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systems

USB-MEA1060 Manual



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1 Introduction

1.1 About this Manual

It is assumed that you already have a basic understanding of technical and software terms. No special skills are required to read this manual.

If you are using the device for the first time, please read the **Important Safety Advice** before **installing the hardware** and **software**, where you will find important information about the installation and first steps.

The device and the software are part of an ongoing developmental process. Please understand that the provided documentation is not always up to date. The **latest information** can be found in the **Help**. Check also the MCS Web site (www.multichannelsystems.com) for downloading up-to-date manuals and Help files.

1.2 Welcome to USB-MEA1060



The USB-MEA1060 is a very compact and portable stand-alone solution. It features an integrated 60-channel filter amplifier and data acquisition. The digitally converted electrode signals are transmitted to the connected computer via universal serial bus (High Speed USB 2.0). Thus, it is possible to use any computer as a data acquisition computer, also a laptop. The size of the complete system is small enough to fit into a laptop bag together with the computer.

Data is recorded, graphed, analyzed, and reviewed with the powerful and easy-to-use MC_Rack program. You can export the data in standard formats to other programs with MC_DataTool.

Raw data from up to 60 electrodes of a microelectrode array (MEA) is amplified by 60 channels of filter amplifiers that are built very small and compact using SMD (Surface Mounted Devices) technology. The small-sized MEA amplifier combines the interface to the MEA probe with the signal filtering and the amplification of the signal. The compact design reduces line pick up and keeps the noise level down. The MEA sensor is placed directly into the small-sized MEA amplifier. When the amplifier is closed, the contact pins in the lid of the amplifier are pressed onto the MEA contact pads. The very close location of the amplifier to the MEA sensor is very favorable concerning a high signal-to-noise ratio.

The USB-MEA1060 amplifier has an integrated heating system for controlling the MEA's temperature. The desired temperature can be easily programmed with a temperature controller. You will not need an incubator during recording — temperature conditions are reliably controlled directly in the MEA dish.

The USB-MEA1060 has been developed for most types of standard upright microscopes. It can also be used with inverted microscopes, with only few limitations.

2 Important Safety Advice

2.1 Important Safety Advice



Warning: Make sure to read the following advice prior to installation or use of 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: Always obey 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.

High Voltage

Electrical cords must be properly laid and installed. The length and quality of the cords must be in accordance with local provisions.

Only qualified technicians may work on the electrical system. It is essential that the accident prevention regulations and those of the employers' liability associations are observed.

- Each time before starting up, make sure that the **power supply** agrees with the specifications of the product.
- Check the **power cord** for damage each time the site is changed. Damaged power cords should be replaced immediately and may never be reused.
- Check the **leads** for damage. Damaged leads should be replaced immediately and may never be reused.
- Do not try to insert anything sharp or metallic into the vents or the case.
- Liquids may cause short circuits or other damage. Always keep the device and the power cords **dry**. Do **not** handle it with wet hands.

Requirements for the installation

- Make sure that the device is not exposed to direct sunlight. Do not place anything on top of the device, and do not place it on top of another heat producing device, so that the air can circulate freely.

2.2 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 / her 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.

2.3 Operator's Obligations

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

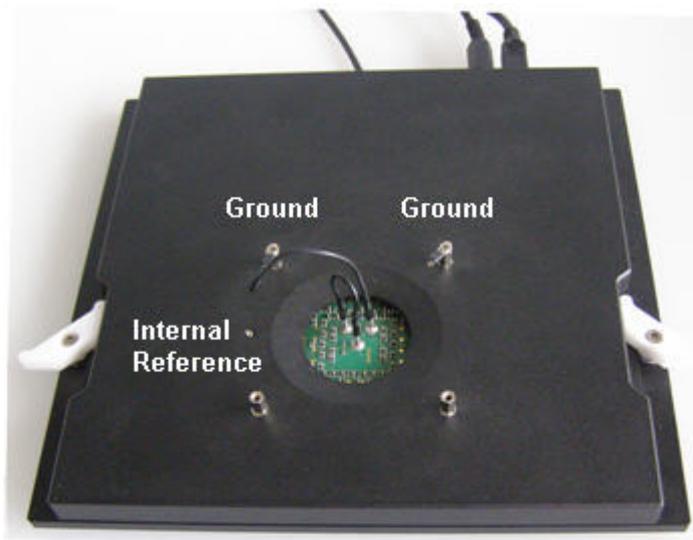
- are familiar with the safety at work and accident prevention regulations and have been instructed how to use the device;
- are professionally qualified or have specialist knowledge and training and have received instruction in the use of the device;
- have read and understood the chapter on safety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

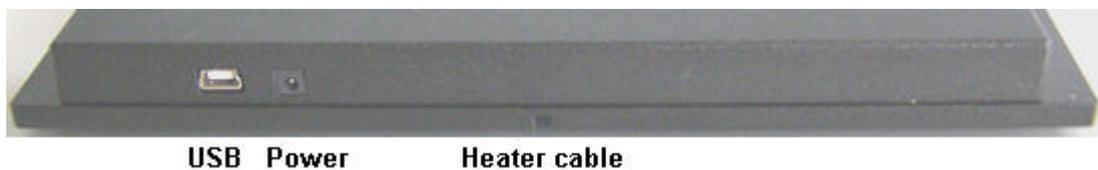
3 USB-MEA1060

3.1 Top View



The USB-MEA1060 amplifier with mounted test model probe.

