

OWNERS MANUAL

Micro TOL
0-1000 NTU

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Catalog No. 24031 (12/04)
Rev. 2.7

DECLARATION OF CONFORMITY

Application of Council Directive

Standard to Which Conformity is Declared:

Product Safety - Tested and passed CE EN61010-1: 1990 + A1: 1992 (73/32 EEC)
- Tested and passed ETL (tested to UL3111-1)
- Tested and passed ETLc (tested to CSA C22.2#1010-2-010)

Immunity – Tested and passed EN61326: 1998

Including:

EN61000-4-2
EN61000-4-3
EN61000-4-4
EN61000-4-5
EN61000-4-6
EN61000-4-8
EN61000-4-11

Emissions - Tested and passed EN61326 (EN55011 Class B)

Manufacturer's Name: HF scientific, inc.

Manufacturer's Address: 3170 Metro Parkway, Fort Myers, Florida 33916-7597

Importer's Name:

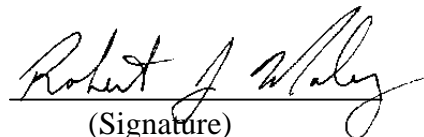
Importer's Address:

Type of Equipment: Process Turbidimeter

Model No: Micro TOL

I, the undersigned, hereby declare that the equipment specified above conforms to the above Directive and Standard

Place: Fort Myers, Florida USA


(Signature)

Robert J. Maley, President

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Specifications

Measurement Range	.01 – 1000.0 NTU
Accuracy	±2% of reading plus 0.01 NTU (0-10 NTU) ±5% of reading plus 0.1 NTU (10-1000 NTU)
Resolution	0.0001 NTU (below 10 NTU)
Response Time	0 - 8 Seconds (0 – 10 NTU Range) 0 – 20 Seconds (0-1000 NTU Range)
Display	Multi-Line Liquid Crystal Display
Two User Programmable Alarms & Analog Output	120-240VAC 2A Form C Relay & 4-20 mA
Communications Port	Bi-directional RS-485 (optional)
Maximum Water Pressure	414 kPa (60 psi.)
Flow Rate	100 ml/min. – 6 liters/min. (.026-1.5 Gal/min)
Operating Temperature Range	1°C – 50°C (34°F – 122°F)
Sample Temperature Range	1°C – 50°C (34°F – 122°F)
Power Supply Voltage	90 – 250 VAC, 47 – 63 Hz
Power Consumption	80 VA
Insulation Rating	Double Insulated, Pollution Degree 2, Overvoltage Category II
Environmental Conditions	Not recommended for outdoor use. Altitude up to 2000 meters Up to 95 % RH (non-condensing)
Enclosure Rating	IP 66 /NEMA 4X
Regulatory Compliance (0-10NTU)	(20023) White Light Version compliant to U.S. EPA 180.1 (20024) Infrared Version compliant to ISO 7027
Shipping Weight	2.5 kg (5.5 lbs.)
Warranty	1 Year from date of shipment

1.0 Overview

The MICRO TOL process turbidimeter allows you to measure the turbidity of your process water on-line. The White Light MICRO TOL has been designed to meet the design criteria specified by the US EPA on turbidity measurement. The infrared MICRO TOL was designed to meet the design criteria specified in ISO 7027 and DIN 27027 for the measurement of the turbidity of a sample. Both models have long life lamps.

1.1 Unpacking and Inspection of the Instrument and Accessories

The table below indicates the items you should find in your turbidimeter shipment.

Item	Part #	Quantity
MICRO TOL Turbidimeter	20023 (White Light Version), or 20024 (Infrared Version)	1
Instruction Manual	24031	1
Desiccant Pouch	21555R	1
Cuvette (Single Pack)	50033	1
Tubing Kit *	51025A	1

* Note - Tubing Kit includes:

- 1-shutoff clamp
- 1-backpressure valve
- 2-connecting tubings with fittings for flow through assembly
- 1-drain vent screw (used in pressurized systems)

Remove the instrument from the packing carton. Carefully inspect all items to ensure that no visible damage has occurred during shipment. If the items you received do not match your order, please immediately contact your local distributor or the HF scientific, inc. Customer Service department.

1.2 The Display

Figure 1 illustrates all the items that can appear on the display. The upper row of the display (1) is used for reporting the turbidity levels and to provide user guidance in the customer setting routine. The lower row of the display (2) is used to communicate error messages and provide user guidance. The display has two icons (3) that are used to indicate the use of access code and offset mode. In addition, mode arrows (4) are used to indicate the current instrument operating mode; AUTO (normal operation), CAL (calibration) and CONFIG (configuration).

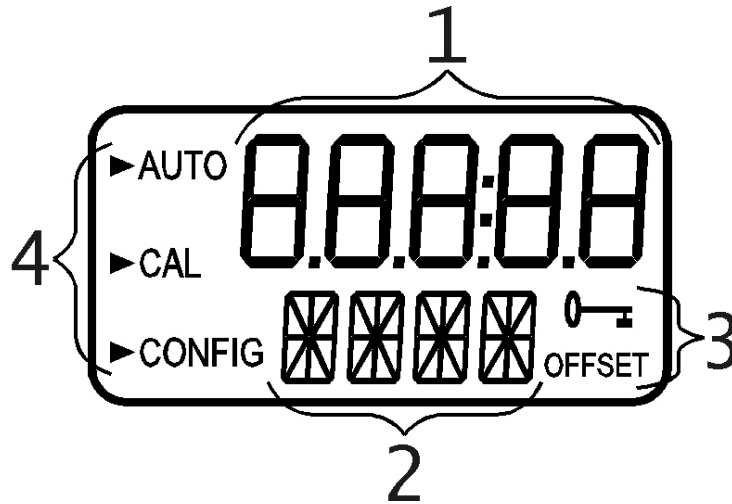


Figure 1 – Display used in the instrument.
 All items used on the display are shown in this figure

1.3 The Touch Pad

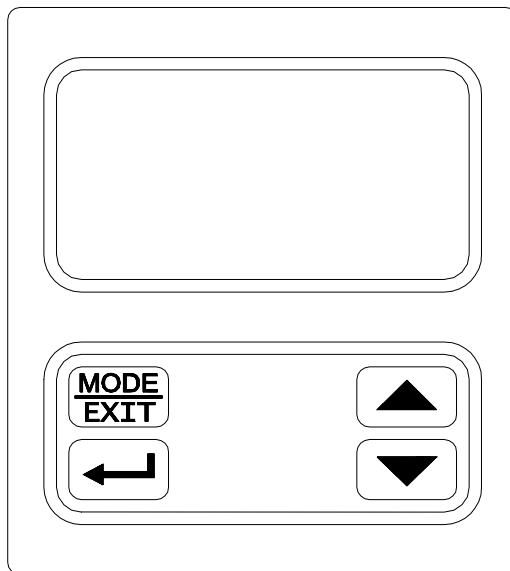


Figure 2: The Micro TOL touch pad.

Figure 2 illustrates the touch pad. The touch pad has four buttons: **MODE/EXIT**, ↵, ▲, and ▼. The **MODE/EXIT** button is used to cycle between the four operational modes of the instrument: **CAL**, **CAL OFFSET**, **CONFIG**, and **AUTO** (Measurement) mode. The ↵ button enters the option (or mode that is highlighted or chosen. The ▲ and ▼ buttons are used to scroll through lists and to increase or decrease settings.

1.4 Vapor purge

The Micro TOL is equipped with a continuous vapor purge system. A replaceable desiccant pouch in the lower portion of the instrument dries the air. System heat is used to warm the air. A fan inside the instrument continuously circulates heated dry air around the optical well and the flow through cuvette. This feature eliminates the need for a dry purge line.

The Micro TOL monitors the replaceable desiccant pouch condition continuously. The LCD display will show **DESC** on the lower line in the event that the desiccant pouch needs replacement. Replacement desiccant pouches are available from HF scientific, inc. or your local representative (part # 21555R).

2.0 Safety

This manual contains basic instructions that you must follow during the commissioning, operation, care and maintenance of the instrument. The safety protection provided by this equipment may be impaired if it is commissioned and/or used in a manner not described in this manual. Consequently, all responsible personnel must read this manual prior to working with this instrument.

In certain instances **Notes**, or helpful hints, have been highlighted to give further clarification to the instructions. Refer to the *Table of Contents* to easily find specific topics and to learn about unfamiliar terms.

3.0 Installation and Commissioning

Prior to use for the first time, the supplied desiccant pouch will need to be installed. Refer to section 9.2 *Replacing or Installing the Desiccant Pouch*.

