# SAUER DANFOSS

Electrohydraulic Actuator – PVED-CC Series 4

Technical Information

COMPLIANT

92[3.62]

45[1.77]

141[5.55]

117[4.61]

5[0.20]

106[4.17]

Revision History

Table of Revisions

Date	Page	Changed	Rev
Aug 2011	All	Major update	DA
Oct 2011	32, 77, 79, 80, 86	Images and table data update.	DB
Nov 2011	27, 28	text update.	DC

List of Abbreviations

Abbreviation	Description
ASIC	**A**pplication **S**pecific **I**ntegrated **C**ircuit - the part of the PVE where spool position is controled to follow setpoint
ATEX	Certificated for use in flammable environment
AVC	**A**uxillery Valve Comand - ISOBUS/J1939 standard signal for valve control
AVCTO	**A**uxillery Valve Comand Time Out - Fault monitoring setting
AVEF	**A**uxillery Valve Estimated Flow - ISOBUS/J1939 standard signal for valve feedback
CAN	**C**ontroller **A**rea **N**etwork - Communication method used by PVED
CLC	**C**losed **L**oop **C**ircuit
CRC	**C**yclic **R**edundancy **C**heck - Method for ensuring validity of data.
-DI	PVE with **D**irection **I**ndication
DM1	**D**iagnostic **M**essage **1** - J1939 message informing about present fault
DM2	**D**iagnostic **M**essage **2** - J1939 message informing about fault history
DM3	**D**iagnostic **M**essage **3** - J1939 message clearing fault history
DSM	**D**evice **S**tate **M**achine. Deterministic description of system process
ECU	**E**lectronic Control Unit
EH	**E**lectro **H**ydraulic
-F	PVE for **F**loat spool. Two variants: 4 pin with float at 75%. 6 pin with separate float.
FMEA	**F**ailure **M**ode **E**ffect **A**nalysis
ISOBUS	Communication standard for CAN
J1939	Communication standard for CAN
LED	**L**ight **E**mitting **D**iode
LS	**L**oad **S**ensing
LVDT	**L**inear **V**ariable **D**ifferential **T**ransducer - Position sensor
NC	**N**ormally **C**losed solenoid valve in PVE
NC-H	**N**ormally **C**losed standard solenoid valve - like in PVE**H**
NC-S	**N**ormally **C**losed solenoid valve **S**uper - like in PVES
NO	**N**ormally **O**pen solenoid valve in PVE
PLC	**P**rogrammable **L**ogical **C**ircuit
PLUS+1™	Trademark for Sauer-Danfoss controllers and programming tool
POST	**P**ower **O**n **S**elf **T**est. Boot up evaluation for PVED

Front cover: V310206, F500053 and F500054.

List of Abbreviations (continued)

Abbreviation	Description
Pp	**P**ilot **P**ressure. The oil gallery for PVE actuation
PVB	**P**roportional **V**alve **B**asic module - valve slice
PVBS	**P**roportional **V**alve **B**asic module **S**pool
PVBZ	**P**roportional **V**alve **B**asic module **Z**ero leakage
PVE	**P**roportional **V**alve **E**lectric actuator
PVEA	**PVE** variant with 2-6 % hysteresis
PVED	**PVE** variant **D**igital controlled via CAN communication
PVEH	**PVE** variant with 4-9% hysteresis
PVEM	**PVE** variant with 25-35% hysteresis
PVEO	**PVE** variant with **O**N/OFF actuation
PVEP	**PVE** variant **P**WM controled
PVES	**PVE** variant with 0-2% hysteresis
PVEU	**PVE** variant with **U**$_s$ 0-10V
PVG	**P**roportional multi-section **V**alve **G**roup
PVHC	**PV** variant with **C**urrent controlled valve actuator
PVM	**P**roportional **V**alve Manual control with handle
PVP	**P**roportional **V**alve Pump side module.Inlet
PVS	**P**roportional **V**alve end plate
PVSK	**P**roportional **V**alve end plate Crane. Inlet module with **S**pool Control
PWM	**P**ulse **W**idth **M**odulation
-R	PVE with **R**amp function
S4 DJ	**S**eries **4** **D**igital **J**1939 service tool software for PVED-CC
SAE	**S**ociety **A**utomotive **E**ngineering
-SP	PVE with **S**pool **P**osition feedback
uC	**M**icro-**C**ontroller
uCSM	**M**icro-**C**ontroller **S**tate **M**achine
U$_{DC}$	Power supply **D**irect **C**urrentl; also called V$_{bat}$ for battery voltage
U$_s$	Steering voltage for the PVE control; also called V$_s$

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Reference

Sauer-Danfoss Doc **520L0344,** *PVG 32 Technical Information*
Sauer-Danfoss Doc **520L0720**, *PVG 100, Technical Information*
Sauer-Danfoss Doc **520L0356**, *PVG 120 Proportional Valve, Technical Information*
Sauer-Danfoss Doc **520L0553**, *PVE series 4, Technical Information*

Standards

- International Organization for Standardization ISO 11898-2 • Road vehicles, CAN, Part 2, High-speed medium access unit (physical layer)
- SAE J 1939
- ISOBUS: ISO 11783 CAN Interface
- International Organization for Standardization EN ISO 13849 Safety of Machinery
- EU Directive: EMC directive 2004/108/EC
- International Organization for Standardization ISO 13766:2006(E) Earth moving machinery - • Electromagnetic compatibility
- EN 982: 1996 + A1:2008, Safety of machinery – Safety requirements for fluid power systems and their components - Hydraulics

PVED-CC with Deutsch connector

V310 300 A

PVED-CC with AMP connector

V310 292 A

Notes

Product Warnings

⚠ Warning

Depending on PVED-CC variant, age and software there are variations in communication and control. Read this technical information before implementing new PVED-CC in applications.

⚠ Warning

A PVG with PVED-CC can only perform according to the present descriptions if conditions in this Technical Information are met.

⚠ Warning

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

⚠ Warning

When the PVED-CC is in modes related to fault the validity of module reporting is limited by the fault type.

⚠ Warning

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

⚠ Warning

Do not adjust the position transducer (LVDT) as this will influence calibration, and thus also safety and performance. This will also be the case by any damage or partial/full fixation of the LVDT.

⚠ Warning

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

⚠ Warning

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

⚠ Warning

Protect persons and environment against oil spill. Hydraulic oil can cause both environmental damage and personal injuries.

⚠ Warning

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

**Product Warnings
(continued)**

⚠ Warning

The PVED-CC is not designed for use with voltage outside nominal for more than 5 minutes per hour and maximum 10% of operating time.

⚠ Warning

When the PVED-CC recognizes a fault it can enter fault mode and disable the operators control of the valve.

⚠ Warning

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

⚠ Warning

Reduced pilot pressure will limit spool control.

⚠ Warning

Too high pilot pressure can harm the system.

⚠ Warning

When performing service. especially at temperatures below 0°C [32°F], avoid twisting and rough handling.

Introduction

The Sauer-Danfoss PVED-CC is a digital (D) controlled PVE-Series 4 actuator for PVG32 and PVG100. The PVED-CC follows the modular Sauer-Danfoss concept.

CC is an abbreviation for CAN bus Communication. The communication is compliant to the SAE J1939 protocol and the ISOBUS standard for flow control.

The PVED-CC has proven its worth and is used in various types of automotive hydraulic applications with high demands to precision and controllability.

The PVED-CC can be controlled by a Sauer-Danfoss PLUS+1 GUIDE application or other devices capable of using communication as defined in this Technical Information.

Customizing of the PVED-CC is done by parameter setting. Settings can be made by the PLUS+1 service tool, the WebGPI service tool or by a CAN gateway that have the same abilities.
PVG with PVED-CC can be delivered with customer defined settings out of factory.

PVG with PVED-CC
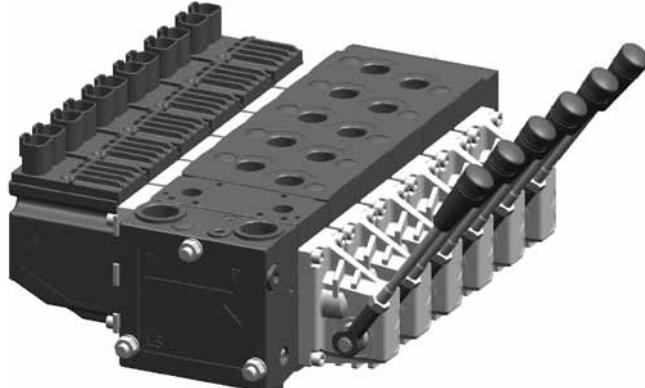
V310 325.A

PVE stands for Proportional Valve Electrical actuator
The Sauer-Danfoss PVE is built on more than thirty years experience of electrical valve control and is the perfect fit for our high performance proportional valves PVG32, PVG100 and PVG120.
All our products are developed in close cooperation with system manufacturers from the mobile hydraulic market which is the reason for our high performance in all market segments.

Overview

With the PVED-CC a hydraulic application with PVG can have up to sixteen individually controlled valves on one CAN bus. Giving full control and feedback for every work function. This requires multiple PVG.

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

- PVED-CC controlling the spool position using pilot oil pressure.
- A handle (PVM) in mechanical interface with the spool.
- The oil flow into the PVG can be controlled using an electrically controlled main oil valve (PVSK). The PVSK can also supply an additional PVG via the High Pressure Carry Over (HPCO) port.

  PVG oil supply can be controlled by a PVED-CC (PVEO-DI) on a PVSK.

PVG 32 structural lay-out with naming
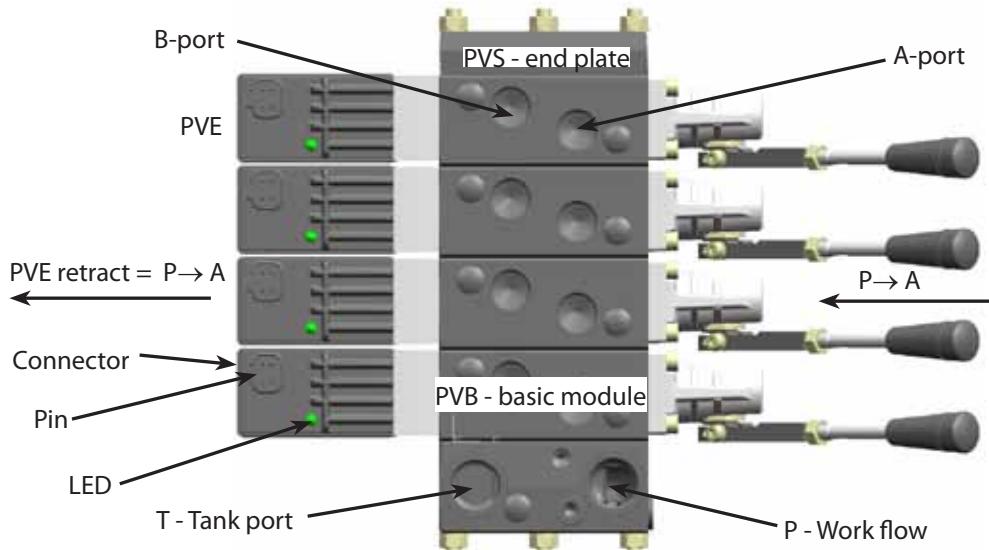
V310 329.A

Overview (continued)

The PVED-CC uses the ISOBUS and J1939 protocol, thus following the standard protocols. The physical layer for CAN communication applies to ISO 11898-2 high speed CAN.

The spool is controlled by flow commands in steps of 0,4% or by spool position with 250 positions in each direction and dead band compensation. Monitored manual operation is possible.

The embedded system also monitors safety. Spool position, communication, electronics, memory, calculations and temperature are continuously evaluated and all violations are broadcasted and logged.

To avoid unnecessary power consumption the PVED-CC has the Power Save feature, where power consumption is reduced by almost 90% when the spool is in neutral.

PVG 32 with PVED-CC

Standard mounted PVG. PVED-CC with Deutsch connector

V310325.A
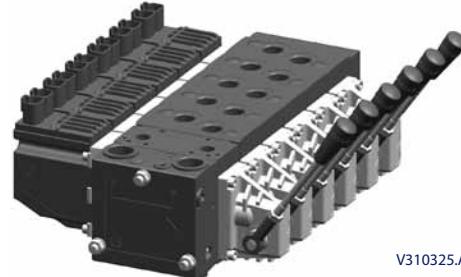
Standard mounted PVG. PVED-CC with AMP connector

V310324.A
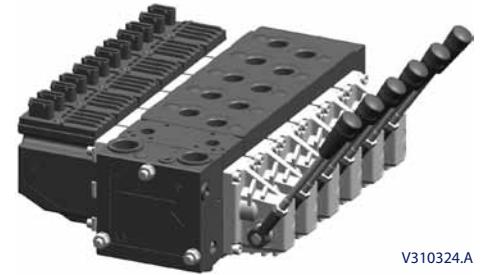
Option mounted PVG with PVSK. PVED-CC with Deutsch connector

V310323.A
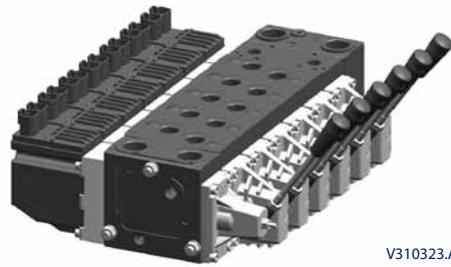
Option mounted PVG with PVSK. PVED-CC with AMP connector

V310322.A
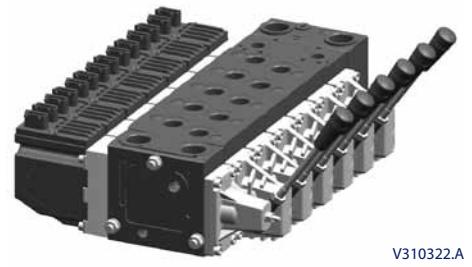
PVG Functionality

This chapter will give an overview of the PVG and its functionality.

Valve section with naming - standard mounted - seen from PVP
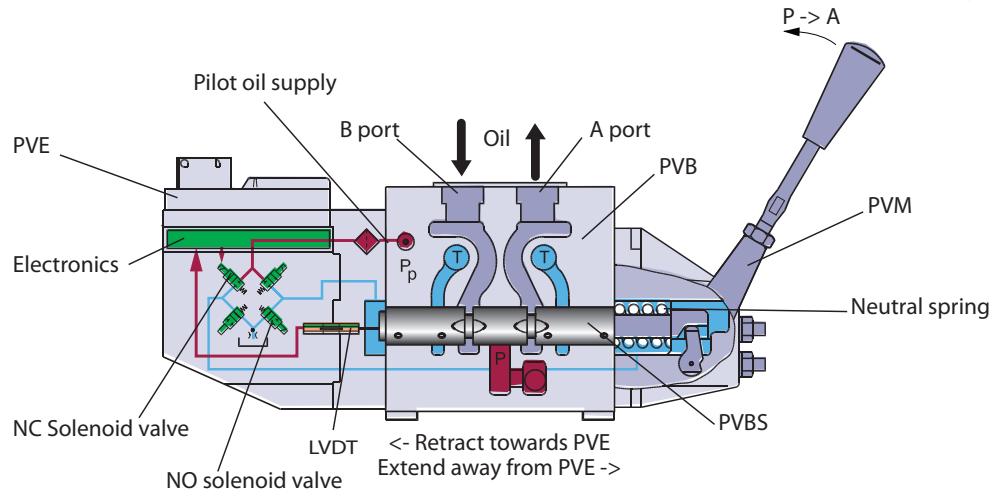
V310072.A

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

Depending on the choice of components the oil work flow enters the PVG through the PVP (proportional valve pump side module) or the PVSK (proportional valve end plate for crane) and enters the PVB (proportional valve basic module) via the P gallery and leaves through the T gallery.

In the figure above you see a valve section seen from PVP towards PVSK with the PVM and PVE standard mounted. PVM and PVE can in general be interchanged, that is called option mounted.

With the spool in neutral, where it is kept by the neutral spring, the connection to the application via ports is blocked.

Moving the spool towards the PVE, as in figure 4, opens a connection between P and A and also between B and T. This is done by either pushing the PVM or sending a retract command to PVED. The PVED move the spool by letting Pilot Oil Pressure (Pp) push on the right end of the PVBS and releasing pressure from the left end. For details on PVG please see relevant Technical information.

Any PVG with PVM can be operated by PVM alone independent of power supply. Any PVG with PVED-CC can monitor PVBS if power and communication conditions are present.

**PVED-CC Functionality
(continued)**

This section main focus is to provide a brief overview before heading into the following technical chapters. Understanding this section is regarded as a minimum in order to understand the use of the actuator.

Before any installation and use of the PVED-CC it is highly recommended that the user understands the technical chapters as well.
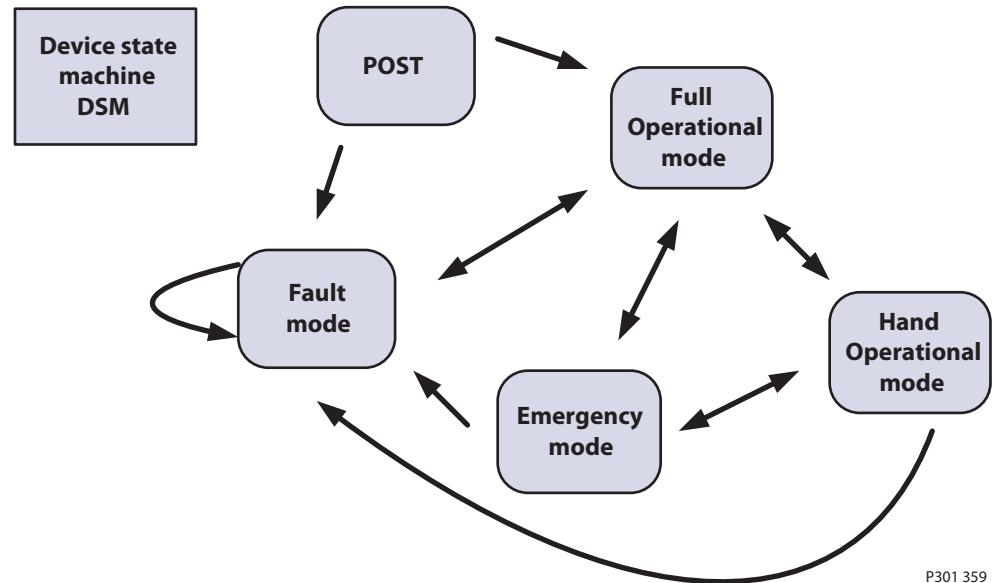
P301 359

The PVED-CC features four different modes of operation: Full Operational mode, Hand Operational mode, Emergency mode and Fault mode.
Older versions only features Full Operational mode and Fault mode.

Prior to operation the PVED-CC performs a Power On Self Test (POST) in order to validate the state of electronics, settings and software.

If the PVED-CC recognizes violations of standard operation it will immediately give a detailed feedback on this event. If the violation is regarded as possibly dangerous the PVED-CC will enter fault mode.

If the PVED-CC recognize violations to standard operation it will immediately give a detailed feedback on this event. If the violation is regarded as possible dangerous the PVED-CC will enter fault mode.

**PVED-CC Functionality
(continued)**

The PVED-CC is a mechatronic device, meaning mechanics, hydraulics, electronics and microcontroler interacting with external systems.
The illustration gives an overview of the actuator tasks. On the left side is external system interaction on the right side internal tasks.

