



Pyxis Lab, Inc.

ST-500 Inline Fluorometer Probe Instruction Manual

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1. Introduction

The Pyxis ST-500 inline fluorometer probe measures the concentration of a fluorescent tracer, PTSA (pyrenetetrasulfonic acid), in water. The fluidic and optical arrangement of the ST-500 probe is designed to overcome many shortcomings associated with other fluorometers. It can be easily inserted into the custom-made tee with a compression fitting port designed to ensure correct positioning of the ST-500 probe in the fluid stream. The ST-500 probe custom mounting tee has two 3/4 inch female NPT ports for plumbing into an existing 3/4 inch sample water line. The ST-500 probe can be connected to any device that accepts an isolated or non-isolated 4-20mA input. In addition to measuring fluorescence, the ST-500 probe has extra photo-electric components that monitor the color and turbidity of the sample water. This extra feature allows the ST-500 probe to automatically compensate for color and turbidity to eliminate interferences common in real-world samples. The ST-500 probe has a short fluidic channel that can be easily cleaned. The ST-500 probe uses a narrow wavelength band gallium phosphide photodiode, integrated with a high temperature tolerant and high humidity resistant optical filter. This combination greatly enhances the robustness of the ST-500 probe. It can be operated under a wide range of ambient conditions without the need of humidity and temperature regulation. The performance of the ST-500 probe is designed to be stable and consistent for a long period time.

Other features of the Pyxis ST-500 probe include:

- Menu-driven calibration procedure using a computer connected via USB or WiFi. Any standard containing PTSA in the range of 20 to 200 ppb can be used for the calibration. The standard can be the water sample itself when the PTSA concentration of the sample has been measured by another fluorometer that has been calibrated. This allows the ST-500 probe to be calibrated without being removed from the system.
- Automatic compensation:
 - turbidity changes up to 150 NTU
 - color changes equivalent to 10 ppm humic acid or 10 ppm iron
- Diagnostic information (probe fouling, color or turbidity over range, failure modes) can be communicated to digital displays via Modbus RTU.
- The ST-500 probe can be easily removed from the custom tee for cleaning without the need for any tools.

2. Unpackaging the Instrument

Remove the instrument and accessories from the shipping container and inspect each item for any damage that may have occurred during shipping. Verify that all accessory items are included. If any item is missing or damaged, please contact Pyxis Lab Customer Service at service@pyxis-lab.com.

2.1. Standard Accessories

- Tee Set (tee, O-ring, and nut)
- Bulkhead Cable
- The Instrument Manual is available from <http://www.pyxis-lab.com/support.html>

2.2. Optional Accessories

- USB-RS485 Adapter (Item Number: MA-485)
- Bluetooth Adapter (Item Number: MA-485B)
- Pyxis Graphic Panel (Item Number: DC-200)
- 100 ppb PTSA Calibration Standard Solutions (Item Number: FCS-50)
- 100 ppb PTSA Calibration Standard Solutions (Item Number: FCS-100)
- 200 ppb PTSA Calibration Standard Solutions (Item Number: FCS-200)
- 1.5 inch OD O-ring (Item Number: MA-150)
- Extension cable – 50 feet (PN:50705)
- Extension cable – 100 feet (PN:5070)

3. Specification

- Power Supply Required: 24 (± 2) VDC @ 65 mA
- Signal Output: 4-20 mA and RS-485 Modbus RTU
- Temperature, Sample Water: 40 – 104 °F (4 – 40 °C)
- Temperature, Ambient during operation: 40 – 120 °F (4 – 49 °C)
- Temperature, Ambient during storage: 20 – 140 °F (-7 – 60 °C)
- Sample Pressure: 100 PSI
- Cable Length: 5 feet, terminated with IP67 connectors
- Water proof connector
- Dimension: Length 6.8 inch (172.7 mm), body diameter 1.44 inch (36.6 mm)
- Weight: 0.37 pounds (170 grams)
- PTSA Measuring Range: 0 to 300 ppb (3 σ error: ± 1 ppb or 5% of reading, whichever is greater)
- Regulatory: CE Marked

4. Installation

It is recommended to install the ST-500 probe tee in the pipe system where sample water flow is upwards. Place the O-ring on the ST-500 probe. Insert the ST-500 probe into the tee. Make sure that the fluidic channel in the ST-500 probe is aligned with the sample flow direction.

