INSTRUCTION MANUAL

DeviceNetÔ Serial Interface Unit

Model: IN313-DN1-B

Table of Contents

DEVICENET OVERVIEW 3

DEVICENET PROTOCOL 3
DEVICENET NETWORK 4
PLC & PC BASED DEVICENET CONTROLLERS 5

IN313-DN1-B FEATURES 6

2.1 BASIC FEATURES 6
2.2 ADVANCED FEATURES 7
2.2.1 Self-Diagnostics: *7*
2.2.2 Specific Assembly Instances: *7*
2.2.3 SMC Specific Service: Watchdog Reset Action *8*
2.3 USER INTERFACE 8
2.4 THE LED INDICATORS 9
2.5 OUTPUT STATUS LEDS 10
2.6 THE SWITCH SETTINGS 11
2.7 INTERFACE TO VALVE MANIFOLD 12
2.8 THE INTERFACE BLOCK 13
2.9 SOLENOIDS CONNECTOR 14
2.10 SOLENOIDS CONNECTOR 15

APPLICABLE SOLENOID VALVES 16

APPLICABLE SERIES OF SOLENOID VALVES 16
MANIFOLD MODEL NUMBERS 16
SOLENOID VALVE NUMBERING SCHEME 17

SPECIFICATIONS 18

GENERAL SPECIFICATIONS 18
ENVIRONMENTAL SPECIFICATIONS 18
ELECTRICAL SPECIFICATIONS 19
NETWORK SPECIFICATIONS 20
ELECTRONIC DATA SHEET (EDS) 21

PHYSICAL DIMENSIONS 22

VALVE MANIFOLD DIMENSIONS 22

ORDERING INFORMATION 25

MANIFOLD WITH SI UNIT 25

DEVICENET OVERVIEW

DeviceNet Protocol

DeviceNet is a connection based, event-driven, communication network designed for real-time control in industrial applications. Developed by Allen Bradley in 1993, DeviceNet incorporates the ISO standard model and Controller Area Network (CAN) technology for low-level sensor/actuator communications, and includes provisions for powering devices directly from the network.

DeviceNet protocol has since been transferred to Open DeviceNet Vendor Association (ODVA), an independent non-profit organization responsible for its technical and marketing activities. Please refer to ODVA newsletters for updated information on the DeviceNet protocol and the ODVA organization (www.odva.org).

The following diagram illustrates a DeviceNet network consisting of a Controller and various sensors and actuator on the bus.

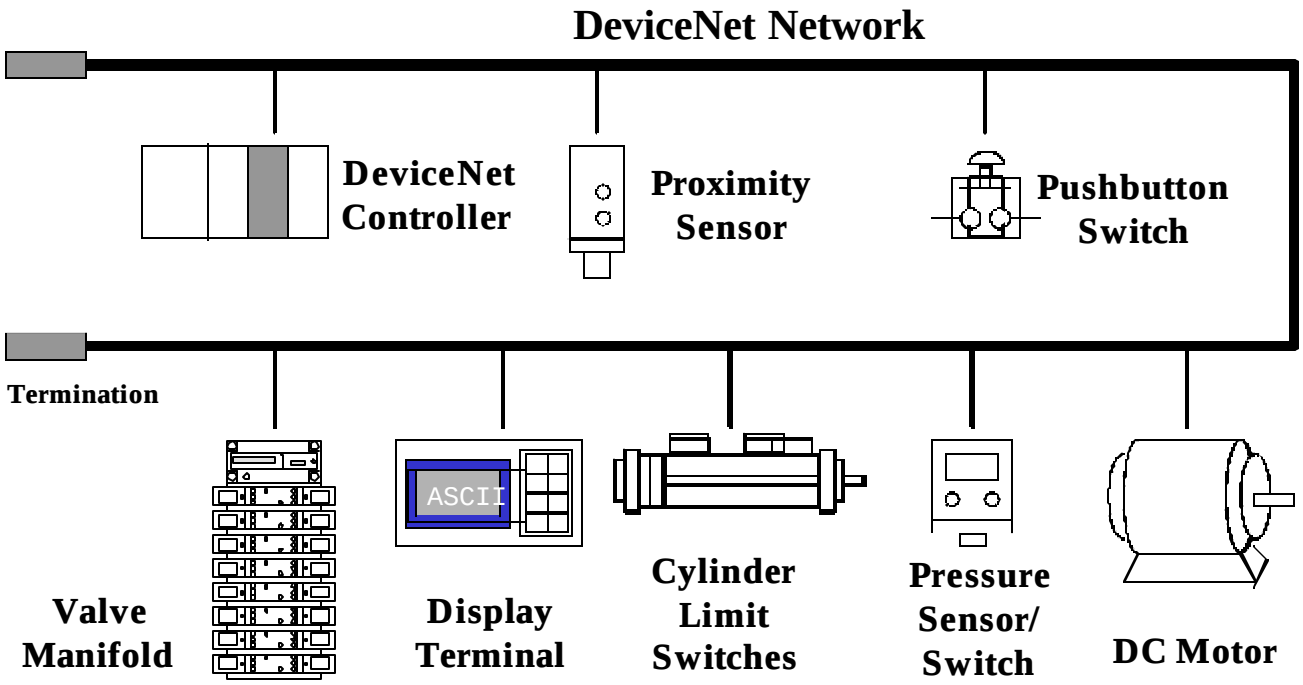

Figure 1.1 Illustration of a typical DeviceNet Network

DeviceNet Network

A typical DeviceNet network consists of a main trunk and multiple drops. The main trunk is terminated on both ends with termination resistors (120Ω) and may be as long as 1640ft (500m). The drop cables, which connect the DeviceNet nodes to the main trunk, are relatively, short (20ft/6m). DeviceNet Tee's are used to connect the drop cables to the main trunk.

The main trunk as well as the drop cables are made up of 5 individual conductors. These are:

`V+' and `V-'	Network power supply (24 VDC and OVDC)
`CAN-H' and `CAN-L'	Communication lines (twisted pair)
Drain	Shield

Each DeviceNet network can have up to 64 physical nodes. Each physical node requires an address referred to as Media Access Control identification (MAC-ID). A node can take on any MAC-ID from 0 to 63, but can not have one that is already assigned to another node.

