Experiment BI-1: ECG Signal Conditioning

Equipment Required

PC or Mac Computer

IX-TA data acquisition unit and power supply

USB cable

ROAM Wireless ECG

C-DIN-BB: Din to Breadboard cable

C-BNC-BB: BNC to Breadboard cable

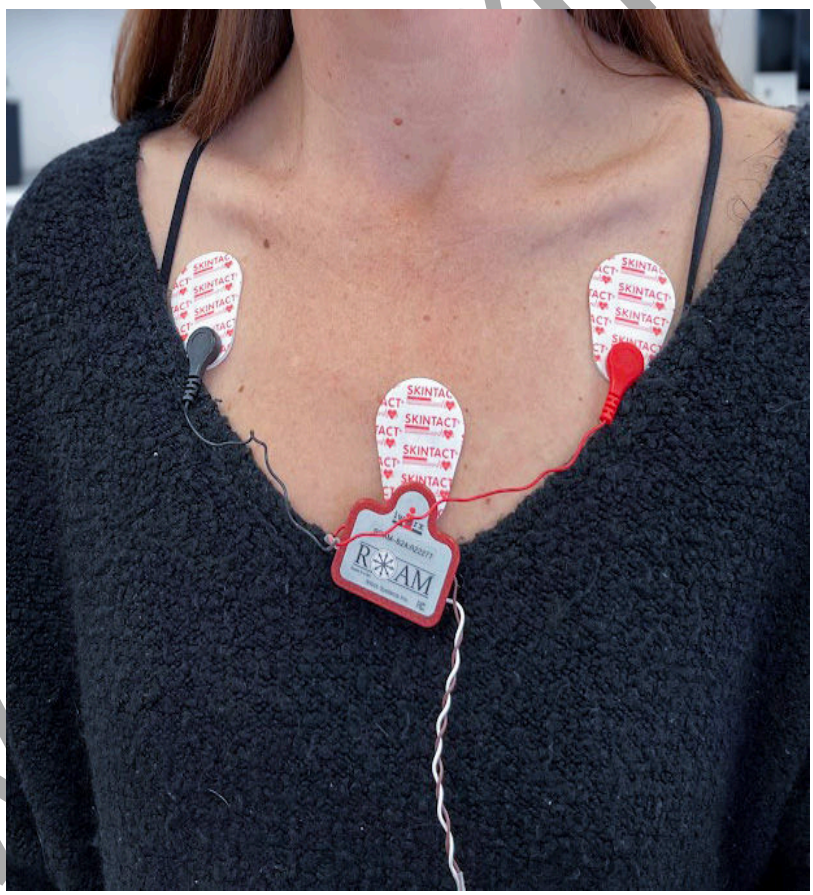
A-BREADBOARD: Breadboard.

