Stimulus System of Shielded Room (DC)

This manual is to provide basic information to work with the stimulus system of the shielded room (DC) in ABL (see Image 1).

The manual includes stimulus system descriptions and wiring, but also details about the stimulus software and synchronization between external devices.
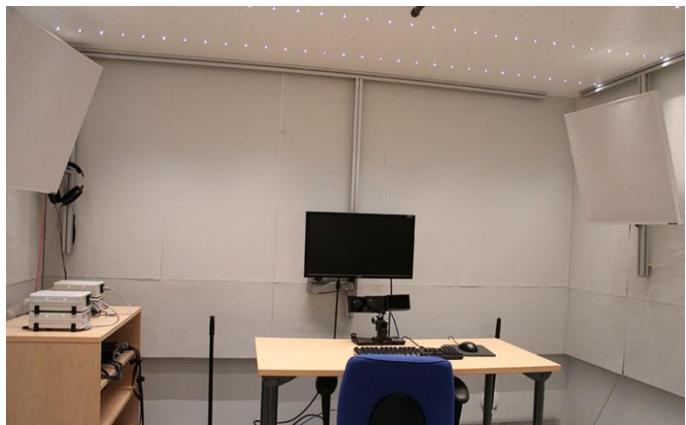
Image 1: Control room on the left, inside the shielded room on the right

1 System Setup

Following component table and wiring diagram shows the components and their positions in the ABL.

Table 1: Stimulus system components

Device	Image & Details
Stimulus PC Control Room Stimulus Monitor	 Supermicro
Stimulus Monitor (24", 144Hz) Shielded Room	 BenQ XL2420Z
Parallel Box Control Room	

Optical Video Transmitter Control Room	 DVI Gear Fiber Optic Transmitter Dual Link DVI DVI-7320Tx SN 13521988
Optical Video Receiver Shielded Room	 DVI Gear Fiber Optic Transmitter Dual Link DVI DVI-7320Tx SN 14520078
USB Extender Local Control Room	 Black Box, 4-port USB 2.0MM Fiber Extender (local), SN: BB404A-06L-A03942
USB Extender Remote Shielded Room	 Black Box, 4-port USB 2.0MM Fiber Extender (remote), SN: BB404A-06R-A03942

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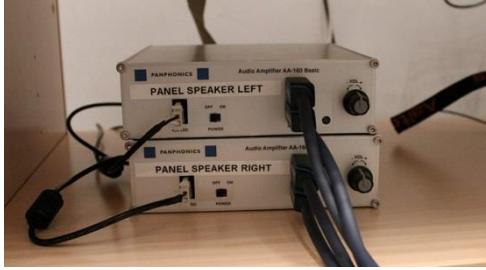
|	
External Soundcard Shielded Room	RME Fireface UCX SN: 23671535
Amplifier Left Amplifier Right Shielded Room	Panphonics, Audio Amplifier AA-160 Basic SN: 022633 (Left) SN: 022632 (Right)
Panel Speakers (Left and right) Shielded Room	Panphonics, Soundshower (60 x 60cm). SN: 6181 (Left) and 6182 (Right)
Head Phones Shielded room	Sennheizer 400

