

## Fitness Assessment – Fat Burning Zone

### Equipment Required

PC or Mac Computer and USB cable  
IX-TA data acquisition unit and power supply  
A-FH-1000 Flow head with flow head tubing  
A-GAK-201 Reusable mask and non-rebreathing valve  
6ft smooth bore tubing (35mm I.D.)  
5 Liter Mixing Chamber  
iWire-GA CO<sub>2</sub>/O<sub>2</sub> Gas Analyzer with filter and Nafion gas sample tubing  
A-CAL-200 Calibration kit  
ANT+ Heart rate monitor  
Treadmill with adjustable speed and gradient or Fitness Bike  
3 Liter Calibration syringe

### Background

The ‘fat burning zone’ is a theory that you should maintain your heart rate at just 70 – 80% of your maximum heart rate during exercise to burn more fat.

The fat burning zone theory seeks to help people lose weight by tapping into the body’s fat storage rather than its carbohydrates. It is assumed that the body burns a greater percentage of fat with lower-intensity exercises than at higher intensities because the body does not require ‘fast energy’ from carbohydrates. As such, this theory promotes longer and lower-intensity cardio workouts that maintain your heart rate within the ‘fat burning zone’.

However, that is a bit of a misconception. While it is true that the body burns fat during low-intensity workouts, the fat burning rate remains low and you have to exercise longer to burn the same amount of calories you would at higher intensities.

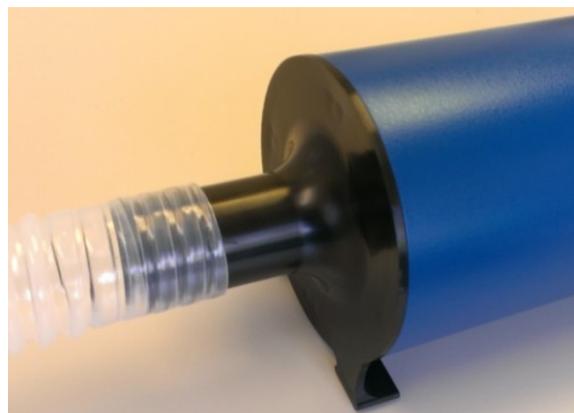
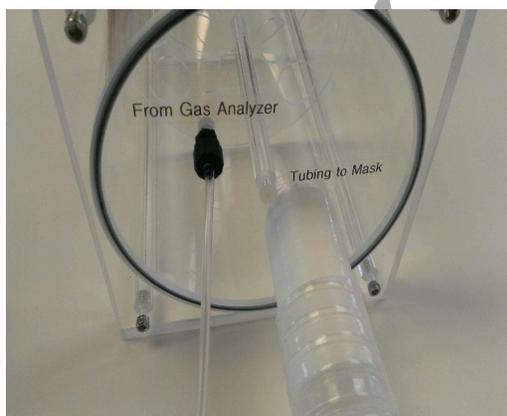
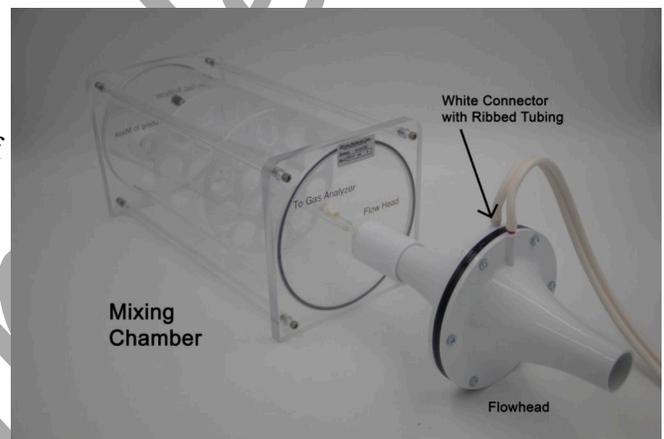
In a high-intensity workout, although your body uses your stored carbohydrates (glycogen) first for ‘fast energy’, it depletes this rapidly enough to force your body to tap into your fat storage. This means that high-intensity workouts are more efficient in burning way more **total** calories – both glycogen calories and fat calories. Ultimately, the total number of calories you burn leads to the most weight (and fat) loss.

## Setup the IXTA and the iWireGA

1. Place the IXTA on the bench, close to the computer.
2. Use the USB cable to connect the computer to the USB port on the rear panel of the IXTA.
3. **Connect the iWire-GA unit to the front of IXTA using the iWire-1 port.**
4. Plug the power supply for the iWire-GA into the electric outlet. Insert the plug on the end of the power supply cable into the labeled socket on the rear. Use the power switch to turn on the unit. Confirm that the power light is on.
5. Plug the power supply for the IXTA into the electrical outlet. Insert the plug on the end of the power supply cable into the labeled socket on the rear of the IXTA. Use the power switch to turn on the unit. Confirm that the power light is on.

## Setup the Metabolic Cart

1. Locate the A-FH-1000 flow head and tubing in the iWorx kit.
2. Plug the flow head tubing into channel A1 of the IX-TA, matching the colors.
3. Connect the other end of the flow head tubing to the flow head, making sure that the ribbed side of the tubing connects the red marked port on the flow head.
4. Locate the mixing chamber in the iWorx kit.
5. Connect end of the flow head to the flow head port of the mixing chamber, making sure that the white port faces the mixing chamber. Make sure the tubing is in an upright direction.
6. Locate the non-rebreathing valve, mask, and smooth bore tubing in the iWorx kit
7. Attach one end of the smooth bore tubing to the **“Tubing to Mask”** inlet of the mixing chamber.
8. Attach the other end of the smooth bore tubing to the calibration syringe.

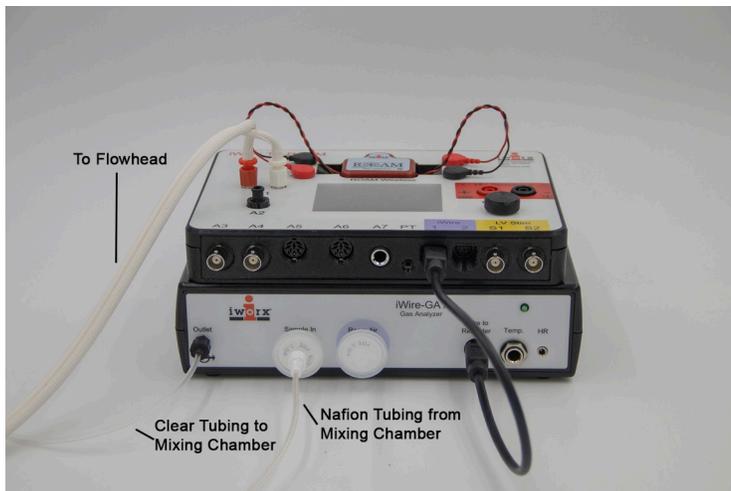


9. Attach the mask to the side port of the non-rebreathing valve, using the provided adaptor, if needed.

*Note: There are arrows on the valve that indicate the direction of air flow. The white port is the inlet and the clear port is the outlet. The Clean Bore tubing will be plugged into the clear port later when testing the subject.*