Alcohol swabs

Disposable ECG electrodes

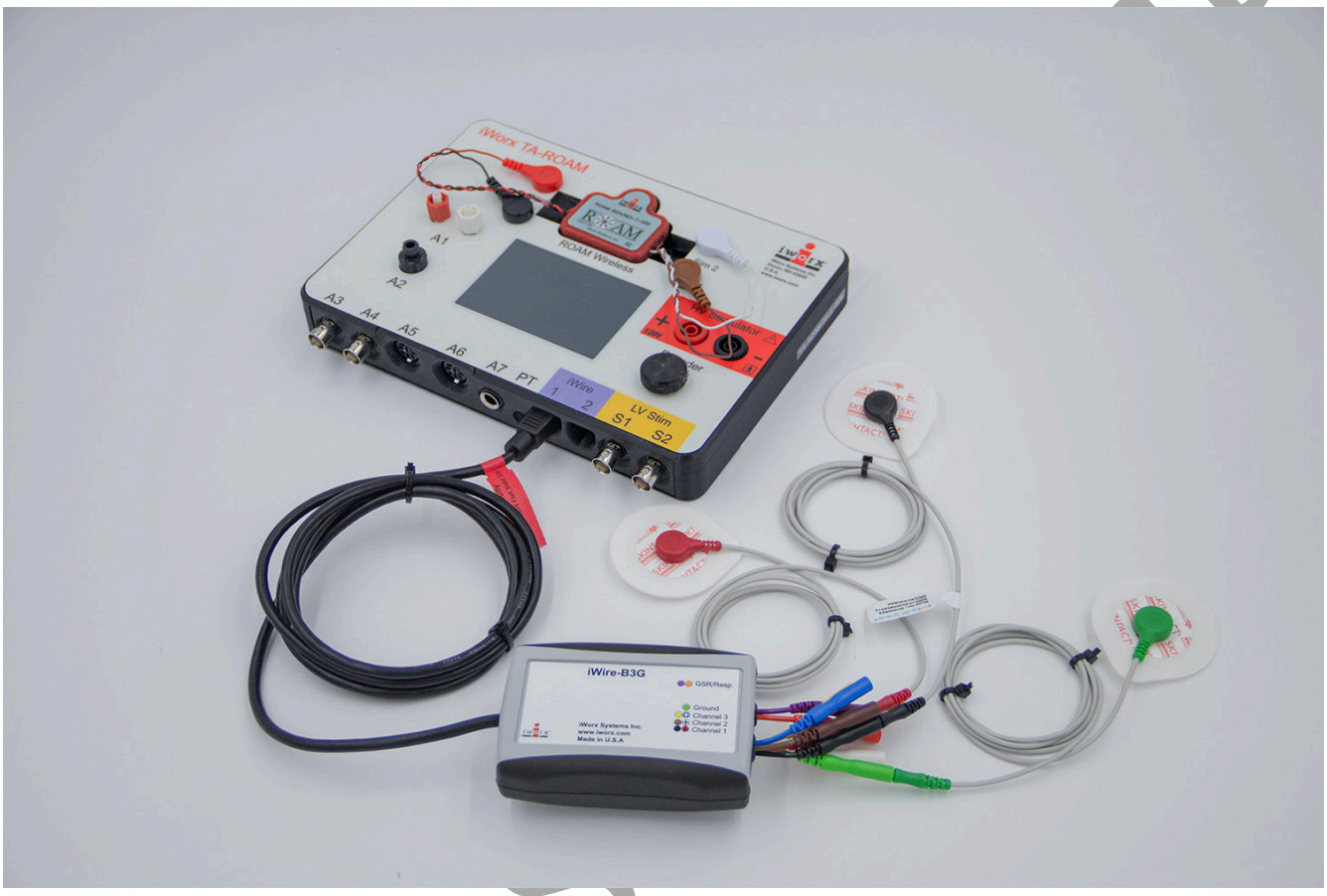
ECG Cable Setup

1. Remove the ROAM from the dock and place the electrodes as shown.



Iwample Lab

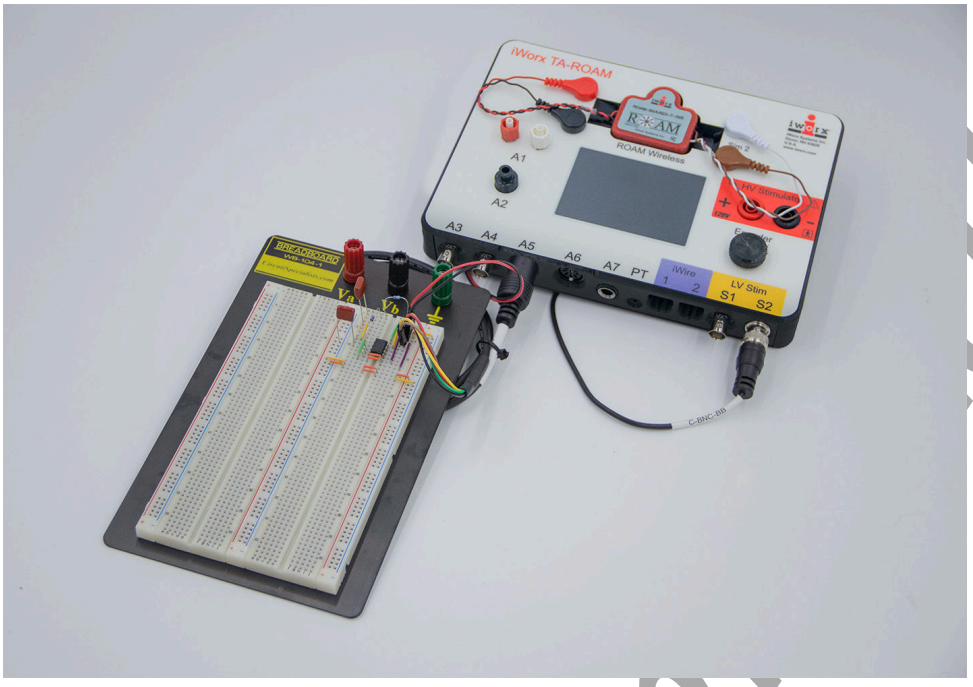
Instruct the subject to sit quietly with their hands in their lap. If the subject moves, the ECG trace will move off the top or bottom of the screen. If the subject moves any muscles in the arms or upper body, electromyograms (EMGs) from the muscles will appear on the ECG recording as noise.



