

# OPERATING INSTRUCTIONS AND SYSTEM DESCRIPTION OF THE

## PDES-01AM

# PNEUMATIC DRUG EJECTION MODULE WITH ANALOG TIMER FOR EPMS-07 SYSTEMS



VERSION 1.6

npi 2008

---

## Table of Contents

1. Safety Regulations .....	3
2. EPMS-07 Modular Plug-In System .....	4
2.1. Components of the EPMS-07 Housing .....	4
2.2. General System Description / Operation .....	4
2.3. System Grounding .....	5
2.4. Technical Data .....	5
3. PDES System .....	6
3.1. System Description .....	6
3.2. Description of the Front Panel .....	7
3.3. microJECT micro Valve Pipette Holder (Option) .....	9
3.4. Operation .....	9
4. Literature .....	12
5. Technical Data .....	13

## 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 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.

**HIGH PRESSURE PRECAUTIONS:** While working with PDES systems and components always adhere to the appropriate safety measures for handling high pressure pneumatic systems. Before using the PDES or any external pneumatic device please read manuals and instructions carefully.

- Always turn off pressure source before connecting or disconnecting the PDES system.
- Any component used (tubes, fittings etc.) must be specified for the maximum possible pressure.
- Do not use any aggressive, combustible or explosive gases. Only gases such as air, nitrogen, carbon dioxide, helium, etc. are allowed.
- Use only dry, oil free, filtered gases (max. 5 µm filter is allowed).
- Maximum input pressure must be below 4 bar (58 psi).

## 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. Free area must be protected with 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.

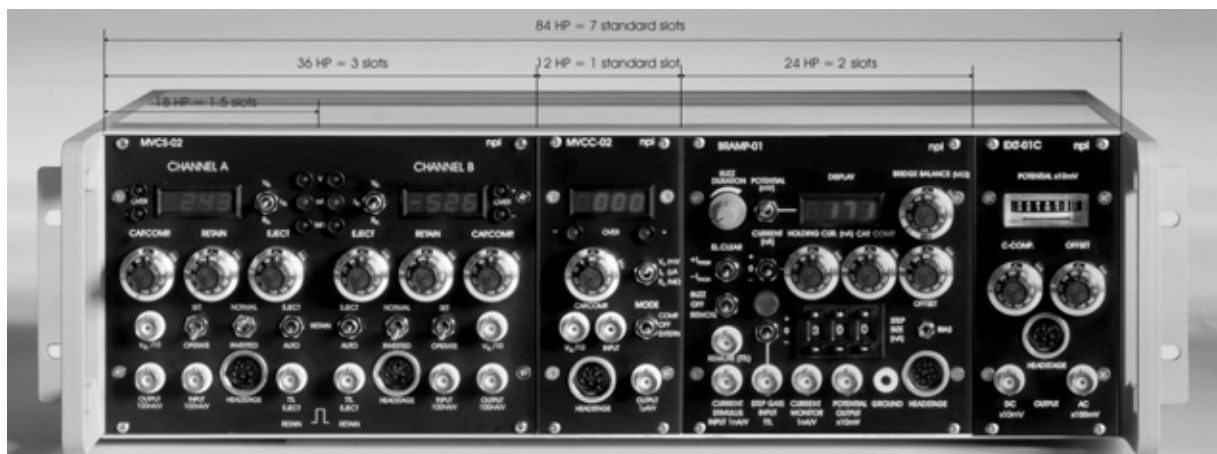


Figure 1: Example of a measurement system located in an EPMS housing with two channel iontophoresis and balance module (MVC3-02, MVCC-02), bridge amplifier module (BRAMP-01R) and an extracellular amplifier module (EXT-01C)

### **2.3. System Grounding**

The 19" cabinet is grounded by the power cable through the ground pin of the mains connector (= protective earth, see chapter 1). 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 Volts AC, 60/50 Hz, fuse 2 A / 1 A slow, 45-60 W