10. Place the filter on the Sample In port of the iWire-GA in the lower right front corner of the gas analyzer. Attach the braided end of the Nafion sampling tube to the filter.
11. Connect the other end of the Nafion sampling tubing to the white “To Gas Analyzer” port on the mixing chamber near the Flow Head



12. Attach a Clear tubing to the outlet gas analyzer.
13. Attach the other end of the clear gas analyzer tubing to the “From Gas Analyzer” connector on the mixing chamber next to the smooth bore tubing

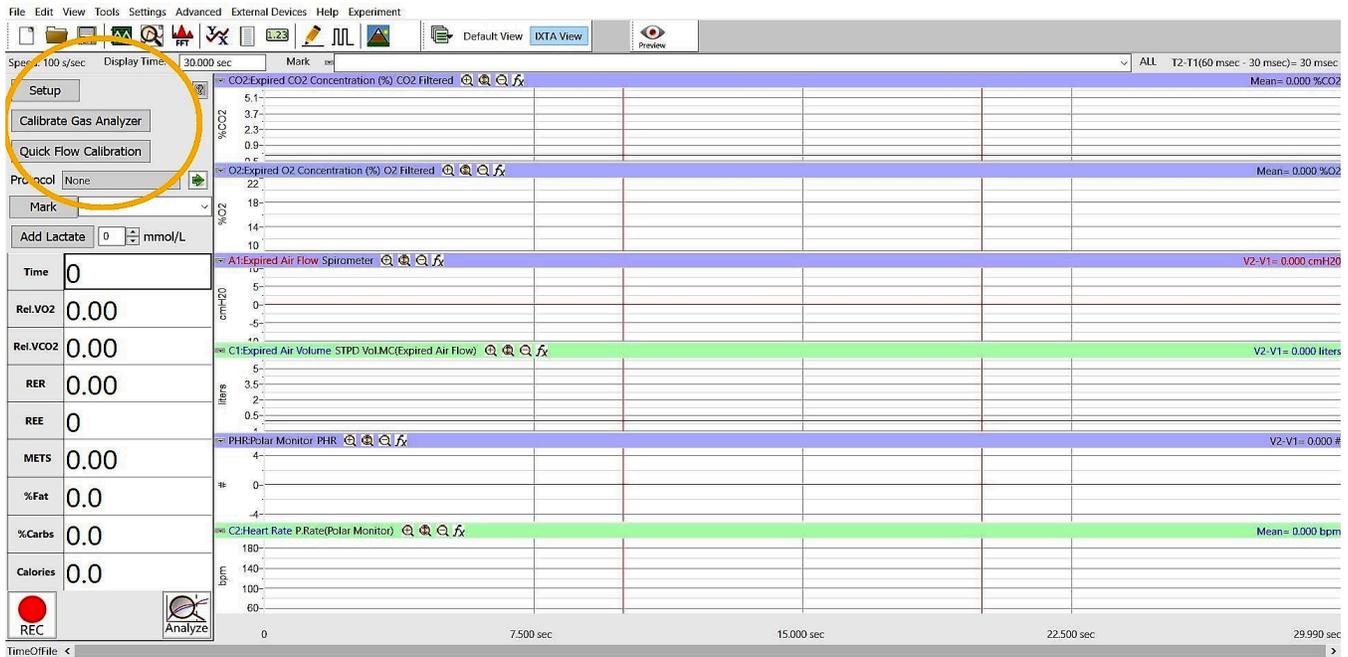


Using the **ANT+ Heart Rate Sensors** such as Garmin HR monitor, Scosche Rhythm+ Heart Rate Monitor Armband, etc.

1. Plug the ANT+ USB dongle into the computer. You should have entered the license number for the ANT+ device in LabScribe, using the External Devices menu, during the initial setup. Enable the ANT+ sensor from the External Devices Menu.
2. Get the ANT+ heart rate sensor ready for use, according to the instructions provided with the sensor.

# Software Setup:

## 1. Load the Fitness Assessment settings.

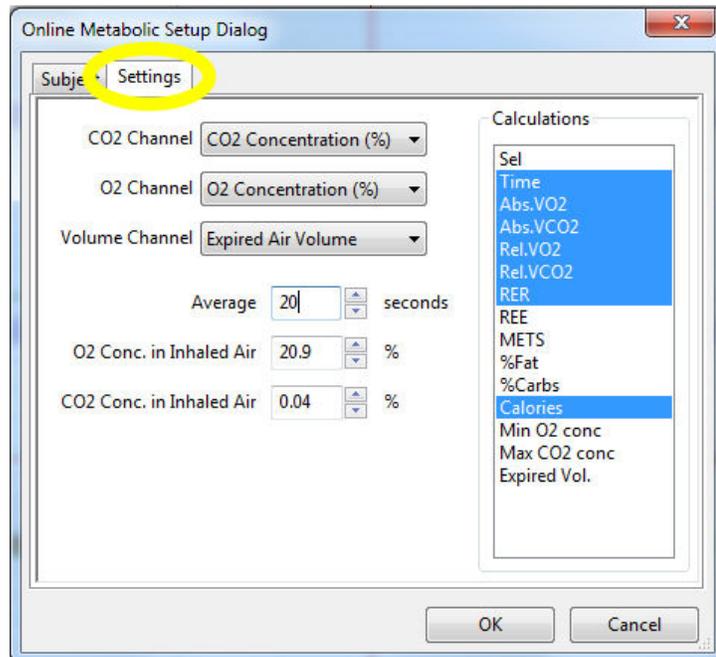


## 2. Click the **Setup** button shown in the left side window. The Online Setup Dialog window will open

- Enter your subject's information or Load a subject from a previously saved file.

The 'Online Metabolic Setup Dialog' window has two tabs: 'Subject' and 'Settings'. The 'Subject' tab is active and contains a 'Load Subject' button. Below it are input fields for 'Name', 'Protocol', 'Age' (30), 'Sex' (Male), 'Height(cm)' (160), 'Weight(kg)' (80), 'Maximum Heart Rate' (200), and 'Blood Pressure' (120 / 70). 'OK' and 'Cancel' buttons are at the bottom right.

- Click “Settings” to change any parameters you wish to view
- Click OK to save the changes.



