

Construction Manual

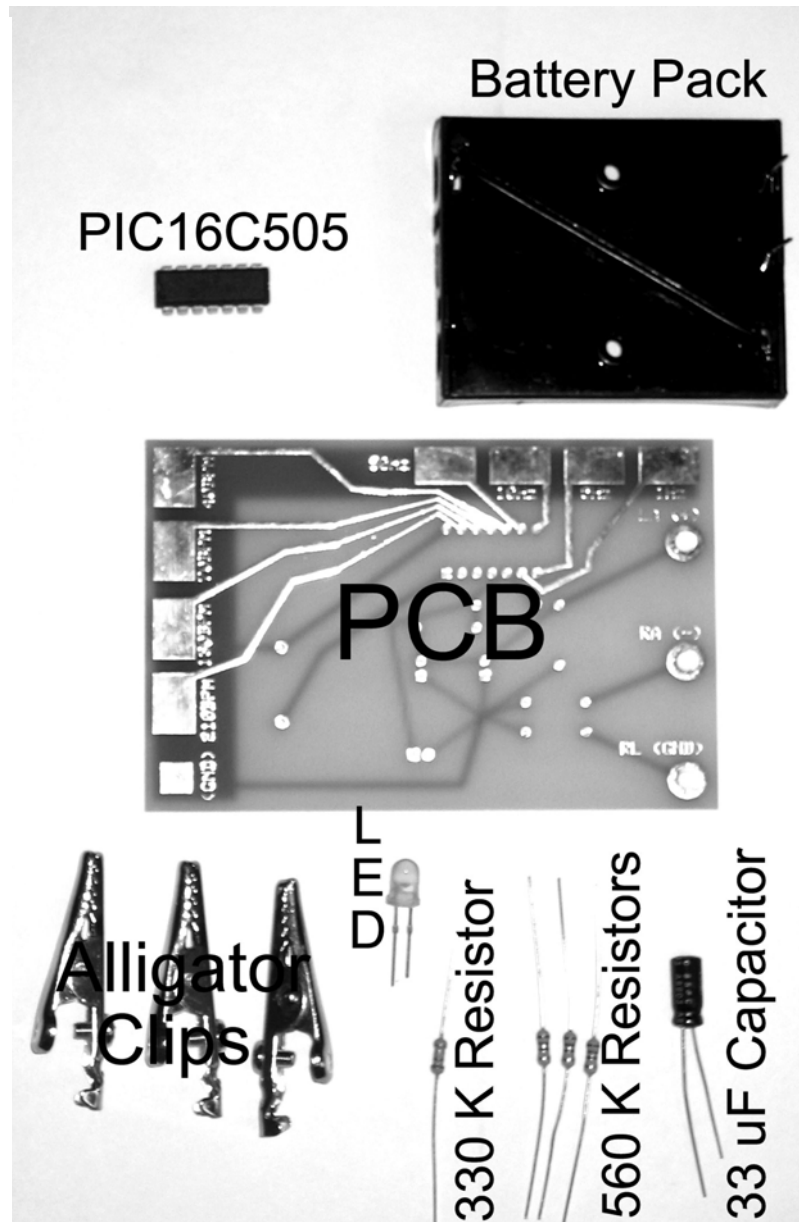
ECG Tester

April 26, 2005

Kit Contents

Your ECG Tester kit should contain the following:

- 1 PIC16C505
- 1 Battery Pack
- 1 PCB
- 3 Alligator Clips
- 1 LEF
- 1 330K Ohm
- 3 560 Ohm
- 1 33 uF Capacitor

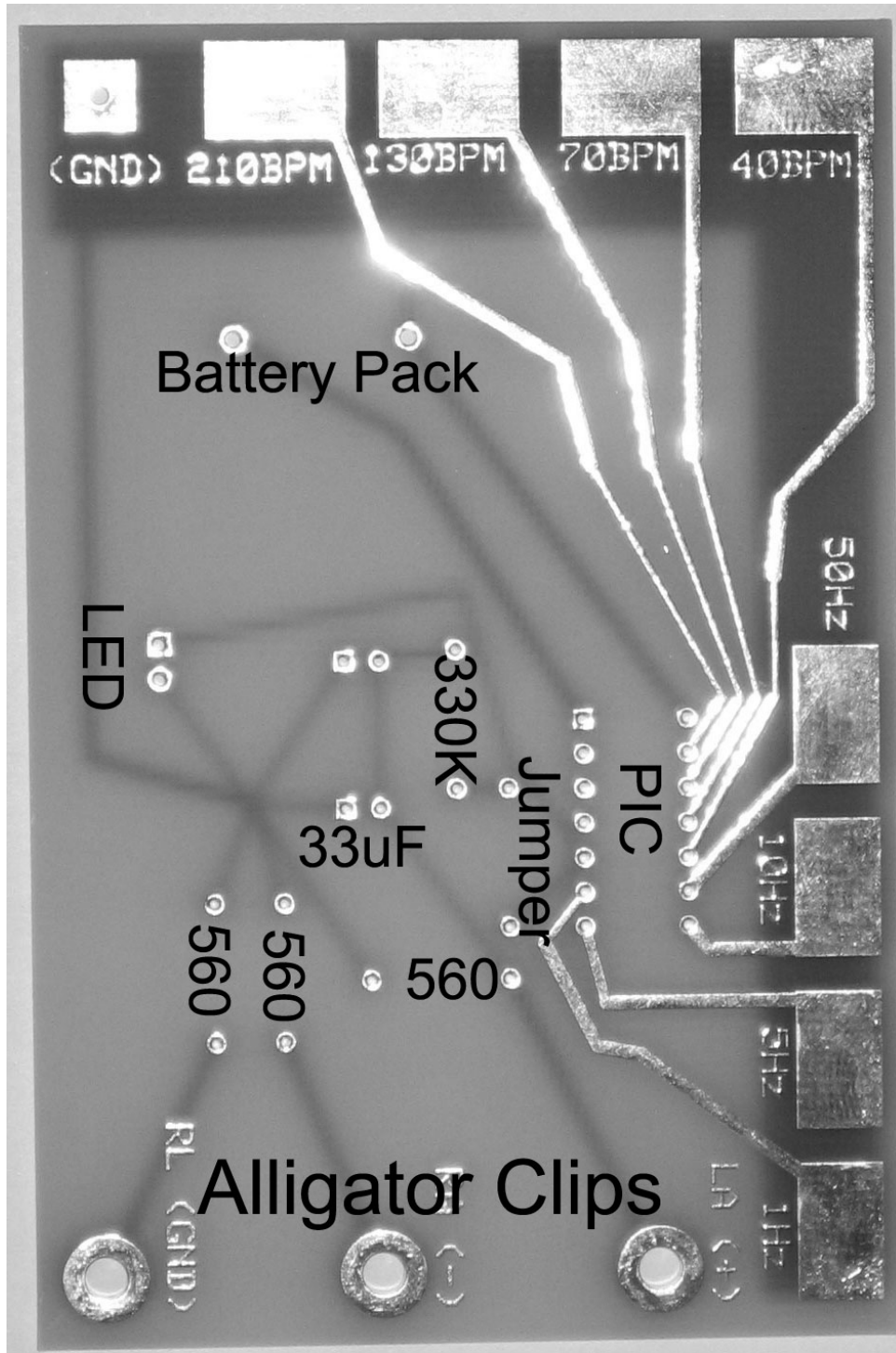


Tools You Will Need:

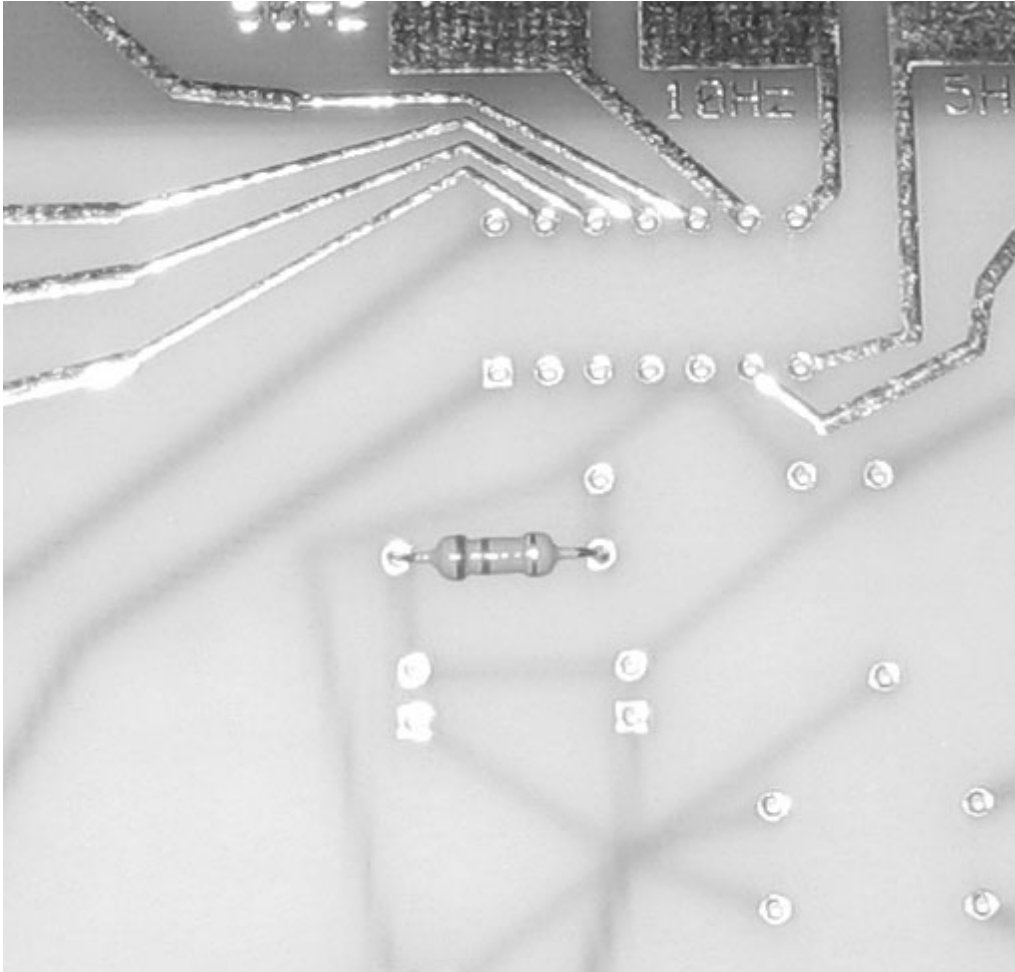
- Soldering Iron
- Solder
- Wire Cutters
- Small Philips Screwdriver
- Small Pliers

PCB Schematic

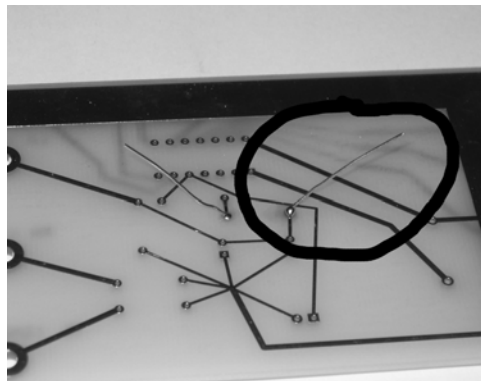
**Note: Be sure to refer back to this page as you build the ECG tester, in order to insure that you are doing it correctly.*



