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MultiLogPRO

Weather Station™

For clearer weather, use the best tool for weather monitoring and microclimate experimenting

including

WeatherLab™

User Guide

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Weather Station

User Guide

Fourier Systems

Second Edition

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1 Introduction

The MultiLogPRO Weather Station is a high performance weather station for educational purposes.
The MultiLogPRO Weather Station consists of a data logger – the MultiLogPRO, six sensors, a solar power supply, a mounting tripod and the MultiLogPRO WeatherLab software.
The station measures: Temperature, humidity, and barometric pressure, rainfall, wind speed and wind direction.
The temperature and humidity sensors are in fact, a two in one sensor located inside the Radiation Shield. The Barometric Pressure sensor is in the sensor adaptor inside the Weather Station main box and the other three are external sensors.
The MultiLogPRO is placed in the Weather Station main box to protect it from harsh weather conditions
The power is supplied from a solar panel and rechargeable battery.
The MultiLogPRO is connected to the computer either by a 30m long cable or by a RF transmitter and receiver.
The software records the data from the MultiLogPRO, displays, saves and analyzes it. Please refer to Section 4 for further details.

2 Parts List

2.1 Case

2.2 Mounting Tripod and bag

2.3 Magnet antenna with antenna shelf**

2.4 Wind sensor (Anemometer)

Figure 1: Anemometer

2.5 Rain Collector mounted on tray

Figure 2: Rain collector, base and cone

2.6 MultiLogPRO

Figure 3: MultiLogPRO

2.7 Radiation Shield with Temperature and Humidity dual sensor mounted inside

Figure 4: Radiation shield with the temperature and humidity dual sensor mounted inside

2.8 Solar Panel on shelf

Figure 5: Solar Panel

2.9 Weather Station main box containing items 2.9.1 to 2.9.9

2.9.1 Two rechargeable 12V batteries

2.9.2 Adaptor box for the rain and wind sensors and containing the barometric pressure sensor

2.9.3 Charge controller

2.9.4 Transmitter**

2.9.5 Two sensor cables

2.9.6 MultiLogPRO – transmitter communication cable**

2.9.7 MultiLogPRO and transmitter power cable

2.9.8 Charge controller – batteries cable

2.9.9 Charge controller – Solar panel cable

2.10 Serial communication cable adaptor

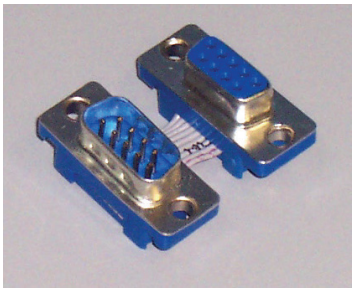


Figure 6: Serial communication cable adaptor

2.11 30 meters communication cable:
9 – pin D type plug*

2.12 1.5 meters communication cable:
9 – pin D type plug

2.13 Receiver**

2.14 Whip antenna for receiver**

2.15 Computer – Receiver communication cable:
9 – pin D type plug to stereo phone plug**

2.16 AC-DC power adaptor for the receiver or MultiLogPRO**

2.17 WeatherLab software CD

2.18 Compass

2.19 10 black nylon cable ties

* Not used in wireless connection

** Not used in standard cable connection

3 Station Installation

3.1 Installation Options

3.1.1 Standard Cable Connection

The MultiLogPRO is directly connected to the computer by 30m serial cable.

If you are using this option skip steps 3.2.12, 3.2.14.A and 3.2.16.A of the installation.

You won't need items 2.3, 2.9.4, 2.9.6 and 2.13 to 2.16 from the part list.

3.1.2 Wireless Connection

The MultiLogPRO is connected to an RF transmitter and the data is transmitted to a receiver that is connected to the computer.

If you are using this option skip steps 3.2.14.B and 3.2.16.B of the installation.

You won't need item 2.11 from the part list.

The transmission range is 300m if the transmitter and the receiver are in line of sight. If not the range is reduced considerably and depends on the medium between the transmitter and the receiver

Note: In wireless mode, transmission is one way only, from MultiLogPRO to the computer. There is no way of programming or operating the MultiLogPRO via the software, therefore there are two steps to take if you wish to reprogram your Weather Station. Firstly, temporarily connect MultiLogPRO to the computer with the supplied communication cable (step 3.2.15) and set it up. Secondly, set the system to transmit data by pushing the **Enter** button on the MultiLogPRO itself.

3.2 Assembling the Weather Station

3.2.1 Choosing a Location

Try to position your Weather Station as follows:

1. Mount the tripod on a level surface, so that the center pole is vertical.

2. Install in a location where wind flow is unobstructed by trees and nearby buildings

3. Try to avoid possible obstructions from rainfall

4. If you install the Weather Station on a roof, the anemometer (wind sensor) must be at least 1.2 m above the roofline for accurate wind measurements

5. The Solar Radiation Shield works best in a location where there is a steady breeze.

6. Do not install over or near water sprinklers. The Solar Radiation Shield is not designed to protect the sensor from water sprayed upwards.

7. Avoid placing near any space that can heat up a lot during the day.

8. The solar panel works best when the surface of the panel receives full sunlight. Mount the Weather Station away from fences, buildings, trees or any other obstructions that may cast shadows over the panel.

9. The solar panel should be mounted facing south in the Northern Hemisphere and north in the Southern Hemisphere.

3.2.2 Mounting the Tripod

1. Take the Tripod out of its bag and unfold it.

2. Pull out the extension tube to about 50cm and secure it.

3. Fasten all the screws tightly.

3.2.3 Securing the Tripod

You must secure the tripod to the surface.

Mounting on a wooden surface

Screw a hook into the floor adjacent to each leg and fasten the leg to the hook with a nylon cable tie.

Mounting on a concrete surface

Insert rawlbolts with eyelets adjacent to each leg and fasten the leg to the hook with a nylon cable tie.

If you want to avoid drilling into the floor you will have to place heavy weights on each leg

Mounting on a soil surface

Hammer pegs with eyelets adjacent to each leg and fasten the leg to the hook with a nylon cable tie.

3.2.4 Open the case and identify the various components
(see on page 2).

3.2.5 Preparing the Rain Collector

1. Remove the cone from the base by rotating the base anti-clockwise until the latches on the cone line up with the latch openings in the base then lift the cone away from the base.

2. Carefully remove the tie that holds the bucket in place during shipping.

3. Place the cone back onto the base by putting the latches on the cone into the latch openings in the base and rotating the cone

clockwise until the latches “lock” into place.

As you reattach the cone, make sure to run the cable to the cable slot in the base, or the cone will not fit snugly against the base.

4. Place the debris screen, point down, into the cone. The screen prevents large bits of debris from blocking the funnel hole

3.2.6 Preparing the Anemometer (Wind Sensor)

1. Open the anemometer kit and attach the drip ring. The anemometer drip rings provide protection against icing of the wind vane and wind cups. Follow the instructions below to attach the two drip rings:

A. Place one of the drip rings on a flat surface with the small hole facing up.

B. Securely press the wind vane on top of the drip ring.

Note: You may want to start with the vane tilted slightly.

C. Make sure the ring fits securely between the two ridges on the vane with the lower edge parallel to the bottom of the wind vane.

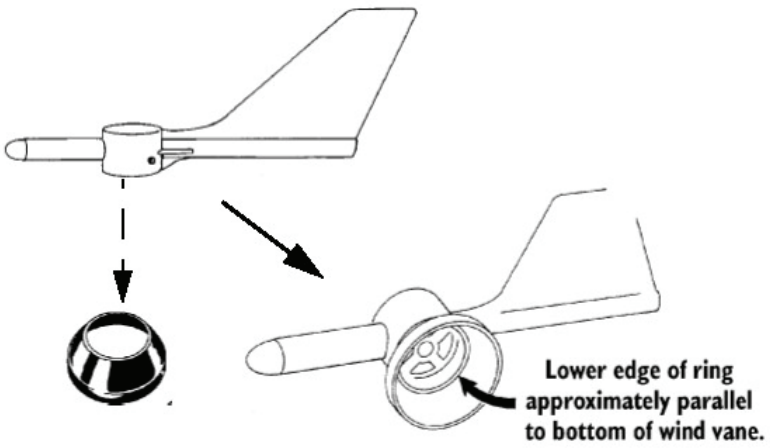


Figure 7: Installing the drip ring onto the wind vane

D. Install the small end of the other drip ring on the wind cup end of the anemometer control head as shown below.

Note: The wind cup end of the control head has the smaller of the two stainless steel shafts

E. Gently push up the drip ring until it reaches the groove on the control head.

F. Make sure the lower edge of the drip ring is aligned with the lower edge of the control head.

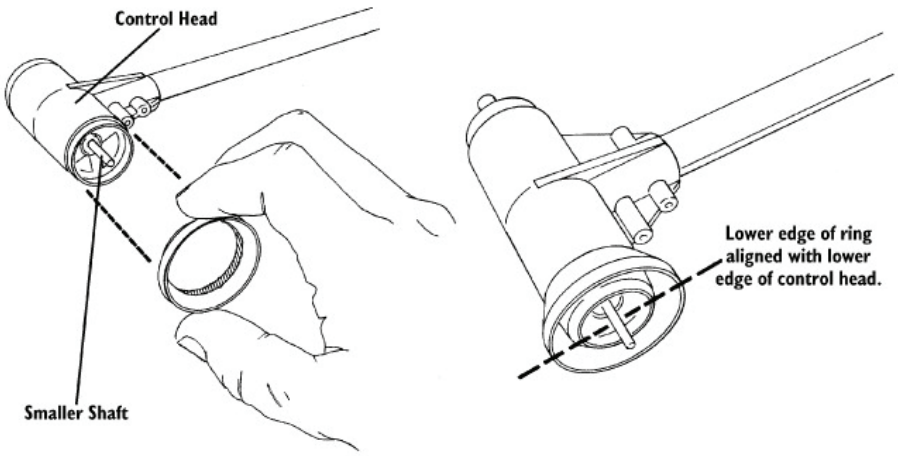


Figure 8: Installing the drip ring onto the anemometer control head

2. Attach the wind cups:

A. Push the wind cups onto the stainless steel shaft at the end of the arm (see Figure 9).

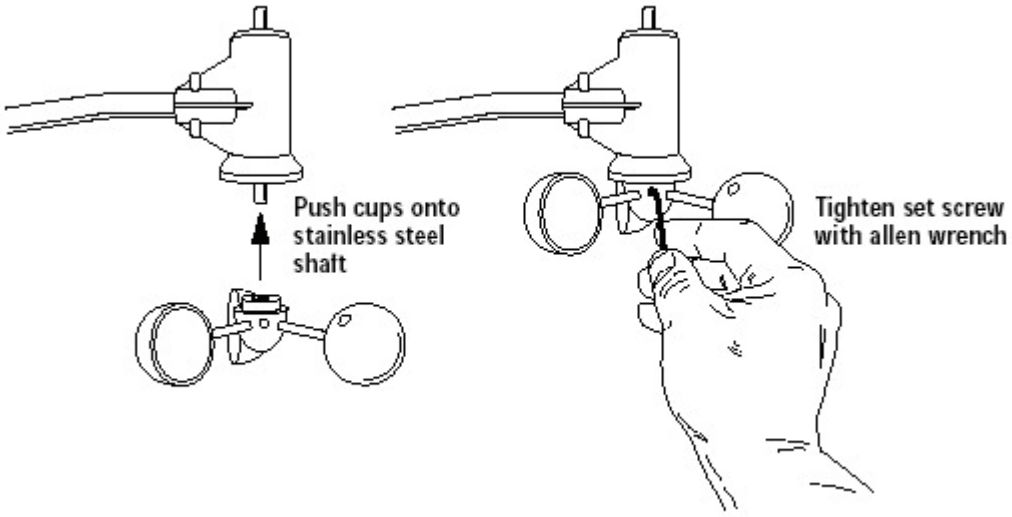


Figure 9: Installing the wind cups

B. Slide the wind cups as far up the shaft as possible.

C. Use the Allen wrench provided to tighten the setscrew on the side of the wind cups.

Note: When you let go of the wind cups, they should drop slightly.

D. Spin the wind cups. If they do not spin freely, loosen the setscrew and lower the cups slightly. Repeat until the wind cups spin freely.

3. Attach the Wind Vane:

A. Place the wind vane on the shaft (see Figure 10)

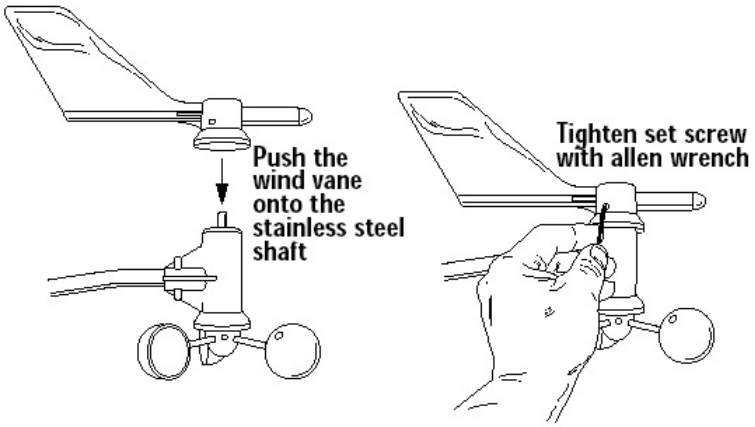


Figure 10: Installing the wind vane

B. Slide the wind vane down the shaft as far as it will go

C. Use the Allen wrench provided to tighten the setscrew on the side of the wind vane.

4. Check the Anemometer Base Orientation:

A. Insert the anemometer arm into the base

B. Attempt to push the #4-40 x 1 1/4” pan head screw through the holes in the arm and the base (see Figure 15).

3.2.7 Preparing to Install the Weather Station Components

For easy mounting we advise you to slide the Weather Station components (except for the main Weather Station box) over the tripod's extension tube before raising it to its maximum height. Slide the components in the following order:

1. First the **Solar Panel**: Slide the two Ω-bolts that are connected to the back of the solar panel box over the tripod’s extension tube

2. Next the **Radiation Shield**: Slide the two U-bolts at the back of the Radiation Shield's mounting bracket over the tripod's extension tube

3. Next the **Rain Collector**: Slide the two Ω-bolts at the back of the tray over the tripod's extension tube

3.2.8 Installing the Anemometer and the Antenna Shelf

1. Install the Anemometer Base:

A. Hold the anemometer base against the top end of the pipe and insert one U-bolt through the back of the base into the two lower holes in the base so that the U-bolts wrap around the pipe (see Figure 11)

B. Place a ¼ " lock washer and a ¼ " wing nut over each end of the U-bolt and tighten the wing nuts slightly

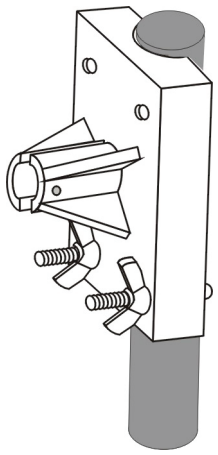


Figure 11: Installing the Anemometer base

C. Position the anemometer so that it will face the same direction as the solar panel (see section 3.2.9 on page 14 and Figure 16), then fasten the wing nuts tightly

D. Insert the other U-bolt through the back of the base into the two upper holes and then place the antenna shelf so it sits on top of the pipe with the U bolt passing through its holes (see Figure 12)

