Dancer Design

INNOVATION IN ELECTRONICS

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AirStim Mk. 2 Air Vibration Controller - User Guide

SAFETY INFORMATION

- **NOTE** – the control unit is not MRI-safe and should not be placed close to an MRI scanner.
- No user serviceable parts inside. Refer servicing to qualified persons.
- Use only with the power supply provided with the equipment.
- In the event of electrical or mechanical failure, contact Dancer Design.
- The pressure of the air supply should be regulated or limited to 1.5 bar (22 psi, 150 kPa) maximum. Do not connect *directly* to an air cylinder or a hospital air supply outlet. Use the regulator supplied with the equipment to reduce the pressure to 1-1.5 bar.

Other important information

The control unit contains a pressure release valve which opens when the inlet pressure reaches 2 bar (29 psi, 200 kPa). This will cause a hissing sound from the inside of the control unit. If this happens, reduce the inlet pressure until it stops, then increase it again to a safe value.

All pneumatic connections are made via push-in tubing adapters for metric tubing. To attach a tube, simply push it into the connector. There will be some ‘give’ as the tubing passes the internal o-ring, after which it will be impossible to push it in any further. To release a tube, press the release ring with one hand whilst pulling the tube with the other. The tube should come out easily. Do not pull the tube without pressing the release ring as this will damage the retaining springs inside the connector.

Make sure the air supply is connected to the inlet, not to one of the outlets.

Do not operate the valves for extended periods with no air supply connected.

Overview

The Dancer Design AirStim Mk.2 is a device designed to generate a pulsed air supply for driving pneumatic vibratory stimulators. Pressurised air from the inlet is switched to the outlets by two pairs of high speed valves. The valves are controlled by an Arduino Nano Every microcontroller, which facilitates easy communication, accurate control of stimulus frequency, and the possibility of creating custom programs.
The AirStim has a USB port on the rear panel. When connected to a PC this appears as a virtual COM port. The device can be controlled by sending simple text commands through this port. This means that it can be controlled easily using any programming language that allows serial communication via a COM port.

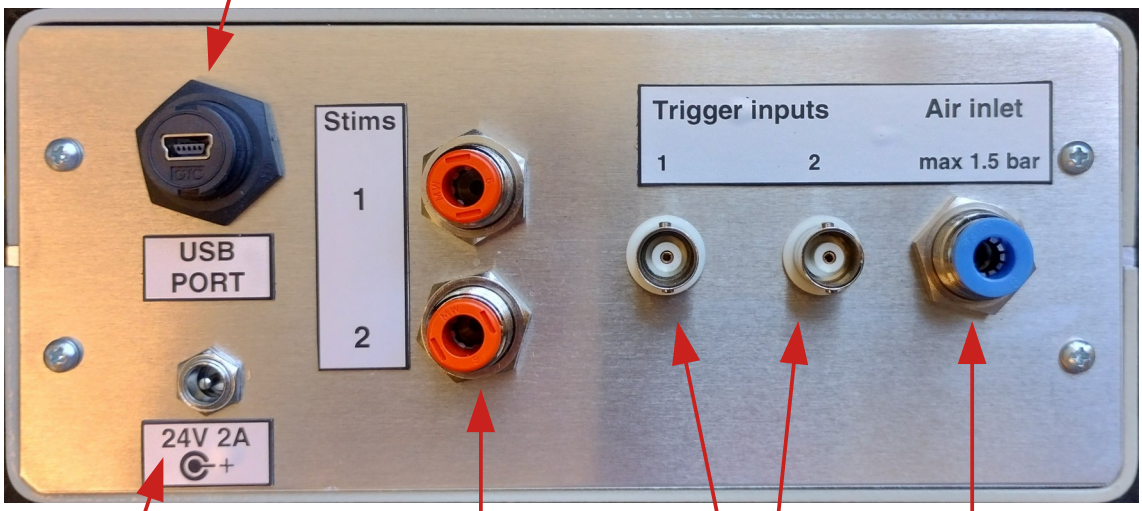
Front panel

Power switch

Test buttons

Rear panel

USB connection



Power inlet

Air outlets
to stimulators
(6mm tubing)

TTL trigger
inputs

Air inlet
(6mm tubing)

Setting up the AirStim

Connect the air supply hose to the regulator, and the regulator output to the inlet of the AirStim. Ensure the regulator dial is turned to the off setting (fully anticlockwise).