3.2 Rear Panel



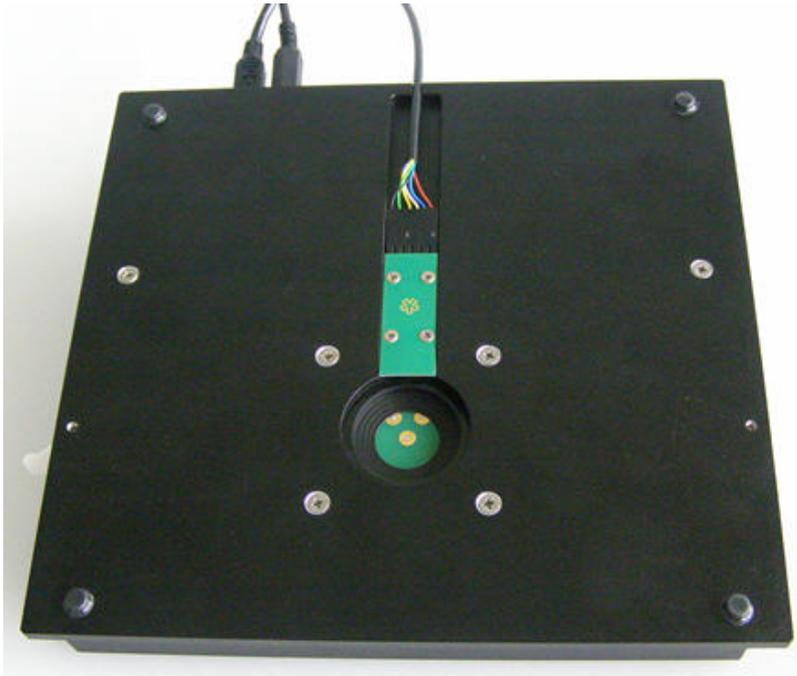
USB

The USB connector is used to transfer the digitized data from all data channels to any connected data acquisition computer via USB High Speed 2.0 (type A - mini B) cable.

Power Input

Connect here the power supply unit. This power supply powers the USB-MEA1060 main unit only. The device needs 9 V and 520 mA.

3.3 Bottom



Heating Element

The ground plate contains a heating element with PT100 sensor for controlling the temperature conditions on the MEA. Connect the heating element with the heater cable to the temperature controller. The connector is symmetrical, it can be connected either way.

3.4 Integrated Filter Amplifiers (FA)

Raw data from the amplifier is amplified by a 60-channel filter amplifier with fixed gain (1200) and bandwidth (1 Hz to 5 kHz).

An amplifier with input type S includes a common ground and a reference electrode.

Amplifiers with input type S have single ended inputs and all channels are grounded. The measurement is the difference between the signal and the ground. The signal source's ground and the amplifier's ground should have the same value for obtaining good results.

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.

Important: It is very important that the amplifier ground is always connected to the bath with a plain silver wire or with an Ag/AgCl pellet, when you are not using a reference electrode. When using a MEA with internal reference, please connect the amplifier ground to the internal reference plug on the amplifier. Please see chapter "Mounting a MEA Probe".

Signal Amplification and Filters

The filter amplifier combines a band pass filter and the signal amplification in one instrument.

The broad bandwidth of 1 Hz to 5 kHz is suitable for a broad range of applications, such as spike and field potential recording from neurons or recording of cardiac signals. The digital filter of the MC_Rack program can be used to adjust the pass band and filter the raw data. Please see the MC_Rack Help or Manual for more information. This way, you are very flexible in designing your experiments. Please note that you may need a higher sampling rate to avoid aliasing. See also the chapter "Integrated Data Acquisition" for more information. For slow signals like field potentials, a bandwidth of 1 to 300 Hz is appropriate. If you like to record fast signals like spikes, a pass band of 300 Hz to 3 kHz is suitable. Cardiac signals have fast and slow components; therefore, you usually need a wider bandwidth of 1 Hz to 3 kHz.

Please note that the gain of the filter amplifier is a fixed hardware property; and that you can not change the gain of the amplifier by software controls. Please also note that the ratio of the output signal to the input signal, that is, the gain, is not a fixed parameter for the complete bandwidth. The gain that was specified for the amplifier, for example, 1200, is not fully reached at the borders of the amplifier's pass band. The general rule is, that at the lower and upper limit of the frequency band, the gain is, that is approximately 70 %, of the full gain. Therefore, you should use a bandwidth that is at a safe distance of the signals of interest. Outside the pass band, the gain decreases with the frequency and finally approaches zero.

For more information on gain and filters in general, please refer to standard literature or contact your local retailer.

