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Bridge-8

Transducer amplifier module for the ISO-DAM8a bioamplifier

INSTRUCTION MANUAL

Serial No._____

11/00

World Precision Instruments

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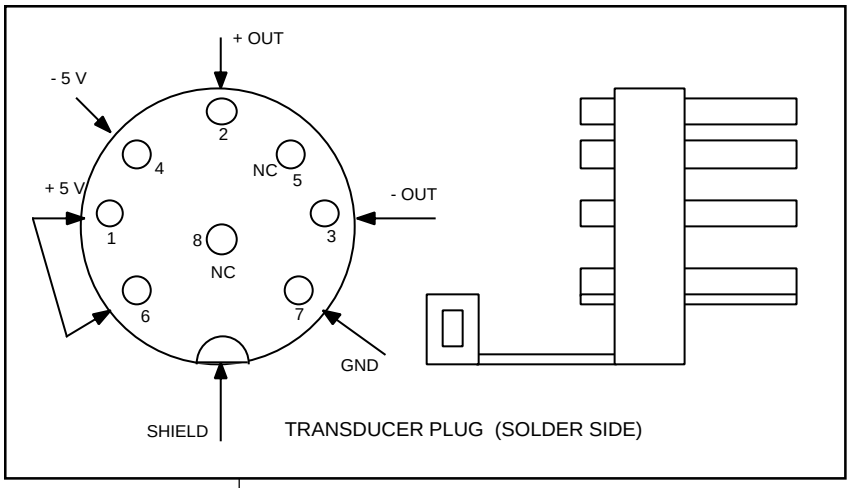
Introduction

Any combination of **ISO-DAM8a** or **Bridge-8** modules may be combined in the same instrument main frame. Bridge-8 includes a differential amplifier featuring high input impedance, high common mode rejection of electrical interference and low current leakage input terminals. Force, pressure, temperature, displacement, light and other physical parameters are readily measured. Thermocouple wire transducers with cold junction references for a wide range of temperature monitoring are also available.

Each channel contains: a regulated DC power supply, 10 volts (+ 5 and - 5 volts with respect to signal ground) to provide DC power to transducers and a precision differential amplifier with selectable voltage amplification and variable position adjustment control. Each module includes a low pass filter with conditioner for strain gauges and other transducers.

Single Channel Installation

1. Remove two screws on the right and left sides of the instrument enclosure, respectively. Then remove eight screws on the bottom of the enclosure.
2. Slide the internal chassis out of the enclosure.
3. Remove the two screws holding the blank panel where the new channel is to be installed.
4. Plug the connector of this channel into the new module and then secure the channel in position with two screws.
5. Slide the chassis into the enclosure and reinstall all screws.



TRANSDUCER PLUG (SOLDER SIDE)

Fig. 1

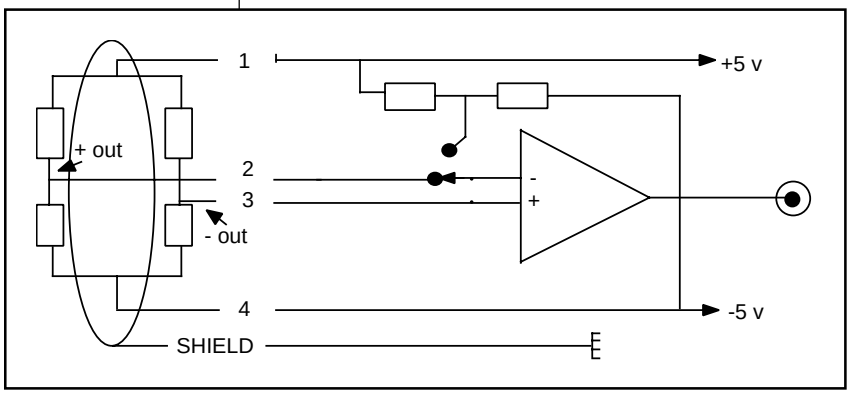
Operation

Transducers are connected to Bridge-8 via the 8-pin transducer input connector on the front panel. Spare 8-pin DIN plugs are provided with each instrument to allow the user to rewire the cables of other manufacturers' transducers to connect to Bridge-8 modules (Fig. 1).

