

Osmic Enterprises Inc.

fMRI Olfactometer



Cincinnati, OH

Osmic fMRI Olfactometer

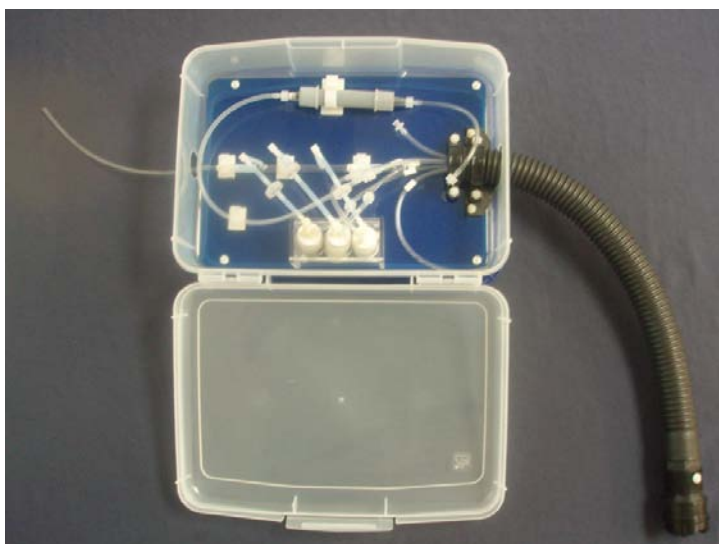
This manual describes the software that controls the fMRI Olfactometer from Osmic Enterprises, Inc. The software has the ability to turn on and off single channels of odorant according to a prespecified experimental protocol. This document gives an overview of the operation of the olfactometer and discusses the function of each of the buttons/controls.

The olfactometer consists of two components. The first component is the control box (Figure 1a.) which houses the mechanical and electrical elements, including solenoid valves, pressure gauge, flowmeters and the I/O and A/D board. The second component is the odor reservoir box (Figure 1b.) which contains the individual odor reservoirs and mixing manifold. The odor reservoir box is constructed entirely of plastic and glass components (all MRI compatible) and is connected to the control box via a 25 foot long hose housing the individual flow lines. The hose from the odor reservoir box passes through the wall of the fMRI room via a wave guide to connect to the control box by means of a quick-disconnect fitting. The olfactometer can be configured to deliver from three to six individual odor stimuli, one at a time, to a subject in a MRI magnet.

Figure 1a.



Figure 1b.



If an experiment requires exposure to more than eight odor stimuli, the total number of stimuli available can be increased by using multiple odor reservoir boxes. In this case, both the 25 ft long hose and the hose from the odor reservoir box would be fitted with quick-disconnect fittings. When a new set of odorants was required, the odor reservoir box with the new odorants could be quickly replaced between sessions.

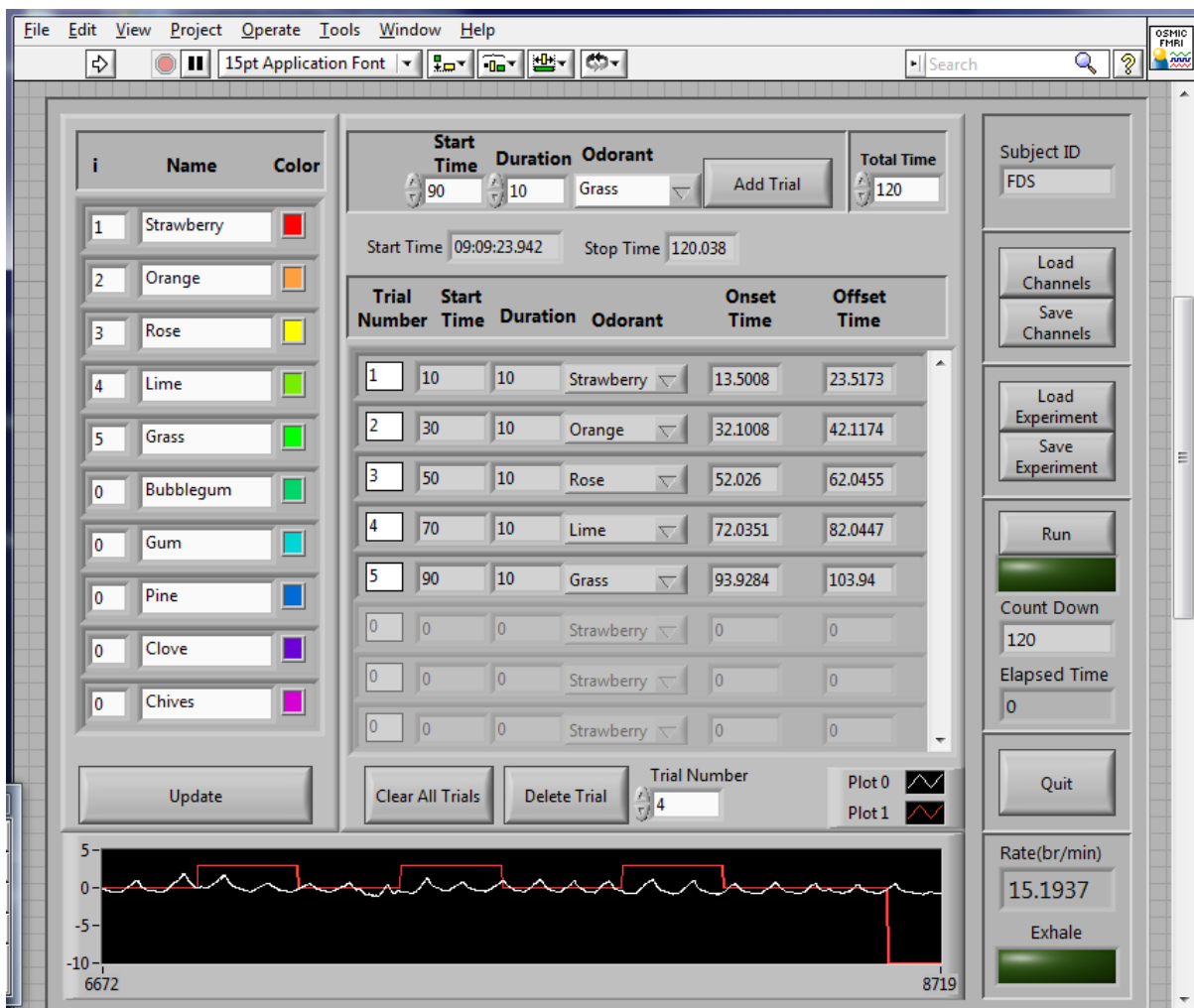
The olfactometer can be controlled by either of two ways: 1) by the software provided by OEI; or 2) by programs such as E-prime® or Presentation® via the parallel port (or by the LJU12-PH I/O board for Presentaion). The OEI software is described below; control via the parallel port is described immediately afterwards.

