

Technical Information

PVE Series 7

Electro-hydraulic Actuators



Revision history

Table of revisions

| Date | Changed | Rev |
|---------------|---|------------|
| August 2023 | Updated image | 0402 |
| July 2022 | Updated image | 0401 |
| February 2021 | Corrected data in PVEM, PVEA, PVEH, and PVES technical sections | 0310 |
| June 2020 | Minor changes throughout | 0309 |
| | Changed document number from 'BC00000378' to 'BC218286485446' | XX |
| March 2020 | Various updates to data. | 0307 |
| April 2019 | All reaction times tables, notes changes. | 0204 |
| December 2018 | New image on page 5-6. | 0203 |
| July 2018 | Minor update. | 0202 |
| June 2018 | PVE actuation, connector image changes. | 0201 |
| May 2018 | Restored missing information. | 0105 |
| April 2018 | Minor updates. | 0104 |
| February 2017 | Added detailed Fault Monitoring description | 0103 |
| January 2017 | Minor updates | 0102 |
| November 2016 | First edition | 0101 |

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PVE Electrical Actuator

PVE Series 7 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 32/100/120/128/256/PVG 128/256.

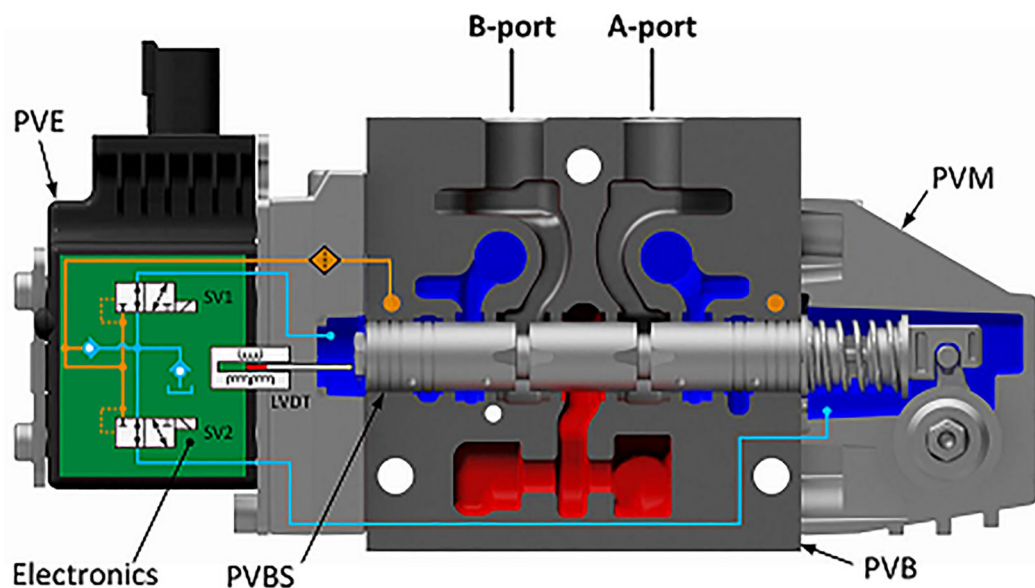
The actuator positions the main spool in a PVG work section in order to control either the flow or the pressure of the oil distributed to/from the work function. The control signal to the actuator is an analog voltage signal, enabling the user to operate the work function remotely by means of a joystick,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

The analog PVE Series 7 actuator program features five different main hydraulic principle variants (PVEO/PVEM/PVEA/PVEH/PVES). 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 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.

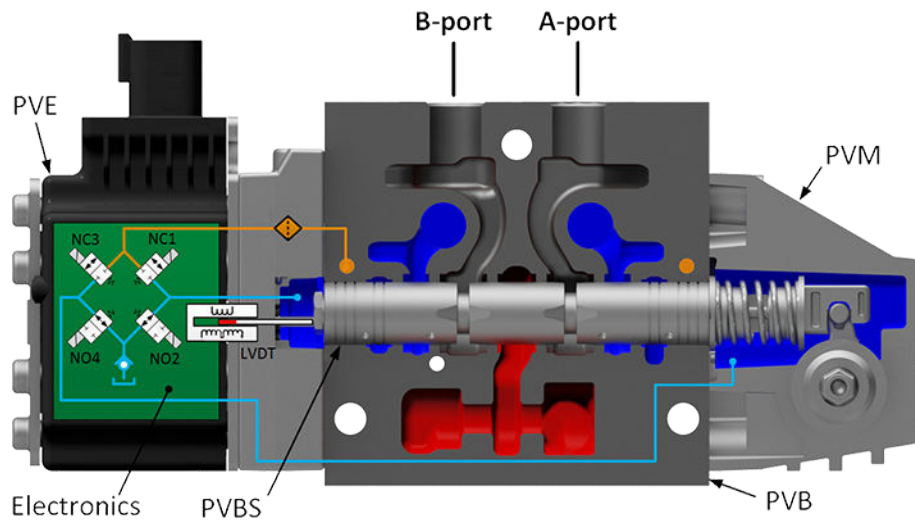
The analog PVE Series 7 actuator program for PVG 128/256 features two different main hydraulic principle variants (PVEO and PVEH). The different hydraulic principles combined with the different solenoid valve regulation principles determine whether the actuator controls the spool proportionally according 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 32 with PVEO/PVEM (PVEO without LVDT)



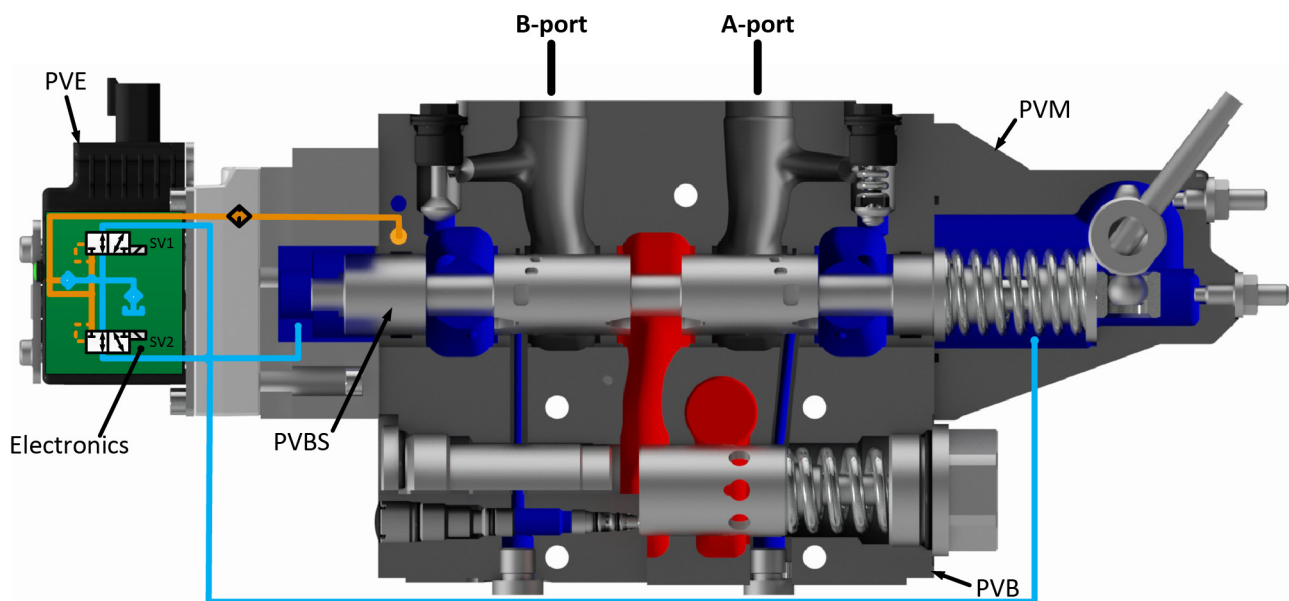
PVE Electrical Actuator

PVG 32 with PVEH/PVES



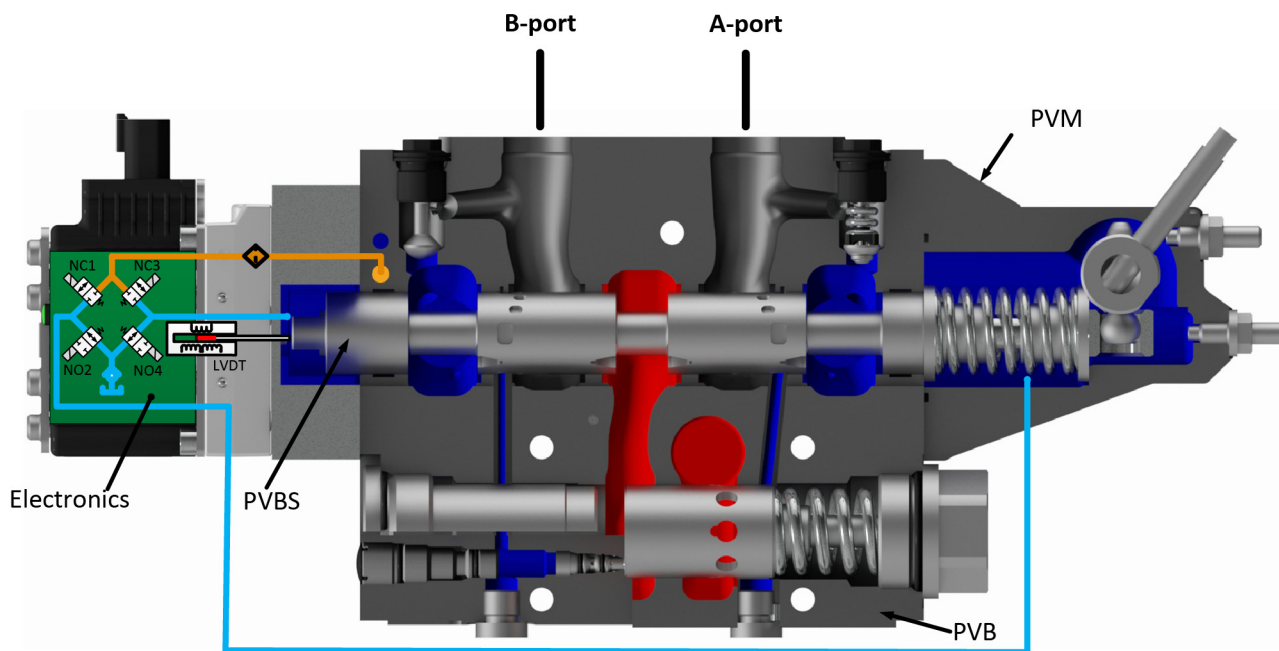
PVEA has the same housing as PVEO/PVEM and similar hydraulic principle as PVEH/PVES, but with fixed orifices instead of NO2 and NO4.

PVG 256 with PVEO



PVE Electrical Actuator

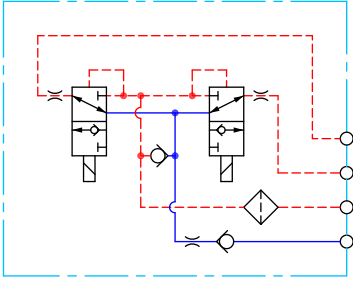
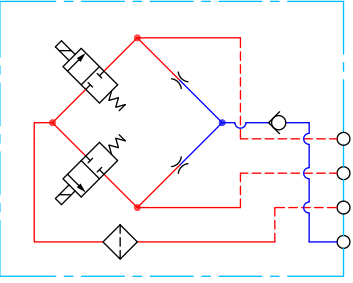
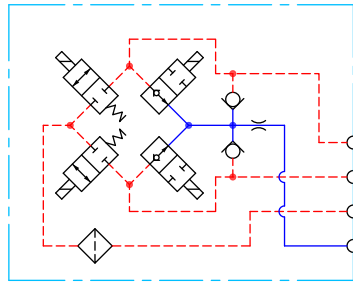
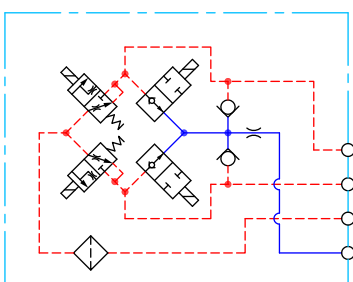
PVG 256 with PVEH



PVE Series 7 variants overview

| Schematic | Description |
|--|---|
| <p><i>PVEO schematic</i></p> <p>P109195</p> | <p>PVEO – ON/OFF voltage control for non-proportional functions, see PVEO</p> <ul style="list-style-type: none"> • Neutral position or max. spool stroke according to control signal • 12 V_{DC} or 24 V_{DC} supply voltage • DEUTSCH, AMP or DIN/Hirschman connectors • Standard PVE pilot oil pressure of 13.5 bar [196 psi] • LED only indicating Power ON or Power OFF • Ramp (-R) or Direction Indication output (-DI) functionality |
| <p><i>PVEO-HP schematic</i></p> <p>P109195</p> | <p>PVEO-HP – ON/OFF voltage control for non-proportional functions, see PVEO-HP</p> <ul style="list-style-type: none"> • Neutral position or max. spool stroke according to control signal • 12 V_{DC} or 24 V_{DC} supply voltage • DEUTSCH, AMP or DIN/Hirschman connectors • To be used with PVH/PVHC pilot oil pressure of 25 bar • LED only indicating Power ON or Power OFF |

PVE Electrical Actuator

| Schematic | Description |
|--|---|
| <p><i>PVEM schematic</i></p>  <p>P109196</p> | <p>PVEM – proportional spool control for functions with medium performance demands, see PVEM</p> <ul style="list-style-type: none"> • 9–32 V_{DC} multi-voltage power supply • DIN or Hirschman connectors • Standard PVE pilot oil pressure of 13.5 bar [196 psi] • LED indicating error state and passive fault monitoring • Float (-F), quick Ramp (-R) or Quick reaction functionality (-Q) |
| <p><i>PVEA schematic</i></p>  <p>P109197</p> | <p>PVEA – proportional spool control for functions with high performance demands, see PVEA</p> <ul style="list-style-type: none"> • 9–32 V_{DC} multi-voltage power supply • Variants available with DEUTSCH or AMP connectors • Standard PVE pilot oil pressure of 13.5 bar [196 psi] • LED indicating error state and active or passive fault monitoring • Direction Indication output (-DI) or Neutral Power-Off (-NP) functionality |
| <p><i>PVEH schematic</i></p>  <p>P109198</p> | <p>PVEH – proportional spool control for functions with high performance demands, see PVEH</p> <ul style="list-style-type: none"> • 9–32 V_{DC} multi-voltage power supply • DEUTSCH, AMP or DIN/Hirschman connectors • Standard PVE pilot oil pressure of 13.5 bar [196 psi] • LED indicating error state and active or passive fault monitoring • Float (-F), Direction Indication output (-DI), Neutral Power-Off (-NP), Spool Position output (-SP) or 0-10 V_{DC} control signal (-U) functionality |
| <p><i>PVES Schematic</i></p>  <p>P109199</p> | <p>PVES – proportional spool control for functions with high performance and reaction demands, see PVES</p> <ul style="list-style-type: none"> • 9–32 V_{DC} multi-voltage power supply • Analog voltage control signal 25-75% of supply voltage • DEUTSCH, AMP or DIN/Hirschman connectors • Standard PVE pilot oil pressure of 13.5 bar [196 psi] • LED indicating error state and active or passive fault monitoring • Variants available with Spool Position output (-SP) or 0-10 V_{DC} control signal (-U) functionality |

PVE Electrical Actuator

Safety in Systems

All types and brands of control valves, including proportional valves, can fail. Therefore, the necessary protection against the serious consequences of a functional failure should always be built into the system.

General safety considerations

For each application an assessment should be made for the consequences of the system in case of pressure failure and uncontrolled or blocked movements.

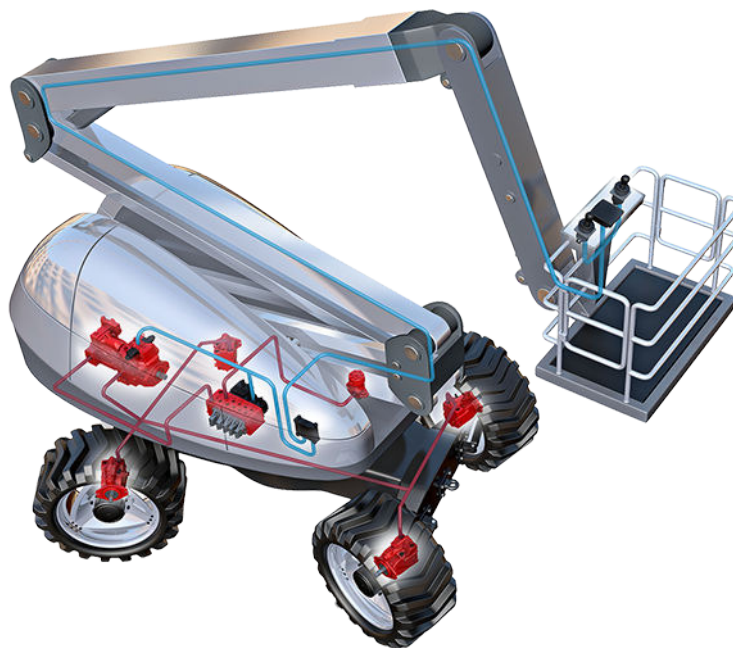
⚠ Warning

Because the proportional valve is used in many different applications and under different operating conditions, it is the sole responsibility of the manufacturer to ensure that all performance, safety and warning requirements of the application is met in his selection of products and complies with relevant machine specific and generic standards.

Control system example

An example of a control system using an aerial lift is shown below:

Aerial lift

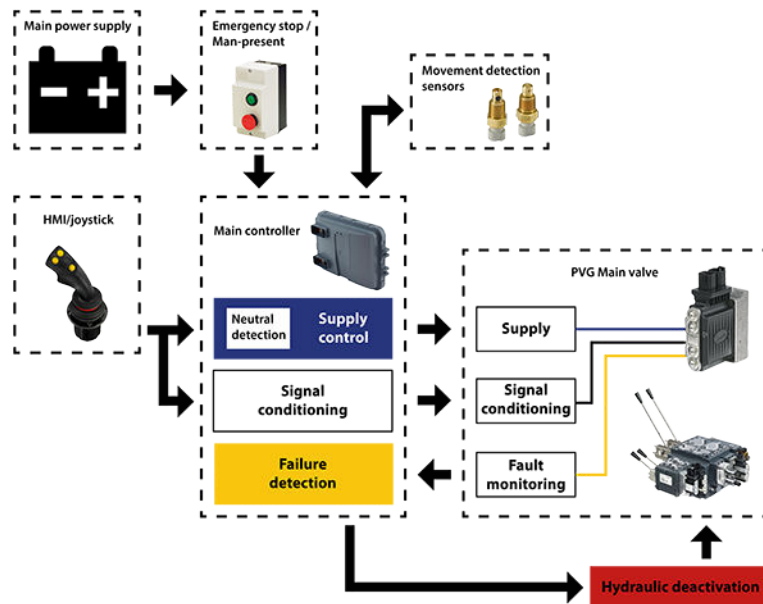


This example breaks down the control system into smaller bits explaining the architecture in depth. Even though many Danfoss components are used in the PVG control system.