Table 2: Wiring diagram of the stimulus system
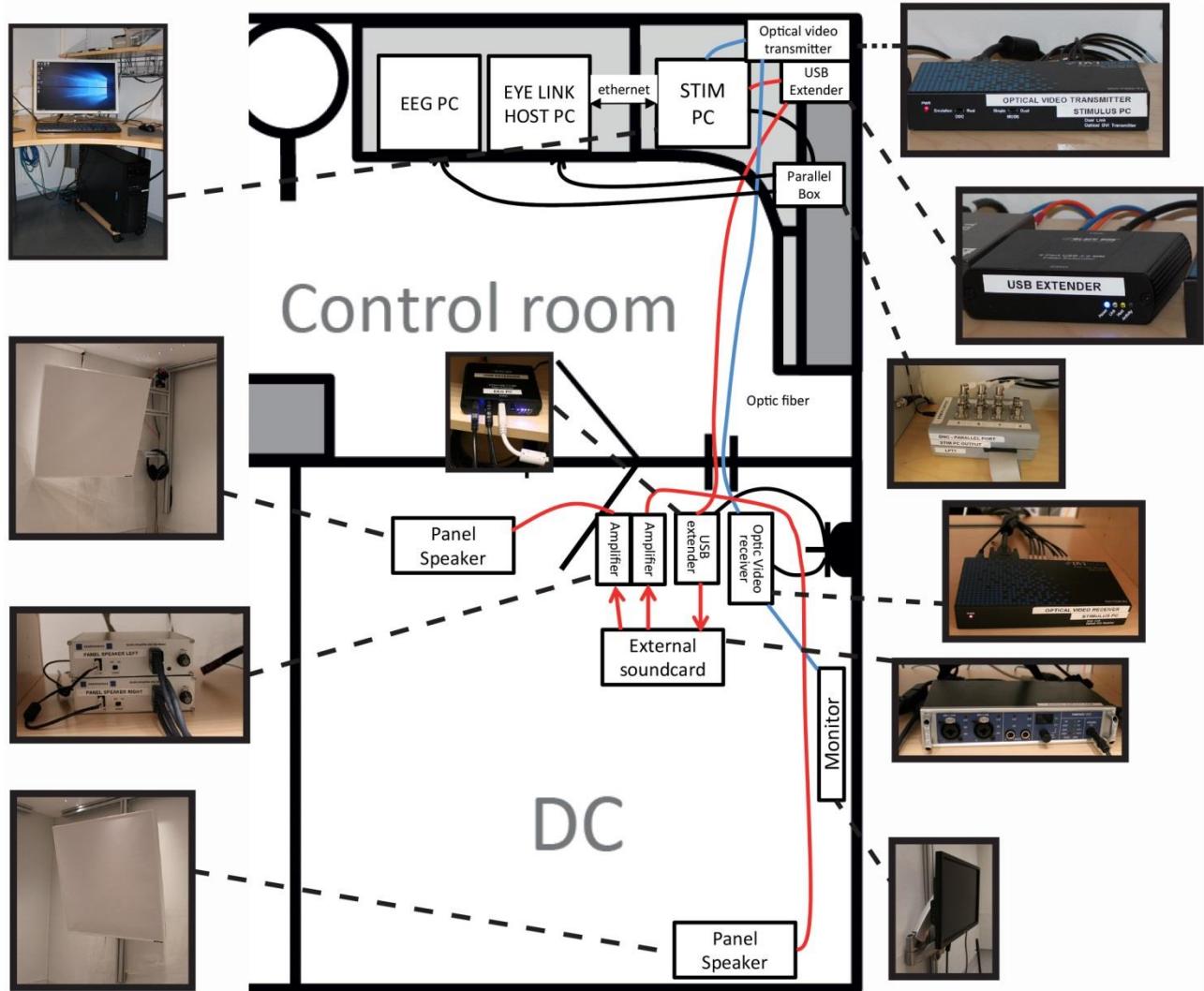
2 Stimulus PC

Stimulus PC in ABL normally controls the whole experiment; it can both present the visual and audio stimuli, and also can be synchronized with external devices and used for trigger sending.

Stimulus PC is connected by default to:
- Two monitors (other in the control room, other in the shielded room) which are cloned, so that they show the same image.
- An external sound card via USB cable (+optic link)
- Parallel Box for TTL triggering

- Eye Link Host PC via Ethernet cable
- Headphones for checking the audio stimuli outside the shielded room.

Image 2: Backside of the Stimulus PC

Table 3: Components of the Stimulus PC

Component	Details
Manufacturer	Supermicro
Operating system	Windows 10 Enterprise 2015 LTSB
CPU	Intel ® Core™ i7-4771 CPU@3,50 GHz
Memory	16 GB
Sound card	Realtek High Definition audio / RME Fireface UCX (external soundcard)
Display adapter	NVIDIA GeForce GTX 650 Ti

Table 4: Softwares of the Stimulus PC (17.1.2017)

Sofware	Version
Presentation	18.1. Build 06.09.15
Experiment Builder	1.10.1630
DataViewer	2.3.22
PsychoPy2	1.83.04

3 Stimulus Software

Currently Presentation, Experiment Builder and PsykoPy are available in the Stimulus PC for stimulus presentation. Also it's possible to install other presentation softwares like Matlab and E-Prime, if needed (contact personnel)

This chapter described the basic settings when using the above mentioned software in ABL.

