PVED-CLS Controller For Electro-hydraulic Steering

Firmware release note

Software version 1.98

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
31 Mar 2017	Created	1.0

Document references

Literature
OSPE Steering valve, SASA sensor, Technical information, 11068682
EHPS Steering Valve, PVE Actuation, OSPCX CN Steering Unit, 520L0521
OSPE steering valve service manual, L1506577
EHPS steering valve service manual, AX00000235

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
FDA	Fault Detection Algorithm
FMI	Failure mode Identifier
GMC	Guidance machine command
GMS	Guidance machine status
MAIN UC	main micro-controller, the one controlling the proportional valve
MMI	Man machine interface
L2L	Lock to lock ratio (Number of steering wheel revolution for steering the wheels from max right to max left and vice versa)
LVDT	Linear variable differential transformer
PAE	Product application engineer
PGN	Page group number
PSM	Program sequence monitoring
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

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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 via following link:
HTTP://POWERSOLUTIONS.DANFOSS.COM/PRODUCTS/STEERING/PVED-CLS-INTELLIGENT-STEERING-SUB-SYSTEM/

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.

3 1.98 Release

3.1 RELEASED FILES

File name	Description
APP-_CLS-_M_R198_SEHS----_11153340_-B02_22032017_0701PM.hex	PVED-CLS MainUC firmware hex file format
APP-_CLS-_S_R198_SEHS----_11153341_-B02_22032017_0705PM.hex	PVED-CLS SafetyUC firmware hex file format
APP-_CLS-_M_R198_SEHS----_11153340_-B02_22032017_0701PM.bios	PVED-CLS MainUC firmware binary file format
APP-_CLS-_S_R198_SEHS----_11153341_-B02_22032017_0705PM.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_R198_SEHS----_11153340_-B02_22032017_0701PM.plg	PLUS+1 Service tool MainUC diagnostic file
APP-_CLS-_S_R198_SEHS----_11153341_-B02_22032017_0705PM.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_1.98_rev_A.P1D	PLUS+1 Service tool service pages file
PVED_CLS_Application_Database_1.98.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_1.98.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_R198_SEHS.xml	Main OEM enriched default file
OEM_Default_parameters_APP-CLS-_S_R198_SEHS.xml	Safety OEM enriched default file
OEM_PLUS1_Default_parameters_198.xml	PLUS+1 OEM default file
APP-_CLS-_M_R198_SEHS----_11153340_-B02_22032017_0701PM.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 1.98 can be found in section 6.

3.2 DOCUMENTATION

Document	Revision	Description
PVED-CLS communication protocol	3.42	Description of CAN message protocol
PVED-CLS KWP2000 protocol	1.77	Description of KWP2000 protocol used for parameter read/write and firmware download
PVED-CLS Safety Manual	1.98.1	Detailed description of all safety functions and system integration
PVED-CLS User Manual	1.4	Detailed description of functionality and parameters in PVED-CLS
PLUS+1 Service Tool User Guide	1.8	Installation guideline for PLUS+1 service tool
PVED-CLS Technical Information	0103	Technical specification for PVED-CLS

3.3 CERTIFICATION STATUS

Certification update in progress. Contact PAE for status.

4 Software upgrade instructions

4.1 UPGRADE INSTRUCTIONS FOR 1.98 RELEASE FROM 1.97 RELEASE

For upgrading PVED-CLS firmware to 1.98 from 1.97, please follow these steps:
Installation of PLUS+1 service tool. Installation and setup instructions are described in document: PLUS+1 Service Tool User Guide.

Install the PLG files (for filenames, refer to section 3.1) for 1.98 included in the release package. Go to File/Install Diagnostic Data and press install. In the file dialog, find the three files with the ending .PLG.

Use PLUS+1 service tool to download the 3.85 bootloader to MainUC and SafetyUC. When asked for a password, type "BOOT". The bootloader file (for filenames, Refer to section 3.1) is the same for MainUC and safetyUC. A comfortable alternative to downloading .hex files, also the .mlhx file can be used. Find additional information on how to download the bootloader .hex or .mlhx to PVED-CLS in PLUS+1_Service_Tool_Guide.docx.

Use PLUS+1 service tool to download the 1.98 firmware (for filenames, refer to section 3.1) to MainUC and SafetyUC. In PLUS+1 service tool, open File/File download, choose controller and matching .hex file. This must be done for both controllers while making sure the correct firmware is downloaded to the right controller. A comfortable alternative to downloading .hex files, also the .mlhx file can be used. When asked for a password, type "CLSM" for MainUC and "CLSS" for SafetyUC. Information on how to download the firmware .hex or .mlhx to PVED-CLS is found in PLUS+1_Service_Tool_Guide.docx.

EEPROM parameter update

There are no changes of the EEPROM parameter layout between 1.98 and 1.97 release. Therefore, no additional steps have to be performed.

Important	Verify that all parameters are set correctly before release.

4.2 UPGRADE INSTRUCTIONS FOR 1.98 RELEASE FROM 1.96 RELEASE

This section describes the procedure for upgrading existing PVED-CLS units with 1.98 from 1.96. If the upgrade is done from earlier versions, additional steps are required. Contact Danfoss PAE for details.

For upgrading PVED-CLS firmware to 1.98 from 1.96, please follow these steps:
Installation of PLUS+1 service tool. Installation and setup instructions are described in document: PLUS+1 Service Tool User Guide.

Install the PLG files (for filenames, refer to section 3.1) for 1.98 included in the release package. Go to File/Install Diagnostic Data and press install. In the file dialog, find the three files with the ending .PLG.

Use PLUS+1 service tool to download the 3.85 bootloader to MainUC and SafetyUC. When asked for a password, type "BOOT". The bootloader file (for filenames, Refer to section 3.1) is the same for MainUC and safetyUC. A comfortable alternative to downloading .hex files, also the .mlhx file can be used. Find additional information on how to download the bootloader .hex or .mlhx to PVED-CLS in PLUS+1_Service_Tool_Guide.docx.

Use PLUS+1 service tool to download the 1.98 firmware (for filenames, refer to section 3.1) to MainUC and SafetyUC. In PLUS+1 service tool, open File/File download, choose controller and matching .hex file. This must be done for both controllers while making sure the correct firmware is downloaded to the right controller. A comfortable alternative to downloading .hex files, also the .mlhx file can be used. When asked for a password, type "CLSM" for MainUC and "CLSS" for SafetyUC. Information on how to download the firmware .hex or .mlhx to PVED-CLS is found in PLUS+1_Service_Tool_Guide.docx.

EEPROM parameter update

Open PVED-CLS_1.98_rev_A.P1D in service tool

Go to Info page and set the desired signature password. Contact your nearest PAE for acquiring the password. Before downloading any parameters to PVED-CLS verify that the values are correct before applying the signature.

There have been some changes in the parameters going from 1.96 to 1.98. The changes are displayed in the table below. The parameters have been grouped, and an explanation for the change is given per group.

