Instruction for Use

LabBench I/O

- Response and stimulus device that is intended for psychophysical experiments

LABBENCH

LABBENCH

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CE

The product complies with the directives:

- EMC Directive (2004/108/EC)
- RoHS 2 (2011/65/EU)

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Important Safety Notice:

LabBench I/O is designed for research use only. Inventors' Way ApS does not condone the use of the LabBench I/O device for clinical/medical applications. LabBench I/O and accessories provided by Inventors' Way ApS are not intended to diagnose, mitigate, treat, cure, or prevent disease.

The LabBench I/O device is designed for biophysical measurements within research. Please ensure that only qualified, adequately trained scientists use the device.

1 TABLE OF CONTENTS

2 INTRODUCTION

The LabBench® I/O is a response and stimulus device that is intended for psychophysical experiments. With this device, you can collect responses for threshold estimation with LabBench® Response devices.

3 INTENDED USE

The LabBench I/O system is intended for use by scientists within the field of neuroscience to study psychophysical experiments.

The LabBench I/O system is intended to be used for experimental protocols that are under ethical review/approval as potentially one out of several methods to investigate human pain perception.

4 USE LIMITATIONS

The LabBench I/O system is **NOT** to be used for the following:

- Experimental protocols where measurements from the system are used in decisions regarding medical treatment of an experimental subject.

5 OPERATING PRINCIPLE

The LabBench I/O device can control stimulators with analogue waveforms (STIMULATOR A) and/or a digital trigger (STIMULATOR T). This analogue waveform and the digital trigger can be used to control electrical stimulators such as the Digitimer DS5 stimulator (STIMULATOR A) or the Digitimer DS8R stimulator (STIMULATOR A + T). However, any stimulator controlled by an analogue voltage/digital trigger can be controlled by the LabBench® I/O device.

The device can generate triggers (D00-D15 and Trig OUT) to external equipment such as EEG amplifiers or data acquisition cards such as National Instrument DAQmx cards.

Stimulus and trigger generation can be triggered either from external software by the USB Connection, external equipment through the trigger (TRIG IN), an auditory or vibrotactile stimulus with a LabBench® ATRIG device, or a visual stimulus with a LabBench VTRIG device connected to the response ports of the LabBench I/O.

The response ports also allow the experimenter to connect psychophysical rating devices, response pads or buttons for forced choice or yes/no response tasks, respectively. Sensor devices such as feedback assisted handheld and cuff pressure algometers can also be connected to the response ports of the device.

6 INTENDED USER

The intended user is a research professional within neuroscience that has a minimum of training equivalent to the bachelor's level or is under close supervision of a research professional with this level of training.

7 WARNINGS AND SAFETY INSTRUCTIONS

7.1 WARNINGS

1. Do not use the LabBench I/O Device or accessories if there is visible damage to their enclosures; otherwise, the subject or experimenter may be at risk of electric shocks.
2. Do not use any cables with visible damage; otherwise, the subject or experimenter may be at risk of electric shocks.
3. If the LabBench I/O system is used outside its intended use, the protection offered to the subject and experimenter by the equipment may be impaired.

7.2 PRECAUTIONS

1. When using the device, please make sure that the power supply cables supplying the equipment is connected to protective ground; otherwise, the subject or experimenter may be in risk of electric shocks.
2. Only use the device while the subject is sedentary; otherwise, the subject may be in risk of falls or pulling on the equipment.
3. Please ensure that only qualified, adequately trained scientists are operating the device or that they are closely supervised during its operation.
4. Only use LabBench I/O in lighted indoor conditions.
5. Protect all parts of the device from contact with water.
6. Do not store LabBench I/O where temperatures may exceed: +10 to +40 °C.
7. Do not use LabBench I/O where temperatures may exceed: +10 to +30 °C.
8. Do not transport LabBench I/O in temperatures that may exceed: -20 °C to +60 °C
9. Do not attempt to repair or modify LabBench I/O, as it is not designed to be serviced and/or repaired other than by the manufacturer. In case of a malfunction/technical problem, please return LabBench I/O to Inventors' Way ApS.
10. Do not install the device close to magnetic field generators.

8 PRODUCT DESCRIPTION

This section provides a description of the connections that available on the LabBench I/O device and its status indication.

