Pyxis®

ST-774 Dissolved Oxygen Sensor
User Manual

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Pyxis Lab, Inc.
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Table of Contents

Warranty Information

Confidentiality
The information contained in this manual may be confidential and proprietary and is the property of Pyxis Lab, Inc. Information disclosed herein shall not be used to manufacture, construct, or otherwise reproduce the goods described. Information disclosed herein shall not be disclosed to others or made public in any manner without the express written consent of Pyxis Lab, Inc.

Standard 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.

Warranty Term
The Pyxis warranty term is thirteen (13) months ex-works. 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 during 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 (RA) Number 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 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. To receive an RMA you can generate a request on our website at https://pyxis-lab.com/request-tech-support/.

Pyxis Technical Support
Contact Pyxis Technical Support at +1 (866) 203-8397, service@pyxis-lab.com, or by filling out a request for support at https://pyxis-lab.com/request-tech-support/.

1 Introduction

The Pyxis ST-774 sensor is an ultra-low range dissolved oxygen (DO) sensor with a measurement range of 0.0 - 2,000 ppb and lower limit of detection 0.1 ppb (μg/L). It is based on the principle of fluorescence quenching to determine the partial pressure of the dissolved oxygen in water. It incorporates Pyxis' advanced technology in the field of fluorescence. The ST-774 offers the robustness associated with optical/luminescent DO sensor technology while achieving the ultra-low detection limit compatible to an amperometric DO sensor.

The ST-774 and other Pyxis dissolved oxygen sensors (ST-772 and ST-776) measure the oxygen partial pressure that is at equilibrium with the dissolved oxygen in water. The relationship between the partial pressure (PO_2) and the concentration of the dissolved oxygen is governed by Henry's law:

$$DO/ppb = K PO_2. \tag{1}$$

where K is Henry's Law constant, which is a function of the temperature and the ionic strength (or conductivity) of the water sample. Pyxis uses the latest USGS equations to convert the measured partial pressure and temperature measured by the built-in temperature sensor to a DO value in ppb (or μg/L) for the ST-774 sensor.

The ST-774 sensor offers an easily replaceable, front loading DO membrane cap that has been independently developed by Pyxis Lab, with a typical service life of up to two years. The flat front-end design of the ST-774 sensor makes this platform less prone to contamination or fouling and is very easy to clean. The sensor body is composed of 316L stainless steel and is well suited for aggressive industrial application use. The ST-774 sensor offers both 4–20mA and RS-485 Modbus outputs and is Bluetooth enabled when used in conjunction with the MA-CR or PowerPACK Series Bluetooth Adapters.

1.1 Main Features

The ST-774 sensor includes the following features:

1. 0.0–2,000 μg/L measurement range
2. 0.1 Lower Level of Detection
3. Built-in temperature and pressure sensors
4. Accurate and stable measurement with ultra-low drift
5. Built-in transmitter without the need of using a preamplifier or meter head
6. Dual outputs: isolated 4–20 mA signal and RS-485 Modbus
7. Long-distance transmission with higher stability and accuracy
8. Wireless calibration, diagnostics, data trend via **uPyxis®** App when used with MA-CR Adapter
9. Zero-point calibration with nitrogen and slope calibration in O_2-containing calibration gas
10. Alternative Zero-Calibration using 5% Catalyzed Sodium Sulfite Solution
11. **ST-774 Service-Swap Program** (P/N ST-774-SWAP)

    (a) $700 Per Year Factory Calibrated/Reconditioned Sensor Only Exchange
    (b) Client Issues PO#
    (c) Pyxis sends new or reconditioned unit
    (d) Client sends us unit in need of recalibration and service
    (e) Even exchange – eliminates client calibration and maintenance

2 Specifications

Table 1. ST-774 Specifications

Specification*	ST-774
Part Number (P/N)	53715
Output Range for DO (4-20mA)	0.0–2,000 μg/L (ppb)
Lower Level of Detection	0.1 μg/L (ppb)
Dissolved Oxygen Resolution	0.1 μg/L (ppb)
Dissolved Oxygen Accuracy	$\pm$0.3 μg/L (ppb) or $\pm$1%
Method	Blue Light Irradiated Excitation Red Light Reference
Response Time (90%)	Liquid Phase <30s / Gas Phase <10s
DO Membrane Cap Life	2 years
Calibration	High Point Calibration: 0.1% Oxygen in Nitrogen Gas Zero Calibration: 99.999% Nitrogen Gas -or- Zero Calibration: 5% Catalyzed Sodium Sulfite (2–4 hour soak)
Outputs	4–20mA Analog Output, RS-485 Digital Output with Modbus protocol
Installation	1/4" OD Swagelok
Cable Length	Attached 1.5 m/4.9 ft 8-Pin cable, MA-1.5CR Cable (1.5 m/4.9 ft 8-Pin Male Adapter/Flying Lead)
Power Supply	22–26 VDC, 0.6 W
Dimension (L × Dia)	11.8 × 2.36 inch (300 × 60 mm)
Weight [†]	4.74 lbs. (2150 g)
Material	316L Stainless Steel
Operational Temperature	32–122 °F (0–50 °C)
Pressure	Up to 145 psi (1.0 MPa)
Enclosure Rating	IP67/IP68
Regulation	CE, RoHS

* With Pyxis's continuous improvement policy, these specifications are subject to change without notice.

