

## Little Dipper™ 2 In-Line Fluorometer



September 29, 2020

P/N 998-2821

Version E

**TURNER DESIGNS**

1995 N. 1<sup>st</sup> Street

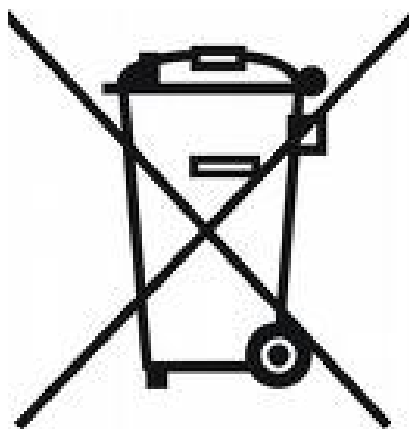
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### **WASTE ELECTRICAL AND ELECTRONIC EQUIPMENT (WEEE) DIRECTIVE**

Turner Designs is in the business of designing and selling products that benefit the well-being of our environment. Accordingly, we are concerned with preserving the surroundings wherever our instruments are used and happy to work with customers by complying with the WEEE Directive to reduce the environmental impact resulting from the use of our products.

#### **WEEE Return Process:**

To arrange the return of an end-of-life product, proceed as follows:

If you purchased your instrument through a Turner Designs Distributor please contact your local representative. They will instruct you where to return the end-of-life product.

If you purchased your instrument directly from Turner Designs please contact Turner Designs Customer Service:

By Phone: 1-408-212-4041 or Toll Free: (877) 316.8049

By Email: Customer Service at [support@turnerdesigns.com](mailto:support@turnerdesigns.com)

Turner Designs will provide a WEEE RMA Number, a Shipping Account Number, and a Ship to Address. Package and ship the product back to Turner Designs.

The product will be dealt with per Turner Designs' end-of-life recycling program in an environmentally friendly way.

## 1. Introduction

### 1.1 Description

Turner Designs' Little Dipper™ 2 is an accurate, single-channel fluorometer designed to measure the concentration of your fluorophore of interest. The Little Dipper™ 2 provides a 4 - 20 mA output signal proportional to the concentration of the fluorophore in the sample or source water. In a representative application, Little Dipper™ 2 can be used with a data collection system to monitor and control the level of treatment chemicals in industrial applications. The sample water's fluorescence intensity is measured by passing the sample water, containing the fluorophore of interest, past the Little Dipper's optical window. An excitation light source illuminates the solution and excites the fluorophore in the solution which fluoresces at a different wavelength. The intensity of the emitted light is proportional to the concentration of the fluorophore in the sample or source water. Turner Designs' Little Dipper™ 2 has a low maintenance design that will provide trouble-free performance.

### 1.2 Inspection and Setup

| Part Number | Dynamic Range                         | Factory Adjusted             |
|-------------|---------------------------------------|------------------------------|
| 2820-000-A  | < 1 to 300 ppb typical for PTSA       | < 1-200ppb (18.0mA – 19.5mA) |
| 2820-000-F  | < 1 to 100ppb typical for Fluorescein | < 1-100ppb (18.0mA – 19.5mA) |

If your application requires a different concentration range, the Calibration Cable kit P/N 2820-505 is required. Contact [Accessory Sales](#) to purchase. Refer to calibration procedure in Section 3. Refer to Appendix E if integrating with a Control Box.

Little Dipper™ 2 Fluorometer  
with label specifying serial  
number of unit



4-20mA cable P/N 021-2800  
5-foot long cable with 4 bare  
leads: Black, Red, Orange  
and Brown

Calibration Cable Kit P/N 2820-505



Calibration Cable



12v Power Supply

Threaded Connection Ring



1 in. (NPT) mounting tee for  
flow through measurements.

## 2. Installation and Operation

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### 2.1 Installation

Turner Designs' Little Dipper™ 2 is rated for light industrial environments.

Do not install the Little Dipper™ 2:

