doric

Wireless Fiber Photometry

User Manual

Version 1.0.0

Contents

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System Overview

1.1 Wireless Fiber Photometry System

The Wireless Photometry System (Fig. 1.1 & 1.2) is a cable-free solution for acquiring neuronal data without restricting the animal movement. The Wireless Headstage has both LED light sources and detectors to excite and collect photometry signals between the *fiber optic Cannula* and the *Console*.

A standard Wireless Fiber Photometry system (Fig. 1.1 & 1.2) contains the following elements:

- The *Wireless Fiber Photometry Headstage*. See section 1.1.1.
- The *Wireless Base-Station*. See section 1.1.2.
- The *Headstage Battery Charger*. See section 1.1.3.
- The *Dummy Headstage*. See section 1.1.4.
- The *Fiber optic cannula*.
- The Neuroscience Console 500 *(NC500)* or Behavior and Bundle Photometry Console 300 *(BBC300)* . The table below compares the main features of the two consoles.
- The *Doric Neuroscience Studio* software.

Table 1.1: *Comparing consoles for wireless photometry*

	BBC300	**NC500**
SUPPORTING		
# base station per console	4	2
# headstage per base-station	1	4
Max # headstages per console	4	8
COMPATIBILITY		
Wireless Photometry	X	X
Basic Photometry		X
Bundle Photometry	X	X
Miniature Microscopy		X
Electrophysiology		X

