Imprint

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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. MCS assumes no responsibility in any case of contravention.

• 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 miniature preamplifier that cannot be repaired.
• Protect the device from heat. Do not autoclave!
• You can clean the connectors with distilled water in an ultra sonic 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.
Welcome to the MPA32I

The 32-Channel Miniature Preamplifier MPA32I is connected to the microelectrodes for providing the initial tenfold amplification stage.

It has additional common ground and reference electrode inputs. 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. Electrode damage is prevented by the very low bias current. The high input impedance ensures stable long-term recordings. Ideally, the input impedance would be infinite. 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 miniature preamplifier has a high input impedance to avoid this problem.

Adapters for all standard microelectrodes such as NeuroNexus probes (from www.neuronexustech.com) 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.
3 Setting Up and Connecting the MPA

3.1 General Setup Recommendations

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** or the **metal case** of the miniature preamplifier to the common ground of the setup. (The GND input is internally connected to the metal case.)

3. Connect the **reference electrode** to the **reference input** of the miniature 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 the **recording electrodes** to the **recording channels** of the miniature preamplifier. You can either use single electrodes or multitrodes with the miniature preamplifier. MCS provides adapters for standard probes.

6. Connect **all unused recording channels** to the **GND input** or to the reference electrode if the reference and ground electrode of the amplifier are short circuited, to avoid noise pickup. As the total amplifier gain generally lies in the range of 1000, even very small noise signals may generate high noise signals.
7. 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 Testing the Noise Level of the Setup

A **terminal plug** that connects all inputs to ground, and a **test model probe** that mimics the **electrode impedance** are available for testing the noise level of the setup.

**Note:** Please note that the test model probe has to be ordered separately.

All instruments were thoroughly tested at the factory site before delivery. The suggested tests are mainly intended for optimizing and troubleshooting your setup, to exclude any damage that might have occurred during transportation, or to fulfill your own guidelines, for instance. It will take only a few minutes time and can save time and trouble in the long run. Multi Channel Systems recommends running these tests before you start your real experiments.

1. Connect the terminal plug to one miniature preamplifier and the test model probe to the other as shown in the picture (do not mismatch the polarity). If you have only one MPA32I, you can perform the two tests consecutively.

2. Connect the MPA32I with the test model probe to channels 1 to 32 of the signal collector.

3. Connect the MPA32I with **terminal plug** to channels 33 to 64 of the signal collector.

4. Make sure that all other connections are appropriate, and that your setup has an appropriate grounding and shielding as recommended in the chapter “General Setup Recommendations”.
4 Setting up MC_Rack

Please refer to the MC_Rack Manual for more information.

- Start MC_Rack.
- Open the file MPA32I_NoiseTest.rck on the installation volume (see folder Tutorial). This rack contains the virtual MC_Card instrument as data acquisition device with a continuous raw data display and an Analyzer to measure the peak-to-peak amplitude.

- Click Start to start the recording.
- --- OR --- Set up the rack on your own:

  - Click Data Source Setup on the Edit menu. Select a 1-dimensional layout. Select the number of electrode channels (at least 32).

  - Add the data acquisition to your virtual rack.

  - 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 miniature preamplifier with a gain of 10 and a following filter amplifier with a gain of 100, the total gain is 1000.

  - Select an input voltage range of -819.2 to +818.8 mV and a sampling rate of 10000 Hz.

  - On the Edit menu, click Add Data Display to add a raw data display to your virtual rack.

  - 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 64.

  - Adjust the display ranges to 500 ms and +/-50 µV.

  - On the Edit menu, click Add Analyzer to add an Analyzer to the virtual rack. Select all or two typical channels on the Channels tabbed page. Select the Peak-Peak Amplitude parameter on the Analyzer tabbed page.

  - On the Edit menu, click Add Parameter Display to add a Parameter Display to the virtual rack.

  - In the virtual rack tree view, select the Display 2 and click the Layout tabbed page. Set up a channel map with all channels that were assigned to the Analyzer.

  - Click the Ranges tabbed page and enter 0 to 10 s for the x-range and 0 to 100 µV for the y-range.
**Typical Results**

Typical results of this test are shown in the following screen shot. The filter amplifier used for this test had a gain of 100 and a bandwidth of 0.5 to 5000 Hz (FA64I-100-0.5-5000). If you use a filter amplifier with a narrower bandwidth, you can generally expect a slightly lower noise level.

