Electronic Instruments for the Life Sciences

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OPERATING INSTRUCTIONS AND SYSTEM DESCRIPTION FOR THE

EXT-T2

8-CHANNEL EXTRACELLULAR AMPLIFIER SYSTEM FOR 2 TETRODES

(WITH x10 HEADSTAGE AMPLIFICATION)

VERSION 2.3
npi 2020

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1. Safety Regulations

<u>VERY IMPORTANT</u>: Instruments and components supplied by npi 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. npi electronic disclaims any warranties for such purpose. Equipment supplied by npi 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 npi 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 npi 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. EXT-T2 Amplifier / Filter

2.1. System Description

The EXT-T2 instrument is an amplifier/filter with headstages for two tetrodes, A and B. The signals recorded from every single tetrode attached to the headstages are amplified; filtered, and linked to the BNC connectors OUTPUT 0 to OUTPUT 3 for each tetrode. Each OUTPUT is available at two BNC connectors. The GROUND plug provides system ground. Measurements are done in single-ended configuration against GROUND.

2.2. Description of the Front Panel

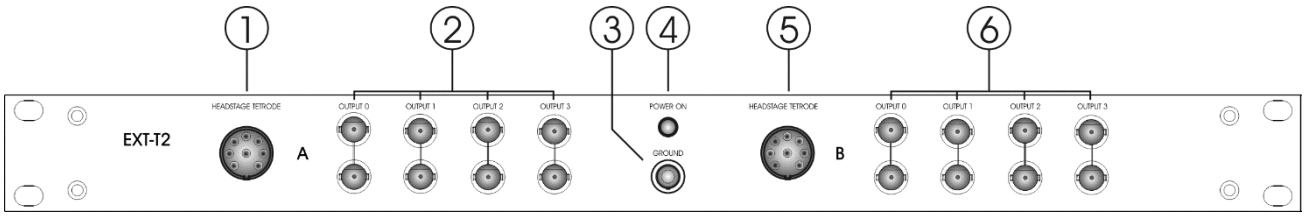


Figure 1: front panel view of EXT-T2

(1) HEADSTAGE A connector

Connector for the HEADSTAGE of TETRODE A

(2) OUTPUT 0…OUTPUT 3 connectors

BNC connectors providing the amplified and filtered signals of tetrode A

(3) GROUND connector

Banana jack providing system ground

(4) POWER ON LED

LED indicating that POWER is switched ON

(5) HEADSTAGE B connector

Connector for the HEADSTAGE of TETRODE B

(6) OUTPUT 0…OUTPUT 3 connectors

BNC connectors providing the amplified and filtered signals of tetrode B.

Note: Make sure not to exchange headstages A and B. Otherwise the offset of the single channels might not be accurate.

2.3. Setting filters and gain

Amplification factors (x100, x200, x500; x1000) and corner frequencies of high pass (DC, 0.1, 0.3, 1 Hz) and low pass (100, 500, 2k, 8k Hz) filter can be set internally by DIL switches (see Figure 2). The DIL switches for the respective channels and filter/gain settings are shown in Table 1.

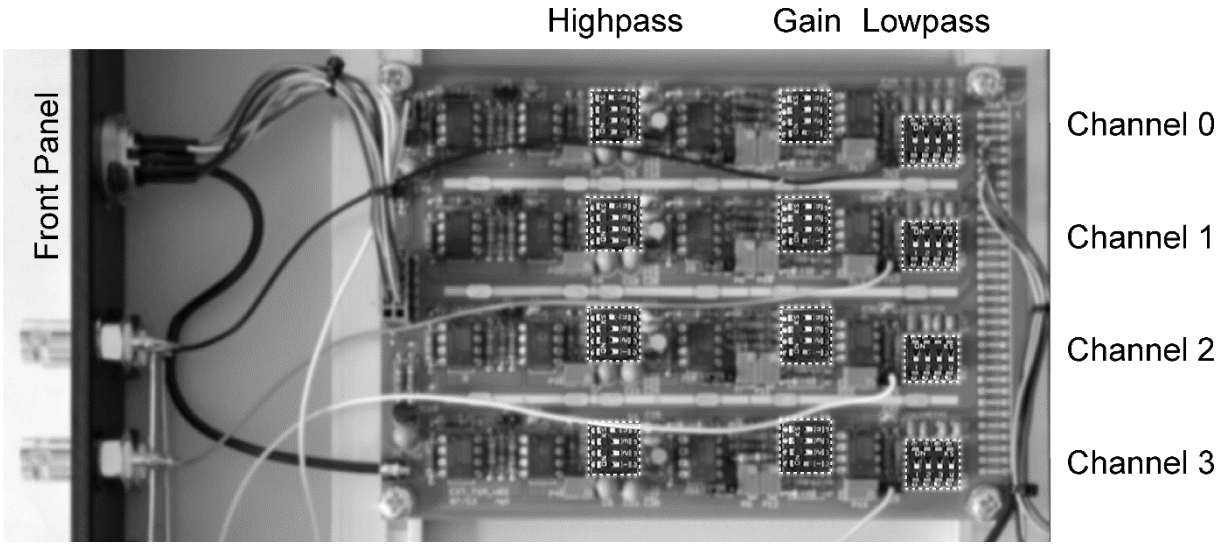


Figure 2: PCB of one tetrode amplifier, position of the DIL switches for filter and gain selection.