WARNING

Do not over tighten the compression nuts and/or the threaded pipe when connecting the tee to the sample line.

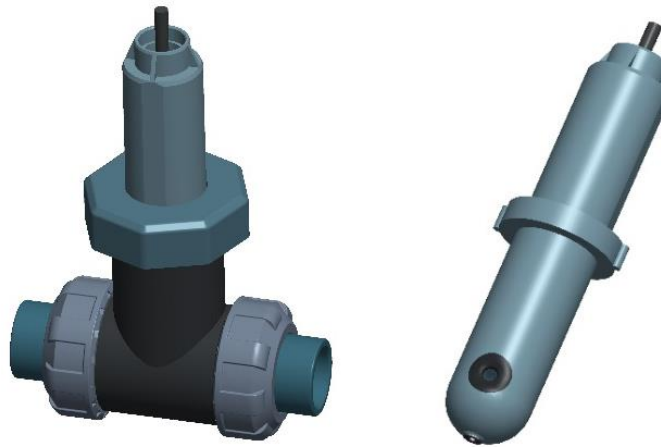


Fig 1. ST-500 with Tee Set

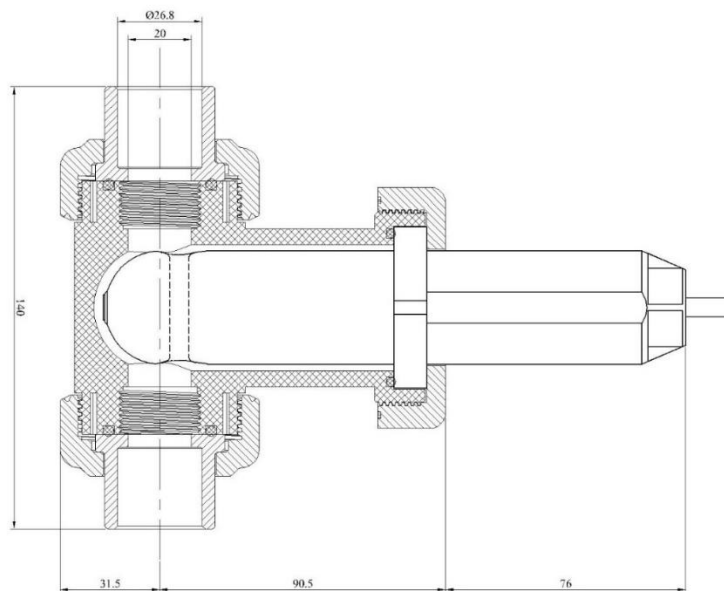


Fig 2. ST-500 Dimensions

4.1. Quick 4-20mA Start

Note: The negative 24V power terminal and the negative 4-20 mA terminal on the ST-500 probe are internally connected.

If the negative 24V power terminal and the negative 4-20 mA terminal in the controller are internally connected (non-isolated 4-20mA input), it is unnecessary to connect the 4-20 mA negative wire (blue) to the 4-20 mA negative terminal in the controller. If a separate DC power supplier other than that from the controller is used, make sure that the output from the power supply is rated for 22-26 VDC @ 65mA.

Follow the wiring table below to connect the ST-500 probe to a controller.

Wire Color	Designation
Red	24 V +
Black	24 V -
White	4-20 mA +
Green	4-20 mA -, internally connected to 24 V – (power ground)
Blue	RS-485 A
Yellow	RS-485 B
Clear	Shield, solution ground

4.2. Connect via USB

Figure 3 shows the connection between a computer and the ST-500 probe via USB-RS485 adapter. Use the USB-RS485 adapter provided by Pyxis Lab Inc. (Item Number: MA-485). Using other USB-485 adapters may result in permanent damage of the ST-500 probe communication hardware.

