OPERATING INSTRUCTIONS

BRAIN PRODUCTS
Solutions for neurophysiological research

TriggerBox Plus & TriggerBox Extension

Product revision 01



Accessories

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About this document

This document describes how to use the TriggerBox Plus 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.

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



Notice: This symbol indicates that the incorrect use of the product(s) may bring about a risk of **damage to property**. Failure to observe the information in this document constitutes incorrect use.



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: This symbol indicates a reference to a related chapter, section or document.



New: This symbol indicates changes or new content at this point.

Revision history

Page	Status	Subject
--	--	new document for TriggerBox Plus hardware

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 Plus comes in: thanks to its standard interfaces (LPT, D-Sub, BNC, RJ45, etcetera) it can combine trigger signals from several sources and forward up to 16 signals to one output.

With the TriggerBox Plus, triggers that are sent to the amplifiers are also available as markers in the network based on LabStreamingLayer (LSL). An LSL network stream can be provided in the local wireless network or via ethernet. LSL markers can be used in addition to hardware triggers, but also as an alternative. This means that the TriggerBox Plus can work independently of a connected amplifier.

The TriggerBox Plus can be connected to a stimulus presentation computer via USB or LPT. It is possible to write 8-bit codes directly to the TriggerBox Plus, that are immediately sent to the amplifier and/or to the network as LSL markers. It is also possible to read any input connected to the TriggerBox Plus. Both reading and writing operations occur within under 1 ms.

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

Product identification

Product designation	**TriggerBox Plus** **TriggerBox Extension**
Article number	TriggerBox Plus: BP-210-9031 TriggerBox Extension: BP-210-9040
Manufacturer	Brain Products GmbH Zeppelinstrasse 7 DE-82205 Gilching Tel: +49 (0) 8105 733 84 - 0 Fax: +49 (0) 8105 733 84 - 505 Web: https://www.brainproducts.com Email: techsup@brainproducts.com We are registered as a manufacturer of electrical and/or electronic equipment with the stiftung elektro-altgeräte register, Nordostpark 72, 90411 Nürnberg, Germany, under the registration number DE89975135.
Warranty	https://www.brainproducts.com/legal/brain-products-warranty-conditions/

Combination with other products

TriggerBox Plus

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

Product	**Manufacturer**
LiveAmp with Sensor & Trigger Extension	Brain Products GmbH
actiCHamp family	Brain Products GmbH
BrainAmp family	Brain Products GmbH
TriggerBox Extension	Brain Products GmbH
MR scanners outside of the MR scanner room	Siemens, General Electric, Bruker, Philips
Stimulation equipment/computers	different manufacturers[a]
Computers for power supply via USB	different manufacturers[a]

a. Equipment must comply with IEC 62368-1, EN 62368-1, or equivalent safety standards.

TriggerBox Extension

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

Product	**Manufacturer**
LiveAmp with Sensor & Trigger Extension	Brain Products GmbH
actiCHamp family	Brain Products GmbH
BrainAmp family	Brain Products GmbH
TriggerBox and TriggerBox Plus	Brain Products GmbH

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.



This symbol confirms compliance with the environmental requirements for electronic products (only applies to China).



MR Unsafe: An item which poses unacceptable risks to the patient, medical staff or other persons within the MR environment*



No contact with liquids: Make sure that liquids do not enter the enclosure.



Brain Products GmbH confirms the compatibility of this product according to the Directive 2014/53/EU (RED) of the European Parliament and the Council of 16 April 2014 on the harmonization of the laws of the Member States relating to the making available on the market of radio equipment.

The Brain Products GmbH confirms the RoHS compliance of this product according to Directive 2011/65/EU of the European Parliament and the Council of 8 June 2011 on the restriction of the use of certain hazardous substances in electrical and electronic equipment (recast published in the Official Journal of the European Union on 1 July 2011) as well as all its amendments up to and including the Commission delegated directive (EU) 2015/863 of 31 March 2015 (published in the Official Journal of the European Union on 4 June 2015).



Brain Products GmbH confirms the compatibility of this product according to the Radio Equipment Regulation 2017 of 4 December 2017

Brain Products GmbH confirms the RoHS compliance of this product according to The Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment Regulations 2012 of 15 November 2016.



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

Canada
Contains IC: 21098-ESPWROVERE
This device complies with the USA FCC Federal Communications Commission CFR47 Part 15. Operation is subject to the following two conditions:

1 This device may not cause harmful interference, and

2 This device must accept any interference received, including interference that may cause undesired operation.

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes:
1. l'appareil ne doit pas produire de brouillage;
2. l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

USA
Contains FCC ID: 2AC7Z-ESP32WROVERE
This device complies with the USA FCC Federal Communications Commission CFR47 Part 15. Operation is subject to the following two conditions:
(1) this device may not cause harmful interference, and
(2) this device must accept any interference received, including interference that may cause undesired operation.
This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy, and if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna
- Increase the separation between the equipment and receiver
- Consult your Brain Products' distributor for help.

Japan
Contains MIC ID: 211-200403
Japan Radio Equipment Compliance: Japanese Technical Regulation Conformity Certification of Specified Radio Equipment (Ordinance of MPT No.37, 1981), Article 2, Paragraph 1, Item 19, "2.4 GHz band wide band low power data communication system".

* Definitions from ASTM international standard F2503-20 (IEC 62570:2014)

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

The TriggerBox Plus 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 Plus 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 Plus 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 tap).

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 Plus or TriggerBox Extension.
- Due to the wireless module in the TriggerBox Plus, the minimum distance to all persons shall be 20 cm.

Risks of personal injury



CAUTION

Risk of entanglement in cables

Test participant and personnel could become entangled in the cables. Lay cables carefully in order to ensure the safety of the test participant 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 Plus* to the trigger output of an amplifier.

Take special care when you make the connections.

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

The product and associated cables is MR unsafe. It contains magnetic materials. The TriggerBox Plus 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 MRI facility.

Risk of damage to the TriggerBox Plus when using a defibrillator

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

Note on the data acquisition

Note

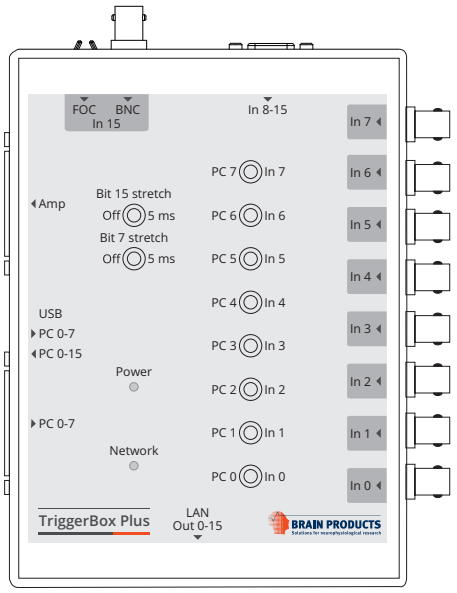
During operation, keep a distance of at least 3 m from cell phones or similar transmitters, other sources of high-level interference such as microwave, x-ray or similar equipment that may cause sparks. Otherwise trigger information may be lost or corrupted.

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.

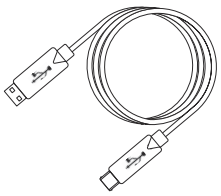
Chapter 1 Scope of delivery

TriggerBox Plus

BP-210-9031



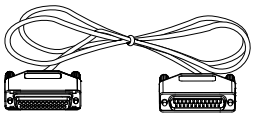
USB cable, 3 m
BP-345-1030



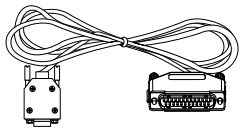
Application Suite USB
BP-270-6010



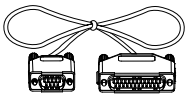
Cable DSUB25/LPT cable, 3 m
BP-245-1565



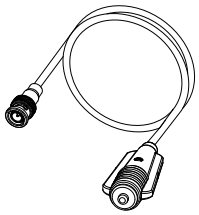
Trigger cable, 3 m
BP-245-NNNN[a]



Test cable, 0.5 m
BP-245-1010[b]



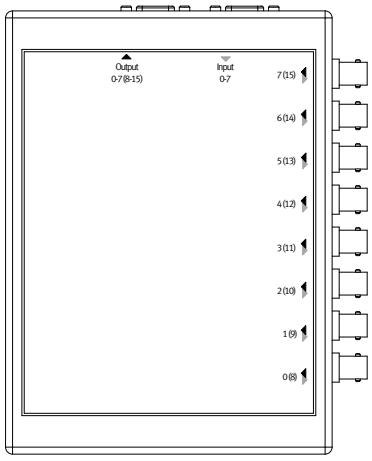
BNC push button, 1.9 m
BP-345-9000



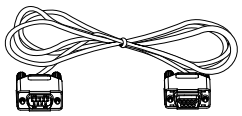
a. Specific for your amplifier.
b. Only if Trigger cable does not have a 9-pin D-Sub connector.