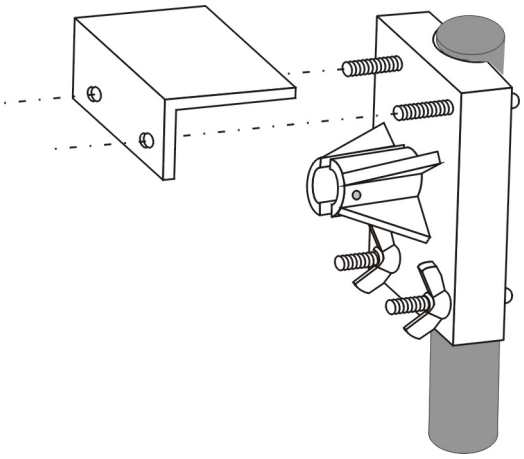


Figure 12: Installing the antenna shelf

E. Place a ¼” lock washer and a ¼” wing nut over each end of the U-bolt and tighten the wing nuts (see Figure 13)

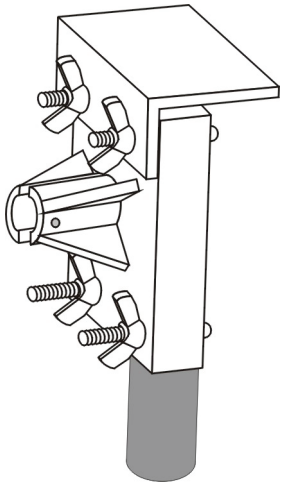


Figure 13: the anemometer base with the antenna shelf

2. Install the anemometer arm:

A. Insert the anemometer arm into the anemometer base. Guide the anemometer cable through the slot as you insert the arm (see Figure 14)

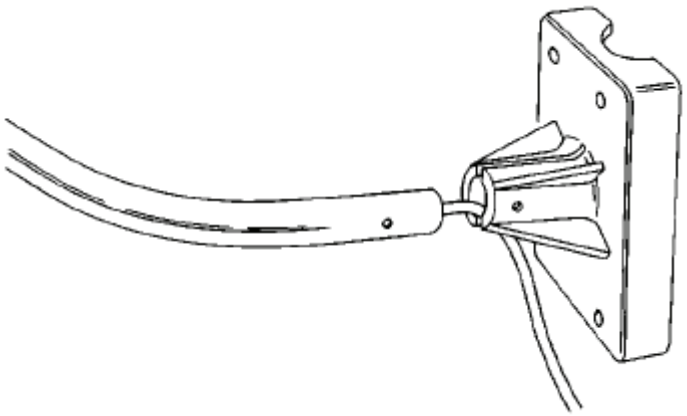


Figure 14: Inserting the anemometer arm to the base

B. Insert the pan head screw into one of the holes in the base and slide it through the arm. Secure the pan head screw using the flat washer, lock washer, and hex nut as shown in Figure 15

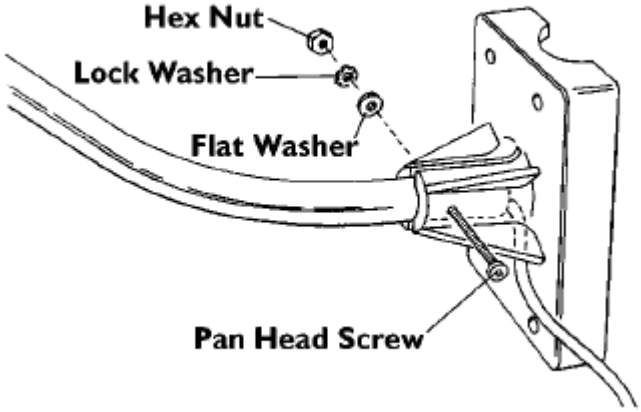


Figure 15: Attaching the anemometer arm to the base

3. Raise the extension tube to its maximal height and fasten tightly

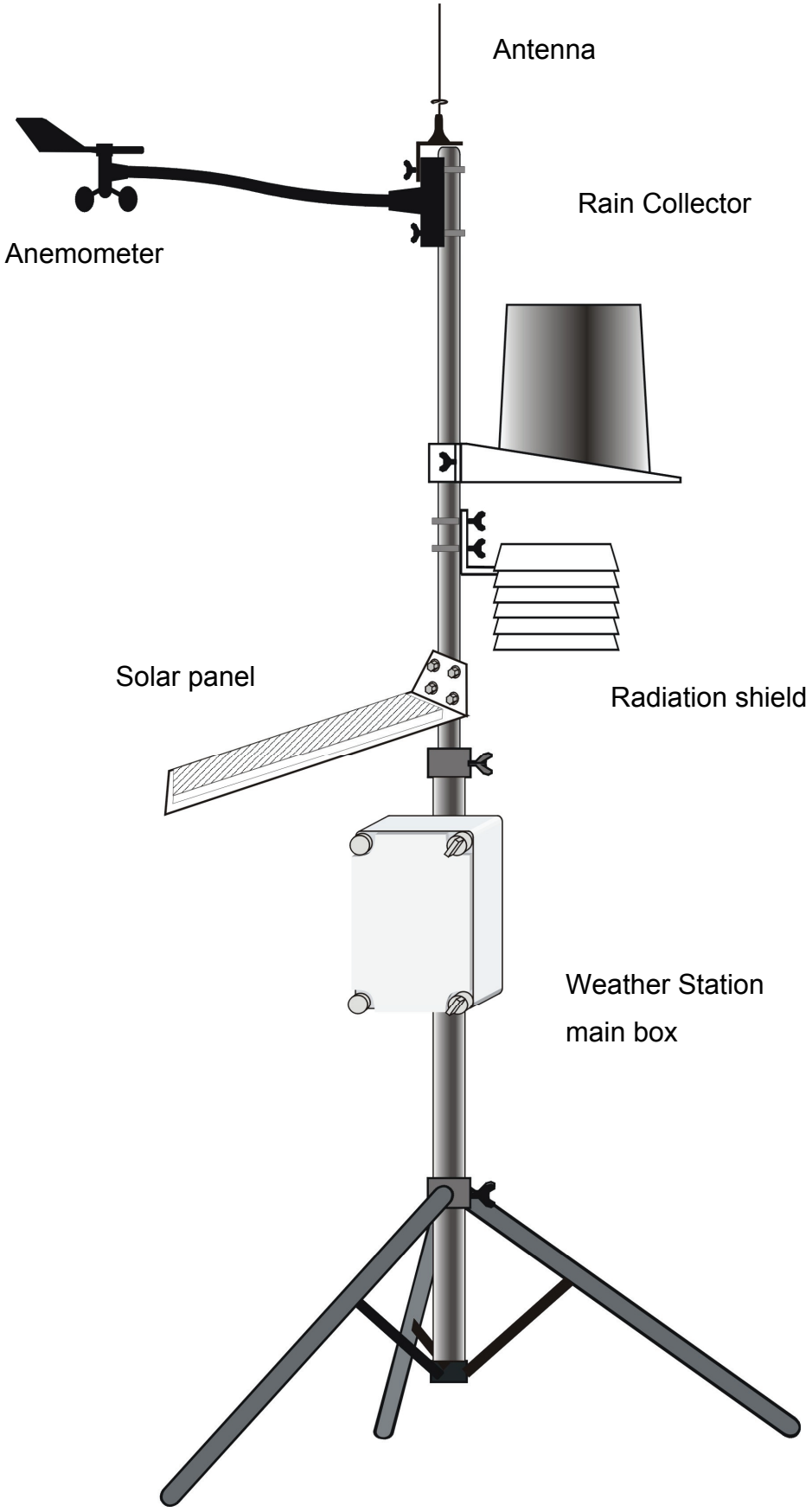


Figure 16: Mounting the Weather Station

3.2.9 Installing the Solar Panel

1. Install the solar panel facing south in the Northern Hemisphere and north in the Southern Hemisphere so it will be exposed to the sun

2. Position the solar panel about 3cm above the lower end of the extension tube (see Figure 16 on page 13) and tighten the four wing nuts.

3.2.10 Installing the Radiation Shield

Install the radiation shield so it sits opposite and above the solar panel (see Figure 16 on page 13)

1. Position the radiation shield's mounting bracket about 12cm above the solar panel. Make sure that the bottom of the radiation shield is just above the solar panel to ensure good ventilation

2. Tighten the four wing nuts

3.2.11 Installing the Rain Collector

Install the rain collector above the radiation shield (see Figure 16 on page 13):

1. Position the tray about 5cm above the radiation shield's mounting bracket and tighten the two wing nuts

2. Level the tray horizontally.

3.2.12 Installing the Antenna (Wireless Connection Only)

Place the magnet antenna on top of the antenna shelf (see Figure 16 on page 13)

3.2.13 Installing the Main Weather Station Box

1. Mount the Weather Station main box about 5cm beneath the top of the base tube (see Figure 16 on page 13) so it sits under the radiation shield

2. Unscrew the two Ω bolts from the back of the Weather Station main box

3. Hold the back of the Weather Station main box against the tripod's base tube, 5cm beneath the top

4. Place one Ω bolt so it wraps around the pipe and the two upper screws at the back of the box are inserted to the U-bolt holes

5. Place a ¼ ” lock washer and a ¼ ” wing nut over each screw and tighten the wing nuts slightly

6. Position the box so it sits under the radiation shield, then fasten the wing nuts tightly

7. Place the other Ω bolt so that the two lower screws are inserted into its holes

8. Place a ¼ ” lock washer and a ¼ ” wing nut over each screw and tighten the wing nuts

3.2.14 Wiring the Weather Station

Open the Weather Station main box: unscrew the two plastic screws on the upper and lower right sides of the box

Follow either the instructions in the next **wireless connection** section or in the **cable connection** section on page 18, depending on the communication option you intend to use

See also the wiring diagrams on page 22

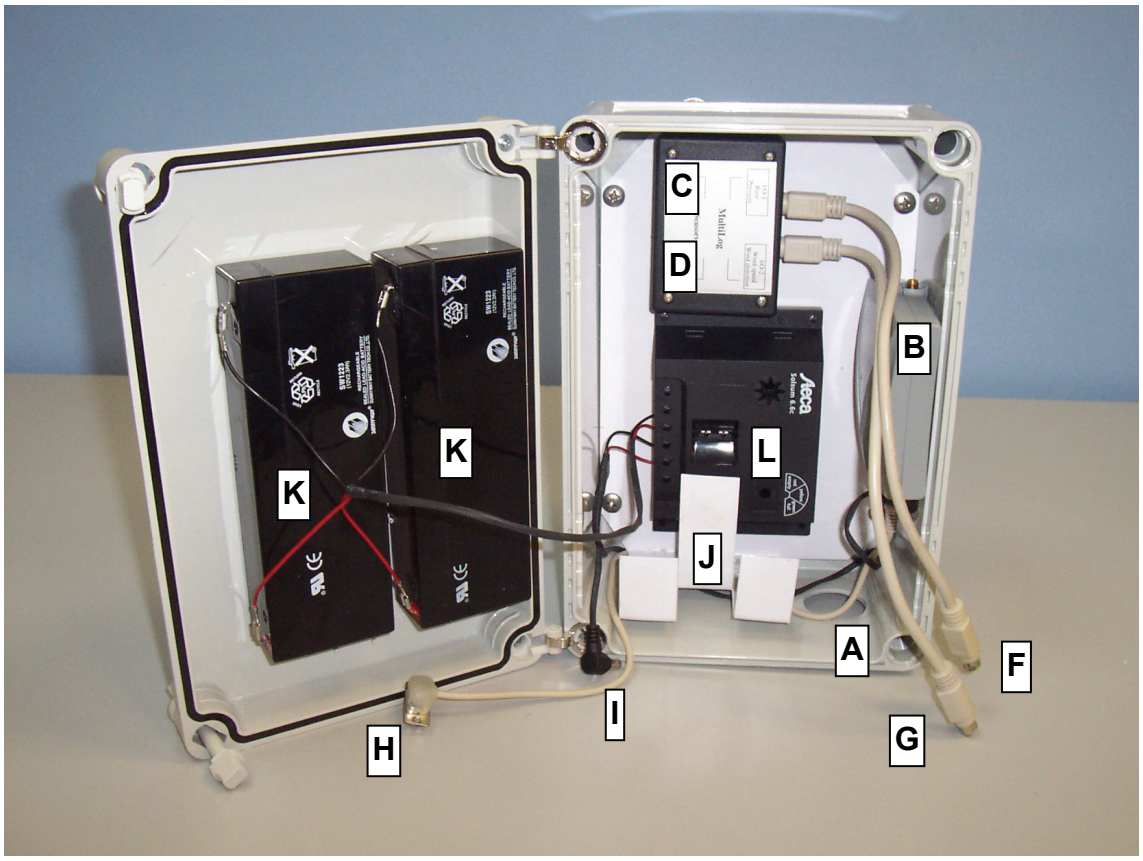


Figure 17: Wiring the Weather Station main box

A. Wireless Connection

1. Insert the antenna cable to the Weather Station main box through the hole at the bottom of the box (**A**) and connect it to the antenna socket (**B**) at the top of the transmitter (see Figure 17)

2. Insert the rain sensor cable to the Weather Station main box through the hole at the bottom of the box (**A**) and connect it, flat side out, to the rain socket (**C**) on the sensor adaptor (see Figure 17)

3. Insert the anemometer cable to the Weather Station main box through the hole at the bottom of the box (**A**) and connect it, flat side out, to the rain socket (**D**) on the sensor adaptor (see Figure 17)

4. Insert the solar panel cable to the Weather Station main box through the hole at the bottom of the box (**A**), connect the male lug

terminal to the female lug terminal of the charge controller cable, and then connect the female lug terminal to the male lug terminal of the charge controller cable

5. Connect the cables to MultiLogPRO:

A. Insert the humidity and temperature sensor cable from the radiation shield to the Weather Station main box through the hole at the bottom of the box (**A**) and connect it to input 3 (I/O -3) on top of MultiLogPRO

B. Connect the sensor cable (**F**) to input 1 (I/O-1) on top of MultiLogPRO

C. Connect the sensor cable (**G**) to input 2 (I/O-2) on top of MultiLogPRO

D. Connect the communication cable (**H**) from the transmitter to the COMM socket on the left side of MultiLogPRO (see Figure 17)

E. Connect the power cable (**I**) to the 9 -12V socket on the left side of MultiLogPRO (see Figure 17)

6. Place MultiLogPRO in its holder (J) in the Weather Station main box (see Figure 17 and Figure 18)

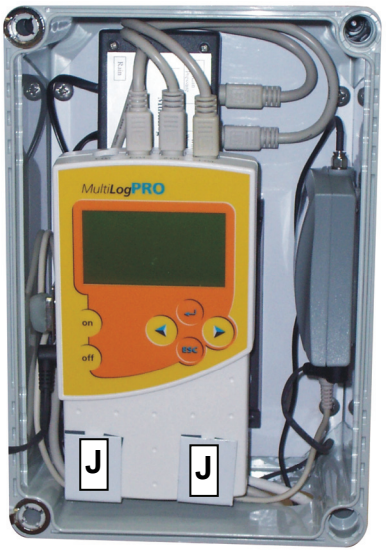


Figure 18: MultiLogPRO inside the Weather Station main box

7. Press the **on** button 

in MultiLogPRO's keypad to turn MultiLogPRO on

8. Wait until the main menu is displayed on MultiLogPRO's LCD screen, then press Enter  to begin transmitting data

Note: in wireless mode, transmission is only one way, and there is no way of programming or operating the MultiLogPRO via the software, therefore you **must** set the system to transmit data by pushing the **Enter** button on the MultiLogPRO itself.

