# Q-S222 Galvanic Skin Response (GSR) Sensor

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# Table of Contents

### IMPORTANT NOTICE

*The Galvanic Skin Response Sensor described in this manual is for educational and research use only.  It is not to be
used as a clinical or diagnostic tool.*

# Overview of Galvanic Skin Response

Galvanic Skin Response (GSR) is used as an indicator of stress in human subjects. When stressed, subjects perspire more, and this, together with other physiological events, alters skin conductance. This change in conductance is measured by placing electrodes in contact with the skin. This is done most conveniently by attaching electrodes to the fingers, though other body parts, such as the back of the neck, have been used. Unlike in other electrophysiological measurements, no electrode gel should be used between the electrodes and the skin, since this would alter or buffer skin conductivity changes.

**Short-term stress** events may be elicited in response to psychological shocks, such as mentioning the word "spider" to a subject who has an aversion to arachnids, or showing a hypodermic needle to someone with an intense dislike of injections. The responses appear as peaks in the voltage output that occur within seconds of the stimulus being presented. This type of response is most often looked for in polygraph (lie detector) analysis. The response is quite small, appearing as brief peaks in the voltage output. Typical peak sizes are no more than a few hundred millivolts.

The **basal response** measures slower changes in skin conductance that occur with changes in mood. Increased stress or excitement is indicated by a gradual increase in voltage output, whereas relaxation is seen as a gradual decline in voltage output.

With the Qubit Q-S222 GSR sensor, two cables are attached by alligator clips to tab electrodes on two fingers of one hand, and the conductivity of the skin between the electrodes is measured. The second and third fingers or second and fourth fingers of one hand are most commonly used in investigations. The electrodes should be attached with light pressure. The polarity of the electrodes is not important. The 0 to 5 V analog signals from the GSR sensor are recorded by a LabQuest Mini data interface and displayed in Logger Pro software in meters and time graphs. Skin conductance is measured in units of micro Siemens (µS).

The sensor has 2 analog outputs, a high range (40 µS) and a low range (5 µS). The 5 µS output can be offset with a potentiometer to permit high sensitivity measurements over the entire range from 0 to 45 µS.

## Components for use of the Q-S222 GSR Sensor

Q-S222 GSR Sensor
Power supply
A263 Tab Electrodes (pkg. of 100)
C610 LabQuest Mini data acquisition interface (not included)
C901 Logger Pro Data Acquisition Software (not included)
C404 Customized Setup Files (not included)
Manual

## Quick Start Up Steps

1. Load Logger Pro software onto the computer (pg. 9)
2. Load C404 customized files (pg. 9)
3. Connect the power supply to the Q-S222 GSR
4. Connect the 40 µS data cable to analog channel 1 on the LabQuest Mini
5. Connect the 5 µS output data cable to analog channel 2
6. Connect the USB cable between the LabQuest Mini and the computer
7. Turn the 5 µS offset potentiometer on the Q-S222 off (i.e. fully clockwise)
8. Wash the subject's hands with soap. Do not wipe fingers with alcohol since this will dry the skin and alter its conductance. **Electrode gel should not be used** as it will also change skin conductance.
9. Press the sticky tab electrodes onto the finger pads as shown in the photo below.
10. Attach the alligator clips on the input wires of the Q-S222 to the tabs of the electrodes.
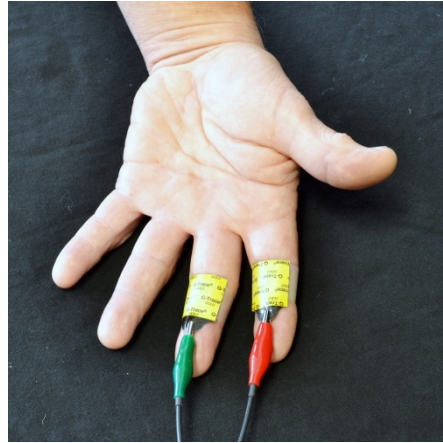
11. Open the "Q-S222 GSR Setup" file to start the Logger Pro software. Note for convenience, a shortcut to this file can be placed on the desktop.