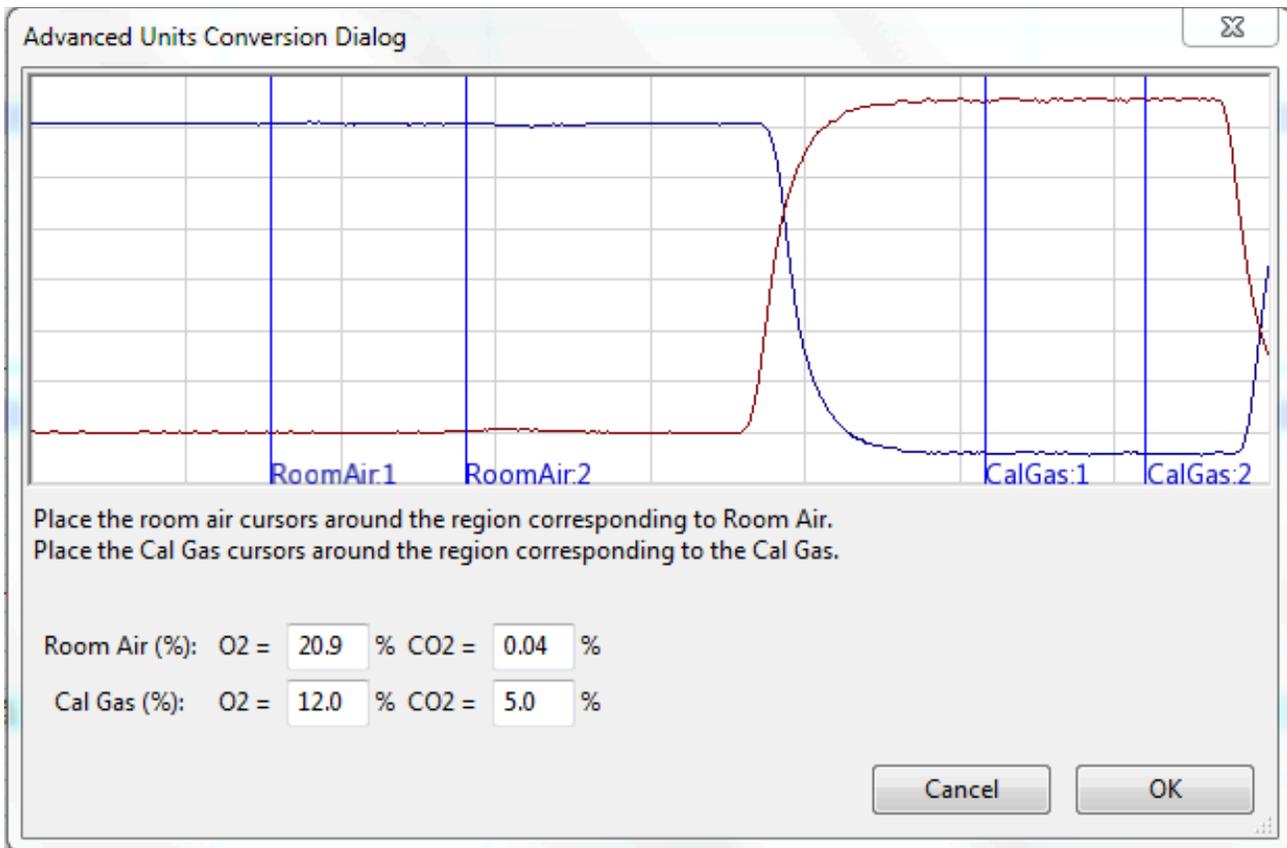
## Calibrating the iWire-GA Gas Analyzer

*Note: Warm up the iWire-GA for at least 15 minutes prior to use. Make sure the calibration gas tank is located close to the Fitness Assessment equipment.*

This procedure will calibrate the O<sub>2</sub> and CO<sub>2</sub> channels.

1. Connect the gas sample tubing of the A-CAL-150 Calibration Kit to the output barbed connector of the gas regulator.
2. Click the **Calibrate Gas Analyzer** button. Click Perform Quick Software Gas Calibration.
3. Follow the directions as prompted. Room air will be sampled for 10 seconds. Calibration gas will be sampled for 20 seconds.
4. If necessary, move the cursors into correct position.
5. Click OK.





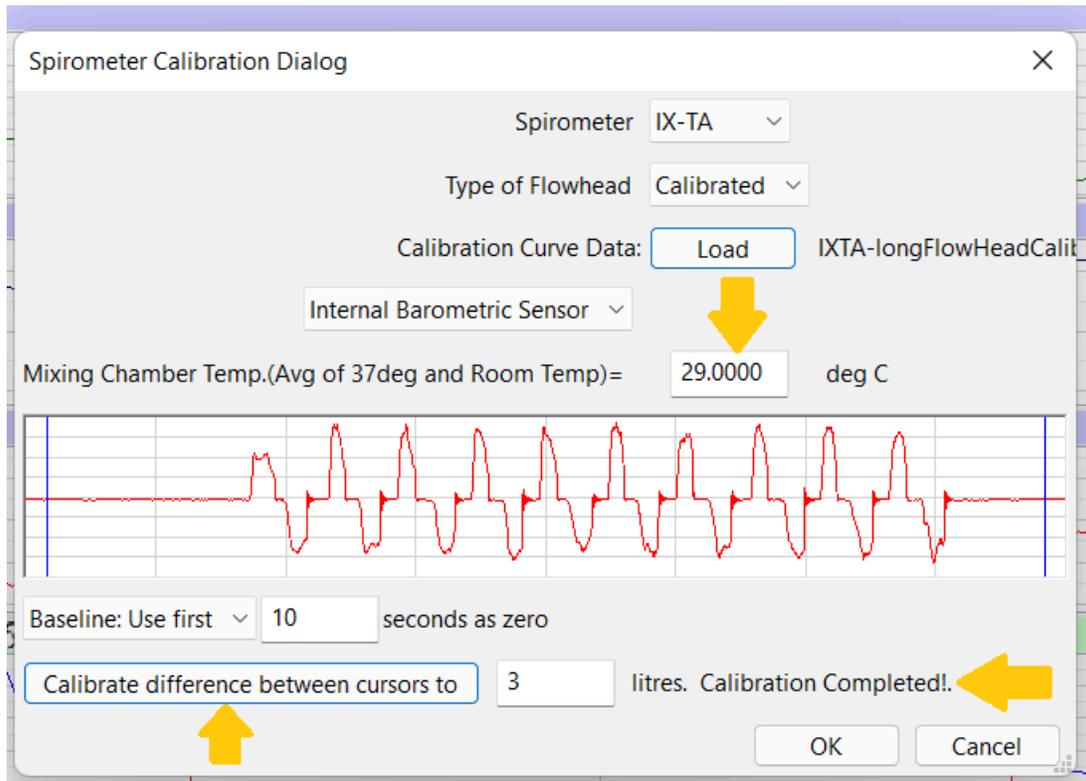
## Quick Flow Calibration :

A pre-saved .iwxgcd (file IXTA-longFlowHeadCalibration) is already loaded for you.

If you prefer, click “Load”, to load the .iwxgcd file created when you performed the optional full flow head calibration.

Perform the Quick Flow Calibration by clicking the button and following the prompted directions as they pop up on the LabScribe Screen.

- After the calibration data has been collected, The Spirometer Calibration dialog window will pop-up.
- Position the two cursors on the flat line to either side of the recording shown.
- Change the temperature to 29 deg C
- Click the 'Calibrate difference between cursors to' button.
- Click OK.



### Prior to performing your test:

Determine the correct concentration of O<sub>2</sub> in the mixing chamber:

- Click on the Preview button.
- Record room air by sampling air through the mixing chamber. Look at the value for O<sub>2</sub> as you record for approximately 10 seconds. It should be reading between 20.7% and 21%.