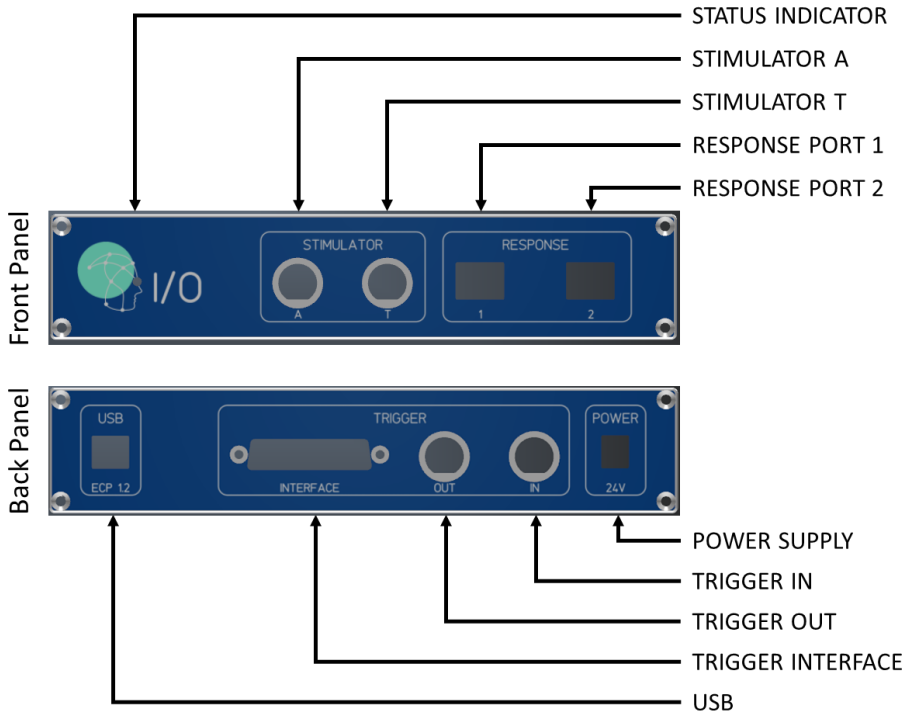


Figure 1: Illustrations of the connectors and indicators on the front and back panel of the LabBench I/O device. The STATUS INDICATOR is tricolour indicator (GREEN, RED, YELLOW) that informs the user of the current operating mode of the system.

Front panel connectors:

Connector	Type	Description
STIMULATOR A	OUT	An analog output that can provide a control signal to external stimulators. This analog signal can be specified either as piecewise linear segments or as a series of samples.
STIMULATOR T	OUT	Can provide TTL trigger pulses to external stimulators.
RESPONSE PORT 1/2	IN/OUT	General purpose response ports to which response devices such as rating scales, response buttons, auditory and visual triggers can be connected. *Note: please see section 8.2 for a further description of the response ports and devices that can be connected to it.*

Back panel connectors:

Connector	Type	Description
POWER SUPPLY	DC socket	24V Power to the device.

Connector	Type	Description
TRIGGER IN	IN	Can accept TTL triggers that can trigger generation of analog output signals and trigger sequences.
TRIGGER OUT	OUT	Can provide TTL trigger pulses to external equipment; data acquisition card (such as NI DAQmx), EEG Amplifiers, and similar.
TRIGGER INTERFACE	OUT	A general-purpose INTERFACE port that can provide power to external equipment, measure analog signals, and provide up to 16-bit contextual triggers to external equipment such as EEG amplifiers.
USB	Digital	Allow for control of and data collection from the LabBench I/O device. The USB connection is a virtual serial port with the ECP communication protocol. *Note: for a details regarding implementation ECP communication protocols please refer to: https://github.com/Inventors-Way/Inventors.ECP. The specification of the ECP protocol for the LabBench I/O device please refer to [IOL-61-006-DOC Software Interface Description] document.*

Operating modes:

Mode	Description	Indication
IDLE:	The device is turned on without performing a stimulation.	STATUS INDICATOR will display a solid GREEN light.
ACTIVE:	The device is generating stimulus analog output and/or trigger sequence.	STATUS INDICATOR will display a solid YELLOW light.
PENDING:	A stimuli and triggers are awaiting trigger signal before they are being generated. *Note: the device can be configured to be triggered by a HIGH pulse on TRIGGER IN or an event that is received from a response device connected to RESPONSE PORT 1 or 2.*	STATUS INDICATOR will be blinking YELLOW.
ERROR:	A device or configuration error. *Note: two faults may trigger the error state; 1) 24V power has not been connected to the device, or 2) the required response devices has not been connected to the RESPONSE PORTs.*	STATUS INDICATOR will display a solid RED light.

8.1 STIMULUS GENERATION

This system is intended to control external stimulators working in one of three modes: ANALOG MODE, ANALOG TRIGGERED MODE, or TRIGGERED MODE. Below is a description of how LabBench I/O can be used to control external stimulators working in one of these three modes:

Mode	Description
ANALOG MODE	External stimulators that operate in ANALOG MODE are controlled by an analogue voltage (STIMULATOR A), meaning that its output will be proportional to an analogue input signal. The digital output (STIMULATOR T) in Stimulus Ctrl is unused in this mode. An example of such a stimulator is an electrical stimulator that works as a voltage-controlled current source (VCCS). This is the case for the DS5 stimulator from Digitimer or the NoxiSTIM from NoxiTEST. The ANALOG MODE provides the highest degree of computer control of the stimulus, and thus the greatest control capabilities for the experimenter.
ANALOG TRIGGERED MODE	External stimulators operating in an ANALOG TRIGGERED MODE is still controlled by an analogue voltage. However, the analogue voltage (STIMULATOR A) is a DC voltage that only controls the intensity of a predefined stimulus. This predefined stimulus is generated each time the stimulator is triggered by a digital trigger (STIMULATOR T). An example of such a stimulator is the DS8R stimulator from Digitimer.
TRIGGERED MODE	In this mode, LabBench I/O cannot control the intensity of the stimuli generated by the external stimulator, but only the timing of the stimuli by providing triggers to the stimulator (STIMULATOR T). The analog output (STIMULATOR A) is unused in this mode. The intensity for this type of stimulator is typically set manually by a control on the stimulator. An example of this type of stimulator is the DS7 stimulator from Digitimer.