### 3. PDES System

#### 3.1. System Description

Pressure ejection is a convenient method for applying both ionic and non-ionic solutions from micropipettes. This method is popular for two reasons. First, it can apply to almost all solutions. Second, the amount of solution ejected can be monitored by viewing the tip of the micropipette under a microscope.

npi PDES units are designed for pressure ejection of drugs in physiological and pharmacological studies. PDES systems can be equipped with high pressure outputs (up to  $P_{\max} = 4$  bar / 58 psi) for drug application with fine-tipped micropipettes or with low-range pressure output ( $P_{\max} = 0.7$  bar / 10 psi) for controlled droplet application from large-tipped pipettes.

The PDES-01AM is a system with  $P_{\max} = 4$  bar (58 psi). The device is designed as a module for the npi EPMS-07 system. It comprises of one channel consisting of a precision pressure regulator, an electronically controlled valve, (or a very fast micro valve located in the *microJECT*), an analog timer and an analog pressure display. Ejection of drugs can be activated manually or via a TTL input.

Mode of operation and timing is selected by controls at the front panel. If the internal timer is used, the eject time is preset by a control and the time base can be selected by a toggle switch. The operational status is indicated by a red/green LED.

The pressure connectors are also located at the front panel of the instrument. The injection channel is equipped with an INPUT coupling where the pressure source is connected, an OUT coupling where the injection pipette or the *microJECT* headstage, respectively, is connected, and an EXHAUST coupling where a low "retain" pressure can be applied in order to avoid capillary effects at the tip of the injection pipette (analogous to the "retaining" current used in iontophoretic systems). This pressure must be generated by an additional pneumatic device. Please contact npi electronic for details. Systems with *microJECT* are additionally equipped with a connector for controlling the micro valve inside the *microJECT*.

The injection pressure is preset by a precision pressure regulator. The pressure is displayed on an analog manometer. Additional pneumatic devices (tubes, fittings, connectors, filters etc.) are available. Please contact npi electronic for details.

A calibration procedure allowing quantitative drug application is described by Hofmeier and Lux (1981), (see chapter 4).

