

## User Guide

# EMG

This user guide has been created to educate and inform the reader about doing EMG measurements

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

**[www.mindmedia.com](http://www.mindmedia.com)**

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## Introduction

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

## Required Equipment

Depending on the chosen setup, the following is required to perform EMG measurements:

- Nexus-4, NeXus-10 or NeXus-32
- EXG Sensor or EXG Sensor TP
- EXG Ground or EXG Ground TP
- Pre-gelled EMG electrodes\*, EMG triode electrodes (gelled/un-gelled) or EMG TP electrodes with din 1.5 mm pin
- Alcohol pads
- Skin marker

\*High quality electrodes like the Meditrace or ARBO electrodes are recommended to ensure good signal quality.

## EMG 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 EMG, the NeXus-10 and NeXus-32 up to 4 positions of EMG.

	NeXus-4	NeXus-10	NeXus-32
1 position EMG	✓	✓	✓
2 positions EMG	✓	✓	✓
4 positions EMG	✗	✓	✓

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

## EXG sensor setup

### 1 or 2 channels

For one or two positions EMG connect the EXG Sensor to input A&B of the NeXus-4, C&D of the 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.



	NeXus-4	NeXus-10	NeXus-32
EMG position 1	Input A&B: EXG pair 1	Input C&D: EXG pair 1	Input 25&26: EXG pair 1
EMG position 2	Input A&B: EXG pair 2	Input C&D: EXG pair 2	Input 25&26: EXG pair 2

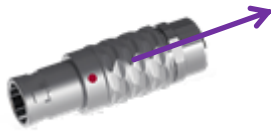
### 3 or 4 channels

For three or four positions EMG connect the EXG Sensor to input A&B and C&D of the NeXus-10 and input 25&26 and 27&28 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.



	NeXus-10	NeXus-32
EMG position 1	Input A&B: EXG pair 1	Input 25&26: EXG pair 1
EMG position 2	Input A&B: EXG pair 2	Input 25&26: EXG pair 2
EMG position 3	Input C&D: EXG pair 1	Input 27&28: EXG pair 1
EMG position 4	Input C&D: EXG pair 2	Input 27&28: EXG pair 2

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



Refer to literature for electrode positions on the muscle of interest (positive and negative electrode) and optionally mark the positions with a skin marker. Often the position of interest is the belly (central mass) of the muscle.

Optionally clean the skin with an alcohol pad at all electrode positions before applying the electrodes.

### Single snap-on electrodes

Snap the EMG electrodes on to the EXG snap-ons. The use of high quality electrodes like EMG Meditrace or ARBO electrodes is recommended.



Place the red (positive) and black (negative) electrodes on to the skin at the position of interest. Make sure the electrodes at the muscle of interest are placed parallel to the muscle fibers. The orientation of the positive and negative snap-on is not critical, they can be mutually swapped. Usually the electrodes are placed right next to each other.

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



Snap the EMG electrode on to the EXG ground snap-on.



Place the ground electrode on to the skin. The position of the ground is preferably a bony position with minimal EMG activity near the other electrodes (e.g. wrist, elbow, C7 or ankle).

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

### Triode electrodes

Snap the EXG and EXG ground snap-ons on to a disposable EMG triode electrode.



When using un-gelled electrodes apply conductive gel on to the EMG triode electrode

Place the electrode on to the skin at the position of interest. Make sure the red (positive) and black (negative) snap-ons are placed parallel to the muscle fibers. The orientation of the positive and negative snap-on is not critical, they can be mutually swapped.

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



In case of multiple positions, the ground is connected to one of the triodes.



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



## EXG sensor TP setup

### 1 or 2 channels

For one or two positions EMG connect the EXG Sensor TP to input A&B of the NeXus-4, C&D of the 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.