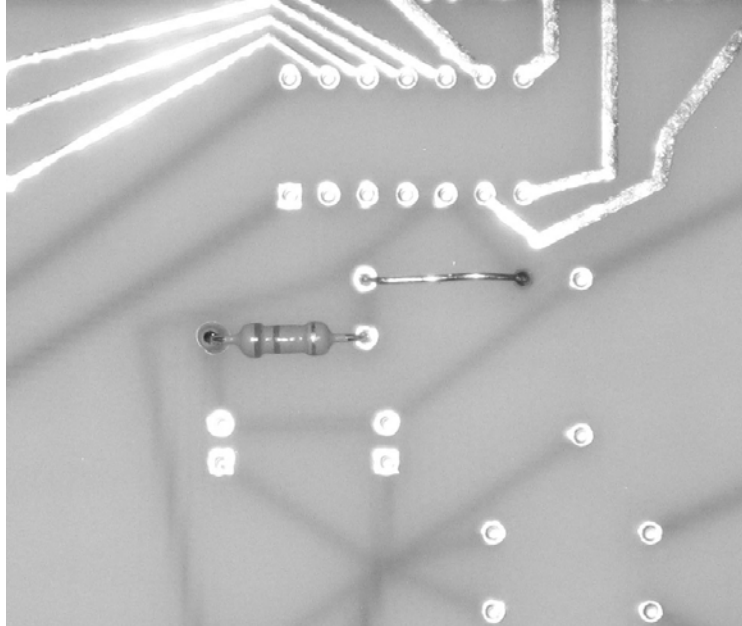
Step 1: Install 330K Ω Resistor



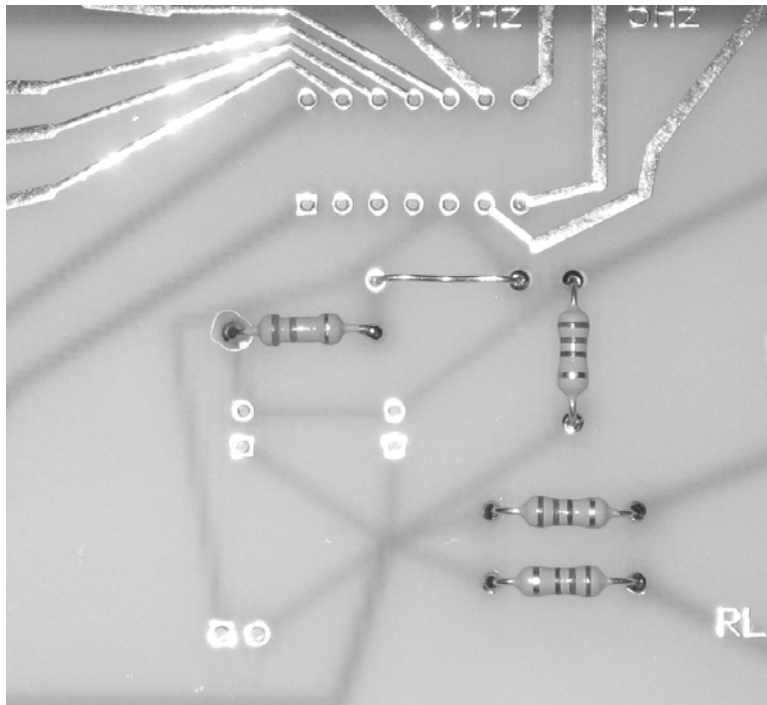
**Note: Be sure to save the lead from the installation of the 330K resistor, as it will be used as a jumper wire in the next step.*



