MAKING MODERN LIVING POSSIBLE

Technical Information

Electrohydraulic Actuator
Type PVEP / PVEP-F

powersolutions.danfoss.com

Revision history

Table of revisions

Date	Changed	Rev
May 2014	Converted to Danfoss layout – DITA CMS	BB
Feb 2010	Drawing, and Japan location	BA
Mar 2008	Small update	AB
Nov 2005	First edition	AA

Contents

Introduction

The PVEP is an electro-hydraulic actuator for the Sauer-Danfoss PVG valve system. The two modules are controlled with PWM (Pulse Width Modulated) inputs. The aim of the document is to generate a common understanding of the PVEP product and its specifications.

The PVEP is an electro-hydraulic actuator aimed as pilot stage for primarily PVG32 and PVG100 proportional valves.

The PVEP is a true mechatronic module comprising a digital solenoid valve bridge, a contactless transducer and control electronics in one package suitable to ensure severe environmental stresses found in mobile equipment.

The PVEP has two low frequency PWM inputs that determine the set point for main spool control in the valve. This differs from the standard PVE programme where an analogue ratio metric signal forms the input set point to the valve.

The PVEP will be available in two versions, a standard PVEP and a PVEP-F for valves with float position option.

This technical information will cover the control functionality for each version of the PVEP.

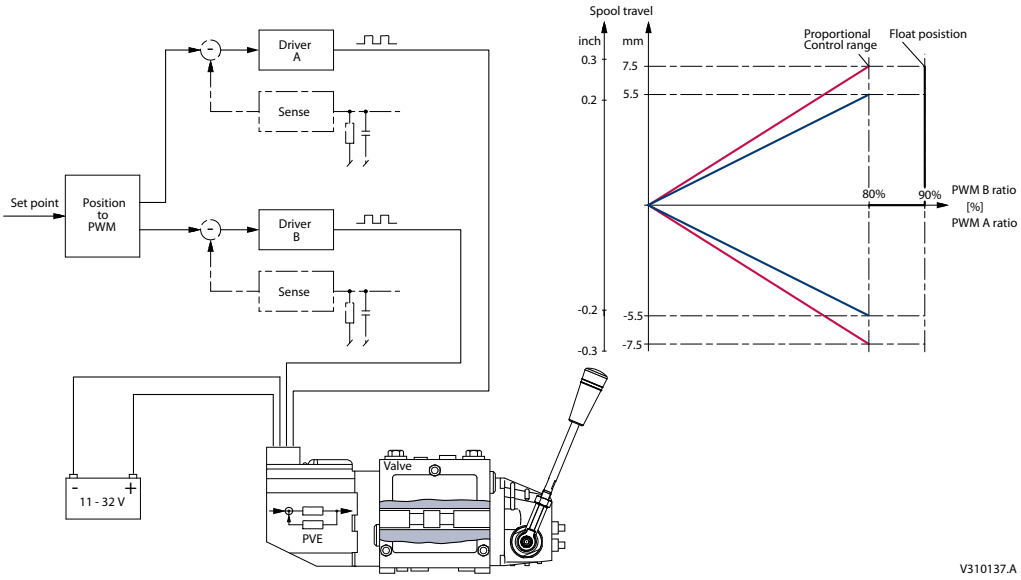
PVEP and accessories		Code numbers
PVEP with Deutsch DT connector	Standard	11034832
	PVEP-F (float)	157B4753
Cable with 6-pin Deutsch DT connector		11007513

Function

Function

Controlling a PVEP requires two PWM signals. The basic concept between a controller and the PVEP is shown in the picture below.

Current control is not possible with PVEP.



It is important that the Power supply (V_{bat}) is connected before the PWM signal.

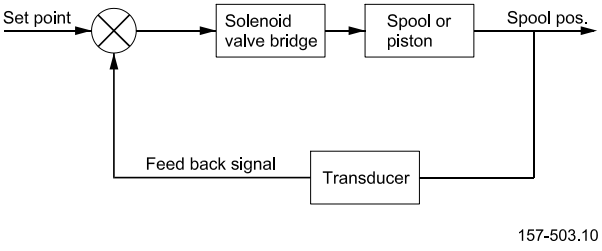
PWM signals are low power voltage signals; hence no current drivers are needed.

