BRAIN PRODUCTS
Solutions for neurophysiological research

GSR-MR Module
Operating Instructions

Version 005

valid as of May 2, 2016*

BRAINVISION
professional GSR MR

* Valid until publication of a new version of the operating instructions

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Contents

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About these Operating Instructions

These Operating Instructions describe the GSR-MR Module.

The Operating Instructions are a component of the device and its accessories supplied by Brain Products GmbH. They must be precisely adhered to in order to ensure that the device is used as intended and operated correctly and to guarantee the concomitant safety of test subjects, users and third parties. Make sure that these Operating Instructions are always available to users.

The structure of the Operating Instructions

The Operating Instructions have five chapters:

- Chapter 1 contains stipulations on how to perform combined EEG-fMRI measurements safely with the GSR-MR Module.
- Chapter 2 provides information about how to configure the Recorder workspace for the use of the GSR-MR Module.
- Chapter 3 describes how you must install the system's hardware components.
- Chapter 4 contains notes on the maintenance, cleaning and disposal of the device.
- Chapter 5 contains the terms of the warranty.

Target group of the Operating Instructions

The Operating Instructions are intended for users in the psychological and neurophysiological research area as well as physicians and medical experts. If the GSR-MR Module is to be used in an MR environment, knowledge of how to perform MR measurements safely is vital.

Conventions used in the Operating Instructions

The Operating Instructions use the following typographical conventions:

Italic — Italic text is used to identify menus, menu commands, dialog boxes, options, the names of files and folders and the labels on the devices. Italic font is also used to highlight portions of running text.

Underscore — Underscored text indicates a cross-reference or a web address.

● — The blue dot indicates the end of a chapter.

The Operating Instructions also use the following symbols to help you find your way around:

 The *Personal injury* symbol indicates that incorrect use of the devices may result in a health hazard to the test subject, the user and/or a third-party. Incorrect use means non-adherence to the stipulations set out in these Operating Instructions.

 The *Damage to property* symbol indicates that the incorrect use of the devices may bring about a risk of damage to property.

 The *Stop* symbol indicates that you should not carry out a particular action.

 A *note* draws your attention to important (technical) information.

 A *cross-reference* refers to a section of these instructions or an external document that has a bearing on the running text at this point.

 A *tip* gives you advice, recommends a particular approach or draws your attention to an interesting aspect.

The *New* symbol indicates that new material has been added at this point.

Revision history

Page	Status	Subject
43	modified	Product identification (CE marking)

Reporting errors and support

We would ask you to report without delay any error you find in this document, any fault on the products or any malfunction that you observe when using this product. To do so, please contact your local dealer, who will also assist you in general questions about the product.

Preface

Skin resistance is an extremely informative indicator of consciousness and emotional states such as stress or pain. For decades, the measurement of skin resistance has been one of the most frequently employed procedures in the field of psychophysiological research and is also used as a psychiatric research method.

Our GSR-MR Module has been specially developed for combined EEG-fMRI measurements in MR scanners. As part of our MR product line, it is used in combination with the BrainAmp ExG MR amplifier and the ExG AUX Box.

The GSR-MR Module converts the electric conductance of the skin to a voltage recorded by a bipolar amplifier input. It is used together with skin electrodes that are brought into contact with the test subject. The contact between the electrodes and the skin of the test subject is established by means of a special gel. Use with invasive and subcutaneous electrodes is prohibited.

The GSR-MR Module is compact, optimally shielded against the influence of the strong electromagnetic fields that develop in MR scanners and, thanks to its high level of common-mode rejection, guarantees top-quality data. It also offers a very high level of safety and ensures that the test subject remains perfectly comfortable.

Intended use

As of September 30th, 2013 the GSR-MR Module is not a medical device anymore and may be used in the context of non-medical applications in order to carry out fundamental or applied research on the basis of neurophysiological methodology and data.

Use of the GSR-MR Module for diagnosis, therapy, monitoring of vital physiological processes (such as cardiovascular functions etc.) or other medical purposes is expressly forbidden.

The GSR-MR Module is intended to be used for acquiring and transmitting changes in skin resistance.

Correct Use

The GSR-MR Module is permitted to be used by users in the psychological and neurophysiological research area as well as physicians and medical experts.

The GSR-MR Module is not permitted to be used by

- unqualified persons (e.g. laymen),
- persons who cannot read (e.g. due to visual impairment) or understand (e.g. due to a lack of language skills) the Operating Instructions.

The GSR-MR Module can be used to record neuro-/electrophysiological signals from healthy and sick adults, children and animals.

The use of the GSR-MR Module for medical purposes is not permitted.

The GSR-MR Module is permitted to be used in the following environments: Research institutes, and other non-medical environments (e.g. at home), hospitals, clinics and other medical environments, provided that all the other stipulations regarding correct use are met and that the devices are used in accordance with its intended use.

The GSR-MR Module is not permitted to be used in the following environments:

- vicinity of explosive gases as may be the case in operating theaters, for example,
- oxygen enriched atmospheres.

The user is solely liable for any risks to test subjects associated with the investigation, if the device is not used in accordance with the correct use.

All versions of GSR-MR Module that have been released into the market as medical products do remain medical products. Brain Products will continue to treat them as medical products (i.e. to perform post market surveillance, for example) until the end of their service life.

The user should however be aware that if a former GSR-MR Module version that was a medical device is replaced by a newer version that is not a medical device anymore, the terms and conditions of the new GSR-MR Module version are effective only from then on.