A DeviceNet network requires a 24VDC power supply. The supply connection to the main trunk is made using a special Tee connector referred to as a Power Tap. The Power Taps are connection splices with active components to limit the current and eliminate reverse bias.
Please refer to the DeviceNet cabling specification for detailed information on the DeviceNet Tees and Power Taps.

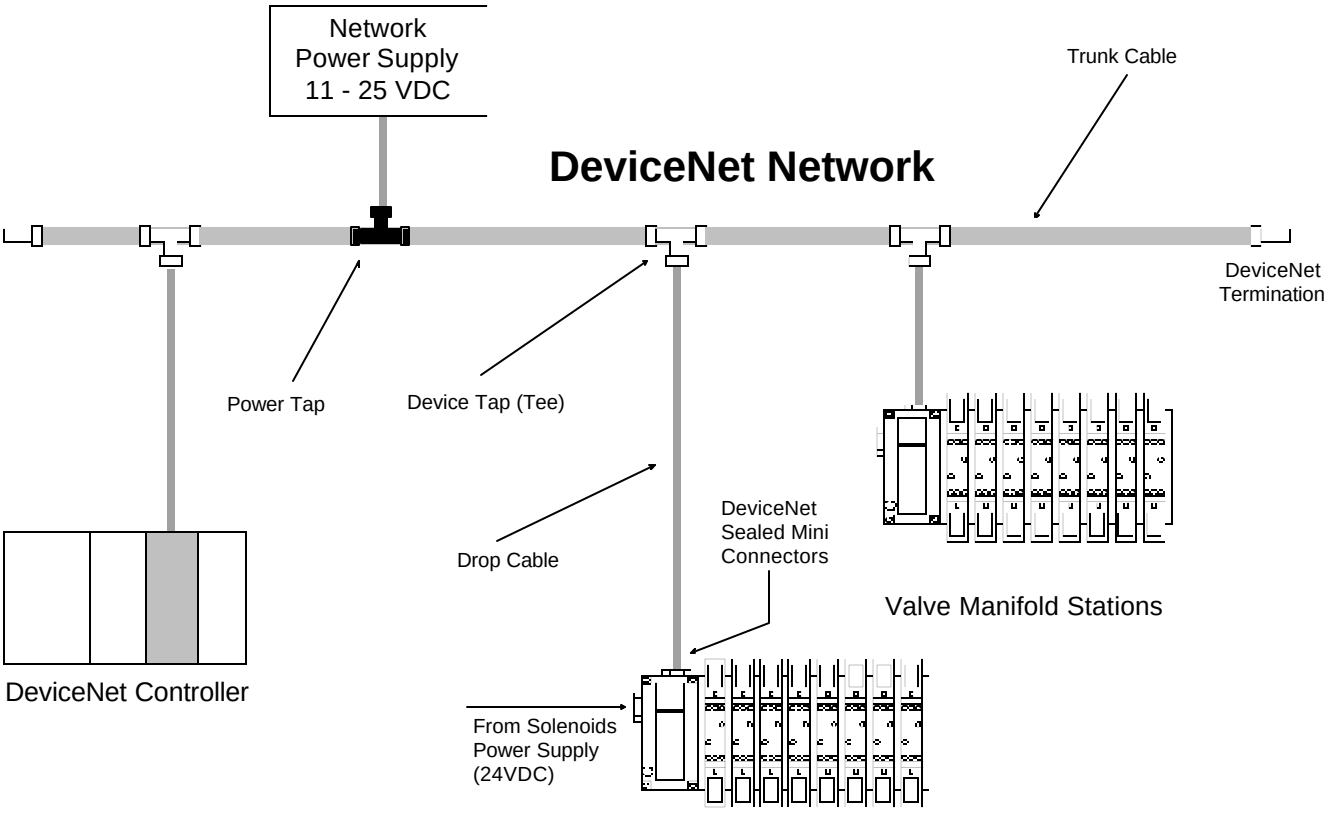

Figure 1.2 DeviceNet Cabling Diagram

PLC & PC based DeviceNet controllers

Either a PC (Personal Computer) or a PLC (Programmable Logic Controller) based controller can act as a master scanner or client on a DeviceNet network. In either case, the scanner must fully comply with the DeviceNet specifications.

The following is a partial listing of PC and PLC based DeviceNet controllers. Please refer to the ODVA literature or visit ODVA's website (www.odva.org) for latest information on available DeviceNet compatible controllers.

Company	Controller	Description
Allen Bradley	1771-SDN	Scanner Card for PLC5
Allen Bradley	1747-SDN	Scanner card for SLC500
Omron	C200HW-DRM21	For C200HC PLC's
Omron	CVM1-DRM21	For CVM1, CV500, CV1000 and CV2000 PLC's
SS-Technologies	5136-DN-PC	For ISA bus (PC's)
SS-Technologies	5136-DN-VME	For VME bus systems
SS-Technologies	5136-DN-PCM	For PCMCIA (Laptop PC's)

Table 1.1 List of compatible controllers

IN313-DN1-B FEATURES

2.1 Basic Features

DeviceNet network can be configured for master/slave or peer-to-peer type of operation. The IN313-DN1-B unit operates as a Group-Two-Only Server, and utilizes the Predefined Master-Slave Connection set. In the peer-to-peer operation, the unit behaves as a Server only.

The IN313-DN1-B unit converts DeviceNet serial signals to parallel output data and directs them to the corresponding solenoids mounted on a valve manifold. This eliminates the need for dedicated parallel lines from the controller to individual solenoids and hence reduces the wiring requirements.

The Serial Interface unit can drive up to 16 single or 8 double solenoid valves or combination of single and double solenoids as long as the maximum number of solenoids does not exceed 16.

IN313-DN1-B can be configured locally via the MACID/BAUD DIP switches or remotely via the DeviceNet network. A 2 pin DIP switch located on the bottom of the unit allows selection of the LOCAL (factory default) or REMOTE configuration modes. Figure 2.1 shows the position of the DIP switch. Switch position 2 in the ON position indicates REMOTE operation.