3.5 Integrated Data Acquisition

Analog input signals are acquired from the data source and digitized by the 60-channel analog-digital converter that is integrated into the main unit. Recorded signals are converted in real time into digital data streams at sampling rates of up to 50 kHz per channel. You will not miss even the fastest biological signals. Data is transferred to the computer via High Speed USB 2.0 port.

In contrast to the MC_Card, the input voltage range is fixed when working with the USB-MEA1060 amplifier. The sampling rate can be adjusted with the software controls in the MC_Rack program. Please refer to the MC_Rack Help or Manual for more information.

DC Offset Correction

An offset correction is generally not necessary, because the intrinsic DC offsets of the USB-MEA1060 is very low in comparison to the signals of interest. You can use the MC_Rack offset correction feature to remove even this low offset and reset all channels to zero. Please refer to the MC_Rack Help or Manual for more information.

Note: If you observe a large offset on any channel(s), you should contact your local retailer for troubleshooting. The offset correction is not intended for removing large offsets, because this will decrease the input voltage range.

Sampling Rate

It is recommended to adjust the sampling rate according to your signals, because the higher the sampling rate, the bigger the file size will be.

As a rule of thumb, the sampling rate should equal five times the highest signal frequency for a good digitized representation of the continuous analog signals. If the sampling rate is too low, you will miss signals and / or see artifacts. For example, this means approximately 15 kHz for spike recording, or 10 kHz for cardiac signals (which have fast and slow waveform components).

USB-MEA1060 Manual

Please note that the sampling rate also depends on the amplifier's bandwidth. According to the Nyquist-Shannon sampling theorem, the sampling rate should be at least twice the bandwidth of the analog (hardware) low pass filter, that is 10 kHz sampling rate when using a filter amplifier with a cutoff frequency of 5 kHz. The 1/2 bandwidth frequency is also called Nyquist frequency. You should not lower the sampling rate when using a low-pass digital filter. This is the case because the whole amplifier bandwidth is recorded and then high frequency noise is removed with the digital low pass filter after recording. Frequencies (noise) that are above half the sampling rate (for example above 2.5 kHz at a 5 kHz sampling rate) will be transformed into lower frequencies. This is called aliasing. The resulting low-frequency noise passes the digital low pass filter and increases your noise level. You may ignore these recommendations if saving hard disk space is more important for your application than the noise level.

Note: The sampling frequency should be at least five times the highest signal frequency and at least twice the bandwidth of the filter amplifier.

Example:

You have a broadband filter amplifier with a bandwidth of 1 Hz to 5 kHz. The expected signals have a maximum frequency of 1 kHz. Therefore, you want to filter the data with a digital low pass filter and a cutoff frequency of 1 kHz. A sampling rate of 5 kHz (five times the highest signal frequency) would be required for faithfully reproducing the signals, but you should use a sampling rate of at least 10 kHz because the sampling rate should equal twice the bandwidth of the analog filter, regardless of the digital filter properties.

If you had an amplifier with a cutoff frequency of 1 kHz instead, no digital filter would be required, and a sampling rate of 5 kHz would be sufficient.

Software Package

With the high-performance data acquisition and analysis program MC_Rack, you can flexibly manage all data streams. For example, you can display the raw data of all channels while recording only the raw data of the channels of interest and the extracted parameters of all channels. This saves computer performance and hard disk space.

MC_Rack is not limited to special applications, but can be flexibly adapted to a wide range of applications.

The ".mcd" data format is supported by several third party programs for further analysis. You can also easily convert recorded data to universal formats such as ASCII with the MC_DataTool program.

3.6 Setting Up and Connecting the USB-MEA1060



Warning: Please read the separate user manuals of all devices before installation, especially the warnings and safety information. Make sure all devices are switched off before you connect them to the power supply. Damage to the devices and even fatal injuries may result from improper installation or use.

Note: Using a USB hub for connecting the USB-MEA1060 to the computer is not recommended. The system needs a broad bandwidth for the data transmission. Recording might not be possible, especially if a second device that sends or receives continuous data streams, for example, a web cam or USB speakers, is connected to the same USB port.



Warning: Spilled liquid can damage or even completely destroy the electronics of the USB-MEA1060 amplifier. Please be extremely careful when setting up your perfusion system and when starting the perfusion. Take care that the flow rates of the inlet and outlet flow match so that flooding of the amplifier is efficiently prevented.

1. Provide a power supply in the immediate vicinity of the installation site.
2. Place all devices on a stable and dry surface, where the air can circulate freely and the devices are not exposed to direct sunlight. Set up the MEA chip, and connect the ground cable.
3. Set up the computer (with installed MC_Rack program).
4. Connect the USB output connector to a free USB 2.0 port of the data acquisition computer.
5. Connect the USB-MEA1060 amplifier to a power outlet of the same electrical system (connected to the same ground / earth wire) as all other components of the setup, for example, the computer or shielding.
6. Connect the internal heating element at the bottom of the amplifier to a Temperature Controller's output channel (D-Sub 9 socket) with the black heater cable. Do not connect the black heating element cable to the data acquisition computer!
7. You should use a Faraday cage or appropriate materials, for example, aluminum foil for shielding the amplifier. The shielding should be connected to the amplifier's ground, for example, to the screws of the cover.
8. Install the MC_Rack program from the installation volume if it is not already installed.
9. Start the MC_Rack program and select the USB-MEA1060-1 as the data source. Please see chapter "Setting up MC_Rack" and the MC_Rack Help / User Manual for more details on how to define the data source.

