Skin response

Skin response, also known as galvanic skin response (GSR), electrodermal response (EDR) or skin conductance (SC) is a measurement method based on bio-electrical properties of the skin. The eSense Skin Response applies a very small, safe and unnoticeable electrical voltage and resulting electrical current to the skin. Through the changes of this small current, we can measure the activity of the perspiratory glands of the skin far below the threshold of self-perception.

In terms of physics, skin conductance is measured in µSiemens or shortly µS (where µ denotes a millionth and Siemens is the unit of conductance). “Skin resistance” is also a common term, simply denoting the inverse of conductance.

The activity of the perspiratory glands is determined by the autonomic nervous system, which contains two major subunits: the parasympathetic nervous system and the sympathetic nervous system. The perspiratory glands of the skin are solely controlled by the sympathetic nervous system, making them a good indicator for inner strain and stress. The sympathetic nervous system reacts to stress stimuli by activating all the “emergency functions” of the body, bringing it to a state of heightened responsiveness: Pulse and blood pressure are rising along with the glucose level in the blood and general alertness. With these changes comes the effect of “wet hands” on which our measurement relies. A scientific theory for this effect assumes that our ancestors needed it to have a firmer grip on things, for example in a flight or pursuit through difficult terrain. When the threatening situation is over, the parasympathetic nervous system becomes dominant: Pulse, blood pressure and glucose level are falling. The body enters a rest state to allow recuperation, and the hands become dry again.

The increased activity of the perspiratory glands through a (stress) stimulus is easily visible through the associated increase in skin conductance. The stimulus can be mental or emotional strain, or taking a sudden, deep breath, or a startling action like someone unexpectedly clapping his hands. Just try it with the eSense, you will easily see the effects!

Stress and its vegetative symptoms can be greatly reduced through biofeedback training, where you intentionally work on lowering your skin response.

How to use skin response in biofeedback training?

Skin response is a quite universal tool for biofeedback training. It is widely used in the therapy of anxiety, panic disorders and specific phobias. Further fields of use are high blood pressure, tinnitus and sleep disorders. If you suffer from a serious disorder or medical condition, always consult a professional physician or therapist, and do not attempt a treatment on your own. The eSense Skin Response is not a medical device and may only be used for stress reduction training.

Measurements are done by placing two electrodes on two fingertips of the same hand. The dark-colored lower side of the electrode should be in good skin contact.

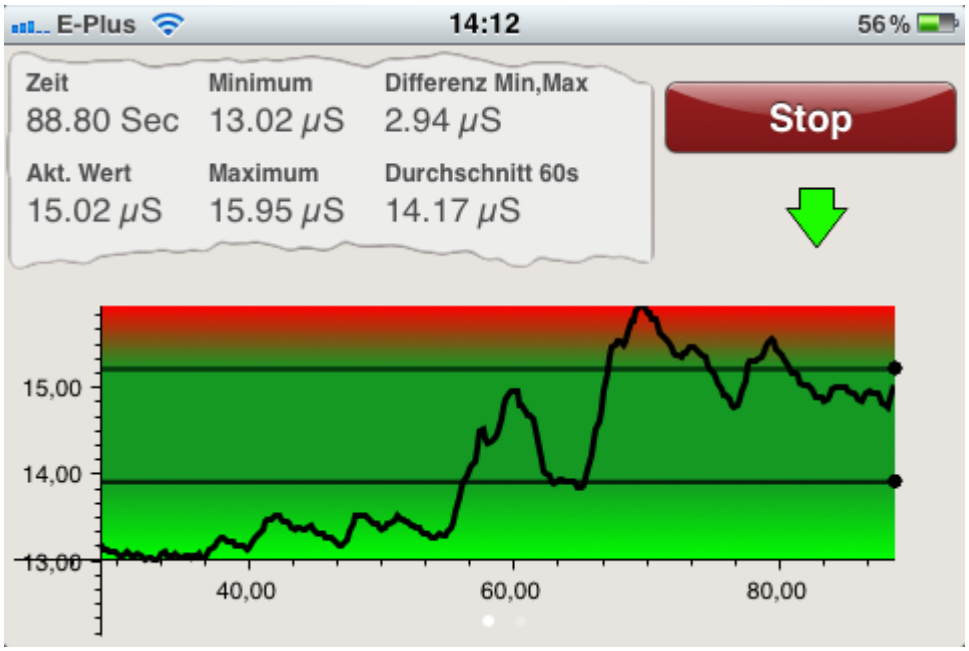
The goal of the feedback training is twofold: A reduction of the permanent, basic level of stress, and a reduction of the immediate stress response to a particular stimulus.

