



ISO-80

Isolated Differential Amplifier

www.wpiinc.com

INSTRUCTION MANUAL

Serial No. _____

102810

World Precision Instruments



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ABOUT THIS MANUAL

The following symbols are used in this guide:



This symbol indicates a CAUTION. Cautions warn against actions that can cause damage to equipment. Please read these carefully.



This symbol indicates a WARNING. Warnings alert you to actions that can cause personal injury or pose a physical threat. Please read these carefully.

NOTES and TIPS contain helpful information.



Fig. 1 — ISO-80



ISO-80

INTRODUCTION

The **ISO-80** is a high performance, isolated, differential amplifier designed for extracellular recording of nerve/muscle cell action potentials in vitro and in vivo. Other functions include measuring electrode impedance and generating current for applications such as tissue marking, stimulation and electrode cleaning. It is a battery-powered, low-noise, AC-coupled differential amplifier electrically isolated from main power and ground lines.

The **ISO-80** is provided with a remote headstage (1 m cable) which incorporates an electrode impedance test function and a constant current stimulator. The constant current stimulator can be used for cell marking, stimulation or electrode cleaning.

Typical applications include measuring EMG, EEG, extracellular and action potentials. The **ISO-80** is electro-magnetically shielded for improved noise rejection, and it employs both high pass and low pass filtering with gain from 100x to 10,000x.

INSTRUMENT DESCRIPTION

Parts List

- ISO-80 Amplifier
- ISO-80P Probe
- ISO-80 Startup Kit (pictured in Figure 3) includes:
 - (1) pkg. of four 0.031" to wire electrode adapters (#5470)
 - (2) 6-foot, BNC to 3.5mm plug cables (#CBL102)
 - (2) Electrode holders (#M3301EH)
 - (2) 0.031" Electrode adapters (#5469)
 - (2) mini-banana to 2mm socket adapters (#13388)
 - (2) uninsulated mini-banana plugs with solderable turrents (#2035)
 - (1) Black insulated mini-banana plug (#2033)
 - (1) Red Insulated mini-banana plug (#2034)
 - (1) 3-foot cable with ground clip (#3294)
 - (1) 1 mm Ag/AgCl Electrode on 70mm wire (#EP1) (Figure 2)
- One Charger (120VAC with U.S. Plug - #3545, 240VAC with CEE Plug - 3546 or 240VAC with British Plug - 3547)
- Instruction Manual

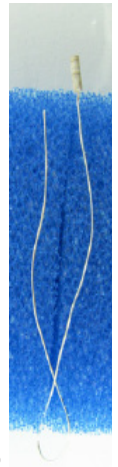


Fig. 2 – EP1.

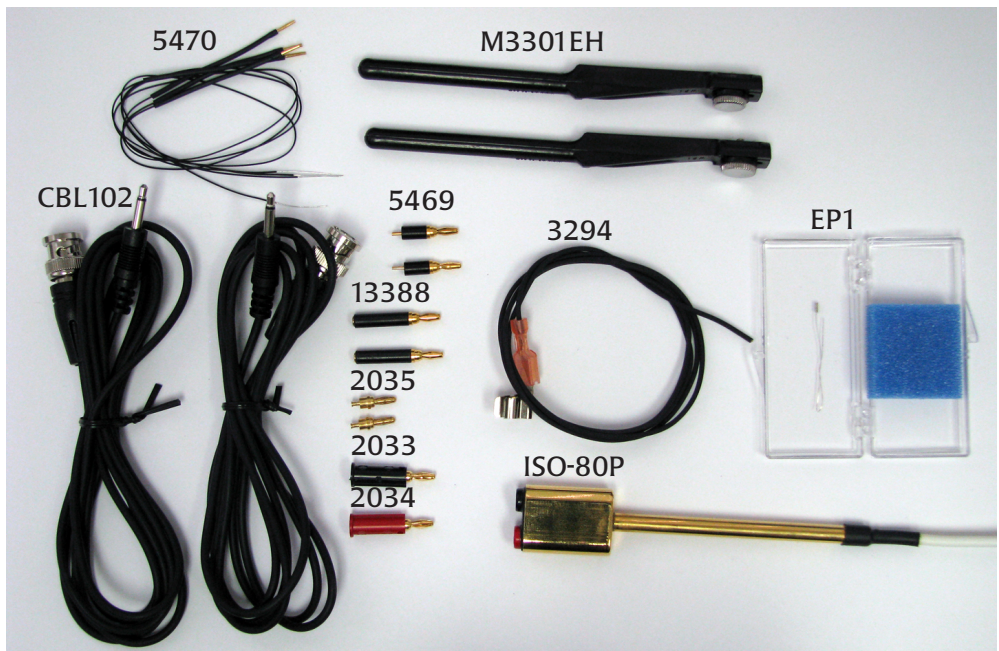


Fig. 3 – ISO-80 Startup Kit



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Unpacking

Upon receipt of this instrument, make a thorough inspection of the contents and check for possible damage. Missing cartons or obvious damage to cartons should be noted on the delivery receipt before signing. Concealed loss or damage should be reported at once to the carrier and an inspection requested. Please read the section entitled "Claims and Returns" on page 20 of this manual. Please call WPI Customer Service if any parts are missing.