**Noise level test with #MPA8I and FA64I-100-0.5-5000 filter amplifier.**

The noise level is 60 µV peak to peak with the provided test model probe (channels 1 – 32) and 20 µV peak to peak with grounded inputs (channels 33 – 64). The top window shows raw data; the bottom window shows the extracted peak-to-peak amplitudes of channels 1 and 33. (The miniature preamplifier was shielded by a metal case connected to the ground/earth of the test lab.)
5 Connecting FlexMEAs

FlexMEA36, plastic spacer and adapter (ADPT-FM-32) connected to a 32-channel miniature amplifier MPA32l.

The side with no screws is considered the top side of the MPA32l. If the adapter is oriented as shown in the figure, the FlexMEA36 is inserted with the contact pads facing downward.

For connecting the FlexMEA72 you need the adapter ADPT-FM-72. Please see the datasheet FlexMEA72 in the Appendix.

Connecting the FlexMEA36

- The FlexMEA adapter has a drawer for inserting the FlexMEA36. Open the slot of the white drawer. Grip the sides of the white slot cover with your fingers and carefully pull open the slot cover only a little bit (about 1 or 2 mm). Do not demount the cover as the plastic supports might break easily.

- Insert the FlexMEA36 into the slot of the drawer, with the contact pads upside down. Insert the plastic spacer into the slot of the drawer.

Important: Please use a thin plastic spacer between the FlexMEA36 and the connector so that the contact pads make a tight contact to the connector pins. Otherwise, the FlexMEA36 will sit too loose and will have a bad contact resulting in a higher noise level. The spacer should be placed on the opposite side of the contact pads of the FlexMEA36 in the drawer.

- Carefully push back the slot cover of the white drawer until it locks.
FlexMEAs

FlexMEAs are made of flexible polyimide material (Polyimide 2611 foil), perfect for in vivo and special in vitro applications. Only 12 µm "thick" and weighing less than 1 g, the FlexMEA biosensor is very thin and lightweight.

FlexMEA36 has 32 titanium nitride (TiN) electrodes plus two internal reference electrodes and two ground electrodes. The flexible base is perforated for a better contact with the surrounding tissue.

The electrodes have a diameter of about 30 µm with an interelectrode distance of 300 µm.

Contact pads and conducting material is pure gold.

FlexMEA72 has 72 titanium nitride (TiN) electrodes plus four internal reference electrodes and four ground electrodes. The flexible base is perforated for a better contact with the surrounding tissue.

The electrodes have a diameter of about 100 µm with an interelectrode distance from 625 to 750 µm.

Contact pads and conducting material is pure gold.

Using FlexMEAs

FlexMEAs are usually connected to a headstage preamplifier that is connected to a filter amplifier or programmable gain amplifier (see also the ME-System product line of Multi Channel Systems MCS GmbH). FlexMEAs can be via adapter connected to a 32-channel miniature preamplifier MPA32I from Multi Channel Systems for in vivo experiments. FlexMEAs are stable at a temperature range from 10 °C to 40 °C.

Warning: Do not autoclave or sterilize FlexMEAs by heat. These MEA types are not heat stable and will irreversibly damaged if the temperature is too high.

Do not use ultrasonic bath for cleaning!
5.1 EcoFlexMEAs

EcoFlexMEAs are made of flexible polyimide material (Kapton), perfect for in vivo and special in vitro applications. Only 50 µm "thick" and weighing less than 10 g, the EcoFlexMEA biosensor is thin and lightweight.

EcoFlexMEA36 has 32 gold electrodes plus two internal reference electrodes and two ground electrodes. The flexible base is perforated for a better contact with the surrounding tissue. The gold electrodes have a diameter of about 50 µm with an interelectrode distance of 300 µm and an impedance of approximately 50 kOhm. Contact pads and conducting material is pure gold.

EcoFlexMEA24 has 24 gold electrodes plus two internal reference electrodes and two ground electrodes. The flexible base is perforated for a better contact with the surrounding tissue. The gold electrodes have a diameter of about 80 µm with an interelectrode distance of 300 µm and an impedance of approximately 50 kOhm. Contact pads and conducting material is pure gold.

