HongKe 虹科 doric

光遗传学TTL脉冲发生器

用户手册

Version 1.2.1

Contents

1

General Overview

(a) *4-channel Generator* (b) *8-channel Generator*

Figure 1.1: *Optogenetics TTL Pulse Generator.*

The *Doric Optogenetics TTL Pulse Generator* (OTPG) allows the modulation of pulse signal trains as well as their triggering. The generator connects to a computer using a USB-B cable, while each channel can be connected to a device using a BNC cable. The most commonly used devices are *LED Drivers*, *Laser Drivers* and *Shutters*. It can be used to coordinate between many input/output signal of different devices.

The generator comes in 4-channel (Fig. 1.1a) and 8-channel (Fig. 1.1b) models. For the 4-channel OTPG, all channels can either be used as an output, to deliver a pulse train, or as an input, to receive trigger signals. For the 8-channel OPTG, a maximum of four of any ports can be used as inputs and all ports all can be used as outputs. The OTPG is controlled using the *Doric Neuroscience Studio* (see chapter 2).

2

Operations Guide

The *Optogenetics TTL Pulse Generator* (OTPG; 4 or 8 channels) are controlled by the *Doric Neuroscience Studio*. Various pulses train sequences can be designed for any type of experiment.

The *OTPG* user interface (Fig. 2.1) is split into two main sections: the **Controls & Settings** (Section 2.2) and the **Acquisition view** (Section 2.3). From these sections, the **Channel(s) configuration** (Section 2.1) window can be accessed to add and configure channels.

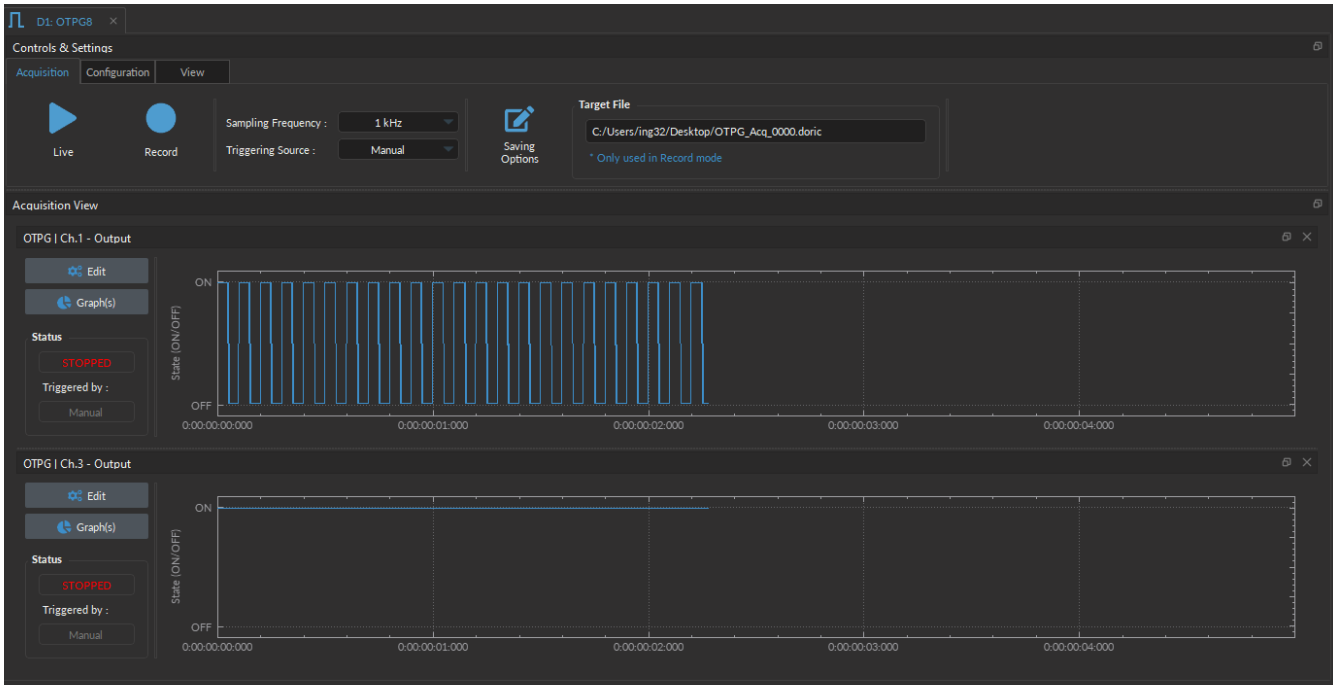


Figure 2.1: *Optogenetics TTL Pulse Generator Interface.*

2.1 Channel Configuration

2.1.1 Channel Configuration Window Overview

Figure 2.2: *Channels Configuration Main Interface.*

The **Channels configuration** window is used to configure each channel. The window can be accessed by using either the **Add channel** or **Edit** buttons. This window is separated into multiple sections shown in Figure 2.2 that are defined below.

