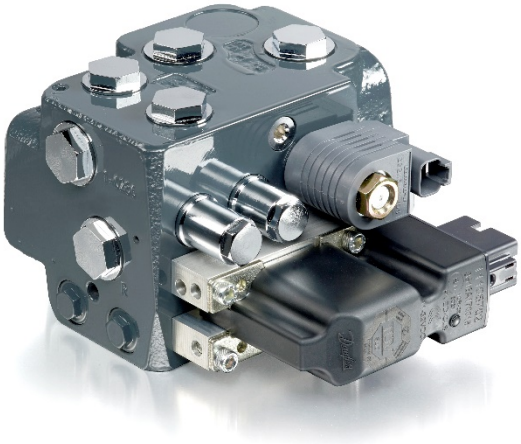
ENGINEERING
TOMORROW

MultiAxis-Steer™

EHI Electrohydraulic steering valve with PVED-CLS controller

Release note

FW 1.00



Important User Information

Danfoss is not responsible or liable for indirect or consequential damages resulting from the use or application of this equipment.
The examples and diagrams in this manual are included for illustration purposes. Due to the many variables and requirements associated with any particular installation, Danfoss cannot assume responsibility or liability for the actual used bases on the examples and diagrams.
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The following notes are used to raise awareness of safety considerations.

Warning	Identifies information about practices or circumstances that can cause a hazardous situation, which may lead to personal injury or death, damage or economic loss.
Attention	Identifies information about practices or circumstances that can lead to personal injury or death, property damage, or economic loss. Attentions help you identify a hazard, avoid a hazard, and recognize the consequence.
Important	Identifies information that is critical for successful application and understanding of the product.
Recommendation	Identifies a typical use of a functionality or parameter value. Use recommendations as a starting point for the final configuration process of the system.

Revisions and references

Revision history

Date	Change	Revision
29 Oct 2019	First release FW 1.00	1.2

Document references

Literature
EHi Steering Valve Technical Information, BC00000379en
EHi Service Manual, AX00000350en

Definitions and Abbreviations

AD	Analog to digital converter
AUX	Auxiliary
CAN	Controller Area Network
CRC	cyclic redundancy check
COV	Cut-off valve
DTC	Diagnostic trouble code
FMI	Failure mode Identifier
LVDT	Linear variable differential transformer
MAIN UC	main micro-controller, the one controlling the proportional valve
MMI	Man machine interface
N-Axis	Indicating any slave axis in a master/slave steering system with multiple slave axis
PAE	Product application engineer
PGN	Page group number
PVED	Proportional Valve Electronic Digital
PVED-CLS	a special type of PVED being developed for new steering applications
SAFETY UC	the micro-controller in the safety related channel, the one controlling the cut-off valve
SASA	Steering angle sensor absolute
SEHS	Safe EH Steering
SPN	Suspect Parameter Number
STW	steering wheel
TBD	to be defined
UC	micro-controller
VSP	vehicle speed
WA	wheel angle
WAS	Wheel angle sensor
VA	Virtual Axis
VAA	Virtual Axis Angle
VAP	Virtual Axis Position

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1 Introduction

1.1 PURPOSE OF THE DOCUMENT

This document contains information of all released files, documentation and provides information about how to upgrade existing PVED-CLS units.

2 Errata information

The latest errata information is always available on the Danfoss homepage: www.Danfoss.com

The document contains errata information for:

- PVED-CLS boot loader
- PVED-CLS application
- Documentation
- PLUS+1 Service tool
- Other topics related to the steering system

If further information to any errata is required, contact your nearest Danfoss Product Application Engineer

Attention	The system integrator and/or responsible for the target system is advised to periodically observe the errata information as new information will be added as needed. It is recommended that system integrators and responsibles for the system, after commissioning, sign up for the email notification service.