Control of the fMRI Olfactometer by OEI software

In addition to the executable file (Osmic fMRI Main application) required to run the program, there needs to be two additional folders present in the same folder/location. These are the "Results" folder and the "ConfigFiles" folder. The "Results" folder is the location where all results files for each experimental run are placed at the completion of an experiment, e.g., "Breathingxxxx.txt" and "Resultsxxxx.txt".. The "ConfigFiles" folder contains the "Setup.Config", the "Channels.Config" file and the "Experiment.Config" file. The contents of these folders are described in greater detail in the following pages.











Figure 2 is the main graphical user interface; this is the form on the screen when the software is started.

Figure 2.



The program currently can switch on and off up to 10 odorant channels. By default these are named ch1 to ch10; however, it is possible to customize these names to make them more informative (Figure 3a.). The name of each channel may be altered, but the Update button needs to be pressed before the new names will be recognized in the pull down menus, described below, for creating experimental trials.

Figure 3a.

i	Name	Color
1	Strawberry	
2	Orange	
3	Rose	
4	Lime	
5	Grass	
0	Bubblegum	
0	Gum	
0	Pine	
0	Clove	
0	Chives	

Update

If the odorant names are customized they can be saved to a configuration file, using the “Save Channels” button, for later re-use via the “Load Channels” button.

Figure 3b.

Load Channels

Save Channels

Channels_101911.config

[Channels]

index 0 = 1.000000

name 0 = "ch1"

color 0 = 16711680

index 1 = 2.000000

name 1 = "ch2"

color 1 = 16752448

index 2 = 3.000000

name 2 = "ch3"

color 2 = 16776960

index 3 = 4.000000

name 3 = "ch4"

color 3 = 7859712

index 4 = 5.000000

name 4 = "ch5"

color 4 = 65280

index 5 = 6.000000

name 5 = "ch6"

color 5 = 54634

index 6 = 7.000000

name 6 = "ch7"

color 6 = 54741

index 7 = 8.000000

name 7 = "ch8"

color 7 = 27349

index 8 = 9.000000

name 8 = "ch9"

color 8 = 6947029

index 9 = 10.000000

name 9 = "ch10"

color 9 = 13959381

Setting up experiment

The experimental setup has three parts. The first is where experimental trials are added to the experimental protocol (Figure 4a.), second is a display of the current experimental protocol (Figure 4b.) and the final section is the ability to clear single trials or all trials (Figure 4c.). To add a trials to the experiment enter in a “Start Time” in seconds, an odorant “Duration” time and select an odorant from the pull down menu of odorants. Once that is done press the “Add Trial” button and the trial will be added to the experimental protocol displayed below it. In addition, the “Total Time” needs to be specified. This is the total time of the experiment and needs to be longer than the start time plus the duration of the last odorant presented in the experimental protocol.

Figure 4a.

Figure 4a shows the experimental setup interface. It includes input fields for Start Time (90), Duration (10), Odorant (Grass), and Total Time (120). An "Add Trial" button is present to the right of the input fields.

Below is a figure of the experimental protocol portion of the interface with an experiment .

Figure 4b.

