TriggerBox & TriggerBox Extension

Operating Instructions
Product revision 02
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About this document

This document describes how to use the TriggerBox and TriggerBox Extension and how they are integrated into a measurement setup. This document forms an integral part of the product. It must be precisely adhered to in order to ensure that the product is used as intended and operated correctly to guarantee the concomitant safety of test subjects, users and third parties. Keep this document in a safe place and make sure that it is always available to the users.

No part of this document may be reproduced or distributed in any form without the express written permission of Brain Products. The operator may print this document to make it available for the users of the product.

Make sure that you have the most recent version of this document instructions for your product or product revision. You can find the most recent version on our website: http://www.brainproducts.com.

Target group of this document

This document is intended for users in the psychological and neurophysiological research area as well as physicians and medical experts with experience in performing physiological data acquisition. Staff must also know how to work safely and reliably with the permitted amplifier and the associated recording software.

Structure of this document

This document is divided into the following chapters:

- Chapter 1 contains an overview of the scope of delivery
- Chapter 2 gives an overview of the main features of the product and describes the connectors.
- Chapter 3 contains the steps you have to do, before you can use the product.
- Chapter 4 gives instructions for using the products.
- Chapter 5 describes setup examples.
- Chapter 6 contains information on cleaning and maintenance.
- Chapter 7 contains information on the disposal of the products.
Conventions in this document

Typographical conventions

**Bold** indicates items on the user interface (menus, buttons, switches, connectors, options) and is used for emphases in the text

*Italic* indicates titles of dialog boxes/tabs, file locations and is used to indicate product names

**Underscore** indicates cross-references and web addresses

**Monospaced** indicates text or characters to be entered at the keyboard

Symbols

![Caution](image) **Caution**: This symbol indicates that incorrect use of the product(s) may result in a **personal injury** to the test subject, the user and/or a third-party. Failure to observe the information in this document constitutes incorrect use.

![Notice](image) **Notice**: This symbol indicates that the incorrect use of the product(s) may bring about a risk of **damage to property**.

![Note or Tip](image) **Note** or **Tip**: This symbol draws your attention to important information relating to the current topic and to recommendations on how to use the product(s).

![Cross-reference](image) **Cross-reference**: This symbol indicates a reference to a related chapter, section or document.

![New](image) **New**: This symbol indicates changes or new content at this point.

Revision history

<table>
<thead>
<tr>
<th>Page</th>
<th>Status</th>
<th>Subject</th>
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</thead>
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<tr>
<td>7</td>
<td>modified</td>
<td>Product identification (CE marking)</td>
</tr>
</tbody>
</table>
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.
About the product

In many EEG/EP measurement setups, EEG/EP signals and trigger signals are recorded at the same time. Simple setups can effortlessly be realized with simple cables. Complex setups with different trigger sources, however, require cables and interfaces that are unique for one specific application.

The solution is a universal interface that can interconnect all trigger sources to the amplifier. This is where TriggerBox comes in: thanks to its standard interfaces (LPT, D-Sub, BNC, etcetera) it can combine trigger signals from several sources and forward up to 16 signals to one output.

Revision 2 of TriggerBox is offering even more flexibility. It gives the possibility to use the USB port of the stimulus presentation computer for trigger transmission and is no longer dependent from the increasingly scarce LPT port technology. The TriggerBox revision 2 provides a virtual serial port via USB that can be directly addressed from your stimulus presentation software.

With additional features (e.g. galvanic isolation and pulse stretching) the TriggerBox is an expedient and flexible tool for many setups.

Product identification

| Product designation         | TriggerBox  
| Article number              | TriggerBox: BP-210-9030  
| Manufacturer                | Brain Products GmbH  
| Manufacturer                | Zeppelinstrasse 7  
| Manufacturer                | D-82205 Gilching  
| Tel:                        | +49 (0) 8105 733 84 - 0  
| Fax:                        | +49 (0) 8105 733 84 - 505  
| Web:                        | http://www.brainproducts.com  
| Email:                      | techsup@brainproducts.com  
| Warranty                    | http://brainproducts.com/contact.php  

Combination with other products

TriggerBox

The TriggerBox is intended to be used with the following products:

<table>
<thead>
<tr>
<th>Product</th>
<th>Manufacturer</th>
</tr>
</thead>
<tbody>
<tr>
<td>V-Amp family</td>
<td>Brain Products GmbH</td>
</tr>
<tr>
<td>actiCHamp family</td>
<td>Brain Products GmbH</td>
</tr>
<tr>
<td>BrainAmp family</td>
<td>Brain Products GmbH</td>
</tr>
<tr>
<td>TriggerBox Extension</td>
<td>Brain Products GmbH</td>
</tr>
<tr>
<td>QuickAmp family</td>
<td>Twente Medical Systems International (TMSi)</td>
</tr>
<tr>
<td>MR scanners outside of the MR scanner room</td>
<td>Siemens, General Electric, Bruker, Philips</td>
</tr>
<tr>
<td>Stimulation equipment/computers</td>
<td>different manufacturers(^a)</td>
</tr>
<tr>
<td>Computers for power supply via USB</td>
<td>different manufacturers(^a)</td>
</tr>
</tbody>
</table>

\(^a\) Equipment must comply with the currently applicable version of IEC 60601, IEC 60950-1 or EN 60950-1.