Breadboard Setup

1. Insert the BNC connector on the end of the C-BNC-BB cable into the S1 stimulator port of the TA.
2. Connect the other end of the C-BNC-BB cable to the breadboard.
3. Insert the DIN8 connector of the C-DIN-BB cable into the A5 port of the TA.
4. Connect the other end of the C-DIN-BB cable to the breadboard.

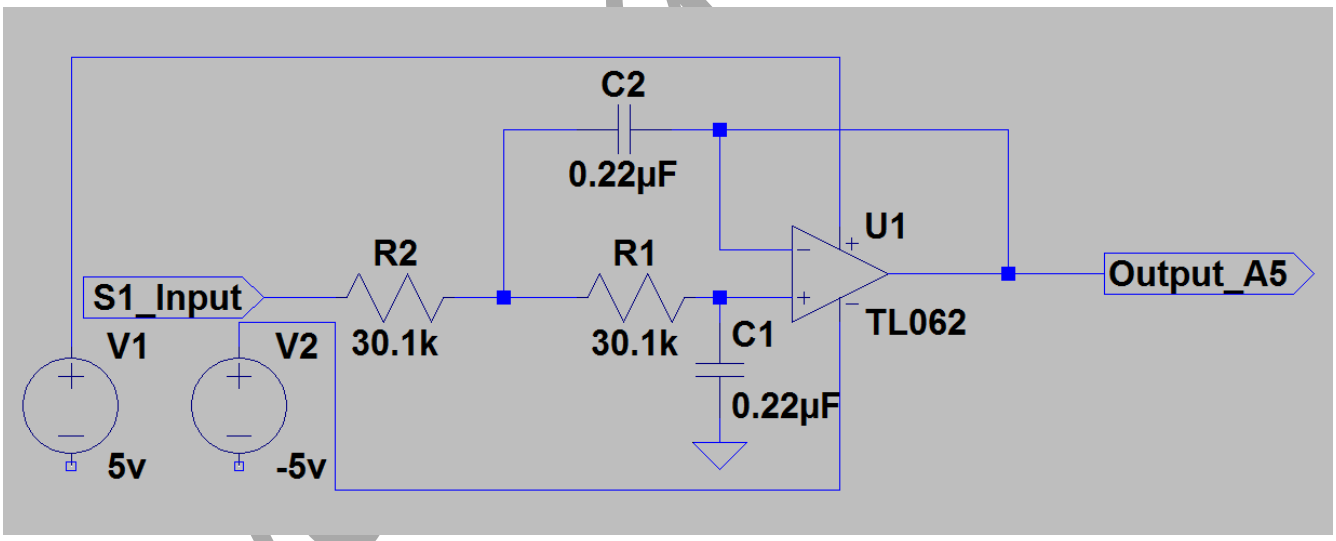
iWorx Sample



Design the Filter Circuit

Here is an example of a filter circuit for a 2 pole low pass filter.