3.1 Mounting & Site Selection

The instrument is designed for wall mounting. If wall mounting is not practical, the instrument can be mounted on any suitable level surface. For ease of service there should be about 20 cm (8") free area above the instrument; this will ensure enough room for calibration and cuvette maintenance. Choose a location that is easily accessible for operation and service and ensure that the front display rests at eye level. The overall mounting dimensions of the instrument are shown in Figure 3. The recommended mounting screws are M6 (1/4") for the instrument enclosure and M4 (3/16") for the junction box. The Micro TOL is designed to have the field terminal box cradled under the sensor portion of the instrument. It is recommended that the field terminal box be mounted first, and then the rest of the instrument be mounted on top.

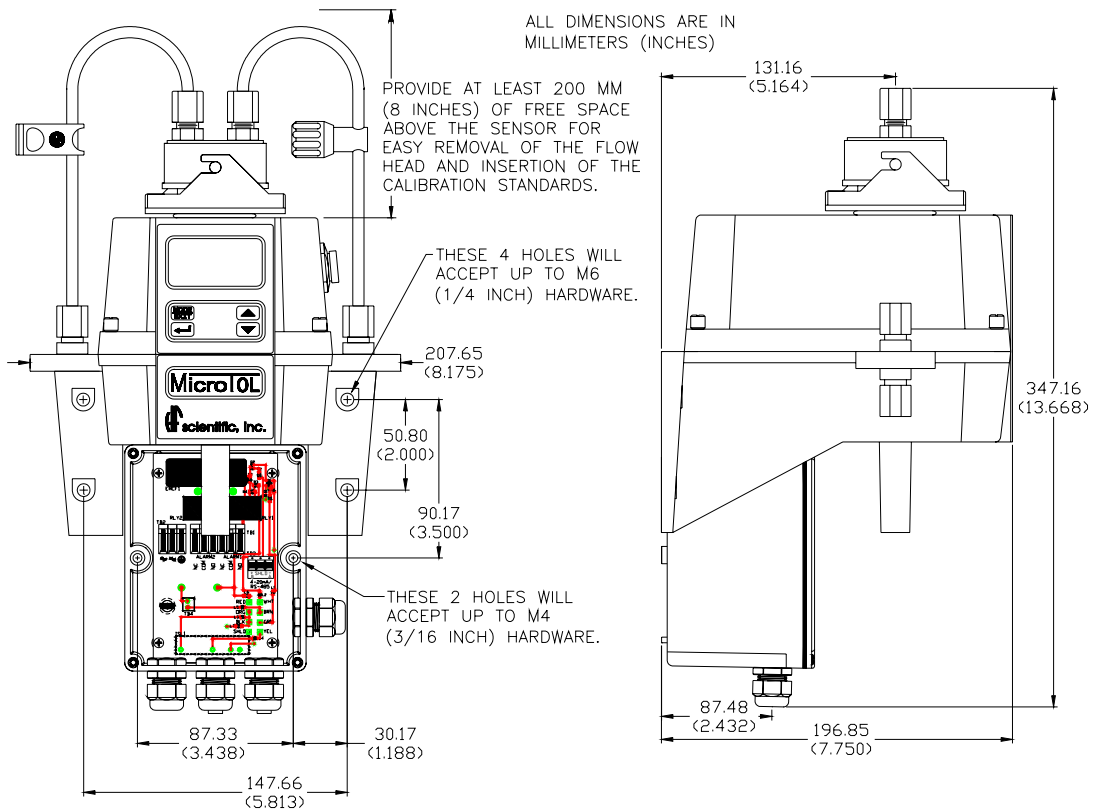


Figure 3: Overall Mounting Dimensions of the Instrument

It is critical that the instrument be mounted as close as possible to the sampling point to ensure a quick response time (within 2-3 meters (6-10 ft) of the sampling point).

3.2 Plumbing

The recommended plumbing for the instrument is shown in Figure 4. The instrument is designed to require very little head pressure to operate. The flow through cuvette is rated for a flow of 100ml/min. – 6 liters/min. (0.26-1.5 Gal/min), and a maximum pressure of 414 kPa (60 PSI.). The maximum allowable fluid temperature is 50°C (122°F).

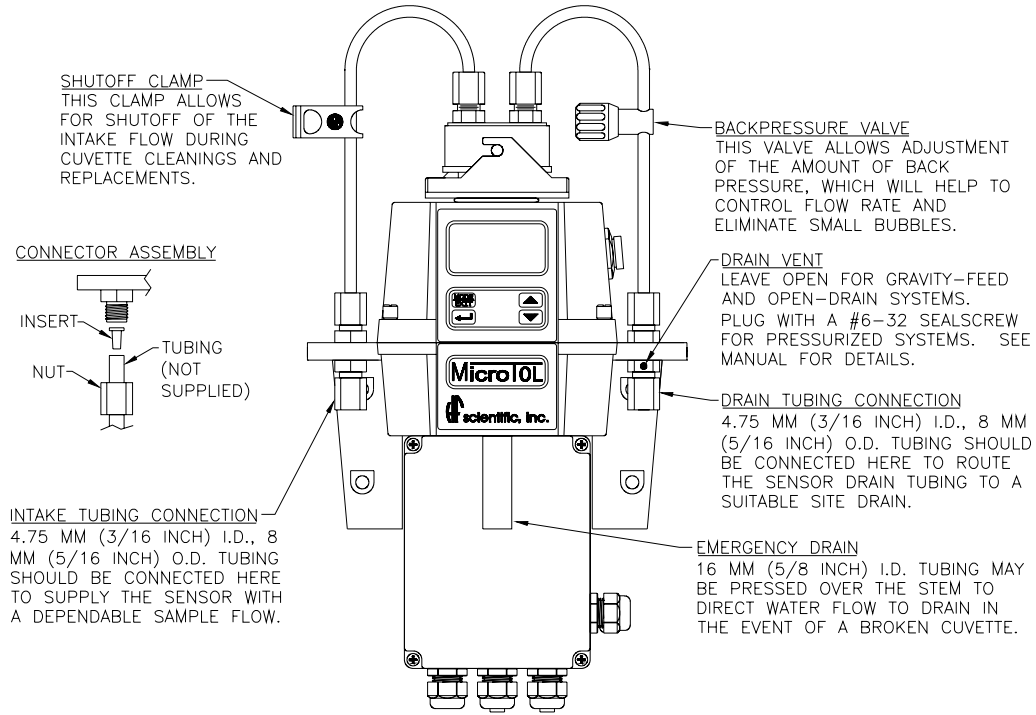


Figure 4: Recommended Plumbing for the Instrument

The instrument is equipped to be plumbed using 4.75 mm (3/16”) ID, 8 mm (5/16”) OD flexible tubing. Opaque tubing should be used if the tubing will be exposed to sunlight, to prevent algae growth.

In figure 4, there are two flow devices shown. The one on the input side is a shutoff clamp used during cuvette maintenance. The other device is a backpressure valve. Backpressure may be required to prevent air from coming out of solution, which may be observed as tiny air bubbles.

The instrument is equipped with an internal foot valve, which opens in case the flow through cuvette ruptures, to prevent damage to the sensor. The stem of the emergency drain can be connected to a 16 mm (5/8”) tube (not supplied) to direct the flow of water to a convenient drain. Keep the length of this emergency drain to a minimum.

Note: The foot valve system can handle up to 1.5 liters per minute (0.4 gallon per minute). Flow rates higher than this will cause the instrument to flood in the event of a ruptured cuvette.

3.2.1 Pressurized Systems: For pressurized systems, keep the pressure below 69 kPa (10 PSI) or 7.62 m (25 foot) of head or limit the flow the 1 liter per minute. An inline flow regulator is available from HF scientific inc. catalog number 19778.

3.2.2 Drain Vent: The Micro TOL has been fitted with a drain vent in the “OUT” bulkhead fitting. This fitting allows for atmospheric equalization, thus helping to alleviate bubble formation in the cuvette.

In high-pressure systems, minor leakage may occur. This will subside once normal flow is established.

For systems, where the “OUT” line does not return to an open drain, a 6:32 seal screw is provided which should be inserted into the vent hole and tightened.

3.3 Electrical Connections

All of the electrical connections to the instrument are made through the field terminal box, which should be located under the sensor section of the instrument. The connections are labeled within the terminal box and are self-descriptive (see Figure 5). Please follow all local and government recommendations and methods for installation of electrical connections to and between the instrument and other peripheral devices.