Trial Number	Start Time	Duration	Odorant	Onset Time	Offset Time
1	10	10	Strawberry	13.5008	23.5173
2	30	10	Orange	32.1008	42.1174
3	50	10	Rose	52.026	62.0455
4	70	10	Lime	72.0351	82.0447
5	90	10	Grass	93.9284	103.94
0	0	0	Strawberry	0	0
0	0	0	Strawberry	0	0
0	0	0	Strawberry	0	0

Figure 4c.

Figure 4c shows the interface for clearing trials. It includes buttons for "Clear All Trials", "Delete Trial", and "Close All". A "Trial Number" input field is also present, currently showing 0.

Experiment_101911.Config

[NumberTrials]

count = 10

[Experiment]

TotalTime = 120.000000

StartTime 0 = 10.000000

Duration 0 = 2.000000

Odorant 0 = 0

Index 0 = 1.000000

StartTime 1 = 20.000000

Duration 1 = 2.000000

Odorant 1 = 1

Index 1 = 2.000000

StartTime 2 = 30.000000

Duration 2 = 2.000000

Odorant 2 = 2

Index 2 = 3.000000

StartTime 3 = 40.000000

Duration 3 = 2.000000

Odorant 3 = 3

Index 3 = 4.000000

StartTime 4 = 50.000000

Duration 4 = 2.000000

Odorant 4 = 4

Index 4 = 5.000000

StartTime 5 = 60.000000

Duration 5 = 2.000000

Odorant 5 = 5

Index 5 = 6.000000

StartTime 6 = 70.000000

Duration 6 = 2.000000

Odorant 6 = 6

Index 6 = 7.000000

StartTime 7 = 80.000000

Duration 7 = 2.000000

Odorant 7 = 7

Index 7 = 8.000000

StartTime 8 = 90.000000

Duration 8 = 2.000000

Odorant 8 = 8

Index 8 = 9.000000

StartTime 9 = 100.000000

Duration 9 = 2.000000

Odorant 9 = 9

Index 9 = 10.000000

(A new experimental file can be created by simply cutting and pasting the config file with the appropriate values.)

The Config File

When the program starts it reads in a configuration file. This file is in the **ConfigFiles** folder and is named **Setup.Config**. This file is a simple text file and can be edited by in any text editor. The default config appears below.

The first section **[ChannelDIOMapping]** defines which channel is used for the vacuum and which one to use for the makeup air. It also defines how many seconds the vacuum is to remain on after an odor is switched off. **(Note: the value entered for VacuumChannel must be 2 less than the actual channel.)** The next section, **[TimeParameters]**, is used when the odorants are delivered relative to the participant's breathing. This defines how many seconds to wait after the program identifies the start of an exhale (see Figure 5a. below). Since it is important to time the onset of odorant stimuli presentation at the beginning of inhalation (no odorant is detected during exhalation), the software calculates dynamic thresholds for both phases. (They are dynamic in that their values change over time depending on changes in breathing rate). The "WaitTimeAfterExhale" parameter allows two important modifications to the exposure schedule. First, since the time of exposure is determined by the experimental protocol, it delays the stimulus from being presented if the subject is exhaling at that point in time; and secondly, it allows the onset of stimulus exposure slightly before the threshold for inhalation actually occurs. Finally, since both the onset and offset times are recorded for each stimulus, as well as the actual breathing pattern during stimulus exposure (files are located in "Results" folder, under labels of "Breathingxxxx.txt" and "Resultsxxxx.txt"), it allows a precise judgment of how well stimulus presentation coincided with inhalation (Figure 5b). The last section, **[TTL_Trigger]**, describes parameters related to the input and output pulses that the program uses and creates. The **InChannel** defines the Analog Input (AI) channel (AI2) that the program "listens" to in order to begin. Once the experimenter presses the RUN button the program waits for either the spacebar key to be pressed or a pulse to arrive on this AI2 channel. **The external trigger pulse must be a positive going TTL pulse, 40 msec in duration or greater.** The program also generates a positive going TTL pulse when it start, which is read on the **OutChannel** channel (Analog Output (AO1). This is a 5 volt (TTL) pulse with duration as set by the **Duration** parameter.

Setup.Config

[ChannelDIOMapping]

VacuumChannel = 6 (actual valve number - 2)

MakeUpChannel = 7

VacuumOnTime = 3.000000

[TimeParameters]

WaitTimeAfterExhale = 1.000000 (may be changed)

[TTL_Trigger]

InChannel = AI2

OutChannel = AO1

Duration = 50

Note: Duration = 50 means that a pulse 50 msec long is generated. This is usually an optimal duration-- long enough for MRI to detect, but it can be changed if necessary.

Figure 5a.

