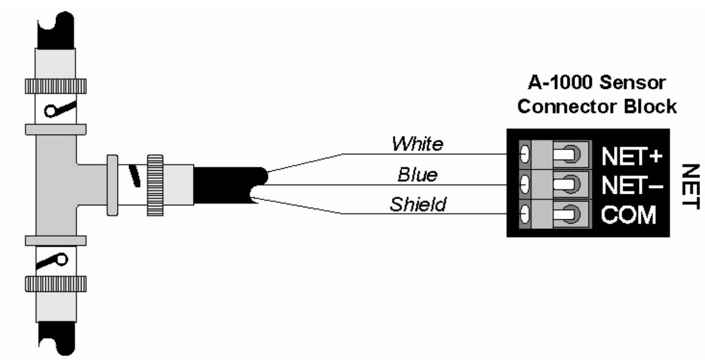

Fig 3-6 : Sensor NET Port Connections

6) Replace the metal strain relief plate.

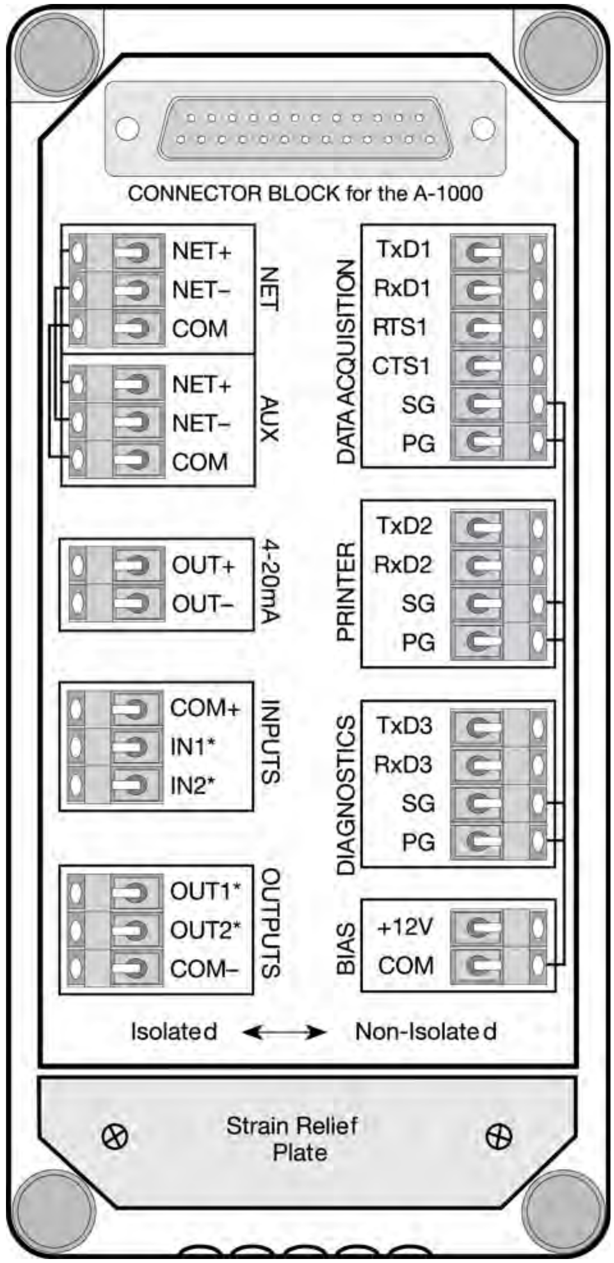

Fig 3-7 : I/O Connector Block

7) Replace the I/O Connector Block on the bottom of the Sensor, taking care not to pinch any wires, and secure it in place by tightening the thumbscrews.
8) Reconnect the power cord and turn the Sensor ON.

4 C80 Controller Setup

4.1 General Information

The C80 Controller provides the user interface with the various Sensors, furnishing data displays and access to individual Sensor parameters. The Controller is either a stand-alone unit or an integral component of the S20P Sensor.

User interaction with the C80 Controller is through a consistent interface. Its 4-line by 16-character display affords full functionality for interacting with its associated Sensors, allowing the user to manage their operation individually.

4.2 C80 Controller Display

The C80 Controller display simultaneously provides data from multiple Sensors. The Controller's faceplate also contains a set of Channel ID LEDs which reflect the operational status of each connected Sensor and ten membrane keys for user interaction.

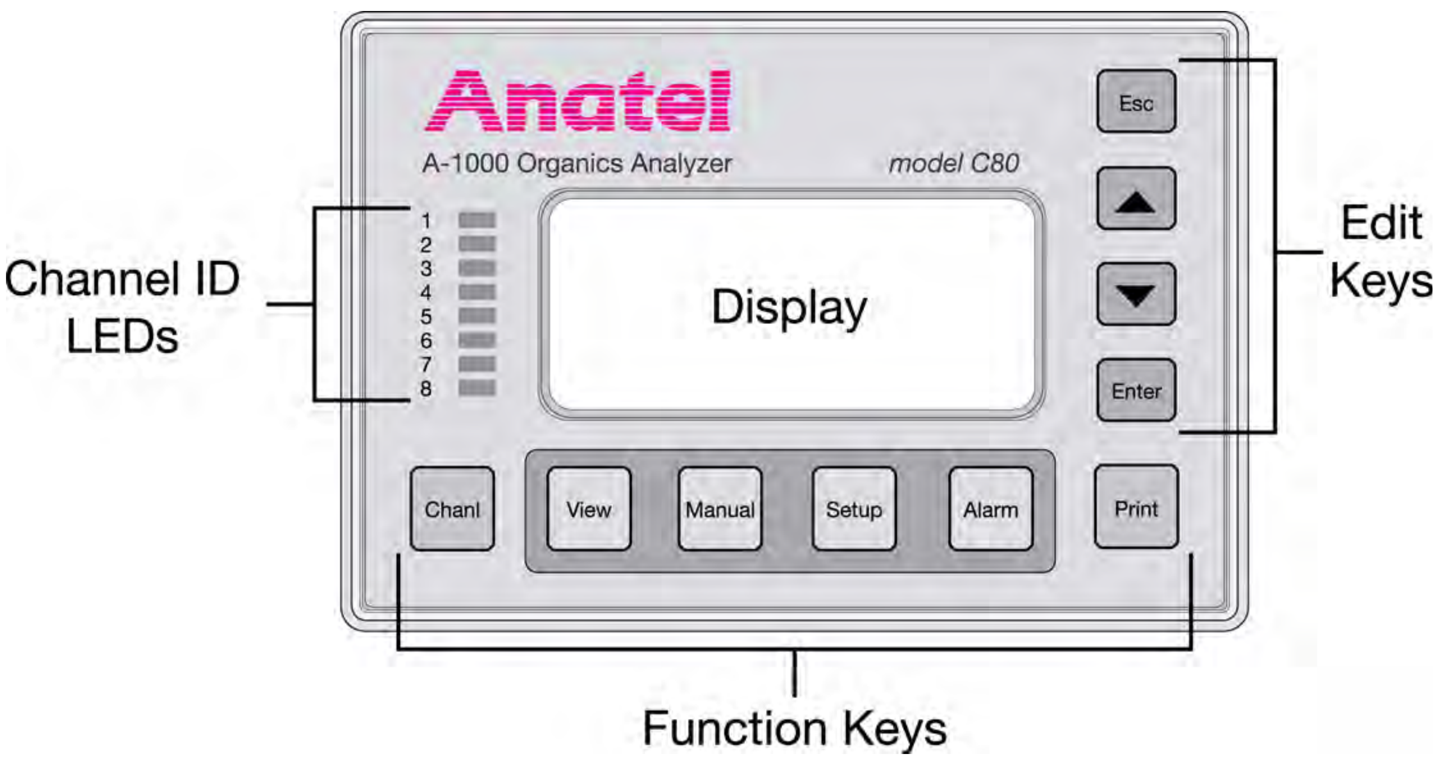

Fig 4-1 : C80 Controller Display

Table 4-1 : C80 Controller Edit Keys

Key	Function
Esc Key	Saves the displayed setting, exits the current screen and returns to the previous screen.
Up and Down Keys	Used to specify menu items and parameter values for selection. The Up arrow key moves the cursor up or left within the display while the Down arrow moves the cursor down or right.
Enter Key	Chooses the indicated menu selection, accesses the Edit Mode or moves the Edit Cursor to the next selection.
Chnl Key	Displays identification and status information on the selected Sensor
View Key	Toggles between a Multichannel, a Single Channel and, if referenced, a Differential View
Menu Key	Accesses operational Mode options for the Sensor.
Setup Key	Accesses global variables for the entire A1000 System as well as operational parameters for individual Sensors
Alarm Key	Acknowledges and displays any A1000 Sensor excursions or System errors.
Print Key	Allows on-demand printouts to be generated in several formats.

4.3 Operational Conventions

Each Sensor's parameter values and operational settings are accessed through menu selections. The Multichannel and Single Channel Views represent the highest level Controller screens; a parameter screen is the lowest level display. It presents the current value for the particular variable, allowing it to be edited.

There are a few general rules that govern the C80 Controller interface:

- The **Up** and **Down Keys** are used to specify (▶) a display item: It is then selected by pressing the Enter Key. A menu item that is followed by a colon (**:**) indicates that a submenu exists.
- A check (√) preceding an item indicates that it is the currently active menu selection.
- While an Edit Mode is employed to change A1000 parameter values, there is no temporary screen. All parameter changes are made in real time and saved by pressing either **Enter** or **Esc** (using **Esc** also exits to the previous screen).
- Any changes made to a Sensor's parameters are immediately output to a local printer, but they do not take effect until the subsequent analysis cycle.

4.4 Contrast Adjustment

Once it has been installed, the contrast level of the Controller's background may have to be adjusted to make its display more easily visible under the ambient lighting conditions. This Controller display adjustment is found in the System Setup Menu.

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To adjust the Controller's display contrast:

1) With any Channel View displayed, press the **Setup Key** and its menu selections are presented.

```
  Sensor Setup:
  System Setup
▶ C80 Setup:
```

Fig 4-2 : Sensor Setup Selections

2) Use the **Up** and **Down Keys** to specify C80 Setup.
3) Press **Enter** to access its submenu.

```
▶ Contrast Adj:
  Beeper Setup:
```

Fig 4-3 : Contrast Selection

4) Specify **Contrast Adj** and press **Enter** once again to display its parameter screen.
5) Use the **Up** and **Down Keys** to lighten or darken the display as necessary.
6) With the contrast set to the desired level, press **Esc** to exit the screen.

Fig 4-4 : C80 Contrast Adjustment Screen

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4.5 View Options

The **View Key** determines the type of Sensor information that is presented in the Controller's LCD display. Three data display formats are offered:

1) Detailed readings for a single Sensor including the current TOC, trend, profile type, resistivity and temperature values.
2) A multichannel listing of all Sensors connected to the Controller, their respective TOC values and current trend. The Sensor's alternate operational modes ("PURGE" or "CLEAN") are also reported.
3) Differential measurements between two Sensors in either the Auto TOC or Purge Mode. This View is available only when one Sensor is referenced to another (see "Differential Mode" on page 73).

Repeatedly pressing the **View Key** cycles through these three display formats. All displayed values are the result of the Sensor's previously completed analysis cycle. These readings are updated at the conclusion of each cycle.

Simultaneous access to a particular Sensor is not permitted with a multi-user Network, such as when multiple C80 Controllers are connected to the same Sensor. In the event a concurrent attempt is made to modify a Sensor (either through another Controller or externally via its serial port), the conflict is reported and access is denied to the second device. Press **Esc** and there is a 30-second delay before control of the busy Sensor is returned to the user.

```
Access denied --
another user has
current access
to this Sensor
```

Fig 4-5 : Sensor Setup Selections

4.5.1 Single Channel View

Detailed analysis data are available for each of the connected Sensors through the Controller's Single Channel View. To examine an individual instrument's data, specify the Sensor and then press the **View Key** until the Single Channel format is displayed.

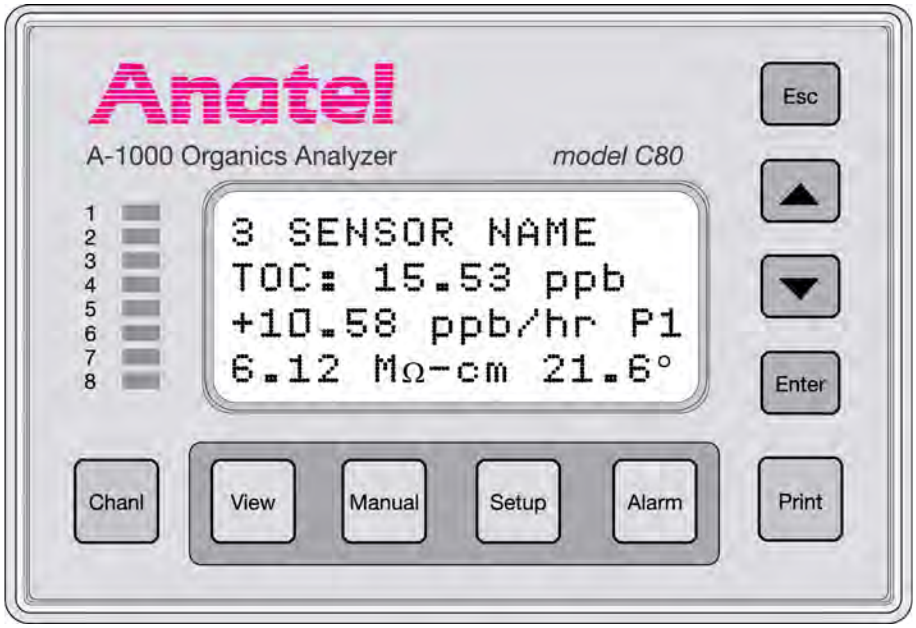

Fig 4-6 : Single Channel View

The first line of the display identifies the Sensor by its Channel ID number and user-entered name. The remaining lines furnish the following information on the Sensor's previous analysis cycle:

- 2: The TOC concentration in ppb.
- 3: The trend of the Sensor's TOC level over the last hour, preceded by a "+" or "–" to indicate its direction. In addition, the Profile Type of the sample is reported as "P1," "P2" or "P3" (see "Auto TOC Mode" on page 57 for an explanation of Profile Types).
- 4: The sample resistivity (or conductivity) and water temperature, in degrees Centigrade.

The individual readings for the other Sensors associated with this Controller can be observed by simply pressing the **Up** and **Down Keys**.

4.5.2 Multichannel View

Multichannel is the initial default view when a C80 Controller is managing more than one Sensor. This Network display affords a summary listing of all its associated Sensors to provide an overview of several aspects of the monitored process. To examine multiple channel data, press the **View Key** until that display format is presented.

The Multichannel View lists each Sensor by its Channel ID and reports its respective TOC value, calculated at the conclusion of its last analysis cycle. The value is followed by a "{" or "}" to indicate the directional trend in TOC levels for that Sensor based on its running average over the last hour. This trend indication initially appears at the conclusion of the Sensor's second analysis cycle. If no direction is denoted, the TOC level has not changed over the trend period. When the Sensor is under remote digital control (see "Software Setup" on page 108), "r/c" is also displayed to report this condition.

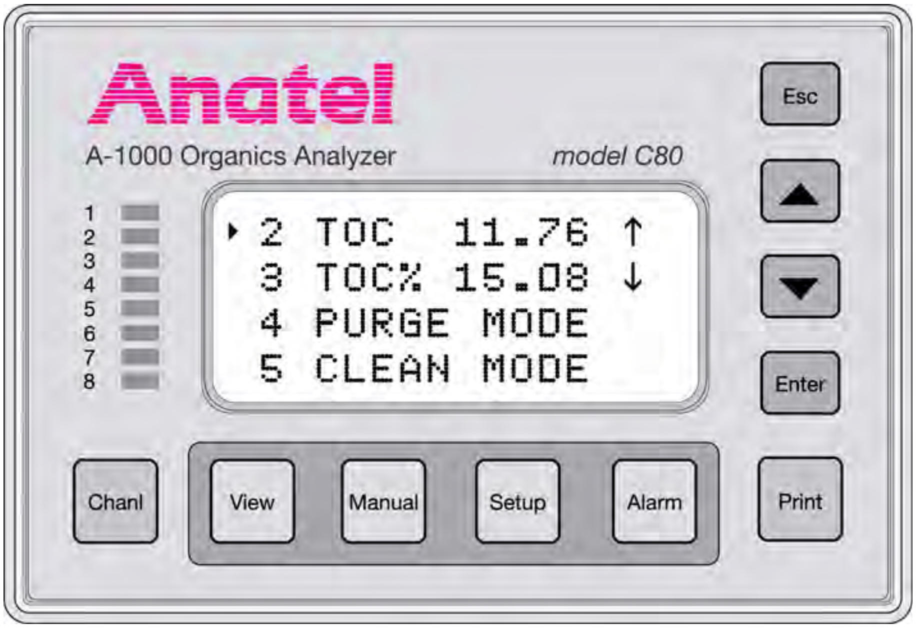

Fig 4-7 : Multichannel View

“PURGE MODE” indicates that water is flowing through the corresponding Sensor’s measurement cell and no analysis is being conducted. In the “CLEAN MODE,” the Sensor’s UV lamp is turned on to oxidize any residual organics while the water sample flows through its measurement cell.

The Multichannel listing can be scrolled in order to view any connected Sensors that are not visible within the Controller’s four-line display by pressing the **Up** and **Down Keys**.

4.5.3 Differential View

The differential readings between any two Sensors may be viewed as long as a reference relationship has been established between them (see “Differential Mode” on page 73). If no reference has been specified, the Differential View is not enabled. Once a Sensor is referenced to another, however, their comparative readings are available by pressing the **View Key** until the differential format is displayed.

Note:
The reference Sensor’s readings are always subtracted from the primary Sensor’s readings in order to obtain differential measurements. In these displays, the readings of Sensor #1 are subtracted from the readings of Sensor #3.

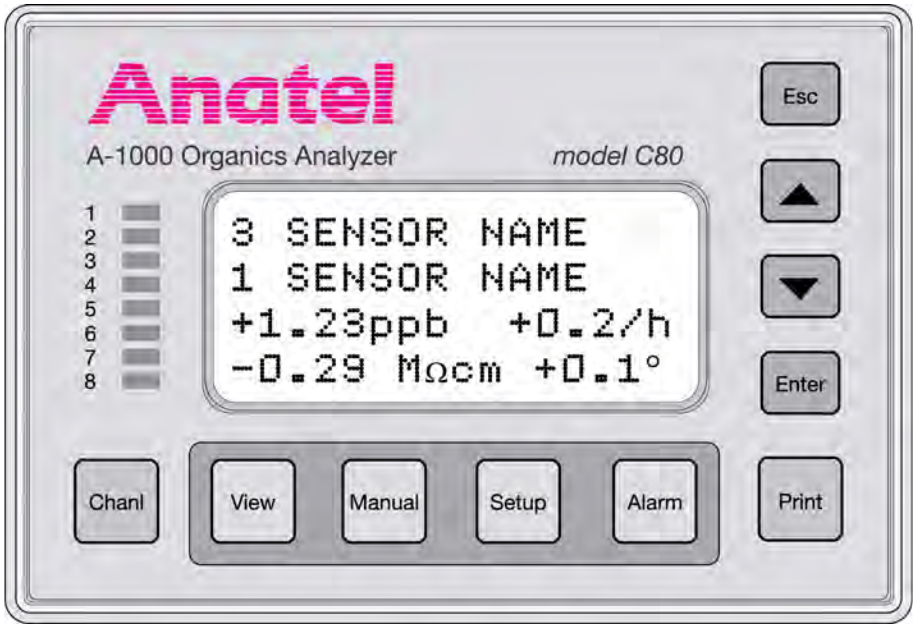

Fig 4-8 : TOC Differential View

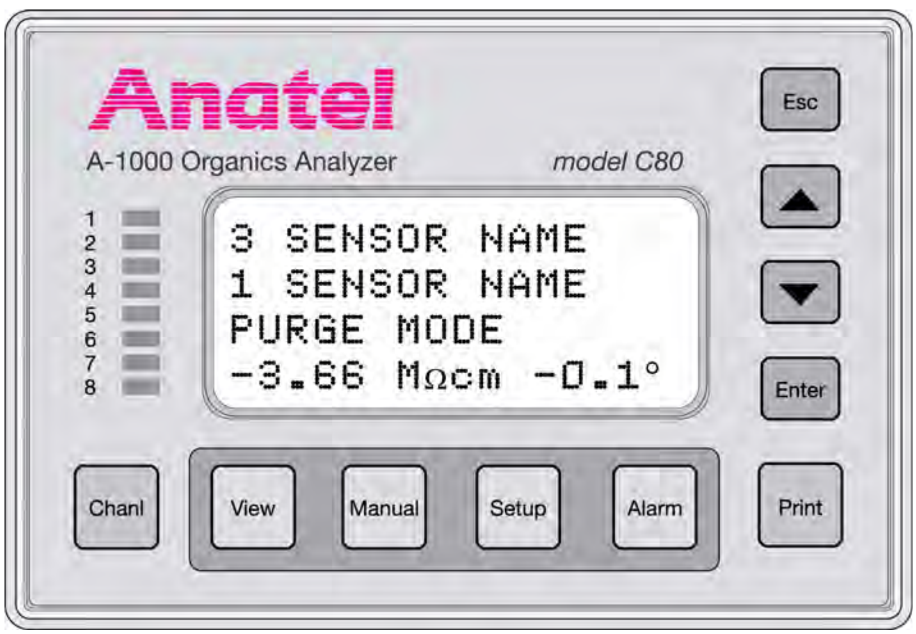

Fig 4-9 : Purge Differential View

The first two lines of the Differential View identify the primary Sensor, followed by the reference Sensor. The information in the last two lines depends on the common operational state of the two Sensors:

- The Auto TOC Mode reports the Sensors' current differential TOC (in ppb), the average difference in their respective TOC values over the past hour, resistivity (in MΩ-cm) or conductivity (in µS/cm) and temperature (in °C).
- The Purge Mode reports the two Sensors' current differential resistivity (in MΩ-cm), or conductivity (in uS/cm), and the sample temperature. "PURGE MODE" also is displayed.

The two referenced Sensors must be in the same operational mode in order to obtain these readings. If the modes of the primary and reference Sensor are not in agreement (i.e., Sensor #3 is in the Auto TOC Mode and Sensor #1 is in the Purge Mode), the message "Differential op-mode mismatch" is presented and no values are displayed. If the Sensor is in the Idle Mode or has experienced a critical error, no data appear in the bottom line of the display.

4.5.4 Channel Display

The **Chnl Key** furnishes general information about the Sensor including its Model and Serial Number, operational mode and current state.

These Channel data are accessible either from the Single Channel View, or by using the **Up** and **Down Keys** to identify the desired Sensor in the Multichannel View

and then pressing **Chnl**. The four lines of data presented in the Channel Display are:

- Sensor's Channel ID Number and userentered Name
- Sensor Model and Serial Number
- Sensor's current operational Mode
- Sensor's current operational State

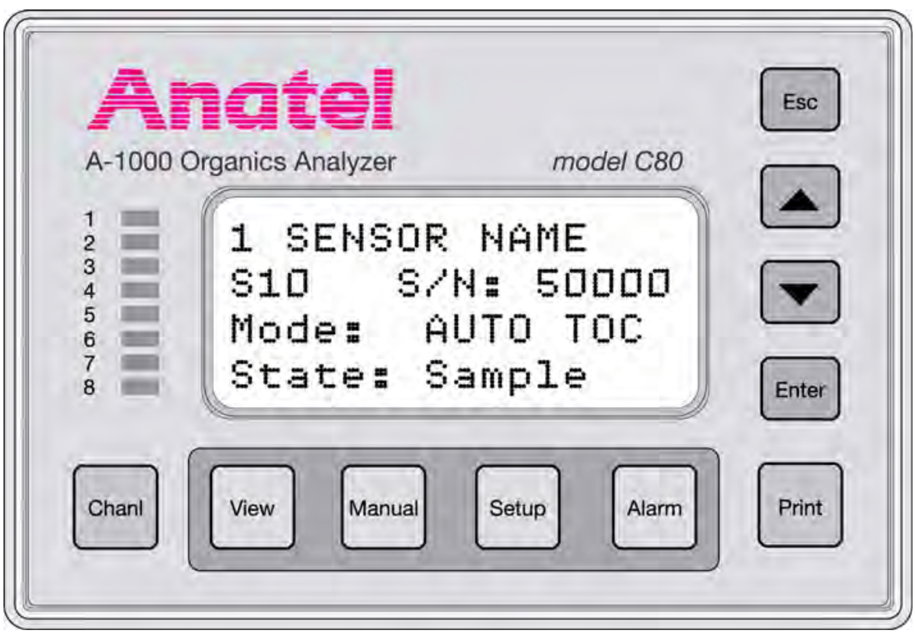

Fig 4-10 : Channel Display

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This information may be examined for other associated Sensors simply by pressing the **Up** and **Down Keys** once the Channel display is presented.

Pressing the **Chnl Key** twice displays the checksum value of the A1000's controlling EPROM as well as its current firmware version. This ROM checksum is calculated each time the Sensor is powered-up and is the same value that would be produced by a device programmer. The checksum value and firmware version are also available on the Sensor Factory Configuration printout (see "Printouts" on page 95).

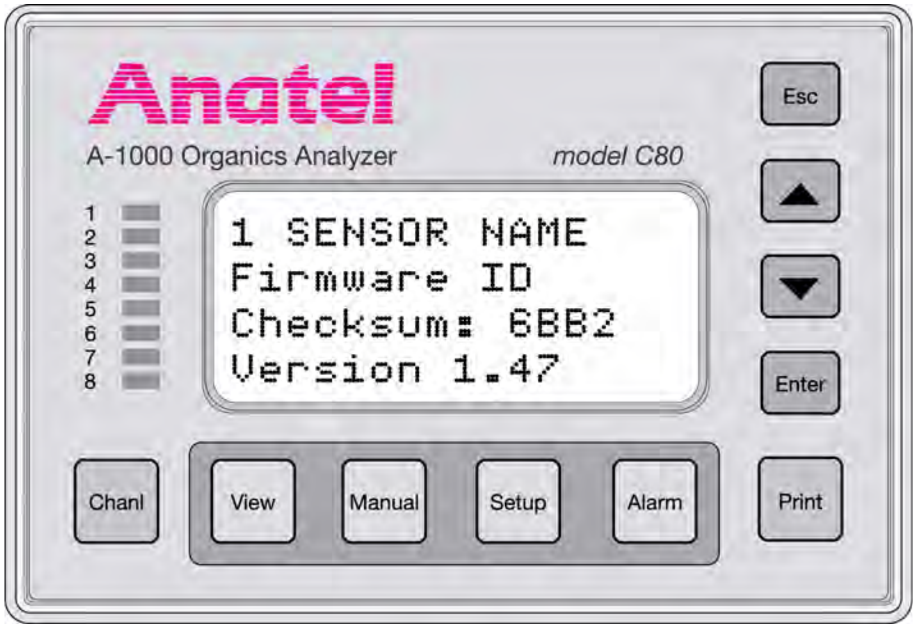

Fig 4-11 : Checksum Display

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5 Sensor Setup

Once they have been installed, A1000 Sensors can begin analysis immediately based on the factory default parameters. The user can selectively alter these default values to tailor the instrument's operation to the requirements of the particular application.

A1000 Sensors run in one of four modes:

- Auto TOC is the Sensor's standard operational mode for monitoring any high-purity water system. In this mode, the Sensor automatically performs successive TOC analyses and reports the results until the process is interrupted by the user.
- Purge Mode opens the Sensor's internal sample valve, allowing sample water to flow through the instrument and flush the measurement cell.
- Resistivity (or conductivity) and temperature readings are reported.
- Differential Mode measurements can be performed as either an Auto TOC or Purge operation. This mode is suited to situations that demand water quality checks, like rinse and clean processes. A primary and a reference Sensor report their respective, and their differential, results.
- Manual Mode allows the user to interrupt automatic operation and manually initiate an analysis cycle.

Appropriate printouts are generated on a Sensor's local printer. On-demand printouts are available in a TOC or Differential format through the **Print Key** .

Parameter changes, limit excursions or any errors detected during operation automatically generate a printout to provide a hard copy of the event.

5.1 Factory Defaults

A1000 Sensors are shipped from the factory equipped with a set of default parameter values so that they can generate data as soon as they have been installed and powered up. A list of the Sensor's current parameter settings is available through the Print Setup menu selection (see "Printouts" on page 95). The Sensor's factory default values are shown in Table 5-1.

Table 5-1 : Sensor Default Factory Values

Parameter	Default Value
Identification	
Sensor Name	Sensor Serial Number
Channel ID Number	1
Reference Sensor	None
Analysis	
Sample Time	00:01:00 h:mm:ss
Cycle Time	00:00:00 h:mm:ss
Analyze Rate	Normal
Valve @ Idle State	Closed

Table 5-1 : Sensor Default Factory Values (Continued)

Parameter	**Default Value**
Outputs	
mA Range	4 to 20mA
TOC Zero-Scale	0000 ppb
TOC Full-Scale	1000 ppb
Resistivity Zero-Scale	000 MΩ–cm
Resistivity Full-Scale	020 MΩ–cm
Temperature Zero-Scale	0000 °C
Temperature Full-Scale	100 °C
Activate External DAC	No (Inactive)
DAC Error Output	Minimum Output
Digital Control	Disabled
Display/Print	
Active Alarm Setup	TOC Alarm
TOC Alarm Limit	0100 ppb
Diff Alarm Limit	0000 ppb
Alarm Beeper	Enabled
TOC Multiplier	1.000
Resistivity/Conductivity Units	MΩ–cm
Print Format	TOC Print
TOC Print Interval	Continuous
% Change in TOC	01 percent
Purge Print Interval	Timed
Print Interval	00:01:00 h:mm:ss
% Change in Resistivity	01 percent

All of these variables, default or user-entered, are stored in battery-backed memory within each Sensor to avoid loss when the instrument is powered down. If a bad battery or other error corrupts these values, a “10–Bad Config” error is reported (see “Troubleshooting” on page 145). If this condition occurs, the default parameters must be restored and then modified as necessary.

To reset the Sensor’s factory default parameters:

1) With the desired Sensor specified in any View, press the **Setup Key**.
2) Use the **Up** and **Down Keys** to specify Sensor Setup.

3) Press **Enter** to display its submenu.
4) Specify **Analysis Setup** and press **Enter**.
5) Specify **More Setup** and press **Enter** to access its submenu.

1	SENSOR NAME
	Valve at Idle:
▶	Factory Default

Fig 5-1 : More Setup Submenu

Note:
This procedure restores all parameters to their factory default values.

6) Use the **Up** and **Down Keys** to specify **Factory Default**.
7) Press **Enter** to display the Factory Defaults Screen.

Fig 5-2 : Factory Defaults Screen

8) Press **Enter** to once again to reinstate the Sensor's default parameter settings; pressing **Esc** exits the screen without making any changes.

5.2 Display Units

Default: Resistivity

This Display/Print submenu selection determines which measurement units are logged, displayed and output to the printer. Sample resistivity is reported in megaohm-centimeters and sample conductivity in microsiemens per centimeter. Either may also be selected.

To specify the reported display units:

1) With the desired Sensor indicated in any View, press the **Setup Key** to display its submenu.
2) Use the **Up** and **Down Keys** to specify **Sensor Setup**.
3) Press **Enter** to access its submenu.
4) Specify **Display/Print** from among the available selections and press **Enter** to display its options.

```
1   SENSOR NAME
    Refernc Sensor:
▶   Resis or Cond:
    Printer Setup
```

Fig 5-3 : Display/Print Submenu

5) Specify **Resis or Cond** and press **Enter**.

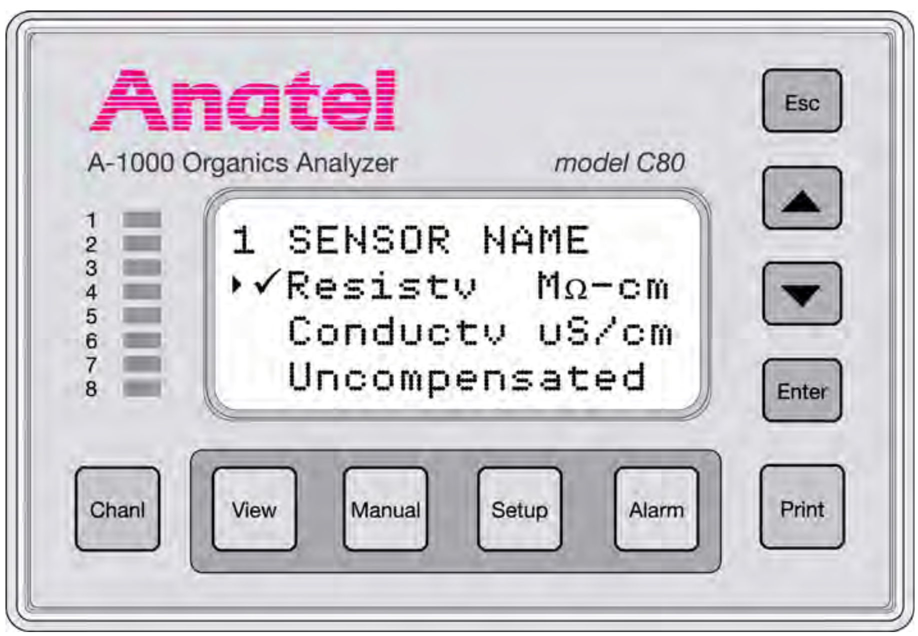

Fig 5-4 : Display Units Screen

6) Use the **Up** and **Down Keys** to select the desired format.
7) Press **Enter** to activate the designated report units.
8) Press **Enter** to exit the screen.

5.2.1 Uncompensated Temperature Measurement

The Anatel A1000 TOC Analysis System software also can report the raw conductivity, or resistivity, of the sample water. A compensation factor normally is applied to the water temperature in order to adjust it to a 25 °C standard. This calculation provides consistency from one analysis reading to the next. Temperature compensation is not always desirable in high-purity water applications, however, so this operational mode uses the actual water temperature in its report and alarm functions.

