GETTING INSTRUMENTS, INC.

DUAL MODE
ANALOG / DIGITAL STIMULUS ISOLATION UNIT

MODEL 4-AD
INSTRUCTION MANUAL

GETTING INSTRUMENTS, INC.

San Diego, CA 92110

Revised 5/99

CONTENTS

I. WARRANTY

The model **4-AD Stimulus Isolator** is hereby warranted to the original purchaser only:

1. Against defects in <u>materials</u> for a period of one (1) year from the date of invoice; and

2. Against defects in <u>workmanship</u> for a period of one (1) year from the date of invoice.

Subject to the provisions of this Warranty, **GETTING INSTRUMENTS, INC**., shall repair or replace, at its option, all **4-AD** Stimulus Isolation Amplifiers which fail to operate properly due to defects in materials or workmanship during the terms of this Warranty at no cost to the purchaser. This Warranty applies only to those **4-AD** Stimulus Isolation Amplifiers which are not altered in any way and which are used in an ordinary and proper manner, as reasonably determined by **GETTING INSTRUMENTS, INC.**

In the event the **4-AD Stimulus Isolation Amplifier** should, within the period of this Warranty, fail to operate properly due to defect, the purchaser shall return the Amplifier, postage prepaid, to **GETTING INSTRUMENTS, INC**., with a note describing product failure. Failure to return the Amplifier within sixty (60) days of product failure shall constitute a waiver of all rights under this Warranty.

THIS WARRANTY IS IN LIEU OF ANY AND ALL OTHER EXPRESSED OR IMPLIED WARRANTIES OF GETTING INSTRUMENTS, INC., INCLUDING ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR ANY PARTICULAR PURPOSE. GETTING INSTRUMENTS, INC. DOES NOT ASSUME, NOR DOES IT AUTHORIZE ANY PERSON TO ASSUME, ON ITS BEHALF, ANY OTHER OBLIGATION OR LIABILITY.

Dated: 7/97

II. INTRODUCTION AND SPECIFICATIONS

BEFORE USING THE **4-AD** STIMULUS ISOLATION AMPLIFIER, READ THIS INSTRUCTION MANUAL.

INITIAL INSTALLATION: The **4-AD SIU** comes fully adjusted and ready to use. Before powering the unit on, open the battery cover and verify that the batteries have remained seated during shipping. Instructions for opening the battery cover are on the back panel of the SIU.

Description

The MODEL 4-AD Stimulus Isolation Amplifier (SIU) is a low-noise optical isolation amplifier designed to optically isolate electrical stimulating currents. Its output can be either proportional to an analog input or gated by a digital input. It is stand alone or rack mounted, and is powered by 20 internal 9V alkaline batteries. The unit operates with ZERO leakage current, high compliance (100VDC), battery test function (indicates good batteries), high linearity in analog input mode, large output dynamic range, fast step response, and biphasic output.

See *http://www.gettinginstruments.com/manuals* for recent versions of Getting Instrument's manuals.

SPECIFICATIONS

Stimulus Isolation Amplifier Specifications	
Input impedance	Analog mode => 10^6 ohm // 2 pF min Digital mode => N/A
Input voltage range	Analog mode => 0 V to 10V or -10V to 0V Digital mode => TTL/CMOS (0 = Logic Low and 5V = Logic High)
Gain	Analog mode => 0.001 Ma/V, 0.01 mA/V, 0.1 mA/V, 1 mA/V Digital mode => Adjustable in the ranges; 0-0.01 mA, 0-0.1 mA, 0-1mA, 0-10 mA
Output	Double-ended, isolated from ground, either voltage or current.
Output Compliance	100VDC
Step response	<8 µS (digital input mode, output 1 mA, load = 1 Kohm). Rise time is somewhat a function of load and output current level.
Leakage current	ZERO
Isolation	2500 Volts (optical)
Dimensions	7.25" x 2.5" x 9"
Other features	Output indicator light illuminates when output is sourcing a current or voltage). Battery test function. Indicator light illuminates when batteries are good. Rack mount option.