PVED-CC Mechatronical interaction
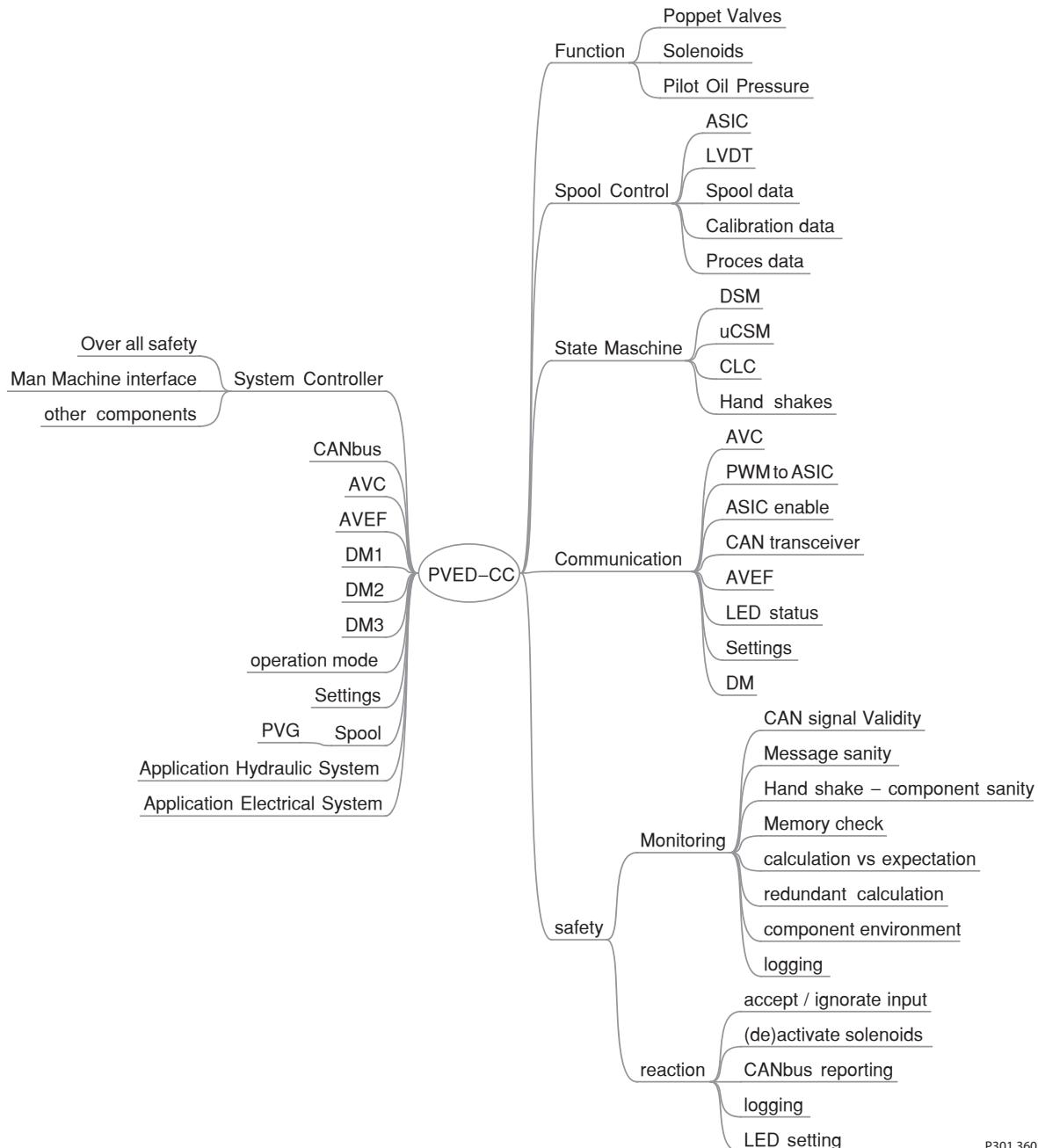
P301 360

Mechanical Sub System

Housing

The housing of the PVED-CC protects the internal parts from the environment and gives the optimal interface to cabling, Pilot oil and spool.

Cable kit

The cabling is one of the great advantages for CAN systems. It reduces the number of cables and gives a simpler system overview.

All units (ECU e.g. PVED) are connected by the CANbus, a CAN high and a CAN low wire which are terminated at the ends. Power and ground wires can with respect to maximum current consumption follow the bus wires.

The bus can either be made as a daisy chain, where the stub from bus to ECU is inside the PVED

120 Ω termination
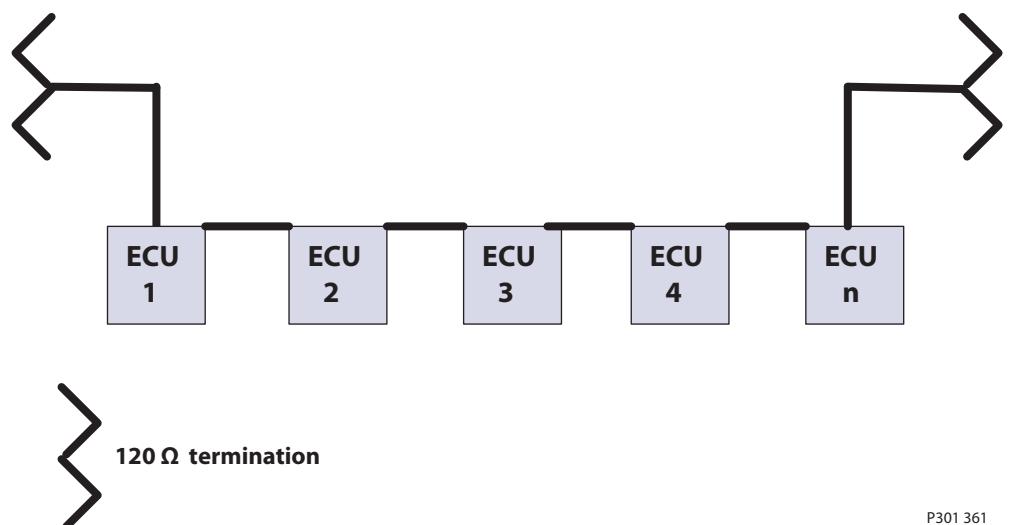
P301 361

or with stubs going from the back bone to the ECU.
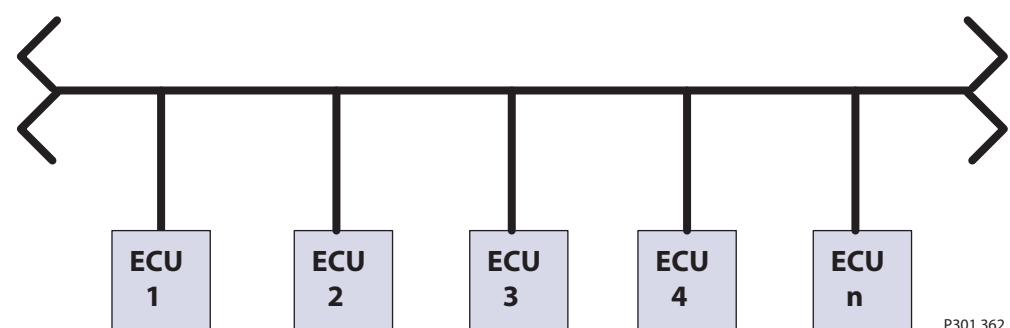
P301 362

Both solutions have advantages and disadvantages. Sauer-Danfoss supports the daisy chain solution with cables but the PVED-CC could easily be used with the back bone solution.

Mechanical Sub System (continued)

Mounting

The Sauer-Danfoss PVG concept is based on parts interchangeability. This is also valid for the PVED-CC and makes field retrofitting possible. PVED can be mounted on both ends of PVB.

PVED-CC

8±0.5 Nm
[70 ±4.4 lbf•in]
5[0.20]

157-660.10.10

157-743.10.10

PVED-CC

8±0.5 Nm
[70 ±4.4 lbf•in]
5[0.20]
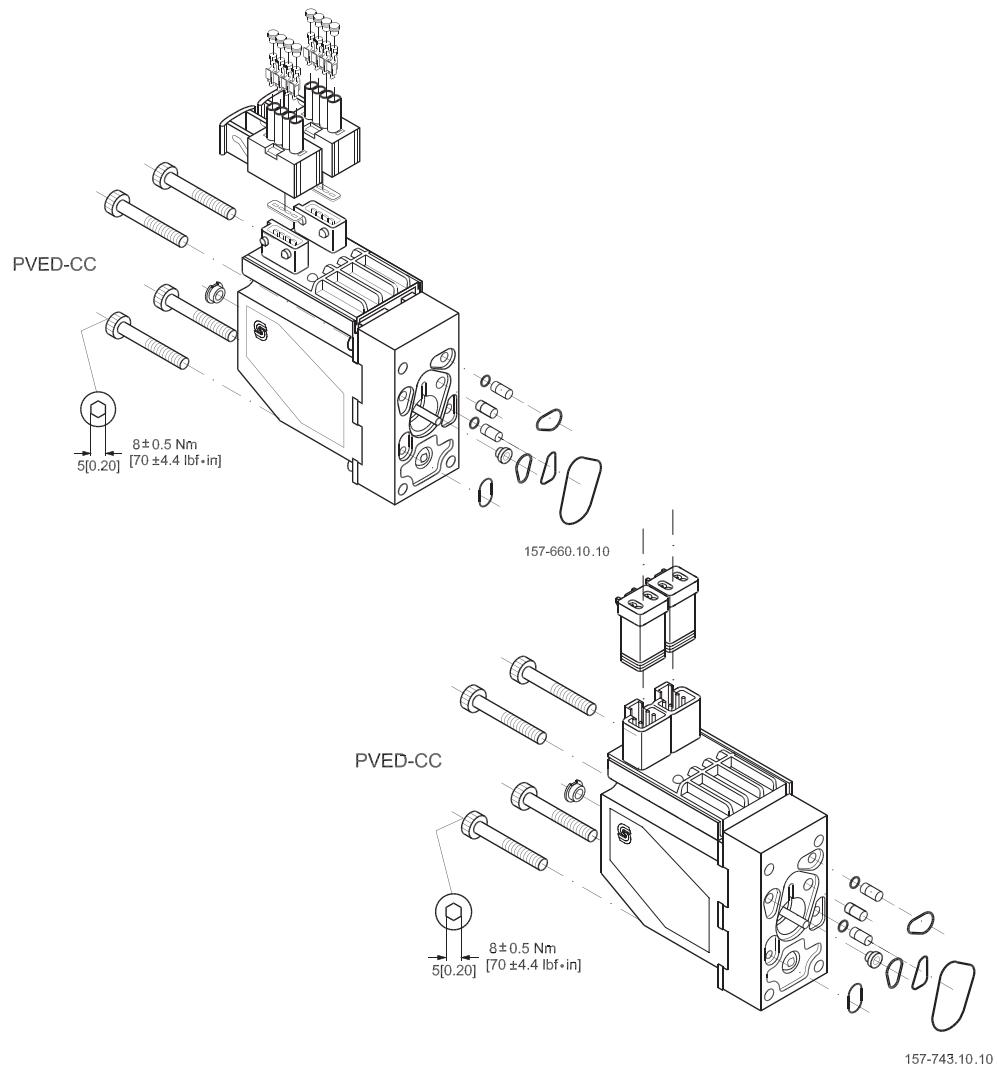
⚠ Warning
Deviation from recommended torque can harm performance and module.

LVDT

The Linear Variable Differential Transducer (LVDT) or position sensor is the interface between the mechanical system (spool) and the electronic system.
The LVDT must never be mechanically adjusted, bent, damaged or partially blocked as this will lead to incorrect information on spool position.

Spool neutral spring

The PVBS neutral spring is an important safety component as it keeps or moves the PVBS in blocked position when solenoid valves are disabled.

Hydraulic Subsystem

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

Pilot oil diagram

V310073.A
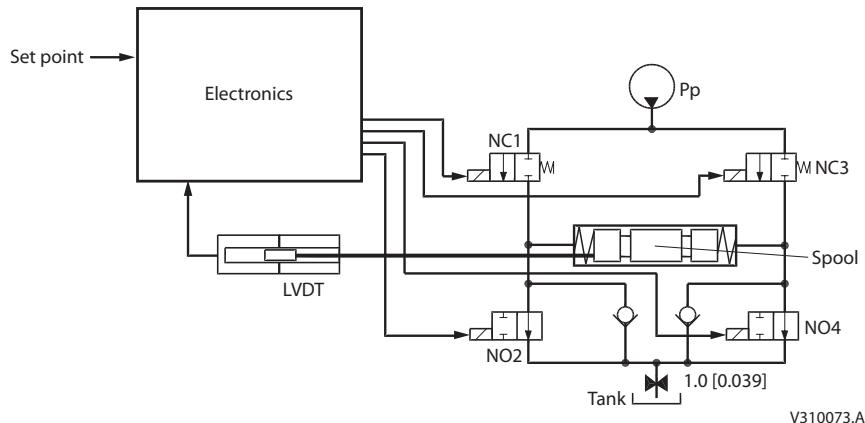
The heart of the hydraulic subsystem is the solenoid valve bridge. It consist of four poppet valves, the two upper ones are normally closed (NC-S) with a small bleed, the two lower ones are normally open (NO).

The Pp will work against the PVBS neutral spring when the spool is moved out of blocked (neutral) and together with the spring when going in blocked. This combined with a larger opening in the NO than in the NC-S will give a faster movement towards blocked than out of blocked.

⚠ Warning
Obstacles for the Pp can have direct influence on spool control. Reduced pilot pressure will limit spool control. Too high Pp can harm the system.

**Electrical and Electronic
Subsystem**

The PVED-CC is an integrated part of the PVE series 4 technology. The Closed Loop
Control of the spool is performed by an ASIC like in all standard PVE but with local
intelligence.

Function blocks for electronics

P301 363
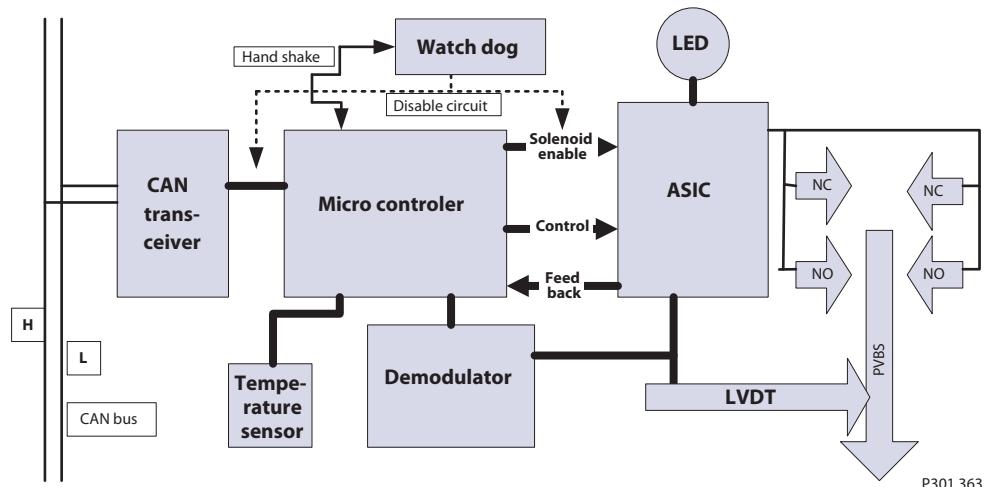
CAN transceiver
Interface to the bidirectional communication on the bus. The transceiver ensures signal
prioritizing, fault free communication and over all signal timing.

Watch dog
If handshakes are not exchanged the solenoids are disabled. If the watch dog detects the
problem CAN communication is also disabled.

Demodulator
Verifies the quality of the LVDT signals

ASIC
Application Specific Integrated Circuit. The part of the PVE where the Closed Loop
Control (CLC) of spool position defined by the uControler recalculated setpoints is
managed.

Microcontroller
Interprets the signals from the system controller. Based on local settings calculates
the set point for the ASIC. Evaluates ASIC feedback. Creates feedback messages to the
system.

Temperature sensor
The sensor monitors device temperature.

LED
The diode gives optical feedback on actuator state

Communication

The PVED-CC has two methods of communication.
- Digital two way communication
- Optical from module

Digital – CANbus

The Control Area Network or simply the CAN bus is an intelligent and efficient communication bus where high important messages have priority without any delaying messages collisions. The PVED-CC uses the ISOBUS / SAE J1939 protocol for communication.

It is used for:
- Control of valve oil flow by Auxiliary Valve Command (AVC).
- Flow reporting from valve to system by Auxiliary Valve Estimated Flow (AVEF).
- Fault and warning reporting by high priority messages.
- Parameter setting both by high priority Process Data commands and low priority service messages.

Optical – LED

Light is implemented to facilitate maintenance and application engineering.

Computerized Subsystem   The PVED-CC operation is based on state machines. The top level is according to this figure. Details are available in the data section of this Technical Information.

⚠ Warning:
Depending on PVED-CC variant, age and software there are variations in communication and control. Read this technical information before implementing new PVED-CC in applications.

DSM for PVED-CC

P301 359
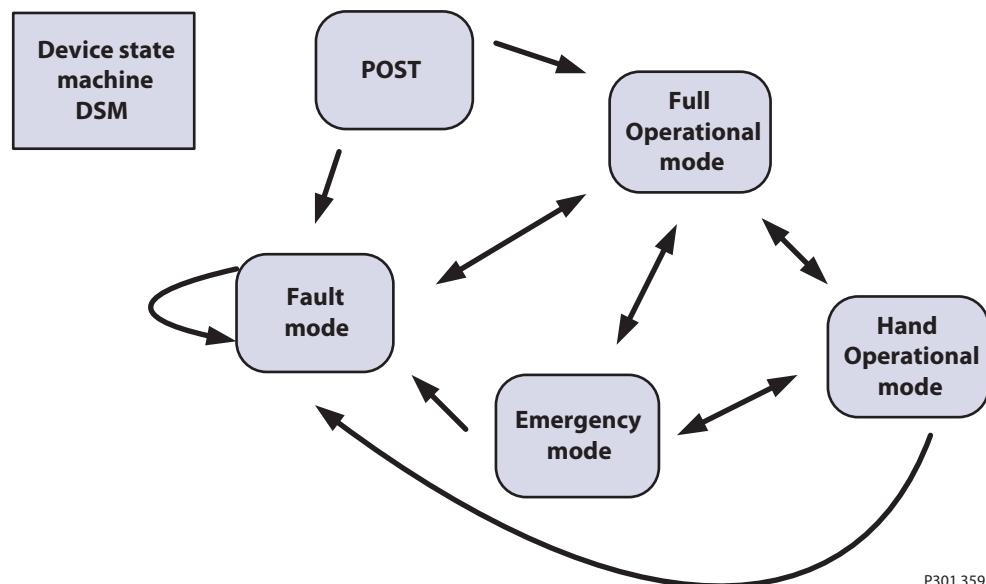
- Transition out of POST (Power On Self Test) is controlled by PVED-CC
- Transition in and out of fault mode is controlled by PVED-CC
- Transition between Full Operational Mode, Hand Operational Mode and Emergency Mode is controlled by operator. These transitions are not available in older versions.

Computerized Subsystem (continued)

Power On Self Test (POST)

When power is applied to the PVED-CC it will initialize components and validate component states and parameter settings. If test is passed the PVED will enter Full Operational mode otherwise it will enter Fault mode. In both cases it will, if possible, make itself known to the network by an address claim followed by if needed a fault message (DM1) and then Auxiliary Valve Estimated Flow message (AVEF).

