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**VAL-SIF-135**

**The Moduflex Manual of Modular  
Pneumatic Valve Islands**

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# The Manual of Modular Pneumatic Valve Islands

Electro-pneumatic automation techniques have progressed through use of PLCs, field buses, cylinder integrated sensors, and modular pneumatic valve islands. Pneumatic valves are now designed into compact islands that are easily configured for specific installation requirements. They are at the center of both the automation network and the man-machine dialog.

Defining the best valve island assembly for each application is now the key answer to performance. This manual presents the numerous possibilities that are offered by the latest modular pneumatic valve islands.

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# 1 Valve Islands Change Automation Practice

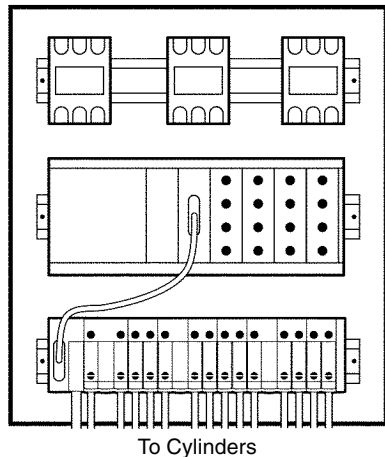
Automation practice is in continual evolution. The latest pneumatic valve island generation offers advantages at several stages: design, installation, machine commissioning, and machine maintenance.

## A Design

New compact modular pneumatic valve islands offer numerous possibilities for automation design.

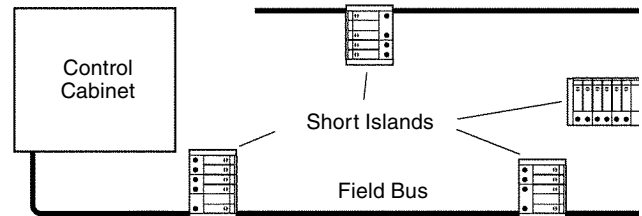
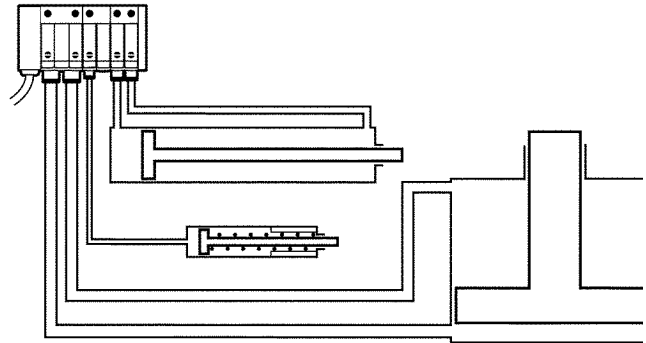
Depending on the machine complexity and the environment, the designer will choose either to centralize or to decentralize the pneumatic valves.

### Central Valve Island in a Cabinet



Control Cabinet with Both Electric and Pneumatic Components

### Remote Short Islands Located Close to the Cylinder

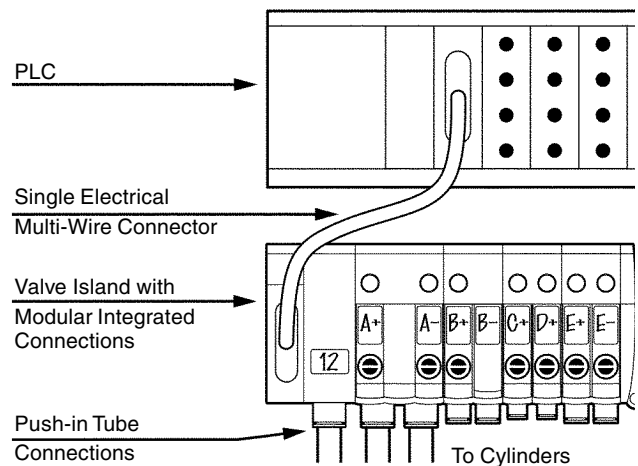


## B Installation

The configuration and the installation of a valve island for a given machine has been simplified with the latest generation of products.

This manual explains each step, from assembling the valve island to plug-in.

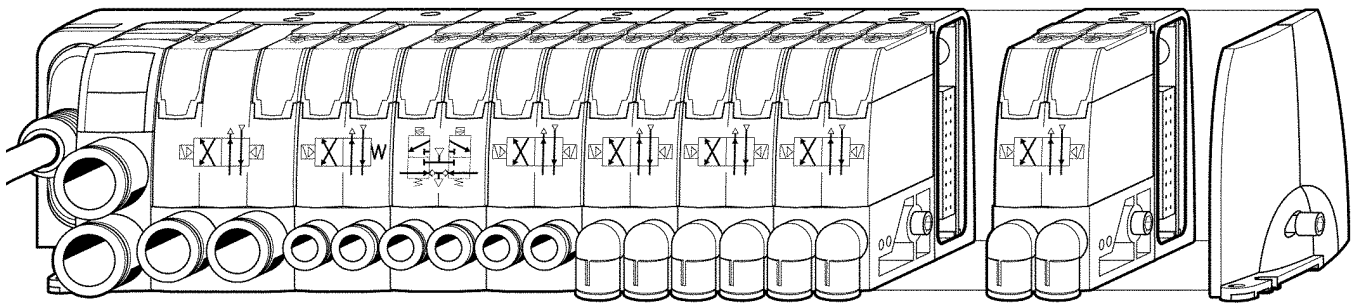
### Valve Island Plug-in Connection to PLC



## C Machine Commissioning

Automation is a step-by-step procedure. Electro-pneumatic machines generally have a final commissioning procedure stage to ensure they fully achieve their task.

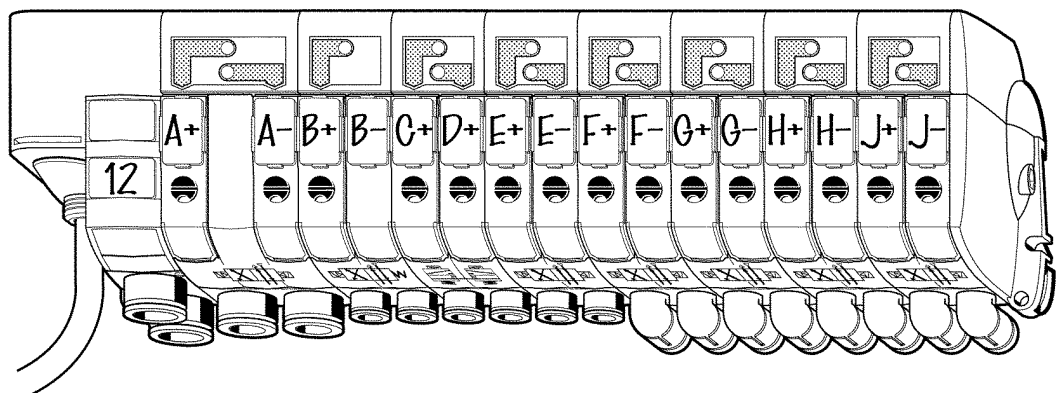
This manual explains how valve islands of the latest generation can easily be configured and re-configured until all cylinders on the machine achieve the required performance.



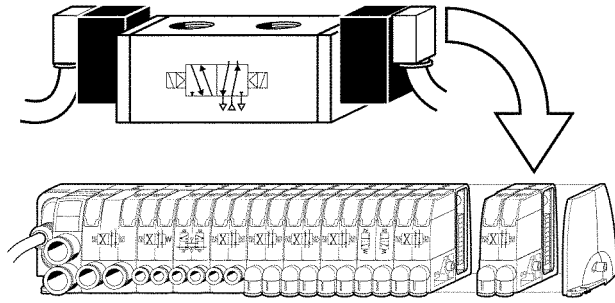
## D Machine Maintenance

Man-machine dialog has been much improved with the latest pneumatic valve islands. They now provide a key function for machine troubleshooting.

This manual shows how each island module, with its identification marking, LED indicators and manual overrides, improves and simplifies the troubleshooting of a machine.



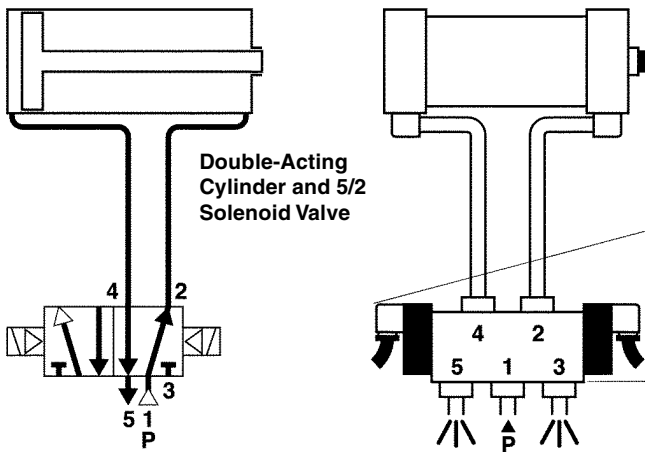
## 2 History from Stand-Alone to Pneumatic Valve Islands



To answer the needs of more and more complex and compact machines, pneumatic automation has continuously progressed:

- In order to be compatible with PLCs, it became low-power electrically controlled;
- What were originally stand-alone valves are now manifolded together into compact, flexible valve islands that include a complete range of functions.

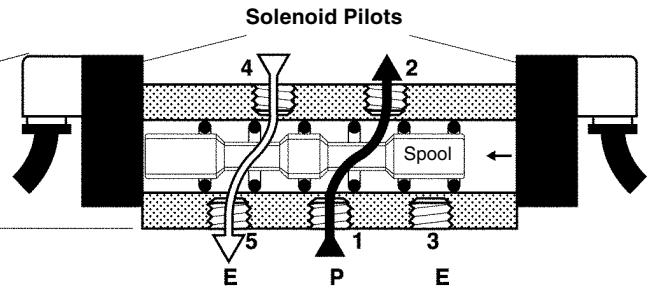
### A Stand-alone Valves



The sketches represent the basic subassembly of a double-acting cylinder that is controlled by a 4-way valve.

The “5/2” specification indicates the number of ports (5) and the number of spool positions (2).

The spool valve design requires an exhaust port at each end (5 ports for a 4-way valve).



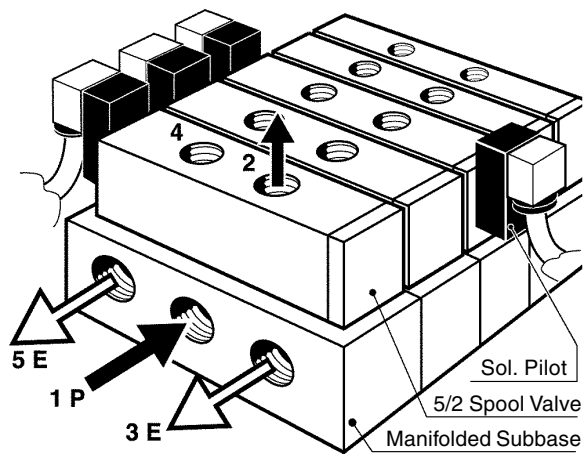
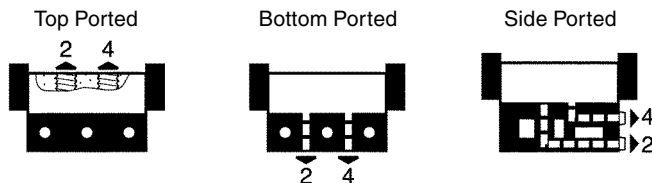
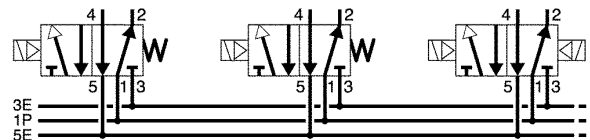
### B Valve Manifolds

As early as the 1980s, large numbers of stand-alone valves on each machine made the installation and piping work long and costly. As with hydraulic valves, designers developed manifolded pneumatic valves, thereby reducing the number of tube connections to be made.

The sketches show a typical 5/2 valve manifold incorporating 3 common channels: common pressure supply 1, and exhaust collection channels 3 and 5.

Depending on the valve and manifold design, output ports to cylinders can either be on top of the valve or in the bottom or on the side of the manifold.

Installation and piping time was tremendously reduced. This manifold design led the way for more than 10 years.



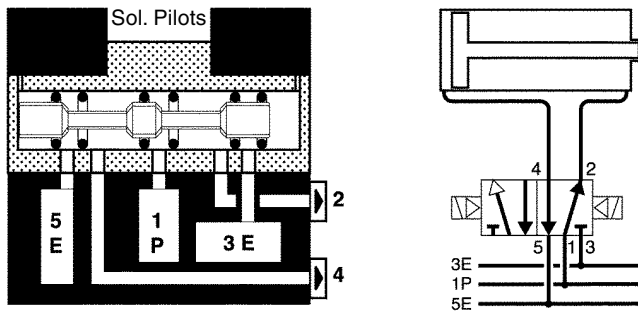
**G 3-Channel Compact Islands**

In the 1990s, with the number of pneumatic valves still increasing on the machines, valve manifolds appeared big and bulky. On the same 3-channel principle, compact islands were developed and taken over, also with a wider choice of options.

It included:

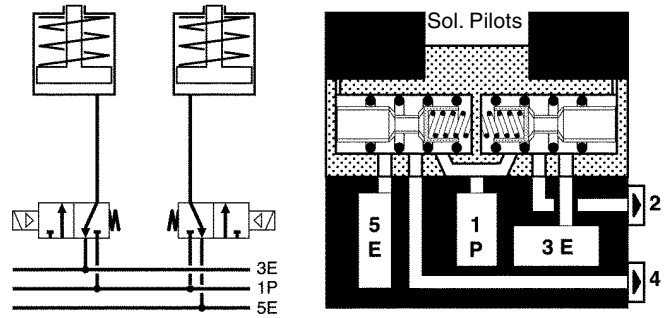
- Pilot exhaust collection for cleaner environment,
- 5/2 valves (4 ways) as well as 3/2 valves (3 ways) as shown on the sketches below.

**5/2 Module (4 Way) for Double-Acting Cylinder**



Spool Valve Design

**Double 3/2 Module (3 Way) for Single-Acting Cylinder**



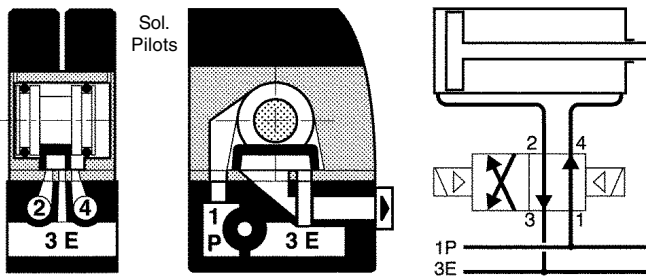
Spool Valve Design

**D 2-Channel Compact Islands**

Today, additional needs must be satisfied: more flexible islands, different valve sizes in the same island, etc. With appropriate valve designs (see illustrations below), islands with only two

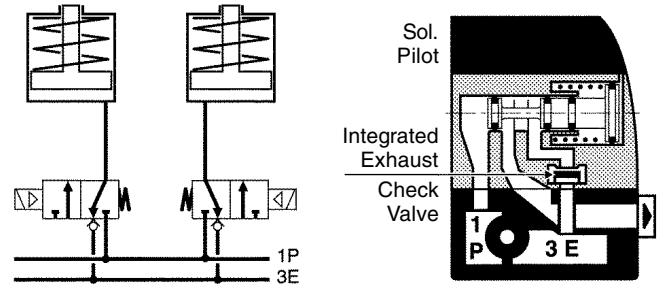
(2) common channels represent a new generation still more compact, with a complete solution for all needs. This allows for new and efficient automation practice.

**4/2 Module (4 Way) for Double-Acting Cylinder**

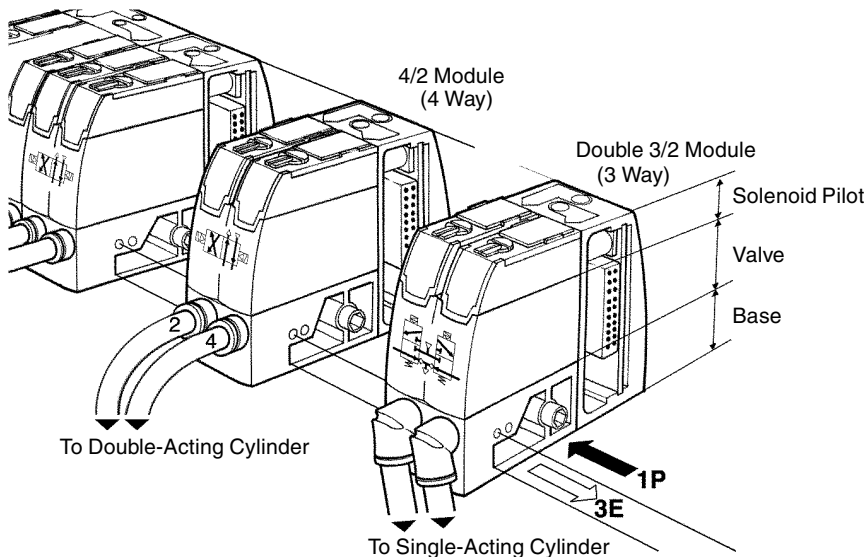


Slide Valve Design

**Double 3/2 Module (3 Way) for Single-Acting Cylinder**

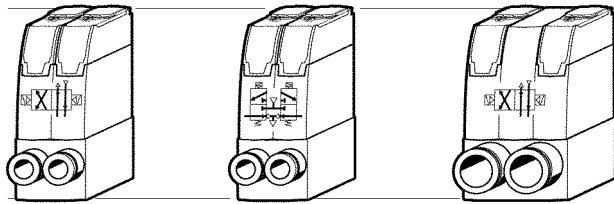


Piston + Spool Design



This 2-channel compact island generation allows considerable progress in automation practice. This manual's target is to describe the progress made.

# 3 Basic Valve Choice for a Given Island



Compact pneumatic valve ranges have been developed and proven. They can now be adapted to all practical situations:

- Different island sizes: long islands, short remote islands near the cylinders, stand-alone valves, etc.
- In a given island, different flows and different valve functions.

## The Right Valve Module for Each Cylinder

### Valve Flow Passage

One island may control both large and small cylinders. This is why valve modules of different flow capabilities can be combined into the same island.

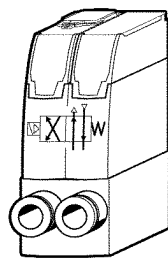
<b>Valve Module Size</b>	<b>Size 1</b>		<b>Size 2</b>	
<b>Tube Size to Cylinder</b>	<b>5/32" OD</b>	<b>1/4" OD</b>	<b>1/4" OD</b>	<b>3/8" OD</b>
<b>Cylinder Bore Size</b>	Ø6 to Ø25 mm	Ø25 to Ø40 mm	Ø40 to Ø63 mm	Ø63 to Ø100 mm

### Valve Function

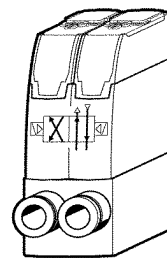
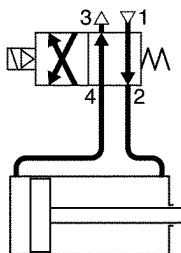
One island may control single or double-acting cylinders, requiring 3/2 or 4/2 valves.

Control may require single or double solenoid pilot valves, or both.

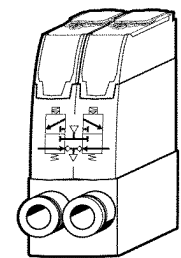
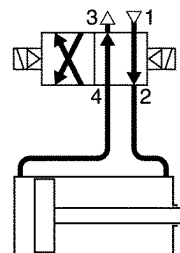
All these valve functions can be combined into the same island together with 3-position valve functions (Chapter 11) and peripheral flow control and pressure regulation modules (Chapter 10).



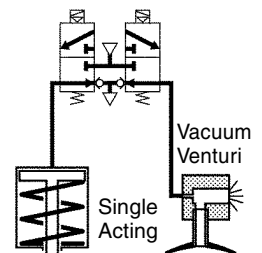
4/2 Single Sol.



4/2 Double Sol.



Double 3/2 NC or NO

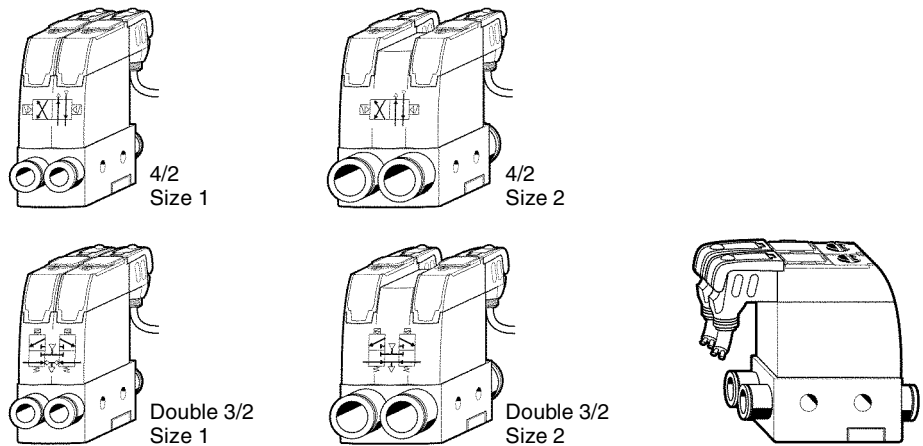


## Pneumatic Valves and Islands for All Applications

The flow and function variations that have been explained on the previous page are completed with the following additions.

