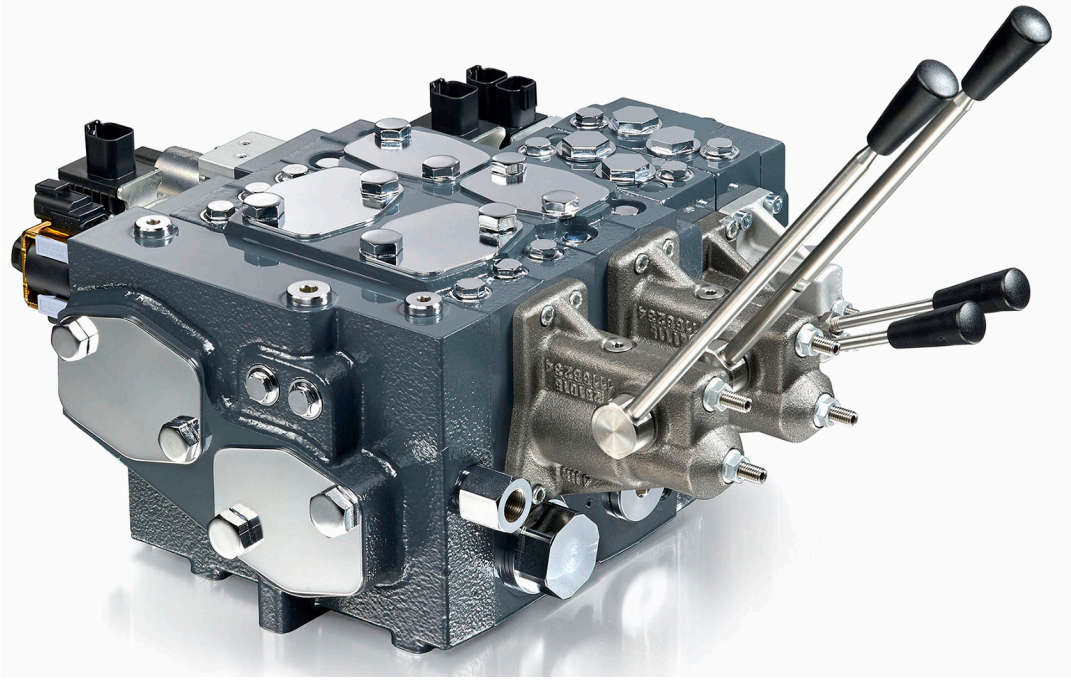
ENGINEERING
TOMORROW

Technical Information

Proportional Valve Group
PVG 128/256



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Revision history

Table of revisions

Date	Changed	Rev
November 2016	First edition	0101

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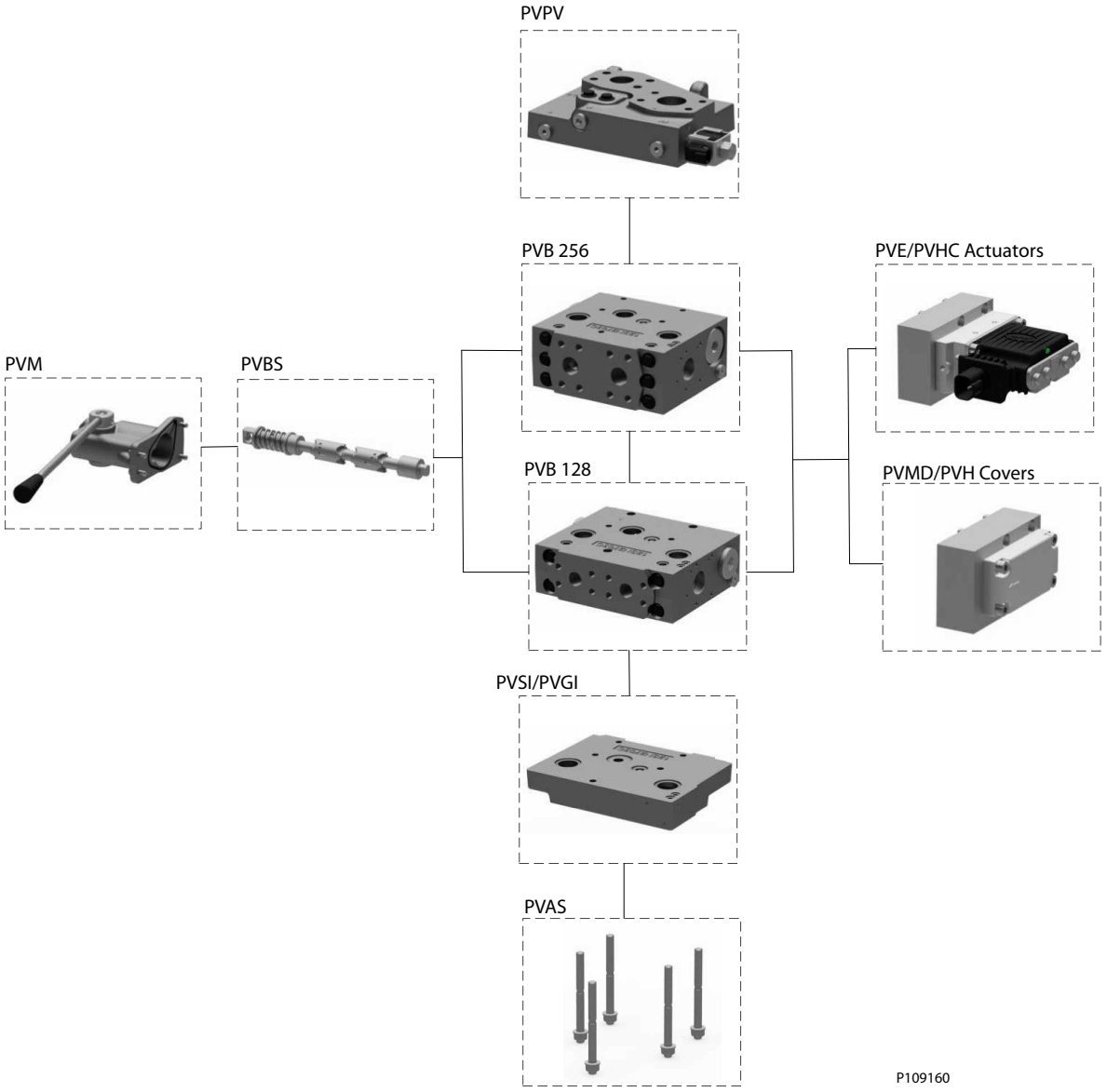
General Information

PVG 128/256 Proportional Valve Group



Navigation

PVPV	*PVB 256*	*PVB 128*
PVBS	*PVM*	*PVE/PVHC*
PVMD/PVH Covers	*PVSI/PVGI*	*PVAS*

General Information

General description

PVG is a hydraulic, load-sensing proportional valve, designed for optimal machine performance and maximum design flexibility.

The PVG 128 and PVG 256 are new members of the PVG product platform.

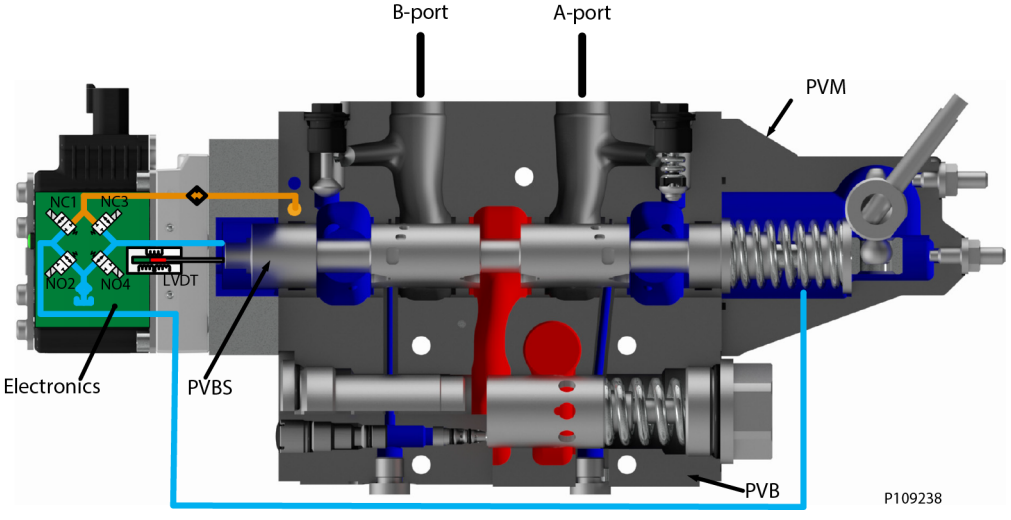
PVG 128 and PVG 256 controls work port flow up to 500 l/min and up to 420 bar work port pressure.

The PVG valve design is based on a modular concept that enables machine designers to specify a valve solution suitable for multiple market segments across multiple applications.

The load independent proportional control valve and high performance actuator technology combined with a low pressure drop design improves the machine performance and efficiency – increasing productivity and reducing energy consumption.

Features of the PVG 128/256 valve

- Inlet flow up to 1200 l/min [317 US gal/min]
- Compact sectional platform solution for easy integration with PVG 16 and PVG 32
- Load-independent flow control:
  - Oil flow to an individual function is independent of the load pressure of this function
  - Oil flow to one function is independent of the load pressure of other functions
- Reliable regulation characteristics across the entire flow range
- Load sense relief valves for A and B port enables reduced energy loss at target pressure
- Optimized for lower pressure drop and higher efficiency
- Several options for connection threads and flange mount
- Compact design, easy installation and serviceability
- Static Load sense system when selecting pump control
- Internal T0 connection in all PVSI/PVGI



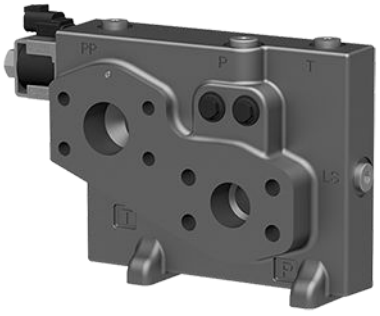
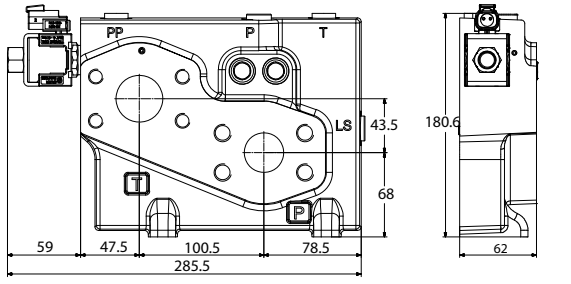
PVPV Inlet Modules

The Closed Center PVPV inlet with integrated pilot pressure reduction valve (PPRV) for PVE activation is intended for use with variable displacement pumps in applications where a valve group with electro-hydraulic or hydraulically controlled work sections is desired.

All Variants are equipped with 2xPVLP shock/anti-cavitation valves for pressure peak protection and anti-cavitation prevention.

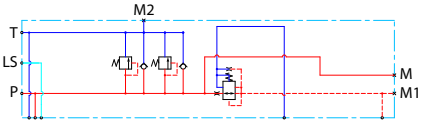
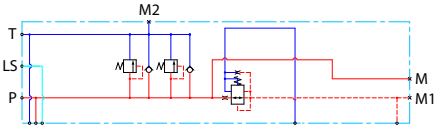
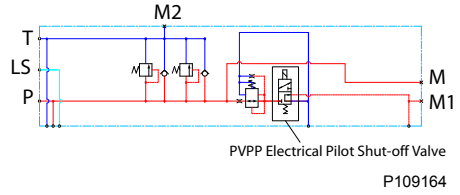
*PVLP is only for system pressure peak protection - not full pump flow.

Optional electrically actuated pilot shut off valve PVPP provides additional functional system safety by removing pilot oil from the electrical actuation or hydraulic actuation system, disabling main spool actuation.

PVPV 256	Dimensions in mm
	

The PVPV 256 inlet module variants are based on a generic platform with a selection of additional features, enabling you to tailor the PVPV inlet to suit the demands of any hydraulic system.

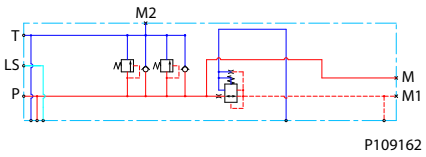
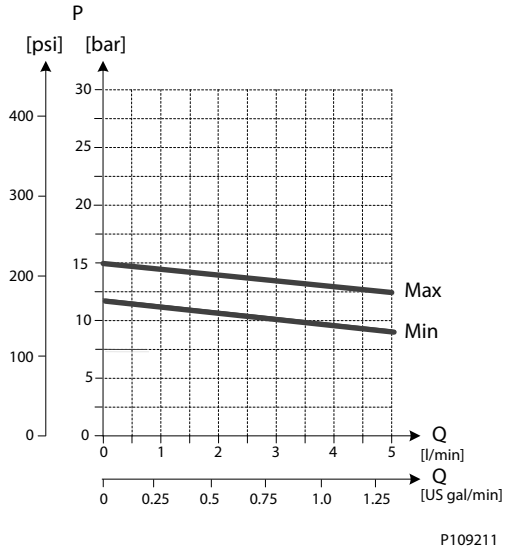
The generic PVPV 256 inlet module platform includes the following main variants:

Symbol	Description
	*Closed Center PVPV with PPRV PVE* Closed center inlet module for variable displacement pumps • Integrated PVLP shock/anti-cavitation valves 2 pcs • Gauge/connection ports for P/T/LS/M measuring gauge • Integrated pilot pressure reducing valve (PPRV) for PVE and/or Mechanical
	*Closed Center PVPV with PPRV for PVH/PVHC* Closed center inlet module for variable displacement pumps. • Integrated PVLP shock/anti-cavitation valves 2 pcs • Gauge/connection ports for P/T/LS/M measuring gauge • Integrated pilot pressure reducing valve (PPRV) for PVH/PVHC and/or Mechanical
	Optional feature: PVPP Electrical Pilot Shut-Off Valve PVPP • Electrically Actuated Pilot Shut Off Valve • Normal Closed Solenoid Valve

PVPV Inlet Modules

Closed Center PPRV for PVE Activation and/or Mechanical

The PVPV 256 inlet modules, also referred to as pump side modules, act as an interface between the PVG 128/256 proportional valve group and the hydraulic pump and tank reservoir.

Schematic	Pilot Pressure Reduction Valve Performance
	

Technical data

Max. rated pressure	P-port continuous	350 bar	[5076 psi]
	P-port intermittent	400 bar	[5800 psi]
	T-port static/dynamic	25/40 bar	[363/580 psi]
Rated Port P (PVPV/PVSI)	P-port	600/600 l/min	[159/159 US gal/min]
Oil temperature	Recommended	30 to 60°C	[86 to 140°F]
	Minimum	-30°C	[-22°F]
	Maximum	90°	[194°F]
Ambient temperature	Recommended	-30 to 60°C	[-22 to 140°F]
Oil viscosity	Operating range	12 to 75 mm^2/s	[65 to 347 SUS]
	Minimum	4 mm^2/s	[39 SUS]
	Maximum	460 mm^2/s	[2128 SUS]
Oil contamination according to ISO 4406	Maximum	23/19/16	

Part number	PPRV	P-port	T-port	LS-port Gauge-port	M-port Gauge-port	T0/T/Pilot Gauge-port	Mounting feet
11173130	PVE	Metric Flange 1-1/4"	Metric Flange 1-1/2"	G3/8"BSP	G3/8"BSP	G1/4"BSP	M12
11176703	PVE	Thread Ports G1-1/2" BSP	Thread Ports G1-1/2" BSP	G3/8"BSP	G3/8"BSP	G1/4"BSP	M12
11176691	PVE	SAE Flange 1-1/4" UNF	SAE Flange 1-1/2" UNF	9/16-18 UNF	3/4-16 UNF	7/16-20 UNF	M12
11176702	PVE	Thread Ports 1-7/8" UNF	Thread Ports 1-7/8" UNF	9/16-18 UNF	3/4-16 UNF	7/16-20 UNF	M12

PVPV Inlet Modules

Accessory module for PVPV 256

Ordering information	12 V	24 V
PVPP Pilot shut off valve	11160318	11160319

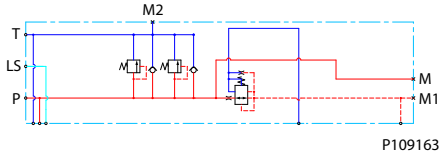
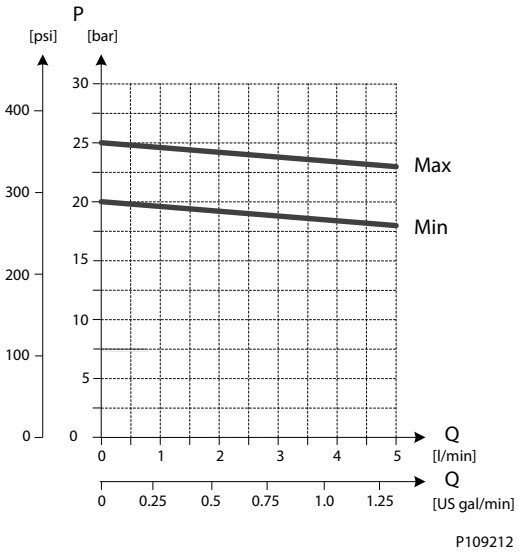
PVPV Inlet Modules

PPRV for PVH/PVHC Activation and/or Mechanical

The Closed Center PVPV inlet with integrated pilot pressure reduction valve (PPRV) for PVH/PVHC activation is intended for use with variable displacement pumps in applications where a valve group with PVH/PVHC controlled work sections is desired.

All Variants are equipped with 2xPVLP shock/anti-cavitation valves for pressure peak protection and anti-cavitation prevention.

Optional electrically actuated pilot shut off valve PVPP provides additional functional system safety by removing pilot oil from the electrical actuation or hydraulic actuation system, disabling main spool actuation.

Schematic	Pilot Pressure Reduction Valve Performance
	

Technical data

Max. rated pressure	P-port continuous	350 bar	[5076 psi]
	P-port intermittent	400 bar	[5800 psi]
	T-port static/dynamic	25/40 bar	[363/580 psi]
Rated Port P (PVPV/PVSI)	P-port	600/600 l/min	[159/159 US gal/min]
Oil temperature	Recommended	30 to 60°C	[86 to 140°F]
	Minimum	-30°C	[-22°F]
	Maximum	90°	[194°F]
Ambient temperature	Recommended	-30 to 60°C	[-22 to 140°F]
Oil viscosity	Operating range	12 to 75 mm^2/s	[65 to 347 SUS]
	Minimum	4 mm^2/s	[39 SUS]
	Maximum	460 mm^2/s	[2128 SUS]
Oil contamination according to ISO 4406	Maximum	23/19/16	

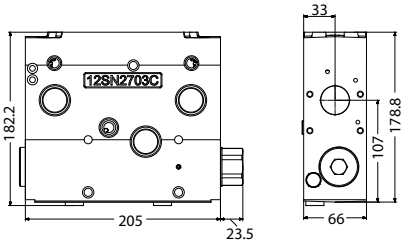
PVPV Inlet Modules

Part number	PPRV	P-port	T-port	LS-port Gauge-port	M-port Gauge-port	To/T/Pilot Gauge-port	Mounting feet
11178095	PVE	Metric Flange 1-1/4″	Metric Flange 1-1/2″	G3/8"BSP	G3/8"BSP	G1/4"BSP	M12
11178098	PVE	Thread Ports G1-1/2" BSP	Thread Ports G1-1/2" BSP	G3/8"BSP	G3/8"BSP	G1/4"BSP	M12
11178117	PVE	SAE Flange 1-1/4″ UNF	SAE Flange 1-1/2″ UNF	9/16-18 UNF	3/4-16 UNF	7/16-20 UNF	M12
11178119	PVE	Thread Ports 1-7/8″ UNF	Thread Ports 1-7/8″ UNF	9/16-18 UNF	3/4-16 UNF	7/16-20 UNF	M12

Accessory module for PVPV 256

Ordering information	12 V	24 V
PVPP Pilot shut off valve	11160318	11160319

PVB 128 Variant Overview

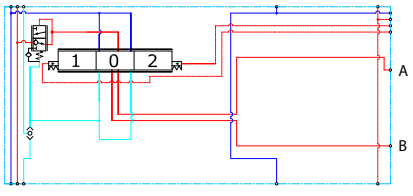
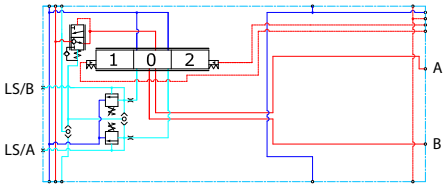
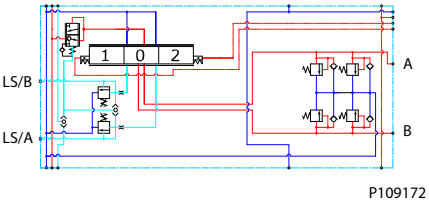
PVB 128	Dimensions (mm)
	

The PVG 128 Basic modules (PVB), also referred to as work sections, is the interface between the PVG 128 proportional valve group and the work function such as a cylinder or a motor.

The PVB basic module variants are based on a generic platform with a selection of additional features, enabling you to tailor the PVB to suit the demands of any hydraulic system.

The compensator is a 3-way type which include load drop check valve functionality, compensator function and neutral relief which avoid A and B port pressure build up in neutral.

The generic PVB basic module platform includes the following main variants.

Symbol	Description
	*PVB 128* Compensated basic module • Integrated LS shuttle network • Integrated compensator with bleed-off
	*Compensated PVB 128 w LSA/B* Compensated basic module with LSA/B relief valve for each work port • Integrated LS shuttle network • Integrated compensator with bleed-off • Integrated, individual adjustable LS A/B pressure relief valves • External LS A/B port connection
	*Compensated PVB 128 with LSA/B and PVLP* Compensated basic module with LSA/B relief valve for each work port and 2xPVLPs for each work port • Integrated LS shuttle network • Integrated compensator with bleed-off • Integrated, individual adjustable LSA/B pressure relief valves • External LSA/B port connection - Integrated PVLP shock/anti-cavitation valve facility

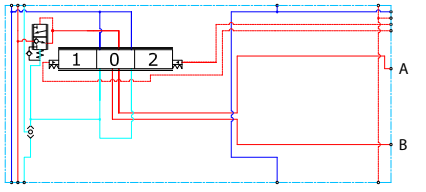
PVB 128 Variant Overview

PVB 128 3-way Compensator

The compensated PVB is intended for controlling a work function where the function behavior in terms of flow and pressures requires independency on the load pressure of other functions used simultaneously.

The compensator is a 3-way type which include load drop check valve functionality, compensator function and neutral relief which avoid A and B port pressure build up in neutral.

Schematic



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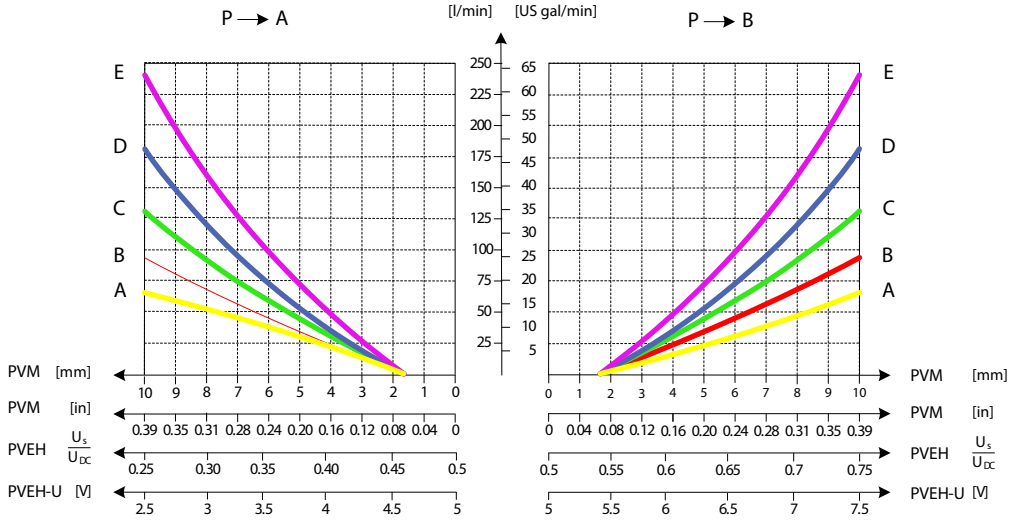
Performance

Oil flow as function of spool travel



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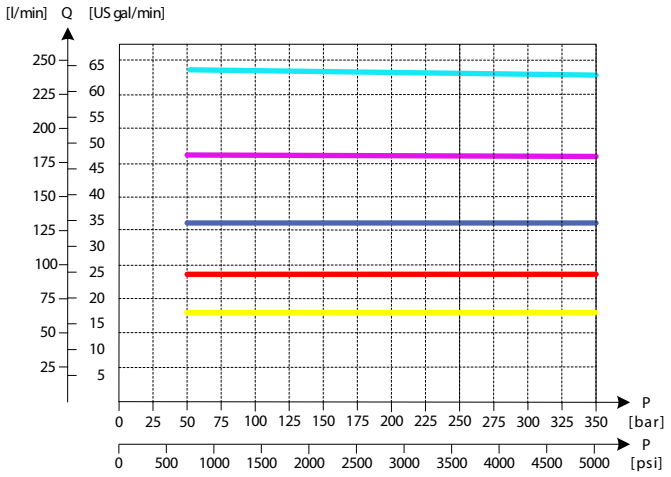
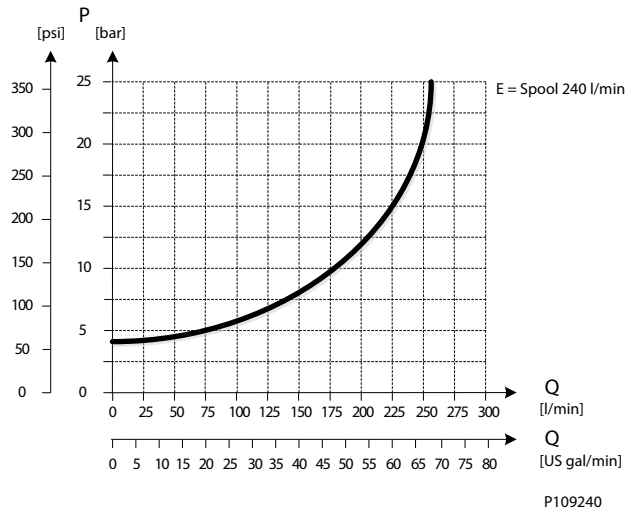
PVB 128 Variant Overview

Load Independent Oil Flow, Pressure Compensated



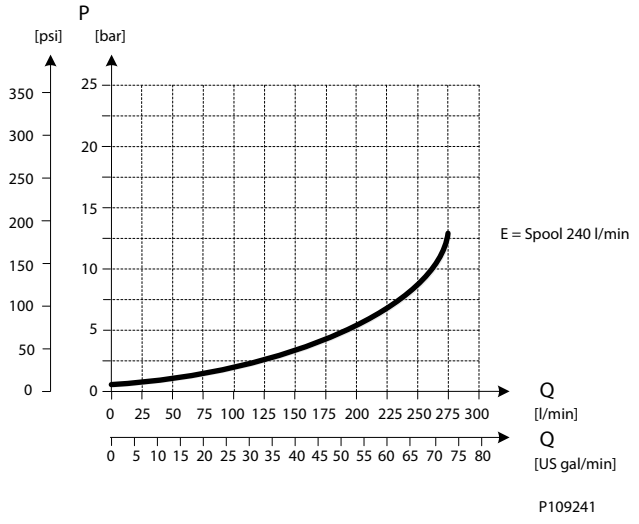
PVB 128 Upstream Performance

Port P to Port A/B at full spool stroke



PVB 128 Downstream Performance

Port A/B to Tank at full spool stroke



Technical data

Max. rated pressure	A/B port continuous	350 bar	[5076 psi]
	A/B port intermittent	400	[5800 psi]
Max. rated flow	A/B port	240 l/min	[63 US gal/min]
Oil temperature	Recommended	30 to 60°C	[86 to 140°F]
	Minimum	-30°C	[-22°F]
	Maximum	90°	[194°F]
Ambient temperature	Recommended	-30 to 60°C	[-22 to 140°F]

PVB 128 Variant Overview

Technical data (continued)

Oil viscosity	Operating range	12 to 75 mm^2/s	[65 to 347 SUS]
	Minimum	4 mm^2/s	[39 SUS]
	Maximum	460 mm^2/s	[2128 SUS]
Oil contamination according to ISO 4406	Maximum	23/19/16	

Part number	A/B-port	PVLP/PVLA	LS A/B-port
11170522	Metric Flange 3/4"	-	-
11170528	G 1" BSP	-	-
11170524	SAE Flange 3/4" UNF	-	-
11170526	Thread Ports 1 5/16 UNF	-	-

PVB 128 Variant Overview

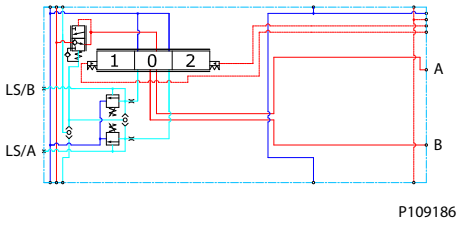
PVB 128 3-way Compensator with LS A/B

The compensated PVB is intended for controlling a work function where the function behavior in terms of flow and pressures requires independency on the load pressure of other functions used simultaneously.