Full Operational mode

In full operational mode the PVED-CC controls the spool based on Auxiliary Valves Commands (AVC) from system master. This mode is characterized by:
- No fault is present
- Full control by CAN bus of PVED
- Fault monitoring is active
- Auxiliary Valve Estimated Flow message (AVEF) is transmitted

Hand operational mode

In hand operational mode the PVED-CC cannot control the spool. This mode is characterized by:
- No fault is present.
- Spool control by PVED is disabled.
- Fault monitoring on spool behavior is disabled. Is maintained on other parameters.
- Auxiliary Valve Estimated Flow message (AVEF) is transmitted

Emergency mode

Emergency mode is similar to Hand operational mode but is entered without any ramping. This mode is characterized by:
- Entered without any delay
- Similar to Hand Operational mode

Fault mode

In fault mode the PVED-CC monitors and reports if possible.
This mode is characterized by:
- One or more faults are present
- LED is orange or red
- PVED tries to force PVBS to blocked position
- AVC from Master is not followed by the module
- Fault monitoring is active and every second present faults are reported
- Auxiliary Valve Estimated Flow message (AVEF) is transmitted.

Settings and System Data

The PVED-CC offers a number of settings for both Spool control, fault monitoring and general system settings. A number of system information parameters are available via the service tool. Details are available in the data section of this Technical Information.

Process data

Process data can be considered as user or situation specific values. They are the runtime settings Ramp timing, scaling of set point, variation of progressivity and port inversion and can be changed during operation by an ISOBUS message.

OEM Data

OEM data can be considered as application or system specific values. They are a number of safety settings, performance settings and the module communication identifier. Also a set of fall back values for the process data are stored as OEM data.

Spool Data

Spool data are parameters used for linearization of the spool. These parameters gives relation between spool position and flow command in order to apply to the ISOBUS standard of 0.4% flow change for each step of the Auxiliary Valve Command (AVC).

General part details

Information like part number, production date, software identification and Name field are also available.

Logging

An error log with event counter is stored in the EEPROM.
During runtime a temperature histogram for the electronics are stored in the EEPROM.

P301 364
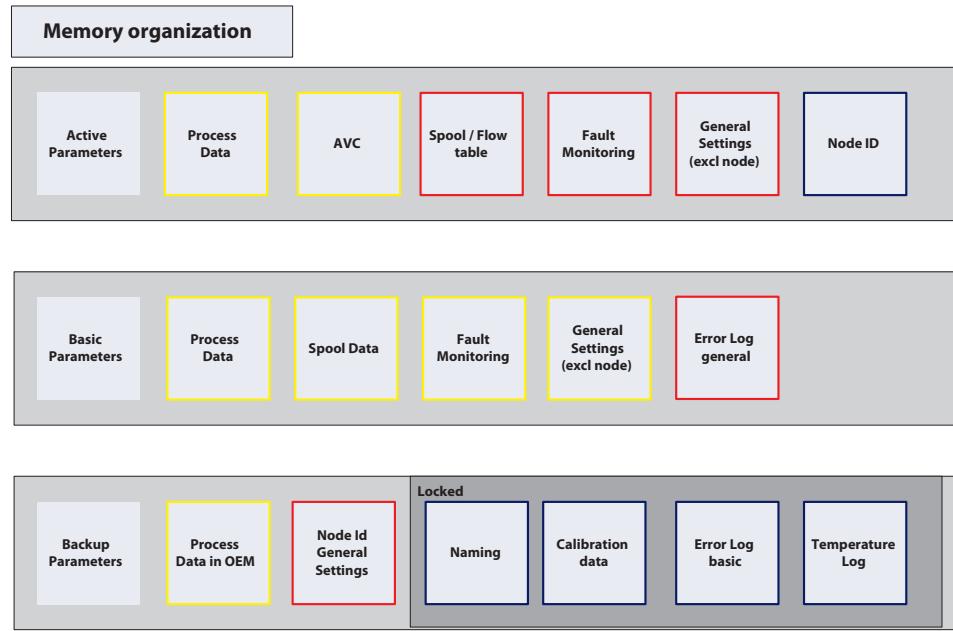
For a general description on Safety in Application please see **520L0553** *PVE Series 4 for PVG 32, PVG 100 and PVG 120 Technical Information.*

Definition

The Sauer-Danfoss definition of safe state transition by fault: Depower solenoids and release spool to neutral spring. PVBS to be forced to blocked position (neutral) by neutral spring.

The PVED-CC has Active Fault Reaction, meaning the solenoids are disabled on fault. Less flow than commanded is not regarded as dangerous by the PVED.

Concept

The PVED-CC safety concept is based on two elements:
- POST – Power On Self Test
- Runtime fault monitoring and reaction

The basic elements for product safety are:
- Continuous module self monitoring
- Fault recognition and reaction
- Fault reporting and recording
- Fault recovery

POST–Power On Self Test

When powered the PVED evaluates settings, circuit, sensors and spool interface . Passing of the POST is a precondition for entering Full Operational Mode.

Runtime Fault Monitoring

After power on set up and POST the runtime fault monitoring takes over. Every time the uCSM enters the safety task a number of feedbacks are evaluated. In parallel the internal handshake between microcontroller and watch dog is running. The faults are categorized by origin and severity level

Fault Origin Category
- Internal PVED
  - Handshake fault
  - Calculation faults
  - Memory faults
  - Components faults
  - Temperature fault
- PVED PVG interaction
  - Spool position faults
- System interaction /communication fault
  - Power supply
  - Invalid commands
  - Missing commands
  - CANbus faults

Fault Severity Level
- Warning. A changes of settings was attempted but could not be followed
- Severe. Based on the present state actuation cannot be continued. This is for fault types permanent and temporary.

Fault Reaction

In case of recognized unintended behavior the PVED-CC can react in three ways.
For some events the reaction is at first occurrence for others after a threshold is passed.
By multiple faults the most severe has priority and the PVED-CC will stay in fault mode until recovered from all faults.

Recorded and Reported Solenoid Disabling

Used by severity level Severe and solenoids are disabled.
If the event is regarded safety or performance threatening the solenoids are disabled (spool forced back to blocked), a distress messages is broadcasted on the CANbus at occurrence and for as long as present and a record is made in the error log.

Recorded and Reported Ignorance

Used by severity level Warning and solenoids are not disabled.
A distress messages is broadcasted on the CANbus at occurrence and as long as present and a record is made in the error log.

Unrecorded Reaction

By missing handshake from microcontroller the Watch dog disables the solenoids and the CAN bus interface.

Fault Recovery

For events of severity level Severe there are one of two ways of recovery.

Reboot:
The event is regarded as system threatening and a system reconfiguration and reevaluation is required.

Resume:
the event is regarded as performance/safety threatening but not system threatening.
When the fault trigger disappears transmission of two AVC Blocked reactivates the PVED.

For events with severity level Warning no recovery needed. The operator might though need to send a valid setting changes to get a desired performance.

Declaration of Conformity

The PVED-CC has CE marking according to the EU directive EMC Directive 2004/108/EC. The declarations are available at Sauer-Danfoss.

Operational Conditions

The PVED-CC will only operate according to this table.

Operational conditions

Mode	Supply			
	Power	**CAN control**	**Pilot oil pressure**	**Oil main pressure**
Electronic test POST	Mandatory	Optional	Optional	Optional
Manual operation	Optional*	Optional*	Optional	Mandatory**
Full operation	Mandatory	Mandatory	Mandatory	Mandatory**

* Mandatory if spool position information is requested.
** If hydraulic performance is expected.

The PVE is designed for use with pilot oil supply. Use without oil supply except intermittent use can harm the system.

The PVE is designed for use with pilot pressure range 10 -> 15 bar [145 -> 220 Psi]. Intermittent pressure peaks up to 50 bar [725 Psi] can be accepted.

Definition: Extend. Spool is further away from PVED than blocked position. Equals to oil out of B-port by standard mounted PVED.

Definition: Retract. Spool is closer to PVED than blocked position. Equals to oil out of A-port by standard mounted PVED.

Definition: Intermittent is no longer than 5 seconds and not more than once per minute.

Performance

Reaction time for actuation

Function @ 21 cSt @ 13,3 bar	Solenoids	Min	Max
Reaction time, neutral to max spool travel	Powered	50 ms	200 ms
Reaction time, max spool travel to neutral	Powered		150 ms
Reaction time, power on to max spool travel	Powered	1000 ms	4000 ms
Reaction time, max spool travel to neutral	Disabled		175 ms
Power up; from power on to CAN active			1000 ms
Hysteresis @0.02Hz		0 %	1 %

Oil viscosity: 21 ± 0,5 cSt,
Pilot pressure (P-T):   13,3 ± 0,5 bar

Dimensions and Layout

PVED-CC with AMP connector

92[3.62]

141[5.55]

117[4.61]

5[0.20]

45[1.77]

106[4.17]

157-394.14

PVED-CC with Deutsch connector

92[3.62]

137.51[5.414]

123.73[4.871]

45[1.77]

106[4.17]

157-722.10
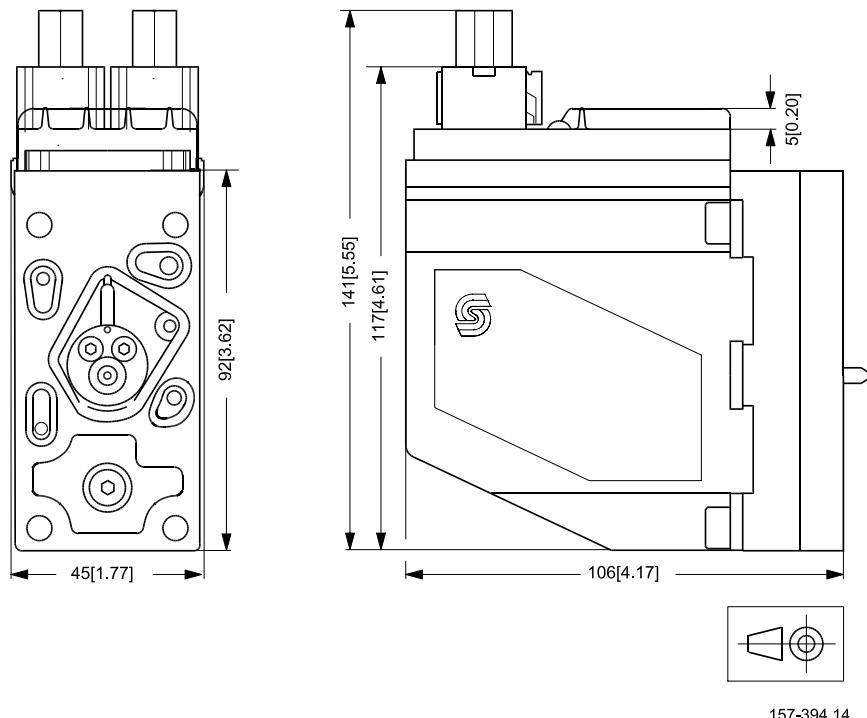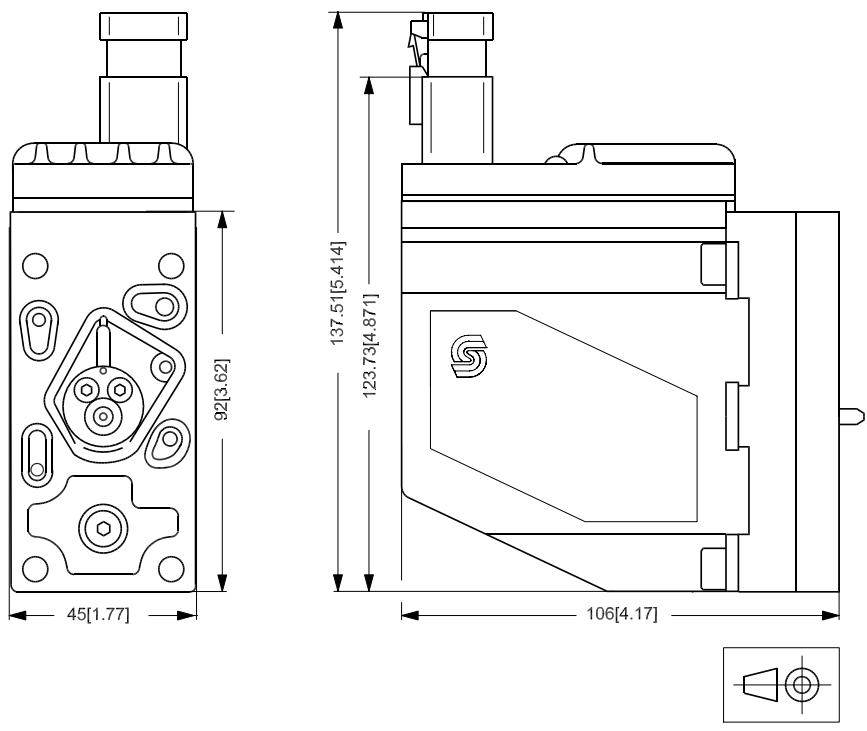
**Dimensions and Layout
(continued)**

AMP version PVED-CC

CAN-L - 1
U$_{DC}$ - 2
CAN-H - 4

Pin no.
1
2
3
4

1 - CAN-L
2 - U$_{DC}$
4 - CAN-H

157-574.13

Deutsch version PVED-CC

U$_{DC}$
CAN-L
CAN-H

CAN-L
U$_{DC}$
CAN-H

157-741.13
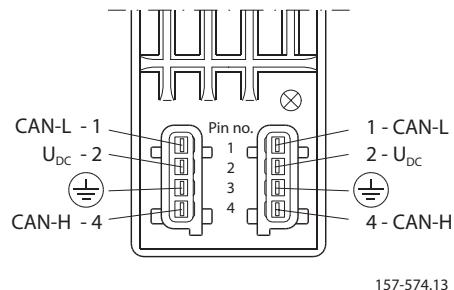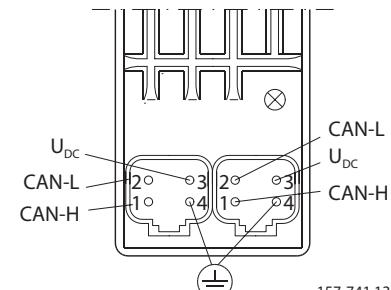
Connection PVED-CC

Connector	CAN low	U$_{DC}$	Ground	CAN high
AMP	pin 1	pin 2	pin 3	pin 4
Deutsch	pin 2	pin 3	pin 4	pin 1

Enclosure and connector

Connector	AMP JPT connector	Deutsch connector
Grade of enclosure*	IP 66	IP 67

* According to the international standard IEC 529
  NB: In particulary exposed applications, protection in the form of screening is recommended.

Voltage and current

Supply Voltage (DC)	
Nominal	11 - 32 V
Minimum	9.5 V (SW alarm 9.0 V)
Maximum	33.5 V (SW alarm 35.5 V)
Max ripple	5 %
Current Consumption	
Current consumption @ 12V in Full Operational mode	750 mA
Power consumption in full operational mode	9 W
Current consumption @ 12V in Hand Operational mode or power save	90 mA
Power consumption in Hand Operational mode or power save	1.1 W

Power consumption is independent on voltage.

Activation of solenoid valves by low voltage outside nominal is for short term excep-
tions, meaning maximum 10 % of operating time and for max 5 minutes within an hour.

Activation of solenoid valves by 9-10 V will give reduced valve performance. Voltage
above 36 V and below 8 V will shut down electronics.

⚠ Warning
Maximum 10 PVED-CC can be powered on same daisy chain simultainously.

The PVED-CC is in conformity with the EU EMC directive 2004/108/EC and complies
to the standard ISO 13766:2006 (E) Earth moving machinery – Electromagnetic
compatibility.

16 PVED-CC can be on the same CANbus simultaneously.
According to J1939 maximum length for a CANbus is 50 meter [1970 inch]

Hydraulic Data

Pilot oil system

Filtering in the hydraulic system

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

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

Oil viscosity

Oil viscosity	range	12 ÷ 75 mm²/s [65 ÷ 347 SUS]
	min.	4 mm²/s [39 SUS]
	max.	460 mm²/s [2128 SUS]

Oil temperature

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

Pilot pressure

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

Operating temperature

	Min	Max
Ambient	-30 °C [-22 °F]	70 °C [158 °F]
Stock	-40 °C [-40 °F]	90 °C [194 °F]
Recommended long time storage in packaging	10 °C [50 °F]	30 °C [86 °F]

PVP modules, Pilot pressure curve

157-520.11
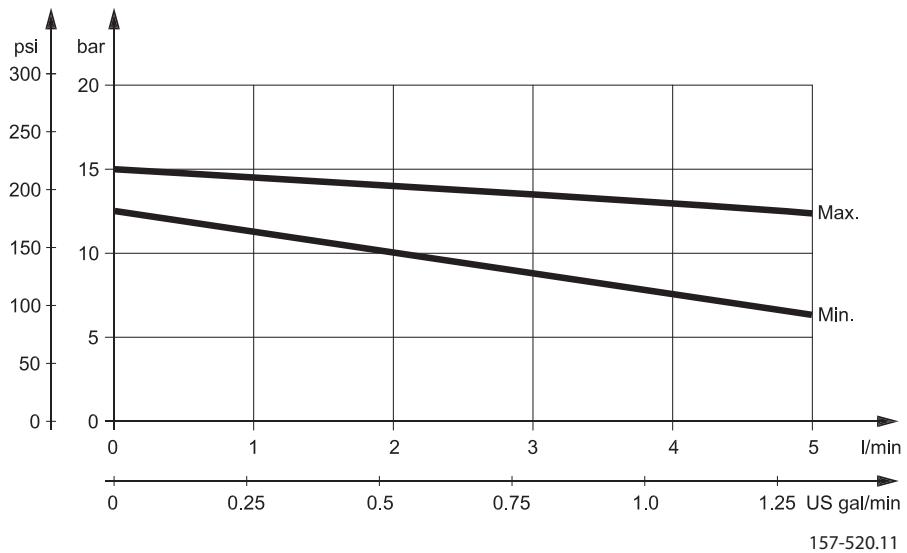
Pilot oil consumption for one PVED-CC

Solenoids depowered	0.2 ÷ 0.4 l/min [0.05 ÷ 0.10 US gal/min]
Spool locked by pilot oil	0.1 ÷ 0.2 l/min [0.03 ÷ 0.05 US gal/min]
Continuous actuation	0.9 ÷ 1.1 l/min [0.24 ÷ 0.29 US gal/min]
One actuation (neutral to max)	0.002 l/min [0.0005 US gal]

Oil viscosity: 21.0 ± 0.5 cSt, Pilot.
Pilot pressure (P-T): 13.3 ±0.5 bar

Hysteresis overview

	NC-S	NC-H
Maximum	2.0%	8.6%
Typical	<½%	4.0%

Electrical Data

Communication

LED

The PVED-CC has four modes, see the table below:

LED color interpretation

LED	PVED-CC mode
Green	Full Operation
Yellow	Power save (if the spool is in blocked position for more than 1 s)
	Manual (error)
Red	Fail-silent (ASIC and CAN Transceiver disabled)

CAN

Physical layer: ISO11898-2 high speed CAN
Protocol: ISO11783-7 / SAE J1939 (29 bit identifiers)
Baud rate: 250 Kbps
Bit timing: TSEG1 = 13
TSEG2 = 4
SJW = 0
BRP=1

According to this time quanta calculated as per data sheet is tq = 200 n.s. (considering fcpu = 20 MHz).

Therefore:

- Before Sample point [t(TSEG1)] = (TSEG1 + 1) x tq = 14 x 200 = 2800 n.s.
- After Sample point [t(TSEG2)] = (TSEG2 + 1) x tq = 5 x 200 = 1000 n.s.
- t(sync-seg) = 1 x tq = 200 n.s.
- 1 Bit time = t(sync-seg) + t(TSEG1) + t(TSEG2) = 200 + 2800 + 1000 = 4000 n.s.
- One sample point at 75 %.
- According to 250 kbps, 1 Bit time = 4000 n.s.