Attach the stimulator hose/s to the outlet/s.

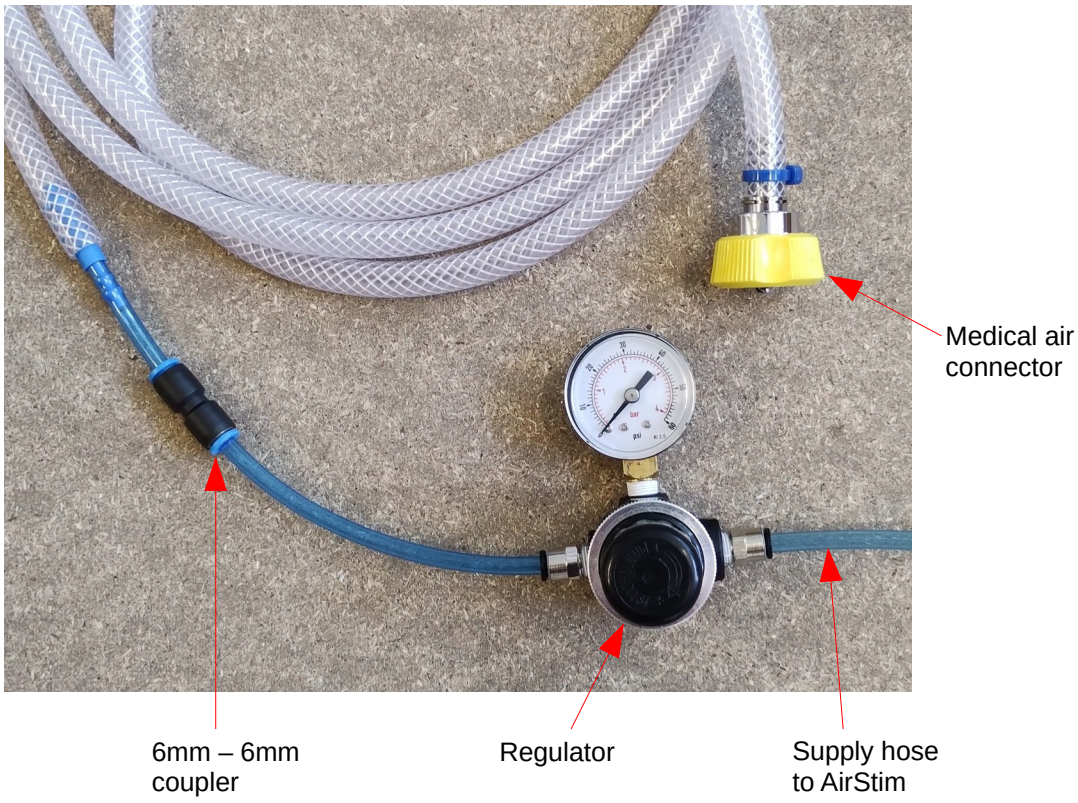
Turn on the air supply. Increase the pressure setting on the regulator until the gauge reads 1 – 1.5 bar.

Connect the power supply and switch on. Check the LED on the front panel is lit.

Press each test button to check that the stimulator is working.

Connect the USB cable between the AirStim and a PC. The device should be recognised as a COM port. You can check that it has been recognised and find its port name using Device Manager in Windows. Note that the PC should recognise the Arduino in the AirStim even with the power switch off. You will need the port name (e.g. “COM6”) if you are writing your own programs to control the AirStim.