12. A Sensor confirmation screen will open in Logger Pro as shown below. "Connect" the two GSR outputs on channels 1 and 2 of the LabQuest Mini.
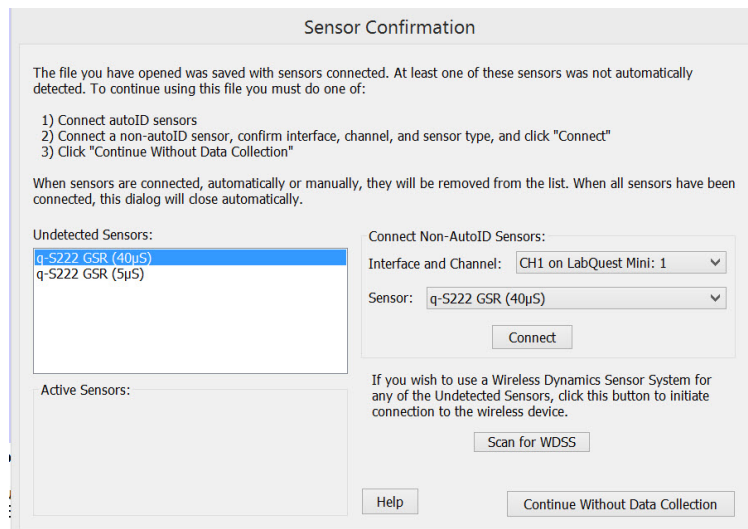


**Note: The q-S222 GSR has been factory calibrated in units of micro Siemens (µS) and does not require further calibration by the user.**

13. Let the subject's hand rest gently on the surface of the bench with the palm facing downwards.

*It is important that the fingers are not moving during an experiment, since changes in electrode contact will greatly affect the signal.*

14. Start data collection by clicking the green button and relax for a few minutes until the signals shown on the graph are stable.
15. Adjust the offset potentiometer for the 5 μS output so that the signal is in the middle of the graph. Further relaxation will now be seen as a reduction in μS output, and excitation will be seen as an increase in the output.

    You are now ready to start the treatment.

16. To test the system, start data collection, and when a stable voltage is attained, exert a pressure with the stomach muscles while keeping the hand still. A transient peak in voltage output should be observed. Alternatively, start data collection with the subject seated in front of the computer with an assistant standing behind the subject. At a time unanticipated by the subject, the assistant should touch the subject on the shoulder, or run a finger against the back of the subject's neck. This should evoke a transient voltage spike irrespective of whether the subject finds the stimulus pleasurable or not.


# Experiments with the GSR Sensor

**The GSR Sensor may be used for a variety of investigations that involve the study of emotional states in test subjects. These include, but are not limited to the following.**

**Rapid Responses**

These responses are transitory responses occurring over a few seconds, and within a few seconds of the onset of the stimulus. Responses are typically small (a few hundred mV) therefore observable in the low range (i.e. sensitive) 5 μS trace. The subject's reaction to various stimuli can be assessed. Examples include:

- Touching the subject unexpectedly. The magnitude of the response should vary depending on the type and location of the touch, as well as with the relationship between the subject and the person applying the stimulus.

- Showing the subject objects that might provoke a response (e.g. pictures of insects, syringes etc.). Bigger responses should be seen in subjects that are completely unaware of the nature of the objects before the experiment starts. As the subject becomes conditioned to the object with repeated exposure the response may decline.