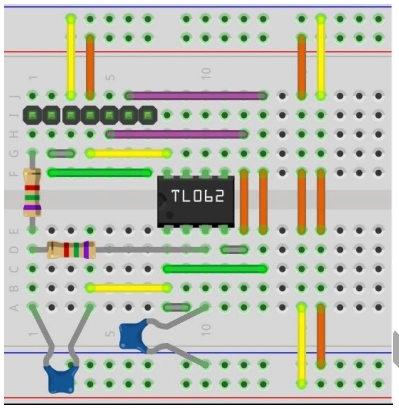
Circuit

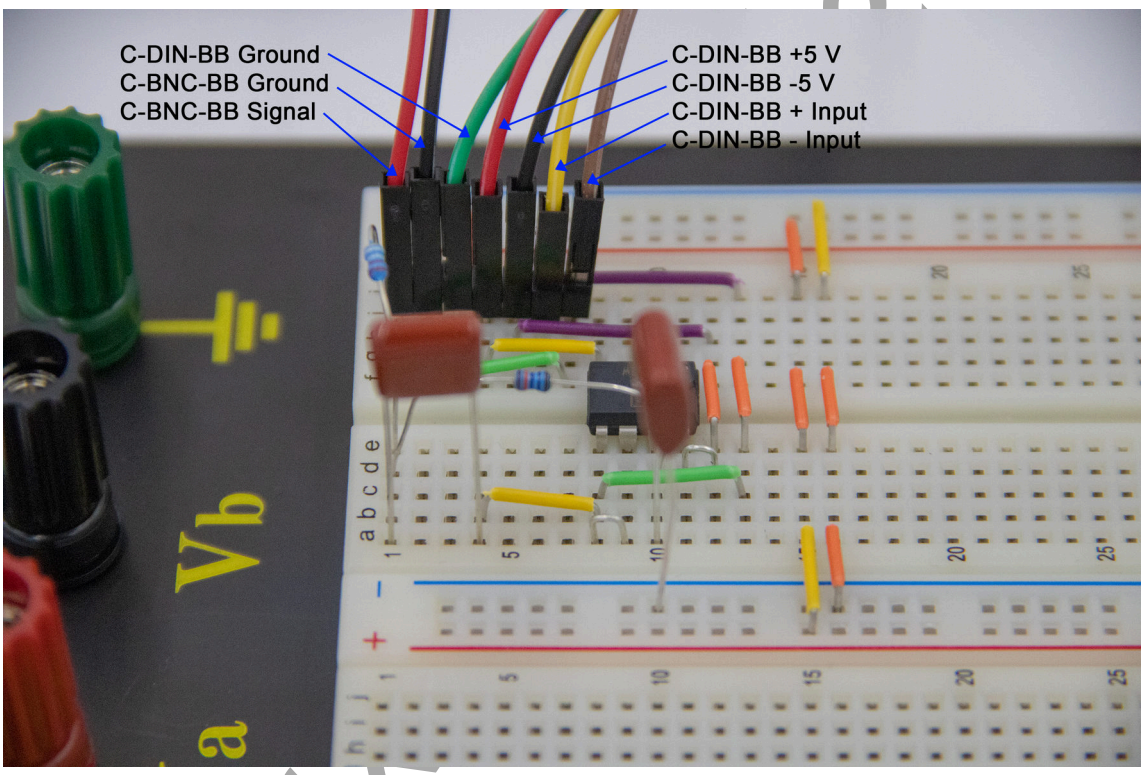


The Filter is a Sallen Key 2-pole low pass filter. Its job is to remove 60Hz electrical noise picked up from fluorescent lights, computers and AC power lines.

iWorx Sample Lab

It is implemented here on the breadboard.





