DSI-7

EEG HEADSET

USER MANUAL

Version 0.1

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1. Disclaimer

Wearable Sensing's DSI-7 system is an EEG system designed for use in scientific and engineering research environments.

Wearable Sensings DSI-7 system was designed, constructed and preliminarily tested for performance and safety. However, this is a research instrument, and Wearable Sensing makes no warrantee concerning its safety. It should only be used by knowledgeable individuals at their own risk.

The Wearable Sensing DSI-7 system is not an FDA approved medical device for use in medical diagnostic or therapeutic applications. Its sole purpose is to measure EEG signals. Any other information gathered from this device, either implied or otherwise, is not the intent purpose of this instrument and is therefore not the responsibility of Wearable *Sensing* or its subsidiaries.

Any usage of this instrument except for the specific purpose outlined above is strictly prohibited and voids all Wearable *Sensing* assurances of the system's durability or functionality except those strictly expressed in the accompanying Operation Manual.

The specifications, information and performance of the Wearable *Sensing* DSI-7 system, may be changed without notice. Since the use of this information and the conditions in which the system is used are beyond the control of Wearable *Sensing* and its subsidiaries, it is the obligation of the customer and/or the equipment operator to determine the correct and safe selection and settings and conditions of use of the device.

The DSI-7 system is provided on "AS IS" basis. WEARABLE *SENSING*, INCLUDING ITS SUBSIDIARIES, DISCLAIMS ANY AND ALL WARRANTIES EXPRESSED, STATUTORY OR IMPLIED WITH RESPECT TO THE SYSTEM OR THE MATERIALS, INCLUDING BUT NOT LIMITED TO ANY IMPLIED WARRANTIES OF MERCHANTABILITY, NON-INFRINGEMENT OR THIRD PARTY RIGHTS AND FITNESS FOR A PARTICULAR PURPOSE.

2. System Overview

Wearable *Sensing*'s DSI- EEG system is designed for easy and comfortable measurement of high fidelity EEG signals in a scientific or engineering research environment, and relaying the EEG data to an external PC. Data is transmitted either via Bluetooth® to a PC.

The core technology of the system consists of ultra- high impedance Dry Sensor Interface (DSI) sensors that work through hair and require no prior skin preparation, nor the use of conductive gels to facilitate electrical contact with the scalp. The sensors can be individually adjusted to improve their contact with the scalp.

The EEG sensors for the DSI-7 system are mounted in a lightweight headset, which positions the sensors at the nominal F3, F4, C3, C4, P3, P4, Fz and Pz positions of the International 10/20 System. The DSI-7 system is available with options to use an ear clip as a ground or linked-ear sensors. A reference sensor (Common Mode Follower, CMF) is available with the option to be placed at the nominal Pz or Fz positions. The headset can be configured with longer arms so that sensors can reach additional locations on the scalp.

The headset and sensors have been designed with user comfort in mind so that the contact pressure, due to the downwards force holding the sensors against the scalp, remains within comfortable limits.

This User Manual has been divided into the following main sections:

1. System Components
2. Getting Ready for Data Collection with the DSI-7 Headset
3. EEG Data Acquisition Using DSI-7 Headset System
4. Cleaning and Maintaining DSI-7 Headset
5. DSI-7 Headset battery recharging and additional capabilities
6. Troubleshooting Guide

Related Manuals

These other manuals are available for Wearable *Sensing*'s hardware and software:

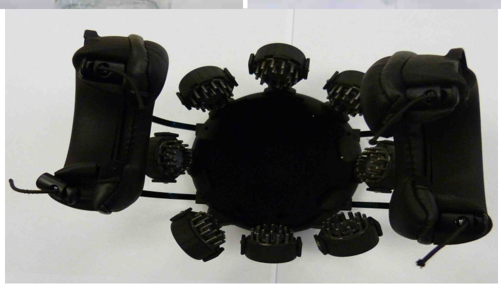
- DSI-Streamer software User Manual

3. System Components

The DSI-7 EEG system is supplied in a single carry-case with two layers, as illustrated below:


The contents of the case include the following components:





DSI-7 Headset for mounting:

- EEG Sensors (with electrodes installed) – 7 sensors total
- EEG Common Mode Follower (CMF)
- Crown section positions sensors in place
-

USB- Bluetooth® adapter

Battery Charger micro-USB-USB Cable

Utility Tool

Spare electrodes:

- Inner electrodes with long pins (x8)

Spare inner foam pad (to be placed under crown piece)

- One spare pads are included.
- The two pads are different thicknesses – choose thickness that best suits each subject.

USB drive containing DSI-Streamer data acquisition software, drivers and PDF versions of the User Manuals.

Measuring Tape

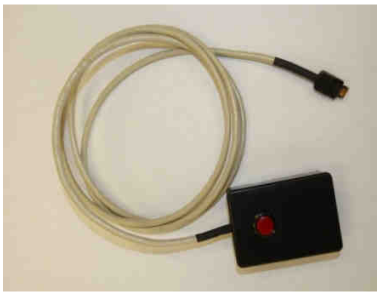
Cleaning brush

Bottle for cleaning fluid

The DSI-Streamer software (supplied on USB drive) requires a PC with Windows XP/Windows Vista/Windows7/Windows 8.

Trigger Module or Cable (*optional*)

A trigger module or cable is available separately from Wearable *Sensing*.