### Stand-alone Modules

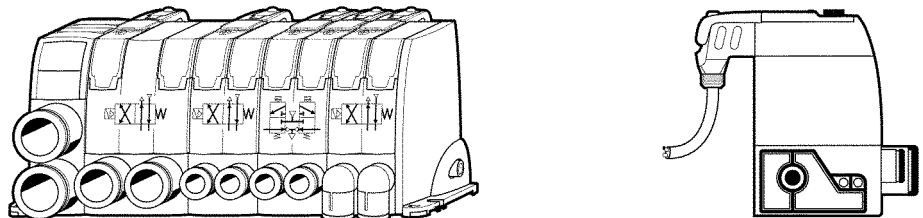
For isolated cylinders on a machine, it is preferable to locate the valve near by; thus a stand-alone module is required. Response time and air consumption are then reduced to a minimum.



### Modules for Islands with Individual Electrical Connectors

For small groups of cylinders, short valve islands can be used.

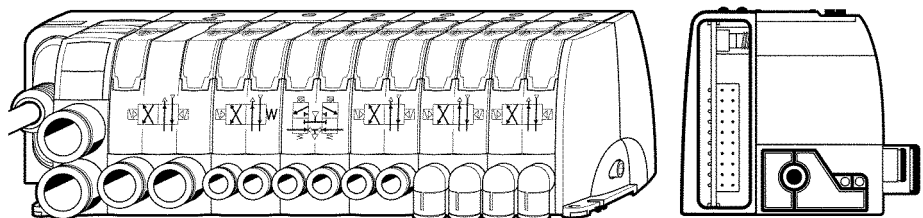
In this case, it is practical to use individual electrically connected valves.



### Modules for Islands with Integrated Connections

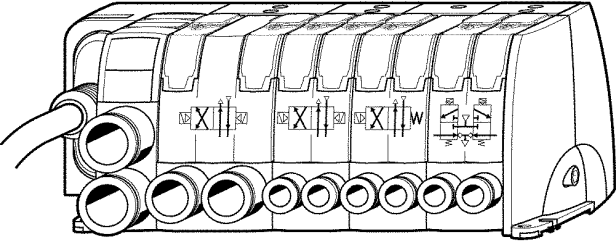
When the number of valves is larger, modular islands are easily assembled with their integrated electrical connection series.

Such islands are then connected to the control PLC with an electric multi-connector that plugs into the island head module or with a field bus connection.





## 4 A Valve Island for Each Application



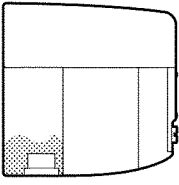
Valve modules selected from the previous pages are assembled into a specific island for each application.

The valve island features push-in connections that clip into the valve modules. For each application, the most effective configuration may be obtained.

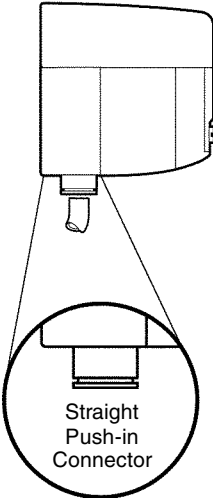
### Tube Connections to Cylinders

Valve Module Size	<b>Size 1</b>		<b>Size 2</b>	
Tube OD	5/32"	1/4"	1/4"	3/8"

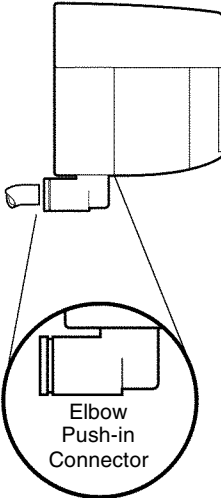
**Basic Module**



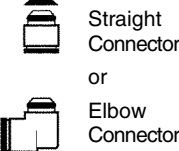
**Complete Module for Valve Island**



Straight Push-in Connector



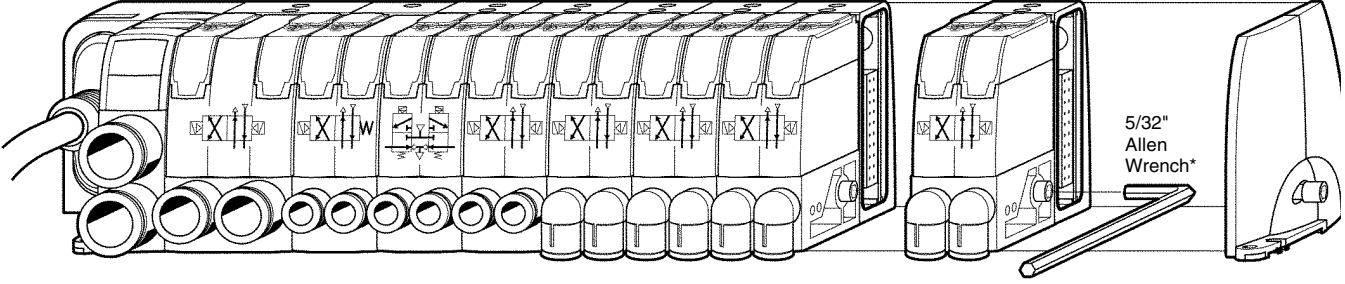
Elbow Push-in Connector



Straight Connector or Elbow Connector

Each valve module is equipped with push-in tube connectors of the required size and configuration. All connectors simply clip into the **basic modules** to obtain the required **complete modules** for valve islands.

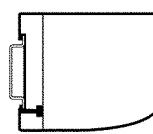
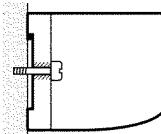
### Valve Island Assembly and Installation



5/32" Allen Wrench\*

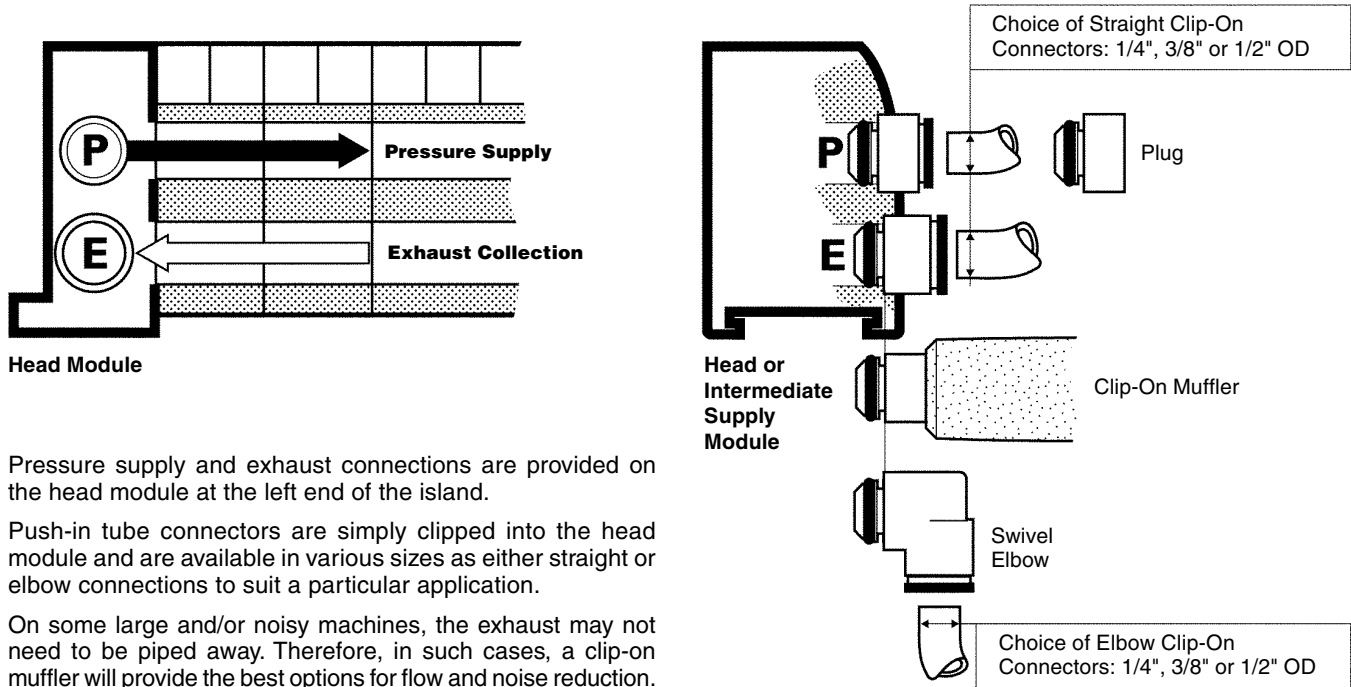
\* Maximum torque rating 13 in. lbs.

To assemble the valve island, modules are fastened side by side at their base. The resulting island is compact and rigid, and can be mounted directly onto the machine or inside an enclosure.



Screw Mounting and DIN Rail Mounting

## Valve Island Pressure Supply and Exhaust Collection



Pressure supply and exhaust connections are provided on the head module at the left end of the island.

Push-in tube connectors are simply clipped into the head module and are available in various sizes as either straight or elbow connections to suit a particular application.

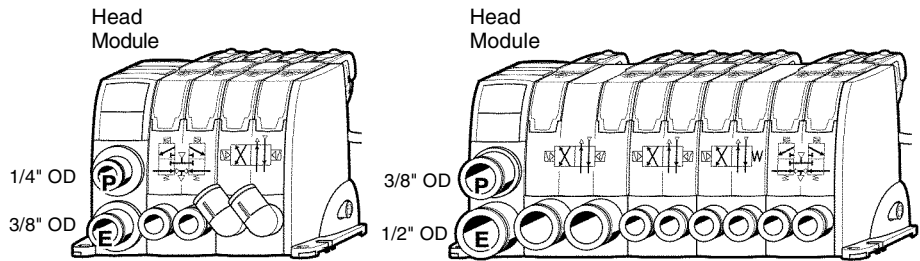
On some large and/or noisy machines, the exhaust may not need to be piped away. Therefore, in such cases, a clip-on muffler will provide the best options for flow and noise reduction.

## Valve Island Configurations to Meet Flow Requirements

Depending on the island size (short or long) and on the size of its valves, the flow requirements can be very different. Each island is easily configured to conform to the flow requirements, and can be easily modified if the cylinder speeds are insufficient.

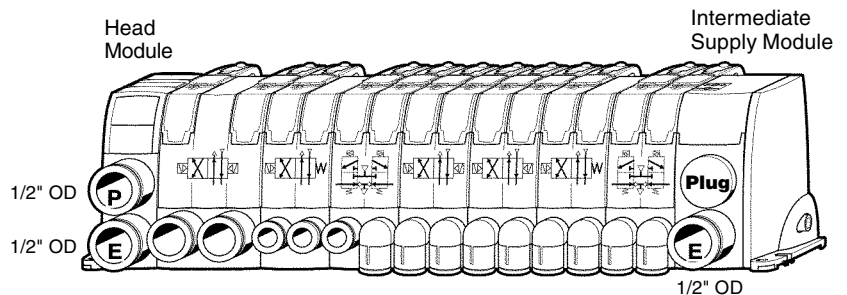
### Short Islands

With only size 1 valves, a short island requires limited flow supply (the tail module is a simple plate). When a size 2 valve is integrated into the island, its flow requirements dictate the island supply and exhaust choices. In all cases, the exhaust section area must be bigger than the supply section area.

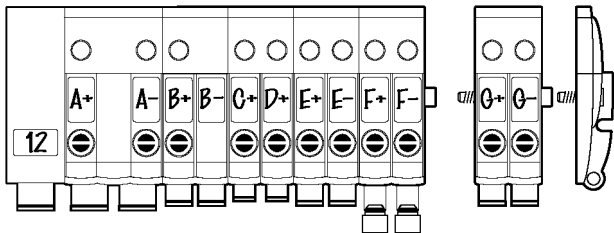


### Long Islands

The double exhaust connector E (Ø 1/2") with maximum flow is generally required, while only one pressure supply connector P is necessary.

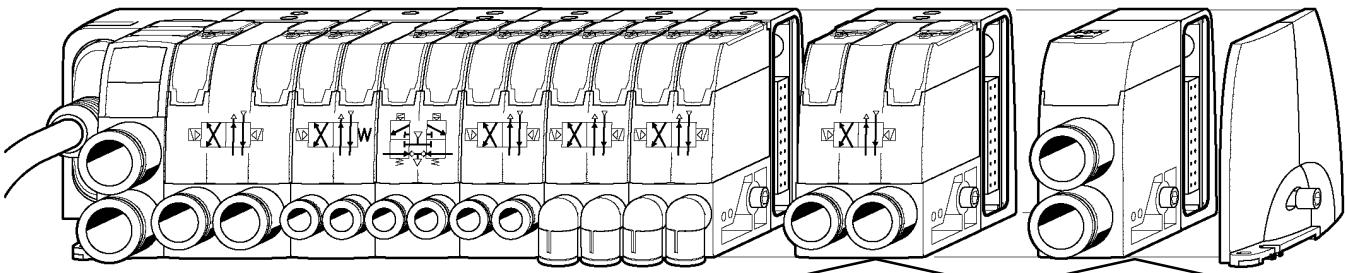


## 5 The Internal Flexibility of Valve Islands



In order to simplify machine commissioning procedures, valve islands must be flexible. Totally modular, they can easily be expanded or reconfigured until they precisely answer the application needs: different cylinders, different flows to achieve the required cylinder speeds, different sections in a given island, etc.

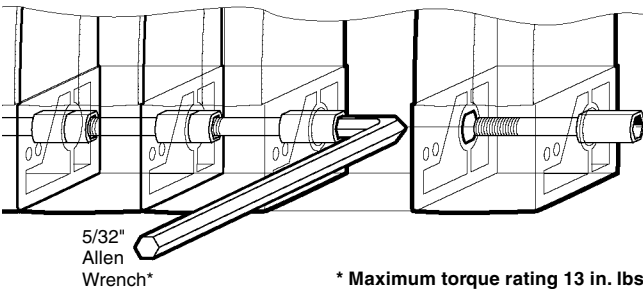
### Island Composition Adaptations



The initial island may be modified until it achieves all requirements. As an example, on the island shown above, the last valve module is being changed for a higher flow and in consequence, the pressure supply and exhaust collection are being doubled.

This **Size 2 Valve Module** will provide the required speed for the cylinder.

This additional **Intermediate Module** will increase the island flow supply and exhaust connection to the required levels.

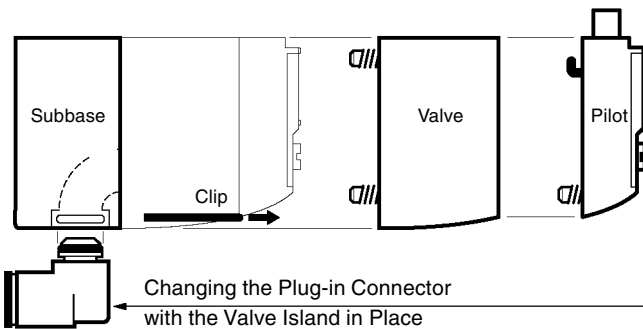


### Easy Island Assembly and Disassembly

When assembling a valve island, the screw head must be orientated (see drawing) so that the following module will prevent the screw from turning.

This facilitates the disassembly of the island in the correct order.

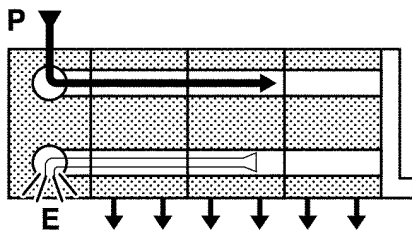
### Tube Connection Variations



For each application, the valve flow passage and the tube size are independently selected.

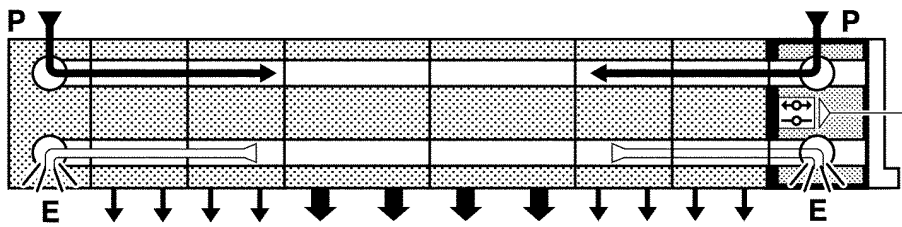
If, however, a cylinder does not reach the required speed, the flexible valve island design allows a change in tube size with the valve island in place. Simply remove the solenoid pilot and the valve, pull out the clip, and replace the tube connector with a larger one.

## Island Division into Different Pressure Sections

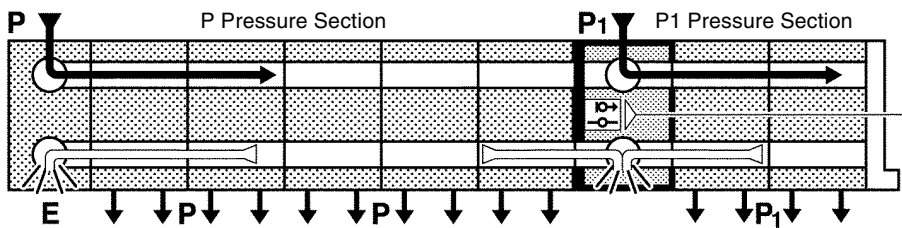


Typical Short Island with Single Supply and Exhaust Collection.

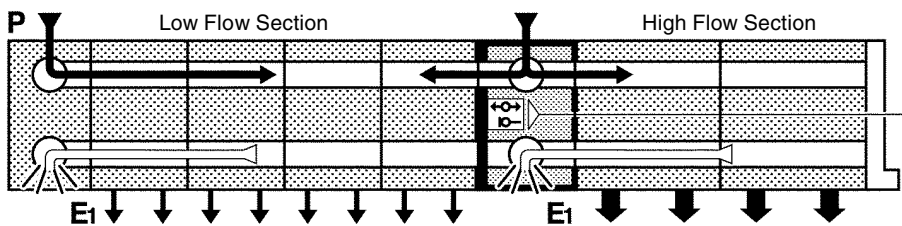
Valve islands may require two (2) or more different pressure sections. The universal intermediate supply module is available to provide any required combination, as shown by the following examples.



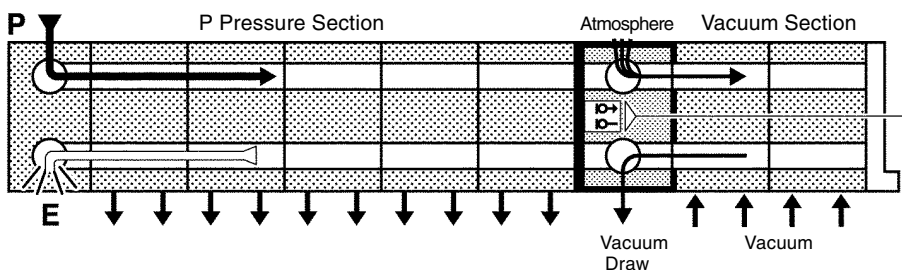
Typical Long Island with Double Supply and Exhaust Collection.  
P and E Channels are Both Open.



Two-Section Island for Different Pressures P and P1.  
P Channel is Blocked.  
E Channel is Open.



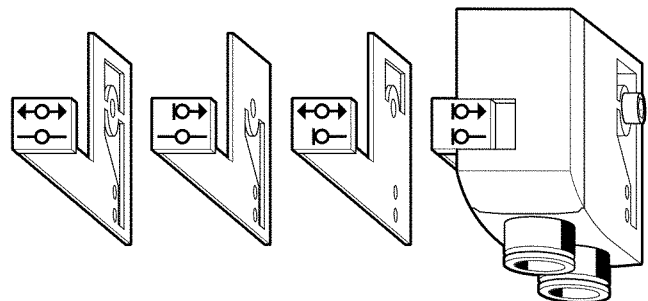
Two-Section Island for Exhaust Separation of High Flow Valves.  
P Channel is Open.  
E Channel is Blocked.



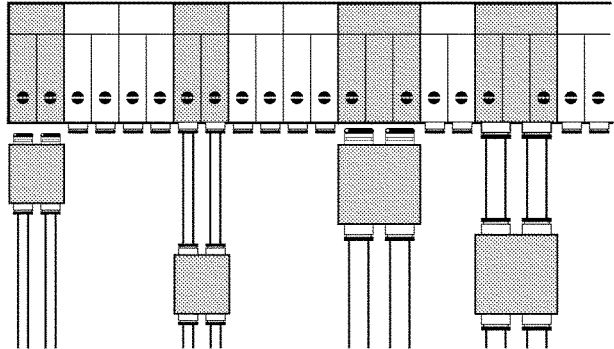
Two-Section Island:  
• One Section with P Pressure.  
• One Section with Vacuum.  
P and E Channels are Both Blocked.

The universal intermediate supply module is supplied with four (4) configuration plates that achieve two (2) functions:

1. Block P or E channel, or none, or both;
2. Present a simple diagram on the island front to indicate the internal configuration.



# 6 The Peripheral Flexibility of Valve Islands



Peripheral control modules add to the valve island flexibility. These modules answer the complementary needs of the cylinders: flow controls, pressure regulation or positioning. They may be plugged in directly to the valve island or installed in-line closer to the cylinder.