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

Closed loop control

The PVEP and the PVEP-F feature an integrated feedback transducer that measures spool movement in relation to the input signal from the main micro controller, and by means of a solenoid valve bridge, controls the direction, velocity, and position of the main spool of the valve.

The integrated electronics compensate for flow forces on the spool, internal leakage, changes in oil viscosity, pilot pressure, etc. with very low hysteresis and high resolution.



Principle

In principle the input signal (PWM signals) 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 feedback signal registered by the electronics. The variation between the set-point signal and feedback signal activates

Function

the solenoid valves. The solenoid valves are actuated so that hydraulic pressure drives the main spool into the correct position.

Inductive Transducer, LVDT (Linear Variable Difference Transducer)

When the main spool is moved, a voltage, proportional to the spool position, is induced. The use of LVDT gives contactless monitoring of the main spool position. This means an extra long working life and no limitation as regards the type of hydraulic fluid used. In addition, LVDT gives a precise position signal of high resolution.

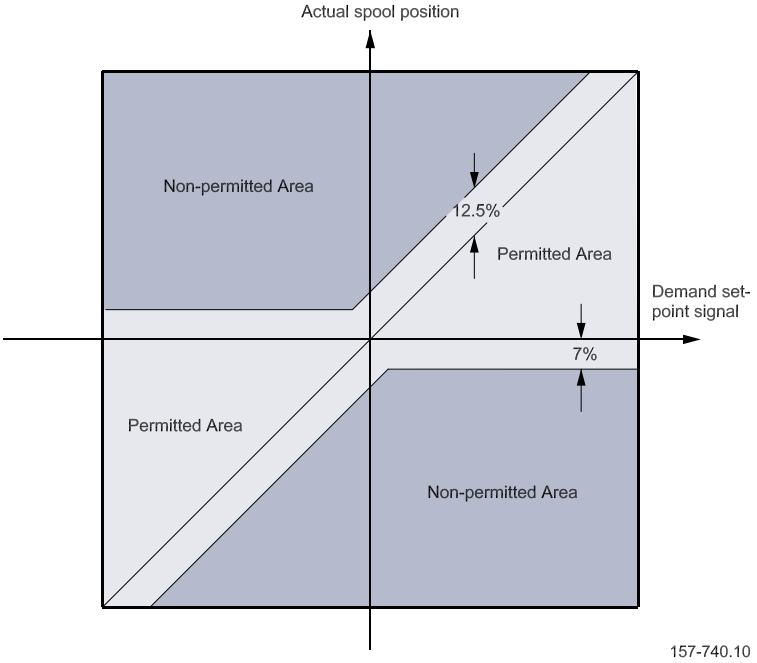
Integrated Pulse Width Modulation

Positioning of the main spool position in the PVEP and the PVEP-F is based on the pulse width modulation principle to the solenoids valves.

Fault monitoring system

PVEP has a built-in active fault monitoring system, which is capable of handling internal and external failures. The fault monitoring system includes:

- Input signal monitoring: If the PWM input signal is corrupted and the signal exceeds the range or if PWM signals are detected at both inputs at the same time, it is interpreted as an error.
- Transducer monitoring: If the signals to and from the LVDT are corrupted (short circuited or disconnected), it is interpreted as an error.
- Closed loop monitoring: If the main spool position does not correspond to the input signal, it is interpreted as an error if the main spool position > input signal. Tolerance bands are associated with these limits (see the figure below).



Active Fault Monitoring Signal (FMS)

On error detection, the solenoid valve set is disabled after a delay of 500 ms, the built-in LED changes state and a message is given as an electrical signal on the error output pin. The error state is memorized and can only be reset by switching off power. In the case of an error, the following actions will be taken:

Function

- All solenoids are switched off.
- Warning signal is sent out through the error connector as a voltage signal.
- A visual Light Emitting Diode switches from green to red light.
- The error state is memorized and continues until the system is actively reset by turning off the supply voltage.

Fault Monitoring Truth Table

Function	LED status	Error output status	Reaction time	Memory
Normal mode	Constant green	Low		
Error mode active FMS				
Input signal faults	Blinking red	High	500 ms	Yes
Transducer faults	Constant red			
Closed loop faults	Constand red			

Input signal monitoring with PVEP-F.

If the main spool position is within 10% from float position or within ~10% from neutral, there will be no error; otherwise the PVEP will go into error state.

The closed loop supervision will detect errors such as electrical and hydraulic errors.