Plugs are inserted into the alarm and 4-20mA/RS-485 cable bulkheads when shipped, to ensure a watertight seal. These plugs should be removed and discarded when cabling to either of these connections.

The power cable bulkhead will accept cable diameters from 5.8mm (.230 in.) up to 10 mm (.395 in.). All terminals are designed to accept wires in the range of 14-28 AWG. All wires should be stripped to a length of 6 mm (¼”). A strain relief strap is provided to reduce tension on the power terminals.

It is the user’s responsibility to assure that the watertight seal is maintained after the terminal box has been wired for operation. If any of the bulkheads are not tightened properly around a cable or plug, the ratings of the instrument will be jeopardized and there is a possibility of creating a shock hazard.

Note: Only qualified electricians should be allowed to perform the installation of the instrument as it involves a line voltage that could endanger life.

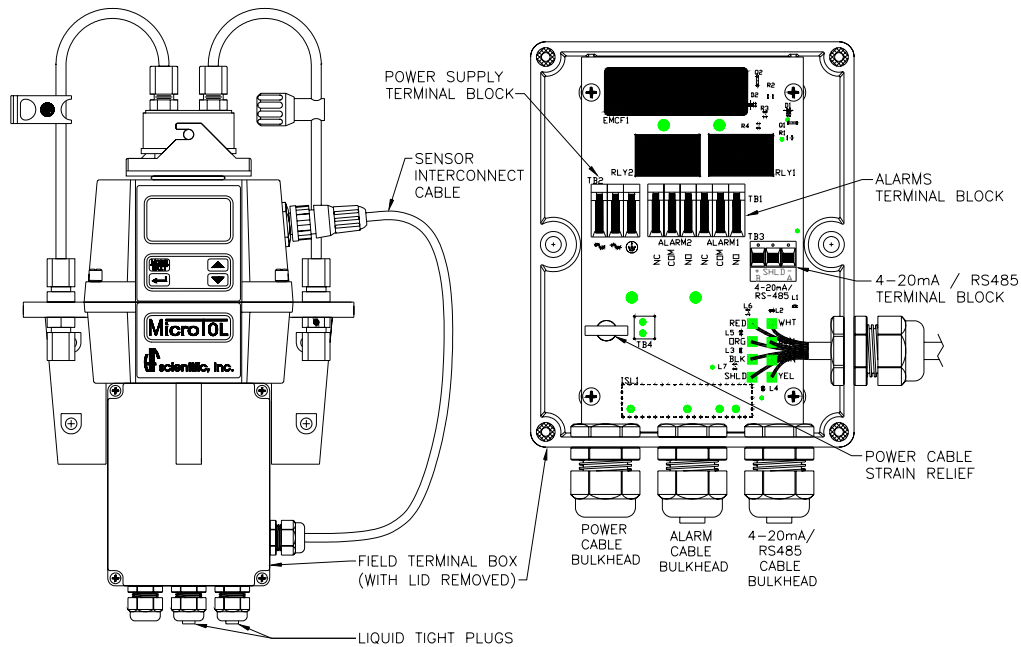


Figure 5: Electrical Connections for the Instrument

3.3.1 Power: The instrument is equipped with a 90-250 VAC, 47-63 Hz switching power supply; please verify that the line voltage falls within these specifications. It is recommended that a circuit breaker be placed prior to the power connection to allow for service. While making your connections, refer to Figure 5. **The Micro TOL is not supplied with a power cord.**

Note: Your Micro TOL is equipped standard with a 4-20 mA output and alarm relays. If the optional RS-485 is installed, the 4-20 mA and the relays are disabled and you should ignore all references to these items.

3.3.2 RS-485 Option: (Part # 19615) The RS-485 half-duplex (2-wire) digital interface option operates with differential levels that are not susceptible to electrical interferences. This is why cable lengths up to 3000 ft can be implemented. The last device on every bus must be terminated with a 120 ohm resistor to eliminate the possibilities of signal reflection on the line. Do not run RS-485 cables in the same conduit as power.

Ensure each instrument is not powered when connecting the RS-485 line. To prevent damage to the instrument, ensure that power is disconnected prior to making connections.

3.3.3 Relays: The Alarm 1 and Alarm 2 relays are mechanical relays rated at 240 VAC 2A. Please note that the relays are labeled NO (Normally Open), NC (Normally Closed) and C (Common). As these alarms are configured fail-safe, the normal condition is with power applied to the Micro TOL and in a non-alarm condition. Operation of these alarms is covered in section 7.5 *Programming the Alarms & 4-20 mA (if used)*.

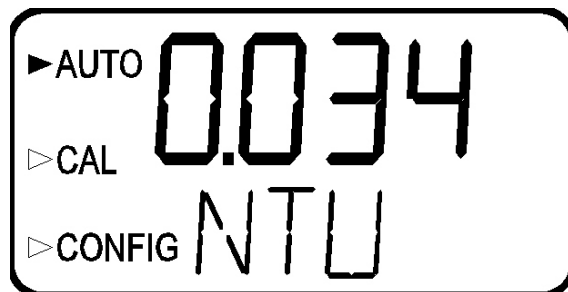
3.3.4 4-20 mA: The 4-20 mA output is driven by a 12 VDC power source and can drive recorder loads up to 450 ohms. This 4-20 mA output is isolated from line power and earth ground. Do not run 4-20 mA cables in the same conduit as power. Operation of these alarms is covered in section 7.5.3 *Setting the 4-20 mA Output (if used)*. Optional optically isolated outputs are available.

Ensure each instrument is not powered when connecting the 4-20 mA. To prevent damage to the instrument, ensure that power is disconnected prior to making connections.

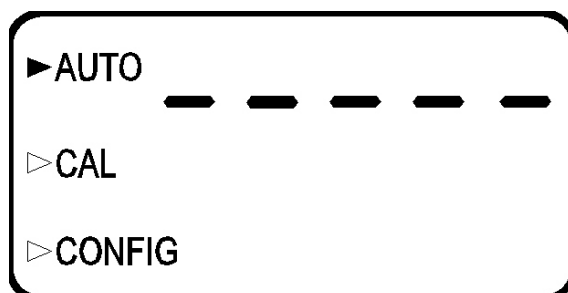
4.0 Operation

This process turbidimeter allows you to measure the turbidity of your process water on-line. The turbidity of the process water is reported in Nephelometric Turbidity Units (NTU). Readings above 1000 NTU are outside the range of this instrument.

During normal operation, the instrument will have the arrow beside **AUTO** highlighted with the current scale displayed on the lower row of the display and the measured reading on the upper row of the display (see illustration below).



In certain instances, during normal operation, the instrument will display a row of dashes across the upper row of the display (see illustration below).



This indicates that either the instrument is performing an auto-ranging function, or the sample has a substantial amount of bubbles. If the dashes remain for an extended period of time, please remove the flow through cell and check the sample for a large amount of bubbles present. If the problem persists, please contact the HF scientific, inc. Technical Services Department for further assistance and guidance.

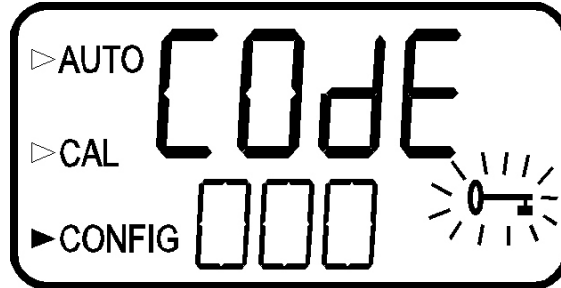
4.1 Routine Measurement

The following steps describe how to measure the turbidity of a sample using this instrument:

1. Apply power to the instrument and allow the unit to warm up (typically 45 minutes – 1 hour on initial commissioning).
2. When a continuous process stream is flowing through the instrument, the instrument will display the measured turbidity level of the sample by displaying it on the LCD screen. In addition, the equivalent signal is provided on the analog (4-20 mA) output, or the digital output, depending on the options selected.

4.2 Security Access Feature

The instrument is equipped with a security access code feature that can be activated in the configuration mode. If the security feature is enabled, the screen shown in the illustration below will appear when you press the **MODE/EXIT** button.



The security code has three numbers that are selectable one at a time. Notice that the first number in the code is flashing; the flashing indicates that this is the number to be changed. Use the \blacktriangle or \blacktriangledown arrows to select the value of the first of the three numbers in the code and then press the \blacktriangledown button to accept the first number of the code. Now enter the second number in the code. Proceed as with the first number followed by \blacktriangledown . Then repeat the process for the third number in the access code, remember to finish with the \blacktriangledown button.

