Manual

UniGo™ Pump LabVIEW

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UniGo Pump Box Contents

¹ iPad bundle only; **²** PC software bundle only; **³** The flow sensor is required for all pump operations.

UniGo Pump Overview
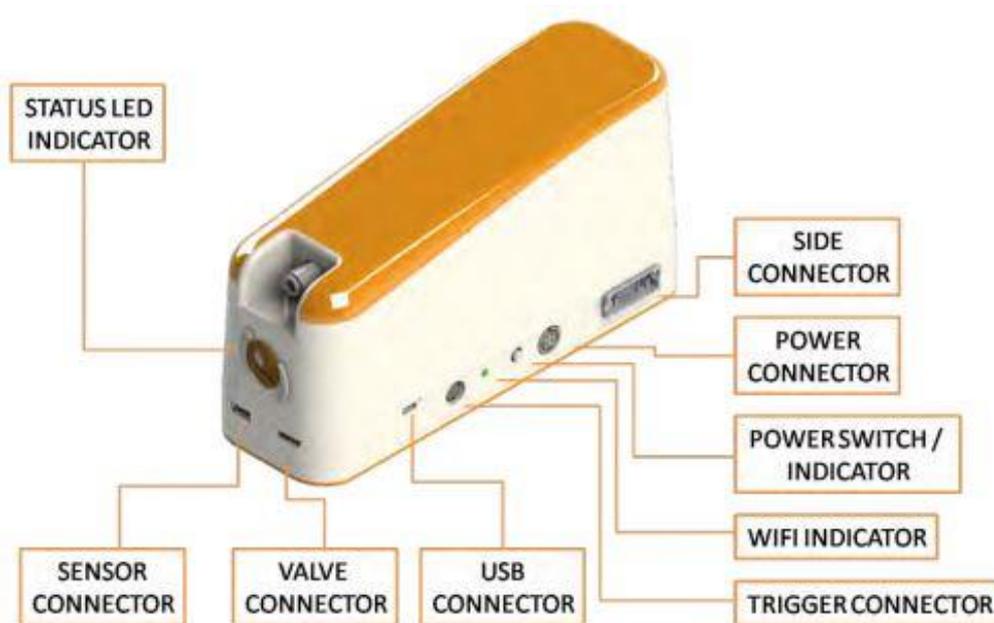
LabVIEW Installation

Please complete the following steps:
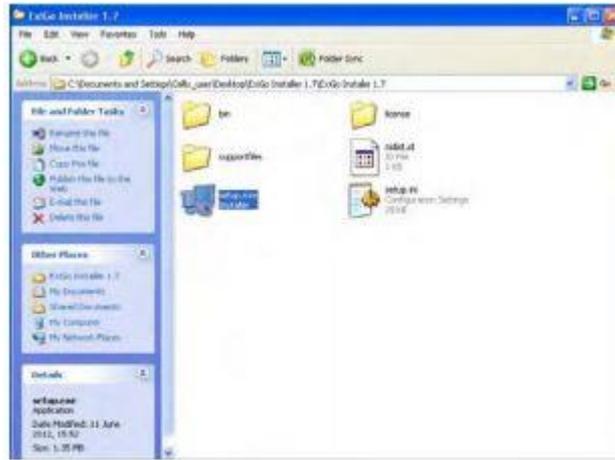
1. Open the LabVIEW installation CD and open the file Setup.exe[1]. Alternatively, you can download the files from our webpage www.wearecellixltd.com
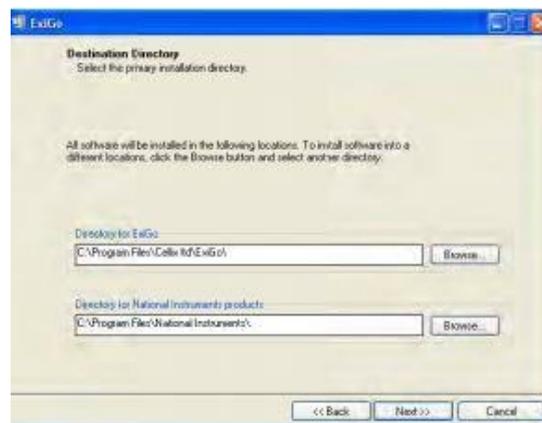
[1] You may require Administrator rights. Please contact your system administrator in case you cannot perform the installation.

