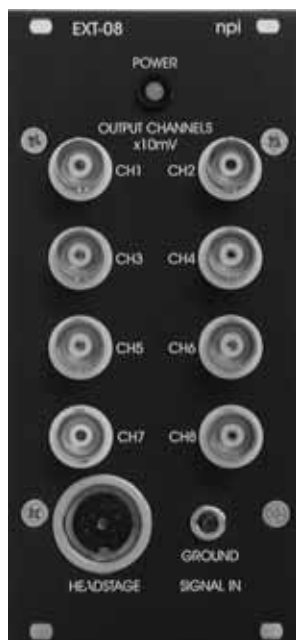


OPERATING INSTRUCTIONS AND SYSTEM DESCRIPTION FOR THE

EXT-08

EIGHT CHANNEL EXTRACELLULAR AMPLIFIER MODULE FOR EPMS SYSTEMS



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1. Safety Regulations

VERY IMPORTANT: Instruments and components supplied by npí electronic are NOT intended for clinical use or medical purposes (e.g. for diagnosis or treatment of humans), or for any other life-supporting system. npí electronic disclaims any warranties for such purpose. Equipment supplied by npí electronic must be operated only by selected, trained and adequately instructed personnel. For details please consult the GENERAL TERMS OF DELIVERY AND CONDITIONS OF BUSINESS of npí electronic, D-71732 Tamm, Germany.

- 1) **GENERAL:** This system is designed for use in scientific laboratories and must be operated by trained staff only. General safety regulations for operating electrical devices should be followed.
- 2) **AC MAINS CONNECTION:** While working with the npí systems, always adhere to the appropriate safety measures for handling electronic devices. Before using any device please read manuals and instructions carefully.
The device is to be operated only at 115/230 Volt 60/50 Hz AC. Please check for appropriate line voltage before connecting any system to mains.
Always use a three-wire line cord and a mains power-plug with a protection contact connected to ground (protective earth).
Before opening the cabinet, unplug the instrument.
Unplug the instrument when replacing the fuse or changing line voltage. Replace fuse only with an appropriate specified type.
- 3) **STATIC ELECTRICITY:** Electronic equipment is sensitive to static discharges. Some devices such as sensor inputs are equipped with very sensitive FET amplifiers, which can be damaged by electrostatic charge and must therefore be handled with care. Electrostatic discharge can be avoided by touching a grounded metal surface when changing or adjusting sensors. **Always turn power off when adding or removing modules, connecting or disconnecting sensors, headstages or other components from the instrument or 19" cabinet.**
- 4) **TEMPERATURE DRIFT / WARM-UP TIME:** All analog electronic systems are sensitive to temperature changes. Therefore, all electronic instruments containing analog circuits should be used only in a warmed-up condition (i.e. after internal temperature has reached steady-state values). In most cases a warm-up period of 20-30 minutes is sufficient.
- 5) **HANDLING:** Please protect the device from moisture, heat, radiation and corrosive chemicals.

2. EPMS-07 Modular Plug-In System

2.1. Components of the EPMS-07 Housing

The following items are shipped with the EPMS-07 housing:

- ✓ EPMS-07 cabinet
- ✓ Power cord
- ✓ Fuse 2 A / 1 A, slow
- ✓ Front covers

2.2. General System Description / Operation

The npf – EPMS-07 is a modular system for processing of bioelectrical signals in electrophysiology (see Figure 1). The system is housed in a 19” rackmount cabinet (3U) containing a power supply and has room for up to 7 plug-in units. The plug-in units are connected to power by a bus at the rear panel.

The plug-in units must be kept in position by four screws (M 2,5 x 10). The screws are important not only for mechanical stability but also for proper electrical connection to the system housing.

In order to avoid induction of electromagnetic noise the power supply unit, the power-switch and the fuse are located at the rear of the housing.