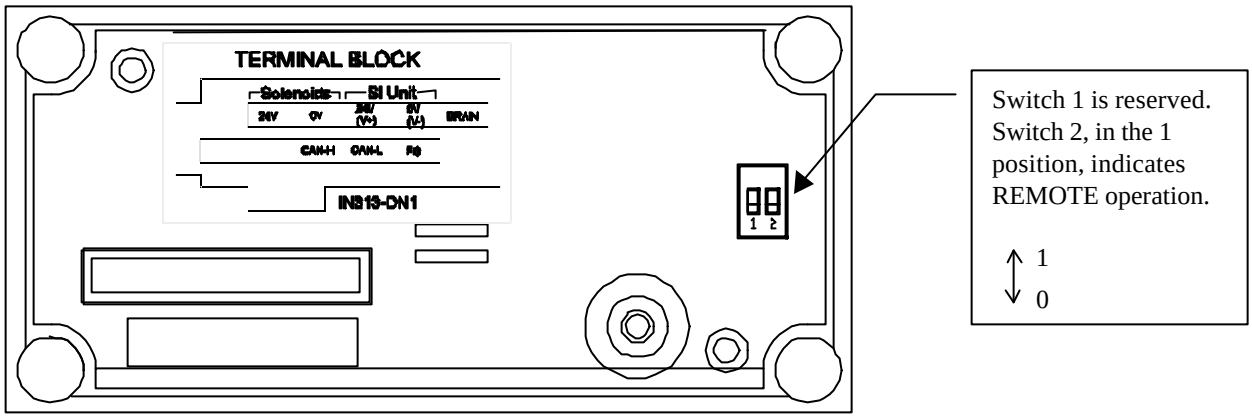

Figure 2.1 Remote/Local Switch

Under the LOCAL configuration mode, the 8-position MAC ID/BAUD DIP switch allows setting of the device node address (MAC-ID), and the transmission speed (Baud rate). The allowable MAC-ID's are 0 - 63 and the three transmission rates are 125, 250, & 500kpbs.

Under the REMOTE configuration mode, the green RMT LED will turn on indicating that the unit is in its remote configuration mode. To configure the unit remotely over the network, proper configuration tools are necessary.

2.2 Advanced Features

2.2.1 Self-Diagnostics:

This feature has been added to the IN313-DN1-B unit. To enter into the self-test mode, perform the following steps:

Set the ADDR/BAUD DIP Switch reading to 11110000 and power up the IN313-DN1-B device; the bicolor MOD/NET LED should alternately flash Red/Green.

Set the DIP Switch to 00001111. This places the IN313-DN1-B device into Self-Test mode; it will ignore the setting of the Remote/Local DIP switch.

The IN313-DN1-B Device will turn ON and OFF one of the 16 output channels in sequence. The Bicolor MOD/NET LED will continuously flash red/green. The IN313-DN1-B unit will transmit a Duplicate MAC ID message at 125Kb/s, with a MAC ID 63, approximately once every 1 second.

To test DIP Switches, change the setting of the DIP Switch to a value other than 00001111. The IN313-DN1-B device will turn on the corresponding output channels, range from channel 0 to 7; the bicolor MOD/NET LED will continuously flash red/green; the IN313-DN1-B device will transmit Duplicate MAC ID message at 125Kb/s, with a MAC ID 63, approximately once every 1 second.

2.2.2 Specific Assembly Instances:

To simplify the configuration of Fault State/Fault Value, Idle State/Idle Value, in Assembly Object (Class Code 4), 4 SMC Pneumatics Inc. specific instances were added, these instances are (all the numbers are decimal number):

Assembly Instance ID	Associated Attributes	Operation	Length	Attribute ID
101	discrete output point fault value	Get/Set	2	3
102	discrete output point fault state	Get/Set	2	3
103	discrete output point idle value	Get/Set	2	3
104	discrete output point idle state	Get/Set	2	3
105	save configuration	Get/Set	1	3
106	watchdog reset action	Get/Set	1	3

To save the changed values in EEPROM, send a Reset service request to the IN313-DN1-B Device Identity Object, Service Code: 5, Class ID: 1, Instance ID: 1, with parameter 0.

2.2.3 SMC Specific Service: Watchdog Reset Action

In Identity Object (Class Code 1), 1 SMC Specific Service was added:

Service Code: 0x32, Watchdog Reset Action;

If this reset Flag is set to 1, IN313-DN1-B will halt on soft reset request; it has no effect on the power cycle/hardware reset.

Class ID:	1
Instance ID:	1
Attribute ID:	None
Data to transmit:	1 Byte
Valid value:	0x01, set the flag, disable the software reset 0x00, clear the flag, enable the software reset

2.3 User Interface

The IN313-DN1-B unit features 3 LED indicators for the following:
Network Power (PWR). DeviceNet module /network status (MOD/NET), local and remote configuration (RMT). Also provided are 16 solenoid status LEDs (O ~ F) for status indication of each individual output. An 8-position DIP switch for Address and Baud rate settings is located to the right of the display section. A 2 position DIP switch for remote/local configuration mode selection is located on the bottom panel of the unit.

Marking	Description
PWR	Power status LED
MOD/NET:	Module & Network LED
OUTPUTS (0 ~ F):	Status Indicators for each output
RMT	Operation mode LED
ADDR/BAUD	Address and Baud Rate Settings

