USB-ME-System Manual

USB-ME64-System
USB-ME128-System
USB-ME256-System

Imprint

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1 Important Safety Advice

1.1 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**. MCS assumes no responsibility in any case of contravention.

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.

2.1 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.

3.1 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.

2 Introduction

2.1 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.

2.2 Welcome to the USB-ME-System

The **USB-ME-System** is a stand-alone solution for acquiring data from up to 256 channels. It can replace the internal computer hardware MC_Card. The analog input signals are acquired and digitized by the **USB-ME-System** and the digital 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 for data processing. Recorded data are graphed, analyzed and reviewed with the powerful and easy-to-use **Multi Channel Suite**, the newest software package from Multi Channel Systems MCS GmbH or the well-proved **MC_Rack** program. You can export the data in standard formats.

The **USB-ME-System** supports up to 256 channels with an amplification factor 1 that means no amplification, data acquisition only.

It is a high flexible system: You can connect, for example, four **MEA60-Systems** via MCS high grade cables or two **MEA120-Systems** or **ME-Systems** in different configurations or whatever comes with 68-pin MCS standard connectors. Please see "Microelectrode Array Systems" and "Microelectrode Array USB-Systems" for more information. You can stack several **USB-ME-Systems** but you need a separate data proceeding computer with **software** for each system.

3 Software Installation

Please check the system requirements before you install the data acquisition software.
MCS cannot guarantee that the software works properly if these requirements are not fulfilled.
Please see the software help or manual for more information. It is recommended that you check
the MCS web site for software updates on a regular basis.

The **USB-ME-System** is a plug and play device. The driver is automatically installed together with
the **Multi Channel Suite** or **MC_Rack** program. It is easier to connect the **USB-ME-System** first
to the data acquisition computer and then install the software**.**

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.

3.1 System Requirements

One of the following Microsoft Windows ® operating systems is required: Windows 8 and 7,
VISTA or XP (English and German versions supported) with the NT file system. Other language
versions may lead to software errors. Windows 8 is essential for the Multi Channel Suite software.

Hardware: (Not required for offline analysis or demo mode). The data acquisition board **USB-ME-
System**. If no **USB-ME-System** 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-ME-System** 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-ME-System** driver to operate the **USB-ME-
System**, which is automatically installed with the **software**. The installation may be invalid if the
USB-ME-System does not respond. Please contact Multi Channel Systems or your local retailer
in this case.

3.1.1 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.

- Turn off Screensaver.

- Turn off Windows Indexing Service. Only important for data hard drive.

- Manual management of automatic Windows Update.

- Power Options: Power scheme: Never turn off monitor, hard disk and system standby.

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

- Be careful when using a Virus Scanner. These programs are known to disturb the software, and
even data loss may occur.

When using an **USB-ME-System** it is recommended to connect a high performance computer
with a separate hard disk for program files and data storage. The provided possibility to use up
to **256** channels with up to 40 kHz needs high memory capacity. Please remove data and
defragment the hard disk regularly to ensure optimal performance.

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 registrated.
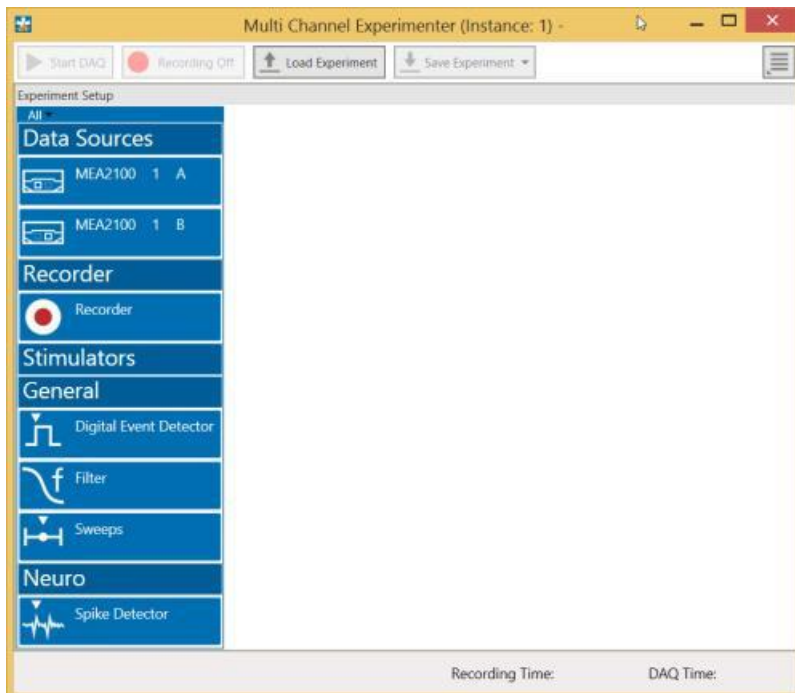
Building a Rack

