

TAIL SUSPENSION

SOF-821

USER'S MANUAL

DOC-006

Rev. 1.3

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Med Associates Inc.
P.O. Box 319
St. Albans, Vermont 05478

Phone: 802.527.2343
Fax: 802.527.5095
www.med-associates.com

notes

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CHAPTER 1 INTRODUCTION

The Tail Suspension test is a technique that is typically utilized to study the effects of anti-depressants on mouse behavior. The primary dependent measure is the time to relative immobility; therefore, the duration and vigor of activity is inferred to be an index of escape persistence.

The Med Associates' Tail Suspension hardware uses a load cell to measure activity, and the load cell interfaces with the Tail Suspension software to represent the activity as a voltage output. The Tail Suspension software records the voltage output as both quantitative and graphical data. Please read through this manual carefully before executing an experiment.

Med Associates, Inc. is committed to providing the scientific community with reliable and innovative behavioral research tools. Please email any comments or inquiries to: sales@med-associates.com.

Thank you for purchasing the Tail Suspension hardware and software. Med Associates, Inc. looks forward to meeting your immediate and future research needs.

CHAPTER 2 SYSTEM SETUP

Software Installation

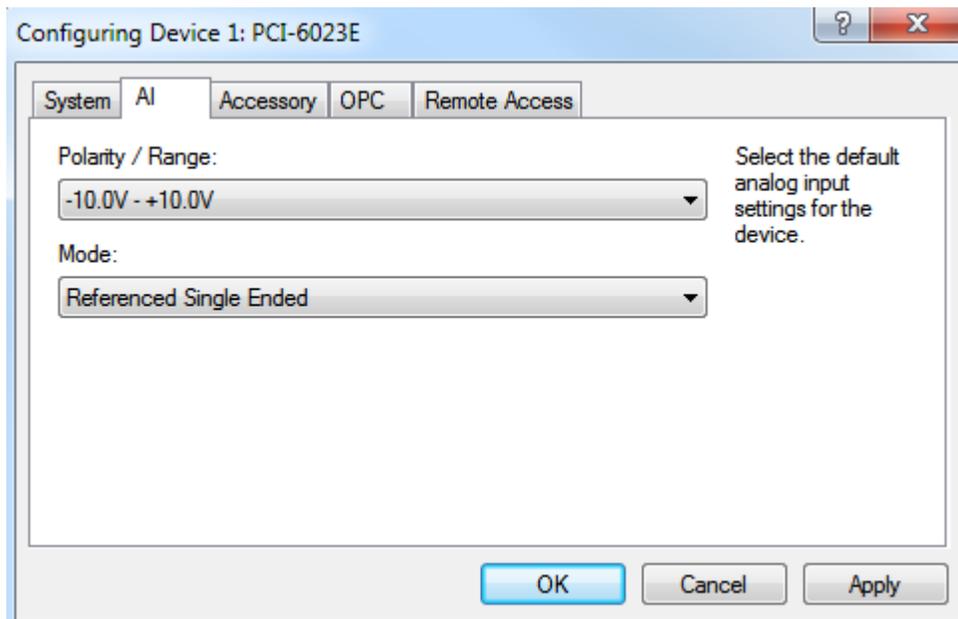
If a complete system was purchased from Med Associates, Inc. the software has been installed and is ready for use, please proceed to the Wiring Guide section.

If Tail Suspension is being installed on a new PC or is being reinstalled, place the CD in the computer's CD drive and click **Install Tail Suspension** when the software splash screen appears. If the CD does not auto-start, navigate to the CD drive in Windows Explorer and double click the "autorun.exe" file to begin the installation and follow the on screen instructions.

DIG-744 Configuration

Once the software and driver installation is complete shut down the PC and install the DIG-744 card according to the directions for installing PCI cards included with the computer. Turn the computer on and run the Measurement & Automation program found on the desktop. Under Devices and Interfaces the PCI-6023E (DIG-744) card will be listed. Click on the PCI-6023E card and click the Properties button. Click on the AI tab and set the mode to Referenced Single Ended, as shown in Figure 2-1. Click OK or Apply and OK to save the configuration change.

Figure 2-1 - Configuring the PCI-6023E (DIG-744) Card



Wiring Guide

A Tail Suspension system will include the following hardware.

