



DAM80

Differential Amplifier

INSTRUCTION MANUAL

Serial No. _____

C115

World Precision Instruments, Inc.

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ORIGINAL

DAM80 Differential Amplifier

Specifications

Input Resistance.....	>10 ¹¹ Ohms, Common Mode and differential.
Input Leakage Current.....	50 picoamperes, max.
Amplification.....	100x, 1000x, 10 ⁴ x
Common Mode Rejection Ratio (CMRR)	100 dB typ. @ 50/60 Hz
Equivalent Noise Signal Input (ENSI).....	0.4 microvolts rms or 2.0 microvolts p/p, 0.1-100 Hz 2.0 microvolts rms or 10 microvolts p/p, 1 Hz-10 KHz
Bandwidth Filter Settings:	
low frequency.....	0.1, 1, 10, 300 Hz
high frequency	100 Hz, 1, 3, 10 KHz
Output Voltage Swing.....	± 8 volts
Output Resistance.....	470 Ohms
Battery Test	1 second audible tone
Calibrator Signal.....	10 Hz square wave, amplitude 100 microvolts
Marker Current Source	D.C. current, variable, 0 to ±90 microamperes. External control voltage range of ±10 volts commands proportional current flow.
Power	2 nine-volt alkaline batteries, supplied
Input Probe	provided

DIGITAL

DAM80 Differential Amplifier

Operating Notes

Included in DAM80 is a MARKER current generator which can inject current through the input probe's inverting input terminal. **The MARKER MODE switch must be OFF when operating the amplifier**

Differential Amplification

Differential amplification is of great importance in bioelectric recording to reduce the ever present effect of noise induction from power lines. A well designed differential amplifier will significantly diminish power line (mains) noise. It is essential that the preparation be connected to a good electrical ground and to the ground of the DAM80 itself. This will have the effect of greatly reducing electrostatically induced potential. In addition to the preparation ground, two differential input connections to the red (non inverting) and black (inverting) probe input connectors must be made via appropriate electrodes applied to the recording site so as to optimally record a bioelectric potential difference.

NOTE: Both input terminals on the probe headstage must be connected so as to have a conductive return path to the preparation ground. The preparation may be connected to amplifier circuit ground using the clip and lead wire provided in the accessories package. The clip should be fixed to the probe handle (circuit ground) and the lead wire connected to the preparation ground electrode. If the probe is used in a monopolar (single electrode) mode, the second electrode (preferably the red, noninverting, input) should be connected to the preparation nearby, or to ground.

The Amplifier

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. A recorder or oscilloscope is connected via the cable provided to the OUTPUT connector on the right side of the amplifier case.

The LOW FILTER selector switch determines the lower cut off frequency. **NOTE that at .1Hz setting the amplifier may take a long time to recover if the user inadvertently disconnects an input wire or if the input is exposed to an excessively large electrical signal.** This is a typical property of AC amplifiers set at very low frequency filter settings. For fast recovery from signal overload the user is advised to operate at the highest frequency setting of the low frequency filter consistent with the application. Generally, slow signals such as ECG and EEG require the 0.1 Hz setting, while nerve action potential recording allows the use of the 10 Hz LOW FILTER setting without sacrificing signal quality.

The recorder or oscilloscope must be in the DC mode so that the DAM80's LOW FILTER settings will be as indicated. It is then necessary to use the POSITION knob to set the DAM80 output to zero or any convenient value so as to position the recording baseline.

The HIGH FILTER selector switch affects the amplifier's speed of response. The 10 KHz setting (widest band setting) enables the amplifier to respond most quickly to rapid signals. However, intrinsic and extrinsic amplifier noise is also enhanced by wideband operation. The user should therefore use the lowest band setting consistent with minimal degradation of the required bio-signal. For ECG and EEG 0.1 KHz will be adequate. For muscle potentials, HIGH FILTER settings of 3 to 10 KHz will be appropriate. Amplification is controlled by the GAIN selector switch.

Instrument POWER is provided by two alkaline 9-volt batteries. Battery operation results in lower internal noise level. Batteries can be tested by activating the BAT/CAL switch. If a short tone is heard, the batteries are functional. Conversely if the tone is absent, the batteries must be replaced.

The Current Generator

It is useful to be able to inject current via the input electrodes for the following possible reasons:

1. To mark tissues by electrolytic deposition of ferrous stains or with current induced lesions.
2. Ionophoresis of drugs or other bio-active agents.
3. Stimulation of nerve cells.

