

eego™ amplifier EE-41x and EE-43x

User Manual



eego amplifier EE-410, EE-411, EE-430 / version 1.0

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IMPORTANT NOTICES

Following the European Medical Device Directive 93/42/EEC Annex IX, **eego amplifier** is a CE class IIa medical device.



This User Manual only covers the EE-410, EE-411, and EE-430 variants of the eego amplifier. Refer to dedicated User Manual for other variants.

For US customers only:

Rx only

Caution: Federal Law (USA) restricts this device to sale by or on the order of a physician.

DISCLAIMER

We have attempted to write this document as accurately as possible. However, mistakes are bound to occur, and we reserve the right to make changes to the products, which may render parts of this document invalid.

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TABLE OF CONTENTS

1	General Information	4
1.1	About this Document	4
1.2	Intended Use	4
1.3	Technical Data and Features Overview	4
1.4	Safety Warnings	5
1.4.1	Important information	5
1.4.2	Safety measures	5
1.4.3	Precautionary measures	6
1.4.4	Warnings	6
1.5	Maintenance and Cleaning	7
1.6	Disposing of Waste Equipment	7
1.7	Product Variants	8
1.8	PC Requirements	8
1.9	Contact Information	8
2	The eego amplifier EE-430, Hardware SETUP description	9
2.1	The eego amplifier EE-430	9
2.2	Biosignal and Impedance Measurements	13
2.3	Recording Trigger Input	14
2.4	Mounting Options for the eego amplifier	14
2.5	LED Status Indicator LIGHTS for the eego amplifier EE-430	15
	APPENDIX A: CONNECTORS AND PINNING TABLES	16
	EEG Connector	16
	Trigger Connectors	17
	Power and Data transmission via USB Connector	17
	APPENDIX B: AMPLIFIER TECHNICAL SPECIFICATIONS (EMC)	18
	APPENDIX C: EXPLANATION OF SYMBOLS	19
	APPENDIX D: Datasheet	20

1 GENERAL INFORMATION

1.1 ABOUT THIS DOCUMENT

With this document, we provide you with all information required to set up and start working with the **eego** amplifier.

If you encounter problems with the device that cannot be resolved using this document please contact us directly via **support@eemagine.com** for further help (please make sure to state the product ID and serial number of your amplifier in the Subject section of your email).

We will coordinate communication with your dealer in case you purchased the device locally.

1.2 INTENDED USE

The **eego** amplifier is intended to be used by or under the direction of a physician for acquisition of EEG signals and to transmit them digitally to a computer.

The device is intended for use on humans.

The device is intended for use in a clinical environment (e.g., hospital, physician's office, etc).

The device is not intended for use in life support systems.

1.3 TECHNICAL DATA AND FEATURES OVERVIEW

The eego amplifier has been designed as a mobile recording device for EEG signals.

It provides access to recorded data over a USB connection to external software over its signal driver interface. The eego amplifier EE-4xx is powered via the USB connection and does not require any additional power source.

This ultimate solution for mobile EEG recording provides 8 channels of referential EEG. The eego amplifier is best used in combination with the eego software for recording or any other CE class IIa software compliant with the eego amplifier and a waveguard EEG headcap (CA-411). The eego amplifier has two 1bit trigger input channels accessible through two micro coax connectors. Impedance values can be measured for all referential electrodes as well as the reference and patient ground electrode. An SDK is available for direct amplifier communication.

The implemented active shielding technology protects the EEG inputs from interference noise. Sampling rate and gain can be set through the user interface of the control software.

Detailed technical specifications, environmental conditions, the available product variants and PC requirements are given in the APPENDIX D: Datasheet for **eego** amplifier.

1.4 SAFETY WARNINGS

The following warnings and cautions apply to the **eego** amplifier:



- Proper use of the **eego** amplifier depends on careful reading of all instructions and labels that come with or on the device inaccurate measurements may be caused by incorrect use of the device.
- Non-compliance with warnings and safety regulations may result in severe personal injury!

