

Technical Information

# Proportional Valve Group

## PVG 16



## Revision history

*Table of revisions*

Date	Changed	Rev
March 2016	Minor update in PVHC technical characteristics	0303
March 2016	Updated to Engineering Tomorrow design.	0302
February 2016	Drawing was updated in topic: How to select the correct spool	0301
September 2015	PVG 16 Step II	0200
March 2015	PVH, PVMD changed under Modules	BF
February 2015	Seal kit added for PVB + PVM	BE
December 2014	PVHC section updated	BD
August 2014	PVEO pin descriptions updated	BC
January 2014	Converted to Danfoss layout – DITA CMS	BB
February 2013	Major layout revision, drawings change	BA
October 2012	New Edition	AA

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## Reference

### Literature reference for PVG products

#### *Literature reference*

Literature title	Type	Order number
PVG 32 Proportional Valve Group	Technical Information	520L0344
PVG 100 Proportional Valve Group	Technical Information	520L0720
PVG 120 Proportional Valve Group	Technical Information	520L0356
PVG 32 Metric ports	Technical Information	11051935
PVE Series 4	Technical Information	520L0553
PVED-CC Electro-hydraulic actuator	Technical Information	520L0665
PVED-CX Electro-hydraulic actuator	Technical Information	11070179
PVE-CI	Technical Information	L1505234
Basic module for PVBZ	Technical Information	520L0721
PVSK module with integrated diverter valve and P-disconnect function	Technical Information	520L0556
PVPV / PVPM pump side module	Technical Information	520L0222
Combination module PVGI	Technical Information	520L0405
PVSP/M Priority module	Technical Information	520L0291
Hitch Control	System Description	11036124
	User Manual	11033753
PVBZ	Data Sheet	520L0681
PVBZ-HS	Data Sheet	520L0956
PVBZ-HD	Data Sheet	11035599
MC024-010 and MC024-012 Controllers	Data Sheet	520L0712

## General information

### PVG 16 introduction

The PVG 16 is a hydraulic load sensing proportional valve group designed to give maximum flexibility in design and build concept. The PVG 16 is designed as a load sensing directional control valve which will lead to increased application efficiency, reducing cooling requirements and fuel saving compared to conventional directional control valves. When the pump is started and the main spools in the individual basic modules (6) (see [PVG 16 sectional view](#) on page 7) are in the neutral position, oil flows from the pump, through connection P, across the pressure adjustment spool (4) to tank. The spring in the pressure adjustment spool determines the pump pressure (stand-by pressure) in neutral.

When one or more of the main spools are actuated, the highest load pressure is fed through the shuttle valve circuit to the spring chamber behind the pressure adjustment spool (4), and completely or partially closes the connection to tank. Pump pressure is applied to the right-hand side of the pressure adjustment spool (4). The pressure relief valve (1) will open should the load pressure exceed the set value, diverting pump flow back to tank.

With a non pressure-compensated basic module incorporating a load drop check valve (8) in channel P, the check valve prevents return oil flow.

The basic module can be supplied without the load drop check valve in channel P for functions with over-centre valves.

The shock and suction valves PVLP (7) with fixed setting on ports A and B are used for the protection of the individual working function against overload and/or cavitation.

In the closed center version an orifice (3) and a plug (5) have been fitted instead of the plug (2). This means that the pressure adjustment spool (4) will only open to tank when the pressure in channel P exceeds the set value of the pressure relief valve (1).

Alternatively a dedicated PVPV inlet for variable displacement pumps can be used. In load sensing systems the load pressure is led to the pump regulator via the LS connection. In the neutral position the pump control sets the displacement so that leakage in the system is compensated for, to maintain the set stand-by pressure.

When a main spool is actuated the pump regulator will adjust the displacement so that the set differential pressure between P and LS is maintained. The pressure relief valve (1) in PVP should be set at a pressure of approx. 30 bar [435 psi] above maximum system pressure (set on the pump or external pressure relief valve).

The PVG 16 is part of a whole family of PVG valves spanning a wide range of flow options. A common feature is the modular build concept combining stacks of flexible slice-sections across the families thus making it possible to build up a valve group to meet requirements exactly. The width and height of the valve remain unchanged whatever combination is specified.

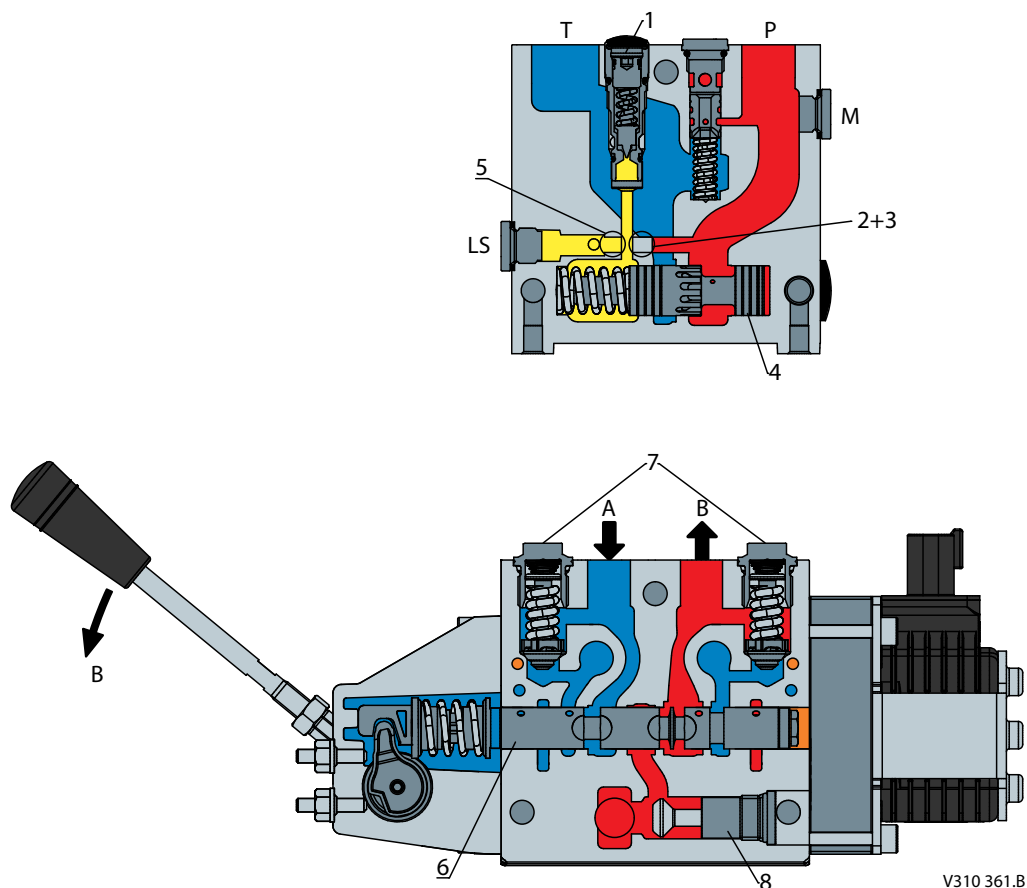
The PVB 16 is available as a compensated basic module giving the features of load-independent flow control:

- Oil flow to an individual work function is independent of the load pressure of this function
- Oil flow to one function is independent of the load pressure of other functions.

The PVB 16 employs the same compensation principle as the proven technology of the PVB 32 - the compensator maintains a constant pressure drop across the main spool (PVBS).

## General information

*PVG 16 sectional view*



### Legend:

- 1. Pressure relief valve
- 2. Plug, open center
- 3. Orifice, closed center
- 4. Pressure adjustment spool
- 5. Plug, closed center
- 6. Main spool
- 7. Shock and suction valve, PVLP
- 8. Compensator or load drop check valve  
(Figure shown is a load drop check valve)

## PVG 16 general features

- Load sensing directional control:
  - Proportional control of oil flow to a work function
- Modular build concept:
  - Up to 12 basic modules per PVG 16 valve group
  - Different, interchangeable spool variants
  - System pressure up to 350 bar [5075 psi]
  - Several types of port connection threads
  - Possible combination with the rest of the PVG family either PVG 32, PVG 100 or PVG 120

## General information

### PVP and PVS from PVG 32 portfolio

The PVG 16 interfaces directly with the PVG 32 product line. The PVG 16 valve is designed to be used with the existing PVP and PVS in the product portfolio from the PVG 32 family. When specifying a PVG 16 valve stack please refer to *PVG 32 Technical Information, 520L0344* for detailed information on PVP and/or PVS.

### Standard build (stack) of PVG 16 valve

Inlet section (PVP reused from the PVG 32 portfolio), 1–12 work sections (PVB) with individual flow controlling spools and end section (PVS reused from the PVG 32 portfolio). Each work section is actuated by manual lever, (PVM), electrical control signal (PVE) or hydraulic control signal (PVH).

### Combining PVG family into a single valve stack

The PVG 16 can be used in conjunction with the other valves in the PVG family by combining them into a single valve stack. Hence a valve stack of PVG 32/16, PVG 100/16 or PVG 120/16 can be assembled. In a PVG 32/16 build no interface module is required as a PVG 16 slice can replace a PVG 32 slice. In a PVG 100/16 or PVG 120/16 build the standard interface modules known today (PVTI and PVGI respectively) are used.

## PVG 16 technical data

### PVG 16 technical data

Maximum pressure	Port P continuous	350 bar <sup>1)</sup>	[5075 psi] <sup>1)</sup>
	Port P intermittent	400 bar	[5800 psi]
	Port A/B continuous	380 bar	[5510 psi]
	Port A/B intermittent	420 bar	[6090 psi]
	Port T, static/dynamic	25/40 bar	[365/580 psi]
Oil flow rated	Port P	140/230 l/min	[37/61 US gal/min]
	Port A/B	65 l/min @ 10 bar pressure drop	[17 US gal/min @ 145 psi pressure drop]
Spool travel	Deadband	± 1.5 mm	[± 0.06 in]
	Proportional range	± 5.0 mm	± 0.2 in]
	Float position	± 7.5 mm	[± 0.3 in]
Max. internal leakage at 100 bar [1450 psi] and 21 mm <sup>2</sup> /s [102 SUS]	A/B → T without shock valve	20 cm <sup>3</sup> /min	[1.85 in <sup>3</sup> /min]
	A/B → T with shock valve (system setting 30 bar [435 psi])	25 cm <sup>3</sup> /min	[2.15 in <sup>3</sup> /min]
Oil temperature (inlet temperature)	Recommended temperature	30 → 60 °C	[86 → 140 °F]
	Minimum temperature	-30 °C	[-22 °F]
	Maximum temperature	90 °C	[194 °F]
Ambient temperature		-30 → 60 °C	[-22 → 140 °F]
Oil viscosity	Operating range	12 - 75 mm <sup>2</sup> /s	[65 - 347 SUS]
	Minimum viscosity	4 mm <sup>2</sup> /s	[39 SUS]
	Maximum viscosity	460 mm <sup>2</sup> /s	[2128 SUS]
Filtration	Max. contamination (ISO 4406)	23/19/16	
PVM regulating range	Proportional	13.9°	
	Float position	22.3°	

## General information

*PVG 16 technical data (continued)*

PVM operating force	PVM + PVMD PVM + PVE <sup>2)</sup>	Neutral pos.	2.2 ±0.2 Nm	[5.0 ± 1.8 lbf·in]
		Max. stroke	2.8 ±0.2 Nm	[6.3 ± 1.8 lbf·in]
	PVM + PVH	Neutral pos.	2.7 ±0.2 Nm	[23.9 ± 1.8 lbf·in]
		Max stroke	7.1 ±0.2 Nm	[62.8 ± 1.8 lbf·in]
PVH pressure	Regulating range		5 – 15 bar	[75 – 220 psi]
	Maximum pilot pressure		30 bar	[435 psi]
	Maximum pressure on T-port		10 bar	[145 psi]
PVE input voltage <sup>3)</sup>	Supply		11 – 32 V <sub>DC</sub>	
	Regulating range		25 – 75% of supply voltage	
PVE SP pin output voltage <sup>3)</sup>	Float		0.5 V <sub>DC</sub>	
	Flow to B-port		1.25 – 2.5 V <sub>DC</sub>	
	Neutral		2.5 V <sub>DC</sub>	
	Flow to A-port		2.5 – 3.75 V <sub>DC</sub>	
	Error		5 V <sub>DC</sub>	

<sup>1)</sup> With PVS1 end plate. Using PVS end plate maximum 300 bar [4351 psi].

<sup>2)</sup> PVE without voltage.

<sup>3)</sup> Voltage is measured between spool output pin and ground (GND)

## Safety in systems

### General safety considerations

All types and brands of control valves, including proportional valves, can fail. Therefore, the necessary protection against the serious consequences of a functional failure should always be built into the system. For each application an assessment should be made for the consequences of the system in case of pressure failure and uncontrolled or blocked movements.

#### Warning

It is the sole responsibility of the machine manufacturer to ensure that all performance, safety, and warning requirements of the application are met in his selection of products. The process of choosing the control system and subsequent safety levels is governed by the machine directive EN 13849.

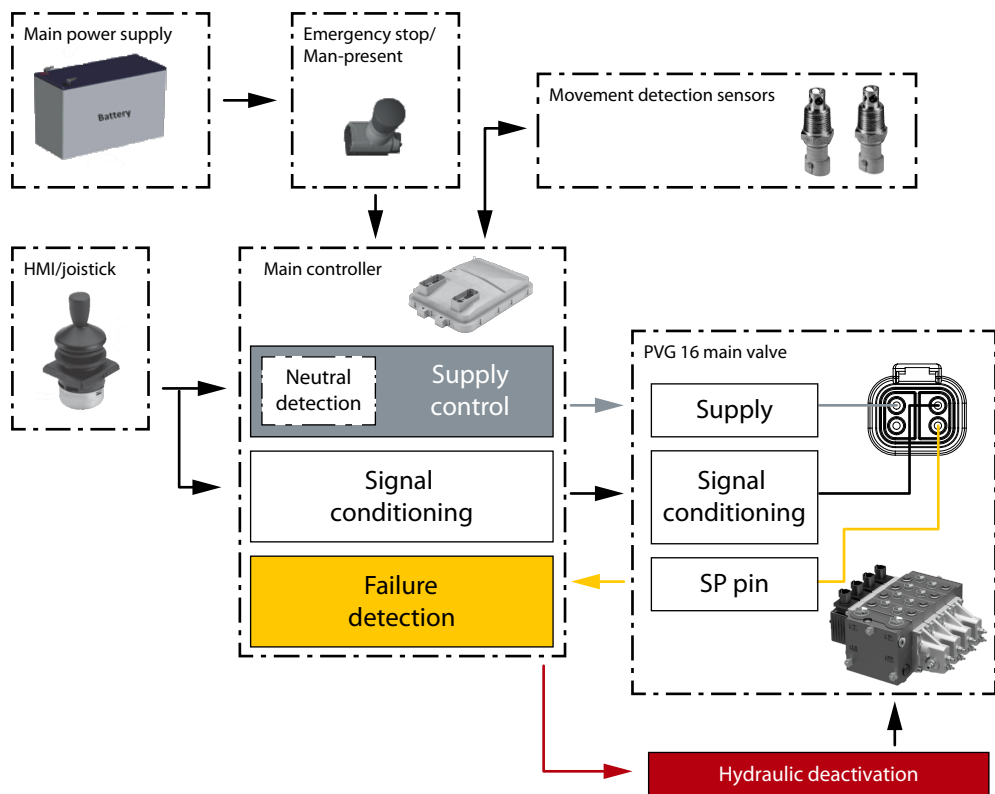
### Control system example

An example of a control system using an aerial lift is shown below. Even though many Danfoss components are shown the example is concentrating on the PVG 16 control system.

This example breaks down the control system into smaller bits explaining the architecture in depth.

The function of the control system is to use the output from the PVEA Series 6 together with other external sensors to ensure the PLUS+1® main controllers correct function of the aerial lift.

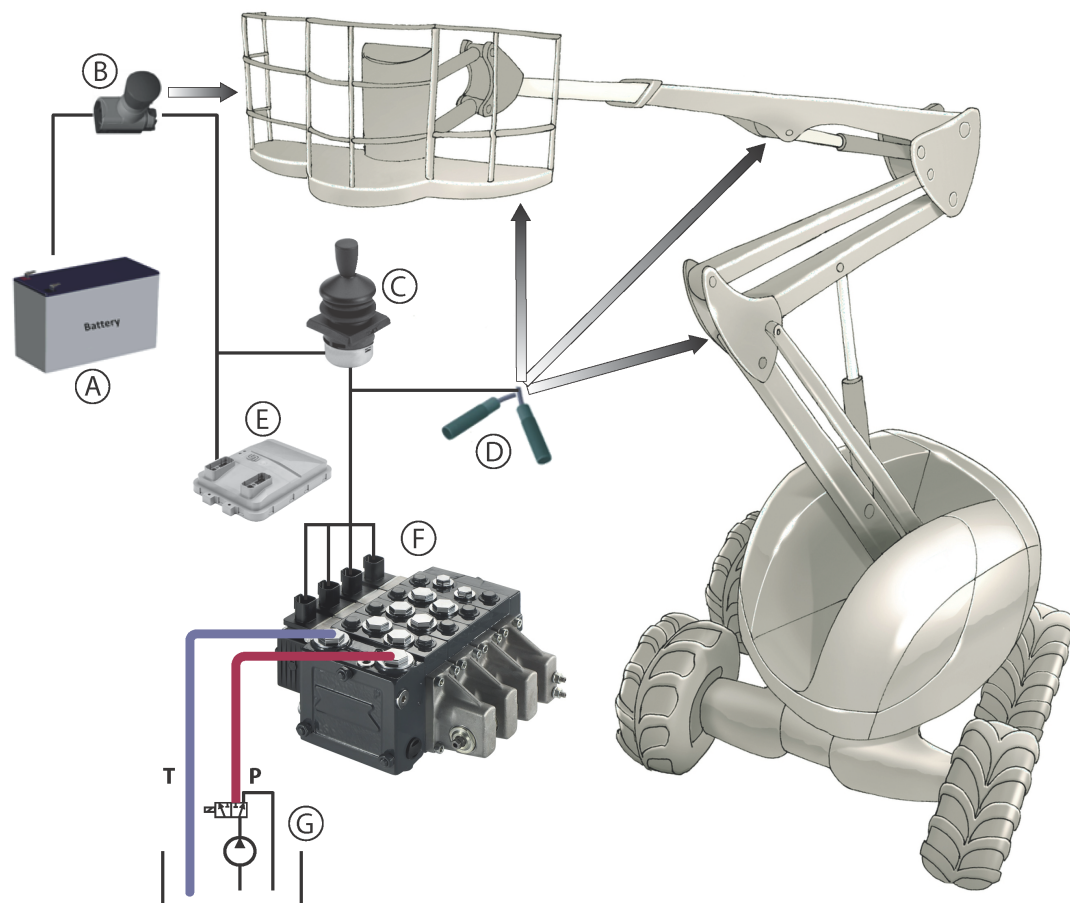
*Electrical block diagram for the illustration below*



P301 877.A

## Safety in systems

Example of a control system for manlift using PVE Fault monitoring input signals and signals from external sensors to ensure the PLUS+1® main controllers correct function of the manlift.



- A:** Main power supply
- B:** Emergency stop/man-present switch
- C:** HMI/Joystick control
- D:** Movement detection sensors
- E:** Main controller
- F:** PVG 16 valve group
- G:** Hydraulic supply with deactivation

### Warning

The equipment manufacturer is responsible for declaring that the control system used in the machine conforms with the relevant machinery directives.

## PVB – basic modules (work sections)

### PVB work ports, interchangeable spools

The PVB (work section) is dedicated to distribute the oil flow coming from the inlet section through the P-gallery across the flow regulating main spool (PVBS) to work port A or B. Furthermore, the PVB returns the flow coming from the implement (motor or cylinder) through the work port A or B across the main spool to the T-gallery.

The PVB is available with two different work port threads:

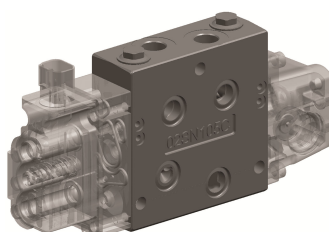
- 3/8" BSP
- 3/4"–16 UNF (SAE-8)

Due to the modular concept of the PVG valves, the PVG 16 main spool (PVBS) can be interchanged by any other version of the PVG 16 main spool.

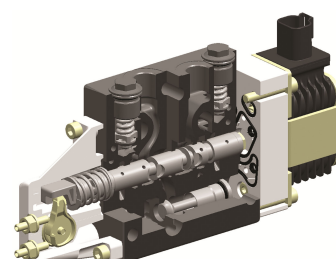
#### Versions available:

1. Compensated modules
2. Uncompensated modules
3. P-channel check valves
4. Shock valves (PVLP)

#### Work ports (A and B) image



#### PVBS spools image



#### Versions available:

##### Compensated PVB 16

- Basic module
- Basic module with facilities for shock and anti-cavitation valves (PVLP/PVLA)
- Basic module with one common LS for port A and port B

##### Non-compensated PVB 16

- Basic module
- Basic module with P-channel check valve
- Basic module with facilities for shock and anti-cavitation valves (PVLP/PVLA)
- Basic module with both P-channel check valve and facilities for shock and anti-cavitation valves (PVLP/PVLA)

### Warning

Activation of many functions simultaneously can cause a reduced operating speed in sections with high load. Activation of a section with high pressure requirement in the same time as a section with low load can increase operating speed in the second section.

