

Experiment HH-10: 12-Lead Electrocardiograms (ECGs)

Equipment Required

PC or Mac Computer

IXTA, USB cable, IXTA power supply

iWire-B3G ECG cable

Electrode lead wires

C-WT-100 Wilson Terminal

Alcohol swabs

Disposable ECG electrodes (12)

Note: It is suggested that students dress appropriately for these exercises. A button-down shirt will make it easier to move the chest lead into correct position.

Electrode Placement

1. The subject should remove all jewelry from his or her neck, wrists, and ankles. Cell phones should be removed from pockets.
2. Use an alcohol swab to clean and scrub regions on each wrist and ankle, under the lateral end of each clavicle and, on the chest. Let the areas dry.
3. Obtain 12 disposable electrodes. Remove each electrode from its protective plastic sheet and apply it to one of the following scrubbed areas on the subject's body:
 - under the lateral ends of each clavicle; for use as the positive and negative electrodes of Lead I.
 - on each wrist and each ankle; for use as the ground and the three electrodes that form the indifferent point for the chest leads.
 - over the right border of the sternum at the 4th intercostal space; for use as the V1 chest lead.
 - over the left border of the sternum at the 4th intercostal space; for use as the V2 chest lead.
 - on the left mid-clavicular line at the 5th intercostal space; for use as the V4 chest lead.
 - halfway between V2 and V4; for use as the V3 chest lead.
 - on the anterior axillary line at the same horizontal level as V4; for use as the V5 chest lead.
 - on the mid-axillary line at the 5th intercostal space; for use as the V6 chest lead.

ECG Cable Setup

1. Locate the iWire-B3G ECG cable and the C-WT-100 Wilson Terminal.
2. Insert the connector on the end of the iWire-B3G cable into the iWire 1 input of the IXTA.

Note: *Connect the iWire-B3G prior to turning on the IXTA.*

3. Attach the five color-coded wires from the Wilson Terminal into the sockets of the iWire-B3G.
4. Attach four color-coded (red, black, green, brown) single electrode lead wires to the sockets on the Wilson Terminal. Snap the other ends of the lead cables to the electrodes on the subject, so that:
 - the red snap lead wire is connected to the electrode below the left clavicle,
 - the black snap lead wire is connected to the electrode below the right clavicle,
 - the green snap lead wire is connected to the electrode on the right ankle,
 - the brown snap lead wire is connected to the electrode on the left leg.
5. Attach the brown lead wire from the Wilson Terminal into the NEG(-) yellow socket on the iWire-B3G.
 - the green wire from the Wilson Terminal will remain disconnected.
6. Attach the blue electrode snap lead to the POS(+) blue input of the iWire-B3G. Snap the other end of this cable to the first chest lead (V1). This will be the lead that is moved to the other chest electrodes during this lab in order to record all of the 6 chest leads.



Figure HH-10-S1: iWire-B3G cable with the Wilson Terminal and the electrode cables attached to an IXTA for recording limb and chest lead ECG.



Figure HH-10-S2: iWire B3G connected to the Wilson Terminal.

