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Manual

ExiGo™ Pump iPad

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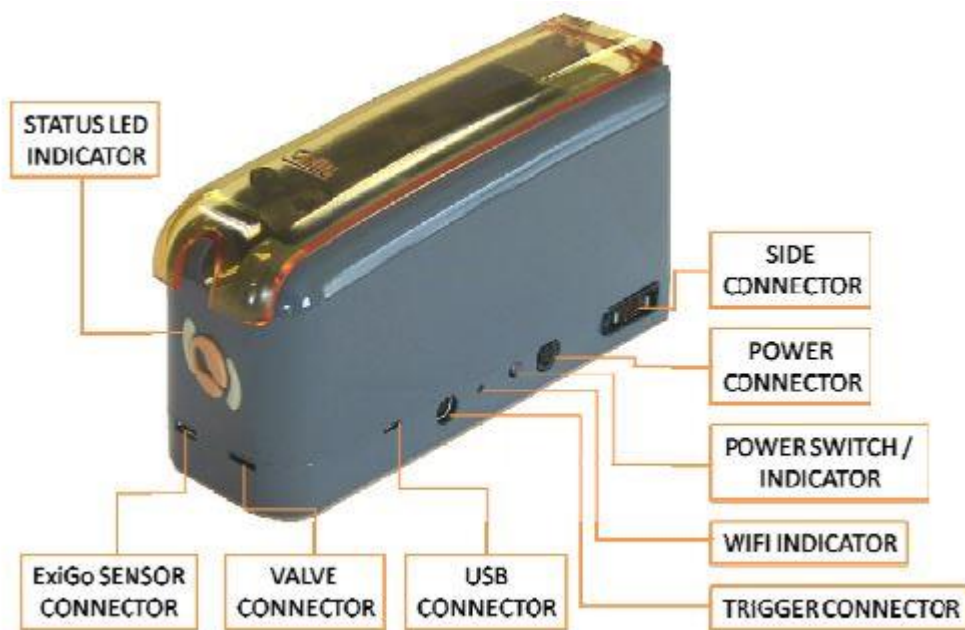
ExiGo Pump Box Contents

¹ iPad bundle only; **²** PC software bundle only; **³** Purchased separately.

ExiGo Pump Overview

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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

Connecting to the ExiGo WiFi

The communication between the iPad and the ExiGo pump is done by means of a WiFi network. Once the ExiGo pump is powered up, it will create a WiFi network (SSID by default containing the serial number of the ExiGo pump i.e. SSID = ExiGo-140 7001).

It is required to connect to this network prior to establishing the communication with the pump. To connect to the WiFi network, please complete the following steps:
1. Connect the power cable to the ExiGo pump and press the power switch.
2. Wait until the colour of the lights changes from white to orange or yellow[1].
3. On the iPad, click on settings:
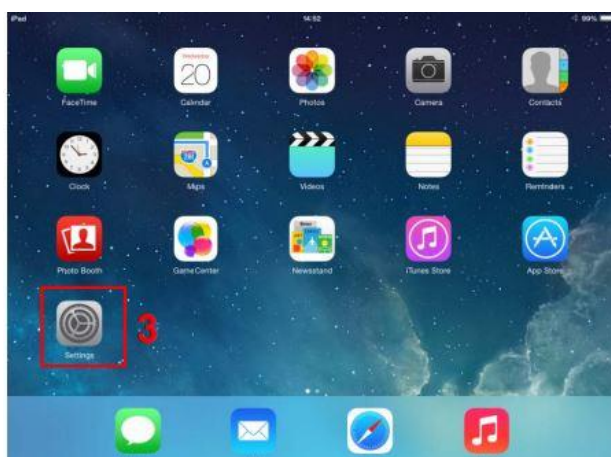
¹ White colour is only shown during booting process.

