MyoPacer

Manual Revision 7
June 2020

ION OPTIX

address:	IonOptix
	396 University Ave
	Westwood, MA
	02090
phone:	617-696-7335
fax:	617-698-3553
email:	info@ionoptix.com
web:	www.ionoptix.com

Contents

Introduction

Overview

The MyoPacer is a simple stimulator designed specifically for the pacing of myocytes. It features multiple stimulation waveforms of up to 40 volts peak to peak. The MyoPacer can act as a stand alone device or can be synchronized to a TTL signal.

This manual is intended to describe the basic connections and operation of the MyoPacer.

User's Guide Conventions

The following stylistic conventions are used throughout this and other IonOptix manuals.

Small Bold Helvetica text refers to specific named items. This includes keystrokes or mouse button selections that, when selected, execute a function. It is includes the names of dialog boxes or window titles.

Bold Italic text refers titles of books and other manuals or sections thereof. The section symbol *§* may be included to indicate that the following name is a section in a manual.

Hardware

Overview

In this Chapter, the hardware related aspects of the MyoPacer will be discussed. The discussion is broken into two parts, the front panel and the back panel.

For a discussion of the menus that actually program the MyoPacer, please see Chapter 2.
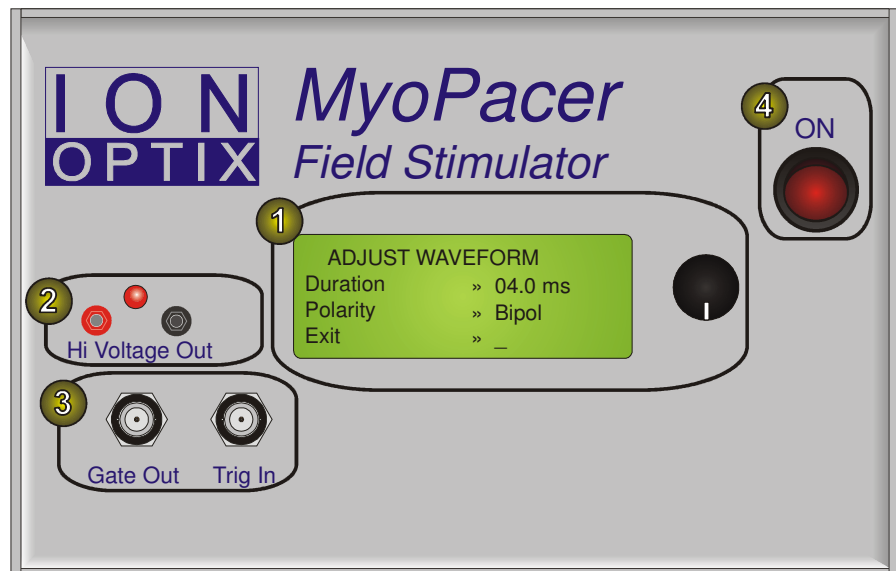
Front Panel

Figure 1 Front Panel Sections: 1) User Interface (LCD and Encoder); 2) High Voltage Output; 3) I/O (Gate Out and Trig In); 4) Power Switch and LED

The front panel of the MyoPacer has four main sections as numbered in the above figure:

1. the user interface section,

2. the high voltage output,

3. the digital I/O section,

4. and the power switch.

The user interface provides and LCD screen and digital encoder for user interaction with the device. Chapter 2 details the operation of the encoder and LCD menu navigation.

The high voltage output and digital I/O sections provide interconnects for basic MyoPacer functionality (the back panel provides interconnects to the lesser-used features of the MyoPacer). All four front panel sections are detailed below.

User Interface

The MyoPacer is designed to be easy programmable under experimental conditions. The interface consists of a 16x4 character LCD screen with displays control menus to the user, and an optical encoder to allow for interaction with the menus.

To permit one-handed adjustment, we used an **Encoder** (or dial) that can be turned as well as clicked. In general, turning the dial edits a current selection whereas clicking the dial will enter or exit the selected item.