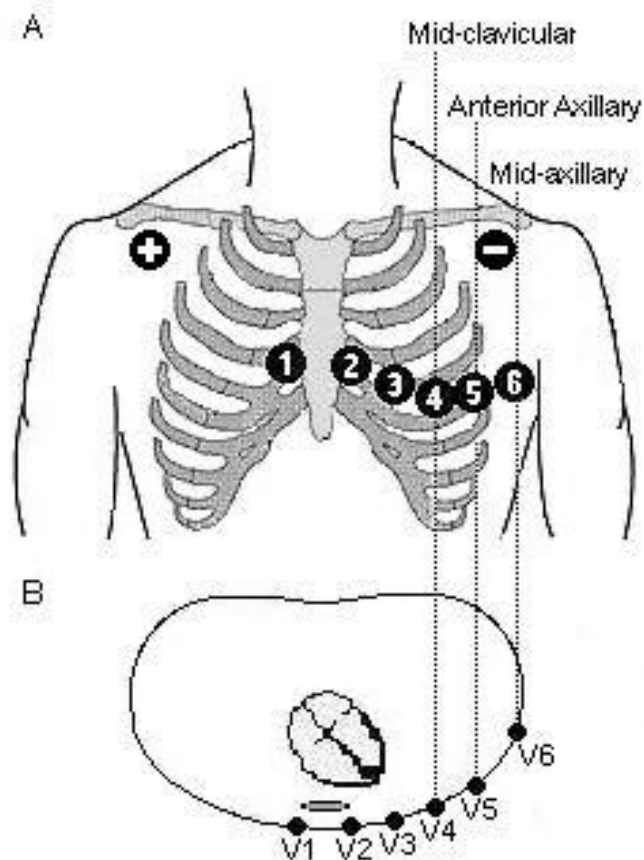


Figure HH-10-S3: A: Frontal view of the electrode positions for Lead I and the six chest leads. B: Top view of the electrode positions for the chest leads.

Experiment HH-10: 12-Lead Electrocardiograms (ECGs)

Exercise 1: ECG from the Chest Leads of a Resting Subject

Aim: To record electrocardiograms from the six chest leads and determine the transition point.

Approximate Time: 30 minutes

Procedure

1. The recording of electrocardiograms from Leads I, II and III, aVR, aVL, aVF, and the six chest leads (V1 through V6) will use the LabScribe software.
2. Make sure the lead wires are attached correctly for recording from Lead I on Channel 1, Lead II on Channel 2, and the first Chest Lead (V1) on Channel 3.
3. Type **Chest Lead V1** in the Mark box.
4. After the subject has been sitting quietly for at least one minute, click the Record button on the LabScribe Main window. Immediately after starting to record, click the mark button to mark the recording for Chest Lead I.
5. Record for at least five minutes. Click the AutoScale All button to display the ECG data.
6. After the electrocardiogram has been successfully recorded from chest lead V1, move the white lead wire (for the 214) or blue lead wire (IXTA) from the active electrode for the V1 lead to the active electrode for the V2 lead. Have someone other than the subject move the lead wire because the subject must remain in the same position for each segment of the recording.

Note: Before recording an ECG from the next lead position, it is important to let the electrodes equilibrate. Wait at least thirty seconds after the lead wire has been moved before recording.

7. Type **Chest Lead V2** in the Mark box.
8. Click the Record button on the LabScribe Main window to record another one minute section of data. Click the mark button to mark the recording for Chest Lead V2. In this particular block, electrocardiograms from chest lead V2 will be recorded.
9. Repeat Steps 3 and 6, moving the white or blue lead wire from the active electrode of one chest lead to the next (V3->, V4-> V5->...) until electrocardiograms have been recorded from all six chest leads. You should have six complete 5 minute blocks of data.
10. Select Save As in the File menu, type a name for the file. Click on the Save button to save the data file.