4.   Within the settings tab, click WiFi.
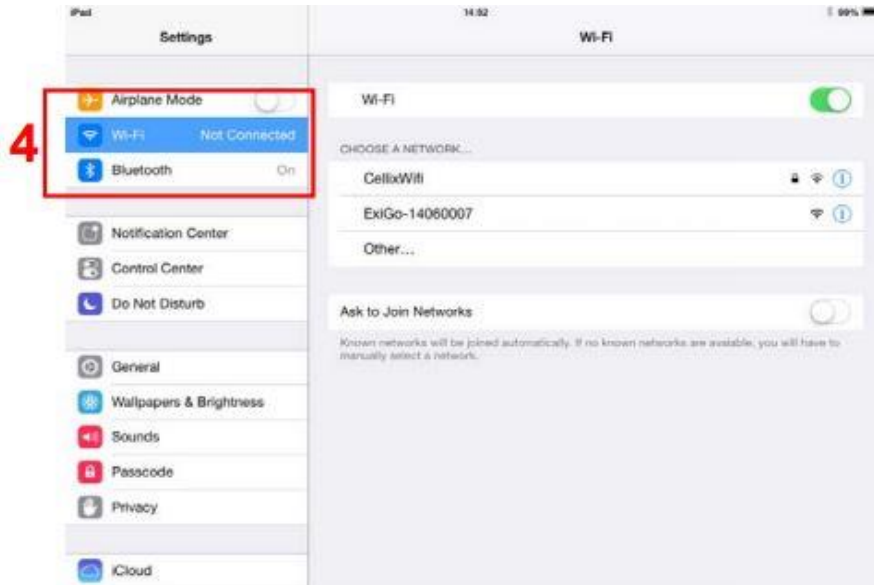
5.   Select the ExiGo network (in this example ExiGo-14060007)**²**.
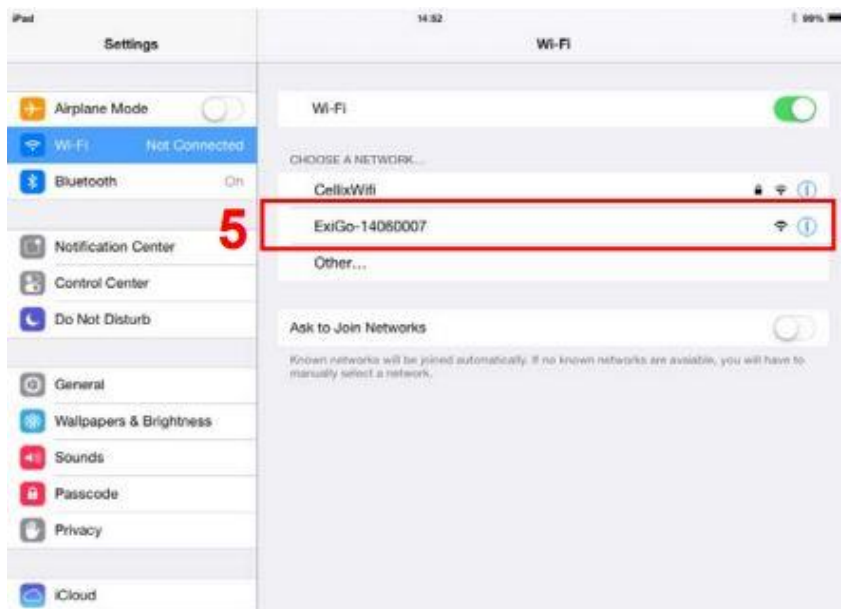
² Exceptionally, the ExiGo pump might take a bit longer to bring up the network. If after one minute the WiFi is not visible, try to switch OFF and ON the WiFi on the iPad. If after this the network is still not visible, please turn OFF and ON the ExiGo pump and try again.

6. Wait until the iPad connects to the network[3].
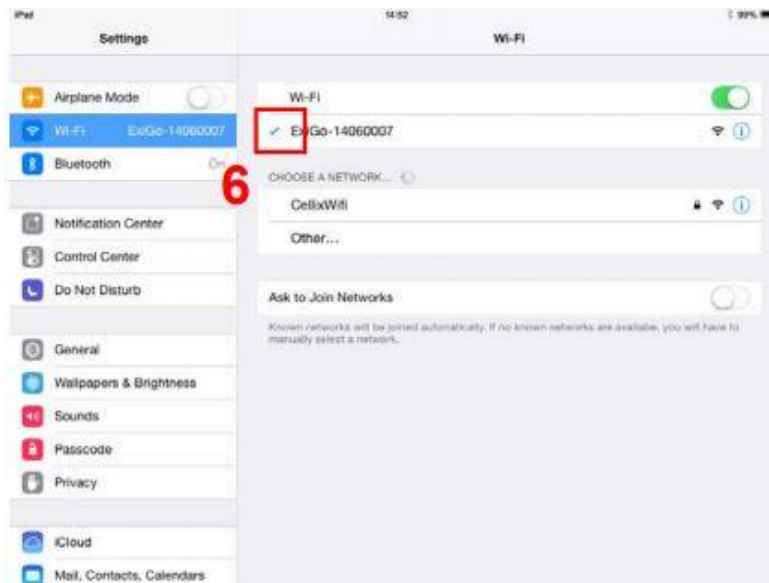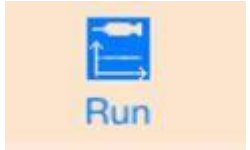
7. Now you can open the SmartFlo app.

[3] A ✓ symbol should appear beside the ExiGo network name after the connection is established.

SmartFlo App Start and Overview

The SmarFlo app user interface is comprised of three different windows

	Configure
	This window allows the user to: • Initialise the pump. • Set the syringe. • Move the pump to the initial position required by the assay.
	Run
	This window allows the user to: • Run the pump in manual mode. • Visualise the measured flow rates. • Set PID parameters.
	Program pump (1 to 4)
	This window allows the user to: • Create a custom waveform and program the pump with it. • Visualise the running assay status.

