Nano
Switching Valve

User's Manual
P/N 162137

LC PACKINGS
A DIONEX Company

www.lcpackings.com

M1700R0

Notice: The Nano Switching Valve is covered by a limited warranty. A copy of this warranty is included with this manual. The customer is required to perform routine maintenance as described in the User's Manual on a periodic basis to keep the warranty in effect.

All information in this manual is subject to change without notice and does not represent a commitment on the part of LC Packings, BV.

The material included in this manual is provided to assist users in the operation, maintenance and repair of the Nano Switching Valve. It is assumed that the individual using this manual has sufficient training in the use of analytical instrumentation and is aware of the potential hazards including (but not limited to) electrical hazards, chemical solvent hazards and the exposure to pressurized solvents.

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Warranty

LC Packings (Netherlands) BV, warrants that the products manufactured and sold by it to be free from defects in material and workmanship for normal use and service from the date of delivery to original purchaser for a period of one (1) year from the date of shipment. This limited warranty does not cover, and no warranty is provided, for parts that by their nature are required to be replaced periodically as a function of use of the normal operation of the system. These items include, without limitation: HPLC columns, fuses, tubing, detector sources, pump piston seals, injector rotors, check valves, filters, any software, etc. In addition, damage due to corrosion, misuse, negligence, accident, alteration of the system or repair by an unauthorized individual is not covered by the warranty. It is understood that the performance characteristics of the instrument require that the mobile phase is degassed with He or vacuum degassed as described in the User's Manual.

This warranty covers products sold under the LC Packings trademark. If a different warranty than the above is indicated in the sales literature, the warranty indicated in the sales literature will prevail. If the system includes equipment supplied by LC Packings but manufactured by a third party, LC Packings makes no warranty of any kind, express or implied, including, without limitation, any warranty of merchantability or fitness for a particular purpose. LC Packings will make available to you, to the extent permitted, the warranties of the manufacturer of the relevant equipment following your timely written request.

If any product covered by this warranty becomes defective during the warranty period, it will be repaired or replaced by LC Packings at no charge to the customer (the repair/replace decision is solely at the option of LC Packings). All warranty requests must be received by LC Packings during the warranty period.

LC Packings will pay for surface transportation to the applicable LC Packings Office (North America – Sunnyvale CA, Europe and Asia - Amsterdam, the Netherlands), if the instrument proves defective within thirty (30) days from the date of shipment (this does not include air freight, drayage, labor, crating charges, customs clearance charges, etc.). The user should carefully follow the directions indicated on the Return Goods Instruction Sheet in the User's Manual. After thirty days, all transportation costs will be at the expense of the customer.

Liability

Under no circumstances shall LC Packings be liable for damage to persons or property. This warranty is the only warranty given by LC Packings with respect to products and software provided with the products and is given in lieu of all other warranties, express or implied, including, without limitation, any warranty of merchantability or fitness for a particular purpose.

Your exclusive remedies and LC Packings's sole liability for any non-conformity or defect in the products and such software will be those expressed herein. Under no circumstances will LC Packings's liability arising from the performance or failure to perform of any product or software, in contract, in tort (including negligence), or otherwise, exceed the purchase price of the product and software. In no event will LC Packings be liable, in contract, in tort (including negligence), or otherwise for special, incidental, consequential or analogous damages, including, without limitation, damages resulting from loss of use, loss

of profits, loss of business or loss of goodwill, even if LC Packings has been advised of the possibility of such damages.

This warranty comprises the entire warranty between LC Packings and the customer. It overrides any warranty related language that may appear in the customer purchase order or other documentation provided by the customer.

This warranty shall be governed by, and construed and enforced in accordance with, the laws of the Netherlands. It is non-transferable and shall run to the benefit of the original purchaser only. Any change, alteration or amendment to this warranty is not valid unless it has been approved in writing by an officer of LC Packings.

Warrantor North America	**Warrantor Europe and Asia**
LC Packings / Dionex	LC Packings (Netherlands) BV
	A Dionex Company
500 Mercury Drive	Abberdaan 114
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Tech Support: (800)-346-6390	

Instructions for Returning Instruments

Before you return any item for repair, please contact the nearest LC Packings office or its local distributor for instructions and obtain a return authorization number.

Pack the equipment carefully, preferably in its original shipping container and ship it to the LC Packings Service Department, using the appropriate address.

North America

LC Packings / Dionex

500 Mercury Drive
Sunnyvale, CA 94088-3603
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Abberdaan 114
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IMPORTANT:

1)   Make certain that the return authorization number is indicated on the address label of the package so that we can properly track and account for your system.

2)   Please include the following

 a)   Company letterhead with the following information.

- Your Name
- Complete Mailing Address
- Telephone Number, fax number and e-mail address
- Return Authorization Number
- A detailed description of the problem.
- The name of the LC Packings personnel to whom you have spoken to regarding the problem
- Return Shipping Information (if appropriate)

 b)   Relevant chromatograms

 c)   A purchase order (if the system is not in warranty)

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Warnings

The Danger sign, Warning sign and the Caution sign shown below are included in various locations in this manual. These signs provide the following information:

Danger: The information in a danger statement relates to a procedure, practice condition or action that if not done correctly or adhered to could lead to personal injury or loss of life.

Warning: The information in a warning statement relates to a procedure, practice condition or action that if not done correctly or adhered to could lead to severe injury and/or damage or destruction to parts or all of the equipment.

Caution: The information in a caution statement relates to a condition that could lead to damage to equipment and/or lead to invalid analytical results.

Note: The information in a note statement relates to important information that should be read and understood before continuing.

Safety Precautions

Note: The following precautions should be followed to minimize the possibility of personal injury and/or damage to property.

Note: Make certain that you are familiar with the contents of this manual before working on the system.

The Nano Switching Valve is typically incorporated into an LC/MS system. The user should follow all safety precautions, warnings, etc provided by the manufacturer of the system(s), in addition note the items presented below:

1) Install the system in a well-ventilated laboratory. If the mobile phase includes volatile or flammable solvents, make certain that they are not allowed to enter the workspace.

2) If the mobile phase includes volatile or flammable solvents, avoid open flames and sparks.

3) If a leak occurs, turn off power to the instrument and remedy the situation immediately.

4) All components of the system should be plugged into a common power line that is directly connected to a true ground.

5) Ensure that all components of the system are grounded to a true ground.

6) Repair or replace faulty power cords and all communication cables.

7) Many organic solvents and buffers are toxic. Make certain that you know the toxicological properties of all mobile phases that you are using.

8) The toxicological properties of many samples may not be well known. If you have any doubt about a sample, treat it as if it contained a potentially harmful substance.

9) Wear protective eye goggles when handling mobile phases or operating the instrument. An eye wash facility and a sink should be close to the unit. If any mobile phase splash on the eyes or skin, wash the affected area and seek medical attention.

10) Dispose of all waste mobile phase in an environmentally safe manner that is consistent with all local regulations. Do not allow flammable and/or toxic solvents to accumulate. Follow a regulated, approved waste disposal program. Never dispose flammable and/or toxic solvents through the municipal sewage system

11) Wear protective eye goggles when handling fused silica tubing (i.e. installation, cutting etc.)