TriggerBox Extension

BP-210-9040



Extension cable, 3 m
BP-345-1020

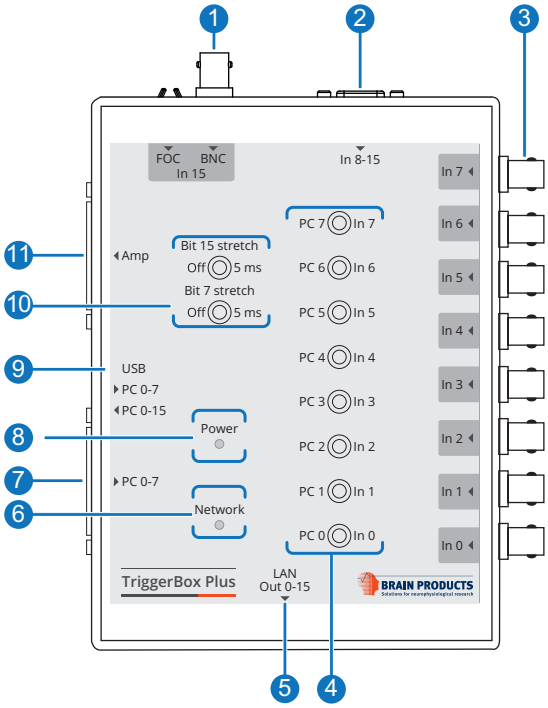


Application Suite USB
BP-270-6010



Chapter 2 Overview of the product

2.1 TriggerBox Plus at a glance



1 Inputs for bit 15 (page 18)

2 Input for bit 8–15 (page 18)

3 Inputs for bit 0–7 (page 19)

4 Bit selector switches (page 19)

5 LAN output

6 Network LED

7 Input for bit 0–7 via LPT (page 21)

8 Power LED (page 20)

9 USB port (power supply/input/output) (page 21)

10 Stretcher switches (page 22)

11 Output for bit 0–15 (page 23)

Numbers against gray background: These inputs are galvanically isolated from one another and the other inputs.

2.2 Connectors and switches of the TriggerBox Plus

Inputs for bit 15

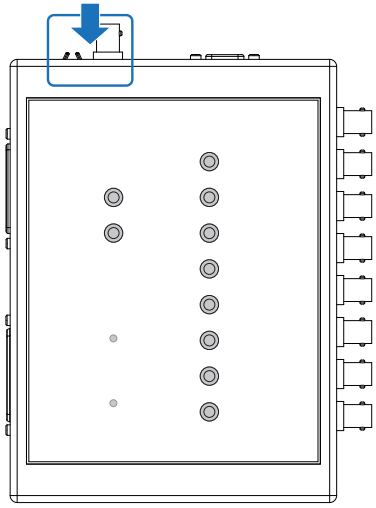
There are two extra inputs for bit 15 on the TriggerBox Plus.

These inputs have the following characteristics:

- **fiber-optic** or **BNC**,
- galvanically isolated from all other inputs,
- it is connected to the output **Amp**,
- default: it is connected to the **USB** port (output),
- can be stretched.

Additional information

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



Input for bit 8–15

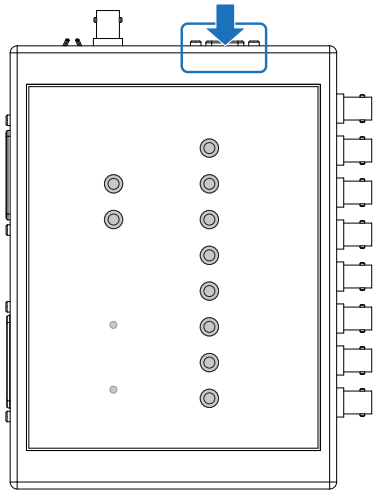
The input **In 8–15** is used to connect the TriggerBox Extension. This allows to add up to eight trigger sources.

The input has the following characteristics:

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

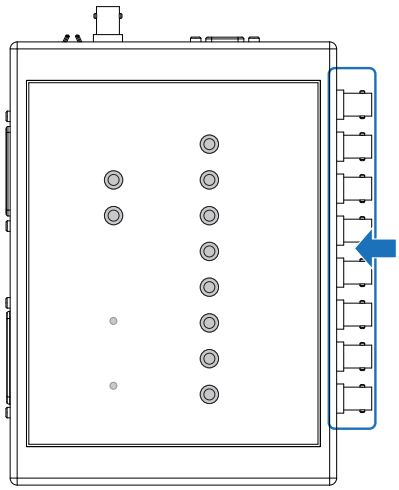
Additional information

➔ The 8 upper bits (bits 8–15) can either be used in combination with equipment that can process 16 bit trigger input (e.g., amplifiers of the BrainAmp family) or when streamed via LSL.



Inputs for bit 0–7 via BNC

The inputs **In 0–In 7** are used to connect individual trigger sources to the TriggerBox Plus.



These inputs have the following characteristics:

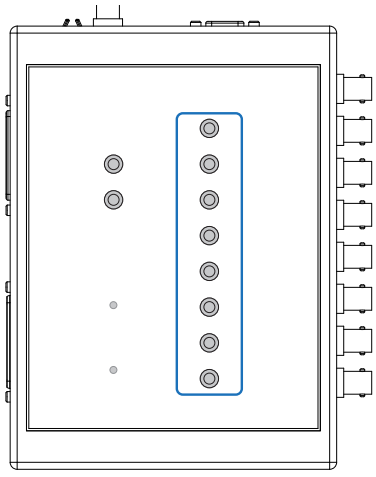
- for a maximum of eight bits (bit 0–7),
- galvanically isolated from one another and all other inputs,
- they are connected to the output **Amp**,
- optional: they are connected to the **USB** port (output),
- bit 7 can be stretched.

Additional information

➔ 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).



- **PC** = selects the single bits of the **PC** inputs (**LPT** or **USB**).
- **In** = selects the corresponding **BNC** input.

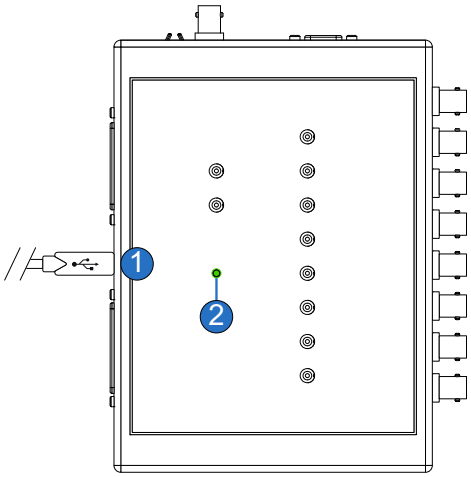
Additional information

➔ The stimulation paradigm determines how many bits are required.

Power LED

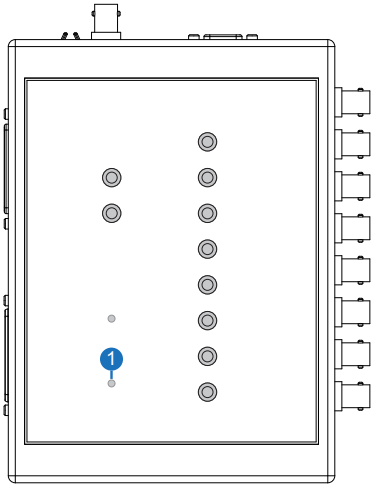
The TriggerBox Plus is powered via **USB** (1). When power is supplied the **Power** LED (2) lights up green.

The power supply is required for the galvanic isolation of the **BNC** inputs and **FOC**/**BNC** input. It is also required for supplying the Ethernet and WiFi network modules.



