

**STIMULUS ISOLATOR**  
**Models A350D and 850A**

**Serial No. \_\_\_\_\_**

**INSTRUCTION MANUAL**

**World Precision Instruments, Inc. (WPI)**  
**375 Quinnipiac Avenue**  
**New Haven, Connecticut 06513 U.S.A.**

**A10E**

## TABLE OF CONTENTS

## INTRODUCTION

General .....	2
Shipping Information .....	2
Specifications .....	3
Safety .....	4

CONTROLS AND CONNECTORS .....	5
-------------------------------	---

## OPERATING DIRECTIONS

General .....	6
Constant Voltage .....	6
Constant Current .....	7
Combining Outputs .....	7
Grounding .....	8

## MAINTENANCE

Battery Replacement .....	9
Cleaning .....	9
Battery Test .....	10

WARRANTY .....	11
----------------	----

**INTRODUCTION****GENERAL**

The Models A350D and 850A Stimulus Isolators convert input square waves into isolated constant voltage or constant current pulses. Utilizing photon coupling, along with battery powered outputs, these instruments achieve nearly ideal isolation of the pulse and train outputs of WPI's series of stimulators. The two models are essentially identical, except for the input interface. The A350D connects by means of a BNC terminated, five-foot (1.5m) cable to the WPI A310 Accupulser™. The 850A plugs into the 1850A module of the WPI 1800 Digipulser.

These isolators can be operated in either of two modes, constant voltage up to 100 volts or constant current up to 5 milliamperes. Outputs are monopolar, switch selectable. The outputs from two or more isolators may be combined for higher voltage or current levels or for bipolar or other complex waveforms.

**SHIPPING INFORMATION**

The isolators are packaged and shipped in a foam-packed container. This manual will be included with the instrument. Upon receipt of the instrument, make a thorough inspection for proper contents and possible shipping damage. If reshipment is necessary, use the original container. If the original container is not available, use any suitable substitute that is rigid and of adequate size. Wrap the instrument in paper and surround with at least four inches of shock absorbing material.

## SPECIFICATIONS

### Input

A350D .....	25-50 mA into diode ( $V_f = 1.2V$ typ) in series with 100 ohms
850A .....	25-50 mA into diode ( $V_f = 1.2V$ typ)

### Isolation

Output to Input .....	$10^{11}$ ohms shunted by 2pF
Output to Ground .....	$10^{11}$ ohms shunted by 15pF

### Output

Mode	Range X1	Range X10	Output R
Constant Voltage	0-0.1V	0-1.0V	200 ohms
Constant Voltage	0-1.0V	0-10V	2 kohms
Constant Voltage	0-10V	0-100V	20 kohms
Constant Current	0-0.5mA	0-5mA	10 Mohm typ
Rise Time .....	4 $\mu$ s (10-90% of 1V) measured with a load of 1Mohm and 150pF		
Polarity .....	Positive or negative, switch selected		

### Power

Input .....	Provided by the input command
Output .....	Three Leclanché (dry cell) batteries WPI 2102, 9V (Eveready 246) WPI 2103, 45V (Eveready 455) WPI 2104, 67.5V (Eveready 467)

**Temperature** ..... 10C (50F) to 40C (104F)

**Dimensions** .....

Height	90mm (3.25in.)
Width	100mm (3.75in.)
Depth	230mm (9.00in.)

**Weight** ..... 3.2kg (71lb)

**SAFETY****Terminology**

WARNING statements identify conditions or practices that could result in personal injury or loss of life.

CAUTION statements identify conditions or practices that could result in damage to the equipment or other property. When marked on the instrument, it also indicates a personal injury hazard not immediately accessible as you read the marking.

**Do Not Use With Humans**

WARNING: THIS INSTRUMENT IS FOR INVESTIGATIONAL USE ONLY IN ANIMALS OR OTHER TESTS THAT DO NOT INVOLVE HUMAN SUBJECTS.

**Output Waveforms**

WARNING: SINCE THE OUTPUT TERMINALS CAN BE AS MUCH AS 100 VOLTS, A POTENTIAL FOR ACCIDENTAL SHOCK TO THE USER EXISTS! USE INSULATED CONDUCTORS AND DO NOT TOUCH ANY EXPOSED TERMINALS!

**Grounding of Output**

The output terminals are floating and isolated. Connecting either to ground, while permissible, effectively causes the loss of isolation. The green chassis terminal is connected only to the internal, isolated chassis.