1) Change in Fast Steer where lock to lock ratio changes when max angle changes, but keep the relation between STW and WA speed. Set to default, and approve the sector.

2) Due to implementation of analog joystick, the name has changed. No modification with Service Tool is needed, but XML naming has changed. Have this in mind when using XML files between the two versions. Changed parameter names means they will not be updated.

3) Parameters added in relation to analog joystick. Set to default, and approve the sector.

4) Parameters added in relation to Elobau joystick protocol implementation. Set to default, and approve the sector.

5) Parameters added in relation to the calculation of cylinder stroke volume and max WA in wheel angle calibration. Set to default, and approve the sector.

6) Change of parameter name. As with point 2, the parameter will not be updated if an 1.96XML file is imported to 1.98.

7) New defaults, please update accordingly

Group	EEPROM address	1.96 XML parameter name	1.98 XML parameter name	1.98 default value
2	48 (sign the sector)	AN_WAS_DATA_SECTOR_CRC_SIGN	AN_SEN_DATA_SECTOR_CRC_SIGN	Sign the sector
	3205	PRIM_WAS_LEFT_MAX_POS_MV	PRIM_AN_SEN_LEFT_MAX_POS_MV	500
	3207	PRIM_WAS_RIGHT_MAX_POS_MV	PRIM_AN_SEN_RIGHT_MAX_POS_MV	4500
	3209	PRIM_WAS_NUTRAL_POS_MV	PRIM_AN_SEN_NUTRAL_POS_MV	2500
	3211	REDNT_WAS_LEFT_MAX_POS_MV	REDNT_AN_SEN_LEFT_MAX_POS_MV	500
	3213	REDNT_WAS_RIGHT_MAX_POS_MV	REDNT_AN_SEN_RIGHT_MAX_POS_MV	4500
	3215	REDNT_WAS_NUTRAL_POS_MV	REDNT_AN_SEN_NUTRAL_POS_MV	2500
	3217	P_WAS_CALIB_SEN_SUPP_VLTG_MV	P_AN_SEN_CALIB_SEN_SUPP_VLTG_MV	5000
	3219	R_WAS_CALIB_SEN_SUPP_VLTG_MV	R_AN_SEN_CALIB_SEN_SUPP_VLTG_MV	5000
	3235	AN_WAS_DATA_SECTOR_CRC	AN_SEN_DATA_SECTOR_CRC	Download the sector
6	3244	WAS_INTERFACE_TYPE	WAS_INTERFACE	0
2	3246	PRIM_WAS_VLTG_CMP_EN	PRIM_AN_SEN_VLTG_CMP_EN	255
	3247	REDNT_WAS_VLTG_CMP_EN	REDNT_AN_SEN_VLTG_CMP_EN	255
3	3327	-	STAT_MSG7_TX_RATE_X10MS	0
	3328	-	STAT_MSG7_PGN_OFFSET	39
4	3329	-	AUX_ELOBAU_JOYSTICK_PGN	64982
7	3369	SAFE_AUX_MAX_JOY_POS_DIFF_ALLOWED_IR (new default value)		100
2	3375	MAX_INTRNL_WA_DIFF_IR	SAFE_MAX_INTRNL_AN_SEN_DIFF_IR	50
	3384	WA_LIMIT_OFFSET_IR	AN_SEN_LIMIT_OFFSET_IR	50
3	3390	-	CAN_WA_LIMIT_OFFSET_IR	50
5	3392	-	MAX_WAS_CYLNDR_STRK_VOL_DIFF_CCM	50
	3394	-	MAX_WAS_WA_DIFF_DEG	3
1	3585	-	L2L_NO_OF_TURNS_WA_RANGE	255
3	3734	-	OL_JOY_DB_OFFSET_IR	0
	3736	-	OL_JOY_NEUTRAL_DB_OFFSET_IR	0
	3738	-	OL_JOY_PNT_X_IR	1000
	3740	-	OL_JOY_PNT_Y_IR	1000
1	3742	-	AUX_L2L_NO_OF_TURNS_WA_RANGE	255
3	3777	-	AN_JOY_CALIB_CNTR	0
	3778	-	AN_JOY_CALIB_CNTR_INVT	255
2	3791	MAX_WAS_NEUTRAL_POS_MV	MAX_AN_SEN_NEUTRAL_POS_MV	4500
	3793	MIN_DIST_BETWEEN_POS_MV	MIN_AN_SEN_DIST_BETWEEN_POS_MV	0
	3795	MIN_WAS_NEUTRAL_POS_MV	MIN_AN_SEN_NEUTRAL_POS_MV	500
3	3841	-	MAX_CAN_WAS_NEUTRAL_POS_MV	4500
	3843	-	MIN_CAN_WAS_DIST_BETWEEN_POS_MV	0

	3845	-	MIN_CAN_WAS_NEUTRAL_POS_MV	500

Note: New parameters in 1.98 are colored in green.
Parameters which have changed their name based on SEHS-1160 are colored in red.

Important	Verify that all parameters are set correctly before release.

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 Safety Manual	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	See chapter 3.3 step 1 to 4
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 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: Software revision history

6.1 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

6.2 CHANGELOG 1.98

6.2.1 New implementations

None

6.2.2 Corrected defects

6.2.2.1 SEHS-2250 (S2) : WAS auto-calibration may result in different maximum steering angle position and cylinder stroke volume for the main and safety controller. This inconsistency may lead to false spool monitoring faults.

JIRA ID	SEHS-2250
Severity	Medium
Introduction	The PVED-CLS has a function to auto-calibrate the maximum achievable wheel angles. As an additional feature, it is possible to also let the PVED-CLS automatically re-calculate the maximum estimated steering angles and the cylinder stroke. The re-calculation is based on the wheel angle calibration values found during auto-calibration. Further information can be found in the user manual for 1.96 or later, section wheel angle sensor calibration.
Problem	PVED-CLS has two controllers which captures their own calibration values which might slightly differ from each other due to tolerances. The two controllers use their own calibrated values to calculate the new maximum steer angle positions and the cylinder stroke volume. Their results may differ slightly as a consequence of the slightly different input data. The difference can have an impact in the maximum steering angle positions in closed-loop algorithms. Here the two controllers may come to different conclusions on where to position the EH-Main spool when the wheel angle set-point and the actual wheel angle are close to each other. The safety controller may calculate a spool-set point which is lower than the main controller spool-set point. Since the main-controller is controlling the spool, the safety controller will observe a larger spool position than it can allow. In extreme cases this may lead the PVED-CLS to enter safe state with safety controller reporting spool monitoring failure (SPN:520204 FMI: 7).
Occurrence	The condition for getting the problem arises if slightly different results from the wheel angle sensor calibration are calculated. When the condition is met, triggering of a false alarm may be provoked by analog noise and is random. According to field observations, calculating slightly different results may happen as often as 15% of the times. - The effect gets more significant the lower the maximum steering angle gets. - The issue is more likely to happen if there is a steep slope of the sensor characteristics (angle VS voltage)
Impact	This issue is only visible when auto adjustment of Maximum steering angles is enabled (ie. P3426 & P3428 > 89deg). If PVED-CLS main and safety controller uses different values for the maximum steering angles and safety controller enters safe state with spool monitoring error (SPN:520204 FMI: 7), PVED-CLS must be power-cycled by hard or soft reset. This error will only be visible in closed loop steering modes (auto-guidance and closed loop joystick)
Work around	Upon every WAS auto-calibration operation the results shall be inspected as follows. Read back the max angles found by PVED-CLS main and safety controller. In case they do not match, either take the value from main controller and download to the safety controller or try to redo the WAS calibration. Reading back the data can be done while in WAS calibration mode via the J1939 parameter read message (see communication protocol). If the values are found not to be equal, WAS calibration can be reset using the calibration reset request message where after all WAS positions (Left, Neutral, Right) need to be re-captured.
Seen on SW version	1.96, 1.97
Solved in SW version	1.98