TriggerBox Extension

The TriggerBox Extension is intended to be used with the following products:

<table>
<thead>
<tr>
<th>Product</th>
<th>Manufacturer</th>
</tr>
</thead>
<tbody>
<tr>
<td>V-Amp family</td>
<td>Brain Products GmbH</td>
</tr>
<tr>
<td>actiCHamp family</td>
<td>Brain Products GmbH</td>
</tr>
<tr>
<td>BrainAmp family</td>
<td>Brain Products GmbH</td>
</tr>
<tr>
<td>TriggerBox</td>
<td>Brain Products GmbH</td>
</tr>
</tbody>
</table>

Beside this general statement about permitted product combinations the user must check, whether 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). Please observe the operating instructions of the respective products.
Markings on the products

The following labels are affixed to the products:

- **Observe the operating instructions.**

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

- **MR Unsafe:** Products with this symbol are not safe for use in an MR environment.


  Next to this symbol, the name and address of the product manufacturer is specified.
Safety information

Please read the following safety information carefully since it helps to prevent personal injury and damage to property. It is assumed that you have the required specialist knowledge in handling the product and accessories.

Brain Products will not accept any liability for loss or damage resulting from a failure to follow these operating instructions and, in particular, the safety instructions.

Intended use

The TriggerBox is used to connect trigger sources, stretch trigger signals and convert optical signals into electrical signals. The TriggerBox Extension is used to send trigger signals to other equipment.

The TriggerBox and TriggerBox Extension are not medical devices and may be used in the context of non-medical applications in order to carry out applied and fundamental research on the basis of neurophysiological methodology. The use for diagnosis, therapy, monitoring of vital physiological processes (such as cardiovascular functions, etcetera) or other medical purposes is expressly forbidden.

Correct use

The TriggerBox and TriggerBox Extension are permitted to be used:

► by personnel in the psychological and neurophysiological research area as well as physicians and medical experts.
► in research institutes and other non-medical environments (e.g. at home), hospitals, clinics and other medical environments, provided that all other stipulations regarding the correct use are met and that the products are used in accordance with its intended use.

The TriggerBox and TriggerBox Extension must not be used:

► by unqualified persons (e.g. laymen) and persons who cannot read (e.g. due to visual impairment) or understand (e.g. due to a lack of language skills) this document.
► in MR scanner environment.
► in vicinity of explosive gases, for example in operating theaters.
in oxygen enriched atmospheres.

- under water (e.g. sea, swimming pool, bath tub) or in environments in which significant amounts of water could enter the products (e.g. under shower, under water-tab).

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

**General precautions**

- Do not open the products and do not modify.
- Handle the product and its accessories with care.
- No liquids must penetrate the products.
- Do not drop the product or allow it to fall and avoid impacts.
- Heat, direct sunlight (UV radiation), moisture, dust, liquids, conductive foreign matter and excessive radiation can shorten the lifetime of the product.
- Use the supplied cables. Brain Products is not liable for damage caused by cables that are not supplied by Brain Products.
- Do not unplug connectors by pulling on their cable. Instead unplug a connector by releasing the locks (if applicable) and by pulling on the connector itself.
- Do not crush or kink the cables.
- Observe the specifications in Appendix A when connecting equipment to the TriggerBox or TriggerBox Extension.

**Risks of personal injury**

**CAUTION**

**Risk of entanglement in cables**

Test subject and personnel could become entangled in the cables. Lay cables carefully in order to ensure the safety of the test subject and personnel.
Risks of damage to property

NOTICE

Risk of damage to the stimulation equipment when two trigger outputs are connected

If you connect the trigger output to the output of the stimulation equipment, the connectors or equipment can be destroyed by too high voltages.

- Do not connect two trigger outputs together.
- Do not connect the output of the TriggerBox to the trigger output of an amplifier.

Take special care when you make the connections.

Risk of damage to the TriggerBox and MR scanner in the MR scanner room

The product is not MR safe. It contains magnetic materials. The TriggerBox can become a projectile by the magnetic force of the MR scanner. Do not use it in the MR scanner room. You can use the product in the control room of an MR scanner.

Risk of damage to the TriggerBox when using a defibrillator

The TriggerBox is not protected against electrical discharges of a defibrillator. Disconnect the TriggerBox before using a defibrillator to avoid damages.

Note on the data acquisition

Note

During operation, keep a distance of at least 3 m from cell phones or similar transmitters, other sources of high-level interference such as microwave, x-ray or similar equipment that may cause sparks. Otherwise trigger information may be lost or corrupted.

The user is responsible for the appropriate measurement setup and the quality of the recorded data. If you have any questions concerning recording and the quality of data acquisition, please contact your local dealer.
Chapter 1  Scope of delivery

**TriggerBox**

- **USB cable, 3 m**
  - BP-210-9030
  - BP-345-1030
- **Application Suite DVD**
  - BP-210-9030
  - BP-270-6000
- **LPT cable, 3 m**
  - BP-210-9030
  - BP-345-1010
  - BP-270-6000
  - BP-245-NNNNa
- **Trigger cable** (screened), 3 m
  - BP-210-9030
  - BP-245-NNNNa
- **Test cable, 0.5 m**
  - BP-210-9030
  - BP-245-1010
- **BNC push button, 1.9 m**
  - BP-210-9030
  - BP-345-9000

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a. Specific for your amplifier.
TriggerBox Extension

BP-210-9040

Extension cable, 3 m
BP-345-1020

Application Suite DVD
BP-270-6000
Chapter 2  Overview of the product

2.1 TriggerBox at a glance

1. Inputs for bit 15 (page 16)
2. Input for bit 8 to 15 (page 16)
3. Inputs for bit 0 to 7 (page 17)
4. Bit selector switches (page 17)
5. Power LED (page 18)
6. Input for bit 0 to 7 via LPT (page 18)
7. USB port (power supply/input/output) (page 19)
8. Stretcher switches (page 19)
9. Output for bit 0 to 15 (page 20)

Numbers against gray background: These inputs are galvanically isolated from one another and the other inputs.
2.2 Connectors and switches of the TriggerBox

Inputs for bit 15

There are two extra inputs for bit 15 on the TriggerBox. These inputs have the following characteristics:

- fiber-optic or BNC,
- galvanically isolated from all other inputs,
- can be stretched.