Configure Window Overview
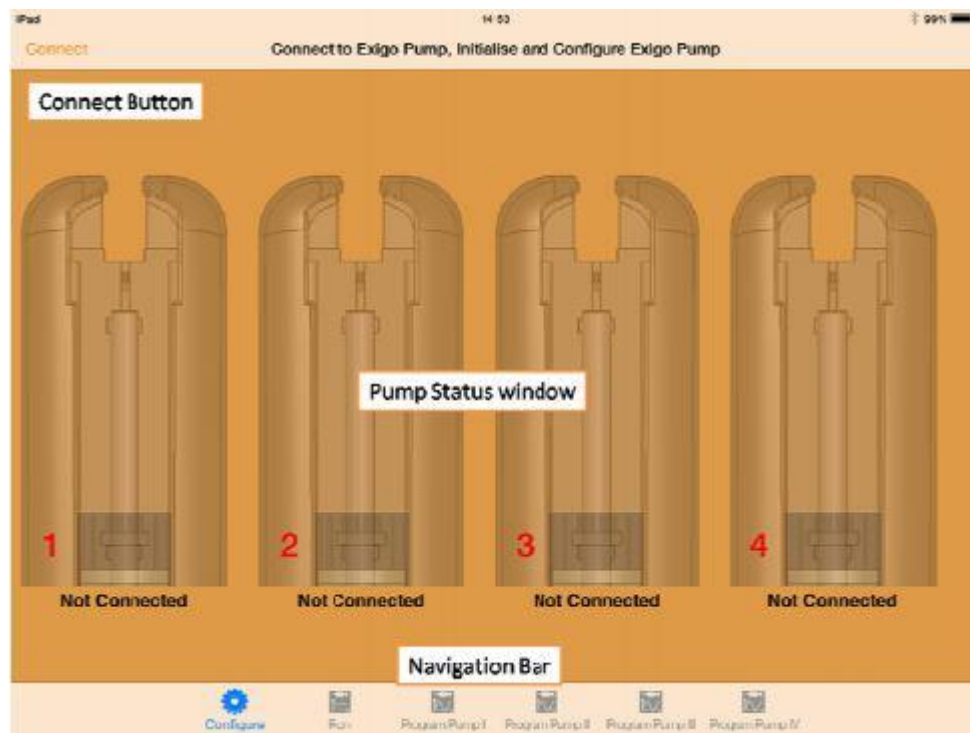
Connect button	Connect to the SmartFlo app[4]
Pump status window	In this section one can: • See the number of pumps connected. • See the status of each connected pump(s). • Select and set the syringe. • Perform a pump displacement.
Navigation bar	Switch among the different window

[4] ⚠**Warning:** please ensure you are connected to the ExiGo WiFi network and there is no USB cable plugged to the ExiGo pump prior to clicking connect.

How to initialise the pump

The "**Not Init**" status means that the pump MUST be initialised prior to starting the assay. To initialise the pump, please follow the next steps:

1. Remove any installed syringe on the pump[5]. Then double tap on the pump's plunger image to begin the initialisation.

[5] ⚠**Warning:** failure to remove any installed syringe may cause the pump to malfunction during the initialisation.

2. The user interface will ask for confirmation and then it will move the pump to the home position.
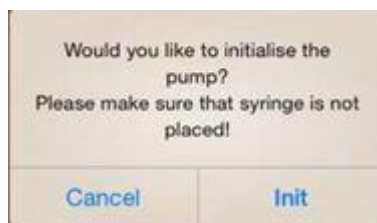
3. Once the Pump is initialised, the status will change to "**Init:Stopped** ".

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How to set the syringe type

The type of syringe to be used during the experiment must be defined prior to running the assay. To set the syringe, please complete the following steps:

1. Double tap on the syringe image in the user interface.
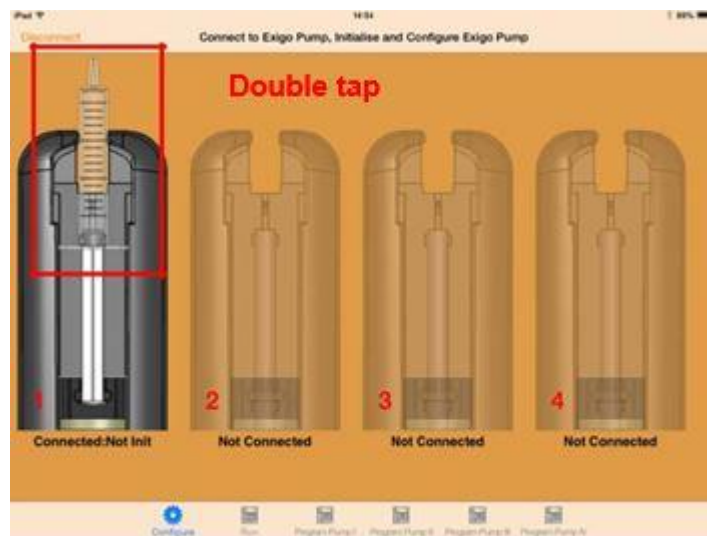
2. A Syringe Selector window will appear*.

