EMG (Muscle Tension) 2 Channel Software Application User Guide

Contents

1 Introduction

This guide introduces the Basic Electromyography (EMG) biofeedback application, part of the Mind-Body Training Tools suite. This set of applications is designed to develop skills in mind-body awareness and self-regulation, particularly in a context of mindfulness and meditation practice.

The purpose of this guide is teach you how to use the software – though it is more of a reference than a tutorial. Other training material is available on the StressResilientMind.co.uk website (address above).

EMG is an electrical correlate of muscle tension. It is easy to appreciate that the state of muscle tension is reflective of your subjective state of mind. EMG biofeedback is a means of developing greater sensitivity to this mind-body relationship, and of transforming your state of mind by changing the underlying physiology.

EMG is measured using sensors in contact with the skin. By selecting the placement of the sensors we can choose to monitor different (sets of) muscles. This guide discusses the most commonly used placements.

The user guide for the Basic EMG application describes EMG in more detail. The 2 channel application simply extends the functionality of the Basic EMG app to 2 channels. I recommend you get familiar with using the Basic application before working with 2 channels.

In keeping with others in the suite, the EMG 2 channel application was designed to support *your* aims, not to supplant them. Achieving low muscle tension is not necessarily the most important thing. Biofeedback should enhance or expand your subjective awareness rather than detract from it.

The guide assumes that you have read the Software Installation and Set-up Guide, and therefore know how to start the application.

The application works with several devices. For an up to date list of supported hardware, please see the StressResilientMind.co.uk website.