If you are uncertain or have any questions about operational safety or about any of the warnings and cautions, then do not hesitate to call or email:

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Phone: +49 30 29048404
E-Mail: support@eemagine.com
<http://www.eemagine.com>

For warnings and safety regulations concerning **waveguard** EEG caps, please refer to the corresponding manual.

1.4.1 IMPORTANT INFORMATION

- There are no known side effects from the use of this equipment.
- **ONLY APPLICABLE TO THE USA:** Under federal law this apparatus may only be sold by or on the order of a physician or licensed practitioner. The apparatus may only be used under the constant supervision of or on the instructions of a physician or other authorized medical professional.

1.4.2 SAFETY MEASURES

- The only external power supply that may be used in combination with the amplifier is a computer device in compliance with the specifications as in APPENDIX D: Datasheet.
- Make sure to use the device only with ISO 60950 or 60601-1 compatible devices for powering and trigger connection.
- Inspect the power cord of connected computers on a regular basis for damages. Do not operate the device with a damaged power cord.
- Do not connect active sensors or electrodes to any of the inputs of the amplifier.
- Do not use the device with adapters, EEG caps or other devices not explicitly listed to be compatible with the device.
- Take care when arranging sensor cables to avoid risks of entanglement or strangulation.
- Reusable electrodes present a potential risk of cross-contamination. Please refer to the documentation that came with your electrodes for instructions on how to prevent this.
- Do not connect the device to a patient undergoing MRI, electro-surgery or defibrillation.
- Do not modify the equipment. Never attempt to unscrew any parts of the amplifier.



- ELECTRICAL SHOCK HAZARD: Do not connect electrode inputs to earth ground. Connecting an earth ground might result in electrocution.
- Conductive parts of ELECTRODES and associated connectors for APPLIED PARTS, including the NEUTRAL/GROUND/REFERENCE ELECTRODE, should not contact other conductive parts including earth.
- ELECTRICAL SHOCK HAZARD: Servicing of the equipment is to be done by approved technicians only.



1.4.3 PRECAUTIONARY MEASURES

- When the amplifier is not in use, please make sure to switch it off (disconnect USB cable).
- The amplifier needs special precautions regarding EMC and needs to be installed and put into service according to the EMC information provided in APPENDIX B: AMPLIFIER TECHNICAL SPECIFICATIONS (EMC); the use of accessories other than specified may result in increased emissions or decreased immunity of the **eego** amplifier EE-4xx and result in improper operation.
- The **eego** amplifier should not be used adjacent to or stacked with other equipment; if this is still necessary, verify normal operation in the configuration in which it will be used. Do also not stack multiple **eego** amplifiers directly on top of each other. Allow for some spacing of several cm in between.
- The use of portable and mobile RF communications equipment can adversely affect the recording; do not use an operating cellular phone within 30 cm (12 inches) of the amplifier, the cables and the electrodes to avoid excessive noise on the signals. See also APPENDIX B: AMPLIFIER TECHNICAL SPECIFICATIONS (EMC).
- During EMC testing the essential performance was monitored based on the input noise voltage (peak to peak) under short circuit load condition and the accuracy of signal reproduction of a 6Hz triangular signal with 1mV_{pp} and DC offset of 300mV applied to all input terminals. The pass/fail criteria were a noise voltage level below 6μV_{pp} (50Hz low pass filtered) and correctness of the waveform within +/-20%.
- There is no special servicing procedure required to guarantee EMC over the lifetime of the device.
- Disposable electrodes which are used for electrophysiological measurements may pose a biohazard. Handle, and when applicable, dispose of these materials in accordance with accepted medical practice and any applicable local, state and federal laws and regulations.



1.4.4 WARNINGS

- Safety and performance of the device are not guaranteed when it is used together with accessories that were not explicitly listed as compatible.
- The device is not defibrillator-proof.
- The device is not suitable for use in an inflammable mixture of anesthetics and air, oxygen or nitrous oxide.
- No chemical agents are to be used with the device. Also not for cleaning purposes.
- The device is not to be immersed in any liquid. Liquids must also not spill on it. Cleaning must be done with a dry cloth.