Use together with other products and components

The GSR-MR Module is permitted by Brain Products to be combined with the following product families:

Product	Manufacturer
BrainVision Recorder	Brain Products GmbH
BrainAmp ExG MR amplifiers	Brain Products GmbH
GSR-MR electrodes (Ag/AgCl)	EasyCap GmbH
ExG AUX Box	EasyCap GmbH
Electrode Gel for GSR	Discount Disposables

Beside this general statement about permitted product combinations, the user must check, if all stipulations of each product (e.g. regarding its MR compatibility) are fulfilled for the specific combination and purpose of application (i.e. intended use and correct use).

Chapter 1 Safety considerations when using the GSR-MR Module

The GSR-MR Module is a part of our MR product line and is subject to the same safety regulations and restrictions on use as all the other components of the BrainAmp MR amplifier system. You will find more detailed safety information in the Operating Instructions for the BrainAmp MR series of amplifiers. The most recent version of these instructions is available for download from our Web site at http://brainproducts.com/downloads.php?kid=5&tab=1.

Read the following safety information carefully. It will help prevent personal injury and damage to property. The manufacturer shall not be liable in the event of any failure to observe the safety information set out below.

There are a number of hazards of a general nature associated with the operation of MR scanners. These hazards are described in the MR scanner documentation. In combination with other physiological measurements (such as GSR), a number of specific safety aspects have to be taken into account. These Operating Instructions deal only with these specific aspects. It is therefore essential that you also read the safety information provided by the manufacturer of the MR scanner.

We assume that users know how to record psychophysiological signals and work with MR scanners safely and that they know enough physics to be able to carry out reliable combined EEG-fMRI measurements.

1.1 General safety information

Use the GSR-MR Module only in combination with the BrainAmp ExG MR amplifier and the ExG AUX Box. These devices offer electrical isolation and can be used in MR scanners.

Only use the GSR-MR Module and its accessories in the environment for which it is intended and in accordance with its intended use.

The GSR-MR Module is licensed for use in MR environments up to 4T.

It is possible to use it outside MR environments, and it is effective for test measurements to establish experimental paradigms.

Under no circumstances should you do any of the following:

- Never open the device.
- Do not repair the device yourself.
- Do not connect the device to electrical connections which are not compliant with the relevant standards.
- Avoid exposure to direct sunlight, high levels of humidity or liquids.
- **Do not use the GSR-MR Module together with a defibrillator.**

Personal injury

1.2 MR sequences

For more detailed information on the safe use of MR sequences, see the Operating Instructions for the BrainAmp MR series of amplifiers. These are available for download from our Web site under the link http://www.brainproducts.com/downloads.php?kid=5&tab=1.

Only use the GSR-MR Module to acquire data during functional MR sequences (fMRI). Only use the echo planar imaging sequences (EPI sequences) provided by the manufacturer as standard. These have no more than one activation pulse ("single shot EPI"). Only use sequences with an inherently low SAR if you wish to perform a structural scan. These include: Magnetization Prepared Gradient Echo (MP-RAGE/Siemens, TFE/Philips, FSPGR/General Electric) and Spoiled Gradient Echo (FLASH/Siemens, T1-FFE/Philips, SPGR/General Electric).

Personal injury

Never use sequences with multiple activation pulses – particularly not sequences with inverting activation pulses. Using these sequences can cause painful burns and lasting injury to test subjects.

Gradient echo field mapping (localizer, scout) is permissible before the beginning of functional measurement. If you have any queries about other sequences, contact the manufacturer of the MR scanner directly.

1.3 Protection of test subjects, users and third parties

Ensure that there are no loops or kinks in the feed lines and electrode cables. Keep cables straight and taut.

Ensure that the test subject does not come into contact with the cables (ribbon cable, power-supply cable, 5-pin connecting cable for connecting the GSR-MR Module, electrode cables; see also Figure 3-1 on page 28 and Figure 3-2 on page 29). The electrode cables must always be fed through the spiral hose.

Use only the cables and electrodes provided.

Always explain to the test subjects that it is theoretically possible for the electrodes and cables to heat up.

Ensure that test subjects can always make themselves heard to the person running the experiment and have some other means of attracting attention such as a bell or alarm.

In extremely rare cases, the electrode materials or electrolyte gel can cause skin irritations. Skin irritations become noticeable when burning, itching sensations occur. In such cases, stop using the device and carefully remove the electrodes and all remaining gel.

If a test subject reports feeling this kind of discomfort, always have the subject medically examined immediately and, if necessary, ensure that the subject receives appropriate care.

Inform Brain Products GmbH immediately to clarify the exact circumstances in which the discomfort occurred and prevent the same thing from happening in the future. You will find the contact details for our technical support team on page 11 of these instructions.

Chapter 2 Configuring BrainVision Recorder

BrainVision Recorder supports the GSR-MR Module from Version 1.10. In order to obtain correct electric conductance values in µS when carrying out measurements using the GSR-MR Module, you have to:

- Convert the output voltage of the GSR-MR Module from mV to µS.
- Compensate the series resistances of the skin electrodes (5 kOhm per electrode).

To do this, you must make various settings in the Recorder workspace. These are described below. You will find detailed information on setting up a workspace in the Recorder in the associated User Manual.