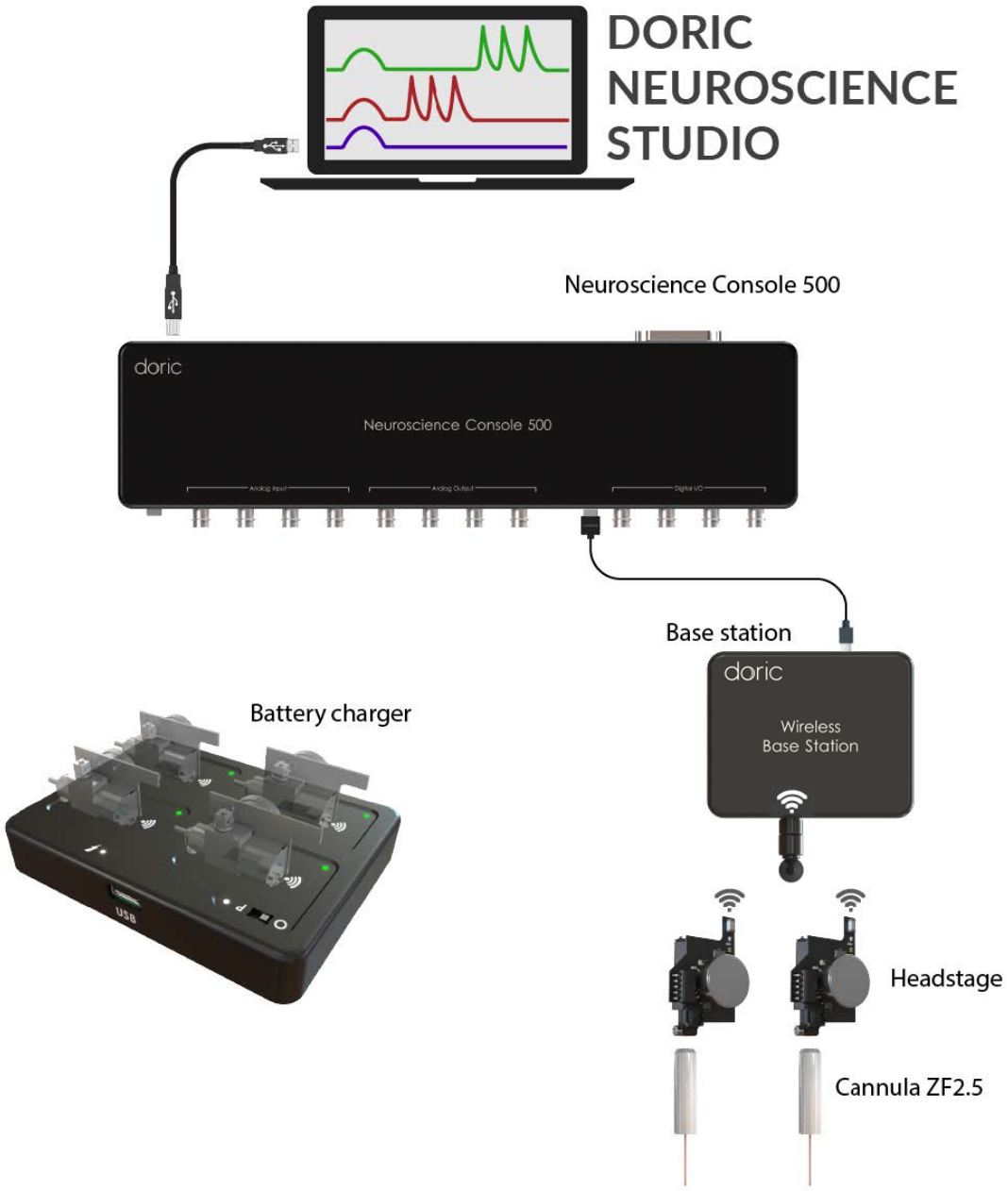


Figure 1.1: *Wireless Fiber Photometry System with NC500*

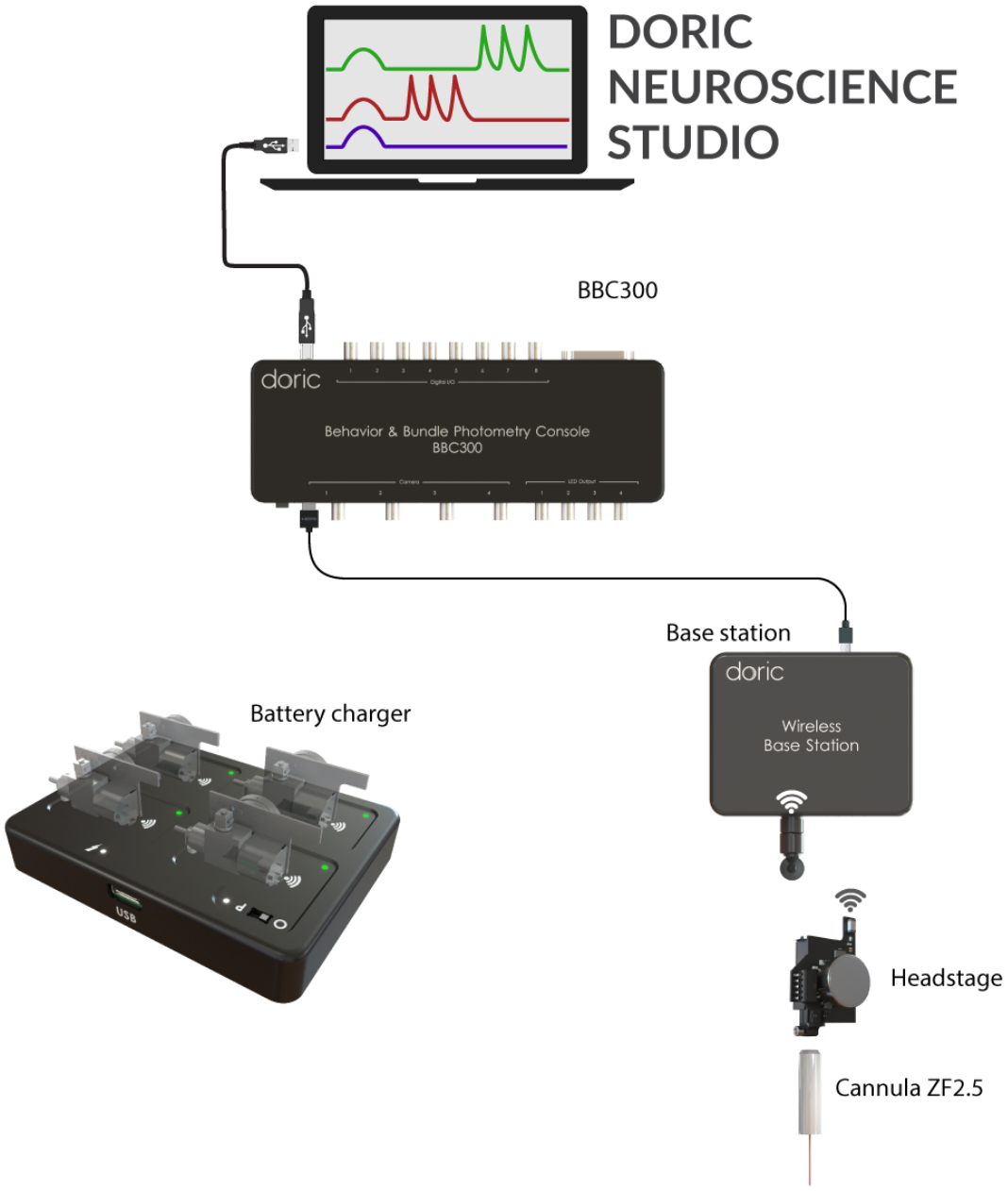


Figure 1.2: *Wireless Fiber Photometry System with BBC300*

1.1.1 Wireless Fiber Photometry Headstage

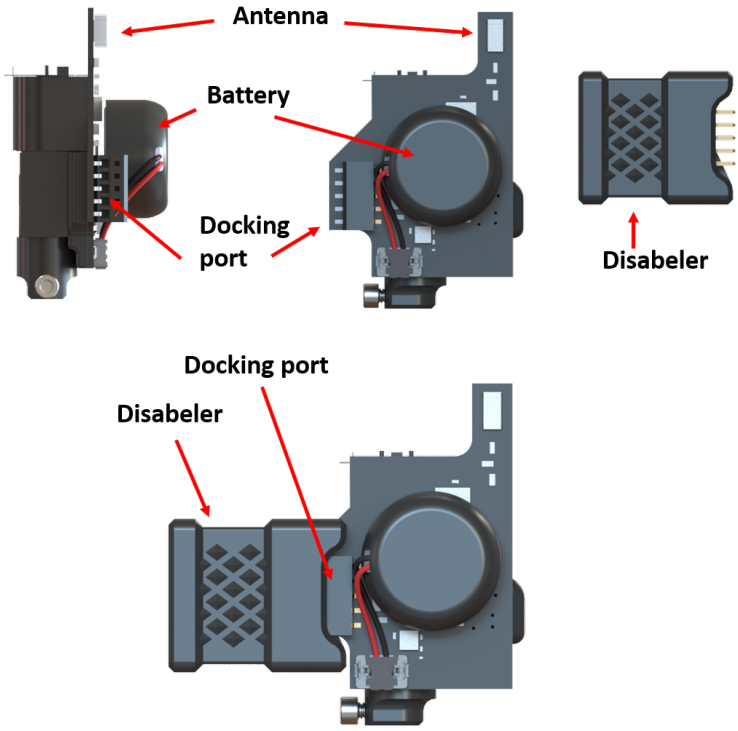


Figure 1.3: *Headstage and disabeler*

The *Wireless Headstage* (Fig. 1.3) is an optic-electronic device that creates the link between the fiber optic cannula and the base-station. It contains LED drivers, two LEDs of choice (isosbestic + biosensor excitation), and a detector to both send light pulses for illuminating the fluorophores and collect the emission wavelengths. The headstage also uses a battery to power the LEDs.

- The **Antenna** (Fig. 1.3) is a small ridge on the side of the headstage used to transmit wireless photometry signal.
- The **Battery** is the source of power for the headstage to function. It can support around two hours of recording at the highest power of the LEDs. Once the battery is assembled to the headstage, it is ideal to not disconnect it in order to increase the longevity of the device. In fact, more than 20 disconnect-reconnect cycles can significantly loosen the connector on the headstage. Once the experiment is finished, to save the remaining power of the battery, the headstage should be connected to the battery charger base or the Disabeler (Fig. 1.3). Otherwise, the headstage will continue to search for wireless connections and use the battery.

  * Upon customer request, it is possible to replace the battery with a larger one for long-term recordings. The larger batteries are more appropriate for recordings in rats.
- The **Headstage connector** (Fig. 1.3), found on the underside of the headstage, links it to the 2.5 mm ferrule cannula via a small screw.
- The **Docking Port** (Fig. 1.3) is used by the *Headstage Charger* to recharge the headstage battery, as well as reprogramming it if necessary.
- The **Disabeler** (Fig. 1.3) is used to disable the wireless connection to reduce battery degradation when the headstage is not used.