[†] Cables excluded

3 Unpacking 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.

3.1 Standard Accessories

The following accessories are included in the ST-774 sensor package:

- DCC-2 Dissolved Oxygen Membrane Cap   P/N: 53716

- MA-1.5CR Cable (1.5 m/4.9 ft 8-Pin Male Adapter/Flying Lead)   P/N: 50746

- MA-CR Bluetooth Adapter for 8-Pin Sensors   P/N: MA-CR

- Bluetooth/USB Adapter for use with **uPyxis®** Desktop App   P/N: MA-NEB

- User Manual available online at https://pyxis-lab.com/support/

3.2 Optional Accessories & Services

The following optional accessories can be ordered at order@pyxis-lab.com or the Pyxis E-Store at https://pyxis-lab.com/shop/

Table 2. Optional Accessories

Accessory Name	Part Number (P/N)
MA-CR Bluetooth Adapter For 8-Pin Pyxis Sensors	MA-CR
DO-Zero Calibration Kit	42058
ST-774/776 Flow Cell Assembly — Replacement	53718
DCC-2 Dissolved Oxygen Membrane Cap — Replacement	53716
DCC-3 Pure Nitrogen Gas 99.9999% Cylinder — 58L — Replacement	42059
DCC-4 Oxygen Gas 0.1% in Nitrogen Cylinder — 58L — Replacement	42060
UC-50 Display & Data Logger	43007
ST-774 Premounted Flow & Calibration Panel	42056
MA-50CR Cable (15 m/50 ft 8-Pin Male/Female Extension Cable)	50743
MA-100CR (30.5 m/100 ft 8-Pin Male/Female Extension Cable)	50744
Pyxis Probe Cleaning Kit	SER-01
ST-774 SERVICE-SWAP PROGRAM — ANNUAL*	ST-774-SWAP

* $700 Annual Fee. PO# Issued For Service. Pyxis Ships New/Reconditions ST-774 Sensor Only. Client Ships Their Sensor to Pyxis for Even Exchange. 30-days to Ship Old Sensor or Pyxis Bills for Value of New ST-774
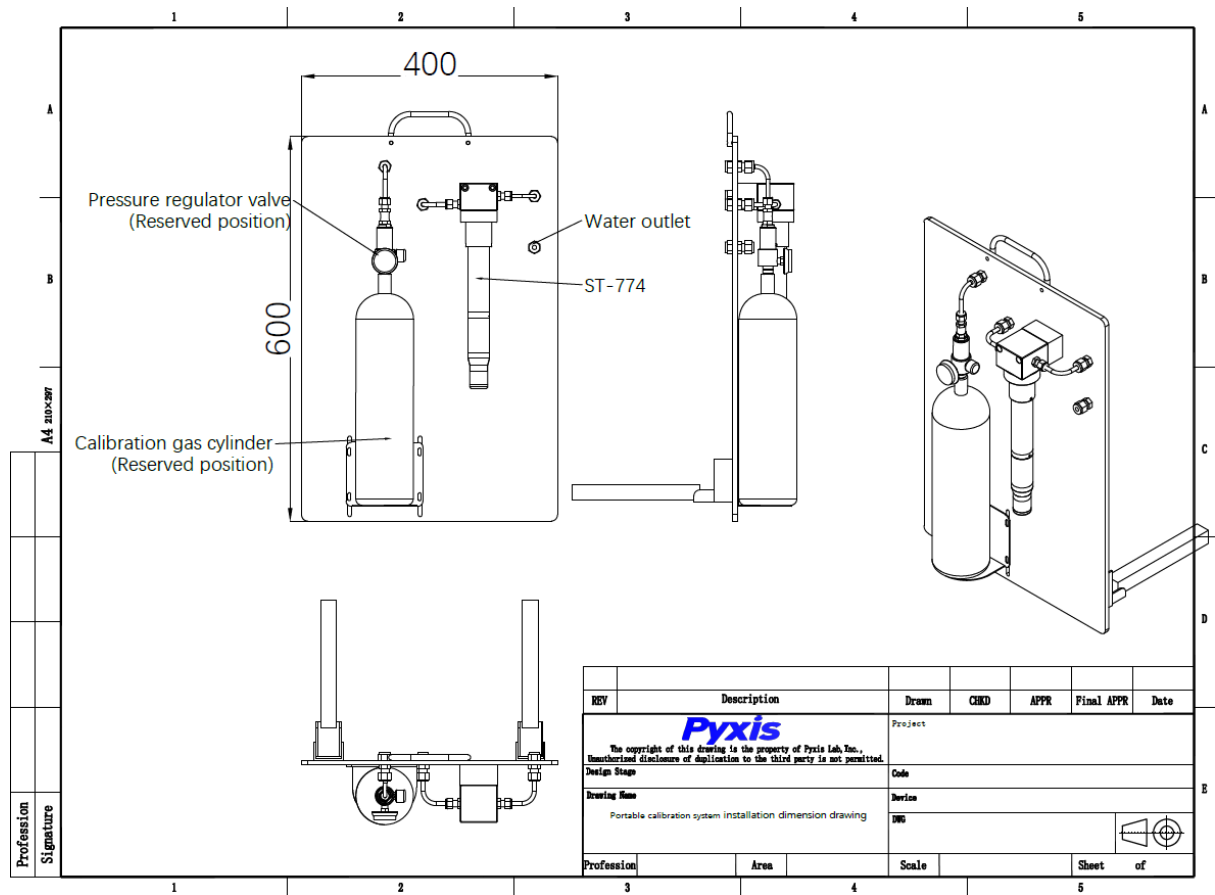
Figure 1. DO-Zero Calibration Kit (P/N: 42058)