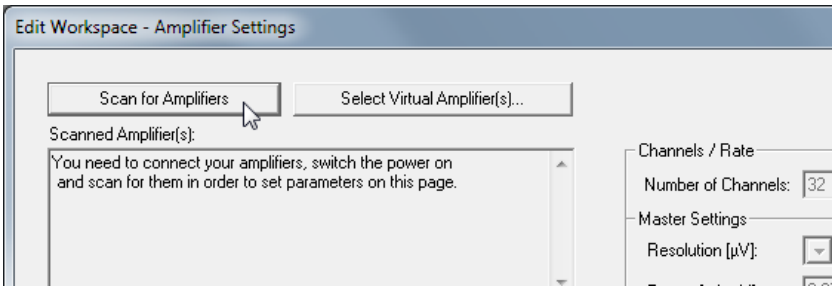
Make sure that the most recent version of the Recorder is installed on your computer. If you need it, the most recent version can be downloaded from our Web site under the link http://www.brainproducts.com/downloads.php?kid=2.

2.1 Setting up a GSR-MR channel

Proceed as follows to set up a GSR-MR channel:

1. On the Recorder menu bar, choose *File › New Workspace*. A dialog box appears.
2. Once you have made the settings you require on the first page of the dialog, you proceed to the *New Workspace - Amplifier Settings* page of the dialog.
3. Click the *Scan for Amplifiers* button on this page (see Figure 2-1).

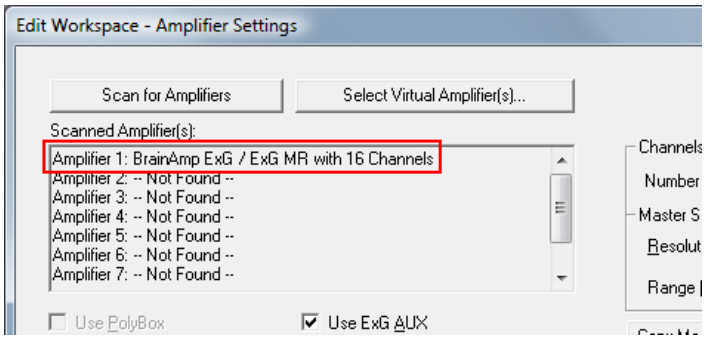
Figure 2-1. BrainVision Recorder, selecting the amplifier



4. The connected amplifier is displayed in the *Scanned Amplifier(s)* text box (see Figure 2-2).

   If you are using more than one amplifier (a BrainAmp MR together with the BrainAmp ExG MR, for example), you must connect the amplifiers in such a way that the BrainAmp ExG MR **always appears at the end** of the *Scanned Amplifier(s)* list. If you do not do so, a warning message will be issued.

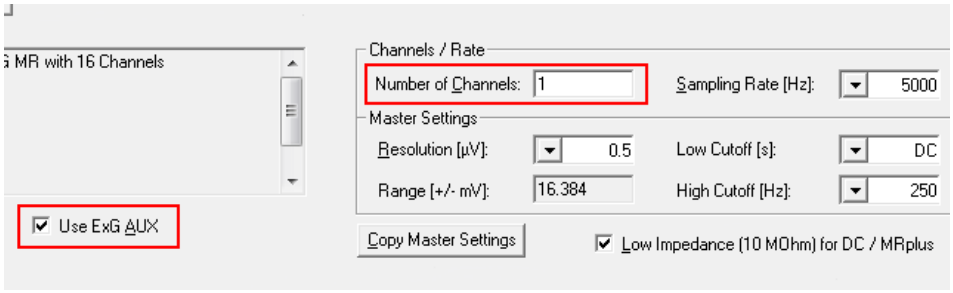
Figure 2-2. Displaying the connected amplifier in the Recorder



5 Enter the total number of channels required in the *Number of Channels* text box.

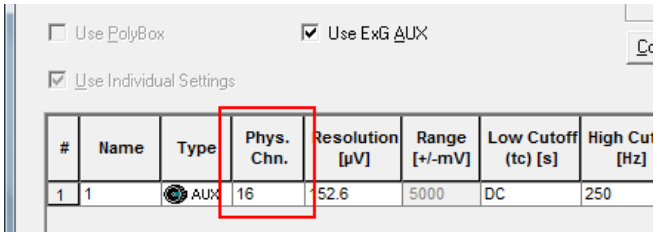
Checking the *Use ExG AUX* box activates sensor support (unit conversion) for the BrainAmp ExG MR channels. The resolution specified under *Master Settings* is deactivated for the ExG AUX Box channels, and DC mode is activated for all AUX channels (see Figure 2-3).

Figure 2-3. Activating the ExG AUX Box and specifying the number of channels



6 In the *Phys. Chn.* column of the channel table, specify the slot for the GSR-MR channel in the ExG AUX Box. In our example, this is slot 16 (see Figure 2-4).

Figure 2-4. Specifying the sensor slot



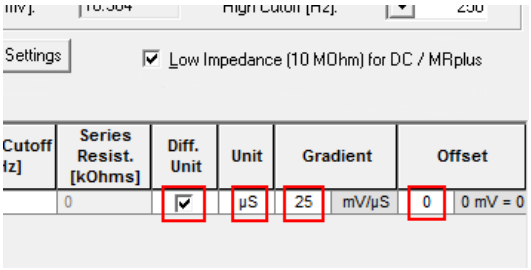
For the high cut-off filter you should generally select 250 Hz for measurements in MR environments. The sampling rate should be 5 kHz.

