



# ETT Olfactometer & ETTDirectControl

The First Paradigm

*Manual and Tutorial*

*Revision 2021.1*





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## The First Paradigm

### Warnings

1. **This device is for research use only!**
2. **The main device / the actual ETT Olfactometer is not MRI compatible.**
3. **Only the ETT Odorant carrier, tubing, respiratory belt and the applicator/nose piece are MRI compatible and thus allowed into the magnet room.**
4. **Feed all tubing through an appropriately sized wave guide to avoid damage to it.**

### Software Installation (ETTDirectControl)

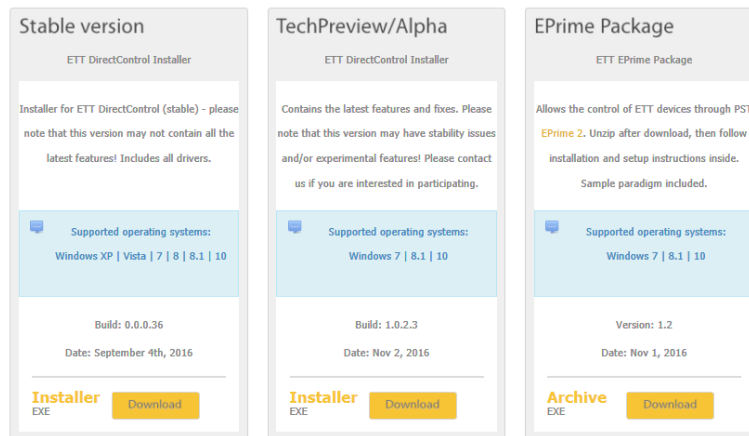
#### Access to our installer

For registered users, we are offering all our software as a download on our website ([emergingtechtrans.com](http://emergingtechtrans.com)). Access will be provided during the purchase of the device via email contact with our support. Additional accounts can be created at any time upon request to [support@emergingtechtrans.com](mailto:support@emergingtechtrans.com).

With access to our support section (Figure 1) there are two to three different versions of ETTDirectControl accessible. Depending on your request, we can unlock specific preview version access. All installer packages describe supported operating systems and contain all necessary dependencies in the package. Should it be required, we are also providing links to the driver and library packages below separately.

It should be noted that the previous stable version, while still actively maintained is limited in its features to support our users that are still using Windows XP. To use all new features, download the current *stable / release* version. Please look at the *Meaning of Update Rings* on page 13, to find out more about each version.

## ETT DirectControl software



## ETT DirectControl Drivers

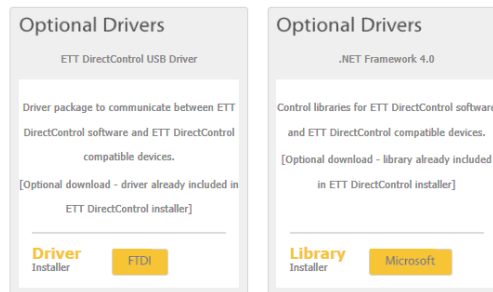


Figure 1 - Software support section on [emergingtechtrans.com](http://emergingtechtrans.com)

## Download

Once the fitting version / update track was chosen, a click on the download button will download the software. All installers automatically contain 32/64bit compatible installers.

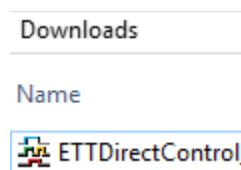


Figure 2 – Double-click on the downloaded executable to initiate the setup process

Since ETTDirectControl requires device drivers, it will require to be installed with Administrator privileges (Figure 3).

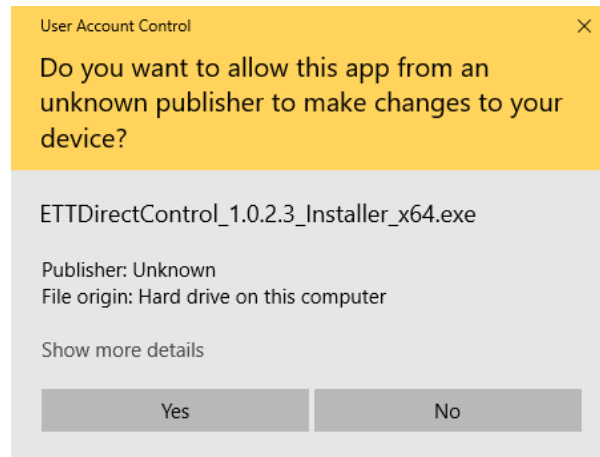


Figure 3 - For drivers and device access ETTDirectControl requires administrator privileges

Once the necessary privileges are granted the installer will guide through each step. Please adjust the settings appropriately and click *Next* each time to progress (Figure 4). If multiple versions of ETTDirectControl are installed on the same machine, change the installation path. Make sure to check to install both pre-requisites:

1. Microsoft .NET Framework 4
2. FTDI USB drivers

Under some circumstances (failed to install .NET Framework) these options must be unchecked and installed separately. Follow Figure 4 through Figure 10 to complete the installation. At last the installer will offer to run ETTDirectControl. Yet again administrator privileges must be granted.

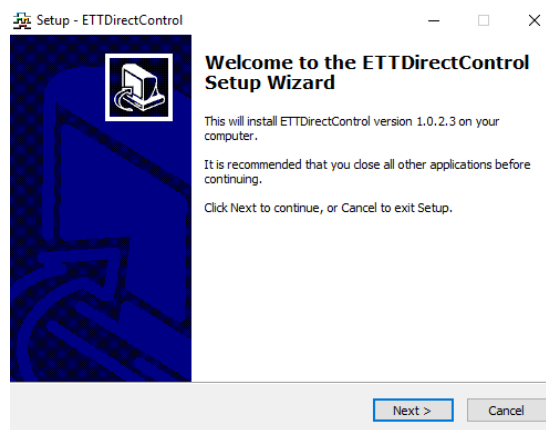


Figure 4 - First page of installer - after selecting the appropriate settings, click next to progress.

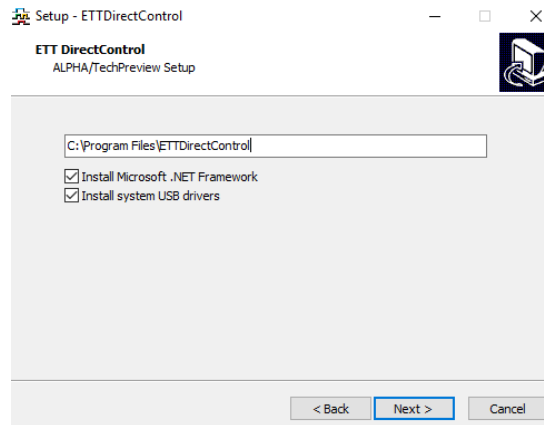


Figure 5 - Adjust the installation path if necessary. Select .NET and USB drivers as they are needed for ETTDirectControl to operate (any needed extras will be automatically checked).

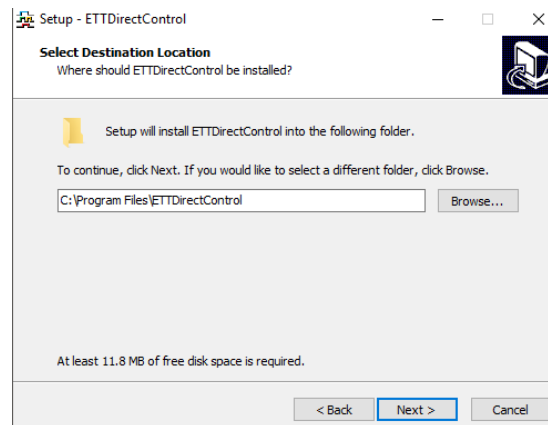


Figure 6 - Define path of installation

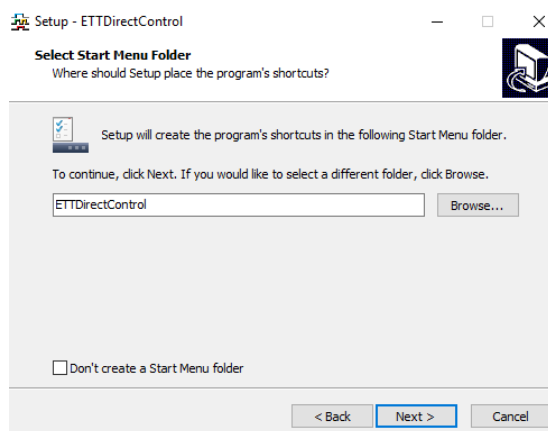


Figure 7 - Set Start Menu folder



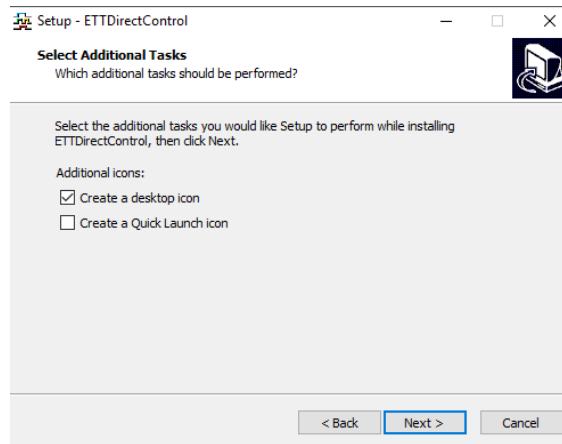


Figure 8 - Adjust icon settings as necessary.

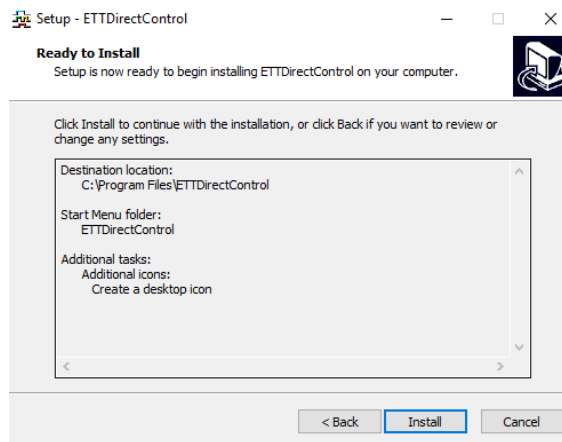


Figure 9 - Trigger actual installation

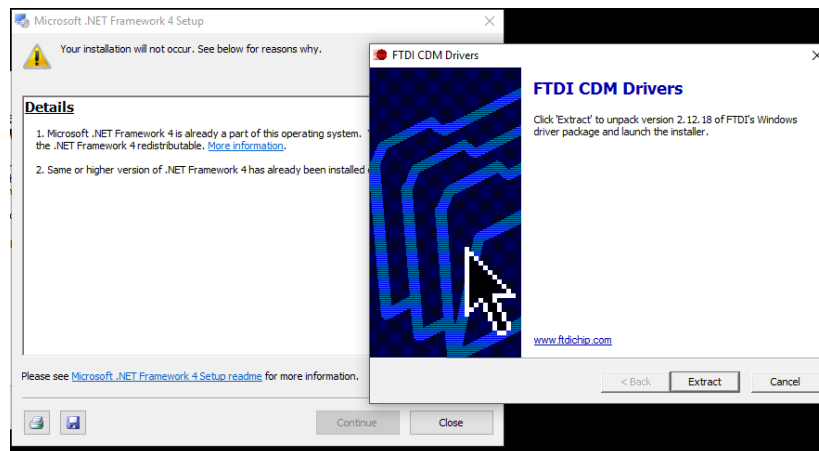


Figure 10 - Step through FTDI USB driver and .NET Framework 4 installers

After successfully completing the installation and first starting the application, it is a good time to first plug the ETT Olfactometer into the USB port (consult Connecting the Device on page 16 if necessary).

The first start might spawn a Windows driver initialization and could take a moment. Once completed, the device should be successfully recognized as shown in Figure 11. Under some circumstances it may be required to reboot the PC before the device can be recognized.

## Software overview

### Manual Mode

The *Manual Mode* tab in ETTDirectControl will list any connected device that is currently compatible to this software. Depending on the type of device and specific features, the interface for the device will adjust. For our Olfactometers a list of channels / valves will be presented in the form of clickable buttons. A gray button means the valve is currently closed, while blue color represents currently opened valves (Figure 11Figure 15). The number of listed buttons will adjust with the number of valves that your specific Olfactometer has.

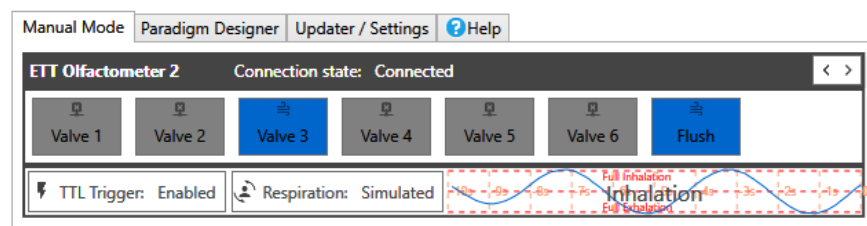


Figure 11 - Manual Mode with connected ETT Olfactometer 2 with active simulated respiratory signal. Valve 3 with the blue background color is opened.

Features custom to each device and their current state will be represented below. In the depicted case of an ETT Olfactometer 2 these are *TTL Trigger* (for external triggers) and control of the *Respiration* sensor system. If the latter is active, a small preview plot of the subjects' respiratory patterns will be depicted next to these.

This mode is meant to help design and debug paradigms, where it can be useful to manually open and close valves to test odorant concentrations and stimulus durations. It can also help to explore the influence of connected sensors that are set around trigger conditions used in the paradigm. Prior to running an experiment with a human subject, it is advisable to check in this view, if all systems are active and working.

### Paradigm Designer

The paradigm designer is used for creating, testing and executing paradigms. It is divided into five sections, which generally represent the common workflow (as shown in Figure 12 and Figure 13). The following list of actions is associated with each of the sections:

0. Creating / Saving / Loading / Running
  - a. Creating new paradigms
  - b. Loading paradigms
  - c. Saving paradigms
  - d. Labeling paradigm run
  - e. Running, stopping paradigms
  - f. Name paradigm
  - g. Navigate to output data
1. Configuration of group components
  - a. Add / edit of valves in Olfactometer
  - b. Add / edit of visual stimuli
  - c. Add / edit further trigger conditions
2. Assembling of components into group
  - a. Create / rename / clone / delete groups
  - b. Assembling of repeatable items from section 1 into groups / conditions
  - c. Reorganizing of group elements temporally
  - d. Adding of groups to paradigm (section 3) in desired order
  - e. Further paradigm settings and randomizer in other sub-tabs
3. Assembly of groups into paradigm sequence
  - a. Assembling of groups into paradigm
  - b. Reordering / removing / cloning of group calls along temporal line
  - c. Preview of final paradigm
  - d. Visualization of progress within paradigm during execution
  - e. Visualization of trigger conditions
4. Respiratory signal
  - a. Plot of respiratory signal
  - b. Visualization of detected inhalation and exhalation onsets
5. Status information
  - a. Currently selected language
  - b. Quick call of subject interface for visual queue
  - c. Connection status to connected device
  - d. Posting of trigger events

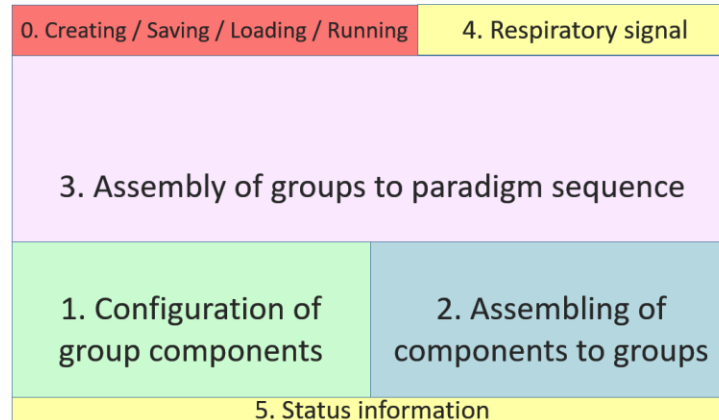


Figure 12 - Sections of the Paradigm Designer in ETDirectControl

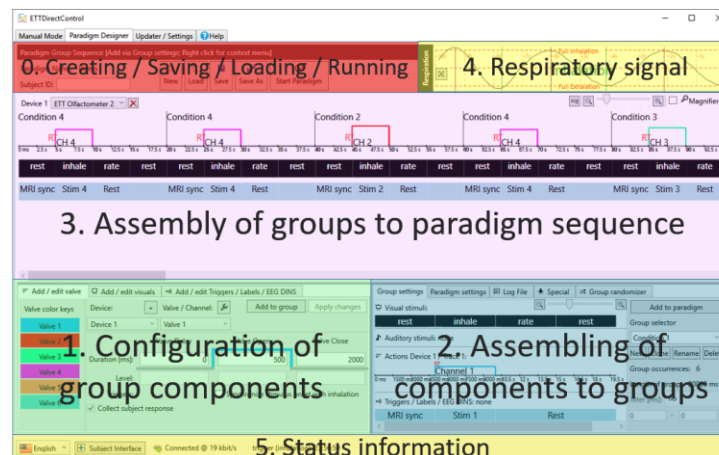


Figure 13 - Overlaid functional sections of Paradigm Designer

The typical workflow would start at 0 and create and name or load a paradigm.

## Updater / Settings

The Updater view is the easiest way to get access to new features. If the current update ring you are on receives an update for either ETDirectControl or the connects device firmware, it will be shown here (Figure 14). We suggest to only allow automatic updates on systems that are not currently used in an active study as updates may cause unexpected disturbance to your current setup. As updates on the preview rings usually come with free access to new features, it might be worth installing these on a separate PC. Sometimes as a quick workaround for a bug reported to us, you might be advised by our support to switch to a current *Alpha* or *Beta* preview version.