4   Installation

4.1   Piping

The ST-774 sensor must always be installed in sample flow at or below the upper temperature limit of the sensor (<122 °F). In many applications a sample pre-cooler will be required to adjust sample temperature to an acceptable level. To properly install the ST-774 sensor, follow the steps below:

1. Mount the flow cell of the sensor to a flat surface.

2. Connect the flow cell's 1/4" Swagelok ports are connected to the sample flow line and allow flow cell and ports to fully drain.

3. Make sure that the O-ring is installed properly in the flow cell.

4. Hand tighten the ST-774 sensor body to the flow cell.
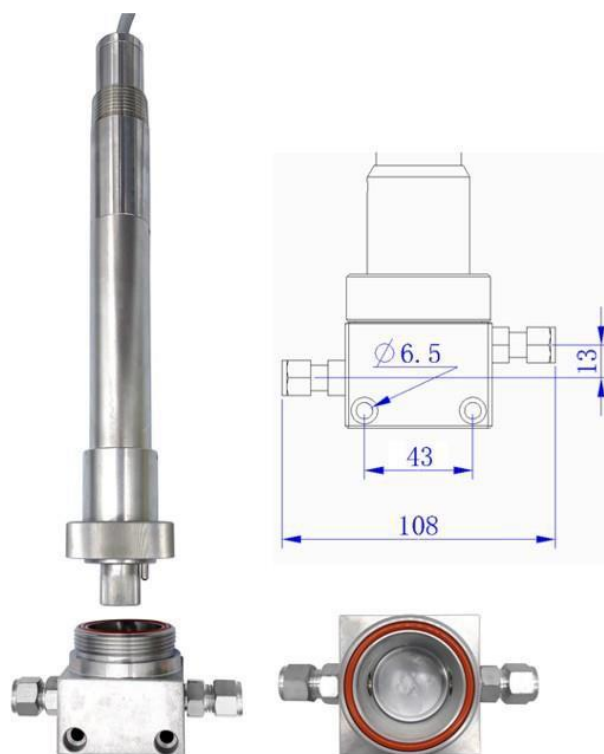
Figure 2. Pipeline installation using ST-774 Flow Cell Assembly (P/N: 53718) with dimensions (mm)

4.2 Wiring

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

> ***NOTE*** *The negative 24V power terminal (power ground) and the negative 4–20mA terminal on the ST-774 sensor <u>are</u> internally connected.*

Follow the wiring table below to connect the ST-774 sensor to a controller:

Table 3.

Wire Color	Designation
Red	24V +
Brown	24V Power ground
Gray*	4–20mA -
White	4–20mA +
Pink	RS-485 C
Blue	RS-485 A
Yellow	RS-485 B
Green	Earth ground
Black	Shield