Parameter Description

Parameters in the PVED-CC are organized in a hierarchy with active parameters as most important and back up parameters as less important. Yellow framing indicates high accessibility, red low and purple read only.

Changing parameters in one position will not necessarily change parameters at other positions. E. g. ramp changed as process data will change performance until next reboot, ramp value changed and stored as process data will have effect until next restore OEM defaults. Changing ramp in OEM data will only have effect for performance if restore OEM data is performed in Process Data screen

Memory organization

P301 364
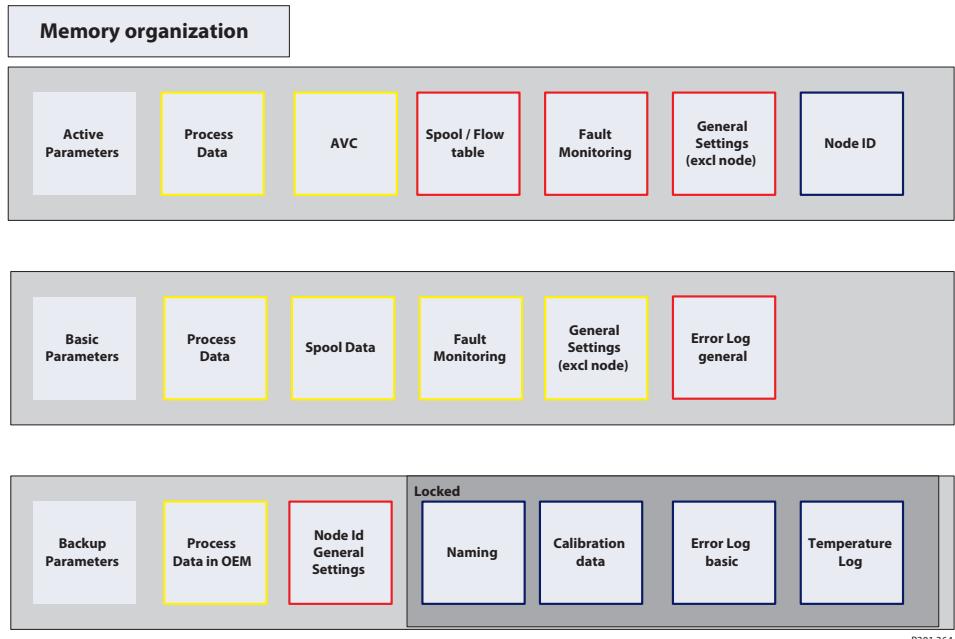
Commercial Identifiers
The part number or sales number gives together with the production day the serial number for the PVED-CC. This is a unique identification of every PVE which is also engraved on the cover.

Communication Identifiers
The CAN bus identification of the PVED-CC is defined by the name field. The function instance, in this document also called node id or source address, is the only accessible parameter in current versions.

Firmware Identifiers
Information about firmware and thus on implemented features is present in the PVED-CC.

Service Parameters
Error log and temperature histogram can be read out.

**Parameter Description
(continued)**

Valve Interface Settings
Calibration data and spool curve defines software interface to the electrical and mechanical environment.

Communication Parameters
Node Id, Estimated Flow Delay, and KWP 2000 parameters defines communication

Safety Parameters
For some faults a threshold for recognition can be set. That is done by the General Timeout (GTO), the Float Time Out (FTO) and the auxiliary valve Command Time Out (CTO). The fault recovery conditions can be altered for a number of faults, named monitoring. Also the Power Save setting has influence on system safety and not only power consumption.

Behavior Parameters
A number of parameters have a direct influence on how the PVED perform on a flow command. These parameters are referred to as process data. These are ramping, scaling, progressivity and port inverting. Also a minimum flow before entering float can be defined. All these parameters can be changed by a single CAN message.

**Parameter Description
(continued)**

Name Field J1939

Dynamic address claiming is not implemented. parameters are read only. Function instance can only be accessed by service tool protocol.

Back up parameters – Node Id General settings –J1939

- Identity Number   201001 (0b 00011000 10001001 01001)   Read Only
- Manufacture code   57 (0b 000 00111001) Sauer Danfoss   Read Only
- ECU instance   0 (0b 000)
- Function instance   0 (0b00000) node id 128 (0x80)
- Function   129 (0b 10000001) auxiliary valve on a tractor
- Reserved   0
- Vehicle system   1 (0b 0000001) Tractor for industry group 2
- Vehicle system instance 0(0b 0000) Front vehicle
- Industry group   2 (0b 010)

msb: byte 8 bit8 lsb: byte 1 bit 1

P301 365
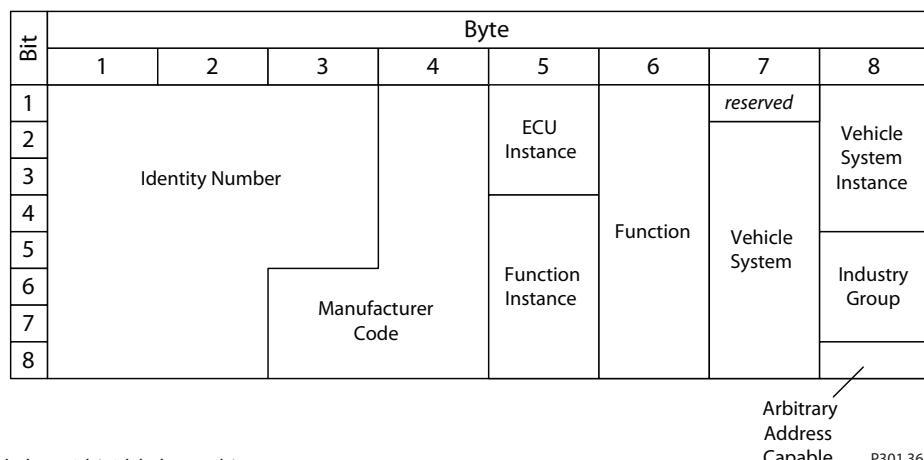
Function instance

Function instance shows the PVED node id.

- 0 (0b00000) node id 128 (0x80)
- 1 (0b00001) node id 129 (0x81)
- 2 (0b00010) node id 130 (0x82)
- …
- 15 (0b01111) node id 143 (0x8F)

Function instance identifies the PVED-CC on the bus as source or target for communication.

In the service tool function instance is shown with decimal number (node Id). Hexa deximal (0x) values are used in communication description. numbers.

Function instance (node Id) 128 (0x80) is default for none configured PVED-CC (spare part).

Back up parameters – Node Id General settings
OEM data. Changes are implemented by boot up
Range: 128 – 143 (0x80 – 0x8F) Default value 128

Example

	SPN	Signal target	Signal source
18EA8006	18EA	80 (PVED 128)	06 (system CTRL)
1CECFF80	1CEC	FF (Broadcast)	80 (PVED 128)

Parameter Description (continued)

Component Id

By use of the service tool part number, serial number, software version and software details are available.
Back up parameters – Node Id General settings- read only – J1939.

Part number
Same as sales number. Also engraved on the PVED-CC housing.

Serial number
Example of serial number: 2211A056182

	Factory	Week	Year	Day*	Machine	Id
Engraved	---	22	11	A	05	6182
Soft	N	22	1	A	---	6182
* Day: A-Monday, B-Tuesday, C-Wednesday, D-Thursday, E-Friday, F-Saturday, G-Sunday						

Also engraved on the PVED-CC housing.

Software naming
Three digits giving a revision number. E.g. 2.68

Software details
- Software version   268   Revision number
- Project name   ISOBUS   Protocol format
- Information   Release   Software status
- Software Part number   11079035
- Hardware Part number   157B4943   Platform identifier. Not sales number
- Hardware Issue   08   Not used parameter
- Software build date   20100121   Compilation information
- Software build time   0953   Compilation information
- Software build host   NORLT422   Compilation information
- Software build location Sauer-Danfoss ApS   Compilation information
- Software label   ISOBUS_R2.68   Compilation information
- Software CRC   5C58   Compilation information

Scaling
Scaling reduces the set point automatically for the PVED. Scaling is relevant if the control speed must be lowered. The value defines how large a part of the set point is valid. Scaling can be defined independently for both extend and retract.

- Active parameters –Process Data – ISOBUS, is not stored for next session.

- Basic parameters – Process Data – WebGPI, is activated and stored for next session.

- Back up parameters – Process Data – OEM Data – WebGPI is not activated but stored. Can be moved to Basic Parameters.

- Configurable: Range: 0 % –100 % in steps of 0.4 % (0-250); Default value 100 % (250)

Parameter Description (continued)

Slope curve

Slope curve is a progressivity scaling of the set point. Slope curve can be used to get finer solution on set point with low flow. Slope curve can be defined independently for both extend and retract.

With PFC 125 and slope 0 (linear) the flow will be 50% of max flow.

With PFC 125 and slope 15 (maximum progressivity) the flow will be close to 15 % of max flow.

Spool characteristic curves

Spool Characteristic Curve

- Active parameters – Process Data – ISOBUS, is not stored for next session.

- Basic parameters – Process Data – WebGPI, is activated and stored for next session.

- Back up parameters – Process Data – OEM Data – WebGPI is not activated but stored. Can be moved to Basic Parameters

- Configurable: Range: 1 (linear) to 16   Default value 1 (linear)
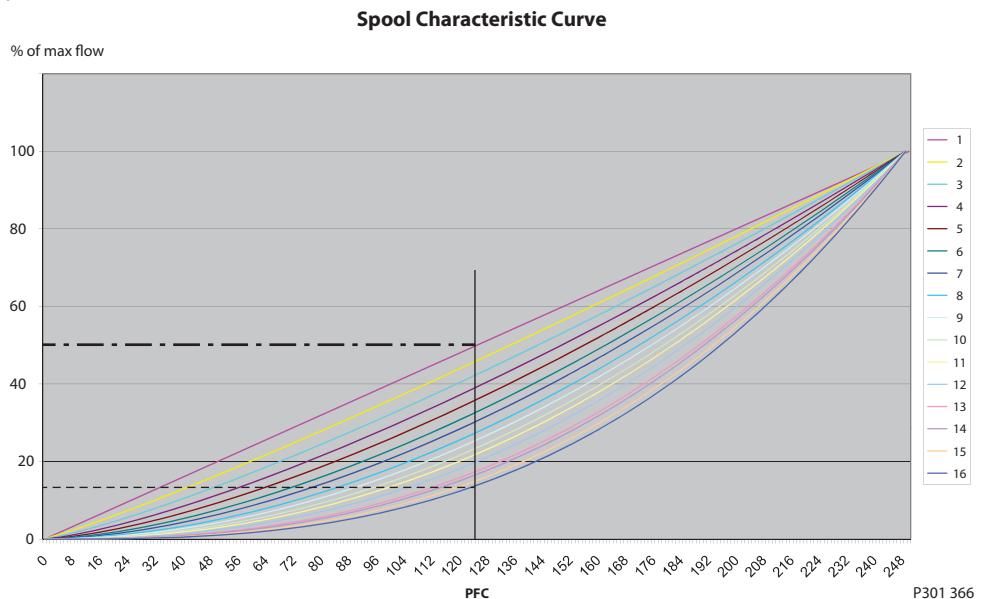
**Parameter Description
(continued)**

Ramp

Ramp builds in a delay in the flow change. Ramp is relevant if fast change in flow can harm the system. The value defines delay time for transition between 0 % and 100 % of maximum flow. Ramp can be defined independently for both flow growth and lowering in both extend and retract direction.

- Active parameters –Process Data –ISOBUS, is not stored for next session

- Basic parameters – Process Data –WebGPI, is activated and stored for next session

- Back up parameters – Process Data- OEM Data –WebGPI is not activated but stored.
  Can be moved to Basic Parameters

- Configurable: Range: 0s to 4s insteps of16ms(0-250); Default value 0s (0)

Invert ports

Invert port mirrors the flow command in the opposite direction. Invert port can be relevant if joy stick is operated from opposite side than standard.

Cannot be used with float spools

- Active parameters – Process Data – ISOBUS, is not stored for next session

- Basic parameters – Process Data – WebGPI, is activated and stored for next session

- Back up parameters – Process Data- OEM Data – WebGPI is not activated but stored.
  Can be moved to Basic Parameters

- Configurable: Range: none inverted and inverted (0-1); Default value none inverted (0)

Float threshold

Float threshold defines minimum flow before entering float. Float threshold can be used to avoid float state for lifted load. Float threshold cannot support float entering from opposite flow than float side of spool.   Ramp builds in a delay in the flow change. Ramp is relevant if fast change in flow can harm the system. The value defines delay time for transition between 0% and 100% of maximum flow. Ramp can be defined independently for both flow growth and lowering in both extend and retract direction..

- Active parameters –Process Data –ISOBUS, is not stored for next session

- Basic parameters – Process Data –WebGPI, is activated and stored for next session

- Back up parameters – Process Data- OEM Data –WebGPI is not activated but stored.
  Can be moved to Basic Parameters

- Configurable: Range: 0% –100% in steps of 0.4% (0-250); Default value 0.4% (1)

Not applying to float threshold will cause a warning.

**Parameter Description
(continued)**

AVEF send out time

The Auxiliary Valve Estimated Flow (AVEF) is an average in full percentage of the flow over the last 80ms (8 samples). The AVEF can be used for flow sharing, monitoring of unintended movement or reduced flow, handshake from PVED etc.

- Basic parameters – OEM data – WebGPI, is activated by send

- Back up parameters – OEM Data – WebGPI activated and stored for next session

- Configurable: Range: 0 - 64255 ms in steps of 10ms. 65535 (0 x FFFF) is disable; Default value 100 ms.

AVC time out (AVCTO)

The Auxiliary Valve Command (AVC) time out is the maximum time span between two set point commands from the system controller. See also error code description for Time guarding on Auxiliary Valve Command. The AVC Time Out is a handshake monitoring of controller.

- Basic parameters – OEM data – WebGPI, is activated by send

- Back up parameters – OEM Data – WebGPI activated and stored for next session

- Configurable: Range: 0 - 65535 ms in steps of 10 ms. 0 is disable;   Default value 0 ms.

Violating AVCTO will cause a fault.

Power save enable

The power save enable reduces the PVED power consumption by 90% when the spool has been in blocked position for more than 1 second.

- Basic parameters – OEM data – WebGPI, is activated by send

- Back up parameters –OEM Data – WebGPI activated and stored for next session

- Configurable: Range: Enabled (0xFF) – Disabled (0);   Default value Enabled.

**Parameter Description
(continued)**

Fault recovery – Fault monitoring mode

The fault recovery defines if a reboot is required for system recovery (Active) after un-demanded spool position or if AVC blocked (passive) can restore the application. Se further description in section Fault monitoring.

- Basic parameters – OEM data – WebGPI, is activated by send

- Back up parameters –OEM Data – WebGPI activated and stored for next session

- Configurable: Range: Passive (0) – Active(0xFF);   Default value Active.

Fault monitoring General Time Out (GTO)

The GTO defines for how long a fault can be accepted before solenoid valves are disabled and DM1 is transmitted. See further description in section Fault monitoring.

- Basic parameters – OEM data –WebGPI, is activated by send

- Back up parameters –OEM Data –WebGPI activated and stored for next session

- Configurable: Range: 250, 500, 750, 1000, 1250, 1500, 1750, 2000 ms;
          Default value 500 ms.

Fault monitoring Float Time Out (FTO)

The FTO defines for how long a float related fault can be accepted before solenoid valves are disabled and DM1 is transmitted. See further description in section Fault monitoring.

- Basic parameters – OEM data –WebGPI, is activated by send

- Back up parameters –OEM Data –WebGPI activated and stored for next session

- Configurable: Range: 750, 1000, 1250, 1500, 1750 ms;   Default value 750 ms.

**Parameter Description
(continued)**

KWP2000 Enable

The KWP2000 is used for passivating the PVED. This is relevant if busload must be reduced for other purposes.

- Basic parameters – OEM data – WebGPI, is activated by send

- Back up parameters –OEM Data – WebGPI activated and stored for next session

- Configurable: Range: Enable (0xFF) – Disable (0);   Default value Enable.

KWP2000 Id

The KWP2000 Id defines whether global addressing or specific addressing must be used for the operation.

- Basic parameters – OEM data – WebGPI, is activated by send

- Back up parameters –OEM Data – WebGPI activated and stored for next session

- Configurable: Range: Specific (0xFF) – Global (0);   Default value Global.

KWP2000 max time

The KWP2000 max time defines maximum interval between messages.

- Basic parameters – OEM data – WebGPI, is activated by send

- Back up parameters –OEM Data – WebGPI activated and stored for next session

- Configurable: Range: 0 s – 255 s;   Default value 5 s.

Parameter Description (continued)

Spool Curve

The spool curve defines relation between PFC in AVC and actual spool position in PVB. See also section Communication. J1939 defines an increment of the PFC by one gives a flow growth of 0.4% of max spool flow. Customization of the spool curve changes this ratio.
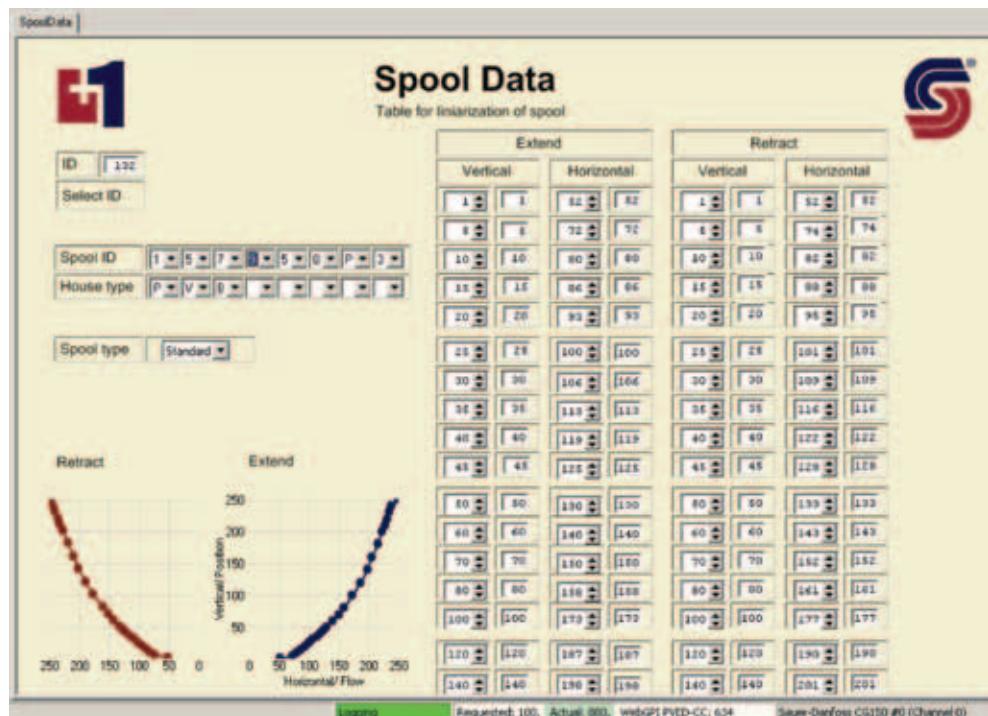
Vertical is the flow command horizontal is the spool position.

Vertical 1 refers to PFC 1 and horizontal 52 is PVBS (7 mm/250)*52 = 1.46 mm out of neutral.