Returns: Do not return any goods to WPI without obtaining prior approval (RMA # required) and instructions from WPI's Returns Department. Goods returned (unauthorized) by collect freight may be refused. If a return shipment is necessary, use the original container. If the original container is not available, use a suitable substitute that is rigid and of adequate size. Wrap the instrument in paper or plastic surrounded with at least 100mm (four inches) of shock absorbing material. Please read the section entitled "Claims and Returns" on page 20 of this manual.

Description

ISO-80 Base Unit - Face

Labeled items on the Figure 3 (ISO-80 face plate) are described below.

- ① **Mode** switch to choose amplification (AMP), electrode impedance measurement (Z) or tissue marking (Marker) mode.
- ② **Marker Amplitude** dial controls the amount of current injected when using the Marker mode.
- ③ **Digital LCD Display** registers readings of 3.5 digits.
- ④ **Output Polarity Select** determines the polarity of the output. Generally, it is set to "+."
- ⑤ **Power I/O** toggle switch turns the meter on (I) and off (O).
- ⑥ **Voltage Gain** toggle switch controls the magnification of the amplifier.
- ⑦ **High Filter** toggle switch affects the high frequency cutoff.
- ⑧ **Ground** port for connecting a ground wire.
- ⑨ **Probe Input** port connection for the ISO80P.
- ⑩ **Low Filter** toggle switch determines the lower cut off frequency.

Fig. 4 – ISO-80, labeled.

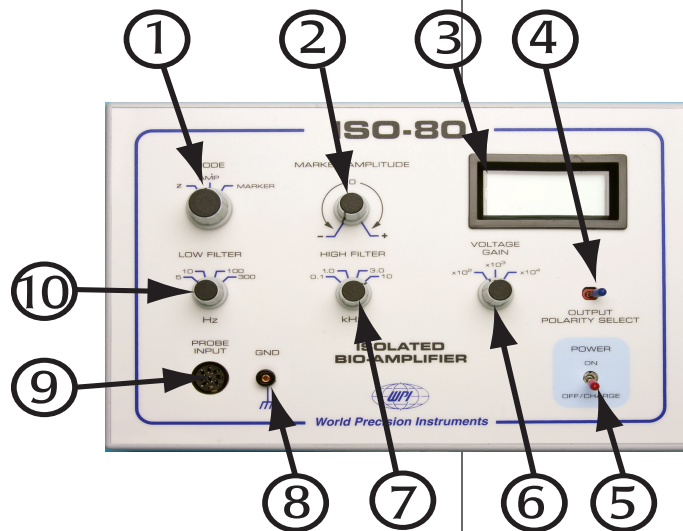




Fig. 5 – ISO-80 Right side view.



Fig. 6 – ISO-80 Right side view.

ISO-80 Base Unit - Right Side

- ① **Charger Input** port for connecting the battery charger.
- ② **Output** port for connecting the ISO-80 with a recorder or oscilloscope.

ISO-80 Base Unit - Left Side

- ① **External Current Control** Input port for connecting an external current generator.

ISO80P Probe

ISO80P is a high impedance probe can be plugged into the PROBE INPUT socket of the ISO-80. Insert the electrodes that will connect with the preparation/subject under test into the two sockets—one red, one black—on the probe.

The probe headstage is epoxy encapsulated within a miniature gold plated metal case. The use of a probe, close to a recording site, minimizes the shunt capacity normally associated with long wire leads from the electrode to the amplifier.



CAUTION: The probe headstage is sensitive to static discharge and can be damaged by a high voltage shock.



ISO-80

OPERATING INSTRUCTIONS

The **ISO-80** has three basic modes of operation, which are selected using the MODE switch on the upper left-hand side of the instrument:

- **AMP**—Voltage amplification. The amplified voltage is made available for external recording or data acquisition at the OUTPUT socket on the right-hand side of the instrument.
- **Z**—Electrode impedance measurement. Operation can monitored on the LCD, and the output is disabled.
- **MARKER**—Tissue marking. Operation can monitored on the LCD, and the output is disabled.