#### P-channel check valve

To prevent return oil flow, thereby lowering the load a P-channel check valve can be incorporated. For applications with over-center valves versions without the P-channel check valve are also available.

#### Shock valves

The shock valve (PVLP) with fixed pressure setting is used for protection of the individual work function against overload by removing any transient pressure spikes generated by the load.



## PVB – basic modules (work sections)

### PVB hydraulic schematics and code numbers

#### PVB Compensated Basic Modules – hydraulic schematics and code numbers

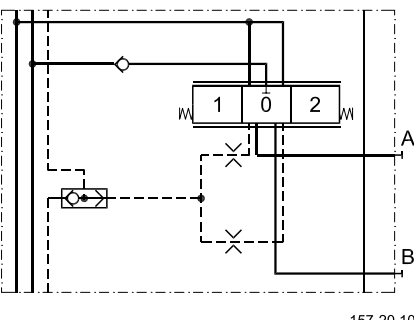
Symbol	PVB description / Port		Code number
<p>P301 831.A</p>	Compensated basic module	3/8" BSP	11130976
		3/4" -16 UNF (SAE-8)	11130977
<p>P301 832.A</p>	Compensated basic module With facilities for shock and anti-cavitation valves (PVL/P PVLA)	3/8" BSP	11130978
		3/4" -16 UNF (SAE-8)	11130979
<p>P301 833.A</p>	Compensated basic module With one common adjustable LS valve for port A and port B	3/8" BSP	11130982
		3/4" -16 UNF (SAE-8)	11130983

#### PVB Non-compensated Basic Modules – hydraulic schematics and code numbers

Symbol	PVB description / Port		Code number
<p>V310 412.A</p>	Basic work module Without P-channel check valve Without shock valve	3/8" BSP	11101421
		3/4" -16 UNF (SAE-8)	11101423
	Basic work module Without P-channel check valve With shock valve	3/8" BSP	11106754
		3/4" -16 UNF (SAE-8)	11106755

**PVB – basic modules (work sections)**

*PVB Non-compensated Basic Modules – hydraulic schematics and code numbers (continued)*

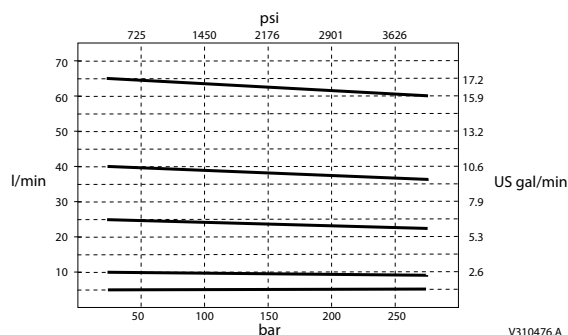
Symbol	PVB description / Port		Code number
	Basic work module	3/8" BSP	11106801
	With P-channel check valve	3/4" -16 UNF (SAE-8)	11106797
	Without shock valve	3/8" BSP	11101424
	With P-channel check valve With shock valve	3/4" -16 UNF (SAE-8)	11101425

**PVB oil flow characteristics**

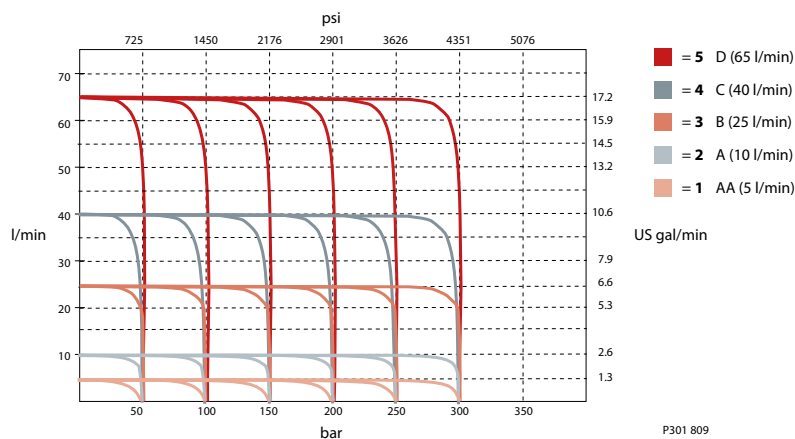
The oil flow from the work ports depends on the type of pump and in turn pump module. The difference is fixed displacement (Open Center) or variable displacement (Closed Center).

The letters AA, A, B, C and D denotes the spool flow sizes ranging from 5 l/min to 65 l/min [from 1.32 to 17.17 US gal/min]. All tests are done by using Tellus32 @ 21mm<sup>2</sup>/s.

*Load-independent oil flow characteristic, pressure-compensated PVB*

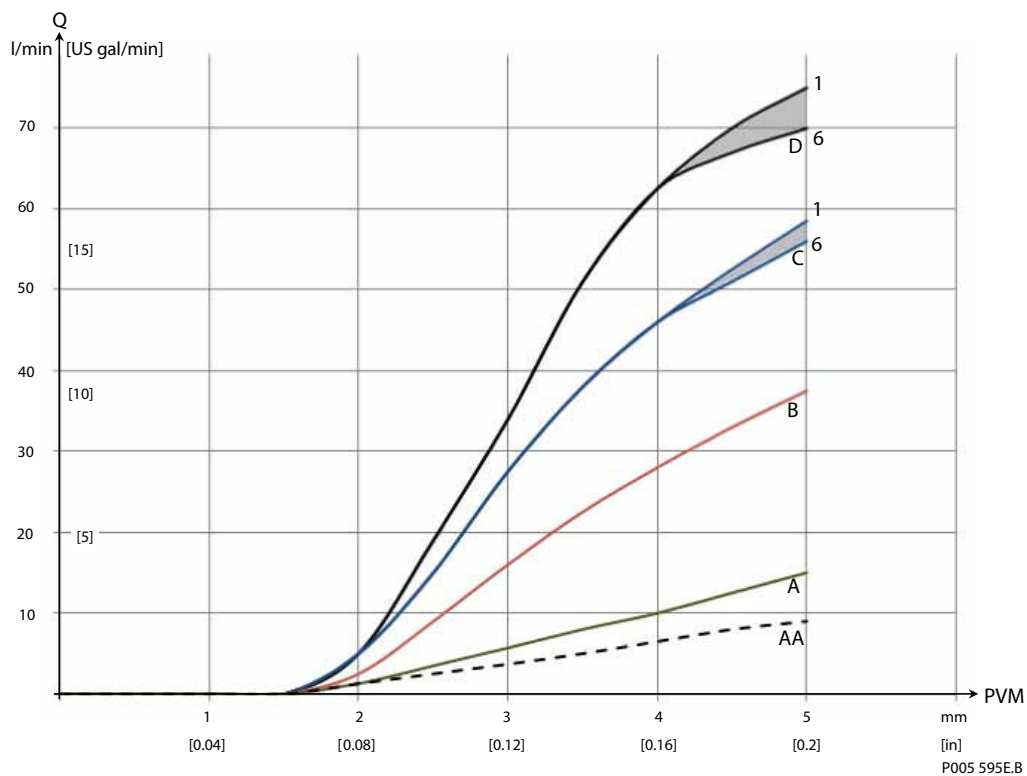


*LS pressure limiting*



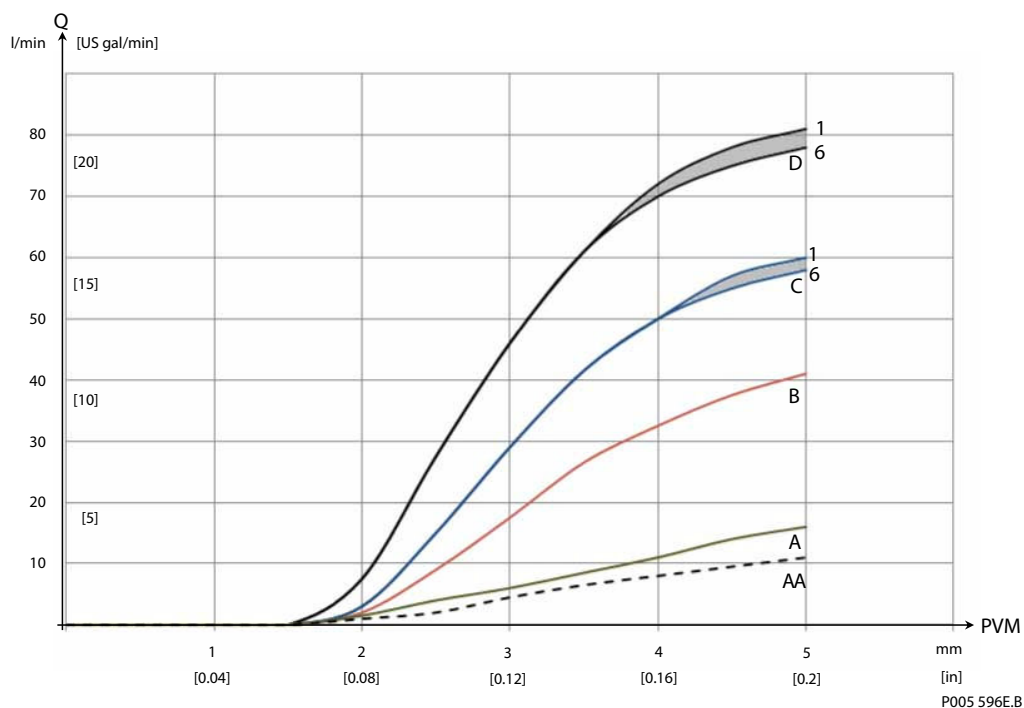
**PVB – basic modules (work sections)**

*Oil flow as a function of spool travel with Open Center PVP*



The flow is dependent on the supplied flow,  $Q_p$ .  
 The characteristics apply to supply oil of 130 l/min [34.3 US gal/min].  
 The numbers 1 and 6 refer to the position of the PVB in the valve stack.

*Oil flow as a function of spool travel with Closed Center PVP*



## PVB – basic modules (work sections)

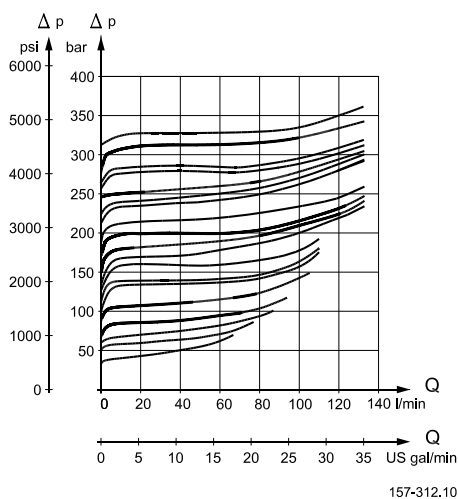
The flow is dependent on the pressure difference between the pump pressure and the LS signal.  
 Normally the pressure difference is set at the LS pump regulator.

Set pressure difference between pump pressure and LS signal = 20 bar [290 psi].

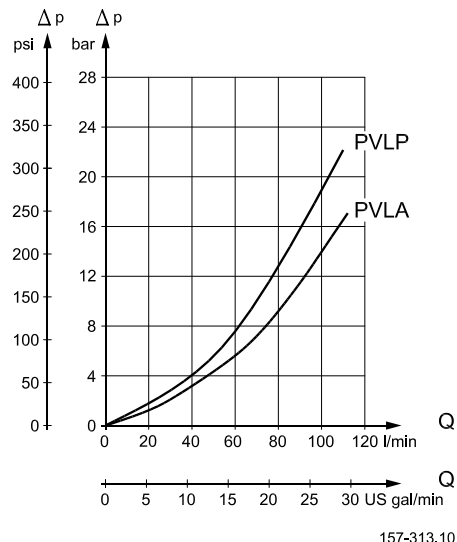
PVLP is set at an oil flow of 10 l/min [2.6 US gal/min]. The shock valve PVLP is designed to absorb shock effects. Consequently, it should not be used as a pressure relief valve.

*Oil flow characteristics – PVLP/PVLA, PVP*

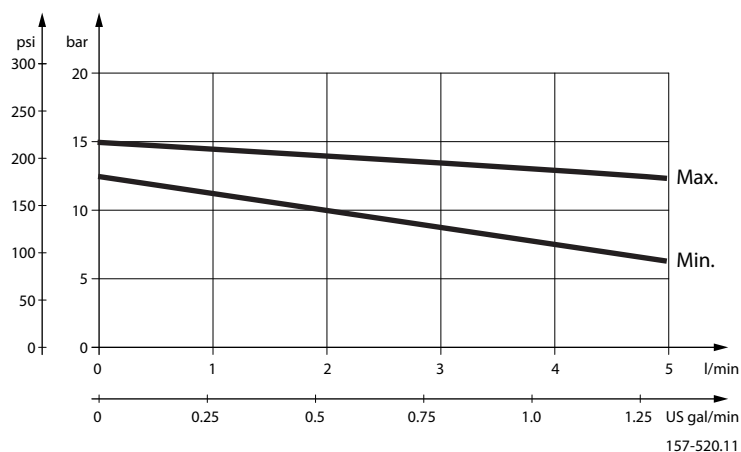
**PVLP shock valve**



**PVLP/PVLA suction valve**

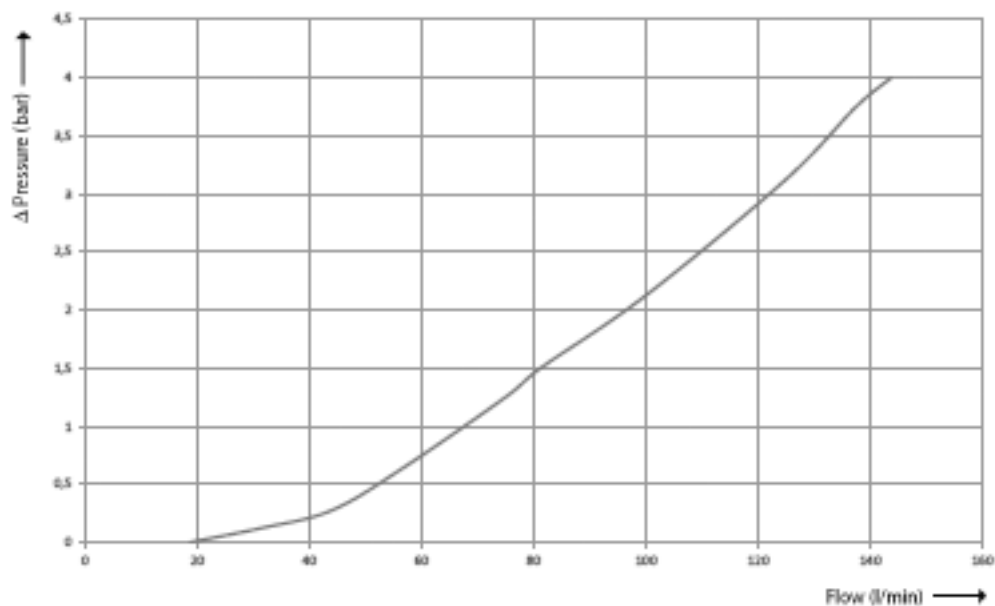


**PVP modules, Pilot pressure curves**

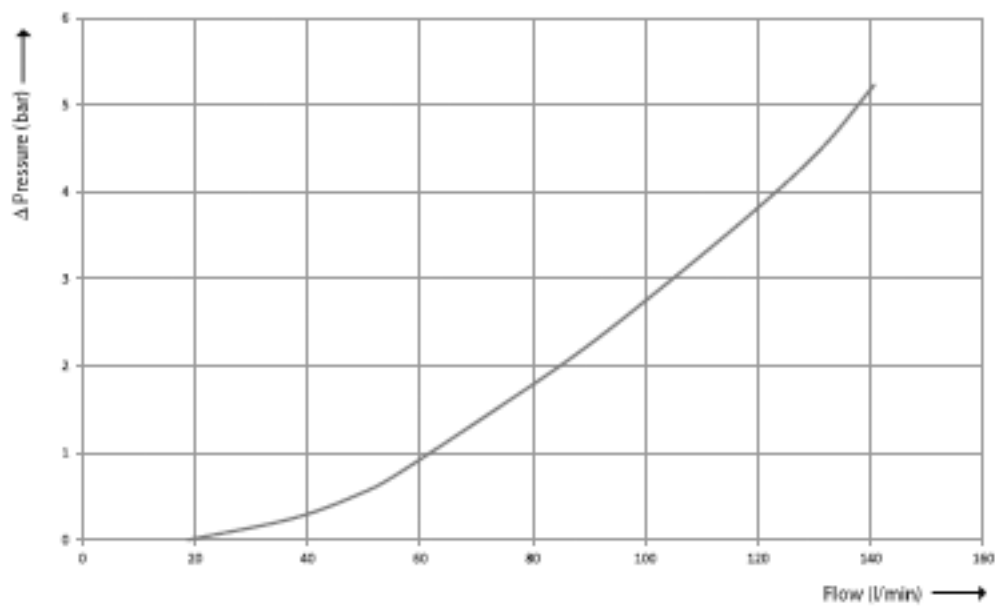


**PVB – basic modules (work sections)**

*Pressure drop through P-line*

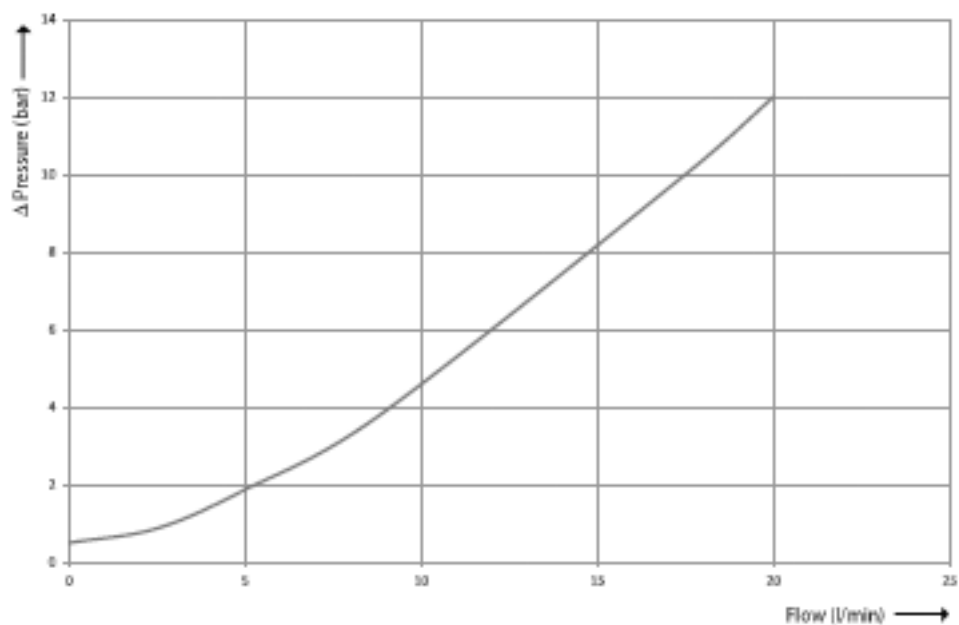


*Pressure drop through T-line*



**PVB – basic modules (work sections)**

*Pressure drop through Pp-line*



## PVBS, main spool

### Flow control, spool characteristic

The spool is directly controlling the oil flow to and from the work ports. This flow is directly proportional with the spool travel. The spool travel is made up of 1.5 mm [0.06 in] dead band and 3.5 mm [0.14 in] active region in each direction giving 0-full flow. An additional 2.5 mm [0.1 in] travel in one direction in order to accommodate float functionality can be used dependant on choice of PVM.

### Flow control

The spools are designed in such a way that the oil flow coming from the pump to the work ports are controlled by the spool travel. When the spool is moved it forms a variable orifice between the P-gallery and one work port and between the other work port and the T-gallery. The size of the orifice is directly linked to the traveled distance of the spool.

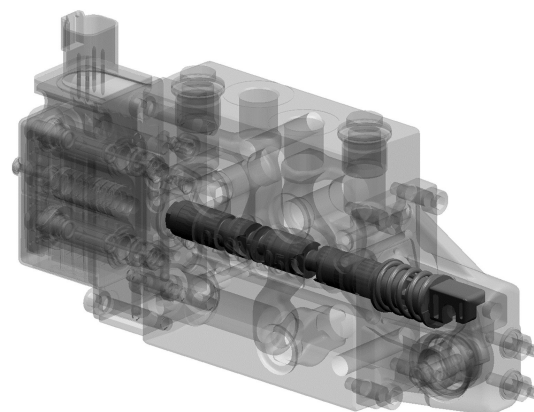
### Spools characteristic

The spools characteristic is linear with a soft start. The spool will have a progressive behavior from neutral to 10% of the full flow. From there it will be linear all the way to maximum flow.

