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1 Welcome to the SE-Wireless-System

The SE-Wireless-System *in vivo* recording system is a product collaboration between Triangle BioSystems International (TBSI) and Multi Channel Systems (MCS). TBSI provides the headstages and receiver and MCS is responsible for the data acquisition integrated within the receiver as well as the MCS-IFB-SE-W interface board. For data acquisition and analysis, the easy to use software package Multi Channel Suite is included.

The system is an all-in-one solution for amplifying, recording, and analyzing *in vivo* data from up to 256 channels. It consists of small sized headstages, a receiver with integrated data acquisition, and a MCS-IFB-SE-W interface board with connectors for additional analog and digital data in- and outputs.

The SE-Wireless-System is available in different channel count variations and with one or two receivers. One receiver is always operated independently by one instance of the Multi Channel Experimenter software. The type of connected receiver (5, 15, 31, 63, 127 or 256 channels) is detected automatically.

For detailed information about components produced by Triangle BioSystems International, please read the respective manuals and datasheets on the TBSI web site trianglebiosystems.com.

For detailed information about the Multi Channel Suite software from MCS, please read the manuals provided on the MCS web site multichannelsystems.com.
2 Important Safety Advice

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

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

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

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

![Warning] Warning: The device are not intended for medical use and must not be used on human. MCS assumes no responsibility in any case of contravation.

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 mains 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. Keep the device and the power cords always 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. Never cover the vents, not even partially, so that the air can circulate freely. Otherwise, the device may overheat.
2.1 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.

2.2 Guarantee and Liability

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

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

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

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

SE-Wireless-System Hardware Setup

- Place the antennas of the receiver within transmission range of your experimental setup. To get optimal results, keep the distance as short as possible.
- Place the interface board not further than 2 m away from the receiver, and connect the two devices with the eSATAp cable.
- Connect the power supply to the interface board.
- Connect the interface board with a USB 3.0 port of a computer where Multi Channel Experimenter is already installed. Avoid USB 2.0 ports (USB 3.0 ports are blue). Do not use USB hubs.
- Switch on the SE-Wireless-System on the rear panel of the interface board and on the front panel of the receiver. The LEDs on the interface board and the receiver should light up.

The receiver antennas must be clipped to a surface within 4 meter from the animal at all times to achieve optimal signal quality. They should be positioned above the animal’s cage. Be careful not to obstruct the line of site path between the animal and the receiver antenna with any material except for glass or plastic.

3.1 SE-Wireless-System Headstages

Headstages are the first elements of the SE-Wireless-System. Headstages from Triangle BioSystems International TBSI are adapted to this wireless system. Please read detailed information about available headstages on the TBSI web site.
3.2 SE-Wireless-System Receiver with integrated DAQ

The receiver from TBSI is the second element of the SE-Wireless-System. Additionally a data acquisition from MCS is integrated in the device. The DAQ is equipped with an A/D converter to release digital signals for further processing to the MCS-IFB-SE-W interface board.

Please connect the receiver via eSATAp cable to the MCS-IFB-SE-W.

One receiver of the SE-Wireless-System can receive analog signals sent from one designated headstage. Two antennae are used for data transmission. The position of the antennae can have an influence on the transmission efficiency.

With a clear line of sight between sender and receiver, an effective transmission range of 4 m is guaranteed under normal circumstances. Under good conditions, the actual range can be much further.

The RF Receiver Base Station is available in many different system configurations to accommodate a wide range of data acquisition system interface requirements. The RF receiver signal is demodulated by a custom digital signal processing system that incorporates a high speed analog to digital converter for demodulating the receiver signal.
3.3 SE-Wireless-System Interface Board MCS-IFB-SE-W

The interface board “MCS-IFB 3.0 Multiboot” is the third element of the SE-Wireless-System. It provides connectors for additional analog input channels and digital trigger in- and outputs.

The interface board is connected to the receiver with an eSATAp cable. The connection to the data acquisition computer is realized via USB 3.0 super speed cable. The interface board has an own power supply.

Front Panel of the "MCS-IFB-SE-W" Interface Board

From the left to the right side of the front panel:

Two Status LEDs

The status LEDs indicate the link status of receiver 1 and / or receiver 2. They light up when one or both receivers are connected to the interface board via eSATAp cable.