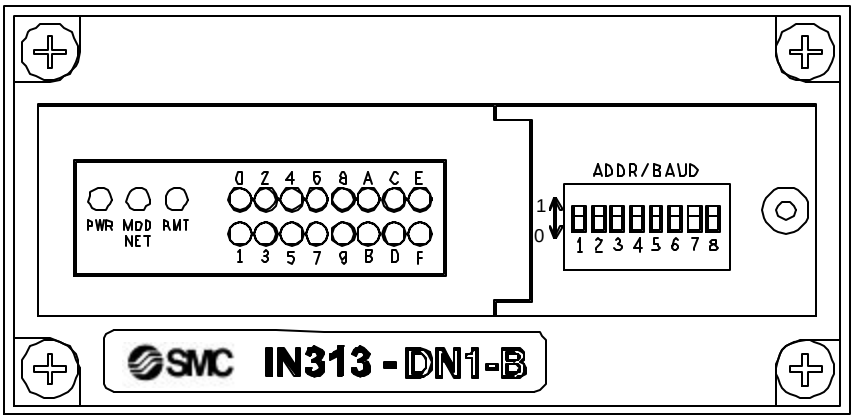

Figure 2.2 IN313-DN1-B Top View

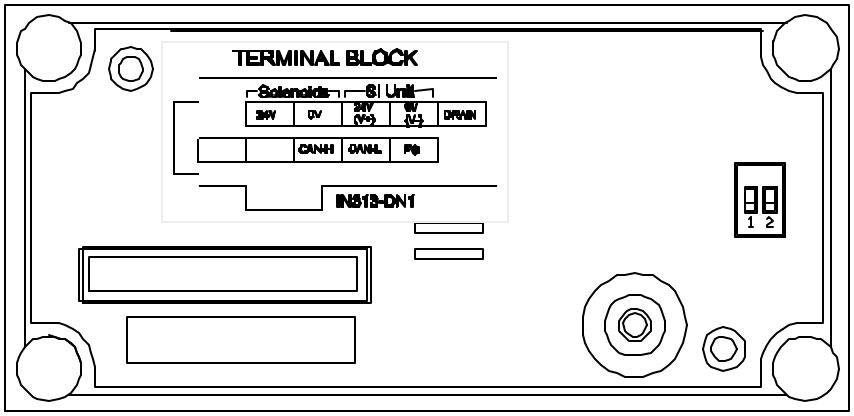

Figure 2.3 IN313-DN1-B Bottom View

Power LED: This LED indicates the presence of the Network power to the unit. The unit accepts 11~25VDC on the DeviceNet v+/v- terminals.

MOD/NET LED: This is a bicolor (Red/Green) LED indicating the unit (module) status as well as the network status.

RMT LED: The remote LED indicates operation mode of IN313-DN1-B device, with the Green LED on, the IN313-DN1-B unit is under remote configuration operation mode, When the Green LED is off, the IN313-DN1-B unit is under local operation mode.

OUTPUT LED: The OUTPUT Green LED indicate the status of output channels. When an OUTPUT channel is on, the corresponding Green LED will be on too. Under remote configuration mode (RMT LED ON), the state of the output channels is all OFF when a network communication error occurs.

2.4 The LED Indicators

The power, network/module and operation mode statuses are displayed with three light emitting diodes (LEDs).

The power indicator is a single color (Green) LED. The LED indicates whether power to the unit is available or not. This indicator does not represent the power to the solenoid valves, but only to the logical section of the SI unit. In other words, the unit may be ON and functioning on the network without supplying power to the solenoid valves.

PWR (Power LED)	
OFF	The main power to the unit is off.
ON (GREEN)	The main power to the unit is on.

Table 2. Definition of PWR LED

Note: Power LED does not represent power to the solenoid valves.

The MOD/NET indicator is a bicolor (RED / GREEN) LED. It represents the status of the internal hardware (Module) as well as the network communications (Network). The operation of the MOD/NET indicator is in accordance with the DeviceNet specifications.

MOD/NET (Module & Network Status LED)	
OFF	The unit is not on-line, (Dup_MAC_ID test not completed yet)
FLASHING GREEN	The unit is on-line but not allocated
SOLID GREEN	The unit is on-line and allocated to a master
FLASHING RED	Recoverable fault, the I/O connection has timed out
SOLID RED	Unrecoverable fault, the unit has failed and can not recover

Table 3. Definition of MOD/NET LED

RMT LED: The remote LED indicates operation mode of IN313-DN1-B device, with the Green LED on, the IN313-DN1-B unit is under remote configuration operation mode, When the Green LED is off, the IN313-DN1-B unit is under local operation mode.

RMT (Remote LED)	
OFF	The IN313-DN1-B unit is under LOCAL Operation Mode
ON (GREEN)	The IN313-DN1-B unit is under REMOTE Operation Mode

Table 4. Definition of RMT LED

2.5 Output status LEDs

16 Output status LEDs show status of the solenoid channels. The LEDs are numbered from 0 ~ F, representing the hexadecimal numbers for 0 ~ 15. The `ON' status of an LED indicates that the corresponding output channel is energized.

Note: The output status LEDs represents the logical status of the output channels, not the actual position of the solenoids.

2.6 The Switch Settings

The Address/Data Rate dip switch consists of 8 elements. Elements 1 through 6 are designated for the MAC-ID address settings, 1 being the least significant bit and 6 being the most significant bit. Elements 7 & 8 are for setting the transmission speed. The up position is ON or logical 1 and down position is OFF or logical 0.

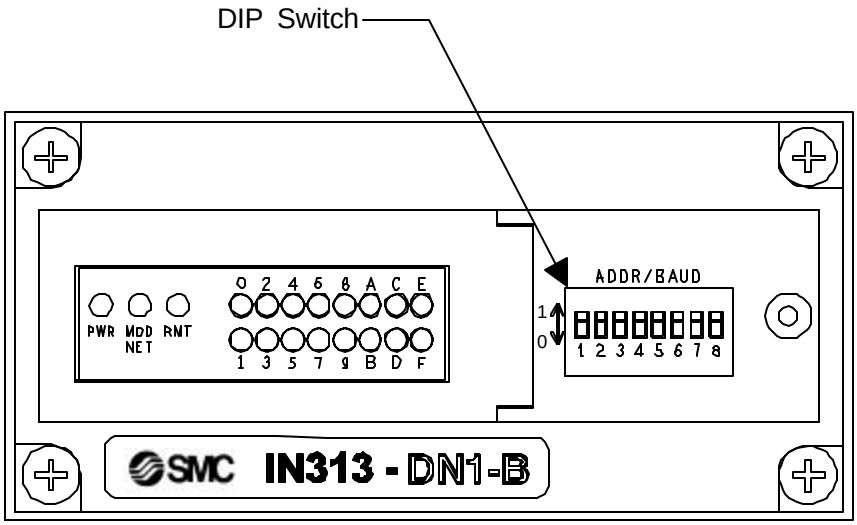

Figure 2.4 Address DIP Switch

DIP SW. #		1	2	3	4	5	6	7	8
Logical value		1	2	4	8	16	32	S0	S1
Station Address	0	0	0	0	0	0	0		
	1	1	0	0	0	0	0		
	2	0	1	0	0	0	0		
	62	0	1	1	1	1	1		
	63	1	1	1	1	1	1		
Transmission Speed (Kbps)	125							0	0
	250							1	0
	500							0	1
	N/A							1	1

Table 5. Address and transmission rate settings

2.7 Interface to valve manifold

The IN313-DN1-B unit has only one 50-pin connector. The external connections to the DeviceNet Network and power supply are provided via the valve manifold Interface Block.

