



**BAK ELECTRONICS, INC. *Biomedical Instrumentation***

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### AC DIFFERENTIAL AMPLIFIERS WITH REMOTE PROBES



MDA-4

MDA-3

Head Stage  
(Pre-Amplifier)



MDA-4P (NEW FOR 2015)

## **Description:**

The MDA-3, MDA-4 & MDA-4P are high performance preamplifiers designed specifically for low level AC neurological and cardiac signals from high impedance electrodes. They utilize a small, very high input impedance differential head stage to minimize capacitive signal loss and noise pick-up. The probe is small enough to be mounted close to the preparation and comes equipped with short mini-gator leads for clipping to metal microelectrodes. Mini-banana jack connectors are provided for + IN, - IN and GROUND.

The Model MDA-4 & MDA-4P feature dual independent head stage relays for micro-stimulation, electrode marking and input gate grounding. Each of the two inputs to the differential amplifier may be independently grounded and the corresponding electrode input jack simultaneously switched to a mini-banana jack on the rear of the probe which can be connected to a stimulator. This is controlled remotely from the probe by either manual switch input or electronic (TTL level) gate signals applied to BNC gate input connectors. A novel application facilitated by this switching involves parallel track microelectrode mapping. Closely spaced, impedance matched microelectrodes give the optimum in common mode noise rejection, particularly for stimulus artifacts. Since each electrode can pick up unit activity, two parallel tracks with a known separation can be recorded in a single pass by a dual microelectrode manipulator. When unit potential is detected, alternately grounding each side of the input stage quickly establishes from which electrode it is coming; the polarity inversion switch can be used to preserve proper waveform appearance.

## **ALL MODELS FEATURE:**

**ADJUSTABLE HIGH AND LOW FREQUENCY FILTERING** - Independently adjustable 7-position controls for band pass filtering. Unit potentials often have most of their signal energy in a narrow band which is different from biological and electronic noise sources such as EMG, EKG, thermal noise and line voltage. Signal-to-noise values may be greatly improved by appropriate filtering, which in turn greatly improves the resolving power of window discriminators such as the DIS-I.

**HIGH INPUT IMPEDANCE, HIGH COMMON MODE REJECTION, DUAL F.E. T.** -100 MegOhms input impedance eliminates signal loss from even the highest impedance microelectrodes and preserves optimal common mode noise rejection even for unmatched source impedance's, further improving critical signal-to-noise ratio.

**ULTRA-LOW NOISE AND HIGH GAIN THROUGHPUT** - Overall design has been optimized for neurophysiological signals, with typically 10  $\mu$ V peak-to-peak amplifier noise in the critical band of 10 Hz to 10 kHz. Gain is continuously adjustable from 100 to 10,000 (including head stage X50 gain) with high output driving power so further amplification is generally unnecessary, even for several output loads such as recorders and signal processors.

**AC OR DC HEAD STAGE COUPLING OPTION**- While AC input coupling is generally employed to isolate the input stage from electrode polarization potentials, DC input coupling is often useful for optimizing common mode rejection and for minimizing the duration of artifacts due to nearby electrical stimulation. This is because input coupling capacitors effectively store charge from the recorded artifact which has to leak back through the microelectrodes before the amplifier can return to normal function. The very low input bias current of the head stage FET allows us to offer a DC coupled version (specify option (1) - price class A - no additional charge) which is completely safe with most metal microelectrodes.

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## **Specifications:**

Input Resistance	100 Megohms shunted by 5 pF
Input Leakage Current	Zero for AC coupled, Less than $10^{-10}$ amps for DC coupled
Gain	100 to 10,000, continuously adjustable
Common Mode Rejection	60,000 min. @ 60 Hz (94 db) 10,000 min. @ 1,000Hz (80db)
Noise	10 Hz to 10 kHz (input shorted) 10 microvolts peak to peak
Input Coupling	AC or DC (specify Mod. (1) for DC)
Maximum Common Mode Signal	$\pm 15$ volts
Input Dynamic Range	200 millivolts
Output Dynamic Range	20 volts peak-to-peak
Low Frequency Filtering Settings	-3 db @ 1, 2, 10, 50, 100, 200 and 500 Hz
High Frequency Filter Settings	-3db @ 0.1, 0.2, 0.5, 1, 2, 5 and 10kHz
Output Polarity	Normal or inverted (switched)
Output Resistance	100 ohms
Gate Pulse (MDA-4 & MDA-4P only)	0.8 Volts (low state) 2.0 Volts (high state)
Power Requirements	$\pm 15$ volts @ $\pm 22.5$ mA except when in gate or stim mode +75 and -22.5 mA (MDA-3 & 4) (4) 3.6 Volt lithium cells (MDA-4P)
Probe	2 - 9 volt lithium batteries located in main unit (U9VL)
Probe Size	1.4"w x 1.3"h x 2.25"d, cable length 10 feet
Physical Dimensions	2.8"w x 5.25"h x 7.25"d (MDA-3/4)

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### *Other BAK Equipment often used with MDA-3,4:*

DDISI Dual Window Discriminator	PSI-1 Pulsed Sample/Hold Integrator
DIS-1 Window Discriminator	PF-1 Paynter Filter
AD-3,6 Analog Delay	ABI-1 AC Bridge Integrator
ISI-1 Interspike Interval Converter	BPG-1,2 Biphasic Pulse Generator
RG-1 Raster Stepper	BSI-1 Biphasic Stimulus Isolator

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Other BAK electronic amplifiers suitable for different requirements:

Low Impedance Differential:	MDA-1, MDA-2
Built In Electrode Impedance Testing:	A-1, A-1B
Batter Powered:	A-1B
Low-Cost Single Ended:	MMRS-1S

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