**NOTE – If the O<sub>2</sub> channel is not reading between 20.7% and 21% - REPEAT the Quick Flow Calibration.**

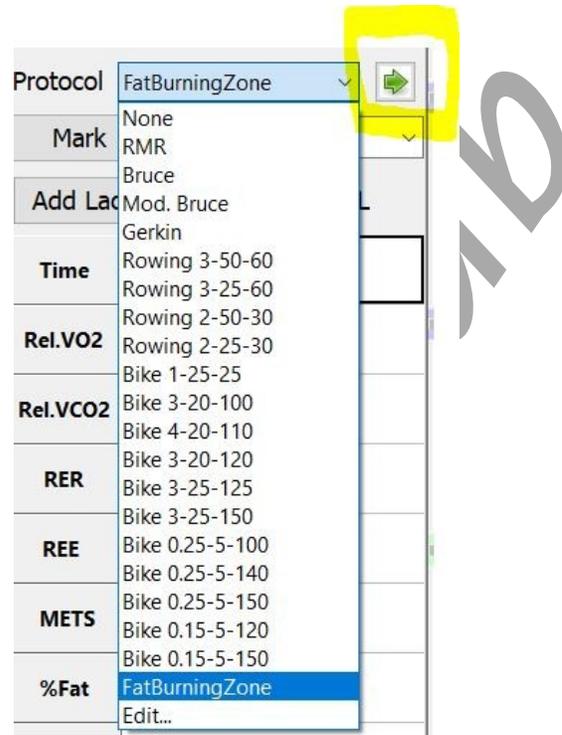
- Click on the Stop button.

Now you are ready to perform your test.

### Performing the Test:

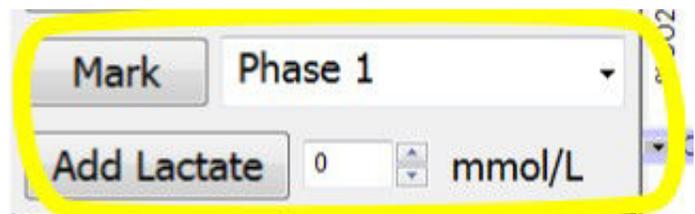
1. Attach the head gear to the mask.
2. Instruct the subject to try on the assembly. Adjust the straps so that the mask fits the subject comfortably. Make sure there are no leaks around the mask.
3. Connect the smooth-bore tubing to the clear outlet of the non-rebreathing valve. There are arrows on the valve that indicate the direction of air flow.
4. Make sure the flaps on the non-rebreathing valve are facing the right way.

5. Remove the smooth-bore tubing from the mixing chamber to record baseline.
6. Choose the Fat Burning Zone Protocol from the Protocol list:



7. Click the Green Arrow to the right of the protocol to start the Exercise
  - The subject will walk for 10 minutes at 1.7 mph
  - The subject will run for 10 minutes at 4.2 mph
8. Wait the 10 seconds at the beginning of the protocol for the system to zero, then reconnect the smooth-bore tubing to the mixing chamber
9. The test has now started

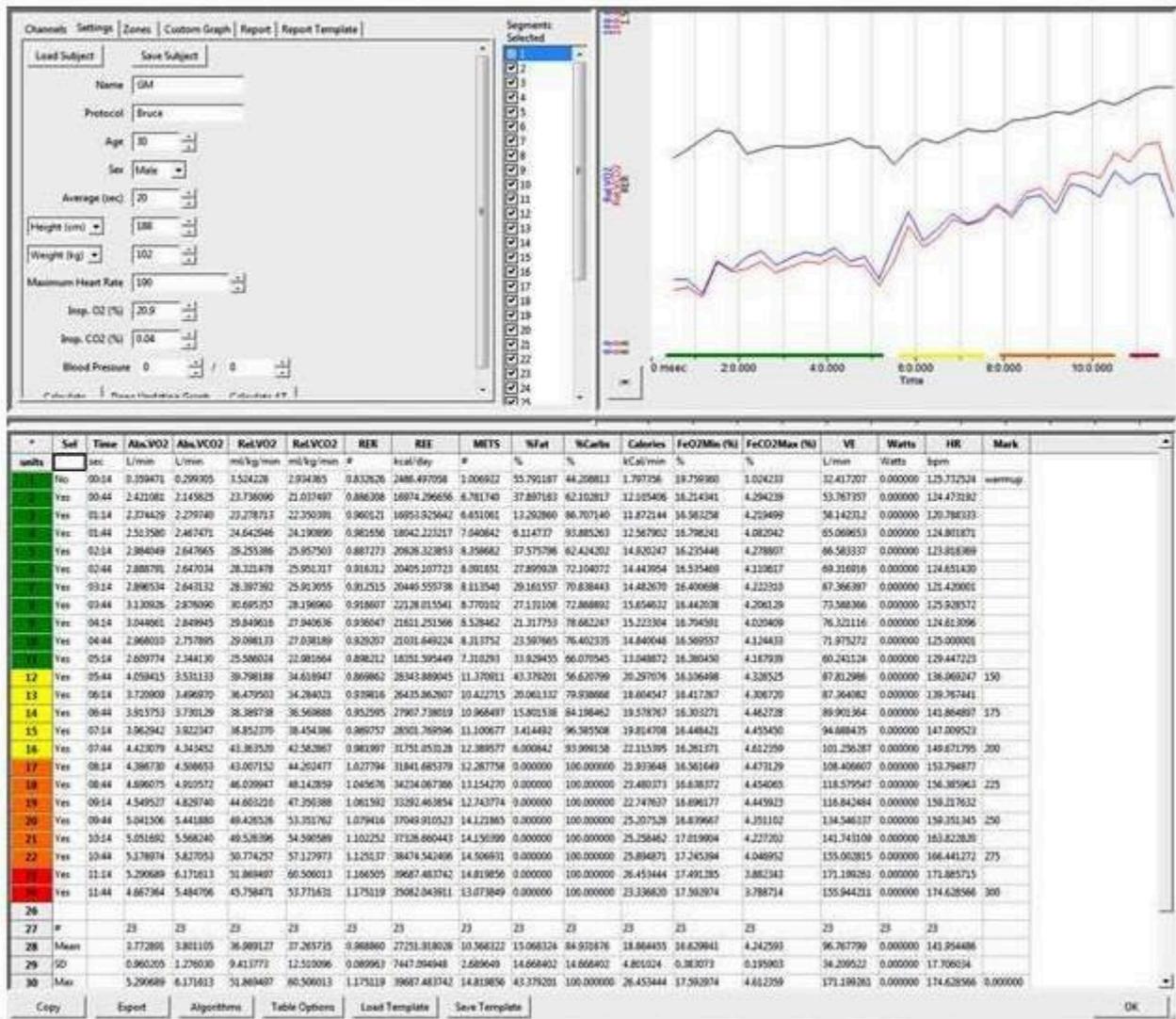
10. The data will automatically be Marked for the protocol chosen. You can make additional marks if you choose by entering text in the text area next to the **Mark** button and clicking on the **Mark** button, or choose one of the preset marks from the drop down list.



11. If lactate values are measured during the test, you may enter them in the record using the **Add Lactate** button.
12. After the 10 minutes of running you can opt to have your subject recover or just Click **Stop**  and then Click Save As to save your data.

# Analyze your data

1. Click **Analyze** to pull up the automated metabolic calculations and chart generator.
2. Make sure channels are set correctly.
3. Click Settings: Your subject information should be automatically populated into the settings.
4. Click Calculate to generate the table as seen below.
5. To generate a Report, click on the Report Tab. Reports can be customized as well.
6. Refer to the metabolic module manual in the LabScribe manual for more information.