III. CONTROLS

Inputs:
- The input mode is either analog or digital. In the analog mode, the output is directly proportional to the amplitude of the input voltage signal. Analog Input range is 0-10V and the gain from the Input to the Output is adjusted via rotary switch. A +/- switch allows negation of input voltages. Digital input is TTL and CMOS compatible. Logic Low is 0V and logic High is 5V. Both inputs are isolated BNCs and the mode (Analog or Digital) is selectable with a toggle switch on the front panel.   Refer appendix A for transfer functions.

Output:
- Output is either a current source or a voltage source (set by a toggle switch). Therefore unit operates as a Voltage Controlled Current Source (VCCS) or a Voltage Controlled Voltage Source (VCVS). The output polarity can be set to allow biphasic operation. Output connector is an isolated BNC and the mode (current or voltage), along with the polarity (+ or -) is selectable with a toggle switch on the front panel. Refer appendix A for transfer functions.

Range:
- Output ranges are 0-0.01mA, 0-0.1mA, 0-1mA or 0-10mA. This range is set from a rotary switch on the front panel. In Analog mode the input range is 0-10V and the output is directly proportional to the input voltage. e.g. when range is 0-1mA, an input sine wave whose peak to peak voltage ranges from 0-6V will produce an output current sine wave of 0-0.6mA. In the Digital mode the output is scaled with the 10-turn Magnitude pot on the front panel. The value of the pot reflects the value of the output current when a digital pulse is applied. For example, when the range is 0-1mA and the pot is set at 6 turns the output current will be 0.6mA during the time that the digital input is at a "high" logic level.
- There are corresponding voltage ranges on the range switch. These range settings are used when the output mode is voltage (when the mode toggle switch near the output is set to VOL). Using the same example as above; when range is 0-5V, an input sine wave whose peak to peak voltage ranges from 0-6V will produce an output voltage sine wave of 0-6V (0.6 x 5V range).

Magnitude:
- The Magnitude knob scales the output amplitude between the minimum and maximum value of the range setting when the unit is set to digital input mode. The knobs scale reads from 0 to 10. For example, with the magnitude knob is set to 5.0, the output mode set to current, the range set to 0-0.1mA, and the input mode set to digital, then a 5V TTL signal applied to the digital input will produce a 0.05 mA output. The knob has no function when the input mode is analog.

Output Mode Switch:

- Output mode can be a Current or a Voltage. See "Output" and "Range" for more details.

Output Polarity:
- Output Polarity can be positive, negative or off (polarity of current or voltage out). In the 'off' position the output is shorted to prevent charge build up in the electrode and can also be used to prevent "power-on" spikes at the output when the unit's ON/OFF power is cycled. e.g. turn Output Polarity switch to OFF position, then power unit on, then set Output Polarity to desired polarity. This will prevent spikes at output which can damage cells. Being able to set the output polarity allows for biphasic operation in the digital mode (see appendix for exact I/O characteristics).

Power:
- Powered by 20 9Volt alkaline batteries. A battery test button on the front panel tells you when to change the battery. Press button, if LED turns on the batteries are good, if not then replace the batteries. Replace batteries by removing the lid on top of the unit, pull out the old batteries and insert new ones.

Battery Test:
- Pushing the battery test switch simulates a load on the batteries and the LED will light indicating good batteries. If the the LED doesn't light you need to change the batteries. See http://www.gettinginstruments.com/BatteryLife.html for detailed analysis of battery life including typical battery life.

Power:
- **Always set the polarity switch to _OFF_ before powering the unit on or off.** The unit is powered by 9 Volt alkaline batteries. A battery test button on the front panel tells you when to change the battery. Press button, if LED turns on the batteries are good, if not replace. Battery replacement instructions are on rear of SIU. Hint: with unit facing you, removal seems to be easier if you rotate the batteries clockwise out of the sockets. You will need to start from the right.

- Duracel batteries are not recommended because very large variances in their physical dimensions may cause problems with their fit in the battery carrier.   We recommend Energizer Alkaline or Panasonic Alkaline. Here's the ordering information if you would like to order batteries from Digi-Key corporation. You can order in packages of 12 and the price is reduced.
  > Digi-Key Corporation
  > Phone: 800-344-4539 or 218-681-6674
  > Web: www.digikey.com
  > **Part number is P145-ND**

  Digikey also sells an inexpensive battery tester. The part number is CEC-2-ND.

Available Options:
- IN and OUT BNC's on the rear panel.