**Do Not Operate in Explosive Atmospheres**

To avoid explosion, do not operate this instrument in an atmosphere of explosive gases.

**Do Not Remove Covers or Panels**

To avoid personal injury, do not remove covers or panels from this instrument. Do not operate the instrument without properly installed covers or panels.

## CONTROLS AND CONNECTORS

## CONTROLS

- Range** Four position rotary switch used to select the output range and the mode of operation. Positions 0.1V, 1.0V and 10V represent constant voltage modes; the 0.5mA position is the constant current mode.
- Multiplier** This switch multiplies the amplitude of the Range switch by either times 1 or times 10.
- NORM/INVERT** This switch changes the polarity of the output signal. In the NORM position, the OUT red terminal is positive in relation to the black terminal.
- LEVEL** This control varies the amplitude of the output signal from 0 to the maximum value set by the Range and the Multiplier switches. The purpose of the 10-turn dial is to provide resolution of the setting as opposed to linearity.

## CONNECTORS

- OUT** Red and black binding posts are used to provide the isolated output signals. With the NORM/INVERT switch in the NORM position, the signal on the red terminal is more positive than on the black terminal.
- CHAS** The green binding post is connected to the chassis of the instrument's isolated output section.
- Rear Panel** Model A350D: The BNC connector at the end of the five-foot (1.5m) cable is used to provide the control signal to the isolator. The signal on the center pin must be more positive than the connector shell.
- Model 850A: The two, male banana plugs are used to provide the control signal to the isolator. The signal on the left plug (as viewed from the rear) must be more positive than on the right plug.

**OPERATING DIRECTIONS****GENERAL**

The isolators are shipped with the batteries installed and are ready for operation. In the following operating instructions, it is assumed that the user has one of WPI's stimulators (or a signal source conforming to the input specifications) available for commanding the isolators.

The output signal amplitude is controlled by the Range and Multiplier switches and the LEVEL control. Combinations of control settings will result in output voltage amplitudes that are variable from 0 to 100 volts. Current amplitudes may be varied from 0 to 5 milliamperes. Very low current outputs, in the nanoampere range, can be achieved by using external resistors.

**WARNING: SINCE THE OUTPUT TERMINALS CAN BE AS MUCH AS 100 VOLTS, A POTENTIAL FOR ACCIDENTAL SHOCK TO THE USER EXISTS! USE INSULATED CONDUCTORS AND DO NOT TOUCH ANY EXPOSED TERMINALS!**

**CONSTANT VOLTAGE**

Operation in the voltage ranges may be verified by connecting an oscilloscope or a DC voltmeter to the OUT terminals. Connect the input to an appropriate signal source and observe the output. If a DC voltmeter is used, the input signal should be at least 10 seconds long, to allow settling of the meter reading and observation.

Set the Range switch to 0.1V, the Multiplier switch to X10, and the LEVEL control to 10, i.e. 100% (completely clockwise). The output should be one volt. Vary the LEVEL control and observe the proportional changes on the output. For example, a setting of 1 in the dial window and 0 on the vernier (10%), should provide an output of 100 millivolts. Note that the purpose of the vernier is to provide resolution to the dial and to facilitate returning to the same level setting. The high, 0.1% resolution of the LEVEL control does not imply high linearity! Repeating the above test with the Range switch in the 1.0V and 10V positions and the Multiplier switch in the X1 and X10 positions will check proper constant voltage mode operation.

Connect an oscilloscope to the OUT terminals and select pulses of different time durations on the input signal source. The isolator's output should faithfully follow the input waveforms.

## CONSTANT CURRENT

Operation in the current range is verified by connecting a DC milliamperemeter across the OUT terminals.

**CAUTION:** To avoid damage to the meter, set the NORM/INVERT switch to NORM and connect the positive terminal of the meter to the red OUT terminal.

Connect the input to an appropriate signal source of at least 10 seconds duration. Set the Range switch to 0.5mA, the Multiplier switch to X10, and the LEVEL control to 10 (100%). The meter should read 5 milliamperes. Vary the LEVEL control and change the Multiplier switch to X1. Observe that the changes in the control settings are reflected in the output current amplitudes.

