INSTRUMENT HANDBOOK
Digital Proportional Control Valve
VP51

For detailed Information view our website on: www.watsonsmith.com

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Complete User Interface Functionality can be found on www.watsonsmith.com

1. INTRODUCTION

The VP51 Programmable Digital Proportional Control Valve for industrial pneumatic pressure control applications. The VP51 can be programmed to meet application requirements, and a standard 10 bar unit can be set at any required outlet pressure setting below this value.

Fluid	compressed air
Output Pressure Range	Up to 10 bar, user adjustable
Output Accuracy	±100mbar (1% full 10 bar range)
Supply Pressure	Up to 14 bar (max)
Flow Capacity	1300 l/min
Control Signal	0-10V, 4-20mA : Factory set
Response Speed	0 - 7; user selectable
Proportional Gain	0 – 7; user selectable
Integral Gain	0 – 7; user selectable
Electrical Supply	24V DC ±25%
Operating Temperature	-20° to 50° C (ambient)

Warranty

A two year warranty applies to all Norgren products. For terms and conditions ask for a copy of our 'General Conditions of Sale.'

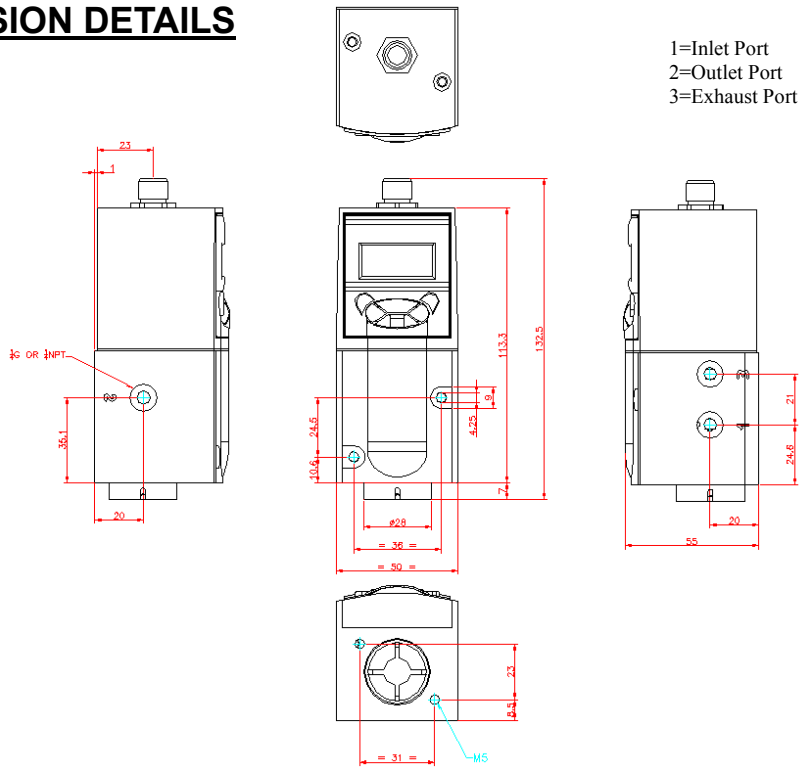
2. SAFETY

Compressed air in its basic state or in its more sophisticated applied forms can result in accidents if it is not properly used. We therefore draw your attention to the following paragraphs*: The Health and Safety at Work Act (1974) makes specific requirements on suppliers and users. To conform with these requirements IMI Norgren Ltd. has, so far as it is reasonably practicable, designed, constructed and tested its products so as to be safe when properly used. Many of our customers, being suppliers as well as users, are reminded of the imposed duties of the above Act and when expediting these duties our technical staff will be pleased to advise. We cannot accept responsibility for the design of plant which might use our equipment and would recommend the use of European Norm (EN) standards and BS 4575:Part 3 (1988) , (Note compliance with these standards does not in itself confer immunity from legal obligation). We also suggest the guidance booklet by the Health and Safety Executive HS(G)39, "Compressed Air Safety" that offers advice on the safe use of compressed air