If you have selected the valid access code, the instrument will be directed to the calibration mode. If the wrong access code is selected, the instrument will return to the **AUTO** mode. Refer to section 7.7 *Setting the Security Access* for more information.

5.0 Instrument Calibration

The instrument was calibrated and tested prior to leaving the factory. Therefore, it is possible to use the instrument directly out of the box. Under normal conditions, recalibration is recommended at least once every three months¹. If calibration is not performed, the instrument will continue to monitor the turbidity of the process water with a decreased accuracy.

Relay contacts are held at the last valid condition and will not change state while the instrument is in the calibration and/or in the configuration mode. While in the calibration mode, the instrument has a time-out feature that automatically returns the system operation to the **AUTO** mode after a thirty (30) minute period of inactivity.

5.1 Calibration Standards

If the Micro TOL will be used over the entire range of .02 to 1000 NTU a complete calibration as described below will be required. If instrument accuracy is only required below 10 NTU, such as potable water, a calibration may be performed using only a 10 NTU and a 0.02 NTU standard. To calibrate starting at the 10 NTU, press the **▲** button to bypass the 1000 NTU and proceed to Section 5.2 *Calibration Procedures*, step 5. Note that using the **▲** and **▼** buttons you can rotate through the requested standards and get to the **END** prompt. Pressing the **↵** button at the **END** prompt will have the same affect as pressing the **MODE/EXIT** button; no calibration change will have been made.

We recommend that you use the following materials during calibration to achieve the full-scale accuracy stated in this manual:

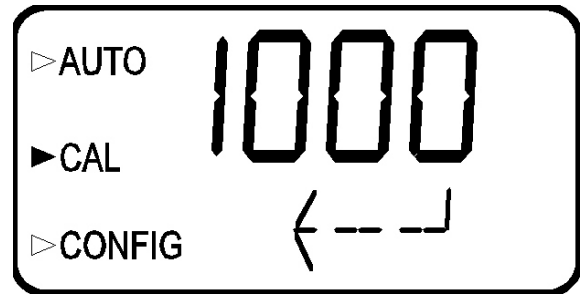
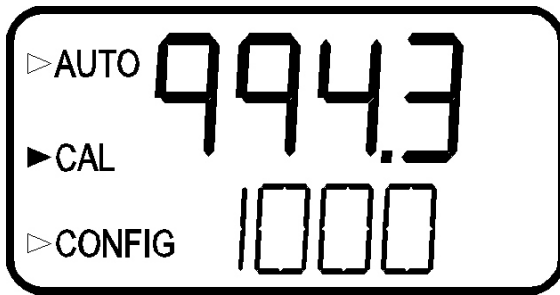
1. 0.02 NTU **PRIME TIME** Calibration Standard available from HF scientific inc.
2. 10.0 NTU **PRIME TIME** Calibration Standard available from HF scientific, inc.
3. 1000 NTU **PRIME TIME** Calibration Standard available from HF scientific, inc.

It is well known that diluted Formazin is unstable. If you choose to use Formazin to calibrate the instrument, ensure that you are using a fresh stock suspension of Formazin to achieve the accuracy quoted for the instrument. A Formazin Stock Solution Kit is available from HF scientific, inc. (Catalog No. 50040). The HF scientific, inc. **PRIME TIME**, primary calibration standards (refer to section 10.0 *Accessories and Replacement Parts List*) are more stable than Formazin and have a minimum shelf life of 12 months. Prior to recalibration, review the expiration dates, to ensure that the standards have not expired.

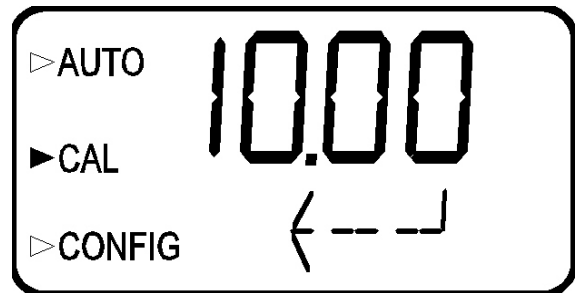
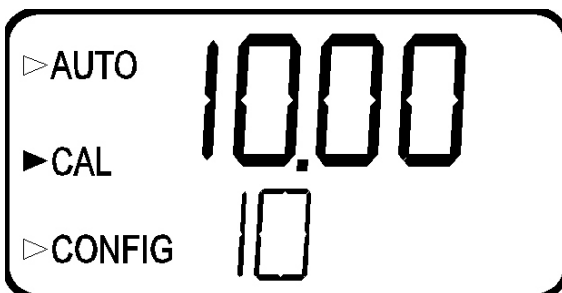
5.2 Calibration Procedures

1. Select the calibration function of the instrument by pressing the **MODE/EXIT** button once. The arrow beside **CAL** will be illuminated on the display. The lower display shows alternating **1000** (the value of the standard that is requested) and **↵**. The upper display shows the real-time reading to allow the standard to be indexed. Refer to section 6.1 for information on indexing cuvettes.

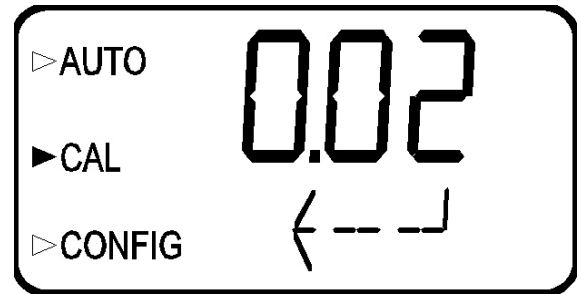
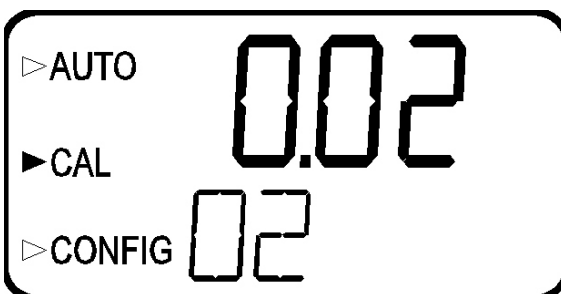
¹ The EPA recommends that on-line turbidimeters be calibrated with a primary standard at least once every three months if they are to be used for EPA reporting.



2. Remove the flow through unit.
3. Insert the requested 1000 NTU standard. Index the standard to the lowest value on the upper display.
4. Press the ↵ button to accept the calibration.
5. The lower display will count down the progress of the calibration step.
6. The lower display will now change to show alternating **10** and ↵, requesting the 10.0 NTU standard.



7. If the alternating **10** and ↵ is not displayed, push the ▲ or ▼ until you get this display.
8. Insert the requested 10.0 NTU standard. Index the standard to the lowest value on the upper display.
9. Press the ↵ button to accept the calibration.
10. The lower display will count down the progress of the calibration step.
11. The lower display will now change to show **02** and ↵, requesting the 0.02 NTU standard.



12. Insert the requested 0.02 NTU standard. Index the standard to the lowest value on the upper display.
13. Press the ↵ button to accept the calibration.
14. The lower display will count down the progress of the calibration step.
15. The instrument will show alternating **END** and ↵.
16. Press the ↵ button to accept the calibration.
17. The instrument will display **SAVE** on the lower display briefly and then the Mode will return to **AUTO**.

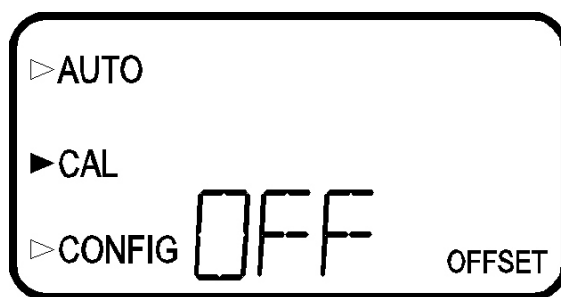
Note: During calibration, the fan inside the instrument is turned off to extend the life of the desiccant. The fan will be turned on after returning to the AUTO mode or after five minutes, whichever ever comes first. It is recommended that the measurement chamber be kept covered during the calibration period and that the flow through cuvette be replaced immediately after the calibration to prevent premature contamination of the desiccant.