* Internally connected to the power ground

4.3 Connecting via Bluetooth

A Bluetooth adapter (P/N: MA-CR) can be used to connect a ST-774 sensor to a smart phone with the **uPyxis®** Mobile App or a computer with a Bluetooth/USB Adapter (P/N: MA-NEB) and the **uPyxis®** Desktop App.
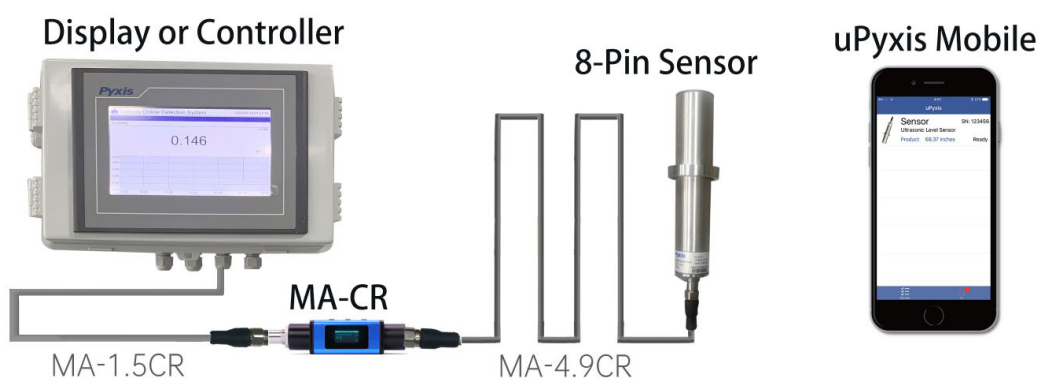
Figure 3. Bluetooth connection to ST-774 sensor MA-CR and uPyxis Mobile App.

5   Setup and Calibration with uPyxis® Mobile App

5.1   Download uPyxis® Mobile App

Download **uPyxis®** Mobile App from **Apple App Store** or **Google Play**.

Figure 4. uPyxis® Mobile App installation

5.2 Connecting to uPyxis® Mobile App

Connect the ST-774 sensor to a mobile smart phone according to the following steps:

1. Open **uPyxis®** Mobile App.

2. On **uPyxis®** Mobile App, pull down to refresh the list of available Pyxis devices.

3. If the connection is successful, the ST-774 and its Serial Number (SN) will be displayed (Figure 5).

4. Press on the **ST-774 sensor image**.

Figure 5.

5.3   Calibration Screen and Reading

When connected, the **uPyxis®** Mobile App will default to the **Calibration** screen. From the **Calibration** screen, you can perform calibrations by pressing on **Zero Calibration**, **Air Calibration**, and **4–20mA Span**.

> ***NOTE*** *Before calibrating, remove the ST-774 sensor from the water and wipe it with a damp cloth to remove debris and any biofouling. If there is water on the membrane, dry it with a soft cloth, taking special care not to damage the membrane.*
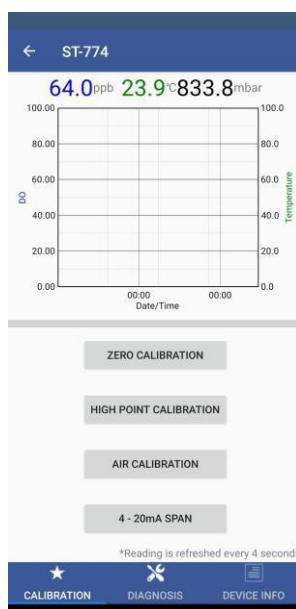

Figure 6.

A depressurized nitrogen source can be connected to the sample cell through the 1/4" OD stainless tubing for the zero-point calibration. The gas flow rate should be regulated between 2 and 10 liter per minute. Alternatively, the Pyxis DO-Zero Calibration Kit (P/N: 42058, seen in Figure 1) can be used for the zero and/or slope calibrations. The kit contains an aluminum gas cylinder 99.9999% Nitrogen (P/N: 42059) equipped with flow regulating pressure gauge and an extra sample cell mounted onto a portable stainless steel panel. See the DO-Zero Calibration Kit in the ST-774 Datasheet for details.

5.3.1   Zero Calibration

1. Place the sensor into the sample cell.

2. Turn on a nitrogen gas flow.

3. Allow the gas flow and the temperature to be stabilized for 15 minutes.

4. Once the displayed oxygen and temperature values are stable, press **Zero Calibration** to perform a zero calibration.

5. If the calibration is successful, the interface will return a message "Calibration Succeeded". If the calibration fails, press **Zero Calibration** again and repeat.

5.3.2 High Point (Slope) Calibration

1. Carry out the zero calibration using nitrogen gas first. See the **Zero Calibration** section.

2. Place the sensor into the sample cell.

3. Turn on a calibration gas (with known oxygen concentration) flow.

4. Allow the gas flow and the temperature to be stabilized for 15 minutes.

5. Once the displayed oxygen and temperature values are stable, press **High Point Calibration**

6. Enter the % concentration of the calibration gas to perform a high point (slope) calibration.

7. If the calibration is successful, the interface will return a message "Calibration Succeeded". If the calibration fails, press **High Point Calibration** again and repeat.

5.3   Diagnosis Screen

From the **Diagnosis** screen, you can check the diagnosis condition as well as **Export & Upload**. This feature may be used for technical support when communicating with service@pyxis-lab.com.

