med associates inc

instrumentation and software for research

WHEEL MANAGER SOFTWARE

SOF-860

USER'S MANUAL

DOC-205
Rev. 3.3

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notes

Table of Contents

CHAPTER 1 | INTRODUCTION

The MED Associates, Inc. Wheel Manager Software is used to record running data from our Wireless Running Wheels (ENV-044, ENV-044V, ENV-047, and ENV-047V). The wheels communicate the number of revolutions made during the last 30 seconds to a Hub (DIG-804 or DIG-807). The Hub is connected via USB to a PC running Wheel Manager Software.

When acquisition is started, the software creates a database file to store data from the running wheels and environmental sensors. Data are not recorded while the software is in Setup mode. These data can be exported to Microsoft Excel® spreadsheet software or MED Associates Wheel Analysis (SOF-861) software for generating actograms and periodograms. Data export features include user-defined time bins and the ability to export an entire file or just a select time range.

Up to four USB Interface Hubs can be connected to one computer, and each of these Hubs can monitor up to 40 Running Wheels and/or Environmental Sensors. This means that the Wheel Manager System allows the user to monitor and record data for up to 160 Running Wheels and/or Environmental Sensors per computer.

System Overview

In order to effectively use the Wireless Running Wheels and Environmental Sensors to collect data, it is important to have a basic understanding of how the wireless sensors transmit data to the DIG-804 and DIG-807 Hubs.

The ENV-044/ENV-044V, ENV-047/ENV-047V Wireless Wheels and the ENV-044E* Wireless Environmental Sensors will transmit data, or Messages, to the Hub as long as they are connected to battery power and are set to the same channel. The transmission of Messages occurs regardless of whether the Wheel Manager software is running or not. Thus, if the Wheels or Environmental Sensors will not be used for data collection for a prolonged period of time it is recommended that the Sensors are disconnected from the battery power supply. Refer to the ENV-044, ENV-047 and ENV-044E Battery Installation section of this manual for instruction on connecting and disconnecting battery power.

The Sensors transmit Messages to the Hub approximately every 30 seconds. This process is graphically illustrated in Figure 5-23. The Messages occur continuously every 30 seconds, or 0.5 minutes.

The Messages from the running wheels contain the total number of wheel revolutions since the last Message was sent successfully to the Hub. If a wheel cannot communicate its counts to the hub, it keeps adding revolutions to the count until it can communicate with its hub.

***NOTE: The ENV-044E Environmental Sensor is no longer available. They are referenced in this manual for legacy customers whom the latest version of the software still supports. See Appendix E | ENV-044E Environmental Sensor.**

Key Terms

Address: **The channel assigned to a Hub and Sensor.**

The **Address** refers to the channel setting assigned to a particular **Hub** or **Sensor**. There are eight available **Addresses** that may be used. All **Sensors** must be set to the same **Address** as the **Hub** that they are intended to communicate with. Refer to the Setting the Channel Number section in Chapter 3 of this manual for detailed information regarding setting the **Address**.

Bin: **The desired resolution of the exported data.**

The **Bin** size indicates how many **Messages** will be summed or averaged together to produce the exported data file. The minimum **Bin** size is one minute. For a **Wheel**, each **Bin** will contain the sum of the wheel revolutions that occurred in all of the **Messages** contained within that **Bin**. For the **Environmental Sensors**, each **Bin** will contain the average temperature, humidity or light level for all of the **Messages** during that **Bin**. Be aware that if a **Bin** size of one minute is used and data from **Environmental Sensors** are exported, there will be **Bins** containing zero value for each measurement type (temperature, humidity and light). This is due to the fact that the sampling period is 90 seconds for each measurement type made by the **Environmental Sensor**. For this reason, if data from an **Environmental Sensor** are being exported a minimum **Bin** size of two minutes is recommended. Refer to the Exporting Data section in Chapter 5 of this manual for further information.

Hub: **The DIG-804 or DIG-807 Wireless Running Wheel USB Interface Hub**

This device connects to the data acquisition computer via a USB cable. Each **Hub** can communicate with up to 40 Sensors, which can be **Wheels** and/or **Environmental Sensors**. Each computer can record data from up to four **Hubs**.

The **Hub** receives **Messages** from each **Sensor** approximately every 30 seconds. The **Hub** must be set to one of eight available **Addresses** and all **Sensors** must be set to the same **Address** as the **Hub** with which they communicate.

Message: **Packet of data sent from a Sensor to the Hub**

Sensors transmit **Messages** to the **Hub** approximately every 30 seconds. Each **Message** contains data measured by the **Sensor** since the last **Message** was transmitted to the Hub.

Sensor: **A device that communicates with the Hub**

The term **Sensor** is used to indicate either a **Wheel** or an **Environmental Sensor**.

Wheels: **The ENV-044 or ENV-047 Wireless Running Wheel**

This device is the low-profile wireless mouse running wheel. It transmits data, or **Messages**, to the **Hub** approximately every 30 seconds. Each **Message** consists of the number of wheel revolutions that occurred since the last **Message** was successfully sent to the **Hub**.

The ENV-044V or ENV-047V Vertical Wireless Running Wheel

This device is a lightweight aluminum wheel suspended from a top unit that fits on standard wire topped home cages. Data are transmitted the same as the low-profile ENV-044 or ENV-047 Wireless Running Wheels.

Quick Start Guide

Begin by installing the Wheel Manager application on a Windows computer with available USB 2.0 ports. If using multiple hubs, set addresses on sensors to match hub (See Setting the Channel Number on page 10). Plug in the hub power cord(s) and connect hub(s) to PC via USB.

Then, follow these steps to acquire data from the running wheels:

1. Exit Wheel Manager, turn hubs OFF, and turn wheels OFF. Install fresh batteries in the wheels.
2. Turn hub power ON. Wait for Windows to install the driver (first time may take several seconds, especially on Windows XP).
3. Start the Wheel Manager software.
4. Open the **Tools** menu and choose **Delete All Wheels**.
5. Turn ON the wheels, one at a time, in the order you would like them to appear. Name each wheel as it appears by clicking the **Name** field of the highlighted wheel.
6. Open the **File** menu and select **Start Acquisition**. Press **OK** on the Session Start dialog.
7. Position wheel bases on stands and install wheels in test subject enclosures.

CHAPTER 2 | RUNNING WHEEL HARDWARE

General Computer Environment

The minimum recommended system is as follows:

- A 1 GHz Computer or higher with an available **USB 2.0** port
- Windows® XP, Windows® Vista 32-bit, Windows® 7, 8, 10 32-bit and 64-bit
- 512 MB of RAM
- CD-ROM Drive
- Keyboard and Mouse

Hardware Identification

Figure 2-1 - ENV-044 and ENV-047 Running Wheel Assembly

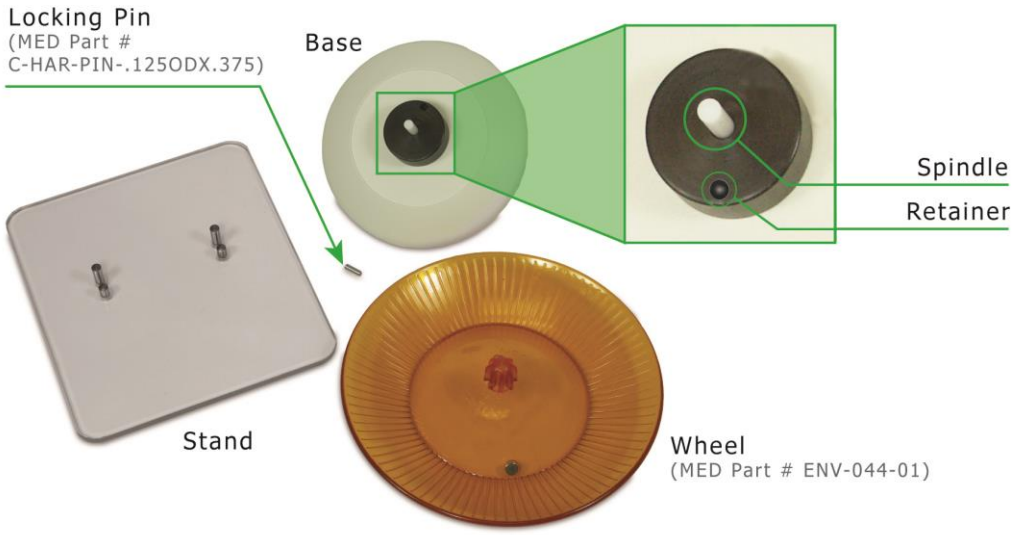


Figure 2-2 - DIG-804 USB Interface Hub Front and Back Panel

Figure 2-3 – ENV-044V Vertical Wireless Running Wheel

Figure 2-4 – ENV-044E Environmental Sensor (No Longer Available, Legacy Reference Only)

Figure 2-5 - USB Cable

Figure 2-6 – ENV-044W Wheel Identification Tool or "wand" (for ENV-044 version 1.3 or prior)

Technical Specifications

ENV-044 and ENV-047 Low Profile Wireless Running Wheels

Operating Frequency:	2.4 GHz to 2.483 GHz
Range:	~15 m (50’)
Power Supply:	Three AAA batteries
Dimensions (Height x Width x Depth):	10.4 cm x 15.5 cm x 15.3 cm (4.1” x 6.1” x 6.0”)
Weight (without batteries):	114 g (4.0 oz)

ENV-044V and ENV-047V Vertical Wireless Running Wheels

Operating Frequency:		2.4 GHz to 2.483 GHz
Range:		~15 m (50’)
Power Supply:		Three AAA batteries
ENV-044V Dimensions: (H x W x D)	Inside cage:	12.7 cm x 7.9 cm x 11.8 cm (5.0” x 3.1” x 4.65”)
	Above cage:	5.1 cm x 12.7 cm x 10.2 cm (2.0” x 5.0” x 4.0”)
	Overall:	17.8 cm x 12.7 cm x 11.8 cm (7.0” x 5.0” x 4.65”)
ENV-047V Dimensions: (H x W x D)	Inside cage:	12.7 cm x 7.9 cm x 11.8 cm (5.0” x 3.1” x 4.65”)
	Above cage:	4 cm x 12.7 cm x 10.2 cm (1.6” x 5.0” x 4.0”)
	Overall:	16.7 cm x 12.7 cm x 11.8 cm (6.6” x 5.0” x 4.65”)
Weight (without batteries):		350 g (12.3 oz)

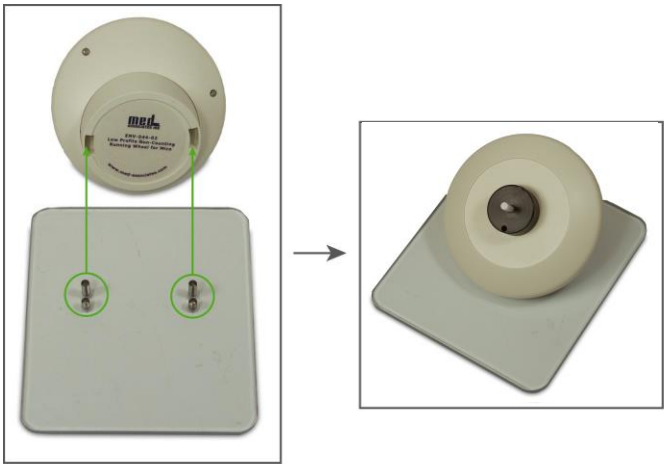
DIG-804 and DIG-807 USB Interface Hub

Operating Frequency:	2.4 GHz to 2.483 GHz
Range:	~15 m (50’)
Power Supply (DIG-804):	6 VDC to 18 VDC
Power Supply (DIG-807):	12 VDC to 15 VDC
PC Interface:	USB 2.0
Dimensions (Height x Width x Depth):	7.1 cm x 21.3 cm x 23.0 cm (2.8” x 8.3” x 9”)
Weight:	610g (21.5 oz)

Running Wheel Assembly

1. Align the guide pins on the stand with the slots in the bottom of the base, as shown in Figure 2-7 and place the base on the stand.