It also detects errors like sticking main spool and sticking in the mechanical part of the feedback transducer.

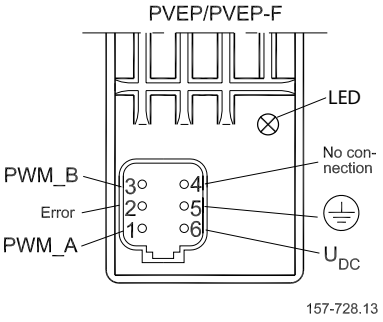
Reaction time

Any error condition has to last for a specific time before an error is reported; otherwise the error condition is ignored.

	Float not active	Float active
Active fault monitoring	500 ms	1000 ms

Technical Data

Electrical specifications



Supply voltage V_{bat}	**range**	11 - 32 V
	max. ripple	5%
	over voltage (max. 5 min)	36 V
PWM	**control range (duty cycle)**	10 - 80%
	float position control	PWM_A = PWM_B = 90%
	frequency	100 - 1000 Hz
	input voltage swing	0 - V_{bat}
	trigger point	70 % of V_{bat}
Input impedance (standard pull down)		5 kΩ
Input capacitor		---
Power consumption		7 W
Error voltage:	**Fault**	V_{bat}
	No fault	< 2 V

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

Warning

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

Standard PVEP

The main spool position feedback via the LVDT enables PVEP to control the proportional valve main spool very smoothly and accurately with a hysteresis of typical 3-4%. PWM frequency can be chosen between 100 to 1000 Hz for A- or B-channel.

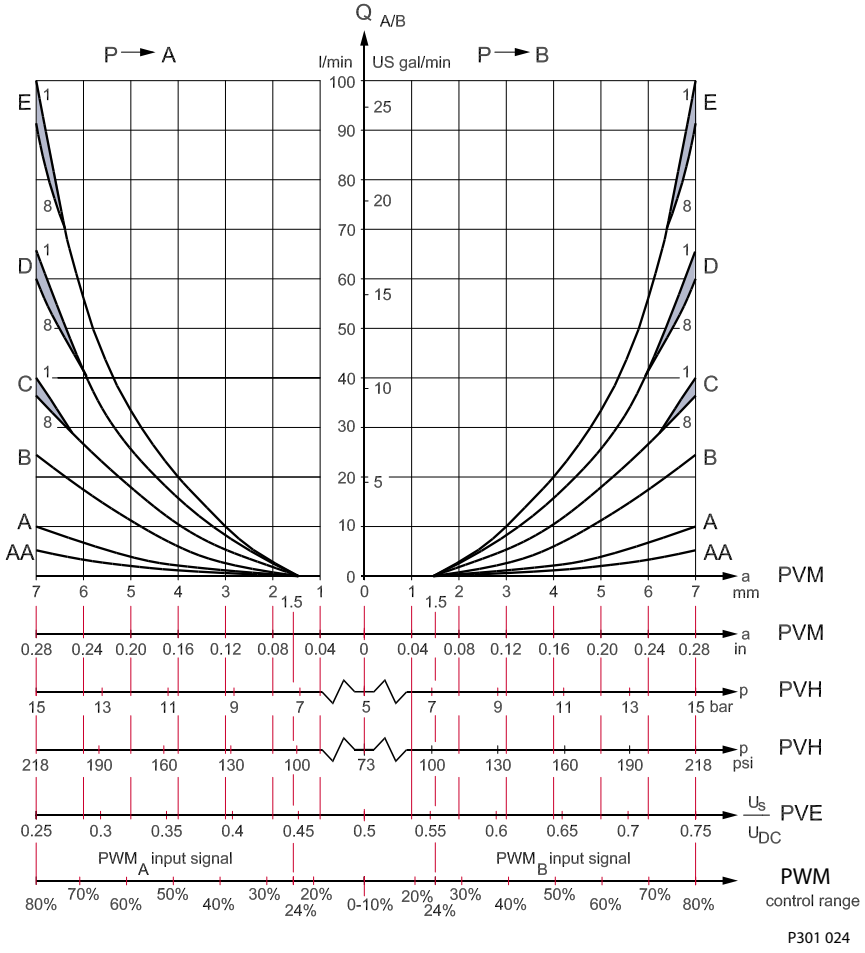
Duty cycle A-signal (pin 1)	Duty cycle B-signal (pin 1)	Function	Error output (pin 3)
0%	0%	Neutral	Low
10%	0%		
0%	10%		
≥10%	≥10%	Fault (Error)	High
0%	10 → 80%	B-port flow	Low
10 → 80%	0%	A-port flow	Low

Technical Data

For the standard PVEP version full stroke is ± 7.0 mm.

