Stimulus Generators 4000 Series and 3008-FA

- Completely software driven

- Current and voltage stimulation

- 3 current output ranges available

- Arbitrary analog waveforms

- Integrated isolation units

- Version with integrated amplifier

STG4000 series: Current and voltage stimulation

Three functions- One device

The stimulus generators of the 4000 series fulfill three functions in one device:

- Current driven stimulation
- Voltage driven stimulation
- Controlling and timing

Main advantages

- 2, 4 or 8 completely independent stimulus outputs available
- For a broad range of applications
- Voltage or current mode selectable via software, 3 current output ranges available
- Optically isolated outputs with the ability to provide any arbitrary analog waveform as a stimulation signal
- One TTL in- and output for each stimulation channel for synchronization with data acquisition or for triggering other devices
- Dynamic online changes and downstreaming

Any arbitrary analog waveform as stimulation signal

A stimulus isolation unit (SIU) is included for each stimulation channel. Therefore, no external SIU is required. You just need to plug in your STG and start your experiment.

Every stimulation channel is freely programmable. You can design any arbitrary analog waveform as stimulation signal for every single channel. There is no need to combine channels to achieve complex stimulation patters, but they can be created for every separate channel either by the included software MC_Stimulus II or by downloading any biological signal to the STG.
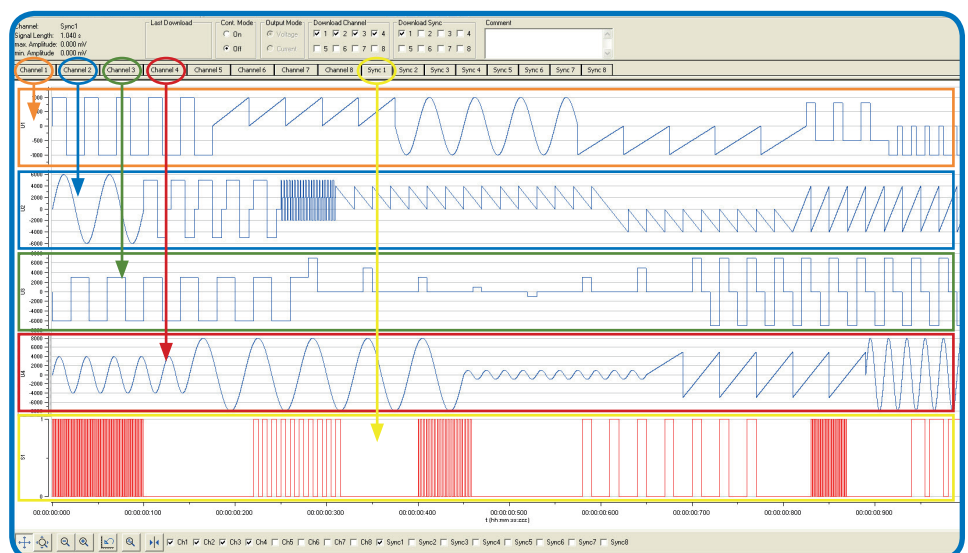
TTL in-/outputs for every stimulation output

The stimulators can receive and deliver TTL pulses via BNC connectors for every single stimulation output. These triggers allow you to control and synchronize other instruments like imaging systems, LED-lights, data acquisition systems, and many more - at a 20 µs precision.

Backside of the STG4008 with 8 digital in- and outputs

Voltage or current mode selectable via software

The STGs of the 4000 series offer the possibility to select the output mode via software. This way, you can switch between voltage and current stimulation easily and quickly.

For the perfect adaption to your experiment, you can select between STG versions with three different current outputs, the voltage output stays the same, no matter which version you choose.

Current output	Voltage output
-160 µA to +160 µA @ 120 V	-8 V to +8 V @ +/-20 mA
-1.6 mA to +1.6 mA @ 120 V	-8 V to +8 V @ +/-20 mA
-16 mA to +16 mA @ 120 V	-8 V to +8 V @ +/-20 mA

Dynamic online changes and downstreaming

The stimulus generators of the 4000 series are the only commercially available pulse generators that can dynamically change the output signal and downstream pulses during stimulation. Thus, you can stimulate continuously over several days, weeks, even months, and generate stimulation sequences on the fly during the experiment.

