

## **STM100 Stimulator Module**

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The STM100A is a single channel stimulation amplifier. The STM100A is designed for use in the following applications:

### **Stimulus and Response Testing**

- Auditory Brainstem Response Testing
- Visual Evoked Response Testing
- Somatasensory Response Testing
- Nerve Conduction Velocity and Latency Recording

### **Biofeedback Procedures**

- Auditory, Visual or Mechanical Feedback from Biophysical Signals

The STM100A incorporates manual and automatic attenuation and polarity controls. Automatic attenuation can be effected in 1 dB steps over a 128 dB range. The STM100A has dual stimulus outputs. One is a 50  $\Omega$  output which can be AC or DC coupled. The other is a very low impedance, high power, AC coupled output which can be used to drive headphones, speakers and other low impedance devices like lights and solenoids. The STM100A can amplify and condition signals from four possible sources:

- D/A Output 0
- D/A Output 1
- Digital I/O CH 15 (PULSE)
- Analog Input CH 15

## **Stimulus Response Testing:**

In nearly all cases of stimulus response testing the STM100A will be used in conjunction with the ERS100A, along with the MP100WS. The ERS100A is a very low noise biopotential amplifier, with sufficient bandwidth ranges to accommodate the variety of evoked potential testing.

For most types of evoked response testing, the MP100 will be operating in Averaging Mode. Typically, the Stimulus Output (usually a pulse) will be provided by I/O 15. The pulse on I/O 15 is output just prior to the data collection pass. I/O 15 provides a pulse output which can be user specified with 1  $\mu$ s resolution. Similarly, the Latency (time between data collection passes) can be specified with 1 ms resolution. A useful feature of the Averaging mode is Artifact Rejection. If the input signal falls outside of the specified bounds, then that particular data collection pass is rejected and not counted as part of the collective average.

In more sophisticated types of evoked response testing, analog waveforms can be created in AcqKnowledge (please refer to Part II of this manual) and then output at a user specified rate prior to the data collection pass. Tone bursts and pips and other arbitrary waveforms can be directed to the STM100A. In the Averaging mode, the output waveform must be less than 4096 points. The waveform will be output, point by point, at the Stimulus Interval specified. If the output waveform is 100 points long and the Stimulus Interval is 25 $\mu$ s, then the entire waveform will be output in 2.5 ms.

Auditory evoked potentials, like the ABR, can be implemented using the STM100A. The STM100A is used to present the auditory pulse or "click" to an auditory stimulator, like the TubePhone-ER3A (OUT101). The OUT101 or headphones (like the TDH-39 or OUT100) plug directly into the EXT STIM jack on the STM100A. "Clicks" can be either rarefaction or condensation (positive or negative pulses). "Click" attenuation can be controlled manually or via the computer in 1 dB steps over a 128 dB range.

Visual evoked potential tests (VEP), like the P300, can be implemented using the STM100A. These tests are very similar to ABR tests, except the stimulation source is the visual equivalent of the auditory "click". Typically, the stimulation source is a reversing checkerboard pattern, displayed on a video monitor. The STM100A has a 50  $\Omega$  output which can be used to trigger the signal on a checkerboard monitor. The STM100A is also capable of driving fast response light sources directly (such as a LED) via the EXT STIM output.