Figure 1: Example of a measurement system located in an EPMS housing with two channel iontophoresis and balance module (MVCS-02, MVCC-02), bridge amplifier module (BRAMP-01R) and an extracellular amplifier module (EXT-01C)

2.3. System Grounding

The 19" cabinet is grounded by the power cable through the ground pin of the mains connector (= protective earth). In order to avoid ground loops the internal ground is isolated from the protective earth. The internal ground is used on the BNC connectors or GROUND plugs of the modules that are inserted into the EPMS-07 housing. The internal ground and mains ground (= protective earth) can be connected by a wire using the ground plugs on the rear panel of the instrument. It is not possible to predict whether measurements will be less or more noisy with the internal ground and mains ground connected. We recommend that you try both arrangements to determine the best configuration.

2.4. Technical Data

- 19" rackmount cabinet, 3U high (1U=1 3/4" = 44.45 mm), for up to 7 plug-in units
- Power supply: 115/230 Volt AC, 60/50 Hz, fuse 2 A / 1 A slow, 45-60 W

3. EXT-08

3.1. EXT-08 Components

The following items are shipped with the EXT-08 system:

- ✓ Amplifier module for the EPMS-07 system
- ✓ Headstage with cables
- ✓ User manual

3.2. General Description

The EXT-08 system is designed for performing low noise recordings of small extracellular signals in slices or *in vivo* preparations using fine tipped glass or metal microelectrodes. The system consists of a module for the EPMS-07 system and a small headstage.

The system has eight channels with differential inputs to suppress noise interference. Outputs are lowpass-filtered (corner frequency: 8 kHz) and have an amplification of x10 DC. The outputs can be connected directly to an oscilloscope or data acquisition system or to other preamplifier / filter units for further processing. The outputs can also be linked internally via the EPMS-07 bus to preamplifier / filter units and finally to the breakout box INT-20M for connection of a data acquisition system with only one cable.

The electrodes are connected via standard 1 mm banana jacks ("plus" [red] input of the eight differential amplifiers). In differential mode the signal of each channel is measured as the difference between the potential at the "plus" input and the potential at the "minus" [black] input.

In the other modes the reference pins of each channel ("minus" [black] input) are connected. This signal is linked either to a plug marked REF or to ground (GND) by a toggle switch located on the top of the headstage.

The channels can be operated independently from each other, e.g. one channel in differential and the others in unipolar mode.

3.3. Description of the Front Panel

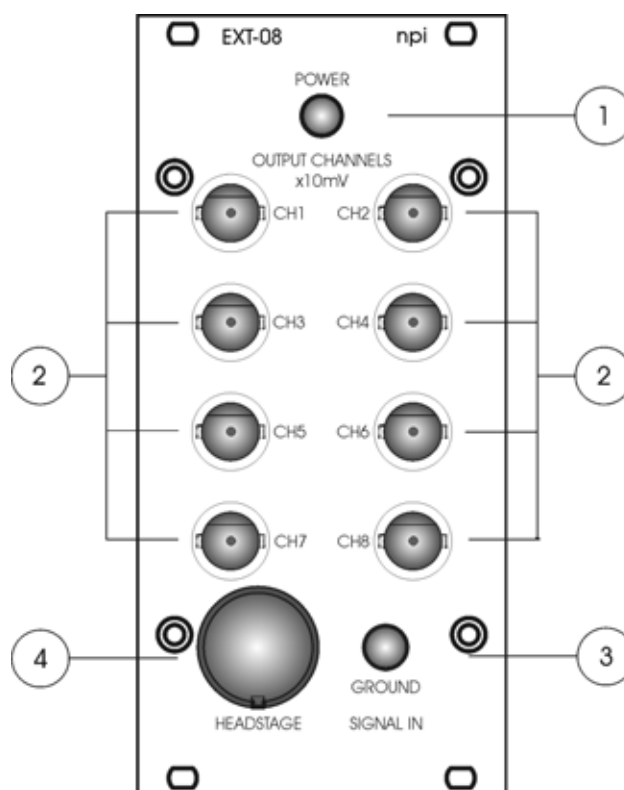


Figure 2: EXT-08 front panel view

(1) POWER LED

LED indicating that the EPMS system is powered on.