How is the training done in detail?

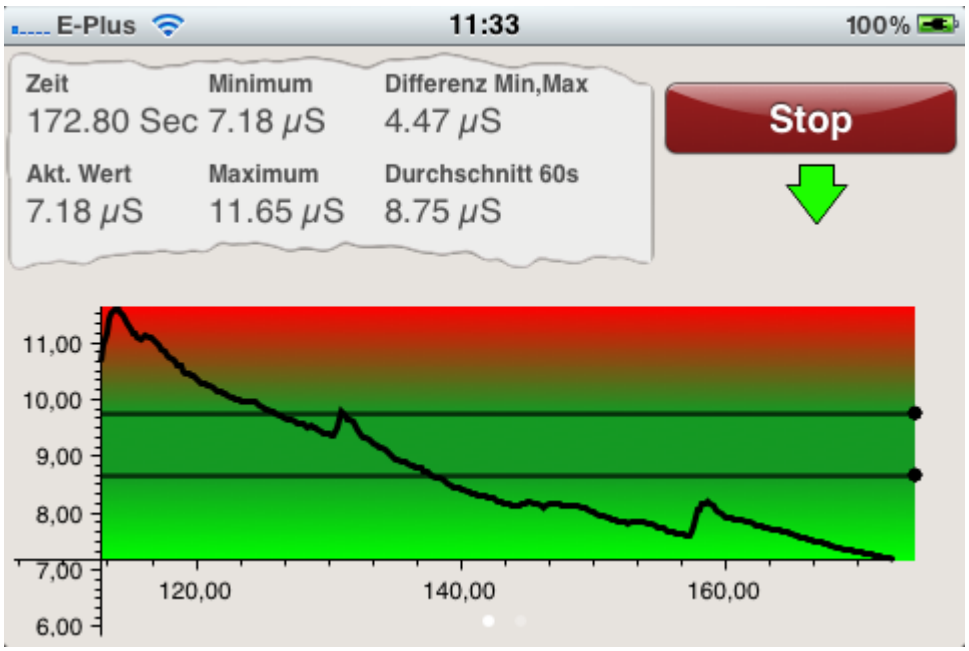
1. A quiet, comfortably tempered room without phones and other sources of distraction, and convenient seating and clothing are the conditions we need for successful training. You should avoid all conditions that can make you sweat out of purely physical reasons, like intense physical activity before training or intense sunlight and heat. To obtain comparable results, you should try to keep your initial and ambient conditions constant through the series of training sessions.
2. Wrap the two electrodes around the upper or middle phalanges of your index and middle finger of the same hand. The dark lower side of the electrodes shall be in good skin contact Using the non-dominant hand is advisable (e.g. the left hand for right handed people) because the skin tends to be a little less callused there. Attach the cables and wrap the tape another time around their clips to ensure a firm contact.

3. You should neither tape the electrodes too firm where you would block blood circulation, nor too weak, letting them slip and move around. Put your hand down onto a comfortable support where it can rest calm and relaxed.
4. Start the application, and have a first glance on the values. If they are below 1µS, the electrical contact through the clip is bad, or your skin is very dry and eventually callused. Check the contact clips or change your hand or the position of the electrodes, if necessary.
5. In comparison with other biofeedback techniques, you will need fewer sessions for a reliable success. 6-10 sessions should be sufficient. To keep focused throughout the entire session you should limit session length to about 15 minutes. If you start feeling tired while training, you should shorten your sessions and practice more often instead.

6. For the interpretation of the measurement we distinguish between “tonic” and “phaseal” effects. The tonic component is the longer-term average of skin conductance and its development during one session. Values for the tonic level can vary between 1 to 15 µS, depending on the individual and the situation. In contrast, rapid changes (fluctutations) of skin conductance, often caused by a sudden stimulus but also appearing spontaneously, are the phaseal component of the skin response. The stimulus causing a phaseal effect can be internal (thoughts, memories, and emotions), or external (images, sounds, and events).
7. In a state of heightened excitation, both the general tonic level and the rate of spontaneous fluctuations is increased. With low excitation and rest comes a lower tonic level and fewer spontaneous fluctuations.
   Example situation for rising excitation:



Example for a consecutive rest phase:



8. **First stage: observe and experiment, determine your initial status**

    a. Record your baseline state for 10 minutes at rest without influencing the measurement. Relax as best as you can and do not watch the measured values, as it would compromise a true baseline measurement.

    b. Have a look at the complete curve and its average tonic level. Does it rise or fall in certain phases, or is the general level constant throughout the measurement? How would your judge your ability to relax during the exercise? Maybe you can already find dependencies between the objective measurement and your subjective feelings of relaxation or excitation? If you find no connection: Don't worry, you surely will during the sessions to come. Keep notes on the general level of the curve and the approximate number of fluctuations per minute in order to know your initial training status. Keep in mind that your daily condition can affect the measurement. **You can send the measured values to your email address using the respective function of the application.**

    c. If you find your skin conductance continuously rising without any reason, you may have attached the electrodes too firmly, making you sweat beneath. At this point, the humidity should be directly noticeable. If necessary, dry your hands and reattach the electrodes with a little more slack.

9. **Second stage: Targeted Biofeedback training with the skin response**

    a. The second stage consists of multiple sessions. These sessions should always follow the following scheme. You shall now exercise conscious relaxation with the feedback signal.

    b. Start the measurement and watch the values for a while. Then try to bring them down through active, conscious intervention. There are many ways to do this, like breathing in a controlled and calm pattern, techniques of muscle relaxation or autosuggestion. The exact way is up to you, your knowledge on relaxation and your will to experiment. The device gives you real-time feedback of even the smallest effects. The training can reduce the tonic level of skin conductance, and the immediate reaction to stimuli.

    c. Both the intensity of a stimulus and its subjective significance will influence the amplitude of the consecutive skin response. The stimulus can be internal in nature (thoughts, memories, and emotions), or external (images, sounds, and events). Inevitably, it will happen to you that you feel unable to relax, for example because of negative thoughts. If you notice a rising skin response as a result, try to bring it down again. Taking a deep breath brings up the skin response as well, so try to bring it down again.

    d. The second stage is about lowering the tonic level of skin conductance, and bringing it down after a stimulus. So you're training to lower your general stress level, as well as your ability calm yourself down after a stressful situation.

10. **<u>Third stage: deliberate provocation, relaxation and stress coping</u>**

    a. We will now actively use stress stimuli (stressors) to improve your ability to deal with them. Because of its immediate feedback and sensitivity, skin response is particularly useful tool to work with direct provocation. It helps to know that the amplitude of the skin reaction is proportional to the intensity of the stressor.

    b. The training begins with a period of rest, so start the measurement and relax for a couple of minutes.

    c. Now a selective stressor should be applied. This can be a certain thought, sound or image with a negative connotation. Almost every person knows certain things or situations that cause distress for him or her. As an example: If you have trouble speaking out loud before a larger group of people, try to imagine the situation and hold a speech before them. Under the influence of such a stressor you are likely to see a surge in skin response. Try to relax to bring it down again and reduce the spontaneous fluctuations.