- If any liquids or moisture penetrate the device or a part thereof, turn the device off, remove the plug from the wall socket and have the device checked by the manufacturer.
- Do not expose the device to direct sunlight, heat from a source of thermal radiation, excessive amount of dust, moisture, vibration, or mechanical shock.
- Do not wind the cables in a loop smaller than 5 cm or bend them sharply, as this may damage the cables.
- During operation with an active connection via USB to a compatible computer, do not connect other USB devices, and do not make changes to any connections.
- If the **eego** amplifier is upgraded or replaced for any reason, make sure to have the control software and interfacing computer checked for compliance by eemagine support before continuing to work with the device. Similarly have the **eego** amplifier checked for compliance when the control software or computer is upgraded or replaced.
- During operation place the device in such a way that connectors and cables are easily accessible.
- Do not use sharp objects such as pencil-points or pen-tips to manipulate the buttons on the control panel, as this may cause damage.
- Do not apply high pressure on the housing and contact the manufacturer when it appears deformed in any way.
- Do not use the device whenever parts of it are damaged.

1.5 MAINTENANCE AND CLEANING

We would like to give a few general recommendations that may help to keep your equipment in good shape and ensure high quality of recordings.

The amplifier is mechanically robust – within limits. Try to protect the device as much as possible from falling and heavy mechanical shocks. Please take special care that the USB cable and the connectors on either side are not under mechanical stress. A broken USB connection may lead to expensive and time-consuming repair of the amplifier.

The EEG head-cap may be attached to the amplifier with the available screws on the connector in case of expected movement of the patient/subject. The screws do not need to be extremely tight but just hold the connectors in place, so please tighten the screws gently.

The expected lifetime of the device is 5 years.

There is no need for periodic testing of the device and accessories during the lifetime. After this, we recommend to test every year.



WARNING: If the amplifier requires cleaning, please use a dry cloth to remove dirt (e.g. gel remainders). Do not use alcohol or cleaning chemicals.

1.6 DISPOSING OF WASTE EQUIPMENT

The **eego** amplifier device bear the symbol for special waste disposal regulations (EU). The symbol means that the products must not be disposed of with regular waste. Instead, it is the user's responsibility to dispose of waste equipment by handing it over to a designated collection point for the recycling of waste electrical



and electronic equipment. The separate collection and recycling of your waste equipment at the time of disposal will help to conserve natural resources and ensure that it is recycled in a manner that protects human health and the environment. For more information about where you can drop off your waste equipment for recycling, please contact your local city office, your household waste disposal service, or the manufacturer.

1.7 PRODUCT VARIANTS

See the APPENDIX D: Datasheet.

1.8 PC REQUIREMENTS

See the APPENDIX D: Datasheet.

1.9 CONTACT INFORMATION

For more information and for reporting problems with **eego** amplifier, please contact eemagine at:

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Gubener Str. 47

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E-Mail: support@eemagine.com

<http://www.eemagine.com/>

2 THE EEGO AMPLIFIER EE-4XX, HARDWARE SETUP DESCRIPTION

2.1 THE EEGO AMPLIFIER EE-430

The **eego** amplifier device has been designed for mobile applications recording EEG and related electrophysiological signals. The compact electronic device is USB-powered and gives access to 8 referential input channels via a 50 pin high density connector (EEG IN) as shown in Figure 2-1. The **waveguard** cap CA-411 is designed for connecting directly with this input port (Figure 2-5). For the eego amplifier EE-410 variant the channels are preconfigured for bipolar inputs, for use with the XE-292 .. XE-296 adapters, to substitute a cap connection with pairs of electrodes for bipolar recording.

The connection of the amplifier the EEG cap and a computer is shown in Figure 2-7.

WARNING: Make sure to use the USB cable delivered with the device.



At the rear (Figure 2-2) a USB 3 micro connector powers the device and provides access to data communication, hardware control.

Trigger input signals can be acquired from devices that deliver TTL output. The two micro-coax connectors on the front side next to EEG IN connector, provide 2 independent single bit trigger input lines (TR IN 1, TR IN 2).