Amplifying Mode

To use the amplify mode, set the POWER switch to ON and the MODE switch to AMP. Modulate the level of amplification by using the VOLTAGE GAIN switch. The gain can be set to 100x, 1,000x, or 10,000x. WPI recommends beginning with 100x.

Filter Settings

The amplifier can amplify voltages which vary at frequencies extending from 5-10 kHz. To set the frequency band of measurement, use the LOW FILTER and HIGH FILTER control knobs.

Low Filter

The LOW FILTER switch sets the lowest frequency signal to be amplified. For example, 5Hz is typical for ECG and EEG measurements. For nerve-action voltage amplification, 10Hz is normally used. Brain in vivo recordings, 300Hz is suitable. Always set the LOW FILTER to a frequency as high as possible. This reduces the risk of interference by low-frequency noise signals.

NOTE: The recording instrument must be able to receive signal frequencies at least as low as the LOW FILTER setting. For example, an oscilloscope must be set to its DC mode.

High Filter

The HIGH FILTER switch sets the highest frequency signal to be amplified. The higher the rate of variation of the measured signal, the faster the response required of the amplifier. The amplifier's fastest response is at the 10KHz setting.

NOTE: The recording instrument must be able to handle signal frequencies at least as high the setting of the HIGH FILTER control.

NOTE: The wider the frequency band used, the greater the intrinsic electronic noise in all circuits. Larger bandwidth increases the intrinsic noise on recordings and the risk of



interference by external signals. The frequency band is set by the LOW and HIGH FILTER controls. Always use the minimum band that produces acceptable quality recordings. For example, for ECG and EEG set the LOW FILTER to 5Hz and the HIGH FILTER to 0.1kHz.

Output

The amplified signal is available at the OUTPUT jack on the right side of the ISO-80. Connect a recorder, oscilloscope or data acquisition system to this jack using the cable (WPI #CBL102) provided in the accessories pack. The polarity of the output can be set using the OUTPUT POLARITY SELECT toggle. In normal operational mode (for example, amplification), set this switch to “+.”

The maximum output available depends on the frequency of the amplified voltage signal. For signals of frequency above 30Hz, the full, AC-signal range output voltage of $\pm 10V$ (20V peak-to-peak (P-P)) is available. Below 30Hz the maximum available output decreases as the frequency decreases. The relationship is shown in Figure 7.

NOTE: To avoid error when measuring low frequency signals, set the amplification so that the maximum available output level is not exceeded. For example, the maximum available output at a frequency 10Hz is 12V P-P. With an input signal of 10mV P-P at 10Hz, the maximum setting of the VOLTAGE GAIN control would be 1000. This gives an output of 10V P-P. If the VOLTAGE GAIN is set to 10,000, the output is limited to 12V P-P, not 100V P-P.

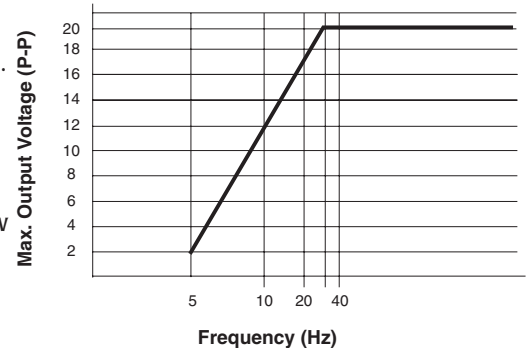


Fig. 7 — Maximum Output vs. Frequency

To obtain extra gain low frequencies, adjust the controls on the recording device (for example, the data acquisition system) connected to the ISO-80.

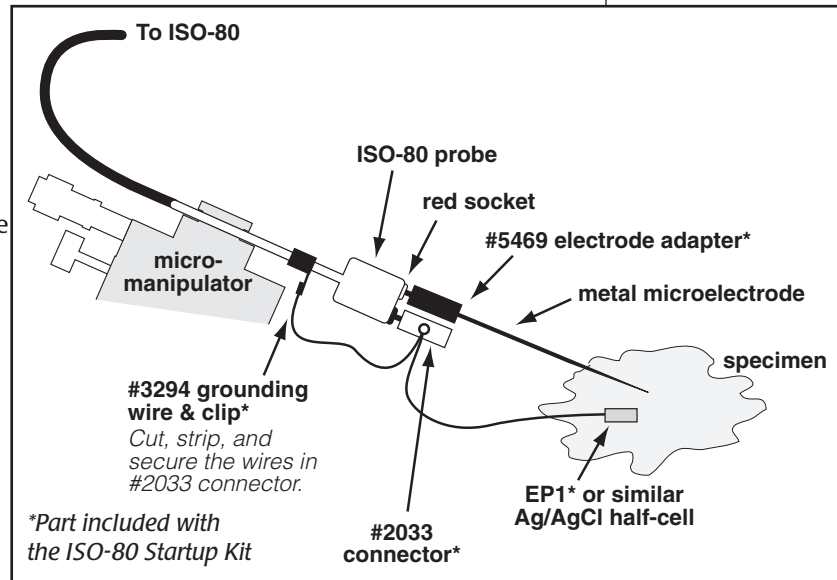
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Modes of Amplification

Specimen voltages may be amplified two ways—single-ended or differentially. Use minimum length of electrode leads to reduce the risk of interference. Screened leads also reduce susceptibility to electrical noise/mains-pickup. If there is a risk of external, electrical interference, use the differential method.