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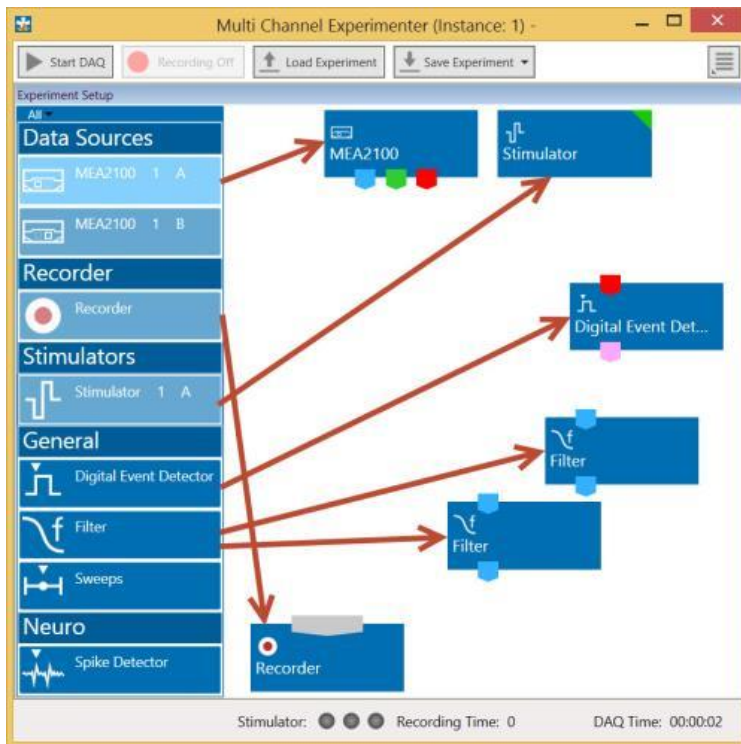
It is also easy to connect the instruments: Please click onto one of the symbols on the lower part of an instrument button to connect this output port via drag and drop with the input port (symbol on the upper side) of the target instrument. Please read the next chapter.
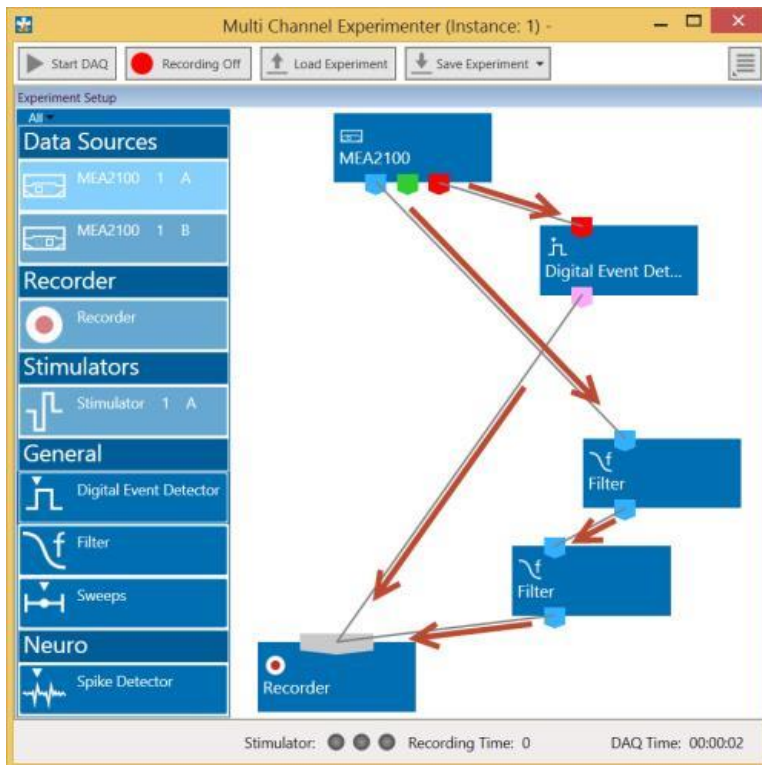
Conventions for Building a Rack

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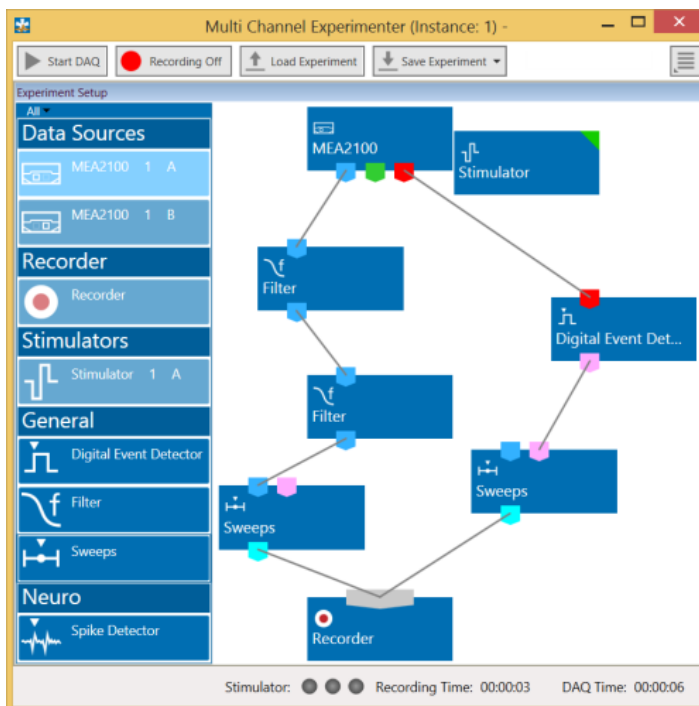
Move as many instruments as you need via drag and drop into the "Experiment Setup" window. It is possible to use the virtual tools more than one time.

3.3   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-ME-System connected to the computer

The Windows operating system detects a new hardware when the **USB-ME-System** is connected to the computer, if the program has not been installed beforehand. Please make sure the device has power, that is, the power LED is lighting. Simply cancel the "Found New Hardware Wizard" and proceed with the installation of the **MC_Rack** program.

Connecting the USB-ME-System 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-ME-System** will be automatically recognized by the operating system.

1. Connect the **USB-ME-System** to the USB port of the data acquisition computer. Please make sure the device has power, that is, the power LED is lighting.

2. Switch the computer on.

    The "Found New Hardware Wizard" is displayed.

3. Choose the option "No", not this time and continue with "Next".

4. Choose the option "Install" the software automatically (recommended) and continue with Next".

5. The Wizard will automatically find the appropriate **USB-ME-System** driver. Continue with Next".

6. The driver installation is finished.

    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 manual for more information. It is recommended that you check the MCS web site for software updates on a regular basis.

    Double-click Setup.exe on the installation volume.