Manual Mode | Paradigm Designer | **Updater / Settings** | ? Help

**Updater**

Update ring: preview / beta ☐ Automatic updates Check for updates

	Version currently installed	Version available online	Initiate individual update
ETTDirectControl:	1.0.1.2	1.0.2.3	<span>Update ETTDirectControl Software</span>
Firmware:	0.0.0.26	0.0.0.26	<span>Update Device Firmware</span>

**Paradigm designer settings**

Default number of available valves on startup [6 or 12 are supported] 6

Directory for user data (paradigms, results, output):  
C:\Users\Sebastian\AppData\Roaming\ETTDirectControl\paradigms Create Open

**Paradigm execution settings**

☒ Log all user input  
☒ Debounce user key presses

**General**

Reset all settings to default

Figure 14 - The Update and Settings view can be used to set basic parameters as well as checking for updates and switching Update Rings. In this case an update to version 1.0.2.3 would be advised. If advised by our support staff, there is also an option to update the device firmware to the latest version.

In addition to updates, this view also manages several essential settings. Changes will automatically be saved upon exiting the application. There is also an option to reset all settings to a tested default. Settings in ETTDirectControl are stored in a clear text XML formatted file. This file named *ETTDirectControl.cfg* can be found in the */Config* subfolder. While it is not recommended, this file can be manually edited to adjust settings. If changes prevent the application from starting or working, a default will be recreated upon deleting the broken file. Warning, if you were on a specific update ring other than *release / stable*, ETTDirectControl will switch back to this as the default ring.

### Meaning of Update Rings

#### Release / Stable

Usually a relatively old version is well tested, but it might be limited in certain features. This track gets updated only once new features are tested thoroughly.

#### Preview / Beta

The beta ring should be understood as a relatively stable version, that allows us to roll out newer tested features to a limited user group. Such features might increase the complexity of the software or in rare cases be unstable.

#### Preview / Alpha

In the alpha ring, we are testing experimental features specifically requested by customers. While the goal is to never release an unstable version, it is possible a version in alpha could crash unexpectedly.

## Help

To get a general understanding of the features of this software and learn how to use ETTDirectControl for the most essential tasks, there are several options.

Almost every button has a Tool Tip which will reveal further information upon hovering over the button for several seconds (Figure 15). Some labels and other controls also contain additional context information. Some of the most important controls are additionally labeled with icons to support interpretation.

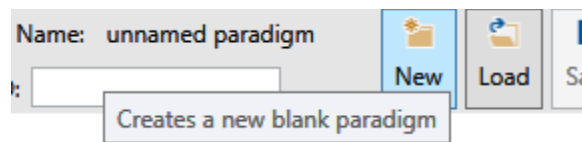


Figure 15 - Typical Tool Tip describing the function or typical use of most features in ETTDirectControl

Under the *Help* tab in ETTDirectControl short, 1 to 2-minute tutorials can be found (Figure 16). A click will automatically jump around topic related controls in the software. A small textbox next to the marked control will explain its function and general use (Figure 17).

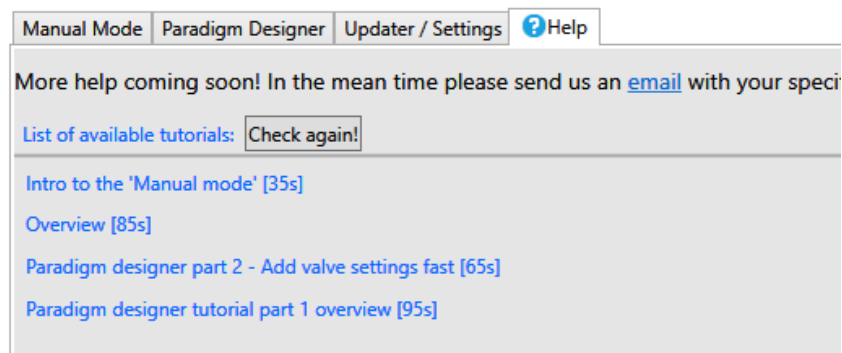


Figure 16 - Basic help system in ETTDirectControl - clicking on any of the links will start a brief description of several essential tasks

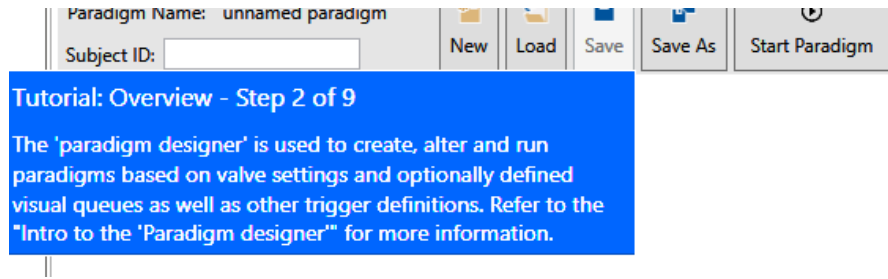


Figure 17 - Example of a speech bubble when using the integrated help system

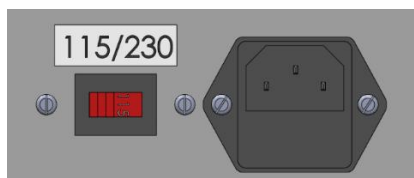
Beyond using the listed features and our other online resources, please feel free to contact us if you have any further questions or problems:

[support@emeringtechtrans.com](mailto:support@emeringtechtrans.com)

## Connecting the Device

### Before the first power up

All ETT devices can be operated with the most common ac supply voltages around the world. Before you start your new ETT Olfactometer please make sure that the voltage setting on the back panel is set to the correct voltage of your local power system (slide switch to position so that correct voltage is readable as in Figure 18). On all newer devices (2x) this is not necessary.



*Figure 18 - Please set the switch on the back panel of your ETT Olfactometer so that the small number on the slider is closest to your local AC power supply.*

Not following this advice might cause severe damage to internal components in your device. If you are unsure, please contact us before you switch on your device.

### ETT Olfactometer 2<sup>+</sup>, ETT Olfactometer 2<sup>C</sup> & ETT Olfactometer 2<sup>S</sup>

To control the olfactometer from a PC, connect the provided USB cord to the *PC CONTROL* USB port on the front panel. Make sure to not plug this cable into the *DATA* or *RESPIRATION* ports as this may damage the olfactometer and/or connected PC. It is recommended to only connect the USB cable to the olfactometer while the device is powered on.



*Figure 19 - Connect the USB cord from your PC to the PC Control port. Please be advised to only use each of the USB ports for its intended purpose!*



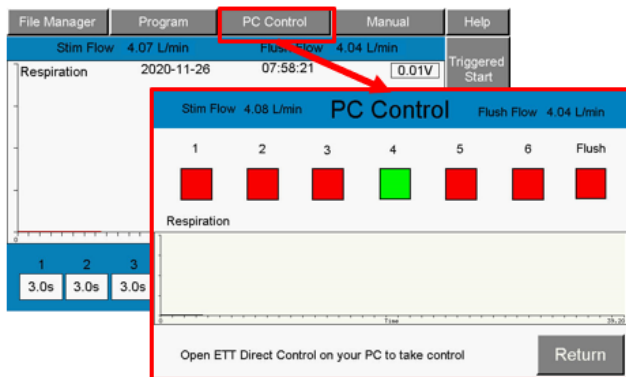


Figure 20 - On the ETT Olfactometer 2+ control is given to the PC via the PC CONTROL button on the main screen of the touchscreen OS.



Figure 21 - Both olfactometers 2C and 2S need to be manually switched to PC control via the button on the front panel.

Upon successful discovery ETTDirectControl should be able to take full control of the olfactometer. It should display device specific control features. Potential firmware updates of your device can be executed directly from the software.

## ETT Olfactometer 2

Power on the device and connect it to the PC via the included USB cable through the *C\_BYPASS* port of the device (see yellow box Figure 22). On the main screen of the touch-screen operating system of your Olfactometer press the *Manual / Computer* button in the top right corner (see Figure 23). Within this control screen (see Figure 24) operation can be handed to the connected PC (see Figure 25).



Figure 22 – Olfactometer 2 front panel with USB port to PC (yellow), Respiratory response port (red) and TLL Trigger in port (green)



Figure 23 - Main screen of the ETT Olfactometer 2 touchscreen operating system

## Manual Control / PC

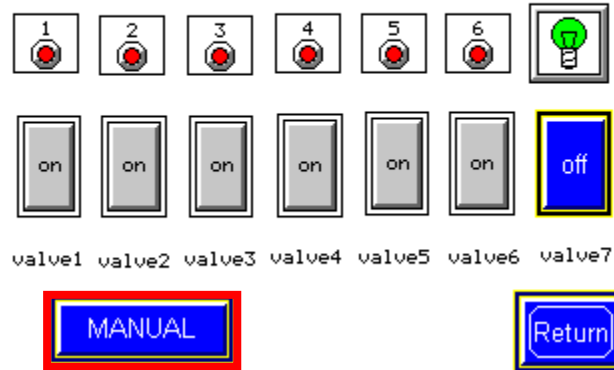


Figure 24 - Manual mode screen of touchscreen operating system of ETT Olfactometer 2. Valves can be switched by checking valves. Currently no control through connected PC

## Manual Control / PC

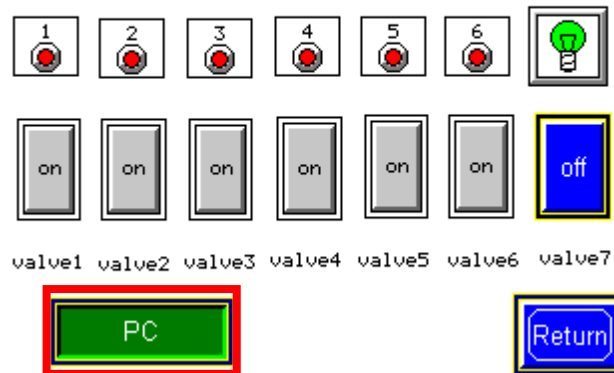


Figure 25 - The ETT Olfactometer 2 screen is switched to external control from a connected PC and the ETDirectControl software or the EPrime package.

### ETT Olfactometer S & ETT Olfactometer C

To change the control context between the front panel valve buttons and software control via the connected PC use the *MANUAL/PC* physical button on the front panel of the ETT Olfactometer S. Just

like with the ETT Olfactometer 2 connected external TTL trigger signals as well as connected respiratory signals will also be transmitted to the connected software. Depending on the currently active context, an LED light will light up indicating *MANUAL* or *PC* control.



Figure 26- ETT Olfactometer S front panel



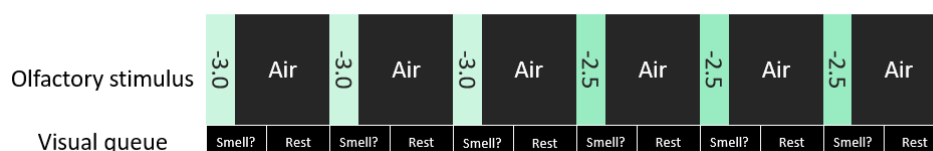
Figure 27 - ETT Olfactometer C front panel

## Prerequisites

### The paradigm

This chapter will step through the creation of a first simple paradigm. For information beyond this description please consult the following paper (doi: 10.3233/JAD-141947). The paradigm presents each subject with 4 concentrations of Lavender (three each time, lowest to highest to avoid habituation). Each stimulus is 6 s long, followed by 30 s of odorless air. The paradigm also contains a visual component presenting either Rest or Smell? depending on the context. We will simply call this paradigm *Four Concentrations* (Figure 28).

#### 4 Concentrations Paradigm



#### 4 Concentrations Paradigm continued

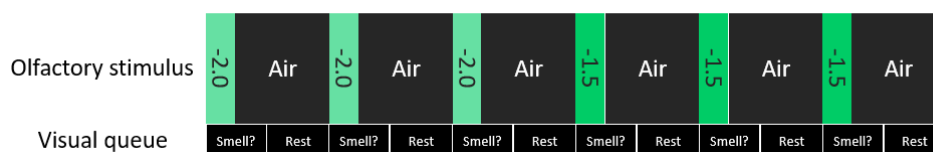


Figure 28 - The four concentrations paradigm from our example

### Preparing the odorants

With the paradigm plan in mind we will also prepare the odorants and load them into the odorant carrier for this experiment. Clean each of the jars from odors if used in previous experiments. Most odorants are oil based, so a mild odorless detergent will remove usually remove any residual odor.

Two main ingredients will be needed:

- Solvent: 1,2-propanediol (Sigma, St. Louis, MO, USA)
- Stimulus odorant: lavender oil (Givaudan Flavors Corporation, East Hanover, NJ, USA)

Create the four concentrations and fill each jar to about the same level. Also, fill the 7<sup>th</sup> jar for the flush location with pure solvent to the same level. Thread the filled bottles into their positions as shown in Figure 29. Don't forget to also add two empty bottles into slots 5 and 6 of the odorant carrier for a proper seal.

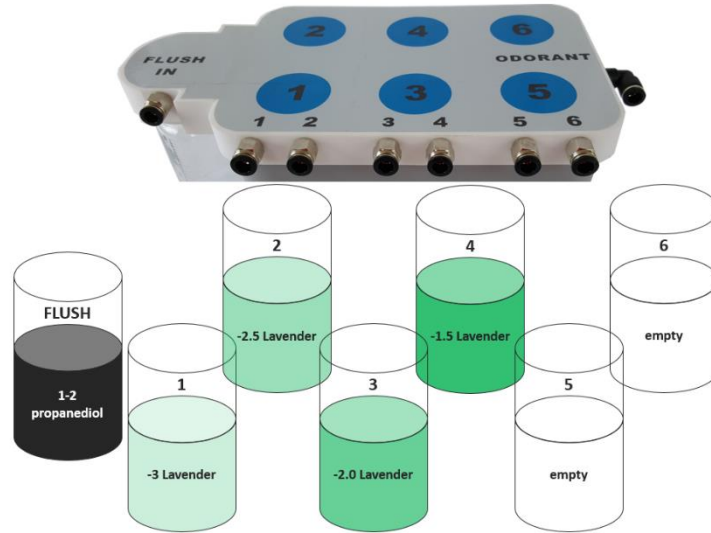


Figure 29 - Distribution of odorant bottles in the odorant carrier.

### Connecting the tubing

With your device, you will also receive a bound bundle of Teflon tubing (length 8 m) and a single line (length 2 m) that will connect the subject applicator mask to the odorant carrier output. To prevent damage and/or premature wear to both the quick release connectors as well as the Teflon tubing always make sure to push the tubing in straight without bending it until the tube is all the way into the connector. The tubing is released by first pushing the blue or black ring sleeve on the connector into the connector as far as possible. While holding the sleeve into the connector one can now safely pull the Teflon tubing out of it without damage (Figure 30).

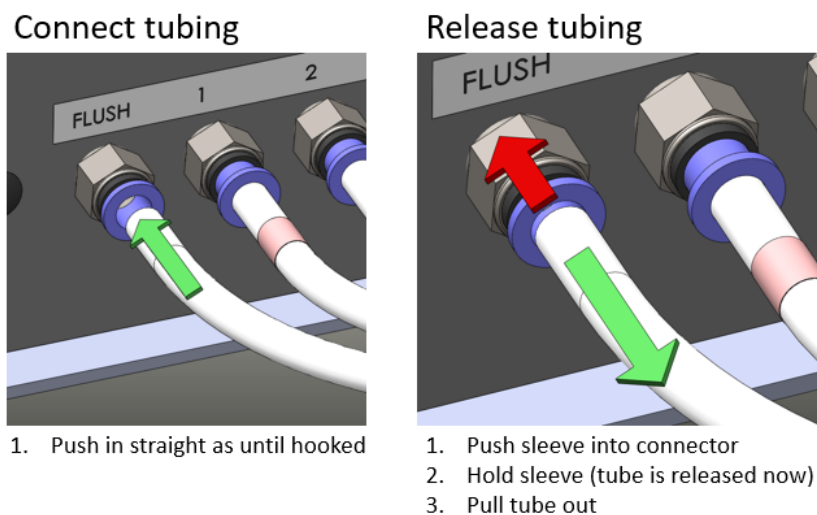
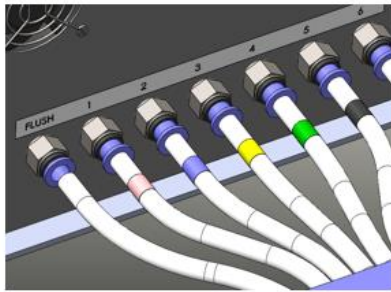


Figure 30 - Connect and release the provided Teflon tubing without damage to both the connector and the tubing

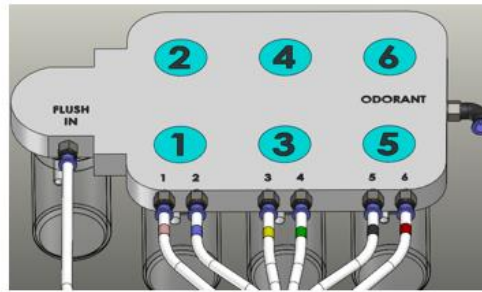
Make sure to align tubing between the device and the odorant carriers as labeled on the tubing via color code (older devices) or numerical code (recent versions) as shown in Figure 31 and Figure 33.