9. Close the Weather Station main box and lock it by fastening the two plastic screws on the upper and lower right sides of the box

B. Cable Connection

1. Insert the rain sensor cable to the Weather Station main box through the hole at the bottom of the box (**A**) and connect it, flat side out, to the rain socket (**C**) on the sensor adaptor (see Figure 17)

2. Insert the anemometer cable to the Weather Station main box through the hole at the bottom of the box (**A**) and connect it, flat side out, to the rain socket (**D**) on the sensor adaptor (see Figure 17)

3. Insert the solar panel cable to the Weather Station main box through the hole at the bottom of the box (**A**), connect the male lug terminal to the female lug terminal of the charge controller cable, and then connect the female lug terminal to the male lug terminal of the charge controller cable

4. Connect the cables to MultiLogPRO:

A. Insert the humidity and temperature sensor cable from the radiation shield and connect it to input 3 (I/O -3) on top of MultiLogPRO

B. Connect the sensor cable (**F**) to input 1 (I/O-1) on top of MultiLogPRO

C. Connect the sensor cable (**G**) to input 2 (I/O-2) on top of MultiLogPRO

D. Connect the serial communication cable adaptor to the COMM socket on the left side of MultiLogPRO so that the other end of the cable will face the rear side of MultiLogPRO

Figure 19: Connecting the serial communication cable adaptor

E. Insert the male plug of the 30m serial communication cable to the Weather Station main box through the hole at the bottom of the box (**A**) and connect it to the serial communication cable adaptor

F. Connect the power cable (**I**) to the 9-12V socket on the left side of MultiLogPRO (see Figure 17)

5. Place MultiLogPRO in its holder (J) in the Weather Station main box (see Figure 17 and Figure 18)

6. Press the **On** button 

in MultiLogPRO's keypad to turn MultiLogPRO on

7. Wait until the main menu is displayed on MultiLogPRO's LCD screen, then press **Enter**  to begin sending data

8. Close the Weather Station main box and lock it by fastening the two plastic screws on the upper and lower right sides of the box

3.2.15 Programming MultiLogPRO

MultiLogPRO ships already programmed to the Weather Station default setup. When turned on it uploads the last setup. To operate the Weather Station in the default mode there is no need to program MultiLogPRO. You can, however, change the setup to meet your special needs. You can add or replace sensors, select another sampling rate and choose definite sampling period.

The Default setup			
Sensors:			
Input 1:	Rain	Input 5:	No sensor
Input 2:	Wind speed	Input 6:	Temperature
Input 3:	Humidity	Input 7:	Wind direction
Input 4:	No sensor	Input 8:	Pressure
Rate:	Every 10 seconds		
Operating mode:	Continuous		
Saving interval:	Every 15 minutes		

You can program MultiLogPRO either from the MultiLogPRO keypad (see page 59) or via the WeatherLab software (see pages 32 and 43).

Note: In wireless mode, transmission is one way only, from MultiLogPRO to the computer. Therefore if you are using wireless connection you need to connect MultiLogPRO to the computer with the supplied communication cable in order to program it

Setting up MultiLogPRO prior to operating it in a wireless connection

Note: If you wish to operate your Weather Station in its default mode there is no need to set MultiLogPRO up, simply proceed to Section 3.2.16 instructions

1. Disconnect MultiLogPRO from the Weather Station main box
2. Connect MultiLogPRO to the supplied AC – DC adaptor and plug the adaptor to the mains
3. Connect MultiLogPRO to the computer with the supplied communication cable
4. Turn on MultiLogPRO by pressing the **On** button on MultiLogPRO keypad
5. Open WeatherLab
6. Setup the Weather Station (see on page 32)
7. Wait until setup is complete
8. Disconnect MultiLogPRO from the mains and from the computer and replace it in the Weather Station main box

3.2.16 Connecting the Weather Station to the Computer

A. Wireless Connection

Connect the receiver to the computer (see Chapter 6 on page 80 to learn more about the receiver):

1. Place the receiver near the computer and connect the serial communication cable:

A. Connect the stereo phone jack to the **RS-232** socket at the bottom of the receiver

B. Connect the type D 9-pin plug to an available serial COM port on your PC

Note:	The serial COM ports are usually located at the back of the computer. Look for a 9 pin D type male socket that matches the female plug of the 30m serial cable.

2. Connect the AC/DC adaptor to the **9-12V DC** socket at the bottom of the receiver and plug the adaptor into the mains.

B. Cable Connection

3. Connect the female plug of the 30m serial cable from MultiLogPRO to an available serial COM port on your computer

Note:	The serial COM ports are usually located at the back of the computer. Look for a 9 pin D type male socket that matches the female plug of the 30m serial cable.

3.2.17 Wiring Diagram

The two diagrams below show the schematic wiring of the Weather Station. Figure 20 shows the power wiring and Figure 21 shows the communication wiring.

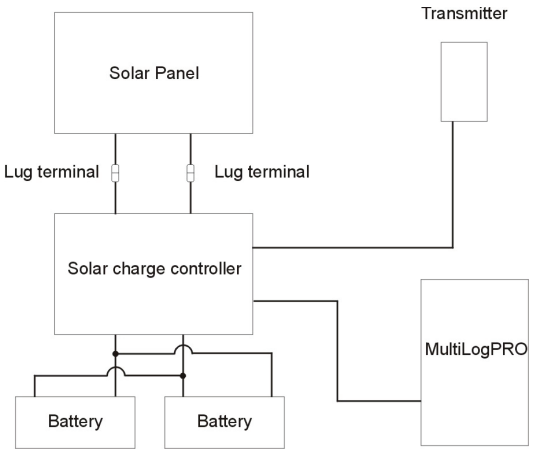


Figure 20: Power connections

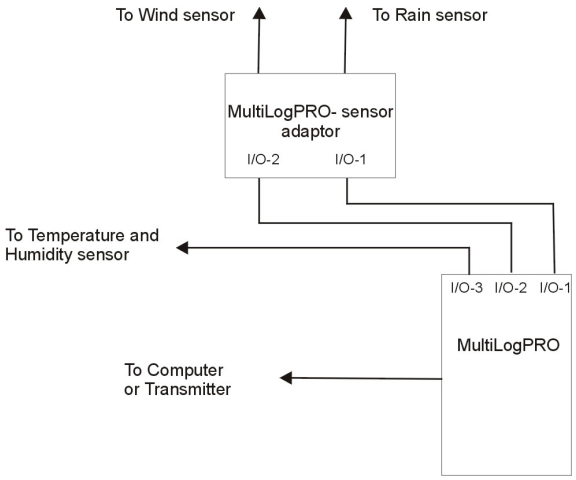


Figure 21: Communication connections

3.3 Powering the Weather Station

The Weather Station is powered by solar energy. To ensure continuous operation even in continuous cloudy weather conditions, the Weather Station is powered with two parallel 12V 2.3Ah rechargeable sealed lead-acid batteries (see **K** in Figure 22)

The batteries are charged by a high power solar panel via a solar charge controller (see **L** in Figure 22) that provides discharge and overcharge protection

The batteries and the controller are located inside the Weather Station main box. In order to reach the controller open the Weather Station box and remove MultiLogPRO.

The Controller Display

The controller contains a green LED (**N**) and a LED (**P**) which can change its color from red via yellow to green in ten different colors. The green LED is on as soon as there is energy from the module. When the controller starts to limit the charge current, this LED is flashing. The LED which can change its color shows the voltage by its color. Red color signifies that the batteries are empty. Green means that they are full.

Before the load is switched off, the LED starts to flash fast. When the load is switched off, the LED flashes slowly.

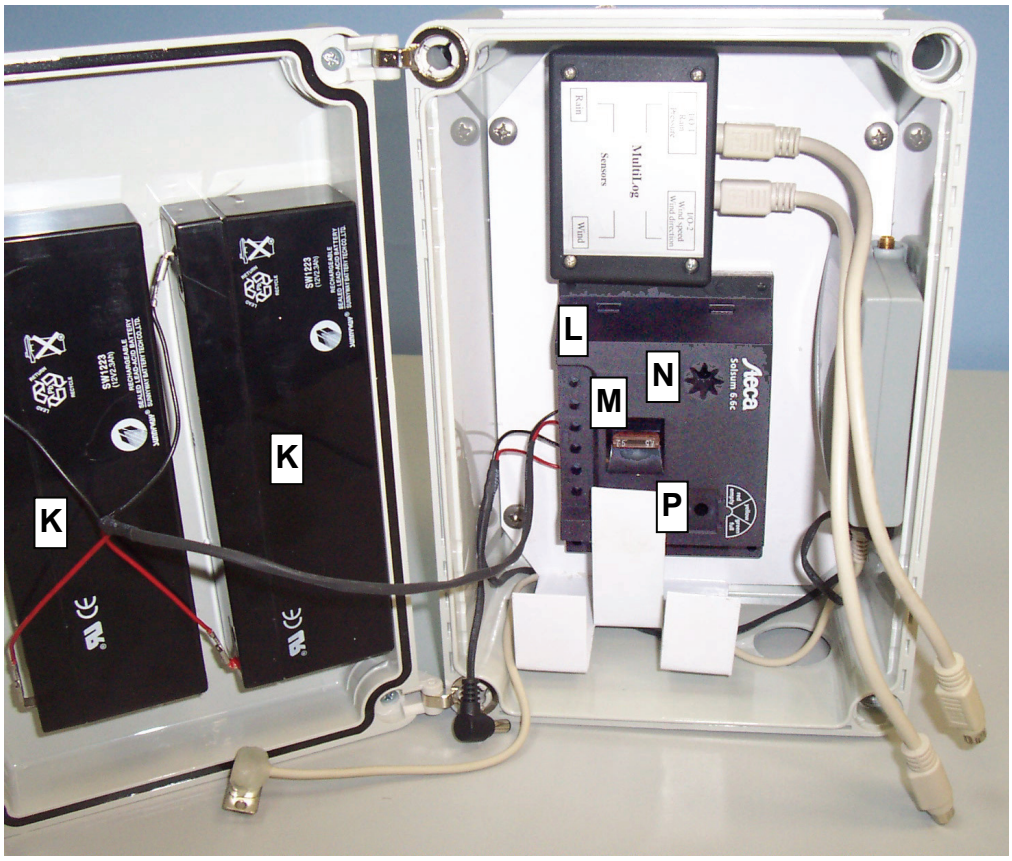


Figure 22: The Weather Station batteries and charge controller

The controller is protected by a 7.5A fuse (**M**).

4 Working with WeatherLab

4.1 Install the Software

4.1.1 System Requirements

To work with WeatherLab your system should be equipped with the following:

Software

- Windows 98™ or later
- Internet Explorer 5.0™ or later (you can install Internet Explorer 5 when you install WeatherLab, since it ships with the product)

Hardware

- Pentium™ III 600MHz or higher
- 64 MB RAM (128 MB recommended)
- 10 MB available disk space

4.1.2 Installation

Uninstalling WeatherLab

Before installing your new version of WeatherLab, uninstall any older versions of the program.

Note: Uninstalling removes program files only – station archive files or data files you created in WeatherLab will remain on your system.

To uninstall the software:

1. From the Start menu select **Settings** then click **Control Panel**,
2. Double click **Add or Remove Programs**
3. From the list of program that you can remove select **WeatherLab**
4. Click **Change/Remove**
5. Select the **Remove** option, then click **Next**
6. At the prompt, click **OK** to confirm that you want to remove WeatherLab

To install WeatherLab

1. Close all programs
2. Insert the CD labeled WeatherLab into your CD-ROM drive
3. Installation will begin automatically. Simply follow the on-screen instructions to continue
4. Follow the on-screen instructions. In the customer information dialog make sure that the install for all users option is selected

Note to Windows XP or 2000 users: WeatherLab needs to modify its folder when running. Ask your system administrator for permission to gain access to all files in WeatherLab folder

In case **auto run** is not working, open **My Computer** and click on the CD drive folder (**d:** drive in most cases) and double-click on the setup icon, then proceed as above.

To install the USB driver
(Needed in case you connect MultiLogPRO or the receiver to the computer via a USB port)

Windows XP

1. Connect the MultiLogPRO to a USB port on your PC and turn the unit on. Windows will automatically detect the new device and open the **Found New Hardware Wizard.**
2. Select the **No, not this time** to prevent Windows from searching for software on the Internet, then click **Next.**
3. Insert the CD labeled WeatherLab into your CD drive
   Windows will automatically detect and copy the necessary files to your system.
4. Click **Finish.**
   Windows will open the **Found New Hardware Wizard** for the second time.
5. Click **Next** to complete the installation.
   Windows will automatically install the necessary components on your system.
6. Click **Finish**.

Older versions of Windows

1. Insert the CD labeled WeatherLab into your CD drive. If Installation begins automatically (and you have already installed WeatherLab), click Cancel to stop installation.
2. Connect the MultiLogPRO to a USB port on your PC and turn the unit on. Windows will automatically detect the new device and open the **Found New Hardware Wizard**.
3. Select **Specify the location of the driver**, and then click **Next**.
4. Select **Search for the best driver for your device**, then check the **Removable Media** checkbox, and then click **Next**.

Windows will automatically detect and copy the necessary files to your system.

5. Click **Finish.**
   Windows will open the **Found New Hardware Wizard** for the second time.
6. Click **Next** to complete the installation.
   Windows will automatically install the necessary components on your system.
7. Click **Finish.**

4.2 Overview

WeatherLab is a comprehensive program that provides you with everything you need in order to collect data from the Weather Station, display live and archive data in graphs, tables and meters, analyze data as well as print or export the data to a spreadsheet.

The program includes two main screens:

- Online screen that monitors live data from the station in up to eight simultaneous graphs and meters including calculated parameters: Daily, monthly and yearly rainfall ,daily minimum and maximum temperatures, wind gusts, dew point, wind chill and heat index.
- Offline screen in which you can display and analyze station archive data in single or multiple graph views, in table or export data to Excel.

The most commonly used tools and commands are displayed on three toolbars. Tools that relate to all aspects of the program and tools that control the MultiLogPRO are located in the main (upper) toolbar. Tools specific to the Online and Offline screen are located on the corresponding toolbars at the bottom of the screen.

The **Logger** menu handles all communication between the computer and MultiLogPRO such as programming the desired operating mode, starting or stopping data recording, as well as downloading the data.

Note: In wireless mode, transmission is only one way, and there is no way of programming or operating the MultiLogPRO via the software, therefore you need to connect MultiLogPRO to the computer with the supplied communication cable in order to program it. And you **must** set the system to transmit data by pushing the **Enter** button on the MultiLogPRO itself.

The **View** menu, **Online** menu and **Offline** menu control the various data display and formatting options.

The **File** menu contains all the commands needed to manage station settings and archive.

4.3 Getting Started

4.3.1 Establish Communication with the Weather Station

1. Run WeatherLab

2. Click **Online view**  on the main toolbar

If WeatherLab detects data coming from MultiLogPRO, it automatically displays the data in the meters and graphs and your Weather Station is ready and operating.

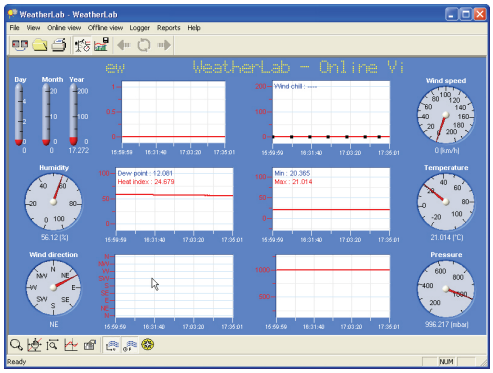


Figure 23: Active online screen

If the meters and graphs remain inactive you must tell WeatherLab to which port the Weather Station is connected

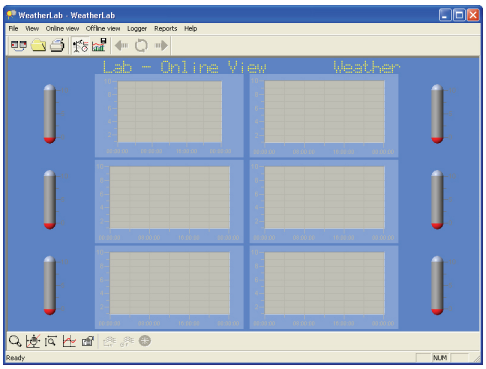
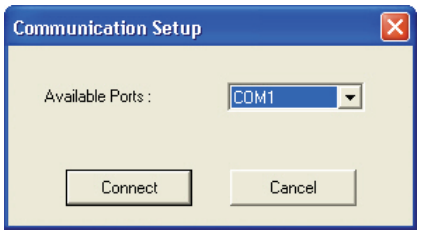


Figure 24: Inactive online screen

3. Click **Logger** on the menu bar, and then click **Comm setup** to display the communication setup dialog:



4. Select the correct port from the **Available Ports** drop list, then click **Connect**

4.3.2 Operating Modes

Fourier Systems' Weather Station offers two operating modes:

Continuous Run

This is the default operating mode.