Trigger Module

Trigger Cable

4. GETTING READY FOR DATA COLLECTION WITH THE DSI-7 SI HEADSET

This Section describes the procedure for setting up the DSI-7 EEG system to acquire data. The DSI-7 EEG system transmits data via Bluetooth® to a PC.

The following sections describe:

4.1 Putting on DSI-7 System
4.2 Acquiring Data with DSI-7 System
4.3 Inspecting EEG Signal Quality
4.4 Removing the DSI-7 System
4.5 Cleaning the DSI-7 System

Maintaining the DSI-7 is described in section 5.

4.1 Putting on DSI-7 System

The DSI-7 Headset has been designed to fit a wide range of heads. Very large or very small heads may not allow correct sensor positioning.

If subject's head is too small, the headset may not fit properly and EEG signal quality may be compromised by poor contact between sensors and scalp and/or motion artifacts due to shifting of the headset on the head. Conversely, if the subject's head is too large, the headset may not fit properly, and if forced could lead to damage to the sensors, headset, or discomfort to the wearer. Differently shaped heads or bulges should also be considered when measuring the head and fitting the headset.

If a subject reports discomfort from the headset, seek to locate the source and make adjustments until the subject is comfortable.
DO NOT keep headset on subject who reports pain that cannot be alleviated.

A. Donning Procedure

The following steps outline the procedure for donning the DSI-7 system.

Step 1: Visual Inspection of Headset & Sensors

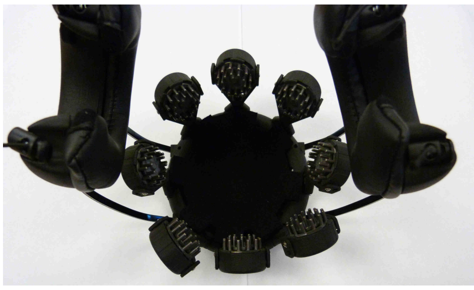


Figure 1. DSI-7 systems.

Visually inspect electrode surfaces (Figure 1).

- Check for obvious concerns, such as loose or damaged electrodes.
- If needed, follow the cleaning instructions in Section 4.5. (In practice, cleaning should be performed after each subject.)

Step 2: Don DSI-7 Headset

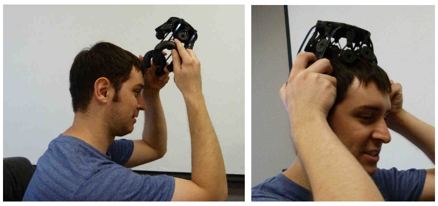


Figure 2. Donning procedure for DSI-7.

- Position headset above and slightly behind the head, tilted slightly upwards in the front as shown in Figure 2 (left).
- Hold ear support pieces away from head during donning (in Figure 2, right).
- Pull headset onto head from back to front until it sits on the head
- Press down on crown section of headset, until it makes contact with the scalp.
- Ensure that the C3 and C4 sensors are not against the routing tubes

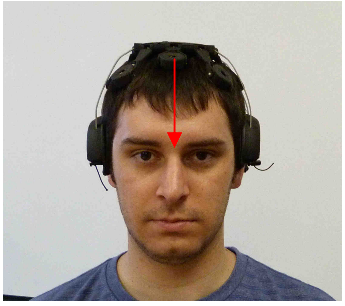


Figure 3. Midline alignment of DSI-7 system.

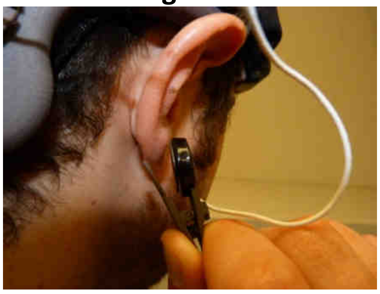


Figure 4. Attaching earclip sensor.

- Shift crown piece left/right to align Fz with the nose. (Figure 3)
- This will ensure that the midline electrodes (Fz and Pz) are located along the subject’s midline.
- For systems with earclip sensors, attach to earclip sensor to earlobe. (Figure 4).

Step 3: Work Sensors Through Hair

Figure 5. Use utility tool to work sensor through subject’s hair.

Figure 6. Take care to ensure that sensors do not lift up from scalp as tool is removed.

- Move hair to prevent excessive bunching beneath sensors.
- Insert the utility tool into the matching cutout in the top board of each sensor pod (Figure 5).
- Rotate the sensor back and forth a few times, first quickly and lightly, then more slowly with slightly more force to ensure contact of the electrode tips with the scalp.
    - The maximum range of motion is ±45°.
- Hold sensor pod down with fingers while you remove utility tool to prevent sensor from lifting off the scalp with the tool (Figure 6).

It is important to hold the sensor down while removing the rotating tool to ensure good contact is maintained. Otherwise the sensor may pull back from the scalp when the tool is removed.

WEARABLE Sensing

4.2 Acquiring Data with DSI-7 System

Step 4: Power-Up DSI-7 System

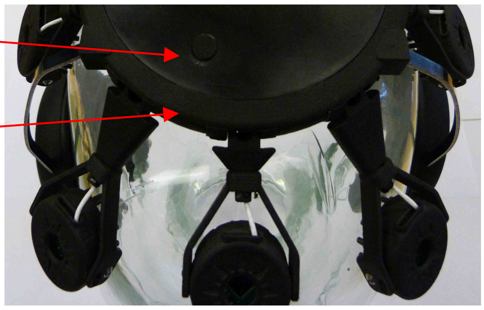


Figure 7. Front panel of DSI-7 system.