### Connect Olfactometer



Align tubing as color or number coded

### Connect Odorant carrier



Match color or number coding as back panel of Olfactometer

Figure 31 - Align channel indices of the device back panel with the labels of the odorant carrier

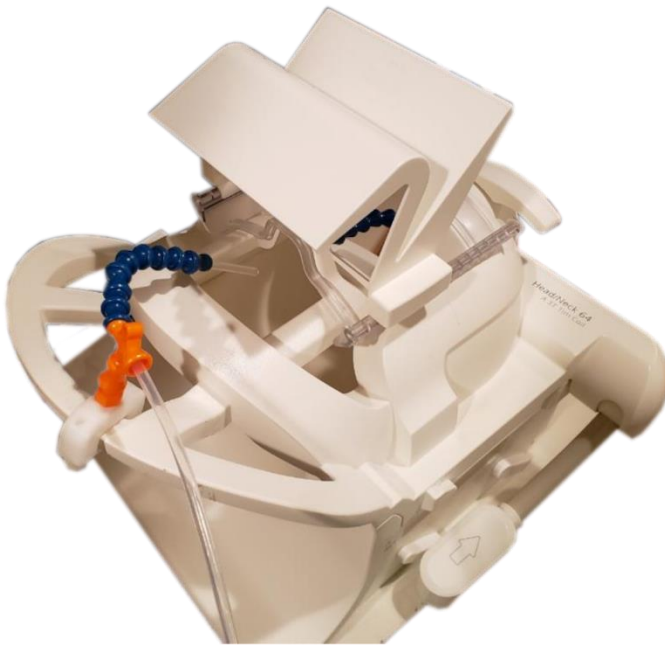
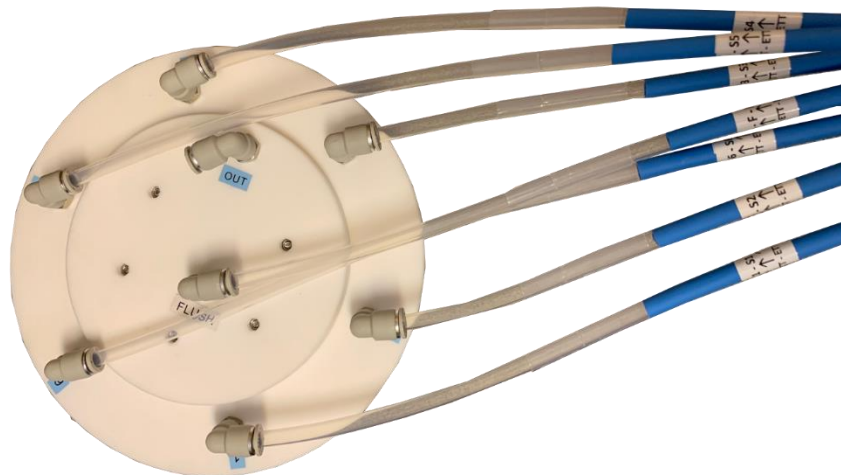


Figure 32 - The latest version of the applicator guides a PTFE tube to the subjects' nose. The flexible and easy to remove Loc-Line system can either be table mounted for EEG or coil mounted for fMRI studies.



*Figure 33 – On older devices the subject applicator mask is connected via the provided single tube*



*Figure 34 - The latest version of the odorant carrier has a circular layout with the flush channel in the central location*

Replace kinked or damaged tubing to assure similar internal flow resistance between each channel and proper seal at the connector.

### Flow rate adjustments

Each device has an integrated oil free compressor that takes in room air from underneath the Olfactometer. Alternatively, some of our devices have a gas input port for compressed air. Both ways, the air will pass through several stages of filters (charcoal, and two stages of micro filtering). The front



panel of the Olfactometer has two columns to adjust the flow rate between stimulus periods that flow across the odorants (*CARRIER*) and during the baseline (*FLUSH*).

On older devices without digital flow measurement, the total flow can be reduced via the *AIR FLOW* dial (Figure 35). The total possible flow depends on the source pressure (external air vs. compressor) and the overall resistance in the system. When using different gasses from room air, make sure to measure the output flow rate with the proper flow column at the output of *Point A* of Figure 33. For more information on the proper adjustment of flow rates between carrier and flush please consult the separate manual *Olfactometer Flow Principles*.

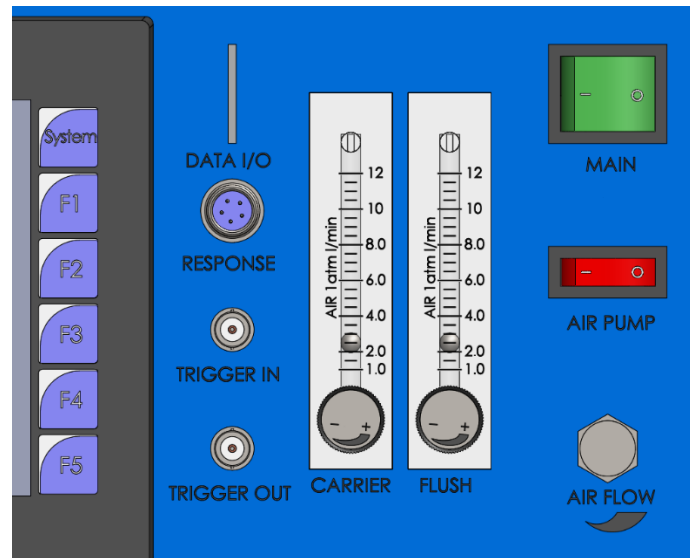


Figure 35 - Air flow columns for stimuli (carrier) and baseline (flush). There is also a total air flow regulator next to the column.

## Creating a simple paradigm

### Creating a new paradigm

First, start or switch context to ETTDirectControl. Click on the *New* button (Figure 36) or right-click on the label *unnamed paradigm* and select *Create new paradigm...* from the context menu.

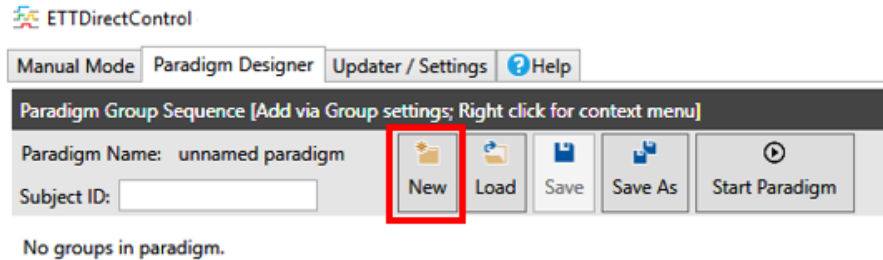


Figure 36 - Create a new paradigm in ETTDirectControl

Create a new folder to contain the future paradigm and name it *Four Concentrations*, then select that folder and ETTDirectControl will automatically generate a paradigm within that folder (Figure 37, Figure 38).

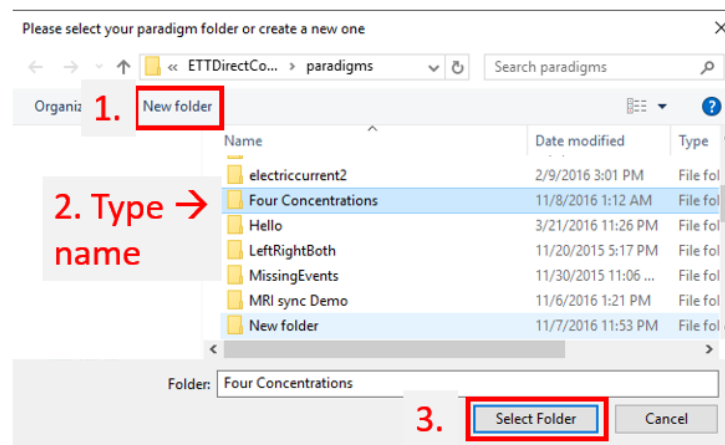


Figure 37 - 1. Create a new folder, 2. Name it 'Four Concentrations', 3. Select the newly created folder

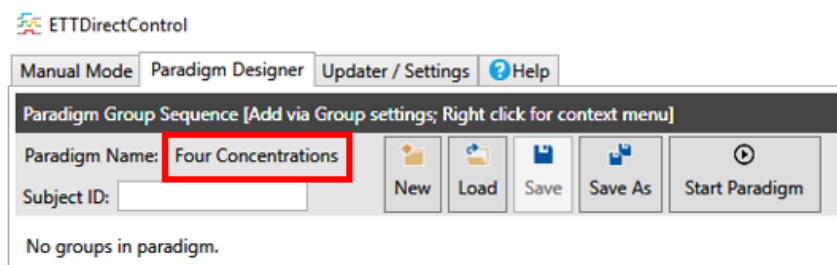


Figure 38 - Successfully created empty paradigm

The newly created paradigm can be saved within the previously defined folder by clicking the *Save* button. To save the same paradigm under a different name, click *Save As*. You can either chose to save it in an existing folder or create a new folder which will be the name of your new paradigm. All output data files, the paradigm and all paradigm resources can be found within that folder.

Existing paradigms can be loaded via the *Load* button. Progress can also be saved at any time by hitting the F1 key on the keyboard for a quick *Save*.

### Configuring an olfactory condition

Navigate to the *Add / edit valve* tab to add an olfactory stimulus. As defined in the prerequisites, a stimulus in this paradigm will be six seconds long, followed by a 30 second odorless block. The base unit of each input block is in milliseconds. Thus, in the duration of the *valve open* period is set to 6000 and the *valve close* duration is set to 30000 (Figure 39).

Figure 39 - Configuration of olfactory stimuli via the valve tab. This can be used to add and edit valves within a group.

The paradigm already contains a predefined device with six possible stimulus channels. If the user were to connect an ETT Olfactometer C or similar device with more possible channels this number will automatically adjust. *Valve 1* is already preselected as the active channel. To the right of this tab, select the *Group settings* tab. The empty paradigm already contains a pre-defined empty group called *Group 1* (Figure 40).

Figure 40 - The group settings tab of an empty pre-defined group.

By clicking on the *Add to group* button in the valve configuration tab, the olfactory stimulus will be added to the selected group (Figure 41).

Figure 41 - Group 1 with added olfactory stimulus

While not used in this specific paradigm a respiratory trigger condition can be automatically tied to the onset of the valve open time of *Channel 1*. If set, the program will wait to proceed with opening valve 1 until an inhalation onset is detected on the connected respiratory belt. To add such a trigger condition or simply change the timing of the currently defined stimulus, click on the Channel visual in the group preview. The selected definition will now be marked with a gray background and the settings are loaded into the valve configuration tab to the left.

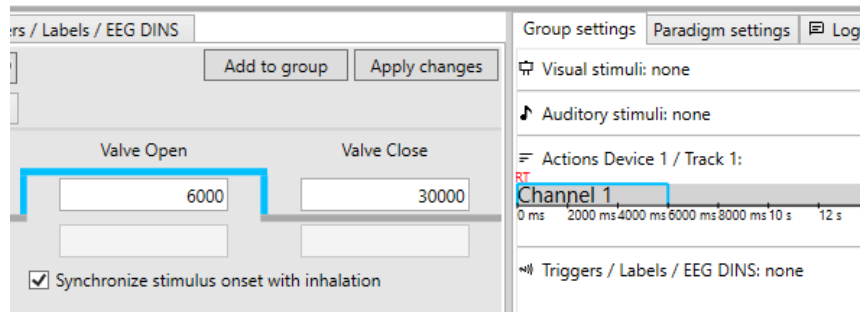


Figure 42 - Respiration trigger condition denoted by red RT selected in group. Uncheck checkbox and apply change to remove.

To use the inhalation, *trigger the Synchronize stimulus onset with inhalation* checkbox needs to be selected. Hit the *Apply changes* button to accept the new definition (Figure 42). To reverse simply re-select the definition in the group settings tab and uncheck the checkbox in the valve configuration tab. Apply changes again and proceed to adding visual stimuli. More detailed information on potential trigger conditions can be found in the section *Using triggers* in this manual.

It is possible to open multiple channels at once or in complex cascades. Additionally, added valves will be automatically appended behind the first track of the current device. The concept of *Tracks* allows the user to easily shift olfactory stimuli in parallel. Tracks can be set via right click in the context menu in the group settings view (Figure 43). Ultimately the composed group, when added to the paradigm, will be condensed into a visual preview of vertically overlapping events (Figure 44).

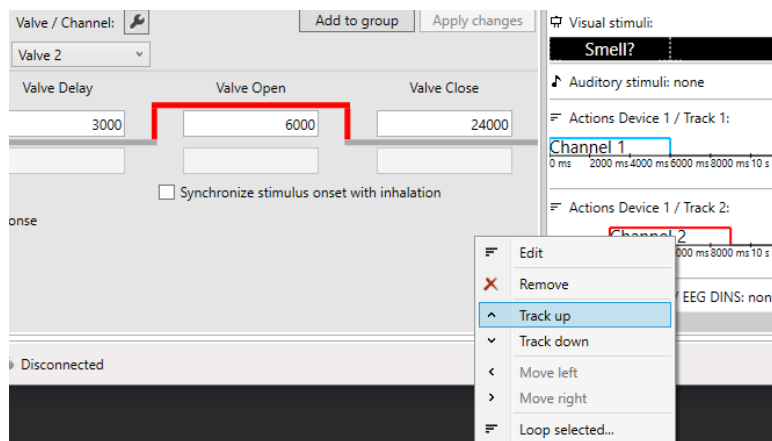


Figure 43 - Olfactory stimuli within one group can be moved past each other or into different tracks via the context menu. Vertically aligned events will automatically execute at the same time during paradigm execution.

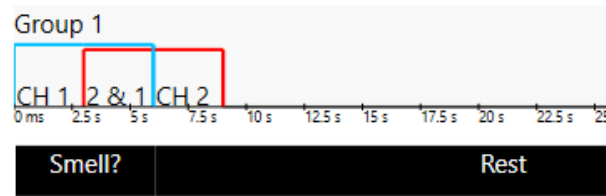


Figure 44 - The final composed view as defined in the previous figure, once added to the paradigm.

Via the *Loop selected...* item in the context menu, it is possible to simplify the creation of pulsed or repetitive paradigms (Figure 45). It is also possible to multi select similar conditions to then loop them or delete them at once. Simply hold the CTRL key while clicking on the desired blocks (Figure 46).

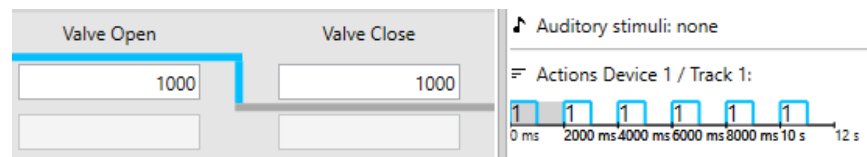


Figure 45 - 1 s on and 1 s off condition looped 6 times via context menu

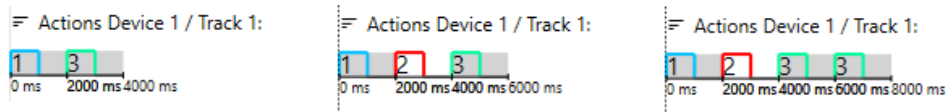


Figure 46 - Three examples of using the multi-select feature.

## Configuring the visual component

This paradigm also has a visual component. While the olfactory stimulus is presented, the subject will be prompted with a white “Smell?” text on black background. In the *Add / edit visuals* tab visual stimuli can be configured (Figure 47). Text or images can be used as stimuli. It is also possible to overlay text over images.

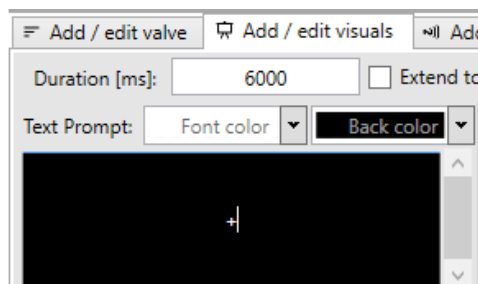


Figure 47 - Simple visual stimulus defining a white cross hair (plus symbol) on black background. Colors can be changed via the two color selector boxes. Their background color represents the currently selected color.

Toggling the *Subject Interface* box in the bottom status bar, will bring up a non-full screen preview of the output of the current visual stimulus. Open the interface and changes will be represented as they occur (Figure 48).

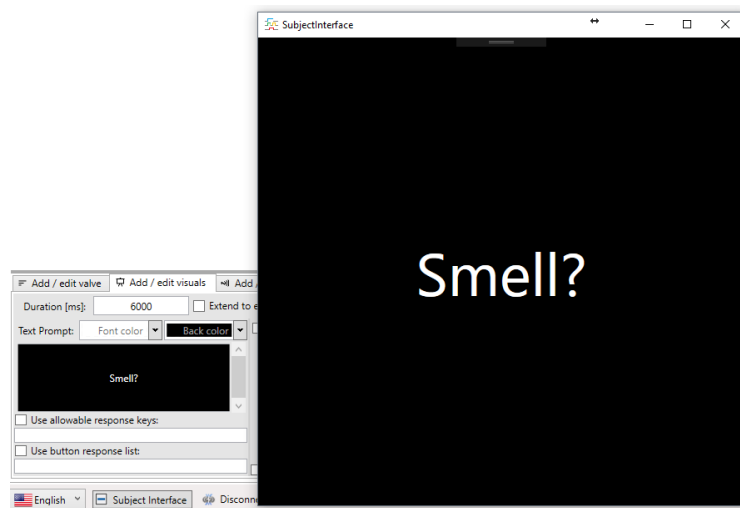


Figure 48 - Preview of subject interface. Define font size, screen id and full screen settings during paradigm execution in Paradigm Settings tab.

Insert the visual stimulus into the paradigm via the *Add to group* button and repeat with the 30 second “Rest” condition. The final setup should look as shown in Figure 49.

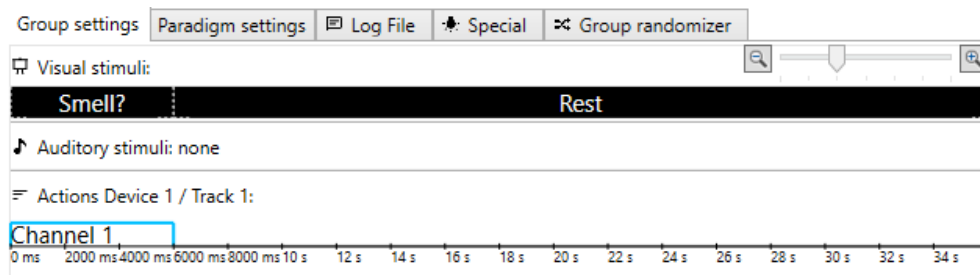


Figure 49 - Final group with visual stimuli and olfactory stimulus definitions.

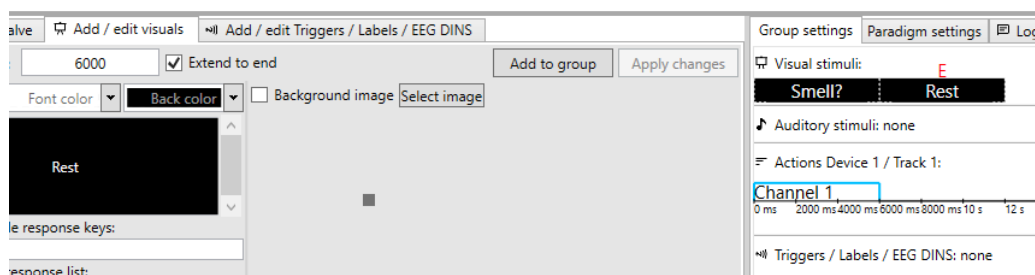


Figure 50 - If the Olfactory stimulus already defines the length of the group, the *Extend to end* checkbox will automatically extend the duration of the visual condition to the end of the group.