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

PVE Electrical Actuator

Electrical block diagram



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.

Caution

A mix of electrical actuation and hydraulic actuation on the same valve stack is not safe. PVE and PVH are designed for different pilot pressure.

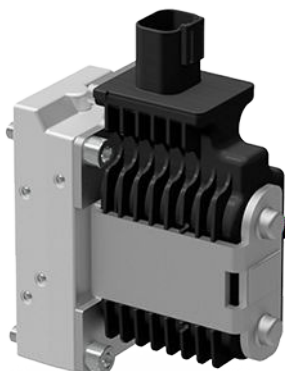
Cost-free repairs, as mentioned in Danfoss General Conditions of Sale, are carried out only at Danfoss or at service shops authorized by Danfoss.

PVEO

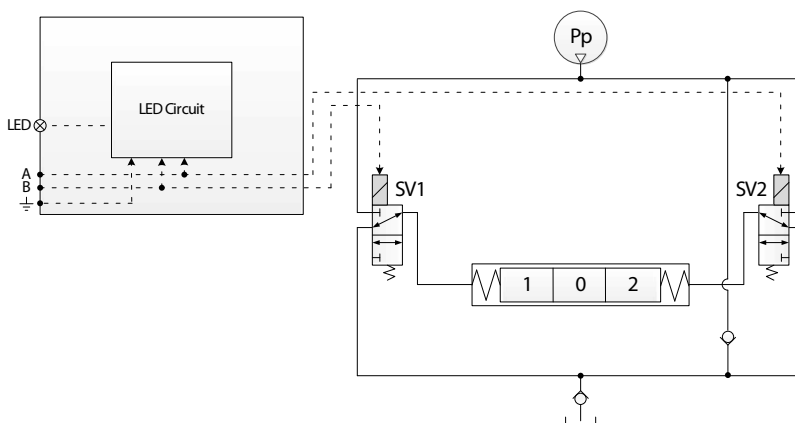
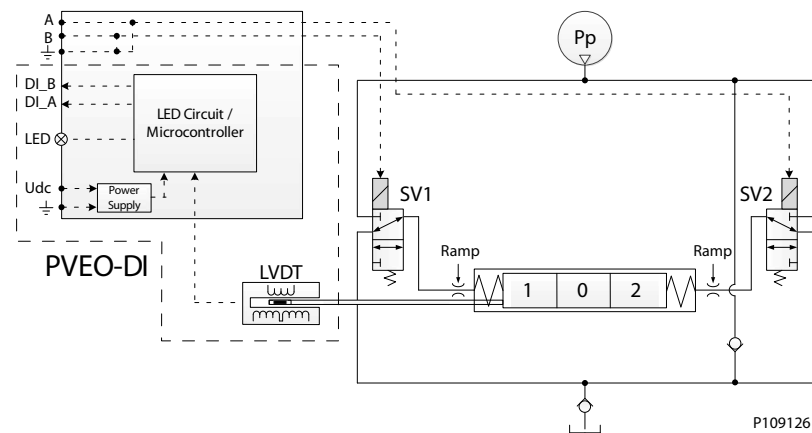
The PVEO actuator is a non-proportional ON/OFF control actuator with open-loop spool control primarily used to control simple ON/OFF work functions where a proportional control of speed or oil flow is not a requirement

The PVEO is available in two different performance variants, the standard PVEO and the PVEO-R with ramp.

PVEO



PVEO functionality



PVEO

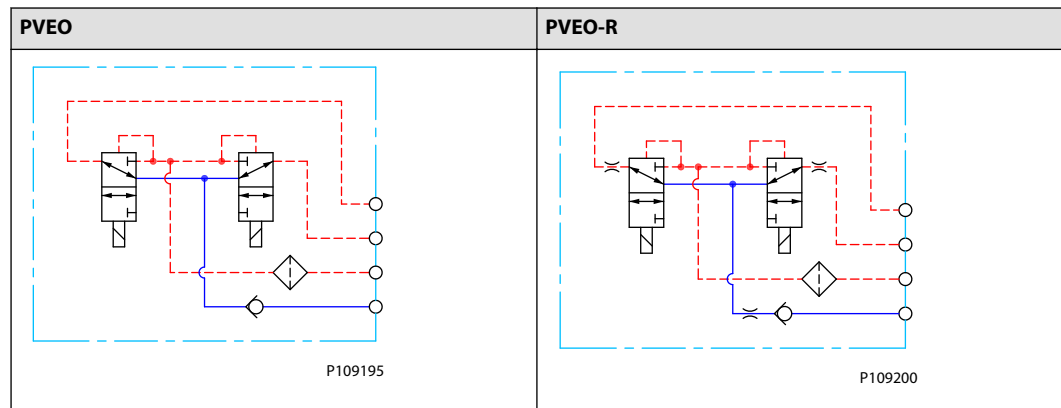
The standard PVEO functionality includes the simplest electric circuit of the PVE Series 7 actuator program, using a fixed 12 Vdc or 24 Vdc supply voltage or signal voltage and a simple LED circuit to control the LED light indicating Power ON/OFF.

The PVEO-DI variant includes an LVDT spool position monitor and a more advanced electric circuit with an embedded micro-controller and separate power supply to handle the Direction Indication functionality.

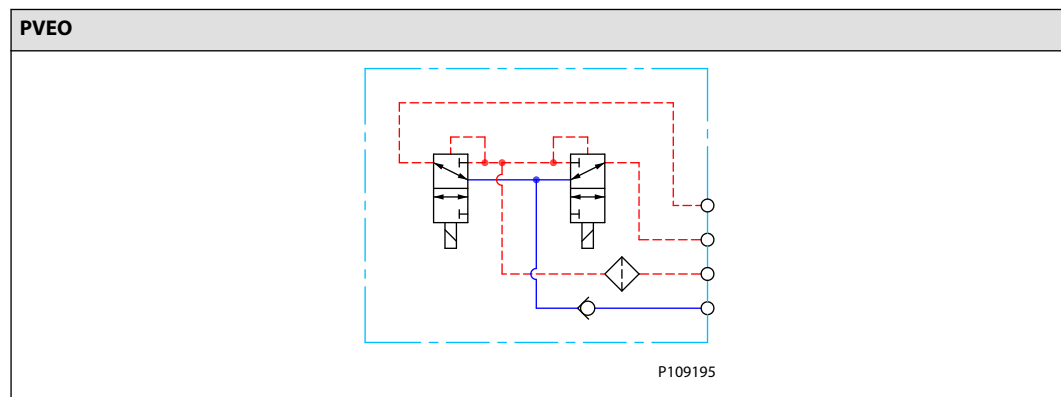
An energization of solenoid valve SV1 and a simultaneous de-energization of SV2 will cause the main spool to move to the right direction and vice versa. If both SV1 and SV2 are energized or de-energized simultaneously, the main spool stays locked in its neutral position.

PVEO Schematics and Dimensions

Schematics



PVEO schematics



PVEO

Dimensions

| PVEO | | Connector height | |
|--|--|-----------------------|--|
| <p style="text-align: center;">P109127</p> | | DEU = 24 mm [0.94 in] | |
| | | DIN = 13 mm [0.51 in] | |
| Weight: 2 kg [4.4 lbs] | | | |
| <p style="text-align: center;">P109231</p> | | | |

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% | |
| <i>Current Consumption</i> | Typical | 708 mA | 361 mA |
| | Minimum | 430 mA | 220 mA |
| | Maximum | 944 mA | 482 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] |

PVEO

Operating Conditions (continued)

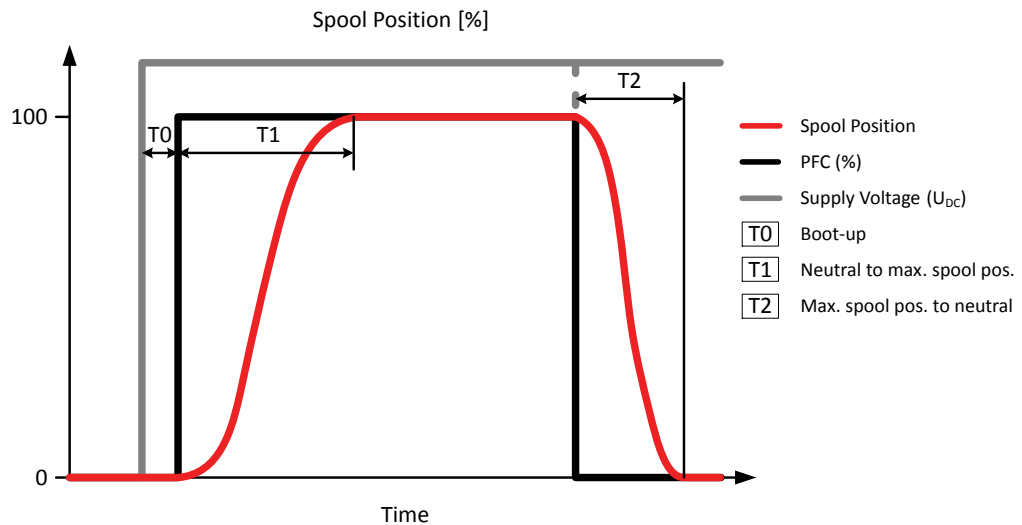
| Description | Type | Value | |
|-----------------------|--------------------|----------------------------------|-----------------|
| Oil Consumption | Neutral | 0.0 l/min | [0.0 gal/min] |
| | Locked position | 0.0 l/min | [0.0 gal/min] |
| | Actuating | 0.9 l/min | [0.24 gal/min] |
| | Actuating (PVEO-R) | 0.3 l/min | [0.08 gal/min] |
| Max T-port pressure | Static | 25 bar | [365 psi] |
| Max T-port pressure | Intermittent | 40 bar | [580 psi] |
| 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 constant |  | Power ON |

PVEO Reaction Times

Reaction times



PVEO

Definition of Step Response

| Reaction | PVG 32 | | PVG 128/256 | |
|--|-----------------|--------|-------------|--------|
| | PVEO PVEO-DI | PVEO-R | A port | B port |
| T0 – Boot-up | 0 | 0 | 0 | 0 |
| T1 – Neutral to max. spool stroke @ Power ON/ @ Constant U _{DC} | 110 ms | 325 ms | 375 ms | 520 ms |
| T2 – Max. spool stroke to neutral @ Power OFF/@ Constant U _{DC} | 110 ms | 340 ms | 350 ms | 600 ms |

PVEO Variants for PVG

PVG 32/100 Variants

| Part number | Type | Connector | IP | Udc | Functionality |
|-----------------------|---------|-----------|----|--------|---------------|
| 11166843 | PVEO | 1x4 DEU | 67 | 12 Vdc | Standard |
| 11166838 | PVEO | 1x4 DEU | 67 | 24 Vdc | Standard |
| 11166866 | PVEO | 1x4 AMP | 66 | 12 Vdc | Standard |
| 11166837 | PVEO | 1x4 AMP | 66 | 24 Vdc | Standard |
| 11166836 | PVEO | 1x4 DIN | 65 | 12 Vdc | Standard |
| 11166743 | PVEO | 1x4 DIN | 65 | 24 Vdc | Standard |
| 11166753 | PVEO-R | 1x4 DEU | 67 | 12 Vdc | Ramp |
| 11166754 | PVEO-R | 1x4 DEU | 67 | 24 Vdc | Ramp |
| 11166867 | PVEO-R | 1x4 AMP | 66 | 12 Vdc | Ramp |
| 11166776 | PVEO-R | 1x4 AMP | 66 | 24 Vdc | Ramp |
| 11166831 | PVEO-R | 1x4 DIN | 65 | 12 Vdc | Ramp |
| 11166908 | PVEO-R | 1x4 DIN | 65 | 24 Vdc | Ramp |
| 11168740 ¹ | PVEO-DI | 2x4 AMP | 66 | 12 Vdc | Standard |
| 11166869 ¹ | PVEO-DI | 2x4 AMP | 66 | 24 Vdc | Standard |

¹ Includes *Direction Indication* special feature

PVG 120 Variants

| Part number | Type | Connector | IP | Udc | Functionality |
|-------------|--------|-----------|----|--------|---------------|
| 11166755 | PVEO | 1x4 DEU | 67 | 12 Vdc | Standard |
| 11166757 | PVEO | 1x4 DEU | 67 | 24 Vdc | Standard |
| 11166815 | PVEO | 1x4 AMP | 66 | 12 Vdc | Standard |
| 11166816 | PVEO | 1x4 AMP | 66 | 24 Vdc | Standard |
| 11166822 | PVEO | 1x4 DIN | 65 | 12 Vdc | Standard |
| 11166744 | PVEO | 1x4 DIN | 65 | 24 Vdc | Standard |
| 11166882 | PVEO-R | 1x4 AMP | 66 | 24 Vdc | Ramp |
| 11166909 | PVEO-R | 1x4 DIN | 65 | 24 Vdc | Ramp |

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 |

PVEO

PVG 128/256 Variants (continued)

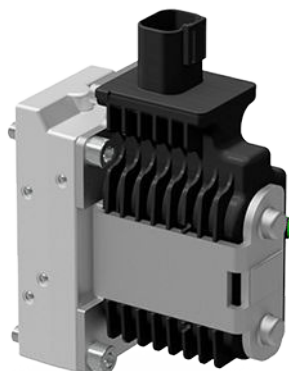
| Part number | Type | Connector | IP | Udc | Functionality |
|--------------------|-------------|------------------|-----------|------------|----------------------|
| 11186331 | PVEO | 1x4 DIN | 65 | 12 Vdc | Standard |
| 11186342 | PVEO | 1x4 DIN | 65 | 24 Vdc | Standard |

PVG 60 Variants

| Part number | Type | Connector | IP | Udc | Functionality |
|--------------------|-------------|------------------|-----------|------------|----------------------|
| 11166939 | PVEO | 1x4 DIN | 65 | 12 Vdc | Standard |
| 11166940 | PVEO | 1x4 DIN | 65 | 24 Vdc | Standard |

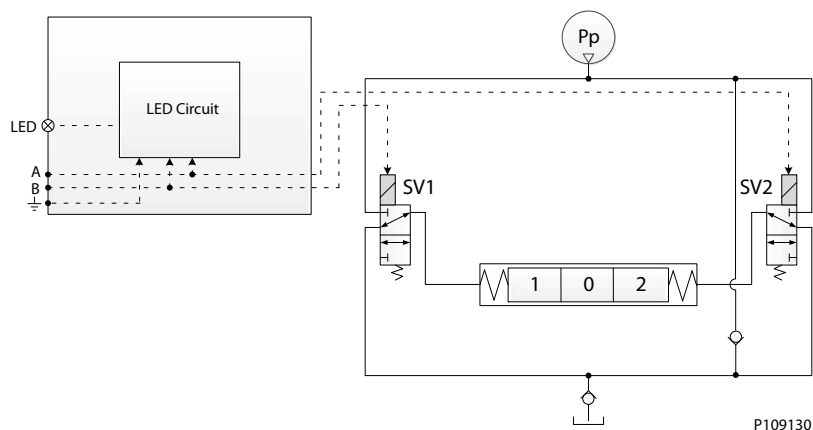
PVEO-HP

The PVEO-HP 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.

PVEO-HP


All variants are available with following features:

- Neutral position or max. spool stroke according to control signal
- 12 V_{DC} or 24 V_{DC} supply voltage
- DEUTSCH, AMP or DIN/Hirschman connectors
- PVH/PVHC pilot oil pressure of 25 bar [362.6 psi]
- LED only indicating Power ON or Power OFF

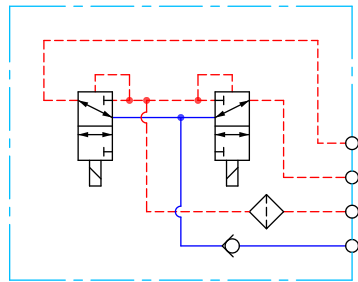
PVEO-HP functionality diagram


The standard PVEO/PVEO-HP functionality includes the simplest electric circuit of the PVE actuator program, using a fixed 12 V_{DC} or 24 V_{DC} supply voltage or signal voltage and a simple LED circuit to control the LED light indicating Power ON/OFF.

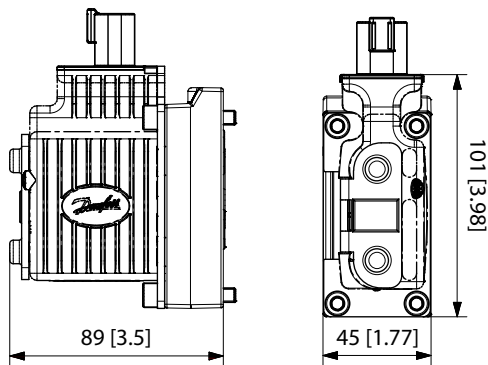
An energization of solenoid valve SV1 and a simultaneous de-energization of SV2 will cause the main spool to move to the right direction and vice versa. If both SV1 and SV2 are energized or de-energized simultaneously, the main spool stays locked in its neutral position.