1.1.2 Wireless Photometry Base-Station

(a) *Base-Station Front* (b) *Base-Station Back*

Figure 1.4: *Wireless Base-Station*

The *Base-station* (Fig. 1.4) transmits the information among the headstage and the photometry console (NC500 and BBC300).
On the front view (Fig. 1.4a), the base-station contains the following:

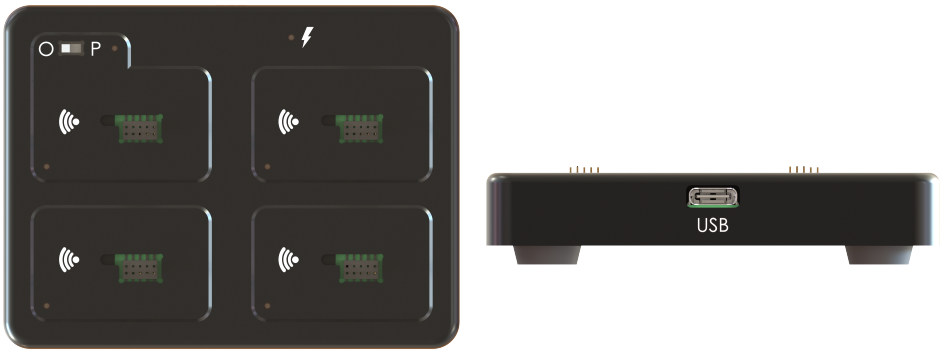
- The **Antenna** communicates with the headstage at 2.4 GHz. Range for up to 2 m distance.
- The **On/Off LED light** displays whether the base-station is on and functioning.
- The **1-4 LED lights** display three different colors each indicating:
  - **Blue**: The headstage is paired with base-station but not enabled in the Doric Neuroscience Studio (DNS) software.
  - **Green**: The headstage is both paired with base-station and enabled in the Doric Neuroscience Studio (DNS) software
  - **All 4 LEDs blinking green**: The base station has been correctly initiated. This will happen for a short period of time at power up (This apply for the NC500 and may change for BBC300).
  - **LEDs 3 and 4 blinking white**: The headstage is on the bootloader mode, which means the firmware can be reprogrammed.

On the back-side view (Fig. 1.4b), the base-station contains two ports:

- The **Service** port is a USB-B input through which the firmware of the base-station channels can be updated. Besides, it can also connect the *Base-staion* to the Doric BBC300 console.
- The **DATA** HDMI connector is used to connect the base-station to the console. If the console is an NC500, connect the base station to one of two possible *Ephys* HDMI ports. If using a BBC300, connect the base station to one of four possible *CAM* USB 3.0 ports using an HDMI-USB 3.0 cable.

If the base station is NOT recognized by the computer, refer to the Appendix (Chapter 3) for additional troubleshooting information.

1.1.3 Wireless Headstage Charger



(a) *Charger Top* (b) *Charger back side*

Figure 1.5: *Wireless Headstage Battery Charger*

The *Wireless Headstage Charger* (Fig. 1.5) is used to recharge the headstage battery and shut down the wireless connection. During the pairing process, all unused headstages must be docked on the charger, otherwise they will be detected in-place of the target headstage.

- The **USB-C Connector** behind the *Wireless Headstage Charger* is used to connect it to the console or directly to a computer to supply the power to charge the headstages. When this connection to the power source is done, the *Status Lights* on top of the *Wireless Headstage Charger* will turn on.
- The four **Docking Ports** are used to recharge up to 4 headstages at a time. When a headstage is connected to a docking Port, its wireless connection is shut down to reduce battery degradation.
- The **Status LED Lights**, on the side of each charging port, displays the connection stage of the headstages.
  - The **Orange** light means no headstage is connected.
  - The **Green** light means the headstage battery is fully charged.
  - The **Red** light means the headstage is connected and charging.
- The **P-O** key across the docking port 1 is a switch that allows users to update the firmware of the headstage. It should always be in "O" for charging purposes. However, if a firmware update of the headstage was required, this key should be on "P" side. In this condition (the small LED light of port one will turn to white color), only one headstage which is connected to the docking port 1 can be upgraded, and it will automatically appear in the Doric maintenance tool software.
- The **Antenna Position Indicator** shows the proper placement of the antenna when docking a headstage to recharge the battery.

1.1.4 Dummy Headstage

The *Dummy Headstage* is a simplified version of the *Wireless Headstage* that is used to habituate an animal subject to the weight of the headstage. It contains no electronics or other valuable components, and will not function as a *Wireless Headstage*.

