STIMULUS ISOLATOR

MODEL A13-75 OPERATION and APPLICATIONS

REVISED 8/14/2000

COULBOURN INSTRUMENTS

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INTRODUCTION

The A13-75 will isolate and amplify any stimulus signal - square pulse, sine, ramps, etc., and control for constant current or constant voltage. A fully protected, direct-coupled output prevents damage from overloads or shorts, and the power supply is completely isolated from the stimulus-signal inputs. A high-speed reed relay electrode shunt provides for stimulus presentation and electrode disconnect and shorting to eliminate tissue charge buildup.

No matter what signal source is used, the isolator's stimulus output can be controlled for either constant (feedback regulated) voltage or current. The voltage of the stimulus signal fed into the input will determine either the voltage or the current of the output.

The 3 ranges of current setting will produce constant current outputs of 0 to 100 microamps, 0 to 1 milliamp, and 0 to 10 milliamps. The input voltage determines the output current in this mode. If the midrange were selected (which produces 100 microamps per volt) and a stimulus complex in the range of 0.5 volts were introduced to the input, the output would be the same stimulus configuration ("waveform") controlled for a constant current in the range of 50 microamps.

In the voltage mode, the unit puts out a constant voltage at the rate of 1 volt per volt input (unity gain); or 10 volts per volt (x10); or 100 volts per volt (x100). If the midrange is selected and the stimulus signal voltage is 0.5 Volts, the output will be the same signal form at a voltage of 5 volts.

Stimulus sources may be synthesized analog signals from signal generators, oscillators, or non-isolated stimulators; or they can be recorded signals from analog tape, digital tape or a computer via analog to digital converters.

INPUT SIGNAL

Any analog signal meeting the requirements listed in the specifications section (page 4) is acceptable. The stimulus signal can be a sine wave, square wave, biphasic pulse pairs, etc. ***NOTE:*** ***The outer collar of the input jack is common to the cabinet and is earth ground, so if you are using a floating source it will become grounded when connected to the isolator.***

For monitoring of the output signal, the ground of the oscilloscope should be connected to the black post and the signal or probe input to the red post (see next page). A 10k Ohm dummy load resistor to simulate the preparation or subject is provided with the unit. It should be placed between the red and black output posts for monitoring. Other values of dummy resistance can be used if the 10k Ohm shunt is not suitable.

NOTE: *The dummy load resistor should not be in place when the stimulator is in use. When an oscilloscope or other instrument is connected to the electrode output, isolation of the signal will be lost due to the ground reference of the monitoring instrument.*

OPERATING THE ISOLATOR (ELECTRODE SHUNT OPERATION)

To deliver stimulation, the shunt relay must be operated. This opens the shunt contacts (NC) and transfers the electrode contacts (COM) to the stimulator contacts (NO).