Single-Ended Amplification

Single-ended amplification is illustrated in Fig. 8. One electrode (the working electrode) is plugged into the red socket on the probe and connected to the test specimen. To complete the electrical circuit and to provide a return path for electrical current, a second electrode (the reference electrode) is connected to the black probe socket, which in turn is connected to the probe handle. The probe handle is the ground of the amplifier circuits—CIRCUIT GROUND. A short lead and a clip for the probe handle are provided for making this connection (WPI #3294).



Interference Effects

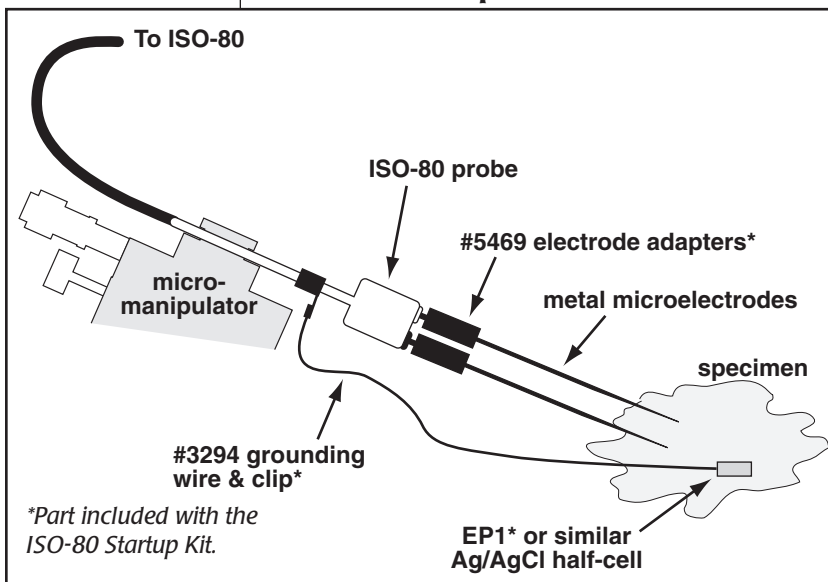
In all laboratories supplied with mains power, a risk of interference from signals flowing in the power lines exists. The interfering signals are usually at a frequency of 50-60Hz and are picked up by any electrical equipment in the area through a process of electromagnetic induction. If the measuring electrodes detect this signal, it will be amplified along with true input voltages and appear on the recordings. Whether this is significant or not depends upon the:

- Level of activity in the mains power lines
- Length of the input wires to the equipment
- Sensitivity of the measuring equipment

If it becomes a problem at the test site, set up the specimen and electrodes in a shielded enclosure that is connected to circuit ground (for example, a Faraday cage). Or, use the differential amplification mode.

Fig. 8 — Single-Ended Amplification

Differential Amplification



When using differential amplification, electrodes from both the red and black sockets on the probe are connected to the specimen. See Fig. 9. The specimen must be connected to circuit ground via the probe handle. See Fig. 10 for an alternate setup where the second microelectrode is separately secured, allowing independent placement of the two electrodes. In either set-up, the difference between the voltages at the two electrodes is amplified. Local interference will be picked up on both electrodes, but in roughly similar amounts on each. By amplifying the voltage difference at the electrodes, these signals largely cancel out. If the interference in the area is particularly strong, and its effect continues to be a problem after differential amplification, use a shielded enclosure.