In some cases, the end last visual stimulus is simply aligned with the longest defined olfactory stimulus. Then, checking the *Extend to end* checkbox next to the visual stimulus *Duration* textbox will automatically extend the duration of the visual stimulus to the end of the group (Figure 49 is equal to Figure 50 during paradigm execution). This automatic extension will be denoted with a red E above the last visual stimulus.

### Managing, cloning and adjusting groups

ETTDirectControl uses groups as a layer between actual events and the ultimate paradigm. Repeated stimulus conditions that are grouped together into one definition and can be reused throughout the paradigm. A simple but very common paradigm as we are trying to build in this tutorial, can thus be created within just a few minutes. Groups can also simply be cloned and altered to define similar conditions. To exemplify this process, rename *Group 1* to *Lavender -3.0* (Figure 51).

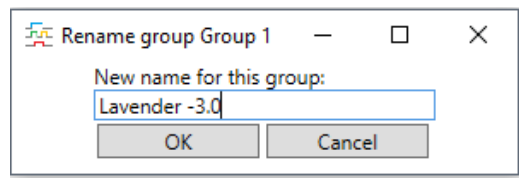


Figure 51 - Rename groups to label experimental conditions.

By hitting the clone button, a new identical copy of this group will be created. The name of the cloned group will be appended with a ".C" for *cloned*. The second general condition of this paradigm is *Lavender -2.5*. Change the cloned groups name to that and alter the olfactory condition to open *Valve 2* instead of *Valve 1* (Figure 52).

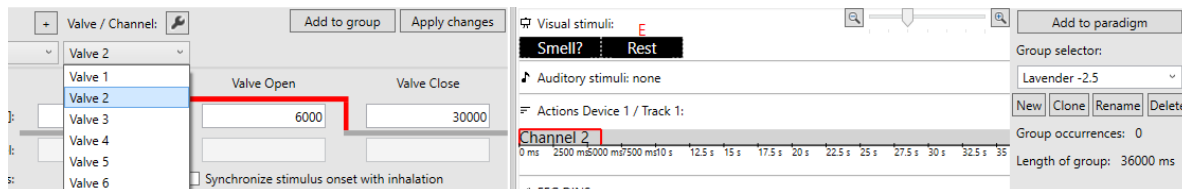


Figure 52 - Changing the active valve on the selected condition to adjust group two to the *Lavender -2.5* condition.

Repeat the above steps for the *Lavender -2.0* (use valve 3) and *Lavender -1.5* (use valve 4) conditions (Figure 53).

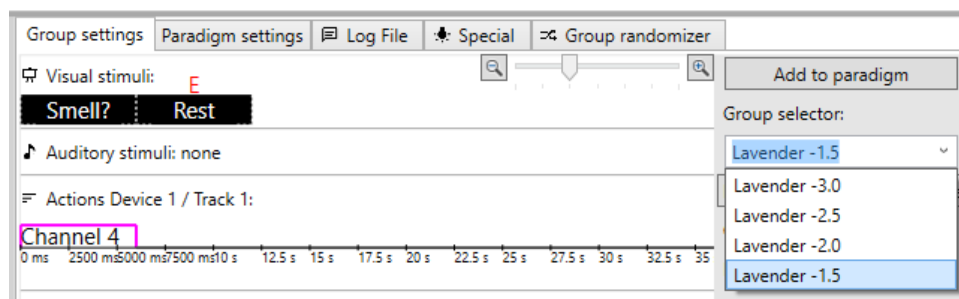


Figure 53 - The final group list for the four concentrations used in this tutorial can be added to the paradigm.

## Assembling paradigm

After defining the four general conditions of this tutorial, it is time to assemble them into an actual paradigm. Groups are added via the *Add to paradigm* button in the *Group settings* tab as previously shown in Figure 53. Clicking this button will append the currently selected group to the end of the paradigm. Repeat three times for each of the four groups with increasing lavender concentration (Figure 54).

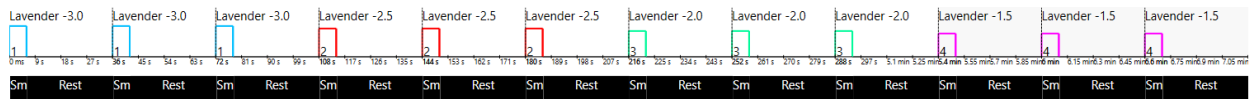


Figure 54 - Each stimulus condition presented three times with increasing lavender concentrations.

## Labeling conditions for data analysis

While not required, it might be useful to label conditions for post-processing purposes - especially when using the *Group randomizer*. In the multi-purpose tab *Add / edit Triggers / Labels / EEG Dins*, simply select the duration of the label, type any label text into the *Label* textbox and it to paradigm. For the rest of the duration of each group, add a *Baseline* label (Figure 55).

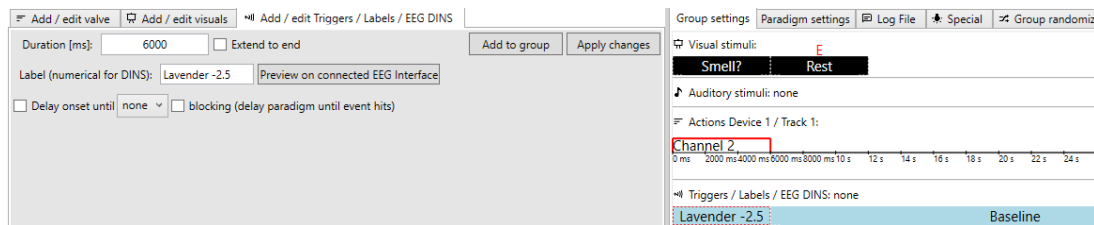


Figure 55 - Labeling conditions 'Lavender -x.y' and 'Baseline' for post-processing in an external tool.

Labels will appear in a separate log file called *TrialMarkers*. The onset of a label can also be tied to a condition like a respiratory exhalation onset. For more information, consult the *Using Triggers* section at the end of this manual.

## Group randomizer

The paradigm proposed in this tutorial is intentionally not randomized in its group calls. The group randomizer offers a unique way of pseudo randomizing parts of the study or the whole experiment. This can be done once when creating a study or every single time a new subject is run. After creating all groups and inserting potentially static portions of a paradigm, go to the *Group randomizer* tab (Figure 56). It allows the user to clear the whole list of currently included groups in the paradigm. After setting the number of trials, the list can be shuffled. A preview on the trial list to be added allows for reshuffling if necessary. The *Append trial list to paradigm* button allows the user to add the previewed list to the existing paradigm. Figure 57 provides an example of a pseudorandomized paradigm.



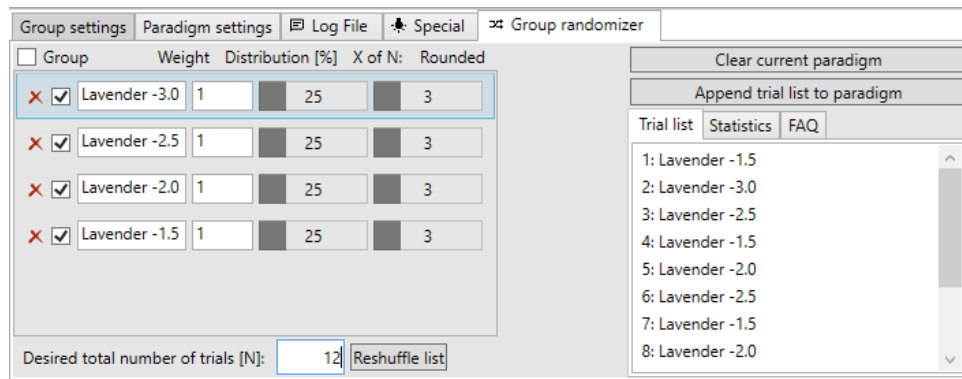


Figure 56 - The Group randomizer with existing groups on the left allows to weight and exclude specific groups. The total number of trials determines the list of trials on the right. Trials can be added to the paradigm via the Append trial list to paradigm button.

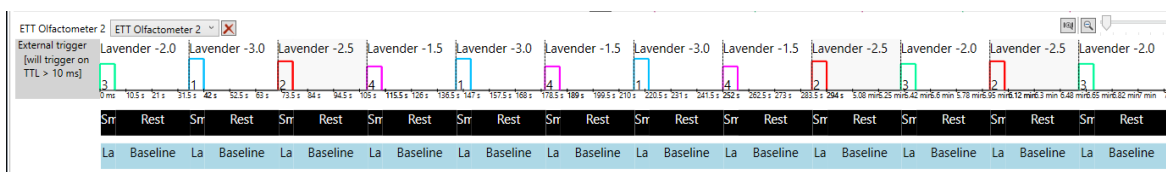


Figure 57 - Pseudo randomized version of the tutorial 4 concentrations paradigm. Trial labels allow for easy post-processing later on.

## Triggered start

When using external TTL triggers, activate the *External TTL Triggered Start* check box in the *Paradigm settings* tab. A block will automatically be inserted ahead of the paradigm in the paradigm designer signifying this trigger condition. Save the paradigm. Once a device is connected, click the *TTL Trigger* button under the *Manual Mode* tab. Make sure the button label ends in *Enabled* for success. The paradigm is now ready to be externally triggered via the TTL trigger in port of the Olfactometer. This feature additionally allows for keyboard keys (t,T or custom) to trigger the start of the paradigm when connected to peripherals from other manufacturers. If the use of such triggers is necessary, the visual *Subject Interface* must have keyboard focus during paradigm execution. Please consult the section about *Using Triggers* at the end of this manual.

## Recording the respiratory signal

The respiratory signal will automatically be recorded if the *Respiration* button of the connected device is set to *Enabled* under the *Manual Mode* tab. Please consult the section about *Using Triggers* at the end of this manual for more information.

## Test run

Before the first test run, the paradigm should be saved again. Full screen settings, external triggers and associated devices will automatically be saved with the paradigm (Figure 58). Make sure all necessary

triggers are active (Figure 58) and especially when using respiratory signal based triggers that inhalation and exhalations onsets are detected properly (Figure 59).

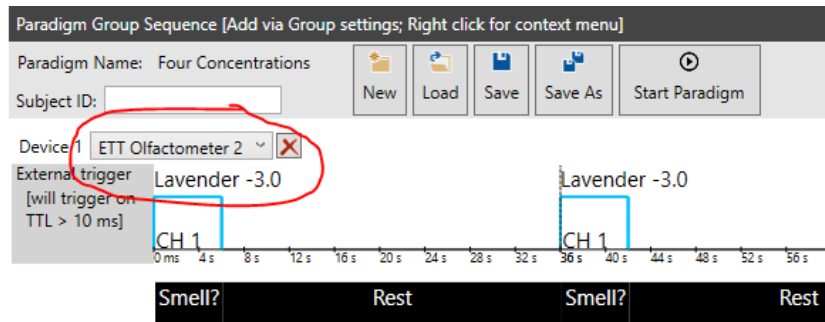


Figure 58 - Associated device to the previously defined group definitions. Multiple devices are supported!

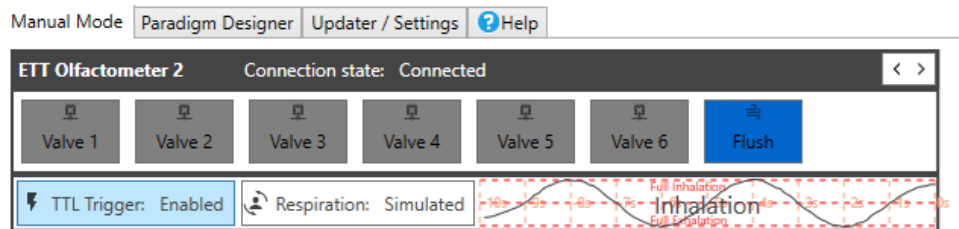


Figure 59 - All systems ready to go with simulated respiratory settings

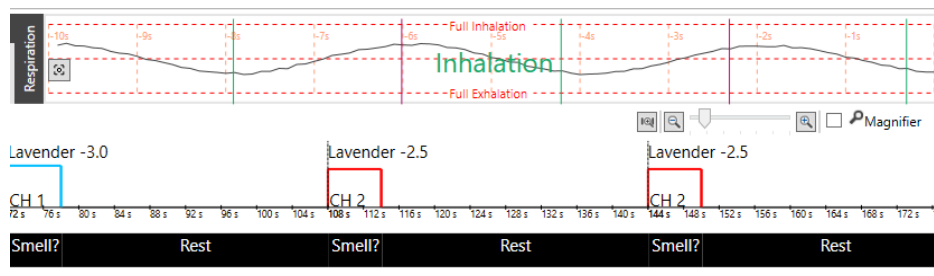


Figure 60 - The respiratory signal is also visualized on the top right corner of the paradigm designer incl. detected inhalation and exhalation onsets.

Paradigm execution is controlled via the *Start Paradigm*, *Stop* and *Manual Trigger* buttons in the top are of the *Paradigm Designer* tab. They will be visible based on the current context. A subject ID can be assigned and will be used in the file names of all protocol files. Once everything is ready, the paradigm can be started by clicking the *Start Paradigm* button.

If set in the *Paradigm settings* tab, the subject interface will be used and jump into full screen on the selected screen. If the full screen mode accidentally gets activated on a single screen system, it can be exited with *ALT + TAB* on the keyboard. Once the paradigm is stopped, the screen will jump back to windowed mode.

While the paradigm is awaiting an external trigger, the *External trigger* label will flash red and gray (Figure 61).

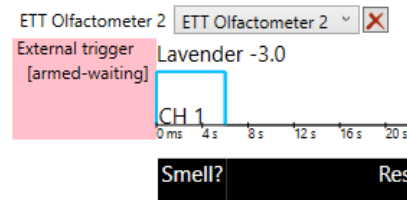


Figure 61 - Running paradigm awaiting an external TTL trigger.

A click on the *Manual Trigger* button can progress the paradigm, if the physical trigger is not available during test runs (Figure 62).



Figure 62 - Clicking the Manual Trigger button will progress the paradigm if it is waiting for a trigger during a test run.

Once the paradigm is running, its progress will be represented via the paradigm designer in multiple ways. Next to the control buttons a status bar and timer will show progress through the paradigm. The progress will also be drawn in red into the actual paradigm once events have passed (Figure 63).

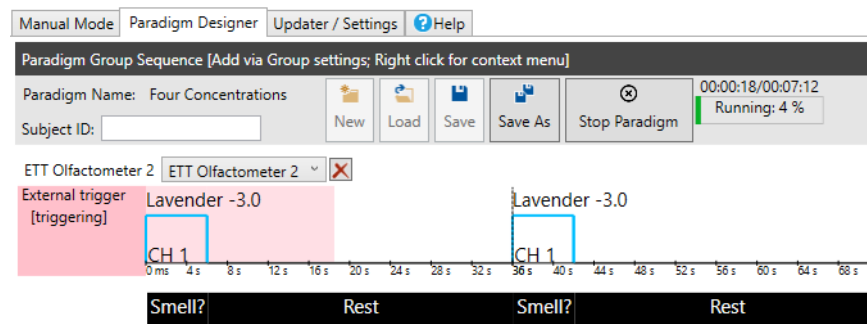


Figure 63 – ETDDirectControl progressing through a paradigm.

Trigger events or user input into the *Subject Interface* are logged into protocol files as well as instantly presented in the bottom status bar of the program (Figure 64).

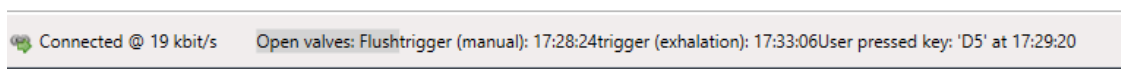


Figure 64 - Opened valves, instant events and subject key presses are shown in the bottom status bar.

Once the paradigm is manually stopped or successfully completed, ETDDirectControl will close all active stimulus valves, close the subject interface and generate a set of protocol files.

## Inspecting the data file

Upon the end of each paradigm, the software generates set of protocol files in the folder of the paradigm. It can be accessed via a right click on the paradigm name. A click on *Open data file location...* will open the *File Explorer* and present the protocol files. The location of these data files as well as the paradigm definitions and all additional files used in the paradigm will always be found in the current user's files: C:\Users\%Username%\AppData\Roaming\ETTDirectControl\paradigms\%Paradigm Name%\

The subfolder *output* contains all protocol files. Each file is saved in cleartext with comma separated values (.csv). Files can easily be opened in any text editor or tabulation software like Excel, but also Matlab or R-Studio. Should your specific data analysis pipeline need different or more information, please contact us to customize the data output for your scenario. Typically, the files are named:

%ParadigmName%,date time string(separated by \_),OutputFileType,SubjectID.csv

The first column is always the time in milliseconds from the paradigm start. Paradigm start time is defined as either the external/keypress (t,T or custom) trigger time or if untriggered just the time when the *Start Paradigm* button was pressed.