2.2 Converting the sensor output voltage

To convert the output voltage of the GSR-MR Module from mV to µS, check the *Diff. Unit* box for the selected channel. The *Unit*, *Gradient* and *Offset* cells are now accessible (see Figure 2-5). Make the settings in these cells on the basis of typical sensor properties:

- *Gradient* = 25 mV/µS
- *Offset* = 0 mV

Figure 2-5. Defining the conversion parameters



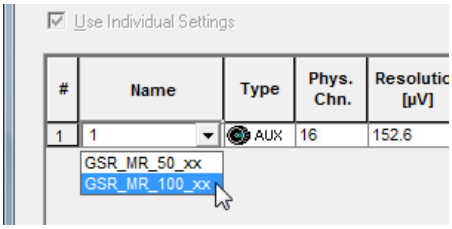
2.3 Correcting the series resistances

You activate the correction of the series resistances of the skin electrodes by clicking the name of the corresponding channel in the *Name* column of the channel table.

The arrow of a drop-down list appears in the corresponding cell. In the drop-down list, choose the entry *GSR_MR_100_xx* (see Figure 2-6).

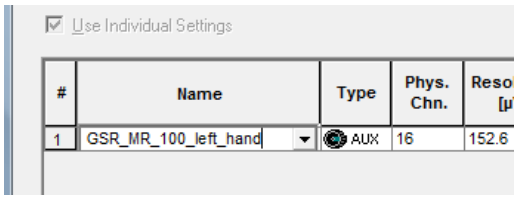
The correction of the series resistances of 5 kOhm will not be error-free unless the channel name is preceded by the prefix *GSR_MR_100*.

Figure 2-6. Choosing the name prefix "GSR_MR_100"



You can now modify the ending of the channel name as you wish: You can replace *_xx* with an ending of your choice such as, for example, *_left*, *_right*, etc. (see Figure 2-7).

Figure 2-7. Modifying the channel name (ending)



Conclude the configuration of the workspace as indicated in the Recorder User Manual. In the *Software Filters* dialog box, ensure that the *Raw Data Saving Filters* check box is cleared (see Figure 2-8).

Figure 2-8. Deactivating software filters for the raw data to be saved

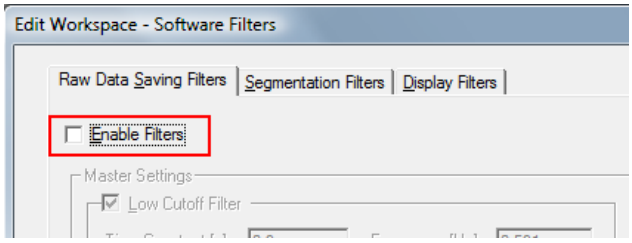
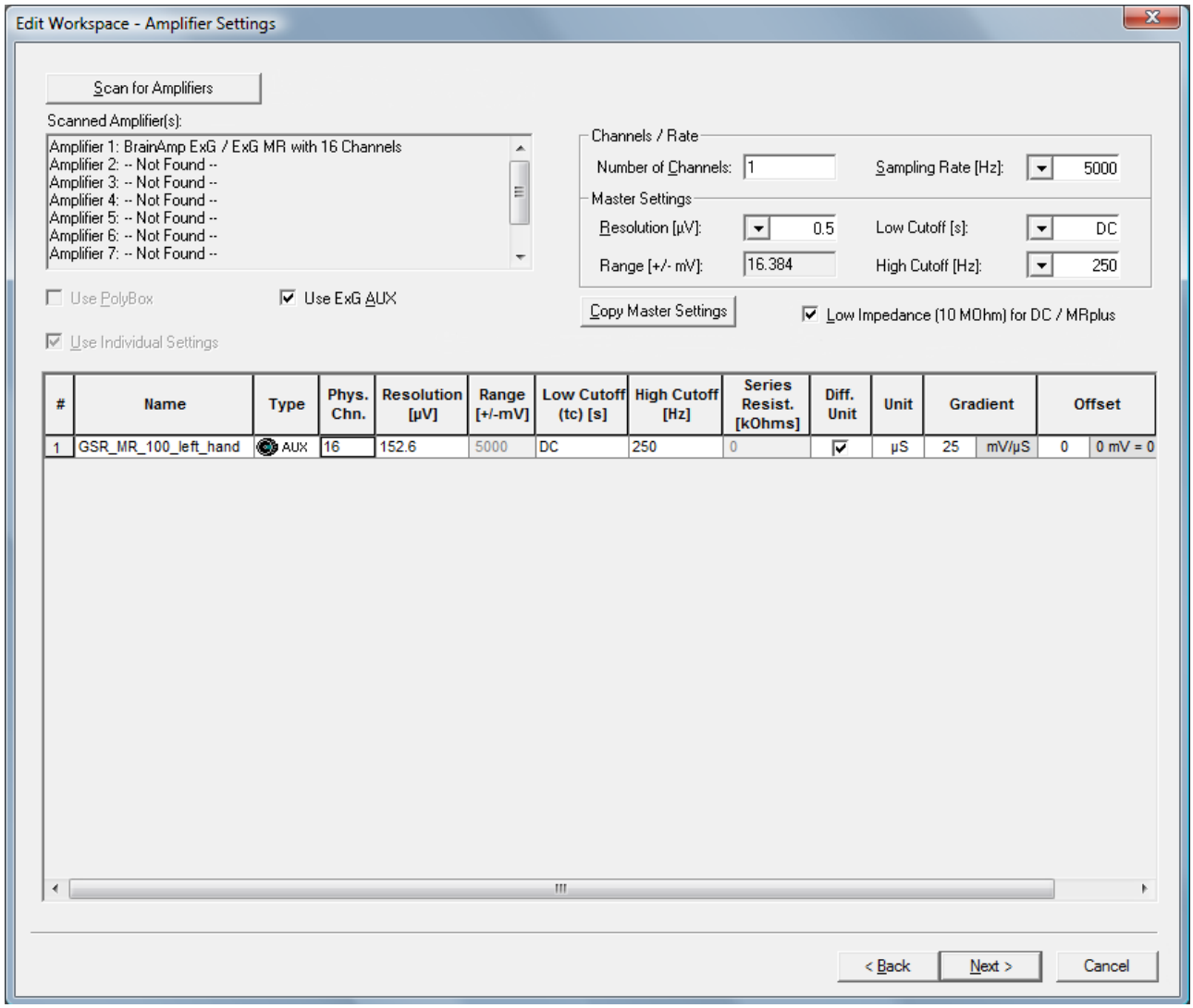


Figure 2-9 summarizes the settings that you have to make for the workspace here.