### 3.2. Description of the Front Panel

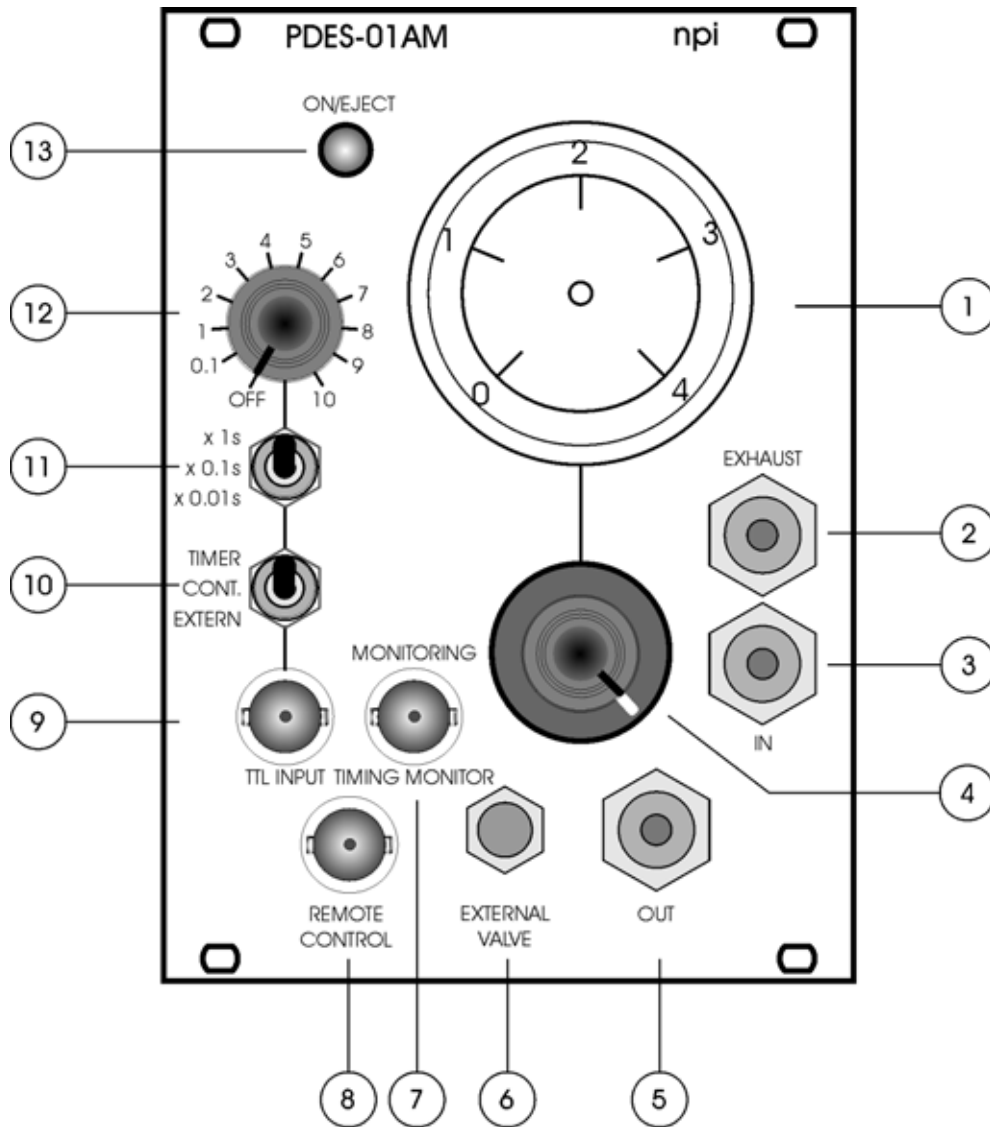


Figure 2: PDES-01AM front panel view (the numbers are related to those in the text below)

**(1) Manometer**

Display indicating the ejection pressure, range: 0-4 bar (0-58 psi) or 0-2.5 bar (0-36 psi).

**(2) EXHAUST connector**

Connector for connecting a “retain” pressure source or for EXHAUST. If no “retain” pressure is connected, the system is exhausted as long as no pressure is applied to the pipette.

**(3) IN connector**

Connector for connecting the filtered, dry and oil-free gas source. The gas source must be filtered by a 5 µm filter element.

**Important:** Do not connect sources of OXYGEN or COMBUSTIBLE gases!!

**Note:** npi recommends an input pressure of 1 bar / 14 psi more than the maximum output pressure.

**(4) Pressure regulator**

Rotary knob for regulating the pressure of the ejection channel. The pressure is indicated by the manometer (#12).

**(5) OUT connector**

Connector for connecting the injection micropipette or for connecting the micropipette holder *microJECT*. The EJECT pressure is supplied to this connector.

**(6) EXTERNAL VALVE connector**

Connector for the electrical connection of the *microJECT*.

**(7) TIMING MONITOR**

BNC connector providing a TTL signal that indicates the status of the regulated injection valve (HI = valve open, LO = valve closed).

**(8) REMOTE CONTROL connector**

BNC connector for connecting a remote control, e.g. a pushbutton.

**(9) TTL INPUT**

BNC connector for connecting a TTL signal for EXTERN operation or for using the internal timer in TIMER operating mode (see also #10).

**(10) Operation mode switch**

Switch for setting the operation mode

**TIMER:** The internal timer is used. The timer can be started via a TTL HIGH signal at #9 or by pushing a pushbutton connected to #8

**CONT.:** The valve is open

**EXTERN:** The valve is open as long as the input signal at #9 is high.  
(see also chapter 3.4)

**(11) x1s / x0.01s / x0.01s switch**

Switch to set the time base of the timer; range: x1 s, x0.1 s or x0.01 s.

