

# actiCAP Operating Instructions

For

actiCAP active electrode system Versions I & II

actiCAP ControlSoftware as of Version 1.2

Version 006

valid as of September 30, 2013\*



\* Valid until publication of new version of operating instructions

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# Contents

	List of	figures	ix	
	List of	tables	. xiii	
	Inform	nation on these Operating Instructions	15	
	The str	ucture of the Operating Instructions	15	
	Target group of the Operating Instructions			
	Conventions used in the Operating Instructions			
	Revisio	n history	17	
	Trouble	eshooting and support	18	
	Prefac	e	19	
	The ac	iCAP system and its benefits	19	
	Intend	ed use	19	
	Correct	Use	. 20	
	Use to	gether with other products and components	21	
Chapter 1	Syste	m overview		
Chapter 2	Notes	s on the safe use of the actiCAP system		
Chapter 3	Software and hardware installation			
	3.1	Installing the actiCAP ControlSoftware	. 30	
	3.1.1	Installation under Windows® XP	. 30	
	3.1.2	Installation under Windows ${ m I}$ Vista, Windows ${ m I}$ 7 or Windows ${ m I}$ 8	. 31	
	3.2	Connecting the amplifier to the actiCAP active electrode system	. 36	
	3.2.1	actiCAP ControlBox Version I	. 36	
	3.2.2	actiCAP ControlBox Version II	. 37	
	3.3	Setting up the power supply	. 41	
	3.3.1	Setting up the power supply via USB and installing the drivers	. 41	
	3.3.2	Setting up the power supply using batteries	. 42	
Chapter 4	Opera	ting the actiCAP ControlBox	. 43	
	4.1	Acquisition mode	. 44	

۷

	4.1.1	Active Shield submode	44		
	4.2	Impedance mode	45		
	4.3	Test signal mode	46		
Chapter 5	Opera	ting the actiCAP ControlSoftware	49		
	5.1	Loading and editing channel definitions and the workspace	51		
	5.2	Functions of the tab bar	56		
	5.2.1	Checking the electrode positions	56		
	5.2.2	Creating electrode groups	58		
	5.2.3	Checking the impedances	60		
Chapter 6	Prepa	ring a measurement	63		
Chapter 7	Cleani	Cleaning the electrodes and cap			
	Using a	Using a disinfectant			
	Cleaniı	ng the electrodes	67		
Chapter 8	Troub	leshooting	71		
	8.1	How do I identify a faulty electrode?	71		
	8.1.1	Identifying a faulty electrode branch	71		
	8.1.2	Identifying a faulty electrode LED	71		
	8.1.3	Identifying a faulty electrode impedance	72		
	8.1.4	Checking the electrode signal	72		
	8.2	How do I replace a faulty electrode?	73		
	8.3	How do I solve problems related to the power supply via USB?	75		
Chapter 9	Guara	rantee and warranty			
Appendix A	Product identification information				
Appendix B	Technical data 8				
Appendix C	Environmental conditions				

Appendix D	Explanation of the markings on the products	87
Appendix E	Ordering codes	89
Appendix F	Using passive pin electrodes	91
	List of abbreviations	93
	Glossary	• 95
	Subject index	• 97

### List of figures

- Chapter 1 System overview
  - 1-1 Overview of the hardware components of the actiCAP active electrode system with Version I of the ControlBox 23
  - 1-2 Overview of the hardware components of the actiCAP active electrode system with Version II of the ControlBox (as of 2011) 24
  - 1-3 actiCAP ControlBox with belt clip 25
  - 1-4 Splitter box with retaining clip 25
  - 1-5 Electrodes: ground, reference and data electrode 25
  - 1-6 Multi-use storage shelves for storing the ControlBox, splitter box and electrodes 26
- Chapter 2 Notes on the safe use of the actiCAP system
- Chapter 3 Software and hardware installation
  - 3-1 Installing Microsoft .NET Framework 31
  - 3-2 Running the actiCAP ControlSoftware installer as administrator 32
  - 3-3 AutoPlay dialog box under Windows® 7 32
  - 3-4 Welcome screen for the actiCAP ControlSoftware installer 33
  - 3-5 Query on attempting to install the actiCAP ControlSoftware 33
  - 3-6 Start page of the installation wizard 34
  - 3-7 Selecting the installation folder 34
  - 3-8 Accepting installation of the driver software 35
  - 3-9 actiCAP ControlBox Version I 36
  - 3-10 Connection between the actiCAP ControlBox Version I and the amplifier-specific adapter using the ribbon cable 37
  - 3-11 actiCAP ControlBox Version II 38
  - 3-12 Uniform color coding for the corresponding connectors in actiCAP ControlBox Version II, showing the sockets for the splitter box (left) and the sockets for the amplifier (right) 38
  - 3-13 Arrow on the sockets of the actiCAP ControlBox (left) and on the plugs of the ribbon cable of the splitter box and amplifier (right) 39
  - 3-14 Open (left) and engaged (right) clamps on the ribbon cable connectors for the splitter box and amplifier 40
  - 3-15 USB port in the battery compartment of the actiCAP ControlBox 41
  - 3-16 Successful installation of the drivers 42

Chapter 4	Operating the actiCAP ControlBox			
	4-1	Recording in BrainVision Recorder 46		
	4-2	Square wave signal in BrainVision Recorder 48		
Chapter 5	Operati	ng the actiCAP ControlSoftware		
	5-1	Display of the channel definition when starting the actiCAP ControlSoftware 49		
	5-2	actiCAP ControlSoftware status bar containing information about the channel definition and workspace to be used 50		
	5-3	Loading an actiCAP channel definition 51		
	5-4	Editing a channel definition 52		
	5-5	Changing the electrode positions 53		
	5-6	Editing the number and names of the channels 53		
	5-7	Explanation of the electrode labels 54		
	5-8	Editing electrode names 54		
	5-9	Loading a Recorder workspace 55		
	5-10	Items in the Help menu 55		
	5-11	Tab bar 56		
	5-12	Controls in the Label Check tab 56		
	5-13	Checking operation (excerpt) 57		
	5-14	Controls in the Electrodes Groups tab 58		
	5-15	Switching between electrode groups 1 and 2 59		
	5-16	Controls in the Impedance Check tab 60		
	5-17	Checking the impedances 61		
	5-18	Tool tip for an electrode 61		
	5-19	Saving the impedances 62		
Chapter 6	6 Preparing a measurement			
	6-1	EOG electrode 64		
	6-2	Filling the electrodes with gel 65		

Chapter 7 Cleaning the electrodes and cap

	7-1	Removing the electrodes from the holders 68	
	7-2	Electrodes in the water bath 69	
	7-3	Cleaning the electrodes with a toothbrush 69	
	7-4	Wrap the electrodes in a towel after cleaning 70	
Chantor 9	Trouble	sheating	
Chapter o	TTOUDLE	Shooting	
	8-1	Square-wave signal in the BrainVision Recorder 72	
	8-2	Removing the electrode from the splitter box 73	
	8-3	Incorrect positioning of an electrode (A) 74	
	8-4	Incorrect positioning of an electrode (B) 74	
Chapter 9	Guarantee and warranty		
Appendix A	Product identification information		
Appendix B	Technical data		
	B-1	actiCAP adapter for QuickAmp with microswitch 82	
	B-2	Port for actiCAP ribbon cable 82	
	B-3	Port for amplifier connection 83	
Appendix C	Environmental conditions		
Appendix D	Explanation of the markings on the products		
Appendix E	Ordering codes		
Appendix F	Using p	assive pin electrodes	
	F-1	Passive pin electrode for actiCAP holder, Ag/AgCl pellet 91	
	F-2	Passive pin electrode, electrode cable with touch-proof connector 91	
	F-3	Passive pin electrodes with actiCAP holders and fabric cap 92	

xii List of figures

## List of tables

System overview

Chapter 1

Chapter 2 Notes on the safe use of the actiCAP system Chapter 3 Software and hardware installation Chapter 4 Operating the actiCAP ControlBox Default settings for the BrainAmp DC amplifier and an actiCAP cap with 32 channels (Recorder 4-1 workspace) 47 Chapter 5 Operating the actiCAP ControlSoftware Chapter 6 Preparing a measurement Chapter 7 Cleaning the electrodes and cap Chapter 8 Troubleshooting Chapter 9 Guarantee and warranty Product identification information Appendix A Appendix B **Technical data** Appendix C **Environmental conditions** Appendix D Explanation of the markings on the products Appendix E Ordering codes

Using passive pin electrodes

Appendix F

**xiv** List of tables

# Information on these Operating Instructions

These Operating Instructions describe the actiCAP active electrode system and the actiCAP ControlSoftware. The Operating Instructions are part of the device and software and the accessories supplied by Brain Products GmbH.

These Instructions must be precisely adhered to in order to ensure that the device and software are employed as intended and operated correctly and to guarantee the concomitant safety of test subjects and operators.

#### The structure of the Operating Instructions

The actiCAP Operating Instructions have 9 chapters:

- <u>Chapter 1</u> provides an overview of all the system components.
- In <u>Chapter 2</u> you will find information on handling the system and associated accessories safely.
- Chapter 3 describes the individual installation steps you need to perform before taking the system into operation.
- Chapter 4 shows you how to operate the actiCAP ControlBox.
- <u>Chapter 5</u> shows you how to operate the actiCAP ControlSoftware.
- <u>Chapter 6</u> provides notes on preparing a measurement using the actiCAP active electrode system.
- Chapter 7 contains notes on cleaning the electrodes and the cap.
- Chapter 8 contains notes on troubleshooting.
- Chapter 9 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.

