

Stress and Strain

Lab Experience

The XR-440 Data Logger is an electronic device that collects and saves voltage information on up to four different input channels. The logger is currently configured to accept voltages within the range of -5 to $+5$ volts, but can also accept input from certain special sensors beyond the scope of this lab. The data logger has an internal power source and is continuously powered ON. Its power source can last up to two years under normal use.

The data logger is installed in a 'Black Box' attached to the bike. The box has two switches, a mini-jack, and a 9-pin connector. The switch marked 'BATT' controls only the power to whatever is plugged into the 9-pin connector (strain gages on a bicycle). Because the strain gages quickly drain the battery, **the BATT switch should only be ON when data is actually being collected or observed**. Please turn it off during setup and communication with the computer. The switch marked LOGGER controls only the start (ON) and stop (OFF) of data collection. Communications between the PC and the data logger can be performed with both BATT and LOGGER switches OFF. However, *valid data* is obtained from the strain gages only when the 'BATT' switch is ON. Finally, the mini-jack is used to communicate with the PC via a black cable with a mating end.

1. Initial Setup

I. Starting the Pocket Logger Software:

Double click on the "Pocket Logger Software" icon on the Windows Desktop.

II. Configuring the Logger Software: (only need to do this once after software startup)

1. Select "**Settings**" from the main menu. A new window will pop up.
2. Select the communications port to which the data logger is connected (**COM1** on these computers).
3. Select the "**19.2k**" option.
4. Leave everything else at the default settings.
5. Click "**OK**" to exit.

III. Real Time Receive Mode:

The black data cable must be connected from the PC to the data logger.

1. **Flip** the LOGGER switch ON then OFF. (This action cancels any pending recording).
2. **Select** "Receive" menu item and then 'Real Time' option.

3. A **new window** should pop up and **display** the data logger and channel information.
4. You are now viewing the real-time data from the sensors.
5. Turn on the BATT switch to observe the output from the sensors.
6. Verify that the output voltage for channel 2 is near 2 volts. If this value is low, the battery that feeds the sensors may be low and you will need to notify your lab instructor.
7. Push on the bicycle and observe how the recorded voltage changes.
8. **Click** the “OK” button to stop this function and return to the main menu.
9. Turn off the BATT switch.

2. Static Test

I. Sending a Setup:

This sets the data logger for collecting and recording data. Also, a setup *will erase all previously recorded data*. **A Setup can be done only once for each time the LOGGER switch is turned on.** That is, the data logger will not accept further Setup requests until data collection from the previously sent Setup has been initiated and concluded via the LOGGER switch. Cycling the LOGGER switch ON then OFF, and then trying the Setup again can resolve most communications problems during a Setup.

1. **Select “Send”** from the main menu. Then **select** the “**Setup**” option. A new setup window will appear:
2. **Type in** the description of the experiment on the “**Session Description**” Option (*i.e.*, **ENG H192 Static Test, Group #N, Bike #**).
3. **Turn ON Channels 1 and 2 and turn OFF Channels 3 and 4** by clicking on the channel number on/off button.
4. **Select** the following settings for Channel 1:
 - a. “**cls/opn**” under the “{Table}” option by using the scrolling menu.
 - b. “**Standard**” under the “Type” option using its scrolling menu.
 - c. **Type “Start /Stop Control”** in the “Description” box.
5. **Select** the following settings for Channel 2:
 - a. “**New Linear Scale**” on the “Table” option by using the scrolling menu. Type a value ‘-5’ for the “Lo value” and a value ‘5’ for the “Hi value”. (Do not type the apostrophes!).
 - b. “**Standard**” on the “Type” option using its scrolling menu.
 - c. **Type “Voltage Signal”** in the “Description” box.
6. **Select** “when ch1 temp probe is attached” for the option “**Start**” and “until ch1 temp. probe is detached” for the option “**Run**”.
7. **Set** the data logger model option to “**XR-440**”.

8. **Set** the resolution in the “**Resolution**” option to 12 bit.
9. **Set** the sampling rate in the “**Sample Rate**” box to "(rf) 50/s" (50 samples per second).
10. **Ensure** the logger is connected to the computer via a black data cable and then click on the “**Send**” button to download the settings to the data logger.
11. **Click** on “OK” in response to all of the warnings and wait while it loads the setup.
12. *If the computer is unable to communicate with the data logger, flip the LOGGER switch ON then OFF and try the setup procedure again. If it still fails to accept the setup then ASK FOR HELP.*
13. The data logger **is now ready** to record voltage data (and will do so when the LOGGER switch is flipped to ON).
14. **Click** on the ‘Exit’ button to return to the main window. In general, DO NOT save changes when asked. The changes you make will be current as long as the Pocket Logger software is not restarted.

II. Running the static test:

In most cases, the BATT switch would be turned ON shortly before a test is run. Always remember to flip the BATT to OFF immediately after flipping the LOGGER switch off, or immediately after leaving real time display, or any time data is not really needed.

1. Disconnect the communications cable from the bike.
2. Prepare to take data in the following manner: (all times are approximate)
 - 5 seconds for an unloaded bike
 - 10 seconds for rider 1 in riding position (no pedaling)
 - 15 seconds for rider 1 pedaling
 - Repeat for remaining team members (**Do not stop the data logger between each step or between each rider.**)
3. Once your team has planned the data collection order, turn on the BATT switch to power the sensors. Flip the LOGGER switch to ON to start the collection (**All data must be collected in a single session. Do not stop the logger until all group members have taken data.**)
4. Keep track of how long you acquire data to verify that the maximum collection time was not exceeded (~3.5 minutes).
5. You stop collecting data by flipping the LOGGER switch OFF.
6. Turn off the BATT switch.