1. The **Channel Options** section allows you to define the Channels Type and the Triggering Options. The different fields of this section are explained in more detail in section 2.1.2.
2. The **Sequence Options** defines the parameters of each pulse sequence for the channel. These parameters are different for each Channel Code. Should a parameter chosen be impossible to apply to a sequence (For example, a **Time ON** greater than 1/**Frequency**), the color of the option boxes will turn **RED**. The different fields for the different Channel Mode are explained in more detail in section 2.1.3
3. The **Sequence Preview** section shows a visualization of the output sequence that will be generated by the current configuration.
4. The **Add** button will save the current channel configuration and enables a new channel to be configured. The **Close** button will close the window without saving the current channel configuration.

2.1.2 Channel Options Section

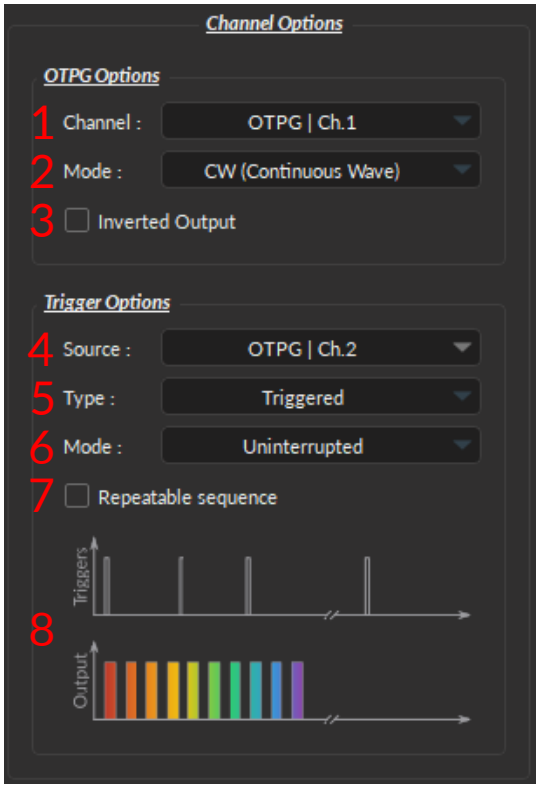


Figure 2.3: *Channel Options of the Channel Configuration Window.*

The Channel Option section is separated in 2 sub-section, the **OTPG Options** section that defines the channel and its mode and the **Trigger Options** section that control the trigger method of the selected channel. The Trigger Options are not available when the channel is in Input mode.

OTPG Options

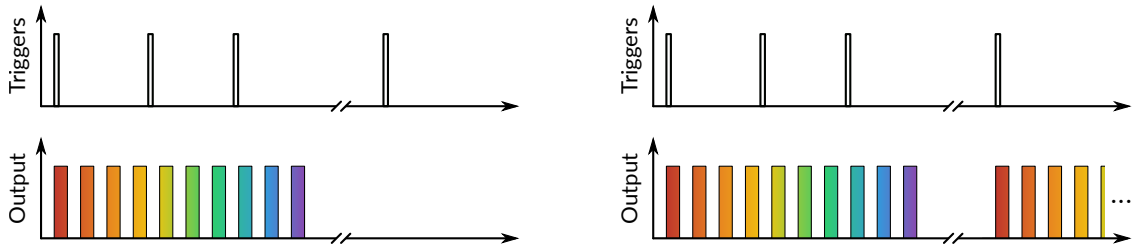
1. The **Channel** field identifies which of the available channels is currently being modified. The channel can be changed by selecting a new one from the drop-down list.
2. The **Mode** field identifies the type of signal sent. Three modes are available, **CW (Continuous Wave)**, **Square**, and **Input** mode. Each mode enables different options of the Sequence Option section that are explained in more detail in section 2.1.3.
3. The **Inverted Output** checkbox reverse the signal output. When selected, the ON TTL signal will send 0 V, while the OFF TTL signal will send 5 V.