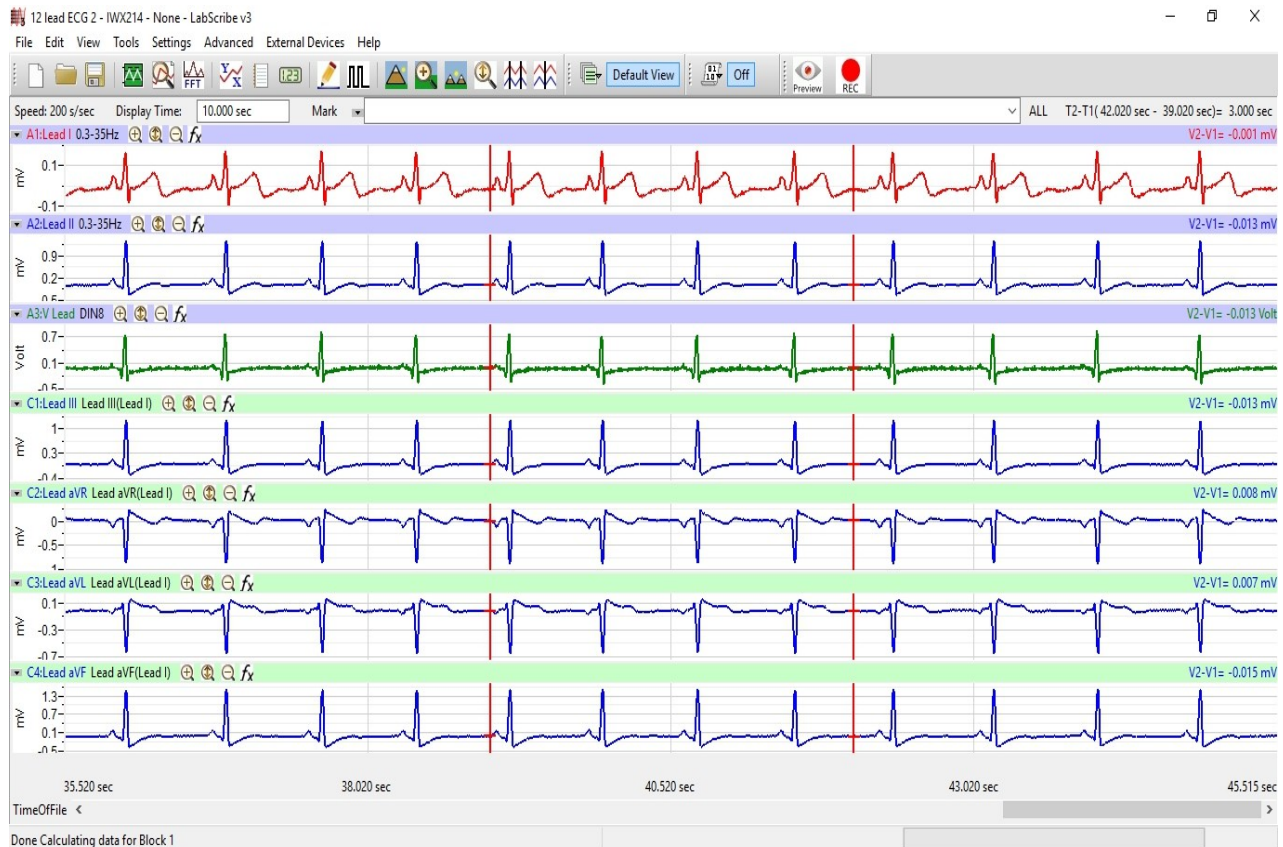


Figure HH-10-:L1 The recording of a 12-lead electrocardiogram as shown in the Main window.

Data Analysis

1. Click the 2-Cursor icon so that two vertical lines appear over the recording window.
2. Click on down arrow to the right of the Mark box. Choose Chest Lead V1 from the list that appears under the Mark box. This will bring your recording back to the first block of data where you recorded from Chest Lead V1.

Note: If you followed the procedure for this exercise, the V1 chest lead should be displayed in the first block of data, V2 in the second, etc...

3. Scroll through this section of data and find an area with at least ten exemplary ECG/pulse cycles in succession.
4. Use the Display Time icons to adjust the Display Time of the Main window to show the complete ECG/Pulse cycles on the Main window.
5. Click the Analysis icon to display the data in the Analysis window.