Note that the application of large currents through recording electrodes will often result in driving the amplifier output off scale until both electrodes and amplifier can recover

Located at the left hand side of the DAM80 front panel are the controls for an on-board MARKER current source. This source allows the user to inject current through the inverting input (black) electrode. **Note that this current flows through the electrode to preparation ground.** The electrode can be an anode or cathode by selecting +DC or - DC respectively on the MARKER MODE switch. Rotating the magnitude of the MARKER AMPLITUDE control clockwise will increase the current, but the actual magnitude and time course of current flow will be determined by electrode geometry and polarization effects. The actual current flow can be monitored by placing a standard microampere current meter or a resistor (see note* below) connected between the preparation ground electrode and the circuit ground (probe handle). The EXTERNAL CURRENT INPUT connector on the right side of the instrument case is provided so that timed or larger currents can be applied. The MARKER AMPLITUDE control is not functional in the EXT mode. **Signals applied to this connector should not exceed ± 20 volts.**

DAM80 Differential Amplifier

*An oscilloscope or recorder connected so as to view the voltage across this resistor will display the time course and magnitude of the current flowing from the electrode to ground. Note that the resistor must be as small as possible so as not to impair the effectiveness of preparation grounding. For example, a 1 K Ohm resistor will display 1 mV per microampere of electrode current. If only DC current is to be monitored, a large capacitor (for example, 10 microfarad, non-polar) across the monitor resistor is recommended to reduce possible noise.

Changing the batteries

Remove the two small screws which secure the rear panel of the instrument. Replace the two old batteries with fresh ones. Secure the rear panel. Turn the POWER switch on and press the BAT/CAL switch for the audible "battery ok" signal. Although any of the common 9 volt transistor batteries will work well, alkaline cells are recommended for longer life. Replace batteries annually or as required. These batteries are available world wide. If the user should have difficulty finding replacements, please contact a WPI representative.

DAM80 Differential Amplifier

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 shipment. 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, transportation, 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.

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 WPI'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 WPI be liable for any special or consequential damages.

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.*

ORIGINAL



Patch Clamp Capillary Glass

WPI offers capillary tubing made from three different types of glass, differing in ID measurement as indicated in the Table.

● **PG52150-4, PG52151-4 and PG52165-4**, is prepared from Corning Kovar Sealing #7052 glass, widely employed in patch clamp experiments. Excellent sealing properties with a variety of cells; electrical properties similar to "hard glass." Most important, thermal properties are more consistent with soda lime (or "soft") glass.

● **PG10150-4 and PG10165-4**, composed of Corning #0010 glass, is very similar in electrical and thermal properties to Corning #0080 (Soda Lime glass). Softens at 625° C and may be described as a low lead glass.

● **PG61150-4 and PG61165-4**, derived from Corning #8161 glass, produces the lowest noise recordings of the glasses described here, comparable to aluminosilicate glasses. Corning #8161 is probably the most versatile of the patch clamp glasses studied to date. It does not require high heater currents necessary for aluminosilicates and pulls at a lower temperature than soda lime type materials.

All patch clamp glass comes without microfilament.

Catalog #	Type	OD/ID(mm)	Dielectric Constant	Softening Point °C	Quantity
PG52150-4	#7052	1.5/0.75	4.9	710	100
PG52151-4	#7052	1.5/1.0	4.9	710	100
PG52165-4	#7052	1.65/1.1	4.9	710	100
PG10150-4	#0010	1.5/0.75	6.7	625	100
PG10165-4	#0010	1.65/1.1	6.7	625	100
PG61150-4	#8161	1.5/1.15	8.3	600	100
PG61165-4	#8161	1.65/1.1	8.3	600	100

Silver, Platinum, Tungsten and Stainless Steel Wire

Annealed silver wire (AGW), 99.99% pure, in two diameters: 0.005-in. wire can be ordered with a Teflon coating (AGT0510), and 0.010-in. wire can be ordered with a PVC coating (AGPVC1025).

Teflon-coated platinum wire (PTT0502) is an alloy of 90% platinum and 10% iridium, giving excellent tensile strength and corrosion resistance.

Tungsten wire (TGWxxxx), available in three diameters, is 99.95% pure.

Catalog No.	Metal	Coating	Diameter	Length
AGW0510	Silver	—	0.005 in.	10 ft
AGW0530	Silver	—	0.005 in.	30 ft
AGW1010	Silver	—	0.010 in.	10 ft
AGW1030	Silver	—	0.010 in.	30 ft
AGT0510	Silver	Teflon	0.005 in.*	10 ft
AGT0525	Silver	Teflon	0.005 in.*	25 ft
AGT05100	Silver	Teflon	0.005 in.*	100 ft
AGT1010	Silver	Teflon	0.010 in.**	10 ft
AGT1025	Silver	Teflon	0.010 in.**	25 ft
AGT10100	Silver	Teflon	0.010 in.**	100 ft
AGPVC1025	Silver	PVC	0.010 in.***	25 ft
PTT0502	Platinum	Teflon	0.005 in.*	2 ft
SS31605	Stainless Steel	—	0.005 in.	50 ft
SS31614	Stainless Steel	—	0.014 in.	30 ft
TGW0325	Tungsten	—	0.003 in.	25 ft
TGW0515	Tungsten	—	0.005 in.	15 ft
TGW1510	Tungsten	—	0.015 in.	10 ft