The integrated LSA/B relief valves are used to limit the maximum work port pressure on the A and B-ports individually.

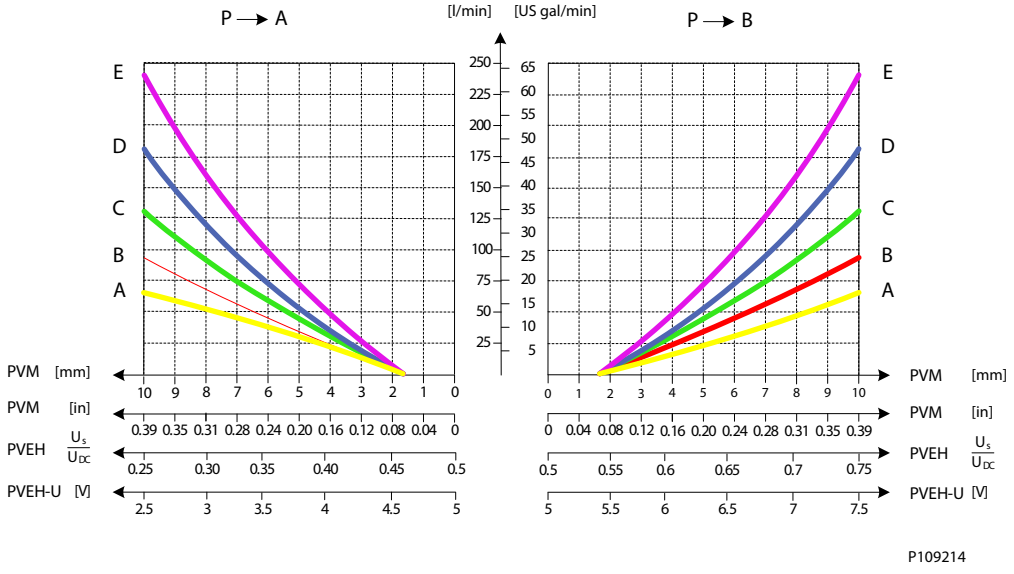
The compensator is a 3-way type which include load drop check valve functionality, compensator function and neutral relief which avoid A and B port pressure build up in neutral.

Schematic



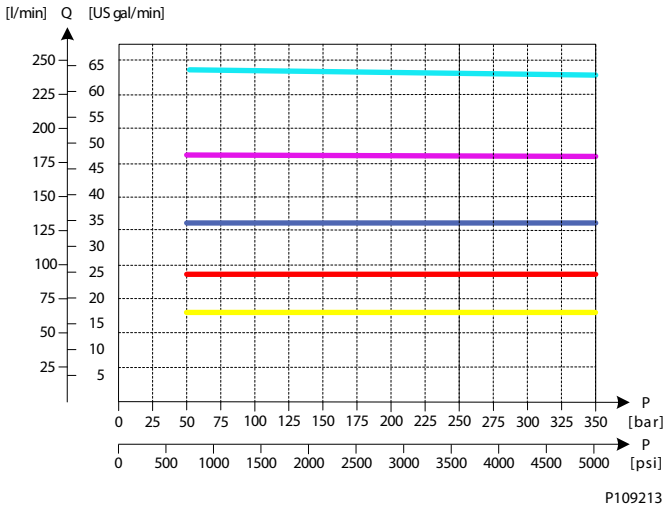
Performance

Oil flow as function of spool travel

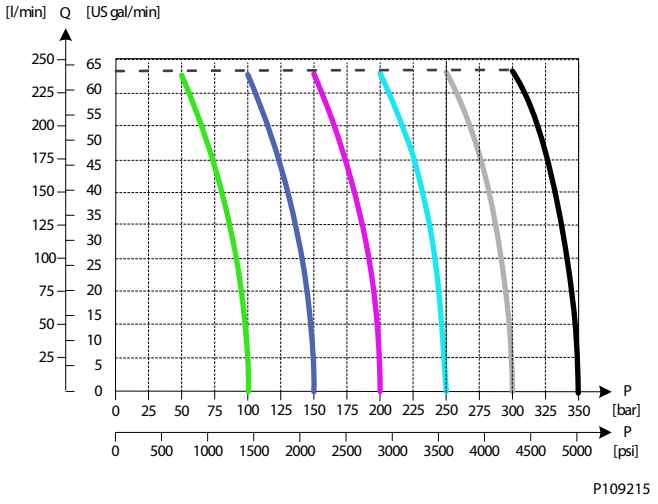


PVB 128 Variant Overview

Load Independent Oil Flow, Pressure Compensated

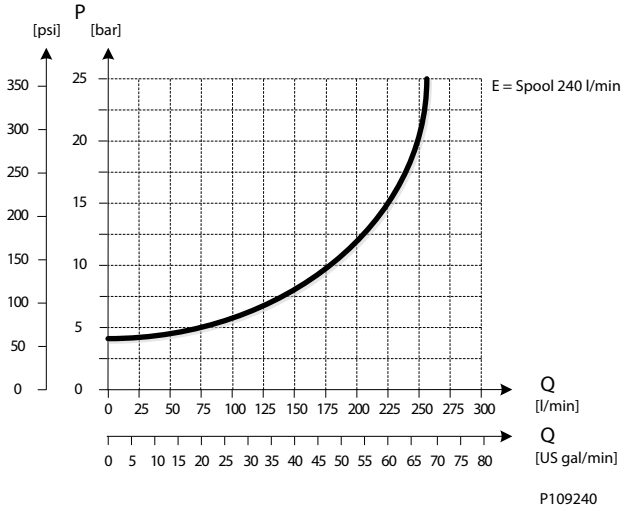


LS A/B Pressure Relief Valve



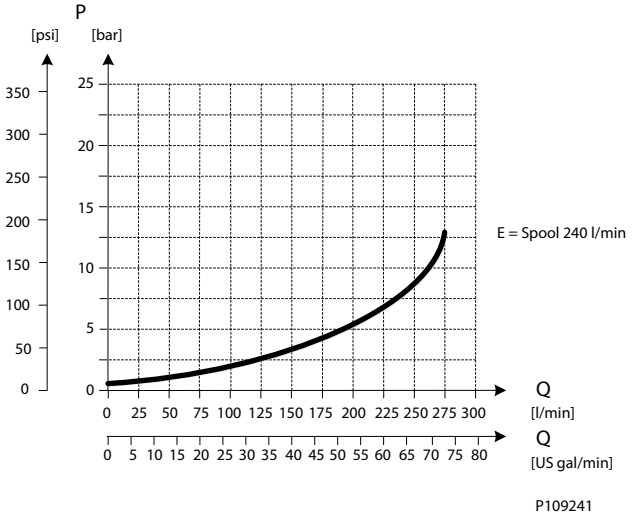
PVB 128 Upstream Performance

Port P to Port A/B at full spool stroke



PVB 128 Downstream Performance

Port A/B to Tank at full spool stroke



Technical data

Max. rated pressure	A/B port continuous	350 bar	[5076 psi]
	A/B port intermittent	400	[5800 psi]
Max. rated flow	A/B port	240 l/min	[63 US gal/min]
Oil temperature	Recommended	30 to 60°C	[86 to 140°F]
	Minimum	-30°C	[-22°F]
	Maximum	90°	[194°F]
Ambient temperature	Recommended	-30 to 60°C	[-22 to 140°F]

PVB 128 Variant Overview

Technical data (continued)

Oil viscosity	Operating range	12 to 75 mm^2/s	[65 to 347 SUS]
	Minimum	4 mm^2/s	[39 SUS]
	Maximum	460 mm^2/s	[2128 SUS]
Oil contamination according to ISO 4406	Maximum	23/19/16	

Part number	A/B-port	PVLP/PVLA	LS A/B-port
11176915	Metric Flange 3/4"	-	G1/4"BSP
11176918	G 1" BSP	-	G1/4"BSP
11176916	SAE Flange 3/4" UNF	-	7/16-20 UNF
11176917	Thread Ports 1 5/16 UNF	-	7/16-20 UNF

PVB 128 Variant Overview

PVB 128 3-way Compensator with LS A/B and PVLP

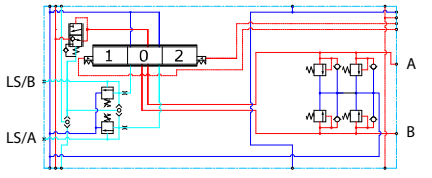
The compensated PVB is intended for controlling a work function where the function behavior in terms of flow and pressures requires independency on the load pressure of other functions used simultaneously.

The integrated LS A/B relief valves are used to limit the maximum work port pressure on the A and B-ports individually.

Featuring 2xPVLP shock/anti-cavitation valves on each work port for pressure peak protection and anti-cavitation prevention

The compensator is a 3-way type which include load drop check valve functionality, compensator function and neutral relief which avoid A and B port pressure build up in neutral.

Schematic



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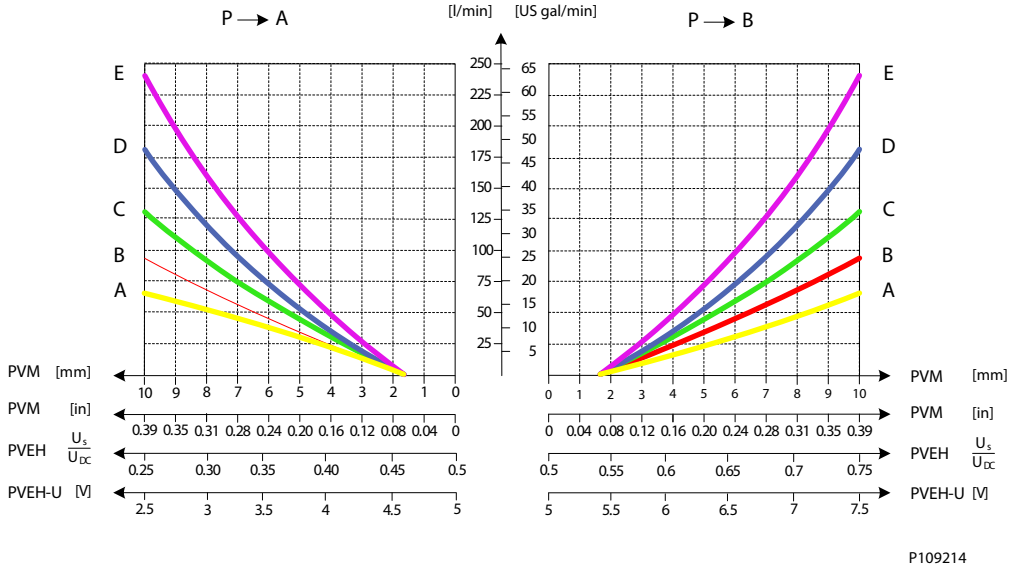
Performance

Oil flow as function of spool travel



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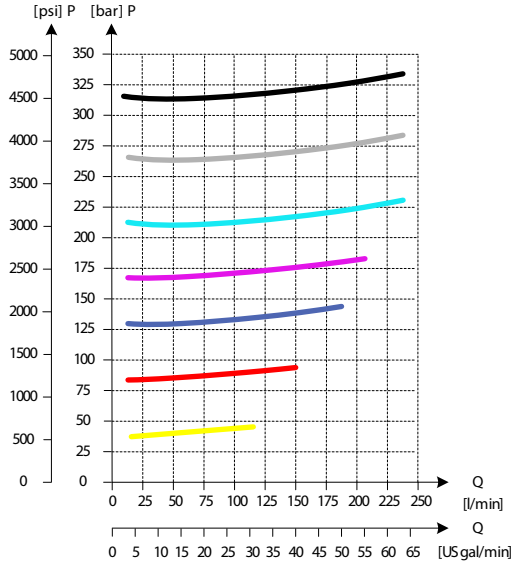
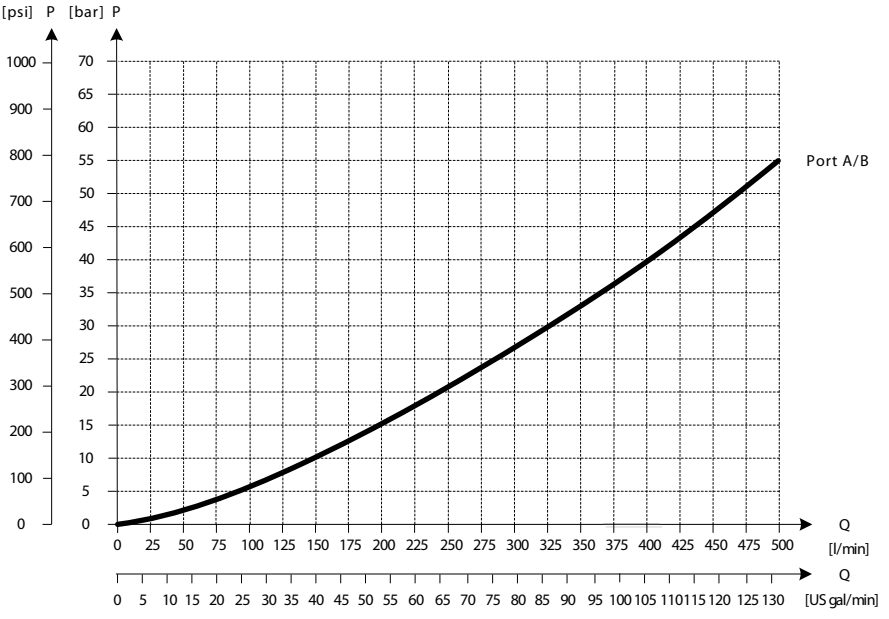
PVB 128 Variant Overview

2xPVLP Shock Valve

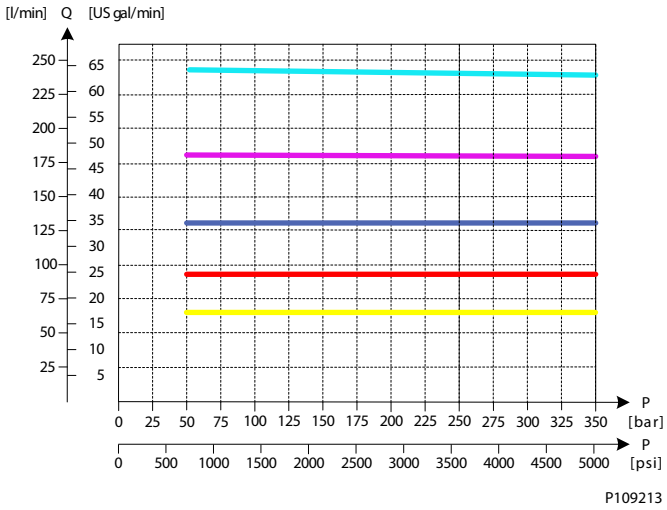


2xPVLA Suction Valve

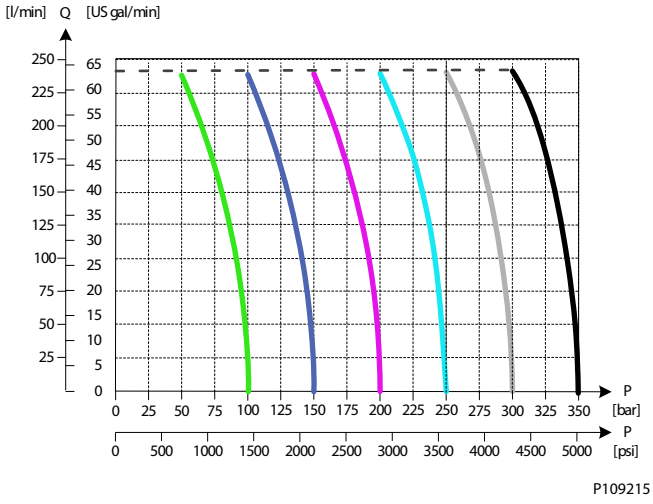


PVB 128 Variant Overview

Load Independent Oil Flow, Pressure Compensated

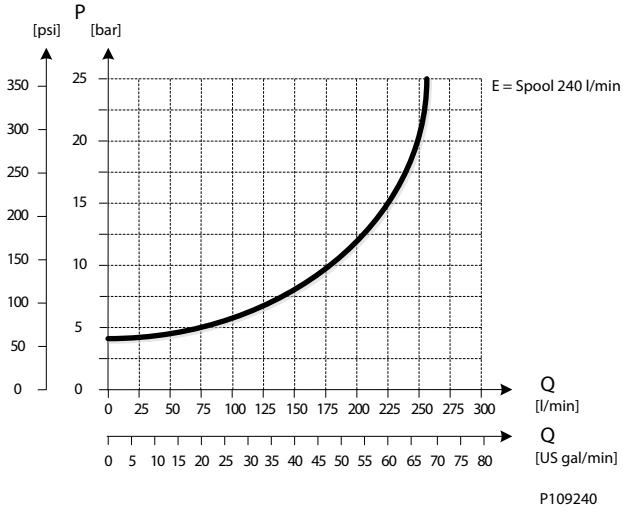


LS A/B Pressure Relief Valve



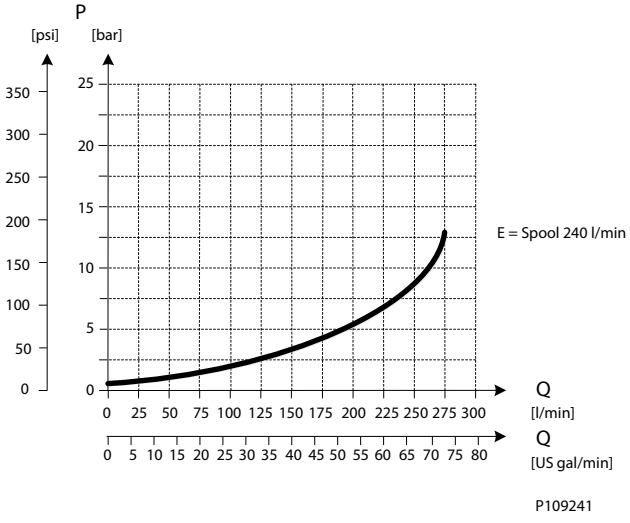
PVB 128 Upstream Performance

Port P to Port A/B at full spool stroke



PVB 128 Downstream Performance

Port A/B to Tank at full spool stroke



Technical data

Max. rated pressure	A/B port continuous	350 bar	[5076 psi]
	A/B port intermittent	400	[5800 psi]
Max. rated flow	A/B port	240 l/min	[63 US gal/min]
Oil temperature	Recommended	30 to 60°C	[86 to 140°F]
	Minimum	-30°C	[-22°F]
	Maximum	90°	[194°F]
Ambient temperature	Recommended	-30 to 60°C	[-22 to 140°F]

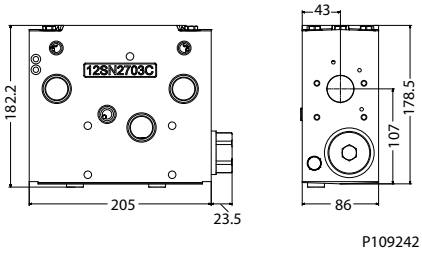
PVB 128 Variant Overview

Technical data (continued)

Oil viscosity	Operating range	12 to 75 mm^2/s	[65 to 347 SUS]
	Minimum	4 mm^2/s	[39 SUS]
	Maximum	460 mm^2/s	[2128 SUS]
Oil contamination according to ISO 4406	Maximum	23/19/16	

Part number	A/B-port	PVLP/PVLA	LS A/B-port
11165621	Metric Flange 3/4"	2 PVLP/PVLA	G1/4"BSP
11170527	G 1" BSP	2 PVLP/PVLA	G1/4"BSP
11170523	SAE Flange 3/4" UNF	2 PVLP/PVLA	7/16-20 UNF
11170525	Thread Ports 1 5/16 UNF	2 PVLP/PVLA	7/16-20 UNF

PVB 256 Variant Overview

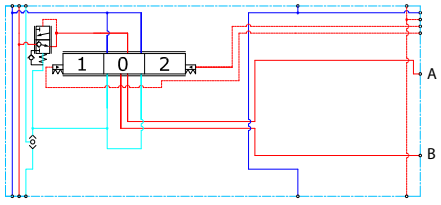
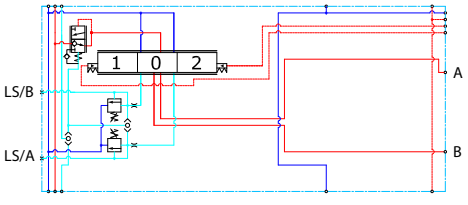
PVB 256	Dimensions (mm)
	

The PVG 256 Basic modules (PVB), also referred to as work sections, is the interface between the PVG 256 proportional valve group and the work function such as a cylinder or a motor.

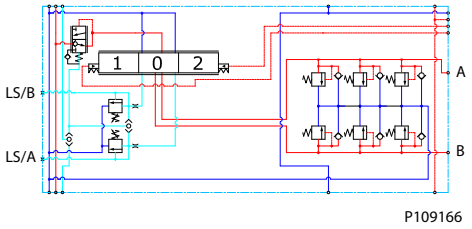
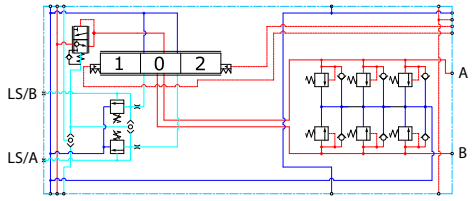
The PVB basic module variants are based on a generic platform with a selection of additional features, enabling you to tailor the PVB to suit the demands of any hydraulic system.

The compensator is a 3-way type which includes load drop check valve functionality, compensator function and neutral relief which avoid A and B port pressure build up.

The generic PVB basic module platform includes the following main variants.

Symbol	Description
	*Compensated PVB 256* Compensated basic module • Integrated LS shuttle network • Integrated compensator with bleed-off
	*Compensated PVB 256 with LS A/B* Compensated basic module with LS A/B relief valve for each work port • Integrated LS shuttle network • Integrated compensator with bleed-off • Integrated, individual adjustable LS A/B pressure relief valves • External LS A/B port connection

PVB 256 Variant Overview

Symbol	Description
 P109166	*Compensated PVB 256 with LS A/B and PVLP* Compensated basic module with LS A/B relief valve for each work port and 3xPVLPs for each work port • Integrated LS shuttle network • Integrated compensator with bleed-off • Integrated, individual adjustable LS A/B pressure relief valves • External LS A/B port connection • Integrated PVLP shock/anti-cavitation valve facility
 P109165	*Compensated PVB 256 with Turbo compensator feature* Compensated basic module with LS A/B relief valve for each work port and 3xPVLPs for each work port • Flow is rated to 500 l/min • Integrated LS shuttle network • Integrated Turbo compensator feature with bleed-off • Integrated, individual adjustable LS A/B pressure relief valves • External LS A/B port connection • Integrated PVLP shock/anti-cavitation valve facility

PVB 256 Variant Overview

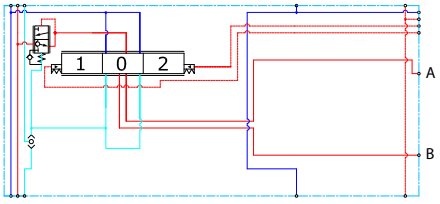
PVB 256 3-way Compensator

The compensated PVB is intended for controlling a work function where the function behavior in terms of flow and pressures requires independency on the load pressure of other functions used simultaneously.

The integrated LS A/B relief valves are used to limit the maximum work port pressure on the A and B-ports individually.

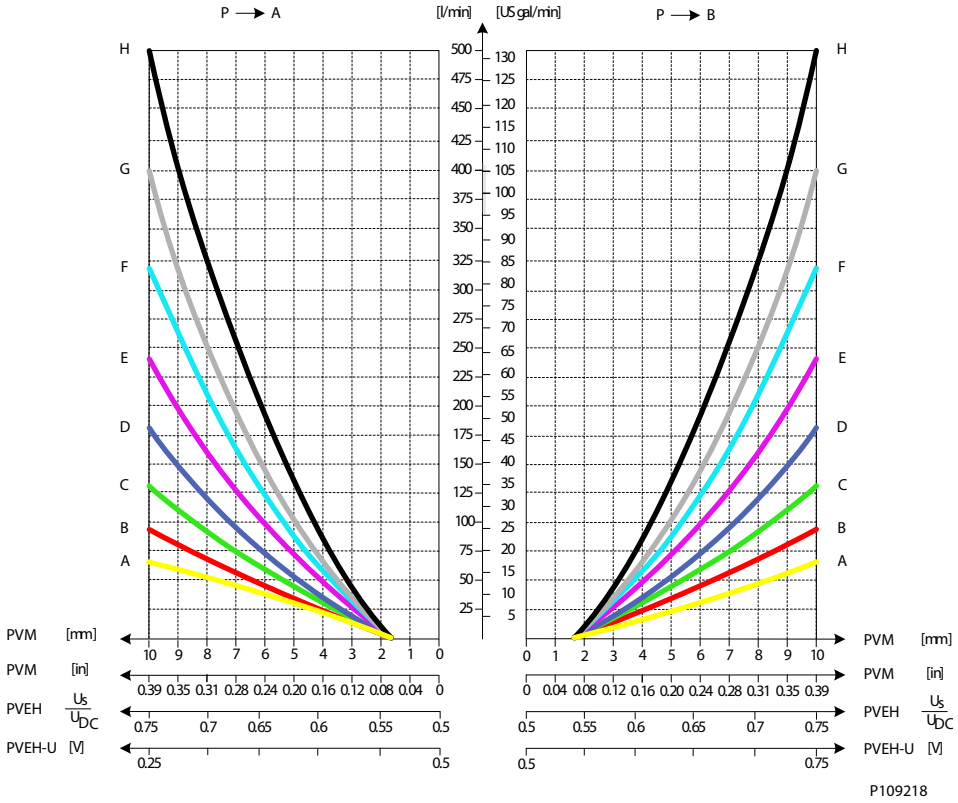
The compensator is a 3-way type which include load drop check valve functionality, compensator function and neutral relief which avoid A and B port pressure build up in neutral.