Positioning the output to zero

Insert the transducer plug into the panel transducer input connector. Switch the **Gain Select** switch for the channel being used to x10 and set the **Bridge** switch to **Differential**. Turn on the **Power** switch at the top of the panel. One or both of the two red **Offset Adjust** indicator lamps will light if a transducer is plugged into the appropriate connector on the front panel. Output coaxial connectors for all channels are located on the rear panel of the instrument. If the **–** lamp is lit, the output voltage level is minus. If the **+** lamp is lit, the output voltage level is positive. To bring the output voltage level to nearly zero volts, adjust the **Offset Adjust** knob above the **Gain** switch so that both lamps are lit together. A significant increase in the sharpness or resolution of the zero adjustment may be achieved by increasing the gain to x100.

Fig. 2



Bridge switch

Many transducers configured as Wheatstone bridges with four resistive elements will directly access the differential amplifier, as represented in Figure 2. When the **Bridge** switch is in the **Differential** position, both inputs of the

differential amplifier, inverting and non-inverting, are connected to the signal terminals of the transducer bridge. In single-ended operation, the inverting input of the differential amplifier is connected to a variable reference potential leaving the non-inverting input available to the signal source. In the **Gnd** (ground) position both the inverting and the non-inverting inputs are connected to ground.

Transducer calibration

Bridge-8 provides fixed and accurate decade amplification steps. Of most interest to the user, however, may be the conversion factor from the physical variable—grams, mm of Hg, mm of displacement—to output voltage. Since the transducer's conversion factor is often not exactly known and varies with the voltage applied to the sensor (10 volts from Bridge-8), it is therefore necessary for the user to calibrate the system using known forces, pressures or displacements to scale the output of Bridge-8 quantitatively with the original physical parameter being measured.

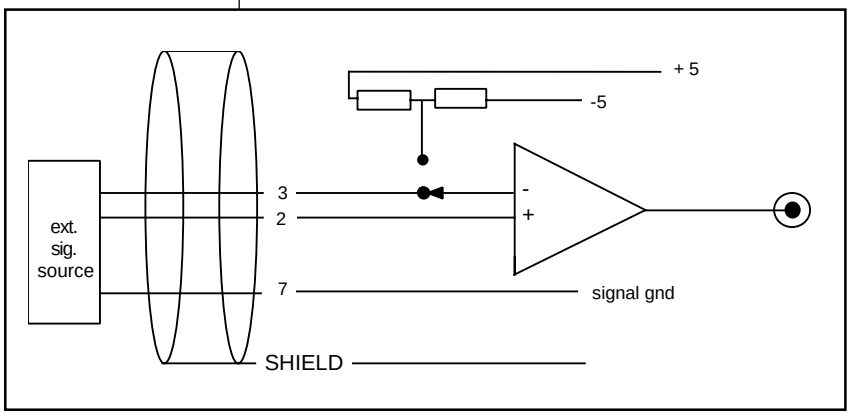
Example

A typical pressure transducer is nominally rated at 5 microvolts out per volt of excitation per mm of Hg. To compute the approximate output from Bridge-8 for this transducer:

5 μV/V • 10 V • Amplification = 0utput μV per mm Hg

Thus, if we had selected x100 Amplification, the output per mm Hg would be approximately 5 mV per mm Hg. Since the nominal rating of 5 μV per volt is usually not exact, the user must, in the end, calibrate the transducer with a known hydrostatic pressure to obtain an accurate conversion factor. (WPI's model **PM015 Pressure Monitor/Calibrator** is a suitable hydrostatic pressure calibration device.)

Fig. 3



General amplification

For transducer types other than resistive bridges, such as active transistor circuits, magnetic, photocell or piezoelectric devices, the instrument's differential amplifier may still be used for signal amplification in differential and single-ended modes. Note that pin 7, instrument ground, must be connected to the circuit ground of the input source to achieve effective amplification. Careful shielding of signal generating devices will result in lower noise "pickup" by the signal input wiring.