6.3 CHANGELOG 1.97

6.3.1 New implementations

6.3.1.1 SEHS-924: Support for systems without WAS

It is now possible to disable the WAS in the PVED-CLS, configurable by p3244. For further information, consult the user manual regarding wheel angle sensor.

Impact to existing applications: None, everything will work as before, if configuration is not changed.
Safety Impact: None for systems not using this feature. Refer to the 'PVED-CLS Safety Function Overview' in the Safety Manual to see which safety functions are not available if the WAS is disabled.

6.3.1.2 SEHS-990: Support for Elobau J4F with 351JCM joystick interface

The PVED-CLS can now be configured to use Elobau J4F with 351JCM joystick for open loop joystick control, enabled by setting p3240 accordingly. A new parameter defines the PGN of the messages from the joystick, p3329. Consult the user manual and communication protocol regarding Elobau joystick for details.

Impact to existing applications: None, everything will work as before, if configuration is not changed.
Safety Impact: None. Consult the Safety manual for information about the Elobau safety concept.

6.3.1.3 SEHS-1069: Addition of Status Message 7

To test the interface and calibration of analog joystick a 7th status message has been added.
To handle the new message two parameters are added: p3327 defining the repetition rate of the message and p3328 defining the PGN offset.
The transmission rate can also be changed run-time via STATUS MESSAGE REQUEST 2. For further information about the two new messages, refer to related Communication Protocol chapters.
Impact to existing applications: None.
Safety Impact: None, it is not recommended to use status message 7 as part of an external safety function.

6.3.1.4 SEHS-1087: Support for Analog open loop joystick interface

It is now possible to use the AD1 and AD2 for either a WAS or a joystick (not possible to combine).
A new operation state is introduced for the calibration of the analog joystick.
Refer to the user manual and communication protocol for further details.
Impact to existing applications: None, everything will work as before, if configuration is not changed and new parameters are set to default.
Safety Impact: None.

6.3.1.5 SEHS-1160: Renaming of sector to "Analog Sensor calibration data"

With the introduction of analog joystick, the calibration values in the sector can be either for WAS or analog joystick, depending on the configuration. Because of that the name is changed so it fits both.
Prior to analog joystick implementation, the sector could only contain calibration data about analog WAS.
See list of parameters with changed name in Table 3.

EEPROM address	1.96 parameter name	1.97 parameter name
48	AN_WAS_DATA_SECTOR_CRC_SIGN	AN_SEN_DATA_SECTOR_CRC_SIGN
3205	Primary WAS max left position (Analogue)	Primary analogue sensor max left position
3207	Primary WAS max right position (Analogue)	Primary analogue sensor max right position
3209	Primary WAS neutral position (Analogue)	Primary analogue sensor neutral position
3211	Redundant WAS max left position (Analogue)	Redundant analogue sensor max left position
3213	Redundant WAS max right position (Analogue)	Redundant analogue sensor max right position
3215	Redundant WAS neutral position (Analogue)	Redundant analogue sensor neutral position
3217	5V sensor supply for primary WAS during calibration	5V sensor supply for primary analogue sensor during calibration
3219	5V sensor supply for redundant WAS during calibration	5V sensor supply for redundant analogue sensor during calibration
3235	AN_WAS_DATA_SECTOR_CRC	AN_SEN_DATA_SECTOR_CRC
3244	WAS interface type	WAS interface
3246	Voltage compensation for primary WAS	Voltage compensation for primary analog sensor
3247	Voltage compensation for redundant WAS	Voltage compensation for redundant analog sensor
3375	Channel cross-check monitoring - max wheel angle divergence (internal)	Channel cross-check monitoring - max analog sensor divergence (internal)
3384	Scaled wheel angle safe state threshold – Scaled wheel angle limit offset	Scaled Analogue Sensor limit offset
3791	Max allowable WAS signal to be captured in Neutral	Max allowable Analogue Sensor signal to be captured in Neutral
3793	Min voltage needed in between the captured WAS values	Min voltage needed in between the captured Analogue Sensor values
3795	Min allowable WAS signal to be captured in Neutral	Min allowable Analogue sensor signal to be captured in Neutral

Table 3: List of parameters with changes names in 1.97

See user manual for further details.
Impact to existing applications: None.
Safety Impact: None.

6.3.1.6 SEHS-1161: The configured fast steer ratio is maintained when maximum WA are changed

This change is designed towards applications which change their settings of the WA lock stops frequently, for example changing tire dimensions.
Consider a machine that has fast steer designed with two STW revolutions lock to lock at a total WA range of 60deg. Tires are changed and now the total WA range is 90deg. If the new function is disabled or previous PVED-CLS firmware is used, the fast steer algorithm will keep the STW lock to lock ratio at two revolutions and thus increase the gain between STW and WA by 50%. This may not be desirable.
With the new implementation, p3585 and p3742 defines at which WA range the STW program lock to lock is designed. If the example from above is used, and p3585 and p3742 parameters are set to 60deg, the STW lock to lock will now increase to three, but it will keep the gain between STW and WA movement. The same is the case for AUX STW device.
To make it compensation happen automatically, the feature for automatic calculation of max WA's and cylinder stroke volume upon WA calibration must be enabled. Refer to the user manual for further details on the lock to lock ratio compensation and how to enable the automatic calculation of max WA's and cylinder stroke volume.

Impact to existing applications: None, everything will work as before, if default values are used.
Safety Impact: None.

6.3.1.7 SEHS-1206: New default value for p3369

Default tolerance for AUX joystick position is increased to 100IR to improve robustness.

Impact to existing applications: None, if an AUX joystick is used with values lower than default, robustness may not be as desired.
Safety Impact: None. The change is aligned with other crosscheck tolerances.

6.3.1.8 SEHS-1211: EEPROM area assigned for OEM usage

A new area in the EEPROM is assigned for OEM usage. The range is p4210-p4311. Usage of parameters is up to the system integrator. The data is not CRC protected.
Impact to existing applications: None.
Safety Impact: None.