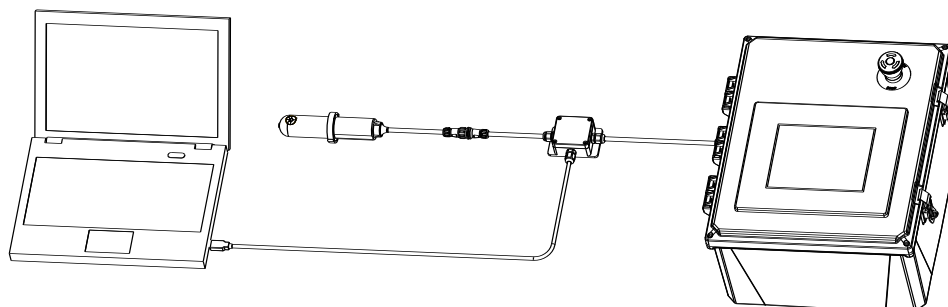


Figure 3. ST-500 connected to computer via USB-485 adapter

4.3. Connect via Wifi/Bluetooth

Figure 4 shows the connection between a computer and the ST-500 probe via WiFi/Bluetooth adapter (P/N: MA-485B). A smart phone app is provided to connect the ST-500 probe to your smart phone via WiFi or Bluetooth interface.

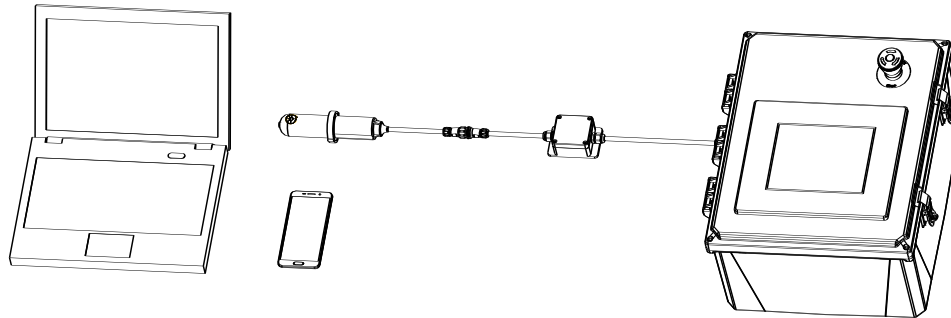
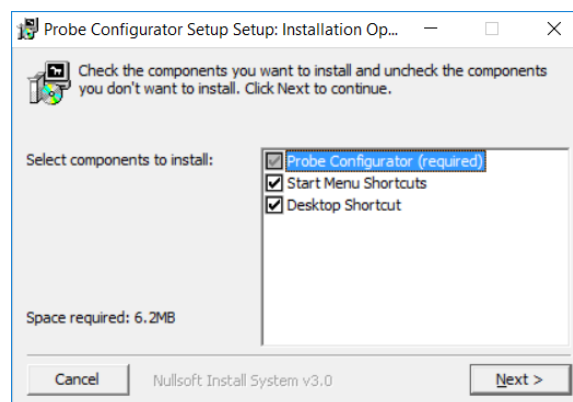


Figure 4. ST-500 connected to computer or smart phone via WiFi/Bluetooth adapter

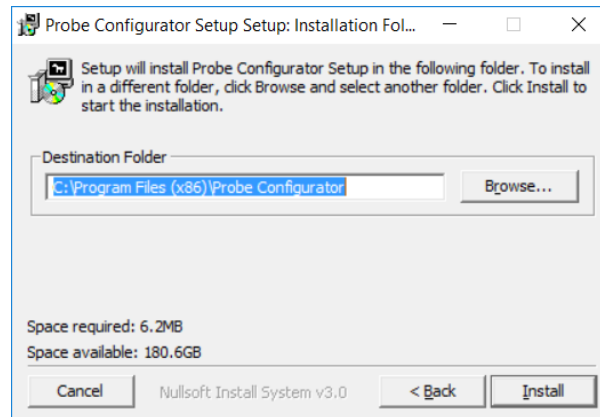
5. Probe Calibration

5.1. Install Probe Configurator

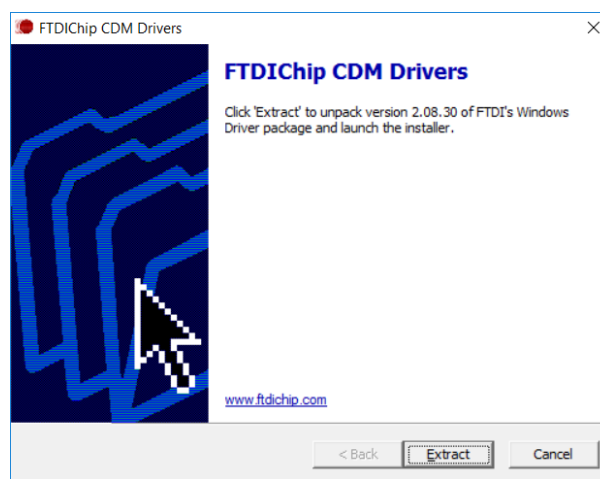
Use the ST-500 Probe Configurator CD (ordered separately) or download the [Probe Configurator software package](http://www.pyxis-lab.com/support.html#Software) from: <http://www.pyxis-lab.com/support.html#Software>. Double click the **Probe Configurator Express.msi** file to install.