Vertical 250 is equal to flow 100%.

Float spools

For float spools Spool type Float opens menu to defines float direction by standard mounting. Float A is float in retract. Maximum flow (vertical 250) is at horizontal 196 (5.5 mm) and for PVBZ at horizontal 171 (4.8 mm). For software version 2.40 and newer float in both directions is supported for PVG 100.

Vertical 1 and vertical 250 must be present to avoid fault.

All values must be equal to or larger than the value to its left. Between two set of parameters (PFC vs position) linear interpolation is used.

Parameter setting is done with the service tool.

Parameter Setting

A number of parameters can be set for each valve using Process Data messages. (ISO11783-7 section B.24)

Process Data Message

Transmission repetition rate	As conditions require		
Data length	8 bytes		
Data page	0		
PDU format	203		
PDU specific	Destination address (128 - 143 for valves 0 - 15)		
Default priority	3		
Parameter group no.	52096 (00CB80$_{16}$)		
Message layout	Byte 1	Bit 8	Reserved (to be sent as '0' until further defined)
		Bits 7 - 6	Data format / error condition
		Bits 5 - 4	Process data type
		Bits 3 - 1	Process data type modifier
	Byte 2	Count number	
	Byte 3	Bits 8 - 5	Implement type
		Bits 4 - 1	Implement position
	Byte 4	Bits 8 - 5	Data dictionary row
		Bits 4 - 1	Data dictionary column
	Bytes 5 - 8	Process variable value	
Parameters	Process data type	00$_b$ = write	
		10$_b$ = read	
	Data dictionary row 6		

Process Data Message

Data dictionary	Column		Default
	0	Scaling extend, 0 - 250 (0 - 100 % in steps of 0.4 %)	250
	1	Scaling retract, 0 - 250 (0 - 100 % in steps of 0.4 %)	250
	2	Not used (Progressive /Degressive)	0
	3	Slope extend, 0, 7, 13, 18, 25, 31, 37, 44, 49, 56, 61, 68, 77, 81, 88, 94	0
	4	Dead band (Not used)	0
	5	Dead band (Not used)	0
	6	Slope retract, 0, 7, 13, 18, 25, 31, 37, 44, 49, 56, 61, 68, 77, 81, 88, 94	0
	7	Not used (Progressive/Degressive)	0
	8	Ramp up extend, 0 - 250 (0 - 4000 ms in steps of 16 ms)	0
	9	Ramp down extend, 0 - 250 (0 - 4000 ms in steps of 16 ms)	0
	A	Ramp up retract, 0 - 250 (0 - 4000 ms in steps of 16 ms)	0
	B	Ramp down retract, 0 - 250 (0 - 4000 ms in steps of 16 ms)	0
	C	Invert port, 0 (Off), 1 (ON)	0
	D	Float threshold, 0 - 250 (0 - 100 % in steps of 0.4 %)	0

Parameter Setting (continued)

To set 50 % scaling on the extend port, send this message to the valve:

ID	DLC	1	2	3	4	5	6	7	8
CCB8006	8	00	00	00	60	7D	00	00	00

To read scaling on the extend port, send this message to the valve:

ID	DLC	1	2	3	4	5	6	7	8
CCB8006	8	10	00	00	60	00	00	00	00

The valve will respond with:

ID	DLC	1	2	3	4	5	6	7	8
CCB8080	8	10	00	00	60	7D	00	00	00

Software ID

According to J1939/71, section 5.3.47

Software identification message

Transmission repetition rate	On request	
Data length	Variable	
Data page	0	
PDU format	254	
PDU specific	218	
Default priority	6	
Parameter group no.	65242 (00FEDA$_{16}$)	
Messages layout	Byte 0	Number of fields (11)
	Byte 1...	SW version
		ASCII * Delimiter
		Project name
		ASCII * Delimiter
		Text information
		ASCII * Delimiter
		Software part number
		ASCII * Delimiter
		Hardware part number
		ASCII * Delimiter
		HW Version
		ASCII * Delimiter
		Build data
		ASCII * Delimiter
		Build time
		ASCII * Delimiter
		Host
		ASCII * Delimiter
		Location
		ASCII * Delimiter
		SW Label
		ASCII * Delimiter
	Max. 185 bytes	

Component ID

According to J1939/71 section 5.3.25

Component identification message

Transmission repetition rate	On request		
Data length	Variable		
Data page	0		
PDU format	254		
PDU specific	218		
Default priority	6		
Parameter group no.	65242 (00FEEB$_{16}$)		
Message layout	Byte 1	ASCII * Delimiter	
	Bytes 2 - 9	Field b: Model	
	Bytes 10	ASCII * Delimiter	
	Bytes 10 - 20	Field c: Serial number	
	Bytes 21 - 22	ASCII * Delimiter	
Fields	Model	The according code of the PVED-CC	
	Serial number	Byte 1	Location: (Nordborg, DK)
		Byte 2	(Space)
		Bytes 3 - 4	Week of production
		Byte 5	Year of production
		Byte 6	Day of the week:
			A = Monday,
			G = Sunday
		Bytes 7 - 10	Running serial

The model and serial number fields are sent in ASCII.

Requesting PGN's

Both Component ID and Software ID are requested using this message:

PGN request message

Transmission repetition rate	On request
Data length	8 bytes
Data page	0
PDU format	234
PDU specific	Destination adress (128 - 143 for valves 0 - 15)
Default priority	6
Parameter group no.	59904 (00EA00$_{16}$)
Message layout	Bytes 1 - 3 requested PGN
	Bytes 4 - 8 not used

To request component ID, send this message to the valve

ID	DLC	1	2	3	4	5	6	7	8
18EA8006	8	EB	FE	00	00	00	00	00	00

The component ID is returned using BAM/TP

	ID	DLC	1	2	3	4	5	6	7	8
BAM	1CECFF80	8	20	16	00	04	FF	EB	FE	00
			BAM	Bytes	Bytes	Packets	Res	PGN	PGN	PGN
DT 1	1CEBFF80	8	01	2A	31	35	37	58	30	39
			Seq	*	1	5	7	B	4	9
DT 2	1CEBFF80	8	02	37	35	2A	4E	20	35	31
			Seq	4	2	*	N	space	5	1
DT 3	1CEBFF80	8	03	31	43	30	30	30	31	2A
			Seq	1	C	0	0	0	1	*
DT 4	1CEBFF80	8	04	2A	FF	FF	FF	FF	FF	FF
			Seq	*						

Component ID extracted from message: *157B4942*N 511C0001**

Fault Mode

If the PVED-CC detects a failure it will send a DM1 within the next 20ms and if defined also disable the solenoid valves.

DM 1 Error message (J1939/73 Section DM1)

Transmission repetition rate	On request		
Data length	8 bytes		
Data page	0		
PDU format	254		
PDU specific	202		
Default priority	6		
Parameter group no.	65226 (00FECA$_{16}$)		
Message layout	Byte 1	Lamp	
	Byte 2	Reserved (FF)	
	Byte 3 - 5	SPN/FMI	
	Byte 6	Occurrence counter	
	Byte 7 - 9	SPN/FMI	
	Byte 10	Occurrence counter	
Details		Lamp	Bits 8 - 7	Malfunction lamp status
			Bits 6 - 5	Red stop lamp status
			Bits 4 - 3	Amber warning lamp status
			Bits 2 - 1	Protect lamp status
		SPN/FMI	Bits 24 - 6	SPN
			Bits 5 - 1	FMI

If one error has been detected, the valve sends

ID	DLC	1	2	3	4	5	6	7	8
18FECA80	8	Lamp	Res	SPN1	SPN2	SPN3/FMI	OC	FF	FF

If more than one error is active BAM/TP is used for transmission

	ID	DLC	1	2	3	4	5	6	7	13,566
BAM	1CECFF80	8	20	16	00	04	FF	CA	FE	00
			BAM	Bytes	Bytes	Packets	Res	PGN	PGN	PGN
DT 1	1CEBFF80	8	01	Lamp	Reserved	SPN1	SPN2	SPN3/FMI	OC	SPN1
			Seq							
DT 2	1CEBFF80	8	02	SPN2	SPN3/FMI	OC	SPN1	SPN2	SPN3/FMI	OC
			Seq							
DT 3	1CEBFF80	8	03	SPN1	SPN2	SPN3/FMI	OC	SPN1	SPN2	SPN3/FMI
			Seq							
DT 4	1CEBFF80	8	04	ON	FF	FF	FF	FF	FF	FF
			Seq	*						

For details see the *Error Codes* chapter, page 59.

Fault Mode (continued)

The errorlog of the PVED-CC is read by requesting the correct PGN. The returned data has the same format as DM1 (J1939/79 Section DM2)

Error message

Transmission repetition rate	On request			
Data length	8 bytes			
Data page	0			
PDU format	254			
PDU specific	203			
Default priority	6			
Parameter group no.	65227 (00FECB$_{16}$)			
Message layout	Byte 1	Lamp		
	Byte 2	Reserved (FF		
	Byte 3 - 5	SPN/FMI		
	Byte 6	Occurrence counter		
	Byte 7 - 9	SPN/FMI		
	Byte 10	Occurrence counter		
Details		Lamp	Bits 8 - 7	Malfunction lamp status
			Bits 6 - 5	Red stop lamp status
			Bits 4 - 3	Amber warning lamp status
			Bits 2 - 1	Protect lamp status
		SPN/FMI	Bits 24 - 6	SPN
			Bits 5 - 1	FMI

To clear the errorlog request the PGN below. The PVED-CC will not respond, but the result can be checked using DM2 (J1939/73 Section DM3)

Error message

Transmission repetition rate	On request
Data length	8 bytes
Data page	0
PDU format	254
PDU specific	204
Default priority	6
Parameter group no.	65228 (00FECC$_{16}$)

State Machine and Operational Modes

After power up, the PVED-CC will go through the following sequence•
- Power On Self Test [POST]
- Initialise communication
- Issue Address Claim CAN message
- Go into operational mode
- Start sending out Auxiliary Valve Estimated Flow messages [AVEF]
- Start listening for Auxiliary Valve Command [AVC] and Process Data [PD]

The AVEF will be send from the PVED as long as it is Transmitting

On the macro level the PVED-CC is driven by a state machine where state changes are driven by operator choice or fault condition with two exceptions.

Device state machine diagram (DSM)
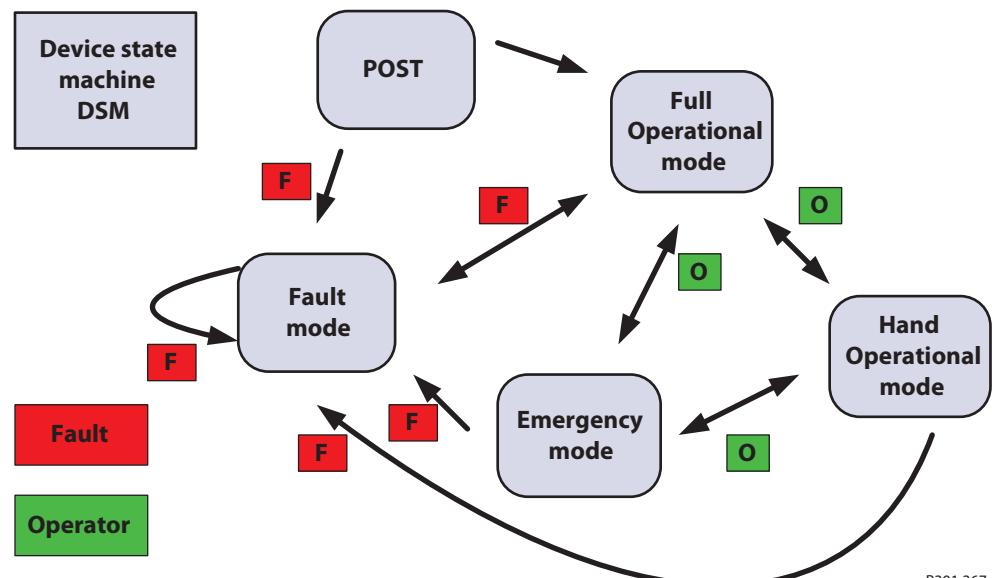
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State Machine and Operational Modes (continued)

Power On Self Test

When the PVED-CC is powered a series of tests are performed before operation start.
- Code CRC is calculated and compared with stored value
- Internal signals are evaluated
- EEPROM stored parameters are compared
- Spool position is evaluated.

uCSM

Short walk through of PVED operation:
After the POST the embedded system starts to follow a 10 millisecond rhythm. Every 10 ms the control task starts. This Microcontroller State Machine (uCSM) defines interaction between valve and system master.

MC state machine diagram(uCSM)
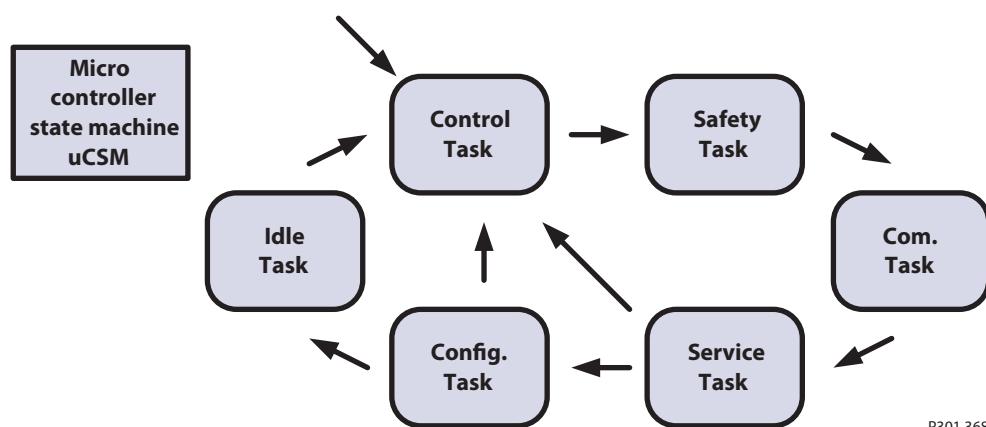
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- Control Task defines set point for the ASIC. Initial value is blocked
- Safety Task verify system state and enable solenoids if allowed and needed
- Communication Task reads communication in buffers and writes to communication out buffers. CAN signal handling
- Service Task evaluate changes in settings if required by system master
- Configuration Task writes to memory
- Idle Task waits for next 10 ms tic

AVEF

The valve will send out an Axillary Valve Estimated Flow (AVEF) message (ISO11783-7 section B.11) based on the average spool position during the last 80ms. Frequency is by default 1/100ms. Value is configurable.

In the present software the message is extended to eight byte.

ID	DLC	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
CFE1080	8	Extend	Retract	State	SD mode	SD PWM	SD SP ASIC	SD SP Ctrl	SD temp

AVEF for node 128 (0x80).

Interpretation

- Extend. Estimated percentage of maximum flow as an averaged over 80 ms calculated on basis of the spool curve with an off set of 125.

Estimated flow in extend	Value in DEC	Value in HEX
0 %	125	7D
25%	150	96
100%	225	E1

- Retract. Estimated percentage of maximum flow as an averaged over 80 ms calculated on basis of the spool curve with an off set of 125.

- State. Four bits are used for indication. Only these values are legal.

State	Blocked	Extend	Retract	Float	Fault
Indicator	0	1	2	3	14

- SD mode uses bit setting in this pattern XPMMHHLA.

Parameter	Indicates	Combination	Interpretation
X	HAND OPERATIONAL	0/1	DISABLED/ENABLED
P	Toggle mode	0/1	De-energized/energized
MM	SOLENOID CONTROL	00	ENERGIZED
		01	Power Save (not in 2.60)
		10	DISABLED
		11	Reserved
HH	PRINT BOARD	00	RESERVED
		01	Old PCB
		10	PCB WITH TEMPERATURE SENSOR AND EXTRA LVDT MONITORING
		11	Reserved
L	LVDT fault	0/1	False/True
A	ASIC error pin	0/1	False/True

- L and A are the internal signals not an indication of the module fail mode. By False no fault is present.
- 0x08 (00001000) Normal operation with activated solenoids, new PCB
- 0x18 (00011000) Normal operation in Power Save, new PCB
- 0xA4 (10100100) Hand operational, solenoids disabled, old PCB, LVDT OK, ASIC OK

AVEF (continued)

- SD PWM is the control signal send from microcontroller to closed loop control.
  - Resolution is 0.8 pct of spool travel.
  - Value is not filtered.

Set point	Value in DEC	Value in HEX
- 7 mm (retract)	0	0
- 1,4 mm	100	64
Blocked	125	7D
+ 7 mm	250	FA

- SD SP ASIC is the spool position calculated by the ASIC.
  - Value is not filtered and not adjusted to module calibration.

Spool position	Value in DEC	Value in HEX
- 7 mm (retract)	0	0
- 1,4 mm	100	64
Blocked	125	7D
+ 7 mm	250	FA

- SD SP CTRL is the spool position calculated by the microcontroller based on direct LVDT feedback to microcontroller.
  - Value is not filtered and not adjusted to module calibration
  - Value is fixed as 0xFE in SW 2.60 and if old PCB is used.

Spool position	Value in DEC	Value in HEX
- 7 mm (retract)	0	0
- 1,4 mm	100	64
Blocked	125	7D
+ 7 mm	250	FA

- SD temp is the instant value for PCB temperature. Resolution is 1 °C.
  - Value is not filtered.
  - Value is fixed as 0xFE in SW 2.60 or if old PCB is used.

Temperature	Value in DEC	Value in HEX
-40 °C [-40 °F]	10	0A
0 °C [32 °F]	50	32
100 °C [212 °F]	150	64
200 °C [392 °F]	250	C8

Flow is 0 % when state is float. Flow above 0 % in extend and retract at the same time is fault.
SD parameters are proprietary use of the AVEF message and can be ignored.
The SD PWM, SD SP ASIC and SD SP CTRL are used for spool monitoring.
If spool is further out than 'Fault Limit' for more than GTO, a fault is raised.

⚠ Warning
The limitation on operating temperature is still valid. Average working temperature above 85 °C [185 °F] and peek temperature above 100 °C [212 °F] can harm electronic components.

AVEF (continued)

In PVED-CC with software version 2.40 and older this format is used.

Auxiliary valve 0 estimated flow

Transmission repetition rate	100 ms		
Data length	8 bytes		
Data page	0		
PDU format	254		
PDU specific	16 (16 - 31 for valves 0 - 15)		
Default priority	3		
Parameter group no.	65040 (00FE10$_{16}$)		
Message layout	Byte 1	Estimated flow extend	
	Byte 2	Estimated flow retract	
	Byte 3	Bits 8 - 7	Fail safe mode
		Bits 6 - 5	Reserved
		Bits 4 - 1	Valve state
	Bytes 4 - 8	Reserved	
Parameters	Estimated flow	Estimated flow as percentage of maximum available flow.	
		Resolution	1 % / bit
		Offset	125 %
		Range	-125 % - 125 %
	Operating mode	*Valve state*	
		0 Blocked	
		1 Extend	
		2 Retract	
		3 Floating	
		14 Error indication	

The PVED-CC will only estimate positive flow, ie. out of the port.

If the spool has moved to 50% flow out of the Retract port, the valve sends this message:

ID	DLC	1	2	3	4	5	6	7	8
CFE1080	8	7D	AF	02	00	00	00	00	00

The "Error Indication" in the valvestate field will be used if the µP detects servere faults in LVDT wiring, memory or internal computation.

State Machine and Operational Modes (continued)

Full operational mode

On the macro level the Full Operational Mode is the default. This is when no faults are present and no special commands are given. In this Mode the operator has full control and controllability of the valve via the system control devices.