3.1) Presentation

Presentation software by _Neuro Behavioral Systems_ is installed on Stimulus PC (Windows 10), and include PresLink and Prexel interfaces for the eye tracker. It can also be synchronized through the parallel port with other external devices. Presentation has a reputation to be temporally precise.

https://www.neurobs.com/presentation/docs/index_html

3.1.1 Video Settings

You can choose which video adapter to use, from
"Settings-Display Device->Adapter" choose "NVIDIA GeForce GTX 650 Ti". Default resolution for BenQ monitor inside the shielded room, is "1920x1200" at 60Hz.
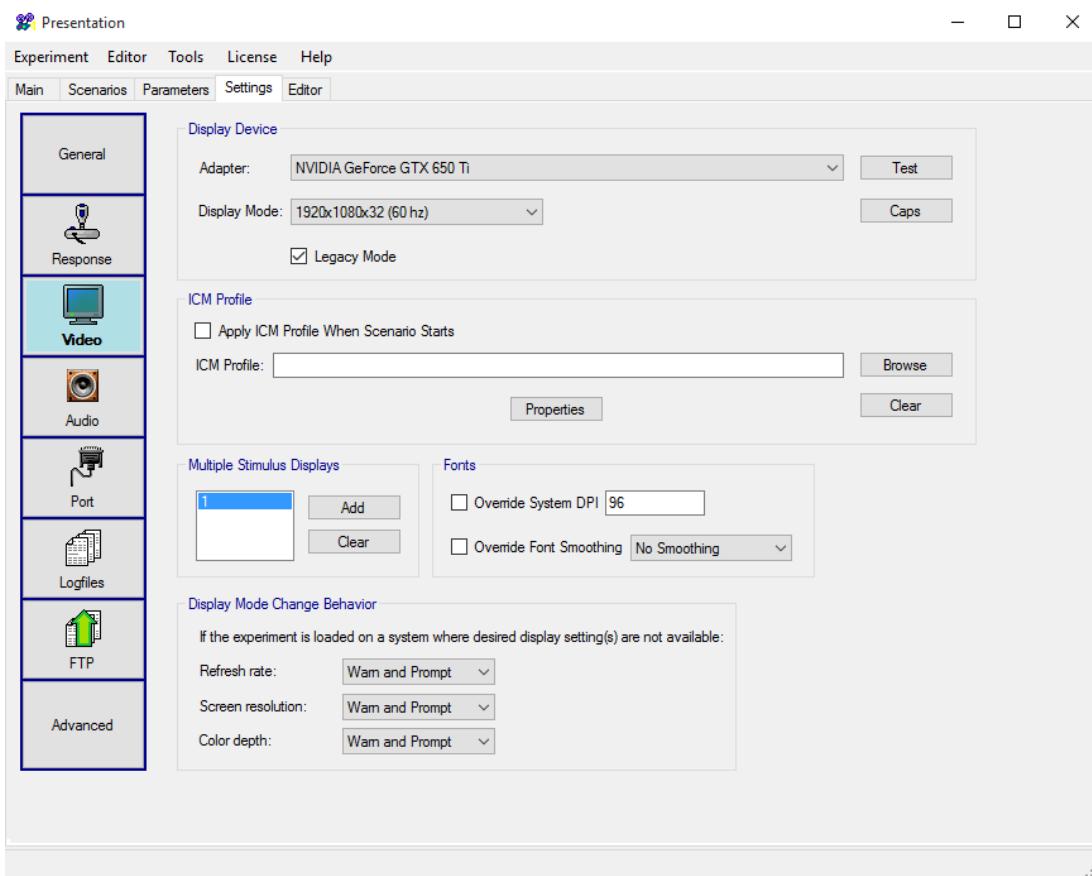
3.1.2 Audio Settings

When using the Fireface UCX external soundcard, set SPDIF/ADAT (1+2) RME Fireface UCX. If there doesn't exist such an option, make sure the Fireface UCX is turned on, and restart the Presentation.