#### Versions available:

1. Different flow versions
2. Open/closed in neutral
3. Float
4. Asymmetric spools

#### Sectional view – spool shown



#### Versions available:

##### Different flow versions

All the spools are flow controlled 4/4 spools. The spool comes in 5 different flow versions, all with a symmetrical flow: 5 l/min [1.32 US gal/min], 10 l/min [2.64 US gal/min], 25 l/min [6.60 US gal/min], 40 l/min [10.57 US gal/min], 65 l/min [17.17 US gal/min].

[The flow specified is at 10 bar \[145 psi\] with 21 mm<sup>2</sup>/ sec \[97 SUS\].](#)

##### Open/closed in neutral

The main spools for the PVG 16 are available with two different functions in neutral – open or closed. *Open in neutral* means that there is a throttled open connection across the main spool from both work ports A and B to the T-gallery. Open in neutral is generally used together with hydraulic motors. *Closed in neutral* means that there is no connection from work port A or B to the T-gallery across the main spool. Closed in neutral spools are generally used together with cylinders.

#### Warning

Using *closed in neutral* spools together with a hydraulic motor can cause a sudden and abrupt stop of the rotation.

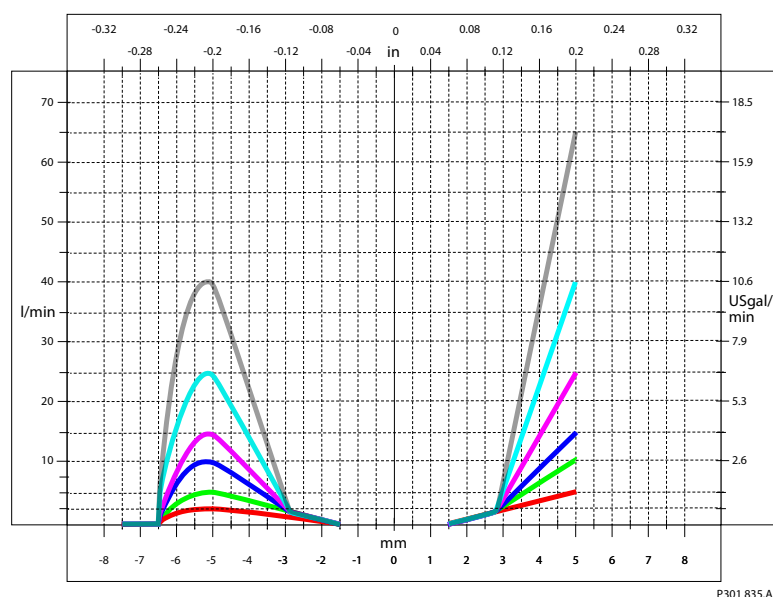
## PVBS, main spool

### Float

A spool with float function as well as normal actuation is capable of opening a connection between both work ports A and B to the T-gallery. This makes it possible for the oil in the e.g. cylinder to flow freely to the tank and the oil in the tank to flow freely from the tank to the work ports. This connection is opened when actuating 7.5 mm to the B direction (normal proportional control ends at 5 mm). Float is used if an application is to move freely back and forth to e.g. follow rough terrain.

### Asymmetric spools

Asymmetrical main spools (PVBS) are designed for use with cylinders whose rod and piston sides differ greatly in volume. When operating with a symmetrical main spool, the difference in volume causes the cylinder's speed to be different in lifting versus lowering situations, given the same set point. If you want the same speed both in lifting and in lowering situations, you need an asymmetrical main spool. Asymmetrical spools have a linear flow characteristic with a progressive soft start. The soft start guarantees a good resolution in the low flow area where fine metering is needed.





## PVBS, main spool

### How to select the correct spool

1. Calculate your cylinder's piston-rod ratio using  $\frac{D_1^2}{D_1^2 - D_2^2}$
2. Use the result to find the right asymmetrical main spool in the table

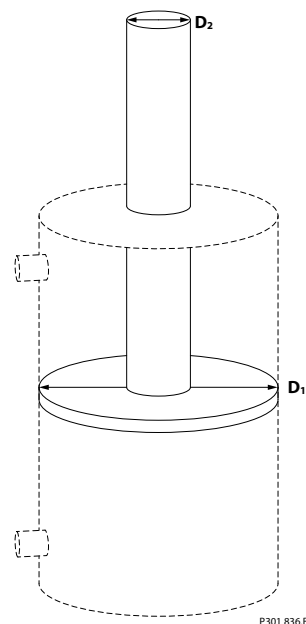
#### Example

- flow request = 25 l/min
- use with PVE
- piston diameter = 150 mm =  $D_1$
- rod diameter = 100 mm =  $D_2$

1. Calculate your cylinder's piston-rod ratio

$$\text{Equation: } \frac{D_1^2}{D_1^2 - D_2^2} = \frac{(150 \text{ mm})^2}{(150 \text{ mm})^2 - (100 \text{ mm})^2} = 1.8$$

2. Use the result to find the right asymmetrical main spool A piston-rod ratio of 1.8 for spools with a 25 l/min flow cannot be found in the table with code numbers. Therefore, we round to the nearest ratio (1.6). The spool with a 25 l/min flow and a cylinder ratio of 1.6 has the code number 11109645.



P301 836.B

### Actuation

The main spool in the PVG 16 can be actuated by one of three means. One is a lever for manual actuation, the second is electrically by a PVE and the third is hydraulically by a PVH. By actuating the main spool with a PVM or PVE the return spring of the spool will act with a force equivalent to 77 N [12.5 bar]. By actuating the main spool with a PVH the return spring will act with a force equivalent to 268 N [23 bar].

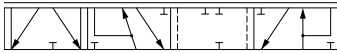
### PVBS hydraulic schematics and code numbers

#### Symmetrical main spools

Symbol	Description	Code number according to flow l/min [US gal/min]				
		5 [1.32]	10 [2.64]	25 [6.60]	40 [10.57]	65 [17.17]
	PVBS Main spool Throttled open neutral position PVM/PVE actuation With float in B-direction	11105537	11105538	11105539	11105540	11105541
	PVBS Main spool Throttled open neutral position PVH actuation With float in B- direction	11109637	11109638	11109639	11109640	11109641
	PVBS Main spool Closed neutral position PVM/PVE actuation With float in B-direction	11105532	11105533	11105534	11105535	11105536
	PVBS Main spool Closed neutral position PVH actuation With float in B-direction	11109632	11109633	11109634	11109635	11109636

## PVBS, main spool

### Asymmetrical main spools

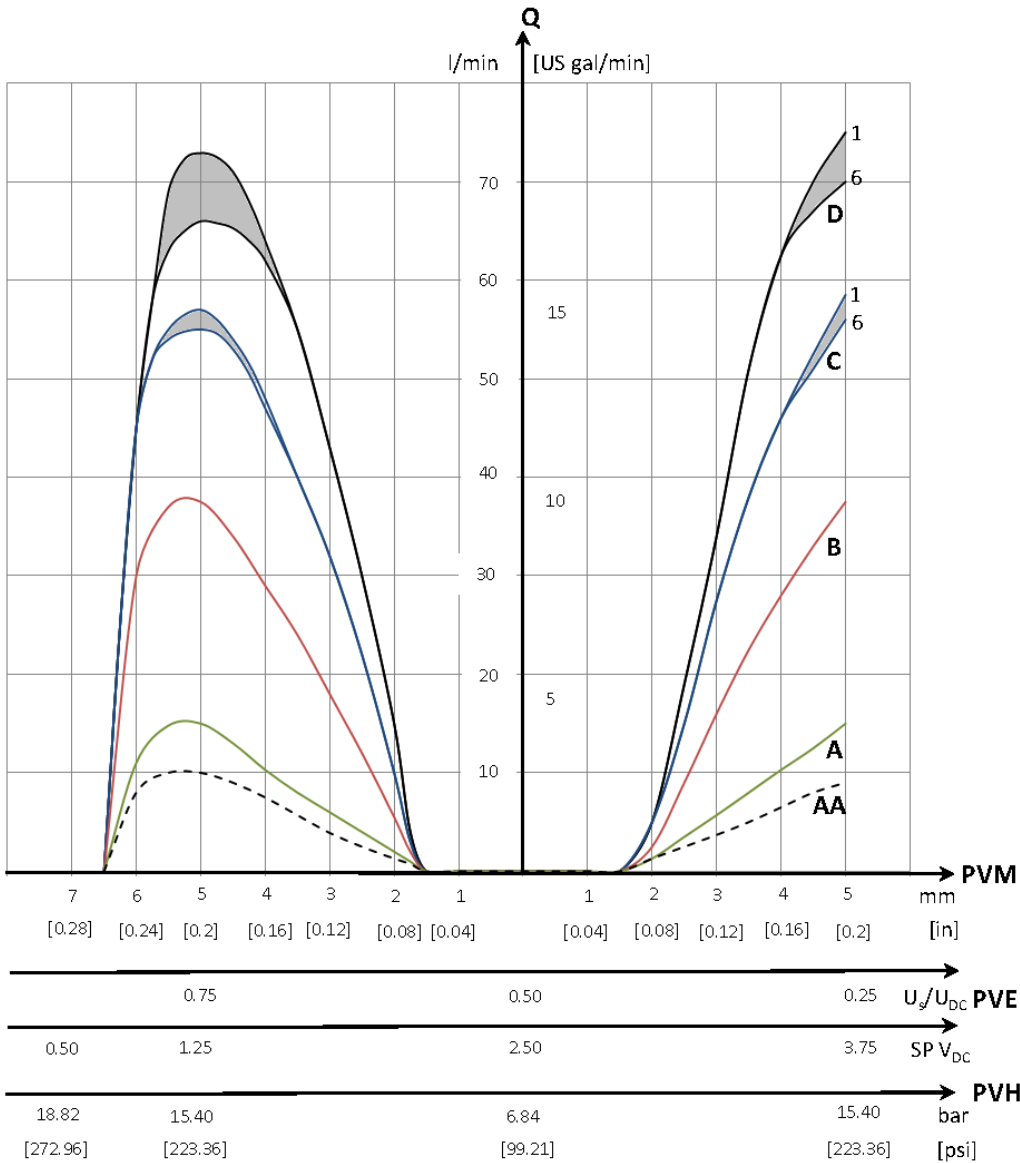
Symbol	Description	Code number according to flow l/min [US gal/min]					
		5/2.5 [1.32/0.66]	10/5 [2.64/1.32]	25/10 [6.60/2.64]	25/15 [6.60/3.96]	40/15 [10.57/3.96]	40/25 [10.57/6.60]
	Cylinder ratio	2.0	2.0	2.5	1.6	2.7	1.6
	PVBS Main spool Closed neutral position PVM/PVE actuation With float in B-direction	11109642	11109643	11109644	11109645	11109646	11109647
	PVBS Main spool Closed neutral position PVH actuation With float in B- direction	11146752	11146753	11146754	11146755	11146756	11146757

### PVBS oil flow characteristics

The letters AA, A, B, C and D denotes the spool flow sizes ranging from 5 l/min to 65 l/min [1.32 to 17.17 US gal/min]. All tests are done by using Tellus32 @ 21mm<sup>2</sup>/s.

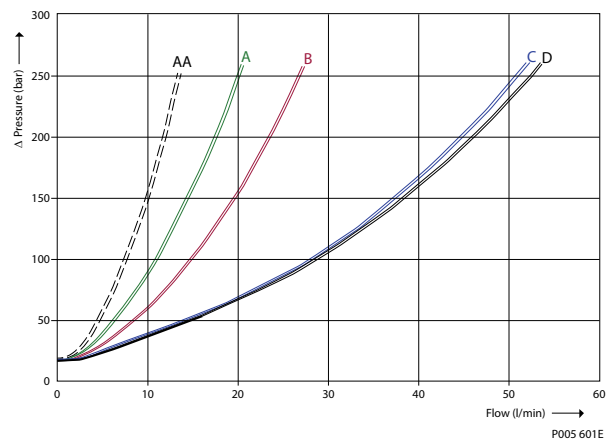
**PVBS, main spool**

*Oil flow as a function of spool travel*

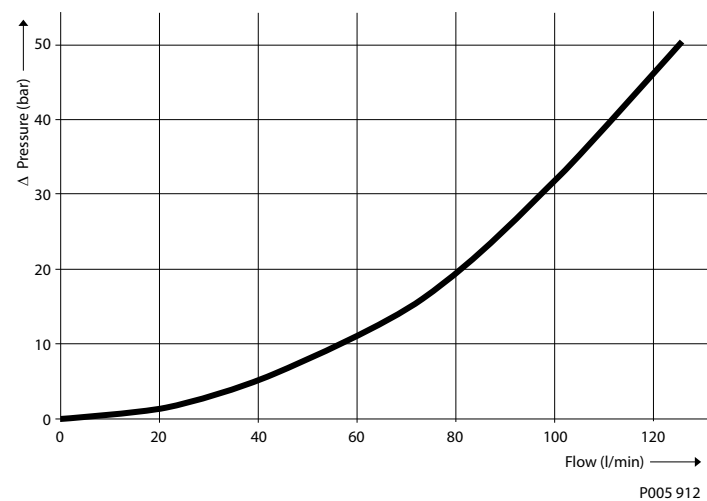


**PVBS, main spool**

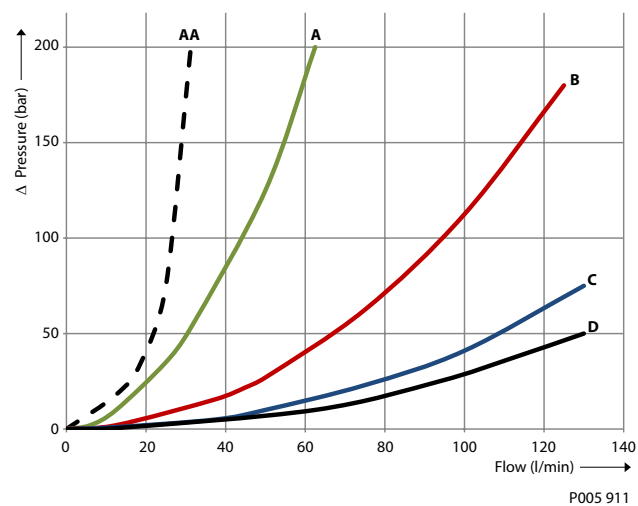
*Pressure drop to tank for open spool in neutral*



*Pressure drop at full spool stroke*



*Pressure drop in float*



## PVM and PVH – mechanical actuation modules

### PVM and PVH general information

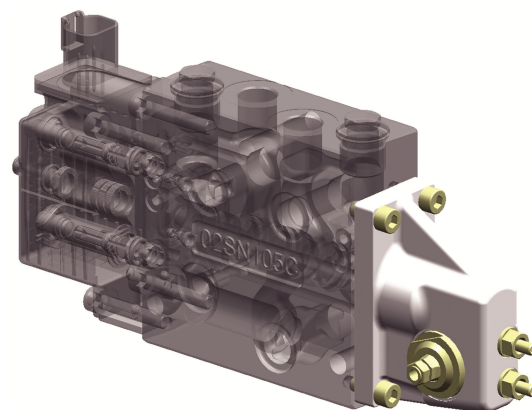
The PVM and PVH are two ways of mechanically controlling the flow from the work ports. The flow is controlled either by an operator using a lever or from a distance by a hydraulic joystick.

These are types of mechanical actuation modules for the PVG 16:

- PVM – a fully manual lever controlled module
- PVH – a hydraulic controlled module
- PVMD – cover

#### Versions available:

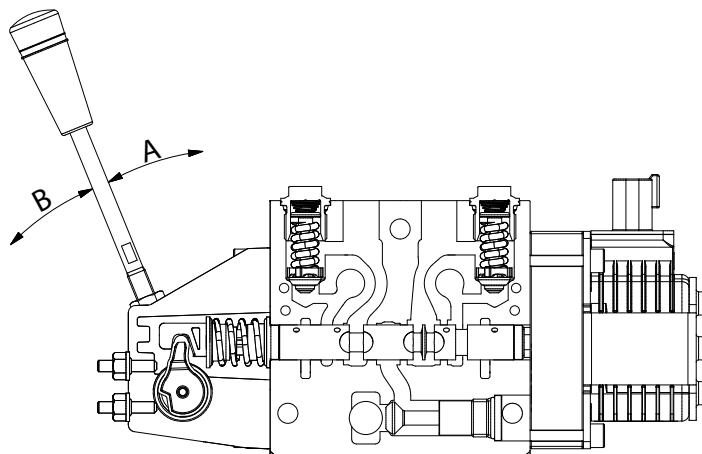
1. PVM with float control
2. PVM without adjustment screws
3. PVM with adjustment screws



### PVM actuation module

The PVM consists of an aluminum base mounted on the end of the valve slice and a lever. When actuating the lever the operator is directly pulling or pushing on the main spool inside the valve hence controlling the flow. The lever has a travel of 16° in either direction from neutral. Actuating the lever fully will move the spool all 5 mm and give full flow. The lever can be mounted / removed without having to remove the PVM base. The PVM can be combined with any PVE, PVH or PVMD (cover).

#### PVM actuation module



#### Versions available:

- **PVM with float control**

If an application with float functionality is needed this PVM is used. It is used when float position is with manual operator actuation. There are no adjustment screws available for this PVM version. The

## PVM and PVH – mechanical actuation modules

setting of this PVM is 5 mm spool travel in the A direction and 7.5 mm spool travel in the B direction giving float.

- **PVM without adjustment screws**

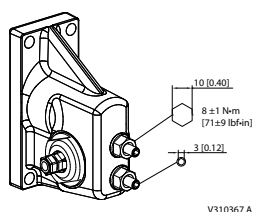
The standard PVM without adjustment screws will allow a spool travel of 5 mm in either direction. Full lever movement to one side will give full flow to the work ports. When the spool is moved 5mm it will stop due to a mechanical limitation build into the PVM base.

- **PVM with adjustment screws**

The standard PVM without adjustment screws will allow a spool travel of 5 mm in either direction. The spool travel in either direction can be limited by the adjustment screws. This will limit the flow out of the work ports thereby reducing the speed of an application.

The spool travel is adjusted by first loosening the nut then adjusting the pinol screw. After adjustment the nut must be tightened again.

### Technical characteristics for PVM



## PVH actuation module

The PVH is an aluminum plate with two threaded connections. When applying pressure through one of the ports, one side of the spool is pushed to one direction hence flow is coming from the work ports.

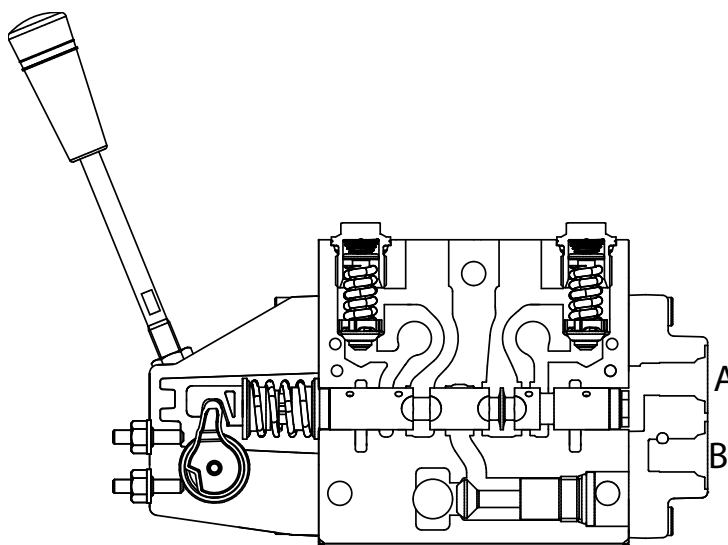
The PVH is available in two types of connector thread types:

- ¼ BSP
- ½" –20 UNF

When using the PVH a spool designed for hydraulic actuation must be chosen. These spools have a stiffer spring designed for the higher actuation pressure used in systems with hydraulic controls.

The PVH is to be combined with a PVM.