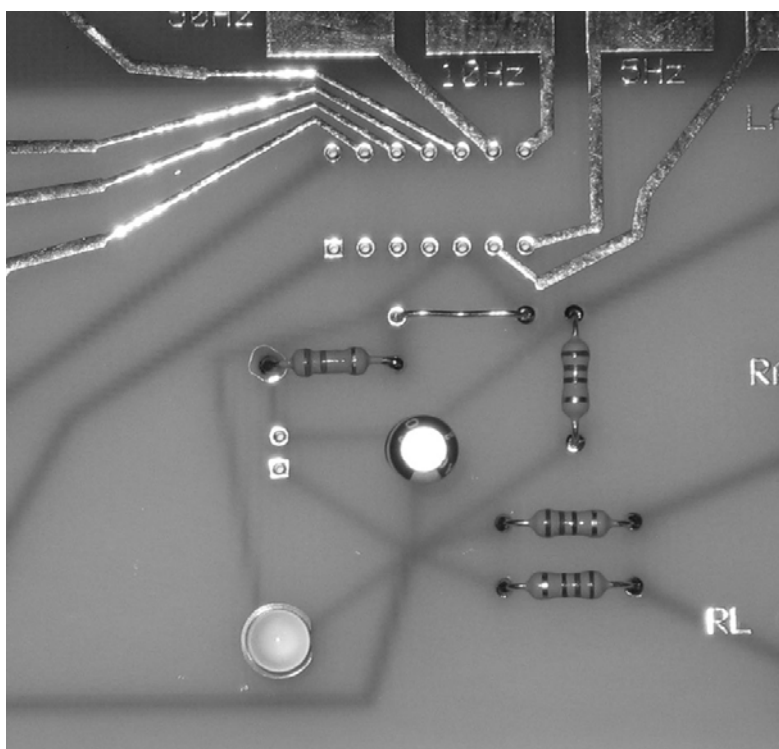
Step 2: Install Jumper Wire



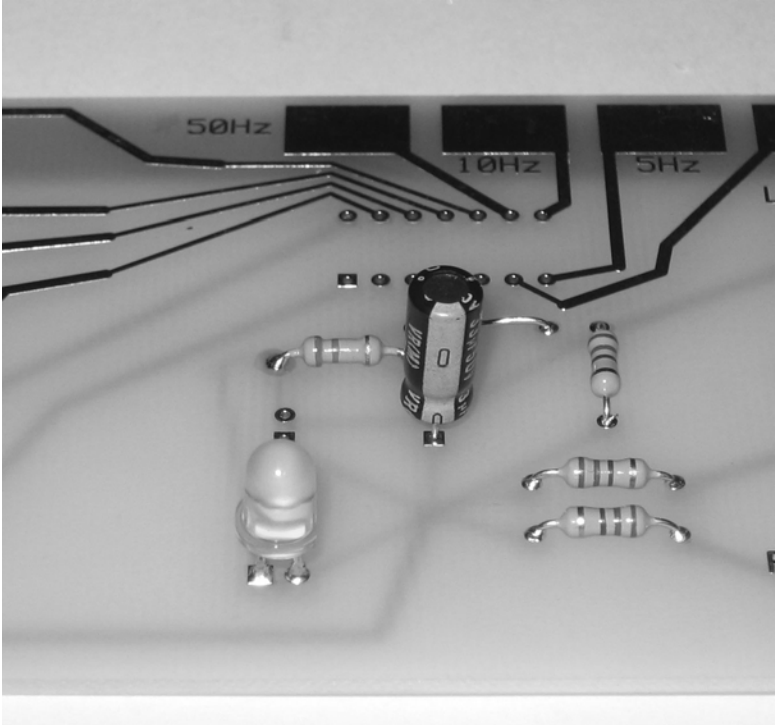
Step 3: Install 560 Ω Resistors



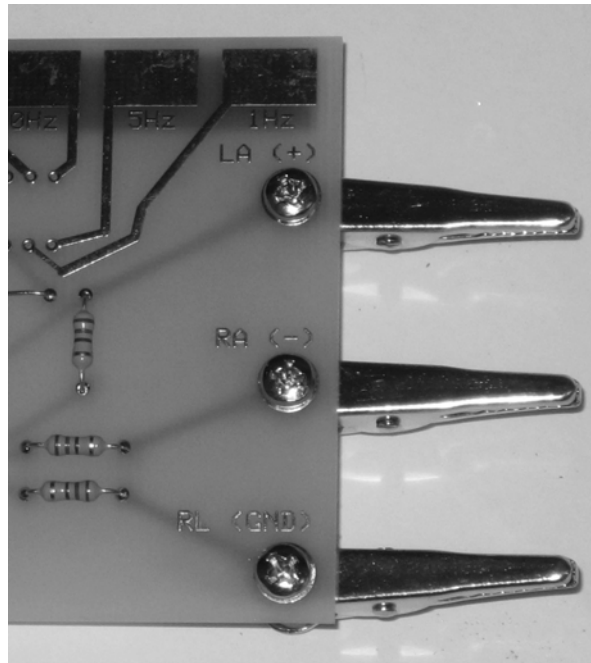
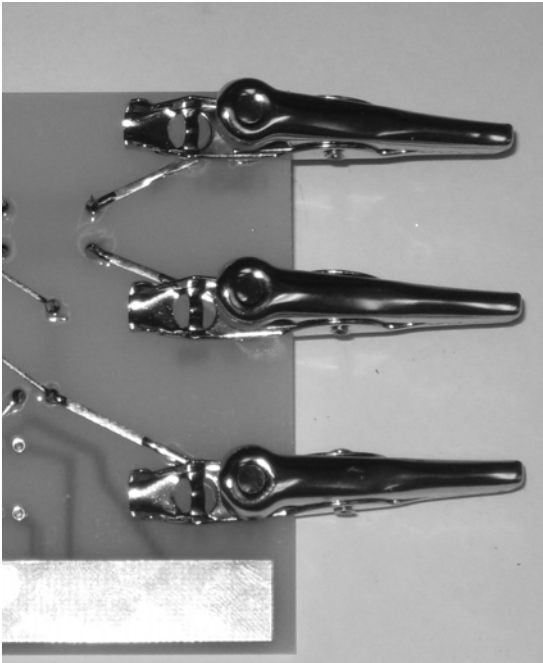
Step 4: Install LED & 33uF Capacitor



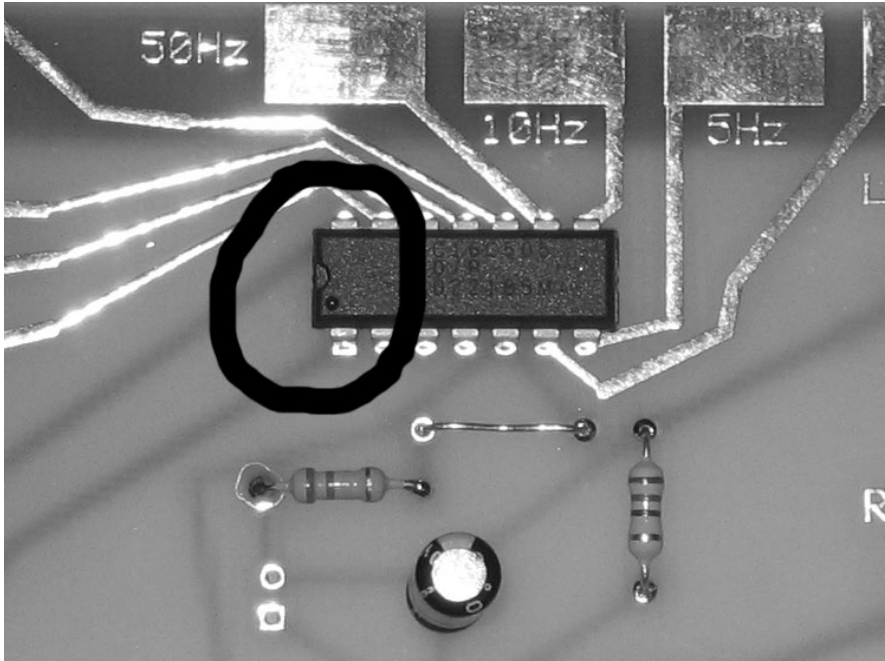
Note: Be sure to install the LED with the longer of the two leads facing towards the left.



