

Micro Preamplifier Manual

μ PA16
 μ PA32



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Multi Channel Systems

MCS GmbH

Aspenhaustraße 21

72770 Reutlingen

Germany

Fon +49-71 21-90 92 5 - 0

Fax +49-71 21-90 92 5 -11

info@multichannelsystems.com

www.multichannelsystems.com

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1 Important Information and Instruction

1.1 Operator's Obligations

The operator is obliged to allow only persons to work on the device, who

- are familiar with the safety at work and accident prevention regulations and have been instructed how to use the device;
- are professionally qualified or have specialist knowledge and training and have received instruction in the use of the device;
- have read and understood the chapter on safety and the warning instructions in this manual and confirmed this with their signature.

It must be monitored at regular intervals that the operating personnel are working safely.

Personnel still undergoing training may only work on the device under the supervision of an experienced person.

1.2 Guarantee and Liability

The General conditions of sale and delivery of Multi Channel Systems MCS GmbH always apply. The operator will receive these no later than on conclusion of the contract.

Multi Channel Systems MCS GmbH makes no Guarantee as to the accuracy of any and all tests and data generated by the use of the device or the software. It is up to the user to use good laboratory practice to establish the validity of his findings.

Guarantee and liability claims in the event of injury or material damage are excluded when they are the result of one of the following.

- Improper use of the device.
- Improper installation, commissioning, operation or maintenance of the device.
- Operating the device when the safety and protective devices are defective and / or inoperable.
- Non-observance of the instructions in the manual with regard to transport, storage, installation, commissioning, operation or maintenance of the device.
- Unauthorized structural alterations to the device.
- Unauthorized modifications to the system settings.
- Inadequate monitoring of device components subject to wear.
- Improperly executed and unauthorized repairs.
- Unauthorized opening of the device or its components.
- Catastrophic events due to the effect of foreign bodies or acts of God.

1.3 Important Safety Advice



Warning: Make sure to read the following advices prior to install or to use the device and the software. If you do not fulfill all requirements stated below, this may lead to malfunctions or breakage of connected hardware, or even fatal injuries.



Warning: Obey always the rules of local regulations and laws. Only qualified personnel should be allowed to perform laboratory work. Work according to good laboratory practice to obtain best results and to minimize risks.

The product has been built to the state of the art and in accordance with recognized safety engineering rules. The device may only

- be used for its **intended purpose**;
- be used when in a **perfect condition**.
- Improper use could lead to serious, even fatal injuries to the user or third parties and damage to the device itself or other material damage.



Warning: The device and the software are **not** intended for medical uses and **must not** be used on humans.

- Malfunctions which could impair safety should be rectified immediately.
- Any physical damage of the cable, such as a broken cable, causes a physical damage of the micro preamplifier that cannot be repaired.
- Protect the device from heat. Do not autoclave!
- You can clean the connectors with distilled water in an ultrasonic bath, but keep the cable away from the fluid. Dry the device with compressed air.
- Use and keep the device always in a dry environment. Do not expose it to fluids or vapor for a longer period of time.

2 Welcome to the μ PA



The μ PA micro preamplifier with 16 or 32 electrode inputs is connected to the microelectrode probes for providing the initial tenfold amplification stage. Gain might be different from default value according to customer specification. The use of a headstage preamplifier unit optimizes the signal to noise ratio.

The micro preamplifier is equipped with an Omnetics socket for NeuroNexus probes. It has an additional **common ground** and a **reference electrode input**. The reference electrode is ideally identical to the recording electrodes and placed into a comparable but inactive area or tissue. Background or noise signals that are picked up by both the reference electrode and the recording electrodes are removed. The metal case provides **electrical shielding**. The very high input impedance ensures stable long-term recordings.

Ideally, the input impedance would be infinite to minimize electrical current. As low voltages are generally recorded, a high current would flow if the input impedance were low. As a result, the amplifier would not be able to deliver the current, and the voltage would break down.




The micro preamplifier has a high input impedance to avoid this problem. **Adapters** for all standard **microelectrodes** such as **NeuroNexus probes** (from NeuroNexus®) for acute and chronic implantations ensure a close proximity to the probe to minimize signal loss and cross talk. Adapters are not included in the standard scope of delivery and have to be ordered separately. For custom adapters, please ask your local retailer or contact Multi Channel Systems MCS GmbH.