Figure 2-7 – Joining the Base to the Stand



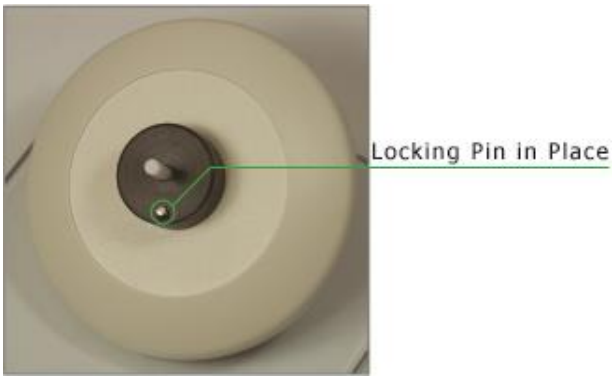
2. Place the wheel on the spindle (refer to Figure 2-1), as shown in Figure 2-8.

Figure 2-8 - Place the Wheel on the Spindle

Locking the Wheel

Remove the wheel from the base by pulling it straight off the spindle. Place the locking pin in the retainer on the base (refer to Figure 2-1), as shown in Figure 2-9. Replace the wheel on the spindle and turn the wheel until the locking pin aligns with the retainer on the wheel. The wheel should now be locked. To unlock the wheel, simply lift the wheel off the base and remove the locking pin.

Figure 2-9 - Locking Pin in Place



Identifying Wheels

CAUTION: The Wheel Identification Tool (or "wand") contains a very strong magnet and may pinch skin caught between the Wheel Identification Tool and a ferromagnetic surface.

Specific wheels may be identified in the Wheel Manager application. When sensors are powered-on (or "wanded" in the case of ENV-044 sensors prior to version 1.4) they send a "Reset" message to their hub. The software indicates a reset wheel by highlighting its row.

To identify ENV-047 wheels, ENV-047V Vertical style wheels, ENV-044 wheels with a top-mounted power switch (version 1.4 or later, see Figure 2-11), and ENV-044V Vertical style wheels, cycle the power switch OFF and ON. This wheel will be highlighted in blue on the Wheel Manager Screen, as shown in Figure 2-12. A red or purple highlight indicates a low battery voltage.

To identify ENV-044 wheels without a top-mounted power switch (version 1.3 or prior) use the Wheel Identification Tool (or "wand", see Figure 2-6). Remove the orange Wheel from the Base (refer to Figure 2-1) and pass the Wheel Identification Tool in a circular motion around the area of the base indicated below, in Figure 2-10.

Figure 2-10 – Identifying a Specific Wheel, ENV-044 version 1.3 or prior

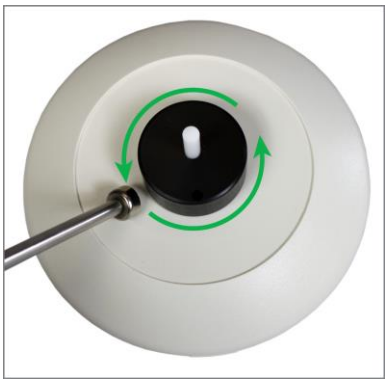


Figure 2-11 - Identifying a Specific Wheel, ENV-044 version 1.4 or later, and ENV-047

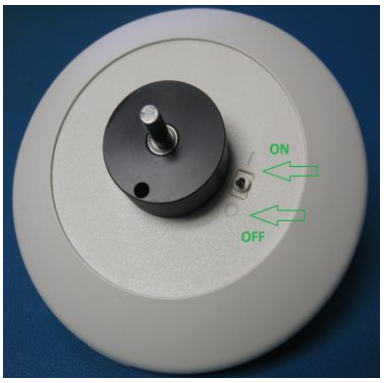
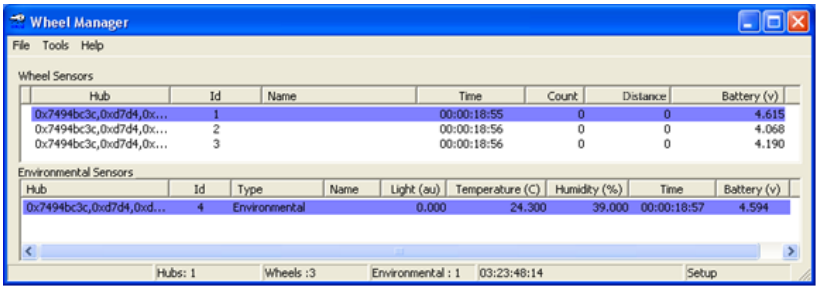


Figure 2-12 - Wheel Manager Main Screen with Wheel Highlighted in Blue



Cleaning Instructions

The **Base** of the ENV-044 or ENV-047 Low Profile Running Wheels (Refer to Figure 2-1) and **Top** of the ENV-044V or ENV-047V Vertical Running Wheels (Refer to Figure 2-3) contain batteries and sensitive electronic components. They should be handled with care and should not be exposed to extreme temperatures. Never submerge the ENV-044/ENV-047 Base or ENV-044V/ENV-047V Top. The exterior of the electronics enclosure should be cleaned by hand using a mild, non-abrasive detergent.

The **Stand** and **Low Profile Wheel** (refer to Figure 2-1) may be cleaned in cage washers or lab dishwashers achieving temperatures up to 80° C. The grooved running surface of the low profile wheels may harbor packed material that benefits from soaking in warm sudsy water before scrubbing with a stiff brush to clean.

Vertical Running Wheels (Refer to Figure 2-3) may be cleaned in a cage washer or lab dishwasher achieving temperatures up to 80° C.

CHAPTER 3 | HARDWARE CONFIGURATION

Setting the Channel Number

NOTE: Be sure that power to the device is disconnected (unplug the DIG-804 or DIG-807 DC power cable or uncouple the battery cable in the ENV-044[V], ENV-047[V] and ENV-044E) before making changes to the settings of the channel selection switches; otherwise the **changes will not be recognized**.

The channel number of a DIG-**804** USB Interface Hub must be the same as the channel number of all of the ENV-044 Low Profile Running Wheels, ENV-044V Vertical Running Wheels, and ENV-044E Environmental Sensors that it will be monitoring, as illustrated in Figure 3-1. The channel number of a DIG-**807** USB Interface Hub must be the same as the channel number of all of the ENV-047 Low Profile and ENV-047V Vertical Running Wheels that it will be monitoring.

DIG-804 hubs will only communicate with ENV-044/ENV-044V/ENV-044E sensors (NOTE part numbers end with '4'). DIG-807 hubs will only communicate with ENV-047/ENV-047V sensors (NOTE part numbers end with '7'). The channel number is set using "DIP" switches on the devices. The location of these switches is indicated in Figure 3-2.

The hub's switches are located on the back panel. To access the switches in the ENV-044, ENV-044E, or ENV-047, twist the bottom cover of the base about ¼ turn and pull. This will expose the circuit board inside the base. To access the switches in the ENV-044**V** or ENV-047**V**, remove the screws retaining the top cover.

Figure 3-1 – Sensors are Detected by Hubs with Same Channel Setting

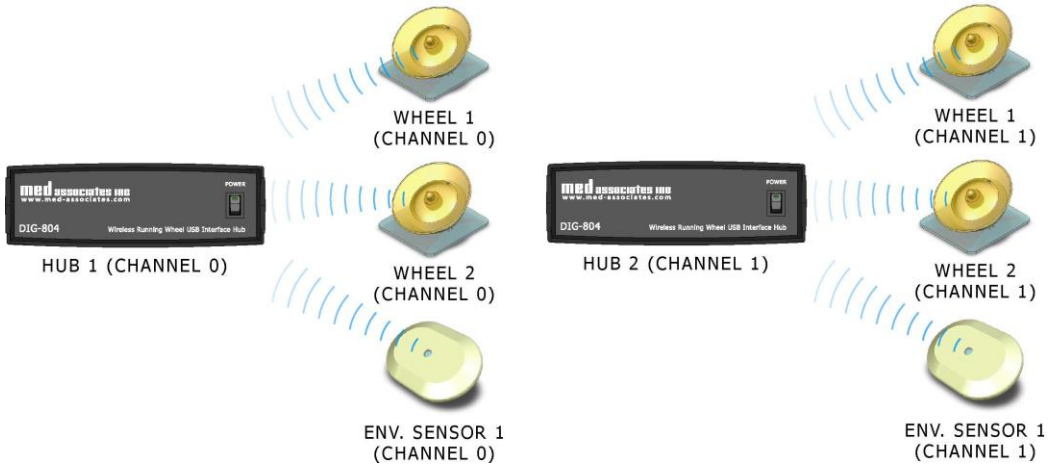
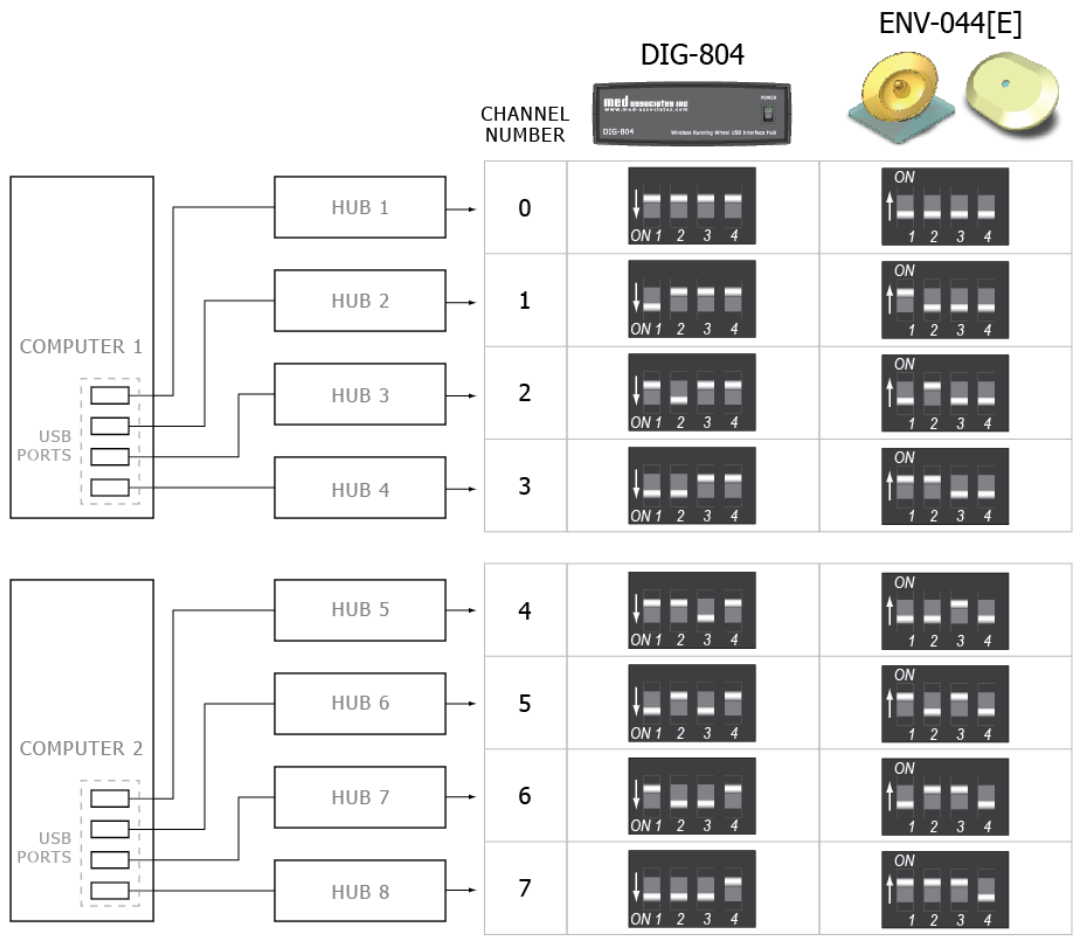