Additional information

- Bit 15 must only be occupied once, that is, either on the TriggerBox or TriggerBox Extension. Otherwise trigger information is lost.

Input for bit 8 to 15

The input **In 8-15** is used to connect the TriggerBox Extension. This allows to add up to eight trigger sources.

The input has the following characteristics:

- for a maximum of eight bits (bit 8 to 15),
- it is not galvanically isolated,
- it is connected to the output Amp,
- it is connected to the USB port (output),
- bit 15 can be stretched.

Additional information

- The **TriggerBox with and TriggerBox Extension** is used with amplifiers of the BrainAmp family. These have a 16 bit trigger input.
**Inputs for bit 0 to 7 via BNC**

The inputs $\text{In 0}$ to $\text{In 7}$ are used to connect individual trigger sources to the TriggerBox.

These inputs have the following characteristics:

- for a maximum of eight bits (bit 0 to 7),
- galvanically isolated from one another and all other inputs,
- they are connected to the output Amp,
- bit 7 can be stretched.

**Additional information**

$\Rightarrow$ To select the desired BNC input, set the corresponding bit selector switch(es) to the BNC side.

**Bit selector switches**

The bit selector switches are used to select the individual bits of the trigger sources. You can switch between the PC side (left) or the BNC side (right).

- $\text{PC} = $ selects the single bits of the PC inputs (LPT or USB).
- $\text{In} = $ selects the corresponding BNC input.

**Additional information**

$\Rightarrow$ The stimulation paradigm determines how many bits are required.
**Power LED**

The TriggerBox is powered via USB (1). When power is supplied the **Power LED (2)** lights up green.

The power supply is required for the galvanic isolation of the BNC inputs and FOC/BNC input.

**Input for bit 0 to 7 via LPT**

The LPT input is used to connect the stimulus presentation computer to the TriggerBox.

This input has the following characteristics:

- it is a parallel port,
- can receive a maximum of eight bits (bit 0 to 7),
- it is **not** galvanically isolated,
- it is connected to the output Amp,
- bit 7 can be stretched.

**Additional information**

- To select the desired bits of the LPT input, set the corresponding bit selector switch(es) to the **PC** side.
USB port (power supply/input/output)

The USB port has the following characteristics:

- input for up to eight bits (bit 0 to 7),
- used as virtual serial port by the software (TriggerBox can be accessed via serial COM port)
- output for up to eight bits (bit 8 to 15),
- power supply for the TriggerBox,
- bit 7 can be stretched,
- not galvanically isolated,
- internally connected to the output Amp.

Stretcher switches

Very short trigger pulses may not be acquired depending on the selected sampling rate. To avoid losing trigger information, the duration of the trigger pulse can be stretched to five milliseconds.

The stretcher switches have the following positions:

- Off = no stretching.
- 5 ms = signal is stretched or shortened.

Additional information

- While short pulses are stretched (top), longer pulses are trimmed (middle) to five milliseconds (bottom).
Output for bit 0 to 15

The output Amp is used to connect an EEG amplifier to the TriggerBox.

This output has the following characteristics:

- output of up to 16 bits

Additional information

⇒ A specific cable for your amplifier family is provided in the delivery. Only use the provided cables.
2.3 TriggerBox Extension at a glance

1 Output (page 22)
2 Input for bit 0 to 7 (page 23)
3 Input/output (page 23)

Note

Numbers in brackets: Sequential numbering if you are using the TriggerBox Extension together with the TriggerBox.


2.4 Connectors of the TriggerBox Extension

Output

The output **Output 0-7 (8-15)** is used to connect the TriggerBox Extension to the TriggerBox.

Signals applied to the BNC connectors are output at this connector.

The connector has the following characteristics:

- output of up to eight bits,
- not galvanically isolated.

Additional information

- You can connect this output to the trigger input of the actiCHamp or V-Amp.

- If you are using all eight BNC inputs, the bit 15 connectors on the TriggerBox (FOC/BNC) must not be occupied.
**Input for bit 0 to 7**

The input **Input 0-7** is used to connect the actiCHamp or another TTL compatible equipment to the TriggerBox Extension. Signals applied to this input, are output at the BNC connectors. Thus, the signals are split on individual trigger lines.

The connector has the following characteristics:

- input of up to eight bits,
- not galvanically isolated.

**Additional information**

- This input is internally connected to the BNC connectors. Bit 0 is on pin 1 of the connector, Bit 1 is on pin 2, etcetera.

**Input/output**

The BNC connectors can be used as input and output. These connectors have the following characteristics:

- Input: Signals applied to the BNC connectors are output at the **Output 0-7 (8-15)**.
- Output: Signals applied to the **Input 0-7** are output at these BNC connectors.
- Not galvanically isolated.
3.1 Check the scope of delivery

The components listed below are included in the scope of delivery. Make sure that the delivery is complete. If the product or package show any signs of damage or if the delivery is incomplete, please contact your local dealer.