    The installation assistant will show up and guide you through the installation procedure.

    Follow the instructions of the installation assistant.

    The **USB-ME-System** driver and **MC_Rack** are installed (or updated) automatically.

Setting up MC_Rack

Please refer to the MC_Rack Manual for more information.

- Start MC_Rack.

- Open the file MPA8I_NoiseTest.rck and / or MPA32I_NoiseTest.rck on the installation volume (see folder Tutorial). This rack contains the virtual MC_Card instrument 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 Set Channel Layout on the Edit menu. In Data Source, select USB-MEA from the left drop down menu and USB-ME32 from the right drop down menu.
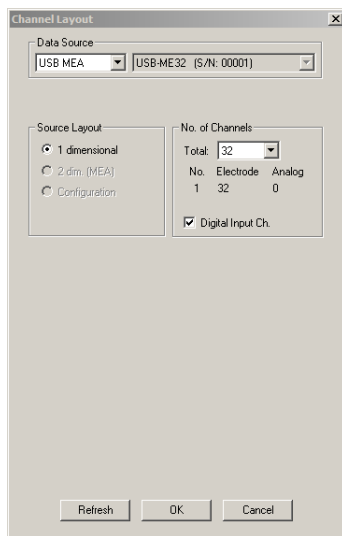
- Add the USB-ME32-FAI to your virtual rack.

- In the tree view pane of the virtual rack, select the USB-ME32-FAI-System 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 32.

- 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.
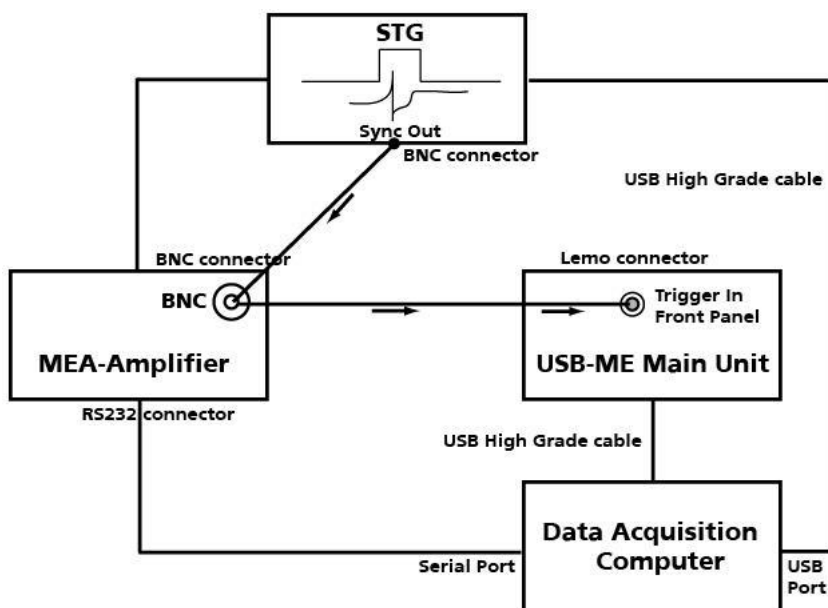
4 Connecting the USB-ME-System

- Provide a power supply in the immediate vicinity of the installation site.

- 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 computer (with installed MC_Rack program).

- Set up the four MEA1060 amplifiers as described in the MEA1060 manual.

- Connect the MEA amplifiers with one, two or four MCS high grade cables (C68x1M) to the 68-pin MCS standard connectors A, B, C, and D on the front panel of the USB-ME-System.

- Connect the USB output connector to a free USB 2.0 port of the data acquisition computer. It is not recommended to use an USB hub.

- Connect the USB-ME-System via power supply unit 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.

- Ground the system.

- Check the power LED on the front panel. It should light up as soon as the power line is connected. If not, check the power source and cabling.

- Install the MC_Rack program from the installation volume if it is not already installed.

- Start the MC_Rack program and select the USB-ME-System as the data source.

    Please see the MC_Rack help / manual for more details on how to define the data source.

Connecting the USB-ME-System with a STG

Connect up to four MEA1060 amplifiers with MCS high grade cables (C68x1M) to the 68-pin MCS standard connectors A, B, C, and D on the front panel of the USB-ME device. Connect a Sync Out of a STG via T- connector at one hand to the BNC connector of the MEA1060 amplifier, and at the other hand to the Digital Trigger IN 0 to 3 at the front panel of the USB-ME device. Make sure that 68-pin MCS standard connector A of MEA amplifier A communicates with Digital Trigger IN 0, MEA amplifier B with 1, C with 2 and D with 3. Please see the following suggestion.

5 USB-ME-Systems

5.1 Setting Up and Connecting the USB-ME64-System

USB-ME64-System is a high flexible system. Via MCS high grade cables it is possible to connect, for example, a **MEA60-System** or **ME-Systems** with at least 64 channels to the 64 analog inputs.

Example: The description of the installation includes an example setup with a MEA1060 amplifier without blanking circuit.

Warning: Please read the separate 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-ME64-System** 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.

Front Panel

Power LED

The **Power LED** lights up when the **USB-ME64** is connected via power supply unit to the power supply system.

Analog Input A

The **68-pin MCS standard connector** on the front panel of the device is an analog input for the data stream coming from the connected amplifier. The connector on the front panel labeled with A communicates with the digital Trigger Input 0. The MCS high grade cables (C68x1M or C68x3M) with 68-pin MCS standard connectors on both heads are used to connect MEA or ME amplifier to the **USB-ME64** for analog data transfer. Please read chapter "Pin Layout" (68-pin MCS standard connector) in the Appendix.

Digital Trigger Input

The **Digital Trigger Input** 0 needs Lemo coaxial cables with BNC connectors for the MEA amplifier at one head and a Lemo connector at the other head for the **USB-ME64** device (C-BNC-Lemo). The Digital Trigger Inputs accept TTL pulses from any device, for example, signals from a stimulus generator STG for triggering the system, and they control the recording.