- Press the **ON/OFF** button twice on the front panel within 2 seconds to turn on DSI-7 system (Figure 7).
- The **Blue** LED will start flashing to indicate that the system seeking to pair via Bluetooth®.
-

Step 5: Plug in Bluetooth

Figure 8. USB-Bluetooth® adapter.

- Plug the USB-Bluetooth® adapter (Figure 8) into a USB port on the PC that will be used for data acquisition.
- The first time the Bluetooth® module is plugged in to the computer, the computer will begin a procedure to automatically install the drivers for the Bluetooth® device.
- If the computer you are using has built-in Bluetooth®, or are using a different module for Bluetooth® communications, then the drivers will already have been installed on your computer.

Step 6: Establish Communication Between DSI-7 System & PC via Bluetooth®

There are two steps for establishing communication to your DSI-7 system.

- The first time you try to connect, add the DSI-7 system as a new Bluetooth device.
- Each time thereafter, you must use the DSI-Streamer software to establish Bluetooth communication between the PC and the DSI-7 system.
- Refer to the DSI-Streamer software User Manual for details of these two steps.

Step 7: Acquiring Data with DSI-7 and DSI-STreamer®

Once communication between the DSI-7 system & the PC has been established, data acquisition can be performed using Wearable *Sensing*'s DSI-Streamer software, which has been included with the DSI-7 system.

Data acquisition with Wearable *Sensing*'s EEG hardware has two modes:

- A *data streaming* mode, in which data is passed to the PC and displayed in real time
- A *data recording* mode, in which data is passed to the PC and written to disk in real time.

Below is a cursory introduction to starting data acquisition and recording EEG data from the DSI-7 system. Refer to the DSI-Streamer software User Manual for more details.

In the **Data Source** tab in the main window (Figure 9), select the **Headset** option under **Source**.

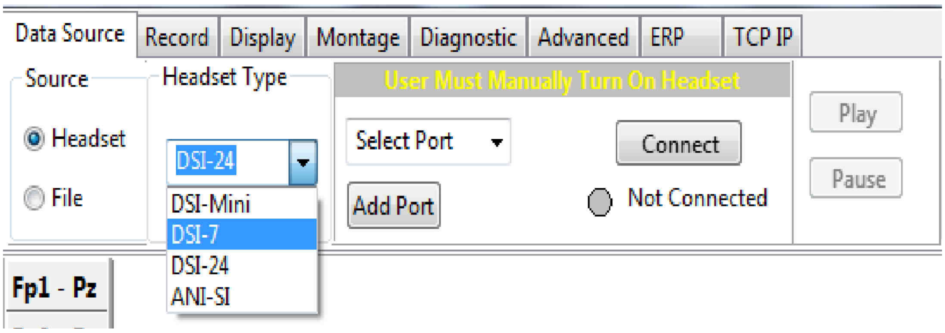


Figure 9. Data Source tab in DSI-Streamer software.

From the drop-down menu under **Headset Type**, choose the "DSI-7" option.
Choose the COM port corresponding to your wired/Bluetooth® connection from the COM port drop-down menu.

- Refer to the DSI-Streamer software User Manual for the procedure to identify the COM ports in use, if not already known.

Press the **Connect** button.

- At this point the **Connect** button will change to **Power off** (see Figure 9).
- At this point the **Play** button will no longer be grayed out.

Press the **Play** button.

- Data will begin streaming from the DSI-7 device to the PC and be displayed in real time.

4.3 Inspecting EEG Signal Quality

Data acquisition is performed using Wearable *Sensing*'s DSI-Streamer software. In total, there are 7 channels of acquisition:

- 7 channels of EEG for each of the sensors (and linked ears if available)
- Signals in DSI-Streamer are labeled according to electrode location.

A. Inspect Signal Quality

Signal quality is established in two steps:

- Monitor the contact impedance of the sensors.
- Monitor the observed signal levels from the sensors.

Refer to the DSI-Streamer software User Manual for using the Diagnostic tab to assist in establishing that the sensors are operating correctly.

B. Sensor Contact Impedance

The contact impedance between an electrode and the skin is measured to control the quality of contact. (Since the DSI sensors operate through hair, the contact is not as obvious as on bare skin.) The EEG sensor and CMF reference sensor contact impedances are monitored continuously by out-of-band sinusoidal signals.

Sensor impedances will gradually go down in the first 1-5 minutes after being placed in the scalp.

- For proper operation of the sensors:
  Impedances should be < 1 MΩ

Note that for time-domain analysis of saved EEG data, it is recommended that the impedance signals should be filtered out using notch filters at the impedance drive frequencies. These are 110 Hz and 130 Hz for the sensor & CMF impedance signals, respectively.

C. Sensor Signal Level

It is generally observed that during the first 1-5 minutes the signal level also decreases.

- For proper operation of the sensors:
  Signal Level should be $< 50\ \mu V_{p\text{-}p}$ or $<15\ \mu V_{rms}$

- Note that we use the term "Signal Level" even though excess voltage levels are indicative of contact noise. We do this because a typical Eyes Open EEG signal (i.e. no excess alpha or beta contributions) has the appearance of broadband noise.
  When the signal level is less than 15 µVrms, the signal is predominantly EEG.