3. Select the desired syringe and tap [Set] to set it.

*Note: the syringes accepted are the following

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Hamilton syringes: 700 Series	
Part number	**Description**
80601	100 µL, model 710 LT SYR
80701	250 µL, model 725 LT SYR
80801	500 µL, model 750 LT SYR

Hamilton syringes: 1000 Series	
Part Number	**Description**
81301	1mL, model 1001 LT SYR

BD Plastipak syringes	
Part number	**Description**
300013	1 mL syringe. Luer tip
300185	2.5 mL syringe. Luer tip
302187	5 mL syringe. Luer tip

Clamping the syringe
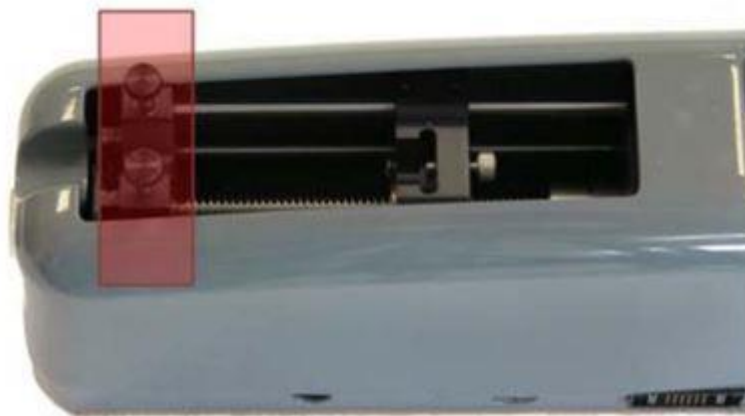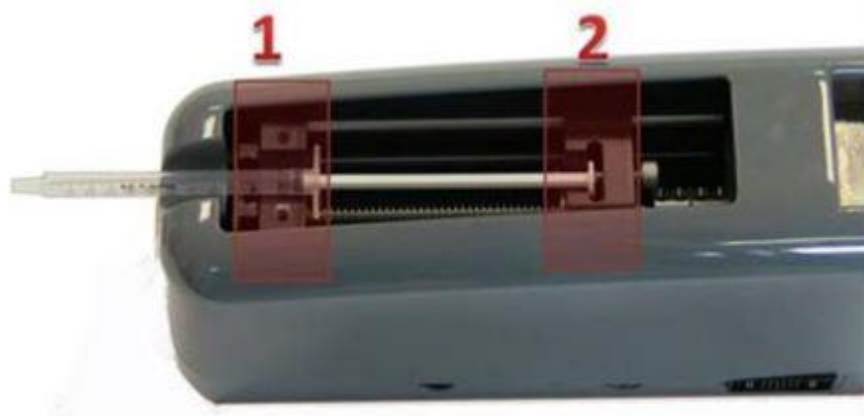

Figure 1

Remove the syringe clamp

Figure 2

Place the syringe in the pump with the body resting on the front of the pump (position 1 in Figure 2) and the plunger resting on position 2. Move the position of the pump's plunger if required (see in the next section).

Figure 3

Put the syringe clamp back in place (Figure 3 position 1) and tighten the screws firmly. Tighten the thumb screw (Figure 3 position 2) to secure the syringe plunger.
Please note that the syringe clamp is reversible, depending on the syringe to be installed. See table below:

5 mL syringe	Smaller syringes	Clamping direction

Move the pump to the assay required position[6]