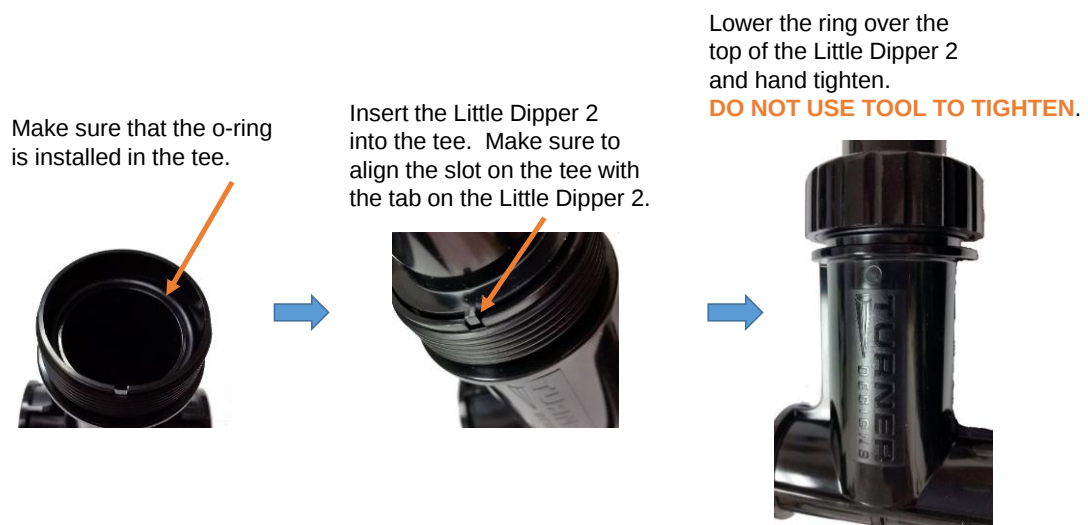
- In direct sunlight or near heat sources - operating temperature 0-50 °C.
- On vibrating walls or surfaces that affect the flow.
- Near devices that produce a strong electromagnetic field, such as large generators.

It is recommended that the Little Dipper™ 2 be installed in such a way that the flow is directed upward to expel any trapped air bubbles or air trapped on the optical window will influence signal and cause erratic readings - see Section 4.0.

### 2.2 Tee Installation

We recommend the following installation procedure for installing the Little Dipper™ 2 onto the mounting tee provided for flow through applications:

1)



2) Connect the mounting tee in line with your flow and start flowing water.

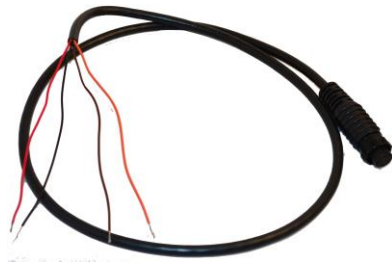
3) Inspect for leaks.

**Note:** In the event the Little Dipper™ 2 must be removed for service, the mounting tee opening can be plugged with Plumbing Plug P/N 2820-520. Contact [Accessory Sales](#) to purchase.



Plumbing Plug P/N 2820-520

- 4) Connect the 4-20mA cable to the top of the Little Dipper™ 2.

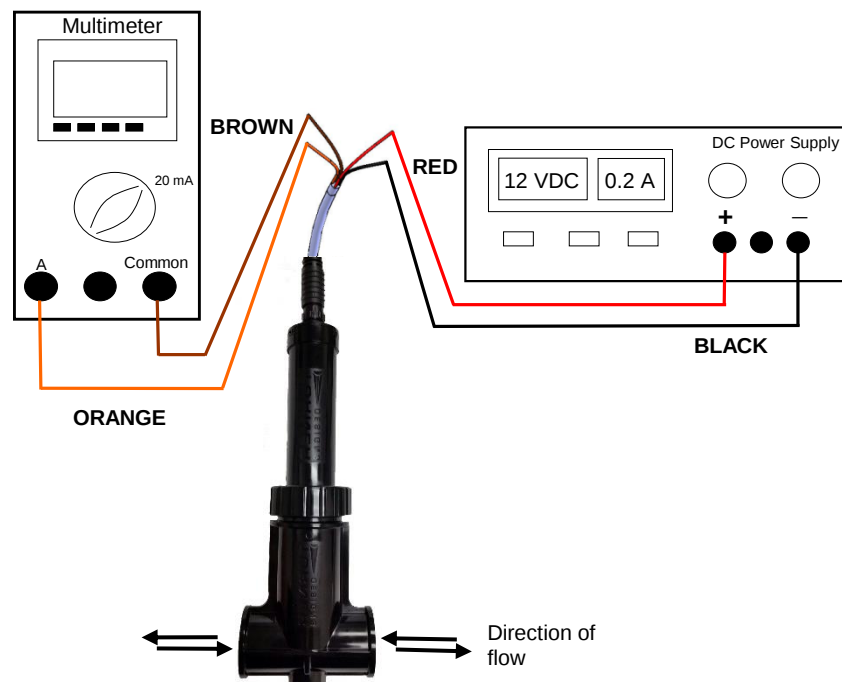


When connecting the Little Dipper 2 to the cable, pay special attention to the orientation of the pins. Once the connection is made, slide the collar down and rotate the collar to secure.



- 5) Connect the Little Dipper™ 2 to the power supply and digital multimeter as shown below.

**Note: The power ground (Black Wire) and the 4-20 mA return (Brown Wire) are not common. These wires should not be connected to the same point. Do not allow the bare wires to touch each other or conductive surfaces. Use standard electrical connection and insulation materials. Failure to properly connect the Little Dipper 2 may result in damaged equipment.**



### 2.3 Operation

Turner Designs' Little Dipper™ 2 uses a Light Emitting Diode (LED) at a specific wavelength to excite the fluorophore of interest in samples or source water. Upon excitation, the fluorophore emits a different wavelength of light (fluorescence) that will be detected by the fluorometer's photodiode.