Computer's own Realtek soundcard is connected to Fireface UCX via optic fiber (Realtek Optical Digital Output), if you want to use higher frequencies than 32kHz.
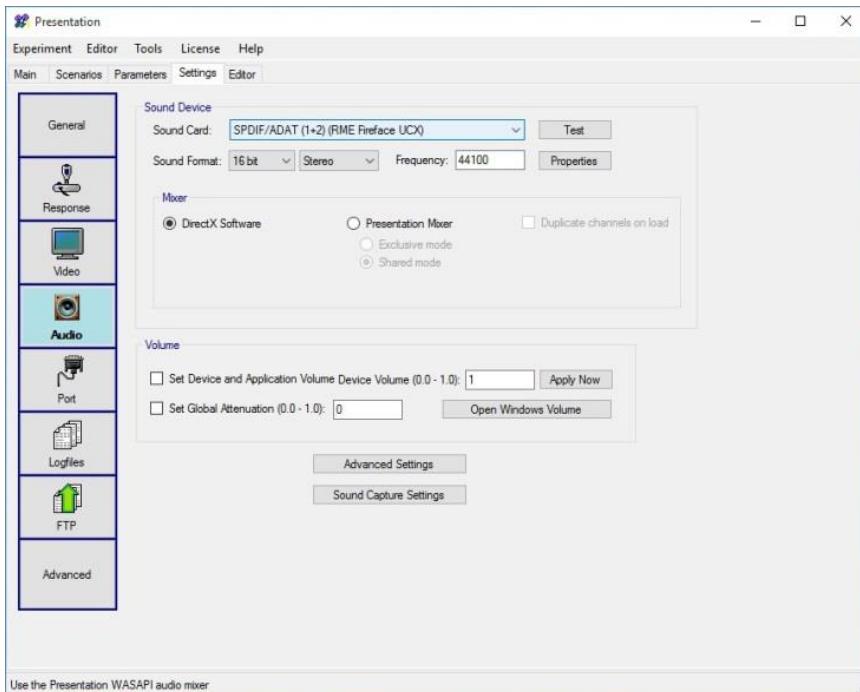
The Frequency set in the example above is set to 44100 Hz. NOTICE: This not actual the real case, because in the settings of USB connection, the frequency is set to 32100 Hz (see 5.1) External Soundcard.

3.2) Experiment Builder

A presentation software made by SR Research, is created especially for communication with the Eye Link eye trackers, but works also without an eye tracker.

3.3) PsykoPy

PsykoPy is a software "For stimulus generation and experimental control in python".

4 Stimulus Monitor

BenQ XL2420Z works as a stimulus monitor inside the shielded room. Its native resolution is: 1920 x 1200, and it's set to 60 Hz as default in ABL. It's a 24" monitor, the full screen size is 530mm x 300mm.

Video feed goes through optic link to the shielded room, by using DVI Gear Fiber Optic Transmitter and Receiver devices.

4.1) Sampling rate

The highest sampling rate can go up to 144Hz (G2G), so around 6.9ms from G2G. Measured Input and output sampling rates are listed into Table 5 and Table 6. Notice that the output rate is not always stable, but some of the output values are averages from several cycles.

Table 5: 60 Hz mode

Input (Hz)	Output (Hz)
2	2
4	4
8	8
20	20
40	40 (average)
50	50 (average)
~80	60
~120	60

144Hz mode

Table 6: 144Hz mode

Input (Hz)	Output (Hz)
100	92
125	114
100	144
144	144

4.2) Delays

Stimulus delay, when measured between TTL-pulse from the parallel port, and analog signal from optic converter.

The measured delay wasn't constant. Delay 34,2±5ms

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4.3) Measuring the delay

We measured illumination changes with our lab made light to voltage converter. When measuring delays, place the light to voltage converter very close to the light source (less than 10mm distance). For attaching use tapes etc. Turn off the lights in the room, for preventing them of interfering the detector.

Image 3: Light to voltage converter

Attach the light converter output to channel one on an oscilloscope. Then connect BNC output pin 1 of the parallel output port box to the channel two on an oscilloscope.