12) If a buffer is used as a part of the mobile phase, flush the system with several volumes of a methanol/water (50/50) solution before it is shut down. This will prevent salt buildup inside the unit.

13) Do not use the instrument in ways other than those indicated in the instructions given in this manual.

$C\epsilon$

DECLARATION OF CONFORMITY

We **LC Packings Nederland BV**
A Dionex Company
Abberdaan 114
1046 AA Amsterdam
The Netherlands

declare that our product

Nano Switching Valve

is in confirmation with the following documents:

EEC directives 89/392, incl. 91/368 and 93/44 (machine safety) and EEC directives 73/23 and 93/68 (low voltage safety), applied with the following standard:

EN61010-1   Safety requirements for laboratory equipment
(Class I, Installation cat. II, Pollution degree II)

WARNING

LC Packings will not accept any liability for damages direct or indirect caused by connecting this instrument to devices which do not meet relevant safety standards.

EEC directives 89/336 and 92/31 (EMC requirements), applied with the following standards:

EN 50081-1   Generic emission standard
EN 50082-1   Generic immunity standard
EN 61000-3-2   Harmonic current emissions

Use shielded cables and connectors for all remote connections.

Amsterdam, April11, 2003

Robert van Ling, QA manager

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Introduction

1.1 Features of the Nano Switching Valve

The LC Packings Nano Switching Valve is an advanced valve switching system for use with the LC Packings *UltiMate™* Dual Gradient Capillary HPLC System (or other manufacturer's parallel Nano-HPLC systems with similar capabilities).

The instrument incorporates the following features:

- A Valco ultra-low dwell volume 1/32" 6-port Nano switching valve which allows for the connection of capillary and Nano HPLC columns without any dead volume.

- Two Nano LC systems can be connected to one mass spectrometer to significantly increase the sample throughput.

- Automatic control of the valve by the CHROMELEON® Chromatographic Management software and other manufacturer's software packages that support the LC Packings *UltiMate* System.

- Manual control at any time, even when a program is running.

- LED's which indicate the present status of the switching valve (microfluidic pathways).

The Nano Switching Valve can be used for a broad variety of applications. Typically the valve is used in post column switching applications.

The instrument is fully compatible with other instrumentation (a minimum of one contact closure, TTL or Open Collector terminal is required).

1.2 Front View of Nano Switching Valve

FIGURE 1-1 Front View Nano Switching Valve

1.3 Rear View of Nano Switching Valve
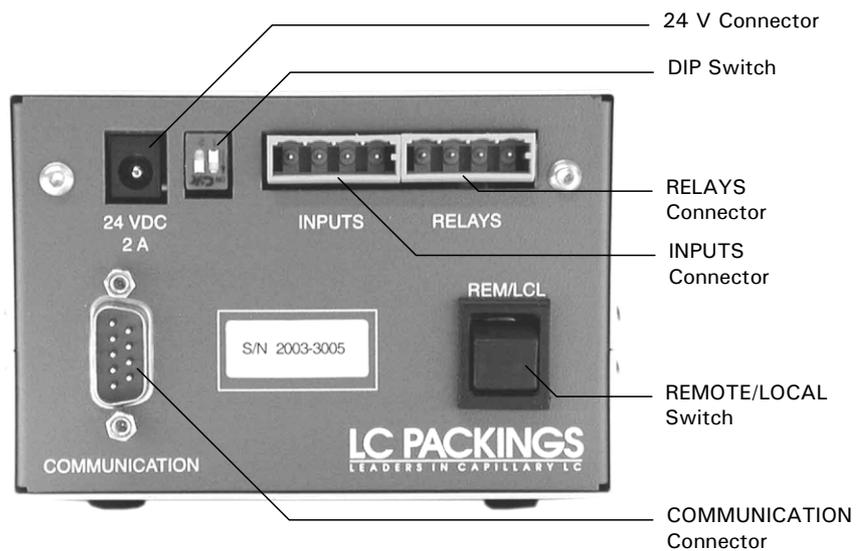
FIGURE 1-2 Rear View Nano Switching Valve

1.4 About this Manual

This manual describes the LC Packings Nano Switching Valve and includes the following information:

CHAPTER 1: *Installation and Getting Started* describes how to install the Nano Switching Valve in conjunction with the LC Packings *UltiMate* Dual Gradient System. It includes the various steps that should be performed to setup the system, to control the valve by an event output, to set up the CHROMELEON® software and to prepare the system for operation.

CHAPTER 2: *Maintenance and Troubleshooting* describes a variety of maintenance procedures to optimize the performance of the Nano Switching Valve. In addition, it discusses how the operator can determine the cause of a difficulty in the operation of the instrument and includes a list of spare/replacement parts.

CHAPTER 3: *Specifications* presents the specifications of the Nano Switching Valve.

If you are using the Nano Switching Valve in conjunction with the LC Packings *UltiMate* Dual Gradient Capillary HPLC System and/or CHROMELEON software, please refer to the documentation provided with these products for supplemental information.

The Nano Switching Valve is used with other manufacturer's equipment (e.g. a mass spectrometer). The manuals provided with these systems should be consulted for additional information such as interfacing requirements.

1.5 Control of the Nano Switching Valve

The position of the Nano Switching Valve is controlled by the event output No. 7 (Relay 1) of the loading pump of the Switchos™ Advanced Microcolumn Switching Unit.

The instrument is fully compatible with other instrumentation (a minimum of one contact closure, TTL or Open Collector terminal is required).

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CHAPTER 2 # Installation and Getting Started

2.1 Installation

The instructions provided below are provided for installation of the LC Packings Nano Switching Valve as part of the LC Packings *UltiMate*™ Dual Gradient Capillary HPLC System as well as installing the instrument as a component in an HPLC system of other manufacturers.

Chapter 2 provides the following installation information:

- Installing the Nano Switching Valve with the *UltiMate* Dual Gradient System (Section 2.3).

- Electrical Connections (Section 2.3.2).

- Fluidic Connections (Section 2.3.3).

When the Nano Switching Valve is used in conjunction with the *UltiMate* system and the FAMOS™ Microautosampler, please refer to the User's Manuals supplied with these units for additional information.

2.1.1   Location of Nano Switching Valve in the LC/MS System

The Nano Switching Valve is placed between the two Nano separation columns and the mass spectrometer interface. If a UV Detector is part of the instrumental set-up, the Nano Switching Valve is placed between the two Nano separation columns and the UV Detector. The location of the valve should be near to the MS to keep connecting tubing short. All equipment should be installed in a facility with the following environmental conditions

- The temperature range should be maintained between 10 and 40°C. The system should be installed in an area in which the temperature is fairly constant (do not place the system near a window, an air conditioning duct or a heating duct). The humidity should be maintained between 20 and 80 % relative humidity.

- If flammable or toxic solvents are to be used, a suitable ventilation system should be provided.

- The use of open flames in the laboratory should be prohibited.

- Corrosive vapors or dust should not be present as these materials can adversely affect the long-term performance of the system.