2. Select the destination folder and click "Next".
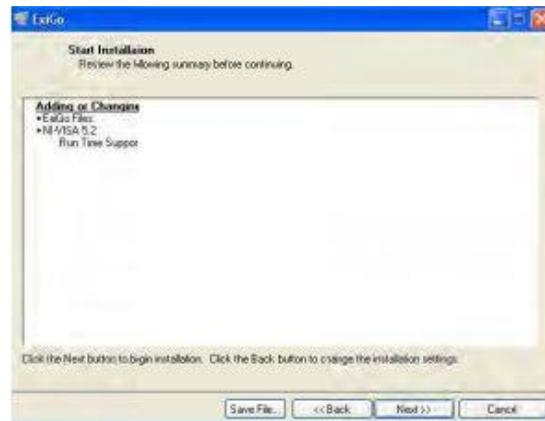
3. Click "Next"[2]
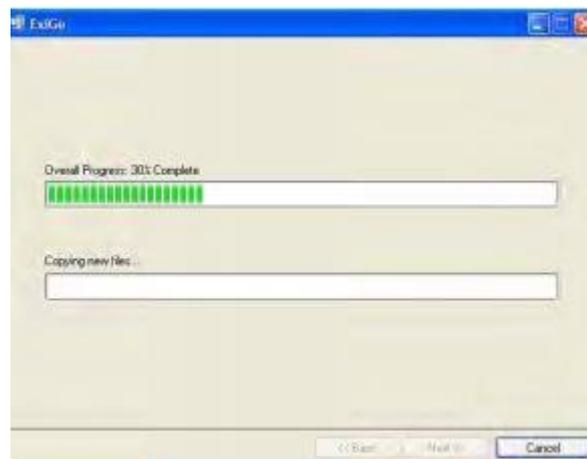
4. Wait until installation is complete
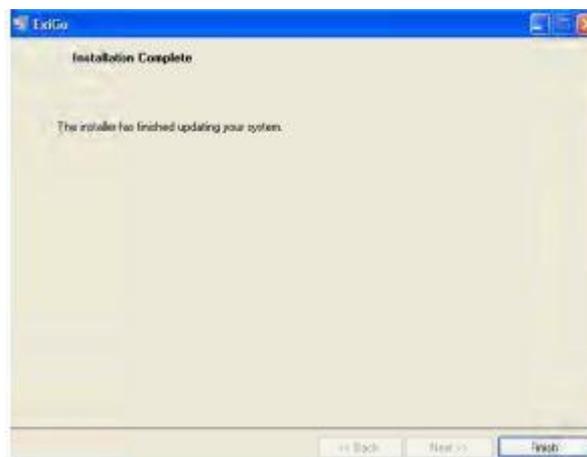
5. Once the installation is complete, click "Finish".
6. Restart your computer if required.

² Please note that the content of this window may vary on each computer, depending on previous versions installed.

Unigo Drivers Installation

Prior to proceeding with the installation of the UniGo drivers; please introduce the LabVIEW installation CD which contains the drivers in your PC. Alternatively, you can download the latest version of the drivers from www.wearecellixltd.com.

1. Click on DPInst32.exe for 32bits operating system or DPInst64.exe operating system.

2. Click "Next".

3. Once the drivers have been installed click Finish.

4.   Connect the power supply to the Power connector and press the power switch until the status LED indicator turns on.

5.   Connect the USB cable to the UniGo USB connector and plug it into your PC.

6.   The PC should detect the new device and commence with the installation of the drivers

7.   Wait until the driver installation is completed.

8.   Your device is ready to be used.

LED Status Colours Explanation

Colour	Effect	Meaning
	Flashing	Pump is booting up. Please wait until status LED changes its colour prior to connect the pump
	2 Flashes and fades out	Pump not initialised and no sensor detected at boot time
	2 Flashes and fades out	Pump not initialised and sensor detected at boot time
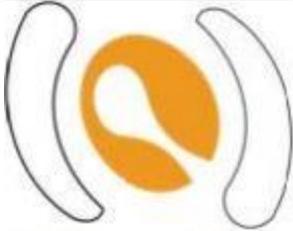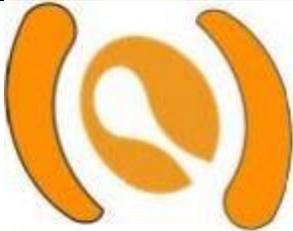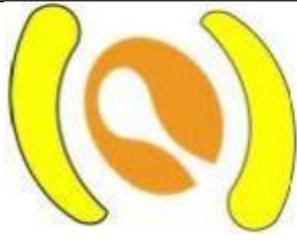
	Flashing	Initialising pump
	Static	Pump ready with no assay programmed
	Rotating	Pump running in manual mode
	Static	Pump ready with programmed
	Rotating	Pump running in assay programmed mode
	Flashing	Critical error. Please contact Cellix technical support

SmartFlo Start and Overview

Starting SmartFlo
To start SmartFlo simply click on the SmartFlo Icon.
Once the interface is open, SmartFlo will try to identify and connect automatically to the UniGo pump[3].

Selecting the correct COM port
The UniGo LabVIEW interface should be capable of determining the correct COM port and establishing communication with the pump automatically. However, in some cases, it may be required for the user to select the adequate COM port, for example, if two or more UniGo pumps are connected to different USB ports in the PC.