Appendix A

## I/O characteristics (transfer functions) for the Analog Mode and the Digital Mode

Note 1; outputs in the transfer function can be a current or a voltage depending on the output mode switch (CUR/VOL). When "Full Range" is referenced this corresponds to the current or the voltage the Range switch is set too. e.g. Range = 1mA/5V and Mode-switch = CUR the output "full range" is 1mA. If the Mode-switch = VOL the ourput full range is 5V.

Note 2; multiple isolation units can be stacked in parallel to obtain functional operation in multiple quadrants. i.e. the transfer functions can be added.

A-SIU I/O Characteristics (Analog Mode)

V_{in}

**Output Scaling Factor = (Vin / 10) x Full Range**

Setting	Transfer functions

I_{out} / V_{out}

$\varnothing A$ · · · t

+ IN
+ OUT

I_{out} / V_{out} vs V_{in}

I_{out} / V_{out}

$\varnothing A$ · · · t

- IN
+ OUT

I_{out} / V_{out} vs V_{in}

I_{out} / V_{out}

$\varnothing A$ · · · t

- IN
- OUT

I_{out} / V_{out} vs V_{in}

I_{out} / V_{out}

$\varnothing A$ · · · t

+ IN
- OUT

I_{out} / V_{out} vs V_{in}

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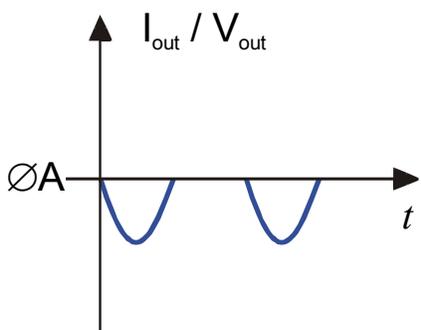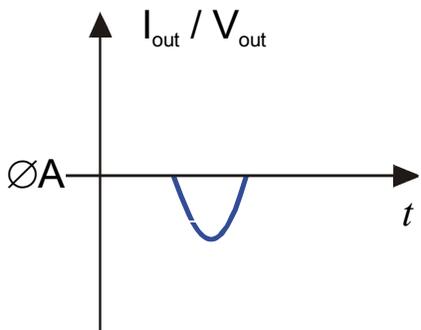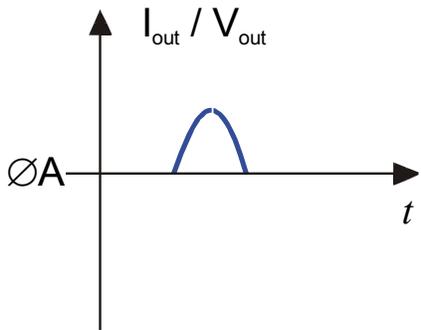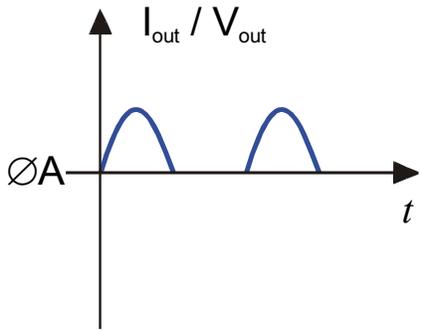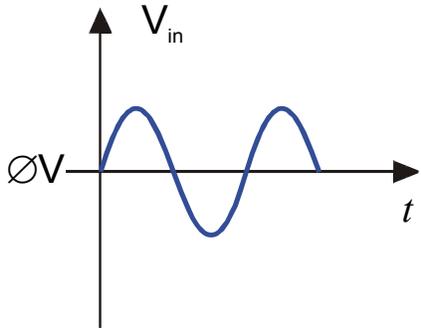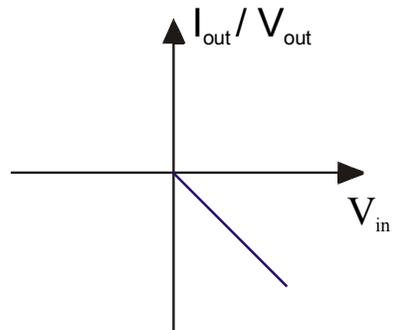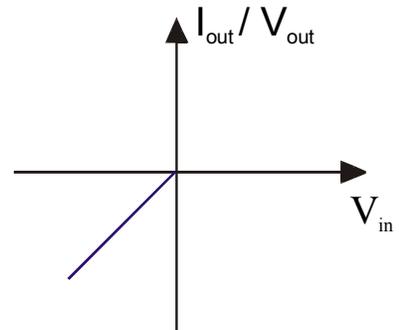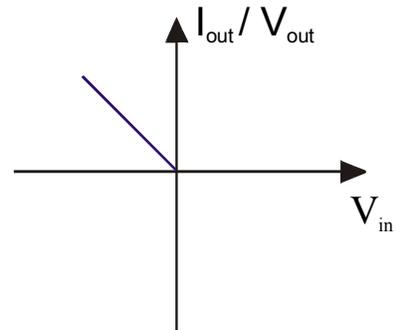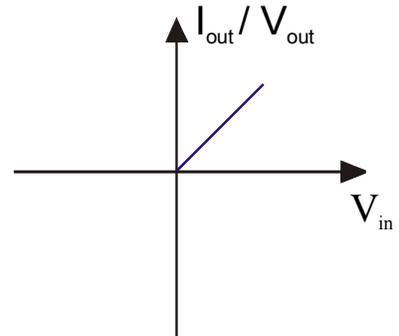
D-SIU I/O Characteristic (Digital Mode)