Rear Panel

Digital In / Out

A **Digital IN / OUT** for 16 digital in- and output bits is available (68-pin MCS standard connector). The Digital IN / OUT connection accepts or generates standard TTL signals. TTL stands for Transistor-Transistor Logic. A TTL pulse is defined as a digital signal for communication between two devices. A voltage between 0 V and 0.8 V is considered as a logical state of 0 LOW), and a voltage between 2 V and 5 V means 1 (HIGH).

The **Digital OUT** allows generating a digital signal with up to 16 bits and read it out, for example by using a **Signal Divider** SD16 from MCS. You can utilize this digital signal to control and synchronize other devices with the **USB-ME64**. Bit 0 of the Digital OUT is separated and available as Lemo connector DIG OUT D0. So if you need only one bit of the digital signal, you don't need the additional signal divider SD16. Please read chapter "**Pin Layout**" (Digital IN / OUT Connector) in the Appendix for more information.

The **Digital IN** can be used to record additional information from external devices as a 16-bit encoded number. The Digital IN is most often used to trigger recordings with a TTL signal from a stimulator. Therefore, the bit 0 of the Digital IN is accessible as Lemo connector on the front panel as Digital Trigger Input 0.

The 16 digital input channels are represented as the digital data stream that is, a stream of 16-bit values, each bit (0 to 15) representing one digital input. Standard TTL signals are accepted as input signals on the digital inputs. Unused input bits, which have an undefined state, should be masked in the Trigger Detector of MC_Rack.

> Warning: A voltage that is higher than +5 Volts or lower than 0 Volts, that is, a negative voltage, applied to the digital input would destroy the electronics. Make sure that you apply only TTL pulses (0 to 5 V) to the digital inputs.

Digital Output D0

The Bit 0 of the Digital OUT is also accessible independently from the 68-pin Digital IN / OUT connector. The digital output channel D0 is generally used for synchronizing the **USB-ME64-System** with a stimulus generator, or with another data acquisition system, for example, an imaging or a patch clamp system. The DIG OUT D0 generates standard TTL pulses.

Synchronization Out- and Input

If you want to use several **USB-ME64-Systems** in parallel, the **SYNC OUT** and **SYNC IN** can be used to synchronize the individual devices. The SYNC OUT of the first device must be connected to the SYNC IN of the second, and so on. For the connection you need cable with Lemo plugs on both heads (C-Lemo-Lemo).

> Warning: Do not use the SYNC IN and SYNC OUT to connect the **USB-ME64** to any other device than another **USB-ME64.**

Audio Output

To the **AUDIO OUT** (3.5 mm phone jack) you can connect an audio system to make the electrical activity audible. By software control, it is possible to convert signals from one data channel into sound. A computer with a sound card and speakers or a headset is required. You can use this feature to hear Electrode Raw Data, for example, or to replay recorded sound. Or you can use an analog channel as a sound input and record any sounds. Thus, you can add spoken commentary to document your data.

Only Analog Raw Data, Electrode Raw Data, and Filtered Data can be converted into sound. The quality of the sound is mono.

Note: You can add only one sound instrument to your rack, and you can convert only one channel into sound.

Analog Input 1 to 4

When connecting a MEA1060 amplifier to the USB-ME64 data acquisition, four additional analog inputs are available, separated from 68-pin MCS standard connector on the front panel, Pin Number 63, 64, 65 and 66. See Appendix chapter "Pin Layout" (68-pin MCS standard connector). If you connect, for example two 32-channel miniature preamplifiers MPA32I, no additional analog inputs are available, all channels are used for recording.

The MEA1060 amplifier delivers analog data streams from 60 channels to the input connector on the front side of the **USB-ME64.** Pin Number 1, 67 and 68 are used for the external power supply, Pin Number 2 is for grounding the signal, GNDS. There are four free channels left, Pin No. 63, 64, 65 and 66, that is for **Analog IN 1 to 4**. In MC_Rack you see the analog channels on channel 61, 62, 63 and 64.

The additional analog inputs 1 to 4 are intended for recording additional information from external devices, for example, for recording patch clamp in parallel to the MEA recording, for monitoring the temperature, or for recording voice. You could also use the analog inputs for triggering, but please note that the digital inputs, especially DIG OUT D0, are intended for accepting TTL pulses. As the gain is generally completely different on the electrode inputs and on the additional analog inputs, signals on the analog channels are recorded "as is", with no respect to the gain specified in MC_Rack.

USB

The USB connector is used to transfer the digitized data from all data channels and the additional digital and analog 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-ME64** main unit only. The device needs 12 V and 410 mA / ~5 W.

Ground

If an additional ground connection is needed, you can connect this plug with an external ground using a standard common jack (4 mm).

External Power Supply

Plug in for the external power supply, for example, PS40W. The PS40W is a standard power supply delivering supply voltages to connected devices. Please read chapter **"External Power Supply"**.

5.2 Setting Up and Connecting the USB-ME128-System

USB-ME128-System is a high flexible system. Via MCS high grade cable it is possible to connect, for example, one **MEA1060 amplifier** or two **MEA1060 amplifiers** or a **ME-Systems** with at least 128 channels to the **128 analog inputs.**

Example: The description of the installation includes an example setup with a MEA1060 amplifier two MEA1060 amplifiers without blanking circuit.

Warning: Please read the separate 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-ME128-System** 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.

Front Panel

Power LED

The **Power LED** lights up when the **USB-ME128** is connected via power supply unit to the power supply system.

