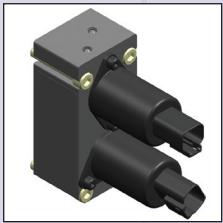
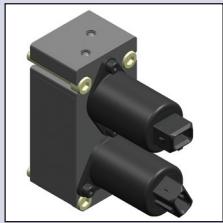
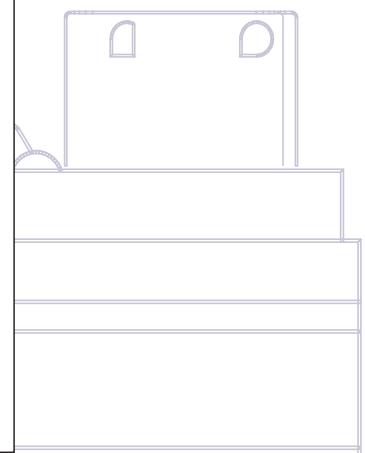
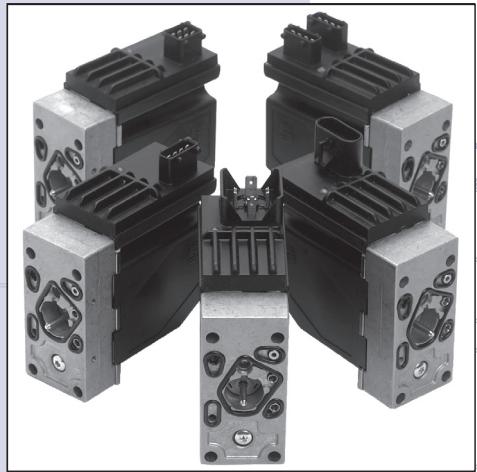
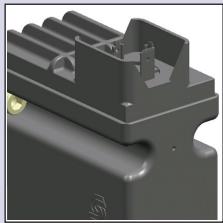
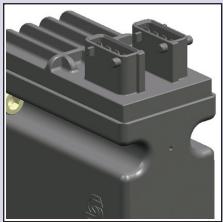
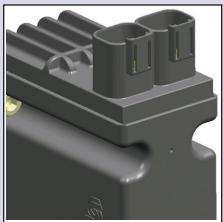
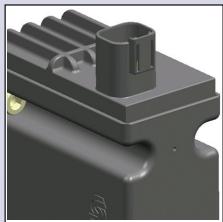




PVE – Series 4

for PVG 32, PVG 100
and PVG 120,
Including PVHC

Technical Information



Revision History

Table of Revisions

Date	Page	Changed	Rev
Jun 2011	All	Major update	FA
Jan 2012	44-45	Various changes	FB
May 2012	All	Major update	GA
Aug 2012	All	Various, new articles about -NP, 1 page more moved all.	GB

List of Abbreviations

Abbreviation	Description
ASIC	Application Specific Integrated Circuit - the part of the PVE where spool position is controled to follow setpoint
ATEX	Certificated for use in explosive environment
AVC	Auxillary Valve Comand - ISOBUS/J1939 standard signal for valve control
AVCTO	Auxillary Valve Comand Time Out - Fault monitoring setting
AVEF	Auxillary Valve Estimated Flow - ISOBUS/J1939 standard signal for valve feedback
CAN	Controller Area Network - Communication method used by PVED
CLC	Closed Loop Circuit
CRC	Cyclic Redundancy Check - Method for ensuring validity of data.
-DI	PVE with Direction Indication
DM1	Diagnostic Message 1 - J1939 message informing about present fault
DM2	Diagnostic Message 2 - J1939 message informing about fault history
DM3	Diagnostic Message 3 - J1939 message clearing fault history
DSM	Device State Machine. Deterministic description of system process
ECU	Electronic Control Unit
EH	Electro Hydraulic
-F	PVE for Float spool. Two variants: 4 pin with float at 75%. 6 pin with separate float.
FMEA	Failure Mode Effect Analysis
ISOBUS	Communication standard for CAN
J1939	Communication standard for CAN
LED	Light Emitting Diode
LS	Load Sensing
LVDT	Linear Variable Differential Transducer - Position sensor
NC	Normally Closed solenoid valve in PVE
NC-H	Normally Closed standard solenoid valve - like in PVEH
NC-S	Normally Closed solenoid valve Super - like in PVES
NO	Normally Open solenoid valve in PVE

© 2013 Sauer-Danfoss. All rights reserved.

Sauer-Danfoss accepts no responsibility for possible errors in catalogs, brochures and other printed material. Sauer -Danfoss reserves the right to alter its products without prior notice. This also applies to products already ordered provided that such alterations can be made without affecting agreed specifications. All trademarks in this material are properties of their respective owners. Sauer-Danfoss, the Sauer-Danfoss logotype, the Sauer-Danfoss S-icon, PLUS+1™, What really matters is inside® and Know-How in Motion™ are trademarks of the Sauer-Danfoss Group.

Front cover illustrations:V310299, V310300, V310294, V310292, V310295, V310291, F300704, drawing 157-506.

**List of Abbreviations
(continued)**

Abbreviation	Description
PLC	P rogrammable L ogical C ircuit
PLUS+1™	Trademark for Sauer-Danfoss controllers and programming tool
POST	P ower O n S elf T est. Boot up evaluation for PVED
Pp	P ilot P ressure. The oil gallery for PVE actuation
PVB	P roportional V alve B asic module - valve slice
PVBS	P roportional V alve B asic module S pool
PVBZ	P roportional V alve B asic module Z ero leakage
PVE	P roportional V alve E lectric actuator
PVEA	P VE variant with 2-6 % hysteresis
PVED	P VE variant D igital controlled via CAN communication
PVEH	P VE variant with 4-9% Hysteresis
PVEM	P VE variant with 25-35% hysteresis
PVEO	P VE variant with ON/OFF actuation
PVEP	P VE variant P WM controled
PVES	P VE variant with 0-2% hysteresis
PVEU	P VE variant with U_s 0-10V
PVG	P roportional multi-section V alve G roup
PVHC	P V variant with C urrent controlled valve actuator
PVM	P roportional V alve M anual control with handle
PVP	P roportional V alve P ump side module. I nlet
PVS	P roportional V alve end plate
PVSK	P roportional V alve end plate crane. I nlet module with S pool C ontrol
PWM	P ulse W idth M odulation
S4 DJ	S eries 4 D igital J 1939 service tool software for PVED-CC
SAE	S ociety A utomotive E ngineering
-R	PVE with R amp function
-NP	PVE with solenoid disable in N eutral P osition
-SP	PVE with S pool P osition feedback
uC	M icro- C ontroller
uCSM	M icro- C ontroller S tate M achine
U_{DC}	Power supply D irect C urrent; also called V_{bat} for battery voltage
U_s	Steering voltage for the PVE control; also called V_s

PVE Series 4 for PVG 32, PVG 100 and PVG 120, Including PVHC

Technical Information

Contents

General Information

List of Abbreviations	2
Reference.....	6
Standards	6
Warnings.....	6
Introduction	7
PVE stands for Proportional Valve Electrical actuator.	7
Overview	8

Functionality

PVG Functionality.....	9
PVE Functionality.....	10
Hydraulic subsystem.....	10
Hydraulic variant: PVEA	11
Hydraulic variant: PVHC.....	11
PVE with ramp.....	11
Electronic subsystem	13

Safety and Monitoring

Safety and Monitoring.....	14
Fault monitoring and reaction.....	14
Spool Position Feedback (-SP)	16
Direction Indication Feedback (-DI).....	17
Solenoid disabling function (-NP)	18

Safety in Application

Building in Safety	19
Hazard and Risk Analysis ISO 12100-1 / 14121.....	19
Control System Example.....	20
PVG32– Mainly used in system with fixed displacement pumps.....	23
PVG100 – Alternative LS dump or pilot supply disconnect.....	23
PVG120 – Pump disconnect/block for variable pumps	23

PVE Control

PVE Control by Voltage.....	24
PLUS+1™ compliance	24
ATEX PVE	24
PVEU–PVE with fixed control signal range	25
PVE controlled with PWM signal	25
PVEP	26
PVEO.....	27
PVE ON/OFF activation.....	27
PVE for Float Spool.....	27
PVHC control.....	29
Hysteresis	30
PVES Series 4.....	30
PVEA Series 4	30
PVEH Series 4.....	30
Example of Use.....	31



PVE Series 4 for PVG 32, PVG 100 and PVG 120, Including PVHC

Technical Information

Contents

Technical Data

Operating Parameters	32
Declaration of conformity	32
PVHC	32
PVEO and PVEM	33
PVEA, PVEH, PVES and PVEU	33
PVEP	34
PVE dimensions for PVG 32 and PVG 100	36
PVE dimensions for PVG 120	38
PVE pinout	40
Standard PVE	41
Standard PVE with DI	42
Standard PVE with SP	42
Standard PVE with NP	42
PVE with separate Float pin	43
PVE with PWM controled – PVEP	43
PVHC connection	44
Product Warnings	45

Code Numbers

PVE Code Numbers for use on PVG 32 and PVG 100	47
PVE Code Numbers for use on PVG 120	49
PVE Accessories	50
Connector Code Numbers at Other Suppliers	50
PVED Code Numbers for use on PVG 32 and PVG 100	51

PVE Series 4 for PVG 32, PVG 100 and PVG 120, Including PVHC

Technical Information

General Information

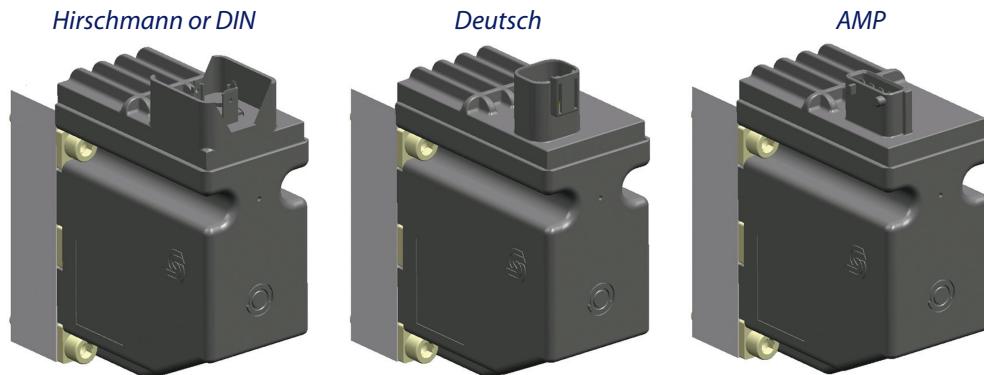
Reference

Sauer-Danfoss Doc **520L0344**, *PVG 32 Proportional Valve Groups, Technical Information*.
Sauer-Danfoss Doc **520L0720**, *PVG 100 Proportional Valve Groups, Technical Information*.
Sauer-Danfoss Doc **520L0356**, *PVG 120 Proportional Valve Groups, Technical Information*.
Sauer-Danfoss Doc **520L0665**, *PVED-CC Electro Hydraulic actuator, Technical Information*
Sauer-Danfoss Doc **11070179**, *PVED-CX Electro Hydraulic actuator, Technical Information*.
Sauer-Danfoss Doc **11051935**, *PVG 32 Metric ports, Technical Information*.

Standards

- International Organization for Standardization ISO 13766 Earth moving machinery - *Electromagnetic compatibility*.
- EN 50014:1997 +A1, A2: 1999
- EN 50028: 1987. For ATEX approved PVE
 - IEC EN 61508
 - ISO 12100-1 / 14121
 - EN 13849 (Safety related requirements for control systems)
 - Machinery Directive 2006/42/EC" (1st Edition December 2009)

PVE with connector variants:



Warnings

Please work through all warnings before implementing actuators in any application. The list of warnings must not be seen as a full list of potential dangers. Depending on application and use other potential dangers can occur.

Warnings are listed next to the most relevant section and repeated in a special section at the end of Technical Data.

Warning

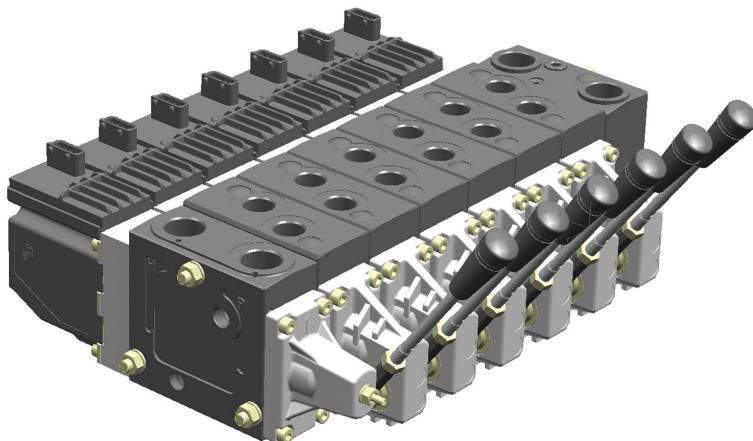
All brands and all types of directional control valves – including proportional valves – can fail and cause serious damage. It is therefore important to analyze all aspects of the application. Because the proportional valves are used in many different operation conditions and applications, the machine builder/ system integrator alone is responsible for making the final selection of the products – and assuring that all performance, safety and Warning requirements of the application are met.

Introduction

PVE Series 4 is the common name for the Sauer-Danfoss PVG electrical actuator.

This technical information covers our voltage controlled PVE and our current controlled PVHC actuator. For the PVHC please see in the PVHC section. The digital actuators PVED-CC and PVED-CX are covered in their special technical information.

PVE controlled PVG with PVSK



PVE stands for Proportional Valve Electrical actuator.

The Sauer-Danfoss PVE is built on more than thirty years experience of electrical valve control and is the perfect fit for our high performance proportional valves PVG32, PVG100 and PVG120, as it is for our EH steering.

All our products are developed in close cooperation with system manufacturers from the mobile hydraulic market. That is the reason for our high performance in all market segments

The PVE can be controlled from a switch, a joystick, a PLC, a computer or a Sauer-Danfoss PLUS+1™ micro-controller.

The PVE is available in multiple variants. A short list here just gives the main variations.

Available PVE variants

Actuation	On/Off
	Proportional - Closed loop controlled
	Proportional - Direct control
Control signal	Voltage
	PWM
	Current (PVHC)
Precision	Standard precision
	High precision
	Super high precision
Feedback	Spool position
	Direction indicator
	Error
	None
Connectors	Deutsch
	AMP
	DIN/Hirschmann
Fault detection and reaction	Active
	Passive
	None
Power supply	11V – 32V multi-voltage
	12V
	24V

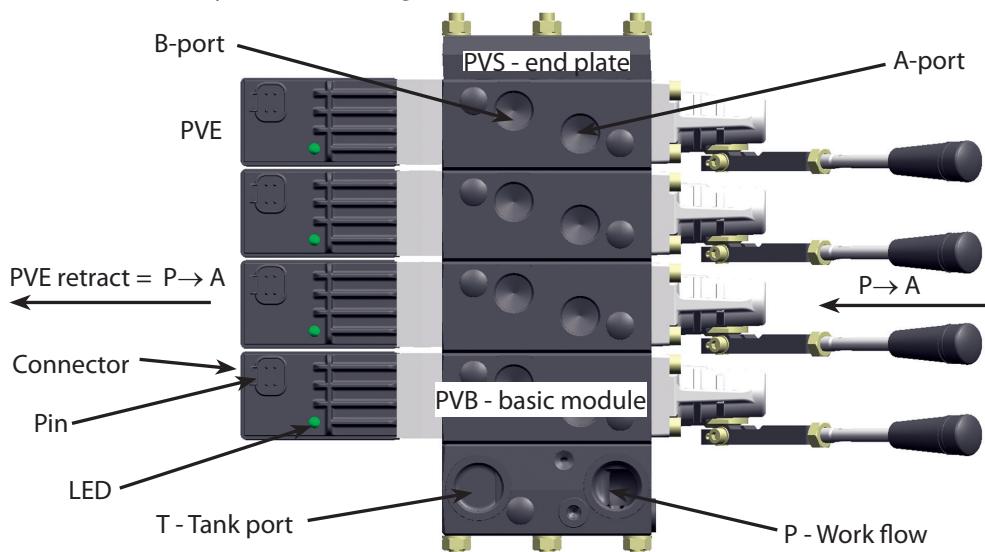
Overview

The PVG is a sectional spool valve stack with up to 12 individually controlled proportional valves. With the PVE the PVG can be operated as single valves or several valves in cooperation.