High Voltage Section

The high voltage section of the MyoPacer consists of two connectors and a LED indicator.

Connectors

The MyoPacer is connected to the stimulation electrodes via the two 2 mm connecting pins. The black connector is at the ground potential while the red connector is the high-power pacing signal. The maximum voltage that can be output on the red terminal is plus or minus 40 V. The MYP100 output is current limited at 120 mA.

Pacing Indicator

The red LED on the Front Panel, right above the high voltage output is directly connected to the high voltage output and will blink red every time a pulse is output. It will remain on for the duration of the pulse.

I/O Section

The MyoPacer provides two I/O connections on the front panel via standard BNC connectors: the gate out signal and the trig in signal. These signals allow for communication between the MyoPacer and other instruments.

Gate Out

The **Gate Out** signal outputs a TTL pulse with every high voltage pulse. The duration of the TTL pulse is the same as the duration of the high voltage pulse. In the IonOptix system this TTL pulse can be used for synchronization of contraction transients. In that case, the **Gate Out** is connected via a BNC cable to the **Mark Input** of the interface box (DSI and FSI). The pulses are then stored as event marks in the IonOptix data files. When storing your experiment on videotape, the TTL pulse can be stored on the audio channel to allow synchronization of the contractions during analysis off-line.

Trig In

The **Trig In** takes a TTL pulse from an outside source to directly. If the **Time Mode** is set to **external triggering**, a rising edge on this signal will cause the MyoPacer to output the appropriate pacing waveform.

Power on/off switch

Power to the MyoPacer is turned on and off with the switch located on the lower right half of the front panel. Flipping the switch to the 'on' position lights up the indicator LED above it, and, after about 1 second, the LCD display will light up.
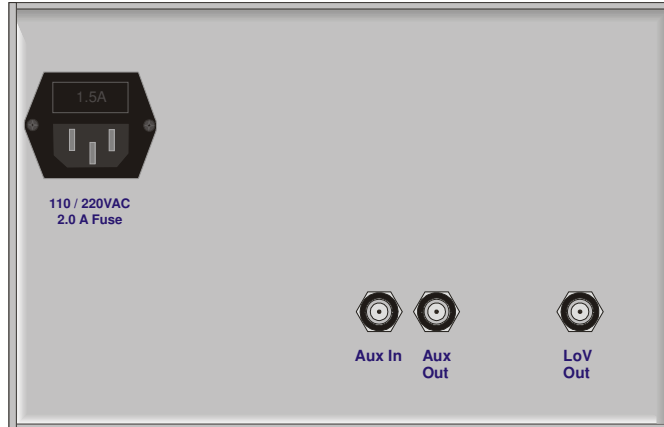
Back Panel

Figure 2 Back panel

Aux out

Identical to *Gate out*, it produces a TTL pulse with every high voltage stimulus.

Aux In

No functionality in this version.

LoV out

Low voltage out is a ±5 V analog channel showing the output of the high voltage stage; +5 V corresponds with 40 V on the high voltage stage, -5 V corresponds with –40 V.

Power inlet

The MyoPacer has a Universal Wide Range Input power supply, with UL, CSA, TUV, and CE mark approval. This means it can be used with power grid voltages ranging from 85 to 265 V AC.

Software

Overview

The heart of the MyoPacer is a microprocessor that is programmed to give the user a wide range of options in setting the stimulator. The user interface with the microprocessor is an LCD screen with an encoder knob that allows navigation through the different menus. In this chapter, each of the menus will be discussed, providing the information needed to program the MyoPacer.