3.7 Software Installation

Please check the system requirements before you install the MC_Rack software. Multi Channel Systems MCS GmbH cannot guarantee that the software works properly if these requirements are not fulfilled. Please see the MC_Rack Help or Manual for more information. It is recommended that you check the MCS web site for software updates on a regular basis.

System requirements

Software: One of the following Windows® operating systems is required: Windows 7, VISTA or XP (English and German versions supported) with the NT file system (NTFS). Other language versions may lead to software errors.

Hardware: (Not required for offline analysis or demo mode) The data acquisition board USB-MEA1060. If no USB-MEA1060 is present, MC_Rack opens in a simulation mode. A computer with low performance may lead to performance limits more often; therefore, MCS recommends an up-to-date computer optionally with a separate hard disk. Please note that there are sometimes hardware incompatibilities of the USB-MEA1060 and computer components; or that an inappropriate computer power supply may lead to artifact signals. Please contact your local retailer for more information on recommended computer hardware.

Important: You need to have installed the latest USB-MEA1060 driver to operate the USB-MEA1060, which is automatically installed with MC_Rack. The installation may be invalid if the USB-MEA1060 does not respond. Please contact Multi Channel Systems or your local retailer in this case.

Recommended BIOS settings

Recommended operating system settings

The following automatic services of the Windows operating system interfere with the data storage on the hard disk and can lead to severe performance limits in MC_Rack. These routines were designed for use on office computers, but are not very useful for a data acquisition computer.

- * Turned off Windows System Restore.
- * Windows Indexing Service deselected for all local disks.
- * Optimize hard disk when idle (automatic disk fragmentation) turned off.
- * It is not recommended to run any applications in the background when using MC_Rack.
- * Remove all applications from Autostart folder.
- * Be careful when using a virus scanner. These programs are known to disturb MC_Rack, and even data loss may occur.

Driver Installation

The USB-MEA1060 is a plug and play device. The driver is automatically installed together with the MC_Rack program. It is easier to connect the USB-MEA1060 first to the data acquisition computer and then install MC_Rack.

Important: Please make sure that you have full control over your computer as an administrator. Otherwise, it is possible that the installed hardware does not work properly.

First Use of MC_Rack

It is also not recommended to run any applications in the background when using MC_Rack. Remove all applications from the Autostart folder.



Warning: The operating system settings of the data acquisition computer were pre-configured by MCS and should not be changed by the user. Changing these settings can lead to program instabilities and data loss.

Installing MC_Rack with the USB-MEA1060 connected to the computer

The Windows operating system detects a new hardware when the USB-MEA1060 is connected to the computer, if the program has not been installed beforehand. Simply cancel the "Found New Hardware Wizard" and proceed with the installation of the MC_Rack program.

Connecting the USB-MEA1060 to a computer with installed MC_Rack

If MC_Rack had already been installed on the computer before the hardware was connected, the operating system needs to load the driver once. After this procedure, the USB-MEA1060 will be automatically recognized by the operating system.

1. Connect the USB-MEA1060 to the USB port of the data acquisition computer.
2. Switch the computer on.
3. The "Found New Hardware Wizard" is displayed.
4. Choose the option "No", not this time and continue with "Next".
5. Choose the option "Install the software automatically" (Recommended) and continue with "Next".
6. The Wizard will automatically find the appropriate USB-MEA1060 driver. Continue with "Next".
7. The driver installation is finished.
8. Please check the system requirements before you install the MC_Rack software. MCS cannot guarantee that the software works properly if these requirements are not fulfilled. Please see the MC_Rack Help or User Manual for more information. It is recommended that you check the MCS web site for software updates on a regular basis.
9. Double-click "Setup.exe" on the installation volume.
10. The installation assistant will show up and guide you through the installation procedure.
11. Follow the instructions of the installation assistant.
12. The USB-MEA1060 driver and MC_Rack are installed (or updated) automatically.