Using EcoFlexMEAs

EcoFlexMEAs are usually connected to a headstage preamplifier MPA31I that is connected to a filter amplifier or programmable gain amplifier (see also the ME-System product line of Multi Channel Systems MCS GmbH). EcoFlexMEAs can be directly connected to a 32-channel miniature preamplifier from Multi Channel Systems for in vivo experiments. EcoFlexMEAs are stable at a temperature range from 10 °C to 125 °C and can be autoclaved.
5.1.1 Connecting 32-Channel NeuroNexus Probes

Important: REF has to be connected for obtaining a proper signal.

Insert the pin array of the NeuroNexus probe into the black connector of the ADPT-NN-32.

Connect the MPA32I to the adapter outputs. Make sure that the orientation of the MPA32I is correct (see illustration).
The indicated numbers are the ME-System channel numbers that will show up in the data acquisition program. GND is the ground, REF is the reference input of the miniature preamplifier and “nc” means not connected.

**Channel Assignment NeuroNexus Probe to MPA32I and Data Acquisition Program**

The following list shows the assignment to the electrode numbers as given by NeuroNexus Technologies.
## Pin Layout ADPT-NN-32

<table>
<thead>
<tr>
<th>Pin No</th>
<th>MPA32I</th>
<th>Software</th>
<th>ADPT-NN-32</th>
</tr>
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<tr>
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<td>Pin No</td>
<td>Channel</td>
<td>Electrode</td>
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<td></td>
</tr>
<tr>
<td>2</td>
<td>REF</td>
<td></td>
<td>REF</td>
</tr>
<tr>
<td>3</td>
<td>CH 1</td>
<td>EL 17</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>CH 2</td>
<td>EL 21</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>CH 3</td>
<td>EL 18</td>
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<td>6</td>
<td>CH 4</td>
<td>EL 23</td>
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<tr>
<td>7</td>
<td>CH 5</td>
<td>EL 19</td>
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<tr>
<td>8</td>
<td>CH 6</td>
<td>EL 25</td>
<td></td>
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<tr>
<td>9</td>
<td>CH 7</td>
<td>EL 20</td>
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<tr>
<td>10</td>
<td>CH 8</td>
<td>EL 27</td>
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<td>11</td>
<td>CH 9</td>
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<td>CH 17</td>
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<td>CH 31</td>
<td>EL 12</td>
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<tr>
<td>34</td>
<td>CH 32</td>
<td>EL 16</td>
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<tr>
<td>35</td>
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<td></td>
</tr>
<tr>
<td>36</td>
<td>GND</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
5.2 Connecting 54-Channel NeuroNexus Probes

Important: REF has to be connected for obtaining a proper signal.

Connect the two MPA32I to the ADPT-NN-54 adapter outputs. Make sure that the orientation of the amplifiers is correct (see illustration).

Side view

Connect MPA32I No. 1 here

Connect MPA32I No. 2 here

Important: Connect both MPA32I with the screws face down. Otherwise, the adapter will not work.

ADPT-NN-54 Pin Layout

**MPA32I No. 1, IN/OUT 1**

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

**MPA32I No. 2, IN/OUT 2**

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

Numbers in italics are the MPA32I pin numbers. The electrode numbers are aligned to the input pins of the MPA32I.

The next figure shows the numbering of the polytrode electrodes.

**Polytrode: electrode numbers**

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 |
|---|---|---|---|---|---|---|---|---|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
6 Service and Maintenance

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 miniature 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 miniature preamplifier for about 5 min before use.

You can also clean the connectors with distilled water in an ultra sonic bath. Dry the connectors with compressed air immediately after sonication and let the amplifier air dry for at least 6 h before use.

Sterilization

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

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

7.1 Power Supply

Supply voltage is applied to the output connector pins 19 and 37. The voltage source should supply a stable noise-free voltage. Do not exceed the maximum voltage.

Pin 19: –3 V to –8 V
Pin 37: +3 V to +8 V

Warning: Do not mismatch the polarity of the power supply. A false connection may damage the unit.