2 Launching the Application

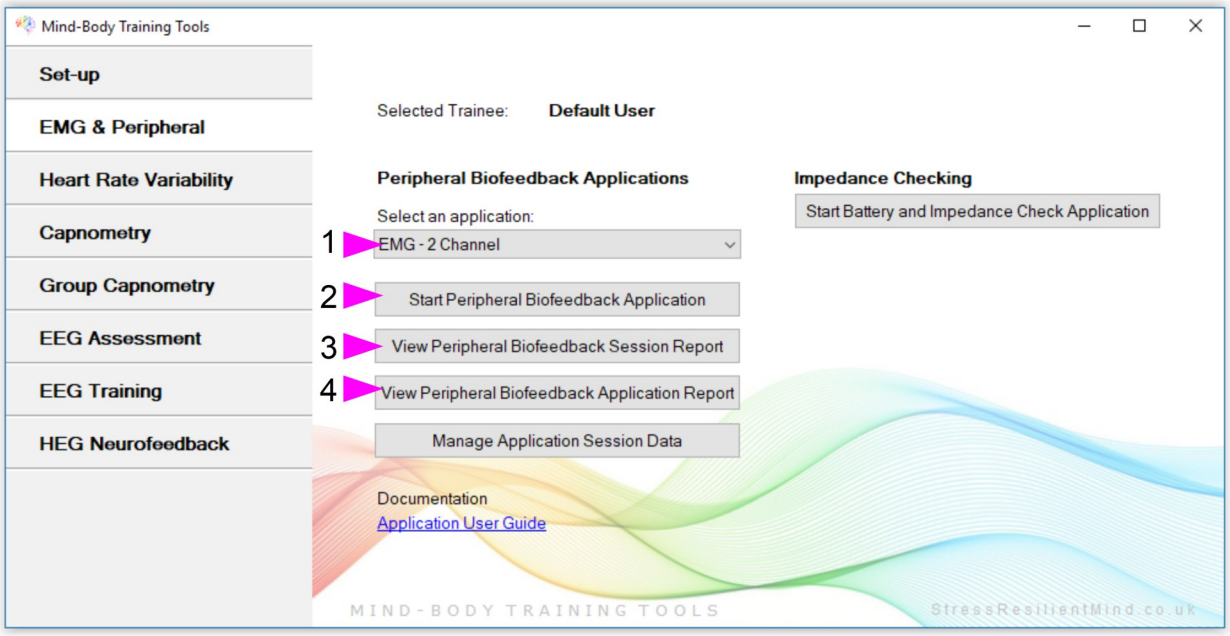


Figure 1 – EMG & Peripheral (biofeedback) Tab of the Platform Application

Figure 1 above shows the EMG & Peripheral tab of the Platform. First you need to select the "EMG – 2 Channel" application from the drop-down list control (labelled 1). Then click the button to launch the app (labelled 2). Make sure you have your BioEra licence key (dongle) inserted into a USB socket. After a few seconds a new window will appear on your screen.

2.1 Hardware Set-up

The physical aspects of hardware set-up (how to connect and use your sensors,, how to check impedances, etc.) are dependent upon the type of amplifier you are using, and are covered in a separate document (Hardware Set-up Guide).

Before you start the application you configure the device set-up options, accessible by clicking a button in the Set-up tab of the Platform. In the dialog, select the type of amplifier (biofeedback device) you are using, in the **EMG source control**. Note, all the source settings are remembered the next time you start the Platform. See the Installation and Set-up Guide for further details of device set-up.

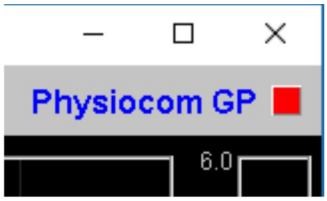


Figure 2 – Amplifier status

One of the device options is 'Simulator'. In simulator mode, you can learn how to use the software without the encumbrance of sensors, leads etc. (The application simply uses recorded data as a source.)

Once you have started the application, you should see your device selection reflected in the device status display in the top right corner of the main window (see figure 2). The lamp (shown as a red square in figure 2) should change to green when you press the play button. If you do not see this happen, it means that the application has not been able to establish a connection with your device. Check it is plugged in and that the batteries are not flat.

For some devices, you'll see a button rather than just text. Pressing this button opens up a dialog that allows you to adjust settings related to the device, such as COM port. The specifics depend on the device – see the Hardware Set-up Guide for more details.

3 About Electromyography (EMG)

EMG is an electrical correlate of muscle tension. I refer you to the Basic EMG User Guide for a full description of EMG as a measurement and a discussion of its relationship to the mind-body connection.

This application differs from the Basic EMG app in offering two channels of EMG. Obviously this allows you to monitor two muscles or muscle groups independently.

A particular application is to monitor the left and right sides of the body, with a focus on the balance between the two sides.