Data is saved automatically to the computer (The WeatherLab software must be running continuously).

The user sets the saving intervals and the sampling rate (see on page 32).

The saved data is the average of all samples that were recorded since the previous save, except the wind direction and rainfall.

In this mode the MultiLogPRO does not save data, and can keep logging as long the station is running.

Stand-alone experiment

Use this mode if you want to operate the Weather Station in a remote outdoor location.

Data is saved in the MultiLogPRO.

In this mode the recording time is restricted by the sampling rate and the logger memory (104,000 samples).

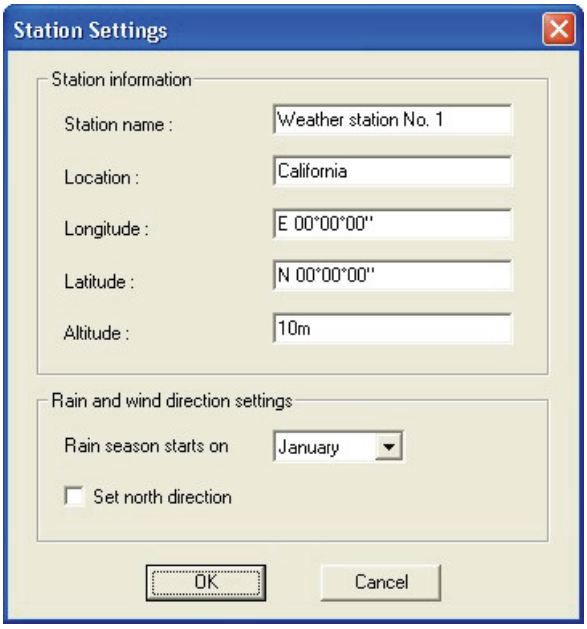
To operate a stand-alone experiment:

1. Connect the Weather Station to a computer and run the WeatherLab.
2. Click **Logger** on the menu bar, and then click setup to open the **Setup** dialog.
3. In the operating mode box select **Individual experiment**.
4. In the **Rate** box, select the desired rate.
5. Click **OK**.
6. Click **Logger** on the menu bar, and then click **Run**.
7. You can now disconnect the computer from the station.
8. When logging ends, connect the Weather Station to the computer, click **Logger** on the menu bar, and then click **Download** to download the data to the computer.

4.3.3 Station Settings

Use the station settings dialog to enter station name and location, to select rain season starting month and to calibrate the station to the north

1. Click **File** on the menu bar, and then click **Station Settings** to open the Station Settings dialog:



2. Enter station information: Name, location, longitude, latitude and altitude in the corresponding boxes

3. Select rain season starting month in the Rain season starts on drop list. The yearly rainfall total will be calculated from the first day of the month selected

4. To calibrate the wind direction sensor to the north for the next time you run the station, check the **Set north direction** check box

5. Click **OK**

4.3.4 Setup the Weather Station

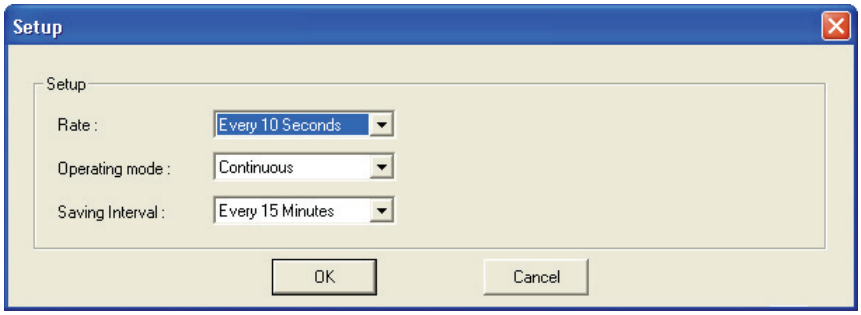
Use the Setup dialog to select operating mode, recording rate and saving interval. For more advanced settings see **Customize your Weather Station** on page 43

To setup your station to the default setup

1. Connect the MultiLogPRO to the PC and turn it on.

2. Click **Logger** on the menu bar, and then click **Setup**.

The setup dialog opens with the default setup:



3. Click **OK** to complete the default setup.

To change the setup:

Rate

Select the desired sampling rate in the **Rate** drop list

Operating mode

Select the desired operating mode in the **Operating mode** drop list

Saving Interval

Select the time interval between two successive savings (in continuous mode only) in the **Saving Interval** drop list

Except for the rainfall, the wind direction, the wind gust and the minimum/maximum temperatures, WeatherLab saves an average of all the samples in a given saving interval.

Wind direction calibration

Before you begin collecting data you should calibrate the Wind direction sensor:

1. Use the compass to point the wind vane to the north. Fix its position with a strip of masking tape.

2. Make sure that WeatherLab is in running and that the Weather Station is connected to the computer.

3. Click **File** on the menu bar, and then click **Station settings**.

4. Check the **Set north direction** check box, and then click **OK**.

5. Click **Logger** on the menu bar, and then click **Run**.

   WeatherLab begins data collection and sets the current wind direction to north.

6. Remove the masking tape from the wind pane.

4.3.5 Start Recording

Click **Logger** on the menu bar, and then click **Run**.

Note: Running MultiLogPRO from WeatherLab is available only in cable connection. If you are operating the Weather Station in wireless connection you must run MultiLogPRO from its keypad.

4.3.6 Stop Recording

Click **Logger** on the menu bar, and then click **Stop**.

Note: Stopping MultiLogPRO from WeatherLab is available only in cable connection, if you are operating the Weather Station in wireless connection you must stop MultiLogPRO from its keypad

4.3.7 Saving Data

Continuous mode

There is no need to save data manually as the data is saved automatically every saving time interval in the station archive folder. The default folder location is: C:\Program Files\Fourier Systems\WeatherLab\Station archive WeatherLab creates a new data file every 24 hours at midnight.

Stand-alone experiment mode

1. After logging ends connect the MultiLogPRO to the computer.

2. Click Logger on the menu bar, and then click **Download**.

3. After downloading is completed, WeatherLab displays the data on the offline graph and prompts to **Save as…** dialog.

4. Enter a new name in the **File name** box.

5. To save the data in a different folder, select a drive and/or folder from the **Save in** box.

6. Click **Save**.

File Location

To select file location:

1. Click **File** on the menu bar, then click **Stored data folder…**

2. To change the file location, click **Browse** and navigate to the desired folder.

3. Click **OK**.

4.3.8 Open Files

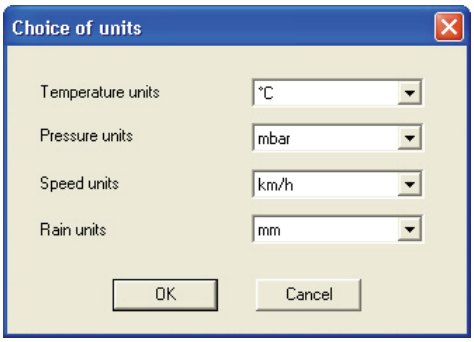
You can open and display station archive files or files that were saved as single experiment files. The data can be displayed in Offline graph screen or in table format (see on page 38)

4.3.9 Change Units Settings

WeatherLab allows you to change the temperature, pressure, wind speed and rainfall units.

To change units:

1. Click **File** on the menu bar, then click **Choice of units**



2. Select the desired units

3. Click **OK**

4.3.10 Print

Print a graph

1. Click **Print**  on the main toolbar.
2. Select the **Graph** option.
3. Click **Print** to open the print dialog box.
4. Click **OK**.

   WeatherLab will print exactly what is seen in the graph display.

Print a table

1. Click **Print**  on the main toolbar.
2. Select the **Table** option.
3. If you want to print only a specific range, uncheck the **Print all data** check box and type the desired row numbers into the **To** and **From** edit boxes.
4. Click **Print** to open the Print dialog box.
5. Click **OK**.

4.4 View the Data

4.4.1 Display Screens

WeatherLab has two display screens.

If you want to display the current weather conditions use the **Online** view.

If you want to browse the station archive, to display data over a certain time span and to analyze it use the **Offline** graph view.

In Offline View WeatherLab is still recording and saving data in the background.

You can switch between the display modes at any time.

- To switch to Offline view click **Offline view**  on the main toolbar.
- To switch to Online view click **Online view**  on the main toolbar.

4.4.2 Online View

The default **online** screen consists of six graphs and six meters, one for each of the six sensors: Temperature, Humidity, and Pressure, Wind speed, Wind direction and Rain.

The rainfall meter displays daily, monthly and yearly bars. You must define the starting month of the yearly rainfall measurements in the **Weather Station Settings** menu (see on page 32)

The daily minimum and maximum temperatures are displayed on the temperature graph.

The calculated dew point and heat index are displayed on the humidity graph.

The calculated wind chill and the wind gusts are displayed on the wind speed graph.

There are three options to display the wind direction. The most frequent data, the wind vector or the wind rose:

- Click **Wind direction frequency** on the lower toolbar to display or remove the most frequent direction graph.
- Click **Wind direction vector** on the lower toolbar to display or remove the direction vector graph.
- Click **Wind rose** on the lower toolbar to display or remove the wind rose

The graphs and the meters are updated every time a new sample is recorded. The meters show the last data sample and the graphs display the last 24 hours of data.

4.4.3 Offline View

Click **Offline view** on the main toolbar to switch to the Offline screen

1. Open data that was saved in Continuous Mode

A. Click **Open by date** on the main toolbar to display the Open by date dialog box:

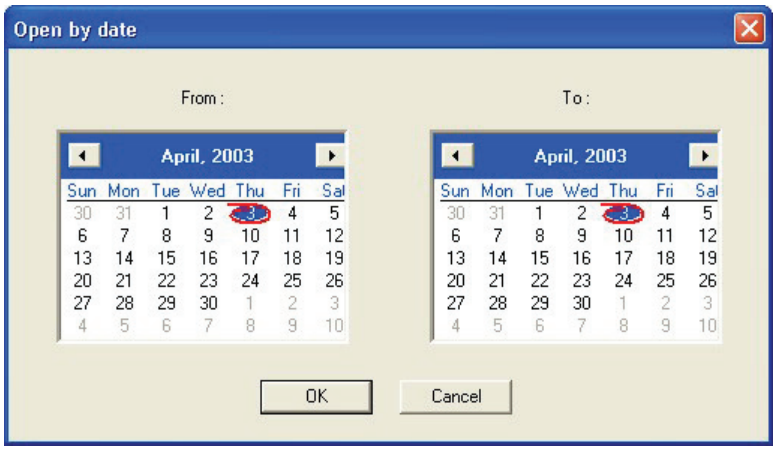


Figure 25: Open station archive

B. Select a date in the **From** box.

C. Select a date in the **To** box.

D. Click **OK**.

WeatherLab will load all the data between the dates you selected and display it in graph or table display.

2. Open data that was saved as an Individual Experiment

A. Click **Open**  , on the main toolbar to open the **Open** dialog box

B. Select a file.

C. Click **OK**.

4.4.4 Display Options

- **One Graph display** – The defaults display can display all, or some of the sensor's data in one large window.
- **Four Graphs display** – Displays the data in four separate graph windows.
- **Table** – The data is displayed in a table.

4.4.5 One Graph Display

Click **One graph display**  on the lower toolbar to switch to the one graph display.

1. What data to display?

When you open data, WeatherLab displays all the data sets in one graph. However you can choose any combination of sensors to display.
Click on any of the sensors buttons at the bottom of the graph to display or clear the sensor's data.

Use the **Clear** button  at the bottom of the graph to clear all the data sets from the display.

Use the **Cursor**  to select a plot and to reveal its y-axis.

2. Time span

When you display data using the **Open by date** dialog you determine the time span of the time axis. You can change this anytime:

A. Click **Offline** on the menu bar, point to **Time span** and then select the desired time span.

B. WeatherLab will display data from the selected time span starting from the date that is currently displayed at the left side of the graph.

C. Click **Next 24** hours  to scroll the display one day forward or click **Previous 24 hours**  to scroll the display one day backward.

3. Rain bars

Click **Display rain bars**  to display the rainfall in daily rain bars

4.4.6 Four Graph Display

If you want to view a large number of data series simultaneously you may find it convenient to use the four graph display.

Click **Four graph display**  on the lower toolbar to switch to one graph display

The data series are grouped in four separate graphs with identical time axis.

To change the data that is being displayed in any graph:

Right click on the right or left y-axis end select an axis title from the popup list

The cursor, the zoom tool and the panning tool are active and operate the same as in the one graph display.

4.4.7 Table

Click on the **Table** button  to display the data in table.

4.4.8 The Cursor

Use the cursor to view individual data recording values, or to reveal a hidden Y-axis.

To display the cursor, double click on an individual data point or click **Cursor**  on the graph toolbar. You can drag the cursor with the mouse to any other point on the plot, or to another plot altogether.

The point coordinates of the selected data recording will appear at the bottom of the graph window.

To remove the Cursor, click **Cursor** a second time.

4.4.9 Zooming and Panning

The zoom tool

A. To zoom into a specific area

Click **Zoom to selection**  on the graph toolbar and drag the cursor diagonally to select the area you want to magnify. Release the mouse button to zoom into the selected area.

Click **Zoom to selection** a second time to disable the zoom tool.

B. Autoscale

Click **Autoscale**  on the graph toolbar to view the full data display, or double click on an axis to autoscale that axis alone.

C. The stretch/compress axis tool

Move the cursor onto one of the graph axes. The cursor icon changes to the double arrow symbol (↔), indicating that you can stretch or compress the axis scale. Drag the cursor to the desired location. Repeat the procedure for the other axis if necessary.

Click **Autoscale**  to restore auto scaling.

Panning

Use the pan tool after zooming in to see any part of the graph that is outside the zoomed area.

To do this, click **Pan**  on the graph toolbar, then click anywhere on the graph and drag the mouse to view another area.

Click **Pan** a second time to disable the Pan tool.

4.4.10 Format the Graph

You can change the data line's color and width.

1. Click **Graph properties**  on the Lower toolbar to open the Graph properties dialog box

2. Select the plot you want to format in the **Select plot** drop list.

3. Select color in the **Color** drop list

4. Select Weight in the **Weight** drop list

5. Click **OK.**

4.4.11 Export Data to EXCEL

In Offline view click **Export to Excel**  to export the currently open data to an Excel spreadsheet.
WeatherLab will open a new Excel workbook displaying the data.

Export file settings
If WeatherLab fails to export the data properly, try to change the export file settings:

1. Click **File** on the menu bar, then click **Export file settings**

2. Check the **Ignore regional settings** check box

3. Click **OK**

4.4.12 Copy the Graph as a Picture

You can copy the offline graph to the clipboard as a picture and then paste it to other Windows programs such as Word or PowerPoint™:

1. Click **Offline view** on the menu bar, then click **Copy graph**.

2. Open the destination file.

3. In the destination file, right click and select **Paste**.

4.5 Customize your Weather Station

Use the Advanced mode to customize your weather station. In this mode you can change the meter styles and format the graphs. In this mode WeatherLab also enables you to replace the existing sensors with other Fourier sensors connected to the station or define and use other vendors' sensors. You can also calibrate the sensors for more accurate requirements.