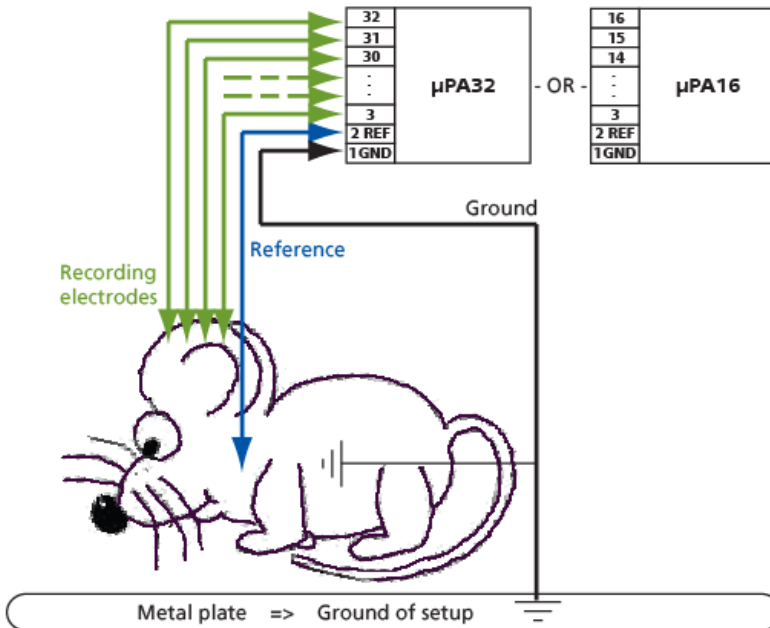
To start working with the μ PA and to learn how to handle the system the **ME/W Signal Generator** is a convenient tool. The ME/W Signal Generator can produce analogue signals identical to those from a variety of biological samples and is therefore a convenient method to test the functionality of the recording system. The ME/W-SG is not included in the standard scope of delivery and has to be ordered separately. Please read the ME/W-SG data sheet for more information.



3 Setting Up and Connecting the μ PA

3.1 General Setup Recommendations

-  Recording inputs: Connect all unused recording electrodes to REF.
-  Reference input: Always connect to reference electrode.
-  Ground: Connect GND to the ground of the experimental setup.



In the following, you find general recommendations for the installation.

Important: It is important that the **complete setup** refers to a **single common ground**. The **reference input** has **always** to be connected. It is recommended to use a **reference electrode**. However, if you are not using a reference electrode, connect the reference input to ground (GND). Otherwise, noise picked up by the reference input will be subtracted from the recording signals. This will either lead to signal loss or to a very high noise level.

1. Ground the animal with a **ground electrode** of large surface area, for example, a liquid gel adhesive electrode, that is connected to the ground of the setup, for example, a large metal table or a Faraday cage, to avoid pickup of noise from the environment. The ground electrode is best positioned in an electrically inactive region not near muscle, nor heart, for example, at the belly.
2. Connect the **GND input** of the micro preamplifier to the common ground of the setup. The ground input is internally connected to the metal case of the preamplifier.

-
3. Connect the **reference electrode REF** to the reference input of the micro preamplifier. Generally, a reference electrode is inserted into non-active tissue of the experimental model. The reference electrode should be identical to the recording electrode so that both electrodes see the same background noise. This is necessary because despite the grounding, the animal's body often has not exactly a potential of zero, due to the electrode impedance, for example. The background noise is then subtracted from the recording signal, increasing the signal to noise ratio. Please note that this may not work if the complete setup is not properly grounded.
 4. (Optional) If two reference electrodes are used, connect the second electrode to the free reference input. Otherwise, leave it free. It is generally not necessary to use a second reference electrode. It can be used to enlarge the surface area of the reference, though.
 5. Connect all unused recording channels to the **GND input** or to the reference electrode, if ground and reference are short circuited, to avoid picking up noise. As the total amplifier gain generally lies in the range of 1000, even very small noise signals may generate high noise signals.
 6. If you are not using a Faraday cage, it might be necessary to shield the complete setup with aluminum foil or similar to prevent electrical interference from the outside. Connect the aluminum foil to the ground of the setup, for example, the metal table.