Analog Inputs A and B

The **68-pin MCS standard connectors** on the front panel of the device are analog inputs for the data streams coming from the connected amplifiers. The connectors on the front panel labeled with A and B communicate with the digital Trigger Inputs 0 and 1. The MCS high grade cables (C68x1M or C68x3M) with 68-pin MCS standard connectors on both heads are used to connect MEA or ME amplifiers to the **USB-ME128** for analog data transfer. Please read chapter "Pin Layout" (68-pin MCS standard connector) in the Appendix.

Digital Trigger Inputs

The **Digital Trigger Inputs** 0 and 1 need Lemo coaxial cables with BNC connectors for the MEA amplifier at one head and Lemo connectors at the other head for the **USB-ME128** device (C-BNC-Lemo). The Digital Trigger Inputs accept TTL pulses from any device, for example, signals from a stimulus generator STG for triggering the system and they control the recording.

Rear Panel

Digital In / Out

A **Digital IN / OUT** for 16 digital in- and output bits is available (68-pin MCS standard connector). The Digital IN / OUT connection accepts or generates standard TTL signals. TTL stands for Transistor-Transistor Logic. A TTL pulse is defined as a digital signal for communication between two devices. A voltage between 0 V and 0.8 V is considered as a logical state of 0 (LOW), and a voltage between 2 V and 5 V means 1 (HIGH).

The **Digital OUT** allows generating a digital signal with up to 16 bits and read it out, for example by using a **Signal Divider** SD16 from MCS. You can utilize this digital signal to control and synchronize other devices with the **USB-ME128**. Bit 0 of the Digital OUT is separated and available as Lemo connector DIG OUT D0. So if you need only one bit of the digital signal, you don't need the additional signal divider SD16. Please read chapter "Pin Layout" (Digital IN / OUT Connector) in the Appendix for more information.

The **Digital IN** can be used to record additional information from external devices as a 16-bit encoded number. The Digital IN is most often used to trigger recordings with a TTL signal from a stimulator. Therefore, the bits 0 and 1 of the Digital IN are accessible as the Lemo connectors on the front panel as Digital Trigger Inputs 0 and 1.

The 16 digital input channels are represented as the digital data stream that is, a stream of 16-bit values, each bit (0 to 15) representing one digital input. Standard TTL signals are accepted as input signals on the digital inputs. Unused input bits, which have an undefined state, should be masked in the Trigger Detector of MC_Rack.

Warning: A voltage that is higher than +5 Volts or lower than 0 Volts, that is, a negative voltage, applied to the digital input would destroy the electronics. Make sure that you apply only TTL pulses (0 to 5 V) to the digital inputs.

Digital Output D0

The Bit 0 of the Digital OUT is also accessible independently from the 68-pin Digital IN / OUT connector. The digital output channel D0 is generally used for synchronizing the **USB-ME128-System** with a stimulus generator, or with another data acquisition system, for example, an imaging or a patch clamp system. The DIG OUT D0 generates standard TTL pulses.

Synchronization Out- and Input

If you want to use several **USB-ME128-Systems** in parallel, the **SYNC OUT** and **SYNC IN** can be used to synchronize the individual devices. The SYNC OUT of the first device must be connected to the SYNC IN of the second, and so on. For the connection you need cable with Lemo plugs on both heads (C-Lemo-Lemo).

Warning: Do not use the SYNC IN and SYNC OUT to connect the **USB-ME128** to any other device than another **USB-ME128.**

Audio Output

To the **AUDIO OUT** (3.5 mm phone jack) you can connect an audio system to make the electrical activity audible. By software control, it is possible to convert signals from one data channel into sound. A computer with a sound card and speakers or a headset is required. You can use this feature to hear Electrode Raw Data, for example, or to replay recorded sound. Or you can use an analog channel as a sound input and record any sounds. Thus you can add spoken commentary to document your data.

Only Analog Raw Data, Electrode Raw Data, and Filtered Data can be converted into sound. The quality of the sound is mono.

Note: You can add only one sound instrument to your rack, and you can convert only one channel into sound.

Analog Input 1 to 4

Four additional analog inputs are available, separated from 68-pin MCS standard connector B on the front panel, Pin Number 125, 126, 127 and 128. See Appendix chapter "Pin Layout" (68-pin MCS standard connector).

The MEA1060 amplifier delivers analog data streams from 60 channels to the input connector on the front side of the **USB-ME128.** Pin Number 1, 67 and 68 are used for the external power supply, Pin Number 2 is for grounding the signal, GNDS. There are four free channels left, Pin No. 63, 64, 65 and 66, that is for **Analog IN 1 to 4**.

The additional analog inputs 1 to 4 are intended for recording additional information from external devices, for example, for recording patch clamp in parallel to the MEA recording, for monitoring the temperature, or for recording voice. You could also use the analog inputs for triggering, but please note that the digital inputs, especially DIG OUT D0, are intended for accepting TTL pulses. As the gain is generally completely different on the electrode inputs and on the additional analog inputs, signals on the analog channels are recorded "as is", with no respect to the gain specified in MC_Rack.

USB

The USB connector is used to transfer the digitized data from all data channels and the additional digital and analog 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-ME128** main unit only. The device needs 12 V.

Ground

If an additional ground connection is needed, you can connect this plug with an external ground using a standard common jack (4 mm).

External Power Supply

Plug in for the external power supply, for example, PS40W. Please read chapter **"External Power Supply"**.

5.3 Setting Up and Connecting the USB-ME256-System

USB-ME-System is a high flexible system. Via MCS 68-pin high grade cables it is possible to connect, for example, four **MEA60-Systems** or two **MEA120-Systems** or a **ME-System** with at least 256 channels to the 256 analog inputs.


Example: The description of the installation includes an example setup with four MEA1060 amplifiers without blanking circuit.