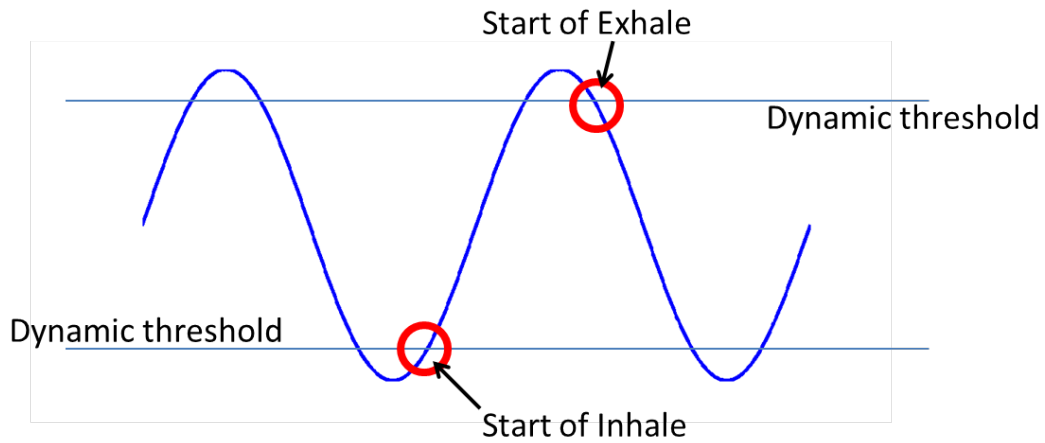
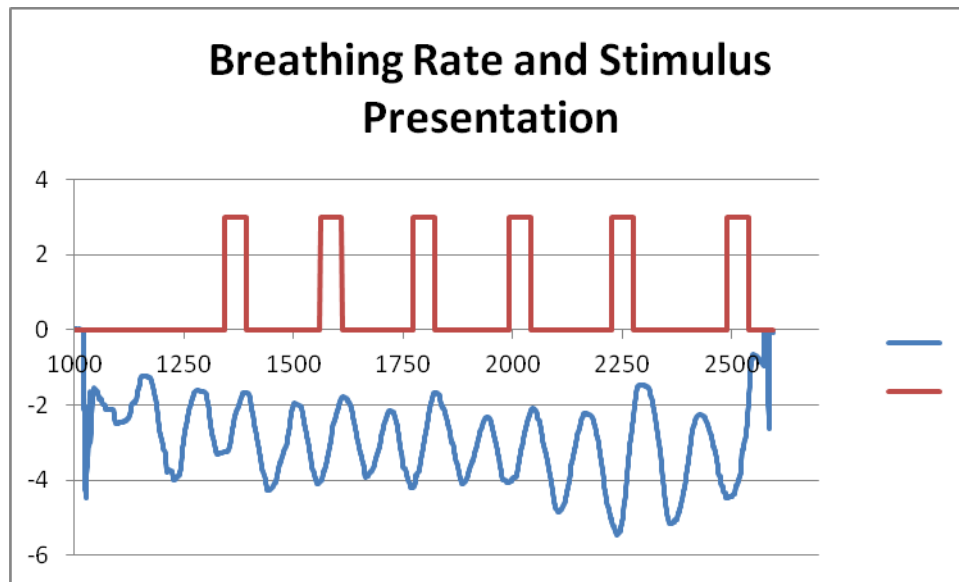


Figure 5b.



"Breathing" file imported into EXCEL

Resultsxxxx.txt

StartTime,Duration,Odorant,OnsetTime,OffsetTime

10, 2,ch1,10.0086,12.0327

20, 2,ch2,19.9921,22.0083

30, 2,ch3,30.0277,32.0568

40, 2,ch4,39.9953,42.0194

50, 2,ch5,50.0169,52.0320

60, 2,ch6,60.0244,62.0565

Dimensional Drawing Of LabJack U12-PH

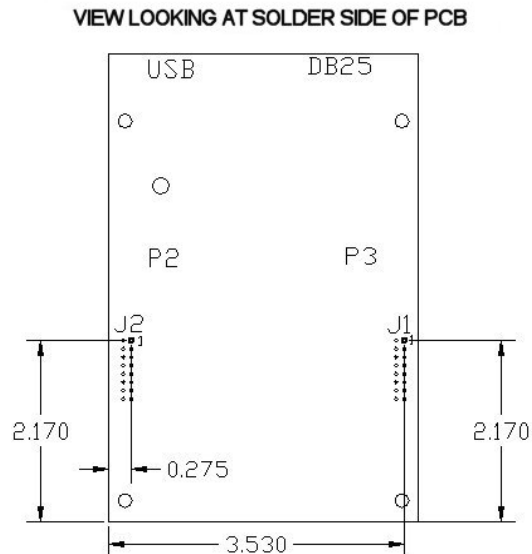
This is a view looking at the solder side of the PCB, not the component side (Figure 6.). On a normal non-OEM LabJack U12, the DB25 and USB connectors are mounted on the component side, along with everything else except the screw terminals and status LED.

The LJU12-PH is an OEM board with pin-headers installed (on the component side) instead of screw-terminals. In addition, the LED is installed on the component side of the board, so nothing is on the solder side.

The pin-headers are standard 2x8 0.1" headers such as Jameco part# 109567. Pin 1 on each header is shown. The pins then go down the column to pin 8. Pin 9 is right next to pin 8 in the other column, and then the pins count up to pin 16 which is right next to pin 1. Pins 1-15 match up with screw terminal connection 1-15 and pin 16 has no connection. Pin 1 on J1 is IO0. Pin 1 on J2 is AI0.

