

User Guide

EEG

This user guide has been created to educate and inform the reader about doing EEG measurements with NeXus.

For more information about NeXus, our BioTrace+ software, please visit our website or contact us.

www.mindmedia.com

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Introduction

This manual provides a step-by-step review of how to do EEG measurements with the NeXus-4, NeXus-10 or NeXus-32. The manual provides information about the required hardware, preparation and measurement steps, background information on artefacts (appendix 1) and care of materials (appendix 2).

Required Equipment

Depending on the chosen setup, the following items are required to perform EEG measurements:

- Nexus-4, NeXus-10 or NeXus-32
- EXG Sensor, EEG Linked Ear Sensor (2 or 4 channel), EXG TP Sensor or EEG Linked Ear TP Sensor (2 or 4 channel)
- EXG Ground or EXG Ground TP
- EEG Discs, EEG Disc Ear Electrodes, EEG Minicap Electrodes, cup or ring electrodes*
- Nuprep
- Electrode paste (e.g. Ten20) or Electro gel
- Ear clips for EEG discs or Ear clips for EEG Minicap electrodes
- Syringe with blunt needle (for Electro gel) or scoop (for Electrode paste)
- Minicap or Microcap
- Tissues
- Cotton swabs
- Measuring tape
- Skin marker

*Ag/AgCl electrodes.

EEG measurement setup

Before the actual measurement can start, the equipment has to be connected. Detailed information on setting up the NeXus can be found in the NeXus User Manual or Quick Start.

The NeXus-4 can measure up to two positions EEG, the NeXus-10 up to 4 and the NeXus-32 up to 21 positions of EEG. Please refer to the *User Guide NeXus-32 qEEG* for a 21 channel cap measurement.

	NeXus-4	NeXus-10	NeXus-32
1 position EEG	✓	✓	✓
2 positions EEG	✓	✓	✓
4 positions EEG	✗	✓	✓
21 positions EEG	✗	✗	✓

Use the Internationally accepted 10-20 EEG system for EEG electrode placement, see Appendix 1: 10-20 EEG system.

Choose an EEG measurement setup and then jump to BioTrace+ for further instructions on software.

EEG/EXG sensor setup with disc electrodes

The following is required to perform EEG measurements in an EXG sensor setup with disc electrodes:

- Nexus-4, NeXus-10 or NeXus-32
- EXG Sensor or EEG Linked Ear Sensor (2 or 4 channel)
- EXG Ground
- EEG Discs (Ag/AgCl) or EEG Disc Ear Electrodes*
- Nuprep
- Electrode paste (e.g. Ten20)
- Ear clips for EEG Disc (Ear) Electrodes
- Measuring tape
- Tissue
- Cotton swabs
- Measuring tape
- Skin marker
- Scoop

* Recommended use is 10-20 times. The layer of Ag/AgCl will gradually wear off influencing signal quality.

* For placing EEG electrodes on the ears with EEG/EXG sensors with LOT numbers L2101 and onwards (February 2021), the EEG Disc Ear Electrodes are used in combination with ear clips.

One position EEG

Connect the EXG Sensor to input A&B of the NeXus-4 or NeXus-10 and input 25&26 of the NeXus-32. Make sure the red dot of the connector is facing downward with the NeXus-4 or NeXus-10 or upward with the NeXus-32. With the EXG sensor A1/M1 or A2/M2 are used as reference. Alternatively, the EEG Linked Ear sensor (2 or 4 channel) can be used for a single channel linked ear referenced setup. In that case, the placement of reference and ground is similar to two positions EEG setup. A bipolar measurement setup will be created by placing the reference on the head, according to the 10-20 system.

Connect the EXG Ground to the Ground (Gnd) of the NeXus.



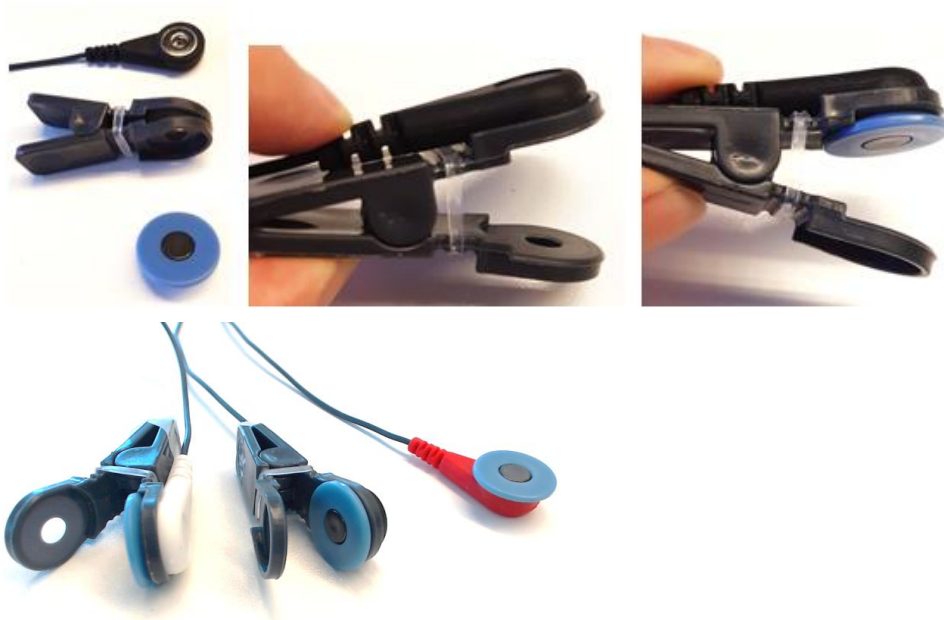
Sensors can be disconnected by pulling the silver ribbed part of the connector backward.



Place a disc electrode on to the red snap-on of pair one of the EXG sensor.



Place the black snap-on of pair one of the EXG sensor and the ground snap-on together with EEG disc (ear) electrodes on to an ear clip.



For placing EEG electrodes on the ears with EEG/ExG sensors with LOT numbers L2101 and onwards (February 2021), the EEG Disc Ear Electrodes are used in combination with ear clips:

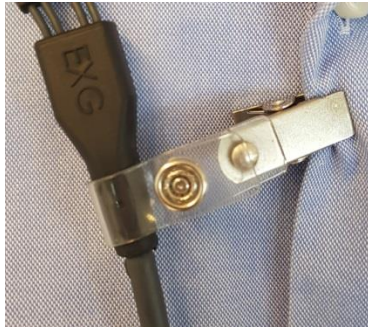


Determine electrode positions according to the 10-20 system by using measuring tape and marking positions with a skin marker.

Rub the skin with a cotton swab and Nuprep at all electrode positions. Remove residual gel with a tissue. As an alternative to using Nuprep, alcohol pads are sometimes used.



Use the clip of the EXG cable to attach the EXG sensor to prevent pulling of the cables.



Apply some electrode paste (e.g. Ten20) to the electrodes by using for example a scoop.



Place the ear clip with the black (reference) snap-on with electrode on to the earlobe of the same side (ipsilateral) of the location of interest.



Place the ear clip with ground snap-on with electrode on to the other earlobe.

Place the red (positive) snap-on with electrode on to the skin at the location of interest.

Minicap

Optionally use the Minicap or Microcap to fix the electrodes. The Minicap also allows for placing the electrodes on the mastoids instead of the ear.



Now go to chapter 'BioTrace+' for further instructions.

Two positions EEG

Connect the EXG Sensor to input A&B of the NeXus-4 or NeXus-10 and input 25&26 of the NeXus-32. Make sure the red dot of the connector is facing downward with the NeXus-4 or NeXus-10 or upward with the NeXus-32.

With the EXG sensor A1/M1 or A2/M2 are used as reference. A bipolar measurement setup will be created by placing the reference on the head, according to the 10-20 system. Use the EEG Linked Ear sensor (2 or 4 channel), to create a linked-ear reference for both positive electrodes. For use of the older linked ear cable, please refer to Appendix 4: Linked Ear cable setup.

Connect the EXG Ground to the Ground (Gnd) of the NeXus.



Sensors can be disconnected by pulling the silver ribbed part of the connector backward.



Place disc electrodes on to the two red snap-ons and place a disc electrode on to the EXG ground snap-on.

Place the two black snap-ons together with disc electrodes on to an ear clip.



For placing EEG electrodes on the ears with EEG/EXG sensors with LOT numbers L2101 and onwards (February 2021), the EEG Disc Ear Electrodes are used in combination with ear clips:



Determine electrode positions according to the 10-20 system by using measuring tape and marking positions with a skin marker.

Rub the skin with a cotton swab and Nuprep at all electrode positions. Remove remaining gel with a tissue. As an alternative to using Nuprep, alcohol pads are sometimes used.



Use the clip of the EXG cable to attach the EXG sensor to prevent pulling of the cables.



Apply some electrode paste (e.g. Ten20) to the electrodes by using for example a scoop.