Currently there are six file types generated for each paradigm run:

1. Triggers (Timing of external TTL, respiratory inhalation onsets, respiratory exhalation onsets, ...)

	A	B	C	D	E
1	Time	Type			
2	-1852	respiratoryAnalogInhalationOnset			
3	0	manual			
4	345	respiratoryAnalogExhalationOnset			
5	2244	respiratoryAnalogInhalationOnset			
6	4442	respiratoryAnalogExhalationOnset			
7	6241	respiratoryAnalogInhalationOnset			
8	7841	respiratoryAnalogExhalationOnset			
9	9641	respiratoryAnalogInhalationOnset			
10	11139	respiratoryAnalogExhalationOnset			
11	12539	respiratoryAnalogInhalationOnset			
12	14039	respiratoryAnalogExhalationOnset			
13	15938	respiratoryAnalogInhalationOnset			
14	17636	respiratoryAnalogExhalationOnset			
15	19635	respiratoryAnalogInhalationOnset			
16	22132	respiratoryAnalogExhalationOnset			
17	24231	respiratoryAnalogInhalationOnset			
18	26528	respiratoryAnalogExhalationOnset			
19	27926	respiratoryAnalogInhalationOnset			
20	30425	respiratoryAnalogExhalationOnset			
21	32223	respiratoryAnalogInhalationOnset			
22	34222	respiratoryAnalogExhalationOnset			
23	36319	respiratoryAnalogInhalationOnset			
24	38019	respiratoryAnalogExhalationOnset			
25	39518	respiratoryAnalogInhalationOnset			
26	41016	respiratoryAnalogExhalationOnset			
27	42517	respiratoryAnalogInhalationOnset			

2. ValveSwitches (Timing of ETT Olfactometer device activity)

	A	B	C
1	Time	List of DeviceID.ValveID	
2	0	1.1.opening	
3	5999	1.1.closing	
4	36000	1.1.opening	
5	41999	1.1.closing	
6	72000	1.1.opening	
7	78000	1.1.closing	
8	108000	1.2.opening	
9	114000	1.2.closing	
10	144000	1.2.opening	
11	150000	1.2.closing	
12	180000	1.2.opening	
13	186000	1.2.closing	
14	216000	1.3.opening	
15	222000	1.3.closing	
16	252000	1.3.opening	
17	258000	1.3.closing	
18	288000	1.3.opening	
19	294000	1.3.closing	
20	324000	1.4.opening	
21	330000	1.4.closing	
22	360000	1.4.opening	
23	366000	1.4.closing	
24	396000	1.4.opening	
25	402000	1.4.closing	
26	432000		

### 3. VisualQueue (Timing of visual stimuli as presented and context information like colors, text, image paths)

	A	B	C	D
1	Time	Prompt	ForeColor	BackColor
2	1	Smell?	FFFFFFFF	FF000000
3	5999	Rest	FFFFFFFF	FF000000
4	36000	Smell?	FFFFFFFF	FF000000
5	41999	Rest	FFFFFFFF	FF000000
6	72000	Smell?	FFFFFFFF	FF000000
7	78000	Rest	FFFFFFFF	FF000000
8	108000	Smell?	FFFFFFFF	FF000000
9	114000	Rest	FFFFFFFF	FF000000
10	144000	Smell?	FFFFFFFF	FF000000
11	150000	Rest	FFFFFFFF	FF000000
12	180000	Smell?	FFFFFFFF	FF000000
13	186000	Rest	FFFFFFFF	FF000000
14	216000	Smell?	FFFFFFFF	FF000000
15	222000	Rest	FFFFFFFF	FF000000
16	252000	Smell?	FFFFFFFF	FF000000
17	258000	Rest	FFFFFFFF	FF000000
18	288000	Smell?	FFFFFFFF	FF000000
19	294002	Rest	FFFFFFFF	FF000000
20	324000	Smell?	FFFFFFFF	FF000000
21	330000	Rest	FFFFFFFF	FF000000
22	360000	Smell?	FFFFFFFF	FF000000
23	366000	Rest	FFFFFFFF	FF000000
24	396000	Smell?	FFFFFFFF	FF000000
25	402000	Rest	FFFFFFFF	FF000000
26	432000		FFFFFFFF	FF000000

### 4. SubjectInput (Timing of Subject Interface keyboard inputs)

	A	B
1	Time	key
2	51963	A
3	54633	D1
4	55721	D5
5		
6		
7		

5. Respiration (Log of respiratory amplitude values)

	A	B	C
1	Time	Raw	Scaled
2	46	932	932
3	148	943	943
4	247	969	969
5	345	945	945
6	446	942	942
7	547	913	913
8	647	878	878
9	744	820	820
10	846	781	781
11	946	718	718
12	1046	659	659
13	1146	591	591
14	1244	523	523
15	1346	446	446
16	1446	367	367
17	1546	298	298
18	1645	261	261
19	1745	202	202
20	1845	138	138
21	1945	102	102
22	2045	96	96
23	2145	71	71
24	2244	81	81
25	2344	80	80
26	2445	89	89
27	2544	106	106
28	2644	143	143

6. TrialMarkers (Timing of specifically marked sections in paradigm to process later as conditions; also, custom trigger log and EEG interface if used)

	A	B
1	Time	Trial
2	5	Lavender -3.0
3	6001	Baseline
4	36000	Lavender -3.0
5	42000	Baseline
6	72000	Lavender -3.0
7	78000	Baseline
8	108001	Lavender -2.5
9	114000	Baseline
10	144000	Lavender -2.5
11	150000	Baseline
12	180000	Lavender -2.5
13	186000	Baseline
14	216000	Lavender -2.0
15	222000	Baseline
16	252000	Lavender -2.0
17	258000	Baseline
18	288000	Lavender -2.0
19	294000	Baseline
20	324000	Lavender -1.5
21	330000	Baseline
22	360000	Lavender -1.5

## Using Triggers in ETTDirectControl

### TTL IN (Externally triggered start)

ETTDirectControl allows paradigms to be triggered by external TTL pulses. Once a BNC cable with a trigger source is connected to the device, and the ETT Olfactometer is connected to the computer, ETTDirectControl will automatically recognize the device. Once the device is connected to the software as shown in Figure 65, valves can be switched and sensors like external TTL trigger or respiratory information can be activated (Figure 66). A click on the same button again will disable.

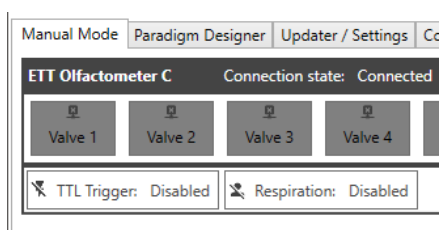


Figure 65 – The Manual Mode tab in ETTDirectControl gives an overview on valve states and other device parameters like TTL Trigger on connected device (off in this case)

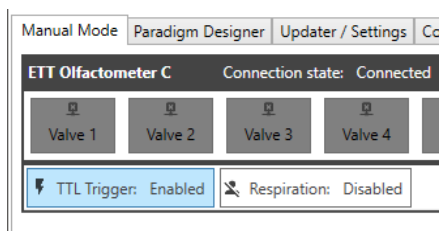


Figure 66 – The TTL Trigger and Respiratory sensor signals can be activated with a click on the respective buttons

To start a specific paradigm with an external TTL, switch the context to the *Paradigm Designer* tab. The checkbox *External TTL Triggered Start* in the *Paradigm Settings* tab of the *Paradigm Designer* will need to be checked (Figure 67). Save the change to the paradigm. Upon the next start of the paradigm it will delay the paradigm start until a TTL pulse is received. The time point of that trigger will form time zero or the origin of all log files. Externally triggered paradigms can be manually triggered via the user interface to test behavior while a true trigger might not be available (Figure 68).

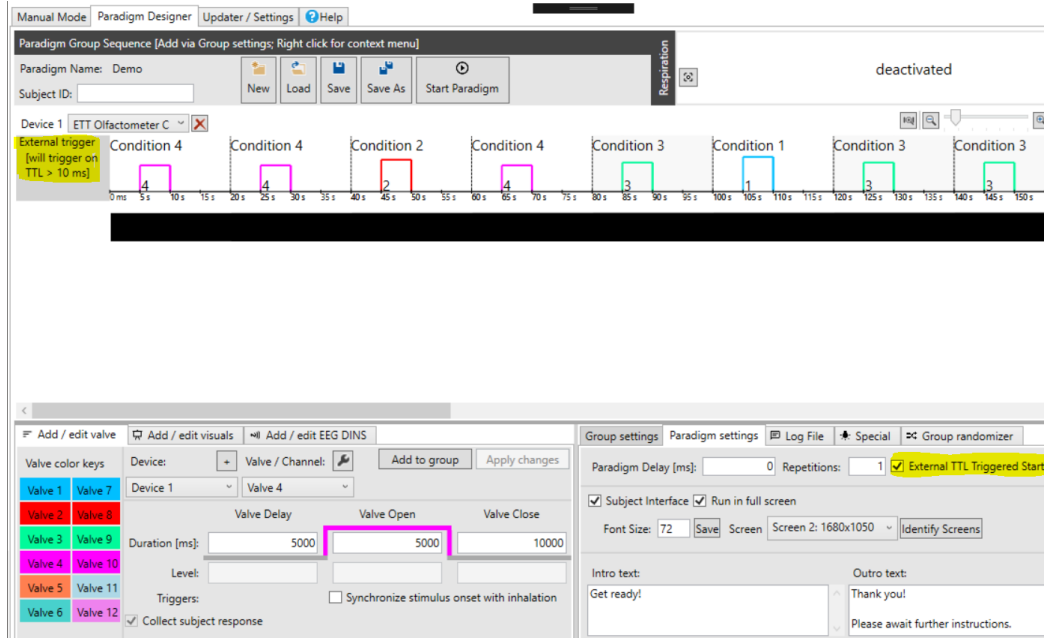


Figure 67 - External TTL triggers can be used to synchronize the paradigm execution with an external visual queue or an EEG or MRI system

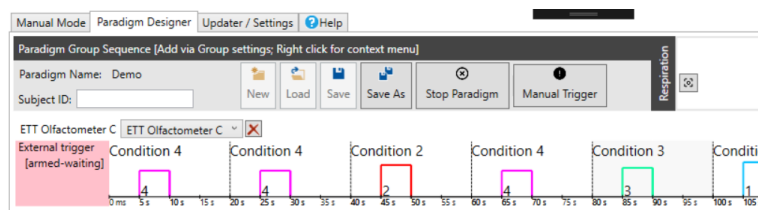


Figure 68 - Upon execution, the paradigm will wait with an armed trigger until a TTL pulse or a manual trigger via button click are received. If the visual context of this software (subject interface) is used, an optional Intro Text can be defined while its waiting

## Respiratory Trigger

An important part of olfactory experiments is tracking the subjects' respiratory cycles, but ideally, we would like to control our paradigm based on inhalation and exhalation. To track the respiratory information, the subject needs to wear the provided chest belt below the base of the sternum. The belt must be connected to the provided receiver box, which is plugged into the *RESPONSE* port on the ETT Olfactometer front panel. Similarly, to the use of external TTL triggers, the respiratory signal needs to be enabled within the software. There are three possible states, which will be shown in the ETTDirectControl *Manual Mode* tab once a device is connected. By default, the respiratory signal is disabled (Figure 65). A click on the *Respiration* button will enable the respiratory signal acquisition. Next to the button, a small preview of the past 10 s of respiratory signal will be plotted.



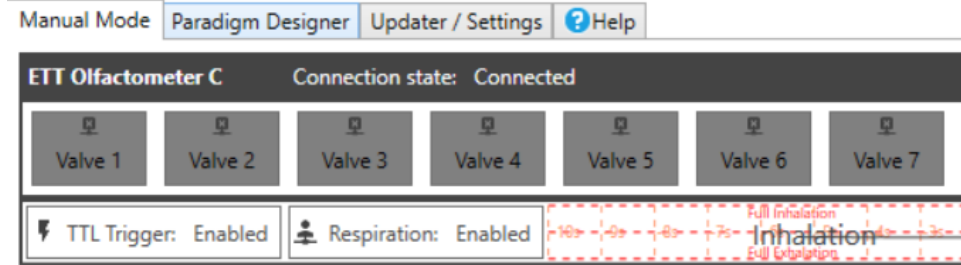


Figure 69 - Enabled respiratory sensor with preview of respiratory plot in ETTDirectControl software

This field will also indicate if the subject is currently inhaling or exhaling. This information can be used to check if the location of the chest belt as well as belt tension are sufficient for the software to properly detect the subject's respiratory cycle.

Especially during subject-less testing, it is useful to use our simulated respiratory signal to pass through set respiratory conditions of a paradigm. This mode is enabled with another click on the respiratory button. The connected device will now provide a signal like a human subject, varying in amplitude and period, with added noise (Figure 70). A larger version of this plot is provided in the *Paradigm Designer* on the top right corner above the assembled paradigm. This plot additionally provides vertical lines on the time points of detected inhalation and exhalation onsets, which are possible trigger conditions to the paradigm.

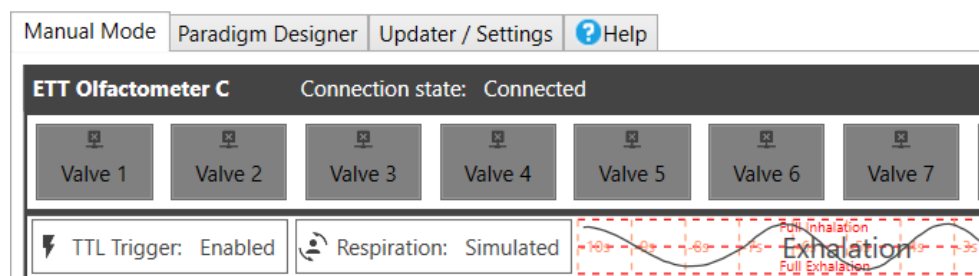


Figure 70 - Simulated respiratory signal to debug paradigms without a human subject

The easiest and most common way to make use of the respiratory trigger is to synchronize the stimulus onset with an inhalation onset. A simple checkbox in the *Add / edit valve* section of the ETTDirectControl software below the *Valve Open Duration* definition will enable that the opening of the defined valve will be delayed until the next detected inhalation onset. If this semiautomatic condition is used, it will be denoted throughout *Group settings* as well as the actual paradigm with a red **RT** flag (Figure 71).

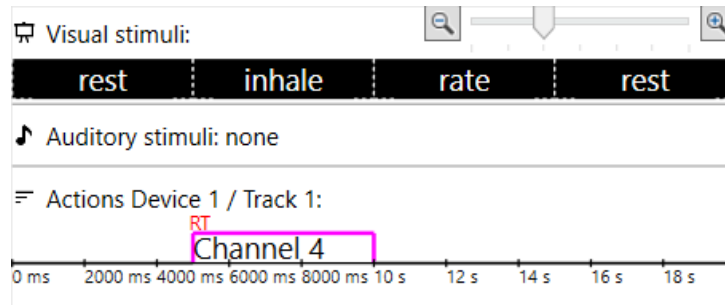


Figure 71 - Visualization of predefined respiratory trigger (inhalation onset synchronization with valve open onset) in group settings via red RT.

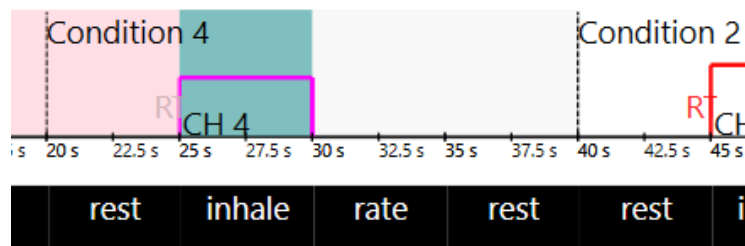


Figure 72 - Visualization of the paradigm during encounter of respiratory condition. The waiting block will flash green and gray until an inhalation onset is detected.

Whenever the software encounters this condition during paradigm execution, it will maintain the state defined prior and update valve settings and visual queue upon onset of the next respiratory cycle. The relevant section will flash green during paradigm execution, while it is awaiting its trigger (Figure 72). For testing purposes, it is possible to manually fulfill the trigger condition by clicking the *Manual Trigger* button.

## Beyond basics

Under certain conditions, the use of the predefined triggers *External TTL Triggered Start* and *Synchronize stimulus onset with inhalation onset* might not be sufficient. When paradigms require complex trigger conditions the use of the *Add / edit Triggers / Labels / EEG DINs* tab might be advisable. In older versions, the same feature will be found in the *Add / edit EEG DINs* tab.

### Case 1 – fMRI TR onset synchronization

In a hypothetical fMRI scenario where the group onset might need to be synchronized with the TR onset which is communicated via a TTL pulse (or optical in Siemens MRI systems; use provided hardware trigger converter box) this tab can be used. In this case as shown in Figure 73 a group named Group 1

was predefined. Currently, it starts out with a 5 s delay. Then the odor connected to channel 1 will be applied to the subject for 5 s. To now synchronize the onset of this group with the occurrence of the TR, a trigger condition named 'MRI TTL sync' or whichever name is preferred can be inserted. The duration of 5 s in this is arbitrarily chosen for readability. Anything that is now vertically aligned in the group settings view of this group, will be delayed until the trigger condition is fulfilled (in this case a TTL pulse is received on the TRIGGER IN port of the ETT Olfactometer). The checkboxes *Delay onset until* and *blocking* both must be checked in this case. Other possible trigger conditions can be chosen from a list in the drop-down menu. To only mark the current section of the paradigm for example as a stimulus period or certain condition like in Figure 74, the two checkboxes should be unchecked and the trigger condition *none* must be checked. Currently there is no further indication within the paradigm as to which trigger condition is currently selected. Clicking on a specific segment marked by a blue box surrounded with a red dotted rectangle will reveal the specific setup and can be changed at any time.

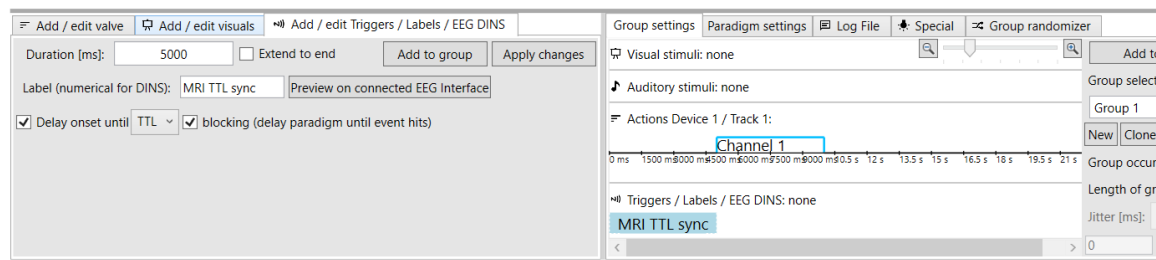


Figure 73 - Using the Add / edit Triggers / Labels / EEG DINS tab to synchronize each group onset with an external TTL pulse. If this interface is not used with our EEG interface system, any label is allowable (even non-numerical). The timing of such labels will be tracked in output protocol files and might be used during data analysis later.