Create a Presentation script, which shows white box on a black background in sequences (one second on, on seconds off). Send trigger signal on the output pin 1, every time the box appears.

4.4) Experiment

Run the presentation script, and measure the delay between the two channels with the oscilloscope. Repeat the measurement at least ten times, and calculate the average. This value is the delay for the stimulus system to produce image.

5 Sound System

Sound system is connected to a stimulus PC, meaning that external sound card is connected via USB connection to USB port of the stimulus PC. USB-connection is established through USB-extender which uses an optic fiber for the shielded room feed through.

Sound system also includes the panel speakers and headphones, which locate inside the shielded room.

Stimulus PC also has its own internal soundcard, Realtek High definition audio, which can be used locally.

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5.1) External Soundcard

RME Fireface UCX, has several input and output channels. The Total Mix software works as a mixer, where you can set which device inputs an output signals is needed.
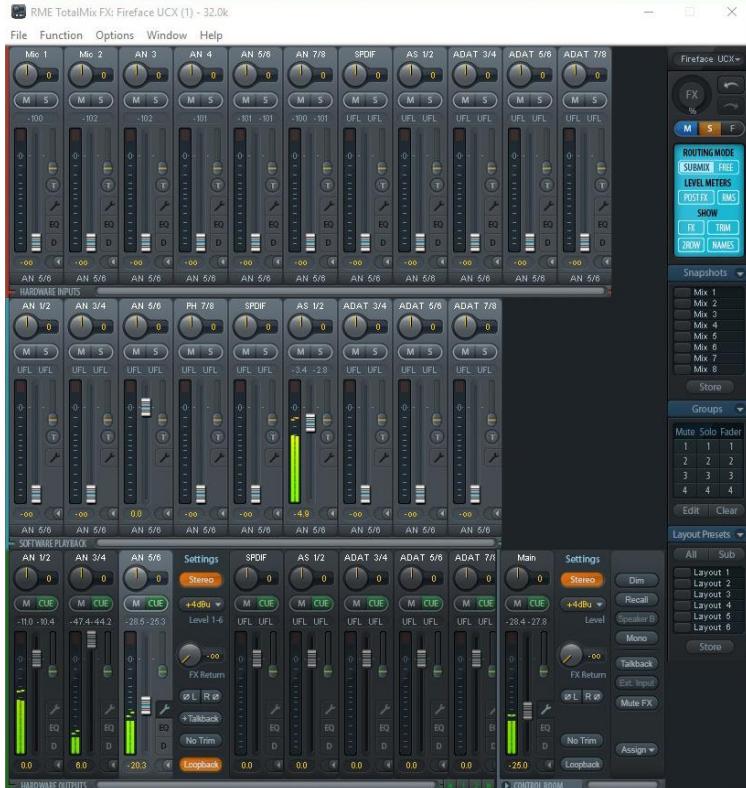
There are several different setup options saved as "snapshot" on the stimulus software, including "headphones", "panelspeakers" and stim "headPhones". You can also create your own setup.

Those defautl settings can be loaded by "load snapshot". They are in the folder k:\Users\maintenance\TotalMix_Audio

Table 7: There are quick icons for Total Mix and USB setting software in the Windows toolbar
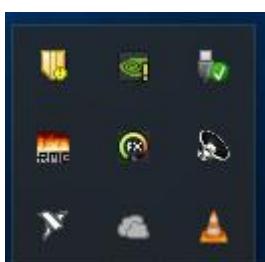
USB-settings can be set from the "Fireface USB settings" –software.
NOTICE: Set the audio to 32.1kHz; higher rates will conflict with the USB extender (Black Box IC404A USB-extender).

```
Fireface USB Settings                          ?   ×

 Fireface UCX(1) | About |

 ┌─ Buffer Size (Latency) ──────────────────────────┐
 │     256 Samples  ▼        Errors: 0/0            │
 └──────────────────────────────────────────────────┘
 ┌─ Output Format ──────────────────────────────────┐
 │  Word      □ Single Speed                        │
 │  Optical   SPDIF      ▼                           │
 │  SPDIF     Consumer   ▼                           │
 └──────────────────────────────────────────────────┘
 ┌─ Options ────────────────────────────────────────┐
 │  DSP       ☑ EQ+D for Record                      │
 │  SPDIF In  □ TMS                                  │
 │  Word In   ☑ Termination                          │
 └──────────────────────────────────────────────────┘
 ┌─ Clock Mode ─────────────────────────────────────┐
 │  Sample Rate   32000 Hz  ▼                        │
 │  Clock Source  Internal  ▼    Current  Internal   │
 │  Pitch         0.000%    ▼                        │
 │   -5%   ────────────┼──────────   +5%            │
 └──────────────────────────────────────────────────┘
 ┌─ Input Status ───────────────────────────────────┐
 │  Word       No Lock      ---                      │
 │  SPDIF opt. Lock         48 kHz                   │
 │  SPDIF coax No Lock      ---                      │
 └──────────────────────────────────────────────────┘

              OK        Cancel
```