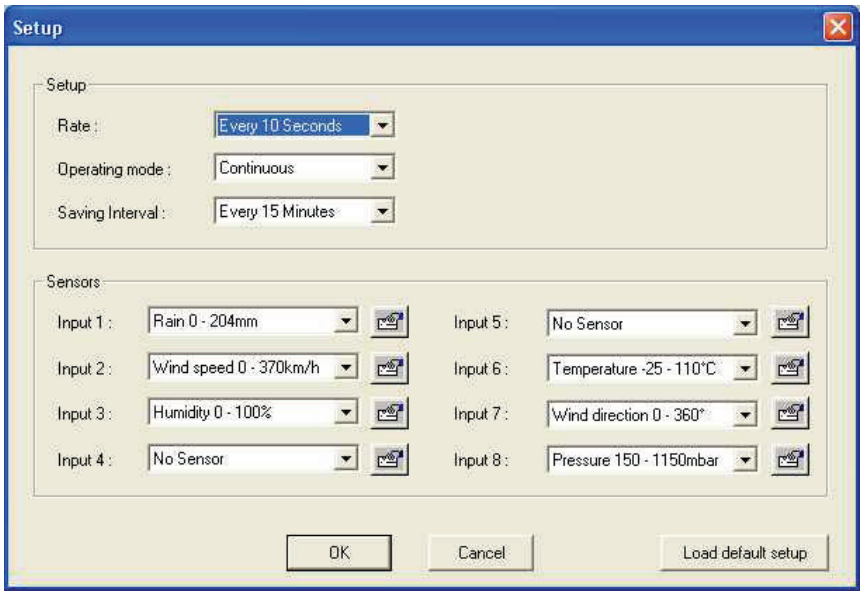
4.5.1 Advanced Mode

To switch to advanced mode:

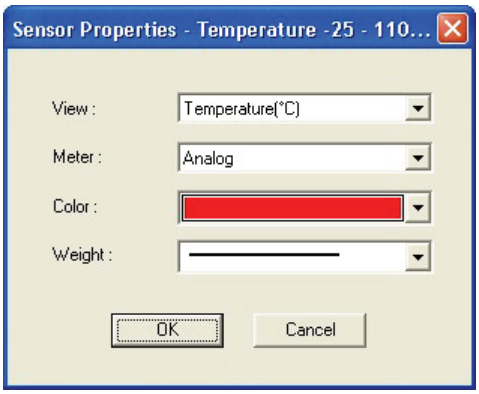
1. Click **File** on the menu bar, then click **Advanced mode** to check it.
2. Click **Logger** on the menu bar, then click **Setup** to open the Advanced setup dialog
3. To return to normal mode click **Advanced mode** a second time to uncheck it.

4.5.2 Change Sensor Properties

1. Click **Logger** on the menu bar, and then click **Setup** to open the Advanced setup dialog:



2. Click **Properties**  next to a sensor input box to open the **Sensor Properties** dialog:



3. Select meter type in the **Meter** drop list

4. Select line color in the **Color** drop list

5. Select line weight in the **Weight** drop list

6. Click **OK**

4.5.3 Use other Fourier Sensors

1. Connect the sensor to MultiLogPRO

2. Click **Logger** on the menu bar, then click **Setup**

3. Select the sensor in the corresponding input box from the drop list

4. Click **OK**

4.5.4 Define a New Sensor

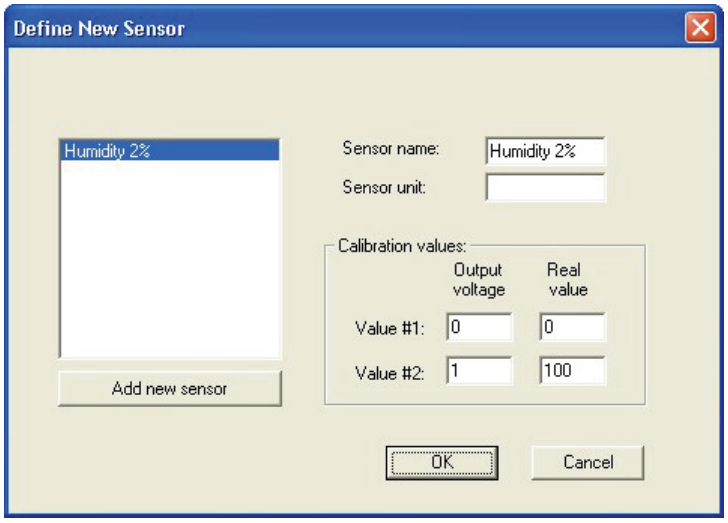
Any additional sensor that you would like to connect to MultiLogPRO must comply with the following restrictions:

1. The sensor's output must be greater than or equal to 0V and less than or equal to 5V. Remember that all sensors transform actual data into electrical data, so the electrical output should remain between 0 and 5 volts.

2. The sensor Transfer Function (sensor output voltage changes vs. the sampled phenomenon changes) must be a linear Transfer Function.

To define a new sensor:

1. Connect MultiLogPRO to the computer.
2. Select **Define New Sensor** from the **Logger** menu to open the **Define New Sensor** dialog box:



3. Click **Add New Sensor.**
4. Type in the sensor name and a sensor unit.
5. Type in two calibration values (two real values and the corresponding output voltages of the sensor).
6. Click **OK**.

WeatherLab adds the new sensor to the sensor list and sends the definitions to MultiLogPRO.

4.5.5 Calibrate Sensor

1. Connect the MultiLogPRO to the PC.
2. Select the **Calibrate Sensors** option from the **Logger** menu.
3. Choose a sensor from the **Sensor** drop list.

4. Enter a distinct real value in each of the **Real Value** edit boxes and the corresponding measured values in each of the **Measured Value** edit boxes (The measured values are the values displayed by WeatherLab when measuring the two real values.

5. Click **OK**.

The calibrated sensor parameters will be saved, so there is no need to calibrate the MultiLogPRO every time you run the WeatherLab program.
To reset to the default calibration for any sensor, select the sensor and click **Restore defaults**.

4.6 Monthly Reports

WeatherLab can produce monthly climatological reports.

4.6.1 About Monthly Reports

The report heading includes date and general information about the Weather Station.
The main part of the report is a table with daily data. Each row of the report's table displays information about a single day of the month. The bottom row shows monthly averages or sums.
The third part summarizes monthly temperature and rainfall level data.

The daily information includes:

- **Day**: The date for each row appears
- **Temperature**
  - **Mean**: The mean temperature of the day

At the bottom of the column, the mean temperature for the month is displayed.

  - **High**: The maximal temperature of the day
  - **Time**: The time at which the maximal temperature occurred

At the bottom of these two columns, the highest temperature recorded during the month and the day on which it occurred are displayed.

  - **Low**: The minimal temperature of the day
  - **Time**: The time at which the minimal temperature occurred

At the bottom of the columns, the lowest temperature recorded during the month and the day on which it occurred are displayed.

- **Heat Deg Days**: The number of heating degree-days accumulated on each day

At the bottom of the column, the total heating degree-days accumulated during the month is displayed.

- **Cool Deg Days**: The number of cooling degree-days accumulated on each day

At the bottom of the column, the total cooling degree-days accumulated during the month is displayed.

- **Rain Fall**: The rainfall accumulated on each day

At the bottom of the column, the total rainfall accumulated during the month is displayed.

- **Wind Speed**
    - **Avg**: The average wind speed for each day

At the bottom of the column, the average wind speed of the month is displayed.

    - **High**: The maximal wind speed for the day
    - **Time**: Time at which the maximal wind speed occurred

At the bottom of the columns, the highest wind speed recorded during the month and the day on which it occurred are displayed.

- **Dom Dir**: The dominant wind direction for the day

At the bottom of the column, the dominant wind direction recorded during the month is displayed.

At the bottom of the report, the following monthly information about temperature and rainfall levels is summarized (the levels can be changed by the user via the report settings dialog):

- **Max >= 90**

The number of days on which high temperature was 90° F (32.2°C) or above

- **Max <= 32**

The number of days on which high temperature was 32° F (0°C) or below

- **Min <= 32**

The number of days on which low temperature was 32° F (0°C) or below

- **Min <= 0**

The number of days on which low temperature was 0° F (-17.8°C) or below.

- **Max Rainfall**

The maximum rainfall on any single day during the month

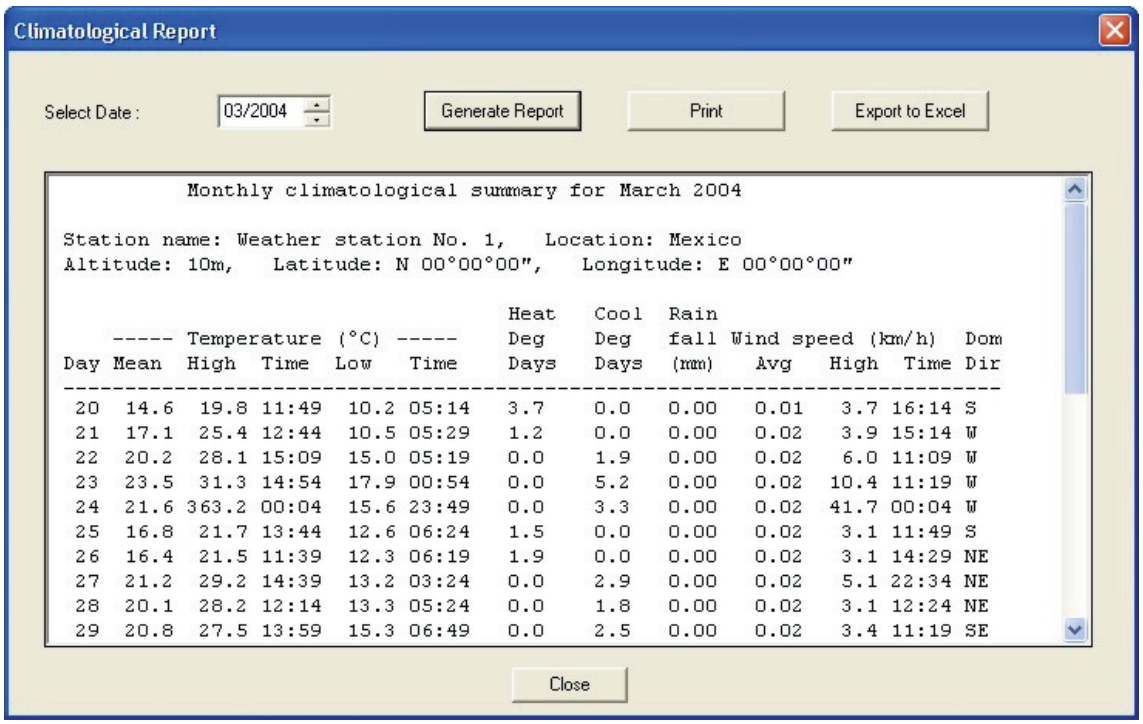
- **Days of Rain**

The number of days on which rainfall exceeded 0.01" (0.2 mm), 0.1" (2 mm), or 1" (20 mm) are displayed

4.6.2 Generating a Monthly Report

1. Click **Reports** on the menu bar, then click **Generate monthly report**

2. Select the desired month and year in the Select Date box, then click **Generate Report**



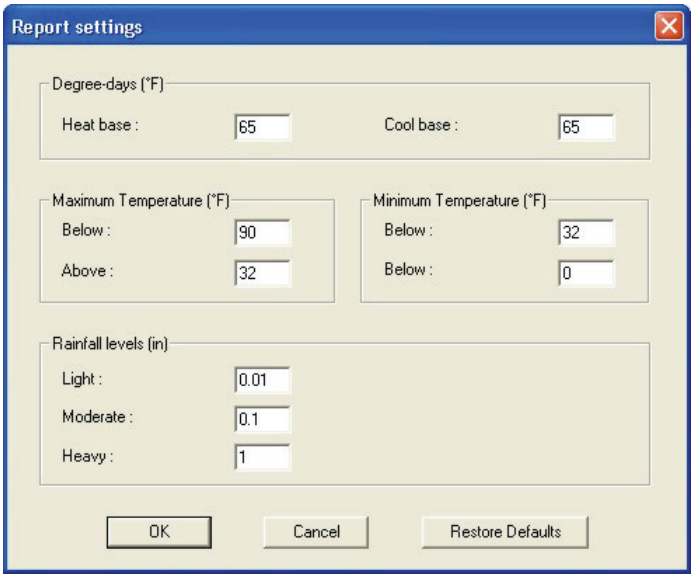
- To print the report click **Print**
- To export the report to excel click **Export to Excel**
- To close the report click **Close**

4.6.3 Report Settings

WeatherLab allows you to change the monthly report parameters.
You can change the heat and cool degree-days thresholds, the hot and cold temperature levels and the rainfall levels.
To change the report settings:

1. Click **Reports** on the menu bar, then click **Report settings**

2. Enter the new parameters, then click **OK**



To restore the defaults parameters click **Restore Defaults**

4.6.4 Heating & Cooling Degree Days

Although degree-days are most commonly used in agriculture, they are also useful in building design and construction, and in fuel use evaluation. The construction industry uses heating degree-days to calculate the amount of heat necessary to keep a building, be it a house or a skyscraper, comfortable for occupation. Likewise, cooling degree-days are used to estimate the amount of heat that must be removed (through air-conditioning) to keep a structure comfortable. Just like growing degree-days, heating and cooling degree-days are based on departures from a base temperature. 65° F is almost always used as this base. It is assumed for heating load calculations that the occupants, lighting, equipment, appliances, cooking, bathing and other activities will raise the temperature from 65° to 68°.

One heating degree–day is the amount of heat required to keep a structure at 65°F when the outside temperature remains one degree below the 65°F threshold for 24 hours. One heating degree–day is also the amount of heat required to keep that structure at 65°F when the temperature remains 24°F below that 65° threshold for 1 hour.
Likewise, one cooling degree–day is the amount of cooling required to keep a structure at 65°F when the outside temperature remains one degree above the 65°F threshold for 24 hours. One cooling degree–day is also the amount of cooling required to keep that structure at 65°F when the temperature remains 24°F above that 65° threshold for 1 hour.
Both heating and cooling degree-days can accumulate in the same day. Also, note that there are no negative degree-days. If the temperature remains below the threshold, there is no degree-day accumulation.
Heating and cooling degree-days are usually calculated by either the High/Low method or the Integration method.

WeatherLab uses the more accurate integration method.
In the integration method, the software calculates degree–days using the average temperature for a saving interval and the saving interval time. For example, if the average temperature during a 15 minute interval was 24° below the base threshold, the software would calculate 0.25 heating degree-days during that interval (24 × 15 minutes in interval/1440 minutes per day). The number of degree-days during each interval are added together to arrive at a degree-day total.

4.7 Toolbar Buttons

4.7.1 Main (Upper) Toolbar

	**Open by date**	Opens station archive
	**Open**	Opens individual experiments
	**Print**	Opens the Print Option dialog box
	**Online view**	Displays Online screen
	**Offline view**	Displays Offline screen
	**Scroll back**	Scrolls back to previous Online screen
	**Auto scroll**	Scrolls automatically to the Online screen
	**Scroll forward**	Scrolls forward to next Online screen

4.7.2 Online Graph (Lower) Toolbar

	**Zoom to selection**	Activates the Zoom tool
	**Pan**	Activates the Pan tool
	**Auto scale**	Returns the graph to full view
	**Graph properties**	Opens the Graph Properties dialog box

	**Wind vector**	Displays the wind direction vector graph
	**Frequent wind**	Displays the most frequent wind direction graph
	**Wind rose**	Displays the wind rose

4.7.3 Offline Graph (Lower) Toolbar

	**Zoom to selection**	Activates the Zoom tool
	**Pan**	Activates the Pan tool
	**Auto scale**	Returns the graph to full view
	**Graph properties**	Opens the Graph Properties dialog box
	**One graph**	Switches to one graph display
	**4 graphs**	Switches to four graph display
	**Table**	Displays table
	**Rain bars**	Displays daily rain bars
	**Previous 24 hours**	Scrolls the graph display one day back
	**Next 24 hours**	Scrolls the graph display one day forward
	**Export**	Exports the opened data to an Excel spreadsheet.