PVEO-HP

PVEO-HP Schematic



P109195

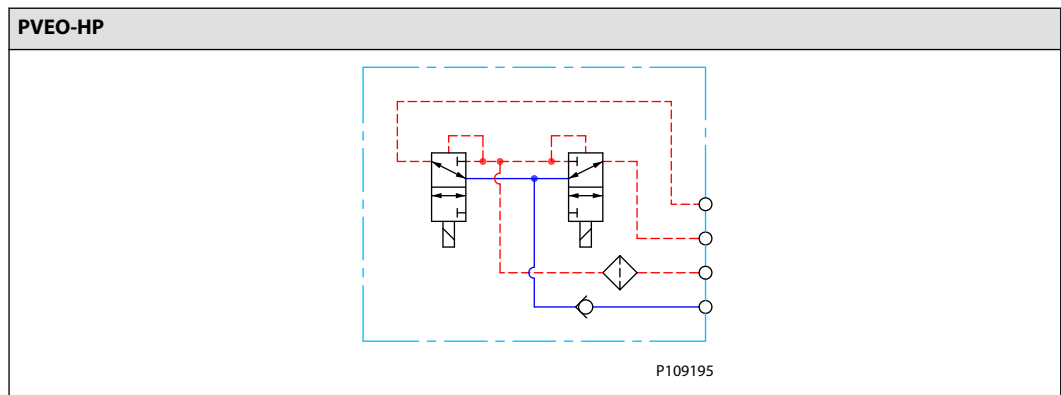


Connector height and weight

| DEUTSCH | AMP | DIN | Weight |
|----------------|----------------|----------------|------------------|
| 30 mm [1.2 in] | 38 mm [1.5 in] | 40 mm [1.6 in] | 0.7 kg [1.54 lb] |

PVEO-HP Schematics and Dimensions

Schematics



PVEO-HP

Dimensions

| PVEO-HP | Connector height |
|--|-----------------------|
| <p style="text-align: center;">P109231</p> | DEU = 24 mm [0.94 in] |
| | AMP = 17 mm [0.67 in] |
| | DIN = 13 mm [0.51 in] |

For more information on dimensions, please see [Dimension Overview for PVE Series 7](#) on page 63.

PVEO-HP Technical Data

Control Specification

| Description | Type | 12 V _{DC} | 24 V _{DC} |
|-----------------------------------|-------------|--------------------------|--------------------------|
| Supply Voltage (U _{DC}) | Range | 11 to 15 V _{DC} | 22 to 30 V _{DC} |
| | Max. ripple | 5% | |
| Current Consumption | Typical | 1093 mA | 555 mA |
| | Minimum | 660 mA | 340 mA |
| | Maximum | 1458 mA | 740 mA |

Technical data

| | | |
|--------------------------|-----------------|-----------------------------|
| Pilot pressure | Nominal | 25 bar [363 psi] |
| | Minimum | 21 bar [305 psi] |
| | Maximum | 25 bar [363 psi] |
| Fluid consumption | Neutral | 0 l/min [0 US gal/min] |
| | Locked position | 0 l/min [0 US gal/min] |
| | Actuating | 0.9 l/min [0.24 US gal/min] |

Technical specification

| Parameter | Minimum | Recommended range | Maximum |
|--|-------------------------------------|---|-----------------------------------|
| Fluid temperature | -30°C [-22°F] | 30 to 60°C [86 to 140°F] | 90° [194°F] |
| Fluid viscosity | 4 mm ² /s [39 SUS] | 12 to 75 mm ² /s [65 to 347 SUS] | 460 mm ² /s [2128 SUS] |
| Fluid cleanliness (mechanical activation) | 23/19/16 (according to ISO 4406) | | |
| Fluid cleanliness (PVE activation) | 18/16/13 (according to ISO 4406) | | |
| Operating temperature | Ambient: -40 to 90°C [-40 to 194°F] | | |

PVEO-HP

Technical specification (continued)

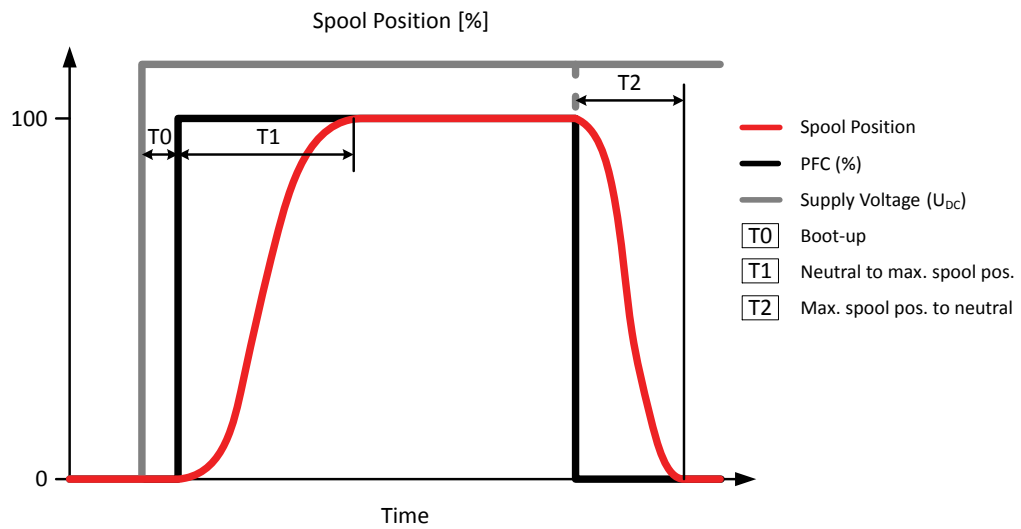
| Parameter | Minimum | Recommended range | Maximum |
|------------------------------------|-------------------|-------------------|---------|
| Max. T-port pressure (static) | 25 bar [365 psi] | | |
| Max T-port pressure (intermittent) | 40 bar [580 psi] | | |

LED characteristic

| Color | LED characteristic | Description |
|----------------|--------------------|-------------|
| Green constant | | Power ON |

PVEO-HP Reaction Times

Reaction times



P301823

Definition of Step Response

| Reaction | PVEO-HP |
|---|---------|
| T0 – Boot-up | 0 |
| T1 – Neutral to max. spool stroke @ Power ON/@ Constant U_{DC} | 90 ms |
| T2 – Max. spool stroke to neutral @ Power OFF/@ Constant U_{DC} | 70 ms |

PVEO-HP Variants for PVG

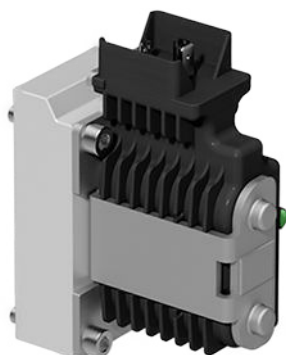
PVG 32/100 variants

| Part number | Type | Connector | IP | Udc | Functionality |
|-------------|---------|-----------|----|--------|---------------|
| 11166765 | PVEO-HP | 1x4 DEU | 67 | 12 Vdc | Standard |
| 11166766 | PVEO-HP | 1x4 DEU | 67 | 24 Vdc | Standard |
| 11166763 | PVEO-HP | 1x4 AMP | 66 | 12 Vdc | Standard |
| 11187524 | PVEO-HP | 1x4 AMP | 66 | 24 Vdc | Standard |
| 11187551 | PVEO-HP | 1x4 DIN | 65 | 12 Vdc | Standard |
| 11187562 | PVEO-HP | 1x4 DIN | 65 | 24 Vdc | Standard |

PVEM

The PVEM actuator is a proportional control actuator with closed-loop spool control primarily used to control work functions with medium performance requirements. The PVEM is available in three different performance variants, the standard PVEM, the PVEM-R with ramp and the PVEM-Q with quick reaction.

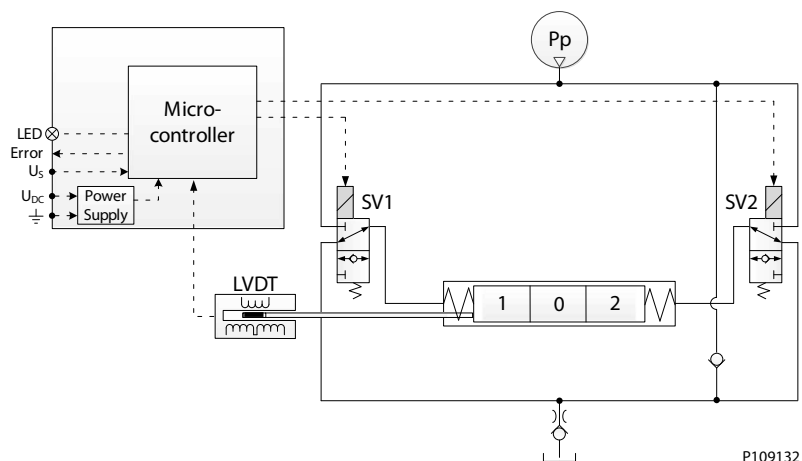
PVEM



Variants are available with following features:

- 11-32 V_{DC} multi-voltage power supply
- Analog voltage control signal 25–75% of supply voltage
- DIN/Hirschman connectors
- Standard PVE pilot oil pressure of 13.5 bar [196 psi]
- LED indicating error state and passive fault monitoring
- Float (-F), quick Ramp (-R) or Quick reaction functionality (-Q)

PVEM functionality



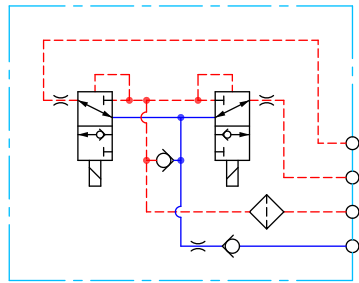
The PVE functionality includes an electric circuit with a closed-loop logic. An embedded micro-controller processes the signal voltage and the LVDT feedback signal and regulates the solenoid valves accordingly.

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.

PVEM

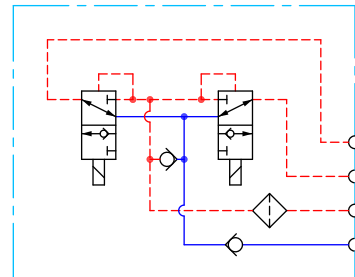
Schematics

PVEM/PVEM-FLB/PVEM-R



P109196

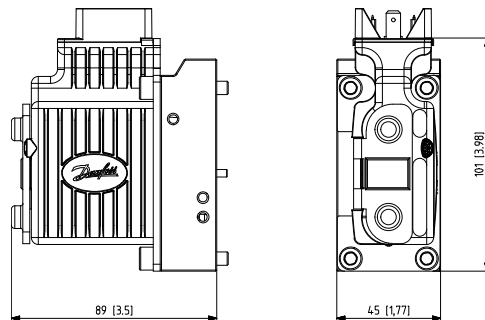
PVEM-Q



P109201

Dimensions

Dimensions drawing

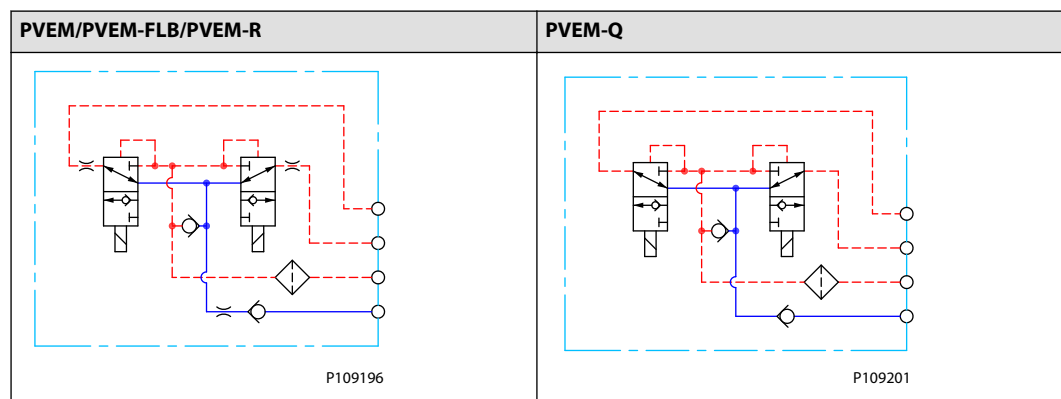


Connector height and weight

| DEUTSCH | AMP | DIN | Weight |
|----------------|----------------|----------------|------------------|
| 30 mm [1.2 in] | 38 mm [1.5 in] | 40 mm [1.6 in] | 0.7 kg [1.54 lb] |

PVEM Schematics and Dimensions

Schematics



PVEM

Dimensions

| PVEM | Connector height |
|--|-------------------------|
| <p style="text-align: center;">P109232</p> | DEU = 24 mm [0.94 in] |
| | AMP = 17 mm [0.67 in] |
| | DIN = 13 mm [0.51 in] |

For more information on dimensions, please see [Dimension Overview for PVE Series 7](#) on page 63.

PVEM Technical Data

Control Specification

| Description | Type | Value |
|------------------------------|-------------|---|
| Supply Voltage (U_{DC}) | Rated Range | 11 to 32 V_{DC} |
| | Max. ripple | 5% |
| Signal Voltage PWM (U_S) | Neutral | $U_S = 0.5 U_{DC} = 50\%$ DUT |
| | Q: P to A | $U_S = (0.5 \text{ to } 0.25) U_{DC} = 50\%$ to 25% DUT |
| | Q: P to B | $U_S = (0.5 \text{ to } 0.75) U_{DC} = 50\%$ to 75% DUT |
| Input Impedance | Rated | 12 k Ω |
| Input Capacitance | Rated | 1 nF |

Current consumption

| Description | @ 12 V_{DC} | @ 24 V_{DC} |
|-------------------------------------|---------------|---------------|
| PWM Frequency (U_S) recommended | > 200 Hz | > 200 Hz |
| Current Consumption | 690 mA | 350 mA |

Pilot pressure

| Minimum | Nominal | Maximum |
|--------------------|--------------------|--------------------|
| 10.0 bar [145 psi] | 13.5 bar [196 psi] | 15.0 bar [218 psi] |

Fluid consumption

| Neutral/Locked position | Actuating (PVEM-R) | Actuating (PVEM-Q) | Actuating |
|-------------------------|--------------------|---|--------------------------------|
| 0 l/min | 0.3 l/min | 1.0 l/min [0.26 US gal/min][0.08 US gal/min] | 0.5 l/min [0.13 US gal/min] |

PVEM

Technical specification

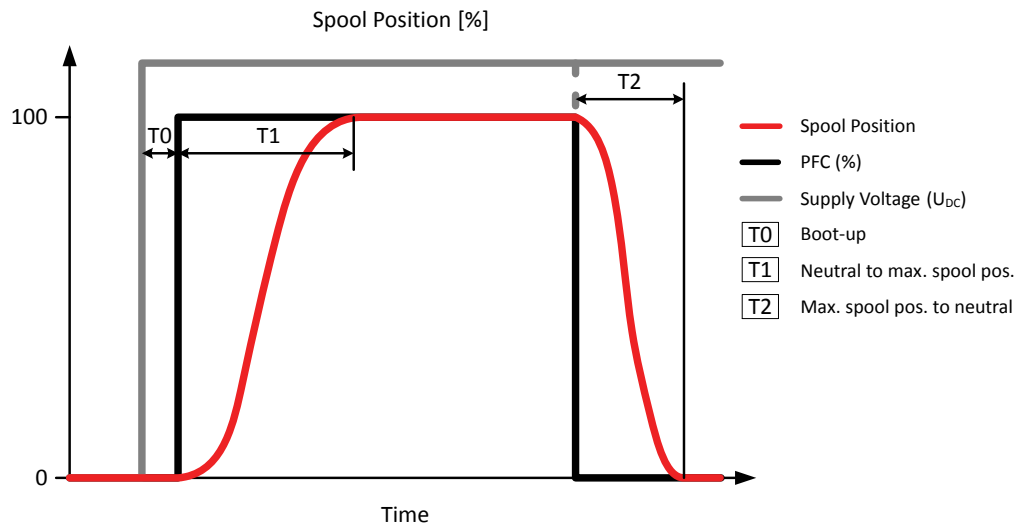
| Parameter | Minimum | Recommended range | Maximum |
|---|-------------------------------------|---|-----------------------------------|
| Fluid temperature | -30°C [-22°F] | 30 to 60°C [86 to 140°F] | 90° [194°F] |
| Fluid viscosity | 4 mm ² /s [39 SUS] | 12 to 75 mm ² /s [65 to 347 SUS] | 460 mm ² /s [2128 SUS] |
| Fluid cleanliness (mechanical activation) | 23/19/16 (according to ISO 4406) | | |
| Fluid cleanliness (PVE activation) | 18/16/13 (according to ISO 4406) | | |
| Operating temperature | Ambient: -40 to 90°C [-40 to 194°F] | | |
| Max. T-port pressure static / intermittent | 20 / 40 bar [365 / 580 psi] | | |

LED characteristic

| Color | LED characteristic | Description |
|-------------------------|--------------------|-------------------------|
| Green constant | | No error – Actuating |
| Green flashing @ 1.5 Hz | | Neutral – Power save |
| Red constant | | Internal error |
| Red flashing @ 1.5 Hz | | External or Float error |

PVEM Reaction Times

Reaction times



P301823

Definition of Step Response

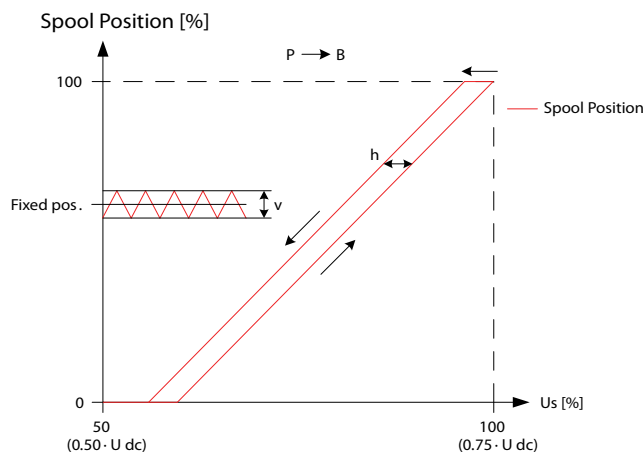
| Reaction | PVEM-R | PVEM/PVEM-FLB | PVEM-Q |
|---|--------|---------------|--------|
| T0 – Boot-up | 15 ms | 15 ms | 15 ms |
| T1 – Neutral to max. spool stroke @ Power ON | 325 ms | 225 ms | 125 ms |
| T2 – Max. spool stroke to neutral @ Power OFF | 110 ms | 110 ms | 110 ms |

PVEM

Definition of Step Response (continued)

| Reaction | PVEM-R | PVEM/PVEM-FLB | PVEM-Q |
|---|--------|---------------|--------|
| T1 – Neutral to max. spool stroke @ Constant U_{DC} | 310 ms | 210 ms | 110 ms |
| T2 – Max. spool stroke to neutral @ Constant U_{DC} | 90 ms | 90 ms | 90 ms |

PVEM Hysteresis and Ripple



| Description | Type | PVEM |
|---------------------------------------|------------|------|
| Hysteresis (h) | Rated [%] | 15 |
| Steady state ripple @ fixed U_s (v) | Rated [mm] | 0.0 |

For more information on hysteresis and ripple, see [Hysteresis and Ripple](#).