Auxiliary Channels

Two reserve auxiliary channels are available for future use. They have no function at the moment.

Digital IN / OUT

A Digital IN / OUT for 16 digital in- and output bits is available (68-pin MCS standard connector) on the rear panel of the interface board. On the front panel four digital IN and four digital OUT connectors bits are also accessible via Lemo connector, DIG IN bit 0 to bit 3 and DIG OUT bit 0 to bit 3. If access to more bits of the DIG IN / OUT channel is required, it is necessary to connect a Di/o board with a 68-pin standard cable. This Di/o board is available as optional accessory.

Power LED

The power LED near to the MCS logo on the front panel of the interface board should light up when the SE-Wireless-System is "ON", and the device is connected to the power line. If not, please check the power source and cabling.
Rear Panel of the "MCS-IFB-SE-W" Interface Board

From the left to the right side of the rear panel:

**Toggle Switch On / Off**

Toggle switch for turning the device on and off. The SE-Wireless-System is switched to status "ON" when the toggle switch is switched to the left. The device is switched "OFF" when the toggle switch is switched to the right. If the SE-Wireless-System is "ON", and the device is connected to the power line, the power LED on the front panel of the interface board should light up. If not, please check the power source and cabling.

**Power IN**

Connect the power supply unit here. This power supply powers both, the headstage and the interface board of the SE-Wireless-System. The device needs 12 V and 2.5 A / 30 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). Not in use in SE-Wireless-Systems.

**Digital IN / OUT**

A Digital IN / OUT for 16 digital in- and output bits is available (68-pin MCS standard connector). Please read chapter "Pin Layout" (Digital IN / OUT Connector) in the Appendix for more information about the pin layout of the 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 Digital IN / OUT extension Di/o from Multi Channel Systems MCS GmbH. You can utilize this digital signal to control and synchronize other devices with the SE-Wireless-System. Bit 0 to 3 of the Digital OUT are separated and available as Lemo connector DIG OUT 0 to 3 on the front panel of the interface board. So if you need only one, two, three or four bits of the digital signal, you don’t need the additional Di/o. 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. The 16 bit digital input channels is a stream of 16 bit values. The state of each bit (0 to 15) can be controlled separately. Standard TTL signals are accepted as input signals on the digital inputs.

⚠️ **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 Volt) to the digital inputs.
Analog Channels

Eight Analog IN channels are available via 10 pin connector. Please read chapter "Pin Layout" (Analog IN Connector) in the Appendix for more information. The additional analog inputs are intended for recording additional information from external devices, for example, for recording patch clamp in parallel to the recording, for monitoring the temperature, or for fluidic control. Two of these channels (No 1 and 2) are available via Lemo connectors on the rear panel of the interface board. You could also use the analog inputs for triggering, but please note that the digital inputs DIG IN 0 to 3 are intended for accepting TTL pulses. Signals on the analog channels are digitized and amplified with a gain factor of 2.

Analog Channels 1 and 2

Two of the eight analog channels described above (analog channel 1 and 2) are directly accessible via two Lemo connectors.

JTAG Connector

20 pin JTAG connector for use of the digital signal processor DSP. Not in use in SE-Wireless-Systems.

Two USB Connectors

Both USB connectors are used to transfer the amplified and digitized data from all data channels and the additional digital and analog channels to any connected data acquisition computer via USB 3.0 super speed (type A - micro B) cable.

Important: It is recommended to connect the USB cables to different USB ports of the computer. Do not use an USB hub!

Audio OUT

To the Audio Out (3.5 mm phone jack) you can connect an audio system to make the electrical activity audible. This audio output is real-time. Headphones or a speaker can be connected directly to the AUDIO OUT. Only two channels at a time can be converted into sound (Stereo). This feature is currently not implemented.

Side Panel of the "MCS-IFB-SE-W" Interface Board

Sockets for connecting up to two receivers via eSATAp cable.

Please use the connector labelled HS1 when working with one receiver only.
4 Multi Channel Suite

Operate the SE-Wireless-System with the Multi Channel Suite software from Multi Channel Systems MCS GmbH.