Metabolic parameters and plots of  $VO_2$ ,  $VCO_2$ , and RER vs. Time, displayed in the Offline Metabolic Calculations window used to analyze data collected during an aerobic fitness test.

Notice that the  $VO_2$  and  $VCO_2$  values increase quickly as the subject performs more strenuous segments of the test.

## Experiment HN-12: Nerve Conduction Velocity & Hand Dominance

*This lab written with assistance from: Nathan Heller, Undergraduate research assistant; Kathryn Forti, Undergraduate research assistant; Keith K. Schillo, PhD, Associate Professor, Biology Department, SUNY Oneonta, Oneonta, NY*

**NOTE: The experiments in this lab will be completed on BOTH the dominant and non-dominant arms/hands.**

**WARNING** - The Stimulator should only be used for the method of application for which the Stimulator is intended as shown in the directions below. If the subject feels a painful stimuli, then the electrodes are in the wrong place.

*Note: Disconnect the subject from the IXTA prior to powering off the device.*

**NOTE: When using the IXTA and built in HV stimulator – all changes in Amplitude are entered directly into the Stimulator Control Panel as shown in the Setup. Click “APPLY” to make any changes.**

### Exercise 1: Stimulus Strength and Muscle Response in the Dominant Arm.

Aim: To determine the effect of stimulus strength on the response of the innervated muscle in the dominant arm.

Approximate Time: 30 minutes

#### **Procedure**

1. Ask the subject to place their right hand on the bench with the palm up. Tell the subject to relax.

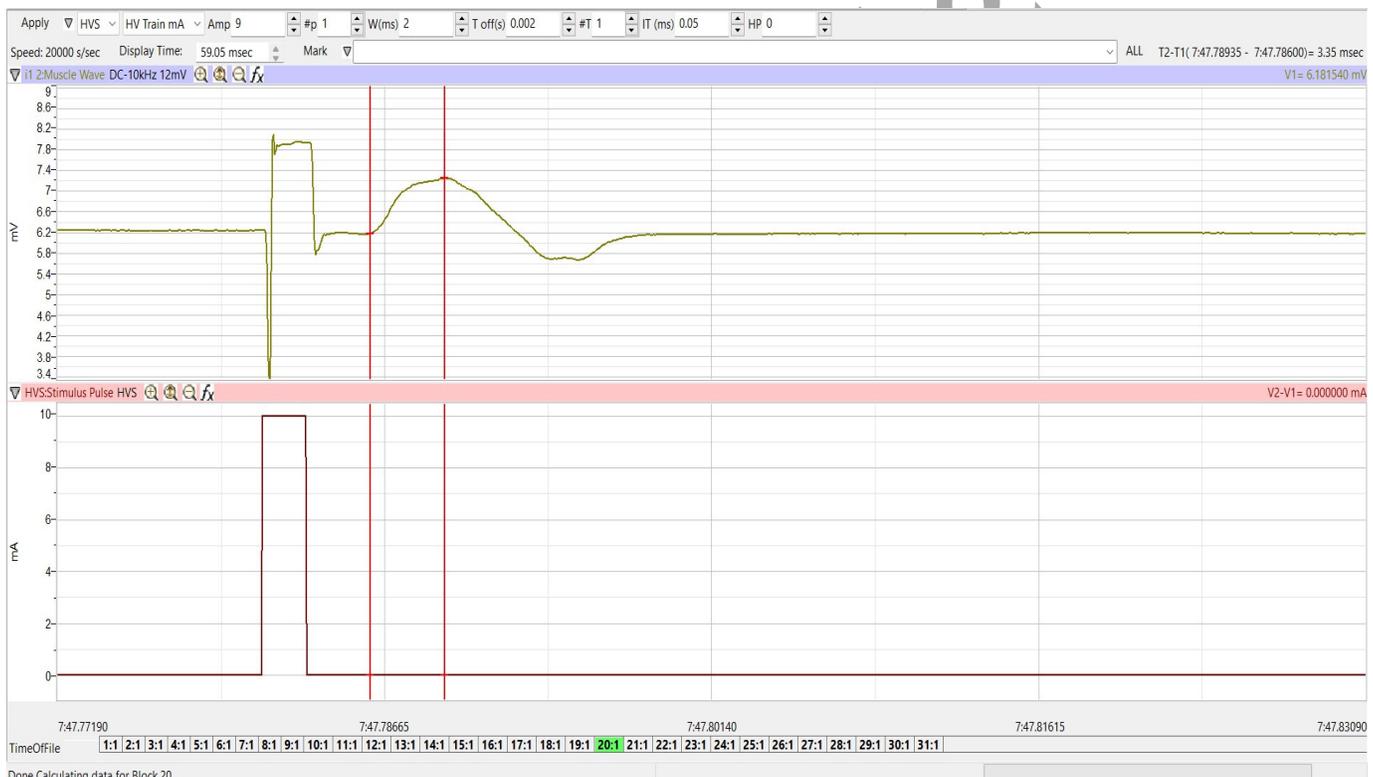
*Note: The subject should make sure to relax their forearm and hand completely. Any tensing of the muscles would interfere with the recording.*

2. Set the Amplitude to zero or in the Stimulator Control Panel for the IXTA (click “Apply” to make the change).
3. Click Record button on the LabScribe Main window. LabScribe will record a single sweep with a display time of 50 milliseconds. Since the output amplitude is set to zero, there should be no response from the abductor muscle.
4. Increase the output amplitude to 0.5 in the software for the IXTA and click Apply. Click the Record button again and record another single sweep. Click the AutoScale button for the Muscle channel to improve the display of the muscle’s response ([Figure HN-12-L1](#)).
5. Continue to increase the output amplitude by 0.5 increments (click “Apply”).
  - Click the Record button to record a single sweep after each increase in the stimulus amplitude.

- Continue to increase the output amplitude and record the response until the muscle impulse reaches a good strong response.
6. Perform the following steps for both the short and long stimulation sites:
- To administer the stimulus, press 'Record' in the upper right hand corner of the computer screen.
  - Repeat this procedure until a response is generated for each distance and measure the amount of time between the start of the stimulus and the peak voltage of the CAP.

**Note:** You may need to continue to increase the amplitude until a response is generated.

7. Select Save As in the File menu, type a name for the file. Click the Save button to save the file (as an \*.iwd file).



*Figure HN-12-L1: A CAP from the median nerve; measuring the amplitude of the response.*

### **Data Analysis**

1. Click the Analysis icon in the LabScribe toolbar to view all the recorded sweeps.
2. Use the Windows control-click function to select the sweeps of interest from the Sweeps list on the bottom of the Analysis window. For comparison, superimpose the selected sweeps on each other by clicking the sweeps of interest. See the figure below.

3. Select V2-V1 and T2-T1 from the Add Functions list if they are not already listed. Data analysis can also be performed on the main window.