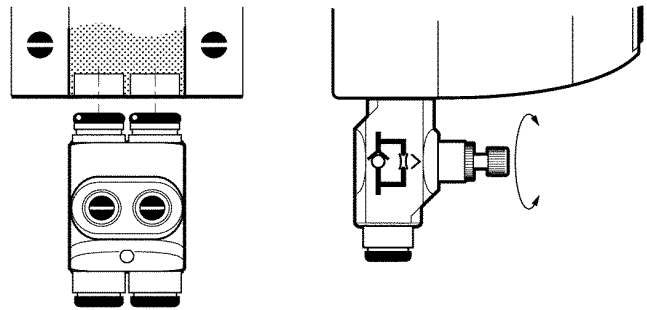
## Valve Island Output Functions

### Dual Flow Control Module

This dual flow control module is suitable for adjusting cylinder speeds by:

- Controlling exhaust flows from a double-acting cylinder;
- Controlling supply flow to a single-acting cylinder.

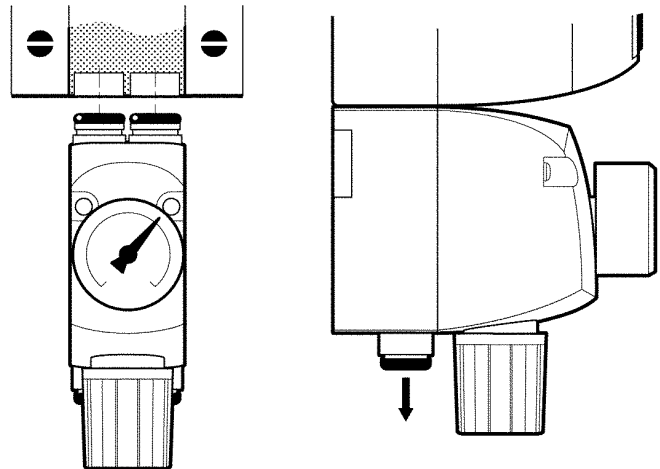
Chapter 10 gives full details.



### Pressure Regulation Module

Adjusting the thrust developed by a cylinder is often necessary. This pressure regulation module enables adjustment of the  $P_1$  pressure required for a given cylinder, and to read it on the attached pressure gauge.

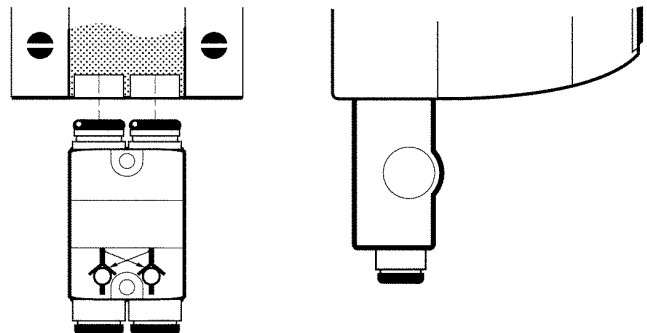
Chapter 10 gives full details.



### Dual Pilot-operated Check Module

With two internally piloted check valves, this module will block both flows and stop cylinder movement as soon as the valve's outputs are both exhausted.

Chapter 11 gives full details.



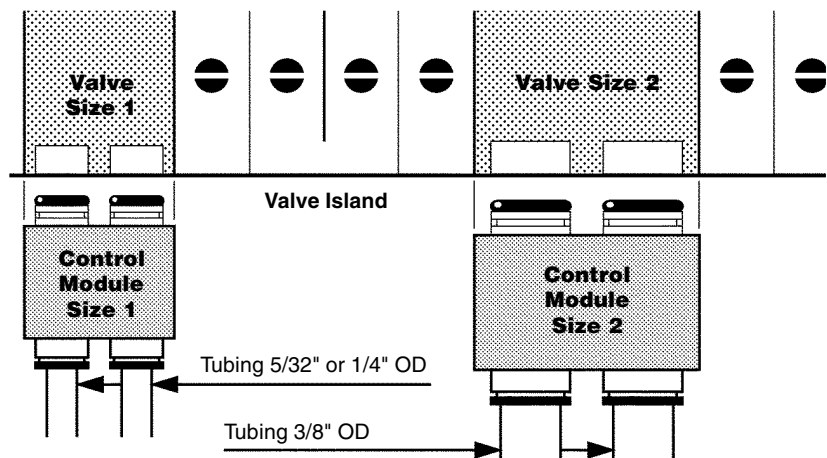
## Peripheral Flexibility with Control Modules

### Sizes and Flows

Corresponding to the two valve sizes, peripheral control modules are available in two (2) sizes:

- Size 1 — .32 Cv,
- Size 2 — .80 Cv.

All cylinders, from 6 mm to 100 mm in bore size, can therefore be accommodated.

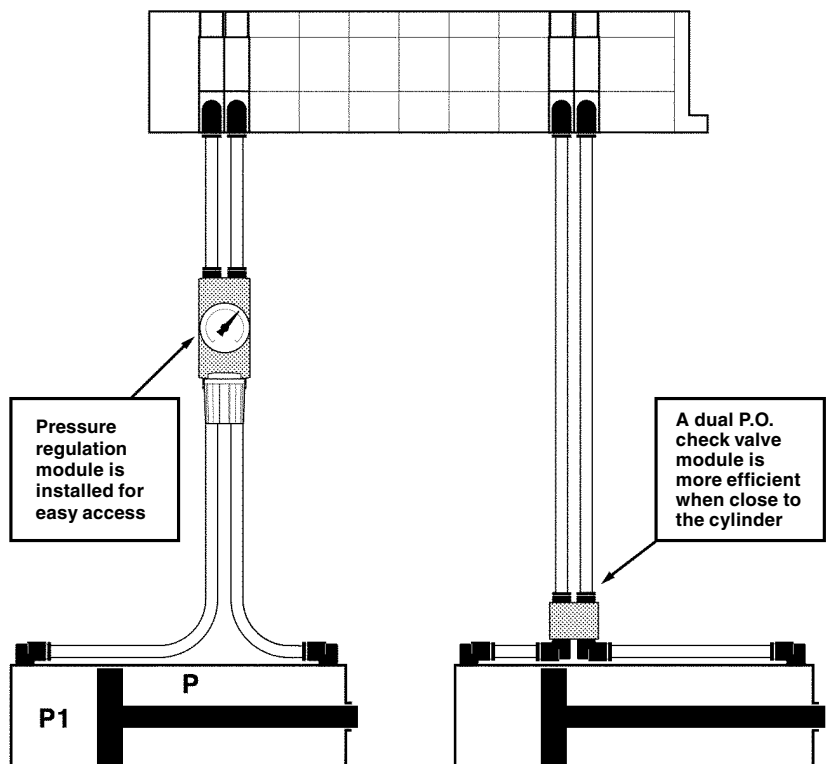
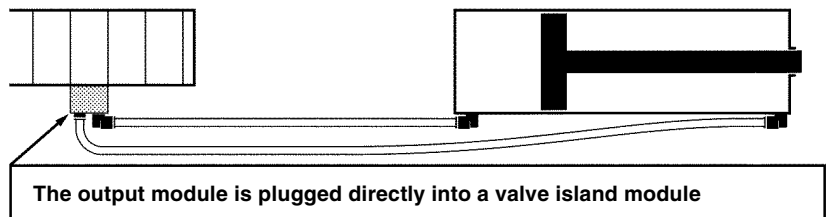


### Different Installations

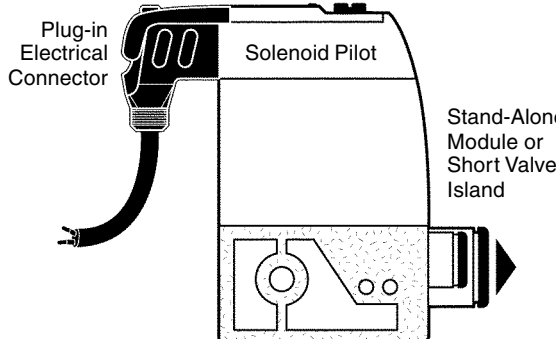
In order to accommodate machine design, and depending on cylinder requirements, the peripheral modules may be plugged into the island or installed in-line, between the valve island and the cylinder.

Flow controls and dual P.O. check valve modules are more efficient when close to the cylinder, while the location of a pressure regulation module makes no difference.

The control modules enable flexibility in designing machines as well as improving their performance during machine commissioning.



# 7 Modules with Individual Electrical Connectors



Plug-in Electrical Connector

Solenoid Pilot

Stand-Alone Module or Short Valve Island

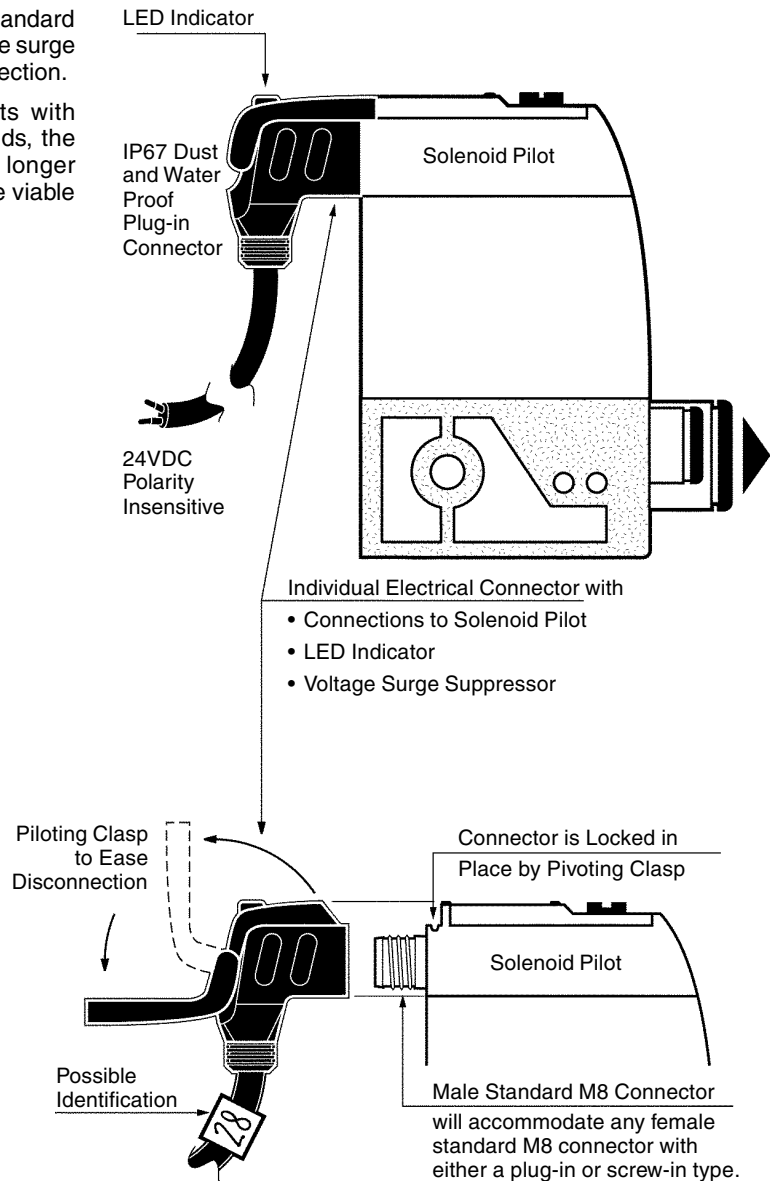
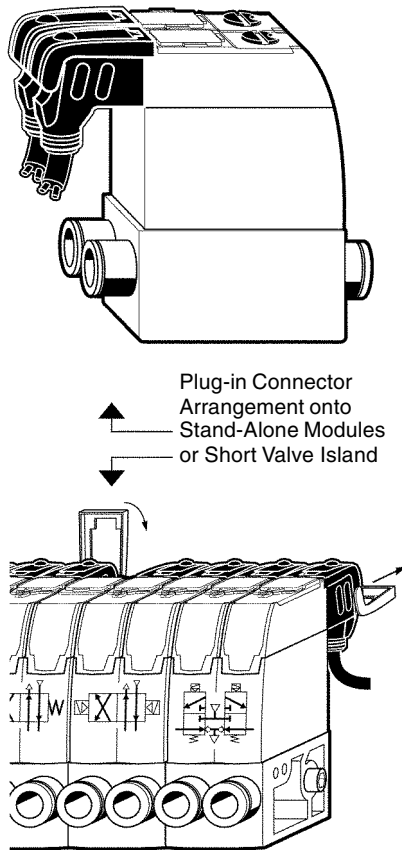
For stand-alone modules or for short valve islands, individual electrical connectors are generally appropriate.

These plug-in connectors are dust-proof and waterproof (IP67), and include the LED indicator and the voltage surge suppressor.

## The Plug-in Dust and Waterproof Connector

This electric connector plugs onto the solenoid pilot standard M8 male thread. It features a LED indicator and a voltage surge suppressor with a cable for a polarity insensitive connection.

All stand-alone modules incorporate solenoid pilots with individual “plug-in” connectors. With short valve islands, the individual connector is still preferred. However, for longer island, integrated electrical connections become more viable (see next Chapter).

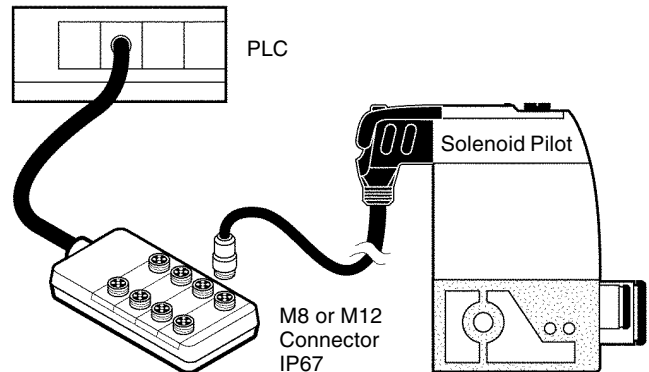
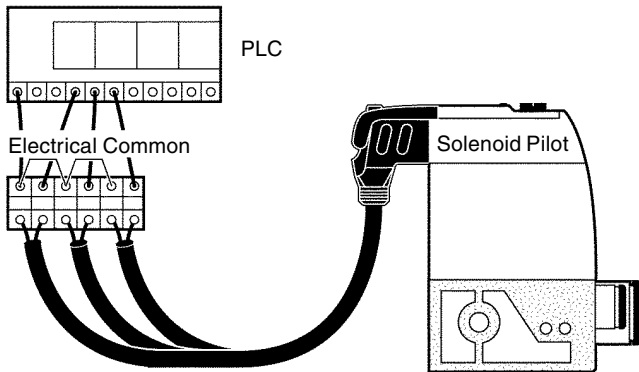


## Connections to PLCs and Other Controls

The two (2) wires of each connector cable can be taken directly to the output terminals of a PLC or field bus module.

If all outputs have a single common terminal, it will be necessary to use an intermediate terminal block with the commons linked as shown in the drawing below.

Connections outside enclosures may be IP67 protected, using the standard M8 or M12 connectors of a terminal box, as shown in the drawing below.



## Pneumatic Valve Islands Conform to the Latest Electrical Requirements

Pneumatic valve islands now have to withstand many different conditions in their various applications:

- Installed inside or outside enclosures;
- Combined with electrical components sensitive to solenoid “spikes” and inside machines subjected to voltage drop;
- Integrated with either positive logic or negative logic controls.

Therefore, the latest generation of valve islands has been developed to satisfy the following requirements in both their individual or integrated connection forms.

### IP65-67 Dust and Water Protection

Valve islands may be installed close to the cylinders they control; this can prove to be a difficult environment. Therefore the electrical parts are dust and water protected. They conform to the following standard: IP67 for individual connector valves and islands and IP65 for integrated electric connections islands.

### Collection of Exhausts (including pilot exhausts)

Increasingly, valve islands are incorporated into the electrical enclosure of a machine.

Therefore, in this case, and applications involving clean rooms or food industry, the latest valve islands enable collection of all air exhaust including these of the solenoid pilots.

### Protection of Controls from Voltage Surges

The voltage surge generated when a coil is de-energized is a common problem and can disrupt control circuits upstream of the valve island. To overcome this problem, the latest generations of valve islands incorporate a voltage surge suppressor with each solenoid pilot.

### Positive Logic (PNP) and Negative (NPN) Compatibility

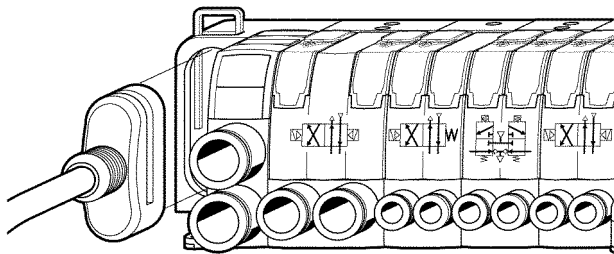
The increasing use of global automation components and machines can raise problems of compatibility between “PNP” and “NPN” circuit design. The latest generation valves and islands overcome this problem as the solenoid pilots are polarity insensitive and can accept 24VDC in any orientation.

### Dependability even with Voltage Drop

Electro-pneumatic automation is often integrated to machines that are submitted to voltage drop; for example, when an electrical motor is started. In order to overcome such working conditions, standard requirements state that the solenoid pilot should still operate 15% under the voltage rating; i.e., 20.4V for a 24V rating. To fulfill such a specification, the solenoid pilot power has to be sufficiently high; for example, 1W is better than 0.5W.



# 8 Islands with Integrated Electrical Connections



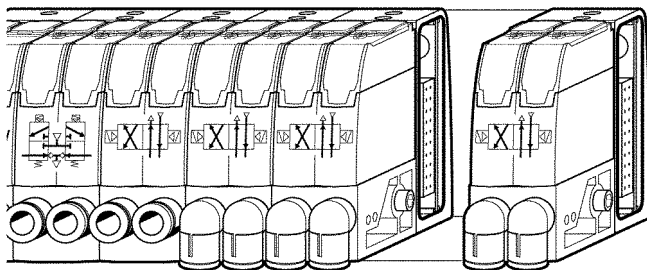
This valve island configuration considerably simplifies installation: with the multi-connector, the time taken in connecting the valve island to controls is reduced to a minimum.

Inside the island, modular integrated circuitry conveys the signals from the multi-connector to each solenoid pilot.

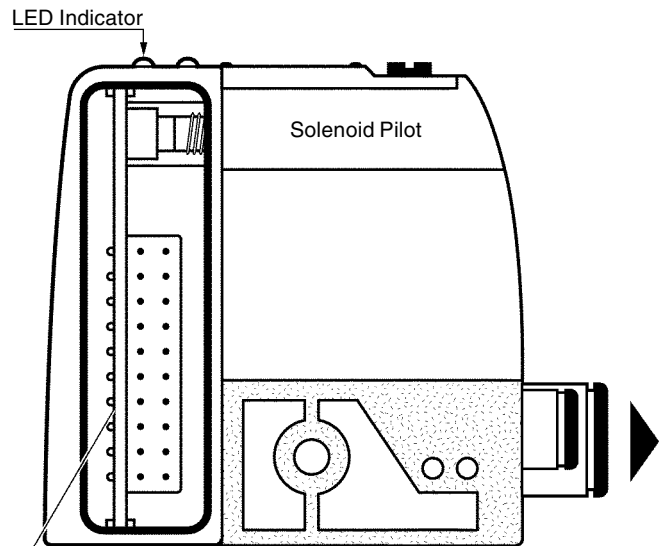
## Integrated Electrical Connections

The island's pneumatic modularity is complemented by the electrical connection modularity. When modules are assembled into an island, they are automatically interconnected. They follow the electrical connection modularity principle that is described in the box below.

The island connections to controls are then made from the electrical head module by one of the methods shown on the next page.



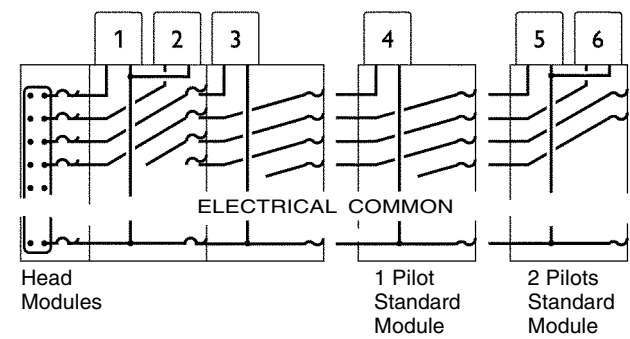
**Modular Valve Island with Integrated Electrical Connections**



Modular Electrical Circuit Including:

- Multiple Connections Between Island Modules
- Connections to Solenoid Pilots
- LED Indicators and Voltage Surge Protection
- Self-Addressing (See Below)

## Valve Self-addressing Modularity Principle



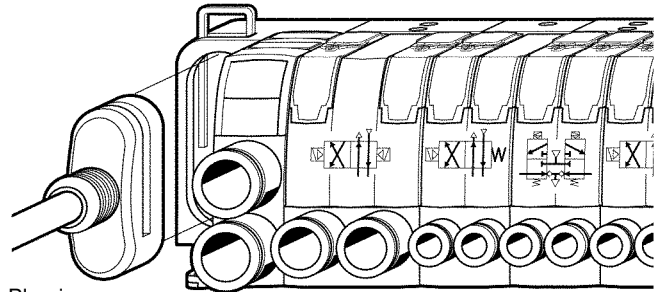
The schematic on the left illustrates the connection principle between each island module:

- An electrical common crosses the whole island connecting one pole of each of the solenoid pilots;
- Connections from the head module are self-addressing; one-step adjusted at each pilot, they step-by-step progress upward until they reach the solenoid that they will control.