Schematic



P109168

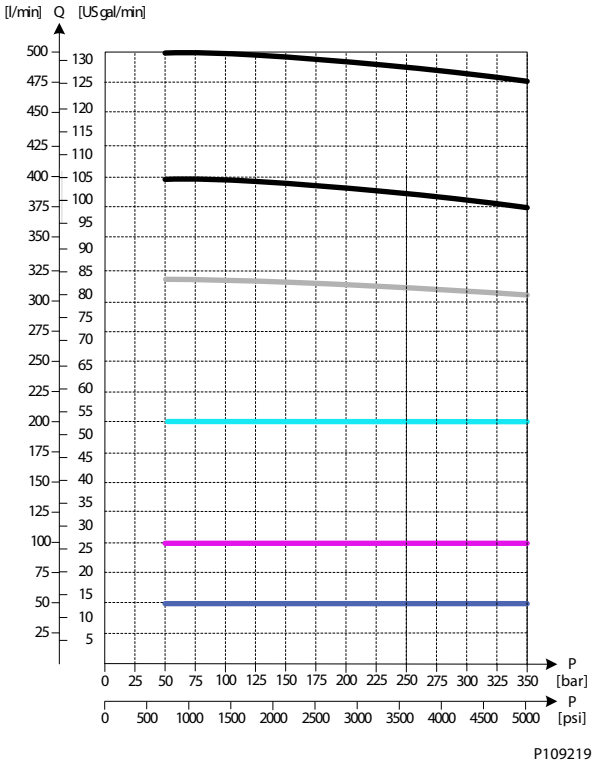
Oil Flow as Function of Spool Travel



P109218

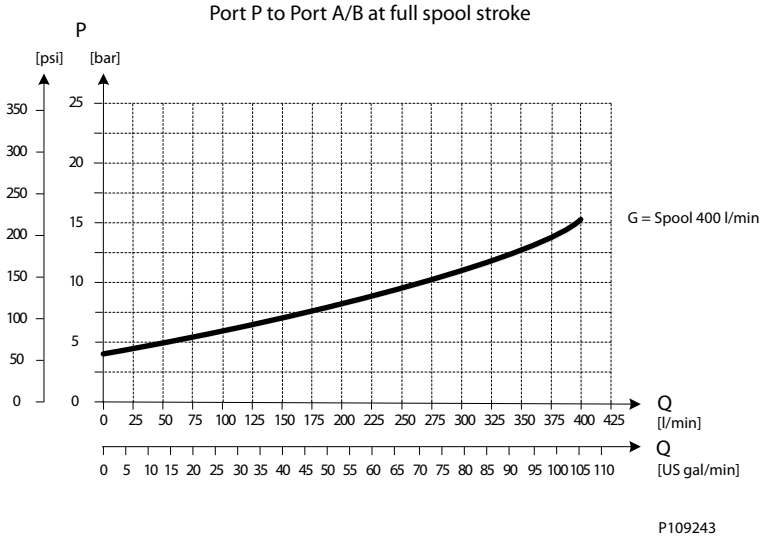
PVB 256 Variant Overview

Load Independent Oil Flow, Pressure Compensated



PVB 256 Upstream Performance

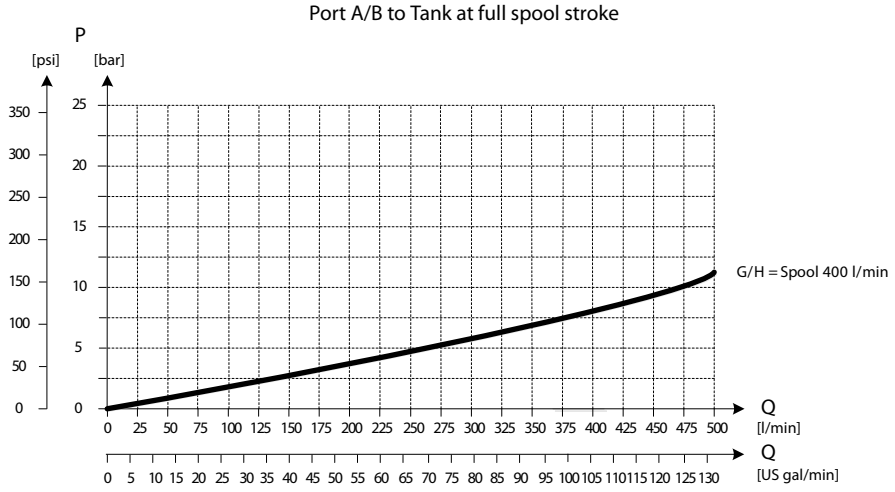
Port P to Port A/B at full spool stroke



PVB 256 Variant Overview

PVB 256 Downstream Performance

Port A/B to Tank at full spool stroke



P109244

Technical data

Max. rated pressure	A/B port continuous	350 bar	[5076 psi]
	A/B port intermittent	400 bar	[5800 psi]
Max. rated flow	A/B port	400 l/min	[106 US gal/min]
Oil temperature	Recommended	30 to 60°C	[86 to 140°F]
	Minimum	-30°C	[-22°F]
	Maximum	90°	[194°F]
Ambient temperature	Recommended	-30 to 60°C	[-22 to 140°F]
Oil viscosity	Operating range	12 to 75 mm^2/s	[65 to 347 SUS]
	Minimum	4 mm^2/s	[39 SUS]
	Maximum	460 mm^2/s	[2128 SUS]
Oil contamination according to ISO 4406	Maximum	23/19/16	

Part number	A/B port	PVLP/PVLA	LS A/B port
11169244	Metric Flange 1″	-	-
11169252	G1-1/4" BSP	-	-
11169248	SAE Flange 1″ UNF	-	-
11177020	Thread Ports 1-5/8 UNF	-	-

PVB 256 Variant Overview

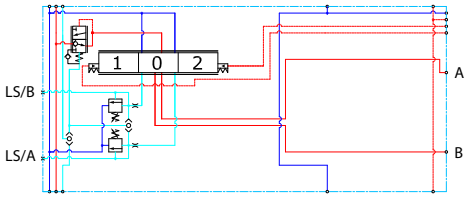
PVB 256 3-way Compensator with LS A/B

The compensated PVB is intended for controlling a work function where the function behavior in terms of flow and pressures requires independency on the load pressure of other functions used simultaneously.

The integrated LS A/B relief valves are used to limit the maximum work port pressure on the A and B-ports individually.

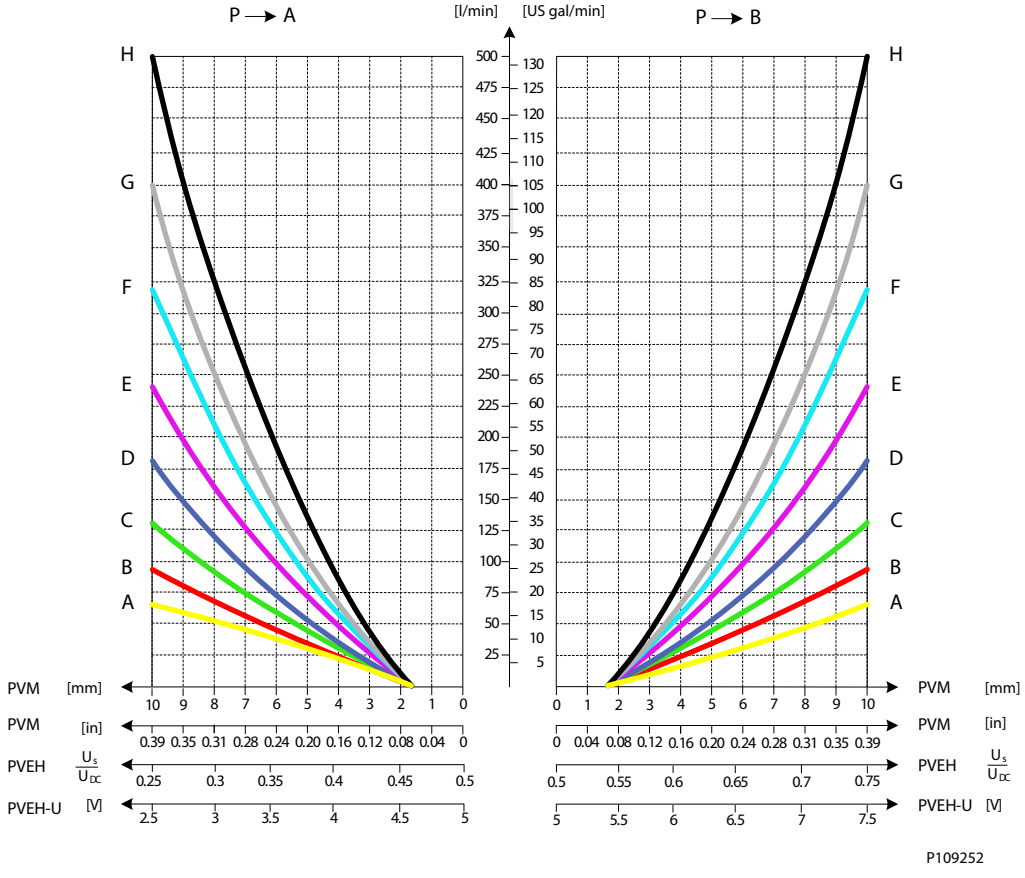
The compensator is a 3-way type which include load drop check valve functionality, compensator function and neutral relief which avoid A and B port pressure build up in neutral.

Schematic



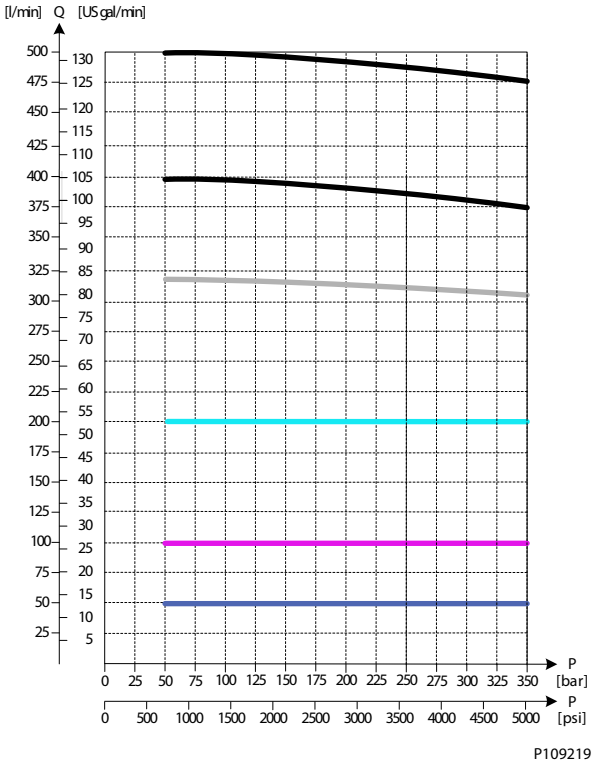
Performance

Oil Flow as Function of Spool Travel

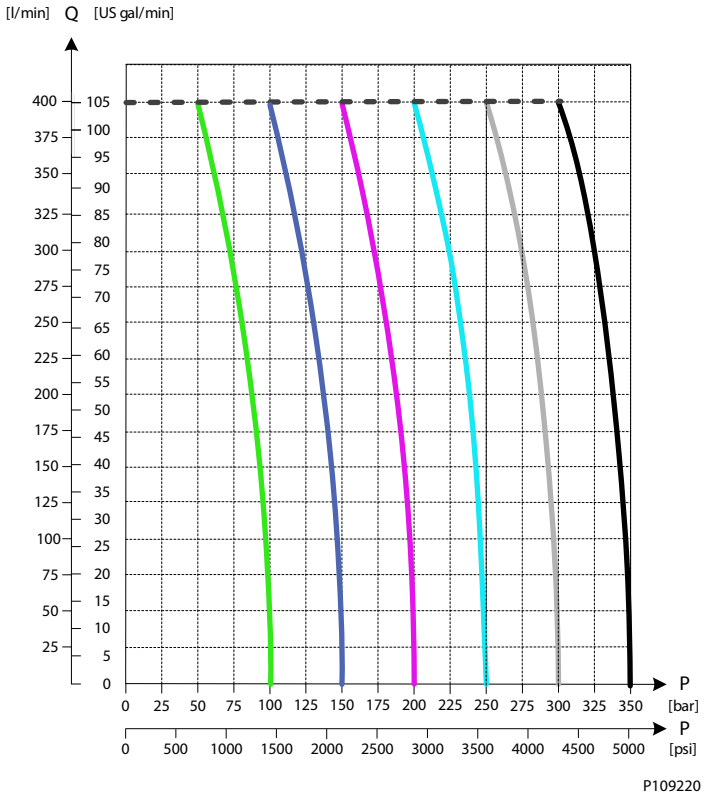


PVB 256 Variant Overview

Load Independent Oil Flow, Pressure Compensated

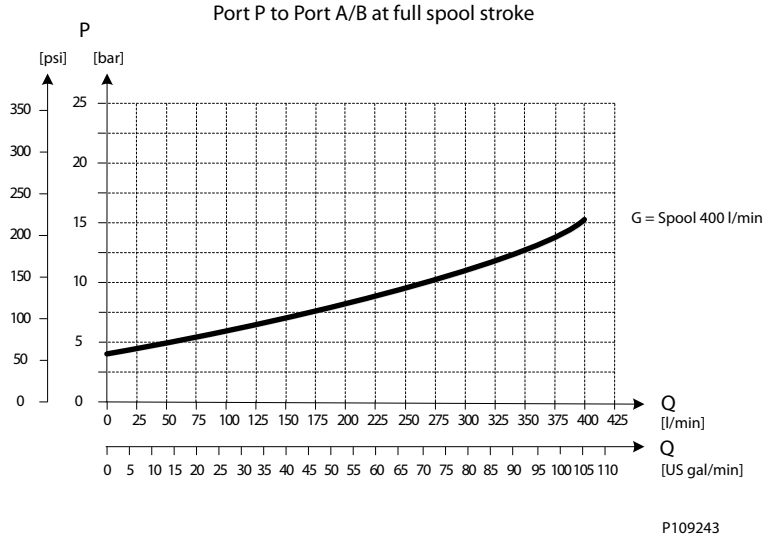


LS A/B Pressure Limitation



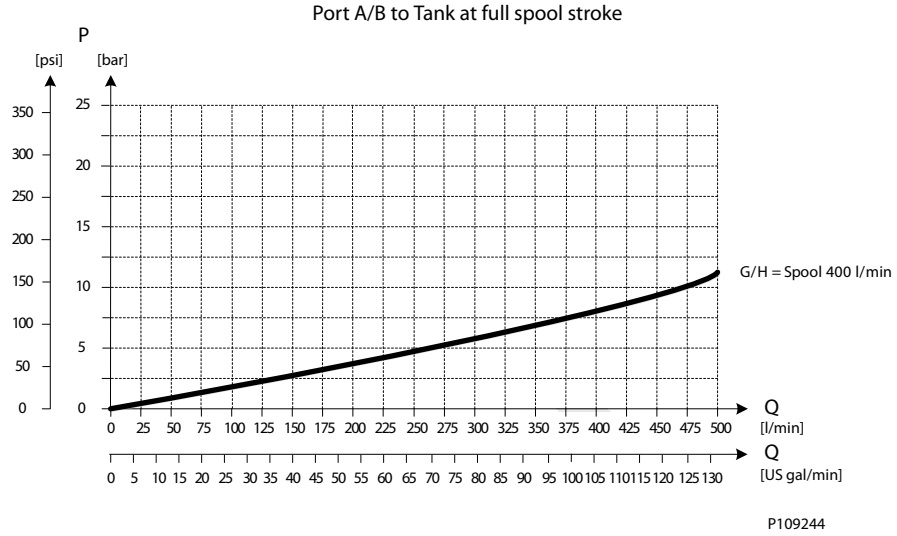
PVB 256 Upstream Performance

Port P to Port A/B at full spool stroke



PVB 256 Variant Overview

PVB 256 Downstream Performance



Technical data

Max. rated pressure	A/B port continuous	350 bar	[5076 psi]
	A/B port intermittent	400	[5800 psi]
Max. rated flow	A/B port	400 l/min	[106 US gal/min]
Oil temperature	Recommended	30 to 60°C	[86 to 140°F]
	Minimum	-30°C	[-22°F]
	Maximum	90°	[194°F]
Ambient temperature	Recommended	-30 to 60°C	[-22 to 140°F]
Oil viscosity	Operating range	12 to 75 mm^2/s	[65 to 347 SUS]
	Minimum	4 mm^2/s	[39 SUS]
	Maximum	460 mm^2/s	[2128 SUS]
Oil contamination according to ISO 4406	Maximum	23/19/16	

Part number	A/B-port	PVLP/PVLA	LS A/B-port
11177015	Metric Flange 1″	-	G1/4"BSP
11177017	G1-1/4" BSP	-	G1/4"BSP
11177016	SAE Flange 1″ UNF	-	7/16-20 UNF
11177019	Thread Ports 1-5/8 UNF	-	7/16-20 UNF

PVB 256 Variant Overview

PVB 256 3-way Compensator with LSA/B and PVLP

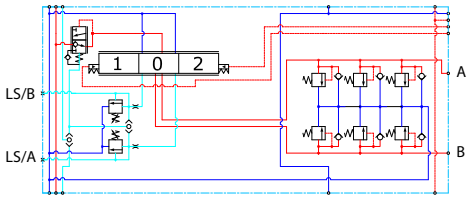
The compensated PVB is intended for controlling a work function where the function behavior in terms of flow and pressures requires independency on the load pressure of other functions used simultaneously.

The integrated LS A/B relief valves are used to limit the maximum work port pressure on the A and B-ports individually.

Featuring 3xPVLP shock/anti-cavitation valves on each work port for pressure peak protection and anti-cavitation prevention.

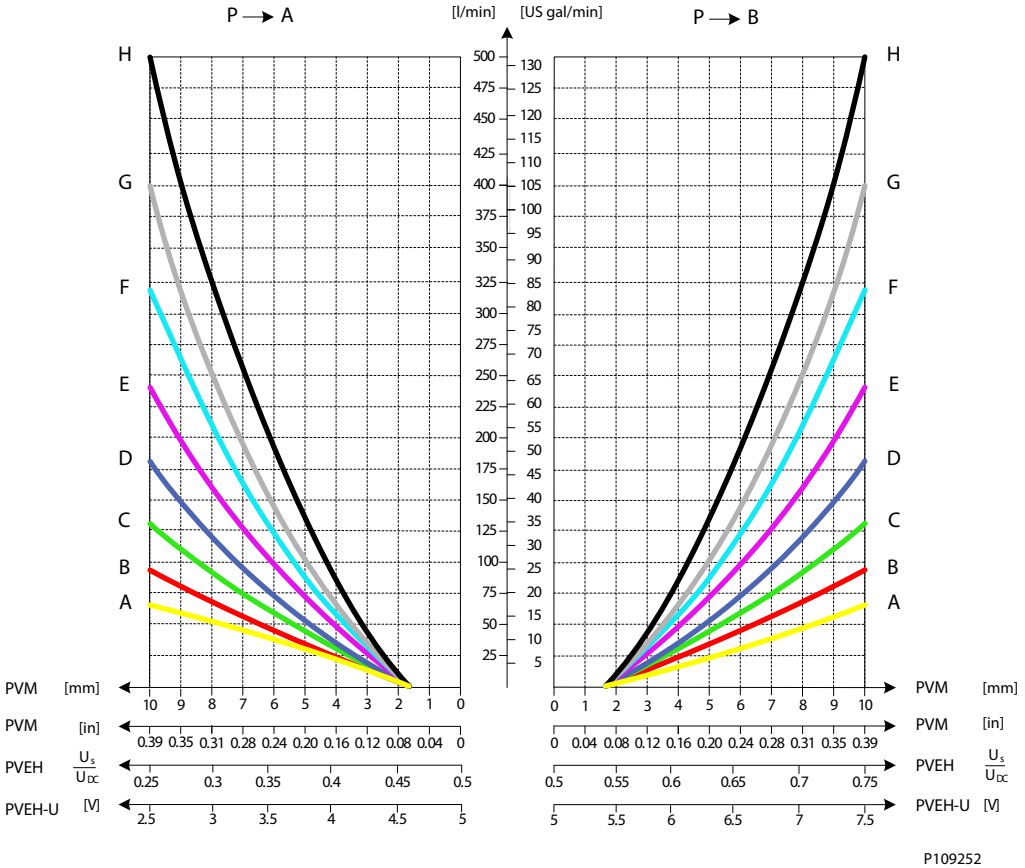
The compensator is a 3-way type which include load drop check valve functionality, compensator function and neutral relief which avoid A and B port pressure build up in neutral.