6.3.2 Corrected defects

6.3.2.1 SEHS-1151: Specific 11bit CAN messages force PVED-CLS to enter safe state with false alarm if AUX device is configured to be present.

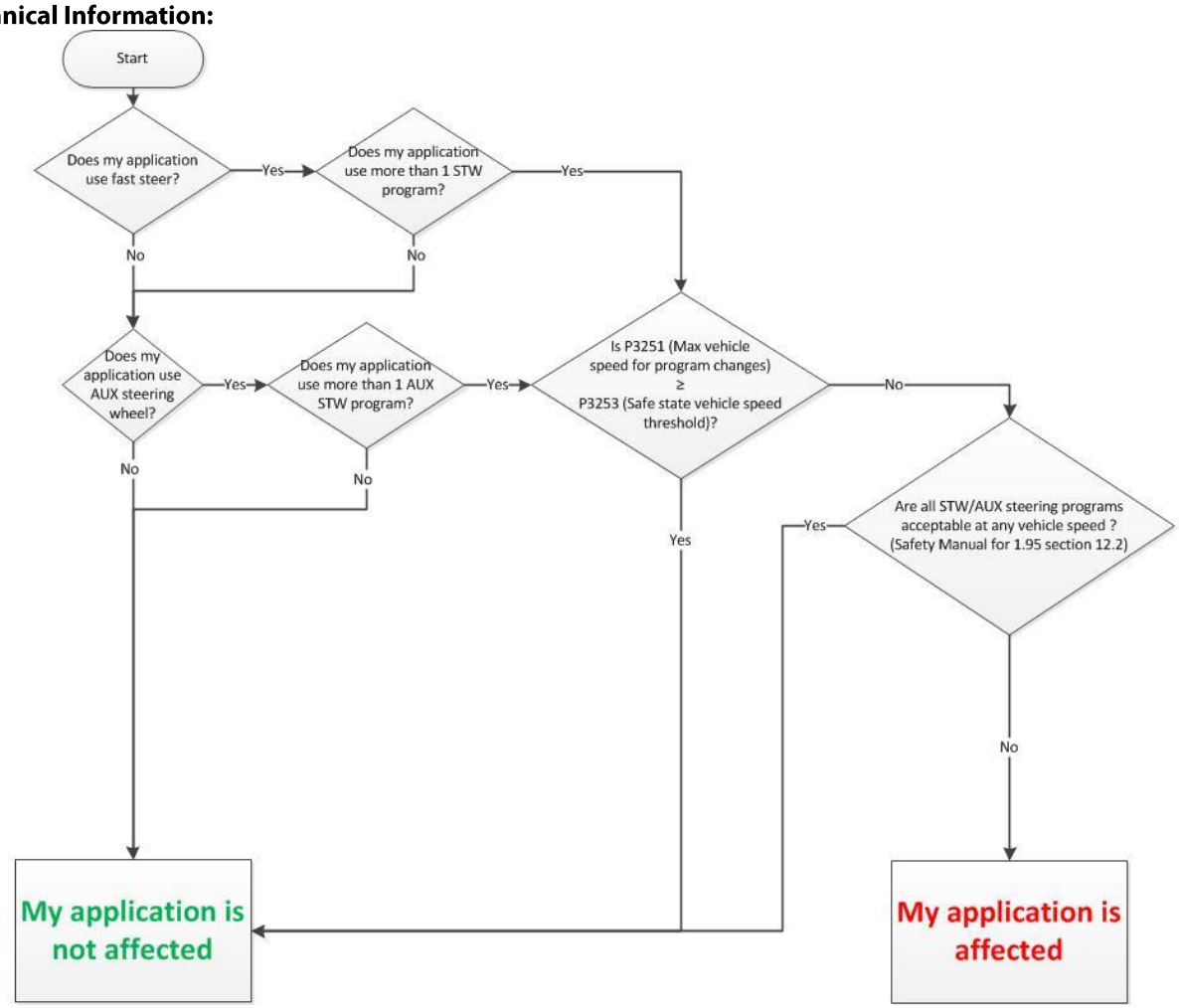
JIRA ID	SEHS-1151
Severity	Medium
Introduction	PVED-CLS supports AUX devices such as Mini steering wheels or joysticks.
Problem	PVED-CLS enters safe state displaying a false alarm if the AUX device is configured to be present and one of the message which are listed in the technical details section is present on the CAN bus.
Occurrence	This issue is systematic and PVED-CLS will enter safe state each time if the AUX device is configured to be present and one of the message ID's which are listed in the technical information section is present on the CAN bus. PVED-CLS will send SPN: 520202 FMI: 9.
Impact	This issue has impact for customers using AUX device and 11 bit CAN messages on the same CAN bus.
Work around	None of the Message ID's listed in the technical information section are allowed to be on the CAN bus if the AUX device is configured to be present on the CAN bus.
Seen on SW version	1.92, 1.93, 1.95, 1.96
Solved in SW version	1.97

Technical Information:
List of 11bit CAN messages ID's which triggers safe state with false alarm.
ID: y3Fh
ID: y7Fh
ID: yBFh
ID: yFFh
Where y represents any number from 1-7.
The content of the message is not relevant for this issue, only the message ID is important.

6.3.2.2 SEHS-1278: MMI STEERING PROGRAM CHANGE LOCK-OUT SSM_058 does not work as intended

JIRA ID	SEHS-1278
Severity	Medium
Introduction	MMI STEERING PROGRAM CHANGE LOCK-OUT SSM_058 prohibits steering program changes in STW or AUX mode if the vehicle speed is above P3251 (Max vehicle speed for program changes). Additional information can be found in the user manual for 1.95 section 7.1.5 or in the safety manual for 1.95 section 12.2.
Problem	If the MMI steering program change lock-out is utilized and the vehicle speed is above the threshold specified by parameter P3251 (maximum vehicle speed for program changes) and the operator tries to change the steering program (e.g. from STW program 1 to STW program 2), the PVED-CLS appears to remain in STW program 1 signaled in the operation status message. See communication protocol for 1.95, section 7.8. The problem is that the PVED-CLS will switch to the locked-out program and use the lock-to-lock configuration given by steering program 2. This program change is however evident when observing the currently applied lock-to-lock ratio displayed in the steering feedback message. See communication protocol document for 1.95 section 14.
Occurrence	The problem is systematic and not random, it is hence under specific conditions and configurations always present. The defect is isolated to Off-Road operation. Please review the flow chart given in the technical information section if an application is affected or not.
Impact	The specific safety function is designed to avoid unintended (erratic) MMI commands from the Main ECU of the machine. If this controller (sporadically and not as per design) changes the steering wheel program at vehicle speeds above the threshold set by P3251 (typically set at 20 km/h), the operator, depending on attention level and the STW program parameters, will observe a change in the lock-to-lock ratio. Upon a change in the STW program will the lock-to-lock ratio become higher or lower resulting in under- or over-steering. As the operator initiates any direction change of the vehicle through the steering wheel. Overall steering is fully controllable, only the amplification factor may change noticeable. If customers and system integrators have integrated the PVED-CLS as specified and recommended in the safety manual, will this defect have no impact at all. The flow chart in the technical information section can assist in determining if an application is potentially affected or not.
Work around	Review Safety manual for 1.95 section 12.2 for recommendations on safe steering program setup. To determine the best possible workaround requires analysis of the individual application - contact Danfoss PAE for advice.
Seen on SW version	1.92, 1.93, 1.95 & 1.96
Solved in SW version	1.97