The oil flow out of the work section (A- or B-port) can be controlled by a combination of the following:

- PVE controlling the spool position using pilot oil pressure.
- A handle (PVM) in mechanical interface with the spool.

PVG 32 structural lay-out with naming



V310329.A

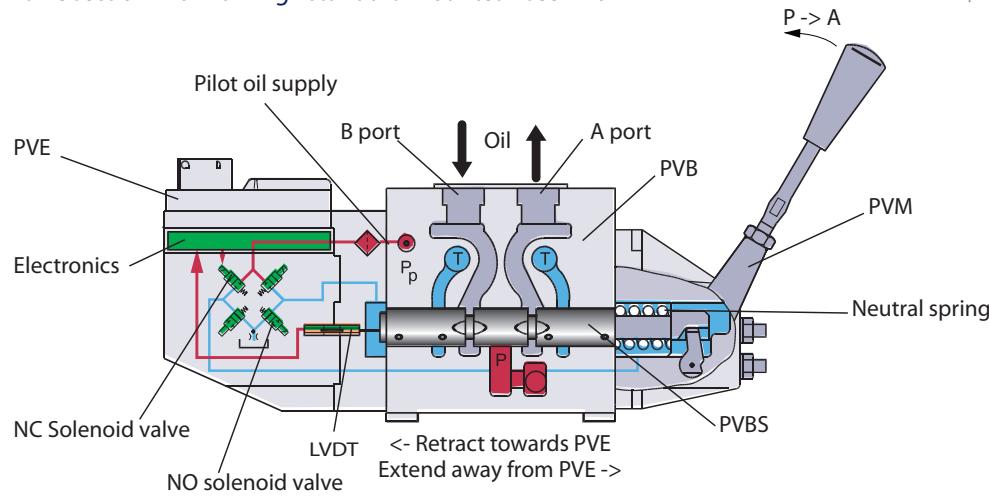
PVG Functionality

The PVG valve distributes oil from pump flow to a particular work function in the application via a specific valve section. This is done by moving the spool (PVBS).

Depending on the choice of components the oil work flow enters the PVG through the PVP (proportional valve pump side module), a PVS, a mid inlet or other system interface and enters the PVB (proportional valve basic module) via the P gallery and leaves through the T gallery. The PVP/PVSK also supplies the Pilot oil pressure (P_p) for the PVE to activate the spool (PVBS). Special designed float spools also allow oil flow in both directions between A- and B-port not opening to pump nor tank.

When looking at the figure you see the valve section from PVP towards PVS with the PVM and PVE standard mounted. When PVM and PVE are interchanged it's called option mounted.

Valve section with naming - standard mounted - seen from PVP



Oil out of A-port = PVM pushed towards PVB = retract = LVDT moves into PVE.

With the spool in neutral, default position when held by the neutral spring, the connection to the application via ports is blocked.

Moving the PVBS towards the PVE, as in the figure, opens a connection between P and A and also between B and T. This is done by either pushing the PVM or activating the PVE.

The PVE moves the PVBS by letting Pilot Oil Pressure (P_p) push on the right end of the PVBS and releasing pressure from the left end.

For details on PVG 32 please see *PVG 32 Proportional Valve Groups, Technical Information, 520L0334*.

PVE Functionality

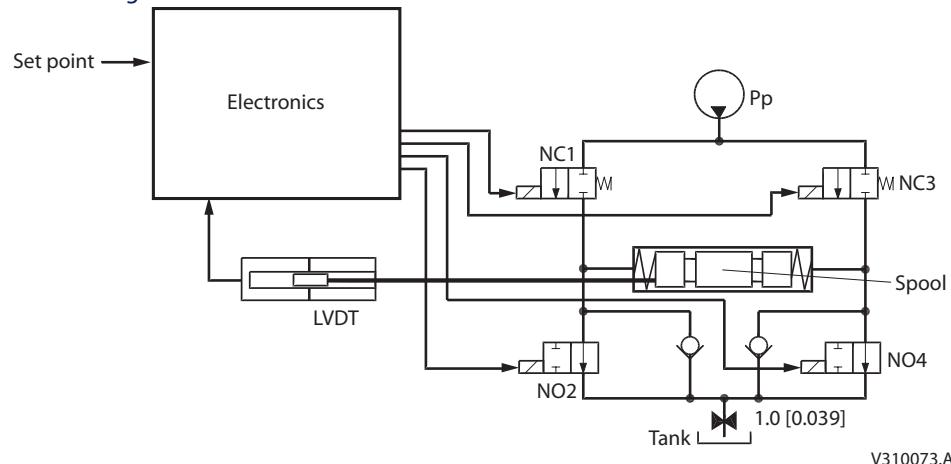
This section has focus on how the PVE works and interacts. The description here is general and variant specific descriptions will all refer to this.

The PVE is an electro mechanical device, meaning that functionality is depending on mechanical, hydraulic, electrical and control conditions given by PVE, PVG, application and vehicle. The result of this is that implementing operation and safety conditions also must include vehicle specific considerations.

Hydraulic subsystem

The hydraulic subsystem is used for moving the spool and thereby open the valve for work flow.

Pilot oil diagram



The hydraulic sub system moves the spool and thereby opens the valve for work flow. The heart in the hydraulic subsystem is the solenoid valve bridge which controls the Pilot Pressure (Pp) on spool ends. It consist of four poppet valves, the two upper are normally closed (NC) and the two lower are normally open (NO). The Pp will work against the PVBS neutral spring when the spool is moved out of blocked (neutral) and together with the spring when going in blocked. This combined with a larger opening in the NO than in the NC will give a faster movement towards blocked than out of blocked.

When the PVE is powered the solenoids are all put in closed state. To move the PVBS to the right NC1 and NO4 are opened and NC3 and NO4 are kept closed.

The activation of the solenoid valves represents oil consumption and thereby also a pressure drop in the pilot oil gallery. By simultaneous use of multiple PVE the Pp can fall and result in performance problems.

The two check valves next to the NO are anti-cavitation valves.
 The orifice to tank reduces tank pressure spikes and can also be used for ramp function.

⚠ Warning

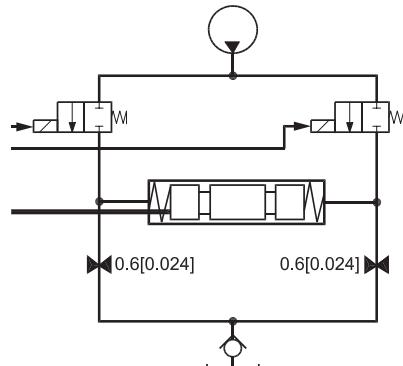
Obstacles for the Pilot oil pressure (Pp) can have direct influence on spool control.
 Reduced Pp will limit spool control. Too high Pp can harm the PVE.

**PVE Functionality
(continued)**

⚠ Warning

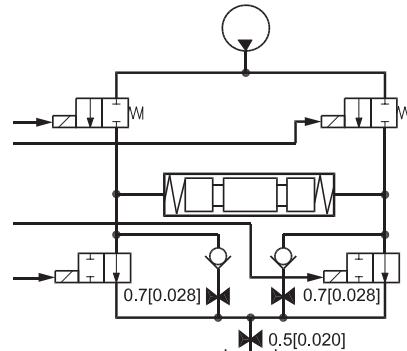
PVEA is not for use on PVG 100.

Hydraulic variants: PVEA
NO2 and NO4 are replaced with orifices.



157-338.10

PVE with ramp
Tank orifice has smaller diameter.



157-469.10

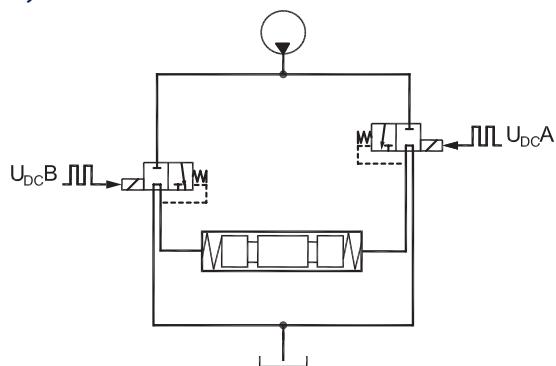
Hydraulic variant: PVHC

The PVHC does not work as a PVE and does not have transducer, anti cavitation nor protection against tank pressure spikes.

It is necessary to use the PVHC in combination with 25 bar [362.6 psi] pilot pressure, and standard FC spools fitted for hydraulic actuation. See *PVG 32 Proportional Valve Groups, Technical Information 520L0344*, *PVG 100 Proportional Valve Groups, Technical Information 520L0720*, and *PVG 120 Proportional Valve Groups, Technical Information 520L0356*.

Because of the 25 bar pilot pressure, it is not possible to combine PVHC with PVE on a PVG.

Hydraulic variant: PVHC



V310374.A

With electrical proportional actuation, the main spool position is adjusted so that its position corresponds to an electrical control signal.

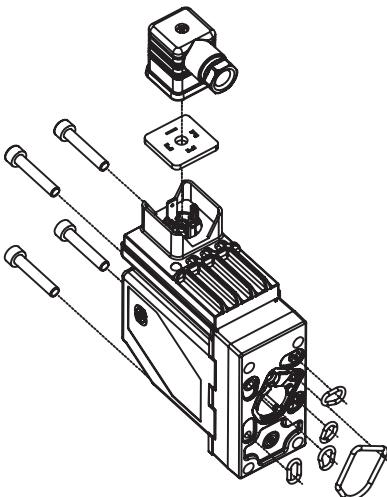
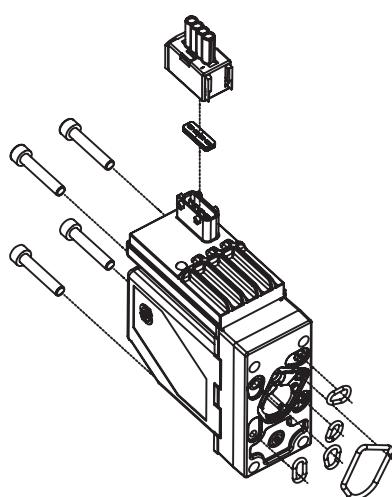
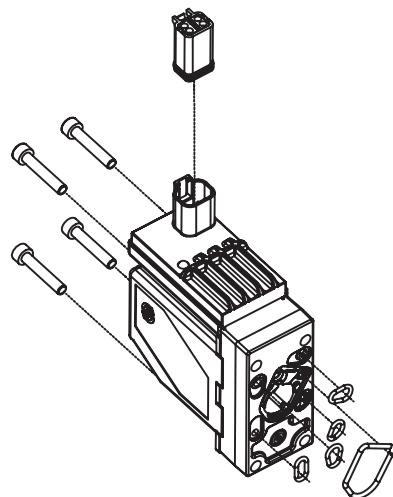
The control signal is converted into a hydraulic pressure signal that moves the main spool in the PVG. This is done by means of two proportional pressure-reducing valves.

The electrical actuator can be controlled either by a current amplifier card, or directly from a programmable micro-controller.

**PVE Functionality
(continued)****Mechanical Subsystem**

The mechanical subsystem gives interface to valve and control system and provides protection to hydraulic and electrical/electronic subsystem. The LVDT, not used on all variants, gives feed back to electronics on spool position. The LVDT is calibrated in production and recalibration should only be done in special cases. The standard PVE has an aluminum block for distributing pilot oil. PVE with anodized block are available.

The connector gives the electrical interface to power and control system. Sauer-Danfoss have a variety of connectors. We know that tradition and the aspects of serviceability are important when our customers choose. We have chosen the Deutsch connector as our main solution. The quality of wiring has direct influence on water integrity and signal quality therefore disturbance or changes in cabling can influence safety and performance.

PVE, Hirschmann/DIN connector*PVE, AMP connector**PVE, Deutsch connector*

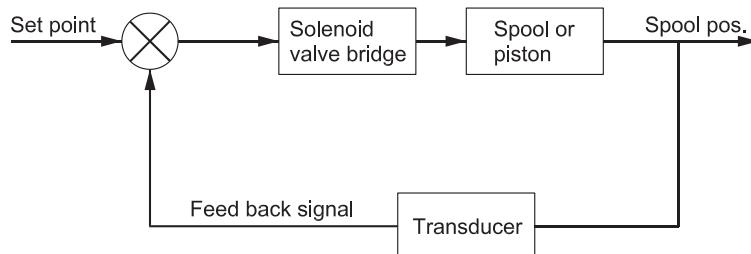
V310390.A

**PVE Functionality
(continued)**

Electronic subsystem

The PVE (A/ H/ M/ S/ U) control signal is a low current voltage, a PWM can also be used. The PVEP has build-in a PWM evaluation and cannot be controlled by proportional voltage. The control signal is referred to as U_s .

Function blocks for electronics



157-503.10

The PVE features Closed Loop Control (CLC). This is made possible by on board electronics and an integrated feedback transducer that measures spool movement. The integrated electronics compensate for flow forces on the spool, internal leakage, changes in oil viscosity, pilot pressure, etc. This results in lower hysteresis and better resolution.

In principle the set-point determines the level of pilot pressure which moves the main spool. The position of the main spool is sensed in the LVDT which generates an electric feed-back signal registered by the electronics. The variation between the set-point signal and feed-back signal actuates the solenoid valves. The solenoid valves are actuated so that hydraulic pilot pressure drives the main spool into the correct position.

The LVDT (Linear Variable Differential Transducer) is an inductive transducer with very high resolution. When the LVDT is moved by the main spool a voltage is induced proportional to the spool position. The use of LVDT gives contact-free connection between mechanics and electronics. This means an extra long lifetime and no limitation as regards the type of hydraulic fluid used.

The PVEO and PVHC do not have embedded control electronics and do not support closed loop control.

Safety and Monitoring

The choice of PVE also decides the level of feedback and safety. PVE are available with fault monitoring, spool direction indication, spool position feedback and separate float control.

The fault monitoring is available in PVEA/H/S/P/U and is a utilization of the ASIC.

Direction Indication is available in PVEO/A/H and they are dual powered PVE where separate pins give an active feedback for spool movement.

Spool position is available in PVES and is a precise feedback on a separate pin for actual spool position.

The separate float control is a protection against unintended float activation.

The PVEM, PVEO and PVHC do not have fault monitoring.

Fault monitoring and reaction

The fault monitoring system is available in two versions:

- **Active fault monitoring** provides a **Warning** signal and deactivates the solenoid valves. A reboot of the PVE is required to reactivate.
- **Passive fault monitoring** provides a **Warning** signal only. A reboot is not required.

Both active and passive fault monitoring systems are triggered by the same four main events:

1. *Control signal monitoring*

The Control signal voltage (U_s) is continuously monitored. The permissible range is between 15% and 85% of the supply voltage. Outside this range the section will switch into an error state. A disconnected U_s pin (floating) is recognized as neutral set point.

2. *Transducer supervision*

The internal LVDT wires are monitored.

If the signals are interrupted or short-circuited, the PVE will switch into an error state.

3. *Supervision of spool position*

The actual position must always correspond to the demanded position (U_s). If the actual spool position is further out from neutral than the demanded spool position (>12%, PVEA: >25%) or in opposite direction, the PVE will switch into an error state. With neutral/blocked setpoint the tolerance is +- 0,5 mm relative the calibrated neutral position. Spool position closer to neutral and in same direction will not cause an error state. The situation is considered "*in control*".

4. *Float monitoring*

Float must be entered or left within a time limit. On the six pin float PVE too high delay will cause an error state. The float Time Outs has own thresholds. Only relevant for the six pin PVEH-F.