Analog voltages on the STIMULATOR A output can be generated with either Stimulus Programs or Stimulus Waveforms. Triggers on the STIMULATOR T, TRIGGER OUT, and TRIGGER INTERFACE connectors can be generated with trigger sequences.

8.1.1 STIMULUS PROGRAMS

Analog voltages on the STIMULATOR A output can be generated with stimulus programs. Stimulus programs can be constructed as a combination of rectangular pulses and ramps, consequently, they can consist of stimuli that can be represented by piecewise linear segments. Internally in the LabBench I/O device, this is implemented with an interpreter that execute simple programs, consisting of a sequence of three instructions:

- STEP: that change the output voltage to a set value.
- INC: that for each update cycle increase the voltage with a specified amount.
- DEC: that for each update cycle decrease the voltage with a specified amount.

These programs can consist of up to 256 instructions, and are intentionally simple, as the absence of jump instructions prevents infinite loops from occurring. With these instructions you can construct waveforms that consists of piecewise linear segments, as shown in the example below:

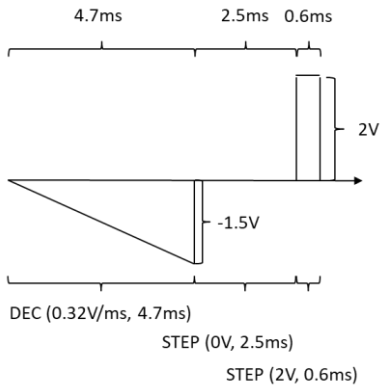
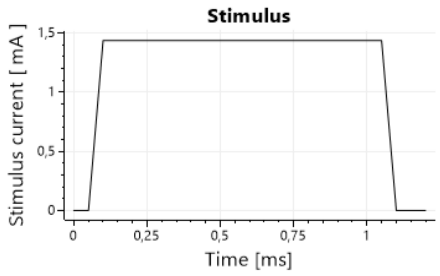


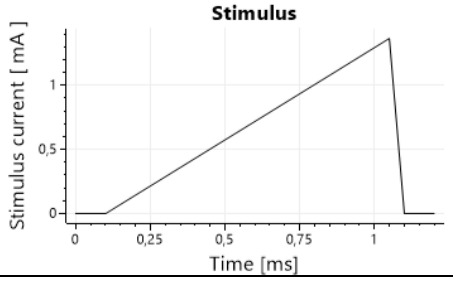
Figure 2: Illustration of a stimulus program that generates a conditioned pulse for perception threshold tracking, which can be used to study the recovery cycle of nerve fibres.

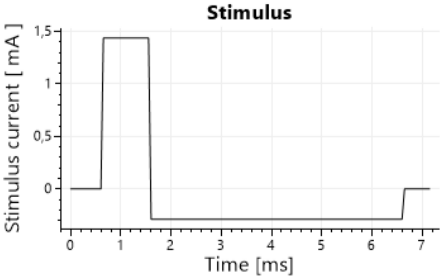
A stimulus program that generates a rectangular pulse that is conditioned by a ramp is shown in **Figure 2**. This program consists first of a DEC (0.32V/ms) instruction that generates the conditioning ramp, a STEP (0V, 2.5ms) that sets the voltage to zero and generates an inter-stimulus-interval of 2.5ms, followed by a STEP (2V, 0.6ms) that generates the rectangular pulse.

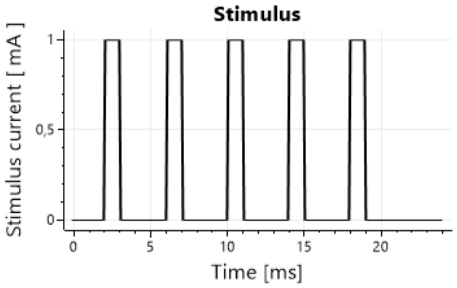
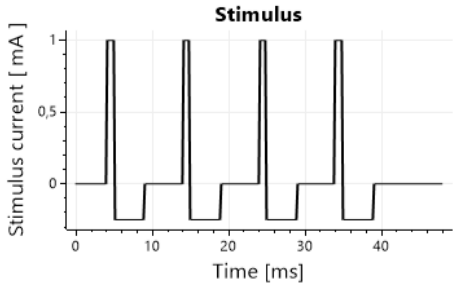
However, the complexity of creating analog waveforms with these instructions is hidden when the LabBench I/O device is controlled from LabBench. With LabBench analog waveforms can be constructed from high-level declaration of a stimulus with the following elements:

Element	Example	Waveform

pulse	`<stimulus>`
	`  <pulse Is="x"`
	`  Ts="1"`
	`  Tdelay="0" />`
	`</stimulus>`
	
	`Program length: 1 instruction`
		

ramp	`<stimulus>`
	`  <ramp Is="x"`
	`  Ts="1" />`
	`</stimulus>`
	
	`Program length: 1 instruction`
	
	Note: if Tdelay is not specified it assumed to be 0.
		

combined stimuli	`<stimulus>`
	`  <combined>`
	`  <pulse Is="x"`
	`  Ts="1" />`
	`  <pulse Is="-x/5"`
	`  Ts="5"`
	`  Tdelay="1"/>`
	`  </combined>`
	`</stimulus>`
	
	`Program length: 2 instructions`
		

Element	Example	Waveform
repeated stimuli	<stimulus> <repeated Tperiod="4" N="5"> <pulse Is="x" Ts="1"/> </repeated> </stimulus> Program length: 9 instructions	
nested stimuli	<stimulus> <repeated Tperiod="10" N="4"> <combined> <pulse Is="x" Ts="1" /> <pulse Is="-x/4" Ts="4" Tdelay="1" /> </combined> </repeated> </stimulus> Program length: 11 instructions	

LabBench uses a text format termed XML, which is what is used above to specify the Stimulus Programs. XML stands for "eXtensible Markup Language." and is a markup language designed to store and transport data in a structured format. In XML, data is represented using tags enclosed in angle brackets (< and >) and attributes to these tags.

To explain this format, we will provide an explanation of the first example above:

```
<stimulus>
   <pulse Is="x"
          Ts="1"
          Tdelay="0" />
</stimulus>
```

Which defines a single rectangular pulse. This example consists of the `<stimulus>` and `<pulse>` elements, where the `<pulse>` element has three attributes named `Is`, `Ts`, and `Tdelay`. The code examples above are snippets from a much larger LabBench configuration file, which define the complete protocol for an experiment.

8.1.2 STIMULUS WAVEFORMS

If a stimulus cannot be described as a combination and repetition of pulse and ramp stimuli, then it is encoded as a Stimulus Waveform when it is sent to the LabBench I/O device. When a stimulus is encoded as a Stimulus Waveform it is converted to an array of analog values, which can if needed be repeated with a given period and offset. Stimulus Waveforms may contain up to 1000 analog values.

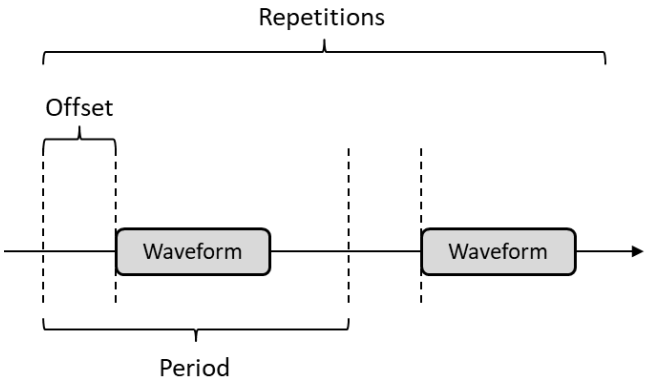
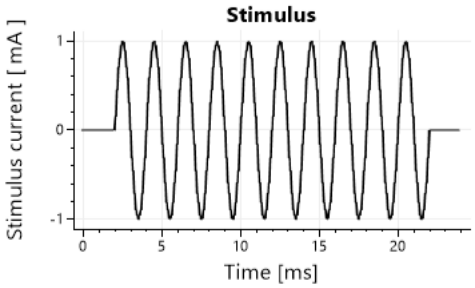
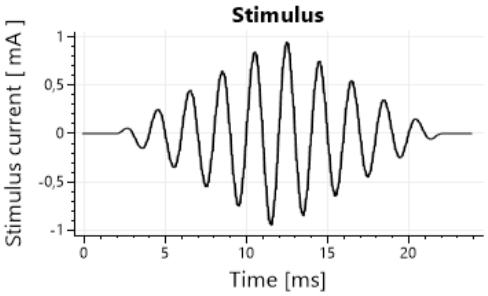


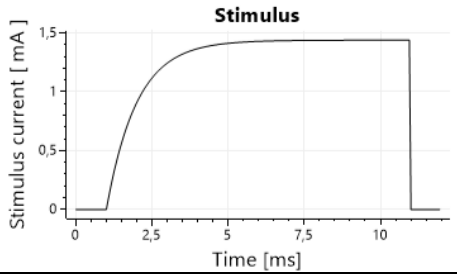
Figure 3: Illustration of a stimulus waveform that is repeated with an offset.