Figure 2-9. Workspace dialog with the settings that have to be made



Chapter 3 Installing the hardware components

Before you begin to use the GSR-MR Module in the MR scanner, we recommend that you always carry out several test measurements on the test subject in accordance with your experimental paradigm outside the MR environment. Familiarize yourself with the signals that are expected as well as with how to install the devices and how to position and attach the electrodes.

Note that it is considerably easier to analyze the signals if you use a volume trigger and the SyncBox. The SyncBox is used to synchronize the clock cycle of MR data acquisition by the BrainAmp ExG with the clock cycle that controls the MR scanner's gradient switching system. The aim is to ensure the stability of GSR recording during MR data acquisition by means of phase synchronicity between the two clock systems. For more detailed information on this subject, see the Operating Instructions for the BrainAmp MR series of amplifiers.

3.1 Installing the BrainAmp ExG MR, attachments and the GSR-MR Module

For more information on the connections on the GSR-MR Module, see Appendix B.

You will find detailed information on the installation and operation of the BrainAmp ExG MR, ExG AUX Box and PowerPack in the Operating Instructions for the BrainAmp MR series of amplifiers.

Ensure that no loops are formed in the feed lines or electrode cables. **Keep cables straight and taut.**

Only use the supplied connecting cables and electrodes because only these guarantee the highest possible level of safety and optimum signal quality.

Take note of Figure 3-1 and Figure 3-2 during the installation and proceed as follows:

1. Place the BrainAmp ExG MR and PowerPack at the foot end of the scanner table. Long conduction paths along the main field lines are thus avoided.
2. Connect the 5.6 V DC output on the PowerPack (2) to the PowerSupply Adapter of the BrainAmp ExG MR (1) using the PowerPack connecting cable (3).
3. Connect the BrainAmp ExG MR (1) and the ExG AUX Box (6) using the 30 cm ribbon cable (4) and the 30 cm power supply cable (5).

   Only use the connecting cables provided. On no account use any longer cables that you may already have.

   Personal injury
4. Connect one end of the 5-pin connecting cable (7) to an AUX channel at the ExG AUX Box (6).
5. Connect the other end of the 5-pin connecting cable (7) to the amplifier side of the GSR-MR Module (8).
6. Apply the electrodes (9) to the test subject (see also Section 3.2 as of page 29).
7. Connect the electrodes (9) to the test subject side of the GSR-MR Module (8).

Figure 3-1 and Figure 3-2 depict the following devices:

1 BrainAmp ExG MR 16

2 PowerPack

3 PowerPack connecting cable

4 Ribbon cable

5 Power supply cable

6 ExG AUX Box

7 5-pin connecting cable

8 GSR-MR Module

9 GSR-MR electrodes

Figure 3-1. Top view of installation

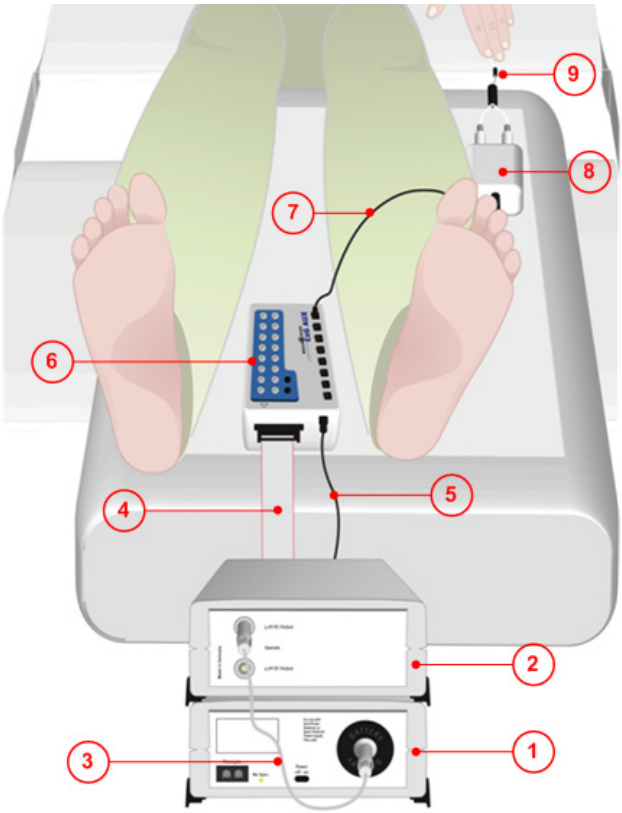
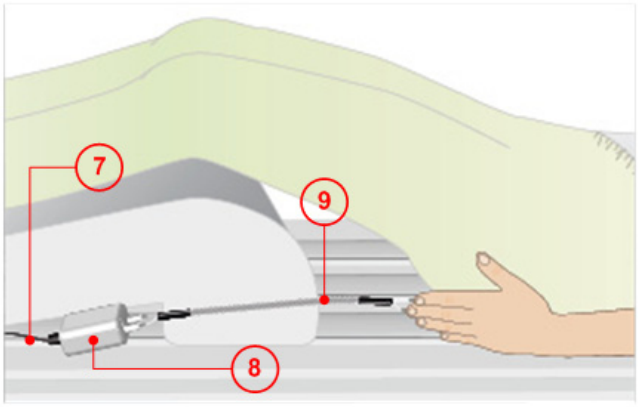


Figure 3-2. Side view of installation



3.2 Applying the GSR-MR electrodes

GSR measurements are usually carried out on the non-dominant hand. Ensure that the other hand of the test subject remains free and that the test subject is not restricted from using the alarm bell.