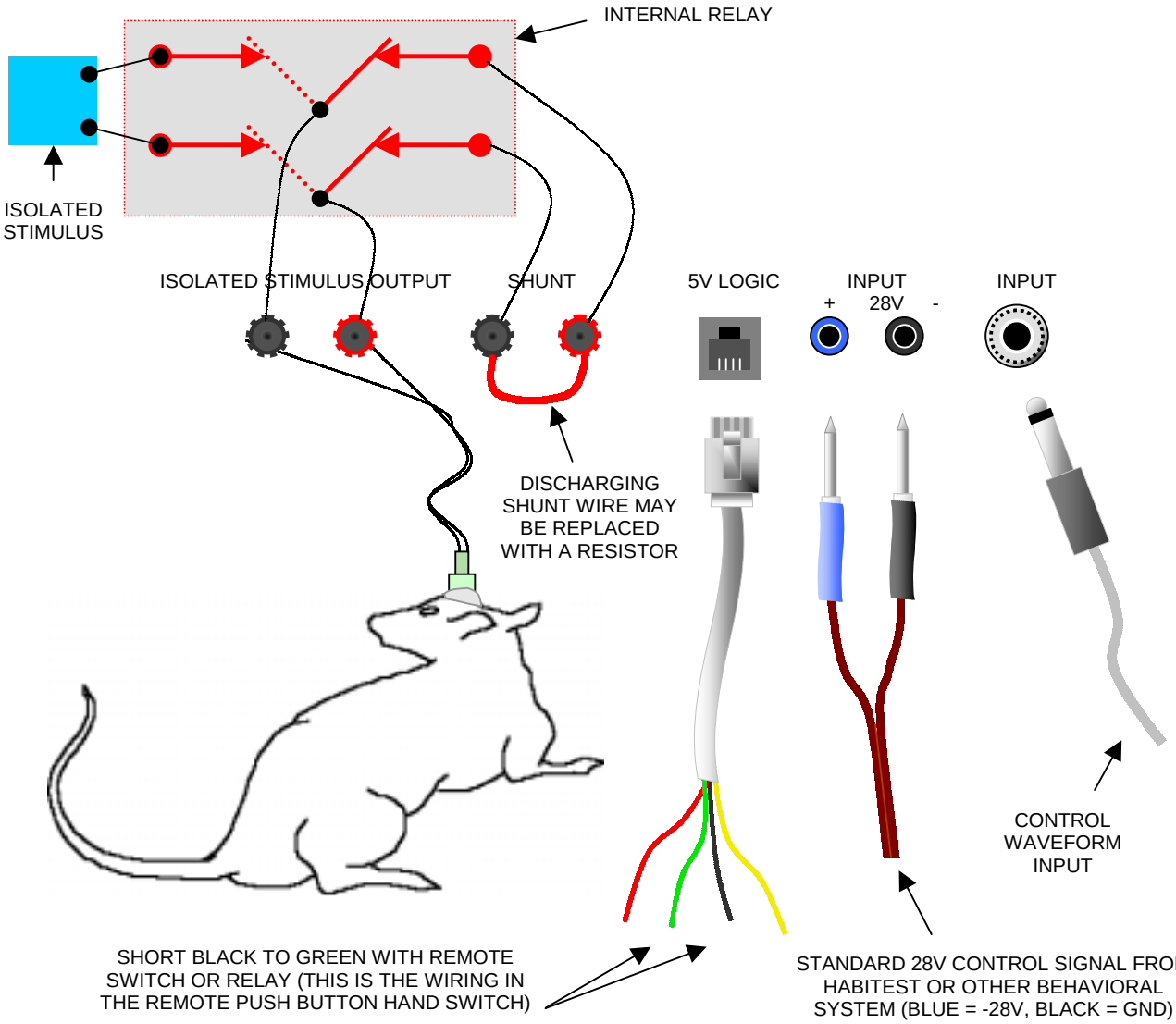
To operate the unit with 5-Volt control logic from another system, use the cable with the (telephone-type) modular jack on the end that is supplied with the unit. Connect ground from the system's power supply of the circuit you wish to use to the green wire, and a low true logic signal to the black wire (see next page).

To operate the unit with a remote relay or switch closure, just short the green wire to the black wire. The remote **hand switch**, which is also supplied, shorts these two wires for hand-switch operation.

For use with our Habitest or other standard behavioral test systems, a 28-Volt control input is also provided. Apply -28 volts from an auxiliary output from a Habitest Linc "Aux" output, or other -28V power driver via the .080 pin-connector cable observing the indicated blue and black polarity indications (next page).

The purpose of the electrode shunt is to short out the electrodes to the preparation when the stimulus is not being applied. The shunt in this unit may be independently operated allowing it to be used as an “operate control”. The relay may also be left on for relatively long periods and the input signal turned on and off for each presentation. Doing this, however, opens the **possibility that small DC offsets in the stimulus reference will charge electrodes and may actually damage tissue** (see Shunted and Synchronized Operation on page 4).

In any stimulator that is capable of very low frequency (or DC) stimulation, these offsets can be a problem. If you are going to use such protocols be sure that the source of your input signal has a good true zero and/or an offset zero adjustment and very stable, low-drift operation. The shunt method of operation not only helps avoid small offset problems, but also prevents noise from both the stimulus source, and any noise that may be induced into the cable from getting to the subject.