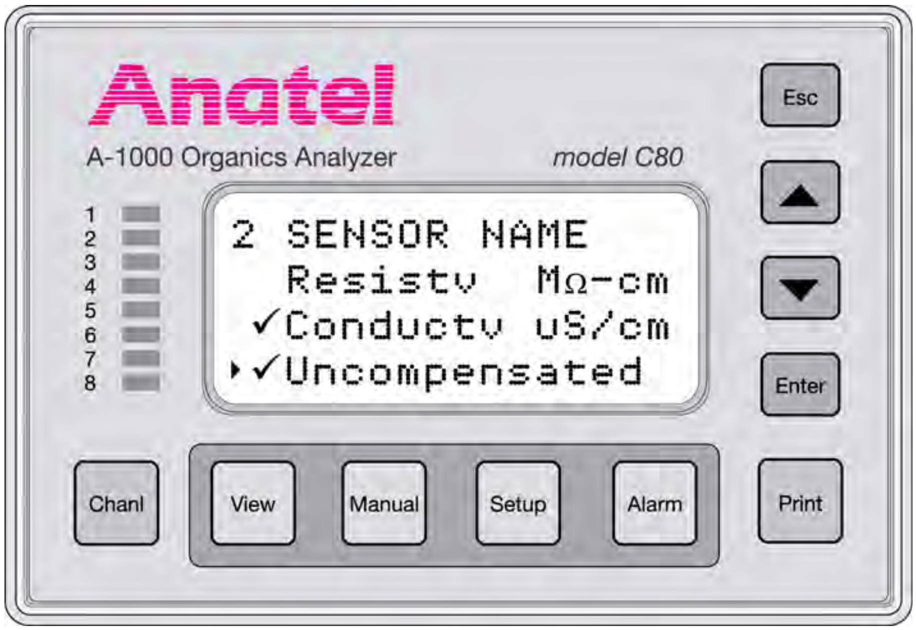

Fig 5-5 : A1000 Uncompensated Conductivity Display

Raw conductivity is reported for the Sensor in place of the temperature compensated value on all the associated C80 Controller displays, as well as in all reports and any output signals. Any uncompensated values are followed by a “U” to distinguish them. The External DAC (Digital-to-Analog Converter) output also may be set to reflect conductivity values (see “Hardware Setup” on page 120).

In addition to reporting the raw values, the Uncompensated Mode monitors them for limit excursions. The Sensor compares the conductivity reading at the end of each analysis cycle to a set of USP (United States Pharmacopeia) standards and issues an alarm if the corresponding limit is exceeded (see “Alarm Reporting” on page 85).

The Uncompensated Mode is enabled or disabled independent of the individual Sensor’s resistivity or conductivity display units. Modifying an A1000 Sensor to report temperature uncompensated values requires altering its **Resistivity/Conductivity Parameter Screen** to reflect this new output. Changes are easily accomplished on the instrument’s associated C80 Controller or, in the case of an S20P Sensor, its integral faceplate.

To specify the Uncompensated Mode:

1) With the desired Sensor indicated in any View, press the **Setup Key** to display its submenu.
2) Use the **Up** and **Down Keys** to specify Sensor Setup.
3) Press **Enter** to access its submenu.
4) Specify **Display/Print** from among the available selections and press Enter display its options.
5) Specify **Resis or Cond** and press **Enter** to show the **Display Units** screen, shown in Figure 5-6.

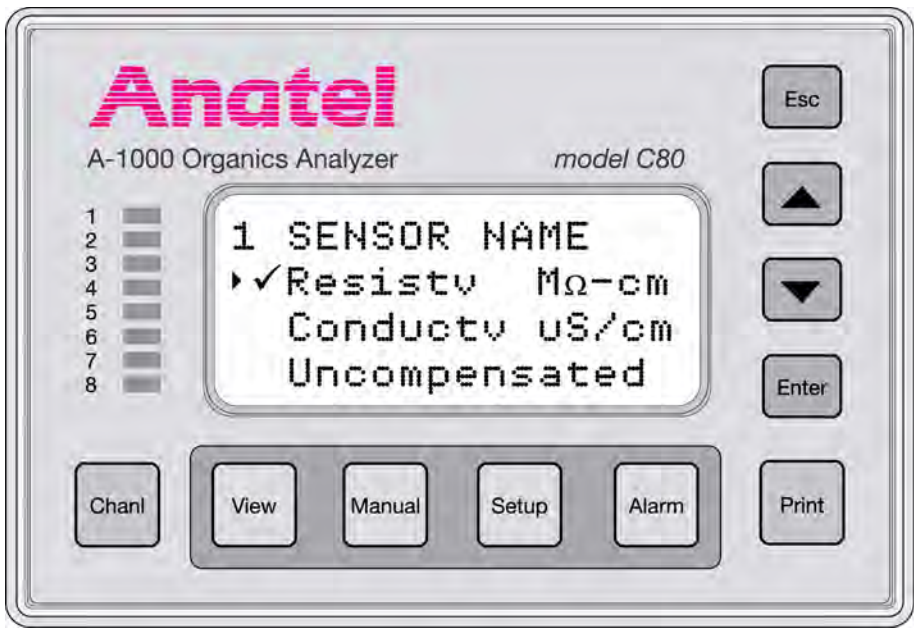

Fig 5-6 : Display Units Screen

6) Use the **Down Key** to scroll down to **Uncompensated** and press **Enter** to toggle the check mark “on,” indicating the Uncompensated Mode is enabled. You also must choose **Conductv μS/cm** if you wish to report uncompensated conductivity alarms (see “Alarm Reporting” on page 85).

Note:
Uncompensated Resistivity may be chosen, but this selection is for display only and does not generate an alarm if the set limit is exceeded.

7) Press **Esc** repeatedly to exit the screen and return to the normal display.

If connected, an External DAC (Digital-to Analog Converter) Module output can represent either resistivity or conductivity. Depending on the chosen measurement unit, the Zero- and Full-Scale outputs may have to be adjusted to reflect the desired uncompensated range.

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To set the uncompensated output range:

1) With the Sensor specified in any View, press the **Setup Key** to display its submenu.
2) Use the **Up** and **Down Keys** to specify **Sensor Setup**.
3) Press **Enter** to display the **Sensor Setup Menu**.
4) Select **Analysis Setup**.
5) Select **Analog Setup** to access its parameter options.
6) Select **DAC Range**.
7) Select **DAC Zero-Scale** to show the **Uncompensated Zero-scale Conductivity Display** screen, shown in Figure 5-7.

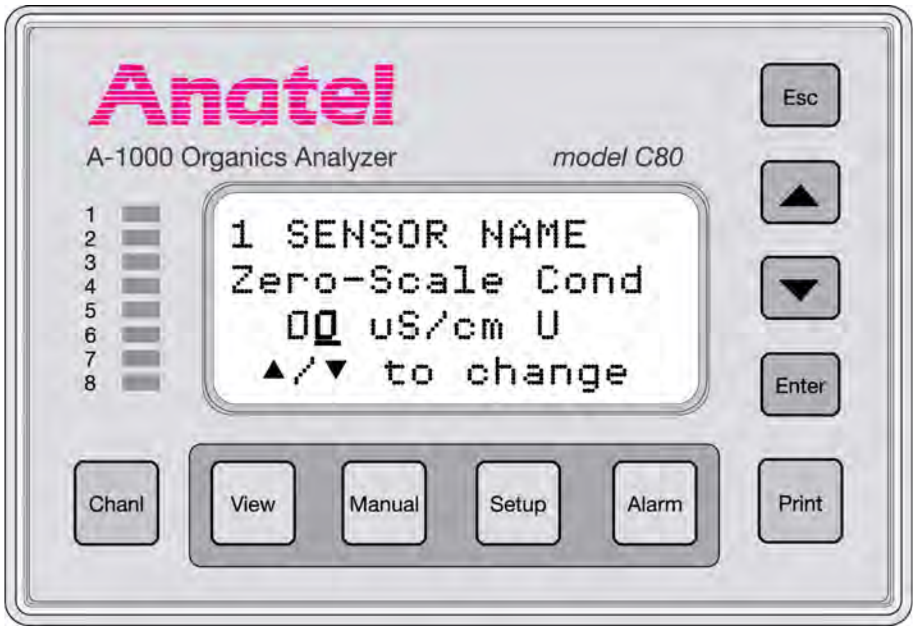

Fig 5-7 : Uncompensated Zero-scale Conductivity Display

8) Specify **Resis/Cond DAC** and press **Enter** to display its zero-scale parameter screen. The units reflect the Resis/Cond parameter selection, displaying “uS/cm U” for an uncompensated conductivity or “MΩ-cm U” for an uncompensated resistivity output.
9) Use the **Up** and **Down Keys** to scroll until the desired value is displayed.

1 SENSOR NAME
Zero-Scale Conf
0<u>1</u> uS/cm U
▲/▼ to change

Fig 5-8 : Display/Print Submenu

10) Press **Esc** twice to retain the Zero-Scale setting and return to the **DAC Range Menu**.

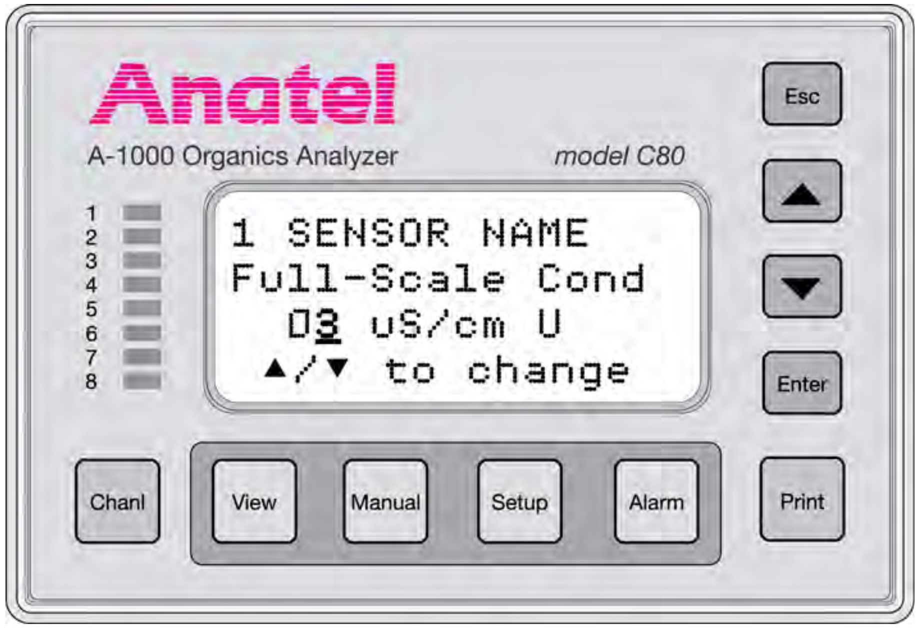

Fig 5-9 : Uncompensated Full-scale Conductivity Display

11) Select **DAC Full-Scale** and press **Enter**.
12) Specify **Resis/Cond DAC** and press **Enter** to display its full-scale parameter screen.
13) Use the **Up** and **Down Keys** to scroll the setting until the desired value is displayed.

1	SENSOR NAME
	Zero-Scale Conf
	01 uS/cm U
	▲/▼ to change

Fig 5-10 : Display/Print Submenu

14) Press **Esc** repeatedly to retain the Full-Scale setting and return to the normal display.

A “U” designates an Uncompensated value in the Controller display. Thus, conductivity reported as “µS/cm” becomes “µS U”; “MΩ-cm” becomes “MΩ U” for a Sensor reporting uncompensated resistivity.

The column headers on printed outputs similarly report “COND UNCMP” and “RESIS UNCMP,” respectively. In instances where the data for multiple Sensors are combined into a single report or view, a separate unit is given for each line of data.

A1000 S10 Organics Analyzer
S/N xxxxx
ID: 2 Name: SENSOR NAME

07/31/2006

TIME	COND UNCMP	TEMP [C]
12:07	0.667	28.0
12:08	1.25	27.5
12:09	1.27	27.3
12:10	1.25	27.3
12:11	1.26	27.3
12:12	1.25	27.3
12:13	1.25	27.2
12:14	1.22	27.3
12:15	1.23	27.3
12:16	1.25	27.3

Fig 5-11 : Purge Printout

5.3 Auto TOC Mode

In this normal (default) operating mode, the Sensor conducts analysis and reporting functions based on its particular parameters. Water samples are analyzed independently by each Sensor, their corresponding results displayed on the associated C80 Controller at the conclusion of each analysis. Printouts are generated by a Sensor's attached printer as specified on its **Printer Setup Menu**. Automatic analysis and reporting continues until manually interrupted by the user or a critical fault is encountered.

To select the Auto TOC Mode:

1) With the desired Sensor specified in any View, press Mto display its operational options.
2) Use the **Up** and **Down Keys** to specify Auto TOC.
3) Press **Enter** to enable the Auto TOC Mode.

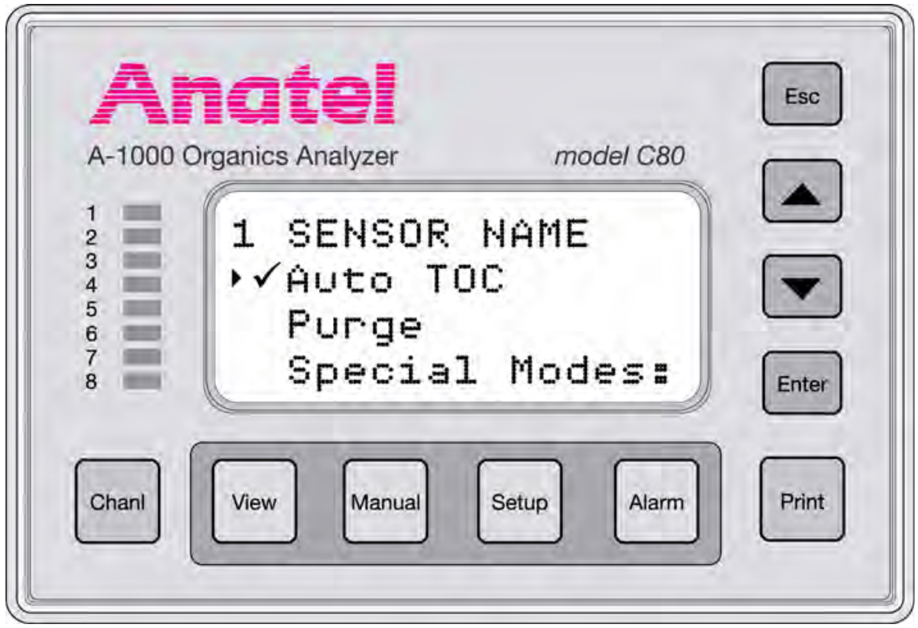

Fig 5-12 : Auto TOC Mode Selection

In this mode, water analyses are conducted automatically by the A1000 Sensor using a patented procedure. TOC measurement uses a microprocessor-controlled photocatalytic process in conjunction with conductivity detection. The initial conductivity of the water sample is determined to establish a reference value. An ultraviolet lamp then oxidizes the sample and the resulting change in conductivity is used to calculate the concentration of Total Organic Carbon present in parts per billion (ppb).

The Auto TOC analysis process is comprised of three successive stages: the Sample, Oxidation and Idle Times. These intervals are referred to collectively as the Cycle Time, its duration specified in the Sensor's setup (see "Auto TOC Printout" on page 66).

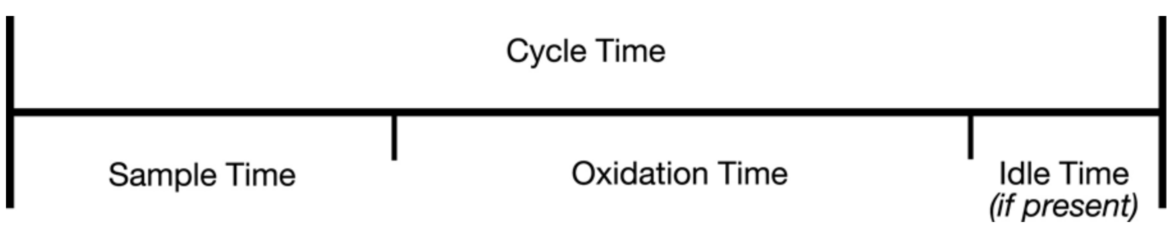

Fig 5-13 : Analysis Time Line

During the Sample Time interval, the UV lamp is turned off and the Sensor's internal sample valve is opened to allow pressurized water to purge the sample inlet line. The sample valve is closed at the conclusion of the Sample Time to capture a new sample in the measurement cell. The conductivity and the temperature of the sample water are measured to establish reference values which are stored in the Sensor's memory for use in calculating the TOC results.

During the Oxidation Time, the Sensor's sample valve is closed, the UV lamp is turned on and oxidation begins. This interval varies depending on the organic content of the water. The nature of the oxidation curve determines the sample to be one of the following Profile Types:

Table 5-2 : Oxidation Profile Types

Profile Type	Abbreviation	Description
1	P1	Easy to oxidize
2	P2	Moderately difficult to oxidize, found only in TOC levels below 25 ppb
3	P3	Difficult to oxidize, intermediate organic acids are formed

Note:
Profile Types may change when the Sensor is placed in the "Fast" Analyze Rate. Use the "Normal" Analyze Rate if the sample's Profile Type is of interest. Refer to "Profile Types" on page 161 *of this manual for a discussion of Profile Types.*

The difference between the final equivalent TOC reading and the beginning reference value is calculated at the end of oxidation to yield the TOC content of the sample. The results of the analysis are then reported on the S10 Sensor, the C80 display and output to the printer.

If TOC analysis is complete before the set Cycle Time has elapsed, the Sensor goes into an Idle State and awaits the start of the next analysis. During this Idle Time, the sample valve is either "Open" or "Closed," depending on the Sensor's Valve @ Idle setting (see "Auto TOC Printout" on page 66).

When the setting is "Open," the measurement cell is continuously purged until the conclusion of the Cycle Time; if "Closed," sample flow through the Sensor is suspended until initialization of the subsequent Sample Time. It is suggested the valve be "Closed" for normal analyses, "Open" in instances where no flow in the sample line is a concern.

If the Cycle Time is less than the duration of the analysis, the next analysis begins immediately. Thus, in order to perform continuous analyses, the Sensor's Cycle Time should be set to the default of "0" minutes. This setting is recommended unless a fixed and lengthy (e.g., hourly) analysis is required.

5.3.1 Auto TOC Software Setup

There are several parameters which define Sensor operation in the Auto TOC Mode. These variables include setting the Sample and Cycle Times, as well as the Sensor's Analyze Rate, Valve @ Idle and TOC Multiplier settings. The first three parameters are accessed through the instrument's Times & Rate Menu and determine the duration of its analysis. As noted, the analysis Cycle Time is comprised of Sample, Oxidation and, in some instances, an Idle Time. The type (TOC or Differential) and the limit (in ppb) of the Sensor's active alarm is determined by its Alarm Setup (see "Alarm Setup" on page 81).

To access the Sensor's Times & Rate Menu:

1) With the desired Sensor indicated in any View, press the **Setup Key** to display its submenu.
2) Use the **Up** and **Down Keys** to specify **Sensor Setup**.
3) Press **Enter** to access its submenu.

4) Specify Analysis Setup from among the available selections and press Enter to display its options.

The Times & Rate Menu offers the following Sensor-specific analysis parameters:

Table 5-3 : Times and Rate Menu Parameters

Parameter	Description
Sample Time	Period of time water flows through the Sensor before its internal sample valve closes and sample analysis begins
Cycle Time	Minimum length of time from the beginning of one analysis to the beginning of the subsequent analysis
Analyze Rate	Determines the oxidation rate of the water sample

Sample Time

Default: 1 Minute

The Sample Time is the period during which water flows through the Sensor's measurement cell prior to oxidation. This ensures that a discrete and representative water sample is oxidized during each analysis. The interval is user-selectable from 00:00:00 to 17:59:59 and a proper setting helps assure accurate and timely analysis results.

For analyses from sources where the water pressure exceeds 15 psig, a good rule-of-thumb is to set the Sample Time to two minutes when the Sensor's Analyze Rate is "Normal." The setting should be increased by one additional minute for each two meters of 1/4" sample tubing, and another minute for each 10°C differential in temperature between the sample water and the room temperature.

Although a lengthy Sample Time guarantees the most accurate resistivity and temperature readings, adequate TOC sampling can be accomplished in shorter intervals. In cases where the Sample Time must be limited or when operating at the "Fast" Analyze Rate, the setting should allow a 100 mL sample flow through the instrument with an additional 50 mL for each meter of 1/4" tubing. Measure the flow through the instrument during the pre-oxidation Sample Time and calculate the time necessary for this volume of water. The flow rate can be checked and verified with a stopwatch and a beaker or graduated cylinder.

Note:
Refer to "Sample Time" on page 161 *for more information on determining Sample Time.*

TOC, resistivity and temperature values all may be compared in the Differential Mode (see "Differential Mode" on page 73). Also be sure that the Sample and Cycle Times are identical for both instruments. Any discrepancies in these two Time intervals produces inconsistencies in the data, particularly temperature. If one Sensor is an S10 and the other an S20P, add an extra minute for each degree of difference between the water sample and the ambient temperature. In all Differential Mode applications, allow adequate time for the Sensors' operational parameters to stabilize before accepting the comparative readings as valid.

To set the Sensor's Sample Time:

1) With the Times & Rate Menu displayed, use the **Up** and **Down Keys** to specify **Sample Time**.

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2) Press Enter to access its parameter screen. The current Sample Time is displayed in an hour:minute:second format and represents duration, not clock time. The flashing block cursor highlights the hour division.
3) Use the **Up** and **Down Keys** to specify the time division to be changed.

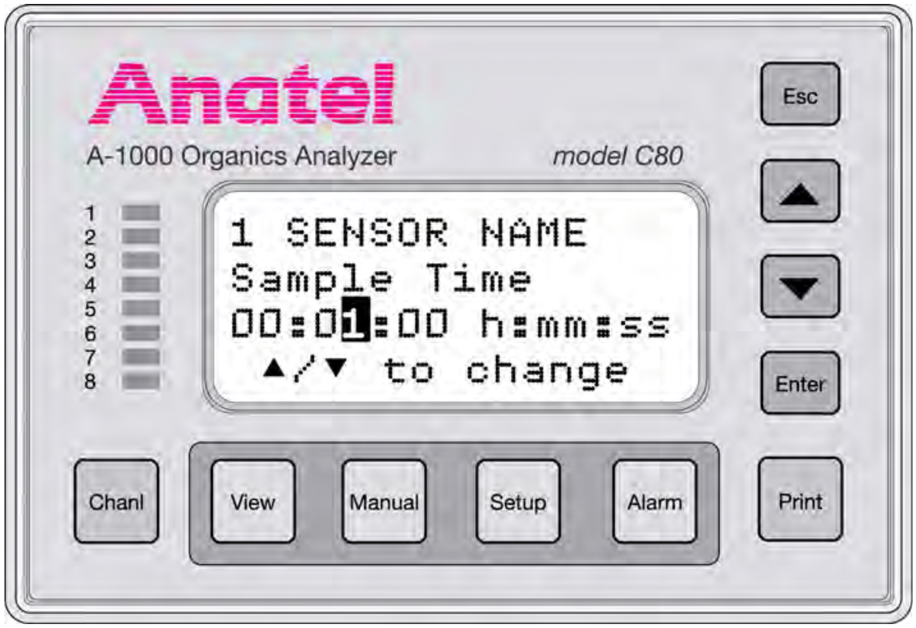

Fig 5-14 : Sample Time Screen

4) Press **Enter** to enable the Controller's Edit Mode and the flashing block becomes an underscore.

1	SENSOR NAME
	Sample Time
	00:01:00 hh:mm:ss
	▲/▼ to change

Fig 5-15 : Sample Time Submenu

5) Use the **Up** and **Down Keys** to scroll until the desired period is displayed. A minimum Sample Time of one minute is recommended for the best TOC analysis results.

1	SENSOR NAME
	Sample Time
	00:03:00 hh:mm:ss
	▲/▼ to change

Fig 5-16 : Sample Time Submenu

6) Press **Enter** to update the setting and advance to the next time segment.

7) Repeat the editing process with each time division until the desired Sample Time has been entered into the display.
8) Press **Esc** twice to retain the setting and return to the Times & Rate Menu.

Cycle Time

Default: 0 minutes

The Cycle Time is user-selectable from 00:00:00 to 17:59:59 and defines the minimum duration of the analysis. If the Cycle Time exceeds the period required for the combined sample and oxidation steps, the Sensor defaults to an Idle state until the next analysis is scheduled to begin. If the specified Cycle Time is less than the combined sample and oxidation times, the next analysis begins immediately.

To set the Sensor's Cycle Time:

1) With the Times & Rate Menu displayed, use the **Up** and **Down Keys** to specify **Cycle Time**.
2) Press **Enter** to access its parameter screen. The current Cycle Time is displayed in an hour:minute:second format, the flashing block cursor highlighting the hour division.
3) Use the **Up** and **Down Keys** to specify the time division to be changed.
4) Press **Enter** to enable the Controller's Edit Mode and the flashing block becomes an underscore.
5) Use the **Up** and **Down Keys** to scroll until the desired period is displayed. For example, if the the Cycle Time to "0." Be sure that the frequency of data reports is appropriate for your process management requirements when determining this interval.

Note:
To assure continuous analyses, set Cycle Time is set to 00:30:00, TOC data will be available at 30-minute intervals.

6) Press **Enter** to retain the setting.
7) Repeat the editing process with each time division until the desired Cycle Time has been entered into the display.
8) Press **Esc** twice to retain the setting and return to the Times & Rate Menu.

Analyze Rate

Default: Normal

The Analyze Rate parameter determines the speed at which oxidation of the sample occurs. Normal is the standard analysis rate: Fast performs the analysis up to three times faster. The Fast rate is recommended only for applications where rapid results are crucial. Prolonged operation on this quicker setting will shorten the life of the Sensor's UV lamp.

To set the Sensor's Analyze Rate:

1) With the Times & Rate Menu displayed, use the **Up** and **Down Keys** to specify Analyze Rate.
2) Press **Enter** to access its parameter screen. The active rate is preceded by a check.
3) Use the **Up** and **Down Keys** to choose between the two available analysis rates.

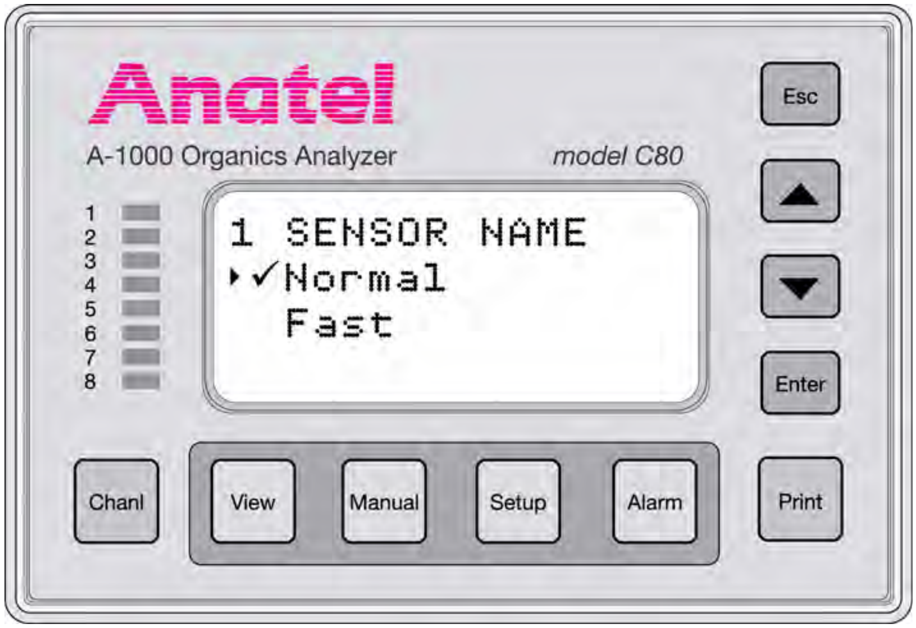

Fig 5-17 : Analyze Rate Screen

4) Press **Enter** to save the specified Analyze Rate.
5) Press the **Esc** Key twice to retain the setting and return to the Analysis Setup Menu.

Note:
When enabled, the Fast Analyze Rate is reported on the Auto TOC Printout (see "Auto TOC Printout" on page 66*).*

Valve at Idle Setting

Default: Closed

The Valve @ Idle setting determines the state of the Sensor's internal sample valve during the Idle Time interval (if any, based on the set Cycle Time) between the completion of a TOC analysis and the initiation of the next analysis. A "Closed" setting prevents sample water from flowing through the instrument; an "Open" setting purges the measurement cell whenever the Sensor is in the Idle state.

To specify the Sensor's sample valve setting when it is in the Idle state:

1) With the desired Sensor indicated in any View, press the **Setup Key** to display its submenu.
2) Use the **Up** and **Down Keys** to specify **Sensor Setup**.
3) Press **Enter** to access its submenu.
4) Specify **Analysis Setup** and press **Enter**.
5) Specify **More Setup** and press **Enter**.
6) Specify **Valve & Defalt** from among the available selections and press **Enter** to display its options.
7) Specify **Valve @ Idle** and press **Enter** to display its parameter screen.

8) Use the **Up** and **Down Keys** to choose the desired sample valve setting during the Sensor's Idle State.

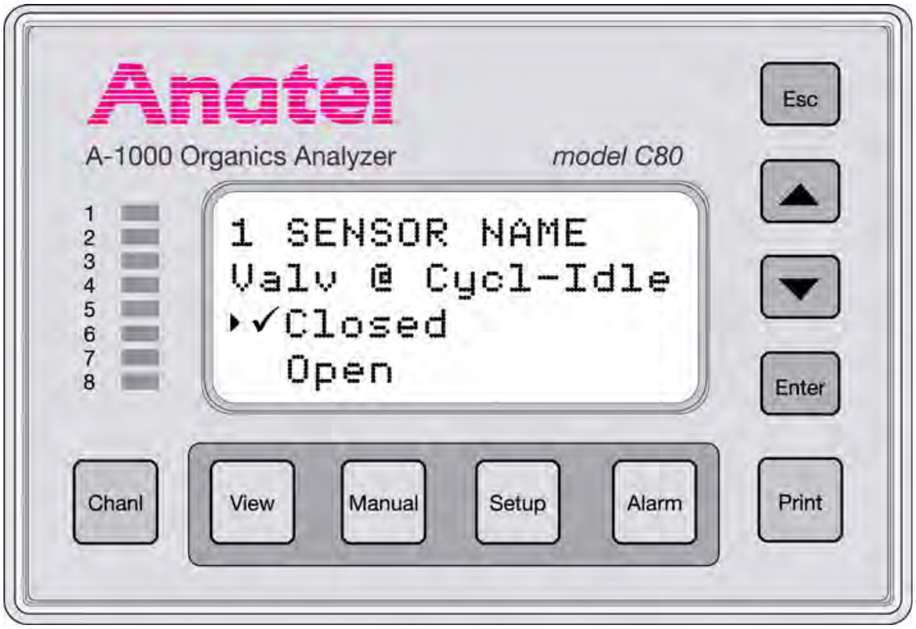

Fig 5-18 : Valve at Idle Screen

9) With the desired Valve @ Idle setting indicated, press **Enter** to enable it.

10) Press **Esc** to retain the setting and exit the screen.

TOC Multiplier

Default: 1.00

CAUTION:

This is not a calibration procedure! changing the TOC multiplier will significantly affect analysis results. Do not alter this setting without instructions from Hach Ultra.

The TOC Multiplier is a variable scaling factor that is applied to the calculated TOC value in order to determine the reported TOC. This compensation factor allows the user to modify the Sensor's reported TOC value to accommodate application and display requirements. The TOC Multiplier typically should not have to be altered.

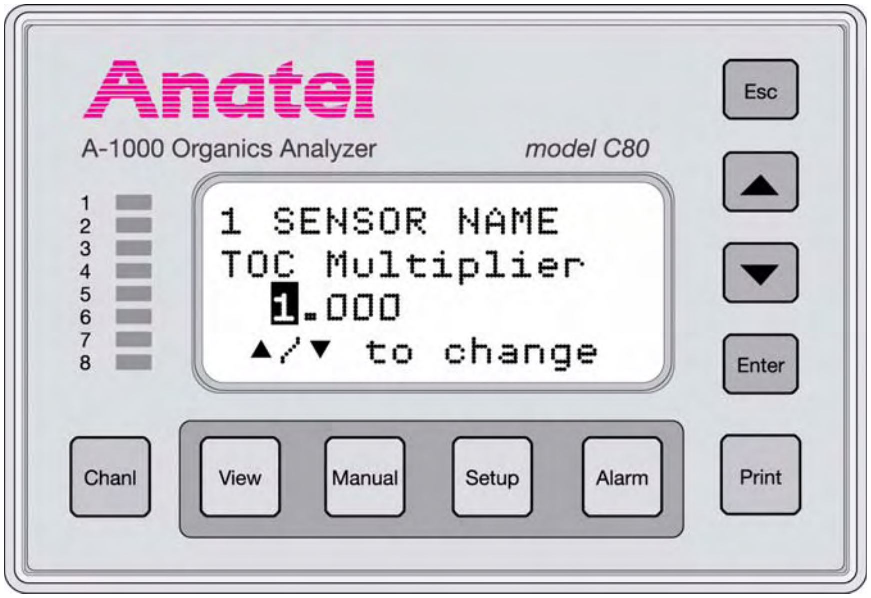

Fig 5-19 : TOC Multiplier Screen

To change the TOC Multiplier:

1) With the desired Sensor indicated in any View, press the **Setup Key** to display its submenu.
2) Use the **Up** and **Down Keys** to specify **Sensor Setup**.
3) Press **Enter** to access its submenu.
4) Specify **Analysis Setup** and press **Enter**.
5) Specify **More Setup** and press **Enter**.
6) Specify **Cell Setup** from among the available selections and press **Enter** to display its options.

1	SENSOR NAME
	Lamp Install:
▶	TOC Multiplier:
	Cell Calibrate:

Fig 5-20 : Celll Setup Submenu

7) Specify **TOC Multiplier** and press **Enter** to display its parameter screen. The flashing block cursor highlights the first digit.
8) Use the **Up** and **Down Keys** to specify which display digit is to be changed.
9) Press **Enter** to enable the Controller’s Edit Mode and the flashing cursor becomes an underscore.
10) Use the **Up** and **Down Keys** to specify the desired value.
11) Press **Enter** to retain the setting.
12) Repeat the editing process until the desired TOC Multiplier value is entered.
13) Press **Enter** to exit the screen.

5.3.2 Auto TOC Printout

Default: Continuous

The Printer Setup parameter determines the format of analysis printouts as well as the frequency at which they are output to the Sensor's local printer. The TOC Format reports an individual Sensor's values while the Diff Format reports the differential values between two A1000 Sensors.

The TOC Format shows the information listed in Table 5-4.