Technical Information:



6.3.2.3 SEHS-1287: GMS message information is not consistent if the vehicle speed is above P3250 and auto-steering engage is attempted

JIRA ID	SEHS-1287
Severity	Medium
Introduction	The GMS (Guidance machine status) message feeds back information to the auto-guidance controller about the estimated curvature and system status.
Problem	On Auto Guidance engage, when VSP is too high (>P3250, see Safety Manual SSM_059) the PVED-CLS will not signal in GMS that GPS1/2 is not possible, and the PVED-CLS will remember the transition from "Not intended for steering" to "Intended for steering" (GPSX_Str_cmd_status, see Communication Protocol section "Auto-guidance related CAN messages"). The PVED-CLS will change to GPS1 or GPS2, when VSP is low enough again.
Occurrence	Every time Auto Guidance is engaged at VSP higher than P3250.
Impact	This problem is limited to systems where Auto Guidance is used, P3250 is below engage speed for the Auto Guidance system. Applying the recommended vehicle speed dependent flow limitation and WA limitation, enables the operator to easily controlled override by the steering wheel.
Work around	Align the auto-guidance controller maximum engage speed with the PVED-CLS (P3250). Applying the recommended vehicle speed dependent flow limitation and WA limitation, enables the operator to easily controlled override by the steering wheel.
Seen on SW version	1.92, 1.93, 1.95, 1.96
Solved in SW version	1.97

6.3.2.4 SEHS-1053: PVED-CLS has no range check for the incoming steering wheel velocity

JIRA ID	SEHS-1053
Severity	Low
Introduction	PVED-CLS uses the steering wheel velocity sent by the SASA sensor to calculate the spool setpoint for the EH-spool.
Problem	Failing to respect the specified CAN data ranges may lead to fast symmetrical oscillating full flow spool set-point commands. The set-point oscillations in the 100Hz range and low-pass filtered by the solenoid valve bridge.
Occurrence	The problem has only been observed during lab tests with simulated SASA input exhibiting extreme out-of-range data.
Impact	None
Work around	Ensure that the steering wheel CAN message data is in the valid range.
Seen on SW version	all
Solved in SW version	1.97

6.3.2.5 SEHS-1168: FDA not robust against wheel angle oscillations with small amplitude

JIRA ID	SEHS-1168
Severity	Low
Introduction	FDA (Fault detection algorithm) monitors the steering system for suspicious steering movements by crosschecking various sensors in the system. For additional information, refer to Safety manual section SSM_030
Problem	Field test has shown that under certain high steered axle load and operation conditions, the WAS can produce oscillating signals. This can provoke false faults in FDA. It is observed in systems where WAS is verified working correctly and exhibiting zero slack.
Occurrence	The problem has only been seen on a single test machine which is a front-loader application and has a front axle with single tyres.
Impact	In case the wheels start oscillating with small amplitude without operator input, PVED-CLS will enter safe state and send SPN: 520205 FMI: 23
Work around	Power cycling of PVED-CLS
Seen on SW version	1.92, 1.93, 1.95, 1.96
Solved in SW version	1.97

6.3.2.6 SEHS-1197: The road switch may trigger false alarms and trip to the safe state.

JIRA ID	SEHS-1197
Severity	Low
Introduction	PVED-CLS offers a PL/AgPL e shutdown method where PVED-CLS can stay powered while driving on the road. This shutdown method includes diagnostics in form of signal validations and crosschecks. More information can be found in the safety manual, SSM_041.
Problem	Two diagnostic functions may detect false alarms under certain road switch signal conditions. The Cut-off supply on pin 6 is monitored by continuously checking that the output is driven as expected. The two-channel road switch signals are monitored by continuously comparing the signal states. Failing to switch the two channels in a synchronized manner will lead to nuisance trips and false alarms. External noise/glitches/jitter may trigger false alarms. Two scenarios have been identified in laboratory during endurance testing: 1) Switching noise/jitter/glitches on the road switch channel driving the Cut-Off supply by pin 6 may trigger the road switch interface diagnostic functions. The Cut-Off supply on pin 6 is monitored by comparing the measured switched output pulse-width with the commanded pulse-width. Any incoming glitches or jitter may in some circumstances be measured as an incorrect pulse-width. If it occurs, the PVED-CLS enters safe state and issues SPN 520198 FMI 8. The system integrator is advised to observe if noise/glitches/jitter is present when the road switch is operated and perform robustness testing as part of the integration. 2) If the road switch is not switching the two channels simultaneously and offsets the signals in the temporal domain, the signal cross-check will detect this. The PVED-CLS will enter the safe state.
Occurrence	The problem depends on the road switch, installation and/or wiring. The noise/glitch/jitter may randomly affect the diagnostic function when the road switch is operated. Not easily repeatable.
Impact	Nuisance trip to safe state. Restart is required to clear the error.
Work around	Locate the source of the noise/glitch/jitter and replace the component. No software fix is available. The problem is solved by using a mechanically linked switch.
Seen on SW version	1.92, 1.93, 1.95, 1.96
Solved in SW version	1.97

6.3.2.7 SEHS-1198: PVED-CLS does not check P3426 & P3428 for consistency before use

JIRA ID	SEHS-1198
Severity	Low
Introduction	PVED-CLS has implemented a function to auto-calibrate the wheel angles. Also it is possible to let PVED-CLS re-calculate the max wheel angle positions and the cylinder stroke based on the wheel angle calibration values found during auto-calibration. For triggering the automatic recalculation of the extreme wheel angle positions the parameters P3426 Maximum steer angle left & P3428 Maximum steer angle right need to be set > 89 deg. Further information can be found in the user manual for 1.96, section Wheel angle sensor calibration.
Problem	PVED-CLS does not have a crosscheck that both of the parameters are configured consistently eg. if P3426 & P3428 > 89 deg (automatic recalculation of extreme wheel angle position during auto-calibration enabled) or P3426 & P3428 ≤ 89. If P3426 & P3428 > 89 and analog wheel angle sensors are used PVED-CLS validates that P3223 & P3225 (for CAN based sensors P3193 & P3195) are ≤ 89 before using these values as extreme wheel angle positions. If fx. P3426 is > 89 and P3428 ≤ 89 PVED-CLS will now use P3223 & P3225 as extreme wheel angle positions regardless of its value which will affect both auto-guidance and AUX joystick closed loop algorithm.
Occurrence	Safety manual for 1.95, section 18 & SSM_047, states that during system integration and parameter configuration it shall be verified that all parameters are set correctly and that the system works as specified. If this rule is followed this problem will not occur.
Impact	If the parameters are incorrectly set and PVED-CLS uses abnormal values for the extreme wheel angle position it will have influence on the closed loop algorithms eg. auto-guidance and AUX closed loop joystick. The influence will purely be on performance and not on safety.
Work around	Ensure that P3426 Maximum steer angle left and P3428 Maximum steer angle right are consistently configured eg. either P3426 & P3428 > 89 deg (automatic recalculation of extreme wheel angle position during auto-calibration enabled) or P3426 & P3428 ≤ 89.
Seen on SW version	1.96
Solved in SW version	1.97

