

# OPERATING INSTRUCTIONS AND SYSTEM DESCRIPTION FOR THE

## **EXT-02F**

# **EXTRACELLULAR AMPLIFIER WITH FILTERS**

One or Two Channel Recordings



VERSION 1.0

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npi electronic GmbH, Hauptstrasse 96, D-71732 Tamm, Germany  
Phone +49 (0)7141-9730230; Fax: +49 (0)7141-9730240  
support@npielelectronic.com; <http://www.npielectronic.com>

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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. EXT-02F

### 2.1. Components

The following items are shipped with this EXT-02F system:

- ✓ Amplifier
- ✓ User manual

⇒ **Optional:** Differential headstage with connectors

### 2.2. System Description

The EXT-02F is designed for extracellular recordings. The standard model comprises of two identical channels, but a one channel version is also available. In the following description of the system only one channel is mentioned, because the two recording channels are identical.

The EXT-02F has a differential input with high input impedance to avoid noise. The output voltage signal is available either filtered AC coupled with variable gain or DC coupled with an amplification factor of ten.

Two LEDs indicate whether the amplifier is running out of its linear range and an analog balance monitor makes the control of offsets easy. A built-in audio speaker monitors the output signal of one channel (A or B). Two phone jacks at the rear panel allow connection of an external speaker or further audio amplification, e.g. computer sound card, power amplifier etc.

### 2.3. Description of the Front Panel

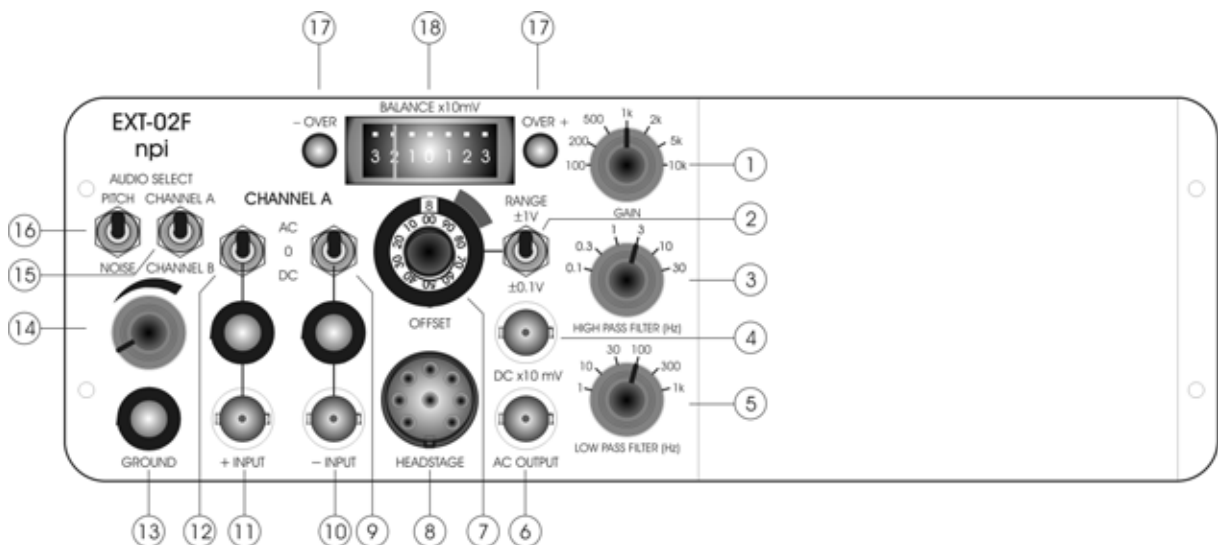


Figure 1: EXT-02F front panel view (one channel version)

In the following description of the front panel elements, each element has a number that is related to that in Figure 1. The number is followed by the name (in uppercase letters) written on the front panel and the type of the element (in lowercase letters). Then, a short description of the element is given. Since the front panel elements are identical for each channel A and B (with identical functions and labels) these elements are numbered and described only once (for channel A).

**(1) GAIN switch**



7-position switch for selecting the GAIN of the filtered output signal at the AC OUTPUT connector (#6).

Amplification factors: x100, x 200, x500, x1k, x2k, x5k, x10k

**(2) OFFSET range switch**



Switch to set the range for the OFFSET potentiometer (#7).

±1V corresponds to a range from 0 mV to 100 mV at the electrode

±0.1V corresponds to a range from 0 mV to 10 mV at the electrode

**(3) HIGH PASS FILTER (Hz) switch**



6-position switch for selecting the corner frequency of the HIGH PASS FILTER.