Apply the electrodes only to the test subject's hand. Do not apply the electrodes to other parts of the body, invasively or subcutaneously.

Personal injury

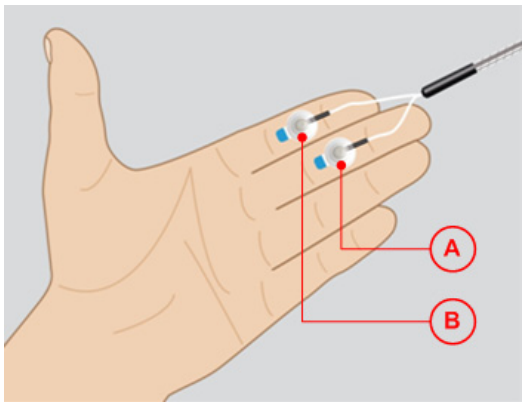
Note Figure 3-3 when applying the GSR-MR electrodes, and proceed as follows:

1. Make sure that the GSR-MR electrodes are dry.
2. Ensure that the test subject's skin is clean.

   However, do not clean the skin too intensively using soap, a brush or alcohol, because this can corrupt the results of the measurements.

   Ensure that the test subject's hands are well supplied with blood and warm. If the test subject has cold hands, this reduces the quality of the measured data.
3. Fill the concave (hollow) side of the electrodes with the supplied GSR electrode gel. **EEG electrode gel is not suitable for GSR measurements.**
4. Use the adhesive rings provided to attach the electrodes to the palm side of the middle phalanx of the index finger (A) and middle finger (B) as indicated in Figure 3-3.

Figure 3-3. Positioning of the electrodes on the non-dominant hand



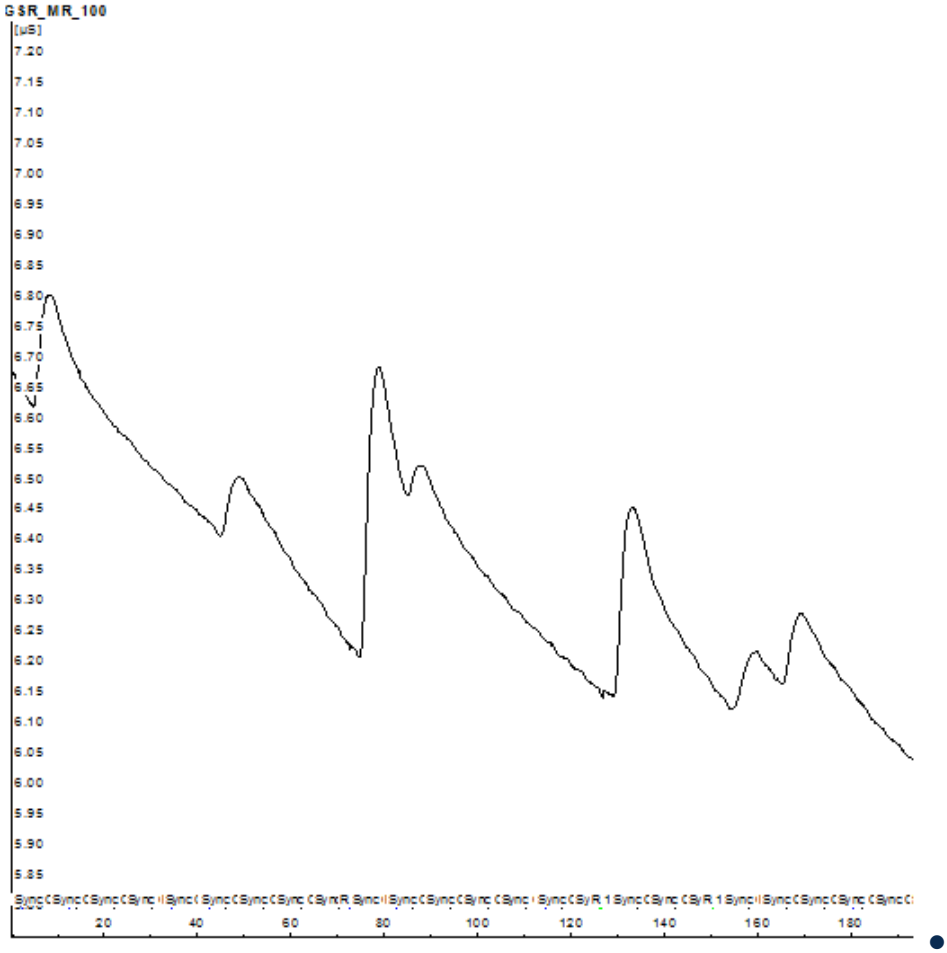
5 Before you finish your preparations and leave the scanner table in its final position, check the functioning of the intercom and alarm bell once more.

On completion of the installation of all components and before the MR scan, we recommend that you carry out a final functional check to make sure the GSR-MR electrodes are not dislocated. The Recorder should be in Monitoring mode.