An area between 86% and 100% DC is used for failure detection, duty cycle in this area is defined as a fault and the failure detection circuit will be activated.

(See the section *Fault monitoring system* on page 6).



	Typical	Minimum	Maximum
Dead band close to zero	4%	0%	6%
Actuation area	90%	80%	95%
Hysteresis at 0.02 Hz	4%	2%	6%

Conditions for above features:

- Pilot pressure: 10.5 bar [152 psi]
- Tank pressure: 10 bar [145 psi]
- Oil temperature interval: 30 – 60°C. [86 - 140°F]
- Ambient temperature: 20 – 40°C [68 - 104°F]
- Viscosity: 21 mm^2/s. [101.9 SUS]
- Nominal voltage: 12 V

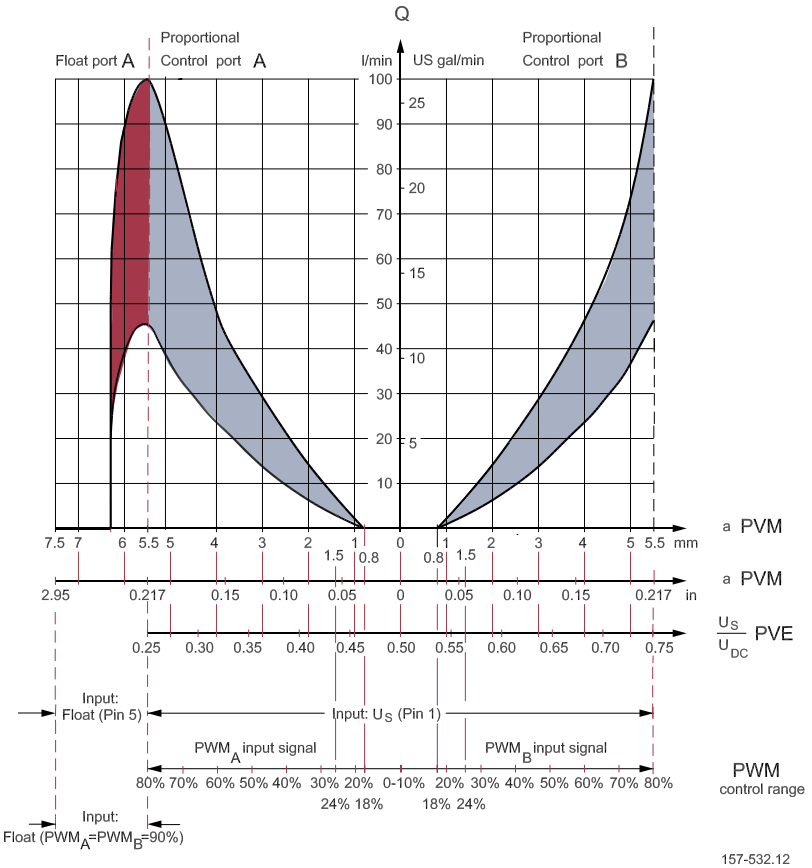
Technical Data

PVEP-F (float version)

For the float position is demanded when applying 90% Duty Cycle simultaneously to both channels. This situation will not cause the failure detection to activate.

For the Float version, full stroke is ± 5.5 mm [± 0.22 in]. Float position occurs at 7.5 mm [0.30 in].

Duty cycle A-signal (pin 1)	Duty cycle B-signal (pin 1)	Function	Error Pin output (pin 3)
0%	0%	Neutral	Low
10%	0%		
0%	10%		
≥ 10%	≥ 10%	Fault (Error)	High
0%	10 → 80%	B-port: 0 - 5.5 mm [0.22 in]	Low
10 → 80%	0%	A-port: 0 - 5.5 mm [0.22 in]	Low
90%	90%	Float A-port 7.5 mm [0.31 in]	Low
≥ 90%	0%	Fault (Error)	High
0%	≥ 90%	Fault (Error)	High