More than 2 UniGo pumps detected
If there are more than 2 UniGo pumps connected (each to an independent USB port), the following dialog should appear.
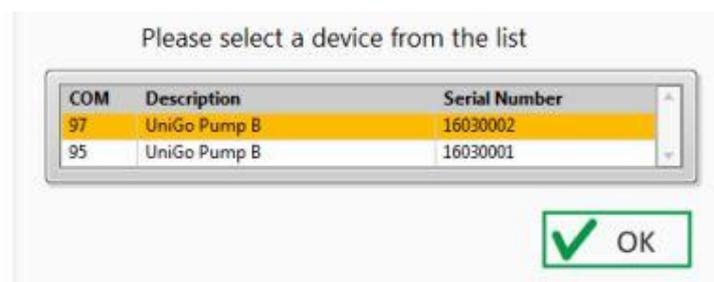
Please select the correct COM port for the pump you would like to connect to.

[3] Please ensure that the UniGo pump is turned on and connected to the PC via USB cable.

Pump not automatically detected

When the LabVIEW user interface is not able to detect the UniGo pump connected, a manual COM port selection menu should appear.
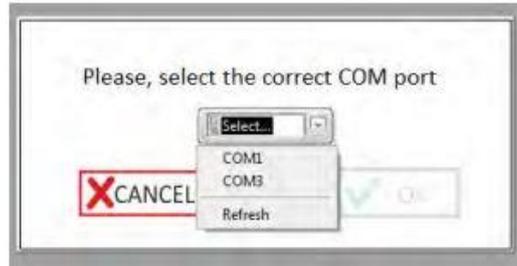
Please, select the correct COM port for your UniGo pump and click ok [4].
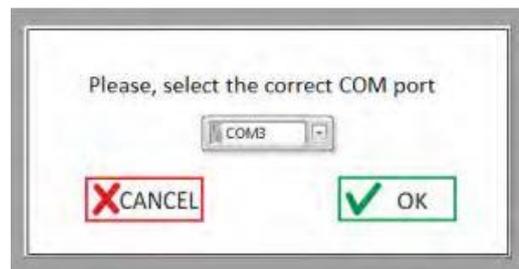
How to manually find the correct COM port

To manually check the COM port assigned to an UniGo pump, open the device manager. Within the section "Ports (COM & LPT)", the UniGo COM port should appear under the name "USB serial port" or "UniGo USB serial port".

Windows XP:
To open the Device Manager click Start -> Control Panel -> System -> Hardware -> Device Manager.

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[4] If your COM port is not in the list, please ensure that the USB cable is properly connected between the UniGo pump and the PC, then click Refresh and try again.
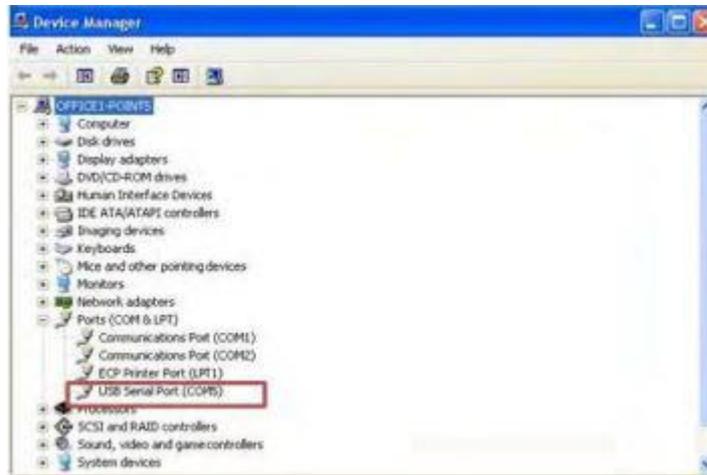
Windows 7:
To open the Device Manager click Start -> Control Panel -> System -> Device Manager.
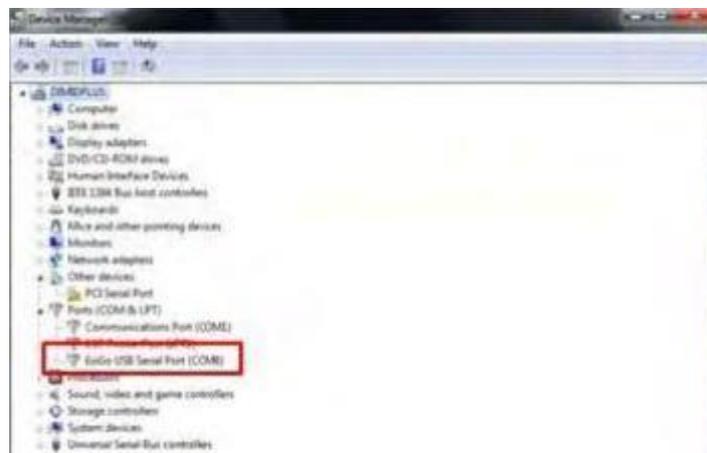
SmartFlo Overview

SmartFlo is comprised of three different windows.