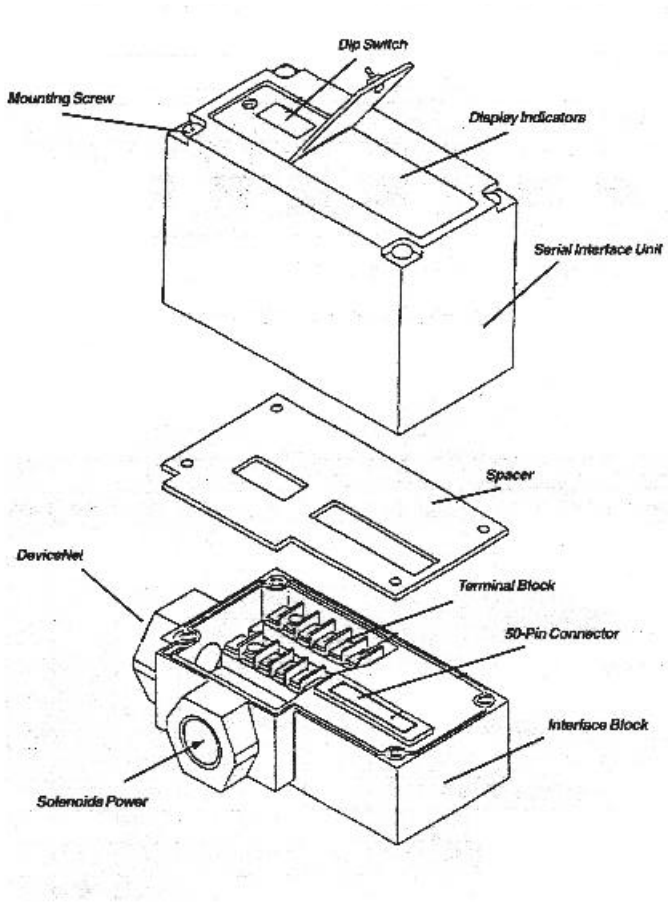

Figure 2.5 View showing the connectors

2.8 The Interface Block

The Interface Block is the section between the IN313-DN1-B and the valve manifold. It provides connections to the outside connectors as well as the internal contacts for the solenoid valves. The Interface Block consists of a Block Terminal and one or two sealed and shielded connectors depending on connector kit selected. One for the DeviceNet network connection, and one for the solenoid power supply.

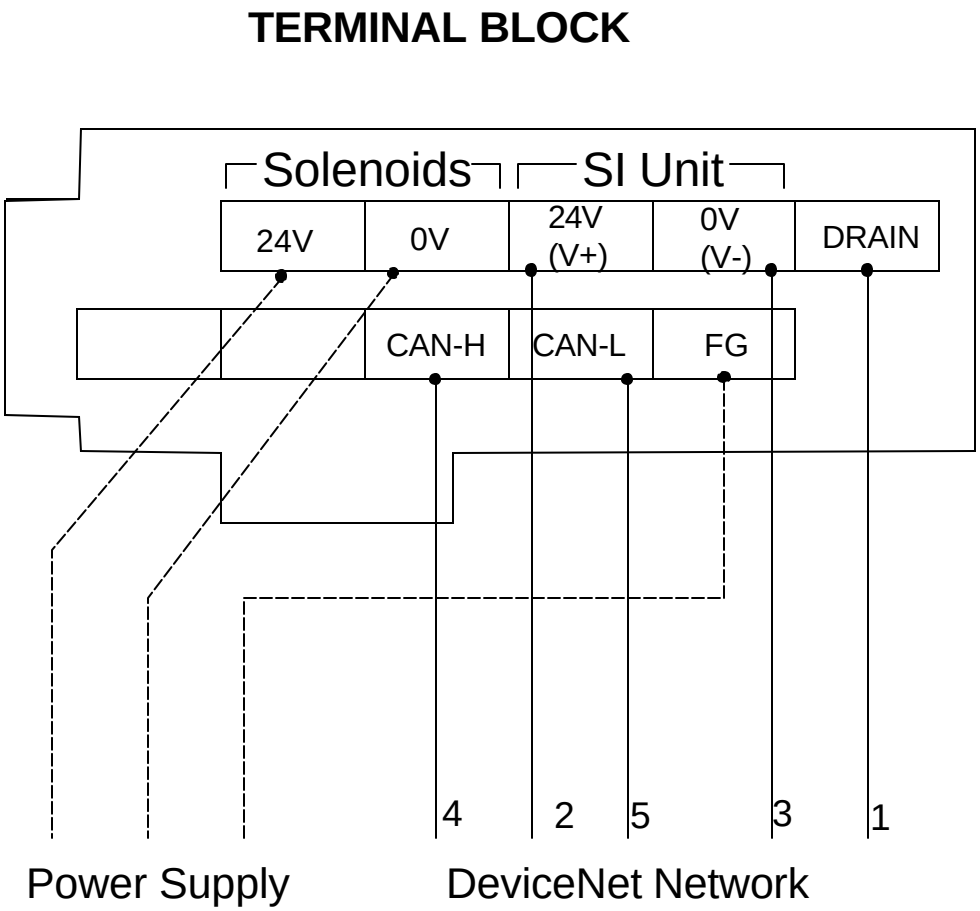

Figure 2.6 The Interface Block

2.9 Solenoids Connector

A 5-pin mini connector plug is pre-connected to the terminal block at the factory. The pin assignments are according to the DeviceNet Specifications for sealed mini connectors. This connector provides interface between the valve manifold and the DeviceNet Network cabling system