Use of the encoder

The encoder operates the MyoPacer. The encoder has 2 modes of operation; turning, and clicking, by pushing on the encoder. Turning scrolls through the menus, the parameter of choice is selected with a click, and changed by turning the encoder again. The desired value is stored by another click.
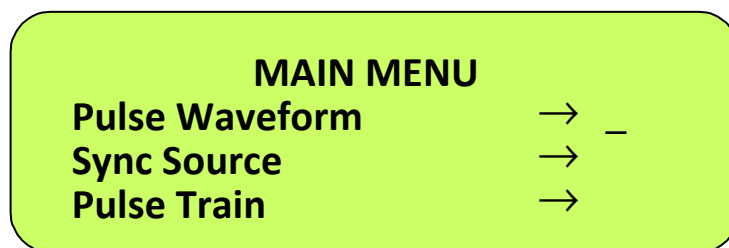
Menus

Main Menu

Figure 3 Main Menu

After turning on the power, the main menu will appear on the LCD screen. Via the main menu you go to the different submenus that allow you to program the MyoPacer. To go to one of the submenus, move the cursor that is on the right-hand side of one of the arrows, to the desired line by turning the encoder. Then click by pushing the encoder. The content of each of the 3 submenus, Pulse Waveform, Sync Source, and Pulse Train, is discussed in a separate paragraph below.

Pulse waveform –pulse duration and polarity

ADJUST WAVEFORM

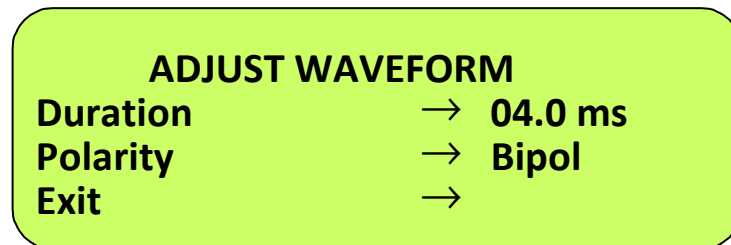|		
Duration	→	**04.0 ms**
Polarity	→	**Bipol**
Exit	→	

Figure 4 Menu for adjusting the waveform

Selecting the *Pulse Waveform* brings up a menu where you have the ability to adjust the *pulse duration* and the *polarity* of the waveform. The default pulse duration is 4 ms. If you want to change the default value, turn the encoder till the cursor is on the line of *duration* and click to select it. Turning the encoder will then change the value. The upper and lower limits of the pulse duration are 90 and 0.4 ms respectively.

Default for polarity is a *bipolar* pulse. Selecting *polarity* and subsequently turning the encoder scrolls you through *alternating*, *positive* and *negative*. Figure 2 shows a schematic drawing of the four pulse shapes.   When you have arrived at the desired option, click the encoder, and exit the menu
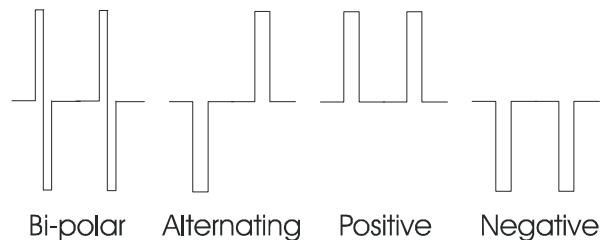

Bi-polar   Alternating   Positive   Negative

Figure 5 The MyoPacer offers four pacing modes.

Sync Source –internal or external timing

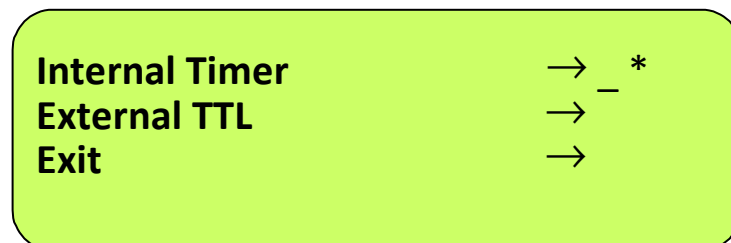|		
Internal Timer	→	_ *
External TTL	→	
Exit	→	

Figure 6 Menu for setting the timer or sync source

The MyoPacer can use 2 different sources for the timing of the stimulus. *Internal* timing uses the 10 MHz clock speed of the microprocessor. This allows the timing of pulse duration and pulse frequency to be very precise; the period between pulses is accurate within 50 μs.