Specifications

Voltage Amplification	x1, x10, x50, x100, x500, x1000 & adjustable
Input Impedance	> 10^{12} Ohms
Input Leakage Current	< 0.1 picoamperes at 25°C, typ.
Voltage Offset Adjustment	± 50 mV (low offset range), ± 100 mV (high offset range)
Amplifier Output Voltage	± 5.0 volts (10 mA, max.)
Transducer Excitation	10 volts (± 5.0 v) (100 mA, max.)
Low Pass Filter Band (kHz)	0.03, 0.1, 0.3, 1, 5, 10, and “wide band”

SYSTEM

Enclosure Dimensions	7 x 17 x 9.2 in. (18 x 43 x 23 cm)

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 ten (10) days after receipt of shipment. Claims for lost shipments must be made within thirty (30) days of receipt of invoice or other notification of shipment. Please save damaged or pilfered cartons until claim is settled. 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

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Repairs

Contact our Customer Service Department for assistance in the repair of apparatus. Do not return goods until instructions have been received. Returned items must be securely packed to prevent further damage in transit. The Customer is responsible for paying shipping expenses, including adequate insurance on all items returned for repairs. Identification of the item(s) by model number, name, as well as complete description of the difficulties experienced should be written on the repair purchase order and on a tag attached to the item.

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

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

World Precision Instruments, Inc.

International Trade Center, 175 Sarasota Center Blvd., Sarasota FL 34240-9258
Tel: 941-371-1003 • Fax: 941-377-5428 • E-mail: sales@wpiinc.com

UK: Astonbury Farm Business Centre • Aston, Stevenage, Hertfordshire SG2 7EG • Tel: 01438-880025 • Fax: 01438-880026 • E-mail: wpiuk@wpi-europe.com
Germany: Liegnitzer Str. 15, D-10999 Berlin • Tel: 030-6188845 • Fax: 030-6188670 • E-mail: wpide@wpi-europe.com
Japan: Physio-Tech Co., Ltd. • 1-6-3 Iwamoto-cho, Chiyoda-ku, Tokyo 100-0032 • Tel: 81-3-3864-2781 • Fax: 81-3-3864-2787 • E-mail: sales@physio-tech.co.jp
Australia: Coherent Life Sciences Pty. Ltd. • 116 Sir Donald Bradman Dr • Hilton, SA 5033 • Tel: (03) 9887-6262 • Fax: (03) 9887-9585 • E-mail: wpiau@ozemail.com.au

WORLD PRECISION INSTRUMENTS, INC.
175 Sarasota Center Boulevard
Sarasota, FL 34240-9258 USA
Telephone: (941) 371-1003 Fax: (941) 377-5428
e-mail wpi@wpiinc.com

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: ISODAM8-x
(covers models: ISODAM8-1 to ISODAM8-8 and Bridge 8. Also active head stage, models: EXCELP and EXCELPM)

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

Safety: EN 61010-1:1993 (IEC 1010-1:1990)

EMC: EN 50081-1:1992
EN 50082-1:1992

and therefore conform(s) with the protection requirements of Council Directive 89/336/EEC relating to electromagnetic compatibility and Council Directive 73/23/EEC relating to safety requirements.

Issued on: 18th February 2000

Dr. Mark P. Broderick
President and COO
World Precision Instruments, Inc.
175 Sarasota Center Boulevard
Sarasota, FL 34240-9258 USA

Mr. Glen Carlquist
Production Manager
World Precision Instruments, Inc.
175 Sarasota Center Boulevard
Sarasota, FL 34240-9258 USA

Iso-DAM8A

Isolated low-noise bioamplifier modules

INSTRUCTION MANUAL

Serial No._____

032706

World Precision Instruments, Inc.