- TriggerBox
- USB cable
- LPT cable
- Trigger cable (screened), specifically for your amplifier
- Test cable (short)
- BNC push button
- Application Suite DVD

3.2 Install the software and drivers

The TriggerBox has a USB port that is used as virtual serial port by the stimulus presentation software. To make full use of its functionalities, install the TriggerBox Test IO software. This installation also comprises all related drivers.

Supported operating systems

- Windows® 7, 32 and 64 bit
- Windows® 8.1, 64 bit

Prepare:

- Application Suite DVD
- Computer on which the stimulus presentation software is running
- TriggerBox not connected to the computer

1 Insert the Application Suite DVD into your computer.
   The welcome window opens automatically.
2. In the welcome window click on Install Accessories / Caps Software > Install TriggerBox Test IO. All relevant drivers for the TriggerBox are installed automatically. This can take several minutes.

⇒ After the installation restart the computer and proceed to the next task.

3.3 Connect to a computer for the first time

To complete installation of the hardware drivers, you must connect the TriggerBox to the computer.

Prepare:
- TriggerBox
- USB cable
- Computer on which you installed the drivers

1. Connect the TriggerBox to the computer with the USB cable.
2. Make sure that the green Power LED lights up, when power is supplied.
   If the Power LED does not light up, check all cable connections and make sure that the computer is switched on.

⇒ Windows® installs the drivers for the USB port, to which you have connected the TriggerBox. When you connect the TriggerBox to another USB port, Windows® installs the driver anew.
3.4 Test the TriggerBox

Note

Perform a test run, before conducting the measurement itself. A test run ensures that the triggers are recorded as desired.

3.4.1 Open the TriggerBox Test IO

Prepare:

- TriggerBox
- USB cable

1. Connect the TriggerBox to the computer with the USB cable.
2. Open the TriggerBox Test IO:
   - Click on the Windows Start button > All Programs > BrainVision > BrainVision TriggerBox.

The following window opens:
3.4.2 **Do the TriggerBox test**

The TriggerBox test checks the function of the outputs and inputs of the TriggerBox independently from your project setup.

**Prepare:**
- TriggerBox
- test cable
- USB cable
- TriggerBox Test IO running

1. Connect the test cable to the output **Amp** and the input **In (8-15)** of the TriggerBox.
2. Connect the TriggerBox to the computer with the USB cable.
3. Set all the selector switches to the PC side (**PC 0 to PC 7**).
4. In the TriggerBox Test IO click on **Start** to run the automatic test.

⇒ All bit combinations are consecutively generated by activating and deactivating combinations of bits 0 to 7.

For more details please refer to the **software help**.
3.4.3 Do the Setup test

The Setup test checks the setup between the stimulus presentation computer and the recording computer.

**Prepare:**
- TriggerBox
- trigger cable (screened)
- USB cable
- Amplifier
- Recording computer (BrainVision Recorder installed)
- Computer with TriggerBox Test IO
- TriggerBox Test IO running

1. Make the connections:
   a. Connect the TriggerBox to the amplifier with the trigger cable (screened).
   b. Connect the TriggerBox to the computer with the TriggerBox Test IO.
   c. Connect the amplifier to the recording computer.

2. Set all the selector switches on the TriggerBox to the PC side (*PC 0 to PC 7*).

3. On the recording computer:
   - Open BrainVision Recorder
   - Click on **Amplifier > Digital Port Settings...**

4. On the computer with the TriggerBox Test IO:
   - Open the TriggerBox Test IO.
   - Click on **Start** to run the test.

   ➔ The active bits are visible in the **Digital Port Settings...** window.

**See also:**

*Connect an amplifier to the TriggerBox*
3.4.4 Do the BNC test

The BNC test is used to check the BNC inputs 0-7 of the TriggerBox.

Prepare:
- TriggerBox
- USB cable
- BNC push button
- test cable

1 Connect the TriggerBox to the computer with the USB cable.
2 Connect the test cable to the output Amp and the input In 8-15 of the TriggerBox.
3 Connect the BNC push button to one of the BNC inputs In 0 to In 7.
   Turn the bayonet housing clockwise, to lock the plug onto the connector.
4 Set the bit selector switch for the connected input to the BNC side.
5 Open the TriggerBox Test IO.

When you press the BNC button, the corresponding bullet in the TriggerBox Test IO toggles color.

For more details please refer to the software help of the TriggerBox Test IO.

Notes on the input levels
- The level of open BNC inputs is high by default.
- The level of the open PC input is set by the amplifier.
- If connected to an LPT port of a computer, the level of the trigger lines on the PC input is determined by the computer.
3.5 Make settings in BrainVision Recorder

Notes

- Special settings are required in BrainVision Recorder when you use the TriggerBox with the BrainAmp-family.
- Take the level condition of each trigger bit into account, to interpret the trigger codes correctly (refer to Appendix A).

Refer to the BrainVision Recorder user manual for details about the:

- digital port settings for your amplifier (especially the BrainAmp-family),
- required trigger length for a specific sampling rate.
4.1 Connect an amplifier to the TriggerBox

Amplifiers are connected to the output Amp.

Prepare:
- TriggerBox
- USB cable
- trigger cable (screened)
- amplifier (for details see table below)

1. Connect the trigger cable (screened) to the output Amp of the TriggerBox.
2. Connect the other end of the trigger cable (screened) to the trigger input of the amplifier.
3. Connect the TriggerBox to the computer with the USB cable.