Figure 2-2 - Tail Suspension PC

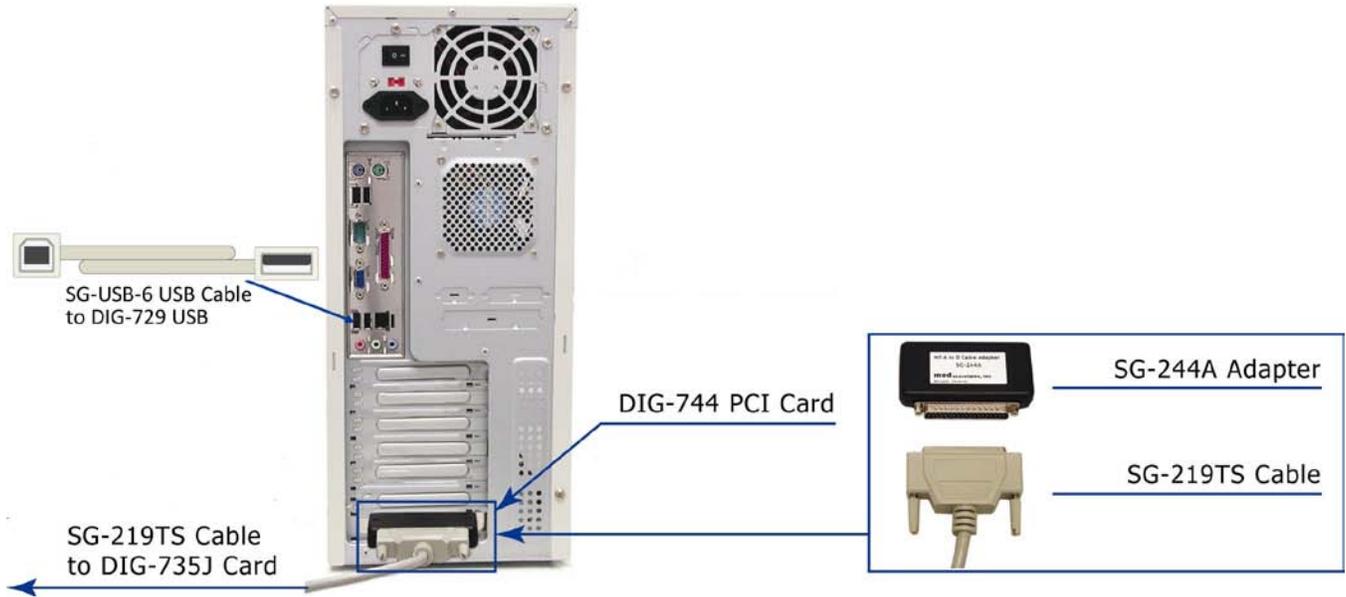


Figure 2-3 - DIG-729 USB Interface

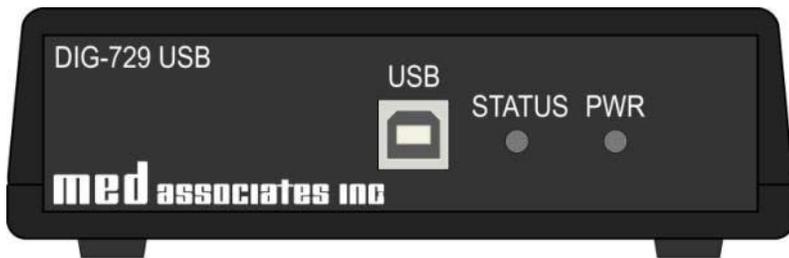


Figure 2-4- Tail Suspension Interface Cabinet



Figure 2-5- ENV-505TS Load Cell Amplifier (one per Tail Suspension chamber)



Figure 2-6 - PHM-300 Tail Suspension Chamber



Follow these steps to assemble your Tail Suspension system:

- 1.) Connect the SG-USB-6 USB cable to any available USB port on the PC and the DIG-729 USB Interface, Figure 2-2.
- 2.) Using the SG-219C-10 or SG-219C-15 control cable connect the DIG-729 USB Interface to the DIG-735J card located in the interface cabinet, Figure 2-3 and Figure 2-4.
- 3.) Attach the SG-244A adapter to the SG-219TS cable (if not attached) and plug the assembly into the DIG-744 PCI card in the PC, Figure 2-2.
- 4.) Connect the SG-219TS cable to the DIG-735J card located in the interface cabinet.
- 5.) Using the SG-219F1 4 pin cable connect the ENV-505TS load cell amplifier (attached to the top of the chamber) to the DIG-735 interface card in the interface cabinet, Figure 2-5. Repeat this step for each chamber in the system.

Note: The DIG-735 interface cards and PHM-300 Tail Suspension chambers are numbered at the factory, this pairing must be kept intact.

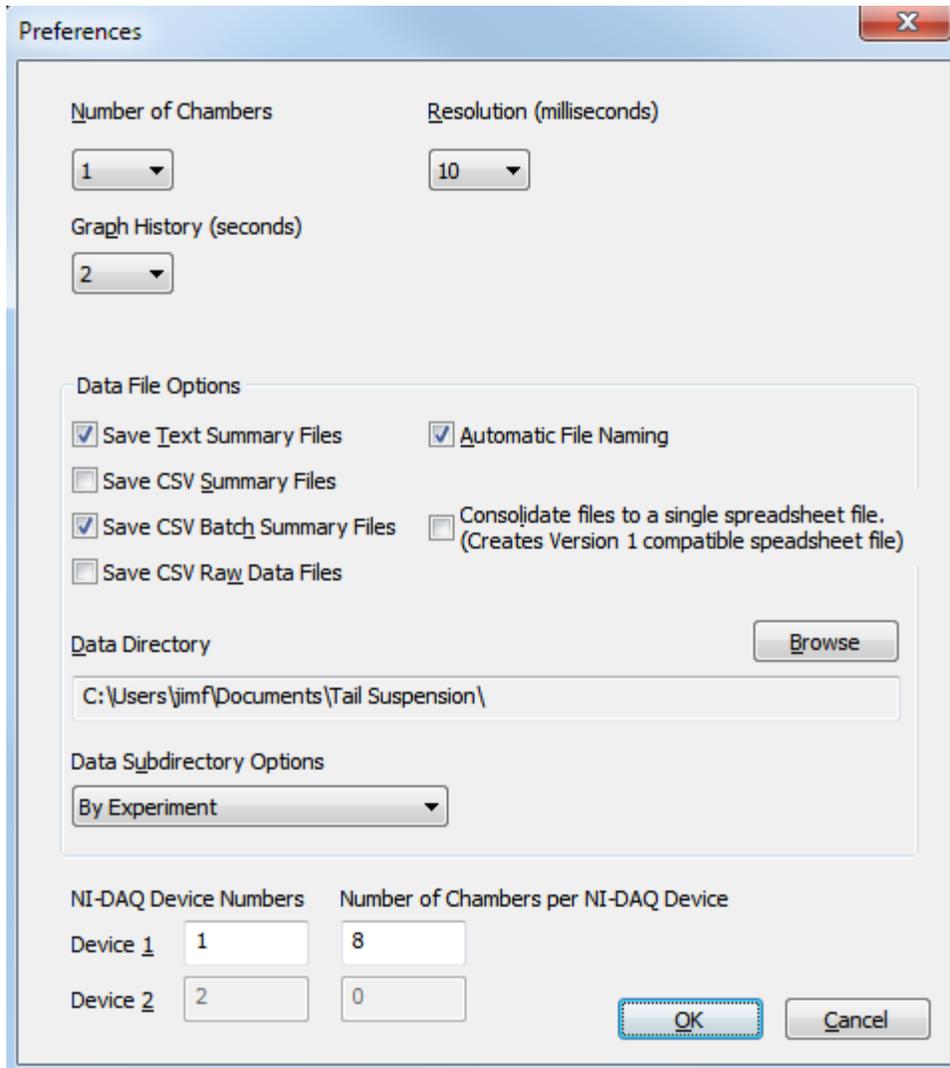
- 6.) Connect the 6 pin cable exiting the back of the chamber to the ENV-505TS amplifier, Figure 2-5 and Figure 2-6. Repeat this step for each chamber in the system.
- 7.) Power on the PC and then using the supplied 6vdc power supply plug in the DIG-729 USB Interface to a wall outlet.

Once power is supplied to the DIG-729 USB Interface, the Found New Hardware Wizard will install the drivers on the PC. The Tail Suspension system is ready for use.