Network LED

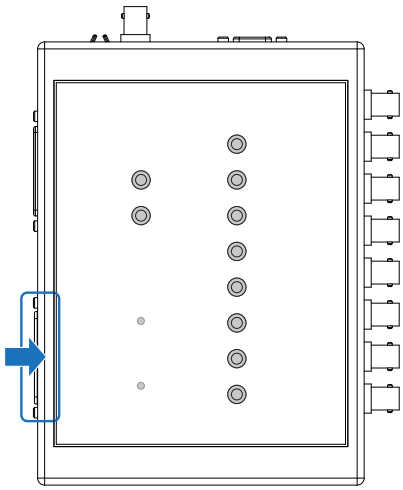
The TriggerBox Plus can be connected to an existing local network or be configured to provide its own network. The **Network** LED (1) indicates the possible states of the connection:



- Off: no WiFi or Ethernet connection active,
- Fast blinking (150:150 ms): Configuration tool connected,
- Slow blinking (300:300 ms): network connection established,
- Flashing (100:1000 ms): waiting for network connection,
- Continuously on: network connection established and at least one LSL client connected to the network stream.

Input for bit 0–7 via LPT

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



This input has the following characteristics:

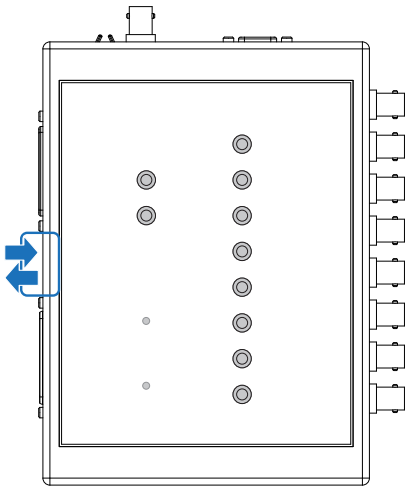
- it is a parallel port,
- can receive a maximum of eight bits (bit 0–7),
- it is **not** galvanically isolated,
- it is connected to the output **Amp**,
- optional: it is connected to the **USB** port (output),
- bit 7 can be stretched.

Additional information

➔ To select the desired bits of the **LPT** input, set the corresponding bit selector switch(es) to the **PC** side.

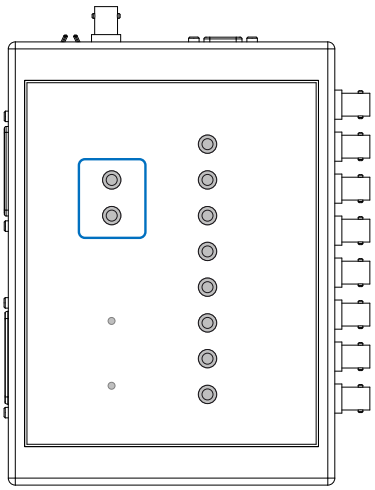
USB port (power supply/input/output)

The **USB** port has the following characteristics:



- input for up to eight bits (bit 0–7),
- used as a serial port by the software (TriggerBox Plus can be accessed via serial COM port),
- output for up to eight bits (bit 8–15), per default, or bit 0–7 via Configuration tool,
- power supply for the TriggerBox Plus,
- bit 7 can be stretched,
- **not** galvanically isolated,
- internally connected to the output **Amp.**

Stretcher switches

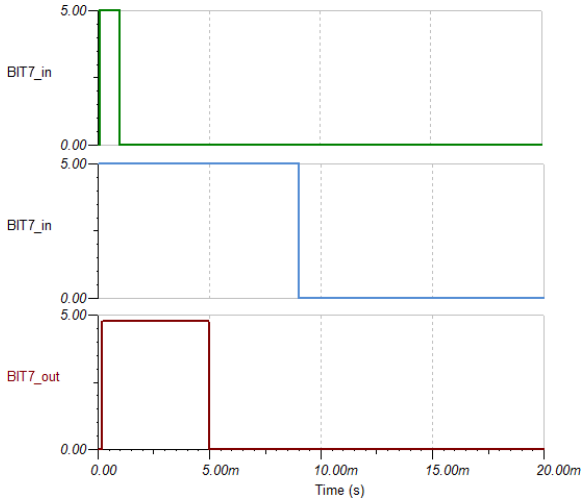


Very short trigger pulses may not be acquired depending on the selected sampling rate. To avoid losing trigger information, the duration of the trigger pulse can be stretched to five milliseconds.
The stretcher switches have the following positions:

- **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 0–15

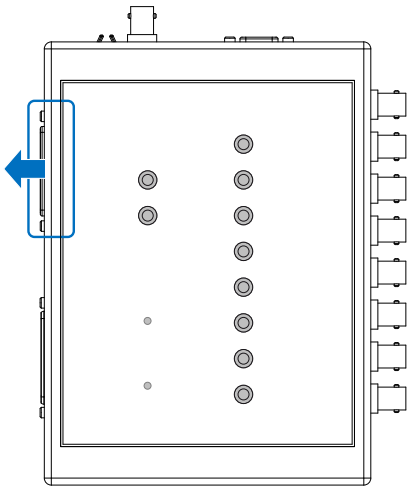
The output **Amp** is used to connect an EEG amplifier to the TriggerBox Plus.

This output has the following characteristics:

- output of up to 16 bits,
- either bits 0–7 (default) or bits 0–15 are sent to the network as LSL markers (can be selected in the Configuration tool).

Additional information

➔ A specific cable for your amplifier family is provided in the delivery. Only use the provided cables.



Notice:

The output **Amp** is not a standard LPT port. You **must not** connect this output to a normal LPT port via a conventional 25 pin D-Sub cable. In this case, use the provided DSUB25/LPT cable (BP-245-1565).

Only use the cables provided by Brain Products when connecting to the output **Amp**.

Ethernet output (LAN Out 0–15)

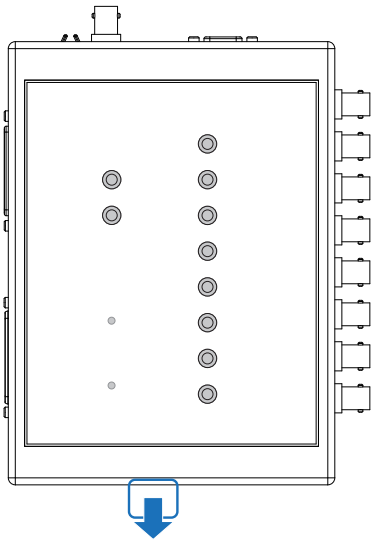
The **LAN Out 0–15** is used to connect the TriggerBox Plus to a cable-based local network.

This output has the following characteristics:

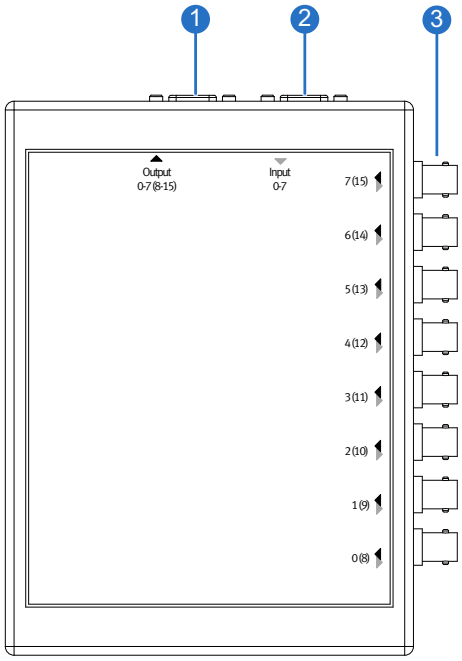
- RJ45 connector,
- output of LSL markers to ethernet.

Additional information

➔ A regular network cable with RJ45 connectors can be used to connect the TriggerBox Plus to the local network, for example, to a network switch.



2.3 TriggerBox Extension at a glance



1 Output (page 25)

2 Input for bit 0–7 (page 26)

3 Input/output (page 26)

Note

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

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 Plus.

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

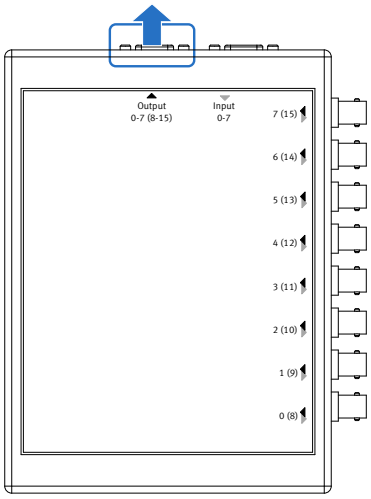
The connector has the following characteristics:

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

Additional information

➔ You can connect this output to the trigger input of the *actiCHamp family* or *LiveAmp* with Sensor & Trigger Extension.