The Multi Channel Suite package consists of three parts: The Multi Channel Experimenter is the online data acquisition software of the Multi Channel Suite. The Multi Channel Analyzer is for offline analysis of data generated with the Multi Channel Experimenter, and the Multi Channel DataManager allows to export Multi Channel Experimenter Data to 3rd party file formats.

Updates are available for free download on a regular basis from the MCS web site. It is recommended always to install the latest software version. To install the software, download and start the respective *.exe file and follow the instructions on the screen. Please consider the system requirements, listed in the respective manuals.

For data acquisition, please read the Multi Channel Experimenter manual for detailed information of general functions of the program. Please see also the movie for illustration.

For data analysis and export, read the manuals Multi Channel Analyzer and Multi Channel DataManager.
5 Troubleshooting

Some Problems and Proposals for Solution

Problem: No neural signals are visible in the Multi Channel Experimenter software.

Suggestion: Verify the AC power connection is in place and the green “Power” LED is illuminated on the front of the RF receiver box. Also, verify that the yellow “Signal Lock” light is illuminated, which confirms that the receiver is receiving the signal transmitted from the headstage.

Problem: Visible neural signal is missing information.

Suggestion: Keep the animal within the 4 meter range of the receiver. If you exceed this range, the radio signal from the headstage will not be strong enough to maintain reliable signal monitoring of the animal. Also, be sure to keep the area under the RF receiver unit’s antennas free from metallic objects, which will reduce signal range and introduce noise.

Problem: Not all channels are visible on the neural signal.

Suggestion: Make sure the headstage connection to the animal is secure.

Potential Problems

The headstage sends signals to the receiver in 2.7 GHz, 3.05 GHz, or 3.375 GHz frequency band. That is why devices working in the same frequency band may disturb the data communication between headstage and receiver.

Important: For bandwidth reasons it is not recommended to use an USB hub to connect the SE-Wireless-System to your computer.
5.1 Technical Support

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

If you have any question or if any problem occurs that is not mentioned in this documentation, please contact your local retailer. The highly qualified stuff will be glad to help you.

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. 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 bottom side of the main unit.
- The software of Multi Channel Experimenter version you are currently using. On the "Help" menu, click "About Multi Channel Experimenter". The displayed dialog box shows the version number.
- The hardware version of the SE-Wireless-System you are currently using is displayed in the "Hardware" tab of the starting dialog.
- The operating system and service pack number on 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.

Storage of Headstages with integrated Batteries

Batteries and accumulators do not belong in normal household waste and, thus, must always disposed of within the framework of existing legislation.

Longterm Storage of the Lithium Polymer Batteries

Important: Ideally store the batteries 70 % charged in a low humidity environment at 5 to 7 °C, for example in the fridge, but not in the freezer. Please check the charging state quarterly to prevent totally self-discharge, which can destroy the batteries.
6 Technical Specifications

The SE-Wireless-System is a 5, 15, 31, 63, 127 or 256 channel wireless in vivo system with headstage, receiver, DAQ and interface board.

Warning: The SE-Wireless-Systems may only be used with the receiver from Triangle BioSystems International TBSI and the DAQ and the MCS-IFB-SE-W from Multi Channel Systems MCS and only for the specified purpose. Damage of the devices and even fatal injuries can result from improper use. Do not open the receiver or the interface 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

**Receiver from TBSI + integrated DAQ from MCS**

Please read the technical specifications of the TBSI receiver on the Triangle BioSystems web site

Dimensions (W x D x H) of the receiver + DAQ in dependence of the channel number of the headstage

- Dimensions for 128-channel headstage: 148 mm x 235 mm x 77 mm
- Dimensions for 64-channel headstage: 148 mm x 235 mm x 64 mm
- Dimensions for 32-channel headstage: 148 mm x 235 mm x 50 mm

Weight in dependence of the channel number of the headstage
- Weight for 128-channel headstage: ±1820 g
- Weight for 64-channel headstage: ±1700 g
- Weight for 32-channel headstage: ±1600 g