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Introduction

The Iso-DAM8A is a modular bioamplifer designed for use with the Iso-DAM8 chassis, which can accommodate up to 8 modules. The Iso-DAM8A input stage is differential and is isolated from the AC power system, *i.e.,* there is no electrical connection to the AC power circuit ground. Isolated preamplification has important advantages over non-isolated amplifiers:

1. No significant current can flow from the preamplifier input terminals to ground. Therefore, input connectors are intrinsically safe and cannot cause electrical shock at the site of measurement.
2. **Problems caused by "ground loops" are eliminated.**

Electrodes or other signal sources may be connected directly to the Iso-DAM8A input connector, or an optional active headstage (WPI Part #74040) may be used. The headstage connects to the Iso-DAM8A through a 5-foot cable. It contains a high impedance differential amplifier in a small metal housing. Electrodes may be connected directly to the headstage, which can be positioned at the measurement site, thus minimizing electrical noise pickup and stray capacitance.

The Iso-DAM8A module contains an input D-C offset adjustment, switch-selectable gain, switch-selectable high pass and low pass filters, a line frequency "notch filter" (settable to 50 or 60 Hz), and an output D-C position adjustment.

The Iso-DAM8 chassis can be ordered for either 110-120VAC or 220-240VAC operation. The chassis can accommodate up to eight Iso-DAM8A bioamplifiers. A separate BNC connector is provided for the output of each channel, and all channel outputs are available at a common DB-25 connector.

Noise and Interference

The bane of low level bioelectric recording is electrical noise and interference originating from the current and voltage in the power mains and room lighting power. Every high amplification preamplifier is subject to this handicap; particularly when using microelectrodes. It is therefore recommended that all input leads be shielded and the preparation connected to earth (ground). Often, it will be necessary to enclose the preparation and electrode lead wires in a Faraday cage or shield to reduce mains induction to sufficiently low levels. Often it will be beneficial to extinguish overhead fluorescent lighting as well. USE OF THE OPTIONAL HEADSTAGE PREAMPLIFIER CAN VASTLY IMPROVE FREQUENCY RESPONSE AND REDUCE NOISE PICKUP WHEN HIGH-IMPEDANCE ELECTRODES ARE USED!

Input Connection

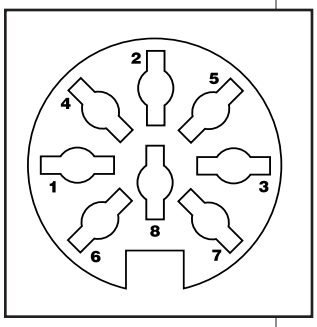


Fig.1 — Input connections

The input connector of the Iso-DAM8A module is a 8-pin “DIN” connector. The pin designations are shown in Figure 1 and the function of each pin is shown in the following table.

PIN	FUNCTION
1	Output from remote headstage.
2	Isolated Ground
3	Reference Connection (See instructions)
4	Direct Input (+)
5	Direct Input (-)
6	Headstage Power (+7.5 VDC)
7	Headstage Power (-7.5 VDC)
8	No connection

Input Cable

For convenience of connection to signal sources, each ISO-DAM8a module is supplied with a 5-foot length of shielded input cable. One end is terminated in a DIN plug which mates with the module. The other end has unterminated tinned leads. The wires are color-coded as shown below:

Red	+ Input
Black	- Input
White	Isolated Ground

Source Select Switch

The Source Select Switch sets the unit to operate either in the Internal Amplifier (direct input mode) or the External Probe mode. When set to the Internal Amplifier (INT), electrodes or other signal sources are connected directly to the INPUT connector. When set to the PROBE position, the unit works with the optional headstage. A center GND position disconnects all inputs to permit the user to establish DC baseline with the POSITION control. Note that in this position, the DC OFFSET and BAL (balance) adjustments have no effect.

Balance Adj.

The DC balance potentiometer allows the user to adjust Gain switch position stability. This potentiometer is accessible through a small screwdriver hole on the front panel. To adjust the DC balance, connect the "+" and "-" inputs of the input connector, or the headstage, if used, to Isolated Ground. Set the GAIN switch to 10. Using an oscilloscope or recorder connected to the Output connector, adjust the POSITION control so that the output trace on the recorder or oscilloscope is near the zero volt level. Rotate the GAIN selector switch from x10 to x10000. If the baseline moves, readjust the DC Balance pot at the x10000 setting with a small screwdriver until the baseline returns its prior setting. The baseline should not deflect appreciably when the GAIN switch is reduced to lower values. Thus the baseline should remain essentially stable (with input grounded) as the Gain switch is rotated.