Like for Stimulus Programs, Stimulus Waveforms can be expressed in the LabBench xml format:

Element	Example	Waveform

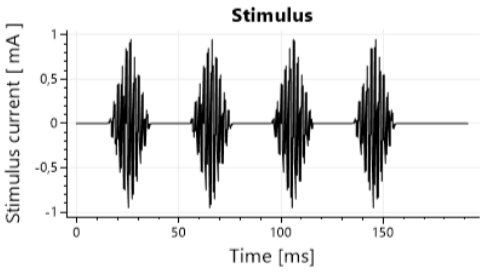
sine	`<stimulus>`
	`  <sine Is="x"`
	`  Ts="20"`
	`  Frequency="500"/>`
	`</stimulus>`
		

window	`<stimulus>`
	`  <window window="Bartlett"`
	`  parameter="0.5">`
	`  <sine Is="x"`
	`  Ts="20"`
	`  Frequency="500"/>`
	`  </window>`
	`</stimulus>`
	
	The window stimulus is a decorator, meaning it can only be used to contain other stimuli. All stimuli within the window will be windowed with the specified window function.
		

arbitrary	`<stimulus>`
	`  <arbitrary`
	`  expression="x * (1 - exp(-t))"`
	`  Ts="10"/>`
	`</stimulus>`
		

repeated waveform

```
<stimulus>
   <repeated N="4"
             Tperiod="40"
             Tdelay="5">
      <window window="Bartlett"
              parameter="0.5">
         <sine Is="x"
               Ts="20"
               Frequency="500"/>
      </window>
   </repeated>
</stimulus>
```



Please note that Stimulus Waveforms may also contain linear stimuli (pulse and ramp), however, the inclusion of one or more non-linear stimuli, will cause the whole stimulus to be encoded as a Stimulus Waveform.

8.1.3 TRIGGER SEQUENCES

Precisely timed sequences of triggers can be generated on the STIMULATOR T, TRIG OUT, and TRIGGER INTERFACE ports with the use of trigger sequences. Trigger sequences consists of a series of TRIGGER INSTRUCTIONS that each contains the following information:

- TRIGGER INTERFACE VALUE: What is the 16-bit value that should be set on the TRIGGER INTERFACE port while the instruction is active.
- TRIGGER OUT VALUE: The value that should be set on the TRIGGER OUT port while the instruction is active.
- STIMULUS TRIGGER VALUE: The value that should be set on the STIMULUS TRIGGER while the instruction is active.
- DURATION: The duration of the trigger instruction

The LabBench I/O can generate trigger sequences with up to 128 trigger instructions. However, as with Stimulus Programs and Waveforms LabBench provide a high-level specification of trigger sequences that hides the complexity of trigger instructions.

```
<combined-triggers>
   <trigger duration="1">
       <code output="Code" value="64" />
   </trigger>
   <repeated-trigger Tperiod="50" N="4">
       <repeated-trigger Tperiod="4 * x" N="5">
          <trigger duration="x">
             <code output="Digital" value="1" />
             <code output="Stimulus" value="1" />
          </trigger>
       </repeated-trigger>
   </repeated-trigger>
</combined-triggers>
```

With this XML format it is possible to construct trigger sequences from logical decorators such as `<combined-triggers>` and `<repeated-trigger>`, and trigger instructions `<trigger>` which contains subelements

<> that specify the outputs that should be generated on the STIMULATOR A (Stimulus), TRIGGER OUT (Digital), and TRIGGER INTERFACE (Code) ports.

The example above will generate a 16-bit contextual trigger (64) to an EEG amplifier, in parallel with a trigger sequence on the STIMULATOR A and TRIGGER OUT ports that consists of a burst of 5 pulses with a period of 5ms, which is repeated 4 times with a period of 50ms. The bursts are started with a delay of 20ms after the generation of the 16-bit trigger to the EEG amplifier.

8.2 RESPONSE PORT

The response port is an open standard that allow several types of response devices to be connected to the LabBench I/O. Physically the response port is a 10-pin RJ50 connector, which contains reserved pins and general-purpose pins. When no response device is connected to the port, the RESPONSE PORT is in an unconfigured state that makes it safe to connect any response device to the port.

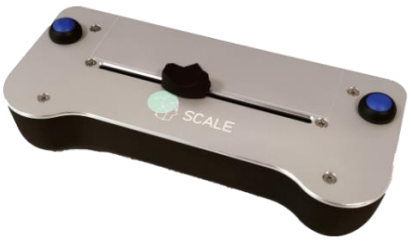
Once a response device is connected to the port, the class of response device is automatically detected and the port is configured by the LabBench I/O to the requirements for that class of response device. Some classes of response devices are further subdivided into subclasses; however, LabBench I/O treats all subclasses of response devices equally, and the subclass is only provided so PC software may know how to interpret the data from a given response device subclass.