Power: powered via MCS-IFB-SE-W

**Interface Board MCS-IFB-SE-W from MCS**

Dimensions (W x D x H): 250 mm x 83 mm x 25 mm
- Weight: 300 g

Front Panel
- 4 Digital inputs: Lemo connector, EPL.00.250 NTN
- 4 Digital outputs: Lemo connector, EPL.00.250 NTN
- 2 Auxiliary channels (not in use): Lemo connector, EPL.00.250 NTN

Rear Panel
- 1 16 bit Digital In / Out: 68-pin MCS standard connector
- 1 8-channel Analog IN: 10-pin connector (2,54 mm grid), dual row standard IDC
- 2 Analog Inputs, Ch 1 and Ch 2: Lemo connector, EPL.00.250 NTN
- Signal input range for analog channels: ±2500 mV
- Gain for analog channels: 2
- DSP port --> Not in use in SE-Wireless-System: 20-pin JTAG connector (1.27 / 2,54 mm grid), dual row standard IDC
- 2 USB 3.0 micro ports: USB 3.0 super speed cable (Type A - Micro B)
- Power Supply: MPU 30, scope of delivery, PWR DC 0.65 x 2.75 mm
- Ground --> Not in use in SE-Wireless-System: Common jack 4 mm, banana plug
- 1 Audio Output --> Not implemented currently: Stereo jack 3.5 mm
- Side Panel: 2 Interface board to headstage: eSATAp, powered eSATA cable
**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 ® 10, 8.1 or Windows 7 with NTFS, English and German version supported

Multi Channel Suite package:

- Multi Channel Experimenter  
  Version 2.11.3 and higher
- Multi Channel Analyzer  
  Version 2.11.3 and higher
- Multi Channel DataManager  
  Version 1.10.5 and higher
6.1 Pin Layout of the MCS-IFB-SE-W Interface Board

6.1.1 MCS-IFB-SE-W Interface Board: 10-Pin Connector (Analog IN)

Analog IN Connector

<table>
<thead>
<tr>
<th>Pin Number</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Analog Channel Number</td>
<td>GND</td>
<td>GND</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td>8</td>
</tr>
</tbody>
</table>

MEA2100 Interface Board: Lemo Connectors for Analog IN

Analog IN 1 and 2, available via Lemo Connectors

<table>
<thead>
<tr>
<th>Analog IN 1</th>
<th>Channel 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Analog IN 2</td>
<td>Channel 2</td>
</tr>
</tbody>
</table>

The gain factor for amplification of all analog channels is 2.
6.1.2 MCS-IFB-SE-W Interface Board: Digital IN / OUT Connector

Digital IN / OUT Connector (68-Pin MCS Standard Connector)

Pin 1    GND
Pin 2    GND
Pin 3 - 10 Digital output channels bit 0 - 7
Pin 11 - 14 GND
Pin 15 - 22 Digital output channels bit 8 - 15
Pin 23 - 26 GND
Pin 27 - 34 Digital input channels bit 0 - 7
Pin 35 - 38 GND
Pin 39 - 46 Digital input channels bit 8 - 15
Pin 47 - 48 GND
Pin 49 - 63 Do not connect
Pin 64 - 66 GND
Pin 67    Positive supply voltage (+ 3.3 V supply voltage)
Pin 68    GND

Digital IN / OUT, separate available via Lemo Connectors

Separate Digital IN Lemo Connectors
Digital IN 1  Bit 0 of the 16 bit digital input channels (Pin 27)
Digital IN 2  Bit 1 of the 16 bit digital input channels (Pin 28)
Digital IN 3  Bit 2 of the 16 bit digital input channels (Pin 29)
Digital IN 4  Bit 3 of the 16 bit digital input channels (Pin 30)

Separate Digital OUT Lemo Connectors
Digital OUT 1  Bit 0 of the 16 bit digital output channels (Pin 3)
Digital OUT 2  Bit 1 of the 16 bit digital output channels (Pin 4)
Digital OUT 3  Bit 2 of the 16 bit digital output channels (Pin 5)
Digital OUT 4  Bit 3 of the 16 bit digital output channels (Pin 6)
7 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.

Newsletter

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 MCS web site.

www.multichannelsystems.com