**Safety and Monitoring
(continued)**

Active fault reaction is activated after 500 ms of error (PVEA: 750 ms).

- The solenoid valve bridge is disabled and the PVBS is released to spring control
- The error pin is powered*
- The LED change color
- The state is memorized and continues until PVE reboot

Passive fault reaction is activated after 250 ms of error (PVEA: 750 ms)

- The solenoid valve bridge is **NOT** disabled and the PVBS is **NOT** released
- The error pin is powered*
- The LED change color
- The state is active for minimum 100 ms and is reset when error disappears

* for PVE with direction indication both DI pins goes low by fault.

⚠ Warning

Error pins from more PVEs may not be interconnected.

Not activated error pins are connected to ground and will disable any active signal.

Error pins are signal pins and can only supply very limited power consumption.

To avoid the electronics in undefined state a general supervision of power supply (U_{DC}) and internal clock frequency is implemented. This function applies to PVEA, PVEH, PVEP, PVES and PVEU independently of fault monitoring version and PVEM - and will not activate fault monitoring.

The solenoid valves are disabled when:

- the supply voltage exceeds 36 V
- the supply voltage falls below 8.5 V
- the internal clock frequency fails

**Safety and Monitoring
(continued)**

Fault monitoring overview

Type	Fault monitoring	Delay before error out	Error mode	Error output status	Fault output on PVE ¹⁾	LED light	Memory (reset needed)
PVEO PVEM PVHC	No fault monitoring	-	-	-	-	-	-
PVEA PVEH PVEP PVES PVEU	Active	500 ms (PVEA: 750 ms)	No fault	Low	< 2 V	Green	-
			Input signal faults	High	$\sim U_{DC}$	Flashing red	Yes
			Transducer (LVDT)			Constant red	
			Close loop fault				
	Passive	250 ms (PVEA: 750 ms)	No fault	Low	< 2 V	Green	-
			Input signal faults	High	$\sim U_{DC}$	Flashing red	No
			Transducer (LVDT)			Constant red	
			Close loop fault				
PVE Float six pin	Active	500 ms	Float not active	High	$\sim U_{DC}$	Constant red	Yes
		750 ms	Float still active				

1) Measured between fault output pin and ground.

⚠ Warning

It's up to the customer to decide on the required degree of safety for the system.

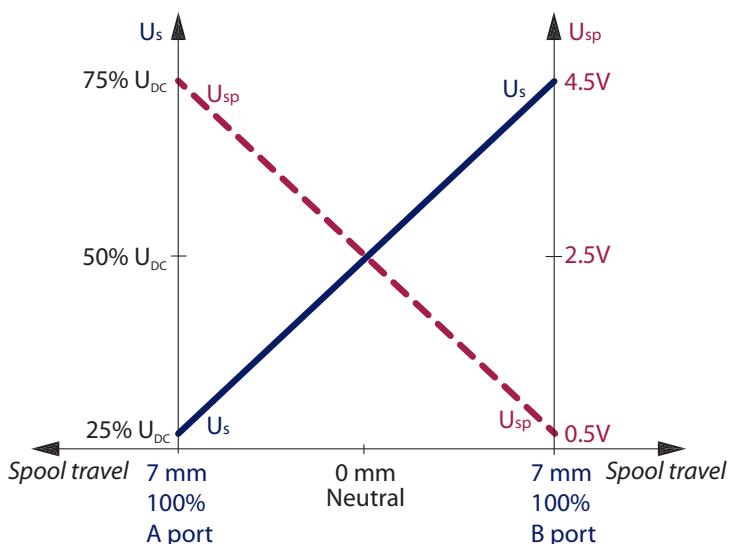
For PVE with direction indication:

- both DI pins go low when error is active.
- when U_{DC1} is disabled, U_s is not monitored and defined as 50%.

Spool Position Feedback (-SP)

The -SP functionality is a 0,5V to 4,5V feedback, inverted in direction relative to U_s with 2,5V as neutral value.

Spool Position Feedback



Direction Indication Feedback (-DI)

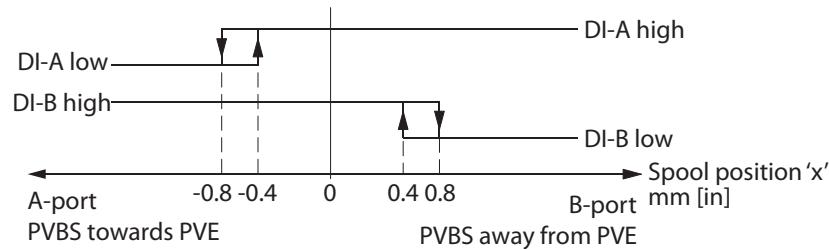
PVE with build in indication for spool movement direction are available.

The PVE-DI has dual power supply. U_{DC1} only supplies solenoid valves. U_{DC2} supplies electronics and feed back. The PVE does not work without U_{DC2} . DI-A and DI-B are relative standard mounting. The input signal fault monitoring is disabled if U_{DC1} is disabled. DI-A and DI-B are relative standard mounting.

The DI has two direction feedback signals with output high (close to U_{DC}) when the spool is in neutral position. If the spool moves out of neutral position, the direction signal switches to low (< 0.2 V). One of the signals goes low by spool ~0,8 mm out of neutral and high by spool within 0,4 mm out of neutral.

Both direction indication signals go low when the error indicator goes high.

Direction Indication Feedback



157-435.10

As shown in the figure, both "DI-A" and "DI-B" signals are "High" when the spool is in neutral position.

When the spool is moving in the A direction, the "DI-A" signal goes "Low" and the "DI-B" signal stays "High".

The reverse is true when the spool is moved in the B direction.

Values for both Direction Indicators, pin A and pin B

Transition to low from high	$0.8 \pm 0.1 \text{ mm} [0.031 \text{ in}]$
Transition to high from low	$0.4 \pm 0.1 \text{ mm} [0.015 \text{ in}]$
Transition to low both pins	error pin goes high
Maximum load of "DI-A" , "DI-B"	50 mA
Voltage DI high by load 20 mA	$> U_{DC} - 1.5 \text{ V}$
Voltage DI high by load 50 mA	$> U_{DC} - 2.0 \text{ V}$
Voltage DI low	$< 0.2 \text{ V}$

Solenoid disabling function (-NP)

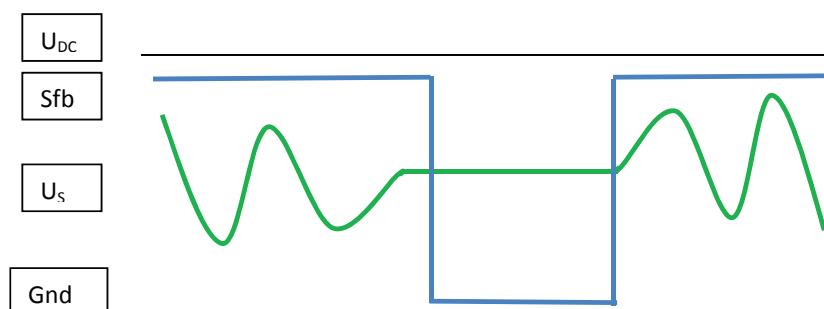
PVEH-NP and PVEA-NP have a build in feature that disables the solenoids by US at 50% and gives a feedback on the solenoid status. This is done to facilitate application monitoring.

The fault monitoring is still activated but the closed loop will remain passive until the control signal shifts.

U_s disable range	48 % U _{DC} to 52 % U _{DC}
Solenoid disable reaction time	From active to passive 750 ms <-> 1000 ms From passive to active 0 ms <-> 50 ms
Solenoid feedback signal	Maximum load 50 mA Voltage if solenoid active by load 20 mA > U _{DC} – 1.5 V Voltage if solenoid active by load 50 mA > U _{DC} – 2.0 V Voltage if solenoid passive < 1 V

PVEH-F (six pin) has also the disable function but not the feedback.
 Our general recommendation is disabling of PVE that are not in active use.

Solenoid disabling function (-NP) curves



Building in Safety

All brands and all types of control valves (incl. proportional valves) can fail. Thus the necessary protection against the serious consequences of function failure should always be built into the system. For each application an assessment should be made for the consequences of pressure failure and uncontrolled or blocked movements.

To determine the degree of protection that is required to be built into the application, system tools such as FMEA (Failure Mode and Effect Analysis) and Hazard and Risk Analysis can be used.

FMEA (Failure Mode and Effect Analysis) IEC EN 61508

FMEA is a tool used for analyzing potential risks. This analytical technique is utilized to define, identify, and prioritize the elimination or reduction of known and/or potential failures from a given system before it is released for production.

Please refer to IEC FMEA Standard 61508.

Hazard and Risk Analysis ISO 12100-1 / 14121

This analysis is a tool used in new applications as it will indicate whether there are special safety considerations to be met according to the machine directives EN 13849. Dependent on the determined levels conformity this analysis will determine if any extra requirements for the product design, development process, production process or maintenance, i.e. the complete product life cycle.

⚠ Warning

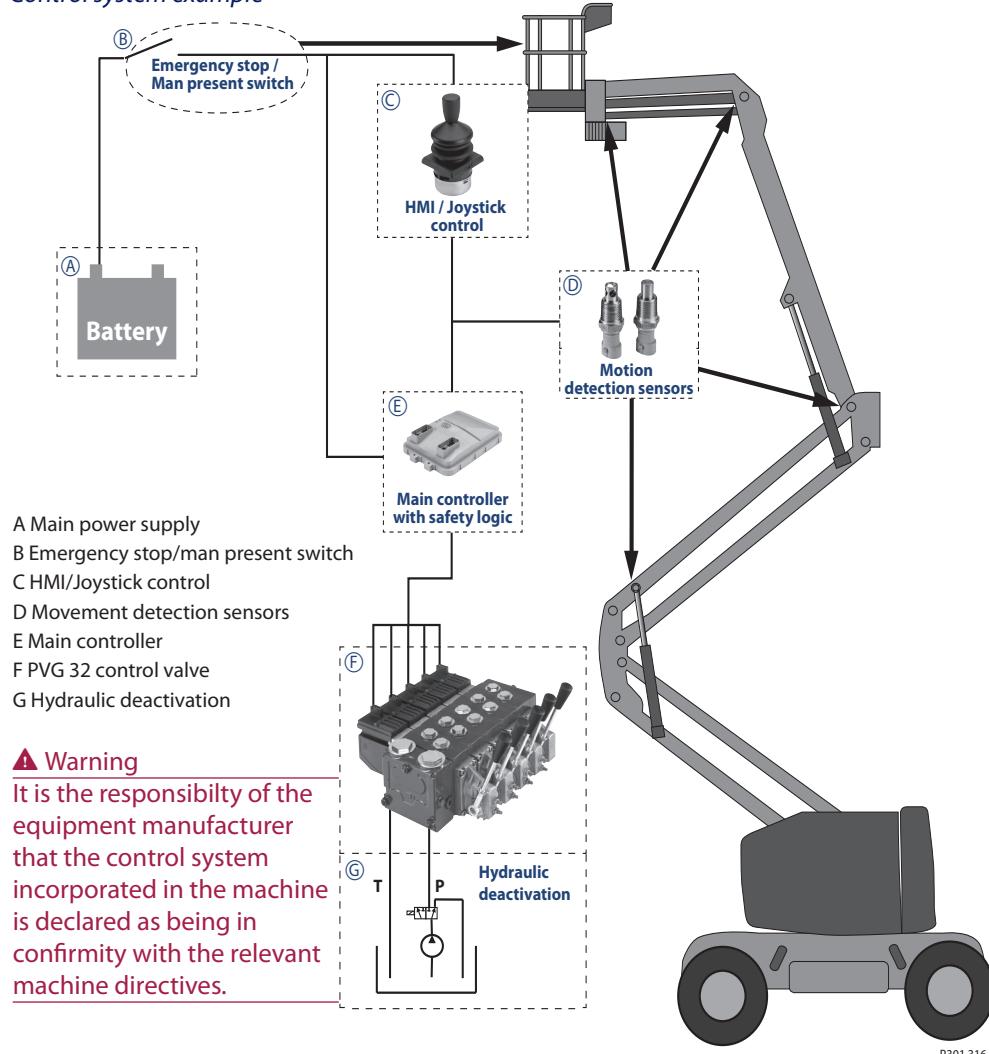
All brands and all types of directional control valves – including proportional valves – can fail and cause serious damage. It is therefore important to analyze all aspects of the application. Because the proportional valves are used in many different operation conditions and applications, the machine builder/ system integrator alone is responsible for making the final selection of the products – and assuring that all performance, safety and Warning requirements of the application are met.

Safety in Application

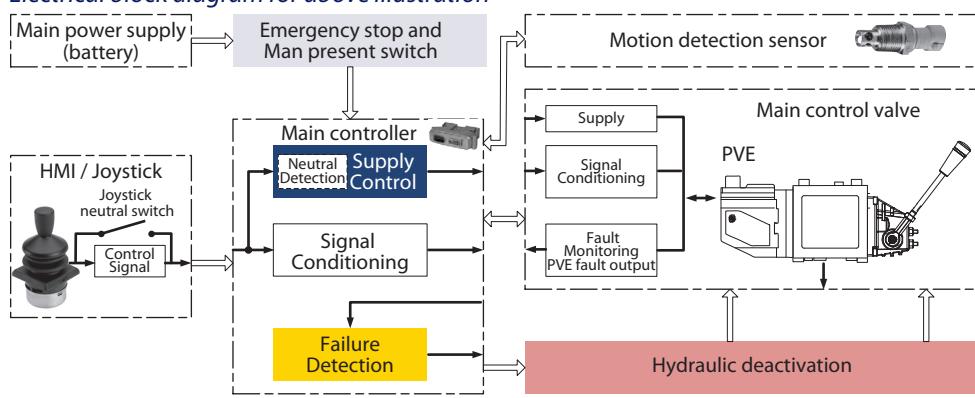
Control System Example

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

Control system example



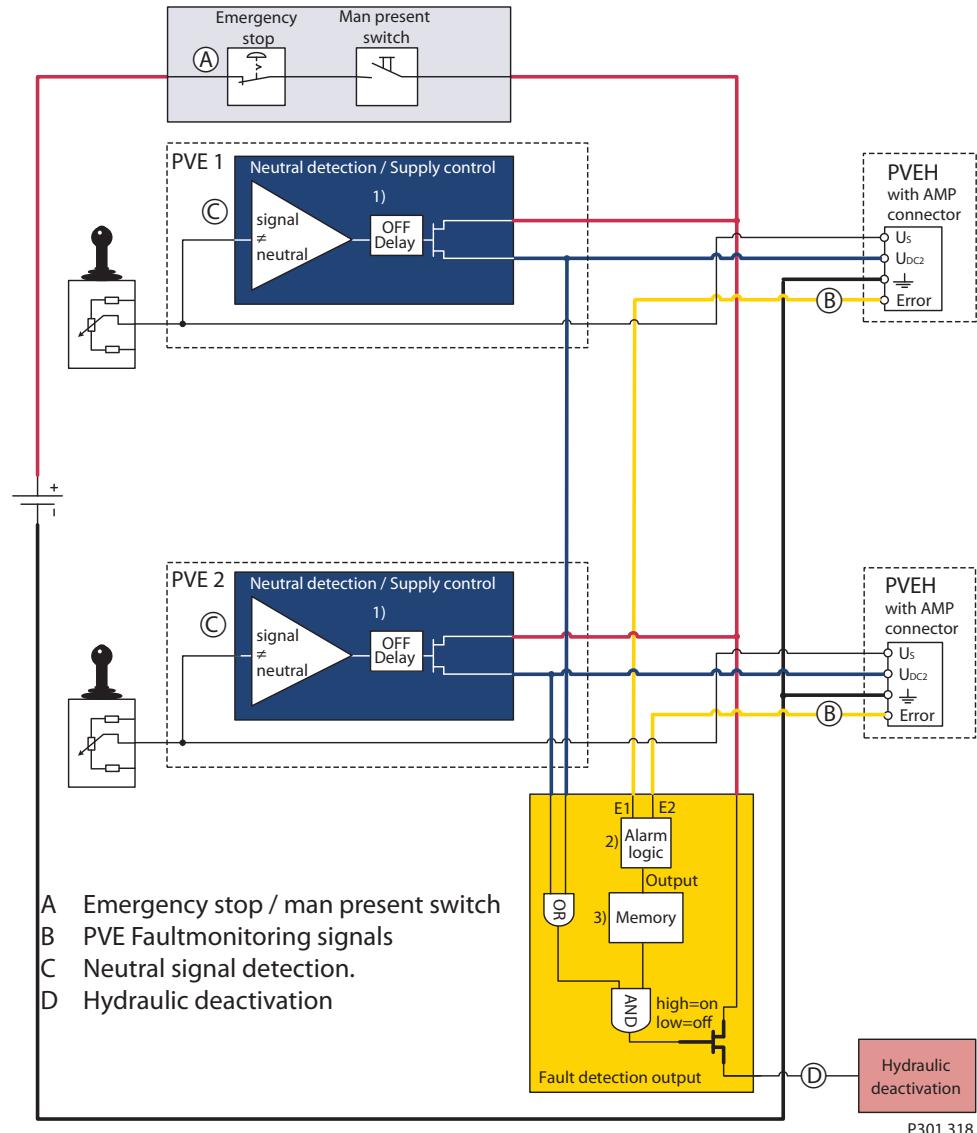
Electrical block diagram for above illustration



Control System Example (continued)

Example of a typical wiring block diagram using PVEH with neutral power off switch and fault monitoring output for hydraulic deactivation.