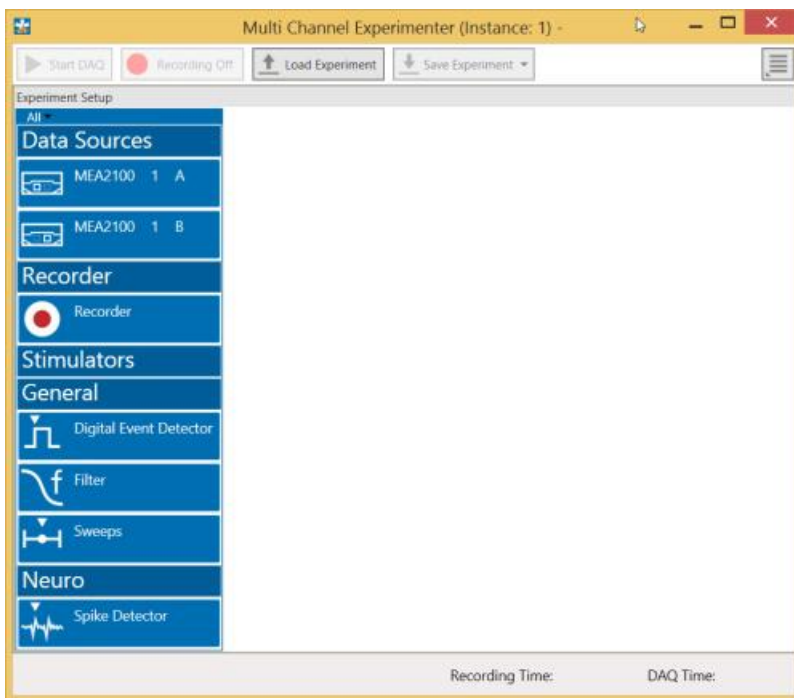
Troubleshooting: If you observe problems with noise, check that the ground of the **setup** is connected to exactly the **same ground** as the **data acquisition computer**. For example, connect the metal table to the ground / earth wire of a free power outlet (of the same electrical system), as the computer is generally connected to ground / earth via the power plug, too. Also, connect the **data acquisition computer's metal case** with a **thick ground wire** to the **ground** of the **setup**, for example the metal table, preferably with a 4 mm plug.

3.2 Multi Channel Experimenter

Double-click the Multi Channel Experimenter icon or select Multi Channel Experimenter from the "Start" menu. The program starts. The main window opens automatically: "Multi Channel Experimenter (Instance: 1)". It is possible to open up to four instances in parallel. Operation is independent for each instance.

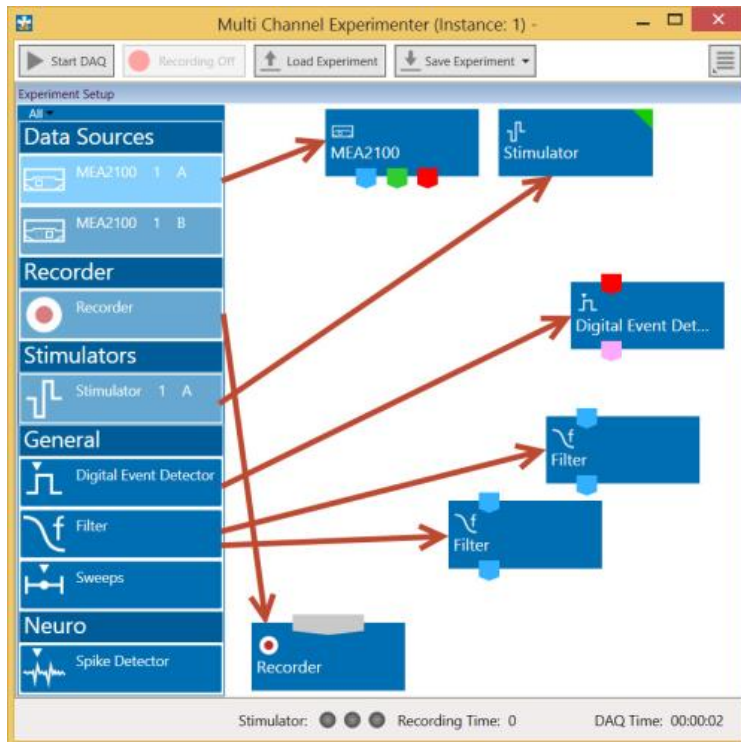
This is your virtual rack configuration in the "Experiment Setup" window, which is blank after program start. On the left side five classes of instruments are provided: "Data Sources", "Recorder" and "Stimulators" are hardware components. The virtual instruments available up to now are divided in "General" and application specific "Neuro".

The header of the dialog contains five buttons: "Start DAQ", "Start Recording", "Load Experiment" and "Save Experiment" in the main toolbar on the left and the "Menu" button on the right. In the bar down under the "Recording Time" and the "DAQ Time" are registered.