The trigger lines are electrically isolated from the patient leads of the amplifier. The trigger adapter XS-432 allows to connect the **eego** amplifier trigger input ports via a DB25 connector. The adapter connects to both ports. For details refer to the dedicated datasheet.



Figure 2-1. The eego amplifier EE-430 shown from the front. A high-density 50 pin connector (EEG IN) provides access to 8 shielded input channels, reference and ground. TTL trigger signals can be Trigger input ports “TR IN 1” and “TR IN 2”. Four mechanical through holes in the amplifier housing allow securing the amplifier, e.g. on a table.



Figure 2-2. The eego amplifier EE-430 shown from the rear. The USB3 micro connector provides access to control the hardware and to stream data. It also powers the device.



Figure 2-3. The LED status indicator light bars are both showing the status of the eego amplifier EE-430.

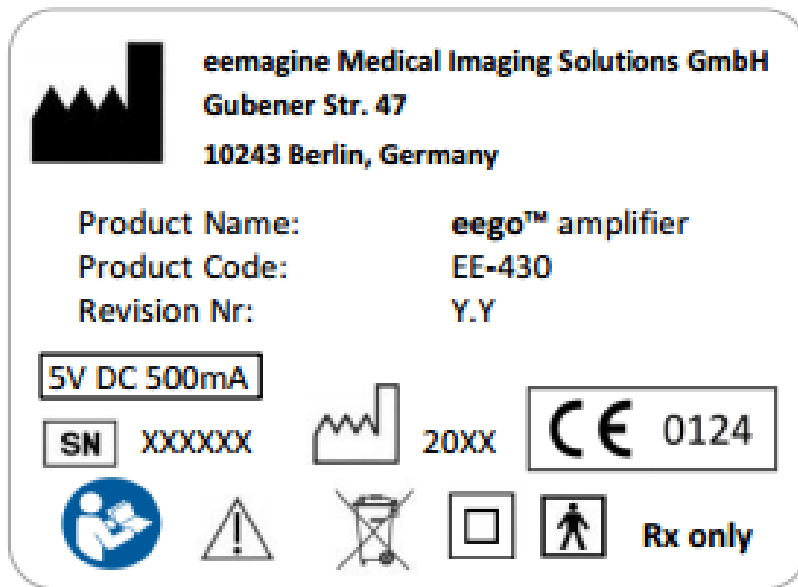


Figure 2-4. The product label at the bottom of the amplifier device shows manufacturer information, product name, code and revision, and serial number, year of production and CE marking. The symbols in the bottom row points are explained in Appendix C.



Figure 2-5. Compatible waveguard cap CA-411, 8 electrodes, with REF and GND (medium size shown). The white labels on the cable indicate product code, (and on other side of label) manufacturer information and serial number.



Figure 2-6: XS-432 trigger port adapter (connects to TR IN 1 and TR IN 2). Refer to dedicated datasheet for XS-432 for pinning information.