Table 5-4 : Sensor TOC Format Information

Parameter	Description
Sensor	Model Number of the Sensor.
SN	Serial Number of the Sensor.
ID	its Channel ID Number.
Name	the user-entered name of the Sensor.
TOC LIMIT	the Sensor's set TOC alarm limit.
SAMPLE TIME	the Sensor's set Sample Time.
CYCLE TIME	the Sensor's set Cycle Time.
TOC MULTIPLY	its set TOC Multiplier value.

Note:
The Sensor must have completed and reported at least one TOC result before this parameter can be set.

Table 5-5 : TOC Printout

Parameter	Description
Data	Current Date
TIME	the time when the sample was captured.
TOC [PPB]	Measured TOC of the sample in parts per billion
%AL	the current TOC value as a percentage of its set Alarm Limit.
TREND [PPB]	TOC directional trend in ppb over the last hour
RESIS (or CONDuctivity)	resistivity (or conductivity) value of the sample.
TEMP	the temperature of the sample.
CRV TYP	the profile type of the sample

Two TOC Print intervals are available. Continuous generates a TOC printout at the conclusion of each analysis; Paper Saver triggers a printout only when the change in TOC level between analyses exceeds a user-defined percentage.

A1000 S10 Organics Analyzer
S/N XXXXX
ID: 1 Name: SENSOR NAME

FAST Analyze Rate

TOC LIMIT [PPB]	SAMPLE TIME [hh:mm:ss]	CYCLE TIME [hh:mm:ss]	TOC MULTIPLY

07/31/2007

TIME [PPB]	TOC [PPB/HR]	%AL @25C	TREND °C	RESIS TYP	TEMP	CRV
16:14	37.0	37%	+0.1	16.9	31.5	P1
16:15	36.9	37%	–0.0	16.9	31.5	P1
16:16	37.1	37%	+0.2	17.0	31.3	P3
16:17	37.1	37%	–0.0	17.0	31.2	P1
16:18	37.0	37%	–0.1	17.1	31.2	P1
16:19	37.1	37%	+0.1	16.9	31.0	P3
16:20	37.0	37%	–0.1	17.0	31.1	P1
16:21	36.8	37%	–0.2	17.1	31.0	P1
16:22	36.9	37%	+0.1	16.9	31.0	P1
16:22	37.0	37%	+0.1	16.9	31.2	P1
16:23	37.2	37%	+0.2	17.0	31.0	P3

Fig 5-21 : TOC Printout

To set the Sensor’s TOC Print interval:

1) With the desired Sensor indicated in any View, press the **Setup Key** to display its submenu.
2) Use the **Up** and **Down Keys** to specify **Sensor Setup**.
3) Press **Enter** to access its submenu.
4) Specify **Display/Print** from among the available selections and press **Enter** to display its options.

```
1  SENSOR NAME
▶  TOC Print:
   Purge Print:
```

Fig 5-22 : Display/Print Submenu

5) Specify **TOC Print** and press **Enter**.

6) Use the **Up** and **Down Keys** to specify one of the two TOC Print outputs.

1 SENSOR NAME
▶ √Continuous
Paper Saver:

Fig 5-23 : TOC Print Submenu

7. Press **Enter** to select the specified format.

- Continuous generates a printout at the conclusion of each analysis.
- Paper Saver generates a printout only when the difference in TOC values between the current and the previous analysis exceeds a user-specified percentage. If this format is chosen, the % Change in TOC must be specified. A flashing cursor underscores the setting.

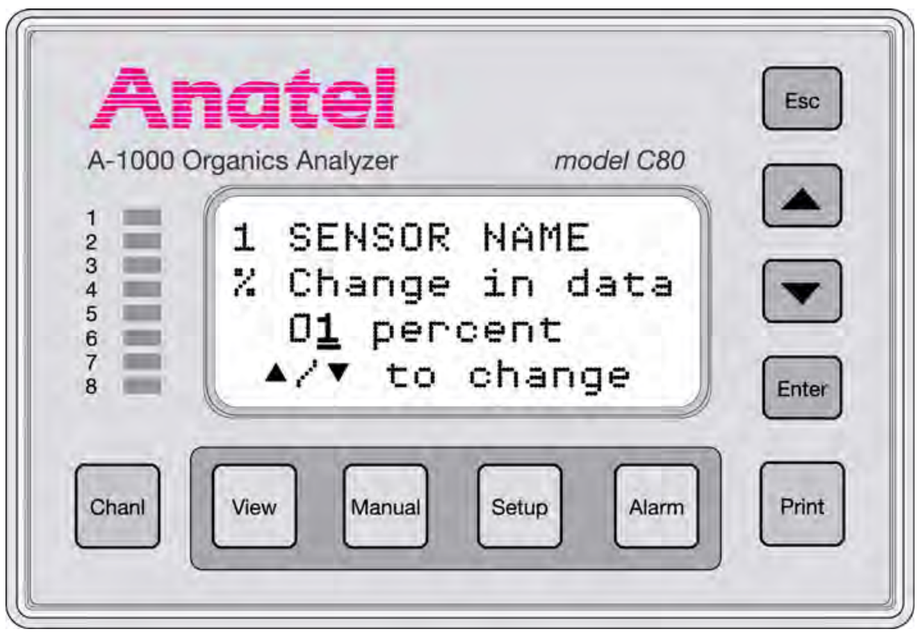

Fig 5-24 : Paper Saver Print Screen

7) Use the **Up** and **Down Keys** to scroll the value until the desired percentage is displayed.

1 SENSOR NAME
% Change in TOC
10 percent
▲/▼ to change

Fig 5-25 : Display/Print Submenu

8) Press **Escape** to retain the setting and exit the screen.

5.4 Purge Mode

In the Purge Mode, the Sensor's internal sample valve is open to permit sample water to continuously flow through its measurement cell. This action provides a method of reporting the resistivity (or conductivity) and temperature values on the Controller's display and on local printouts.

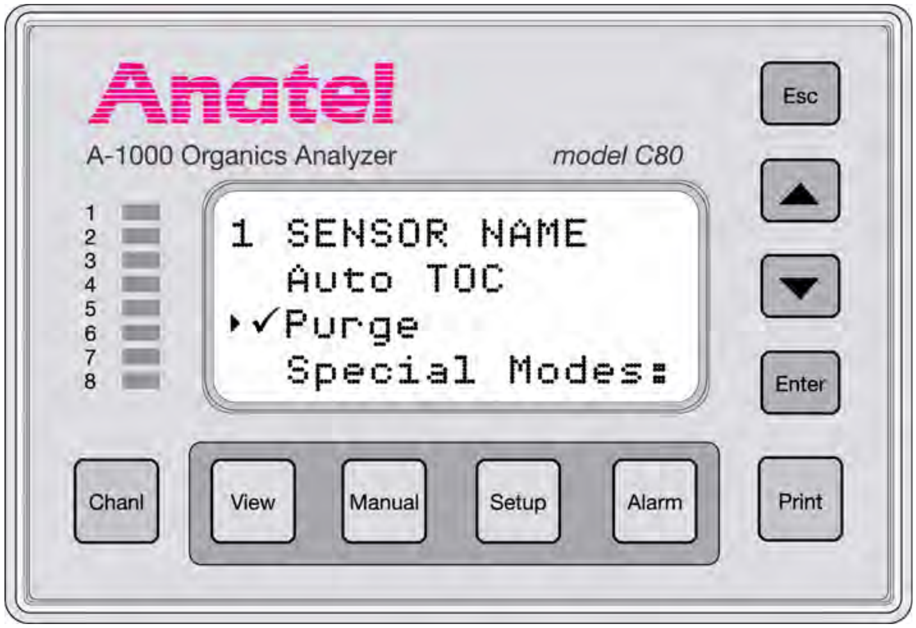

Fig 5-26 : Selecting the Purge Mode

To place the Sensor in the Purge Mode:

1) With the desired Sensor specified in any View, press the **Manual Key** to display its options.
2) Use the **Up** and **Down Keys** to specify **Purge**.
3) Press **Enter** to enable the Purge Mode. The Sensor remains in this operational state until another Mode is chosen.

The only software setup necessary in the Purge Mode is to specify whether the Sensor reports the resistivity or conductivity of the sample water in conjunction with its temperature readings. The Valve at Idle setting furnishes a secondary means of forcing the Sensor to purge itself during the Idle State (see "Valve at Idle Setting" on page 63).

5.4.1 Purge Printouts

Default: Timed / 1 Minute

As with the Auto TOC Mode, there are two potential Purge Print intervals:

- Timed generates a purge printout at user-specified intervals.
- Paper Saver triggers a purge printout only when the change in the water sample's resistivity (or conductivity) level exceeds a user-defined percentage in two successive analyses. The Purge Printout reports the values listed in Table 5-6.

Table 5-6 : Purge Printout Value Descriptions

Value	Description
Sensor	Model Number of the Sensor.
SN	Serial Number of the Sensor.
ID	Its Channel ID Number.
Name	User-entered name of the Sensor.
Data	Current Date
TIME	Time at which the measurement was taken.
RESIS @ 25°C	Resistivity of the sample compensated to 25°C.
TEMP °C	Temperature of the sample in °C.

To specify a Purge Print interval:

1) With the desired Sensor indicated in any View, press the **Setup Key** to display its submenu.
2) Use the **Up** and **Down Keys** to specify **Sensor Setup**.
3) Press **Enter** to access its submenu.
4) Specify **Display/Print** from among the available selections and press **Enter** to display its options.

```
1   SENSOR NAME
    TOC Print:
▶   Purge Print:
```

Fig 5-27 : Display/Print Submenu

A1000 S10 Organics Analyzer
S/N xxxxx
ID: 1 Name: SENSOR NAME

07/31/06

TIME	RESIS	TEMP
	@25°C	°C
12:07	17.1	28.0
12:08	17.1	27.5
12:09	17.2	27.3
12:10	17.2	27.3
12:11	17.3	27.3
12:12	17.2	27.3
12:13	17.1	27.2
12:14	17.1	27.3
12:15	17.0	27.3
12:16	17.1	27.3

Fig 5-28 : Purge Printout

5) Specify **Purge Print** and press **Enter**.

1 SENSOR NAME
▶ √Timed:
Paper Saver:

Fig 5-29 : Purge Print Submenu

6) Use the **Up** and **Down Keys** to specify one of the two Purge Print outputs:
   - Timed generates a printout at the specified interval (Default: 1 Minute).
   - Paper Saver generates a printout when the difference in resistivity values between the current and the previous analysis cycle exceeds a specified percentage. If chosen, this % Change in Res must be specified (Default: 1 percent).

7) Press **Enter** to select the specified format. A flashing cursor highlights the current value.

Timed Purge Print

If **Timed Purge Print** is selected, a flashing block cursor highlights the minutes division.

1) Use the **Up** and **Down Keys** to specify the time division to be changed.
2) Press **Enter** to enable the Controller's Edit Mode and the flashing block becomes an underscore.
3) Use the **Up** and **Down Keys** to scroll until the desired period is displayed.

1	SENSOR NAME
	Print Interval
	00:05:00 hh:mm:ss
	▲/▼ to change

Fig 5-30 : Timed Print Purge Interval Submenu

4) Press **Esc** to save the setting.
5) Repeat the editing process with each time division until the entire Print Interval has been entered into the display.
6) Press **Esc** to retain the setting and exit the screen.

Paper Saver Purge Print

If Paper Saver Purge Print is selected, a flashing cursor underscores the second digit of the setting.

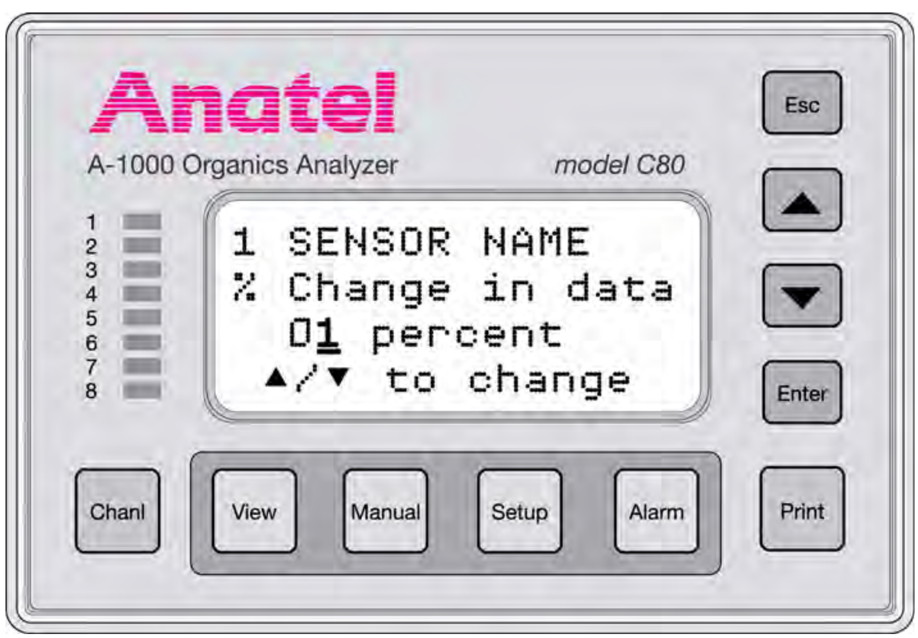

Fig 5-31 : Paper Saver Print Screen

1) Use the **Up** and **Down Keys** to scroll the value until the desired percentage is displayed.
2) Press **Esc** to retain the setting and exit the screen.

1	SENSOR NAME
%	Change in data
	10 percent
	▲/▼ to change

Fig 5-32 : Display/Print Submenu

5.5 Differential Mode

Differential measurements can be invaluable in managing a high purity water system. The A1000 TOC Analysis System allows the user to compare the readings of any two Sensors at the conclusion of each analysis in order to obtain precise and timely differential results.

One Sensor is used to compare the current (last analysis) reading with the reading of another Sensor in order to determine the differential measurement between the two instruments. A selected Sensor can be referenced to any other Sensor attached to the same C80 Controller, thereby allowing their TOC or Purge measurements to be compared directly. The differential values are then displayed on their common Controller (see “Differential View” on page 44) as well as being output to a local (optional) printer.

5.5.1 Differential Setup

The Differential Mode is an extension of two Sensors’ Auto TOC or the Purge Mode. Differential measurements are performed on a primary Sensor and the secondary instrument to which it is referenced. All other operating parameters are identical.

To place the Sensors in the Differential Mode:

1) With the primary Sensor specified in any View, press the **Manual Key** to display its menu selections.
2) Use the **Up** and **Down Keys** to specify either **Auto TOC** or **Purge** as desired.
3) Press **Enter** to enable the specified Mode.
4) Repeat the process to place the referenced Sensor in the same operational Mode.

5.5.2 Referencing Sensors

Default: No Reference

This software selection specifies the secondary Sensor to which the primary (current) Sensor is referenced. Once a reference assignment is specified, the Differential View is available on the primary Sensor and, when specified, the comparative measurements are output to the local printer (see “Differential Printout” on page 75). The data reported are determined by the common operational mode of both Sensors.

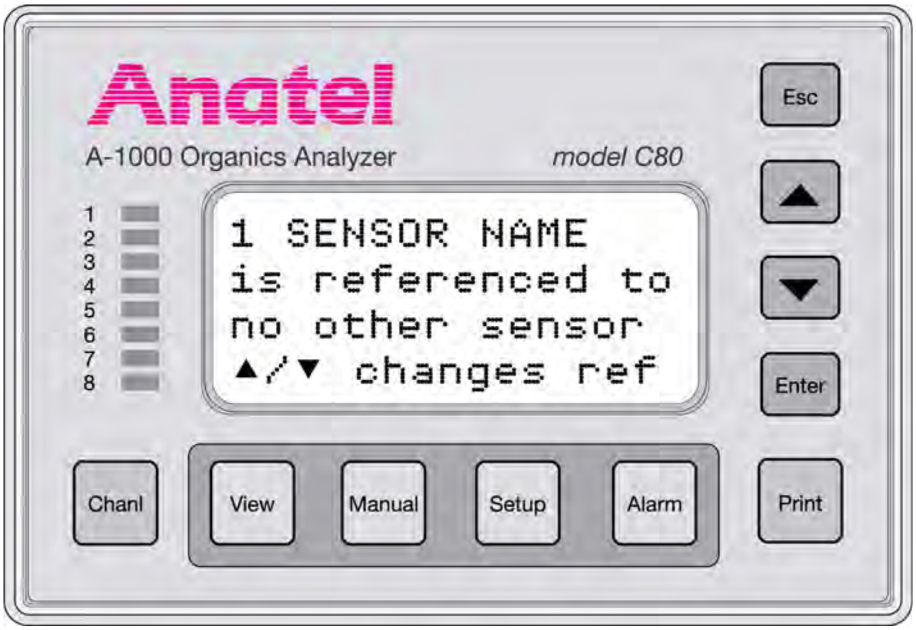

Fig 5-33 : Reference Sensor Screen

To establish a reference between two Sensors:

1) With the desired primary Sensor specified in any View, press the **Setup Key** to display its submenu.
2) Use the **Up** and **Down Keys** to specify **Sensor Setup**.
3) Press **Enter** to access its submenu.
4) Specify **Display/Print** from among the available selections and press **Enter** to display its options.

1	SENSOR NAME
▶	Reference Sensor:
	Resis or Cond:
	Printer Setup:

Fig 5-34 : Display/Print Submenu

5) Specify **Refernc Sensor** and press **Enter** to view the current reference assignment.

Note:
The values of the referenced Sensor are always subtracted from those of the primary Sensor.

6) Use the **Up** and **Down Keys** until the desired reference Sensor's Channel ID Number is displayed.

1	SENSOR NAME
	is referenced to
5	SENSOR NAME
	▲/▼ change ref

Fig 5-35 : Reference Sensor Submenu

7) Press **Enter** to retain the displayed reference and exit the screen.

The differential reading is now active in the Sensor's **View Key** formats, the data displayed dependent on whether both Sensors are in the Auto TOC or the Purge Mode. In either case, the reported values represent the difference between the readings on the two instruments.

1	SENSOR NAME
5	SENSOR NAME
	+26.3 ppb -22/h
	+10.9 MΩcm -7.0°

Fig 5-36 : TOC Differential Display

1	SENSOR NAME
5	SENSOR NAME
	PURGE MODE
	-3.66 MΩcm -0.1°

Fig 5-37 : Purge Differential Display

5.5.3 Differential Printout

Like its displayed counterpart, the data contained on a Differential printout are determined by the common operational Mode of both the primary and the referenced Sensor. In either Mode, the parameter information reported is for the primary Sensor: Information specific to the referenced Sensor is indicated by a "." Primary Sensor data are displayed, followed by the referenced Sensor's value, then the differential measurements between the two Sensors.

A1000 S10 Organics Analyzer
S/N xxxxx
This Sensor: ID: 1 Name: SENSOR NAME
• Ref Sensor: ID: 5 Name: SENSOR NAME

TOC LIMIT [PPB]	SAMPLE TIME [hh:mm:ss]	CYCLE TIME [hh:mm:ss]	TOC MULTIPLY
100	00:01:00	00:00:00	1.000

07/31/06

TIME	TOC [PPB]	%AL	TREND [PPB/HR]	RESIS @25°C	TEMP °C	CRV TYP
15:24	37.0	37%	+0.1	16.9	31.5	P1
15:23 •	36.8	37%	–0.4	17.4	31.0	P3
Diff:	+0.25	---	+0.5	–0.558	+0.5	---
15:31	36.9	37%	–0.0	16.9	31.5	P1
15:30 •	37.2	37%	+0.0	17.2	31.2	P1
Diff	–0.23	---	+0.0	–0.332	+0.4	---
15:37	37.1	37%	+0.1	16.8	31.5	P1
15:36 •	37.1	37%	–0.0	17.1	31.3	P1
Diff	–0.00	---	+0.1	–0.321	+0.2	---
15:43	36.8	37%	–0.1	16.8	31.6	P3
15:43 •	37.0	37%	–0.1	17.1	31.3	P3
Diff	–0.22	---	–0.0	–0.317	+0.3	---

TIME	RESIS @25°C	TEMP °C
12:07	17.1	28.0
12:08 •	17.1	27.5
Diff	–0.0	–0.5
12:09	17.2	27.3
12:10 •	17.2	27.3
Diff	–0.0	–0.0
12:11	17.3	27.3
12:12 •	17.2	27.3
Diff	–0.1	–0.0
12:13	17.1	27.2
12:14 •	17.1	27.3
Diff	–0.0	+0.1
12:15	17.0	27.3
12:16 •	17.1	27.3
Diff	+0.1	–0.0

Fig 5-38 : Differential Printout

The Differential Printout reports the values shown in Table 5-7.

Table 5-7 : Differential Printout Values

Parameter	Description
Sensor	Model Number of the primary Sensor.
SN	Serial Number of the primary Sensor.
ID	Its Channel ID Number of both Sensors.
Name	User-entered name of both Sensors.
TOC LIMIT	This Sensor's set TOC alarm limit.
SAMPLE TIME	This Sensor's set Sample Time.
CYCLE TIME	This Sensor's set Cycle Time.
TOC MULTIPLY	This Sensor's set TOC Multiplier value.
TOC Data	Current Date
TIME	Time each sample was captured.
TOC [PPB]	Differential TOC in parts per billion.
%AL	Current TOC value as a percentage of the set Alarm Limit for both Sensors.
TREND [PPB]	Differential TOC directional trend in ppb over the last hour.
RESIS (or CONDuctivity)	Differential resistivity (or conductivity) of the samples.
TEMP	Differential temperature of both samples.
CRV TYP	Profile type of each sample.
	Purge Data
Date	Current Date
TIME	Time when each sample was captured.
RESIS @ 25°C	Differential resistivity of the sample compensated to 25°C.
TEMP °C	Differential temperature of the sample in degrees Centigrade.

5.6 Manual Mode

Analysis and reporting functions are continuous when the Sensor is in the Auto TOC Mode. There are times, however, when manual control over the Sensor's analysis is desirable. The Manual Samples menu selection allows the user to conduct a single sample analysis when necessary.

The Manual Mode is used to interrupt the current analysis in order to start a new analysis. It is convenient for initiating a manual analysis during Sensor installation or to synchronize Sensor analysis with process equipment.

5.6.1 Manual Samples

Access to the Sensor by other connected C80 Controllers is denied while the instrument is in the Manual Sample or Oxidation State. Access is restored when the Manual Mode is exited.

To conduct a manual measurement:

1) With the desired Sensor indicated in any View, press the **Manual Key** to access its menu selections.
2) Use the **Up** and **Down Keys** to specify Manual Samples.
3) Press **Enter** to display its submenu.
4) Use the **Up** and **Down Keys** to specify Sample.

1	SENSOR NAME	
	State SAMPLE	
▶	Sampl:	0:01:00
	Manual:	

Fig 5-39 : Manual Samples Submenu

Fig 5-40 : Manual Sample State

5) Press **Enter** to initiate a single analysis. “Sample” reflects the Sample Time interval specified in the Sensor’s setup (see “Auto TOC Software Setup” on page 59). The Sensor’s analysis State and values are reported as soon as they become available.
6) Press **Enter** to return to the Manual Samples Menu.
7) Use the **Up** and **Down Keys** to specify Manual.

1	SENSOR NAME	
	State SAMPLE	
	Sampl:	0:01:00
▶	Manual:	

Fig 5-41 : Manual Samples Submenu

8) Press **Enter** to access its parameters and initiate a single analysis. The Duration of the manual period is reported during the course of the analysis.

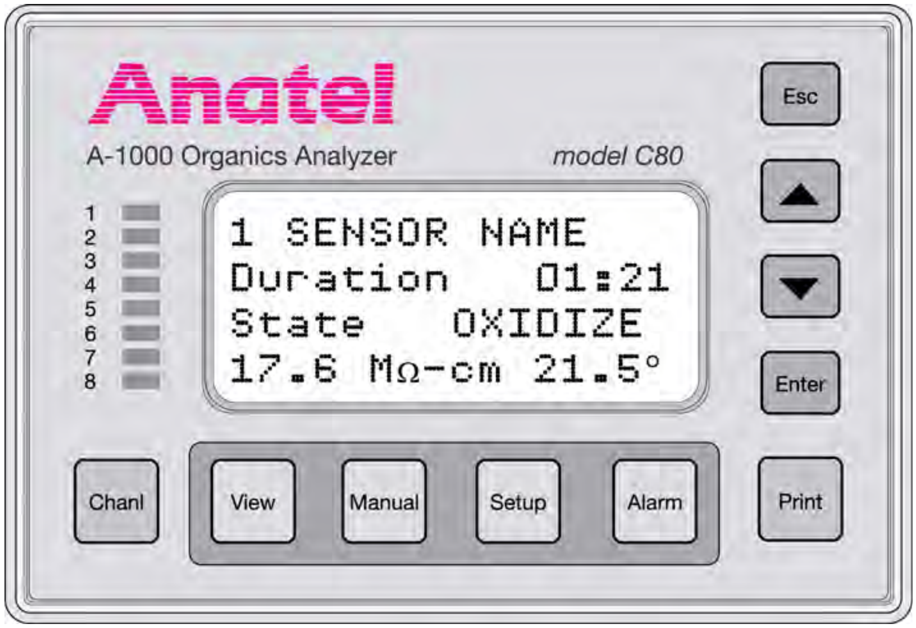

Fig 5-42 : Manual Oxidize State

9) Press **Enter** to stop sampling and the analysis continues with the Oxidation stage. Once oxidation is complete, the sample's TOC value is displayed.
10) Another manual operation can be initiated by pressing Enter again.
11) The Manual Mode can be terminated at any time by pressing the eKey to exit the screen.

6 A1000 Alarms

6.1 Alarm Overview

A Sensor's absolute or differential TOC level can be monitored for fluctuations, an excursion triggering an alarm condition. The type and limit of the alarm can be independently defined for each instrument.

The user is alerted to any TOC limit excursions on the C80 Controller by flashing its entire LCD display, as well as the affected Sensor's Channel LED. When enabled, an audible beeper also sounds to provide additional warning. A hardcopy printout of the excursion is generated automatically. The Sensor's

Digital Output #1 port may be used to transmit its alarm status to a compatible device (see "Digital Outputs" on page 120).

The A1000 alarm reporting facility also is used to report any detected Sensor errors such as a defective UV lamp or an excessively low sample temperature (see "Troubleshooting" on page 145). Summary data on any limit excursion or Sensor error are displayed on the Controller by pressing the Alarm Key; more detailed information is available on the printout.

6.2 Software Setup

There are two alarm variables which can be defined by the user:

- The Sensor's Alarm Setup parameter specifies the type and level of the limit excursion that triggers an alarm condition.
- Beeper Setup enables and disables the Controller's audible alarm.

6.2.1 Alarm Setup

Default: TOC Alarm/100 ppb

The Alarm Setup parameter specifies whether an alarm associated with the Sensor represents an absolute or a differential TOC excursion. It also defines the limit at which the indication is triggered.

To access the Sensor's Alarm Setup parameters:

1) Press the **Setup Key** to display its menu selections.

▶ Sensor Setup:
System Setup:
C80 Setup:

Fig 6-1 : Setup Menu

2) Use the **Up** and **Down Keys** to specify Sensor Setup.
3) Press **Enter** to display the Sensor Setup Menu.
4) Similarly specify and select Analysis Setup.

▶	Analysis Setup:
	Display/Print:
	Sensor Name:
	Diagnostics:

Fig 6-2 : Sensor Setup Menu

5) Specify and select More Setup.

1	SENSOR NAME
	Times & Rate
	Analog Setup:
▶	More Setup:

Fig 6-3 : Sensor Setup Menu

6) Specify and select Alarm Setup to display its submenu.
   - TOC Alarm (default): triggers an alarm indication when the Sensor's reported TOC reading exceeds its specified limit.
   - Diff Alarm: triggers an alarm when the TOC which it is referenced exceeds the specified limit.

1	SENSOR NAME
▶	√ TOC Alarm:
	Diff Alarm:

Fig 6-4 : Alarm Setup Submenu

Note:
The displayed Sensor must be assigned a reference Sensor in order to differential between this Sensor and another to select the Diff Alarm format.

7) Use the **Up** and **Down Keys** to choose the desired alarm format for this Sensor.
8) Press **Enter** to access the corresponding parameter screen. Both of these alarm settings define the Sensor's excursion point as a concentration of TOC in ppb. The flashing block cursor in each screen highlights the first pair of digits.
9) Use the **Up** and **Down Keys** to specify which pair of digits are to be changed.

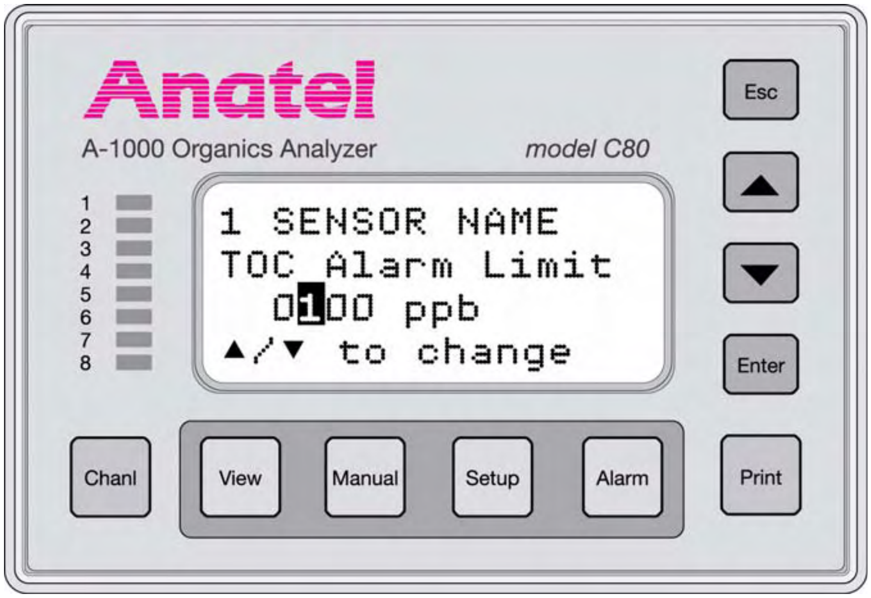

Fig 6-5 : TOC Alarm Limit Screen

10) Press **Enter** to enable the Controller's Edit Mode and the flashing block cursor becomes an underscore.
11) Use the **Up** and **Down Keys** to scroll until the desired value is displayed.
12) Press **Enter** to retain the pair's setting.
13) Repeat the editing process with the other pair of digits, if necessary, to specify the Sensor's TOC or Differential Alarm Limit (0000 to 9999 ppb).

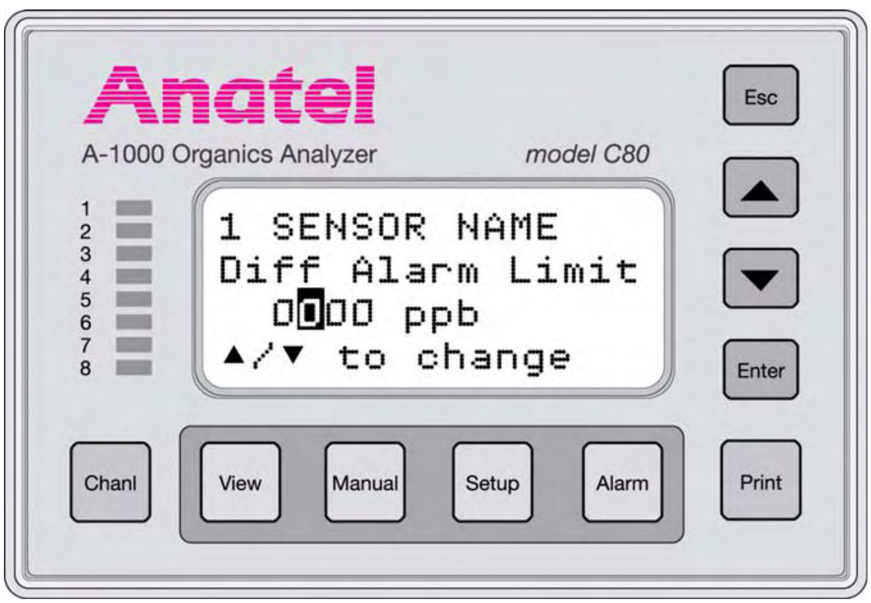

Fig 6-6 : Differential Alarm Limit Screen

14) Press **Enter** to save the Alarm Limit setting and exit the screen.

6.2.2 Beeper Setup

Default: Enabled

The Beeper Setup is a global parameter for sounding the Controller's audible alarm in the event of a TOC limit excursion by one of its connected Sensors. The alarm continues to sound until it is acknowledged by pressing the Alarm Key.

To enable/disable the Controller's Beeper:

1) With any Channel View displayed, press the Setup Key and its menu selections are presented.
2) Use the **Up** and **Down Keys** to specify C80 Setup.

Contrast Adj:
▶ Beeper Setup:

Fig 6-7 : C80 Setup Menu

3) Press **Enter** to access its submenu.
4) Specify Beeper Setup and press **Enter** to display its parameter screen:

   Enabled: The Controller's audible alarm is triggered by a TOC limit excursion.

   Disabled: the Controller's onboard alarm will not sound when any of its connected Sensors experiences a TOC limit excursion.

Fig 6-8 : C80 Alarm Beeper Screen

5) Specify the desired Beeper Setup, then press **Enter** to save the setting and exit the screen.

6.3 Alarm Reporting

The most common A1000 fault condition is a Sensor that measures a TOC value greater than its specified TOC or Differential Alarm setting (see “Alarm Setup” on page 81). There are several ways in which an alarm condition is reported:

- The associated C80’s LCD display flashes.
- The Sensor’s Channel LED flashes red.
- If enabled, the Controller beeps an audible alarm.
- If connected to a printer, a printout is generated documenting the fault. A “High TOC Alarm Warning” is reported on a separate line and includes the limit that was exceeded:

    High TOC Alarm: 60.1 ppb > 50 ppb

- When connected, the signal at the Sensor’s Digital Output #1 port is pulled low (see “Digital Outputs” on page 120).

In the example, the LED indicating the Sensor on Channel #4 has changed from green to flashing red, indicating a TOC excursion. The user can acknowledge the alarm and display its summary status by pressing the Alarm Key.