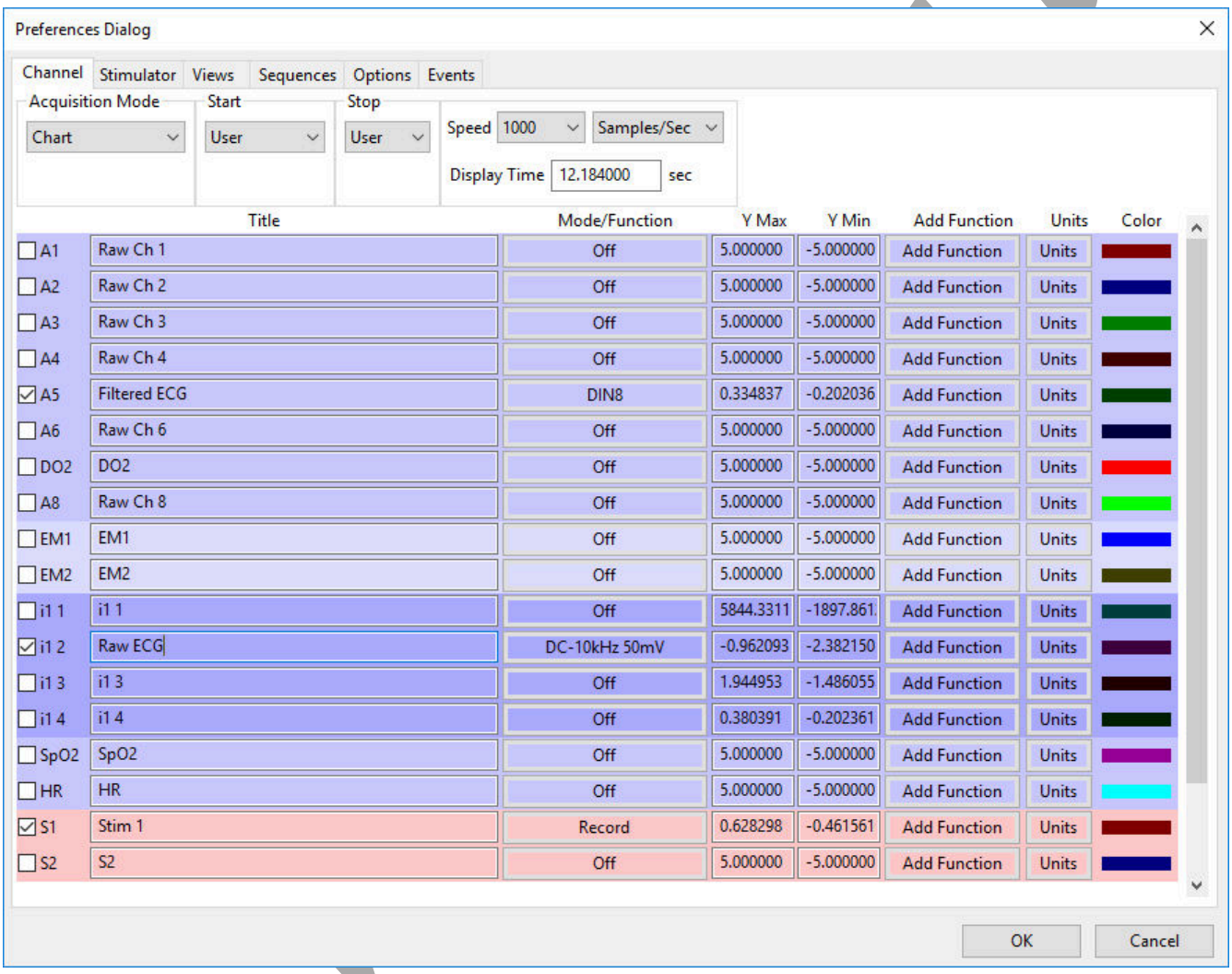
Setting up LabScribe

The provided ECGFilter LabScribe setting file has been preset with the following settings. The instructions here are for your information and to help you modify other iWorx lab experiments to add the option for additional signal conditioning.

Open the Preferences dialog, by choosing Edit→Preferences from the Main Menu.

iWorx Lab

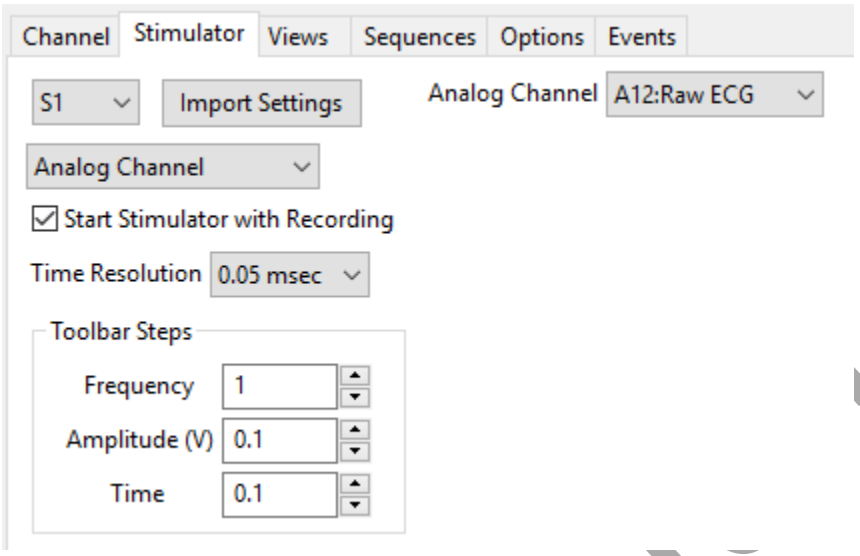
- ***Channels Tab***.
  - Enable the Channels to be recorded and Label them. These channels will be used:
    - A5 (Filtered ECG): This is the output of the Filter
    - i1 2 (Raw ECG): This is the ECG measured by the iWire-B3G
    - S1 (Stimulator): This is what the Stimulator is outputing, which is same as the Raw ECG Channel. You do not have to enable this channel.