6.0 Instrument Offset

In certain instances, you may wish to use an offset factor to calibrate your instrument rather than performing a physical calibration of the instrument (as described in section 5.2). This procedure is not recommended in lieu of regular instrument calibration but it can be used in situations where the number of instruments used makes regular calibration prohibitive. This calibration technique will make the instrument accurate *only* at turbidity levels in the immediate vicinity of the grab sample and *not* in the full range of the instrument. Note that the key icon will be illuminated whenever an offset used. The maximum offset is ± 1.00 NTU. If instrument variation is greater than 1 NTU a full calibration is recommended.

The procedures are as follows:

1. Collect a grab sample of the process water that is being monitored by the instrument and record the turbidity reported by the instrument.
2. Take the grab sample and measure its turbidity using your laboratory turbidimeter (contact the HF scientific, inc. customer services department for examples of laboratory turbidimeters).
3. Compare the turbidity reported by the instrument to that obtained in your laboratory. If the readings are very close, then no offset adjustment or calibration is required and you may stop the procedure at this step. However, if the readings are substantially different (but less than 1 NTU), you may continue on in this procedure to utilize the offset option to improve the turbidity reading of the instrument so that it will agree with your laboratory reading between calibrations.
4. Select the calibration-offset function of the instrument by pressing the **MODE/EXIT** button until the **OFFSET** and the arrow beside **CAL** are illuminated on the display. Refer to the following screen.
5. At this point, the lower row of the display will indicate the operational status of the offset function (ON or OFF). You may change this status by using the \blacktriangle and \blacktriangledown buttons. Once you have set the desired operational status of the offset function press the \blacktriangleleft button to accept it. If you turned the option off, you can return to **AUTO** mode by pressing **MODE/EXIT**.



6. If you turned the option ON, you will be prompted to enter the offset required. This will add or subtract the value of the offset to the measured NTU value. As an example if the Micro TOL measures the process at 0.16 NTU but the laboratory instrument read the sample at 0.12 NTU, adding an offset of -0.04 would result in the Micro TOL displaying 0.12 NTU.

Select the desired offset level using the ▲ and ▼ buttons. Once you have set the desired level, press the ↵ button to accept it.

7. This completes the offset configuration.
8. At this point, the instrument will continue to the configuration (**CONFIG**) mode of the instrument or press **MODE/EXIT** to return to the **AUTO** mode.

6.1 Indexing Calibration Cuvettes

To achieve the greatest accuracy, and account for normal scratches and aberrations in cuvette glass when calibrating, HF scientific inc. recommends indexing the cuvettes.

Each instrument is supplied with a white Indexing Pin located in the collar around the optical well. Standards and standard kits purchased from HF scientific are supplied with indexing rings.

The following two steps allow repeatable indexing of calibration standards:

1. Slowly rotate the standard, inside the optical well, one complete revolution (360°). While rotating the standard slowly, observe the measured turbidity and locate the position of the cuvette having the lowest reading.
2. With the calibration standard positioned at the location having the lowest turbidity reading, install the Indexing Ring over the black light shield on the standard so that the pointer of the Indexing Ring aligns with the Indexing Pin.

6.2 Restoring Factory Settings

If the instrument is unable to perform a calibration due to a low lamp output or a calibration using the wrong standards, the instrument will display **CAL** on the lower row of the display. The operator has two choices to correct this problem. If the operator can determine whether a poor calibration or a low lamp caused the problem, he/she can remedy the problem and recalibrate. If all else fails, the operator may restore the factory calibration by performing the following operation. While in the **AUTO** mode, Push and hold the ▲ button. Now push and release the ↵ then the ▲ button. Factory calibration and factory configuration have now been restored.

Note: Restoring the factory settings allows the use of the Micro TOL with reduced accuracy. The original problem still exists and must be determined and corrected before accurate operation of the Micro TOL will be resumed.

7.0 Instrument Configuration (CONFIG mode)

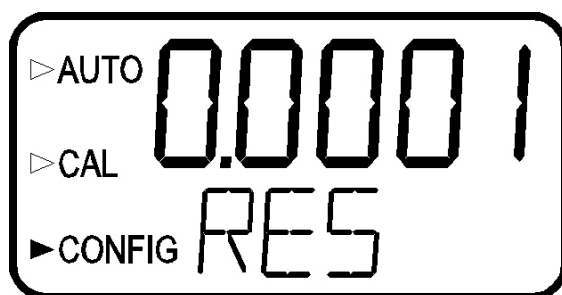
The instrument has been designed to provide you with the ability to customize your instrument according to your needs at any time during normal operation. This mode has been split into sub-menus to facilitate instrument configuration. This section describes how you can use each of the sub-menus to configure your instrument

Enter the **CONFIG** mode of the instrument by pressing the **MODE/EXIT** button until the arrow beside **CONFIG** is illuminated, then press the \downarrow button.

Note: To skip the selection of the **CONFIG** mode, press the **MODE/EXIT** button.

7.1 Displayed Resolution

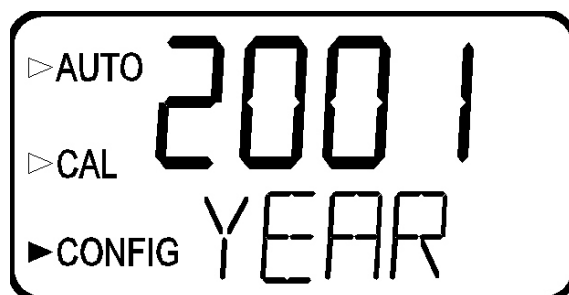
The instrument is equipped with the ability to display several levels of resolution. The instrument can display up to four digits to the right of the decimal place for turbidity readings below 10 NTU. If you feel that the last digit or two is not stable then you may adjust the resolution to hide these digits. Upon entering the **CONFIG** mode, the lower row of the display will show **RES** and the upper row of the display will show the number of digits that will be displayed.



Change the resolution by pressing the \uparrow or \downarrow button. When you have selected the desired digit resolution press the \downarrow button. After pressing the \downarrow button, the word **YEAR** will appear and the current year will be displayed.

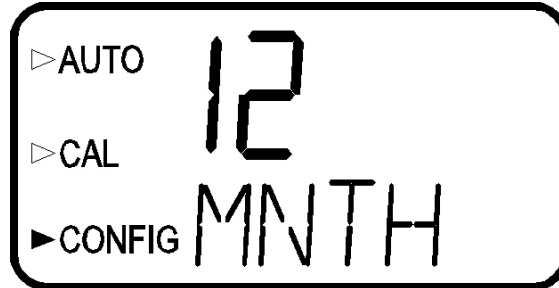
7.2 Setting the Year

With the **YEAR** showing and the year displayed, change the displayed year using the \uparrow or \downarrow buttons. When you have selected the proper year press the \downarrow button to accept the year.

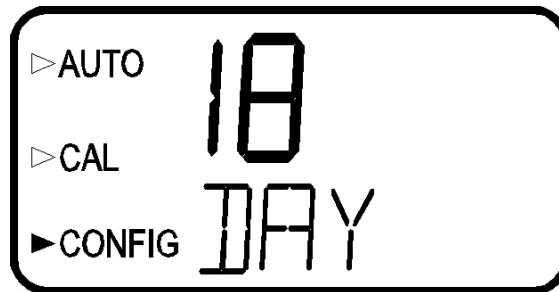


7.3 Setting the Day and Month

After pressing the \downarrow button, **MNTH** will be displayed and you will see a number corresponding to the month.



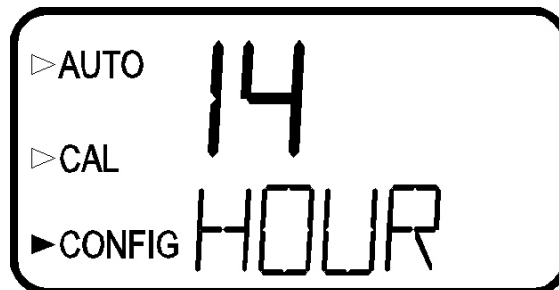
Set the correct month by pressing the \uparrow or \downarrow button to change the displayed month. When you have selected the proper month, press the \downarrow button. After pressing the \downarrow button, **DAY** will be displayed and you will see a number corresponding the day of the month.



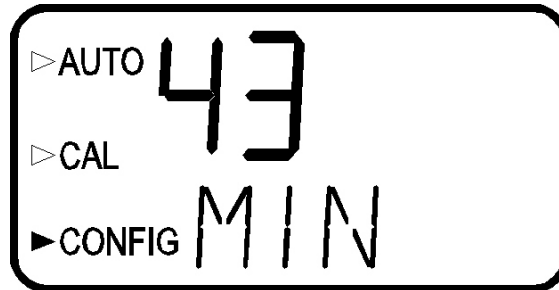
Set the correct day by pressing the \uparrow or \downarrow buttons to change the displayed day. When you have set the proper day, press the \downarrow button.