3.8 Setting up MC_Rack

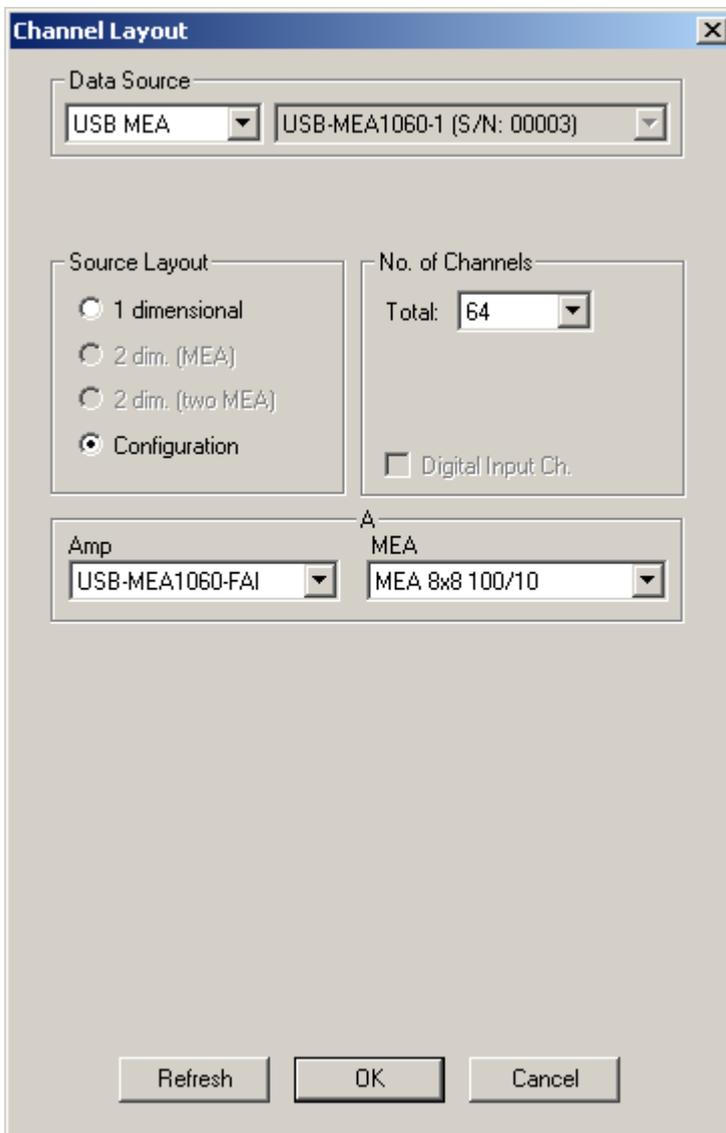
Please refer to the MC_Rack Manual for more information.

1. Start MC_Rack.
2. Open the file MEA_Display.rck on the installation volume. This basic rack contains the virtual MC_Card instrument with appropriate gain settings and a continuous raw data display.
3. Click Start to start the recording.

— OR —

Set up the rack on your own:

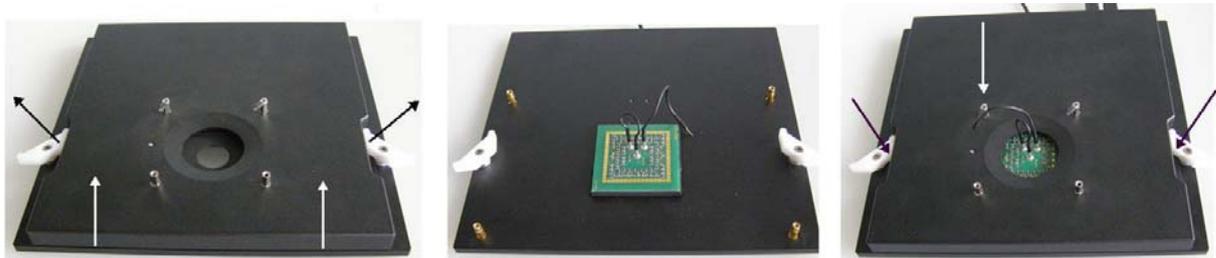
4. Click Data Source Setup on the Edit menu. In Data Source, select USB-MEA from the left drop down menu and USB-MEA1060-1 from the right drop down menu. In Source Layout, click Configuration. Select 64 as total number of channels.
5. Add the USB-MEA1060-1 to your virtual rack.



7. On the Edit menu, click Add Data Display to add a raw data display to your virtual rack.
8. In the virtual rack tree view pane, select the Display 1 and click the Layout tabbed page. Set up a channel map with 64 channels.

4 Operating the USB-MEA1060

4.1 Mounting the MEA Probe and Grounding the Bath



1. Open the lid of the amplifier.
2. Place the MEA probe inside. In this example, the test model probe is shown. The **writing (NMI)** should be on the right side. Otherwise, the MEA layout will not match with the pin layout. This is not very important for standard MEAs with a symmetric electrode field (as long as you document the orientation for your own reference), but it is important for asymmetric MEAs, for example, with internal reference electrode.
3. Replace the lid and close it carefully. In this example, ground the test model probe by connecting the ground of the test model probe and the ground pin of the amplifier.