⚠️ 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-ME-System** 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.
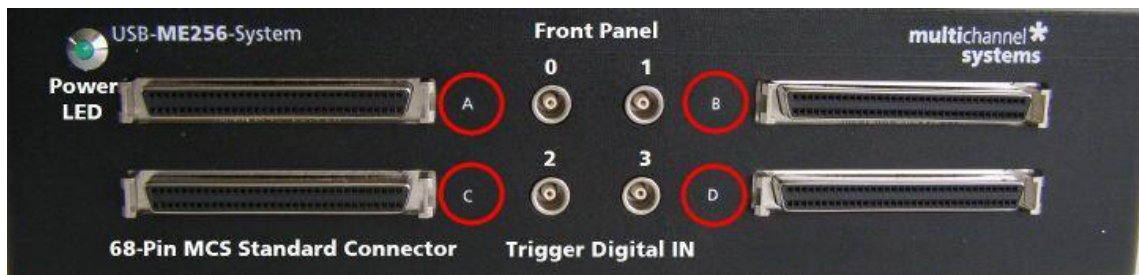
Front Panel

Power LED

The Power LED lights up when the **USB-ME256** is connected via power supply unit to the power supply system.

Analog Inputs A, C, B, and D

The 68-Pin MCS Standard connectors on the front panel of the device are analog inputs for the data streams coming from the connected amplifiers. The connectors on the left side of the front panel labeled with A and C communicate with the left digital Trigger Inputs 0 and 2. The 68-pin MCS standard connectors on the right side labeled with B and D corresponds with the digital Trigger Input 1 and 3. The MCS 68-pin high grade cables (C68x1M or C68x3M) with 68-pin MCS standard connectors on both heads are used to connect MEA or ME amplifiers to the **USB-ME256** for analog data transfer. Please read chapter "Pin Layout" (68-pin MCS Standard connector) in the Appendix.

Digital Trigger Inputs

The Digital Trigger Inputs 0, 1, 2 and 3 need Lemo coaxial cables with BNC connectors for the MEA amplifier at one head and Lemo connectors at the other head for the **USB-ME256** device. The Digital Trigger Inputs accept TTL pulses from any device, for example, signals from a stimulus generator STG for triggering the system, and they control the recording.

Rear Panel

Digital In / Out

A Digital IN / OUT for 16 digital in- and output bits is available (68-pin MCS standard connector). The Digital IN / OUT connection accepts or generates standard TTL signals. TTL stands for Transistor-Transistor Logic. A TTL pulse is defined as a digital signal for communication between two devices. A voltage between 0 V and 0.8 V is considered as a logical state of 0 (LOW), and a voltage between 2 V and 5 V means 1 (HIGH).

The Digital OUT allows generating a digital signal with up to 16 bits and read it out, for example, by using a Signal Divider SD16 from MCS. You can utilize this digital signal to control and synchronize other devices with the **USB-ME256**. Bit 0 of the Digital OUT is separated and available as Lemo connector DIG OUT D0. So if you need only one bit of the digital signal, you don't need the additional signal divider SD16. Please read chapter "Pin Layout" (Digital IN / OUT Connector) in the Appendix for more information.

The Digital IN can be used to record additional information from external devices as a 16-bit encoded number. The Digital IN is most often used to trigger recordings with a TTL signal from a stimulator. Therefore, the bits 0, 1, 2 and 3 of the Digital IN are accessible as the Lemo connectors on the front panel as Digital Trigger Inputs 0 to 3.

The 16 digital input channels are represented as the Digital Data stream, that is, a stream of 16-bit values, each bit (0 to15) representing one digital input. Standard TTL signals are accepted as input signals on the digital inputs. Unused input bits, which have an undefined state, should be masked in the Trigger Detector of MC_Rack.

Warning: A voltage that is higher than +5 Volts or lower than 0 Volts, that is, a negative voltage, applied to the digital input would destroy the electronics. Make sure that you apply only TTL pulses (0 to 5 V) to the digital inputs.

Digital Output D0

The Bit 0 of the Digital OUT is also accessible independently from the 68-pin digital IN / OUT connector. The digital output channel D0 is generally used for synchronizing the **USB-ME-System** with a stimulus generator, or with another data acquisition system, for example, an imaging or a patch clamp system. The DIG OUT D0 generates standard TTL pulses.

Synchronization Out- and Input

If you want to use several **USB-ME-Systems** in parallel, the SYNC OUT and SYNC IN can be used to synchronize the individual devices. The SYNC OUT of the first device must be connected to the SYNC IN of the second, and so on. The cable for connection must have Lemo plugs on both heads.

Warning: Do not use the SYNC IN and SYNC OUT to connect the **USB-ME256** to any other device than another **USB-ME-256**.

Audio Output

To the AUDIO OUT (3.5 mm phone jack) you can connect an audio system to make the electrical activity audible. By software control, it is possible to convert signals from one data channel into sound. A computer with a sound card and speakers or a headset is required. You can use this feature to hear electrode raw data, for example, or to replay recorded sound. Or you can use an analog channel as a sound input and record any sounds. Thus, you can add spoken commentary to document your data.

Only analog raw data, electrode raw data, and filtered data can be converted into sound. The quality of the sound is mono.

Note: You can add only one sound instrument to your rack, and you can convert only one channel into sound.

Analog Input A1 to A4

Four additional analog inputs are available, separated from 68-pin MCS standard connector D on the front panel, Pin Number 253, 254, 255 and 256. See Appendix chapter "Pin Layout" (68-pin MCS standard connector).

The MEA1060 amplifier delivers analog data streams from 60 channels to the input connector on the front side of the **USB-ME256.** Pin Number 1, 67 and 68 are used for the external power supply, Pin Number 2 is for GNDS, grounding the signal. There are four free channels left, that is for Analog IN A1 to A4.