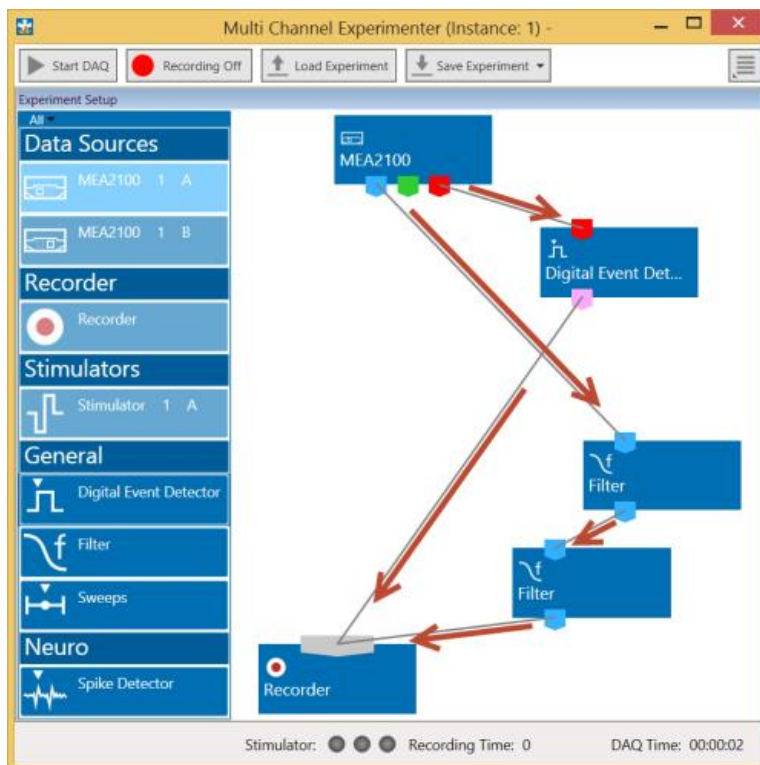


Building a Rack

It is very easy to build a rack: Please click onto the button of the desired instrument and move it via drag and drop from the left to the right side of the main window!



It is also easy to connect the instruments: Please click onto one of the symbols on the lower part of an instrument button to connect this output port via drag and drop with the input port (symbol on the upper side) of the target instrument. Please read the next chapter.



Conventions for Building a Rack

Please consider the rules for connecting the instruments. The Multi Channel Experimenter program allows only connections between output ports at the lower side of the device to the input port on the upper side of the target device. The input and output ports of the devices are color coded for a better assignment of the instruments. The blue symbol represents the port for the "Electrode Raw Data". The green symbol represents the port for the "Auxiliary Analog Data". The red symbol represents the port for the "Digital Data".



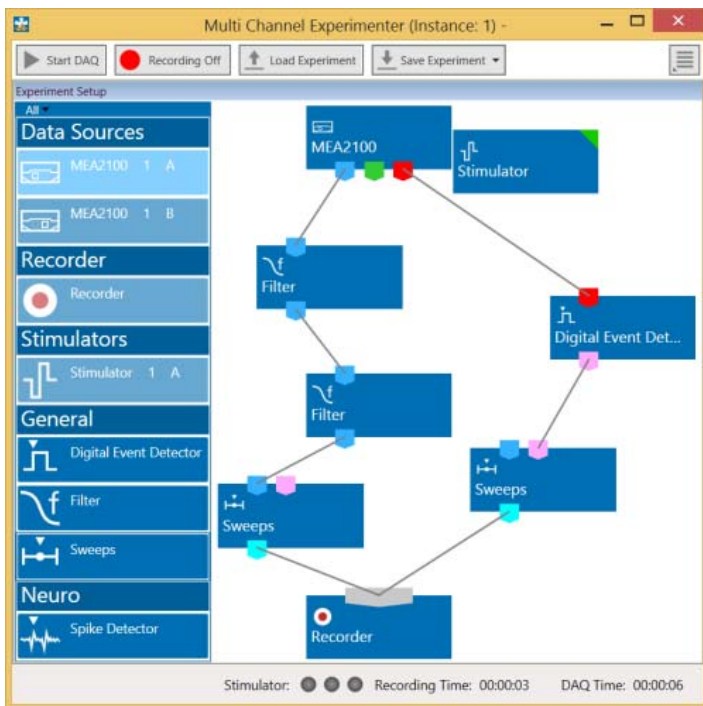
Three color coded output ports of the MEA2100 data acquisition device.

Example: Click on the blue symbol output port of the data source and connect it by drag and drop with the blue symbol input port of the filter. The electrode raw data stream will flow from the data source to the filter. Connect the blue symbol output port from the filter with the black symbol input port of the recorder.

The electrode raw data stream will flow from the filter to the recorder. The black input port of the recorder accepts all types of input data streams and you can connect more than one data stream.



The Multi Channel Experimenter Rack



Move as many instruments as you need via drag and drop into the "Experiment Setup" window. It is possible to use the virtual tools more than one time.