After power (8 - 30 VDC) is applied to the Little Dipper™ 2 allow 5 seconds for the LED to stabilize. After 5 seconds measurements can be taken continuously as current output (4 – 20 mA).

### 3. Calibration Software and Calculations

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The Little Dipper™ 2 is factory adjusted to the following concentrations:

2820-000-A 200ppb PTSA(18.0mA – 19.5mA)  
2820-000-F 100ppb Fluorescein (18.0mA – 19.5mA)

If your application requires a different concentration range, the Calibration Cable kit P/N 2820-505 is required. Contact [Accessory Sales](#) to purchase. Refer to calibration instructions below:

**Note: Refer to Appendix E if integrating with a Control Box.**



#### 3.1 Software Requirements and PC Installation

The LD2 software user interface has been designed to work with Windows-based systems. At this time there is no Macintosh version available.

##### 3.1.1 Minimum PC Requirements

- ◆ Intel® Pentium® 133 MHz microprocessor
- ◆ Microsoft® Windows® 98 or higher
- ◆ 32 MB of RAM
- ◆ 800 x 600 SVGA resolution

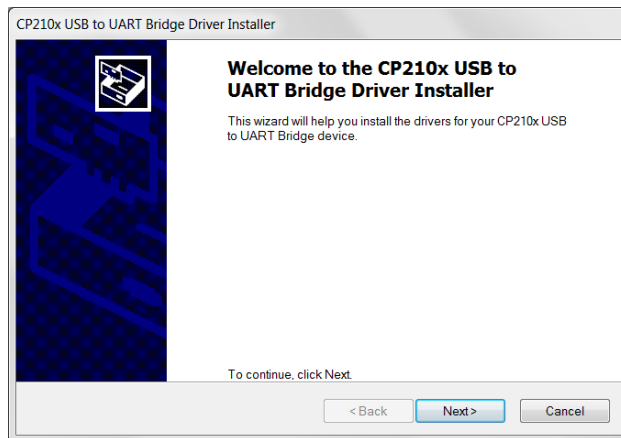
##### 3.1.2 Software and Calibration Cable Installation

Included on the USB flash drive are:

- LD2 application
  - Driver installer for 32-bit Windows OS
  - Driver installer for 64-bit Windows OS
  - Release Notes
  - License Agreement
1. Exit all Windows™ programs
  2. Insert the USB Flash Drive (also located on the Turner Designs Customer Care Software / Firmware webpage under Little Dipper™ 2).
  3. If you're running 64-bit Windows OS, double-click the CP210xVCPInstaller\_x64.exe icon. If you're running 32-bit Windows OS, double-click the CP210xVCPInstaller\_x86.exe icon.

**Note: If you are not sure which OS your computer is running, please follow the instructions in Appendix C.**

4. A screen will appear prompting you to begin the installation process. Click “Next.”



5. Follow the screen prompts to install the driver software. The software will be automatically installed on your computer's C drive.
6. You will see a “Completing the Installation of the CP210x USB to UART Bridge Driver” screen upon successful completion of installation. Click “Finish.”
7. Return to the USB flash drive window and open the LD2 software folder and double click on the “Setup.exe” icon.
8. Follow the screen prompts to install the LD2 application and the accompanying National Instruments application. The software will be automatically installed on your computer's C drive. If you wish to specify an alternate location for the installation, click the “Browse” button and type in the desired location.
9. Once the installation process is complete, restart the computer and locate the LD2 application icon on your desktop or in your applications folder.



### 3.1.3 PC Software Interface

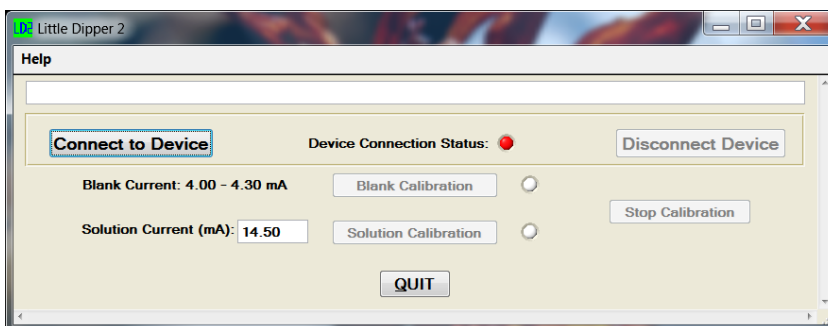
1. Plug the Calibration Cable USB into your computer.
2. Plug the Calibration Cable pins into the connector of the Little Dipper™ 2.

When connecting the Little Dipper 2 to the cable, pay special attention to the orientation of the pins. Once the connection is made, slide the collar down and rotate the collar to secure.