Typical wiring block diagram example



System Control Logic e.g. PLUS+1™ for signal monitoring and triggering signal for deactivation of the hydraulic system.

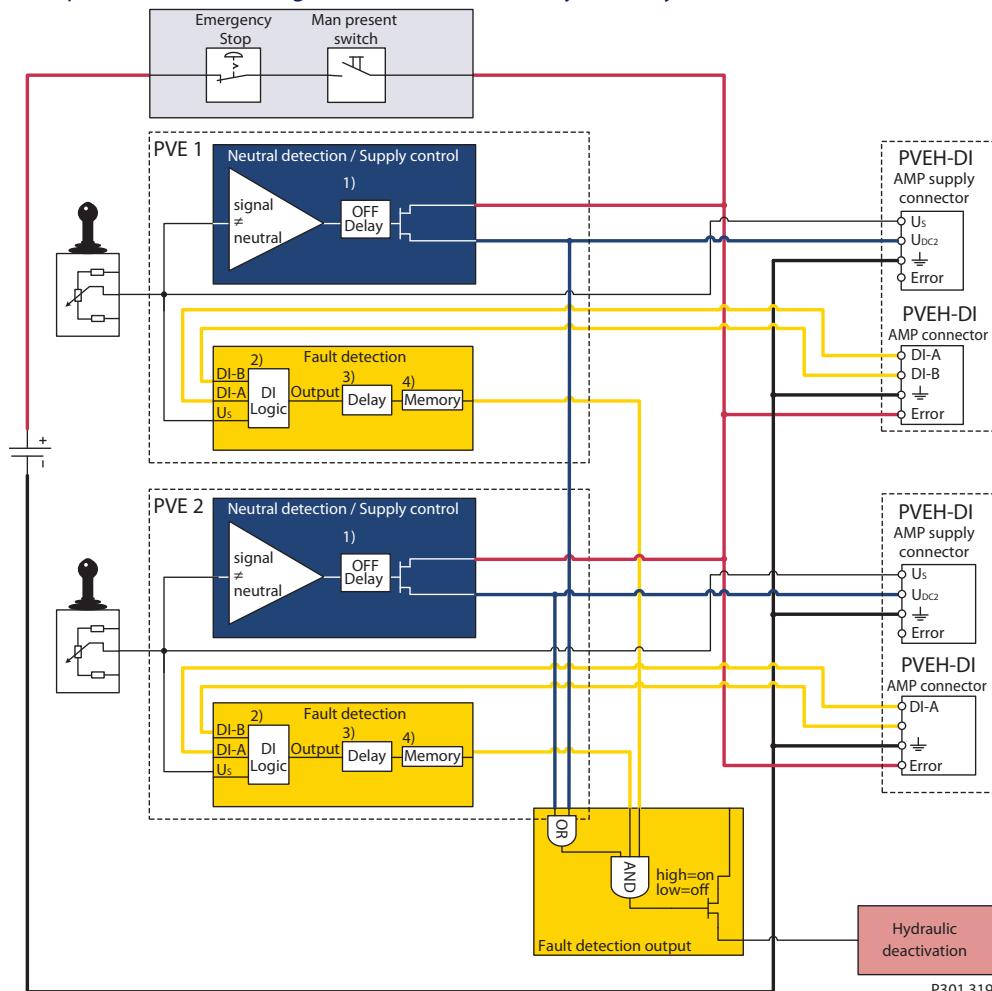
⚠ Warning

It is the responsibility of the equipment manufacturer that the control system incorporated in the machine is declared as being in conformity with the relevant machine directives.

Control System Example (continued)

Similar to previous example using fault monitoring for deactivation of the hydraulic system with extra fault inputs using the PVE's with DI (Direction Indication) function.

Example of fault monitoring for deactivation of the hydraulic system



System Control Logic e.g. PLUS+1™ for signal monitoring and triggering signal for deactivation of the hydraulic system.

⚠ Warning

It is the equipment manufacturers responsibility to ensure that the control system incorporated in the machine is declared as being in conformity with the relevant machine directives.

Other non-electrical modules which can be used in connection with hydraulic deactivation at different levels.

**Control System Example
(continued)****PVG32– Mainly used in system with fixed displacement pumps**

- PVSK, commonly used in crane application - full flow dump
- PVPE, full flow dump for the PVG 120

PVG100 – Alternative LS dump or pilot supply disconnect

- PVPP, pilot oil supply shut off
- External cartridge valve connecting LS Pressure to Tank
- External cartridge valve connecting main Pressure to Tank

PVG120 – Pump disconnect/block for variable pumps

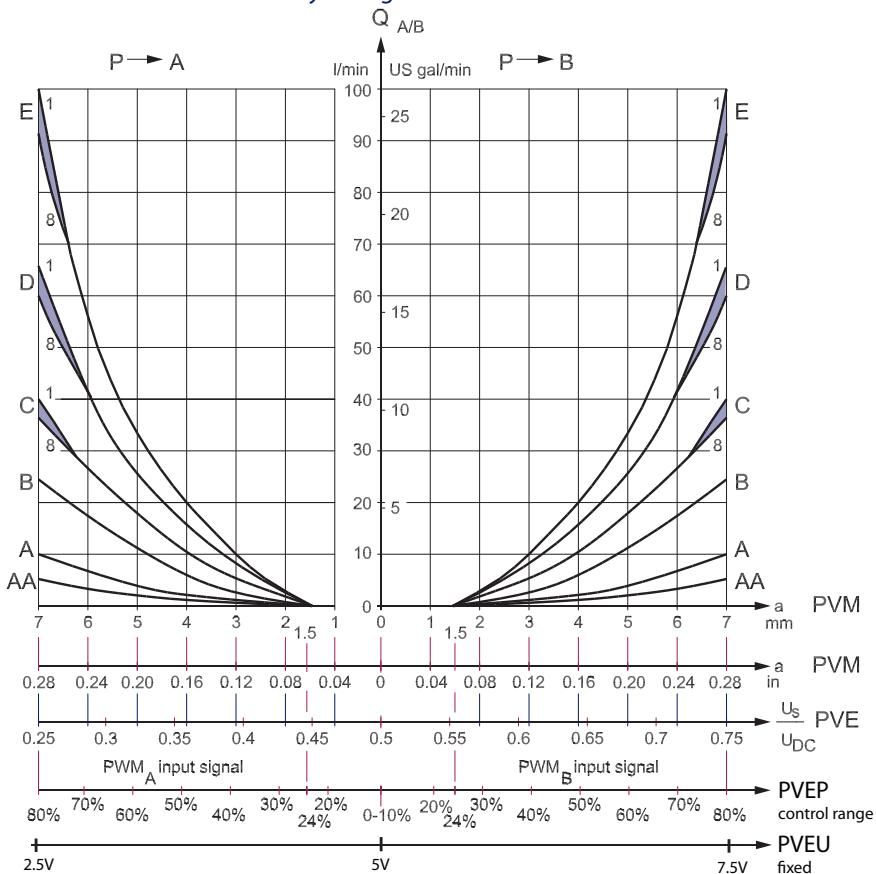
- PVPX, LS dump to tank

PVE Series 4 for PVG 32, PVG 100 and PVG 120, Including PVHC Technical Information PVE Control

PVE Control by Voltage

- The PVE is controlled with a low current voltage signal.
- The spool stroke is proportional to the control voltage (U_s).
- The power is supplied via the supply wire (U_{BAT} or U_{DC}).
- The ratio U_s/U_{DC} defines the actuation. For PVEU a defined voltage.
- A not connected U_s pin (floating) is recognized as $U_s = \frac{1}{2}U_{DC}$.

PVE characteristic – control by voltage



Values for standard mounted PVE (PVEA/M/H/S)

Function	Signal voltage (U_s)
Neutral	$U_s = 0.5 \cdot U_{DC}$
Q: P → A	$U_s = (0.5 \rightarrow 0.25) \cdot U_{DC}$
Q: P → B	$U_s = (0.5 \rightarrow 0.75) \cdot U_{DC}$

Caution

PVEM is not PLUS+1 compliant.

PLUS+1™ compliance

PVEA, PVEH, PVES, PVEO, PVEP and PVED can be controlled by PLUS+1.

The U_{DC} has a capacitance of 2,2 uF which can give problems with some micro-controller power supply. To eliminate this problem Sauer-Danfoss has designed a special resistance supply and control cable.

ATEX PVE

The Sauer-Danfoss PVE ATEX portfolio has the same monitoring and control characteristics as the equivalent standard PVE.

PVE Control by Voltage (continued)

PVEU-PVE with fixed control signal range

The PVEU (PVE 0-10V) is designed for PLC/microcontroller(uC) control hence the U. The control signal U_s is fixed 0 V to 10 V independent of supply voltage U_{DC} .

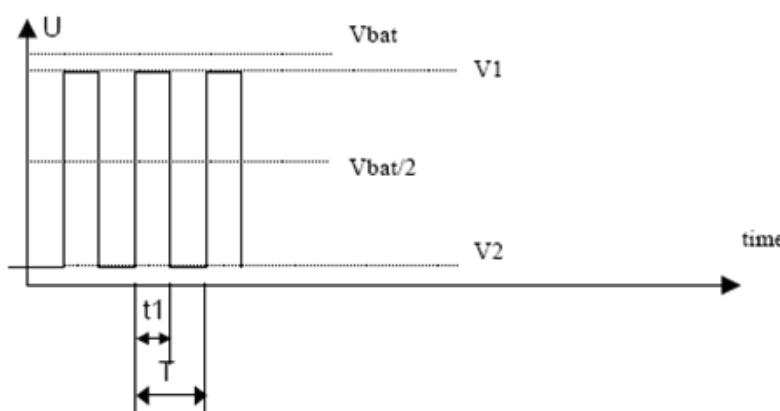
Signal voltage - PVEU

Function	Signal voltage PVEU
Neutral	5V
Q: P → A	5V → 2,5V
Q: P → B	5V → 7,5V

PVE controlled with PWM signal

The standard PVE, PVEA/M/H/S, can also be controlled by a pulse with modulated PWM signal.

The V1 and V2 for PWM must be symmetrically located around U_{DC2} and $V1 \leq U_{DC}$.



Duty cycles for PVE (PVEA/M/H/S/U)

Function	Duty cycle (dc) PVEA/M/H/S
Neutral	50% dc
Q: P → A	50% dc → 25% dc
Q: P → B	50% dc → 75% dc

Recommended PWM frequency for PVE

PVE type	PWM frequency
PVEM	> 200 Hz
PVEA/H/S/U	> 1 kHz

Warning

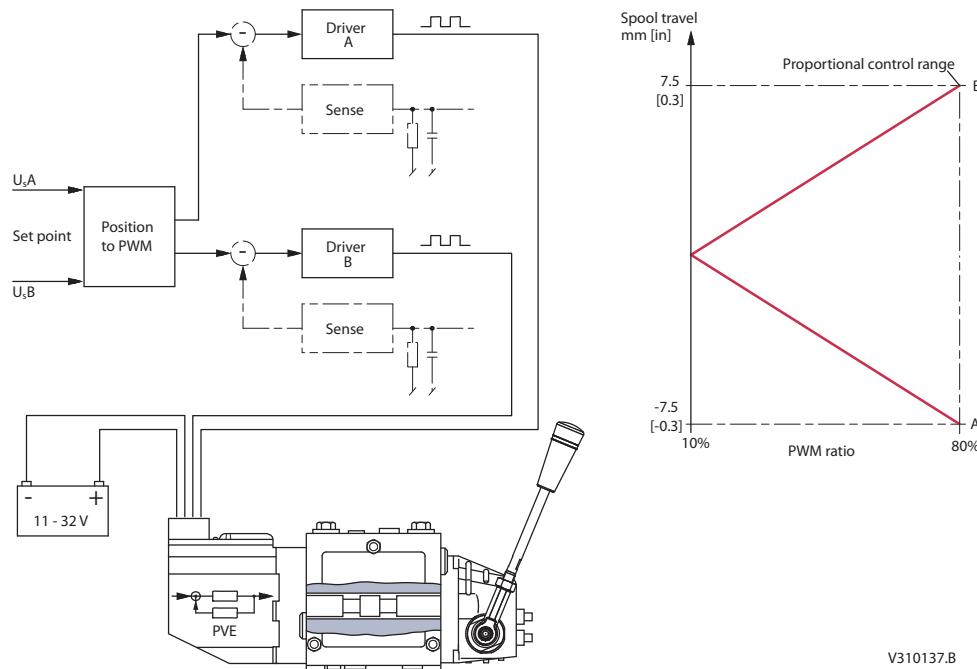
The PWM is not evaluated by the PVE so variance/failure in period (T) will not be detected.

**PVE Control by Voltage
(continued)**

PVEP

The PVEP is designed for PWM control signals only.

PVEP schematic and characteristic



V310137.8

Caution

It is important that the power supply (U_{DC}) is connected before the PWM signal.

PWM signals are low power voltage signals; hence no current drivers are needed. Current control is not possible with PVEP. The PVEP can also be connected to a control signal like used for PVHC.

The PVEP performs a true time difference measurement on the PWM input, thus there is no filtering or conversion involved.

PWM frequency can be chosen between 100 to 1000 Hz.

PVEP signals

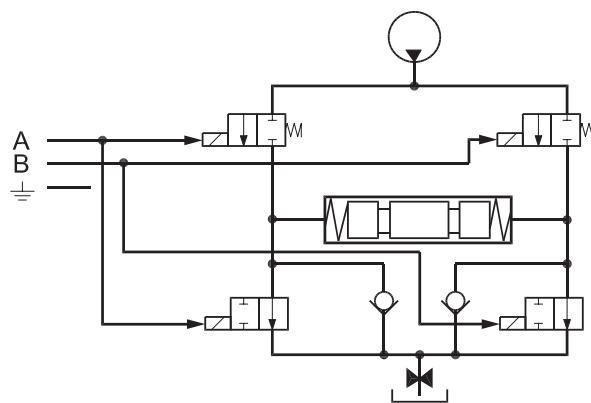
Duty cycle A-signal (pin 1)	Duty cycle B-signal (pin 2)	Function	Error Pin output (pin 3)
0%	0%	Neutral	Low
10%	0%		
0%	10%		
$\geq 10\%$	$\geq 10\%$		High
$< 10\%$	$10 \rightarrow 80\%$		Low
$10 \rightarrow 80\%$	$< 10\%$		Low
A > 86%	B > 86%	Fault (Error)	High

PVEO

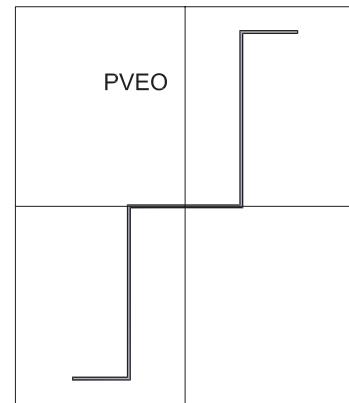
PVE ON/OFF activation

The PVEO has two independent powered sets of solenoids. By powering a set of pins the actuator is activated. By standard mounted PVE the A set gives full flow on A port and B gives on B port. Both directions activated at same time will keep the spool in neutral.