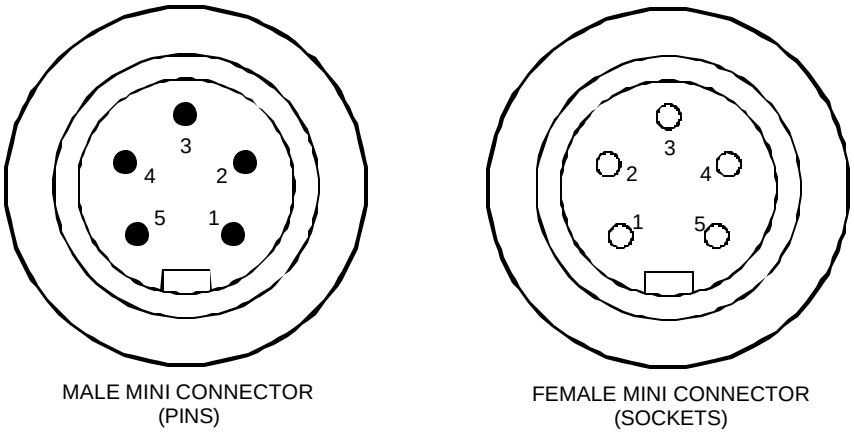

Figure 2.7 Pin Location and Pin Number

The 5-Pin DeviceNet Connector		
Pin 1.	Drain	(Bare wire)
Pin 2.	V+	(Red wire)
Pin 3.	V-	(Black wire)
Pin 4.	CAN-H	(White wire)
Pin 5.	CAN_L	(Blue wire)

Table 6. Connector pin assignment

2.10 Solenoids Connector

A 4-pin mini connector provides connections to a dedicated power supply for the solenoid valves. DeviceNet does not specify the pin assignments for this connector, however, the factory recommended assignments are illustrated in the following diagram:

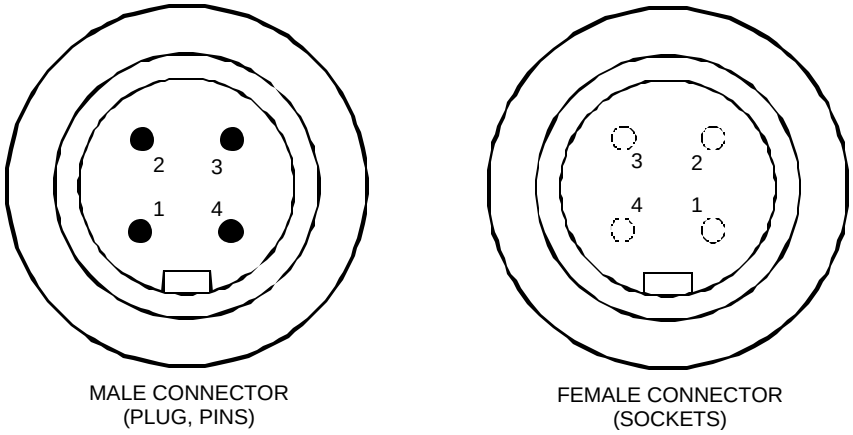

Figure 2.8 Solenoid Supply Connector

The 4-Pin Solenoid Power Connector	
Pin 1.	Ground
Pin 2.	+24V
Pin 3.	No Connection
Pin 4.	0V

Table 7. Pin location and pin number

Note: The IN313-DN1-B requires the 5 pin DeviceNet connection and the 4-pin solenoid supply connection in order to be fully operational. Connector kit IN313-DN1-B-K2 or IN313-DN1-B-K4 provides both for connections and is recommended for most applications. Connector kit IN313-DN1-B-K1 or IN313-DN1-B-K3 allows the 5 pin DeviceNet connector to power the SI unit as well as the solenoid valves (refer to section 6.4)

Caution: To drive the solenoid valves from the network power, extreme care should be taken to avoid overloading the networks power supply. Please refer to the DeviceNet specifications for power supply specifications.

APPLICABLE SOLENOID VALVES

Applicable Series of Solenoid Valves

Valve Series	Valve Type	A,B port size	Cv factor
(N) VZS 2000	5/2, 5/3 lapped spool (metal)	1/8	0.35
(N) VFS 2000	5/2, 5/3 lapped spool (metal)	1/8, 1/4	0.8
(N) VFS 3000	5/2, 5/3 lapped spool (metal)	1/4 3/8	2.0
(N) VFS 4000	5/2, 5/3 lapped spool (metal)	3/8, 1/2	3.6
(N) VFS 5000	5/2, 5/3 lapped spool (metal)	1/2 3/4	5.7
(N) VFR 2000	5/2, 5/3 Q-sealed spool (rubber)	1/8, 1/4	0.9
(N) VFR 3000	5/2, 5/3 Q-sealed spool (rubber)	1/4 3/8	2.3
(N) VFR 4000	5/2, 5/3 Q-sealed spool (rubber)	3/8, 1/2	3.7

Table 3.1 Compatible solenoid valves

Manifold Model Numbers

Valve Series	Manifold model no. :insert # of stations	Min. # of stations	Max # of stations	Max # of solenoids
(N) VZS 2000	(N) VV5ZS2-55SU - 1 –01(T)	04[1]	19[1]	16
(N) VFS 2000	(N) VV5FS2-01SU - 1 –01/02(T)	02[2]	17[2]	16
(N) VFS 3000	(N) VV5FS3-01SU - 1 –02/03(T)	02[2]	11[2]	16
(N) VFS 4000	(N) VV5FS4-01SU - 1 –03/04(T)	02[2]	11[2]	16
(N) VFS 5000	(N) VV5FS5-01SU - 1 –04/06(T)	02[2]	11[2]	16
(N) VFR 2000	(N) VV5FR2-01SU - 1 –01/02(T)	02[2]	17[2]	16
(N) VFR 3000	(N) VV5FR3-01SU - 1 –02/03(T)	02[2]	11[2]	16
(N) VFR 4000	(N) VV5FR4-01SU - 1 –03/04(T)	02[2]	11[2]	16

Table 3.2 Compatible valve manifolds

[1]*Note*: Include 3 stations required for mounting SI unit.
[2]*Note*: Include 1 station required for mounting SI unit.

Solenoid Valve Numbering Scheme

The following tables show the relationship of output channels to solenoid.

Valve Station	1		2		3		4		5		6		7		8	
Solenoid	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B
SI unit output	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F

Eight (8) double solenoid valve manifold

Valve Station	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Solenoid	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B
SI unit output	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F

Sixteen (16) single solenoid valve manifold

Valve Station	1		2		3		4	5	6	7	8	9	10	11	12	13
Solenoid	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B
SI unit output	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F

Combination of single and double solenoid valve manifold

Note: SMC employs a standard wiring method for manifolds with less than 16 valve stations. As many valve stations as possible (starting with the first valve station) are wired for double solenoids, the rest will be wired for single solenoids.

