

Experiment HH-11: ECG ~ Simulations and Comparisons

Equipment Required

PC or Mac Computer

IXTA, USB cable, IXTA power supply

iWire-B3G ECG cable and electrode lead wires

iWorx ECG-SIM-1200 electrocardiogram simulator

Alcohol swabs

Disposable ECG electrodes

Note – You must connect the iWire-B3G to the IXTA prior to turning it on.

ECG Cable Setup

1. Locate the iWire-B3G ECG cable and electrode lead wires in the iWorx kit.
2. Insert the connector on the end of the iWire-B3G ECG cable into the iWire 1 input on the front of the IXTA.
3. Insert the connectors on the red, black, and green electrode lead wires into the matching sockets of the ECG cable.
4. Instruct the subject to remove all jewelry from their wrists and ankles. Turn off and remove cell phones, watches and any other device with a battery. These should be placed away from the subject to avoid electrical noise that can be associated with biopotential recordings.
5. Use an alcohol swab to clean and scrub a region with little or no hair, on the inside of the subject's right wrist, left wrist and the inside of the right ankle. Let the areas dry. Alternate locations can be the areas just under each clavicle and the abdomen. This will give a better recording.
6. Remove disposable ECG electrodes from their plastic shields, and apply the electrodes to the scrubbed areas.
7. Snap the lead wires onto the electrodes, so that:
 - the red (+1) lead is attached to the left wrist or just under the left clavicle,
 - the black (-1) lead is connected to the right wrist or just under the right clavicle,
 - the green (C or ground) lead is connected to the right leg or on the abdomen.
8. Instruct the subject to sit quietly with their hands resting in their lap. If the subject moves, the ECG trace will move off the top or bottom of the screen.

Note: 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. Talking can also generate a noisy recording.



Figure HH-11-S1: The iWire-B3G ECG cable with three lead wires attached connected to the IXTA.

Experiment HH-11: ECG ~ Simulations and Comparisons

Exercise 1: The ECG in a Resting Subject

Aim: To measure the ECG in a resting individual.

Approximate Time: 15 minutes

Procedure

1. Click on the Record button. The signal should begin scrolling across the screen.
2. Click on the AutoScale All button Your recording should look like the figure below.
 - If the signal on the ECG channel is upside down when compared to trace seen below, click on the downward arrow to the left of the channel title and select the Invert function. The trace should now look similar to the one in the figure.
 - If a larger ECG signal is required, the electrodes can be moved from the wrists to the skin immediately below each clavicle.
3. When you have a suitable trace, type **Resting ECG** in the Mark box. Click the mark button. Record for 2 to 3 minutes.
4. Click Stop to halt recording.
5. Select Save As in the File menu, type a name for the file. Click on the Save button to save the data file.