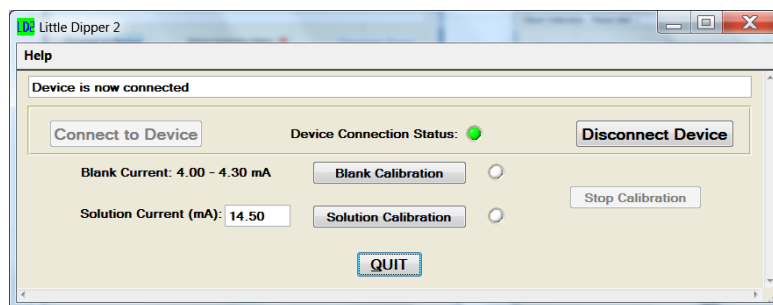


3. Begin LD2 software by double-clicking on the LD2 icon.

4. Plug the 12V power supply into a power source and supply power to the calibration cable.
5. Wait for initialization process to complete.



6. Select the Connect to Device button. The Device Connection Status will turn green when connection is established and "Device is now connected" will appear in the dialog box.



### 3.2 Calibration

Once the connection to the Little Dipper™ 2 has been established in the LD2 Software you can proceed with calibration.

- 1) Obtain a 500mL black glass beaker with
- 2) 500mL of the source water you will be measuring.

**Place the beaker on a non-reflective black surface.**

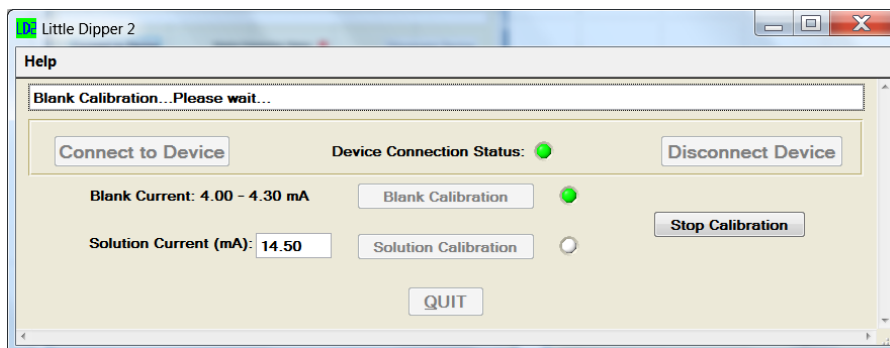
**Note: This water should represent the signal you intend to set as zero, make sure that it does not contain any fluorophore.**

- 3) Fully submerge the optical face in the water.

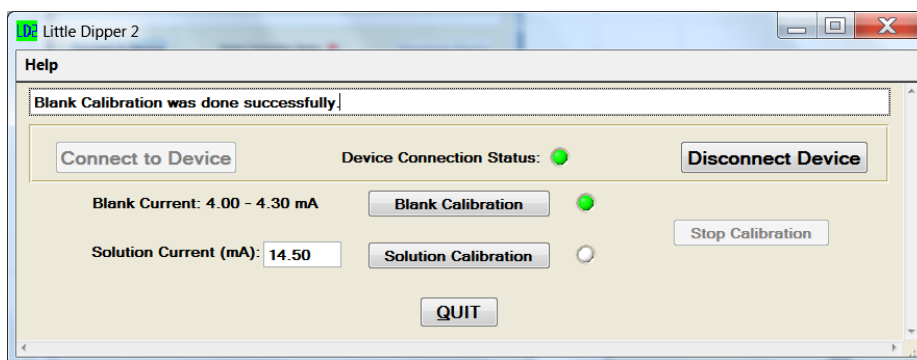


***IMPORTANT NOTE: MAKE SURE TO REMOVE ALL BUBBLES FROM THE OPTICAL FACE BY TILTING THE LITTLE DIPPER™ 2 AND GENTLY SHAKING WHILE FULLY SUBMERGED IN THE WATER AS AIR BUBBLES TRAPPED NEAR OR ON THE OPTICAL HEAD WILL INFLUENCE RESULTS.***

- 4) Once bubbles have been removed select the Blank Calibration button from the LD2 software screen. The dialog box will then state “Blank Calibration...Please wait”.



- 5) Once the blank calibration is complete the following screen will appear:

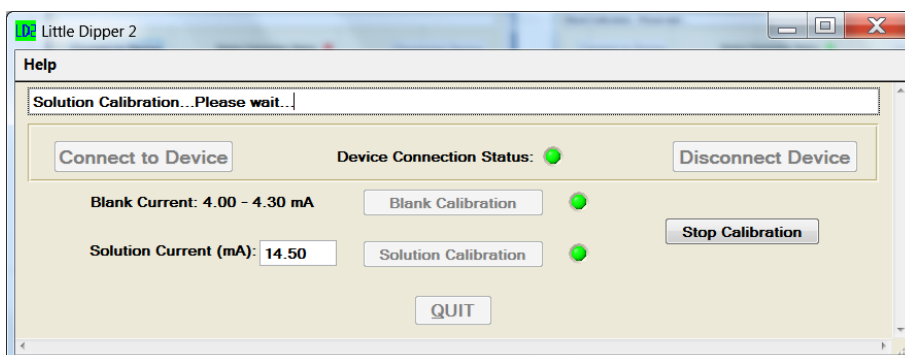


- 6) Remove the Little Dipper™ 2 from the beaker and wipe dry.
- 7) In a second 500mL black glass beaker, , make 500mL of a solution using your fluorophore of interest that represents a concentration you intend to measure or add 500mL of a Turner Designs prepared calibration standards. Contact [Accessory Sales](#) to purchase.
- 8) **Place the beaker on a non-reflective black surface.** Ensure the solution is well mixed, submerge the Little Dipper™ 2 into the solution.

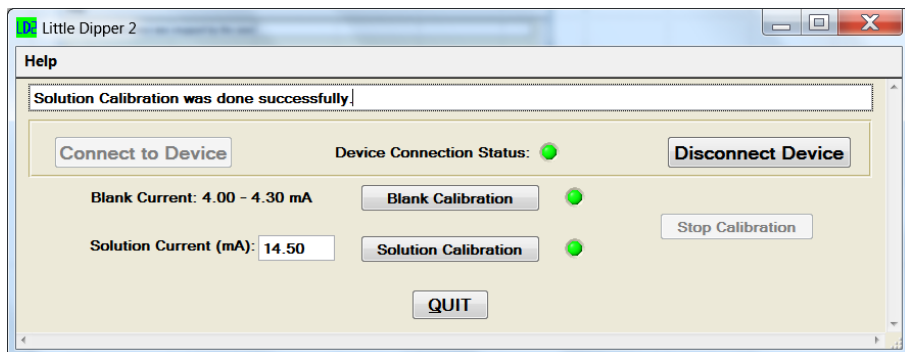


**IMPORTANT NOTE: MAKE SURE TO REMOVE ALL BUBBLES FROM THE OPTICAL FACE BY TILTING THE LITTLE DIPPER™ 2 AND GENTLY SHAKING WHILE FULLY SUBMERGED IN THE WATER AS AIR BUBBLES TRAPPED NEAR OR ON THE OPTICAL HEAD WILL INFLUENCE RESULTS.**

- 9) Once bubbles have been removed, enter the value for mA at which your calibration solution should be set. Select the Solution Calibration button from the LD2 software screen. The dialog box will then state “Solution Calibration...Please wait”.



- 10) Once the solution calibration is complete the following screen will appear:



- 11) Click Quit to close the LD2 Software and remove the Calibration Cable from the Little Dipper™ 2.
- 12) You can now install the Little Dipper™ 2 in line with the system you intend to monitor following installation instructions provided - see Section 2.2.

Data collected upon completing these calibration steps can be put into a table similar to the table below.

Table 1: Example of data collected from calibration Steps 1-10.

| Solution Measured | Concentration   | Multimeter current output |
|-------------------|-----------------|---------------------------|
| Blank Solution    | $C_b$ (0 ppb)   | $R_b$ (4 mA)              |
| Sample Solution   | $C_s$ (100 ppb) | $R_s$ (19 mA)             |

### 3.3 Calculating Concentration Coefficients

You can find the coefficients required for calculating concentrations using the equation:

Equation 1:  $y = mx + c$

Where:

y = the sample concentration,

m = the slope of your equation,

x = the sensor output in mA,

c = the x intercept (offset) when y = 0.

Finding the slope of your equation using example data from Table 1:

Equation 2:  $m = [(C_s - C_b) / (R_s - R_b)]$   
 $m = [(100 - 0) / (19 - 4)] = 100/15 = 6.67$

Finding the c constant using example data from Table 1:

Equation 3:  $0 = [(m * R_b) - C]$   
 $0 = [(m * 4) - C]$   
 $c = 26.68$

Substitute m and c from Equation 1 with end values from Equations 2 and 3:

Equation 4:  $y = 6.67x - 26.8$

You can now calculate y (ppb) concentrations simply by substituting sensor output (mA) values for x in Equation 4.

For general information on how to calibrate your sensor using a control box, refer to Appendix E.