Trigger Options

4. The **Source** trigger option allows to chose between a **Manual Trigger** (activated by the user) or an **Input** trigger, which is coming from a channel input.
5. The **Type** defines the type of trigger that is used to start/stop a sequence. The **Triggered** type can starts and stops a sequence at a rising edge while the **Gated** type can starts the sequence at a rising edge and stops it at a falling edge. A more refined interaction of the trigger with the defined sequence can be set up using the **Mode** field. Not all Trigger Type are available for each combination of Trigger Mode and Repeatability. The different combinations are shown in Figure 2.8.

6. The **Mode** field defines how the trigger activates a sequence. Each mode are not compatible with each combination of trigger type and repeatability. Figure 2.8 shows the different available combinations for the different Trigger Modes. Four Modes are available and are the following:

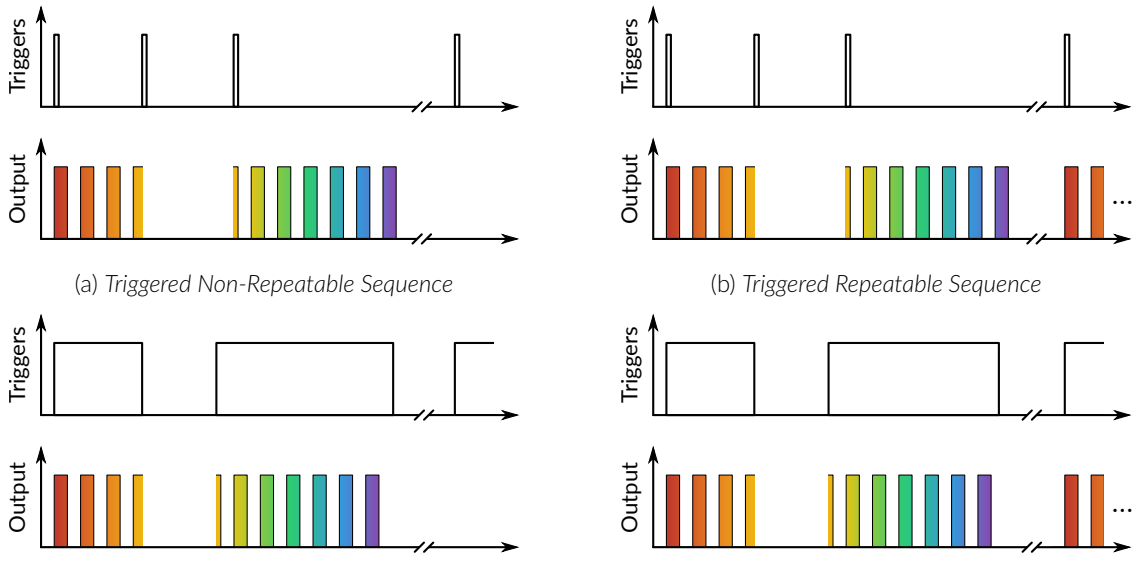
   - **Uninterrupted**: This mode activates the channel sequence when an input greater than 3.3 V is detected by the BNC input. Following input pulses will be ignored while the sequence is running (Fig. 2.4). When the **Repeatable sequence** checkbox is checked, the sequence will restart with the arrival of the first input pulse after the sequence has finished (Fig. 2.4b). This mode is available for *Triggered* pulse only.



(a) *Triggered Non-Repeatable Sequence* (b) *Triggered Repeatable Sequence*

Figure 2.4: *Uninterrupted Sequence Mode.*

   - **Pause**: This mode activates the channel sequence when a rising edge greater than 3.3 V is detected on the BNC input (Fig. 2.5). Following input pulses (when *Triggered*, Fig. 2.5a) or falling edge (when *Gated*, Fig. 2.5c) will pause the sequence and the sequence will continue when the next rising edge is received. When the **Repeatable sequence** checkbox is checked, the sequence will restart with the arrival of the first input pulse after the sequence has finished (Figs. 2.5b and 2.5d).