In the event that the contact impedance and the signal level are not below the recommended values, it may be necessary to manipulate the sensors, as per Step 3.

D. Baseline Reset

Manipulation of the sensors frequently results in transients or saturation of the sensor amplifiers. Under saturation there is no response to the impedance control. For this reason, the DSI-7 system is equipped with a Baseline Reset function that momentarily increases the corner frequency of each sensor's high-pass filter to ≈15 Hz. This facilitates a rapid return to equilibrium after the transient.

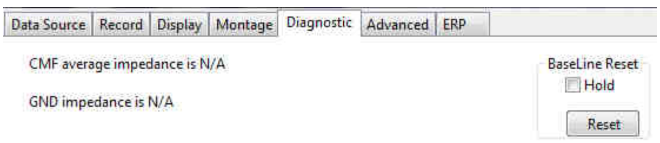


Figure 10. Diagnostic tab from DSI-Streamer software.

- In the **Diagnostic** tab in the main window of the DSI-Streamer software is a **Baseline Reset** option (Figure 10).
- Click the **Reset** button to turn on the Baseline Reset function.
  - Reset function is active for 1 second.
- Check the **Hold** checkbox to hold the Reset function active indefinitely the next time the **Reset** button is clicked.
  - While the Reset function is active, unclick the **Hold** checkbox and click the **Reset** button to turn off Reset.

The EEG signal while the Reset function is active is strongly distorted due to the high value of the high pass corner frequency. However, the impedance values are almost immediately correct once the Reset function has been activated.

Refer to the DSI-Streamer software User Manual for further details about using the Diagnostic tab in the DSI-Streamer interface.

E. Evaluating Physiological Signal Quality

Once the impedances have settled to below 1 MΩ, the quality of the signals should be inspected. The following subsections illustrate good quality EEG recordings of wakeful brain activity, alpha activity, eye-blinks, and jaw clenches.

In the examples below, only electrodes at the International 10/20 locations are shown.

F. Normal Waking EEG

EEG signals vary in shape and amplitude, frequency, and morphology, with age, wakeful state, cognitive load, and disease. During wakefulness, the signal generally is devoid of abnormal features, and looks like the traces shown in the representative screenshot in Figure 11.

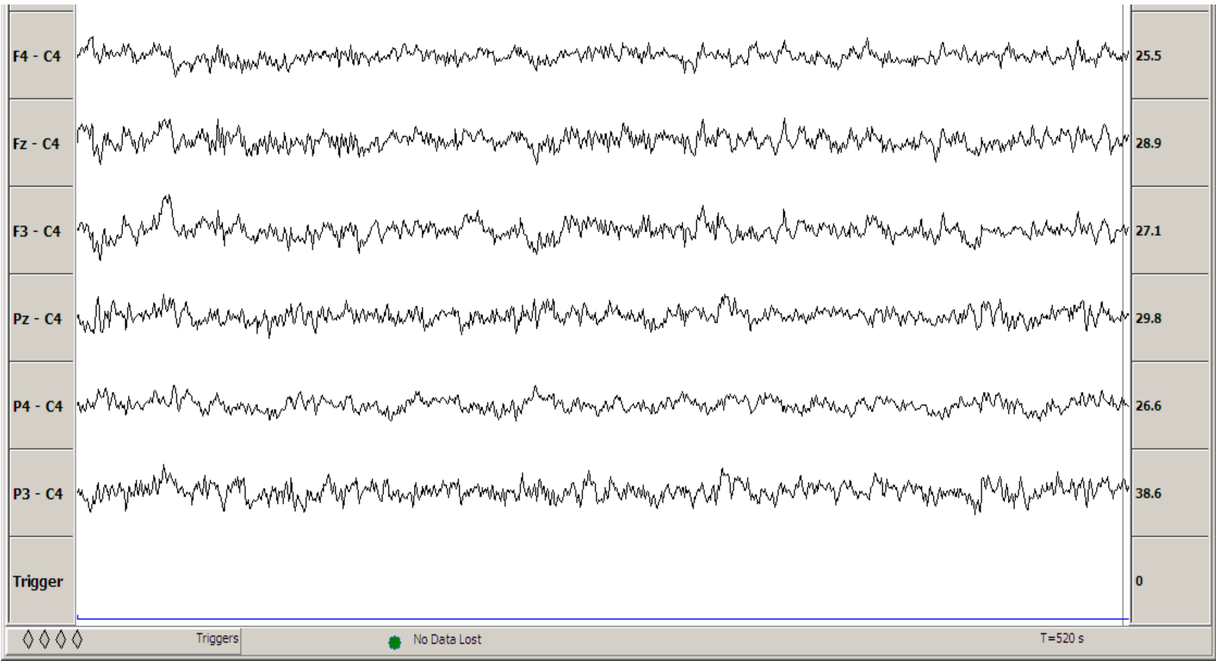


Figure 11. Screen capture of normal waking EEG.

G. Alpha Activity

When most humans close their eyes, their brains produce alpha activity, defined as a rhythmic oscillatory activity with a frequency range between 8 and 12 Hz, and reaching > 50 µV in amplitude.