PVEO schematic and characteristic



157-470.10



157-513.10

⚠ Warning

The PVEO is designed to have $U_{DC}=12\text{ V}$ or $U_{DC}=24\text{ V}$.

The solenoids might be activated by voltage down to 6 V.

PVE for Float Spool

Sauer-Danfoss has developed two PVE variants to support the float spool. The float spool is a $\frac{1}{4}$ spool, where as the standard is a $\frac{1}{3}$ spool giving another characteristic and maximum stroke. These variations are covered by the built-in electronics.

There are two variants of float PVBS.

- Float B – 1,5 mm dead band, max flow at 4,8 mm. Float at B = 8 mm, from 6 mm partial float.
- Float A – 0,8 mm dead band, max flow at 5,5 mm. Float at A = 8 mm, from 6,2 mm partial float (PVBZ).

PVEM-F and PVEH-F with four pin connector are for float B and give no built-in protection against entering float.

PVEH-F with six pin connector is for float A and gives protection against entering float by using low Us. The float signal has priority to the Us in the PVEH-F six pin.

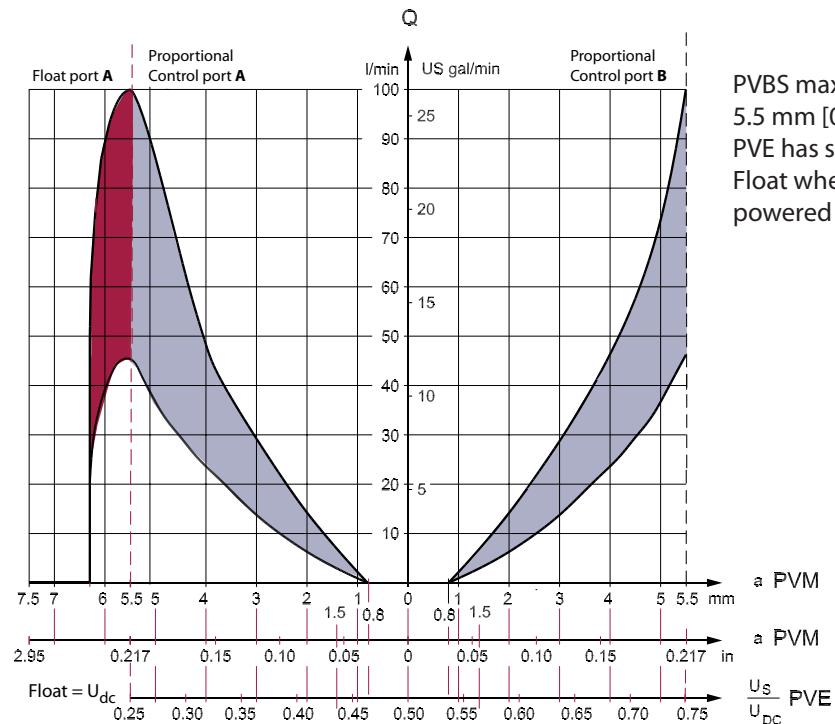
Variants of the float spool PVBS

Float	PVE	PVBS	Progressive control	Float control
A	PVEH-F (6 pin)	Dead band 0.8 mm Max float at 5.5 mm	$U_s: 25\% \rightarrow 75\% U_{DC}$	U_{DC} to float pin Has priority
B	PVEH-F (4 pin)	Dead band 1.5 mm Max float at 4.8 mm	$U_s: 35\% \rightarrow 65\% U_{DC}$	$U_s = 75\% U_{DC}$

PVE for float spools are not designed for standard $\frac{1}{3}$ spools.

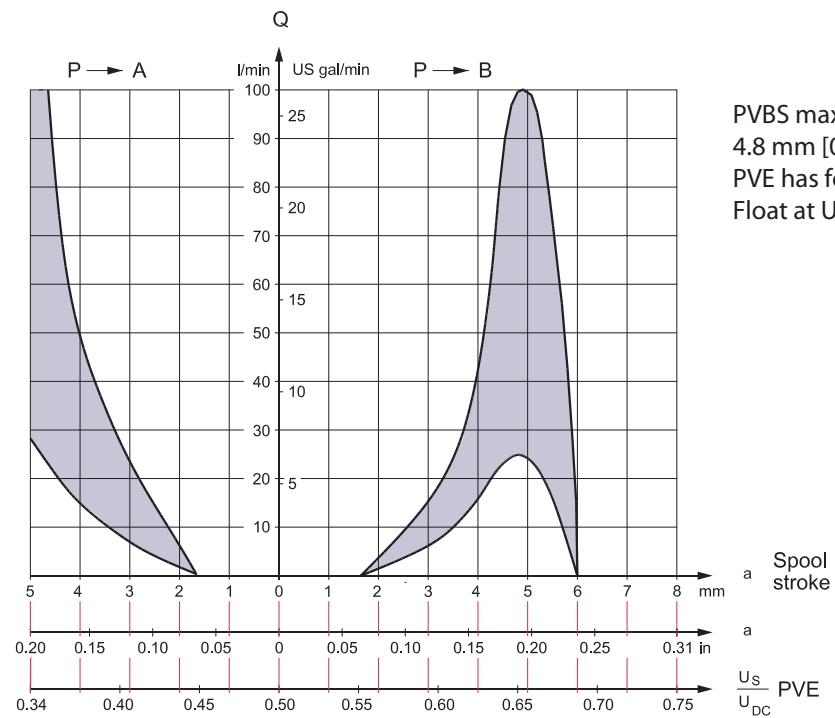
**PVE to the Float Spool
 (continued)**

PVE characteristic – Float A



PVBS maximum float is 5.5 mm [0.22 in].
 PVE has six pins.
 Float when special pin powered at U_{DC} .

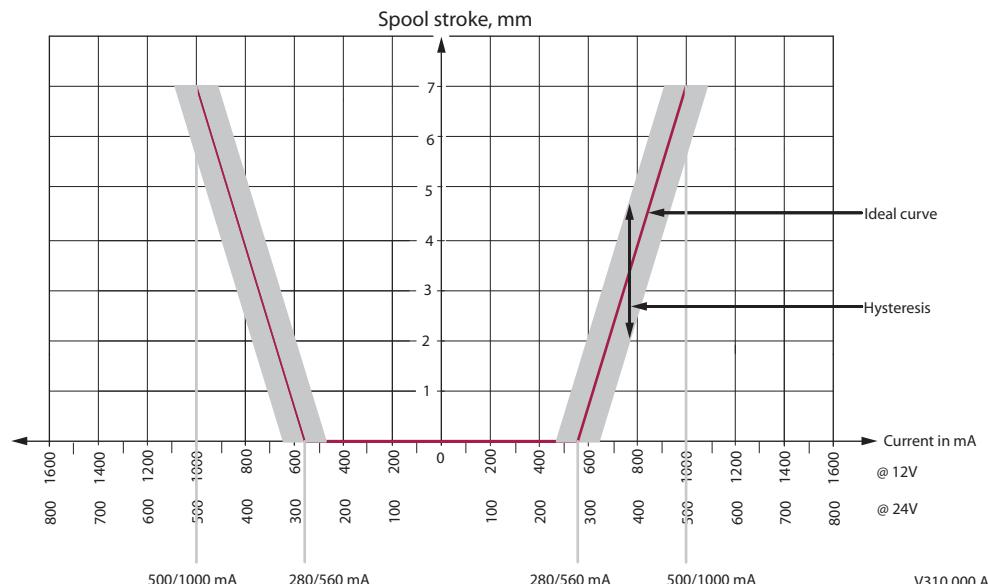
PVE characteristic – Float B



PVBS maximum float is 4.8 mm [0.19 in].
 PVE has four pins.
 Float at $U_S / U_{DC} = 0.75$

PVHC control

PVHC characteristic



PVHC current response and hysteresis @ 25 bar P_p, 21 ctS, 25 °C.

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

The PVHC does not have fault monitoring.

The PVHC does not have internal closed loop control of the spool.

The PVHC has high hysteresis. The hysteresis is affected by viscosity, friction, flow forces, dither frequency and modulation frequency. The spool position will shift when conditions are changed e.g. temperature change.

For PVG controlled by PVHC hysteresis is influenced by lever (PVM).

Hysteresis

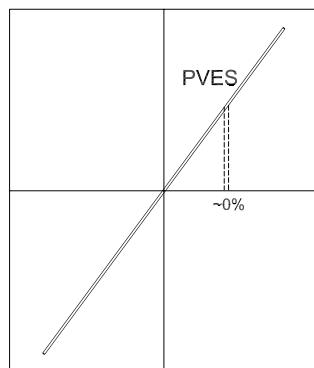
The controllability of the PVE depends on the solenoid valve bridge and the electronic capacity of the module.

Hysteresis is a measurement on spool position precision and repeatability. Hysteresis is not a description of position maintaining.

PVES Series 4

The PVES has an ASIC closed loop circuit and the NC-S solenoids.

PVES voltage, position diagram

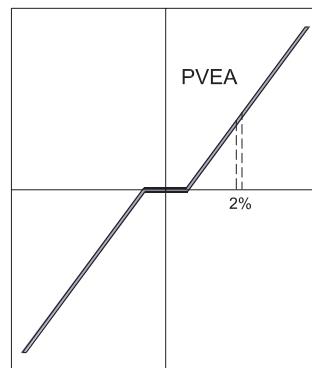


157-775.10

PVEA Series 4

The PVEA has an ASIC closed loop circuit, standard NC solenoids and orifice instead of NO solenoids.

PVEA voltage, position diagram



157-510.10

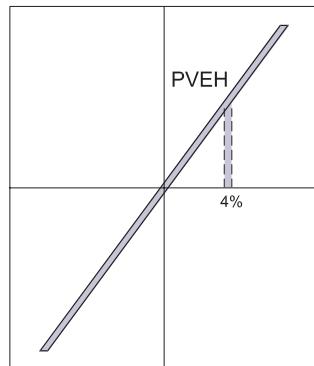
Caution

PVEA is not for use on PVG 100.

PVEH Series 4

The PVEH has an ASIC closed loop circuit and the standard NC solenoids.

PVEH voltage, position diagram



157-511.10

PVE hysteresis overview

PVE	S	A	H	M
Maximum	2 %	6 %	8.6 %	35 %
Typical	<1/2 %	2 %	4 %	25 %

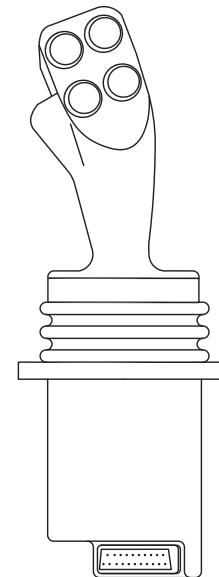
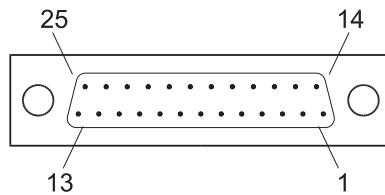
- PVEP has the PVES characteristic.
- PVEU is available with both standard PVEH and super fine PVES characteristic.
- PVHC has hysteresis like PVEM at fixed temperature and viscosity.

For PVHC temperature and viscosity shifts control signal effect.

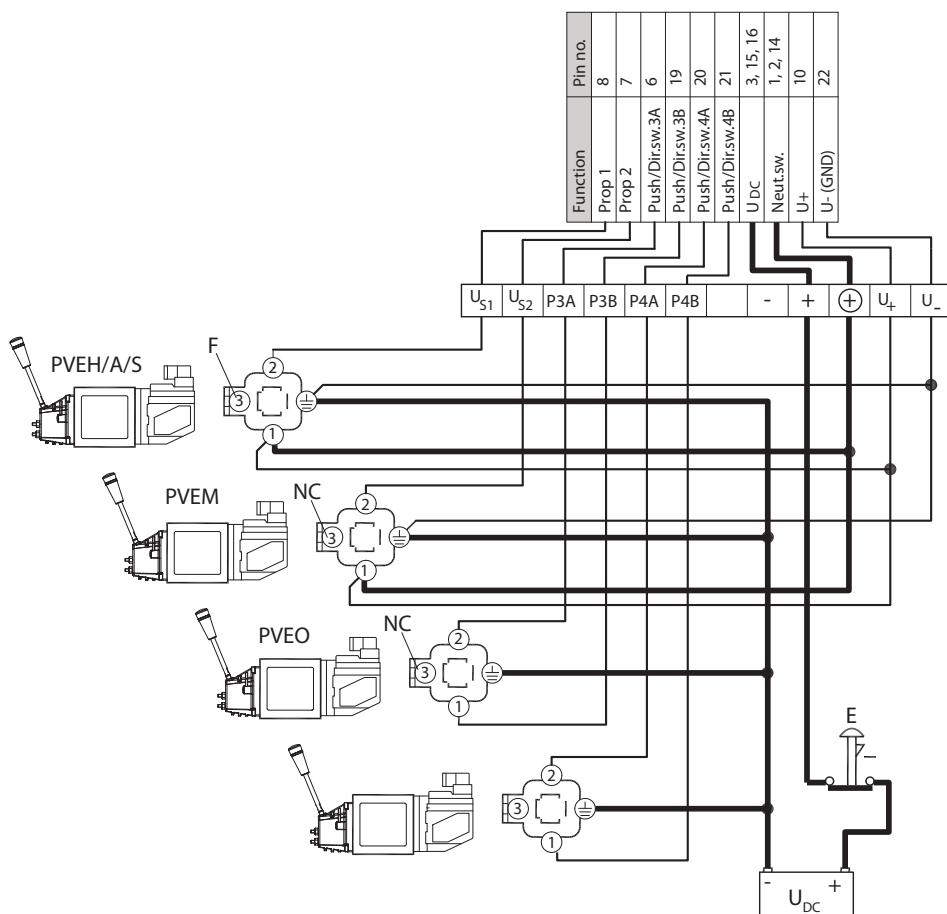
Example of Use

Signal leads must not act as supply leads at the same time unless the distance between the actuator module PVE and terminal board is less than 3 m [3.3 yards] and the lead cross-section is min. 0.75 mm² [AWG 18].

25 Pin SUB-D connector with M3 screws (MIL-DTL-24308)



- E : Emergency stop
- F : Signal output, fault monitoring
- NC : Not connected
- : Signal leads
- : Supply leads



V310116.A

Operating Parameters

Declaration of conformity.

The PVEA/H/P/S/U have CE marking according to the EU directive EMC Directive 2004/108/EC. The declarations are available at Sauer-Danfoss. The PVEO/M and PVHC are not subject to this directive.

⚠ Warning

The PVE is designed for use with pilot oil supply. Use without oil supply can harm the system. The PVE is designed for use with pilot pressure range 10 to 15 bar [145 to 220 psi]. Intermittent pressure peaks up to 50 bar [725 psi] can be accepted. Intermittent is no longer than 5 seconds and not more than once per minute.

The following technical data are from typical test results. For the hydraulic system mineral based hydraulic oil with a viscosity of 21 mm²/s [102 SUS] and a temperature of 50 °C [122 °F] was used.