SMC will also wire the manifolds according to customer specifications. A label is applied to all manifolds indicating the solenoid/SI unit output relationships.

SPECIFICATIONS

General Specifications

Indicators: POWER MOD/NET RMT Solenoids	 Green LED Bicolor Red/Green LED Green LED for Remote / Local configuration modes 16 Green LED's indicating solenoid channels 0~F
Connectors: Network Solenoids To Valve Manifold	 5-pin Sealed Mini Connector, shielded 4-pin Sealed Mini Connector, shielded 50-pin connector to interface block
Casing Material:	Polished cast Aluminum, Conductive Clear plastic window on top with a hinged Section to access address dip switch.
Weight:	1.0 lb, (0.45kg) excluding the interface block and valve manifold
Dimensions:	111mm x 53mm x 72mm (approx. figures)

Table 4.1 General Specifications

Environmental Specifications

Operating Ambient Temperature	0~55°C
Relative Humidity	35~85%RH (no dewing)
Vibration Resistance	80~350Hz @ 5G Per NAVMAT P-9492, par.4.2
Impact Resistance	Up to 10G one time shock (excluding the physical interface to manifold)
Operating Atmosphere	No corrosive gases

Table 4.2 Environmental Specifications

Electrical Specifications

The Network Section:	
Input Voltage (V+)	11~25VDC
Current Requirement	50mA max. @ 24VDC 3/8A fuse
Power Consumption	1.2W max. (1.0W Typical)
The Solenoids Section	
Input Voltage	24VDC ±5%
Current handling	Up to 90mA per channel at 24VDC (2A fuse for all solenoids)
Power handling	Up to 2.1W per channel, 16 ch. Max
Solenoid Driver	Open Collector Transistor
Circuit Isolation	250VDC, Isolation between Network power & Solenoids power
Electro Magnetic Compatibility (EMC)	
Immunity to Fast Transients	Up to 1kV @ 1μs pulse width & 50Hz Applied to all Network and solenoid terminals

Table 4.3 Electrical Specifications

Network Specifications

Protocol	DeviceNet, Vol. 1 (release 2.0)
MAC-ID Range	0~63 Switch selectable via dip switch or remotely settable via network
Communication Speeds	125k, 250k, and 500kbps Switch selectable via dip switch or remotely settable via network
SlaveType	Group-Two-Only slave device
DeviceType	Pneumatic Valve 1B(hex) or 27(decimal) (See DeviceNet device profile for details)
DeviceCode	787 decimal
Hardware Rev.	Please refer to the latest EDS file
Software Rev.	Please refer to the latest EDS file
Manufacturer's Code	07(hex), or 7(decimal)
Max.# of I/O connections	1
No. of bytes Consumed	2 using Polled I/O
No. of bytes Produced	2 using Polled I/O
Connections supported	Explicit & Polled I/O
Indicators: POWER	Green LED indicating ON/OFF status of network power
MOD/NET	Bicolor Red/Green LED indicating the module and Network status
RMT	Green LED indicating Remote configuration enabled.
Connectors: Network	5-pin sealed mini, shielded
Solenoids	4-pin sealed mini, shielded
Solenoid Status Response (*)	Single channel, using an explicit request. All channels, using 0 byte poll message Request.
Solenoid Status for: Error Fall back	All OFF(default) or Hold-Last-State Dip switch configurable in Local mode. Network configurable in Remote mode.
Idle Fall back	Network configurable

Table 4.4 Network Specifications

Poll response to a 0-byte data request is a 2-byte data reflecting the latest status of the output channel.

Electronic Data Sheet (EDS)

The Electronic Data Sheet (EDS) file contains the crucial operational and identification information about the SI Unit. The EDS file can be used to automate configuration of the unit in some DeviceNet controllers and/or scanners. An EDS stub file is loaded into the SI unit prior to shipment and can be downloaded from the node with appropriate DeviceNet software (i.e. DeviceNet Manager etc..). If you need the full EDS file, please contact SMC.

PHYSICAL DIMENSIONS

Valve Manifold Dimensions

(N)VZS2000 Series

(all dimensions in millimeters)

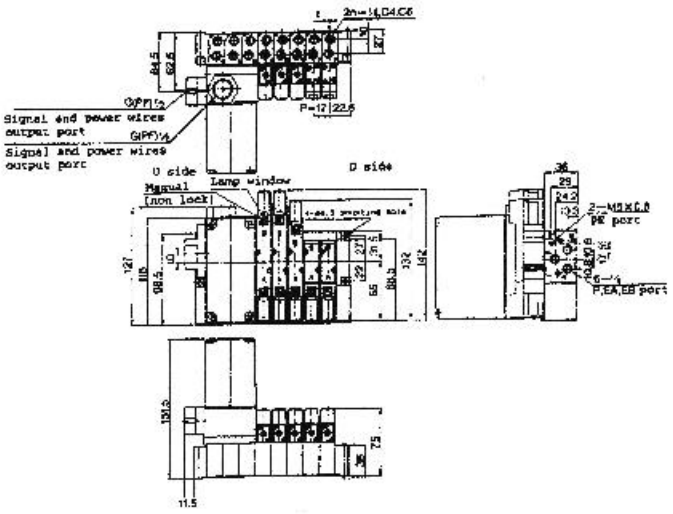

Figure 5.1 (N) VZS2000 Series

(N)VFS2000, (N)VFR2000 Series

(all dimensions in millimeters)

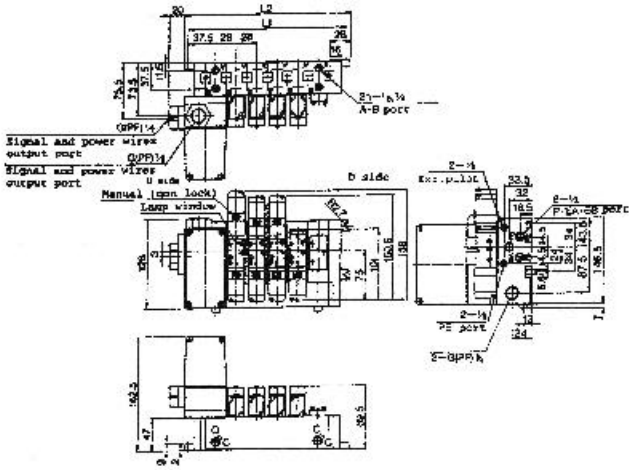

Figure 5.2 (N) VFS2000, (N) VFR2000 Series

(N)VFS3000, (N)VFR3000 Series

(all dimensions in millimeters)