Full operational mode diagram
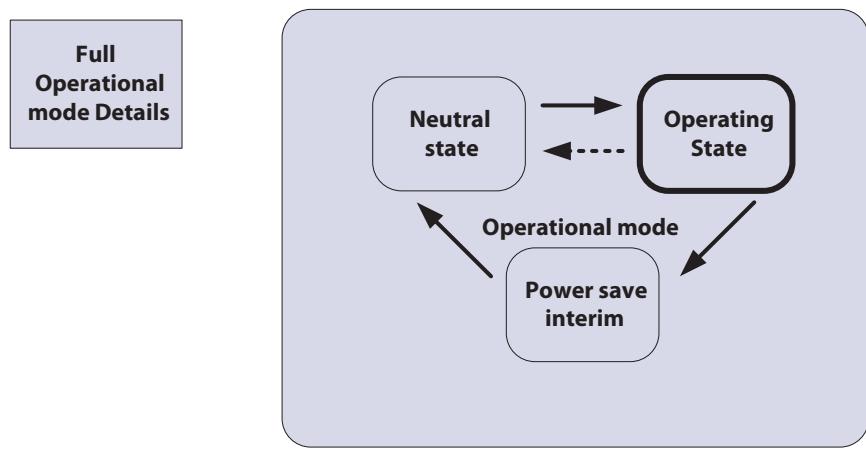
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When PVED is unpowered or in power save mode the main spool is kept in blocked/ neutral position by the neutral spring. By use of the handle (PVM) or the solenoid valves and the Pp the spool can be moved to any position and so open for system pressure to the application.

Closed loop

ASIC: Solenoid control is run at 40Hz in operation mode Full Operational
Solenoid valve control is deactivated in power save. Monitoring is still active.

Spool positioning

- Extend is defined as spool moving away from PVE and equals positive values.
- Retract is defined as spool moving towards PVE and equals negative values.

In Full Operational mode the PVED-CC responds to AVC.

Flow Control

To control the PVED-CC, send AVC messages to it. (ISO11783-7 section B.13)

Auxiliary valve command

Transmission repetition rate	Maximum rate of 1 second between messages for each valve or when a parameter is required to change state. Minimum rate of 10 ms		
Data length	8 bytes		
Data page	0		
PDU format	254		
PDU specific	48 (48 - 63 for valves 0 - 15)		
Default priority	3		
Parameter group no.	65072 (00FE30$_{16}$)		
Message layout	Byte 1	PFC	
	Byte 2	Reserved	
	Byte 3	Bits 8 - 7	Fail safe mode (ignored, always in blocked)
		Bits 6 - 5	Reserved
		Bits 4 - 1	Valve state
	Bytes 4 - 8	Reserved	
Parameters	PFC	Wished flow as percentage of maximum available flow.	
		Resolution	0.4 % / bit
		Offset	0%
		Range	0 - 100%
	Operating mode	*Valve state*	
		0 Blocked	
		1 Extend	
		2 Retract	
		3 Floating	
		Fail safe mode	
		0 Blocked	

AVC	Aux. Valve command	PD	Process data
PFC	Port flow command	BAM	Broadcast announce message
AUX.	Valve estimated flow	TP	Transport protocol

The valve checks messages for coherency and if a message is not correct, the valve will go to blocked and an error message will be issued. To set a flow in a port, the 1st byte must be non-zero and the second must be zero. To go to float, both 1st and 2nd bytes must be zero. If a float threshold is active the previous message must have left the valve in retract above the threshold.

To set 50% flow out of the Retract port, send this message to the valve:

ID	DLC	1	2	3	4	5	6	7	8
CFE3006	8	7D	00	02	00	00	00	00	00

Hand Operational Mode

The possibility to enter a Hand Operational mode is now implemented. This mode de-energize the solenoid valves, disables spool position fault monitoring and AVC time out. This mode is not covered by the ISO 11783 part 7.

Benefits are:
- Hydraulics do not work against the PVM
- No spool position fault is recorded
- Application controller does not have to send set points
- Estimated Flow is still reported to system
- Remaining safety functions in PVED are still active.

To enter Hand Operational mode use the Auxiliary Valve Command (AVC) with port flow 0 % and valve state 10.

ID	DLC	Byte 1 PFC	Byte 2 reserved	Byte 3 state	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
CFE3006	8	0	0	A	0	0	0	0	0

Enter Hand Operational mode for node 128 (0x80).

To leave Hand Operational mode use the Auxiliary Valve Command (AVC) Blocked.

ID	DLC	Byte 1 PFC	Byte 2 reserved	Byte 3 state	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
CFE3006	8	0	0	0	0	0	0	0	0

Leave Hand Operational mode for node 128 (0x80).
Leaving Hand Operational mode will not activate the jitter.

Emergency Stop

Gives blocked set point and overrules any ramping
This mode is not covered by the ISO 11783 part 7.

To enter Emergency Stop use the Auxiliary Valve Command (AVC) with port flow 0 % and valve state 14.

ID	DLC	Byte 1 PFC	Byte 2 reserved	Byte 3 state	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
CFE3006	8	0	0	E	0	0	0	0	0

Start Emergency Stop for node 128 (0x80).

To disable Emergency Stop use the Auxiliary Valve Command (AVC) Blocked.

ID	DLC	Byte 1 PFC	Byte 2 reserved	Byte 3 state	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
CFE3006	8	0	0	0	0	0	0	0	0

Disable Emergency Stop for node 128 (0x80).

Error Code Walk Through

The PVED-CC can detect a number of events that can be seen as faults and will categorize them into error codes (DM). Any of these events will raise a flag in the microcontroller and when the uCSM enters the safety task a system reaction follows.

Non-expected event
- Safety Task counts until threshold value
- If temporary or permanent fault ASIC solenoid enable is disabled (smart reaction is a special case)
  - By Warning, Temporary and Permanent a DM1 is sent
  - Error counter is added one up.

System is kept in this state for the minimum time depending on SW version.

If the state is still present after one second the DM1 is resend. If more than two fault are present a Broadcast Announce Message (BAM) is used. During fault state the system, limited by present faults, still monitors for additional faults.

Recovery
Recovery depends on fault category.
Warning: operation is maintained as before warning was sent.
Temporary: When fault condition disappears and two AVC Blocked are sent operation can be recontinued.
Permanent: A reboot is required to start operation.
Temporary/permanent: recovery depends on monitoring and recovery mode defined in OEM settings.

Settings
A number of OEM settings has influence on the fault monitoring.

General timeout (GTO)
The GTO is the time limit a filtered fault must be present before it is recognized as a fault.

Float timeout (FTO)
As the GTO but only for entering and leaving float.

Auxiliary valve timeout (AVCTO)
The AVCTO works as a watchdog on the controller AVC. The setting can be from 0 to 65535 ms in step of 10 ms. Setting 0 ms disables timeguarding, meaning last received set point is always valid. AVCTO functionality is also defined by SW ver.

Power save (OEM)
Read section on software version variants

Spool curve
Dead band setting and float availability influences fault entering

Float available (spool)
A spool without float cannot be sent to float.

⚠ Warning
The spool with float must have a spool curve for float to avoid unintended float.

Error Code Walk Through (continued)

Error codes

SPN: suspect parameter number. Reference to the SAE J1939.
FMI: Failure mode indicator
Number in brackets is the message sent.
Index is the Sauer-Danfoss fault identification.

1's complement redundancy test

SPN: 299007
FMI: 12, {0xFF, 0x8F, 0x8C} index 0.
Cause: An internal error in the PVED-CC's RAM occurred.
Error: Permanent. This error requires reboot to restore CAN control.
Solution: Turn the ignition key off and back on.
            If the fault code is repeated (the fault code is increased by 1), the PVED-CC
            should be replaced.

1st boot

SPN: 299006
FMI: 12, {0xFE, 0x8F, 0x8C} index 1.
Cause: Reserved for internal use.
Solution: Not available. By reoccurrences you must contact your dealer.

Reserved

SPN: 299005
FMI: 0, {0xFD, 0x8F, 0x80} index 2.
Cause: Reserved for internal use.
Solution: Not available. By reoccurrences you must contact your dealer.

Division by zero

SPN: 299004
FMI: 11, {0xFC, 0x8F, 0x8B} index 3.
Cause: This is an internal software error.
Error: Permanent. This error requires reboot to restore CAN control.
Solution: Cycle power. If the error is repeated replace the PVED-CC

CapCom values

SPN: 299003
FMI: 11 {0xFB, 0x8F, 0x8B} index 4.
Cause: This is an internal software error.
Error: Permanent. This error requires reboot to restore CAN control.
Solution: Cycle power. If the error is repeated replace the PVED-CC

Error Code Walk Through (continued)

Variable truncation

SPN:	299002
FMI:	11 {0xFA, 0x8F, 0x8B} index 5
Cause:	This is an internal software error.
Error:	Permanent. This error requires reboot to restore CAN control.
Solution:	Cycle power. If the error is repeated replace the PVED-CC

Verified write to cell error

SPN:	299001
FMI:	12 {0xF9, 0x8F, 0x8C} index 6
Cause:	This error indicates an error in the parameter storage.
Error:	Permanent. This error requires reboot to restore CAN control.
Solution:	Cycle power. If the error is repeated replace the PVED-CC

Reserved

SPN:	298969
FMI:	0, {0xD9, 0x8F, 0x80} index 7.
Cause:	Reserved for internal use.
Error:	Permanent. This error requires reboot to restore CAN control.
Solution:	Not available. By reoccurrences you must contact your dealer.

Interpolation check

SPN:	298968,
FMI:	11, {0xD8, 0x8F, 0x8B} index 8.
Cause:	Reserved for internal use.
Error:	Permanent. This error requires reboot to restore CAN control.
Solution:	Not available. By reoccurrences you must contact your dealer.

Estimate calibration values error

SPN:	299000
FMI:	13, {0xF8, 0x8F, 0x8D} index 9.
Cause:	Reserved for internal use.
Error:	Permanent. This error requires reboot to restore CAN control.
Solution:	Not available. By reoccurrences you must contact your dealer.

PWM calibration values error

SPN:	298999
FMI:	13, {0xF7, 0x8F, 0x8D} index 10.
Cause:	Reserved for internal use.
Error:	Permanent. This error requires reboot to restore CAN control.
Solution:	Not available. By reoccurrences you must contact your dealer.

Error Code Walk Through (continued)

Mechanical Spool Compensation values

SPN:	298998
FMI:	13, {0xF6, 0x8F, 0x8D} index 11.
Cause:	Incorrect Spool Data Values were sent to the PVED-CC. The values were rejected. This will never happen during normal operation.
Error:	Permanent. This error requires reboot to restore CAN control.
Solution:	Review and correct the Spool Data that is sent to the PVED.

Reserved

SPN:	298997
FMI:	0, {0xF5, 0x8F, 0x80} index 12.
Cause:	Reserved for internal use.
Error:	Permanent. This error requires reboot to restore CAN control.
Solution:	Not available. By reoccurrences you must contact your dealer.

Spool data and Float available

SPN:	298996,
FMI:	2, {0xF4, 0x8F, 0x82} index 13.
Cause:	An attempt was made to program the PVED with Spool Data that indicate that a float position is available, but the curve also extends into the float position. This will never happen during normal operation.
Error:	Temporary. To restore control send two consecutive Blocked commands.
Solution:	Review and correct the Spool Data that is sent to the PVED.

Reserved

SPN:	298967,
FMI:	0, {0xD7, 0x8F, 0x80} index 14.
Cause:	Reserved for internal use.
Error:	Permanent. This error requires reboot to restore CAN control.
Solution:	Not available. By reoccurrences you must contact your dealer.

Reserved

SPN:	298966,
FMI:	0, {0xD6, 0x8F, 0x80} index 15.
Cause:	Reserved for internal use.
Error:	Permanent. This error requires reboot to restore CAN control.
Solution:	Not available. By reoccurrences you must contact your dealer.

Error Code Walk Through (continued)

CRC16 check / Parameter Memory

SPN:	630
FMI:	12, {0x76, 0x02, 0x0C} index 16.
Cause:	At saving values to the EEPROM an error occurred. This can be due to a bad cell.
Solution:	Turn power off and on, wait 20 sec, turn power off and on and check if the message SPN 298994 FMI 11 comes up. Now EEPROM data should be updated with approved data. By reoccurrences modules must be replaced.

Fall back to old values.

SPN:	298995
FMI:	11, {0xF3, 0x8F, 0x8B} index 17.
Cause:	There was an error during CRC16 check of parameter memory, because power was removed at the saving time, and the PVED-CC uses the back up. Warning. You have full control of the PVED.
Solution:	If you have tried to change settings you must repeat.

CRC16 check / Program Memory

SPN:	628
FMI:	12, {0x74, 0x02, 0x0C} index 18.
Cause:	A CRC 16 check was made on the software image and saved in the flash. A CRC 16 check is made on the flash every 10 s and compared. If they do not match this message will be sent out.
Error:	Permanent. This error requires reboot to restore CAN control.
Solution:	Replace the PVED-CC.

Main spool cannot reach neutral from retract

Only accessible in service tool. index 19.
Errors recorded here are for DM1 and DM2 counted with index 26.

In software version 2.40 and older was

ASIC supervision of CL control
SPN: 298965, FMI: 12, {0xD5, 0x8F, 0x8C} index 19.
Cause: The internal electronics (ASIC) in the PVED has reported an error to the micro controller.
Temporary error. Depending on Fault monitoring mode the control of the PVED is regained when the error disappears.
Solution: Not available. By reoccurrences you must replace PVED-CC.

LVDT wiring error

SPN:	298994
FMI:	12, {0xF2, 0x8F, 0x8C} index 20.
Cause:	The LVDT feed back is too high or to low. This could be caused by the LVDT put to an extreme position, a short circuited connection to the LVDT or a broken a broken connection.
Error:	Permanent. This error requires reboot to restore CAN control.
Solution:	Replace the PVED-CC.

Error Code Walk Through (continued)

Power supply above specified range

SPN: 627

FMI: 3, {0x73, 0x02, 0x03} index 21.

Cause: The power supply is above 32 volt

Error: Temporary. Depending on Fault monitoring mode the control of the PVED is restored when the error disappears and the PVED has received two consecutive Blocked commands.

Solution: Lower the voltage to 30 volt and the error will disappear.

Power supply below specified range

SPN: 627

FMI: 4, {0x73, 0x02, 0x04} index 22.

Cause: The power supply is below 10 volt

Error: Temporary. Depending on Fault monitoring mode the control of the PVED is restored when the error disappears and the PVED has received two consecutive Blocked commands.

Solution: Increase the voltage to 11 volt and the error will disappear.

No answer on handshakes

SPN: 298993

FMI: 11, {0xF1, 0x8F, 0x8B} index 23.

Cause: The supervisor is not working correctly, or the microcontroller has stopped sending handshakes to the supervisor.

Error: Permanent. This error requires reboot to restore CAN control.

Solution: Turn the ignition key off and back on, if the fault code is repeated (the fault counter is increased by 1), the PVED-CC should be replaced.

Power-on self test failed

SPN: 298992

FMI: 12, {0xF0, 0x8F, 0x8C} index 24.

Cause: The supervisor did not start up correctly.

Error: Permanent. This error requires reboot to regain CAN control.

Solution: Turn the ignition key off and back on, if the fault code is repeated (the fault counter is increased by 1), the PVED-CC should be replaced.

Special case: Error can occur by download of software. If power is kept on after download the microcontroller reactivates. As the PVED has not been rebooted the electronic is not reset, this causes the error.

Time value for CL control out of range

SPN: 298964,

FMI: 2, {0xD4, 0x8F, 0x82} index 25.

Cause: Reserved for internal use.

Error: Temporary. To restore CAN control send two consecutive Blocked commands.

Solution: Not available. By reoccurrences you must contact your dealer.

Error Code Walk Through (continued)

Main spool cannot reach neutral

SPN:	298991
FMI:	7, {0xEF, 0x8F, 0x87} index 26.
Cause:	The spool is stuck in some position outside neutral position, and the PVED-CC cannot move it back to neutral. The PVED-CC disables the solenoids so the spool should be returned to neutral position by the spring.
Error:	Temporary. Depending on Fault monitoring mode the control of the PVED is restored when the error disappears and the PVED has received two consecutive Blocked commands.
Solution:	Check for dirt in the mechanical part of the valve, especially around the spool. There is also a filter at the pilot oil inlet of the PVED-CC that may be blocked. If this does not help, replace the PVED-CC.
	For DM1 and DM2 this SPN covers index 19 + index 26.
	In service tool index 26 covers "Main spool cannot reach neutral from extend".

Main spool cannot reach float position

SPN:	298990
FMI:	7, {0xEE, 0x8F, 0x87} index 27.
Cause:	The spool cannot go all the way to 7 mm stroke.
Error:	Temporary. Depending on Fault monitoring mode the control of the PVED is restored when the error disappears and the PVED has received two consecutive Blocked commands.
Solution:	Check for dirt in the mechanical part of the valve, especially around the spool. There is also a filter at the pilot oil inlet of the PVED-CC that may be blocked. If this does not help, replace the PVED-CC.

Main spool not in neutral at boot up

SPN:	298989
FMI:	7, {0xED, 0x8F, 0x87} index 28.
Cause:	The spool must be in neutral at boot up. If the PVED-CC is powered up, but not mounted on the valve house, or if it is mounted, but does not have Spool parameters downloaded, the spool will not be in neutral.
Error:	Temporary. Depending on Fault monitoring mode the control of the PVED is restored when the error disappears and the PVED has received two consecutive Blocked commands.
Solution:	Mount the PVED-CC on the valve house, and make sure there is no dirt between the pin and the spool. Turn power back on and see if the message occurs again. If it does, download spool parameters to the valve, turn off/on. If there still is an error, replace the PVED-CC.

Main spool position is greater than the reference

SPN:	298988
FMI:	7, {0xEC, 0x8F, 0x87} index 29.
Cause:	The spool has moved further out than intended.
Error:	Temporary. Depending on Fault monitoring mode the control of the PVED is restored when the error disappears and the PVED has received two consecutive Blocked commands.
Solution:	Power off and on. If the error is repeated, replace the PVED-CC.

Error Code Walk Through (continued)

Main spool position and reference are in opposite directions

SPN: 298987
FMI: 7, {0xEB, 0x8F, 0x87} index 30.
Cause: After a change in set point, the spool must move to the direction of the new set point. If the spool is in the wrong direction after the set fault monitoring delay this error is issued.
Error: Temporary. Depending on Fault monitoring mode the control of the PVED is restored when the error disappears and the PVED has received two consecutive Blocked commands.
Solution: Change to oil with a higher viscosity, set a limitation to the spool stroke or/and change the fault monitoring delay.
If the error is repeated with oil at 20 cS replace the PVED-CC.

Float threshold has not been passed

SPN: 298986
FMI: 7, {0xEA, 0x8F, 0x87} index 31.
Cause: A Port Flow Command to go to floating position was issued when the spool had not moved outside the float threshold.
Error: Temporary. Depending on Fault monitoring mode the control of the PVED is restored when the error disappears and the PVED has received two consecutive Blocked commands.
Solution: Let the spool move outside the float threshold before issuing the floating position command or change the float threshold value.

Time guarding on Auxiliary Valve Command

SPN: 298985
FMI: 19, {0xE9, 0x8F, 0x93} index 32.
Cause: A new set point was not received within the time specified by the Aux Valve Timeout setting.
For version 2.40 and newer Time guarding is only working after first valid AVC and with valve not in blocked.
Error: Temporary. Depending on Fault monitoring mode the control of the PVED is restored when the error disappears and the PVED has received two consecutive Blocked commands.
Solution: Send set points more often or increase the time-out value.