Output

The maximum signal output from any preamplifier channel is ±10 volts. All preamplifier channels have individual coaxial (BNC) connectors on the rear panel of the instrument. Channel numbers start with #1 on the left hand side (front view). Channel outputs are also available on a 25-pin connector for use with data acquisition systems.

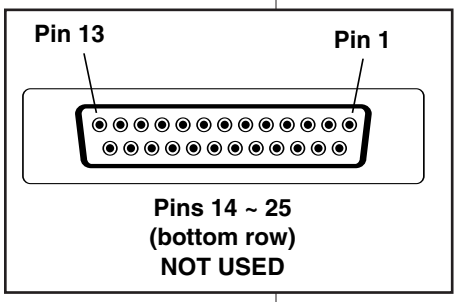


Fig. 2

PIN	FUNCTION	PIN	FUNCTION
1	Channel 1	8	Channel 8
2	Channel 2	9	Ground
3	Channel 3	10	Ground
4	Channel 4	11	Ground
5	Channel 5	12	Ground
6	Channel 6	13	Ground
7	Channel 7		

Filters

Iso-DAM8A provides selected filtering at both the high and low ends of its frequency spectrum. The Low Filter settings are DC, 0.1, 1, 10 and 300 Hz. The High Filter settings are 100, 500 Hz, 1 kHz, 3 kHz, and 10 kHz. Typical settings recommended for ECG and EEG would be Low Filter at 0.1 Hz and the High Filter at 0.1 kHz (100 Hz).

DC Offset

When operating the Iso-DAM8A as a DC amplifier, the user may require a DC offset potential with which to compensate any existing DC voltage from the recording site. The DC Offset knob can provide 0 to >100 mV DC of either polarity with which to reduce (null) the net input signal to zero volts. This becomes increasingly necessary if high gains are to be used with DC amplification. The toggle switch below the DC Offset knob selects the polarity of the offset voltage. If offset adjustment is not required, the toggle switch is kept in the Off position.

Single Channel Installation

1. Remove two screws on the right and left sides of the instrument enclosure, respectively. Then remove eight screws on the bottom of the enclosure.
2. Slide the internal chassis out of the enclosure.
3. Remove the two screws holding the blank panel where the new channel is to be installed.
4. Plug the connector of this channel into the new module and then secure the channel in position with two screws.
5. Slide the chassis into the enclosure and reinstall all screws.

Operation

The connection to and from the amplifier and the settings of the controls will vary greatly from one application to another. The following guidelines may be helpful in establishing initial operating conditions.

1. Input Connections

CAUTION: The inputs to the Iso-DAM8A and the headstage can be damaged by electrostatic discharge. It is recommended that the user momentarily touch the Iso-DAM8A chassis or any grounded metal object