All modules are standard and easily assembled to build the valve island.

## Valve Island Connection to PLCs and Other Controls

An electrical multi-connector is simply added to the basic pneumatic head module to form the complete island with each pin of the connector self addressed to the corresponding solenoid pilot.



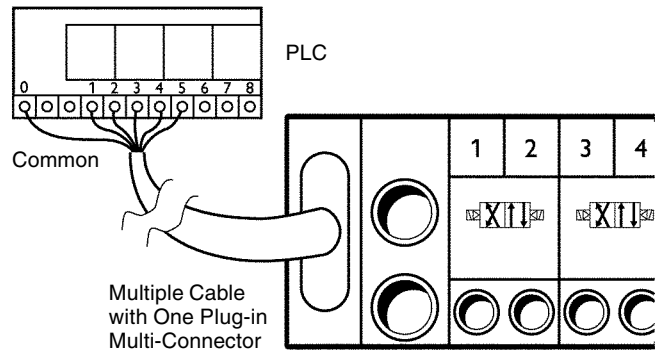
Plug-in Multi-Connector

### Wired Connection to PLC

A multiple cable is plugged into the island head module and each individual wire is connected to the PLC's terminals.

The multicolored cable is a guide to addressing, with each color unique to a solenoid pilot row within the island.

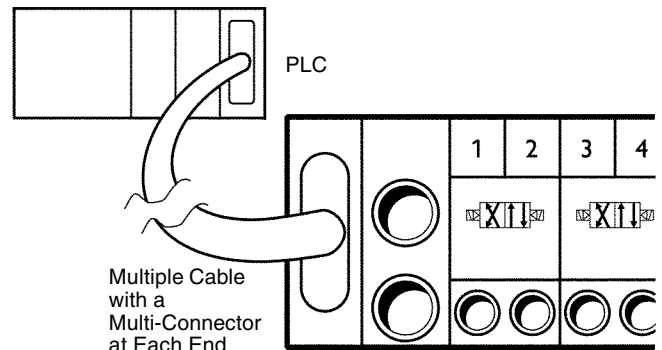
When compared with the individual electrical connector (see Chapter 7) the integrated electrical connection island with multi-connector reduces the connections to be made by almost one half.



Multiple Cable with One Plug-in Multi-Connector

### Plug-in Connection to PLC

It is possible with some well-known PLC models to have a dedicated double multi-connector cable enabling the PLC plug-in card to connect directly to the standard valve island.

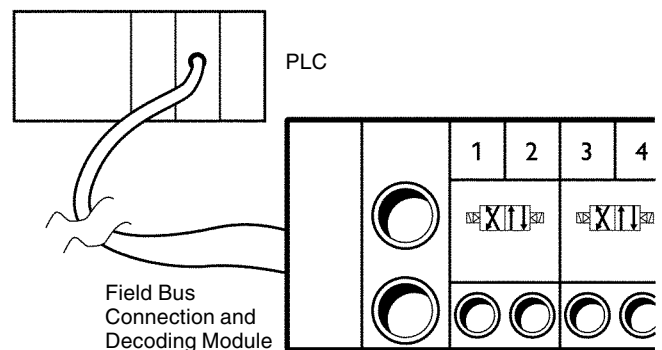


Multiple Cable with a Multi-Connector at Each End

### Field Bus Communication with PLC

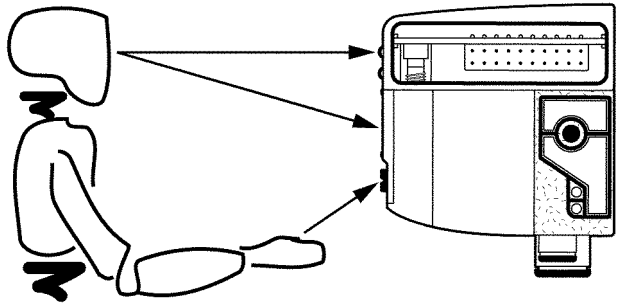
The multi-connector at the head of the island can be replaced by a field bus connection and decoding module.

Valve islands with this option can be connected at any point along the field bus that the PLS controls (see Chapters 15, 16 and 17).



Field Bus Connection and Decoding Module

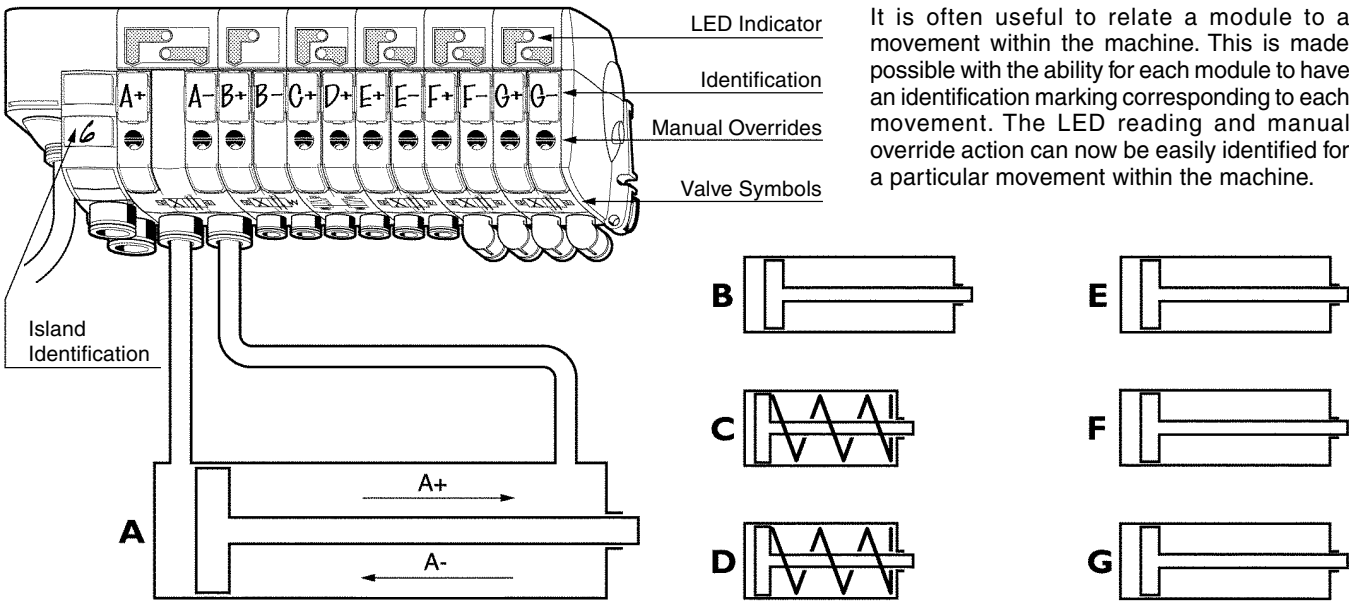
## 9 Man-Machine Dialog through Valve Islands



Pneumatic valves are at the center of electro-pneumatic automation systems. This is why pneumatic valve islands with built-in features enable efficient man-machine dialog.

This achieved, with their method of identification, the LED indicator, and the manual overrides, all of which simplify troubleshooting on the machine.

### Identification Marking on Valve Islands

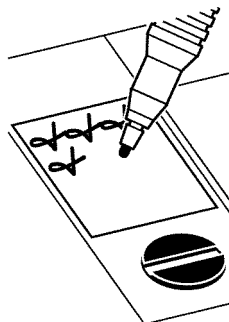


It is often useful to relate a module to a movement within the machine. This is made possible with the ability for each module to have an identification marking corresponding to each movement. The LED reading and manual override action can now be easily identified for a particular movement within the machine.

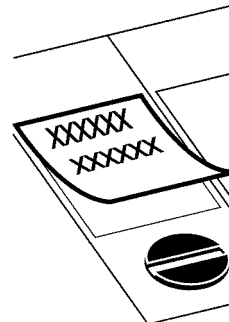
### Valve Island Marking Process

Valve islands have standard 9x17 mm identification areas.

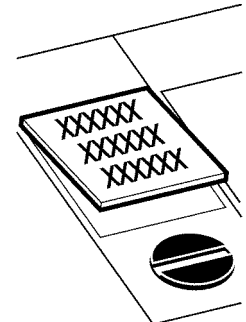
Depending on the application, one can choose between the different marking procedures shown here, from a simple hand marking to a more permanent label or tag marking using computerized equipment.



Handmade Marking with an indelible pencil

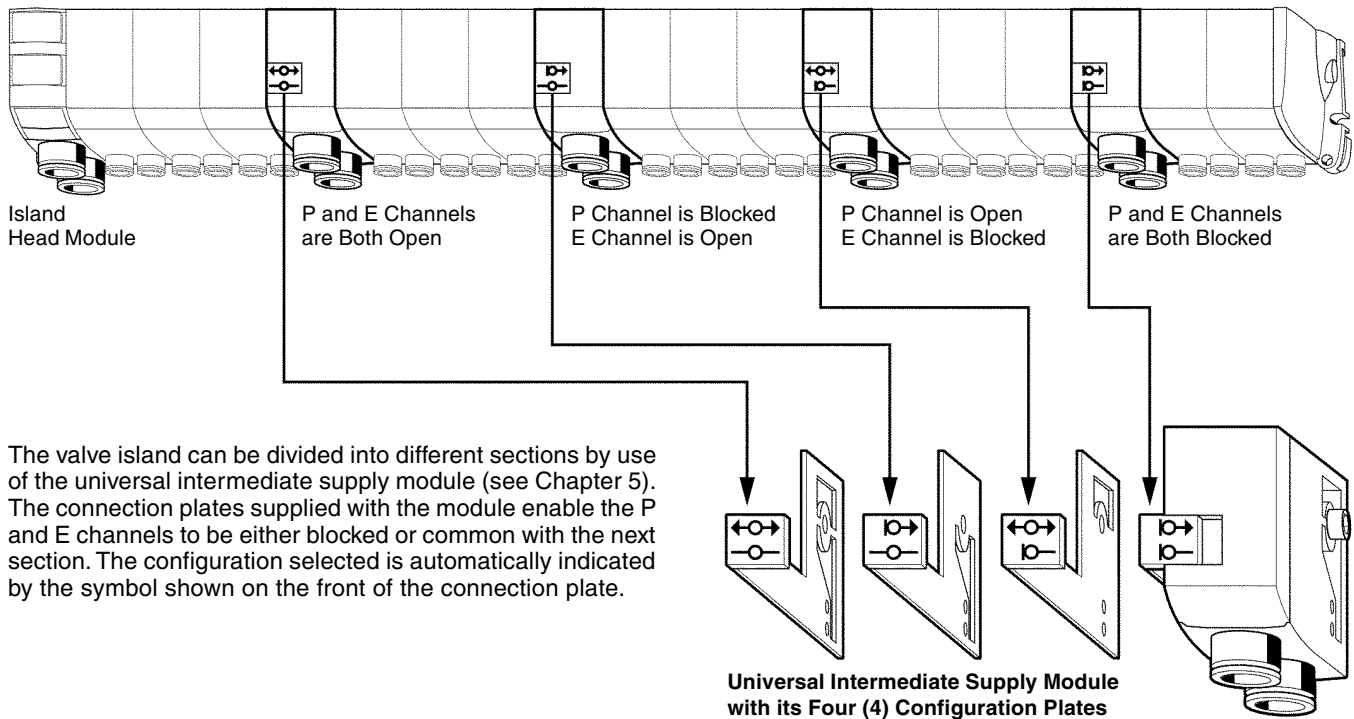


Sticking Label Marked with a laser printer standard label 9x17 mm



Sticking Tag Marked with a tracing table standard tag 9x17 mm

## Identification of Valve Island Sections



## Unique Solenoid Pilot with Multifunction and Adaptable Manual Override

For safety and standardization reasons, most machine builders now use 24VDC. This convergence towards only one voltage leads to a simpler system with a unique solenoid pilot. In order to cater to the man-machine dialog requirements, this solenoid pilot manual override is both multifunctional and adaptable to each stage, from the machine installation to its maintenance.

The standard modules have solenoid pilots with multifunction manual overrides:

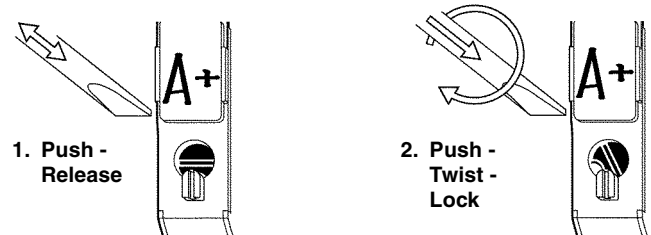
- Push-release function;
- Push-twist-lock function.

Man-machine dialog is then complete, facilitating the commissioning of each machine subassembly. Later, when electrical controls are connected, the manual override may be adapted.

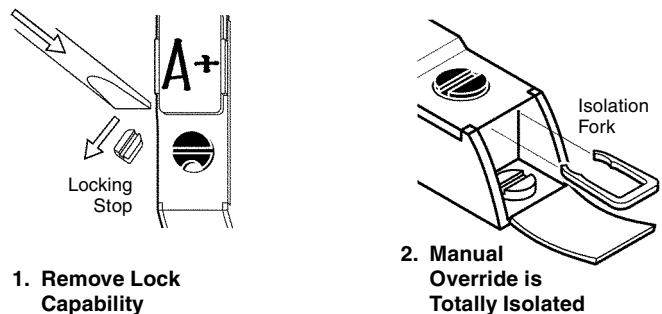
Depending on the machine and its conditions of use, one may either:

- Keep complete multifunction manual overrides;
- Delete the lock capability by removing the locking stop; this will prevent the manual override from being left in the locked position; or
- Make the manual override completely inoperative when automatic controls take care of access for maintenance. An isolation fork is available for this operation.

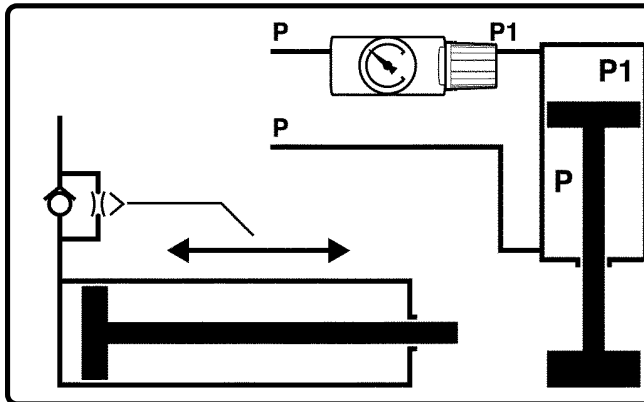
### Multifunction Manual Override



### Manual Override Adaptations



# 10 Islands with Flow and Pressure Controls



As automation develops, pneumatic cylinders require better controls.

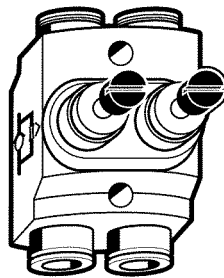
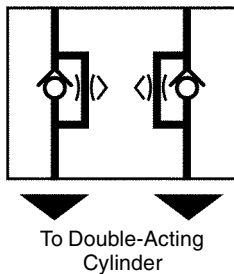
- Speed controls – for this purpose, flow adjustment means are continuously improved for better efficiency and easier access.
- Thrust controls – for this purpose, pressure regulation to the cylinder is now easily added to a circuit that requires it.

## Flow Adjustment = Speed Control

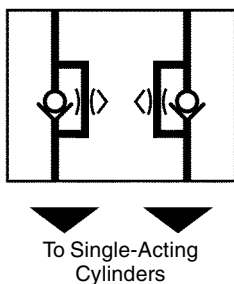
On a double-acting cylinder, extend and retract speeds are adjusted separately by control of air flow exhaust. The control becomes more precise when the flow adjustment is close to the cylinder. The examples show different solutions which are dependent upon the valve-to-cylinder distance and accessibility to the cylinder.

### Dual Flow Control Module

This valve island control module (see Chapter 6) may also be used close to the cylinder.

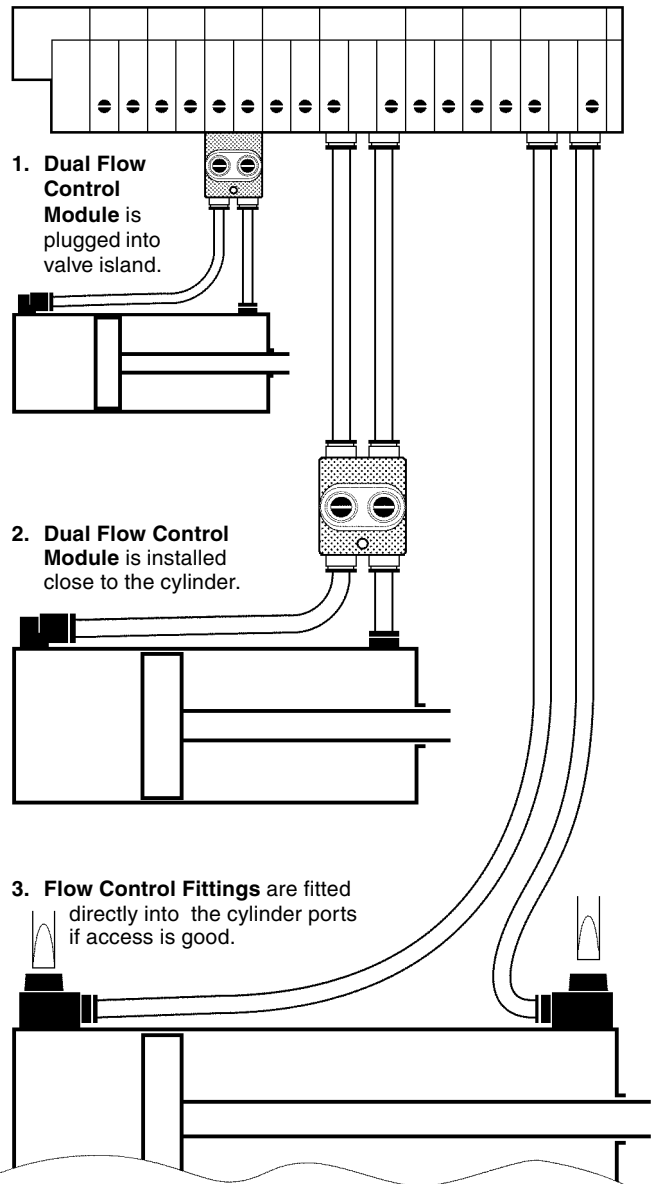
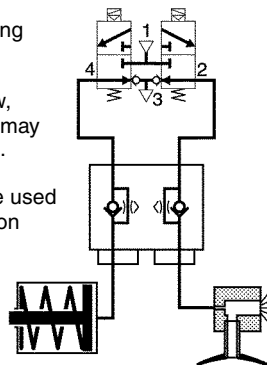


**Note:** Flow control to single-acting cylinders.



For controlling supply flow instead of exhaust flow, the module may be reversed.

This may be used in conjunction with single-acting cylinders.



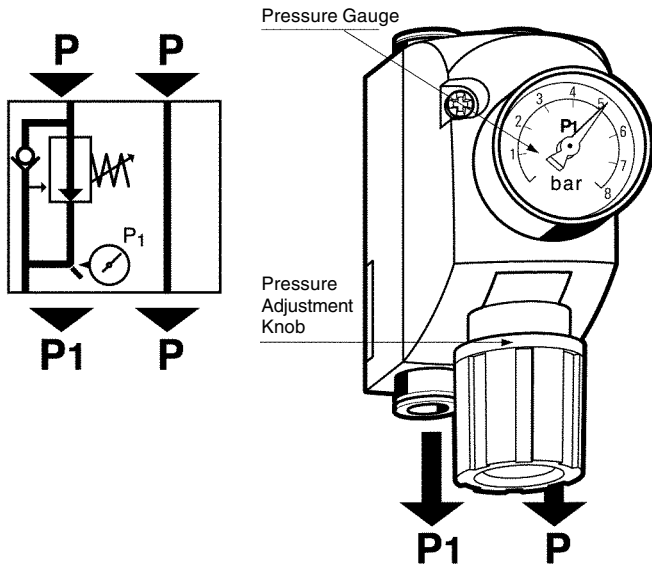
## Pressure Regulation = Thrust Control

Pressure regulation to individual cylinders is increasingly used in automation (see box below).

Most of the time, single port regulation is sufficient – only one chamber of the cylinder is concerned.

Such a regulation may be specified initially but, most often, it has to be added at the machine commissioning stage. The valve island pressure regulation module is available for this.