3. OPERATING DESCRIPTION

The VP51 is a programmable electronic proportional control valve.
The pneumatic section is a diaphragm actuated precision glandless spool valve, pilot pressure applied to the pneumatic section controls the output pressure of the unit.
The pilot pressure is generated and controlled electronically. The feedback signal from the outlet port is compared to the control signal required and ensures a consistent, stable output pressure.
The electronics system requires a nominal 24V DC supply signal. With a 10 Bar standard unit, the user can define their requirements through programming, and set the application parameters needed for the unit, i.e outlet pressure, gain settings, response speed, feedback, etc.

4. DIMENSION DETAILS



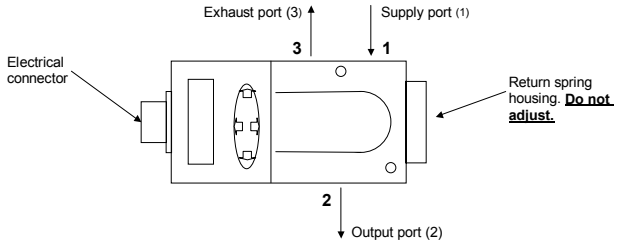
5. INSTALLATION:

Pneumatic Installation

Pneumatic Installation

- Supply Pressure: 5 bar minimum supply pressure
  1 bar (14.5psig) above maximum output required
  (14 bar (203psig) max.)
- Output Pressure Range: 0-10 bar (0-145psig)
- Media: clean, dry 5µm filtered air
- Port size: G1/4; 1/4NPT
- Connect pipe-work using 10mm OD, 8mm ID, plastic pipe, cut cleanly at right angles, with push-fit pipe connections.
- Fit an exhaust silencer to Port 3 if required (this will only slightly degrade exhaust performance)

The connector plug must be hand-tight only, to a tightening force less than 3 Newtons



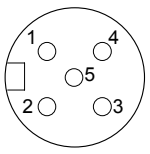
Electrical Installation

Electrical Connections

- Power Supply:24V dc power supply (± 25% with 250mA current capability)
- Signal: 0-10V, 4-20mA, as ordered
- Monitor 10V full scale; Switch mode settable

Connect the unit as follows using 5-core, screened cable and the M12 socket connector supplied:

Pin 1: +24V.D.C. supply (+ve) (RED)
Pin 2: 1V/bar monitor output (WHITE)
Pin 3: control signal (+ve) (BLUE)
Pin 4: common (DC supply, signal and feedback return) (-ve) (BLACK)
Pin 5: chassis (GREEN/YELLOW)