3 1.00 Release

3.1 RELEASED FILES

File name	Description
APP-_CLS-_M_R100_NAXIS---_11153340_-B02_05082019_0458PM.hex	PVED-CLS MainUC firmware hex file format
APP-_CLS-_S_R100_NAXIS---_11153341_-B02_05082019_0502PM.hex	PVED-CLS SafetyUC firmware hex file format
APP-_CLS-_M_R100_NAXIS---_11153340_-B02_05082019_0458PM.bios	PVED-CLS MainUC firmware binary file format
APP-_CLS-_S_R100_NAXIS---_11153341_-B02_05082019_0502PM.bios	PVED-CLS SafetyUC firmware binary file format
BOOT_CLS-_M_R385_KWP2000-_11153472_-rrr_13032015_0438PM.hex	PVED-CLS bootloader file (same file for Main and SafetyUC)
APP-_CLS-_M_R100_NAXIS---_11153340_-B02_05082019_0458PM.plg	PLUS+1 Service tool MainUC diagnostic file
APP-_CLS-_S_R100_NAXIS---_11153341_-B02_05082019_0502PM.plg	PLUS+1 Service tool SafetyUC diagnostic file
BOOT_CLS-_M_R385_KWP2000-_11153472_-rrr_13032015_0438PM.plg	PLUS+1 Service tool Bootloader diagnostic file
PVED-CLS_1.00_rev_C.p1d	PLUS+1 Service tool service pages file
PVED_CLS_Naxis_Database.dbc	CANalyzer database file containing all messages and signals used in PVED-CLS. **Note:** the database uses default values for node ID's and PGN offsets. If the given application uses different values, the database must be updated with these
PVED_CLS_Error_Codes.dbc	CANalyzer database containing all DTC's used in PVED-CLS. **Note:** This requires the J1939 option for CANalyzer.
OEM_Default_parameters_APP-_CLS-_M_R100_NAXIS.xml	Main OEM enriched default file
OEM_Default_parameters_APP-_CLS-_S_R100_NAXIS.xml	Safety OEM enriched default file
OEM_PLUS1_Default_parameters_100.xml	PLUS+1 OEM default file
APP-_CLS-_M_R100_NAXIS---_11153340_-B02_05082019_0458PM.mlhx	PLUS+1 Main and Safety Application software package
BOOT_CLS-_R385_KWP2000-_11153472_-rrr_13032015_0438PM.mlhx	PLUS+1 bootloader software package

The changelog of 1.00 can be found in APPENDIX C.

3.2 DOCUMENTATION

Document	Revision	Description
PVED-CLS MultiAxis-Steer communication protocol	1.01	Description of CAN message protocol
PVED-CLS KWP2000 protocol	1.79	Description of KWP2000 protocol used for parameter read/write and firmware download
PVED-CLS MultiAxis-Steer technical information	1.04	Detailed description of all safety functions and system integration
PLUS+1 Service Tool User Guide	3.0	Installation guideline for PLUS+1 service tool
PVED-CLS Technical Information	2.4	Technical specification for PVED-CLS

3.3 CERTIFICATION STATUS

The certificate for the PVED-CLS valve controller can be found in the document PVED-CLS Functional Safety Annex. The PVED-CLS Functional Safety Annex can be found on the Danfoss homepage: www.Danfoss.com

4 Software upgrade instructions for N-Axis 1.00 Release

For upgrading a PVED-CLS to N-Axis 1.00_B02 from any other firmware, please follow the instructions given in section 5.3.1.

5 APPENDIX A: Service part software

The PVED-CLS service part allows replacing a commissioned PVED-CLS with a new PVED-CLS. The following elements are necessary before proceeding with a service part upgrade.

#	Element	Supplied by
1	PVED-CLS Service part (actuator, hardware)	Danfoss Power Solutions
2	Target boot-loader software (.hex or .mhlx)	Danfoss Power Solutions
3	Target MainUC application software (.hex or .mhlx)	Danfoss Power Solutions
4	Target SafetyUC application software (.hex or .mhlx)	Danfoss Power Solutions
5	MainUC and SafetyUC OEM enriched default files (.xml)	Danfoss Power Solutions
6	PLUS+1 OEM Default File (.xml)	Danfoss Power Solutions
7	Vehicle specific/Application/OEM parameters	OEM / System integrator
8	PVED-CLS MultiAxis-Steer technical information	OEM / System integrator
9	System Safety Validation	OEM / System integrator

There are two levels of parameter default files.