#### **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, buttons, options and the names of files and folders. Italic font is also used to highlight portions of running text.
underscore	Underscored text indicates a cross-reference or a web address.
monospaced	A monospaced font is used to indicate text or characters to be entered at the keyboard.
•	The blue dot indicates the end of a chapter.

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



## **Revision history**

Page	Status	Subject
19	new	Intended use
20	new	Correct use
21	new	Combination with other products
31	new	Support of Windows® 8
67	new	Disinfecting the electrodes

### Troubleshooting and support

You can search for updates of these Operating Instructions under <a href="http://www.brainproducts.com/downloads.php?kid=5&tab=3">http://www.brainproducts.com/downloads.php?kid=5&tab=3</a> on our Web site.

<u>Chapter 8 as of page 71</u> contains notes on troubleshooting. We would ask you to perform the tests listed there before contacting our technical support team.

If you require technical support or if you discover a mistake in the Operating Instructions or observe a fault in the devices or the software or during operation, please contact:

Brain Products GmbH Zeppelinstraße 7 D-82205 Gilching Tel. +49 8105 73384 – 0 Fax: +49 8105 73384 – 505 Web site: <u>http://www.brainproducts.com</u> Email: <u>techsup@brainproducts.com</u>

On request, the technical support team will also send you a form to assist in clarifying faults and problems.

Contact for technical support / reporting errors



#### The actiCAP system and its benefits

Compared with conventional passive electrodes, the actiCAP active electrode system makes it possible to substantially reduce the time taken to prepare test subjects up to the start of the EEG recording, in particular in the case of acquisition with a large number of channels (32 channels or more).

The sensors integrated in the housing consist of high-quality Ag/AgCl (sinter) and are perfectly suited for DC acquisition. "Active" circuits which are integrated in the electrodes (impedance converters) permit recordings at high transition resistances (up to 500 kOhm) and minimize ambient noise, interference due to electrical effects and artifacts due to cable movement thanks to built-in active shielding.

This technology significantly improves the signal to noise ratio even without abrasive impedance minimization and additional cleaning of the skin using alcohol or cleaning products.

The different color LEDs which are integrated in the electrode housing indicate the quality of the current electrode transition resistance. Threshold values (red, yellow, green) and additional functions can be programmed using the supplied actiCAP ControlSoftware and displayed on a computer screen.

The actiCAP active electrode system is extremely versatile and can be used in combination with the following EEG amplifier models: BrainAmp Standard, BrainAmp DC, QuickAmp, FirstAmp and V-Amp.

#### Intended use

As of September 30th, 2013 actiCAP system (including actiCAP hardware components according to <u>Chapter 1</u> and actiCAP ControlSoftware) is not a medical device anymore and can be used only 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 actiCAP for diagnosis, therapy, monitoring of vital physiological processes (such as cardiovascular functions etc.) or other medical purposes is expressly forbidden.

The actiCAP is intended to be used for acquiring and converting neuro-/ electrophysiological signals (e.g. EEG, EMG, ECG, EOG).



#### **Correct Use**

The actiCAP system is permitted to be used by users in the psychological and neurophysiological research area as well as physicians and medical experts.

The actiCAP system 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 actiCAP system can be used to record neuro-/electrophysiological signals from healthy and sick adults, children and animals

The use of the actiCAP system for medical purposes is not permitted.

The actiCAP system is not permitted to be used in the following environments:

- MR scanner environment (see corresponding symbol on hardware components of actiCAP family),
- vicinity of explosive gases as may be the case in e.g. operating theaters,
- oxygen enriched atmospheres,
- underwater (e.g. sea, swimming pool, bath tub) or in environments which significant amounts of water could enter the components of the actiCAP family (e.g. under shower, under water-tab).

The user is solely liable for any risks if the device is not used in accordance with the correct use as described. Brain Products GmbH provides no guarantee and accepts no liability for the results obtained with actiCAP ControlSoftware.

All versions of actiCAP system 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. e.g. to perform post market surveillance) until the end of their service life.

The user should be aware that if a former actiCAP system that was a medical product is replaced by a newer version that is not a medical product anymore, the terms and conditions of the new actiCAP system are effective only from then on.

#### Use together with other products and components

actiCAP system is permitted by Brain Products to be combined with the following product families:

Product	Manufacturer
BrainAmp	Brain Products GmbH
actiCHamp	Brain Products GmbH
V-Amp	Brain Products GmbH
QuickAmp (incl. actiCAP2QuickAmp adapter)	Twente Medical Systems International B.V. (TMSi)
BrainVision Recorder	Brain Products GmbH

actiCAP ControlSoftware can also be used in combination with medical devices, if the combination is specifically approved by the manufacturer of the medical device.

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 System overview

Familiarize yourself sufficiently with the use of the actiCAP active electrode system before using it for the first time.

The actiCAP active electrode system comprises the following items (see <u>Figure 1-1</u>, <u>Figure 1-2</u> ff.):

- (1) between one and four splitter boxes
- (2) each with up to 32 data electrodes
- (3) an active ground electrode (black housing)
- (4) an active reference electrode (blue housing)
- (5) between one and four actiCAP ControlBox-to-amplifier ribbon connection cables
- 6 between one and four amplifier-specific actiCAP adapters If you are using the actiCAP in combination with an amplifier from the BrainAmp family, you do not require an adapter, as the BrainAmp is connected directly to
- (7) a Version I or II actiCAP ControlBox

the actiCAP ControlBox.

As of 2011, a new version of the actiCAP ControlBox has been on the market. You will find detailed information on the improved functions of the ControlBox in Chapter 3 as of page 37.

If you are currently still working with an actiCAP Version I system, you can upgrade it. For information, contact Brain Products.

Note that the adapter must be ordered separately. Adapters are available for virtually all commonly available amplifiers. Contact our technical support team for details. You will find the contact details on page 18.

Figure 1-1. Overview of the hardware components of the actiCAP active electrode system with Version I of the ControlBox

*Figure 1-2.* Overview of the hardware components of the actiCAP active electrode system with Version II of the ControlBox (as of 2011)



To enhance the test subject's freedom of movement, there is a belt clip on the back of the actiCAP ControlBox (see Figure 1-3). You can use the retaining clip on the splitter box (see Figure 1-4) to fix the splitter box to the test subject's collar, for example.

#### Figure 1-3. actiCAP ControlBox with belt clip



Figure 1-4. Splitter box with retaining clip



Figure 1-5. Electrodes: ground, reference and data electrode



You can now purchase special multi-use storage shelves with your actiCAP active electrode system. These considerably facilitate storage and particularly cleaning of the electrodes. You can hang the electrode system in the storage shelves as shown in <u>Figure 1-6</u> to prevent water from the electrodes that you have just cleaned from getting into the ControlBox and splitter box. This allows residual water to collect on the hanging cables and drip off.



*Figure 1-6.* Multi-use storage shelves for storing the ControlBox, splitter box and electrodes

In addition to the above-mentioned components of the actiCAP active electrode system, you will need:

- ▶ NiMH batteries together with a suitable charger
- ► USB cables
- A fabric cap with electrode holders to match the actiCAP active electrode system including accessories (such as gel, nozzles, chin strap etc.)

# Chapter 2 Notes on the safe use of the actiCAP system

Read the following safety information carefully since it will help prevent personal injury and damage to property. It is assumed that as the operator, you have the required specialist knowledge in handling the devices and software.

The manufacturer shall not be liable in the event of any failure to observe the safety information set out below.

The actiCAP active electrode system including the actiCAP ControlSoftware is to be used in the intended environment and in accordance with the intended use. You should particularly avoid exposing the device to direct sunlight, high humidity levels or water.

Do not use the actiCAP active electrode system in MR environments.

#### No tampering

- ▶ Do not open the ControlBox or splitter box by force.
- Do not carry out repairs to the devices yourself.

#### Take care when cleaning

- Always ensure that the plugs and sockets are clean. You can clean them with compressed air if this becomes necessary.
- Do not bring the plugs and sockets in particular into contact with moisture (never wipe the plugs and sockets with a damp cloth).
- ▶ To avoid damage to the splitter box, never let it come into contact with water.

#### Accessories, connections and cables

- Only connect the devices to electrical connections which are compliant with the relevant standards.
- Only connect accessories approved by Brain Products to the sockets of the actiCAP ControlBox.
- Never plug the actiCAP electrode branches or the splitter box into devices other than those for which they were intended.

#### Take care when connecting and disconnecting the equipment

- Only connect or disconnect the plugs on the actiCAP ControlBox when the ControlBox is switched off.
- Always ensure that the splitter box and amplifier are connected to the correct positions on the actiCAP ControlBox.
- Only remove the ground electrode and reference electrode from the ControlBox sockets in exceptional circumstances (e.g. in the event of a fault).









- ► To not force the plugs into the sockets.
- Never remove the plugs from the sockets by pulling the cables.
- Never pull the electrode cables to remove the actiCAP electrodes from their holders. Instead, take the head of the electrode between your thumb and index finger and twist it carefully from the holder (see also Chapter 7 as of page 67).

#### actiCAP ControlSoftware

• Always use the most recent version of the actiCAP ControlSoftware.