4 User Interface

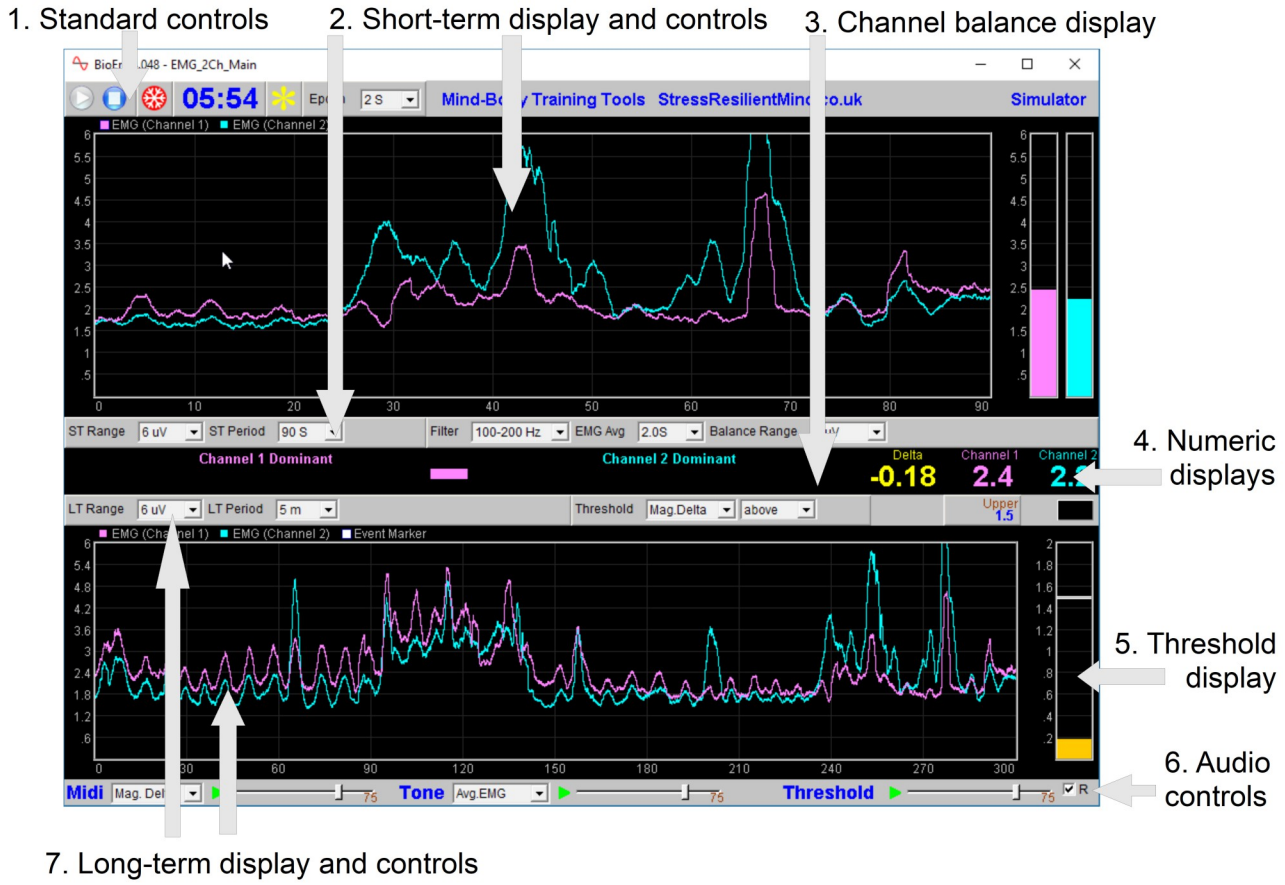


Figure 3 – User Interface

Figure 3 above shows the user interface for the EMG 2-channel application.

4.1 Standard Controls (Start / Stop, etc.)

A set of buttons – Play, Stop and Pause – are the same in all the applications in the suite. They should be self-explanatory.

The 'Epoch' control sets the time period at which data is written to the session data file. This data file is used to generate session reports, which are described in section 6 below. For the EMG 2-channel application, only EMG data is written. Choosing a lower time period generates more data. The setting also controls the level of averaging of the recorded data. For example, if you select 2 seconds, then the application will write to the session data file once every two seconds, the average

EMG over that two second period.

The button marked with a red asterisk is a simple event marker. You can use it to mark adventitious happenings and changes in session conditions. It is particularly useful for coaches and therapists. Events thus marked are represented in the long term chart (see section 4.4 below) by a vertical white line. They are also recorded in the session data file and are shown in session report charts (as dotted vertical lines) (see section 5).

Note that pressing the escape key during a session has the same effect as pressing the red asterisk with your mouse (i.e. it is an alternative).