➔ If you are using all eight **BNC** inputs, the bit 15 connectors on the TriggerBox Plus (**FOC**/**BNC**) must not be occupied.



Input for bit 0–7

The input **Input 0–7** is used to connect the actiCHamp family or another TTL compatible equipment to the TriggerBox Extension.

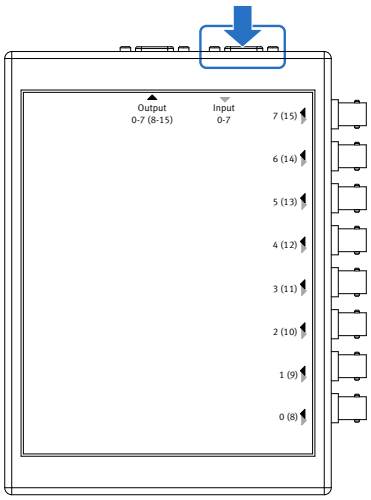
Signals applied to this input, are output at the **BNC** connectors. Thus, the signals are split on individual trigger lines.

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.

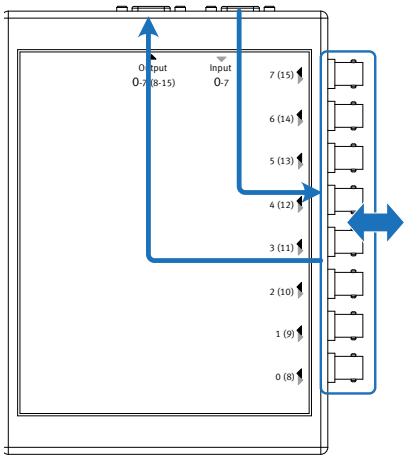


Input/output

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.



Chapter 3 Before you begin

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 Plus
- USB cable
- DSUB25/LPT cable
- Trigger cable, specifically for your amplifier
- Optional: Test cable (short)
- BNC push button
- Application Suite USB (includes manual and Configuration tool)

3.2 Install the software and drivers

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



Supported operating systems

- Windows® 10, 64 bit
- Windows® 11, 64 bit

Prepare:

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

1 Insert the Application Suite USB into a USB drive.
Open Windows Explorer or My Computer and browse to the location of the Application Suite USB.

2 Double click to open the folder.

3 Double click **Autorun.exe**.
The Welcome screen opens.

4 Click **Tools & Accessories**.

5 Select **BrainVision TriggerBox (Plus) (Windows 64-bit)** to start the application. If you select "Typical" or "Complete", the drivers for the TriggerBox and the TriggerBox Plus will be installed. In "Custom", you can decide to only install the TriggerBox Plus drivers.

All relevant drivers for the TriggerBox Plus are installed automatically. This can take several minutes.

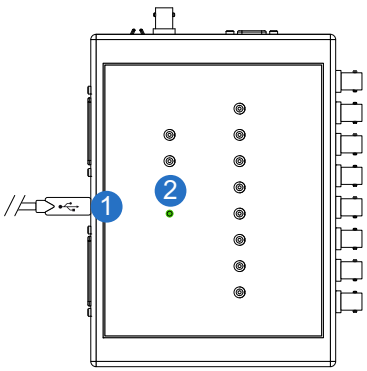
➔ After the installation restart the computer and proceed to the next task.

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 Plus
- USB cable
- Computer on which you installed the drivers

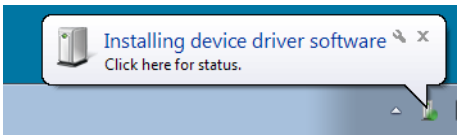


1 Connect the TriggerBox Plus to the computer with the USB cable.

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 Plus. When you connect the TriggerBox Plus to another USB port, Windows® installs the driver anew.



3.4 Test the TriggerBox Plus

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:

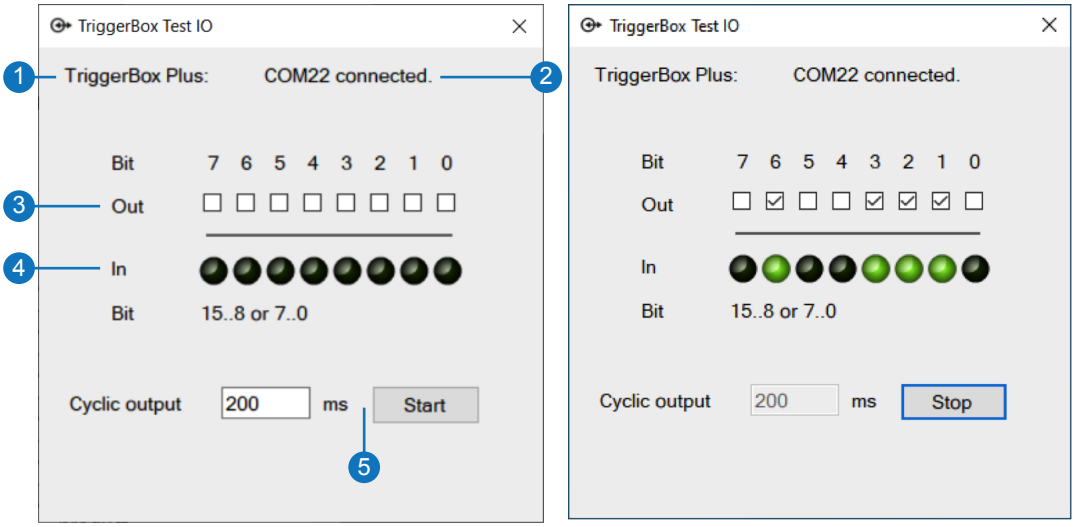
- TriggerBox Plus
- USB cable

1 Connect the TriggerBox Plus to the computer with the USB cable.

2 Open the TriggerBox Test IO:

▷ Click on the *Windows Start button › BrainVision › BrainVision TriggerBox*.

➔ The following window opens:



The TriggerBox Test IO works with the TriggerBox revision 2 and the TriggerBox Plus (if the drivers were installed for both versions).

1 The type of the connected hardware is reflected by the text "TriggerBox" or "TriggerBox Plus" next to the used COM port.

2 If a device is detected, the TriggerBox Test IO reports the COM port here.

3 Here, the lower 8 bits can be activated or deactivated manually from the computer via the USB connection.

4 Depending on the settings in the Configuration tool, the levels of either the lower or higher 8 bits are displayed. The bullets can either indicate a low level (black) or high level (green).

5 Here, an automatically incrementing sequence can be set and started. In this example, the binary-coded number increases by 1 every 200 ms, counting from 0 to 255 and repeating in an endless loop until stopped. The interval can be chosen freely from a minimum number of 100 ms.

3.4.2 Run the TriggerBox Plus connection test

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

Prepare:

- TriggerBox Plus
- Optional: Test cable or Trigger cable with 9-pin D-Sub connector
- USB cable

Check the BNC inputs

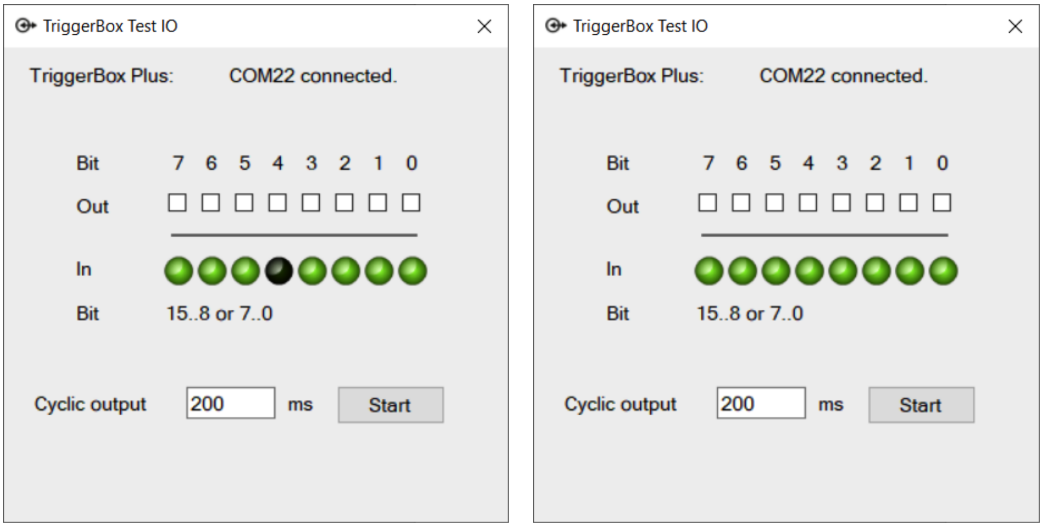
1 Connect the TriggerBox Plus to the computer with the USB cable and start the Configuration tool (see Chapter 3.6).