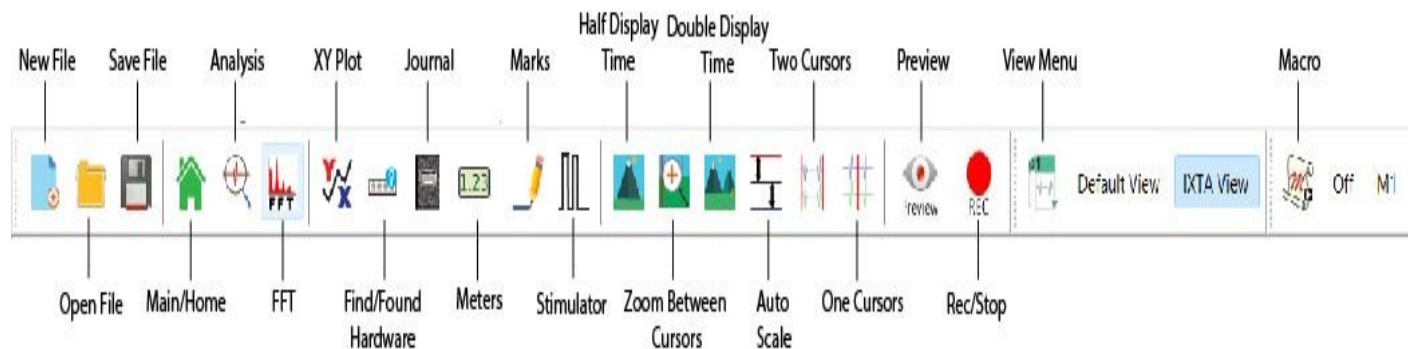


Figure HH-10-L2: The LabScribe toolbar.

6. Look at the Function Table that is above the uppermost channel displayed in the Analysis window. The name of the mathematical functions used in the analysis, V2-V1, T2-T1, and Mean appears in this table. The value for these functions are seen in the table across the top margin of each channel.
7. Once the cursors are placed in the correct positions for determining the amplitudes, V2-V1, the values of the amplitudes 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.
8. 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 of the waves in the ECG cycle.
 - Transfer the name of the mathematical functions used to determine the amplitudes to the Journal using the Add Title to Journal function in the Tools pull-down menu.
 - Transfer the values for the amplitudes to the Journal using the Add Ch. Data to Journal function in the Tools pull-down menu.
 - To transfer the image to the Journal, use the Add Image to Journal function in the Tools pull-down menu.