7.4 Setting the Time

After pressing the \downarrow button, **HOUR** will be displayed and you will see the time displayed on the LCD screen in 24-hour format corresponding to the hour.



Set the correct hour by pressing the \blacktriangle or \blacktriangledown button to change the displayed hour. When you have selected the proper hour, press the \blacktriangledown button. After pressing the \blacktriangledown button, **MIN** will be displayed and you will see the current minute of the hour.



Set the correct minute by pressing the \blacktriangle or \blacktriangledown button to change the displayed minutes. When you have set the correct minute, press the \blacktriangledown button.

7.5 Programming the Alarms & 4-20 mA (if used)

If your instrument does **not** use the RS-485 option, the following menus will be displayed after the date and time.

Two relays are provided that are designed to operate as two independent programmable alarms. You must input three types of information to fully program each alarm:

1. The alarm function (HI, LO, or OFF)
2. The alarm set point (level at which the alarm activates)
3. The delay time for the alarm: the time that the set point must be exceeded prior to alarm activation (prevents ringing in the relay)

These three items are described below:

Alarm Function: The alarms can either be turned OFF or programmed to operate in one of two different manners:

1. HI alarm: the relay changes state when the measured turbidity level is higher than the programmed alarm level for a prescribed amount of time.
2. LO alarm: the relay changes state when the measured turbidity level is lower than the programmed alarm level for a prescribed amount of time.

Note: The relays automatically change state when an internal system failure is detected.

Alarm Set Point: The level at which an alarm activates is called the alarm set point. On the instrument, the alarm set point is designated as “S/P”. The set point is adjustable to any valid turbidity level over the range of the instrument in steps of 0.01 NTU.

Alarm Delay Time: The alarm delay times are used to prevent ringing of the alarm when the measured turbidity level is close to the set point. The function of the delay times is as follows:

Delay On: The turbidity level must exceed the alarm set point continuously for at least this number of seconds before the alarm activates.

If the delay on time is set at 5 seconds and the process turbidity exceeds the set point continuously for only 4 seconds, the alarm will not be activated. However, process turbidity exceeds the set point continuously for 5 seconds or more, the instrument will activate the alarm.

Delay Off: The turbidity level must not exceed the alarm set point continuously for at least this number of seconds prior to deactivation of the alarm.

If the delay off time is set to 5 seconds and the process has exited out of the alarm condition, the alarm will be reset only if the process is out of the alarm condition for a continuous 5 seconds. Otherwise, the instrument will still signal an alarm condition.

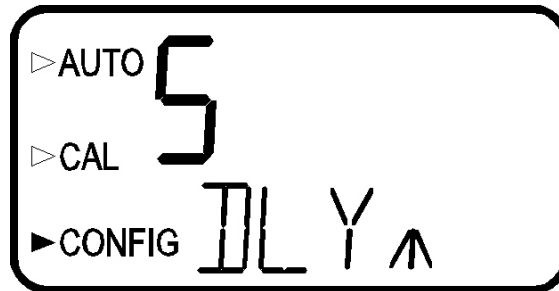
7.5.1 Alarm 1

Alarm 1 Function: The ALM1 is displayed and the display indicates the current function of alarm 1 (**HI**, **LO**, or **OFF**). You can use the \blacktriangle or \blacktriangledown buttons to cycle through and select the desired function. Press the \blacktriangledown button to accept your selection.

If you selected to turn the alarm OFF, you will be immediately prompted to set up alarm 2 (go to section 7.5.2). If, on the other hand, you selected one of the other functionalities you will be prompted to set the delay times.

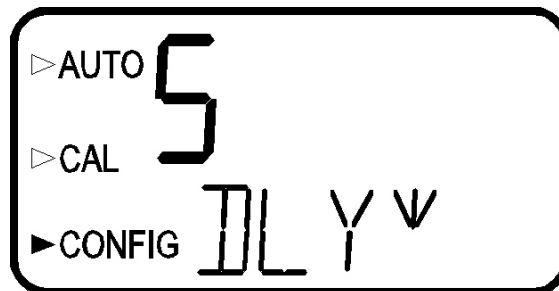
Alarm 1 Set Point: You will be prompted to select the set point for this alarm; this is indicated by “S/P” shown on the lower row of the display. You can select the desired alarm level by using the \blacktriangle and \blacktriangledown buttons. Once you have set the desired set point, press the \blacktriangledown button to accept it.

Alarm 1 Delay Times: *Delay On:* The following display will appear to allow you to select the number of seconds currently set for the “delay on” time.



The current selected number of seconds will be shown. You can select the desired number of seconds for the “delay on” time for this alarm using the \blacktriangle and \blacktriangledown buttons. Once you have set the desired delay time, press the \blacktriangledown button to accept it.

Delay Off: Next, the following display will appear to allow you to select the number of seconds currently set for the “delay off” time.



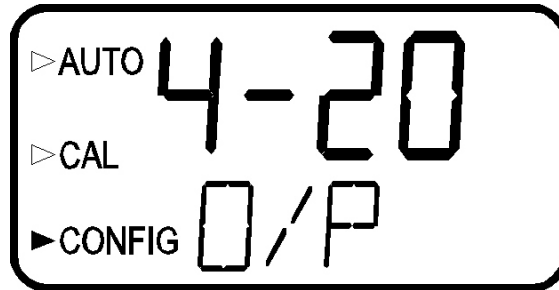
The current selected number of seconds will be shown. You can select the desired delay off time for this alarm using the \blacktriangle and \blacktriangledown buttons. Once you have set the desired delay time, press the \blacktriangledown button to accept it. After you complete the settings for alarm 1 you will be prompted to set up information on alarm #2.

7.5.2 Alarm 2

Repeat the procedure listed in section 7.5.1 to set up the parameters for alarm 2. If you select to turn the alarm OFF, you will be immediately prompted to set up the 4-20 mA output (see section 7.5.3 below). If, on the other hand, you selected one of the other functionalities you will be prompted to set the delay times and the set point as with Alarm #1.

Once you complete the selections for Alarm #2 you will be prompted to set up the analog output.

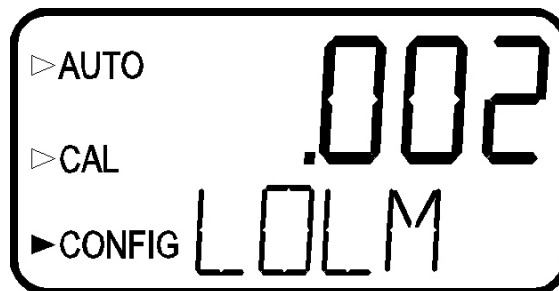
7.5.3 Setting the 4-20mA Output (if used)



The output (O/P) selection allows you to turn the 4-20 mA analog output on (**4-20**), or off (**OFF**). You can select the desired analog output operation using the \blacktriangle and \blacktriangledown buttons. Once you have set the desired operation, press the \blacktriangledown button to accept it.

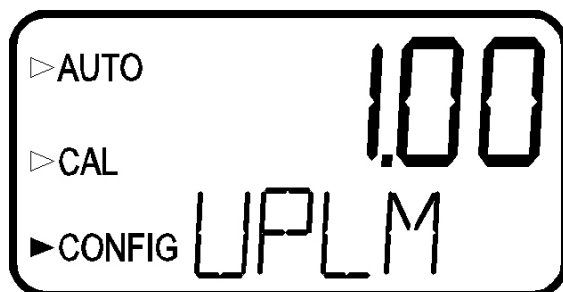
If you selected to turn the 4-20 mA output on, you will be prompted to set the lower (**LOLM**) and upper (**UPLM**) turbidity limits corresponding to the 4 mA and 20 mA output levels. First, you will be prompted with the turbidity limit assigned to the 4 mA output level:

Select the turbidity level you wish to assign to the **LOLM** using the \blacktriangle and \blacktriangledown buttons.



Once you have set the desired level, press the \blacktriangledown button to accept it.

Next, you will be prompted with the turbidity level assigned to the 20 mA output level (**UPLM** on the lower row of the LCD display).