Step 5: Install Alligator Clips

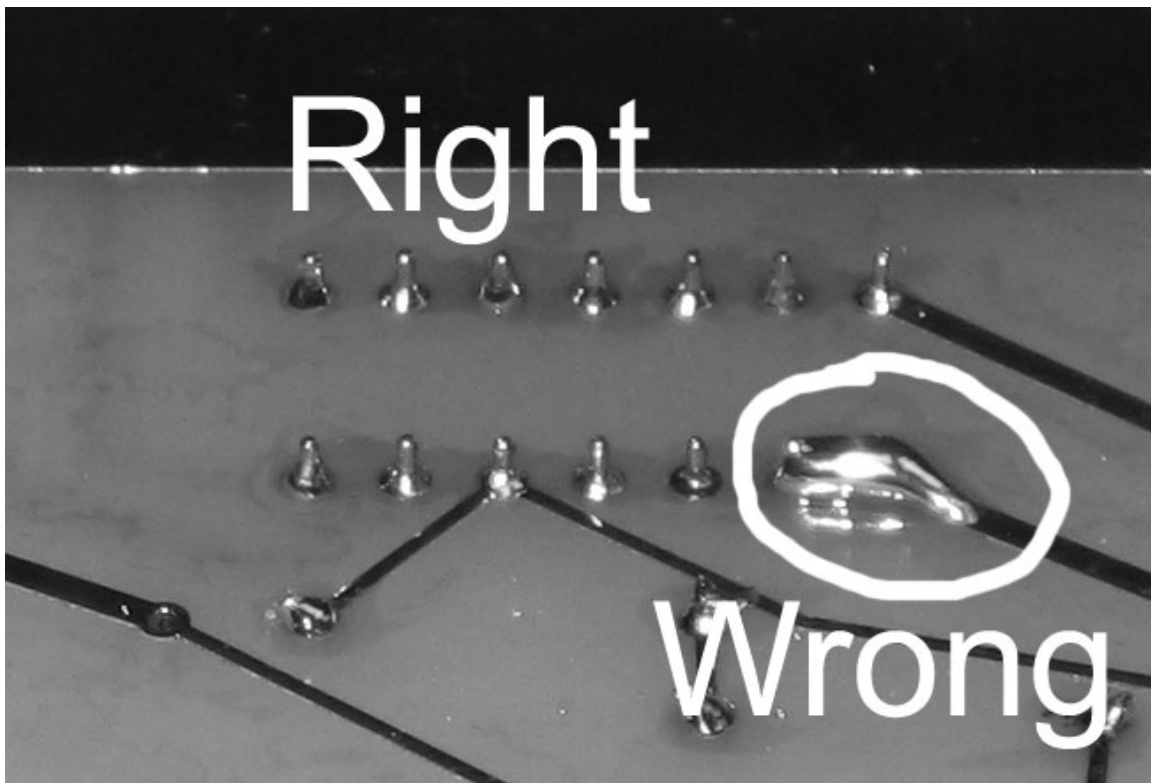


Step 6: Install PIC16C505



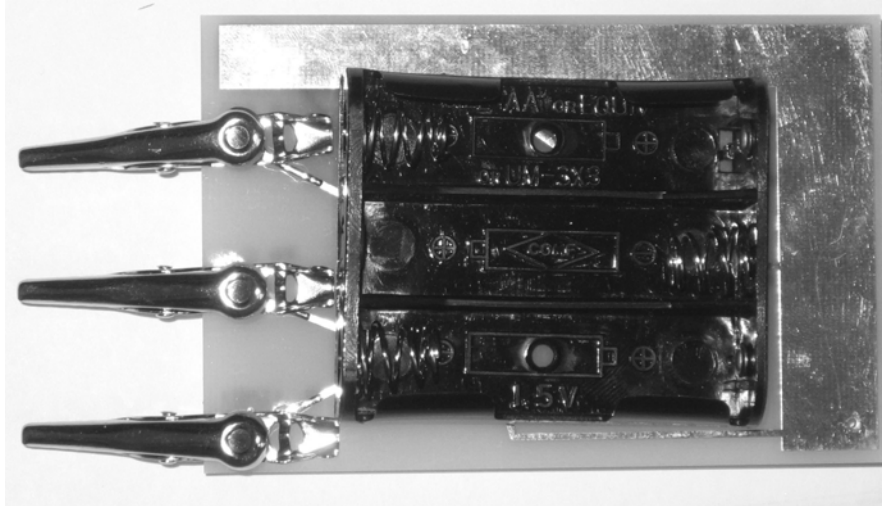
Note: Make sure that the semi-circle indicating the top of the chip is facing to the left when installed in the PCB.

Step 6: Install PIC16C505 (Continued)

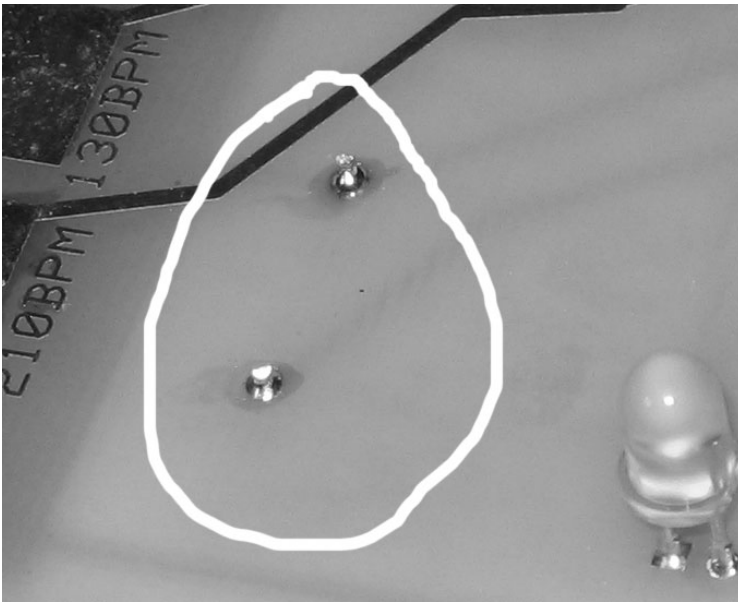


** Note: Be careful when soldering the pins of the chip to the board. Using too much solder can accidentally short two pins together.*

Step 7: Install Battery Pack

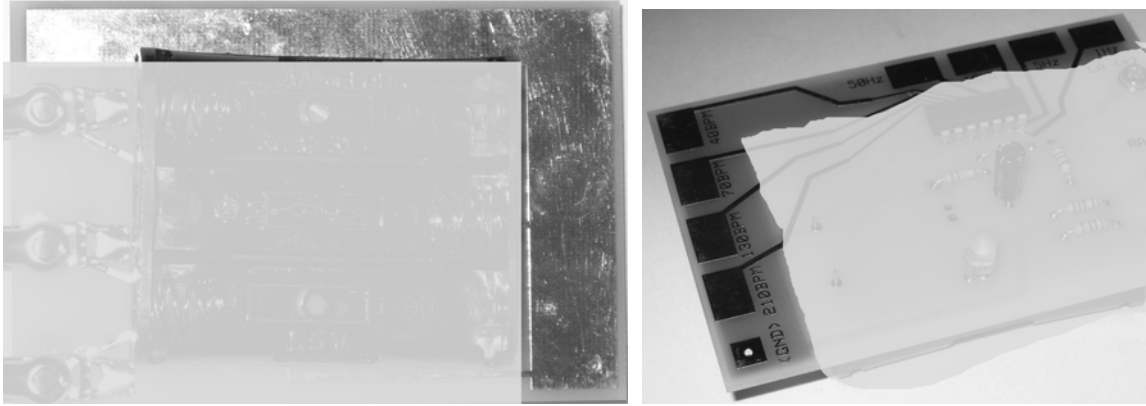


Step 7: Install Battery Pack (Continued)



Note: While the battery Pack is located on the back of the device, it is actually soldered onto the PCB on the front of the device.