To perform a Cleanliness and Selflife Check, first select the **Diagnosis Condition** which defines the fluid type that the ST-774 sensor in currently measuring, then press **Cleanliness and Selflife Check**. If the sensor is clean, a **Clean** message will be shown. If the sensor is severely fouled, a **Please replace the DO membrane cap** message will be shown. In this case, follow the procedure in the **Methods to Cleaning the ST-774Sensor** section of this manual.
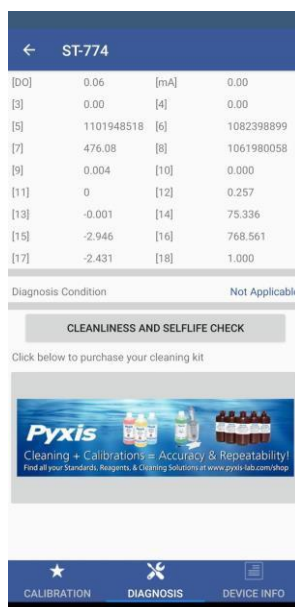

Figure 7.

5.4   Device Info Screen

From the **Device Info** screen. You can name the Device or Product as well as set the Modbus address.
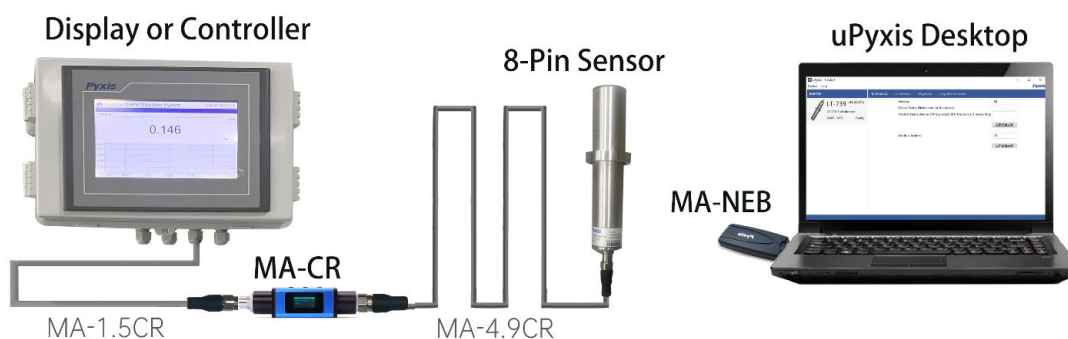

Figure 8.

Figure 9. Bluetooth connection to ST-774 sensor MA-CR, MA-NEB and uPyxis Desktop App.

6   Setup and Calibration with uPyxis® Desktop App

6.1   Install uPyxis® Desktop App

Download the latest version of **uPyxis®** Desktop software package from: https://pyxis-lab.com/upyxis/ this setup package will download and install the Microsoft.Net Framework 4.5 (if not previously installed on the PC), the USB driver for the USB-Bluetooth adapter (MA-NEB), the USB-RS485 adapter (MA-485), and the main **uPyxis®** Desktop application. Double click the **uPyxis.Setup.exe** file to install.
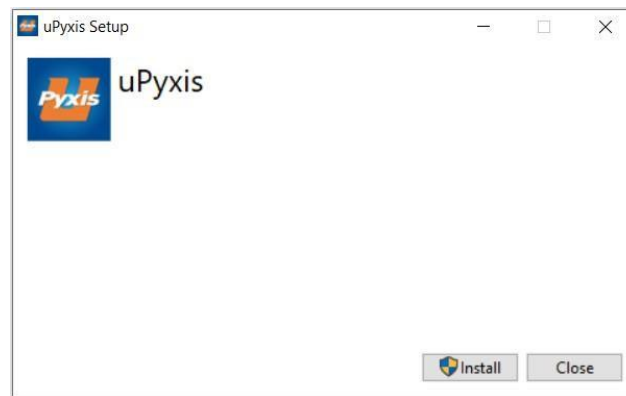
Figure 10. uPyxis® Desktop App installation

Click **Install** to start the installation process. Follow the screen instructions to complete the USB driver and **uPyxis®** installation.

6.2   Connecting to uPyxis® Desktop App

Connect the ST-774 sensor to a Windows computer using a Bluetooth/USB adapter (P/N: MA-NEB) according to the following steps:

1. Plug the Bluetooth/USB adapter into a USB port in the computer.

2. Launch **uPyxis®** Desktop App.

3. On **uPyxis®** Desktop App, click Device → **Connect via USB-Bluetooth** (Figure 10).

4. If the connection is successful, the ST-774 and its Serial Number (SN) will be displayed in the left pane of the **uPyxis®** window.