	NeXus-4	NeXus-10	NeXus-32
EMG position 1	Input A&B: EXG pair 1	Input C&D: EXG pair 1	Input 25&26: EXG pair 1
EMG position 2	Input A&B: EXG pair 2	Input C&D: EXG pair 2	Input 25&26: EXG pair 2

### 3 or 4 channels

For three or four positions EMG connect the EXG Sensor TP to input A&B and C&D of the NeXus-10 and input 25&26 and 27&28 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.



	NeXus-10	NeXus-32
EMG position 1	Input A&B: EXG pair 1	Input 25&26: EXG pair 1
EMG position 2	Input A&B: EXG pair 2	Input 25&26: EXG pair 2
EMG position 3	Input C&D: EXG pair 1	Input 27&28: EXG pair 1
EMG position 4	Input C&D: EXG pair 2	Input 27&28: EXG pair 2

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



Refer to literature for electrode positions on the muscle of interest (positive and negative electrode) and optionally mark the positions with a skin marker. Often the position of interest is the belly (central mass) of the muscle.

Optionally clean the skin with an alcohol pad at all electrode positions before applying the electrodes.

Place the EMG TP electrodes on to the EXG sensors TP.



Place the red (positive) and black (negative) electrodes on to the skin at the position of interest. Make sure the electrodes at the muscle of interest are placed parallel to the muscle fibers. The orientation of the positive and negative snap-on is not critical, they can be mutually swapped. Usually the electrodes are placed right next to each other.

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



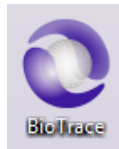
Place an EMG TP electrode on to the EXG ground TP.

Place the ground electrode on to the skin. The position of the ground is preferably a bony position with minimal EMG activity near the other electrodes (e.g. wrist, elbow, C7 or ankle).

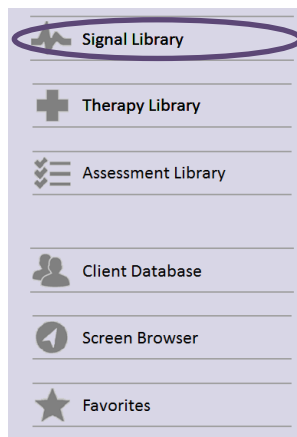
Now go to chapter 'BioTrace+' for further instructions.

## BioTrace+

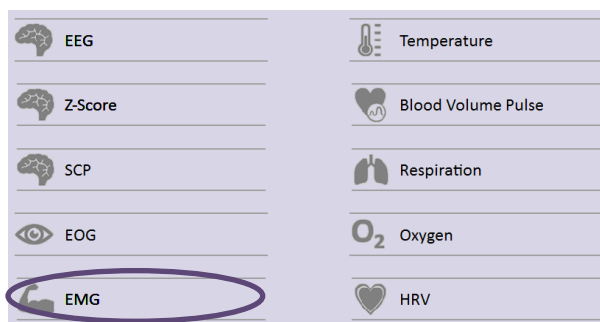
Start the BioTrace+ Software.



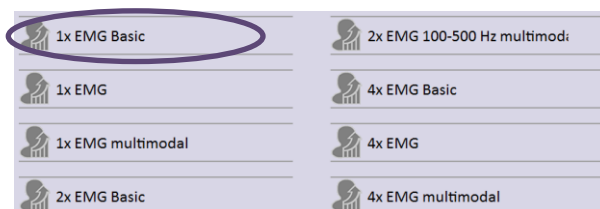
Select **Signal Library**.



Select **EMG**.



Select your preferred visualization screen (e.g. when doing 1 position EMG: 1x EMG basic).



The EMG visualizations differ from each other in

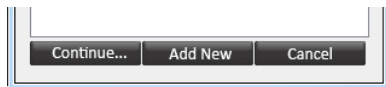
- Number of channels: e.g. 1x EMG, 2x EMG
- Showing spectral analysis (EMG screens) or not (EMG Basic screens). Adding a spectral analysis shows the spectral distribution of an EMG signal.
- Filters: 20-500 Hz or 100-500 Hz in case of placement of electrodes in areas that are affected by cardiac signal (ECG). See appendix 1: Artifacts
- Additional signals. 'Multimodal' screens also show other signals like heart rate, skin conductance, temperature and respiration graphs.