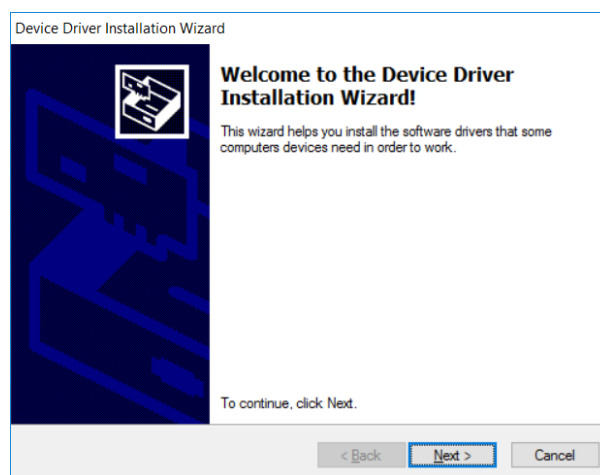
Select components to be installed. Click "Next".



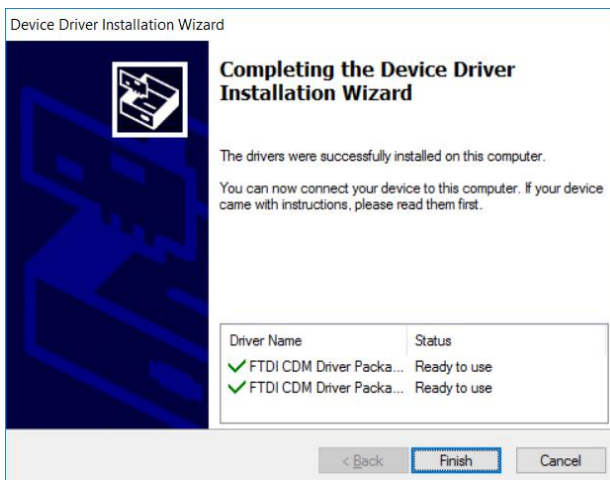
Select installation folder. Click "Install".



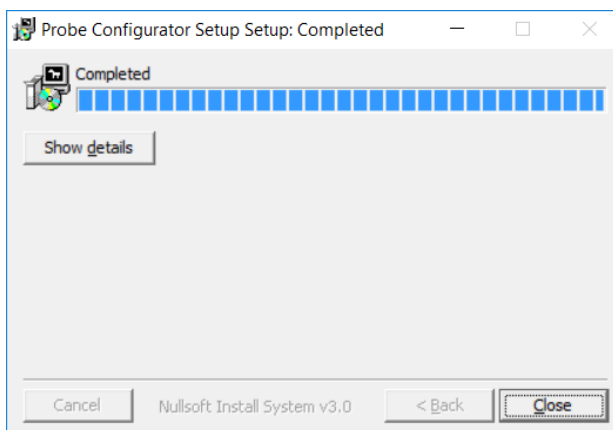
Click "Extract".



Click "Next".



Click "Finish".




Click "Close".

5.2. Calibration via Probe Configurator

The ST-500 probe is calibrated at the factory before shipping. The 4-20mA output is scaled for zero ppb to 200 ppb PTSA. the ST-500 probe can be recalibrated using the Probe Configurator application in a Windows computer. With the Pyxis Wifi or Wifi/Bluetooth adapter, the ST-500 can be calibrated by Pyxis SP-700 or SP-910. Please reference the SP-700 and SP-910 manuals for the calibration procedure.

Smart phone apps are under development. Please Pyxis website to learn or download the latest apps (<http://www.pyxis-lab.com/support.html>).