PVHC

PVHC control specification

Supply voltage U_{DC}	12 V _{DC}	24 V _{DC}
Controller output current	0 – 1500 mA	0 – 750 mA
Pilot pressure	20 – 25 bar [290–363 psi]	
Resistance	4.75 Ω ± 5%	20.8 Ω ± 5%
Response time	150 – 200 ms	
PWM frequency	100 → 400 Hz	

Reaction time PVHC

From neutral position to max. spool travel at power on	max.	0.235s
	rated	0.180s
	min.	0.120s
From max. spool travel to neutral position at power off	max.	0.175s
	rated	0.090s
	min.	0.065s

**Operating Parameters
(continued)**

PVEO and PVEM

PVEO and PVEM control specification

Supply voltage U_{DC}	rated	12 V _{DC}	24 V _{DC}
	range	11 → 15 V	22 → 30 V
	max. ripple	5%	
Current consumption	typical	740 mA	365 mA
	minimum	550 mA	290 mA
	maximum	820 mA	420 mA
Current via DI	maximum	100 mA	

Reaction time PVEO and PVEM

Reaction time in seconds		PVEO	PVEO-R	PVEM
From neutral position to max. spool travel at power on	max.	0.235s	0.410s	0.700s
	rated	0.180s	0.350s	0.450s
	min.	0.120s	0.250s	0.230s
From max. spool travel to neutral position at power off	max.	0.175s	0.330s	0.175s
	rated	0.090s	0.270s	0.090s
	min.	0.065s	0.250s	0.065s
From neutral position to max. spool travel by constant power	max.			0.550s
	min.		-	0.210s
From max. spool travel to neutral position by constant power	max.			0.150s
	min.			0.040s

PVEA, PVEH, PVES and PVEU

PVEA, PVEH, PVES and PVEU control specification

Supply voltage U_{DC}	rated	11 → 32 V
	max. ripple	5 %
Current consumption at rated voltage		0.57 (0.33) A @ 12 V 0.3 (0.17) A @ 24 V
Signal voltage	neutral	0.5 x U_{DC} (PVEU 5V)
	A-port ↔ B-port	0.25 → 0.75 • U_{DC}
Signal current at rated voltage		0.25 → 0.70 mA
Input impedance in relation to $0.5 \cdot U_{DC}$		12 kΩ
Power consumption		7 (3.5) W
Error pin max current		100 mA

Reaction time PVEA, PVEH, PVES and PVEU in sec. (minus PVG 120)

Supply voltage	Function		PVEA Prop. fine	PVEH, PVEP, PVES, PVEU
Disconnected by means of neutral switch	Reaction time from neutral position to max. spool travel	max.	0.500	0.230
		rated	0.320	0.150
		min.	0.250	0.120
Constant voltage	Reaction time from max. spool travel to neutral position	max.	0.550	0.175
		rated	0.400	0.090
		min.	0.300	0.065
	Reaction time from neutral position to max. spool travel	max.	0.500	0.200
		rated	0.320	0.120
		min.	0.250	0.050
	Reaction time from max. spool travel to neutral position	max.	0.250	0.100
		rated	0.200	0.090
		min.	0.150	0.065

PVE Series 4 for PVG 32, PVG 100 and PVG 120, Including PVHC

Technical Information

Technical Data

Operating Parameters (continued)

PVEP

PVEP control specification

Supply voltage U_{DC}	range	11 → 32 V
	max. ripple	5%
	over voltage (max. 5 min)	36 V
PWM control range (duty cycle)		10 → 80%
PWM frequency		100 → 1000 Hz
PWM input voltage swing		0 → U_{DC}
PWM Trigger point		70% of U_{DC}
Input impedance (standard pull down)		5 kΩ
Input capacitor		---
Power consumption		7 W
Error voltage:	Fault	U_{DC}
	No Fault	< 2 V

All connector terminals are short-circuit protected, protected against reverse connection and their combinations. Connecting error pins from two or more PVE's will cause the surveillance system to malfunction.

Oil consumption

Function		Supply Voltage	PVEA	PVEH / M / O / U - PVHC prop. high	PVEP / S / U prop. super
Pilot oil flow for PVE	neutral*	OFF	0 l/min [0 US gal/min]	0 l/min [0 US gal/min]	0.3 l/min [0.106 US gal/min]
	locked*	ON	0.4 l/min [0.106 US gal/min]	0.1 l/min [0.026 US gal/min]	0.1 l/min [0.026 US gal/min]
	continuous actuations*		1.0 l/min [0.264 US gal/min]	0.7 l/min [0.185 US gal/min]	0.8 l/min [0.211 US gal/min]

* 12 bar [174 psi] and 21 mm²/s [102 SUS]

Oil viscosity

Oil viscosity	range	12 → 75 mm ² /s [65 ÷ 347 SUS]
	min.	4 mm ² /s [39 SUS]
	max.	460 mm ² /s [2128 SUS]

Oil temperature

Oil temperature	range	30 → 60°C [86 ÷ 140°F]
	min.	-30°C [-22°F]
	max.	90°C [194 °F]

Pilot pressure PVE

Pilot pressure (relative to T pressure)	nom.	13.5 bar [196 psi]
	min.	10.0 bar [145 psi]
	max.	15.0 bar [217 psi]

Pilot pressure PVHC

Pilot pressure (over tank)*	nom.	25 bar [363 psi]
	min.	21 bar [305 psi]
	max.	25 bar [363 psi]

* Designed to be used with hydraulic activated spools.

Operating Parameters (continued)

Operating temperature

	Min	Max
Ambient	-30°C [-22°F]	60°C [140°F]
Stock	-40°C [-40°F]	90°C [194°F]
Recommended long time storage in packaging	10°C [50°F]	30°C [86°F]

Filtering in the hydraulic system

Required operating cleanliness level	18/16/13 (ISO 4406, 1999 version)
---	-----------------------------------

For further information see Sauer-Danfoss documentation *Hydraulic Fluids and Lubricants, Technical Information 520L0463*.

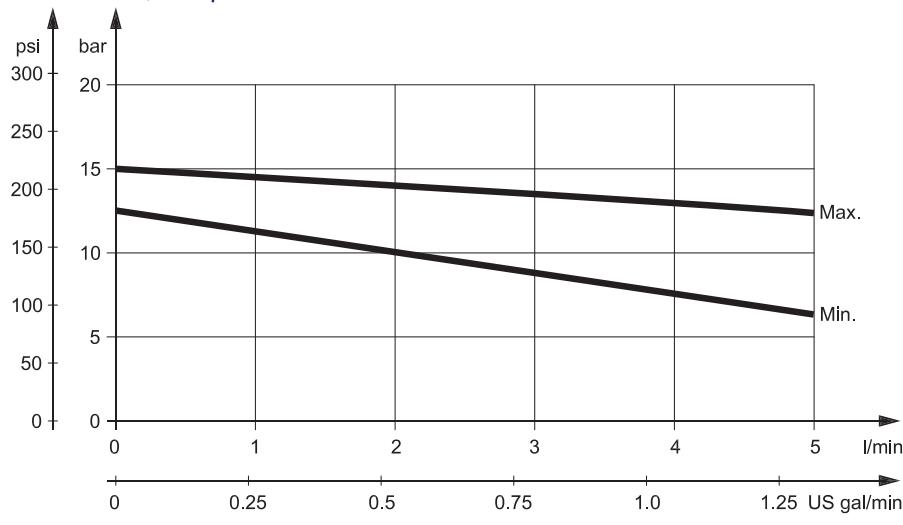
Enclosure and connector

Version of connector	Hirschmann connector	AMP JPT connector	Deutsch connector
Grade of enclosure*	IP 65	IP 66	IP 67

* According to the international standard IEC 529

NB: In particularly exposed applications, protection in the form of screening is recommended.

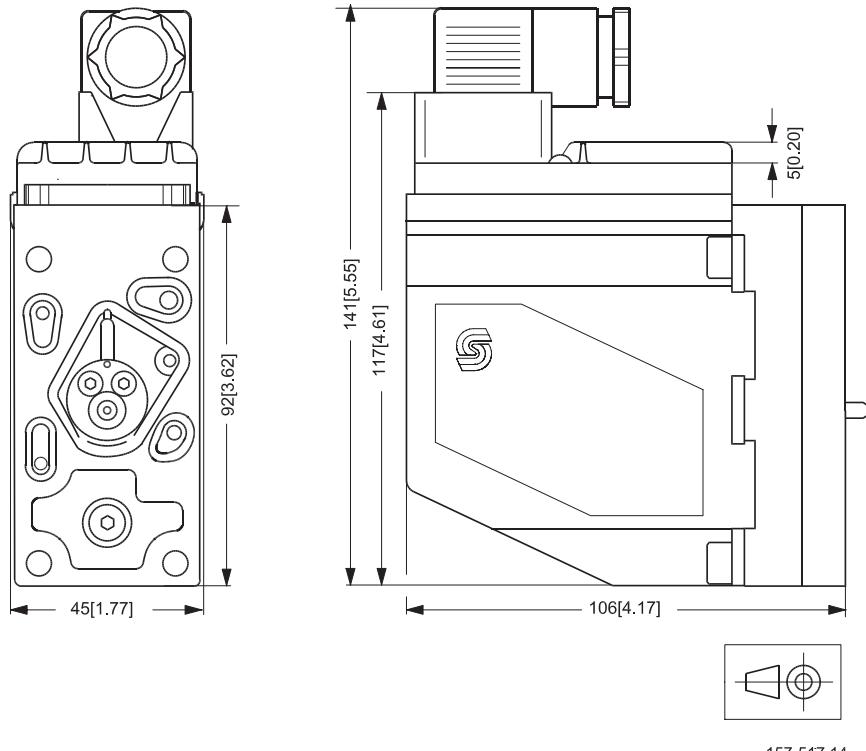
PVP modules, Pilot pressure curves



157-520.11

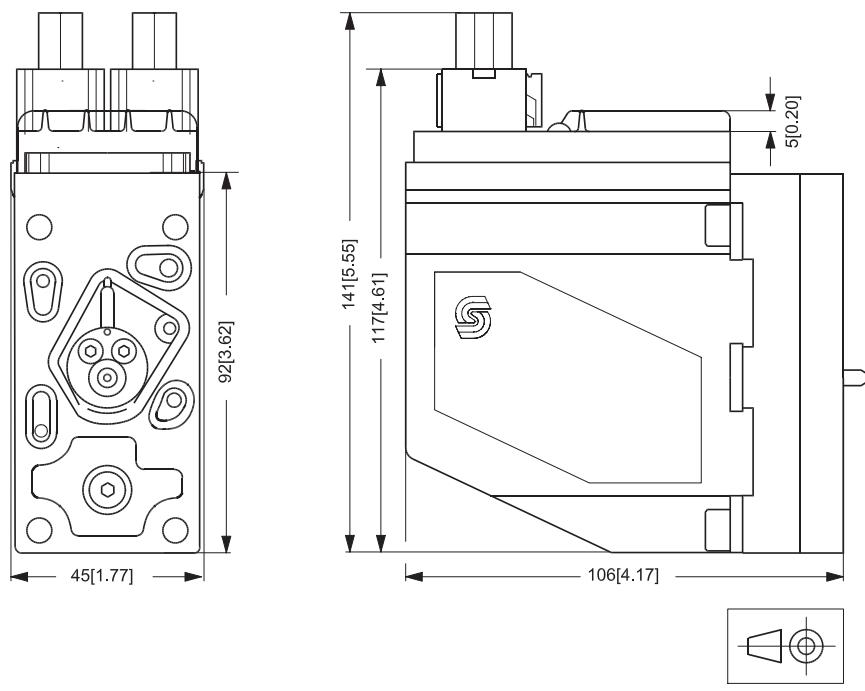
**PVE dimensions for
PVG 32 and PVG 100**

PVE with Hirschmann connector for PVG 32 and PVG 100



157-517.14

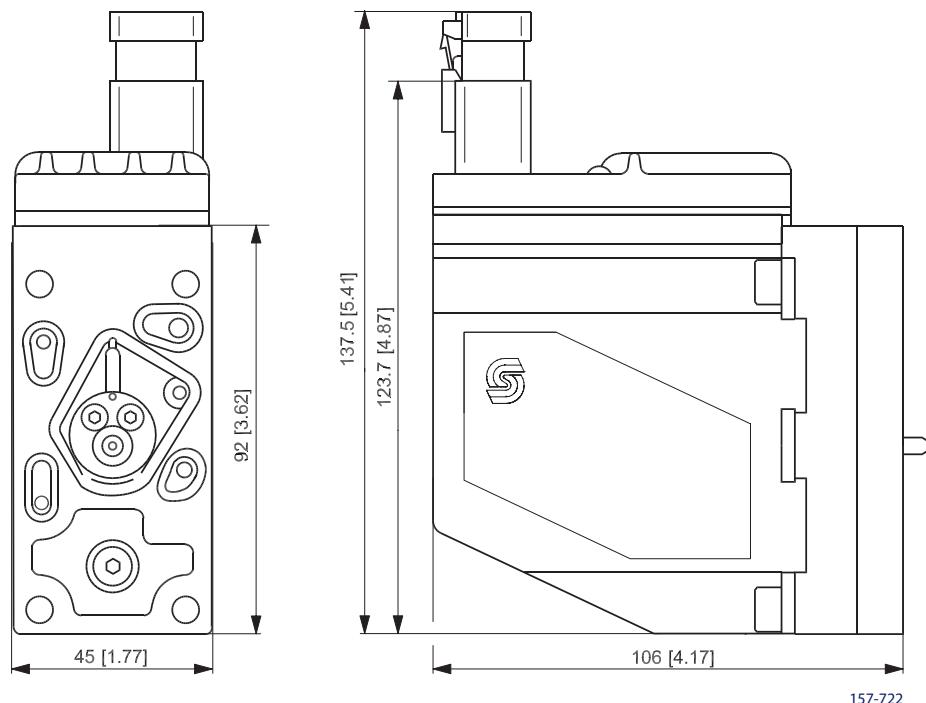
PVE with AMP connector for PVG 32 and PVG 100