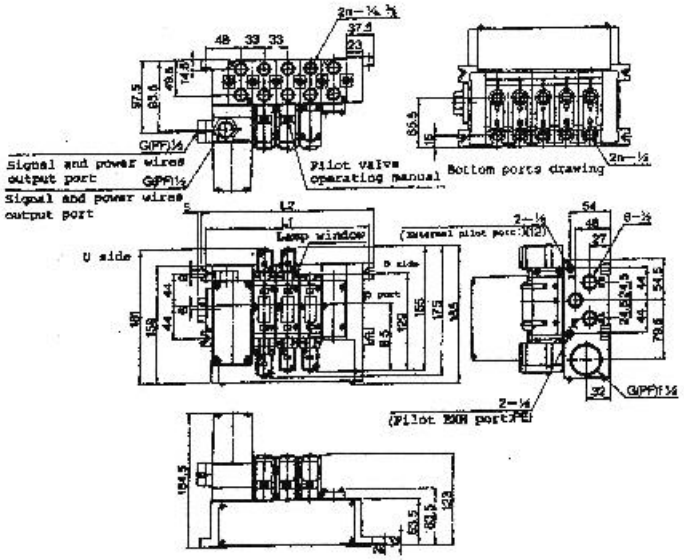

Figure 5.3 (N) VFS3000 Series

(N)VFS4000, (N)VFR4000 Series

(all dimensions in millimeters)

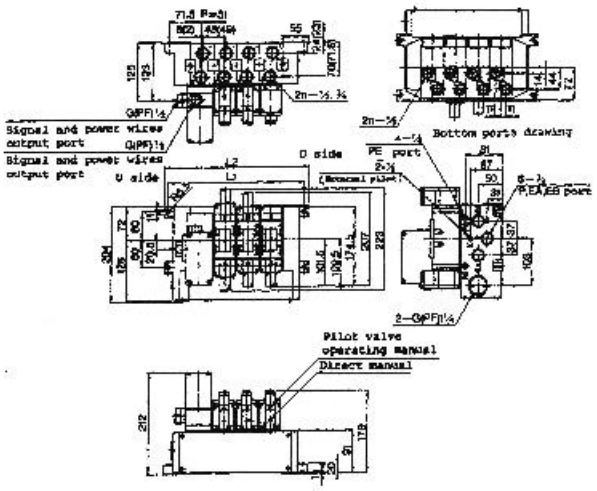

Figure 5.4 (N) VFS4000, VFR4000 Series

(N)VFS5000, (N)VFR5000 Series

(all dimensions in millimeters)

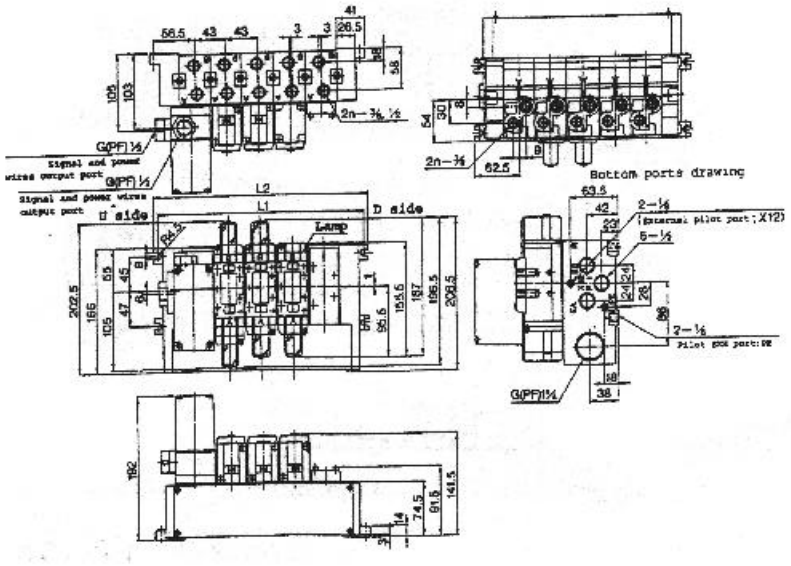

Figure 5.5 (N) VFS5000, (N) VFR5000 Series

Please refer to the corresponding NVFS, VFS, NVFR, VFR, and VZS catalogs for more detailed information about a particular SMC valve manifold.

ORDERING INFORMATION

Manifold with SI unit

When ordering a NVFS/NVFR/NVZS valve manifold with a DeviceNet SI unit, the following items have to be ordered:

1. One Serial Interface Unit Part Number: IN313-DN1-B
2. One standard SI capable manifold
3. One connector kit Part Number: IN313-DN1-B-K1
   Or: IN313-DN1-B-K2
   Or: IN313-DN1-B-K3
   Or: IN313-DN1-B-K4

Only one of the four connector kits available are needed per manifold.

IN313-DN1-B-K1: Consists of a 5-pin MINI Brad Harrison-style connector (solenoids are powered over the DeviceNet network.

IN313-DN1-B-K2: Consists of a 5-pin MINI Brad Harrison-style connector and a 4-pin MINI Brad Harrison-style connector (solenoids are powered separately from the DeviceNet Network.)

IN313-DN1-B-K3: Consists of a 5-pin MICRO Brad Harrison-style connector (solenoids are powered over the DeviceNet network.)

IN313-DN1-B-K4: Consists of a 5-pin MICRO Brad Harrison-style connector and a 4-pin MICRO Brad Harrison-style connector (solenoids are powered separately from the DeviceNet network.)

SMC Corporation of America recommends the use of the IN313-DN1-B-K2 or IN313-DN1-B-K4 connector kit. The connector kit IN313-DN1-B-K1 or IN313-DN1-B-K3 is not recommended for most applications. If your application does require this option, extreme care must be taken to avoid exceeding the network power specifications. Therefore, the DeviceNet network can not drive a large number of solenoids. Please refer to the DeviceNet specifications.