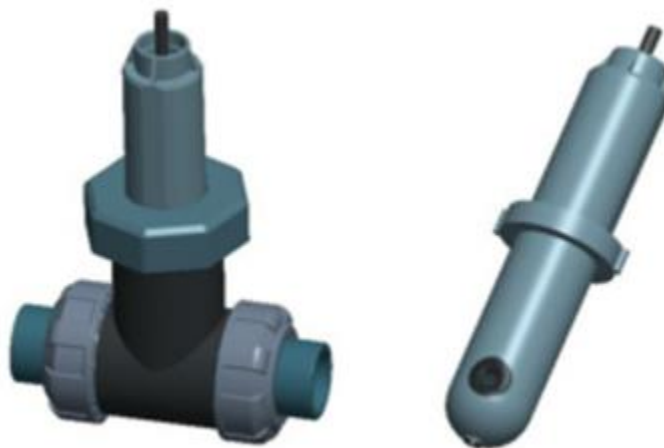




## ST-500 Inline PTSA Fluorometer Probe Operation Manual



Rev. B

**Pyxis Lab, Inc.**

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## **Limited Warranty**

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

### **Device Warranty Term**

The Pyxis warranty term for the ST-500 probe is thirteen (13) months from original shipment from Pyxis. In no event shall the standard limited warranty coverage extend beyond thirteen (13) months from original shipment date.

### **Warranty Service**

Damaged or dysfunctional instruments may be returned to Pyxis for repair or replacement. In some instances, replacement instruments may be available for short duration loan or lease.

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

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

### **Warranty Shipping**

A Repair Authorization Number (RA) must be obtained from Pyxis Technical Support before any product can be returned to the factory. Pyxis will pay freight charges to ship replacement or repaired products back to the customer. The customer shall pay freight charges for returning products to Pyxis. Any product returned to the factory without an RA number will be returned to the customer.

## **Pyxis Technical Support**

Contact Pyxis Technical Support at [service@pyxis-lab.com](mailto:service@pyxis-lab.com) or 1-866-203-8397 (Mo-Fri 7:00AM-5PM MT)

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## 1 Introducing the Pyxis ST-500 Probe

The Pyxis ST-500 inline fluorometer probe measures the concentration of fluorescence tracer PTSA (pyrenetetrasulfonic acid) in water. It can be simply inserted to the compression fitting port of a custom-made tee. The companion tee has two  $\frac{3}{4}$  inch female NPT ports and can be placed to an existing  $\frac{3}{4}$  inch sample water line. The 4-20mA current output of the ST-500 probe can be connected to any controller that accepts an isolated or non-isolated 4-20mA input. The ST-500 probe is a smart device. 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 automatic color and turbidity compensation to eliminate interferences common in real-world samples.

The Pyxis ST-500 probe has a short fluidic channel. It can be easily cleaned. The fluidic and optical arrangement of the ST-500 probe is designed to overcome shortcomings associated with other fluorometers that have a distal sensor surface or a long, narrow fluidic cell. These fluorometers are susceptible to color and turbidity interference and fouling, and difficult to be cleaned.

The Pyxis ST-500 probe uses a narrow wavelength band gallium phosphide photodiode and high temperature-tolerant and humidity-resistant optical filters. This combination greatly enhances the robustness of the 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 can be stable and consistent for a long period time.

### 1.1 Features of the Pyxis ST-500

The ST-500 includes the following features:

- Easy calibration with using uPyxis mobile or desktop app.
- Automatic compensation for turbidity up to 150 NTU and color created by up to 10 ppm iron or equivalent to 10 ppm humic acid.
- Diagnostic information (probe fouling, color or turbidity over range, failure modes) are available in uPyxis app or via Modbus RTU.
- The ST-500 probe can be easily removed from the system without the need of any tools for being cleaned.

## 1.2 Specifications

Specifications are subject to change without notice. Contact Pyxis ([service@pyxis-lab.com](mailto:service@pyxis-lab.com)) for an updated specification list.

Item	Specification
PTSA Range	0 to 300 ppb, precision 0.2 ppb (3 sigma)
Power Supply	24 (±2) VDC, 65 mA
Signal Output	4-20 mA and RS-485 Modbus RTU
Storage Temperature	-7 °C – 60 °C (20 – 140 °F)
Operational Temperature	4 °C – 40 °C (40 – 104 °F)
Sample Pressure	100 PSI
Protection Grade	IP67, Fully Dustproof & Waterproof
Regulation	CE
Dimension (L x W x H)	Length 6.8 inch (172.7 mm), body diameter 1.44 Inch (36.6 mm)
Weight	170 g (0.37 lbs)
Cable Length	5 feet, terminated with IP67 connectors

## 1.3 Unpacking the Pyxis ST-500

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 items listed on the packing slip are included. If any items are missing or damaged, please contact Pyxis Customer Service at [service@pyxis-lab.com](mailto:service@pyxis-lab.com).

## 1.4 Standard Accessories

- Tee Set (tee, O-ring, nut, and straight and threaded socket)
- Bulkhead cable and connector

The full instrument manual is available for download at [www.pyxis-lab.com/support.html](http://www.pyxis-lab.com/support.html)

## 1.5 Optional Accessories

The following optional accessories can be ordered from Pyxis Customer Service, [order@pyxis-lab.com](mailto:order@pyxis-lab.com)

Accessory	Item number (P/N)
USB-RS485 Adapter	MA-485
Bluetooth Adapter	MA-WB
100 ppb PTSA Calibration Standard Solutions	PTSA-100
1.5 inch OD O-ring	MA-150
Extension cable – 50 feet	50705
Extension cable – 100 feet	5070

## 2 Installation

Place the O-ring into the O-ring groove in the tee. Insert the ST-500 probe into the tee. The tee can be connected to a pipe system through the 3/4 inch straight socket or thread socket, both included in the package.