Schematic



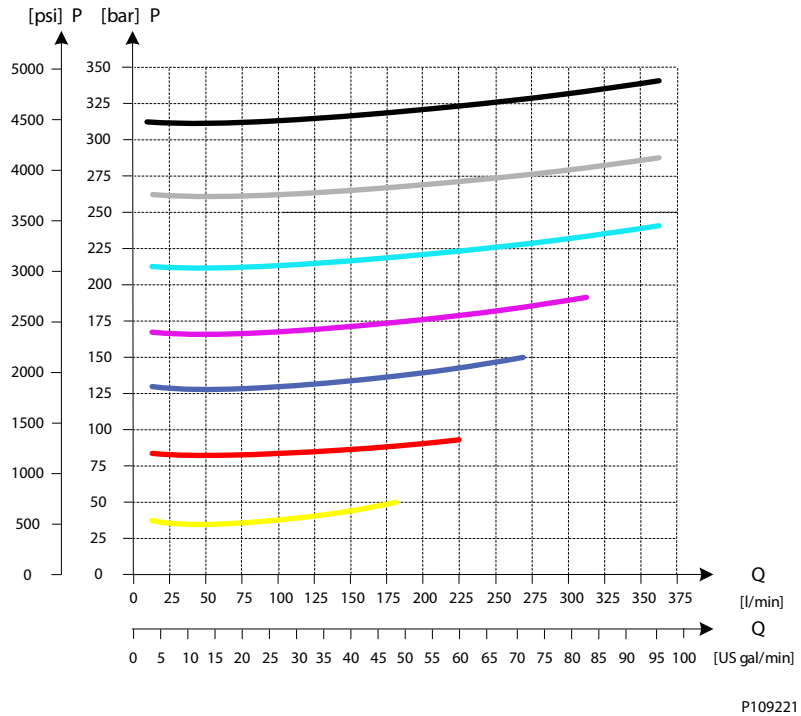
Performance

Oil Flow as Function of Spool Travel

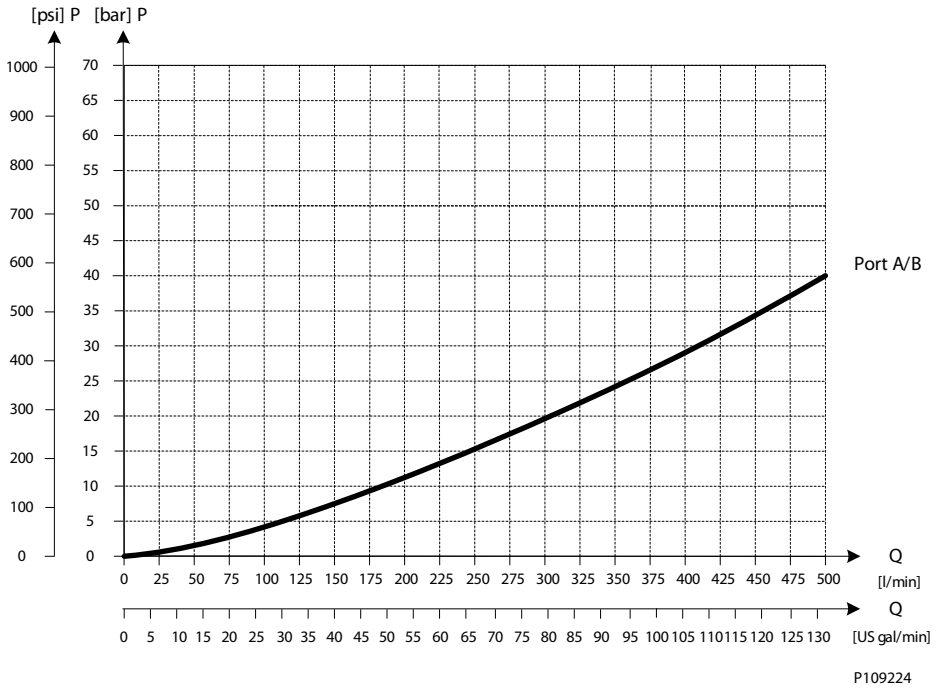


PVB 256 Variant Overview

3xPVLP Shock Valve

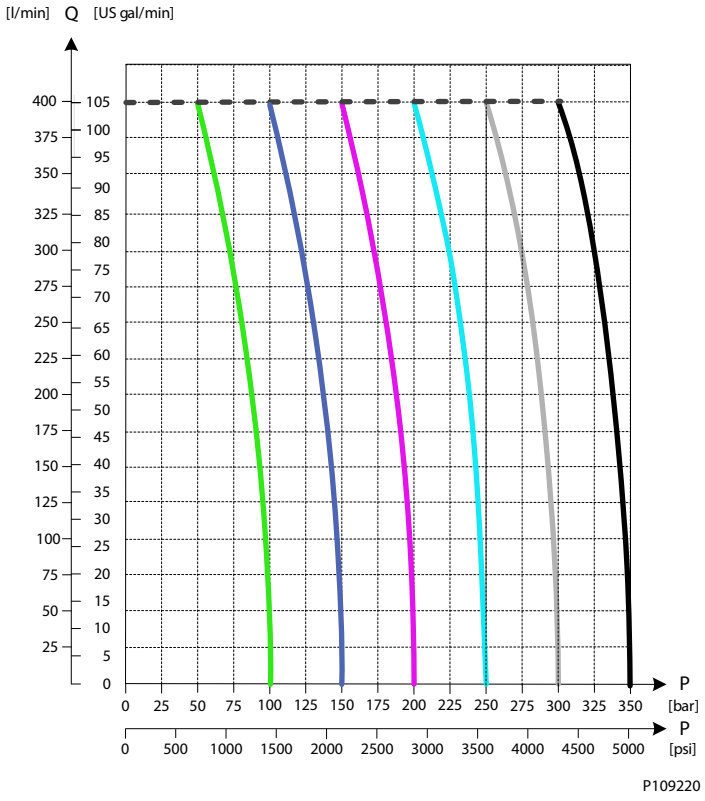


3xPVLA Suction Valve

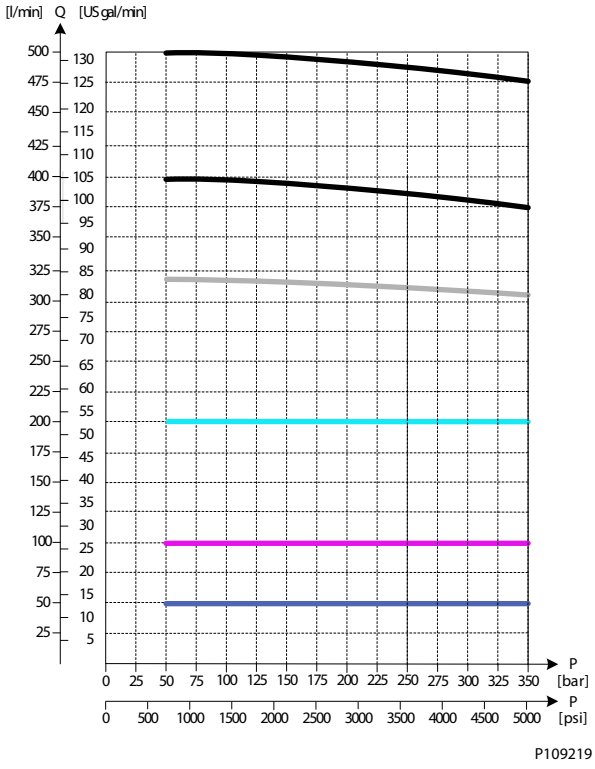


PVB 256 Variant Overview

LS A/B Pressure Limitation

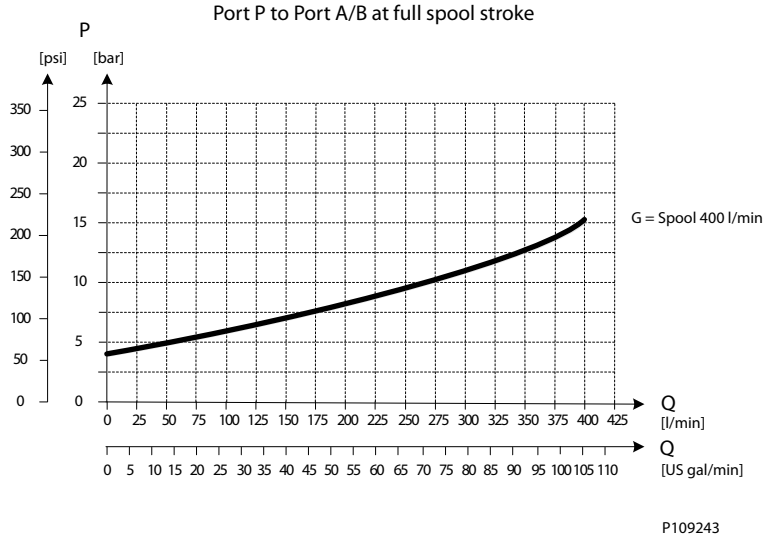


Load Independent Oil Flow, Pressure Compensated



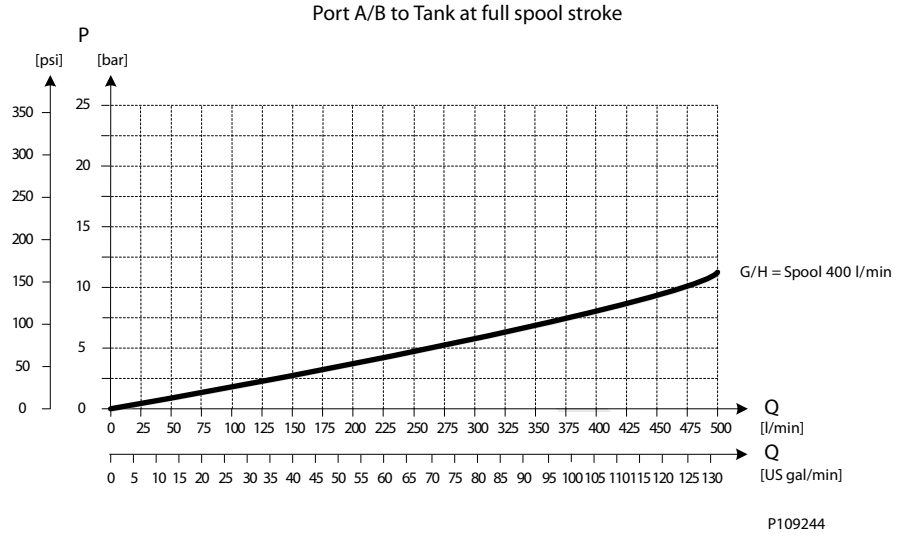
PVB 256 Upstream Performance

Port P to Port A/B at full spool stroke



PVB 256 Variant Overview

PVB 256 Downstream Performance



Technical data

Max. rated pressure	A/B port continuous	350 bar	[5076 psi]
	A/B port intermittent	400 bar	[5800 psi]
Max. rated flow	A/B port	400 l/min	[106 US gal/min]
Oil temperature	Recommended	30 to 60°C	[86 to 140°F]
	Minimum	-30°C	[-22°F]
	Maximum	90°	[194°F]
Ambient temperature	Recommended	-30 to 60°C	[-22 to 140°F]
Oil viscosity	Operating range	12 to 75 mm^2/s	[65 to 347 SUS]
	Minimum	4 mm^2/s	[39 SUS]
	Maximum	460 mm^2/s	[2128 SUS]
Oil contamination according to ISO 4406	Maximum	23/19/16	

Part number	A/B port	PVLP/PVLA	LS A/B port
11169243	Metric Flange 1″	3 PVLP/PVLA	G1/4"BSP
11169251	G1-1/4" BSP	3 PVLP/PVLA	G1/4"BSP
11169247	SAE Flange 1″ UNF	3 PVLP/PVLA	7/16-20 UNF
11177018	Thread Ports 1-5/8 UNF	3 PVLP/PVLA	7/16-20 UNF

PVB 256 Variant Overview

PVB 256 3-way Compensator with LS A/B, PVLP and Turbo

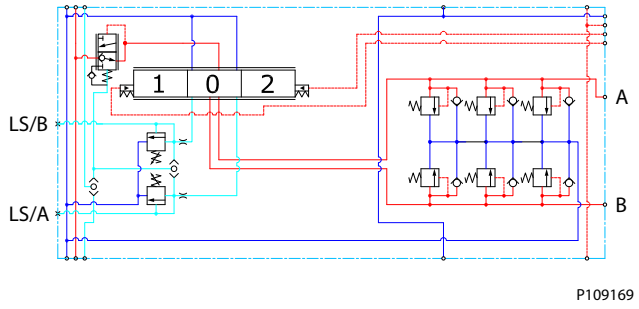
The compensated PVB is intended for controlling a work function where the function behavior in terms of flow and pressures requires independency on the load pressure of other functions used simultaneously.

The integrated LS A/B relief valves are used to limit the maximum work port pressure on the A and B-ports individually.

Featuring 3xPVLP shock/anti-cavitation valves on each work port for pressure peak protection and anti-cavitation prevention.

The compensator is a 3-way type which include load drop check valve functionality, compensator function and neutral relief which avoid A and B port pressure build up in neutral.

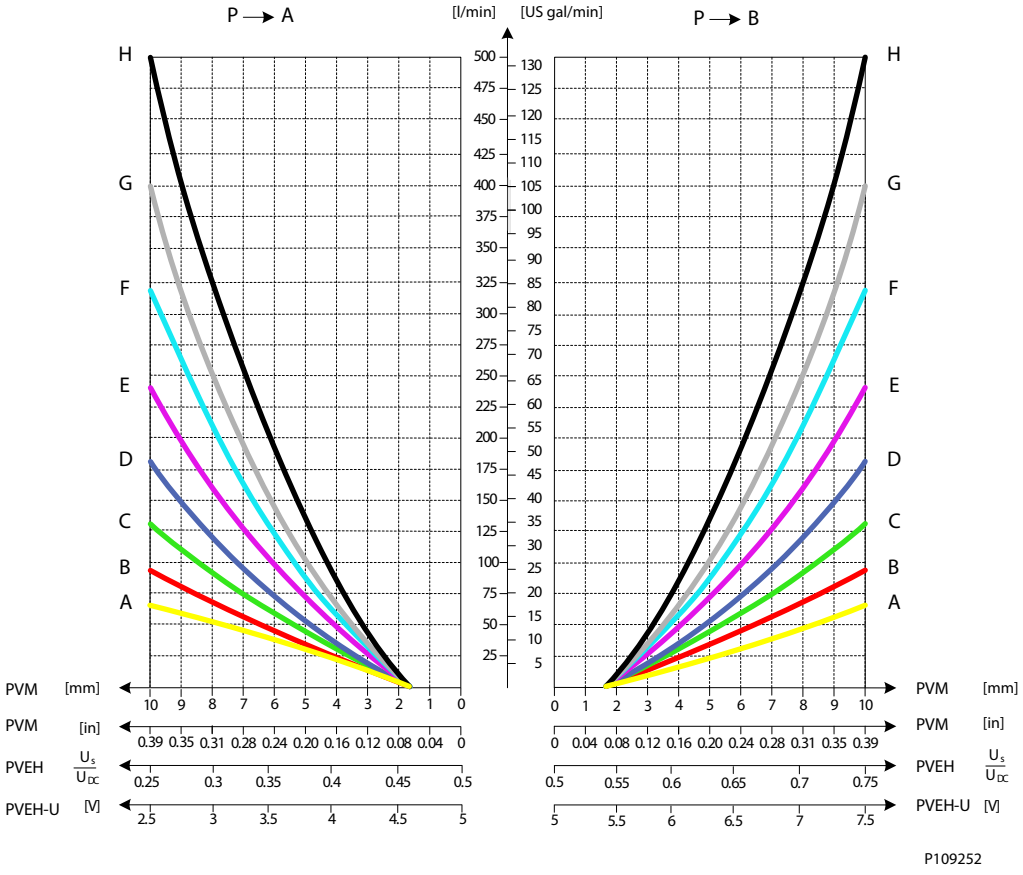
Schematic



PVB 256 Variant Overview

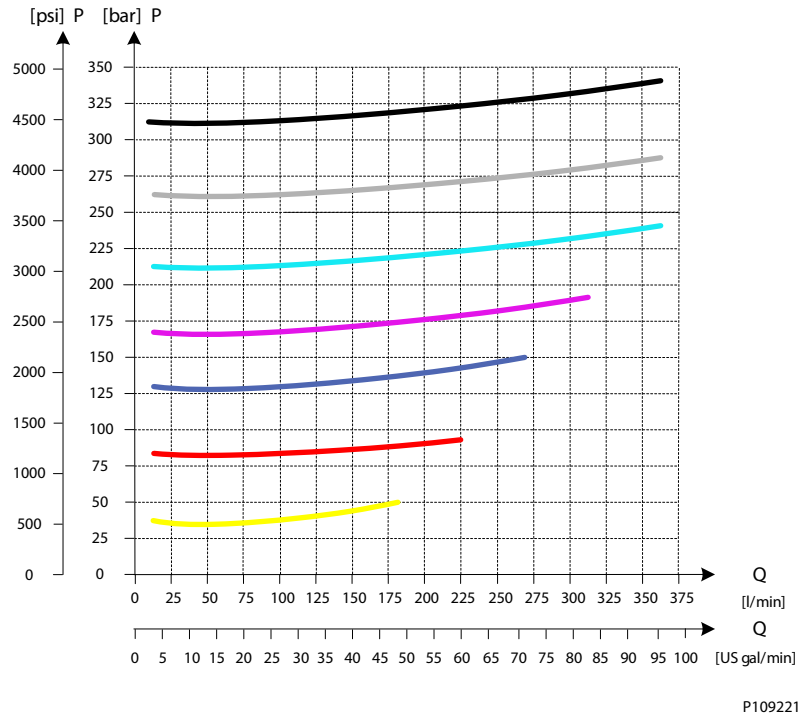
Performance

Oil Flow as Function of Spool Travel

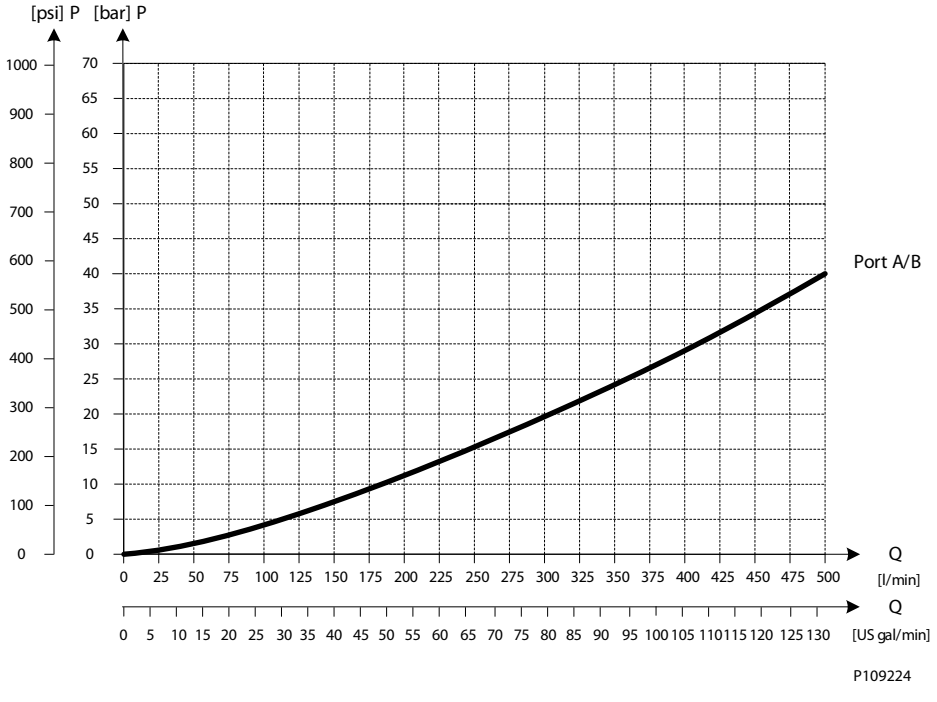


PVB 256 Variant Overview

3xPVLP Shock Valve

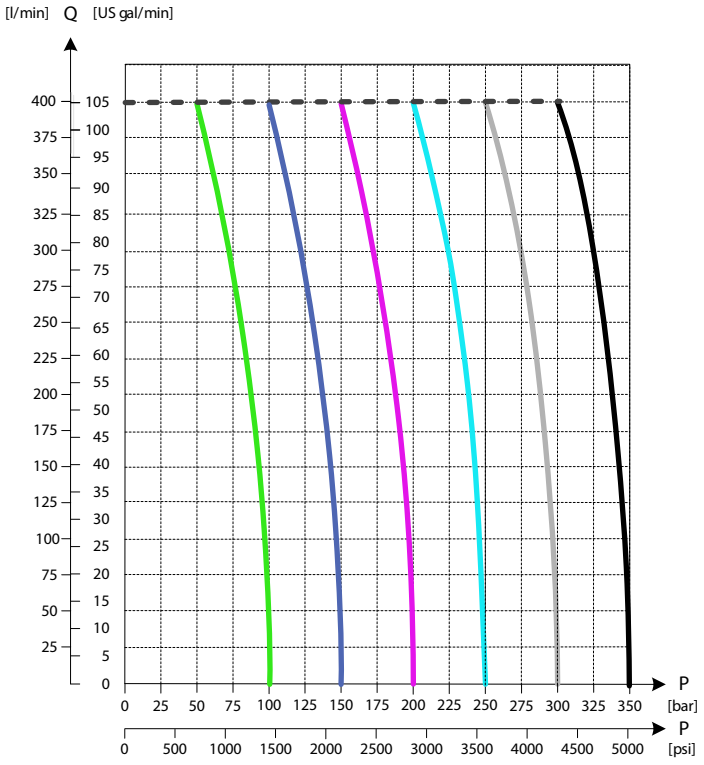


3xPVLA Suction Valve

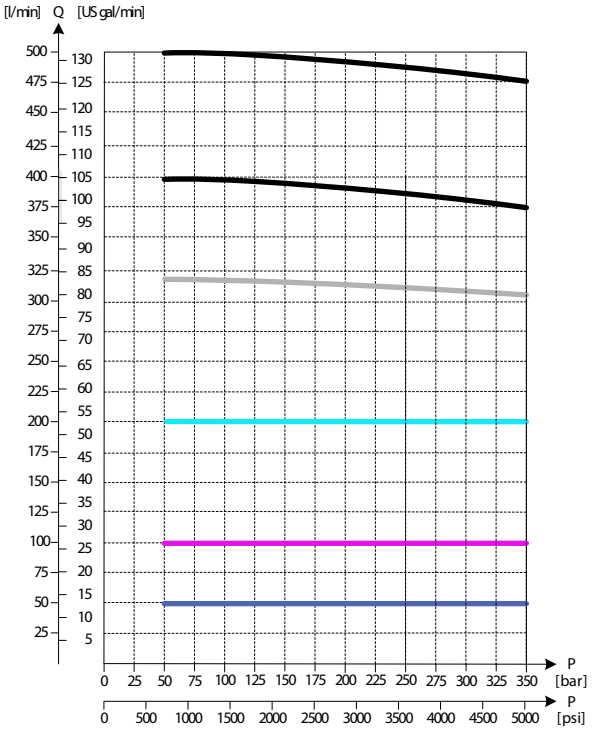


PVB 256 Variant Overview

LS A/B Pressure Limitation

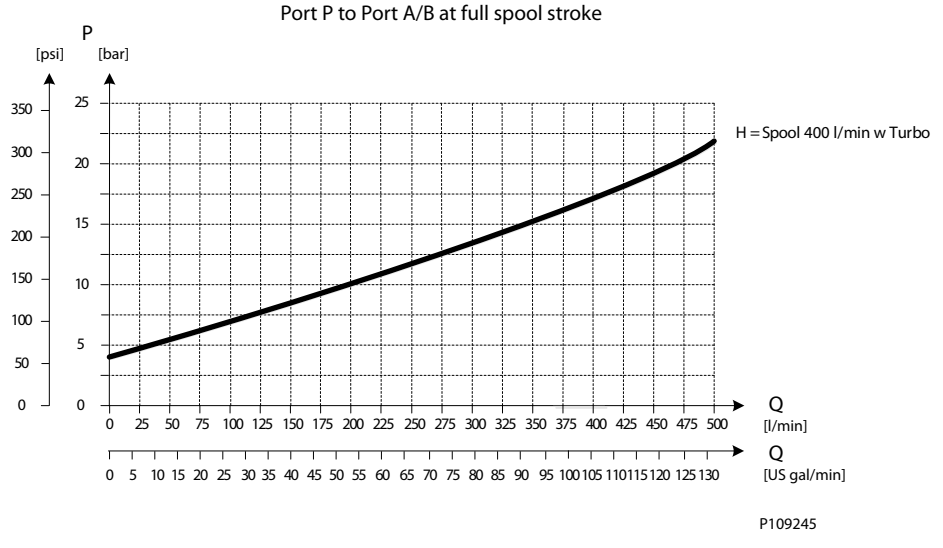


Load Independent Oil Flow, Pressure Compensated



PVB 256 Turbo Upstream Performance

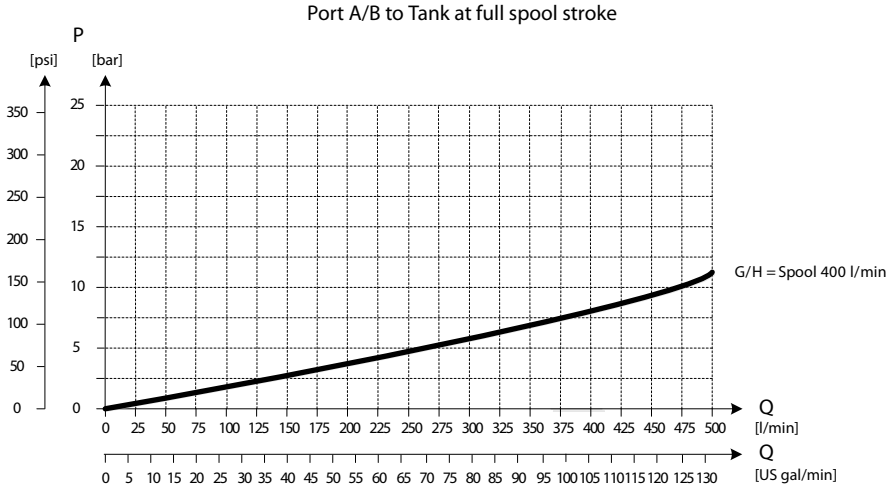
Port P to Port A/B at full spool stroke



PVB 256 Variant Overview

PVB 256 Downstream Performance

Port A/B to Tank at full spool stroke



Technical data

Max. rated pressure	P-port continuous	350 bar	[5076 psi]
	P-port intermittent	400 bar	[5800 psi]
	T-port static/dynamic	25/40 bar	[363/580 psi]
Max. rated flow	A/B port	500 l/min	[132 US gal/min]
Oil temperature	Recommended	30 to 60°C	[86 to 140°F]
	Minimum	-30°C	[-22°F]
	Maximum	90°	[194°F]
Ambient temperature	Recommended	-30 to 60°C	[-22 to 140°F]
Oil viscosity	Operating range	12 to 75 mm^2/s	[65 to 347 SUS]
	Minimum	4 mm^2/s	[39 SUS]
	Maximum	460 mm^2/s	[2128 SUS]
Oil contamination according to ISO 4406	Maximum	23/19/16	

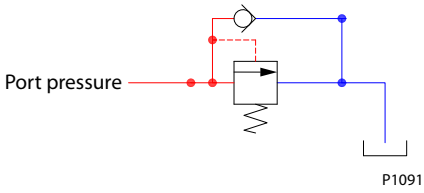
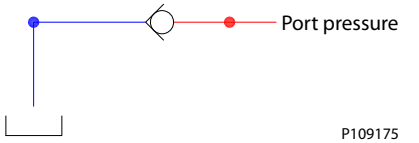
Part number	A/B port	PVLP/PVLA	LS A/B port
11183379	Metric Flange 1"	3 PVLP/PVLA	G1/4"BSP
11183406	G1-1/4" BSP	3 PVLP/PVLA	G1/4"BSP
11183404	SAE Flange 1" UNF	3 PVLP/PVLA	7/16-20 UNF
11183402	Thread Ports 1-5/8 UNF	3 PVLP/PVLA	7/16-20 UNF

PVLP Shock and PVLA Suction Valves

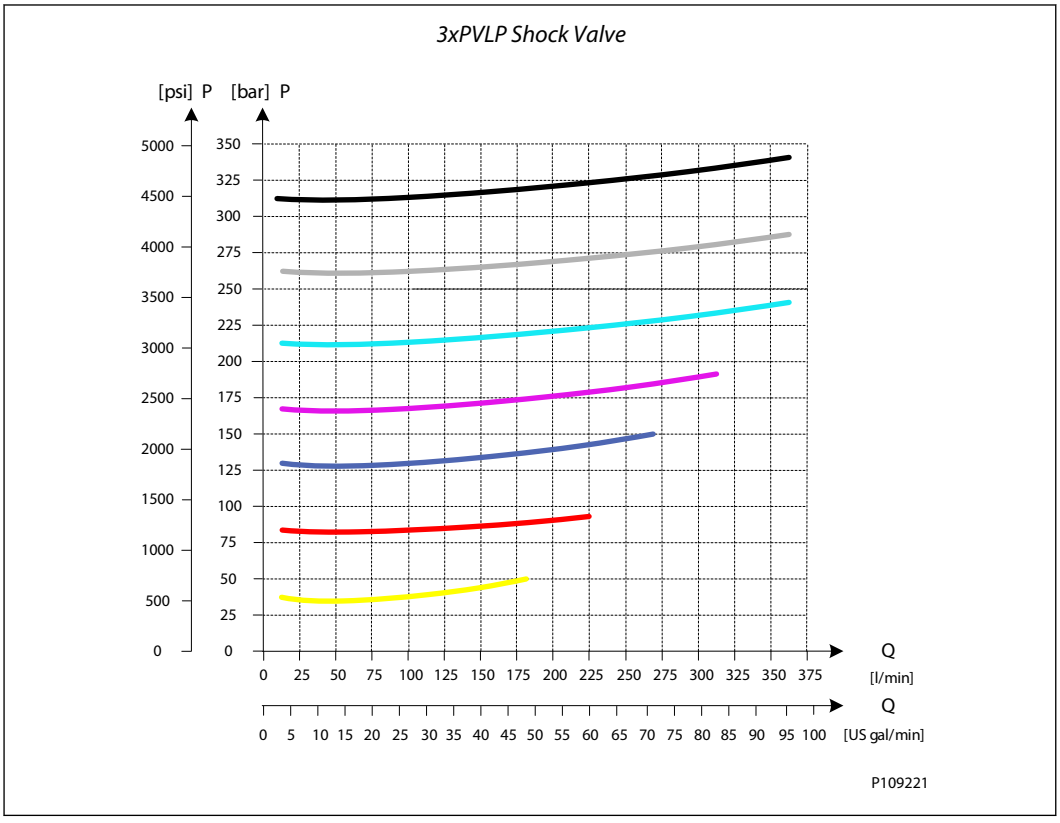
PVLP is set at an oil flow of 10 l/min [2.6 US gal/min] per unit.

The shock valve PVLP is designed to absorb shock effects. Consequently, it should not be used as a pressure relief valve.

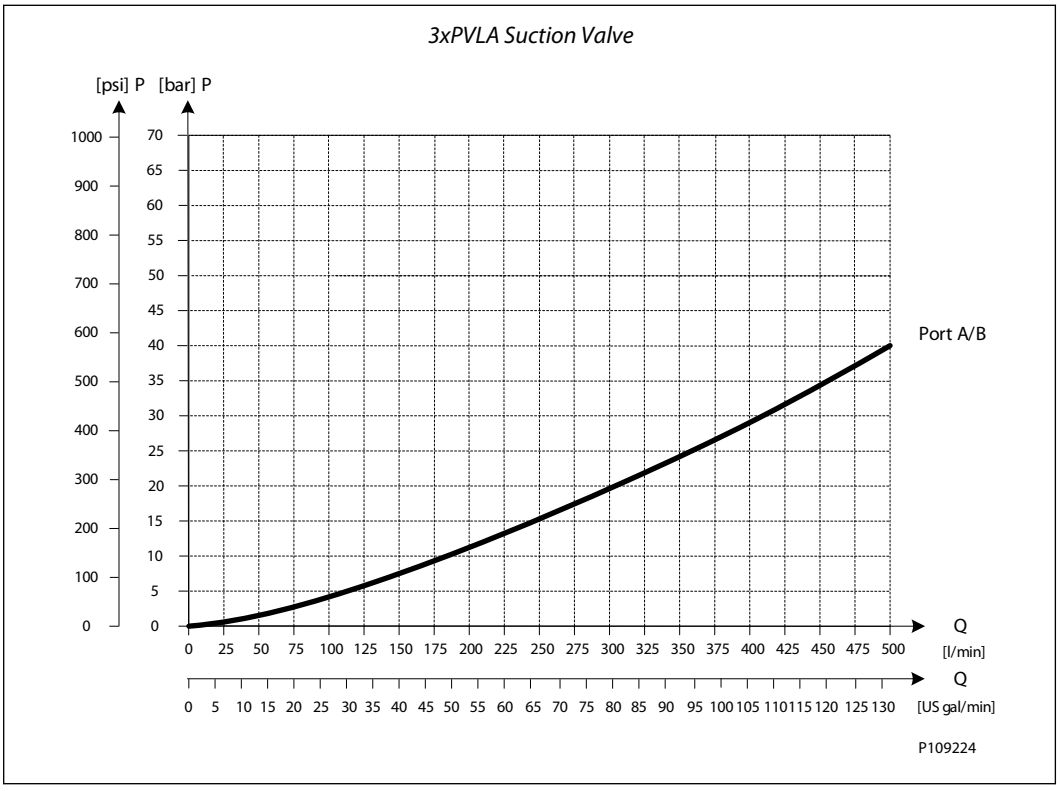
If the working function requires the use of a pressure relief valve, a PVB basic module with built-in LSA/B pressure limiting valve should be used.