A convenient way of setting the current level is to make the setting in a voltage range. Using the 1.0V range and the X10 multiplier, each volt of output is equal to 0.5 milliamperes. This means that when the LEVEL dial is set to 10, the output voltage is 10 volts, which represents 5.0 milliamperes. Set up a voltage equivalent to the desired current, then switch to the 0.5mA current range to obtain the current output. Using the 1.0V range and the X1 multiplier, each volt of output is equal to 50 microamperes.

The output current will remain constant independent of the external resistance, as long as the voltage across the resistance does not exceed 100 volts. Using the X1 multiplier, the full 0.5 milliamperes is available for load resistances of 200,000 ohms or less. With the X10 multiplier, the full 5 milliamperes is available with load resistances of 20,000 ohms or less.

Very low level currents (nanoampere range) are obtained by using the appropriate voltage range and inserting a 10 megohm resistance in series with the stimulating electrode. The high resistance in series with the electrode effectively makes the output a constant current. The current range for the 0.1V and X1 range, with a 10 megohm series resistor is 0 to 10 nanoamperes. The series resistance used should be at least 100 times the electrode resistance.

## COMBINING OUTPUTS

Two or more isolator outputs may be combined, either in series (voltage mode) or parallel (current mode). This may be done to obtain larger voltages or currents than what is available from a single isolator. Bipolar and complex waveforms are also possible.

**CAUTION:** Operation with an inductive load at high output currents, may damage the isolator.



**GROUNDING**

The green CHAS binding post is connected to the isolated, internal chassis of the output section. This terminal provides a guarding feature useful in some biological applications. If an electrode connected to this terminal is interposed between the stimulating electrodes, capacitive currents which would normally flow to ground should be reduced and less stimulus artifact should be observed. This technique may not be necessary in many experimental situations, since some artifact is desirable to mark the recording, at the instant the stimulus is applied.

The red and black OUT terminals are floating and isolated. Connecting either to ground, while permissible, effectively causes the loss of isolation.

**MAINTENANCE****BATTERY REPLACEMENT**

Under normal use, the batteries should last for several months. If the instrument is not going to be used for more than three months, the batteries should be removed to prevent damage from corrosion.

To avoid unnecessary battery replacement, perform the battery test in the following section before proceeding. If it becomes necessary to replace the batteries, use the following procedure:

1. Remove the four screws from the two rear sides of the isolator.
2. Slide out the battery holding assembly from the rear of the instrument.
3. Note the location of the batteries. All three are different.
4. Unsnap the battery connectors and replace each battery, in its proper location, with batteries specified in the Introduction of this manual.
5. Reassemble the instrument by reversing the order of the above steps.

**CLEANING**

**CAUTION:** Do not use alcohol, aromatic hydrocarbons or chlorinated solvents for cleaning. They may adversely react with plastic materials used to manufacture the instrument.

The exterior of this instrument may be cleaned periodically to remove dust, grease and other contamination. There is no need to clean the inside. Use a soft cloth dampened with a mild solution of detergent and water. Do not use abrasive cleaners.

**BATTERY TEST**

1. Set the Range switch to 10V, the Multiplier switch to X10, the NORM/INVERT switch to NORM, and the LEVEL dial to 10.

**WARNING: DANGEROUS VOLTAGES MAY EXIST IN THE FOLLOWING SET-UP!  
DO NOT TOUCH ANY EXPOSED COMPONENTS OR TERMINALS!  
USE ONLY INSULATED TOOLS FOR CONNECTIONS!**

2. Connect a DC voltmeter or an oscilloscope to the OUT terminals; red to plus, black to minus.
3. Connect an input signal of at least 10 second duration and observe the meter or the oscilloscope. If the output falls much below 100 volts, the batteries should be replaced. If you do not need the 100 volt output, operation will not be affected by lower voltage batteries until their charge is completely depleted.

## WARRANTY

WORLD PRECISION INSTRUMENTS, INC. warrants to the original purchaser that this equipment, including its components and parts, shall be free from defects in material and workmanship for a period of one year from the date of shipment. World Precision Instruments, Inc.'s obligation under this warranty shall be limited to repair or replacement, at the option of World Precision Instruments, Inc., of the equipment or defective components or parts upon receipt thereof f.o.b. World Precision Instruments, Inc., New Haven, Connecticut. Return of a repaired instrument shall be f.o.b. World Precision Instruments, Inc., New Haven Connecticut. The above warranty is contingent upon normal usage and does not cover products which have been modified without World Precision Instruments Inc.'s approval or which have been subjected to unusual physical or electrical stress or on which the original identification marks have been removed or altered. The above warranty will not apply if adjustment, repair or parts replacement is required because of accident, neglect, misuse, failure of electric power, air conditioning, humidity control, transportation, or causes other than normal and ordinary usage. To the extent that any of its equipment is furnished by a manufacturer other than World Precision Instruments, Inc., the foregoing warranty shall be applicable only to the extent of the warranty furnished by such other manufacturer. This warranty will not apply to appearance terms, such as knobs, handles, dials or the like.