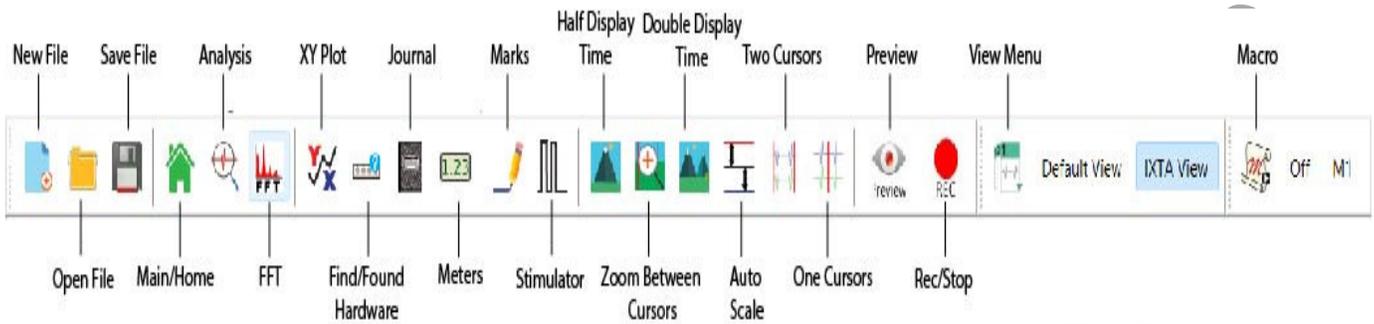


Figure HN-12-L2: The LabScribe toolbar.

4. Go to the Sweep List at the top of the Analysis Window and select the sweep that has the lowest muscle response from the short distance. Selecting a sweep from this menu will display the measured values of that sweep in the table at the top of the Analysis window.
5. Click the 2-Cursor icon in the LabScribe toolbar. Drag one cursor to the left of the stimulus artifact and the second cursor to the peak of the muscle response. The value for V2-V1 in the table at the top of the Analysis window is the amplitude of the muscle response.



Figure HN-12-L3: Comparison of muscle responses to different stimulus amplitudes. Sweeps are superimposed in the Analysis window. Values for sweep #21 are shown.

6. The functions in the channel pull-down menus of the Analysis window can also be used to enter the names and values of the parameters from the recording to the Journal. To use these functions:
  - Place the cursors at the locations used to measure the muscle response.
  - Transfer the names of the mathematical functions used to determine the muscle response to the Journal using the Add Title to Journal function in the Muscle Channel pull-down menu.
  - Transfer the values for the change in muscle response to the Journal using the Add Ch. Data to Journal function in the muscle channel pull-down menu.
7. Record the stimulus amplitude used to generate the nerve response along with the other data for the sweep in the Journal.
8. Find the amplitudes (V2-V1) for the other selected sweeps in the same manner. Record these values and the values of the stimulus amplitudes used to generate these responses in the Journal.
9. Graph the amplitude of the muscle response as a function of the stimulus amplitude.
10. Place one cursor on the start on the stimulus and one cursor on the peak of the response and perform these calculations:
  - Calculate the average amplitude of the three responses for each distance.
  - Calculate the difference between the long (B) and short (A) distances (mm) =  

$$D_B - D_A = \Delta D$$
  - Calculate the difference in the average conduction times between the two distances (ms)  

$$T_B - T_A = \Delta T$$
  - Calculate the Nerve Conduction Velocity (mm/ms or m/s)  

$$\Delta D / \Delta T$$
11. Repeat the procedure three times and calculate the nerve conduction velocity for each of these replicates. Calculate the average of these three measurements.
12. Table 1 shows nerve conduction velocities in the median nerves of eight subjects who underwent the procedure outlined in this laboratory protocol.
13. According to values reported in the scientific literature conduction velocity of the median nerve ranges between 40 and 78 m·s<sup>-1</sup>. All but two of the test subjects had velocities that fell within this range.
  - It is noteworthy that the three lowest conduction velocities were from the three oldest subjects, one of whom was previously diagnosed with a mild case of Carpal Tunnel Syndrome. According to previous studies the mean conduction velocity of the median nerve is 57 m·s<sup>-1</sup>. The mean conduction velocity measured with this protocol is 51.4225 m·s<sup>-1</sup>.

### Questions

1. Does the amplitude of the action potential in each fiber in the median nerve increase or do the numbers of nerve fibers in the nerve that respond increase with increased stimulus strength?
2. Does the amplitude of the muscle response increase because the response of each muscle fiber increases or the number of muscle fibers responding increases?
3. Which stimulus amplitudes are subthreshold? Which ones are suprathreshold or submaximal? Which ones are supramaximal?
4. How do conduction velocities differ by:
  - age?
  - gender?
  - Handedness?

**Table HN-12-L1. Median Nerve Conduction Velocity in Eight Subjects.**

Subject	Gender	Age	Conduction Velocity ( $\text{m}\cdot\text{s}^{-1}$ )
1	F	20	67.72
2	M	44	37.59
3	F	21	62.34
4	F	19	51.19
5	F	19	52.8
6	F	63	44.9
7	M	21	58.76
8	M	61	36.08
<b>Mean</b>			51.42
<b>Standard deviation</b>			11.40