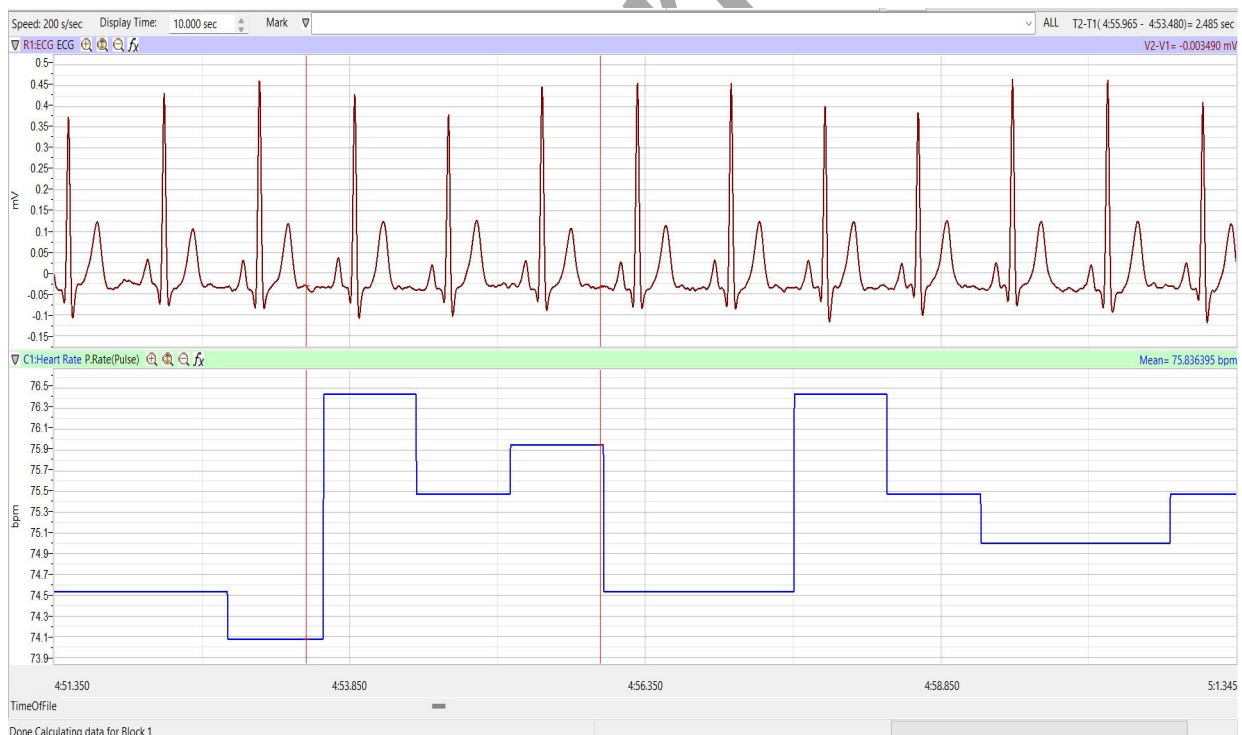


Figure HH-11-L1: ECG, and heart rate displayed on the Main window.

Data Analysis

1. Scroll through the recording and find a section of data with ten exemplary ECG cycles in succession.
2. Use the Display Time icons to adjust the Display Time of the Main window to show the complete ECG cycles on the Main window.
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 mathematical functions, V2-V1, T2-T1 and Mean should appear on screen. Values for V2-V1, T2-T1 and Mean on each channel are seen in the table across the top margin of each channel, or to the right of each graph.

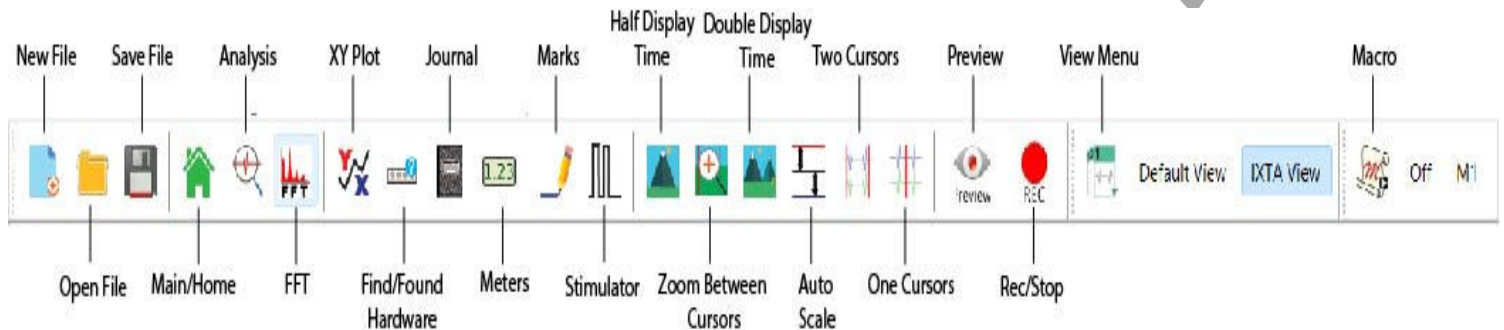


Figure HH-11-L2: The LabScribe toolbar.

5. Once the cursors are placed in the correct positions for determining the specific values for each ECG cycle, the values can be recorded in the on-line notebook of LabScribe by typing their names and values directly into the Journal, or on a separate data table.
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 amplitudes and period of the ECG/Pulse cycle.
 - Transfer the names of the mathematical functions used to determine the amplitudes and time interval to the Journal using the Add Title to Journal function in the ECG Channel pull-down menu.
 - Transfer the values for the amplitudes and beat period to the Journal using the Add Ch. Data to Journal function in the ECG Channel pull-down menu.