The Nano Switching Valve requires approximately 110 mm (4.3") of linear bench space. The power consumption of the Nano Switching Valve is 50 VA.

⚠ **CAUTION** **Caution: Do not install the Nano Switching Valve in areas subject to shock, dust, or in direct sunlight.**

2.2 Unpacking

When the Nano Switching Valve is received, carefully unpack the unit and verify receipt of all components according to the packing list (some components include sub-packing lists). It is recommended that all packing materials be saved in the event that it is necessary to return any item to the factory.

If there is external damage to the shipping box, the damage should be reported to the shipping agent and LC Packings upon receipt of the goods. If internal damage is observed or if any items are missing, this should be reported to the shipping agent and to LC Packings as soon as it is observed.

⚠ **CAUTION** **Caution: If there is any apparent damage to the instrument, the user should investigate the nature of the damage before plugging the unit into the mains to ensure that powering up of the instrument will not create a hazardous condition or damage internal components. If the damage appears significant, call LC Packings or its local representative before connecting the unit to the mains.**

2.3 Installing the Nano Switching Valve with the *UltiMate* Dual Gradient System

The following section describes how to install the Nano Switching Valve as a component in the LC Packings Dual Gradient *UltiMate* Capillary HPLC system.

2.3.1 System Overview

The Nano Switching Valve is placed between the two Nano separation columns and the mass spectrometer interface (FIGURE 2-1). If a UV Detector is part of the instrumental set-up, the Nano Switching Valve is placed between the two Nano separation columns and the UV Detector. The location of the valve should be near to the MS to keep connecting tubing short.
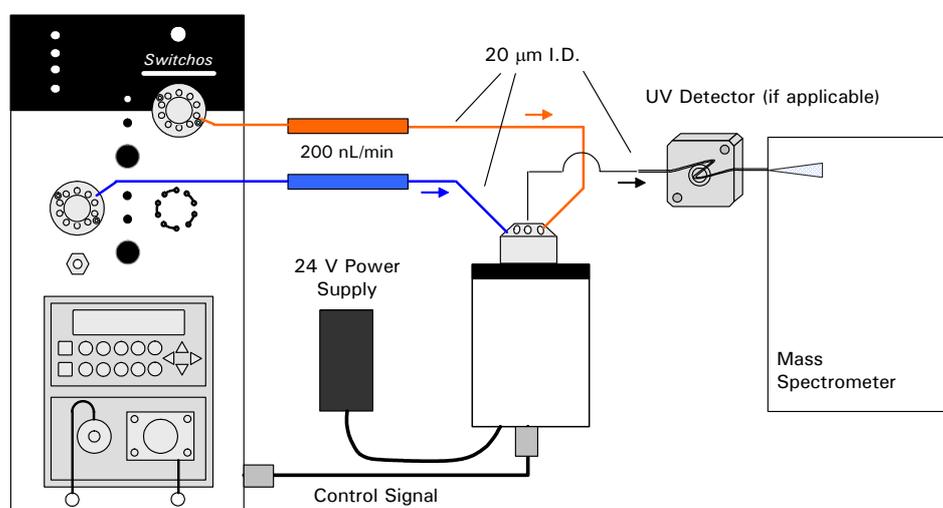
FIGURE 2-1   System Overview with the Nano Switching Valve

2.3.2 Electrical Connections

The Nano Switching Valve is controlled by the event output No. 7 (Relay) of the loading pump of the Switchos Advanced Microcolumn Switching Unit.

All electrical connections are made on the rear panel of the instrument (FIGURE 1-2).

⚠️ **CAUTION** **Caution: Avoid touching the electrical contacts on the terminal strips. Electrostatic discharges could damage internal components. The manufacturer will not accept any liability for damages directly or indirectly caused by connecting the Nano Switching Valve to instruments which do not meet relevant safety standards.**

2.3.2 A   INPUTS Connector

Use the supplied I/O cable (FIGURE 2-2) to connect the Nano Switching Valve and the event output No. 7 (Relay) of the loading pump of the Switchos™.

Covers removed to show details

white   brown

brown   white

To Nano Switching Valve INPUTS	
Signal	**Pin No.**
Position A	1
GROUND	3

From Switchos EVENTS		
Signal	**Color**	**Description**
Relay 1	brown	
Relay 1	white	
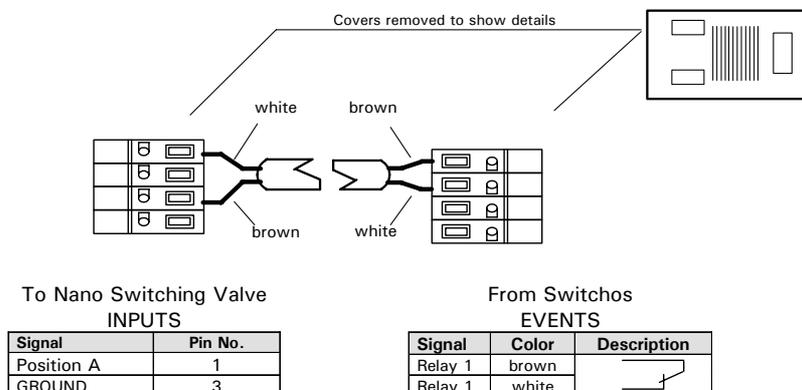
FIGURE 2-2 The I/O Cable

To connect the I/O cable:

a) Connect the 4-pin female connector labeled 'Inputs' to the INPUTS terminal of the Nano Switching Valve.

b) Connect the 4-pin female connector labeled 'Switchos Pump' to the EVENT 7 and 8 terminal of the Switchos loading pump.

If the Nano Switching Valve is to be installed as a component in an HPLC system of other manufacturers, please refer to TABLE 2-1 and Section 3.4.

TABLE 2-1   The INPUTS Connector

Pin Number	Description	
1	Position A Input	
2	Position B Input	
3	Ground	
4	(24V)	**INPUTS**

⚠ **CAUTION** **Caution: If the controlling device does not offer a potential free contact closure output, make certain that the polarity is correct (e.g. connect the ground pin of the Nano Switching Valve to the ground pin of the controlling device). The output signal of the controlling device must be TTL level compatible.**

2.3.2 B   COMMUNICATION Connector

The COMMUNICATION connector is used to change the input (operating) mode of the Nano Switching Valve (FIGURE 1-2) and can be used to control the device by a COM port of the PC (the RS-232 control is not yet supported by CHROMELEON).

2.3.2 C   RELAY Connector

The RELAY outputs serve to indicate the current valve position (e.g. if the Nano valve is in position 1-2 the 'Relay A' output is active). Refer to APPENDIX A for more details about the RELAY output.

TABLE 2-2   The RELAY Output

Output	Pin No.	Description	
Relay A (Position 1-2)	1		
	2		
Relay B (Position 6-1)	3		**RELAYS**
	4		

2.3.2 D   POWER Connector

Since the valve control module is shipped with a universal power supply for input voltages from 100 to 240 VAC, manual voltage setting is not required. The power cable should be inserted in the black socket labeled '24 VDC' on the left side of the rear panel (FIGURE 1-2).