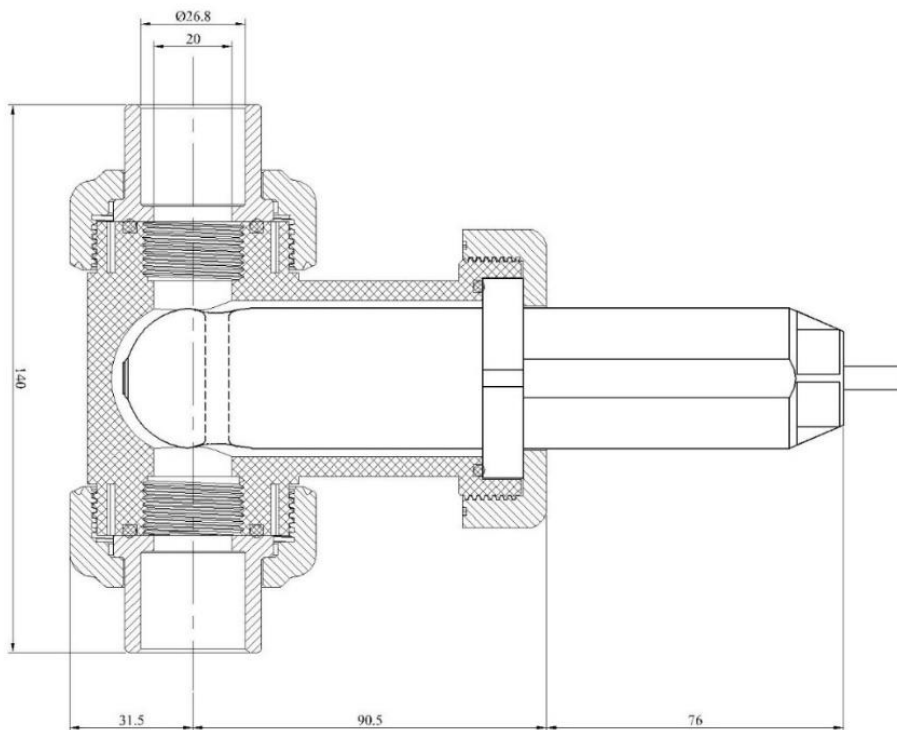


Figure 1. Dimension of the ST-500 and the tee (mm)

## 3 Quick 4-20mA Start

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

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

Note: The 24V power ground and the 4-20 mA- return are internally connected.

If the 24V power ground and the 4-20 mA- return in the controller are internally connected (non-isolated 4-20mA input), it is unnecessary to connect the 4-20 mA- (blue wire) 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.

Detailed wiring diagrams for common controllers are available from [www.pyxis-lab.com](http://www.pyxis-lab.com).

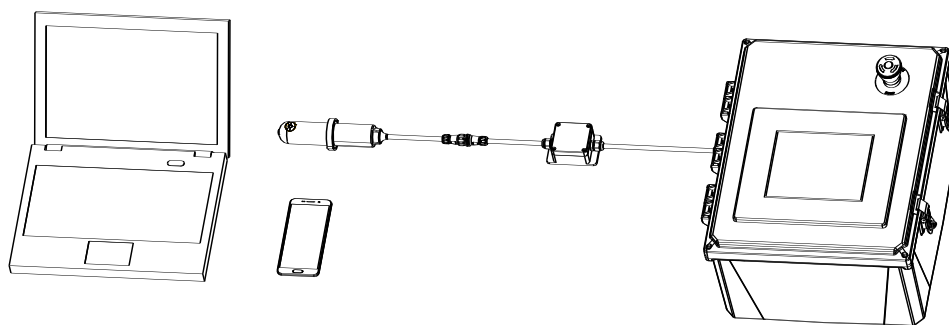
## 4 Calibration and Diagnosis

The ST-500 probe can be calibrated in a two-point (zero + slope) procedure using a deionized water sample and a standard containing 20 to 200 ppb PTSA. For accurate measurement in the low PTSA concentration range (< 50 ppb), the two-point calibration is required. The probe can be also calibrated by a single point method. 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.

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.

### 4.1 Calibration and Diagnosis by uPyxis Mobile App

Connect and power the ST-500 probe using the Pyxis Bluetooth adapter (P/N: MA-WB) as shown in the following connection diagram. The power should be sourced from a 24 VDC power terminal of a controller. If a controller is not available, please purchase a 24 V power supplier that can directly connect to the ST-500 probe with proper cable connectors from Pyxis.



*Figure 2. Power the ST-500 by Pyxis Bluetooth adapter*

Download and install uPyxis app from **Apple App Store** or **google Play Store**. Turn on Bluetooth in the phone (please do not pair your Bluetooth to uPyxis. uPyxis app will do the pairing). Open the uPyxis app in the phone. Swipe down to fresh the phone screen to scan the available Pyxis Bluetooth devices. The discovered devices will be listed (figure 3).