Switch the NeXus on.

Click the **recording** button.

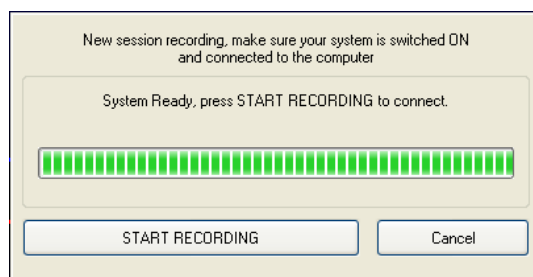


The *select a client* dialog box will appear.



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

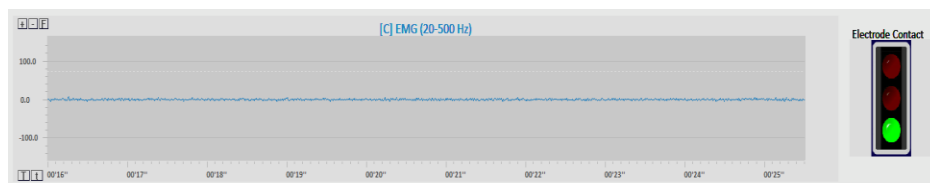
The *New session recording* screen will appear. Click **Start recording** to start recording a session.



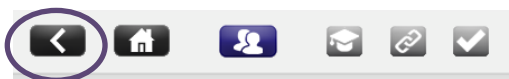
Click the **signal check** button to check electrode contact and cardiac signal (ECG) interference.



Electrode contact can be checked for the selected position.



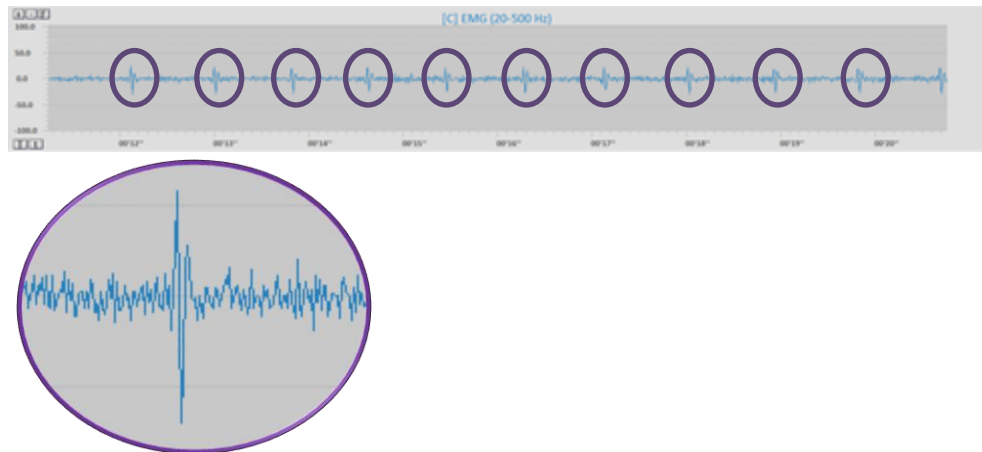
Click the **back** button.



Visually inspect the EMG 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 artifacts, see the Appendix 1: Artifacts.

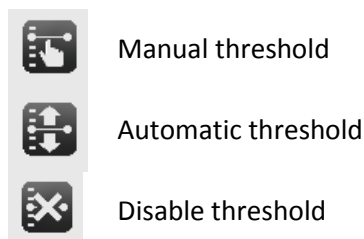
- **Cardiac signals**

In some cases the electrical signal of the heart (ECG) can show up in the EMG. The pulsation of veins below an electrode can also cause artifacts in the EMG. For this reason a different filter setting is often used (100-500 Hz screens).