5.2.1. Connect via USB Adapter

Connect the ST-500 probe to a Windows computer using a USB-RS485 adapter. Properly connect the USB adapter to the probe and the 24V power supplier as shown in fig 3. Double click the Probe Configurator icon  to launch the program. The Probe Configurator application will detect the com port number and set up the communication parameters automatically. Click **Connect** button to connect to the ST-500 probe. If the connection is successful, the ST-500 probe parameters such as **Serial Number** and **Modbus Address** will be displayed as shown in Fig 5. Click the AutoRefresh checkbox, **Measurement** section will be updated with probe measurement values every 3 seconds as shown by Fig 5.

If the connection fails, please check if ports other than the Pyxis USB adapter are listed by clicking on the down arrow (∨). Select other port listed and click on Connect again. If the connection cannot fill be made, please check the power supplier and make sure that the probe/adapter/power supplier are connected according to Fig 3.

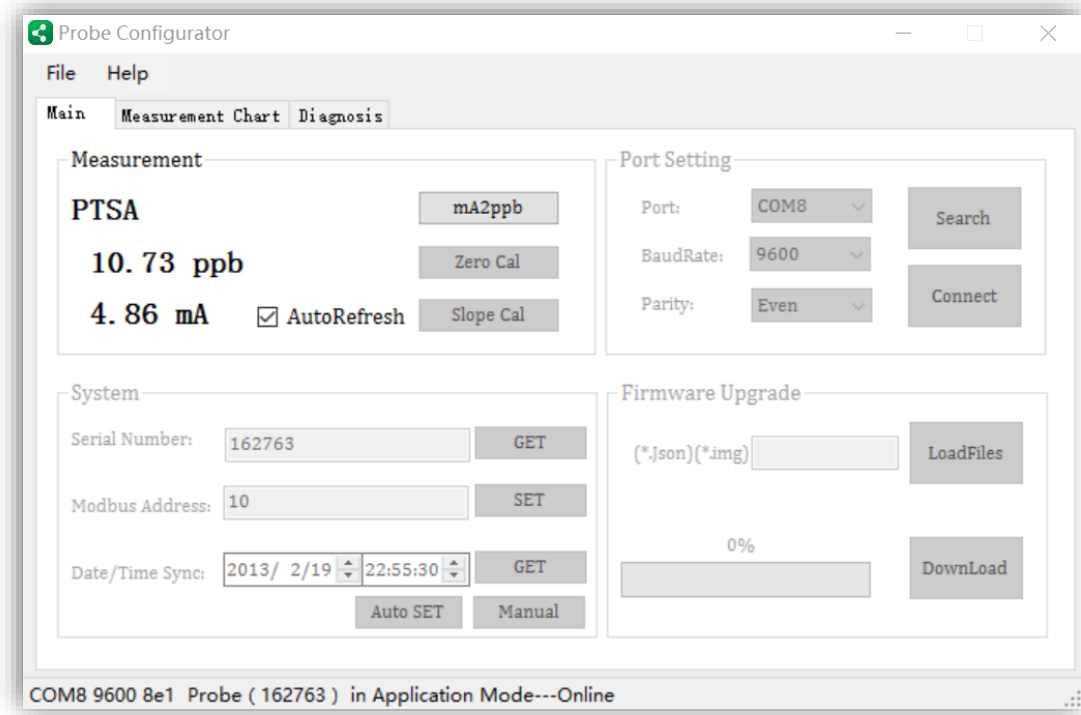



Figure 5. Connected via USB Adapter

5.2.2. Connect via Pyxis WiFi Adapter or Pyxis Wifi/Bluetooth Adapter

Connect the ST-500 probe to a Windows computer using a WiFi-RS485 (or WB-RS485) adapter according to following steps:

1. Connect the probe to the WiFi/Bluetooth adapter first and then connect the adapter to the controller or a 24VDC power supply according to Fig 4
2. Select WiFi hotspot with its SSID started with "ST500-xxxx", e.g., "500-0953"
3. Input password "pyxis2015" and connect to the hotspot
4. Double click the Probe Configurator-WIFI.exe icon  to launch the program
5. Click the search button to locate the hotspot and then connect the Connect button as shown by Fig 6

Note: After the probe and WiFi/Bluetooth is powered up, it may take up to 10 seconds for the adapter to establish the wireless signal for communication.