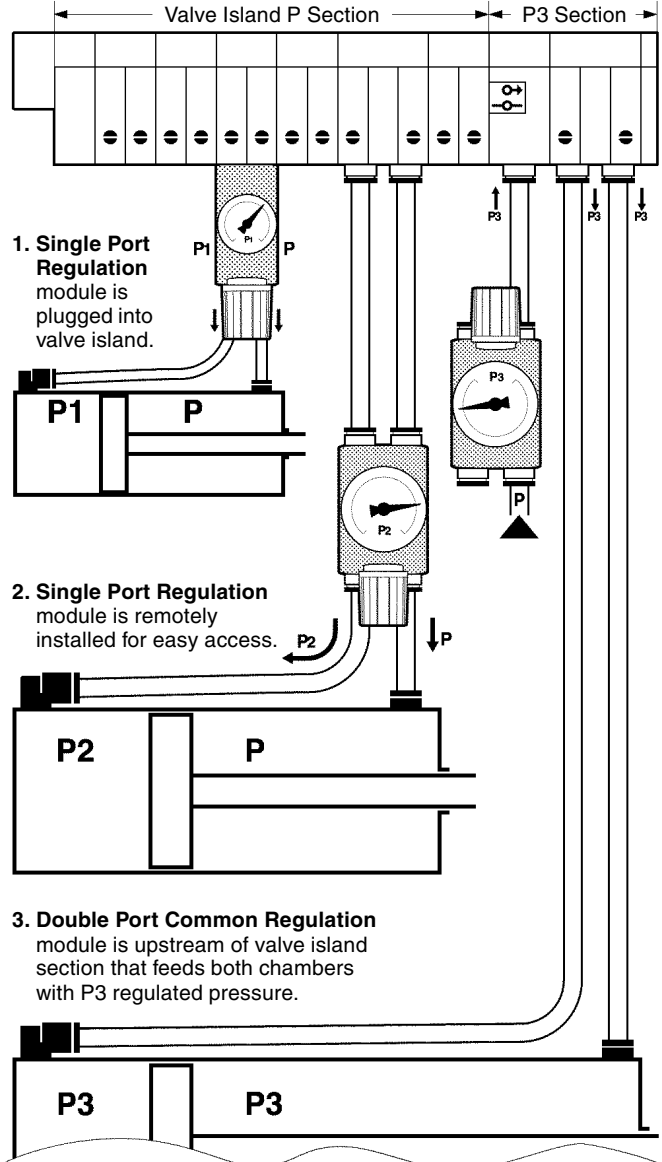
### Pressure Regulation Module



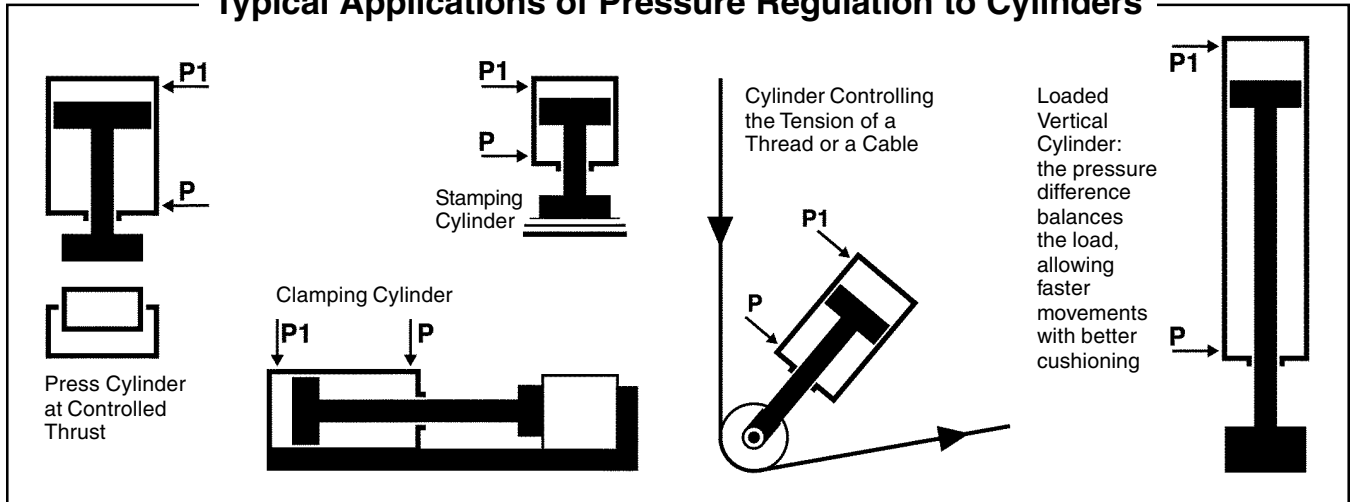
An integrated pressure regulator reduces the P pressure to the P<sub>1</sub> pressure required. The regulator is of the vented type. Therefore, when lowering the pressure level, it exhausts the excess pressure to the new level.

It also includes a non-return valve allowing full exhaust flow.

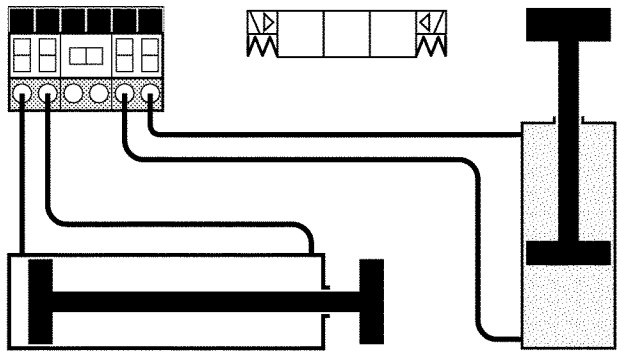
This module is normally installed downstream of the valve. The pressure gauge has a damper to protect it from pressure oscillations. Depending on the application, the pressure gauge may be remotely mounted, or integrated into the machine control panel.



### Typical Applications of Pressure Regulation to Cylinders



# 11 Islands for 3-Position Valve Applications

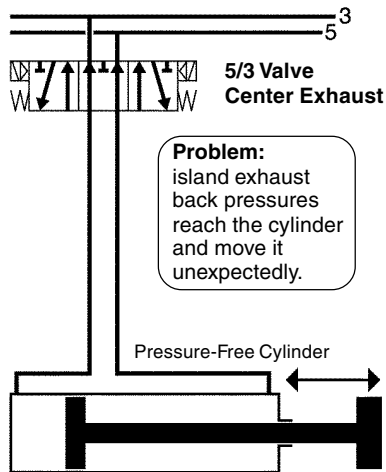


3-position valves are traditional for positioning, blocking or venting pneumatic cylinders.

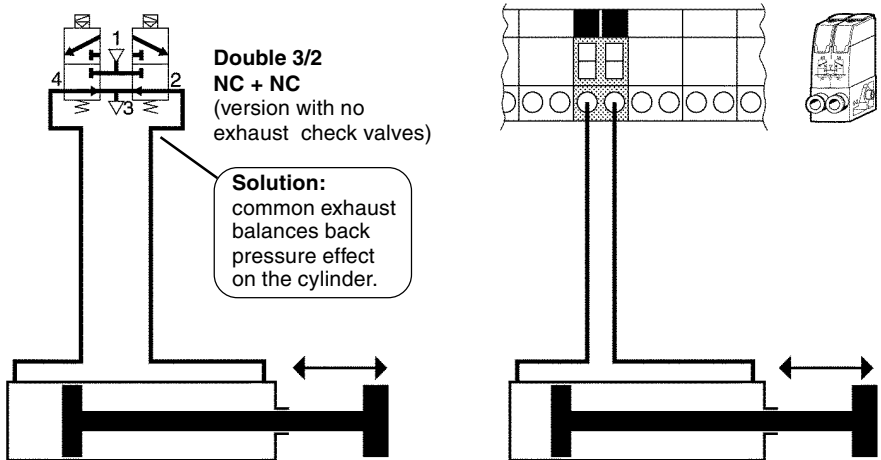
Because pneumatic valves are now commonly assembled into islands, 3-position valve functions have to be adapted in order to meet all applications allowing for exhaust back pressures and long distances between valves and cylinders.

## 3-Position Center Exhaust – Pressure-Free Cylinder

### Traditional Configuration

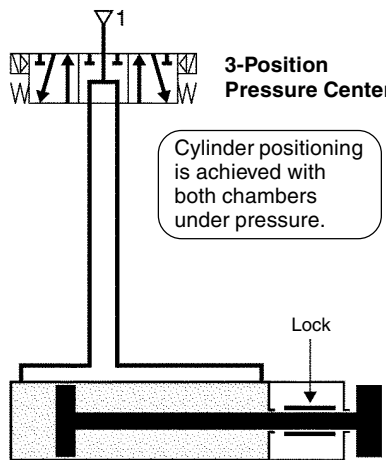


### New Generation – Double 3/2 NC + NC

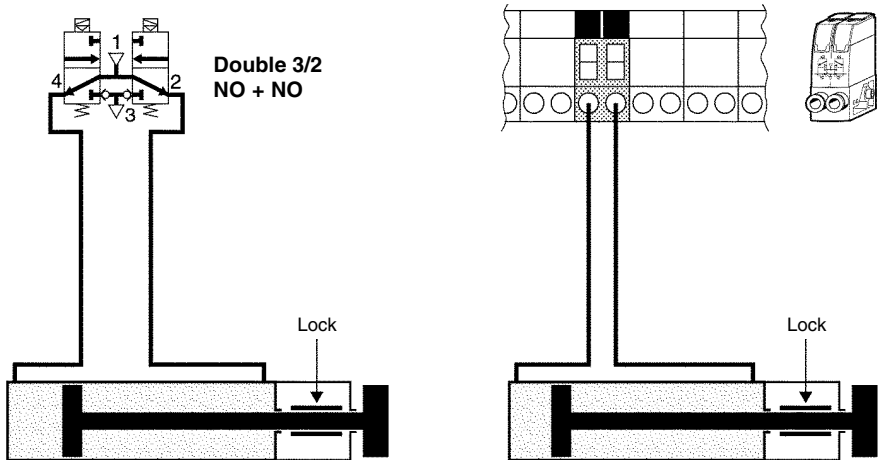


## 3-Position Pressure Center – Cylinder Fitted with Locking Device

### Traditional Configuration

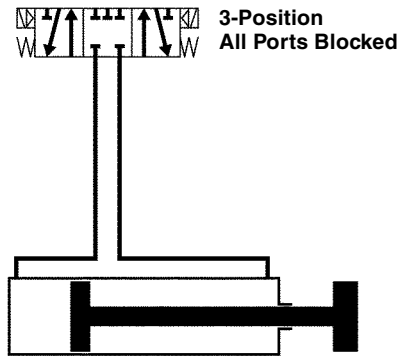


### New Generation – Double 3/2 NO + NO

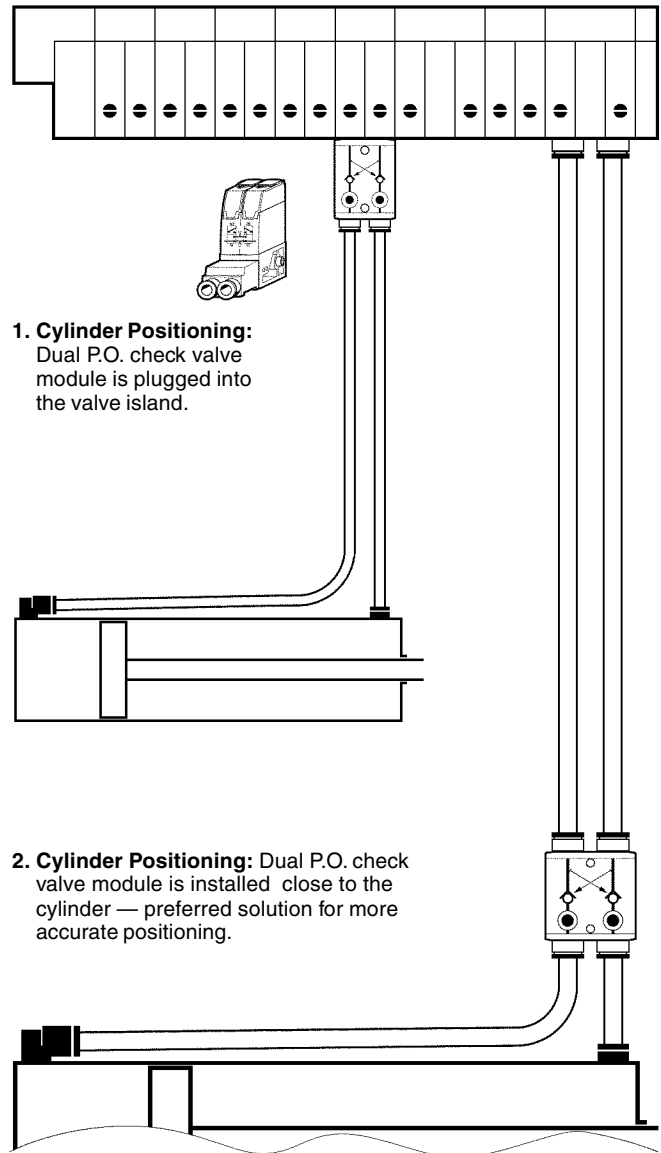


### 3-Position, All Ports Blocked – Cylinder Positioning

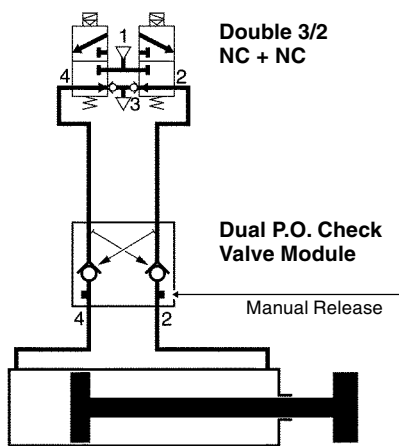
#### Traditional Configuration



**Problem:** in center position, compact valves are not perfectly sealed – cylinder position cannot be held indefinitely.



#### Double 3/2 NC + NC and Dual P.O. Check Valve



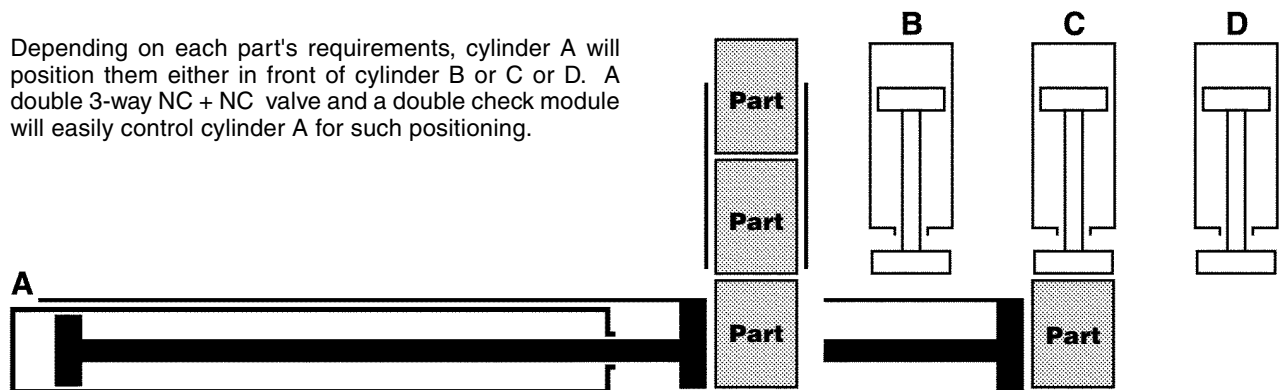
**Solution:** a dual P.O. check module is totally sealed.

At the outputs of a double 3/2 NC + NC valve, the dual P.O. check valve module achieves efficient and stable cylinder positioning. As soon as both lines are exhausted by the main control valve, the two internally piloted check valves close tight. The cylinder is then stabilized.

The manual pressure releases may then eventually be used for an adequate machine positioning.

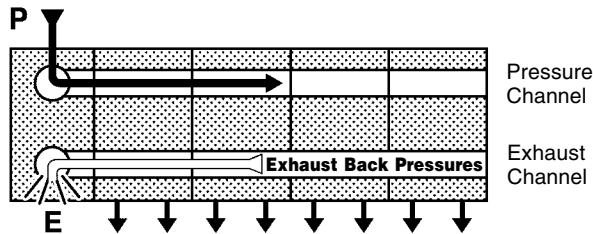
#### Typical Application Using Cylinder Positioning

Depending on each part's requirements, cylinder A will position them either in front of cylinder B or C or D. A double 3-way NC + NC valve and a double check module will easily control cylinder A for such positioning.





## 12 Valve Islands Exhaust Back Pressure Control



The problems associated with exhaust back pressures are already well known with traditional valve manifolds.

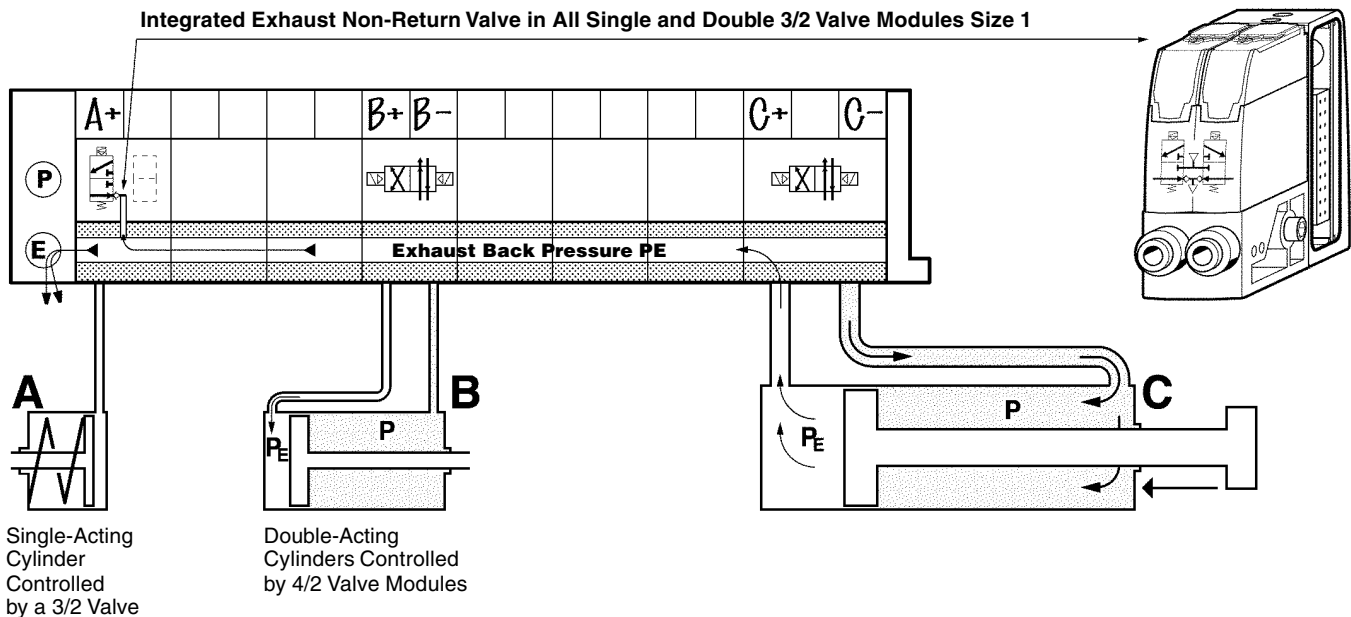
The latest generation of valve islands provides new solutions to this problem—either to block exhaust back pressures or to limit them to a level that would not affect the application.

### Blocking Exhaust Back Pressures with 3/2 Modules

From the example shown below, one can see the following:

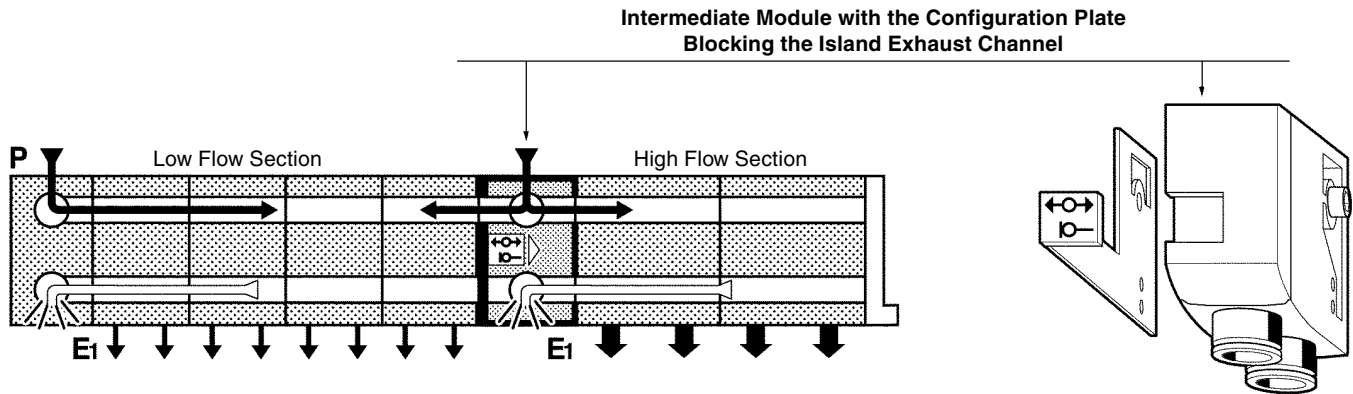
- C cylinder, large and fast moving, may feed the island exhaust channel with an exhaust back pressure  $P_E$ .
- Such a back pressure is normally under 14 PSI. Since the opposite pressure, P, is high, it will not affect double-acting cylinders, such as B.
- However such a back pressure may affect a single-acting cylinder A if its pressure threshold is low.

Such small single-acting cylinders may pop out unexpectedly whenever an exhaust back pressure rises into the island. To avoid such malfunctions, 3/2 valve modules size 1 feature integrated exhaust non-return valves that will block any exhaust back pressure from reaching the acting cylinders they control.