Connector pinout looking onto the end of the instrument

6. PROGRAMMABLE MENU STRUCTURE

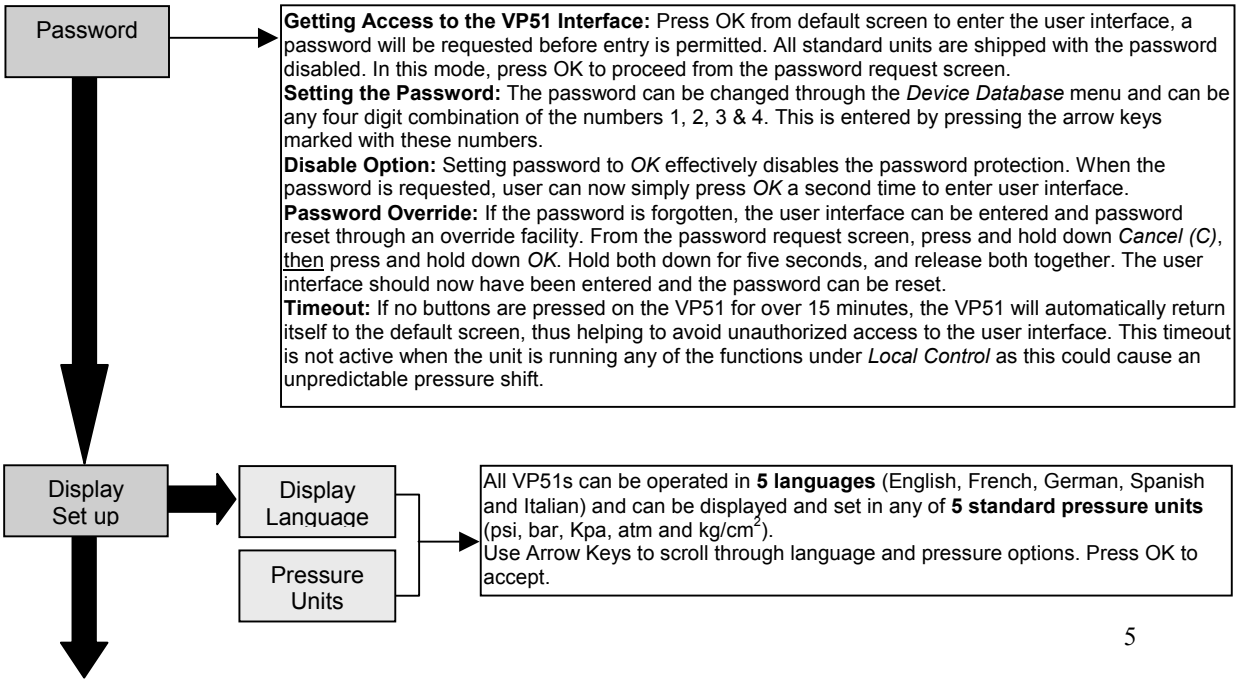
Programmable Proportional Pressure Control Valve
User Interface Functions and Descriptions