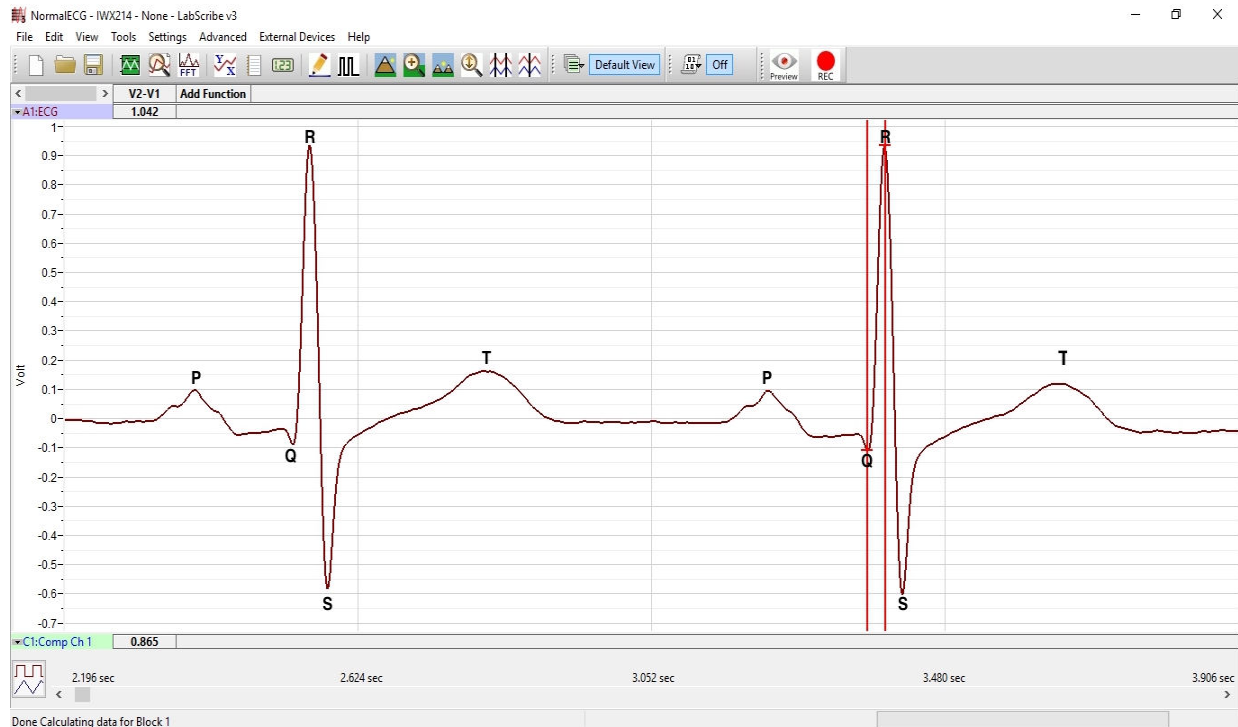


Figure HH-11-L3: An ECG recording. Peaks are labeled to show cursor positions.

7. Use the mouse to click on and drag the cursors to specific points on the ECG/Pulse recording to measure the following (measure 5 ECG cycles):
 - The R-wave amplitude. Place one cursor on the Q wave that precedes the R wave and the second cursor on the peak of the R wave. The value for V2-V1 on the ECG channel is this amplitude.
 - The beat period, which is the time interval between two adjacent R waves. Place one cursor on the peak of an R wave and the second cursor on the peak of the adjacent R wave. The value for T2-T1 is the beat period.
 - The P-wave amplitude. Place one cursor on the baseline that precedes the P wave and the second cursor on the peak of the P wave. The value for V2-V1 on the ECG channel is this amplitude.
 - The T-wave amplitude. Place one cursor on the peak of the T wave and the second cursor on the baseline after the T wave. The value for V2-V1 on the ECG channel is this amplitude.
 - The P-R interval. Place one cursor at the beginning of the P wave and the second cursor at the beginning of the QRS complex. The value for T2-T1 is the P-R interval.
 - The Q-T interval. Place one cursor at the beginning of the QRS complex and the second cursor at end of the T wave. The value for T2-T1 is the Q-T interval.
 - The T-P interval. Place one cursor at the end of the T wave and the second cursor at the beginning of the P wave. The value for T2-T1 is the T-P interval.

