



# Amplifier Selection Guide

Electrophysiology is study of the flow of ions in living tissue, that is the electrical properties of cells and tissues, measuring voltage change of a biological entity from a single ion channel proteins to an organ (for example, heart). Micro electrodes (glass pipette filled with an electrolyte) are placed inside a single cell for intracellular measurement and near the surface of a cell or in a preparation for extracellular measurement.

An amplifier, in simplest terms, is an electronic device that magnifies an input signal. In this case, the amplifier magnifies the small voltage changes in cells or tissues. Not all amplifiers are created equal. The way an amplifier

is designed to handle the intrinsic noise of an electronic device and the bandwidth limitations of the amplifier greatly affects the quality and sustainability of the final output signal.

WPI has been designing and building amplifiers since 1967. Quality components is the key to our faithful reproduction of an input signal. WPI offers the following types of amplifiers for Life Science researchers:

- Intracellular—for measurements inside a single cell
- Extracellular—for measurement in interstitial fluid (outside a cell)
- Transducer Amplifiers—for pressure, force displacement, temperature measurements and more

## Extracellular Amplifiers

### **DAM50 Extracellular Potential Amplifiers**

The **DAM50** extracellular potential amplifier is a battery powered bio-amplifier. This differential amplifier has both AC and DC modes. It offers selectable high and low pass filters and position control to offset galvanic potentials.



### **DAM80 Extracellular Potential Amplifiers**

The **DAM80**, and AC only amplifier, features a very low noise, high impedance, remote active headstage probe that can be mounted in micromanipulators. This is perfect for up-close cortical recording or extracellular recording from high impedance glass or metal microelectrodes. Like the **DAM50**, it also provides selectable high and low pass filters and a gated current for tissue marking. It is battery powered. It offers gated or manual current generation for histological marking, iontophoresis or cell stimulation.



### **ISO-80 Isolated Differential Amplifier**

The **ISO-80** provides low noise AC coupled amplification. It is excellent for extracellular nerve action potentials *in vitro* and in living animals. It includes a remote headstage with electrode impedance test functionality and a constant current stimulator. It can be used for measuring EEG, EOG, extracellular and action potentials. It has DC isolated shielding and both high pass and low pass filtering with gain from 100 to 10,000



## Intracellular Amplifiers

### **Duo773 2-Channel Intracellular Amplifier**

The dual microprobe system (**Duo 773** electrometer) is ideal for dual or differential studies. With separate negative capacity controls and built in active filtering, it offers virtually artifact-free differential measurement. It includes two probe headstages ( $10^{15}\Omega$  and  $10^{11}\Omega$  probes) to monitor action potential signals from ion-specific micro electrodes and KCl filled electrodes. Features include capacity compensation, a tickler circuit and active filters. Current can be injected without draining off the measured voltage. An audible compliance alarm sounds when the electrode voltage exceeds the probe input maximum allowed voltage. In addition, it includes bridge balance, independent outputs and a digital meter for monitoring injection current or voltages.



### **Electro705 Basic Intracellular Amplifier**

This low noise, high quality intracellular amplifier is battery powered and includes a remote headstage. Its capacitance compensation can neutralize up to 50pF of electrode shunt capacity. Further reduce stray capacitance with the driven guard shield (included). It has a tickler circuit for cell penetration, an electrode resistance test, a probe test port to test the intrinsic noise and gain. It offers baseline position control to neutralize artifact voltages prior to recording. Two units can be linked to create an optional differential amplifier system.



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## Intracellular Amplifiers *(continued)*

### FD223A Amplifier/Electrometer

The **FD223A** measures ion concentrations within a cell. It requires the use of intracellular ion selective electrodes. Researchers usually make their own glass micro-pipette electrodes. Making an ISE electrode requires a liquid ion exchanger. WPI offers three liquid ion exchangers (**IE010**-Hydrogen, **IE190** - Potassium, **IE200** - Calcium Neutral). The **FD223A** is similar to other intracellular amplifiers, except that it has a much higher input impedance ( $10^{15}\Omega$ ). The standard input impedance is  $10^{12}\Omega$ . The higher the impedance, the closer the current consumption of the probe approaches zero. The higher impedance electrometer offers a method for examining the intracellular voltage without draining off the measured current.



## Transducer Amplifiers

### TBM4M

The transbridge amplifier (**TBM4M**) is a four channel analog transducer manifold that is designed to amplify output voltage signals from pressure, force, displacement, temperature transducers, etc. Each channel contains a regulated 10V power supply (+5V and -5V 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. A variety of pressure sensors and force transducers are available, as well as a photocell (**LUME**) to measure incident light over the near infra red spectrum.



### Optical Transducer Amp

The **SI-BAM21-LCB** KG Optical Force Transducer Amplifier is used in conjunction with the SI-H muscle physiology systems. The **SI-BAM21-LCB** powers the force transducer and converts the output of the transducer to an amplified analog voltage that is proportional to the force applied to the force transducer. The output signal can be multiplied by a factor of 1, 2, 5 or 10 to provide better resolution for a minimal change in applied force.



Amplifier	AC/DC	Differential	Headstage	EMG EKG	Stimulation	Isolated	Multi-channel	Battery Powered	Connectors
<b>Intracellular Bioamplifiers</b>									
<b>FD223A</b>	DC	◆	◆				2		2 mm pin
<b>Electro 705</b>	DC		◆					◆	2 mm pin
<b>Duo773</b>	DC	◆	◆		◆		2		2 mm pin
<b>Extracellular Bioamplifiers</b>									
<i>WPI's Low-Noise Amplifiers Outperform Cheap Imitations</i>									
<b>DAM50</b>	AC/DC	◆		◆				◆	RJ-11
<b>DAM80</b>	AC	◆	◆	◆	◆			◆	Mini Banana
<b>ISO80</b>	AC	◆	◆	◆	◆	◆		◆	Mini Banana
<b>Transducer Amplifiers</b>									
<b>TBM4M</b>	DC	◆					4		8-pin DIN WPI transducers
<b>SI-BAM21-LC</b> <b>SI-BAM21-LCB</b>									KG Transducers only
<b>Epithelial Voltage/Current Clamp Bio Amplifier</b>									
<b>EVC4000</b>	DC				◆		1-4		Ussing 2 mm



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