- Asking the subject questions of a provocative nature. It is recommended that caution and sensitivity be observed with respect to the subject's rights to privacy when conducting such investigations. Note that the GSR sensor measures emotional state, and similar responses can be obtained for circumstances that provoke either positive

or negative emotional reactions.  As with polygraph tests, numerous physiological parameters need to be measured (not just GSR) for proper psycho physiological assessments.
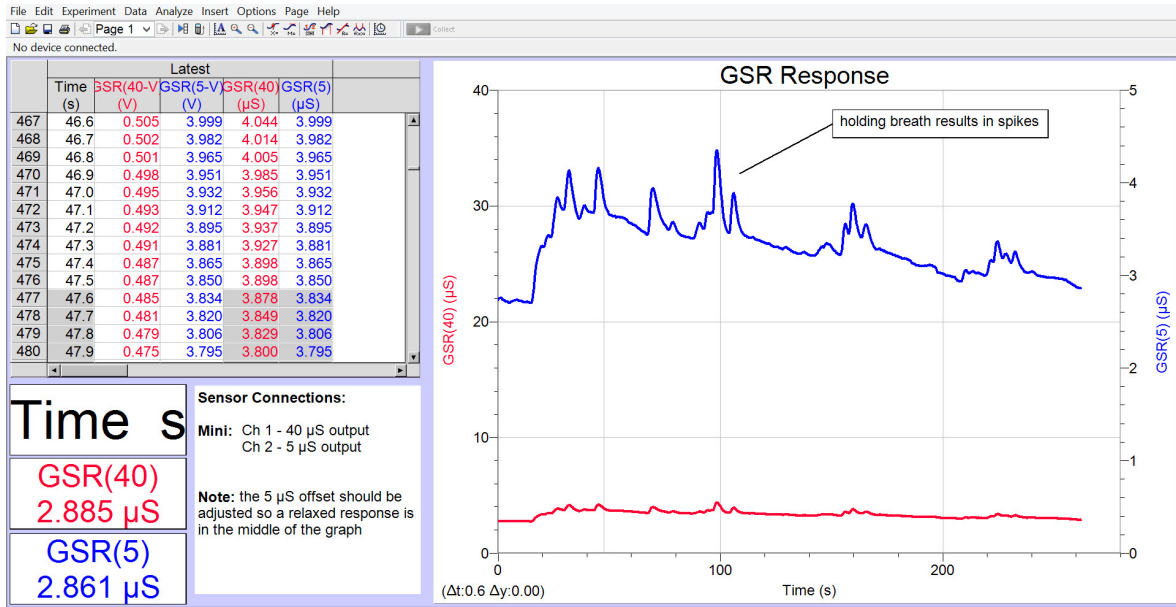
**Note: Channel 3 is free on the LabQuest Mini for recording another physiological signal. Also multiple Minis may be connected to Logger Pro to record more analog (0 to 5 V) signals. Contact Qubit Systems for advice on other physiological sensors (eg. heart rate, skin temperature, blood pressure, EKG/EMG, respiration rate).**

**Basal Responses**

 Basal emotional states do not change rapidly with brief emotional changes such as those elicited by a shock stimulus. The basal response is most often used in biofeedback studies for the control of stress, and also to determine factors that cause emotional excitation or relaxation over the longer term (several minutes rather than a few seconds). Investigations may include biofeedback studies in which the subject uses relaxation techniques to reduce stress. In this case, the subject sets an initial voltage output to represent the starting point, and then attempts to reduce the voltage value consciously by relaxation techniques such as deep breathing, imagery or listening to music or a calming voice. Often, a temporary increase in voltage is observed at the start of the experiment as the subject recognizes the experiment itself as a stress.

The basal GSR output can also be used to assess a subject's response to various images and colours. After a relaxation phase with eyes closed, in which the basal signal declines, the subject is asked to open the eyes and look at an image or a large card of a specific colour. Usually, opening the eyes causes an increase in GSR signal, but the rapidity and degree of the increase is greatly influenced by the image or the colour that is immediately observed. Provocative images cause a rapid increase, and bright red tones cause a more rapid increase than muted green or blue tones.

An example of data obtained by periods of rapid breathing followed by relaxed breathing is shown below.