Supply hose and regulator



Communication with the AirStim

The device is controlled by sending simple text commands through the COM port. Commands are terminated with a carriage return character (or carriage return & line feed).

List of commands

Q – Query device present
This command simply checks that the AirStim is present. The device responds with “Q” followed by CR/LF to confirm.

G – Go. Start a stimulus on the specified channel
Format: Gn
n is channel number 1 or 2

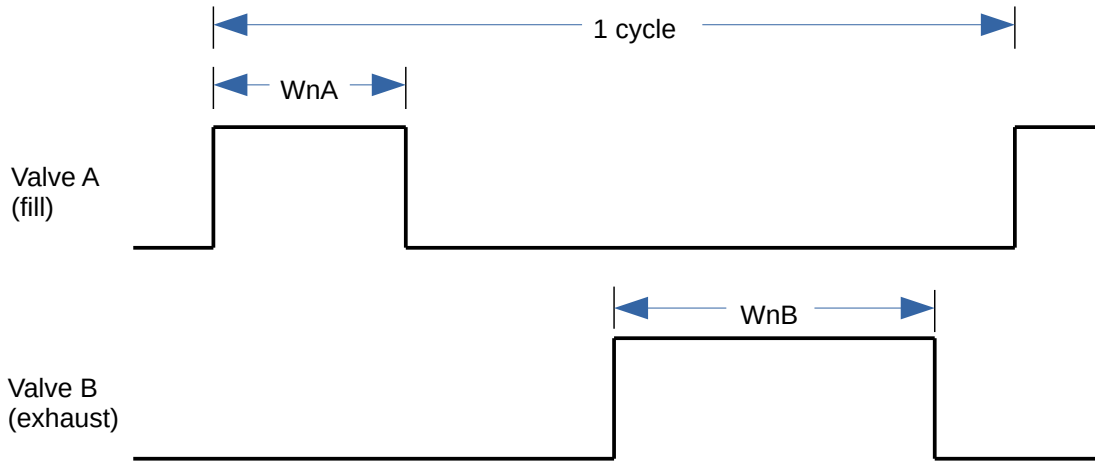
S – Stop. Stop a stimulus on the specified channel
Format: Sn
n is channel number 1 or 2

F – Set stimulus frequency
Format: Fn f (note the space between Fn and f)
n is channel number 1 or 2, f is frequency expressed as an integer between 1 and 400 Hz

W – Set pulse width
Format: Wnv w
n is channel number 1 or 2, v is the valve being addressed (“A” = fill valve, “B” = exhaust valve), w is the pulse width expressed as a percentage of the cycle time (1 to 49).
Example: “W1A 15” = set channel I fill valve pulse width to 15%