You can connect the TriggerBox to the following amplifiers:

<table>
<thead>
<tr>
<th>Amplifier</th>
<th>Max. bits</th>
<th>Connector name</th>
</tr>
</thead>
<tbody>
<tr>
<td>BrainAmp</td>
<td>16</td>
<td>Trigger (at USB adapter)</td>
</tr>
<tr>
<td>actiCHamp</td>
<td>8</td>
<td>Trigger In</td>
</tr>
<tr>
<td>V-Amp</td>
<td>8</td>
<td>Trigger 1</td>
</tr>
</tbody>
</table>
4.2 Connect a stimulus presentation computer

The stimulus presentation computer can be connected to the USB port (1) or the LPT input (2) of the TriggerBox. Use the LPT port of your computer for the TriggerBox. If you do not have an LPT port or if it is occupied, use the USB port instead. It is used as virtual serial port by the software.

Note that the USB port is also used for power supply.

Use the LPT port

Prepare:
- TriggerBox
- USB cable
- LPT cable

1 Connect the LPT cable to the input **PC 0-7** of the TriggerBox.
2 Connect the other end of the LPT cable to the stimulus presentation computer.
3 Connect the TriggerBox to the computer with the USB cable.
   The USB connection is necessary for power supply.

Use the USB port

Prepare:
- TriggerBox
- USB cable

1 Connect the USB cable to USB connector of the TriggerBox.
2 Connect the other end of the USB cable to the stimulus presentation computer.
4.3 Select the trigger sources (bit 0 to 7)

You select the trigger source for bits 0 to 7 with the bit selector switches. You can switch between the PC inputs (USB and LPT) and the BNC inputs (In 0 to In 7) for each bit.

Before each measurement, make sure to set bit selector switches correctly.

Prepare:
- Make all connections according to your project.
- The TriggerBox is connected to an amplifier (page 31) and stimulus presentation computer (page 32).

1 Connect the trigger sources to the TriggerBox.
2 Set the bit selector switches
   - PC side for trigger pulses from the stimulus presentation computer.
   - BNC side for trigger signals from external equipment, for example the push button.

Example

The stimulus presentation software requires four bits. Therefore, connect the stimulus presentation computer to the TriggerBox, and set the bit selector switches 0 to 3 to the PC side. Other trigger sources require another four bits. Connect these sources to the BNC inputs In 4 to In 7 and set the bit selector switches 4 to 7 to the BNC side.
### 4.4 Connect the TriggerBox Extension

You connect it to the TriggerBox Extension to the TriggerBox if you want to add further trigger sources.

**Prepare:**
- TriggerBox
- TriggerBox Extension
- Extension cable

1. Connect the extension cable to the **Input (8-15)** of the TriggerBox.
2. Connect the extension cable to the **Output 0-7 (8-15)** of the TriggerBox Extension.

→ For further details on this setup, please refer to Section 5.3.
4.5 Stretch short pulses

Very short trigger pulses may not be acquired depending on the selected sampling rate. To avoid losing trigger information, the duration of the trigger pulse can be stretched to five milliseconds. You can connect trigger sources with very short trigger pulses at the inputs for bit 7 and bit 15.

Stretch bit 7

Prepare:
- TriggerBox and all necessary cables.

1. Connect a trigger source to one of the inputs for bit 7:
   - BNC input In 7,
   - PC input PC 0-7 (LPT), or
   - USB input.
2. Set the stretcher switch for bit 7 to 5 ms.

Stretch bit 15

Prepare:
- TriggerBox and all necessary cables.

1. Connect a trigger source to one of the inputs for bit 15:
   - FOC/BNC input In 15, or
   - In 8-15 via the TriggerBox Extension.
2. Set the stretcher switch for bit 15 to 5 ms.

See also:
- Connect an amplifier to the TriggerBox
- Connect a stimulus presentation computer

Notes
- Bit 7 or 15 must be connected only once.
- When you set the stretch switch to 5 ms, long trigger pulses will be trimmed to 5 ms.
4.6 Connect the push button

The push button is mainly used for the BNC test, but you can also use it as a response button.

Prepare:
- TriggerBox
- BNC push button
- TriggerBox is connected to an amplifier (page 31) and stimulus presentation computer (page 32).

1 Plug the push button on one of the BNC inputs at the TriggerBox.
2 Turn the bayonet housing clockwise, to lock the plug onto the connector.

⇒ You can also connect the BNC push button the TriggerBox Extension.

4.7 Convert optical signals

The TriggerBox can convert optical signals into electrical signals, when you connected a trigger line to the fiber-optic connector.

Prepare:
- TriggerBox
- trigger cable screened
- fiber-optic cable
- TriggerBox is connected to an amplifier (page 31) and stimulus presentation computer (page 32).

1 Connect the fiber-optic cable to the input for bit 15. The fiber-optic connector is isolated.
2 Connect the TriggerBox to the amplifier.

⇒ Optical signals connected to the input for bit 15 are sent to the amplifier as electrical signals.
4.8 Split D-Sub signals

When you use the input of the TriggerBox Extension, the signals are split, that is, the signal on pin 1 of the input is available on the BNC 0, pin 2 on BNC 1 etcetera.

The input of the TriggerBox Extension is internally connected to the BNC connectors. Thus, when you apply trigger signals to the input, the signals are available on the BNC connectors. You can connect the actiCHamp or another TTL compatible output equipment to this input.