Fig. 9 —
Differential Amplification

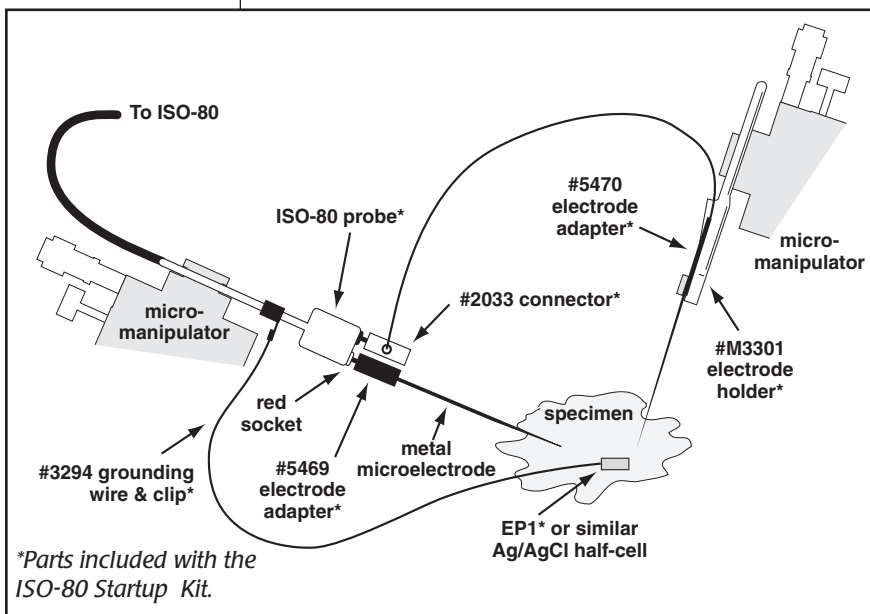


Fig. 10 — Differential Amplification

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Measuring Electrode Impedance: the Z Mode

To check electrode impedances (100K-20M Ω) with the **ISO-80**, set the MODE switch set to Z. The **ISO-80** supplies a small (20nA peak-to-peak) current, alternating at 300Hz, to the electrode connected to the red (non-inverting) input socket of the probe. A reference electrode completes the current path back to the CIRCUIT GROUND of the **ISO-80**. As the **ISO-80** delivers current through the probe, an audible tone sounds. Electrode impedance is displayed on the **ISO-80** LCD.

NOTE: The amplifier output is disabled in the Z mode, and no signal can be seen.

Electrode impedance may be measured in situ (electrode and probe connected to the preparation) or in a special test set-up.

In Situ Measurement

Measurement in-situ is made in the normal recording set-ups, as shown in Figures 8, 9 and 10.

NOTE: In the differential amplification configuration, only the electrode in the red socket can be measured.

To make the measurement:

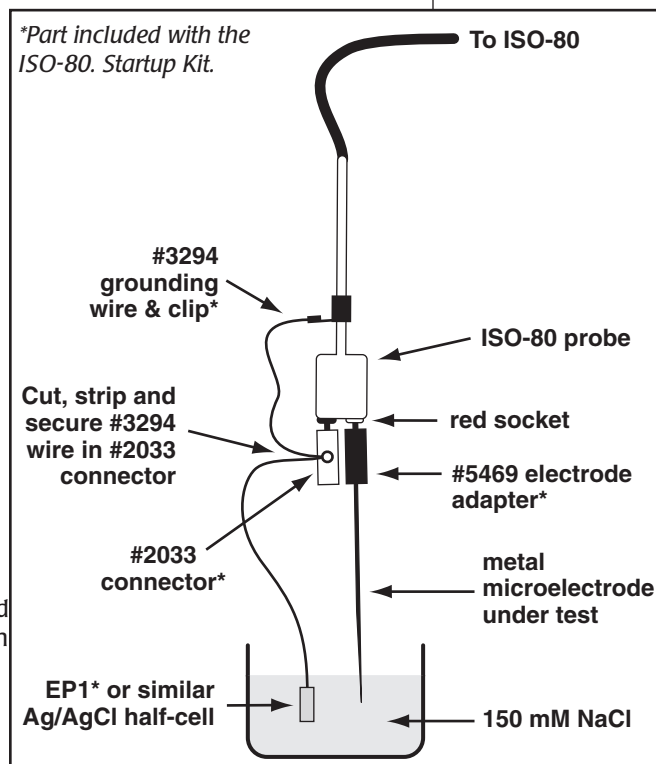
1. Verify that the POWER switch is ON
2. Set the MODE switch to Z.
3. Electrode impedance is then shown on the LCD. The audible tone ceases when the MODE switch is set to AMP.

Test Setup

The test set-up is shown in Fig 9.

1. Insert the test electrode into the red socket on the probe.
2. Connect the black socket to CIRCUIT GROUND by using the clip on the probe handle (WPI #3294) or the GND jack socket on the instrument panel.
3. Insert the electrode under test in a 150nM NaCl solution.
4. Insert the silver wire reference electrode provided in the startup kit (WPI #EP1) in the same solution and connect it to the CIRCUIT GROUND.
5. To make the measurement, verify that the POWER switch is at ON

Fig. 11 —
Electrode Impedance Test





6. Set the MODE switch to Z.
7. Electrode impedance is then shown on the LCD. The audible tone ceases when the MODE switch is set to AMP.