# **Chapter 3** Software and hardware installation

Complete installation of all hardware and software components comprises the following steps, *which must be carried out in the sequence given*:

- 1 Install the most recent version of the actiCAP ControlSoftware
- 2 Connect the amplifier to the actiCAP active electrode system
- 3 Set up the power supply to the actiCAP ControlBox
  - a Connect the actiCAP ControlBox to the computer using the USB cable supplied
  - **b** (Alternatively to a) Set up the power supply using batteries

The following always applies, and in particular for users of Version II of the actiCAP ControlBox: Connect the splitter box and the amplifier to the actiCAP ControlBox before you connect the ControlBox to the computer using the USB cable.

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Before using the actiCAP active electrode system for the first time, you must also read the safety instructions in <a><u>Chapter 2 as of page 27</u></a> carefully. It is assumed you have the required specialist knowledge in handling the devices and software.

#### 3.1 Installing the actiCAP ControlSoftware

The system has the following hardware and software requirements:

- Operating system: Windows® XP Service Pack 2, Windows® Vista Service Pack
   1, Windows® 7 (32-bit and 64-bit)
- Platform: Microsoft .NET Framework 2.0
- ▶ USB driver: USB 2.0
- Minimum configuration: Intel Pentium III processor 1 GHz or higher, graphics adapter with a resolution of 1024 x 768 pixels and 32768 colors

#### 3.1.1 Installation under Windows® XP

If you are using Windows® XP, proceed as follows:

- 1 Start Windows®.
- 2 Insert the supplied actiCAP program CD into your CD-ROM drive.
- **3** If your computer is set up to autostart a CD-ROM, the menu that guides you through the installation will appear after a short time. If your computer is not set up to autostart CD-ROMs, you must run the installation program manually. Proceed as follows:
  - **a** From the taskbar, choose *Start > Run*.
  - **b** Click the Browse *button*.
  - **c** In the *Browse* dialog box, select your CD-ROM drive and double-click the *Autorun.exe* file to open it.
- **4** Follow the instructions displayed. The installation process that follows is described in  $\bigcirc$  Section 3.1.2, step 5 through step 10 as of page 32.

The actiCAP ControlSoftware requires the Windows® .Net Framework 2.0 extension supplied by Microsoft. If Microsoft .NET Framework 2.0 is not present on your system, then a message is displayed by the actiCAP ControlSoftware. Accept the installation of Microsoft .NET Framework 2.0 (see Figure 3-1).

Microsoft .NET Framework Version 2.0

The Microsoft Web site asks you whether you want to install Microsoft .NET Framework Version 3.5. Accept the installation because Version 3.5 also contains Version 2.0.

System requirements

#### Figure 3-1. Installing Microsoft .NET Framework



Before you start the actiCAP ControlSoftware, connect the actiCAP ControlBox to your computer as described in <u>Section 3.2 as of page 36</u>. If you do not do so then you will see the error message "Unable to load ActiCAP X.dll" when you start the actiCAP ControlSoftware.

#### 3.1.2 Installation under Windows® Vista, Windows® 7 or Windows® 8

If you are using Windows® Vista, Windows® 7 or Windows® 8, proceed as follows:

- **1** Start Windows®.
- 2 Insert the supplied actiCAP program CD into your CD-ROM drive.
- **3** If your computer is set up to autostart a CD-ROM, then the *Autoplay* dialog box opens automatically after a short period. If your computer is not set up to autostart CD-ROMs, you must run the installation program manually. Proceed as follows:
  - a Open the CD-ROM drive in Windows® Explorer.



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**b** In the *Browse* dialog box, select your CD-ROM drive and double-click the *Autorun.exe* file to open it (see Figure 3-2).



Figure 3-2. Running the actiCAP ControlSoftware installer as administrator

4 In the AutoPlay dialog box, click Run Autorun.exe (see Figure 3-3).

Figure 3-3. AutoPlay dialog box under Windows® 7



**5** When the installation file is run, the *Welcome to actiCAP Control Installation* dialog box is shown. Click *Install actiCAP ControlSoftware* (see Figure 3-4).

actiCAP ControlSof	tware Installation	
$\times$		Ź
We	elcome to actiCAP ControlSoftware Ins	stallation
	What would you like to do?	
	Install actiCAP ControlSoftware	Prod Go to Prod
	Install further Components	🇬 Go to Cap
	Find out how to set-up your System	🇬 Go to Cap
	Find out how to replace electrodes	Go to furth
	Prowse the CD	
	www.brainproducts.com	m
Copyright ® Brain Prod	ILLES GMDH - Zeppelinstrasse 7 - 82205 Gilching - Germany	

#### Figure 3-4. Welcome screen for the actiCAP ControlSoftware installer

**6** The system may ask you whether you want to permit installation of the actiCAP ControlSoftware. Click *Yes* (see Figure 3-5).

Figure 3-5. Query on attempting to install the actiCAP ControlSoftware



**7** A wizard opens. Click *Next* (see Figure 3-6).

#### Figure 3-6. Start page of the installation wizard



**8** You select the actiCAP ControlSoftware installation folder during the course of installation (see Figure 3-7).

#### Figure 3-7. Selecting the installation folder

🛃 actiCAP Control	
Select Installation Folder	
The installer will install actiCAP Control to the following folder.	
To install in this folder, click "Next". To install to a different folder, ente	r it below or click "Browse".
Folder: C\\Program Files\\Brain Products\actiCAP Control\	Browse
	DIOWSE
	Disk Cost
Install actiCAP Control for yourself, or for anyone who uses this comp	outer:
Everyone	
🔘 Just me	
Cancel	Back Next >

**9** If you are prompted to do so during the process, it is essential to agree to the installation of the driver software by clicking the option *Install this driver software anyway* in the *Windows Security* dialog box (see Figure 3-8).

E.

#### Figure 3-8. Accepting installation of the driver software



**10** Follow the installation instructions which are now displayed until installation is completed.

Before you start the actiCAP ControlSoftware, connect the actiCAP ControlBox to your computer as described in <u>Section 3.2 as of page 36</u>. If you do not do so then you will see the error message "Unable to load ActiCAP X.dll" when you start the actiCAP ControlSoftware.

For information on the assignment of the electrodes to the physical channels, visit our Web site which can be accessed using the following link: <u>http://www.brainproducts.com/</u> downloads.php?kid=8&tab=2.

# 3.2 Connecting the amplifier to the actiCAP active electrode system

#### 3.2.1 actiCAP ControlBox Version I

If you are using Version I of the actiCAP ControlBox (see Figure 3-9), the splitter box (with 32 active data electrodes at each port) is permanently connected to the ControlBox with a ribbon cable. This means that the splitter box does not have to be connected to the ControlBox separately. You only need to connect the amplifier to the ControlBox.

Figure 3-9. actiCAP ControlBox Version I



Connect the ControlBox to the amplifier and the amplifier-specific adapter as follows using the supplied ribbon cable (see Figure 3-10):
- **1** Ensure that the *actiCAP ControlBox is switched off*.
- 2 Plug in the ribbon cable at the front of the actiCAP ControlBox. When doing this, always make sure that the sockets are connected in the right order. The first amplifier is plugged into the socket marked *1-32* etc.
- 3 Then connect the ribbon cable to the amplifier-specific adapter or directly to the amplifier.
- 4 Connect the amplifier-specific adapter to the amplifier.

*Figure 3-10.* Connection between the actiCAP ControlBox Version I and the amplifier-specific adapter using the ribbon cable



## 3.2.2 actiCAP ControlBox Version II

If you are using Version II of the actiCAP ControlBox (see Figure 3-11), you can plug the splitter box(es) (or actiCAP electrode branches with 32 active data electrodes each) into the ControlBox using the ribbon cable supplied. The number of splitter boxes is automatically detected by the ControlBox after a reboot.

The ground electrode and the reference electrode are no longer permanently fitted to the ControlBox as previously, but can be plugged into the ControlBox separately. This makes it easier to replace these two electrodes.





#### Figure 3-11. actiCAP ControlBox Version II

When connecting the splitter box(es) and the amplifier to the actiCAP ControlBox, always observe the correct connection position and sequence. The connectors *Ch. 1-32 Amplifier* through *Ch. 97-128 Amplifier* allow you to connect up to four amplifiers. The connectors *Ch. 1-32 Splitter Box* through *Ch. 97-128 Splitter Box* allow you to connect up to four actiCAP splitter boxes. The corresponding connectors are color coded for the sake of clarity (see Figure 3-12).

*Figure 3-12.* Uniform color coding for the corresponding connectors in actiCAP ControlBox Version II, showing the sockets for the splitter box (left) and the sockets for the amplifier (right)



If you do not observe the correct sequence when connecting the devices, the system will not detect them. Thus, for example, it is not possible to operate a single amplifier on amplifier socket 2 (yellow), or an amplifier on amplifier socket 1 (green) and a splitter box on splitter box socket 2 (yellow). The plugs on the ribbon cables for the splitter box and the amplifier also have an arrow (see Figure 3-13) indicating the direction in which the plug is inserted into the socket. Ensure that the arrow on the plug is aligned with the arrow on the socket. The different number of pins on the plugs for the amplifier and the splitter box ensure that the two plugs cannot be confused.

