

OPERATING INSTRUCTIONS AND SYSTEM DESCRIPTION FOR THE

VD-24-03

VALVE CONTROLLER FOR 24 VALVES



VERSION 2.1
npi 2003

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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.
- 6) **POWER SUPPLY:** The power supply can drive up to three valves simultaneously (sufficient for most experiments). Other power supplies which can drive up to eight valves simultaneously are available on request.

2. VD-24 BPS Valve Driver System

2.1. General Description

The VD-24-03 BPS valve driver system is able to control a valve bench of 24 valves. The 24 valves are controlled in groups of eight valves. These groups are called “ports”, i.e. valves 1...8 are grouped in port A, 9...16 in port B and 17...24 in port C.

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 or manually via toggle switches for each valve at the front panel. A LED for each channel indicates the valve state. It is possible to control up to 24 valves with the VD-24-03. 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 other boards which provide TTL compatible I/O lines.

Each solenoid valve is activated by a TTL compatible pulse generated from 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 2). 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.

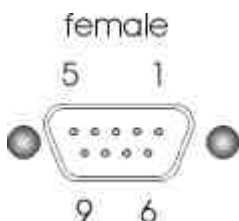
The following steps should give a quick overview of all functions and help you to understand and use the control functions. Power supply, I/O board and valve benches are connected at the rear panel.

2.2. Installation

In the following only the hardware installation of the valves of port A is described. Ports B and C are installed analogue.

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).



1 = valve 1	6 = valve 6
2 = valve 2	7 = valve 7
3 = valve 3	8 = valve 8
4 = valve 4	9 = COMMON
5 = valve 5	

I/O Board

Rear panel: Connect the I/O board to the VD-24-03 using the 50-pole SCSI ribbon cable plugged in the connector labeled PCI 6503 at the VD-24-01.

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 3).
- Set the duration of the peak voltage with the potentiometer labeled T_{peak} at the front panel (#2, Figure 3).
- Set the holding voltage with the potentiometer labeled V_{hold} at the front panel (#4, Figure 3).

Note: These settings apply to all eight channels of a port!

- Usually the VD-24-03 is used with the PCI-6503. Valves 1...8 are assigned to port A, valves 9...16 to port B and 17...24 to port C.

Configuration 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 1).

Configuration for port A (in CellWorks: Hardware configuration – Digital lines out – Digital out Port Assignment - Lines 08-15 assigned to PCI-6503, port B; see Figure 1).

Configuration for port A (in CellWorks: Hardware configuration – Digital lines out – Digital out Port Assignment - Lines 16-23 assigned to PCI-6503, port C; see Figure 1).

Note: CellWorks always starts counting with 0, i.e. valve 1 is assigned to line 00!!

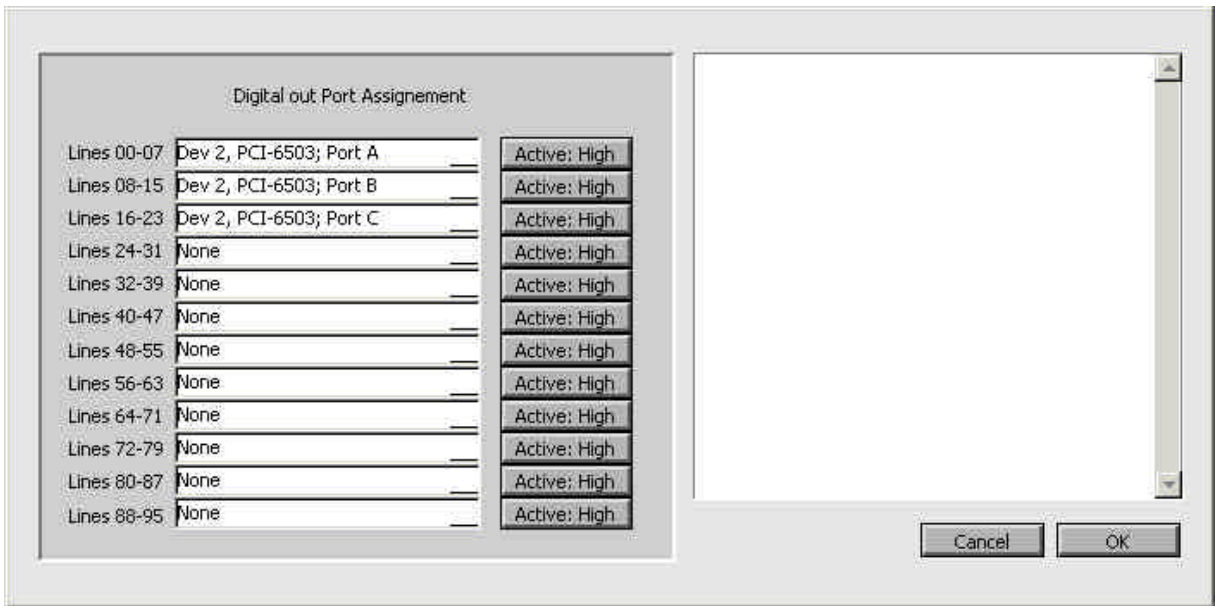


Figure 1: Configuration of digital ports in CellWorks 5.x using PCI-6503 from National Instruments with 24 digital I/O lines