In most cases, the position of the pump after initialisation will not be suitable for placing the syringe. To move the pump, simply drag the pump plunger on the user interface and drop it to the required position. An indicator of the approximate volume displaced during the pump movement will appear.
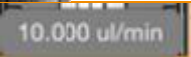
[6] ⚠**Warning:** it is strongly recommended to remove any installed syringe prior to move the pump's plunger. Failure to do so may cause the pump to malfunction during the displacement process.
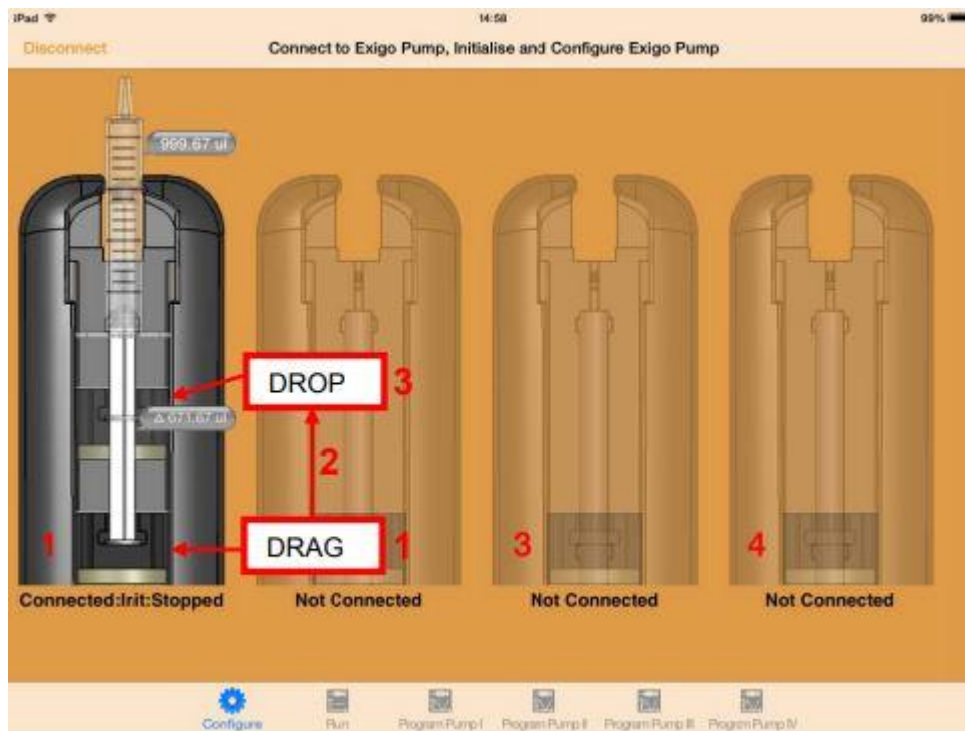
The pump plunger will update its position on the app in real time while the displacement is being performed.

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Run Window Overview

Pump controls		Run/Stop: starts or stops the pump with the selected flow rate.
		Flow rate selector.
		Set: opens the PID and syringe settings.
Flow rate viewer	Displays the current measured flow rate[7].	
Flow rate evolution graph	Displays the measured flow rates during the last 50 seconds	

[7] An ExiGo sensor is required to visualise the pump flow rate.

Manual assay: how to set the flow rate

To set the flow rate manually, please complete the following steps:

1. Click in the flow rate selector:
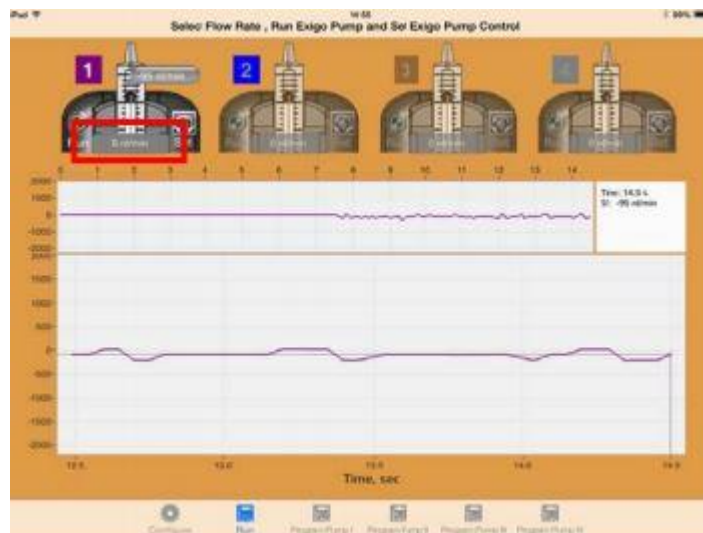
2. Set the desired flow rate value. Slide up and down with your fingers to select the right value:

3. The introduced flow rate should now appear within the flow rate selector:

4. Once the flow rate has been set, press the RUN button to start the pump with the selected flow rate.
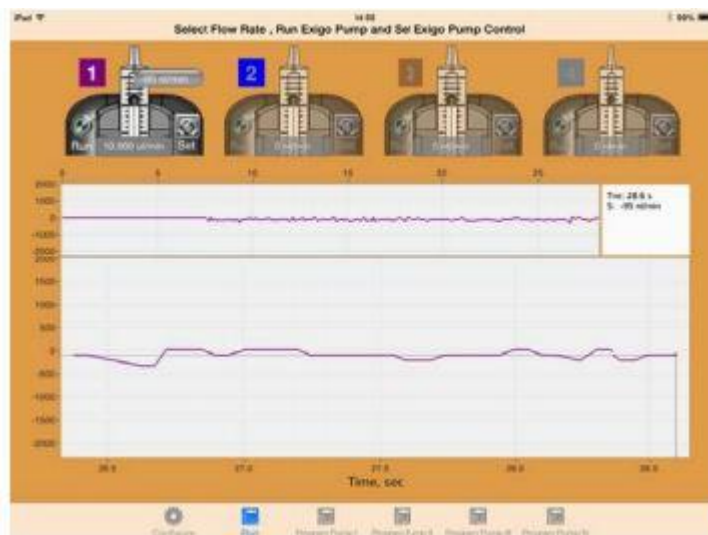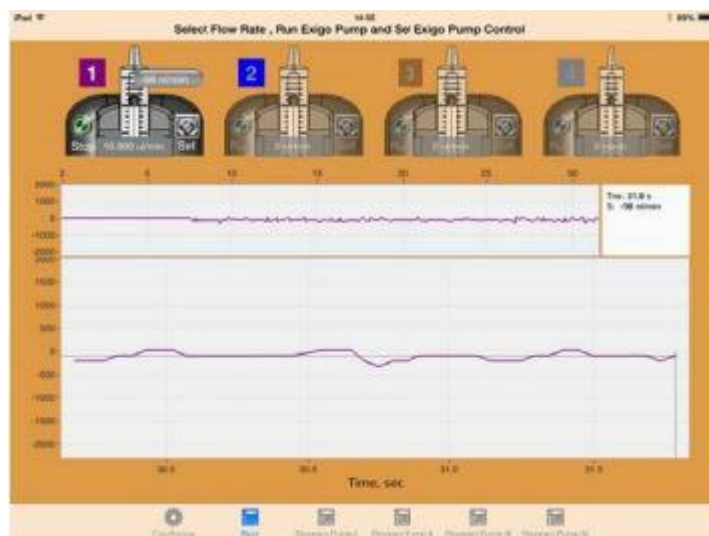