Tap the discovered ST-500 probe to connect to the probe. uPyxis app can identify the probe type if multiple Pyxis probes are discovered in the scan. For legacy old generation probes, a dialog message window will be displayed to ask the user to tell the app the probe type. In case, please select ST-500.

As shown in figure 4, the calibration page after uPyxis is connected to the probe via the Pyxis Bluetooth adapter displays the current PTSA value. Three functional tabs are available in this page: **Zero Calibration**, **Slope Calibration**, and **4-20mA Span**.

#### 4.1.1 Calibration by uPyxis Mobile App

Place the probe in deionized water and tap **Zero Calibration** to carry out the zero-point calibration.

Place the probe in a PTSA standard and tap **Slope Calibration** to carry out the slope calibration. Enter the PTSA concentration in the dialog window as in figure 5. For the best result, the PTSA standard should be in the range of 20 to 200 ppb.

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.

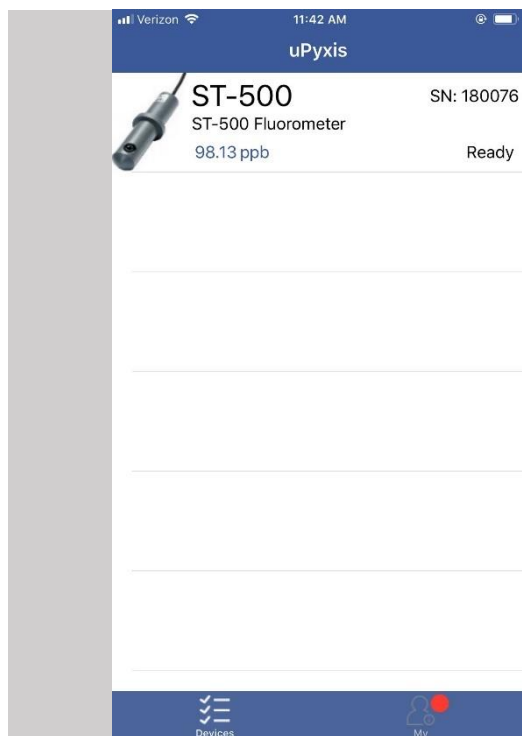


Figure 3. A ST-500 discovered by Bluetooth scan

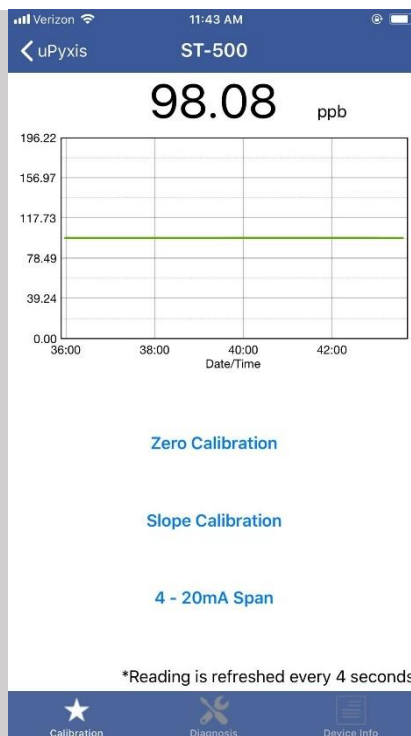


Figure 4. Calibration page

#### 4.1.2 4-20mA Span

The default 4-20mA span is 20 mA = 200 ppb and 4 mA = 0 ppb PTSA. Tap **4-20mA Span** to change the PTSA value corresponding to the 20 mA output (figure 6).



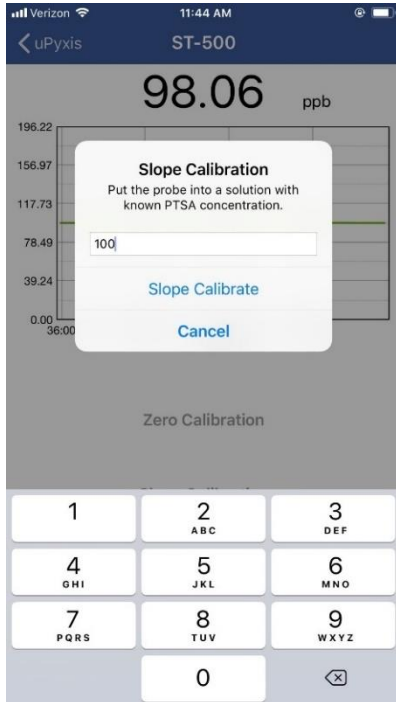


Figure 5. Enter PTSA concentration

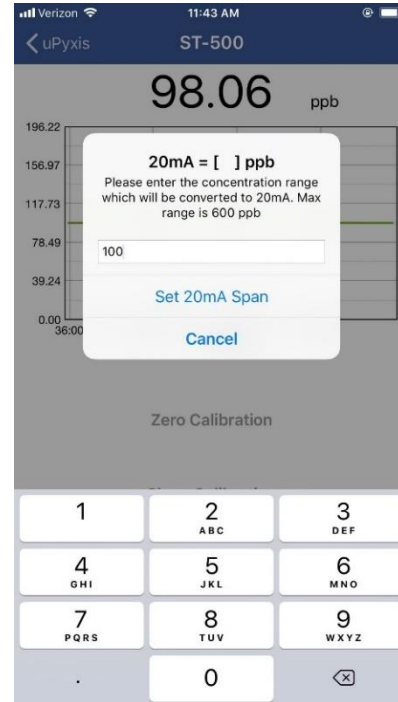


Figure 6. Enter PTSA concentration to set 4-20mA

### 4.1.3 Diagnosis

Tap **Diagnosis** in the bottom of the app page to launch the diagnosis page (figures 7 and 8).