- ***Stimulator Tab***
  - Choose S1 stimulator
  - Set the mode to Analog Channel
  - Choose A12: Raw ECG as the analog channel to be send to the Stimulator output

iWorx Lab

- Enable Start Stimulator with Recording.



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Experiment BI-1: ECG Signal Conditioning

Exercise 1: The ECG and LowPass filter

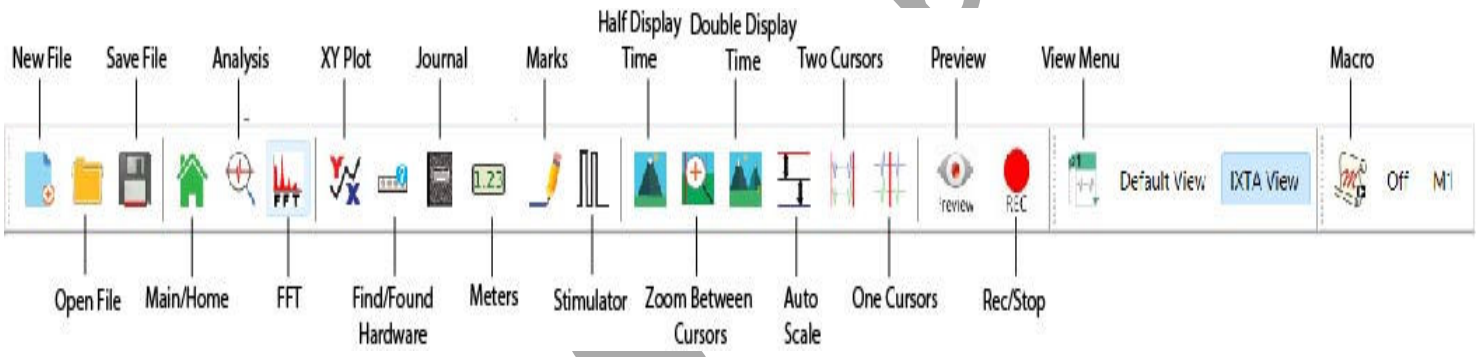
Aim: To record an ECG and low pass filter the signal to reduce 60 Hz noise.

Procedure

1. Click on the Record button, located on the upper right side of the LabScribe Main window. The signal should begin scrolling across the screen.

