

Somatosensory Responses

using SmartEP

Somatosensory responses

Somatosensory responses can be acquired by providing surface electrical stimulation to a patient's upper or lower limbs. This procedure is useful to determine the integrity of the somatosensory pathways as well as help diagnose the nature of any possible sensory impairment.

A two-pronged handheld stimulator can be used to locate the best possible electrode locations, then surface electrodes placed at those locations. A pulse stimulation is typically used. Recording surface electrodes are placed on the limbs being tested and on the subject's skull.

Connecting the equipment

The Somatosensory box and stimulator must be connected to the USB box as specified by the following instructions to ensure safe use.

1. Plug in the power supply for the USB box as shown in the hardware installation manual, and connect it to your isolation transformer using a medical grade power cord.



Fig.1 - USB Box Connectors

2. Connect the power for the Somatosensory Box to the isolation transformer using a medical grade power cord.
3. Connect the Yellow DIN connector of the USB box to the Yellow DIN connector of the Somatosensory Box using the cable provided and aligning the arrows on the connectors and cable. This cable is also color coded to avoid confusion.

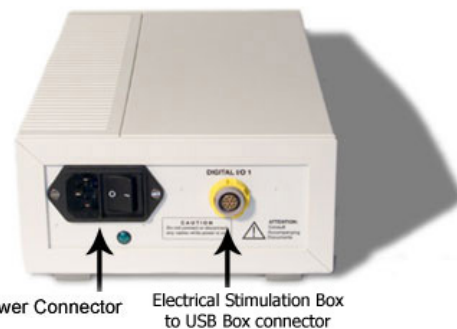


Fig.2 - Somatosensory Box Connectors

4. Plug the Somatosensory Stimulator to the somatosensory box by plugging the cable into the black connector located at the front of the box. Turn the dial of the stimulator all the way to the left (lowest setting).
5. Turn ON the USB box and then turn ON the Somatosensory box, in that order.
6. Dab a small amount of conductive gel at approximate stimulus sites to find best stimulus location.



WARNING: When using the somatosensory equipment, The Subject MUST BE DISCONNECTED FROM THE STIMULATOR BEFORE POWERING UP. Electrical shock may occur. Maintain the Dial on the stimulator to the lowest position when the equipment is not in use.

Electrode Placement

Lower Extremity Electrode Placement

- **Cz'**: 2 centimeters posteriorly to the vertex on midline
- **Lt.PF**: Left Popliteal fossa
- **Rt.PF**: Right Popliteal fossa
- **Lumbar**: Lumbar spinal cord (L3 or L5)
- **Ref.:** Reference Site, varies with test.

Use the REF electrode site as a reference for the Lumbar electrode, Lt.PF and Rt.PF. Fpz may be used as a reference electrode for Cz' when testing the lower limbs. The ground for all recording electrodes should be the same.

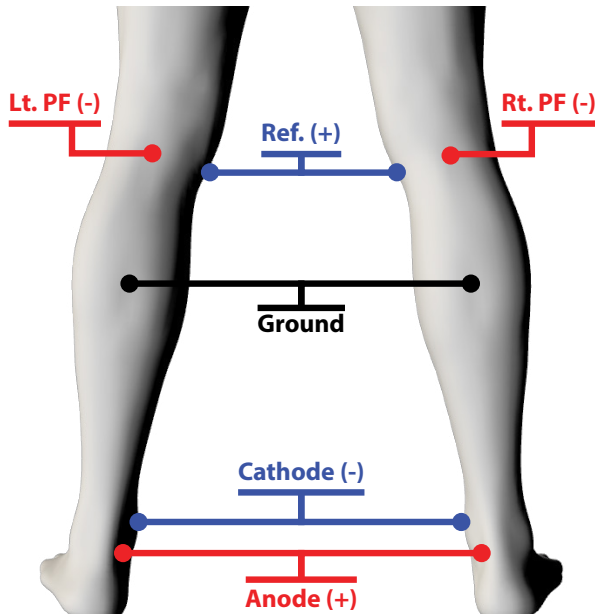


Fig.3 - Suggested lower limb electrode placement

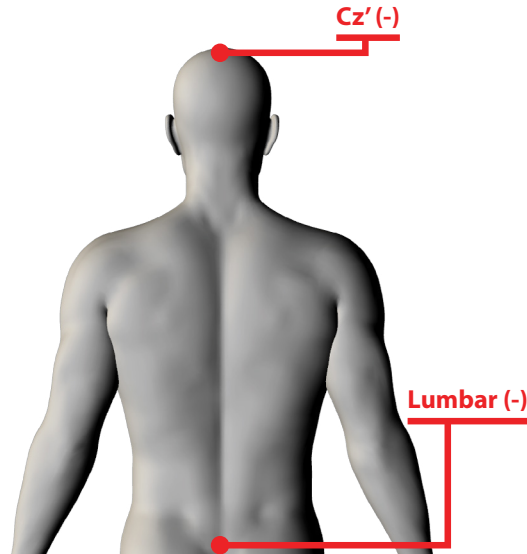


Fig.4 - Additional electrodes for lower limb acquisition
Upper Extremity Electrode Placement

- **Fpz:** The Forehead at the midline (Reference for C3' and C5)
- **C3':** Midway between C3 and P3
- **C4':** Midway between C4 and P4
- **EP1:** Left Erb's Point (Reference for C3' and EP2)
- **EP2:** Right Erb's Point
- **C5:** Cervical Spine at C5 (C7 or C2)

Notice that the ground electrode shown on the following figure refers to the ground used for the recording electrodes as there is no ground for the stimulation electrodes. The ground for all recording electrodes should be merged to the same electrode site. When testing the left side, C4' replaces C3'; EP2 becomes a reference electrode, while EP1 becomes the active electrode.