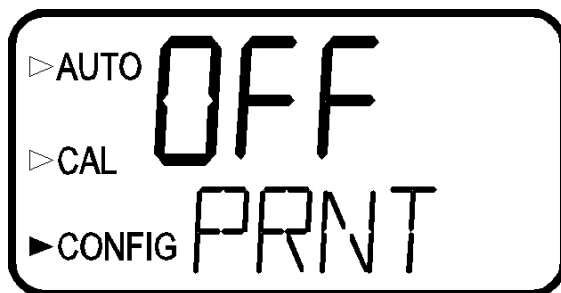
Select the turbidity level you wish to assign to the **UPLM** using the \blacktriangle and \blacktriangledown buttons.

Once you have set the desired level, press the \blacktriangledown button to accept it. The next prompt will be for the access code. Refer to section 7.7 *Setting the Security Access Option*.

7.6 Configuring the RS-485 I/O Port (if equipped)

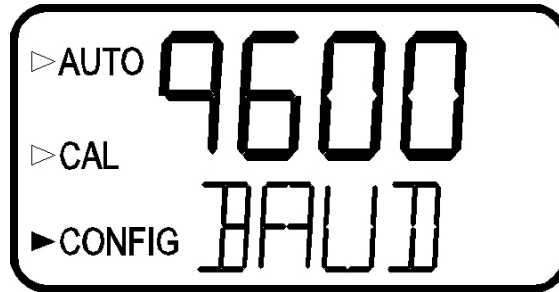
If your instrument is equipped with the option, the following menu will be displayed after the date and time.

Automatic/Timed Printouts: After pressing the \blacktriangledown button, **PRNT** will be displayed. The Upper row of the display will indicate whether this option is turned **ON** or **OFF**. Turn **ON** to select timed printouts.



Next, select the printing interval. This is the interval at which the instrument will print out the instantaneous turbidity level, time, and date. Your choices are **1 HOUR**, **4 HOUR**, **8 HOUR**, **15 MIN** & **30 MIN**. Use the \blacktriangle or \blacktriangledown button to change and the \blacktriangledown button to select. You will then be requested to select the **BAUD**.

Note: The timing for the interval starts at midnight.



Select the correct baud rate (1200, 2400, 4800, or 9600) for operation of the I/O port by pressing either the \blacktriangle or \blacktriangledown button to change the displayed baud rate. When you have selected the proper baud rate press the \blacktriangledown button to continue on to 7.7 *Setting the Security Access Option*. The communication parameters are 8 bits, no parity and 1 stop bit.

Note: The information printed out in the timed printout has the format: x.xx NTU dd mm yyyy hh:mm. The resolution of the turbidity level output is the same as the resolution of the turbidity level on the display.

Bi-Directional Communication: The instrument is equipped with the ability for bi-directional communication. This means that a remote unit can prompt the instrument to send out the current turbidity levels via the RS-485. If the timed print option was turned **OFF**, the next prompt will be for the address of the Micro TOL.



Here you can select the desired instrument address (1-255) using the \blacktriangle or \blacktriangledown buttons. Once you are satisfied you can press the \blacktriangledown button to select. You will then be requested to select the **BAUD**.

Select the correct baud rate (1200, 2400, 4800, or 9600) for operation of the I/O port by pressing the \blacktriangle or \blacktriangledown buttons to change the displayed baud rate. When you have selected the proper baud rate press the \blacktriangledown button to continue on to 7.7 *Setting the Security Access Option*. The communication parameters are 8 bits, no parity and 1 stop bit.

Communication Protocol: The originating instrument (master) has a designated address of 00 hex and each instrument has a designated address from 01 hex to FF hex. The communication protocol is as follows: the master computer will send out a 5 BYTE instruction to the instrument to request data and the correct instrument will respond with a 18 BYTE return message. To ensure a smooth transition of information each instrument is designed with a 100-200 ms hang up time: the instrument waits 100-200 ms before switching from receive to transmit to send the information to the master computer.

The 5 BYTE message sent by the master computer is detailed as follows:

- BYTE #1 is an attention character (3A in hex format)
- BYTE #2 is the native address of the master instrument that is requesting information from the instruments in the RS485 loop. This address is 00 hex by definition (sent in hex format).
- BYTE #3 is the address of the instrument being queried (sent in hex format)
- BYTE #4 is the command/request to be serviced. 00 hex is the request to have the instrument report the current turbidity level (sent in hex format)
- BYTE #5 is the Check Sum of the previous 4 bytes (sent in hex format). Note that 1 hex is added to the sum as an offset level.

When a command of 0 hex is issued by the master computer, the instrument that was addressed will provide an 18 BYTE return message. This message is detailed as follows:

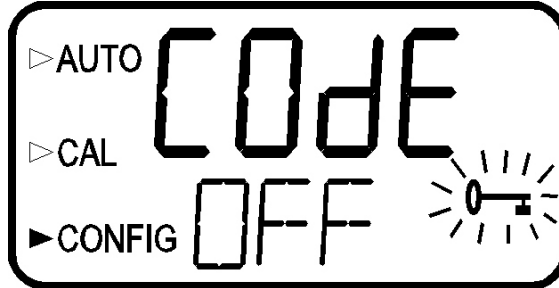
- BYTE #1 is an attention character (3A in hex format)
- BYTE #2 is the native address of the instrument that is responding (sent in hex format).
- BYTES #3-10 represent the current turbidity value (including decimal place) sent in hex. All hex values should be converted to ASCII. Any unused bytes (depending on selected resolution) are filled to the right with spaces (20 hex).
- BYTES #11-13 represent the engineering units measured with this instrument: 'NTU' (sent in hex format). All hex values should be converted to ASCII.
- BYTES #14-15 represent the instrument status WORD in hex format (high BYTE first). This provides information on the mode that the instrument is currently in.
- BYTES #16-17 represent the instrument warning status WORD in hex format (high BYTE first). This status WORD provides detailed information on warnings that the instrument has stored. If this WORD is 0 hex then the instrument is operating with no warnings or problems observed in operation.
- BYTE #18 is the Check Sum of the previous 17 bytes (sent in hex format). Note that 1 hex is added to the sum as an offset level.

The Baud rate used in this feature is the same as the baud rate set in the previous section on automatic/timed printouts. The other parameters for the digital communication are 8 bit, no parity and one (1) stop bit.

An optional PC software package, called HF ONLINE (HF catalog # 19783) allows for an interface with up to 255 Micro TOL's for the purpose of data logging. This package is similar to a small SCADA system and operates by communicating over the interface.

7.7 Setting the Security Access

The instrument is equipped with a security access. If this option is turned on, the user is required to input the access code into the instrument to get to any mode other than **AUTO**. The only code is 333. This code may not be changed. See section 4.2 for more information on this security feature. The security key icon will be visible and flashing on the display whenever the access option is selected using the \blacktriangle or \blacktriangledown buttons. (ON or OFF).



7.8 Saving Configuration Settings

Once you have set the desired security code functionality, press the \blacktriangle button to accept it. You will now see a screen with the word **SAVE** on the lower row of the display, indicating that your settings were saved. The Micro TOL will automatically return to the normal **AUTO** mode of the instrument.

You can enter this menu at any time to reset or change any of the parameters. You can exit at any point in the menu by using the **MODE/EXIT** key. Any features that you have modified will be saved.



8.0 Troubleshooting & Maintenance

8.1 Micro TOL Fault Detection

The Micro TOL performs continuous diagnostic monitoring. In the Micro TOL there are three levels of fault detection; warnings, errors and failures.

A **warning** indicates that there is a system problem that does not interfere with the operation of the instrument and can be corrected by the operator. These warnings consist of 4-20 mA loop open (**MA**) if equipped, and desiccant replacement required (**DESC**). At this level of fault there is only a screen display indicating the problem.

An **error** indicates a failure or a problem that does interfere with the operation but can be corrected by the operator. These errors consist of lamp out (**LAMP**) & no flow (**FLOW**) (if equipped with the flow switch). If any of these conditions occurs, both alarm relays (if equipped) will be activated and the 4-20 mA output will be held at 2 mA (if equipped). If any of these errors occur the instrument will still display readings, however the accuracy is not known and the instruments readings should not be trusted.

A **failure** is a system fault. This is NOT a problem that the operator can correct, and the unit must be returned to the factory for service. These failures consist of failures in the CPU, A/D, EEPROM or other devices internal to the instrument (**FAIL**). If a failure occurs, the instrument will not operate. At best it will display the word FAIL on the lower row and both alarm relays (if used) will be activated and the 4-20 mA output will be held at 2 mA (if used).

If any fault conditions occur, the message indicating the fault will be shown on the lower row of the display.