The additional analog inputs A1 to A4 are intended for recording additional information from external devices, for example, for recording patch clamp in parallel to the MEA recording, for monitoring the temperature, or for recording voice. You could also use the analog inputs for triggering, but please note that the digital inputs, especially DIG OUT D0, are intended for accepting TTL pulses. As the gain is generally completely different on the electrode inputs and on the additional analog inputs, signals on the analog channels are recorded "as is", with no respect to the gain specified in MC_Rack.

USB

The USB connector is used to transfer the digitized data from all data channels and the additional digital and analog 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-ME256 main unit only. The device needs 12 V and 1.1 A / ~13 W.

Ground

If an additional ground connection is needed, you can connect this plug with an external ground using a standard common jack (4 mm).

5.4 External Power Supply

The external power supply PS40W is used for all USB-ME-Systems.

External power supply through: Plug in for the external power supply, for example, PS40W. The external power supply energizes the devices that are connected to the USB-ME256, for example, filter amplifier, gain amplifier or MEA amplifier with blanking circuit. The conductive path from the three pins of the plug in runs through the device to the front 68-pin MCS Standard connector and occupies Pin Number 1, 67 and 68. (Please see also chapter "Pin layout" 68-pin MCS standard connector in the Appendix).

The PS40W is a standard power supply delivering supply voltages to connected devices. The PS40W is especially recommended for use with Multi Channel Systems products, for example, it is perfect for supplying power to MEA1060BC or to programmable gain amplifiers PGA and for other custom setups that lack an internal power supply IPS10W. It supplies power with +/- 7 V output voltage, 2.5 A output current, and about 40 W output power. The PS40W stabilizes two voltages using the linear regulation technique. The outputs of the device have over-current and over-temperature protection. In case of a failure of the PS40W, the output voltages are decreased. Fuses protect the electronic components against fatal damages.

If you connect four MEA1060 amplifiers from Multi Channel Systems MCS GmbH to the USB-ME256, that means maximum load, it will be necessary to use the strong power supply PS40W with +/- 7 V to generate about 40 W output power. Otherwise the following amplifiers will not be sufficiently supported.

Important: Do not mismatch the polarity of the power supply. A false connection may cause permanent damages.

Note: If by any cause the supply voltages are reduced, the recorded signals could be deformed.

Please do not place the external power supply device PS40W near to the data acquisition device in experimental setup! The PS40W will disturb the data acquisition with 50 Hz hum, that is, why the PS40W should be placed in a distance to the data acquisition device.

Cabling

For Digital Out D0, and Analog Input A1 to A4 on the rear panel of the device you need the same special coaxial cable as for the Digital Trigger In plugs on the front panel: Lemo cable with one head BNC connector, the other head "Lemo" connector. Please see the picture below. Sync In and Sync Out need Lemo cable with two Lemo connectors.

6 Troubleshooting

6.1 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.

6.2 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 or click "About" in "Help" in the main menu of MC_Rack.

- The amplifier type and serial numbers of the connected amplifiers. You will find them on the devices.

- 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.

6.3   No Computer Connection / No Recording Possible

You cannot establish a connection to the computer. The **USB-ME-System** channel layout is not available in MC_Rack. 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 power LED is not lightning. 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 power LED is lighting. The USB port might not support USB 2.0 or might not be working.

Check the USB port. Only full 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-ME-System** is connected via 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-ME-System** directly to a USB port, not via hub.

6.4   Cable Connection not correct / No Recording Possible

You cannot establish a signal from the amplifier. The **USB-ME-System** channel layout in MC_Rack shows 50 Hz hum only.

Possible causes:

? The cable connection from the computer to the periphery is not complete. 68-pin MCS standard connectors need to be fixed in the provided plugs by a firm connection. Otherwise no data transfer is possible.

Check the MCS high grade cable, and the 68-pin MCS standard connectors. If this does not solve the problem, contact your local retailer for support.

? The cable connection from the computer to the periphery is not correct.

Make sure not to mistake inputs for outputs in the connected devices.

6.5 Triggering / Digital Input does not Work

You have connected a TTL source (for example, the Sync Out of a stimulus generator) to the digital output D0 of the **USB-ME-System**, and configured the virtual rack in MC_Rack for triggering displays or data acquisition by the TTL source, but you do not see any sweeps.

Possible causes:

? The TTL source does not generate true TTL signals (5 V TTL level), or the TTL pulse duration is too short in combination with the sampling rate, so that the pulse is missed in-between two data points.

The **USB-ME-System** can only accept TTL signals (5 V TTL level) as a digital input stream. The TTL pulse needs to be optimized according to the sampling rate. Otherwise, a detection of the trigger cannot be guaranteed.

? The software settings for the Trigger Detector do not match with the hardware configuration.

In MC_Rack, add a Trigger Detector to your virtual rack, and select the Digital Data D1 input stream as the Trigger. Check the pin layout of the digital IN / OUT connector and make sure that the same bit input that is connected is selected in the software. (The standard settings of the Trigger Detector are for using bit 0.) Mask all unused bits. Select the appropriate logical state (generally HIGH) for triggering. Please see the MC_Rack help or manual for more details.

7   Appendix

7.1   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 the opportunity for you to exchange your experience or thoughts with other users worldwide.