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

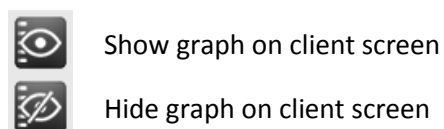
Set threshold setting controls of a bar graph.




Set the training direction of a bar graph, to either train to reduce muscle tension or increase muscle tension.



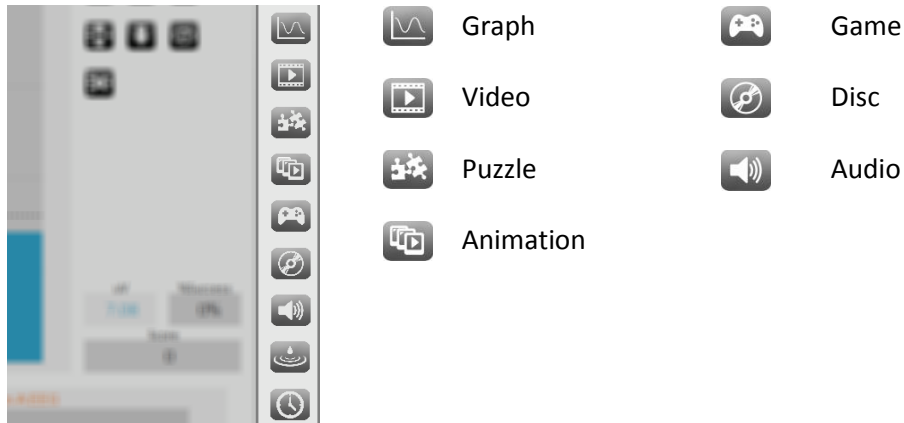
It is possible to show and hide the bar graph feedback on the client screen.



*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.



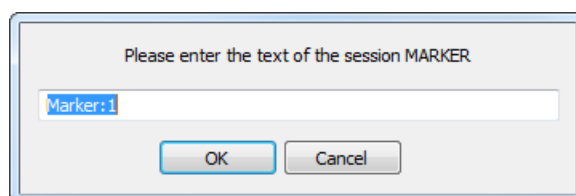
Select other content during a recording by clicking the change feedback icon in the right top corner. This can only be used with videos, animations, games, puzzles, and audio.



Markers can define a certain event during a recording. These markers can be added manually by pressing *the marker symbol* in *Session controls in the left bottom corner* (or by pressing **Enter**):



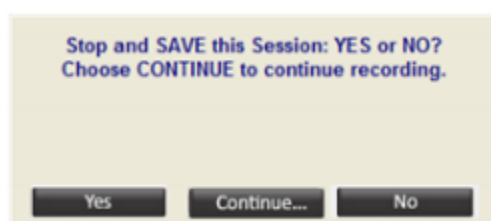
The following dialog box appears for naming markers.



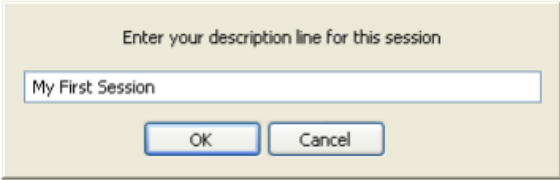
In order to stop the recording, click the **stop** button.



An alert box will appear.



Click **Yes** and save the session and enter a description of the session.



Enter your description line for this session

My First Session

OK Cancel

Confirm by clicking **OK**, the session is now saved.

## Appendix 1: Artifacts

- **50/60 Hz interference**

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. The connectors and carbon coated cables of the sensors have active noise cancellation, resulting in a minimum of noise during recording.

- **Cardiac signals**

In some cases the electrical signal of the heart (ECG) can show up in the EMG, especially when electrodes are placed near the heart. An example is placing the electrodes on the upper trapezius muscle. For this reason a different filter setting is often used (100-500 Hz screens). The pulsation of veins below an electrode can also cause short spikes in the EMG. The latter is relatively rare though.



## Appendix 2: 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.