PVLP schematic	PVLA schematic
	

3xPVLP Performance



PVLP Shock and PVLA Suction Valves



Technical data

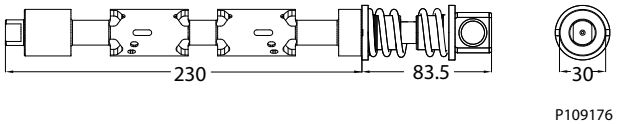
Oil temperature	Recommended	30 to 60°C	[86 to 140°F]
	Minimum	-30°C	[-22°F]
	Maximum	90°	[194°F]
Ambient temperature	Recommended	-30 to 60°C	[-22 to 140°F]
Oil viscosity	Operating range	12 to 75 mm^2/s	[65 to 347 SUS]
	Minimum	4 mm^2/s	[39 SUS]
	Maximum	460 mm^2/s	[2128 SUS]
Oil contamination according to ISO 4406	Maximum	23/19/16	

PVLP Shock and PVLA Suction Valves

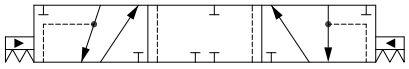
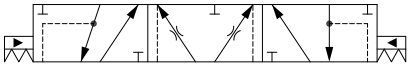
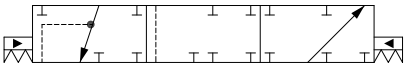
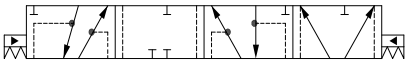
Ordering information

Description	Pressure setting in bar	Part number
PVLA	-	157B2001
PVLP	32	157B2032
	50	157B2050
	63	157B2063
	80	157B2080
	100	157B2100
	125	157B2125
	140	157B2140
	150	157B2150
	160	157B2160
	175	157B2175
	190	157B2190
	210	157B2210
	230	157B2230
	240	157B2240
	250	157B2250
	265	157B2265
	280	157B2280
	300	157B2300
	320	157B2320
	350	157B2350
	380	157B2380
PLUG	-	157B2002

PVBS PVE Electric Activation and/or Mechanical

PVBS 128/256	Dimensions (mm)
	 P109176

PVBS Variant Overview for PVB 128/256

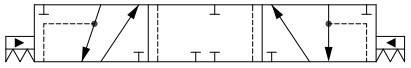
Symbol	Description
 P109177	*Standard FC spools closed neutral position* • 4-way, 3-position • Closed neutral position • Flow Control AB • Spools from 65 to 240 l/min only to be used with PVB 128 • Spools above 240 l/min to be used with PVB 256
 P109178	*Standard FC spools Throttled open neutral position* • 4-way, 3-position • Throttled open neutral position • Flow Control AB • Spools from 65 to 240 l/min to be used with PVB 128 • Spools above 240 l/min only to be used with PVB 256
 P109179	*Standard FC spools single acting closed neutral position* • 3-way, 3-position • Closed neutral position • Flow Control B • Spools from 65 to 240 l/min to be used with PVB 128 • Spools above 240 l/min only to be used with PVB 256
 P109180	*Standard FC spools float A closed neutral position* • 4-way, 3-position • Closed neutral position • Flow Control AB • Float P→A→F • Spools from 65 to 240 l/min to be used with PVB 128 • Spools above 240 l/min only to be used with PVB 256

PVBS PVE Electric Activation and/or Mechanical

Flow Control PVBS closed neutral position for PVB 128/256

Schematic

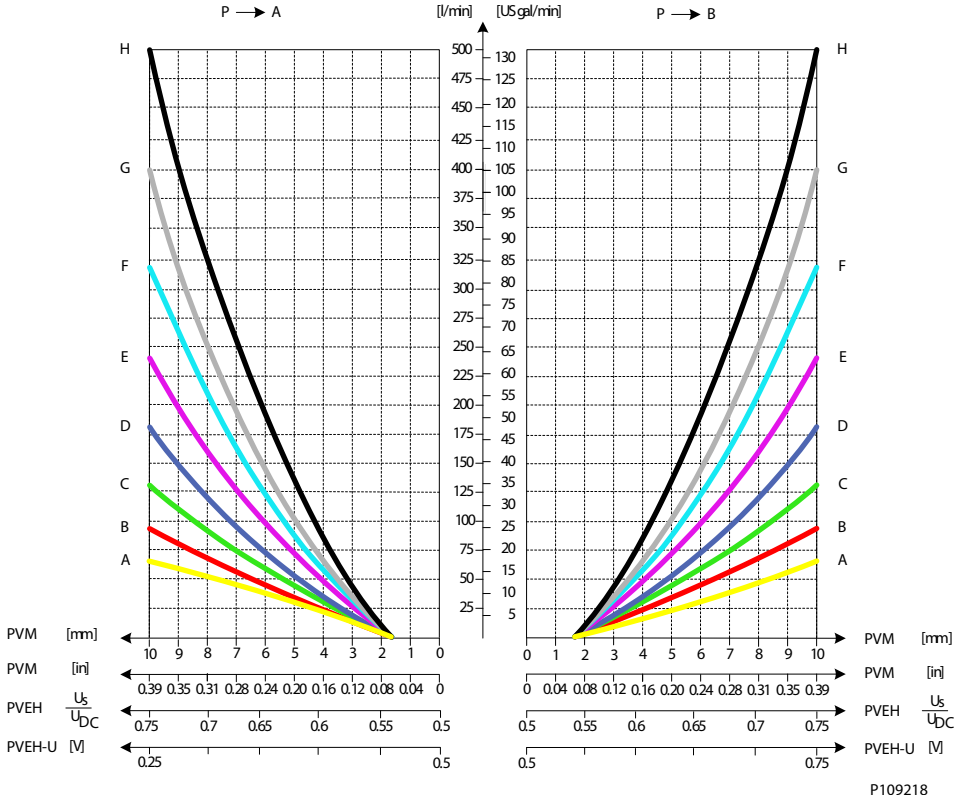
4-way, 3-position Closed Neutral Position



P109177

Performance

Oil Flow as Function of Spool Travel



P109218

Technical data

Oil temperature	Recommended	30 to 60°C	[86 to 140°F]
	Minimum	-30°C	[-22°F]
	Maximum	90°	[194°F]
Ambient temperature	Recommended	-30 to 60°C	[-22 to 140°F]
Oil viscosity	Operating range	12 to 75 mm^2/s	[65 to 347 SUS]
	Minimum	4 mm^2/s	[39 SUS]
	Maximum	460 mm^2/s	[2128 SUS]
Oil contamination according to ISO 4406	Maximum	23/19/16	

PVBS PVE Electric Activation and/or Mechanical

Part number	A→T	P→A	P→B	B→T	Flow Control	Dead band
	(l/min)					
11177686	65	65	65	65	FC AB	1.7 mm
11177738	95	95	95	95	FC AB	1.7 mm
11177750	130	130	130	130	FC AB	1.7 mm
11177448	180	180	180	180	FC AB	1.7 mm
11177798	240	240	240	240	FC AB	1.7 mm
11178733	320	320	320	320	FC AB	1.7 mm
11177058*	400	400	400	400	FC AB	1.7 mm

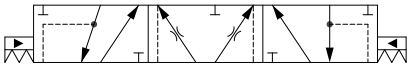
* Up to 500 l/min in combination with PVB 256 3-way Turbo Compensator feature

PVBS PVE Electric Activation and/or Mechanical

Flow Control PVBS Throttled Open Neutral Position for PVB 128/256

Schematic

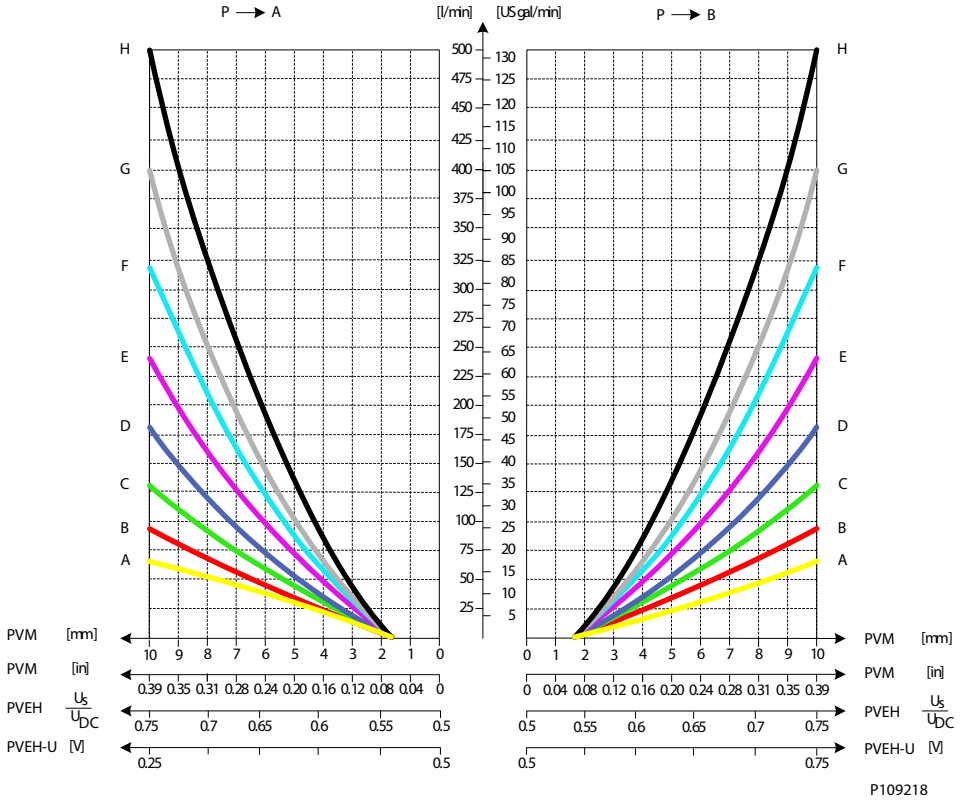
Standard FC spools Throttled open neutral position



P109178

Performance

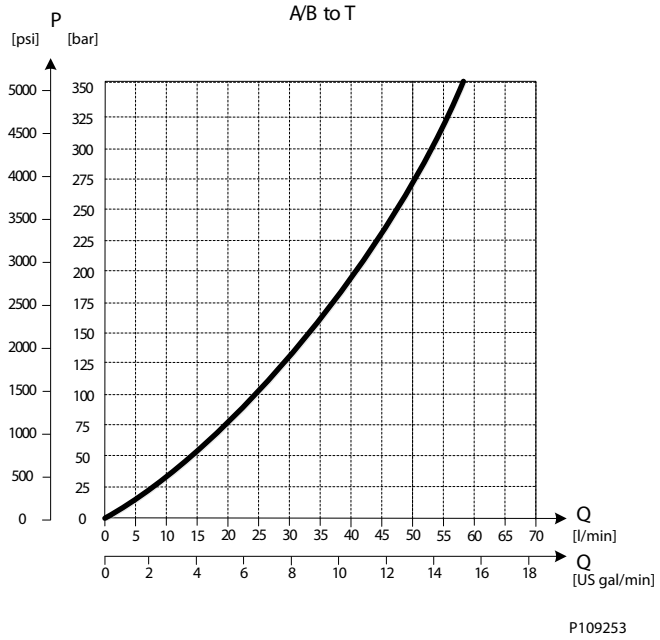
Oil Flow as Function of Spool Travel



P109218

PVBS PVE Electric Activation and/or Mechanical

Pressure drop for open spool in neutral position



Technical data

Oil temperature	Recommended	30 to 60°C	[86 to 140°F]
	Minimum	-30°C	[-22°F]
	Maximum	90°	[194°F]
Ambient temperature	Recommended	-30 to 60°C	[-22 to 140°F]
Oil viscosity	Operating range	12 to 75 mm^2/s	[65 to 347 SUS]
	Minimum	4 mm^2/s	[39 SUS]
	Maximum	460 mm^2/s	[2128 SUS]
Oil contamination according to ISO 4406	Maximum	23/19/16	

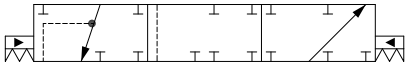
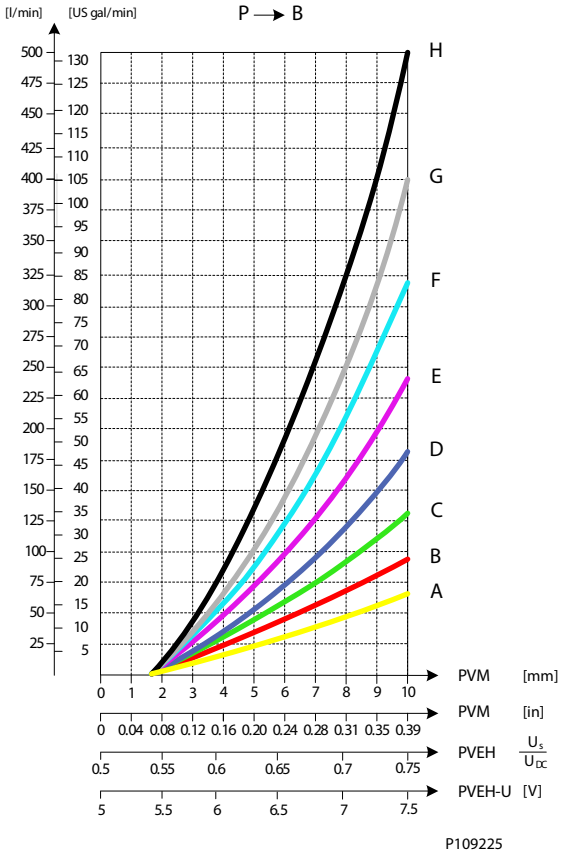
Part number	A→T	P→A	P→B	B→T	Flow Control	Dead band
	(l/min)					
[1]	65	65	65	65	FC AB	1.7 mm
11182537	95	95	95	95	FC AB	1.7 mm
11178290	130	130	130	130	FC AB	1.7 mm
11178310	180	180	180	180	FC AB	1.7 mm
11182619	240	240	240	240	FC AB	1.7 mm
11182618	320	320	320	320	FC AB	1.7 mm
11182617[2]	400	400	400	400	FC AB	1.7 mm

[1] Please contact your Danfoss Power Solutions representative if one of these variants is needed.

[2] Up to 500 l/min in combination with PVB 256 3-way Turbo Compensator feature

PVBS PVE Electric Activation and/or Mechanical

Flow Control PVBS 3-way, 3-position for PVB 128/256

Schematic	Performance
3-way, 3-position Closed Neutral Position P→B  P109179	 P109225

Technical data

Oil temperature	Recommended	30 to 60°C	[86 to 140°F]
	Minimum	-30°C	[-22°F]
	Maximum	90°	[194°F]
Ambient temperature	Recommended	-30 to 60°C	[-22 to 140°F]
Oil viscosity	Operating range	12 to 75 mm^2/s	[65 to 347 SUS]
	Minimum	4 mm^2/s	[39 SUS]
	Maximum	460 mm^2/s	[2128 SUS]
Oil contamination according to ISO 4406	Maximum	23/19/16	

Part number	A→T	P→A	P→B	B→T	Flow Control	Dead band
	(l/min)					
1	-	-	65	65	FC AB	1.7 mm
1	-	-	95	95	FC AB	1.7 mm
1	-	-	130	130	FC AB	1.7 mm
1	-	-	180	180	FC AB	1.7 mm
1	-	-	240	240	FC AB	1.7 mm

PVBS PVE Electric Activation and/or Mechanical

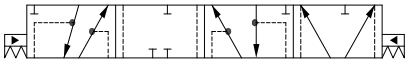
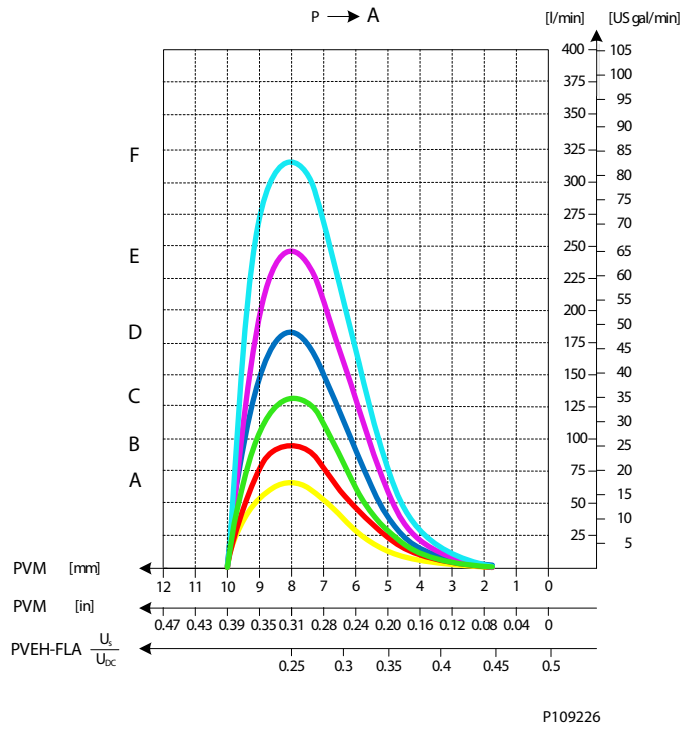
Part number	A→T	P→A	P→B	B→T	Flow Control	Dead band
	(l/min)					
[1]	-	-	320	320	FC AB	1.7 mm
[12]	-	-	400	400	FC AB	1.7 mm

[1] Please contact your Danfoss Power Solutions representative if one of these variants is needed.

[2] Up to 500 l/min in combination with PVB 256 3-way Turbo Compensator feature

PVBS PVE Electric Activation and/or Mechanical

Flow Control PVBS with Float for PVB 128/256

Schematic	Performance
Standard FC spools float A closed neutral position  P109180	 P109226

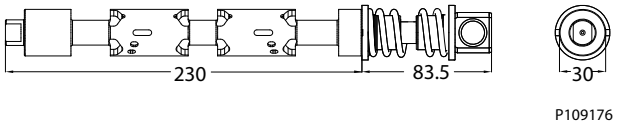
Technical data

Oil temperature	Recommended	30 to 60°C	[86 to 140°F]
	Minimum	-30°C	[-22°F]
	Maximum	90°	[194°F]
Ambient temperature	Recommended	-30 to 60°C	[-22 to 140°F]
Oil viscosity	Operating range	12 to 75 mm^2/s	[65 to 347 SUS]
	Minimum	4 mm^2/s	[39 SUS]
	Maximum	460 mm^2/s	[2128 SUS]
Oil contamination according to ISO 4406	Maximum	23/19/16	

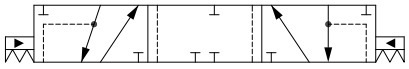
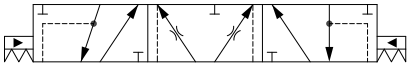
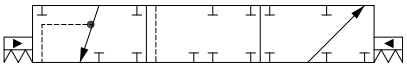
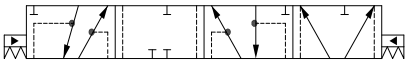
Part number	A→T	P→A	P→B	B→T	Flow Control	Dead band
	(l/min)					
[1]	65	65	65	65	FC AB	1.7 mm
[1]	95	95	95	95	FC AB	1.7 mm
[1]	130	130	130	130	FC AB	1.7 mm
[1]	180	180	180	180	FC AB	1.7 mm
[1]	240	240	240	240	FC AB	1.7 mm
[1]	320	320	320	320	FC AB	1.7 mm

[1] Please contact your Danfoss Power Solutions representative if one of these variants is needed.

Hydraulic Activation and/or Mechanical

PVBS 128/256	Dimensions (mm)
	 P109176

PVBS Variant Overview for PVB 128/256

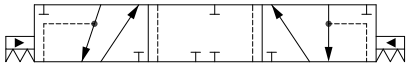
Symbol	Description
 P109177	*Standard FC spools closed neutral position* • 4-way, 3-position • Closed neutral position • Flow Control AB • Spools from 65 to 240 l/min to be used with PVB 128 • Spools above 240 l/min only to be used with PVB 256
 P109178	*Standard FC spools Throttled open neutral position* • 4-way, 3-position • Throttled open neutral position • Flow Control AB • Spools from 65 to 240 l/min to be used with PVB 128 • Spools above 240 l/min only to be used with PVB 256
 P109179	*Standard FC spools single acting closed neutral position* • 3-way, 3-position • Closed neutral position • Flow Control B • Spools from 65 to 240 l/min to be used with PVB 128 • Spools above 240 l/min only to be used with PVB 256
 P109180	*Standard FC spools float A closed neutral position* • 4-way, 3-position • Closed neutral position • Flow Control AB • Float P→A→F • Spools from 65 to 240 l/min to be used with PVB 128 • Spools above 240 l/min only to be used with PVB 256

Hydraulic Activation and/or Mechanical

Flow Control PVBS closed neutral position for PVB 128/256

Schematic

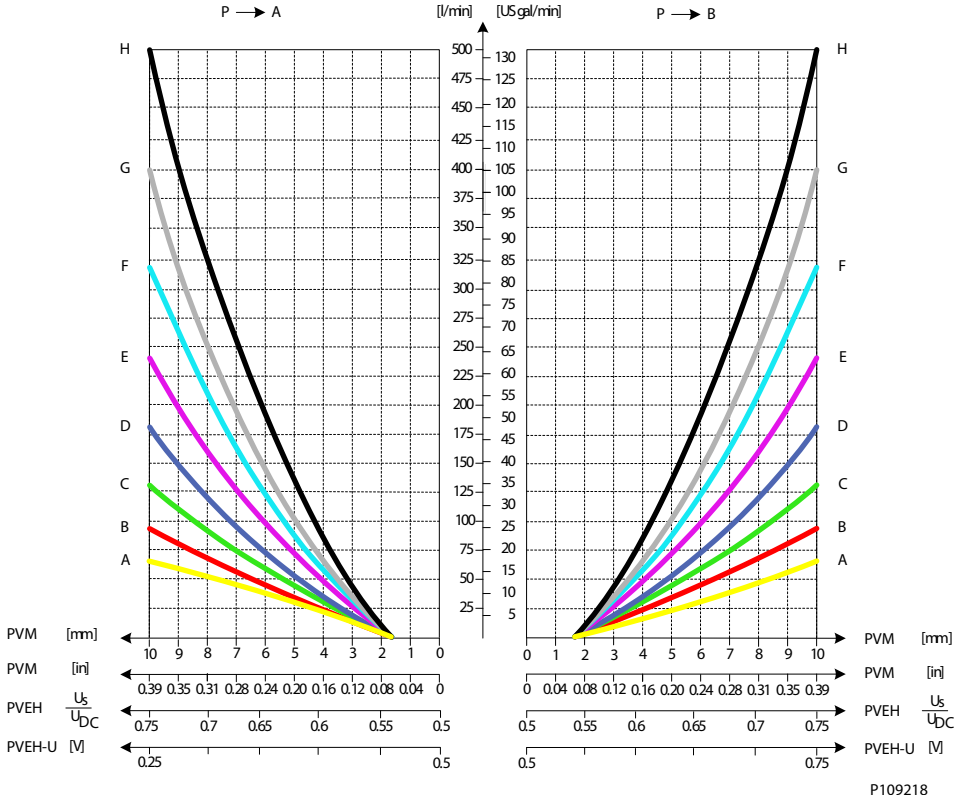
4-way, 3-position Closed Neutral Position



P109177

Performance

Oil Flow as Function of Spool Travel



P109218

Technical data

Oil temperature	Recommended	30 to 60°C	[86 to 140°F]
	Minimum	-30°C	[-22°F]
	Maximum	90°	[194°F]
Ambient temperature	Recommended	-30 to 60°C	[-22 to 140°F]
Oil viscosity	Operating range	12 to 75 mm^2/s	[65 to 347 SUS]
	Minimum	4 mm^2/s	[39 SUS]
	Maximum	460 mm^2/s	[2128 SUS]
Oil contamination according to ISO 4406	Maximum	23/19/16	

Hydraulic Activation and/or Mechanical

Part number	A→T	P→A	P→B	B→T	Flow Control	Dead band
	(l/min)					
11184159	65	65	65	65	FC AB	1.7 mm
11178602	95	95	95	95	FC AB	1.7 mm
11182643	130	130	130	130	FC AB	1.7 mm
11182640	180	180	180	180	FC AB	1.7 mm
11182638	240	240	240	240	FC AB	1.7 mm
11182635	320	320	320	320	FC AB	1.7 mm
11182621*	400	400	400	400	FC AB	1.7 mm

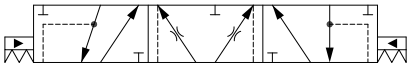
* Up to 500 l/min in combination with PVB 256 3-way Turbo Compensator feature

Hydraulic Activation and/or Mechanical

Flow Control PVBS Throttled open neutral position for PVB 128/256

Schematic

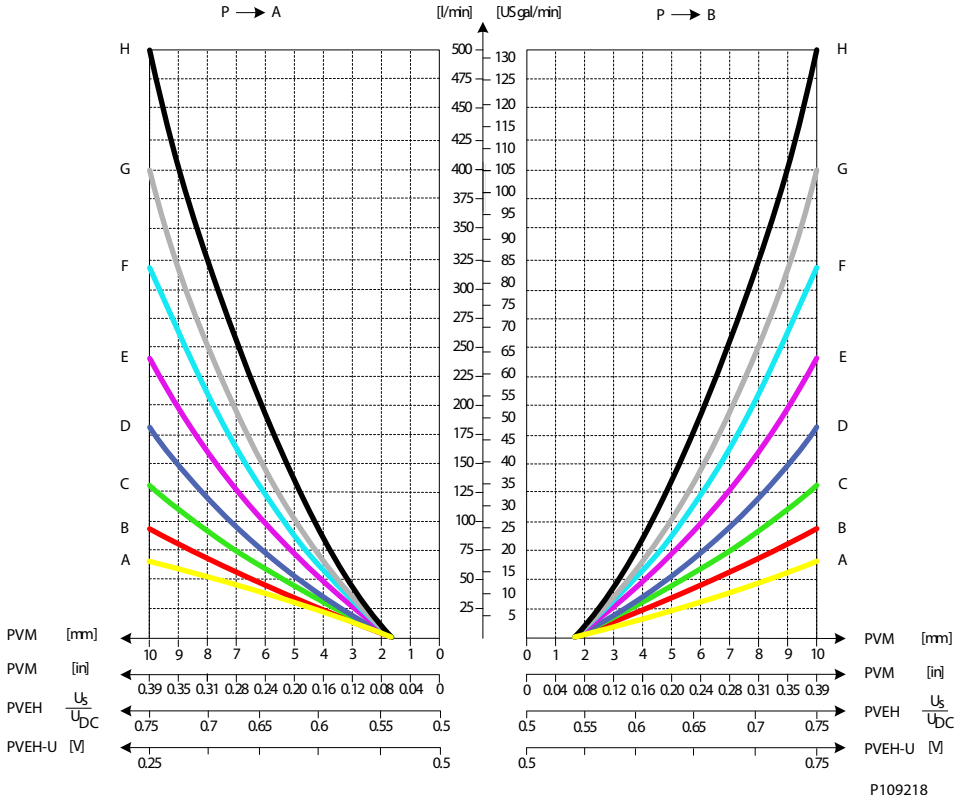
4-way, 3-position Throttled Open Neutral Position



P109178

Performance

Oil Flow as Function of Spool Travel



P109218

Technical data

Oil temperature	Recommended	30 to 60°C	[86 to 140°F]
	Minimum	-30°C	[-22°F]
	Maximum	90°	[194°F]
Ambient temperature	Recommended	-30 to 60°C	[-22 to 140°F]
Oil viscosity	Operating range	12 to 75 mm^2/s	[65 to 347 SUS]
	Minimum	4 mm^2/s	[39 SUS]
	Maximum	460 mm^2/s	[2128 SUS]
Oil contamination according to ISO 4406	Maximum	23/19/16	

Hydraulic Activation and/or Mechanical

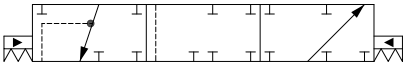
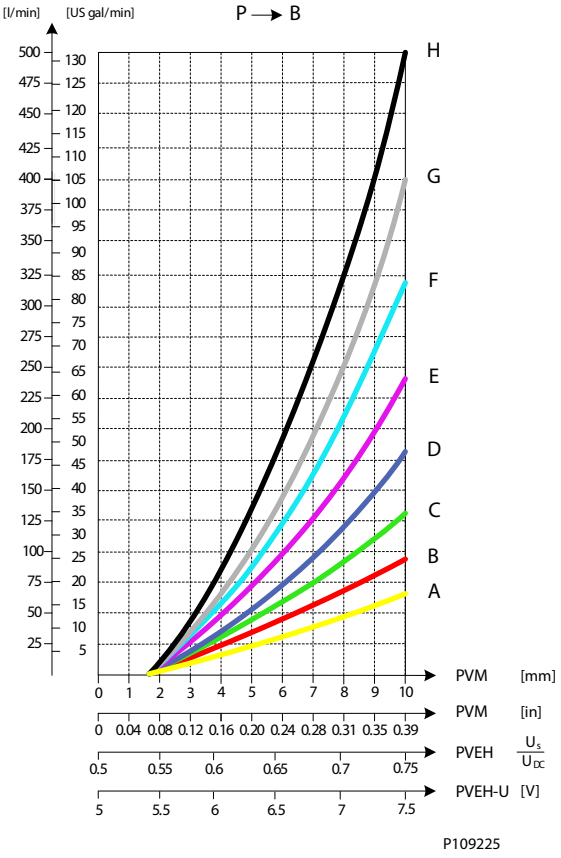
Part number	A→T	P→A	P→B	B→T	Flow Control	Dead band
	(l/min)					
[1]	65	65	65	65	FC AB	1.7 mm
11183604	95	95	95	95	FC AB	1.7 mm
11183602	130	130	130	130	FC AB	1.7 mm
11183441	180	180	180	180	FC AB	1.7 mm
11178318	240	240	240	240	FC AB	1.7 mm
11180718	320	320	320	320	FC AB	1.7 mm
11178984[2]	400	400	400	400	FC AB	1.7 mm

[1] Please contact your Danfoss Power Solutions representative if one of these variants is needed.