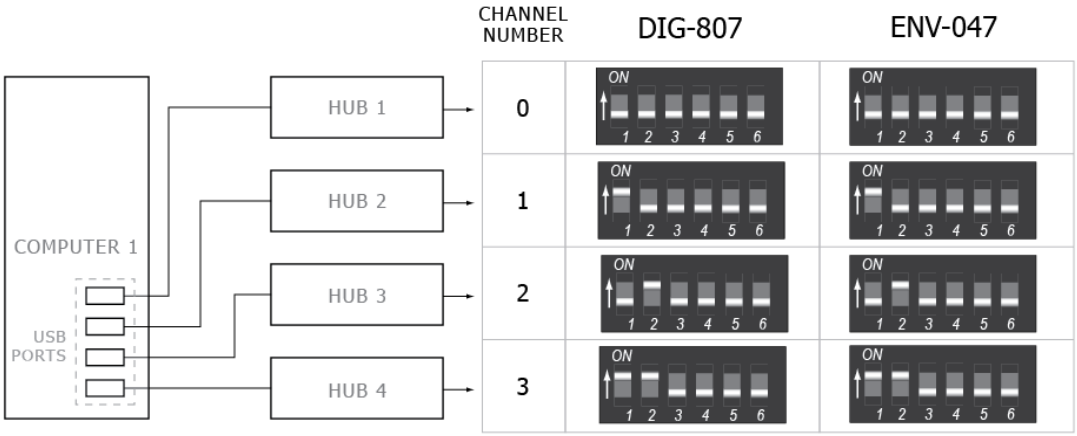
Figure 3-2 - Location of Channel Selection Switches

A diagram of the channel selection switches are shown in Figure 3-3. On the DIG-804 and ENV-044, switches 1, 2, and 3 can be used to set the desired channel and Switch 4 **MUST be set to OFF**. On the DIG-807 and ENV-047, switches 1 – 4 can be used to set the desired channel and Switches 5 and 6 **MUST be set to OFF**. The default setting for these switches is 0 (all switches set to OFF). The switch settings for each of the eight possible channels are shown in Figure 3-4.

Figure 3-3 - Channel Selection Switches, DIG-804 and ENV-044(left), DIG-807 and ENV-047(right)

Figure 3-4 – Channel Selection Switch Settings for Hubs and Sensor





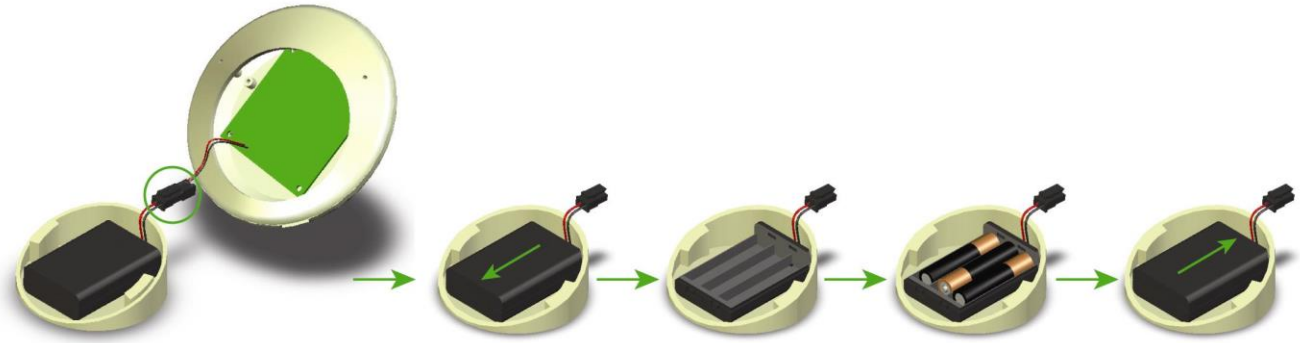
NOTE: The DIG-807's ON orientation is opposite of the DIG-804 but the channel selection switch settings are the same.
The DIG-807 and ENV-047 will allow up to 4 computers and 16 hubs.

Once the channel selection switches are set to the desired channel, reconnect the device's power supply and turn on the power switch (if present).

ENV-044, ENV-047 and ENV-044E Battery Installation

1. Remove the bottom cover of the base by twisting it about ¼ turn and pulling. This will expose the battery case.
2. Disconnect the battery cable.
3. Remove the battery case cover by sliding it back as indicated in Figure 3-5.
4. Install three AAA batteries as indicated inside the battery case.
5. Replace the battery case cover by sliding it back in place. This is important, without the battery cover the batteries can be forced out of electrical contact by the springs.
6. Reconnect the battery cable, being careful to properly align the two connectors.
7. Replace the bottom cover of the base by aligning the tabs on the cover with the slots in the base, and then twist the base about ¼ turn.

Figure 3-5 - Battery Installation Procedure



The proper orientation of the bottom cover will cause the running wheel to be at a 30 degree angle from horizontal. If the bottom cover is installed incorrectly, the running wheel will be approximately level.

Figure 3-6- Incorrect (left) and Correct (right) Bottom Cover Installation

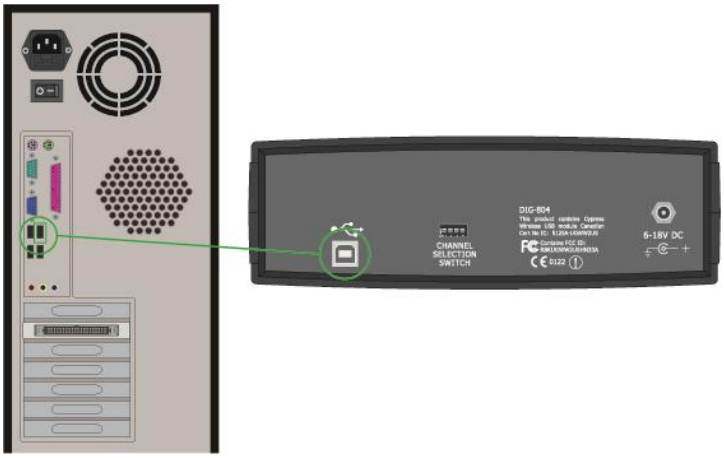
DIG-804 and DIG-807 USB Interface Hub Wiring Instructions

The DIG-804 is powered via the "6 - 18V DC" connector on the back panel. The DIG-807 is powered via the "12 - 15V DC" back panel connector. Using the supplied AC to DC power rectifier (6V – 18V DC for DIG-804, 12V – 15V DC for DIG-807) connect the power supply connector on the back of the Interface Hub to a standard wall outlet.

Figure 3-7 - Connect 6 - 18 VDC Connector to Wall Outlet

Using the supplied USB cable, connect the USB port on the back of the Interface Hub to the USB port on the computer that was used during driver installation. If a different USB port is used, it may be necessary to reinstall the DIG-804/DIG-807 drivers (see Appendix B).

Figure 3-8 – Connect the DIG-804 USB Port to Computer USB Port



Turn the Interface Hub ON using the POWER switch on the front panel.

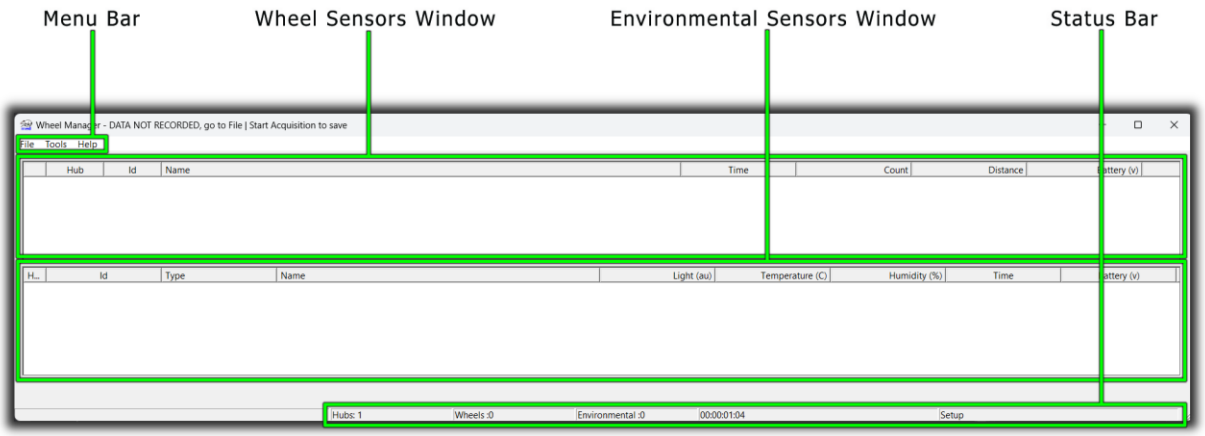
Figure 3-9 – Turn on the Interface Hub

CHAPTER 4 | USER INTERFACE

Main Screen

The main screen consists of a menu bar, two separate data display windows (one for Wheel Sensors and the other for Environmental Sensors), and a status bar.

Figure 4-1 – Wheel Manager Screen

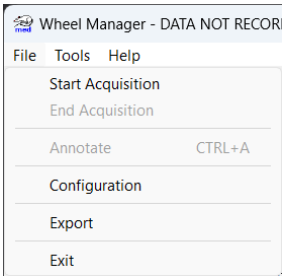


Menu Selections

When the Wheel Manager software application is opened there are three menus available on the Menu Bar: File, Tools and Help.

File Menu

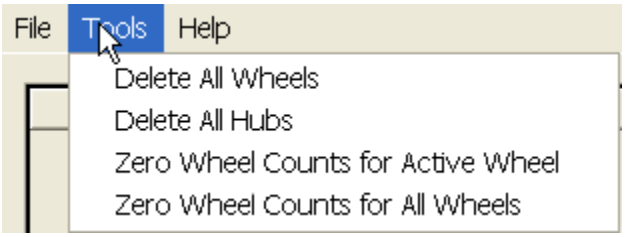
Figure 4-2 – File Menu Options



- Start Acquisition: Begins storing data from running wheels and environmental sensors.
- End Acquisition: Enabled after acquisition is started. Ends data storage.
- Annotate: Enabled after acquisition is started. Opens the Annotation screen.
- Configuration: Opens Configuration screen.
- Export: Opens Export screen.
- Exit: Closes the application, ending acquisition if in Acquiring mode.

Tools Menu

Figure 4-3 - Tools Menu



- Delete All Wheels: Removes all wheels and environmental sensors from the Wheel Manager screen. As wheels consequently communicate with their hub, they will reappear on the sensor list. Be aware that the wheels and environmental sensors will appear with new ID numbers assigned the next time they communicate with the Hub. Also, after deletion the sensors will reappear with the Name field blank.
- Delete All Hubs: Removes all hubs from the application's hub list. As hubs are rediscovered, they may be numbered differently from before the Delete All Hubs command was issued. Use this command **only in Setup mode** (not while acquiring data) to keep wheel data consistent in terms of the hub number associated with the wheels. This command is useful while configuring multi-hub systems, or when wheel communication has become erratic or compromised.
- Zero Wheel Counts for Active Wheel: Clears the wheel revolution counts for the active, or selected, wheel. The active wheel is highlighted in blue (satisfactory battery voltage) or purple (low voltage). See note.
- Zero Wheel Counts for All Wheels: Clears the wheel counts for all wheels. See note.

NOTE: Zeroing wheel counts will NOT affect data saved in a *.WLS data file, only the wheel revolution counts on the Wheel Sensors Window will be reset to zero.

Help Menu

Figure 4-4 - Help Menu

- Manual: Displays the User's Manual.
- About: Opens the **About** screen to display software version, and a list of connected Hubs. See Figure 4-5.

The DIP value shown on the About Wheel Manager screen indicates the channel settings of the dipswitch on the hub for the specified hub number. Each hub must have a unique DIP setting that matches the wheels and environmental sensors communicating with that hub.