2.3.3   Fluidic Connections for Fraction Collection

The Nano Switching Valves should be installed as near as possible to the *UltiMate* Capillary HPLC system. FIGURE 2-3 presents the fluidic connections of a Parallel Nano LC application.
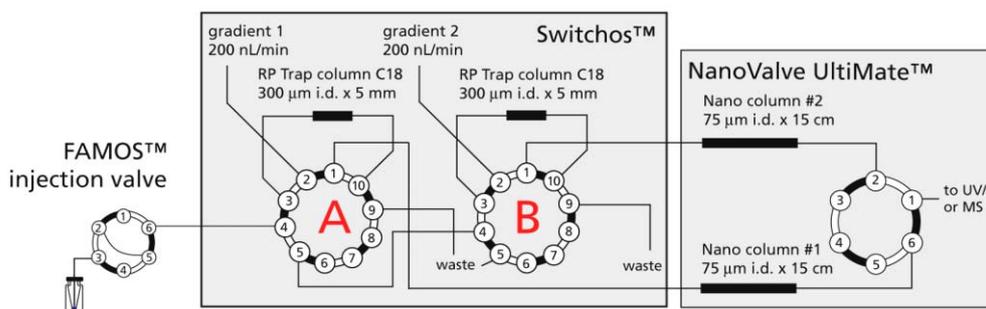
FIGURE 2-3   Fluidic Connections for a Parallel Nano-LC Application

2.3.3 A   Connecting the Nano Valve

For the Nano flow connections 280 μm O.D. and 20 μm I.D. fused silica tubing is provided and should be used. The same tubing can is used for the waste connections. Different techniques are used to connect the individual components (see also the fluidic diagram FIGURE 2-3):

- All tubing on the Nano Switching Valve is connected by means of the supplied 1/32″ one-Piece fittings and sleeves.

- All tubing on the Switchos valves is connected by 1/16″ one-piece fittings and the appropriate sleeves.

- Some connections do not have to withstand high pressure and therefore standard Teflon® sleeves are used (e.g. the connection to the MS).

⚠️ **CAUTION**

Caution: Do not use any connections other than the one-piece 1/32" fittings (P/N 162132) and sleeves (P/N 162139) supplied with the Nano Switching Valve. Using standard connections (e.g. Vici/Valco 1/32" zero dead volume nuts and fittings) may damage the valve fitting details or introduce dwell ('dead') volumes.

👉 **Note: For optimal connection, always make certain that all capillaries present a clean square cut.**

👉 **Note: It is recommended that metal tubing is not employed with the Nano Switching Valve..**

To connect the fused silica tubing to the Nano Switching Valve:

a) Remove the fused silica outlet tubing of Nano column 2 (connected to Switchos valve B) and connect the column outlet to port 2 of the Nano valve (FIGURE 2-4). Use a piece of the 280 μm O.D. / 20 μm I.D. fused silica capillary (P/N 160475) and a 300 μm PEEK sleeve (P/N 162139).
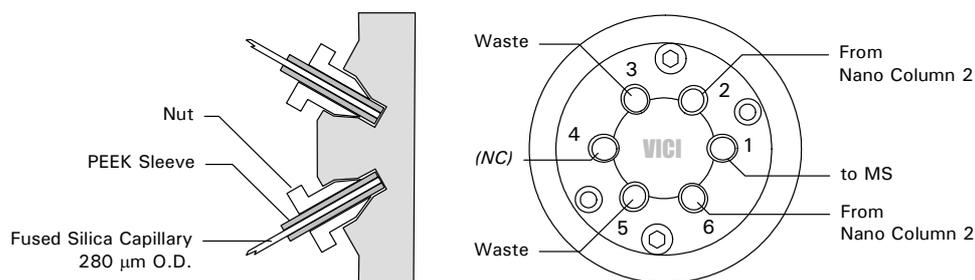
FIGURE 2-4   Connecting the Nano Valve

b) Connect a piece of the same 280 μm O.D. fused silica tubing to port 1 of the Nano valve using a 300 μm PEEK sleeve. Connect the other side to the MS spray capillary, this is normally done by using a standard Teflon sleeve connector (e.g. use P/N 160489 to connect 280 μm fused silica capillaries).

c) Remove the fused silica outlet tubing of Nano column 1 (connected to Switchos valve A) and connect the column outlet to port 6 of the Nano valve (FIGURE 2-4). Use the same 280 μm O.D. fused silica capillary and 300 μm PEEK sleeve.

👉 **Note: For optimal performance it is important to keep all connections as short as possible. The length of fused silica tubing that is required is dependent on the location of your Mass spectrometer, the *UltiMate* system and the Nano Switching Valve.**

d) Port 3 and 5 are waste lines. Use two pieces of the 280 μm O.D. fused silica tubing for the waste connection.

2.3.3 B   Preparing a low pressure Teflon sleeve connection

The column outlets of the Nano columns 1 and 2 are connected with a low pressure Teflon sleeve. Most often the MS interface uses the same type of connection.

To prepare a low pressure Teflon sleeve connections:

a) Select a Teflon sleeve connector that matches the O.D. of the capillary you want to connect (e.g. use P/N 160489 to connect 280 μm fused silica capillaries).

b) Put the end of one capillary you want to connect completely all the way through the Teflon Peek sleeve so that its end extends by approximately 5 - 10 cm.

c) Cut a 1-2 cm piece from the end of the capillary and pull the capillary back through the sleeve until the end is positioned in the middle of the sleeve.

d) Connect the other capillary end (FIGURE 2-5). The connection can withstand pressures up to 10 bar (150 psi).

Teflon Connector

Fused Silica Capillary
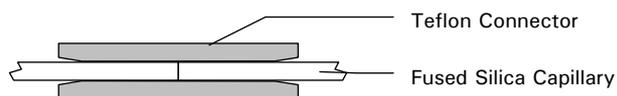
FIGURE 2-5   Low Pressure Connection using a Teflon Sleeve

2.3.4   Installing a WAGO Type Connector

The following section describes how to attach the supplied WAGO type connectors to a cable.

To prepare a connection using a WAGO type connector:

a) Insert the rounded end of the lever latch into the square opening of the selected connector of the plug strip (item 1, FIGURE 2-6).
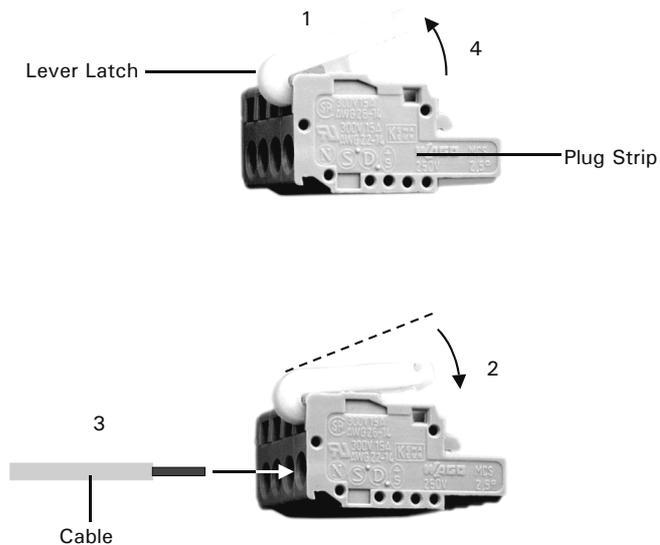
FIGURE 2-6 Connector for Terminal Strips

b) Press the lever latch down as indicated by the arrow so that it is flush with the top of the plug strip (item 2, FIGURE 2-6).

c) Insert the uninsulated end of the wire into the opening under the catch (item 3, FIGURE 2-6).

d) Release the catch and remove the lever latch from the plug (item 4, FIGURE 2-6).

e) The cable is now firmly anchored in the plug strip.