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Specifications

Table 2.1: *Wireless Headstage General Specifications*

SPECIFICATIONS	VALUE	NOTES
Dimensions	Height 29.38 mm Width 19.24 mm Thickness 15.29 mm	
Mass	4.55 g 2.95 g	Including 40 mAh battery Without battery
Transmission Frequency	2.4 to 2.5 GHz	
RF Data Speed	2 Mbps	
Sampling Rate	10 kHz	On each channel
ADC Resolution	14 bits	
Saturation level	˜6 nW	
Detector Bandwidth	0 - 500 Hz	
Roll-off rate for low-pass filter	-40 dB/decade	
Detector Sensitivity	˜0.48 V / nW	@ 520 nm
Operation distance	0-2 m	For optimal performance
Maximum LED Power	405 / 415 nm = 100 µW 470 nm = 150 µW 560 nm = 20 µW	With 400 µm fibre

Table 2.2: *Wireless Fiber Photometry Base Station Specifications*

SPECIFICATIONS	VALUE	NOTES
Dimensions	Height 28.50 mm Width 108 mm Thickness 87 mm	Without antenna
Antenna dimension	Length 108.5 mm Diameter 9 mm	
Mass	230 g	
Transmission Range	Up to 2 m	
Wireless Frequency Band	2.4 - 2.5 GHz	
Number of Headstage	Up to 4 1	With NC500 console With BBC300 console
Base Station Interface	HDMI USB-B	With NC500 console With BBC300 console

Table 2.3: *Wireless Fiber Photometry Battery Charger Specifications*

SPECIFICATIONS	VALUE	NOTES
Dimensions	Height 84 mm Width 63.47 mm Thickness 17.07 mm	
Mass	170 g	
Charger Interface	USB-C	
Charger Power Supply	AC/DC adapter 5 Watt (5 V, 1 A)	With 1 meter cable USB-C to USB-A
Charger Headstage Capacity	4	
Battery charge duration	120 min	With 2 LEDs at 100% power
Battery recharge time	˜60min	For a 40 mAh battery

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Appendix

When using the **BBC300** console with a Base-station on a new computer for the first time, it is very likely that the Base-station will **NOT** be recognized properly by the computer.

Below are the instructions to instal the correct driver for the Base-station to ensure proper functionality.

1. Verify that the device is correctly connected by ensuring the white LED next to the SMA connector remains steadily illuminated (Figure 3.1).

Figure 3.1: *The white LED on the Base-Station indicating that the device is powered on.*

2. On the computer, access the **Device Manager** by typing its name in the Windows search bar and selecting it from the results (Figure 3.2).
3. Check if *Wireless Base-station* appears under the *Other devices* tab with an exclamation mark (Figure 3.3).
    - If it appears with an exclamation mark, proceed with updating the USB driver.
    - If it does not appear, the issue is not related to the USB driver update.
4. Open *Zadig*. This software is installed as part of the Doric Neuroscience Studio installation. By default, it can be found in: `C:\Program Files\Doric Lenses\Doric Neuroscience Studio\drivers\utils` under the name `zadig-2.5.exe`.
5. Select *Wireless Base-station* from the dropdown menu (see label 1 in Figure 3.4).
6. Click on *Install Driver* (see label 2 in Figure 3.4).

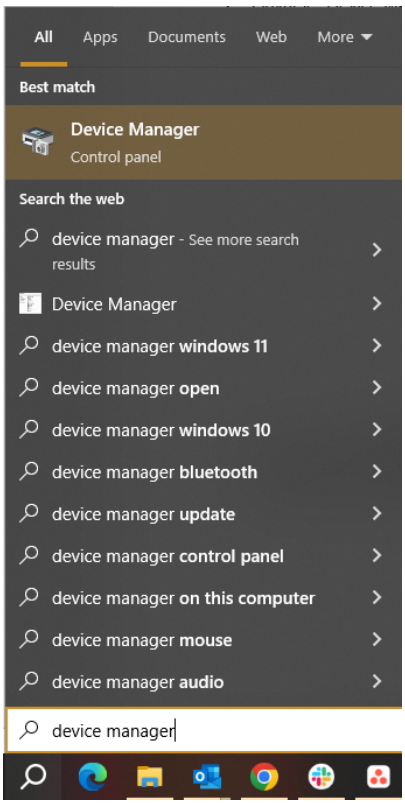

Figure 3.2: *Find the Device Manager by Windows search bar.*

7. Once the installation is complete, confirm that *Wireless Base-station* appears under the *Universal Serial Bus devices* tab in Device Manager (Figure 3.5).