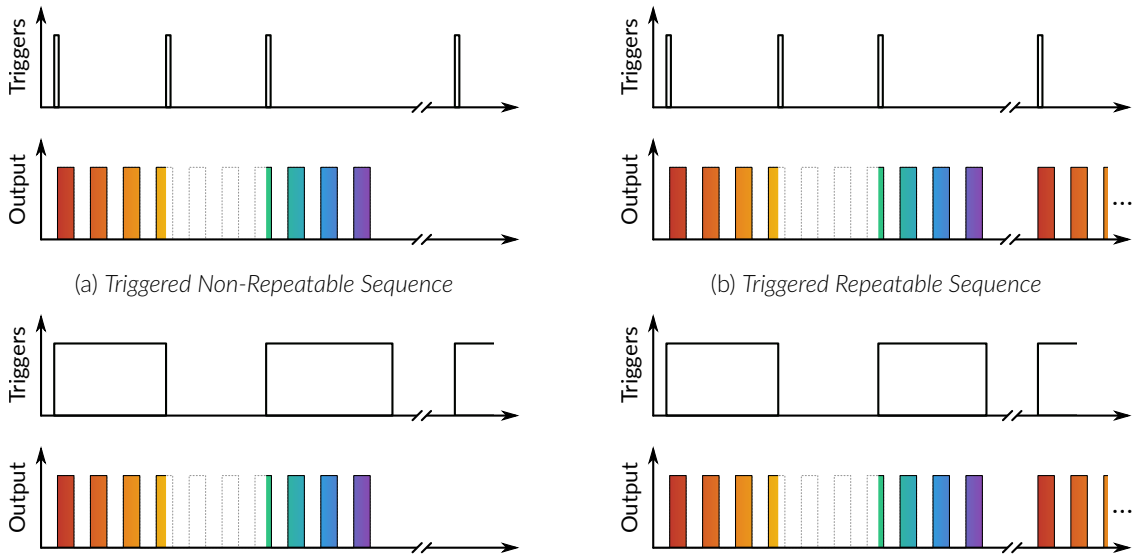


(a) *Triggered Non-Repeatable Sequence* (b) *Triggered Repeatable Sequence*

(c) *Gated Non-Repeatable Sequence* (d) *Gated Repeatable Sequence*

Figure 2.5: *Pause Sequence Mode.*

   - **Continue**: This mode activates the channel sequence when a rising edge greater than 3.3 V is detected on the BNC input (Fig. 2.6). The following input pulse (when *Triggered*, Fig. 2.6a) or a falling edge (when *Gated*, Fig. 2.6c) will turn off the output, but the sequence will continue. The output will be turned back on at the reception of the following rising edge. Triggers only affect the output voltage value. When the **Repeatable sequence** checkbox is checked, the sequence will restart with the arrival of the first input pulse after the sequence has finished (Figs. 2.6b and 2.6d).
   - **Restart**: This mode activates the channel sequence when a rising edge higher than 3.3 V is detected on the BNC input. The following input pulse (when *Triggered*, Fig. 2.7a) or falling edge (when i, Fig. 2.7b) will

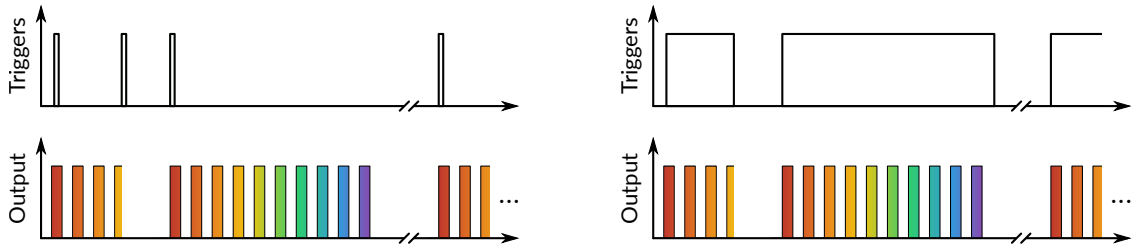


(a) *Triggered Non-Repeatable Sequence* (b) *Triggered Repeatable Sequence*

(c) *Gated Non-Repeatable Sequence* (d) *Gated Repeatable Sequence*

Figure 2.6: *Continue Sequence Mode.*

stop the sequence and the sequence will restart from the beginning when the next rising edge is received. When the sequence is completed, it will restart with the next input pulse.