Hardware Setup

Before running an experiment the chamber(s) must be configured. Select **File > Preferences** to access the Preferences screen, Figure 2-7.

Figure 2-7- Chamber Preferences Screen



Number of Chambers Select the number of PHM-300 Tail Suspension chambers that will be used.

Resolution Sets the data acquisition rate in milliseconds per sample. A lower number means a faster sample rate. 10ms is the recommended rate.

Graph History Determines how many seconds of data will be displayed on the screen.

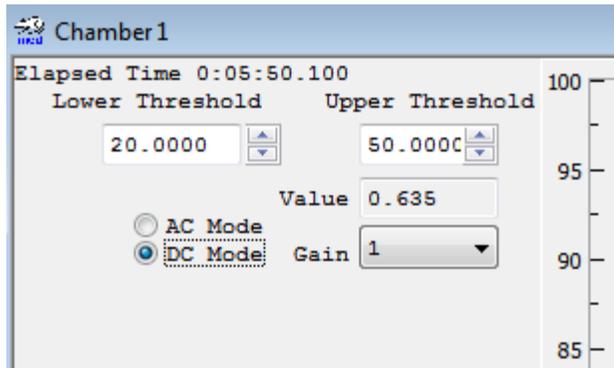
Save Text Summary Files	Saves a text summary file of the experiment. This is the original data file format.
Save CSV Summary Files	Saves a comma separated value (CSV) version of the text summary file. CSV files can easily be imported to Excel or other data handling programs for post-processing.
Save CSV Batch Summary Files	Saves a CSV batch summary file. A batch summary file is a single data file that contains the results of multiple experiments. This is helpful when experiments contain a limited number of data blocks.
Save CSV Raw Data Files	Automatically converts the raw data file to a spreadsheet file when the experiment is complete. By default this setting is turned off as spreadsheet files can be very large and raw data files can be converted to spreadsheet files at any time, by going to Create > Create CSV Raw Data File .
Automatic File Naming	Automatically names the data files based on experiment, group, and subject. If not selected, a file name must be entered manually for each chamber in the Experiment Settings dialog.
Consolidate files to a single spreadsheet file	Exports one spreadsheet file for all chambers that is compatible with version 1 of Tail Suspension software.
Browse (Data Directory)	Sets the directory where all data files are stored.
Data Subdirectory Options :	<p>By Experiment - automatically creates a subdirectory for each experiment, and all data files are saved into the appropriate experiment directory.</p> <p>By Month_Year - automatically creates a subdirectory for each month, and all data files are saved into the appropriate month directory.</p> <p>By Month_Day_Year - a subdirectory is created for each day.</p> <p>None - no subdirectories are created and all data files are saved into the data directory.</p>
NI-DAQ Device Number	Sets the number of the NI-DAQ device (DIG-744 PCI card) to use. The device number is listed in the Measurement and Automation program; typically this number is set to 1

Chamber Calibration

Calibrate each load cell amplifier before starting a new protocol, or when abnormal conditions are detected.

Select **File > Calibrate**, the calibration screen will appear, Figure 2-8.

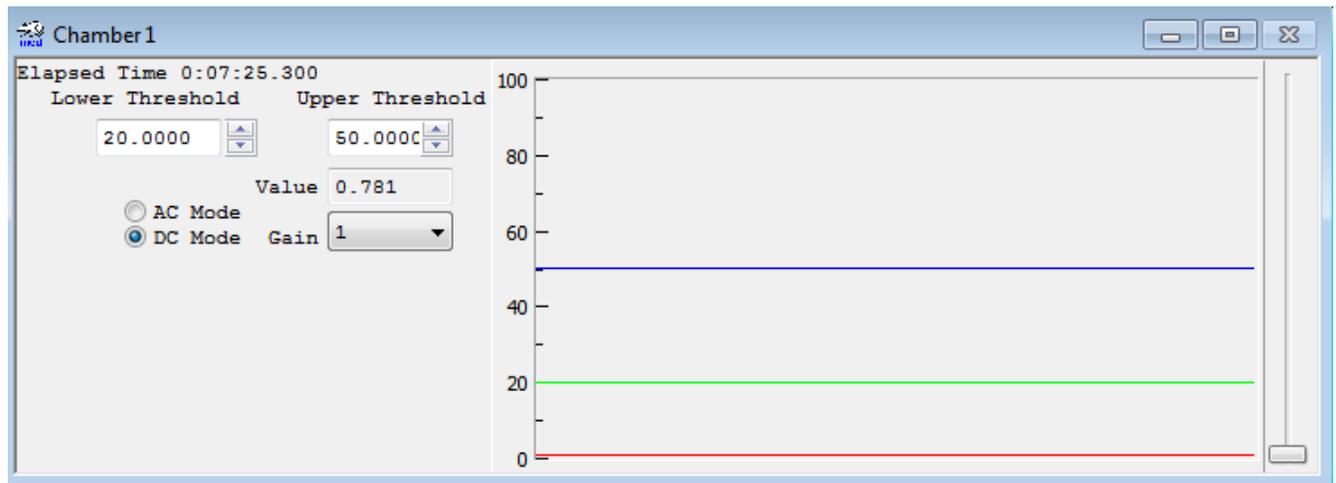
Figure 2-8- Calibration Screen



To calibrate the system:

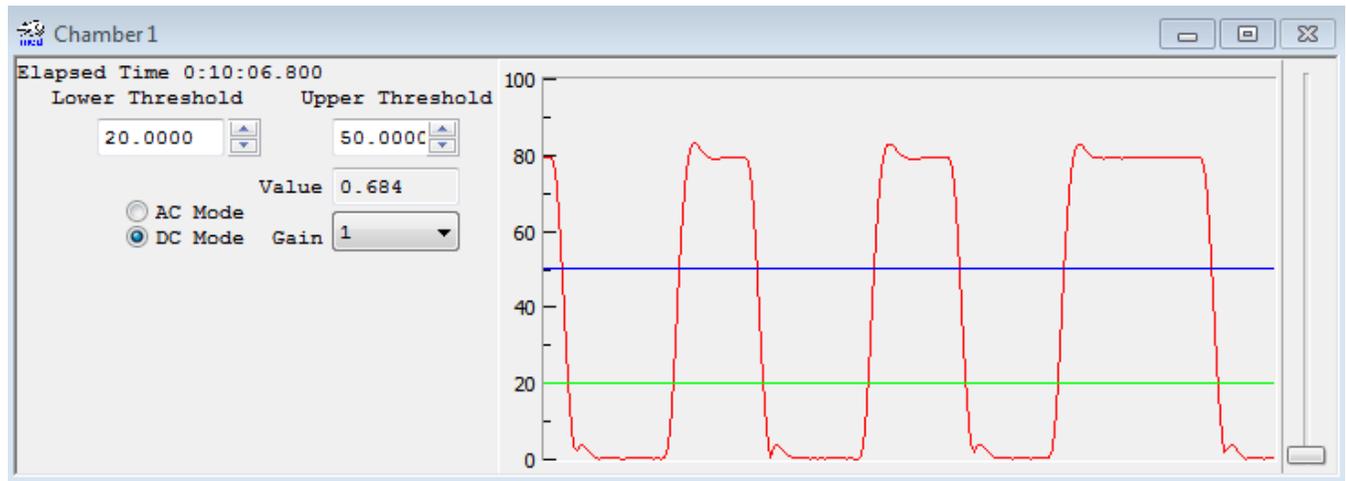
- Set the Gain to 1 and the coupling mode to DC.
- Set the **TEST/RUN** switch on the ENV-505TS amplifier to **RUN** and the **0g/40g** switch to the **40g**.
- With a small slotted screw driver adjust the tare control on the ENV-505TS until the plot value is as close to, but not less than zero. Slow, small movements should be used.

Figure 2-9- Adjusting the Tare Control



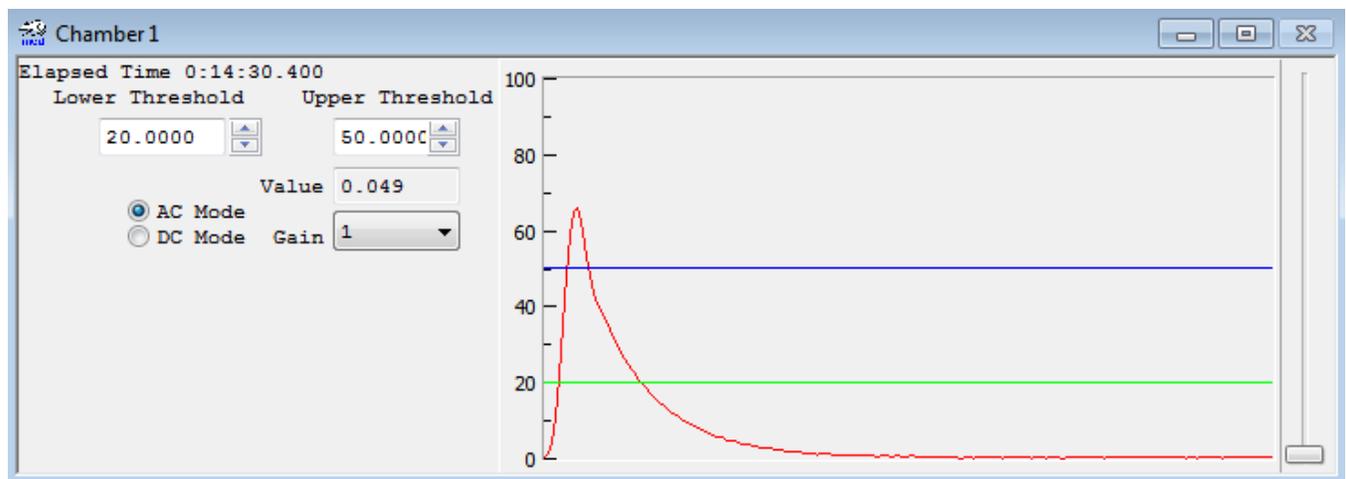
- Increase the Gain to 16, and adjust the tare control again until the plot value is as close to, but not less than zero.
- Switch the Gain back to 1 and the plot line should disappear into the 0 line.
- Set the **TEST/RUN** switch on the ENV-505TS to **TEST**. The display will indicate an 80% (40g) reading. Alternating the **0g/40g** switch will result in an image as shown in Figure 2-10.

Figure 2-10- 0g/40g Test Pulses



- Set the coupling mode to **AC** and the **0g/40g** switch to **40g**. A 40g impulse response that will return to 0g due to the AC coupling should be seen, Figure 2-11.

Figure 2-11- 0g/40g Impulse Response



- Set the **TEST/RUN** switch to **RUN** and leave the **0g/40g** at **40g**. Calibration of the load cell amplifier is complete.

Calibration is a diagnostic procedure intended to verify the functionality of the ENV-505TS load cell amplifier. Calibration cannot verify the functionality of the load cell itself.

To verify load cell functionality, suspend a known weight (1g-50g) from the hanger with the calibration in **DC Mode**. Make sure the weight is motionless and then allow a 15 - 30 sec settling time. Note the displayed value. If the displayed value across multiple chambers differs, and the instructions for load cell amplifier calibration have been followed, please contact Med Associates customer support at support@med-associates.com.

Click **File > Stop Calibration** to exit the calibration mode.

CHAPTER 3 TAIL SUSPENSION SOFTWARE

Dependant Variables

Along with saving raw data, the Tail Suspension Software saves and calculates the following parameters:

Table 3-1 - Dependant Variables

Elapsed Time	The amount of time the chamber has been running
Time Below Lower Threshold	The amount of time that activity took place below the lower threshold
Time Above Lower Threshold	The amount of time that activity took place at or above the lower threshold but below the upper threshold
Time Above Upper Threshold	The amount of time activity took place at or above the upper threshold
Lower Threshold Crossings	The number of times activity took place below the lower threshold and then became greater than or equal to the lower threshold
Upper Threshold Crossings	The number of times activity took place below the upper threshold and then became greater than or equal to the upper threshold
Sum Above Lower Threshold	The sum of the activity data point values below the upper threshold and greater than or equal to the lower threshold
Sum Above Upper Threshold	The sum of the activity data point values above or equal to the upper threshold

Menu Options

File menu options

Table 3-2 - File Menu Options

Preferences	Set the number of chambers, resolution, graph history size, data file options, the data storage directory
Calibrate	Calibrate the inputs for each chamber
Exit	Exit the Tail Suspension program

Experiment menu options*Table 3-3 - Experiment Menu Options*

Start Experiment	Displays the experiment form and allows the experiment to be started.
Start Chambers	Start the currently configured chambers
Stop Chambers	Stop currently running chambers and saves the data
Abort Chambers	Abort currently running chambers without saving data
Pause Chambers	Pause currently running chambers
Resume Chambers	Resume paused chambers

View menu options*Table 3-4- View Menu Options*

View Text Summary File	Display summary text data files
View CSV Summary File	Display CSV summary data files
View CSV Batch Summary File	Display CSV batch summary files
View Raw Data File	Display raw data files
View CSV Raw Data File	Display CSV raw data files

Create menu options*Table 3-5 - Create Menu Options*

Create Text Summary File	Creates a text summary file from a raw data file
Create CSV Summary File	Creates a CSV summary file from a raw data file
Create CSV Batch Summary File	Creates a CSV batch summary file from a set of raw data files
Create CSV Raw Data File	Creates a CSV raw data file from a raw data file

NOTE: CSV (Comma Separated Value) file format is a common spreadsheet format that can be viewed using any spreadsheet application.