Figure 4-5 - About Screen

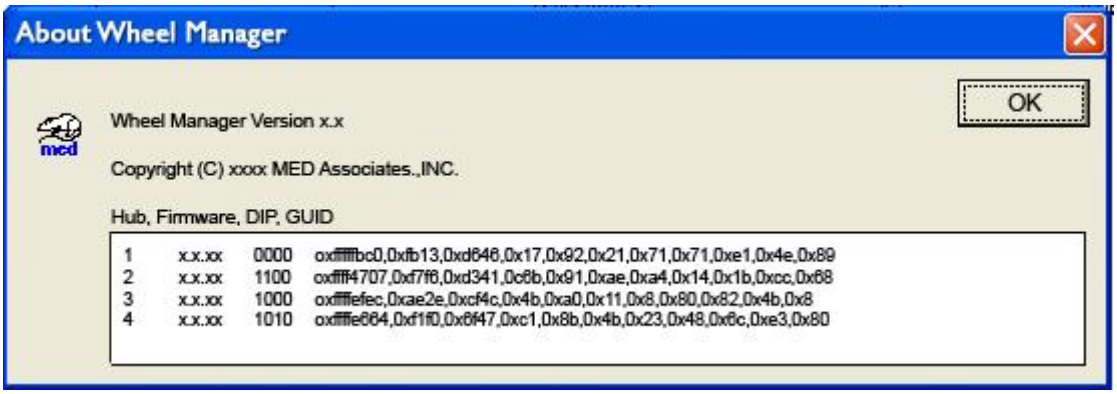
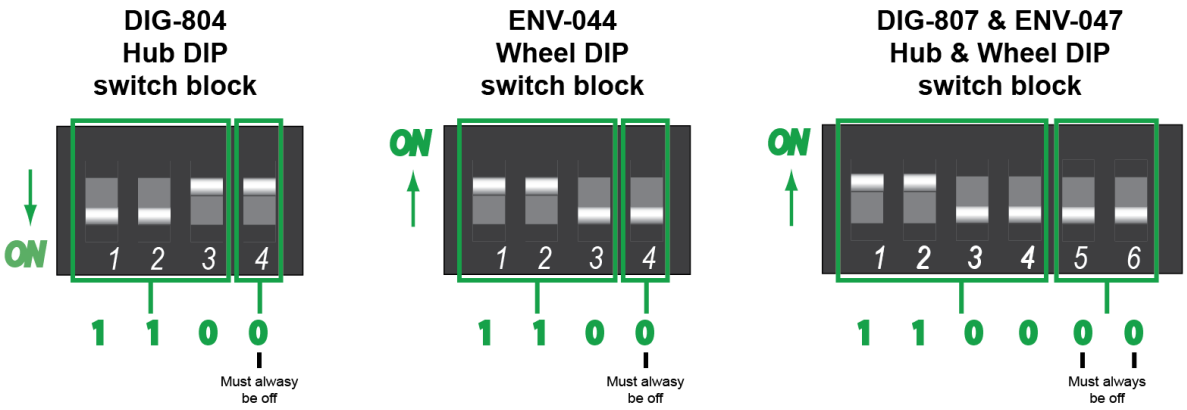


Figure 4-6 – DIP Switch Setting Example



Wheel Sensors Window

The Wheel Sensors portion of the Wheel Manager window (Refer to Figure 4-1) displays the following information. The width of the columns may be adjusted by dragging the boundary on the right side of the column heading. The mouse cursor will change to a double-headed arrow when positioned properly. Hold down the left mouse button and drag to resize the column. Clicking on a column header will sort the rows by that column's value. Clicking on the same column header a second time will sort the rows in the opposite order of that column's value.

- Hub: The number of the hub that is receiving data. In setup mode, it shows the 32 character Globally Unique Identifier (GUID). In acquisition mode, it shows number 1-4.
- ID: The ID number of the wheel. ID numbers are issued sequentially as the wheels are initially recognized by the hub.
- Name: The user may enter text in the Name field that will help identify each wheel. Enter text by clicking in the desired field. **Do not use** the single quote or double quote character in sensor names.

  NOTE: If two different wheels are given the same name and the **Use Sensor Names** option is selected during data export, the data collected from these wheels will be merged in the data file. This can be useful if hardware problems occur and a wheel needs to be replaced during a study.
- Time: The time on the master hub (displayed in Status bar) when the wheel last successfully sent a message to the hub.
- Count: The number of revolutions made by the wheel since the software application was opened if in Setup Mode or since data acquisition was begun if in Acquisition Mode. The count may be zeroed via the Tools menu. This count is updated every 30 seconds.
- Distance: The distance traveled by the wheel since the software application was opened if in Setup Mode or since data acquisition was begun if in Acquisition Mode. The distance may be zeroed via the Tools menu. This distance is updated every 30 seconds. The distance is proportional to the count in units of kilometers.
- Battery (v): The wheel sensor's battery voltage.
  ENV-044 low battery = 3.65 volts
  ENV-047 low battery = 2.50 volts

Sensor Row Colors

A sensor's row background color varies based on four factors: the sensor's battery voltage, how recently the sensor communicated with Wheel Manager, the type of last message from the

sensor, and the user's mouse clicks on the row. The possible colors are **neutral** (same as the window background), **blue**, **red**, **purple**, **yellow**, or **olive**.

Table 4-1 – Wheel Row Color Meanings

Sensor Row Background Color Table	Voltage OK	Low Voltage	Low Signal
Last message type = Reset -OR- Row selected with mouse click	Blue	Olive	Purple
Last message type = Data -AND- Row NOT selected with mouse click	Neutral	Yellow	Red

A sensor row with a **neutral background** indicates a good battery voltage, the last message from the sensor was a "regular" data message (not a "reset" message), and the user has not clicked on the row with the mouse.

A sensor with a **blue background** has good battery voltage, and the last message from the sensor was "reset" message or the user clicked on the row with the mouse. A reset message will be sent when a wheel is reset with the ENV-044 Wheel Identification Tool (on wheels with no external power switch: versions 1.3 or earlier) or when the wheel is powered ON. Also, a wheel may occasionally send a reset message, especially in a situation where it is not in strong communication with its hub. Press the keyboard Escape key to clear the highlighted wheel (removes the blue background).

A sensor row with a **yellow background** indicates a low battery voltage, the last message from the sensor was a "regular" data message, and the user has not clicked on the row with the mouse (see Figure 4-7 and Figure 4-10). ENV-044[V] sensors have a low voltage threshold of 3.65 Volts. ENV-047[V] sensors have a low voltage threshold of 2.50 Volts. A yellow (or olive) background indicates that the batteries should be replaced to avoid loss of data collection.

A sensor row with an **olive background** has a low battery, and the last message from the sensor was a "reset" message or the user clicked the row with the mouse. Again, an **olive or yellow row background means the batteries should be replaced soon**.

A sensor row with a **red background** hasn't communicated in the past 2 minutes, and the user has not clicked on the row with the mouse. This indicates that either the battery has died and needs to be replaced, the sensor is out of range, or there is a communication issue. A red (or purple) background indicates that the batteries should be replaced, or the sensor should be moved into range.

A sensor row with a **purple background** hasn't communicated in the past 2 minutes, and the last message from the sensor was a "reset" message or the user clicked the row with the mouse. Again, a **purple or red row background means the batteries should be replaced, or the sensor should be moved into range**.

Figure 4-7 shows wheel id 1 is selected and highlighted blue. Figure 4-8 shows wheels 1 and 2 with low battery, with wheel 1 highlighted olive, and wheel 2 yellow. Figure 4-9 shows wheels 1 and 2 with low signal communication, with wheel 1 highlighted olive, and wheel 2 yellow. The satisfactory voltage for a sensor is >3.65V. Figure 4-10 shows the bar being dragged to resize the viewing panes.

Figure 4-7 – Multiple Wheel Sensors with No Issues, Id 1 is selected

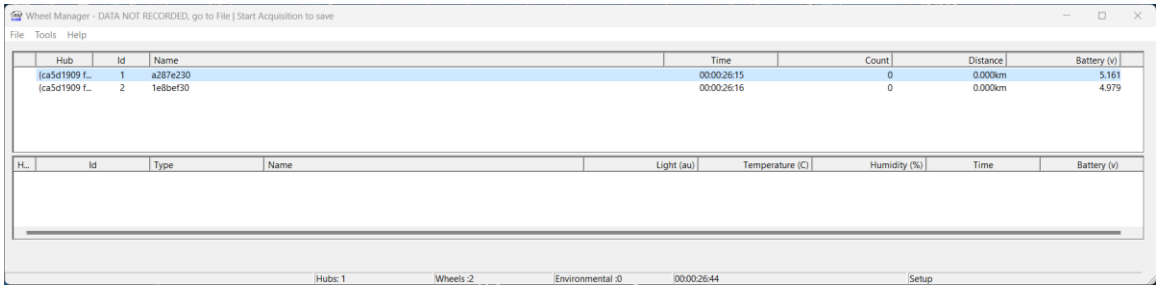


Figure 4-8 – Multiple Wheel Sensors with Low Battery, Id 1 is selected

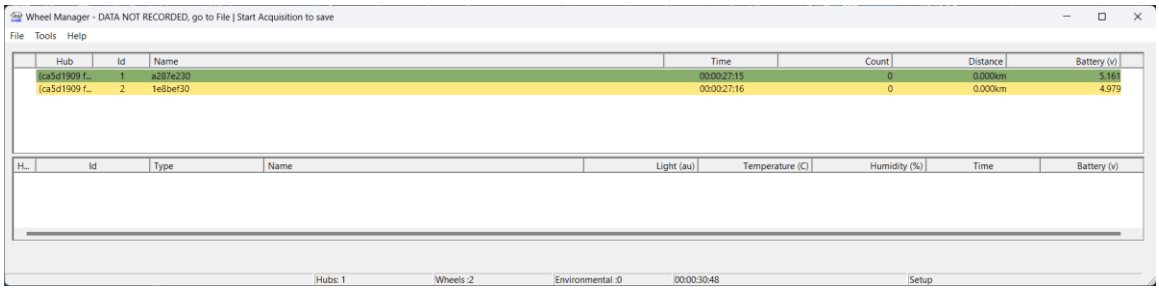


Figure 4-9 – Multiple Wheel Sensors with Low Signal Communication, Id 1 is selected

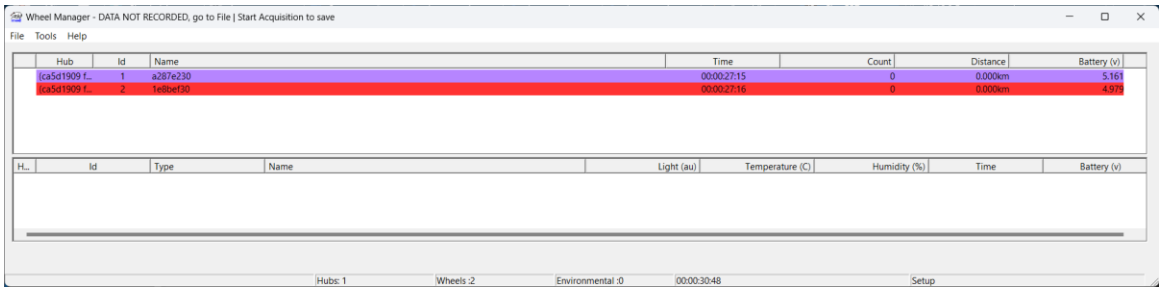
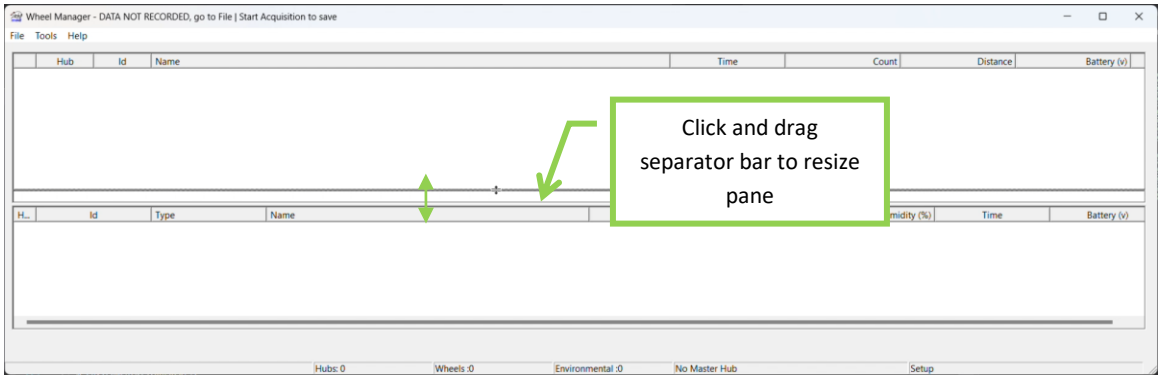


Figure 4-10 – Resize Viewing Panes



NOTE: To change the size of the viewing panes, click on the separator bar between the panes and drag it up or down to make the view smaller or larger, as noted in Figure 4-10.

