How to Record an Accurate EKG and Heart Rate

This illustrated tech-note will help you solve common signal problems quickly to get the most from your EKG biofeedback system.

In this document we will discuss the two main placement areas, the chest and the limbs, and how to get the best signal from them.

Troubleshooting mechanical problems
What if the software cannot detect any signal? First, check that the sensor is properly connected to the encoder. Also, make sure the electrodes are adhering properly. Verify that the encoder is loaded with batteries, switched on and the LED is lit. Finally, check the fiber optic connection to the PC.

Electrode placement
To obtain a high-quality EKG, you must prepare the electrode site properly. We recommend the use of Thought Technology Unigel electrodes. If the electrodes won't adhere to the skin because of excess hair, perspiration, or oily skin, wipe the skin with an alcohol or skin prep wipe, and apply a dab of supplementary conductive gel to the electrode. If you have tried several placements in the process of obtaining the optimum signal, it is a good idea to apply a fresh electrode to the prepared site. If your placement requires gel, use EKG type conductive gel, not other nonconductive pastes. Place electrodes on fleshy areas and avoid bony prominence, large muscle and hairy areas. If the client is thin, you might have to vary the sites slightly to keep electrodes off the ribs. Having applied the electrodes, make sure the wires aren't pulling on them.

Chest Placements
Chest placements are normally the most reliable and give the cleanest signals. However they have obvious disadvantages over the less invasive limb placements.

The standard placement for Thought Technology’s EKG leads is as shown in the diagram. If you put the positive and negative the wrong way around when using CardioPro it may inform you of the incorrect polarity.
The standard placements assume an average positioning of the heart. There may be anatomical variations between people, which affect the heart’s positioning in the chest. If after trying the standard position the signal is not clear try adjusting the positive or negative electrodes. Start by moving the positive electrode to the left, if this does not improve the signal replace it to the original position and try moving the negative one. If it is necessary to move the electrodes, you may have to replace them with fresh ones once you have identified the optimum position.

**Limb Placements**
The limbs act as electrical extensions of the body. There are two types of limb placement: Wrist, wrist and leg or just wrist to wrist. The wrist to wrist is the easiest to set up and most flexible for the client. To reduce the noise on these placements move the electrodes higher on the limbs, limb placement is more susceptible to movement artifact, if you cannot get a stable signal return to the chest placement. For stable wrist to wrist placements have the client relax their arms and shoulders and rest the lower arms next to their sides not elevated on the chair arms.
What should the EKG signal look like?

The above trace is a normal well-recorded EKG signal, there is no drift or noise and a sufficiently large R and S spike for the computer to reliably read the heart rate and inter-beat-interval.

Solving problems with the tracing

**Noise** - Poor electrode placement, client movement, muscular tension, can cause “Noise” or artifact. To eliminate artifact, check electrode connections, move the limb electrodes higher on the limb, and encourage the client to relax. Clip the encoder to the belt of the client and move the client further from the computer, and secure any excess sensor wiring beneath clothing where possible. The trace below clearly has noise, the human eye can easily pick out the beats but for the computer the noise can disguise the beats.

**Signal Drift** - Client movement, poor skin preparation and electrode contact, dry electrodes, respiratory interference, and electrode movement can cause a wandering baseline. To eliminate a wandering baseline, apply fresh gelled electrodes, encourage the client to relax and hold still momentarily, and check electrode positions. Ask him to hold his breath and not to talk for 3 to 6 seconds if he can.

**Electrical Noise** - Improper grounding of electrical equipment, faulty electrodes, and poor electrode contact can cause electrical or 50 or 60-cycle interference (indicated by the thickened baseline). This is minimized in Thought Technology equipment by the encoder’s appropriate filtering. Maximize the distance between the encoder and sources of electrical noise such as the computer.

Getting it right the first time - By making these guidelines part of your routine, you can eliminate many avoidable problems--and correct the unavoidable ones quickly.