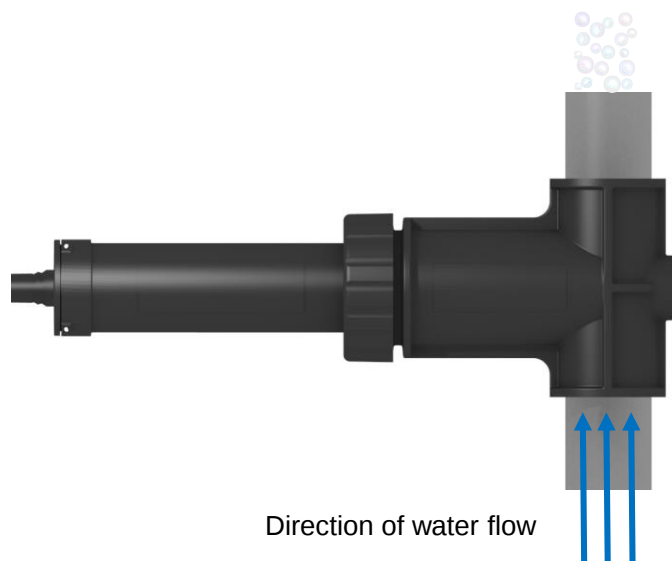
## 4. Recommended Measurement Practices

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### 4.1 Minimizing Variations in Signal

Turner Designs' Little Dipper™ 2 has a flat surfaced optical window that might trap air bubbles when positioned vertically. For this reason we recommend:

- 1) Installing Little Dipper™ 2 horizontally so that the mounting tee is in a vertical position.



- 2) That the flow direction is upward through the mounting tee.

This will ensure than any trapped air bubbles will be released and will not interfere with sample measurement.

### 4.2 Temperature Considerations

Fluorescence is temperature dependent. The fluorecence signal from most fluorophores will decrease as sample temperature increases. However, fluorescence values can be corrected for temperature effects if the temperature correction coefficient of the fluorophore being measured is known. Table 2 lists known temperature correction coefficients. These coefficients can be used with recorded temperatures in the following equation to correct temperature effects on fluorescence values:

$$Fr = Fs * e^{[n (Ts-Tr)]}$$

Where:

Fr = the calculated fluorecence at the reference temperature, Tr

Tr = the reference temperature

Ts = the sample temperature at time of reading Fs

Fs = the sample's fluorecence at the time the temperature of the sample is measured, Ts.

e = the base of natural log

n = Temperature Coefficient for whatever dye is used - see Table 2.

For greatest accuracy, determine the Temperature Coefficient of the dye or fluorophore being used, record the sample temperature, and correct the sensor output for changes in

temperature. Additional information on how to apply these corrections is included in the Turner Designs Application Note: [A Practical Guide to Flow Measurements](#).

Table 2: Temperature Coefficients for specific dyes. Changes in the dye concentration are exponential as opposed to linear.

| Dye         | Temperature Coefficient (n)  |
|-------------|------------------------------|
| PTSA        | -0.00126 / °C    Exponential |
| Fluorescein | 0.0036 / °C    Exponential   |

## 5. Maintenance and Warranty

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The Little Dipper™ 2 Fluorometer is designed for light industrial monitoring applications that require continuous measurements. It provides maximum performance and solid state reliability with minimal maintenance.

A maintenance check should be made once per month to ensure the optical window is free from any chemical or biological fouling. Frequency of maintenance checks are dependent on the fouling rate of the system being monitored. Systems that have a higher fouling rate might require more frequent maintenance checks.

### 5.1 Maintenance Check Using Standard Solutions

You may check if the unit is responding correctly simply by running standard solutions past the optical window.

- 1) Make a standard solution (solution of known concentration of the fluorophore being measured) that is less than the maximum concentration set for the Little Dipper™ 2.
- 2) Flow this solution past the optical window and record the mA reading
- 3) Calculate the solution concentration using your equation determined from Section 3.3 and compare to the actual solution concentration.
- 4) If the calculated concentration varies by more than 5% of the actual solution's concentration, see Section 5.2 for visual inspection and cleaning.

***Maintenance checks are important and will ensure the Little Dipper™ 2 is continuing to provide maximum performance and measurement reliability.***

### 5.2 Visual Inspection and Cleaning

To visually check if the optical window has been fouled:

- 1) Remove the Little Dipper™ 2 from the mounting tee.
- 2) If there is any noticeable fouling, use a soft bristle brush or non-abrasive cloth material and soapy water to clean the optical window. Be sure to rinse thoroughly.
- 3) If the fouled window is unable to be cleaned with soapy water and the soft bristle brush, make a 10% HCL solution and use that solution, in place of the soapy water, with the soft bristle brush to clean the window.

***Note: Hydrochloric acid is a hazardous material and should only be handled by qualified personnel.***

- 4) Once the optical window has been cleaned, re-install the mounting tee back onto the Little Dipper™ 2.

***Note: See Section 2.2 on how to properly install the mounting tee.***

**Note:** In the event the Little Dipper™2 must be removed for service, the mounting tee opening can be plugged with Plumbing Plug P/N 2820-520. Contact [Accessory Sales](#) to purchase.



Plumbing Plug P/N 2820-520

### 5.3 Warranty Terms

Turner Designs warrants the Little Dipper™ 2 and accessories to be free from defects in materials and workmanship under normal use and service for a period of 12 months from the date of shipment from Turner Designs with the following restrictions:

- Turner Designs is not responsible for replacing parts damaged by accident or neglect. Your instrument must be installed according to instructions in the User's Manual. Damage from corrosion is not covered. Damage caused by customer modification of the instrument is not covered.
- This warranty covers only Turner Designs products and is not extended to equipment used with our products. We are not responsible for incidental or consequential damages, except in those states where this limitation is not allowed. This warranty gives you specific legal rights and you may have other rights which vary from state to state.
- Damage incurred in shipping is not covered.