Imagine the possibilities of the system, like feedback studies or modulated white-noise stimulation. The Stimulus Streamer, a basic program for loading and playing ASCII and MP3 files, will be provided, but you can integrate the program controls (DLL) into your custom program as well. For example, you can use biological signals recorded with your custom data acquisition system and feed the data directly into the stimulus generator, making it perfect for neuronal network studies.
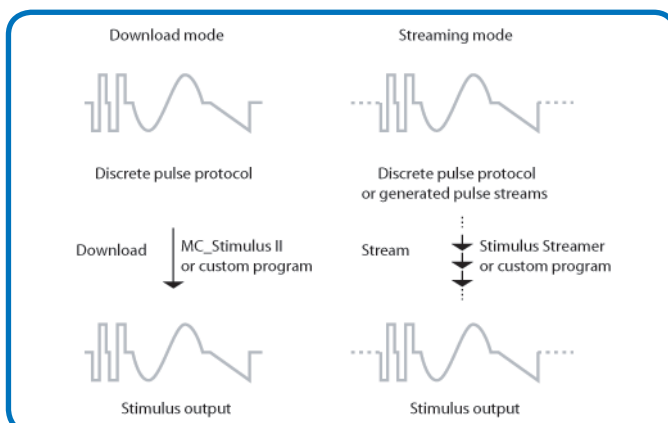
For a broad range of applications

Neuronal networks:

- Long-time stimulation
- Feedback stimulation
- White noise stimulation
- Biological signals as stimulation patterns
- Multiple files can be applied to one or more electrodes

Brainslices:

- Flexible LTP induction patterns
- Studies of synaptic plasticity

Sceletal Muscle:

- Evoke isometric and isotonic contractions

Cardiac cells and tissues:

- Study influence of artificial pacemakers
- Pace cardiac cell cultures
- Pace tissue preparations like slices, purkinje fibers, or papillary muscle
- Mimic cardiac environment during stem cell differentiation

Software: MC_Stimulus II

Freely programmable waveforms

You can easily design your own waveforms with the WYSIWYG editor of the included stimulus software: freely combine mono- or biphasic rectangular pulses, ramps, or sine waveforms to design stimulation patterns of unlimited complexity on each output channel.

Single pulses can be grouped and looped to generate pulse trains with individual timing and intervals. You can apply a completely different protocol to each of the up to 8 stimulation outputs. Repeat your stimulation protocol as many times as you need or let it run infinitely and then stop it manually or on a trigger event. An internal quartz-controlled clock guarantees precise timing over a long period.
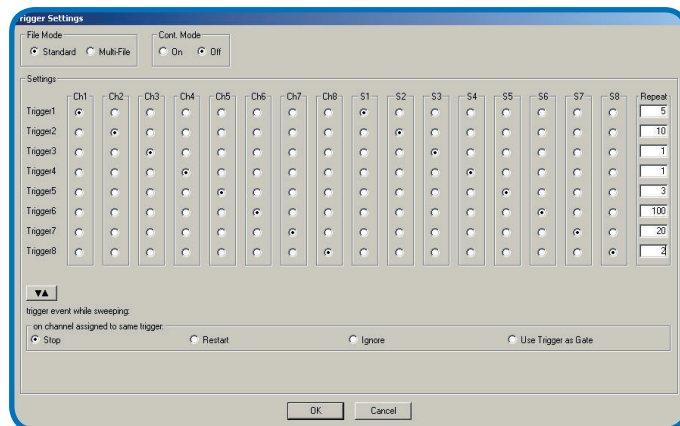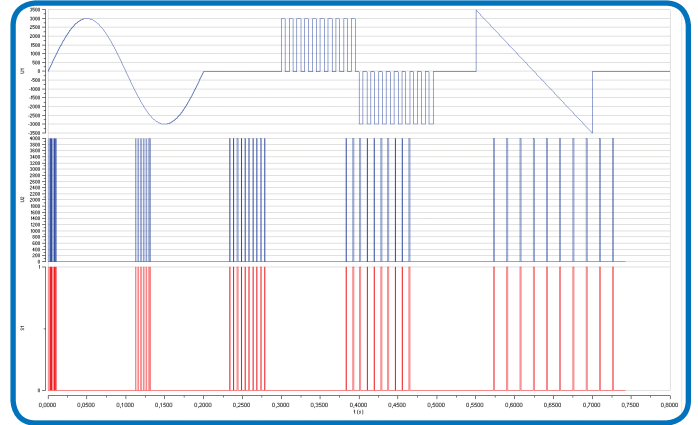
Triggering stimulation

Every stimulation pattern can be started and stopped manually or on an external trigger (TTL), for example from a switch or any other external control.

The STG4000 series allows you to trigger each of the up to 8 analog output channels independently.

Each stimulator is equipped with one TTL output and one TTL input for each stimulation channel. The stimulation on up to 8 channels can be controlled by the same trigger (synchronous operation) or by different triggers (independent or asynchronous operation).

This way, you can apply up to 8 complex stimulation patterns to separate stimulating electrodes with a precise timing based on different trigger sources or criteria.


Importing external ASCII files

You can also import files generated by external programs, for example biological signals captured by a data acquisition system or curves derived from complex mathematical functions.

