

BioAmp

(Ver.6)

**Universal Biological
Amplifier System**

User's Manual

SUPERTECH

Comparison, and general features of the BioAmp system

In our choice there are three different amplifier systems. This booklet describes the BioAmp amplifier family. Our other amplifier products are MultiAmp, and LinearAmp families. All of them are up-to-date, easy to use, highly reliable, microprocessor-controlled constructions. We manufacture three different amplifier families, because the three product lines are optimized for different application fields. Please read through the appropriate descriptions at the website of Supertech for the details.

BioAmp amplifier is a general purpose biological amplifier. BioAmp amplifier is optimal for a number of biological applications.

BioAmp's main fields of applications:

- Extracellular recording
- Microelectrode recording (Juxtacellular recording, Single-unit activity, Field Potential, Motor Units, etc.)
- Evoked Potentials (EVP)
- Body-surface potentials (ECG, EMG, EEG, ERG, etc.)
- Micropotentials (HIS-bundle, Late Potential, etc.)
- Multi-channel applications (EEG Brain Mapping, Cortical Depth Mapping, etc.)

The BioAmp system must not be used in human experiments, because it has not got European permission for human applications.

BioAmp is a programmable amplifier, but it has no sampling circuits in the signal path at all. In other words, it is controlled by a built-in microcontroller, or a remote computer, but it has got only high-performance, low noise, low distortion analogue amplifier circuits. This feature is indispensable when you use averaging techniques for processing its output signal. The internal microcontroller, and the optional digital port (which offers remote control facility from a PC) are optically isolated from the amplifier stages. In this way we could connect all the advantages of high accuracy analogue amplifier circuits, and easy usage of digital control.

Although BioAmp is a programmable equipment, it does not need a separate computer to work. According to this fact, it can be used as a stand-alone amplifier (while possessing an optional serial port to communicate with a PC). This stand-alone feature is very comfortable, because the computer is always given, but it should be used to collect, and to process the experimental data. BioAmp's microcontroller on the front panel has got a 3-button keypad, and menu-driven internal software, so it is very friendly to use.

The internal structure of BioAmp is modular, so the number of the amplifier channels, and the number of the microcontrollers built in one equipment can be decided independently. Only the aspects of the application field should be considered when we decide, how many amplifier channels, and how many microcontrollers will be placed in the cage of the equipment (for example it is comfortable to use only one microcontroller to program all the EEG channels together, but another controller

should be used, if there is a single unit channel in the system, and a third controller is necessary, if there are further channels for ECG).

Technical data

In the BioAmp system the High Pass Filter, the Low Pass Filter, and the Gain have got 8 possible positions. The actual values, realised during the manufacturing process can be ordered with the default parameters, but they can be requested with special values, to meet any special requirements, as well. The default values for the Filter and Gain sections are listed below. Any combination of the parameters can be selected, even the invalid settings (for instance, if the High Pass Filter is set to higher frequency, than the Low Pass Filter). The invalid settings result no faults in the equipment, only the output voltage will be driven to zero.

High Pass Filter settings:

- DC (0 Hz)
- 0.16 Hz (1 s)
- 0.53 Hz (0.3 s)
- 1.6 Hz (0.1 s)
- 5.3 Hz (0.03 s)
- 10 Hz
- 30 Hz
- 100 Hz

Low Pass Filter settings:

- 15 Hz
- 30 Hz
- 70 Hz
- 150 Hz
- 500 Hz
- 2 kHz
- 5 kHz
- 10 kHz

Gain settings:

- 500
- 1,000
- 2,000
- 5,000
- 10,000
- 20,000
- 50,000
- 100,000

The Notch Filter (hum noise filter) of the BioAmp is tuned to 50 Hz (or optionally to 60 Hz). The Notch Filter can be switched on and off in the software running on the

front plate microcontroller. The rejection ratio of the Notch Filter on its central frequency is 40 dB.

There is a possibility to select the full amplifier chain of BioAmp as Inverting or Noninverting characteristics. This selection is also a menu point of the software running on the front plate microcontroller.