6.3.2.8 SEHS-1199: PVED-CLS enters safe state instead of WAS/Spool calibration mode when calibration sectors are corrupted

JIRA ID	SEHS-1199
Severity	Low
Introduction	PVED-CLS has implemented a function to auto-calibrate the wheel angles and the spool deadbands. In case PVED-CLS detects corrupted calibration parameters eg. parameters being out of valid range or wrong CRC values, it will enter the respective calibration service mode.
Problem	in 1.96, PVED-CLS will enter safe state and not calibration service mode if the calibration sectors are corrupted.
Occurrence	This problem is visible every time the calibration sectors gets corrupted
Impact	PVED-CLS will enter safe state and the user will have to clear the corruption with PLUS+1 or other service tool and trigger re-calibration of the corrupted parameters.
Work around	The user will have to clear the corruption with the PLUS+1 or some other service tool and trigger re-calibration of the corrupted parameters.
Seen on SW version	1.96
Solved in SW version	1.97

6.3.2.9 SEHS-1123: WAS auto-calibration gives different results in main and safety controller for maximum steer angle position and cylinder stroke volume calculation.

JIRA ID	SEHS-1123
Severity	Cosmetic
Introduction	PVED-CLS has implemented a function to auto-calibrate the wheel angles. Also it is possible to let PVED-CLS re-calculate the maximum steer angle positions and the cylinder stroke based on the wheel angle calibration values found during auto-calibration. Further information can be found in the user manual for 1.96, section Wheel angle sensor calibration.
Problem	PVED-CLS has two controllers which captures their own calibration values which might slightly differ from each other due to tolerances. The two controllers use their own calibrated values to calculate the new max maximum steer angle positions and the cylinder stroke volume which will slightly differ from each other as a consequence of the slightly different input data. The difference in the results is judged to be of cosmetic nature and will not have any influence on performance.
Occurrence	If the enhanced WAS calibration function is activated (P3426 & P3428 > 89deg or P3086 > 10000ccm) the new calculated values will always deviate slightly for main and safety controller, but only in very extreme cases this will have impact on performance. In 1.97, this issue is resolved by implementing a crosscheck for the calculated values by main and safety. After the crosscheck, the values calculated by main controller are stored in both the EEPROM for main and the safety controller.
Impact	None
Work around	None
Seen on SW version	1.96
Solved in SW version	1.97

6.3.2.10 SEHS-1154: PVED-CLS uses the same SPN for all crosschecks performed on AUX closed loop joystick signals

JIRA ID	SEHS-1154
Severity	Cosmetic
Introduction	PVED-CLS performs crosscheck of the incoming AUX primary and redundant sensor signals. Further information can be found in the safety manual, SSM_064.
Problem	PVED-CLS uses the same SPN, SPN: 520231 FMI: 25, to indicate problems of the AUX sensor regardless of which signal validation failed. This is not in accordance with the SPN generation for signal crosschecks for other external sensor input.
Occurrence	The problem is systematic
Impact	If SPN: 520231 FMI: 25 is reported by PVED-CLS, the user will have to debug all AUX sensor signals instead of being directly directed to the problematic signal which has triggered the failure.
Work around	None
Seen on SW version	1.96
Solved in SW version	1.97

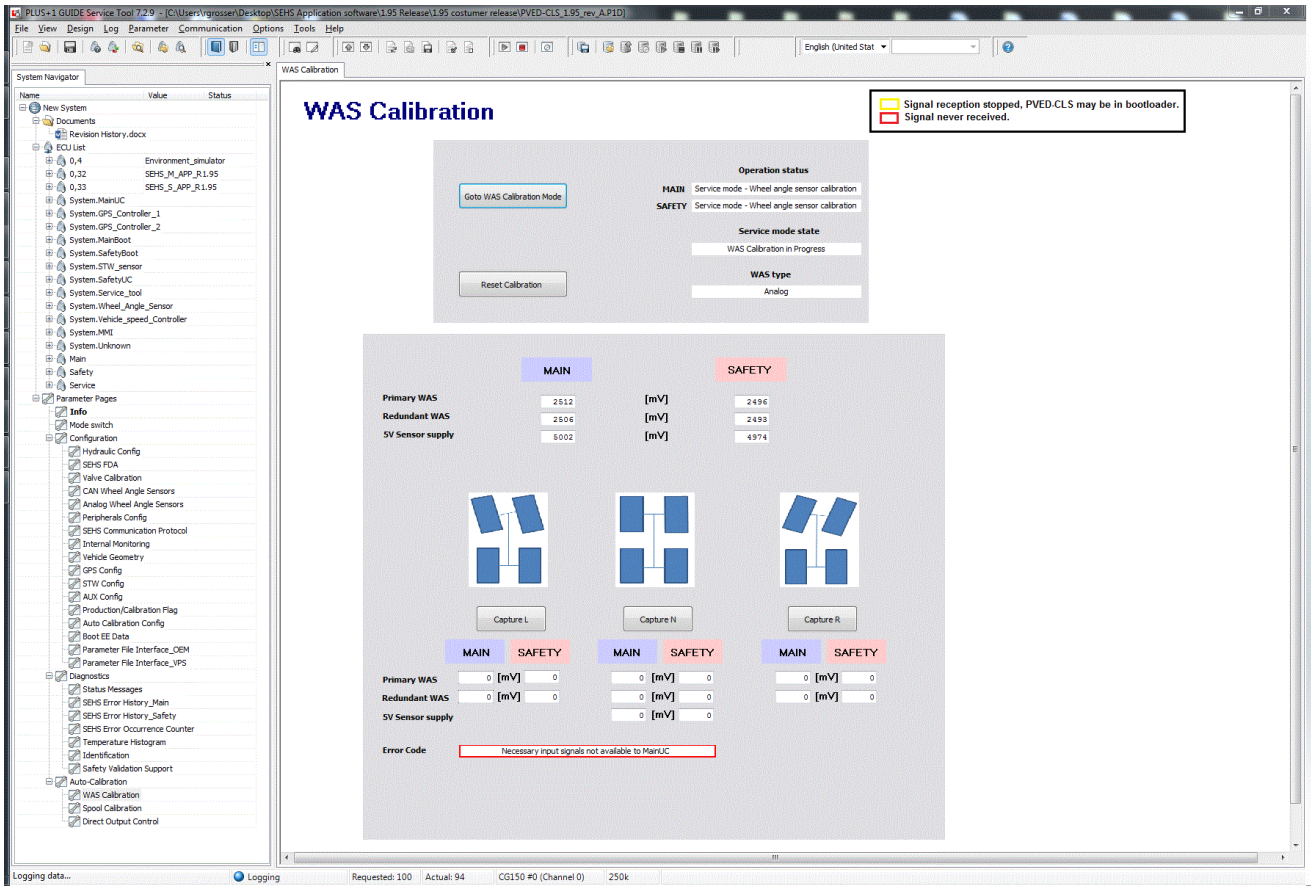
6.3.2.11 SEHS-1202: Wrong information shown in status message 2, Closed loop wheel angle setpoint in AUX closed loop joystick steering mode