4.2 Short Term Displays and Controls

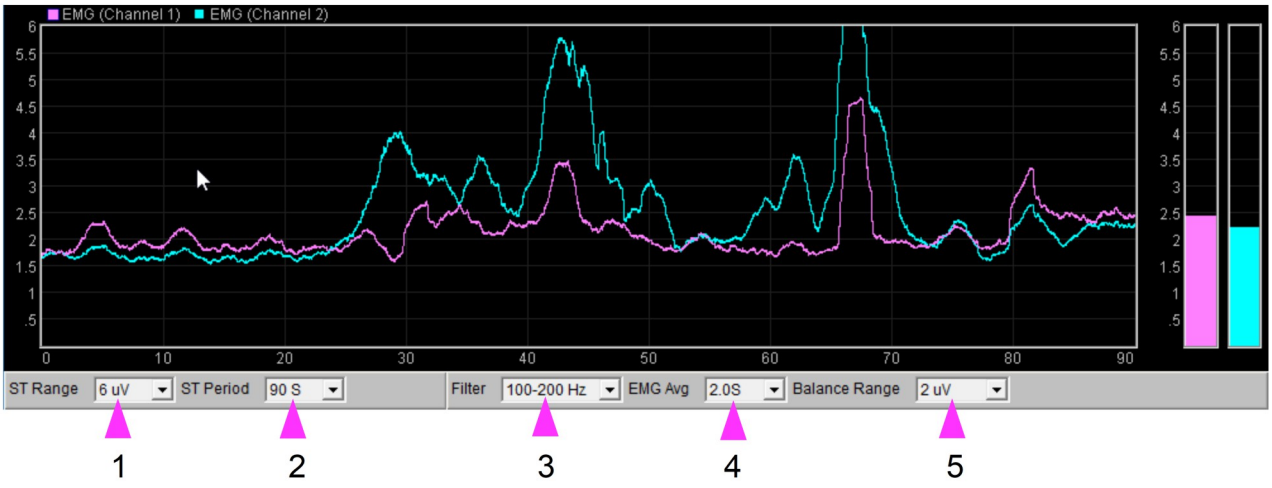


Figure 4 – Short term display and controls

This chart shows the two channels of EMG as they vary over the short term.

The drop-down list controls below the chart control how the EMG signal is processed and displayed. The table below describes these controls

ST Range	Sets the EMG range or the vertical range for the chart.
ST Period	Controls how long it takes the trace to traverse the whole chart from right to left.
Filter	Sets the frequency range for the filter on the raw EMG signal. Raw EMG is a rapidly oscillating voltage. This control works in the same way as the equivalent control in the basic EMG application. The user guide for that application describes filtering in much more detail. In general I recommend you stick to the setting of 100-200 Hz.
EMG Avg	Controls the time period over which the EMG signal is averaged – this in effect sets the level of smoothing on the trace. With a low average there is much more variation, including a degree of "noise", but the signal is more responsive to subtle changes too.
Balance Range	This control sets the EMG range for the balance display, which you can see immediately below these controls in figure 3 (it is not shown in figure 4). This chart is described in the following section (4.3).

4.3 Balance Display

In this display (labelled 3 in figure 3), a horizontal bar moves out from a central point. It is useful when you're using the application to monitor the balance between left and right sides of the body. It shows immediately which side is dominant in terms of muscle tension.

In relation to balance, the application calculates the difference between the two channels. This difference is referred to as “delta” in the software controls and charts – for example a numeric display (labelled 4 in figure 3). Delta is channel 2 EMG minus channel 1 EMG. I suggest if you're monitoring left / right balance, you use channel 1 for the left side and channel 2 for the right – this will mean the balance display makes more sense.

The range for the balance display is set by the control labelled 5 in figure 4.