### Exercise 2: Stimulus Strength and Muscle Response in the Non-Dominant Arm.

**Aim:** To determine the effect of stimulus strength on the response of the innervated muscle in the non dominant arm.

**Approximate Time:** 30 minutes

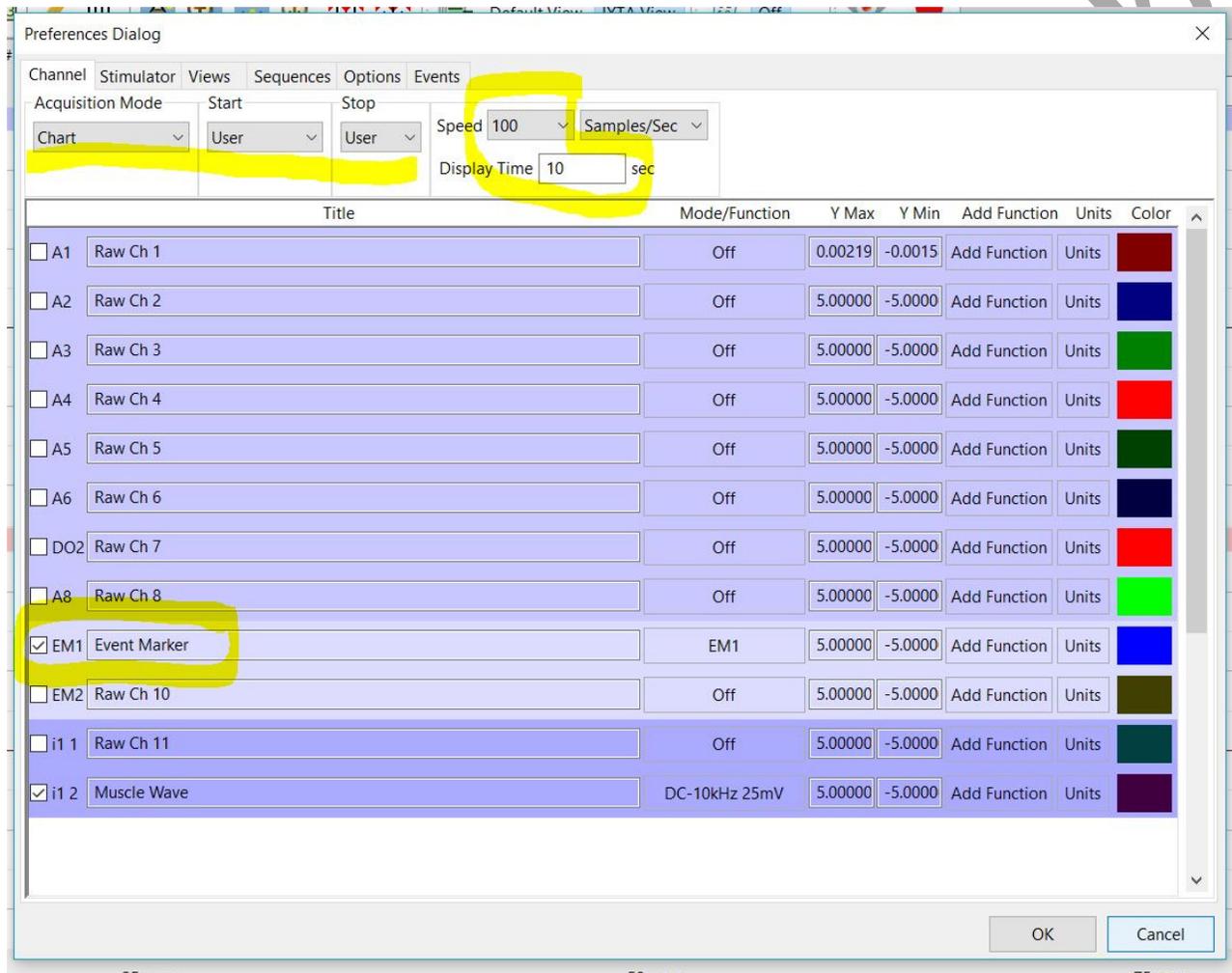
### Procedure

Repeat the procedure for Exercise 1 on the non-dominant arm for both recording and data analysis.

## ADJUST THE SETTINGS FILE:

To complete Exercises 3 and 4 – you will need to adjust the settings file:

1. Click Edit → Preferences to open this screen:



2. Make the following changes:

- Change Acquisition Mode from ScopeMultiple to **Chart**
- Start and Stop = **User**
- Speed will be changed from 20000 to **100**
- Display time = **10**
- Put a check mark in channel **EM1**, and change the name = **Event Marker**
- Uncheck **i1-2** and **HVS**
- Click **OK**

### Exercise 3: Reaction Time and Visual Signals using the Dominant Hand

Aim: To measure the reaction time of a subject to a visual signal using the dominant hand.

Approximate Time: 15 minutes

#### *Procedure*

1. Read all instructions carefully before beginning to record.
2. Information for the subject:
  - Instruct the subject to sit in a chair and face the computer screen.
  - Watch the right side of the computer screen and quickly press the event marker when the signal appears on the computer screen.
3. Directions for the other student(s):
  - Out of sight of the subject, another student should prepare to quietly press and release the F1 key on the keyboard to generate a black line on the screen.
    - In this exercise, the other student(s) will help the subject perform ten trials.

***Warning: In this exercise, it is important to press and release F1 key quietly because any sound could be used by the subject as a signal.***

4. Click on the Record button.
5. Type “Visual-Dominant” in the Mark box to the right of the Mark button. Press the mark button to mark the recording.
6. Instruct the subject to press the event marker as soon as he or she sees black line on the right side of the computer screen.
7. Use the F1 key to deliver ten visual signals to the subject. The signals **should not be less than three seconds nor more than six seconds apart.**
8. After the tenth response, click Stop to halt recording.
9. Click on the Save button to save the data file.

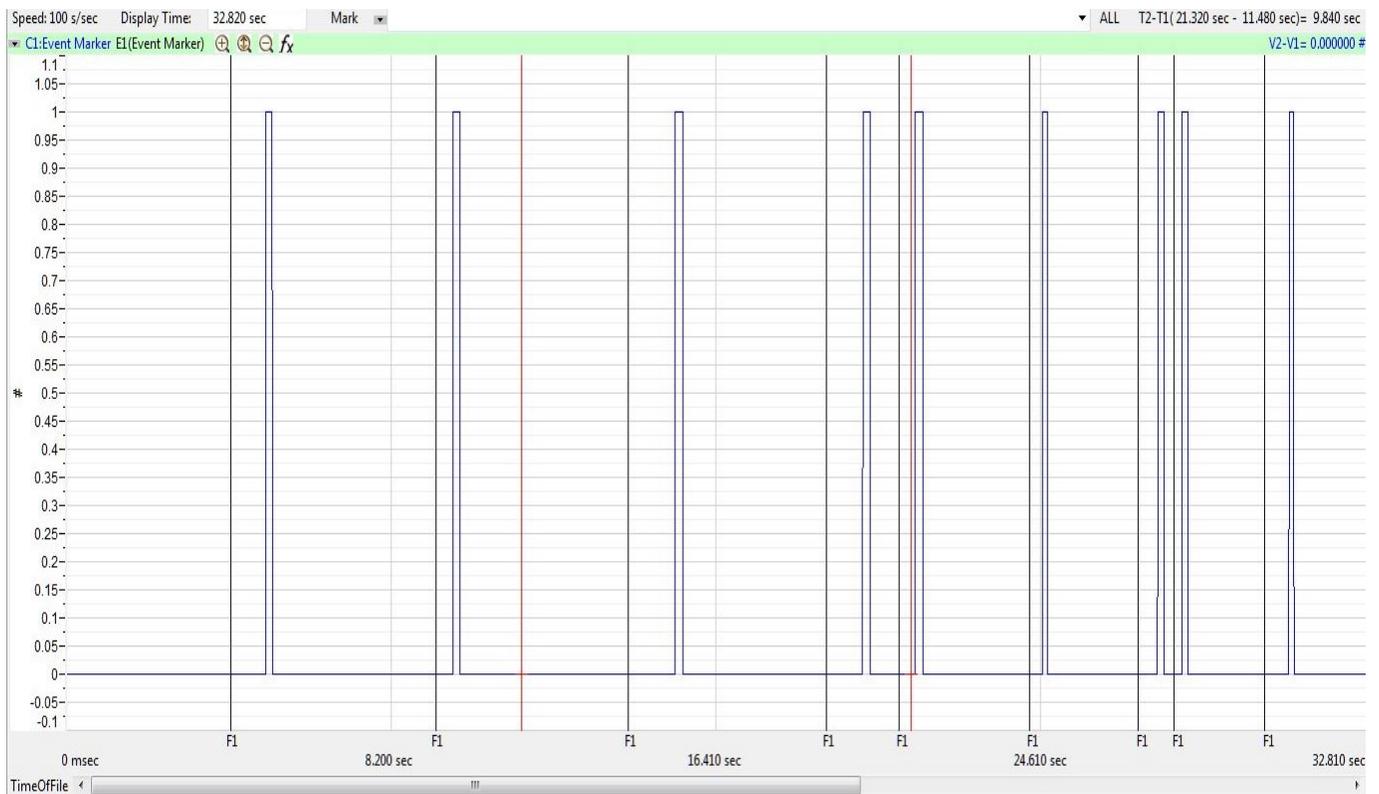


Figure HN-12-L5: Visual signals, each followed by the subject's response, are displayed on the Main window. Each visual signal is made by clicking the F1 key; each response mark is made by the subject pushing the event marker.