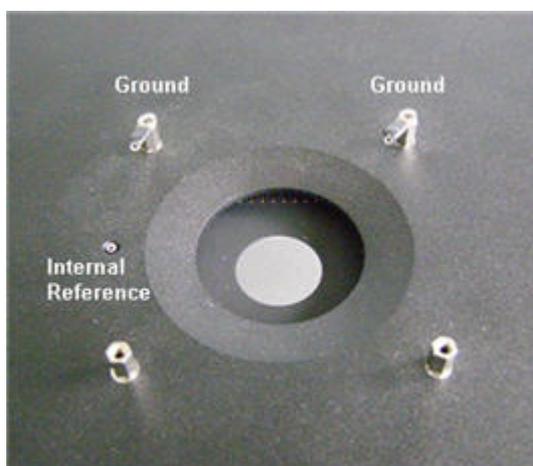
Grounding the bath

You can ground the bath with a plain silver wire or with an Ag/AgCl pellet. Only the Ag/AgCl electrode provides a stable intrinsic potential. In practice, the plain silver wire will be good for 90 % of applications. If you do not achieve satisfying results with the plain silver wire, try an Ag/AgCl electrode.

If you use MEAs with internal reference electrode, you can use the reference electrode for grounding the bath (Pin 15). This has the advantage that you can keep the culture chamber closed and sterile (for example, with MEA-MEM semipermeable membranes).

Important: If you use a MEA with internal reference electrode, you have to connect Pin 15 to ground with the provided cable.

1. Attach the provided **silver wire** or **pellet** to the amplifier's **ground** and place it into the **bath**, near the rim of the culture chamber. If you use a MEA with **internal reference electrode**, connect the ground to the **reference electrode socket (pin 15)** with the provided connector. Make sure that the orientation of the MEA inside the amplifier is correct (internal ground electrode on the left side, NMI label on the right side).



2. Replace the shielding. Make sure the setup is complete.
3. Wait until the amplifier has recovered and you see the standard noise level on all channels before starting your experiment. The recovery time depends on the electrode type of the MEA chip. It usually takes about one to two minutes.

4.2 First Functional Tests

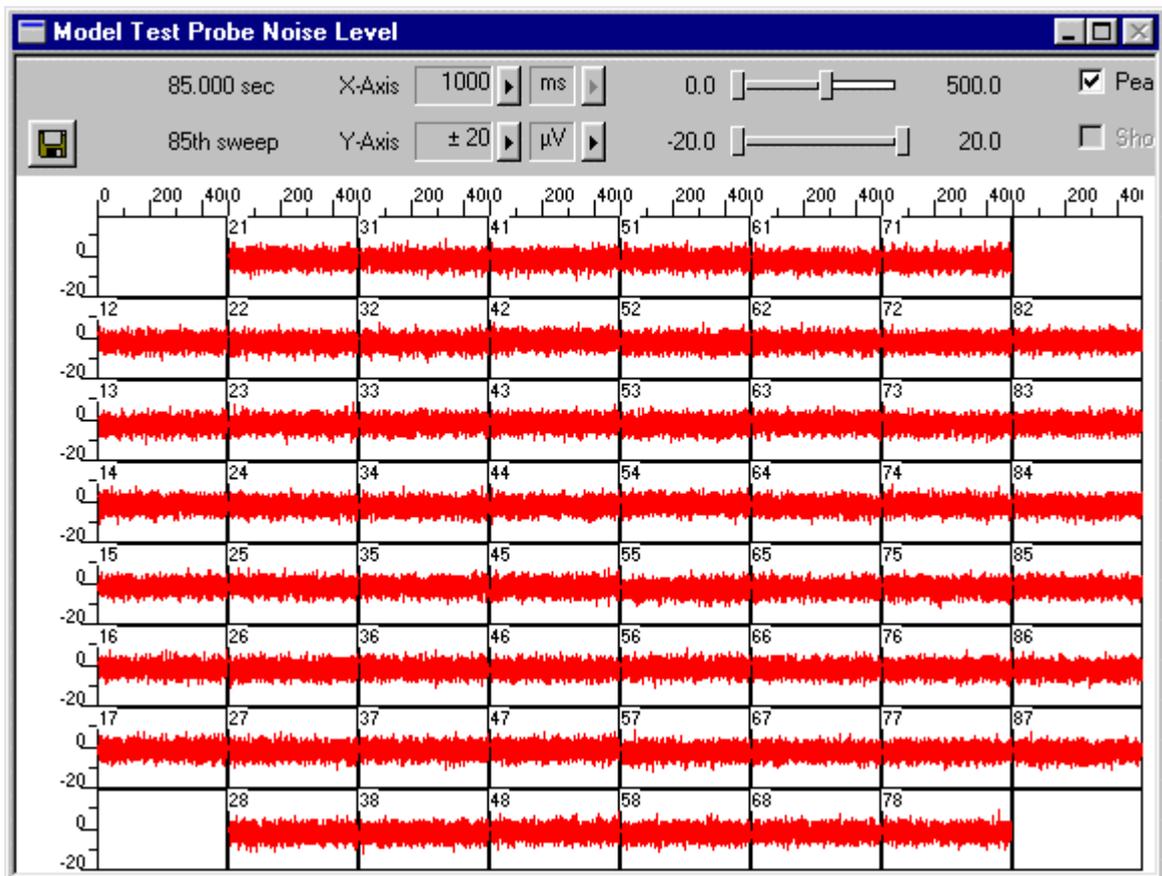
The USB-MEA1060 amplifier has been thoroughly tested at the factory site before delivery. However, you may want to perform some tests yourself before you begin your experiment to exclude any damage that might have occurred during transportation, or to fulfill your own guidelines, for instance. Some of the tests will also help you to get to know the basic functions of the hard- and software, like a short tutorial. It will take only a few minutes time and can save you time and trouble in the long run. Multi Channel Systems MCS GmbH recommends running these tests after the setup of your system before you start your real experiments.