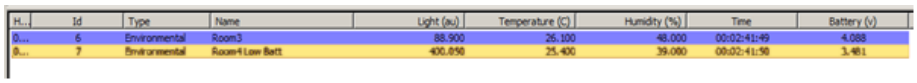
Environmental Sensors Window

The Environmental Sensors portion of the Wheel Manager window (refer to Figure 4-1) displays the following information. The width of the columns may be adjusted by dragging the boundary on the right side of the column heading.

- Hub: The number of the hub that is receiving data from an environmental sensor.
- ID: The ID number of the sensor. ID numbers are issued sequentially as the sensors are initially recognized by the hub.
- Type: The type of sensor being monitored.
- Name: The user may enter text in the Name field that will help identify each sensor. Enter text by clicking in the desired field.

  NOTE: If two different sensors are given the same name and the **Use Sensor Name**s option is selected during data export, the data collected from these sensors will be merged in the data file. This can be useful if hardware problems occur and a sensor needs to be replaced during a study.
- Light: The light level being detected by the sensor. The light level is measured in arbitrary units (au).
- Temperature: The temperature in degrees Celsius (°C) being detected by the sensor.
- Humidity: The percent relative humidity (%RH) being detected by the sensor.
- Time: The hub's time when the last message (Temperature, Light, or Humidity) was received.
- Battery (v): The environmental sensor's battery voltage. The environmental sensor data will be highlighted in red (as shown in Figure 4-11) when the voltage drops below the low voltage threshold (3.65V for ENV-044 wheels). This indicates that the battery should be replaced to avoid the loss of data collection. If the row is selected with a mouse click, the row will be highlighted purple to indicate the environmental sensor is selected **and** below the voltage threshold.

Figure 4-11 - Environmental Sensor Id 6 is Selected and Id 7 has Low Battery Voltage



Status Bar

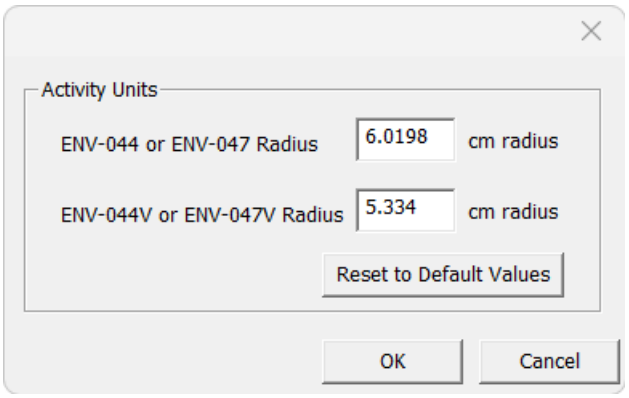
The status bar displays the following information (refer to Figure 4-1):

- Hubs: The total number of hubs being recognized by the software.
- Wheels: The total number of wheels being recognized by the software.
- Timer: The timer has multiple functions. It begins incrementing when the application is opened and restarts when data acquisition is started. It decrements to the start time of data acquisition if the **Start on Time** feature is used (see Figure 5-4).
- Status Indicator: Indicates the current status of the software (**Setup**, **Acquiring**, or **Wait for Start Time**.).

Configuration Window

To change the wheel radius, select **File | Configuration**. The Configuration screen in Figure 4-12 will appear. The radius values of the ENV-044, ENV-047, ENV-044V, and ENV-047V wheels can edited here in units of centimeters. The wheel radii can be reset to the system values by clicking the "Reset to Default Values" button. Each bin in the distance column will have the distance calculated as kilometers using the animal's revolutions and the running radius defined in the two edit boxes labeled "ENV-044 or ENV-047 Radius" and "ENV-044V or ENV-047V Radius". The ENV-044 Radius is the distance from the wheel spindle center to the animal's running "track" on the orange running wheel. From laboratory observation, most animals run around the midpoint of the grooved surface of the low-profile wheels. The ENV-044V/ENV-047V Radius is the distance from the center of the wheel axle to the inside of the running surface on the vertical style wheels.

Figure 4-12 – Configuration Screen



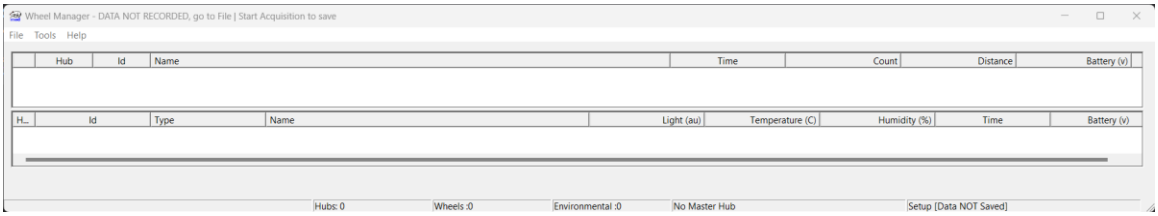
CHAPTER 5 | USING THE SOFTWARE

Prior to opening the Wheel Manager software, be sure that the DIG-804/DIG-807 is properly connected and turned on. Refer to Chapter 3, DIG-804 and DIG-807 USB Interface Hub Wiring Instructions for further information regarding wiring.

NOTE: The driver is specific to the computer USB port used during driver installation. Consequently if a different computer USB port is used at a later time, it may be necessary to repeat the driver installation procedure.

Open the Wheel Manager software application by double clicking on the desktop shortcut. The screen shown in Figure 5-1 will appear. The software will recognize any hubs that are connected to the computer. In this example the status bar is indicating that there is one hub connected to the computer and no wheels or environmental sensors are being detected.

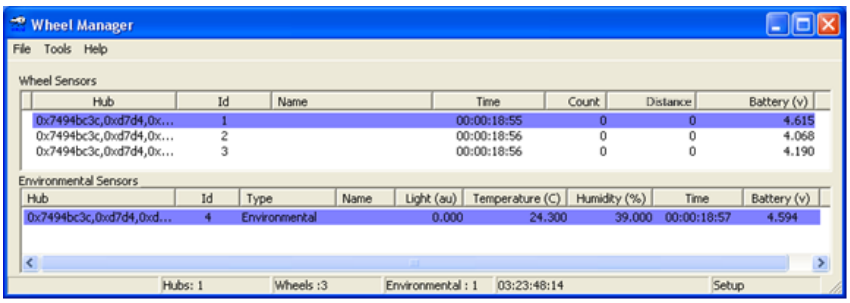
Figure 5-1 – Wheel Manager Main Screen



Issuing ID Numbers

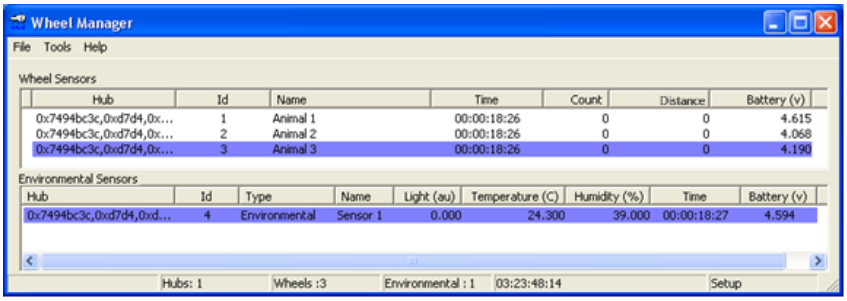
1. Begin by verifying that each wheel and environmental sensor is set to the same channel as its hub (refer to Setting the Channel Number section Chapter 3).
2. Install batteries in each wheel and environmental sensor as instructed in the ENV-044, ENV-047 and ENV-044E Battery Installation section of this manual (Chapter 3), however do not connect the battery cable to the sensor yet.
3. If the wheels and environmental sensors have been issued names previously that are no longer valid, select **Tools** | **Delete All Wheels**.
4. Connect the battery cable in the wheel or environmental sensor that should be issued ID #1. The wheel or environmental sensor should appear on the screen immediately.
5. Name the wheel with the subject name, cage name, or other unique identifier.
6. Replace the bottom cover of the base by aligning the tabs on the cover with the slots in the base, and then twist the base about ¼ turn.
7. Repeat Steps 4 - 6 for each additional wheel or environmental sensor. The ID number will increment by one each time.

Figure 5-2 - Wheel Manager Main Screen with Three Wheels and One Environmental Sensor



The screen shown in Figure 5-2 depicts a system with one hub, three wheels and one environmental sensor. Names may be issued to the wheels or environmental sensors at this point, as shown in Figure 5-3.

Figure 5-3 - Wheels and Environmental Sensor with Names



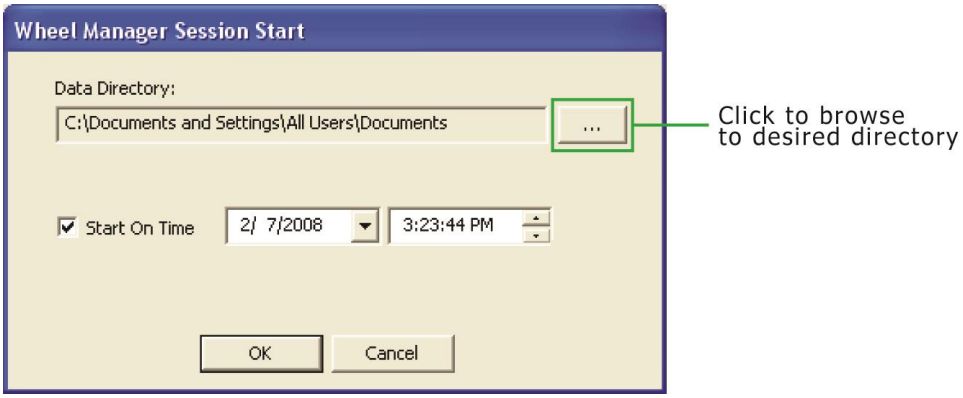
To assign a name to a sensor, click the sensor row's name field, type in the name, and then press **ENTER** to save the change. Single (') and double (") quote characters are not allowed in the name field.

Wheel rows can be sorted in order of the value of a column by clicking on that column's header. Clicking the column header a second time sorts the rows in reverse order of that column's value.

Starting Data Acquisition

To begin acquiring data select **File | Start Acquisition**. The screen shown in Figure 5-4 will appear.

Figure 5-4 – Session Start Screen



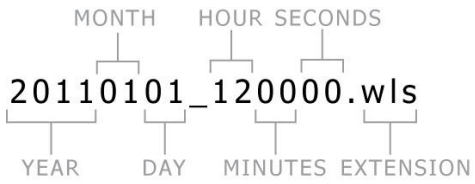
- Data Directory: The directory where the data will be saved. To change the data directory click on the "**…**" button indicated in Figure 5-4.
- Start On Time: Enable this option to delay the start of the data acquisition. Select the desired date and time for the acquisition to begin. If unchecked, the data acquisition will begin as soon as the **OK** button is clicked.