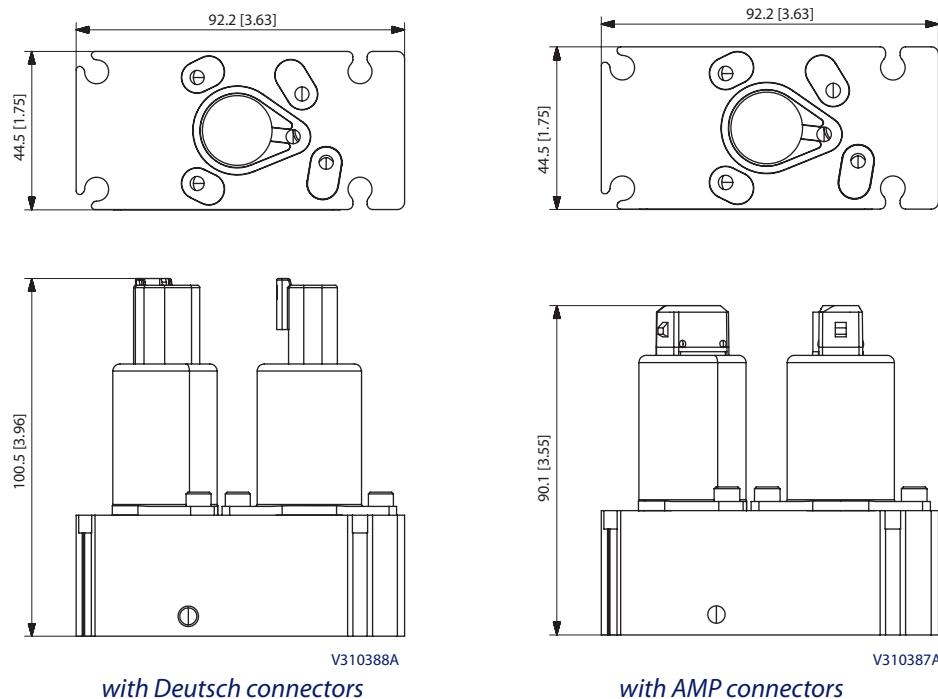
157-394.14

**PVE dimensions for
PVG 32 and PVG 100
(continued)**

PVE with Deutsch connector for PVG 32 and PVG 100

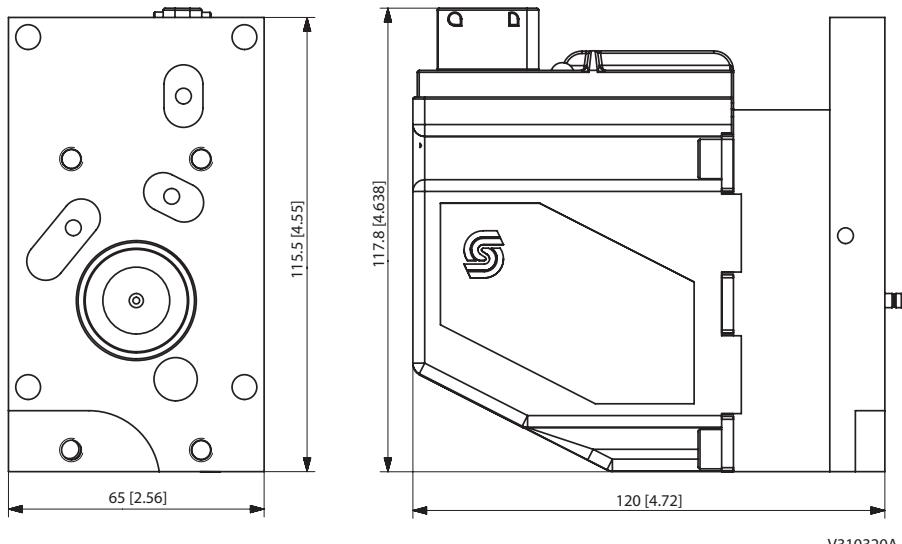


PVHC for PVG 32 and PVG 100



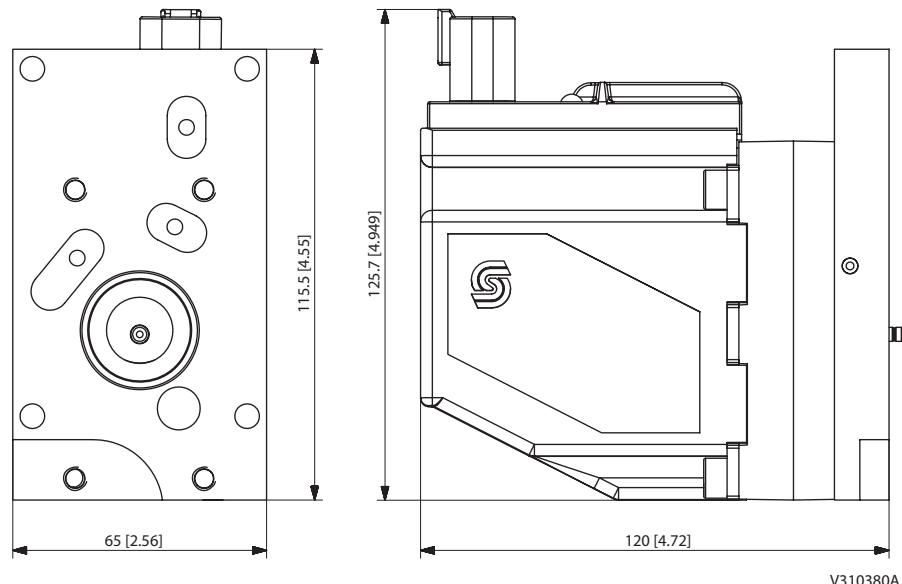
**PVE dimensions for
PVG 120**

PVE with AMP connector for PVG 120



V310320A

PVE with Deutsch connector for PVG 120

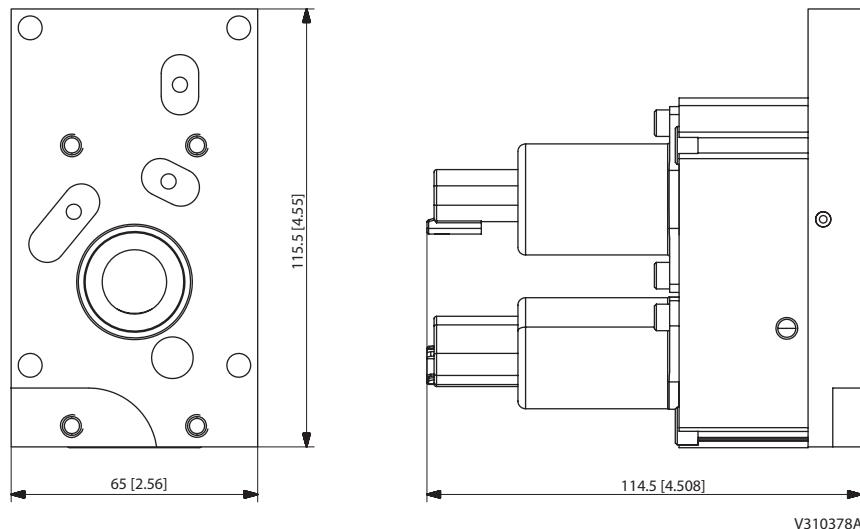


V310380A

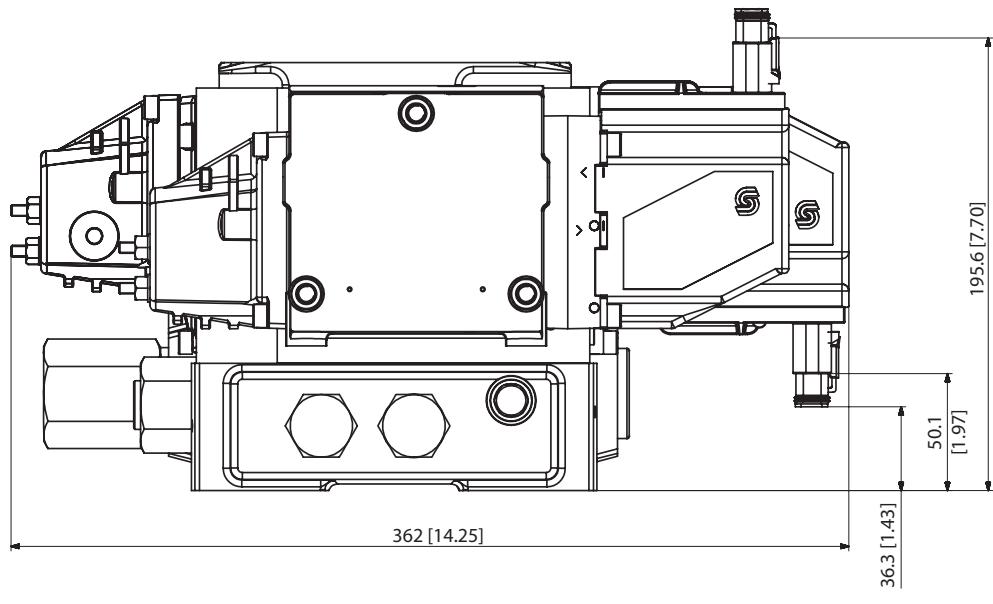
Please notice that connector needs extra space for mounting.

**General Dimensions
(continued)**

PVHC with Deutsch connector for PVG 120



PVG 120 and PVG 32 combo with Deutsch connector



PVE Series 4 for PVG 32, PVG 100 and PVG 120, Including PVHC

Technical Information

Technical Data

PVE pinout

Connection PVEO with direction indication (DI)

Connector 1	A U_{DC}	B U_{DC}	Gnd	Gnd
AMP (grey)	p 1	p 2	p 3	p 4
Connector 2	DI-B	DI-A	Gnd	U_{DC2}
AMP (black)	p 1	p 2	p 3	p 4

Connection PVEO standard

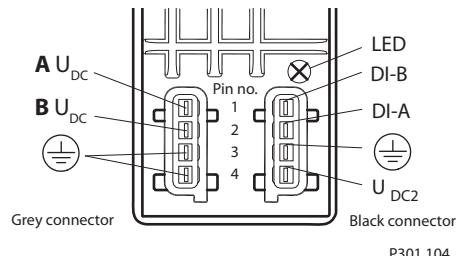
Connector	A	B
AMP/Hirschmann/ DIN	pin 1	pin 2
Deutsch	pin 1	pin 4
Function	A (pin 1)	B (pin 2)
Neutral	0	0
Q: P → A	U_{DC}	0
Q: P → B	0	U_{DC}

Control all PVEO

Connector	A	B
AMP/Hirschmann/ DIN	pin 1	pin 2
Deutsch	pin 1	pin 4

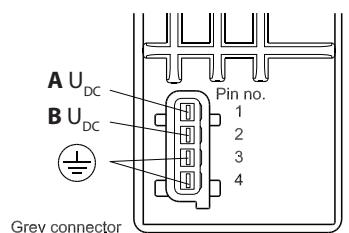
- Ground pins are internally connected.
- Pin 3 is not connected on Hirschmann/DIN version of PVEO.
- U_{DC2} supplies electronics for feedback signal on PVEO-DI.

AMP version of PVEO-DI



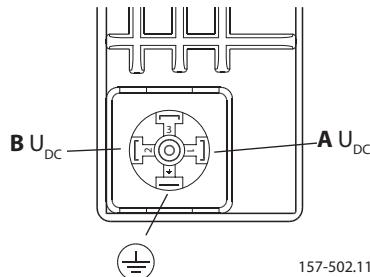
P301 104

AMP version of PVEO/PVEO-R



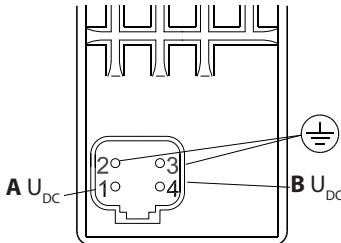
157-498.12

Hirschmann/DIN version of PVEO / PVEO-R



157-502.11

Deutsch version of PVEO



157-760.13

PVE pinout (continued)

Standard PVE

*Connection PVEA/PVEH/PVEM/PVES/PVEU
- also with float B four pin*

Connector	U_s	U_{DC}	Gnd	Error
AMP	pin 1	pin 2	pin 3	pin 4
Hirschmann/ DIN	pin 2	pin 1	gnd	pin 3
Deutsch	pin 1	pin 4	pin 3	pin 2

- On PVEM the error pin is not used and not connected (pin 3 Hirschmann/DIN).
- Ground pins are internally connected.

*Control (U_s) for standard mounted PVEA/
PVEH/ PVEM/ PVES*

Function	Voltage relative	PWM
Neutral	$0,5 \cdot U_{DC}$	50%
Q: P → A	$0,5 \rightarrow 0,25 \cdot U_{DC}$	50% → 25%
Q: P → B	$0,5 \rightarrow 0,75 \cdot U_{DC}$	50% → 75%

Control (U_s) for standard mounted PVEU

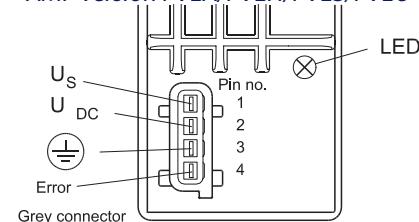
Function	PVEU
Neutral	5 V
Q: P → A	5 V → 2,5 V
Q: P → B	5 V → 7,5 V

*Control (U_s) for standard mounted PVEH/
PVEM float B four pin version*

Function	Voltage relative	PWM
Neutral	$0,5 \cdot U_{DC}$	50%
Q: P → A	$0,5 \rightarrow 0,34 \cdot U_{DC}$	50% → 34%
Q: P → B	$0,5 \rightarrow 0,65 \cdot U_{DC}$	50% → 65%
Float	$0,75 \cdot U_{DC}$	75%

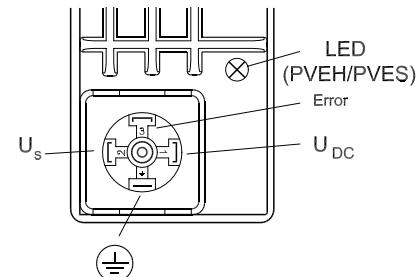
PVEM is not PLUS+1 compliant.

AMP version PVEA/PVEH/PVES/PVEU

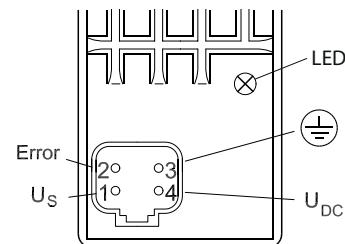


157-500.10

Hirschmann/DIN version PVEH/PVEM/ PVES/PVEH float B/PVEM float B



Deutsch version PVEA/PVEH/PVES/PVEU/ PVEH float B



157-759.11

PVE Series 4 for PVG 32, PVG 100 and PVG 120, Including PVHC

Technical Information

Technical Data

PVE pinout (continued)

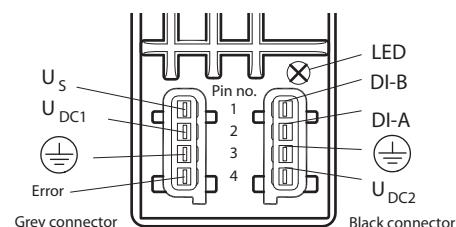
Standard PVE with DI

Connection PVE with direction indication (DI)

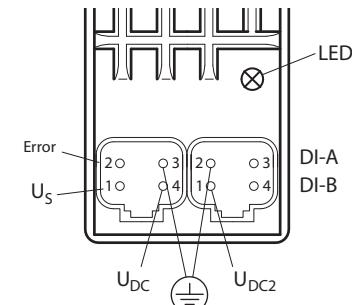
Connector 1	U_s	U_{DC1}	Gnd	Error
AMP (grey)	p 1	p 2	p 3	p 4
Deutsch	p 1	p 4	p 3	p 2
Connector 2	DI-B	DI-A	Gnd	U_{DC2}
AMP (black)	p 1	p 2	p 3	p 4
Deutsch	p 4	p 3	p 2	p 1

- Ground pins are internally connected.
- U_{DC2} only supplies electronics for feedback signal and error pin on PVEA-DI / PVEH-DI. Two separate power sources can be used.