Mailing list

If you have subscribed to the 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

7.2   Scope of Delivery

1	USB-ME main device
1	USB 2.0 High Speed cable (type A - mini B)
1 - 7	Lemo coaxial cable with BNC and Lemo connectors (1 m)
1	Power cable: Lemo 4 mm connector
1	Power supply unit with country specific power cord
1	Data acquisition and analysis software Multi Channel Suite (Version 1.2.2 or higher)
1	Data acquisition and analysis software MC_Rack (Version 3.6.3 or higher)
1	Data export software MC_DataTool (Version 2.4.1 or higher)
1	USB-ME manual

7.3 Pin Layout

Analog IN

Pin Layout   68-Pin MCS Standard Connector
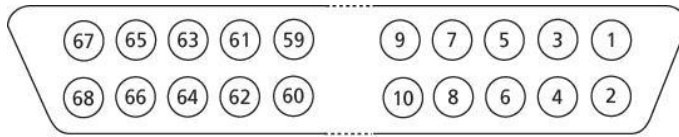
	A	B	C	D
Pin 1	GNDP (power ground)	GNDP	GNDP	GNDP
Pin 2	GNDS (signal ground)	GNDS	GNDS	GNDS
Pin 3 - 66	Channels 1 - 64	65 - 128	129 - 192	193 - 256
Pin 67	Pos. voltage supply	Pos. voltage supply	Pos. voltage supply	Pos. voltage supply
Pin 68	Neg. voltage supply	Neg. voltage supply	Neg. voltage supply	Neg. voltage supply

Galvanically isolated voltage supply and ground. Pin 1, 67, and 68 are connected to the external power supply, for example, PS40W.

Additional ANALOG IN

Please note that channels 253 to 256 are not used for recording analog data from MEA amplifier. The 68-pin MCS Standard Connector has 64 possible channels for recording, but MEA amplifier only has 60 channels for recording data. That is why channel 253 to 256 are diverged from 68-pin MCS Standard Connector D at the front panel and connected to the Analog 1 to 4 at the rear panel. These channels are used for the additional analog inputs of the **USB-ME256.**

Analog 1	Channel 253	Connector D, Pin 63
Analog 2	Channel 254	Connector D, Pin 64
Analog 3	Channel 255	Connector D, Pin 65
Analog 4	Channel 256	Connector D, Pin 66

Digital IN / OUT Connector

68-Pin MCS Standard Connector
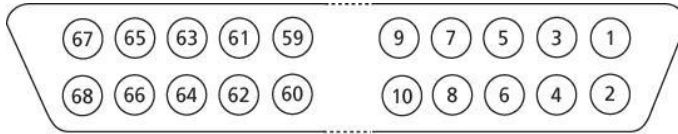
Digital Out D0   Bit 0 of the 16 bit digital output channels (Pin 3)

Pin	1	GNDP (power ground)
Pin	2	GNDS (signal ground)
Pin	3 - 10	Digital output channels bit 0 - 7
Pin	11 - 14	GNDS (signal ground)
Pin	15 - 22	Digital output channels bit 8 - 15
Pin	23 - 26	GNDS (signal ground)
Pin	27 - 34	Digital input channels bit 0 - 7
Pin	35 - 38	GNDS (signal ground)
Pin	39 - 46	Digital input channels bit 8 - 15
Pin	47 - 48	GNDS (signal ground)
Pin	49 - 63	Internal use (do not connect)
Pin	64 - 66	GNDS (signal ground)
Pin	67	Positive supply voltage output
Pin	68	Negative voltage supply output

7.4 Technical Specifications

The **USB-ME-System** is an Analog / Digital board converting analog signals in digital data streams in real-time.

⚠️ Warning: The device may only be used together with MEA-Systems or ME-Systems from Multi Channel Systems MCS GmbH, and only for the specified purpose. Damage of the device and even fatal 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.

General characteristics

Operating temperature	10 °C to 50 °C
Storage temperature	0 °C to 50 °C
Relative humidity	10 % to 85 %, non-condensing
Dimensions (L x D x H)	210 x 210 x 35 mm (USB-ME64 / USB-ME128) 210 x 210 x 50 mm (USB-ME256)
Weight	1750 g (USB-ME64), 1850 g (USB-ME128) 2350 g (USB-ME256)

Signal inputs

Number of analog recording channels	60 (64) / 120 (128) / 240 (252)
Input voltage	± 4 V
Input impedance	10 kΩ
Bandwidth	DC to 15 kHz
Number of additional analog inputs	4 (if available)
Input impedance	1 MΩ || 1 nF
DC offset	max. ± 2 mV
Number of digital input channels	16
Digital input signals	TTL
Number of digital output channels	16
Digital output signals	TTL
Sampling frequency	up to 50 kHz (software controlled)
Data resolution	16 Bit
Maximal data rate	20.5 MB/s
Data transfer	USB 2.0 High Speed (true USB 2.0 transfer rate)
Cross talk (neighbour channel)	typical 0.01 %, maximal 0.025 %
Cross talk (other channels)	incapable of measurement

Interface and connectors

Front panel

1 / 2 / 4 Digital Inputs	Lemo connector, EPL.00.250 NTN
1 / 2 / 4 x 64 Analog In	68-pin MCS standard connectors, MCS high grade cable

Rear panel

1 16 Bit Digital In / Out	68-pin MCS standard connectors, MCS high grade cable
1 Digital Out D0	Lemo connector, EPL.00.250 NTN
1 Sync In	Lemo connector, EPL.00.250 NTN
1 Sync Out	Lemo connector, EPL.00.250 NTN
1 Audio Output	Stereo jack 3.5 mm, FFA.00.250 CTAC29
4 Analog Inputs	Lemo connector, EPL.00.250 NTN
USB	USB 2.0 High Speed cable (type A - mini B, 5 pin)
Power Supply	DC PWR 0.7 x 2.35 mm, PWR DC 0.65 x 2.75 mm
Ground	Common jack 4 mm, banana plug,
External Power through	Lemo EPG.0B.303 HLN

Power supply unit (MPU 30)

Input voltage	90 – 264 VAC @ 47 – 63 Hz
Output voltage	11 – 13 V
Max. Power	30 W

Software

Operating system	Microsoft Windows ® 8 or 7, XP or Vista with NTFS English and German version supported
Multi Channel Suite program: Data acquisition and analysis software	Version 1.2.2 and higher
MC_Rack program: Data acquisition and analysis software	Version 3.6.3 and higher
MC_DataTool program: Data export software	Version 2.4.1 and higher Axon binary file (*.abf), ASCII file (*.txt), binary file (*.raw)

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