Color menu options*Table 3-6 - Color Menu Options*

Input	Changes the color of the load cell trace
Upper Threshold	Changes the color of the upper threshold line
Lower Threshold	Changes the color of the lower threshold line

Window menu options*Table 3-7- Window Menu Options*

Cascade	Stack multiple open windows on top of each other
Tile	Tile open windows next to each other
Arrange Icons	Organizes minimized windows

CHAPTER 4 RUNNING AN EXPERIMENT

Start by choosing **Experiment > Start Experiment** to open the Experiment Settings screen, Figure 4-1.

Figure 4-1- Experiment Settings Screen

Choose an existing experiment from the Experiment ID drop down list or add a new experiment with the **Add Experiment** button and the Add Experiment window will open. Enter an experiment ID, Figure 4-2, and click **OK** to save this Experiment ID.

Figure 4-2- Add Experiment Window

Select the **Modify Experiment** button to set the experiment time and threshold settings, Figure 4-3.

Figure 4-3- Modify Experiment Screen

Experiment Time - Enter the length of the experiment and choose seconds or minutes.

Upper & Lower Thresholds – Tail Suspension implements three timers to record

- 1.) Time spent below the lower threshold
- 2.) Time spent above the lower threshold, but below the upper threshold
- 3.) Time spent above the upper threshold.

Most researchers are interested in immobility as defined by only the lower threshold. Therefore, set the lower threshold to a level that differentiates immobility from mobility according to the researcher’s specifications.

The upper threshold may be used to distinguish moderate immobility when there is a greater level of activity. If this is not desired, it is recommended to set the upper threshold to 100.

Block Time - The duration of user-defined “block” intervals within the session. Adjust the **Number of Blocks** to divide the Experiment Time into components (“blocks”) that can be statistically analyzed at a later time. The total number of blocks that will be written to the summary file is displayed in the **Number of Blocks** box.

Start Trigger – If a start trigger is set, the software will automatically start the timer and data collection when the start trigger value is met or exceeded. The trigger will only happen after the Start

button, Figure 4-4, has been pressed. It is recommended to use the lower threshold value, or slightly lower, as the start trigger value. Enter zero in the Start Trigger box to disable this feature.

Gain – The gain will amplify the signal from the load cell by the value selected. Generally the gain will be increased for smaller/lighter animals.

Once the experiment parameters are defined, click **OK** to return to the Experiment Settings screen. Enter the information for **Group** and **Subject ID**, and add any **Subject Info** or **Comments** to be saved in the data file. If utilizing more than one tail-suspension chamber, select **Copy data to all chambers**. This option will save Experiment ID and Group ID to all chambers, but Subject ID and other subject-specific information will need to be entered for each chamber.

From the experiment settings screen, Figure 4-1, click **Start Experiment**. The **Select Chamber to Start** screen will appear, Figure 4-4. Choose the chamber(s) to be started and click **Start** and data acquisition will begin.