[2] Up to 500 l/min in combination with PVB 256 3-way Turbo Compensator feature

Hydraulic Activation and/or Mechanical

Flow Control PVBS 3-way, 3-position for PVB 128/256

Schematic	Performance
3-way, 3-position Closed Neutral Position P→B  P109179	 P109225

Technical data

Oil temperature	Recommended	30 to 60°C	[86 to 140°F]
	Minimum	-30°C	[-22°F]
	Maximum	90°	[194°F]
Ambient temperature	Recommended	-30 to 60°C	[-22 to 140°F]
Oil viscosity	Operating range	12 to 75 mm^2/s	[65 to 347 SUS]
	Minimum	4 mm^2/s	[39 SUS]
	Maximum	460 mm^2/s	[2128 SUS]
Oil contamination according to ISO 4406	Maximum	23/19/16	

Part number	A→T	P→A	P→B	B→T	Flow Control	Dead band
	(l/min)					
1	-	-	65	65	FC AB	1.7 mm
1	-	-	95	95	FC AB	1.7 mm
1	-	-	130	130	FC AB	1.7 mm
1	-	-	180	180	FC AB	1.7 mm
1	-	-	240	240	FC AB	1.7 mm

Hydraulic Activation and/or Mechanical

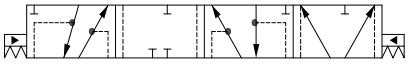
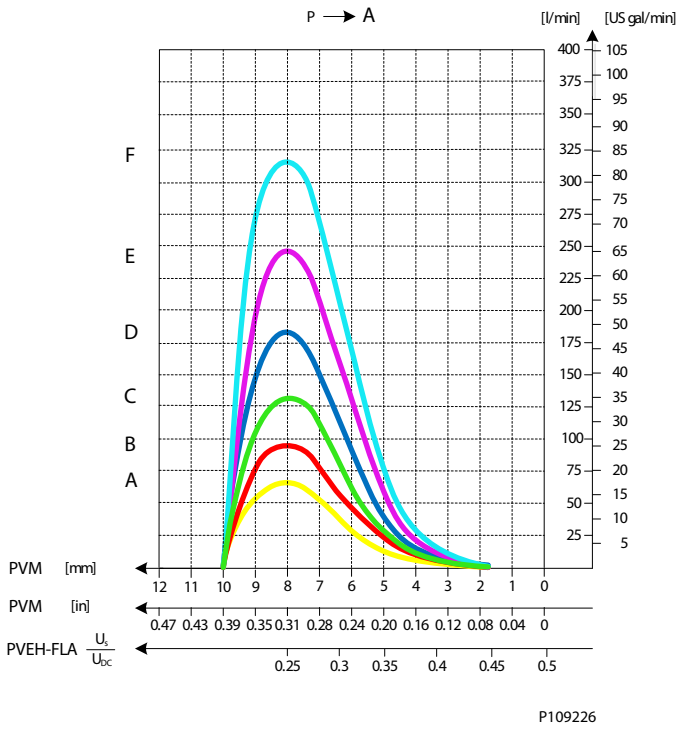
Part number	A→T	P→A	P→B	B→T	Flow Control	Dead band
	(l/min)					
[1]	-	-	320	320	FC AB	1.7 mm
[12]	-	-	400	400	FC AB	1.7 mm

[1] Please contact your Danfoss Power Solutions representative if one of these variants is needed.

[2] Up to 500 l/min in combination with PVB 256 3-way Turbo Compensator feature

Hydraulic Activation and/or Mechanical

Flow Control PVBS with Float for PVB 128/256

Schematic	Performance
Standard FC spools float A closed neutral position  P109180	

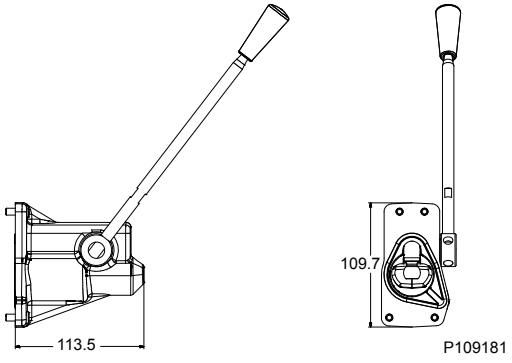
Technical data

Oil temperature	Recommended	30 to 60°C	[86 to 140°F]
	Minimum	-30°C	[-22°F]
	Maximum	90°	[194°F]
Ambient temperature	Recommended	-30 to 60°C	[-22 to 140°F]
Oil viscosity	Operating range	12 to 75 mm^2/s	[65 to 347 SUS]
	Minimum	4 mm^2/s	[39 SUS]
	Maximum	460 mm^2/s	[2128 SUS]
Oil contamination according to ISO 4406	Maximum	23/19/16	

Part number	A→T	P→A	P→B	B→T	Flow control	Dead band
	(l/min)					
[1]	65	65	65	65	FC AB	1.7 mm
[1]	95	95	95	95	FC AB	1.7 mm
[1]	130	130	130	130	FC AB	1.7 mm
[1]	180	180	180	180	FC AB	1.7 mm
[1]	240	240	240	240	FC AB	1.7 mm
[1]	320	320	320	320	FC AB	1.7 mm

[1] Please contact your Danfoss Power Solutions representative if one of these variants is needed.

PVM Manual Activation

PVM	Dimensions (mm)
	

The PVM manual activation cover is intended for use on any work section where the operator has to have the ability to interact with the spool manually.

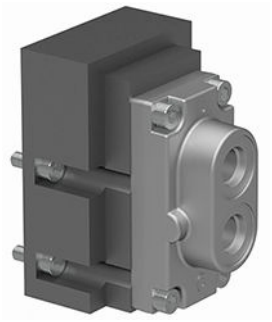
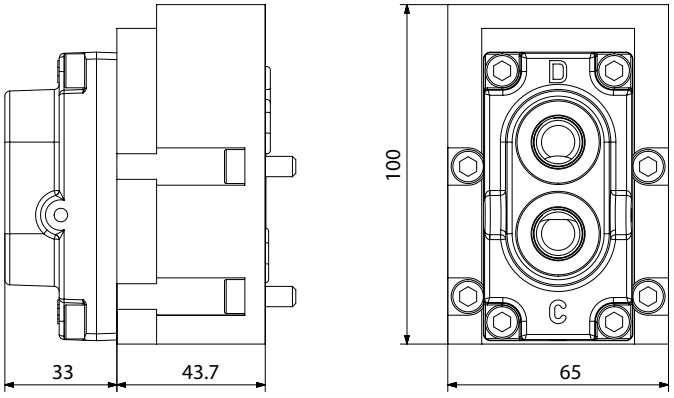
The adjustment screws are intended for limiting the spool travel and thereby the maximum achievable flow.

Technical data

Spool displacement		Torque	
From neutral position	PVM+PVMD	12 N·m	106 lb·ft
	PVM+PVE	12 N·m	106 lb·ft
	PVM+PVH	30 N·m	365 lb·ft
Max. spool travel	PVM+PVMD	30 N·m	365 lb·ft
	PVM+PVE	30 N·m	365 lb·ft
	PVM+PVH	91 N·m	805 lb·ft
Standard Control Range		30°	
Control lever range + float position		37°	

Part number	Material	Adjustment screws	Lever base and lever	B-port Gauge
11176644	Cast iron	-	Yes	No
11175317	Cast iron	Yes	Yes	G1/8" BSP
11176635	Cast iron	Yes	Yes	3/8"-24 UNF

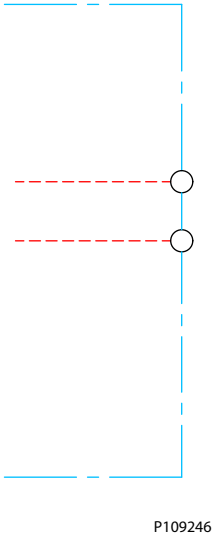
PVH Hydraulic Actuation

PVH 128/256	Dimensions (mm)
	

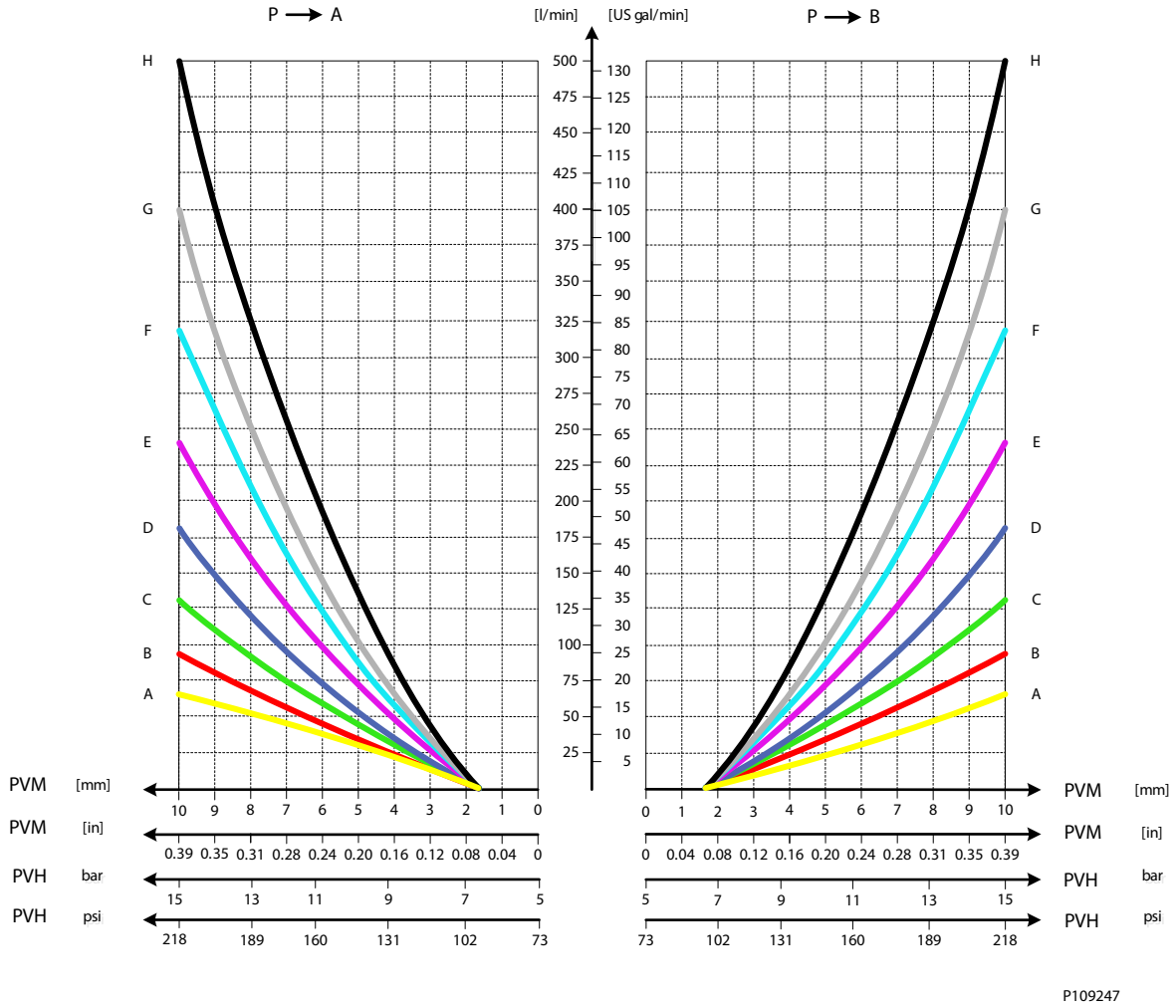
The PVH hydraulic activation cover is intended for use on any work section where the operator wants to have a possibility to interact with the main spool via a hydraulic joystick.

Inlet with Hydraulic Pilot Pressure is needed.

PVH schematic



PVH Hydraulic Actuation

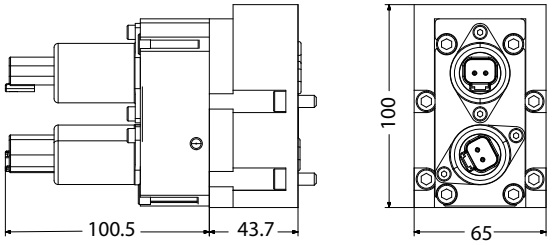


Technical data

Main Spool Spring control pressure range	5 – 15 bar	[73 – 218 psi]
Pilot oil pressure range between 20 and 25 bar	20 – 25 bar	[290 – 362 psi]
Max. pressure on port T (the hydraulic remote control lever should be connected directly to tank).	10 bar	[145 psi]

Part number	Material	Connection
11187777	Aluminum	G1/4" BSP
11187776	Aluminum	9/16"-18 UNF

PVHC Electro-Hydraulic Actuator type

PVHC	Dimensions (mm)
	

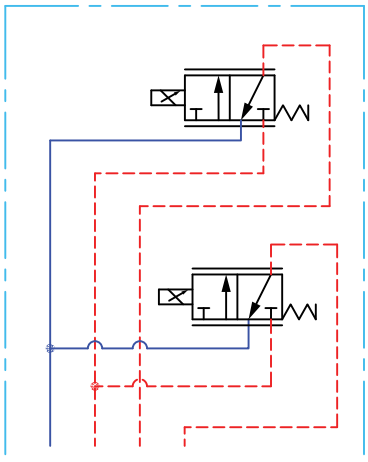
The PVHC is an electrical actuator module for main spool control.

The PVHC control is done by dual Pulse Width Modulated (PVM) high current supply 100-400 Hz PWM control signals.

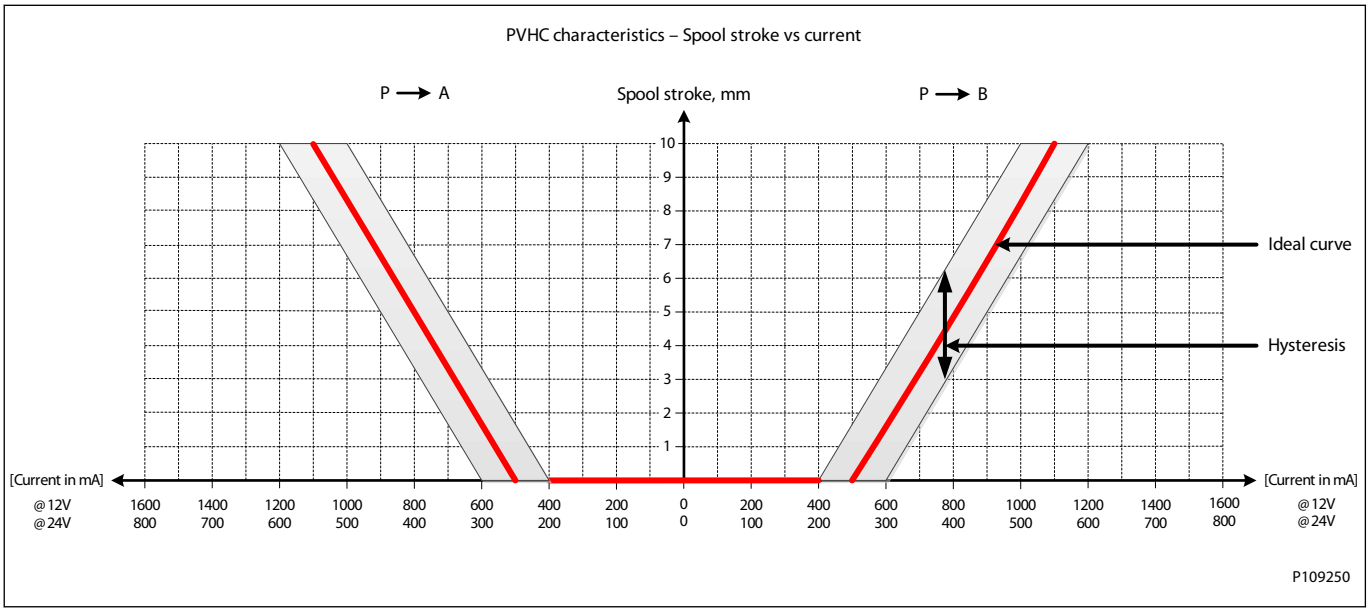
The hysteresis is affected by viscosity, friction, flow forces, dither frequency and modulation frequency. The spool position will shift when conditions are changed such as temperature change.

Inlet with Hydraulic Pilot Pressure is needed.

Dither frequency with a certain amplitude is needed for optimal application performance.

Schematic


PVHC Electro-Hydraulic Actuator type

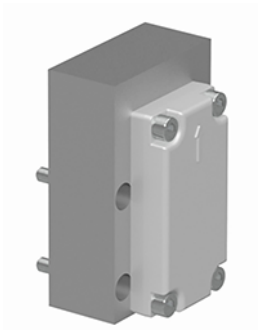
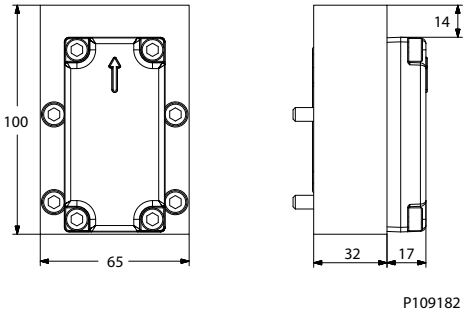


Technical data

Main Spool Spring control pressure range	5-15 bar	[73-218 psi]
Pilot oil pressure range between 20 and 25 bar	20-25 bar	[290-362 psi]
Max. pressure on port T	10 bar	[145 psi]
PVHC 12 Volt Current Input	0-1500 mA	
PVHC 24 Volt Current Input	0-750 mA	
Ambient Temperature Range	-30°C to 80°C	[-22 °F to 176°F]
Medium Temperature Range	-20°C to 80°C	[-4 °F to 176°F]
Oil contamination according to ISO 4406 Maximum	23/19/16	

Part number	Power supply	Connector type
11187757	12V	AMP
11187772	12V	DEUTSCH
11187774	24V	AMP
11187775	24V	DEUTSCH

PVMD Cover Manual Actuation Only

PVMD	Dimensions (mm)
	

The PVMD cover is used when work section is purely mechanical activated.

Part number	Material
11187779	Aluminum

PVE Electrical Actuator

PVE Electrical Actuator

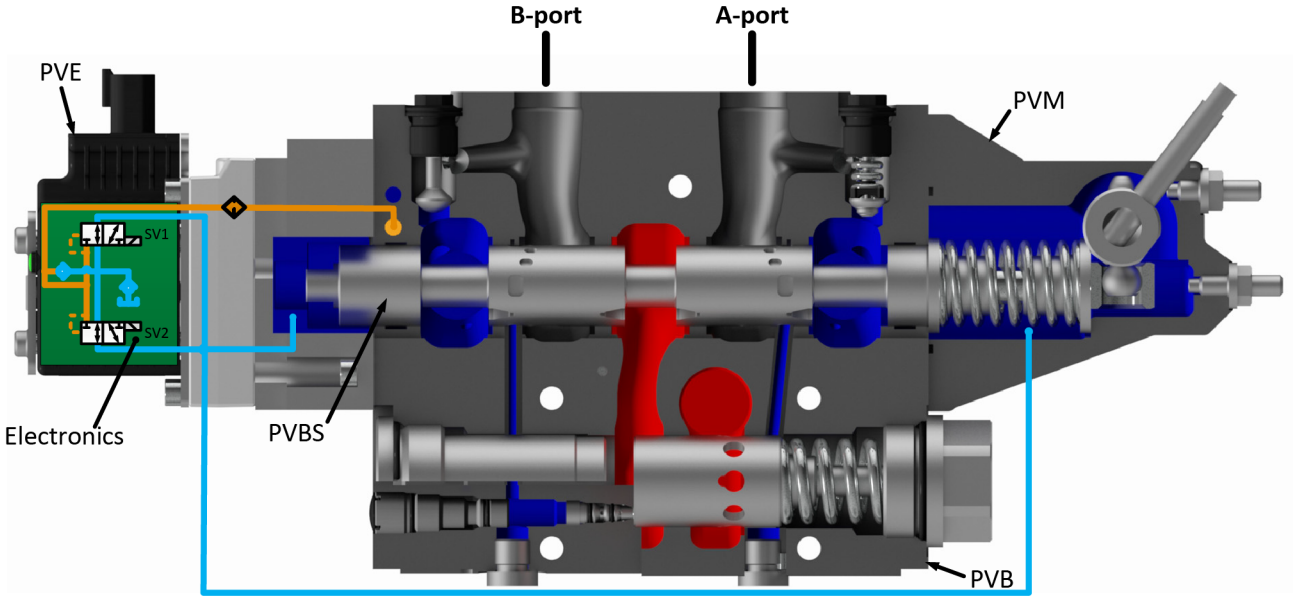
The analog PVE Series 7 is an electro-hydraulic actuator used to control a single work section of a PVG proportional valve group. The PVE Series 7 actuator program includes variants with different performance levels and features for PVG 128/256.

The actuator positions the main spool in a PVG work section in order to control either the flow or the pressure of the oil distributed to/from the work function. The control signal to the actuator is an analog voltage signal, enabling the user to operate the work function remotely by means of a joystick, a controller or the similar.

The electro-hydraulic solenoid valve bridge of the actuator is available in different designs utilizing different regulation principles, depending on performance variant. The actuator positions the main spool by distributing pilot oil pressure to either side of it, pressurizing one side by pilot pressure while relieving the opposite side to tank and vice versa, as illustrated below. All proportional actuators feature a closed-loop spool control and continuous fault monitoring.

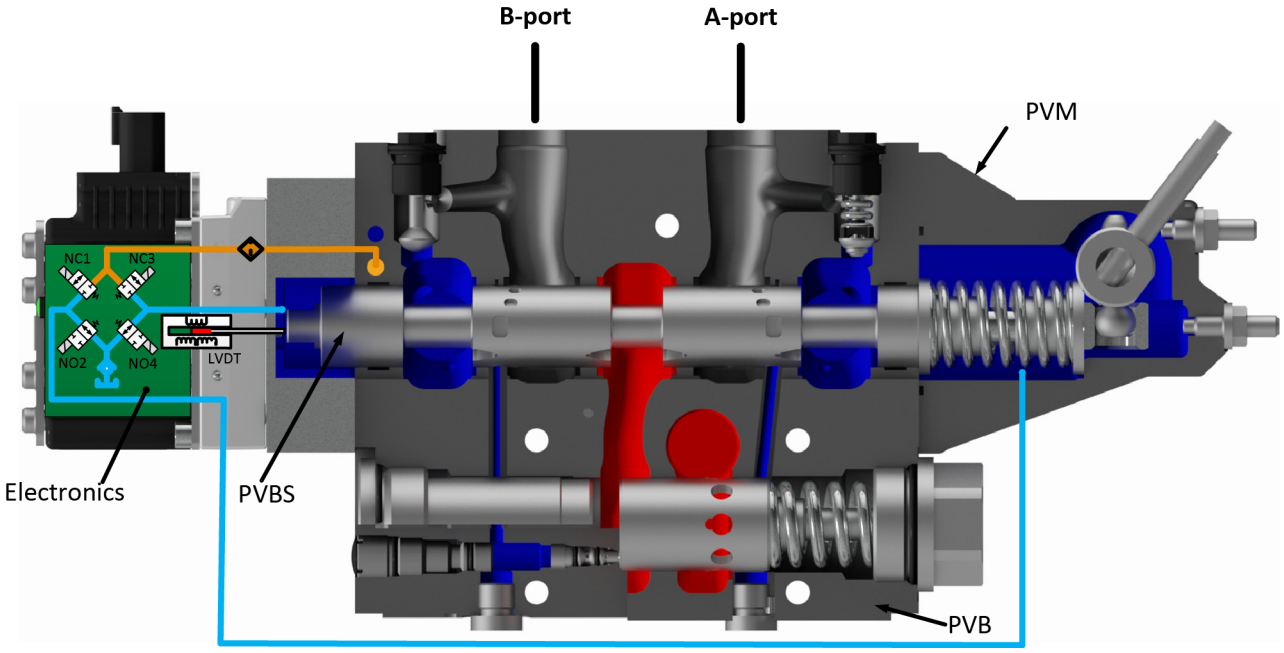
The analog PVE Series 7 actuator program for PVG 128/256 features two different main hydraulic principle variants (PVEO and PVEH). The different hydraulic principles combined with the different solenoid valve regulation principles determine whether the actuator controls the spool proportionally according to a demand signal or ON/OFF according to a voltage signal. The voltage control characteristic of the PVE Series 7 actuators is shown in the figure below to the left.

