# How to interface Brain Products hardware and software from Presentation®

Presentation® can interface with Brain Products hardware and software in two ways:

1. By sending hardware triggers that are directly recorded with the EEG (or EMG, EOG ...) data stream
2. By connecting to Brain Products Remote Control Server 2 via TCP to directly control BrainVision Recorder

This introduction will help you in setting up EEG experiments using Presentation® and Brain Products equipment with using just one of the above possibilities or a combination of both.

## 1. Sending hardware triggers from Presentation® to Brain Products amplifiers

If you want to send hardware triggers to our amplifiers, the most straightforward solution is to use the parallel port (LPT port) on your stimulation computer; however, in modern PCs, parallel ports are not commonly used any more. For PCs without a parallel port, we provide the perfect alternative: the TriggerBox. The TriggerBox can be connected to the stimulation computer via USB and will be recognized as a serial device. In Presentation®, the TriggerBox can be used as a virtual parallel port. In the following paragraphs, we will show you how to use the parallel port and the TriggerBox in Presentation® for sending hardware triggers to Brain Products amplifiers.

### Sending triggers via the parallel port

All Brain Products amplifiers (BrainAmp family, QuickAmp, V-Amp and actiCHamp, as well as LiveAmp with the LiveAmp Sensor & Trigger Extension (STE)) are equipped with parallel communication marker input ports and with a cable which connects the standard parallel port of the PC to the marker input port of the amplifier. The Presentation® software is easily and conveniently able to handle the parallel port for sending codes which mark the timing of events, like stimuli or responses.

The amplifier synchronizes the marker with the ongoing EEG data and sends the data stream with the markers to the data acquisition software (BrainVision Recorder), where the codes of the marker are interpreted and stored together with the EEG data.

### How to add a new parallel port or how to change the settings of an existing port in Presentation®

In ***Settings › Port › Output Ports***, enter the following settings (Figure 1):

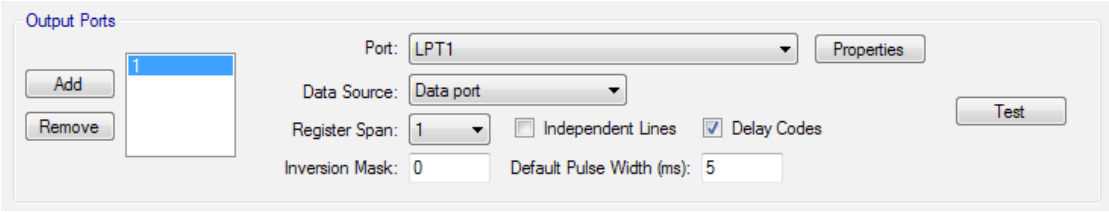


Figure 1: Settings for using the parallel port in Presentation®.

More details can be found in the online documentation of Presentation®.

## How to test the connection between Presentation® and the Brain Products EEG system

The easiest way for testing the connection is to click on 'Test' in ***Settings › Port › Output Ports*** (Figure 1) which opens the 'Port Output Test' window where you can send single triggers of variable value and length. Please make sure that BrainVision Recorder is running, has the correct amplifier connected and is in Monitoring mode. Also make sure that the marker input of the amplifier and the LPT port of the PC, where Presentation® is installed, are connected with the trigger cable that is delivered together with the EEG system.

Once the codes are sent from Presentation®, the corresponding markers should appear below the data stream (see Figure 2).

For sending triggers in actual experiments, Presentation® has its own built-in functions to send triggers via the output port. Please check the 'Event Port Output' section of the Presentation® online documentation for details.

From the two available options, it is recommended to use the second one which requires the write_codes header parameter to be true.

Always make sure to send trigger pulses that are at least as long as the time between two samples in BrainVision Recorder. We recommend using at least 2x the sampling time for our BrainAmp, actiCHamp, and LiveAmp amplifiers (please consult the BrainVision Recorder manual for V-Amp). For example, when using LiveAmp with a sampling rate of 1000 Hz, the time between two samples would be 1 ms. Therefore, in this case, use pulses that are at least 2 ms long.