Imported signals can be further edited, grouped, or repeated directly in the included stimulus software MC_Stimulus and are simply downloaded onto the stimulus generator by a single mouse click. The example shows a spike waveform recorded from an organotypic hippocampal culture on a Microelectrode Array (MEA) at a sampling rate of 50 kHz after the ASCII import into the MC_Stimulus program.
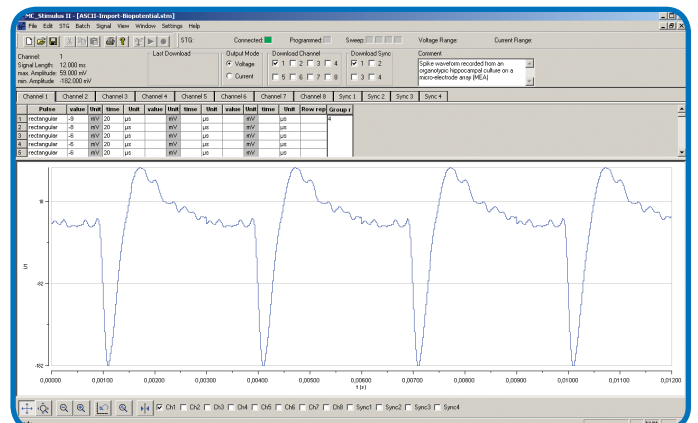
Multi File Mode

In addition to switching between different stimulation protocols on separate channels, the Multi File Mode makes it possible to switch between different patterns on the same electrode(s). You can load up to 8 different stimulation files, each containing the individual program for up to 8 separate stimulating electrodes. Each stimulation file is controlled by a separate trigger. This feature allows you to switch rapidly between up to 8 different stimulation protocols on the same or overlapping channels.

For example, you can control stimulation pattern A (red arrows in the figure) by trigger 1 on electrode 1, 2, 3, and stimulation pattern B (green arrows) by trigger 2 on electrode 2 and 3, and so on. With this feature, you can react with different pulse patterns in response to the biological behavior.
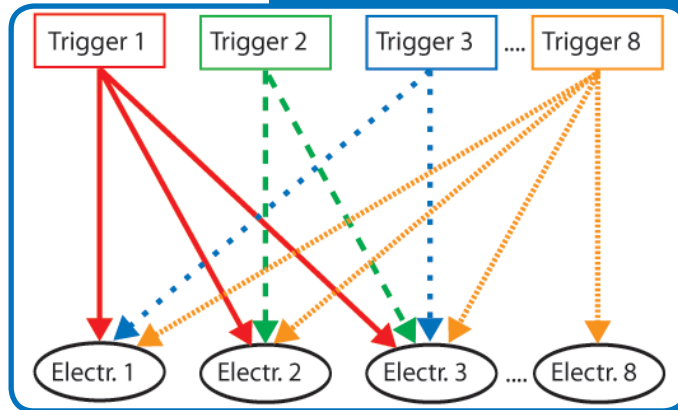
Extended Multi File Mode

The extended Multi File Mode is controlled through the Digital In (D-IN) of the stimulus generator. The D-IN has an 8 bit resolution and can assume 256 different states. Correspondingly, up to 256 stimulation patterns (files) can be downloaded to the stimulus generator and each pattern can be assigned to one state of the D-IN. Each of these stimulation patterns can define the output of one or more of the STG's stimulation and SyncOut channels.

With the D-IN interface you can now automatically switch between different stimulation patterns with a latency of only a few microseconds. There are two modes available for the Extended Multi File function, continuous and triggered. In continuous mode, the STG continuously monitors the state of the D-IN and starts the assigned stimulation pattern as soon as the state of the D-IN changes. In triggered mode, the same happens only when an additional external trigger is applied.
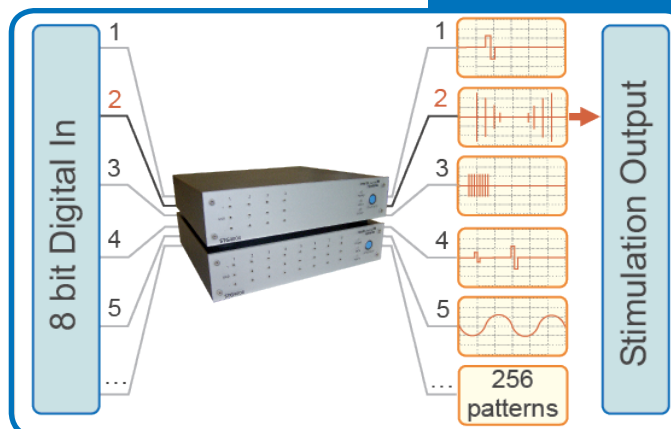
STG3008-FA: Stimulating and amplifying

Invasive intracardiac electrophysiology

The STG3008-FA together with the catheter (EPR-800, EPR-801, or EPR-802) from Millar Instruments (www.millar.com) can be used for invasive intracardiac electrophysiology studies in transgenic mice as young as five days old and in even younger mice following minimally invasive transesophageal electrophysiology studies.