⚠ **CAUTION** **Caution: Avoid touching the electrical contacts on the terminal strips of the instrument. Electrostatic discharges could damage internal components.**

Using the Nano Switching Valve

3.1 Overview

The following sections provide information how to use and control the Nano Switching Valve:

- Control of the Nano Switching Valve (Section 3.2)

- Control of the Nano Switching Valve using CHROMELEON (Section 3.3).

- Using other Software Packages or other Manufacturer's Equipment (Section 3.4)

3.2 Control of the Nano Switching Valve

The Nano Switching Valve can be operated in remote and in local mode. In local mode the position of the Nano valve is controlled by the Manual Switch on the front panel. In remote mode the inputs Position A and B of the INPUTS connector define the position of the valve. The current valve position is indicated by the two Position LEDs 'pos 1-2' and 'pos 6-1'.

The remote mode of the Nano Switching Valve can be adjusted to meet the needs of the driving device (e.g. single line control by input A or control by input A and B). Refer to APPENDIX A for more details about reprogramming the input mode and the setting of the DIP switch. The default input mode is Input Mode 3.

3.2.1   Local Mode vs. Remote Mode

LOCAL mode - when the REM/LCL switch is set to LOCAL mode (the switch is set to the lower position), the unit can be controlled on a local basis by the switch on the front panel (FIGURE 1-1). Any change that is made will override the present condition (regardless of whether it was set via Local or Remote Control). When the unit is in LOCAL mode, the INPUTS connector is disabled.

REMOTE mode - when the REM/LCL switch is set to REMOTE mode (the switch is in the upper position) the instrument is controlled by an external device. In this mode, the INPUTS connector is enabled and the switch on the front panel is deactivated. The Nano valve will be positioned according to the current signals of the INPUTS connector.

☞ **Note: If the instrument is in REMOTE control mode and the INPUTS connector on the rear panel is not connected, the Nano valve is "locked" in position '1-2'.**

3.3   Control of the Nano Switching Valve using CHROMELEON

The following section describes how to setup the CHROMELEON software to control the Nano Switching Valve. It is assumed that the user has a basic understanding of the CHROMELEON software and its modules.

3.3.1   Control from the Panel

The position of the valve can be changed from the CHROMLEON panel. The CHROMELEON (version 6.50 SP2) Service Pack CD provides a predefined panel for the control of the *UltiMate* Dual Gradient and the Nano Switching Valve in a parallel Nano LC application ('DualGradUlt_ParLC.pan'). The panel is shown in FIGURE 3-1.
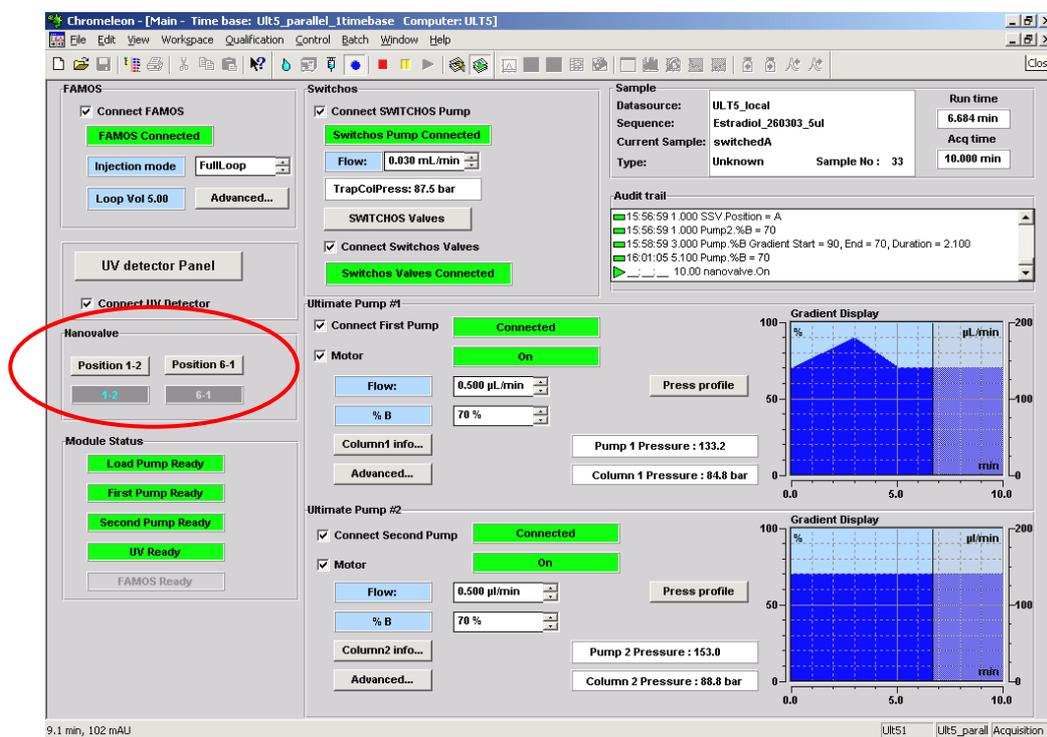
FIGURE 3-1   CHROMELEON Panel for Parallel Nano LC

The two buttons indicated in the Nanovalve region (FIGURE 3-1) control the position of the Nano Switching Valve. A click on the button will change the valve position to the corresponding position.

A detailed description of the features of CHROMELEON is provided in Software Manual provided with CHROMLEON and in the *UltiMate* User's Manual.

3.3.2   Control in a CHROMELEON Program File

In Parallel LC the Nano valve is switched during a program to connect one column outlet at a time to the mass spectrometer (FIGURE 2-1). The position of the valve is controlled by the status of the event output 7 (relay1) output of the Switchos loading pump.

The status of the relay can be either 'On' or 'Off'. The two possible situations are presented below:

nanovalve.State = Off   *;Nano valve position 1-2, column 2 is connected to MS*

nanovalve.State = On   *;Nano valve position 6-1, column 1 is connected to MS*

Refer to the documentation provided with the *UltiMate* Dual Gradient Capillary HPLC System to get more information about programming. In addition, various examples of CHROMELEON programs are provided.