PVEM Variants for PVG

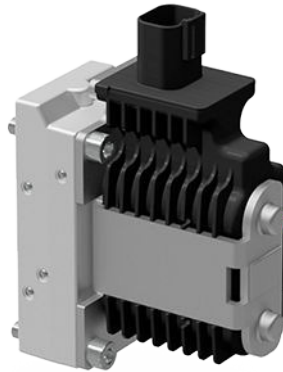
PVG 32/100 Variants

| Part number | Type | Connector | IP | Fault Monitoring | Functionality |
|-------------|----------|-----------|----|------------------|----------------|
| 11166829 | PVEM | 1x4 DIN | 65 | Passive | Standard |
| 11166852 | PVEM-FLB | 1x4 DIN | 65 | Passive | Float B-port |
| 11166845 | PVEM-R | 1x4 DIN | 65 | Passive | Ramp |
| 11166853 | PVEM-Q | 1x4 DIN | 65 | Passive | Quick Reaction |

PVEA

The PVEA actuator is a proportional control actuator with a closed-loop spool control primarily used to control work functions with above medium performance requirements.

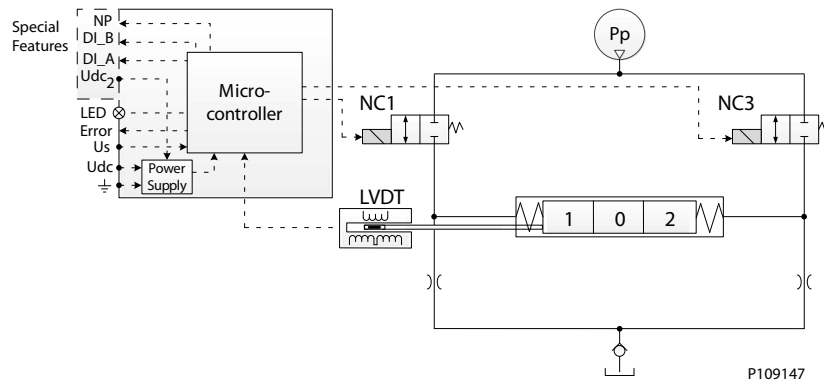
PVEA



- 11-32 V_{DC} multi-voltage power supply
- Analog voltage control signal 25–75% of supply voltage
- Standard PVE pilot oil pressure of 13.5 bar [196 psi]
- DEUTSCH or AMP connectors
- LED indicating error state and active or passive fault monitoring
- Direction Indication output (-DI) or Neutral Power-Off (-NP) functionality

PVEA-DI functionality

PVEA-DI functionality



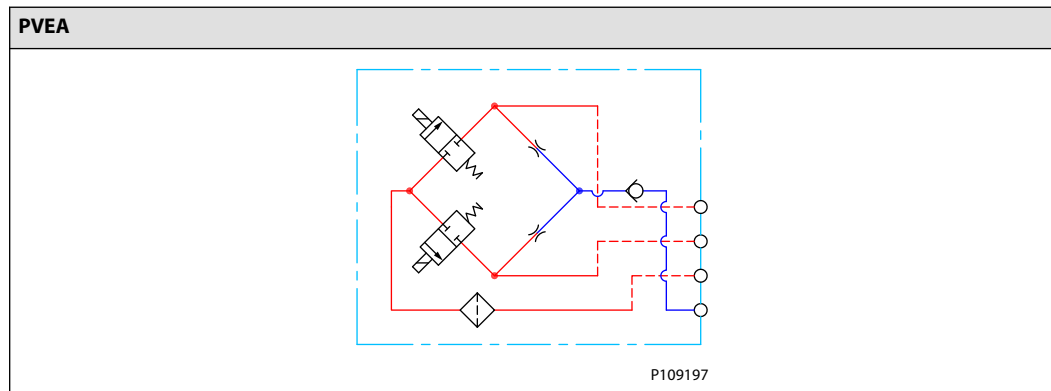
The PVE functionality includes an electric circuit with a closed-loop logic. An embedded micro-controller processes the signal voltage and the LVDT feedback signal and regulates the solenoid valves accordingly.

A continuous modulation of solenoid valve NC1 and a simultaneous 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 modulation of both NC1 and NC3 balances the main spool in its stroked position. The main spool oscillates in its stroked position at a frequency corresponding to the modulation frequency. When both NC1 and NC3 are de-energized, the main spool moves back to its neutral position by means of the main spool neutral spring and the hydraulic principle.

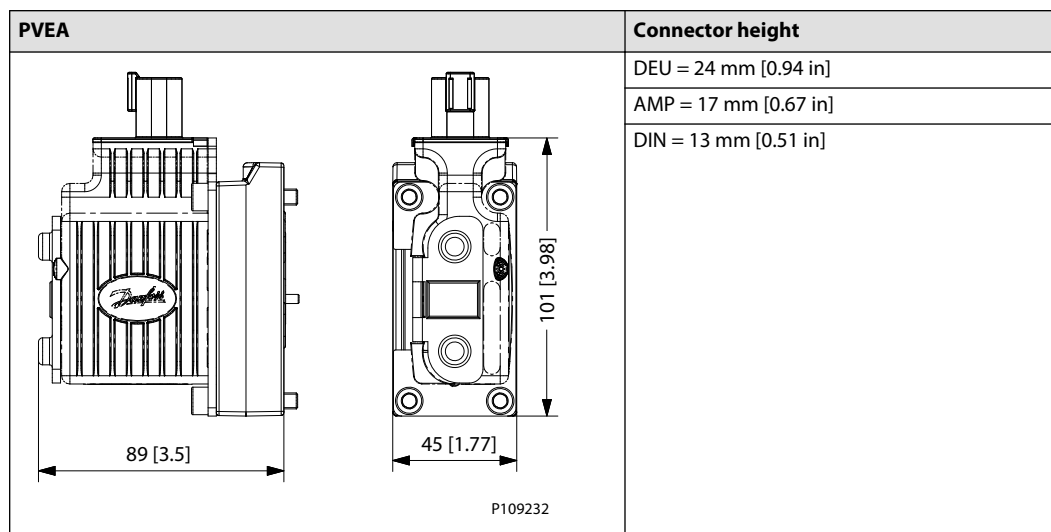
PVEA

PVEA Schematics and Dimensions

Schematics



Dimensions



For more information on dimensions, see [Dimension Overview for PVE Series 7](#) on page 63.

PVEA Technical Data

Control Specification

| Description | Type | Value |
|------------------------------|-------------|---|
| Supply Voltage (U_{DC}) | Rated Range | 11 to 32 V_{DC} |
| | Max. ripple | 5% |
| Signal Voltage PWM (U_S) | Neutral | $U_S = 0.5 U_{DC} = 50\%$ DUT |
| | Q: P to A | $U_S = (0.5 \text{ to } 0.25) U_{DC} = 50\%$ to 25% DUT |
| | Q: P to B | $U_S = (0.5 \text{ to } 0.75) U_{DC} = 50\%$ to 75% DUT |
| Input Impedance | Rated | 12 k Ω |
| Input Capacitance | Rated | 1 nF |

PVEA

Current consumption

| Description | @ 12 V _{DC} | @ 24 V _{DC} |
|---|----------------------|----------------------|
| PWM Frequency (U _S) recommended | > 1000 Hz | > 1000 Hz |
| Current Consumption | 290 mA | 150 mA |

Pilot pressure

| Minimum | Nominal | Maximum |
|--------------------|--------------------|--------------------|
| 10.0 bar [145 psi] | 13.5 bar [196 psi] | 15.0 bar [218 psi] |




Fluid consumption

| Neutral | Locked position | Actuating |
|---------|-----------------|--------------------------------|
| 0 l/min | 0 l/min | 1.0 l/min [0.26 US gal/min] |

Technical specification

| Parameter | Minimum | Recommended range | Maximum |
|---|-------------------------------------|---|-----------------------------------|
| Fluid viscosity | 4 mm ² /s [39 SUS] | 12 to 75 mm ² /s [65 to 347 SUS] | 460 mm ² /s [2128 SUS] |
| Fluid cleanliness | 18/16/13 (according to ISO 4406) | | |
| Storage temperature | Ambient: -50 to 90°C [-58 to 194°F] | | |
| Operating temperature | Ambient: -40 to 90°C [-40 to 194°F] | | |
| Max. T-port pressure static / intermittent | 25 / 40 bar [365 / 580 psi] | | |

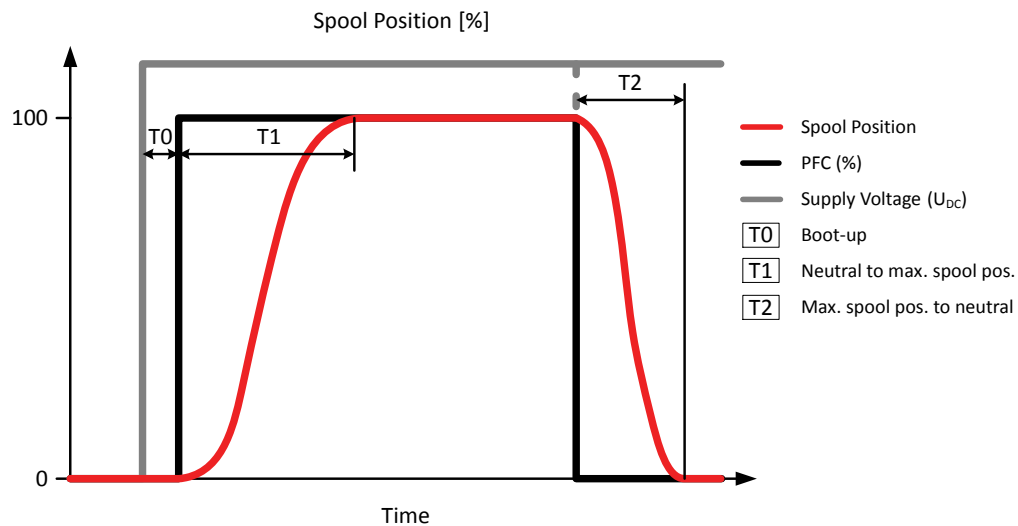
LED characteristic

| Color | LED characteristic | Description |
|-------------------------|---|-------------------------|
| Green constant |  | No error – Actuating |
| Green flashing @ 1.5 Hz |  | Neutral – Power save |
| Red constant |  | Internal error |
| Red flashing @ 1.5 Hz |  | External or Float error |

PVEA

PVEA Reaction Times

Reaction times

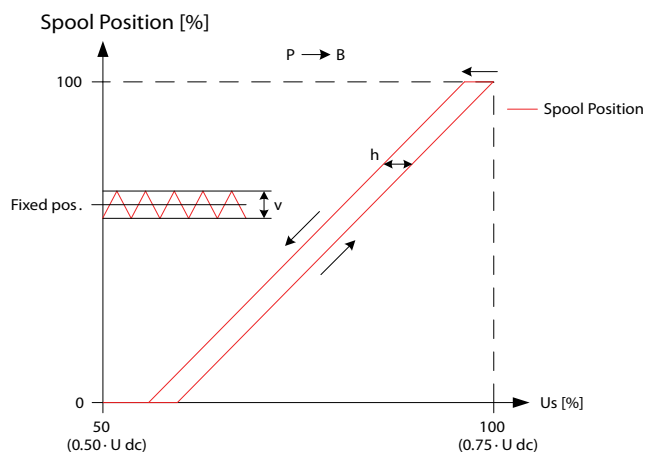


P301823

| Reaction | PVG 32 (PVEA) |
|--|---------------|
| T ₀ – Boot-up [ms] | 50 ms |
| T ₁ – Neutral to max. spool stroke @ Power ON | 355 ms |
| T ₂ – Max. spool stroke to neutral @ Power OFF | 260 ms |
| T ₁ – Neutral to max. spool stroke @ Constant U _{DC} | 305 ms |
| T ₂ – Max. spool stroke to neutral @ Constant U _{DC} | 210 ms |

PVEA Hysteresis and Ripple

Spool position vs. supply (%)



| Description | Type | PVEA |
|--|------------|------|
| Hysteresis (h) | Rated [%] | 2 |
| Steady state ripple @ fixed U _s (v) | Rated [mm] | 0.3 |

For more information on hysteresis and ripple, see [Hysteresis and Ripple](#).

PVEA

PVEA Variants for PVG

PVG 32/100 Variants

| Part number | Type | Connector | IP | Fault monitoring | Functionality |
|-----------------------|-------------|------------------|-----------|-------------------------|----------------------|
| 11177346 | PVEA | 1x4 DEU | 67 | Passive | Standard |
| 11177347 | PVEA | 1x4 DEU | 67 | Active | Standard |
| 11177353 | PVEA | 1x4 AMP | 66 | Passive | Standard |
| 11177348 | PVEA | 1x4 AMP | 66 | Active | Standard |
| 11177345 ¹ | PVEA-NP | 1x6 DEU | 67 | Active | Standard |
| 11177357 ² | PVEA-DI | 2x4 DEU | 67 | Active | Standard |
| 11177356 ² | PVEA-DI | 2x4 AMP | 66 | Passive | Standard |
| 11177355 ² | PVEA-DI | 2x4 AMP | 66 | Active | Standard |

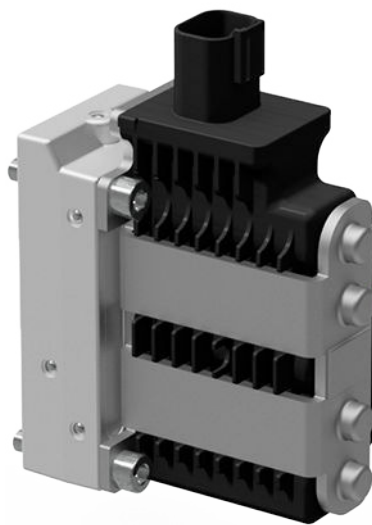
¹ Includes *Neutral Power-OFF* special feature

² Includes *Direction Indication* special feature

PVEH

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

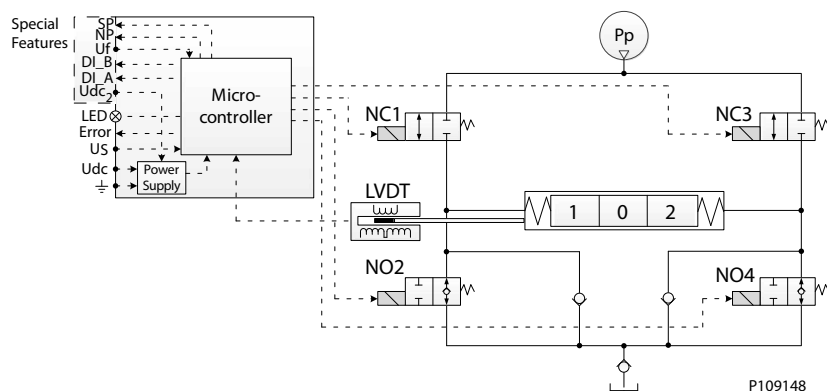
PVEH



- 11-32 V_{DC} multi-voltage power supply
- Analog voltage control signal 25–75% of supply voltage
- Standard PVE pilot oil pressure of 13.5 bar [196 psi]
- DEUTSCH, AMP or DIN/Hirschman connectors
- LED indicating error state and active or passive fault monitoring
- Float (-F), Direction Indication output (-DI), Neutral Power-Off (-NP), Spool Position output (-SP) or 0-10 V_{DC} control signal (-U) functionality

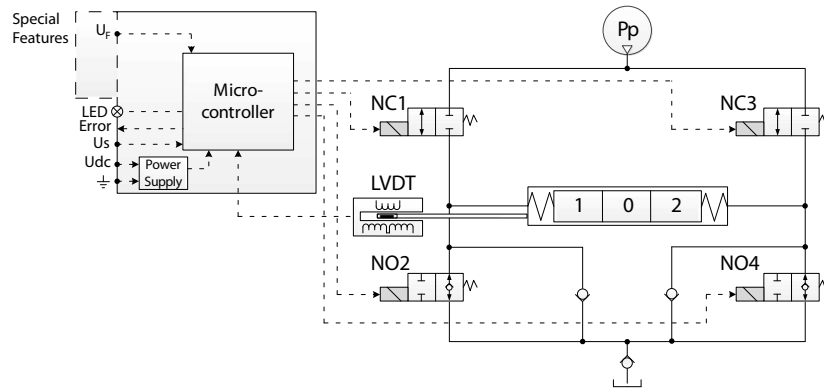
PVEH functionality

PVEH functionality



PVEH

PVEH functionality

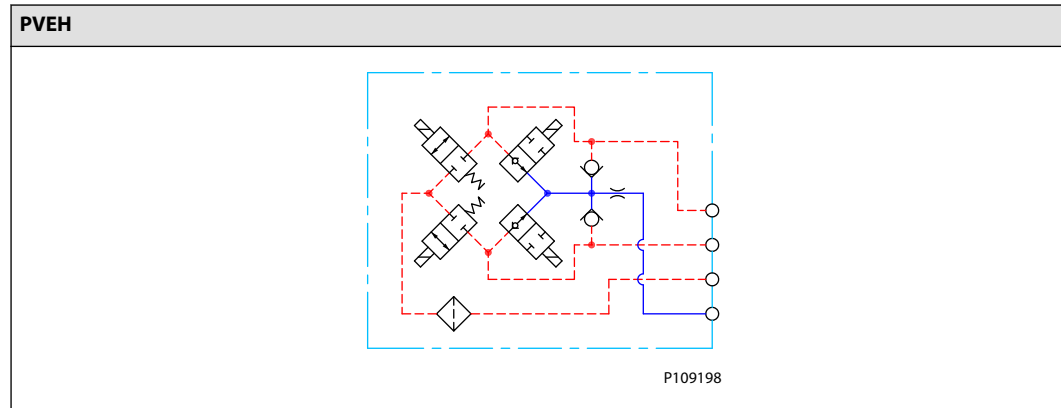


The PVE functionality includes an electric circuit with a closed-loop logic. An embedded micro-controller processes the signal voltage and the LVDT feedback signal and regulates the solenoid valves accordingly.

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 balances 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.