The ultra-miniature size of the Millar EP catheters allows them to be introduced invasively or minimally invasively to various sites of the animal, including:

- Jugular vein for placement inside the right atrium and right ventricle
- Esophagus for placement next to the heart
- Carotid artery for placement inside the left ventricle

Stimulus generator and amplifier

The STG3008-FA acts as an amplifier and stimulus generator at the same time. For each electrode, the user can select by software whether it should be used for stimulation or for recording. Amplified analog signals for all recording channels are available from Lemo outputs at the back of the device.

- Each electrode can be used for stimulating or recording
- Each electrode can run an independent stimulation pattern
- Gain adjustable for all recording electrodes: 100, 200, 500 or 1000
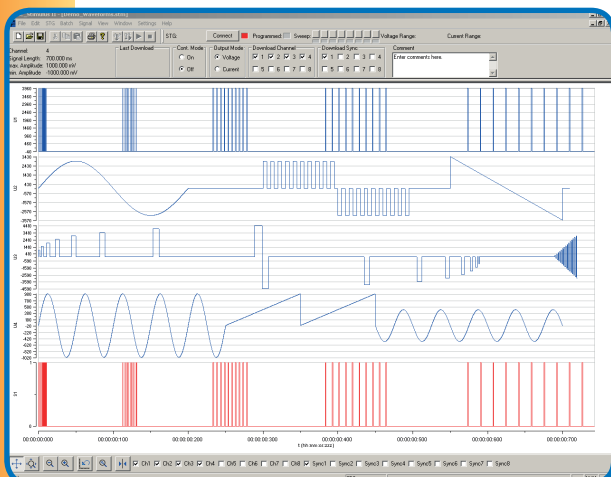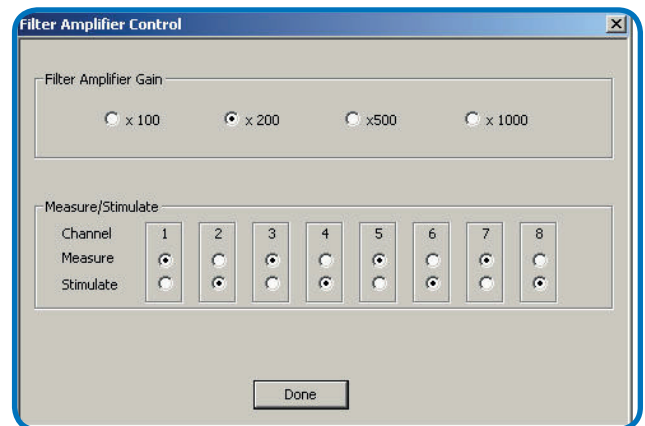
Stimulation

The flexible and easy-to-use MC_Stimulus software enables to program

- Complex stimulus waveforms: freely combine mono- or biphasic rectangular pulses, ramps, or sine waveforms
- Even biological signals through ASCII import: imported signals can be further edited, grouped or repeated

Technical specifications

STG 4000 Series

Number of channels	2, 4 or 8
Voltage output	-8 V to +8 V @ +/-20 mA
Voltage output resolution	1 mV
Voltage output slope	> 4 V/µs
Current output	-160 µA to +160 µA @ 120 V or -1.6 mA to +1.6 mA @ 120 V or -16 mA to +16 mA @ 120 V
Current output resolution	20 nA (160 µA version) 200 nA (1.6 mA version) 2000 nA (16 mA version)
Current output slope	600 µA/µs @ R_L = 10 kΩ

STG3008-FA

Stimulus Generator

Number of channels	8
Voltage output	-8 V to +8 V @ +/-20 mA
Voltage output resolution	1 mV
Voltage output slope	> 4 V/µs
Current output	-1.6 mA to +1.6 mA @ 120 V
Current output resolution	200 nA
Current output slope	600 µA/µs @ R_L = 10 kΩ

Amplifier

Number of channels	8
Gain	100, 200, 500 or 1000 (software selectable)
Bandpass filter	1 Hz - 2.2 kHz

All STGs

Resolution	14 bit
Time resolution	20 µs
Output signals	Freely programmable (rectangular, ramp, sinewave)
Maximum frequency (rectangular waveform)	25 kHz
Interface (connection to computer)	USB High Speed
Download rate	max. 480 MB per second

Software

Operating system	Microsoft Windows® XP, Vista or 7
Data import	ASCII file format

LabView interface available

Distributed by:

Smart Ephys | multichannel systems
a division of Harvard Bioscience, Inc.

● Made
● in
● Germany