Generating Marker Current: the Marker Mode

Marker current passes through the red (non-inverting) input socket of the probe, then to the recording electrode in situ (the electrode and probe connected to the preparation). Either the single-ended (Figure 6) or differential (Figures 7 and 8) configuration may be used.

NOTE: In the differential amplification configuration, marker current only passes through the electrode in the red socket.

Marker current can be generated two ways. The first way uses the internal MARKER current generator facility built into the **ISO-80** circuit design. The second way uses an external voltage source applied to the EXTERNAL CURRENT CONTROL INPUT.

NOTE: The current generated using the internal source is a DC current. That generated by an external source can be either AC or DC, depending on the source.

Using the ISO-80 Internal Current Generator

Marker currents up to 20 μ A are available with the MODE switch set to MARKER. The magnitude of the current delivered is adjustable using the MARKER AMPLITUDE knob and is displayed on the LCD. An audible tone sounds the instrument delivers current.

To initiate current:

1. Verify that the POWER is ON.
2. Set the MODE switch to MARKER.
3. Set the MARKER AMPLITUDE control knob to 0.
4. Adjust the MARKER AMPLITUDE control to achieve the required current. The current value is displayed on the LCD.

Using the ISO-80 External Current Control Input

Current may be controlled by an external voltage source using the EXTERNAL CURRENT CONTROL INPUT socket on the left side of the **ISO-80**. The actual current generated depends on the magnitude of the voltage applied. The scale factor used is 100mV = 1 μ A.

NOTE: The voltage applied must be within the range 0V to \pm 2 volts. The voltage may be either DC or an AC pulse, sine wave or other wave form.

1. Verify that the POWER is ON.



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2. Set the MODE switch to MARKER.
3. The current value is displayed on the LCD.

NOTE: When using the External Input there is no electrical isolation.

Maximum Current Level

When using either the internal current source or external current control, the maximum current available depends on the impedance of the electrode used. The greater the impedance of the electrode, the lower the available current. With an electrode impedance of $Z \text{ M}\Omega$ The relationship is:

For example, with a $1 \text{ M}\Omega$ electrode, the maximum current (MARKER AMPLITUDE control

$$I_{\text{max}} = \frac{10}{Z} \mu\text{A}$$

turned to maximum) is $10 \mu\text{A}$.



INSTRUMENT MAINTENANCE

Recharge the Batteries

Power is provided by two 9V rechargeable batteries. With the **ISO-80** in full, continuous operation, the batteries should last for 20 - 24 hours before recharging is necessary. When the batteries need to be recharged, LOW BAT displays on the LCD. Recharge batteries for 6 hours to restore them to full charge. If the batteries have been totally discharged (for example, after several months of shelf storage without use), 10 hours of charging may be necessary.

When recharging is necessary, plug the charger into the CHARGER INPUT socket on the right side of the **ISO-80**. Verify that the POWER is set to OFF/CHARGE.

Replacement Parts

Replacement parts can be ordered using the part numbers in Table 1 (below). For additional accessories, refer to the Table 2 on page 14.

Table 1: Replacement Parts

WPI Part #	Description
ISO-80P	Replacement Probe
3414	9V NiMH Battery, each (2 required)



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ACCESSORIES

Table 2 (below) lists accessory parts and provides a brief description of the parts.

Table 2: Accessory Parts

WPI Part #	Description
CBL102	3.5 mm Phone plug-to-BNC Cable
EP1	Ag/AgCl pellet (70mm wire)
MEH1S	1mm Pipette holder (2mm pin)
MEH3SBW	Mini banana pipette holder
MEH8	Microelectrode holder, right angle
M3301EH	2mm skt. to 0.031 skt. adapter
2851	BNC-to-BNC Cable
2033	Black Insulated Mini-Banana Plug
2034	Red Insulated Mini-Banana Plug
2035	Uninsulated Mini-Banana Plug
2505	Electrode handle, 6.3mm
3294	Ground clip with wire, 3' cable
3484	Rack Mount Kit (for 2 DAM preamps)
3485	Ringstand Mounting Kit
5371	Cable, Low Noise (2mm pin to 2mm pin)
5469	Metal Microelectrode Adapter for DAM80 (<i>mini-banana plug to 0.031 in. (0.79 mm) socket</i>)
5470	2" Cable to 0.031 skt.
13388	Adapter, mini-banana plug to 2mm socket
13620	Low-noise cable for microelectrode holder
300040	2mm skt. to 2mm skt. Manipulator holder
300102	Electrode Extension, 4-inch, 2mm to 0.031" metal electrode