3.4 Using other Software Packages or other Manufacturer's Equipment

The Nano Switching Valve can be controlled through any relay output of the *UltiMate* system or any other system. If you are using a different software package than CHROMELEON to control the *UltiMate* System, please refer to CHAPTER 2 for details about installing the unit and the documentation provided with your mass spectrometer software for details how to program the relay outputs of the *Ultimate* system. If you are using a different HPLC system than the *UltiMate* system to control the Nano Switching Valve, please refer to the documentation provided this system for details about using relay outputs and to CHAPTER 2 for details about installing the unit.

CHAPTER 4

Maintenance and Troubleshooting

4.1 Overview

This chapter provides information to assist in optimizing the performance of the Nano Switching Valve and maintaining it in your laboratory. It includes the following material:

- **Maintenance** - describes a series of activities that should be performed on a periodic basis to optimize the performance of the system and minimize down time (Section 4.2).

- **Replacing Components** – provides directions for replacing components due to wear or to re-configure the system (e.g. changing the syringe) to meet the requirements of a different analytical procedure (Section 4.3).

- **Troubleshooting** - discusses a series of activities that should be used to determine the cause of a problem (Section 4.5).

- **Spare Parts Lists** – Presents a listing of components that are used to maintain the unit or to change the configuration (Section 4.6)

4.2 Maintenance

Maintenance refers to a variety of activities that should be performed on a routine basis to optimize performance of the system. Many routine maintenance activities can be readily performed by the user.

In some cases (e.g. replacement of critical components), we recommend that a factory trained service engineer should be called to perform the operation. This will ensure optimal long term performance and maximum uptime. LC Packings provides a broad range of service support activities to ensure that the Nano Switching Valve is functioning in a suitable manner. These activities can be customized to meet the specific needs of the customer. For further information, please contact your local LC Packings office or representative.

TABLE 4-1   Recommended Maintenance Schedule

Frequency	Operation
Every Day	Before operating, check for any air bubbles in the fluidic lines and degas the wash solvent.
	Check that there are no leaks of the fluidics connections.
	Check that salts are not deposited by the fluidics joints or the needle.
	When using buffer solutions, flush the system thoroughly after use with a solvent that does not contain buffers/salts.
Every 3 months	Inspect the condition of all tubing (cracks, nicks, cuts, clogging).
Every year	Replace: Rotor seal of the Nano valve
	Check: Stator of the Nano valve

☞ **Note: The frequency of the various activities described above is a good starting point. As the user gains experience with the system, it will be found that some activities can be done less frequently and other need to be done more frequently. The frequency is dependent on a number of factors including the nature of the sample and the mobile phase.**

4.3 Replacing Major Components

A variety of components on the Nano Switching Valve can be readily changed by the user as required to ensure that the instrument is maintained in optimal condition.

In most cases, re-assembly of a component is identical to its disassembly, except that the steps are performed in the reverse order. If no comment is made, it should be assumed that the assembly of a component or installation of a component is identical to disassembly or removal, except that the actions are in the reverse order.

4.4 The Nano Valve

The LC Packings Nano Switching Valve is equipped with a Model CN2 1/32" Cheminert® 6-Port Nanovolume Switching Valve manufactured by Valco Instruments, Co. Inc. This valve is designed to offer optimal results with the switching system as it is made from materials that are inert to materials used in liquid chromatography and is designed to provide exceeding low carryover when switched.

☞ **Note: A detailed discussion on the Installation, Use and Maintenance of the valve is presented in Technical Note 813 from Valco Instruments, Co. Inc. and can be obtained at the Valco website (www.Valco.com)**

4.4.1 Cleaning and Replacing Parts

In most instances, the only maintenance that is required is cleaning of the valve. Cleaning can often be accomplished by flushing all the lines with an appropriate solvent(s). The selection of the solvent is dependent on the nature of the sample and the mobile phases that are used. Typically solvents such as methanol, acetonitrile, methanol/water (80/20) or acetonitrile/water (80/20) should be used.

☞ **Note: Do not disassemble the valve unless system malfunction is definitely isolated to the valve.**

☞ **Note: Do not remove the valve assembly from the actuator unless it is absolutely required. Getting the valve assembly and the actuator realigned can be problematic; with a 0.1 mm (.004") flow path, there is little room for error.**

4.4.1 A   Disassembly of the Valve

To disassemble the valve:

a)   Use a 9/64" hex driver to remove the socket head screws which secure the cap and stator to the valve body (FIGURE 4-1).
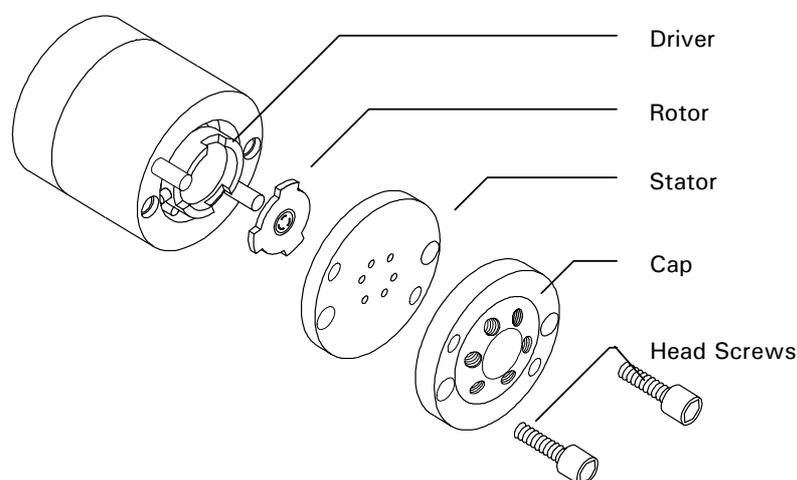

Driver

Rotor

Stator

Cap

Head Screws

FIGURE 4-1   Exploded View of the Nano Valve

b)   The cap has one polished sealing surface on the bottom and the stator has sealing surfaces on its top and bottom. To insure that the sealing surfaces are not damaged, rest the cap on its top face and rest the stator on a clean soft surface.

c)   With your fingers or a small tool, gently pry the rotor away from the driver (FIGURE 4-1).

d)   Examine the rotor sealing surface for scratches. If you see any, the rotor must be replaced.

e)   Examine the stator and cap sealing surfaces. If scratches are visible between the ports, that part must be replaced or resurfaced. Contact LC Packings for help in determining if resurfacing is feasible.

f)   Clean all the parts thoroughly with an appropriate solvent, taking care that no surfaces get scratched.

☞   **Note: The most common problem in the use of the valve with HPLC is the formation of buffer crystals, which are usually water-soluble. After cleaning, it is not necessary to dry the rotor.**

4.4.1 B   Reassembly of the Valve

To reassemble the valve:

a) Replace the rotor in the driver, making sure that the rotor sealing surface with its engraved flow passages is facing out. The pattern is asymmetrical to prevent improper placement.

b) Replace the stator onto the body, making sure that the top side faces out. The two sides can be distinguished by the fact that the bottom has smaller holes and the top has larger conical holes.

c) Replace the cap. Insert the two socket head screws and tighten them gently until both are snug.

⚠ **CAUTION** **Caution: Do not overtighten the screws, they simply hold the assembly together and do not affect the sealing force, which is automatically set as the screws close the cap against the valve body.**

d) Test the valve by pressurizing the system. If the valve does not hold pressure it should be returned for repair.

