

# OPERATING INSTRUCTIONS AND SYSTEM DESCRIPTION FOR THE

## DPA-2FL

# LOW-NOISE DIFFERENTIAL AMPLIFIER / FILTER MODULE FOR EPMS SYSTEMS



VERSION 1.3  
npi 2013

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## Table of Contents

1. Safety Regulations.....	3
2. EPMS-07 Modular Plug-In System.....	4
2.1. General System Description / Operation.....	4
2.2. EPMS-07 Housing.....	4
2.3. EPMS-E-07 Housing.....	4
2.4. PWR-03D.....	4
2.5. System Grounding.....	5
EPMS-07.....	5
EPMS-E-07.....	5
2.6. Technical Data.....	5
EPMS-07.....	5
EPMS-E-07.....	5
3. DPA-2FL Differential Amplifier / Filter Module.....	6
3.1. DPA-2FL Components.....	6
3.2. System Description.....	6
3.3. Signal Flow Diagram.....	6
3.4. Description of the Front Panel and Operation.....	7
4. Literature.....	10
5. Technical Data.....	11

## 1. Safety Regulations

**VERY IMPORTANT:** 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 only by trained staff. 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. EPMS-07 Modular Plug-In System

### 2.1. General System Description / Operation

The npI EPMS-07 is a modular system for processing of bioelectrical signals in electrophysiology. The system is housed in a 19" rackmount cabinet (3U) 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. Free area must be protected with covers.

### 2.2. EPMS-07 Housing

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

- ✓ EPMS-07 cabinet with built-in power supply
- ✓ Mains cord
- ✓ Fuse 2 A / 1 A, slow
- ✓ Front covers

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.

### 2.3. EPMS-E-07 Housing

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

- ✓ EPMS-E-07 cabinet
- ✓ External Power supply PWR-03D
- ✓ Power cord (PWR-03D to EPMS-E-07)
- ✓ Mains chord
- ✓ Fuse 1.6 A / 0.8 A, slow
- ✓ Front covers

The EPMS-E-07 housing is designed for low-noise operation, especially for extracellular and multi channel amplifiers with plugged in filters. It operates with an external power supply to minimize distortions of the signals caused by the power supply.

### 2.4. PWR-03D

The external power supply PWR-03D is capable of driving up to 3 EPMS-E housings. Each housing is connected by a 6-pole cable from the one of the three connectors on the front panel of the PWR-03D to the rear panel of the respective EPMS-E housing. (see Figure 1, Figure 3). A POWER LED indicates that the PWR-03D is powered on (see Figure 1). Power switch, voltage selector and fuse are located at the rear panel (see Figure 2).

**Note:** The chassis of the PWR-03D is connected to protective earth, and it provides protective earth to the EPMS-E housing if connected.



Figure 1: PWR-03D front panel view



Figure 2: PWR-03D rear panel view

**Note:** This power supply is intended to be used with npi EPMS-E systems only.

## 2.5. System Grounding

### EPMS-07

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.



### EPMS-E-07

The 19" cabinet is connected to the PROTECTIVE EARTH connector at the rear panel. The chassis is linked to protective earth only if the PWR-03D is connected. It can be connected also to the SYSTEM GROUND (SIGNAL GROUND) on the rear panel of the instrument (see Figure 3).

**Important:** Always adhere to the appropriate safety measures.

Figure 3: Rear panel connectors of the EPMS-E-07

## 2.6. Technical Data

19" rackmount cabinet, for up to 7 plug-in units

Dimensions: 3U high (1U=1 3/4" = 44.45 mm), 254 mm deep

### EPMS-07

Power supply: 115/230 V AC, 60/50 Hz, fuse 2 A / 1 A slow, 45-60 W

### EPMS-E-07

External power supply (for EPMS-E): 115/230 V AC, 60/50 Hz, fuse 1.6/0.8 A, slow

Dimensions of External power supply: (W x D x H) 225 mm x 210 mm x 85 mm

### 3. DPA-2FL Differential Amplifier / Filter Module

#### 3.1. DPA-2FL Components

The following items are shipped with the DPA-2FS system:

- ✓ Amplifier / Filter module for the EPMS-07 system
- ✓ User manual

#### 3.2. System Description

The DPA-2FL differential amplifier/filter is a plug-in unit for the npI EPMS-07 modular system. The DPA-2FL is designed to amplify and filter very small bio-electrical signals. The input voltage range is  $\pm 12$  V, the inputs are protected up to 15 V. All inputs and the output are BNC connectors.

The input impedance is 1 M $\Omega$ . Using the differential input configuration common mode signals and noise are removed allowing recordings of signals with very small amplitudes. An optional NOTCH filter removes 50 Hz / 60 Hz noise.

DC offsets can be compensated either by the using the OFFSET control or the HIGH PASS filter.

The GAIN range is x10 to x10000 and the output signal is passed through the HIGH PASS, LOW PASS and NOTCH filter.

**Important:** To avoid noise interference the respective toggle switch should be in the zero position if one of the inputs is not used.

#### 3.3. Signal Flow Diagram

The signal is passed through the DPA-2FL as shown below.