4.8 Mathematical Calculations

Real time Display

In real time display the raw data is displayed, except for the wind direction.

Wind Direction

- **Vector** – The direction of a vector that is the sum of 11 unit vectors whose directions are the current wind direction and the previous 10 wind directions measurements
- **Freq** – The most frequent direction of the current direction plus the previous 10 wind directions measurements
- **Rose** – The last 1000 wind directions are scattered in polar coordinates so that current data is in the outer radius and previous data moves toward the center.

Wind Gust

The maximum wind speed during the last saving interval

Minimum and Maximum Temperatures

The minimum and maximum temperatures of the last day

Dew Point

Dew point is the temperature to which air must be cooled for saturation (100% relative humidity) to occur, providing there is no change in water content. The dew point calculation uses the relative humidity – RH (%) and the temperature – T (^{o}C) and calculated with the following formula:

$$T_D = \frac{1}{\frac{1}{T+K} - \frac{\ln(RH/100)}{B}} - K$$

Where:

$K = 273°C$, $B = 5420°K$

Heat Index

The Heat index uses the temperature and the relative humidity to determine how hot the air actually "feels." When humidity is low, the apparent temperature will be lower than the air temperature, since perspiration evaporates rapidly to cool the body. However, when humidity is high (i.e., the air is saturated with water vapor) the apparent temperature "feels" higher than the actual air temperature, because perspiration evaporates more slowly.

Wind Chill

The wind chill index combines the temperature and wind speed to tell you how cold the wind makes it "feel".

Offline Display

In offline display the saved data is displayed. Except for the wind direction, the wind gust and the minimum/maximum temperatures, the data is an average of all the measurements in a given saving interval.

Wind Direction

The most frequent wind vector during the saving interval

Wind Gust

The maximum wind speed during the saving interval

The Minimum and Maximum Temperatures

The maximum and minimum temperatures of the day

5 Working with MultiLogPRO

5.1 General

5.1.1 External Connections

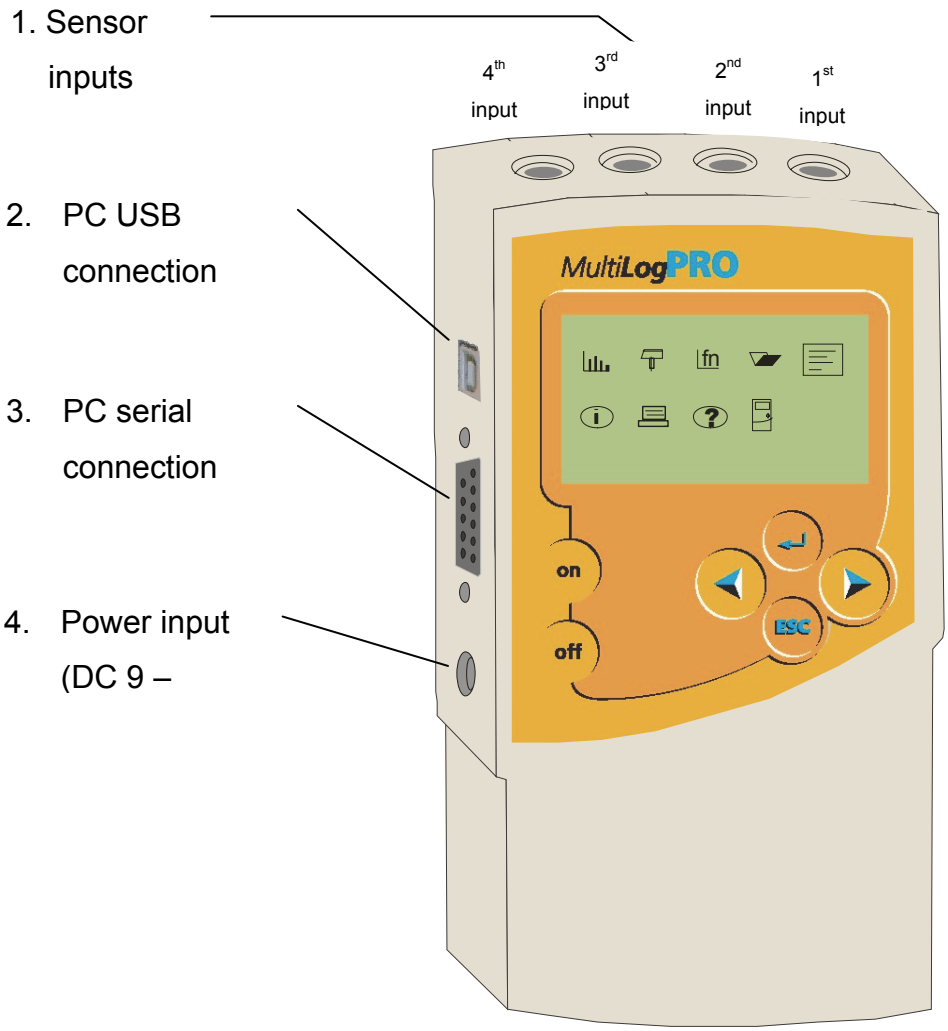


Figure 26: MultiLogPRO external connections

1. **Sensor input/output (I/O) sockets** marked (I/O-1 I/O-2 I/O-3 and I/O-4): These sockets are used to connect the sensors. Normally, all four sockets can be used simultaneously.

To connect a sensor to the MultiLogPRO use one of the *mini-din* cables. Plug one end of the cable into the data logger - arrow facing up, and the other end into the sensor - arrow facing down.

If you are using one sensor only connect it to input 1. If you are using two sensors connect them to inputs 1 and 2, and so on.

In order to connect more than 4 sensors at a time, use the splitter cables, which will enable the connection of up to 8 sensors simultaneously. When a splitter cable is connected, it must be connected to the socket in the correct numerical order (e.g. for 5 sensors, connect the splitter cable to I/O-4). One of the two splitter cables is marked with arrows - that is the main input (the lower I/O number), the second line is marked with the letter S (split) - indicating that it is the secondary input (the higher I/O number). Connect up to four input splitters (DT011) to split the MultiLogPRO's inputs starting with I/O-4 (the splitters **must** be connected in order):

- I/O-4 splits into I/O-4 and I/O-5
- I/O-3 splits into I/O-3 and I/O-6
- I/O-2 splits into I/O-2 and I/O-7
- I/O-1 splits into I/O-1 and I/O-8

Note: Before connecting the mini-din cable to the data logger or the sensor sockets, make sure that the mini-din plug is correctly positioned in front of the socket. Connecting the cable in an awkward position might cause damage to the cable pins.

2. **PC serial communication socket:** Connect the 9-pin Type D cable between this port and one of the computer's PC COM Ports. At the back of the computer you will find a 9-pin Type D male socket. If your computer is using this port for the mouse, look for a 25-pin D shell male socket near the mouse. Use the RS-232 9 to 25-pin adaptor to connect the MultiLogPRO serial cable to the 25-pin port (the adaptor is included with the MultiLogPRO).

3. **PC USB communication socket (optional).** Connect the USB Type B plug to the MultiLogPRO and the USB Type A plug to the PC (you need to install USB driver).

4. **External DC power supply socket:** Plug in an AC/DC 9 - 12V adaptor to turn MultiLogPRO on. The adaptor should meet the required specifications (see section 5.1.2).

5.1.2 AC/DC Adaptor

- Output: Capacitor filtered 9 to 12 VDC, 400mA.
- Female plug, center Negative.

5.2 Stand-Alone Operation

5.2.1 Front Panel Layout

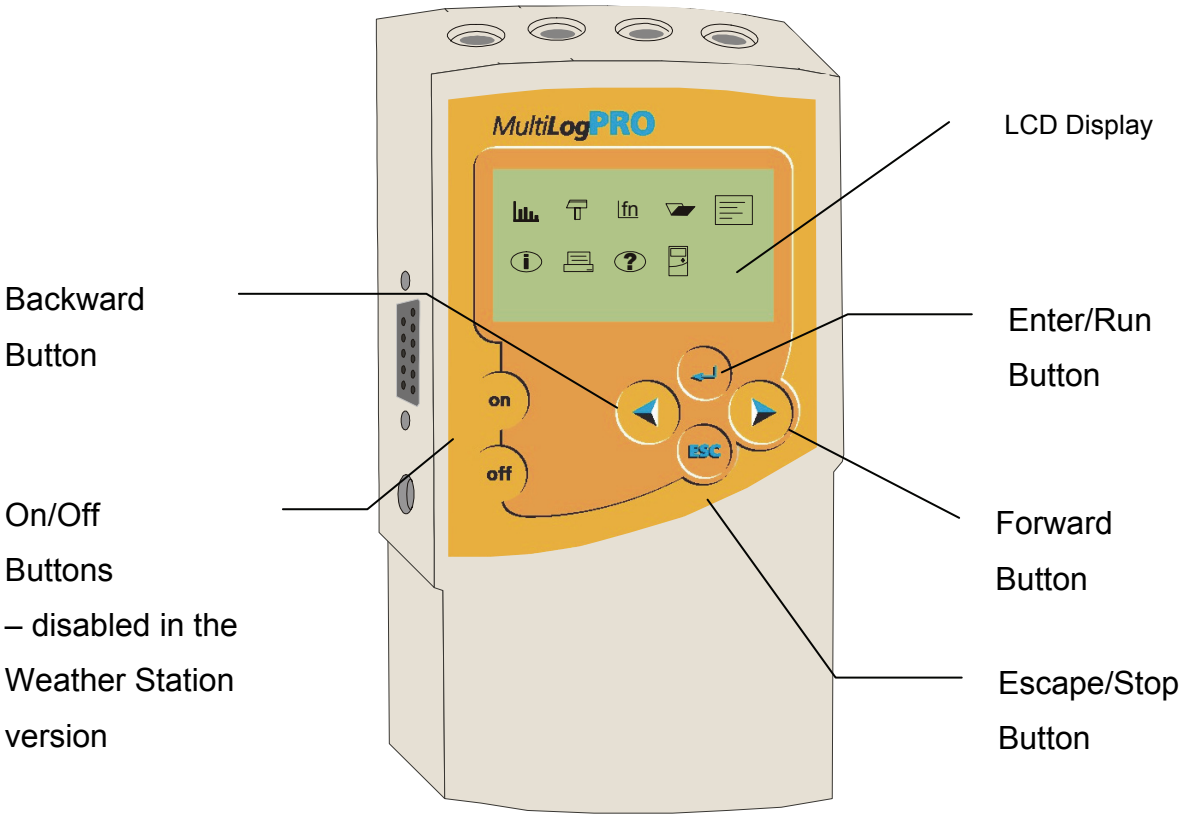


Figure 27: MultiLogPRO front panel

5.2.2 Input Modes

MultiLogPRO has two Input Modes. The default mode is **Auto ID** and the MultiLogPRO is in this mode when turned on for the first time. When using more than 4 sensors, when using VERNIER sensors, or if you've defined your own sensor, switch to the **8 inputs** mode. Select the **system configuration** menu in the **MAIN MENU** and choose the mode you want (see page 72).
MultiLogPRO saves the current mode selection and will open in that mode the next time you turn it on.

1. **Auto ID**

Automatic sensor identification – just plug in the sensors and the MultiLogPRO prepares itself to collect data from these sensors.
While in this mode you can work with up to 4 sensors simultaneously.

2. **8 inputs**

This mode enables data logging from up to 8 sensors simultaneously. Connect up to four input splitters (DT011) to multiply the MultiLogPRO's inputs starting with I/O-4 (the splitters **must** be connected in order):

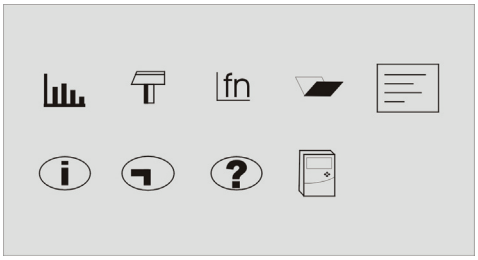
- I/O-4 splits into I/O-4 and I/O-5
- I/O-3 splits into I/O-3 and I/O-6
- I/O-2 splits into I/O-2 and I/O-7
- I/O-1 splits into I/O-1 and I/O-8

In the splitter cable, one of the two wires is marked with arrows - that is the main input (the lower I/O number). The second wire is marked with the letter S (split) - indicating that it is the secondary input (the higher I/O number).
To learn how to switch to 8 inputs mode please refer to section 5.2.9 on page 72.
In this mode there is no automatic sensor identification. Select the sensors manually either from the MultiLogPRO setup menu (see section 5.2.6 on page 66) or using the WeatherLab software
Use this mode if you want to work with more than 4 sensors or if you are using VERNIER sensors.

5.2.3 Quick-Start

1. Turn on MultiLogPRO

Plug the supplied AC/DC 9 - 12V adaptor into MultiLogPRO (see page 55), then plug it to the mains. You will see the initialization screen. MultiLogPRO performs a brief self-check and displays its status including battery level, and then loads the last setup you used (see page 72). Wait until you see the Main Menu screen:



2. Plug in the sensors

Start with the first input on the right. If MultiLogPRO is in Auto ID mode (the default mode) it will display the setup menu and will identify the sensors you've plugged in.

```
Input – 1     Microphone
Input – 2     Light
Input – 3
Input – 4

→     RATE = 10/s
      SAMPLES = 500
      DISPLAY = numeric
```

Note: Sensors must be added successively, starting with input-1. If a single sensor is used it must be connected to I/O-1. If two sensors are used in an experiment, they must be connected to I/O-1 and I/O-2.

The arrow indicates that MultiLogPRO is ready to accept a new sampling rate.

If the MultiLogPRO is in 8 input mode you have to select the sensors manually (see page 66).

3. Select Rate

Use the **Forward**  and **Backward**  arrow buttons to select the desired rate, and then press the **Enter** button  .

```
Input – 1     Microphone
Input – 2     Light
Input – 3
Input – 4

      RATE      = Every sec
→     SAMPLES   = 500
      DISPLAY   = numeric
```

MultiLogPRO automatically switches to the next step in the setup process and the arrow moves to the “samples” row.

4. Select total number of samples

Use the **Forward**  and **Backward**  arrow buttons to select the number of samples, and then press the **Enter** button  .

```
Input – 1     Microphone
Input – 2     Light
Input – 3
Input – 4

      RATE      = Every sec
      SAMPLES   = 200
→     DISPLAY   = numeric
```

5. **Choose display**

Use the **Forward**  and **Backward**  arrow buttons to select the type of display, and then press the **Enter** button  .

```
Input – 1     Microphone
Input – 2     Light
Input – 3
Input – 4

      SAMPLES  = 200
      DISPLAY  = graphic
→     START    = ( > ).
```

6. **Start recording**

Press the **Forward** arrow button  to start recording.

Or press the **Enter** button if you want to go back to the first item (Rate).

You can stop recording any time by pressing the **Escape** button  .