SPECIFICATIONS

Input Impedance	>10 ¹¹ Ω // 8 pico-farads (typical)
Input Leakage Current	50pA maximum
Gain	100, 1000, 10000
Common Mode Rejection	100dB typical (Gain=100-10,000, Frequency =5Hz-10kHz)
Noise, Referred to Input	0.4μV RMS (5-10Hz) 2.0μV RMS (10Hz-10kHz)
Filter Setting	
Low cutoff	5, 10, 100, 300Hz
High cutoff	100 Hz, 1kHz, 3kHz, 10kHz
Maximum Output voltage	±8V
Electrode Impedance Range	100KΩ - 20MΩ
Stimulation Current	
Elect. Impedance ≤0.5MΩ	0 to ± 20μA
Elect. Impedance =1MΩ	0 to ± 10μA
Elect. Impedance =2MΩ	0 to ± 5μA
Maximum Stimulation Voltage	±15V
Maximum Electrode Voltage	±40V
External Current Injection Input	
Scale Factor	10μA/V
Frequency Range	DC to 10kHz
Voltage Range	-2.0 to +2.0V
Output Impedance	600Ω
Display	3½ Digit LCD
Power	Two 9V NiCd batteries
Expected Battery Life	20 hours with fully charged batteries

APPENDIX A: WIRING CONFIGURATIONS

The following wiring configurations are for use on one or two micromanipulators such as WPI's M3301R/L. These configurations may require parts not included in the ISO-80 startup kit. Parts not included are marked with an asterisk (*).

Dual Metal Electrode *(Add two metal electrodes)*

Qty	Order No.	Description
A	1 5469	Mini banana to 0.031 skt. Adaptor
B	1 13388	Mini banana to 2 mm skt. Adaptor
C	1 5371*	2 mm pin to 2mm pin 2' cable
D	1 300102*	2mm skt to 0.031 skt. Adaptor
E	1 3294	Ground clip to wire 3' cable
F	1 EP1*	Ag/AgCl pellet (70mm wire)
	Optional*	MEH8 and 2505 handle, 13620 cable

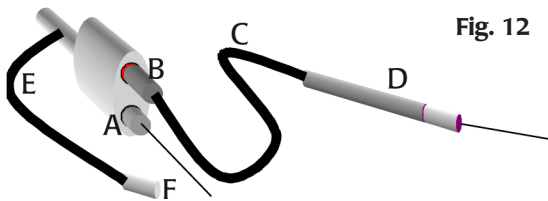


Fig. 12

Single Metal Electrode *(Add single metal electrode)*

Qty	Order No.	Description
A	1 5469	Mini banana to 0.031 skt. Adaptor
B	1 2033	Mini banana plug black
C	1 EP1*	Ag/AgCl pellet (70mm wire)
D	1 3294	Gnd clip to wire 3' cable

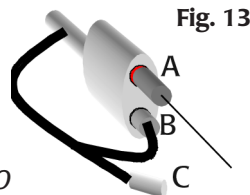


Fig. 13

Dual Metal Electrode *(Add two metal electro)*

Qty	Order No.	Description
A	2 2033	Mini banana to wire turret
B	2 M3301EH*	2mm skt. to 0.031 skt. Adaptor
C	1 5470*	2" cable to 0.031 skt.
D	1 3294	3' cable with ground clip
E	1 EP1	Ag/AgCl pellet (70mm wire)

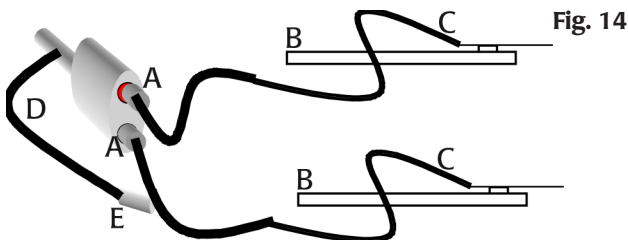
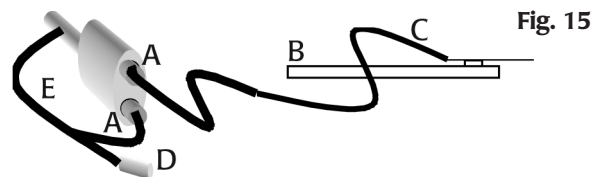


Fig. 14

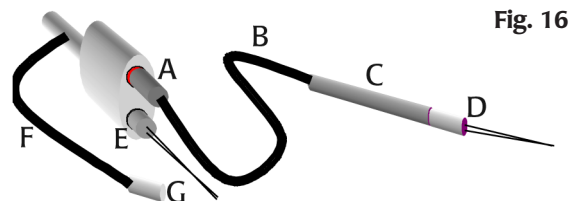
Single Metal Electrode (Add single metal electrode)