Presentation® automatically resets the value to zero at the end of a pulse. The value zero marks the baseline and cannot be used as a trigger code because it is not interpreted by BrainVision Recorder.

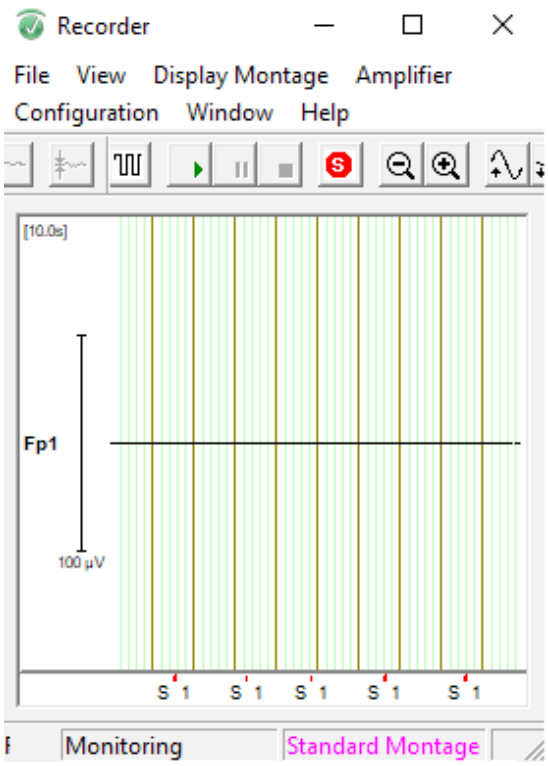


Figure 2: Receiving triggers in BrainVision Recorder. The triggers appear as red ticks at the bottom of the graph.

## How to add TriggerBox as an emulated parallel port

You can use our TriggerBox instead of the parallel port without almost any additional effort. You just have to install a small application, the TriggerBox Test IO. After this application is installed, you can go to ***Settings › Port › Output Ports*** again and enter the following details (Figure 3):

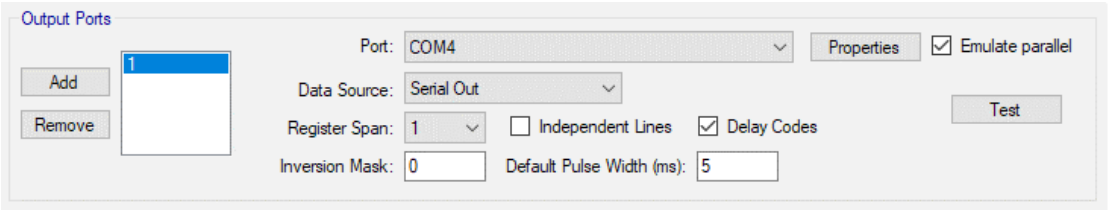


Figure 3: Settings for using TriggerBox in Presentation®.

In addition, you need to enter some arbitrary values under 'Properties' (Figure 4). Since the TriggerBox is only a virtual serial port, the actual values do not matter, but they cannot be empty, otherwise Presentation® will respond with a warning message.

The Brain Products Marker Sending Demo example experiment (available on the Brain Products Website) demonstrates how markers can be sent from Presentation® to a Brain Products amplifier.

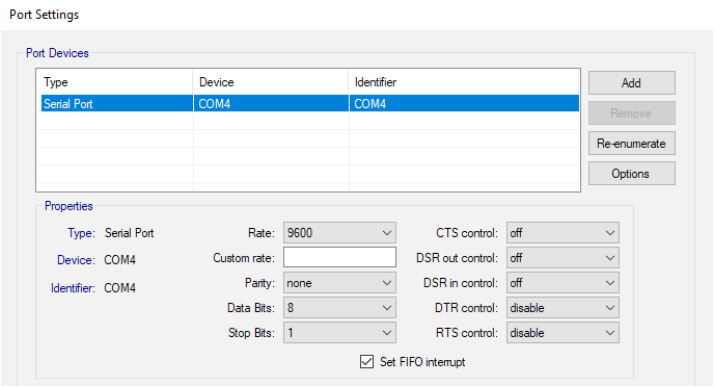


Figure 4: Setting arbitrary values for TriggerBox in its 'Properties'.