Digital In
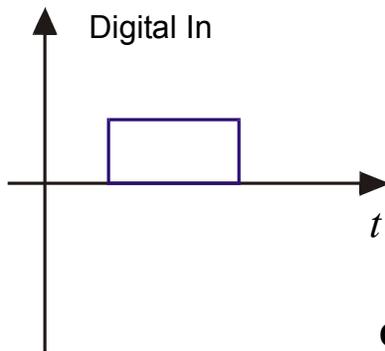
Output Scaling Factor = (# turns on mag. pot / 10) x Full Range

Polarity Setting

Transfer functions

I_{out} / V_{out}

I_{out} / V_{out}

+ OUT

1.4V   5V V_{in}

I_{out} / V_{out}

I_{out} / V_{out}

- OUT

1.4V   5V V_{in}
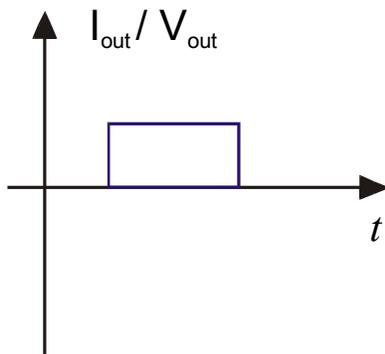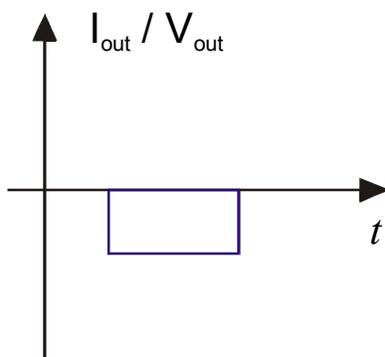
Input is Logic high (5V) or low (0V) and is TTL or CMOS compatible.
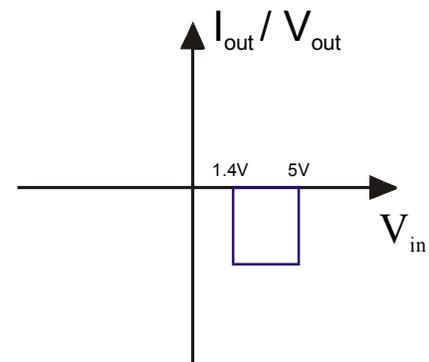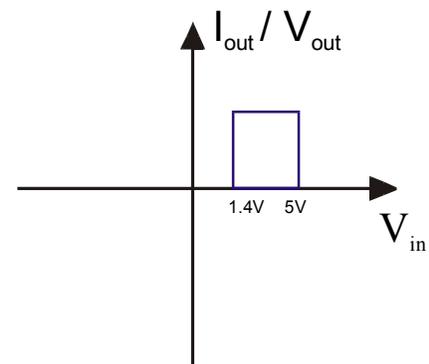
The actual amplitude of the output is governed by the 10-Turn Magnitude potentiometer on the front panel where 10-turns corresponds to full range on Range knob. Output is linear down to zero.