Exigo flow sensor: visualising the flow rates

The performance of the ExiGo pump can be significantly increased by means of using an ExiGo sensor to obtain real-time flow rate feedback. Each ExiGo flow sensor is plug-and-play; therefore it can be connected to the pump at any moment. Immediately after plugging-in the ExiGo flow sensor, the real time flow rate measurements will appear within the flow rate viewer. Once the ExiGo flow sensor is connected, it is possible to activate the PID control to improve the accuracy and dynamic response of the ExiGo pump.
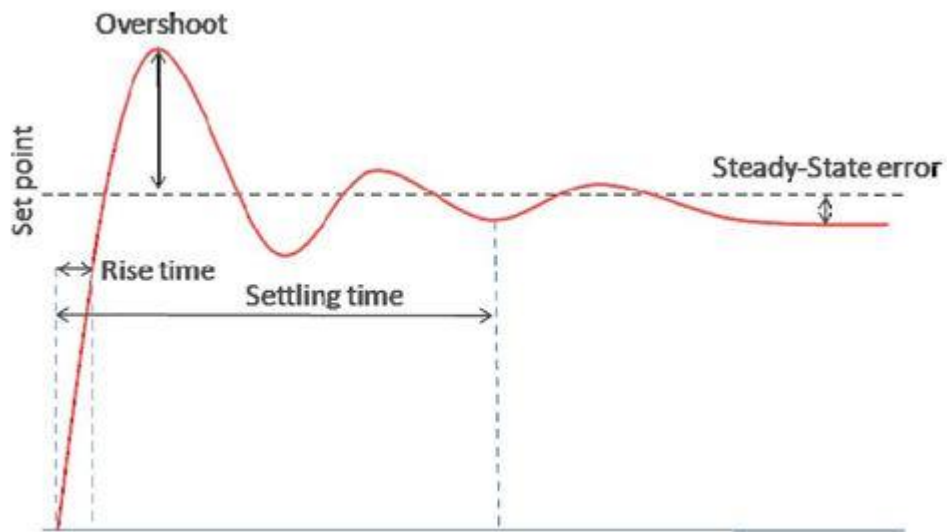
Figure 5

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 Pump Window Overview

	Add Constant	Adds a constant flow rate
Waveform elements bar	**Add Ramp**	Adds a ramp flow rate
	Add Step	Adds a step flow rate
	Add Sine	Adds a sine flow rate
Workspace	Contains the elements of your custom waveform	
Pump(s) control bar	**Program**	Programs the selected pump with the created waveform
	Run	Run the selected pump with the programmed waveform
	Run All	Run the programmed pumps simultaneously
Waveform graph tab	Slide up the bar to see the current waveform	

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Program mode: defining a custom waveform

1. It is possible to program the ExiGo pump to have a precise control of the flow rates and duration of a certain experiment.