Place the ear clips with the black (reference) snap-on with electrode on to the left and right earlobe.

Place the ground electrode preferably near the other reference electrodes on the scalp.

Place the red (positive) snap-ons with electrode on to the skin at the location of interest.



Minicap

Optionally use the Minicap or Microcap to fix the electrodes.



Now go to chapter 'BioTrace+' for further instructions.

Four positions EEG

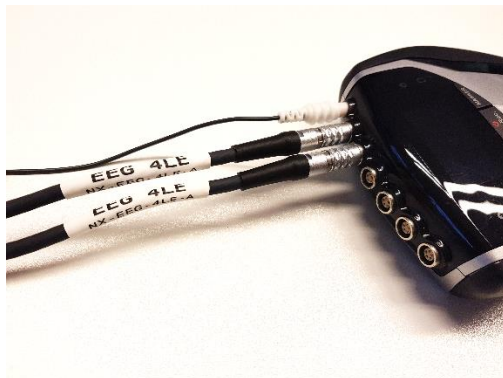
When measuring four positions EEG, a linked-ear setup is recommended. Connect both EEG Linked Ear sensor connectors to input A&B and C&D on the NeXus-10 or input 25&26 and 27&28 on the NeXus-32. Make sure the red dot of the connector is facing downward with the NeXus-10 or upward with the NeXus-32. For a 4 positions EEG setup with the older EEG linked-ear cables and EXG sensor, please refer to Appendix 4: Linked Ear cable setup. A bipolar measurement setup will be created by placing the reference on the head, according to the 10-20 system.



Sensors can be disconnected by pulling the silver ribbed part of the connector backward.



Connect the EXG Ground to the Ground (Gnd) of the NeXus.



EEG Linked Ear Sensor

The two parts of the linked ear sensor should already be connected by a small black tube as shown below.



Place disc electrodes on to the four red snap-ons and place a disc electrode on to the EXG ground snap-on.

Place the two black snap-ons together with disc electrodes on to an ear clip.



For placing EEG electrodes on the ears with EEG/ExG sensors with LOT numbers L2101 and onwards (February 2021), the EEG Disc Ear Electrodes are used in combination with ear clips:



Determine electrode positions according to the 10-20 system by using measuring tape and marking positions with a skin marker.

Rub the skin with a cotton swab and Nuprep at all electrode positions. Remove remaining gel with a tissue. As an alternative to using Nuprep, alcohol pads are sometimes used.



Use the clip of the EXG cable to attach the EXG sensor to prevent pulling of the cables.



Apply some electrode paste (e.g. Ten20) to the electrodes by using for example a scoop.



Place the ear clips with the black (reference) snap-on with electrode on to the left and right earlobe.

Place the ground electrode preferably near the other reference electrodes on the scalp.

Place the red (positive) snap-ons with electrode on to the skin at the location of interest.



Minicap

Optionally use the Minicap or Microcap to fix the electrodes.



Now go to chapter 'BioTrace+' for further instructions.

EEG/EXG sensor TP setup with Minicap electrodes

The following is required to perform EEG measurements in an EXG sensor TP or EEG Linked Ear TP setup with minicap electrodes:

- Nexus-4, NeXus-10 or NeXus-32
- EXG Sensor TP or EEG Linked Ear TP Sensor (2 or 4 channel)
- EXG Ground TP
- EEG Minicap Electrodes (sintered Ag/AgCl)
- Electro gel
- Ear clips for EEG Minicap electrodes
- Syringe with blunt needle
- Minicap or Microcap
- Tissue
- Cotton swabs
- Measuring tape
- Skin marker

One position EEG

Connect the EXG Sensor to input A&B of the NeXus-4 or NeXus-10 and input 25&26 of the NeXus-32. Make sure the red dot of the connector is facing downward with the NeXus-4 or NeXus-10 or upward with the NeXus-32. With the EXG sensor A1/M1 or A2/M2 are used as reference. Alternatively, the EEG Linked Ear sensor (2 or 4 channel) can be used for a single channel linked ear referenced setup. In that case, the placement of reference and ground is similar to two positions EEG setup.

Connect the EXG Ground TP to the Ground (Gnd) of the NeXus.



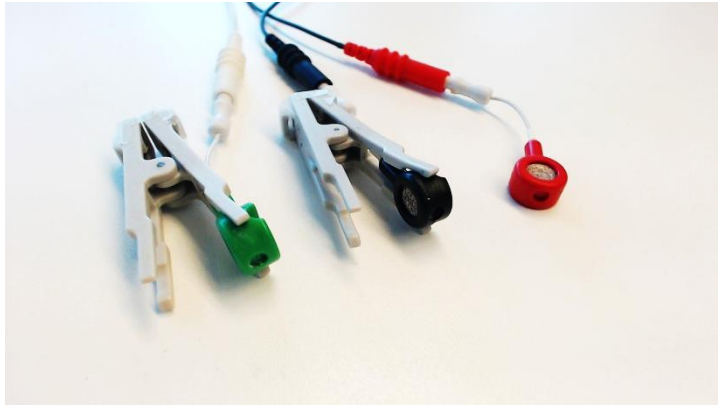
Sensors can be disconnected by pulling the silver ribbed part of the connector backward.



Place Minicap electrodes on to pair one of the EXG sensor TP and place a Minicap electrode on to the EXG ground TP. Slightly twist the connector in to EXG TP connection in order to make good connection.



Place the black TP connection (reference) with electrode of pair one and the ground with electrode on to an ear clip.



Determine electrode positions according to the 10-20 system by using measuring tape and marking positions with a skin marker.

Use the clip of the TP cable to attach the TP sensor to prevent pulling of the cables.



Place the Minicap or Microcap on the head.



Apply some Electro gel to the electrodes by using a cotton swab or a syringe with blunt needle.

Due to the fluid nature of electro gel, rubbing the skin with an abrasive gel is usually not necessary.

When using electrode paste (e.g. Ten20), rub the skin with a cotton swab and Nuprep at all electrode positions. The location of the ground electrode is preferably near other electrodes on the scalp. Remove residual gel with a tissue. As an alternative to using Nuprep, alcohol pads are sometimes used.

Place the ear clip with the black (reference) electrode on to the earlobe of the same side (ipsilateral) of the location of interest.



Place the ear clip with ground snap-on with electrode on to the other earlobe.

Place the red (positive) electrode on to the skin at the location of interest. Use the Minicap or Microcap to fix the electrode. The Minicap also allows for placing the electrodes on the mastoids instead of the ear. In that case the ear clips are not necessary.



Now go to chapter 'BioTrace+' for further instructions.

Two positions EEG

Connect the EXG Sensor to input A&B of the NeXus-4 or NeXus-10 and input 25&26 of the NeXus-32. Make sure the red dot of the connector is facing downward with the NeXus-4 or NeXus-10 or upward with the NeXus-32.

With the EXG sensor A1/M1 or A2/M2 are used as reference. Use the EEG Linked Ear sensor (2 or 4 channel), to create a linked-ear reference for both positive electrodes. For use of the older linked ear cable, please refer to Appendix 4: Linked Ear cable setup.

Connect the EXG Ground TP to the Ground (Gnd) of the NeXus.

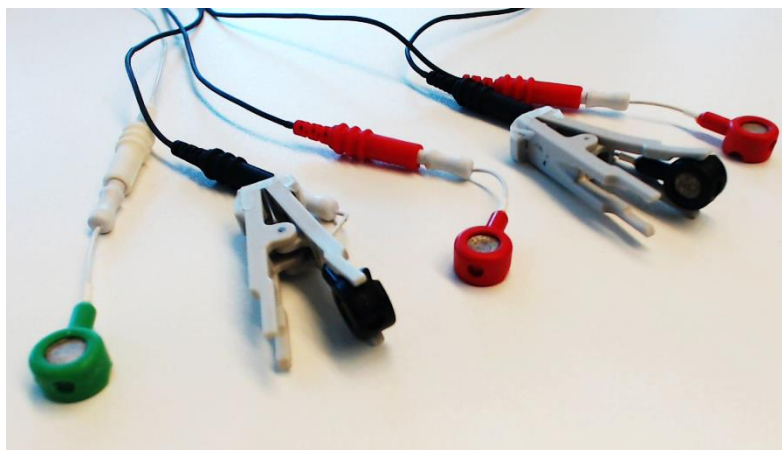


Sensors can be disconnected by pulling the silver ribbed part of the connector backward.



Place Minicap electrodes on to the red and black TP connections and place a Minicap electrode on to the EXG ground TP. Slightly twist the connector in to EXG TP connection in order to make good connection.

Place the black TP connection (reference) electrodes on to an ear clip.



Determine electrode positions according to the 10-20 system by using measuring tape and marking positions with a skin marker.

Use the clip of the TP cable to attach the TP sensor to prevent pulling of the cables.



Place the Minicap or Microcap on the head.



Apply some Electro gel to the electrodes by using a cotton swab or a syringe with blunt needle.