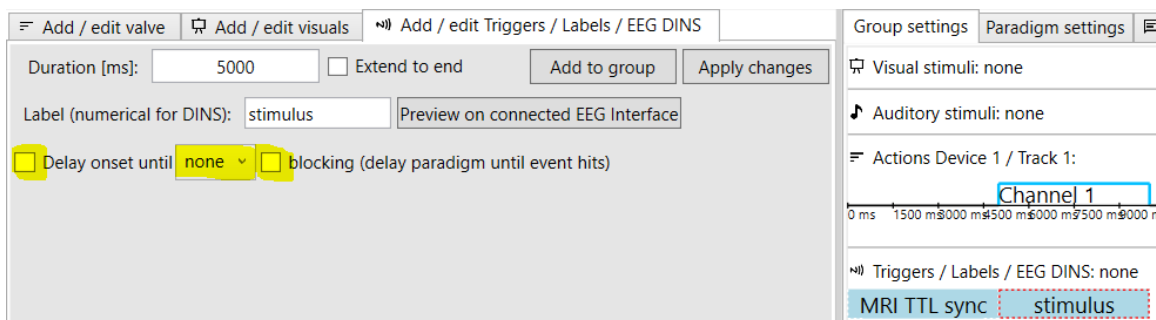


Figure 74 – To simply label a section (in this case as stimulus presentation), uncheck the delay checkbox, select none as the trigger type and uncheck the blocking checkbox.

### Case 2 – specific exhalation onset condition

It might further be useful under certain conditions to tie an *Exhalation onset* to a specific time point in the paradigm so the stimulus odor will already be delivered during the onset of the subjects next inhalation. In this case, the group's device actions are already defined:

- delay time with all valves closed of 5 seconds

- valve open time of channel 1 of 4 seconds
- another valve close time of 20 seconds at the end

Additionally, a visual queue is implemented as follows:

- 5 seconds white '+' on black background during rest period
- 4 seconds white 'x' on black background during the stimulus presentation
- 5 seconds white '\*' on black background during a subject feedback period
- 15 seconds of white '+' on black background during rest period

The final setup should look like Figure 75.

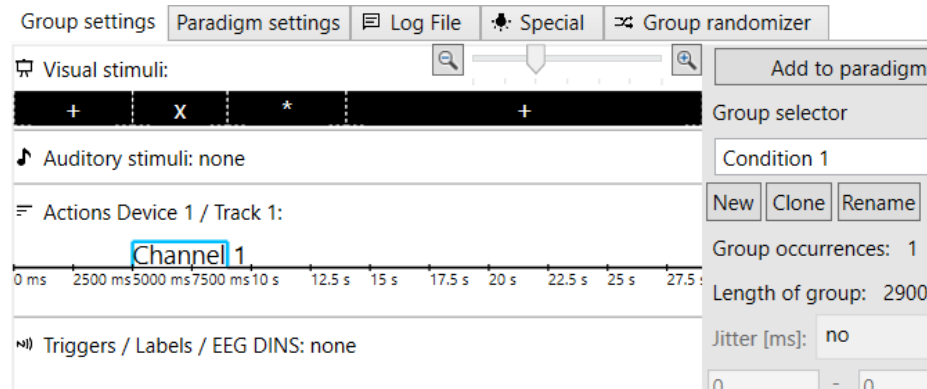


Figure 75 - Visual queue and device actions defined prior to attaching more trigger conditions.

Assuming for this specific cohort the full respiratory cycle is about 4 seconds long, with 1.5 s inspiration and 2.5 s expiration - to assure the stimulus valve is opening while the subject is still exhaling we will insert an exhalation trigger one second prior to the stimulus onset into the paradigm.

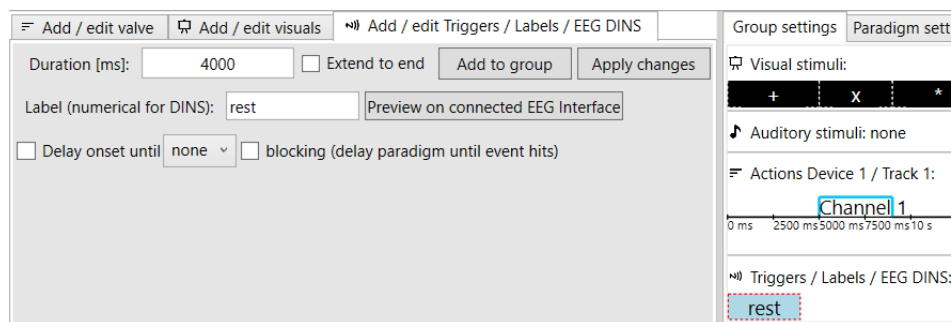


Figure 76 - Setting up a non-delaying label in ETTDirectControl

To push the actual delaying event to the correct time point, we must first insert a blank time point without any condition as shown in Figure 76. The label can be descriptive and freely chosen, as in this case *rest*.

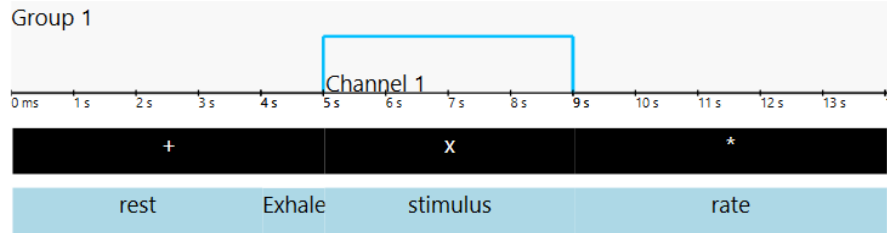


Figure 77 - Group setup in ETTDirectControl with device settings on top, visual queue below and trigger labels on the bottom on the blue background.

Figure 78 - Configuration of an Exhalation onset trigger in the paradigm

Right after the *rest* label, insert a *respiratoryAnalogExhalationOnset* from the triggers tab as described in Figure 78. The paradigm will now delay the onset until an exhalation onset event will be detected on the respiratory sensor signal data.

## Cleaning the odorant carrier

Before we start:

1. **The odorant carrier is made from soft solid Teflon material**
  - i. Only hand tighten screws
  - ii. If screws are too tight, they will strip the Teflon block
  - iii. If screws are not tight enough, they will not seal
2. **The odorant carrier is sealed with small clear silicone flap valves/gaskets**
  - i. They can be hard to see on light colored surfaces
  - ii. Small debris can prevent them from sealing properly when reinstalling
  - iii. Do not lose
3. **A cleaning bath will be required**
  - i. A cleaning bath will be required
  - ii. The choice of detergent or solvent depends on the odorants used
  - iii. Alcohol or non-odorous soap are typical

For questions and advice consult [emergingtechtrans.com](http://emergingtechtrans.com) in the support section or contact ETT at [support@emergingtechtrans.com](mailto:support@emergingtechtrans.com)

## Cleaning the carrier top

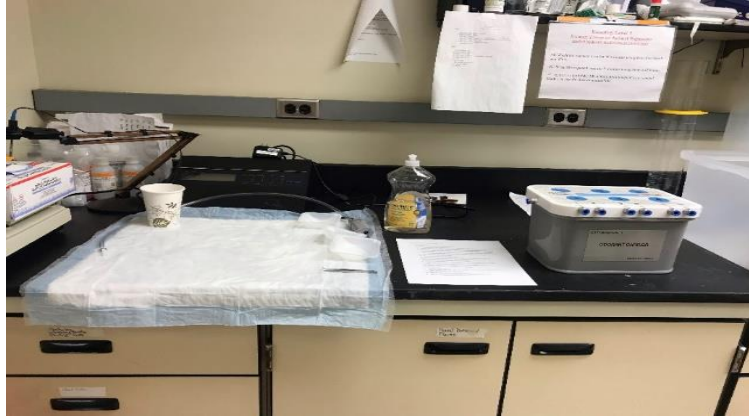
Please consult the section: *Before we start:*

This procedure is only recommended for experienced users and comes at the risk of damaging/removing odorant carrier labels and stickers. An alternative procedure is to only soak valves and gaskets as described in the below process but not submerge the entire carrier.

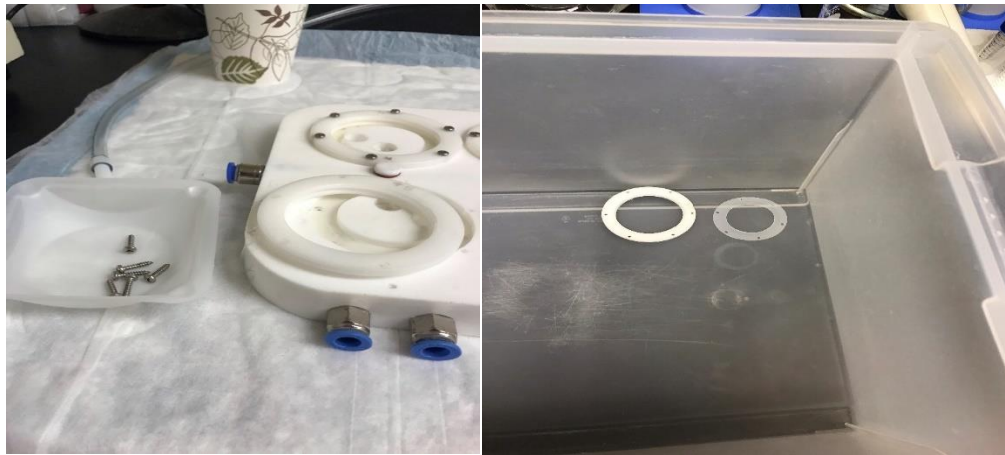
1. Unscrew the bottles from the carrier top



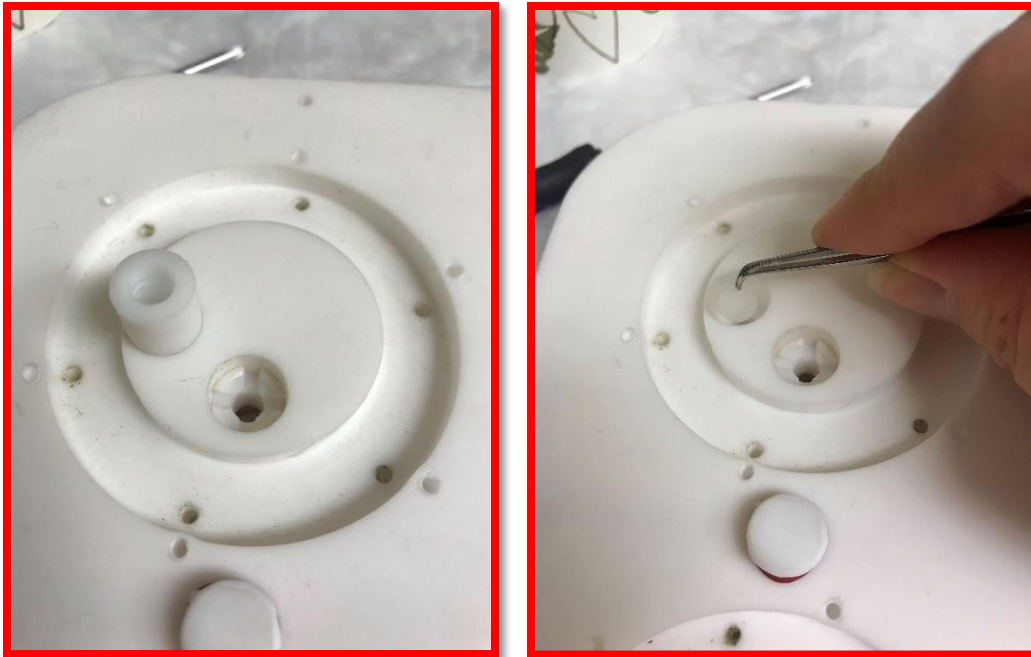
2. Cover the bottles with their respective cap
3. Put a clean pad or towel on the clean work surface and put the carrier top on it



4. Carefully unscrew all the screws from the bottle thread retainers and place them on a container
5. Place all bottle thread retainers (solid white rings) and bottle gaskets (clear silicone rings) from each channel in a cleaning bath



6. Each circle has two plugs to secure the back flow preventing valves (inlet and outlet to the glass odorant chamber). Under each plug should be a clear valve/gasket (backflow preventer). Do not lose! Slowly, pull up those plugs and put them in a separate container.  
**CAUTION: THERE IS A SMALL CLEAR SILICONE VALVE/GASKET UNDERNEATH EACH PLUG! DO NOT DISCARD! VALVE MIGHT GET PULLED OFF WITH PLUG.**



7. Using tweezers take the small “clear” valve/gasket from each valve and store them in a separate container – There should be 2 per stimulus channel. Depending on the odorant carrier version there may be one or two additional valves in the flush channel

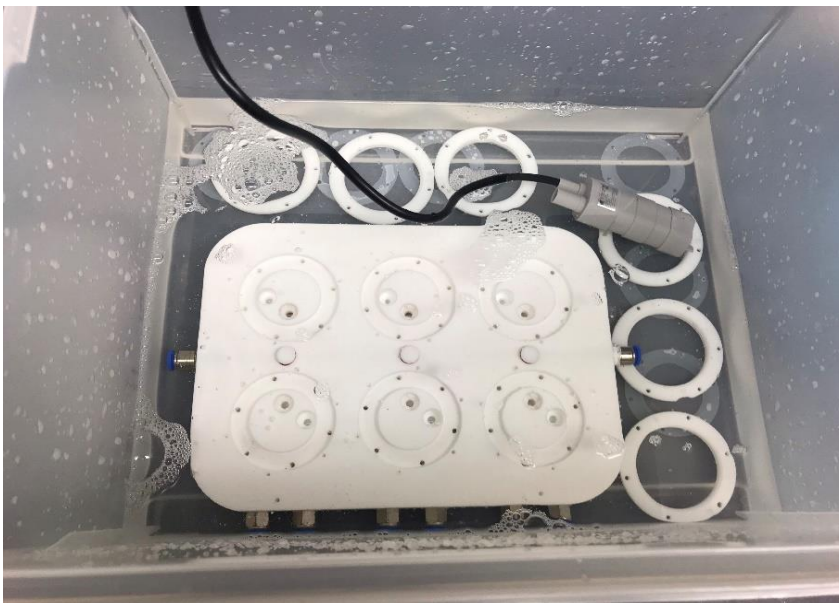


8. Place the whole carrier top into the cleaning bath (WARNING: This may remove the top sticker on the odorant carrier). An alternative to full submersion is to thoroughly wipe the underside and gasket receptacles with alcohol soaked, lint free cloth.

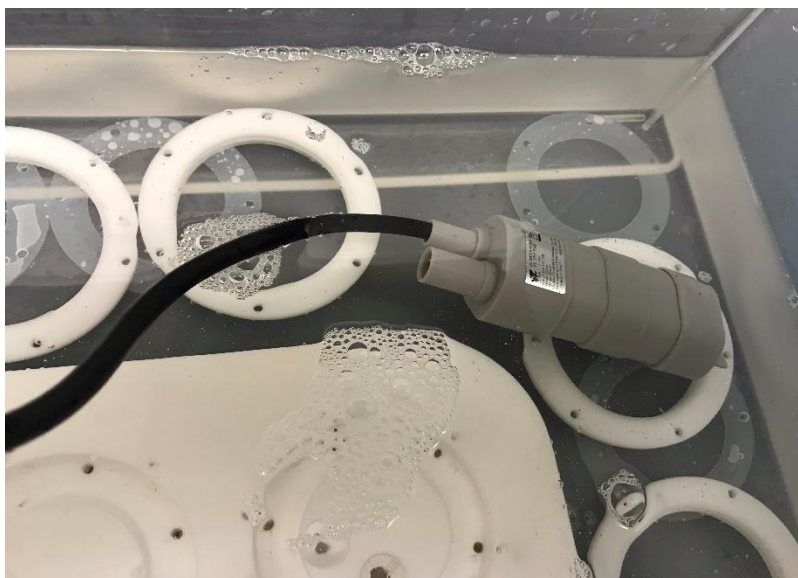




9. Fill the cleaning bath with warm distilled water
10. Fill until all items are covered with water
11. Use the clear non-scented soap or alcohol and put a small amount in the cleaning bath



12. Place a watertight pump into the water or aggravate the water by hand – make sure it is fully immersed in the water



13. Run the pump for several hours
14. If possible, connect pump outlet with each channel inlet on the carrier for several minutes to force cleaning solution through the internal channels of the carrier
15. Turn off the pump and put all the materials from the top as well as the top itself on the clean pad using gloves
16. Dump the soapy water
17. Rinsed and remove all soap on the carrier and its components to avoid future contamination
18. Then place back in the cleaning bath with fresh warmed distilled water
- 19. Repeat steps 12-18 until all odors are removed**

Dump the distilled water and dry all parts before reassembly.

### Cleaning the bottles

ETT Olfactometer glassware is dishwasher compatible. We recommend to handwash the lids contain a plastic threaded part and a Teflon insert to assure a tight odorless seal.