### 5.4 Warranty Service

To obtain service during the warranty period, the owner shall take the following steps:

1. Write, email or call the Turner Designs Technical Support department and describe as precisely as possible the nature of the problem.

**Phone:** 1 (877) 316-8049

**Email:** [support@turnerdesigns.com](mailto:support@turnerdesigns.com)

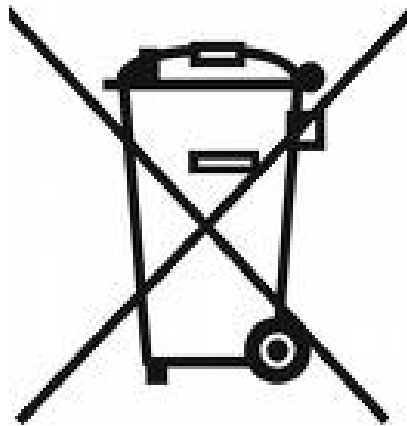
2. Carry out any adjustments or tests as suggested by the Technical Support Department.
3. If proper performance is not obtained you will be issued a Return Materials Authorization number (RMA) to reference. Package the unit, write the RMA number on the outside of the shipping carton, and ship the instrument, prepaid, to Turner Designs. If the failure is covered under the warranty terms, the instrument will be repaired and returned free of charge, for all customers in the contiguous continental United States. For customers outside of the contiguous continental United States customer pays for shipping duties and documentation to Turner Designs. Turner Designs pays for return shipment (custom duties, taxes and fees are the responsibility of the customer).

## 5.5 Out of Warranty Service

Follow steps for Warranty Service as listed above. If our Technical Support department can assist you by phone or correspondence, we will be glad to, at no charge. Repair service will be billed on a fixed price basis, plus any applicable duties and/or taxes. Shipment to Turner Designs should be prepaid. Your bill will include return shipment freight charges.

**Address for Shipment:**

Turner Designs, Inc.  
1995 N. 1<sup>st</sup> Street  
San Jose, CA 95112



**Equipment Specified as Electrical and Electronic Waste**

## Appendix A: Fluorometer and Mounting Tee Specifications

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| Parameter                      | Specification                                                                                               |
|--------------------------------|-------------------------------------------------------------------------------------------------------------|
| Linearity (over dynamic range) | 0.99 r <sup>2</sup>                                                                                         |
| Power Draw                     | 0.88 W @ 12 VDC (1.0 W max.)                                                                                |
| Input Voltage                  | 8 – 30 VDC                                                                                                  |
| Signal Output                  | 4 – 20 mA                                                                                                   |
| Light Source                   | Light Emitting Diode                                                                                        |
| Detector                       | Photodiode                                                                                                  |
| Warm up time                   | 5 seconds                                                                                                   |
| Dimensions                     | Length: 8.63 in. (21.9 cm)<br>Diameter (housing): 1.30 in. (3.3 cm)<br>Diameter (flange): 1.72 in. (4.4 cm) |
| Weight                         | 4.4 oz. (125 g)                                                                                             |
| Material                       | PVC – Type I, Rigid injection-molded plastic                                                                |

### Mounting Tee Specifications

| Parameter               | Specification                                |
|-------------------------|----------------------------------------------|
| Material                | PVC – Type I, Rigid injection-molded plastic |
| Threading               | 1 inch (NPT)                                 |
| Length                  | 3.30 in. (8.4 cm)                            |
| Dynamic Pressure Rating | 100 PSI                                      |

## Appendix B: Wiring Guide

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| Wire Color  | Function                                             | Connection                        |
|-------------|------------------------------------------------------|-----------------------------------|
| Red         | Supply Voltage<br>8 – 30 VDC                         | PSU – Positive Connection         |
| Black       | Supply Ground<br>0 VDC                               | PSU – Ground Connection           |
| Orange      | Signal out to data logger,<br>“A”, 4 – 20 mA DC      | Multimeter “A” Connection         |
| Green/Brown | Signal out to data logger,<br>“Common”, 4 – 20 mA DC | Multimeter “Common”<br>Connection |

## Appendix C: How to Determine Your Version of Windows OS

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### Is my PC running the 32-bit or 64-bit version of Windows?

The terms **32-bit** and **64-bit** refer to the way a computer's processor (also called a CPU), handles information. The 64-bit version of Windows handles large amounts of random access memory (RAM) more effectively than the 32-bit version. Follow the steps in the sections below to find out if your PC is running the 32-bit or 64-bit version of Windows and what edition of Windows is on your PC.