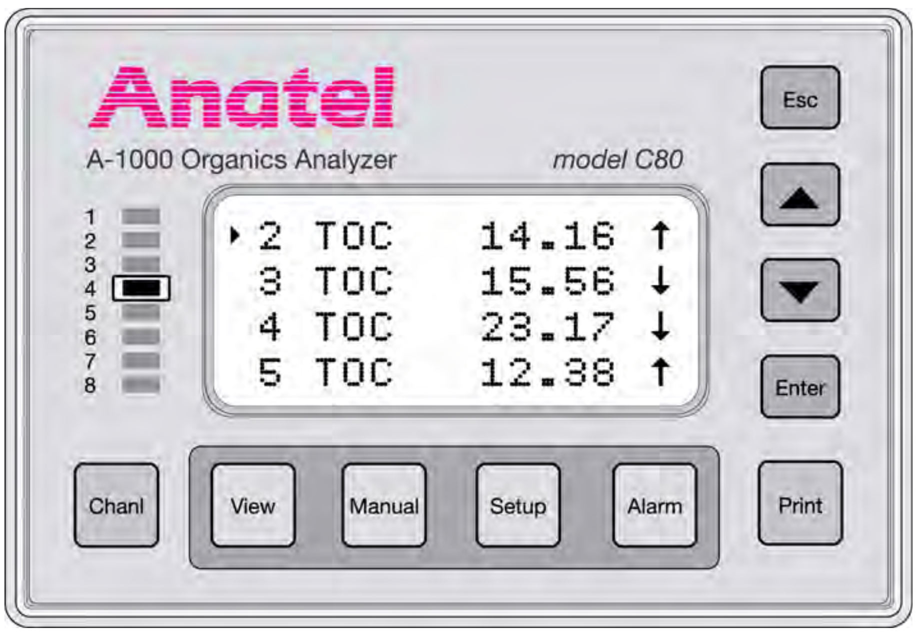

Fig 6-9 : Reported Sensor Alarm

The Controller LCD is also used to display Sensor malfunctions, reported as Error Codes (see “Error Codes” on page 143). Different than a limit excursion, an error indicates an electromechanical or analytical instrument failure. The Sensor’s Channel LED and the Controller’s display still flash, but there is no audible alarm (regardless of the Beeper Setup) to alert the user that there is a problem.

6.3.1 Uncompensated Temperature Alarms

Alarms are reported for conductivity excursions only in the Uncompensated Mode (see “Uncompensated Temperature Measurement” on page 53) and require that “Conductv” and “Uncompensated” be selected in the Resistivity/Conductivity Parameter Screen. In the Auto TOC mode, the alarm limit is checked at the end of each analysis cycle, In the Purge mode, it is checked every 15 seconds. The raw conductivity limits are in accordance with the specifications set forth in the method “<645> Water Conductivity” of the USP 23 Fifth Supplement (Nov. 15, 1996, pp. 3465–3467). These are shown in Table 6-1.

Table 6-1 : Temperature-Based Limits

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

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

To ensure agreement between all data outputs on the A1000 system, TOC, conductivity and temperature values are all rounded to match the Controller’s accuracy for alarm limit checking, display, printouts, and any digital outputs.

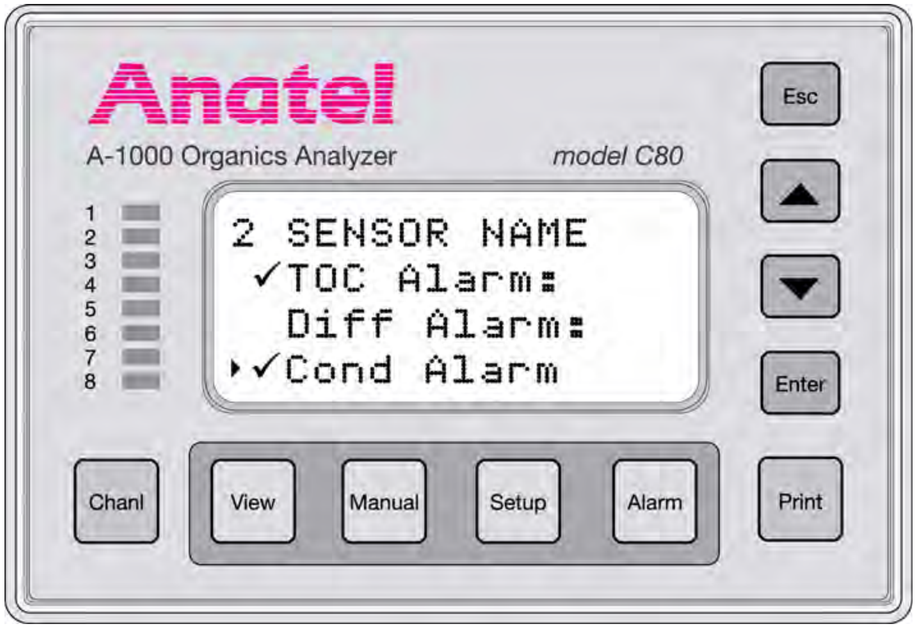

Fig 6-10 : Alarm Setup Menu

Note:

The Cond Alarm parameter does not appear unless the display was set to "Conductv" (see "Auto TOC Software Setup" on page 59).

To access the Sensor's Alarm Setup parameters:

1) Press the **Setup Key** to display its menu selections.
2) Use the **Up** and **Down Keys** to specify Sensor Setup.
3) Press **Enter** to display the Sensor Setup Menu.
4) Similarly specify and select Analysis Setup.
5) Specify and select More Setup.
6) Specify and select Alarm Setup to display its submenu.
7) Use the **Down Key** to select the Cond Alarm format for this Sensor and press **Enter** to toggle the check mark "on," indicating that uncompensated conductivity alarm monitoring has been enabled.
8) Press **Enter** to exit the screen. In the Auto TOC mode, the alarm limit is checked at the end of each analysis cycle, In the Purge mode, it is checked every 15 seconds.

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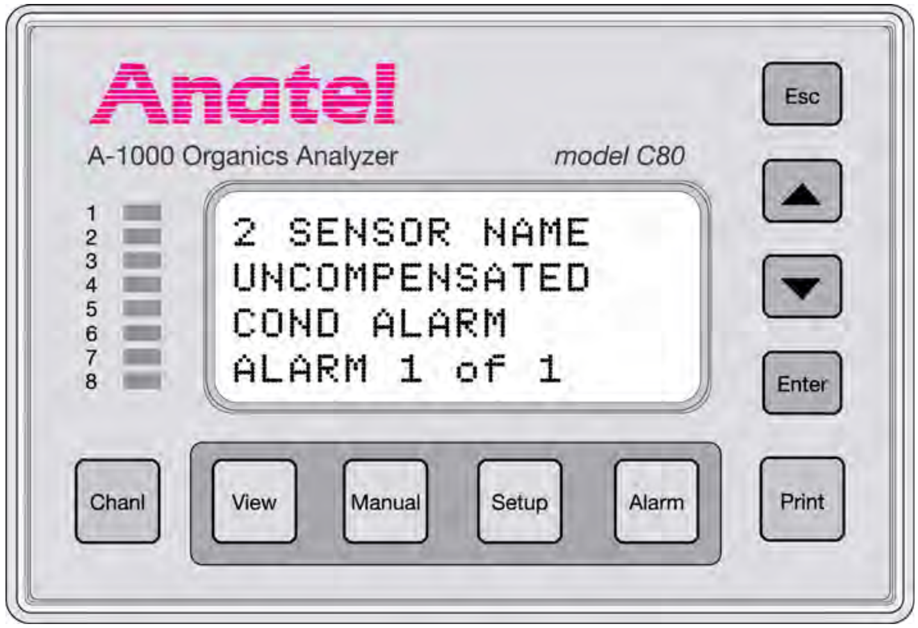

Fig 6-11 : Uncompensated Conductivity Alarm

When the uncompensated limit is exceeded, an alarm is generated and several things occur:

- The LED corresponding to the Sensor's Channel ID begins flashing red on all of its associated A1000 C80 Controllers.
- The error is logged and becomes available for display on any of those Controllers.
- If the Sensor is attached to a local printer, a hardcopy of the condition is generated containing the time of the excursion, the measured conductivity and temperature, and the USP conductivity limit that was exceeded. For example:

  12:07 Alarm 1.452 µS @ 33.2C >[1.4 @ 30C]

Excursions reported in subsequent analyses are output only at the normal user-specified interval or percent change unless the sample water conductivity falls below the specified limit. In that case, a new error report is output to ensure that each limit excursion is recorded.

- The Sensor's Digital Output #2 is asserted to allow alarm annunciation to an external device.

6.4 Alarm Acknowledgement

A limit excursion is acknowledged by specifying the appropriate Sensor and then pressing the Alarm Key. Acknowledgement stops the Controller's LCD from flashing, stops the flashing red Channel ID, and silences the audible warning. If more than one alarm has been detected, all must be acknowledged before these fault indications are terminated. The red Channel LED is restored to green when the Sensor's TOC level falls below its set limit.

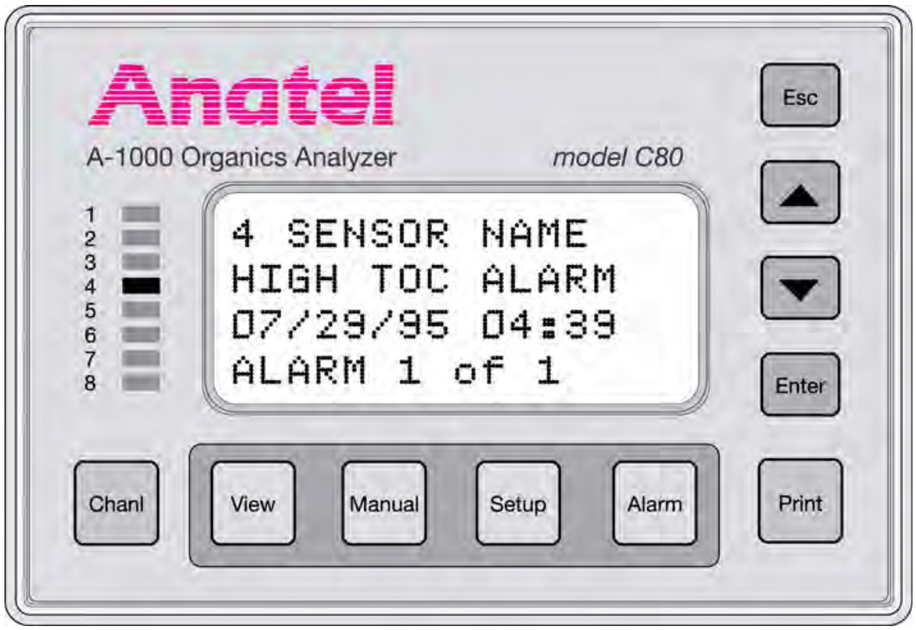

Fig 6-12 : Acknowledged Sensor Error

Acknowledgement presents the following alarm information on the Controller's LCD display:

- Affected Sensor's Channel ID and its user-entered Name
- Cause of the alarm
- Date and time the alarm was detected
- Current number of alarms logged for the displayed Sensor.

In Figure 6-12, the message reports that the TOC level exceeded its specified alarm limit on Channel #4. In the event of multiple excursions, the date and the time each alarm was detected are displayed, as well as the count currently logged for the Sensor.

Any additional (different) errors for the Sensor can be examined by pressing the **Up** and **Down Keys** to scroll through its error log. Once displayed, errors are erased from the display but are still available on the Sensor's log (see "Data Logger" on page 93). The alarm status of the other Sensors can be observed by repeatedly pressing the Alarm Key. If no fault conditions exist for a particular Sensor, "No Errors" is reported in the display.

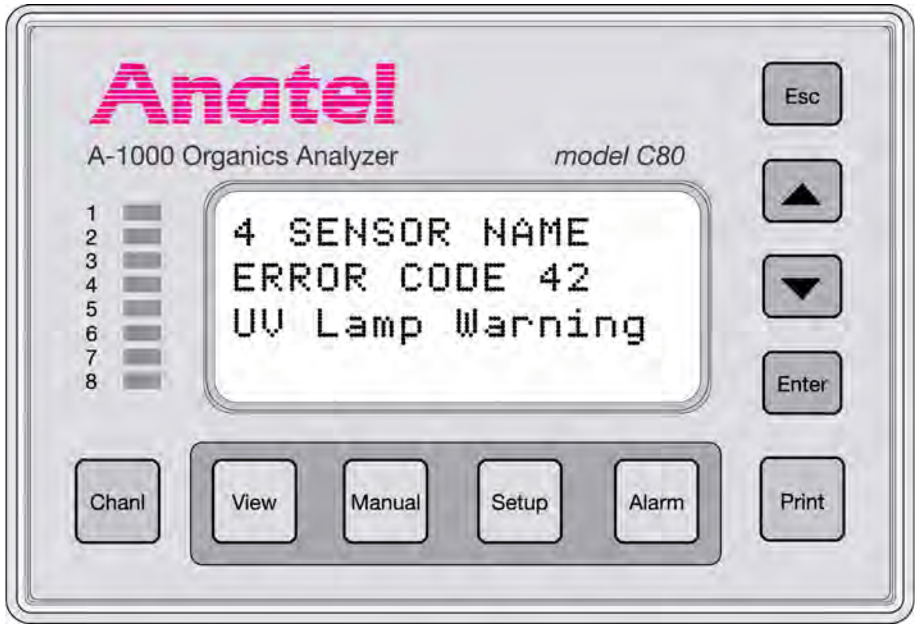

Fig 6-13 : Error Code Reporting

The Alarm Key is also used to acknowledge Sensor Errors. When a Sensor error is detected, it displays the following information:

- Affected Sensor's Channel ID and its userentered Name.
- Code number representing the Error.
- Brief message describing the nature of the Error.

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7 Printer Output

All A1000 Sensors are equipped with an output port for a local printer, although the S20P is already equipped with an integral printer. Automatic hardcopy reports are generated periodically based on the chosen Print Format. Printouts detailing individual Sensor and global Network information can be produced on demand through the **Print Key**. It also furnishes access to the Sensor's data log permitting the its contents to be printed or its memory erased.

7.1 Hardware Setup

Printer connections are made to the PRINTER Port on the Sensor's Connector Block. This RS-232C interface communicates at 1200 baud, 8 data bits, 1 stop bit and no parity. Three- or five-conductor cable is adequate for most serial interfaces (AWG 24 is recommended), depending on the particular printer.

Printer output connections are made on the Senor's I/O Connector Block as follows:

1) Turn the Sensor OFF and disconnect the power cord from its source.
2) Remove the I/O Connector Block from the bottom of the Sensor by loosening the four thumbscrews.
3) Loosen and remove the two Phillips-head screws that secure the metal strain relief plate.
4) Feed the interface wiring through one of the five holes at the end of the Connector Block cover and along the corresponding slot in the foam padding.

Note:
When purchased from Hach Ultra, the local printer's (PN FG 2996301) interface cable is provided.

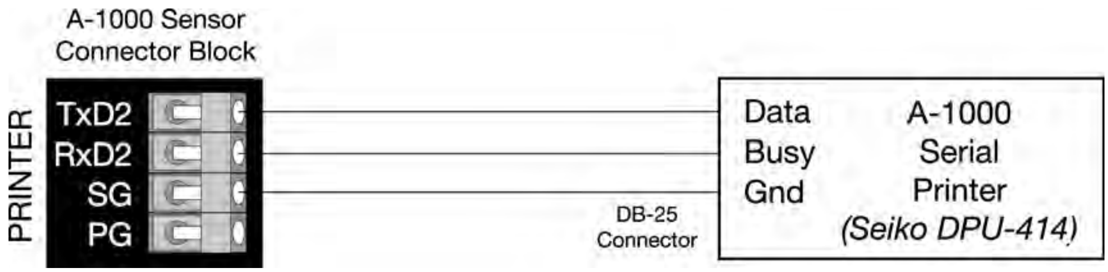

Fig 7-1 : External Printer Wiring

5) Make the necessary serial connections to the Sensor's PRINTER port as shown.
6) Replace the metal strain relief plate.
7) Replace the I/O Connector Block on the bottom of the Sensor, taking care not to pinch any wires, and secure it in place by tightening the thumbscrews.
8) Reconnect the power cord and turn the Sensor ON.

When using the Seiko Instruments Inc. DPU-414 Type II Thermal Printer, the two DIP switches on its bottom are preset at the factory as shown in Table 7-1.

Table 7-1 : Seiko Instruments Inc. DPU-414 Type II Thermal Printer DIP Switch Defaults

DIP Switch 1			**DIP Switch 2**		
1	Off	Serial Interface	1	On	8 Data Bits
2	Off	CR only	2	On	No Parity
3	On	40-Column	3	Off	Even Parity
4	On	Standard Characters	4	Off	1200 Baud
5	Off	0 Font Setting	5	On	1200 Baud
6	Off	American Font	6	On	1200 Baud
7	On	American Font			
8	On	American Font			

7.2 Software Setup

Hard copies of A1000 data can be produced on demand and other print-related operations can be performed. The available print options include the following functions:

- Setting the format for the Sensor's printouts.
- Printing, examining and erasing the Sensor's data log.
- Printing comprehensive Sensor setup and factory configuration parameters.

7.2.1 Print Format

Default: TOC Format

This menu item specifies the format of the printout. The default format details TOC-related data for the indicated Sensor. The alternative format reports equivalent analysis information on the designated Sensor and its reference, as well as the differential measurements between the two instruments.

Note:
The chosen Format applies to all printouts associated with this instrument, but is independent of the automatic Printer Setup interval and other Sensor-specific settings like the Alarm Setup and the Controller's display.

To select the Sensor's Print Format:

1) With the desired Sensor specified in any View, press the **Print Key** to access its submenu.
2) Use the **Up** and **Down Keys** to specify Sensor Print.
3) Press **Enter** to display the available functions.

4) Specify Print Format and then press **Enter** to display its two output options:
   - TOC Format outputs the current date, the TIME at which each sample was captured, the measured TOC in PPB, the current TOC value as a percentage of its Alarm Limit, the directional TREND over the last hour, RESIStivity (or CONDuctivity) and TEMPerature values, and the CuRVe (Profile) TYPe of the sample.
   - Diff Format data are identical except that the results reported for each analysis are: the primary Sensor, the referenced Sensor (indicated by a •) and their Differential values for each category.

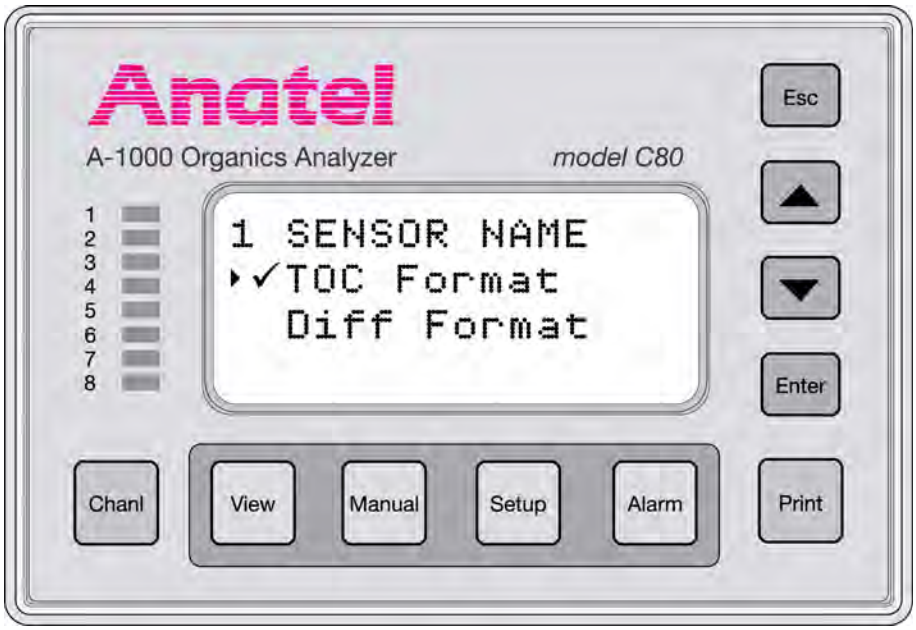

Fig 7-2 : Print Format Screen

Note:
The Sensor must be referenced to another to select the Diff Format.

For more information on each of these operational Modes and examples of their Print Formats, refer to “Auto TOC Mode” on page 57 and “Differential Mode” on page 73.

5) Specify the desired Print Format and press **Enter** to generate it.
6) Press **Enter** to exit the screen.

7.2.2 Data Logger

Each Sensor’s onboard log protects against data loss by chronologically recording any data that are sent to a local printer including analysis results, detected errors and parameter changes. The log also tracks the

Sensor’s available memory and can be erased. The data log is only updated when data are sent to the printer. The amount of data in the log depends on the Sensor’s Printer Setup and the Analyze Rate settings. Sampling at one-minute intervals, for example, the log will retain approximately two and a half days worth of information before it begins writing over the earliest data recorded.

To access Data Logger information:

1) With the desired Sensor specified in any View, press the **Print Key** to access its submenu.
2) Use the **Up** and **Down Keys** to specify Data Logger.

1	SENSOR NAME
	Print Format:
▶	Data Logger:
	Printouts:

Fig 7-3 : Print Submenu

3) Press **Enter** to display the available options:
   - Print Data Log generates a printout of all the data currently stored in the Sensor's memory
   - Memory Usage estimates the percentage of the Sensor's memory log currently occupied by data
   - Erase Data Log purges the Sensor's memory buffer (this selection requires user confirmation)

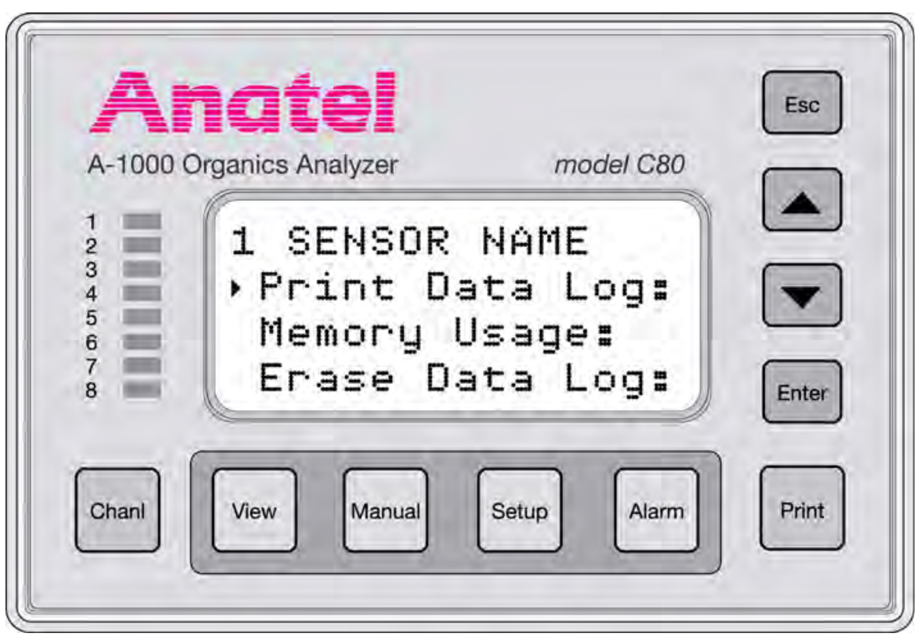

Fig 7-4 : Data Logger Screen

4) Use the **Up** and **Down Keys** to specify the desired Data Logger function.
5) Press **Enter** to execute the specified function.
6) Press **Enter** to exit the screen.

7.2.3 Printouts

The Printouts option provides detailed setup information on the individual instruments. These two hardcopy outputs list all of the Sensor's operational parameters and its factory configuration parameters.

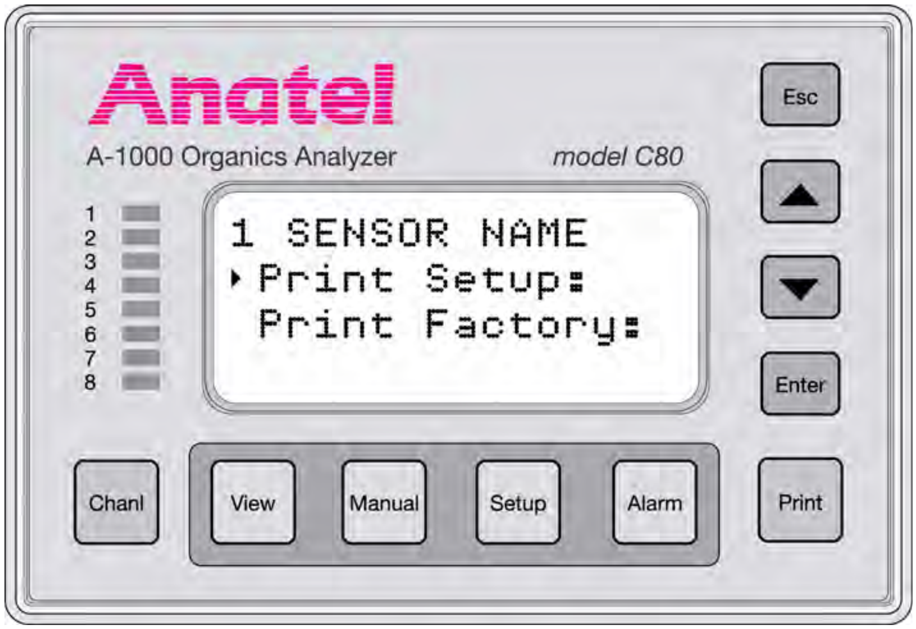

Fig 7-5 : Printouts Screen

To generate Printouts of this parameter information:

1) With the desired Sensor specified in any View, press the **Print Key** to access its menu.
2) Use the **Up** and **Down Keys** to specify Printouts.
3) Press **Enter** to display the available options:
    - Print Setup generates a hard copy of all the Sensor's current user-defined parameters.
    - Print Factory outputs a copy of the instrument's factory-programmed parameters. These values facilitate Sensor service and cannot be changed by the user. The Controller display also reports the firmware Version, its time and date.

1	SENSOR NAME
	Print Format:
▶	Data Logger:
	Printouts:

Fig 7-6 : Print Submenu

4) Use the **Up** and **Down Keys** to specify the desired Printout function.
5) Press **Enter** to generate the specified output. The information in both Printouts is preceded by the following Sensor-specific header data:
   - Model
   - Serial Number
   - Channel ID Number
   - User-entered Name
   - Current Date and Time

6) Press **Enter** to exit the screen.

Examples of printouts are shown in Figure 7-7 and Figure 7-8.

A1000 S10 Organics Analyzer
S/N xxxxx
ID: 1 Name: SENSOR NAME

Sensor Factory Configuration

Calib Date, Number: 05/09/96,90,1
Cal Gain, Offset: 0.067648,–0.001271
Thermistor Factor a: 0.000940192
Thermistor Factor b: 0.00021917
Thermistor Factor c: 1.33957e-07
Holder Temp V-ref: 0
Holder Temp factor: 0
Holder Temp V/I-resis: 0
Sensor, Rev, Firmware Ver: 111,1.47
Checksum: 6BB2

Fig 7-7 : Sensor Factory Configuration Printout

A1000 S10 Organics Analyzer
S/N xxxxx
ID: 1 Name: SENSOR NAME
Sensor Parameter Settings
07/31/06 14:32:41

Sample Time = 00:01:00
Cycle Time = 00:00:00
TOC Alarm Limit = 100
Diff Alarm Limit = 000
Reference Sensor = 1
ID Number = 2
ID Name = SN-1001
Analyze Rate = NORMAL
Valve State at Idle = CLOSED
External DAC Module = INACTIVE
Res/Cond Units = Megohm–cm
Print Format = TOC
TOC Print Interval = CONTINUOUS
PURGE Print Interval = TIMED
Active Alarm Limit = TOC
20mA I Range = 4-20 mA
DAC Error Output = Min Out
TOC Paper Saver %Change = 1
Purge Paper Saver %Change = 1
PURGE Timed Print = 00:01:00
TOC DAC Zero Scale = 000
TOC DAC Full Scale = 1000
TOC Multiplier = 1.000
Resis DAC Zero-Scale = 000
Resis DAC Full-Scale = 020
Temp DAC Zero-Scale = 000
Temp DAC Full-Scale = 0100
Digital Control = Disabled

Fig 7-8 : Sensor Parameter Settings Printout

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8 Analog Outputs

A1000 Sensors provide two methods for outputting signals to external analog devices. The first offers TOC data through the dedicated 4–20 mA port located on the instrument's Connector Block; the second outputs resistivity and/or temperature data to optional External DAC (Digital -to-Analog Conversion) Modules via the Sensor's DIAGNOSTICS port. The output from the DAC Module is a 4-20 or 0-20 mA signal which then can be used by a variety of compatible analog devices.

This section describes how to establish hardware connections for the standard TOC output and the optional External DAC output as well as how to set the necessary operational parameters for each.

8.1 TOC Output

An analog signal corresponding to the Sensor's TOC reading is always available via its 4-20 mA port. This current output may be converted to a voltage if desired by inserting a conversion resistor into the wiring scheme.

Software settings determine the analog output range in addition to its corresponding zero-scale and fullscale values. A user-specified signal may also be output to designate Sensor errors.

8.1.1 Hardware Setup

The Sensor can generate an isolated current output ranging from 4-20 or 0-20 mA that is proportional to its most recent TOC reading. This analog output drives resistances between 50 and 500 ohms, including the interconnecting cables. The signal can be converted to a voltage output by incorporating an appropriate conversion resistor:

Table 8-1 : Conversion Resistors

Resistor	4-20 mA DC Voltage Range	0-20 mA DC Voltage Range
50Ω	0.2–1 VDC	0–1 VDC
250Ω	1–5 VDC	0–5 VDC
500Ω	2–10 VDC	0–10 VDC

Note that the precision of the resistor directly affects the accuracy of the data. A 1% wirewound resistor or better is recommended. For maximum data integrity, the resistor should be mounted across the receiving device's input terminals.

TOC Analog output connections are made to the Senor's I/O Connector Block as follows:

1) Turn the Sensor OFF and disconnect the power cord from its source.
2) Remove the I/O Connector Block from the bottom of the Sensor by loosening the four thumbscrews.
3) Loosen and remove the two Phillips-head screws that secure the metal strain relief.
4) Feed the interface wiring through one of the five holes at the end of the Connector Block cover and along the corresponding slot in the foam padding.

5) Make the necessary positive and ground connections to the Sensor's 4-20mA terminals.
6) Replace the metal strain relief plate.

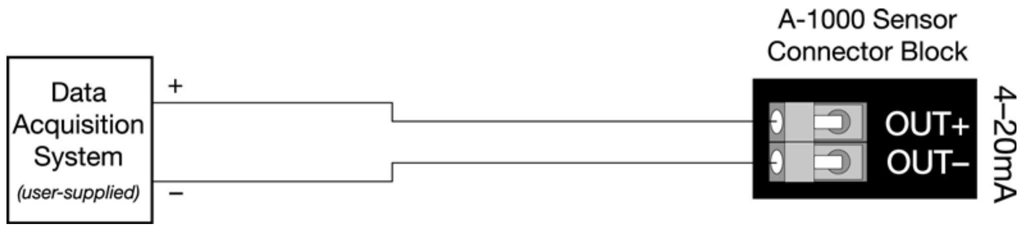

Fig 8-1 : Current Output Wiring

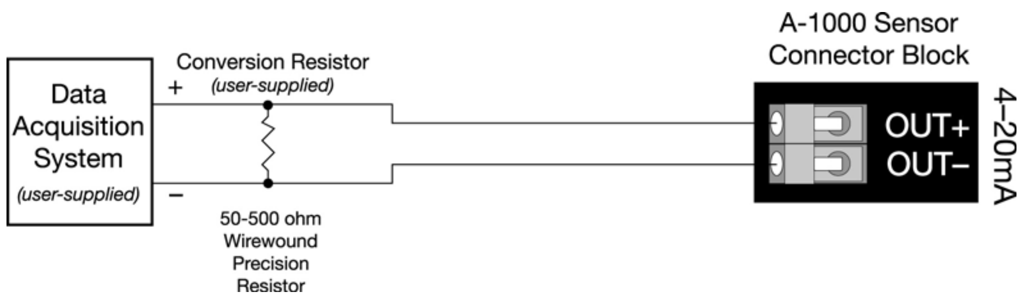

Fig 8-2 : Voltage Output Wiring

7) Replace the I/O Connector Block on the bottom of the Sensor, taking care not to pinch any wires, and secure it in place by tightening the thumbscrews.
8) Reconnect the power cord and turn the Sensor ON.

8.1.2 Software Setup

The analog signal generated at the conclusion of an analysis cycle is calculated based on the sample's reading and represents TOC in ppb. The transmitted signal remains constant until the next analysis cycle is complete. If a critical error is encountered during a TOC analysis, the analog output goes to a pre-defined error output state.

Setting the TOC output consists of:

- Specifying the analog output range.
- Defining the associated zero-scale and full-scale values that establish the resolution of that signal.
- Establishing the signal that is to be output in the event of a Sensor error.

All of the Sensor's analog parameters are defined through its Analog Setup Menu.

1) With the Sensor specified in any View, press the Setup Key to display its submenu.

▶ Sensor Setup:
System Setup:
C80 Setup:

Fig 8-3 : Setup Menu

2) Use the **Up** and **Down Keys** to specify Sensor Setup.
3) Press **Enter** to display the Sensor Setup Menu.

▶ Analysis Setup:
Display/Print:
Sensor Name:
Diagnostics:

Fig 8-4 : Sensor Setup Menu

4) Specify Analysis Setup and then press **Enter** to access its submenu.
5) Specify Analog Setup and press **Enter** to display its parameter options:
   - DAC Range sets the Sensor's internal, and external, analog output range as 4-20 mA (default) or 0–20 mA. The limits of this range correspond to the zero-scale and full-scale values entered for TOC, resistivity and temperature (see "DAC Range Settings" on page 101).
   - Ext DAC Module enables the output to an External DAC Module (see "External DAC Module" on page 109).
   - DAC Err Output determines the fixed value of the Sensor's analog output signal in the event of a critical error (see "DAC Error Output" on page 105).

1	SENSOR NAME
▶	DAC Range:
	Ext DAC Module:
	DAC Err Output:

Fig 8-5 : Analog Setup Menu

DAC Range Settings

The DAC Range Menu provides access to the Sensor's analog output range as well as its zero-scale and full-scale settings.

To display the DAC Range Menu:

1) With the Analog Setup Menu displayed, specify DAC Range and then press **Enter** to display its available menu selections.

1 SENSOR NAME
▶ DAC mA Range:
DAC Zero-Scale:
DAC Full-Scale:

Fig 8-6 : DAC Range Setup Menu

Analog Output Range

Default: 4 to 20 mA, optional: 0 to 20 mA

The mA Range internally defines the span (4 to 20 or 0 to 20 mA) of the analog output that is presented at the Sensor's 4–20 mA port. The lower and upper limits of the chosen range correspond to the Zero-Scale and Full-Scale TOC values.