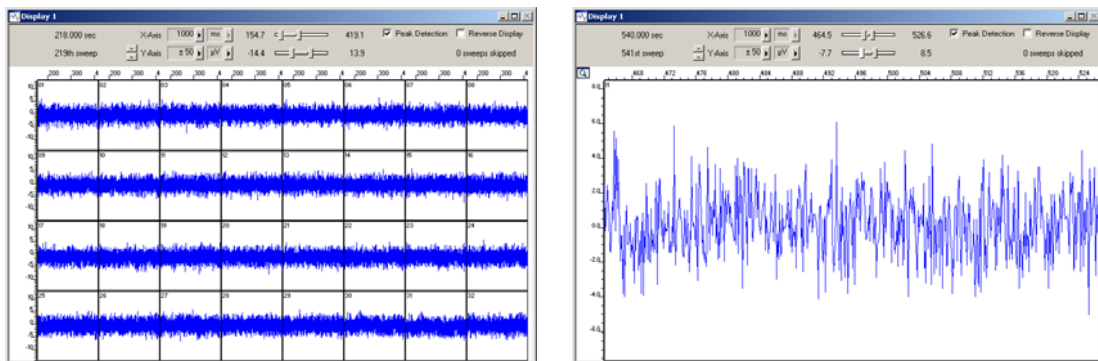
3.3 Setting up MC_Rack

Please refer to the MC_Rack Manual for more information.

1. Start MC_Rack. Click **Data Source Setup** on the **Edit** menu. Select a 1-dimensional layout. Select the number of electrode channels, 16 channels when using a μ PA16, 32 channels when using a μ PA32. Deselect the check box for the digital channel if you do not need it.
2. Add the data acquisition to your virtual rack.
3. In the tree view pane of the virtual rack, select the data acquisition, and click the **Hardware** tab. Enter the total amplifier gain according to the specifications of the instruments. For example, for a micro preamplifier with a gain of 10 and a following filter amplifier with a gain of 100, the total gain is 1000.
4. On the **Edit** menu, click **Add Data Display** to add a raw data display to your virtual rack.
5. In the virtual rack tree view pane, select the Display 1 and click the Layout tabbed page. Set up a channel map with channels 1 to 16 or 1 to 32 or select "Default Map".
6. Adjust the display ranges to 1000 ms and $\pm 50 \mu\text{V}$.

3.3.1 Noise Level Test

Typical results of a noise level test are shown in the following screen shots. The Portable ME32-System used for this test had a total gain of 1000 and a bandwidth of 1 to 5000 Hz. If you use a filter amplifier with a narrower bandwidth, you can generally expect a slightly lower noise level.

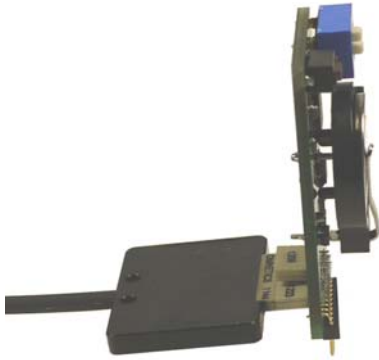


To test the noise level, please connect the μ PA32 to a Portable ME32-System, for example, but without electrode probe. The noise level is $60 \mu\text{V}$ peak to peak. The window shows electrode raw data.

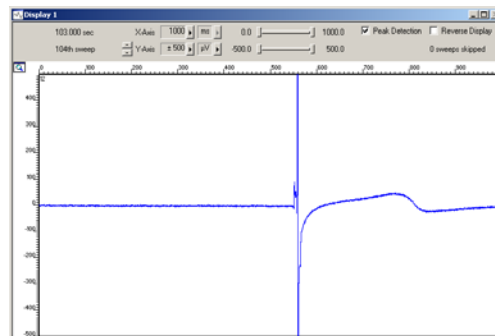
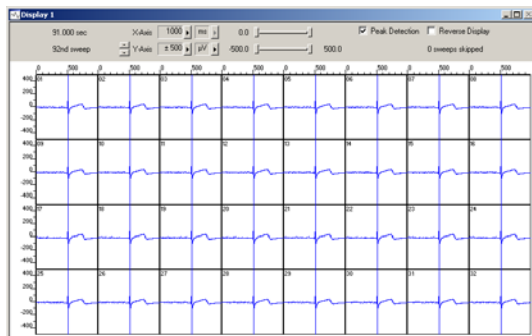
3.3.2 ME/W-SG Test

The following screen shots show the results of a test with a ME/W-SG signal generator. Please read the data sheet for more information.

Connect the ME/W-SG to the μ PA32 via Omnetics connector on the bottom of the signal generator. The Omnetics connector of the μ PA is lettered in black and the Omnetics connector of the ME/W-SG respectively. Please connect the devices in this way that the letters are on one side, facing to the bottom of the ME/W-SG as shown on the picture.