Highpass	
Switch	**Frequency**
1	1 Hz
2	0.3 Hz
3	0.1 Hz
4	DC

Gain	
Switch	**Amplification**
1	100
2	200
3	500
4	1000

Lowpass	
Switch	**Frequency**
1	100 Hz
2	500 Hz
3	2 kHz
4	8 kHz

Table 1: Filter frequencies and amplification factors for the respective DIL switches.

To access the DIL switches inside the EXT-T2 housing, the top plate has to be removed: (switch power off, disconnect power supply). The top cover is secured with three screws on the rear. Remove this screws and slide the cover towards the rear to remove it.
Make sure you re-insert this metal cover and secure it with the screws before re-powering the EXT-T2.

The four filter frequencies or gain settings, respectively, are dedicated to one of the four little white switches of every DIL switch (see picture on the left). I.e. to set a certain gain or filter frequency, only one of the switches is in upper position, the other three must be in the lower position. If more than one switch is in upper position, this results in an undefined mixture of frequencies/gain settings.

There is one exception:

Lowpass filter: if all four switches are in lower position, the lowpass filter is set to wideband, i.e. 20 kHz.

2.4. Description of the Rear Panel

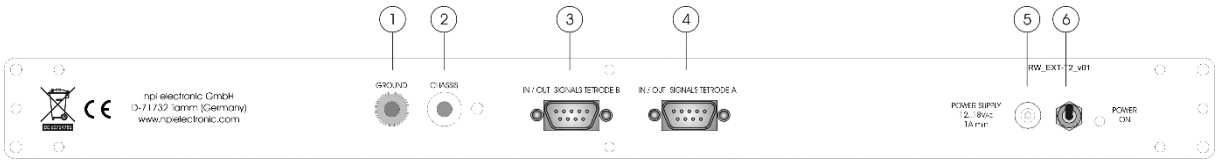


Figure 3: rear panel view of EXT-T2

(1) GROUND

This connector is linked to the internal system ground which has no connection to the 19" cabinet (CHASSIS) to avoid ground loops

(2) CHASSIS

This connector is not linked to system ground and can be used for grounding the CHASSIS independently from system ground

(3) IN / OUT SIGNALS TETRODE B

Not connected

(4) IN / OUT SIGNALS TETRODE A

Not connected

(5) POWER SUPPLY connector

Connector for the wall POWER SUPPLY (12V…18V AC, 1A min.)

(6) POWER ON switch

Switch to turn POWER ON (upper position).

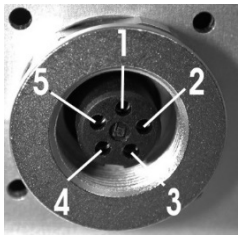
Note: GROUNG and CHASSIS are not connected by default. This is usually a good way to avoid ground loop, which might lead to noise or high frequency ringing. However, there are situations where interconnecting GROUND and CHASSIS helps reducing noise. Unfortunately, there is no way to predict which way is better.
We provide these two connectors at the rear panel so that the user can try and decide which way works best at the given setup – interconnected or disconnected.

3. Headstage

Figure 4: one headstage of the EXT-T2

Headstage Elements

P_{EL} Connector for the tetrode (see also Figure 5)
REF Not connected
GND Ground connector



1 Ground connector (GND)
2 Channel 1 connector (CH0)
3 Channel 3 connector (CH2)
4 Channel 4 connector (CH3)
5 Channel 2 connector (CH1)

Figure 5: tetrode connector

3.1. Test Adapter

There is a small test adapter provided with the system. If this adapter is connected, all four headstage inputs are connected to ground via four individual 1 MΩ resistors. Using this adapter provides a “clean zero” input. This way the amplifier can be tested for potential offsets or to find sources of noise or hum within the experimental setup.

4. Technical Data

Input resistance:	$>10^{12}$ Ω, range ±1 V
Output:	Overall gain (x100, x200, x500, x1000), selectable by DIL switch
	Output range: ±12 V into 1 kΩ / ±1 V into 50 Ω load
Low pass filter:	100, 500 2k, 8k Hz, selectable by DIL switch
High pass filter:	DC, 0.1, 0.3, 1 Hz selectable by DIL switch
Power requirements:	12…18 V AC, 1 A min.; wall power supply
Dimensions:	19” rackmount cabinet, 19” (483 mm), 10” (250 mm), 1.75” (44 mm)
Headstage Size:	70 x 26 x 26 mm
Headstage Amplification:	x10
Holding Bar:	Length: 150 mm; diameter: 8 mm