5.2.4 Working with the MultiLogPRO Menus

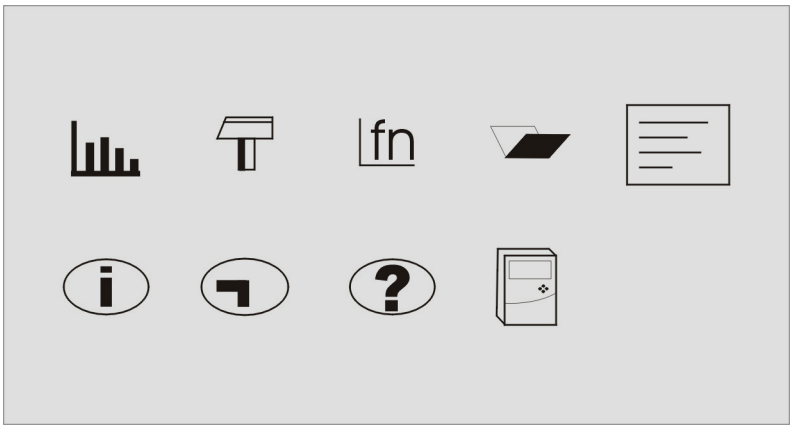
1. **Turning MultiLogPRO on and off**

In the Weather Station version of MultiLogPRO the on and off buttons are disabled to ensure continuous Weather Station operation. To turn MultiLogPRO on simply plug the Weather Station power cable or the supplied AC/DC adaptor into the 9 -12V socket on the left side of MultiLogPRO

Note: Turning MultiLogPRO off **will not** erase the sample memory. The data stored in the memory will be kept for up to 10 years.

2. Main menu display

When turned on, MultiLogPRO opens with a system information window and then displays the main menu:



MultiLogPRO has 9 menus. Use the Forward or Backward **Arrow** buttons to highlight a menu and press the **Enter** button to select it. Then use the **Arrow** buttons to scan the options. Press the **Enter** button to select an option. The MultiLogPRO automatically executes the command.

3. Menu buttons

	**Forward**	Move to the next menu or to the next menu options
	**Backward**	Move to the previous menu or menu options
	**Enter (Start)**	Enter the selected menu or select the current menu option and move to the next menu command or start recording
	**Escape (Stop)**	Return to the main menu or stop recording

4. Menu Icons and commands

Start Start recording

Press the **Enter** button to start recording

Setup Setup MultiLogPRO in 4 steps:

Rate – select recording rate

Samples – select the total number of recording points

Display – select the way MultiLogPRO will display the data (at a rate of up to 10 samples per second):

1) Numeric	Displays the sensor values and the sample number.
2) Meter	Displays all active sensors in a bar meter display along with their values.
3) Table	Displays the last 6 values of all the active sensors in a table.
4) Graphic	Displays a graphic representation of the sampled sensors.

At rates higher then 10/s the MultiLogPRO will display the data in a graph at the end of the logging period.

Start – Press the Forward **arrow** to start recording

Function Display statistics of the current data

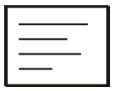
1) Minimum – The minimum graph value.

2) Maximum – The maximum graph value.

3) Average – The graph average.

Open Open a stored data in graphic display

Use the Forward and Backward **Arrow** buttons to browse the stored files,
press the **Enter** button to open a file



Notes Display experiment notes and instructions

Use the **Arrow** buttons to browse the notes.

Info Display system information:

1) Number of experiments stored in MultiLogPRO's internal memory.
2) Memory usage.
3) MultiLogPRO version.
4) Battery level (unplug any sensor and external power supply)
5) Current date and time.

Timing Enter to the timing module

You can select between the following timing events:
1) Stopwatch
2) Time and speed in one photogate
3) Time and speed between two photogates
4) Time, speed and acceleration between two photogates

Help On-line help and specifications

Configuration Configure the MultiLogPRO:

Input Mode – Select Input Mode: Auto ID or 8 inputs

Memory clear – Delete the stored data files

Distance – Select the range of the Distance sensor: 1.5m or 10m

DO2 – Press the **Forward arrow** button to enter the DO_2 menu

Contrast – Use the **arrow** buttons to tune the screen contrast

Comm – Press the **Forward arrow** button to connect to a computer or the **Backward arrow** button to connect to TI calculator

5.2.5 Graphic Display

MultiLogPRO will automatically use a graphic display in three cases:

1. If the recording rate is 10/s or less and you selected Graphic Display in the setup menu
2. Once logging has ended for an experiment with a data recording rate of over 10/s
3. When opening a stored recording.

The graphic display is available for recordings with up to 4 sensors simultaneously.

The Cursor

Use the Cursor in Graphic Display mode to read data values or to zoom in to the area around a selected point. The cursor is displayed automatically after logging has ended, or when opening a stored recording.

1. Use the **Forward**  and **Backward**  arrow buttons to move the cursor.

2. MultiLogPRO displays the point coordinates at the bottom of the graph.

3. If there is more then one sensor, press the **Enter** button  to move the cursor to another plot on the graph.

Zooming

Position the cursor in the area you want to zoom into.

1. Press the two arrow buttons,  and  , simultaneously. You will zoom in around the cursor in a 2:1 ratio.

2. Press the **Escape** button  to zoom out.

5.2.6 Measuring Timing Events

MultiLogPRO incorporates an accurate Timer module with resolution of 0.1ms. The timer can measure several types of events triggered by Fourier Systems' photogates:

- Time and speed with one photogate
- Time and speed between two gates
- Time, speed and acceleration between two gates
- Stopwatch

While in Timer mode MultiLogPRO does not store data.

To perform a timing measurement:

Connect one or two photogates to MultiLogPRO

Note: MultiLogPRO must be in PC communication mode (see page 72)

Use the **Forward** and **Backward** arrow buttons to navigate to the **Timing** menu

Press **Enter** to display the timing menu:

```
_ _ _ _ _TIMING _ _ _ _ _

→Mode: Time Speed
 Measure:    In1
 Card width: 30mm
 Gates distance:  20cm
 Start ( > )
```

The arrow indicates that MultiLogPRO is ready to accept the timing mode

Use the arrow buttons to select the desired timing mode:

Stopwatch, Time Speed or Time Speed Acc

Stopwatch

```
_ _ _ _ _TIMING _ _ _ _ _

→Mode: Stopwatch
 Measure:    _ _ _
 Card width: _ _ _
 Gates distance:  _ _ _
 Start ( > )
```

In this mode operates as a standard stopwatch with resolution of 0.01s.

1. Press **Enter** four times, then pres the **Forward** arrow to enter the Stopwatch mode

   Press the **Forward** arrow to start measuring time

Press the **Forward** arrow a second time to stop the watch

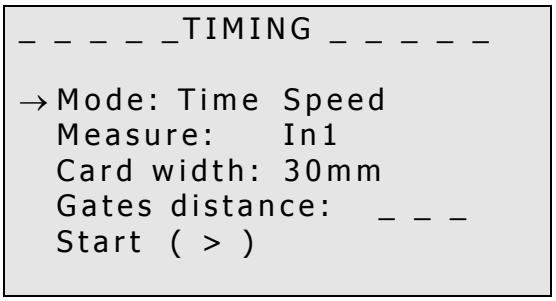
Press the **Backward** arrow to reset the watch

Press **Escape** to exit the stopwatch mode and return to the timing menu

Press **Escape** a second to return to the main menu

Time and Speed

In this mode MultiLogPRO measures time and speed either in one gate or between gates



Press **Enter** to select this mode. The arrow moves to the **Measure** row

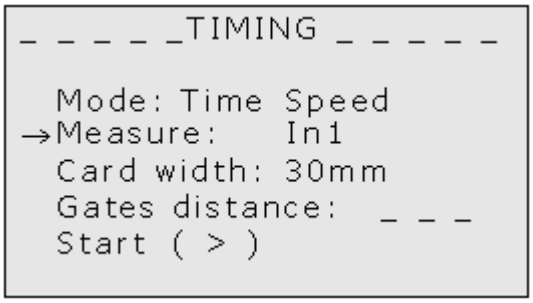
Use the **Forward** and **Backward** arrow buttons to select **In1** if you want to measure time and speed in one gate or **In1** → **In2** if you want to measure time and speed between two gates

Time and speed at one gate

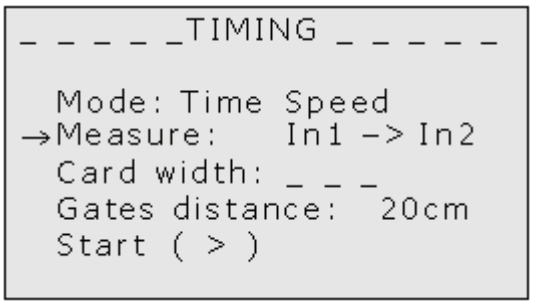
MultiLogPRO measures the time between blocking and unblocking the photogate at input 1

Time and speed between gates

MultiLogPRO measures the time between blocking the photogate at input 1and blocking the photogate at input 2



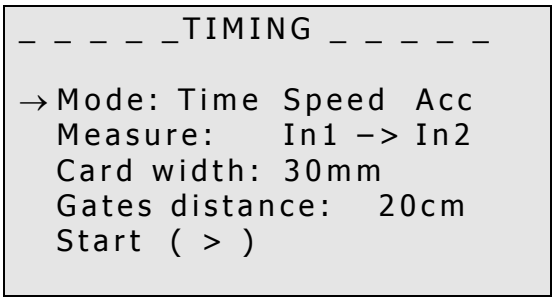
1. Press **Enter**, then use the arrow buttons to select the card (the body that blocks the gate) width in mm between 0 to 59mm
2. Press **Enter** twice, then use the **Forward** arrow button to enter to a timing standby mode
3. Timing begins each time a body blocks the photogate and ends when unblocking the photogate. MultiLogPRO then displays the elapsed time between entering and leaving the gate and the speed of the body
4. Use the arrow buttons to scroll between the time and speed results
5. Press **Escape** to return to the timing menu
6. Press **Escape** a second to return to the main menu



1. Press **Enter** twice, then use the **Forward** arrow button to select the distance between the photogates in cm between 0 to 99cm
2. Press **Enter**, then use the **Forward** arrow button to enter to a timing standby mode
3. Timing begins each time a body enters the first photogate (input 1) and ends when leaving the second photogate (input 2). MultiLogPRO then displays the elapsed time between entering the gates and the body's average velocity
4. Use the arrow buttons to scroll between the time and speed results
5. Press **Escape** to return to the timing menu
6. Press **Escape** a second to return to the main menu

Time, Speed and Acceleration

In this mode MultiLogPRO measures the crossing time at the first gate, the time it takes the body to move from one gate to the second gate and the crossing time at the second gate and returns the time between gates, the average speed and the average acceleration.



1. Press **Enter** twice, then use the arrow buttons to select the card (the body that blocks the gate) width in mm between 0 to 59mm

2. Press **Enter**, then use the **Forward** arrow button to select the distance between the photogates in cm between 0 to 99cm

3. Press **Enter**, then use the **Forward** arrow button to enter to a timing standby mode

Timing begins each time a body enters the first photogate (input 1) and ends when leaving the second photogate (input 2). MultiLogPRO then displays the elapsed time between entering the gates and the body's average velocity and acceleration

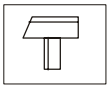
1. Use the arrow buttons to scroll between the time, speed and acceleration results

2. Press **Escape** to return to the timing menu

3. Press **Escape** a second time to return to the main menu

5.2.7 Select Sensors Manually

You must be in 8 input mode to be able to select the sensors manually (see page 58)

1. In the **Main Menu** screen, use the arrow buttons to select the setup menu icon  .

2. Press the **Enter** button  to enter the setup menu:

```
→   Input – 1
    Input – 2
    Input – 3
    Input – 4

    RATE = 10/s
    SAMPLES = 500
    DISPLAY = numeric
```

3. Use the **Forward**  and **Backward**  arrows to select the sensor in input 1 and then press the **Enter** button  . The arrow indicator will move to the second input.

4. Repeat this procedure with all the sensors you plugged in.

5. After the fourth sensor has been selected, the screen will list the next 4 sensors:

```
→   Input – 5
    Input – 6
    Input – 7
    Input – 8

    RATE = 10/s
    SAMPLES = 500
    DISPLAY = numeric
```

You can press the **Enter** button in the last input if you want to go back to the first input.

6. When you've finished selecting the sensors press the **Escape** button 

. The arrow indicator will point to the **Rate** command and you must complete the setup, as detailed in section 5.2.3.

Note: When you turn the MultiLogPRO off it will save the setup for the next session.

5.2.8 Load the Last Setup

When you turn MultiLogPRO on, it automatically loads the last setup.

5.2.9 Configure Your MultiLogPRO

Use the **System configuration** menu to select the Input Mode, to clear the MultiLogPRO's memory, to change the screen contrast, to configure your Distance sensor or to calibrate the DO_2 sensor.

In the **MAIN MENU** screen, select the **System configuration** icon  to display the configuration screen. The default configuration is:

```
→   Input Mode:  Auto ID
    Memory clear ( > )
    Distance  10m
    Do2 calibration ( > )
    Contrast  ( < )  ( > )
    Comm      ( PC )
```

Use the **Forward**  and **Backward**  **arrows** to select the mode and then press the **Enter** button  to move to the next item. You can press the **Escape** button 

to leave the configuration menu at any time, saving the new changes you made. Press **Enter** button in the last item (Contrast) if you want to go back to the first item (Input Mode).

1. Input Mode

Select between **Auto ID** – automatic sensor identification and **8 inputs** – manual sensor selection (See also page 58).
The new configuration will be the default mode until the next time you change it.

2. Memory clear

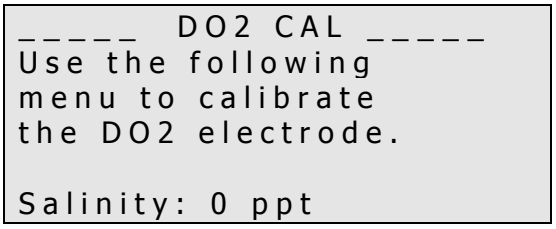
Press the **Forward** arrow button  if you want to delete all previous data files from the MultiLogPRO.

3. Distance sensor range

Select **2m** to configure your distance sensor to a range of 0.4 – 2m, or **10m,** to configure your distance sensor to a range of 0.4 – 10m.
The new configuration will be the default range until the next time you change it.

4. DO_2 sensor calibration

If you need to calibrate a DO_2 sensor press the **Forward** arrow button  to enter the DO_2 calibration screen:



Use the **arrow** buttons to select between 0, 5, 10, 15, 20, 25, 30 and 35 ppt and press the **Enter** button to confirm and move to *Calibrate altitude*.
Use the arrow buttons to select between 0, 500, 1000, 1500, 2000, 2500, 3000 and 3500 ft and press the **Enter** button to confirm.
MultiLogPRO will display the calculated upper limit of the calibrated range and will exit the DO_2 calibration screen.
The new calibration parameters will be saved until the next time you change them.

5. Screen contrast

Use the **arrow** buttons to adjust the LCD screen contrast.

Any contrast adjustment will be saved until the next time you change it.

6. Connect to a computer or to a TI calculator

Press **Forward**  to connect to a computer or the **Backward**  to connect to a TI calculator.

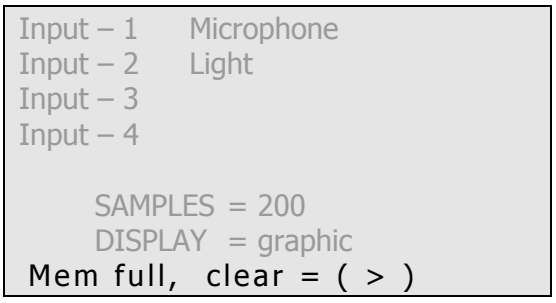
5.2.10 Internal Clock and Calendar

The internal clock is set the first time you use the **Setup** command from the WeatherLab software to program the MultiLogPRO, and is automatically updated to the PC's time and date each time you connect your MultiLogPRO to a PC.

The internal clock and calendar is kept updated independent of the 7.2V battery condition, even when the MultiLogPRO is turned off.