Default parameter file (chapter 3.1 Released files)	**Description**	**Supplied by**
OEM_PLUS1_Default_parameters_<ver>.xml OEM_Default_parameters_APP-CLS-_M_R<ver>_SEHS.xml. OEM_Default_parameters_APP-CLS-_S_R<ver>_SEHS.xml	The EEPROM memory data for a given software version. The data is denoted 'defaults' as they set all EEPROM cells to specific values and defines the EEPROM sector layout for e.g. CRC calculations. The default parameters are not specific to <u>any</u> vehicle or system – this customization is performed via the vehicle specific/Application/OEM parameters. A PVED-CLS controller will as a minimum be programmed with default parameters from Danfoss.	Danfoss Power Solution
Vehicle specific/Application/OEM parameter file	The parameters needed to achieve the desired functionality on a specific vehicle type. These parameters may be changes to default values or replacing an entire parameter sector with values specific to the vehicle type. The CRCs needs to be recalculated for the changed sectors.	OEM / System integrator

5.1 IMPORTANT SAFETY CONSIDERATION

Attention

The OEM system integrator is responsible for:
Carefully studying this appendix before commissioning a service part to a target installation.
Being familiar with the PVED-CLS Safety Manual for the target PVED-CLS software version.
Installing approved parameters to the target system/vehicle type prior to commissioning the service part PVED-CLS.
Performing validation of the PVED-CLS before commissioning the target system/vehicle.
Unless subject for returning a replaced PVED-CLS to Danfoss, the replaced PVED-CLS shall be decommissioned by e.g. adequately marking the part to avoid unintended installation to another vehicle or modifying the part so re-installation is never possible.

Warning

Do not commission a PVED-CLS service part without performing safety validation.
Contact your nearest Danfoss Product Application engineer if the PVED-CLS is not behaving as expected or if there is doubt about the service part handling procedure.

5.2 SERVICE PART FUNCTIONALITY

A PVED-CLS service part shall be software configured before use. The PVED-CLS service part software is restricted to the following functionality:
The PVED-CLS service part software cannot pilot any valve to steer out oil and is therefore in a constant safe condition.
The PVED-CLS will stay in 'Initialization' mode when powered.
DM1 information "PVED-CLS Service Part" (SPN 520240, FMI 31), severity level "INFO", is transmitted every 1000ms by both main and safety controller.
All outputs (5V sensor supply, High-side switch output/COV output, EH coils supply switch) are de-energized.
Only operational status CAN message is broadcast.
Signals on AD1-3 inputs are ignored (no signal monitoring is active).
Failure conditions on the external interface are ignored including the LVDT.
Monitoring internal mal-functions is active.
The following CAN messages are ignored: Status message requests, Service mode requests, Auto-guidance, Vehicle speed, MMI, Wheel Angle, SASA, AUX.

5.3 SERVICE PART CONFIGURATION AND CAN NODE ID

Software component	**Version**	**Software name**	**Program date**
PVED-CLS firmware (.hex)			
Boot-loader software version	3.85	BOOT_CLS-_M_R385_KWP2000-_11153472_-rrr	13.03.15
Main application software version	0.00	APP-_CLS-_M_P000_SEHS-SP-_00000000_-rrr	07.12.15
Safety application software version		APP-_CLS-_S_P000_SEHS-SP-_00000000_-rrr	
	MainUC	SafetyUC	
KWP2000 CAN node ID (default)	32d	33d	
KWP2000 CAN frame (default)	Frame data optimization (DLC is used) – see note 2		
J1939 source address (default)	19d	90d	

Note 1: Ensure that the CAN node ID are correct before connection to the target CAN bus. Incorrect CAN node IDs may lead to CAN bus mal-function.

Note 2: See section on FRAME PADDING MODE / OPTIMIZED DLC MODE in the KWP2000 protocol documentation.

5.3.1 PLUS+1 service tool procedure for upgrading a service part

The PVED-CLS service part can be configured from its default configuration to any released software version by following the below procedure. The procedure may be performed prior to or after mounting on the valve and connection to the target CAN bus.