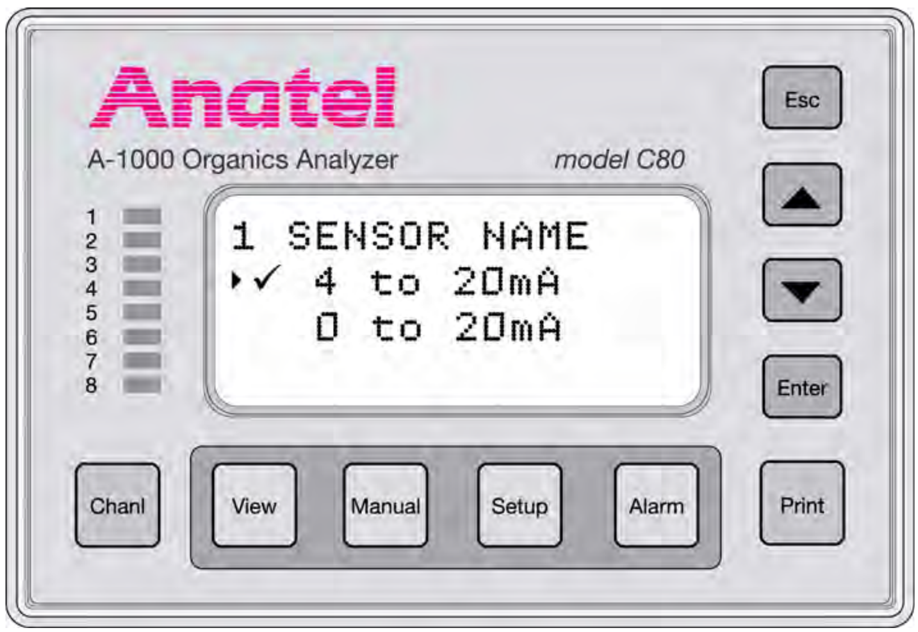

Fig 8-7 : mA Range Screen

Note:
The chosen analog output range must match the range on the connected device for proper communication.

To set the Sensor's mA Range:

1) With the DAC Range Menu displayed, specify mA Range and press **Enter** to display its parameter screen.
2) Use the **Up** and **Down Keys** to specify the desired analog output range.
3) Press **Enter** to enable the mA Range selection.
4) Press **Enter** to return to the DAC Range Menu.

TOC Output Range

Defaults: Zero-Scale – 0000 ppb, Full–Scale – 1000 ppb , Range: 0000 to 9999

These settings define the lower and upper ppb limits proportional to the mA Range setting. The analog signal generated at the conclusion of each analysis is converted to a scaled TOC value for display and reporting purposes.

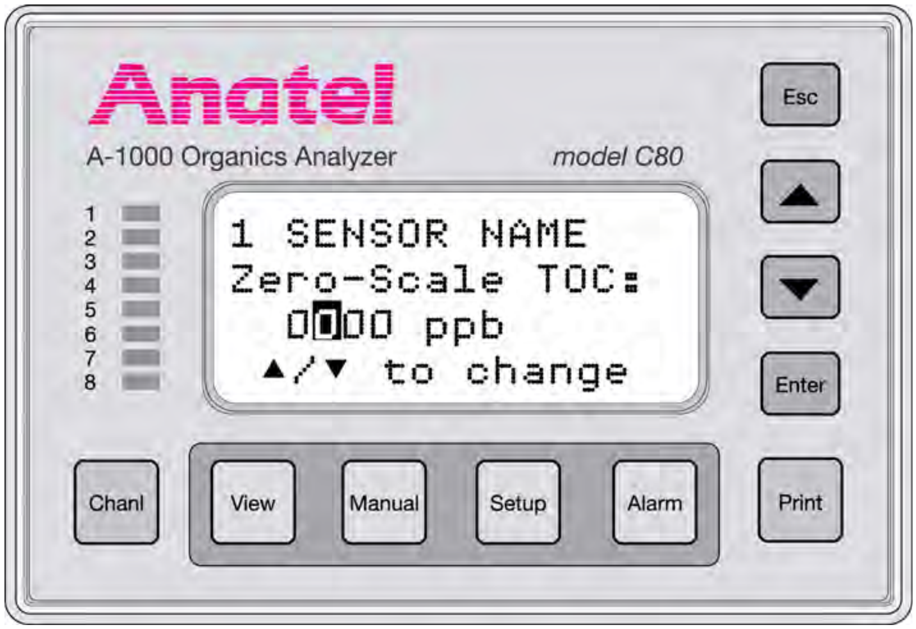

Fig 8-8 : Zero-Scale TOC Screen

To set the TOC output range:

1) With the DAC Range Menu displayed, use the UD Keys to specify DAC Zero-Scale.

1	SENSOR NAME
	DAC mA Range:
▶	DAC Zero-Scale:
	DAC Full-Scale:

Fig 8-9 : DAC Range Setup Menu

2) Press **Enter** to display its menu selections.
3) Specify TOC DAC and press **Enter** to display its zero-scale parameter screen. The flashing block cursor highlights the first pair of digits.
4) Use the **Up** and **Down Keys** to highlight the digit pair that is to be changed.
5) Press **Enter** to enable the Controller's Edit Mode and the flashing block becomes an underscore.

1	SENSOR NAME
	Zero-Scale TOC:
	0000 ppb
	▲/▼ to change

Fig 8-10 : TOC DAC Submenu

6) Use the **Up** and **Down Keys** to scroll the pair until the desired value is displayed.
7) Press the **Esc Key** to retain the setting.
8) Repeat the editing process with the other pair of digits if necessary to display the desired value.

1	SENSOR NAME
	Zero-Scale TOC:
	0025 ppb
	▲/▼ to change

Fig 8-11 : TOC DAC Submenu

9) Press **Esc** twice to retain the Zero-Scale TOC setting and return to the DAC Range Menu.
10) Select **DAC Full-Scale** and press **Enter**.

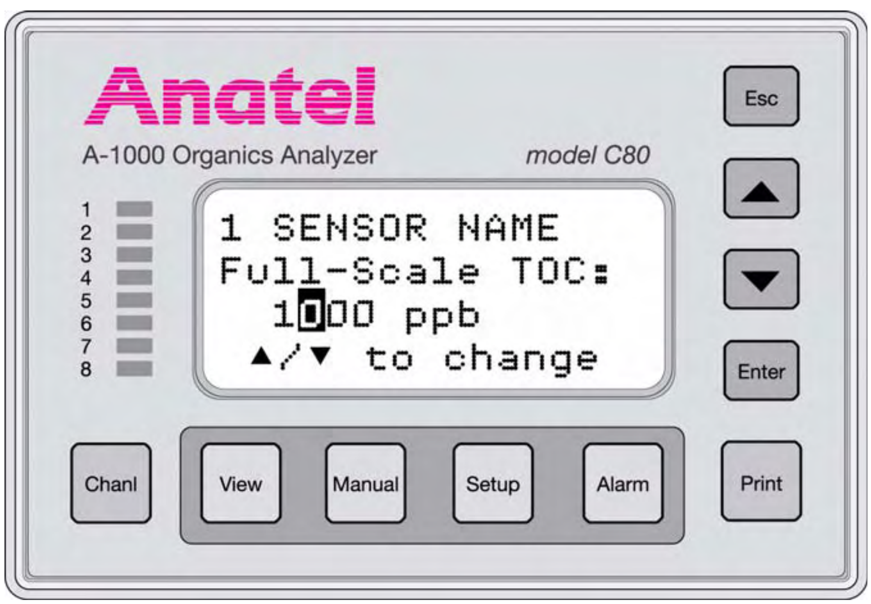

Fig 8-12 : Full-Scale TOC Screen

Note:
The Full-Scale TOC value must be greater than the Zero-Scale TOC value.

11) Specify TOC DAC once again and press **Enter** to display its full-scale parameter screen. The flashing block cursor highlights the first pair of digits.
12) Use the same procedure as that described in step 4 through step 9 to specify the Full-Scale TOC value and return to the DAC Range Menu.

1 SENSOR NAME
Full-Scale TOC:
0100 ppb
▲/▼ to change

Fig 8-13 : TOC DAC Submenu

DAC Error Output

Default: Minimum Output

The user may select from among three states to be output when a fatal error is encountered which causes the Sensor to abort its current analysis. This fixed signal is global for all analog outputs and can be used externally to indicate an error condition.

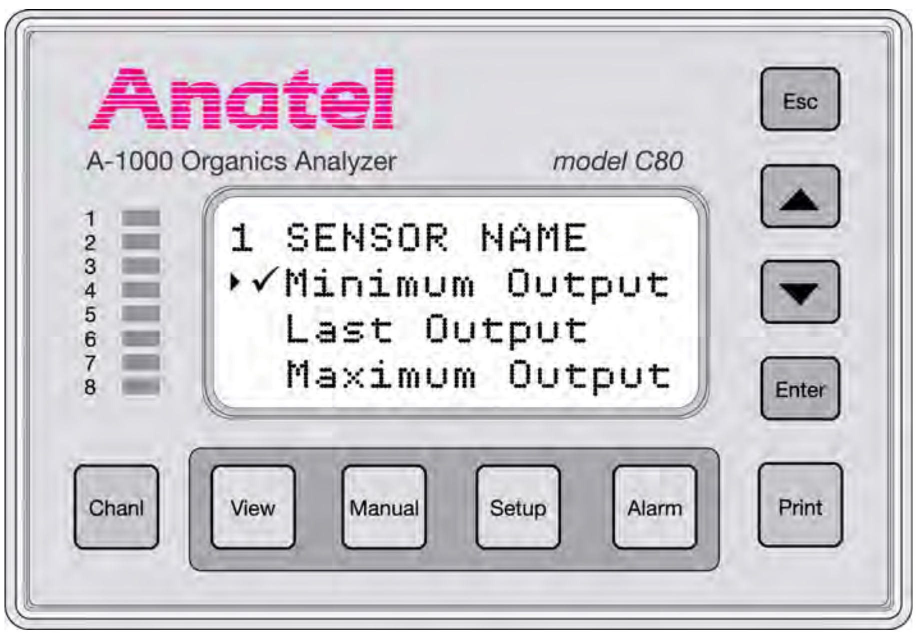

Fig 8-14 : DAC Error Output Screen

To specify the DAC Error Output:

1) With the Sensor's Analog Setup Menu displayed, use the **Up** and **Down Keys** to specify DAC Err Output.
2) Press **Enter** to display its parameter screen.
3) Use the **Up** and **Down Keys** to specify the desired setting:
   - Minimum Output transmits the Sensor's corresponding Zero-Scale TOC value.
   - Last Output transmits the Sensor's last reading.
   - Maximum Output transmits the Sensor'scorresponding Full-Scale TOC value.

4) Press erepeatedly to retain the DAC Error Output setting and return to a channel display.

8.2 Optional Resistivity and Temperature Outputs

Resistivity DAC: P/N FG2006702, Temperature DAC: P/N FG2006802

The necessity for an analog output to report the Sensor's resistivity and temperature values is addressed through external Digital-to-Analog Converter (DAC) Modules. A separate DAC Module is required for each desired analog output. Hach Ultra supplies pre-programmed, pre-wired DAC Modules to forward this processed information to a data acquisition system, remote meter or other analog input device.

Software setup of the External DAC Module includes enabling the Sensor output, defining its range as well as its zero-scale and full-scale values, and the signal that is to be output in the event of an error.

8.2.1 Hardware Setup

External DAC Modules are connected to the Sensor at its DIAGNOSTICS Port. This RS232C interface communicates at 1200 baud, 8 data bits, 1 stop bit and no parity. Three- or five-conductor cable is adequate for this analog interface (AWG 24 is recommended). Two DAC Modules can be daisy-chained to obtain both resistivity and temperature data and can be positioned up to 50 feet from the associated Sensor (Hach Ultra provides 5 feet of cabling).

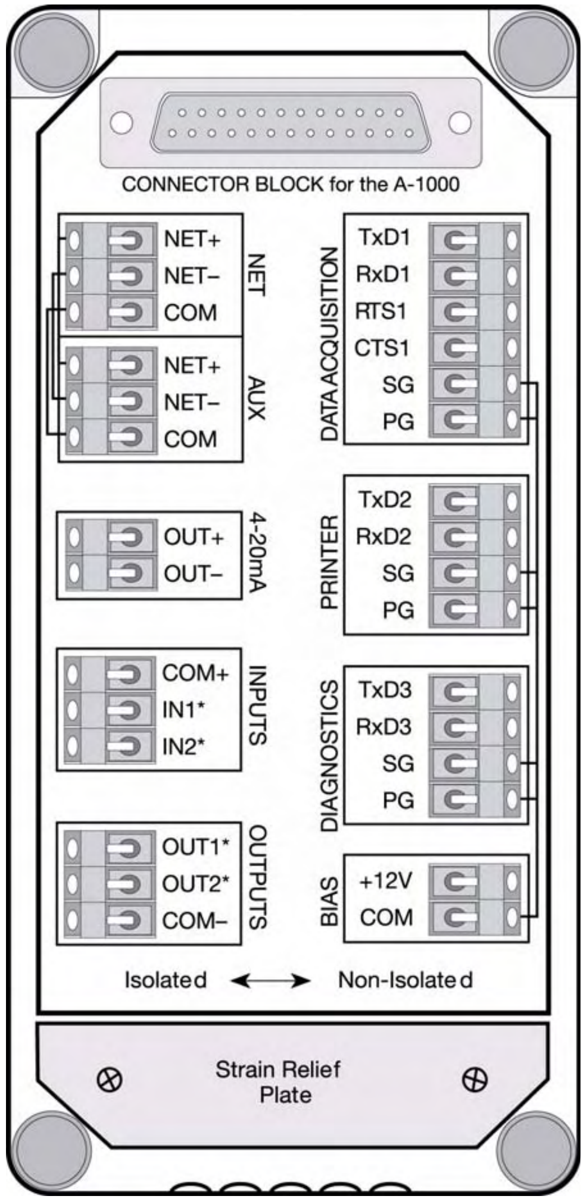

Fig 8-15 : Connector Block for the A1000

These auxiliary analog connections are made on the Senor's I/O Connector Block as follows:

1) Turn the Sensor OFF and disconnect the power cord from its source.
2) Remove the I/O Connector Block from the bottom of the Sensor by loosening the four thumbscrews.
3) Loosen and remove the two Phillips-head screws that secure the metal strain relief plate.
4) Feed the Module wiring through one of the five holes at the end of the Connector Block cover and along the corresponding slot in the foam padding.

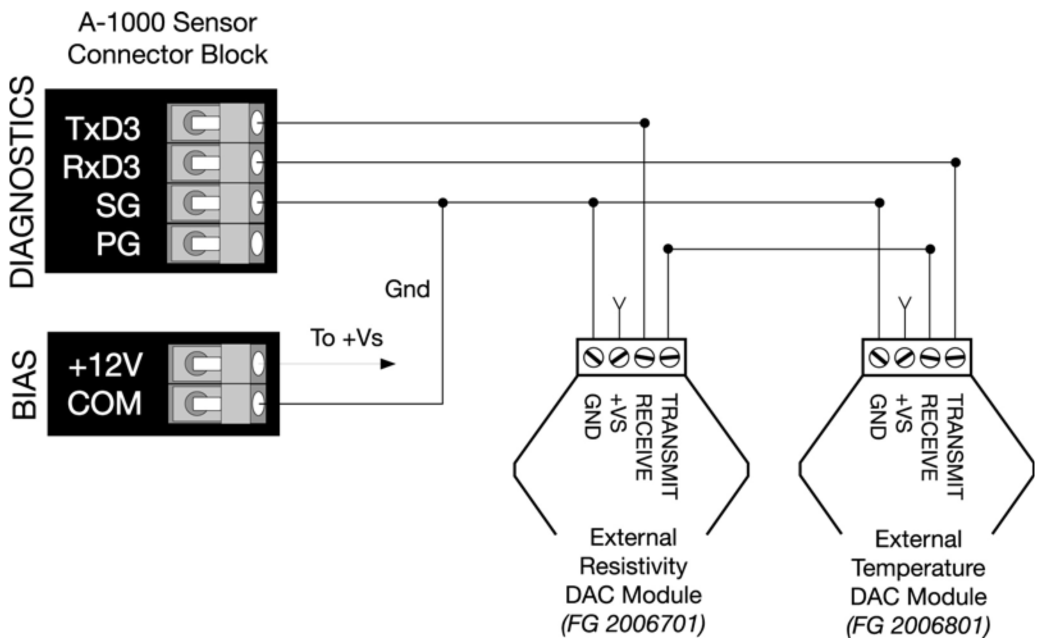

Fig 8-16 : External DAC Wiring

Note:
The S20P Sensor's integral printer is wired to its BIAS port. An external +12 VDC supply must be provided for any DAC Modules in these instances.

5) Make the necessary connections to the Sensor's DIAGNOSTICS port as shown.
6) Replace the metal strain relief plate.
7) Replace the I/O Connector Block on the bottom of the Sensor, taking care not to pinch any wires, and secure it in place by tightening the thumbscrews.
8) Reconnect the power cord and turn the Sensor ON.

8.2.2 Software Setup

The output signal generated at the conclusion of an analysis cycle is calculated based on the sample's reading and represents either resistivity (in MΩ-cm) or temperature (in °C). The transmitted signal remains constant until the next analysis cycle is complete. If a critical error is encountered during an analysis, the external analog output goes to a pre-defined error output state.

Setting the External DAC output consists of:

1) Enabling the Sensor's DAC output.
2) Specifying the analog output range.
3) Defining the associated zero-scale and full-scale values that establish the resolution of that signal.
4) Establishing the signal that is to be output in the event of a Sensor error.

External DAC Module

Default: No

This software switch enables and disables the resistivity and temperature output to an External DAC Module. The Module converts the output into an analog signal for processing by a variety of devices. This signal also reflects the DAC Error Output (see 8.3.2.5) in the event of a Sensor error.

To enable/disable the External DAC Module interface:

1) With the Sensor specified in any View, press the Setup Key to display its submenu.

```
▶ Sensor Setup:
  System Setup:
  C80 Setup:
```

Fig 8-17 : Setup Menu

2) Use the **Up** and **Down Keys** to specify **Sensor Setup**.
3) Press **Enter** to display the **Sensor Setup Menu**.
4) Specify **Analysis Setup** and press **Enter**.
5) Specify **Analog Setup** and press **Enter** to access its parameter options.
6) With the Analog Setup Menu displayed, specify **Ext DAC Module**.

```
1 SENSOR NAME
  DAC Range:
▶ Ext DAC Module:
  DAC Err Output:
```

Fig 8-18 : Analog Setup Menu

7) Press **Enter** to view its parameter screen.
8) Use the **Up** and **Down Keys** to toggle the software switch to **Yes** to enable this analog output; **No** disables it.
9) Press **Enter** to save the Ext DAC Module setting.

Note:
On activation of the External DAC Module, an Error Code #17: “Bad DAC Module” indicates that there is a communications problem.

10) Press **Esc** to return to the Analog Setup Menu.

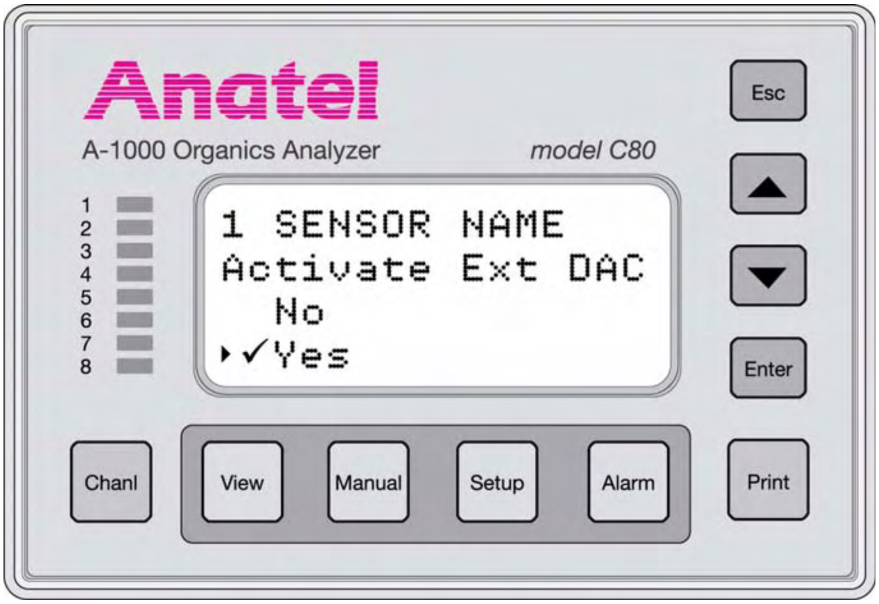

Fig 8-19 : External DAC Module Screen

Analog Output Range

Default: 4 to 20 mA, Optional: 0 to 20 mA

The mA Range internally defines the span (4 to 20 or 0 to 20 mA) of the analog output that is presented at the Sensor's DIAGNOSTICS port. Note that this setting is global for all analog outputs. The lower and upper limits of the chosen range correspond to the Zero-Scale and Full-Scale Resistivity or Temperature values, depending on the output.

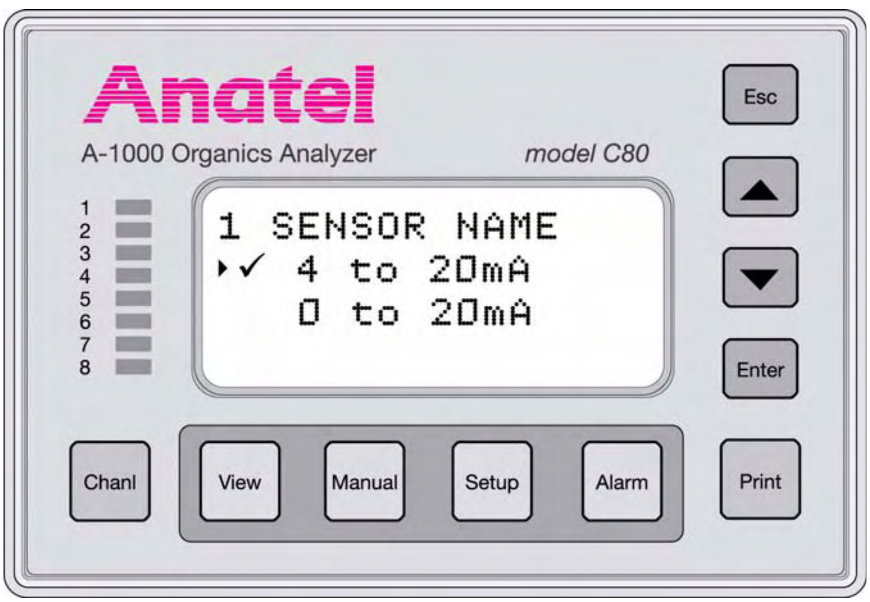

Fig 8-20 : mA Range Screen

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To set the Sensor's mA Range:

1) With the Analog Setup Menu displayed, select **DAC Range** to display its menu selections.
2) Specify **mA Range** and press **Enter** to display its parameter screen.
3) Use the **Up** and **Down Keys** to specify the desired analog output range.
4) Press **Enter** to enable the **mA Range** selection.

Note:
The chosen analog output range must match the range of the connected device for proper communication.

5) Press **Esc** to return to the DAC Range Menu.

Resistivity Output

Defaults: Zero-Scale – 00 MΩ-cm, Full–Scale – 20 MΩ-cm, Range: 00 to 20 MΩ-cm

The DAC Resis setting defines the upper and lower limits that are proportional to the mA Range setting. The analog signal is converted to a scaled resistivity value for output.

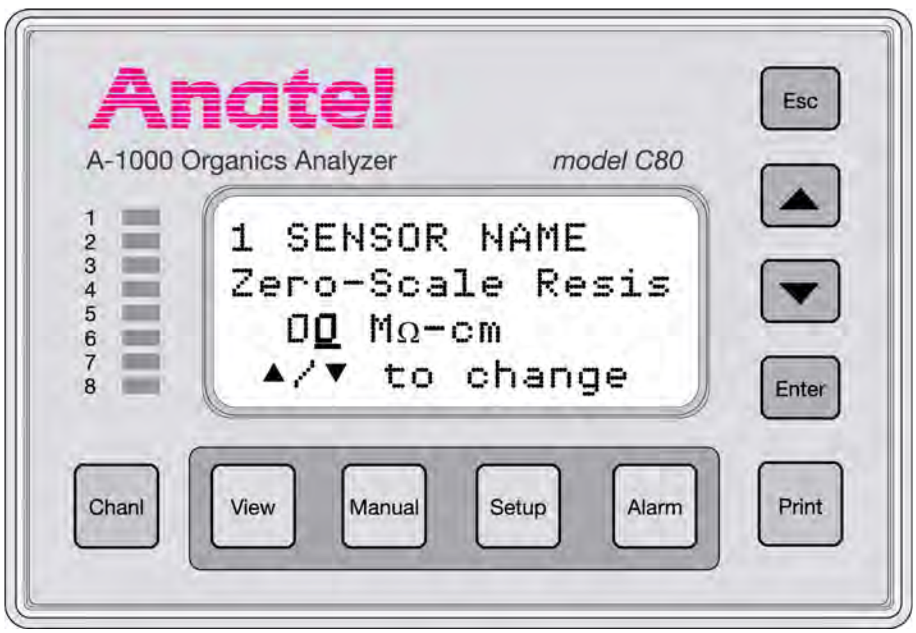

Fig 8-21 : Zero-Scale Resistivity Screen

To set the resistivity output range:

1) With the DAC Range Menu displayed, use the **Up** and **Down Keys** to specify **DAC Zero-Scale**.

1	SENSOR NAME
	DAC mA Range:
▶	DAC Zero-Scale:
	DAC Full-Scale:

Fig 8-22 : DAC Zero-Scale Menu

Note:
Resistivity is output regardless of the Display Units setting (see “Display Units” on page 52).

2) Press **Enter** to display its menu selections.
3) Specify **Resis DAC** and press **Enter** to display its zero-scale parameter screen.

1	SENSOR NAME
	Zero-Scale Resis
	10 MΩ-cm
	▲/▼ to change

Fig 8-23 : Zero-Scale Parameter Screen

4) Use the **Up** and **Down Keys** to scroll in one megaohm increments until the desired value is displayed.
5) Press **Esc** twice to retain the Zero-Scale Resis setting and return to the DAC Range Menu.
6) Select **DAC Full-Scale** and press **Enter**.
7) Specify **Resis DAC** and press **Enter** to display its fullscale parameter screen.

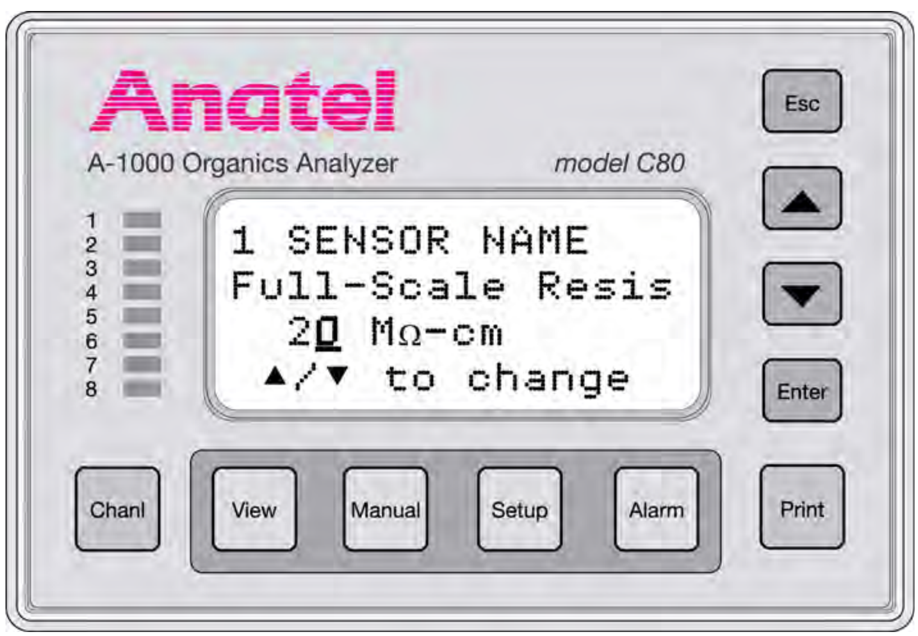

Fig 8-24 : Full-Scale Resistivity Screen

8) Use the **Up** and **Down Keys** to scroll the setting until the desired value is displayed.

1	SENSOR NAME
	Full-Scale Resis
	10 MΩ-cm
	▲/▼ to change

Fig 8-25 : Zero-Scale Parameter Screen

Note:
The Full-Scale Resis value must be greater than the Zero-Scale Resis value.

9) Press **Esc** twice to retain the Full-Scale Resis setting and return to the **DAC Range Menu**.

Temperature Output

Defaults: Zero-Scale – 0 °C, Full–Scale – 100 °C, Range: 00 to 100 °C

The DAC Temp setting defines the upper and lower limits that are proportional to the mA Range setting. The analog signal is converted to a scaled temperature value for output.

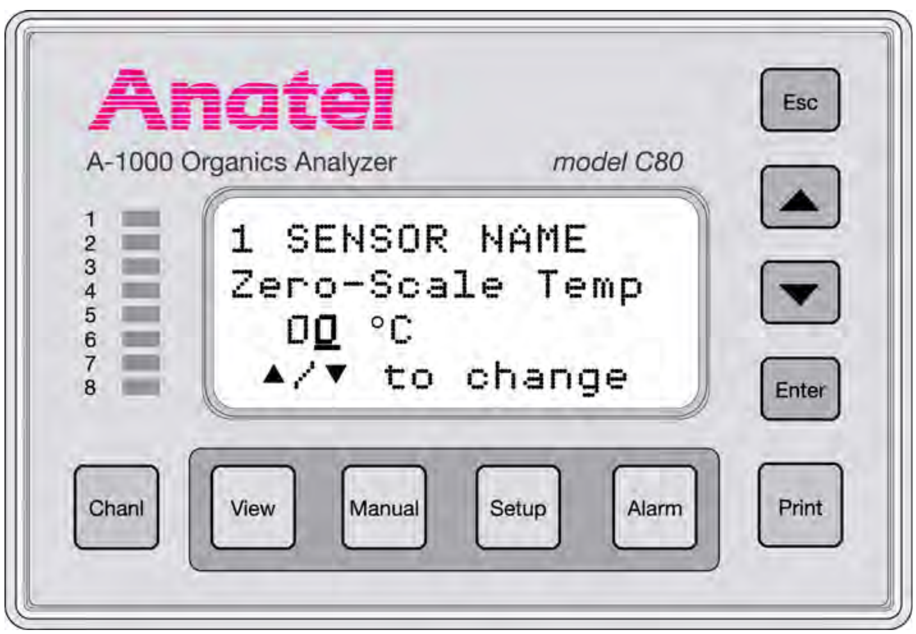

Fig 8-26 : Zero-Scale Temperature Screen

To set the temperature output range:

1) With the DAC Range Menu displayed, use the **Up** and **Down Keys** to specify DAC Zero-Scale.

1	SENSOR NAME
	DAC mA Range:
▶	DAC Zero-Scale:
	DAC Full-Scale:

Fig 8-27 : DAC Range Menu

2) Press **Enter** to display its menu selections.
3) Specify **Temp DAC** and press **Enter** to display its zero-scale parameter screen.
4) Use the **Up** and **Down Keys** to scroll in one degree increments until the desired value is displayed.

1	SENSOR NAME
	Zero-Scale Temp
	25 °C
	▲/▼ to change

Fig 8-28 : Zero-Scale Parameter Screen

5) Press **Esc** twice to retain the Zero-Scale Temp setting and return to the DAC Range Menu.
6) Select **DAC Full-Scale** and press **Enter**.
7) Specify **Temp DAC** and press **Enter** to display its fullscale parameter screen.

1	SENSOR NAME
	Full-Scale Temp
	75 °C
	▲/▼ to change

Fig 8-29 : Zero-Scale Parameter Screen

8) Use the **Up** and **Down Keys** to scroll the setting until the desired value is displayed.

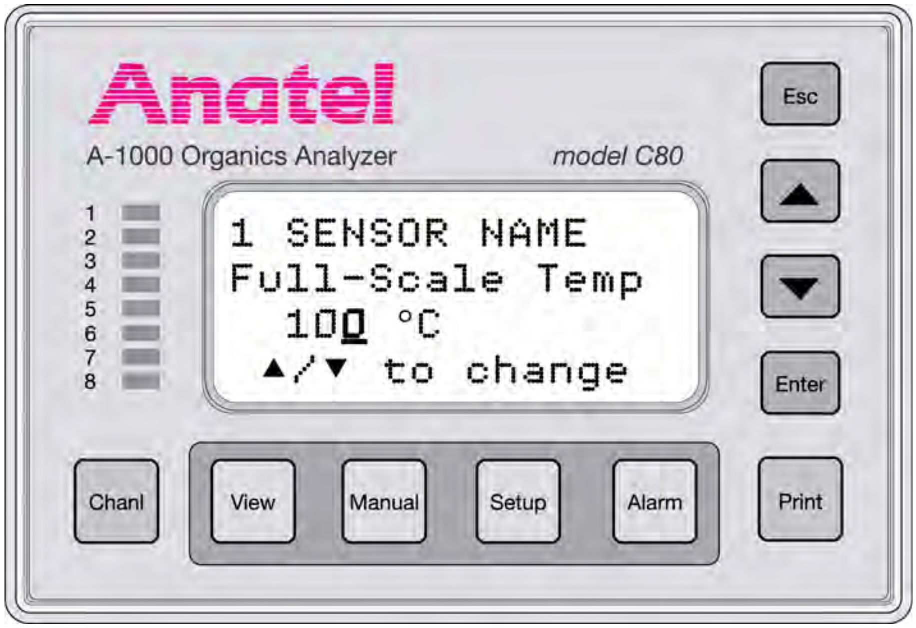

Fig 8-30 : Full-Scale Temperature Screen

Note:
The Full-Scale Temp value must be greater than the Zero-Scale Temp value.

9) Press **Esc** twice to retain the Full-Scale Temp setting and return to the DAC Range Menu.

DAC Error Output

Default: Minimum Output

The user may select from among three states to be output when a fatal error is encountered which causes the Sensor to abort its current analysis. This fixed signal is global for all analog outputs and can be used externally to indicate an error condition.