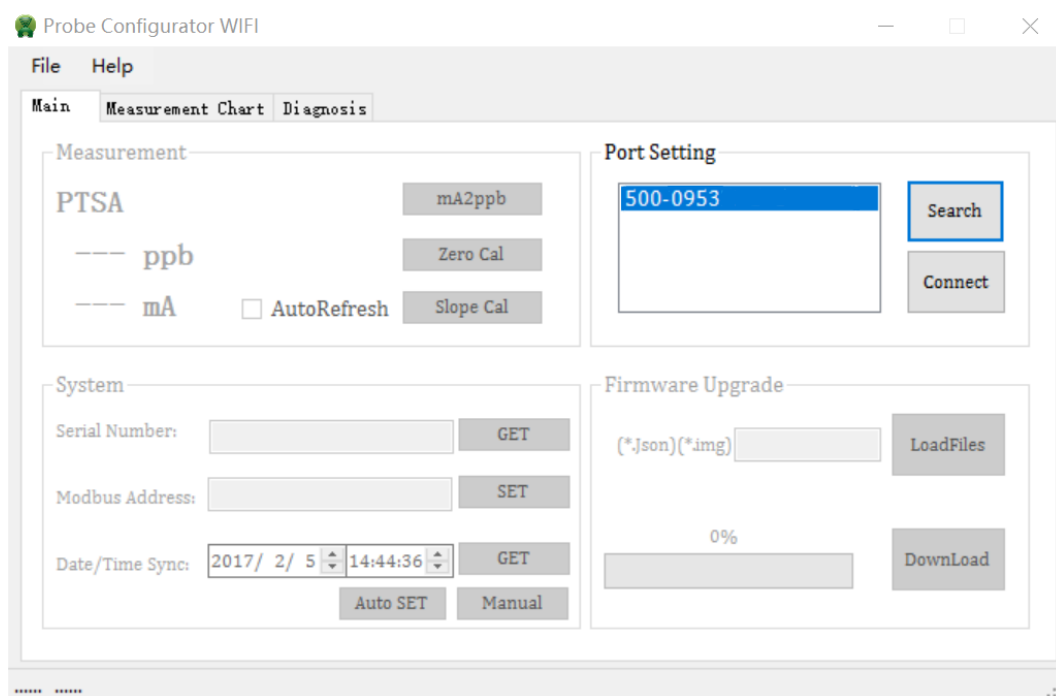


Figure 6. Connected via WiFi Adapter

5.2.3. Zero Calibration

Zero Point Calibration Place the ST-500 probe into deionized water. Click the **Zero Cal** button perform a zero-point calibration. If calibration is successful, the *Calibration Successful* message will be displayed. Note, please uncheck AutoRefresh before zero calibration

5.2.4. Slope Calibration

Place the ST-500 probe into a solution with a known PTSA concentration. Click the **Slope Cal** button to carry out the slope calibration. Make sure AutoRefresh is not checked as well.

The PTSA concentration in the calibration solution should be in the range of 20 to 200 ppb.

If the calibration is successful, the *Calibration Successful* message will be displayed. If errors are determined, an error message indicating the cause of the errors will be displayed.

The zero-point calibration and slope calibration can be carried out separately.

The slope calibration should be performed after the zero-point calibration.

Direct sunlight or indoor light on the ST-500 probe should be avoided although it is not necessary to completely shield the ST-500 probe from the ambient light during both the zero point and slope calibrations.

The calibration solution could be the sample water itself. The concentration of PTSA in the sample water can be determined with using a Pyxis SP-350 (or similar offline fluorometer),

or calculated from the concentration of any measurable species in the sample water such as polymer, phosphate, or molybdate.

5.2.5. 4-20 mA Output Setup

The default setting for 20 mA is 200 ppb and 4 mA for 0 ppb PTSA. Click the **mA2ppb** button to rescale ppb to 4-20 mA output.

Example: If the 20mA value is reset to 100 ppb, the ST-500 probe will output 20 mA at 100 ppb, 12 mA at 50 ppb, and 4 mA at 0 ppb.

5.3. Calibration on the Controller

With the default probe settings, the controller should be set up to convert 4 mA to 0 ppb and 20 mA to 200 ppb. Additionally, the ST-500 probe can be calibrated by changing the conversion factor on the controller without performing the zero point and slope calibration steps. The controller can be configured to show the PTSA concentration without the need to calibrate the ST-500 probe using a standard solution. Determine the PTSA ppb concentration in the water sample by using the Pyxis SP-350 (or similar offline fluorometer) or calculated from the concentration of any measurable species in the sample water such as polymer, phosphate, or molybdate.