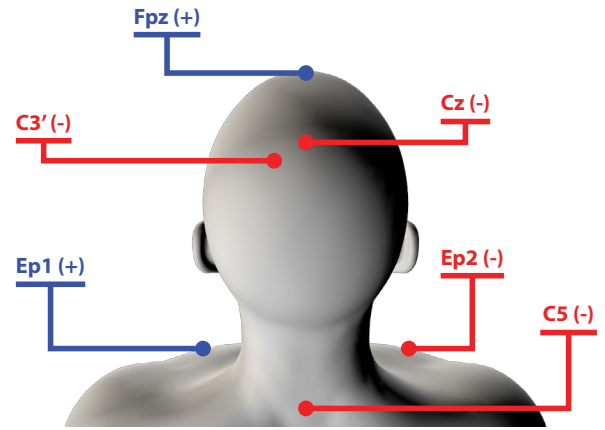


Fig.5 - Electrode placement for upper limb evaluation

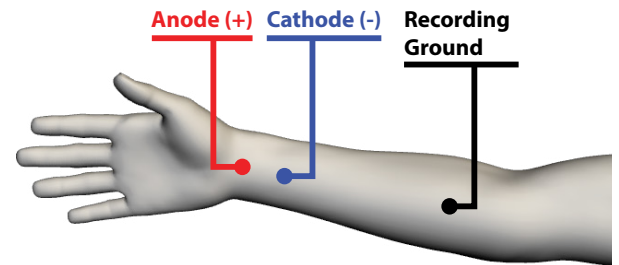


Fig.6 - Suggested stimulating electrode locations

Performing an acquisition

1. Connect the Somatosensory Box and the USB Box as previously outlined.
2. Connect the handheld Electrical Stimulator to the Electrical Stimulation Box black Fischer connector.
3. Start system by turning ON the USB box, turning ON the Electrical Stimulator Box and starting SmartEP.
4. From the SmartEP main menu, choose **[PROTOCOL > MODALITY > SOMATOSENSORY > STANDARD]**.
5. On the control panel, make sure the stimulus is OFF (Stim: OFF).
6. Set the current limit level on the control panel.
7. Place surface electrodes as needed and connect them to the transmitter box.
8. Define your stimulus as necessary using the Somatosensory Stimulus Generation window as explained above. When testing humans, a pulse should not exceed 600 microseconds for optimal results. Click the Save button when done, then click OK to close the window.
9. Set the estimated current limit and the Intensity on the SmartEP control panel; turn the stimulation ON.
10. Apply the two prongs of the stimulator to the testing area and press the side

button to apply the stimulus. Graduate the potentiometer dial as necessary to find the muscular reflex threshold.

11. If the impedance on the testing site is too high (less than 80% current return), the Impedance LED will light up and an impedance reduction procedure will be necessary.
12. Modify the testing intensity on the SmartEP control panel to reflect the adjustments that were just investigated using the potentiometer dial.
13. Turn the stimulation OFF and connect the stimulus electrodes to the testing site. Electrodes may be connected to the outlets on the Electrical Stimulation Box or the outlets on the Handheld Electrical Stimulator.
14. Select the appropriate side, rate, phase, number of sweeps and intensity as needed for testing.
15. Click on the **[ACQUIRE]** button on the control panel to begin acquisition.
16. Once done, label, analyze, and organize your waveforms as needed.

Suggested Parameters

This is a general guideline for acquisition of somatosensory responses. It is recommended to acquire 2 to 4 waveforms to properly assess repeatability of the response.

- **Gain:** 50K.
- **Filters:** 30 to 1000 Hz.
- **Number of Sweeps:** 250.
- **Analysis Time:** 0 to 30 ms.
- **Artifact Rejection Level:** 25 μ V.
- **Stimulus:** 200 μ s Biphasic (200 μ s positive, 200 μ s zero, 200 μ s negative).
- **Intensity:** Limit at 20 mA. Intensity at 10 mA.
- **Rate:** 3-7 Hz (5.1 or 5.3 Hz recommended).
- **Shape:** Biphasic.
- **Transducer:** electrodes.
- **Impedance:** < 7 kOhms.

NOTE: Electrodes are delivering Current if Control Panel indicator is showing ON

Software limits

Due to safety considerations, certain limits have been implemented in the software and hardware. Other limitations have been implemented by regulatory entities when it pertains to human subjects. Limitations are given by this table:

Units Limits

- **Voltage (Hardware):** 400V.
- **Current (Software):** 100mA.
- **Stimulation Rate (Software):** 100/s.
- **Pulse Width (Human - FDA):** 600 μ s.

Marking Peaks

To diagnose a condition accurately, you may need to first place labels on the recently acquired waveform. Follow these steps for each label:

- Right click at the point of the waveform where the label is to be placed.
- Select "Mark Other Peak" from the menu, enter your own label, and save it for future use.
- Once placed, drag the top and bottom markers to their respective places as needed.

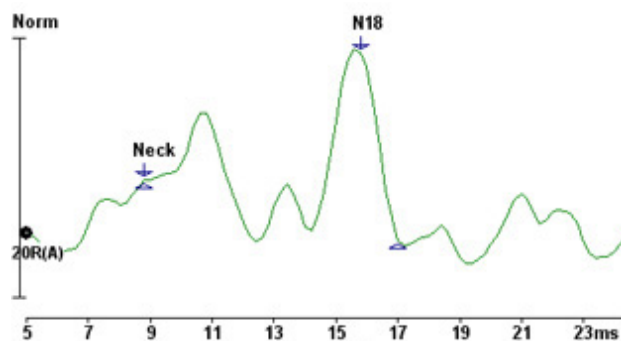


Fig.7 - Suggested label placement