*Figure 3-13.* Arrow on the sockets of the actiCAP ControlBox (left) and on the plugs of the ribbon cable of the splitter box and amplifier (right)



Connect the splitter box and the amplifier to the actiCAP ControlBox in this order:

- 1 Ensure that the *actiCAP ControlBox is switched off*.
- 2 Connect the black ground electrode to the four-pin *GND* connector of the actiCAP ControlBox.
- 3 Connect the blue reference electrode to the five-pin *REF* connector of the actiCAP ControlBox.
- **4** Connect the splitter box to the appropriate socket on the ControlBox. The first actiCAP electrode branch and hence the first splitter box is plugged into the socket marked *Ch. 1-32 Splitter Box* etc.
- **5** Now plug the ribbon cable for the amplifier into the appropriate socket on the actiCAP ControlBox. The first amplifier is plugged into the socket marked *Ch. 1-32 Amplifier* etc.

The plugs on the ribbon cables are self-locking. Ensure that the clamps are open before you insert the plug (see Figure 3-14, left). As soon as you push the plug into the socket, the clamps automatically engage to prevent the plug from becoming disconnected inadvertently, e.g. if the ribbon cable is pulled. Always ensure that the plugs are pushed home fully: The clamps must be engaged and point outwards (see Figure 3-14, right). To remove the plug from the socket, press both clamps at the same time. The plug is released automatically.

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Note that the actiCAP active electrode system does not work unless the ground electrode and the reference electrode are connected. *Figure 3-14.* Open (left) and engaged (right) clamps on the ribbon cable connectors for the splitter box and amplifier



#### 3.3 Setting up the power supply

The actiCAP active electrode system can be powered and operated either via one of your computer's USB ports or with batteries. If you only want to use the actiCAP active electrode system with batteries, skip Section 3.3.1 and go straight to > Section 3.3.2 as of page 42.

# 3.3.1 Setting up the power supply via USB and installing the drivers

If the actiCAP active electrode system is to be used on a USB port then it is important that the port can ensure a supply current of 500 mA. This complies with the USB2.0 specification.

To supply the actiCAP ControlBox with power via USB and install the drivers, connect it to your computer. Proceed as follows:

- 1 Open the battery compartment at the rear of the actiCAP ControlBox.
- 2 Remove the batteries, if necessary.
- 3 Connect the supplied USB cable to the actiCAP ControlBox (see Figure 3-15).

*Figure 3-15.* USB port in the battery compartment of the actiCAP ControlBox

We generally recommend that you only supply the actiCAP ControlBox with power via USB during impedance measurement and software-controlled tests (see <u>Section 5.2 as of page 56</u>). You should use batteries to supply the actiCAP ControlBox with power when you are actually acquiring data.

 Connect the supplied USB cable to a USB port on your computer. We recommend that you always run the actiCAP ControlBox on an active USB hub with a separate power supply to ensure a stable supply (see also <>>> Section 8.3 on page 75).

**5** When you first use the actiCAP ControlBox, the computer will inform you that it has detected a new hardware component and that the drivers have been



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Note that Windows® requires you to install the driver again each time you change USB port.

installed successfully (see <u>Figure 3-16</u>). If you wish, you can also insert the supplied actiCAP program CD and let the system search for suitable drivers.

6 When the drivers have been successfully installed, the actiCAP ControlBox emits a short beep. The actiCAP active electrode system is supplied with electricity via the USB connection. You can now make the required settings using the actiCAP ControlSoftware (for detailed information, refer to <a>Chapter 5 as of page 49</a>).

Figure 3-16. Successful installation of the drivers



## 3.3.2 Setting up the power supply using batteries

Instead of powering the actiCAP ControlBox via USB, you can also use batteries. You should always power the unit with batteries when acquiring data and only power it via USB for impedance measurement.

To use batteries, open the cover on the rear of the actiCAP ControlBox and insert the batteries. Make sure that the polarity is correct!

When running the actiCAP ControlBox on batteries, only use four Mignon (AA) NiMH batteries with a capacity of at least 2100 mA/h.



Do not use any other type of battery and do not use any alkaline batteries.

# **Chapter 4** Operating the actiCAP ControlBox

The actiCAP active electrode system has the following four primary functions or modes, which you can activate directly from the actiCAP ControlBox:

- Acquisition mode
- Active Shield submode
- Impedance mode
- Test signal mode

You can activate or deactivate the functions using the buttons on the actiCAP ControlBox. Keep the appropriate button held down until an acoustic signal confirms activation or deactivation of the function and the corresponding LED lights up or goes out.

The following buttons are present on the actiCAP ControlBox:

 N
 Test

 Z
 Impedance

 S
 Active Shield

 U
 Power

We recommend that you make any necessary settings on the actiCAP active electrode system in USB mode and perform measurements in battery mode.

## 4.1 Acquisition mode

You activate the actiCAP ControlBox by pressing *Power*  $\bigcup$ . The unit is now in acquisition mode. Depending on the power supply method you have chosen, the *Battery Good* LED (battery operation) or *USB Power* LED (power supplied by USB) lights up yellow.

In acquisition mode, the EEG signals are transmitted to the amplifier and can be recorded.

You can deactivate the actiCAP ControlBox by pressing *Power* 🛈 again.

#### 4.1.1 Active Shield submode

Active shield is a submode of acquisition mode. This mode allows you to reduce ambient influences such as noise, electrical interference or interference due to cable movement by "guarding" at the cables and electrodes of the actiCAP active electrode system.

Be aware, however, that the use of active shielding only leads to a significant improvement of quality of the EEG data if you are using an amplifier with a low level of common-mode rejection.

To activate the additional function active shield, press the *Active Shield* 🙆 button when in acquisition mode. The *Active Shield* LED lights up in blue in addition to the *Battery Good* LED or *USB Power* LED indicating acquisition mode.

To use the active shield submode, it is essential to set the reference electrode even if you are using an amplifier with an average reference such as the QuickAmp.

#### 4.2 Impedance mode

To activate impedance mode (and consequently also impedance measurement), press the *Impedance*  $[\mathbf{Z}]$  button when in acquisition mode.

During the measurement, the impedance values are displayed by the colored LEDs which are built into the electrodes. The factory settings are as follows:

- Green LED impedance less than 25 kOhm
- Yellow LED impedance between 25 and 60 kOhm
- Red LED impedance greater than 60 kOhm

When using active electrodes, an impedance of 25 kOhm is completely sufficient in order to achieve outstanding data quality during the EEG recording.

The impedance measurement is performed synchronously for all the channels for up to 64 electrodes. If more than 64 electrodes are used then the measurement is performed for one 32-channel electrode set.

You can switch through all 32-channel electrode sets by pressing *Impedance* Z again.

Power consumption is relatively high in impedance mode. If you are using batteries, you should therefore limit use of this mode to the minimum period necessary. The factory setting provides for an impedance measurement time of five minutes. After this time has expired, the actiCAP active electrode system reverts to acquisition mode. You can modify this factory setting using the actiCAP ControlSoftware.

Make sure that the actiCAP active electrode system always possesses an adequate power supply. A poor power supply may cause the electrode LEDs to flicker.

Please note that due to the impedances generated in the active electrodes, the employed recording software is not able to determine or display any valid impedance values. You can only view the precise values using the supplied actiCAP ControlSoftware (for more information, see  $\bigcirc$  Section 5.2.3 as of page 60).

As of Version 1.20, BrainVision Recorder possesses an interface to the actiCAP ControlSoftware. For more detailed information on this function, see the Recorder user manual as of Version 005.

It is necessary to set the ground electrode to perform impedance measurements.

You will find information on how to modify the duration of the impedance measurement in Section 5.2.3 on page 60.

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## 4.3 Test signal mode

Test signal mode allows you to check whether the signals from the data electrodes are functioning correctly. Proceed as follows:

- 1 Connect the actiCAP active electrode system to the amplifier.
- 2 Place the ground electrode and the data electrodes in saline.
- **3** Press *Power*  $\bigcup$  to switch on the actiCAP ControlBox.
- **4** Press *Test*  $\overline{\mathbb{N}}$ . The corresponding LED lights up.
- 5 Start the recording software and record the EEG signal.
- 6 If you are using BrainVision Recorder to perform recording, press the *Monitor* 
  button. If you want to record the test signal, click the *Start/Resume Recording*button (see Figure 4-1).

For monitoring the data on screen, we recommend a scaling value of  $200 \ \mu$ V.





For more detailed information on setting up a workspace in BrainVision Recorder, refer to the corresponding User Manual.

You must set up a workspace if you are using the BrainVision Recorder recording software. The necessary workspace settings depend on the amplifier type and number of channels. When you set up your workspace, we recommend that you use the highest possible resolution, the largest possible sampling rate, the greatest available bandwidth and no filters.

#### Table 4-1. Default settings for the BrainAmp DC amplifier and an actiCAP cap with 32 channels (Recorder workspace)

Name: actiCAP-32Ch-Standard-2-BA Raw File Folder: C:\Vision\Raw Files

#### Channels

# Name Phys. Chn Resolution/ Low Cutoff[s] High Cutoff[Hz] Notch[Hz] Gradient Offset

11	Ivanic	inyo. omi	Unit	How outcorr[b]	nigh outoir[h2]	10000111123	ordarent	011000
1	Fpl	1	0.1 µV	DC	1000	Off		
2	Fp2	2	0.1 µV	DC	1000	Off		
3	F7	3	0.1 µV	DC	1000	Off		
4	F3	4	0.1 µV	DC	1000	Off		

#### Software Filters

\_\_\_\_\_

==== Raw Data Saving Filters ==== Disabled

==== Segmentation Filters ==== Disabled

==== Display Filters ==== Disabled The actiCAP ControlBox generates a square wave with an amplitude of 200  $\mu$ V<sub>pp</sub>. If all the data electrodes are working properly, you will see the following signal in the recording software after a few seconds (see <u>Figure 4-2</u>).