(a) *Triggered Non-Repeatable Sequence* (b) *Triggered Repeatable Sequence*

Figure 2.7: *Restart Sequence Mode.*

	Triggered		Gated	
	Non-repeatable sequence	Repeatable sequence	Non-repeatable sequence	Repeatable sequence
Uninterrupted	✓	✓		
Pause	✓	✓	✓	✓
Continue	✓	✓	✓	✓
Restart		✓		✓

Figure 2.8: *Trigger options possibilities.*

7. The **Repeatable sequence** checkbox, when selected, allows a sequence to be repeated. Not all modes and trigger types can be repeated. Please refer to the Figure 2.8 to know the repeatable sequence combinations.

8. The **Sequence Visualisation** shows a graphical representation of the behavior of the selected Trigger Option Type, Mode and Repeatability.

2.1.3 Sequence Options Section

CW (Continuous Wave) Mode

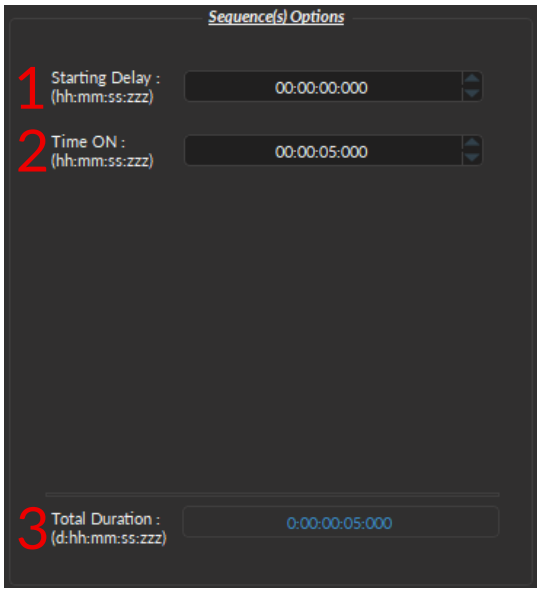


Figure 2.9: *Sequence Options of the CW Channel Mode.*

The **CW (Continuous Wave)** channel mode allows the creation of a continuous TTL signal. The following elements appear in the **Sequence Options** section (Fig. 2.9).

1. The **Starting Delay** defines the time between the activation of the pulse sequence and the beginning of the signal.

2. The **Time ON** defines the length of time the continuous signal is active. Should the time chosen be 0, the signal will continue until the pulse is stopped manually.

3. The **Total Duration** shows the total expected duration of the pulse sequence. Should the duration be infinite, the box will display ∞. If there is an error in parameter selection, this box will display **N/A**.

Square Mode

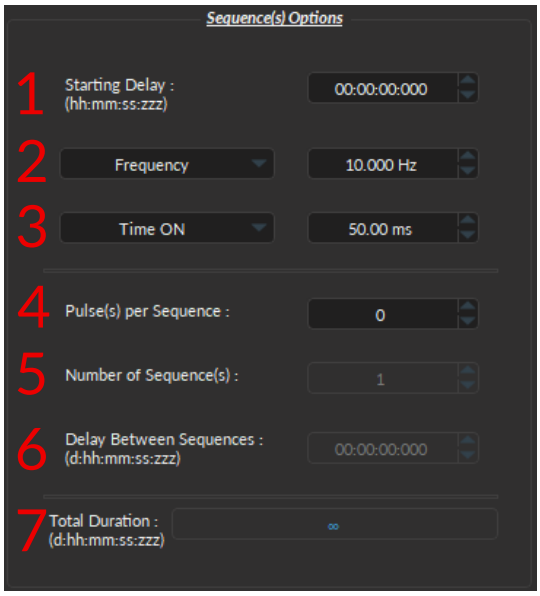


Figure 2.10: *Sequence Options of the Square Channel Mode.*

The **Square** channel mode allows the creation of a square TTL pulse sequence. The Sequence Options of this mode are shown in Figure 2.10 and are explained below.

1. The **Starting Delay** defines the time between the activation of the pulse sequence and the beginning of the signal.
2. The **Frequency** sets the frequency (in Hz), which is the number of pulses per second. The frequency can also be changed to the **Period**. For example, a signal at 10 Hz (frequency) will output one pulse every 100 ms (period), whereas a signal at 0.5 Hz (frequency) will output one pulse every 2 seconds (period).
3. The **Time ON** defines the length of a single pulse. This time can also be converted to a **Duty Cycle**, which represents the % of the period the pulse duration corresponds to.
4. The **Pulse(s) per sequence** set the number of pulses per sequence. If it is set to 0, the number of pulses will be infinite.
5. The **Number of sequence(s)** sets the number of times that the sequence will be repeated.
6. The **Delay between sequences** sets the delay between each sequence.
7. The **Total Duration** shows the total expected duration of the pulse sequence. Should the duration be infinite, the box will display ∞. If there is an error in parameter selection, this box will display **N/A**.