    ∗NOTE∗ *After the sensor and Bluetooth is powered up, it may take up to 10 seconds for the adapter to establish the wireless signal for communication.*
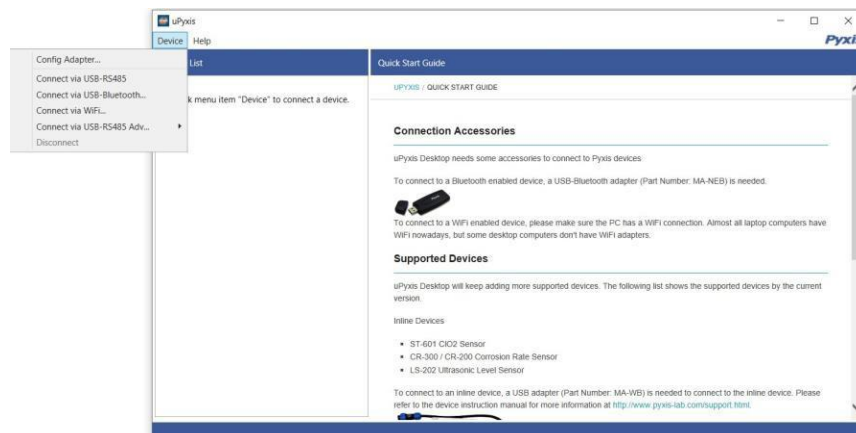

Figure 11.

6.3   Information Screen

Once connected to the device, a picture of the device will appear on the top left corner of the window and the **uPyxis®** Desktop App will default to the **Information** screen. On the **Information** screen you can set the information description for **Device Name**, **Product Name**, and **Modbus Address**, then click **Apply Settings** to save.
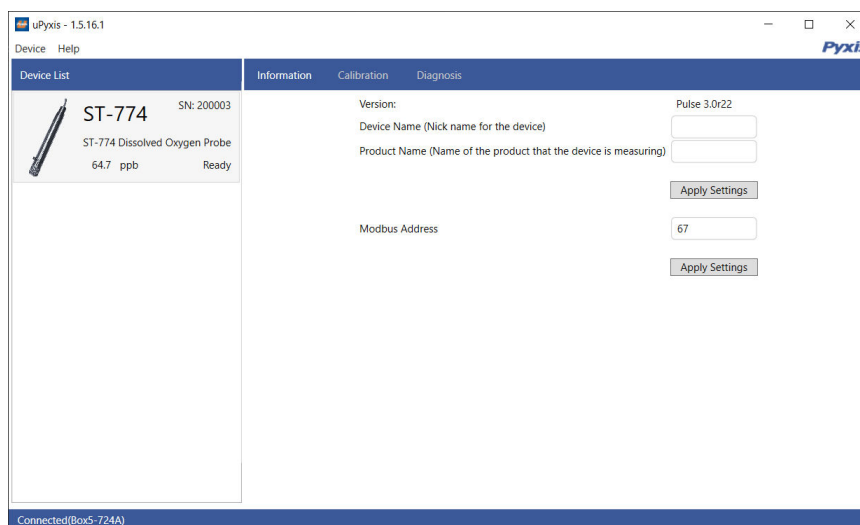

Figure 12.

6.4   Calibration Screen

From the **Calibration** screen, you can perform calibrations by pressing on **Zero Calibration**, **Air Calibration**, and **4–20mA Span**.

> ***NOTE*** *Before calibrating, remove the ST-774 sensor from the water and wipe it with a damp cloth to remove debris and any biofouling. If there is water on the membrane, dry it with a soft cloth, taking special care not to damage the membrane.*
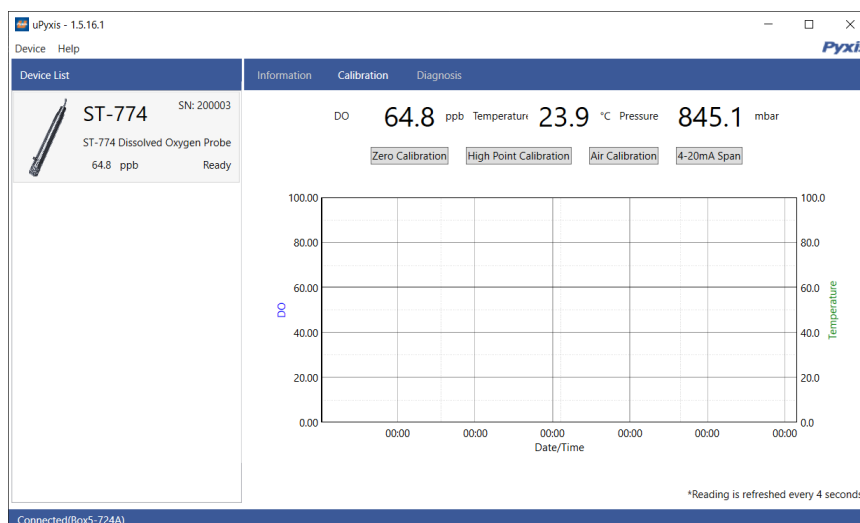

Figure 13.