Figure 4-2. Square wave signal in BrainVision Recorder

Press *Test*  $\mathbb{N}$  again to switch the actiCAP ControlBox back to acquisition mode. •

# Chapter 5 Operating the actiCAP ControlSoftware

The actiCAP ControlSoftware allows you to adjust the factory settings of the actiCAP active electrode system to meet your requirements, to set the LEDs of the data electrodes to light up in different colors and to view the impedance values during EEG acquisition.

The dialog boxes are illustrated below on the basis of an actiCAP active electrode system with one 32-electrode set. If further electrode sets are used then these are listed as additional 32-electrode groups.

Start the actiCAP ControlSoftware by double-clicking the actiCAP icon **s** which you will find on your desktop after installation has been completed successfully.

By default, the *Label Check* tab is displayed. When you start the software for the first time, all the electrodes are arranged at the right-hand edge of the screen. After this, the last channel definition to have been used is displayed whenever you start the software.

*Figure 5-1.* Display of the channel definition when starting the actiCAP ControlSoftware



Note that you require at least Version 1.2.2.0 of the software to operate the new actiCAP ControlBox (Version II). A free update is available on our Web site at <u>http://www.brainproducts.com/</u> downloads.php?kid=8&tab=4.



You will find detailed information on channel definition and on setting up workspaces in <u>Section 5.1 as of page 51</u> and <u>Section 5.2 as of page 56</u>. The status bar (see <u>Figure 5-2</u>) at the bottom of the working area shows the channel definition and the workspace that are being used and the status of the actiCAP ControlBox.

*Figure 5-2.* actiCAP ControlSoftware status bar containing information about the channel definition and workspace to be used



# 5.1 Loading and editing channel definitions and the workspace

The *File* menu item contains the following functions:

File menu item

*Load Channel Definition...* loads stored actiCAP channel definitions (see <u>Figure 5-3</u>). actiCAP channel definitions have the suffix \*.acdf.

*Edit Channel Definition...* is used to edit the actiCAP channel definition settings.

Save Channel Definition... saves the actiCAP channel definition settings.

Load Recorder Workspace... loads saved Recorder workspaces.

*Reset All* resets all the settings to their default values.

Exit closes the program.

Figure 5-3. Loading an actiCAP channel definition



Choose *File > Edit Channel Definition*... to open the *Channel Definition* dialog box. Here you can modify the settings for the actiCAP channel definitions (see Figure 5-4).

Figure 5-4. Editing a channel definition



To change the positions of the electrodes, left-click on an electrode, hold down the mouse button and drag the electrode to the required position (see Figure 5-5).

*Reset position...* allows you to reset the electrodes to their initial positions.



# *Figure 5-5.* Changing the electrode positions

You can modify the number of electrodes under *Channels:*. In the channel list, you can assign new names to the individual electrodes (see Figure 5-6).

Figure 5-6. Editing the number and names of the channels



Two items of information are displayed for each electrode (see <u>Figure 5-7</u>): The first line contains the name of the electrode and the second line contains the number of the electrode in the relevant branch (1 through 32) as well as the number of the associated electrode branch.

#### Figure 5-7. Explanation of the electrode labels



You can right-click on the electrode to open the *Edit Electrode Name* dialog box (see <u>Figure 5-8</u>) where you can change the electrode name.





You can use *Load BrainVision Recorder Workspace*... to load the BrainVision Recorder workspace corresponding to your electrode cap. This has the suffix \*.rwksp (see Figure 5-9).

You can also use the button *Import from Recorder workspace*..., which is located in the lower part of the *Channel Definition* dialog box (see Figure 5-4), to load a Recorder workspace.

Help					
Load Channel Definition	n Dheck				
Edit Channel Definition.					
Save Channel Definition					
Load Recorder Workspa	ce 🕞				
Reset All		$\frown$			
Exit					
		E-2			
-01-0	ni l	2/1			
Den Den					
act	iCAP Control 🕨 Sample 🗸 😽	Search Sample			
		0			
Organize   Nev	wfolder	≣== ▼			
☆ Favorites	Name	Date modified			
	actiCAP-32Ch-Standard-2-BA.rwksp	8/30/2007 1:56 PM			
詞 Libraries	actiCAP-64Ch-Standard-2-BA.rwksp	10/21/2008 11:13			
	actiCAP-128Ch-Standard-2-BA.rwksp	10/21/2008 11:30			
Computer					
Local Disk (C:)					
Computer					
Computer  Local Disk (C:)  Timages (D:)  OVD RW Drive	(E:) D				
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Computer Local Disk (C:) Images (D:) PUD RW Drive	(E:) D <ul> <li>(E:) The second secon</li></ul>	Workspace (*.rwksp)			
Computer	(E:) D <ul> <li>(E:) T</li> <l< td=""><td>Workspace (*.rwksp)</td></l<></ul>	Workspace (*.rwksp)			

#### *Figure 5-9.* Loading a Recorder workspace

To save the settings you have made, click *Save*... in the *Channel Definition* dialog box. Click *Exit* to complete configuration. If you have changed the configuration, you will be prompted to save the changed configuration.

The Help menu contains the items Contents... and About...:

Help menu

Choose Contents... to open these Operating Instructions.

Choose *About...* to display the firmware version of the actiCAP ControlBox and the version number of the actiCAP ControlSoftware.

#### *Figure 5-10.* Items in the Help menu

R actiCAP Control					
File Help					
Labe Conten	ts Impedance (	Check			
Lal About.					
Default color					
Red					
Manual check		$\frown$			

# 5.2 Functions of the tab bar

The tab bar (see <u>Figure 5-11</u>) is located directly under the menu bar and contains the tabs *Label Check*, *Electrodes Groups* and *Impedance Check*. These tabs allow you to switch between the individual filters.



actiCAP Control						
<u>File H</u> elp	<u>File Help</u>					
Label Check	Electrodes (	Groups Impedance Check				
Label Che	eck					
Default color						

#### 5.2.1 Checking the electrode positions

You can use the *Label Check* function to check the position of the individual electrodes by lighting up the LEDs of the data electrodes individually one after the other. The check always starts with the first electrode.





Under *Default color*, you can select the color of the LEDs from the associated dropdown menu. You can choose between red, yellow and green. The checking operation can be carried out in *Manual check* and *Automatic check* modes. In *Manual check* mode, you activate each electrode in turn manually. You activate the next electrode by pressing the space bar or by clicking >. To go back to the previous electrode, click <.

In *Automatic check* mode, you can activate each electrode in turn at the interval you set. The check starts with the first data electrode. Start the checking operation by clicking <u>Start</u>. Click <u>Pause</u> to interrupt the check and <u>Continue</u> to resume the operation at the point at which you interrupted it. Click <u>Stop</u> to terminate the operation. The next checking operation then starts at electrode 1 again.





#### 5.2.2 Creating electrode groups

You can use the *Electrodes Groups* function to combine the data electrodes to form user-defined groups and then light up these groups (or the LEDs of the electrodes) one after the other.

Figure 5-14. Controls in the Electrodes Groups tab



A group can comprise up to 64 electrodes. If you are using an actiCAP active electrode system that has 96 channels or more, each of the groups only includes 32 data electrodes.

To set up a group, click one of the buttons Group 1 Group 2 Group 3 Group 4 and then click on the electrodes that you want to add to the selected group. When you do this, the electrode is set to the LED color which you have selected under *Default color*. Alternatively, you can assign a color by right-clicking on the selected electrode and choosing the color from the context menu.

The four buttons allow you to switch between the different groups you set up. In this case, only the LEDs corresponding to the electrodes in the selected group light up (see Figure 5-15).

To remove electrodes from a group, click the associated button to display the group in color. Now click on the electrodes you want to remove.

Click Tum off LEDs to switch off the LEDs.

These user-defined electrode groups are only available in this form in the *Electrodes Groups* function. If you switch to a different function (data acquisition, impedance measurement etc.), all the electrodes are addressed again and all the LEDs light up.



#### *Figure 5-15.* Switching between electrode groups 1 and 2

#### 5.2.3 Checking the impedances

The *Impedance Check* function allows you to start and stop impedance measurement and view the impedance values.

Figure 5-16. Controls in the Impedance Check tab



During acquisition, the impedance values are displayed by the LEDs which are built into the electrodes. The displayed colors correspond to different ranges of values:

▶ If a value is reached that is lower than the *Good level (kOhm)* value, the LED lights up in green.

▶ If a value is reached that lies between the values *Good level (kOhm)* and *Bad level (kOhm)*, the LED lights up in a color between yellow and orange if the *Use Scaling* box is checked.

▶ If an impedance value is measured that is higher than the value *Bad level* (*kOhm*), then the LED lights up in red.

You can modify the values of *Good level* (*kOhm*) and *Bad level* (*kOhm*). You can set a value in the range 1 kOhm to 500 kOhm. You can change the value in steps of 1 kOhm.

If you change a value then the color scale in the *Impedance* group box is adapted automatically.