5.2.11 Clear the Memory

If you want to start recording and the MultiLogPRO's internal memory is full you will see this message at the bottom of the display:



Press the **Forward** arrow button  to clear the memory.

In order to clear the MultiLogPRO's memory when it is not full, use the **Memory clear** command from the **Configuration** menu (see page 72).

5.2.12 Choose the Right Setup

1. **Sampling rate**

The sampling rate should be determined by the frequency of the phenomenon being sampled. If the phenomenon is periodic, sample at a rate of at least twice the expected frequency. For example, sound recordings should be sampled at the highest sampling rate – 20,800/sec, but changes in room temperature can be measured at slower rates such as once per second or even slower, depending on the speed of the expected changes.

THERE IS NO SUCH THING AS OVER-SAMPLING. For extremely smooth graphs, the sampling rate should be about 20 times the expected frequency.

Note: Sampling at a rate slower than the expected rate can cause *frequency aliasing*. In such a case, the graph will show a frequency much lower than expected. In Figure 28 below, the higher frequency sine wave was sampled at 1/3 of its frequency. Connecting the sampled points yielded a graph with a lower, incorrect frequency.

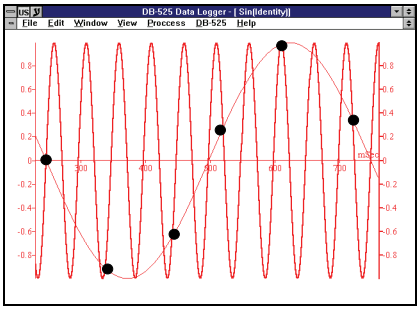


Figure 28: Frequency Aliasing

2. **Manual sampling**

Use this mode for:

- Recordings or measurements that are not related to time.
- Situations in which you have to stop recording data after each sample obtained, in order to change your location, or any other logging parameter (Note: During the experiment NO CHANGES can be made to the MultiLogPRO's configuration).

To start an experiment using manual data logging, set the RATE to **Manual** and press the **Enter** button  once to start the data recording, and then press the Enter button each time you want to collect a sample.

3. **Sampling Points**

After you have chosen the sampling rate, choosing the number of points will determine the logging period: Samples / Rate = Logging time. You can also choose the duration of an experiment first, and then calculate the number of samples: Samples = Logging time × Rate.

Continuous

In the Continuous mode, MultiLogPRO does not save data, and can continue logging indefinitely.

If MultiLogPRO is connected to the PC and the WeatherLab software is running, the data is automatically saved to the computer and displayed in a real time graph.

To operate in Continuous mode select **RATE** equal to or less than 100/s and **SAMPLES = Continuous**.

You can also select Continuous mode directly from the WeatherLab software.

Note: MultiLogPRO must be set to a display mode other than graphic to enable the Continuous mode.

5.2.13 Programming Rules and Limitations

The following are some rules and limitations you must take into account when programming the MultiLogPRO, as MultiLogPRO integrates all programming limitations automatically. MultiLogPRO will only allow the programming of settings that comply with the rules below.

1. Sampling points:

   - Increasing the number of active inputs limits the number of sampling points one can choose. The following condition must be always satisfied: Samples × Active Inputs < Memory. MultiLogPRO's memory is sufficient for 100,000 samples. However, when sampling at rates faster than 100 samples per second the memory can store only two experiments of 32,000 samples each.
   - Selection of 100,000 sampling points will create 2 files of 50,000 points each in the data logger's memory

2. Sampling rate:

The number of sensors in use limits the maximum sampling rate:

Number of Sensors	Maximum Sampling Rate
1 sensor	20,800 samples per second
2 sensors	8,500 samples per second
3 sensors	5,700 samples per second
4 sensors	4,300 samples per second
5 sensors	3,400 samples per second
6 sensors	2,800 samples per second
7 sensors	2,439 samples per second
8 sensors	2,134 samples per second

3. Continuous sampling

   - Continuous sampling is possible up to a maximum sampling rate of 100/s.
   - The data must be presented in a display mode other than graphical.

5.3 Sensor Calibration

In this chapter you will learn how to increase the MultiLogPRO system accuracy using calibration. Most of the sensors are linear, i.e. the output level of each sensor changes according to the equation:

$$Y = aX + b$$

Where:

Y - output of the sensor (voltage level changing from 0 to 5V).

X - sensor input.

a - sensor gain.

b - sensor offset.

The calibration process allows us to control the offset, and in some cases even the gain, of a sensor. The MultiLogPRO system offers 4 types of calibration:

- Hardware offset calibration.
- MultiLogPRO automatic zero calibration
- WeatherLab Sensor calibration
- Factory calibration (no manual calibration required)

5.3.1 Hardware Offset Calibration

On some of the sensors there is a screw controlling the sensor offset. To calibrate the sensor, rotate this screw until the sensor shows the correct measured value (obtain the actual "correct value" from another source that is known to be accurate).

5.3.2 MultiLogPRO Automatic Zero Calibration

MultiLogPRO is able to automatically calibrate the sensor offset for all analog sensors accurately, quickly, and for every new experiment conducted.
The calibration method is very simple. Whenever you plug in a sensor, the data logger checks to see if the selected sensor measures a value within ±2% of its “zero value”. If so, MultiLogPRO sets that value as zero.

1. To enable this feature, make sure that the sensors are at their “zero values” when you plug them in. To ensure the most accurate “zero value”: Shorten the Voltage sensor plugs.

2. Leave the Current sensor plugs open.

3. Cover the Light, Photo-Gate, and Microphone sensors.

4. Insert the pH sensor in a pH-7.0 solution.

5. Unload the Force Transducer.

6. Place the Accelerometer on a stationary surface.

7. Place the Temperature probes in ice water.

8. Place the Pressure sensor in a 1 ATM (1013 mb) Chamber.

5.3.3 pH Temperature Compensation

To compensate a pH sensor for temperature changes, plug the temperature sensor into Input 1, and the pH sensor in Input 2. MultiLogPRO will then display the compensated pH value.

5.3.4 DO2 Calibration

To calibrate your DO_2 sensor with the right salinity and altitude parameters, use the **DO_2 Calibration** command from the **Configuration** menu (see page 73)

5.3.5 WeatherLab Sensor Calibration

The sensors can also be calibrated using the **Calibrate Sensors** option in WeatherLab's **Logger** menu.

5.3.6 Factory Calibration (no calibration required)

All digital sensors that are essentially "timers" leave the factory fully calibrated, and do not suffer from any accuracy degradation. An example of such a sensor is the Sonic Ranger distance sensor, which measures the time passed from the transmission of a sound pulse to its echo reception.

6 The Receiver

6.1 Overview

The Receiver is designed to receive wireless data from the Weather Station and send it to the computer.

The Receiver is equipped with two LED indicators to show Receiver status and is powered by an AC/DC mains adaptor.

6.2 Getting Started

6.2.1 Locating the Receiver

Locate the Receiver near the computer. You can either place it on a tabletop or hang it on the wall

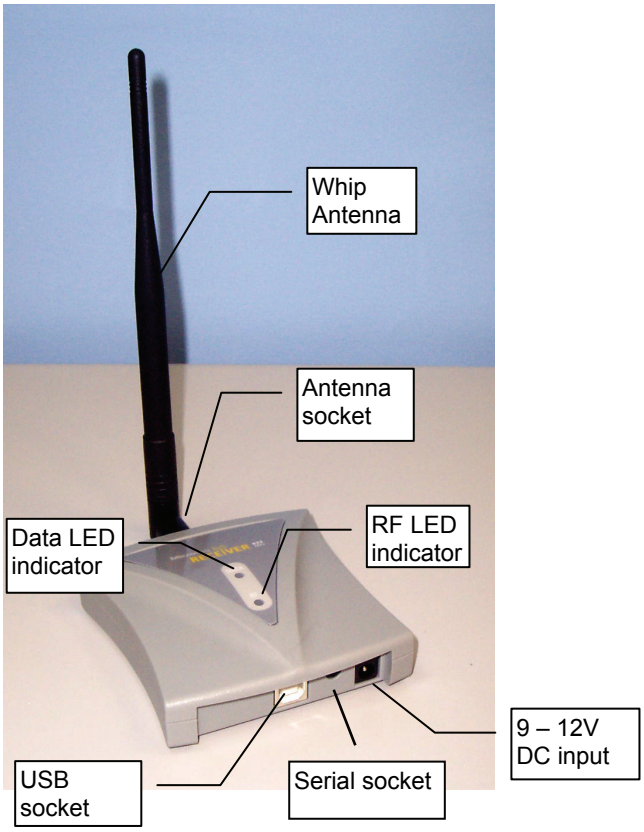


Figure 29: The Receiver layout

6.2.2 Connecting the Antenna

Screw the supplied whip antenna to the SMA antenna socket at the top of the Receiver (see Figure 29).
If the Receiver is lying on a tabletop use the hinge to bend the antenna to an upright position.

Note: You can also use Fourier Systems' magnet antenna.

6.2.3 Powering the Receiver

Connect the supplied AC/DC adaptor to the **9-12V DC** input at the bottom of the Receiver (see Figure 29), and then connect it to the mains.

6.2.4 Connecting the Receiver to a Computer

Use either USB or serial communication cable.

To connect a serial communication cable:

- Connect the stereo phone jack to the **RS-232** socket at the bottom of the receiver (see Figure 29)

- Connect the type D 9-pin plug to an available serial COM port on your PC

To connect a USB communication cable:

- Connect the USB type B rectangular plug of the USB communication cable to the USB input at the bottom of the receiver (see Figure 29)
- Connect the USB plug of the USB communication cable to a free USB input at the back of your computer

The Receiver is now ready to receive data and transfer it to the computer.

6.3 LED Indicators

Two LED indicators are used to indicate the Receiver's status. The indicators are located on the Receiver's front panel. The upper LED is marked **DATA** and the lower LED is marked **RF**.

The **RF** indicator lights in red whenever the Receiver receives RF carrier of the operating frequency (433MHz in Europe or 915MHz in the US).

The **DATA** indicator lights in green whenever the Receiver receives Weather Station data.

7 Experiment Notes, the Influence of Natural Ventilation on Indoor Climate

7.1 Introduction

The indoor climate is influenced by several factors: the characteristics of the building envelope (size, orientation, type of building materials, and the location of openings) and ventilation. The ventilation depends on wind speed and the size and location of the openings (windows and doors). Effective natural ventilation can reduce the indoor temperature and improve human comfort sensations. In this experiment, the influence of natural ventilation will be examined.

7.2 Equipment

MultiLogPRO Weather Station

7.3 Equipment Setup Procedure

1. Choose a classroom that has at least two openings in two different directions. Ideally, one opening should be orientated to the more frequent wind direction.

2. Locate the Weather Station in the center of the classroom.

Figure 30: The Weather Station in the classroom.

7.4 Experimental Procedure

1. Leave the doors and windows of the classroom closed for at least an hour before beginning to record data.

2. Open the MultiLogPRO Weather Station program.

3. Click the **Start** button to start recording.

Note: Although there is no wind flow in the first half hour the wind direction sensor will record the direction that it is facing as a constant number. One may move the wind direction sensor to the north (0°), in this case the curve will show 0 on the x axis and therefore the results of natural ventilation will be easier to understand from the graph.

4. After half an hour open the doors and windows.

5. Wait a further forty minutes before analyzing the data.

6. Switch to the **Offline** mode.

7. Load today's data.

8. Leave only temperature, humidity, wind direction and wind speed data by de-selecting the other sensors - click on the corresponding buttons below the graph.

7.5 Data Analysis

Use the **cursor** and the **grid** to perform the following analysis.

Examine the curves of the climatic parameters and answer the following questions:

1. Until what stage are the curves stable?
2. What are the changes in each curve?
3. At what stage are the changes in the curve most pronounced?
4. Which curves stabilize and when?

Calculate the heat stress inside the classroom according to the Heat Stress Index:
(Dry bulb temperature + wet bulb temperature) /2, at two points: One - before ventilation, two - after ventilation.

7.6 Questions

A. Examine the relationship between the various climatic parameters in your graph:

1. What is the influence of wind speed on wind direction?
2. What is the influence of the wind on temperature?
3. What is the influence of temperature on relative humidity?

B. What is the impact of ventilation on indoor temperature and indoor heat stress?

C. What can be learned from this experiment about the impact of ventilation on indoor climate?

1. To what extent can natural ventilation reduce indoor temperatures?

2. How much time is required for ventilation to reduce temperature?

D. Which classroom in your school or college is best orientated towards high ventilation? Explain your answer.

7.7 Further Suggestions

1. Conduct simultaneous tests in two classrooms with different opening orientations and compare the results. According to your findings, what general recommendations can you make for the orientation and size of classroom windows and doors in order to create comfortable climatic condition? E.g. what orientation would you choose for the largest windows?

2. Measure the outdoor temperature and examine the relationship between outdoor and indoor climate, with and without ventilation. Where and when is the temperature highest? Where and when is the heat stress highest?

3. Combine the results of this experiment with those in Activity Two, which examines the temperature of exterior walls and roofs of buildings. Which classroom in your school or college is best orientated from the climatic point of view?

8 Specifications

Data Logger	MultiLogPRO version 8.6WTI

Sensors	**Range**	**Sensitivity**	**Accuracy**
Temperature	-15 to 110 °C	0.25°C	±2%
Humidity	0 to 100% RH	0.4%	±2%
Barometric Pressure	800 to 1150mBar	1mBar	±15mB
Rain Collector	0 to 204 mm	0.2 mm	±0.2 mm
Wind Speed	0 to 270 km/h	0.36km/h	± 0.36km/h
Wind Direction	0 to 360 °	0.46 °	±0.46 °

Output	RS-232 PC Host Interface at 19,200 bps
	USB 1.1 specification compliant
	RF transmitter

Sampling	
Samples Memory	100,000 samples
Sampling Rates	From 1 sample per hour to 1 sample per 10 seconds

Power Supply	
Solar Panel	Max power 10W
Battery	2 parallel 12V 2.3Ah rechargeable sealed lead-acid batteries
Charge Controller	Discharge protection
	Overcharge protection
	Temperature compensation
	Gassing regulation
	Fuse: 7A

Software	WeatherLab
System Requirements	Software ▪ Windows 98™ or later ▪ Internet Explorer 5.0™ or later (you can install Internet Explorer 5 when you install WeatherLab, since it ships with the product) Hardware ▪ Pentium™ III 600MHz or higher ▪ 64 MB RAM (128 MB recommended) ▪ 10 MB available disk space

Receiver

Communication Ports	RS232 at 19.2Kbps
	USB at 1.5Mbps
Power Supply	External: 9-12VDC, minimum 300mA
RF Receiver	European version: Frequency: 433.92MHz Type approved to ETS 300-220 Usable range: to 300m (75m indoors) North America version: Frequency: 914.5MHz Usable range: to 120m (30m indoors)
Antenna	SMA connector Supplied with rubber whip antenna (with a hinge)
Dimensions	10×9×2.5 cm
	CE and FCC standard compliance

Transmitter

Communication Ports	RS232 at 19.2Kbps USB at 1.5Mbps
Power Supply	External: 9-12VDC, minimum 300mA
RF Transmission	European version: Frequency: 433.92MHz EMC conformant to EN 300-683 Type approved to ETS 300-220 Usable range: to 300m (75m indoors) 10mW on 433.92MHz 2^{nd} harmonic < -60dBc North America version: Frequency: 914.5MHz EMC conformant to EN 301 489-3, FCC PART 15.249 Usable range: to 120m (30m indoors) 1mW on 914.5 MHz Harmonics/spurious emissions -55dBs
Antenna	SMA connector Supplied with magnet antenna
Dimensions	10×9×2.5 cm
	CE and FCC standard compliance

9 Appendix: Figures

10 Index

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