Step 8: Drip Solder Onto PCB Pads



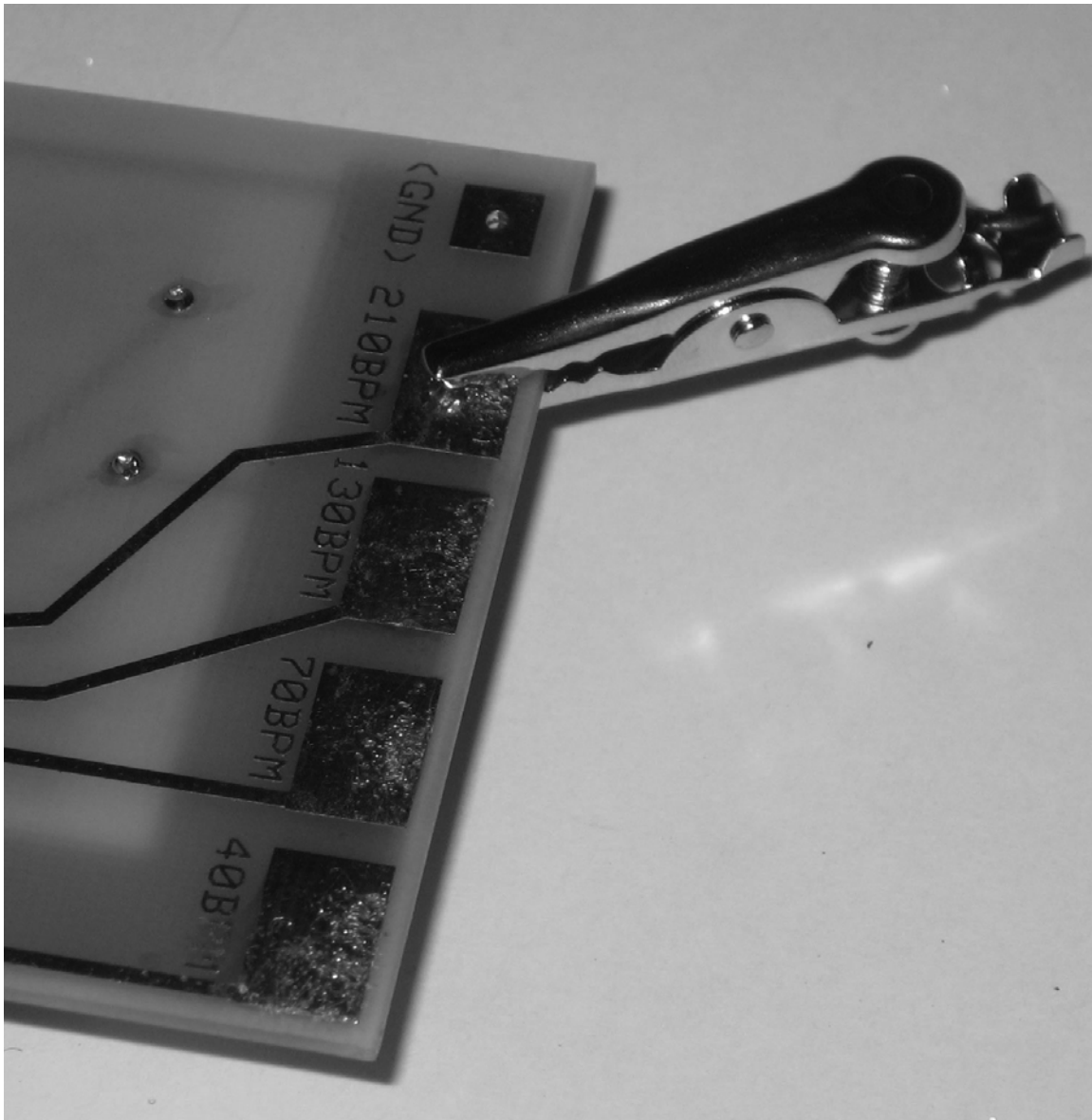
Note: this is done to increase the longevity of the device. Be sure not to get the pads too hot, or the PCB may be damaged.

Completed ECG Tester



Testing The Device

If the batteries are installed, the LED should light up. If a clip is used to short any one of the 8 pads, as in the picture below, then the LED should begin to blink.



User Instruction Manual

ECG Tester

April 26, 2005

Table of Contents

| | | |
|------|-------------------------------|------|
| I. | Overview of device..... | 3/15 |
| II. | Connection of ECG leads..... | 4/16 |
| III. | Use of the Switch..... | 5/17 |
| IV. | Power Supply..... | 7/19 |
| V. | Repair/debugging options..... | 7/19 |

Overview of ECG tester

This device is used to synthesize 4 types of waveforms: sine waves at 1, 5, 10 and 50 Hz and NSR waveforms at 40, 70, 130 and 210 beats per minute. When connected to an ECG machine, this device will output one of the above waveforms. The main parts of this device that the user should be acquainted with are the switch which allows the user to switch between one of the four types of inputs, the alligator clips which interface with the ECG machine, and the battery pack which provides the device with power. The complete device is shown in Figures 1a and 1b.



Figure 1a: Front of board with alligator clips for ECG leads on right and switch inputs on the top and left of device

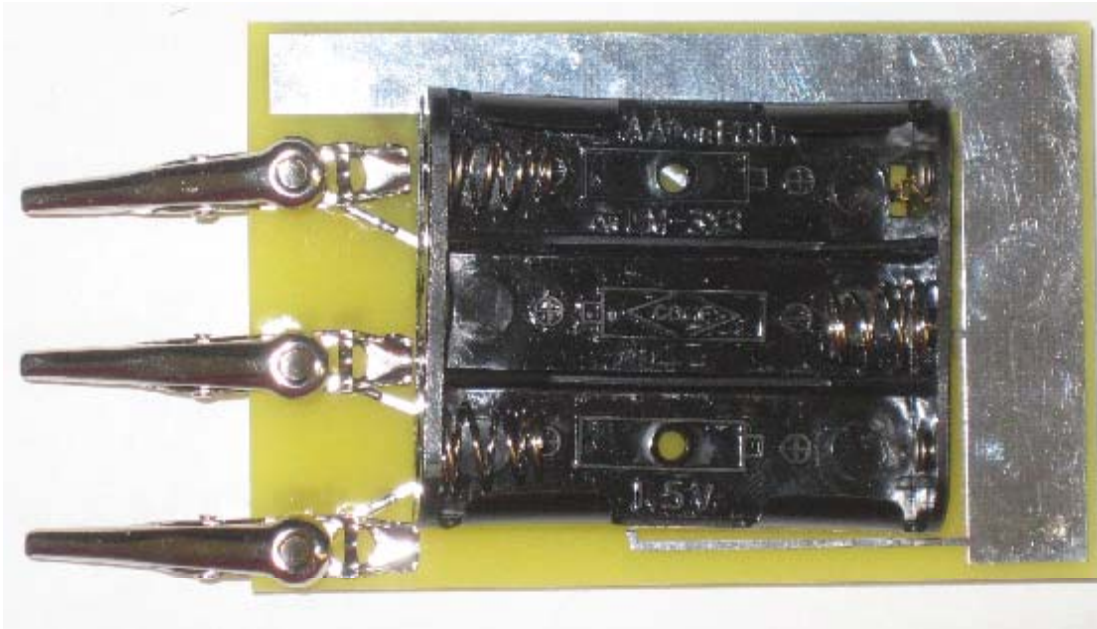


Figure 1b: Back of board with attachment of battery pack

Connection of the ECG leads

This device has outputs for a three leads of an ECG machine. On a three lead ECG machine, top output is the clip for the lead from the left arm, the middle output is the lead from the right arm and the bottom lead is from the right leg as shown in Figure 2a.