PVEH Schematics and Dimensions

Schematics



PVEH

Dimensions

| PVEH | Connector height |
|--|--|
| <p style="text-align: center;">P109158</p> | DEU = 24 mm [0.94 in] DIN = 13 mm [0.51 in] |
| <p>2 kg [4.4]</p> <p style="text-align: center;">P109233</p> | |

PVEH Technical Data

Control Specification

| Description | Type | Value |
|------------------------------|-------------|---|
| Supply Voltage (U_{DC}) | Rated Range | 11 to 32 V _{DC} |
| | Max. ripple | 5% |
| Signal Voltage PWM (U_S) | Neutral | $U_S = 0.5 U_{DC} = 50\%$ DUT |
| | Q: P to A | $U_S = (0.5 \text{ to } 0.25) U_{DC} = 50\%$ to 25% DUT |
| | Q: P to B | $U_S = (0.5 \text{ to } 0.75) U_{DC} = 50\%$ to 75% DUT |
| Input Impedance | Rated | 12 k Ω |
| Input Capacitance | Rated | 1 nF |

Current consumption

| Description | @ 12 V _{DC} | @ 24 V _{DC} |
|-------------------------------------|----------------------|----------------------|
| PWM Frequency (U_S) recommended | > 1000 Hz | > 1000 Hz |
| Current Consumption | 540 mA | 270 mA |

PVEH

Current consumption (continued)

| Description | @ 12 V _{DC} | @ 24 V _{DC} |
|-----------------|--|----------------------|
| Max. DI Current | 200 mA | 200 mA |
| Power Save | 25 mA @ U _{DC} = 32 V _{DC} | |

Pilot pressure

| Minimum | Nominal | Maximum |
|--------------------|--------------------|--------------------|
| 10.0 bar [145 psi] | 13.5 bar [196 psi] | 15.0 bar [218 psi] |





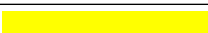
Fluid consumption

| Neutral | Locked position | Actuating |
|-----------|-----------------|--------------------------------|
| 0.0 l/min | 0.0 l/min | 0.7 l/min [0.18 US gal/min] |

Technical specification

| Parameter | Minimum | Recommended range | Maximum |
|---|-------------------------------------|---|-----------------------------------|
| Fluid viscosity | 4 mm ² /s [39 SUS] | 12 to 75 mm ² /s [65 to 347 SUS] | 460 mm ² /s [2128 SUS] |
| Fluid cleanliness | 18/16/13 (according to ISO 4406) | | |
| Storage temperature | Ambient: -50 to 90°C [-58 to 194°F] | | |
| Operating temperature | Ambient: -40 to 90°C [-40 to 194°F] | | |
| Max. T-port pressure static / intermittent | 25 / 40 bar [365 / 580 psi] | | |

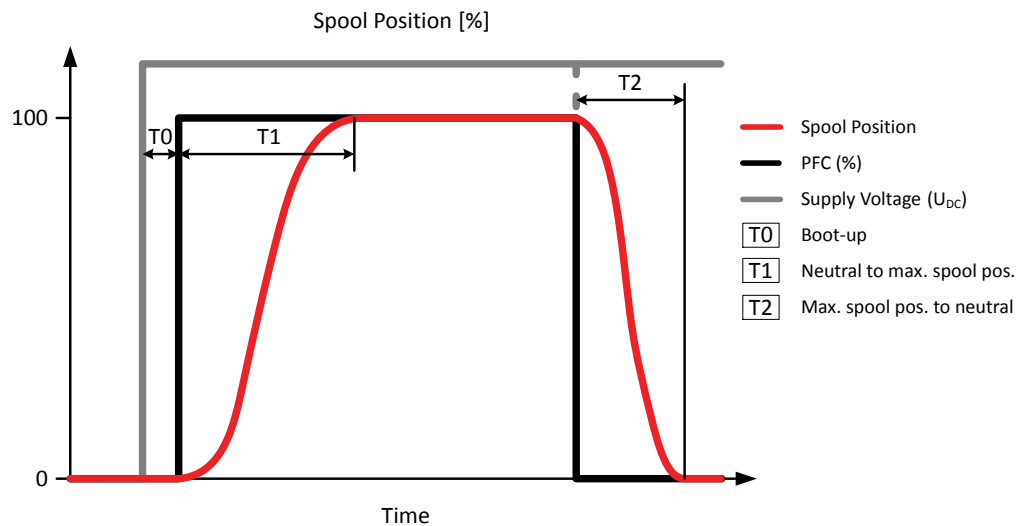
LED Characteristic

| Color | LED Characteristic | Description |
|-------------------------|---|-------------------------|
| Green constant |  | No error – Actuating |
| Green flashing @ 1.5 Hz |  | Neutral – Power save |
| Red constant |  | Internal error |
| Red flashing @ 1.5 Hz |  | External or Float error |
| Yellow |  | Disable mode |

PVEH

PVEH Reaction Times

Reaction times

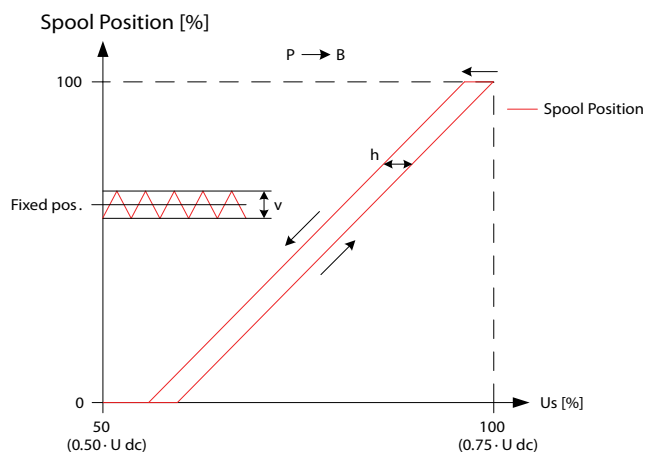


P301823

| Reaction | PVG 32 | PVG 128/256 |
|--|--------|-------------|
| T0 – Boot-up [ms] | 40 ms | 40 ms |
| T1 – Neutral to max. spool stroke @ Power ON [ms] | 155 ms | 400 ms |
| T2 – Max. spool stroke to neutral @ Power OFF [ms] | 130 ms | 300 ms |
| T1 – Neutral to max. spool stroke @ Constant U_{DC} [ms] | 115 ms | 380 ms |
| T2 – Max. spool stroke to neutral @ Constant U_{DC} [ms] | 90 ms | 270 ms |

PVEH Hysteresis and Ripple

Spool position vs. supply (%)



| Description | Type | PVEH |
|---------------------------------------|------------|------|
| Hysteresis (h) | Rated [%] | <24 |
| Steady state ripple @ fixed U_s (v) | Rated [mm] | 0.0 |

PVEH

PVEH Variants for PVG

PVG 32/100 variants

| Part number | Type | Connector | IP | Fault monitoring | Functionality |
|-----------------------|----------|-----------|----|------------------|--------------------|
| 11166732 | PVEH | 1x4 DEU | 67 | Passive | Standard |
| 11166775 | PVEH | 1x4 DEU | 67 | Active | Standard |
| 11166825 | PVEH | 1x4 AMP | 66 | Passive | Standard |
| 11166818 | PVEH | 1x4 AMP | 66 | Active | Standard |
| 11166824 | PVEH | 1x4 DIN | 65 | Passive | Standard |
| 11166817 | PVEH | 1x4 DIN | 65 | Active | Standard |
| 11166832 ¹ | PVEH-U | 1x4 AMP | 66 | Passive | Fixed US 0-10 V dc |
| 11166821 ¹ | PVEH-U | 1x4 AMP | 66 | Active | Fixed US 0-10 V dc |
| 11166770 ¹ | PVEH-U | 1x4 DIN | 65 | Passive | Fixed US 0-10 V dc |
| 11166772 ¹ | PVEH-U | 1x4 DIN | 65 | Active | Fixed US 0-10 V dc |
| 11166840 | PVEH-FLB | 1x4 DEU | 67 | Passive | Float B-port |
| 11166742 | PVEH-FLB | 1x4 DEU | 67 | Active | Float B-port |
| 11166839 | PVEH-FLB | 1x4 DIN | 65 | Active | Float B-port |
| 11166841 ² | PVEH-FLA | 1x6 DEU | 67 | Active | Float A-port |
| 11168738 ² | PVEH-FLA | 1x6 AMP | 66 | Passive | Float A-port |
| 11168739 ² | PVEH-FLA | 1x6 AMP | 66 | Active | Float A-port |
| 11166773 ³ | PVEH-SP | 1x6 DEU | 67 | Active | Standard |
| 11166750 ⁴ | PVEH-NP | 1x6 DEU | 67 | Fast active | Standard |
| 11166835 ⁵ | PVEH-DI | 2x4 DEU | 67 | Active | Standard |
| 11166820 ⁵ | PVEH-DI | 2x4 AMP | 66 | Passive | Standard |
| 11166819 ⁵ | PVEH-DI | 2x4 AMP | 66 | Active | Standard |

¹ Includes *Disable Mode* special feature

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

³ Includes *Spool Position* special feature

⁴ Includes *Neutral Power-Off* special feature

⁵ Includes *Direction Indication* special feature

PVG 120 variants

| Part number | Type | Connector | IP | Fault monitoring | Functionality |
|-----------------------|--------|-----------|----|------------------|--------------------|
| 11166760 | PVEH | 1x4 DEU | 67 | Passive | Standard |
| 11166814 | PVEH | 1x4 AMP | 66 | Passive | Standard |
| 11166801 | PVEH | 1x4 AMP | 66 | Active | Standard |
| 11166813 | PVEH | 1x4 DIN | 65 | Passive | Standard |
| 11166777 | PVEH | 1x4 DIN | 65 | Active | Standard |
| 11166771 ¹ | PVEH-U | 1x4 DIN | 65 | Passive | Fixed US 0-10 V dc |
| 11166767 ¹ | PVEH-U | 1x4 DIN | 65 | Active | Fixed US 0-10 V dc |

¹ Includes *Disable Mode* special feature

PVEH

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 |

¹ Includes *Disable Mode* special feature

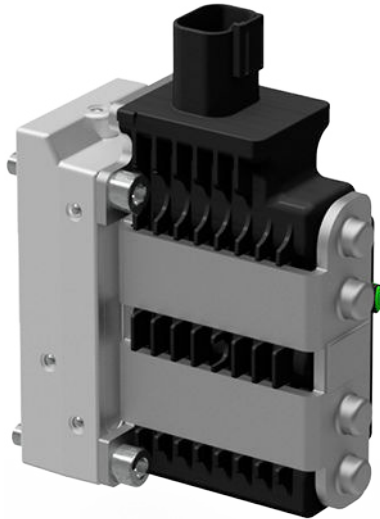
PVG 60 variants

| Part number | Type | Connector | IP | Fault monitoring | Functionality |
|-------------|------|-----------|----|------------------|---------------|
| 11166910 | PVEH | 1x4 DIN | 65 | Active | Float B-port |

PVES

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

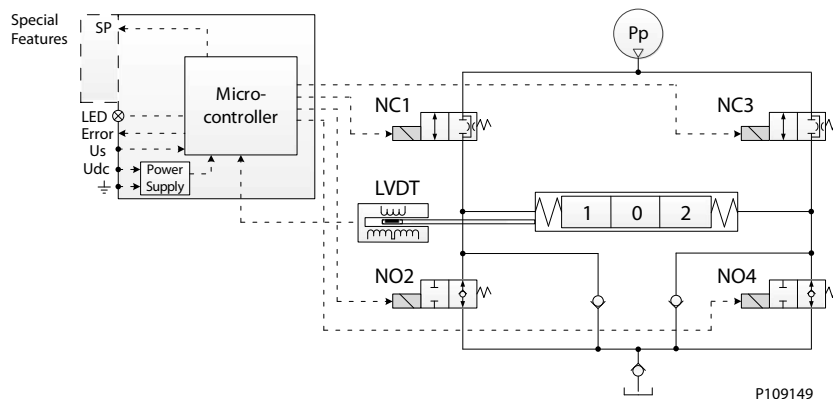
PVES



- 11-32 V_{DC} multi-voltage power supply
- Analog voltage control signal 25–75% of supply voltage
- Standard PVE pilot oil pressure of 13.5 bar [196 psi]
- DEUTSCH, AMP or DIN/Hirschman connectors
- LED indicating error state and active or passive fault monitoring
- Spool Position output (-SP) or 0-10 V_{DC} control signal (-U) functionality

PVES functionality

PVES functionality



The PVE 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.

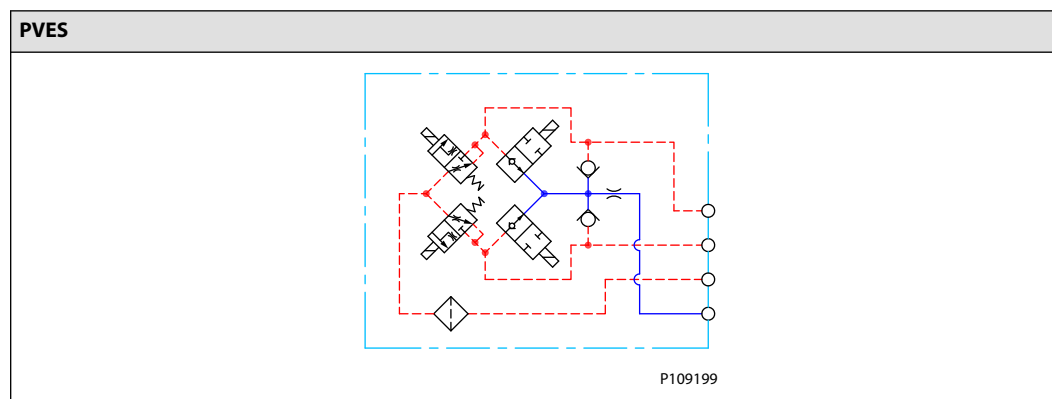
A continuous modulation of solenoid valves NC1 and NO4 together with a simultaneous energization of NO2 and de-energization of NC3 causes the main spool to move to the right direction and vice versa. When the main spool is stroked to the far right, a simultaneous energization of both NO2 and NO4 and de-energization of both NC1 and NC3 balances 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

PVES

to move back to its neutral position by means of the main spool neutral spring and the hydraulic principle.

PVES Schematics and Dimensions

Schematic



Dimensions

| PVES | | Connector height |
|---------|--|-----------------------|
| | | DEU = 24 mm [0.94 in] |
| | | AMP = 17 mm [0.67 in] |
| | | DIN = 13 mm [0.51 in] |
| P109235 | | |

For information on dimensions, see [Dimension Overview for PVE Series 7](#) on page 63.

PVES Technical Data

Control Specification

| Description | Type | Value |
|------------------------------|-------------|---|
| Supply Voltage (U_{DC}) | Rated Range | 11 to 32 V_{DC} |
| | Max. ripple | 5% |
| Signal Voltage PWM (U_S) | Neutral | $U_S = 0.5 U_{DC} = 50\%$ DUT |
| | Q: P to A | $U_S = (0.5 \text{ to } 0.25) U_{DC} = 50\%$ to 25% DUT |
| | Q: P to B | $U_S = (0.5 \text{ to } 0.75) U_{DC} = 50\%$ to 75% DUT |

PVES

Control Specification (continued)

| Description | Type | Value |
|-------------------|-------|-------|
| Input Impedance | Rated | 12 kΩ |
| Input Capacitance | Rated | 1 nF |

Current consumption

| Description | @ 12 V _{DC} | @ 24 V _{DC} |
|---|----------------------|----------------------|
| PWM Frequency (U _S) recommended | > 1000 Hz | > 1000 Hz |
| Current Consumption | 560 mA | 280 mA |

Pilot pressure

| Minimum | Nominal | Maximum |
|--------------------|--------------------|--------------------|
| 10.0 bar [145 psi] | 13.5 bar [196 psi] | 15.0 bar [218 psi] |

Fluid consumption

| Neutral | Locked position | Actuating |
|----------------------------------|----------------------------------|--------------------------------|
| 0.03 l/min [0.106 US gal/min] | 0.01 l/min [0.026 US gal/min] | 0.8 l/min [0.21 US gal/min] |

Technical specification

| Parameter | Minimum | Recommended range | Maximum |
|--|-------------------------------------|---|-----------------------------------|
| Fluid viscosity | 4 mm ² /s [39 SUS] | 12 to 75 mm ² /s [65 to 347 SUS] | 460 mm ² /s [2128 SUS] |
| Fluid cleanliness | 18/16/13 (according to ISO 4406) | | |
| Storage temperature | Ambient: -50 to 90°C [-58 to 194°F] | | |
| Operating temperature | Ambient: -40 to 90°C [-40 to 194°F] | | |
| Max. T-port pressure static / intermittent | 25 / 40 bar 265 / 580 psi | | |

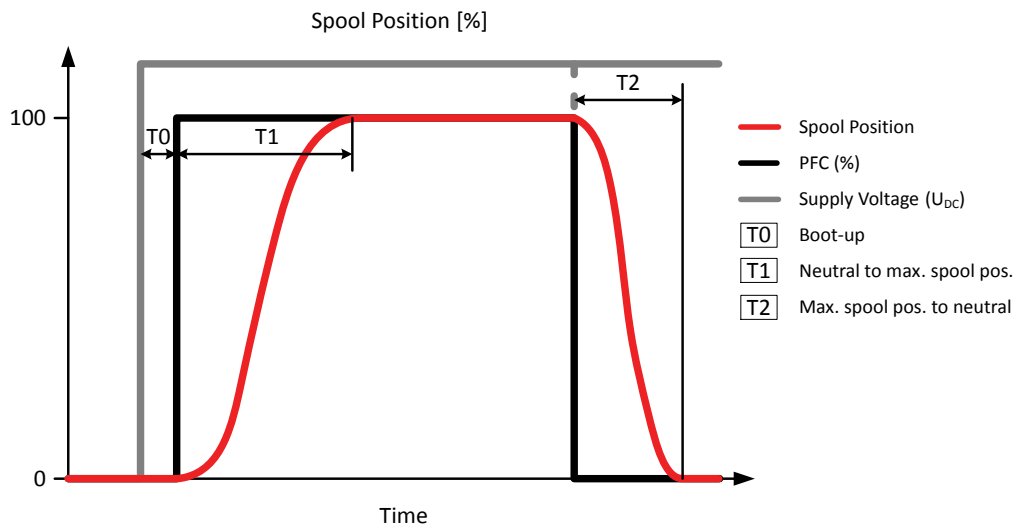
LED Characteristic

| Color | LED Characteristic | Description |
|-------------------------|--------------------|-------------------------|
| Green constant | | No error – Actuating |
| Green flashing @ 1.5 Hz | | Neutral – Power save |
| Red constant | | Internal error |
| Red flashing @ 1.5 Hz | | External or Float error |
| Yellow | | Disable mode |

PVES

PVES Reaction Times

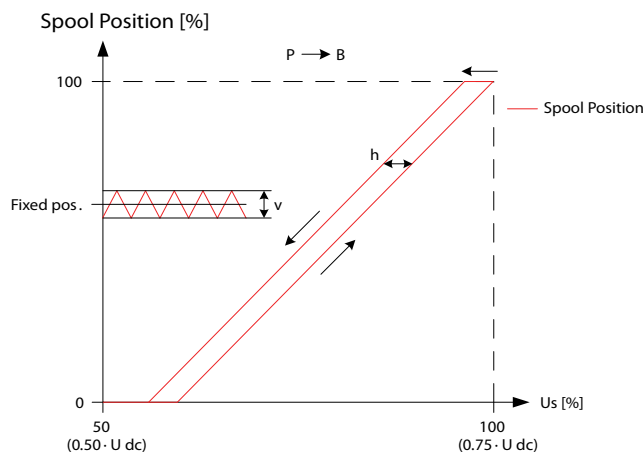
Reaction times



P301823

| Reaction | PVES |
|--|--------|
| T0 – Boot-up [ms] | 45 ms |
| T1 – Neutral to max. spool stroke @ Power ON | 170 ms |
| T2 – Max. spool stroke to neutral @ Power OFF | 135 ms |
| T1 – Neutral to max. spool stroke @ Constant U _{DC} | 125 ms |
| T2 – Max. spool stroke to neutral @ Constant U _{DC} | 90 ms |

PVES Hysteresis and Ripple



| Description | Type | PVES |
|------------------------------------|------------|------|
| Hysteresis (h) | Rated [%] | <0.5 |
| Steady state ripple @ fixed US (v) | Rated [mm] | 0.2 |

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

For more information on hysteresis and ripple, see [Hysteresis and Ripple](#).