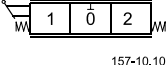
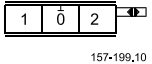
### PVH actuation module



V310363.B

## PVM and PVH – mechanical actuation modules

### PVM/PVH hydraulic symbols and code numbers

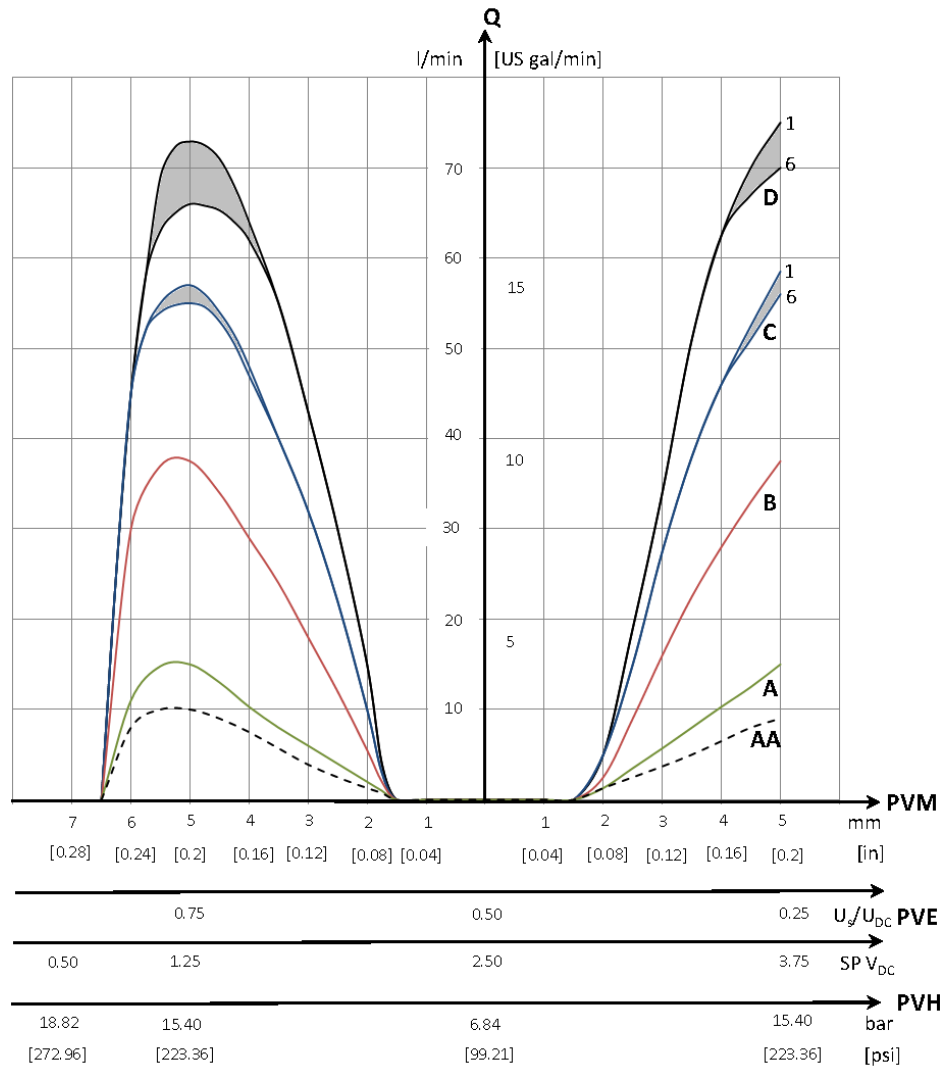
Symbol	Description	Comments	Code number
	PVM Manual actuation Without adjustment screws Without float	Without lever	11107505
		With lever	11107333
	PVM Manual actuation Without adjustment screws With float	Without lever	11107506
		With lever	11107335
	PVM Manual actuation With adjustment screws Without float	Without lever	11107507
		With lever	11107332
	PVH Hydraulic cover	¼ " BSP	11108380
		UNF ½" -20	11108381
-	PVMD Cover for PVM		11105518

### PVM/PVH oil flow characteristics

The letters AA, A, B, C and D denotes the spool flow sizes ranging from 5 l/min to 65 l/min [from 1.32 to 17.17 US gal/min]. All tests are done by using Tellus32 @ 21mm<sup>2</sup>/s.

**PVM and PVH – mechanical actuation modules**

*Oil flow as a function of spool travel*

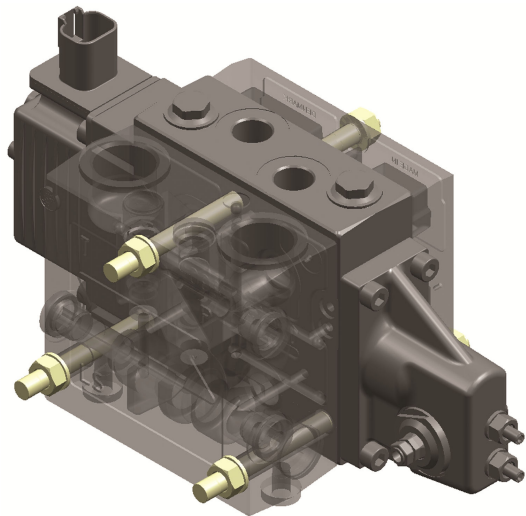




**PVAS**

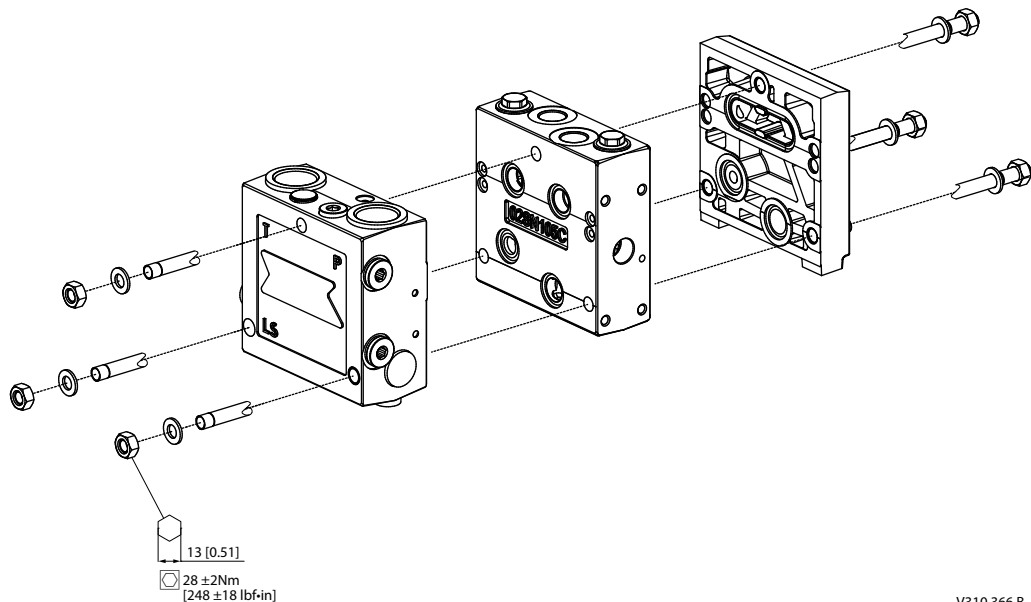
**PVAS design**

The PVAS consists of three tie rods, six washers and six nuts. The tie rods are inserted through the entire length of the PVG valve stack. The nuts are tightened at the pump side and the end plate.



For certain combinations with PVG 100/16, PVG 120/16 and some PVS 32 the tie rod are thread-mounted into the interface.

*Technical characteristics for PVAS*



V310 366.B

**Module selection guide**

*Module width according to module type*

Module type	Module width
PVB 32 / PVP / PVSK	48 mm [1.89 in]
PVB 16	40 mm [1.57 in]
PVS	23 mm [0.91 in]

## PVAS

*PVAS code numbers according to accumulated module width interval*

Accumulated module width interval				PVAS code number
mm		[in]		
Minimum	Maximum	Minimum	Maximum	
48	72	[1.89]	[2.83]	157B8000
73	96	[2.87]	[3.78]	157B8031
97	120	[3.82]	[4.72]	157B8001
121	144	[4.76]	[5.67]	157B8021
145	168	[5.71]	[6.61]	157B8002
169	192	[6.65]	[7.56]	157B8022
193	216	[7.60]	[8.50]	157B8003
217	240	[8.54]	[9.45]	157B8023
241	264	[9.49]	[10.39]	157B8004
265	288	[10.43]	[11.34]	157B8024
289	312	[11.38]	[12.28]	157B8005
313	336	[12.32]	[13.23]	157B8025
337	360	[13.27]	[14.17]	157B8006
361	384	[14.21]	[15.12]	157B8026
385	408	[15.16]	[16.06]	157B8007
409	432	[16.10]	[17.01]	157B8027
433	456	[17.05]	[17.95]	157B8008
457	480	[17.99]	[18.90]	157B8028
481	504	[18.94]	[19.84]	157B8009
505	528	[19.88]	[20.79]	157B8029
529	552	[20.83]	[21.73]	157B8010
553	576	[21.77]	[22.68]	157B8030
577	600	[22.72]	[23.62]	157B8061
601	624	[23.66]	[24.57]	157B8081
625	648	[24.61]	[25.51]	157B8062
649	672	[25.55]	[26.46]	157B8082

PVG 100 and PVG 120 have their own tie rod portfolio and is not included in the table above.

*PVG 32/PVG 16 configuration, PVAS standard*

No. of PVB 32 modules (down)	No. of PVB 16 modules								
	0	1	2	3	4	5	6	7	8
0	157B8000	157B8001	157B8002	157B8022	157B8023	157B8024	157B8005	157B8006	157B8007
1	157B8001	157B8002	157B8003	157B8023	157B8024	157B8025	157B8006	157B8007	157B8008
2	157B8002	157B8003	157B8004	157B8024	157B8025	157B8026	157B8007	157B8008	157B8009
3	157B8003	157B8004	157B8005	157B8025	157B8026	157B8027	157B8008	157B8009	157B8010
4	157B8004	157B8005	157B8006	157B8026	157B8027	157B8028	157B8009	157B8010	157B8061
5	157B8005	157B8006	157B8007	157B8027	157B8028	157B8029	157B8010	157B8061	157B8062
6	157B8006	157B8007	157B8008	157B8028	157B8029	157B8030	157B8061	157B8062	–
7	157B8007	157B8008	157B8009	157B8029	157B8030	157B8081	157B8062	–	–
8	157B8008	157B8009	157B8010	157B8030	157B8081	157B8082	–	–	–
9	157B8009	157B8010	157B8061	157B8081	157B8082	–	–	–	–

Technical Information  
PVG 16 Proportional Valve Group

PVAS

PVG 32/PVG 16 configuration, PVAS standard (continued)

No. of PVB 32 modules (down)	No. of PVB 16 modules								
	0	1	2	3	4	5	6	7	8
10	157B8010	157B8061	157B8062	157B8082	–	–	–	–	–
11	157B8061	157B8062	–	–	–	–	–	–	–
12	157B8062	–	–	–	–	–	–	–	–

PVG 32/PVG 16 configuration, PVAS standard (continued)

No. of PVB 32 modules (down)	No. of PVB 16 modules						
	9	10	11	12	13	14	15
0	157B8027	157B8028	157B8029	157B8010	157B8061	157B8062	157B8082
1	157B8028	157B8029	157B8030	157B8061	157B8062	–	–
2	157B8029	157B8030	157B8081	157B8062	–	–	–
3	157B8030	157B8081	157B8082	–	–	–	–
4	157B8081	157B8082	–	–	–	–	–
5	157B8082	–	–	–	–	–	–

PVG 32/PVG 16 configuration, PVAS mid-inlet

No. of PVB 32 modules	No. of PVB 16 modules							
	0	1	2	3	4	5	6	7
0	157B8031	157B8021	157B8022	157B8003	157B8004	157B8005	157B8025	157B8026
1	157B8021	157B8022	157B8023	157B8004	157B8005	157B8006	157B8026	157B8027
2	157B8022	157B8023	157B8024	157B8005	157B8006	157B8007	157B8027	157B8028
3	157B8023	157B8024	157B8025	157B8006	157B8007	157B8008	157B8028	157B8029
4	157B8024	157B8025	157B8026	157B8007	157B8008	157B8009	157B8029	157B8030
5	157B8025	157B8026	157B8027	157B8008	157B8009	157B8010	157B8030	157B8081
6	157B8026	157B8027	157B8028	157B8009	157B8010	157B8061	157B8081	157B8082
7	157B8027	157B8028	157B8029	157B8010	157B8061	157B8062	157B8082	–
8	157B8028	157B8029	157B8030	157B8061	157B8062	–	–	–
9	157B8029	157B8030	157B8081	157B8062	–	–	–	–
10	157B8030	157B8081	157B8082	–	–	–	–	–
11	157B8081	157B8082	–	–	–	–	–	–
12	157B8082	–	–	–	–	–	–	–

PVG 32/PVG 16 configuration, PVAS mid-inlet (continued)

No. of PVB 32 modules	No of PVB 16 modules						
	8	9	10	11	12	13	14
0	157B8027	157B8008	157B8009	157B8010	157B8030	157B8081	157B8082
1	157B8028	157B8009	157B8010	157B8061	157B8081	157B8082	–
2	157B8029	157B8010	157B8061	157B8062	157B8082	–	–
3	157B8030	157B8061	157B8062	–	–	–	–
4	157B8081	157B8062	–	–	–	–	–
5	157B8082	–	–	–	–	–	–

## PVAS

PVG 32/PVG 16 configuration, PVAS PVSK

No. of PVB 32 modules	No. of PVB 16 modules							
	0	1	2	3	4	5	6	7
0	157B8031	157B8021	157B8022	157B8003	157B8004	157B8005	157B8025	157B8026
1	157B8021	157B8022	157B8023	157B8004	157B8005	157B8006	157B8026	157B8027
2	157B8022	157B8023	157B8024	157B8005	157B8006	157B8007	157B8027	157B8028
3	157B8023	157B8024	157B8025	157B8006	157B8007	157B8008	157B8028	157B8029
4	157B8024	157B8025	157B8026	157B8007	157B8008	157B8009	157B8029	157B8030
5	157B8025	157B8026	157B8027	157B8008	157B8009	157B8010	157B8030	157B8081
6	157B8026	157B8027	157B8028	157B8009	157B8010	157B8061	157B8081	157B8082
7	157B8027	157B8028	157B8029	157B8010	157B8061	157B8062	157B8082	-
8	157B8028	157B8029	157B8030	157B8061	157B8062	-	-	-
9	157B8029	157B8030	157B8081	157B8062	-	-	-	-
10	157B8030	157B8081	157B8082	-	-	-	-	-
11	157B8081	157B8082	-	-	-	-	-	-
12	157B8082	-	-	-	-	-	-	-

PVG 32/16 PVAS PVSK configuration (continued)

No. of PVB 32 modules	No. of PVB 16 modules						
	8	9	10	11	12	13	14
0	157B8027	157B8008	157B8009	157B8010	157B8030	157B8081	157B8082
1	157B8028	157B8009	157B8010	157B8061	157B8081	157B8082	-
2	157B8029	157B8010	157B8061	157B8062	157B8082	-	-
3	157B8030	157B8061	157B8062	-	-	-	-
4	157B8081	157B8062	-	-	-	-	-
5	157B8082	-	-	-	-	-	-

PVG 100/16 or PVG 120/16 configuration

No. of PVB 32 modules	No. of PVB 16 modules								
	0	1	2	3	4	5	6	7	8
0	-	157B8000	157B8001	157B8021	157B8022	157B8023	157B8004	157B8005	157B8006
1	157B8000	157B8001	157B8002	157B8022	157B8023	157B8024	157B8005	157B8006	157B8007
2	157B8001	157B8002	157B8003	157B8023	157B8024	157B8025	157B8006	157B8007	157B8008
3	157B8002	157B8003	157B8004	157B8024	157B8025	157B8026	157B8007	157B8008	157B8009
4	157B8003	157B8004	157B8005	157B8025	157B8026	157B8027	157B8008	157B8009	157B8010
5	157B8004	157B8005	157B8006	157B8026	157B8027	157B8028	157B8009	157B8010	157B8061
6	157B8005	157B8006	157B8007	157B8027	157B8028	157B8029	157B8010	157B8061	157B8062
7	157B8006	157B8007	157B8008	157B8028	157B8029	157B8030	157B8061	157B8062	-
8	157B8007	157B8008	157B8009	157B8029	157B8030	157B8081	157B8062	-	-
9	157B8008	157B8009	157B8010	157B8030	157B8081	157B8082	-	-	-
10	157B8009	157B8010	157B8061	157B8081	157B8082	-	-	-	-
11	157B8010	157B8061	157B8062	157B8082	-	-	-	-	-
12	157B8061	157B8062	-	-	-	-	-	-	-

Technical Information  
**PVG 16 Proportional Valve Group**

**PVAS**

*PVG 100/16 or PVG 120/16 configuration (continued)*

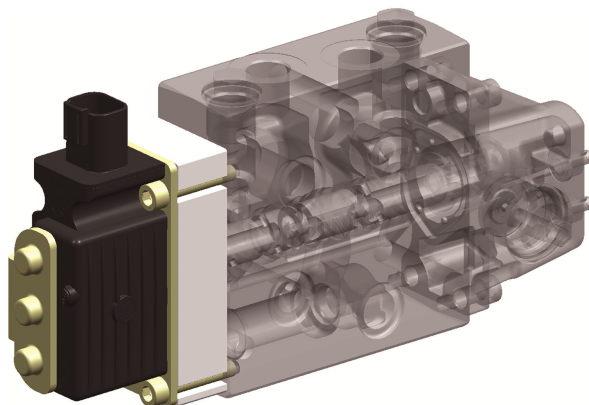
No. of PVB 100 modules	No. of PVB 16 modules						
	9	10	11	12	13	14	15
0	157B8026	157B8027	157B8028	157B8009	157B8010	157B8061	157B8081
1	157B8027	157B8028	157B8029	157B8010	157B8061	157B8062	157B8082
2	157B8028	157B8029	157B8030	157B8061	157B8062	-	
3	157B8029	157B8030	157B8081	157B8062	-	-	-
4	157B8030	157B8081	157B8082	-	-	-	-
5	157B8081	157B8082	-	-	-	-	-
6	157B8082	-	-	-	-	-	-

## PVE – electrical actuation modules

### PVE features

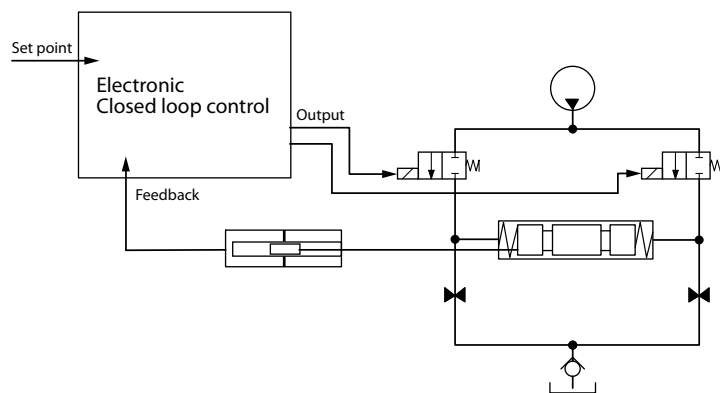
- Electrical actuation
- Spool position output
- Fault monitoring
- Power save

#### *PVE actuation module*



The PVE is a means of controlling the flow of the work ports at a distance from the physical valve. The flow is controlled by sending a control signal to the PVE. Result is the spool position being proportional to the electric signal.

#### *PVEO/A/-F hydraulic subsystem*



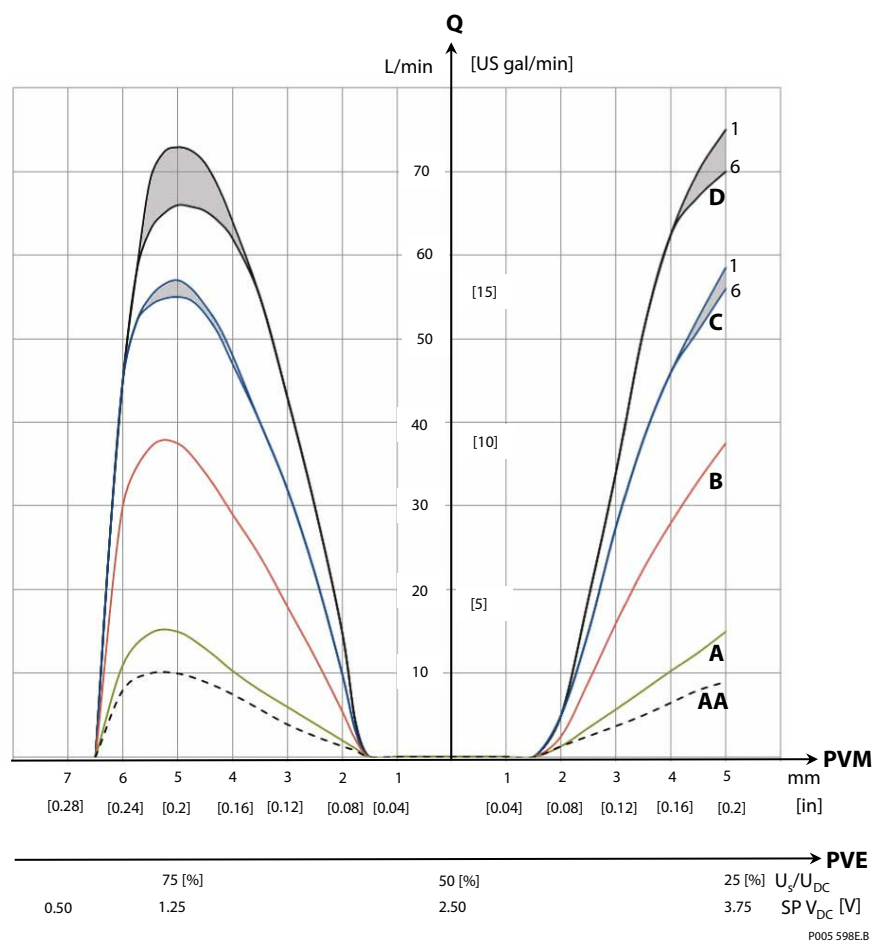
P301 876.A

### Electrical actuation

The PVEA is powered by the DC voltage source available on the application with any voltage between 11 and 32 V<sub>DC</sub> inclusive. The control signal for the PVEA is a ratio-metric signal with reference to the supply voltage.