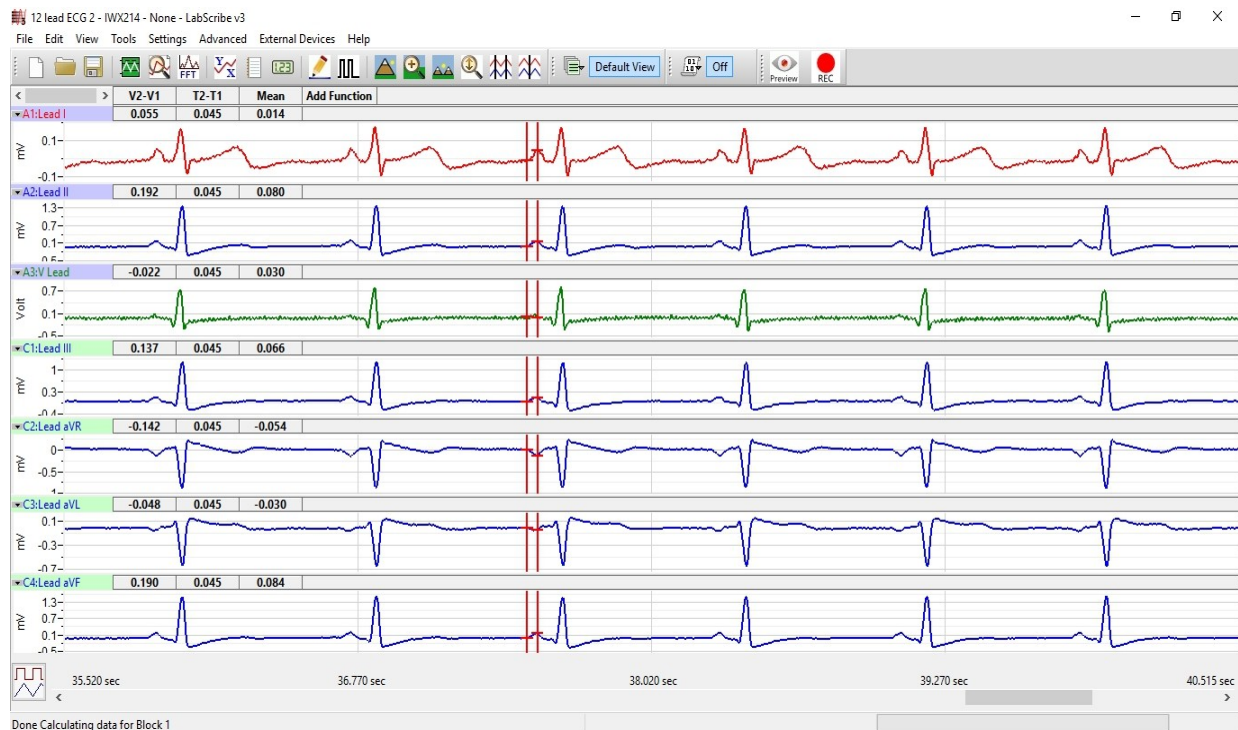


Figure HH-10-L3: In the Analysis window, the electrocardiogram showing the cursors in position to measure the amplitude (V2-V1) of a P-wave.

9. Use the mouse to click and drag the cursors across the first block of data for ChestLead 1 to measure:
 - the amplitude, V2-V1, of five adjacent R waves in the ECG from Lead I, Lead II and the V1 chest lead. The amplitude is measured from the onset of the Q wave to the peak of R wave.
 - the amplitude, V2-V1, of five adjacent P waves in the ECG from the same section of data. The amplitude is measured from the baseline, between the T and P waves, to the peak of P wave.
 - the amplitude, V2-V1, of five adjacent T waves in the ECG from the same section of data. The amplitude is measured from the baseline to the peak of T wave.
10. Click the Main Window icon from the LabScribe toolbar to go back to the main recording window.
11. Repeat steps 2 through 10 to measure and record the amplitudes of five P, R, and T waves from each of the next 5 chest leads and Leads I and II.
12. Calculate the average amplitudes of the P, R, and T waves for each lead. Enter these values into Table 1.
13. Find the transition point of the subject by examining the recordings from the six chest leads. Find the lead where the R wave is equal in magnitude to the S wave but in the opposite direction.

Questions

1. From which leads are inverted P and T waves recorded? From which leads are inverted R waves recorded?
2. From which lead is the amplitude of the R wave equal, and opposite in direction, to the S wave?
3. Which lead is over the anterior edge of the interventricular septum?

Table HH-10-L1: The average amplitudes (in mvs) for each of the waves recorded from each lead.

Average Amplitudes	P Wave	R Wave	T Wave
Lead I			
Lead II			
V1			
V2			
V3			
V4			
V5			
V6			
Lead III			
aVR			
aVL			
aVF			

Exercise 2: ECG from the Chest Leads of Other Students

Aim: To record electrocardiograms from the six chest leads of other subjects and determine their transition points.

Approximate Time: 20 minutes per subject

Procedure

1. Disconnect the leads from the first volunteer's electrodes and place them on the electrodes of a second student.
2. Follow the procedures in Exercise 1 to record electrocardiograms from the six chest leads of the new subject.
3. Repeat the procedures until all subjects have recorded their chest lead electrocardiograms.

Data Analysis

Make the same measurements as done in Exercise 1.

Questions

1. Do the R waves, from the same lead position, go in the same direction for all subjects? The P waves? The T waves?
2. What would cause the same type of wave from the same lead to go in the opposite direction in different subjects?
3. Do all subjects have the same transition point? Which leads were found to be the transition points in the subjects tested? What could cause a difference in the transition points?

Exercise 3: ECG Hypothesis, Data Collection and Analysis

Aim: To have students design their own experiment based on their knowledge of what may alter a person's ECG.

Approximate Time: 60 minutes depending on hypothesis

Procedure

1. Formulate a hypothesis where you would expect to see changes in the subject's ECG.
2. Make sure to present this hypothesis to your instructor and get permission to do the experiment prior to continuing with your experiment.
3. Follow the procedures in Exercise 1 to record an ECG from your subject and collect data during the testing of your hypothesis. Timing changes will be the most significant observations.

Data Analysis

1. Make the same measurements as done in Exercise 1.
2. Create a data table in which to record your data.
3. Compare your data to the data recorded in Exercise 1.

Questions

1. What happened to the subject's ECG during the testing of your hypothesis?
2. What parameters changed? How did they change?
3. Did your hypothesis get the expected results? Why or why not?