Input Mode

The **Input** mode (Fig 2.11) records a signal as long as there is a high TTL signal on the chosen console channel. The channel can then be used as a trigger source for all the other channels of the OTPG. No **Sequence Options** or **Sequence Previews** are available for this mode.

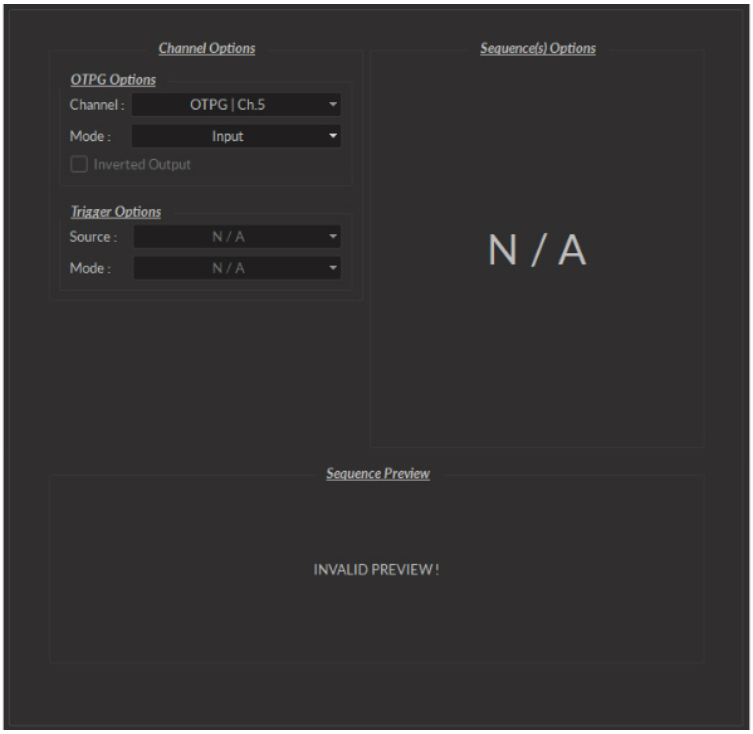


Figure 2.11: *Channels Configuration of the Input Mode Interface*

2.2 Control and Settings

The **Control and Settings** box is used to manage the different parts of the software. It contains three tabs, the **Acquisition**, **Configuration**, and **View** Tabs.

2.2.1 Acquisition Tab

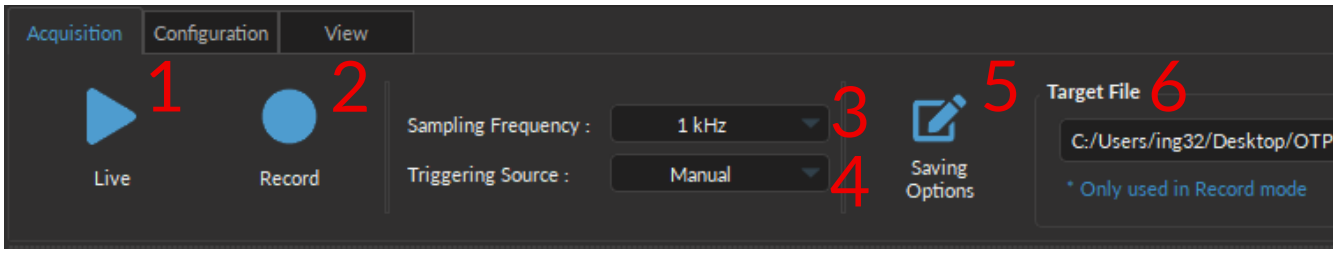


Figure 2.12: *Acquisition Tab*

The different buttons and fields of the **Acquisition Tab** are shown in Figure 2.12 and their functions are explained below.