2 In the Configuration tool set the “Read via USB” setting to “Use bits 0–7”, apply and close the tool.

3 Set all the selector switches to the **In** side (**In 0**–**In 7**).

4 Start the TriggerBox Test IO.

5 Connect the Push button to all **BNC** inputs consecutively and press the button. A press of the button will result in the color of the respective **In** bit to go black. A release will change the color back to green. The example in the images demonstrate the pressing and releasing of a button connected to **In 4**.



Note

The TriggerBox Test IO reacts to changes in the states. Therefore, the colors may only show the correct information after at least one detected state change.

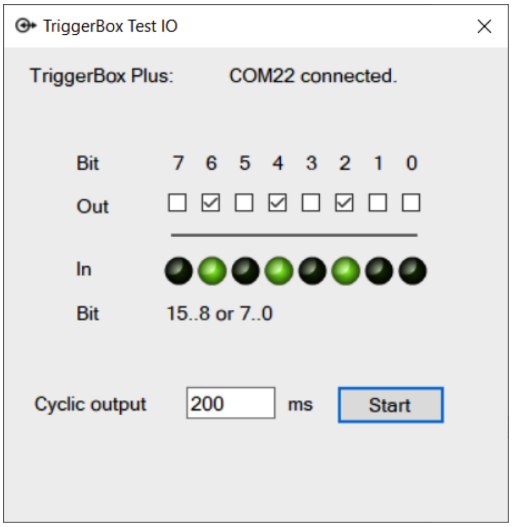
6 For bit 7, test the effect of the bit stretcher by moving the switch to the right (towards 5 ms). In this case, the level will go to low and only appear green after the button release for 5 ms (which can be too short to be noticeable).

➔ All 8 bits should result in the same pattern, except bit 7 when the bit stretcher is activated.

Check inputs 8–15

1 Connect the TriggerBox Plus to the computer with the USB cable and start the Configuration tool.
2 In the Configuration tool set the “Read via USB” setting to “Use bits 8–15”, apply and close the tool.
3 Connect the test cable to the output **Amp** and the input (**In 8–15**) of the TriggerBox Plus.
4 Connect the TriggerBox Plus to the computer with the USB cable.
5 Set all the selector switches to the **PC** side (**PC 0**–**PC 7**).
6 Start the TriggerBox Test IO.
7 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 0–7. The same states will appear for the Out and In Bits.

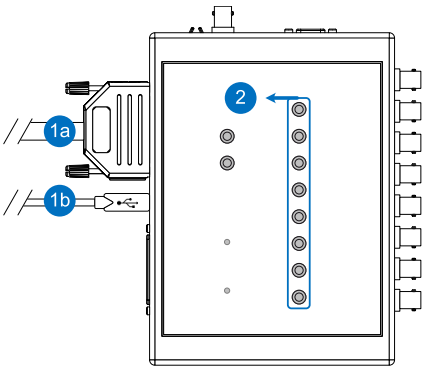


3.4.3 Run the Setup test

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

Prepare:

- TriggerBox Plus
- Trigger cable
- 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 Plus to the amplifier with the trigger cable.
   b Connect the TriggerBox Plus 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 Plus to the **PC** side (**PC 0**–**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 Plus

3.5 Make settings in BrainVision Recorder

Notes

- Special settings are required in BrainVision Recorder when you use the TriggerBox Plus 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.

3.6 Change the settings in the Configuration tool

Prepare:

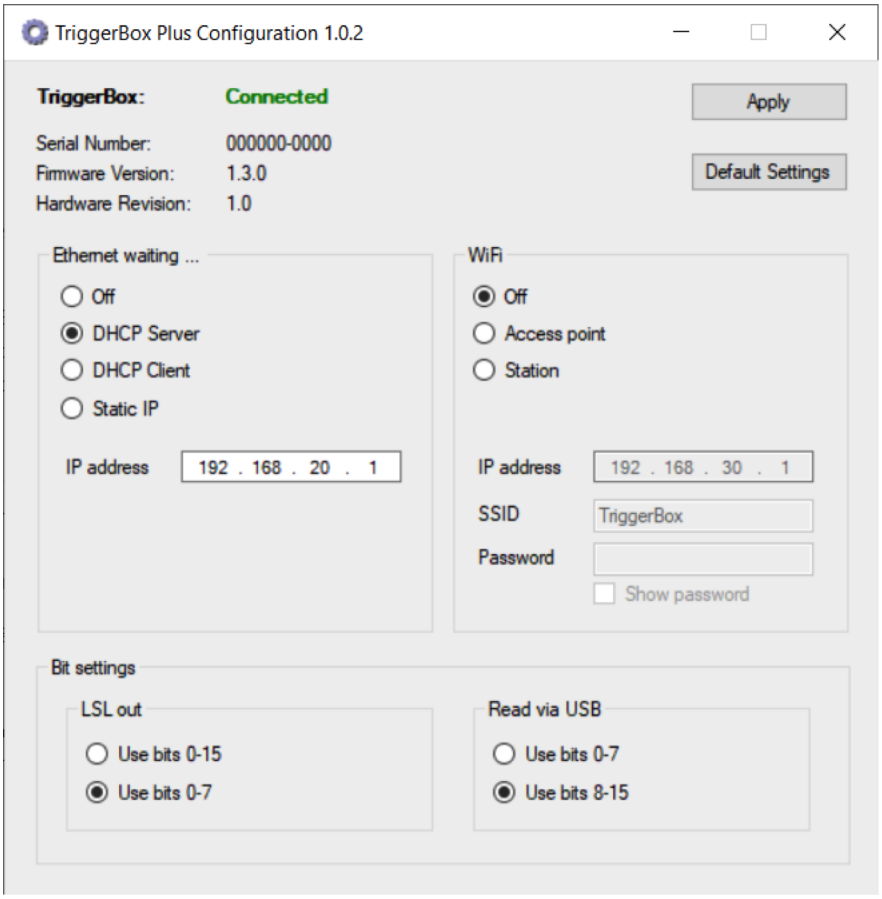
- TriggerBox Plus
- USB cable
- LAN cable (optional)

1 Connect the TriggerBox Plus to the computer with the USB cable.

2 Open the TriggerBox Configuration Tool:

▷ Click on the Windows Start button › BrainVision › BrainVision TriggerBox Plus Configuration. Make sure that no other software is currently connected to the TriggerBox Plus.

➔ The following window opens:



In the image, the default settings are shown. It is possible to reactivate the default settings at any time by clicking on “Default Settings” followed by “Apply”. As long as the default settings are used, the TriggerBox Plus offers the same functionality as the TriggerBox revision 2, with some additional, but optional, features:

- The TriggerBox Plus works as a DHCP server and provides an LSL marker stream to any connected clients.
- It is possible to read bit 15 not only from the D-Sub connector (**In 8–15**), but also from the **In 15 FOC** or **BNC** inputs.

The Configuration tool can be used to set up network parameters that enable the TriggerBox Plus to provide an LSL marker stream to the network. The TriggerBox Plus can either use a wired network connection (“Ethernet”) or a wireless network (“WiFi”).

Ethernet:

- Off: Select this to deactivate any wired connection. This setting is automatically selected if any one of the active WiFi settings is chosen.
- DHCP Server: Enter an IP address for the TriggerBox Plus. Any client that is connected via LAN cable will receive an IP address in the same subnet.
- DHCP Client: The TriggerBox Plus will receive an IP address if it is connected via LAN cable to a DHCP server.
- Static IP: Enter an IP address for the TriggerBox Plus and connect it to a network (for example via a network switch) that is in the same subnet and still has the address available.

WiFi:

- Off: Select this to deactivate any wireless connection. This setting is automatically selected if any one of the active Ethernet settings is chosen.
- Access point: Configure the TriggerBox Plus as an access point. Enter an IP address for the TriggerBox Plus, along with an SSID and a password. If a password is provided the network is WPA2-protected. Otherwise, the network is open. Up to 4 wireless clients can connect to this access point and will receive an IP address in the same subnet.
- Station: Configure the TriggerBox Plus as a wireless client by providing the SSID and password of an active access point. The TriggerBox Plus will receive an IP address in the same subnet of the access point. Note:



Note

The TriggerBox Plus can only connect to 2.4-GHz networks.