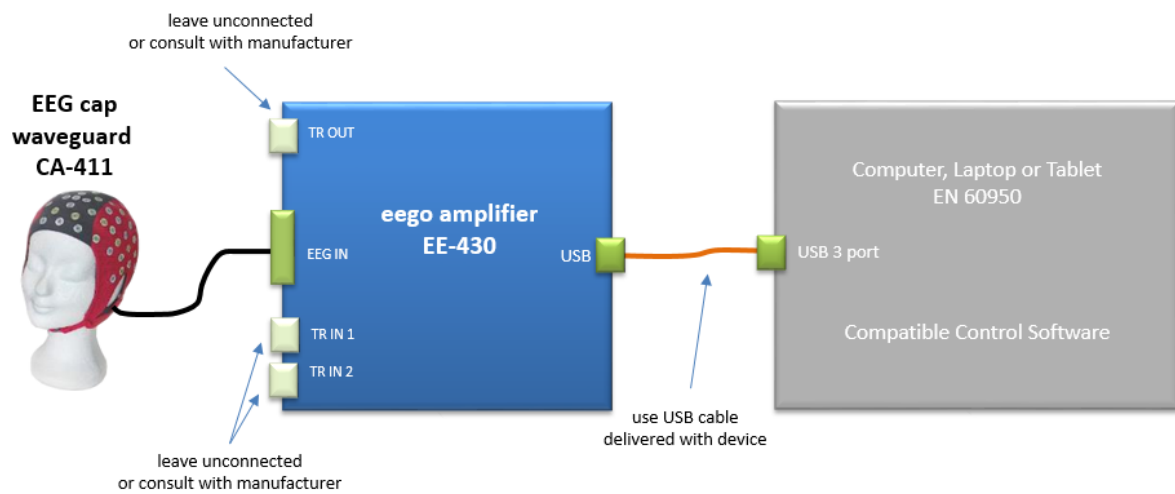


Figure 2-7: Connection diagram.

2.2 BIOSIGNAL AND IMPEDANCE MEASUREMENTS

Measurements of physiological parameters such as EEG require highest quality and fidelity of the electronic equipment and sensors used with it. The **eego** amplifier EE-4xx has been developed on the basis of latest state of the art core electronic components (integrated circuits). The modern chip-set allowed miniaturizing hardware without compromises in signal quality and keeping the power consumption low. The device weights less than 100 grams and has a small form factor.

The input stage of the 8 referential input channels to the amplifier has been optimized for EEG recordings with a **waveguard** head caps. The preamplifier component implements active shielding, which greatly suppresses external noise effects that typically contaminate EEG signals. Active shielding works such that the buffered input signal (no amplification of signal amplitude but impedance transformation) is put on the coaxial shield of an electrode lead inside the **waveguard** cap. This way, electrical transmission of external noise through the coaxial shield into the signal wire is minimized due to the zero voltage difference between the signal wire and it's shield.

The input stage of the amplifier registers incoming signals against a common dedicated reference electrode. The measured voltages strongly depend upon the quality of the reference signal and it is highly recommended to pay attention to good preparation of the reference electrode. For the **waveguard** cap model CA-411 the electrode M1 (left Mastoid) is defined as the REF electrode.

In order to measure physiological signals with high sensitivity, the human body acting as a source of voltage differences and the amplifier ground (the electrical zero-point from which the operating range is determined) have to be connected. This can be - for convenience - an electrode lead in the **waveguard** cap: the model CA-411 defines M2 (right Mastoid) to be the ground (GND) position. Nonetheless, any other accessible body part can be used to make the GND connection – with no effect on the measured signal amplitudes. See also the cap datasheet and its user guide for more information.

The GND connection actually implements a driven ground, that provides a reference for the measured voltages relative to the human body. Electrical currents are kept well below limits defined for patient safety in medical devices. The driven ground allows measuring signal amplitudes of the voltage of the driven ground without saturation effects, regardless of the polarity of the signal. The actual signal range is determined by the amplification factor of the input stage, which is programmable in steps.

With the **eego** amplifier you can also record bipolar signals. In this case the REF channel is not used but each of the 8 channels is measuring the difference between its positive and negative input port.

Regardless of referential or bipolar recordings the amplified data stream of input signals is converted from analog (continuous in amplitude and time) to digital (discrete in amplitude and time). Both dimensions – voltage and time – are digitized in a way that the analog waveforms can be approximated without loss of quality in further review and analysis steps. The resolution is in the order of a few nV (nano Volts) depending on the selected signal. Each signal has its own converter, so that no multiplexing effects occur.

The digital data stream is converted into a protocol suitable for computer communication (USB). Communication between computer and amplifier works in two ways: control commands sent by the

application software set the amplifier state and parameters (e.g. sampling rate and signal range), and the amplifier sends EEG data, trigger and status information according to the respective operation mode.

The application software sets up communication via the USB interface and provides the user interface to display and record the EEG waveforms.

The amplifier is simply switched on and off by connecting or disconnecting it from a USB 2 port of a compatible computer (refer to Appendix D for compatibility reference).

2.3 RECORDING TRIGGER INPUT

In case you want to record event-related activity, you must have a trigger generating device available (maximum 5V), that is able to deliver TTL trigger pulses to a DB25 connector with the pinning defined in the datasheet for the XS-432 adapter.