Figure 4-4- Select Chamber to Start

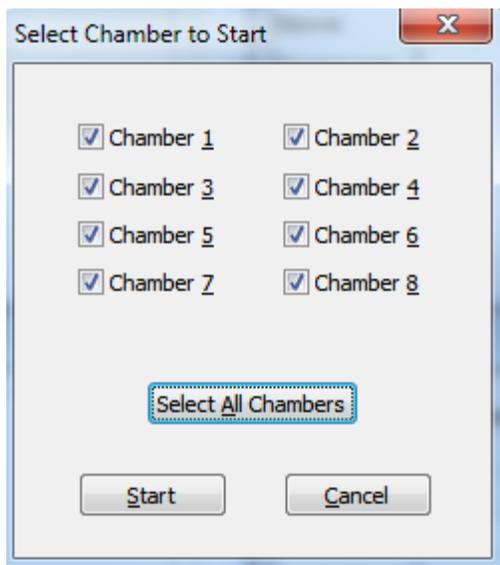


Figure 4-5- Multiple Experiments Running

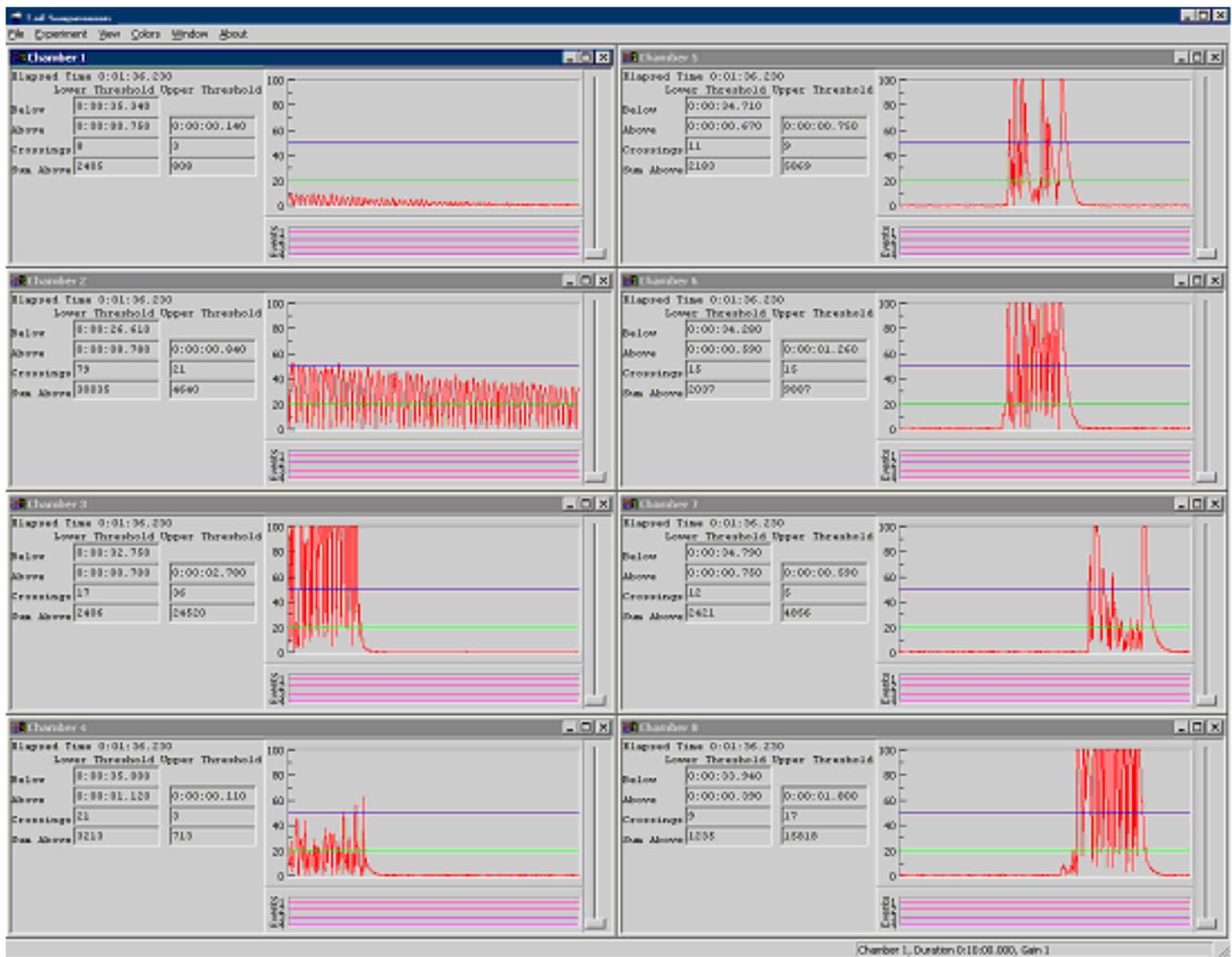
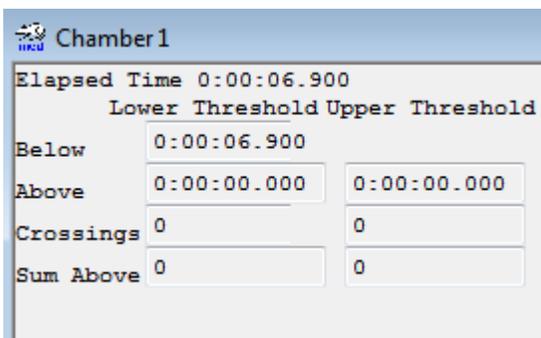


Figure 4-5 is an example of the Tail Suspension software screen with 8 chambers running. Figure 4-6 is an expanded view of the data details block displayed for each chamber as an experiment is running.

Figure 4-6- Experiment Detail Information Block



Elapsed Time - How long the experiment has been running.

Below and **Above** - Refer to the amount of time in seconds spent below and above each threshold for the current_block (see **Block Time**).

Crossings - The number of times the plot crossed above and then below Lower Threshold or Upper Threshold for the current block.

Sum Above - The cumulative total of the data points above each threshold. This number depends on the resolution value set on the Experiment Preferences screen.

To stop a chamber before an experiment is complete, click **Experiment > Stop Chambers**. A screen similar to Figure 4-4 will display. Select the chamber(s) to be stopped and click **OK**. Selecting **Cancel** will return to the main Experiment screen without stopping any chambers.

NOTE: Once a chamber is stopped it should not be restarted. Restarting a chamber will invalidate the raw data file. To stop and then restart the chamber, use the **Pause** option.

To pause a currently running chamber, click **Experiment > Pause Chambers**. A screen similar to Figure 4-4 will display. Select the chamber(s) to pause and click **Pause**. Clicking **Cancel** will return to the main Experiment screen without pausing any chambers. While a chamber is paused, no data is recorded and the clock is stopped.

To restart a paused chamber, click **Experiment > Resume Chambers**. A screen similar to Figure 4-4 will again be displayed, select the chamber(s) to continue, and click **Resume**. **Cancel** will return to the experiment runtime screen leaving the chambers paused.

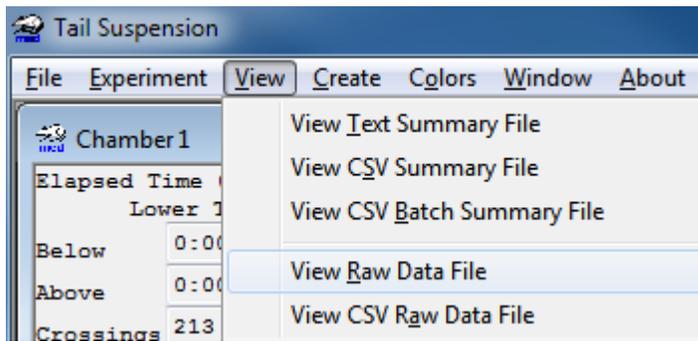
To display the runtime graph for several chambers simultaneously, click **Window > Tile**.

CHAPTER 5 DATA ANALYSIS

Accessing Tail Suspension Viewer

To access the Tail Suspension Viewer utility, start the Tail Suspension program and click **View > View Raw Data File**, Figure 5-1.

Figure 5-1- Accessing Tail Suspension Viewer



In the File Open dialog box select the desired raw data file and it will be opened in Tail Suspension Viewer. Once Tail Suspension Viewer is open, additional files may be opened by clicking **File > Open Data File**.