8. Calculate the following values and record your results into the Journal or on the data tables below:

- The average beat period, in seconds/beat.
- The heart rate, which is expressed in beats per minute and calculated from the average beat period by using the following equation:

$$\text{Heart Rate (beats/minute)} = 60 \text{ seconds/minute} / \# \text{ seconds/beat}$$

Note: Heart Rate can also be determined by looking at the Mean function on the Heart Rate Channel. The more data on screen - the more accurate the Mean heart rate. Double the display time to get at least 60 seconds of data on screen for a more accurate heart rate measurement.

- The average P-R interval.
- The average Q-T interval.
- The average T-P interval.

Questions

1. What electrical and mechanical events take place during the R wave? P wave? T wave?
2. What other events are taking place in the cardiovascular system during these individual waves?
3. What are the physiologic responses associated with the events in a cardiac cycle?
4. Explain how glands in the body can affect the cardiac cycle.
5. What external factors have an influence on normal cardiac rhythms?

Exercise 2: The ECG in Other Subjects

Aim: To measure ECG in three other subjects.

Approximate Time: 15 minutes per subject

Procedure

Repeat Exercise 1 on three other subjects. Try to pick subjects of different age and gender than your own.

Data Analysis

Analyze the data for each subject using the same techniques used in Exercise 1.

Questions

1. Did you notice differences in the average wave amplitudes between subjects? If so, what could cause the differences between these values?
2. Is the beat period or heart rate the same for each subject? What could cause any differences that you see?

Table HH-11-L1: Values of ECG Amplitudes at rest for all subjects measured.

	Self			Subject 1			Subject 2			Subject 3		
	Q-R	P Wave	T Wave	Q-R	P Wave	T Wave	Q-R	P Wave	T Wave	Q-R	P Wave	T Wave
Mean												

Table HH-11-L2: Values of ECG Intervals at rest for all subjects measured.

[illegible]

Mean												
Mean R-R												
Mean Heart Rate												

Exercise 3: Using the iWorx ECG-SIM-1200

Aim: To observe and measure different ECG heart rhythms using the iWorx ECG-SIM-1200 electrocardiogram simulator.

Approximate Time: 15 minutes

Procedure

1. Attach ECG cable to the iWorx ECG-SIM-1200.
 - The red lead attaches to the snap electrode labeled RA (IWX/214) or LA (IXTA)
 - The black lead attaches to the snap electrode labeled LA (IWX/214) or RA (IXTA)
 - The green lead attaches to the snap electrode labeled LL

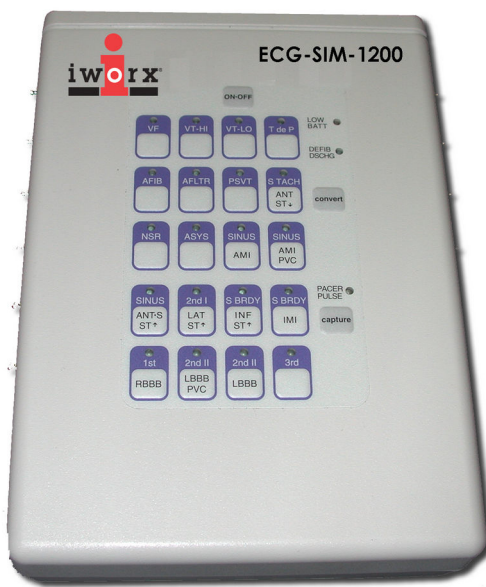


Figure HH-11-L4: The iWorx ECG-SIM-1200 Electrocardiogram Simulator.

2. Click on the Normal Sinus Rhythm (NSR) button. Click Capture to change the ECG pattern generated by the ECG simulator.

3. Type **Normal Sinus** in the Mark box. Click on the Record button, located on the upper right side of the LabScribe Main window. The signal should begin scrolling across the screen.
4. Immediately click the mark button and then record for a minute or two.