(2) OUTPUT CHANNELS CH1...CH8 connectors

BNC connectors providing the DC OUTPUT of the eight electrodes with an amplification of ten and lowpass-filtered (corner frequency: 8 kHz).

(3) GROUND connector

Banana plug providing system ground. Please note that system ground is different from mains ground (see chapter 2.3).

(4) HEADSTAGE connector

12 pole connector for the headstage cable.

3.4. Headstage

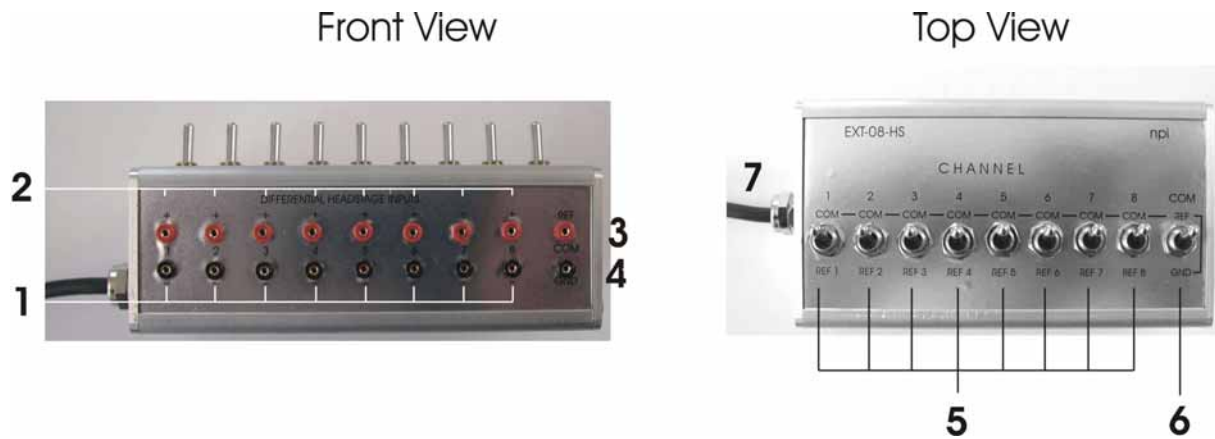


Figure 3: headstage of the EXT-08

The headstage consists of the following elements:

- 1 Black 1 mm banana connector for extracellular microelectrodes (minus pole) (1...8 = - input of the differential amplifier, lower row).
- 2 Red 1 mm banana connector for extracellular microelectrodes (plus pole), (1...8 = + input of the differential amplifier (upper row).
- 3 REF / COM:
Connector of the reference electrode for measurements with common reference. This connector is used if differential recordings with one reference electrode should be performed (Common Referenced Operation). This common reference electrode is connected here (REF. = - input of the differential amplifier).
- 4 GND:
Ground connector. This plug provides system ground for grounding the preparation (e.g. by a bath electrode). Please note that the system ground is different from the mains ground.
- 5 Mode switches:
These switches select the mode of operation for each channel (see chapter 3.5).
- 6 COM switch
This toggle switch selects whether the common reference signal is used (REF) or not (GND). In GND position the plug is connected to ground.
- 7 Headstage cable to amplifier.
The headstage is connected to the module by a flexible cable and a 12-pole shielded connector. (HEADSTAGE). The headstage is housed in a small metal box. All connectors are standard 1 mm plugs. The enclosure of the headstage is connected to ground.

3.5. Operation

Unipolar Operation

The REF. signal is not used. The COM toggle switch (#6, Figure 3) on the headstage must be in the GND position and the mode switches (#5, Figure 3) must be in the COM position. Signals are measured with respect to ground (GND).

Common Referenced Operation

If differential measurements with a common reference should be performed [signal at + inputs 1..8 (#2, Figure 3), the COM toggle switch (#6, Figure 3) must be in the REF. position and the mode switches (#5, Figure 3) must be in the COM position. The reference electrode, connected to the REF. plug (#3, Figure 3), must be placed properly with respect to the recording electrodes.