No device connected.

| | | Latest | | | |
|---|---|---|---|---|---|
| | Time (s) | GSR(40-V) (V) | GSR(5-V) (V) | GSR(40) (µS) | GSR(5) (µS) |
| 467 | 46.6 | 0.505 | 3.999 | 4.044 | 3.999 |
| 468 | 46.7 | 0.502 | 3.982 | 4.014 | 3.982 |
| 469 | 46.8 | 0.501 | 3.965 | 4.005 | 3.965 |
| 470 | 46.9 | 0.498 | 3.951 | 3.985 | 3.951 |
| 471 | 47.0 | 0.495 | 3.932 | 3.956 | 3.932 |
| 472 | 47.1 | 0.493 | 3.912 | 3.947 | 3.912 |
| 473 | 47.2 | 0.492 | 3.895 | 3.937 | 3.895 |
| 474 | 47.3 | 0.491 | 3.881 | 3.927 | 3.881 |
| 475 | 47.4 | 0.487 | 3.865 | 3.898 | 3.865 |
| 476 | 47.5 | 0.487 | 3.850 | 3.898 | 3.850 |
| 477 | 47.6 | 0.485 | 3.834 | 3.878 | 3.834 |
| 478 | 47.7 | 0.481 | 3.820 | 3.849 | 3.820 |
| 479 | 47.8 | 0.479 | 3.806 | 3.829 | 3.806 |
| 480 | 47.9 | 0.475 | 3.795 | 3.800 | 3.795 |

Time s

GSR(40)
2.885 µS

GSR(5)
2.861 µS

**Sensor Connections:**

**Mini:** Ch 1 - 40 µS output
Ch 2 - 5 µS output

**Note:** the 5 µS offset should be adjusted so a relaxed response is in the middle of the graph

GSR Response

holding breath results in spikes

GSR(40) (µS)

GSR(5) (µS)

Time (s)

(Δt:0.6 Δy:0.00)

## Data Acquisition Using the LabQuest Mini Interface

**LabQuest Mini Interface**

The LabQuest Mini interface has 3 analog and 2 digital channels. The interface is connected to the computer (PC or Macintosh) by a USB cable. The interface converts the analog voltages (12 bit A to D) to digital signals which are transmitted to the computer via USB and processed by the Logger Pro software. The green LED indicates that the LabQuest Mini is recognized by the drivers and is ready to collect data.

**Installing and Running Logger Pro 3**

*PC Users:*

(1) To start, a complete copy of Logger Pro 3 must be installed on the computer. Before starting the installation, make sure all USB cables are disconnected from the computer. Failure to do so may cause an error in the installation of the drivers.

(2) Run the installation and do not change the default destination directory. Logger Pro 3 will be installed in C:/Program Files/Vernier Software/Logger Pro 3.

(3) The setup process will automatically load the USB drivers for connecting the LabQuest Mini or other interfaces to the computer.

(4) If QuickTime 6 (or greater) is not installed on the computer, install it when prompted. QuickTime will allow use of the picture and movie features of Logger Pro 3.

(5) You will be prompted to connect the LabQuest Mini or other interfaces to the computer via the USB connection.

(6) Click 'Finish' to complete the installation process.

(7) Proceed to the C404 installation (below) before opening the Logger Pro.

(8) You can start logger pro directly from the experimental file that is located on the C404 disk and can be transferred to user specified location and a shortcut may be created on the desktop for easy access. Double click the "Q-S222 GSR Setup" file.

(9) If Logger Pro detects the LabQuest Mini interface, the Logger Pro screen will appear with a star (icon for LabQuest Mini) in the top left corner.
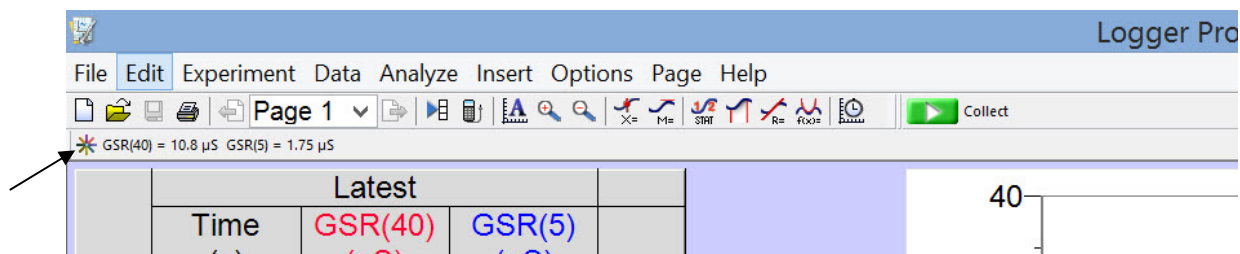