### Data Analysis

1. Scroll to the beginning of the data recorded for Exercise 1 to display the trials on the Main window.
2. Use the Display Time icons to adjust the Display Time of the Main window to show both the visual signal made with the event marker and the mark made by the subject's response on the Main window. Double the display time to show all the responses.

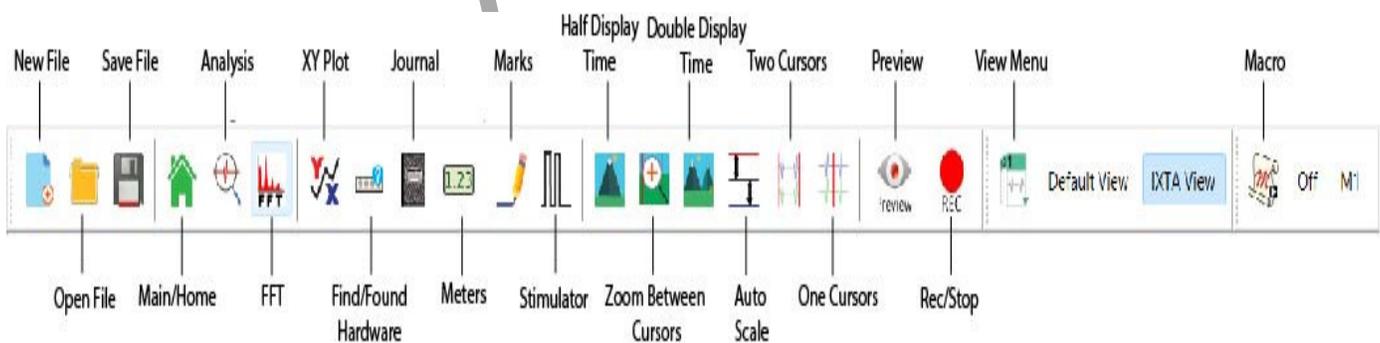


Figure HN-12-L6: The LabScribe toolbar.

3. Data can be collected from the Main window or the Analysis window. If you choose to use the Analysis window, click on the Analysis window icon in the toolbar.
4. The value T2-T1 is shown in the upper right of the Main window or the upper left of the channel in the Analysis window.
5. Use the mouse to click on and drag a cursor to the onset of the visual signal. Drag the other cursor over to the onset of the mark made by the subject responding to the visual signal.
6. Once the cursors are placed in the correct positions for determining the reaction time, record the value for T2-T1 on a separate data table.
7. Once the reaction time in the first trial is measured and recorded, repeat Steps 5 and 6 on the data from the second trial. Continue for all 10 trials.

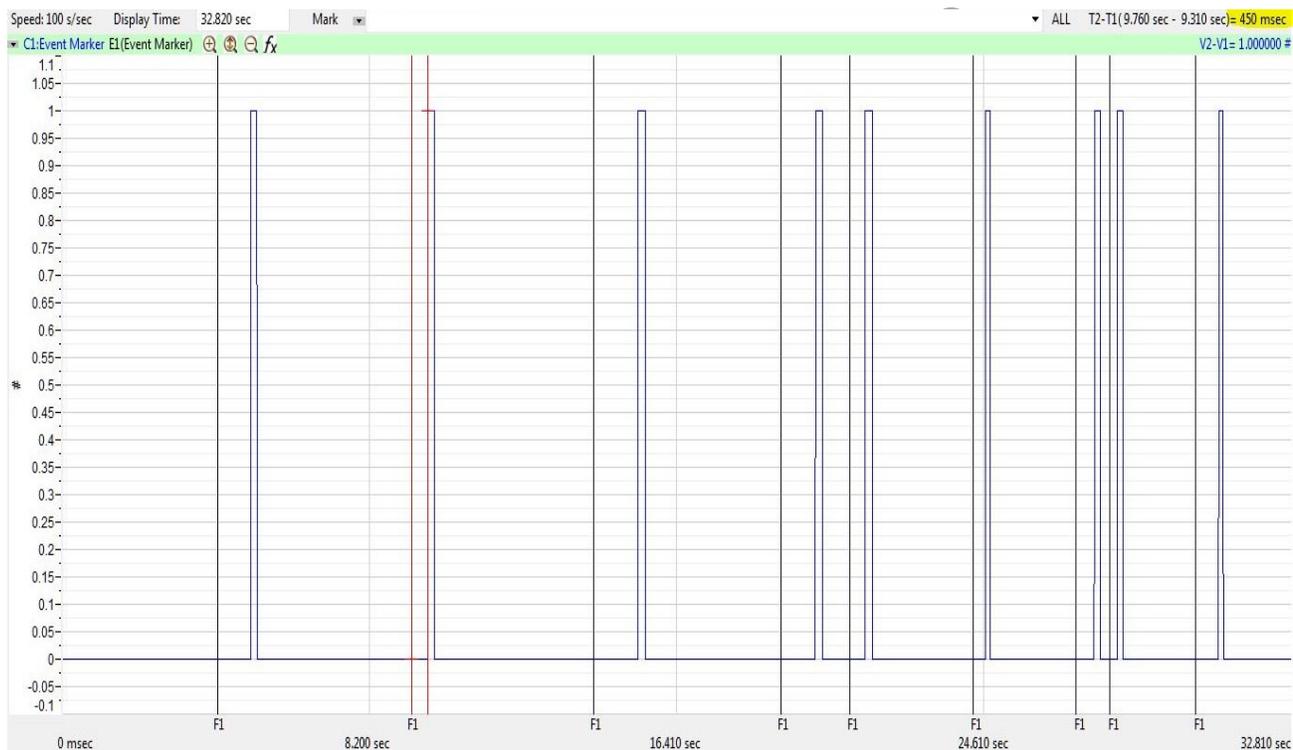


Figure HN-12-L7: A visual signal, followed by the subject's response. The two cursors are positioned at the beginning of the visual signal and on the mark for measurement of the subject's reaction time (T2-T1) in this trial = 450 msec.

#### Exercise 4: Reaction Time and Visual Signals using the Non-Dominant Hand

Aim: To measure the reaction time of a subject to a visual signal using the non-dominant hand.

Approximate Time: 15 minutes

#### Procedure

Repeat the procedure for Exercise 3 using the non-dominant hand for both recording and data analysis.

### ***Questions***

1. Does handedness affect the reaction time to the visual stimulus?
2. What could be the reasons for your answers to question 1?
3. Is nerve velocity different in the dominant vs non-dominant arm?
4. Does nerve velocity have any effect on handedness or is it the other way around? Is there any effect at all?
5. What is the physiological explanation for the data you have found?

### ***References***

Buschbacher RM and Prahlow ND. 2006. Manual of Nerve Conduction Studies. 2<sup>nd</sup> ed. New York: Demos Medical Publishing; 2006. p. 10-17.

Palmieri, R. M., Ingersoll, C. D., & Hoffman, M. A. 2004. The Hoffmann Reflex: Methodologic Considerations and Applications for use in Sports MEDicine and Athletic Training Research. Journal of Athletic Training, 39(3), 268-277.