Make sure that the test subject is relaxed before the measurement is carried out. After several minutes of relaxation, the values measured should be distributed around a reliable baseline. Make sure that the test subject is lying quietly and does not move her hand during measurement. This prevents artifacts from occurring.

The spontaneous fluctuations of the GSR signal should be visible (see Figure 3-4). To provoke deflections of the GSR signal, you can ask the test subject to perform a Vasalva maneuver (forcible exhalation against a closed airway).

Figure 3-4. Example of a GSR curve during laser stimulation, Siemens 3T TIM Trio



Chapter 4 Maintenance, cleaning and disposal

4.1 Maintenance

The GSR-MR Module is maintenance-free.

4.2 Cleaning

Before you clean the GSR-MR Module, disconnect it from the test subject and its attachments.

Clean the GSR-MR Module, electrodes and lines only with a soft, damp cloth.

Ensure that the device, connectors and sockets do not come into contact with moisture.

Dry the GSR-MR Module carefully with a cloth after cleaning it.

Never clean the GSR-MR Module with rubbing alcohol or other such aggressive cleaning agents.

Damage to property

Do not treat the module with chlorine or sterilize it.

Damage to property

If any of the pins are soiled or bent, return the GSR-MR Module to Brain Products.

4.3 Disposal

As soon as the device, accessories and cables have reached the end of their service life, dispose of them in accordance with the relevant national regulations. In Germany, for example, the legislation governing electrical and electronic equipment (known as the ElektroG) is applicable. In the EU and EFTA, the WEEE Directive 2002/96/EC on Waste Electrical and Electronic Equipment applies.

Do not dispose of your devices, accessories and cables with ordinary household waste.

Subject to the provision that only original equipment supplied by Brain Products is involved, Brain Products will accept return of the equipment and handle disposal on request.

Chapter 5 Terms of warranty

Guarantee

Brain Products GmbH provides the statutory guarantees for the GSR-MR Module and its attachments.

In Germany, a statutory minimum guarantee period applies for accessory components which are not explicitly listed here.

Warranty

Brain Products GmbH provides a warranty of 36 months as of the date of purchase in respect of all devices labeled with a Brain Products serial number.

Exclusion from warranty

The power and connection cables provided, the GSR-MR electrodes, the consumables (batteries) and the BrainCap (MR) are excluded from the manufacturer's warranty.

Hardware and software upgrades are also not included in the warranty.

The warranty does not extend to any collateral or consecutive loss or damage of whatsoever nature and/or any costs resulting from a defect or functional impairment (e.g. data loss).

Warranty claims expire in the following cases:

- In the event of loss or damage due to the failure to exercise due care and attention and the use of the products other than for their intended purpose.

  This includes loss or damage caused by sand, dust, falling, impact, pressure, severe vibrations, external wear, overload, extreme heat or cold, excessive humidity, moisture or liquids of whatever nature, unstable power supply, incorrect transport, leaked batteries, insufficient packaging on dispatch.

- In the event of interventions, modifications, changes, repairs and any other work of whatsoever type performed on the products by a person not authorized by the manufacturer.

- If accessories or consumables other than OEM parts are used.

- In the event of a failure to observe the current Operating Instructions.

Appendix A Product identification information

Product designation:	BrainVision GSR-MR Module BrainVision Galvanic Skin Response Module for use in MR scanners
Manufacturer:	Brain Products GmbH Zeppelinstraße 7 D-82205 Gilching (Munich) Phone: +49 8105 73384 – 0 Fax: +49 8105 73384 – 505 Web site: http://www.brainproducts.com Email: techsup@brainproducts.com
EMC testing:	According to IEC 60601-1-2:2007
Electrical testing:	According to IEC 60601 (2nd ed.)
Accessories:	5-pin connecting cable to connect the GSR-MR Module, Adhesive rings

Appendix B Technical data

Supply voltage:	± 5 V DC
Power consumption:	‹ 0.5 mA
Measuring principle:	Constant voltage, 0.5 V
Measuring range:	1 to 100 µS
Resolution:	0.2 nS
Absolute error:	‹ 2 µS
Total electrode resistance:	10 kOhm
Dimensions (H x W x D):	22 x 30 x 45 mm
Weight:	20 g

Connectors on the GSR-MR Module

The input/output of the GSR-MR Module (see Figure B-1) is a Binder 719 5-pin female connector (see Figure B-3).

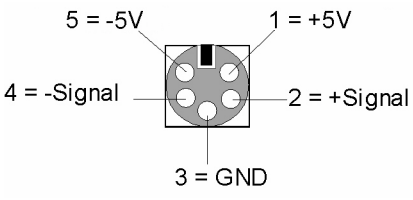
The electrode inputs of the GSR-MR Module (see Figure B-2) are 1-pin DIN 1.5 mm safety sockets.

Each electrode in the GSR-MR electrode set is inserted in one of the sockets. There is no need to worry about the polarity of the electrodes.

Figure B-1. Input/output of the GSR-MR Module (amplifier side)

Figure B-2. Electrode inputs of the GSR-MR Module (test subject side)

Figure B-3. Pin assignment of the 5-pin socket



Appendix C Environmental conditions

The following conditions must be satisfied for the use of the GSR-MR Module:

Operation	Temperature range: 0 °C to 40 °C (32 °F to 104 °F) Relative humidity: 30 to 90%, non-condensing Atmospheric pressure range: 700 hPa to 1050 hPa
Transport	Temperature range: -35 °C to 65° C (-31 °F to 149 °F) Relative humidity: 30 to 90% Atmospheric pressure range: 700 hPa to 1050 hPa
Storage	Temperature range: -35 °C to 65 °C (-31 °F to 149 °F) Relative humidity: 30 to 90% Atmospheric pressure range: 700 hPa to 1050 hPa

Appendix D Explanation of the markings on the devices

Observe the Operating Instructions.