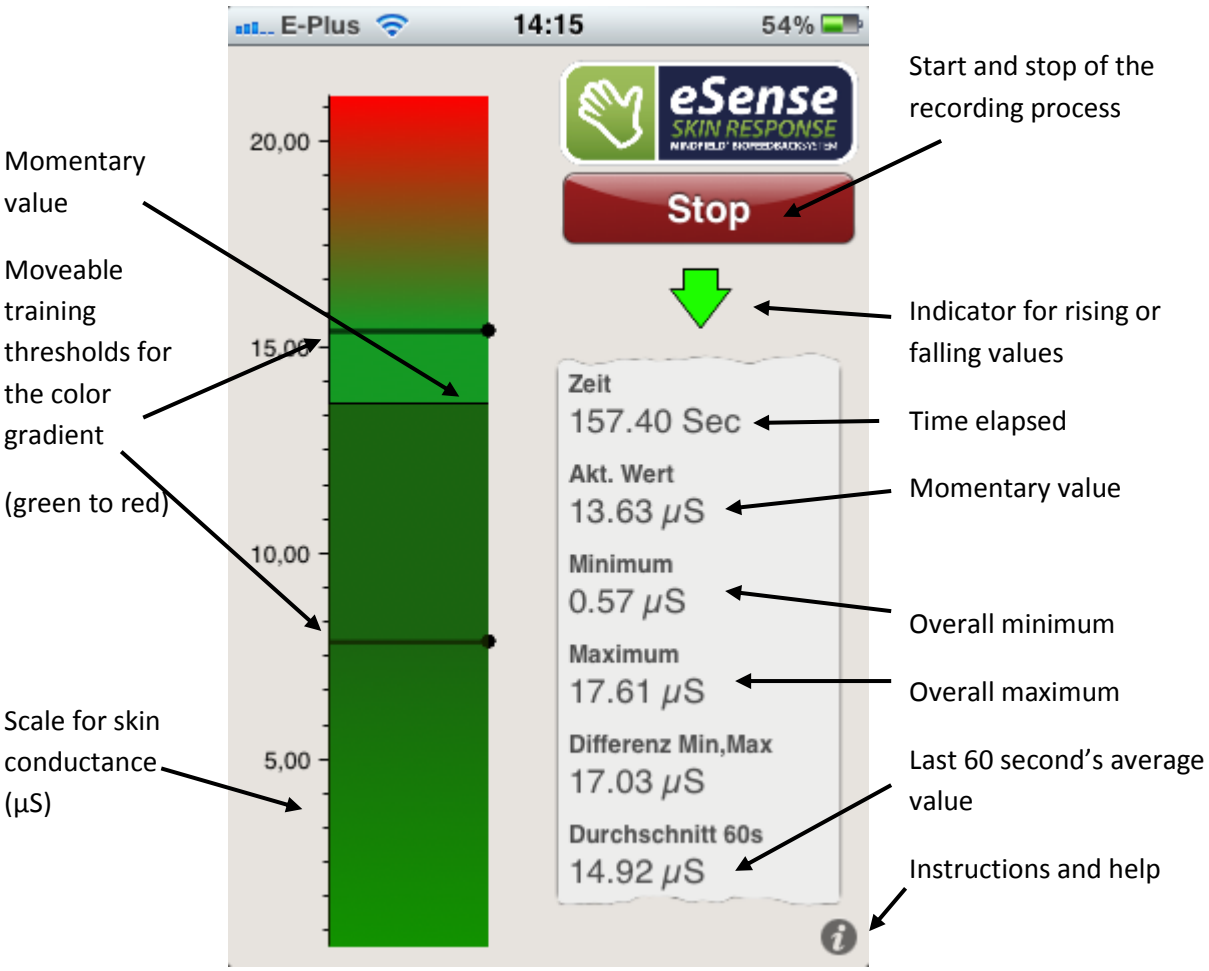
    d. Alternate phases of relaxation and stress stimuli during the session. After three or four rounds you should finish the session with a relaxation phase. Don't overstrain yourself. Perform multiple sessions over a longer period of time, until you have the impression that you stress response is significantly reduced or you recover quicker after a stress situation.

11. **<u>Fourth stage: Transfer, relaxation without feedback</u>**

    a. Now you can check if you can achieve improved relaxation with lower skin response levels and less fluctuations even without feedback. Record a 10-minute baseline without watching the measurement while relaxing as best as you can. Afterwards, compare it to the baseline measurement from the first stage. Your overall level of skin conductance should have dropped, and/or the spontaneous fluctuations should have reduced. Your daily condition can affect the measurement, so repeat it if you feel you had an unusual day.

    a. As a more challenging transfer exercise, exert stress stimuli on yourself like in third stage, but this time without the aid of the feedback. Try to maintain your calm and relaxation, and check afterwards if you succeeded. Have you been able to keep your skin conductance comparatively low and limit the amount of fluctuations, even without the immediate feedback? If you're able to do this, and your baseline has also dropped in comparison to the first stage, you have successfully completed the stress reduction training. When you encounter stress situations in everyday life, recall the training situation, and use your new skills to stay relaxed!

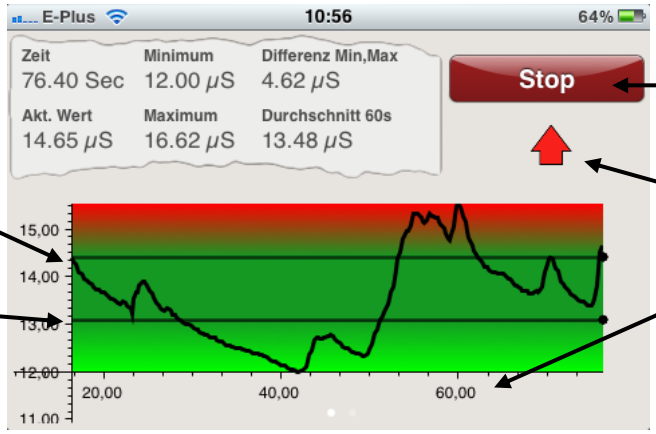
How does the eSense Skin Response App work?