PVG 256 with PVEO



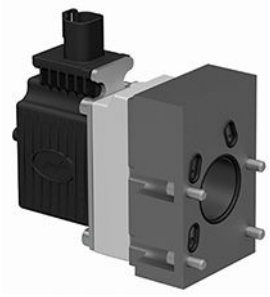
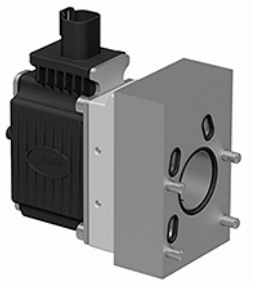
PVE Electrical Actuator

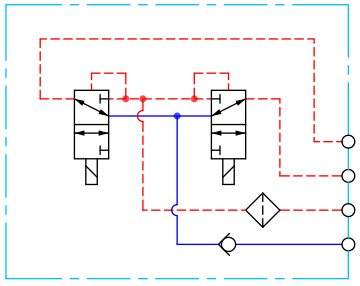
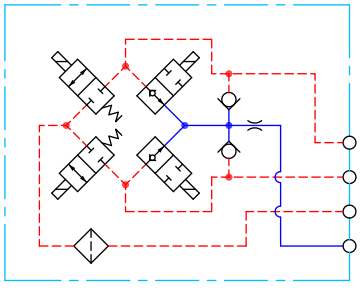
PVG 256 with PVEH



PVE Variant Overview

PVE Variant Overview

PVEO Series 7	PVEH Series 7
	

Symbol	Description
 P109195	*PVEO* ON/OFF voltage control for non-proportional functions. • Neutral position or max. spool stroke according to control signal • Variants available with 12 V dc or 24 Vdc supply voltage • Variants available with DEUTSCH, AMP or DIN/Hirschmann connectors • To be used with standard PVE pilot oil pressure of 13.5 bar • LED only indicating Power ON or Power OFF
 P109198	*PVEH* Proportional spool control for functions with high performance and reaction demands. • All variants with 11-32 Vdc multi-voltage power supply • Variants available with DEUTSCH, AMP or DIN/Hirschmann connectors • To be used with standard PVE pilot oil pressure of 13.5 bar • All variants with LED indicating error state and active or passive fault monitoring • Variants available with Float (-F) or 0-10 V dc control signal (-U) functionality

PVE Variant Overview

PVEO

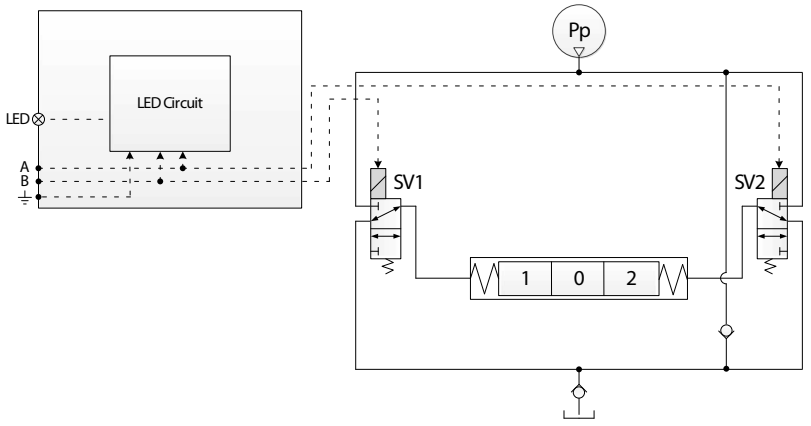
The PVEO actuator is a non-proportional ON/OFF control actuator with open-loop spool control primarily used to control simple ON/OFF work functions where a proportional control of speed or oil flow is not a requirement.

The standard PVEO functionality includes the simplest electric circuit of the PVG 128/256 actuator program, using a fixed 12 Vdc or 24 Vdc supply voltage or signal voltage and a simple LED circuit to control the LED light indicating Power ON/OFF.

An energization of solenoid valve SV1 and a simultaneous de-energization of SV2 will cause the main spool to move to the right direction and vice versa. If both SV1 and SV2 are energized or de-energized simultaneously, the main spool stays locked in its neutral position.

Functionality

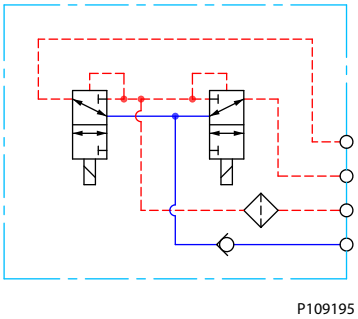
PVEO



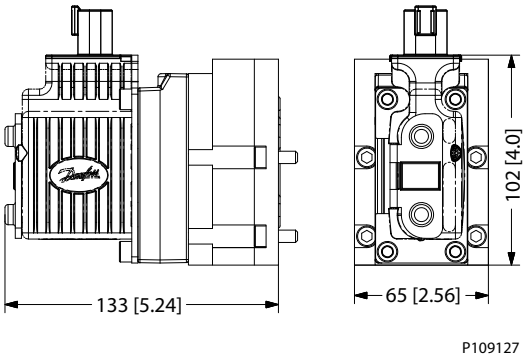
PVEO Schematics and Dimensions

PVEO schematics

PVEO



PVE Variant Overview

PVEO dimensions	Connector height
	DEU = 30 mm [1.2 in] AMP = 38 mm [1.5 in] DIN = 40 mm [1.6]

For more information on dimensions, see *Dimension Overview*.

PVEO Technical Data

Control Specification

Description	Type	Value	
Supply Voltage (Udc)	Rated	12 Vdc	24 Vdc
	Range	11 to 15 Vdc	22 to 30 Vdc
	Max. ripple	5%	
Current Consumption	Typical	480 mA	250 mA
	Minimum	430 mA	220 mA
	Maximum	950 mA	480 mA

Operating Conditions

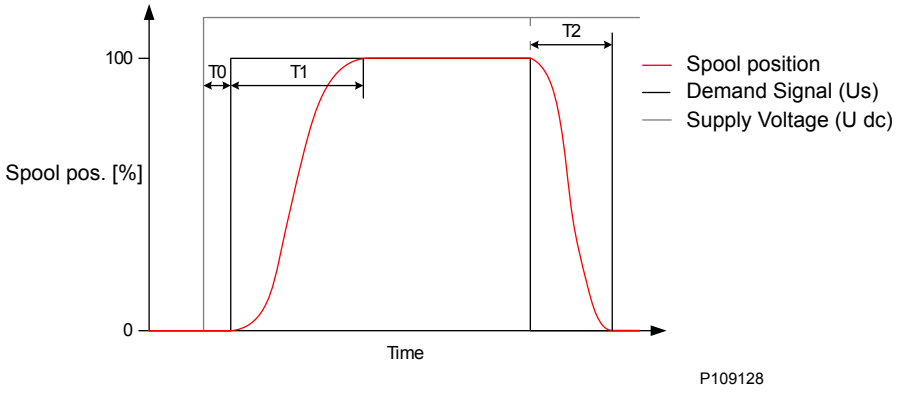
Description	Type	Value	
Pilot Pressure	Nominal	13.5 bar	[196 psi]
	Minimum	10.0 bar	[145 psi]
	Maximum	15.0 bar	[218 psi]
Oil Consumption	Neutral	0.0 l/min	[0.0 gal/min]
	Locked position	0.0 l/min	[0.0 gal/min]
	Actuating	0.9 l/min	[0.24 gal/min]
Storage Temperature	Ambient	-50 to +90°C	[-58 to +194°F]
Operating Temperature	Ambient	-40 to +90°C	[-40 to +194°F]
Oil Viscosity	Operating range	12 to 75 cSt	[65 to 347 SUS]
	Minimum	4 cSt	[39 SUS]
	Maximum	460 cSt	[2128 SUS]
Oil Cleanliness	Maximum	18/16/13 (according to ISO 4406)	

LED Characteristic

Color	LED Characteristic	Description
Green		Power ON

PVE Variant Overview

PVEO Reaction Times



Reaction	PVEO
T1 – Neutral to max. spool stroke @ Constant Udc [ms]	320 ms
T2 – Max. spool stroke to neutral @ Constant Udc [ms]	350 ms

The stated values are preliminary values and can be subject to change once an increased statistical basis is achieved.

For more information on reaction times, see *Reaction Times*.

PVEO Variants for PVG

PVG 128/256 Variants

Part number	Type	*Connector*	IP	Udc	*Functionality*
11186328	PVEO	1x4 DEU	67	12 Vdc	Standard
11186330	PVEO	1x4 DEU	67	24 Vdc	Standard
11186331	PVEO	1x4 DIN	65	12 Vdc	Standard
11186342	PVEO	1x4 DIN	65	24 Vdc	Standard

PVE Variant Overview

PVEH

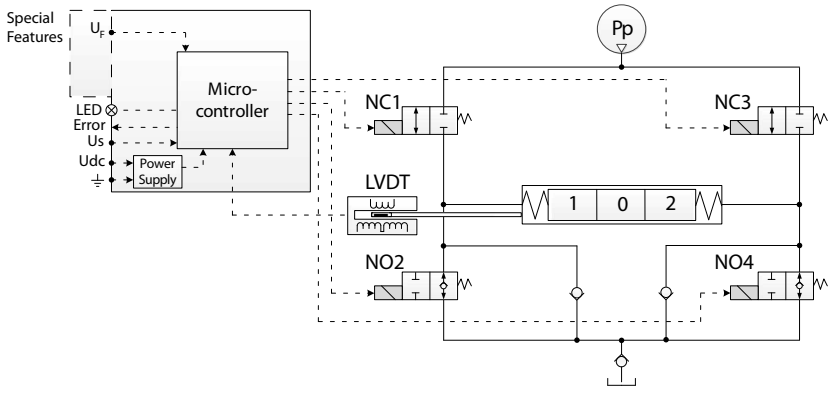
The PVEH actuator is a proportional control actuator with closed-loop spool control primarily used to control work functions with high performance requirements.

The PVEH functionality includes an electric circuit with a closed-loop logic. An embedded micro-controller processes the signal voltage and the LVDT feedback signal and regulates the solenoid valves accordingly. Features such as active or passive fault monitoring, LED indicating fault state, error output pin and Power Save are all default PVEH features.

A continuous modulation of solenoid valves NC1 and NO4 together, with a simultaneous energization of NO2 and de-energization of NC3, causes the main spool to move to the right direction and vice versa. When the main spool is stroked to the far right, a simultaneous energization of both NO2 and NO4 and de-energization of both NC1 and NC3 locks the main spool in its stroked position. An emergency stop activated when the spool is stroked will cause all solenoid valves to de-energize causing the main spool to move back to its neutral position by means of the main spool neutral spring and the hydraulic principle.

Functionality

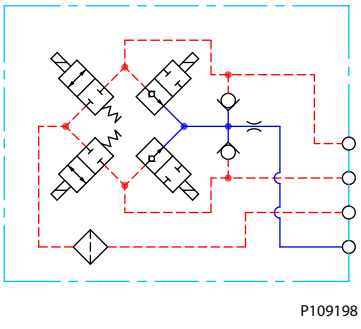
PVEH



PVEH Schematics and Dimensions

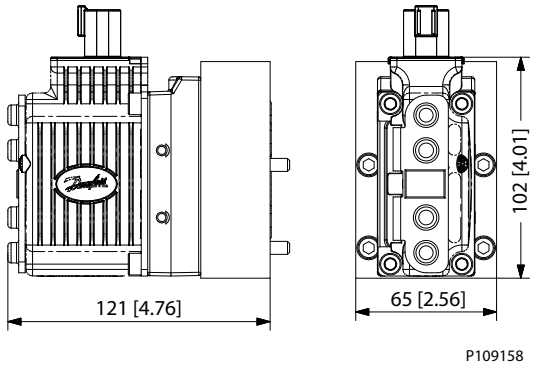
Schematics

PVEH



PVE Variant Overview

Dimensions

PVEH	Connector height
	DEU = 30 mm [1.2 in] AMP = 38 mm [1.5 in] DIN = 40 mm [1.6 in]

For more information on dimensions, see *Dimension Overview*.

PVEH Technical Data

Control Specification

Description	Type	Value
Supply Voltage (Udc)	Rated	11 to 32 Vdc
	Range	11 to 32 Vdc
	Max. ripple	5%
Signal Voltage (Us)	Neutral	Us = 0.5 Udc
	Q: P to A	Us = (0.5 to 0.25) · Udc
	Q: P to B	Us = (0.5 to 0.75) · Udc
Signal Voltage PWM (Us)	Neutral	Us = 50% DUT
	Q: P to A	Us = 50% to 25% DUT
	Q: P to B	Us = 50% to 75% DUT
PWM Frequency (Us)	Recommended	> 1000 Hz
Current Consumption	@ 12 Vdc	540 mA
	@ 24 Vdc	270 mA
Input Impedance	Rated	12 kΩ
Input Capacitance	Rated	100 nF

Operating conditions

Description	Type	Value	
Pilot Pressure	Nominal	13.5 bar	[196 psi]
	Minimum	10.0 bar	[145 psi]
	Maximum	15.0 bar	[218 psi]
Oil Consumption	Neutral	0.0 l/min	[0.0 gal/min]
	Locked Position	0.0 l/min	[0.0 gal/min]
	Actuating	0.7 l/min	[0.18 gal/min]
Storage Temperature	Ambient	-50 to +90°C	[-58 to +194°F]
Operating Temperature	Ambient	-40 to +90°C	[-40 to +194°F]

PVE Variant Overview

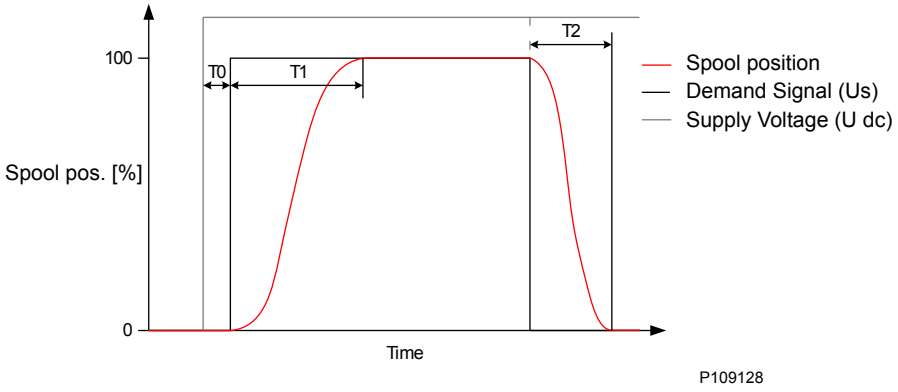
Operating conditions (continued)

Description	Type	Value	
Oil Viscosity	Operating range	12 to 75 cSt	[65 to 347 SUS]
	Minimum	4 cSt	[39 SUS]
	Maximum	460 cSt	[2128 SUS]
Oil Cleanliness	Maximum	18/16/13 (according to ISO 4406)	

LED characteristic

Color	LED Characteristic	Description
Green		Actuating
Green @ 1.5 Hz		Neutral - *Power Save*
Red		Internal fault
Red @ 1.5 Hz		External or float fault
Yellow		*Disable Mode*

PVEH Reaction Times

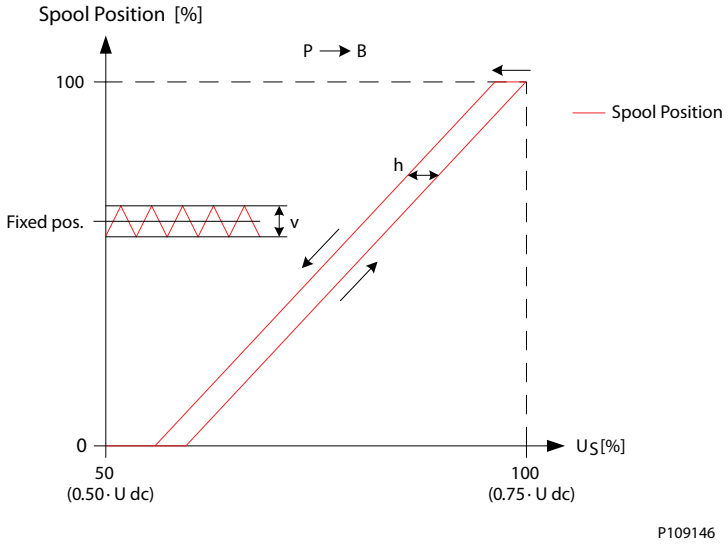


Reaction	PVEH
T0 – Boot-up [ms]	80 ms
T1 – Neutral to max. spool stroke @ Power ON [ms]	350 ms
T2 – Max. spool stroke to neutral @ Power OFF [ms]	380 ms
T1 – Neutral to max. spool stroke @ Constant Udc [ms]	320 ms
T2 – Max. spool stroke to neutral @ Constant Udc [ms]	350 ms

For more information on reaction times, see *Reaction Times*.

PVE Variant Overview

PVEH Hysteresis and Ripple



Description	Type	PVEH
Hysteresis (h)	Rated [%]	1.5%
Steady state ripple @ fixed Us (v)	Rated [mm]	0.0

For more information on hysteresis and ripple, see *Hysteresis and Ripple*.

PVEH Variants for PVG

PVG 128/256 variants

Part number	Type	*Connector*	IP	*Fault monitoring*	*Functionality*
11186325	PVEH	1x4 DEU	67	Passive	Standard
11186326	PVEH	1x4 DEU	67	Active	Standard
11186321	PVEH	1x4 DIN	65	Passive	Standard
11186322	PVEH	1x4 DIN	65	Active	Standard
11186323[1]	PVEH-U	1x4 DIN	65	Passive	Fixed US 0-10 Vdc
11186324[1]	PVEH-U	1x4 DIN	65	Active	Fixed US 0-10 Vdc
11186327[2]	PVEH-FLA	1x6 DEU	67	Active	Float A-port

[1] Includes *Disable Mode* special feature

[2] Includes *Dedicated Float Pin (UF)* special feature

Connector Overview

Connector Overview

PVEO

Connector	Pin 1	Pin 2	Pin 3	Pin 4
1x4 AMP	Udc_A	Udc_B	GND	GND
1x4 DEUTSCH	Udc_A	GND	GND	Udc_B
1x4 DIN	Udc_A	Udc_B		GND

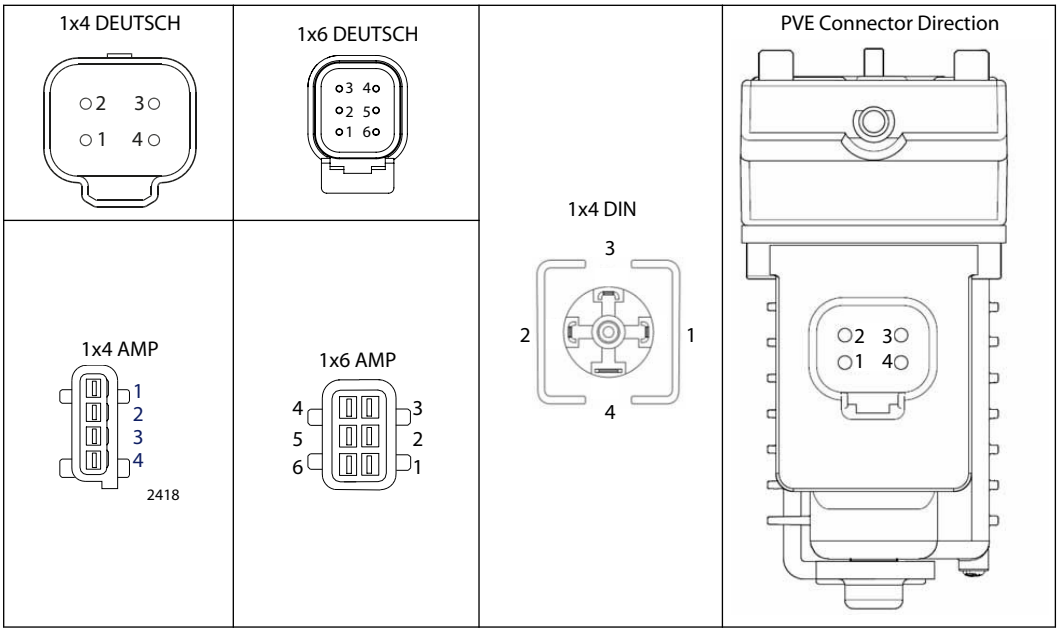
PVEH/PVEH-U

Connector	Pin 1	Pin 2	Pin 3	Pin 4
1x4 AMP	Us	Udc	GND	Error
1x4 DEUTSCH	Us	Error	GND	Udc
1x4 DIN	Udc	Us	Error	GND

PVEH-FLA

Connector	Pin 1	Pin 2	Pin 3	Pin 4	Pin 5	Pin 6
1x6 AMP	Us	Udc	GND	Error	Float	
1x6 DEUTSCH	Us	Error	Float		GND	Udc

Connector diagrams



Fault Monitoring and Fault Reaction

All proportional control PVG 128/256 actuators feature an integrated fault monitoring, detecting spool stroke inconsistencies, internal hardware defects and demand signal inconsistencies.

The actuators feature a generic fault reaction and specific fault reactions depending on the type of fault monitoring, either passive or active.

Generic Fault Reaction

All PVE's with fault monitoring are triggered by the following four main events:

Control Signal Monitoring	The Control signal voltage (Us) is continuously monitored. The permissible range is between 15% and 85% of the supply voltage (U dc). Outside this range the PVE will switch into an error state. A disconnected Us pin (floating) is recognized as a neutral set point.
Transducer/LVDT Supervision	The internal LVDT wires are monitored. If the signals are interrupted or short-circuited, the PVE will switch into an error state.
Supervision of Spool Position	The actual position must always correspond to the demanded position (Us). If the actual spool position is further out from neutral than the demanded spool position or in opposite direction, the PVE will switch into an error state. Spool position closer to neutral and in same direction will not cause an error state – the situation is considered "in control."
Float Position Monitoring	Float position must be entered or left within a time limit. On the 1x6 pin float PVE's a too high delay will cause an error state – this is only relevant for the 1x6 pin PVEH-F actuators.
Temperature Monitoring	When the temperature is too high the PVE's LED will light constant red and solenoid valves will be disabled.

Fault Reaction Overview

Description	Monitoring	LED	Solenoid valves	Error pin output	Fault reaction time (ms)
					PVEH
Spool not at setpoint	Active*		Disabled	High	500
	Passive		-	High	250
Unable to reach float position	Active*		Disabled	High	1000
	Passive		-	High	1000
U dc > max.	Active		Disabled	-	-
	Passive		Disabled	-	-
U dc < min.	Active		Disabled	-	-
	Passive		Disabled	-	-
Us out of range	Active*		Disabled	High	500
	Passive		-	High	250
LVDT error	Active*		Disabled	High	500
	Passive		-	High	250
Temp > max.	Active*		Disabled	High	250
	Passive		Disabled	High	250

* Does not have Auto Recovery

Functionality Overview

Standard and Fixed US 0-10 Vdc

All standard proportional actuator variants PVEH can be controlled by an analog signal voltage (Us) or a PWM controlled signal voltage (Us) proportional to the supply voltage (Udc).

The PVEH-U variants are controlled by a fixed 0-10 Vdc signal voltage (Us), directly compatible with standard PLC control.

PVEO

Description	Type	Value	
Supply voltage (Udc)	Rated	12 Vdc	24 Vdc
	Range	11 to 15 Vdc	22 to 30 Vdc
	Max. ripple	5%	

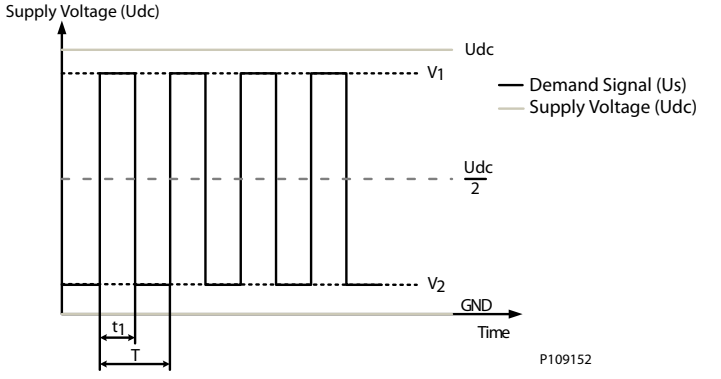
PVEH

Description	Type	Value
Supply voltage (Udc)	Rated	11 to 32 Vdc
	Range	11 to 32 Vdc
	Max. ripple	5%
Signal voltage (Us)	Neutral	Us = 0.5 · Udc
	Q: P to A	US = (0.5 to 0.25) · Udc
	Q: P to B	US = (0.5 to 0.75) · Udc

PWM Voltage Control

The PVEH actuator variants can be controlled by a PWM controlled signal voltage (Us) proportional to the supply voltage (Udc).

The V_1 and V_2 must be symmetrical around Udc/2 and V_1 must be equal to or less than Udc.