You will find detailed information on impedance mode of the actiCAP ControlBox in <u>Section 5.2</u> as of page 56. The *Timeout* value specifies the time in minutes during which impedance measurement is active. The factory setting provides for an impedance measurement time of five minutes. If this period is exceeded then the actiCAP ControlBox automatically switches back to acquisition mode. You can change the *Timeout* as required.

You can reset the *Good level*, *Bad level* and *Timeout* settings to the factory values by clicking *Reset*.

These settings are permanently stored in the actiCAP ControlBox. They are therefore also available even if you subsequently switch to battery operation of the actiCAP active electrode system. Click the *Impedance On* button in the *Block Check* group box to start impedance measurement. The electrodes are displayed together with the associated impedance values (see Figure 5-17).

#### Figure 5-17. Checking the impedances



When you move the mouse pointer over the electrodes you will see a tool tip containing the following information:

- ► Name of the electrode
- Physical channel name
- Electrode branch, i.e. membership of the corresponding electrode of the associated actiCAP ControlBox electrode branch
- ▶ Impedance value of the electrode

In our example (see Figure 5-18), channel FC5 has the physical channel name 8, belongs to electrode branch 1 and has an impedance of 5 kOhm.

#### Figure 5-18. Tool tip for an electrode



All impedance values are shown simultaneously for up to 64 electrodes. If you are using more than two actiCAP electrode branches or more than 64 electrodes, then the *Next electrodes block* button becomes available in the *Block Check* group box. 32 electrodes are measured at any one time. If you want to measure the impedances of the next electrode group (i.e. the next 32 electrodes), select *Next electrodes block*.

If you check the *Use Scaling* box, a color scale is used to display the impedances. The color scale is subdivided into three areas: The topmost area displays the *Bad level* and the bottom area the *Good level*. The middle area of the color scale represents the transition between *Good level* and *Bad level*. The reference electrode and the ground electrode are displayed separately. The color used to display these two electrodes is also based on the color scale.

To stop impedance measurement, click *Impedance Off*. The actiCAP ControlBox switches back to acquisition mode.

You can save the measured values (and the changes you have made) in a text file. To do this, click *Save Impedance*. Next click *Save Info* in the dialog box which now opens (see Figure 5-19).



💦 Impedance Measu	rement				
Brain Product	s actiCAP 1	Impedance File Version 1.0		*	
; Data create	d by the ad	tiCAP Control Software			
actiCAP Control Box Setup					
Good Level [k	Ohms]: 25	5			
Bad Level [k0	hms]: 50	)			
Timeout [min]	: 50			=	
Control Box V	Version: Oc	t 18 2006 11:01:45			
Electrode Set	Version:				
	Ma	ar 1 2006 13:46:03			
	and the second				
IMPEDAN	ICE DA1	A			
Transdance [10	hand at OF	6 2000 12.26.24.			
Impedance [ko	/imm] ac 05.0	.2005 12.30.34.			
Phys. Chn.	Name	Electrode Label / Set No.	Impedance	[kOhm]	
# 1	Fp1	1 / 1		7	
# 2	Fp2	2 / 1		4	
# 3	F7	3 / 1		5	
# 4	F3	4 / 1		17	
# 5	Fz	5 / 1		1	
# 6	F4	6 / 1		4	
# 7	F8	7 / 1		10	
# 8	FC5	8 / 1		19	
# 9	FC1	9 / 1		7	
		Exit Save Info			

# Chapter 6 Preparing a measurement

Familiarize yourself with operation of the actiCAP active electrode system and carry out some test measurements before you start acquiring signals. In all cases, it is essential to observe the safety information in  $\bigcirc$  Chapter 2 as of page 27.

In principle, it is possible to perform acquisition with any test subject. However, before performing acquisition, make sure that the test subject is not sensitive to the electrode caps used including the electrodes and electrode gels.

If necessary, consult the device manufacturer, in particular if the test subject has an unhealthy skin or skin surface.

Insert the electrodes in the actiCAP holders. Each actiCAP electrode set consists of 32 electrodes which are numbered from 1 to 32. The cap has different holders for each branch and these are also numbered from 1 to 32. These numbers enable you to assign the electrodes to the corresponding holders quickly.

If you are using the more recent version of the actiCAP adapter QuickAmp then 32 microswitches are available to you to switch off individually selected channels. This function is particularly valuable if a channel is faulty and you want to exclude it from the Common Average.

The actiCAP delivery documentation also contains the cap specifications.

Perform the following steps:

- In the BrainVision Recorder, assign the physical channel to the electrode position (e.g. FP1). The first electrode of the first branch has the physical channel
   1 and the first electrode of the second branch has the physical channel 33, for instance.
- **2** Place the cap on the test subject.
- 3 Fill the electrodes with gel.
- 4 Perform the impedance measurement.

You can also use the electrodes to acquire EOGs, EMGs and ECGs. When doing so, use the supplied actiCAP holders. Proceed as follows:

- 1 Insert the electrodes in the holders.
- 2 Use an adhesive ring to apply the electrodes to the required part of the body.
- **3** Fill the electrode with gel.

 Requirements relating to the test subject

 Preparing the cap

 Image: Construction of the actic of the a

Example: The first branch corresponds to the color green. You should therefore insert the electrode which has the number 1 in the green actiCAP holder which has the number 1. The second branch corresponds to the color "transparent". Insert the first electrode in this branch in the transparent actiCAP holder with the number 1.



#### Figure 6-1. EOG electrode

Minimizing the impedance values

To minimize the impedance values, switch the actiCAP ControlBox to impedance mode (see section  $\bigcirc$  Section 5.2 as of page 56). The LEDs of the electrodes now light up in red.

First minimize the impedances of the ground and reference electrodes and only then minimize the impedances of the data electrodes.

Proceed as follows:

- 1 Carefully push the blunt needle of the nozzle through the electrode aperture as far as the test subject's head skin.
- **2** Gently roughen the test subject's head skin by means of careful circular movements of the blunt needle of the nozzle. This increases the contact area between the electrode gel and the skin of the head.
- **3** Use the nozzle to apply a small amount of gel (0.2 to 0.3 ml) directly to the skin of the head.
- **4** Fill the remaining space in the electrode with gel.

In this way, you will easily achieve the transition resistance of 25 to 35 kOhm that is required in order to perform measurements with actiCAP.

When the impedance value changes, the electrode LEDs changes from red to yellow or green depending on the ranges you have set.

For more detailed information on checking impedances with the actiCAP ControlSoftware, see Section 5.2 as of page 56.

Figure 6-2. Filling the electrodes with gel



Using this procedure and with a little practice, two people should be able to prepare 32 channels in 4 to 5 minutes or 64 channels in approximately 8 minutes.

The impedances improve with time: To start with, fill all the electrodes with gel as described above. Once you have prepared all the electrodes accordingly, perform a visual check of the impedances.

If the impedance in one or more electrodes has not been sufficiently minimized (LED lit yellow or red), use the blunt needle in the nozzle to push through the electrode aperture again and roughen the test subject's head skin a little more by means of circular movements. If necessary, use a little more gel.

66 Chapter 6 Preparing a measurement

# **Chapter 7** Cleaning the electrodes and cap

We recommend that you clean the cap and the electrodes immediately each time they have been used. When doing this, always first disconnect the subject from the actiCAP active electrode system.

The electrodes, and the electrode pins in particular, are sensitive components. Handle them with great care. Always set down the electrodes on a soft surface (e.g. a towel).

*Make sure that only the electrode heads but not the housings of the actiCAP ControlBox and splitter box come into contact with the water.* 

# Using a disinfectant

If you wish to disinfect the electrodes and electrode cables, use Sekusept forte S $\$ and soak them for approximately 15 minutes in a 3% solution or 1 hour in a 1% solution. Then rinse them under running water.

# **Cleaning the electrodes**

Proceed as follows to clean the electrodes:

Remove the electrodes from the holders by twisting them carefully. When doing this, avoid pulling on the electrode cables. Instead, hold the entire electrode head between your thumb and index finger (see Figure 7-1).

A Damage to property



*Figure 7-1.* Removing the electrodes from the holders

- Fill a plastic bowl with lukewarm water.
   Do not use a metal bowl, as this can cause a coating to form on the sensitive Ag/ AgCl pellets of the electrodes.
- **3** Place the electrodes in the water bath and let them soak for approx. 10 minutes (see Figure 7-2).

*Figure 7-2.* Electrodes in the water bath



**4** Then clean the electrodes with a toothbrush (see <u>Figure 7-3</u>).

If the electrodes are particularly dirty, you can use a mild cleaning agent. However, note that many dishwashing agents can leave a film on the electrodes. Children's shampoos have proved to be the most suitable products. Then rinse the electrodes briefly under lukewarm running water. If the water in your region is hard, you should also stir the electrodes in distilled water.

*Figure 7-3.* Cleaning the electrodes with a toothbrush





- 5 If necessary, you can also clean the electrode cables by rinsing them briefly in the water bath.
- **6** Then remove the electrodes from the water. When doing so, make sure that *the splitter box does not come into contact with water*. We recommend that you cover the splitter box with a towel before you remove the electrodes from the water.
- **7** Wrap the electrodes in a towel (see Figure 7-4). Any residual dampness can dry off in the air.

You can also leave the electrodes to dry on the special storage shelves (see also  $\bigcirc$  Chapter 2 as of page 27).

Figure 7-4. Wrap the electrodes in a towel after cleaning





Always avoid the following:

Do not leave the electrodes and fabric cap to soak for extended periods.

Do not store the electrodes in a disinfectant.