JIRA ID	SEHS-1202
Severity	Cosmetic
Introduction	PVED-CLS supports an AUX closed loop joystick device. When operating this device, PVED-CLS send information in status message 2 about the closed loop wheel angle setpoint. See additional information in PVED-CLS communication protocol for 1.96, section 7.3 Status message 2.
Problem	If the parameters configuring the AUX closed loop vehicle speed dependent wheel angle limitation function (See safety manual for 1.96, SSM_062) specified by P3720, P3721 or P3722, are set to be higher than the physical extreme wheel angle position set by P3426 & P3428 (if the physical extreme wheel angle points are auto-calibrated, the physical extreme wheel angle positions are specified by P3223 & P3225 for analog wheel angle and P3193 & P3195 for CAN based wheel angle). If the system is configured as described and the requested wheel angle exceeds what is configured as physically possible, the wheel angle setpoint in status message 2 goes out of the valid range -1000 to 1000. In this case PVED-CLS should clamp the value to -1000 to 1000.
Occurrence	The Problem only occurs if the parameters configuring the AUX closed loop vehicle speed dependent wheel angle limitation function (See safety manual for 1.96, SSM_062), P3720, P3721 or P3722, are set to be higher than the physical extreme wheel angle position set by P3426 & P3428 (if the physical extreme wheel angle points are auto-calibrated, the physical extreme wheel angle points are specified by P3223 & P3225 for analog wheel angle and P3193 & P3195 for CAN based wheel angle) and the operator requests a wheel angle beyond the physical range.
Impact	If this information is not used by the operator this problem has no impact. The value gets clamped to the correct range before it is used in further calculations. If the value is used for any calculation externally, the value must be limited to the range -1000 to 1000 before use (raw CAN value rolls over to 0xFFFF if lower than -1000.
Work around	If the value is used for any calculation externally, the value must be limited to the range -1000 to 1000 before use (raw CAN value rolls over to 0xFFFF if lower than -1000. Note that status message (Status messages 1 - 7) information shall not be used for safety critical calculations.
Seen on SW version	1.96
Solved in SW version	1.97

6.3.2.12 SEHS-1065: PLUS+1 Service tool shows not-existing error in WAS auto-calibration

JIRA ID	SEHS-1065
Severity	Cosmetic
Introduction	PVED-CLS has implemented a function to auto-calibrate the wheel angles which can be invoked by the service tool. Further information can be found in the user manual for 1.95, section 9.1 Wheel angle sensor calibration.
Problem	The WAS auto-calibration page in the service tool has a field "Error code" which shows the default value "Necessary input signals not available to MainUC" until a calibration status message containing this signal has been received. This may be confusing to the operator. The red square around the field indicates that a CAN message containing this signal has not been received yet. See screenshot in the technical information section. The value displayed is therefore not valid until the red square disappears.
Occurrence	This error message will be visible every time the WAS auto-calibration is started from the service tool.
Impact	The field "Error code" should be ignored a long as the red square is visible around the field.
Work around	None
Seen on SW version	1.92, 1.93, 1.95, 1.96
Solved in SW version	1.97

Technical Information:



6.3.2.13 SEHS-1263: Valid parameter range incorrect in the PLUS+1 service tool for parameters P3243, P3582 & P3718.

JIRA ID	SEHS-1263
Severity	Cosmetic
Introduction	By using the PLUS+1 service tool it is possible to configure the parameters for PVED-CLS
Problem	Valid parameter range incorrect in the PLUS+1 service tool for P3243, P3582 & P3718. The correct ranges are: P3243 Max COV connection test current: 10-255 P3582 STW Anti-jerk filter Cut-off frequency: 5-200 (incorrect in the user manual too) P3718 AUX low pass Filter cut off frequency: 5-200
Occurrence	The problem is systematic
Impact	This has no impact for costumers. If any parameter is configured out of the ranges implemented in the application, PVED-CLS will enter safe state.
Work around	P3243, P3582 & P3718 shall always be configures inside the valid range: P3243 Max COV connection test current: 10-255 P3582 STW Anti-jerk filter Cut-off frequency: 5-200 P3718 AUX low pass Filter cut off frequency: 5-200
Seen on SW version	1.92, 1.93, 1.95, 1.96
Solved in SW version	1.97

6.3.2.14 SEHS-1501: Plus+1 Service tool does not update reserved bytes in service mode CAN messages

JIRA ID	SEHS-1501
Severity	Cosmetic
Introduction	The Plus+1 service tool can be used to identify, configure & calibrate PVED-CLS units
Problem	The Plus+1 service tool only updates the bytes which carries valid information before sending a CAN message. This means that if a CAN message is sent which has all 8 bytes with signal information, then all 8 bytes will be updated. If the next CAN message to be sent from the Plus+1 service tool only has 2 bytes with signal information, then only these 2 bytes will be updated where as byte 3-8 will stay with the old information. This has no influence on the functionality because PVED-CLS does not validate these bytes, but it is not according to the PVED-CLS Communication protocol.
Occurrence	This problem is systematic
Impact	This issue is cosmetic and has no influence on the functionality. If costumers want to implement their own service tool functionality, they should follow the PVED-CLS communication protocol and not what is sent by the Plus+1 service tool.
Work around	In costumers want to build their own service tool, they should follow PVED-CLS communication protocol and not directly implement what the Plus+1 service tool is sending.
Seen on SW version	1.92, 1.93, 1.95, 1.96
Solved in SW version	1.97

6.4 CHANGELOG 1.96

6.4.1 New implementations

6.4.1.1 SEHS-763: WAS calibration can automatically calculate maximum steer angle positions and cylinder stroke volume

A new feature for the WAS calibration makes it possible to automatically recalculate the maximum steer angle positions and the cylinder stroke volume. The calculation relies on a information on the delta wheel angle sensor voltage change and the related wheel angle change.
This feature is useful for applications where the physical steering geometry changes frequently f. x. when twin tires are mounted. The automatic recalculation takes place under the calibration procedure and ensures that related parameters are adjusted to ensure optimal steering performance.
Additional information on how this feature works and how to configure it can be found in the user manual for 1.96, section wheel angle sensor auto-calibration.