Due to the fluid nature of electro gel, rubbing the skin with an abrasive gel is usually not necessary.

When using electrode paste (e.g. Ten20), rub the skin with a cotton swab and Nuprep at all electrode positions. The location of the ground electrode is preferably near other electrodes on the scalp. Remove residual gel with a tissue. As an alternative to using Nuprep, alcohol pads are sometimes used.

Place the ear clips with the black (reference) electrodes on to the left and right earlobe.



Place the ground electrode preferably near the other reference electrodes on the scalp. Use the Minicap or Microcap to fix the electrodes.

Place the red (positive) electrodes on to the skin at the location of interest. Use the Minicap or Microcap to fix the electrode. The Minicap also allows for placing the electrodes on the mastoids instead of the ear. In that case the ear clips are not necessary.



Now go to chapter 'BioTrace+' for further instructions.

Four positions EEG

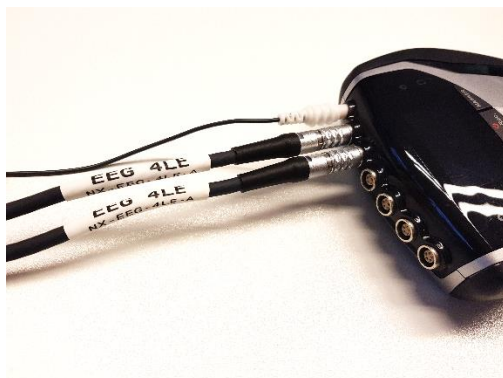
When measuring four positions EEG, a linked-ear setup is recommended. Connect both EEG Linked Ear TP sensor connectors to input A&B and C&D on the NeXus-10 or input 25&26 and 27&28 on the NeXus-32. Make sure the red dot of the connector is facing downward with the NeXus-10 or upward with the NeXus-32. For a 4 positions EEG setup with the older EEG linked-ear cables and EXG sensor, please refer to Appendix 4: Linked Ear cable setup.



Sensors can be disconnected by pulling the silver ribbed part of the connector backward.



Connect the EXG Ground TP to the Ground (Gnd) of the NeXus.



EEG Linked Ear Sensor

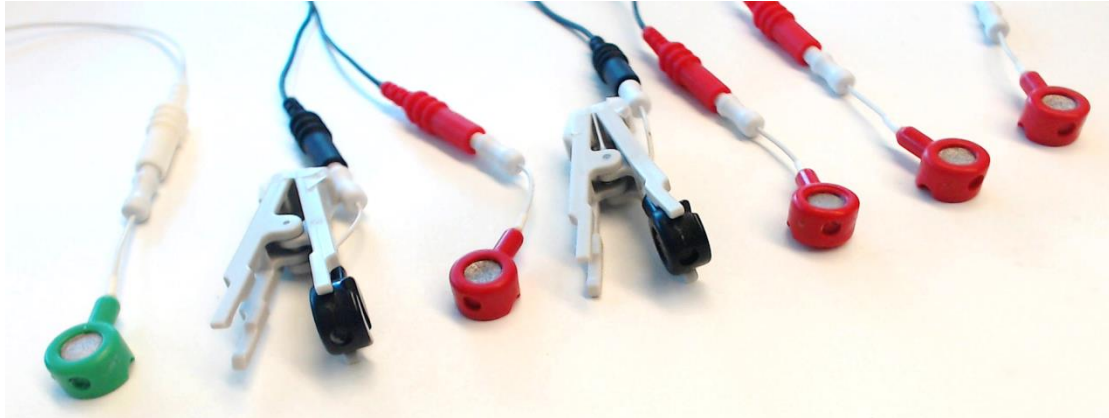
The two parts of the linked ear sensor should already be connected by a small black tube as shown below.



Place Minicap electrodes on to the red TP connections and place a Minicap electrode on to the ground TP connection. Slightly twist the connector in to EXG TP connection in order to make good connection.

Place black Minicap electrodes on to the black TP connections

Place the black TP connection (reference) electrodes on to an ear clip.



Determine electrode positions according to the 10-20 system by using measuring tape and marking positions with a skin marker.

Use the clip of the TP cable to attach the TP sensor to prevent pulling of the cables.



Place the Minicap or Microcap on the head.



Apply some Electro gel to the electrodes by using a cotton swab or a syringe with blunt needle.

Due to the fluid nature of electro gel, rubbing the skin with an abrasive gel is usually not necessary.

When using electrode paste (e.g. Ten20), rub the skin with a cotton swab and Nuprep at all electrode positions. The location of the ground electrode is preferably near other electrodes on the scalp. Remove residual gel with a tissue. As an alternative to using Nuprep, alcohol pads are sometimes used.

Place the ear clips with the black (reference) electrodes on to the left and right earlobe.



Place the ground electrode preferably near the other reference electrodes on the scalp. Use the Minicap or Microcap to fix the electrodes.

Place the red (positive) electrodes on to the skin at the location of interest. Use the Minicap or Microcap to fix the electrode. The Minicap also allows for placing the electrodes on the mastoids instead of the ear. In that case the ear clips are not necessary.



Now go to chapter 'BioTrace+' for further instructions.

EEG/EXG sensor TP setup with cup or ring electrodes

The following is required to perform EEG measurements in an EXG sensor TP or EEG Linked Ear TP setup with minicap electrodes:

- Nexus-4, NeXus-10 or NeXus-32
- EXG Sensor TP or EEG Linked Ear TP Sensor (2 or 4 channel)
- EXG Ground TP
- EEG cup or ring electrodes (Ag/AgCl)
- Nuprep
- Electrode paste (e.g. Ten20)
- Measuring tape
- Tissue
- Cotton swabs
- Skin marker
- Scoop

One position EEG

Connect the EXG Sensor to input A&B of the NeXus-4 or NeXus-10 and input 25&26 of the NeXus-32. Make sure the red dot of the connector is facing downward with the NeXus-4 or NeXus-10 or upward with the NeXus-32. With the EXG sensor A1/M1 or A2/M2 are used as reference. Alternatively, the EEG Linked Ear sensor (2 or 4 channel) can be used for a single channel linked ear referenced setup. In that case, the placement of reference and ground is similar to two positions EEG setup.

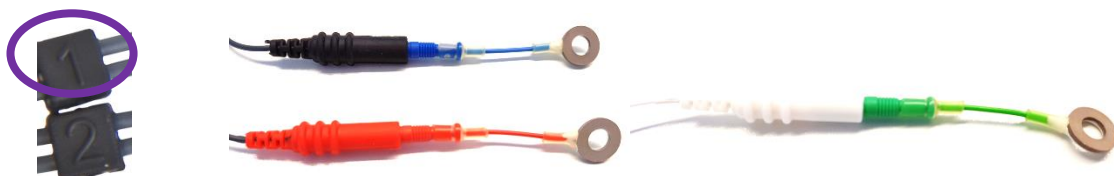
Connect the EXG Ground TP to the Ground (Gnd) of the NeXus.



Sensors can be disconnected by pulling the silver ribbed part of the connector backward.



Place cup or ring electrodes on to pair one of the EXG sensor TP and place a cup or ring electrode on to the EXG ground TP.



Determine electrode positions according to the 10-20 system by using measuring tape and marking positions with a skin marker.

Rub the skin with a cotton swab and Nuprep at all electrode positions. Remove residual gel with a tissue. As an alternative to using Nuprep, alcohol pads are sometimes used.



Use the clip of the TP cable to attach the TP sensor to prevent pulling of the cables.



Apply some electrode paste (e.g. Ten20) to the electrodes by using for example a scoop.



Place the black (reference) electrode on to the earlobe of the same side (ipsilateral) of the location of interest.

Place the ground electrode on to the other earlobe.

Place the red (positive) electrode on to the skin at the location of interest.

Now go to chapter 'BioTrace+' for further instructions.

Two positions EEG

Connect the EXG Sensor to input A&B of the NeXus-4 or NeXus-10 and input 25&26 of the NeXus-32. Make sure the red dot of the connector is facing downward with the NeXus-4 or NeXus-10 or upward with the NeXus-32.

With the EXG sensor A1/M1 or A2/M2 are used as reference. Use the EEG Linked Ear sensor (2 or 4 channel), to create a linked-ear reference for both positive electrodes. For use of the older linked ear cable, please refer to Appendix 4: Linked Ear cable setup.

Connect the EXG Ground TP to the Ground (Gnd) of the NeXus.



Sensors can be disconnected by pulling the silver ribbed part of the connector backward.



Place cup or ring electrodes on to the red and black TP connections and place a cup or ring electrode on to the EXG ground TP. Slightly twist the connector in to EXG TP connection in order to make good connection.

Place the black TP connection (reference) electrodes on to an ear clip.