## PVE – electrical actuation modules

Oil flow as a function of spool travel



Giving the PVEA a control signal of 50% of supply voltage will make it place the spool in its neutral position, hence no flow to the work ports. A signal ( $U_s$ ,  $U_{DC}$ ) between 25-50% or between 50-75% will make the spool move in either direction. At 25 and 75% the spool will be at full stroke at either side.

The PVEA and PVEA-F features an integrated feedback transducer that measures spool movement in relation to the input signal. This feedback is part of the closed loop control of the spool position making the PVEA and PVEA-F capable of compensating for changes in the flow forces on the spool, pilot pressure or the viscosity of the oil.

The PVEO is powered by a fixed voltage of either 12 or 24 V<sub>DC</sub>. Applying this voltage to one of two pins will make the PVEO actuate the spool to full stroke. When removing the voltage again the spool will return to neutral position.

### Spool position output

The PVEA has a build in spool monitoring circuit. This circuit is communicating to the surroundings by an analogue 0-5 V<sub>DC</sub> pin. The translation between a voltage out on the pin to spool movement can be found in the technical characteristics section of this chapter.

The voltage outputted between 1.25 to 2.5 V<sub>DC</sub> and 2.5 to 3.75 V<sub>DC</sub> is directly proportional to the position of the spool and therefore the flow.

The PVEO has no spool position output pin.

## PVE – electrical actuation modules

### Fault monitoring

When the voltage on the SP-pin goes to 5 V<sub>DC</sub> the PVEA has detected an error. The error detection is monitoring the sanity of the command signal, comparing the spool position with the command signal and the closed loop control.

Besides outputting 5 V<sub>DC</sub> on the spool position pin the PVEA will change the color of the LED for visual recognition of the error. Normally the LED would light green, but in case of a command signal error the LED will be flashing red. If any of the other two errors occur the LED will change its color to constant red.

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[The PVEO has no fault monitoring.](#)

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### Power save

The PVEA has a power save mode. This mode is entered when the command signal to the PVEA is below 15% of the supply voltage. Entering power save mode will turn off the power to the solenoid valves. Power save mode can be identified by the LED blinking green at 1 Hz.

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[The PVEO has no power save mode.](#)

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### PVEO/A code numbers

*PVEO/A versions and code numbers*

Description		Code number
PVEO, electrical actuation, ON/OFF control	12 V <sub>DC</sub> control signal	11106793
	24 V <sub>DC</sub> control signal	11106794
PVEA, electrical actuation, proportional control		11103692
PVEA-F, electrical actuation, proportional control, with float in B-direction		11106795

### PVE-CI code numbers

*PVE-CI versions and code numbers*

Description		Code number
PVEO-CI	J1939/ISObus	11124002
PVEA-CI		11121945
PVEO-CI	CANopen	11149443
PVEA-CI		11149437

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[Refer to PVE-CI, Series 6, Technical Information L1505234 for further information.](#)

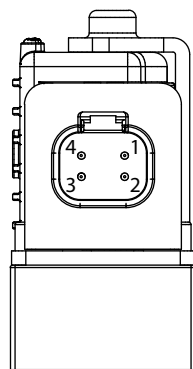
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### PVEA pin connector layout

The PVEA is available as the PVE for proportional control of the spool. It has a 4 pin DEUTSCH connector.



## PVE – electrical actuation modules



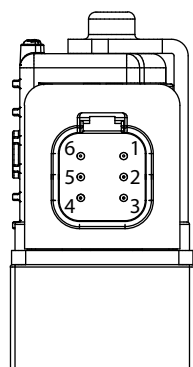
V310 358.A

Legend:

- 1. Vi (signal pin)
- 2. Sp (spool position)
- 3. Vneg ( $\div$ )
- 4. Vbat (+)

## PVEA-F pin connector layout

The PVEA-F is available for float options. It has a 6 pin DEUTSCH connector where the float command has a dedicated pin. All features in the PVEA is also in the PVEA-F.



V310 359.A

Legend:

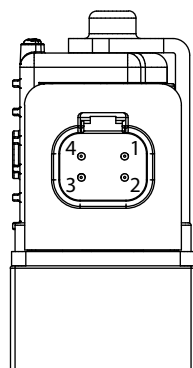
- 1. Vi (signal pin)
- 2. NC (not connected)
- 3. Vf (float)
- 4. Sp (spool position)
- 5. Vneg ( $\div$ )
- 6. Vbat (+)

## Warning

When PVEA-F is given float command it will actuate the spool into float state no matter what position in spool has or set point given to PVEA-F.

## PVEO pin connector layout

The PVEO is available for simple ON/OFF actuation of the main spool. It has a 4 pin DEUTSCH connector.



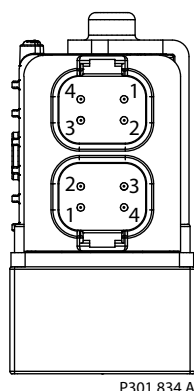
V310 358.A

Legend:

- 1. Supply Vbat when flow is wanted in A direction
- 2. Vneg ( $\div$ )
- 3. Vneg ( $\div$ )
- 4. Supply Vbat when flow is wanted in B-direction

## PVE – electrical actuation modules

### PVE-CI pin connector layout



Legend:  
1. CAN\_H  
2. CAN\_L  
3. Vbat (+)  
4. Vneg (-)

## PVE technical data

### Technical characteristics for PVEO

<b>Supply voltage <math>U_{DC}</math></b>	Rated	12 V <sub>DC</sub>	24 V <sub>DC</sub>
	Range	11 to 15 V <sub>DC</sub>	22 to 30 V <sub>DC</sub>
	Ripple	max. 5 %	
<b>Current consumption</b>		320 mA @ 12 V <sub>DC</sub>	160 mA @ 24 V <sub>DC</sub>
<b>Power consumption</b>		4 W	
<b>Oil consumption</b>	Neutral	0.04 l/min	
	Full flow steady state	0.06 l/min	
	Peak	1 l/min	

### Technical characteristics for PVEA / PVEA-F

<b>Supply voltage <math>U_{DC}</math></b>	Rated	11 to 32 V <sub>DC</sub>
	Range	11 to 32 V <sub>DC</sub>
	Ripple	max. 5 %
<b>Current consumption at rated voltage</b>		320 mA @ 12 V <sub>DC</sub> 170 mA @ 24 V <sub>DC</sub>
<b>Power consumption</b>		0.5 W
<b>Oil consumption</b>	Neutral	0.04 l/min
	Full flow steady state	1 l/min
	Peak	1.3 l/min
<b>Signal voltage</b>	Neutral	$0.5 \cdot U_{DC}$
	A-port	$0.25 \cdot U_{DC}$
	B-port	$0.75 \cdot U_{DC}$
<b>Signal current at rated voltage</b>		0.25 to 70 mA
<b>Input impedance in relation to neutral</b>		12 k $\Omega$
<b>Input capacitor</b>		100 $\mu$ F
<b>SP pin current</b>		2 mA
<b>SP pin resolution</b>		250 steps from 0-5 V <sub>DC</sub>

## PVE – electrical actuation modules

### Technical characteristics for PVE-CI

<b>Supply voltage <math>U_{DC}</math></b>	Rated	11 to 32 V <sub>DC</sub>
	Range	11 to 32 V <sub>DC</sub>
	Ripple	max. 5 %
<b>Current consumption at rated voltage</b>		320 mA @ 12 V <sub>DC</sub> 170 mA @ 24 V <sub>DC</sub>
<b>Power consumption</b>		0.5 W
<b>Oil consumption</b>	Neutral	0.04 l/min
	Full flow steady state	1 l/min
	Peak	1.3 l/min

[Refer to PVE-CI, Series 6, Technical Information L1505234 for further information.](#)

### SP pin

Voltage	Translation
0.5 V <sub>DC</sub>	Float (B-direction)
1.25 V <sub>DC</sub>	Full flow B-port
2.5 V <sub>DC</sub>	Neutral
3.75 V <sub>DC</sub>	Full flow A-port
5.0 V <sub>DC</sub>	Error

### PVEO/PVEO-CI reaction time

Reaction time	A-direction	B-direction
Neutral to full spool stroke	173 ms	105 ms
Full spool stroke to neutral	396 ms	565 ms

### PVEA/PVEA-F/PVEA-CI reaction time

Reaction time	A-direction	B-direction
Neutral to full spool stroke	188 ms	142 ms
Full spool stroke to neutral	125 ms	120 ms

### PVEO and PVEA/PVEA-F oil consumption

PVE type	PVEO	PVEA/PVEA-F
Neutral position	0.04 /min [0.01 US gal/min]	0.04 l/min [0.01 US gal/min]
Actuating to full stroke	0.6 l/min [0.16 US gal/min]	1 l/min [0.26 US gal/min]
Full stroke steady state	1 l/min [0.26 US gal/min]	1.3 l/min [0.34 US gal/min]

## PVE – electrical actuation modules

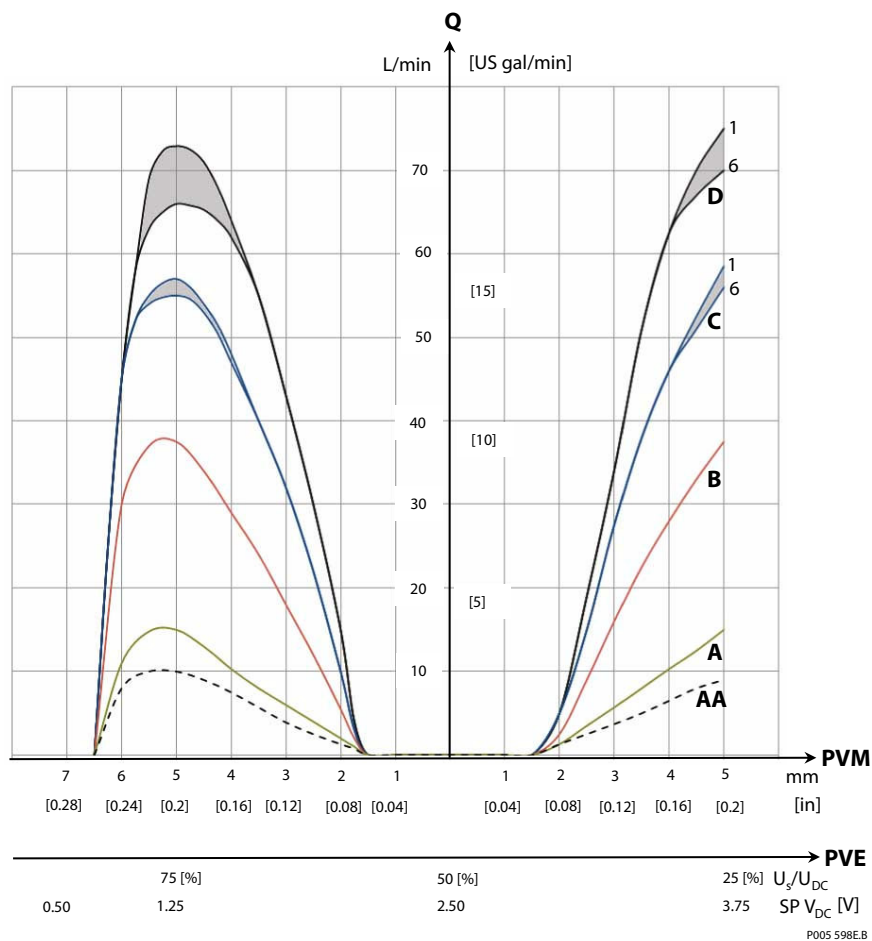
### Fault monitoring overview

PVE Type	Fault monitoring	Delay before error out	Error mode	LED light
PVEO	No fault monitoring	–	–	–
PVEA	Passive	250 ms	No fault	Green
			Input signal faults	Flashing red
			Transducer (LVDT)	Constant red
			Close loop fault	

## PVE oil flow characteristics

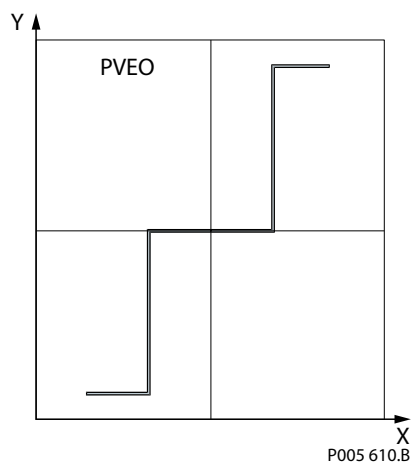
The letters AA, A, B, C and D denotes the spool flow sizes ranging from 5 l/min to 65 l/min [from 1.32 to 17.17 US gal/min]. All tests are done by using Tellus32 @ 21mm<sup>2</sup>/s.

### Oil flow as a function of spool travel

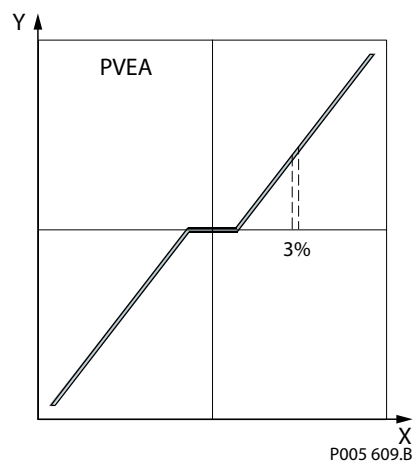


## PVE – electrical actuation modules

*PVEO and PVEO-CI voltage-position diagram*



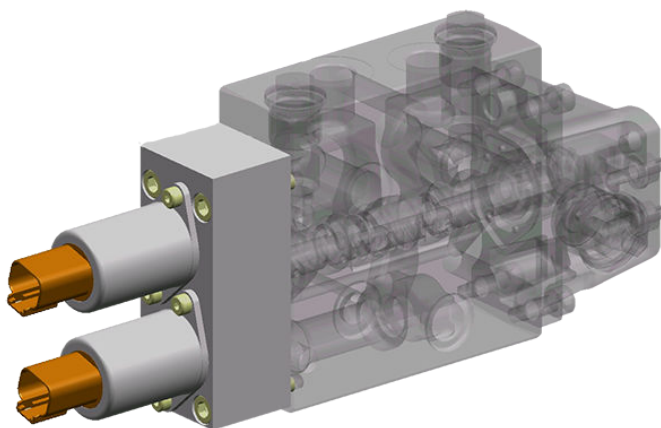
*PVEA/PVEA-F and PVEA-CI voltage-position diagram*



## PVHC, high current actuation module – electrical

- Electrical actuation
- Pin layout

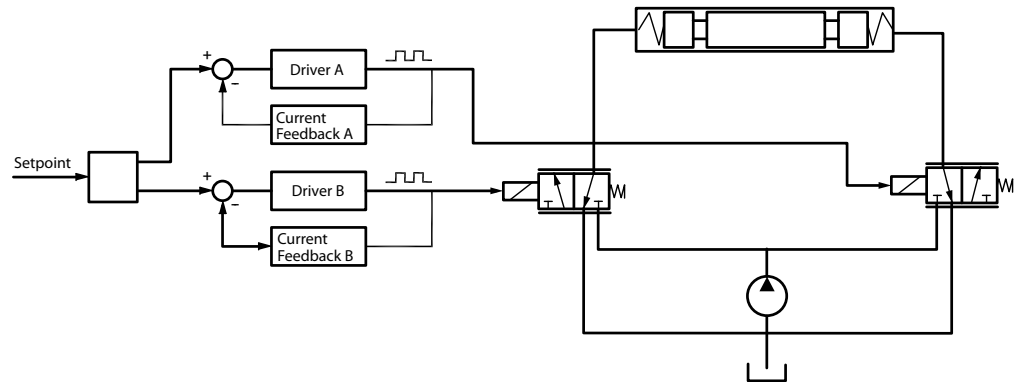
*PVHC high current actuator*



The PVHC is a means of controlling the flow of the work ports at a distance from the physical valve. The flow is controlled by sending a PWM signal to the one of two pressure reduction valves. Result is the spool position being proportional to the current.

## PVE – electrical actuation modules

### PVHC hydraulic subsystem



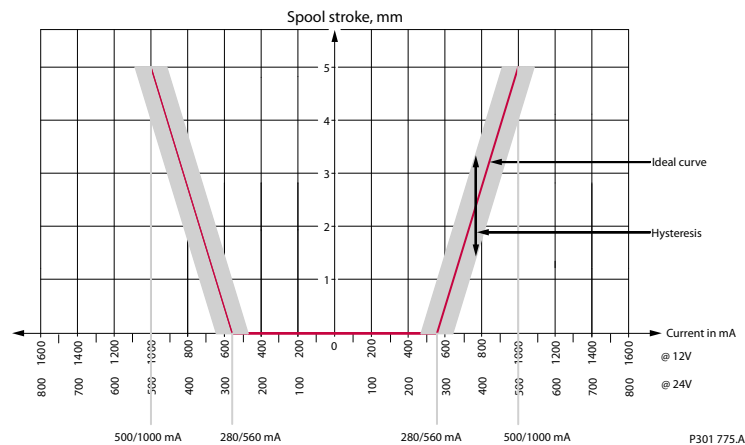
V310 434

The PVHC needs 25 bar pilot pressure and is therefore used together with PVBS and PVP for hydraulic (PVH) actuation.

### Electrical actuation

The PVHC is powered and controlled by a PWM DC voltage source available on the application with either 12 or 24 V<sub>DC</sub> dependent on the type of PVHC.

### PVHC characteristic



Giving the PVHC a PWM signal with a current of 0 mA will make it place the spool in its neutral position, hence no flow to the work ports. Increasing the current on one of the two pressure reduction valves will make the spool move in one direction.

The PVHC does not feature any integrated feedback transducer to measure the spool position. Therefore it does not feature any closed loop control of the spool.

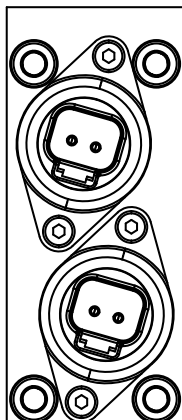
### Versions and code numbers

#### PVHC versions and code numbers

Description	Code number	
	12 V <sub>DC</sub>	24 V <sub>DC</sub>
PVHC, electrical actuation, proportional control	11126941	11127535

## PVE – electrical actuation modules

*PVHC pin layout – DEUTSCH version*



V310 435

### Technical characteristics for PVHC

*PVHC technical characteristics*

<b>Supply voltage <math>U_{DC}</math></b>	12 V <sub>DC</sub>	24 V <sub>DC</sub>
<b>Controller output current</b>	0 – 1200 mA	0 – 600 mA
<b>Resistance</b>	4.75 $\Omega$ $\pm$ 5%	20.8 $\Omega$ $\pm$ 5%
<b>Pilot pressure control range</b>	20 – 25 bar [290 – 363 psi]	
<b>Recommended dither frequency</b>	40 Hz	
<b>Recommended amplitude</b>	250 mA	

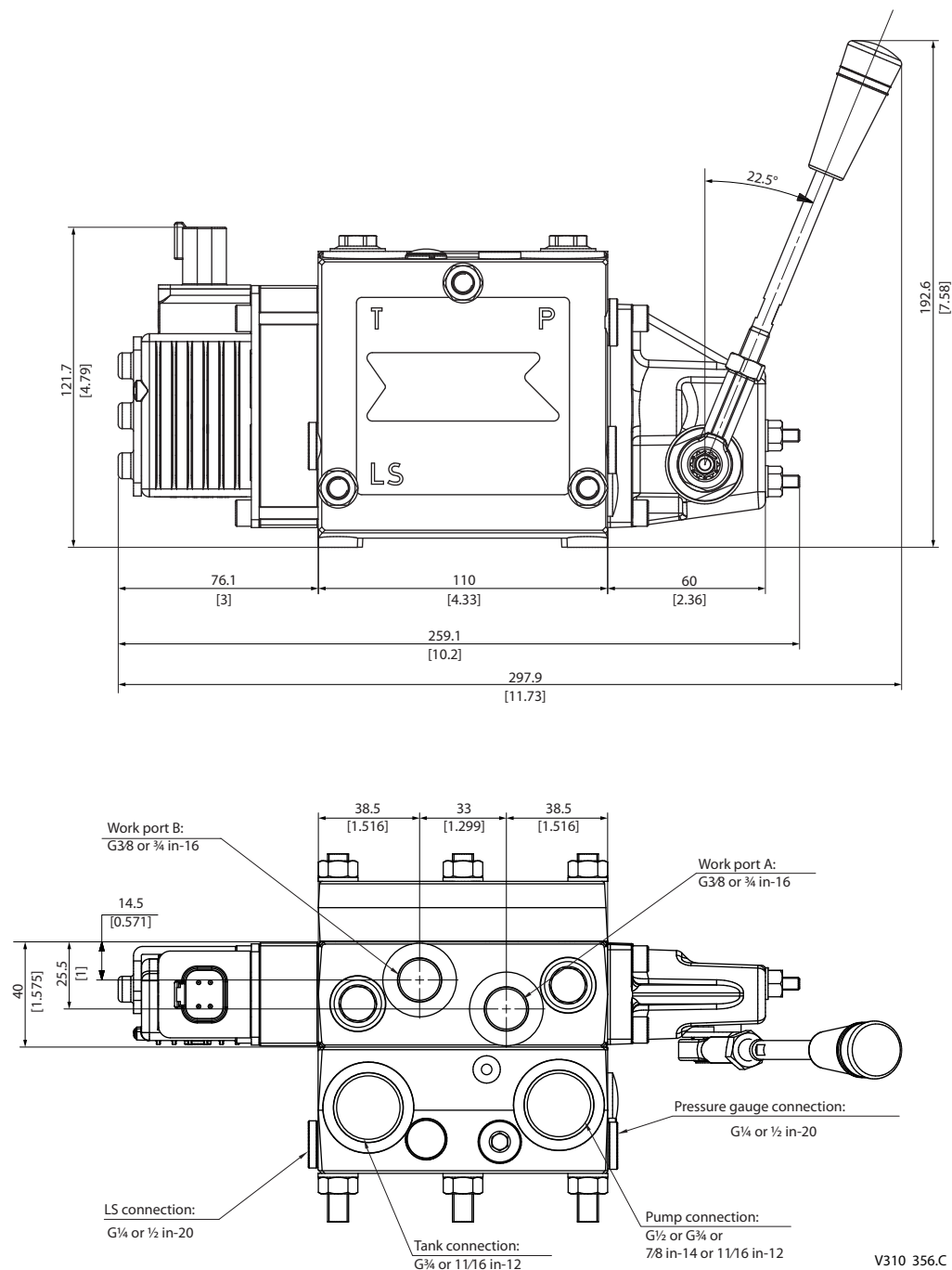
*PVHC reaction time*

From neutral position to max. spool travel at power on	A-direction	<90 ms
	B-direction	<90 ms
From max. spool travel to neutral position at power off	A-direction	<90 ms
	B-direction	<90 ms