When all of the information on this screen is entered correctly, click **OK** to begin data acquisition. The timer on the status bar will begin incrementing when acquisition begins.

Data File Name Format

The data files are saved with a .wls extension and will automatically be issued file names using the date and time that the data acquisition was started. The data file name format is as shown in Figure 5-5.

Figure 5-5 - Data File Name Format



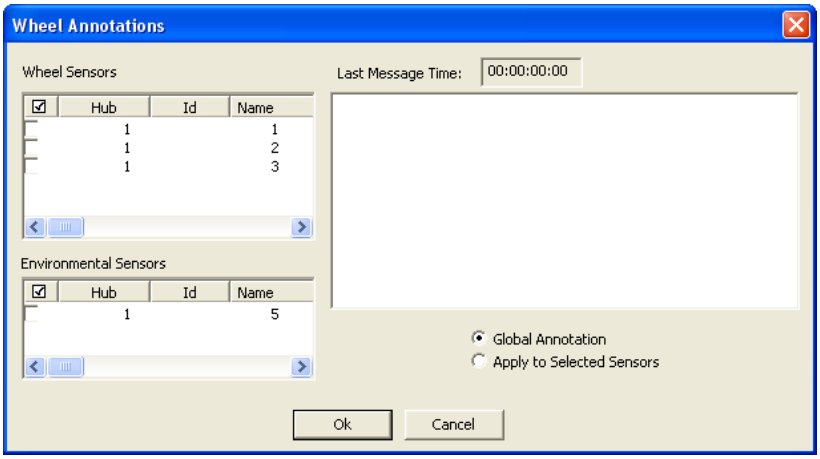
Annotations

Annotations may be added during data acquisition by clicking **File | Annotate**. The screen shown in Figure 5-6 will appear. Select **Global Annotation** to apply the annotation to all of the wheels or **Apply to Selected Sensors** to apply the annotation only to the wheel sensors or

environmental sensors selected. Enter the desired text in the field and click **OK** to save the annotation to the data file. The annotations are displayed in the Wireless Wheel Analysis SOF-861 Software.

Annotations can be used to indicate an event in the data file, for example when batteries were changed or when cage changes were performed.

Figure 5-6 – Wheel Annotations Screen



Zeroing Wheel Counts

To zero the wheel counts for the active, or selected, wheel, select **Tools** | **Zero Wheel Counts for Active Wheel** or right-click anywhere on the screen and choose **Zero Wheel Counts for Active Wheel**. Note that only the wheel selected will be reset to zero.

To zero the wheel counts for all wheels, select **Tools** | **Zero Wheel Counts for All Wheels** or right-click anywhere in the window and select **Zero Wheel Counts for All Wheels**.

A prompt will appear asking the user to verify whether or not this action should be carried out.

It is important to note that the wheel counts will NOT be reset to zero in the data file; it is reset ONLY on the Wheel Manager Sensors Window.

Deleting all Wheels

In order to remove all wheels and environmental sensors from the Wheel Manager screen and reset the ID numbers and Names, select **Tools** | **Delete All Wheels**. A warning message will appear prompting the user to verify whether or not this action should be carried out.

Be aware that the wheels and environmental sensors will most likely appear with different ID numbers the next time they communicate with the Hub

Ending Data Acquisition

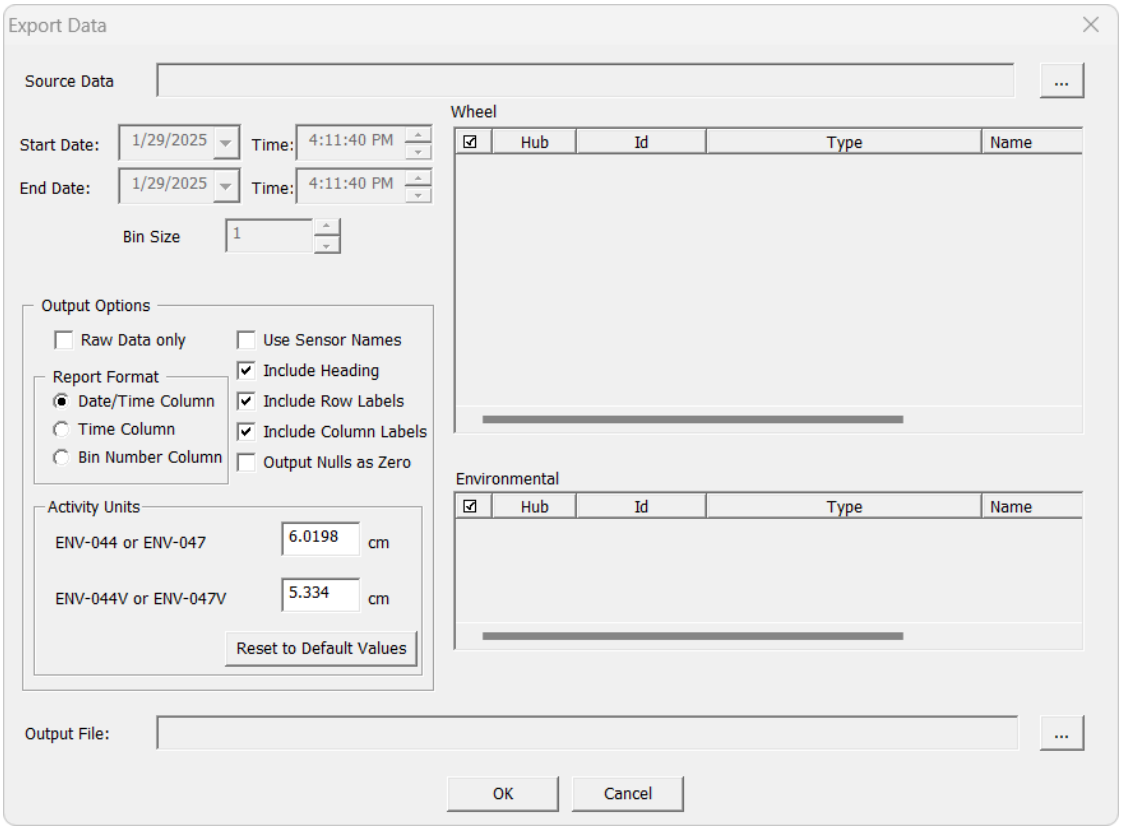
Select **File | End Acquisition** from the menu to end data acquisition. A prompt will appear asking the user to verify whether or not to end the acquisition. When the acquisition is ended, the ending time is recorded in the database, and then the database will close.

Exporting Data

To export a data file to Microsoft Excel® spreadsheet software or other data analysis software, select **File | Export**. The screen shown in Figure 5-7 will appear. Click on the "**…**" button in the upper right corner to browse to the desired source data file. The screen shown in Figure 5-8 will appear.

The default exported file format is a tab-delimited text file with an XLS extension. When opened with Microsoft Excel, a series of dialogs will walk through the conversion to a proper Excel data file.

Figure 5-7 - Export Data Screen



Select the desired source data file and click **Open**. The screen shown in Figure 5-9 will appear.

Figure 5-8 – Select the Source Data File

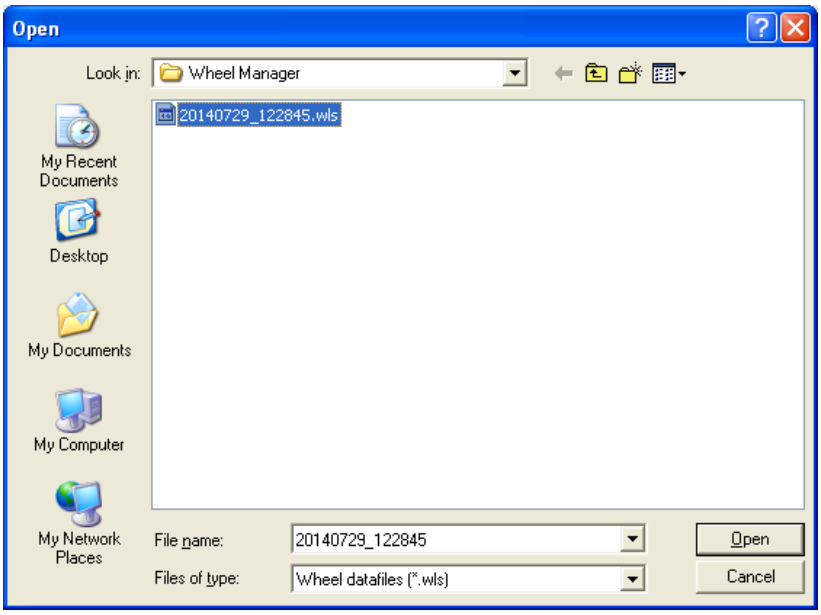
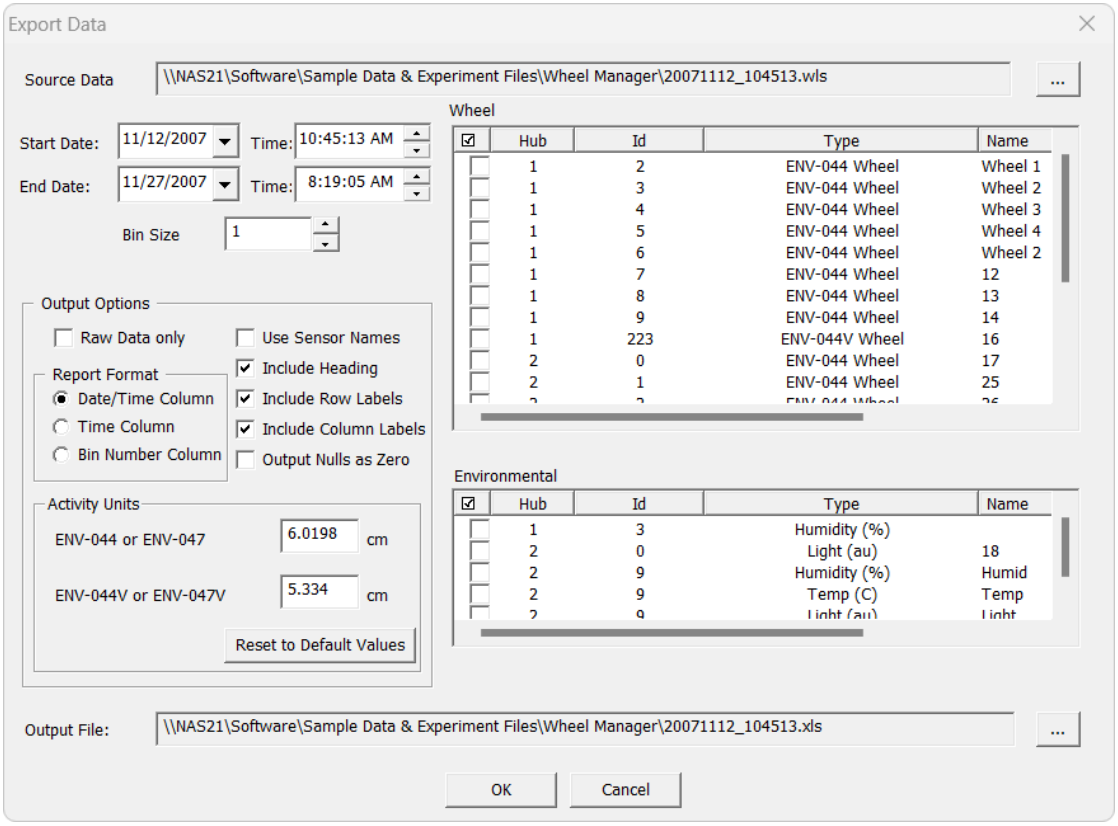


Figure 5-9 – Export Data Screen with Source Data File Selected



The Export Data screen will now contain the file name of the source data file. The following Output Options are available:

- Start Date and Time: By default, the date and time that data acquisition was started. Can be adjusted to a later date or time if desired.
- End Date and Time: By default, the date and time that the data acquisition was ended. Can be adjusted to an earlier date or time if desired.
- Bin Size (min): Set the desired bin size in minutes.