J1	J2
1 IO0	1 AI0 Belt In
2 IO1	2 AI1
3 GND	3 GND Belt GND
4 IO2	4 AI2 InChannel
5 IO3	5 AI3
6 GND	6 GND GND
7 AO0	7 AI4
8 AO1 OutChannel	8 AI5
9 GND Gnd	9 GND
10 CNT	10 AI6
11 GND	11 AI7
12 GND	12 GND
13 +5V	13 +5V
14 +5V	14 +5V 5vdc
15 STB	15 CAL
16 NC	16 NC

Figure 6.



Below (Figure 7.) is a picture of the pneumatic respiratory belt connected to the pressure transducer (small box), with the output signal conducted to the J2/P2 connector of the Labjack board via the BNC cable. Power is provided to the pressure transducer via a 5 VDC wall transformer. In actual operation, two lines (out of the 10; a 1/16" line may also be available) within the 25 foot quick disconnect hose are used for the belt. One is used to transmit the pressure changes produced by the belt when the subject breathes. The second is used to adjust the pressure within the system, via the squeeze bulb, to obtain an optimal recording signal. This allows changes to be made throughout the session as needed if conditions warrant. To use the belt, secure it around the lower abdomen of the subject using the Velcro strap; the air bladder should be in front. Note the value of the trace in the Respiratory box at the bottom of the main form. The belt's strap should be tightened when the subject has breathed out so that it fits comfortably. After the subject is positioned on the MRI gurney, open the valve on the squeeze bulb, pump air into the belt's bladder and then close the valve. Have the subject exhale and hold; open the valve on the squeeze bulb until the trace comes back down or close to baseline. This setting should now allow optimal recording of respiration.

Figure 7.



The "trigger" signal (AI2; connection not shown) is also on the J2/P2 connector. The "output" signal (AO1; connection not shown) is on the J1/P3 connector. Both signals are TTL signals. All connection are made via BNC connectors mounted on the back of the instrument. Duration of the signals is specified in the Setup.config file. A value of 50 (50 msec) is probably an optimal value. Lower durations may be possible, depending on the MRI. It should be noted that the "output" signal commences prior to the activation of the odor valve. This means that if the duration was set for 1000, the "output" signal would come on, remain on for 1 sec, terminate,

and then the odor valve would be activated. Selecting a duration of 50 would mean that the output signal would go on 1/20 of a second before the odor valve was activated.

The "trigger" signal (AI2; connection not shown) is also on the J2/P2 connector. The "output" signal (AO1; connection not shown) is on the J1/P3 connector. Both signals are TTL signals. All connection are made via BNC connectors mounted on the back of the instrument. Duration of the signals is specified in the Setup.config file. A value of 50 (50 msec) is probably an optimal value. Lower durations may be possible, depending on the MRI. It should be noted that the "output" signal commences prior to the activation of the odor valve. This means that if the duration was set for 1000, the "output" signal would come on, remain on for 1 sec, terminate, and then the odor valve would be activated. Selecting a duration of 50 would mean that the output signal would go on 1/20 of a second before the odor valve was activated.

Pin configuration for the LabJack (J2/P2)

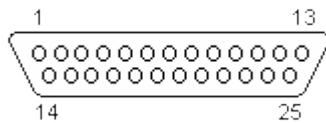
Table 1.

Function	LabJack Pin Label	
Amplified breathing trace	AI0	From pressure transducer
	AI1	
Ground	GND	GND from pressure transducer
Trigger Input	AI2	(from MRI to start program; plus GND)
	AI3	
	GND	(GNDfor MRI trigger)
	AI4	
	AI5	
	GND	
	AI6	
	AI7	
Ground	GND	GND from 5 vdc power supply of transducer
	+5V	
	+5V	
	CAL	

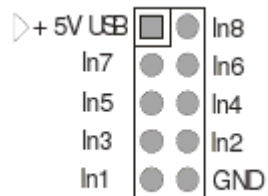
Pin config for the LabJack (J1/P3)**Table 2.**

Function	LabJack Pin Label	
	IO0	
	IO1	
	GND	
	IO2	
	IO3	
	GND	
	AO0	
Marker (TTL) out with Start and each stimulus	AO1	To MRI
	GND	(for MRI marker)
	CNT	
	GND	
	5 VDC	
	5 VDC	
	STD	
	NC	

Pin configuration for the 25-pin output to relay driver boards



DB-25 Male
to 10 pin box header -female



The cable plugs into the Elexol ULN2803 switch boards. Note that the upper left pin (+5VUSB, the one in the square) corresponds to the bottom left pin on the switch board (the one in the square). The above pin labels are used in the table below for the configuration.