Illegal CAN address

SPN: 298984
FMI: 2, {0xE8, 0x8F, 0x82} index 33.
Cause: An attempt was made to change the CAN ID of the PVED-CC to an illegal value.
Error: Warning. You have full control of the PVED.
Solution: Use a legal CAN ID. CAN IDs 128 [0x80] to 143 [0x8F] are available.

Error Code Walk Through (continued)

Command out of range

SPN:	298983
FMI:	2, {0xE7, 0x8F, 0x82} index 34.
Cause:	A Port Flow Command with a flow of more than 250 was received.
Error:	Warning. You have full control of the PVED.
Solution:	Send commands that don't exceed 250.

Scaling error

SPN:	298982
FMI:	2, {0xE6, 0x8F, 0x82} index 35.
Cause:	A Process Data or WebGPI value for scaling was larger than 250.
Error:	Warning. You have full control of the PVED.
Solution:	Set scaling to maximum 250.

Ramps error

SPN:	298981
FMI:	2, {0xE5, 0x8F, 0x82} index 36.
Cause:	A Process Data or WebGPI value for ramps was larger than 250.
Error:	Warning. You have full control of the PVED.
Solution:	Set ramps to maximum 250.

Float threshold error

SPN:	298980
FMI:	2, {0xE4, 0x8F, 0x82} index 37.
Cause:	A Process Data or WebGPI value for float threshold was larger than 250.
Error:	Warning. You have full control of the PVED.
Solution:	Set float threshold to maximum 250.

Dead band compensation error

SPN:	298979
FMI:	2, {0xE3, 0x8F, 0x82} index 38.
Cause:	A spool data value was not within defined range.
Error:	Warning. You have full control of the PVED.
Solution:	Send valid parameters

Slope error

SPN:	298978
FMI:	2, {0xE2, 0x8F, 0x82} index 39.
Cause:	A Process Data or WebGPI value for slope was not one the 16 predefined values.
Error:	Warning. You have full control of the PVED.
Solution:	Use one of: 0, 7, 13, 18, 25, 31, 37, 44, 49, 56, 61, 68, 77, 81, 88, and 94. Each number represents an increasingly progressive curve.

Error Code Walk Through (continued)

Shape error

SPN:	298977
FMI:	2, {0xE1, 0x8F, 0x82} index 40.
Cause:	Reserved for future use.

Invert port error

SPN:	298976
FMI:	2, {0xE0, 0x8F, 0x82} index 41.
Cause:	A Process Data or WebGPI command was sent to invert the ports, but this is not allowed, if the spool has a floating position available.
Error:	Warning. You have full control of the PVED.
Solution:	You cannot invert ports.

Illegal combination of Port Flow Command and Blocked state

SPN:	298975
FMI:	2, {0xDF, 0x8F, 0x82} index 42.
Cause:	You are not allowed to set a Port Flow >0 if the valve state command is Blocked (0)
Error:	Temporary. Depending on Fault monitoring mode the control of the PVED is restored when the error disappears and the PVED has received two consecutive Blocked commands.
Solution:	Set Port Flow to 0 if the wished state is Blocked.

Illegal combination of Port Flow Command and Float state

SPN:	298974
FMI:	2, {0xDE, 0x8F, 0x82} index 43.
Cause:	You are not allowed to set a Port Flow >0 if the valve state command is Float (3)
Error:	Temporary. Depending on Fault monitoring mode the control of the PVED is restored when the error disappears and the PVED has received two consecutive Blocked commands.
Solution:	Set Port Flow to 0 if the wished state is Float.

Port Flow Command above 100%

SPN:	298973
FMI:	2, {0xDD, 0x8F, 0x82} index 44.
Cause:	A Port Flow Command with a flow of more than 100% (250) was received.
Error:	Temporary. Depending on Fault monitoring mode the control of the PVED is restored when the error disappears and the PVED has received two consecutive Blocked commands.
Solution:	Don't send commands that exceed 100% (250).

Error Code Walk Through (continued)

Illegal Valve State

SPN:	298972
FMI:	2, {0xDC, 0x8F, 0x82} index 45.
Cause:	An Auxiliary Valve Command with an undefined state was received.
Error:	Temporary. Depending on Fault monitoring mode the control of the PVED is restored when the error disappears and the PVED has received two consecutive Blocked commands.
Solution:	Only send commands with one of: Blocked (0), Extend (1), Retract (2) or Float (3).

Illegal valve state and illegal Port Flow Command

SPN:	298971
FMI:	2, {0xDB, 0x8F, 0x82} index 46.
Cause:	An illegal command was send from the controller.
Error:	Temporary. Depending on Fault monitoring mode the control of the PVED is restored when the error disappears and the PVED has received two consecutive Blocked commands.
Solution:	Only send commands with values PFC; 0 – 250 and State; 0 – 3.

Illegal combination of inverted ports and float properties

SPN:	298970
FMI:	2, {0xDA, 0x8F, 0x82} index 47.
Cause:	A Process Data or WebGPI command was sent to invert the ports, but this is not allowed, if the spool has a floating position available.
Error:	Temporary. Depending on Fault monitoring mode the control of the PVED is restored when the error disappears and the PVED has received two consecutive Blocked commands.
Solution:	You can not invert ports.

Notes

Error Code Walk Through (continued)

Error code walk through overview table

Index	CAN Value	SPN/FMI	Designation	Fault Status
0	0xFF 0x8F 0x8C	SPN=299007 FMI=12	RAM: 1's complement redundancy test	Permanent
1	0xFE 0x8F 0x8C	SPN=299006 FMI=12	EEPROM: First boot	Permanent
2	0xFD 0x8F 0x80	SPN=299005 FMI=0	Reserved for future use	Reserved
3	0xFC 0x8F 0x8B	SPN=299004 FMI=11	CALCULATION: Division by zero	Permanent
4	0xFB 0x8F 0x8B	SPN=299003 FMI=11	CALCULATION: CapCom values	Permanent
5	0xFA 0x8F 0x8B	SPN=299002 FMI=11	CALCULATION: Variable truncation	Permanent
6	0xF9 0x8F 0x8C	SPN=299001 FMI=12	EEPROM: Verified write to cell	Permanent
7	0xD9 0x8F 0x80	SPN=298969 FMI=0	Reserved for future use	Reserved
8	0xD8 0x8F 0x8B	SPN=298968 FMI=11	CALCULATION: Interpolation Check	Permanent
9	0xF8 0x8F 0x8D	SPN=299000 FMI=13	VALIDATION: Estimate calibration values	Permanent
10	0xF7 0x8F 0x8D	SPN=298999 FMI=13	VALIDATION: PWM calibration values	Permanent
11	0xF6 0x8F 0x8D	SPN=298998 FMI=13	VALIDATION: Spool Data	Permanent
12	0xF5 0x8F 0x80	SPN=298997 FMI=0	Reserved for future use	Reserved
13	0xF4 0x8F 0x82	SPN=298996 FMI=2	VALIDATION: Spool data and Float Available	Permanent
14	0xD7 0x8F 0x80	SPN=298967 FMI=0	Reserved for future use	Reserved
15	0xD6 0x8F 0x80	SPN=298966 FMI=0	Reserved for future use	Reserved
16	0x76 0x02 0x0C	SPN=630 FMI=12	Calibration Memory	Permanent
17	0xF3 0x8F 0x8B	SPN=298995 FMI=11	EEPROM: Fall Back to old values due to CRC16 failure	Warning
18	0x74 0x02 0x0C	SPN=628 FMI=12	Program Memory	Permanent
19	-	-	"Main spool cannot reach neutral from retract".	Permanent
20	0xF2 0x8F 0x8C	SPN=298994 FMI=12	SENSOR: LVDT wiring	Temporary
21	0x73 0x02 0x03	SPN=627 FMI=3	Power Supply (exceeds specification)	Temporary
22	0x73 0x02 0x04	SPN=627 FMI=4	Power Supply (below specification)	Permanent
23	0xF1 0x8F 0x8B	SPN=298993 FMI=11	SUPERVISOR: No answer on handshakes	Permanent
24	0xF0 0x8F 0x8C	SPN=298992 FMI=12	SUPERVISOR: power on self test failed	Permanent
25	0xD4 0x8F 0x82	SPN=298964 FMI=2	VALIDATION: Timer values for CL-control out of range	Temporary / Permanent

Error Code Walk Through (continued)

Index	CAN Value	SPN/FMI	Designation	Fault Status
26	0xEF 0x8F 0x87	SPN=298991 FMI=7	CONTROL: Main spool can not reach neutral WebGPI: "Main spool cannot reach neutral from extend".	Temporary / Permanent
27	0xEE 0x8F 0x87	SPN=298990 FMI=7	CONTROL: Float state not reached	Temporary / Permanent
28	0xED 0x8F 0x87	SPN=298989 FMI=7	CONTROL: Main spool not in neutral at boot up	Temporary / Permanent
29	0xEC 0x8F 0x87	SPN=298988 FMI=7	CONTROL: Main spool position is greater than the reference	Temporary / Permanent
30	0xEB 0x8F 0x87	SPN=298987 FMI=7	CONTROL: Main spool position and the reference is in opposite direction	Temporary / Permanent
31	0xEA 0x8F 0x87	SPN=298986 FMI=7	CONTROL: Float threshold has not been passed	Temporary
32	0xE9 0x8F 0x93	SPN=298985 FMI=19	COMMUNICATION: Time guarding on Auxiliary Valve Command	Temporary
33	0xE8 0x8F 0x82	SPN=298984 FMI=2	VALIDATION: Illegal CAN address	Warning
34	0xE7 0x8F 0x82	SPN=298983 FMI=2	VALIDATION: Command out of range	Warning
35	0xE6 0x8F 0x82	SPN=298982 FMI=2	VALIDATION: Scaling	Warning
36	0xE5 0x8F 0x82	SPN=298981 FMI=2	VALIDATION: Ramps	Warning
37	0xE4, 0x8F, 0x82	SPN=298980 FMI=2	VALIDATION: Float threshold	Warning
38	0xE3, 0x8F, 0x82	SPN=298979 FMI=2	VALIDATION: Dead Band Compensation	Warning
39	0xE2, 0x8F, 0x82	SPN=298978 FMI=2	VALIDATION: Slope	Warning
40	0xE1, 0x8F, 0x82	SPN=298977 FMI=2	VALIDATION: Shape	Warning
41	0xE0, 0x8F, 0x82	SPN=298976 FMI=2	VALIDATION: Invert port	Warning
42	0xDF, 0x8F, 0x82	SPN=298975 FMI=2	VALIDATION: Illegal combination of Port Flow Command and Blocked.	Warning
43	0xDE, 0x8F, 0x82	SPN=298974 FMI=2	VALIDATION: Illegal combination of Port Flow Command and Float state	Warning
44	0xDD, 0x8F, 0x82	SPN=298973 FMI=2	VALIDATION: Port Flow Command above 100 %	Warning
45	0xDC, 0x8F, 0x82	SPN=298972 FMI=2	VALIDATION: Illegal Valve State	Temporary
46	0xDB, 0x8F, 0x82	SPN=298971 FMI=2	VALIDATION: Illegal Valve State and illegal Port Flow Command	Temporary
47	0xDA, 0x8F, 0x82	SPN=298970 FMI=2	VALIDATION: Illegal combination of inverted ports and float properties	Temporary

For parameter setting and reading by application engineering and service Sauer-Danfoss has developed a service tool.

PC

USB

CAN bus cable
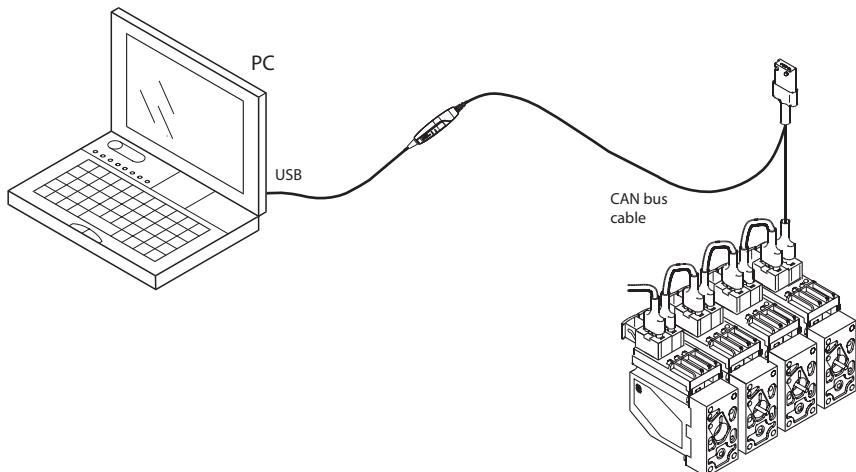
157-630.11

Requirements

- Service tool software PLUS+1 PVE Service Tool S4 DJ (or WebGPI)
- PC
- Service cable and CAN termination for PVED
- CG 150 CAN USB interface for PLUS+1 (or WebGPI gateway)
- Power supply

Sauer –Danfoss offers the PLUS+1 PVE Service tool S4 DJ (Series 4 Digital J1939) software for PVED-CC for free download. It can be downloaded from

http://www.sauer-danfoss.com

11103046 Service tool S4 DJ self-extracting PC application

The file with license is for customers who don't have the PLUS+1 GUIDE or PLUS+1 service tool installed already. Others should use the standard P1D file.

Sauer-Danfoss also supports the WebGPI service tool. The WebGPI can be bought at

http://www.sauer-danfoss.com/Products/ProductArchive/
WebGPICommunicationSoftware/index.htm

The setup application WebGPI PVED-CC.exe can also be found here and must be performed after installation of the WebGPI.

Installation of the software is self instructing and choices should just be default accepted.

**PLUS+1 PVE Service Tool S4 DJ**

⚠ Warning

This software application
- does not include any safety functionality towards use of hydraulic applications.
- can activate the actuator and thereby the hydraulic application.
- can alter safety and performance for PVED-CC and their applications.

Any setting of parameters and use of PVED-CC is on the responsibility of the user.

Installation

Before use of PVED-CC and this service tool consult the Sauer-Danfoss Technical Information, Electrohydraulic Actuator Type PVED-CC, 520L0665
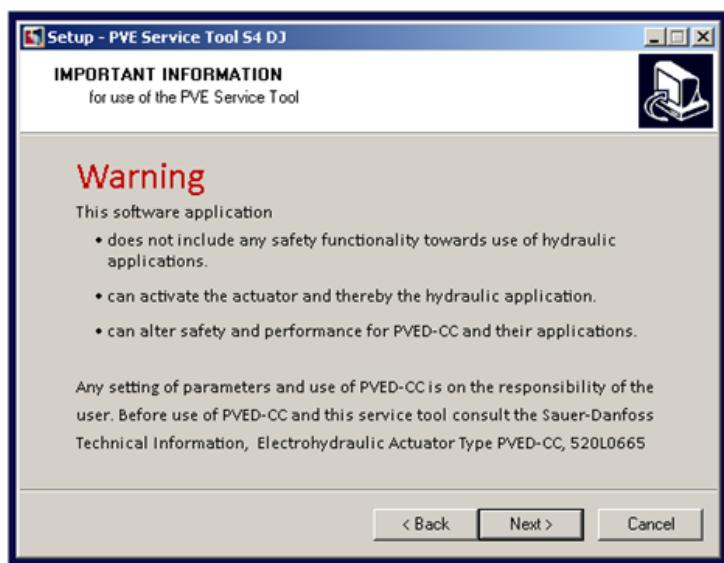

The PLUS+1 PVE Service Tool S4 DJ with included license runs as two installations.

Before initial start of the S4 DJ a PVED-CC must be connected to the PC via a CG150 and powered.
The application will only run if a PVED-CC is chosen
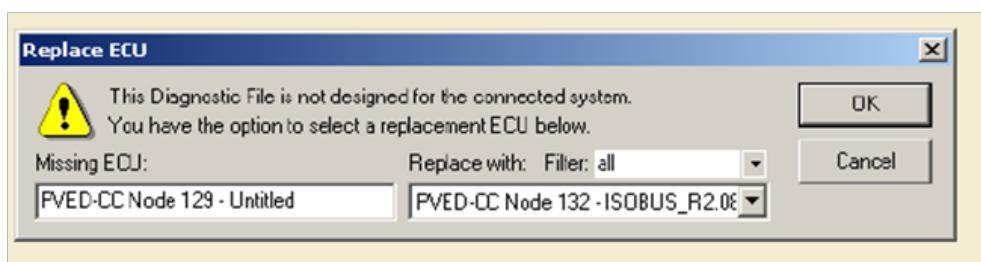
Use of Service Tool

The service tool includes a help tool

If questions are not answered by this walk through please look up in the help tool.

Parameters are supported by hover over descriptions.

As a PLUS+1 standard the navigation pane to the left identifies all components on the bus

Use of Service Tool (continued)

When Process Data or one of the sub levels is chosen the PVED for examination can be selected/replaced.

- Push Select ID (default 129)
- open the Replace with curtain
- chose Node
- pres OK
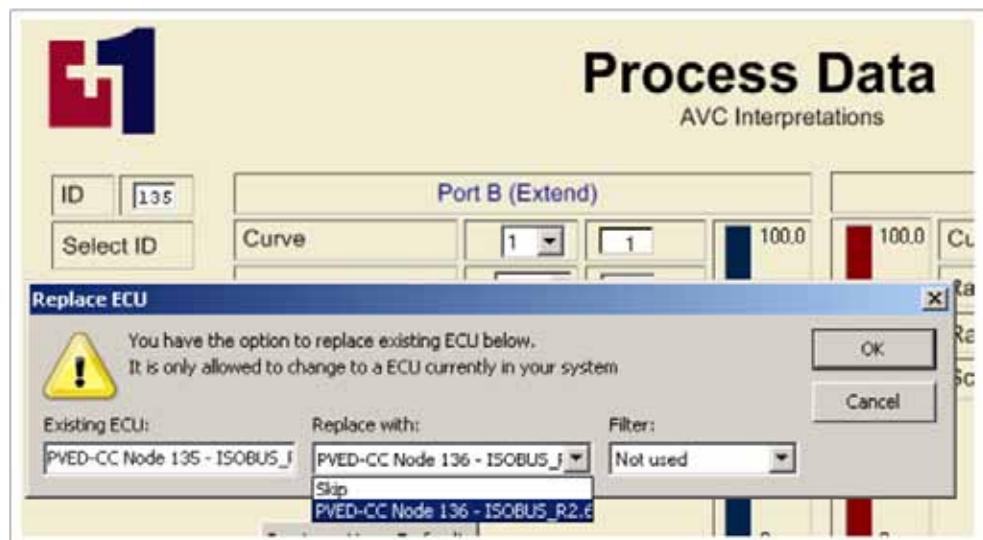
Changing parameters is either done by

- choosing a value in a curtain (Port B Curve)
- push arrow up/down to go step wise (Port A scaling)
- type value in the write field (Port A Ramp Down)
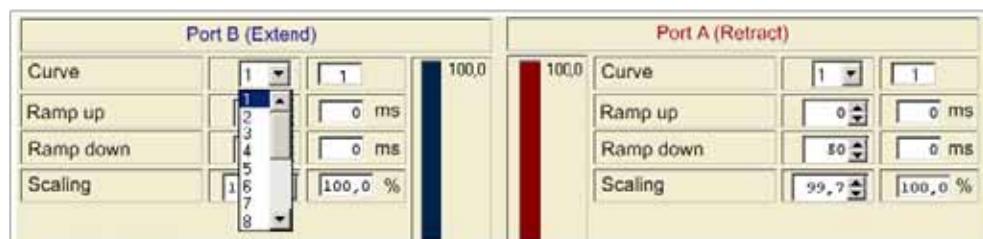
Service tool will change selected value to best fit by step and range violation. See section Data description or section Parameter description or section Ordering.