4.4 Long Term Display and Controls

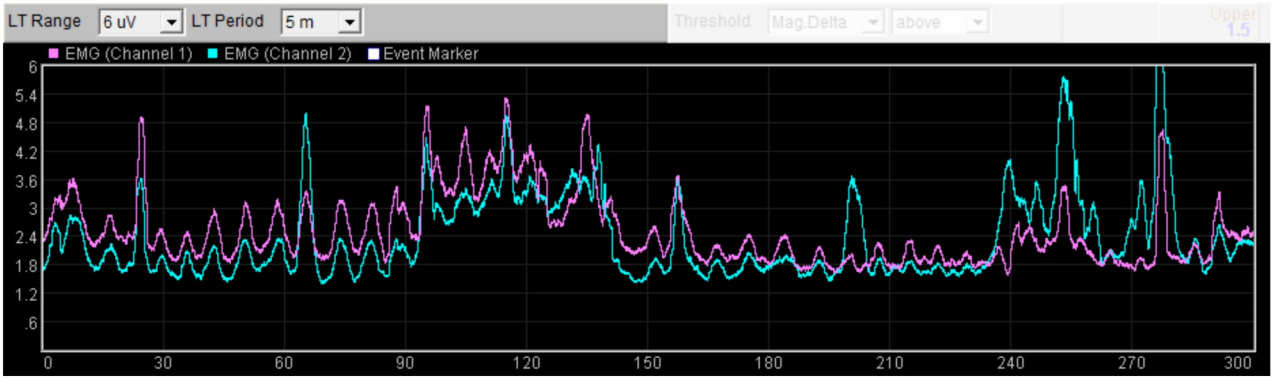


Figure 5 – Long term display and controls

The long-term display (figure 5 above) shows the variation of the EMG over a longer time scale (up to 30 minutes). The two drop-down list controls shown above the chart control the horizontal (time) range and vertical (EMG) range.

4.5 Threshold Display and Controls

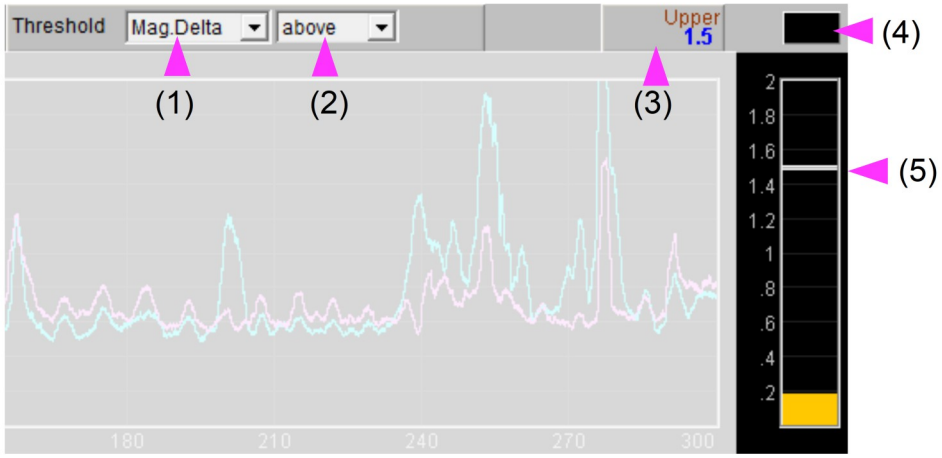


Figure 6 – Threshold display and controls

Threshold-based feedback is designed to follow a consistent pattern throughout all the applications, and therefore it made sense to describe threshold functionality in a single place, viz. The Guide to Audio and Threshold-based Feedback (a separate document). I recommend you read that before trying to make sense of this section.

(Controls for threshold-based audio feedback are covered in section 4.6 below.)

There is a single threshold in the EMG 2 channel application, shown in figure 6. You can control which parameter to use for threshold-based feedback using the drop-down list control labelled 1 in figure 6. In this control, “delta” means the difference between the two channels, i.e. channel 2 EMG – channel 1 EMG. Another option is “Mag. Delta” which means the magnitude of the difference, ignoring the positive or negative sign.

Please note that changing this setting sometimes causes the application to restart, meaning that you lose the session data written before that point. If session reports are important to you, I recommend choosing a setting at the start of your session and sticking with it.

The range of the threshold's bar graph is set by one of the drop-down list controls associated the short-term display, described in section 4.2 above. That is, the threshold range is either the short term EMG range, or it is the range for the channel difference, “delta”.