In order to measure alpha activity, ask subjects to close their eyes, and inspect the signals for oscillations such as the ones shown in the representative screenshot in Figure 12, which shows two alpha spindles in the center of the screen. Note that since not all subjects produce alpha activity with their eyes closed; eye-blinks or looking left and right or up and down are often used as a surrogate control protocol due to the large EOG signals they generate on the frontal electrodes.

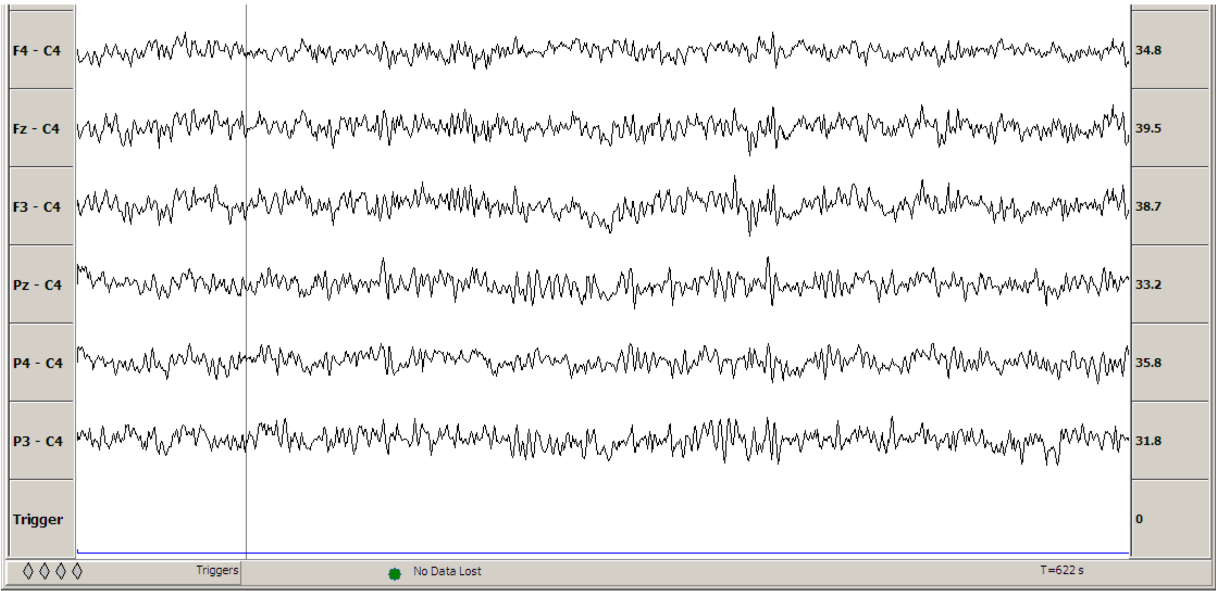


Figure 12. Screen capture of alpha activity during an Eyes Closed measurement.

H. Eye Blink Artifacts

Eye blinks generate a large potential, especially on Frontal. The representative screenshot in Figure 13 shows rapid eye-blinks in the frontal sensors. Subjects should be instructed to blink rapidly to produce such signals.

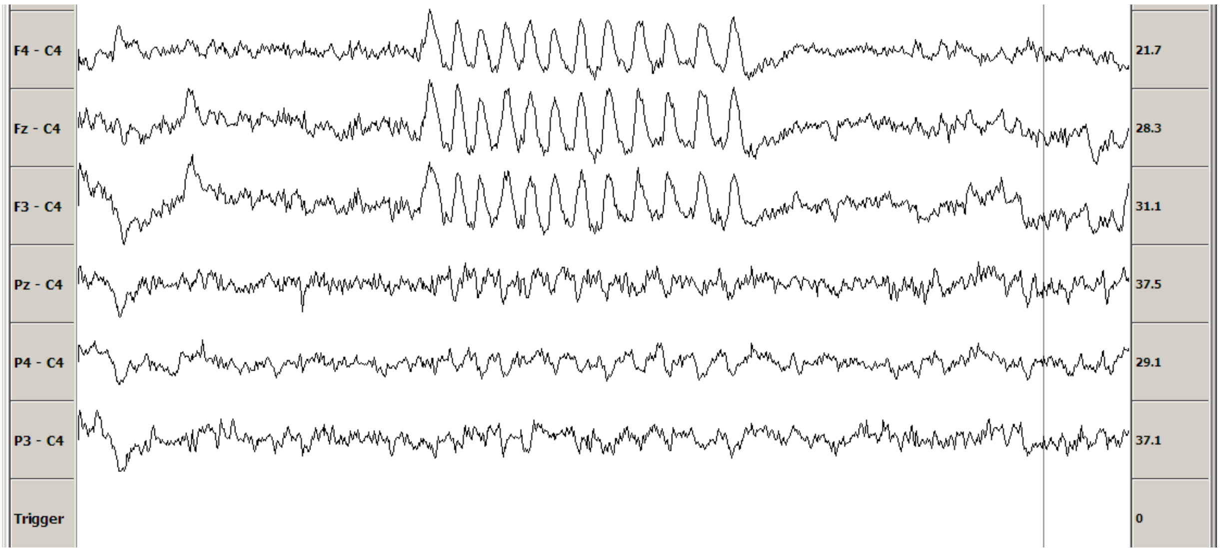


Figure 13. Screen capture of blink artifact.