## PVG 16 dimensions

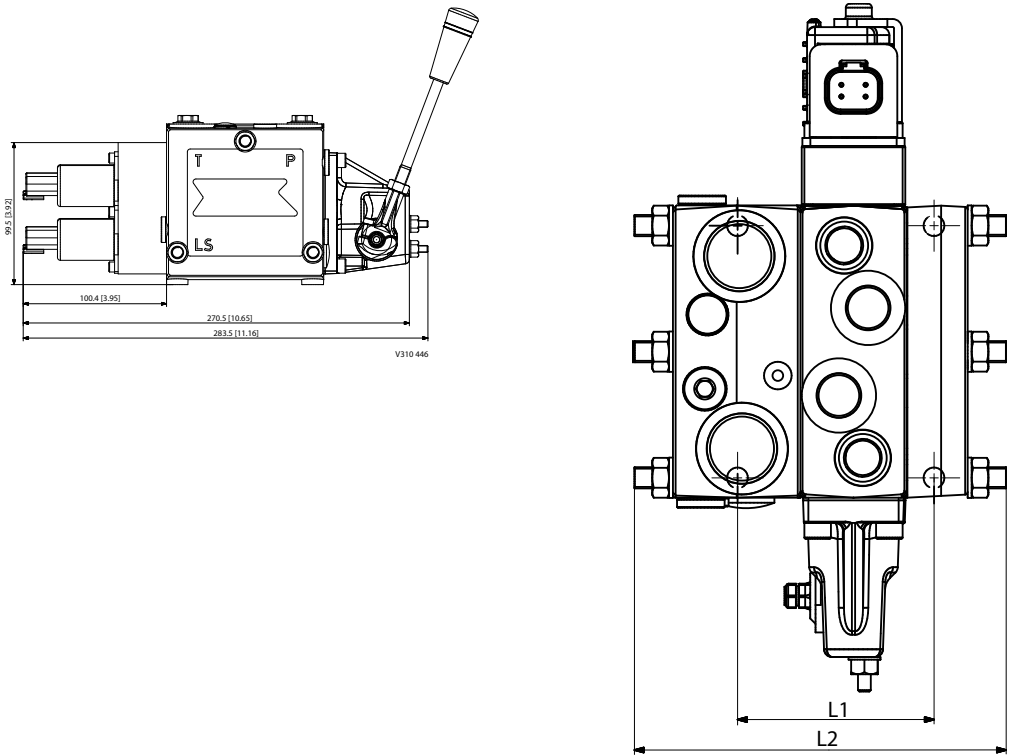
### PVG 16

*PVG 16 dimensions*





**PVG 16 dimensions**



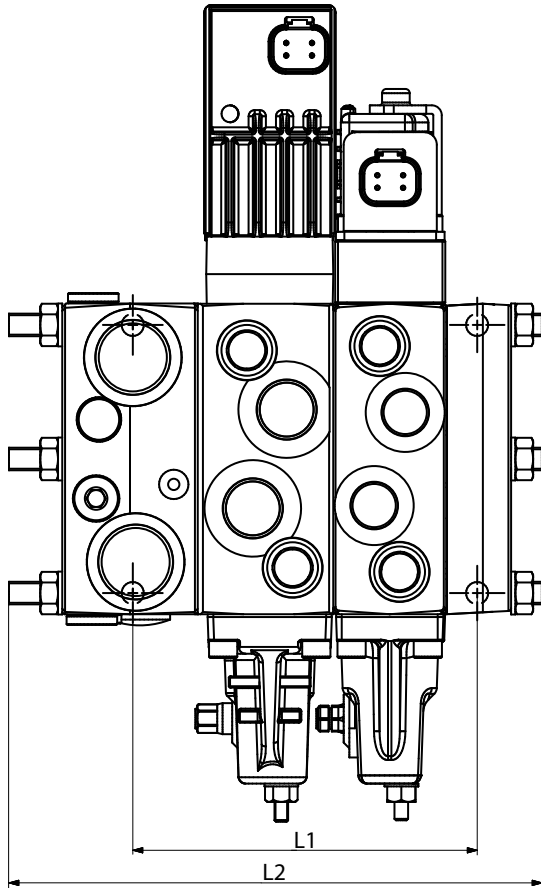
*PVB 16 dimensions (12 sections)*

Number of PVB 16		1	2	3	4	5	6	7	8	9	10	11	12
L1	mm	74	114	154	194	234	274	314	354	394	434	474	514
	[in]	[2.91]	[4.49]	[6.06]	[7.64]	[9.21]	[10.79]	[12.36]	[13.94]	[15.51]	[17.09]	[18.66]	[20.24]
L2	mm	140	189	213	262	311	336	385	434	458	507	551	576
	[in]	[5.51]	[7.44]	[8.39]	[10.31]	[12.24]	[13.23]	[15.16]	[17.09]	[18.03]	[19.96]	[21.69]	[22.68]

## PVG 16 dimensions

### PVG 32/16

*PVB 32/16 combination valve stack dimensions*



*PVB 32/16 combination valve stack dimensions*

Number of PVB 32 (down)			Number of PVB 16										
			1	2	3	4	5	6	7	8	9	10	11
1	L1	mm	122	162	202	242	282	322	362	402	442	482	522
		[in]	[4.80]	[6.38]	[7.95]	[9.53]	[11.10]	[12.68]	[14.25]	[15.83]	[17.40]	[18.98]	[20.55]
	L2	mm	189	238	262	311	360	385	434	483	507	551	600
		[in]	[7.44]	[9.37]	[10.31]	[12.24]	[14.17]	[15.16]	[17.09]	[19.02]	[19.96]	[21.69]	[23.62]
2	L1	mm	170	210	250	290	330	370	410	450	490	530	570
		[in]	[6.69]	[8.27]	[9.84]	[11.42]	[12.99]	[14.57]	[16.14]	[17.72]	[19.29]	[20.87]	[22.44]
	L2	mm	238	287	311	360	409	434	483	507	551	600	646
		[in]	[9.37]	[11.30]	[12.24]	[14.17]	[16.10]	[17.09]	[19.02]	[19.96]	[21.69]	[23.62]	[25.43]
3	L1	mm	218	258	298	338	378	418	458	498	538	578	618
		[in]	[8.58]	[10.16]	[11.73]	[13.31]	[14.88]	[16.46]	[18.03]	[19.61]	[21.18]	[22.76]	[24.33]
	L2	mm	287	336	360	409	458	483	527	576	600	646	694
		[in]	[11.30]	[13.23]	[14.17]	[16.10]	[18.03]	[19.02]	[20.75]	[22.68]	[23.62]	[25.43]	[27.32]

## PVG 16 dimensions

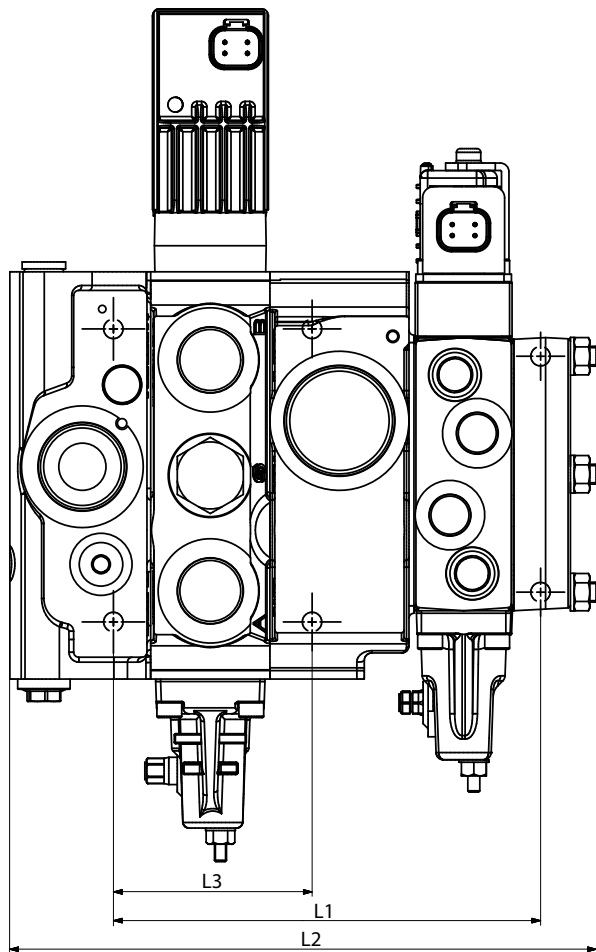
PVB 32/16 combination valve stack dimensions (continued)

Number of PVB 32 (down)			Number of PVB 16										
			1	2	3	4	5	6	7	8	9	10	11
4	L1	mm	266	306	346	386	426	466	506	546	586	626	-
		[in]	[10.47]	[12.05]	[13.62]	[15.20]	[16.77]	[18.35]	[19.92]	[21.50]	[23.07]	[24.65]	-
	L2	mm	336	385	409	458	483	527	576	622	646	694	-
		[in]	[13.23]	[15.16]	[16.10]	[18.03]	[19.02]	[20.75]	[22.68]	[24.49]	[25.43]	[27.32]	-
5	L1	mm	314	354	394	434	474	514	554	594	634	-	-
		[in]	[12.36]	[13.94]	[15.51]	[17.09]	[18.66]	[20.24]	[21.81]	[23.39]	[24.96]	-	-
	L2	mm	385	434	458	507	551	576	622	670	694	-	-
		[in]	[15.16]	[17.09]	[18.03]	[19.96]	[21.69]	[22.68]	[24.49]	[26.38]	[27.32]	-	-
6	L1	mm	362	402	442	482	522	562	602	-	-	-	-
		[in]	[14.25]	[15.83]	[17.40]	[18.98]	[20.55]	[22.13]	[23.70]	-	-	-	-
	L2	mm	434	483	507	551	600	622	670	-	-	-	-
		[in]	[17.09]	[19.02]	[19.96]	[21.69]	[23.62]	[24.49]	[26.38]	-	-	-	-
7	L1	mm	410	450	490	530	570	610	-	-	-	-	-
		[in]	[16.14]	[17.72]	[19.29]	[20.87]	[22.44]	[24.02]	-	-	-	-	-
	L2	mm	483	527	551	600	646	670	-	-	-	-	-
		[in]	[19.02]	[20.75]	[21.69]	[23.62]	[25.43]	[26.38]	-	-	-	-	-
8	L1	mm	458	498	538	578	618	-	-	-	-	-	-
		[in]	[18.03]	[19.61]	[21.18]	[22.76]	[24.33]	-	-	-	-	-	-
	L2	mm	527	576	600	646	694	-	-	-	-	-	-
		[in]	[20.75]	[22.68]	[23.62]	[25.43]	[27.32]	-	-	-	-	-	-
9	L1	mm	506	546	586	626	-	-	-	-	-	-	-
		[in]	[19.92]	[21.50]	[23.07]	[24.65]	-	-	-	-	-	-	-
	L2	mm	576	622	646	694	-	-	-	-	-	-	-
		[in]	[22.68]	[24.49]	[25.43]	[27.32]	-	-	-	-	-	-	-
10	L1	mm	554	594	634	-	-	-	-	-	-	-	-
		[in]	[21.81]	[23.39]	[24.96]	-	-	-	-	-	-	-	-
	L2	mm	622	670	694	-	-	-	-	-	-	-	-
		[in]	[24.49]	[26.38]	[27.32]	-	-	-	-	-	-	-	-
11	L1	mm	602	-	-	-	-	-	-	-	-	-	-
		[in]	[23.70]	-	-	-	-	-	-	-	-	-	-
	L2	mm	670	-	-	-	-	-	-	-	-	-	-
		[in]	[26.38]	-	-	-	-	-	-	-	-	-	-

## PVG 16 dimensions

### PVG 100/16

*PVB 100/16 combination valve stack dimensions*



*PVB 100/16 combination valve stack dimensions*

Number of PVB 100 (down)			Number of PVB 16										
			1	2	3	4	5	6	7	8	9	10	11
1	L1	mm	172	212	252	292	332	372	412	452	492	532	572
		[in]	[6.77]	[8.35]	[9.92]	[11.50]	[13.07]	[14.65]	[16.22]	[17.80]	[19.37]	[20.94]	[22.52]
	L2	mm	236	285	311	358	407	432	481	530	554	603	652
		[in]	[9.29]	[11.22]	[12.24]	[14.09]	[16.02]	[17.01]	[18.94]	[20.87]	[21.81]	[23.74]	[25.67]
	L3	80 mm [3.15 in]											
2	L1	mm	220	260	300	340	380	420	460	500	540	580	620
		[in]	[8.66]	[10.24]	[11.81]	[13.39]	[14.96]	[16.54]	[18.11]	[19.69]	[21.26]	[22.83]	[24.41]
	L2	mm	284	333	359	406	455	480	529	578	602	651	700
		[in]	[11.18]	[13.11]	[14.13]	[15.98]	[17.91]	[18.90]	[20.83]	[22.76]	[23.70]	[25.63]	[27.56]
	L3	128 mm [5.04 in]											

## PVG 16 dimensions

PVB 100/16 combination valve stack dimensions (continued)

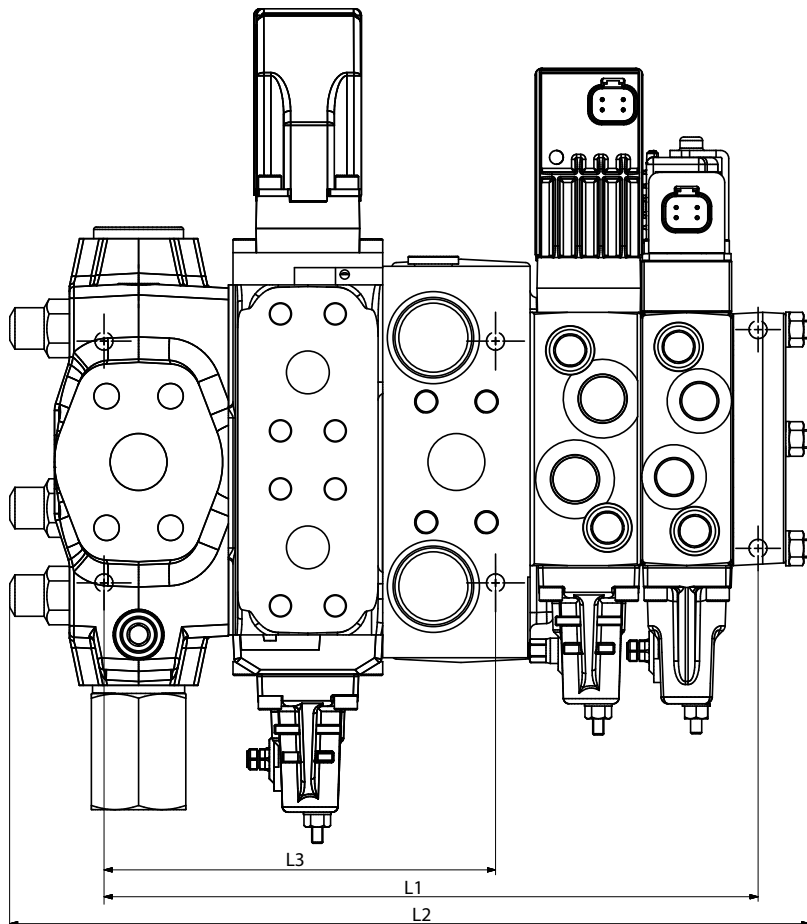
Number of PVB 100 (down)			Number of PVB 16										
			1	2	3	4	5	6	7	8	9	10	11
3	L1	mm	268	308	348	388	428	468	508	548	588	628	668
		[in]	[10.55]	[12.13]	[13.70]	[15.28]	[16.85]	[18.43]	[20.00]	[21.57]	[23.15]	[24.72]	[26.30]
	L2	mm	332	381	407	454	503	528	577	626	650	699	748
		[in]	[13.07]	[15.00]	[16.02]	[17.87]	[19.80]	[20.79]	[22.72]	[24.65]	[25.59]	[27.52]	[29.45]
	L3	176 mm [6.93 in]											
4	L1	mm	316	256	396	436	476	516	556	596	636	676	716
		[in]	[12.44]	[10.08]	[15.59]	[17.17]	[18.74]	[20.31]	[21.89]	[23.46]	[25.04]	[26.61]	[28.19]
	L2	mm	380	429	455	502	551	576	625	674	698	747	796
		[in]	[14.96]	[16.89]	[17.91]	[19.76]	[21.69]	[22.68]	[24.61]	[26.54]	[27.48]	[29.41]	[31.34]
	L3	224 mm [8.82 in]											
5	L1	mm	364	404	444	484	524	564	604	644	684	724	764
		[in]	[14.33]	[15.91]	[17.48]	[19.06]	[20.63]	[22.20]	[23.78]	[25.35]	[26.93]	[28.50]	[30.08]
	L2	mm	428	477	503	550	599	624	673	722	746	795	844
		[in]	[16.85]	[18.78]	[19.80]	[21.65]	[23.58]	[24.57]	[26.50]	[28.43]	[29.37]	[31.30]	[33.23]
	L3	272 mm [10.71 in]											
6	L1	mm	412	452	492	532	572	612	652	692	732	772	812
		[in]	[16.22]	[17.80]	[19.37]	[20.94]	[22.52]	[24.09]	[25.67]	[27.24]	[28.82]	[30.39]	[31.97]
	L2	mm	476	525	551	598	647	672	721	770	794	843	892
		[in]	[18.74]	[20.67]	[21.69]	[23.54]	[25.47]	[26.46]	[28.39]	[30.31]	[31.26]	[33.19]	[35.12]
	L3	320 mm [12.60 in]											
7	L1	mm	460	500	540	580	620	660	700	740	780	820	860
		[in]	[18.11]	[19.69]	[21.26]	[22.83]	[24.41]	[25.98]	[27.56]	[29.13]	[30.71]	[32.28]	[33.86]
	L2	mm	524	573	599	646	695	720	769	818	842	891	940
		[in]	[20.63]	[22.56]	[23.58]	[25.43]	[27.36]	[28.35]	[30.28]	[32.20]	[33.15]	[35.08]	[37.01]
	L3	368 mm [14.49 in]											
8	L1	mm	508	548	588	628	668	708	748	788	828	868	908
		[in]	[20.00]	[21.57]	[23.15]	[24.72]	[26.30]	[27.87]	[29.45]	[31.02]	[32.60]	[34.17]	[35.75]
	L2	mm	572	621	647	694	743	768	817	866	890	939	988
		[in]	[22.52]	[24.45]	[25.47]	[27.32]	[29.25]	[30.24]	[32.17]	[34.09]	[35.04]	[36.97]	[38.90]
	L3	416 mm [16.38 in]											

There is a horizontal difference of 23.5 mm [0.93 in] in the mounting plane of the PVG 100/PVG 16.

## PVG 16 dimensions

### PVG 120/16

*PVB 120/16 combination valve stack dimensions*



There is a horizontal difference 62.5 mm [2.46 in] in the mounting plane of the PVG 120/PVG 16.