## Blocking Exhaust Back Pressures Inside the Island

Another method to block exhaust back pressures when they may affect the application is to isolate the valves in the island that control the largest and fastest cylinders. The illustration below shows how this may be easily achieved with an intermediate module (see Chapter 5).



## Limiting Exhaust Back Pressures in a Valve Island

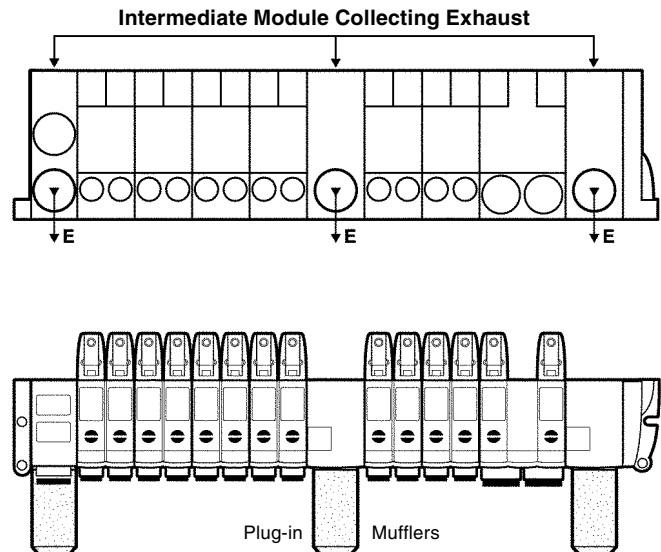
In a valve island, it is important to limit exhaust back pressures to about 14 PSI maximum so that all double-acting cylinders efficiently achieve their function at 87 PSI.

By reducing the exhaust flows of the largest cylinders, back pressure is eliminated as it develops, particularly on its return stroke (does not affect the cycle time).

### Collected Exhaust

Depending on the sizes of the cylinders and the speed required by the application, exhaust back pressures may still remain too high in the island after cylinder exhaust flow adjustment.

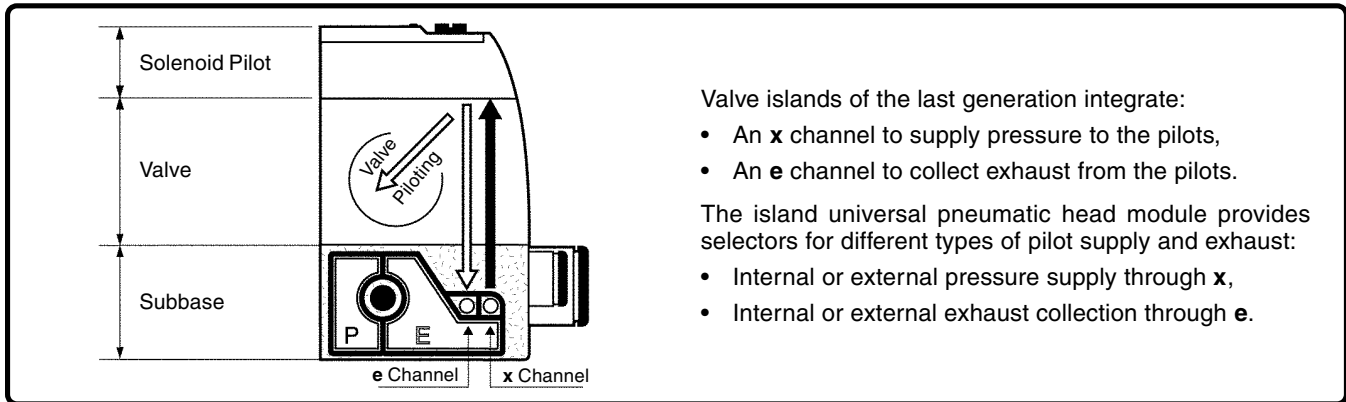
Such back pressures in the island may be efficiently evacuated through multiple exhaust collections using the intermediate module (see Chapter 5).



### Exhaust Through Mufflers

For applications that do not require the exhausts to be collected, a plug-in muffler into each exhaust port of the island will evacuate exhaust back pressures.

# 13 Valve Islands Internal / External Pilot Supply and Exhaust



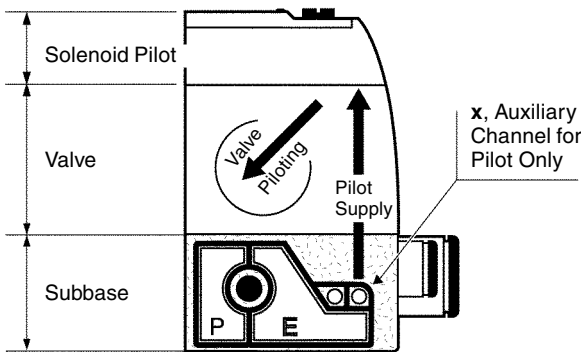
Valve islands of the last generation integrate:

- An **x** channel to supply pressure to the pilots,
- An **e** channel to collect exhaust from the pilots.

The island universal pneumatic head module provides selectors for different types of pilot supply and exhaust:

- Internal or external pressure supply through **x**,
- Internal or external exhaust collection through **e**.

## External / Internal Pilot Supply



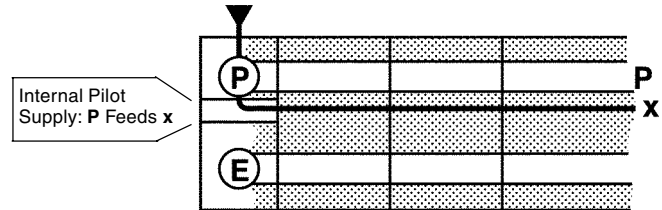
In all valve islands, subbases incorporate an auxiliary channel **x** to supply pressure to the solenoid pilots. Depending on the application, this channel:

- May be fed by the main pressure **P** if it is between 43 to 120 PSI; this is the “internal pilot supply” of the valve island,
- May be fed separately, when pressure **P** is lower than 43 PSI (43 PSI being the minimum pressure to pilot the valves); this is the “external pilot supply” of the valve island.

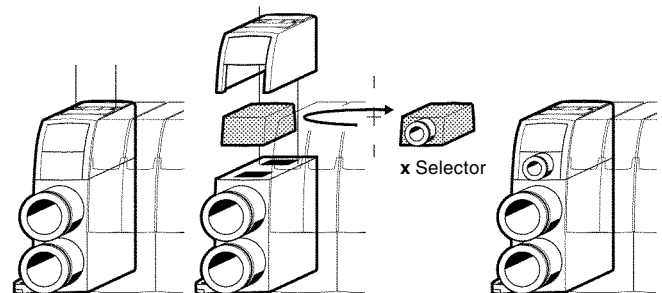
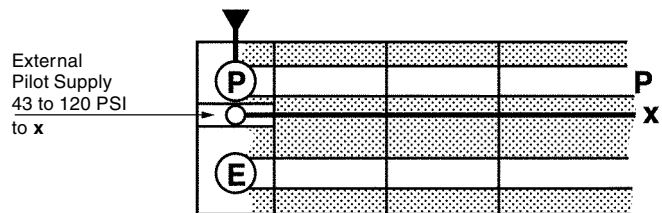
The new valve island generations have a universal pneumatic head module that allows these two types of pilot supplies. This head module incorporates a 2 position **x** selector:

- The internal pilot supply position is the normal position; no connection port is visible since no external supply is necessary.
- If required, the external pilot supply position can be obtained manually by rotating the selector; it then presents a push-in connection port for a 4 mm OD tubing that will feed the pilot pressure (43 to 120 PSI) to the **x** channel.

**P = 43 to 120 PSI**



**P = 0 to 43 PSI**

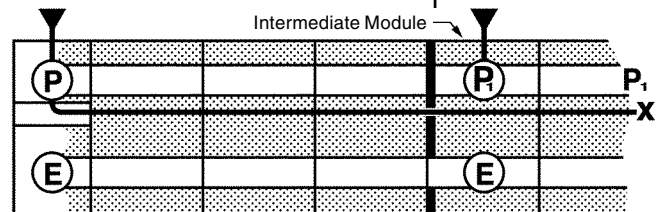


**x** Selector is Positioned for Internal Pilot Supply

**x** Selector is Positioned for External Pilot Supply

**P = 43 to 120 PSI**

**P<sub>1</sub> = 0 to 43 PSI**



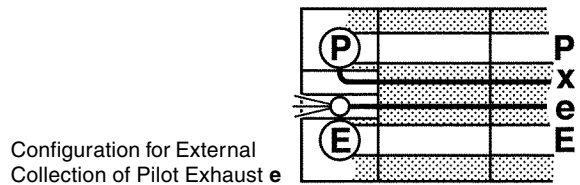
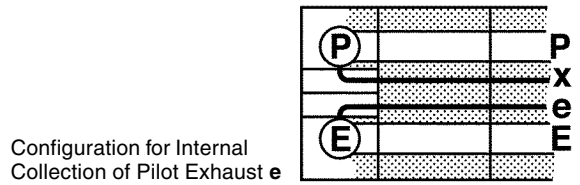
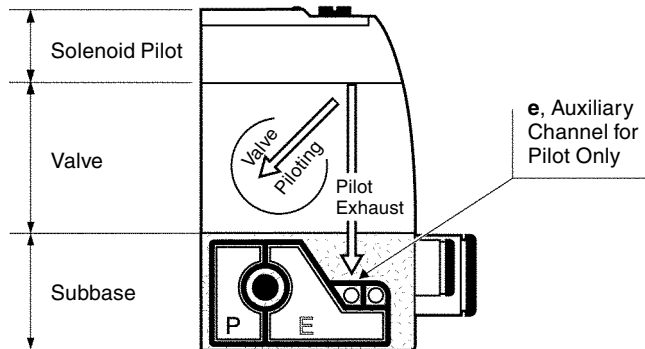
Standard Pressure Island Section

Low Pressure Island Section

## Special Case: Multi-section Valve Island

The intermediate module that separates two island sections is crossed by the auxiliary channel **x**. When an island includes several sections working at different pressures, an internal pilot supply pressure is satisfactory, if the first section operates at 43 to 120 PSI pressure.

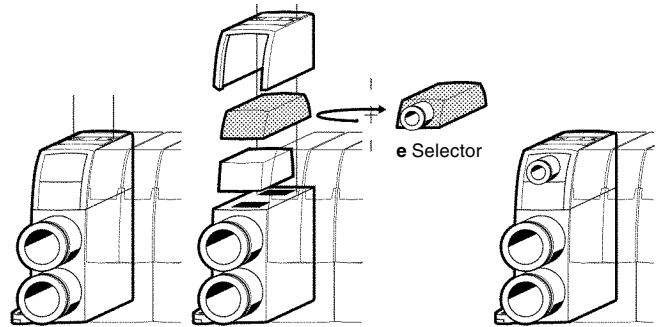
## External / Internal Pilot Exhaust Collection



In all valve islands, subbases also incorporate an auxiliary channel **e** to collect the solenoid pilot exhausts. Depending on the application, this channel:

- May exhaust directly into the main exhaust channel **E** if no important exhaust back pressure is to be feared (see Chapter 12).
- May be collected separately when a persistent back pressure will possibly delay the depiloting of some of the valves into the island, or for vacuum applications (see Chapter 14).

In order to choose between the internal or the external collection of the island pilot exhaust, a second 2-position selector is integrated into the pneumatic island head module, as shown here.

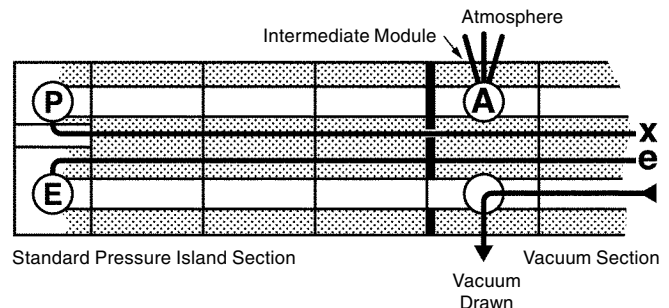


**e Selector is Positioned for Internal Collection of Pilot Exhaust**

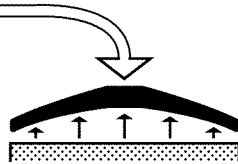
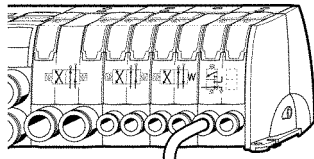
**e Selector is Positioned for External Collection of Pilot Exhaust**

### Special Case: Multi-section Valve Island

The intermediate module that separates two island sections is crossed by both auxiliary channels **x** and **e**. When an island includes several sections, including a section working with vacuum where no exhaust should pollute the vacuum drawn (see Chapter 14), an internal collection of pilot exhaust is satisfactory if the first section is the one that works at a typical pressure.



## 14 Valve Islands for Vacuum Applications

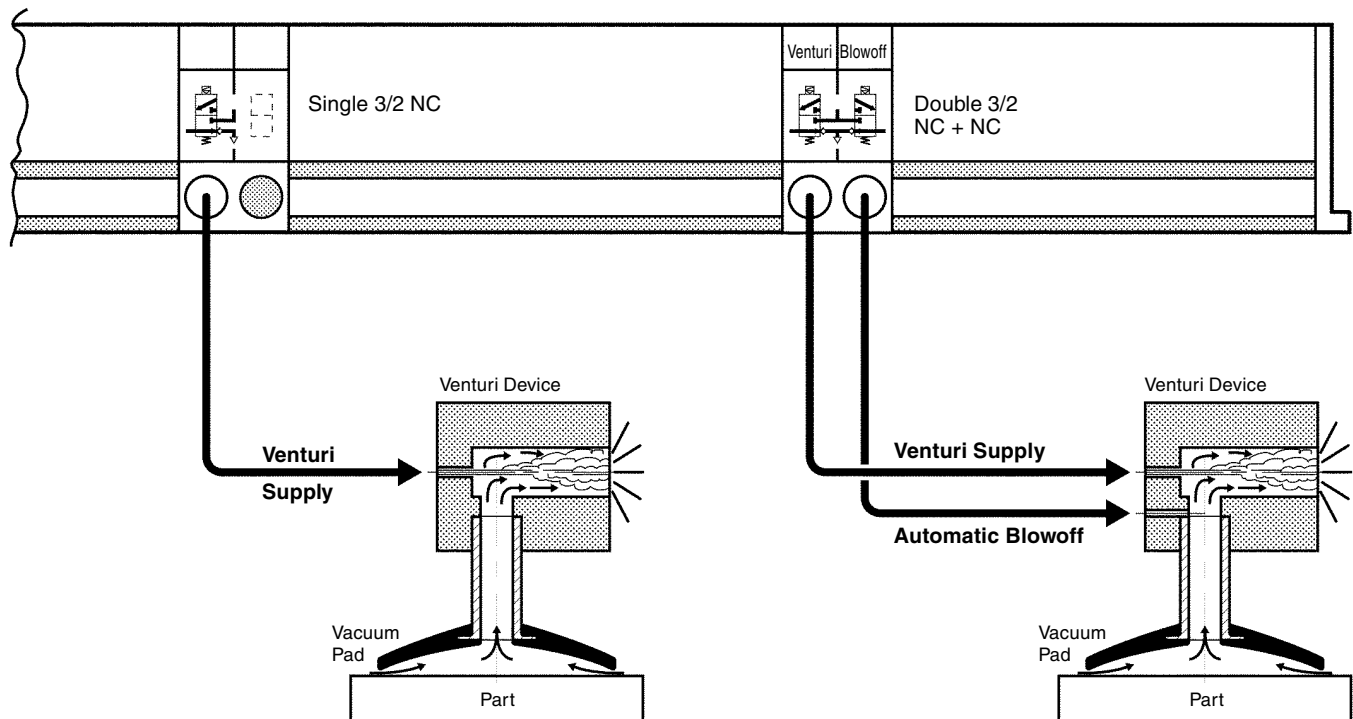


Pneumatic automation is often combined with vacuum applications:

- To pick up parts and to move them;
- To vacuum pack or to process under vacuum.

Within electro-pneumatic circuits and machines, new generation pneumatic valve islands can simplify circuit design and installation of combined pneumatic and vacuum systems.

### Providing Controls for Vacuum Venturi Devices



The Venturi device is also called an “ejector” or a vacuum generator and is well known to pneumatic engineers. It produces vacuum from an air pressure supply. The air jet generates a fast moving flow stream that draws the surrounding atmospheric air. The resulting air movement creates a vacuum when the entry of atmospheric air is blocked by a part.

This simple and compact system replaces costly and cumbersome vacuum pumps and their piping. It is mostly used to pick up and move parts.

The vacuum pad that picks up the part is ideally combined with the Venturi device.

In order to supply the Venturi, a single 3/2 NC valve is integrated into the closest valve island. To limit air consumption, it is advantageous to adjust the pressure that reaches the Venturi. This is easily done by adding a pressure regulation module to the valve island.

If besides the Venturi supply an automatic blowoff is required, a double 3/2 NC + NC will control the complete system:

- One 3/2 for the Venturi supply;
- One 3/2 for the automatic blowoff. The integrated exhaust non-return valve in all 3/2 modules size 1 (Chapter 12) will prevent external air from polluting the venturi vacuum.

## Valve Island in a Vacuum Distribution Network

When the vacuum level or the flow requirement is high, an electric vacuum pump is installed on the machine with a vacuum distribution network.

In this case, 3/2 pneumatic valves are used to control the different vacuum circuits or 4/2 double solenoid function is necessary. 3/2 pneumatic valves should be Normally Open in order to obtain vacuum outputs when electrical signals are on.

Vacuum controls generally require large flows; most of the time, size 2 valves are necessary.

In the valve island, vacuum is drawn through the channel normally used for the common exhaust while the other channel may be used differently, depending on the application.

### No Blowoff or Permanent Blowoff

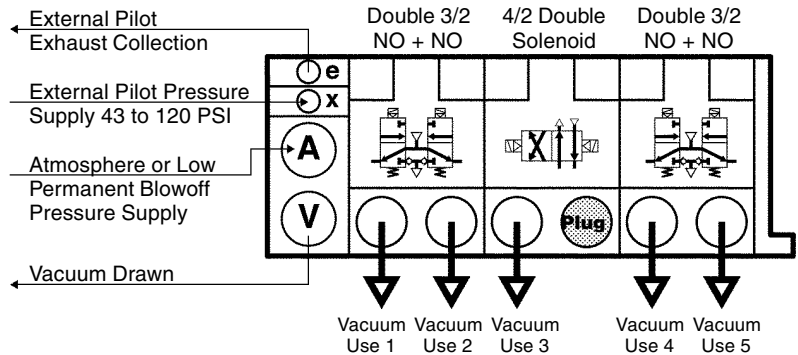
The top illustration presents a typical vacuum valve island whose channel is normally used for the main pressure supply either connected to atmosphere (no blowoff) or to a low-pressure supply that will act as permanent blowoff toward the vacuum pads when they are not connected to vacuum.

### Intermittent Blowoff

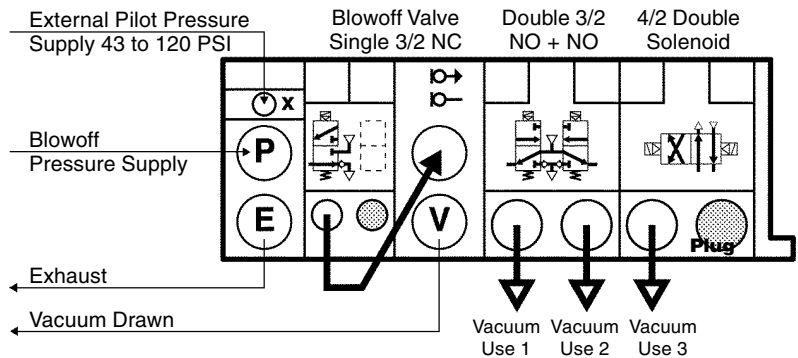
The second illustration presents a vacuum valve island equipped with a head blowoff valve that will send a pressure for blowoff only when required. A size 1 single 3/2 is sufficient for this purpose.

In both cases, the auxiliary channel **x** will be supplied with a 43 to 120 PSI pressure for solenoid pilots (Chapter 13). In the first case, the auxiliary channel **e** is collected externally in order to avoid pressurizing the vacuum channel with the pilot exhausts.