Configure the LSL output:

The TriggerBox Plus provides either the 8 lower bits or the full 16 bits that appear on the **Amp** output of the TriggerBox Plus. The binary code of either 8 or 16 bits will be transformed to a decimal number and will be provided as an integer LSL marker at the time of any change of the value. To configure this behaviour, the Bit settings can be adjusted:

LSL out:

- Use bits 0–15: In this case, the integer value that will be sent as an LSL marker is the decimal number of a 16-bit code. Because the upper 8 bits are usually high per default, this can result in large numbers.
- Use bits 0–7: In this case, only the lower 8 bits will be transformed into an integer. The upper 8 bits are often not required, and stimulus presentation tools can only send 8-bit codes via USB. Therefore, this setting is set as the default.



Note

There is a connection limit of 12 clients. No more than 12 clients can connect to the TriggerBox Plus LSL stream simultaneously, no matter what kind of client it is.

Configure the reading functionality:

The TriggerBox Plus can read values to the PC from any of the inputs, not just **In 8–15**.

- Use bits 0–7: This setting needs to be selected if you want to read BNC inputs from **In 1–7** or from **PC 0–7** (parallel port).
- Use bits 8–15: This setting needs to be selected if you want to read from the D-Sub9 **In 8–15** input or from the **FOC**/**BNC In 15** inputs. This is the default setting.

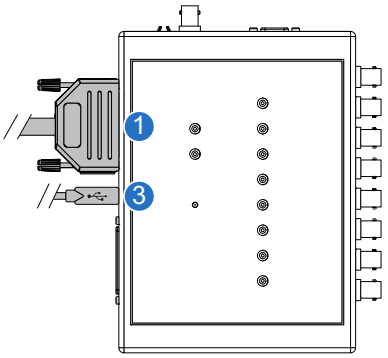
Chapter 4 Using the product

4.1 Connect an amplifier to the TriggerBox Plus

Amplifiers are connected to the output **Amp**.

Prepare:

- TriggerBox Plus
- USB cable
- Trigger cable
- Amplifier (for details see table below)



1 Connect the trigger cable to the output **Amp** of the TriggerBox Plus.

2 Connect the other end of the trigger cable to the trigger input of the amplifier.

3 Connect the TriggerBox Plus to the computer with the USB cable.

➔ You can connect the TriggerBox Plus to the following amplifiers:

Amplifier	Max. bits	Connector name
BrainAmp family	16	Trigger (at USB adapter)
actiCHamp family	8	Trigger In
LiveAmp with Sensor & Trigger Extension	8	Trigger In

Notice:

The output **Amp** is not a standard LPT port. You **must not** connect this output to a normal LPT port via a conventional 25 pin D-Sub cable. In this case, use the provided DSUB25/LPT cable (BP-245-1565).

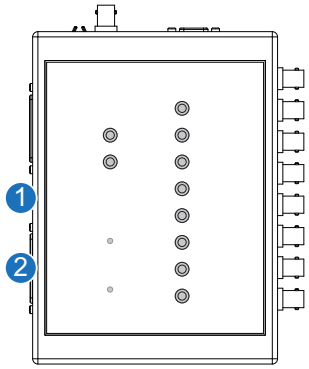
Only use the cables provided by Brain Products when connecting to the output **Amp**.

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 Plus.

Use the LPT port of your computer for the TriggerBox Plus. If you do not have an LPT port or if it is occupied, use the USB port instead. It is used as a serial port by the software.

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



Use the LPT port

Prepare:

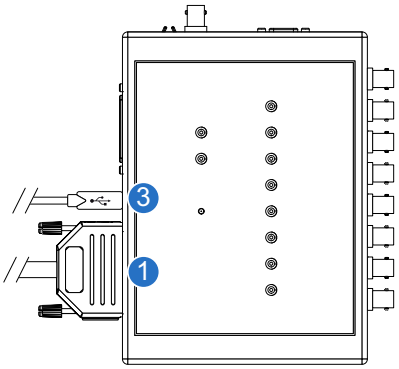
- TriggerBox Plus
- USB cable
- LPT cable

1 Connect the LPT cable to the input **PC 0–7** of the TriggerBox Plus.

2 Connect the other end of the LPT cable to the stimulus presentation computer.

3 Connect the TriggerBox Plus to the computer with the USB cable.

The USB connection is necessary for power supply.



Use the USB port

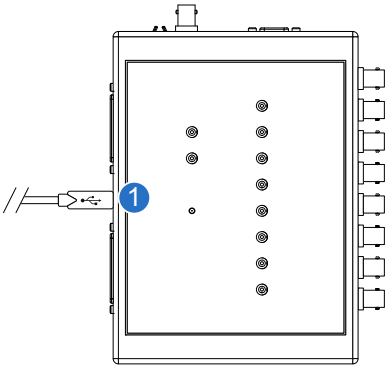
Prepare:

- TriggerBox Plus
- USB cable

1 Connect the USB cable to **USB** connector of the TriggerBox Plus.

2 Connect the other end of the USB cable to the stimulus presentation computer.

3 When setting up the TriggerBox Plus on the stimulus presentation computer, the correct COM port and a baud rate of 2.000.000 need to be specified.



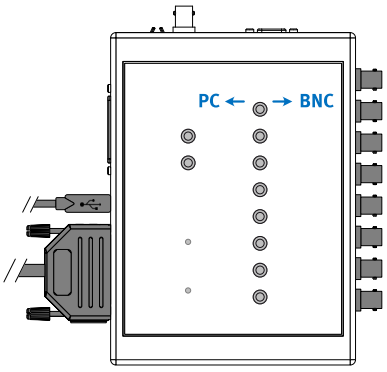
4.3 Select the trigger sources (bit 0–7)

You select the trigger source for bits 0–7 with the bit selector switches. You can switch between the **PC** inputs (**USB** and **LPT**) and the **BNC** inputs (**In 0**–**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 Plus is connected to an amplifier (page 38) and stimulus presentation computer (page 39).

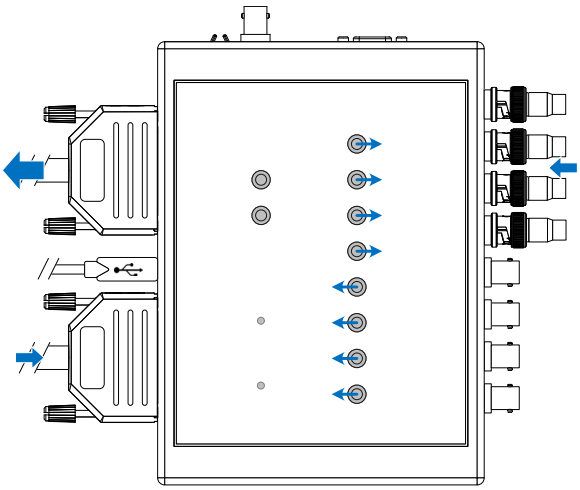


1 Connect the trigger sources to the TriggerBox Plus.

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 Plus, and set the bit selector switches 0–3 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 4–7 to the **BNC** side.



4.4 Using LabStreamingLayer (LSL)

The TriggerBox Plus takes any signal that is sent to the amplifier via the output **Amp** and translates it into an integer value that is sent as a marker in the LSL marker stream. In this case, it is irrelevant if an actual amplifier is connected or not. In other words, the TriggerBox Plus can be used without a connected amplifier and send only LSL markers to the network instead of hardware triggers to the amplifier. However, it is also possible to use hardware triggers as usually, or even both modalities at the same time. These two things need to be considered when actively using LSL markers:

1 The network settings. These can be configured in the Configuration tool.

2 The TriggerBox Plus either sends the lower 8 bits or the full 16 bits. Because the upper 8 bits are rarely used, the default setting in the Configuration tool is “Use bits 0–7” under “LSL out”. It is still possible to use the whole 16 bits, for example when using bit 15, but one must be aware that the typically high states of open inputs will result in large numbers (e.g., the binary number ‘11111111 00000000’ is ‘65280’ in decimal and toggling only bit 0 will result in LSL marker codes ‘65280’ and ‘65281’. In this case, the setting of only using the lower 8 bits will result in ‘0’ and ‘1’).

The LSL Marker stream will be called “TriggerBox Plus [Serial Number]”. Up to 12 clients can actively be connected simultaneously to the LSL marker stream from the TriggerBox Plus.

4.5 Connect the TriggerBox Extension

Connect the TriggerBox Extension to the TriggerBox Plus if you want to add further trigger sources.