### 3.4. Description of the Front Panel and Operation

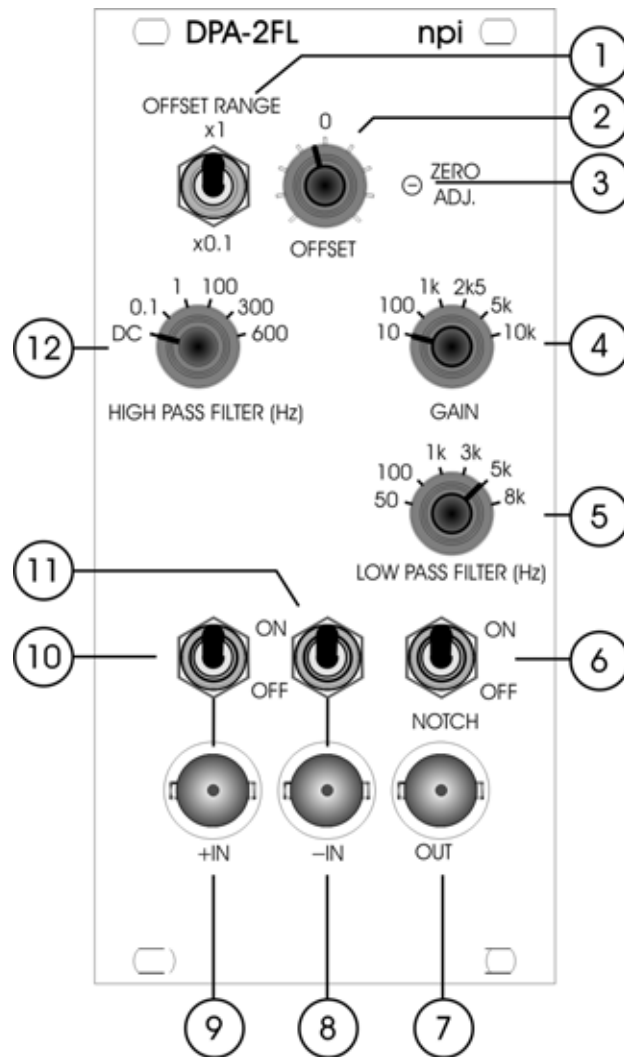


Figure 4: DPA-2FL front panel view

In the following description of the front panel elements each element has a number that is related to that in Figure 4. 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.

## OFFSET unit



The OFFSET unit consists of (1) OFFSET RANGE switch, (2) OFFSET potentiometer and (3) ZERO ADJ. trim-pot.

### (1) OFFSET RANGE switch

Toggle switch for selecting the OFFSET range, x0.1 or x1.

### (2) OFFSET potentiometer

Potentiometer for compensating a DC OFFSET.

### (3) ZERO ADJ. trim-pot

Trim-pot for setting the ZERO baseline for the OFFSET.

Trim-pots for compensating amplifier offsets. If the baseline is not zero even if the input is grounded and the OFFSET potentiometer is in 0 position, this offset can be compensated using the ZERO ADJ. trim-pot. Compensation procedure:

- Set the input switches to OFF to ground the inputs, and set the HIGH PASS FILTER to 100 Hz.
- Set the GAIN range switch to 10 and adjust the baseline to zero using the ZERO ADJ. trim-pot.
- Switch the GAIN factor switch to all positions and readjust to zero if necessary.

**Note:** The overall OFFSET compensation is the product of the reading of both controls, range switch and potentiometer.

**Important:** The offset compensation works only if the HIGH PASS FILTER switch is set to DC. If the HIGH PASS FILTER is used, the OFFSET control is disabled.

### (4) GAIN switch



6-position rotary switch for setting the amplification factor (GAIN) of the signal (10, 100, 1k, 2.5k, 5k and 10k).

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



6-position rotary switch for setting the corner frequencies of the single pole LOW PASS FILTER: 50, 100, 1k, 3k, 5k, 8k Hz.

**Note:** By combining HIGH- and LOW PASS FILTER, a filter with bandpass characteristic can be implemented easily.



(6) NOTCH filter switch (option)



Switch for enabling (ON) or disabling (OFF) the optional NOTCH filter.

(7) OUT connector



BNC connector providing the conditioned signal.

(8, 9) – IN, + IN connector



BNC connectors 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 –IN is subtracted from the signal that is connected to +IN.

**Note:** If only one input is used (single ended configuration) the other should be grounded to avoid coupling of noise (see also **10** and **11**).

(10, 11) input switches



ON / OFF toggle switches for grounding the BNC connectors **8** and **9**. In OFF position the inputs are grounded.

(12) HIGH PASS FILTER (Hz)switch



6-position rotary switch for setting the corner frequencies of the single pole HIGH PASS FILTER: DC, 0.1, 1, 100, 300, 600 Hz.

In DC position the HIGH PASS FILTER is disabled.

**Note:** By combining HIGH- and LOW PASS FILTER, a filter with bandpass characteristic can be implemented easily.

## 4. Literature

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## 5. Technical Data

### DPA-2FL

Input range:	$\pm 12$ V; protected up to 15 V
Input impedance:	1 M $\Omega$ , related to ground
Input capacitance:	30 pF
Noise:	<5 $\mu$ V rms @ full bandwidth (8 kHz) and gain 10k
OFFSET compensation:	set by potentiometer, range x0.1 or x1, set by toggle switch
HIGH PASS FILTER:	single pole, attenuation: -6 dB / octave, corner frequencies (Hz): DC; 0.1, 1, 100, 300, 600
LOW PASS FILTER:	single pole, attenuation: -6 dB/octave, corner frequencies (Hz): 50, 100, 1k, 3k, 5k, 8
NOTCH FILTER:	50 Hz or 60 Hz
GAIN:	rotary-switch 10, 100, 1k, 2.5k, 5k, 10k
Output:	range: $\pm 12$ V into 1 k $\Omega$ / $\pm 1$ V into 50 $\Omega$
Size:	front panel 12 HP (60.6 mm) x 3U (128,5 mm), 7" (175 mm) deep

### EPMS-07 SYSTEM

Power requirements:	115/230 V AC, 60/50 Hz, fuse 2 A / 1 A, slow, 45-60 W (dependent on the modules plugged in)
Dimensions:	19" rackmount cabinet, 3U high (1U = 1 3/4" = 44.45 mm)