Tail Suspension Viewer Menu Options

File Menu

Open Data File Opens a Tail Suspension raw data file

Close Data File Closes a data file

Print Prints current screen

Import Imports previous versions of Tail Suspension data files

Exit Exits the program

Controls Menu

Play Scrolls forward through the data file

Pause Stops scrolling of the data file

Rewind Scrolls in reverse through the data file

Fast Forward Scrolls forward at 10x speed

Fast Reverse Scrolls in reverse at 10x speed

Beginning Returns to beginning of data file

End Goes to end of data file

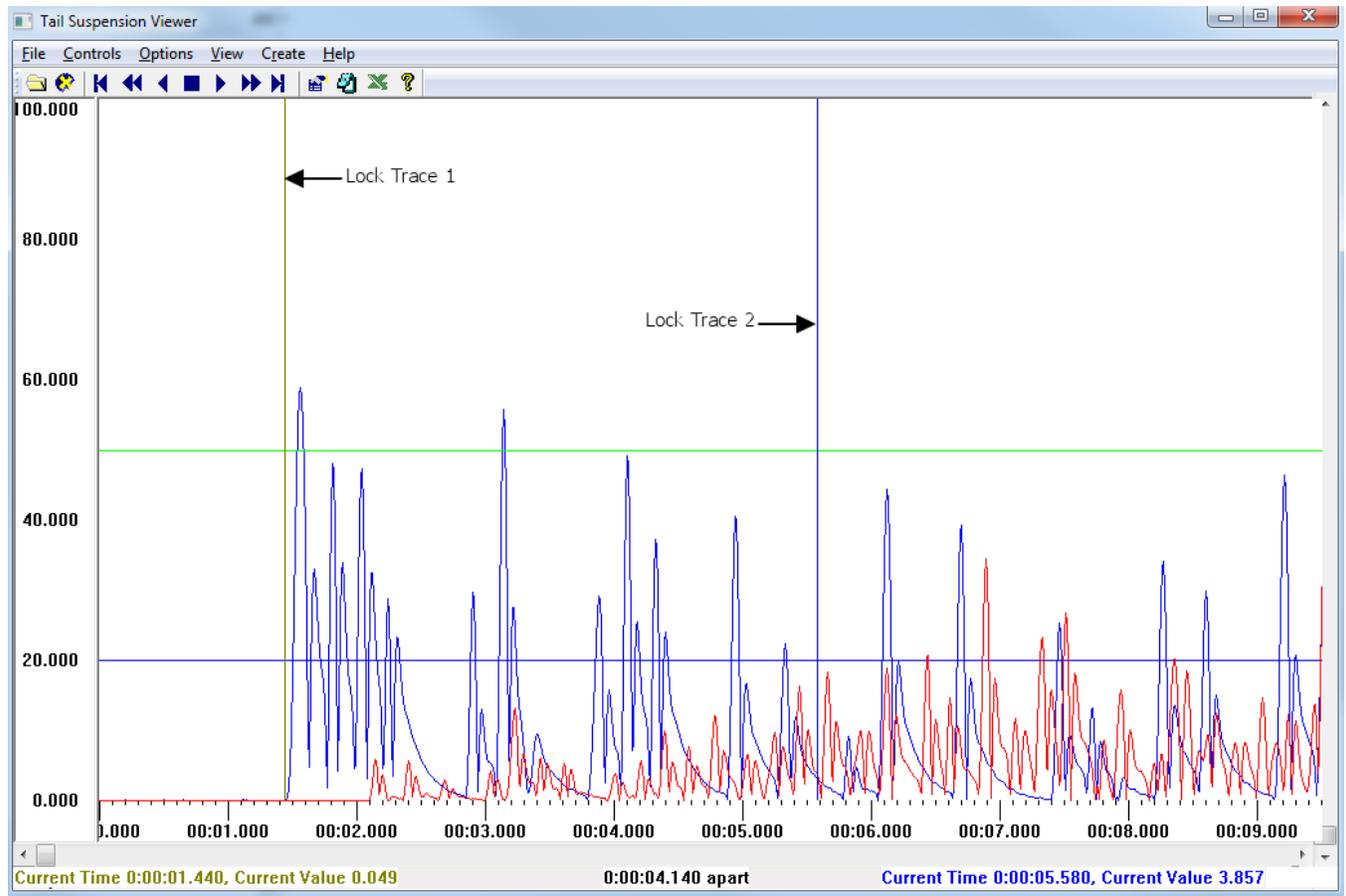
Refresh	Refreshes the screen
Options Menu	
Colors	Modifies the color of the thresholds, tracking and data lines
Current File	Selects the current file for playback only
View Menu	
File Information	Displays information about the open files and allows recalculation of threshold parameters
Zoom	Changes the scale of the data graph.
Tracking	Turns the Tracking Line (Trace 2) on and off
Lock Trace 1	Locks the Trace 1 position. When locked, Trace 1 will not change unless manually moved. When not locked the Trace 1 position will change as the file is viewed
Lock Trace 2	Locks the Trace 2 position
View Text Summary File	Displays summary files
View CSV Summary File	Displays CSV summary files
View CSV Batch Summary File	Displays CSV batch summary files
View CSV Raw Data File	Displays CSV raw data files
Create Menu	
Create Text Summary File	Creates a text summary file from a raw data file
Create CSV Summary File	Creates a CSV summary file from a raw data file
Create CSV Batch Summary File	Creates a CSV batch summary file from a set of raw data files
Create CSV Raw Data File	Creates a CSV raw data file from a raw data file

Help Menu

Displays program information and Tail Suspension version number.

Tail Suspension Viewer Screen

Figure 5-2- Viewer Screen Showing Two Data Files



Trace Lines 1 and 2

Click and drag trace lines 1 and 2 (if enabled) to the desired location in the data viewer to display the current location's value and time in the bottom status bar. Trace line 1's data is displayed in the lower left corner of the status bar and line 2's data is displayed in the lower right corner of the status bar.

Tracking

Enabling/disabling **Tracking** in the Options menu turns trace line 2 on and off. When tracking is enabled the status bar will also indicate the time between the trace lines. Note example above in Figure 5-2: "0:00:04.140 apart".

Zoom

To enlarge the size of the viewer graph click **View > Zoom** and select one of the available scale factors from 0.1 – 20.

To zoom the graph along the x-axis make sure the **View > Zoom > X-Axis** is checked. When the zoom value is less than 1, View > Zoom > X-Axis is automatically checked.

Viewing Multiple Chambers

When a raw data file is open in the Tail Suspension Viewer, click **File > Open** to select other data files to view. The different plots will show in the view window and will track together when **Controls > Play** is selected. Figure 5-2 shows two different data files displayed in the Tail Suspension Viewer by a blue trace and a red trace.

It is helpful to modify the colors of the lines to distinguish the results between subjects. Select **Options > Colors** and select a data file. Choose a color to represent the selected data using the **Color** window and press **OK**.