I. Jaw Clench Artifacts

Jaw clenches generate a large electromyographic (EMG) potential on all electrodes. Ask subjects to clench jaw, and inspect signal. Figure 14 shows typical EMG artifact due to jaw clenching.

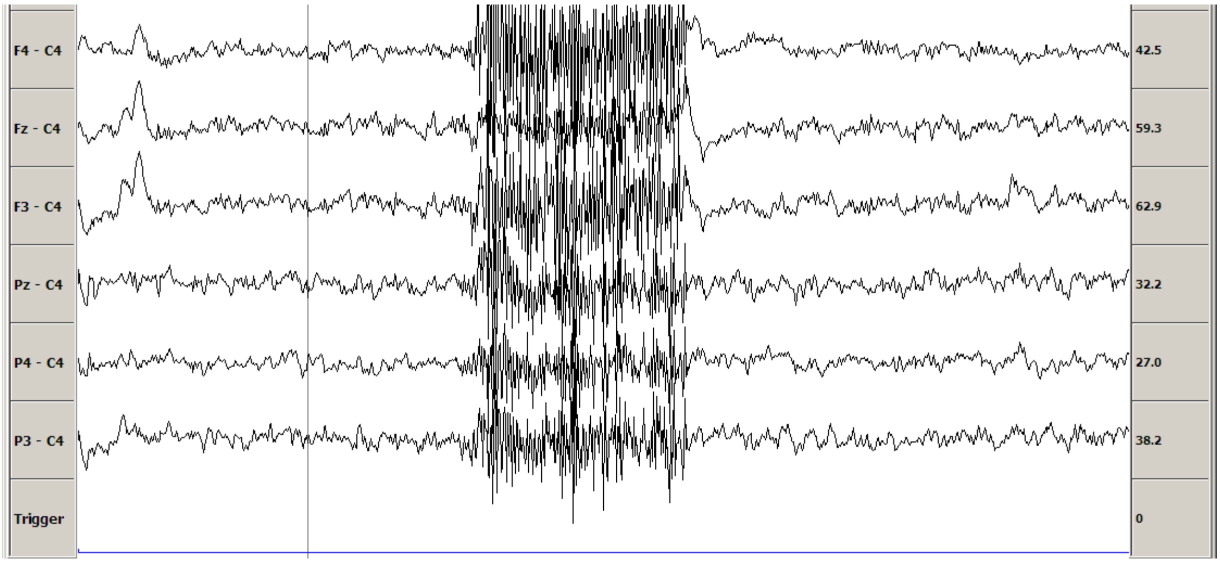


Figure 14. Screen capture of jaw clench EMG.

J. Undesirable Artifacts

The signals and artifacts described above are to be expected as part of EEG measurements. The artifacts described below can be minimized during the setup procedure.

Pulse, Motion, and Common Mode (CM) Artifacts

1. Pulse Artifact

Pulse artifacts are rhythmic oscillations that are due to the micromotion induced by blood throbbing in the arteries, and may appear on one or more sensors. These artifacts are more likely to appear on sensors that are not making good contact with the scalp or with sensors that are directly over a blood vessel.

The solution is to move the affected sensor 1-2 mm to one side and/or work it through the hair and wait for the artifact to fade. On occasion, the artifact can disappear without intervention by the experimenter, but this cannot be relied upon.

2. Motion Artifacts

Motion artifacts are large interfering signals detected by an EEG sensor that are induced by the subject's motion, either due to electrode displacement against the scalp or deformation of the skin.

The sensors' support is designed to minimize relative motion between the sensor and the subject, and also to maintain a constant pressure on the scalp. However, if sensors are not making proper contact on the scalp, motion artifacts can be induced.

In order to evaluate motion artifacts, ask the subject to perform activities normally expected in light ambulatory environments (e.g. walking, sitting down). The level of artifacts can be estimated by the increase of the noise compared to the baseline measured when the subject is still.

Note that during these motion tests the subject should refrain from blinking to prevent blink artifacts from being interpreted as motion artifacts.

The sensors' support is designed to minimize relative motion between the sensor and the subject, and also to maintain a constant pressure on the scalp. However, if sensors are not making proper contact on the scalp, motion artifacts can be induced.

3. **Common-Mode (CM) Artifacts**

Common -mode (CM) artifacts are large interfering signals detected by an EEG sensor due to voltages appearing on the body. These can either be due to triboelectric charging of the subject produced by the subject's motion (e.g. walking, sitting or standing up from a chair) or via pickup of a nearby electric field (e.g. tribelectrically charged person walking nearby, mains pickup).[1] The CMF is utilized to dynamically remove CM artifacts from the input of the sensors. The degree of rejection of CM artifacts between sensors is often determined by the quality of the electrical contact to the scalp (low contact impedance implies good rejection of CM artifact).

It is recommended that in order to evaluate the level of CM artifacts, the CM signal due to tapping a foot should be measured. In order to isolate this effect from motion artifact, the operator should stamp their foot whilst being maintaining good electrical contact with the subject (e.g. holding a hand of the subject), and monitor the EEG trace to look for the presence of CM artifacts (or absence thereof) such as the ones illustrated in Figure 15.

Figure 15. Screen capture of CM artifact during tapping.
Note the lack of visible artifact in the EEG channels.