Do not chlorinate the electrodes as this may result in corrosion.

Do not use any hot sterilization methods (e.g. autoclave) since this may damage the cable insulation.

Never use spirit to clean the electrodes and fabric cap.

Never use liquids to clean the splitter box.



Chapter 8 contains test scenarios and recommendations that should assist you when conducting tests and localizing faults before you contact our technical support team.

# 8.1 How do I identify a faulty electrode?

## 8.1.1 Identifying a faulty electrode branch

It is possible that the actiCAP ControlSoftware does not correctly detect the individual electrode branches, even though there is no hardware fault. To exclude this problem, check that you observed the sequence of the installation steps specified in  $\bigcirc$  <u>Chapter 3</u>:

- 1 First connect the splitter box(es) and the amplifier to the actiCAP ControlBox.
- **2** Only after you have done this, connect the actiCAP ControlBox to your computer using the supplied USB cable.
- **3** Open the actiCAP ControlSoftware and check that all the electrode branches that are present are listed correctly in the software.

## 8.1.2 Identifying a faulty electrode LED

- 1 Insert the batteries in the actiCAP ControlBox.
- 2 Place all electrodes including the reference electrode and ground electrode in a saline bath (approx. 3 tablespoons of salt to 1 liter of water). Only ever use a plastic bowl for this.
- **3** Press the *Impedance* **Z** button on the actiCAP ControlBox.
- 4 If the LEDs in the electrodes are working correctly, they light up green.If one or more data electrodes do not light up green, these electrodes are faulty.If the LEDs of all the electrodes light up red, the reference electrode or ground electrode is faulty.

#### 8.1.3 Identifying a faulty electrode impedance

- 1 Connect the actiCAP ControlBox to the computer using the USB cable supplied.
- 2 Place all electrodes including the reference electrode and ground electrode in a saline bath (approx. 3 tablespoons of salt to 1 liter of water). Only ever use a plastic bowl for this.
- 3 Open the actiCAP ControlSoftware, go to the *Impedance Check* tab and start impedance measurement (see section 5.2.3 as of page 60).
- **4** Depending on the salinity of the water bath, the impedance values should be between 0 kOhm and 5 kOhm. If the value for an electrode is above 20 kOhm, this electrode is in all probability faulty.

#### 8.1.4 Checking the electrode signal

- 1 Connect the actiCAP ControlBox to the computer using the USB cable supplied.
- **2** Connect the actiCAP ControlBox to the amplifier.
- **3** Place all electrodes including the reference electrode and ground electrode in a saline bath (approx. 3 tablespoons of salt to 1 liter of water). Only ever use a plastic bowl for this.
- 4 Open the Recorder software.
- **5** Press the *Test*  $\mathbb{N}$  button on the actiCAP ControlBox.
- **6** If all channels are working properly, a square-wave signal (see <u>Figure 8-1</u>) is shown on all channels in the Recorder. If this is not the case, the corresponding electrode is faulty.



#### Figure 8-1. Square-wave signal in the BrainVision Recorder
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#### 8.2 How do I replace a faulty electrode?

Electrodes may only be replaced by persons authorized to do so by Brain Products. Please contact our technical support team in this regard (for contact details, see <u>page 18</u> of these Operating Instructions).

Proceed as follows to replace a faulty electrode:

- **1** Before the electrode is replaced, disconnect the actiCAP ControlBox from the power supply (battery or USB).
- **2** Open the splitter box by unscrewing the screw in the center under the label (1 to 32, 33 to 64 etc.).
- **3** Remove the splitter box cover.
- 4 Unscrew the metal bar on the side of the faulty electrode, by releasing the 2 small machine screws at each end of the bar.
- **5** Carefully withdraw the faulty electrode. This is best done by taking a toothpick or screwdriver, for instance, and carefully removing the front part of the electrode from the splitter (see Figure 8-2).

Figure 8-2. Removing the electrode from the splitter box

**6** Carefully insert the new electrode. Ensure that the four metal teeth engage correctly in the splitter and that the rubber sheathing is aligned and does not protrude.



Figure 8-3. Incorrect positioning of an electrode (A)

Figure 8-4. Incorrect positioning of an electrode (B)



- **7** Replace the metal bar with the flat side facing down and secure it with the screws.
- 8 Replace the cover on the splitter box and secure it with the small screw in the middle. Affix the label to the splitter box again.

If the EEG curve obtained for an acquisition is very flat, check that the plug is seated correctly (see step 4).

### 8.3 How do I solve problems related to the power supply via USB?

It is possible that the actiCAP ControlBox does not work correctly when it is powered The problem from the USB port. It is not immediately evident whether it has been deactivated by the operating system or there is a fault in the ControlBox. If you are running other devices on a USB port alongside the actiCAP ControlBox, Background there is a risk that insufficient power is available for the ControlBox to operate correctly. A USB port on a computer is generally supplied with 500 mA at 5 V. All devices on the USB port are uniformly assigned 100 mA. After the device has registered at the USB port, the device driver on the computer attempts to switch the device to a configuration where it can function correctly. The controller of the USB port then decides whether sufficient power is available for this. If this is the case, the connected device operates correctly. Otherwise the original configuration (uniform consumption  $\leq$  100 mA) is retained to avoid overloading the power supply and the device that is consuming more power than is assigned to it is switched off by the controller. To ensure that your actiCAP ControlBox works without problems, you should observe Our recommendation the following recommendations:

- 1 Only power the actiCAP ControlBox via USB during impedance measurement and software-controlled tests (*Label Check* for checking the electrode positions, *Electrode Groups* for creating electrode groups and *Impedance Check* for checking the impedance values). You should use batteries to supply the actiCAP ControlBox with power when you are actually acquiring data.
- **2** When performing impedance measurement, always run the actiCAP ControlBox on an active USB hub with a separate power supply.

If you still have any problems with the actiCAP ControlBox, contact out technical support team. You will find the contact details on <u>page 18</u> of these Operating Instructions.

76 Chapter 8 Troubleshooting

# Chapter 9 Guarantee and warranty

To ensure the greatest possible level of safety of test subjects and users as well as to ensure trouble-free operation, we recommend that you only use accessories approved by Brain Products GmbH. No warranty claims will be accepted in regard to loss or damage due to the use of unsuitable accessories and/or consumables.	C Parte
Brain Products GmbH provides the statutory guarantees for the actiCAP active electrode system and its accessories.	Guarantee
Brain Products GmbH provides a warranty of 12 months as of the date of purchase in respect of the electrodes and the fabric cap and a warranty of 36 months as of the date of purchase in respect of the other hardware.	Warranty
Any supplied power and connection cables, detached sensors in the electrodes and consumables (batteries) are excluded from the manufacturer's warranty. Hardware and software upgrades are also not included in the warranty.	Exclusion from warranty
The warranty does not extend to any collateral or consecutive loss or damage of whatsoever nature and/or any costs resulting from defect or functional impairment.	
Warranty claims expire:	
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, and insufficient packaging on dispatch;	
In the event of intervention, modifications, changes, repairs and any other work of whatsoever type performed on the devices by persons not authorized by the manufacturer.	

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If accessories or consumables other than OEM parts are used.

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

78 Chapter 9 Guarantee and warranty

### Appendix A Product identification information

Product designation: Software Manufacturer: actiCAP active electrode system (16-/32-/64-/ 96-/ 128-channel) actiCAP ControlSoftware as of Version 1.2 Brain Products GmbH Zeppelinstraße 7 D-82205 Gilching (Munich) Phone: +49 8105 73384 - 0 Fax: +49 8105 73384 - 33 Web site: www.brainproducts.com Email: techsup@brainproducts.com 80 Appendix A Product identification information

### Appendix B Technical data

Acquisition mode	
Amplification:	1
Input impedance:	> 200 MOhm
Operating frequency:	DC - 5000 Hz
Inherent noise	
(including electrode noise):	< 2 $\mu$ V <sub>pp</sub> for 0.1 – 35 Hz band
Dynamic range:	± 1000 mV
Offset voltage:	< 20 mV (incl. electrode offset) measured in 0.9 % saline (NaCl)
Active Shield submode	
Gain REF-GND electrode:	- 10
Impedance mode	
Measuring frequency:	30 Hz
Measuring range:	1 to 500 kOhm
Measuring current:	< 7.5 μA
Measuring cycle time:	< 4 s (128 channels)
Battery operation	
Туре:	4 x AA NiMH rechargeable batteries (2100 mA/h minimum capacity)
Rated voltage of batteries:	4.8 V
Voltage threshold	
( <i>Replace Battery</i> LED lights up):	4.0 V (the actiCAP cannot be operated for more than 30 minutes)
Operating time:	< 6 hours in acquisition mode with fully charged batteries
Maximum power consumption in Acquisition and test signal mode:	45 mA / actiCAP -32 70 mA / actiCAP -64 90 mA / actiCAP -96 110 mA / actiCAP -128
Maximum power consumption in impedance mode:	185 mA / actiCAP -32 460 mA / actiCAP -64 230 mA / actiCAP -96 255 mA / actiCAP -128

#### USB interface

Rated voltage:	5 V (± 15 %)
Maximum power consumption in Acquisition and test signal mode:	60 mA / actiCAP -32 90 mA / actiCAP -64 120 mA / actiCAP -96 150 mA / actiCAP -12
Maximum power consumption in	
impedance mode:	250 mA / actiCAP -32 500 mA / actiCAP -64 310 mA / actiCAP -96 340 mA / actiCAP -128
Power consumption in standby	50 mA
inoue:	50 IIIA
Power consumption in power-saving mode:	<0.5 mA
Physical isolation:	Galvanic isolation of the USB port in the actiCAP ControlBox
Computer	

USB cable length:	2 m
Supported operating systems:	Windows® XP, Windows® Vista, Windows® 7 (32-bit and 64-bit) Windows® 8 (32-bit and 64-bit)

#### actiCAP adapter for QuickAmp

Figure B-1. actiCAP adapter for QuickAmp with microswitch





#### Figure B-3. Port for amplifier connection



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84 Appendix B Technical data

### Appendix C Environmental conditions

The actiCAP active electrode system and its accessories may only be used in environments that are not exposed to sunlight, humidity, water, dirt, conducting contaminants and extreme radiation (EMC, HF sources).