Replaying the Experiment

The buttons at the top of the screen control the playback of the data file. The controls are:

-  Jumps to the beginning of a raw data file.
-  Scrolls backward in time at a fast speed until stopped, or the beginning of the file is reached.
-  Scrolls backward in time at a normal speed until stopped, or the beginning of the file is reached.
-  Stops scrolling.
-  Scrolls forward in time at a normal speed until stopped, or the end of the experiment is reached.
-  Scrolls forward in time at a fast speed until stopped, or the end of the experiment is reached.
-  Jumps to the end of a raw data file.
-  Displays the File Information screen.
-  Open a text based summary file
-  Open a .csv batch summary file
-  Displays the Tail Suspension Viewer About screen.

Closing the Raw Data File

Files are closed automatically when the viewer is exited with **File > Exit**. If multiple files are being viewed on the same graph, the **File > Close Data File** option will allow the user to select which data files to close.

CHAPTER 6 VIEWING EXPERIMENT SUMMARY INFORMATION

Summary Data Files

The various summary files that are generated can be selected in the **File > Preferences** window.

To view experiment summary information, click **View > Test Summary File** and select a data file. The summary data are automatically opened in Microsoft WordPad®. The first row of the file lists the date and time on which the experiment was completed. Subject, session, and other identifying information are then listed, followed by the independent variables (e.g. experiment length and block time).

The dependent variables are listed in the section titled **Summary Blocks**. The time above and below each threshold, the number of threshold crossings, and the sum above each threshold are listed for each block.

Sample Text Summary File

Printed on : 07/03/2014 08:56:05

Tail Suspension Summary, Version 3.5.0.0

Experiment ID: Badger Test 7-3-14

Group ID :

Subject ID : Badger

Subject Info :

Comment :

Session # : 1

Experiment Length : 120 seconds

Block Time : 30 seconds

Number of Blocks : 4

Experiment Date and Time : 07/03/2014 08:54:04

Actual Run Time : 0:02:00.000

Resolution : 10 milliseconds

Upper Threshold : 50.000

Lower Threshold : 20.000

-----Summary Blocks-----

Block Number 1

Time Below Lower Threshold : 0:00:26.420

Time Above Lower Threshold : 0:00:03.450

Time Above Upper Threshold : 0:00:00.130

Lower Threshold Crossings : 83

Upper Threshold Crossings : 3

Sum Above Lower Threshold : 10051.5

Sum Above Upper Threshold : 737.6

Block Number 2

Time Below Lower Threshold : 0:00:20.240

Time Above Lower Threshold : 0:00:08.980

Time Above Upper Threshold : 0:00:00.780
 Lower Threshold Crossings : 172
 Upper Threshold Crossings : 33
 Sum Above Lower Threshold : 27854.2
 Sum Above Upper Threshold : 4261.8

Block Number 3

Time Below Lower Threshold : 0:00:16.700
 Time Above Lower Threshold : 0:00:12.760
 Time Above Upper Threshold : 0:00:00.540
 Lower Threshold Crossings : 199
 Upper Threshold Crossings : 20
 Sum Above Lower Threshold : 40219.2
 Sum Above Upper Threshold : 3076.1

Block Number 4

Time Below Lower Threshold : 0:00:14.630
 Time Above Lower Threshold : 0:00:13.900
 Time Above Upper Threshold : 0:00:01.470
 Lower Threshold Crossings : 217
 Upper Threshold Crossings : 39
 Sum Above Lower Threshold : 45087.8
 Sum Above Upper Threshold : 9610.1

CSV Summary File

The CSV (comma separated value) summary data files are the same as the text summary file format shown above, except using commas as column separators for easy opening in a spreadsheet program.

CSV Batch Summary File

The CSV batch summary files created by Tail Suspension contain the summary data from multiple experiments in an easy to read format that is understood by most spreadsheet programs.

CSV Raw Data File

The CSV raw data files created by Tail Suspension contain the raw data in a ready-to-import format that can be read by most spreadsheet programs. Following is part of a sample CSV file.

The first value in each row is the raw value. The raw value is the voltage read by the DIG-744 (NI-DAQ card) at every time point (defined by **Resolution**) multiplied by 10, and the raw value is always between -100.000 and 100.000.

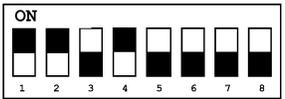
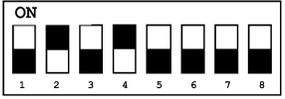
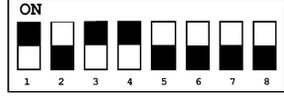
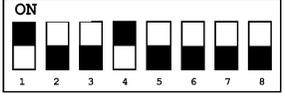
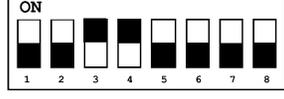
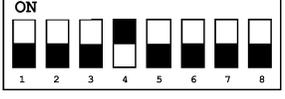
0.195
 0.324
 1.113
 2.644
 2.257
 1.045

CHAPTER 7 DIG-735 INFORMATION

DIG-735 Dip Switch Settings

The DIG-735 has a dip switch labeled SW1 used to set the address of each card that corresponds to the chamber number. The cards and chambers are configured and labeled prior to shipping. Should the address of a DIG-735 need to be changed, the following settings should be used.

To access the dip switch, turn off the power to the interface cabinet, and remove the DIG-735 card from the interface cabinet. Use the following table to set each DIG-735 card with the appropriate address. The black squares represent the switch position.

Chamber#	JP2 (Jumper) Setting	Chamber#	JP2 (Jumper) Setting
1		5	
2		6	
3		7	
4		8	

The Integration Switch

The integration switch sets the signal integration to be either on or off. Signal integration is used to smooth the response signal. For example, when the subject is struggling, the raw signal (integration off) will swing back and forth from zero. This may cause many threshold crossings and increment the time below threshold, when the animal is not actually freezing. With the integration on, the raw signal is integrated over time, so when the subject is struggling the signal will stay high. Only when the subject is truly not moving will the signal go to zero. Experiment with this switch to see which setting works best.

The High-Pass Filter

The DIG-735 features an adjustable high-pass filter that can be adjusted by turning the knob on the DIG-735 module. This filter can be used for getting rid of low frequency artifacts and any DC drift from the load cell. The default position for the switch is 1 Hz. Experiment with this filter to see which setting works best.

APPENDIX A CONTACT INFORMATION

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

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

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