As is evident from the diagram, the operation of the relay removes the electrode leads from the normally closed contacts that provide a dead short across the leads (with the shunt in place). It transfers them to the output of the stimulator circuit causing the stimulus to be applied to the leads and hence the subject. **The shunt relay transfers in less than 500 microseconds.**

BIOPOTENTIAL RECORDING

To record from the preparation (subject) via the stimulation electrodes while the stimulator is *not* stimulating, remove the shunt (jumper) from the binding posts and connect the recording amplifier to them. If you are using a single ended (2-lead) amplifier, connect the positive (or signal input) to red and the negative (ground or reference) input to black. This will maintain "right reading" charts or 'scope traces. It will also earth ground the subject if the ground electrode from your amplifier is not floating, but is true earth ground. (However it will only do this during recording *not* during stimulation.)

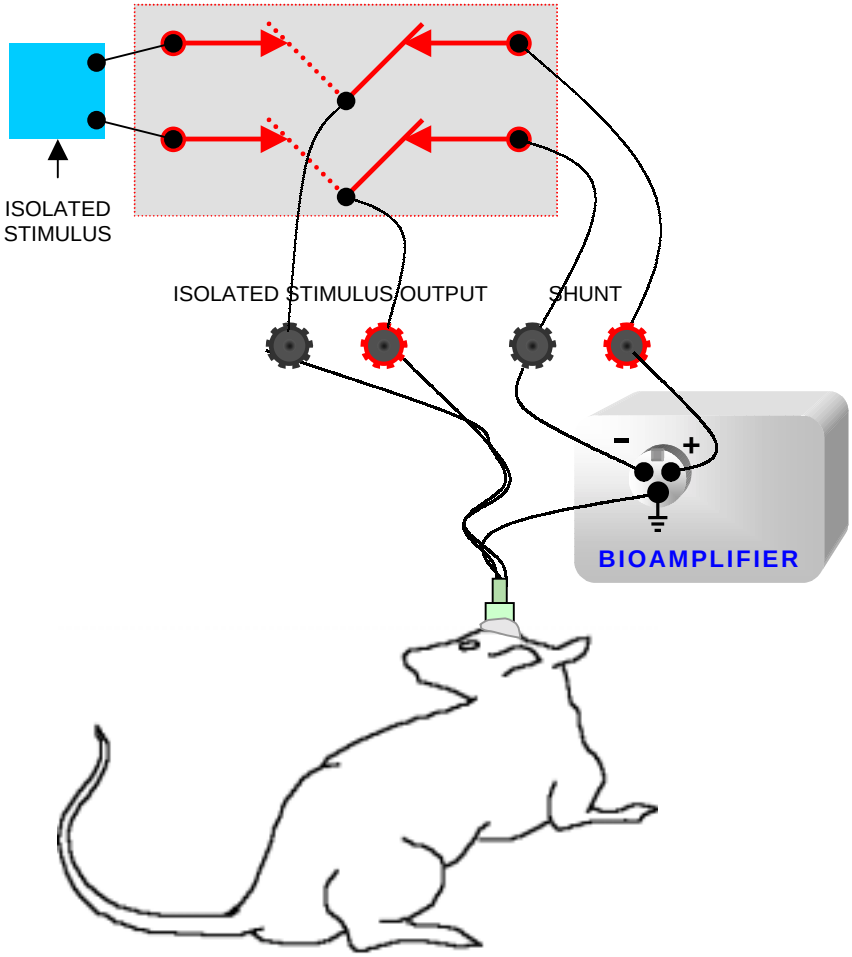
If you are using a differential amplifier, connect the positive input to red and the negative input to black (if "right-reading" traces are important). Connect the ground reference to the subject. Note that the ground reference is not switched under this circumstance so the subject will be connected to whatever ground reference the amplifier has *between and during stimulation.* For very clean, noise free records, an isolated amplifier is recommended.

ELECTRODE CABLES

Electrode cables should always be kept as short as possible to minimize resistive and capacitive effects on the stimulus signal. For constant-voltage stimulation, electrode resistance and capacitance has a minimal effect on the stimulus signal.

For constant-current stimulation, however, electrode resistance and cable capacitance have a more dramatic effect on the stimulus signal. For optimum results, electrode resistance should be 10K Ohms or less. If it is not practical to get electrode resistance down to that value, then electrode cable capacitance must be minimized.