* (0.007 including Teflon)

** (0.012 including Teflon)

Micropipette Storage Jar

Stores up to 30 micropipettes, filled or unfilled, up to three inches in length. A gentle sliding action inserts or removes pipettes without damage to the delicate tips. (*Specify O.D. of glass.*)

E2 Micropipette Storage Jar

1965 Replacement Ring, 0.75-1.0 mm glass

1966 Replacement Ring, 1.2-1.5 mm glass

1967 Replacement Ring, 2.0 mm glass

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MEH Series Microelectrode Holders & Electrochemical Half-Cells

WPI's microelectrode holders provide convenient coupling between fluid-filled glass microelectrodes and high input impedance amplifiers. A reversible Ag/AgCl pellet (or a silver wire) molded into the holder body provides stable potential and long life. Electrical connection is made either by a MALE 2 mm pin or a FEMALE 2 mm socket. The connector is either in line with the glass pipette (STRAIGHT) or at a RIGHT ANGLE to it. Glass is held in the holder with a screw-cap or a rubber gasket (no cap). Filling WPI microelectrode holders with a chloride electrolyte results in stable electrode potentials. Suitable electrolytes include KCl, NaCl and CaCl₂. Holders are supplied for standard WPI single capillary tubing of 1.0, 1.2, 1.5 and 2.0 mm outside diameters. Proper holder selection depends on experimental application, technique, set-up, space and instrumentation.

Quick-connect luer fittings for four common sizes of tubing (1/16, 3/32, 1/8, 5/32 ID) are included with holders which have luer ports.

MEH6RF/SF is designed primarily for use with the Model 900A Micropressure System; **EHB1** for use in electrode beveling; and **MEH3SW** 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.

MICROELECTRODE HOLDERS

SPECIFY O.D. OF GLASS (1.0, 1.2, 1.5 OR 2.0 mm) WHEN ORDERING.

	Angle	Connector	Half-Cell	Pressure Port	Screw Cap
APEH1	Right	Male	Pellet	No Port	2 Caps
APEH2	Right	Male	Wire	No Port	2 Caps
EHB1	Straight	Male	Wire	No Port	N/A
EHBF	Straight	Female	Wire	No Port	N/A
MEH1R	Right	Male	Pellet	No Port	No Cap
MEH1RF	Right	Female	Pellet	No Port	No Cap
MEH1S	Straight	Male	Pellet	No Port	No Cap
MEH1SF	Straight	Female	Pellet	No Port	No Cap
MEH2R	Right	Male	Pellet	Male Luer	w/Cap
MEH2RF	Right	Female	Pellet	Male Luer	w/Cap
MEH2S	Straight	Male	Pellet	Male Luer	w/Cap
MEH2SF	Straight	Female	Pellet	Male Luer	w/Cap
MEH2SFW	Straight	Female	Wire	Male Luer	w/Cap
MEH2SW	Straight	Male	Wire	Male Luer	w/Cap
MEH3R	Right	Male	Pellet	No Port	w/Cap
MEH3RF	Right	Female	Pellet	No Port	w/Cap
MEH3S	Straight	Male	Pellet	No Port	w/Cap
MEH3SB	Straight	Banana	Pellet	No Port	w/Cap
MEH3SF	Straight	Female	Pellet	No Port	w/Cap
MEH3SFW	Straight	Female	Wire	No Port	w/Cap
MEH3SW	Straight	Male	Wire	No Port	w/Cap
MEH4RF	Right	Female	Pellet	3-mmPort	w/Cap
MEH4SF	Straight	Female	Pellet	3-mmPort	w/Cap
MEH4SFW	Straight	Female	Wire	3-mmPort	w/Cap
MEH6RF	Right	Female	Pellet	2-mmPort	w/Cap
MEH6SF	Straight	Female	Pellet	2-mm Port	w/Cap
MEH7	Right	Male	Pellet	2-mmPort	w/Cap & Rod
MEH7W	Right	Male	Wire	2-mmPort	w/Cap & Rod
MEH8	Right	Male	Pellet	No Port	w/Cap & Rod
MEH900R	Right	Male	Pellet	2-mmPort	w/Cap
MEH900S	Straight	Male	Pellet	2-mmPort	w/Cap
MPH1	Straight	None	None	Female Luer	w/Cap & Rod
MPH3	Straight	None	None	Male Luer	w/Cap & Rod
MPH4	Straight	None	None	2-mm Port	w/Cap & Rod
1571			Silicone Rubber Sealant (5 oz)		

SPECIFY O.D. OF GLASS (1.0, 1.2, 1.5 OR 2.0 mm) WHEN ORDERING.

