

OPERATING INSTRUCTIONS AND SYSTEM DESCRIPTION FOR THE

VD-24-01

VALVE CONTROLLER FOR 8 VALVES



VERSION 2.01
npi 2002

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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.
- 6) **POWER SUPPLY:** The power supply one included can drive up to three valves simultaneously (sufficient for most experiments). Other power supplies which can drive up to eight valves simultaneously are available.
- 7) **VALVE BENCHES:** Do not connect valve benches with "open collector" configuration like BPS-8 or BPS-4 from ALA Scientific Instruments.

2. VD-24 BPS Valve Driver System

2.1. General Description

The VD-24-01 BPS valve driver system is able to control a valve bench of 8 valves. The system can be expanded for controlling up to 24 valves.

There are usually two common problems encountered when using solenoid valves for perfusion experiments in pharmacological investigations. First, if the valves are on for long periods of time they tend to heat up causing hot perfusion solutions. Second, if a valve opens or closes electrical artifacts can cause unwanted spikes in the recording.

To avoid these problems npI designed the VD-24 solenoid valve driver. The VD-24 allows the handling of solenoid valve benches via computer control, manually via toggle switches for each valve at the front panel or from an external triggering device connected to the TTL IN BNC connectors. A LED for each channel indicates the valve state. It is possible to control up to 8 valves with the VD-24-01. The valves are organized in one port block for easy connection to the “DIO” series digital I/O boards from NATIONAL INSTRUMENTS (www.ni.com) or the 48 I/O board from LPTek Corporation (www.lptek.com) or other boards which provide TTL compatible I/O lines.

Each solenoid valve is activated by a TTL compatible pulse generated from an external triggering device, a digital output of the interface board or with the corresponding toggle switch at the VD-24 front panel. This pulse is transformed into a signal composed of a short high voltage spike (peak voltage) that opens the valve very fast and a hold pulse at lower voltage (hold voltage) that keeps the valve open with a minimum of heat dissipation (see Figure 4). The peak (start-up) voltage, length of the peak voltage and the hold voltage can be adjusted by the user. In addition, typical valve switching artifacts are removed using the approach described above.

By reducing the nominal valve voltage to the holding voltage overheating of the solenoid valve is prevented. Thus, heat transfer to the perfusion media is removed.

The following steps should give a quick overview of all functions and help you to understand and use the control functions. Power supply and I/O board are connected at the rear panel.

2.2. Installation

Power Supply and Valve Bench

Rear panel: Insert the power supply plug into the connector PWR IN PORT A. Connect the valve bench via the 9-pole SUBD connector (OUTPUT PORT A).

Important: Do not connect valve benches with “open collector” configuration like BPS-8 or BPS-4 from ALA Scientific Instruments (special versions for the VD-24 exist). The VD-24-01 is designed in a current source configuration (see Figure 1). The valve bench must not contain freewheeling diodes (valves have common ground connector, see Figure 1 for the right polarity).

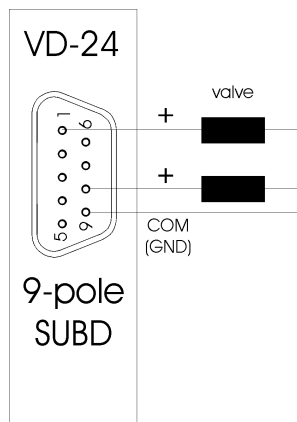


Figure 1: Scheme of valve control. For better viewing only channel 1 and 8 are shown. The other channels are connected the same way.

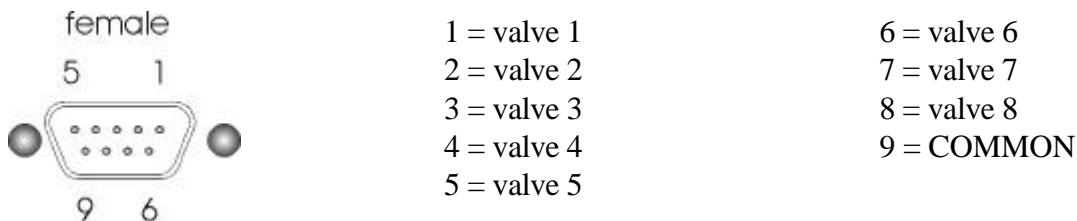


Figure 2: Pinout of the 9-pole SUBD connector

I/O Board

Rear panel: Connect the I/O board to the VD-24-01 using the 50-pole SCSI ribbon cable plugged in the connector labeled PCI 6503 at the VD-24-01.

External Trigger

Front panel: Connect the external triggering device to the TTL IN BNC connectors using BNC cables.