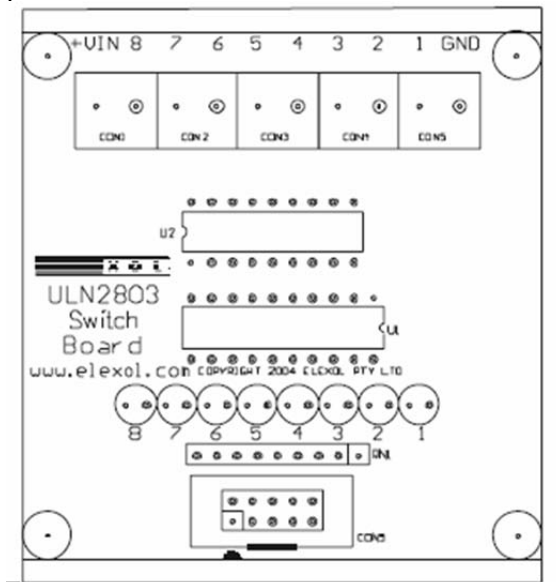


Table 3. Lines from Labjack to Elexol ULN2803 switch boards

Function	DB-25 Male	10 pin box Header Female #1	10 pin box Header Female #1
channel 1	1	In1	
channel 2	2	In2	
channel 3	3	In3	
channel 4	4	In4	
channel 5	5	In5	
channel 6	6	In6	
channel 7	7	In7	
channel 8	8	In8	
NC	9		
+5V	10	+5VUSB	
+5V	11		+5V USB
+5V	12		
+5V	13		
GND	14	GND	
GND	15		GND
GND	16		
GND	17		
channel 9	18		In1
channel 10	19		In2
channel (11)	20		In3
channel (12)	21		In4
channel (13)	22		In5
channel (14)	23		In6
channel (15)	24		In7
channel (16)	25		In8

Switch Board Outputs

The switch board is connected to the solenoids



Table 4. Elexol ULN2803 switch board to solenoids

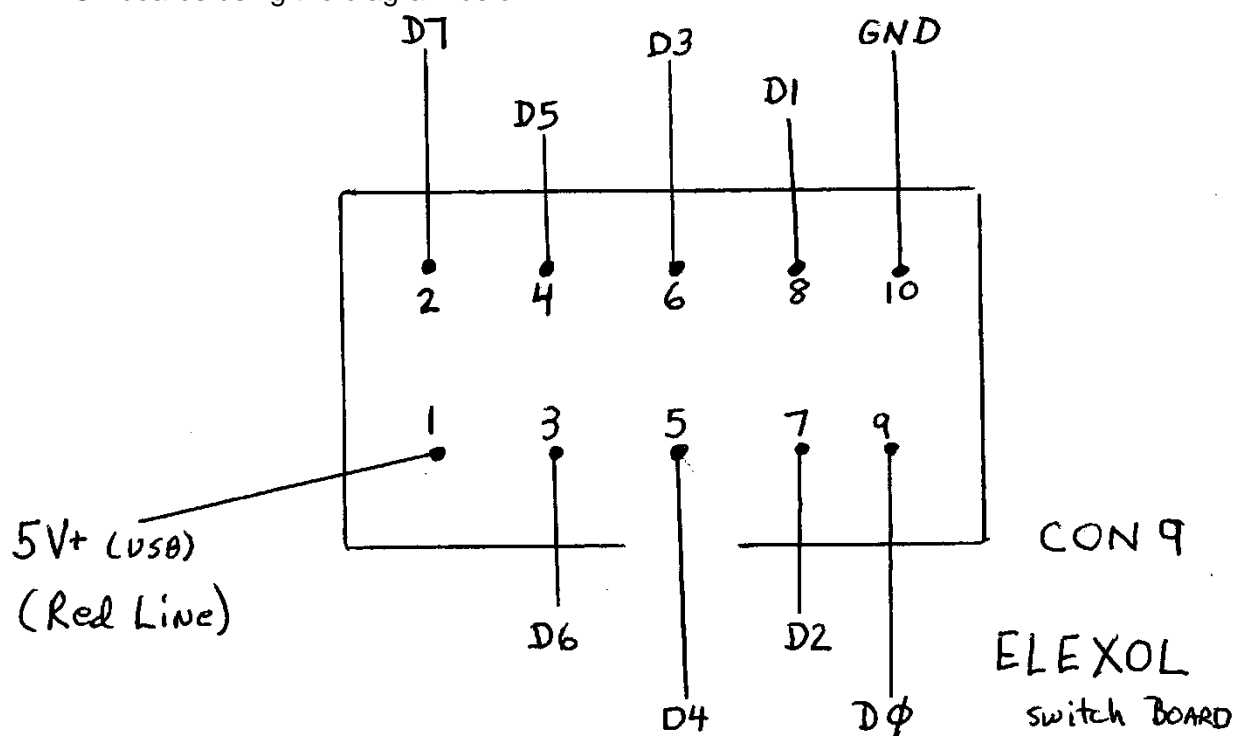
Connect To	Switch Board #1	Switch Board #2
Power for Solenoids 1-8	+VIN	
Ground for Solenoid For Ch8	8	
Ground for Solenoid For Ch7	7	
Ground for Solenoid For Ch6	6	
Ground for Solenoid For Ch5	5	
Ground for Solenoid For Ch4	4	
Ground for Solenoid For Ch3	3	
Ground for Solenoid For Ch2	2	
Ground for Solenoid For Ch1	1	
	GND	
Power for Solenoids 9-16		+VIN
Ground for Solenoid For 9		8
Ground for Solenoid For 10		7
Ground for Solenoid For 11		6
Ground for Solenoid For 12		5
Ground for Solenoid For 13		4
Ground for Solenoid For 14		3
Ground for Solenoid For 15		2
Ground for Solenoid For 16		1
		GND