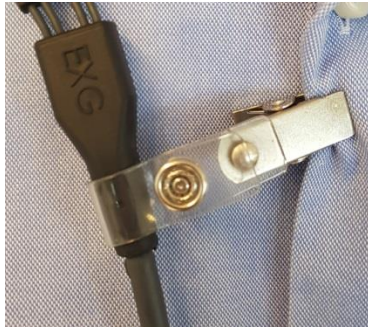


Determine electrode positions according to the 10-20 system by using measuring tape and marking positions with a skin marker.

Rub the skin with a cotton swab and Nuprep at all electrode positions. Remove remaining gel with a tissue. As an alternative to using Nuprep, alcohol pads are sometimes used.



Use the clip of the TP cable to attach the TP sensor to prevent pulling of the cables.



Apply some electrode paste (e.g. Ten20) to the electrodes by using for example a scoop.



Place the black (reference) electrodes on to the left and right earlobe.

Place the ground electrode preferably near the other reference electrodes on the scalp.

Place the red (positive) electrodes on to the skin at the locations of interest.

Now go to chapter 'BioTrace+' for further instructions.

Four positions EEG

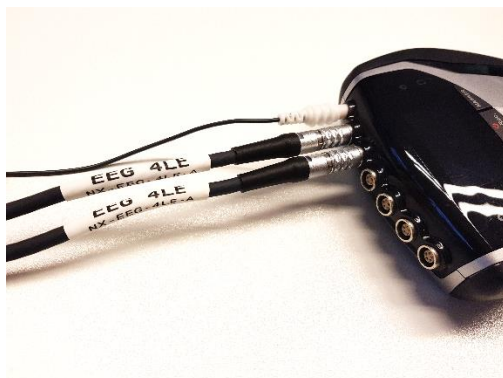
When measuring four positions EEG, a linked-ear setup is recommended. Connect both EEG Linked Ear TP sensor connectors to input A&B and C&D on the NeXus-10 or input 25&26 and 27&28 on the NeXus-32. Make sure the red dot of the connector is facing downward with the NeXus-10 or upward with the NeXus-32. For a 4 positions EEG setup with the older EEG linked-ear cables and EXG sensor, please refer to Appendix 4: Linked Ear cable setup.



Sensors can be disconnected by pulling the silver ribbed part of the connector backward.



Connect the EXG Ground TP to the Ground (Gnd) of the NeXus.



EEG Linked Ear Sensor

The two parts of the linked ear sensor should already be connected by a small black tube as shown below.



Place cup or ring electrodes on to the red TP connections and place a cup or ring electrode on to the ground TP connection. Slightly twist the connector in to EXG TP connection in order to make good connection.

Place black cup or ring electrodes on to the black TP connections

Place the black TP connection (reference) electrodes on to an ear clip.



Determine electrode positions according to the 10-20 system by using measuring tape and marking positions with a skin marker.

Rub the skin with a cotton swab and Nuprep at all electrode positions. Remove remaining gel with a tissue. As an alternative to using Nuprep, alcohol pads are sometimes used.



Use the clip of the TP cable to attach the TP sensor to prevent pulling of the cables.



Apply some electrode paste (e.g. Ten20) to the electrodes by using for example a scoop.



Place the black (reference) electrodes on to the left and right earlobe.

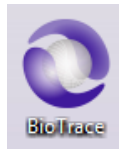
Place the ground electrode preferably near the other reference electrodes on the scalp.

Place the red (positive) electrodes on to the skin at the locations of interest.

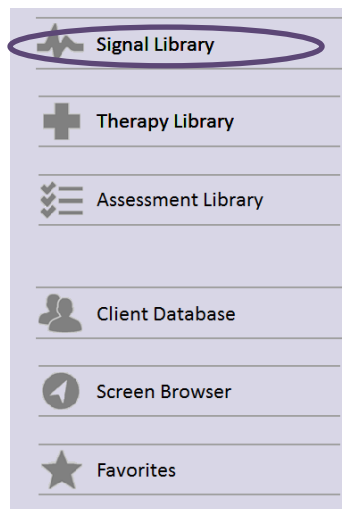
Now go to chapter 'BioTrace+' for further instructions.

BioTrace+

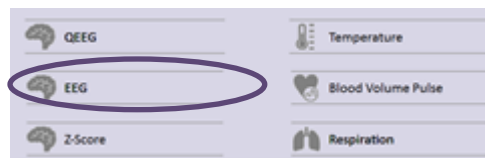
Start the BioTrace+ Software.



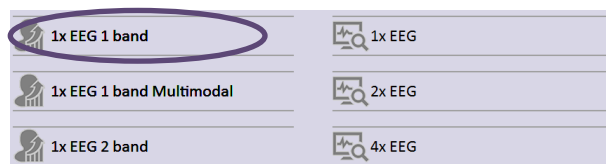
Select **Signal Library**.



Select **EEG**.



Select your preferred measurement screen, depending on number of positions (e.g. 1 position EEG 1 band).



The EEG visualizations differ from each other in

- Number of channels: e.g. 1x EEG, 2x EEG.
- Showing specific frequency bands: e.g. SMR, Gamma
- Additional signals. 'Multimodal' screens also show other signals like heart rate, skin conductance, temperature and respiration graphs.

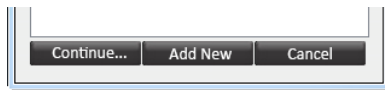
Make sure the person sits comfortable, preferably in a slight recline with feet elevated. A rolled towel can be used to support the neck.

Switch the NeXus on.

Click the **recording** button.

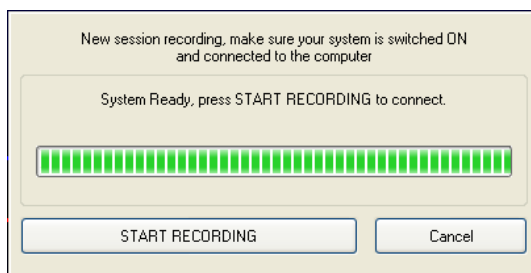


The *select a client* dialog box will appear.



Select a client and click **Continue...** or click **Add New** for adding a new client.

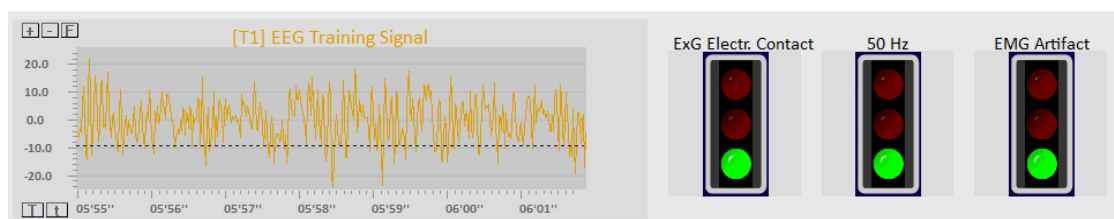
The *New session recording* screen will appear. Click **Start recording** to start recording a session.



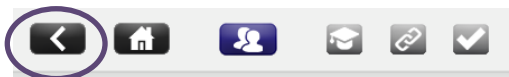
Click the **signal check** button to check electrode contact, 50/60 Hz artifact and muscle tension (EMG) interference.



Electrode contact, 50/60 Hz artifact and muscle tension (EMG) interference can be checked for the selected positions.



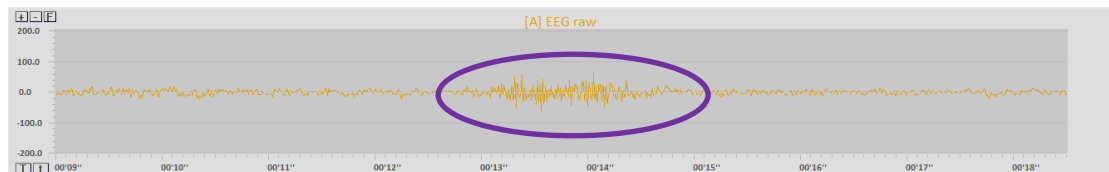
Click the **back** button.



Visually inspect the EEG to pinpoint and possibly reduce artifacts. Prevention is better than to cure and prevents having to mark and remove artifacts afterwards. For more details about the following artifacts, see the Appendix 2: Artifacts.

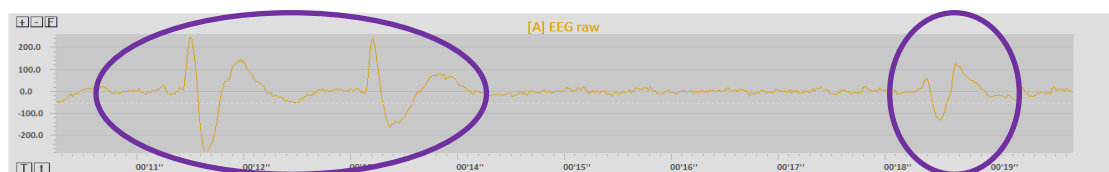
- **Muscle tension**

Electrical activity of the muscles occurs, (head, shoulders, tongue, jaws, etc.). Make sure to relax.