Prepare:
- TriggerBox Extension
- actiCHamp
- extension cable

1. Connect the extension cable to the Input 0-7 of the TriggerBox Extension.
2. Connect the other end of the extension cable to the trigger output of the amplifier.
   At actiCHamp this is the connector **Trigger Out**.
3. Connect the equipment that receives the trigger signals to the BNC connectors labeled **0 (8) to 7 (15)**.
5.1 Connecting bit 15

Bit 15 can be applied on three different inputs:

1. fiber-optic connector (FOC), isolated
2. BNC connector, isolated
3. BNC connector of bit 15 on the TriggerBox Extension, not isolated.

The different connection possibilities for bit 15 provide a high level of flexibility.

Additional information

- Only ever use ONE of the three connections for bit 15. Never use two or three of the available connections at the same time. In this way, no trigger signals are lost or wrongly obtained.

- Bit 15 can be stretched (see 4.5 Stretch short pulses).

5.2 Using 9 bits

The TriggerBox on its own can send up to 9 trigger bits to an amplifier.

The first 8 bits are connected to the PC and BNC inputs. Bit 9 is connected to In 15.

For 9-bit setup, you must use an amplifier that can handle more than 8 trigger bits, for example BrainAmp amplifiers.
5.3 Using 16 bits

For a setup with 16 bits you connect the TriggerBox Extension to the TriggerBox. You can use the 16 bit setup only with amplifiers of the BrainAmp family.

Example 1: Simple setup

Bits 0 to 7 are occupied by the stimulus presentation computer (PC input) and bits 8 to 15 are occupied by the TriggerBox Extension.

Example 2: Complex setup

9 bits are occupied on the TriggerBox (bit 0 to 7 and bit 15) and 7 bits are occupied on the TriggerBox Extension (bit 8 to 14).

Note

Make sure, that bit 15 is either occupied on the TriggerBox or on the TriggerBox Extension.
Chapter 6  After using the product

6.1  Cleaning

Before cleaning disconnect all cables. Connectors must not come into contact with moisture. Moisture causes corrosion.

Clean the products with a slightly damp cloth.

For disinfecting the surfaces of the products, we recommend to use a cleaning agent based on propylalcohol, for example a solution containing 25 % Ethanol and 35 % Propane-1-ol. Adhere to the safety precautions of the manufacturer of the cleaning agent.

**NOTICE**

Risk of damage during cleaning.

- Never clean the products and accessories under running water.
- Never use aggressive or corrosive cleaning agents.
- Never clean the products when the test subject is connected to them or when they are connected to the power supply.
- The products must not be sterilized.

6.2  Maintenance information

The TriggerBox and TriggerBox Extension require no maintenance.

Repairs may only be carried out by Brain Products.

Regularly inspect the products and accessories for damage and check that the connections are clean. In the event of any defects, please contact your local dealer.
Chapter 7  Disposal of the product

For disposal of the products, accessories and cables please observe the applicable legislation. In the EU and EFTA, the WEEE Directive 2002/96/EC on Waste Electrical and Electronic Equipment applies. In Germany, for example, the “ElektroG” additionally governs electrical and electronic equipment.

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

On request, Brain Products will take back your old products, provided that they are original Brain Products parts.
Appendix A  Technical data

Common technical data

**Ambient conditions**

<table>
<thead>
<tr>
<th>Operation</th>
<th>Temperature: 0 °C to 40 °C (32 °F to 104 °F)</th>
<th>Relative humidity: 30 % to 85 %, non-condensing</th>
<th>Atmospheric pressure: 700 hPa to 1,050 hPa</th>
</tr>
</thead>
<tbody>
<tr>
<td>Storage and transport</td>
<td>Temperature: 0 °C to 60 °C (32 °F to 140 °F)</td>
<td>Relative humidity: 30 % to 85 %, non-condensing</td>
<td>Atmospheric pressure: 700 hPa to 1,050 hPa</td>
</tr>
</tbody>
</table>

To prevent mechanical damage during transport, please pack the product in such a way, that it is not subject to vibration.

**Cables**

<table>
<thead>
<tr>
<th>Cable Type</th>
<th>Connector Details</th>
<th>Length</th>
</tr>
</thead>
<tbody>
<tr>
<td>LPT cable</td>
<td>D-Sub 25 female</td>
<td>3 m</td>
</tr>
<tr>
<td></td>
<td>D-Sub 25 male</td>
<td></td>
</tr>
<tr>
<td>Trigger cable</td>
<td>D-Sub 25 male shielded</td>
<td>3 m</td>
</tr>
<tr>
<td></td>
<td>D-Sub 9 female OR D-Sub 16 female</td>
<td></td>
</tr>
<tr>
<td>Test cable</td>
<td>D-Sub 25 male</td>
<td>0.5 m</td>
</tr>
<tr>
<td>USB cable</td>
<td>Type B</td>
<td>3 m</td>
</tr>
<tr>
<td>Push button</td>
<td>Push button</td>
<td>1.9 m</td>
</tr>
<tr>
<td>Extension cable</td>
<td>D-Sub 9 male</td>
<td>3 m</td>
</tr>
<tr>
<td></td>
<td>D-Sub 9 female</td>
<td></td>
</tr>
</tbody>
</table>
**System requirements for the TriggerBox Test IO**

| Operating system | Windows® 7, 32 and 64 bit
|                  | Windows® 8.1, 64 bit
| Software requirements | .NET4
| USB port | USB 2.0 or higher