AMP version PVEA-DI/PVEH-DI



Deutsch version PVEA-DI/PVEH-DI



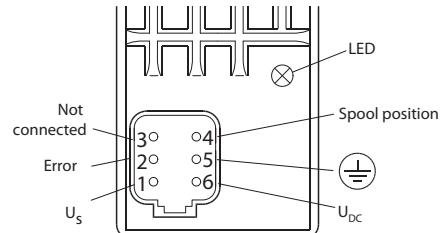
P301 105

Standard PVE with SP

Connection PVE with Spool Position (SP)

Connector	U_s	Error	SP	Gnd	U_{DC}
Deutsch	p 1	p 2	p 4	p 5	p 6

Deutsch version PVES-SP

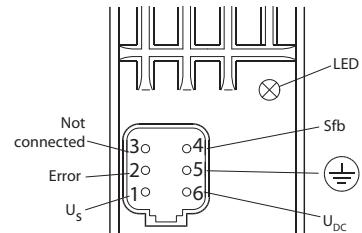


Standard PVE with NP

Connection PVE with Neutral Power off (NP)

Connector	U_s	Error	Sfb	Gnd	U_{DC}
Deutsch	p 1	p 2	p 4	p 5	p 6

Deutsch version PVES-NP



Control (U_s) for standard mounted PVEA-DI / PVEH-DI, PVES-SP, PVEA-NP, PVEH-NP

Function	U_s	PWM
Neutral	$0,5 \cdot U_{DC}$	50%
Q: P → A	$0,5 \rightarrow 0,25 \cdot U_{DC}$	50% → 25%
Q: P → B	$0,5 \rightarrow 0,75 \cdot U_{DC}$	50% → 75%

PVE pinout (continued)

PVE with separate Float pin

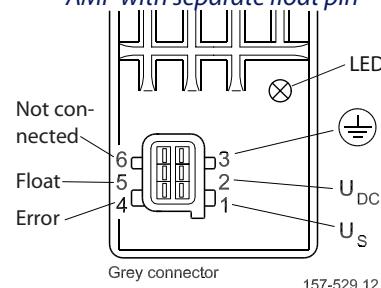
Connection PVEH with float A six pin

Connector	U_s	U_{DC}	Float	Ground	Error
AMP	pin 1	pin 2	pin 5	pin 3	pin 4
Deutsch	pin 1	pin 6	pin 3	pin 5	pin 2

*Control (U_s) for standard mounted PVEH/
PVEM float A six pin version*

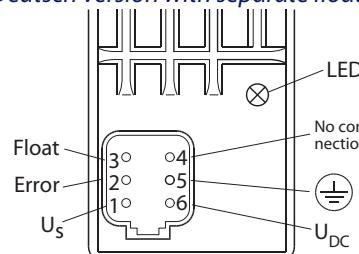
Function	PWM A	PWM B
Neutral	$0,5 \cdot U_{DC}$	50%
Q: P → A	$0,5 \rightarrow 0,25 \cdot U_{DC}$	$50\% \rightarrow 25\%$
Q: P → B	$0,5 \rightarrow 0,75 \cdot U_{DC}$	$50\% \rightarrow 75\%$
Float	U_{DC} on float pin	

AMP with separate float pin



157-529.12

Deutsch version with separate float pin



157-779

PVE with PWM controled – PVEP

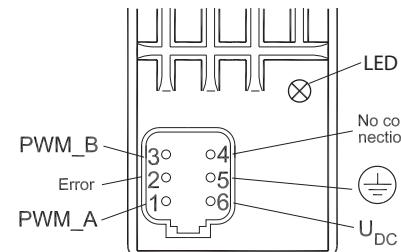
Connection PVEP

Connector	PWM A	Error	PWM B	Gnd	U_{DC}
Deutsch	p 1	p 2	p 3	p 5	p 6

Control (U_s) for standard mounted PVEP

Function	Voltage relative	PWM
Neutral	< 10%	< 10%
Q: P → A	$10\% \rightarrow 80\%$	< 10%
Q: P → B	< 10%	$10\% \rightarrow 80\%$

Deutsch version with PVEP



157-728.13

**Proportional Version
(continued)**

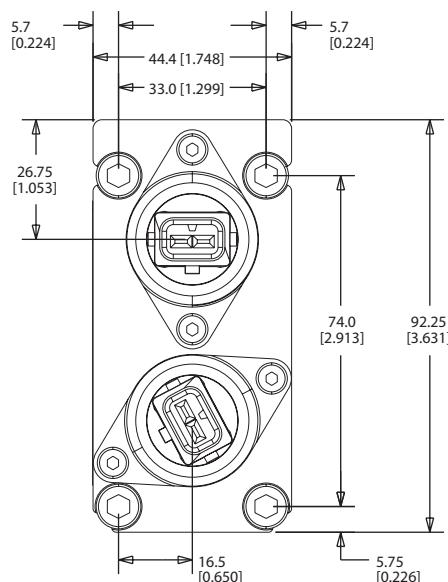
PVHC connection

- 100-400 Hz PWM control signals.
- Each connector controls one direction and must have U_{DC} and ground
- No constraints on pin for U_{DC} and ground.

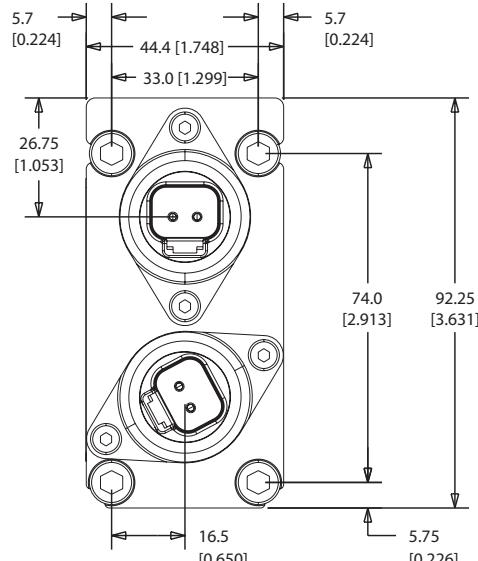
Input control

Parameter	Control range	
	12 V	24 V
Controller output current range	0 - 1500 mA	0 - 750 mA

PVHC with AMP



PVHC with Deutsch



Product Warnings**⚠ Warning**

Not applying to the Operational Conditions can compromise safety.

⚠ Warning

All brands and all types of directional control valves – including proportional valves – can fail and cause serious damage. It is therefore important to analyze all aspects of the application. Because the proportional valves are used in many different operation conditions and applications, the machine builder/ system integrator alone is responsible for making the final selection of the products – and assuring that all performance, safety and Warning requirements of the application are met.

⚠ Warning

A PVG with PVE can only perform according to description if conditions in this Technical Information are met.

⚠ Warning

In particularly exposed applications, protection in the form of a shield is recommended.

⚠ Warning

When the PVE is in fault mode the quality of performance and validity of feedback is limited depending on the fault type.

⚠ Warning

Error pins from more PVEs may not be connected. Inactive error pins are connected to ground and will disable any active signal.

⚠ Warning

Error pins are signal pins and can only supply very limited power consumption.

⚠ Warning

Deviation from recommended torque when mounting parts can harm performance and module.

⚠ Warning

Adjustment of the position transducer (LVDT) will influence calibration, and thereby also safety and performance.

⚠ Warning

When replacing the PVE, the electrical and the hydraulic systems must be turned off and the oil pressure released.

PVE Series 4 for PVG 32, PVG 100 and PVG 120, Including PVHC

Technical Information

Technical Data

⚠ Warning

PVEA is not for use on PVG 100.

⚠ Warning

Hydraulic oil can cause both environmental damage and personal injury.

⚠ Warning

Module replacement can introduce contamination and errors to the system. It is important to keep the work area clean and components should be handled with care.

⚠ Warning

After replacement of modules or cables wiring quality must be verified by a performance test.

⚠ Warning

By actuation at voltage below nominal PVG will have reduced performance.

⚠ Warning

The PVE is not designed for use with voltage outside nominal.

⚠ Warning

Obstacles for the Pilot oil can have direct influence on spool control.

⚠ Warning

Reduced pilot oil pressure will limit spool control.

⚠ Warning

Too high pilot oil pressure can harm the PVE.

PVE Code Numbers for use on PVG 32 and PVG 100

Deutsch connector code numbers

Feature		S	std.	float A	float B	DI	NP	SP	Fast-no memory	ramp
Connector			1x4	1x6	1x4	2x4	1x6	1x6	1x4	
PVEA*	active	-	157B4792			157B4796	11105542			
	passive		11107365							
PVEH	active	-	157B4092	157B4398		157B4096	11105543			
	passive		157B4093		157B4392					
PVES	active	S	157B4892						157B4894	
	passive	S	11089276					11108994		
PVEP	active	S	11034832*							
PVEU	passive	S	11089090							
PVEO	12V	-	157B4291							11109080
	24V		157B4292							11109092

S = super fine hysteresis, 1x4 = one plug four pins, * 1x6 = one plug six pins

AMP connector code numbers

Feature		S	std.	float A	DI	anodized	ramp-ano	ramp
Connector			1x4	1x6	2x4	1x4	1x4	1x4
PVEA*	active	-	157B4734		157B4736			
	passive		157B4735		157B4737	157B4775		
PVEH	active	-	157B4034	157B4338	157B4036	157B4074		
	passive		157B4035		157B4037	157B4075		
PVES	active	S	157B4834					
	passive	S	157B4835			157B4865		
PVEU	active	S	11089091					
	active	-	157B4044					
	passive		157B4045					
PVEO	12V	-	157B4901		157B4905			157B4903
	24V		157B4902		157B4906	157B4272	157B4274	157B4904

S = super fine hysteresis, 1x4 = one plug four pins, * 1x6 = one plug six pins

⚠ Warning

PVEA is not for use on PVG 100.

**PVE Series 4 for PVG 32, PVG 100 and PVG 120, Including PVHC
Technical Information
Code Numbers**

**PVE Code Numbers
for use on PVG 32 and
PVG 100 (continued)**

Hirschmann/DIN connector code numbers

Feature		S	std.	float B	anodized	ramp
Connector			1x4	1x4	1x4	1x4
PVEH	active		157B4032	157B4332		
	passive		157B4033		157B4073	
PVES	active	S	157B4832			
	passive	S	157B4833			
PVEM	12 V		157B4116	157B4416		157B4516
	24 V		157B4128	157B4428		157B4528
PVEO	12 V		157B4216		157B4266	157B4217
	24 V		157B4228		157B4268	157B4229

S = super fine hysteresis, 1x4 = one plug four pins

ATEX (24 V) connector code numbers

Cable type		S	PFOP	PFOP	PFOP, cable dir PVB	BFOU
Flying wire			5 m	10 m	5 m	5 m
PVEH	passive		11084101	11084109	11084092	11084098
		S	11084102	11084110	11084093	11084099
PVEO			11084100	11084108	11084051	11084097

S = super fine hysteresis,

AMP/Deutsch code numbers for PVHC

Connector	Code Number
PVHC	12 V
	24 V
AMP	11112037
	11112036
PVHC	12 V
	24 V
Deutsch	11112038
	11112039

**PVE Code Numbers for
use on PVG 120**

AMP code numbers

Feature		anodized
Connector		1x4
PVEH	active	155G4094
	passive	155G4095
PVEO	12 V	155G4282
	24 V	155G4284

1x4 = one plug four pins

Hirschmann/DIN code numbers

Feature		anodized
Connector		1x4
PVEH	active	155G4092
	passive	155G4093
PVES	passive	11111210
	12 V	155G4272
PVEO	24 V	155G4274

Deutsch code numbers

Feature		anodized
Connector		1x4
PVEH	passive	11111206
	12 V	11110601
PVES	passive	11111207
	24 V	11110652
PVEO	12 V	11110597
	24 V	11110598
PVHC	12 V	
	24 V	

ATEX (24 V) connector code numbers

Cable type	PFOP	PFOP	PFOP, cable dir PVB	BFOU
Flying wire	5 m	10 m	5 m	5 m
PVEH	passive	11084104	11084112	11084096
PVEO		11084103	11084111	11084095

PVE Series 4 for PVG 32, PVG 100 and PVG 120, Including PVHC

Technical Information

Code Numbers

PVE Accessories

Connector code numbers

Code number	Description	
157B4992	AMP CONNECTING KIT (GREY)	4 pin with housing, contact and wire sealing
157B4993	AMP CONNECTING KIT (BLACK)	4 pin with housing, contact and wire sealing
984L3165	EL-PLUG, ON-OFF black	Hirschmann DIN connector set*

Set of seals code numbers

Code number	Description	Actuator
157B4997	Set of seals	PVE for PVG 32/ PVG 100
155G8519		PVE for PVG 120 (also interface plate/PVB for PVHC)
11061235		PVHC for PVG 32/ PVG 100

Cables code numbers

Feature	Wire colors						Length	Code number
Connector	pin 1	pin 2	pin 3	pin 4	pin 5	pin 6		
Deutsch	4 pin	white	blue	yellow	red	—	—	4 m 11007498
	4 pin	white	blue	yellow	red	—	—	4 m 11099720 *24V
	6 pin	white	blue	yellow	red	black	green	4 m 11007513
AMP	4 pin	white	blue	yellow	red	—	—	4 m 157B4994
	4 pin	white	blue	yellow	red	—	—	4 m 11099719 *24V
	6 pin	white	red	black	yellow	green	blue	5 m 157B4974
AMP/black coding	4 pin	white	blue	yellow	red	—	—	4 m 157B4995 **-DI

Cables are with oil resistant coating.

*24V Special cable for use with PLUS+1 MC microcontroller in 24V systems.

**-DI Additional cable for PVE with direction indication.

Connector Code Numbers at Other Suppliers

Connector part numbers for purchase at other suppliers

Connector	House	wire sealing (blue)	JPT contact (loose piece)	sealing mat between male-female part
Deutsch female	4 pin DT06-4S	—	—	—
	6 pin DT06-6S			
AMP female/grey	4 pin 2-967059-1	828904-1	929930-1	963208-1
	6 pin 2-963212-1	—	—	963205-1
AMP female/black	4 pin 1-967059-1			—
AMP crimp tool	169400-1			—
AMP die set for crimp tool	734253-0			—

These connector code numbers are not Sauer-Danfoss numbers.



PVE Series 4 for PVG 32, PVG 100 and PVG 120, Including PVHC

Technical Information

Code Numbers

PVED Code Numbers for use on PVG 32 and PVG 100

Cables code numbers for PVED-CC

Feature	Wire colors				Description	Code number
Connector	pin 1	pin 2	pin 3	pin 4		
Deutsch	4 pin	white	blue	yellow	red	4 m cable
AMP	4 pin	white	blue	yellow	red	4 m cable
AMP/black	4 pin	white	blue	yellow	red	4 m cable
Service tool interface cable/ AMP					4 m cable	157B4977
AMP					0.1m loop cable	157B4987
AMP/black					Terminator	157B4988
Deutsch					0.1m loop cable	11007531
Deutsch					Terminator	11007561
Deutsch					Terminator dummy	11007563

CAN Interface

10104136	CG 150 CAN USB interface
----------	--------------------------

Connector	2x4
Deutsch	SW 2.68
AMP	SW 2.68

1x4 = one plug four pins



Products we offer:

- Bent Axis Motors
- Closed Circuit Axial Piston Pumps and Motors
- Displays
- Electrohydraulic Power Steering
- Electrohydraulics
- Hydraulic Power Steering
- Integrated Systems
- Joysticks and Control Handles
- Microcontrollers and Software
- Open Circuit Axial Piston Pumps
- Orbital Motors
- PLUS+1™ GUIDE
- Proportional Valves
- Sensors
- Steering
- Transit Mixer Drives

Sauer-Danfoss is a global manufacturer and supplier of high-quality hydraulic and electronic components. We specialize in providing state-of-the-art technology and solutions that excel in the harsh operating conditions of the mobile off-highway market. Building on our extensive applications expertise, we work closely with our customers to ensure exceptional performance for a broad range of off-highway vehicles.

We help OEMs around the world speed up system development, reduce costs and bring vehicles to market faster.
Sauer-Danfoss – Your Strongest Partner in Mobile Hydraulics.

Go to www.sauer-danfoss.com for further product information.

Wherever off-highway vehicles are at work, so is Sauer-Danfoss.

We offer expert worldwide support for our customers, ensuring the best possible solutions for outstanding performance. And with an extensive network of Global Service Partners, we also provide comprehensive global service for all of our components.

Please contact the Sauer-Danfoss representative nearest you.

Members of the Sauer-Danfoss Group:

Comatrol

www.comatrol.com

Schwarzmueller-Inverter

www.schwarzmueller-inverter.com

Turolla

www.turollaocg.com

Valmova

www.valmova.com

Hydro-Gear

www.hydro-gear.com

Sauer-Danfoss-Daikin

www.sauer-danfoss-daijin.com

Local address:

Sauer-Danfoss (US) Company
2800 East 13th Street
Ames, IA 50010, USA
Phone: +1 515 239 6000
Fax: +1 515 239 6618

Sauer-Danfoss ApS
DK-6430 Nordborg, Denmark
Phone: +45 7488 4444
Fax: +45 7488 4400

Sauer-Danfoss GmbH & Co. OHG
Postfach 2460, D-24531 Neumünster
Krokamp 35, D-24539 Neumünster, Germany
Phone: +49 4321 871 0
Fax: +49 4321 871 122

Sauer-Danfoss-Daikin LTD.
Shin-Osaka TERASAKI 3rd Bldg. 6F
1-5-28 Nishimiyahara, Yodogawa-ku
Osaka 532-0004, Japan
Phone: +81 6 6395 6066
Fax: +81 6 6395 8585

W W W . s a u e r - d a n f o s s . c o m