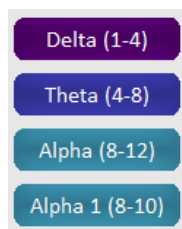
- **Eye movement**

Blinking or looking up or down.

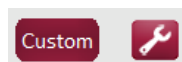


After having checked signal quality, the actual measurement can be started.

Click the *Frequency Band Controls*, to change frequency range settings.

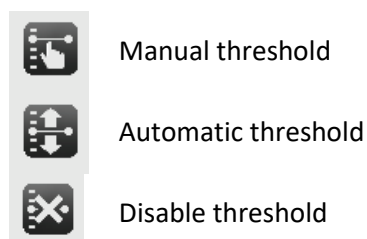


Set a custom frequency range by clicking the wrench next to **Custom**.



Set a frequency range between 0.1 and 50.0 Hz. Click **OK** after setting the custom range and click custom to apply these settings.


Set threshold setting controls of a bar graph.



Set the training direction of a bar graph.




Train up

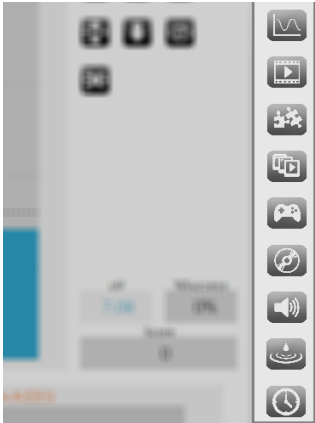



Train down


Feedback Type Controls are shown on the right side of a training screen.


Press the Windows logo key  +P for extending display to dual monitor setup


Select one of the feedback options that are available on the right side.




 Graph


 Video


 Puzzle


 Animation

 Game

 Disc

 Audio

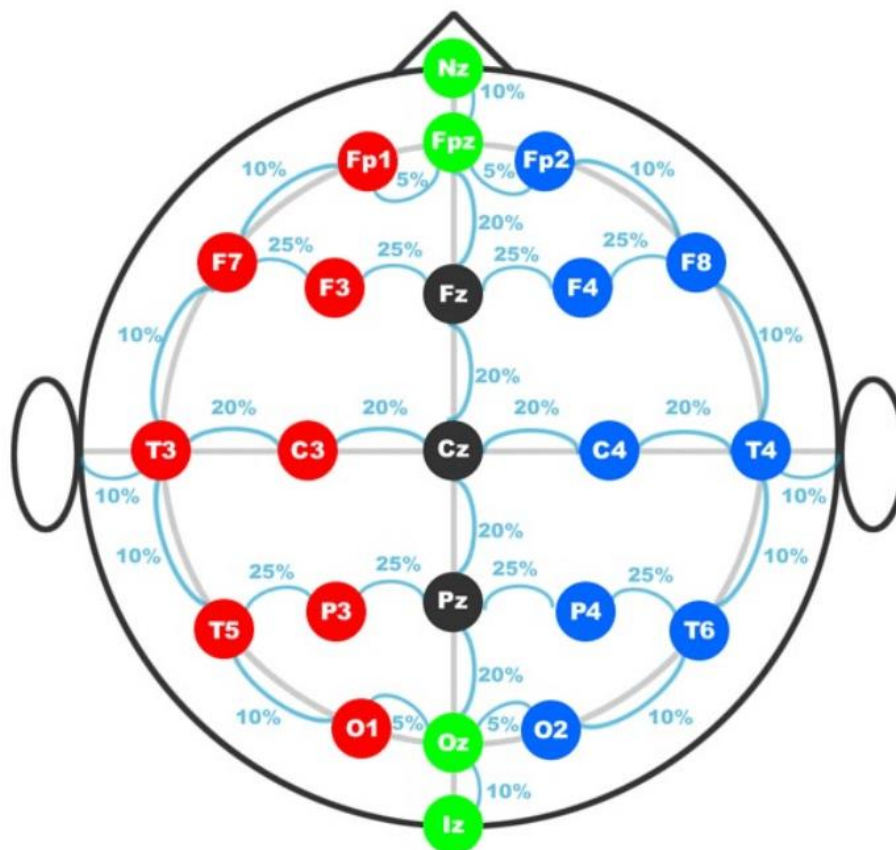
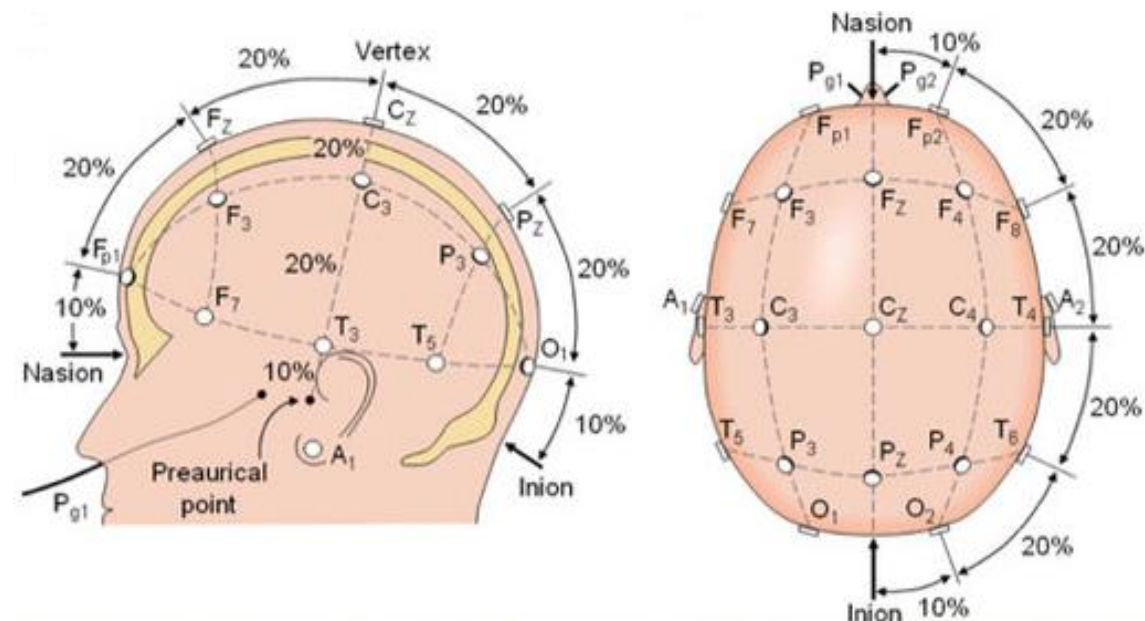
 Zoomer

 Mandala

For more information on feedback options and controls, please refer to the software manual.

Appendix 1: 10-20 EEG system

Use the Internationally accepted 10-20 EEG system for EEG electrode placement.



Appendix 2: Artifacts

- 50/60 Hz interference** The EEG activity has very low voltages, expressed in microvolts. Electrical interference can arise from electrical devices, lighting, etc. Electrical devices and cables transport electrical power at a level of 110-230 Volts AC. This power is alternating 50 or 60 times per second and therefore called “alternating current” or AC. This 50 or 60 Hertz activity can show up in the EEG, especially where the electrode doesn’t make good contact, or where there are simply too many cables and electrical devices around. This is a very common artifact. The quality and design of the hardware also strongly influences the presence of 50/60 Hz.
- Muscle tension** Electrical activity of the muscles (head, shoulders, jaws, tongue, etc.) can interfere with the EEG. EMG activity can reach amplitudes of more than 100 microvolts. Thus the EMG is more powerful than the EEG signal. Too much muscle tension can completely contaminate the EEG. Make someone aware of EMG artifacts by instructing them to clench teeth, chewing, frown, raise eyebrows, move the head side to side, up and down and swallow to produce artefacts while looking to their EEG signals. Pay close attention to the temporal electrodes T3, T4, T5 and T6 (modified combinatorial nomenclature or 10-10 system- T7, T8, P7 and P8) to identify muscle artifact from the masseter muscles. EMG may also be observed quite strongly in the frontal and occipital electrodes.
- Eye movement** Eye movement, both slower (looking up or down) and faster (blinking the eye) can cause artifacts, which are larger than the actual EEG signals. These artifacts are very frequent. Eye blinks are most visible in the frontal locations (Fp1, Fp2, F3, F4, F7, F8). Make someone aware of eye movement artifacts by instructing them to blink, move eyes up, down, right and left while looking at their EEG signals.
- Cardiac signals** In some cases the electrical signal of the heart (ECG) can show up in the EEG. The pulsation of veins below an electrode can also cause short spike in the EEG. This artifact is relatively rare.

Appendix 3: Care of materials

NeXus EXG sensor cleaning

The NeXus EXG sensors can only be cleaned. There are no procedures or prescriptions for disinfecting.

The sensor cables and snap-ons can be cleaned with lukewarm water and with an alcohol solution (70%) or alcohol prep pads (do not submerge in water or in alcohol solution).

Please avoid cleaning the connector, as this may affect its performance.