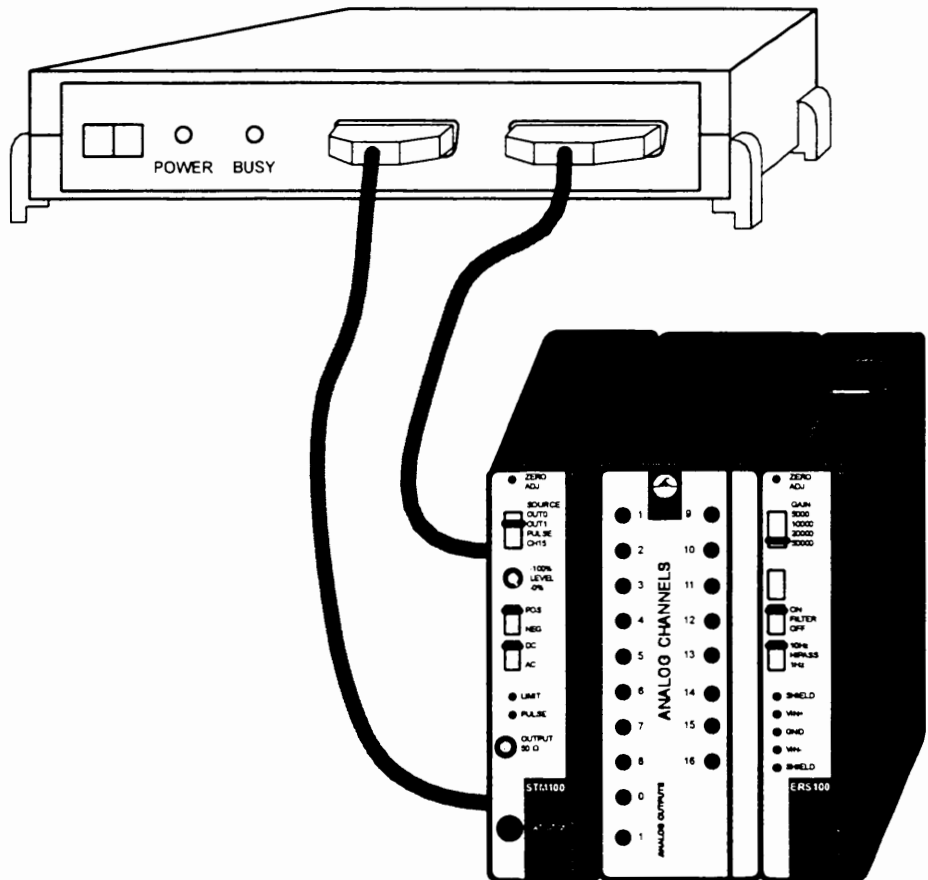
Somatosensory response tests can be implemented using the STM100A. These tests are very similar to ABR and VEP tests, except the stimulation source is usually an electrical pulse or mechanical impulse applied at some point along the leg or arm. Somatosensory tests are used to characterize the perception of touch. By connecting a solenoid to the EXT STIM output of the STM100A a mechanical pulse can be generated for peripheral nervous system stimulation.

General nerve conduction velocity tests are evoked potential tests, but they generally do not require extensive signal averaging like the ABR or P300 tests. The STM100A can perform these types of tests, however the STM100A output is limited to a 20 V pk-pk signal. In the case of invitro or invivo experimentation the 20 volt range of the STM100A is typically adequate. For surface electrode stimulators, often higher voltage is required. For these special cases, the STM100A can be used to trigger the external stimulator used. Please contact the Biopac Systems, Inc. Application department for more information.

### **Biofeedback Procedures:**

The STM100A can also be used to condition and amplify the signals coming from any biopotential or transducer amplifier. The source amplifier has to have its output switched to CH 15 (last channel). The STM100A SOURCE switch needs to be placed on CH 15 as well. With headphones or speaker plugged into the EXT STIM jack, biopotential signals like EMG can be heard directly. The EXT STIM output can also be used to drive visual indicators directly so rhythmic or pulsatile signals (like ECG or Respiration) can be easily observed. Mechanical actuators like relays and solenoids can also be directly connected to the STM100A.

The STM100A is placed on the opposite side of the UIM100 as compared to other 100A series amplifier modules. The STM100A always requires connection of both Analog and Digital cables to the MP100. The MP100 analog and digital cables first plug into the STM100A, then the UIM100 snaps onto the free side of the STM100A. Other amplifier modules, like the ERS100A, snap onto the UIM100A. The following diagram illustrates proper connection of the STM100A to the MP100 and other modules.



*STM100A connection to MP100, UIM100 and ERS100A*

## STM100 Specifications

<b>Stimulus Output Voltage</b>	20 volts pk-pk max
<b>Minimum Pulse Width</b>	10 $\mu$ s minimum
<b>Current Output Drive</b>	
<b>50 <math>\Omega</math> Output</b>	$\pm$ 100 mA
<b>Ext Stim Output</b>	$\pm$ 1.0 amp
<b>Ext Stim Output Impedance</b>	Less than 0.1 $\Omega$
<b>Input Sources</b>	DA0, DA1, PULSE (I/O 15), CH 15
<b>Polarity Control</b>	Manual or Digital control (Digital I/O 7, H-POS, L-NEG)
<b>Attenuation Control</b>	Manual or Digital control
<b>Attenuation Control Range</b>	128 dB (Digital I/O 0-6, LSB- MSB)
<b>Attenuation Step Resolution</b>	1 dB
<b>Indicators</b>	PULSE, Current Limit