	Main
	This window allows the user to:
	• Initialise the pump.
	• Set the syringe.
	• Move the pump to the initial position required by the assay.
	Manual
	This window allows the user to:
	• Run the pump in manual mode.
	• Visualise the measured flow rates.
	• Record the measured flow rates.
	• Set PID parameters.
	Program
	This window allows the user to:
	• Create a custom waveform and program the pump with it.
	• Visualise the running assay status.
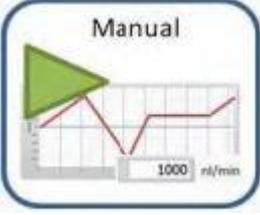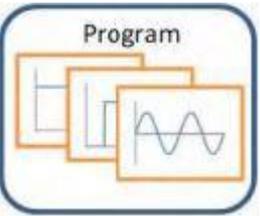
Main window overview
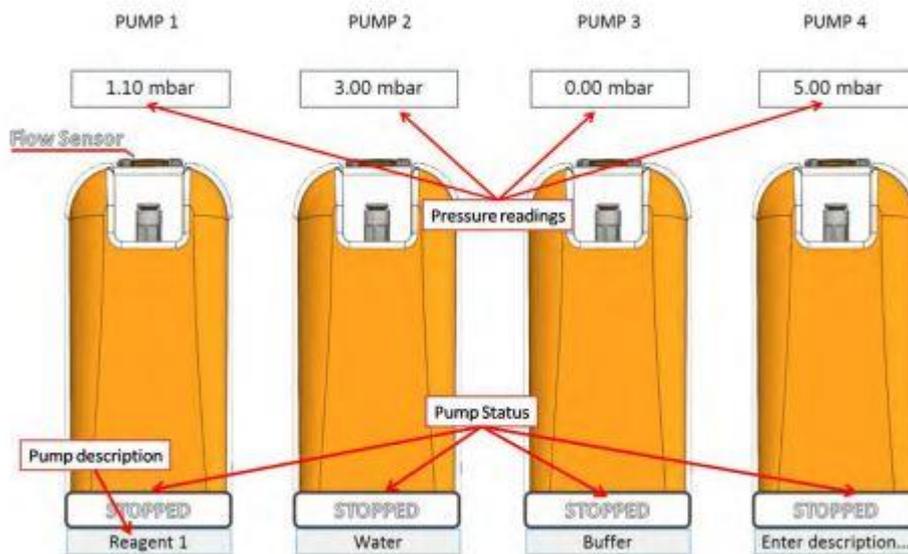
Manual window overview
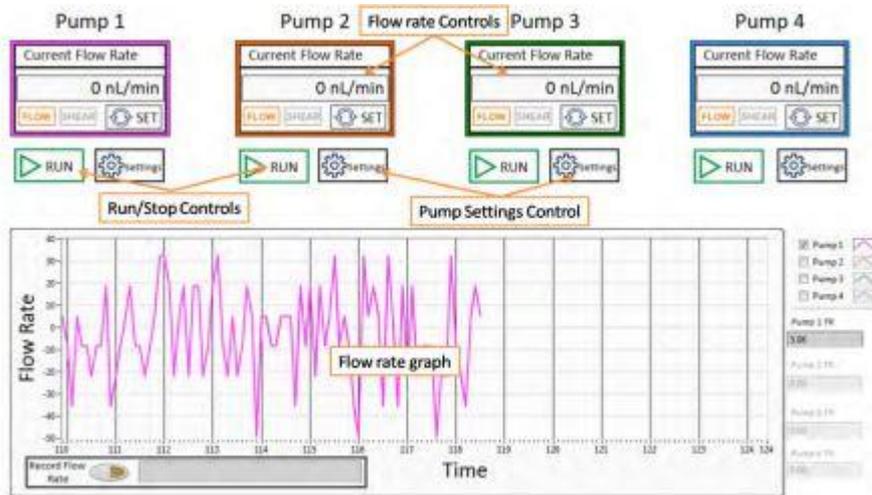
Program window overview
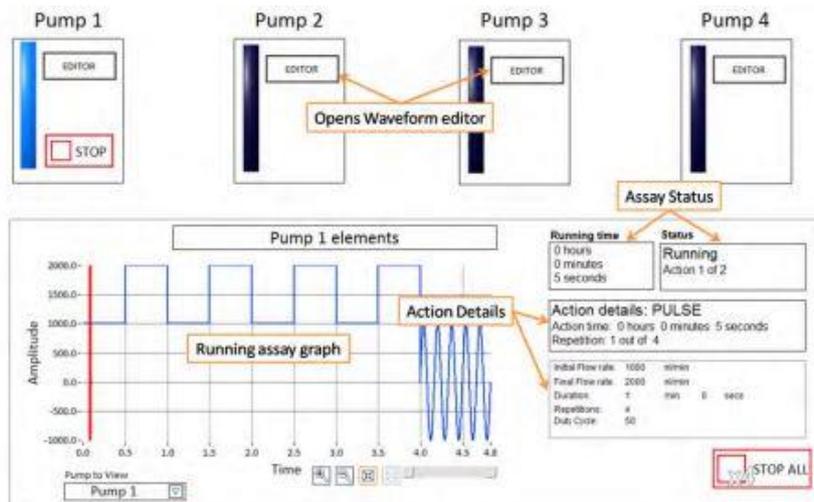
Manual Assay: How to Set the Flow Rate

There are two possibilities to set the flow rate manually. One is in flow rate units (L/min) and the other in shear stress units (dyne/cm^2)

Flow Rate Units:

    1.   Click in the flow rate indicator.

    2.   Set the desired flow rate value. Use the **+** and **-** controls to change to positive or negative flow rate. Click "green tick" tab to accept the changes.