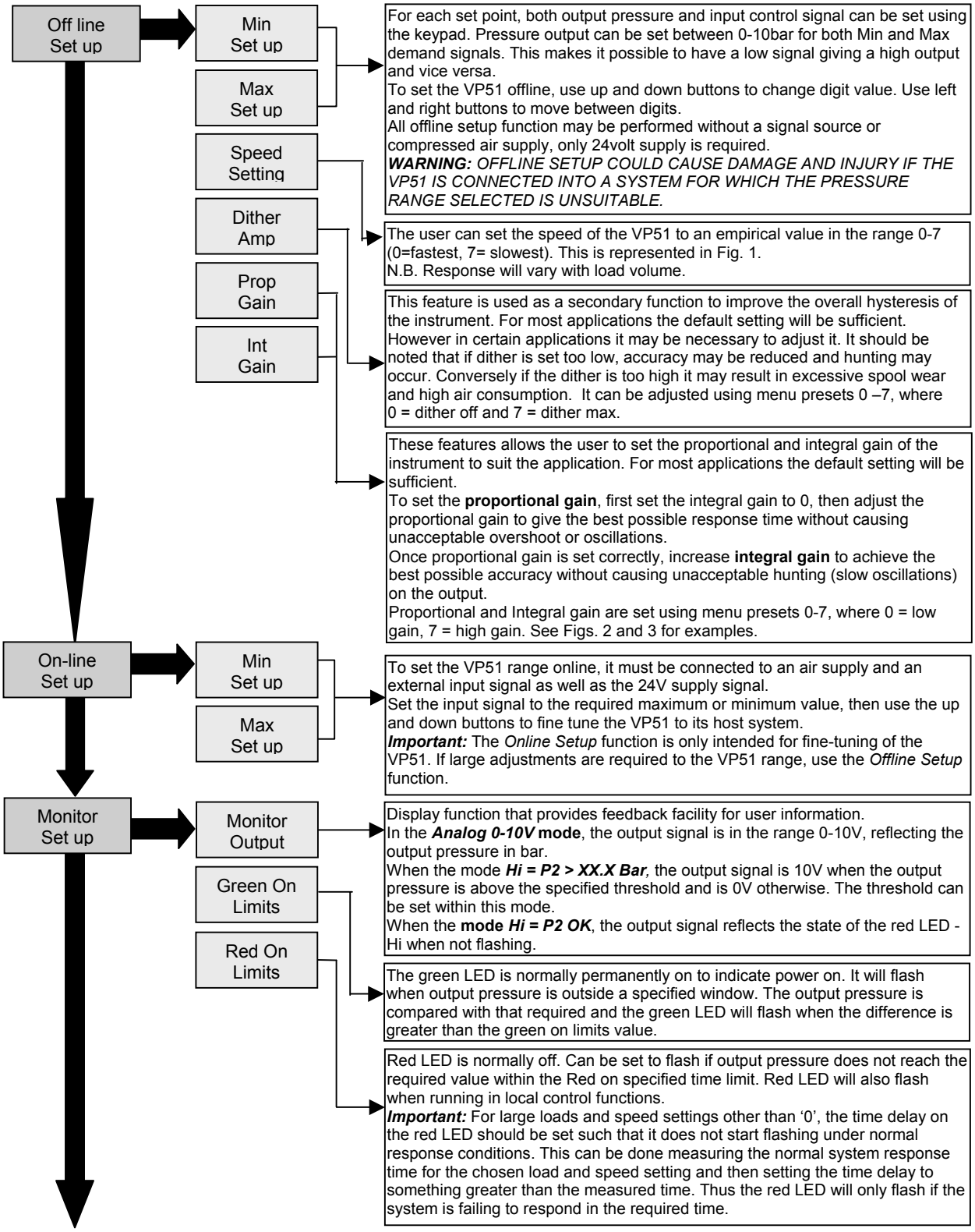
The VP51 has a 2 x 8 digit alphanumeric display with a permanent backlight, which under normal operation displays the current pressure and input signal. This is referred to as the default screen. By using the keypad, the user can gain access to a range of settable parameters.

The VP51 user interface is navigated using a six-button keypad - Up, Down, Left, Right, OK and Cancel:
Use the OK button to enter the menu from the default screen, move to the next level of the menu structure and accept changes within functions.
Use the Cancel (*C*) button to move back through the levels of the menu structure and to cancel changes within functions.
Use the Up and Down buttons to move between menu options within a level and to set digit values within functions. Use the Left and Right buttons to move between settable digits within functions.

Offline and Online Range Setup: The VP51 input signal and output pressure ranges can be set independently. For both set points, output pressure can be set at any value between 0 and 10 bar, to the nearest 0.1 bar. Likewise, input signal can be set between 0 and 10V (or 4 and 20mA). It is also possible to set the VP51 to be reverse acting, so that for a low input signal, the pressure is high and vice versa.
Important: It should be noted that the *Max* and *Min* set points do not become the operating limits of the instrument but are simply the two points required to define the gradient and offset of the straight line characteristic of the VP51. For example, if the *Min* set point is set to 1.5 Bar at 1.0V and the *Max* set point is 8.5 Bar at 8.0V then at 0V the output pressure will be 0.5 Bar and at 9V, the output pressure will be 9.5 bar. It should also be noted that the instrument accuracy, as quoted in the datasheet, applies to the product configured as a 0-10 bar instrument. For reduced ranges, the percentage accuracy will therefore decrease.

Menu Structure





For each set point, both output pressure and input control signal can be set using the keypad. Pressure output can be set between 0-10bar for both Min and Max demand signals. This makes it possible to have a low signal giving a high output and vice versa.
To set the VP51 offline, use up and down buttons to change digit value. Use left and right buttons to move between digits.
All offline setup function may be performed without a signal source or compressed air supply, only 24volt supply is required.
WARNING: *OFFLINE SETUP COULD CAUSE DAMAGE AND INJURY IF THE VP51 IS CONNECTED INTO A SYSTEM FOR WHICH THE PRESSURE RANGE SELECTED IS UNSUITABLE.*

The user can set the speed of the VP51 to an empirical value in the range 0-7 (0=fastest, 7= slowest). This is represented in Fig. 1.
N.B. Response will vary with load volume.