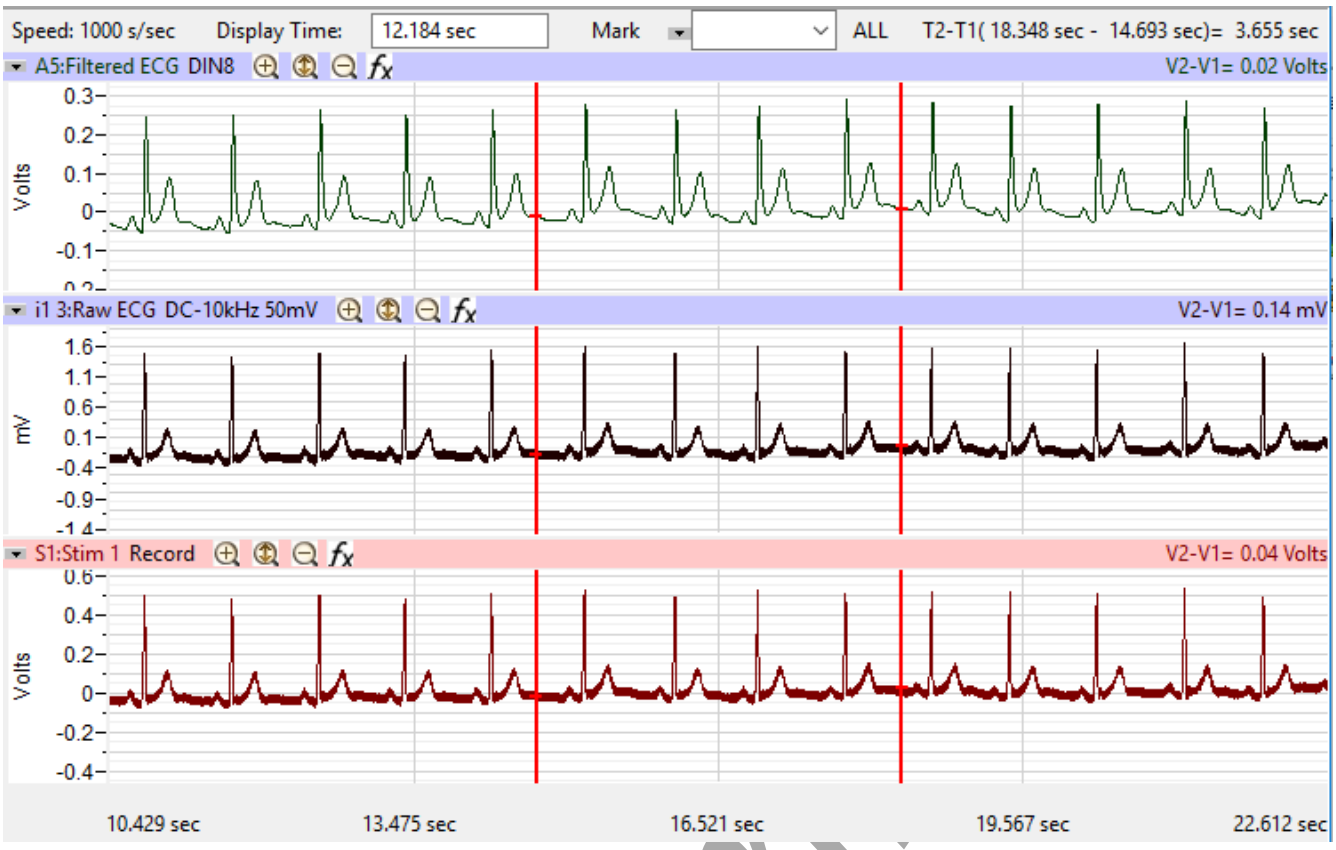
   Note: *If the user clicks the Record button and there is no communication between the iWorx unit and computer, an error window will appear in the center of the Main window. Make sure the iWorx unit is turned on and connected to the USB port of the computer. Click OK and select the Find Hardware function from the LabScribe Tools menu.*

2. Click on the AutoScale All button on the LabScribe toolbar, to Autoscale all the channels.



3. Record for a minute or two.
4. Click Stop to halt the recording and click File → Save As to save your data file.
   - Channel A12: Raw ECG is the Raw ECG signal recorded by the iWire-B3G.
   - Channel S1: Stim 1 is the output of the Stimulator that is send to the breadboard
   - Channel A5: Filtered ECG is the Filtered output of the ECG signal, after signal conditioning on the Breadboard.
5. The signals on A12 and S1 are the same, and have some 60Hz noise.
6. The Filtered Signal is recorded on Channel A5. The 60 Hz noise has been filtered out with the 2 pole low pass filter, as set according to the Setup PDF document.

iWorx Sample Lab



Optional Exercises: The ECG and Signal Conditioning.

Extend the first exercise to test other signal conditioning that can be performed on the ECG signal.

For example:

1) What happens if you use a 4 pole filter instead of a 2 pole filter?
2) What happens if you use a different topology for the filter?
3) What happens if you use a high pass filter?
4) What happens if you use a band pass filter?
5) What filter cutoffs are best at reducing the noise but still maintain the signal?

IWorx Sam