Ag/AgCl Half-Cells

Stable and well-balanced in the presence of current, these small and inexpensive half-cells are easy to work with as bath electrodes.

RC1	Reference Cells with 1.5 m lead
RC1T	Reference Cell, 1.5 m lead, 2 mm pin
RC2	Reference Cell with 2.0 mm pin
RC2F	Reference Cell with female connector
EP2	Ag/AgCl Electrode 2.0 mm diam x 4 mm
EP4	Ag/AgCl Electrode 4.0 mm diam x 1 mm
EP8	Ag/AgCl Electrode 8.0 mm diam x 1 mm
EP12	Ag/AgCl Electrode 12.0 mm diam x 1 mm

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Kwik-Fil™ Borosilicate Glass Capillaries

Clean, high quality glass for the production of micropipette electrodes

	Description	Length	w/ Fil	Quantity	OD/ID(mm)	Item	
Borosilicate	Single Capillary	3 in.	✓	500	1.0/0.58	1B100F-3	
	Single Capillary	3 in.		500	1.0/0.58	1B100-3	
	Single Capillary	3 in.	✓	350	1.2/0.68	1B120F-3	
	Single Capillary	3 in.	✓	225	1.2/0.68	1B150F-3	
	Single Capillary	4 in.	✓	500	1.0/0.58	1B100F-4	
	Single Capillary	4 in.		500	1.0/0.58	1B100-4	
	Single Capillary	4 in.	✓	350	1.2/0.68	1B120F-4	
	Single Capillary	4 in.		225	1.5/0.84	1B150-4	
	Single Capillary	4 in.	✓	225	1.5/0.84	1B150F-4	
	Single Capillary	4 in.	✓	125	2.0/1.12	1B200F-4	
	Single Capillary	6 in.	✓	500	1.0/0.58	1B100F-6	
	Single Capillary	6 in.		500	1.0/0.58	1B100-6	
	Single Capillary	6 in.	✓	350	1.2/0.68	1B120F-6	
	Single Capillary	6 in.		350	1.2/0.68	1B120-6	
	Single Capillary	6 in.	✓	225	1.5/0.84	1B150F-6	
	Single Capillary	6 in.		225	1.5/0.84	1B150-6	
	Single Capillary	6 in.	✓	125	2.0/1.12	1B200F-6	
	Two-Barrel	4 in.	✓	100	1.5/0.84	2B150F-4	
	Three-Barrel	4 in.	✓	100	1.2/0.68	3B120F-4	
	Five-Barrel	4 in.	✓	65	1.2/0.68	5B120F-4	
	Seven-Barrel	4 in.	✓	60	1.0/0.58	7B100F-4	
	Two-Barrel	6 in.	✓	100	1.5/0.84	2B150F-6	
	Three-Barrel	6 in.	✓	100	1.2/0.68	3B120F-6	
	Five-Barrel	6 in.	✓	65	1.2/0.68	5B120F-6	
	Seven-Barrel	6 in.	✓	60	1.0/0.58	7B100F-6	
	Thin-Wall	3 in.	✓	500	1.0/0.75	TW100F-3	
	Thin-Wall	3 in.	✓	225	1.5/1.12	TW150F-3	
	Thin-Wall	4 in.	✓	500	1.0/0.75	TW100F-4	
	Thin-Wall	4 in.		500	1.0/0.75	TW100-4	
	Thin-Wall	4 in.	✓	225	1.5/1.12	TW150F-4	
	Thin-Wall	4 in.		225	1.5/1.12	TW150-4	
	Thin-Wall	6 in.	✓	500	1.0/0.75	TW100F-6	
	Thin-Wall	6 in.	✓	225	1.5/1.12	TW150F-6	
	Thin-Wall	6 in.		225	1.5/1.12	TW150-6	
	Thick Septum Theta	6 in.		100	1.5/1.02	TST150-6	
	Ultrawick	4 in.	✓	10	2	UW200-4	
	Ultrawick	6 in.	✓	10	2	UW200-6	
	Piggyback	4 in.	✓	225	1.51/0.84	PB150F-4	
	Piggyback	6 in.	✓	225	0.75/0.35	PB150F-6	
					1.5/0.84		
					0.75/0.35		
	Economy	Single Capillary	3 in.		1000	1.9/1.35	BG78185-3
		Single Capillary	3 in.		1000	1.5/1.0	BG78150-3
	Aluminosilicate	Single Capillary	4 in.	✓	100	1.0/0.75	AS100F-4
		Single Capillary	6 in.	✓	100	1.0/0.75	AS100F-6

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