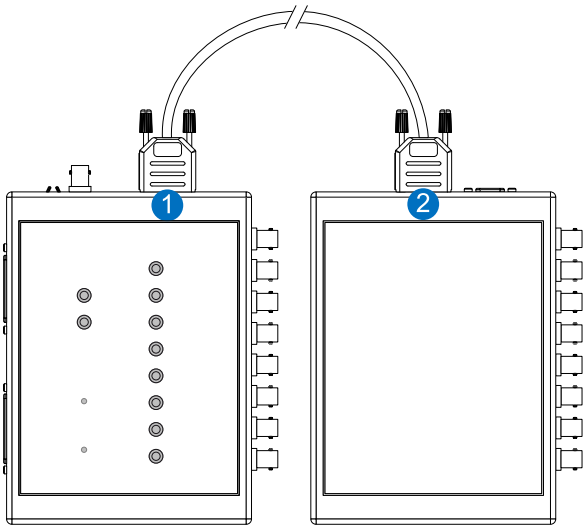
Prepare:

- TriggerBox Plus
- TriggerBox Extension
- Extension cable

1 Connect the extension cable to the Input **In 8–15** of the TriggerBox Plus.

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 5.2.



4.6 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.

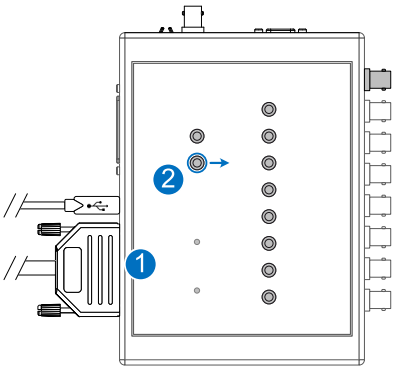
You can connect trigger sources with very short trigger pulses at the inputs for bit 7 and bit 15.

Stretch bit 7

Prepare:

- TriggerBox Plus 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**.

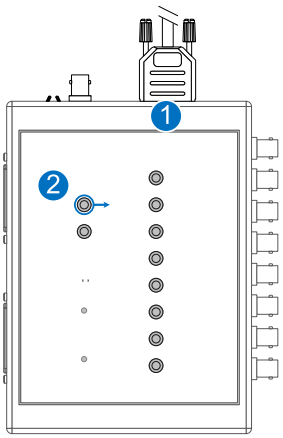


Stretch bit 15

Prepare:

- TriggerBox Plus 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 Plus
- ▶ 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.

4.7 Connect the push button

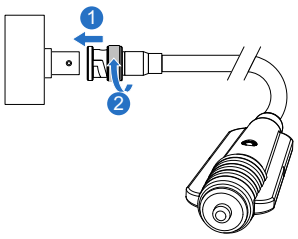
The push button is mainly used for the BNC test, but you can also use it as a response button.

Prepare:

- TriggerBox Plus
- BNC push button
- TriggerBox Plus is connected to an amplifier (page 38) and stimulus presentation computer (page 39).

1 Plug the push button on one of the **BNC** inputs at the TriggerBox Plus.

2 Turn the bayonet housing clockwise, to lock the plug onto the connector.



➔ You can also connect the BNC push button to the TriggerBox Extension.

4.8 Convert optical signals

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

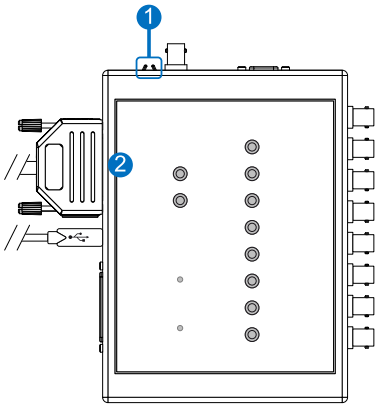
Prepare:

- TriggerBox Plus
- Trigger cable
- Fiber-optic cable
- TriggerBox Plus is connected to an amplifier (page 38) and stimulus presentation computer (page 39).

1 Connect the fiber-optic cable to the **FOC** input for bit 15.

The fiber-optic connector is isolated.

2 Connect the TriggerBox Plus to the amplifier.



➔ Optical signals connected to the input for bit 15 are sent to the amplifier as electrical signals or as LSL markers via the LSL network stream if configured accordingly in the Configuration tool.

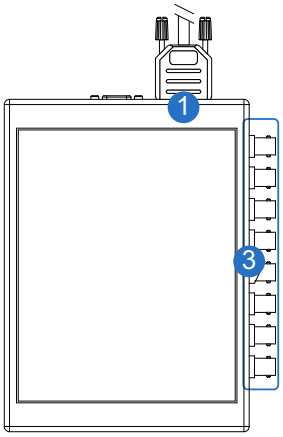
4.9 Split D-Sub signals

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 (Plus), LiveAmp with Sensor & Trigger Extension, or another TTL compatible output equipment to this input.

Prepare:

- TriggerBox Extension
- actiCHamp (Plus) or LiveAmp with Sensor & Trigger Extension
- 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 (Plus) 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)**.

Chapter 5 Configuration examples

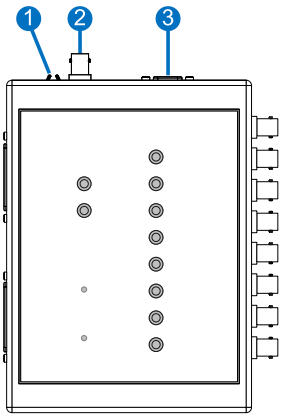
5.1 Connecting bit 15

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.

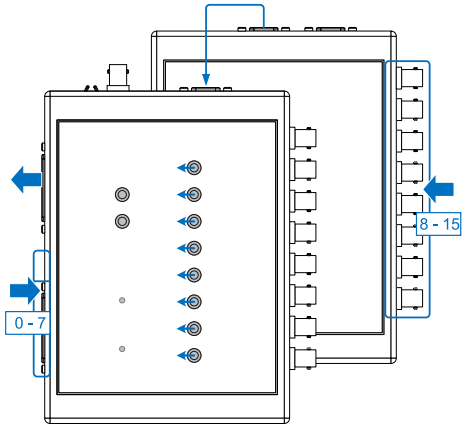
➔ Bit 15 can be stretched (see 4.6 Stretch short pulses).

5.2 Using 16 bits

For a setup with 16 bits you connect the TriggerBox Extension to the TriggerBox Plus. You can use the 16 bit setup only with amplifiers of the BrainAmp family or when using the LSL stream.

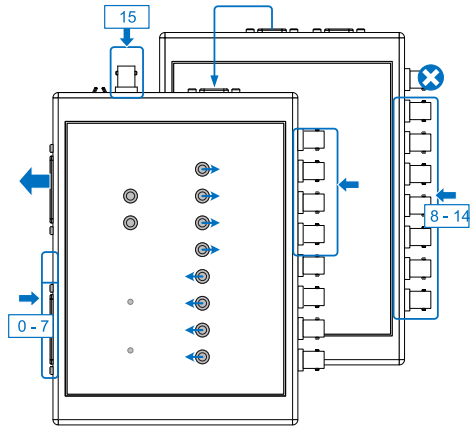
Example 1: Simple setup

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



Example 2: Complex setup

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



Note

Make sure that bit 15 is either occupied on the TriggerBox Plus 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.

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 participant is connected to them or when they are connected to the power supply.
- The products must not be sterilized.

6.2 Using a disinfectant

For disinfecting the surfaces of products (amplifiers, batteries, adapter boxes, etc.), we recommend wiping them down with a tissue drenched in a 70% concentration of isopropyl alcohol (commonly called isopropanol or 2-propanol) for at least 30 seconds.

If you are unable to purchase the products mentioned above in your region, a disinfecting product with similar proportions and active ingredients would be recommended.

6.3 Maintenance information

The TriggerBox Plus 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 2012/19/EU 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.

Data protection: We would like to point out to all end users of the products that you are responsible for deleting personal data on the products to be disposed of.

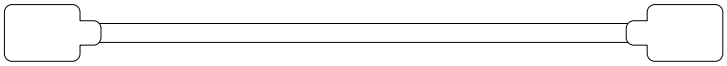
Appendix A Technical data

Common technical data

Ambient conditions

Operation	Temperature: 0 °C to 40 °C (32 °F to 104 °F) Relative humidity: 30 % to 85 %, non-condensing Atmospheric pressure: 700 hPa to 1,050 hPa
Storage and transport	Temperature: 0 °C to 60 °C (32 °F to 140 °F) Relative humidity: 30 % to 85 %, non-condensing Atmospheric pressure: 700 hPa to 1,050 hPa
To prevent mechanical damage during transport, please pack the product in such a way that it is not subject to vibration.	