8.2 System FAIL Message

Normally, this condition indicates that the instrument will require servicing. Contact either the HF scientific, inc. Technical Service Department or the HF scientific, inc. Customer Service Department.

HF scientific, inc.
3170 Metro Parkway
Fort Myers, Florida 33916-7597
Phone: (239) 337-2116
Fax: (239) 332-7643
Email: info@hfscientific.com

8.3 Diagnostic Chart

Symptom	Cause	Cure
Lower display shows MA	4-20 mA loop open	Check wiring. See sections 3.3.4 and 7.5.3
Lower display shows DESC	Desiccant pouch bad	Change desiccant pouch. See section 9.2
Lower display shows CAL	Calibration failure	Refer to sections 5 and 6.1
Lower display shows LAMP	Lamp failed	Replace lamp. Refer to section 9.3
Lower display shows FLOW	Sample flow has stopped	Restore flow. Contact HF about factory installed option
Lower display shows FAIL	Major system fault	Refer to section 8.1 & 8.2
Readings are higher than expected	<p>(1) Bubbles in solution</p> <p>(2) Condensate or leaky cuvette</p> <p>(3) Flow through cuvette dirty</p> <p>Instrument out of calibration</p>	<p>(1) Ensure that the drain vent is open and is not obstructed. See section 3.2.2.</p> <p>(2) Apply backpressure. See section 3.2 and figure 4</p> <p>(3) For sever cases of bubbles a stilling chamber is available. Call HF scientific. Part# 20106</p> <p>Check flow through cuvette for condensate or leaks.</p> <p>Clean cuvette. See section 9.1</p> <p>Recalibrate. Refer to section 5</p>
Readings are erratic	<p>(1) Bubbles in solution</p> <p>(2) Debris in flow through</p>	<p>(1) See above</p> <p>(2) Clean debris from cuvette</p>
Readings are lower than expected	Instrument out of calibration	Recalibrate. Refer to section 5
Upper display shows O-r	Sample Over-Range	Check sample. Must be over 1000 NTU.

8.4 Technical and Customer Assistance

If for any reason you need assistance regarding this instrument please do not hesitate to contact either the HF scientific, inc. Technical Service Department or the HF scientific, inc. Customer Service Department:

HF scientific, inc.
 3170 Metro Parkway
 Fort Myers, Florida 33916-7597
 Phone: (239) 337-2116
 Fax: (239) 332-7643
 Email: info@hfscientific.com

9.0 Routine Maintenance

9.1 Cleaning the Flow Through Cuvette

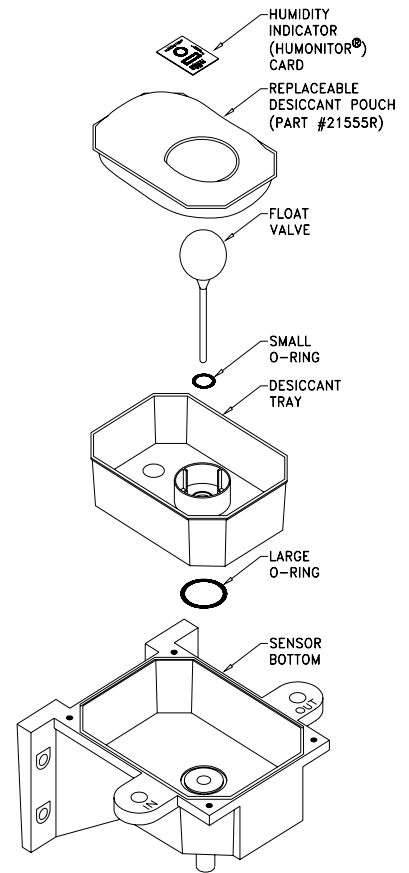
Measurement cuvettes used for both grab sample and the flow through should be clean and free of marks or scratches. Cleaning is accomplished by cleaning the interior and exterior with a detergent solution and then rinsing several times with distilled or de-ionized water. The cuvette can be replaced by first shutting off the flow using the provided shutoff clamp; unscrewing the old cuvette and replacing with a fresh clean one.

9.2 Replacing or Installing the Desiccant Pouch

The Micro TOL continuously checks the condition of the desiccant tray. When the desiccant gets in such a condition that it may cause problems, the instrument will display **DESC** on the lower portion of the display.

Proper use of the supplied desiccant is essential in maintaining the performance of the instrument. The desiccant has been designed to have a long life; however, replacement of the desiccant pouch will be required from time to time. It is also essential that all enclosure seals be maintained. The emergency drain and o-rings that are supplied with each new instrument, form part of the instrument humidity seal. Inspect these items each time the desiccant pouch is replaced. Replace any parts found to be defective.

The desiccant should be replaced when the instrument displays **DESC**. A new sealed desiccant pouch and indicator card are available from HF scientific inc. part #21555R. To initially install or remove the old desiccant, simply unscrew the four corner thumbscrews and remove the electronics half of the instrument. Open the bag protecting the new desiccant pouch and replace (or install for a new instrument) in the desiccant tray assembly.



Note: Once the bag is opened, install the desiccant pouch immediately.

9.3 Replacing the Source Lamp

The source lamps in the Micro TOL's are designed for long life. The IR lamp is rated for 10 years and the white light version is rated for 7 years. If your lamp should need replacement, we recommend you call HF Customer Service Department for assistance.

9.4 Replacing the Battery

The Micro TOL uses a 10-year life lithium battery as a backup for the contained real-time clock chip. This battery is non-rechargeable, but should last the life of instrument. Failure of this battery does not disable the instrument, however some functions such as automated print options will not function. This battery is not designed to be field replaced. Exchange modules are available from HF scientific inc. Call HF Customer Service Department for assistance.

10.0 Accessories and Replacement Parts List

The items shown below are recommended accessories and replacement parts.

Accessory	Catalog Number	
	White Light	Infrared
PRIMEIME Calibration Kit, Low Range, .02 & 10 NTU	29953	19956
PRIMEIME Calibration Kit, Full Range, .02, 10 & 1000 NTU	29957	19961
Formazin Stock Kit	50040	50040
Formazin Stock Solution, 4000 NTU, 500 ml	70914	70914
Replacement Desiccant Pouch	21555R	21555R
Electronic Service Module	19815	19815I
Operating Manual, Micro TOL	24031	24031
Software for data collection and reporting	19783	19783
Flow Regulator, Micro TOL	19778	19778
Tubing Kit Containing: 1-shutoff clamp , 1-backpressure valve, 2-connecting tubings with fittings for flow through assembly, 1-drain vent screw.	51025A	51025A

To order any accessory or replacement part, please contact the HF scientific, inc. Customer Service Department. If for any reason you need technical assistance regarding this instrument please do not hesitate to contact the HF Technical Services Department.

HF scientific, inc.
3170 Metro Parkway
Fort Myers, Florida 33916-7597
Phone: (239) 337-2116
Fax: (239) 332-7643
Email: info@hfscientific.com

11.0 Warranty

HF scientific, inc., as vendor, warrants to the original purchaser of this instrument that it will be free of defects in material and workmanship, in normal use and service, for a period of one year from date of delivery to the original purchaser. HF scientific, inc.'s, obligation under this warranty is limited to replacing, at its factory, the instrument or any part thereof. Parts, which by their nature are normally required to be replaced periodically, consistent with normal maintenance, specifically reagent, desiccant, sensors, electrodes and fuses are excluded. Also excluded are accessories and supply type items.

Original purchaser is responsible for return of the instruments, or parts thereof, to HF scientific, inc.'s factory. This includes all freight charges incurred in shipping to and from HF scientific, inc.'s factory.

HF scientific, inc. is not responsible for damage to the instrument, or parts thereof, resulting from misuse, environmental corrosion, negligence or accident, or defects resulting from repairs, alterations or installation made by any person or company not authorized by HF scientific, inc.

HF scientific, inc. assumes no liability for consequential damage of any kind, and the original purchaser, by placement of any order for the instrument, or parts thereof, shall be deemed liable for any and all damages incurred by the use or misuse of the instruments, or parts thereof, by the purchaser, its employees, or others, following receipt thereof.

Carefully inspect this product for shipping damage, if damaged, immediately notify the shipping company and arrange an on-site inspection. HF scientific, inc. cannot be responsible for damage in shipment and cannot assist with claims without an on-site inspection of the damage.

This warranty is given expressly and in lieu of all other warranties, expressed or implied. Purchaser agrees that there is no warranty on merchantability and that there are no other warranties, expressed or implied. No agent is authorized to assume for HF scientific, inc. any liability except as set forth above.

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