These restrictions on electrodes and cable apply to high-frequency signals and fast rise and fall pulses. Minimal length electrode cable and minimal electrode resistance will help prevent distortion of the stimulus signal. If the stimulus signal is a low-frequency signal or a pulse train with slower rise and fall time properties, electrode resistance and cable capacitance effects are less critical.



Monitoring the stimulus signal at the electrode output with an oscilloscope will indicate if any signal distortion is present. The oscilloscope should only be used for setting up and checking.

MANUAL CONTROL FUNCTIONS

The mode of operation is selected using the mode switch on the front panel - constant voltage or constant current. Range is selected using the switch on the front panel. The output is proportional to the input with the range switch selecting the ratio. The specification listing below shows each range for both modes with the output to input ratio.

In the **constant voltage mode**, the voltage across the electrodes will remain constant as the electrode circuit resistance (from the subject or tissue prep) changes. *Voltage will remain constant at **up to 100 volts** as long as the **current required** by the preparation is **less than 60 milliamps** (1.5K Ohms minimum resistance).*

In the **constant current mode**, the current flowing through the electrodes will remain constant as the electrode circuit resistance (from the subject or tissue prep) changes. *Current will remain constant at **up to 10 milliamps** as long as the **voltage required** by the preparation is **less than 100 volts**.*

SHUNTED AND SYNCHRONIZED OPERATION

When it is necessary to present a discrete stimulus signal rather than "switching into" a "free-running" signal, you must synchronize the closing of the relay with each stimulus presentation. Since the relay is guaranteed to switch and become stable in about 1/2 millisecond, we recommend that you set your program to issue the close command (using the same clock) 1 millisecond before initiating the stimulus complex. This will assure closure and add a constant time to the stimulus delivery.

SPECIFICATIONS:

Control Input 1

+5Volt (via modular phone input jacks).
(The hand switch and cable below using this jack are supplied with the unit.)
Remote hand switch with modular phone-jack cable.
5VDC, low true logic via stripped-wire modular phone-jack cable.
Any Switch closure via stripped-wire modular phone-jack cable.

Control Input 2

–28Volt (via .080 pin jacks).
28VDC from Habitest Aux. Output via Blue and Black, .080-pin cable.

Signal Input

Input Impedance: 1 Megohm
Input Signal Voltage Range: 0 to +/-10 Volts peak
+/-15 Volts max.
Input Frequency Range: DC to 100 KHz
Input Connector: Modular (phone) jack (0.125 dia.)

Signal Output

Output Impedance: Near zero for loads up to 15 mA
Output Voltage Range: 0 to +/-100 Volts nominal peak (+/-125 volts max.).
Output Frequency Range: DC to 100 KHz.
Output Rise Time: 12 microseconds -100 Volt change
Output Current Range: 0 to 60 mA peak - constant *voltage* mode.
0 to 10 mA peak - constant *current* mode.
Output Short Circuit Current: 60 mA max. (constant-*voltage* mode only).

Constant Voltage Output: 3 Selectable Ranges:

1) 0 to +/-10 Volts	1 Volt out / Volt in.
2) 0 to +/-100 Volts	10 Volts out / Volt in.
3) 0 to +/- max. Volts	100 Volts out / Volt in.

Constant Current Output: 3 Selectable Ranges:
1) 0 to 100 microamp 10 microamp out / Volt in.
2) 0 to 1 milliamp 100 microamp out / Volt in.
3) 0 to 10 milliamp 1 milliamp out / Volt in.

Controls: Constant Current / Constant Voltage Select
Input / Output Linearity: 2% FS

Isolation

Voltage Isolation > 7500 Volts
Input to Output Capacitance = 1pF at MHz
Input to Output Impedance > 10^{10} Ohms (at 500 VDC)
Output to Ground Impedance > 10^{10} Ohms

Power Requirements

115VAC-50/60Hz or 220/240VAC-50/60Hz (specify on order).
High-isolation, split winding transformers are used in the power supply.
This eliminates the need for batteries, yet provides isolation from ground.

Physical

Dimensions: 3-1/2 inches high x 17-1/2 inches wide x 13-1/2 inches deep.
Weight: 14 lbs.