Display on iPhone®/ iPod touch® in vertical format

Same values like in vertical format

Moveable training thresholds for the color gradient (green to red)



Start and stop of the recording

Indicator for rising or falling values

Time scale in seconds

Display on iPhone®/ iPod touch® in horizontal format

Sweep your finger over the display to change between the horizontal format and the animation.

Double tap on the animation to maximize it!

Falling skin conductance keeps the animation going, while rising values will stop it. You want to bring your skin conductance down, so keep the animation going!

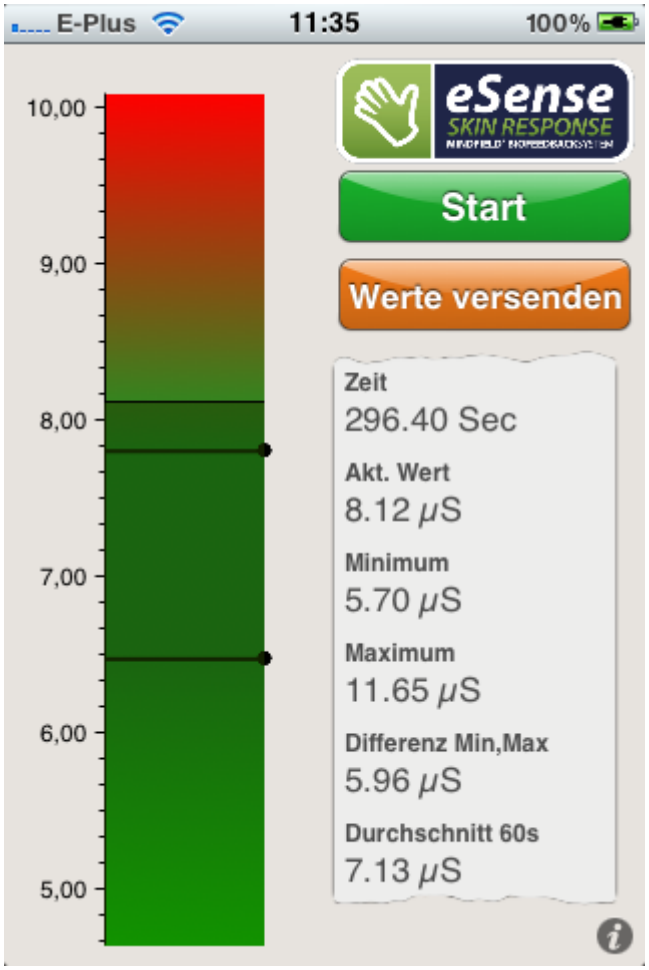
Display on iPhone®/ iPod touch® in horizontal format

Move two fingers together (“pinch”) to shrink the animation to original size!

Tap on Custom Video to choose your own video, an on Default Video to return to the standard video!

After stopping a recording, you can transfer the measured values via e-mail. You need an email account in your iOS for this function.

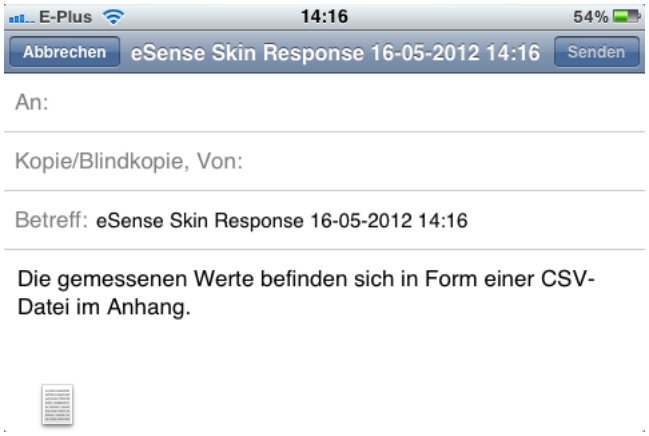
5 values per second are saved to a CSV file where every line is a value, so 5 lines correspond to one second of measurement.



Click on „Werte versenden (send values)“ to send a CSV (comma separated value) file to your personal or any other email.

The file can be processed in Microsoft Excel™ or Open Office.

Exporting the measured values via E-Mail.



If you are using an iPad®, all functions described above are displayed on a single screen. The functionality itself is identical.