2.3. Configuration

- ❑ Activate channel 0 permanently by pushing the respective toggle switch at the front panel to the upper position.
- ❑ Set the peak voltage with the potentiometer labeled V_{peak} at the front panel (#3, Figure 5).
- ❑ Set the duration of the peak voltage with the potentiometer labeled T_{peak} at the front panel (#2, Figure 5).
- ❑ Set the holding voltage with the potentiometer labeled V_{hold} at the front panel (#4, Figure 5).

Note: These settings apply to all eight channels.

- ❑ Usually the VD-24-01 is used with the PCI-6503 configured for port A (in CellWorks: Hardware configuration – Digital lines out – Digital out Port Assignment - Lines 00-07 assigned to PCI-6503, port A; see Figure 3).

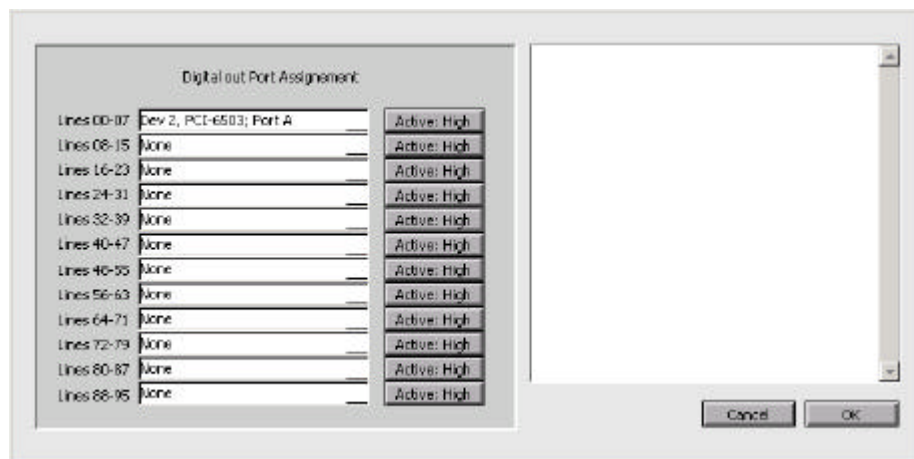


Figure 3: Configuration of digital ports in CellWorks

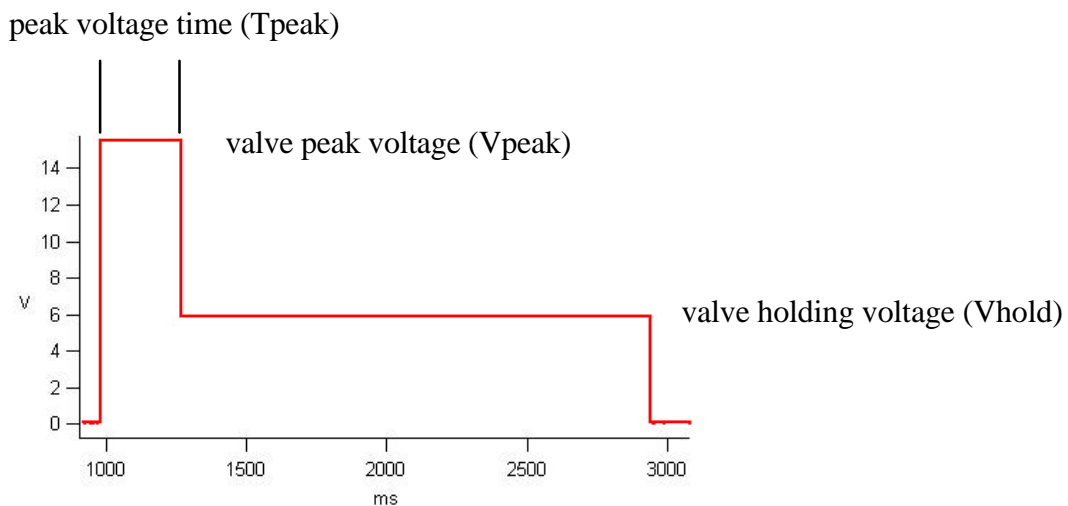
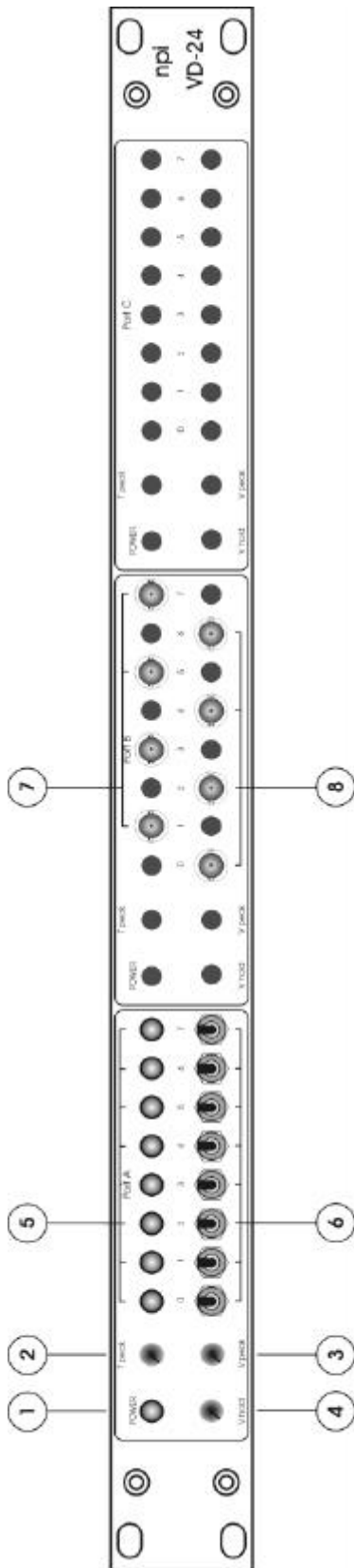