PVES

PVES Variants for PVG

PVG 32/100 variants

| Part number | Type | Connector | IP | Fault monitoring | Functionality |
|-----------------------|---------|-----------|----|------------------|-------------------|
| 11166748 | PVES | 1x4 DEU | 67 | Passive | Standard |
| 11166864 | PVES | 1x4 DEU | 67 | Active | Standard |
| 11166859 | PVES | 1x4 AMP | 66 | Passive | Standard |
| 11166858 | PVES | 1x4 AMP | 66 | Active | Standard |
| 11166849 | PVES | 1x4 DIN | 65 | Passive | Standard |
| 11166857 | PVES | 1x4 DIN | 65 | Active | Standard |
| 11166745 ¹ | PVES-U | 1x4 DEU | 67 | Passive | Fixed Us 0-10 Vdc |
| 11166747 ¹ | PVES-U | 1x4 AMP | 66 | Active | Fixed Us 0-10 Vdc |
| 11166752 ² | PVES-SP | 1x6 DEU | 67 | Passive | Standard |

¹ Includes *Disable Mode* special feature

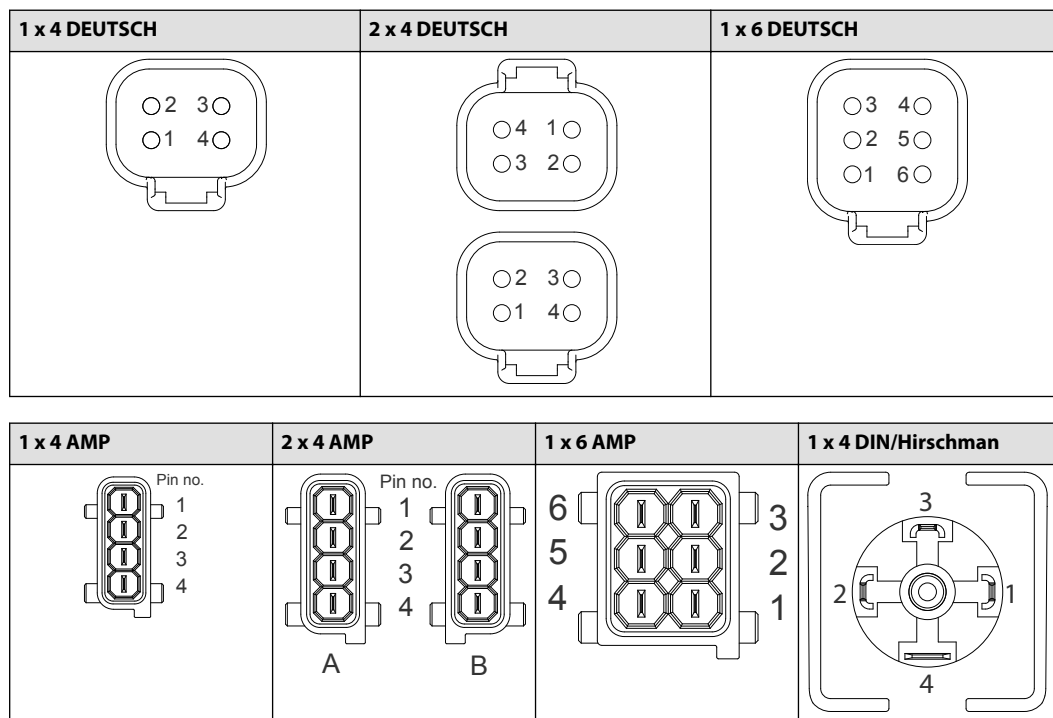
² Includes *Spool Position* special feature

PVG 120 variants

| Part number | Type | Connector | IP | Fault monitoring | Functionality |
|-------------|------|-----------|----|------------------|---------------|
| 11166761 | PVES | 1x4 DEU | 67 | Passive | Standard |
| 11166762 | PVES | 1x4 DIN | 65 | Passive | Standard |

Connector Overview

Connector Overview



PVEO-DI 4-pin AMP Connector

| Pinout | Pin 1 | Pin 2 | Pin 3 | Pin 4 |
|-------------|-------------|-------------|-------|-----------|
| 2x4 AMP (A) | U_{DC_A} | U_{DC_B} | GND | GND |
| 2x4 AMP (B) | DI-B | DI-A | GND | U_{DC2} |

PVEM 4-pin DIN Connector

| Pinout | Pin 1 | Pin 2 | Pin 3 | Pin 4 |
|---------|----------|-------|-------|-------|
| 1x4 DIN | U_{DC} | U_S | Error | GND |

PVEO, PVEO-R and PVEO-HP 4-pin Connector

| Pinout | Pin 1 | Pin 2 | Pin 3 | Pin 4 |
|-------------|-------------|-------------|-------|-------------|
| 1x4 AMP | U_{DC_A} | U_{DC_B} | GND | GND |
| 1x4 DEUTSCH | U_{DC_A} | GND | GND | U_{DC_B} |
| 1x4 DIN | U_{DC_A} | U_{DC_B} | - | GND |

PVEA/PVEH/PVESPVEH/PVEH-U

| Pinout | Pin 1 | Pin 2 | Pin 3 | Pin 4 |
|-------------|----------|----------|-------|----------|
| 1x4 AMP | U_S | U_{DC} | GND | Error |
| 1x4 DEUTSCH | U_S | Error | GND | U_{DC} |
| 1x4 DIN | U_{DC} | U_S | Error | GND |

Connector Overview

PVEA-DI and PVEH-DI 4-pin Connector

| Pinout | Pin 1 | Pin 2 | Pin 3 | Pin 4 |
|-----------------|------------------|-----------------|-------|------------------|
| 2x4 AMP (A) | U _S | U _{DC} | GND | Error |
| 2x4 AMP (B) | DI-B | DI-A | GND | U _{DC2} |
| 2x4 DEUTSCH (A) | U _S | Error | GND | U _{DC} |
| 2x4 DEUTSCH (B) | U _{DC2} | GND | DI-A | DI-B |

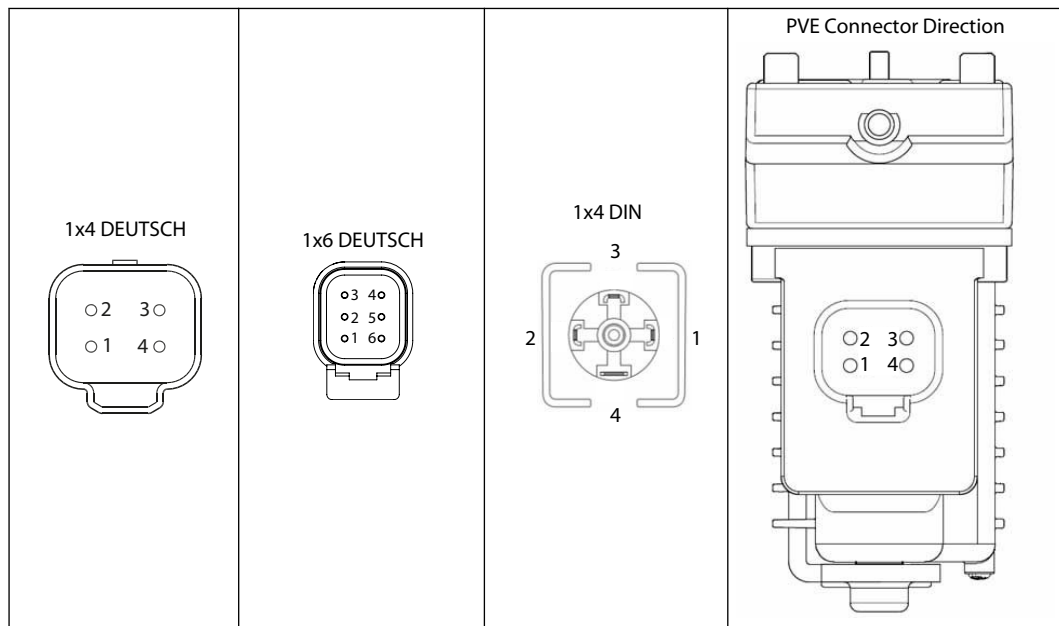
PVEH-FLA 6-pin Connector

| Pinout | Pin 1 | Pin 2 | Pin 3 | Pin 4 | Pin 5 | Pin 6 |
|-------------|----------------|-----------------|-------|-------|-------|-----------------|
| 1x6 AMP | U _S | U _{DC} | GND | Error | Float | - |
| 1x6 DEUTSCH | U _S | Error | - | SP | GND | U _{DC} |
| 1x6 DEUTSCH | U _S | Error | Float | - | GND | U _{DC} |

PVEH-SP and PVES-SP 6-pin Connector

| Pinout | Pin 1 | Pin 2 | Pin 3 | Pin 4 | Pin 5 | Pin 6 |
|-------------|----------------|-------|-------|-------|-------|-----------------|
| 1x6 DEUTSCH | U _S | Error | - | SP | GND | U _{DC} |

Connector diagrams



Fault Monitoring and Reaction

All proportional control PVE Series 7 actuators feature:

- Integrated fault monitoring
- Detecting spool stroke inconsistencies
- Detecting internal hardware defects
- Detecting demand signal inconsistencies
- Fault reaction depending on the type of fault monitoring
 - Generic
 - Specific

The PVEA comes with a passive fault monitoring.

Passive and active fault monitoring refers to whether or not the actuator is reacting on the error when it is detected.

Active fault monitoring

No matter what kind of error is detected, the solenoid valves will be disabled and the operation that the valves/spool controls will stop immediately and spool will go to neutral position. Active fault monitoring keeps a “memory” of the error, even if it is no longer registered. The active fault monitoring does not have Auto Recovery because of this “memory” and a reboot/restart will therefore be required to reactivate the solenoid valves.

With an active fault monitoring the following scenarios will take place when an error is detected/occurs:

- The LED light will switch from green to red and the error pin output will go high
- The solenoid valves will be disabled and the operation that the valves/spool controls will stop immediately
- The active fault monitoring does not have Auto Recovery, so when the error is fixed/no longer is registered a reboot/restart of the PVE is required to reactivate it.

Passive fault monitoring

Passive fault monitoring does not disable the solenoid valves when an error is detected. It will continue to operate despite that an error was detected. When the error no longer is registered the passive fault monitoring will “forget” the error and continue as if the error was never there.

With a passive fault monitoring the following conditions will happen when an error is detected/occurs:

- The LED light will switch from green to red and the error pin output will go high
- The solenoid valves will continue operating at the set point given at the time of the error
 - Only exception is if the error is caused by the supply voltage (U_{DC}) being either above or below the allowed range or if the temperature measured on the internal electronics board is higher than allowed. In these cases, the solenoid valves will be disabled.

Generic Fault Reaction

All PVE actuators with fault monitoring are triggered by the following main events:

| | |
|------------------------------------|--|
| Control Signal Monitoring | The Control signal voltage (U_S) 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 U_S 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. |

Fault Monitoring and Reaction

| | |
|--------------------------------------|--|
| 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 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 <i>in control</i> . |
| Float Position Monitoring | Float position must be entered or left within a time limit. A too high delay on the 1x6 pin float PVE will cause an error state – this is relevant for the 1x6 pin PVEH-F actuators only. |
| Temperature Monitoring | When the temperature is too high the PVE LED will light constant red and solenoid valves will be disabled. |

Fault Reaction Overview

All entries have an Auto Recovery feature unless marked otherwise.

| Description | Monitoring | LED | Solenoid valves | Error pin output | Fault reaction time | |
|--------------------------------|------------|-------|-----------------|------------------|---------------------|------|
| | | | | | PVEM/H/S | PVEA |
| Spool not at setpoint | Active* | | Disabled | High | 500 | 750 |
| | Passive | | - | High | 250 | 750 |
| Unable to reach float position | Active* | | Disabled | High | 1000 | 1000 |
| | Passive | | - | High | 1000 | 1000 |
| U dc > max. | Active | | Disabled | - | - | - |
| | Passive | | Disabled | - | - | - |
| U dc < min. | Active | ----- | Disabled | - | - | - |
| | Passive | ----- | Disabled | - | - | - |
| Us out of range | Active* | | Disabled | High | 500 | 750 |
| | Passive | | - | High | 250 | 750 |
| LVDT error | Active* | | Disabled | High | 500 | 750 |
| | Passive | | - | High | 250 | 750 |
| Temp > max. | Active* | | Disabled | High | 250 | 750 |
| | Passive | | Disabled | High | 250 | 750 |

* Does not have Auto Recovery

Error Pin Specification

All proportional control PVE Series 7 actuators feature an error pin, indicating when an error is detected/ occurs, according to the Fault Reaction Overview table. The specifications of the error pin is shown below.

| Description | No error | Error |
|----------------|-------------|-------|
| Output state | Low | High |
| Output voltage | <2 Vdc | ~Udc |
| Output current | Max. 100 mA | |

Functionality Overview

Standard and Fixed US 0-10 Vdc

All standard proportional actuator variants (PVEM/PVEA/PVEH/PVES) PVEH can be controlled by an analog signal voltage (U_s) or a PWM controlled signal voltage (U_s) proportional to the supply voltage (U_{dc}).

PVEO

| Description | Type | Value | |
|-----------------------------|-------------|--------------|--------------|
| Supply voltage (U_{dc}) | Rated | 12 Vdc | 24 Vdc |
| | Range | 11 to 15 Vdc | 22 to 30 Vdc |
| | Max. ripple | 5% | |

PVEM/PVEA/PVEH/PVESPVEH

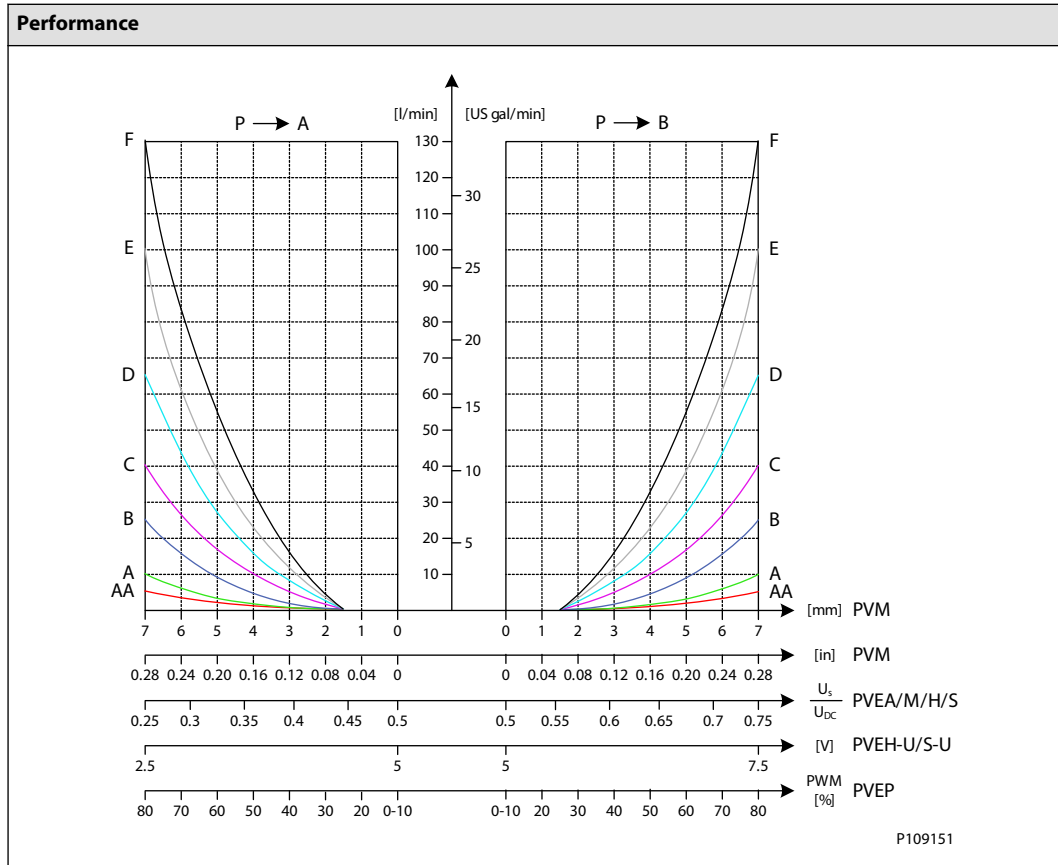
| Description | Type | Value |
|-----------------------------|-------------|---|
| Supply voltage (U_{dc}) | Rated | 11 to 32 Vdc |
| | Range | 11 to 32 Vdc |
| | Max. ripple | 5% |
| Signal voltage (U_s) | Neutral | $U_s = 0.5 \cdot U_{dc}$ |
| | Q: P to A | $U_s = (0.5 \text{ to } 0.25) \cdot U_{dc}$ |
| | Q: P to B | $U_s = (0.5 \text{ to } 0.75) \cdot U_{dc}$ |

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

PVEH-U

| Description | Type | Value |
|-----------------------------|-------------|---------------------|
| Supply voltage (U_{dc}) | Rated | 11 to 32 Vdc |
| | Range | 11 to 32 Vdc |
| | Max. ripple | 5% |
| Signal voltage (U_s) | Neutral | $U_s = 5 \text{ V}$ |
| | Q: P to A | 5 V to 2.5 V |
| | Q: P to B | 5 V to 7.5 V |

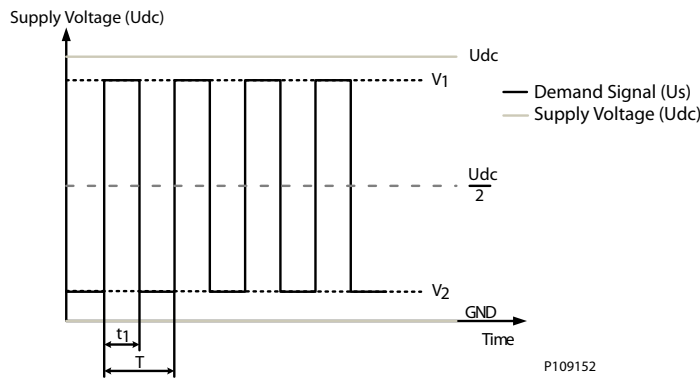
Functionality Overview



PWM Voltage Control

The PVEM/PVEA/PVEH/PVES PVEH actuator variants can be controlled by a PWM controlled signal voltage (U_s) proportional to the supply voltage (U_{dc}).