3.   The introduced flow rate should appear now within the flow rate indicator. Press to "SET" to update the pump flow rate set point.

4.   Once the flow rate has been set, press the "RUN" button to start the assay.
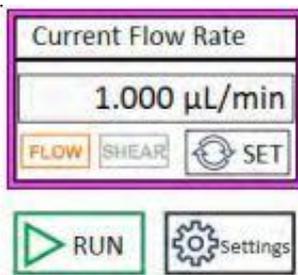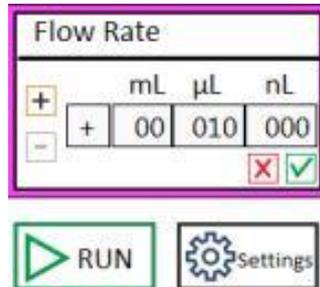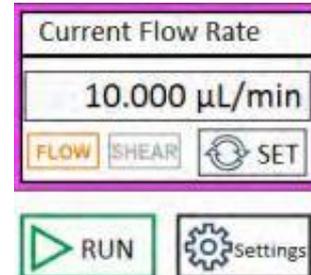
Figure 1   Figure 2   Figure 3

Shear Stress Units:

1. Click the "Settings" button.
2. Click the biochip icon.
3. Select your biochip or enter the fluidic channel dimensions[5] and the viscosity of the liquid to be used and click "update".
4. After step 3, the "SHEAR" button becomes available. Change the indicator to dynes by clicking the "SHEAR" button.
5. Introduce the desired shear stress. Use the **+** and **-** controls to change to positive or negative shear stress. Click "green tick" tab to accept the changes.
6. The introduced shear stress should appear now within the flow rate indicator. Press "SET" to update the pump flow rate set point. Once the shear stress is set press the "RUN" button to start the assay.

[6] Check the microfluidic chip manufacturer's datasheet.
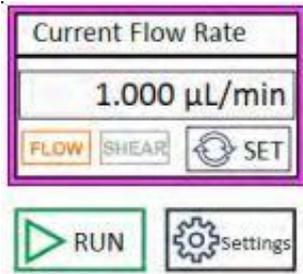
Figure 4

Figure 5
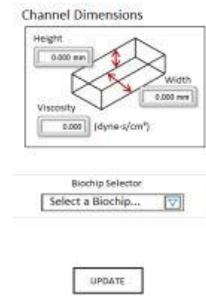
Figure 6
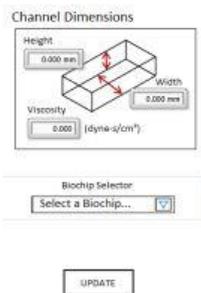
Figure 7
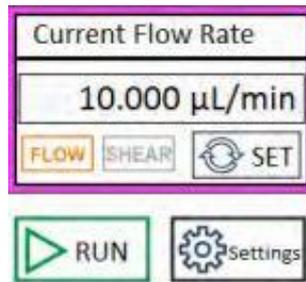
Figure 8
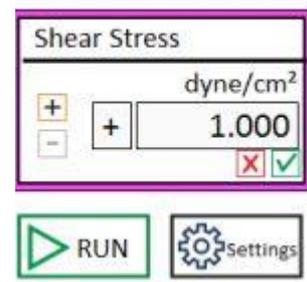
Figure 9
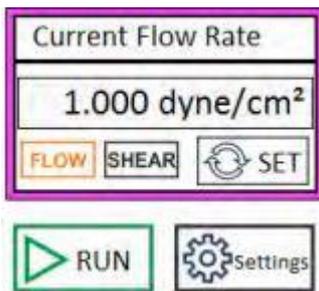
Figure 10

Unigo Flow Sensor: Visualising the Flow Rates

The flow sensor provides an accurate real-time feedback of the flow rate. It is required for the pump to work. It is plug-and-play; therefore, it can be connected to the pump at any moment. While the sensor is disconnected, the pump can be configured, but it will not run unless the sensor is plugged in. Once the sensor is connected and recognised by the pump, a "Flow Sensor" indicator will appear in LabVIEW. Please see Figure 11.
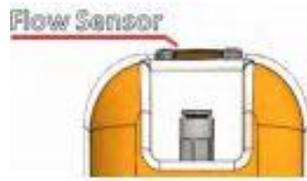
Figure 11

Immediately after plugging in the UniGo sensor, the real time flow rate measurements will appear within the manual tab.
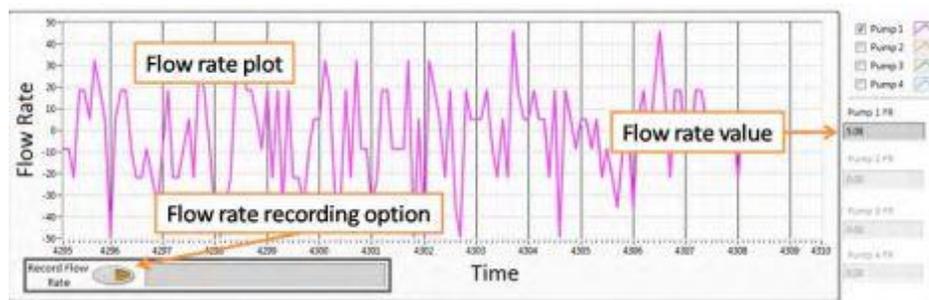
Figure 12

It is possible to record the measured flow rates within a assay as well as when running in manual mode. Please refer to the section on "Recording the Flow Rate Data" for more details.