Data in the protected field shows actual value in PVED.

To change value in the PVED use the Download parameters to ECU button. Down arrow.

It is recommended to use the upload button before saving data to file.

Process Data Screen

The Process Data screen gives access to the actual performance settings and an AVC tool.

⚠ Warning

Parameters in the AVC tool can activate the actuator and thereby the hydraulic application. This software application does not include any safety functionality towards use of hydraulic applications.
Any setting of parameters and use of PVED-CC is the responsibility of the user.
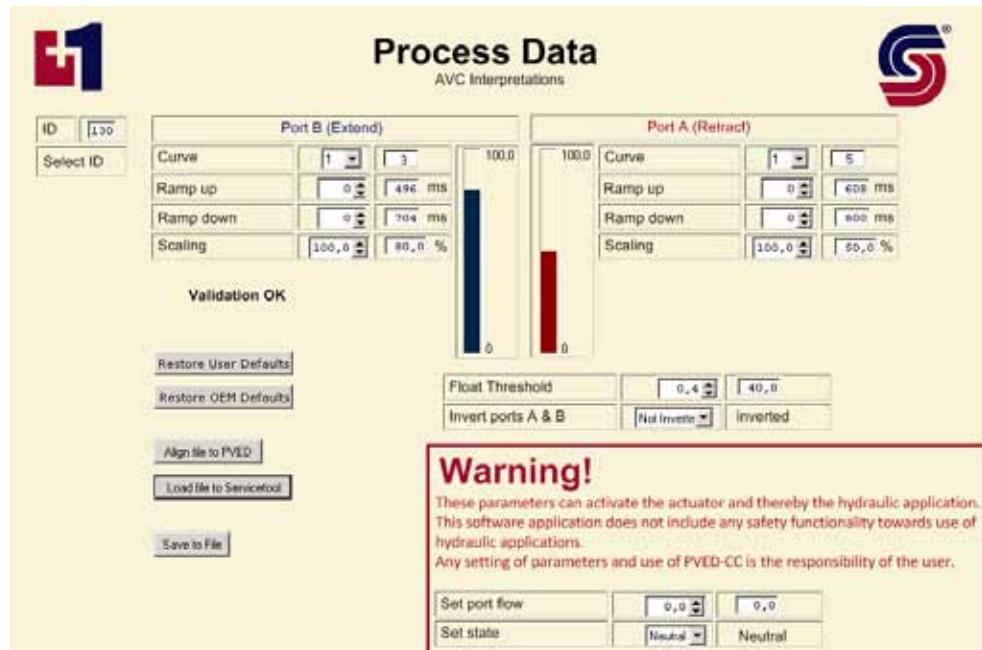
Parameters can be changed manual.

Restore User Defaults. Saved user defaults overwrite present settings made by green arrow.

Restore OEM defaults. Values from OEM Settings are transferred to replace present Process Data.

Download parameters. Present setting in PVED is stored as user default.

Read from file. A file in xml-format with Process Data can be written to the tool.

The Plus+1 service tool will by default not allow parameter download if source and target do not have same ID. To compensate the S4 DJ has a button for aligning source file to new targets. Before download press Align file to PVED and then chose file to fit and ID of target. The XML is changed to new source/target number.

After align load file to service tool.
When file is loaded to service tool use F4 or button to load to PVED

Save to file. Present screen settings are stored to a file in xml-format.

Live View Screen

The live view screen shows present AVC and AVEF

Error Log Screen

The Error Log screen shows error history for PVED.

Error Active indicates a DM1 is sent at the moment.

Error no longer active shows that a DM1 has been but are no longer active.

Save to file will save PVED parameters from ECU list and error history to a file in dBase format.

Clear Error Log will send a DM3 to the PVED clearing all Error no longer active faults and add one to position 7 "Error log Cleared".

Spool Data Screen
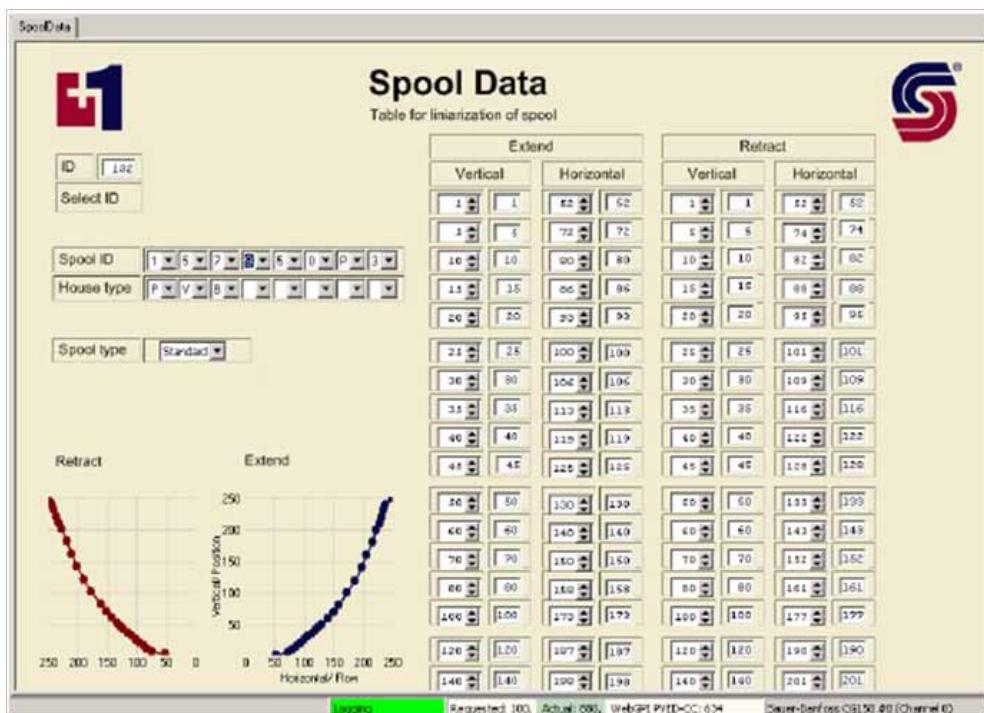
Spool Data Screen shows the spool linearization file

Parameters can be changed manually or by file download as for process data.

A spool curve with this characteristic will neither linearize nor have dead band compensation but will follow the spool mechanical characteristic with 250 positions each direction.
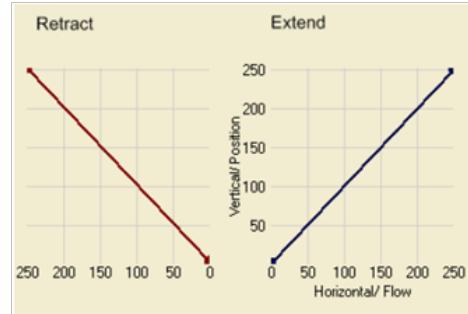
OEM Data Screen
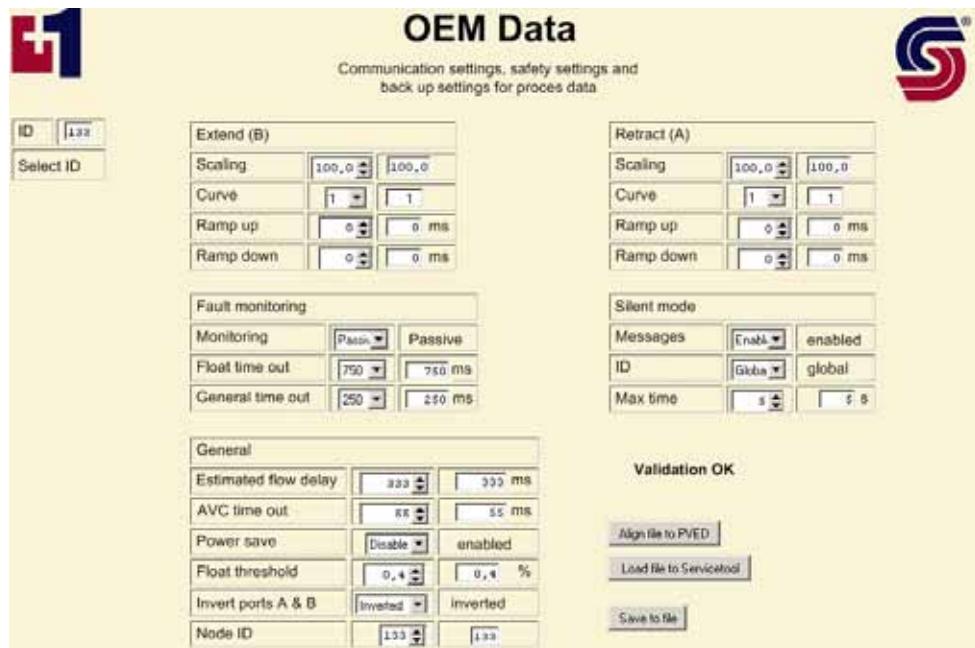
OEM DATA screen shows the present OEM data for the PVED.

Parameters can be changed manually or by file download as for process data.

Calibration Screen
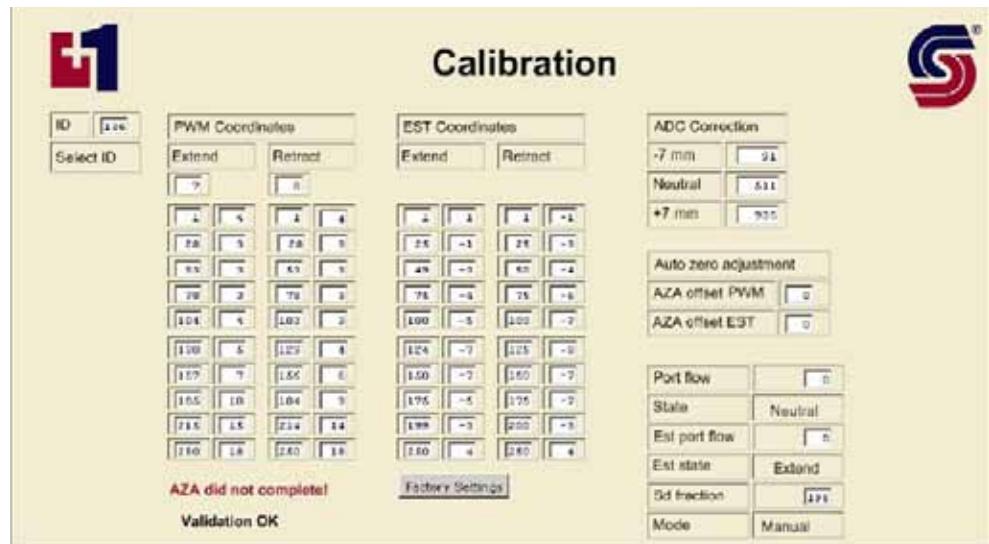
Calibration screen shows calibration parameters for the present PVED

Use Case

In all use cases PVED-CC must be connected to the service tool and powered. Additional ECU can be connected. Only one instance of every function instance (Node Id) can be present on the bus.

Creation of master file

Valid for Process Data, OEM Data and Spool Data
- Ensure screen shows right settings.
- Save to file.

PVED resetting to new parameter files

This process is relevant for end of line programming and service replacement. Valid for Process Data, OEM Data and Spool Data
- Open relevant screen
- Press Read from file
- Select master file and press ok
- Press "download parameters to ECU" arrow (F4)

If Node Id was changed this will only have effect after reboot.

If default Process Data is a copy of OEM Data only a press Restore OEM Defaults on Process Data screen is required.

Ordering

When PVG32 with PVED-CC are ordered a Settings Agreement must be forwarded as well as assembly specification.

Agreements can be made as a

- Specific agreement for a single specification
- General agreement for PVG

Parameter agreement template

Customer OEM Parameter list - OEM Data for PVED-CC
Agreement between
Customer Name:
Business unit PVG, Sauer-Danfoss:
Filled in by:
Customer representitive:
SD sales representitive:
Date:

Factory settings for spare part PVED-CC

Name	Description	Value Range	Default Value
OEM Scaling Extend	Scaling Extend	0-250 (0-100% , step 0.4%)	250
OEM Scaling Retract	Scaling Retract	0-250 (0-100% , step 0.4%)	250
OEM Slope Extend	Slope Extend (lineary to progressive)	0 7 13 18 25 31 37 44 49 56 61 68 77 81 88 94	0 (linearly)
OEM Slope Retract	Slope Retract (lineary to progressive)	0 7 13 18 25 31 37 44 49 56 61 68 77 81 88 94	0 (linearly)
OEM Ramp Extend Up	Ramp Extend Up (0 to 4 sec)	0-250 (0-4000ms in step of 16ms)	0
OEM Ramp Extend Down	Ramp Extend Down (0 to 4 sec)	0-250 (0-4000ms in step of 16ms)	0
OEM Ramp Retract Up	Ramp Retract Up (0 to 4 sec)	0-250 (0-4000ms in step of 16ms)	0
OEM Ramp Retract Down	Ramp Retract Down (0 to 4 sec)	0-250 (0-4000ms in step of 16ms)	0
OEM Float Threshold	Float Threshold (The port flow command must be above this value to allow float)	0-250 (0-100% , step 0.4%)	1 (0,4%)
OEM Invert port	Invert port	0 non-inverted , 1 inverted	0 (non-inverted)
OEM Estimate Sendout Time	How often is Estimate Flow send on CAN-Bus	0 - 64255 ms, 65535 is disable (step of 10 ms)	100 ms
OEM Aux Valve Command Timeout	Manual mode if a set point (AVC) is not received before timeout	0 - 65535, 0 is disabled (step of 10 ms)	0 ms
OEM Node ID	Change Node ID	128-143 (0x80- 0x8F)	128
OEM Power Save Enable	If the valve has AVC BLOCKED for more than 0,5 second, the current to solenoid valves is disabled	0 FALSE, 255 TRUE	255 TRUE
OEM Validation	If new invalid data were sent this value is set to false	0 FALSE, 255 TRUE	255 TRUE

Ordering (continued)

Name	Description	Value Range	Default Value
Supervision of closed loop control is Active	A supervision fault will cause a Permanent or a Temporary Blocked	0 FALSE (Temporary), 255 TRUE (Permanent)	255 TRUE
Supervision of closed loop control Float Timeout	Float Timeout from Float Supervision fault to the PVED-CC goes into Blocked. This might be different from the General timeout in cold weather.	750, 1000, 1250, 1500, 1750 ms	750 ms
Supervision of closed loop control General Timeout	General Timeout from supervision fault to the PVED-CC goes into Blocked	250, 500, 750, 1000, 1250, 1500, 1750, 2000 ms	500 ms
KWP2000 Max time between Messages in Sec	A KWP2000 messages must arrive within the max time, otherwise the PVED-CC will leave the KWP2000 mode.	0 – 255	5
KWP2000 Enable	Enable or disable KWP2000 in the PVED-CC	0 FALSE, 255 TRUE	255 TRUE
KWP2000 Use Specific ID	The PVED-CC will react on a KWP2000 message sent with a global ID or with a specific ID.	0 FALSE, 255 TRUE	0 FALSE

PVED-CC setting agreement for PVG

	Value Range	PVED1	PVED2	PVED3		PVEDN
ScalingExtend	0-250 (0-100% , step 0.4%)	250	250	250		250
ScalingRetract	0-250 (0-100% , step 0.4%)	250	250	250		250
ExtendCurve	0 7 13 18 25 31 37 44 49 56 61 68 77 81 88 94	0 (linearly)	0 (linearly)	0 (linearly)		0 (linearly)
RetractCurve	0 7 13 18 25 31 37 44 49 56 61 68 77 81 88 94	0 (linearly)	0 (linearly)	0 (linearly)		0 (linearly)
RampExtendU	0-250 (0-4000ms, step 16ms)	0	0	0		0
RampExtendD	0-250 (0-4000ms, step 16ms)	0	0	0		0
RampRetractU	0-250 (0-4000ms, step 16ms)	0	0	0		0
RampRetractD	0-250 (0-4000ms, step 16ms)	0	0	0		0
FloatThreshold	0-250 (0-100% , step 0.4%)	1 (0,4%)	1 (0,4%)	1 (0,4%)		1 (0,4%)
Invport	0 non-inverted , 1 inverted	0 (non-inverted)	0 (non-inverted)	0 (non-inverted)		0 (non-inverted)
SendoutTimeLSB SendoutTimeMSB	0 - 64255 ms, 65535 is disable (step of 10 ms)	100 ms	100 ms	100 ms		100 ms
AVCTimeoutLSB AVCTimeoutMSB	0 - 65535, 0 is disabled (step of 10 ms)	0	0	0		0
NodeID	128-143 (0x80- 0x8F)	129	130	131		134
PowerSaveEnable	0 FALSE, 255 TRUE	255 TRUE	255 TRUE	255 TRUE		255 TRUE
Validation	0 FALSE, 255 TRUE	255 TRUE	255 TRUE	255 TRUE		255 TRUE
SupervisCLCActive	0 FALSE (Temporary), 255 TRUE (Permanent)	255 TRUE	255 TRUE	255 TRUE		255 TRUE
SupervisFloatTOLSB SupervisFloatTOLSB	0 - 65535 ms, (step of 10 ms)	750 ms	750 ms	750 ms		750 ms
SupvisGenTOLSB SupvisGenTOLSB	0 – 65535 ms, (step of 10 ms)	500 ms	500 ms	500 ms		500 ms
KWP2000MsgTime	0 – 255	5	5	5		5
EnableKWP2000	0 FALSE, 255 TRUE	255 TRUE	255 TRUE	255 TRUE		255 TRUE
UsedSpecificID	0 FALSE, 255 TRUE	0 FALSE	0 FALSE	0 FALSE		0 FALSE

PVED 1 is the PVED closest to PVP.
All changed cell must have light gray shading and bold font.

Ordering (continued)

List of correlation between NodeID and function.

Node ID		Function
129	=	
130	=	
131	=	
132	=	
133	=	
134	=	
135	=	
136	=	
137	=	
138	=	
139	=	
140	=	
141	=	
142	=	
143	=	

Ordering (continued)

PVED Code Numbers for use on PVG 32 and PVG 100

AMP connector code numbers

Feature		super fine
Connector		2x4
Deutsch	SW 2.68	11079033
	SW 2.08	157B4944
AMP	SW 2.68	11079034
	SW 2.08	157B4943

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

Connector code numbers

Part number	Name
157B4992	AMP CONNECTING KIT (GREY) 4 pin with housing, contact and wire sealing

CAN Interface

10104136	CG 150 CAN USB interface
162B0004	WebGPI gateway

Set of seals code numbers

Part number	Name	Actuator
157B4997	Set of seals	Seal Kit PVE 32
155G8519	Set of seals	Seal kit PVE 120

Connector part numbers for purchase at other suppliers

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

Cables code numbers

Feature		Wire colors				Description	Code number
Connector		pin 1	pin 2	pin 3	pin 4		
Deutsch	4 pin	white	blue	yellow	red	4 m cable	11007498
AMP	4 pin	white	blue	yellow	red	4 m cable	157B4994
AMP/black	4 pin	white	blue	yellow	red	4 m cable	157B4995
Service tool interface cable/ AMP						4 m cable	157B4977
AMP						0.1m loop cable	157B4987
AMP/black						Terminator	157B4988
Deutsch						0.1m loop cable	11007531
Deutsch						Terminator	11007561
Deutsch						Terminator dummy	11007563

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