Cables

			
DSUB25/LPT cable	D-Sub 25 female	3 m	D-Sub 25 male
Trigger cable	D-Sub 25 male shielded	3 m	D-Sub 9 female OR D-Sub 16 female
Test cable	D-Sub 25 male	0.5 m	D-Sub 9 male
USB cable	Type B	3 m	Type A
Push button	Push button	1.9 m	BNC
Extension cable	D-Sub 9 male	3 m	D-Sub 9 female

Notice:

The output **Amp** is not a standard LPT port. You **must not** connect this output to a normal LPT port via a conventional 25 pin D-Sub cable. In this case, use the provided DSUB25/LPT cable (BP-245-1565).

Only use the cables provided by Brain Products when connecting to the output **Amp**.

System requirements for the TriggerBox Test IO

Operating system	Windows® 10 or later, 64 bit with Microsoft Visual C++ runtime
Software requirements	.NET4
USB port	USB 2.0 or higher

Technical data of the TriggerBox Plus

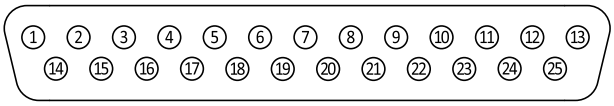
Power supply	4.5 VDC to 5.5 VDC 300 mA Power supply via USB port of computer; computer must comply with either IEC 60601-1, EN 60601-1, IEC 62368-1, EN 62368-1, or equivalent safety standards.
Pulse stretcher	Switch position **5 ms**: Stretching of relevant trigger pulse to 5 ms ±1 ms. Switch position **OFF**: No stretching of relevant trigger pulse.
USB port	USB 2.0, type B configured as serial port delay ‹ 1 ms jitter ‹ 1 ms LSL marker generation: ‹1ms Reading inputs via USB: ‹1ms
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
LAN/Ethernet connector (**LAN Out 0–15**)	RJ45
Wireless transmission protocol	WIFI/WLAN protocols 802.11b,g,n
Frequency band for wireless data transmission	In the 2.4 GHz ISM band. There are no restrictions for its use worldwide.
Network LED	LAN/WLAN status
Electromagnetic Compatibility (EMC)	Tested according to EN 61326-1:2021 (IEC 61326-1:2020)

Level conditions

- The levels of open **BNC** and **PC** inputs are by default high.
- 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



Pin	Description
1	NC[a]
2	Bit 0
3	Bit 1
4	Bit 2
5	Bit 3
6	Bit 4
7	Bit 5
8	Bit 6
9	Bit 7
10 - 24	NC
25	Ground
Metal frame	Shield

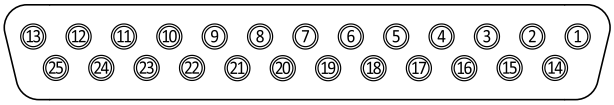
a. NC = not connected

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



Pin	Description
1	NC
2	Bit 0
3	Bit 1
4	Bit 2
5	Bit 3
6	Bit 4
7	Bit 5
8	Bit 6
9	Bit 7
10	Bit 8
11	Bit 9
12	Bit 10
13	Bit 11
14	Bit 12
15	Bit 13
16	Bit 14
17	Bit 15
18 - 23	NC
24	+5
25	Ground
Metal frame	Shield

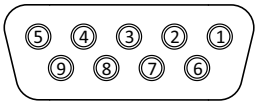
Notice:

The output **Amp** is not a standard LPT port. You **must not** connect this output to a normal LPT port via a conventional 25 pin D-Sub cable.

Only use the cables provided by Brain Products when connecting to the output **Amp**.

Pinout: In 8–15

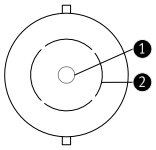
9-pin D-Sub, female, top view



Pin	Description
1	Bit 8
2	Bit 9
3	Bit 10
4	Bit 11
5	Bit 12
6	Bit 13
7	Bit 14
8	Bit 15
9	Ground
Metal frame	Shield

Pinout: BNC connectors (In 0–7 and bit 15)

BNC socket (female), isolated, top view



Pin	Description
1	Inner conductor: Signal
2	Outer conductor: Ground

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:

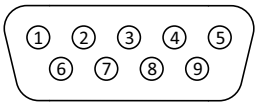
- 1 mm Plastic Optical Fiber (POF): max. distance 30 m
- 200 µm Hard Clad Silica (HCS): max. distance 300 m
- max. signal frequency: 10 MHz
- low-active

Technical data of the TriggerBox Extension

Dimensions (L x W x H)	192 mm x 160 mm x 35 mm
Weight	450 g

Pinout: Output 0–7 (8–15)

9-pin D-Sub, male, top view



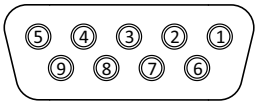
Pin	**Description**
1	Bit 0 (8)
2	Bit 1 (9)
3	Bit 2 (10)
4	Bit 3 (11)
5	Bit 4 (12)
6	Bit 5 (13)
7	Bit 6 (14)
8	Bit 7 (15)
9	Ground
Metal frame	Shield

The output can be connected to the following equipment:

Equipment	**Max. bits**	**Input name**	**Input type**
TriggerBox Plus	8	In 8–15	D-Sub 9, female
actiCHamp (Plus)	8	Trigger In	D-Sub 9, female
LiveAmp with Sensor & Trigger Extension	8	Trigger In	D-Sub 9, female

Pinout: Input 0–7

9-pin D-Sub, female, top view



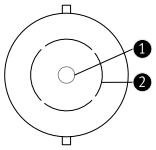
Pin	Description
1	Bit 0
2	Bit 1
3	Bit 2
4	Bit 3
5	Bit 4
6	Bit 5
7	Bit 6
8	Bit 7
9	Ground
Metal frame	Shield

This input can be connected to the following equipment:

Equipment	Max. bits	Input name	Input type
actiCHamp (Plus)	8	Trigger Out	D-Sub 9, male
LiveAmp with Sensor & Trigger Extension	8	Trigger Out	D-Sub 9, male

Pinout: BNC connectors 0(8) to 7(15)

BNC socket (female), not isolated, top view



Pin	Description
1	Inner conductor: Signal
2	Outer conductor: Ground

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

Amplifier	**Max. bits**	**Name of input port**	**Connector type**
BrainAmp (via USB adapter)	16	Trigger (on USB adapter)	D-Sub 26, female
LiveAmp with Sensor & Trigger Extension	8	Trigger In	D-Sub 9, female
actiCHamp (Plus)	8	Trigger In	D-Sub 9, female

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.

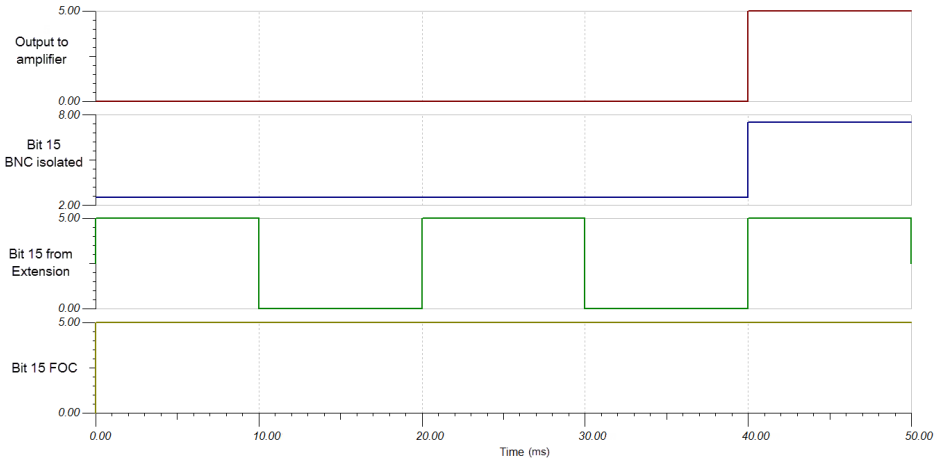


Figure A-1. Bit 15 - Overlapping trigger signals, resulting in lost trigger information

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.

Appendix B Ordering codes

Designation	Ordering code
TriggerBox Plus (details see page 15)	BP-210-9031
TriggerBox Extension (details see page 16)	BP-210-9040

The following can also be ordered:

Designation	Ordering code
BNC Cable - 1m	BP-345-1000
BNC Shielded Trigger Cable - 2m	BP-280-0015