*PVB 120/16 combination valve stack dimensions*

Number of PVB 120 (down)			Number of PVB 16										
			1	2	3	4	5	6	7	8	9	10	11
1	L1	mm	284	324	364	404	444	484	524	564	604	644	684
		[in]	[11.18]	[12.76]	[14.33]	[15.91]	[17.48]	[19.06]	[20.63]	[22.20]	[23.78]	[25.35]	[26.93]
	L2	mm	348	397	421	470	519	544	593	642	666	715	759
		[in]	[13.70]	[15.63]	[16.57]	[18.50]	[20.43]	[21.42]	[23.35]	[25.28]	[26.22]	[28.15]	[29.88]
	L3	170 mm [6.69 in]											
2	L1	mm	351	391	431	471	511	551	591	631	671	711	751
		[in]	[13.82]	[15.39]	[16.97]	[18.54]	[20.12]	[21.69]	[23.27]	[24.84]	[26.42]	[27.99]	[29.57]
	L2	mm	413	462	486	535	584	609	658	707	731	780	824
		[in]	[16.26]	[18.19]	[19.13]	[21.06]	[22.99]	[23.98]	[25.91]	[27.83]	[28.78]	[30.71]	[32.44]
	L3	237 mm [9.33 in]											

## PVG 16 dimensions

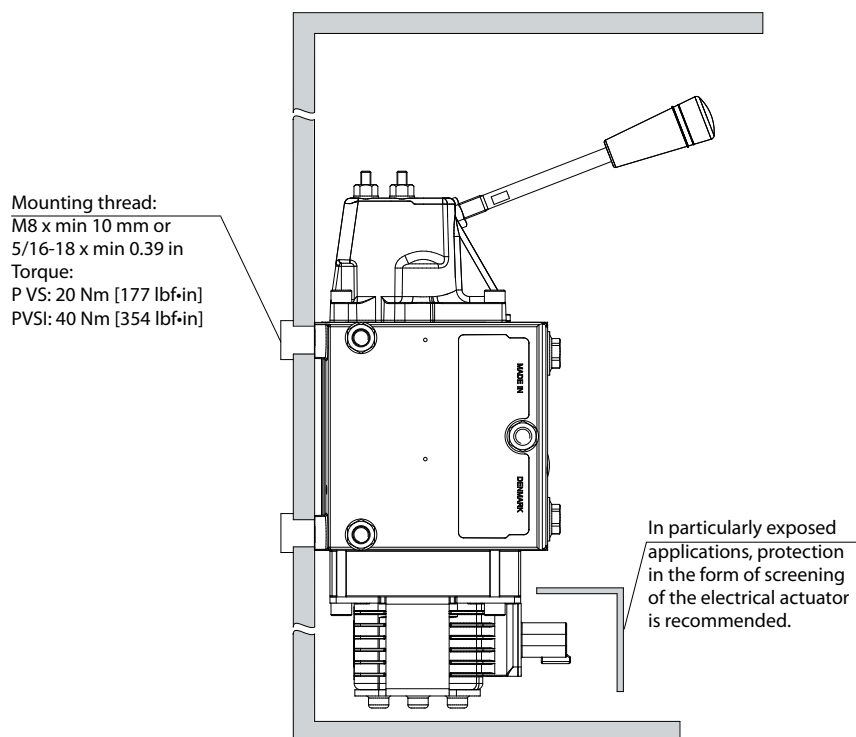
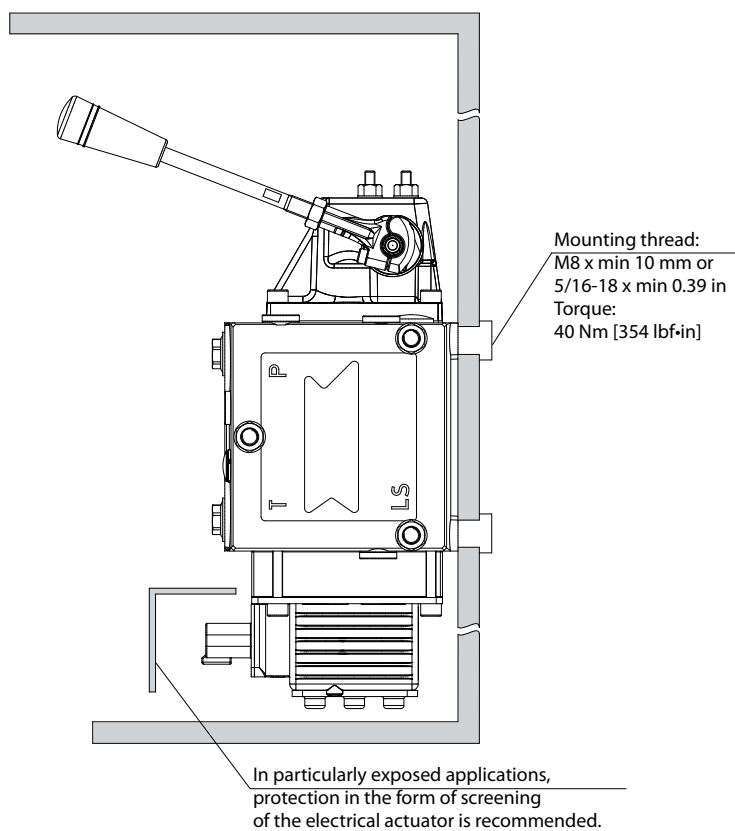
PVB 120/16 combination valve stack dimensions (continued)

Number of PVB 120 (down)			Number of PVB 16										
			1	2	3	4	5	6	7	8	9	10	11
3	L1	mm	418	458	498	538	578	618	658	698	738	778	818
		[in]	[16.46]	[18.03]	[19.61]	[21.18]	[22.76]	[24.33]	[25.91]	[27.48]	[29.06]	[30.63]	[32.20]
	L2	mm	478	527	551	600	649	674	723	772	796	845	889
		[in]	[18.82]	[20.75]	[21.69]	[23.62]	[25.55]	[26.54]	[28.46]	[30.39]	[31.34]	[33.27]	[35.00]
	L3		304 mm [11.91 in]										
4	L1	mm	485	525	565	605	545	685	725	765	805	845	885
		[in]	[19.09]	[20.67]	[22.24]	[23.82]	[21.46]	[26.97]	[28.54]	[30.12]	[31.69]	[33.27]	[34.84]
	L2	mm	543	592	616	665	714	739	788	837	86	910	954
		[in]	[21.38]	[23.31]	[24.25]	[26.18]	[28.11]	[29.09]	[31.02]	[32.95]	[3.39]	[35.83]	[37.56]
	L3		371 mm [14.61 in]										
5	L1	mm	552	592	632	672	712	752	792	832	872	912	952
		[in]	[21.73]	[23.31]	[24.8]	[26.46]	[28.03]	[29.61]	[31.18]	[32.76]	[34.33]	[35.91]	[37.48]
	L2	mm	608	657	681	730	779	804	853	902	926	975	1019
		[in]	[23.94]	[25.87]	[26.81]	[28.74]	[30.67]	[31.65]	[33.58]	[35.51]	[36.46]	[38.39]	[40.12]
	L3		438 mm [17.24 in]										
6	L1	mm	619	659	699	739	779	819	859	899	939	979	1019
		[in]	[24.37]	[25.94]	[27.52]	[29.09]	[30.67]	[32.24]	[33.82]	[35.39]	[36.97]	[38.54]	[40.12]
	L2	mm	673	722	746	795	844	869	918	967	991	1040	1084
		[in]	[26.50]	[28.43]	[29.37]	[31.30]	[33.23]	[34.21]	[36.14]	[38.07]	[39.02]	[40.94]	[42.68]
	L3		505 mm [19.88 in]										
7	L1	mm	686	726	766	806	846	886	926	966	1006	1046	1086
		[in]	[27.01]	[28.58]	[30.16]	[31.73]	[33.31]	[34.88]	[36.46]	[38.03]	[39.61]	[41.18]	[42.76]
	L2	mm	738	787	811	860	909	934	983	1032	1056	1105	1149
		[in]	[29.06]	[30.98]	[31.93]	[33.86]	[35.79]	[36.77]	[38.70]	[40.63]	[41.57]	[43.50]	[45.24]
	L3		572 mm [22.52 in]										
8	L1	mm	753	793	833	873	913	953	993	1033	1073	1113	1153
		[in]	[29.65]	[31.22]	[32.80]	[34.37]	[35.94]	[37.52]	[39.09]	[40.67]	[42.24]	[43.82]	[45.39]
	L2	mm	803	852	876	925	974	999	1048	1097	1121	1170	1214
		[in]	[31.61]	[33.54]	[34.49]	[36.42]	[38.35]	[39.33]	[41.26]	[43.19]	[44.13]	[46.06]	[47.80]
	L3		639 mm [25.16 in]										

Due to the large size of the PVG 120 interface-module it is necessary to have at least one PVG 32 module between the PVGI and the first PVG 16 slice.

## Installation

### PVG 16 installation

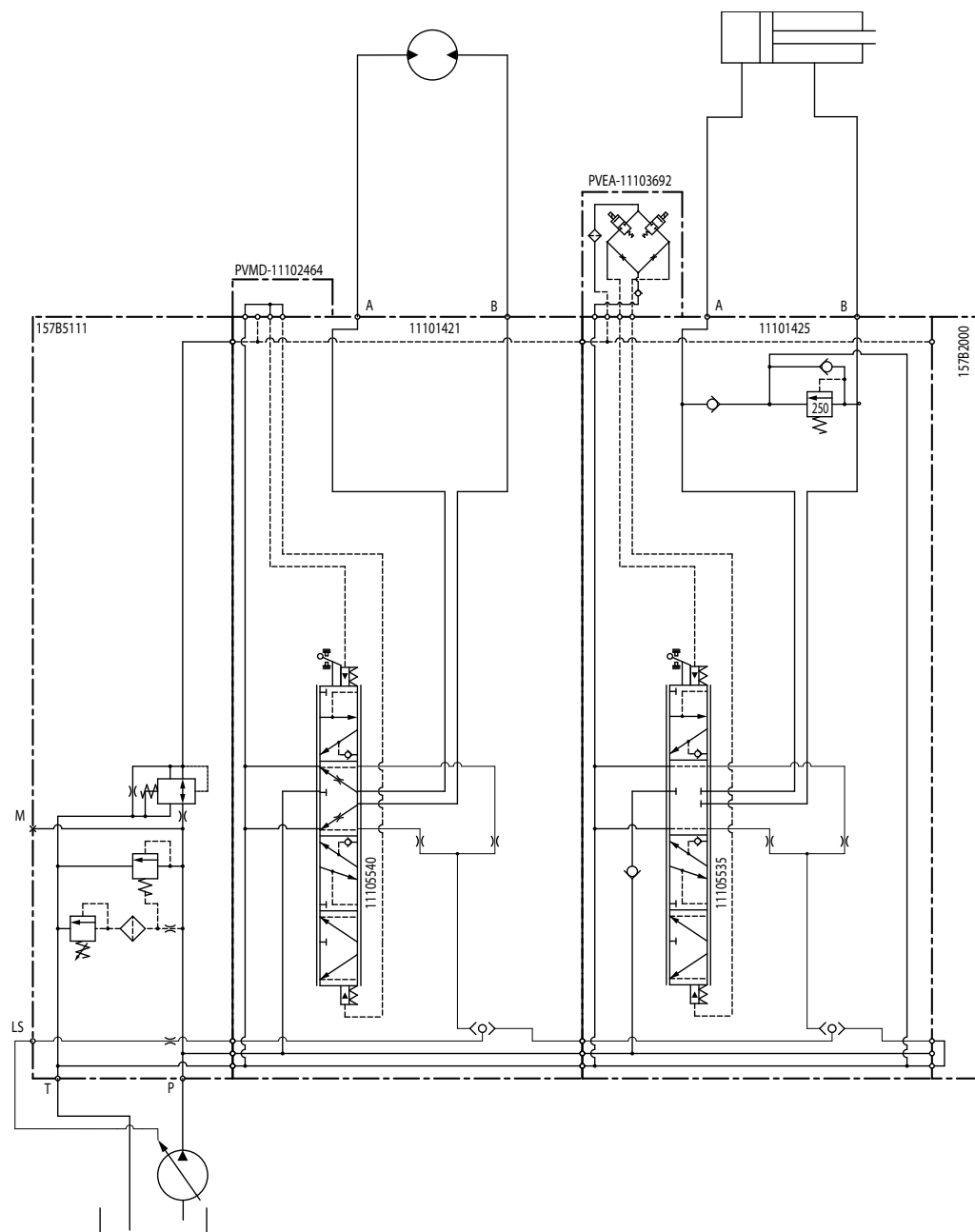


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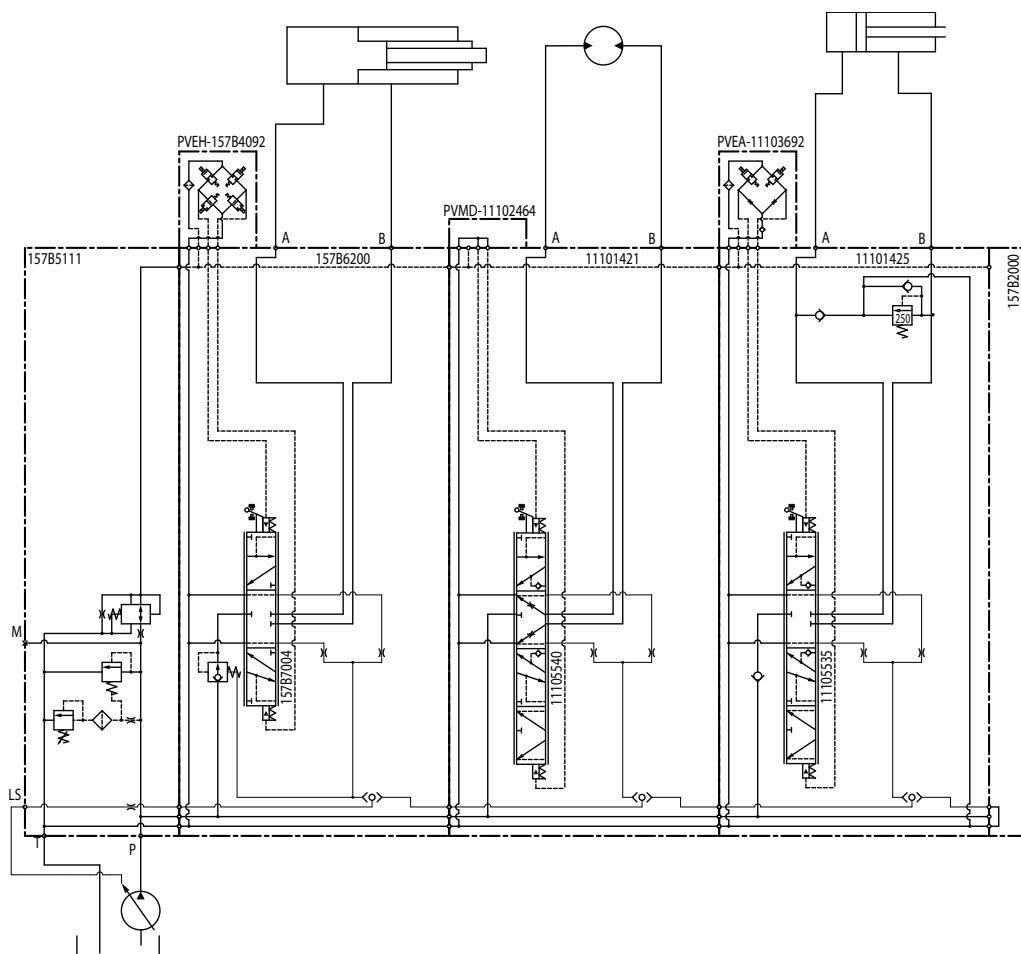
## Application examples

### PVG 16



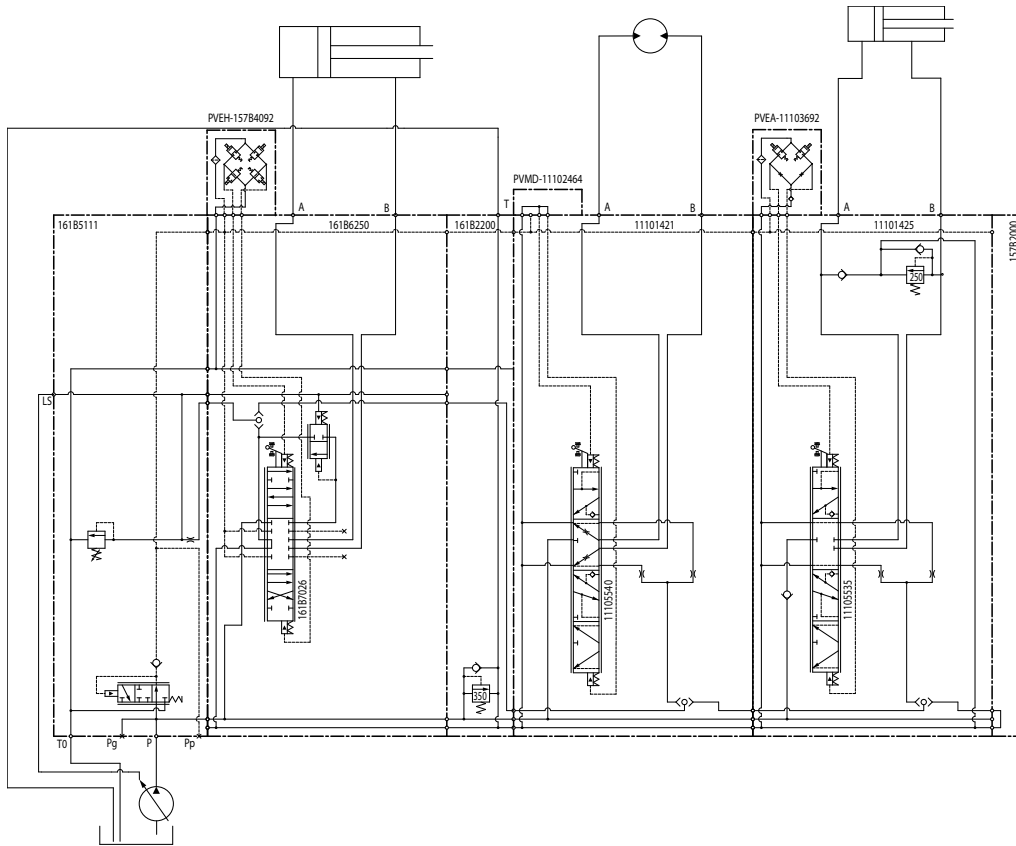
## Application examples

### PVG 32/16

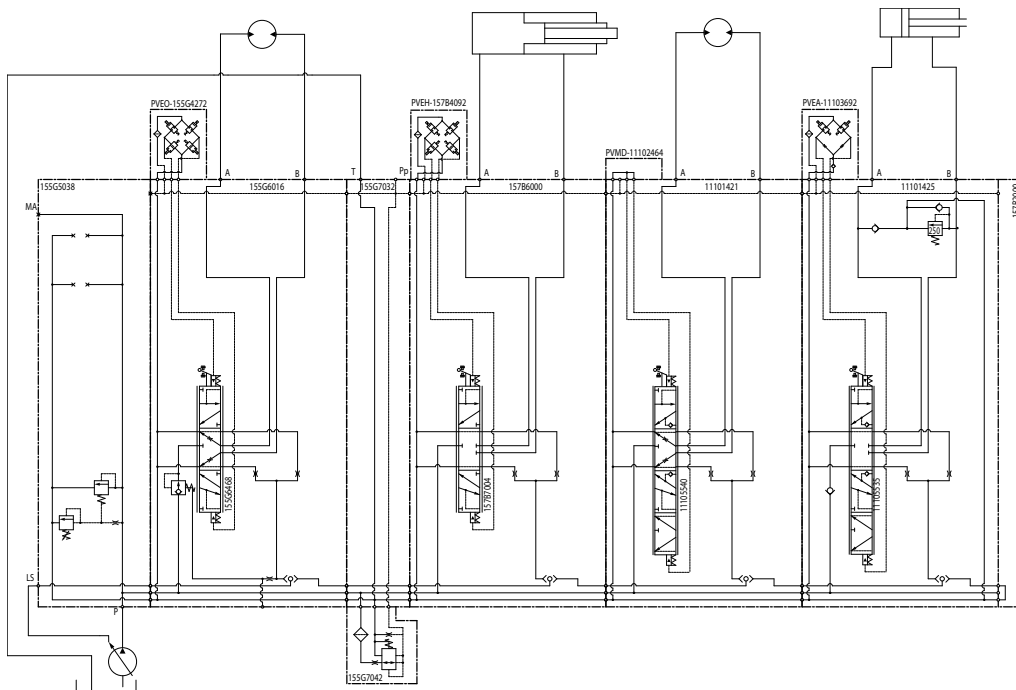


## Application examples

### PVG 100/16



### PVG 120/16



### Application examples

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Due to the large size of the PVG 120 interface-module it is necessary to have at least one PVG 32 module between the PVGI and the first PVG 16 slice.

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## Hydraulic system

### Hydraulic system efficiency

A complete hydraulic system can be implemented in many different ways. There is no sole answer to: which system solution is the right one? The solution will depend on what is the aim of the vehicle manufacturers, if they are aiming for high productivity, and/or a low fuel consumption, and/or a compact design, and/or a high operator comfort, etc.

An important topic to consider when it comes to system design is *energy efficiency*. Components in a system have their individual efficiency and as such the components contribute to the total energy consumption. This energy consumption is directly proportional with the emission of the application and the operating costs.

The power needed to generate the flow and pressure for each system function is vital as surplus energy used to generate excess flow and pressure is converted into heat and thereby loss.

There are generally three types of mobile hydraulic systems:

- Fixed displacement with constant flow,
- Variable displacement with constant pressure and
- Variable displacement with load sense (LS).