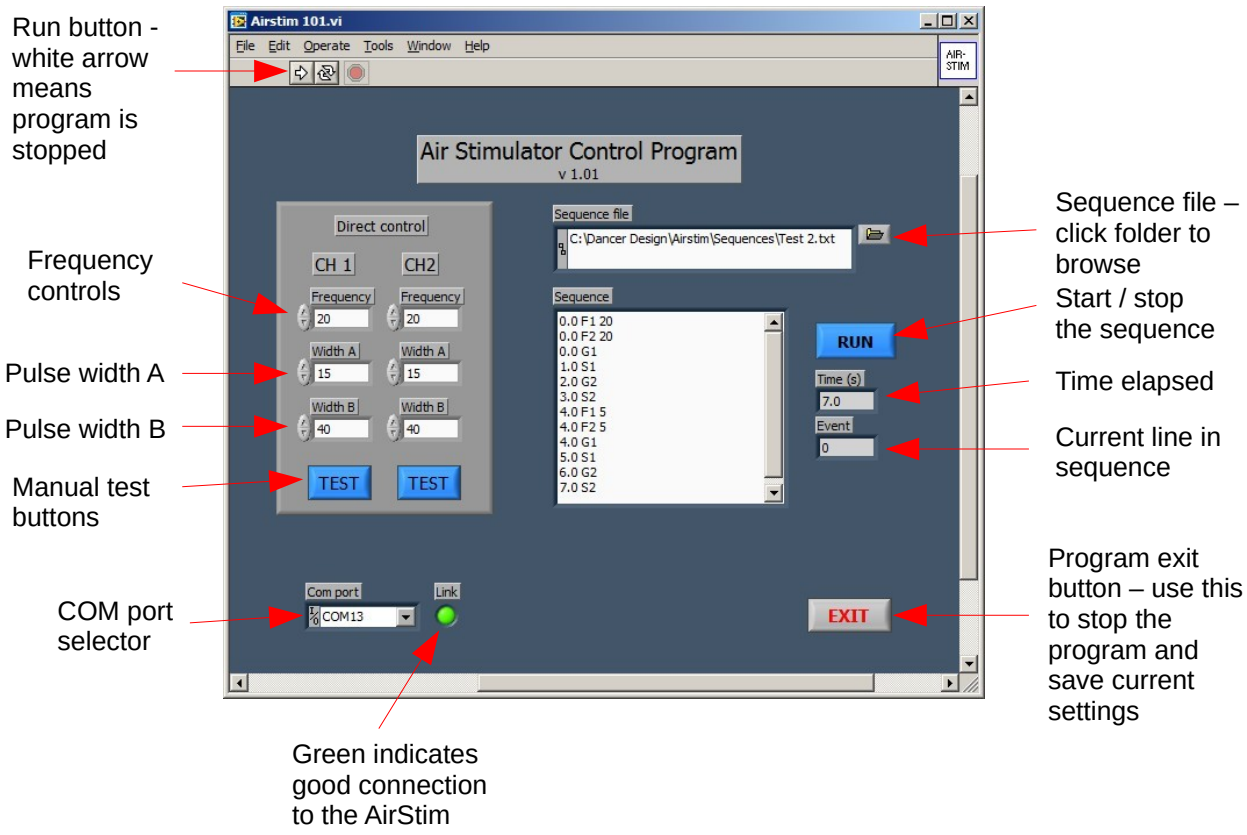
Explanation of valve cycle and pulse width

Each channel has two valves, valve A connects the stimulator to the air supply, which inflates it, and valve B connects the stimulator to atmosphere, which allows it to deflate. The vibratory motion of the stimulator is created by opening the two valves alternately. Software in the Arduino controls the pulse width of each valve as well as ensuring that they are never on simultaneously.
Each valve may be open for between 1 and 49 percent of the total cycle time. Because the stimulator inflates faster than it deflates it is usual for pulse width A to be shorter than pulse width B. 15% and 40% are the default values. The larger pulse width A is, the more turgid the stimulator will be.



AirStim control program

A simple program for controlling the AirStim from a Windows PC is provided with the device. This allows the parameters of the stimulation to be varied, and can run a simple timed sequence of stimuli.



The control program is written in LabVIEW, and requires the LabVIEW 8.6 runtime environment to be installed. This is available for download from:
http://download.ni.com/#support/labview/windows/runtime/8.6/

The installer will create a working folder C:\Dancer Design\Airstim. Inside this is the Sequences folder where sequence files are stored. Sequence files are text files which can be created and edited with a simple text editor. Each line in the file contains a time value followed by a space, then the command to be sent to the AirStim controller (see above for list of commands). Commands with the same time value will be executed as quickly as possible in sequence.

Sequence file example

0.0 F1 5	*@time 0.0, set ch.1 frequency to 5Hz*
0.0 G1	*@time 0.0, start stimulus on ch.1*
1.0 S1	*@time 1.0, stop stimulus on ch.1*
2.0 F1 20	*@time 2.0, set ch.1 frequency to 20Hz*
2.0 G1	*@time 2.0, start stimulus on ch.1*
3.0 S1	*@time 3.0, stop stimulus on ch.1*