Response devices provide the LabBench I/O with extensive and versatile response collection capabilities, and is based on the following classes of response devices:

Class	Subclasses	Description
Analog Scale Device (ASD)	N/A	Analog scale devices are response devices that allow a subject to rate a sensation on a psychophysical rating scale, such as visual analog scales, numerical rating scales, categorical scales, or similar. These devices also allow subjects to mark events with two response buttons.
Digital Response Device (DRD)	N/A	Digital response devices are a general-purpose response device class in which the response device is controlled with the ECP serial communication protocol. This class is included to allow highly complex response devices to be implemented in the future, for which simple analog and digital signals do not suffice for their control and data collection.
Response Button (BTN)	N/A	Response devices that consist of a single push button, which can be used to determine psychophysical thresholds or mark events in an experimental protocol.

Class	Subclasses	Description
Analog Response Device (ARD)	N/A	Response devices that can provide visual indications to a subject and allow them to press a button for each indicator. This can be used to implement for example forced choice response paradigms for adaptive estimation of psychometric thresholds and functions.
Stimulus Sensor (SEN)	Algometer	Feedback Assisted Handheld Pressure Algometers. *Note: feedback assisted algometry provides a display to experimenter of how close the actual applied pressure is to the correct pressure to apply.*
	Cuff Algometer	Feedback Assisted Cuff Pressure Algometers.
	Temperature	Temperature sensors for measurement of skin temperature in nerve excitability studies and similar experimental protocols.
Trigger Device (TRG)	Visual	Response devices that can generate triggers from visual stimuli that are presented on computer monitors, tablets, etc.
	Auditory	Response devices that can generate triggers from auditory stimuli.

Currently, the following types of response devices are available for the LabBench I/O device:

Device	Class	Description
LabBench SCALE	ASD	The LabBench SCALE is a psychophysical rating device where the subject can rate a sensation on scales such as visual analog scales, numerical rating scales, categorical rating scales and similar. The scales are experimenter defined.  The subject can mark events and thresholds with two response buttons.

Device	Class	Description
LabBench RESPONSE	BTN	The LabBench RESPONSE is a response pad consisting of two response buttons and two indicators, one above each response button.  This response pad allows for two-interval-two-alternative forced choice response tasks in adaptive estimation algorithms for psychometric thresholds and/or functions.
LabBench BUTTON	ARD	The LabBench BUTTON is a simple, ergonomic, one button response device, which can be used in yes/no response tasks. 
LabBench ATRIG	TRG	The LabBench ATRIG device is a passthrough device that can convert an analog signal to a digital trigger when the analog signal exceeds a threshold value. This can be used to generate precisely timed triggers from auditory stimuli, or from the controls signal for a vibrotactile stimulator, such as for example the Tactor vibrotactile stimulator from Engineering Acoustics.
LabBench VTRIG	TRG	The LabBench VTRIG device uses an optical sensor to convert visual stimuli to digital triggers.
LabBench PSENSE	SEN	The LabBench PSENSE device is a device that contains a pressure sensor which can either be used for calibration of LabBench CPAR+ devices or for feedback-assisted cuff pressure algometry.

At the time of reading this manual there may be more response devices available. For a current list of available response devices please refer to the product list on the labbench.io website.

As the response port is an open standard, it is also possible for researchers with a technical background to implement their own custom response devices, which will work with the LabBench I/O device. If you wish to implement your own custom response device, then please refer to the [LAB-10-008-DOC Interface Design Description (RESPONSE)] document.

8.3 TRIGGER IN/OUT

The LabBench I/O contains a 1-bit trigger input (TRIGGER IN) and output (TRIGGER OUT). The trigger input can be used to start generation of stimulus programs/waveforms and trigger sequences and can be used to timestamp events that are received from response devices.

Examples of events from response devices are events such as the reception of auditory or visual triggers, button pressed, or similar events.

The TRIGGER OUT trigger output is controlled with trigger sequences.

8.4 TRIGGER INTERFACE

The primary function of the TRIGGER INTERFACE port is the generation of up to 16-bit contextual triggers for external recording equipment such as EEG amplifiers. However, the TRIGGER INTERFACE port also contains functionality for powering external equipment and sampling analog signals.

The TRIGGER INTERFACE port contains the following signals:

Pin	Name	Digital	Analog	Specification
1	Trig_Data_07	DOUT	NA	Trigger data bit 7.
2	Trig_Data_06	DOUT	NA	Trigger data bit 6.
3	Trig_Data_05	DOUT	NA	Trigger data bit 5.
4	Trig_Data_04	DOUT	NA	Trigger data bit 4.
5	Trig_Data_03	DOUT	NA	Trigger data bit 3.
6	Trig_Data_02	DOUT	NA	Trigger data bit 2.
7	Trig_Data_01	DOUT	NA	Trigger data bit 1.
8	Trig_Data_00	DOUT	NA	Trigger data bit 0.
9	+24V	+24V	+24V	Can be used to supply a connected device with 24V power, maximal current draw 500mA.
10	MISC	DIN, DOUT	AIN	Can be used for sampling an analog voltage or as a digital input/output pin.
11	+3V3	+3V3	+3V3	Can be used to supply a connected device with 3V3 power, maximal current draw 50mA. Shall be used for selecting trigger data output voltage
12	+5V	+5V	+5V	Can be used to supply a connected device with 5V power, maximal current draw 50mA. Shall be used for selecting trigger data output voltage
13	Analog in	DIN	AIN	Can be used for sampling an analog voltage or as a digital input pin.
14	Trig_Data_08	DOUT	NA	Trigger data bit 8.
15	Trig_Data_09	DOUT	NA	Trigger data bit 9.
16	Trig_Data_10	DOUT	NA	Trigger data bit 10.
17	Trig_Data_11	DOUT	NA	Trigger data bit 11.
18	Trig_Data_12	DOUT	NA	Trigger data bit 12.
19	Trig_Data_13	DOUT	NA	Trigger data bit 13.
20	Trig_Data_14	DOUT	NA	Trigger data bit 14.
21	Trig_Data_15	DOUT	NA	Trigger data bit 15.
22	GND	GND	GND	Ground for all signals.
23	V_D08-15	IN	IN	Voltage selection for TrigData 08-15*.
24	V_D00-07	IN	IN	Voltage selection for TrigData 00-07*.
25	Analog in	DIN	AIN	Can be used for sampling an analog voltage or as a digital input pin.

** Voltage selection is performed by applying the required voltage to Pin 23 and 24. This voltage can either be supplied by Pin 11 (+3.3V voltage levels) or Pin 12 (+5.0V voltage levels) or be supplied by external equipment. The voltage must between 1.8V and 5.0V.*

With a suitable adaptor cable, the TRIGGER INTERFACE port (Trig_Data_00 – Trig_Data_15) can generate contextual triggers, for a full specification of the TRIGGER INTERFACE port please refer to the [LAB-10-009-DOC Interface Design Description (INTERFACE)] document.

9 OPERATING THE LABBENCH I/O DEVICE

This section provides a conceptual view of how to perform experimental procedures with the LabBench I/O device using the LabBench software.

For detailed instructions on how to design and execute experimental protocols with the device, please refer to the LabBench Book.

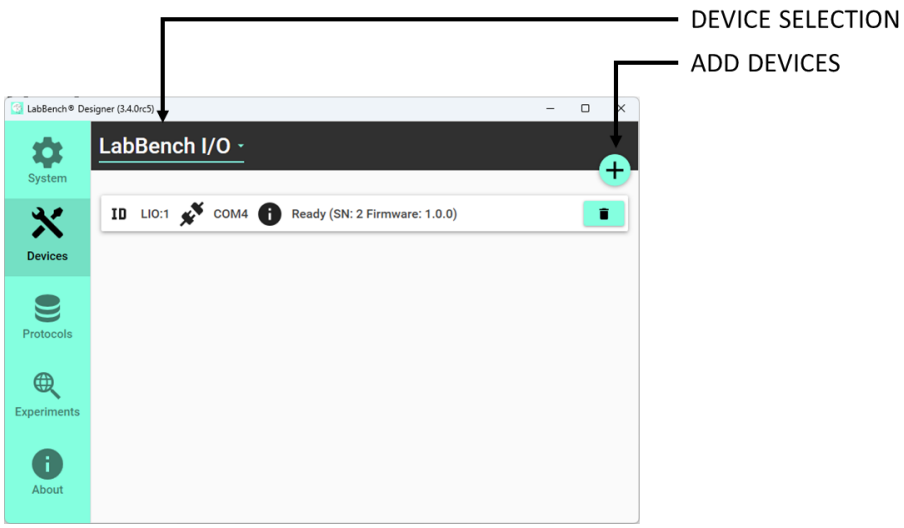
9.1 TURNING ON THE DEVICE

The device is turned on and off by connecting and disconnecting the 24V power brick that is supplied with the device. When the device is connected to the 24V power brick the device will be operational 10s after the power has been connected.

As the microprocessor in the device is powered through the USB connection it is possible to communicate with the device even if the 24V power brick has not been connected. Consequently, the device can inform the user if he/she has forgotten to connect the power brick. In that case the device will be in an error state as indicated by a red STATUS INDICATOR and an error message will be displayed in the LabBench software.

9.2 INSTALLING THE DEVICE IN LABBENCH

Before the device can be used in LabBench protocols, the device must first be added to a LabBench system. This is performed with the LabBench Designer program under the Devices tab, as illustrated below:



To add the LabBench I/O device:

1. Connect the device to the computer with its USB cable.
2. Open the LabBench Designer
3. Go to the Devices tab.
4. Select the LabBench I/O device in the DEVICE SELECTION control.
5. Click the ADD DEVICES button; this will scan for all attached LabBench I/O devices that is currently attached to the computer and add all devices that are not currently installed to the LabBench system.

9.3 RUNNING EXPERIMENTS

The LabBench I/O device is intended to be used in LabBench Protocols or by using its MATLAB or Python API in 3rd party software such as MATLAB Psychophysics Toolbox or PsychoPy.