4.6 Audio Feedback Controls

Again, please read the Guide to Audio and Threshold-based Feedback to gain a fuller understanding of the audio feedback controls, which are shown in figure 7 below.

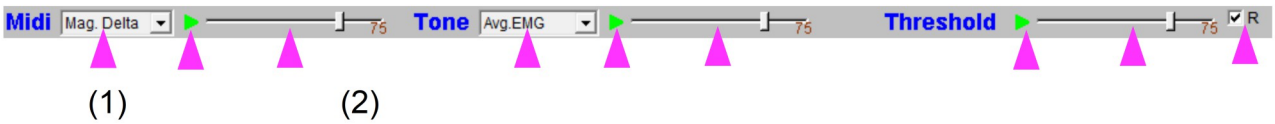


Figure 7 – Audio feedback controls

For the most part audio feedback works as it does in other applications. There are “play” buttons,, volume sliders, and for midi and tone feedback, drop down lists to select which parameter to base feedback on.

Threshold-based audio feedback is based on the parameter selected for the threshold controls, labelled 1 in figure 6 above and mentioned in section 4.5.

5 Session Reports

The application records data so that you can generate a report for your sessions. The report contains summary data and graphs showing the progression of the feedback parameter over the whole session.

To generate and open a session report, click the button labelled 3 in figure 1. A dialog window opens in which you can select various options (see figure 8).

The software creates the report in html format. It will be opened using your computer's default web browser, e.g. chrome or firefox. (Note that a live internet connection is not needed.) The html file is saved, so you can for example email it to someone. See the Installation and Set-up Guide for details of file storage.

5.1 Report Options

Most of the options should be self-explanatory.

If you change your mind about options on seeing your report, you can regenerate the report by clicking the report button (3 in figure 1), then checking 'Overwrite existing report'.

Setting a maximum EMG amplitude is a basic way of excluding “artefacts”, for example if you changed your posture during the session. Data points exceeding the maximum value are excluded.

5.2 Adding Notes to a Report

You can choose to write some notes for your session report. Checking 'Add notes to report' (top right of the dialog) allows you to do this.

You may wish to add notes after having first seen the report. In this case, simply click the button (3 in figure 1) again, and check the Add notes option. This will regenerate the report with your added notes.

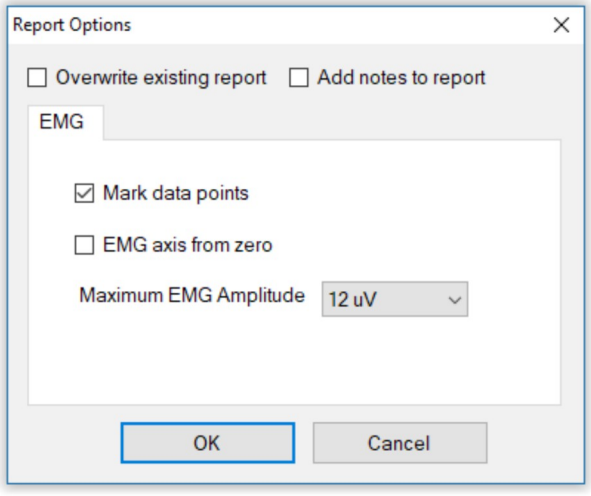
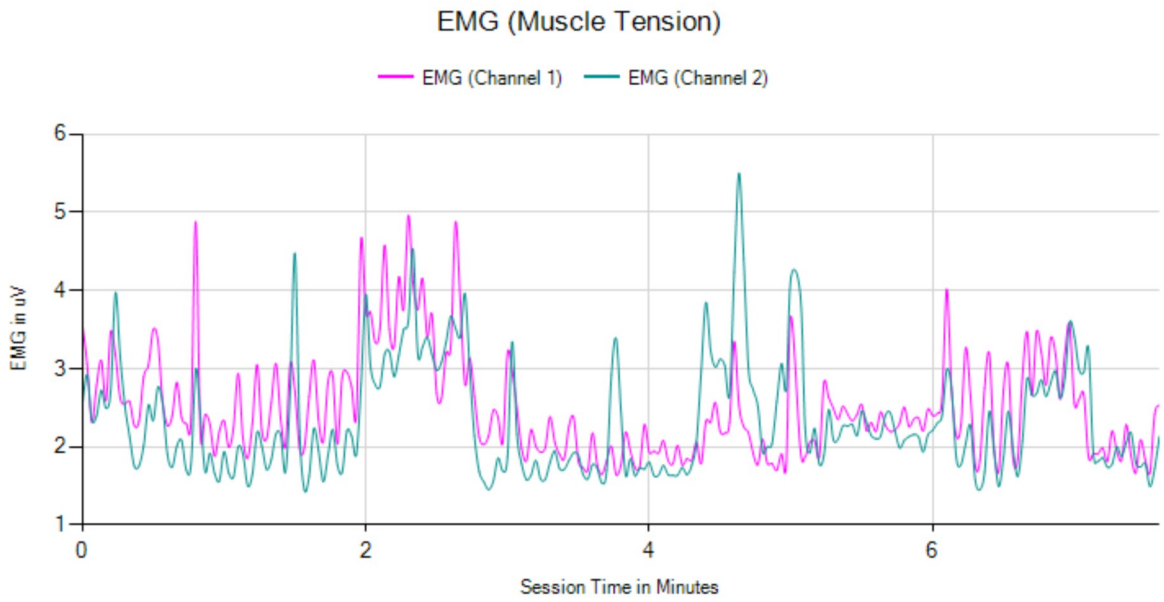