Control of the fMRI Olfactometer by E-prime or Presentation via the parallel port

Often a laboratory will already be using a standard software program such as E-prime® (Psychology Software Tools, Inc.) or Presentation® (Neurobehavioral Systems, Inc.) to control the stimuli in a fMRI study. If Presentation® is being used, it can control the olfactometer directly via the LabJack U12-PH board since it can interface with National Instrument drivers. E-prime® programs control external devices by signals sent via the parallel port. By unplugging the cables going to the Elexol ULN2803 switch board (#1) from the LabJack U12-PH and plugging in the cables coming from the DB25 connector, the solenoid valves controlling the presentation of odor stimuli will be directly and entirely controlled by the external software programs. This includes all timing parameters. Examples written in E-prime® for controlling the valves are located in the folder called "Documentation for E-prime®" in a folder call "E-prime® examples. Note: Only outputs 0-7 can be controlled. This means only seven valves (plus the makeup air valve) can be controlled; no vacuum line. Also, a 5 vdc power supply must be connected to the DB25 cable via the black and white (5vdc) twisted pair to power the controller cards in this mode.

Control of OLFACT fMRI via parallel port

Control of the OLFACT fMRI via parallel port is accomplished using an ELEXOL I/O 24 ULN2803 Switch Board. A 25 line cable is connected to the 10 pin connector (CON9) on the ELEXOL boards using the diagram below.



CON9 Pin#

1	5V+ (USB)
2	D7
3	D6

white, external power supply
controls solenoid valve 8
controls solenoid valve 7

4	D5	controls solenoid valve 6
5	D4	controls solenoid valve 5
6	D3	controls solenoid valve 4
7	D2	controls solenoid valve 3
8	D1	controls solenoid valve 2
9	D0	controls solenoid valve 1
10	GND	ground from external power supply

Software control of the ELEXOL I/O board is accomplished through E-prime® by using the "WritePort" command, e.g., WritePort &H378, 0, with the last digit indicating the valve to be turned on. Note: to open a valve, two valves must be turned on—valve 10 (normally open valve, now output 7) one valve from valves 1-7 (normally closed valves). The actual value will depend on whether one is using binary or decimal notation. Please see the accompanying E-prime® program examples to further see how valves are turned on and off.

Osmic_parallel_current.ebs2
Osmic_parallel_current.ebs2
Osmic_parallel_toggle.ebs2
Osmic_parallel_toggle.ebs2

E-prime® (from E-prime® manual)

Send a Signal to an External Device

Support for sending a signal to an external device (e.g., another machine, EEG) is available in E-Prime via port communications or through writing your own Windows DLLs.

For port communications, a small amount of script must be used in an InLine Object. To send a signal to the port, you should use the WritePort command in an Inline in your experiment. The parameters for WritePort are as follows:

WritePort address, value

The address of your port can be found by selecting "System" from the Windows Control Panel, clicking on the Device Manager tab, and navigating to Ports. Select the parallel (LPT or printer) port, click the Properties button, and select the Resources tab. The address of the currently accessible port will be shown.

In the WritePort command, the port address may be specified in decimal or hexadecimal notation. Please refer to the Val function in the E-Basic Help file for further explanation. When using hexadecimal notation, E-Basic requires "&H" to be inserted prior to the address:

WritePort &Haddress, value

The most common parallel port address is (in decimal) 888, which translates in hexadecimal notation to 378. However, we strongly recommend that you refer to your own System properties to find the available port address on your own machine.

You must also remember that, when writing to the parallel port, you are sending 8 bits of data at once. For the WritePort command, the value parameter is translated into binary notation to determine the bit pattern. Since this binary representation corresponds to a specific bit representation, you must send a value which translates (in binary) to send the appropriate bit representation. Essentially, you should write a "1" to any bit whose corresponding pin you wish to turn "on." A "0" is written to any bit whose corresponding pin you wish to turn "off". If you were to send all "0"s to the port, the binary notation for this would be 00000000. To send a signal to bit number '2', the binary notation would translate to 00000010. The bit pattern then corresponds to the pin connections. Bits are either 0-based or 1-based. Pins are always 1-based.

******* Please Note: The first available bit to pin connection begins at bit number 1 and at pin number 2. You cannot send a signal to pin number one.*******

Therefore, if you wanted to turn on bit number one on a 1-based bit pattern, and leave the rest off, you would send a signal of "1" to pin 2, and a signal of 0 to pins 3-9. In binary notation, this would be written as 00000001. In decimal or hexadecimal notation, this would translate to "1". If your port address were (in hexadecimal) 378, the Write Port syntax for this would be:

WritePort &H378, 1

Bit to pin mapping is relatively standard for the parallel port. Please refer to documentation for your hardware and/or port address for a mapping of bits to pins.