For a full description of how-to setup and run LabBench protocols please refer to the LabBench documentation, which also provides descriptions of how to use the LabBench I/O device with LabBench.

10 SAFETY MEASURES - ANALOG OUTPUT RELAY

To protect the subject against unwanted stimuli the analog output of the LabBench I/O is protected by a watchdog and a relay. It is common for electronic equipment to generate a spike/glitch on their analog outputs when they are turned on, this is the case with for example National Instruments DAQmx data acquisition cards, which is commonly used to control ANALOG MODE and ANALOG TRIGGERED MODE stimulators such as the DS5 or DS8R from Digitimer.

These glitches pose a risk to the subject, as if the experimenter connects the subject to the stimulator and then turn the analog generator on, then the subject may be subjected to a very intense, painful, and potentially harmful stimulus.

To prevent this from occurring, the LabBench I/O has a relay on the STIMULATOR A analog output. This relay will first connect the analog output to the STIMULATOR A connector once the device has been turned on and is operating correctly. The relay will disconnect the analog output if:

1. 24V power is removed.
2. The firmware is not resetting the watchdog controlling the relay. This ensures that if the firmware malfunctions, then the analog output will be disconnected.

11 MAINTENANCE, CLEANING, STORAGE, AND DISPOSAL

11.1 MAINTENANCE

The LabBench I/O does not require regular maintenance. We recommend a visual inspection of all input/output connections every 3 months or 50 hours of use.

Other maintenance instructions:

If the system does not operate as described in the section Operating the LabBench I/O device, it indicates that it does not operate correctly. In that case, please get in touch with the manufacturer.

11.2 CLEANING

A damp cloth with a MILD detergent may be used to wipe the outside of the LabBench I/O Device.

11.3 STORAGE

Store the LabBench I/O system outside direct sunlight, accordingly to their storage temperature and humidity, as specified in section TBD.

11.4 DISPOSAL

The LabBench I/O system meets the requirements of guideline 2005/96/EG (used electric and electronic devices [WEEE]).

The WEEE symbol [redacted] on a part of the LabBench I/O system or in this manual indicates that this part must not be disposed of in general waste. These parts of the LabBench I/O system must be sent to an approved waste disposal facility, or, in case of doubt returned to the manufacturer.

12 AVAILABLE ARTICLES

The following articles are available for use with the LabBench I/O device:

Item	**Part Number**
LabBench I/O	PN-IOL-80-01-001-001
LabBench SCALE	PN-PRS-80-01-001-001
LabBench BUTTON	PN-BTN-80-01-001-001
LabBench RESPONSE	PN-PRS-80-02-001-001
LabBench ATRIG	PN-ATG-80-01-001-001
LabBench VTRIG	PN-VTG-80-01-001-001

13 TECHNICAL DESCRIPTION

Installation category	II
Operating modes	IDLE, ACTIVE, PENDING, ERROR.
Controls	None, all functionality is software defined.
Indicators	Front LED indicator
Analog Output	+- 10V with a maximal update rate of 20kHz.
Connectors	**Front**: Response Connector, Type 10P10C: For a specification of this port, please refer to LAB-10-008-DOC Interface Design Description (RESPONSE). Stimulating output signals. Analog and trigger. (BNC) **Back**: 24 VDC power supply port, DC socket 5.5mm (2.5mm centre pin) Centre pin positive. USB 2.0 Interface, Type B plug. Trigger IN TTL signal (0V or 5V). Impedance 10 kOhm (BNC) Trigger OUT TTL signal (0V or 5V). Impedance 100 Ohm (BNC) Trigger Interface type D-SUB 25: For a specification of this port, please refer to LAB-10-009-DOC Interface Design Description (INTERFACE).
Power supply	24 Vdc, max input power 24 Watt
Dimensions	42mm x 210mm x 148mm (HxWxL). Ex. Connectors and feet.
Weight	940 gr.
Ingress protection	IP20
Operating temperature	+10 to +30 C°

Operating Humidity	30 to 75 % relative humidity
Storage temperature	+10 to +40 C°
Storage Humidity	30 to 75 % relative humidity
Transportation temperature	-20 °C (no humidity control) and +60 °C
Transportation Humidity	Max 93 % relative humidity. BEFORE OPERATION AFTER TRANSPORTATION LabBench I/O MUST BE STORED IN OPERATING ENVIROMENT FOR AT LEAST 1 HOUR.
Atmospheric pressure	900mBar – 1050mBar
Recommended USB cable (Supplied)	AMP-Connectivity, PN 1487588-1

14 DECLARATION OF CONFORMITY

The product complies with the directives:

- EMC Directive (2004/108/EC)
- RoHS 2 (2011/65/EU)

Manufacturer:

LabBench I/O is a product made by the Danish manufacturer Inventors' Way ApS

Inventors' Way ApS
Niels Jernes Vej 10,
9220 Aalborg
Denmark

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