WARNING: The trigger generating device must be IEC 60950 compatible. Do not connect any other devices to TR IN1 or TR IN2 and always use the adapter XS-432. The same holds for the trigger output port (TR OUT). TR OUT has no function in the current version of the amplifier. Leave it unconnected.



WARNING: To run an ERP experiment, please insert the trigger adapter XS-432 into the micro coax trigger input of the amplifier (TR IN 1 or TR IN 2). The adapter is then connected to the DB25 port of the trigger generating device. The adapter connects to both TR IN ports and carries the identifiers “1” and “2” on the top. Make sure the “1” is mating with TR IN 1 and the “2” with TR IN 2.



Refer also to the XS-432 Datasheet for more information.

The 2-bit trigger information is encoded in a decimal trigger code (from 1 to 3) in the recording software.

Please be aware that only rising flanks are detected as triggers and as high trigger bits! A trigger pulse should have a length of at least 2-3 times the reciprocal of the sampling rate. In between triggers the Low level must also be hold for 2-3 times the reciprocal of the sampling rate.

2.4 MOUNTING OPTIONS FOR THE EEGO AMPLIFIER

The **eego** amplifier EE-4xx can be used as a stationary device or as a mobile device.

When using **eego** amplifier as a stationary device, please make absolutely sure that the amplifier cannot drop from the table, e.g. when the patient is connected with the cap and tries to walk away or when the USB cable is dragged over the table sides. You can for example put a string through the mounting holes to fixate the amplifier housing.

WARNING: Do not touch the device for longer periods but only when moving it during setup or after operation. Do not press the device for longer time periods against the skin of the Subject or the Operator. Keep contact duration to skin below 10s.



2.5 LED STATUS INDICATOR LIGHTS FOR THE EEGO AMPLIFIER EE-4XX

The LED lights at the side edges of the eego amplifier EE-4xx (refer to Figure 2-3) indicate power and data status as well as possible hardware problems. The two multi-color LED indicators at each side operate symmetrically (identical signaling).

The LED indicators can have the following states:

LED color	Visual indication	Status description
OFF	-	Amplifier is switched OFF and is not powered
Green	Breathing*	Amplifier is ON (powered via USB), no data is acquired
Green	Blinking	Data is acquired (streamed)
Blue	Blinking	Impedance data is acquired
Red	Constant or Blinking	Device error, restart device, contact support

Table 2-1 Status indicated by the LEDs. (* brightness of the LEDs is oscillating slowly)

The LED indicators are not active when the amplifier is turned off and receives no power via USB.

APPENDIX A: CONNECTORS AND PINNING TABLES

EEG CONNECTOR

The eego amplifier EE-4xx has one EEG input connector labeled “EEG IN”. The 50-pin high-density, high-quality connector give access to the 8 shielded referential inputs (EE-411, EE-430) or bipolar inputs (EE-410), the reference electrode and the patient ground. The table below provides the mapping between connector pins, channel numbers and electrode labels when combined with a CA-411 waveguard cap.

eego amplifier EE-4xx EEG IN connector			
Channel Number	Electrode CA-411	Pin numbers, 50-pin high-density connector	
		Signal	Shield (for 26-42)
1 (POS)	Fz	01	26
1 (NEG)	-	02	27
2 (POS)	Cz	03	28
2 (NEG)	-	04	29
3 (POS)	Pz	05	30
3 (NEG)	-	06	31
4 (POS)	F3	07	32
4 (NEG)	-	08	33
5 (POS)	F4	09	34
5 (NEG)	-	10	35
6 (POS)	Fpz	11	36
6 (NEG)	-	12	37
7 (POS)	C3	13	38
7 (NEG)	-	14	39
8 (POS)	C4	15	40
8 (NEG)	-	16	41
REF	M1	17	42
reserved*	not connected	18	43
GND	M2	19	44
reserved*	not connected	20	45
reserved*	not connected	21	46
reserved*	not connected	22	47
reserved*	not connected	23	48
reserved*	not connected	24	49
reserved*	not connected	25	50

*terminal must remain open, do not connect!