Example: If the ST-500 probe outputs 10 mA (Y) in a 120 ppb (X) standard solution, calculate this value (z) according to: $z = (X \text{ ppb} * 20 \text{ mA}) / (Y \text{ mA} - 4 \text{ mA})$

$$z = (120 \text{ ppb} \times 20 \text{ mA}) / (10 \text{ mA} - 4 \text{ mA}) = 400 \text{ ppb}$$

Fill in the z value 400 for 20 mA output in the controller's mA-to-value configuration setup. This will force the *controller* to show 120 ppb when the ST-500 probe is immersed in a 120 ppb solution.

6. Communicating using Modbus RTU

The ST-500 probe is configured as a Modbus slave device. In addition to the ppb PTSA value, many operational parameters, including warning and error messages, are available via a Modbus RTU connection.

Contact Pyxis Lab Customer Service (service@pyxis-lab.com) for more information.

7. Probe Cleaning and Maintenance

The ST-500 probe is designed to provide reliable and continuous PTSA readings even when installed in moderately contaminated industrial cooling waters. Although the optics are

compensated for the effects of moderate fouling, heavy fouling will prevent the light from reaching the sensor, resulting in low readings and the potential for product overfeed if the ST-500 is used as part of an automated control system. When used to control product dosing, it is suggested that the automation system be configured to provide backup to limit potential product overfeeds, for example by limiting pump size or duration, or by alarming if the pumping rate exceeds a desired maximum limit.

The ST-500 probe is designed to be easily removed, inspected, and cleaned if required. It is suggested that the ST-500 probe be checked for fouling and cleaned on a monthly basis. Heavily contaminated waters may require more frequent cleanings. Cleaner water sources with less contamination may not require cleaning for several months.

7.1. Determining the Need to Clean

The need to clean the ST-500 probe can be determined by visual inspection or by the probe response to calibration standards. The ST-500 probe can be connected to a laptop computer to provide diagnostic information including probe fouling as described in Section 7.3 of the User's Manual.

Visual Inspection Method: Remove the ST-500 from its custom mounting tee. When the ST-500 probe is powered, a flashing blue light should be visible inside the ST-500 probe's quartz measuring tube. If a flashing blue light is not visible, the ST-500 probe should be cleaned.

Calibration Standard Method: Obtain a calibration standard with a concentration in the operating range of the system to be measured.

Standards are available from Pyxis-Lab as PTSA-50, PTSA-100, or PTSA-300 at <http://www.pyxis-lab.com/ptsa.html>.

After performing the visual inspection, remove any visible deposits with a soft cloth. Place the ST-500 probe in a small beaker containing a calibration solution. The readout device should indicate the calibration solution concentration, or the product concentration equivalent to that PTSA concentration. If the readout is not within 10% of the expected value, the ST-500 probe should be cleaned using the methods below prior to recalibration.

Diagnostics Method: The diagnosis information can be obtained by connecting the ST-500 probe to a PC with the Probe Configurator application installed. Connect to the ST-500 probe with Probe Configurator application per paragraph 5.2. Click the Diagnosis tab. Click Refresh button and a range of operational parameters will be displayed as shown by Fig 7.