2. Click "Program pump X[9]" to open the waveform editor for the selected pump. Add the elements of your waveform by tapping on add constant, add ramp, etc.
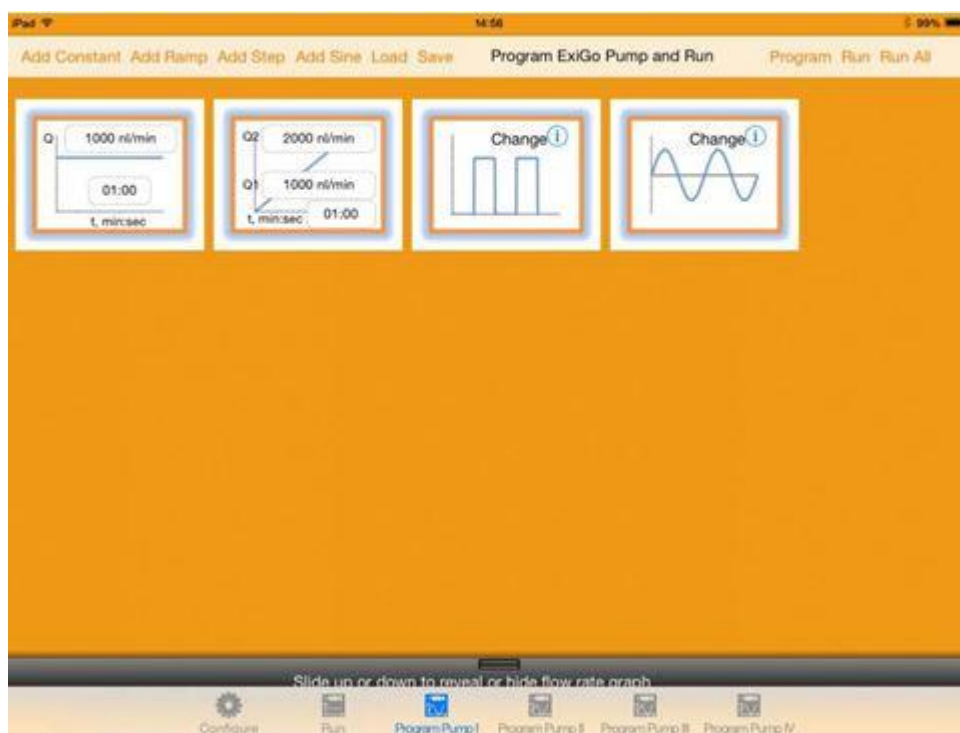
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3. Change the parameters of the elements added (flow rate, running time, etc).

[9] "X" can refer to pumps 1 to 4.

4. Slide up the Waveform graph bar to double check that the graph corresponds with the elements introduced.
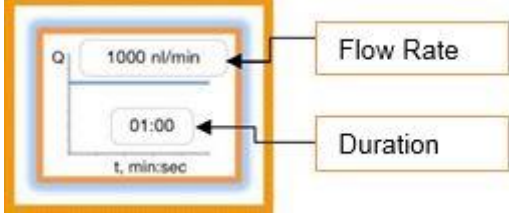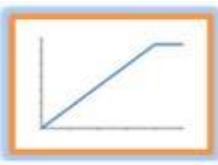

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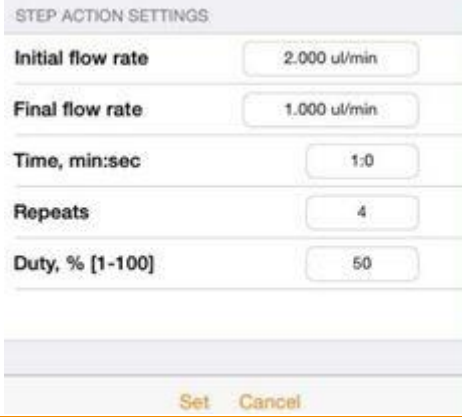
5. Click program to program the custom waveform to the selected ExiGo pump

6. Repeat steps 1 to 3 for the remaining connected pumps.

7. Click "**Run**" to run a particular pump or "**Run All**" to run all the programmed pumps simultaneously.
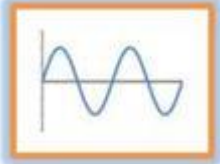
Waveform editor

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

- Constant flow/pause
- Ramp
- TrainPulses
- Sine

Elements description

Constant flow	
Flow rate	Flow rate set point for the constant step. Set to 0 if you would like to create a pause.
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	
Initial flow rate	Maximun flow rate of the pulse(s)
Final flow rate	Minimun flow rate of the pulse(s)
Time, min:sec	Duration of one full cycle of the pulses in minutes and seconds
Repeats	Number of pulses of the Train Pulse step
Duty, % [1–100]	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.

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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
Time, min:sec	Duration of one full cycle of the pulses in minutes and seconds[10]
Repeats	Number of full cycles of the sine wave step
Phase	The starting angle of the sine wave from 0 to 360 degrees

[10] The full duration of the sine wave is determined by period x repetitions.