Switch the dip switch into the desired position and press the control button to start the device. The example below shows heart signals (ECG ventricle). The Portable ME32-System used for this test had a total gain of 1000 and a bandwidth of 1 to 5000 Hz.



3.4 Service and Maintenance

3.4.1 Cleaning the Connectors



Warning: It is recommended to avoid the use of cleaning solutions to avoid corrosion. If a wet cleaning is required, use distilled water. Make sure that only the connectors touch the liquid; do not submerge the micro preamplifier or the cable. Otherwise, you can fatally damage the electronics.

- Clean the connectors with 70 % alcohol and cotton swabs from time to time.
- If this does not provide satisfying results, insert only the connectors into a small beaker with acetone or alcohol and treat them in an ultrasonic bath for 10 to 20 s. Air-dry the micro preamplifier for about 5 min before use.
- You can also clean the connectors with distilled water in an ultrasonic bath. Dry the connectors with compressed air immediately after sonication and let the preamplifier air dry for at least 6 h before use.

3.4.2 Sterilization



Warning: Do not autoclave or sterilize micro preamplifiers by high heat (above 70 °C) or vapor. The material is not heat-stable and may deform under heat. Vapor can lead to a corrosion of the electronics.

Micro preamplifiers can be sterilized with standard methods that are **not** based on high heat or vapor, for example, with 70 % alcohol, UV-light, or by thermal sterilization in an oven at 56 °C with an incubation time of 8 hours.

4 μ PA16



The micro preamplifier μ PA16 is equipped with an Omnetics socket. You can directly connect different types of NeuroNexus probes (from NeuroNexus $\text{\textcircled{R}}$, www.neuronexustech.com) without the need of an adapter. Please see below. Please find the connectors and corresponding mating connectors listed in chapter "Technical Specifications".

NeuroNexus Electrode Probes, for example:

- NeuroNexus AXIAL
- NeuroNexus C16
- NeuroNexus CM16
- NeuroNexus F16
- NeuroNexus H16
- NeuroNexus HP16
- NeuroNexus MRC16
- NeuroNexus MRCM16

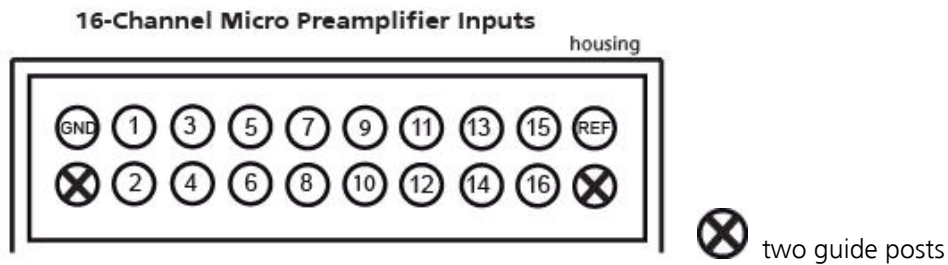
To connect the following NeuroNexus probes with 32 electrodes you need two μ PA16.

- NeuroNexus H32
- NeuroNexus HC32

Adapters for all standard microelectrodes such as **NeuroNexus probes** for acute and chronic implantations ensure a close proximity to the probe to minimize signal loss and cross talk. Adapters are not included in the standard scope of delivery and have to be ordered separately. For custom adapters, please ask your local retailer or contact Multi Channel Systems MCS GmbH.

4.1 Pin Layout μ PA16

4.1.1 Input Connector



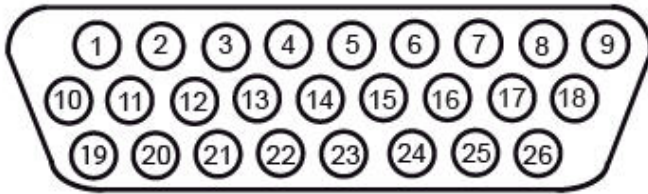
This illustration shows the pin layout of the Omnetics connector A79039-001 (NSD-18-DD-GS with 2 guide posts, female), viewed from the front, with the metal housing of the μ PA16 above.

The reference input is used for connecting a reference electrode.