Note: An excellent introduction to the methods of extracellular recordings can be found in Lalley et al., 1999 (see chapter 4, for more references).

Differential Operation

All channels can be operated independently from each other in differential mode. In this mode the signal of each channel is measured as the difference between the potential at the “plus” (red) input (#2, Figure 3) and the potential at the “minus” (black) input (#1, Figure 3). Therefore, the electrode for recording the extracellular signal has to be connected to the “plus” input and the reference electrode to the “minus” input of the respective channel.

Caution: All headstage inputs are sensitive to static discharges. They are equipped with very sensitive FET amplifiers, which can be damaged by electrostatic charge and therefore, must be handled with care. Electrostatic discharge can be avoided by touching a grounded metal surface when changing or adjusting the electrodes. If a headstage is not used, the input should always be connected to ground (either using an appropriate connector or with aluminum foil wrapped around the headstage).

Always turn power off when connecting or disconnecting headstages from the EPMS-07 housing (see also chapter 1).

4. Literature

- ❑ Barmashenko, G., Eysel, U. T., & Mittmann, T. (2003). Changes in intracellular calcium transients and LTP in the surround of visual cortex lesions in rats. *Brain Res.* **990**, 120-128.
- ❑ Boulton, A. A., Baker, G. B. & Vanderwolf, C. H. (eds.) (1990). *Neurophysiological Techniques, Basic Methods and Concepts*. Humana Press, Clifton, New Jersey.
- ❑ Huemmeke, M., Eysel, U. T., & Mittmann, T. (2002). Metabotropic glutamate receptors mediate expression of LTP in slices of rat visual cortex. *Eur.J.Neurosci.* **15**, 1641-1645.
- ❑ Huemmeke, M., Eysel, U. T., & Mittmann, T. (2004). Lesion-induced enhancement of LTP in rat visual cortex is mediated by NMDA receptors containing the NR2B subunit. *J Physiol* **559** , 875-882.
- ❑ Schulz, D., Huston, J. P., Jezek, K., Haas, H. L., Roth-Harer, A., Selbach, O., & Luhmann, H. J. (2002). Water maze performance, exploratory activity, inhibitory avoidance and hippocampal plasticity in aged superior and inferior learners. *Eur.J.Neurosci.* **16**, 2175-2185.
- ❑ Kettenmann, H. & Grantyn, R. (eds.) (1992). *Practical Electrophysiological Methods*. Wiley-Liss, New York
- ❑ Lalley, P.M., A.K. Moschovakis and U. Windhorst (1999) Electrical Activity of Individual Neurons In Situ: Extra- and Intracellular Recording, in: U. Windhorst and H. Johansson (eds.) Modern Techniques in Neuroscience Research, Springer, Berlin, New York
- ❑ Müller, Ch.M. (1992) Extra- and Intracellular Recording in the Slice, in: Kettenmann, H. & Grantyn, R. (eds.) Practical Electro-physiological Methods, Wiley-Liss, New York
- ❑ Ogden, D. (ed.) (1992) Microelectrode Techniques - The Plymouth Workshop Handbook, Second Edition, The Company of Biologists Ltd., Cambridge
- ❑ Seidenbecher, T. and H.C. Pape (2001) Contribution of intralaminar thalamic nuclei to spike-and-wave-discharges during spontaneous seizures in a genetic rat model of absence epilepsy, *European Journal of Neuroscience*, Vol. 13:1537-1546
- ❑ Windhorst, U. and H. Johansson (eds.) (1999) Modern Techniques in Neuroscience Research, Springer, Berlin, Heidelberg, New York

5. Technical Data

Headstage:	eight differential inputs, 1 mm banana jacks
Input impedance:	1 T Ω
Input voltage range:	± 1 V
Max. input voltage:	± 15 V
Output range:	± 10 V
Output impedance:	250 Ω
Output filter:	lowpass, corner frequency: 8 kHz