The foregoing obligations set forth in this paragraph are in lieu of all obligations and liabilities, including all warranties of MERCHANTABILITY or otherwise, expressed or implied or statutory, and state World Precision Instruments, Inc.'s entire and exclusive liability and purchaser's exclusive remedy for any claim of damages in connection with the sale or furnishing of all equipment, including design, suitability for use, operation, or installation. There are no warranties which extend beyond the description of the face hereof. In no event shall World Precision Instruments, Inc. be liable for any special or consequential damages.

**WARNING: THIS EQUIPMENT IS NOT DESIGNED OR INTENDED FOR USE ON ANY HUMAN; FOR ANIMAL USE ONLY.**

May 30, 1984

## MICROELECTRODE HOLDERS

WPI's microelectrode holders provide convenient coupling between fluid-filled glass microelectrodes and high input impedance amplifiers. A reversible Ag/AgCl pellet is molded into the body of WPI microelectrode holders, providing stable potential and long life (some models use a silver wire in place of the Ag/AgCl pellet). Microelectrode holders are supplied for standard WPI single capillary tubing of 1.0, 1.2, 1.5 and 2.0 mm outside diameters.

MEH Derived from Micro Electrode Holder

3 Numbers in this position indicate the holder style as described below.

F F indicates a female connector.

S S or R designates Straight or Right Angle.

W W indicates use of silver wire rather than a pellet.

10 The last two digits represent the outer diameter of the glass capillaries that the holder is drilled to accept.

Holder styles mentioned above are numbered as follows:

1. A small diameter microelectrode holder used when access space and small size are of paramount importance.
2. This model contains a threaded cap for clamping onto the pipette and a 4.0 mm pressure injection port.
3. This design offers a strain relieved, threaded tip providing sturdy microelectrode support.
4. Designed with a 2 mm pressure port and threaded end cap, this style is primarily designed for patch clamp studies.
5. This model offers a luer-type port and threaded end cap and is available only with a female connector.

Other WPI model microelectrode holders include MEH900 (S/R) designed primarily for use with WPI Model 900 Micropressure System; EH B1 for use with WPI Model F 29 VoltOhm Meter for electrode beveling; and MEHF25S which is designed for microtitration of chloride with a silver wire as the electrode and a solution of silver nitrate filling the holder. MPH models do not contain Ag/AgCl half-cells and are used for pressure injection of substances through microelectrodes. APEH models are also designed for use in pressurized injection procedures.

	Port	Cap	Angle	Connector	Half-Cell
MEH1R	No	No	Right	Male	Pellet
MEH2R	Yes	Yes	Right	Male	Pellet
MEH3R	No	Yes	Right	Male	Pellet
MEH1RF	No	No	Right	Female	Pellet
MEH2RF	Yes	Yes	Right	Female	Pellet
MEH3RF	No	Yes	Right	Female	Pellet
MEH4RF	Yes	Yes	Right	Female	Pellet
MEH1S	No	No	Straight	Male	Pellet
MEH2S	Yes	Yes	Straight	Male	Pellet
MEH2SW	Yes	Yes	Straight	Male	Wire
MEH3S	No	Yes	Straight	Male	Pellet
MEH4S	Yes	Yes	Straight	Male	Pellet
MEH5S	Luer	Yes	Straight	Male	Pellet
MEH25S	No	Yes	Straight	Male	Wire
MEH1SF	No	No	Straight	Female	Pellet
MEH2SF	Yes	Yes	Straight	Female	Pellet
MEH2SFW	Yes	Yes	Straight	Female	Wire
MEH3SF	No	Yes	Straight	Female	Pellet
MEH3SFW	No	Yes	Straight	Female	Wire
MEH4SFW	Yes	Yes	Straight	Female	Wire
APEH1	No	2	Right	Male	Pellet
APEH2	No	2	Right	Male	Wire
MEH900S	Yes	Yes	Straight	Male	Pellet
MEH900R	Yes	Yes	Right	Male	Pellet
MPH1	Luer	Yes	Straight	None	None
MPH3	Yes	Yes	Straight	None	None

\* Specify O.D. of glass (1.0, 1.2, 1.5, or 2.0 mm) when ordering.