The second option is synchronizing the MyoPacer to external stimuli from for example a pulse generator. Set the *sync source* to e*xternal TTL*, and connect the pulse generator to Trig In on the front panel. With every TTL pulse coming in, the MyoPacer will put out a stimulus pulse. You will still have to specify the *amplitude*, *duration* and *waveform* of the stimulus.

Pulse train –frequency and amplitude

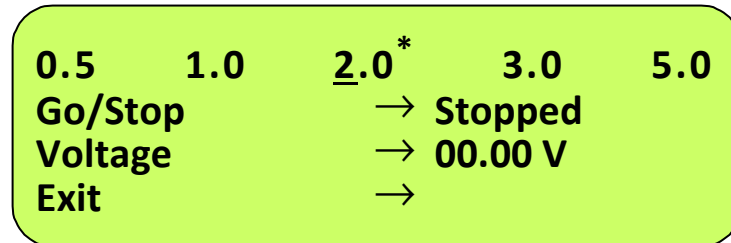| 0.5 | 1.0 | 2.0* | 3.0 | 5.0 |
Go/Stop		→ Stopped		
Voltage		→ 00.00 V		
Exit		→		

Figure 7 Menu for setting pacing frequency and voltage

The *pulse train* menu is the most frequently used menu and probably the only menu that you will need to use during the experiment. Here frequency and amplitude are adjusted and it is the menu where you start the pacing.

Adjusting frequency

The Myp100 allows to preset 5 stimulus frequencies. The five frequencies are displayed on the top line of the *pulse train* menu. Default values are 1.0 for all frequencies. In order to change a frequency, turn the *encoder* till the cursor is placed under the frequency you want to alter. Click the encoder to get into the frequency sub-menu.
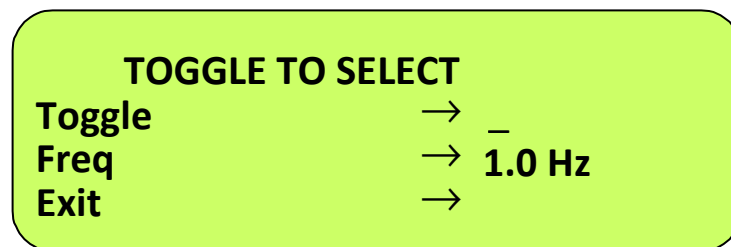
TOGGLE TO SELECT
Toggle → _
Freq → 1.0 Hz
Exit →

Figure 8 Submenu for adjusting the frequency

The *Toggle* line is used to actually select that frequency as the pacing frequency. When clicking *Toggle* you will return to the previous menu, but now the asterisk will be placed at the frequency that you just selected.

On the *frequency* line, the frequency gets adjusted. Put the cursor on the frequency line, click, and turn the encoder to get to the desired frequency. To adjust to sub 1 Hz values, or to get fractions (e.g. 1.5 Hz), click again. This will put the cursor under the second digit, which can now be adjusted.

If you have adjusted the frequency, but don't want it selected yet, leave the menu via the Exit line.

This way you can pre-set 5 frequencies. During the experiment it is possible to quickly switch between the frequencies by double clicking the desired frequency; the first click brings you to the sub menu, the second click toggles the frequency.

Go/Stop

Clicking the *Go/Stop* line activates and deactivates the high voltage stage. In other words; the pacing stimuli will not start until Go/Stop is set to *Running*. The pacing frequency will be the frequency on the top line that is indicated with an asterisk

Voltage

The default *Voltage* setting is set to 0 V. This will prevent inadvertently starting to pace the cells at a high voltage. It also means that no cells will start pacing unless the voltage has been adjusted. Selecting Voltage by clicking the encoder will put the cursor under the first digit, and turning the encoder will change the voltage in 10V steps. For fine adjustment click the encoder again. This will put it under the next adjustable digit. Putting the cursor under the right most digit (3 clicks) allows adjustment of the voltage in 0.05 V steps. Maximum voltage is 40 V in the current version of the MyoPacer. Note that the current is limited to 120 mA. When the current demand exceeds 120 mA, the stimulator will not put out the specified voltage anymore, but a lower number.

Index