Pin	Channel	Pin	Channel
Ground GND		Reference REF	
Pin 1	Channel 1	Pin 9	Channel 9
Pin 2	Channel 2	Pin 10	Channel 10
Pin 3	Channel 3	Pin 11	Channel 11
Pin 4	Channel 4	Pin 12	Channel 12
Pin 5	Channel 5	Pin 13	Channel 13
Pin 6	Channel 6	Pin 14	Channel 14
Pin 7	Channel 7	Pin 15	Channel 15
Pin 8	Channel 8	Pin 16	Channel 16

4.1.2 Output Connector

16-Channel Micro Preamplifier Outputs



The signal ground is connected to the ground of the amplifier. The signal ground is used as the reference for the following filter amplifier.

Pin	Channel	Pin	Channel
Pin 2	Channel 1	Pin 11	Channel 2
Pin 3	Channel 3	Pin 12	Channel 4
Pin 4	Channel 5	Pin 13	Channel 6
Pin 5	Channel 7	Pin 14	Channel 8
Pin 6	Channel 9	Pin 15	Channel 10
Pin 7	Channel 11	Pin 16	Channel 12
Pin 8	Channel 13	Pin 17	Channel 14
Pin 9	Channel 15	Pin 18	Channel 16
1, 10, 19, 23	Ground GND		
20, 21, 22	Positive supply voltage		
24, 25, 26	Negative supply voltage		

4.2 Technical Specifications μ PA16

Operating temperature	0° C to 50° C
Storage temperature	0° C to 50° C
Relative humidity	10 % to 85 % non-condensing
Dimensions (W x D x H)	ca. 17 mm x 17 mm x 2.5 mm w/o connector ca. 21 mm x 17 mm x 2.5 mm with connector
Length of cable	1.5 m
Weight	1.5 g without cable
Maximum tensile strength of cable	20 N
Input connector type	18-pin dual-row Omnetics NSD series A79039-001, female
Mating connector type	Omnetics NPD series (NPD-18-xx-GS with 2 guide posts, male)
Output connector type	26-pin HD D-Sub, male (Harting TB 09 56 200 5615)
Number of amplifier channels	16
Supply voltage range	± 2.5 V
Supply current range	< 15 mA, typically ± 14 mA
Gain	10
Bandwidth	DC to 50 kHz
Input voltage range	± 250 mV (with respect to a supply voltage of 2.5 V)
Input impedance	1 G Ω @ 1 kHz
Input capacitance	13 pF
Input noise	< 1.2 μ V _{RMS} (0.1 Hz to 10 Hz, inputs shortened)
Noise density	$e_n = 10$ nV / $\sqrt{\text{Hz}}$ @ 1 kHz
Output voltage range	± 2.5 V (supply voltage range)

5 μ PA32



The micro preamplifier μ PA32 is equipped with an Omnetics socket. You can directly connect different types of NeuroNexus probes (from NeuroNexus®, www.neuronexustech.com) without the need of an adapter. Please see the list below. Please find the connectors and corresponding mating connectors listed in chapter “Technical Specifications”.

NeuroNexus Electrode Probes, for example:

- NeuroNexus CM32
- NeuroNexus F32
- NeuroNexus H32
- NeuroNexus MRCM32
- NeuroNexus HP32

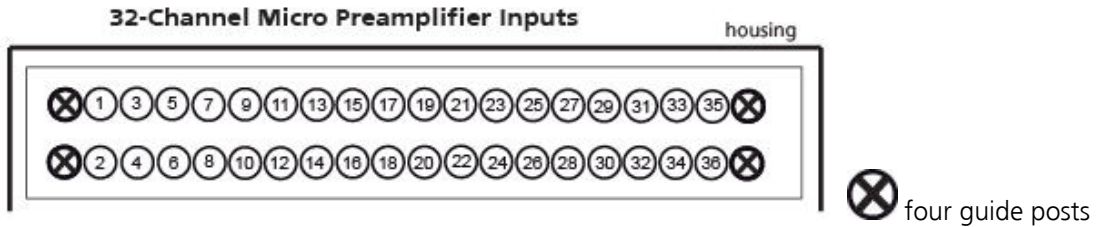
To connect the following NeuroNexus probes with 64 electrodes you need two μ PA32.

- NeuroNexus H64
- NeuroNexus HC64

Adapters for all standard **microelectrodes** such as **NeuroNexus probes** for acute and chronic implantations ensure a close proximity to the probe to minimize signal loss and cross talk. Adapters are not included in the standard scope of delivery and have to be ordered separately. For custom adapters, please ask your local retailer or contact Multi Channel Systems MCS GmbH.