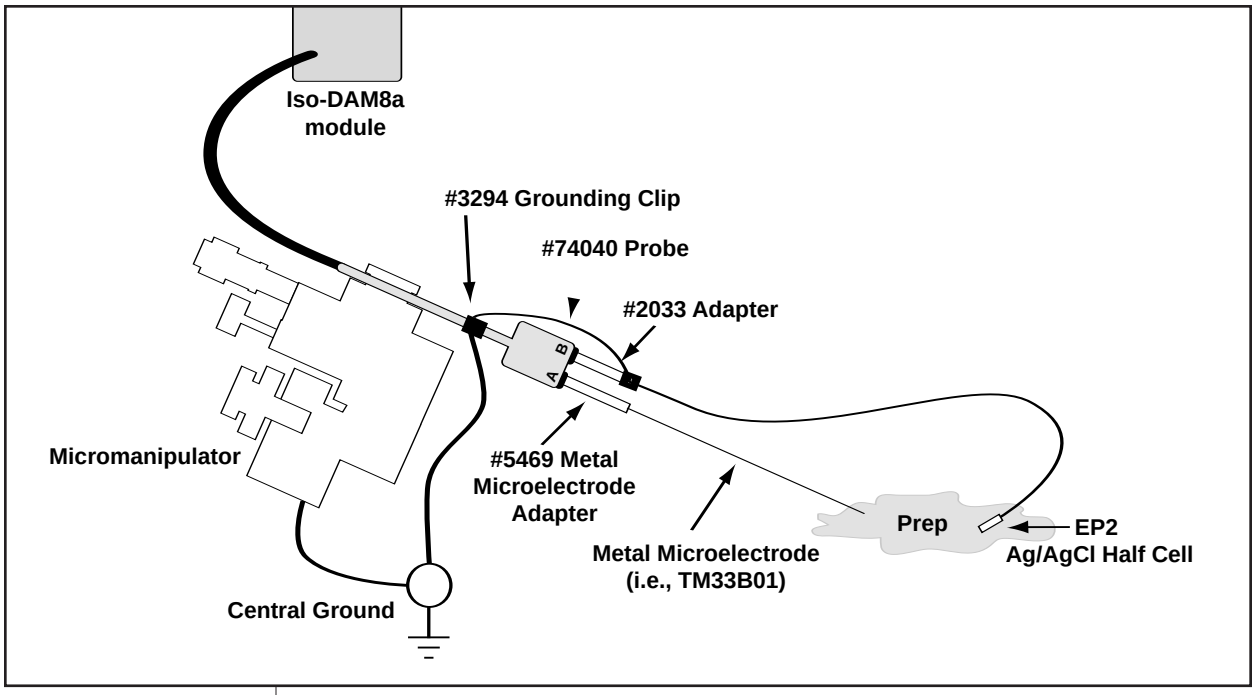


Fig. 3 — Extracellular recording with metal micro-electrode.

before connecting wire or electrodes to the inputs.

It is very important to minimize input lead length, and use of shielded cable is recommended for any leads over 2 or 3 inches (except grounding leads). Both the inverting and non-inverting inputs must be connected. A “floating” (non-connected) input will cause amplifier saturation.

The Iso-DAM8A inputs can be connected in either differential or single-ended modes. Differential connection can reduce noise pickup, and is usually preferable to single-ended. Figure 3 shows a typical single-ended configuration. The optional remote headstage is shown in these examples.

The two inputs on the headstage are electrically identical, except that positive-going signals applied to the RED non-inverting input will produce a positive-going output from the Iso-DAM8A, whereas a positive-going signal applied to the BLACK inverting input will produce a negative-going output. The same holds true for the non-inverting “+” input and inverting “-” input on the INPUT connector. Reversing the connections from that shown will simply result in an inverted signal.

2. Output Connections

Output from each Iso-DAM8A module is available on the rear panel from a standard BNC connector or all channels are available at the 25-pin connector; see page 3 for pin designations. The Iso-DAM8A output is suitable for application to any recording or data acquisition device.

3. Grounding

Proper grounding is critical to successful biological signal monitoring. The optimum grounding configuration is the “single-point ground”, in which each component of a monitoring setup is connected to a single point which is then connected to earth or mains ground. This grounding configuration is used in Figures 2 and 3.

4. Shielding

The isolation feature of the Iso-DAM8A minimizes, but cannot eliminate, noise pickup from electric distribution lines, fluorescent lights, computers, motors, radio frequency transmitters, microwave ovens, etc. Use of shielded wires for input connection is necessary if the subject is located more than a few inches from the amplifier inputs. Even the use of shielded wires and proper grounding may be insufficient in a high electrical noise environment, particularly if high impedance electrodes are used, if the signal level is low (less than 100 millivolts or so), or if high frequency response is required. In these situations, the use of a metal shield, known as a Faraday cage, which encloses the subject and the headstage may be necessary.