Step	Action	Software (chapter 3.1 Released files)	Support documentation/information
1	Install the same PVED-CLS bootloader software in both MainUC and SafetyUC. The software can be installed individually to each controller or by selecting a boot-loader software package (.mhlx).	BOOT_CLS-_M_R<ver>_KWP2000-_11153472_-rrr_<timestamp>.hex	Refer to PLUS+1 Service Tool User Guide
2	Install PVED-CLS application software in MainUC and SafetyUC respectively.	APP-_CLS-_M_R<ver>_SEHS-----_11153340_<Buildno>_<timestamp>.hex APP-_CLS-_S_R<ver>_SEHS-----_11153341_<Buildno>_<timestamp>.hex	
3	Install default parameters. **Note** The default file comes with correct CRCs for each sectors. All sectors are signed by Danfoss (Manufacturer) by default. **Important** It is the responsibility of the system integrator to install vehicle specific parameters <u>after</u> the default parameters have been programmed. See step 4.	OEM_PLUS1_Default_parameters_<ver>.xml	Entering a valid PSAC is not required. **Install new platform parameters** Go to PLUS+1 System Navigator ->Configuration-> Parameter File Interface_VPS Import PLUS+1 OEM Default file and press 'Download' **Install default parameters** Go to PLUS+1 System Navigator -> Configuration-> Clone PVED-CLS Import PLUS+1 OEM Default file and press 'Download' Note: Please select the same file for both download operations.
4	Install vehicle specific parameters to complete the upgrade.	Customer data for the target vehicle type	The customer data may be contained in an .xml file as in step 3.
5	Clear MainUC and SafetyUC error history. If the power is cycled during step 1 to 4, errors may be logged in the PVED-CLS error history. In this case the error history shall be cleared before the PVED-CLS is taken into use.		Press 'Clear Error History' on: PLUS+1 System Navigator -> Diagnostics -> SEHS Error History_Main PLUS+1 System Navigator -> Diagnostics -> SEHS Error History_Safety
6	Perform software system validation.		See PVED-CLS S5 n-axis user and safety manual for identification of the target installation software and repair instructions. Retrieve the installed software version and parameter sector CRC values: PLUS+1 System Navigator -> Diagnostics -> Identification

6 APPENDIX B: How to setup PVED-CLS to work without hydraulics

For tests on a bench or desktop, it can be useful to configure PVED-CLS in a way that it can go operational without the need to have it connected to hydraulics. To achieve this state, certain parameter values must be set and the interfacing signals - e.g. Master Wheel Angle, Vehicle Speed, Wheel Angle Sensor, etc must be simulated.
The configuration below assumes that the system is configured to only have 1 slave axis.

Following Signals, CAN messages must be present to make PVED-CLS N-Axis 1.00 operational:

- Valid Wheel Angle sensor signal (Analog or CAN) according to calibrated values in EEPROM sector:
    - Analog Sensor Calibration Data if P3239 = 0 (WAS = Analogue)
    - CAN WAS Calibration Data if P3239 = 1 (WAS = CAN)
- MMI CAN messages according to PVED-CLS N-Axis communication protocol
- Vehicle speed CAN messages according to PVED-CLS N-Axis communication protocol
- Road Switch signals (and relays). (This functionality can be disabled if required by P3237)
- Master Wheel Angle CAN messages according to PVED-CLS N-Axis communication protocol
- The Spool position must be in neutral which can be achieved by:
    - Mounting PVED-CLS on to a steering unit (EHi, OSPE, etc)
    - Mounting a neutral plate which fixes the LVDT spool position transducer to neutral

The actual spool position can be monitored in status message 1 (see PVED-CLS N-Axis communication protocol)

Some EEPROM parameters must be set according to following list:

Index	**Name**	**Value**	**Comment**
P3078	Cut-off valve monitoring POST timeout	0	Setting this parameter to 0 disables the Cut-off valve monitoring because hydraulics are required for this
P3245	Total Number of n-Axis nodes	1	Sets the number of slave axis to 1

7 APPENDIX C: Software revision history

7.1 IMPACT SEVERITY RANKING GUIDELINE

The rankings done on the individual new implementations and the corrected defects is based on Table 1 and Table 2.

New Implementations

	Cosmetic	None / Low	Medium	High
Impact to existing applications	No impact on existing application if PVED-CLS is upgraded to most recent software versions. New implementations are fully backwards compatible.		Functionality modified, but similar performance/ user experience can be obtained. Possibly parameters need to be revisited.	Functionality changed completely, existing functionality not available any longer.
Safety Impact	Safety not impacted.		Safety affected to some degree. Configuration must be revisited for changed functionality.	Safety highly influenced and one or more safety functions are affected, additional explanations required. Application Safety validation must be repeated.

Table 1: Explanation of impact scorings for new implemented features

Corrected Defects

	Cosmetic	Low	Medium	High
Severity	Cosmetic issue which has no effect to safety or performance.	Existing application are not affected by this defect if functionality is not used or if it's used, a workaround can limit the impact.	Existing applications are to some degree affected. A workaround can possibly limit the impact.	High impact to existing applications. Danfoss recommends that PVED-CLS is upgraded to most recent software version or a workaround is implemented. For issues with high severity, Danfoss will issue either a PIB or a service bulletin.

Table 2: Explanation of impact scorings for corrected defects

7.2 CHANGELOG 1.00

This is the first release of N-axis.

8 Contact

In case of questions, contact your nearest Danfoss Product Application Engineer.