This symbol indicates that defective devices must not be disposed of with household waste. Dispose of in accordance with national regulations or return the device and its accessories to the manufacturer.

MR Conditional: Devices with this symbol are suitable for use in an MR environment under certain conditions. Take note of the special application stipulations.

MR Safe: Devices with this label are safe for use in an MR environment.

The Brain Products GmbH confirms the electromagnetic compatibility (EMC) of this product according to the Directive 2014/30/EU of the European Parliament and of the Council of 26 February 2014 on the approximation of the laws of the Member States relating to electromagnetic compatibility.

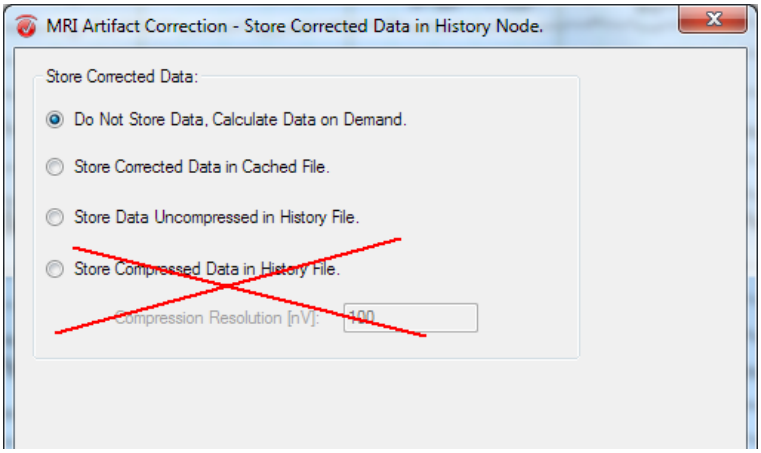
Appendix E Note on the evaluation of GSR data

The visual analysis of GSR data is facilitated by the grid view in the BrainVision Analyzer.

Depending on the environmental conditions and configuration, the GSR-MR Module produces a signal that is largely free of scanner artifacts.

If you record EEG, EMG or ECG data at the same time as the GSR data, you can use the Analyzer's MR Correction transform to correct the scanner artifacts in the GSR signal in the same way as for the remaining data. As with any other data type, there may be a loss of precision when the *Store Compressed Data in History File* option is used. We therefore advise you to select an alternative method of saving the data.

Figure E-1. Do not use the "Store Compressed Data in History File" option



Experience shows that pulse artifact correction is not necessary.

The GSR signal can be filtered using a 1 Hz low-pass filter in accordance with the typical bandwidth.

If you want to further process the GSR data using software from a third-party supplier, it is usually sufficient to reduce the sampling rate of the GSR data to 10 Hz. ●

Appendix F Recommended reading

W. Boucsein, D.C. Fowles, S. Grimnes, G. Ben-Shakhar, W.T. Roth, M.E. Dawson, D.L. Filion, Society for Psychophysiological Research Ad Hoc Committee on Electrodermal Measures. Publication recommendations for electrodermal measurements. Psychophysiology. 2012 Aug;49(8), 1017-34.

W. Boucsein, Electrodermal Activity. Plenum Press, New York, 1992.

R. Stern, K. Quigley, W. Ray, Psychophysiological Recording. Oxford, Oxford University Press, 2000.

D.C. Fowles, M.J. Christie, R. Edelberg, W.W. Grings, D.T. Lykken, P.H. Venables, Committee report. Publication recommendations for electrodermal measurements. Psychophysiology 18 (1981), 232-9.

A. Mobascher, J. Brinkmeyer, T. Warbrick, F. Musso, H.J. Wittsack, R. Stoermer, A. Saleh, A. Schnitzler and G. Winterer, Fluctuations in electrodermal activity reveal variations in single trial brain responses to painful laser stimuli. A fMRI/EEG study, Neuroimage (2008).

Appendix G Ordering codes

System

GSR-MR set:	BP-02810-MR

Components

GSR-MR Module:	BP-02811-MR
GSR-MR electrode set (130 mm, 5 kOhm), corresponds to (9) in Figure 3-2 on page 29:	BP-02813-MR
Connecting cable for GSR-MR Module (60 cm, 5-pin), corresponds to (7) in Figure 3-2 on page 29:	BP-02812-MR
Electrode gel for GSR:	BP-BM-60
Adhesive rings (inside diameter 8 mm, 100 units):	FMS-060231

List of abbreviations

AUX ..... Auxiliary

DC ..... Direct current

DIN ..... Deutsches Institut für Normung (German standards Institute)

EC ..... European Community

ECG ..... Electrocardiography

EFTA ..... European Free Trade Association

EMC ..... Electromagnetic compatibility

EMG ..... Electromyography

EPI ..... Echo Planar Imaging

FFE ..... Fast Field Echo

FLASH ..... Fast Low Angle Shot

fMRI ..... Functional magnetic resonance imaging

FSPGR ..... Fast Spoiled Gradient Echo

GSR ..... Galvanic skin response

MP-RAGE ..... Magnetization Prepared Rapid Gradient Echo

MR ..... Magnetic resonance

SPGR ..... Spoiled Gradient Recalled

TFE ..... Turbo Field Echo

WEEE ..... Waste Electrical and Electronic Equipment Directive