1. Dump the old odorant with tap water down the sink
2. Soak the bottles in warm soapy water (optional when using dishwasher in step 3)
3. Clean the bottles with warm soapy water / run through dishwasher
4. Dry bottles and lids
5. Use filtered and oil-free compressed air to accelerate the drying process
6. Replace labels at your convenience (dry erase or permanent markers can be used in place of stick on labels)

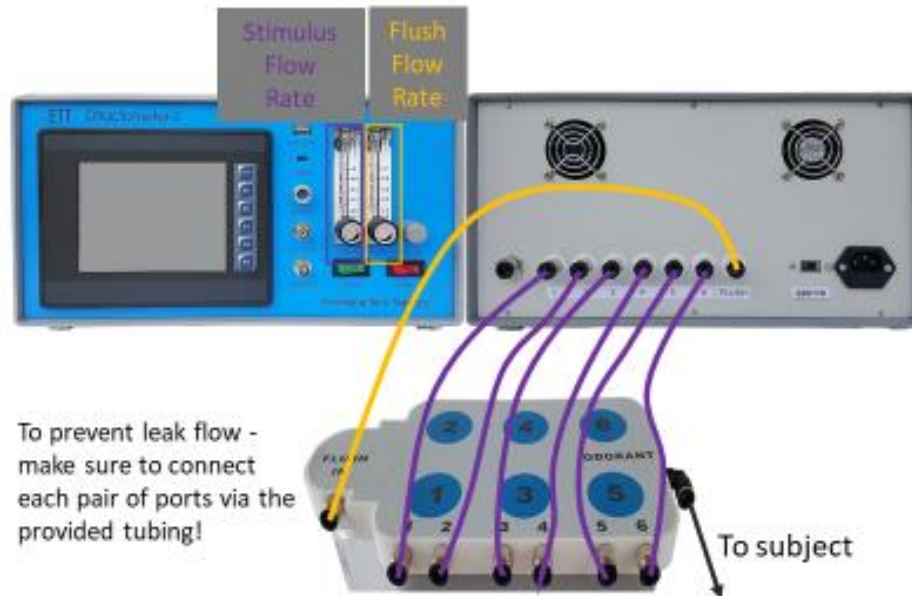
### Cleaning the tubing

Olfactometer tubing is made from non-stick FEP (similar to Teflon). If contamination occurs due to spills or condensation of high vapor concentrations, tubing can simply be flushed with distilled water or even

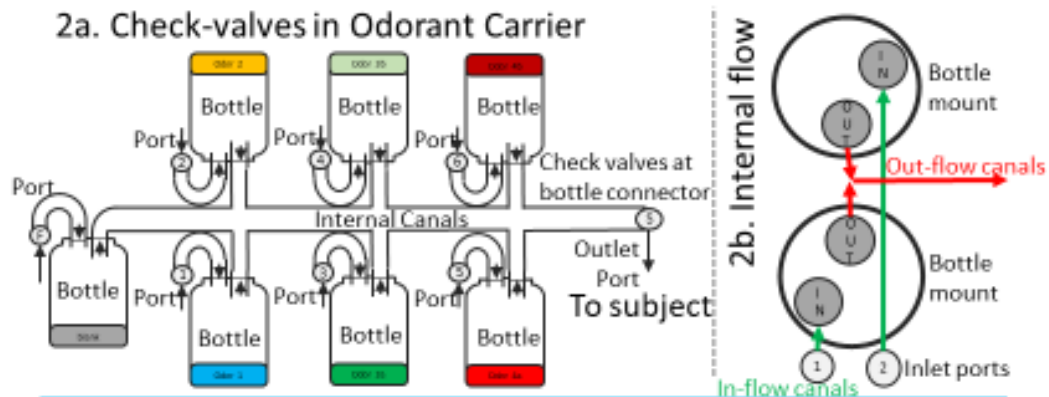
alcohol depending on the intensity of the spill. It is advised to use the air of the olfactometer to blow tubing dry after washing before storing it.

## Odorant flow setup

### Carrier Setup



### Check valve layout in the odorant carrier



#### Air Flow

1. Clean air enters the carrier through port F and 1-6 (if valve opened on Olfactometer)
2. Air passes a check valve into its respective odorant bottle
3. Air gets odorized
4. Air exits bottle through check valve to prevent back flow from other bottles
5. Air mixes with other odorants (if other valves opened and or blank air from flush channel as "Carrier" and "Flush" flow rates are set
6. Air exits the Odorant Carrier to the subject

## Typical air flow configurations

### Possible configurations:

#### Case 1a:

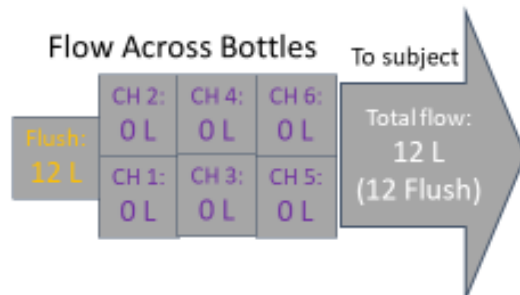
**Valves:** "Flush"

1	2	3	4	5	6	F
---	---	---	---	---	---	---

**Flow Settings** on Front Panel:

6 L	6 L
Carrier / Stimulus	Flush

**Resulting** Flow Rates on Bottles in Odorant Carrier:



#### Case 1b:

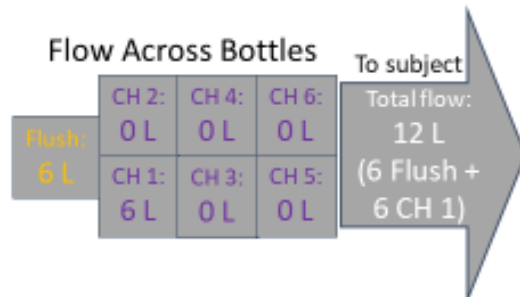
**Valves:** "Channel 1"

1	2	3	4	5	6	F
---	---	---	---	---	---	---

**Flow Settings** on Front Panel:

6 L	6 L
Carrier / Stimulus	Flush

**Resulting** Flow Rates on Bottles in Odorant Carrier:



#### Case 1c:

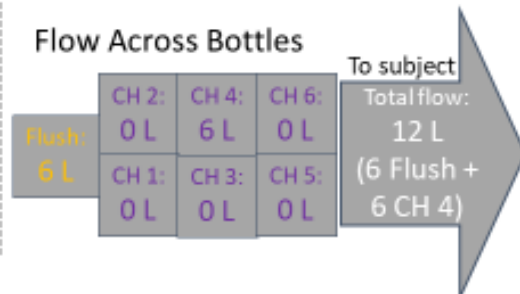
**Valves:** "Channel 4"

1	2	3	4	5	6	F
---	---	---	---	---	---	---

**Flow Settings** on Front Panel:

6 L	6 L
Carrier / Stimulus	Flush

**Resulting** Flow Rates on Bottles in Odorant Carrier:



### Case 2a:

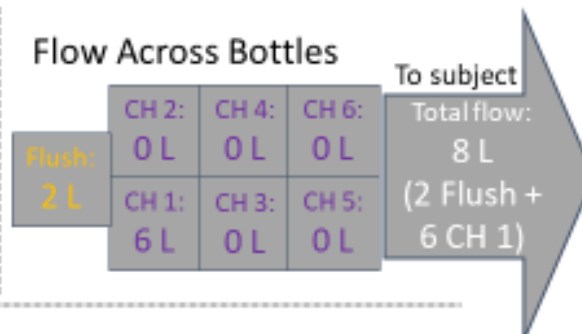
**Valves:** "Channel 1" different flow



**Flow Settings** on Front Panel:

6 L	2 L
Carrier / Stimulus	Flush

**Resulting** Flow Rates on Bottles in Odorant Carrier:



### Case 2b:

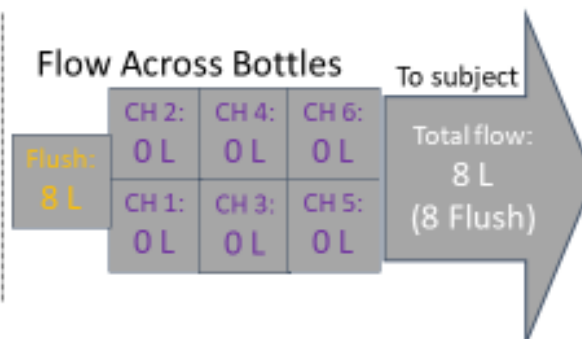
**Valves:** "Flush" different flow



**Flow Settings** on Front Panel:

6 L	2 L
Carrier / Stimulus	Flush

**Resulting** Flow Rates on Bottles in Odorant Carrier:



### General rules:

1. In the "FLUSH" condition the total flow will be the addition of "Carrier" and "Flush" as set on the front panel flows columns.
2. During a valve open condition the total flow will be the flow as set on the "Carrier" flow column on the front panel.
3. If multiple Stimulus valves are opened, the total flow will be composed as: Flush (as set on "Flush") added to each Stimulus Channel, ("Carrier" flow divided by number of opened stimulus channels – Stimulus flow will be split equally between multiple opened Carrier/Stimulus channels)

## Configuration for multiple channels at once

### Multiple channels at once

#### Case 3a:

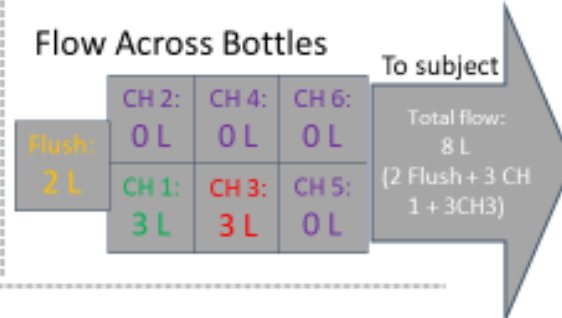
**Valves:** "Channel 1" & "Channel 3" different flow



**Flow Settings** on Front Panel:

6 L	2 L
Carrier / Stimulus	Flush

**Resulting** Flow Rates on Bottles in Odorant Carrier:



#### Case 3b:

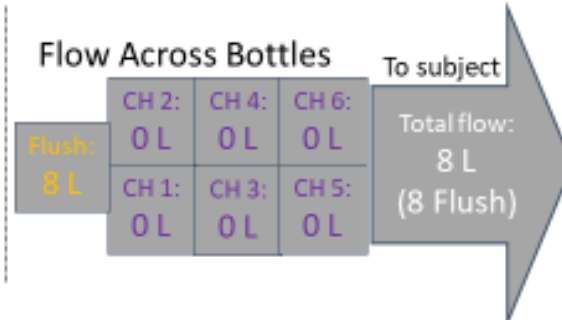
**Valves:** "Flush" different flow



**Flow Settings** on Front Panel:

6 L	2 L
Carrier / Stimulus	Flush

**Resulting** Flow Rates on Bottles in Odorant Carrier:



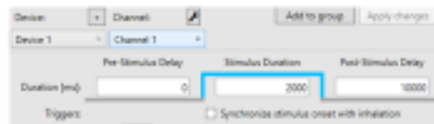
#### General rules:

1. Odorants between stimulus channels will roughly split the flow if the resistances in each tube to the odorant carrier is equal
2. Valves can be overlapped with different timing (you can open CH1 500ms before CH3, then open together for 2s, then close CH1 500ms earlier)



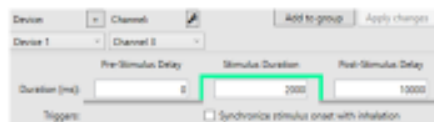
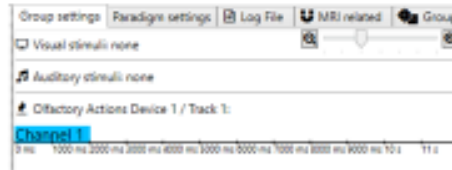
## Setting up multiple channels within ETTDirectControl

### Setting it up in ETTDirectControl



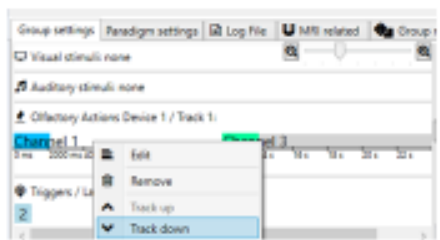
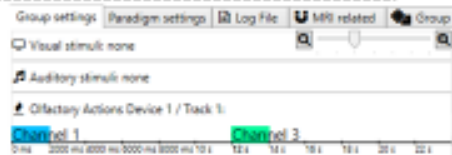
First add Channel 1 as desired

The group editor will represent the setup

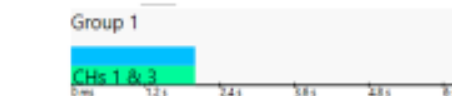


Then add Channel 3 to the group

The group editor will show Channel 3 behind Channel 1



To bring the start time of Channel 3 to Channel 1, right-click on CH3 and click *Track down*



CH1 & 3 will now open together



If CH1 has a *Pre-Stimulus delay* the delay will be shown in the program



## ETT EEG Trigger Interface

### Hardware setup

#### System overview

Via a system of adapters ETTDirectControl can mark events in EGI and other manufacturers EEG systems. The sub-component required can be connected to the ETTDirectControl PC via USB. The ETT EEG Trigger Interface can feed up to 50 different DIN labels into the EGI NetStation software. For this to work the Parallel Port of the ETT EEG Trigger needs to be plugged into the EGI AV DEVICE DIN Adapter.



*Figure 79 - Previous version of the EET EEG Interface*



*Figure 80 - Current version of the ETT EEG Interface*

A full system overview can be seen in Figure 81. The EGI AV Device DIN Adapter is connected via Serial Port to the EEG system specific CLOCK SYNC I/O device. This is then connected via fiber optic cable to the amplifier, which is in turn connected via Data I/O fiber optic cable and FireWire converter to the EGI NetStation Control MAC computer.

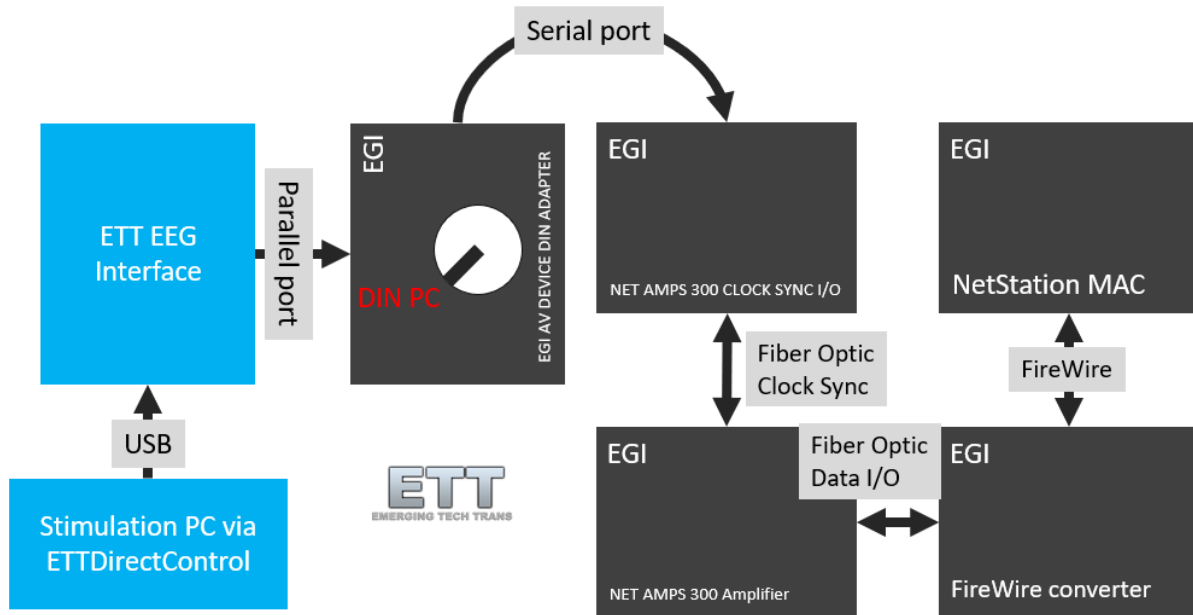


Figure 81 - ETT EEG Interface setup with respect to EGI system components

The EGI AV DEVICE DIN Adapter is normally used to run visual or auditory timing tests. Any equipment related to such tests should be disconnected first.

The rotary dial on the DIN Adapter should be dialed to *DIN PC*.

## Software Setup

### Prerequisites

After all hardware connections are made and all devices are turned on it is advisable to first assure that the ETT EEG Interface is recognized by the PC that has ETT Direct Control loaded. To see it working, one first has to get the EGI NetStation software ready.

### EGI NetStation

NetStation should be loaded with the preferred session template that would normally be used for the study. The system should work without measuring gains and all other prerequisites that the program steps through during startup. So those can be skipped for initial testing. A net also doesn't have to be connected to the amplifier, but all components must be connected and powered on as shown in Figure 81.

Assert that the EGI AV device adapter is dialed to DIN PC. In NetStation, navigate to the *Digital Input Controls* panel. Set the source to *EGI Response Pad* as shown in Figure 82.

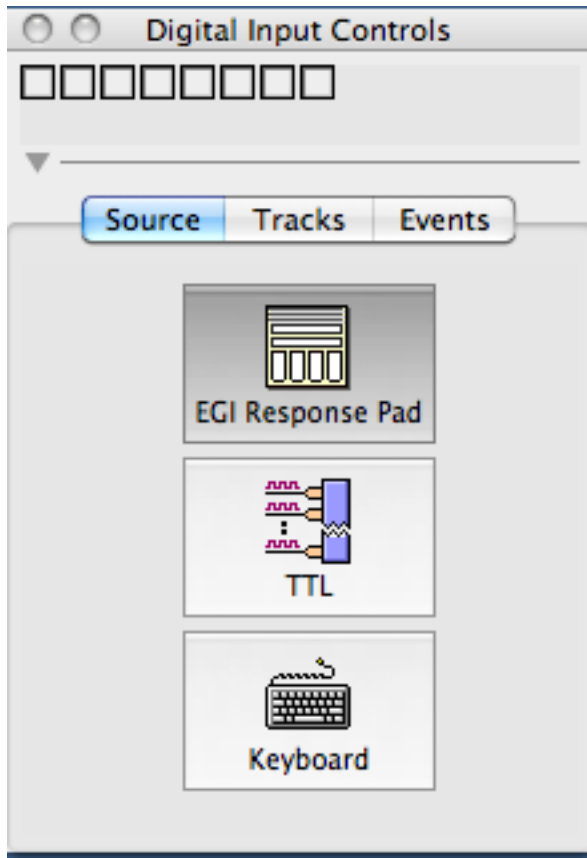


Figure 82 - EGI NetStation Source setup

Activate the *Events* button in the main window to visualize DINS below *Calibration* and *Marks* as shown in Figure 83. At this point everything should be ready to continue with the setup in ETT Direct Control. Once that setup is completed submitted events will be marked as labeled DINS in the DIN track within the NetStation main window (Figure 84).