A depressurized nitrogen source can be connected to the sample cell through the 1/4" OD stainless tubing for the zero-point calibration. The gas flow rate should be regulated between 2 and 10 liter per minute. Alternatively, the Pyxis DO-Zero Calibration Kit (P/N: 42058, seen in Figure 1) can be used for the zero and/or slope calibrations. The kit contains an aluminum gas cylinder 99.9999% Nitrogen (P/N: 42059) equipped with flow regulating pressure gauge and an extra sample cell mounted onto a portable stainless steel panel. See the DO-Zero Calibration Kit in the ST-774 Datasheet for details.

6.4.1   Zero Calibration

1. Place the sensor into the sample cell.

2. Turn on a nitrogen gas flow.

3. Allow the gas flow and the temperature to be stabilized for 15 minutes.

4. Once the displayed oxygen and temperature values are stable, click **Zero Calibration** to perform a zero calibration.

5. If the calibration is successful, the interface will return a message "Calibration Succeeded". If the calibration fails, click **Zero Calibration** again and repeat.

6.4.2   High Point (Slope) Calibration

1. Carry out the zero calibration using nitrogen gas first. See the **Zero Calibration** section.

2. Place the sensor into the sample cell.

3. Turn on a calibration gas (with known oxygen concentration) flow.

4. Allow the gas flow and the temperature to be stabilized for 15 minutes.

5. Once the displayed oxygen and temperature values are stable, click **High Point Calibration**

6. Enter the % concentration of the calibration gas to perform a high point (slope) calibration.

7. If the calibration is successful, the interface will return a message "Calibration Succeeded". If the calibration fails, click **High Point Calibration** again and repeat.

6.5 Diagnosis Screen

After the device has been calibrated and installation has been completed, to check diagnosis, click on **Diagnosis**. When in the **Diagnosis** screen you can view the Diagnosis Condition of the device. This feature may be used for technical support when communicating with service@pyxis-lab.com. To perform a Cleanliness and Selflife Check, first select the **Diagnosis Condition** which defines the fluid type that the ST-774 sensor is currently measuring, then click **Cleanliness and Selflife Check**. If the sensor is clean, a **Clean** message will be shown. If the sensor is fouled, a **Please replace the DO membrane cap** message will be shown. In this case, follow the procedure in the **Methods to Cleaning the ST-774** section of this manual.
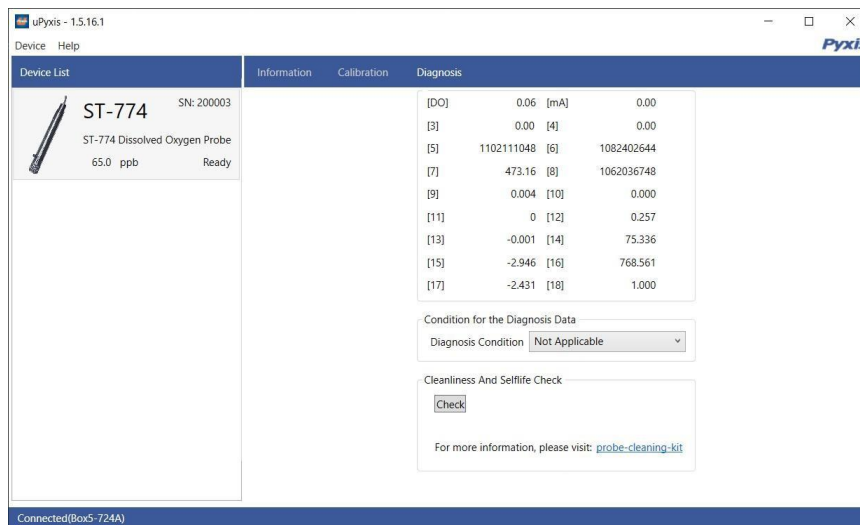

Figure 14.