Rearranging the elements

It is possible to modify the order as well as delete any of the elements of your waveform
To activate the editor mode of the waveform editor please complete the following steps:
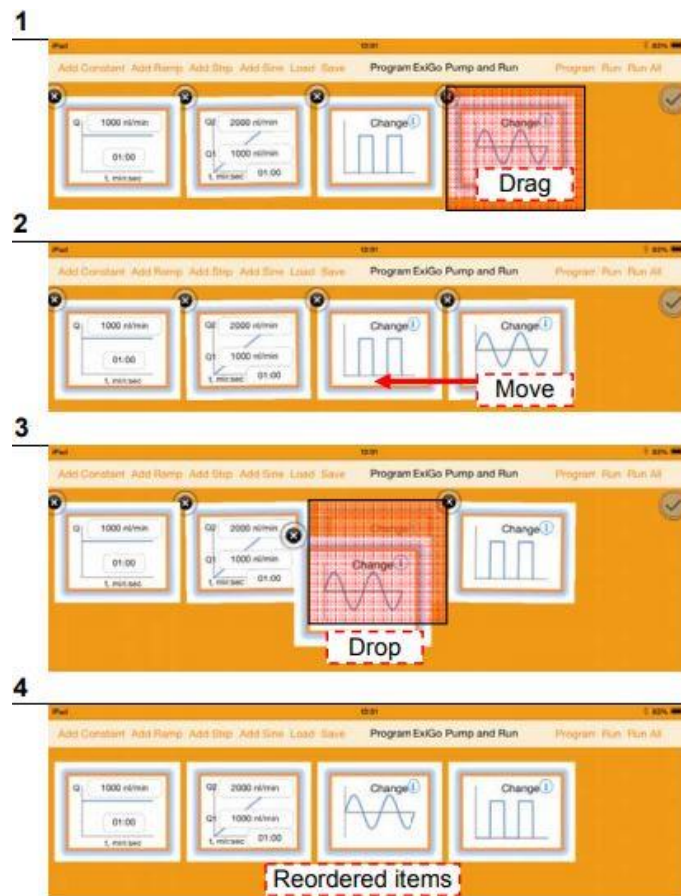
1. Press one of the elements of your waveform for more than 2 seconds

2. The waveform editor is in editor mode now

3. To rearrange the items, simply drag and drop the element to move into the desired position:

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4. The new position of the items can be checked by means of sliding up the Waveform graph bar:
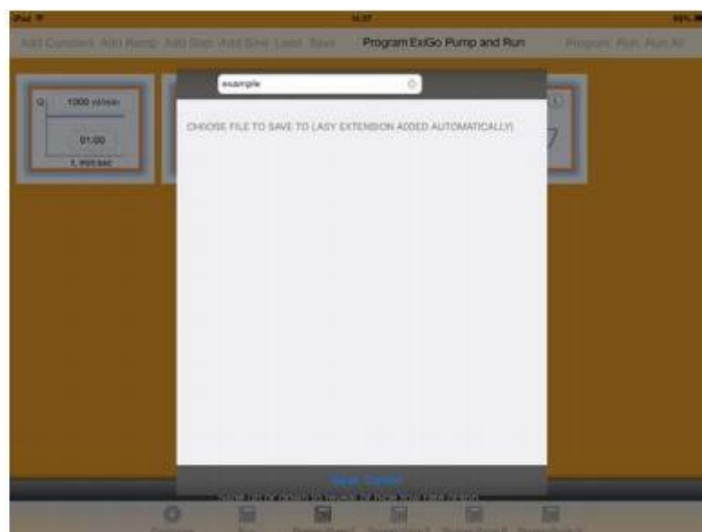

Open/save custom waveforms

One can load and/or save a custom waveform onto a PC using the following buttons:

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| Load	To load a previously saved protocol and program it into the ExiGo pump
Save	To save a custom waveform onto a PC

- Saving a protocol/waveform

To save a custom waveform or protocol, simply tap "**Save**". Type in the name of your waveform and click save.

- Loading a protocol/waveform

To load a custom waveform or protocol, simply tap "Load". Select the previously saved element and click load.

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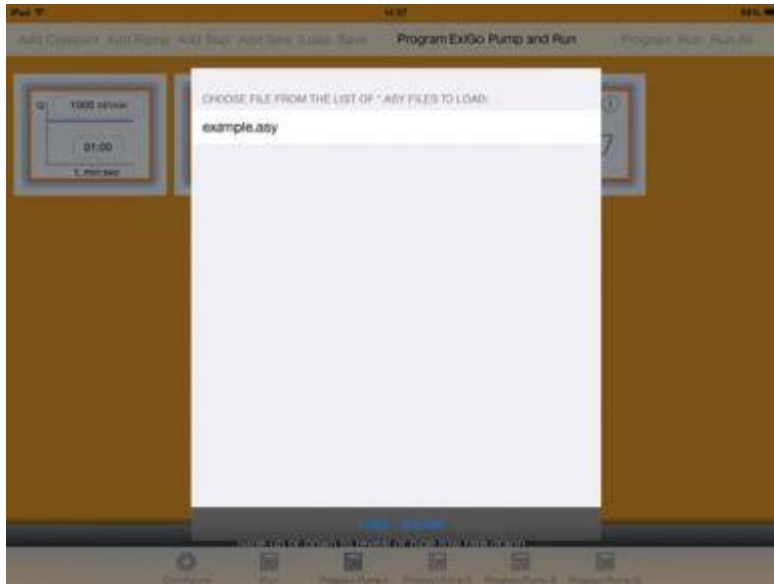
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