E-Prime is capable of sending a signal to the port for interfacing with an external device. The receipt and handling of the signal by the other machine is the responsibility of the user. With the WritePort command, E-Prime may be used to trigger an event (e.g., signal an external device to begin data acquisition) or notify an external device of an event (e.g., in order to mark the event in the data collected by the external device).

When sending more than a TTL pulse to the port, you must write your own Windows DLLs. The only information and/or support PST can offer is to direct you to the DECLARE statement in E-Basic Help. Essentially, you can bring the library of calls from into E-Prime by copying and pasting them into the User script of your experiment. In doing so, you will likely no longer use E-Prime's "WritePort" command for port communications, but will rather use the specific commands you have imported. Writing Windows DLLs is best done by a professional programmer, and is beyond the scope of PST's support for E-Prime.

NOTE : Since the computer does a check of the parallel port during power on, turning pins on and off, the fMRI should be disconnected from the box until the E-prime program is run.

Loading of Odorants into Odor Reservoirs

The actual selection of the odorants used in the fMRI olfactometer is entirely dependent upon the experimental protocol being employed. Once they have been selected, odorants are loaded into the odor reservoir vials (ORV). The ORV are 20 ml vials containing an absorbent material to sequester the liquid and to provide a greater surface area for faster headspace equilibrium. Most vials shipped contain absorbent that has an affinity for oils; absorbent material for water-based odorants is available.

The lids on the ORV contain two barb fitting for 1/8" tubing. The inlet port has a #14 Teflon tube insert that extends into the vial to promote mixing of the incoming air with the headspace. A good way to load the ORV is via a ~10 ml transfer pipet. Five to seven mls of the odorant should be placed into the ORV. **After loading of the odorant, it is extremely important that the lid be closed tightly; otherwise, the integrity of the airflow system is disrupted.** The vial can be reused, after proper cleaning, but in most cases only for the same odorant. If a new odorant is to be introduced in the system, a new vial, Teflon tubing and check valve should be used.

Figure 8. (ORV without absorbent)



Delivery of Odor Stimuli to Subject

There are several ways to deliver the odorant stimuli to the subject in the MRI magnet: by a modified oxygen cannula or by an oxygen mask. An oxygen mask may be preferred by some, but being made out of plastic, they can absorb and retain odors, especially if the odors are "sticky". This problem can be minimized by first spraying the mask with a Teflon spray. If required, there is also a line in the olfactometer that is configured to serve as a vacuum line that allows evacuation of odors that linger in the mask (see page 8).

The preferred method is to deliver the stimuli via a modified oxygen cannula. In this method, the odorized air does not flow through the plastic cannula. Instead, the odorized air enters the nostrils via Teflon tubes that have been inserted inside the tips of the cannula (see Figures 9a. and 9b.). The cannula is fitted in the usual manner (over the ears, behind the head), but it's only purpose is to hold the Teflon tubes in place.

Figure 9a.



Figure 9b.



fMRI Psychophysics Software

Unlike auditory or visual stimuli, olfactory stimuli are very difficult to generate and quantify--especially quantify. Once the olfactory stimuli have been selected, one needs to be able to quantify the stimulus. Although gas chromatographs and photoionization detectors are used for this purpose, they are 1) expensive and not usually available; and 2) do not measure "smell" directly, only some analog associated with it. Consequently, quite often the best way to quantify smell is by psychophysical measures--how the individual perceives the smell.

The fMRI Psychophysics program does this task. It presents an odorant to a subject for four seconds and then asks them to rate it on two dimensions: 1) how intense is it (strength) (Figure 10); and how pleasant (not shown)? Each scale is a Likert scale of 1-10; the subjects responses are stored for analyses in a file on the computer (C:\Psychophysics\Data). By using the subjects responses, the olfactory stimuli can be adjusted until they meet the researchers requirements. (If different parameters are of interest, the labels on the scales can be changed, e.g., from "Pleasantness" to "Familiarity".

Figure 10.

The screenshot displays the 'Odors 1 - 8' window of the fMRI Psychophysics Software. The interface includes a 'Return to Menu' button, a 'Click on a button to present an aroma' instruction, and a 'Check for Rating Scales' checkbox. A grid of buttons labeled 'odor 1' through 'odor 8' is visible. To the right, an 'Intensity' scale is shown with a vertical list of numbers from 1 to 10, each in a yellow box. The number '1' is currently selected in the intensity scale. The window title bar shows 'Form1' and 'fMRI Psychophysics'.

Setup of fMRI Psychophysics 6 odor program

Note: This is the setup for a 6 odor olfactometer; the actual file names will change for different configurations.

1. Copy the folder "Psychophysics" to Drive C:
2. Copy "Project Shell fMRI Psychophysics 6 odors" application program to Desktop
3. To run the program, click on "Project Shell fMRI Psychophysics 6 odors".

The first page collects subject demographics.

Select both check boxes to advance to the program.

The subject is presented with 6 buttons (1-6). When a button is selected, the odor is presented for 4 sec. If the "scales" option is selected, after the odor is presented the subject is asked to rate the odor stimulus first on intensity and then on "how pleasant". If the "scales" option is selected, the subject's responses are stored in a file in the folder "Psychophysics\Data

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