The V_1 and V_2 must be symmetrical around $U_{dc}/2$ and V_1 must be equal to or less than U_{dc} .



PVEM Control Specification

| Description | Type | Value |
|-----------------------------|-------------|--------------|
| Supply Voltage (U_{dc}) | Rated | 11 to 32 Vdc |
| | Range | 11 to 32 Vdc |
| | Max. ripple | 5% |

Functionality Overview

PVEM 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 | > 200 Hz |

PVEA/PVEH/PVESPVEH Control specification

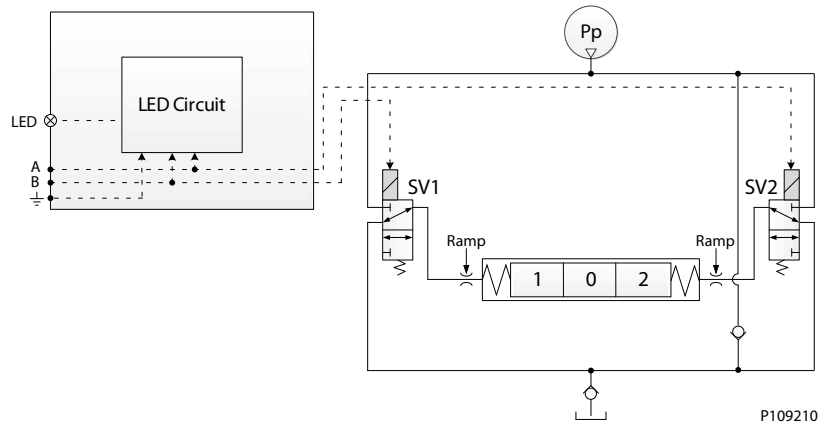
| Description | Type | Value |
|-------------------------|-------------|---------------------|
| Supply Voltage (Udc) | Rated | 11 to 32 Vdc |
| | Range | 11 to 32 Vdc |
| | Max. ripple | 5% |
| Signal Voltage PWM (Us) | Neutral | Us = 50% DUT |
| | Q: P to A | Us = 50% to 25% DUT |
| | Q: P to B | Us = 50% to 75% DUT |
| PWM Frequency (Us) | Recommended | > 1000 Hz |

Functionality Overview

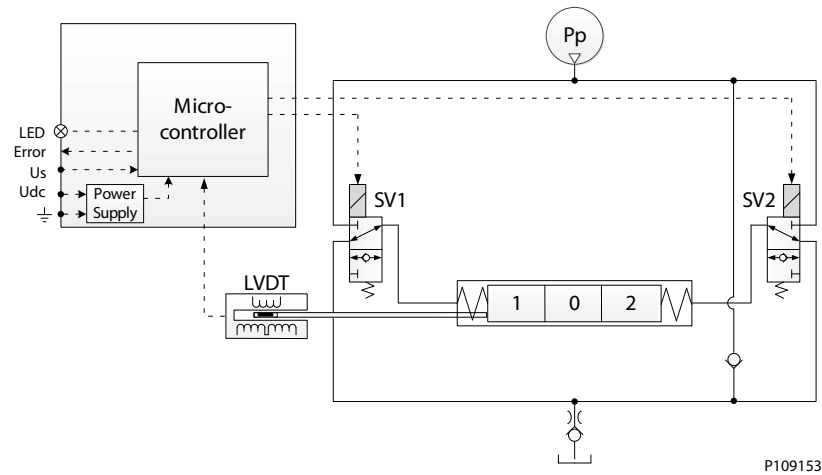
Ramp (-R)

The Ramp functionality is a rate limitation of the spool stroke, resulting in extended reaction times and in some cases a smoother control of the main spool compared to the standard PVEO variant. The Ramp functionality of a *PVEO-R* variant is achieved purely hydraulically by implementing two orifices working on both sides of the main spool (integrated in the actuator). The Ramp functionality of a *PVEM-R* variant is achieved in the regulation principle.

PVEO with ramp functionality (PVEO-R)



PVEM with ramp functionality (PVEM-R)



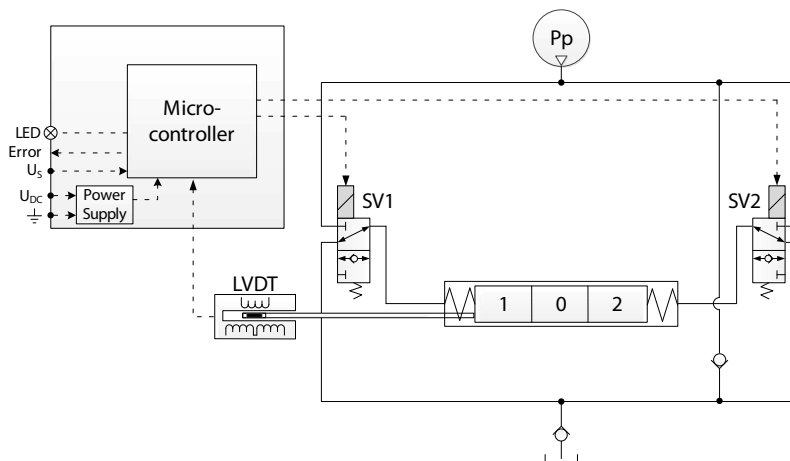
For reaction times, see [PVE S7 Reaction Times](#) on page 61

Functionality Overview

Quick Reaction (-Q)

The Quick Reaction functionality of the *PVEM-Q* variant results in shorter reaction times and a more rapid or aggressive control of the main spool compared to the standard PVEM variant. The Quick Reaction functionality of a PVEM-Q is achieved by replacing the combined orifice and check valve with a check valve in the connection to tank and changing the regulation principle.

PVEM with quick reaction functionality (PVEM-Q)



For reaction times, see [PVE S7 Reaction Times](#) on page 61.

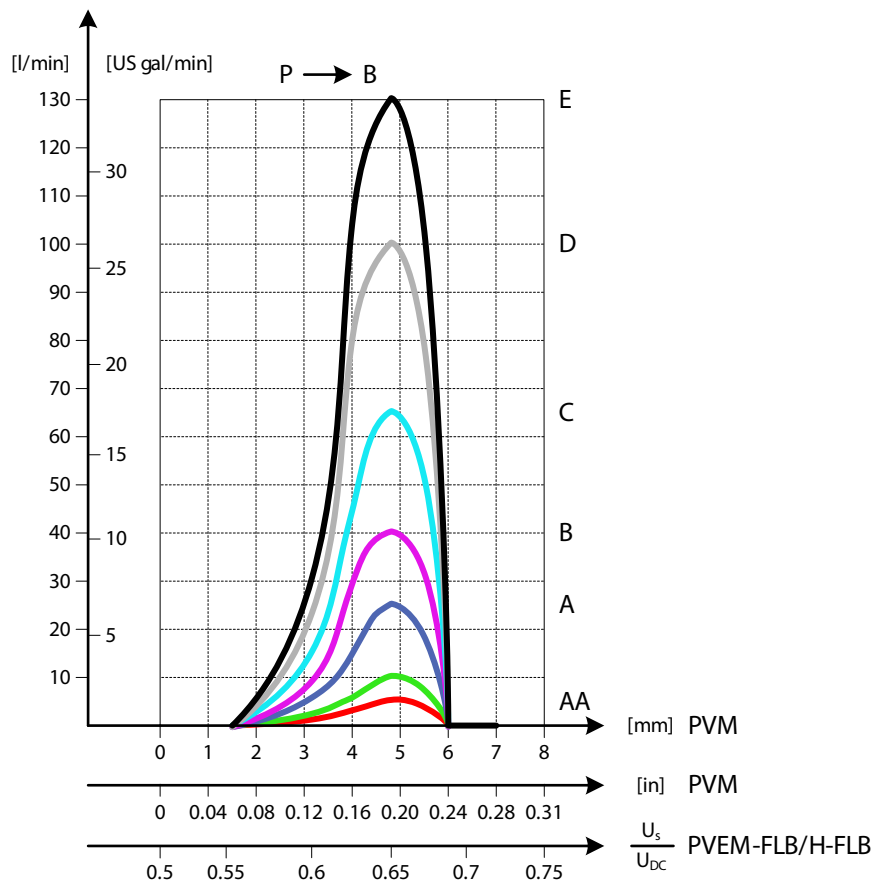
Functionality Overview

Float B-Port (-FLB)

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

| PVE Type | PVBS Type | Standard FC | Float Control |
|--------------------|--|--|---------------------------|
| PVEM-FLB (1x4 pin) | Deadband 1.5 mm Max. B-port flow 4.8 mm | $U_s = (0.35 \rightarrow 0.65) \cdot U_{DC}$ | $U_s = 0.75 \cdot U_{DC}$ |
| PVEH-FLB (1x4 pin) | | | |

Float in B-port functionality



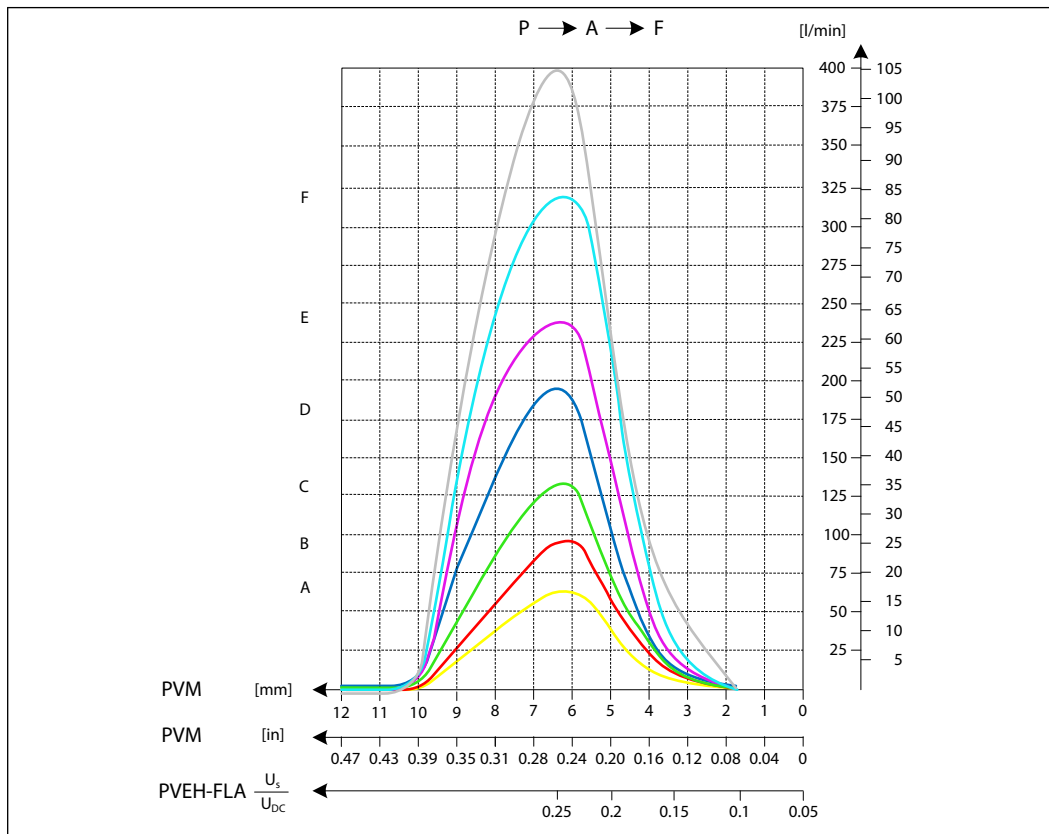
P109155

Functionality Overview

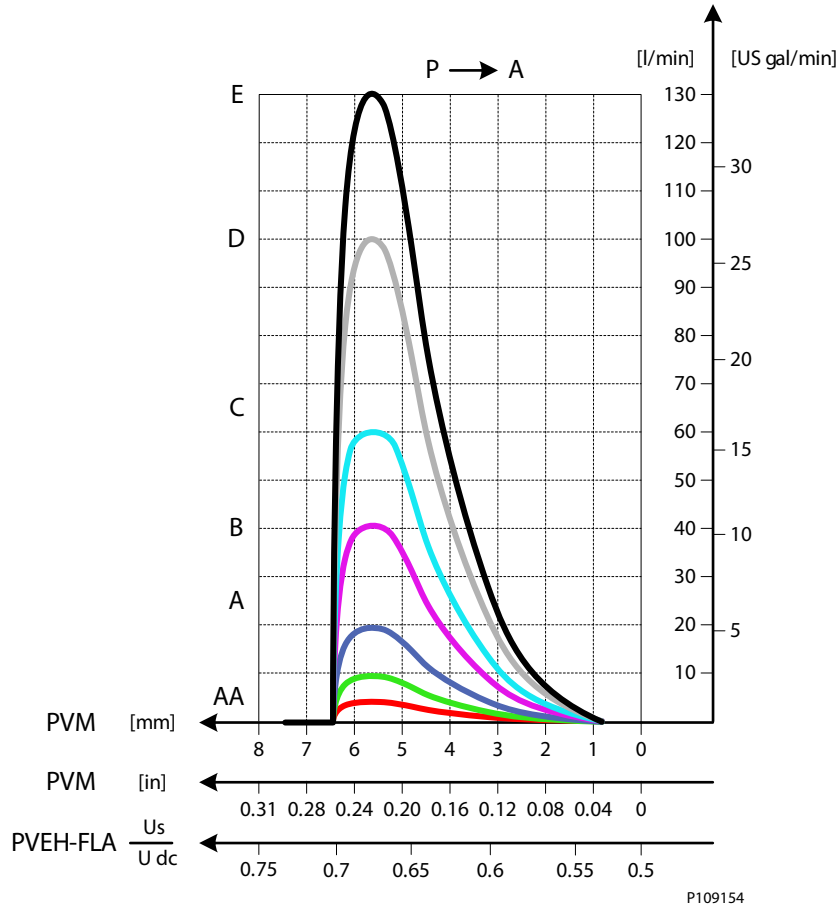
Float A-Port (-FLA)

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 0.8 mm | $U_s = (0.25 \rightarrow 0.75) \cdot U_{dc}$ | U dc to dedicated float pin (UF) |
| | Max. A-port flow 5.5 mm | | |



Functionality Overview



PVE Power Save

All proportional actuator variants feature a Power Save mode, de-energizing the solenoid valve bridge. The Power Save mode is entered when the signal voltage (U_s) and the LVDT spool position has been in neutral for 750 ms. As soon as the signal voltage (U_s) 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.

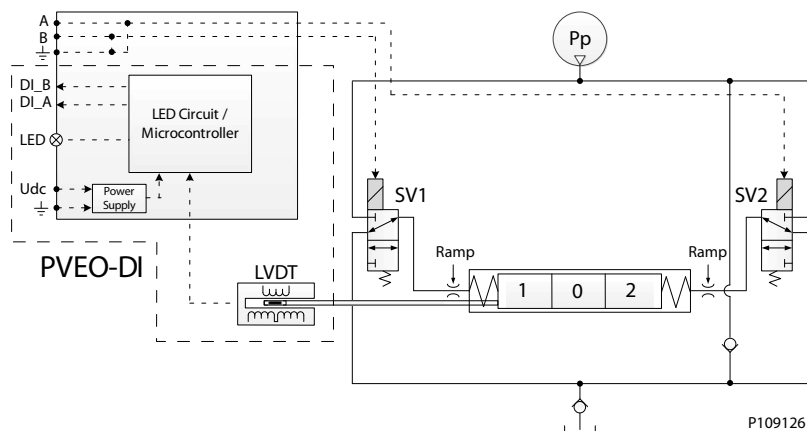
For current consumption values, please see chapter [Current Consumption](#).

Special Features

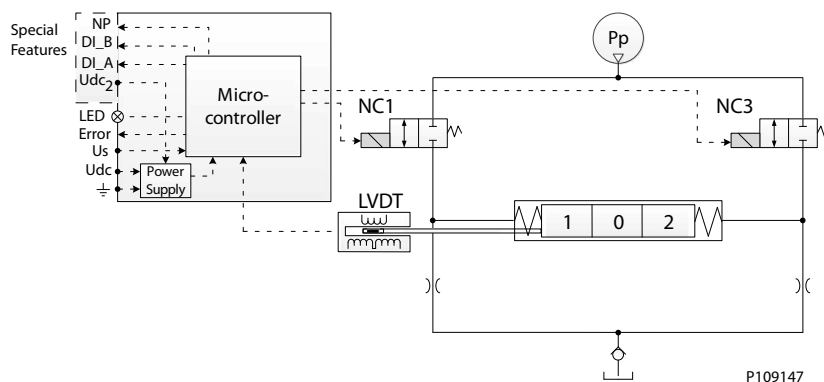
Direction Indication (-DI)

The PVEO-DI/PVEA-DI/PVEH-DI actuator variants feature an integrated Direction Indication output derived from the LVDT spool position, indicating the state of the main spool (neutral, A-port or B-port).