PVEH Control specification

Description	Type	Value
Supply Voltage (Udc)	Rated	11 to 32 Vdc
	Range	11 to 32 Vdc
	Max. ripple	5%

Functionality Overview

PVEH Control specification (continued)

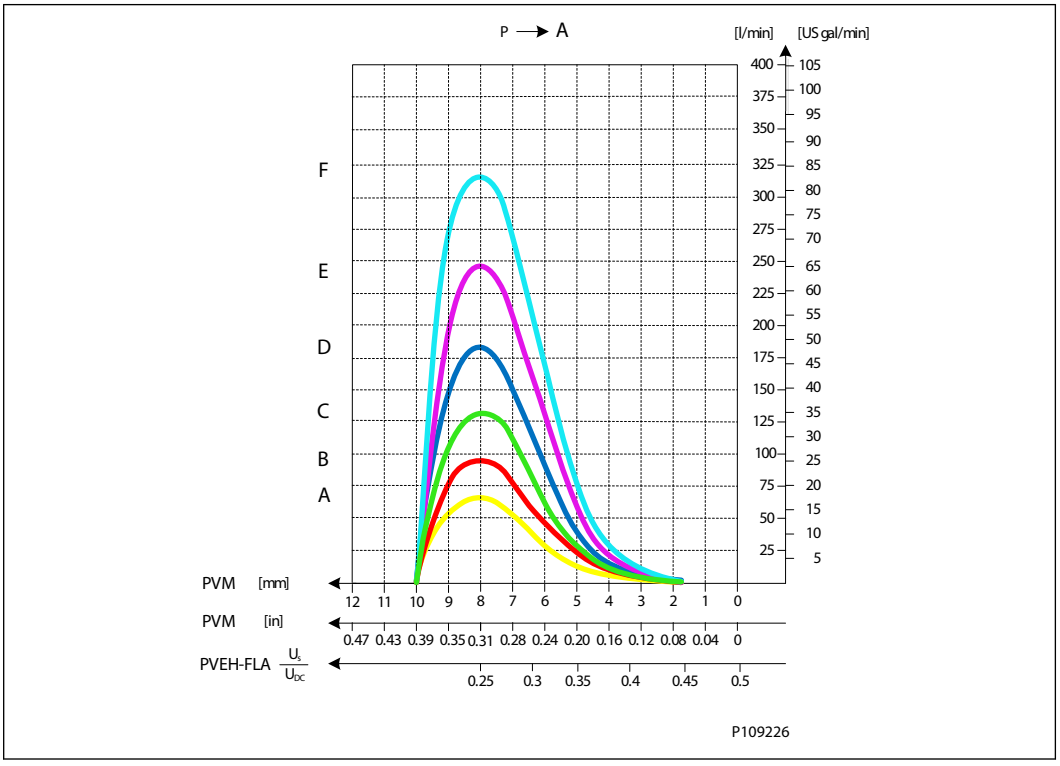
Description	Type	Value
Signal Voltage PWM (Us)	Neutral	Us = 50% DUT
	Q: P to A	Us = 50% to 25% DUT
	Q: P to B	Us = 50% to 75% DUT
PWM Frequency (Us)	Recommended	> 1000 Hz

Functionality Overview

Float A-Port (-FLA)

The Float A-Port functionality enables the proportional PVEH-FLA actuator variants to enter the main spool into a float position. The PVE actuators with Float A-Port functionality is compatible with the dedicated main spools with electronic float in A-port.

PVE Type	PVBS Type	Standard Flow Control	Float Control
PVEH-FLA (1x6 pin)	Deadband 1.7 mm	Us = (0.25 → 0.75) · Udc	U dc to dedicated float pin (UF)
	Max. B-port flow 8.0 mm		



Power Save

All proportional actuator variants (PVEH) feature a Power Save mode, de-energizing the solenoid valve bridge. The Power Save mode is entered when the signal voltage (Us) and the LVDT spool position has been in neutral for 750 ms. As soon as the signal voltage (Us) or the LVDT spool position is out of neutral the PVE will leave its Power Save mode and re-energize the solenoid valve bridge as usual.

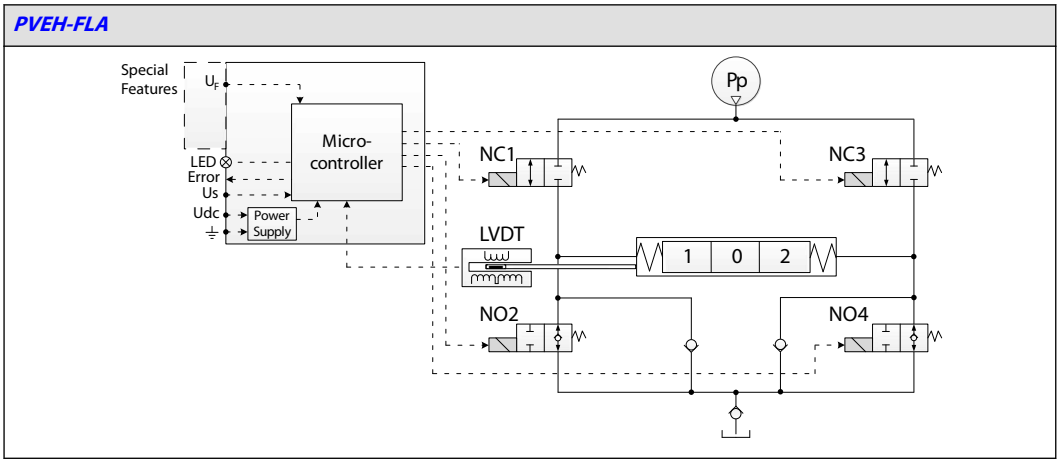
The Power Save mode results in increased power efficiency by reducing the current consumption of the PVE actuators in neutral position. The Power Save mode has no effect on the performance of the PVE actuator.

For current consumption values, please see chapter *Current Consumption*.

Special Features

Dedicated Float Pin (UF)

The Dedicated Float Pin (UF) feature is related to the PVEH-FLA actuator variant described in the chapter *Float A-Port*. The PVEH-FLA uses 1x6 pin AMP or DEUTSCH connectors, as shown in the chapter *Connector Overview*, enabling the user to move the main spool into its float position by powering a dedicated float pin (UF).



Dedicated Float Pin (UF) Specification

Low or not connected	Normal operation
High	Float
Input range	Udc
Max. voltage	32 Vdc

Disable Mode

The PVEH-U actuator variants controlled by a fixed 0-10 Vdc signal voltage (Us), feature the ability to enter a disable mode, deactivating the counteracting force on the main spool created by the solenoid valve bridge, when using manual override (hand operational mode). The disable mode is entered by sending a signal voltage (Us) of 16.2% of 10 Vdc when in Power Save.

For more information, please see *Power Save*.

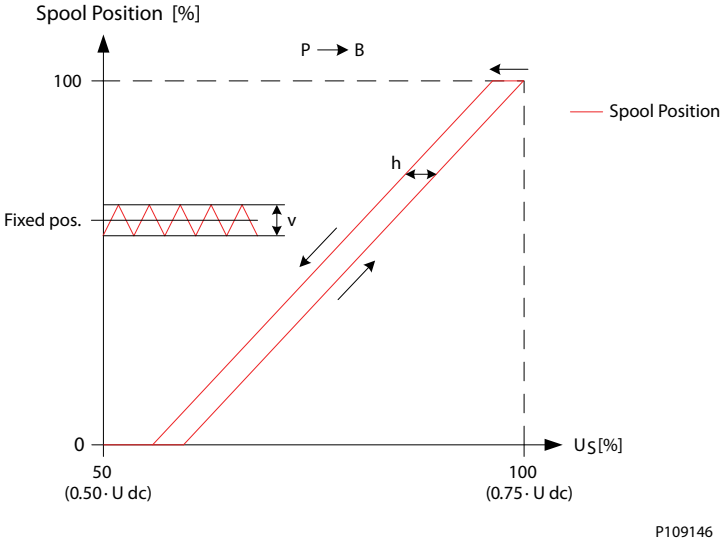
Performance Overview

Reaction Times

PVG 128/256 reaction times

Reaction	PVEO	PVEH
T0 [ms]	0 ms	80 ms
T1 @ Power ON [ms]	320 ms	350 ms
T2 @ Power OFF [ms]	350 ms	380 ms
T1 @ Constant U dc [ms]	320 ms	320 ms
T2 @ Constant U dc [ms]	350 ms	350 ms

Hysteresis and Ripple



Type	Hysteresis (h)	Steady state ripple @ fixed Us (v)
	Rated [%]	Rated [mm]
PVEH	4	0.0
PVEH 256	1.5	0.0

Oil Consumption

Type	Neutral	Locked position	Actuating
	[l/min]		
PVEO	0.0	0.0	0.9
PVEH	0.0	0.0	0.7

PVSI/PVGI End and Interface Plates

The PVG PVGI Interface Plate act as an interface between the PVB 256/128 and PVB 32/16 basic modules which enables you to build a combo valve with PVB 256/128/32/16.

Optional the PVSI End Plate features additional P and T connection to accommodate an additional 600 l/min pump flow.

Versions available with LX connection. PVSI and PVGI are all in cast iron.

PVGI Functionality	PVSI w P and T-ports Functionality	PVSI Functionality
		

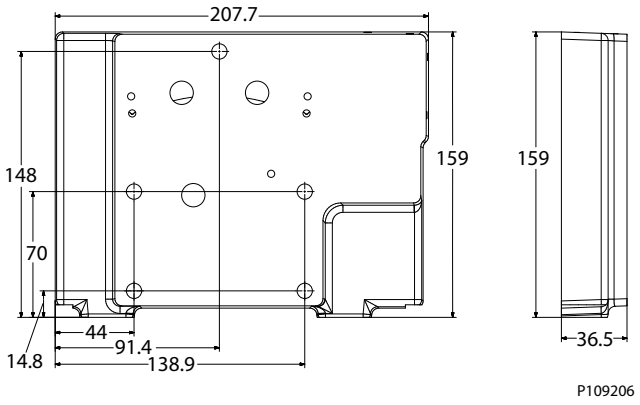
Symbol	Description
 P109184	*PVGI interface plates* Interface plate to connect PVB 256/128 with PVB 32/16 • With T0 to be used with T0 equipped PVG 32 modules • Without T0 for PVG 16 modules and/or PVG 32 without T0
 P109205	*PVSI with P and T connections* PVSI with P and T-port connection for additional 600 l/min Pump flow • Metric flange • SAE Flange • BSP treaded ports • UNF treaded ports
 P109227	*PVSI End Plate* PVSI End Plate • With and without LX connection • Cast Iron

PVSI/PVGI End and Interface Plates

PVGI Interface Plate

The PVGI Interface Plate connects the P-, T-, LS- and Pp-channels in PVB 128/256 to the corresponding channels in PVB 32 and/or 16 modules.

T0 variant featured for PVB 32 modules equipped with T0.

Schematic	Dimensions (mm)
	

Technical data

Max. rated pressure	P-port continuous	350 bar	[5076 psi]
	P-port intermittent	400 bar	[5800 psi]
	T-port static/dynamic	25/40 bar	[363/580 psi]
Oil temperature	Recommended	30 to 60°C	[86 to 140°F]
	Minimum	-30°C	[-22°F]
	Maximum	90°	[194°F]
Ambient temperature	Recommended	-30 to 60°C	[-22 to 140°F]
Oil viscosity	Operating range	12 to 75 mm^2/s	[65 → 347 SUS]
	Minimum	4 mm^2/s	[39 SUS]
	Maximum	460 mm^2/s	23/19/16
Oil contamination according to ISO 4406	Maximum	23/19/16	

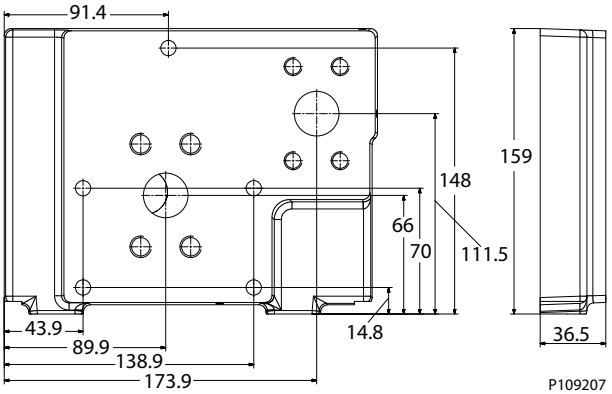
Part number	T0	PVGI width	Mounting feet
11171422	No	37 mm	M12
11171423	Yes	37 mm	M12

PVSI/PVGI End and Interface Plates

PVSI with P and T port

The PVSI with P and T port connections enables an additional 600 l/min pump flow to a PVG 128/256 valve.

Metric and SAE flange connections as well as BSP and UNF treaded ports.

Schematic	Dimensions (mm)
 P109205	 P109207

Technical data

Max. rated pressure	P-port continuous	350 bar	[5076 psi]
	P-port intermittent	400 bar	[5800 psi]
	T-port static/dynamic	25/40 bar	[363/580 psi]
Max. rated flow	P-port	600 l/min	[159 US gal/min]
Oil temperature	Recommended	30 to 60°C	[86 to 140°F]
	Minimum	-30°C	[-22°F]
	Maximum	90°	[194°F]
Ambient temperature	Recommended	-30 to 60°C	[-22 to 140°F]
Oil viscosity	Operating range	12 to 75 mm^2/s	[65 → 347 SUS]
	Minimum	4 mm^2/s	[39 SUS]
	Maximum	460 mm^2/s	23/19/16
Oil contamination according to ISO 4406	Maximum	23/19/16	

Part number	P-port	T-port	Width	Mounting feet
11171418	Metric Flange 1″	Metric Flange 1-1/4″	37 mm	M12
11179952	Thread Ports G1" BSP	Thread Ports G1-1/4" BSP	37 mm	M12
11171421	SAE Flange 1″ UNF	SAE Flange 1-1/4″ UNF	37 mm	M12
11171416	Thread Ports 1-5/16 UNF	Thread Ports 1-5/8 UNF	37 mm	M12

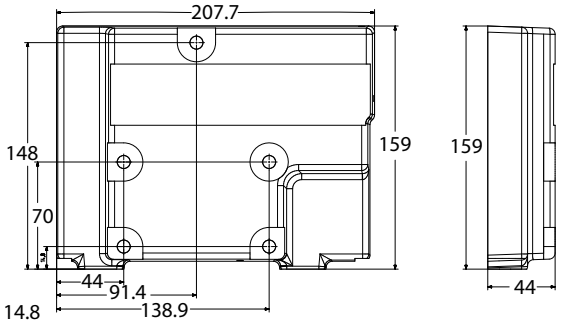
PVSI/PVGI End and Interface Plates

PVSI with or without LX connection

The PVSI made of Cast Iron work as an End Plate.

The PVSI with LX connection enables another valves LS pressure to be shuttled to the pump when needed.

The LX port treads are with BSP or UNF tread.

Schematic	Dimensions (mm)
 P109227	 P109208

Technical data

Max. rated pressure	P-port continuous	350 bar	[5076 psi]
	P-port intermittent	400 bar	[5800 psi]
	T-port static/dynamic	25/40 bar	[363/580 psi]
Oil temperature	Recommended	30 to 60°C	[86 to 140°F]
	Minimum	-30°C	[-22°F]
	Maximum	90°	[194°F]
Ambient temperature	Recommended	-30 to 60°C	[-22 to 140°F]
Oil viscosity	Operating range	12 to 75 mm^2/s	[65 → 347 SUS]
	Minimum	4 mm^2/s	[39 SUS]
	Maximum	460 mm^2/s	23/19/16
Oil contamination according to ISO 4406	Maximum	23/19/16	

Part number	LX-port	Mounting feet
11171419	-	M12
11179950	G1/4"BSP	M12
11179949	7/16-20 UNF	M12

PVAS

Stay Bolts for PVG 128 and 256 consists of 2 different kits:

1. PVAS containing 2 stay bolts – shall be placed in spec sheet under PVAS 1.
2. PVAS containing 3 stay bolts – shall be placed in spec sheet under PVAS 2.

Furthermore, O-rings is a part of the PVAS kits.

The table below shows which 2 PVAS kits required for the specification according to number of PVB 128 and/or PVB 256.

Table 1.

		PVB 256							
	Modules	0	1	2	3	4	5	6	7
PVB 128	0		11187672+ 157B8021	11187673+ 157B8003	11187674+ 157B8005	11187675+ 157B8026	11187676+ 157B8028	11187688+ 157B8010	11187698+ 157B8062
	1	11187320+ 157B8001	11187677+ 157B8022	**11187681+ 157B8024**	11187684+ 157B8006	11187685+ 157B8008	11187687+ 157B8010	11187690+ 157B8081	
	2	11187617+ 157B8002	11187678+ 157B8004	11187682+ 157B8006	11187686+ 157B8027	11187691+ 157B8029	11187692+ 157B8061		
	3	11187655+ 157B8023	11187679+ 157B8025	11187683+ 157B8007	11187693+ 157B8009	11187694+ 157B8061	11187695+ 157B8082		
	4	11187656+ 157B8005	11187680+ 157B8007	11187696+ 157B8028	11187697+ 157B8030	11187698+ 157B8062			
	5	11187658+ 157B8026	11187699+ 157B8008	11187687+ 157B8010	11187690+ 157B8081				
	6	11187702+ 157B8027	11187703+ 157B8029	11187704+ 157B8081					
	7	11187705+ 157B8009	11187694+ 157B8061	11187695+ 157B8082					
	8	11187697+ 157B8030	11187709+ 157B8082						
	9	11187710+ 157B8062							

Ex. For 2 PVB 256 and 1 PVB 128:

PVAS 1 = 11187681

PVAS 2 = 157B8024

For PVG 128/256 in combination with PVG 16/32 please see *PVAS for Combo*.

PVAS

PVAS for Combo

Stay Bolts for PVG 128/256/16/32 consists of 2 different kits:

1. PVAS containing 2 stay bolts - please look in *Table 2* and use P/N before + symbol.
2. PVAS containing 3 stay bolts – please look in *Table 2* and write down the length in millimeters after the + symbol.

Furthermore, O-rings is a part of the PVAS kits – no additional P/N needed.

Table 2.

		PVB 256							
		0	1	2	3	4	5	6	7
PVB 128	0	36	11187672+123	11187673+209	11187674+295	11187675+381	11187676+467	11187688+553	11187698+639
	1	11187320+103	11187677+189	**11187681+275**	11187684+361	11187685+447	11187687+533	11187690+619	
	2	11187617+169	11187678+255	11187682+341	11187686+427	11187691+513	11187692+599		
	3	11187655+235	11187679+321	11187683+407	11187693+493	11187694+579	11187695+665		
	4	11187656+301	11187680+387	11187696+473	11187697+559	11187698+645			
	5	11187658+367	11187699+453	11187687+539	11187690+625				
	6	11187702+433	11187703+519	11187704+605					
	7	11187705+499	11187694+585	11187695+671					
	8	11187697+565	11187709+651						
	9	11187710+631							

Table 3.

		PVB 16										
		0	1	2	3	4	5	6	7	8	9	10
PVB 32	0		64	104	144	184	224	264	304	344	384	424
	1	72	112	**152**	192	232	272	312	352	392	432	
	2	120	160	200	240	280	320	360	400	440		
	3	168	208	248	288	328	368	408	448			
	4	216	256	296	336	376	416	456				
	5	264	304	344	384	424	464					
	6	312	352	392	432	472						
	7	360	400	440	480							
	8	408	448	488								
	9	456	496									
	10	504										

Example

For 2 PVB 256 and 1 PVB 128 and 1 PVB 32 and 2 PVB 16:

PVAS 1 P/N = **11187681** from *Table 2*.

PVAS

PVAS 2 = **275** mm from *Table 2* + **152** mm from *Table 3* = 275+152 =427 mm which equals **157B8027** in *Table 4*.

PVAS P/N Overview

Table 4.

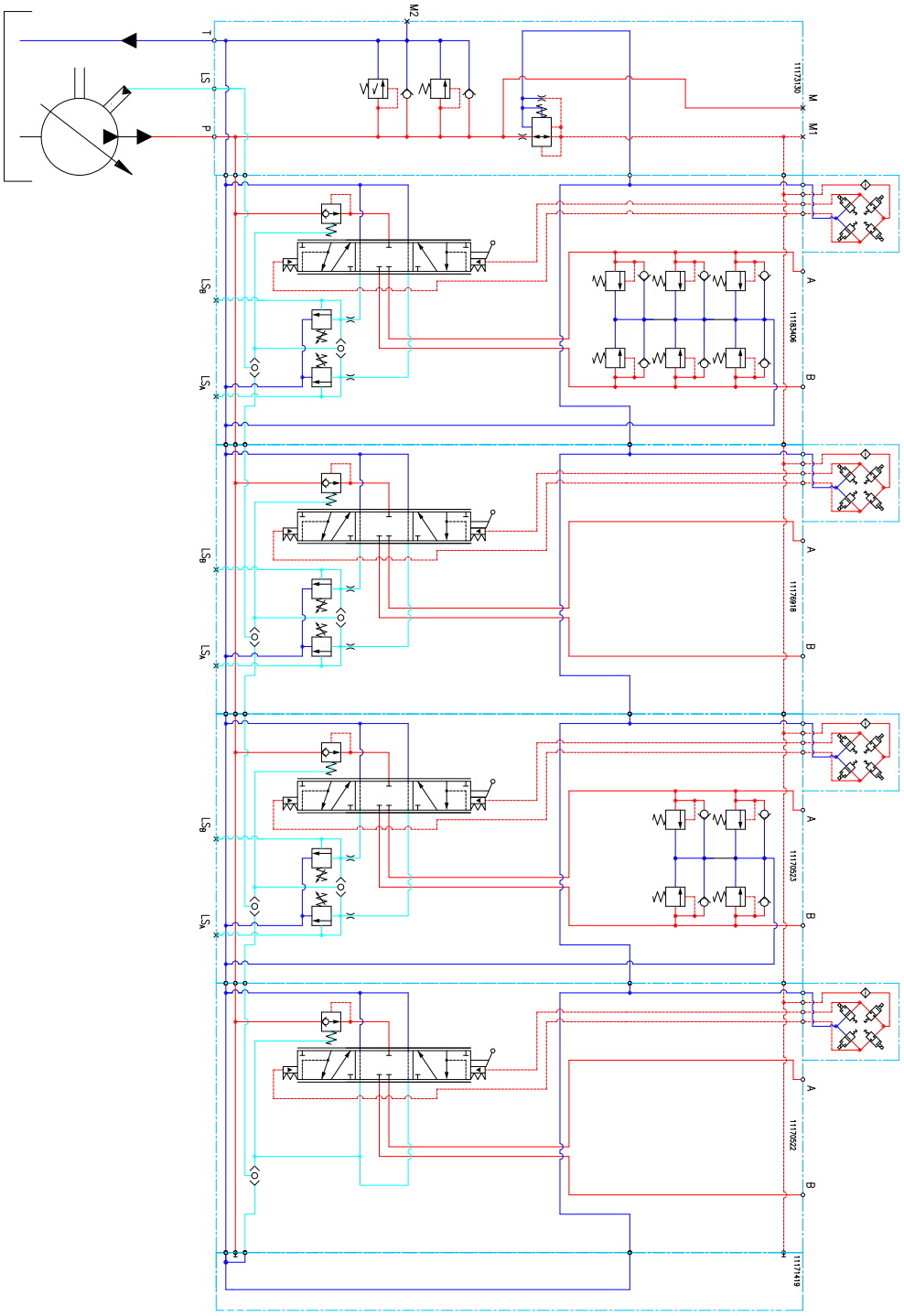
Part number	Accumulated module length in mm
157B8082	661-672
11188189	649-660
157B8062	637-648
11188194	625-636
157B8081	613-624
11188195	601-612
157B8061	589-600
11188196	577-588
157B8030	565-576
11188197	553-564
157B8010	541-552
11188198	529-540
157B8029	517-528
11188199	505-516
157B8009	493-504
11188200	481-492
157B8028	469-480
11188201	457-468
157B8008	445-456
11188202	433-444
157B8027	**421-432**
11188203	409-420
157B8007	397-408
11188204	385-396
157B8026	373-384
11188205	361-372
157B8006	349-360
11188206	337-348
157B8025	325-336
11188207	313-324
157B8005	301-312
11188208	289-300
157B8024	277-288
11188209	265-276
157B8004	253-264
11188210	241-252
157B8023	229-240
11188211	217-228
157B8003	205-216
11188212	193-204

PVAS

Table 4. (continued)

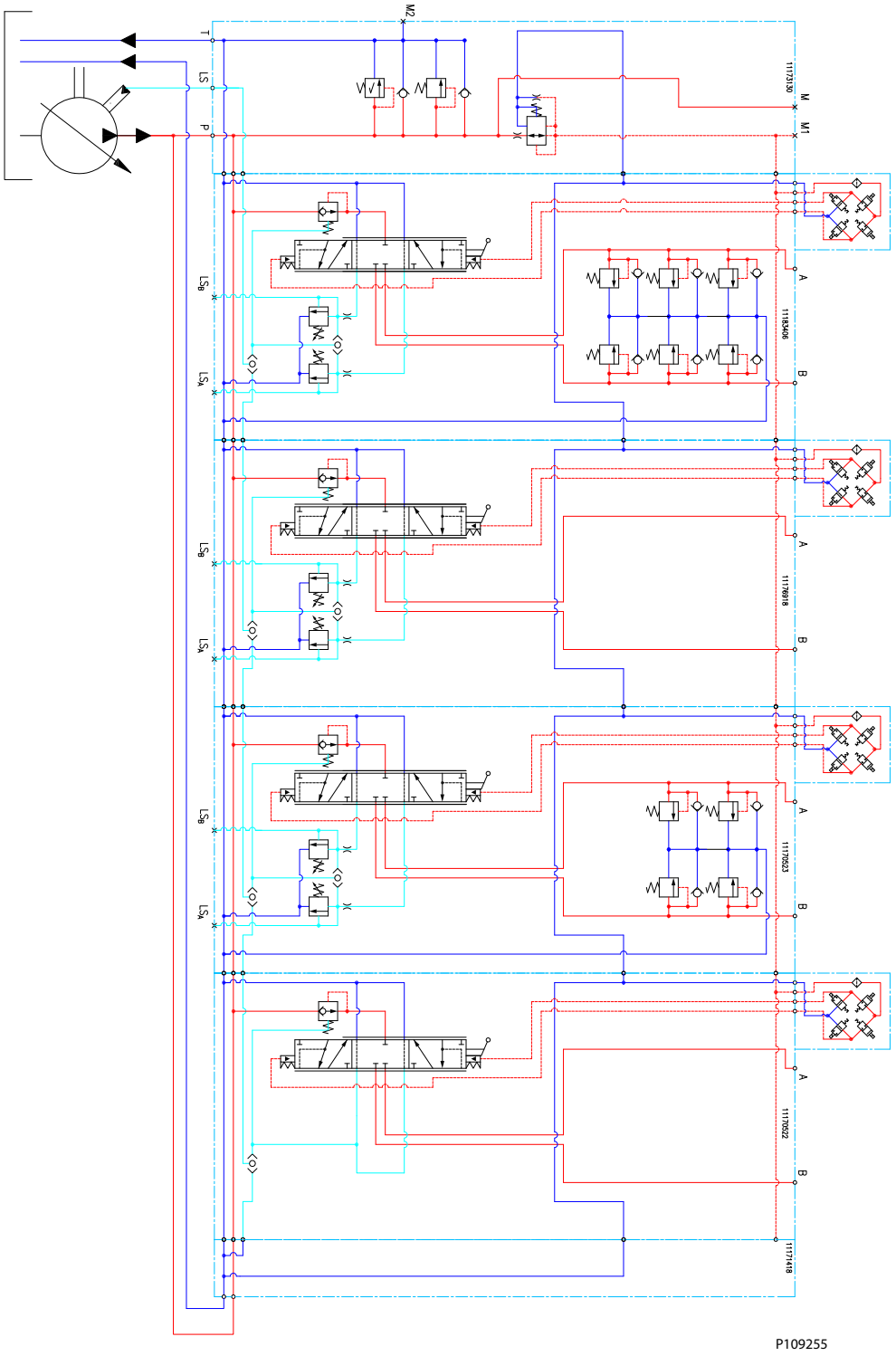
Part number	Accumulated module length in mm
157B8022	181-192
11188213	169-180
157B8002	157-168
11188214	145-156
157B8021	133-144
11188215	121-132
157B8001	109-120
11188216	97-108
157B8031	85-96
11188217	73-84
157B8000	61-72
11188218	49-60
11188219	20-48

Valve Schematics



P109254

Valve Schematics



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