4.3 General Performance / Noise Level

Please use the provided test model probe to test the amplifier immediately after installation. The test model probe is already mounted on the amplifier. It simulates a MEA with a resistor of 220 kOhm and a 1 nF capacitor between bath and electrode, please see chapter "Test Model Probe" in the Appendix. Use MC_Rack or your custom data acquisition program to record from the test model probe and to check the amplifier. Please refer to chapter "Setting up MC_Rack".

Typical Results of Noise Level Test

Typical results of this test are shown in the following screen shot.



5 Troubleshooting

5.1 About Troubleshooting

The following hints are provided to solve special problems that have been reported by users. Most problems occur seldom and only under specific circumstances. Please check the mentioned possible causes carefully when you have any trouble with the product. In most cases, it is only a minor problem that can be easily avoided or solved.

If the problem persists, please contact your local retailer. The highly qualified staff will be glad to help you. Please inform your local retailer as well, if other problems that are not mentioned in this documentation occur, even if you have solved the problem on your own. This helps other users, and it helps MCS to optimize the instrument and the documentation.

Please pay attention to the safety and service information in the separate user manuals of the related products and in the software help. Multi Channel Systems has put all effort into making the product fully stable and reliable, but like all high-performance products, it has to be handled with care.

5.2 No Computer Connection / No Recording Possible

You cannot establish a connection to the computer. The USB-MEA1060 is not available in MC_Rack Data Source Setup. When loading a previously saved virtual rack file, you will get an error message and the simulator will be started automatically.

Or you get an error message when starting the recording in MC_Rack after a successful computer connection.

Possible causes:

? The supply power is not connected or there is a technical problem with the instrument.

Check the power source and the cable connections. If this does not solve the problem, contact your local retailer for support.

? The USB port might not support USB 2.0 or might not be working.

Check the USB port. Only high speed USB 2.0 ports can be used. Try another USB 2.0 port.

? You can establish a connection, but get an error message when starting the recording in MC_Rack. The bandwidth of the USB port is not sufficient for recording. This can be the case if the USB-MEA1060 is connected via a USB hub, and a second device that sends or receives continuous data streams, for example, a web cam or USB speakers, is connected to the same USB port.

Connect the USB-MEA1060 directly to a USB port, not via a hub.

5.3 Noise on Single Electrodes

The noise level on single electrodes is significantly higher than $\pm 8 \mu\text{V}$.

Possible causes:

? The electrode or the contact pin of the amplifier may be defective. To test this, do the following.

1. Open the amplifier and turn the MEA by 90 degrees.
2. Close the amplifier again and start the recording.

If the same electrode in the MEA layout is affected, the amplifier's contact is not ok.

If another electrode is now affected and the previously affected electrode is ok now, the MEA electrode is not ok, but the amplifier is fine.

— OR —

Use the test model probe to test the amplifier.

5.4 MEA Electrode is defective

See also the MEA Manual.

Possible causes:

? The contact pads are contaminated.

Clean the contact pads carefully with a swab and pure (100 %) alcohol.

? The contact pads or the electrodes are damaged. Use a new MEA.

Try to handle and clean the MEA more carefully next time.

5.5 Contact Pin is defective

Possible causes:

? The contact pins are contaminated.

Clean the contact pins carefully with a smooth and clean tissue and pure (100 %) alcohol.

? The contact pins are damaged.

Replace the contact pins carefully. Please see the Spare Parts list on the MCS web site.

Try to handle and clean the contact pins more carefully next time.

5.6 Unsteady Baseline

The baseline is unstable, signals are jumping or drifting.

Possible causes:

? Bath electrode is not connected to ground.

Connect the internal or external bath electrode to one of the ground inputs of the amplifier as described in "Mounting the MEA Probe".

? AgCl bath electrode needs is not well-chlorided.

Rechloride the electrode or use a new one.

? The MEA has an internal reference electrode and Pin 15 is connected to ground appropriately, but the orientation of the MEA inside the amplifier is wrong. In this case, the wrong (standard size for recording) electrode is connected to ground, but not the reference electrode.

Open the amplifier and check the orientation of the MEA and the reference electrodes described in "Mounting the MEA Probe".

5.7 Liquid Spilled onto Amplifier



Warning: Spilled liquid can damage or even completely destroy the electronics of the MEA amplifier. Avoid it by all means.

Of course it is best to completely avoid this situation and consider the following instructions as an "emergency measurement" only. Even with this measurement, a severe damage to the instrument cannot be excluded. It is very important that the amplifier is **not** connected or used again before repair to avoid further damage caused by corrosion. Even if the initial damage is negligible, the additional damage inflicted by corrosion over a longer period of time can completely destroy the electronics.