(9) If Logger Pro cannot detect the LabQuest Mini Interface, a message will appear "no device connected". The LED on the Minis should be green. A red LED indicates that power is on (supplied by the computer through the USB) but there is no communication between the interfaces and the computer. In this case, exit the "Q-S222 GSR Setup" file and unplug the USB cable from the computer. Reconnect the USB cable. Allow the computer to recognize the Mini (bell tone) and then re-open the "Q-S222 GSR Setup" file.

**C404 Custom Setup Files:**

Qubit Systems' C404 Custom Ssetup Files CD contains all of Qubit Experiment files (designed by Qubit Systems) including "Q-S222 GSR Setup". The Experiment files contain the setup (i.e. graphs, table, calculations etc) for the various experiments, as well as the

calibration constants for the Qubit sensors. The C404 disk also contains manuals for the different Qubit sensors and packages. These files can be copied to user specified location on the computer and the experimental file of interest for this sensor – "Q-S222 GSR Setup" should be placed in an accessible location or have a shortcut created on the desktop to the file.

**Graph Ranges, Run Time and Data Collection**

To modify the range of the x and y-axes, click on the maximum and/or minimum values and type in the new values.

If you wish to alter the maximum time allotted to your experiment or the rate of data sampling, select "Experiment", then "Data Collection" or click on the clock icon in the top menu.
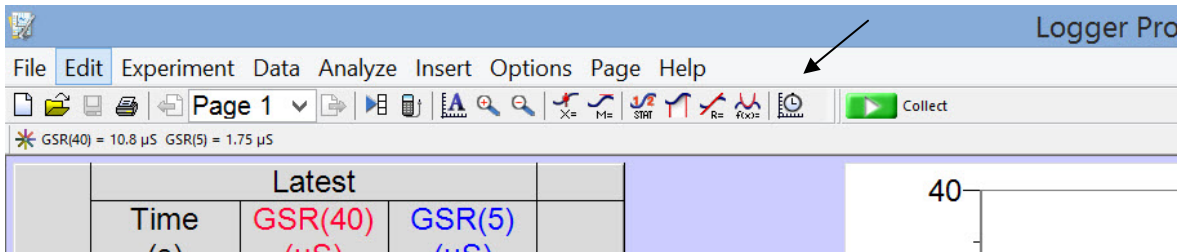


Type in the duration time of your experiment in the box labelled "Duration". **Note that the maximum value you select for the Time-axis limits the time over which you can collect data for a particular run.** If your experiment exceeds the allotted time, select "Experiment", then "Store Latest Run". You may then restart data collection. Data from the first part of your experiment will remain on the screen as a faint trace and new data will be plotted in a bolded shade of the same colour. You can collect numerous runs in this way. Each run will be collected to a separate data table. When you save your data, all of the runs will be saved under the same file name.
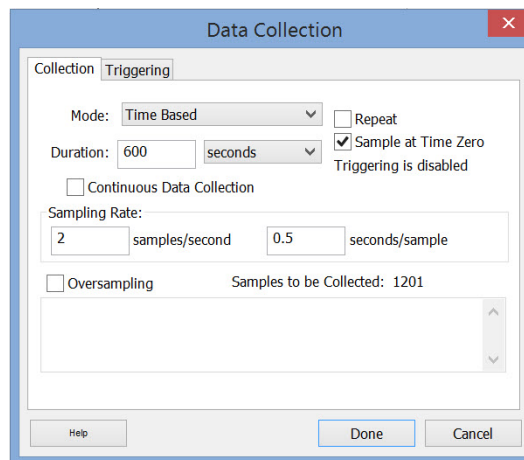
You may also alter the "Sampling Rate" at which you collect data.  The default rate for GSR is 10 samples/s. To start data collection, click on the "Collect" green icon above the graphs.  This will change to a "Stop" red icon.  Click on the "Stop" icon to stop data collection.