## How the marker codes are interpreted by BrainVision Recorder

All markers get a ***Position***, ***Type***, and ***Description*** property in BrainVision Recorder.

***Position*** describes the EEG data point which the marker belongs to. It is the first data point where the amplifier detected the active trigger.

***Type*** of the marker is defined by the ***Digital Port Settings***, located in the menu ***Amplifier***. Here, a type can be assigned to every bit of the trigger input port and the markers automatically get the corresponding label as ***Type*** property (Figure 5). The ***Type*** field cannot be empty and cannot contain special characters.

The values of the bits, which have identical ***Type***, are interpreted together, while the values of the bits with different ***Types*** are interpreted independently.

For example, if all 8 bits of the parallel port have different ***Type*** labels, all of them are interpreted independently, which means that a maximum of eight different codes can be used. This operating mode corresponds to the 'independent lines' parallel port handling mode of Presentation®. In the example shown in Figure 5, BrainVision Recorder can receive three different ***Types***: a binary input with the ***Type*** 'Master' which receives triggers over the LiveAmp's Trigger input port and the ***Types*** 'Stimulus' and 'Response', both of which consist of 4 bits.

***Description*** contains a letter and a number. The letter is the capitalized first letter of the ***Type*** field. The number is equal to the binary coded signal that arrived on the channels which are interpreted together. For the example in Figure 5, the possible trigger ***Descriptions*** would be M1, S1–S15, and R1–R15. Thus, for each ***Type***, you can receive $2^n$-1 (n = number of bits) different triggers because 0 is not recognized as a trigger by BrainVision Recorder.

The ***Digital Port Settings*** also define whether the high or the low signal should be interpreted as the active one. The default is high active, which corresponds to the default setting of Presentation®, where no inversion mask is applied.

Please find further explanation in the User Manual of BrainVision Recorder.

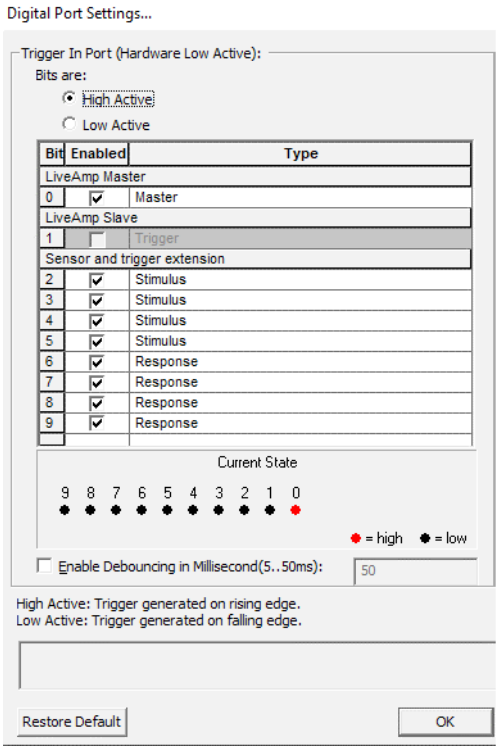


Figure 5: Digital Port Settings, in this case for a LiveAmp 32 which has 1 Trigger input port in addition to the 8 input ports provided by the Sensor & Trigger Extension for LiveAmp.

## Is it possible to run BrainVision Recorder and Presentation® on the same computer?

Although it is technically possible, this setup is definitely not recommended. Both applications run in at least high priority mode and the proper availability of the system resources is critical for both programs; therefore, it is highly recommended to run them on separate computers.

## 2. Controlling BrainVision Recorder via Remote Control Server 2 from Presentation®

If you want to go a step further, you can even run the complete experiment control from within Presentation® by using Brain Products Remote Control Server 2 (RCS) and the BrainVision Remote PCL Extension for Presentation®.