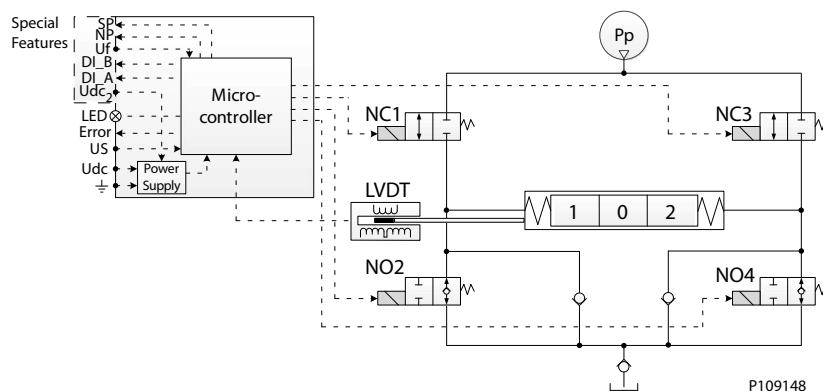
PVEO-DI functionality



PVEA-DI functionality



PVEH functionality



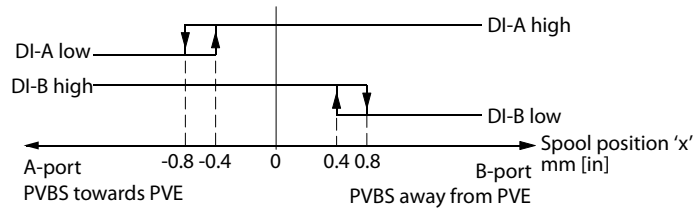
The Direction Indication feature uses a dual power supply with the 2x4 pin AMP and DEUTSCH connectors as shown in the chapter [Connector Overview](#) on page 43.

Special Features

When both DI_A and DI_B signals are High the main spool is in its neutral position.

When the DI_A signal goes Low and the DI_B signal stays High, the main spool is moving in the A-port direction, and vice versa. The relation between the direction indication feedback and the output signal is shown below.

Direction indication feedback



157-435.10

| | A-Port | B-Port |
|-------------------|---|-----------------|
| DI signals a1, a2 | -0.8 mm ± 0.4 mm | 0.8 mm ± 0.4 mm |
| Max. DI load | 200 mA | |
| DI High @ 20 mA | > U _{DC} - 1.5 V _{DC} | |
| DI High @ 100 mA | > U _{DC} - 2.0 V _{DC} | |
| DI Low | < 0.2 V _{DC} | |

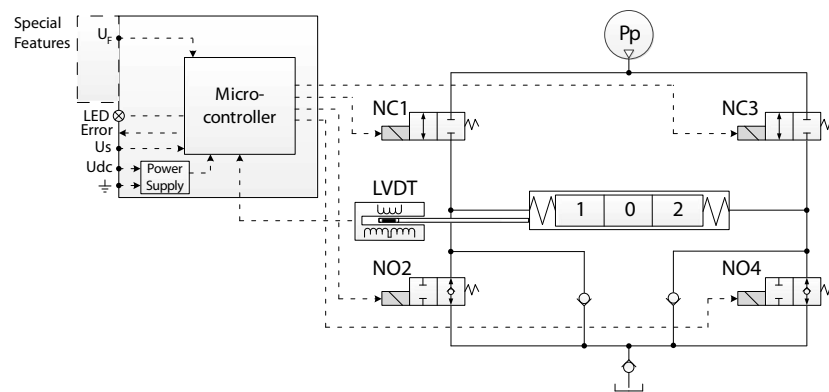
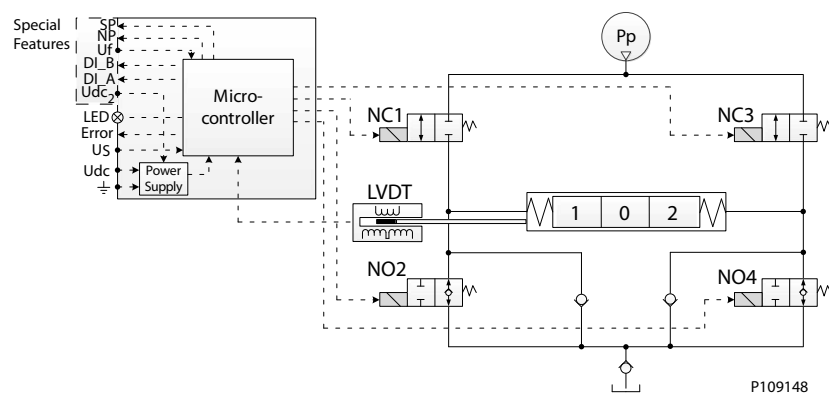
Special Features

Dedicated Float Pin (UF)

The Dedicated Float Pin (UF) feature is related to the PVEH-FLA actuator variant enabling the user to move the main spool into its float position by power. The PVEH-FLA uses 1x6 pin AMP or DEUTSCH connectors.

- Normal operation: Low or not connected
- High Float
- Input range: U_{DC}
- Max. voltage: $32 V_{DC}$

PVEH-FLA functionality diagram

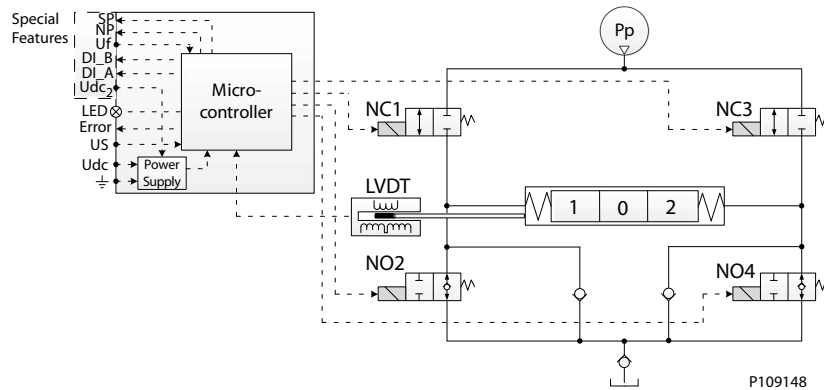


Special Features

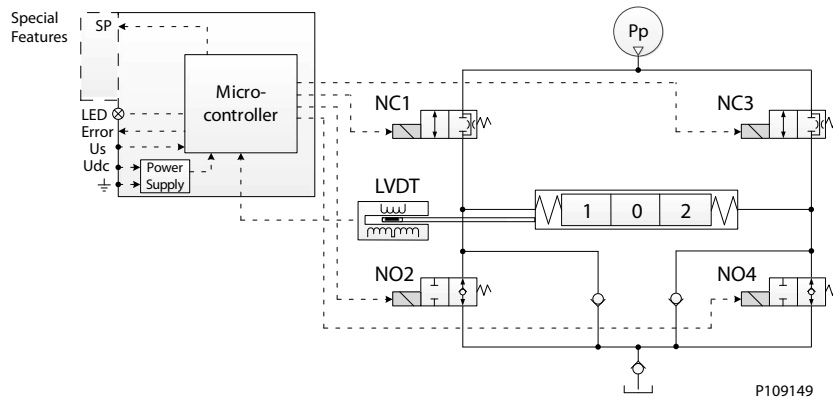
Spool Position (SP)

The Spool Position (SP) feature available in the PVEH-SP/PVES-SP actuator variants enables the user to derive from the LVDT spool position of the main spool by means of an analog voltage signal on the dedicated spool position (SP) output pin.

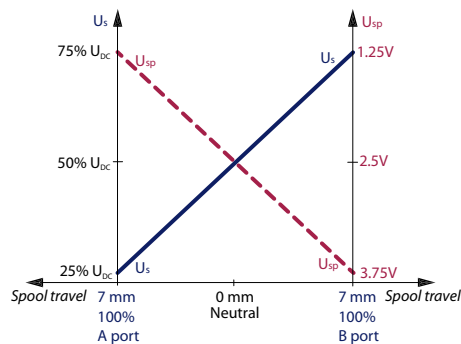
PVEH-SP functionality diagram



PVES-SP functionality diagram



Spool Position feedback



SP feedback signal from 0.5 to 4.0 V_{DC} inverted in direction relative to U_s 2.5 V_{DC} as the neutral value
 SP from neutral to maximum stroke (mm)
 SP maximum load is 0.5 mA
 Output range for A-port: 2.5 – 1.25 V_{DC} and for B-port: 2.5 – 3.75 V_{DC}

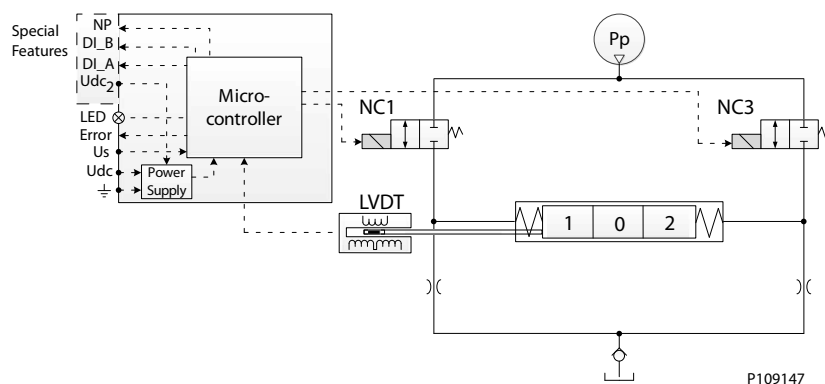
The PVEH-SP/PVES-SP uses a 1x6 DEUTSCH connector. For more information, please see [Connector Overview](#) on page 43.

Special Features

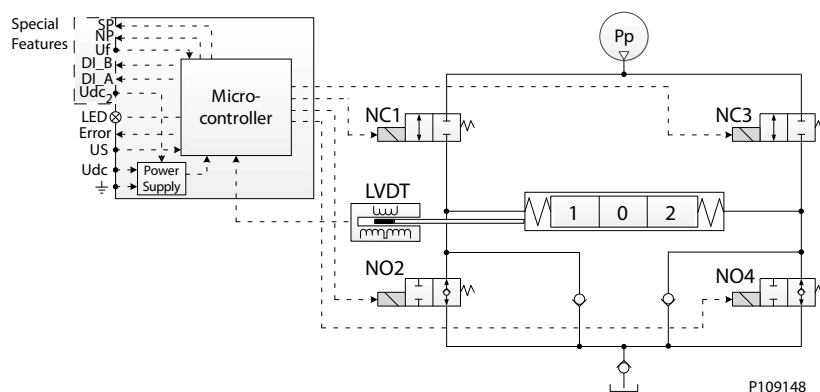
Neutral Power-OFF (NP)

The Neutral Power-OFF (NP) feature available in the PVEA-NP and PVEH-NP actuator variants enables the user to identify whether the solenoid valves in the actuator are energized or de-energized via a dedicated neutral power-OFF (NP) output pin.

PVEA-NP functionality diagram

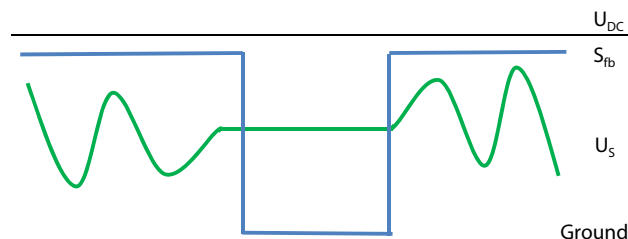


PVEH-NP functionality diagram



The Neutral Power-OFF (NP) signal is defined as shown below:

Solenoid disabling function (-NP) curves



- Normal operation from $> U_{DC}$ to $2 V_{DC}$
- Power Save $< 1 V_{DC}$ (solenoid valves de-energized)
- NP maximum load is 50 mA

The PVEA-NP/PVEH-NP uses a 1x6 DEUTSCH connector. For more information, please see [Connector Overview](#) on page 43.

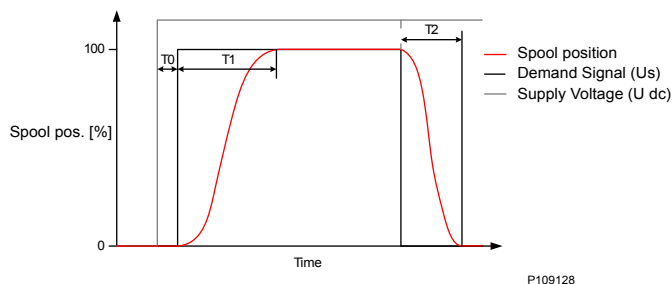
Special Features**Disable Mode**

The PVEH-U and PVES-U actuator variants controlled by a fixed 0-10 V_{DC} signal voltage (U_S), feature the ability to enter a disable mode. This causes the counteracting force on the main spool created by the solenoid valve bridge to deactivate, when using Manual OverRide (MOR).

The disable mode is entered by sending a signal voltage (U_S) of 15% or lower of 10 V_{DC} when in Power Save.

Performance Overview

PVE S7 Reaction Times



| Reaction |
|-----------------------------------|
| T0 – Boot-up [ms] |
| T1 – Neutral to max. spool stroke |
| T2 – Max. spool stroke to neutral |
| T1 – Neutral to max. spool stroke |
| T2 – Max. spool stroke to neutral |

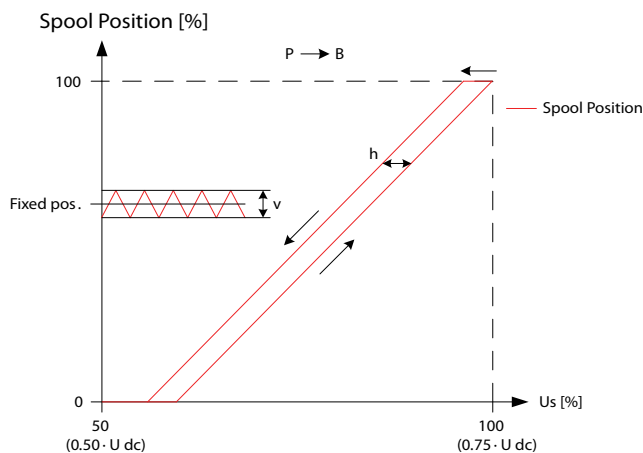
PVG 32/100 PVEO—PVEM-R reaction times

| Reaction | PVEO | PVEO-R | PVEO-HP | PVEM | PVEM-R |
|-------------------------|------|--------|---------|------|--------|
| T0 [ms] | 0 | 0 | 0 | 15 | 15 |
| T1 @ Power ON [ms] | 110 | 325 | 90 | 225 | 325 |
| T2 @ Power OFF [ms] | 110 | 340 | 70 | 110 | 110 |
| T1 @ Constant U dc [ms] | 110 | 325 | 90 | 210 | 310 |
| T2 @ Constant U dc [ms] | 110 | 340 | 70 | 90 | 90 |

PVG 32/100 PVEM-Q—PVES reaction times

| Reaction | PVEM-Q | PVEA | PVEH | PVES |
|-------------------------|--------|------|------|------|
| T0 [ms] | 15 | 50 | 40 | 40 |
| T1 @ Power ON [ms] | 125 | 355 | 155 | 155 |
| T2 @ Power OFF [ms] | 110 | 260 | 130 | 130 |
| T1 @ Constant U dc [ms] | 110 | 305 | 115 | 115 |
| T2 @ Constant U dc [ms] | 90 | 210 | 90 | 90 |

Hysteresis and Ripple



Performance Overview

| Type | Hysteresis (h) | Steady state ripple @ fixed Us (v) |
|-----------------|----------------|------------------------------------|
| | Rated [%] | Rated [mm] |
| <i>PVEM</i> | 15 | 0.0 |
| <i>PVEM-R</i> | 15 | 0.0 |
| <i>PVEM-Q</i> | 15 | 0.0 |
| <i>PVEA</i> | 2 | 0.3 |
| <i>PVEH</i> | 4 | 0.0 |
| <i>PVEH 256</i> | 1.5 | 0.0 |
| <i>PVES</i> | 0 | 0.2 |

Current Consumption

| Type | Typical | Minimum | Maximum | <i>Power Save</i> |
|-------------|---------|---------|---------|-------------------|
| | [mA] | | | |
| <i>PVEO</i> | | | | |
| <i>PVEH</i> | | | | 25 |

| Type | Typical | Minimum | Maximum |
|-------------------------|---------|---------|---------|
| | [mA] | | |
| <i>PVEO @ 12 Vdc</i> | 480 | 430 | 950 |
| <i>PVEO @ 24 Vdc</i> | 250 | 220 | 480 |
| <i>PVEO-HP @ 12 Vdc</i> | 750 | 660 | 1460 |
| <i>PVEO-HP @ 24 Vdc</i> | 380 | 340 | 740 |

| Type | @ 12 Vdc | @ 24 Vdc |
|-------------|----------|----------|
| | [mA] | |
| <i>PVEM</i> | 690 | 350 |
| <i>PVEA</i> | 290 | 150 |
| <i>PVEH</i> | 540 | 270 |
| <i>PVES</i> | 560 | 280 |

Oil Consumption

| Type | Neutral | Locked position | Actuating |
|----------------|---------|-----------------|-----------|
| | [l/min] | | |
| <i>PVEO</i> | 0.0 | 0.0 | 0.9 |
| <i>PVEO-R</i> | 0.0 | 0.0 | 0.3 |
| <i>PVEO-HP</i> | 0.0 | 0.0 | 0.9 |
| <i>PVEM</i> | 0.0 | 0.0 | 0.5 |
| <i>PVEM-R</i> | 0.0 | 0.0 | 0.3 |
| <i>PVEM-Q</i> | 0.0 | 0.0 | 0.3 |
| <i>PVEA</i> | 0.0 | 0.4 | 1.0 |
| <i>PVEH</i> | 0.0 | 0.0 | 0.7 |
| <i>PVES</i> | 0.3 | 0.1 | 0.8 |

Dimension Overview

Dimension Overview for PVE Series 7

PVG 32/100 variants

| PVEO/PVEM/PVEA | PVEH/PVES | Connector Height |
|----------------|-----------|--|
| | | DEU = 30 mm [1.2 in] AMP = 38 mm [1.5 in] DIN = 40 mm [1.6 in] |

PVG 120 variants

| PVEO | PVEH/PVES | Connector Height |
|------|-----------|--|
| | | DEU = 30 mm [1.2 in] AMP = 38 mm [1.5 in] DIN = 40 mm [1.6 in] |

Dimension Overview

PVG 128/256 variants

| PVEO | PVEH | Connector Height |
|----------------|----------------|---|
| <p>P109127</p> | <p>P109158</p> | <p>DEU = 30 mm [1.2 in]</p> <p>AMP = 38 mm [1.5 in]</p> <p>DIN = 40 mm [1.6 in]</p> |

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