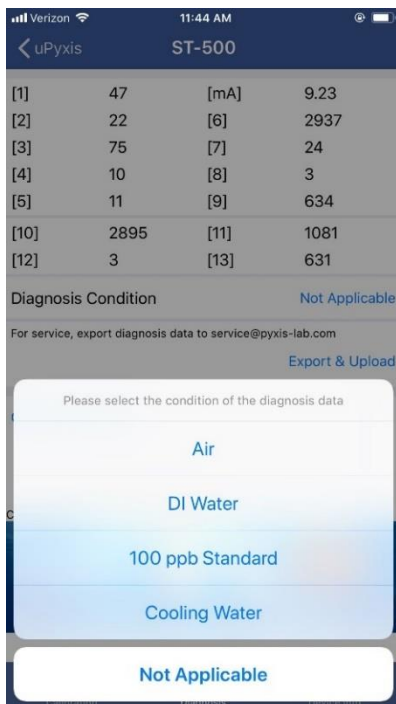


Figure 7. Select diagnosis condition

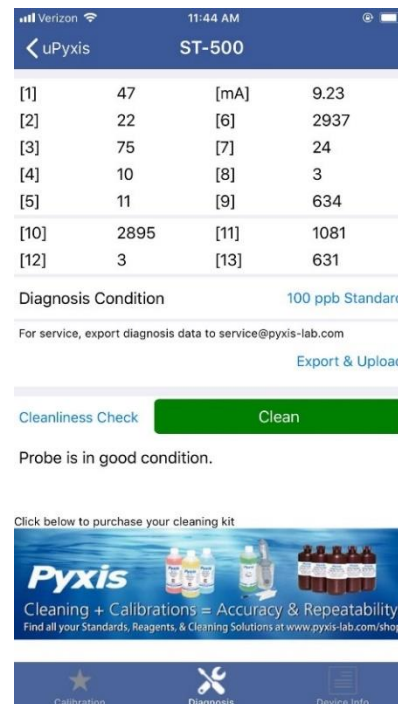


Figure 8. Cleanliness check result and raw data

In this page, the raw data measured by the probe is displayed. To help troubleshooting possible issues with the probe, please save images of these data when the probe is respectively placed in a clean water (tap water or deionized water), in a PTSA standard, and in the sample that the probe is intended for.

In the diagnosis page, the probe cleanliness check can be performed. Please place the probe in a PTSA standard or other water samples available and select the sample condition by tapping **Diagnosis Condition** (figure 7). Tap **Cleanliness Check** to carry out the check. If the probe is clean, a green **Clean** message tab will be shown (figure 8). If the probe is severely fouled, a red **Fouled** message tab will be shown. In this case, please clean the probe according to the procedure in Section 6.

## 4.2 Calibration and Diagnosis by uPyxis Desktop App

Download and install uPyxis desktop app from [www.pyxis-lab.com/support-2/](http://www.pyxis-lab.com/support-2/). Connect and power the ST-500 probe to a computer via the Pyxis USB-RS485 adapter according to connection diagram below. 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.

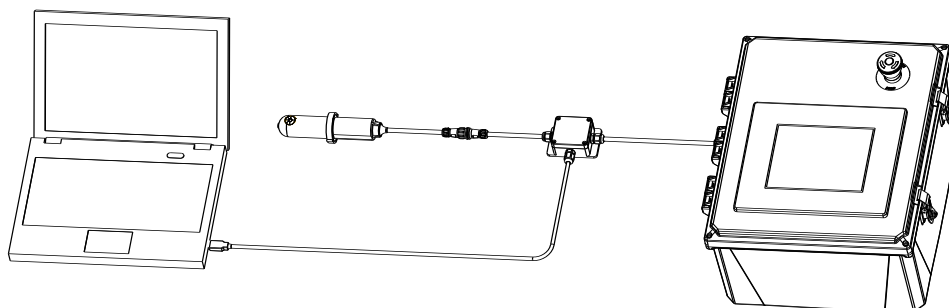


Figure 7. Connect the ST-500 to a computer via Pyxis USB adapter

Establish connection between uPyxis app and the ST-500 through the following steps:

1. Open the desktop uPyxis app.
2. Click **Device** tap to launch the connection option menu.
3. Select **Connect via USB-RS485** (figure 10).
4. Select the Comm Port to make a connection (figure 11) (normally only one Comm port is identified by uPyxis. If more than one Comm port listed in the selection dropdown, you may try to select each one to see if a connection can be made. Alternatively, you may use the Windows Device Manager to identify the Comm Port that the Pyxis USB adapter is used.)

After the connection is established, the ST-500 probe series number and current PTSA reading are displayed on the left of the information page (figure 12). In this page, a nickname can be assigned to the probe. The probe Modbus address can be changed from its default 10.