7 Outputs

7.1 4–20mA Output Setup

The 4–20mA output of the ST-774 sensor is scaled as:

- Dissolved Oxygen:

    – 4 mA = 0 ppb

    – 20 mA = 2000 ppb

7.2 Adjusting 4–20mA Span

Users may adjust the output scale using 4–20mA Span to change the dissolved oxygen ppb value corresponding to the 20 mA output via **uPyxis®**. For the **uPyxis®** Mobile App, press **4-20mA Span** found on the **Calibration and Reading Screen**, shown in Figure 15. For the **uPyxis®** Desktop App, click **4-20mA Span** found on the **Calibration Screen**, shown in Figure 16.
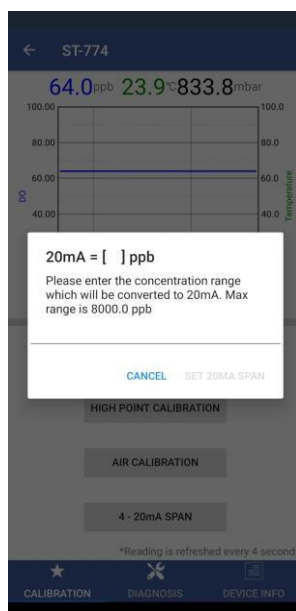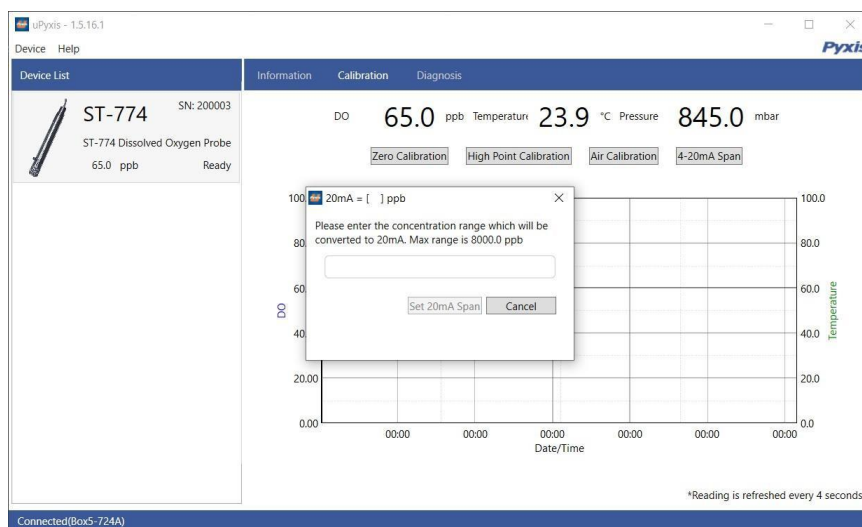

Figure 15.

Figure 16.

7.3 Communication using Modbus RTU

The ST-774 sensor is configured as a Modbus slave device. In addition to the dissolved oxygen ppb 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.

8   Sensor Maintenance and Precaution

The ST-774 sensor is designed to provide reliable and continuous dissolved oxygen readings even when installed in moderately contaminated industrial 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-774 sensor 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 overfeed, for example by limiting pump size or duration, or by alarming if the pumping rate exceeds a desired maximum limit.

The ST-774 sensor is designed to be easily removed, inspected, and cleaned if required. It is suggested that the ST-774 sensor be checked for fouling and cleaned/calibrated 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-774 sensor can be determined by the **Cleanliness and Selflife Check** using either the **uPyxis®** Mobile App (see the **Mobile Diagnosis Screen** section) or the **uPyxis®** Desktop App (see the **Desktop Diagnosis Screen** section). If the **Cleanliness and Selflife Check** continues to return a **Please replace the DO membrane cap**, use an Allen wrench to remove the protective cover, unscrew the current membrane cap, check whether the inside of the ST-774 sensor flashes blue and red light, then screw on a new membrane cap and re-fasten the protective cover.

8.1   Methods to Cleaning the ST-774 Sensor

Any equipment in contact with industrial cooling systems is subject to many potential foulants and contaminants. Our inline sensor cleaning solutions below have been shown to remove most common foulants and contaminants. The surface of the DCC-2 Dissolved Oxygen Membrane Cap can be cleaned with a cotton swab. Please do not use sharp instruments to clean the membrane cap. In addition, the Pyxis Inline Probe Cleaning Solution Kit may also be used to removal of heavy deposits, especially inorganics, and can be purchased at our online E-Store https://pyxis-lab.com/product/probe-cleaning-kit/.

Figure 17. Inline Probe Cleaning Solution Kit

To clean the ST-774 sensor, remove the sensor and the DO membrane cap from the water in use, wipe it with a damp cloth to remove debris and growing organisms, and use a cotton swab dipped in water to clean up the dirt on the membrane surface. Unscrew the membrane cap, check whether the inside of the ST-774 sensor flashes blue and red light; after the inspection, screw the DO membrane cap back onto the sensor.

8.2   Storage

Avoid long term storage at temperature over 100 °F. Avoid long term storage with the sensor exposed to ambient light as it may reduce the membrane lifetime. In an outdoor installation, properly shield the ST-774 sensor from direct sunlight and precipitation.

9   Troubleshooting

If the ST-774 sensor output signal is not stable and fluctuates significantly, make an additional ground connection — connect the black (shield, earth ground) wire to a conductor that contacts the sample water electrically such as a metal pipe adjacent to the ST-774 tee.

10   Contact Us

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