The following environmental conditions must be satisfied for the operation, transport and storage of the actiCAP active electrode system and its accessories:

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

86 Appendix C Environmental conditions

### **Appendix D** Explanation of the markings on the products

The following labels are affixed to the actiCAP ControlBox and only apply to the hardware of the actiCAP system (i.e. do not apply to actiCAP ControlSoftware):

	Observe the Operating Instructions.
MR	This symbol indicates that the device is not suitable for MR.
CE	The manufacturer confirms that this product meets the requirements laid down in the Directive 2004/108/EC of the European Parliament and of the Council of December 15, 2004 on the approximation of the laws of the Member States relating to electromagnetic compatibility.
Ť	Patient applied part of type BF. Although this symbol confirms a BF applied part according to IEC 60601 (2nd ed.) this product is not a medical device. Not for use with a defibrillator!
	This symbol confirms compliance with the environmental requirements for electronic devices (only applies to China).
	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.
	Protection class II. Please note that this is not a medical device.
	The name and address of the device manufacturer are specified next to this symbol.

Appendix D Explanation of the markings on the products

## Appendix E Ordering codes

#### System

actiCAP 16-channel active electrode system:	BP-04199
actiCAP 32-channel active electrode system:	BP-04200
actiCAP 64-channel active electrode system:	BP-04201
actiCAP 96-channel active electrode system:	BP-04202
actiCAP 128-channel active electrode system:	BP-04203
Components	
actiCAP ControlBox	
+ 1 active ground + 1 active reference electrode:	BP-04240
actiCAP amplifier adapter (touch-proof):	BP-04241
actiCAP amplifier adapter + connection cable (QuickAmp):	BP-04241-QA
actiCAP 16-channel electrode set with 16 active electrodes:	BP-04242-16
actiCAP 32-channel electrode set with 32 active electrodes:	BP-04242-32
actiCAP single ground electrode:	BP-04243-GRD
actiCAP single reference electrode:	BP-04243-REF
actiCAP single data electrode:	BP-04243-SIG
actiCAP electrode holder:	BP-04244
actiCAP cap without electrodes and holders:	BP-04250
actiCAP 32 standard cap with holders, without electrodes:	BP-04251
actiCAP 64 standard cap with holders, without electrodes:	BP-04252
actiCAP 96 standard cap with holders, without electrodes:	BP-04253
actiCAP 128 standard cap with holders, without electrodes:	BP-04254
actiCAP ControlBox-amplifier connection cable, 100 cm:	BP-04255
actiCAP USB cable:	
	BP-04256
actiCAP charger for NiMH batteries:	BP-04256 BP-04257
actiCAP charger for NiMH batteries: actiCAP NiMH rechargeable batteries:	BP-04256 BP-04257 BP-04258
actiCAP charger for NiMH batteries: actiCAP NiMH rechargeable batteries: actiCAP multi-use storage shelves:	BP-04256 BP-04257 BP-04258 BP-04263
actiCAP charger for NiMH batteries: actiCAP NiMH rechargeable batteries: actiCAP multi-use storage shelves: actiCAP starter set:	BP-04256 BP-04257 BP-04258 BP-04263 BP-04259-Visc

90 Appendix E Ordering codes

### Appendix F Using passive pin electrodes

You can also use passive pin electrodes specially developed for the actiCAP holders and the fabric cap as an alternative to the active electrodes. The electrode pellet of the pin electrode (see Figure F-F-1) consists of high-quality Ag/AgCl. The generous filling aperture in the electrode means that it can be prepared and cleaned very rapidly. The electrode cable (see Figure F-F-2) is fitted with a touch-proof connector and is extremely flexible and robust.

You can upgrade your actiCAP system with the passive pin electrodes, thus allowing you to switch easily between active and passive electrodes to meet the requirements of your various experimental configurations. You can simply continue to use the fabric cap and the electrode holders as you do so.

Figure F-1. Passive pin electrode for actiCAP holder, Ag/AgCl pellet



The pellet of the passive pin electrode is extremely delicate. Handle it carefully to avoid breaking off the pellet.







*Figure F-3.* Passive pin electrodes with actiCAP holders and fabric cap



You will find detailed information on connecting the pin electrodes to an amplifier or an electrode input box and on cleaning the electrodes on our Web site: <a href="http://www.brainproducts.com/productdetails.php?id=36&tab=2">http://www.brainproducts.com/productdetails.php?id=36&tab=2</a>.

#### List of abbreviations

- DC ..... Direct current
- ECG ..... Electrocardiogram
- EMC ..... Electromagnetic compatibility
- EMG ..... Electromyogram
- EOG ..... Electrooculogram
- GND ..... Ground electrode
- HF ..... High frequency
- MR ..... Magnetic resonance
- NiMH ..... Nickel-metal hydride battery
- REF ..... Reference electrode

94 List of abbreviations

#### Glossary

#### A

**Active Shield:** Recording mode that allows ambient noise, interference due to electrical effects and artifacts due to cable movement to be minimized.

**Average reference:** Type of montage in which the average of all selected channels is used as a reference.

#### В

**Band width:** Frequency range of an EEG channel defined as the difference between the lowest and highest frequencies that can be represented.

**BrainAmp:** Amplifiers from Brain Products with 32 channels each (can be extended) that can be used in different fields (laboratory acquisition, combined EEG-fMRI measurements, EEG-TMS acquisition, etc.).

#### С

**Channel definition:** Contains stored information on the number, arrangement, name and branch number of the electrodes. File name extension: .acdf.

Common Average: see Average Reference.

#### F

**FirstAmp:** Compact amplifier from Brain Products with 8 channels and 2 AUX channels suitable in particular for study and training purposes.

#### I

**Impedance measurement:** Operating mode of the actiCAP ControlBox for measuring the resistance of the electrodes.

Impedance: Resistance between the electrode and the skin.

#### Μ

Monitoring: Observation of the EEG signals on screen.

#### Q

**QuickAmp:** Amplifier in which the average value across all channels is used as the average reference for the individual channels (common average reference).

R

**Recorder:** The EEG recording software from Brain Products featuring extensive storage, filtering and display functions.

**Resolution:** Specifies the granularity with which the value range of the EEG signal is subdivided during digital acquisition. A higher resolution means finer granularity and more accurate acquisition of the original signal. Unit:  $\mu V$ .

#### S

**Sampling rate:** Number of data points measured per second when acquiring an EEG digitally.

**Scaling:** In the context of displaying the EEG signal, scaling is the assignment of an amplitude value in  $\mu$ V to an interval.

#### V

**V-Amp:** Compact amplifier from Brain Products with 8 or alternatively 16 channels and 2 AUX channels that can, for instance, be used for BCI applications.

#### W

**Workspace:** Storage locations in the Recorder for files containing processing steps performed on the EEG data, user-defined recording parameters, amplifier settings and other information. File name extension: .rwksp.

96 Glossary

#### Subject index

#### Α

actiCAP ControlBox attaching 25 connecting to a BrainAmp 37 connecting to EEG amplifier 36 connecting to the computer 41 deactivating 44 status 50 actiCAP ControlSoftware installing 30 starting 49 adapter (amplifier) 23, 36–37 ambient influences reducing 44

#### В

BrainAmp 23, 37 buttons (ControlBox) 43

#### С

channel definition 51, 52, 53 loading 51 saving 55 common-mode rejection 44

#### D

data recording 44 disposal 87 driver installing 34 drivers installing 41–42

#### E

electrode groups creating 58 electrodes assigning colors 56 assigning to physical channels 36 attaching 63 care 70 changing names 53–54 changing position 52–53 cleaning 25 labels 54

#### F

firmware 55

#### G

ground electrode 37, 39, 45, 46, 71

#### I

impedance minimizing 64 saving 62 impedance measurement 45, 60 color scale 62 factory settings 60 starting 61 stopping 62 impedance measurement time 45 changing 60

#### L

LEDs color change 60 factory settings 45 flickering 45 switching off 58

#### Μ

Microsoft .NET Framework 30

#### 0

operating modes 43 acquisition 44 Active Shield 44 impedance check 45 test signal 46

#### Ρ

power consumption 45 power supply 42 using batteries 42 power supply via USB port 41 program CD 30, 31, 42

#### Q

QuickAmp 44, 63 adapter 82

#### R

Recorder 46, 63 loading a workspace 54 setting up a workspace 46 reference electrode 37, 39, 71 ribbon cable connector 39–40

#### S

square wave signal 48, 72 storage 25–26 system requirements 30

#### Т

test signal recording 46

#### U

USB hub 41, 75