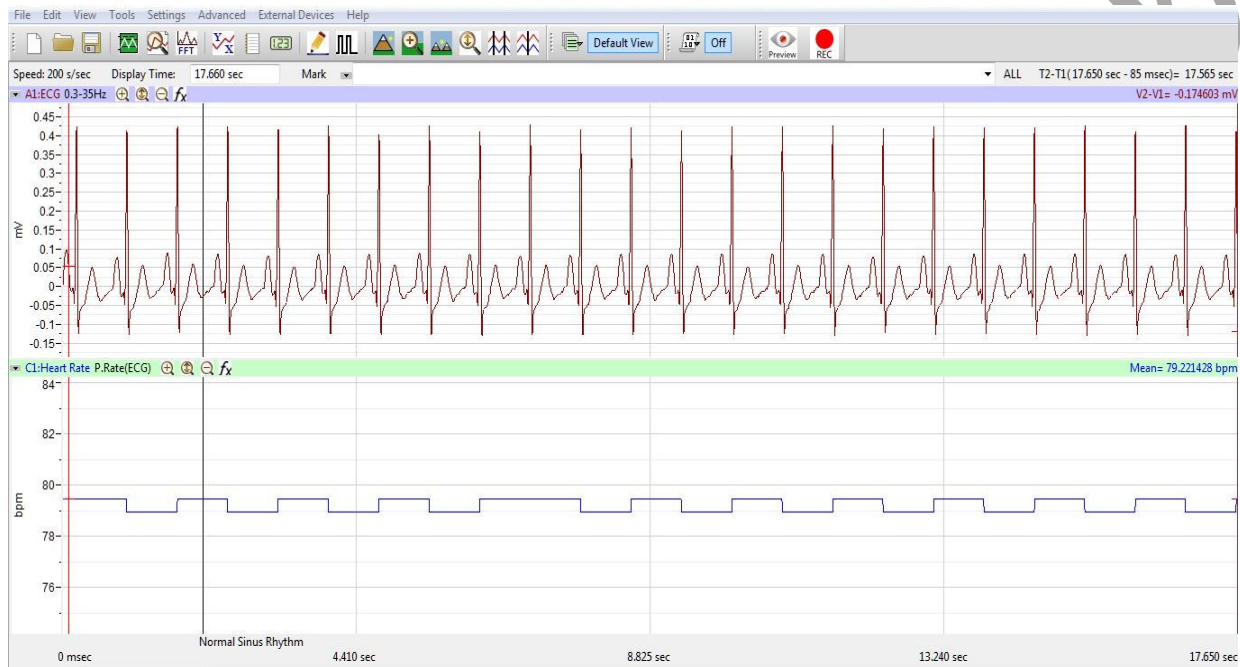


Figure HH-11-L5: Normal sinus rhythm as generated by the ECG simulator.

5. Click on the AutoScale button at the upper margin of both channels. Use the same techniques used in Exercise 1 to display the signals properly.
6. Select Save in the File menu on the LabScribe window.

Data Analysis

Analyze the data for Normal Sinus Rhythm using the same techniques used in Exercises 1 and 2.

- Record the data collected in your own data table or in the Journal.

Questions

1. How does the data collected from you and your other subjects compare to the data collected from the ECG simulator?
2. If there is a difference, what could be some contributing factors?

Exercise 4: Using the iWorx ECG-SIM-1200 to Record Other Cardiac Rhythms

Aim: To measure a variety of other cardiac rhythms using the electrocardiogram simulator.

Approximate Time: 15 minutes per rhythm measured

Procedure

1. Repeat Exercise 3 testing at least three other abnormal cardiac rhythms.
2. Click on the button of the rhythm you would like to test, ex: Sinus Tach (**S TACH**).
3. Click Capture to change the ECG pattern generated.
4. Options include:
 - Sinus Tachycardia
 - Atrial Fibrillation
 - Torsade
 - Atrial Flutter and many others
5. Mark the recording appropriately and record each abnormal rhythm for one to two minutes.

Data Analysis

Analyze the data for each abnormal cardiac rhythm using the same techniques used in the previous exercises.

- Be sure to keep track of what is different about each of the rhythms.
- Record this data in your own data table or in the Journal.

Questions

For each of the options chosen:

1. What is the major difference between this recording and the one of a normal ECG?
2. Explain what could be happening physiologically to cause the abnormality.
3. Explain what can be done to a patient experiencing this abnormal rhythm to get him/her back to a normal sinus pattern.