TRIGGER CONNECTORS

The eego amplifier EE-4xx has two micro coax trigger input ports (Figure 2-1):

TR IN 1: inner conductor is the positive TTL input terminal, outer conductor is trigger ground. The maximum input voltage is 5V. Do not exceed this voltage level.

TR IN 2: inner conductor is the positive TTL input terminal, outer conductor is trigger ground. The maximum input voltage is 5V. Do not exceed this voltage level.

TR IN 1 corresponds to the least significant trigger bit. TR IN 2 refers to the second trigger bit.

The third trigger port “TR OUT” is reserved and must remain open. Do not connect to it.

POWER AND DATA TRANSMISSION VIA USB CONNECTOR

The micro USB 3 connector of the eego amplifier must be connected with a USB 2.0 compatible port of a compatible computer (refer to APPENDIX D: Datasheet).

Do not attach the eego amplifier USB interface to other devices.

Use only the USB cable provided with the eego amplifier for connecting to the computer. Please inspect the settings for the USB ports available at your computer, and make sure ‘power saving’ options are turned off for the USB ports.

APPENDIX B: AMPLIFIER TECHNICAL SPECIFICATIONS (EMC)










The compliance in the tables below is valid for *eego amplifier EE-430 (EE-41x equivalent)* with following accessories:

Part	Cable length (m)
USB cable	1.0
XS-432 trigger adapter cable MCX to BNC	0.2
CA-411 waveguard caps	1.2

Guidance and manufacturer's declaration – electromagnetic emissions		
<i>The eego amplifier EE-430 is intended for use in the electromagnetic environment specified below. The customer and/or user of the eego amplifier EE-430 should ensure that it is used in such an environment.</i>		
Emission Test Compliance	Compliance	Electromagnetic Environment - guidance
RF Emissions CISPR 11	Group 1	The <i>eego amplifier EE-430</i> uses RF energy only for its internal function. Therefore, its RF emissions are very low and are not likely to cause any interference in nearby electronic equipment. The <i>eego amplifier EE-430</i> is suitable for use in all establishments, including domestic and those directly connected to the public low-voltage power supply network that supplies buildings used for domestic purposes.
RF Emissions CISPR 11	Class B	
Harmonic Emissions IEC 61000-3-2	DC powered, Not applicable	
Voltage Fluctuations/ Flicker Emissions IEC 61000-3-3	DC powered, Not applicable	

Guidance and manufacturer’s declaration – electromagnetic immunity			
The eego amplifier EE-430 has been tested as compliant according to standards as indicated below.			
Immunity Test Standard	Compliance test level		Electromagnetic Environment - guidance
Electrostatic discharge (ESD) IEC 61000-4-2	± 2,4,8,15 kV air ± 8 kV contact		Floors should be wood, concrete, or ceramic tile. If floors are covered with synthetic material, the relative humidity should be at least 30 %.
Electrical fast transients IEC 61000-4-4	Not applicable		
Surge IEC 61000-4-5	Not applicable		
Voltage dips, short interruptions and voltage variations on power supply input lines IEC 61000-4-11	Not applicable		
Power frequency (50/60 Hz) magnetic field IEC 61000-4-8	Not applicable		
Conducted RF IEC 61000-4-6	Not applicable		
Radiated RF electromagnetic fields IEC 61000-4-3	3 V/m 80 MHz to 2.5 GHz		
Radiated RF electromagnetic disturbances IEC 61000-4-3	Band (MHz)	Immunity Level (V/m)	
	380-390	27	
	430-470	28	
	704-787	9	
	800-960	28	
	1700-1990	28	
	2400-2570	28	
	5100-5800	9	
The use of portable and mobile RF communications equipment can adversely affect the recording; do not use an operating cellular phone within 30 cm (12 inches) of the amplifier, the cables and the electrodes to avoid excessive noise on the signals.			