Noise

The noise level of BioAmp was measured under the following conditions. A monopolar (single-ended) headstage was used. The input signal of the headstage was generated by a battery-powered square wave generator. The output impedance of this generator was 470 Ohms. The measured noise voltages were referred to the input of the headstage (in other words, they were measured at the output, but they were calculated to the input, divided by the actual Gain). The actual settings of the BioAmp main amplifier, except the Low Pass Filter, have negligible effect for the total noise characteristics. The noise level depends mainly on the type of the preamplifier, and the Low Pass Filter setting. The results of the noise measurement are:

If the bandwidth is 10 kHz (the low pass filter is opened to the widest range), the input noise RMS voltage is less than 12 microVolts (50 microVolts peak-to-peak).

If the bandwidth is limited to 2 kHz with the low pass filter, the input noise RMS voltage is less than 5 microVolts (20 microVolts peak-to-peak).

If the bandwidth is limited to 500 Hz with the low pass filter, the input noise RMS voltage is less than 2.5 microVolts (10 microVolts peak-to-peak).

The difference between amplifier models mostly depends on the quality of the design. Such features as hum noise, square wave transient response, phase response, frequency domain characteristics, ability of parasite oscillations, thermal stability, reliability, etc. are responsibility of the designer. But there is no real difference in the signal to noise ratios of biological amplifiers manufactured by different firms. The signal to noise ratio depends on the internal design of the operational (and instrumentational) amplifier integrated circuits. The race of the smaller electronic noise is a race of the semiconductor manufacturers. The designer can only choose from the good amplifiers, from the leader semiconductor factories.

Ground topology

There is a general design method in the high gain amplifiers, what is applied in BioAmp, as well. Usually in the biological amplifiers (as in our amplifiers, too, if optical isolators are not used) the Input GND, and Output GND points are connected together internally. The ohmic resistance between them is less than 0.05 Ohms. However they are signed as different points, because in the interior of the amplifier

the ground network forms a linear topology, not a single-point GND (as it is advised in the text-books). The suppression of the hum noise is better, if the ground line follows the signal line linearly according to the increasing signal amplitudes from the input to the output. To establish a single-point shielding ground is a good solution at the output end of the signal ground line. Unfortunately the security ground wires are also connected to the metal enclosures of the equipments. The security ground wires are usually hum noise sources for the biological amplifiers (because they usually drive some mains-frequency fault currents from other equipments, from other rooms), but they must not be disconnected, they are compulsory to be used. If you use a mains isolation transformer with symmetrical secondary coil, you can eliminate the disadvantage of the security ground (if in your lab it is allowed to use, please check the local rules). The vibration isolation table, the manipulators, the Faraday-cage, metal parts in the Faraday-cage, the oscilloscope, the PC, the Output GND of the amplifier, and the real, separated signal ground line (coming from the earth directly, if it is available) should be connected to this single-point shielding ground. But the ground point of the biological target (the slice chamber, or the body of the animal) should be isolated from the shielding ground point (special care should be taken with the metal parts close to the target in the Faraday-cage). The Input GND point of the amplifier is used to provide a low impedance ground to the biological object only. The Input GND point to the biological object is the GND pin at the input of the headstage.

Preamplifiers (in other words Headstages)

All BioAmp amplifiers have got multi-purpose connectors for external preamplifiers. This method gives an opportunity to use different types of input modules to meet all the future demands. Until now we have developed many different preamplifier versions for BioAmp.

If you can not find the appropriate model for your special task in our actual choice, we will develop a special preamplifier especially for you. It is our method, how we can improve the features of our equipments. We collect all the notices and feedbacks of our customers, and we implement their knowledge into the features of BioAmp.

The BioAmp system has got an optional optical isolator module, what can be configured in the same channel number as the whole amplifier system. The optical isolator module has got 4 kV of isolation voltage. The optical isolator modifies only one parameter of BioAmp. The optical isolator circuit has got unity gain, with noninverting characteristics, but the High Pass Filter can not be used with DC setting, if the optical isolator module is applied. The optical isolator module provides the standard technical security level, but does not provide a juristic security (it does not provide a legality of human experiments).

Connectors

The pin assignment of the 20-pin wire connectors, what are used to connect the 4-channel, or 8-channel headstage to the BioiAmp are not published here. The user must not connect any other equipment into these connectors, only the appropriate products (manufactured by Supertech) should be connected. However, if you are interested to know them, please call, or email us.

The pin assignment of the 20-pin, 2.54 mm output wire connector of each 8-channel output sections of the BioAmp amplifier is shown in the Appendix.

Warranty

We give you full warranty service, including rest parts for the period of 3 years by default. Longer warranty periods can also be defined and agreed (the actual conditions should be discussed before placing the order).