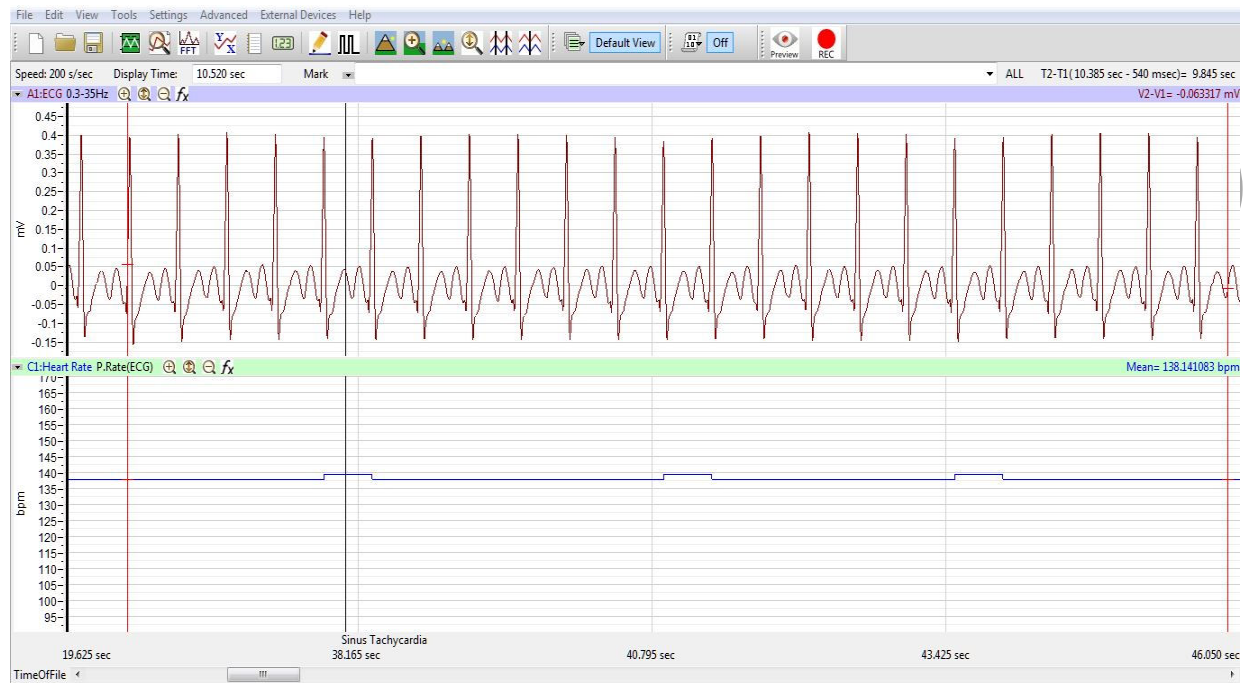


Figure HH-11-L6: Sinus Tachycardia

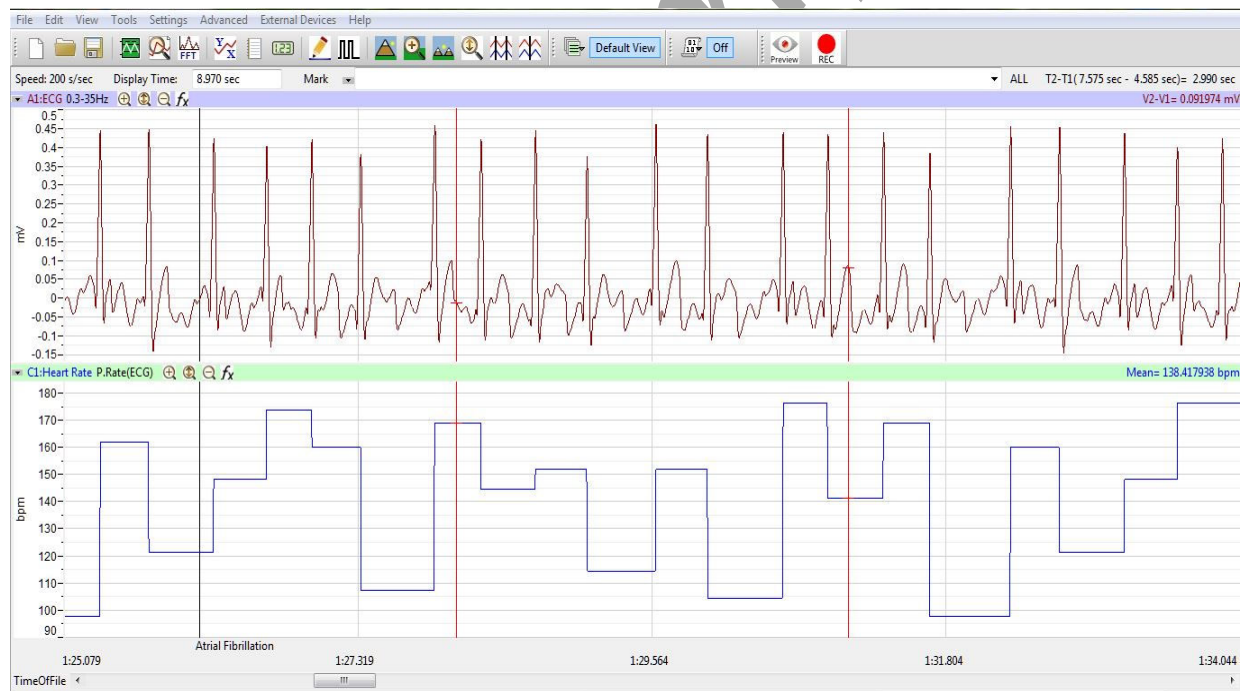