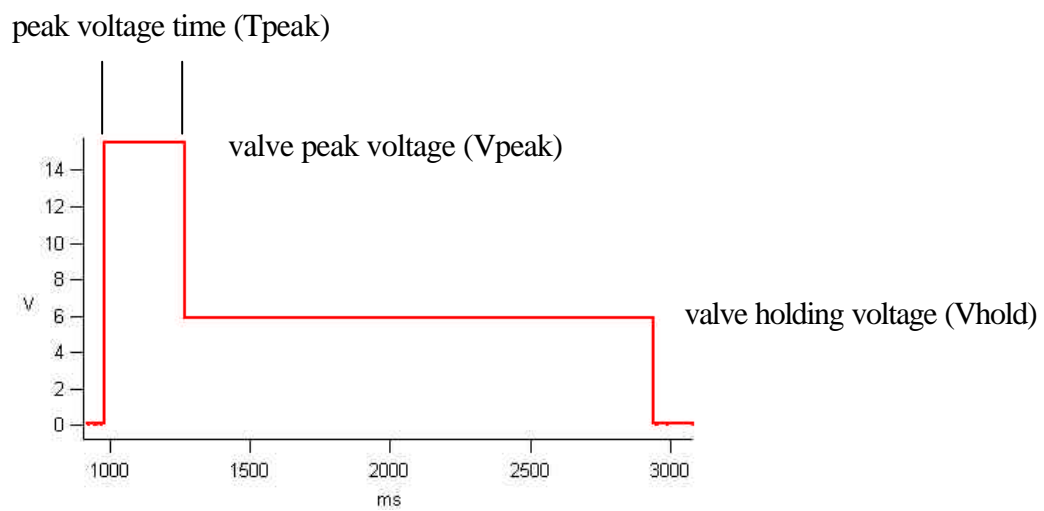


Figure 2: Example for the time course of the controlling voltage

3. Description of the Front Panel

In the following only the controls and indicators of port A are described. Ports B and C are operated analogue.

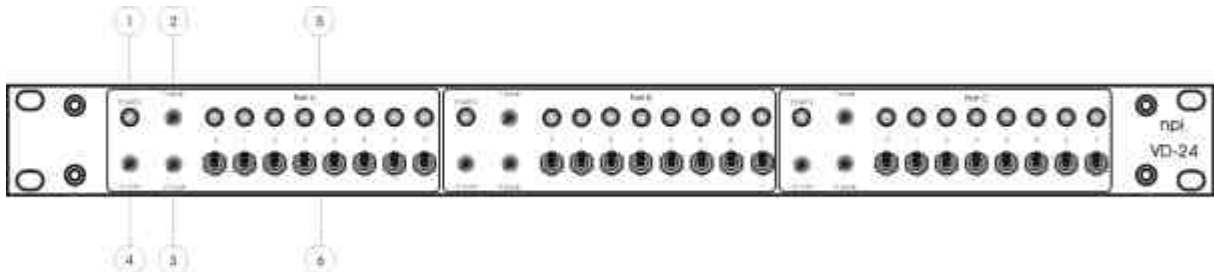


Figure 3: Front panel view of the VD-24-03

(1) POWER LED

Green LED that indicates that the VD-24-03 is connected to a power supply

(2) T_{peak} trim potentiometer

Potentiometer to set the duration of the peak (start-up) voltage for the valves

(3) V_{peak} trim potentiometer

Potentiometer to set the peak (start-up) voltage for the valves

(4) V_{hold} 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.

Note: The settings of #1, #2, and #3 apply to all eight valves of a port!

4. Operation

- ❑ Activate a channel either by software (CellWorks) using the I/O ports of a PCI-6503, or manually by the respective toggle switch at the front panel. Generally, the toggle switches override the settings by software. Thus, if you want to control the valves exclusively by software set the toggle switches to the middle position.

Note: The PCI-6024E has only eight digital lines for controlling maximal eight valves.

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 npi.

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:	24 (for 3 valve benches)
Output connectors:	valve bench connectors (9-pole SUBD)

Inputs

Power inputs:	+12 ... +36 V, power supply connector, one for each valve bench
Control Inputs:	50-pole connector for PCI-6503, 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}):	30 ... 300 ms adjustable with trim potentiometer T_{peak} (front panel)
Valve activation:	with I/O card (software) or toggle switches

Dimensions

19" rackmount cabinet, 19" (483 mm) wide, 10" (255 mm) deep, 1.75" (44 mm) high
weight: 3.5 kg