Figure 4: Example for the time course of the controlling voltage

3. Description of the Front Panel



- (1) POWER LED
Green LED that indicates that the VD-24-01 is connected to a power supply
- (2) Tpeak trim potentiometer
Potentiometer to set the duration of the peak (start-up) voltage for the valves
- (3) Vpeak trim potentiometer
Potentiometer to set the peak (start-up) voltage for the valves
- (4) Vhold trim potentiometer
Potentiometer to set the hold voltage for the valves
- (5) Status LEDs
LEDs that indicate the status of a valve, ON = valve activated (usually: open), OFF = valve deactivated (usually: closed); one LED for each valve
- (6) Valve switches
3-position toggle switches to activate a valve permanently (switch in upper position), to deactivate a valve (switch in middle position) or to activate a valve as long as the switch is pushed in the lower position; one switch for each valve.
- (7, 8) TTL IN connectors
BNC connectors for connecting an external triggering device. HI = valve activates, LO = valve inactivates.

Figure 5: Front panel view of VD-24-01

4. Operation

- ❑ Activate a channel either by software (CellWorks) using the I/O ports of the PCI-6503 (DIO 24) or manually by the respective toggle switch at the front panel or via TTL signal connected to the respective TTL IN BNC. Generally, the three possibilities to activate a channel are linked by “OR logic”. For example, if you want to control the valves exclusively by software set the toggle switches to the middle position and be sure that all signals at the TTL IN BNC connectors are LO.

Very Important: A maximum of three valves can be opened simultaneously! If you try to open more simultaneously, the voltage will break down and you have to reset the VD-24 manually by disconnecting the power supply! If you need to open more valves simultaneously please contact npj.

4.1. Grounding

If necessary the VD-24 can be grounded via the green / yellow banana plug at the rear panel. In case of noise connect this plug to the central ground of your setup e.g. amplifier ground. The banana plug is internally linked to the housing and the enclosure of the cable to the valve bench. It is not possible to predict whether measurements will be less or more noisy with the enclosure of the VD-24 connected to central ground. We recommend that you try both arrangements to determine the best configuration.

5. Technical Data

Power Outputs

Output voltage:	0 ... +32 V (depending on the input voltage and the adjusted control parameters V_{hold} and V_{peak})
Output current:	max. 0.5 A per channel
Number of channels:	8 (for 1 valve bench)
Output connector:	valve bench connector (9-pole SUBD)

Inputs

Power inputs:	+12 ... +36 V, power supply connector for one valve bench
Control Inputs:	- 50-pole connector for PCI-6503 (National Instruments), TTL compatible, impedance 5 k Ω , low level at <2 V - 8 BNC connectors, TTL compatible, impedance 5 k Ω , low level at <2 V

Control Parameters

Hold voltage (V_{hold}):	+2 ... +24 V, adjustable with trim potentiometer V_{hold} (front panel)
Peak voltage (V_{peak}):	+8 ... +32 V, adjustable with trim potentiometer V_{peak} (front panel)
Peak time (T_{peak}):	50 ... 250 ms adjustable with trim potentiometer T_{peak} (front panel)
Valve activation:	with I/O card (connector at the rear panel) or toggle switch (front panel)

Dimensions

19" rackmount cabinet, 19" (483 mm) wide, 14" (355 mm) deep, 1.75" (44 mm) high
weight: 3 kg