Figure HH-11-L7: Atrial Fibrillation

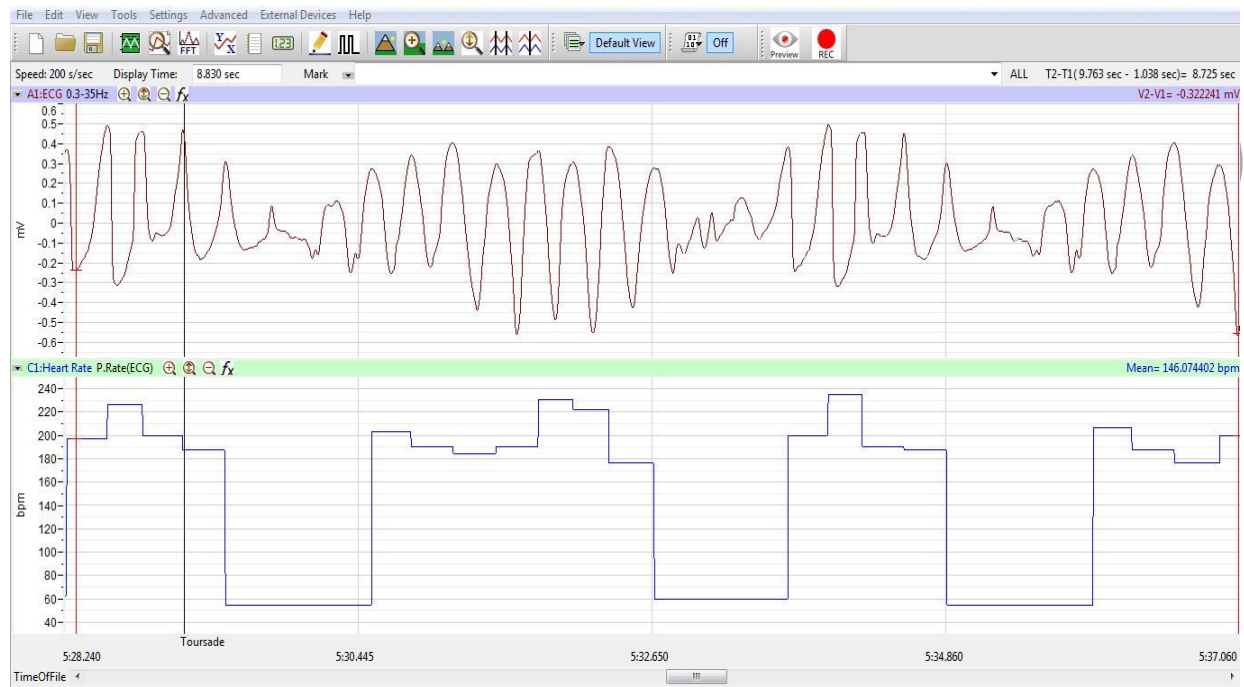


Figure HH-11-L8 Toursade