NOTE: The recommended minimum bin size is one minute if wheel data only are being exported and two minutes if environmental sensor data are being exported. This will prevent "holes" in the data.

- Raw Data only: Disables all report Output Options and Bin Size. Only one Wheel or Environmental Sensor can be selected. An example of a raw data file is shown in Figure 5-22.
- Use Sensor Names: Enable this option in order to have Sensor Names appear in the exported data file. Refer to Figure 5-21.

NOTE: Leave **Use Sensor Names** unchecked if Names were not assigned to the sensors.

- Report Format: Allows the user to select the format of the bin labels in the exported data file.
  - Date/Time Column: Each bin will be labeled using the date and time of the corresponding bin.
  - Time Column: Each bin will be labeled using the time of the corresponding bin (in minutes).
  - Bin Number Column: Each bin will be labeled using the bin number.
- Include Heading: If checked, a heading will appear in the exported data file. This heading includes the date and time that the data was exported; the data file name, data acquisition start and stop times and the number of hubs and wheels. Refer to Figure 5-18.
- Include Row Labels: If checked, each row (or bin) will be labeled according to the "Report Format" selected. Refer to Figure 5-18.
- Include Column Labels: If checked, each column of data will be labeled with the Hub ID, Sensor Type and Sensor ID numbers, or names if "Use Sensor Names" is selected. Refer to Figure 5-18.

- Sensor Type: The sensor type is indicated in the Column Label using a numeric value.

Sensor Type	Column Label
ENV-044 Low Profile Running Wheel Sensor	1
Light Sensor	2
Temperature Sensor	3
Humidity Sensor	4
ENV-044V Vertical Running Wheel Sensor	5
ENV-047 Low Profile Running Wheel Sensor	8
ENV-047V Vertical Running Wheel Sensor	9

- Output Nulls as Zero: If checked, the export will output zeroes, rather than nulls, for blank records/values. Refer to Figure 5-20.
- Activity Units Both Revolutions and Distance units are exported.
  - Revolutions Each bin in this column will have the number of wheel rotations for that time period.
  - Distance (km) Each bin in this column will have the distance calculated as kilometers using the animal's running radius defined in the two edit boxes labeled "ENV-044 or ENV-047 Radius" and "ENV-044V or ENV-047V Radius". The ENV-044 Radius is the distance from the wheel spindle center to the animal's running "track" on the orange running wheel. From laboratory observation, most animals run around the midpoint of the grooved surface of the low-profile wheels. The ENV-044V/ENV-047V Radius is the distance from the center of the wheel axle to the inside of the running surface on the vertical style wheels.
- Wheel Sensors: Select the wheel sensors to include in the exported data file. Click the ☑ to select all of the wheel sensors.
- Environmental Sensors: Select the environmental sensor data to include in the exported data file. Click the ☑ to select all of the environmental sensors.
- Output File: Displays the destination folder of the exported data file. Click the "**…**" button in the lower right corner to browse to a different destination folder.

When all of the correct information has been entered, click **OK** to export the data file to the destination folder. Exported files are saved as tab-separated value format with .XLS or .TSV extension, or comma-separated value with a .CSV extension. Many spreadsheet programs can import these files. Open the desired spreadsheet software application and open the file. Several sample data files are shown in Appendix C.

Appendix A| Driver and Software Installation

NOTE: Before beginning the installation, phone, fax, or e-mail MED Associates with the registration information in order to receive the software installation password. This password will be necessary during the installation process.

1. Insert the Wheel Manager CD and the screen shown in Figure 5-10 will appear. Click **Install the Wheel Manager software** and the screen shown in Figure 5-11 will appear.

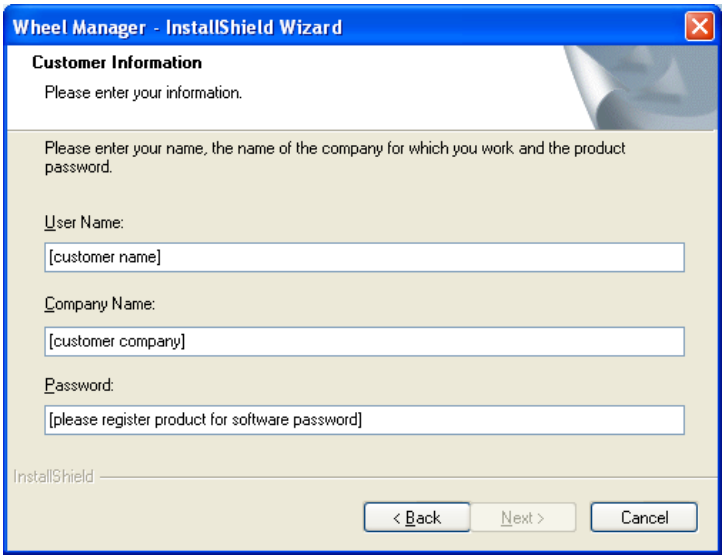
Figure 5-10 - Menu Screen

2. Click **Install** in the lower right corner of the screen to begin installation of the Wheel Manager software and the DIG-804 driver. The screen shown in Figure 5-12 will appear.

Figure 5-11 – InstallShield Wizard

3. Enter a User Name, Company Name and Password then click **Next** to continue. (The password is issued when the software is registered with MED Associates). The screen shown in Figure 5-13 will appear.

Figure 5-12 – Customer Information

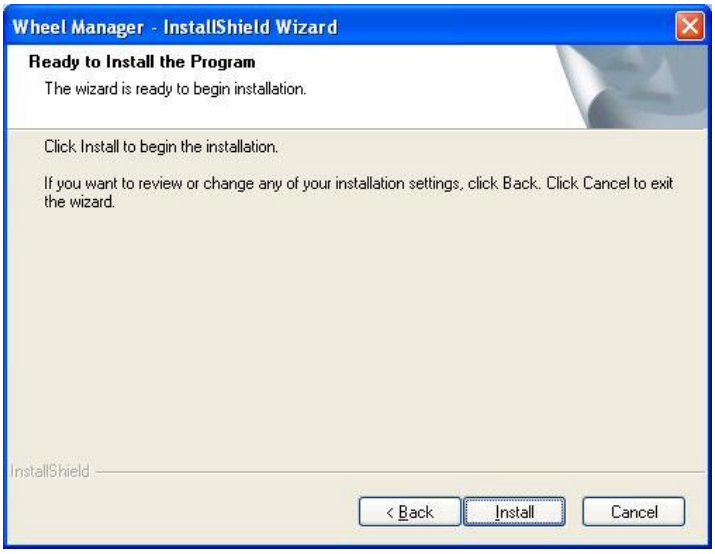


4. If the destination folder shown is acceptable, click **Next** to continue. If not, click **Browse…** and browse to the desired destination folder.

Figure 5-13 – Choose Destination Location

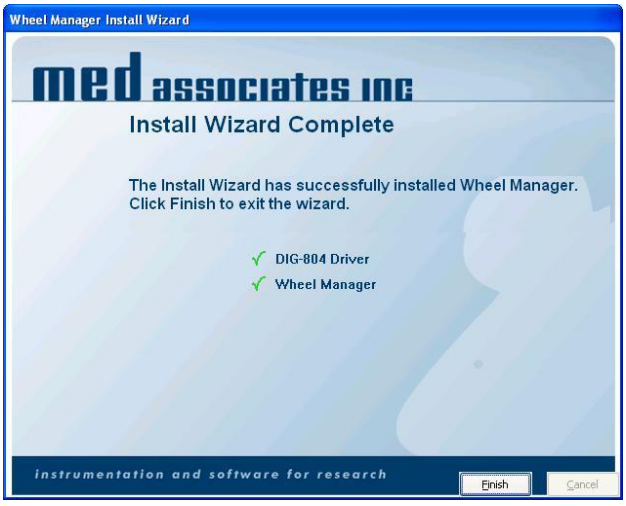
5. If all of the information entered is correct, click **Install**. Click **Back** to review or change any of the installation settings and click Cancel to exit the InstallShield Wizard.

Figure 5-14 – Ready to Install



6. Software and driver installation are now complete. Click **Finish** (lower right corner of the screen) to exit.

Figure 5-15 – Wheel Manager Installation Complete



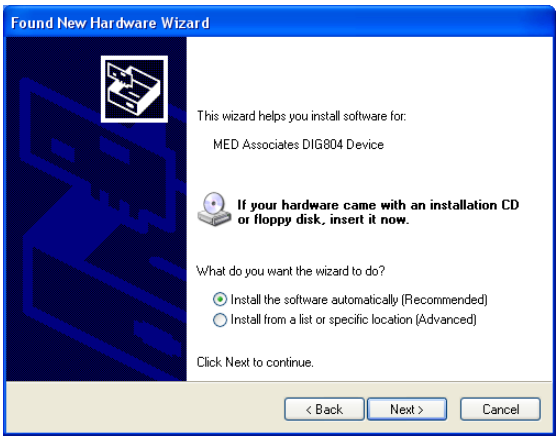
Appendix B| DIG-804/DIG-807 Driver Installation for Windows XP

Driver installation is automatic in Windows Vista, Windows 7, and later versions.

NOTE: The driver is specific to the computer USB port used during driver installation. Consequently if a different computer USB port is used at a later time, it may be necessary to repeat the installation procedure.

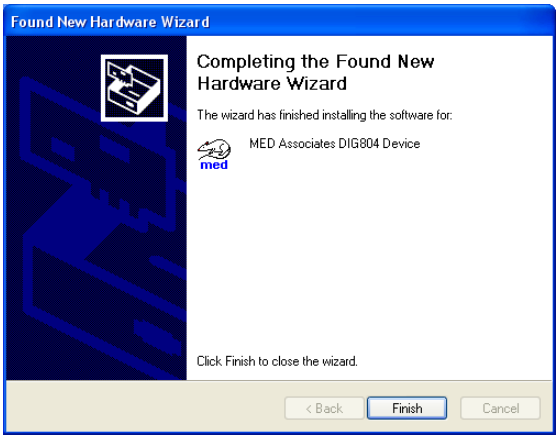
1. When the DIG-804/DIG-807 USB Interface Hub is connected to the desired USB port on the computer and the device is turned on (refer to Chapter 3, DIG-804 and DIG-807 USB Interface Hub Wiring Instructions for more information), the screen shown in Figure 5-16 will appear.
2. Select **Install the software automatically (Recommended)** then click **Next**.