Electrode (Ag/AgCl) cleaning

Electrodes can be cleaned with lukewarm water.

Pay attention to the residual layer of gel or paste, which could dry and influence signal quality. This creates high resistance layer that prevents the recording.

Do not use abrasive or sharp objects which may result in permanent damage of the electrodes.

Electrode (Ag/AgCl) storage

If the electrodes will not be used for a few days or longer, it is recommended to clean and dry the electrodes before they are stored.

Put them in e.g. a re-sealable plastic bag, so that the moisture cannot act on the electrode.

Appendix 4: Linked-ear cable setup

EXG sensor setup with disc electrodes

The following is required to perform EEG measurements in an EXG sensor setup with disc electrodes:

- Nexus-4, NeXus-10 or NeXus-32
- EXG Sensor
- EXG Ground
- EEG Discs* (Ag/AgCl) / EEG Disc Ear Electrodes**
- Nuprep
- Electrode paste (e.g. Ten20)
- Ear clips for EEG Disc or EEG disc Ear Electrodes
- Measuring tape
- Tissue
- Cotton swabs
- Measuring tape
- Skin marker
- Scoop

* Recommended use is 10-20 times. The layer of Ag/AgCl will gradually wear off influencing signal quality.

** For placing EEG electrodes on the ears with EEG/EXG sensors with LOT numbers L2101 and onwards (March 2021), the EEG Disc Ear Electrodes are used in combination with ear clips.

One position EEG

Connect the EXG Sensor to input A&B of the NeXus-4 or NeXus-10 and input 25&26 of the NeXus-32. Make sure the red dot of the connector is facing downward with the NeXus-4 or NeXus-10 or upward with the NeXus-32.

Connect the EXG Ground to the Ground (Gnd) of the NeXus.



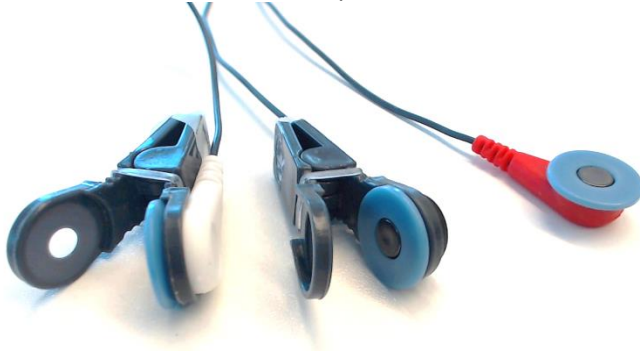
Sensors can be disconnected by pulling the silver ribbed part of the connector backward.



Place a disc electrode on to the red snap-on of pair one of the EXG sensor.



Place the black snap-on of pair one of the EXG sensor and the ground snap-on together with disc electrodes on to an ear clip.



Determine electrode positions according to the 10-20 system by using measuring tape and marking positions with a skin marker.

Rub the skin with a cotton swab and Nuprep at all electrode positions. Remove residual gel with a tissue. As an alternative to using Nuprep, alcohol pads are sometimes used.



Use the clip of the EXG cable to attach the EXG sensor to prevent pulling of the cables.



Apply some electrode paste (e.g. Ten20) to the electrodes by using for example a scoop.



Place the ear clip with the black (reference) snap-on with electrode on to the earlobe of the same side (ipsilateral) of the location of interest.



Place the earclip with ground snap-on with electrode on to the other earlobe.

Place the red (positive) snap-on with electrode on to the skin at the location of interest.

Minicap

Optionally use the Minicap or Microcap to fix the electrodes. The Minicap also allows for placing the electrodes on the mastoids instead of the ear.



Now go to chapter 'BioTrace+' for further instructions.

Two positions EEG

Connect the EXG Sensor to input A&B of the NeXus-4 or NeXus-10 and input 25&26 of the NeXus-32. Make sure the red dot of the connector is facing downward with the NeXus-4 or NeXus-10 or upward with the NeXus-32.

To create one reference for both positive electrodes, use the linked ear cable.

In a linked-ear setup, the positive electrodes are referenced to two linked negative electrodes. In order to create a linked-ear setup, a Linked Ear cable is placed in between the EXG sensor and the input of the Nexus. Refer to the linked ear manual for an extensive overview.

Connect the EXG Ground to the Ground (Gnd) of the NeXus.



Sensors can be disconnected by pulling the silver ribbed part of the connector backward.



Place disc electrodes on to the two red snap-ons of the EXG sensor and place a disc electrode on to the EXG ground snap-on.

Place the two black snap-ons of the EXG sensor together with disc electrodes on to an ear clip.



Determine electrode positions according to the 10-20 system by using measuring tape and marking positions with a skin marker.

Rub the skin with a cotton swab and Nuprep at all electrode positions. Remove remaining gel with a tissue. As an alternative to using Nuprep, alcohol pads are sometimes used.



Use the clip of the EXG cable to attach the EXG sensor to prevent pulling of the cables.



Apply some electrode paste (e.g. Ten20) to the electrodes by using for example a scoop.



Place the ear clips with the black (reference) snap-on with electrode on to the left and right earlobe.

Place the ground electrode preferably near the other reference electrodes on the scalp.

Place the red (positive) snap-ons with electrode on to the skin at the location of interest.



Minicap

Optionally use the Minicap or Microcap to fix the electrodes.



Now go to chapter 'BioTrace+' for further instructions.

Four positions EEG

When measuring four positions EEG, a linked-ear setup is recommended. Connect the linked-ear cables to input A&B and C&D on the NeXus-10 and input 25&26 and 27&28 on the NeXus-32. Make sure the red dot of the connector is facing downward with the NeXus-10 or upward with the NeXus-32.



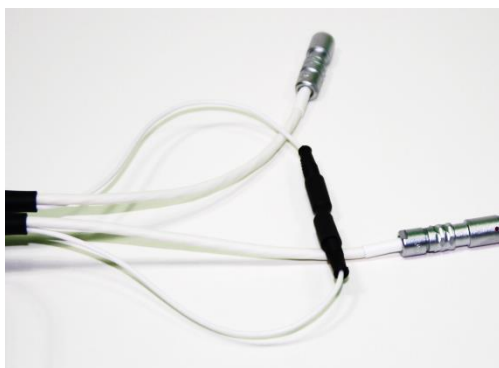
Sensors can be disconnected by pulling the silver ribbed part of the connector backward.



Connect the EXG Ground to the Ground (Gnd) of the NeXus.



Connect the black connectors of the two Linked ear cables by using the small black tube.



Connect the EXG Sensors to the Linked Ear cables. Make sure the red dots of the connectors are aligned.



Place disc electrodes on to the four red snap-ons of the EXG sensor and place a disc electrode on to the EXG ground snap-on.

Place the two black snap-ons of the EXG sensor which is connected to input A&B of the NeXus-10 and input 25&26 of the NeXus-32 together with disc electrodes on to an ear clip.



Determine electrode positions according to the 10-20 system by using measuring tape and marking positions with a skin marker.

Rub the skin with a cotton swab and Nuprep at all electrode positions. Remove remaining gel with a tissue. As an alternative to using Nuprep, alcohol pads are sometimes used.



Use the clip of the EXG cable to attach the EXG sensor to prevent pulling of the cables.



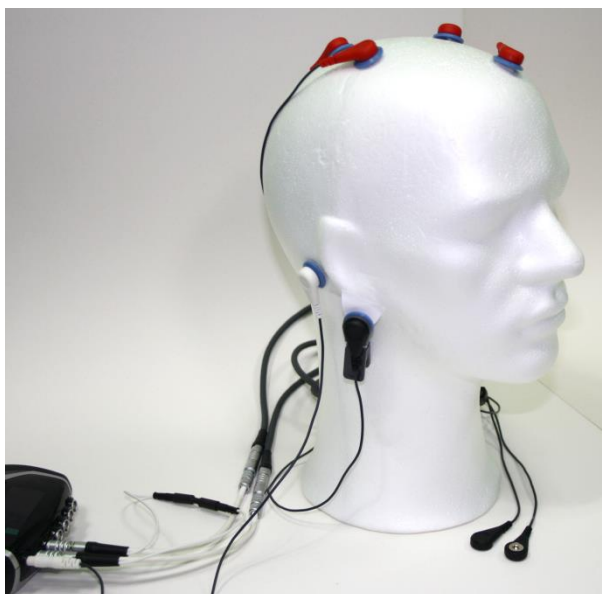
Apply some electrode paste (e.g. Ten20) to the electrodes by using for example a scoop.



Place the ear clips with the black (reference) snap-on with electrode on to the left and right earlobe.

Place the ground electrode preferably near the other reference electrodes on the scalp.

Place the red (positive) snap-ons with electrode on to the skin at the location of interest.



Minicap

Optionally use the Minicap or Microcap to fix the electrodes.



Now go to chapter 'BioTrace+' for further instructions.