☞ **Note: When re-installing the valve, make certain that the proper tubing is attached to the appropriate fitting.**

⚠ **CAUTION** **Caution: Do not use any connections other than the one-piece 1/32″ fittings (P/N 162132) and sleeves (P/N 162139) supplied with the Nano Switching Valve. Using standard connections (e.g. Vici/Valco 1/32″ zero dead volume nuts and fittings) may damage the valve fitting details or introduce dwell ('dead') volumes.**

4.5 Troubleshooting

Troubleshooting refers to the determination of the cause of a problem. Since the Nano Switching Valve is typically incorporated into an HPLC system, the first step is to determine if the problem is due to this unit. The Nano Switching Valve should be removed from the system and an injection should be performed. Compare the results from the two runs; if the observed results without the unit present acceptable data, the problem is most likely due to the Nano Switching Valve.

Analytical problems also might be caused by external influences, like temperature and/or light sensitive samples. For this reason it is important to be sure the application was running without problems before and nothing has been changed.

TABLE 4-2   Troubleshooting the Nano Switching Valve

Problem	Probable Cause	Solution
LED A and LED B are NOT illuminated	No power	Check the connections of the 24 V power supply
LED A and LED B are illuminated at the same time	The Nano Valve does not switch …	Disconnect/ the 24 V power supply and connect it again to reset the error
	• due to valve sticking	Clean Valve
	• clamp ring slippage	*Contact LC Packings*
	• other positioning problems	*Contact LC Packings*
The Nano valve does change its position	No control signal	Check the connections
	Both inputs are active at the same time	Check the connection to the MS and for a short circuit between white and green cable (wire #5 and 6)
	Wrong input mode	Check/change input mode
	Wrong DIP switch Setting	Check/change Setting
In 'Toggle Mode' (Mode 2) the Nano valve remains in Position A	The control module is operated in Input Mode 1 rather than in Input Mode 2	Change to Input Mode 2
The micro valve switches to position B, but it switches back after short delay.	The control signal is applied to Input B rather than to Input A (Mode 2)	Check the connections
The Manual switch must be switched two times before the valve switches (Mode 2)	*Correct function*	-

4.6 Spare Parts Lists

4.6.1   Major Items

Part Number	Description
161734	Nano Switching Valve for Parallel LC for Dual Gradient UltiMate™ System
162137	User's Manual for the Nano Switching Valve

4.6.2   Accessories

Part Number	Description
162132	1/32" Fitting for Nano Switching Valve, 6 pcs.
162139	1/32" PEEK sleeve, 3 cm, 300 μm I.D. (6 pcs)
160475	Fused Silica Tubing I.D. 20 μm / O.D. 280 μm, 5 m
160483	Cutter for fused silica tubing (cleavage stone)
160071	Solvent organizer communication cable
162131	I/O cable for Nano Switching Valve
160081	Connector set

4.6.3   Spare Parts

Part Number	Description
162129	Rotor seal 6-port Nano Switching Valve
162128	Stator/insert for 6-port Nano Switching Valve, 0.10 mm

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CHAPTER 5 # Specifications

5.1 General

5.1.1 Physical

Dimensions (WxDxH)	110 mm (4.3 in) x 260 mm (10.5 in) x 75 mm (3.0 in).
Weight	2.1 kg

5.1.2 Electrical Connections

24 VDC / 2 A	DC Power Supply, 24 V DC / 2 A
INPUTS	2x TTL (Position A Input , Position B Input) 1x 24 VDC / 2A
RELAYS	2x Relay (normally open)

5.1.3 DC Power Supply

AC Input	100 - 240 V, 50 - 60 Hz, 50 VA
DC Output	24 V DC / 2 A

5.2 Fluidics

5.2.1 1/32″ Cheminert[®] 6-Port Nanovolume Switching Valve

Port-to-Port volume	< 25 nL
Bore size	100 μm (.004")
Fittings detail	1/32″

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Changing the Operating Mode of the Nano Switching Valve

A.1   Overview

The format of the control signal provided by the controlling device may require an adjustment of the operating mode of the Nano Switching Valve. Changing the operating mode includes the adjustment of the input mode as well as the proper setting of the DIP switch. In conjunction with the *UltiMate* Dual Gradient Nano HPLC System, no further adjustments are required.

To interface the unit to other controlling devices than the *UltiMate* system, the two inputs lines (Input A/B) of the INPUT connector (Section 2.3.2 A) can be programmed for different input modes via the COMMUNICATION input. In addition, the DIP switch on the rear panel (FIGURE 1-2) needs to be set according to the programmed input mode. Four different input modes are available:

- **Input Mode 1** - the position of the micro valve is defined by the status of Input A and the status of Input B.

- **Input Mode 2** - the position of the micro valve will toggle each time a signal is applied to Input A.

- **Input Mode 3** – (default mode) the position of the micro valve is directly controlled by the status of Input A.

- **Input Mode 4** – inverted Input Mode 3

The following sections provide information about the different input modes and how to reprogram and setup the valve:

- Input Mode 2 vs. 3 – Section A.1.1

- Input Mode 1 and 4 – Section A.1.2

- Reprogramming the Nano Switching Valve – Section A.1.3

A.1.1 Input Mode 2 vs. 3

FIGURE A-1 presents two different control output signals available from the controlling device and the resulting valve position when operated in input mode 2 and 3.

- **Input Mode 3** (single line control, default mode) – the position of the Nano valve is directly controlled by the status of Input A. When the Input A is connected to Ground, the valve will move into position 6-1. An open input will drive it back to position 1-2. In addition, the Input B is used as enabling/disabling signal. Connecting the Input B to Ground enables the valves while an open input will disable it. Switching the DIP switch #2 ON (lower position) connects Input B internally to Ground and enables the valve, e.g. no external enable signal is required (FIGURE A-2, Mode 3).

- **Input Mode 2** (toggle mode) – the position of the Nano valve will toggle each time an active signal (connection to Ground) is applied to Input A. When operating the Nano Switching Valve in this input mode it is recommended that you use the manual switch to set the valve in a defined position (e.g. 1-2) prior starting the separation. Applying an active signal (connection to Ground) to Input B will toggle the valve position and toggle it again after a programmed delay (Section A.1.3-B). DIP switch #2 must be switched to OFF (FIGURE A-2, Mode 2).