Figure 2a: Outputs of device are on the right.

This device can also be used with a five lead ECG machine. In this case, the right arm and left arm are connected as described previously. One of the other leads (RL, LL or C) can be connected to the bottom alligator clip. Please see Figure 2b for more details. The other two leads remain unattached. Similarly, this device can be used with a 12-lead ECG machine. The top alligator clip connects to the lead from the left arm or a positive electrode, the middle alligator clip connects to the lead from the right arm or a negative electrode and finally, the bottom lead connects to the right leg or a reference electrode.



Figure 2b. Attachment of device to a five-lead ECG machine

Use of the switch

The switch consists a metal ground strip on the back of the PCB, eight individual patches of solder on the front of the PCB and a clamp (see figures 3a and 3b for more detail).

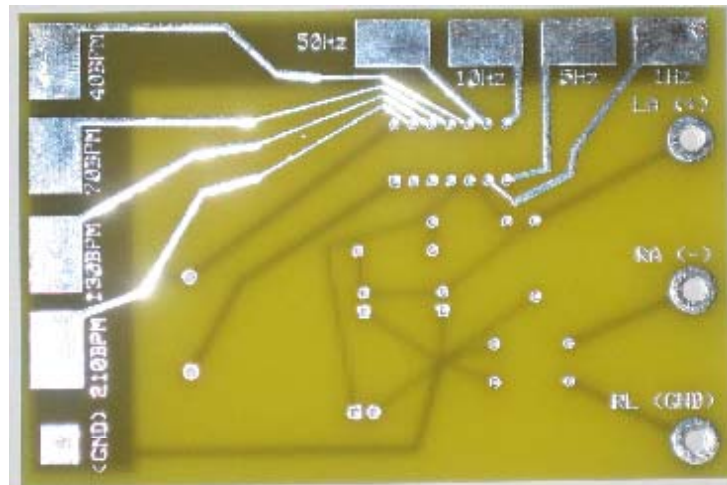


Figure 3a: Front of PCB. Notice the squares of solder that provide a place of attachment so that the user can select a given input.

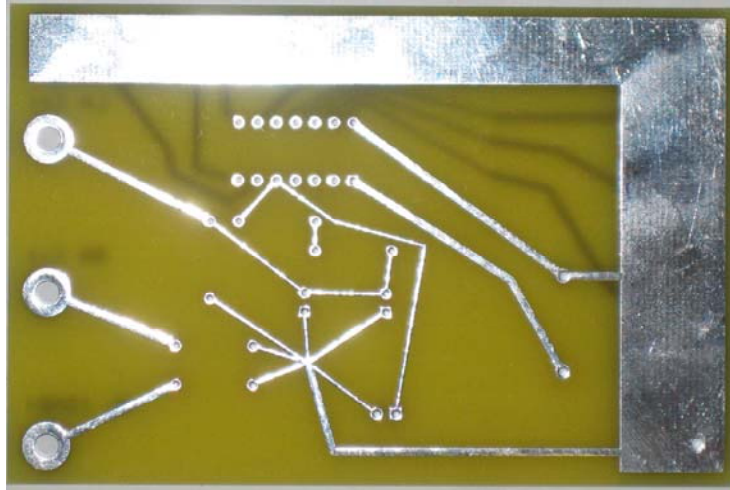


Figure 3b: Back of PCB. Notice the strip of solder that runs on the back of the PCB that provides a place of attachment so that the user can select a given input.

In this design, the strip of metal on the backside of the PCB is connected to ground. On the top of the PCB, there are 8 solder patches which correspond to the 8 input waveforms. To turn the switch on, the user must clamp the desired input to ground as shown in Figure 5.3c. This clamp can be an alligator clip as shown or a pair of pliers may be used as well. Once the input is clamped to ground, the signal then travels to the PIC. Initially all the pins on the PIC are set high, so the PIC will notice that one of the pins has been set low. The low input from the pin will turn on the desired waveform in the PIC.

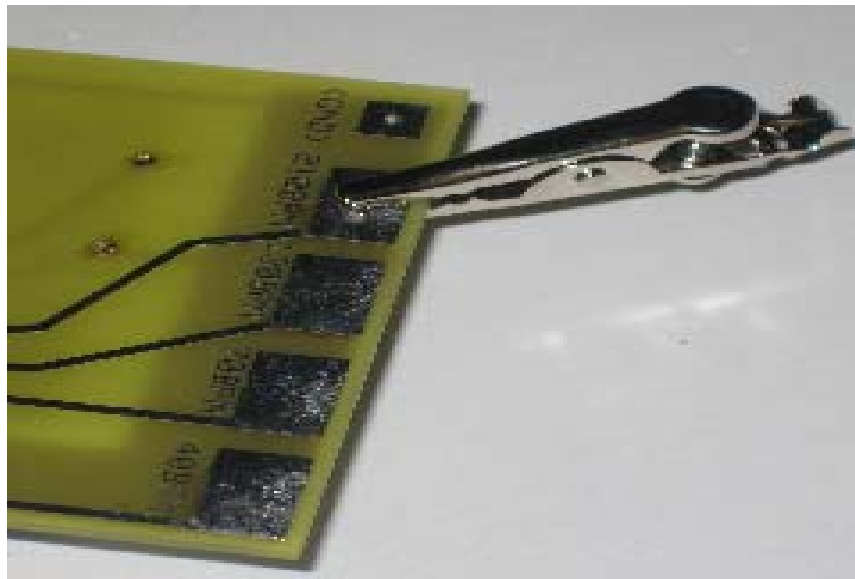


Figure 3c: Final PCB layout with alligator clamp to switch on.