[1] Wearable Sensing's EEG sensors are essentially high-sensitivity, high-impedance antennae, and are consequently very sensitive to the common mode (CM) electric field appearing on the body. A person walking nearby may possess an electric potential many thousands of volts relative to the subject due to triboelectric charging (consider the electric shock experienced when touching metal in a dry environment), and this potential couples capacitively to the subject, causing the voltage appearing on the subject to change as the other person walks by. Wearable Sensing's EEG systems have strong protection from this type of electric fields. This is usually at the level of 60-80 dB.

Note that when the system is operating correctly, the artifacts should appear on the CMF channel, but should not appear on any of the sensor channels.[2] Sensors that show CM artifact should be worked further through the hair and waited upon to settle further.

If most of the sensors show artifacts with a similar pattern, then it is likely that it is the CMF sensor that is not making proper contact, and should be worked further through the hair and waited upon to settle further.

[2] If motion artifacts do not appear in the CM channel, there is not enough charge pumped in the body and one cannot judge the level of CM mitigation. In this case the operator should stomp stronger and/or stomp on material that is opposite in the triboelectric series to the material of the sole of the operator's shoe/foot (e.g. skin – Teflon, rubber – Nylon).

4.4 Removing the DSI-7 System

Turn Off DSI-7 System

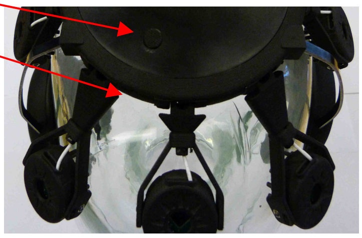


Figure 16. Front panel of DSI-7 system.

- Press and hold the **ON/OFF** button on the electronics package for about six seconds (Figure 16).
- Slow flashing of the **GREEN** and **RED** LED indicates that the system is ready to turn off OFF.
- Now, release the button to turn off the DSI-7 system

Remove DSI-7 System

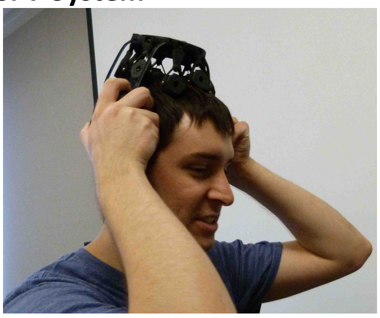


Figure 17. Removing DSI-7 headset.

- Lift headset off the head by grasping the ear pads and lifting up till headset is free of the head.
- Clean system as described in Section 5.

4.5 Cleaning the DSI-7 System

In order to maintain signal quality, and furthermore in the interests of hygiene, it is recommended to wash the sensor components that that come in contact with the subject's skin. The sensor components that come into users' skin are shown in Figure 18 and include:

- Sensor electrodes (inner & outer electrodes)
- Replaceable neoprene foam pads

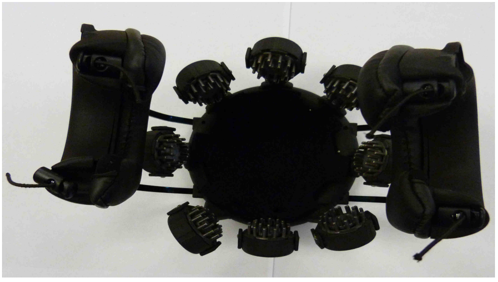


Figure 18. Inside view of DSI-7 showing areas that contact skin.

A. Cleaning Supplies

Recommended cleaning supplies for the DSI-7 system are:

- Soft bristle brush provided with DSI-7 system)
- Cleaning solution – Wearable *Sensing* recommends either
    - 70% Isopropyl Alcohol, or
    - 70% Ethanol

  Either cleaning solution can be stored in bottle provided with DSI-7 system.

B. Cleaning Procedure

Figure 19. Dip brush into cleaning fluid.

- Pour a small amount of cleaning fluid into a container.
- Dip bristles of cleaning brush into cleaning fluid (Figure 19).

Figure 20. Electrode cleaning procedures.

- Using the soft bristle brush, gently clean the electrodes by applying the cleaning solution to all of the pins.
- Apply brush to pins on both the inner and outer electrodes (Figure 20, top row).
- Repeat for each sensor.
  Allow the sensors to dry completely.
    - The drying process can be expedited using compressed air (Figure 20, bottom).

Storage of DSI-7 System

Figure 21. Storage case for DSI-7 system.

- In order to avoid damage, DSI-7 system should be stored in the case in which it was received (Figure 21).

Dispose of cleaning fluid appropriately.

5.1 Recharging the DSI-7 Headset Batteries

The DSI-7 system is supplied with one installed Li-ion battery.

The batteries should be charged when the LED flashes yellow. Flashing Red indicates Very low battery level. The Batteries should be charged using the battery charger.

Recharging the Battery

Remove and turn OFF headset.

- Plug in the the micro-USB Charge cable into the Battery Charger port that is under the foam pad.
- The other end of the charge cable can be plugged into the USB port of a powered up computer to charge the headset.
- The headset is not functional when it is charging.
- To check charging status, turn on the headset and note LED color
    - Yellow indicates charging
    - Green indicates charged
- The system shuts off when the USB is unplugged.

5.2 Replacing Electrodes

Wearable *Sensing* recommends that the sensor electrodes should be replaced after 100 uses. Alternatively, electrodes should be also replaced if there is build up of dirt and oils from hair, if they are noticeably scratched, or if signal quality is consistently poor.