Corner frequencies (Hz): 0.1, 0.3, 1, 3, 10, 30

**(4) DC x10 mV output connector**



BNC connector providing the unfiltered output signal in DC mode with an amplification of ten.

**(5) LOW PASS FILTER (Hz) switch**



6-position switch for selecting the corner frequency of the LOW PASS FILTER.

Corner frequencies (Hz): 1, 10, 30, 100, 300, 1k

**Note:** A combination of both LOW and HIGH PASS FILTER leads to a filter with bandpass characteristics.

**(6) AC OUTPUT connector**



BNC connector providing the filtered output signal in AC mode with an amplification set by #1.

**(7) OFFSET potentiometer**

10 turn potentiometer for OFFSET compensation for the measured potential in DC mode, i.e. the potential provided at connector #4. The range is set by switch #2. The analog BALANCE monitor (#18) displays the offset in the range of  $\pm 30$  mV and is used for optimal cancellation of the offset.

**Note:** Position 5 corresponds to 0 V OFFSET.

**(8) HEADSTAGE connector**

Connector for the **optional** headstage.

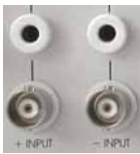
**(9, 12 ) INPUT coupling switches**

Switches for selecting the input coupling of the signal.

AC: the input signal is AC coupled with a corner frequency of 0.1 Hz

DC: the input signal is DC coupled

0: the input signal is grounded.

**(10, 11) – INPUT, + INPUT connectors**

Banana jacks or BNC connectors, respectively for connecting the input signal. The inputs can be used in single ended or differential configuration. In differential configuration the signal which is connected to –INPUT is subtracted from the signal that is connected to +INPUT. If only one input is used (single ended configuration) the other should be grounded to avoid coupling of noise.

**Important:** Only one of the INPUTS must be used, i.e. either the banana jacks or the BNC connectors or the (optional) headstage!!

**(13) GROUND connector**

Banana jack providing system ground.

**(14) Audio volume potentiometer**

Potentiometer for setting the volume of the speaker. Turning clockwise will turn up the sound.

**(15) CHANNEL selector**

Switch for selecting whether the signal of CHANNEL A or CHANNEL B is monitored by the audio monitor.

**(16) PITCH / NOISE selector**

Switch for selecting the audio MODE.

**NOISE:** The voltage of the INPUT signal is transduced to sound.

**PITCH:** The voltage of the INPUT signal is converted into a tone with a frequency equivalent to the amplitude of the INPUT voltage.

**(17) + / - OVERLOAD LEDs**

LEDs that indicate if the amplifier 10% below its positive or negative limit ( $\pm 10$  V). The linear range of the amplifier is  $\pm 12$  V.

**(18) BALANCE x10mV meter**

The analog BALANCE monitor displays the OFFSET in the range of  $\pm 30$  mV and is used for optimal cancellation of the OFFSET.

## **2.4. Description of the Rear Panel**

**ON / OFF**

Control for switching the EXT-02F ON or OFF.

**LINE OUT**

Phone jack connector for external audio amplification, e.g. with sound cards, power amplifiers etc.

**EXT SPEAKER**

Phone jack connector for external speaker.

**AC INPUT SUPPLY**

Connector for an external power supply (+14 V AC, 0.5 A).

### 3. Technical Data

Differential Input:	CMR >90 dB at 1 kHz (tested with 0 $\Omega$ input resistance)
Input:	>10 <sup>12</sup> $\Omega$ , range $\pm 1$ V
Output x10mV DC:	gain x10
	Output range: $\pm 12$ V into 1 k $\Omega$ / $\pm 1$ V into 250 $\Omega$ load
Output AC:	selectable gain (x100, x200, x500, x1k, x2k, x5k, x10k)
	Output range: $\pm 12$ V into 1 k $\Omega$ / $\pm 1$ V into 250 $\Omega$ load
Line Out:	impedance: 20 k $\Omega$ , 3.5 mm mono phone jack
Speaker Out:	impedance: 8 $\Omega$ , 3.5 mm mono phone jack
Low pass filter:	1, 10, 30, 100, 300, 1k Hz
High pass filter:	0.1, 0.3, 1, 3, 10, 30 Hz
Offset compensation:	$\pm 0.1$ V switch position: $\pm 10$ mV, 10 turn potentiometer $\pm 1$ V switch position: $\pm 100$ mV, 10 turn potentiometer
Potential monitor:	analog display for the electrode offset, range $\pm 30$ mV
Wall power supply:	+14V AC, 0.5 A
Dimensions:	245 x 200 x 90 mm