**(12) TIMER potentiometer**

Potentiometer to set the ejection time. The total ejection time is the reading of this potentiometer multiplied by the reading of the time base switch (#11). In OFF position the ejection channel is turned off (no pressure can be applied).

**(13) ON / EJECT LED**

Indicates the operational status of the ejection channel.

red light: valve is closed, i.e. OUT connector is closed and EXHAUST connector is open.

green light: valve is open, i.e. OUT connector is open and EXHAUST connector is closed.

**3.3. *microJECT* micro Valve Pipette Holder (Option)**

The valve which is controlled by the PDES is located in the micro valve pipette holder, called *microJECT* (see Figure 3). Tube and cable of the *microJECT* are connected at the front panel of the modular PDES system.

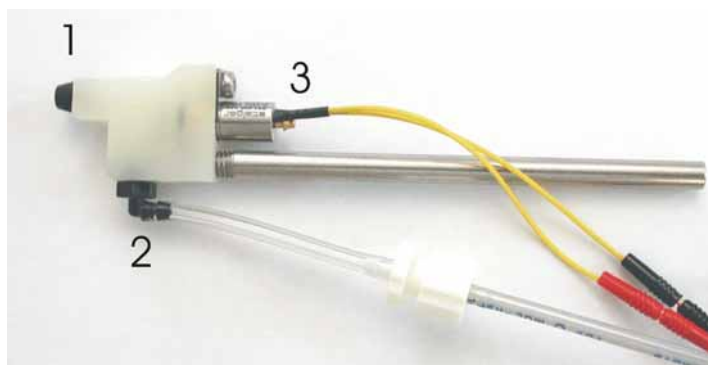


Figure 3: *microJECT*

- 1: pipette connector
- 2: connector for EJECT pressure
- 3: connector for EXHAUST pressure (optional)

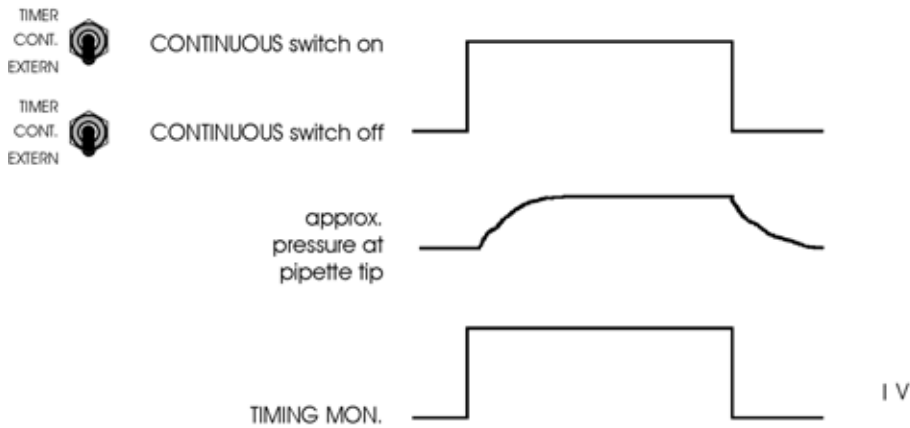
**3.4. Operation**

- ❑ Connect the gas source (max. 5 bar) to the INPUT connector at the front panel. The gas source must be filtered by a 5 µm filter element.

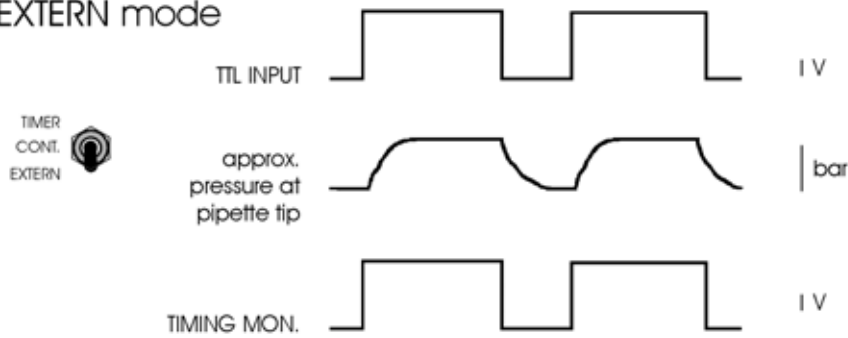
**Important:** Do not connect sources of OXYGEN or COMBUSTIBLE gases!! The gas source **MUST** be dry and oil free!! Please use a degreaser and filter the gas source by a 5 µm filter element.