## Prepare the recording computer:

In order to set up the communication between Presentation® and RCS, you first have to install the RCS software from the Brain Products website. The installation comes with a Client and a Server module. You only need the Server module but can use the Client for testing its functionality.

After you have installed RCS, start the Server module as Administrator (this is important if you want to operate BrainVision Recorder in Administrator mode, e.g., to be able to select amplifiers). RCS must be running on the same computer BrainVision Recorder is

supposed to be started on. We assume that Presentation® is running on a different computer within the same network. Before you can connect to RCS from Presentation®, first enter the IP address of the computer with RCS in the Server module. To do so, click on 'Disconnect', then on ***File › Settings***, and enter the address, while leaving the port at '6700'. Afterwards, click 'Save and close' and Connect.

Now, RCS is waiting for a connection from Presentation®.

## Prepare the stimulation computer:

Communication between RCS and Presentation® is provided via the BrainVision Remote PCL Extension. You can download the newest dll from https://bitbucket.org/neurobs/brainvisionremotepclextension/downloads/. To register the downloaded dll as an extension in Presentation®, go to ***Tools › Extension Manager*** and click 'Select Extension File', select and open the dll, enter a name next to 'Register As' and click 'Register Extension'. Now, the extension should be listed under 'Registered Extensions'.

You are now all set to use the commands necessary for communicating with RCS in your Presentation® scripts.

These are all the provided commands you can include in your scripts:

brain_products::remote bp = new brain_products::remote("‹IP address›", "‹Port›");
This command initiates the connection between Presentation® and RCS. Just enter the IP address and port of the computer that runs RCS. The port is 6700 per default.

bp.open_recorder("‹workspace›", "‹experiment›", "‹subject›", ‹timeout›);
Here, you open BrainVision Recorder and send the main parameters, such as the workspace, name of the experiment, and subject ID. You also have to set the timeout. A recommended value would be 10000 ms.

bp.set_impedance_check_mode();
This command starts the impedance check mode.

bp.set_view_test_mode();
This command starts showing a test signal in BrainVision Recorder.

bp.set_monitoring_mode();
This command starts monitoring mode.

bp.stop_viewing();
This command can be used to stop viewing the test signal or stop monitoring mode.

bp.start_recording();
This command starts the recording of EEG data. Note that the file will be recorded in the folder specified within the workspace and saved as ‹experiment›_‹subject›.eeg.

bp.pause_recording();
Use this command to pause recordings.

bp.resume_recording();
Use this command to continue a paused recording.

bp.stop_recording();
This command stops the recording.

bp.dc_reset();
In case you do not use high pass filters online and have large drift, you can use this command to reset the DC offset.

bp.close_recorder();
This command closes BrainVision Recorder.

bp.select_amplifier("‹amplifier›");
With this command you can change the amplifier that is currently selected in BrainVision Recorder (e.g., "LiveAmp", "actiCHamp", or "BrainAmp Family"). For a list of possible strings check the list in BrainVision Recorder that appears after going to ***Configuration › Select Amplifier***.

bp.set_serial_number("‹LiveAmp serial number›");
If you send the serial number of the LiveAmp ("LA-xxxxxx-xxxx"), which is written on its back, you no longer have to manually search for and connect to the LiveAmp. Instead, you can immediately send bp.set_monitoring(); or bp.set_impedance_check_mode(); and BrainVision Recorder will connect to the specified LiveAmp automatically.

bp.send_raw_message("‹raw message›", ‹number of responses›, ‹response array›);
This functionality is mostly used for debugging, or if you need to send commands that are not yet included in the BrainVision Remote PCL Extension. You either have to know the number of responses or enter the maximum possible number (4) and wait for the timeout.

bp.set_overwrite_protection(‹true/false›);
This command turns overwrite protection on or off.

bp.send_annotation("‹Description›", "‹Stimulus›");
Use this command to send annotations to BrainVision Recorder. Note that these text messages do not guarantee the same accurate timing precision as hardware triggers.

You can find a scenario (Brain_Products_BVRemotePCLExtension_demo) that demonstrates how to use most of these commands, including the sending of triggers, on the Brain Products website).