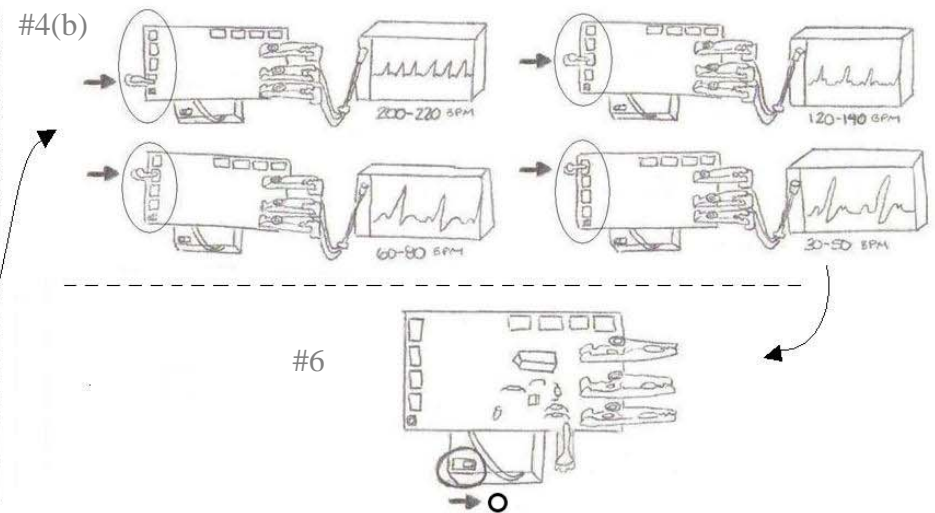
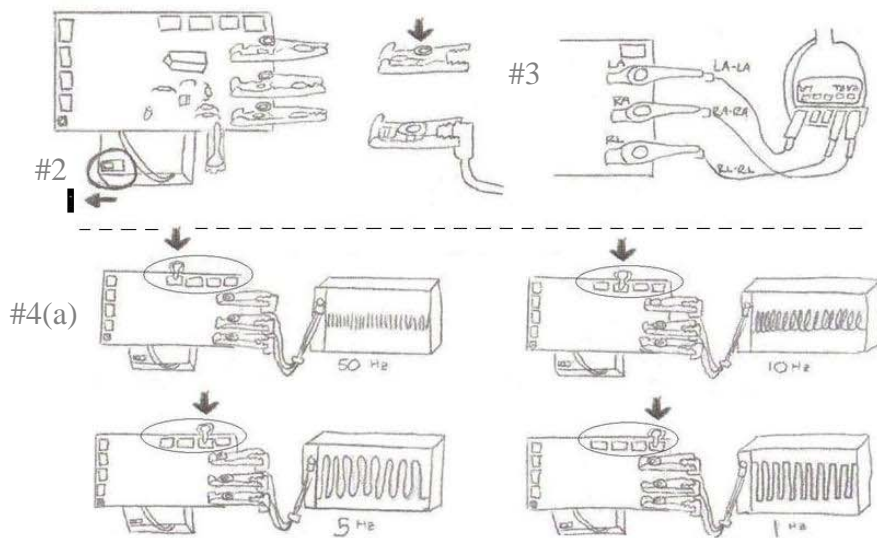
Power Source

The power source for the device is three 1.5V batteries which insert into the battery pack included in the design. To turn the device on, insert the batteries into the battery pack. Note the orientation of the battery before insertion. When the device is on, the green LED will light up. Also, the LED will flash according to the frequency and shape of the waveform. When outputting a sine wave, the LED will flash on and off with the frequency of the waveform. When outputting a NSR waveform, the LED will flicker to indicate the QRS complex. To turn the device off, remove the batteries.

*****NOTE: Please remove the batteries after every use to prolong battery life *****

Repair/ Debugging Options

Always make sure the device is on. If the LED is not on, check the voltage of the batteries to ensure that they have not died. Also, check to make sure the leads of the ECG machine are connected correctly and that the device. Finally, make sure the device does not get wet as water can damage the circuitry.



ECG tester instructions

1. Switch on the ECG machine.
2. Turn on the tester by moving the switch on the battery pack to "ON" |
3. Connect the tester to the ECG using the ECG cables. Clip the leads from the ECG with the tester clamps with the same name: RL with RL (indicates right leg), LA with LA (left arm), RA with RA (right arm).
4. Clip the small clamp in the desired location. The appropriate wave should appear on the ECG tester. The LED will blink once for each wave produced.
 - a. Sinusoidal waves: in order of decreasing frequencies 50 Hz, 10 Hz, 5 Hz, 1 Hz
 - b. Physiological waves: 34 BPM, 60 BPM, 107 BPM, 176 BPM simulate heart beats of approximately 40, 70, 130, and 210 beats per minute
5. Detach the ECG leads from the tester clamps.
6. Turn off the tester – move the battery pack switch to "OFF" ○

Common Problems

The signal on the screen does not have the desired frequency

You have to compare the four signals of each type. Sometimes the frequency numbers listed on the tester are not exact. The important thing is that the frequencies have approximately the correct proportions.

There is no signal on the screen

Make sure that the metal parts of the ECG leads are in contact with the metal tester clamps.
Verify that the connections between the cables and the ECG are secure

The wave on the screen had the desired form, but now it doesn't

Especially with the highest-frequency settings, leaving the ECG at the same setting for a long time may cause the wave to become chaotic. Just remove the small clip from the tester and replace it after a few seconds.

Instrucciones para el probador de ECG

1. Prenda la máquina de ECG
2. Prenda el probador moviendo el interruptor del paquete de la batería a "ON" |
3. Conecte el probador al ECG con los cables del ECG. Sujete los cables del ECG con las grapas del probador con el mismo nombre: RL con RL (indica pierna derecha), LA con LA (brazo izquierdo), RA con RA (brazo derecho).
4. Sujete la grapa pequeña en el lugar deseado. La onda apropiada debe aparecer en la pantalla del ECG. El LED parpadeará una vez por cada onda producida.
 - a. Ondas sinusoidales: en orden de frecuencias disminuyentes 50 Hz, 10 Hz, 5 Hz, 1 Hz
 - b. Ondas fisiológicas: 34 BPM, 60 BPM, 107 BPM, 176 BPM simulan latidos del corazón de aproximadamente 40, 70, 130, y 210 golpes por minuto
5. Desconecte los cables de ECG de las grapas del probador.
6. Apagúe el probador – mueva el interruptor del paquete de la batería a "OFF" ○

Problemas comunes

La señal mostrada en la pantalla del ECG no tiene la frecuencia deseada

Hay que comparar las cuatro señales de cada tipo. A veces los números de frecuencia listados en el probador no son exactos. Lo importante es que las frecuencias tengan aproximadamente las proporciones correctas

No hay señal en la pantalla

Asegurarse que la parte de metal del cable del ECG tiene contacto con la grapa de metal del probador.
Verifique que las conexiones entre los cables y el ECG estén seguras

La onda en la pantalla tuvo la forma deseada al principio, pero ahora no

Especialmente con las colocaciones más altas, dejando el ECG con la misma señal por un largo rato puede causar que la onda llegue a caos o que se quede en un solo valor. Sólo hay que sacar la grapa pequeña y reemplázala de nuevo después de unos segundos