#### Computers Running Windows XP

Click **Start**, right-click **My Computer**, and then click **Properties**.

- If “x64 Edition” is listed under **System**, you’re running the 64-bit version of Windows XP.
- If you don’t see “x64 Edition” listed under **System**, you’re running the 32-bit version of Windows XP.

The edition of Windows XP you're running is displayed under **System** near the top of the window.

#### Computers Running Windows Vista or Windows 7

Click the **Start** button, right-click **Computer**, and then click **Properties**.

- If “64-bit Operating System” is listed next to **System type**, you’re running the 64-bit version of Windows Vista or Windows 7.
- If “32-bit Operating System” is listed next to **System type**, you’re running the 32-bit version of Windows Vista or Windows 7.

The edition of Windows Vista or Windows 7 you're running is displayed under **Windows edition** near the top of the window.

For more information about 32-bit and 64-bit Windows 7, see **32-bit and 64-bit Windows: frequently asked questions**. <http://windows.microsoft.com/en-us/windows/32-bit-and-64-bit-windows#1TC=windows-7>

#### Computers Running Windows 8

1. Open the Windows 8 Control Panel.

**Tip:** You can check your Windows 8 system type much faster from the Power User Menu but it's probably speedier that way only if you're using a keyboard or mouse. With that menu open, click or touch on **System** and then skip to Step 4.

2. Touch or click on **System and Security** within **Control Panel**.

*Note:* You won't see a **System and Security** link in Control Panel if your view is set to either Large icons or Small icons. If so, find **System** and touch or click on it, then skip to Step 4.

3. With the System and Security window now open, click or touch **System**.

4. With the System applet now open, titled View basic information about your computer, find the System area, located under the large Windows 8 logo.

The **System type** will say either **64-bit Operating System** or **32-bit Operating System**.

Citation:

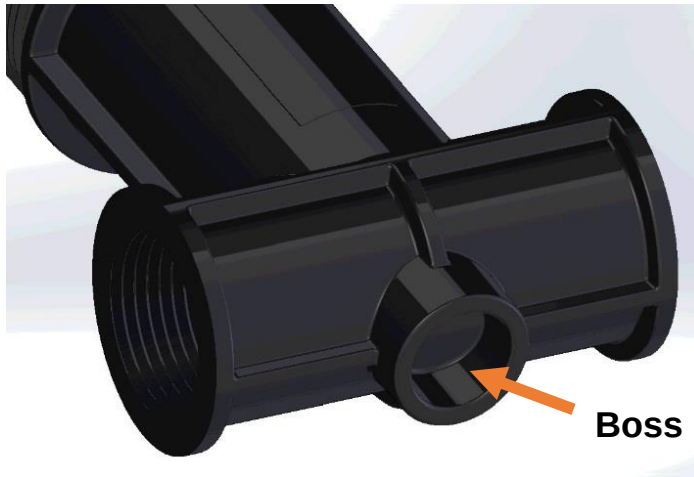
"Is my PC running the 32-bit or 64-bit version of Windows?." Microsoft Corporation. Viewed online on February 9, 2014 at <http://windows.microsoft.com/en-us/windows7/find-out-32-or-64-bit>.

Additional source: <http://windows.microsoft.com/en-us/windows/which-operating-system>

## Appendix D: Tee Modification

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It is possible to modify the tee to add a clean-out plug or other item directly opposite the LD2. This can be done by drilling and tapping the small boss shown in the picture to a 1/2" NPT thread.



## Appendix E: General Information for Calibrating with LD2 Control Box

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The Little Dipper™ 2 may be purchased as a sensor integrated with control boxes from third party vendors, in which case the calibration instructions in section 3.2 cannot be used to calibrate or set a new range for control box wired sensors. Refer to the control box's manual for calibration instructions.

Every control box will have its own specific procedure for calibrating integrated sensors. The following is a general procedure for calibrating your control box integrated sensor:

- 1) Make sure the control box is powered on and power is getting to the sensor.
- 2) Put your hand in front of the sensor and look at the response displayed on the control box display; the response should increase as your hand gets closer to the sensor's optical head and vice versa.
- 3) Enter the control box's calibration mode.
- 4) Put the sensor in blank solution or source water that does not contain the fluorophore of interest.
- 5) Using control box commands set the blank.
- 6) Put the sensor in a solution with a known concentration of the fluorophore of interest.
- 7) Using control box commands input the concentration value of the standard solution being measured.
- 8) Using control box commands set the standard solutions response.
- 9) Make sure the settings for this sensor calibration are saved.

Now you can read both blank and standard solution and the control box should display actual concentration values for those solutions read.

It is recommended that a final check be made after the unit is calibrated. To make this check you will need to dilute your standard solution by half using your blank solution or source water. Simply fill a container half full with your standard solution and add approximately the equivalent volume of blank solution or source water to your standard solution. Stir the solution and read it using your calibrated sensor. The control box should display approximately half of the calibration value set during the calibration procedure.