This feature is used as a secondary function to improve the overall hysteresis of the instrument. For most applications the default setting will be sufficient. However in certain applications it may be necessary to adjust it. It should be noted that if dither is set too low, accuracy may be reduced and hunting may occur. Conversely if the dither is too high it may result in excessive spool wear and high air consumption. It can be adjusted using menu presets 0 –7, where 0 = dither off and 7 = dither max.

These features allows the user to set the proportional and integral gain of the instrument to suit the application. For most applications the default setting will be sufficient.
To set the **proportional gain**, first set the integral gain to 0, then adjust the proportional gain to give the best possible response time without causing unacceptable overshoot or oscillations.
Once proportional gain is set correctly, increase **integral gain** to achieve the best possible accuracy without causing unacceptable hunting (slow oscillations) on the output.
Proportional and Integral gain are set using menu presets 0-7, where 0 = low gain, 7 = high gain. See Figs. 2 and 3 for examples.

To set the VP51 range online, it must be connected to an air supply and an external input signal as well as the 24V supply signal.
Set the input signal to the required maximum or minimum value, then use the up and down buttons to fine tune the VP51 to its host system.
Important: The *Online Setup* function is only intended for fine-tuning of the VP51. If large adjustments are required to the VP51 range, use the *Offline Setup* function.

Display function that provides feedback facility for user information.
In the ***Analog 0-10V*** **mode**, the output signal is in the range 0-10V, reflecting the output pressure in bar.
When the mode ***Hi = P2 > XX.X Bar,*** the output signal is 10V when the output pressure is above the specified threshold and is 0V otherwise. The threshold can be set within this mode.
When the **mode *Hi = P2 OK***, the output signal reflects the state of the red LED - Hi when not flashing.

The green LED is normally permanently on to indicate power on. It will flash when output pressure is outside a specified window. The output pressure is compared with that required and the green LED will flash when the difference is greater than the green on limits value.

Red LED is normally off. Can be set to flash if output pressure does not reach the required value within the Red on specified time limit. Red LED will also flash when running in local control functions.
Important: For large loads and speed settings other than '0', the time delay on the red LED should be set such that it does not start flashing under normal response conditions. This can be done measuring the normal system response time for the chosen load and speed setting and then setting the time delay to something greater than the measured time. Thus the red LED will only flash if the system is failing to respond in the required time.

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Local Control → Manual Control

Local control function enables the user to manually set output pressure using arrow keys. To accept command press OK. This will display an output pressure warning. To return to Remote Control press C followed by OK. This will display the main menu structure.
Manual Control is part of the *Local Control* menu. Within *Manual Control* the user can set the VP51 to output any pressure between 0 and 10 bar to 3 significant figures, without affecting the end points. The up and down buttons are used to change digit values. The left and right buttons to move between digits.
WARNING: *MANUAL CONTROL COULD CAUSE DAMAGE AND INJURY IF THE VP51 IS CONNECTED INTO A SYSTEM FOR WHICH THE PRESSURE CHANGES SELECTED ARE UNSUITABLE.*

Device Database

Display function that shows device ID, serial No, etc.
Database Contents: Users have read only access to part number, serial number, software version, factory calibration date and run time. All this data is accessible under the *Device Database* menu.
Tag Number: The VP51 has a user settable eight digit tag. Use the left and right buttons to move between digits and the up and down buttons to set the digits.
Help: For further assistance on the VP51, visit the Watson Smith website at www.watsonsmith.com.