World Precision Instruments, Inc. (WPI)  
 375 Quinnipiac Avenue  
 New Haven, CT 06513 U.S.A.  
 (203) 469-8281 TWX: 710-465-2638

## GLASS CAPILLARIES

Kwik-Fil Borosilicate Glass Capillaries for the production of micropipette electrodes are made from high quality, clean and consistent glass stock. Close dimensional tolerances are kept which assures uniformity and reproducibility of microelectrodes. Kwik-Fil capillaries are available from stock in one, two, three, five and seven barrel configurations. Also offered are thin wall glass capillaries.

Multi-barrel configurations are designed for microionophoresis applications. The capillaries are fused together in the manufacturing process. These multi-barrel capillaries have an inner filament in each barrel to facilitate easy and rapid filling.

Thin Wall Capillaries are offered both with or without the inner filament. The concentricity of this material provides excellent strength. The significant features of thin wall electrodes are their fine tip, short taper and exceptionally low resistance endowing them with a very short time constant. Thin wall capillaries without filaments do not have the Kwik-Fil feature.

Thick Septum Theta offers superior cell impalement owing to a spear point tip (self-beveling), low resistance when used as a single microelectrode, and superior double microelectrodes with low trans-tip coupling. One must note that the effective tip cross section of Thick Septum Theta will increase significantly because a "natural bevel" results owing to the prominent forward spear-like projection of the septum.

Ultrawick is capillary-filled with porous quartz fibers. The natural wicking action make this glass excellent for use as a microdiffusional salt bridge.

And lastly, the most recent introduction to our glass product line, PH100-6, pH-sensitive glass capillary tubing. A special low resistance formula and excellent response characteristics make this the glass of choice for both micro and macro pH electrodes.

Description	Inner Filament	OD / ID	Quantity	4-inch	6-inch
Single Capillary	Yes	1.0/0.58 mm	500	1B100F-4	1B100F-6
Single Capillary	No	1.0/0.58 mm	500	1B100-4	1B100-6
Single Capillary	Yes	1.2/0.68 mm	350	1B120F-4	1B120F-6
Single Capillary	Yes	1.5/0.86 mm	225	1B150F-4	1B150F-6
Single Capillary	Yes	2.0/1.16 mm	125	1B200F-4	1B200F-6
Two-Barrel	Yes	1.5/0.86 mm	100	2B150F-4	2B150F-6
Three-Barrel	Yes	1.2/0.68 mm	100	3B120F-4	3B120F-6
Five-Barrel	Yes	1.2/0.68 mm	65	5B120F-4	5B120F-6
Seven-Barrel	Yes	1.0/0.58 mm	60	7B100F-4	7B120F-6
Thin-Wall Capillary	Yes	1.0/0.78 mm	500	TW100F-4	TW100F-6
Thin-Wall Capillary	Yes	1.5/1.17 mm	225	TW150F-4	TW150F-6
Thin-Wall Capillary	No	1.5/1.05 mm	225	TW150-4	TW150-6
Aluminosilicate	Yes	1.0/0.78 mm	100	AS100F-4	AS100F-6
Ultrawick		2.0 mm	10	UW200-4	UW200-6
Thick Septum Theta		1.5/1.02 mm	100		TST150-6
pH Glass Capillary	No	1.0/0.60 mm	50		PH100-6

## SILVER/SILVER CHLORIDE HALF-CELLS AND SILVER WIRE

RC1 Reference Cell with 1.5 meter lead	EP2 Ag/AgCl Electrode 2.0 mm	AGW0510 Silver Wire .005" x 10 ft
RC2 Reference Cell with 2.0 meter lead	EP4 Ag/AgCl Electrode 4.0 mm	AGW0530 Silver Wire .005" x 30 ft
RC2F Reference Cell with female conn.	EP8 Ag/AgCl Electrode 8.0 mm	AGW1010 Silver Wire .010" x 10 ft
	EP12 Ag/AgCl Electrode 12 mm	AGW1030 Silver Wire .010" x 30 ft

World Precision Instruments, Inc. (WPI)  
 375 Quinpiac Avenue  
 New Haven, CT 06513 U.S.A.  
 (203) 469-8281 TWX: 710-465-2638