Setting the PID parameters

To define the PID parameters, click the "settings" button within the manual tab and click the PID icon

Proportional (P): the proportional gain defines how quickly the system will change its output to reduce the existing error (flow rate set point minus current flow rate). Therefore, the proportional parameter will increase the speed of the control system response. However, if the proportional value is too large, the system will begin to oscillate. Using the P parameter on its own may lead to a steady-state error (offset) between desired flow rate and current flow rate.

Integral (I): the integral term sums the instantaneous flow rate error over time and gives the accumulated offset that should have been corrected. Thus, its main purpose is to drive the flow rate steady-state error to zero. A large value of the integral parameter may cause the system to overshoot the set point value and even oscillate.

Derivative (D): the derivative term is proportional to the rate of change of the system output (pump flow rate). Therefore, it "predicts" the system behaviour decreasing the system output if the flow rate is changing rapidly. This parameter helps to reduce overshoot and settling time, but an incorrect value may cause the system to become unstable.

Advanced Options
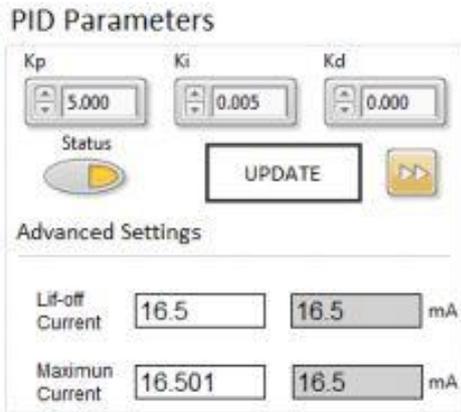
Figure 14

Lift-Off current (LOC): the lift-off current is the minimum current required for the valves to open. This value is dependent on the input pressure as well as the operating pressure. Represents the minimum current applied to the valves in the steady state. Changing this parameter may increase the responsiveness of the control but a value too high will impede the valve to close completely in the steady state which may lead to a leaky system. The maximum value allowed is the maximum current value.

Maximum current: this represents the maximum current applied to the valves to open fully. Reducing this value might reduce the instability of the system. However, the maximum air flow that the system is able to inject, or release is reduced accordingly. The minimum value allowed is the current LOC value.
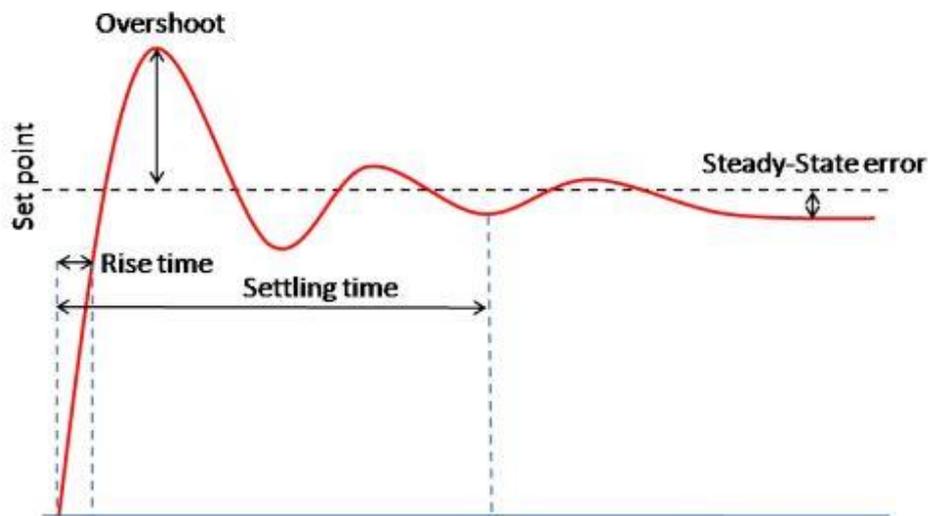
Figure 15

How to tune PID:

1. Set all parameters to 0.
2. Increase **P** and change the set point until the dynamic response of the pump is fast enough without oscillating.
3. Increase gradually the **I** value to minimise the steady-state error. The Integral parameter can be any value between 0 and 1 but it is very sensitive and may cause the system to oscillate. Therefore, it is recommended to start using a value of 0.001. A value over 0.1 will probably lead the system to become unstable.
4. In case of a large overshoot when changing the set point, increase the **D** value gradually until the optimal ratio overshoot/response time is achieved. However, a large value of **D** may slow down the dynamic response of the system.