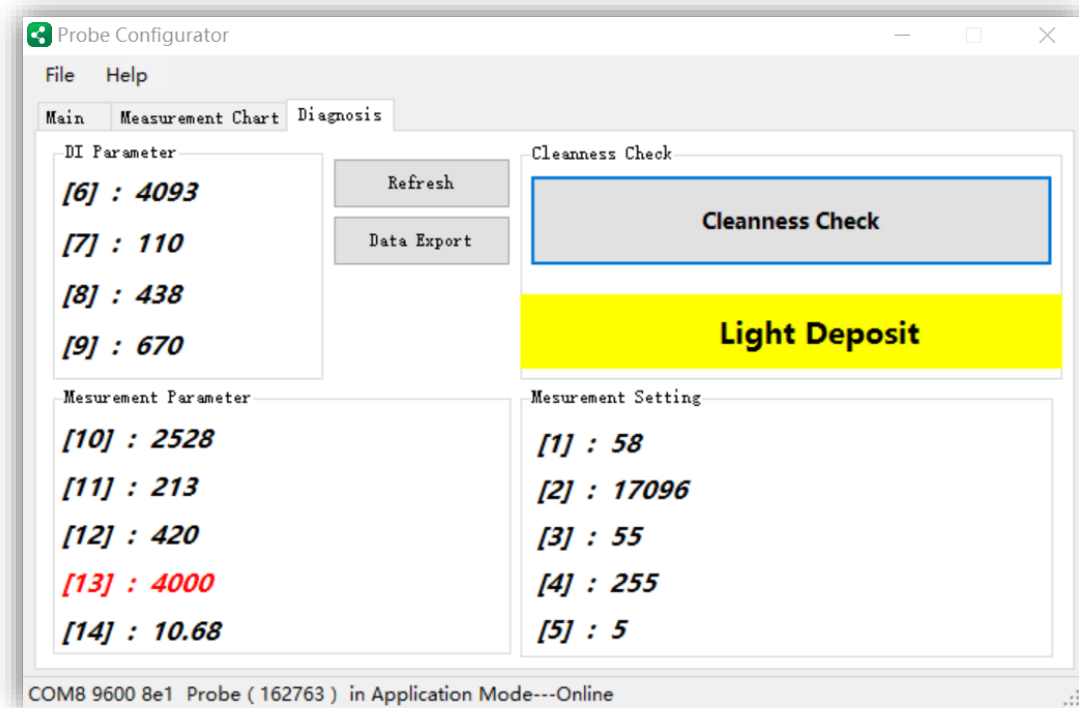


Fig 7. Probe Configurator Diagnosis Tab

Capture the screen shot (Alt-PrtScr) and forward it to service@pyxis-lab.com along with contact information and current system conditions. Pyxis customer service will reply with a diagnosis and recommendations.

Remove the ST-500 probe from its custom mounting tee and place the ST-500 probe into a small beaker containing deionized water. Click the **Cleanness Check** button to determine if the ST-500 probe is fouled. The ST-500 probe can also be placed into a standard solution to acquire additional information to determine the cleanliness of the probe.

7.2. Methods to Clean the ST-500 Probe

Any equipment in contact with industrial cooling systems is subject to many potential foulants and contaminants. There is no universal cleaner for all possible deposits. The three mild chemical cleaning solutions below have been shown to remove most common foulants and contaminants. A small soft bristle brush, Q-Tips[®] cotton swab, or soft cloth may be used to safely clean the probe housing and the quartz optical sensor channel.



WARNING

Do not use an organic solvents or strong acid or base to clean the ST-500 probe.
Do not use abrasive cleaners of any kind.

7.2.1. Iron or Manganese or other inorganic Deposits

Soak the lower half of the ST-500 probe in 100 ml CLR Rust Remover for 30 minutes. Rinse the ST-500 probe with distilled water and then check for the flashing blue light inside the ST-500 probe quartz tube. If the surface is not entirely clean, continue to soak the ST-500 probe for an additional 30 minutes. CLR Rust Remover may be purchased at consumer product stores including Walmart and Home Depot.



<https://www.walmart.com/ip/CLR-Calcium-Lime-Rust-Remover/14574716>

<http://www.homedepot.com/p/CLR-28-oz-Calcium-Lime-and-Rust-Remover-CL-12/100049980>

7.2.2. Light Rust, Oil, Biofilm, and Other Light Deposits



Use a cotton swab soaked with the 91% isopropanol (also known as isopropyl alcohol, available from pharmaceutical stores such as following.

<http://www.cvs.com/shop/health-medicine/first-aid/antibiotic-antiseptic/cvs-health-91-isopropyl-alcohol-prodid-1011920>)

Swab the inner surface of the ST-500 probe quartz tube in a circular motion several times. Rinse the ST-500 probe with distilled water and check for flashing blue light indication inside the ST-500 probe quartz tube. If surface is not entirely clean, continue to soak the ST-500 probe for an additional 30 minutes.

7.3. Other Common Troubleshooting Issues

If the ST-500 probe output signal is not stable and fluctuates significantly, make an additional solution ground connection – connect the clear solution ground wire to a conductor that contacts the sample water electrically such as a brass pipe adjacent to the ST-500 tee.

Carry out routine calibration check against a PTSA standard. If necessary, carry out the zero point and slope calibration.

6.4 Storage

Avoid long term storage at temperature over 100 °F. In an outdoor installation, properly shield the ST-500 probe from direct sunlight and precipitation.

Contact Us

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