5.1 Pin Layout μ PA32

5.1.1 Input Connector

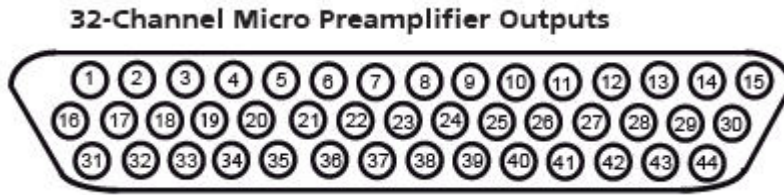


This illustration shows the pin layout of the Omnetics connector A79023-001 (NSD-36-DD-GS with 4 guide posts, female), viewed from the front, with the metal housing of the μ PA32 above.

The reference input is used for connecting a reference electrode.

Pin	Channel	Pin	Channel
Pin 1	Ground GND	Pin 19	Channel 17
Pin 2	Reference REF	Pin 20	Channel 18
Pin 3	Channel 1	Pin 21	Channel 19
Pin 4	Channel 2	Pin 22	Channel 20
Pin 5	Channel 3	Pin 23	Channel 21
Pin 6	Channel 4	Pin 24	Channel 22
Pin 7	Channel 5	Pin 25	Channel 23
Pin 8	Channel 6	Pin 26	Channel 24
Pin 9	Channel 7	Pin 27	Channel 25
Pin 10	Channel 8	Pin 28	Channel 26
Pin 11	Channel 9	Pin 29	Channel 27
Pin 12	Channel 10	Pin 30	Channel 28
Pin 13	Channel 11	Pin 31	Channel 29
Pin 14	Channel 12	Pin 32	Channel 30
Pin 15	Channel 13	Pin 33	Channel 31
Pin 16	Channel 14	Pin 34	Channel 32
Pin 17	Channel 15	Pin 35	Ground GND
Pin 18	Channel 16	Pin 36	Ground GND

5.1.2 Output Connector



The signal ground is connected to the ground of the amplifier. The signal ground is used as the reference for the following filter amplifier.

Pin	Channel	Pin	Channel
Pin 1	Channel 1	Pin 23	Channel 20
Pin 2	Channel 4	Pin 24	Channel 23
Pin 3	Channel 7	Pin 25	Channel 26
Pin 4	Channel 10	Pin 26	Channel 29
Pin 5	Channel 13	Pin 27	Channel 32
Pin 6	Channel 16	Pin 28	Ground GND
Pin 7	Channel 19	Pin 29	Negative supply voltage
Pin 8	Channel 22	Pin 30	Positive supply voltage
Pin 9	Channel 25	Pin 31	Ground GND
Pin 10	Channel 28	Pin 32	Channel 3
Pin 11	Channel 31	Pin 33	Channel 6
Pin 12	Ground GND	Pin 34	Channel 9
Pin 13	Ground GND	Pin 35	Channel 12
Pin 14	Positive supply voltage	Pin 36	Channel 15
Pin 15	Positive supply voltage	Pin 37	Channel 18
Pin 16	Ground GND	Pin 38	Channel 21
Pin 17	Channel 2	Pin 39	Channel 24
Pin 18	Channel 5	Pin 40	Channel 27
Pin 19	Channel 8	Pin 41	Channel 30
Pin 20	Channel 11	Pin 42	Ground GND
Pin 21	Channel 14	Pin 43	Negative supply voltage
Pin 22	Channel 17	Pin 44	Negative supply voltage

5.2 Technical Specifications μ PA32

Operating temperature	0° C to 50° C
Storage temperature	0° C to 50° C
Relative humidity	10 % to 85 % non-condensing
Dimensions (W x D x H)	ca. 20 mm x 25 mm x 3 mm w/o connector ca. 24 mm x 25 mm x 3 mm with connector
Length of the cable	1.5 m
Weight	2 g w/o cable and plug
Maximum tensile strength of cable	20 N
Input connector type	36-pin dual-row Omnetics A79023-001 (NSD-36-DD-GS with 4 guide posts, female)
Mating connector type	Omnetics for example A70001-001 (NPD-36-xx-GS with 4 guide posts, male)
Output connector type	44-pin HD D-Sub, male (Harting TB 09 56 300 5615)
Number of amplifier channels	32
Supply voltage range	± 2.5 V
Supply current range	$< \pm 30$ mA, typically ± 26 mA
Gain	10
Bandwidth	DC to 50 kHz
Input voltage range	± 250 mV (with respect to a supply voltage of 2.5 V)
Input impedance	1 G Ω @ 1 kHz
Input capacitance	13 pF
Input noise	< 1.2 μ V _{RMS} (1 Hz to 10 kHz, inputs short-circuited)
Noise density	$e_n = 10$ nV / $\sqrt{\text{Hz}}$ @ 1 kHz
Output voltage range	± 2.5 V (supply voltage range)

6 Contact Information

Local retailer

Please see the list of official MCS distributors on the MCS web site.

User forum

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Mailing list

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