**Technical data of the TriggerBox**

| Power supply | 4.5 VDC to 5.5 VDC
|              | 160 mA
|              | Power supply via USB port of computer; computer must either comply with IEC 60601 or IEC 60950.
| Pulse stretcher | Switch position **5 ms**: Stretching of relevant trigger pulse to 5 ms ±1 ms.
|                 | Switch position **OFF**: No stretching of relevant trigger pulse.
| USB port | USB 2.0, type B configured as virtual serial port
|          | delay < 1 ms
|          | jitter < 1 ms
| Input signal | 0 VDC to 5 VDC,
| Supported input signal logic | TTL (0-5 VDC), CMOS, low voltage TTL (0-3.3 VDC)
| Output signal | 0 VDC to 5 VDC, depending on the input signal
| Dimensions (L x W x H) | 200 mm x 160 mm x 40 mm
| Weight | 580 g

**Level conditions**

- The levels of open BNC inputs are by default high.
- The level of the open PC input is set by the amplifier.
- If connected to an LPT port of a computer, the level of the trigger lines on the PC input is determined by the computer.
Pinout: PC 0-7

25-pin D-Sub (LPT), male, top view

<table>
<thead>
<tr>
<th>Pin</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>NC&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>2</td>
<td>Bit 0</td>
</tr>
<tr>
<td>3</td>
<td>Bit 1</td>
</tr>
<tr>
<td>4</td>
<td>Bit 2</td>
</tr>
<tr>
<td>5</td>
<td>Bit 3</td>
</tr>
<tr>
<td>6</td>
<td>Bit 4</td>
</tr>
<tr>
<td>7</td>
<td>Bit 5</td>
</tr>
<tr>
<td>8</td>
<td>Bit 6</td>
</tr>
<tr>
<td>9</td>
<td>Bit 7</td>
</tr>
<tr>
<td>10 - 24</td>
<td>NC</td>
</tr>
<tr>
<td>25</td>
<td>Ground</td>
</tr>
</tbody>
</table>

Metal frame | Shield

<sup>a</sup> NC = not connected

Electrical characteristics

- TTL level: 0 VDC to 5 VDC
- Shield and ground are usually connected to one another in the computer.
**Pinout: Out (Amp)**

25-pin D-Sub, female, top view

<table>
<thead>
<tr>
<th>Pin</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>NC</td>
</tr>
<tr>
<td>2</td>
<td>Bit 0</td>
</tr>
<tr>
<td>3</td>
<td>Bit 1</td>
</tr>
<tr>
<td>4</td>
<td>Bit 2</td>
</tr>
<tr>
<td>5</td>
<td>Bit 3</td>
</tr>
<tr>
<td>6</td>
<td>Bit 4</td>
</tr>
<tr>
<td>7</td>
<td>Bit 5</td>
</tr>
<tr>
<td>8</td>
<td>Bit 6</td>
</tr>
<tr>
<td>9</td>
<td>Bit 7</td>
</tr>
<tr>
<td>10</td>
<td>Bit 8</td>
</tr>
<tr>
<td>11</td>
<td>Bit 9</td>
</tr>
<tr>
<td>12</td>
<td>Bit 10</td>
</tr>
<tr>
<td>13</td>
<td>Bit 11</td>
</tr>
<tr>
<td>14</td>
<td>Bit 12</td>
</tr>
<tr>
<td>15</td>
<td>Bit 13</td>
</tr>
<tr>
<td>16</td>
<td>Bit 14</td>
</tr>
<tr>
<td>17</td>
<td>Bit 15</td>
</tr>
<tr>
<td>18 - 23</td>
<td>NC</td>
</tr>
<tr>
<td>24</td>
<td>+5</td>
</tr>
<tr>
<td>25</td>
<td>Ground</td>
</tr>
<tr>
<td></td>
<td>Shield</td>
</tr>
</tbody>
</table>
### Pinout: In 8-15

9-pin D-Sub, female, top view

<table>
<thead>
<tr>
<th>Pin</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Bit 8</td>
</tr>
<tr>
<td>2</td>
<td>Bit 9</td>
</tr>
<tr>
<td>3</td>
<td>Bit 10</td>
</tr>
<tr>
<td>4</td>
<td>Bit 11</td>
</tr>
<tr>
<td>5</td>
<td>Bit 12</td>
</tr>
<tr>
<td>6</td>
<td>Bit 13</td>
</tr>
<tr>
<td>7</td>
<td>Bit 14</td>
</tr>
<tr>
<td>8</td>
<td>Bit 15</td>
</tr>
<tr>
<td>9</td>
<td>Ground</td>
</tr>
<tr>
<td></td>
<td>Metal frame</td>
</tr>
</tbody>
</table>
Pinout: BNC connectors (In 0 to In 7 and bit 15)

BNC socket (female), isolated, top view

<table>
<thead>
<tr>
<th>Pin</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Inner conductor: Signal</td>
</tr>
<tr>
<td>2</td>
<td>Outer conductor: Ground</td>
</tr>
</tbody>
</table>

Electrical characteristics

- TTL level: 0 VDC to 5 VDC, low-active
- inner conductor terminated with 10 kOhm pull-up resistor to 5 V operating voltage
- max. current: 0.5 mA
- isolation voltage: 2,500 V
- isolation resistance: 50 MOhm and 50 pF
- min. pulse width: 1 μs
- max. signal frequency: 1 MHz
- delay time: 55 ns

Technical data of the FOC input

Based on HFBR-2528 receiver suitable for fiber optic cables of type:

- 1 mm Plastic Optical Fiber (POF): max. distance 30 m
- 200 μm Hard Clad Silica (HCS): max. distance 300 m
- max. signal frequency: 10 MHz
- low-active
Technical data of the TriggerBox Extension

<table>
<thead>
<tr>
<th>Dimensions (L x W x H)</th>
<th>192 mm x 160 mm x 35 mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight</td>
<td>450 g</td>
</tr>
</tbody>
</table>

Pinout: Output 0-7 (8-15)

9-pin D-Sub, male, top view

<table>
<thead>
<tr>
<th>Pin</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Bit 0 (8)</td>
</tr>
<tr>
<td>2</td>
<td>Bit 1 (9)</td>
</tr>
<tr>
<td>3</td>
<td>Bit 2 (10)</td>
</tr>
<tr>
<td>4</td>
<td>Bit 3 (11)</td>
</tr>
<tr>
<td>5</td>
<td>Bit 4 (12)</td>
</tr>
<tr>
<td>6</td>
<td>Bit 5 (13)</td>
</tr>
<tr>
<td>7</td>
<td>Bit 6 (14)</td>
</tr>
<tr>
<td>8</td>
<td>Bit 7 (15)</td>
</tr>
<tr>
<td>9</td>
<td>Ground</td>
</tr>
<tr>
<td></td>
<td>Metal frame</td>
</tr>
</tbody>
</table>

The output can be connected to the following equipment:

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Max. bits</th>
<th>Input name</th>
<th>Input type</th>
</tr>
</thead>
<tbody>
<tr>
<td>TriggerBox</td>
<td>8</td>
<td>In 8-15</td>
<td>D-Sub 9, female</td>
</tr>
<tr>
<td>actiCHamp</td>
<td>8</td>
<td>Trigger In</td>
<td>D-Sub 9, female</td>
</tr>
<tr>
<td>V-Amp</td>
<td>8</td>
<td>Trigger 1</td>
<td>D-Sub 9, female</td>
</tr>
</tbody>
</table>
**Pinout: Input 0-7**

9-pin D-Sub, female, top view

<table>
<thead>
<tr>
<th>Pin</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Bit 0</td>
</tr>
<tr>
<td>2</td>
<td>Bit 1</td>
</tr>
<tr>
<td>3</td>
<td>Bit 2</td>
</tr>
<tr>
<td>4</td>
<td>Bit 3</td>
</tr>
<tr>
<td>5</td>
<td>Bit 4</td>
</tr>
<tr>
<td>6</td>
<td>Bit 5</td>
</tr>
<tr>
<td>7</td>
<td>Bit 6</td>
</tr>
<tr>
<td>8</td>
<td>Bit 7</td>
</tr>
<tr>
<td>9</td>
<td>Ground</td>
</tr>
<tr>
<td></td>
<td>Metal frame</td>
</tr>
<tr>
<td></td>
<td>Shield</td>
</tr>
</tbody>
</table>

This input can be connected to the following equipment:

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Max. bits</th>
<th>Input name</th>
<th>Input type</th>
</tr>
</thead>
<tbody>
<tr>
<td>actiCHamp</td>
<td>8</td>
<td>Trigger Out</td>
<td>D-Sub 9, male</td>
</tr>
</tbody>
</table>
**Pinout: BNC connectors 0(8) to 7(15)**

BNC socket (female), not isolated, top view

<table>
<thead>
<tr>
<th>Pin</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Inner conductor: Signal</td>
</tr>
<tr>
<td>2</td>
<td>Outer conductor: Ground</td>
</tr>
</tbody>
</table>

Electrical characteristics

- power supply: None
- signals with TTL level 0 V to 5 V can be connected
- max. permitted current in signal path: 10 mA

**Trigger interfaces on amplifiers**

<table>
<thead>
<tr>
<th>Amplifier</th>
<th>Max. bits</th>
<th>Name of input port</th>
<th>Connector type</th>
</tr>
</thead>
<tbody>
<tr>
<td>BrainAmp (via USB adapter)</td>
<td>16</td>
<td>Trigger (on USB adapter)</td>
<td>D-Sub 26, female</td>
</tr>
<tr>
<td>V-Amp</td>
<td>8</td>
<td>Trigger 1</td>
<td>D-Sub 9, female</td>
</tr>
<tr>
<td>actiCHamp</td>
<td>8</td>
<td>Trigger In</td>
<td>D-Sub 9, female</td>
</tr>
</tbody>
</table>
Technical characteristics of bit 15

The three inputs of bit 15 are interconnected via an AND gate. The AND logic circuit has the following functions:

1. It only processes the low active trigger signal.
   When bit 15 is occupied more than once, several bit 15 trigger pulses can be received at the same time. The outbound trigger signal, however, does not allow to reconstruct the actual trigger source. This is due to the AND gate: it only processes low active signals and as long as one trigger signal is low, the output is low. Thus, status changes of the other trigger lines are ignored (compare Figure A-1) and information may get lost.

2. It prevents outputs from short-circuiting.
   In cases where multiple trigger pulses enter at the same time, the AND gate prevents these outputs from short-circuiting.

![Figure A-1. Bit 15 - Overlapping trigger signals, resulting in lost trigger information](image)

In the example above, only bit 15 from the isolated BNC input is transmitted to the amplifier, since it is low. The signals from the TriggerBox Extension are lost.

**Only ever use ONE of the three connections for bit 15.** Never use two or three of the available connections at the same time. In this way, no trigger signals are lost or wrongly obtained.