#### Fixed displacement system with constant flow

Uses a pump with fixed displacement to generate a fixed flow to the system. In standby the flow is sent from the pump through the valve and back into the reservoir. Whenever a consumer requests a portion of the flow to perform a work function, the fixed displacement system brings the entire flow up to the load pressure. The valve will then divide the flow into work port flow and surplus flow sending this back to the reservoir.

The efficiency of a fixed displacement system is directly proportional to the percentage of the total flow used by the consumer. If the consumer uses 10% of the total flow available the fixed displacement system is 10% efficient. If the consumer uses 75% of the total available flow the system is 75% efficient.

#### Variable displacement system with constant pressure

Uses a variable displacement pump to regulate the flow to system consumer needs. The flow is always pressurized to the setting of the pump pressure compensator independent of the consumer(s) pressure need. In standby the pressure remains at full system pressure and only leakage flow is circulated back to the reservoir. Whenever a consumer request a flow to perform a work function the pump will deliver this flow only, but at full system pressure, independent of the function pressure need.

The efficiency of a fixed displacement system is directly proportional to the percentage of the total pressure needed to perform the work, If 10% of the pressure is needed the fixed displacement system is 10% efficient. If 75% of the pressure is needed the fixed displacement system is 75% efficient.

#### Variable displacement system with load sense

Uses a variable displacement pump to give the consumer the requested flow at the needed pressure. In standby only pump leakage is circulated back to reservoir – at only margin pressure. Whenever a consumer requests a flow the pump delivers this flow at needed pressure plus a margin pressure to compensate internal resistance and system control.

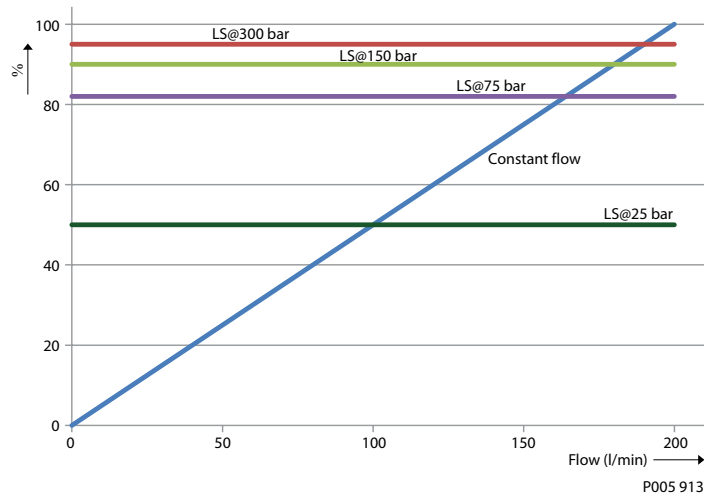
The efficiency of a LS system, despite its pressure control, is not proportional to the flow or pressure but a result of the pump margin pressure setting.

The easiest way to compare the efficiencies of the systems is to make an example. Considering a pump with a maximum flow rate of 200 l/min [52.8 US gal/min] and a system pressure of 300 bar [4351 psi].

A comparison of fixed and variable displacement systems gives the LS system a huge efficiency advantage over the fixed displacement system, especially in the high pressure and low-to-medium flow applications.

## Hydraulic system

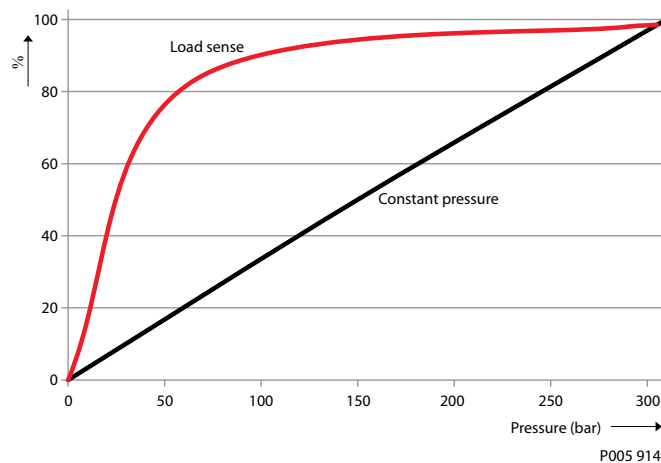
*Fixed vs variable displacement system*



Considering multiple consumers where the high flow work functions are seldom used, the LS system will increase the advantage over the fixed displacement system.

A comparison of fixed and variable displacement systems gives the variable displacement system an efficiency advantage over the fixed displacement system in the lower pressure range of an application.

*Fixed vs variable displacement system*

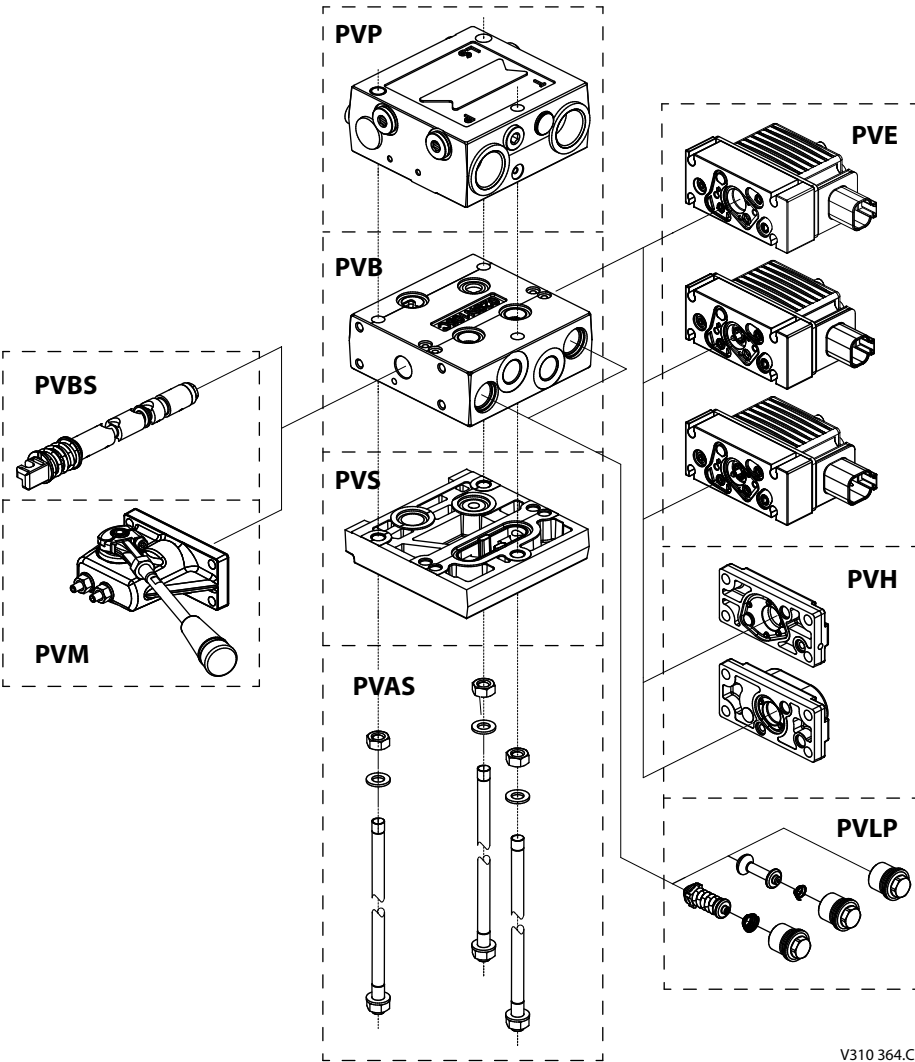


Considering multiple consumers at different pressures the variable displacement system will increase the efficiency over the fixed displacement system.

Although the variable displacement system is the most complex of the three systems it potentially offers great advantages in terms of efficient use of energy and in turn the compliance with power management requirements. The PVG family offers products for both constant flow and load sense systems for the best solution for the mobile hydraulic system.

## PVG 16 modules and code numbers

### Modules and code numbers



V310 364.C

### Ports connections:

P = G ½ in; 14 mm deep or G ¾ in; 16 mm deep [7/8–14; 0.65 in deep or 11/16–12; 0.75 in deep]

LS, M = G ¼ in; 12 mm deep [½–20; 0.47 in deep]

T = G ¾ in; 16 mm deep [11/16–12; 0.75 in deep]

### PVE, Electrical actuation

Description	Code number	
	12 V <sub>DC</sub>	24 V <sub>DC</sub>
<b>PVEO, ON/OFF</b> control	11106793	11106794
<b>PVHC</b> Proportional control	11126941	11127535
<b>PVEA</b> Proportional control	11103692	
<b>PVEA-F</b> Proportional control, with float in B-direction	11106795	

## PVG 16 modules and code numbers

### PVE-CI, Electrical actuation

Description		Code number
PVEO-CI	J1939/ISOBus	11124002
PVEA-CI		11121945
PVEO-CI	CANopen	11149443
PVEA-CI		11149437

### PVB, compensated module

Description		Code number
Compensated basic module	3/8" BSP	11130976
	3/4"-16UNF	11130977
Compensated basic module with facilities for shock and anti-cavitation valves (PVL/PVLA)	3/8" BSP	11130978
	3/4"-16UNF	11130979
Compensated basic module with one common adjustable LS valve for port A and port B	3/8" BSP	11130982
	3/4"-16UNF	11130983

### PVB, non-compensated basic module

Description		Code number	
		With check valve	Without check valve
No facilities for shock valves	3/8" BSP	11106801	11101421
	3/4"-16UNF	11106797	11101423
Facilities for shock valves	3/8" BSP	11101424	11106754
	3/4"-16UNF	11101425	11106755

### PVM, Mechanical actuation

Description	Code number	
	With lever	Without lever
Without adjustment screws, without float	11107333	11107505
Without adjustment screws, with float	11107335	11107506
With adjustment screws, without float	11107332	11107507

### PVBS, Spools

Description	Code number				
	Flow l/min [US gal/min]				
	5 [1.32]	10 [2.64]	25 [6.60]	40 [10.57]	65 [17.17]
Open neutral, use with PVE	11105537	11105538	11105539	11105540	11105541
Open neutral, use with PVH	11109637	11109638	11109639	11109640	11109641
Closed neutral, use with PVE	11105532	11105533	11105534	11105535	11105536
Closed neutral, use with PVH	11109632	11109633	11109634	11109635	11109636



## PVG 16 modules and code numbers

### Asymmetrical main spools

Description	Code number according to flow l/min [US gal/min]					
	5/2.5 [1.32/0.66]	10/5 [2.64/1.32]	25/10 [6.60/2.64]	25/15 [6.60/3.96]	40/15 [10.57/3.96]	40/25 [10.57/6.60]
<b>Cylinder ratio</b>	<b>2.0</b>	<b>2.0</b>	<b>2.5</b>	<b>1.6</b>	<b>2.7</b>	<b>1.6</b>
Closed neutral, use with PVE	11109642	11109643	11109644	11109645	11109646	11109647
Closed neutral, use with PVH	11146752	11146753	11146754	11146755	11146756	11146757

### PVH, PVMD, Covers

Description		Code number
PVH, Hydraulic actuation	G 1/4 BSP	11108380
	9/16-18 UNF	11108381
PVMD, Cover for PVM		11105518

### PVP, Pump side module

Description	Thread	Code number
Open centre pump side module for pumps with fixed displacement. For purely mechanically actuated valve groups.	P = G 1/2; T = G 3/4	157B5000
	P = 7/8-14; T = 11/16-12	157B5200
	P, T = G 3/4	157B5100
	P, T = 11/16-12	157B5300
Closed centre pump side module for pumps with variable displacement. For purely mechanically actuated valve groups.	P = G 1/2; T = G 3/4	157B5001
	P = 7/8-14; T = 11/16-12	157B5201
	P, T = G 3/4	157B5101
	P, T = 11/16-12	157B5301
Open centre pump side module for pumps with fixed displacement. With pilot oil supply for electrically actuated valves.	P = G 1/2; T = G 3/4	157B5010
	P = 7/8-14; T = 11/16-12	157B5210
	P, T = G 3/4	157B5110
	P, T = 11/16-12	157B5310
Closed centre pump side module pumps with variable displacement. With pilot oil supply for electrically actuated valves.	P = G 1/2; T = G 3/4	157B5011
	P = 7/8-14; T = 11/16-12	157B5211
	P, T = G 3/4	157B5111
	P, T = 11/16-12	157B5311
Open centre pump side module for pumps with fixed displacement. With pilot oil supply for electrically actuated valves Connection for electrical LS unloading valve, PVPX.	P = G 1/2; T = G 3/4	157B5012
	P = 7/8-14; T = 11/16-12	157B5212
	P, T = G 3/4	157B5112
	P, T = 11/16-12	157B5312
Closed centre pump side module pumps with variable displacement. With pilot oil supply. Connection for electrical LS unloading valve, PVPX	P = G 1/2; T = G 3/4	157B5013
	P = 7/8-14; T = 11/16-12	157B5213
	P, T = G 3/4	157B5113
	P, T = 11/16-12	157B5313
Open centre pump side module for pumps with fixed displacement. For mechanical actuated valves. Connection for LS unloading valve, PVPX.	P, T = G 3/4	157B5102
Closed centre pump side module for pumps with variable displacement. For mechanical actuated valves. Connection for LS unloading valve, PVPX.	P, T = G 3/4	157B5103

## PVG 16 modules and code numbers

### PVP, Pump side module (continued)

Description	Thread	Code number
Open centre pump side module for pumps with fixed displacement. With pilot oil supply for electrical actuation and connection for pilot oil pressure.	P, T = G 3/4	157B5180
	P, T = 11/16-12	157B5380
Closed centre pump side module pumps with variable displacement. With pilot oil supply for electrical actuation and connection for pilot oil pressure.	P, T = G 3/4	157B5181
	P, T = 11/16-12	157B5381
Open centre pump side module for pumps with fixed displacement. With pilot oil supply for hydraulic actuation and connection for pilot oil pressure.	P, T = G 3/4	157B5190
	P, T = 11/16-12	157B5390
Closed centre pump side module pumps with variable displacement. With pilot oil supply for hydraulic actuation and connection for pilot oil pressure.	P, T = G 3/4	157B5191
	P, T = 11/16-12	157B5391
Open center pump side module for pumps with fixed displacement. With pilot oil supply for electrically actuated valves and damped pressure adjustment spool.	P, T = G 3/4	11008849
Open center pump side module for pumps with fixed displacement. With pilot oil supply for hydraulic actuated valves and damped pressure adjustment spool.	P, T = G 3/4	11008851

### PVS, End plate

Description	Thread	Code number
PVS, aluminum end plate	Foot = M8	157B2000
	Foot = 5/16-18	157B2020
PVS, aluminum end plate with LX-connection	LX = G1/8; Foot = M8	157B2011
	LX = 3/8-24; Foot = 5/16-18	157B2021
PVSI, cast iron end plate	Foot = M8	157B2014
	Foot = 5/16-18	157B2004
PVSI, cast iron end plate with LX-connection	LX = G1/4; Foot = M8	157B2015
	LX = 1/2-20; Foot = 5/16-18	157B2005
PVSI, cast iron end plate with P-, T-, LX- and M-connection	P = 3/8; T = 1/2; LX = 1/4; M = 1/4; Foot = M8	157B2920
PVST, iron end plate with T-connection	T = 1/2; Foot = M8	157B2500
	T = 7/8-14; Foot = 5/16-18	157B2520

### PVAS, Assembly kit

Accumulated module length interval		Code number
mm	[in]	
55 – 72	[2.17 – 2.83]	157B8000
79 – 96	[3.11 – 3.78]	157B8031
103 – 120	[4.06 – 4.72]	157B8001
127 – 144	[5.00 – 5.67]	157B8021
151 – 168	[5.49 – 6.61]	157B8002
175 – 192	[6.89 – 7.56]	157B8022
199 – 216	[7.83 – 8.50]	157B8003
223 – 240	[8.78 – 9.45]	157B8023
247 – 264	[9.72 – 10.39]	157B8004
271 – 288	[10.67 – 11.34]	157B8024
295 – 312	[11.61 – 12.28]	157B8005
319 – 336	[12.56 – 13.23]	157B8025
343 – 360	[13.50 – 14.17]	157B8006
367 – 384	[14.45 – 15.12]	157B8026

## PVG 16 modules and code numbers

### PVAS, Assembly kit (continued)

Accumulated module length interval		Code number
mm	[in]	
391 – 408	[15.39 – 16.06]	157B8007
415 – 432	[16.34 – 17.00]	157B8027
439 – 456	[17.28 – 17.95]	157B8008
463 – 480	[18.23 – 18.90]	157B8028
487 – 504	[19.17 – 19.84]	157B8009
511 – 528	[20.12 – 20.79]	157B8029
535 – 552	[21.06 – 21.73]	157B8010
559 – 576	[22.00 – 22.68]	157B8030
583 – 600	[22.95 – 23.62]	157B8061
607 – 624	[23.90 – 24.57]	157B8081
631 – 648	[24.84 – 25.51]	157B8062
655 – 672	[25.79 – 26.46]	157B8082

### PVLP, Shock and Anti-cavitation valves

Code number		157B2032	157B2050	157B2063	157B2080	157B2100	157B2125	157B2140	157B2150	157B2160	157B2175	157B2190
Settings	bar	32	50	63	80	100	125	140	150	160	175	190
	[psi]	[460]	[725]	[914]	[1160]	[1450]	[1813]	[2031]	[2175]	[2320]	[2538]	[2755]

Code number		157B2210	157B2230	157B2240	157B2250	157B2265	157B2280	157B2300	157B2320	157B2350	157B2380	157B2400
Settings	bar	210	230	240	250	265	280	300	320	350	380	400
	[psi]	[3045]	[3335]	[3480]	[3625]	[3845]	[4061]	[4351]	[4641]	[5075]	[5511]	[5801]

### PVLA, Anti-cavitation valve

Description	Code number
Plug A or B	157B2002
Valve A or B	157B2001


## Accessories

### Seal kit

Description	Code number
Seal kit for PVE and PVHC	11133165
Seal kit for one work section	157B8999
Seal kit for seven work sections	11156335
PVM seal kit	157B3999
Loop cable 175 mm, DEUTSCH 4-PIN	11095622
Cable 4000 mm, DEUTSCH 4-PIN	11095741
CG 1502*	11153051
120 Ω terminator	11007561

\* Only to be used with PLUS+1\* Service Tool version 7.1.10 or newer.

## Order specification

		<b>PVG16</b>		
Subsidiary/Dealer			PVG No.	
Customer			Customer Part No.	
Application			Revision No.	

Section v	Function	A-Port v	B-Port v
<b>1</b>		PVP	
		p = bar	
<b>2</b>	<b>a</b> PVM	PVB	PVBS
	<b>b</b> PVLP/PVLA	LS <sub>A</sub> bar LS <sub>B</sub> bar	PVE/PVH/PVMD <b>c</b> PVLP/PVLA <b>b</b>
<b>3</b>	<b>a</b> PVM	PVB	PVBS
	<b>b</b> PVLP/PVLA	LS <sub>A</sub> bar LS <sub>B</sub> bar	PVE/PVH/PVMD <b>c</b> PVLP/PVLA <b>b</b>
<b>4</b>	<b>a</b> PVM	PVB	PVBS
	<b>b</b> PVLP/PVLA	LS <sub>A</sub> bar LS <sub>B</sub> bar	PVE/PVH/PVMD <b>c</b> PVLP/PVLA <b>b</b>
<b>5</b>	<b>a</b> PVM	PVB	PVBS
	<b>b</b> PVLP/PVLA	LS <sub>A</sub> bar LS <sub>B</sub> bar	PVE/PVH/PVMD <b>c</b> PVLP/PVLA <b>b</b>
<b>6</b>	<b>a</b> PVM	PVB	PVBS
	<b>b</b> PVLP/PVLA	LS <sub>A</sub> bar LS <sub>B</sub> bar	PVE/PVH/PVMD <b>c</b> PVLP/PVLA <b>b</b>
<b>7</b>	<b>a</b> PVM	PVB	PVBS
	<b>b</b> PVLP/PVLA	LS <sub>A</sub> bar LS <sub>B</sub> bar	PVE/PVH/PVMD <b>c</b> PVLP/PVLA <b>b</b>
<b>8</b>	<b>a</b> PVM	PVB	PVBS
	<b>b</b> PVLP/PVLA	LS <sub>A</sub> bar LS <sub>B</sub> bar	PVE/PVH/PVMD <b>c</b> PVLP/PVLA <b>b</b>
<b>9</b>	<b>a</b> PVM	PVB	PVBS
	<b>b</b> PVLP/PVLA	LS <sub>A</sub> bar LS <sub>B</sub> bar	PVE/PVH/PVMD <b>c</b> PVLP/PVLA <b>b</b>
<b>10</b>	<b>a</b> PVM	PVB	PVBS
	<b>b</b> PVLP/PVLA	LS <sub>A</sub> bar LS <sub>B</sub> bar	PVE/PVH/PVMD <b>c</b> PVLP/PVLA <b>b</b>
<b>11</b>	End section	PVS	
<b>12</b>	PVAS section	PVAS	
Comments:			
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