

Basic EEG Hookup Procedure

Example Hookup

1. Apply a small amount of **Spectra Gel** to the Wrist Strap Ground Electrode and apply it to the subject's wrist. For oily skin an alcohol wipe may be helpful. Note: the strap is conductive, the button directly under the snap connector may not be. Connect the EEG cable ground lead to the strap.
2. Wrap the sports headband around the subject's head. The placement is around the forehead and occipital area.
3. Run the both active leads upward under the left side of the head band just forward of the left ear. Temporarily leave the loose cables hanging.



Fig 1

Mastoid placement.

4. Press **10-20 Paste** into the recessed cavity of a biopotential electrode. Be sure it appears in the small hole on the back of the electrode. Leave a liberal mound of paste on the face of the electrode (Fig 1).
5. Locate the right mastoid (Fig 2). This is the area behind the ear that is usually clear of hair. Feel a small hollow area that does not move when the subject clenches their teeth. Gently clean the mastoid area with NuPrep.
6. Insert one of the biopotential electrodes into the black pin jack on the EEG cable. Press the electrode against the right mastoid area (Fig 4). A small back and forth rotation will insure good contact.
7. Move the headband carefully down over the electrode to hold it in place (Fig 5). The cable should be routed up over the top of the head to provide support.



Fig 2



Fig 4

Ear Placement.

4. Route the EEG cable with the black pin down under the sports band behind the right ear (Fig 5a).
5. Press **10-20 Paste** into the metal cup of the ear clip electrode. Insert the ear clip pin into the black pin jack on the EEG cable.
6. Clean the subject's ear lobe with **Nu Prep**.
7. Attach the ear clip electrode to the subject's ear lobe. The cable should be routed as shown in Fig 5A.



Fig 5



Fig 5A

- Part the subject's hair to expose the scalp at CZ (very top of the head). We find that it is helpful to temporarily hold the hair out of the way with hair clips (Fig 3). Clean the scalp with NuPrep. If excess hair spray is present, especially the kind that imparts a stiff texture to the hair, it will need to be removed from the scalp.
- Clip the two active EEG leads to the subject's clothing on the left side to support the cable. Leave approximately 16 inches of free cable to allow for connection to the electrodes on the head (Fig 7).



Fig 3

- Insert the other biopotential electrode into the blue pin jack on the EEG cable. Press the electrode into the prepared area at Cz (Fig 6). A small back and forth rotation will insure good contact.



Fig 6

Note: Do not press the electrode all the way down against the scalp. The underlying hair will force it to spring up causing a poor connection. The 10-20 Paste should provide a solid connection between electrode and scalp.

- A single sheet of Kleenex tissue rolled into a narrow strip and held in place with hair clips will provide additional support for the Cz electrode if necessary (Fig 7).
- Carefully pull the EEG cable back under the headband to remove any excess from the top of the head. The mastoid cable should be routed up over the head, but not contact the Cz electrode.
- Check the amount of cable between the headband and clothing clip to assure the subject can turn his head without putting a strain on the cable. It is essential that the electrodes not move when the head is turned. Figure 7 shows the complete hookup.



Fig 7

- Plug the EEG cable into EMG/EEG channel 1 of the Preamp Box.

A Few Notes on Hookups

Poor EEG signal quality is mostly caused by poor contact and/or electrode movement. Properly cleaned skin and sufficient **10-20 Paste** will assure good electrical contact. The most common problem here is insufficient paste and pressing the electrode down too firmly. There must be a column of paste between the metal part of the electrode and the skin.

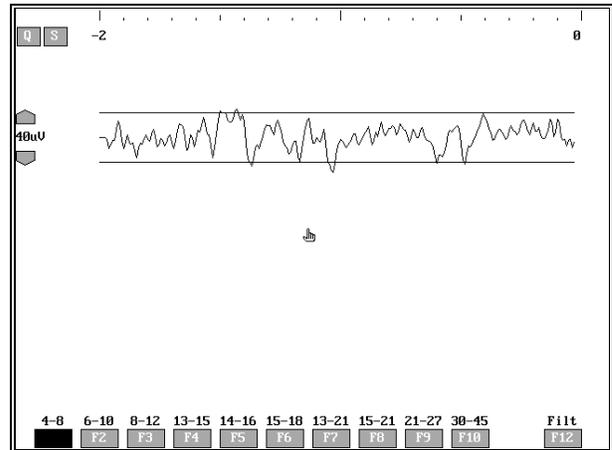
Even the slightest electrode movement will produce low frequency artifacts which can mimic delta/theta EEG signals. To prevent movement, the EEG cable must be secured so that it moves with the electrode attachment point. The sports headband is ideal in this regard. It is flexible enough not to be moved by the subject's temporalis muscle activity and secures the cable against the head. **Under no circumstances should the cables be allowed to hang unsupported.**

We highly recommend the mastoid placement rather than the ear for the same reason. With most subjects, the ear lobe moves with the jaw. This causes the cable to tug on the ear electrode and create movement artifacts especially during interactive EEG training. Claims that the ear is a quiet reference and therefore superior to the mastoid have no basis in fact.