EXG sensor TP setup with Minicap electrodes

The following is required to perform EEG measurements in an EXG sensor TP setup with minicap electrodes:

- Nexus-4, NeXus-10 or NeXus-32
- EXG Sensor TP
- EXG Ground TP
- EEG Minicap Electrodes (sintered Ag/AgCl)
- Electro gel
- Ear clips for EEG Minicap electrodes
- Syringe with blunt needle
- Minicap or Microcap
- Tissue
- Cotton swabs
- Measuring tape
- Skin marker

One position EEG

Connect the EXG Sensor TP to input A&B of the NeXus-4 or NeXus-10 and input 25&26 of the NeXus-32. Make sure the red dot of the connector is facing downward with the NeXus-4 or NeXus-10 or upward with the NeXus-32.

Connect the EXG Ground TP to the Ground (Gnd) of the NeXus.



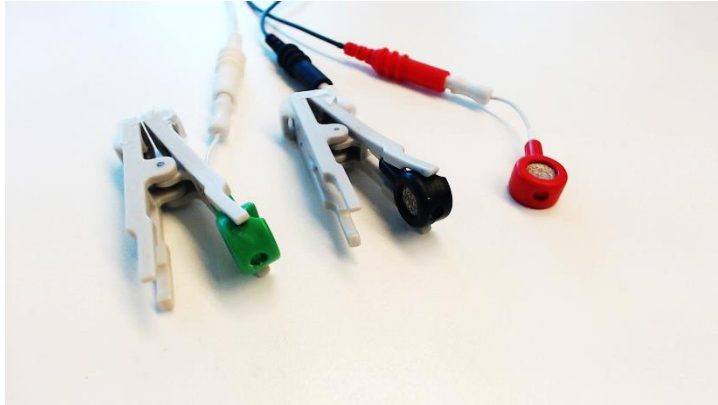
Sensors can be disconnected by pulling the silver ribbed part of the connector backward.



Place Minicap electrodes on to pair one of the EXG sensor TP and place a Minicap electrode on to the EXG ground TP. Slightly twist the connector in to EXG TP connection in order to make good connection.



Place the black TP connection (reference) with electrode of pair one and the ground with electrode on to an ear clip.



Determine electrode positions according to the 10-20 system by using measuring tape and marking positions with a skin marker.

Use the clip of the EXG TP cable to attach the EXG TP sensor to prevent pulling of the cables.



Place the Minicap or Microcap on the head.



Apply some Electro gel to the electrodes by using a cotton swab or a syringe with blunt needle.

Due to the fluid nature of electro gel, rubbing the skin with an abrasive gel is usually not necessary.

When using electrode paste (e.g. Ten20), rub the skin with a cotton swab and Nuprep at all electrode positions. The location of the ground electrode is preferably near other electrodes on the scalp. Remove residual gel with a tissue. As an alternative to using Nuprep, alcohol pads are sometimes used.

Place the ear clip with the black (reference) electrode on to the earlobe of the same side (ipsilateral) of the location of interest.



Place the earclip with ground snap-on with electrode on to the other earlobe.

Place the red (positive) electrode on to the skin at the location of interest. Use the Minicap or Microcap to fix the electrode. The Minicap also allows for placing the electrodes on the mastoids instead of the ear. In that case the ear clips are not necessary.



Now go to chapter 'BioTrace+' for further instructions.

Two positions EEG

Connect the EXG Sensor TP to input A&B of the NeXus-4 or NeXus-10 and input 25&26 of the NeXus-32. Make sure the red dot of the connector is facing downward (NeXus-4 or NeXus-10) or upward (NeXus-32).

To create one reference for both positive electrodes, use the linked ear cable.

In a linked-ear setup, the positive electrodes are referenced to two linked negative electrodes. In order to create a linked-ear setup, a Linked Ear cable is placed in between the EXG sensor and the input of the Nexus. Refer to the linked ear manual for an extensive overview.

Connect the EXG Ground TP to the Ground (Gnd) of the NeXus.

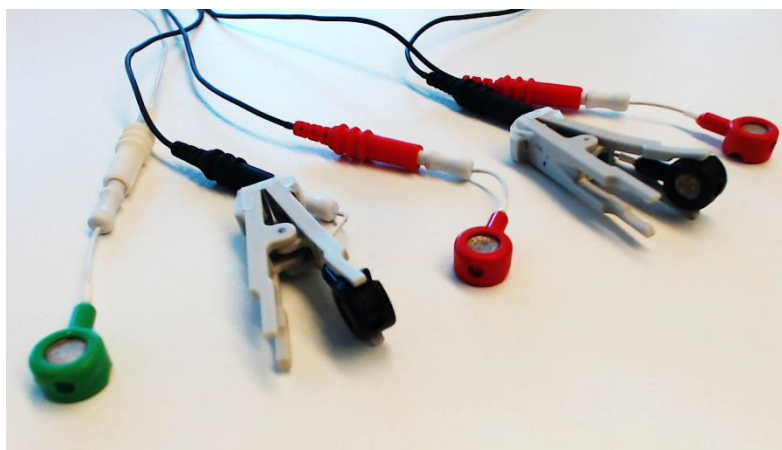


Sensors can be disconnected by pulling the silver ribbed part of the connector backward.



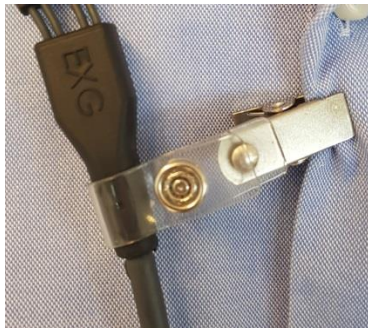
Place Minicap electrodes on the EXG sensors TP and place a Minicap electrode on to the EXG ground TP. Slightly twist the connector in to EXG TP connection in order to make good connection.

Place the black TP connection (reference) electrodes on to an ear clip.



Determine electrode positions according to the 10-20 system by using measuring tape and marking positions with a skin marker.

Use the clip of the EXG TP cable to attach the EXG TP sensor to prevent pulling of the cables.



Place the Minicap or Microcap on the head.



Apply some Electro gel to the electrodes by using a cotton swab or a syringe with blunt needle.

Due to the fluid nature of electro gel, rubbing the skin with an abrasive gel is usually not necessary.

When using electrode paste (e.g. Ten20), rub the skin with a cotton swab and Nuprep at all electrode positions. The location of the ground electrode is preferably near other electrodes on the scalp. Remove residual gel with a tissue. As an alternative to using Nuprep, alcohol pads are sometimes used.

Place the ear clips with the black (reference) electrodes on to the left and right earlobe.



Place the ground electrode preferably near the other reference electrodes on the scalp. Use the Minicap or Microcap to fix the electrodes.

Place the red (positive) electrodes on to the skin at the location of interest. Use the Minicap or Microcap to fix the electrode. The Minicap also allows for placing the electrodes on the mastoids instead of the ear. In that case the ear clips are not necessary.



Now go to chapter 'BioTrace+' for further instructions.

Four positions EEG

When measuring four positions EEG, a linked-ear setup is recommended. Connect the linked-ear cables to input A&B and C&D on the NeXus-10 and input 25&26 and 27&28 on the NeXus-32. Make sure the red dot of the connector is facing downward (NeXus-10) or upward (NeXus-32).



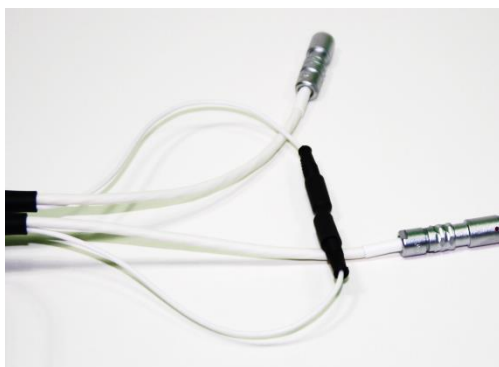
Sensors can be disconnected by pulling the silver ribbed part of the connector backward.



Connect the EXG Ground TP to the Ground (Gnd) of the NeXus.



Connect the black connectors of the two Linked ear cables by using the small black tube.



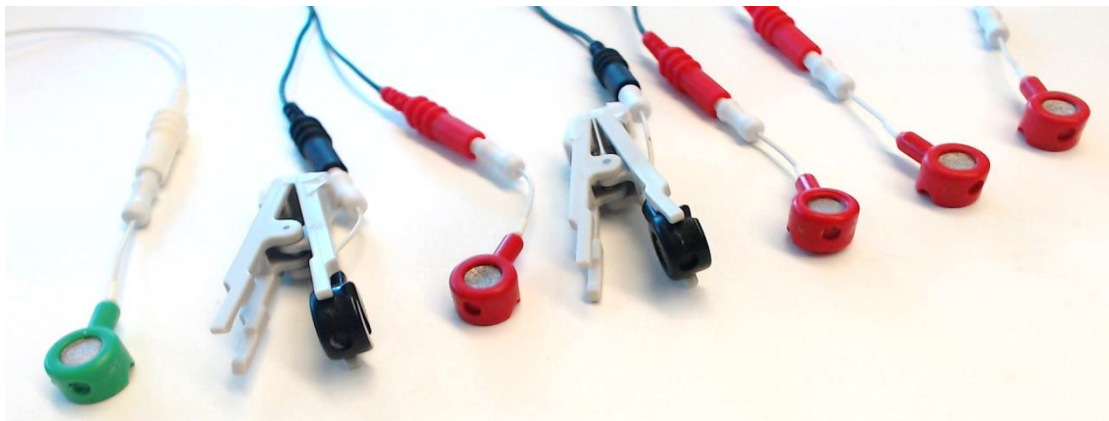
Connect the EXG Sensors TP to the Linked Ear cables. Make sure the red dots of the connectors are aligned.