1. The **Live** button starts all the configured channels without recording their signal.
2. The **Record** button starts all the configured channels and record the signal for each of them at the defined **Sampling Frequency**. The recorded datas are saved in a .doric file (hdf5 based file) where the saved path and filename can be defined through the **Saving Options** button.
3. The **Stampling Frequency** field defines the frequency at which the recorded signal (using the Record button) is sampled. Note: In Doric Studio version 6 and later, the record button also saves the configuration of the OTPG (channel parameters, sampling frequency, ...) in the same .doric file. Use the Load config button (see section 2.2.2) to load this parameters.

4. The **Triggering Source** field defines if the sampling will be triggered manually (by clicking Live or Record) or will be triggered by one of the input channel.
5. The **Saving Options** button opens an external window that allows you to configure the saving path and filename of the channels signal file.
6. The **Target File** field indicates the saving path and filename of the channels signal file.

2.2.2 Configuration Tab

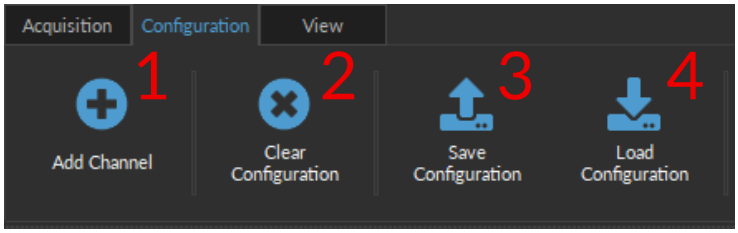


Figure 2.13: *Configuration Tab*

The different buttons of the **Configuration Tab** are shown in Figure 2.13 and their functions are explained below.

1. The **Add Channel** button opens the **Channels configuration** window to setup the channels. This window is detailed in section 2.1.
2. The **Clear Configuration** button resets the acquisition view and all other parameters set. Any configurations already set will be lost.
3. The **Save Configuration** button is used to save the OTPG configuration in a **.doric** format.
4. The **Load Configuration** button allows an OTPG configuration in **.doric** format to be loaded. Recorded data files also contains the configuration used during the experiment and this configuration can be loaded using this button.

2.2.3 View Tab

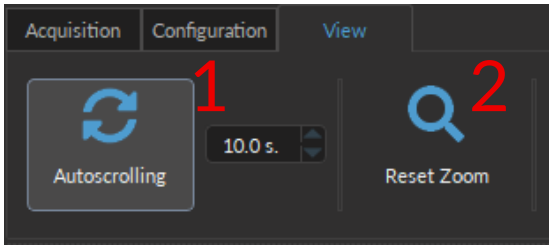


Figure 2.14: *View Tab*

The different buttons and fields of the **View Tab** are shown in Figure 2.14.

1. The **Autoscrolling** button, when clicked, makes the graphs scroll as new data appears. The duration (in seconds) kept on display is controlled by the field beside the button.
2. The **Reset Zoom** button resets the horizontal axis of all graphs displayed in the **Acquisition View** to the duration chosen in the **Autoscrolling** field.