- ❑ Connect the injection pipette to the OUT connector at the front panel
- or
- ❑ connect the *microJECT* pipette holder to the two *microJECT* connectors at the front panel (#5 and #6, Figure 2), and connect your ejection pipette to the *microJECT* (#1, Figure 3).
  
- ❑ If a low "retain" pressure (analogous to the "retaining" current used in iontophoretic systems) is required, connect the "retain" pressure source to EXHAUST at the front panel.
- ❑ Turn on pressure and adjust the pressure to the desired value using the pressure regulator.
- ❑ Connect a timing unit to the TTL INPUT connector (#9, Figure 2) at the front panel
- or
- connect a pushbutton to the REMOTE CONTROL connector (#8, Figure 2) at the front panel
- ❑ The LED is green when no ejection occurs and red when the pressure is applied to the pipette.
- ❑ Select the operation mode using the toggle switch (#11, Figure 2) at the front panel.
  - In the CONT. position positive pressure is applied to the pipette continuously.
  - In the EXTERN position the duration of the application is determined directly by the duration of the TTL signal.
  - In the TIMER position the duration is preset by the timer control (#12, Figure 2) and time base (#11, Figure 2) of the PDES. Application is started with a TTL signal connected to TTL INPUT (#9, Figure 2) or by pressing the pushbutton connected to #8, Figure 2. In position OFF of the timer control for pressure ejection is disabled.