Qty	Order No.	Description
A 2	2033	Mini banana plug black
B 1	M3301EH*	2mm skt. to 0.031 skt. Adaptor
C 1	5470*	2" cable to 0.031 skt.
D Fig. 8	EP1*	Ag/AgCl pellet (70mm wire)
E 1	3294	Ground clip to wire 3' cable



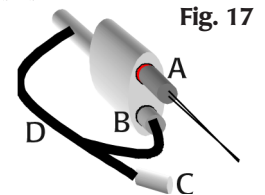
Dual Micropipette (Add 1 mm glass micropipettes)

Qty	Order No.	Description
A 1	13388	Mini banana to 2 mm skt. Adaptor
B 1	5371*	2 mm pin to 2mm pin 2' cable
C 1	300040*	2mm skt to 2mm skt. manipulator holder
D 1	MEH1S*	1mm pipette holder (2mm pin)
E 1	MEH3SBW*	Mini banana pipette holder
F 1	3294	Ground clip to wire 3' cable
G 1	EP1*	Ag/AgCl pellet (70mm wire)
	Optional*	MEH8 and 2505 handle, 13620 cable



Single Micropipette (Add 1 mm glass micropipette)

Qty	Order No.	Description
A 1	MEH3SBW*	Mini banana pipette holder
B 1	2033	Mini banana plug black
C 1	EP1*	Ag/AgCl pellet (70mm wire)
D 1	3294	Ground clip to wire 3' cable



NOTE: When ordering MEH1S and MEH3SBW, include the appropriate suffix. For example, MEH1S-10.

10 - 1.0mm glass, 12 - 1.2mm glass, 15 - 1.5mm glass, 20 - 2.0mm glass



ISO-80



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DECLARATION OF CONFORMITY

We: World Precision Instruments, Inc.
175 Sarasota Center Boulevard
Sarasota FL 34240-9258
USA

as the manufacturers of the apparatus listed, declare under sole responsibility that the product(s):

Title: ISO 80 System

to which this declaration relates is/are in conformity with the following standards or other normative documents:

EMC: EN 50082-1:1992

and therefore conform(s) with the protection requirements of Council Directive 89/336/EEC relating to electromagnetic compatibility.

Issued on: July 13, 2001

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WARRANTY

WPI (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 receipt. WPI's obligation under this warranty shall be limited to repair or replacement, at WPI's option, of the equipment or defective components or parts upon receipt thereof f.o.b. WPI, Sarasota, Florida U.S.A. Return of a repaired instrument shall be f.o.b. Sarasota.

The above warranty is contingent upon normal usage and does not cover products which have been modified without WPI'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, or causes other than normal and ordinary usage.

To the extent that any of its equipment is furnished by a manufacturer other than WPI, 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.

WPI makes no warranty of any kind, express or implied or statutory, including without limitation any warranties of merchantability and/or fitness for a particular purpose. WPI shall not be liable for any damages, whether direct, indirect, special or consequential arising from a failure of this product to operate in the manner desired by the user. WPI shall not be liable for any damage to data or property that may be caused directly or indirectly by use of this product.

Claims and Returns

- Inspect all shipments upon receipt. Missing cartons or obvious damage to cartons should be noted on the delivery receipt before signing. Concealed loss or damage should be reported at once to the carrier and an inspection requested. All claims for shortage or damage must be made within 10 days after receipt of shipment. Claims for lost shipments must be made within 30 days of invoice or other notification of shipment. Please save damaged or pilfered cartons until claim settles. In some instances, photographic documentation may be required. Some items are time sensitive; WPI assumes no extended warranty or any liability for use beyond the date specified on the container.
- WPI cannot be held responsible for items damaged in shipment en route to us. Please enclose merchandise in its original shipping container to avoid damage from handling. We recommend that you insure merchandise when shipping. The customer is responsible for paying shipping expenses including adequate insurance on all items returned.
- Do not return any goods to WPI without obtaining prior approval and instructions (RMA#) from our returns department. Goods returned unauthorized or by collect freight may be refused. The RMA# must be clearly displayed on the outside of the box, or the package will not be accepted. Please contact the RMA department for a request form.
- Goods returned for repair must be reasonably clean and free of hazardous materials.
- A handling fee is charged for goods returned for exchange or credit. This fee may add up to 25% of the sale price depending on the condition of the item. Goods ordered in error are also subject to the handling fee.
- Equipment which was built as a special order cannot be returned.
- Always refer to the RMA# when contacting WPI to obtain a status of your returned item.
- For any other issues regarding a claim or return, please contact the RMA department

** Electrodes, batteries and other consumable parts are warranted for 30 days only from the date on which the customer receives these items.*

Warning: This equipment is not designed or intended for use on humans.

World Precision Instruments, Inc.

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