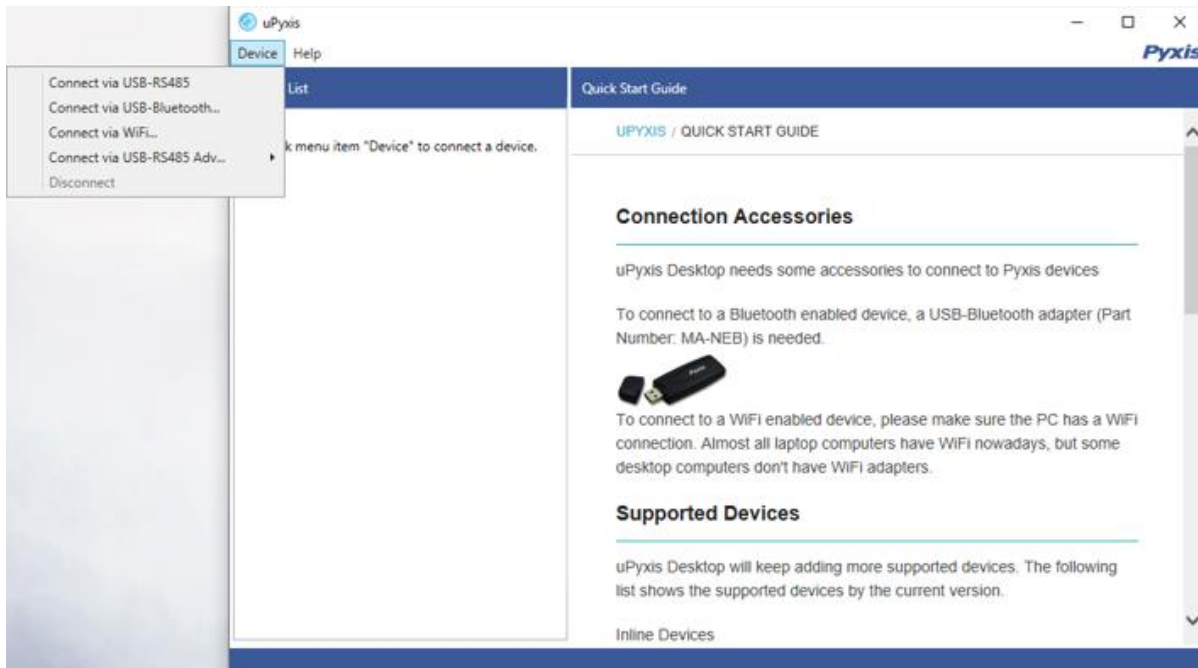


Figure 8. Connection Options

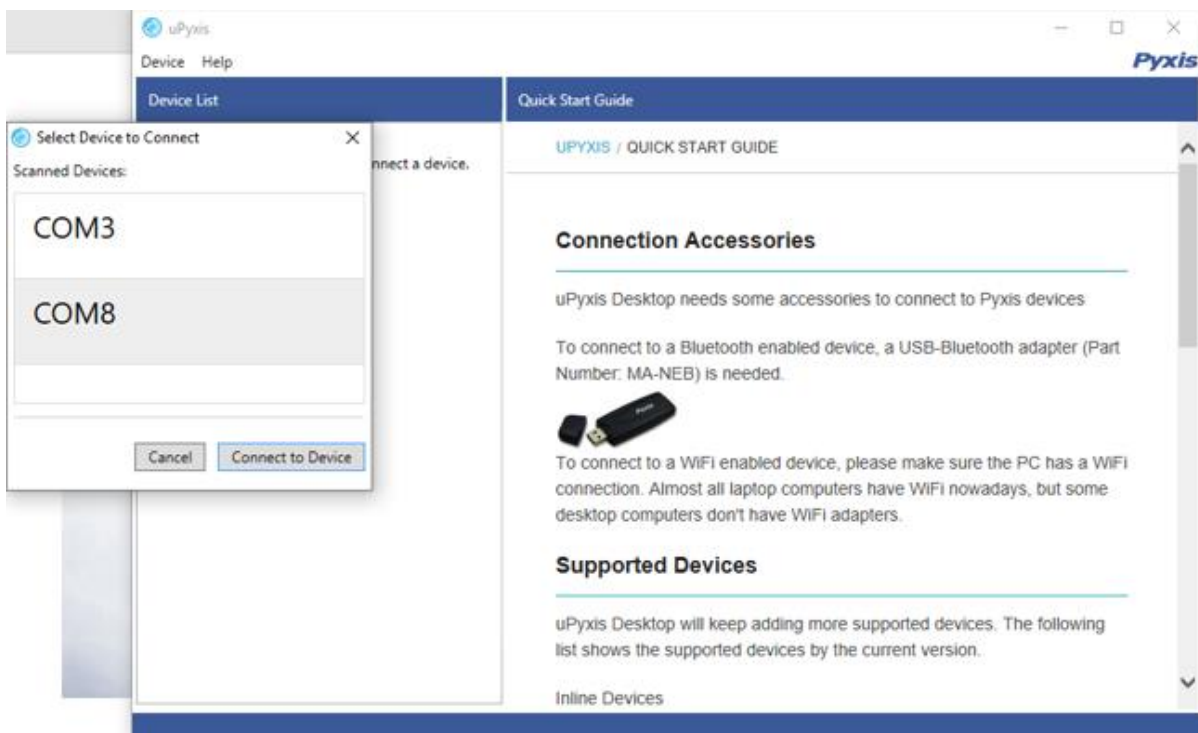


Figure 9. Select a Comm port

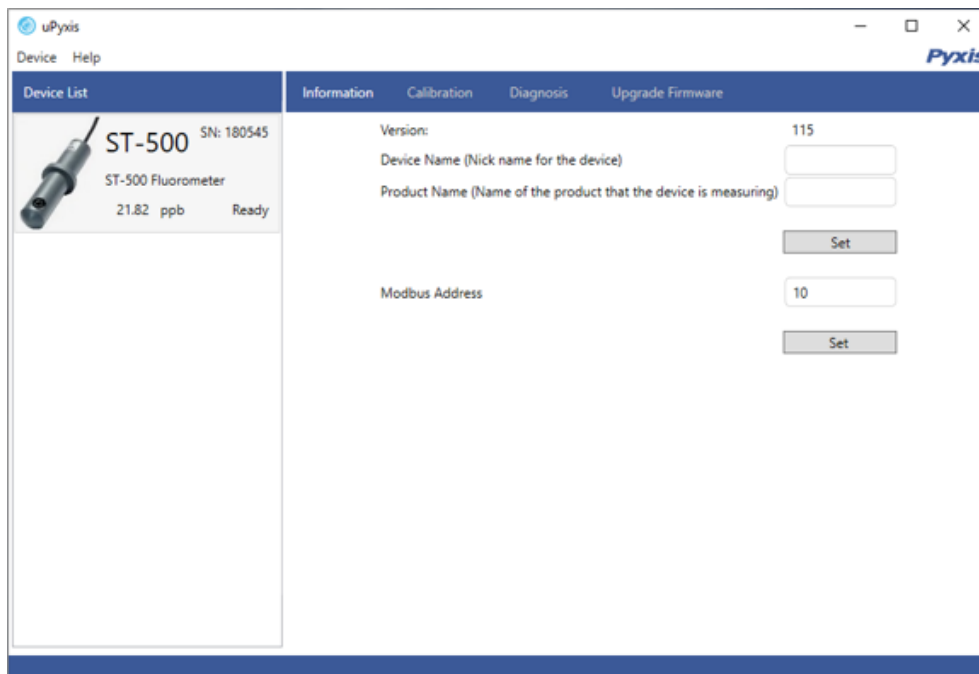


Figure 10. Connected to a ST-500 probe and information page

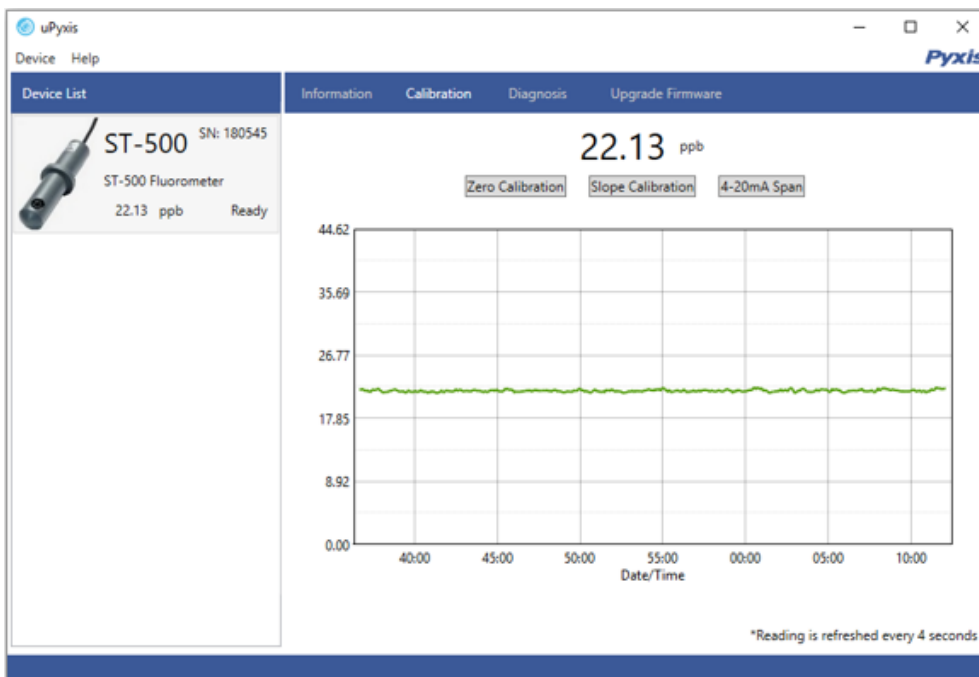


Figure 11. Calibration page

### 4.2.1 Calibration

Click **Calibration** to launch the calibration page (figure 13). Place the probe in deionized water and click **Zero Calibration** to carry out the zero-point calibration.

Place the probe in a PTSA standard and click **Slope Calibration** to carry out the slope calibration. Enter the PTSA concentration in the dialog window as in figure 14. For the best result, the PTSA standard should be in the range of 20 to 200 ppb.

#### 4.2.2 4-20mA Span

The default 4-20mA span is 20 mA = 200 ppb and 4 mA = 0 ppb PTSA. Click **4-20mA Span** to change the PTSA value corresponding to the 20 mA output (figure 15).

#### 4.2.3 Diagnosis

Click **Diagnosis** to the diagnosis page (figures 16 and 17). In the diagnosis page, the raw data measured by the probe is displayed. To help troubleshooting possible issues with the probe, please save an image of these data when the probe is placed in a clean water (tap water or deionized water), in a standard, and in the sample that the probe is intended.

In the diagnosis page, the probe cleanliness check can be performed. Please place the probe in a PTSA standard or other water samples available and select the sample condition by click **Diagnosis Condition**. Click **Cleanliness Check** to carry out the check. If the probe is clean, a green **Clean** message will be shown. If the probe is severely fouled, a red **Fouled** message will be shown. In this case, please clean the probe according to the procedure in Section 6 of this manual.