5.2) Panel Speakers

Panphonics "Sound shower" panel speakers are highly directional speakers, so before experiment, you need to direct the speakers closely towards the subject.

They are passive speakers and work with Panphonics amplifier. Each panel has its own amplifier. The operational frequency range is between 300 – 20000Hz, so speakers don't play low frequencies.

Currently the panel speakers are connected to the balanced line output channels 1 and 2 of the External Fireface UCX soundcard.

5.3) Headphones

Sennheizer HD600, can be connected phone 7/8 output port of the external soundcard. Headphones create some artefacts to EEG measurements, so use Etymotic earphones or Panel Speakers instead.

Another set of Sennheizer HD600 headphones are connected directly to the stimulus PC in the control room. These headphones enable to listen to an audio stimulus also in the control room for monitoring purposes.

Informed frequency response on the website 12-40500Hz.

https://en-us.sennheiser.com/global-downloads/file/4640/HD600_560026_1114_EN.pdf

5.4) Earphones

Earphones by Etymotic can be connected to phone 7/8 output port of the external soundcard. Their operational range is up to 16kHz and don't' create any artefacts to EEG data.

6 Communication with external devices

6.1) Parallel Box

Parallel box is connected to the parallel port (LPT1) of the Stimulus PC. Parallel box can be used for TTL triggering from the Stimulus PC to any other device. There are 8 pins for channels 1-8, and which can be connected other devices with BNC-cables.
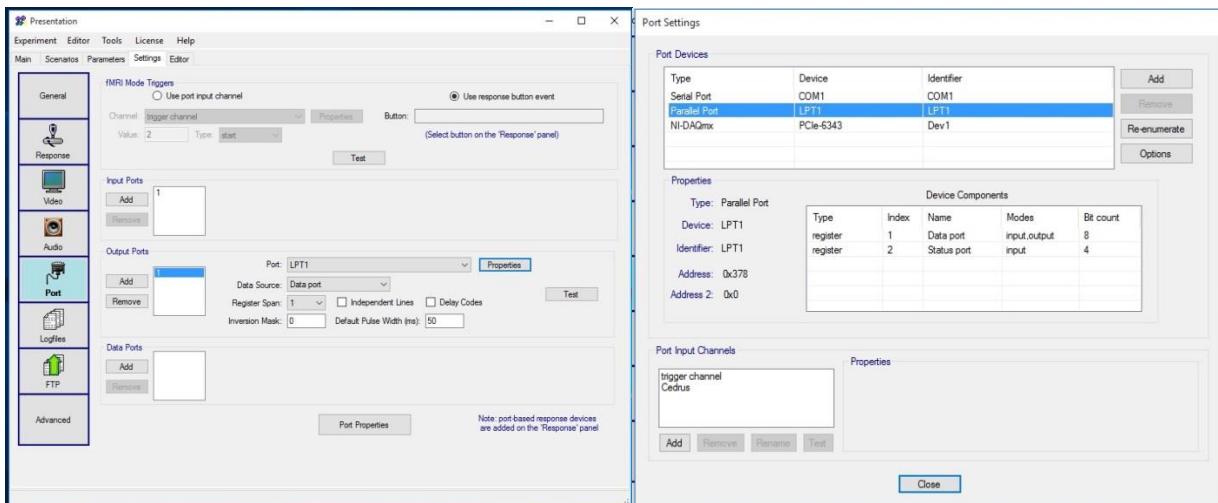

Image 4: Parallel port settings in the Presentation software. Use LPT1 as an output port.