III. Downloading the data:

1. Reconnect the data logger to the computer. Select the options “**Receive**” then “**Data**” from the main menu. A new window will appear asking for a

filename and a location for it to be saved to. Save to a unique file on your network drive. The software will communicate with the data logger and will download the data.

2. Click **“Yes”** when it asks to display the data on a plot. Under the **“Change”** menu, select **“Viewports.”** Hide the channels that are not of interest (*i.e.*, the channel 1 start/stop data in most cases).
3. To export the data for manipulation and further plotting, **from the graph window**, under the **“File”** menu select **“Export”**. Choose **“ASCII”** and click **“ok”**. Then select **“comma separated values”**, **“all points”**, and click on **“Save As.”** When prompted to save the exported data, give it a unique name and save it to your network drive.

3. Dynamic Test

I. Sending a Setup:

1. **Select “Send”** from the main menu. Then **select** the **“Setup”** option. A new setup window will appear:
2. **Type in** the description of the experiment on the **“Session Description”** Option (*i.e.*, **ENG H192 Dynamic Test, Group #N, Bike #**).
3. If the Pocket Logger software has not been restarted since the static test, the setup values should be the same. Otherwise, follow the static test instructions to set the values.
4. **Insure** the logger is connected to the computer via a black data cable and then click on the **“Send”** button to download the settings to the data logger.
5. **Click** on **“OK”** in response to all of the warnings and wait while it loads the setup.
6. *If the computer is unable to communicate with the data logger, flip the LOGGER switch ON then OFF and try the setup procedure again. If it still fails to accept the setup then ASK FOR HELP.*
7. The data logger **is now ready** to record voltage data (and will do so when the LOGGER switch is flipped to ON).
8. **Click** on the ‘Exit’ button to return to the main window. In general, **DO NOT** save changes when asked.
9. **Proceed to either the Indoor or Outdoor dynamic tests, as identified by the lab instructor.**

Ila. Indoor dynamic test:

1. Disconnect the communications cable from the bike.
2. Select the lightest and heaviest members of your group to ride the bike.
3. Prepare to take data in the following manner: (all times are approximate)

- 5 seconds for an unloaded bike
 - 10 seconds for rider 1 in riding position (no pedaling)
 - 45 seconds for rider 1 pedaling with bumps (covered in step 5)
 - Repeat for other team member (**Do not stop the data logger between each step or between each rider.**)
4. Once your team has planned the data collection order, turn on the BATT switch to power the sensors. Flip the LOGGER switch to ON to start the collection (**All data must be collected in a single session. Do not stop the logger until both group members have taken data.**)
 5. During the 45-second riding period, have one team member steady the bike stand. Have a second team member bounce the front fork of the bike to simulate a minor rough ride. (The bike stand is not designed to handle a moving bike, so keep the bouncing to a minimum.)
 6. Keep track of how long you acquire data to verify that the maximum collection time was not exceeded (~3.5 minutes).
 7. You stop collecting data by flipping the LOGGER switch OFF.
 8. Turn off the BATT switch.

IIb. Outdoor dynamic test:

1. Disconnect the communications cable from the bike.
2. Select the lightest and heaviest members of your group to ride the bike.
3. Proceed out to the loading dock area and bring a helmet.
4. Prepare to take data in the following manner: (all times are approximate)
 - 5 seconds for an unloaded bike
 - 10 seconds for rider 1 in riding position (no pedaling)
 - 45 seconds for rider 1 pedaling with bumps (covered in step 6)
 - Repeat for other team member (**Do not stop the data logger between each step or between each rider.**)
5. Once your team is outside and has planned the data collection order, turn on the BATT switch to power the sensors. Flip the LOGGER switch to ON to start the collection (**All data must be collected in a single session. Do not stop the logger until both group members have taken data.**)
6. During the 45-second riding period, ride around the loading dock area and over the 2x4 to simulate minor bumps on the front fork. **The helmet must be worn while riding the bike.**
7. Keep track of how long you acquire data to verify that the maximum collection time was not exceeded (~3.5 minutes).
8. You stop collecting data by flipping the LOGGER switch OFF.
9. Turn off the BATT switch.
10. Return to the lab room to download data.

III. Downloading the data:

1. Return the bike to the bike stand.
2. Reconnect the data logger to the computer. Select the options “**Receive**” then “**Data**” from the main menu. A new window will appear asking for a filename and a location for it to be saved to. Save to a unique file on your network drive. The software will communicate with the data logger and will download the data.
3. Click “**Yes**” when it asks to display the data on a plot. Under the “**Change**” menu, select “**Viewports.**” Hide the channels that are not of interest (*i.e.*, the channel 1 start/stop data in most cases).
4. To export the data for manipulation and further plotting, **from the graph window**, under the “**File**” menu select “**Export**”. Choose “**ASCII**” and click “**ok**”. Then select “**comma separated values**”, “**all points**”, and click on “**Save As.**” When prompted to save the exported data, give it a unique name and save it to your network drive.