	Typical	Minimum	Maximum
Dead band close to zero	4%	0%	6%
Actuation area	90%	80%	95%
Hysteresis at 0.02 Hz	4%	2%	6%

Technical Data

Conditions for above features:

- Pilot pressure: 10.5 bar [152 psi]
- Tank pressure: 10 bar [145 psi]
- Oil temperature interval: 30 – 60°C. [86 - 140°F]
- Ambient temperature: 20 – 40°C [68 - 104°F]
- Viscosity: 21 mm^2/s. [101.9 SUS]
- Nominal voltage: 12 V

PVEP and PVEP-F

Pilot oil consumption and pilot supply

Function	Voltage	Unit	PVEP
Pilot flow rate per PVE	Off	l/min [US gal/min]	0.3 [0.09]
Pilot flow rate in locked position	On		0.1 [0.03]
Pilot flow per 1 full spool travel	On		0.001 [0.0003]
Pilot supply pressure (relative tank)		bar [psi]	12 – 14 [174 – 203]
Filter in PVEP inlet module		µ	150

Oil viscosity

Recommended range	Minimum	Maximum*
12 – 75 mm^2/s [65 – 347 SUS]	4 mm^2/s [39 SUS]	460 mm^2/s [2128 SUS]

* Max. start up viscosity 2500 mm^2/s

Oil temperature

Recommended range	Minimum	Maximum
30 – 60°C [86 –140°F]	-30°C [-22°F]	90°C [194°F]

Operating temperature

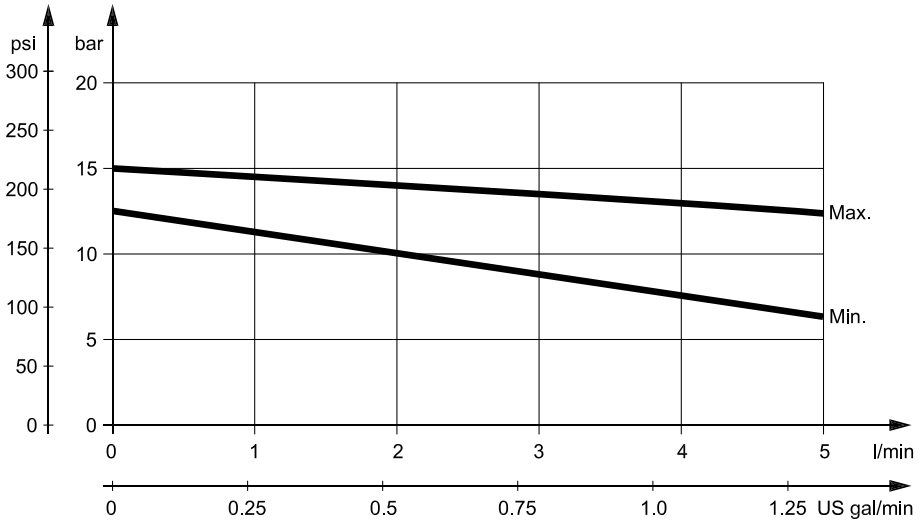
Ambient		Stock	
Minimum	Maximum	Minimum	Maximum
-30°C [-22°F]	60°C [140°F]	-40°C [-40°F]	90°C [194°F]

Pilot pressure (relative to T pressure)

Nominal	Minimum	Maximum
13.5 bar [196 psi]	10 bar [145 psi]	15 bar [217 psi]

Technical Data

PVP Modules, Pilot Pressure curves



Filtering in the hydraulic system

Max. permissible degree of contamination (ISO 4406, 1999 version)	23/19/16

Grade of enclosure for Deutsch connector

Grade of enclosure*	IP66

* According to the international standard IEC 529.

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

Response times

Time	Typical	Minimum	Maximum
Power on - Full stroke	135 ms	100 ms	200 ms
Neutral - Full stroke	90 ms	65 ms	175 ms
Full Stroke -Neutral	130 ms	100 ms	200 ms
Full Stroke -Neutral	80 ms	65 ms	100 ms