6.2) Ethernet connection

Stimulus PC has two Ethernet slots; other is for internet connection, and other one for connecting the computer directly to Eye Link Host PC (blue cross wired cable). The name of the Eye Link Ethernet connection is "EyeLink 1000 plus). IP address for that current slot is 100.1.1.4.

6.3) Cedrus Response Pad

BG-610 response pad is connected to the serial port of the Stimulus PC. The serial cable has ferrite beads around the feedthrough of the shielded room.
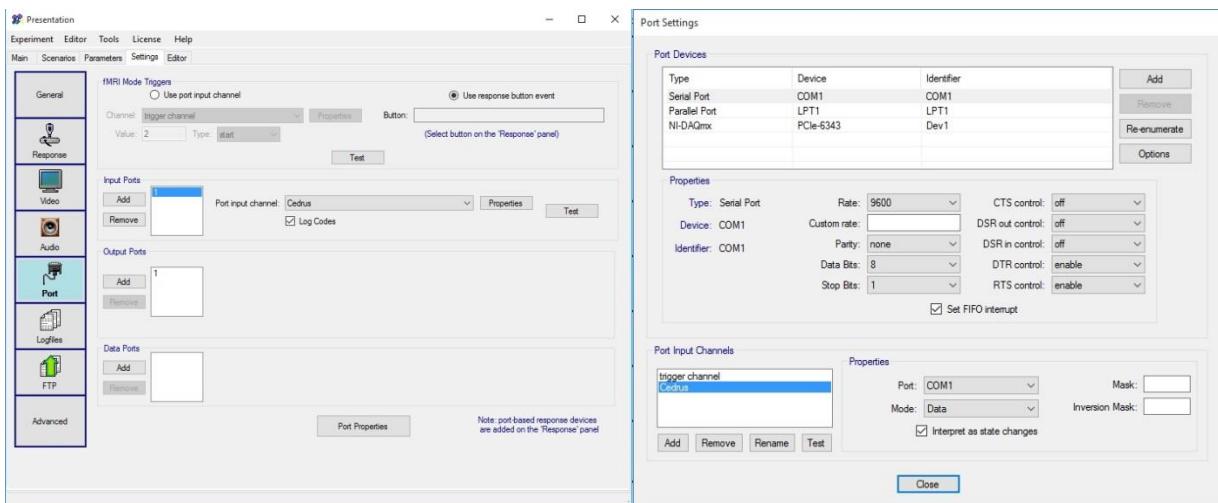

*Image 5: Presentation settings of the Cedrus response pad.*
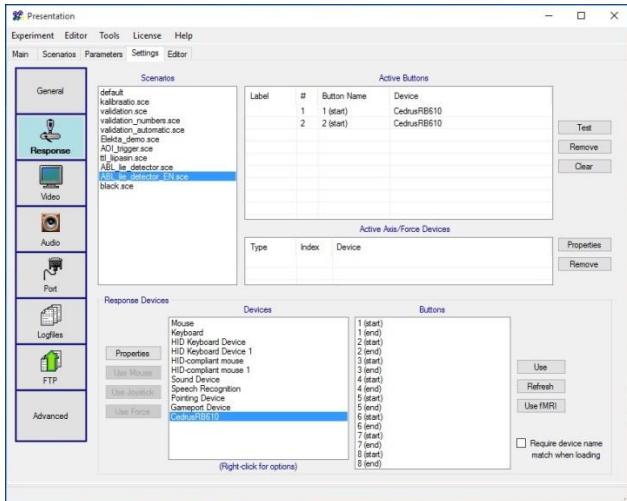
Image 6: Cedrus response pad can be added as button in "the Response window", when it's defined in the "input Port" settings first.

As a default, the Presentation will send triggers via parallel port on every serial port trigger input. To prevent that, put the following line into your header in the scenario file:

```
response_port_output = false;
```