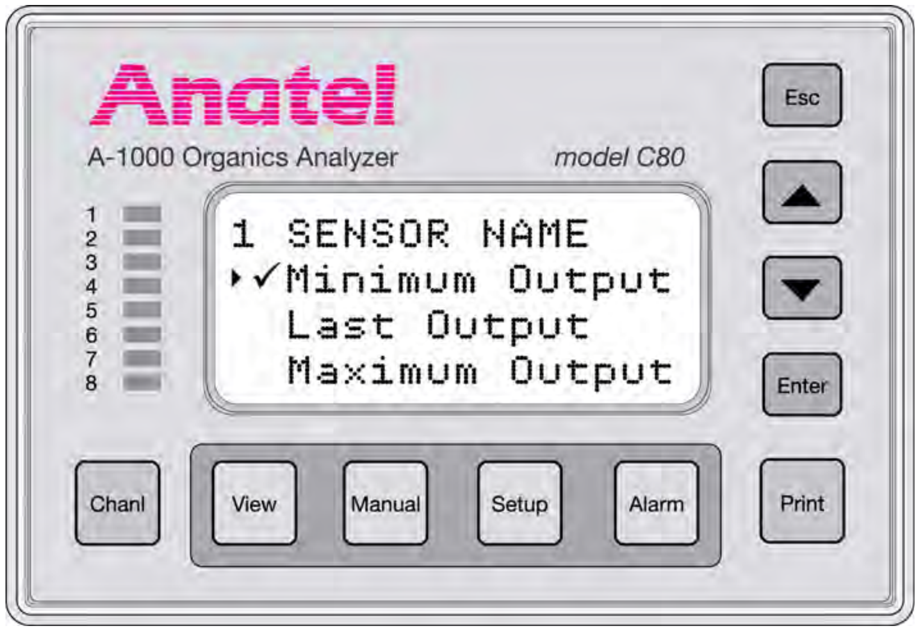

Fig 8-31 : DAC Error Output Screen

To specify the DAC Error Output:

1) With the Sensor's Analog Setup Menu displayed, use the **Up** and **Down Keys** to specify **DAC Err Output**.

1	SENSOR NAME
	DAC Range:
	Ext DAC Module:
▶	DAC Err Output:

Fig 8-32 : Analog Setup Menu

2) Press **Enter** to display its parameter screen.
3) Use the **Up** and **Down Keys** to specify the desired setting:
   - Minimum Output transmits the Sensor's Scorresponding Zero-Scale TOC value.
   - Last Output transmits the Sensor's last reading.
   - Maximum Output transmits the Sensor's corresponding Full-Scale TOC value.
4) Press **Esc** repeatedly to retain the DAC Error Output setting and return to a channel display.

9 Digital Inputs and Outputs

The Sensor's I/O Connector Block is equipped with two opto-isolated inputs and two opto-isolated outputs for receiving and sending digital signals. The digital inputs allow limited supervisory control of the Sensor by a remote device or switch. A pair of digital outputs is also provided for connection to such compatible devices as a remote alarm indicator or a Programmable Logic Controller (PLC).

CAUTION:
The A1000 digital outputs ARE NOT designed for process control functions such as pump On/Off switching or water system shutdown. These connections are not intended to act as, or replace, a PLC.

Digital input and output connections are made on the Sensor's I/O Connector Block as follows:

1) Turn the Sensor OFF and disconnect the power cord from its source.
2) Remove the I/O Connector Block from the bottom of the Sensor by loosening the four thumbscrews.
3) Loosen and remove the two Phillips-head screws that secure the metal strain relief plate.
4) Feed the interface wiring through one of the five holes at the end of the Connector Block cover and along the corresponding slot in the foam padding.
5) Make the necessary connections to the appropriate DIGITAL terminals (see below).

Note:
Observe the correct polarity when making any digital input and output connections to the Sensor.

6) Replace the metal strain relief plate.
7) Replace the I/O Connector Block on the bottom of the Sensor, taking care not to pinch any wires, and secure it in place by tightening the thumbscrews.
8) Reconnect the power cord and turn the Sensor ON.

9.1 Digital Inputs

Both of the digital inputs perform specific Sensor functions, allowing total control over its operation and synchronization with the rest of the process. The first set of inputs is used to initiate an analysis from an external device like a PLC. The analysis is based on the instrument's specified Sample Time, Cycle Time and Analyze Rate settings. The second input dictates the Sensor's operational mode as either Auto TOC or Purge. Both inputs also require that the Sensor be placed under "Digital Control."

9.1.1 Hardware Setup

The two digital inputs share a common positive terminal. They are driven by a 5 to 30 VDC external power source or the Sensor's 12 VDC Bias and designed to operate from open collector, open drain or relay outputs. Each input draws between 1 and 14 mA, depending on the applied voltage. The hardware connections are established as described in "Digital Inputs" above, the Inputs terminals having the following designations and functions:

- IN1* allows external initiation of an analysis. When Input #2 selects the Auto TOC Mode, a high-to-low state transition forces the Sensor to initiate an analysis cycle.
- IN2* selects between the Auto TOC (high state) and the Purge (low state) Mode. State transitions are ignored on IN1* when the Sensor is in the Purge Mode.

Table 9-1 : Hardware Connections

IN1*	IN2*	Mode
--	High	Auto TOC
--	Low	Purge
High to Low (minimum 0.1 second pulse duration)	High	Begin Analysis

Note:
Forcing a new analysis before the previous cycle has been completed will generate an Error Code "41–R/C Trigger."

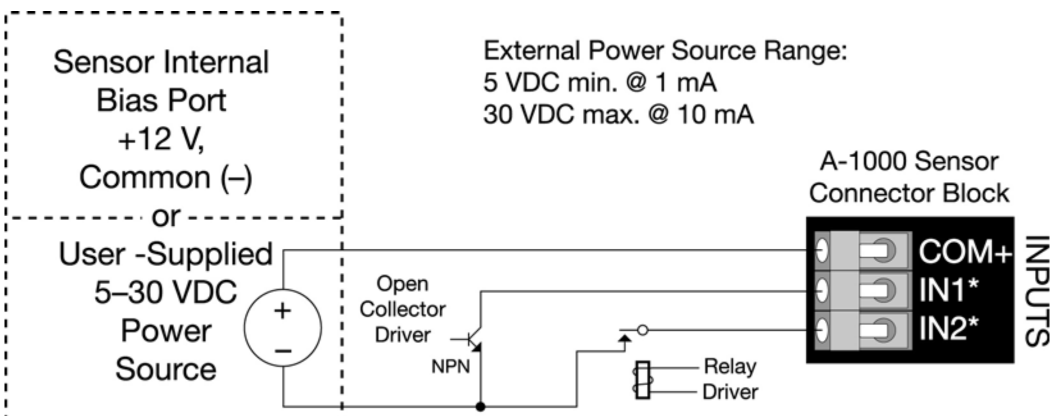

Fig 9-1 : Typical Digital Input Wiring

9.1.2 Software Setup

The Digital Control parameter must be enabled for the Sensor to accept any digital input signals. This software switch is accessed through the Manual Key and, once enabled, displays "r/c" in conjunction with the Sensor's displayed TOC readings to indicate that the instrument is operating under remote control.

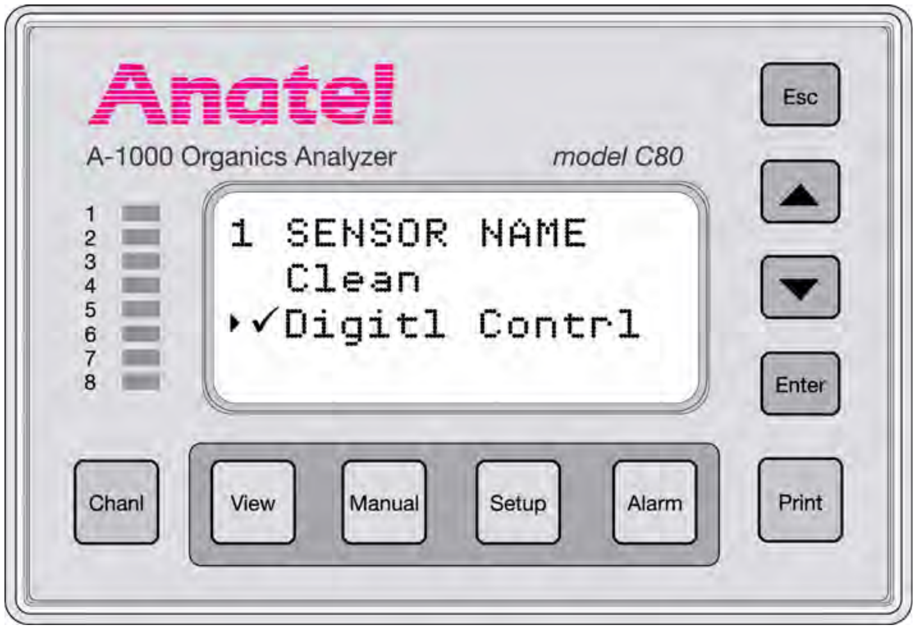

Fig 9-2 : Special Modes Screen

To enable external Digital Control:

1) With the Sensor specified in any View, press the **Manual Key** to display its submenu.

1	SENSOR NAME
▶	Modes:
	Manual Samples:

Fig 9-3 : Manual Submenu

2) Use the **Up** and **Down Keys** to specify **Modes**.
3) Press **Enter** to display the **Modes Menu**.
4) Specify **Special Modes** and press **Enter** to display its operational options.

1	SENSOR NAME
	Auto TOC
	Purge
▶	√Special Modes:

Fig 9-4 : Modes Menu

5) Use the **Up** and **Down Keys** to indicate Digitl Control.

6) Press **Enter** to enable external digital control of the Sensor. Activating this mode inserts “r/c” anywhere the Sensor’s TOC status is displayed to indicate that it is under remote control.
7) Press **Esc** to exit the Special Modes Screen.

9.2 Digital Outputs

The digital outputs also transmit specific Sensor information. The first digital output reports the instrument’s current TOC alarm status and can be used to trigger an alarm indication or similar response. The second digital output reports the state of the Sensor’s internal solenoid valve.

9.2.1 Hardware Setup

Both digital outputs are 8.5 mA current sinks which share a common negative terminal. They are designed to drive solid state relay inputs and have a compliance range from 5 to 30 VDC. The hardware connections are described in “Digital Inputs” on page 117, the OUTPUTS terminals carrying the following designations and functions:

- OUT1* reports the Sensor’s TOC level as above (low state) or below (high state) the user-specified Alarm Limit.
- OUT2* reports the state of the Sensor’s solenoid valve as open (high state) or closed (low state). Alternatively, if temperature uncompensated conductivity is specified as the display units, this output reflects that value in µS/cm.

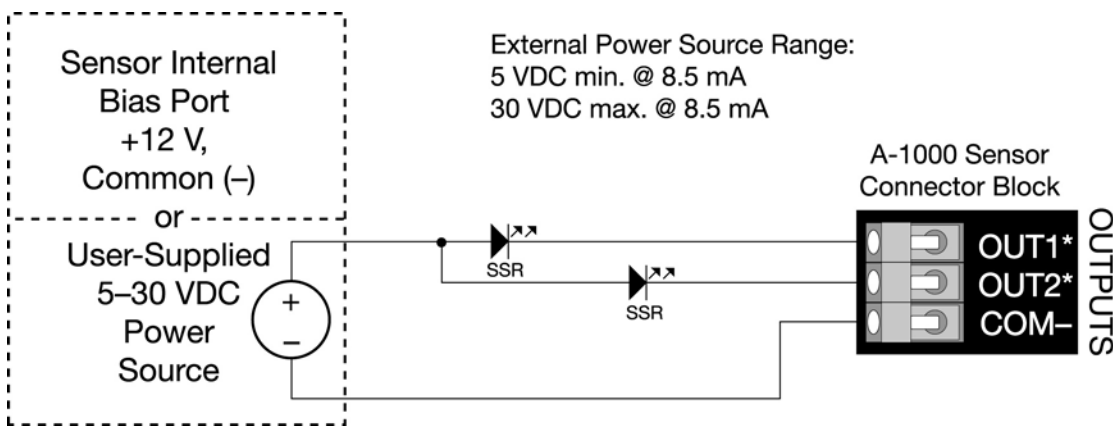

Fig 9-5 : Typical Digital Output Wiring

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10 12 VDC Bias Output

A1000 Sensors are equipped with a Bias connection. It can supply power for such auxiliary devices as the External DAC Modules in order to obtain resistivity and temperature data from S10 Sensors. The Bias connection is used by the integral printer on the S20P Sensor.

10.1 Hardware Setup

The “BIAS” Port furnishes 12 VDC, 1/2 Amp power from the Sensor’s supply. The port is non-isolated and therefore discretion should be used when attaching an external device.

Bias connections are made to the Senor’s I/O Connector Block as follows:

1) Turn the Sensor OFF and disconnect the power cord from its source.

CAUTION:
Drawing more than the available power may cause erratic behavior, loss of data, instrument shutdown, and/or component damage.

2) Remove the I/O Connector Block from the bottom of the Sensor by loosening the four thumbscrews.
3) Loosen and remove the two Phillips-head screws that secure the metal strain relief plate.
4) Feed the interface wiring through one of the five holes at the end of the Connector Block cover and along the corresponding slot in the foam padding.
5) Make the necessary positive and ground connections to the Sensor’s BIAS terminals.
6) Replace the metal strain relief plate.
7) Replace the I/O Connector Block on the bottom of the Sensor, taking care not to pinch any wires, and secure it in place by tightening the thumbscrews.
8) Reconnect the power cord and turn the Sensor ON.

11 Serial Communications

A1000 Sensors are equipped with a bidirectional serial interface that allows them to communicate with a wide variety of intelligent devices such as a Programmable Logic Controller (PLC) or a host computer. The wiring is configured as for any PC-compatible Data Terminal Equipment (DTE) interface.

11.1 Hardware Setup

Serial connections are made to the Sensor on its “DATA ACQUISITION” Port. This RS-232C connection communicates at 1200 baud, 8 data bits, 1 stop bit and no parity. Three- or five-conductor cable is adequate for most serial interfaces (AWG 24 is recommended), depending on the connected device.

Interface connections are made on the Sensor’s I/O Connector Block as follows:

1) Turn the Sensor OFF and disconnect the power cord from its source.
2) Remove the I/O Connector Block from the bottom of the Sensor by loosening the four thumbscrews.
3) Loosen and remove the two Phillips-head screws that secure the metal strain relief plate.
4) Feed the interface wiring through one of the five holes at the end of the Connector Block cover and along the corresponding slot in the foam padding.
5) Make the necessary connections to the Sensor’s DATA ACQUISITION Port as shown.

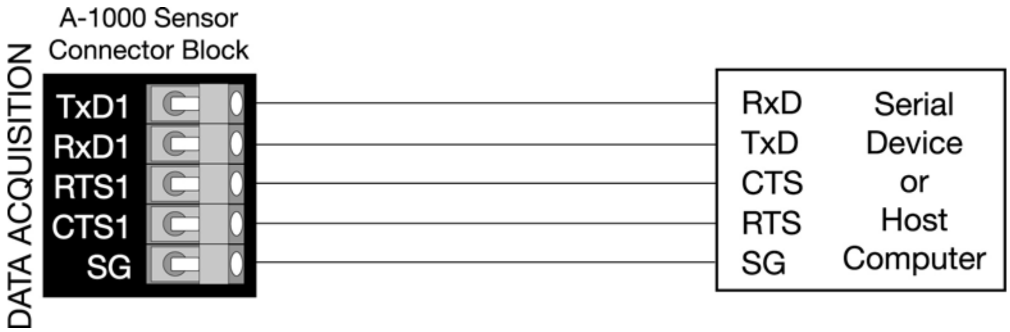

Fig 11-1 : Serial Wiring

6) Replace the metal strain relief plate.
7) Replace the I/O Connector Block on the bottom of the Sensor, taking care not to pinch any wires, and secure it in place by tightening the thumbscrews.
8) Reconnect the power cord and turn the Sensor ON. The pin number correspondence between DB-9 and DB-25 connectors on a PC-compatible serial port is shown in Table 11-1.

Table 11-1 : DB-9 to DB-25 Pin Correspondance

Signal	DB-9	DB-25	Function	DTE	DCE
TxD	3	2	Transmit Data	Output	Input
RxD	2	3	Receive Data	Input	Output
RTS	7	4	Request-To-Send	Output	Input
CTS	8	5	Clear-To-Send	Input	Output
DSR	6	6	Data Set Ready	Input	Output
SG	5	7	Signal Ground	–	–
DCD	1	8	Data Carrier Detect	Input	Output
DTR	4	20	Data Terminal	Ready	Output
RI	9	22	Ring Indicator	Input	Output

11.2 A1000 Command Set

Serial interface commands consist of Mode Set, Parameter Set, Data Read, and Data Logger functions. The commands consist of two-character ASCII text mnemonics. Some commands also require one or more arguments, each delimited by at least one space (ASCII 32; 20 Hex), followed by the command mnemonic. Each command string is terminated with a carriage return (ASCII 13; 0D Hex).

Note:
A1000 Sensors respond to either uppercase or lowercase commands.

The A1000 Sensor will respond with an “OK>” prompt after the command has been accepted. In addition, Data Read and Parameter Set commands elicit a reply that consists of one or more numeric or text values, each delimited by at least one space, and terminated by a carriage return, linefeed pair (ASCII 13,10; 0D,0A Hex).

Both commands and replies use a “free field” format, so the number of delimiting spaces and length of each argument or data field may vary. If a command is rejected due to invalid syntax, for instance, refusal is indicated by a question mark (ASCII63; 3F Hex) reply preceding the “OK>” prompt.

The notations used to represent command arguments are shown in Table 11-2.

Table 11-2 : Representations of Command Arguments

Notation	Command Argument
hh:mm:ss	hours, minutes, seconds
n	decimal number (e.g., “1.234)
i	integer (e.g., “1”)
s	text string (e.g., “SENSOR_NAME”)
b	binary flag (“1” or “0”)

11.2.1 Mode Set Commands

The Mode Set commands are used to determine the Sensor's operational mode. Any changes generate an automatic printout.

Table 11-3 : Mode Set Commands

Command	Function	Comment
MC	Self-Clean Mode	Valve open, lamp on
MD	Auto TOC Mode	Continuous TOC analyses
ME	Clear Error Log	Erases errors from memory
MO i	Start TOC Analysis	One or more TOC analyses, then goes to Idle State. The default is one analysis cycle if an argument ("i") is not specified.
MP	Purge Mode	Valve open, lamp off, shows resistivity/conductivity and temperature.
MZ	Idle State	Places the Sensor in the Idle State (if present).

11.2.2 Parameter Set Commands

Issuance of the "HR" command displays or sets the user-defined Sensor parameters. When issued without arguments, the Sensor's current settings are displayed; issued with arguments, the specified parameters are changed for the Sensor and a printout is generated documenting the modification. If an "out of bounds" value is sent, the entire command is ignored.

Command: "HR hh:mm:ss n n i i s b b b b b b i i hh:mm:ss n n n n n i <cr>"

Table 11-4 : Parameter Set Commands

Command	Function	Section
HR t t i i…	Sample Time (hh:mm:ss)	"Sample Time" on page 60
	Cycle Time (hh:mm:ss)	"Cycle Time" on page 62
	Absolute TOC Alarm Limit (ppb)	"Alarm Setup" on page 81
	Differential TOC Alarm Limit (ppb)	"Alarm Setup" on page 81
	Reference Sensor (0 = none, 1–8 otherwise)	"Referencing Sensors" on page 74
	Sensor Channel ID # (1–8)	"ID to S/N Cross Reference" on page 33
	Sensor Name (1–13 characters)	"Sensor Name" on page 21
	Analysis Rate (0 = normal, 1 = fast)	"Analyze Rate" on page 62
	Valve State @ Idle (0 = open, 1 = closed)	"Valve at Idle Setting" on page 63
	Diagnostic Port Function (0 = normal, 1 = External DAC Module)	"External DAC Module" on page 109
	Resistivity Units (0 = MΩ-cm, 1 = µS, 2 = MΩ-cm uncompensated, 3 = µS/cm uncompensated)	"Analog Output Range" on page 110
	Printout Format (0 = TOC, 1 = Differential)	"Printouts" on page 95
	TOC Mode Print Strategy (0 = Continuous, 1 = Paper Saver)	"Auto TOC Printout" on page 66

Table 11-4 : Parameter Set Commands (Continued)

Command	Function	Section
	Purge Mode Print Strategy (0 = Continuous, 1 = Paper Saver)	“Purge Printouts” on page 70
	Active Alarm Type (0 = absolute ppb, 1 = differential ppb, 2 = absolute ppb & uncompensated conductivity alarm, 3 = differential ppb & uncompensated conductivity alarm)	“Software Setup” on page 81
	Analog Output Type (0 = 4 to 20 mA, 1 = 0 to 20 mA)	“Analog Output Range” on page 102
	20mA Output On Error (0 = minimum value, 1 = unchanged, 2 = maximum value)	“DAC Error Output” on page 105
	TOC Mode Paper Saver Percentage Change (0–100)	“Auto TOC Printout” on page 66
	Purge Mode Paper Saver Percentage Change (0–100)	“Purge Printouts” on page 70
	Purge Mode Interval Between Printouts (hh:mm:ss)	“Purge Printouts” on page 70
	Zero-Scale TOC Range (ppb)	“Analog Output Range” on page 102
	Full-Scale TOC Range (ppb)	“TOC Output Range” on page 103
	TOC Multiplier Factor	“TOC Multiplier” on page 64
	External DAC Zero-Scale Resistivity Range (MΩ-cm)	“Resistivity Output” on page 111
	External DAC Full-Scale Resistivity Range (MΩ-cm)	“Resistivity Output” on page 111
	External DAC Zero-Scale Temperature Range (°C)	“Temperature Output” on page 113
	External DAC Full-Scale Temperature Range (°C)	“Temperature Output” on page 113
	Digital Control (0 = disabled, 1 = enabled)	“Digital Outputs” on page 120
Example: "HR 00:01:00 00:00:00 100 300 0 1 SENSOR_NAME 0 0 0 3 0 0 0 2 0 2 1 1 00:01:00 0 20.0 0 9999 1.0 0 18 0 100 1 <cr>"		
	Set Time (MM:DD:YY:hh:mm:ss format)	“System Time” on page 19
Example: "SY 03 04 1993 12 33 00 <cr>"		

Note:
Issuing the “HR” command without specifying arguments restores the current parameter settings.

11.2.3 Data Read Commands

Data Read functions return multiple values, the string terminated with a <cr><lf>.

Table 11-5 : Data Read Commands

Command	Function	Comment	Notes
RD	Read Sensor Data	Returns one line of time stamped data from when the unit began oxidation: mm/dd/yyyy, hh:mm, mode, state, TOC in ppb, alarm percentage, trend in ppb/hr, resistivity in MΩ- cm, temperature in °C, curve (profile) type and oxidation time in seconds.	The mode is: 1 = Auto TOC 2 = Single TOC 3 = Digital TOC 4 = Sample Manual 5 = Manual Manual 6 = Clean Mode 7 = Purge Mode 8 = Digital Purge 9 = Temperature Test 10 = Calibrate 11 = Idle Mode 12 = Failure Mode The state is: 1 = Idle 2 = Sample 3 = Oxidize 4 = Calibrate 5 = Repurge
RE	Read Sensor Errors	Returns time stamped errors, if any, since the last ME command issued, one error per line: hh:mm:ss (time of first occurrence), error code, number of occurrences and error description.	

11.2.4 Data Logger Commands

The Data Logger functions return information on the Sensor’s internal Data Log. The size of the Data Logger file can be limited, if desired, by issuing an “LE” command before initiating a series of critical analysis measurements.

Table 11-6 : Data Logger Commands

Command	Function	Comment
LE	Erase Data Log	Erases contents of Data Log, freeing non-volatile RAM. Issue this command to reduce the size of the Data Log before taking a series of critical measurements.
LP	Display Data Log	Displays the contents of the Data Log. If any third character is appended to the command (i.e., “LPx”), the display is aborted.
LU	Report Log Usage	Displays what percentage (0 to 100) of the Data Log has been used.

12 A1000 Maintenance

12.1 Maintenance Overview

A1000 Sensors require periodic maintenance in order to ensure the continued accuracy and reliable performance of the instrument.

The UV lamp has a limited life and should be replaced every four to six months, depending on whether the Sensor operates primarily in the “Normal” or the “Fast” Mode. It is recommended that the measurement cell have an annual calibration verification. The lithium battery has a service life of 3–5 years.

Maintenance procedures may be performed either by the user or by Hach Ultra customer service personnel. The most common maintenance procedures are UV lamp replacement, cleaning the air filters, lithium battery replacement and printer maintenance. In most instances, the user can perform these periodic maintenance procedures in the field.

Annual A1000 Sensor calibration verification is recommended to ensure accurate analysis results. Hach Ultra offers a Standard Operating Procedure (SOP#1001) for performing a calibration verification in the field.

Hach Ultra also offers service and extended warranty options to cover scheduled maintenance, calibration and repairs. In cases where returning the Sensor to the factory is impractical, on-site maintenance and/or verification can be performed by a Hach Ultra technician, or a certified instrument may be rented.

Repairs are performed only at Hach Ultra Service Centers due to the specialized equipment and parts required. Contact Hach Ultra for more information or to schedule a service plan.

If problems persist after performing maintenance or repair procedures, contact the Hach Ultra Customer Service department at 800.866.7889 or +1-541.472.6500. Should it be necessary to return the equipment to the factory for maintenance or repair, refer to “Service Procedures” on page 155.

CAUTION:
Purge all water from the Sensor when taking the instrument out of service. Residual water will freeze inside the unit, expand and damage the measurement cell. Such damage is time-consuming to repair and is not covered by the warranty.

12.2 Self-Cleaning Mode

It is possible to contaminate an A1000 Sensor’s measurement cell on any water system or after longterm storage or inactivity. This condition is indicated by suddenly changing or erratic TOC or resistivity readings. Extended self-cleaning using the ultraviolet lamp to oxidize contaminants in the cell is the recommended procedure to alleviate such problems.

In the Self-Clean Mode, the Sensor’s sample valve is opened to allow water to flow through the cell. The UV lamp is turned on to oxidize any organic contaminants, which are subsequently flushed from the Sensor by the sample flow.

To place a Sensor in the Self-Clean Mode:

1) With the desired Sensor indicated in any View, press the **Manual Key** to display its menu.

1 SENSOR NAME
▶ Modes:
Manual Samples:

Fig 12-1 : Manual Submenu

2) Use the **Up and Down Keys** to specify **Modes**.
3) Press **Enter** to display its submenu.
4) Specify **Special Modes** from among the available options and press **Enter**.

1 SENSOR NAME
Auto TOC
Purge
▶ √Special Modes:

Fig 12-2 : Modes Menu

5) Specify **Clean** and press **Enter** once again to initiate this operational mode. Allow the Sensor to operate in the Self-Clean Mode for 3 to 4 hours, longer if contamination is significant.

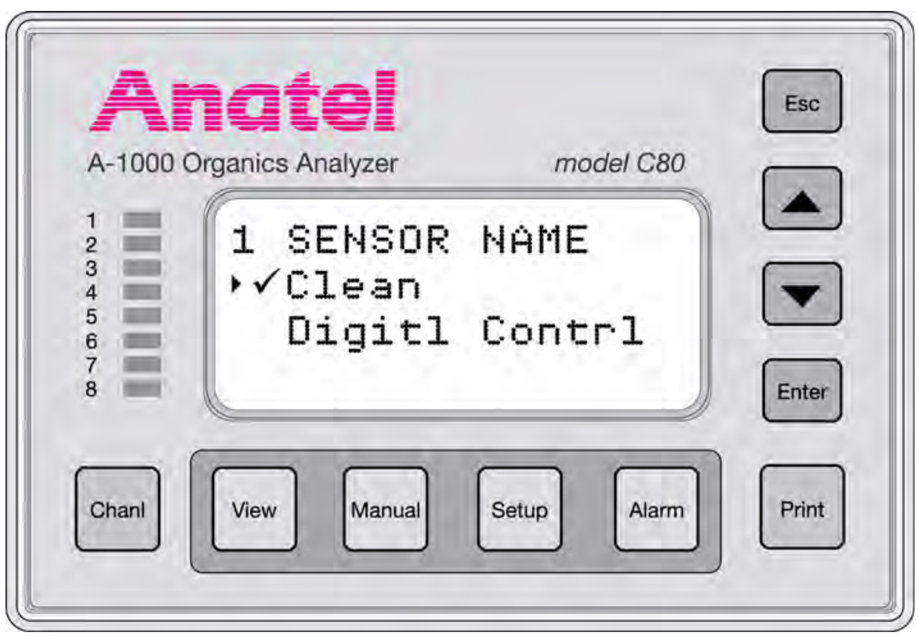

Fig 12-3 : Selecting the Self-Clean Mode

6) Repeat step 1 through step 3 and select Auto TOC in the Modes Menu to terminate Sensor self-cleaning and restore normal analysis.

The A1000's external case can be cleaned by wiping it with a soft cloth moistened with water. Do not use abrasive cleaners as they can scratch the instrument's painted finish and do not subject the enclosure to a direct spray as it could damage internal components.

12.3 Prepartory Maintenance Procedures

Certain maintenance procedures require the removal of either of the Sensor's covers to access the instrument's internal components. These procedures are common to S10 and S20P Sensors in order to service the following components:

- UV Lamp
- Sample Valve
- Air Filters
- Lithium Battery
- (Optional) Printer

To access the Sensor's internal components:

1) Close the upstream isolation valve to stop water flow to the instrument.

CAUTION:

Unplug the Sensor's power cord and exercise extreme CAUTION as there are HIGH VOLTAGES present inside the instrument's Power Supply. It is also recommended that you electrically ground yourself before opening the Sensor to avoid potential electrostatic damage to any of its internal components.

2) Turn the Sensor OFF and disconnect the power cord from its AC source.
3) To disconnect the inlet and outlet tubing, hold each bulkhead fitting with a 3/4" wrench while loosening its 9/16" compression fitting.
4) If necessary, remove the I/O Connector Block by loosening the four thumbscrews that secure it to the bottom of the instrument.
5) The handle on the S20P Sensor must be disassembled to permit access to internal components. Remove the Phillips-head screw on both ends of the handle and then gently separate the supports to remove it.
6) Loosen the four 5/64" hex screws at each corner of the Sensor cover to remove it. The two hex screws located between the sample inlet and outlet also must be unscrewed when removing the Sensor's Water I/O Cover.
7) When replacing a Sensor cover, evenly tighten each of the four hex screws until they are snug.

CAUTION:

Do not overtighten the screws.

8) Restore the Sensor's plumbing and electrical connections and turn it ON.

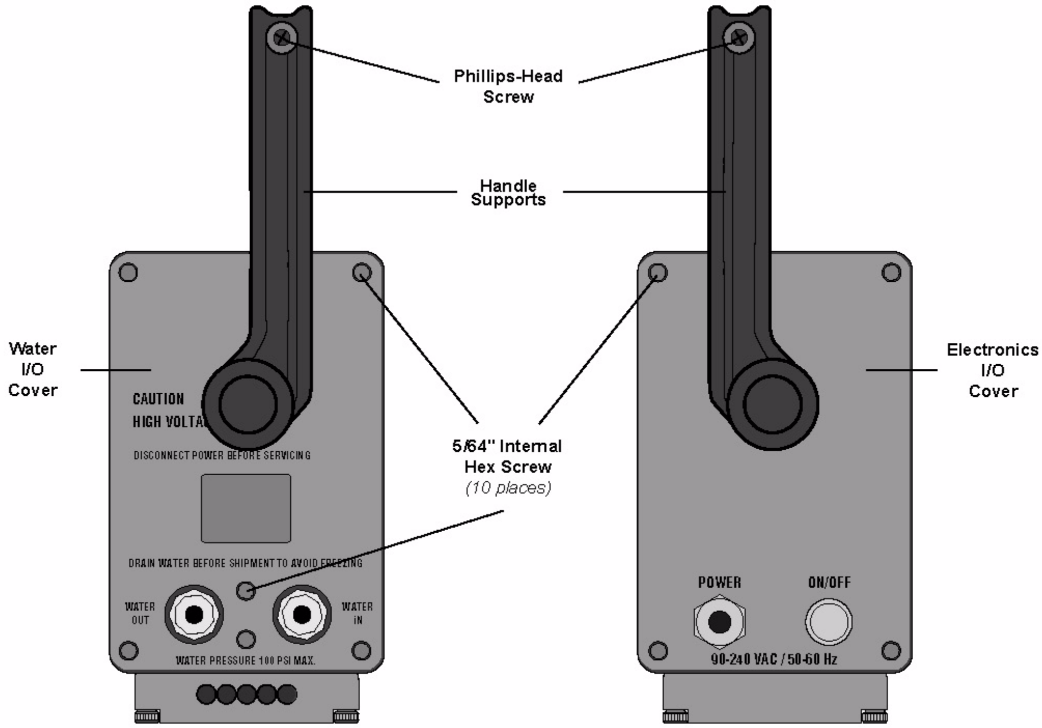

Fig 12-4 : Accessing the Sensor's Internal Components

12.4 UV Lamp Replacement

Within USA: FG 6000401, Outside USA: FG 6000501

The Sensor's UV lamp performance begins to deteriorate after approximately 6 months of use in the "Normal" Analyze Rate, 4 months if operating at the "Fast" Rate. The lamp also should be replaced if the self-diagnostics indicate its failure or if the time required for sample oxidation increases suddenly and remains significantly longer than usual. UV Lamp Replacement Kits are available to perform on-site lamp exchange. Alternatively, the Sensor may be returned to Hach Ultra for lamp replacement.

The Sensor logs UV lamp usage based on its total hours of operation and advises when replacement is warranted. Error Code 42 ("UV Lamp Warning") is reported on the Controller whenever the affected Sensor's operational mode is changed in addition to being output to the printer at the start of each day. The Sensor's Channel LED flashes red until it is acknowledged by pressing the **Alarm Key**. This reporting process continues until the UV lamp is replaced.

To replace the Sensor's UV lamp:

1) Disconnect the Sensor's AC power cord from its supply source.
2) Disconnect the plumbing from the WATER IN and WATER OUT connections.

WARNING

Allow the cell to cool until it can be touched. Handling a hot cell could result in injury.