**Data Analysis with Logger Pro 3**

(1)   Position the cursor at the beginning of the data set that you wish to analyze, then click and hold with the mouse.

(2)   Drag the cursor across the data set and unclick.  A greyed box will appear on the screen to show the data range to be analyzed.

(3)   Select "Analyze", and then choose from a wide variety of analysis options.  For example, use:

- "Examine" to scroll through the data points at specific time intervals.
- "Integral" to integrate the selected data.
- "Statistics" to automatically perform a variety of statistical analyses.

You can also fit curves and tangents to the selected data by choosing the appropriate menu option. Note the analysis functions can also be accessed from icons in the menu.

**Specifications of Q-S222 GSR Sensor**

- Power Supply: 9V, 560mA
- Units:  (uS) uSiemens
- Resolution: 40uS Range = 0.0097uS, 5uS Range = 0.0012uS
- Accuracy: 0.5% for Full Scale, or better
- Range: 40uS and 5uS
- Offset: 5uS Range can be offset from 0 to 40 uS
- Gain: System Gain is 1980 and 15840 for 40uS and 5uS
- Cut-off Frequency fc High= 7.2 Hz
- Patient Isolation: 1500Vrms
- Size (h/w/l) cm: 2.8/6.2/9.2
- Weight (g): 200
- Materials: plastic (black)
- Warranty: 1 years

## Qubit Systems Warranty Information

QUBIT warrants all its instruments to be free from defects in materials or workmanship for a period of **one year** from the date of invoice/shipment from QUBIT.

If at any time within this warranty period the instrument does not function as warranted, return it and QUBIT will repair or replace it at no charge. The customer is responsible for shipping and insurance charges (for the full product value) to QUBIT.   QUBIT is responsible for shipping and insurance on return of the instrument to the customer.

No warranty will apply to any instrument that has been (i) modified, altered, or repaired by persons unauthorized by QUBIT; (ii) subjected to misuse, negligence, or accident; (iii) connected, installed, adjusted, or used otherwise than in accordance with the instructions supplied by QUBIT.

The warranty is return-to-base only, and does not include on-site repair charges such as labour, travel, or other expenses associated with the repair or installation of replacement parts at the customer's site. QUBIT repairs or replaces the faulty instruments as quickly as possible; maximum time is one month. QUBIT will keep spare parts or their adequate substitutes for a period of at least five years.

Returned instruments must be packaged sufficiently so as not to assume any transit damage. If damage is caused due to insufficient packaging, the instrument will be treated as an out-of-warranty repair and charged as such.

QUBIT also offers out-of-warranty repairs. These are usually returned to the customer on a cash-on-delivery basis.  Wear & Tear Items are excluded from this warranty. The term Wear & Tear denotes the damage that naturally and inevitably occurs as a result of normal use or aging even when an item is used competently and with care and proper maintenance.

## Return Procedure

Before returning any instrument to QUBIT:

Consult the operating manual or contact Qubit to ensure that the instrument(s) is in fact faulty and has not just been set up improperly.

Contact QUBIT before sending anything back.  We will issue an RMA number and provide shipping instructions.   QUBIT will refuse any goods that are returned without an RMA number, or which are sent in a manner outside of QUBIT'S  stipulations.

If you have encountered a program failure, we need a printed copy of any faults you have seen, including how to reproduce them.  Include these in the return package along with your mailing address.

Include a copy of the Invoice on which the product was shipped to you.

All returns must be shipped prepaid.  Unpaid packages will not be accepted.

In case of questions contact QUBIT by

E-mail: info@qubitsystems.com,

 by phone: (01)-613 384 1977,

or by fax: (01)-613 384- 9118.