Place Minicap electrodes on to the red EXG sensors TP and place a Minicap electrode on to the EXG ground TP. Slightly twist the connector in to EXG TP connection in order to make good connection.

Place black Minicap electrodes on to the black electrodes of the EXG sensor TP which is connected to input A&B of the NeXus-10 and input 25&26 of the NeXus-32.

Place the black TP connection (reference) electrodes on to an ear clip.



Determine electrode positions according to the 10-20 system by using measuring tape and marking positions with a skin marker.

Use the clip of the EXG TP cable to attach the EXG TP sensor to prevent pulling of the cables.



Place the Minicap or Microcap on the head.



Apply some Electro gel to the electrodes by using a cotton swab or a syringe with blunt needle.

Due to the fluid nature of electro gel, rubbing the skin with an abrasive gel is usually not necessary.

When using electrode paste (e.g. Ten20), rub the skin with a cotton swab and Nuprep at all electrode positions. The location of the ground electrode is preferably near other electrodes on the scalp. Remove residual gel with a tissue. As an alternative to using Nuprep, alcohol pads are sometimes used.

Place the ear clips with the black (reference) electrodes on to the left and right earlobe.



Place the ground electrode preferably near the other reference electrodes on the scalp. Use the Minicap or Microcap to fix the electrodes.

Place the red (positive) electrodes on to the skin at the location of interest. Use the Minicap or Microcap to fix the electrode. The Minicap also allows for placing the electrodes on the mastoids instead of the ear. In that case the ear clips are not necessary.



Now go to chapter 'BioTrace+' for further instructions.

EXG sensor TP setup with cup or ring electrodes

The following is required to perform EEG measurements in an EXG sensor TP setup with cup or ring electrodes:

- Nexus-4, NeXus-10 or NeXus-32
- EXG Sensor TP
- EXG Ground TP
- EEG cup or ring electrodes (Ag/AgCl)
- Nuprep
- Electrode paste (e.g. Ten20)
- Measuring tape
- Tissue
- Cotton swabs
- Skin marker
- Scoop

One position EEG

Connect the EXG Sensor TP to input A&B of the NeXus-4 or NeXus-10 and input 25&26 of the NeXus-32. Make sure the red dot of the connector is facing downward with the NeXus-4 or NeXus-10 or upward with the NeXus-32.

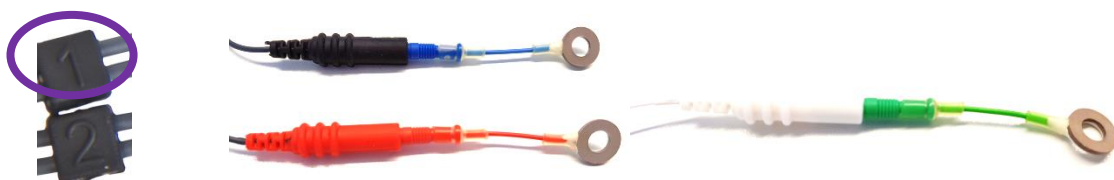
Connect the EXG Ground TP to the Ground (Gnd) of the NeXus.



Sensors can be disconnected by pulling the silver ribbed part of the connector backward.



Place cup or ring electrodes on to pair one of the EXG sensor TP and place a cup or ring electrode on to the EXG ground TP.



Determine electrode positions according to the 10-20 system by using measuring tape and marking positions with a skin marker.

Rub the skin with a cotton swab and Nuprep at all electrode positions. Remove residual gel with a tissue. As an alternative to using Nuprep, alcohol pads are sometimes used.



Use the clip of the EXG TP cable to attach the EXG TP sensor to prevent pulling of the cables.



Apply some electrode paste (e.g. Ten20) to the electrodes by using for example a scoop.



Place the black (reference) electrode on to the earlobe of the same side (ipsilateral) of the location of interest.

Place the ground electrode on to the other earlobe.

Place the red (positive) electrode on to the skin at the location of interest.

Now go to chapter 'BioTrace+' for further instructions.

Two positions EEG

Connect the EXG Sensor TP to input A&B of the NeXus-4 or NeXus-10 and input 25&26 of the NeXus-32. Make sure the red dot of the connector is facing downward (NeXus-4 or NeXus-10) or upward (NeXus-32).

To create one reference for both positive electrodes, use the linked ear cable.

In a linked-ear setup, the positive electrodes are referenced to two linked negative electrodes. In order to create a linked-ear setup, a Linked Ear cable is placed in between the EXG sensor and the input of the Nexus. Refer to the linked ear manual for an extensive overview.

Connect the EXG Ground TP to the Ground (Gnd) of the NeXus.



Sensors can be disconnected by pulling the silver ribbed part of the connector backward.



Place cup or ring electrodes on the EXG sensors TP and place a cup or ring electrode on to the EXG ground TP.

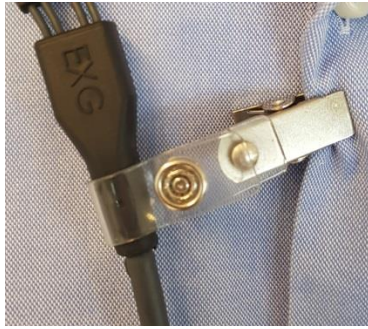


Determine electrode positions according to the 10-20 system by using measuring tape and marking positions with a skin marker.

Rub the skin with a cotton swab and Nuprep at all electrode positions. Remove remaining gel with a tissue. As an alternative to using Nuprep, alcohol pads are sometimes used.



Use the clip of the EXG TP cable to attach the EXG TP sensor to prevent pulling of the cables.



Apply some electrode paste (e.g. Ten20) to the electrodes by using for example a scoop.



Place the black (reference) electrodes on to the left and right earlobe.

Place the ground electrode preferably near the other reference electrodes on the scalp.

Place the red (positive) electrodes on to the skin at the locations of interest.

Now go to chapter 'BioTrace+' for further instructions.

Four positions EEG

When measuring four positions EEG, a linked-ear setup is recommended. Connect the linked-ear cables to input A&B and C&D on the NeXus-10 and input 25&26 and 27&28 on the NeXus-32. Make sure the red dot of the connector is facing downward (NeXus-10) or upward (NeXus-32).



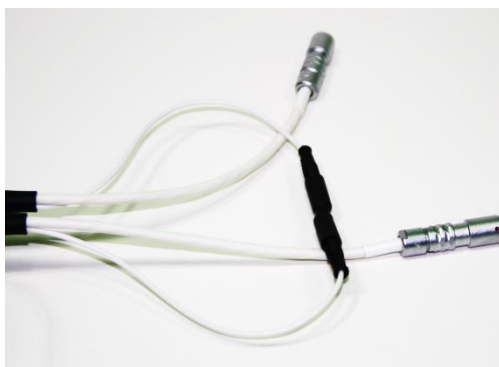
Sensors can be disconnected by pulling the silver ribbed part of the connector backward.



Connect the EXG Ground TP to the Ground (Gnd) of the NeXus.



Connect the black connectors of the two Linked ear cables by using the small black tube.



Connect the EXG Sensors TP to the Linked Ear cables. Make sure the red dots of the connectors are aligned.



Place cup or ring electrodes on to the red EXG sensors TP and place a cup or ring electrode on to the EXG ground TP.



Place cup or ring electrodes on to the black electrodes of the EXG sensor TP which is connected to input A&B of the NeXus-10 and input 25&26 of the NeXus-32.

Determine electrode positions according to the 10-20 system by using measuring tape and marking positions with a skin marker.

Rub the skin with a cotton swab and Nuprep at all electrode positions. Remove remaining gel with a tissue. As an alternative to using Nuprep, alcohol pads are sometimes used.



Use the clip of the EXG TP cable to attach the EXG TP sensor to prevent pulling of the cables.



Apply some electrode paste (e.g. Ten20) to the electrodes by using for example a scoop.



Place the black (reference) electrodes on to the left and right earlobe.

Place the ground electrode preferably near the other reference electrodes on the scalp.

Place the red (positive) electrodes on to the skin at the locations of interest.

Now go to chapter 'BioTrace+' for further instructions.