Figure 8 – Report options

5.3 Sample Session Report

Training Session Report

Training Application	EMG (2 Channel)
User Name	Default User
Session Date	30/08/18 11:49



EMG (2 Channel) Summary Data

Parameter	Mean	Max	Min
EMG (channel 1)	2.51	4.96	1.39
EMG (channel 2)	2.33	5.5	1.45

6 Application Report

An application report summarises all the sessions for the currently selected user, in charts and a table.

To generate and open an application report, click the button labelled 4 in figure 1. A dialog window opens in which you can select various options (see figure 9).

As with session reports, the software creates the application report in html format. It will be opened using your computer's default web browser, e.g. chrome or firefox. (Note that a live internet connection is not needed.) The html file is saved, so you can for example email it to someone. See the Installation and Set-up Guide for details of file storage.

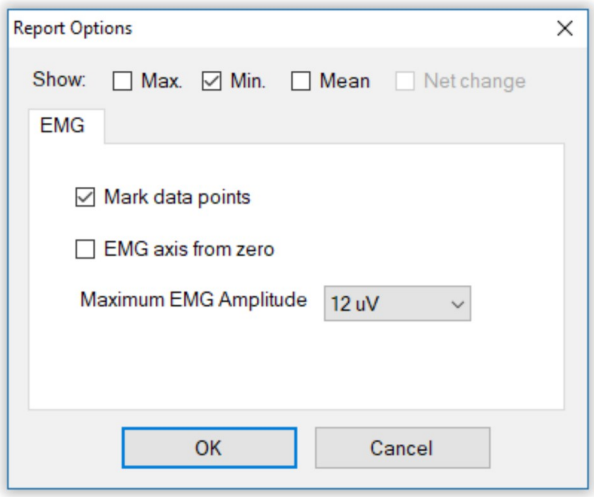


Figure 9 – Report options

6.1 Report Options

The application report options dialog is an adapted version of the session report options dialog. Many of the options are the same, and should be self-explanatory. See section 5.1 above.

As with all of the application reports in the suite, there is a chart for each of the main parameters tracked in the application – in the case of the EMG 2 channel application that means EMG amplitude, one chart for each channel. For each chart you can opt for line graphs for the maximum, minimum, mean and standard deviation. The line graphs have one point per session.