The procedure for replacing electrodes is presented below.

Replacing Inner Electrodes

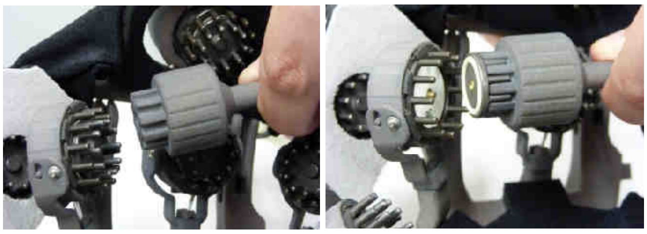


Figure 22. Removing Inner Electrode using the utility tool provided.

Removing Inner Electrodes:

- Unscrew electrode tips by rotating them counter clockwise using utility tool (Figure 22).

DO NOT PUSH DOWN on electrode while rotating or you may damage sensor. The sensor locks and allows you to screw or unscrew electrode tips when the spring is full extended.

Figure 23. Attaching Inner Electrode using the utility tool provided.

Attaching Inner Electrodes:

- Screw new electrode tips by rotating them clockwise (Figure 23).
- The inner electrodes come supplied with a neoprene O-ring at the rear. This prevents ingress of moisture to the electrode-sensor contact, thereby avoiding undesired electrochemical effects.
- Ensure O-ring is well compressed, but do not over-tighten sensors.

Over-tightening the electrode can damage the connection on the sensor, rendering the sensor unusable.

6. External Triggers

In order to detect Evoked Response Potentials (ERPs), we need to specify the time of onset of the relevant event. This event marker must be conveyed to the EEG acquisition hardware to be accurately digitized and used to synchronize ERPs.

Triggers extends the capabilities of EEG systems to integrate with other equipment that is able to send a appropriate signals. It also enables interfacing with a host of software applications that are able to send commands to the parallel port to trigger reference events for the ERP.

Wearable Sensing's DSI systems have a trigger input port that is triggered by potential changes >3V.

Trigger input specifications:

- Input Port: Hirosi 12 pin
- Voltage range is between +3V and +12V.
- Required Pulse duration: >15 milliseconds
- Minimal Pulse intervals: > 15ms

Trigger Data Output:
Trigger events are marked on the DSI-Streamer software GUI by a 1 second green diamond flash at the bottom left of the screen.

Triggers are also timestamped and recorded as an additional column in the EEG data files.

Figure 24. Trigger input connector on Wearable *Sensing*'s DSI-7 systems.

- The DSI-7 system supports 4 independent trigger signals.
- The trigger inputs are accessible via the input connector on the input connector of the electronics package (Figure 24).
- The trigger inputs are optically isolated so that connecting triggers to the DSI-7 system does not compromise the isolation from common-mode signals obtained by using wireless communication.

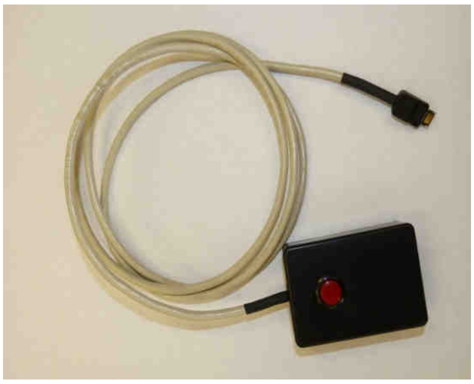


Figure 25. Trigger Module.

Figure 26. Trigger Cable.

- A Trigger Module (Figure 26) & a Trigger Cable (Figure 26) are available separately from Wearable Sensing.
- The Trigger Module (Figure 26) has a push-button that generates a single bit input trigger signals and passes it via the cable to the DSI-7 system. This push button trigger can be used as an external event market.
- Connect the Trigger Module directly to the DSI-7 system trigger inputs.
- Alternatively, a Trigger Cable (Figure 26) can be used to connect a PC parallel port to the trigger inputs on the DSI-7.

7. TROUBLESHOOTING GUIDE

Poor Signal Quality or Unusual Artifacts

If, after manipulating electrode tips through the hair and then waiting for

- The contact impedances to drop, and/or
- The signal quality to improve

It is observed that many of the sensors continue to produce poor quality data, then the following steps should be taken:

- Turn off the DSI-7 system.
- Clean the electrodes (or replace them if they are worn out) as described in Section 5.
- Ensure that the electrodes are not damaged and, if replaced, that they are screwed on well.
    - A contact impedance higher than 5 MΩ[3] may indicate poor contact between the sensor and electrode (e.g. the thread is dirty).
- Don the system as described in Section 4.
    - Ensure proper positioning of the sensors in relation to the head.
- Ensure that there is not a nearby source of large EM fields or microwave radiation.
- Turn on DSI-7 system and monitor data using DSI-Streamer software.

- Refer to the DSI-Streamer software User Manual for details about troubleshooting using the **Diagnostic** tab in the main window of the DSI-Streamer interface.

If data quality continues to be poor, record a segment of data and email it to Wearable Sensing Tech Support.

[3] An impedance equal to 99 MΩ will be reported if no signal is passing though the channel. This can occur when a) there is no connection between the head and the sensor input (bad electrode-to-sensor or electrode-to-head contact), or b) the line is broken. If the problem persists with a replaced electrode, return the headset to Wearable *Sensing* for maintenance.