1. **Immediately** remove the amplifier from the power supply, that is, unplug the amplifier. Do not connect or use it again before repair.
2. Contact your local retailer and send the amplifier to Multi Channel Systems MCS GmbH for cleaning and repair. MCS will check the device and prepare a quote for you, depending on the work and material costs needed for repair.

Important: It is very important to remove the salt from the amplifier immediately after the liquid was spilled to avoid corrosion. Even if you decided to send the amplifier to repair, it is generally recommended to remove the salt first to prevent further damage by corrosion during the shipment.

6 Appendix

6.1 Technical Support

Please read the chapter "Troubleshooting" of the manual first. Most problems are caused by minor handling errors. Contact your local retailer immediately if the cause of trouble remains unclear. Please understand that information on your hardware and software configuration is necessary to analyze and finally solve the problem you encounter. Please keep information on the following at hand:

- * Description of the error (the error message text or any other useful information) and of the context in which the error occurred. Try to remember all steps you had performed immediately before the error occurred. The more information on the actual situation you can provide, the easier it is to track the problem.
- * The serial number of the device. You will find it on the backside of the housing.
- * The operating system and service pack number of the connected computer.
- * The hardware configuration (microprocessor, frequency, main memory, hard disk) of the connected computer. This information is especially important if you have modified the computer or installed new hard- or software recently.
- * The version of the recording software. On the "Help menu", click "About" to display the software version.

6.2 Service and Maintenance

You should clean the contact pins of the amplifier with a soft tissue and pure (100 %) alcohol from time to time, especially if you have problems with the noise level. It may be necessary after a longer time of operation to replace the contact pins. Please send the USB-MEA1060 amplifier back to Multi Channel Systems MCS GmbH for replacing the gold connectors.



Warning: Please be very careful when handling the amplifier, and cleaning the device. The pins can be easily damaged.

6.3 Technical Specifications

USB-MEA1060

General characteristics:	
Operating temperature	10 °C to 50 °C
Storage temperature	0 °C to 50 °C
Relative humidity	10 % to 85 %, non-condensing
Dimensions (W x D x H)	195 x 185 x 15 mm
Weight	950 g
60-Channel data acquisition:	
Sampling frequency	Up to 50 kHz (software controlled)
Data resolution	16 bit
Number of analog input channels	60
Number of digital output channels	60
60-Channel Filter Amplifier:	
Input voltage range	+/- 3.4 mV
Bandwidth	1 Hz - 5 kHz
Gain	1200
Cross talk (channel to channel)	typical 0.01 %, max. 0.1 %
Interface and connectors:	
USB	USB 2.0 High Speed cable (type A – mini B)
Power supply	Barrel connector 0.7 x 2.35 mm
Heating element and temperature sensor:	
Heating element impedance	20 Ω
Temperature sensor type	PT 100 with four wire connection
Power supply unit:	
Output voltage	9 V with max. 1.3 A
Input voltage	100 - 240 V
Max. Power	11.7 W

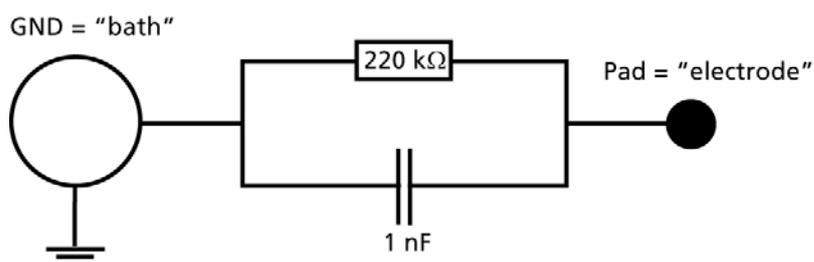
Software:	
MC_Rack program:	Version 3.7.0 and higher
Operating system	Microsoft Windows® 7, Vista or XP with NTFS, English and German versions are supported
MC_DataTool program	Version 2.4.5 and higher
Data Export:	ASCII (*.txt), binary file (*.raw) format



Warning: The device may only be used together with MEAs from Multi Channel Systems MCS GmbH, and only for the specified purpose. Damage of the device and even injuries can result from improper use. Do not open the data acquisition box and do not change hardware configuration as it could lead to improper behavior of the system.

6.4 Test Model Probe

The provided test model probe simulates a MEA with a resistor of 220 k Ω and a 1 nF capacitor between bath and electrode, for all 60 electrodes, and can be used for testing MEA amplifiers.



6.5 Scope of Delivery

1	USB-MEA1060 amplifier
1	USB 2.0 High Speed cable (type A - mini B)
1	Power supply unit with country specific power cord
1	Data acquisition and analysis software MC_Rack
1	Data export software MC_DataTool
1	USB-MEA1060 Manual
1	USB-MEA1060 Data Sheet

6.6 Contact Information

Local retailer

Please see the list of official MCS distributors (sales info) on the web site

User forum

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

News Letter

If you have subscribed to the newsletter, 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

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