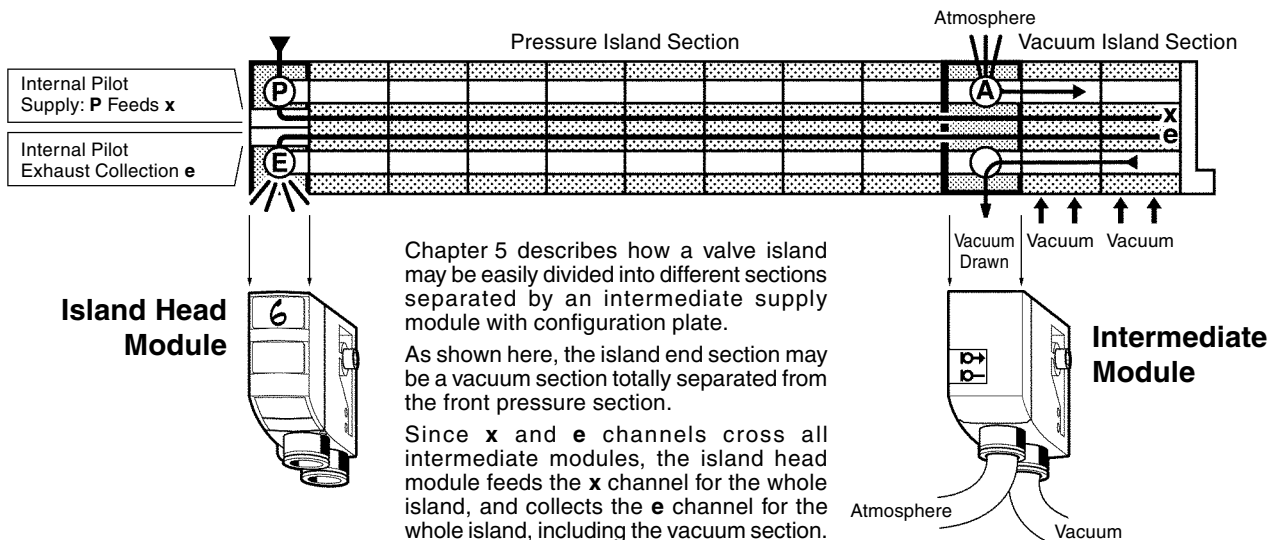
### Vacuum Valve Island with No Blowoff or with Permanent Blowoff



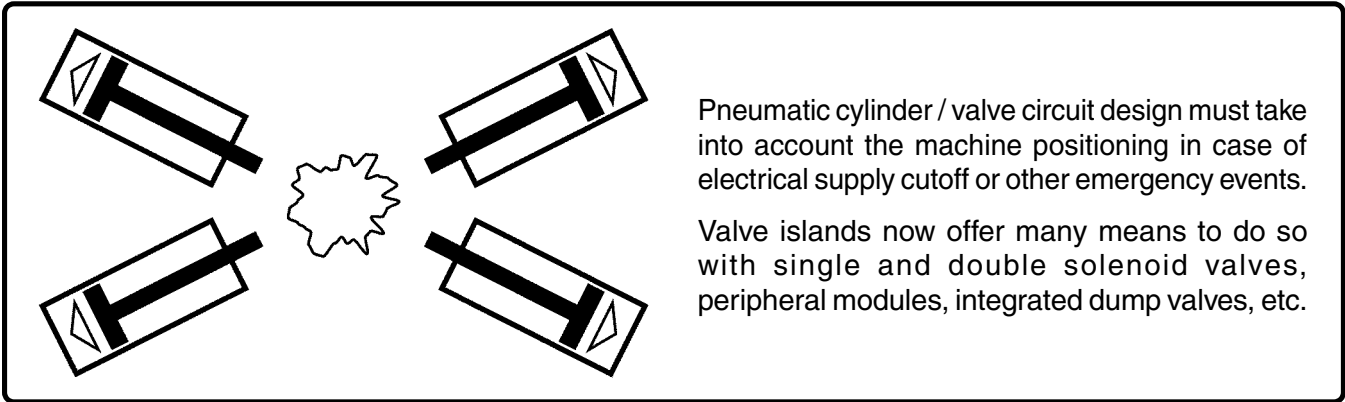
### Vacuum Valve Island Equipped for Intermittent Blowoff



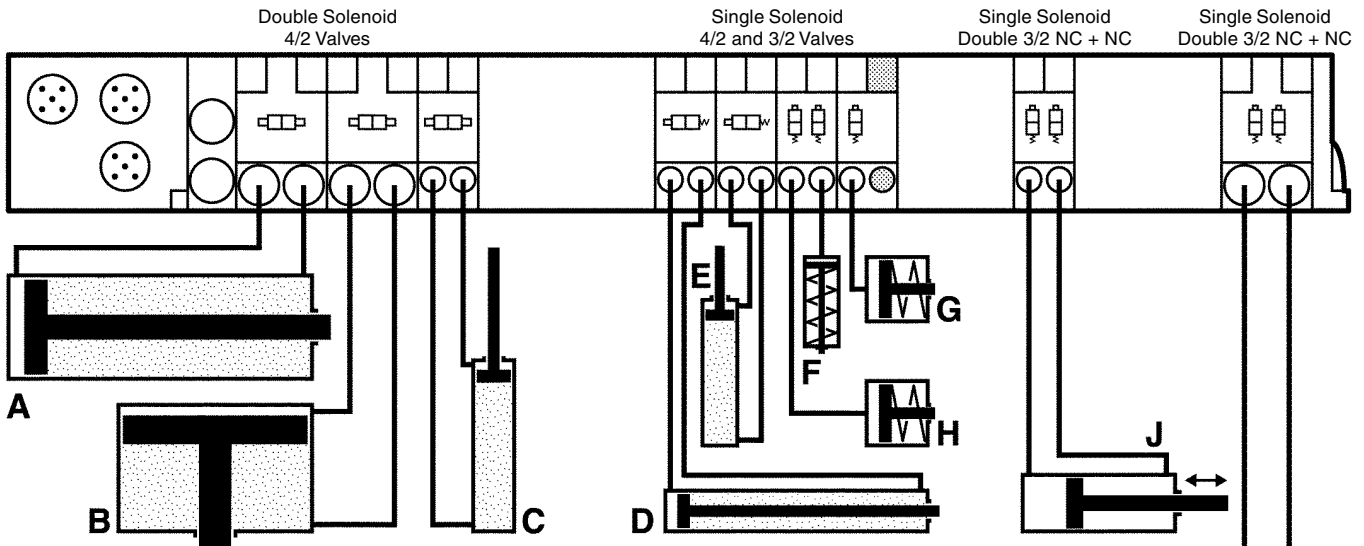
## Pressure and Vacuum Combined in the Same Island



# 15 Valve Islands and Emergency Machine Positioning



## Single / Double Solenoid Valve Choice for Adequate Emergency Positioning



These cylinders maintain their last position and action in case of electrical cutoff.

These cylinders retract in a chosen position.

This cylinder becomes totally pressure free.

Designers of electro-pneumatic machines have to define the cylinder positioning when electrical supply gets cut off; for example, for an emergency requirement.

A clamping cylinder will maintain its action so that the part it is holding does not take off under the action of a cutting tool.

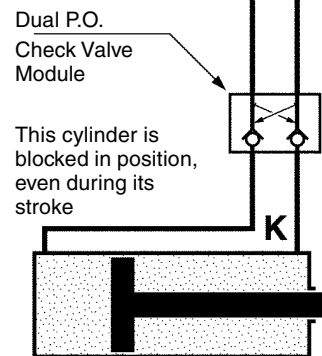
On the contrary, a stamping cylinder will retract in its initial position, and a transfer cylinder may be blocked along its stroke.

Pneumatic valve islands provide all means to obtain emergency machine positioning. The different solutions are presented on the valve island above.

- A, B and C double-acting cylinders are controlled with double solenoid valves. These will keep their position in case

of electrical cutoff. The cylinders will maintain their positions and actions.

- D and E double-acting cylinders are controlled with single solenoid valves. Their spring return will bring them back in the initial position corresponding to the required initial position of the cylinder.
- F, G, and H single-acting cylinders will retract as well with the help of their spring.
- Controlled with a single solenoid double 3/2 NC+NC valve, the double-acting J cylinder will be exhausted on both chambers when an electrical cutoff happens (see Chapter 11).
- Due to the double P.O. check valve module, the double-acting K cylinder will be blocked along its stroke (see Chapter 11).



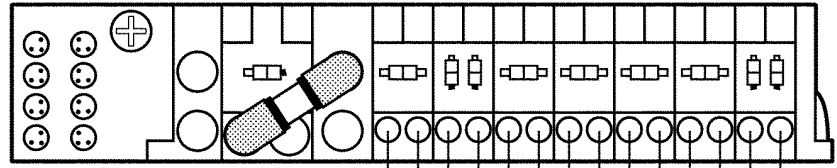
## Valve Island with Integrated Dump Functions

In case of emergency, electrical supply cutoff, a general dump action on many cylinders may often be required. This is easily done with a valve island by mounting a dump valve controlling the island pressure supply channel. The dump valve will be single solenoid in order to automatically dump the pressure when electrical is cut off. A 4/2 size 2 valve will have enough flow to dump a whole size 1 valve island.

The dump action will concern either:

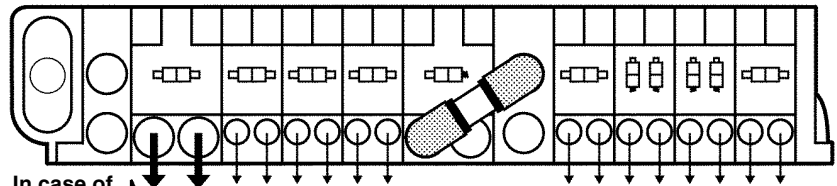
- All the cylinders controlled by the valve island. The dump valve will then be at the island's head (top drawing), or
- Just a few cylinders among the ones controlled by the valve island. The dump valve will concern only the valves on its right (second drawing), or
- Several valve islands all controlled by only one dump valve (third drawing).

Dump Valve  
 4/2 Single Solenoid  
 Size 2



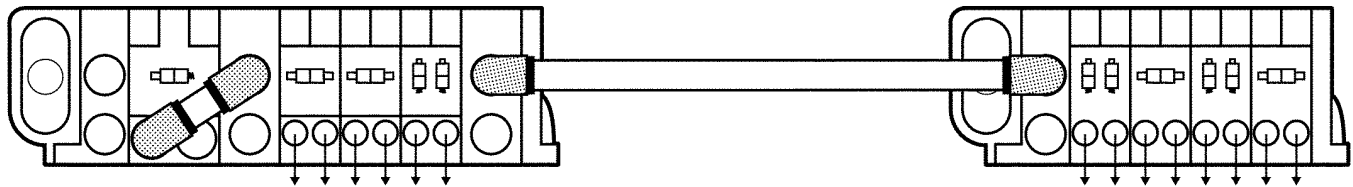
In case of electrical cutoff, pressure is dumped on all cylinders.

Dump Valve  
 4/2 Single Solenoid  
 Size 2



In case of electrical cutoff... pressure remains on these cylinders... and pressure is dumped on these cylinders.

Dump Valve  
 4/2 Single Solenoid  
 Size 2



A dump valve may control several valve islands

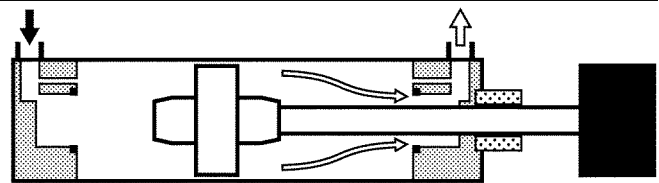
## Dump and Soft Start Functions

Double-acting cylinders have adjustable cushions at the end of their stroke. Such cushioning is necessary for loaded cylinders. They are efficient when the movement is controlled by the working pressure but also by the exhausting back pressure that limits the speed through external flow control. When restarting after an exhausting back pressure has been previously totally exhausted by a dump action, the cylinder movement may be brutal and the cushioning less efficient.

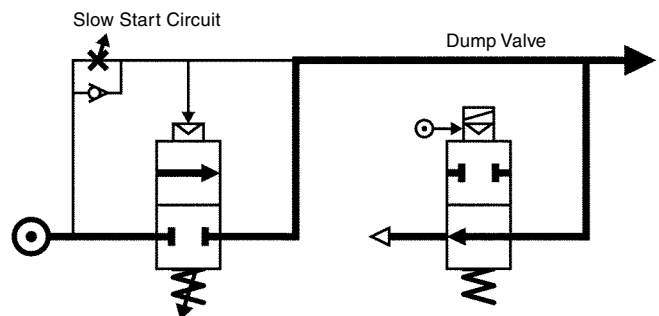
For average and big-loaded double-acting cylinders, a dump action will have to be followed by a soft start. For this purpose, a dump and soft start FRL unit will replace the dump valve into the valve island.

The circuit of such an FRL unit describes the following two functions:

1. The dump 2/2 valve, solenoid pilot controlled;
2. The slow start pneumatic circuit. The downstream valve and cylinders receive a small flow supply until the pressure reaches a sufficient level to pilot the main flow 2/2 valve whose pilot pressure may be adjusted.

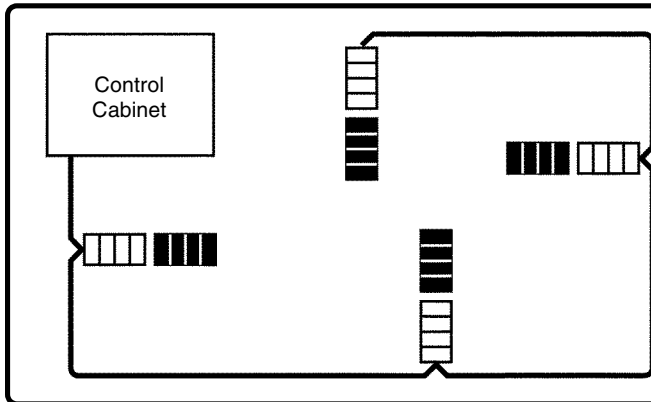


### FRL Integrated Dump and Soft Start Function





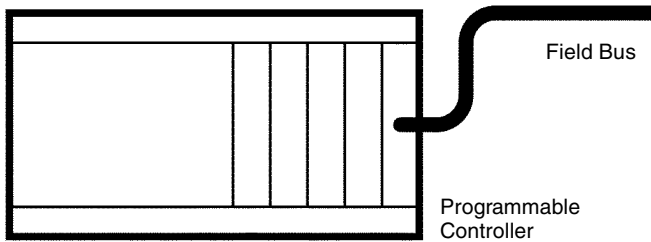
# 16 Valve Islands Connected to IP20 Input / Output Modules



Industrial automation has progressed with the introduction of remote input / output modules, which can be adapted to most electro-pneumatic applications and communicate via a field bus system.

Offered as IP20 only (non-protected), these field bus connected I/O are very modular and lead to efficient and competitive electro-pneumatic applications.

## The Evolution of Bus Connected IP20 Input / Output Modules



Field bus systems and their remote inputs / outputs were first developed for large and complex automation applications:

- Sophisticated bus protocols, difficult to implement and maintain,
- I/O modules with a minimum of 16 outputs and 16 inputs.

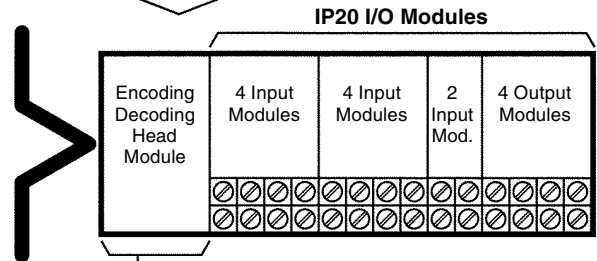
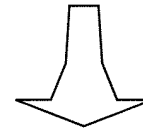
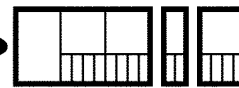
In this context, only a few complex and large electro-pneumatic applications could use the field bus system.

Later, simpler bus protocols and standard connections were developed for more standard applications, example ASi (see next Chapter).

More recent developments include modular designs for remote inputs / outputs where modules of 2 or 4 I/O can be assembled together with a head module that connects to the field bus.

This progress in field bus automation provides solutions for more electro-pneumatic applications. As with electro-pneumatic valve islands, input / output bus islands can be assembled to suit the specific requirements of machine control.

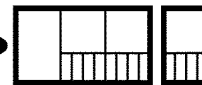
This has resulted in even very simple control systems becoming a viable and competitive option.



Head module is specific of the bus protocol that may be:

- Profibus Dp
- Interbus S
- Fipio
- ASi
- DeviceNet
- Can Open
- Sensor Loop
- SDS, etc.

These modules may be supplied by your usual electrical automation supplier.



Each remote I/O block is assembled with the input and the output number appropriate to the subsystem to be controlled.

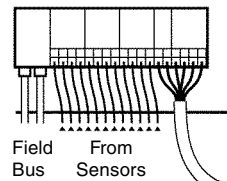
## Electro-Pneumatic Applications with IP20 Inputs / Outputs

In most electro-pneumatic applications, IP20 would need additional protection within an enclosure.

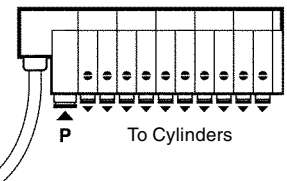
Depending upon the applications, the valve island can be mounted in the same enclosure.

Alternatively, the IP65 valve island could be mounted outside the enclosure and closer to the cylinders as shown on the diagram.

Field Bus Connected IP20 I/O Modules in Control Cabinet.



Integrated Connection IP65 Valve Island Close to Cylinders.

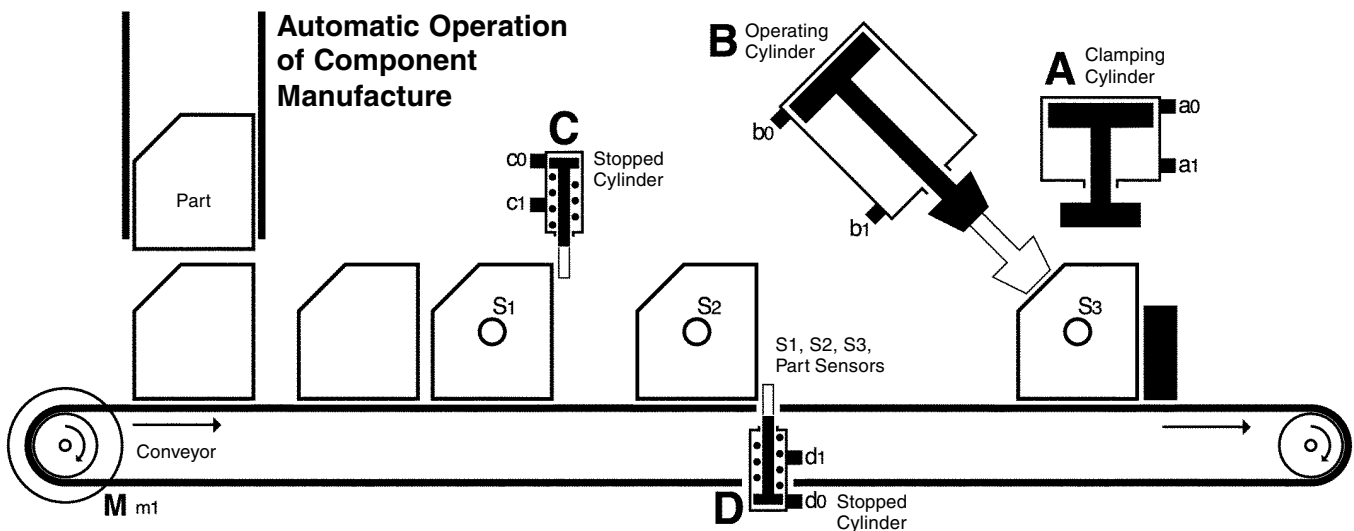
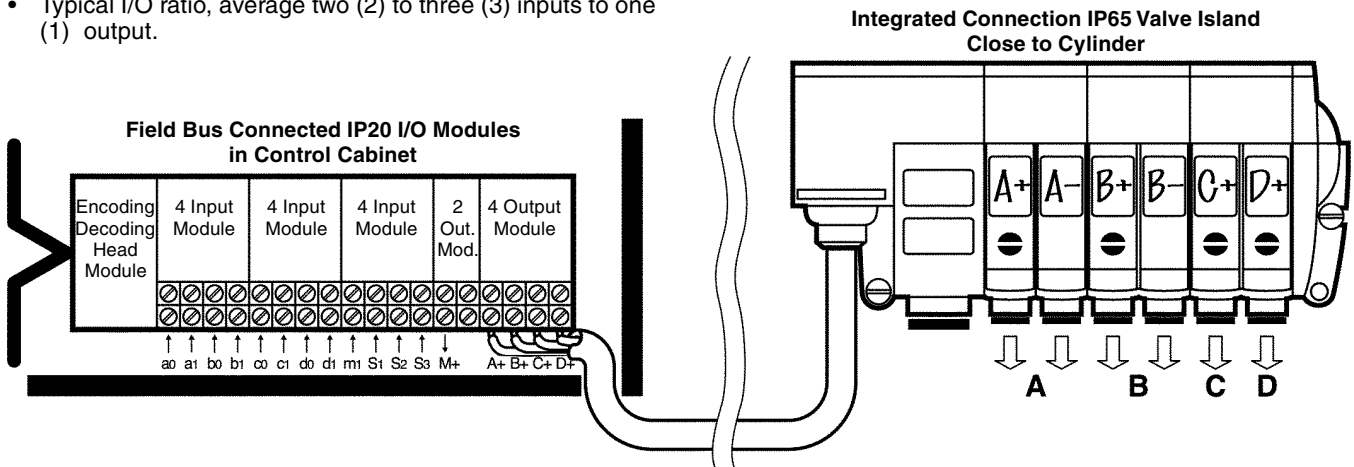


## A Typical Example

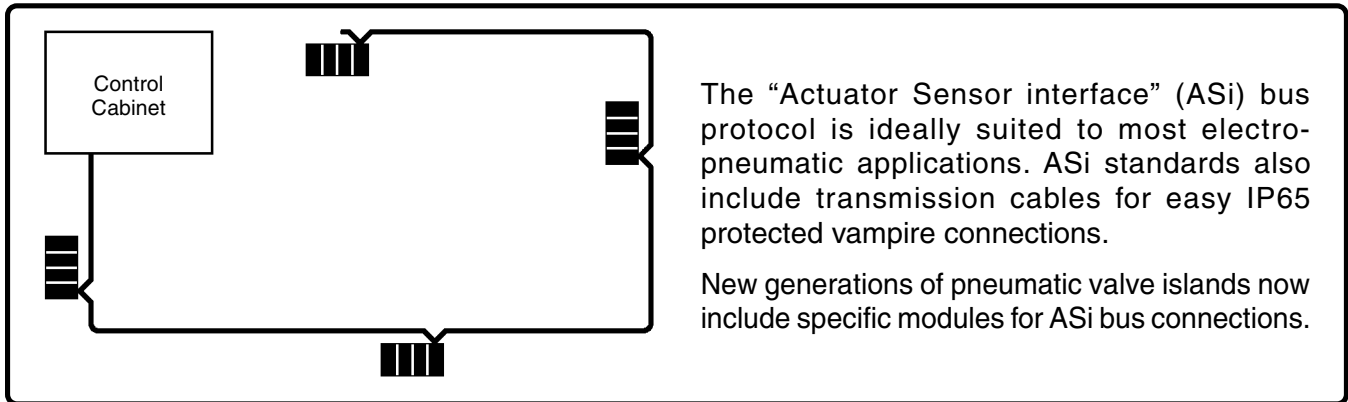
The application shown is a fairly typical simple electro-pneumatic subassembly, which may form only a small part of a larger application covered by the field bus.