Program Mode: Defining a Custom Waveform

It is possible to program the UniGo pump to have a precise control of the flow rates and duration of a certain experiment.
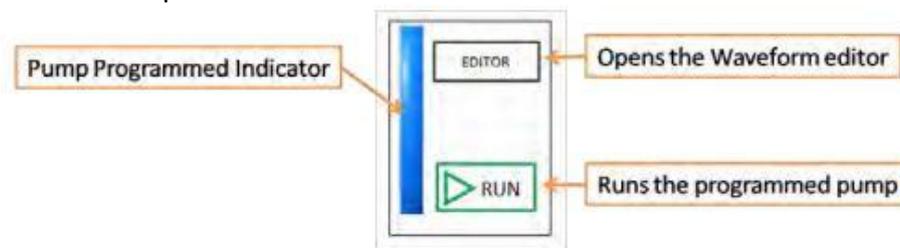
Figure 16

1. Click "EDITOR" to open the waveform editor.
2. Create your custom waveform and click OK.
3. Click "Program" button to program the selected pump.
4. Repeat steps 1 to 3 for the remaining pumps.
5. Click "RUN" to run a particular pump or "RUN ALL" to run all the programmed pumps simultaneously.

Waveform Editor

The waveform editor allows you to create a custom waveform for your UniGo pump.
You can add four different elements to your waveform:

- Constant flow/pause
- Ramp
- TrainPulses
- Sine

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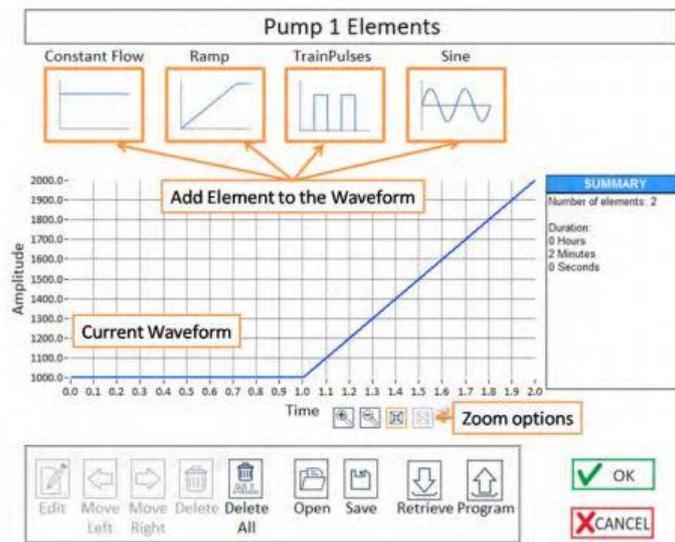
Figure 17
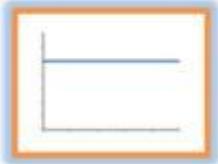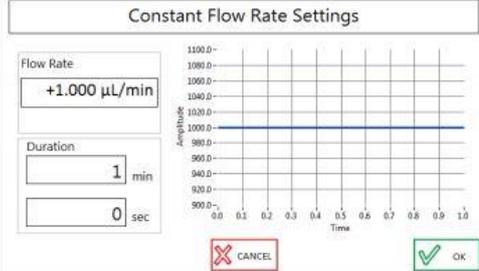
Constant flow	
Flow rate	Flow rate set point for the constant step. Set to 0 if you would like to create a pause.
Duration	Duration on the constant step in minutes and seconds
Ramp	
Initial flow rate	Initial flow rate of the ramp
Final flow rate	Final flow rate of the ramp
Duration	Duration on the ramp in minutes and seconds
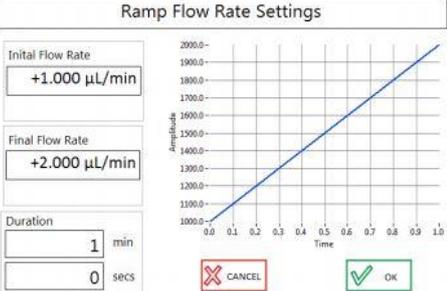
TrainPulses	
Max flow rate	Maximun flow rate of the pulse(s)
Min flow rate	Minimun flow rate of the pulse(s)
Period	Duration of one full cycle of the pulses in minutes and seconds
Repetitions	Number of pulses of the Train Pulse step
Duty cycle	Ratio between the maximum and minimum flow rate of the pulse(s). For instance duty cycle = 60 means that the pulse(s) will remain 60% of the period on minimum flow rate and 40% of the period on maximum flow rate.
Sine	
Amplitude flow rate	Amplitude is measured between the centre of the sine wave and its maximum value
Offset flow rate	Defines the position of the centre of the sine wave regarding the zero position
Period	Duration of one full cycle of the pulses in minutes and seconds[6]
Repetitions	Number of full cycles of the sine wave step
Phase	The starting angle of the sine wave from 0 to 360 degrees
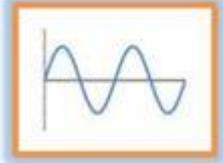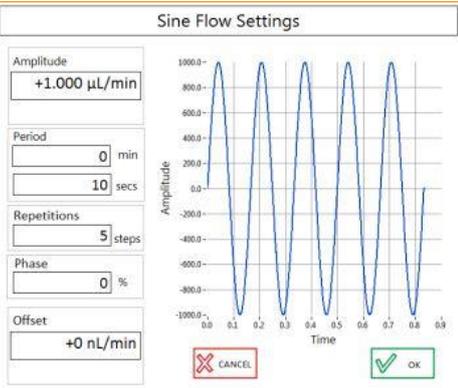
[6] The full duration of the sine wave is determined by period x repetitions.