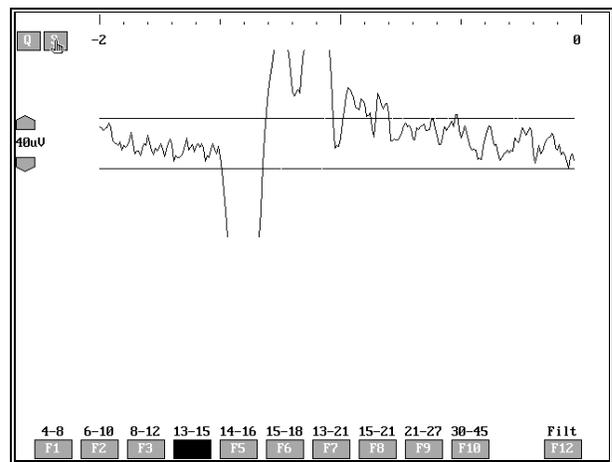
Verifying the Signal Quality

Select **On-line EEG** (selection 4) from the System Control Screen. The raw data display shown at the right will appear. The waveform may vary depending on the subject's EEG and the quality of the hookup. The lines above and below the "40uV" label indicate the calibration for 40 microvolts peak to peak. Press the "-" key on the numeric keypad or click on the down arrow icon to change the range to 20 microvolts. Press the "+" key on the numeric keypad or click on the up arrow icon to return to 40 microvolts. Two seconds of data are displayed on the screen. New data enters the display on the right and scrolls to the left.

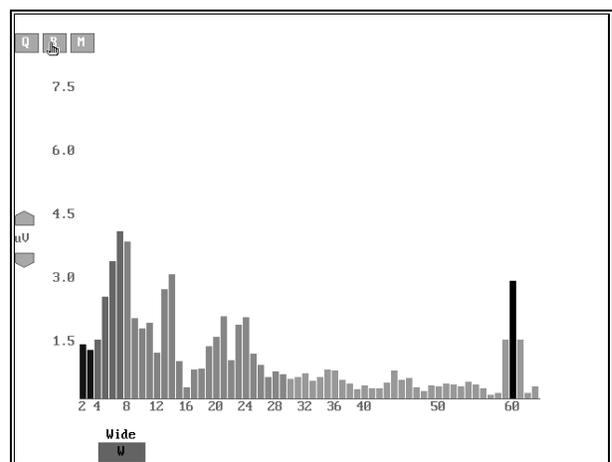
1. While observing the raw EEG waveform, wave your hand approximately 6 inches above the Cz electrode being careful not to contact the electrode or subject's hair. An artifact such as the one at the right is an indication that the electrode is not making good contact. See the suggestions below to correct the problem.
2. Ask the subject to move the head gently from right to left. It is normal to see some change in the EEG, but a large low frequency artifact is an indication that the cable or electrode is moving.
3. Press the "S" key or click on the **S button** to switch to the spectrum display. A display similar to the one shown at the right will appear. The spectrum may vary depending on the subject's EEG and the quality of the hookup. The bars are colored to indicate each commonly defined EEG frequency range. A separate bar at 60 Hz is useful in evaluating the hookup for power line interference.



Typical EEG without Artifacts



Low Frequency Artifact

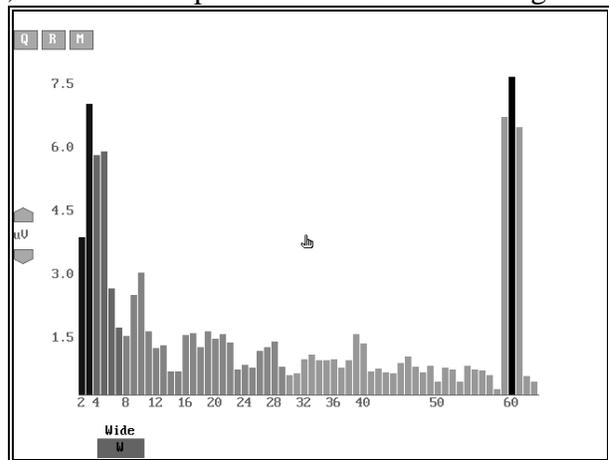


Typical Spectrum with Acceptable 60 Hz

The display at the right is an indication of excessive 60 Hz interference. This problem is usually the result of poor electrode contact. It can also be caused by the use of an ungrounded outlet or defective surge suppresser. If 60 Hz is off scale, click on the up arrow to increase the range so the actual value can be measured. While a reading can range as high as 20 uV without affecting the F1000's ability to accurately process the signals, it is an indication of something wrong. Normal values are in the range of less than 5 uV.

Electrode Contact Problems

Contact between the electrode and the scalp is dependent upon the presence of **10-20 Paste** between the metal in the electrode and clean skin. Some of the factors that can cause poor contact follow:



Spectrum with Excessive 60 Hz

1. Failure to fill the electrode cavity with paste.
2. Failure to maintain paste between the electrode and scalp, usually due to insufficient paste or pressing the electrode too firmly against the scalp. A very slight rotation of the electrode with only slight downward press will often seat the electrode and improve contact.
3. Oil or hair spray on the person's scalp.
4. Natural dryness of some person's scalp. It sometimes helps to let body heat soften the paste slightly before rotating the electrode.
5. If all else fails, remove the electrode, reclean the scalp with **NuPrep**, add paste to the electrode, and reapply.
6. **It is imperative that movement and 60 Hz artifacts be resolved before proceeding with EEG work. Poor signal quality is the single most common cause of poor results.**