2.3 Acquisition View

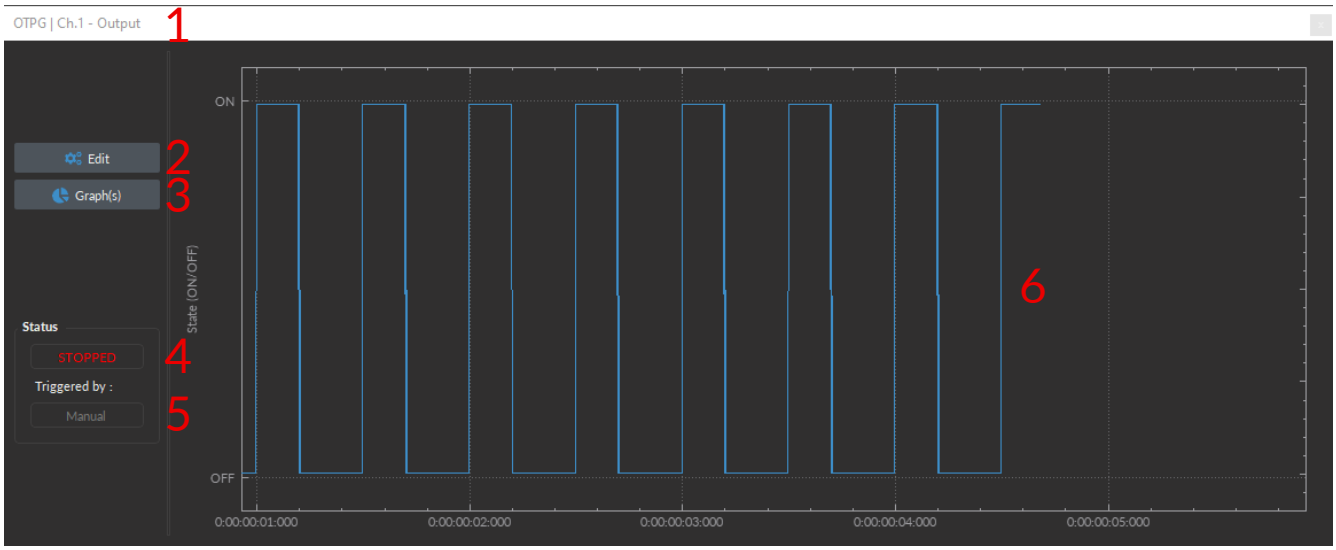


Figure 2.15: *Acquisition View Box*

The **Acquisition View** box displays all the information concerning active channels. Each channel chosen using the **Add Channel** button is displayed in this section, occupying a rectangular box. Each **Channel box** shows the following basic elements shown in Figure 2.15.

1. The **Channel name** is located on the upper left of the **Channel box**, identifying the type of channel and it's number, corresponding to the one displayed on the *OTPG*. The channel name can be modified in the Graph(s) menu.
2. The **Edit** button allows the editing of channel parameters, opening the **Channel Configuration** window. For additional information, see section 2.1.
3. The **Graph(s)** button opens an external window with options to change the displayed parameters of the graphic as well as the possibility to change the graphic name.
4. The **Status** box shows whether the channel is active, displaying **STOPPED** when inactive and **RUNNING...** when active.
5. The **Triggered By** box shows the current trigger source of the channel sequence.
6. The **Sequence Display** box shows a graphic of the recorded channel. It shows the signal as it is generated by an output channel or as it is received by an input channel. The sampling rate of the displayed graphic is controlled by the **Sampling Frequency** field in the Acquisition Tab.

3

Specifications

Table 3.1: *General Specifications*

SPECIFICATIONS	VALUES	NOTES
Maximum On/Off Time	5 hours/Infinity	
Maximum Sequence Duration	Infinity (continuous) or 10^7 Pulses	
Minimum Pulse Duration	0.017 ms	
Time Resolution Accuracy	± 1 µs*# of channels running	
Maximum Value of Repeat	4 294 967 296	
Maximum/Minimum Pulse Frequency	30 kHz / $5.47e^{-5}$ Hz	
Pulse Stability	0.1 µs	
Voltage Output	5 V	
Maximum Input Voltage	5 V	
TTL level	Hi > 3.3 V; Low < 1.5 V	
Current Consumption	<100 mA (4 ch)/ <200 mA (8ch)	Powered by computer USB port
Output Current	20 mA (Maximum)	
Dimensions		
4-channel OTPG	135 x 58 x 21 mm^3	Depth includes connectors
8-channel OTPG	135 x 70 x 21 mm^3	Depth includes connectors
Mass		
4-channel OTPG	174 g	
8-channel OTPG	199 g	

Table 3.2: *Recommended Environmental Specifications*

DESCRIPTION	OPERATION	STORAGE
Use	Indoor	Indoor
Temperature	0-40 °C	0-40 °C
Humidity	40-60 % RH, non condensing	40-60 % RH, non condensing

4

Support

4.1 Maintenance

The product does not require any maintenance. Do not open the enclosure. Contact Doric Lenses for return instructions if the unit does not work properly and needs to be repaired.

4.2 Warranty

This product is under warranty for a period of 12 months. Contact Doric Lenses for return instructions. This warranty will not be applicable if the unit is damaged or needs to be repaired as a result of improper use or operation outside the conditions stated in this manual. For more information, see our Website.

4.3 Disposition

Figure 4.1: *WEEE directive logo*

According with the directive 2012/19/EU of the European Parliament and the Council of the European Union regarding Waste Electrical and Electronic Equipment (WEEE), when the product will reach its end-of-life phase, it must not be disposed with regular waste. Make sure to dispose of it with regards of your local regulations. For more information about how and where to dispose of the product, please contact Doric Lenses.

4.4 Contact us

For any questions or comments, do not hesitate to contact us by:

Phone 1-418-877-5600

Email sales@doriclenses.com

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