APPENDIX C: EXPLANATION OF SYMBOLS

	Manufacturer symbol: indicated with name, address
	Serial number
	Year of manufacture
	Conformité Européenne, CE mark, with number of Notified Body involved in the conformity assessment
	Follow the instructions for use (i.e., this user manual)
	Warning sign: warnings apply
	Special waste disposal regulations apply (EU)
	Safety according to class II electrical equipment (IEC 60601-1)
	Applied parts: type BF (IEC 60601-1)
Rx only	Caution: Federal Law (USA) restricts this device to sale by or on the order of a physician.

APPENDIX D: DATASHEET



Manufacturer: eemagine Medical Imaging Solutions GmbH
Gubener Straße 47
10243 Berlin
Germany

Product Name: eego amplifier

Product Code: EE-410, EE-411, EE-430 / version 1.0

Classification: CE class IIa according to the MDD 93/42/EEC Annex IX

Description: The **eego** amplifier has been designed as a mobile recording device for EEG signals.

It provides access to recorded data over a USB connection to external software over its signal driver interface. The **eego** amplifier EE-4xx is powered via the USB connection and does not require any additional power source.

This ultimate solution for mobile EEG recording provides 8 channels of referential or bipolar EEG. The **eego** amplifier is best used in combination with the **eego** software for recording or any other CE class IIa software compliant with the **eego** amplifier and a **waveguard** EEG headcap (CA-411). The **eego** amplifier has two 1bit trigger input channels accessible through two micro coax connectors. Impedance values can be measured for all referential electrodes as well as the reference and patient ground electrode. An SDK is available for direct amplifier communication.

The implemented active shielding technology protects the EEG inputs from interference noise. Sampling rate and gain can be set through the user interface of the control software.

Product variants covered:

Product code	Description
EE-410	eego amplifier, 8ch bipolar, 2048 Hz
EE-411	eego amplifier, 8ch referential, 2048 Hz
EE-430	eego amplifier, 8ch referential, 512 Hz

Specifications:

Dimensions (width * depth * height)	86 * 100 * 16 mm
Weight	<100 g
Resolution and input stage	24 bit, true DC input for all channels, one A/D converter per channel
Number of referential or bipolar channels	8 actively shielded inputs. Separate reference and patient ground
Input noise (referential)	< 1.0 μVRMS (lowest sampling rate and signal range)
Input impedance (referential)	>1 G Ω
Input signal range (referential)	150 – 1000 mV _{PP} (programmable gain)
Common-mode rejection ratio (referential)	>100 dB
Maximum sampling rate (depends on amplifier type)	512 Hz (512 Hz and 500 Hz), 2048 Hz (2048 Hz and 2000 Hz)
Trigger input	2 bit TTL, electrically separated from amplifier
USB output interface	USB, electrically separated from amplifier
Operating temperature	10°C to 40°C
Storage temperature	10°C to 40°C
Transport temperature	0°C to 50°C
Humidity	15% to 93%
IP class	The enclosure protection class is IP20 according EN 60529 (IP20: protection against fingers or objects < 12mm)
Atmospheric pressure	70 kPa to 106 kPa
OS requirements	MS Windows 7, 8.1, or 10 (32bit, 64bit) Debian 8.x with g++ 4.9 compiler (32bit & 64bit OS and applications) 2GB RAM working memory USB 2.0 connection for amplifier Control software must be compatible and designed for eego amplifier
PC Compliance	EN 60950, EMC Directive 2014/30/EU, the Low Voltage Directive 2014/35/EU, the RoHS Directive 2011/65/EU, the Ecodesign Directive 2009/125/EC, and the Radio Equipment Directive 2014/53/EU where applicable

Warning:

Proper use of the **eego** amplifier depends on careful reading of all instructions and labels that come with or are present on the device. Incorrect use of the device may cause inaccurate measurements. Non-compliance with warnings and safety regulations may result in severe personal injury and total loss of equipment.

Disclaimer: We have attempted to write this document as accurately as possible. However, mistakes are bound to occur, and we reserve the right to make changes to the products, which may render parts of this document invalid. No part of this document may be copied or reproduced without the explicit permission of the authors.