This application demonstrates:

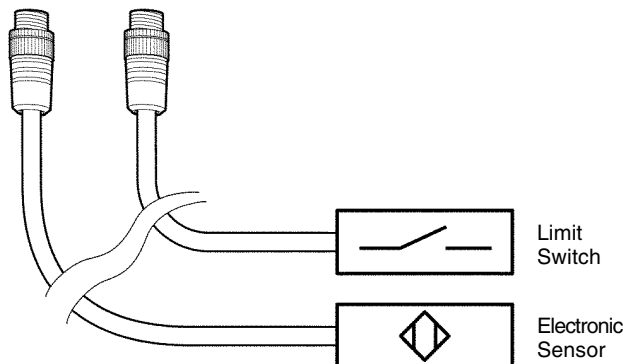
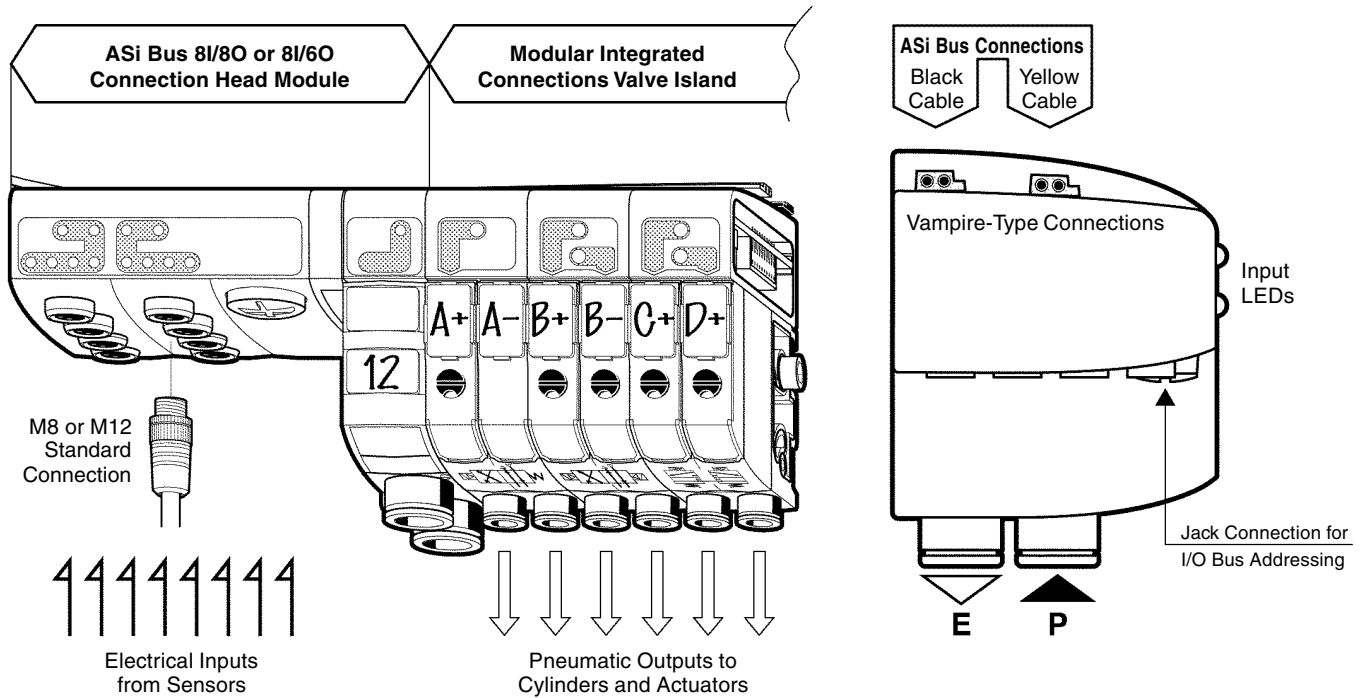
- The ease of mounting and interconnecting the I/O island and a valve island.
- Typical I/O ratio, average two (2) to three (3) inputs to one (1) output.



# 17 Remote Short Valve Islands with ASi Bus



## Valve Islands for ASi Bus Connections



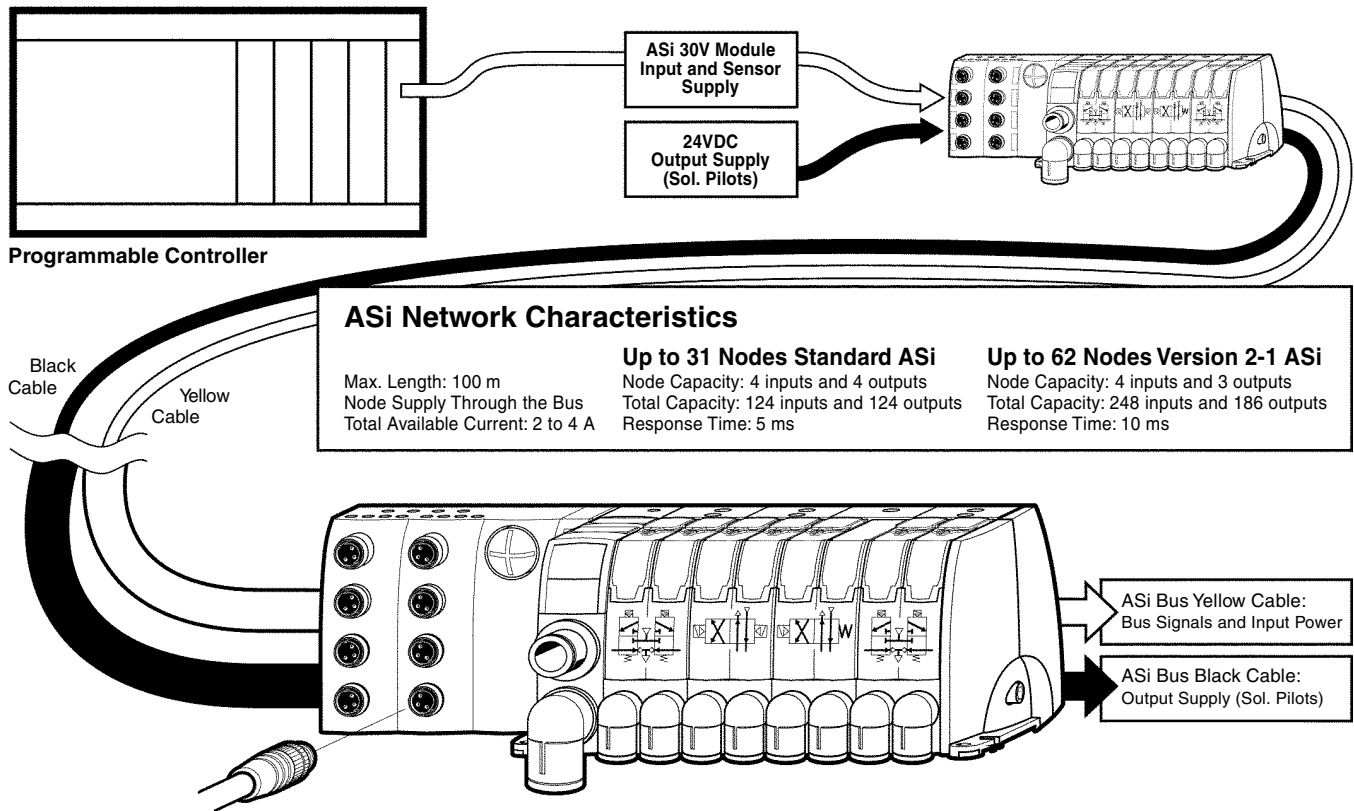
Valve islands with integrated connections can be supplied with an ASi bus head enabling the following:

1. IP65 vampire connections for the two ASi bus cables.
2. Decoding the bus signals and energizing the required solenoid.
3. Supply of power to sensors, receive input signals and coding them for the ASi bus transmission.

Any type of electrical or electronic sensor may be connected to ASi bus island head modules.

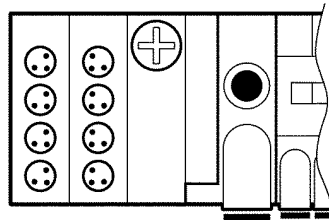
Outputs and inputs have separate power supplies, therefore preventing any interference.

## ASi Bus Electro-Pneumatic Automation Practice

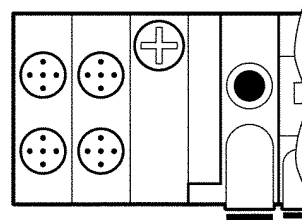


### Head Module Versions

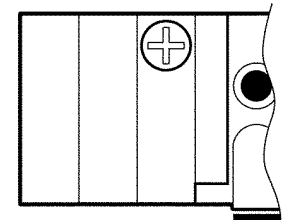
**M8 Input Connections**  
for 8 input signals to the island



**4 M12 Input Connections**  
for 8 input signals to the island  
(2 input signals per M12 connection)



**No Input Connection**  
for no input signal to the island



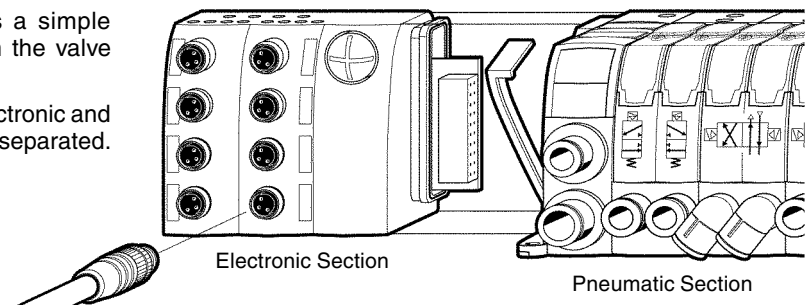
Depending on the application, the valve island may be supplied with eight (8) M8 input connections, four (4) M12 input connections or no input connection when inputs and outputs are separate.

Islands are IP65 water and dust protected. They may be installed remote from enclosure near pneumatic actuators resulting in simpler piping, reduced air consumption and reduced response time.

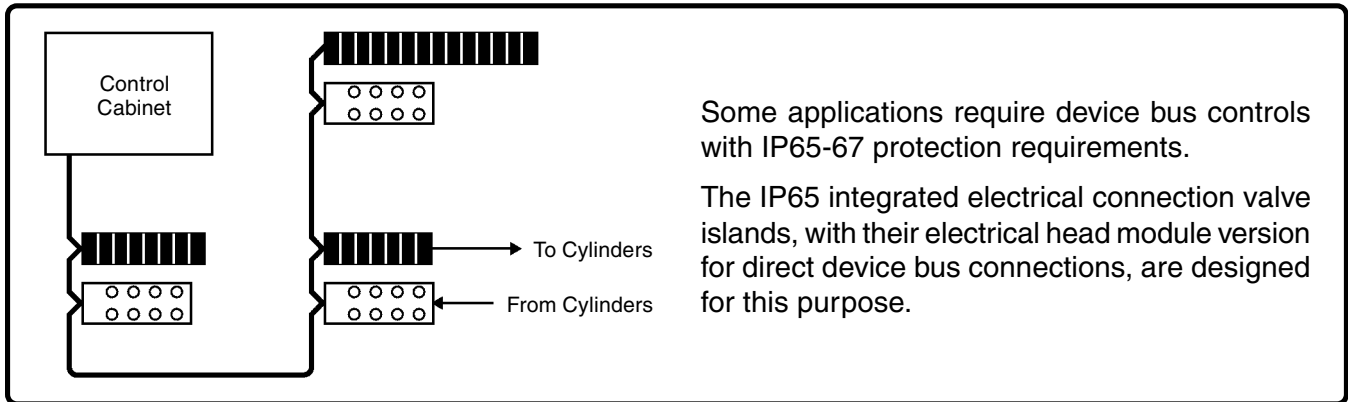
## Separate Access to Pneumatic and Electronic Sections

When the valve island has been installed, it is a simple operation to separate the ASi head module from the valve island as shown in the diagram.

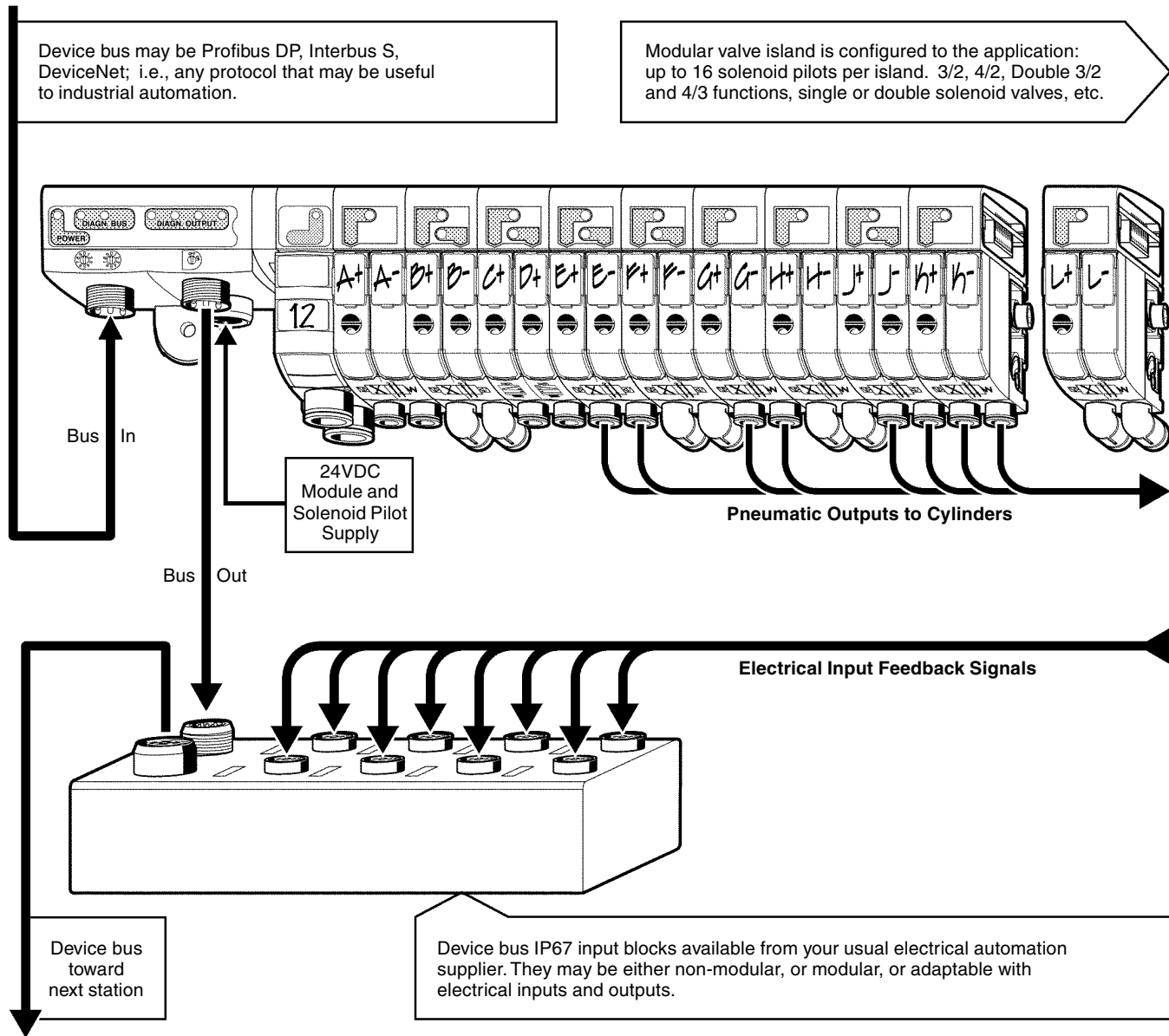
This will ease maintenance, if necessary, as the electronic and pneumatic sections of the island can be completely separated.



# 18 Valve Islands with Device Bus Connections

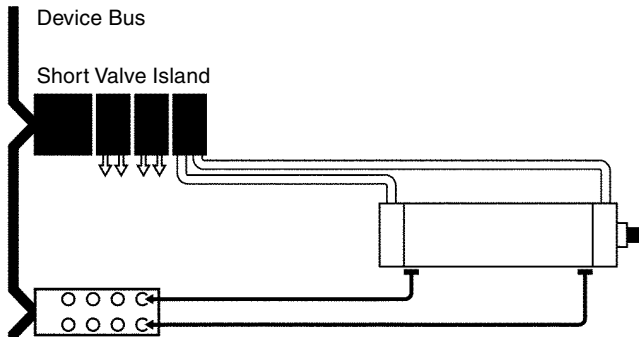


## Valve Islands with Device Bus Connections



## Device Bus Electro-Pneumatic Automation Practice

### From Short Remote Valve Islands... To Longer Valve Islands

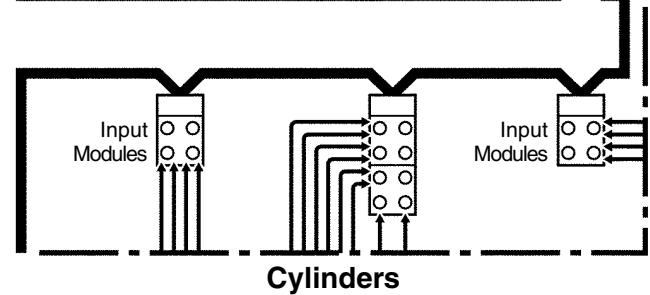
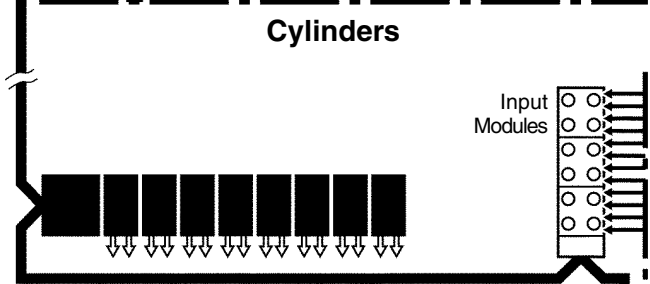
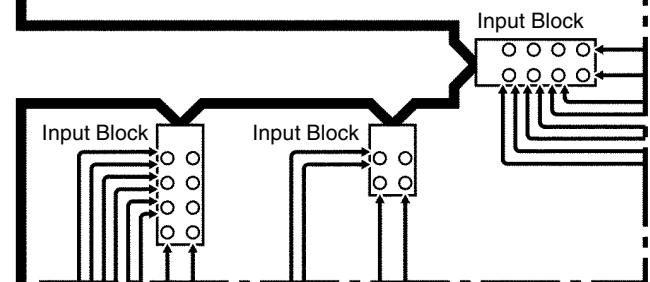
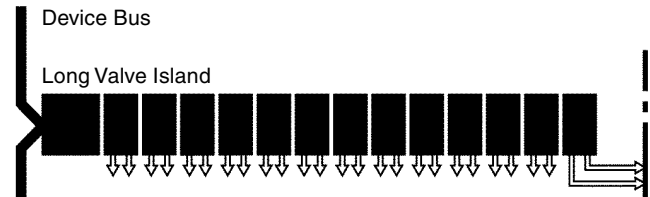
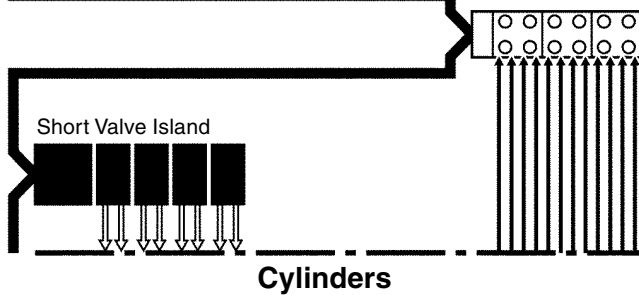


Depending on the application, the valve islands may either be:

- Short and remote, each valve island being close to a small group of cylinders, or
- Longer (up to 16 solenoid pilots) in order to control a larger number of cylinders.

Electrical feedback signals may be collected either:

- By non-modular blocks [eight (8) inputs], or
- By modules assembled together, each presenting four (4) inputs.



### Separate Access to Pneumatic and Electronic Sections

When the valve island has been installed, it is a simple operation to separate the bus head module from the valve island as shown in the diagram.

This will ease maintenance if necessary as the electronic and pneumatic sections of the island can be completely separated.