Input Connector

32-Channel Miniature Preamplifier inputs

| Pin 1: GND (ground) | Pin 2: Reference | Pin 3-34: Channel 1-32 | Pin 35: Reference | Pin 36: GND (ground) |

This illustration shows the pin layout viewed from the front, with the case screws upside down.

The two reference inputs are used for connecting a reference electrode. Both inputs are equal, so it does not matter which of the two inputs is used. If both are used, the mean of both reference signals is used as reference.

Output Connector

32-Channel Miniature 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.
7.2 Test Model Probe

Test model probe for MPA32i - pin layout

**Test signal IN**: You can use the jumper to connect the signal input pin (Signal IN) to ground (standard situation for a noise level test), or you can connect a data source, for example, a sine wave generator to the input (and the ground of the test signal to the signal ground input) to test the signal distribution. The input signal is distributed across all recording channels.

**Model test probe for MPA - circuit**

**Test signal input jumper**

**Reference input jumper**

**REF I N**: The standard situation in an experiment should be that the reference electrode has properties identical or close to the recording electrodes. You can remove the jumper to connect the reference output of the test model probe to the same resistors as the recording channels to mimic the experimental situation, or you can use the jumper to connect the reference output to ground.

<table>
<thead>
<tr>
<th></th>
<th>DC</th>
<th>Dynamic</th>
<th>Capacitance</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>4.7 MΩ</td>
<td>330 kΩ</td>
<td>150 pF</td>
</tr>
</tbody>
</table>
8 Contact Information

Local retailer

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

User forum

The Multi Channel Systems User Forum provides an excellent opportunity for you to exchange your experience or thoughts with other users worldwide.

Mailing list

If you have subscribed to the ME-System mailing list, you will be automatically informed about new software releases, upcoming events, and other news on the product line. You can subscribe to the list on the contact form of the MCS web site.

www.multichannelsystems.com
## Technical Specifications MPA32I

<table>
<thead>
<tr>
<th>Specification</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operating temperature</td>
<td>0° C to 50° C</td>
</tr>
<tr>
<td>Storage temperature</td>
<td>0° C to 50° C</td>
</tr>
<tr>
<td>Relative humidity</td>
<td>10 % to 85 % non-condensing</td>
</tr>
<tr>
<td>Dimensions (W x D x H)</td>
<td>27 x 36 x 5 mm</td>
</tr>
<tr>
<td>Weight</td>
<td>7 g w/o cable and plug, 56 g with cable and plug</td>
</tr>
<tr>
<td>Length of the cable</td>
<td>1.5 m</td>
</tr>
<tr>
<td>Maximum tensile strength of cable</td>
<td>20 N</td>
</tr>
<tr>
<td>Input connector type</td>
<td>Dual-row precision sockets, 50 mil (1.27 mm) grid pattern, for 0.35 to 0.45 mm round pins</td>
</tr>
<tr>
<td>Supply voltage</td>
<td>± 3 V to ± 8 V DC</td>
</tr>
<tr>
<td>Supply current</td>
<td>&lt; ± 14 mA, typically ± 9 mA</td>
</tr>
<tr>
<td>Number of input channels</td>
<td>32</td>
</tr>
<tr>
<td>Input voltage</td>
<td>± 500 mV (with respect to a supply voltage of 5 V)</td>
</tr>
<tr>
<td>Input impedance</td>
<td>$10^{12} \ \Omega$ parallel to 10 pF</td>
</tr>
<tr>
<td>Input noise</td>
<td>&lt; 1.5 $\mu$V$_{rms}$ (1 Hz to 5 kHz, inputs short-circuited)</td>
</tr>
<tr>
<td>Noise density</td>
<td>$e_n = 15 \ nV/\sqrt{Hz}$</td>
</tr>
<tr>
<td>Number of output channels</td>
<td>32</td>
</tr>
<tr>
<td>Output voltage</td>
<td>= supply voltage</td>
</tr>
<tr>
<td>Output current</td>
<td>max. = 10 mA</td>
</tr>
<tr>
<td>Output impedance</td>
<td>0 $\Omega$</td>
</tr>
<tr>
<td>Bandwidth</td>
<td>DC to 50 kHz</td>
</tr>
<tr>
<td>Gain</td>
<td>10</td>
</tr>
</tbody>
</table>