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3) Remove the Sensor's Water I/O Cover as outlined in "Prepartory Maintenance Procedures" on page 131 to access the UV lamp assembly.
4) Remove the plastic lamp assembly cover.
5) Disconnect the heater connector and unplug the two UV lamp plugs by pulling them straight out of their sockets.
6) Loosen the three 1/8" hex bolts which secure the UV lamp. Support the lamp assembly to prevent it from falling and being damaged.

CAUTION:
The hex bolts should be loosened (and tightened) evenly to avoid breaking the UV lamp.

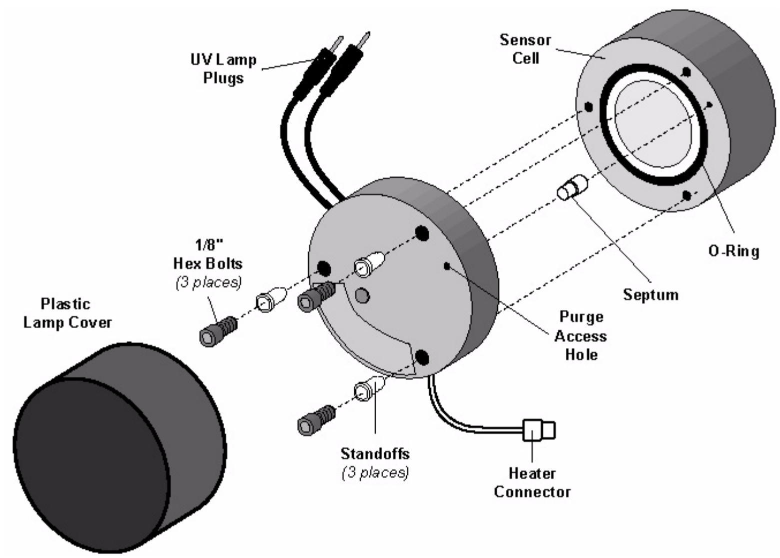

Fig 12-5 : Exploded View of Lamp

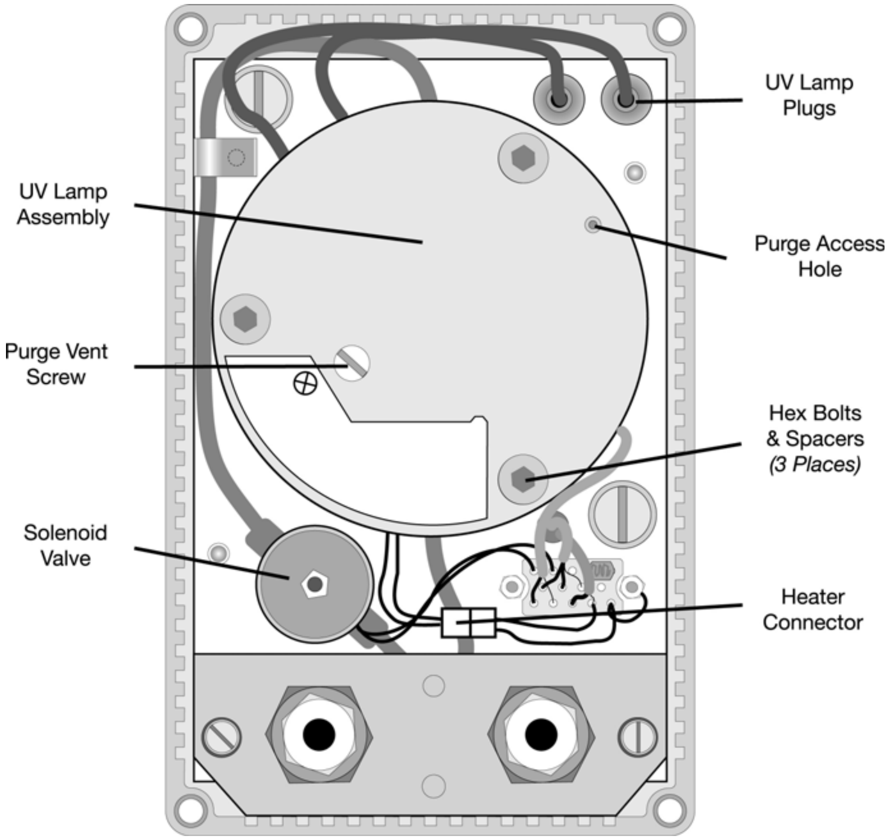

Fig 12-6 : Analyzer Module Assembly

WARNING

DO NOT touch the quartz window or the UV lamp.

7) Gently remove the UV lamp assembly from the enclosure. Discard the standoffs, the septum and the O-Ring located inside the housing.
8) Install the new O-Ring and septum. The larger end of the septum should be inserted into the UV Lamp Chamber.
9) Carefully position the new UV lamp assembly on the cell. UV lamp leads should be in the eleven o’clock position and the purge access hole must align with the septum.

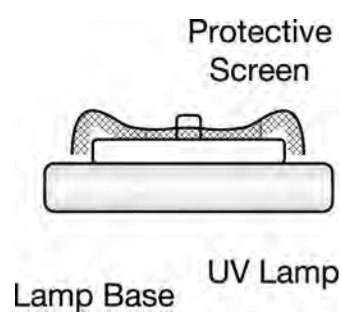

Fig 12-7 : Side View of Lamp

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CAUTION:
Tighten the hex bolts carefully. Uneven or undertightening will result in a faulty seal.

10) Install the new standoffs, replace the hex bolts and tighten all three evenly until some resistance is felt. Alternately torque the bolts until they seat, then tighten them another 1/8-turn.
11) Replace the plastic lamp cover, then reconnect the lamp's heater wires and plugs. Tuck all the wiring back inside the Sensor enclosure.

After replacing the UV lamp assembly (or any time it is removed from the Sensor housing) the lamp chamber must be purged with nitrogen to minimize the absorption of ultraviolet light. The purging aerosol supplied with the UV Lamp Replacement Kit is 99.99% pure nitrogen and should last the life of the UV lamp under normal operating conditions.

12) Loosen the brass purge screw until the exhaust hole is completely exposed, but no further. This outlet provides an escape for the nitrogen.
13) Locate the purge needle inside the nitrogen canister cap and attach it to the gas bottle.
14) Insert the purge needle into the access hole and through the septum until the red plastic component comes into contact with the UV lamp housing.

CAUTION:
DO NOT force the needle into the access hole; the needle could bend and damage the septum, creating leaks in the lamp housing.

15) Purge the UV lamp chamber with nitrogen for 10 seconds. The gas escaping from the purge vent screw may make a hissing sound.

Note:
Purging the UV lamp chamber should not use all of the nitrogen. Keep the remaining gas on hand in the event the lamp chamber must be opened for other maintenance or troubleshooting procedures.

16) Tighten the purge vent screw while continuing to spray nitrogen into the lamp chamber. When the vent screw is tight, withdraw the needle.
17) Replace the Water I/O Cover, re-establish the inlet and outlet water connections and replace the handle on portable A1000 Sensors.
18) Plug the AC power cord into its supply and turn the Sensor ON.

The Sensor's internal counter tracks UV lamp usage in hours. It must be reset each time a new lamp is installed in order to accurately report when light intensity has diminished below recommended levels.

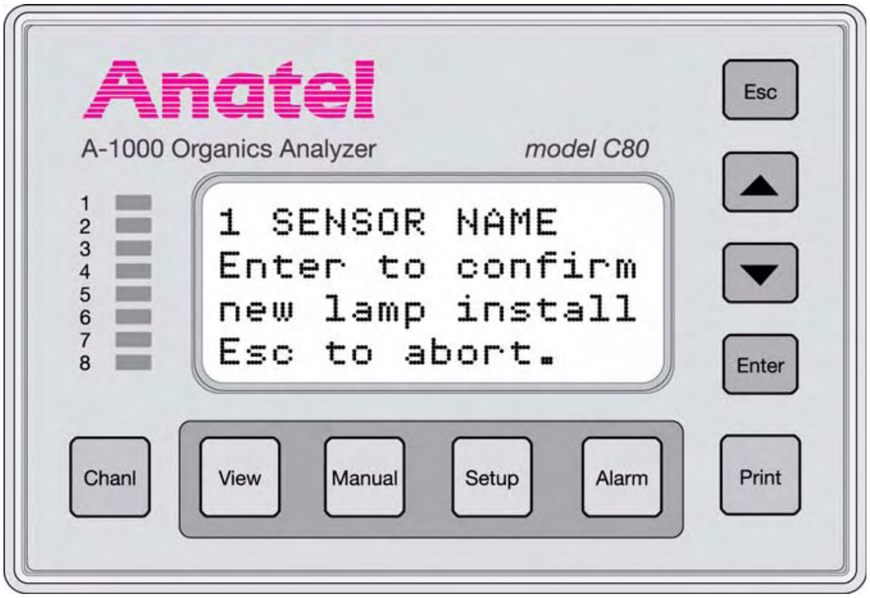


Fig 12-8 : Resetting the Lamp Counter

To reset the Sensor's UV Lamp counter:

19) With the appropriate Sensor specified in any View, press **Setup** to access its submenu.
20) Specify **Sensor Setup** and press **Enter**.
21) Specify **Analysis Setup** and press **Enter**.
22) Specify **More Setup** and press **Enter**.
23) Specify **Cell Setup** and press **Enter**.
24) Specify **Lamp Install** and press **Enter**.
25) Press **Enter** to confirm the new lamp installation.
26) Press **Esc** to exit the screen.

12.5 Sample Valve

The Sensor's internal sample valve does not require regular maintenance. It may occasionally have to be serviced, however, in order to restore normal flow to the instrument. The most common problem with the sample valve is blockage (due to dirt, DI resin beads, gasket remnants, etc.) which either clogs the sample plumbing or prevents the valve from closing properly.

Symptoms of a blockage are:

- Sample water flow through the Sensor could be restricted and much lower than normal. This condition may cause a corresponding drop in TOC and/or resistivity readings because the water sample may not be sufficiently replaced within the measurement cell.
- The water sample continues to flow when the Sensor is turned OFF or when it is in the oxidation stage of analysis. Even a very small amount of flow will cause the reported TOC to change. If problems with the valve are suspected or persistent analysis errors are experienced, proper Sensor operation should be verified by observing flow through the drain line during several analyses.

In either instance, the sample valve should be backflushed and possibly disassembled and cleaned to restore normal flow. If a clogged sample valve is a recurring problem, a Prefilter Kit (P/ N FG2000901) can be installed to reduce the need for frequent disassembly and cleaning of the sample valve.

Note:
Backflushing is also used to clean the Sensor's water filters.

To backflush the sample valve:

1) Turn off the sample water supply by closing the upstream isolation valve.
2) Disconnect both the input and the output tubing connections by holding the bulkhead fitting with a 3/4" wrench while loosening the 9/16" compression fitting.
3) Reverse the flow path through the Sensor by connecting the inlet tubing to the outlet fitting and the outlet tubing to the inlet fitting.
4) Open the upstream isolation valve to restore the sample water supply.
5) With the desired Sensor specified in any View, press the **Manual Key** to access its menu.

1	SENSOR NAME
	Auto TOC
	Purge
▶	√Special Modes:

Fig 12-9 : Modes Menu

6) Use the **Up** and **Down Keys** to specify **Purge**.
7) Press **Enter** to place the Sensor in the **Purge Mode**. In this mode, the sample valve remains open, allowing the sample water to continuously flow through the measurement cell.
8) After 30 seconds, select **Auto TOC**, then **Purge** 30 seconds later. Repeat the process several times to open and close the sample valve; it may help to dislodge trapped particulates. Alternatively, use the Valve Test (see "Cell Tests" on page 151) to open and close the Sensor's sample.
9) Turn off the sample water supply by closing the upstream isolation valve.
10) Reconnect the inlet and outlet tubing to their appropriate fittings.
11) Open the upstream isolation valve to restore the sample water supply.

If the problem persists after the Sensor has been backflushed, the sample valve must be disassembled and cleaned to ensure that it functions properly.

To clean the sample valve:

12) Remove the Water I/O cover as as described in "Prepartory Maintenance Procedures" on page 131.
13) While holding the valve post stationary with a flathead screwdriver, use a 9/16" wrench to loosen the locknut on the end of the valve assembly.
14) Gently pull on the Water I/O bulkhead until it extends approximately 1/4" from the edge of the Sensor enclosure.
15) Noting its orientation, gently pull the valve coil off the plunger housing. Be careful not to stress the wires of the valve coil as the wires could dislodge from their pins.

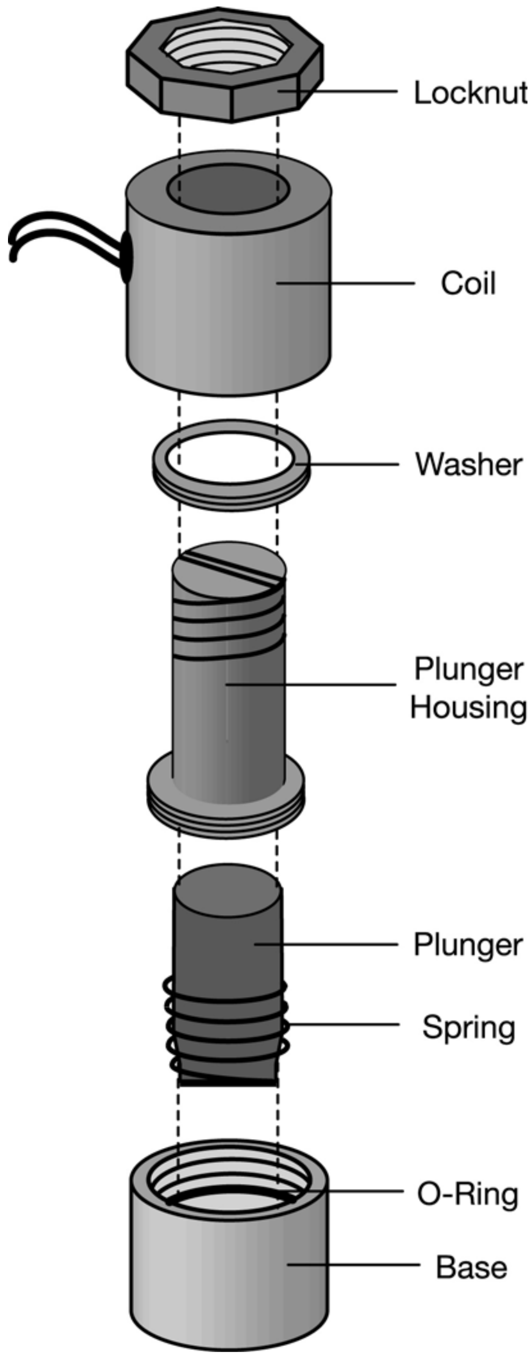


Fig 12-10 : Sample Valve, Exploded View

16) Use a flathead screwdriver to unscrew and remove the plunger housing.
17) Check the housing to verify that the plunger moves freely. Clean any debris from the housing.
18) Check the valve base and gently use a dry swab to dislodge and remove any particles.
19) Replace the plunger housing and screw it on snugly

CAUTION:
Do not overtighten.

20) Replace the valve coil, taking care not to damage its wire. Route the wire around the coil rather than between it and the UV lamp assembly.
21) Secure the coil on the sample valve assembly with the 9/16” locknut.

12.6 Air Filter Cleaning

Each A1000 Sensor is equipped with air filters which can become clogged over time, reducing performance and stressing components. The filters should be checked periodically and cleaned when necessary to guarantee unobstructed air flow through the instrument.

The frequency of air filter cleaning depends on the ambient environment in which the Sensor is located. Dirtier air demands more frequent filter cleaning.

To service the Sensor’s air filters:

1) Remove both the Water I/O and Electronics I/O Covers as described in the preparatory procedures in “Prepartory Maintenance Procedures” on page 131.
2) Locate the two air filters on the bottom of the Sensor enclosure, one at each end of the instrument.

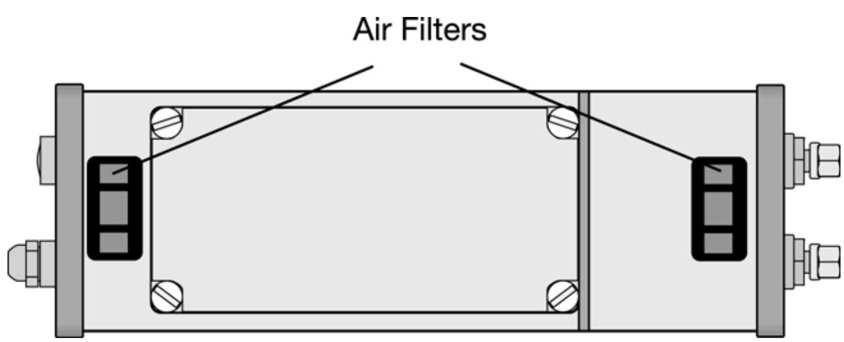


Fig 12-11 : Sensor Air Filters

3) Rinse out the two air filters and allow them to dry before reinstalling them in the Sensor.
4) Replace the two Sensor covers.
5) Restore the sample water supply and re-establish power to the Sensor.

12.7 Lithium Battery Replacement

Replacement Kit: FG 5005601

The Sensor’s lithium battery maintains all nonvolatile (user-entered) parameters to prevent them from being erased from memory during an AC power loss. Although it possesses up to a 5-year life, the battery will eventually have to be replaced. Error Code “11–Bad Battery” reports when the lithium battery is dead and must be replaced to ensure its backup capabilities. The battery replacement kit includes the lithium battery and a cable tie to secure it in position.

CAUTION:

Any logged data will be lost and an Error Code "4–Data Log Corrupt" will be reported when the battery is replaced. Print the data log as described in "Printouts" on page 95 for a copy of the data.

To check or replace the Sensor's lithium battery:

1) Remove the Sensor's Electronics I/O Module Cover as outlined in "Prepartory Maintenance Procedures" on page 131.
2) Remove the Power Supply Assembly from the enclosure, being careful not to disconnect its DC power cable from the circuit board backplane.
3) Release the 26-pin ribbon cable from its connector on the I/O board and move it out of the way.
4) Disconnect the 6-conductor flexible cable to the display module from the processor board.
5) Firmly grasp the 26-pin connector block and gently pull on it to slide both boards out of the enclosure. The boards do not have to be removed

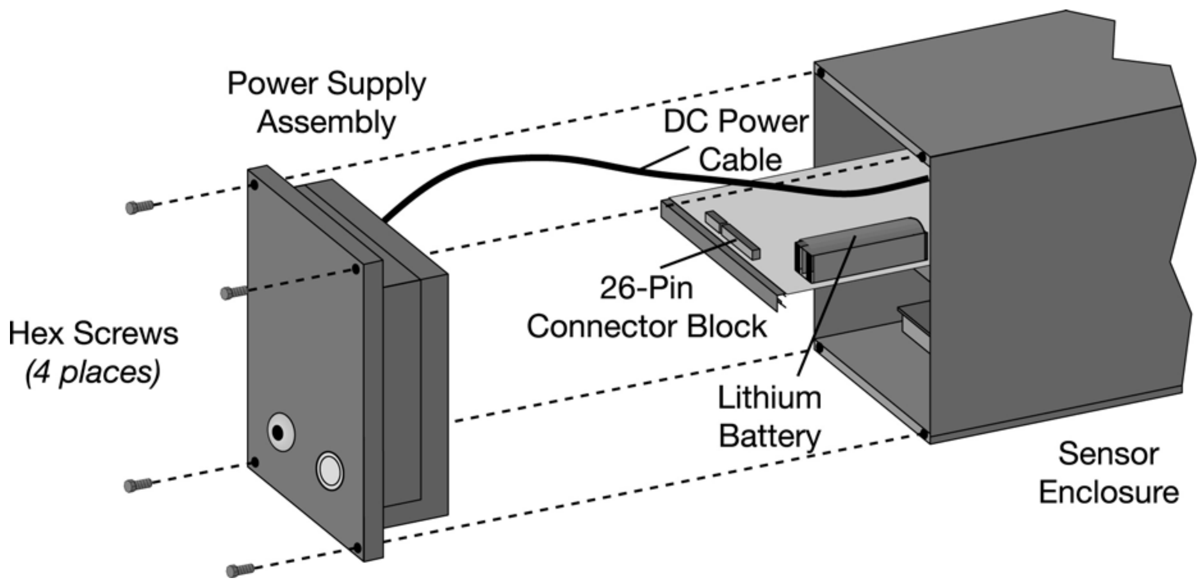


Fig 12-12 : Electronics I/O Assembly, Exploded View

WARNING

Properly dispose of expired batteries. Lithium batteries present a fire, explosion and burn hazard—do not attempt to incinerate, recharge or disassemble them.

6) Check the battery with a voltmeter. A voltage of 3.2 to 3.6 VDC is normal, less than 3.0 VDC and the lithium battery should be replaced.

To replace the battery:

7) Cut the plastic cable tie and remove the old battery. Place the new battery in its holder, making sure to observe polarity.
8) Secure the battery in its holder with the cable tie.
9) Firmly but gently slide the boards back into the enclosure until they seat in their connectors.
10) Position the DC power cable on the right side of the flexible ribbon cable before reconnecting it to the processor board. For S20P Sensors, the connector is the leftmost set of pins at the end of the processor board; for S10 Sensors, it is the rightmost set of pins. In either case, the black dotted line (indicating Pin #1) on the ribbon cable should be on the right side.
11) Reconnect the 26-pin ribbon cable and secure it in place by latching the tabs at each end of the connector. The solid red line (again designating Pin #1) should be positioned on the right side of the connector.
12) Tuck the DC power cable in front of the flexible cable to prevent it from contacting exposed blades of the fan assembly and replace the Electronics I/O Cover. Make sure the DC cable is not pinched between the power supply and the circuit boards.
13) Restore AC power to the Sensor. The Controller initially will report Error Codes “10–Bad Config” and “11–Bad Battery” when the Sensor is turned ON. This display is normal and should be ignored.

12.8 Printer Maintenance

The Seiko Instruments Model DPU-414 thermal printer is integral to the S20P and available as a desktop printer for local use with the S10 Sensor. Refer to the Seiko Operation Manual for detailed information on the DPU-414 Printer. The Manual is provided with stand-alone printers and included in the S20P Sensor Installation Kit.

12.8.1 Paper Replacement

PN FG 5005101 (10 rolls)

The appearance of a red stripe along the edge of the paper is an indication that the roll is getting low. When the paper runs out, the printer’s red OFF LINE/PAPER END LED begins flashing. Additional thermal paper rolls are available from Hach Ultra.

Note:
If paper has run out and the A1000 has sent data to the printer, the green ON LINE LED also flashes. The data are output with their appropriate time and date stamps when the new paper roll is installed and the printer is back online.

To replace the printer paper roll:

1) Remove the spent paper roll from the rear of the printer. Leave the printer and the Sensor both turned “ON.”
2) Cut off the first section of the roll (approximately 8”) which is attached with glue.
3) Cut the paper lead into a “V” shape as shown.

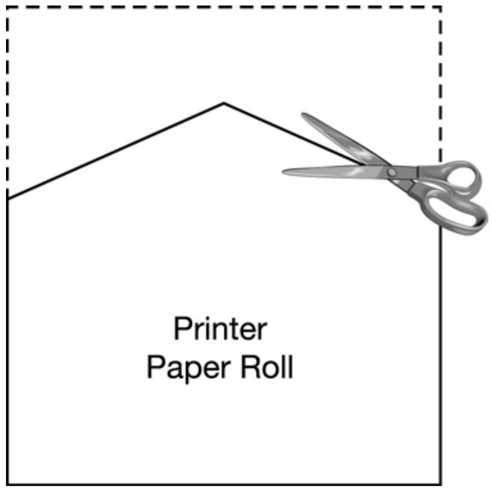


Fig 12-13 : Trimming the Paper Roll

4) Insert the point of the “V” into the appropriate slot, feeding the paper from the bottom of the roll. The OFF LINE/PAPER END LED stops flashing and when the paper is inserted properly.
5) Push the paper advance button until the “V” is past the tear shield.
6) Press the ON LINE button. Any data accumulated after the previous roll expired are now printed.

13 Troubleshooting

In addition to the standard self-tests conducted by the Sensor during its analyses, an extended diagnostic and reporting facility is incorporated to inform the user about the nature of a problem. Error Codes, in conjunction with user-initiated diagnostic tests, serve to isolate the source of the problem.

The checksum value of the A1000's controlling EPROM and its current firmware version may be displayed by pressing the **Chanl Key** twice. This ROM checksum is routinely calculated as part of the Sensor's power-up diagnostics and is the same checksum value that would be produced by a device programmer. The ROM checksum and firmware version are also available on the Sensor Factory Configuration printout (see "Printouts" on page 95).

13.1 Error Codes

Functional range and logic checks are reviewed continuously to determine the functional status of each instrument during every analysis. If one or more errors is detected, the Controller's display and the faulty Sensor's corresponding LED begin flashing (see "Alarm Reporting" on page 85). The appropriate Error Code is logged for display and output to the printer. Reported errors fall into two classifications: critical and non-critical.

Critical errors (Codes 1-99) are indicative of either an electromechanical or analytical failure of the Sensor. These errors could result from such conditions as an exhausted UV lamp, a faulty solenoid valve or a hardware malfunction.

Computational results are still reported, and a recovery is attempted by initiating a new analysis cycle. If the recovery is successful, the red Channel LED returns to green (although the error is logged for display on the Controller and output to the associated printer) and normal operation resumes.

If the recovery is unsuccessful, attempts persist and the results of the most recent successful analysis are displayed. The Controller display and the Channel LED continue to flash red until acknowledged by pressing the **Alarm Key**.

Once acknowledged, the relevant Error Code is displayed and the Controller stops flashing. But the Channel LED is not restored to green until a successful analysis is completed. Each Sensor maintains an error log of as many as 30 separate entries. An error log entry consists of the Error Code number, the total number of occurrences of that particular type of error and a time stamp of its initial occurrence.

Non-critical errors (Codes 100 to 254) include communications errors and are not displayed or printed. Non-critical errors do not inhibit Sensor operation. A printout of non-critical errors may be obtained through the Sensor's Diagnostic Menu. The error log is erased whenever power is cycled on the Sensor or when the "ME" command is issued (see Table 11-3 on page 125).

Table 13-1 : A1000 Electromechanical Error Codes

Code	Message	Indication
1	Bad ROM	Hardware failure
2	Bad RAM	Hardware failure
3	Watchdog Timeout	Hardware failure
4	Data Log Corrupt	Invalid data log (hardware failure or battery removed)
5	Bad DUART	Hardware failure
6	Bad NET	Power Hardware failure
7	No Flash	Hardware failure
8	Bad Flash	Hardware failure
9	Bad Flash CRC	Hardware failure
10	Bad Config	Invalid user configuration (hardware failure or battery removed)
11	Bad Battery	Lithium battery depleted
12	Bad Opcode	Hardware failure
13	FP Exception	Hardware failure
14	DOS Exception	Hardware failure
15	Bad Timer	Hardware failure
16	Bad 7135	A/D Hardware failure
17	Bad DAC Module	Hardware failure
18	Network Problem	Hardware failure or a network wiring problem exists
19	Voltage Error	Sensor failed the voltage test
20	Duplicate ID	Two Sensors have the same Channel ID or a network wiring problem exists

Table 13-2 : A1000 Analysis Error Codes

Code	Message	Indication
21	Cond Cal Noise	Hardware failure
22	Bad Cal Slope	Hardware failure
23	No Cal Slope	Hardware failure
24	Cond Cal Sync	Hardware failure
25	AD Sync Mismatch	Hardware failure
26	TOC Convert Sync	Hardware failure
27	False Cond	Hardware failure or water drained from instrument
28	Bad Temp Convert	Hardware failure

Table 13-2 : A1000 Analysis Error Codes (Continued)

Code	Message	Indication
29	Bad TOC Convert	Hardware failure or water drained from instrument
30	AD Overwrite	Hardware or network failure
31	Lamp Freq High	Hardware failure
32	Lamp Freq Low	UV lamp or hardware failure
33	Bad UV Lamp	UV lamp or hardware failure
34	Analysis Timeout	In cases where analysis is incomplete after 2000 seconds (33.3 minutes), the instrument displays the final TOC value and proceeds with another analysis. This error can be the result of a hardware failure or a very high TOC level
35	Low Ox Rate	The oxidation rate during analysis is too low to be realistic, either from a hardware failure, bad UV lamp or unsuitable water chemistry
36	Chem Interfere	Unable to analyze TOC due to water chemistry
37	Temp Low	Temperature less than 0°C or a hardware failure
38	Temp High	Temperature more than 100°C or a hardware failure
39	Resist Low	Resistivity less than 0.1 Mohm-cm at 25°C
40	Resist High	Temperature compensated resistivity more than 20 Mohm-cm or a hardware failure
42	UV Lamp Warning	Ultraviolet lamp needs to be replaced
80–99	None	Hardware failure

13.2 Troubleshooting

With the exception of Error Codes“4,” “10,” “11” and “18,” the Electromechanical Errors are not user-serviceable.

- A “Data Log Corrupt” error, if caused by changing the lithium battery, will result in lost data that cannot be recovered (see “Lithium Battery Replacement” on page 139).
- A “Bad Config” can be corrected by restoring the factory default parameters (see “Factory Defaults” on page 49), then modifying them as necessary.
- A “Bad Battery” can be replaced (see “Lithium Battery Replacement” on page 139). A “Network Problem (18)” indicates faulty communications; check A-Net wiring and contact Hach Ultra if the problem persists.

The Analysis Errors listed in Table 13-3 warrant a general check to verify that your isolation valve is open and the Sensor’s solenoid valve (see “Sample Valve” on page 136) is functional. This is done by watching the output of the drain line through an entire analysis. Flow should be unrestricted during the Sample Time, there should be absolutely no flow (watch for dripping) during oxidation, and there should be no bubbles evident in the drain line at the start of a new analysis. In the case of errors “34–36,” an hour or more of self-cleaning is recommended (see “Self-Cleaning Mode” on page 129).

Table 13-3 : A1000 Analysis Errors

Error Code	Corrective Action
27/29	Check the water supply to the Sensor for unobstructed, bubble-free flow.
32/33	Check UV lamp connections; replace the UV lamp assembly if necessary.
34	If TOC is greater than 1000 ppb or the Sensor has been idle for a long period prior to analysis, place the instrument in the Self-Clean Mode for at least one hour before attempting another analysis. If the problem persists, it is either a hardware problem or an unsuitable application; contact Hach Ultra.
35	The solenoid valve is plugged or the UV lamp is going bad; backflush the solenoid (see "Sample Valve" on page 136), then replace the UV lamp if necessary.
36	In some cases, the accuracy of the reported TOC value may be affected by the presence of certain ions. This condition occurs primarily in water with less than 5 megaohm-cm resistivity. If it persists, the sample water is unsuitable for A1000 analysis.
37/38	Temperatures outside the range of 0° to 100°C are considered hardware failures. If not, the sample is beyond the Sensor's specifications.
39/40	An alert that the quality of the sample water is outside the instrument's optimum performance range. Measure the resistivity of the sample water. Large discrepancies in the measurements may be due to a hardware failure; contact Hach Ultra.
41	Reports a suspended analysis cycle and does not affect Sensor operation.
42	Replace the UV lamp (see "UV Lamp Replacement" on page 132)

Any questionable problems should be referred to Hach Ultra at 800.866.7889 or +1-541.472.6500. The following information should be included in any correspondence with the factory:

- Instrument's serial number
- Sample resistivity and temperature
- Current and historical TOC data
- Current and historical error codes
- Setup Printout
- Process resistivity and temperature
- Any drain flow observed during sample oxidation
- Any other significant changes in operating conditions

If existing problems warrant equipment return, contact Hach Ultra at 800.866.7889 or +1-541.472.6500. Do not return any equipment to Hach Ultra without a return authorization. Refer to "Return Procedures" on page 155 for instructions on obtaining a return authorization.

CAUTION:

Purge all water from the Sensor when taking the instrument out of service (see "Prepartory Maintenance Procedures" on page 131). Residual water will freeze inside the unit, expand and damage the measurement cell. Such damage is time-consuming to repair and is not covered by the warranty.

13.2.1 Purging the Instrument

CAUTION:

Remember that an instrument stored in a warehouse in the winter can be freeze-damaged if water is left inside and a unit shipped from a warm climate to a cold climate is exposed to extreme temperatures en route.

It is extremely important to drain the A1000 of all water whenever the instrument is removed from its source for two reasons:

- When removing the Analyzer from service for temporary or long term storage (longer than a month), any water remaining in the measurement cell is a medium for bacteria growth. In addition, elements contained in the sample water will settle and adhere to the instrument components causing contamination. It is strongly recommended to self-clean the Sensor for an extended period of time when reinstalling it to ensure accurate and stable data.
- Purging the water out of the Analyzer also avoids freeze damage. If the Sensor is stored or shipped in an extremely cold environment, the water inside the instrument will expand and could severely damage sensitive components. Replacing these components is expensive and will increase the amount of repair time as much as a week.

To purge the A1000 of entrained water:

1) Press the ON/OFF button to turn the A1000 off.
2) Close the (user-supplied) upstream isolation valve to terminate the water supply to the Analyzer.
3) Disconnect the sample tubing from the A1000’s WATER IN connection. A small amount of water will be present in the instrument and its plumbing. The water drains from this connection due to gravity and its location at the bottom of the Sensor’s measurement cell. Take steps to catch this water when disconnecting the tubing so it doesn’t spill onto the work surface.
4) Press the ON/OFF button once again to restore power to the Analyzer.
5) Press the **Manual Key** to access its menu selections.
6) Use the **Up** and **Down Keys** to specify Modes.
7) Press **Enter** to display its submenu.
8) Specify **Purge** and press **Enter** to flush the instrument.
9) Raise the open end of the tubing connected to the WATER OUT port as high as possible above the Sensor. Water should drain from the WATER IN port. If the entrained water does not readily drain, gently blow into the open end of the tubing to force the water out of the measurement cell. The cell has been purged when air is exhausted from the WATER IN connection.

WARNING

Do not blow into the drain tubing if there are any harmful materials in the water sample—exercise care and use pressurized oxygen or nitrogen instead.

Note:

Once the water is purged from the Analyzer cell, an “Error 27: False Conductivity” may be reported. This is normal due to the dry measurement cell.

10) When the water is completely drained, turn the Analyzer off, disconnect it from its power supply, and cap the plumbing connections. The instrument is ready for shipment or storage.