5. Idle Settings

If you are not certain what settings are required, the following settings are a good starting point:

PROBE SELECT: GND
LOW FILTER: DC
DC OFFSET: OFF
GAIN: 10
HIGH FILTER: 10 kHZ
NOTCH FILTER: OFF
POSITION: Mid-range
POWER: OFF

6. Control Adjustment

After connecting inputs and outputs, the amplifier can be turned on. The POSITION control may be used to establish a baseline setting on the recording device. It is usual to set this control so that the recording device indicates zero when the PROBE SELECT is in the GND position. The PROBE SELECT switch should then be set appropriately for the setup. If the headstage is used, set the switch to PROBE; if direct connection is made to the Iso-DAM8A input, set the switch to INT.

The GAIN control should be set so that the desired signal produces a significant (greater than 30% of full scale or so) on the recording device. If the recording device has a gain or sensitivity control, it is usually preferable to set the recording device to a low gain and the Iso-DAM8A to a high gain.

The HIGH and LOW filters should be used to reject noise outside the signal frequency range. If the signal is transient in nature and DC response is not required, the LOW filter should be set to the highest setting that does not distort the signal. The HIGH filter should be set to the lowest setting that does not distort the signal.

If line noise is a problem, the NOTCH FILTER may be set to 50 or 60 Hz, as appropriate for the power system. Use of the notch filter can severely distort some signals.

If a large DC offset is present in the setup, the DC OFFSET control can be used to cancel it. The setting of this control can be quite “touchy”, especially at high gain settings.

Iso-DAM8A Module Specifications

Voltage Gain	x10, x100, x1000, x10,000
Input Impedance to Gnd, each input	> 10^{12} Ohms DC, 5 picofarads (typical)
Input R, Between Inputs	>10^{12} Ohms DC, 3 picofarads (typical)
Amp Noise, Input Shorted	< 0.2 µV rms (1-100 Hz), < 1 µV rms (1-10 kHz)
Bandwidth	DC to 10 kHz
	High Filter (Low Pass) 0.1, 0.5, 1, 3, 10 kHz Low Filter (High Pass) 0.1, 1, 10, 300 Hz
Input Offset Voltage Adjust.	± 1VDC
Common Mode Rejection	> 100 dB @ 50/60 Hz with <10 Ohm source 70dB typical with balanced 1 Megohm source
Notch Filter Settings	50 Hz, 60 HZ, Off
Line noise rejection	>40 dB
Output Voltage Swing	± 10 Volts Maximum
Output Resistance	200 Ohms
Output Position adjustment	±1VDC
SYSTEM	
Power Source	Power Adapter 110-120V/60 Hz or 220-240/50 Hz (user specifies)
Enclosure Dimensions	6.8 x 17 x 11.2 in. (17 x 43 x 28 cm)
Shipping Weight	10 to 21 lb (4.5 to 9.5 kg)

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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.

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• 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

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

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World Precision Instruments, Inc.
International Trade Center • 175 Sarasota Center Boulevard • Sarasota FL 34240-9258 USA
Tel: 941-371-1003 • Fax: 941-377-5428 • E-mail: sales@wpiinc.com • Internet: http://www.wpiinc.com
UK: Astonbury Farm Business Centre, Astonbury, Stevenage, Herts SG2 7EG UK • Tel: 0438-880025 • Fax: 0438-880026 • E-mail: wpiuk@wpi-europe.com
Germany: Liegnitzer Str. 15 D-10999 Berlin, Germany • Tel: 030-6188845 • Fax:030-6188670 • E-mail: wpide@wpi-europe.com

WORLD PRECISION INSTRUMENTS, INC.
175 Sarasota Center Boulevard
Sarasota, FL 34240-9258 USA
Telephone: (941) 371-1003 Fax: (941) 377-5428
e-mail wpi@wpiinc.com

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: Modular Bio-Amplifier System
Type: ISO-DAM8A
Model Number: ISO-DAM8A-X
Where X =1 to 8 modules

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

EN 50011:1991 Class B
EN 50082-1:1992

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

Issued on: February 12, 2001

Dr. Mark P. Broderick
President and COO
World Precision Instruments, Inc.
175 Sarasota Center Boulevard
Sarasota, FL 34240-9258 USA

Mr. Glen Carlquist
Production Manager
World Precision Instruments, Inc.
175 Sarasota Center Boulevard
Sarasota, FL 34240-9258 USA

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