Open/save custom waveforms

You can load and/or save a custom waveform onto a PC using the following buttons:
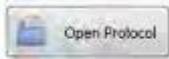
Open Protocol — To load a previously saved protocol and program it into your UniGo pump.
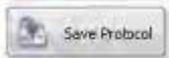
Save Protocol — To save your custom waveform into your computer.
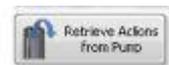
Retrieve Actions from Pump — If your UniGo pump is currently programmed with a custom waveform, you can retrieve it and modify it.

Recording the Flow Rate Data

It is possible to record the measured flow rates during a certain experiment in a log file. To generate the log file, please complete the following steps:

Figure 18

1. Click the Record Flow Rate button to start recording the data
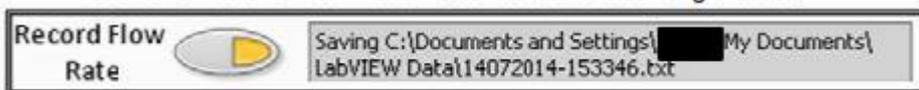
Figure 19

2. The log file will be created automatically using the current date and time as a filename[7,8,9].
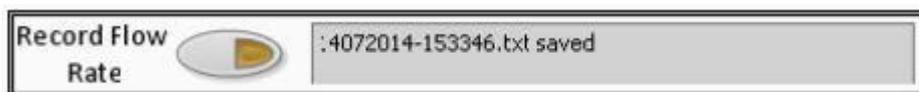
Figure 20

3. Click the Record Flow Rate button a gain to stop recording the data and create the log file. The indicator will show the name of the log file created.
4. The created log file will have a format like the following example.

Date	Time	Pump 1 FR	Pump 2 FR	Pump 3 FR	Pump 4 FR
14/07/2014	15:33:46.23	879.660000	-38.500000	-100.00000 0	0.000000
14/07/2014	15:33:46.26	879.660000	-38.500000	18.640000	0.000000
14/07/2014	15:33:46.32	879.660000	-38.750000	-96.610000	0.000000
14/07/2014	15:33:46.39	738.980000	-20.000000	-96.610000	0.000000
14/07/2014	15:33:46.45	879.660000	-20.000000	-213.55000 0	0.000000

[7] The log file will be saved by default within the path C:\Documents and Settings\<user>\My Documents\LabVIEW Data.

[8] The user can modify the filename after the recording is completed.

[9] If the recorded data becomes very large, the software will automatically create several log files of smaller size with a different index added to its filename: for instance:

08052014-161119.txt,
08052014-161119_1.txt
08052014-161119_2.txt

Other Settings

Sensor Details

Sensor Type	Serial Number
50 ul/min	131600253

Displays information regarding the flow sensor: the flow rate range and the serial number.

LED Lights

LED Lights   ON

Turn ON or OFF the LED lights on the ExiGo pump
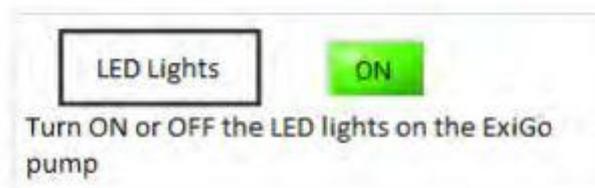
The user can turn on and off the LED lights of the pumps for those experiments which are sensitive to light.

Correct Pressure Offset

Set the preassure offset to zero
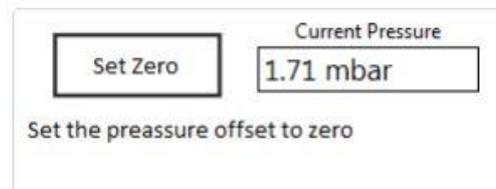
It is possible to correct the pressure offset by clicking the Set Zero button[10].

Device Information

Device Type: Unigo
Serial Number: 16030002
PCB Version: 1.1
Firmware Version: 1.0.0
Mar 22 2016 11:48:02

Displays information relative to the pump: Serial number, Firmware version, etc.

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[10] Use only in case the pressure has an offset and ensure that the system is fully depressurised prior to changing this parameter.

For more information on the UniGo pump or any other Cellix product or service, please call: Republic of Ireland: +353-1-4500-155.

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