### CONTINUOUS mode



### EXTERN mode



### TIMER mode

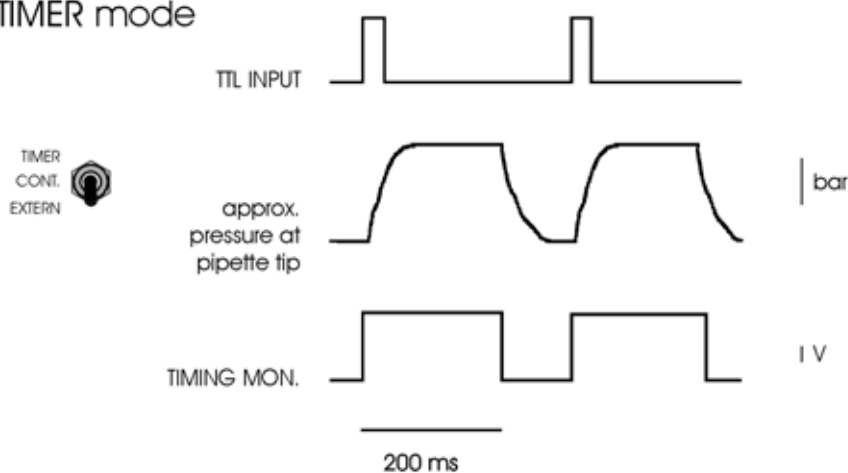


Figure 4: Operation modes of the PDES-01AM

---

## 4. Literature

- ❑ Bickmeyer, U., Heine, M., Manzke, T., & Richter, D. W. (2002). Differential modulation of Ih by 5-HT receptors in mouse CA1 hippocampal neurons. *Eur.J.Neurosci.* **16**, 209-218.
- ❑ Fischer, W., Wirkner, K., Weber, M., Eberts, C., Koles, L., Reinhardt, R., Franke, H., Allgaier, C., Gillen, C., & Illes, P. (2003). Characterization of P2X3, P2Y1 and P2Y4 receptors in cultured HEK293-hP2X3 cells and their inhibition by ethanol and trichloroethanol. *J Neurochem.* **85**, 779-790.
- ❑ Hahnel, C. (1992). Quantitative Microinjection, in: H. Kettenmann and R. Grantyn (eds.) *Practical Electrophysiological methods*, Wiley-Liss, New York.
- ❑ Hofmeier, G & Lux, H. D. (1981). The time course of intracellular free calcium and related electrical effects after injection of CaCl<sub>2</sub> into neurons of the snail *Helix pomatia*, *Pflügers Arch.* **391**, 242-251.
- ❑ **Lalley, P.M. (1999) Microiontophoresis and Pressure Ejection, in: U. Windhorst, and H. Johansson (eds) *Modern Techniques in Neuroscience Research*, Springer, Berlin Heidelberg, New York.**
- ❑ Luthardt, J., Borvendeg, S. J., Sperlagh, B., Poelchen, W., Wirkner, K., & Illes, P. (2003). P2Y(1) receptor activation inhibits NMDA receptor-channels in layer V pyramidal neurons of the rat prefrontal and parietal cortex. *Neurochem.Int.* **42**, 161-172.
- ❑ Misgeld, U. (1992). Droplet application of Agonists, in: H. Kettenmann and R. Grantyn (eds.) *Practical Electrophysiological methods*. Wiley-Liss, New York
- ❑ Partridge, L. D., Zeilhofer, H. U. & Swandulla, D. (1998). Combined Whole-Cell and Single-Channel Current Measurement with Quantitative Ca<sup>2+</sup> Injection or Fura-2 Measurement of Ca<sup>2+</sup>. In P.M. Conn (Ed.) *Ion Channels Part B, Methods in Enzymology* **293**, Academic Press San Diego.
- ❑ Wetzel, C. H., Oles, M., Wellerdieck, C., Kuczkowiak, M., Gisselmann, G., & Hatt, H. (1999). Specificity and sensitivity of a human olfactory receptor functionally expressed in human embryonic kidney 293 cells and *Xenopus Laevis* oocytes. *J.Neurosci.* **19**, 7426-7433.
- ❑ Wirkner, K., Stanchev, D., Koles, L., Klebingat, M., Dihazi, H., Flehmig, G., Vial, C., Evans, R. J., Furst, S., Mager, P. P., Eschrich, K., & Illes, P. (2005). Regulation of human recombinant P2X3 receptors by ecto-protein kinase C. *J Neurosci.* **25**, 7734-7742.

## 5. Technical Data

### Source gas:

air, nitrogen, helium etc. no aggressive, combustible or explosive gases, filtered by a 5 µm filter element

### Pressure range:

input pressure: max. 5 bar (1 bar = 10<sup>5</sup> Pa)  
pressure control range: 0-4 bar; display range 0-4 bar  
or  
0-2 bar; display range 0-2.5r

### Input and output couplings:

hose fitting connect type for 4 mm (inner diameter) tubing

### Status / EJECT time indicator:

red/green LED

red light: channel has been turned off, valve is closed

green light: valve is open

### Mode selection:

three position toggle switch, TIMER, CONT., EXTERN

Minimum pressure pulsed width: 100 ms, 1 ms with *microJECT*

Analog timer: 0.001 – 0.1 s, 0.1 - 1 s or 1 - 10 s with linear control, range set by toggle switch time base selector (0.01 s, 0.1 s, 1 s)

### TTL INPUT:

standard BNC connector, TTL (LO = 0-2.5 V, HI = 2.5-12 V), input impedance 10 kΩ

## EPMS-07 SYSTEM

### Power Requirements

115/230 V AC, 60/50 Hz, fuse 2 A / 1 A, slow, 45-60 W (depending on the modules plugged in)

### Dimensions

19" rackmount cabinet, 3U high (1U = 1 3/4" = 44.45 mm)