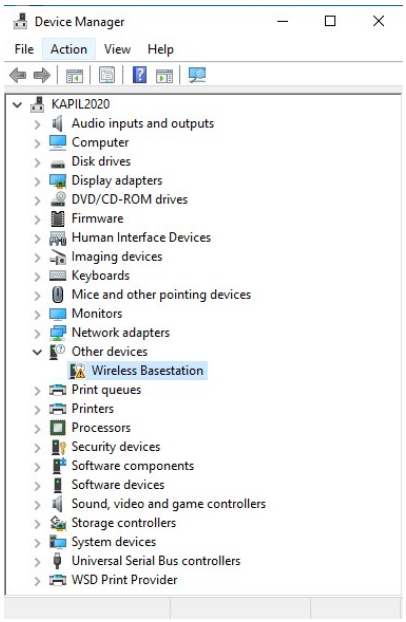

Figure 3.3: *Missing USB driver for Wireless Base-station in Device Manager.*

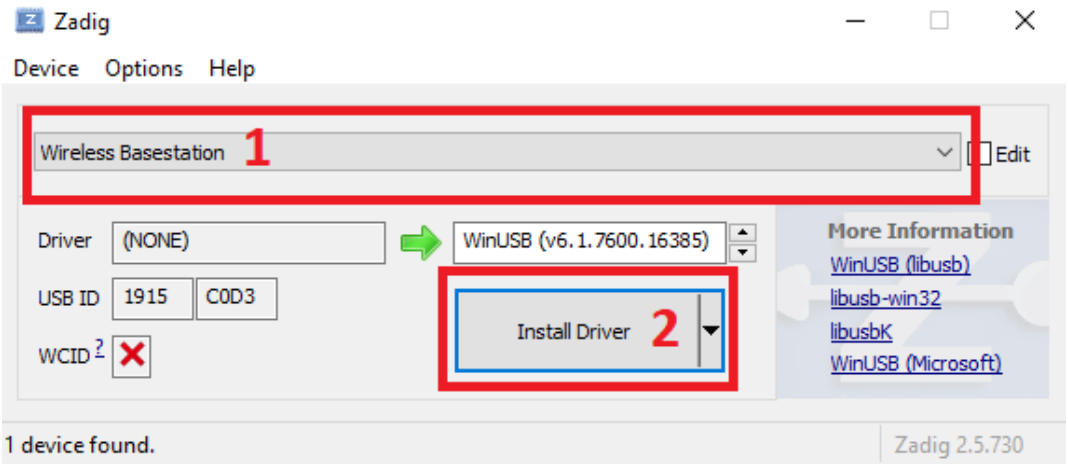

Figure 3.4: *USB driver installer for Wireless Base-station.*

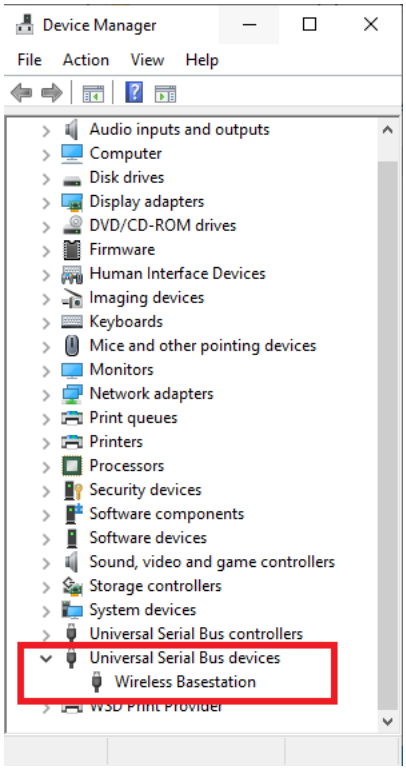

Figure 3.5: *Wireless Base-station displayed in Device Manager after successful USB driver installation.*

4

Support

4.1 Maintenance

The product does not require any maintenance. Do not open the enclosure. Contact Doric Lenses for return instructions if the unit does not work properly and needs to be repaired.

4.2 Warranty

This product is under warranty for a period of 12 months. Contact Doric Lenses for return instructions. This warranty will not be applicable if the unit is damaged or needs to be repaired as a result of improper use or operation outside the conditions stated in this manual. For more information, see our Website.

4.3 Contact us

For any questions or comments, do not hesitate to contact us by:

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