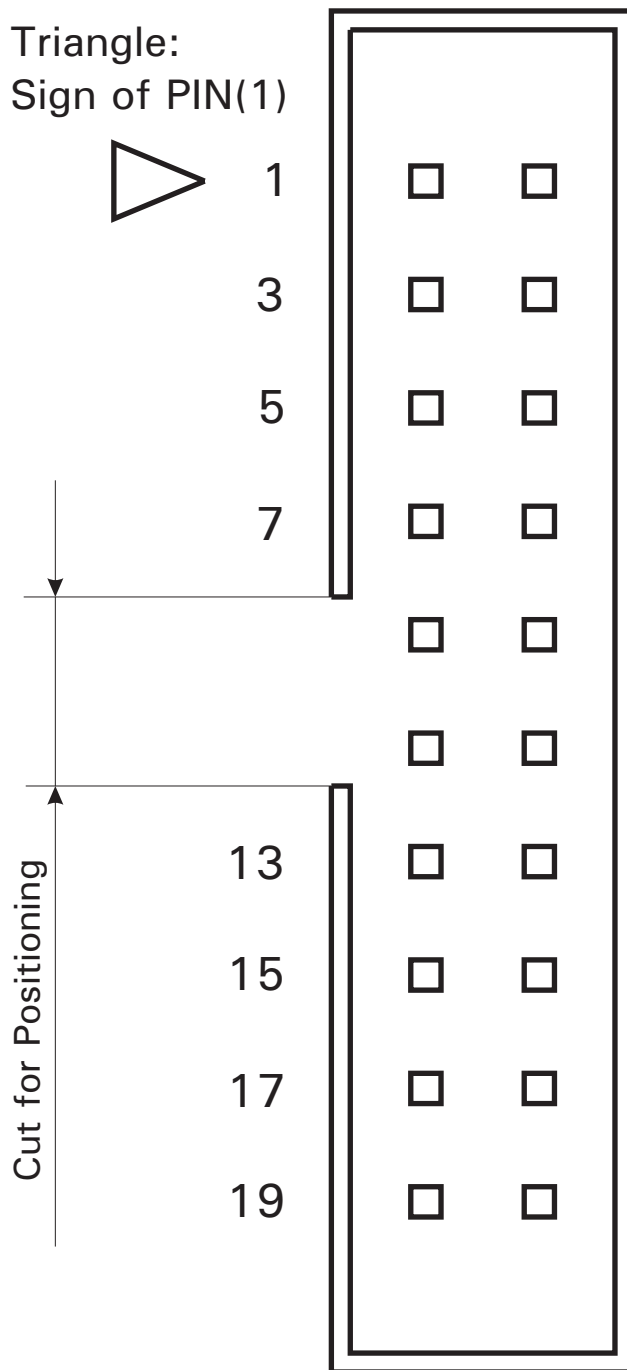
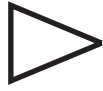
International technical hotline by phone: +36-20-9234-386

Technical hotline by email: office@superte.ch

For further technical information please visit our website. Supertech continuously uses two websites with the same content. Please use that one, which is easier for you to remember:

www.superte.ch and the other: www.super-tech.eu

Triangle:
Sign of PIN(1)



- | | |
|----|--------------------------|
| 1 | PIN(1): Out GND |
| 2 | PIN(2): Output 1, or 9 |
| 3 | PIN(3): Out GND |
| 4 | PIN(4): Output 2, or 10 |
| 5 | PIN(5): Out GND |
| 6 | PIN(6): Output 3, or 11 |
| 7 | PIN(7): Out GND |
| 8 | PIN(8): Output 4, or 12 |
| 9 | PIN(9): Out GND |
| 10 | PIN(10): Output 5, or 13 |
| 11 | PIN(11): Out GND |
| 12 | PIN(12): Output 6, or 14 |
| 13 | PIN(13): Out GND |
| 14 | PIN(14): Output 7, or 15 |
| 15 | PIN(15): Out GND |
| 16 | PIN(16): Output 8, or 16 |
| 17 | PIN(17): Out GND |
| 18 | PIN(18): Out GND |
| 19 | PIN(19): Out GND |
| 20 | PIN(20): Out GND |

The appropriate 20-pin, 2.54 mm female plug compatible with this output connector is IDS-020-S100-01/P manufactured by E-tec Corp.

Output Connector of each 8-channel sections of BioAmp, V.1