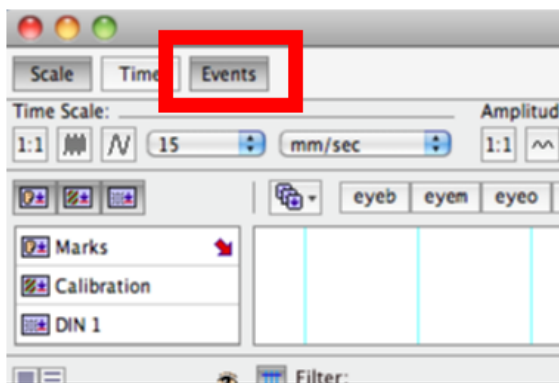


Figure 83 - For DIN visualization click on Events to activate the Events track (DIN 1)

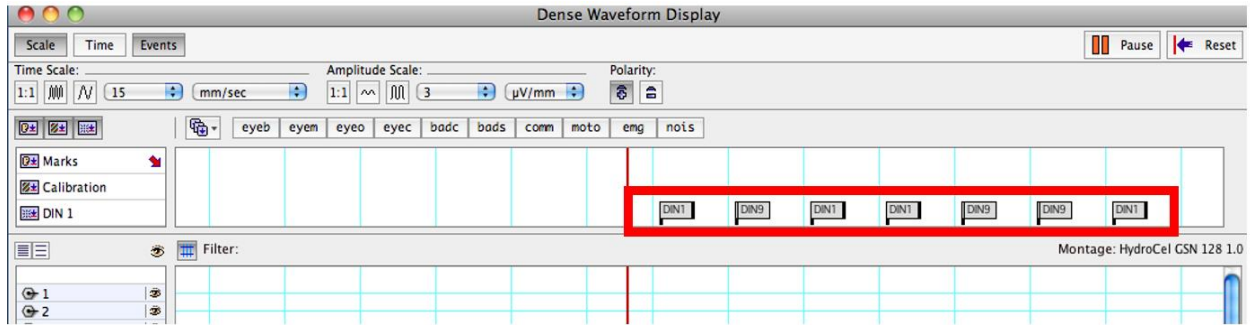


Figure 84 - After successful implementation DINs will be marked with their ID in the DIN1 track within NetStation

## ETT Direct Control

The ETT EEG Interface should get automatically recognized once connected to ETT Direct Control (Figure 85). At this point all functions in this *Manual Mode* tab can be ignored – only confirm it is connected. A switch to the *Paradigm Designer* tab and then a switch to the EEG labels setup as shown in Figure 86.

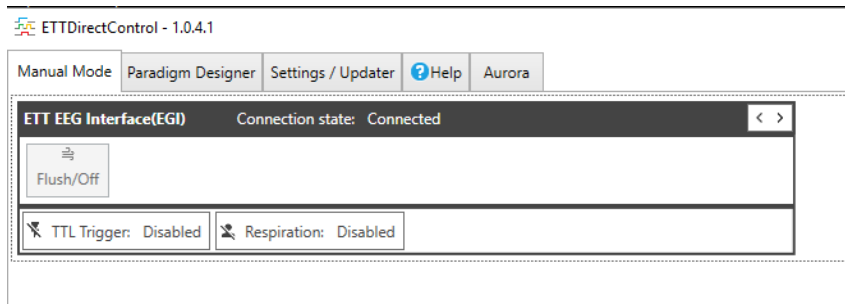


Figure 85 - ETT EEG Interface (EGI) in ETT Direct Control Manual Mode tab once successfully connected

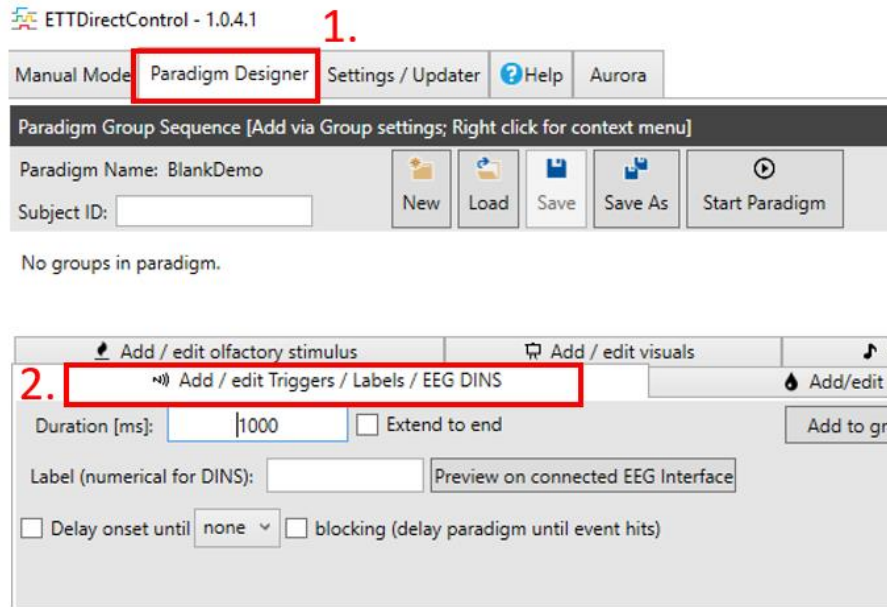


Figure 86 - First switch to the Paradigm Designer tab, then in the Group configuration section click Add / edit Triggers / Labels / EEG DINS

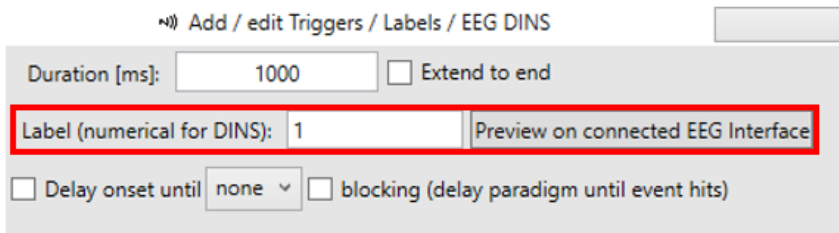


Figure 87 - If the ETT EEG Interface is connected one can preview numerical DIN settings by typing the number and clicking the preview button

To test basic functionality one can set the label in the *EEG DINS Label* textbox to a number between 1 and 63. Clicking the *Preview on connected EEG Interface* (Figure 87) will submit the DIN to the EEG system and visualize it in the waveform window under DIN1 with its respective ID in EGI NetStation.

Setting and Previewing this field to 0 will reset the DIN settings. If everything worked so far, a simple group can be compiled. First *Save* the paradigm as “EEG DIN sample”. Switch to the *Add / edit visuals* tab and set the *Duration* to 1000 ms, change the text label to 1 and finally click the *Add to group* button as shown in Figure 88. Now that a visual stimulus is added to the paradigm, switch back to *Add / edit EEG DINS*.

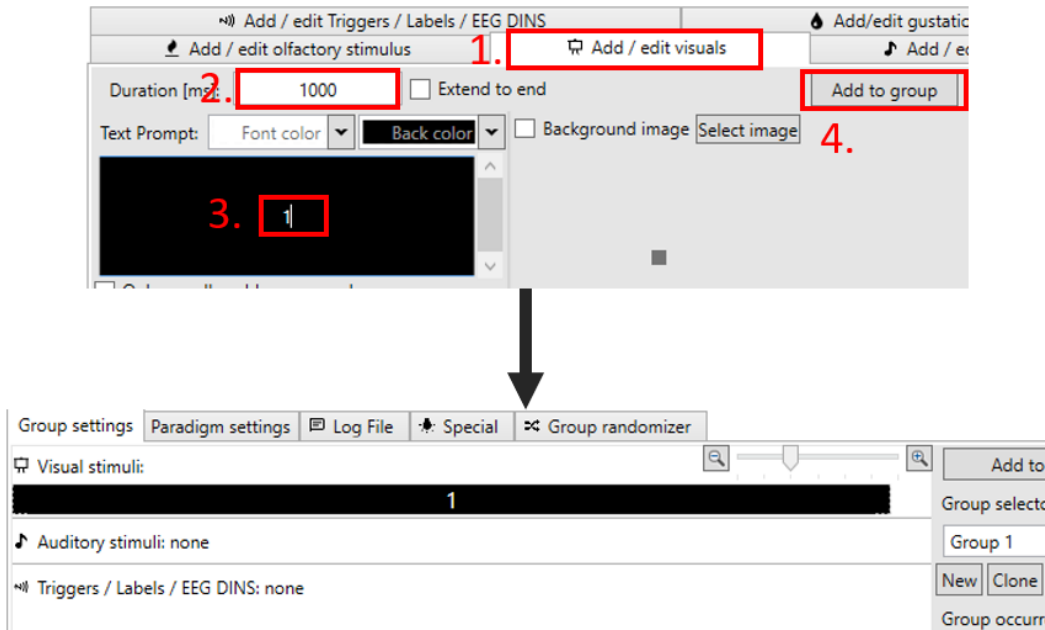


Figure 88 - Add a 1 s number presentation to the paradigm

Set the Label to 1 and Duration to 1000 ms and click the *Add to Group* button (Figure 89).

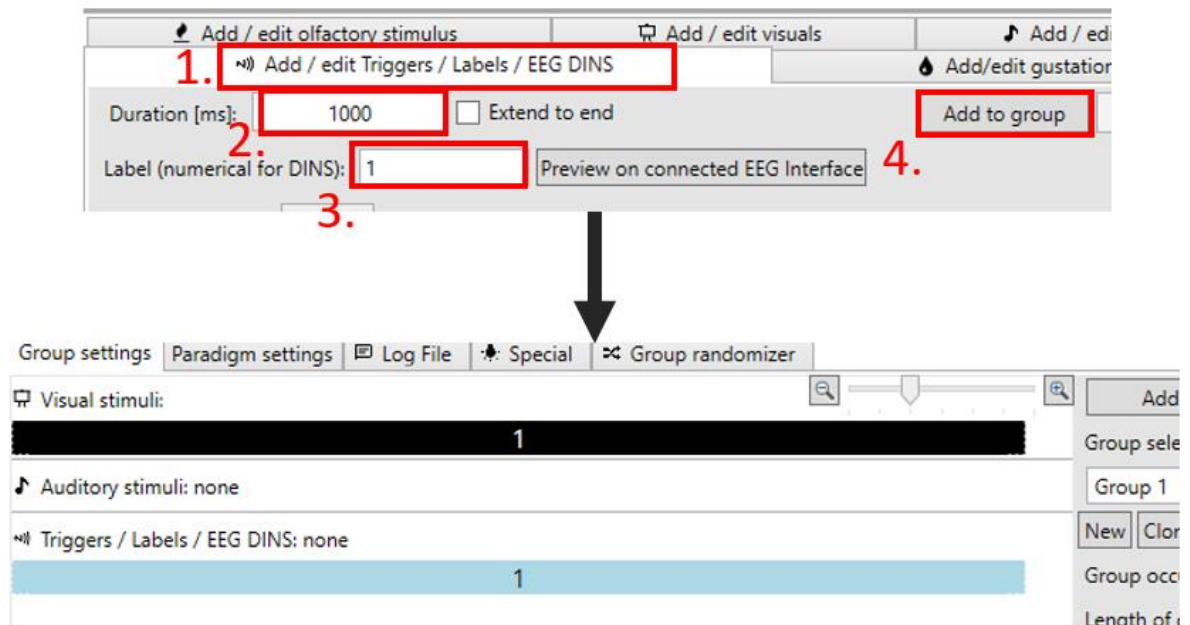


Figure 89 - Insert a 1s EEG DIN1 to the Group 1 that already contains a visual stimulus

Hit F1 on your keyboard for a quick save. Now create a new group by clicking on the *New* button in the group settings. The text above should state *Group 2*. Now repeat the same steps above. First insert a

visual stimulus (set the label to 2 instead of 1) and after insert a new DIN label (again, set the label to 2 instead of 1) just as shown in Figure 90.

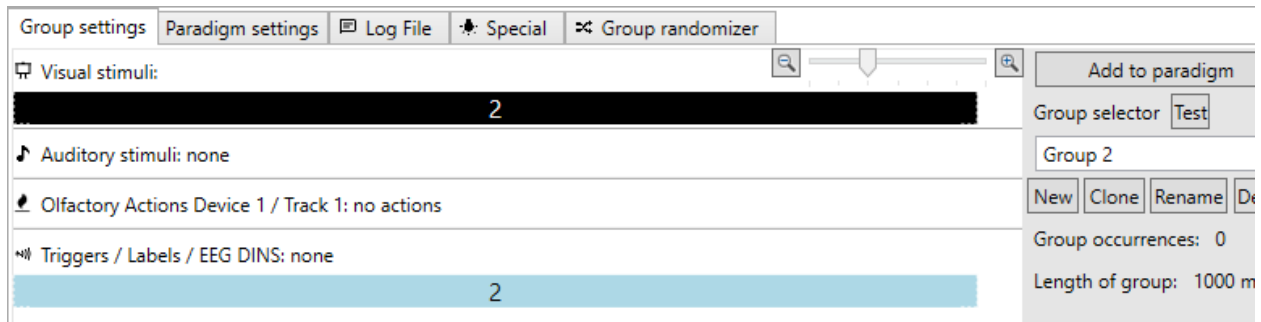


Figure 90 - Setting up Group 2

In *Paradigm Settings* check *Subject Interface* and *Run in full screen* (Figure 91). Now switch to the *Group randomizer* and click *Update and Re-shuffle List* until you like the distribution of group calls. Then click on *Append trial list to paradigm* and hit F1 on your keyboard to save the paradigm (Figure 92).

As shown in Figure 93, this will create a problem if the desire is to label the onset of each group in the EEG system. Since the EEG DINs have the same duration as the visual stimulus (general group length), when switching to the same group twice in a row the ETT EEG Interface will not send another DIN. This behavior is intentional for different scenarios, but to work around it, we can edit the duration of the DINs in each of the groups to be slightly shorter than the overall group length as shown in Figure 94.

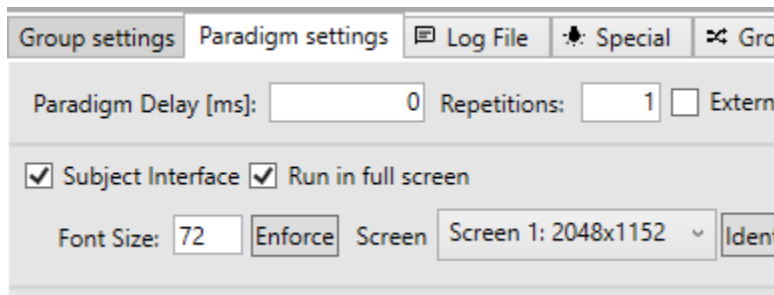


Figure 91 - Paradigm settings to show the paradigms visual stimuli in full screen

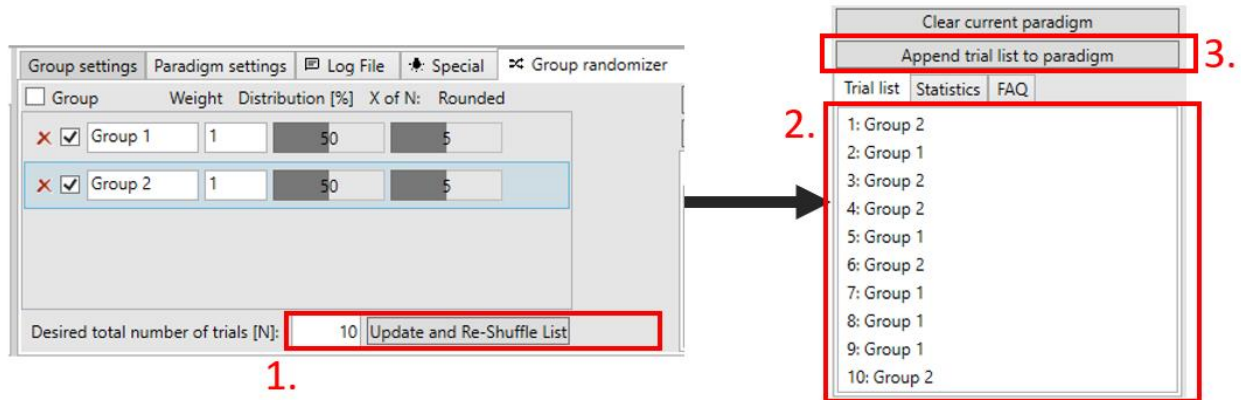


Figure 92 - Use the Group randomizer to generate a list of 10 trials

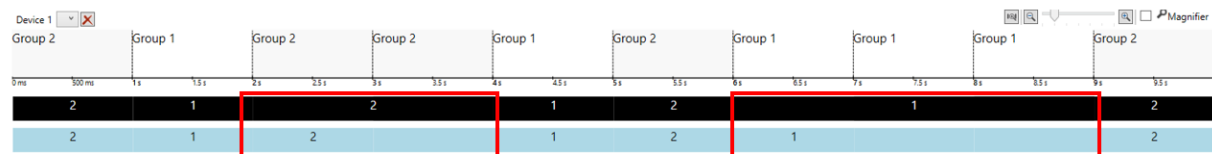


Figure 93 - Since both the EEG label calls and the visual stimuli have the same length, no new EEG DIN call will be initiated when calling the same group twice in a row.

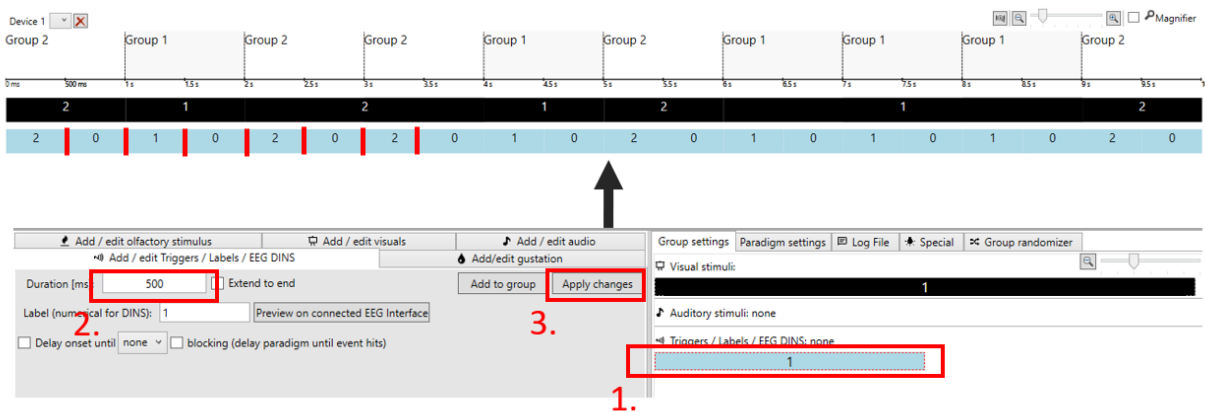


Figure 94 - Reducing the EEG DIN duration to anything shorter than the group length will assure that the DIN is sent out at the start of each group call

Now it's time to save the paradigm one more time (F1) and do a confirm the ETT EEG Interface is still connected in the *Manual Mode* tab. Then we can start the paradigm and observe the DINs in NetStation as shown in Figure 84.