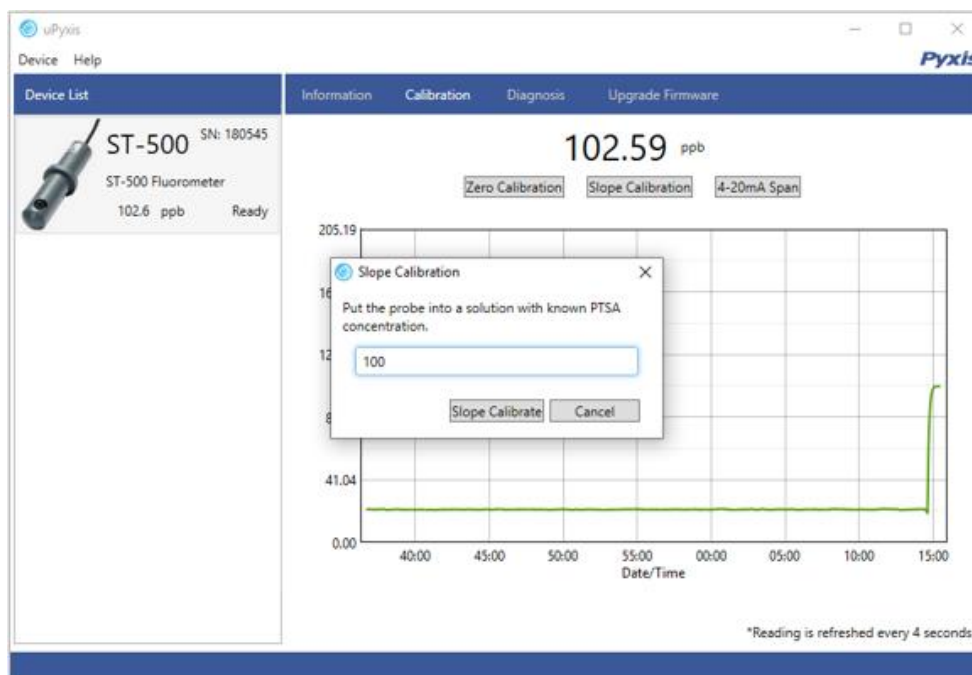


Figure 12. Enter PTSA concentration for slope calibration

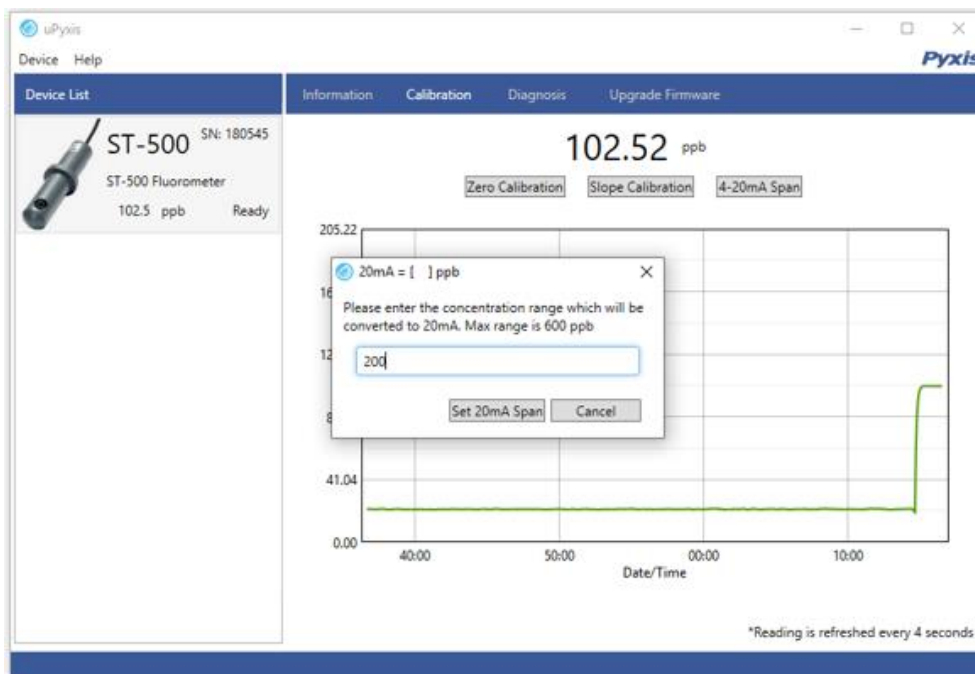


Figure 13. Set 4-20mA span

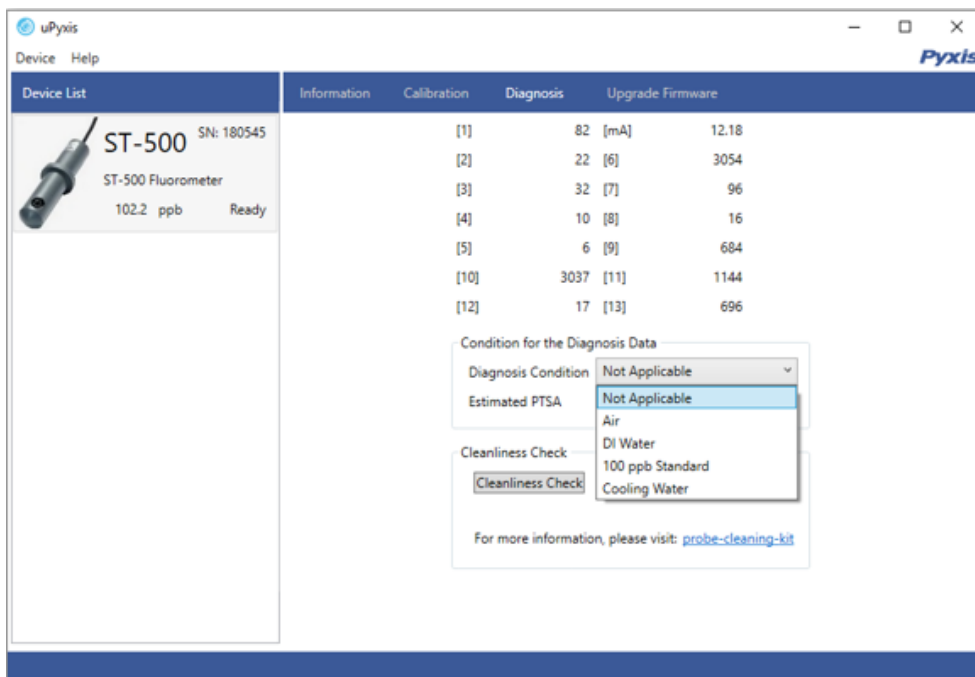


Figure 14. Select diagnosis condition before cleanliness check

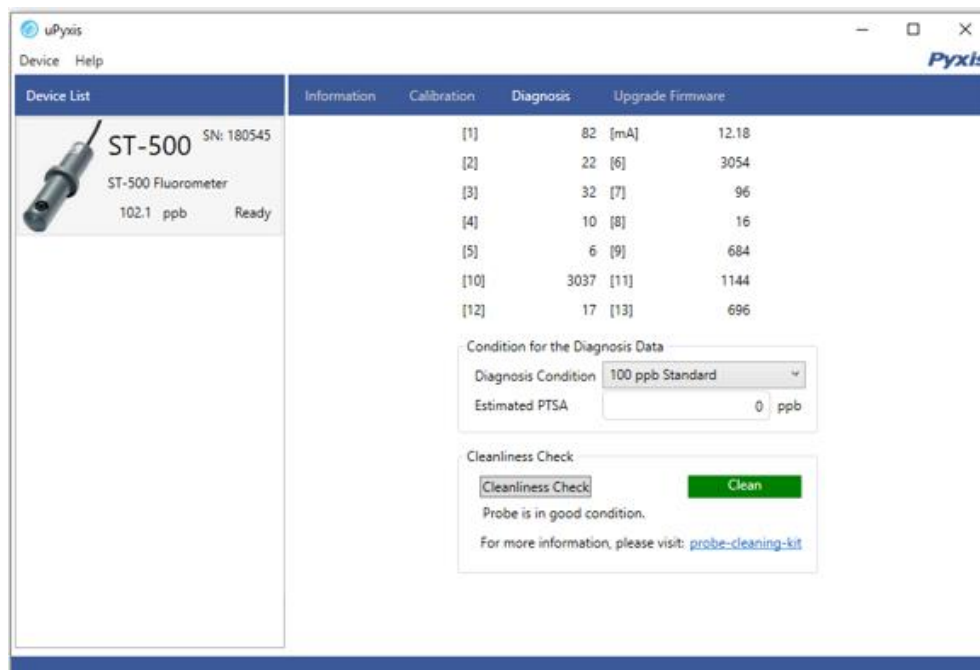


Figure 15. Cleanliness check and raw diagnosis data

### 4.3 Calibration on the Controller

It is recommended that ST-500 calibration is carried out using uPyxis app as demonstrated in the section above. Alternatively, a single point calibration can be carried on the controller by adjusting the mA-to-ppb ratio. A two-point calibration could be also carried out on the controller by adjusting both the mA-to-ppb ratio and the zero-point 4-20mA current value. Please follow the controller manufacturer’s procedure to carry the 4-20mA calibration. With the default probe settings, the controller should be set up to convert 4 mA to 0 ppb and 20 mA to 200 ppb.

For the single calibration involving the water sample itself, please determine the PTSA concentration in the 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.

## 5 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](mailto:service@pyxis-lab.com)) for more information.

## 6 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.

The need to clean the ST-500 probe can be determined by the Cleanliness Check using uPyxis app as described in the above section.

### 6.1 Cleaning Procedure

A light deposit inside the probe quartz tube can be cleaned by a Q-tip. Aged heavy deposition, especially iron oxide deposited, can be removed using a cleaning solution that is capable of removing iron, such as the Pyxis Cleaning Solution Kit available from Pyxis online Estore/Catalog <https://pyxis-lab.com/product-category/accessories/page/2/>

Soak the lower half of the ST-500 probe in 100 ml inline probe cleaning solution 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.



Figure 16. Pyxis Cleaning Solution Kit



The diagnosis function in uPyxis app in a phone or a PC can be used to check Cleanliness of the probe before and after cleaning as described in Section 4 of this manual.

## 6.2 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.

## Contact us

Contact us if you have questions about the use or maintenance of the ST-500 probe:

**Pyxis Lab, Inc.**

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1-866-203-8397

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[service@pyxis-lab.com](mailto:service@pyxis-lab.com)