☞ **Note: When operating the Nano Switching Valve in Input Mode 2, please note that you have to switch the manual switch (FIGURE 1-1) two times to change the position of the Nano valve.**
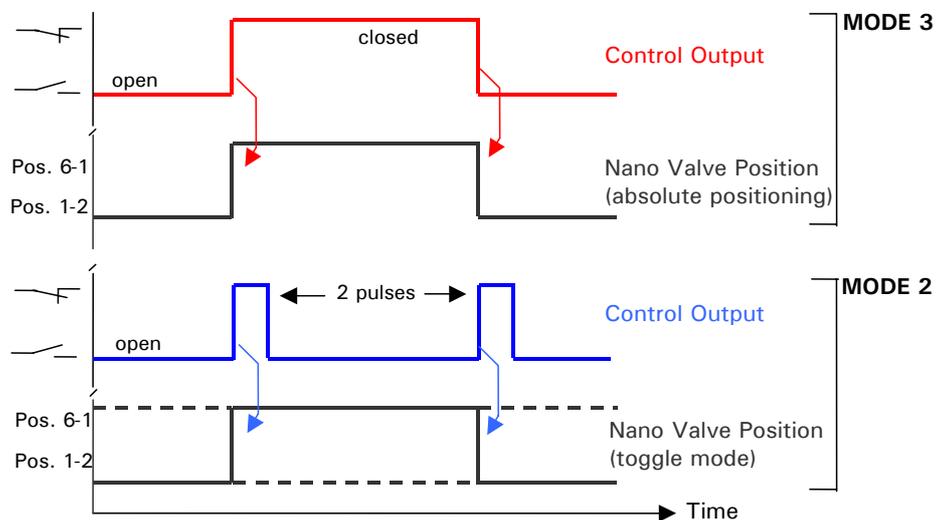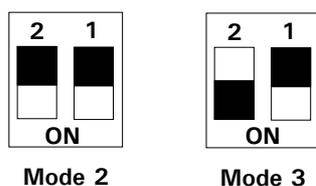

FIGURE A-1 Input Mode 2 vs. Mode 3

Mode 2   Mode 3

FIGURE A-2 DIP Switch Settings Mode 2 and Mode 3

A.1.2 Input Mode 1 and 4

- **Input Mode 1** (two line control)- the position of the Nano valve is defined by the status of Input A and the status of Input B as follows: Input B connected to Ground will drive the valve into position 6-1 while Input A connected to Ground will drive it back to position 1-2. DIP switch #2 must be switched to OFF and DIP switch #1 to ON (FIGURE A-3, Mode 1).

- **Input Mode 4** (inverted mode 3) - the position of the micro valve is controlled by the status of Input A while Input B is used to enable/disable the micro valve. Input A connected to Ground will drive the micro valve into position 1-2 (normal mode) while an open input will drive it to position 6-1 (parking mode). Connecting Input B to Ground disables the valves while an open input will enable it. The DIP switches #2 and #1 must be switched to OFF (FIGURE A-3, Mode 4).
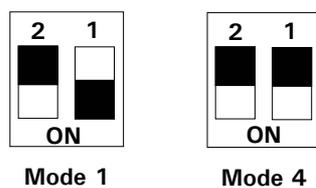

FIGURE A-3 DIP Switch Settings Mode 1 and Mode 4

A.1.3 Reprogramming the Nano Switching Valve

This section provides information how to change the input mode of the Nano Switching Valve.

A.1.3-A Changing the Input Mode

To change the input mode:

a) Connect the Nano Switching Valve to the PC using the provided serial communication cable (P/N 160071).

b) Switch the unit on and start your terminal program (e.g. HyperTerminal provided with Windows® 95/98/2000/NT). Setup the communication parameters: *9600 baud, no parity, 8 data bits, 1 stop bit, no handshaking*.

c) Send the **VR<Enter>** and **SM <Enter>** commands to check communication.

d) Send the **SM n<Enter>** command to set Input Mode n (e.g. send **SM 2<Enter>** to change to Input Mode 2).The valid range is 1 - 4 (default input mode is Input Mode 3).

FIGURE A-4 shows the response of the Nano Switching Valve after sending the **VR<Enter>** and **SM<Enter>** command.
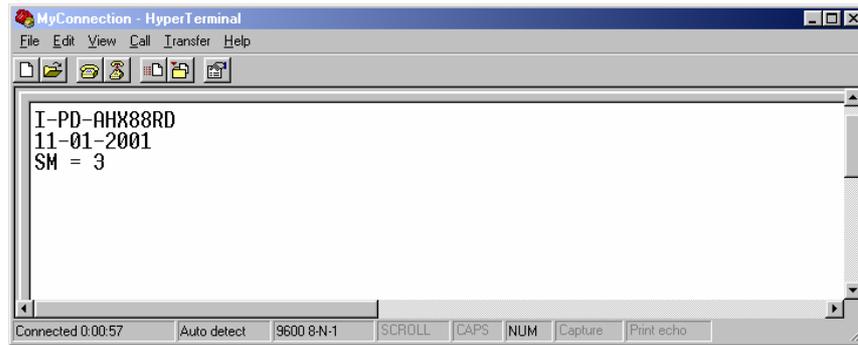
FIGURE A-4 Response of the Nano Switching Valve

e) Switch the unit off and disconnect it.

A.1.3-B Changing the 'Toggle Back' Time

☞ **Note: This feature is available in input mode 2 only.**

To display and change the delay time (which the valve waits before switching back to the original position):

a) Follow step a) and b) of Section A.1.3-A.

b) Send the **DT<Enter>** command to check communication. The current delay time will be displayed.

c) To change the delay to *nnnnn* ms, send the **DT nnnnn<Enter>** command (e.g. send **DT 10000<Enter>** to change the delay time to 10 seconds). The valid range is 0 – 65000 ms.

d) Switch the unit off and disconnect it.

A.1.3-C Default Settings

The Nano Switching Valve has been shipped with the default parameters presented in TABLE A-1.

TABLE A-1

Description	Command	Value
Baud Rate	SB	9600 baud
Device ID	ID	disabled
Input Mode	SM	3
Delay Time	DT	100

A.1.3-D Available Serial Commands

TABLE A-2 list serial commands available to either change the input mode or to control the Nano Switching Valve using the serial port.

TABLE A-2

Command	Description
CP<enter>	Displays the current actuator position
CC<enter>	Sends the actuator to Position A
CW<enter>	Sends the actuator to Position B
GO n<enter>	Sends the actuator to Position n, where n is A or B
TO<enter>	Toggles the actuator to the opposite position
TT<enter>	delay time, then rotates back to the original position.
ID<enter>	Displays the current device ID setting
ID n<enter>	Sets the device ID to value n, from 0 to 9 ***NOTE: When the ID feature is enabled, all commands to the device must be prefaced by the ID number. Entering ID* disables this feature (discussed below.)***
ID*<enter>	Clears the ID variable
SB<enter>	Displays the current baud rate
SB nnnn<enter>	Sets the baud rate to 1200, 2400, 4800, 9600 (default), 14400, 19200, 28800, or 38400. The parity setting, number of data bits, and number of stop bits cannot be changed.
SO nnnn<enter>	Turns off the position outputs after a delay, set in milliseconds to the closest 5 ms interval, from 0 to 30,000 ms. The outputs are always on (SO = 0) by default
SM<enter>	Displays the current digital input mode
SM n<enter>	Sets the digital input mode to Mode n, where n is 1 or 2
DT<enter>	Displays the current delay time in milliseconds
DT n<enter>	Sets the delay time from 0 to 65,000 milliseconds ***NOTE: The total delay time equals n = 2 milliseconds***
VR<enter>	Displays the part number and date of the firmware
/?<enter>	Displays list of valid commands
IN<enter>	Starts a re-initialization sequence

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