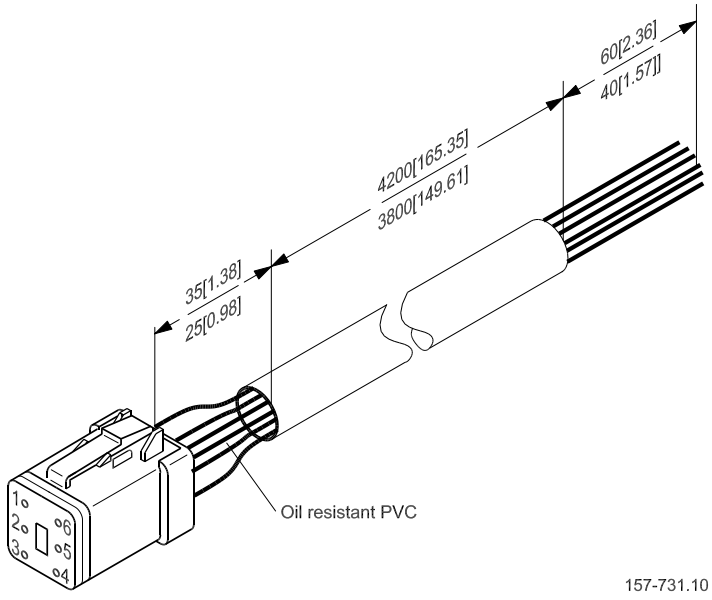
Viscosity: 21 mm^2/s. [101.9 SUS]

Pilot pressure: 10.5 bar [152 psi]

Accessories and Dimensions

Accessories

Cable with 6-pin Deutsch DT connector



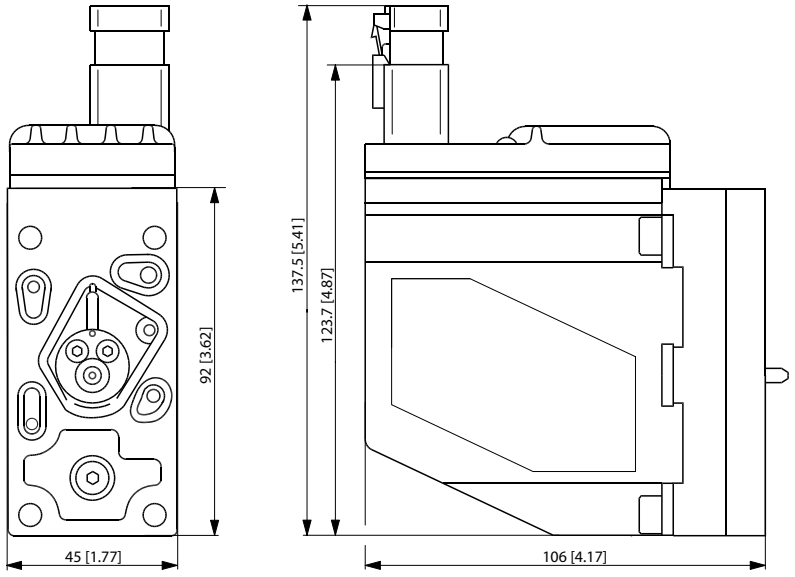
Model code No. for cable with 6-pin Deutsch DT connector: 11007513

Pins color code

Pin 1	Pin 2	Pin 3	Pin 4	Pin 5	Pin 6
White	Blue	Yellow	Red	Black	Green

Accessories and Dimensions

Dimensions



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

Danfoss Power Solutions 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.
Danfoss – Your Strongest Partner in Mobile Hydraulics.

Go to www.powersolutions.danfoss.com for further product information.

Wherever off-highway vehicles are at work, so is 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 Danfoss Power Solution representative nearest you.

Comatrol
www.comatrol.com

Schwarzmüller-Inverter
www.schwarzmueller-inverter.com

Turolla
www.turollaocg.com

Valmova
www.valmova.com

Hydro-Gear
www.hydro-gear.com

Daikin-Sauer-Danfoss
www.daikin-sauer-danfoss.com

Local address:

Danfoss
Power Solutions US Company
2800 East 13th Street
Ames, IA 50010, USA
Phone: +1 515 239 6000

Danfoss
Power Solutions GmbH & Co. OHG
Krokamp 35
D-24539 Neumünster, Germany
Phone: +49 4321 871 0

Danfoss
Power Solutions ApS
Nordborgvej 81
DK-6430 Nordborg, Denmark
Phone: +45 7488 2222

Danfoss
Power Solutions
(Shanghai) Co., Ltd.
Building #22, No. 1000 Jin Hai Rd
Jin Qiao, Pudong New District
Shanghai, China 201206
Phone: +86 21 3418 5200