Factory Defaults

Factory defaults settings can be restored from any user set conditions. At the *Factory Defaults* menu, press *OK* and you will be invited to *Restore Defaults.* Press *OK* again and all VP51 settings will be restored to their factory set values as printed on data label.
WARNING: *RESTORING FACTORY DEFAULTS COULD CAUSE DAMAGE AND INJURY IF THE VP51 IS CONNECTED INTO A SYSTEM FOR WHICH THE FACTORY SET RANGE (0-10 Bar, 0-10V) IS UNSUITABLE.*

Warning Messages

Warning P2 Shift

This message indicates that the output pressure (P2) may change as a result of user intervention. If this acceptable OK should be pressed, if this is not acceptable press Cancel.

Remote Control

This message will appear when leaving manual control. It prompts the user to confirm that the instrument should return to being driven by a remote control signal. To accept this press OK, to remain in manual press C.

Fig. 1 - Speed Setting Effects at default Proportional and Integral Gain

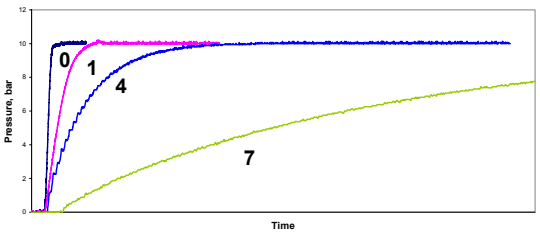


Fig. 2 - Proportional Gain Effects at default Integral Gain and Speed

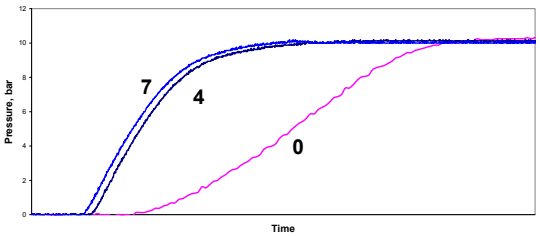
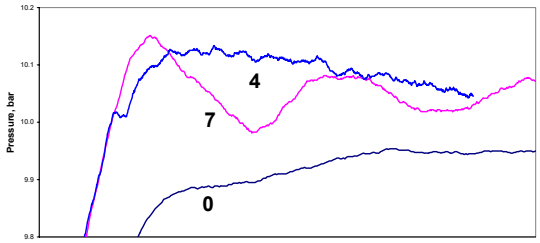


Fig. 3 - Integral Gain Effects at default Proportional Gain and Speed



7. BRIEF INSTALLATION INSTRUCTIONS

SUMMARY
If you need more information, please read the complete handbook.

1. Connect an air supply (11 bar max) to the VP51 filtered to 5 µm; use thread sealant. (e.g. red loctite 542)
- **Use Oil-Free Air**
- **Do Not use PTFE Tape**
2. Connect a suitable signal source (0-10V, 4-20mA) to range to pin 3 (blue) +ve and pin 4 (black) common –ve.
3. Connect a 24V dc power supply across pin 1 (red) and Pin 4 (black)
- **Check the Connections and Polarity**
4. Connect a suitable load or gauge to the outlet port
5. Switch on supply and the proportional valve should operate
6. Set-up can be made off-line (pressure) for desired outlet pressure, feedback signal and range settings. Fine tuning can be performed using online set-up.
7. Adjust the Proportional and Integral Gains, Dither Amplitude and Speed, if necessary

8. EC DECLARATION OF CONFORMITY

The VP51 Proportional Valve complies with the generic EMC standards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EC DECLARATION OF CONFORMITY FOR THE VP51 DIGITAL PROPORTIONAL VALVE

IMI

BS EN 50081-2 : 1994:	Electromagnetic Compatibility Generic Emission Standard Part 2: Industrial Environment
BS EN 61000-6-2:1999:	Electromagnetic Compatibility Part 6-2: Generic Standards-Immunity for Industrial Environments