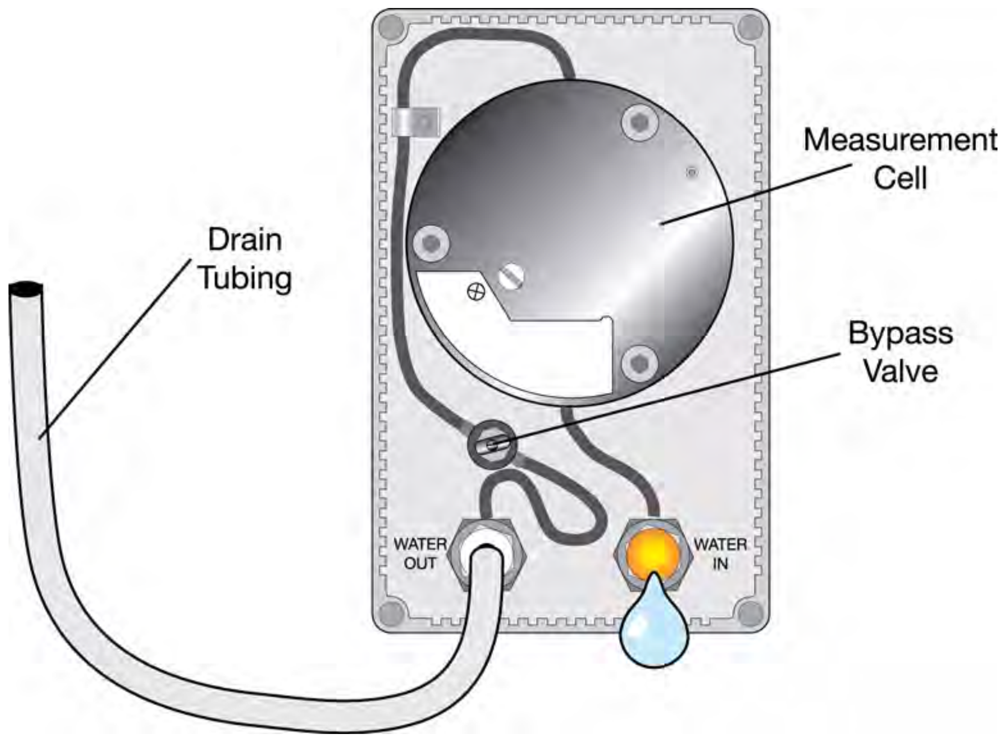


Fig 13-1 : Purging the A1000 Measurement Cell

Note:
For assistance in performing this procedure, call Hach Ultra at 800.866.7889 or +1-541.472.6500 for assistance.

13.3 Sensor Diagnostics

Diagnostic tests conducted on individual Sensors can be quite helpful in isolating the source of a reported error. The C80 Controller software is equipped with a series of user-initiated diagnostic and reporting capabilities that are designed to facilitate the resolution of detected problems. These internal tests can be conducted to verify the instrument's electronic, analysis and communications components to assure that they are functioning properly. The results of these diagnostic tests are reported on the display as well as on an automatic printout.

To perform Sensor diagnostics:

1) With the suspect Sensor specified in any View, press the **Setup Key** to access its menu selections.
2) Use the **Up** and **Down Keys** to specify **Sensor Setup**.
3) Press **Enter** to display its submenu.
4) Specify **Diagnostics** and press **Enter** to display the available options.

1	SENSOR NAME
▶	Electronics:
	Cell:
	I/O:

Fig 13-2 : Diagnostics Menu

5) Specify the desired diagnostic area and then press **Enter** to display its function.

13.3.1 Electronics Tests

The Sensor's electronic diagnostics are divided into three tests:

- Voltage
- Memory/Error
- Display/Print

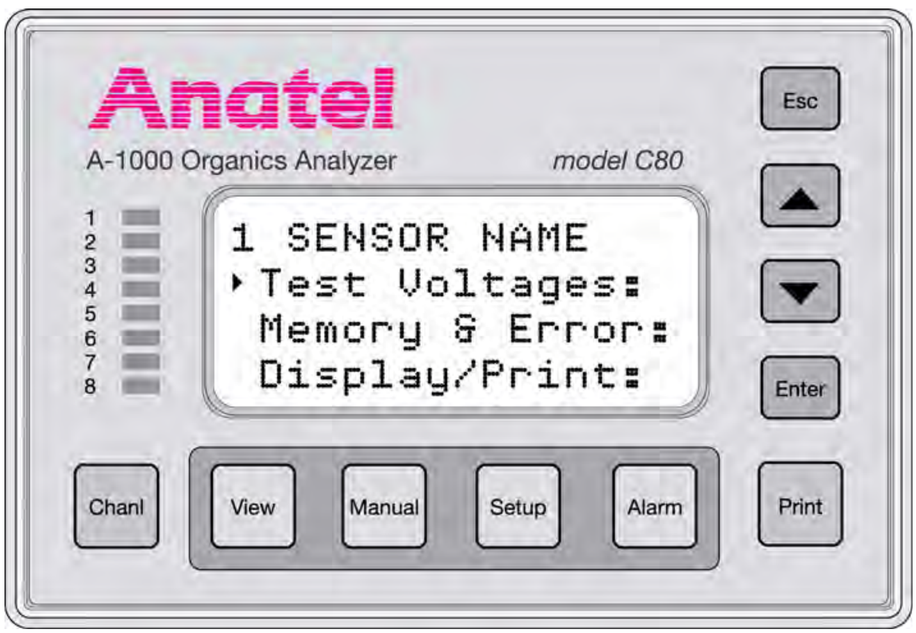


Fig 13-3 : Electronics Diagnostic Screen

To conduct a diagnostic test on any of the Sensor's electronic systems:

1) With the Sensor's Diagnostics Menu displayed, specify **Electronics** and press **Enter** to access its options. Each of the Electronics Menu selections offers two diagnostic options:
    - Test Voltages
        - Voltages is a pass/fail test which compares the current Sensor voltages to their nominal baseline levels.
        - Baselines prints a list of the Sensor's baseline voltage values.
    - Mem & Error
        - Memory Test verifies that the Sensor's RAM is functional.
        - Errors generates a printout of all non-critical communications errors logged for the Sensor.
    - Display/Print
        - Display Test verifies operation of the Sensor's and the Controller's LCD by darkening all of the pixels in the display.
        - Printer Test confirms all characters are printing.
2) Press **Enter** to execute the chosen operation. The results of the test are presented on the Controller's display and a printout is generated. Contact Hach Ultra if the Sensor fails any of these tests.
3) Press **Esc** twice to return to the Electronics Menu to perform another circuitry test, or press it three times to return to the Diagnostics Menu.

13.3.2 Cell Tests

These tests facilitate manual control of the Sensor's ultraviolet lamp and its internal sample valve. Diagnostics testing interrupts the current TOC analysis. Normal analysis resumes upon termination of the test.

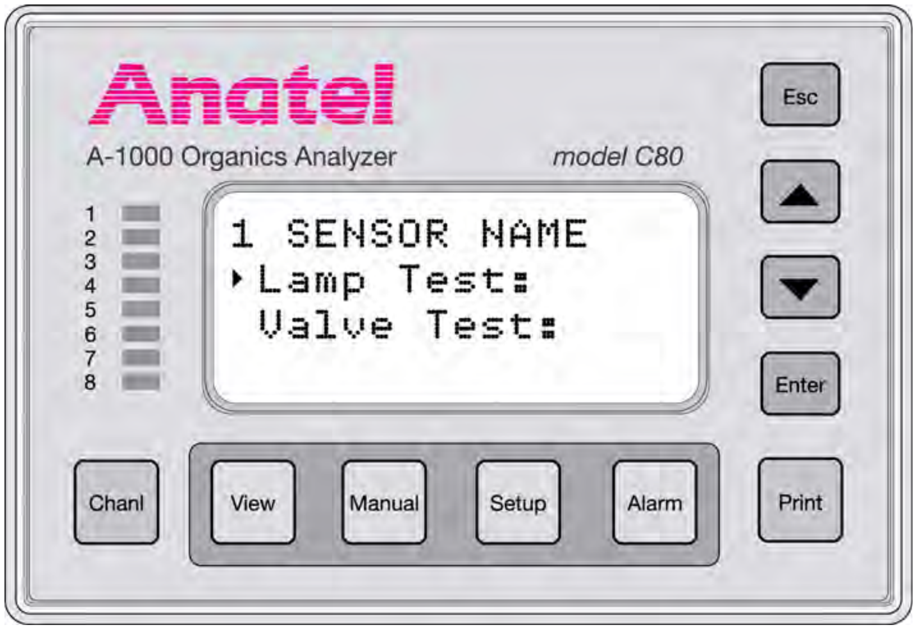


Fig 13-4 : Cell Diagnostics Screen

To check the status of these two Sensor components:

1) With the Sensor's Diagnostics Menu displayed, specify **Cell** and press **Enter** to access its options. The Cell Menu offers two options:
    - Lamp Test sets the UV lamp to “On” or “Off.”
    - Valve Test sets the sample valve to “Open” or “Closed.”
2) Use the **Up** and **Down Keys** to specify the desired diagnostic selection.
3) Press **Enter** to toggle the component's state. A printout is generated of the change.
4) Press **Esc** twice to return to the Cell Menu to perform the other function, or press it three times to return to the Diagnostics Menu.

13.3.3 I/O Tests

These pass/fail diagnostics verify the operation of the Sensor's serial and digital I/O circuits. An external loopback connector is required for these tests and should be attached to the appropriate Sensor port.

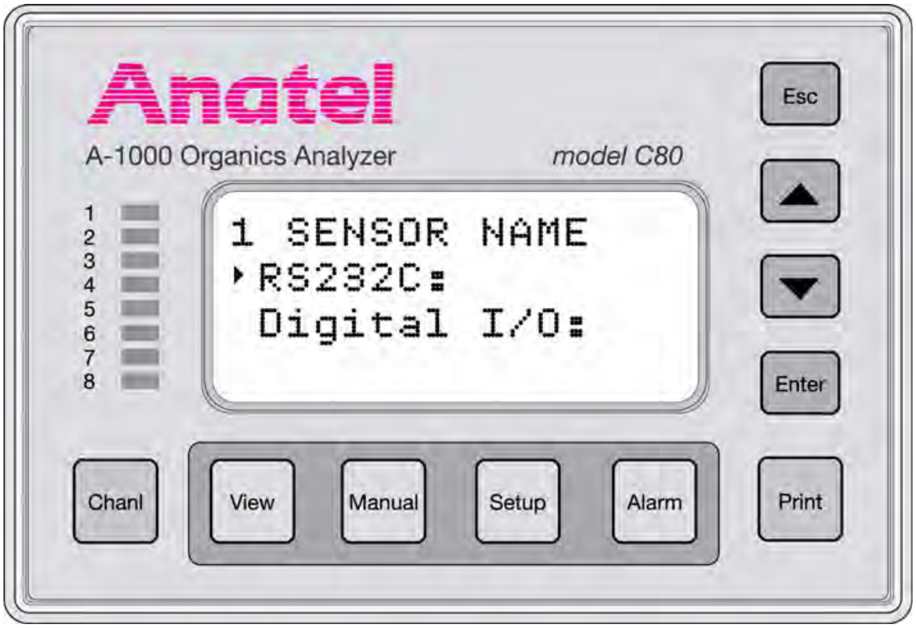
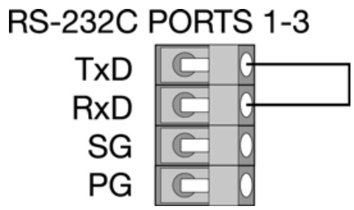


Fig 13-5 : I/O Diagnostics Screen

To check operation of the Sensor's I/O connections:

1) With the Sensor's Diagnostics Menu displayed, specify I/O and press Enter to access its options. The I/O Menu offers two options:
   - RS-232C runs an individual loopback test on each of the connected serial ports. A jumper must be applied to the RxD and TxD terminals on each of the Sensor's serial ports as shown.
   - Digital I/O verifies the Sensor's digital input and output connectors. A jumper must be applied RS-232C PORTS 1-3 across the Sensor's digital input and output TxD terminals as shown.
2) Use the **Up** and **Down Keys** to specify the desired communications test.
3) Press **Enter** to execute the test. The results are presented on the Controller display and a corresponding printout is generated. If the Sensor fails either of the tests, check the wiring before contacting Hach Ultra for assistance.
4) Press **Esc** repeatedly in order to return to previous display screens.



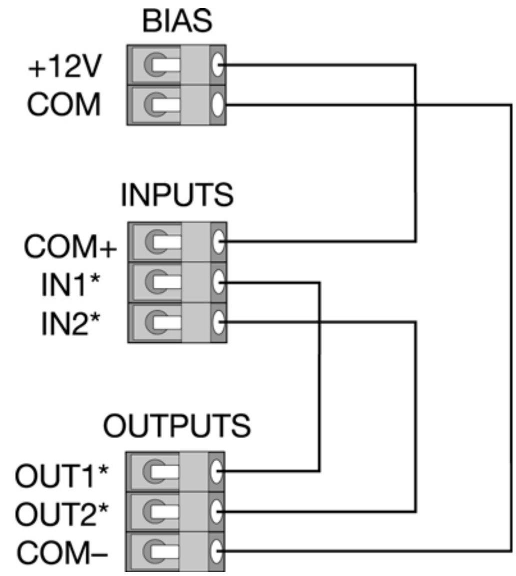


Fig 13-6 : RS-232 Loopback Wiring

Fig 13-7 : Digital I/O Loopback Wiring

13.3.4 Network Test

The Network Test provides a method of verifying that a Sensor is interfacing with its associated Controller. This communications check can be performed on any A1000 Sensor to verify proper communications without affecting A-Net operation.

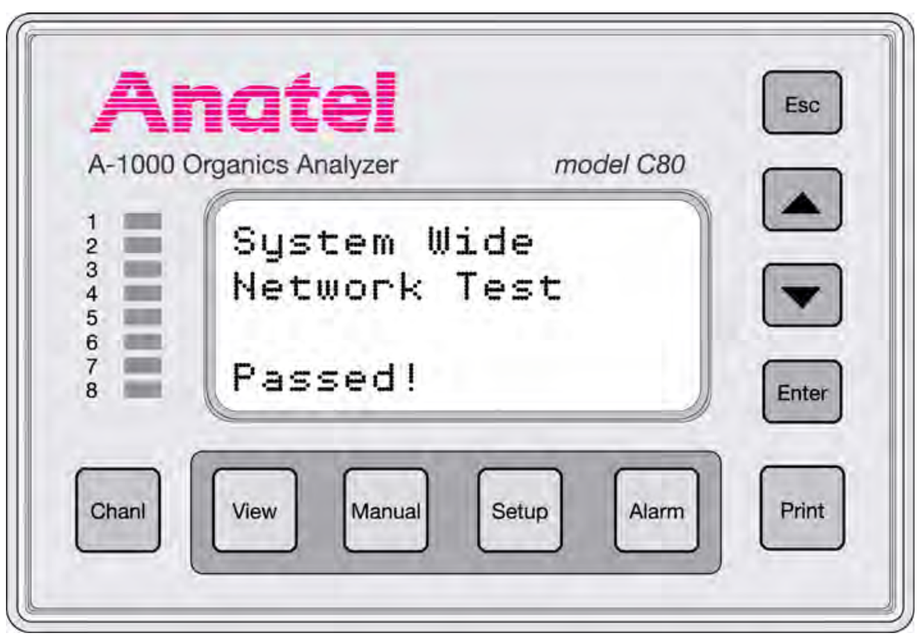


Fig 13-8 : Network Test Screen

To perform a Network Test:

1) With any Sensor specified, press the **Setup Key** to display its menu selections.
2) Use the **Up** and **Down Keys** to specify **System Setup**.
3) Specify **Network Test** and then press **Enter** to perform the test. The Controller reports the results of this communications check.

If the Network Test fails, confirm the Sensor's hardware connections and perform the check once again. If the Sensor continues to fail the Network Test, execute a Memory test (as outlined in "Electronics Tests" on page 149) to generate a printout of the instrument's recorded communications errors and then contact Hach Ultra.

Appendix A: Service Procedures

A.1 Return Procedures

To return the A1000 TOC Analyzer for service, first obtain a returned material authorization number (RA#). The RA# is necessary for any instrument that requires repair or calibration by an authorized service center. Include the RA# on the shipping label when the instrument is returned.

While the RA# process is described in this section, for the most up-to-date RA# process information, including copies of all required forms, call Hach Ultra at 800-866-7889 or +1 541-472-6500.

To return an instrument for credit, please contact the local sales representative.

WARNING

The following actions must be performed when returning any unit for any reason to prevent personal injury and/or damage to the unit.

CAUTION:

Purge all water from the Sensor before returning the unit for service. Residual water will freeze inside the unit, expand and damage the measurement cell. Such damage is time-consuming to repair and is not covered by the warranty.

- All analyzers returned for repair or replacement must be thoroughly cleaned and all process material removed.
- Sludge contains bacteria that could be hazardous to Hach Ultra personnel. If a contaminated unit is received, Hach Ultra reserves the right to have the unit removed and destroyed by a hazardous material disposal team at the shipper’s expense.

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A.2 Technical Support Information

Technical Support Engineers are available to provide high quality advice and recommendations for applications, product operation, measurement specifications, hardware and software, factory and customer site training.

Please provide name, company, phone, fax, model number, serial number and comment or question.

Hach Ultra Analytics
5600 Lindbergh Drive
Loveland, CO 80538

Global Headquarters
Service Department
6, route de Compois, C.P. 212,
CH-1222 Vésenaz, Geneva, Switzerland
Tel 41 22 594 64 00 Fax 41 22 594 64 88
www.hachultra.com

Call +1 (541) 472-6500
Toll Free (800) 866-8854 (US/CA)
Fax +1 (541) 474-7414
6:00 AM to 5:00 PM Pacific Time
Monday through Friday
Email: TechSupportGP@hachultra.com

Appendix B: Specifications and Options

The Anatel A1000 TOC Analytical System is specifically designed for use in applications that monitor ultrapure water with a typical resistivity greater than 5MΩ-cm (as low as 1 megaohm-cm for pH neutral waters) compensated to 25°C.

At a minimum, the A1000 System consists of a single Sensor and a C80 Controller. The maximum configuration may contain up to 8 Sensors and 8

Controllers in addition to a host computer and associated input/output devices. These specifications refer to the A1000 Network regardless of the specific System configuration.

Note:
Specifications are subject to change without notice.

B.1 A1000 Specifications

B.1.1 Performance Specifications

Automatic TOC Mode	
Operating Range	0.05 to 9999 ppb as carbon
Repeatability	±0.05 ppb < 5 ppb TOC
	±1% > 5 ppb TOC
Minimum Input Resistivity	5.0 MΩ-cm for all waters
	1.0 MΩ-cm for neutral waters
	0.2 MΩ-cm for water with $C0_2$ as sole conductive species
Ambient Operating Temperature	
S10 Sensor	5°C to 35°C (41°F to 95°F)
S20P Sensor	5°C to 35°C (41°F to 95°F)
Sample Water Temperature	0°C to 100°C (32°F to 212°F)
Inlet Pressure	100 psig maximum (690 kPa)
Display Resolution	0.00 to 19.99 ppb
	20.0 to 199.9 ppb
	200 to 9999 ppb
Purge (Resistivity/Conductivity) Mode	
Operating Range	
Resistivity	0.01 to 18.20 MΩ-cm
Conductivity	0.05 to 100 microsiemens/cm
Temperature Compensation	To 25°C over entire range of 0° to 100°C (based on a NaCl model)
Display Resolution	Three significant figures as resistivity
	Four significant figures as conductivity
Accuracy	±3% over 0° to 100°C range

B.1.2 A1000 Physical Specifications

General	
Installation Category	II, IEC 1010
Pollution Degree	2, IEC 664
Indoor Use Only	
A1000 Network	
Type	RS-485
Maximum Number of Sensors	8
Maximum Number of C80 Controllers (any configuration)	8
Maximum Network Length	1 km (3,000 ft)
Network Cabling	Shielded Twin-axial, Twist-Lock BNC

B.2 C80 Controller Specifications

P/N FG 1000201 (120 VAC, 60 Hz), P/N FG 1000301 (230 VAC, 50 Hz)

The Model C80 Controller provides multiple Sensor display, individual instrument setup, system alarm indication and printer control functions for up to 8 Sensors via an RS-485 Network.

Displays	
Main	4-line x 16-character Super-Twist LCD
Channel	8 Bi-color (red/green) LEDs
Physical	
Operating Temperature	0°C to 40°C (32°F to 104°F)
Maximum Relative Humidity	90% RH
Maximum Altitude	4,000 m (13,125 ft)
Case	ABS front panel with Lexan overlay
Size	120 mm L x 81 mm W x 48 mm D (4.7 L x 3.2 W x 1.9 in. D)
	2.5 in. total depth behind panel
	(allow 4-5 in. to avoid crimping)
Weight	0.75 kg (1.5 lb)
Mounting	Panel
Connections	
Communications	Shielded Twin-axial, Twist-Lock BNC
Power	9 VDC Wall-Mount Power Pack (120 VAC ±10%, 60 Hz standard 230 VAC ±10%, 50 Hz optional)

B.3 S10 Sensor Specifications

P/N FG 1000401

The S10 Sensor is the basic analysis component in the A1000 TOC Analytical System.

Display	
Main	1-line x 16-character Super-Twist LCD
Backlighting	Yellow LED
Character Height	0.163 in.
Physical	
Operating Temperature	0°C to 35°C (32°F to 95°F)
Maximum Relative Humidity	80% RH
Maximum Altitude	2,000 m (6,561 ft)
Size	330 mm L x 172 mm W x 112 mm D (13.0 L x 6.8 W x 4.4 in. D)
Weight	6.5 kg (12.75 lb)
Power	100 to 240 VAC, 50/60 Hz, 2/1 Amp
I/O Connections	
Serial Interfaces	RS-485 opto-isolated Network RS-232 Data Acquisition RS-232 Printer RS-232 Diagnostics
Digital I/O	Two opto-isolated inputs Two opto-isolated outputs
Analog	Opto-isolated 4-20 mA output Non-isolated 12 VDC output @ 1/2 Amp max.

B.4 S20P Sensor Sepcifications

P/N FG 1000601

The Model S20P Sensor combines a C80 Controller, handle, feet, the standard Model S10 Sensor and a 40-column thermal printer to provide a complete and integrated portable TOC analysis system.

Display	
Main	4-line x 16-character Super-Twist LCD
Backlighting (adjustable)	Yellow LED
Character Height	0.163 in.
Physical	
Operating Temperature	0°C to 35°C (32°F to 95°F)
Maximum Relative Humidity	80% RH
Maximum Altitude	2,000 m (6,561 ft)

Size	330 mm L x 172 mm W x 112 mm D (13.0 L x 6.8 W x 4.4 in. D)
Weight	8.25 kg (16.5 lb)
Power	100 to 240 VAC, 50/60 Hz, 2/1 Amp
Connections	
Serial Interfaces	RS-485 opto-isolated Network RS-232 Data Acquisition RS-232 Diagnostics
Digital I/O	Two opto-isolated inputs Two opto-isolated outputs
Analog	Opto-isolated 4-20 mA output

B.5 Thermal Printer Specifications

P/N FG 2009401

WARNING

Properly dispose of expired batteries. Lithium batteries present a fire, explosion and burn hazard. Do not attempt to incinerate, recharge or disassemble them.

The Seiko Instruments Model DPU-414 Type II is a 40-column thermal printer. It can operate as a standalone reporting device with the S10 Sensor and is integrated into the design of the S20P Sensor.

The S20P printer’s onboard NiCad battery is not field-replaceable; contact Hach Ultra for replacement. The battery can be recharged, however, by turning the printer “OFF” and the S20P “ON” for eight hours.

Print	
Method	Thermal Serial Dot-Matrix
Format	9 dots high x 7 dots wide
Speed	52.5 characters per second (cps)
Width	89.6 mm
Paper Size	112 mm, 40-column
Buffer	7400 characters
Physical	
Dimensions	162 mm W x 240 mm L x 58.5 mm D (6.38 W x 9.45 L x 2.30 in. D)
Temperature Range	0°C to 40°C
Humidity	30 to 80% RH (non-condensing)
Connections	
Power	120 VAC, 60 Hz Standard (230 VAC, 50 Hz Optional)
NiCad Battery (S20P only)	4.8 VDC, 1.5 Amp
Interface	RS-232 Serial, 1200 Baud

B.6 Sample Time

During the Sample Time, the Sensor's sample valve is open to allow the measurement cell to purge of any residual contamination. This parameter is set as outlined in "Sample Time" on page 60.

An empirical method for determining an appropriate Sample Time for any flow rate is to switch the instrument into the Purge Mode at the end of an oxidation cycle and note the time it takes for the resistivity reading to stabilize. Double this time to obtain a proper Sample Time interval. For systems where the water pressure varies, use the average of several such readings or update the Sample Time settings when inlet conditions change.

The Sensor must be rinsed completely in order to accurately measure sample resistivity. Even minute amounts of residual oxidation products will reduce the resistivity of a high-purity water sample considerably. The A1000 Sensors compensate the reported resistivity for variations in temperature by using high intensity UV which, in conjunction with an integral heater, warms the measurement cell. A substantial Sample Time re-establishes the temperature balance as well as flushing the previous sample.

As an example, in 18 MΩ-cm water containing 100 ppb TOC, a rinse of 99% will lower the measured TOC by only 1 ppb. Sample resistivity, however, will degrade by more than 2.5 MΩ-cm.

B.7 Profile Types

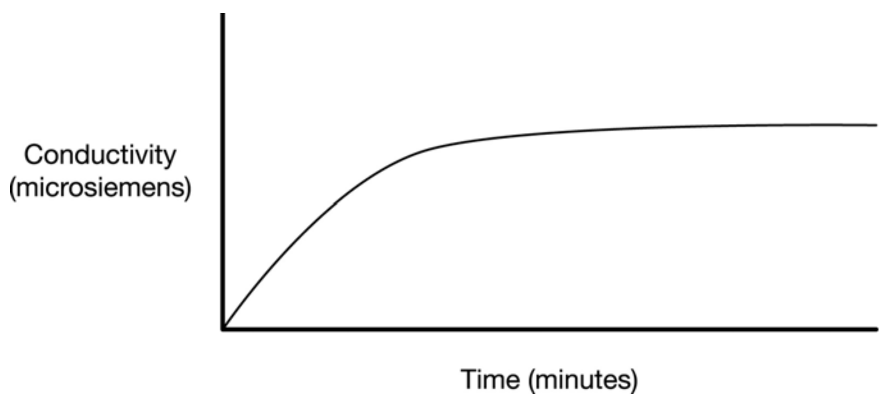

Fig B-1 : P1-Type Oxidation Curve

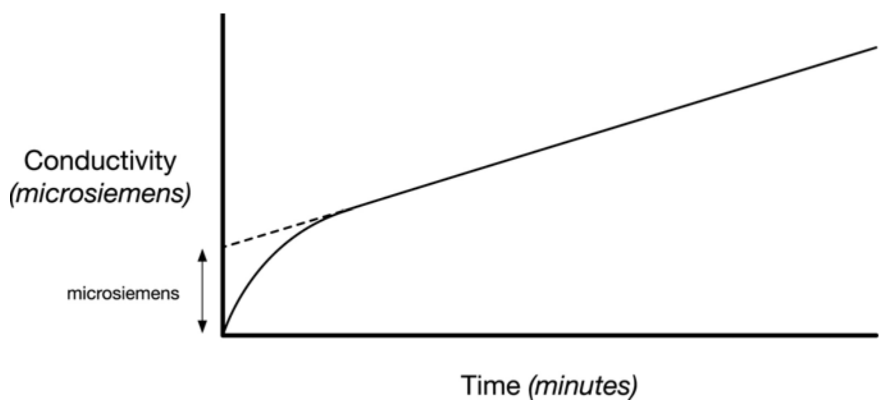

Fig B-2 : P2-Type Oxidation Curve

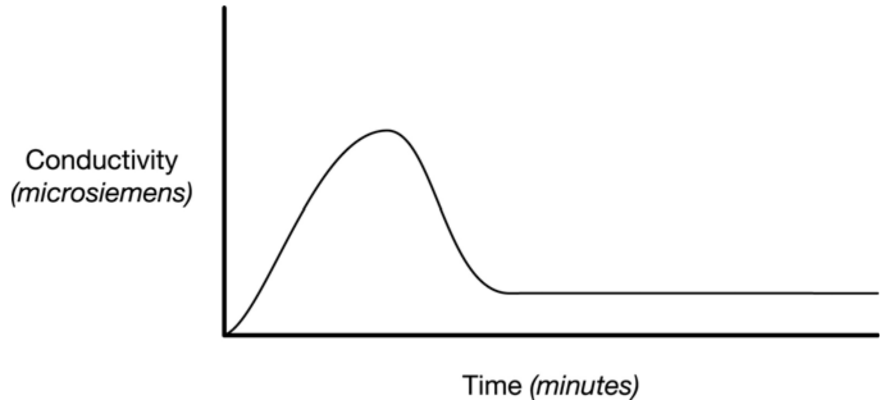

Fig B-3 : P3-Type Oxidation Curve

A1000 Sensors continuously monitor conductivity and temperature during analysis to ensure complete oxidation (100% yield) of the sample. The relationship between conductivity and time is called the “oxidation curve.” Three forms of oxidation curve are reported:

- Type 1 (“P1”)
- Type 2 (“P2”)
- Type 3 (“P3”)

Conductivity is always increasing until oxidation is complete in a P1 sample. This indicates that few intermediate organic acids, which have higher conductivity than the equivalent CO_2, are formed. A P3 sample contains significant amounts of these acids. Consequently, conductivity peaks then decreases as completion nears. P2 samples occur at low TOC levels and are very similar to a P1, or minor P3, sample in which the organic “background” of the measurement cell must be adjusted.

Abrupt changes in the Profile Type can indicate a change in water chemistry. For example, a change from a P2 to a P3 Profile Type at a TOC level of 10 ppb, indicates a contamination shift towards more complex compounds. This comparison is also valid between water treatment systems when TOC levels are similar. Note that changing to the “Fast” Analyze Rate may change the Profile Type. The “Normal” Analyze Rate is recommended for applications where the Profile Type is of interest.

Simple organics, such as methanol, report P1 up to relatively high levels (in excess of 500 ppb). More complex organics tend to oxidize as a P3 Type at all but the lowest levels (less than 25 ppb). In this instance, complex indicates either very large organics with a high molecular weight or organics that contain some element which resists oxidation. As TOC levels vary, the location of this transition shifts but the accuracy of the measurement is maintained. Neither the Profile Type nor the analysis conditions cause any variations in TOC readings.

Appendix C: Certifications

C.1 Overview

This section contains the WEEE statement and any Certificates of Conformity. For more information, contact a local Hach Ultra representative or contact the factory at 800-866-7889 or +1-541-472-6500.

DECLARATION OF CONFORMITY

(according to ISO/IEC Guide 22 and EN 45014)

MANUFACTURER'S NAME: Anatel Corporation

MANUFACTURER'S ADDRESS: 5600 Lindbergh Drive
Loveland, Colorado 80538 U.S.A.

declares that the product

A1000 Total Organic Carbon (TOC) Analysis System, inclusive of model(s):

- **C80 Controller**
- **S10 Sensor, S20 Sensor and S20P Sensor**
- **Gateway Network Interface**

to which this declaration relates, *meets the essential health and safety requirements* and is in conformity with the following EU Directive:

EMC Directive 89/336/EEC

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

Safety: LVD EN 61 010–1:1993 + A2:1995

EMC: CENELEC EN 50 081–2:1993, Class B†
- Conducted EN 55 011:1992, Class B, Group 1
- Radisted EN 55 011:1992, Class B, Group 1

CENELEC EN 50 082–2:1995
- IEC 801–2, EN 61 000–4–2; 4kV CD, 8kV AD
- IEC 801–4, EN 61 000–4–4; 2kV Signal Lines, 2kV Power Lines
- IEC 801–3, ENV 50 140, EN 61 000–4–3; 10V/m
- IEC 801–6, ENV 50 141, EN 61 000–4–5; 10V

† The product was tested in a typical configuration of Anatel's TOC Monitoring System.

Supplementary Information:

The product herewith complies with the requirements of the Low Voltage Directive 73/23/EEC and the EMC Directive 89/336/EEC. The subject products were also tested by LGA Ref #EMC–295/2129 for certificate of conformity to EMC directive, and LGA GS Mark Certificate #9741007, conformity to LVD directive.

The CE Marking has been affixed on the devices according to the EU Directive 89/336/EEC.

VP of Operations
Anatel Corporation
Boulder, Colorado

Appendix D: Glossary

Several of the terms used throughout this User Guide have specific meaning within high-purity water applications.

Conductivity	A measure of the flow of electrical current through water. This conductance, very low with high-purity deionized water, is the reciprocal of resistivity and is measured in microsiemens per centimeter (µS/cm).
High-Purity Water (HPW)	A term that differentiates between simple deionized water and the purer water required for more critical processes. High-purity implies water that is low in potential contaminants such as ions, microorganisms, organics and particles.
Megaohm (MΩ)	a measurement of 1,000,000 ohms
Microsiemens (µS)	a unit of conductance in the meter-kilogram-second system equivalent to one millionth of an ampere per volt.
Organics	organic chemicals which include carbon except for carbonate (CO2, HCO3, CO3) or cyanide (CN) related compounds. Oxygen is very common in organics and they almost always include hydrogen.
Oxidation	the loss of electrons by a chemical species, typically with oxygen. Organic carbon, for example, oxidizes to carbon dioxide and water.
Parts per billion (ppb)	a term used to report trace chemical analyses. It refers to the concentration of the element or compound present within one billion parts of water. One microgram per liter (µg/L) is equal to 1 ppb).
Resistivity	resistance, measured in megaohmcentimeters (MΩ-cm), to the flow of electrical current through high-purity water. Resistivity is a means of continuously measuring the purity of the water and is the reciprocal of conductivity.
Temperature Compensation	resistivity and conductivity of electric current in water depend on the temperature of the water. The lower the temperature, the higher the resistivity and the lower the conductivity. Resistivity and conductivity measurements typically are corrected to 25°C. In other words, they reflect the values they would report at a sample temperature of 25 °C.
Total Organic Carbon (TOC)	a measurement of the organics present in water based on it carbon content. High-purity water measures TOC in parts per billion (ppb).

Appendix E: Sensor Log

Table E-1 : Sensor Log

Channel Number	Sensor Name	Location	Model and Serial Number	Installation Date

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Annex

Tables and illustrations

User Notes

Global Headquarters
6, route de Compois C.P. 212
CH-1222 Vesenaz, Geneva, Switzerland
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Fax +41 (0)22 594 64 99

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Grants Pass, Oregon 97526 USA
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Fax +1 541 472 6170

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