Figure 5-16 – Install Software Automatically



3. Click **Finish** to close this screen. Driver installation is now complete.

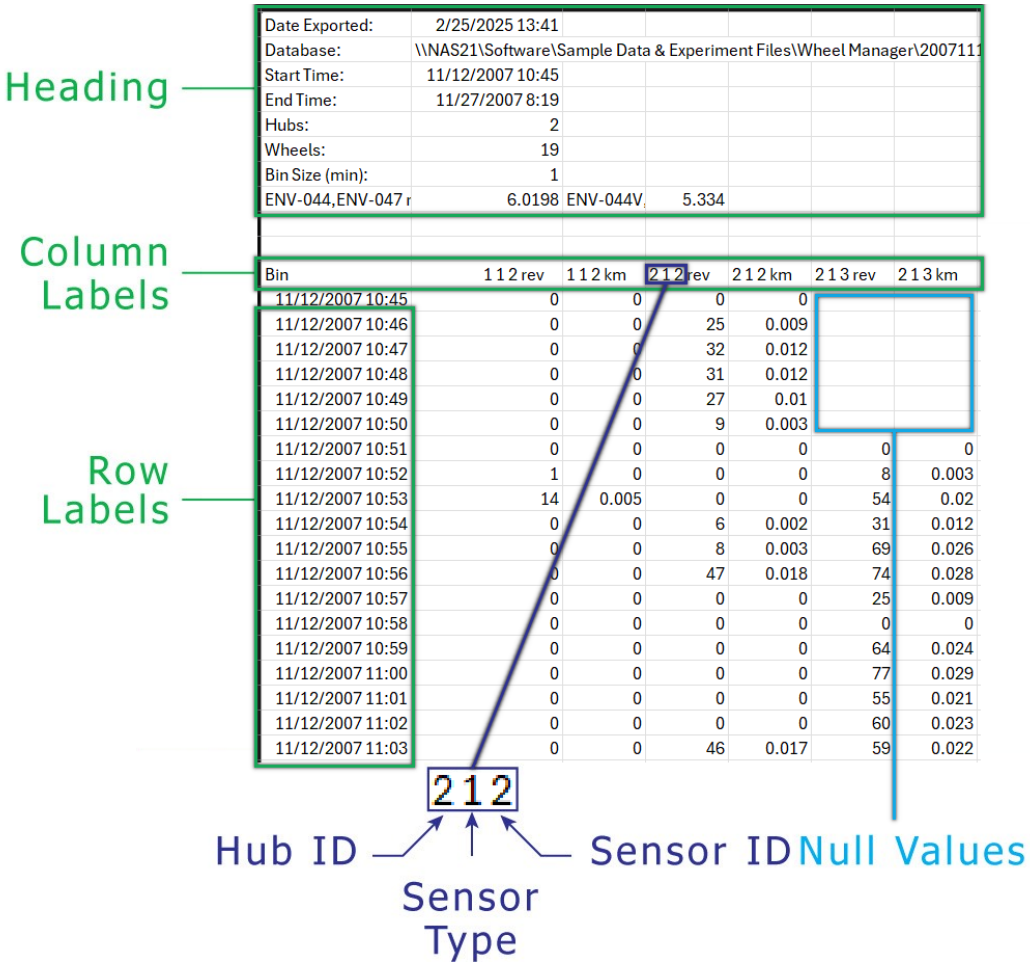
Figure 5-17 – Found New Hardware Wizard Complete



Appendix C| Sample Exported Data Files

The sample data file shown in Figure 5-18 was generated using the Output Options shown in Figure 5-19. The sample data file shown in Figure 5-20 was generated using the same Output Options, but with the **Output Nulls as Zero** option enabled.

Figure 5-18 - Sample Exported Data File with Labels Identified



Date Exported:	2/25/2025 13:41					
Database:	\\NAS21\Software\Sample Data & Experiment Files\Wheel Manager\2007111					
Start Time:	11/12/2007 10:45					
End Time:	11/27/2007 8:19					
Hubs:	2					
Wheels:	19					
Bin Size (min):	1					
ENV-044,ENV-047 r	6.0198	ENV-044V,	5.334			
Bin	112 rev	112 km	212 rev	212 km	213 rev	213 km
11/12/2007 10:45	0	0	0	0		
11/12/2007 10:46	0	0	25	0.009		
11/12/2007 10:47	0	0	32	0.012		
11/12/2007 10:48	0	0	31	0.012		
11/12/2007 10:49	0	0	27	0.01		
11/12/2007 10:50	0	0	9	0.003		
11/12/2007 10:51	0	0	0	0	0	0
11/12/2007 10:52	1	0	0	0	8	0.003
11/12/2007 10:53	14	0.005	0	0	54	0.02
11/12/2007 10:54	0	0	6	0.002	31	0.012
11/12/2007 10:55	0	0	8	0.003	69	0.026
11/12/2007 10:56	0	0	47	0.018	74	0.028
11/12/2007 10:57	0	0	0	0	25	0.009
11/12/2007 10:58	0	0	0	0	0	0
11/12/2007 10:59	0	0	0	0	64	0.024
11/12/2007 11:00	0	0	0	0	77	0.029
11/12/2007 11:01	0	0	0	0	55	0.021
11/12/2007 11:02	0	0	0	0	60	0.023
11/12/2007 11:03	0	0	46	0.017	59	0.022

Figure 5-19 - Output Options Used to Generate Exported Data Shown Above

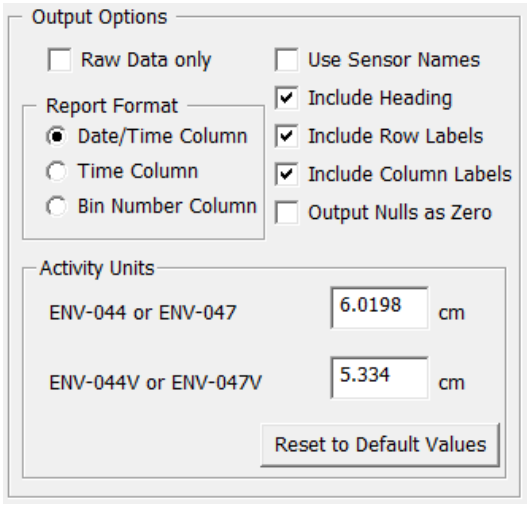


*Figure 5-20 – Sample Exported Data File with **Output Nulls as Zero** Enabled*

Bin	1 1 2 rev	1 1 2 km	2 1 2 rev	2 1 2 km	2 1 3 rev	2 1 3 km
11/12/2007 10:45	0	0	0	0	0	0
11/12/2007 10:46	0	0	25	0.009	0	0
11/12/2007 10:47	0	0	32	0.012	0	0
11/12/2007 10:48	0	0	31	0.012	0	0
11/12/2007 10:49	0	0	27	0.01	0	0
11/12/2007 10:50	0	0	9	0.003	0	0
11/12/2007 10:51	0	0	0	0	0	0

Null Values

The sample exported data file shown in Figure 5-21 was generated with the **Use Sensor Names** option enabled. The wheels were named “26”, “27”, and “Wheel 1”.

*Figure 5-21 – Sample Exported Data File with **Use Sensor Names** Enabled*

Sensor Names

Bin	26 rev	26 km	27 rev	27 km	Wheel 1 rev	Wheel 1 km
11/12/2007 10:45	0	0			0	0
11/12/2007 10:46	25	0.009			0	0
11/12/2007 10:47	32	0.012			0	0
11/12/2007 10:48	31	0.012			0	0
11/12/2007 10:49	27	0.01			0	0
11/12/2007 10:50	9	0.003			0	0
11/12/2007 10:51	0	0	0	0	0	0

The sample exported data file shown in Figure 5-22 was generated with the **Raw Data Only** option enabled. The message time (MsgTime) is shown in milliseconds. The message type (MsgType) is indicated using a numeric value. A message reading ‘131’ indicates a Sensor Reset and a message reading ‘134’ indicates a Sensor Message. The battery voltage (Battery) is in volts DC.

*Figure 5-22 – Sample Exported Data File with **Raw Data Only** Enabled*

Date Exported:	1/5/2011 9:27		
Database:	C:\Documents and Settings\Wheel Manager\20110104_150139.wls		
Start Time:	1/4/2011 22:00		
End Time:	1/4/2011 22:00		
Hubs:	1		
Sensor:	3		
MsgTime	MsgType	Battery	Count
30346	134	4.493	0
59749	134	4.493	0
89821	134	4.493	0
119223	134	4.493	0
149294	134	4.493	0
178695	134	4.514	0
208473	134	4.514	0
238125	134	4.493	0
267903	134	4.493	0
297554	134	4.493	0
327331	134	4.493	0

Appendix D | FCC Compliance

This device complies with part 15 of the FCC rules. Operation is subject to the following two conditions:

1. This device may not cause harmful interference, and
2. This device must accept any interference received, including interference that may cause undesired operation.

Appendix E | ENV-044E Environmental Sensor

The ENV-044E Environmental Sensor communicates with DIG-804 hubs, and not DIG-807 hubs. DIG-804 hubs are no longer produced. Therefore this section on ENV-044E sensors is for legacy hardware customers.

ENV-044E Environmental Sensor Technical Specifications

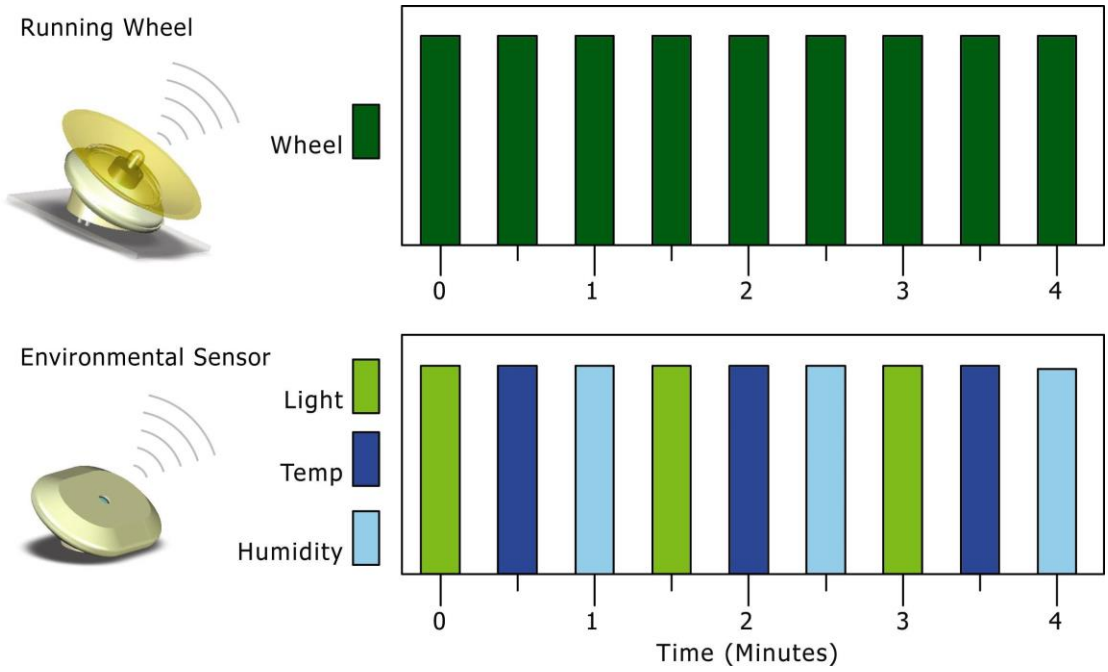
Operating Frequency:	2.4 GHz to 2.483 GHz
Range:	~15 m (50')
Power Supply:	Three AAA batteries
Dimensions (Height x Width x Depth):	2.5" x 6.5" x 4.3" (6.4 cm x 16.5 cm x 10.9 cm)
Weight (without batteries):	133 g (4.7 oz)
Operating Temperature:	-40°C to 85°C (-40°F to 185°F)
Humidity Accuracy:	± 2.0%RH
Temperature Accuracy:	± 0.3°C @ 25°C

ENV-044E Environmental Sensor:

This device is the wireless **Sensor** that measures ambient light levels (in arbitrary units, a.u.), temperature (in degrees Celsius) and percent relative humidity (in %RH). The **Environmental Sensor**, like the **Wheel**, transmits **Messages** to the **Hub** approximately every 30 seconds. However, only one measurement is contained in each **Message** sent from the **Environmental Sensor**. One **Message** will contain temperature data, then the next will contain the light data and the next will contain the humidity data. This means that the sampling rate for each measurement type is 90 seconds. This is illustrated in Figure 5-23. Notice that at time 0 a Message that contained the Light measurement was transmitted to the hub, at time 0.5 minutes a Message was transmitted that contained the Temperature measurement, and at time 1.0 minute a Message was transmitted that contained the Humidity measurement.

The Messages sent from the Environmental Sensor contain the average light, temperature and humidity measurement since the last Message with that measurement type was successfully sent. Thus, the sampling rate for each measurement made by the Environmental Sensor is approximately 90 seconds. If data from Environmental Sensors is being exported with a Bin size of one minute, be aware that some Bins will contain zero values due to the sampling rate for each measurement type. To avoid this, a minimum Bin size of two minutes is recommended when exporting data from Environmental Sensors.

Figure 5-23 - Sensor Transmission Diagram



Appendix F | Contact Information

Please contact Med Associates, Inc. for information regarding any of our products.

Visit our website at www.med-associates.com for contact information.

For technical questions, email support@med-associates.com.