Impact to existing applications: None, the new feature for recalculating the maximum steer angle positions and cylinder stroke volume can be disabled which makes the WAS calibration backwards compatible.
Safety Impact: None

6.4.1.2 SEHS-728: Support for AUX closed loop joystick

From 1.96, PVED-CLS offers support for AUX closed loop joystick steering. Additional information on the joystick closed loop functionality can be found in the user manual for 1.96. New safety and risk mitigation functions implemented along with the AUX closed loop joystick can be found in the safety manual for 1.96, SSM_062, SSM_063 & SSM_064.

Impact to existing applications: None
Safety Impact: None if functionality is not used. High if the functionality is used, safety validation has to be performed before use. Additional information on how to do a safety validation is found in the safety manual for 1.96, section System integration and Testing.

6.4.1.3 SEHS-805: Support for guidance machine message layout according to ISO11783-7:2015

In 1.96, PVED-CLS can support the guidance machine status specified by ISO11783-7:2015. Additional information on signals and state transitions can be found in the communication protocol, section Auto-guidance related CAN messages. PVED-CLS supports both ISO11783-7:2015 and ISO11873-7:2009 guidance machine status message layout and a parameter controls which message layout to use (P3326).

Impact to existing applications: None, the new feature is parameter controlled and fully backwards compatible.
Safety Impact: None, the guidance machine status message only contains non-safety relevant information.

6.4.1.4 SEHS-750: EMC robustness improvement for the Dout shortcut protection

PVED-CLS provides protection for shortcuts on the Dout signal. The output shuts down the power switch immediately in case higher currents than 4A are observed. This shortcut protection for the Dout signal has shown to be too sensitive against external influences during a mutual coupling test and the issue may be observed if external circuitry, relays etc. generates back-emf when switching. The shortcut protection is now reworked and the robustness is improved.

Impact to existing applications: None
Safety Impact: None

6.4.1.5 SEHS-751: EMC robustness improvement for the battery voltage monitoring

PVED-CLS monitors its battery voltage and enters safe state immediately in case an overvoltage condition (Vbat > 35.5V) is observed. This battery voltage signal monitoring has shown to be too sensitive for PVED-CLS to stay operational during a load dump test. The battery voltage monitoring is now reworked to ignore short overvoltage conditions coming from load dump pulses.

Impact to existing applications: None
Safety Impact: None

6.4.1.6 SEHS-572: PVED-CLS checks for compatible boot loader version

A new feature is included in 1.96 where PVED-CLS crosschecks the downloaded boot loader and application for compatibility. This may be useful for service tools which do not support software package compatibility prior to downloading.
If an incompatible software configuration is observed, PVED-CLS enter safe state and reports SPN: 1562 FMI: 31.

Impact to existing applications: None
Safety Impact: None

6.4.2 Corrected defects

6.4.2.1 SEHS-809: Defect in WAS auto-calibration does not allow user to re-capture the same WA value

JIRA ID	SEHS-809
Severity	Low
Introduction	PVED-CLS has implemented a function to auto-calibrate the wheel angles. Further information can be found in the user manual for 1.95, section 9.1 Wheel angle sensor calibration.
Problem	A defect in the PVED-CLS WAS auto-calibration causes that it is not possible to re-capture calibration values if the first round of values are found incorrect by the user. It is only the safety controller which is affected by this. The main controller correctly captures and downloads the subsequent calibration values. There are several functions which can be configured to capture and react to this failure: 1. PVED-CLS offers features which can limit the range of accepted calibration values. These are configured by: - P3791: Max allowable WAS signal to be captured in neutral - P3795: Min allowable WAS signal to be captured in neutral - P3793: Min Voltage needed in between the captured WAS values Additional information on how to configure these values can be found in the user manual for 1.95, Section 9.3.1.1 Auto-calibration parameter plausibility check. 2. If the first captured value violates the parameter crosschecks done at boot up (User manual for 1.95, section 16.3.5 for analog wheel angle sensors and 16.3.4. for CAN based wheel angle sensors), PVED-CLS will enter safe state at power up. The reported error code depends on if analog or CAN wheel angle sensors are used. Analog WAS: SPN:520236 FMI: 2 CAN WAS: SPN: 520235 FMI: 2 3. If the parameter validations mentioned in 1. and 2. do not capture the failure, Main and Safety controller crosschecks their wheel angle internally during normal operation. This crosscheck is configured by P3351 & P3352. If this crosscheck fails, PVED-CLS will enter safe state and report SPN: 520215 FMI: 25. Further information can be found in the safety manual, SSM_018, SSM_019 & SSM_020. 4. If the crosscheck described in 3. does not capture this either, the difference between the correctly captured value in main controller and the incorrectly captured value in safety controller is negligible. After the crosscheck done between main and safety, both controllers use the wheel angle from main controller for further calculation which means that incorrectly captured wheel angle value will not have any effect in the system.
Occurrence	This problem will occur if a WA value is captured more than once during WAS auto-calibration.
Impact	If this is not detected by the operator itself during calibration, PVED-CLS will, if the calibrated values differ too much from each other, enter safe state because of incorrect parameter combination on the calibrated values (see problem report).
Work around	In case one of the WA values is captured wrongly, do not try to capture it again, but reset the calibration sequence and start the calibration from the beginning. Use the calibration reset message, which is described in the communication protocol for 1.95, section 5.3.4. Calibration reset request. The functions described in problem report (1. - 3.) should be fine-tuned. Always validate steering behavior after calibration.
Seen on SW version	1.92, 1.93, 1.95
Solved in SW version	1.96

6.4.2.2 SEHS-1145: PVED-CLS loses synchronization during power-on-self-test and reports SPN: 520211 FMI: 19.

JIRA ID	SEHS-1145
Severity	Low
Introduction	PVED-CLS performs a power-on-self-test every time the power is cycled or soft reset is sent. This self-test includes internal monitoring functions, low level RAM and Flash tests as well as the output stage.
Problem	During the power-on-self-test it was observed that PVED-CLS may lose the synchronization between the 2 microcontrollers which leads to PVED-CLS booting up in safe state and reporting SPN: 520211 FMI: 19.
Occurrence	Problem was observed once during excessive power-up stress testing with battery voltage modulation (1 out of 20000 power cycles)
Impact	PVED-CLS must reboot either by power cycle or by sending soft reset.
Work around	The controller requesting the soft-reset shall check the PVED-CLS response and apply a repeat on time out policy
Seen on SW version	1.93, 1.95
Solved in SW version	1.96

6.4.2.3 SEHS-919: Service mode is not entered if ValveType is EH/OSPE and spool is not in neutral

JIRA ID	SEHS-919
Severity	Low
Introduction	PVED-CLS will enter service mode if requested by sending the service mode request or by setting calibration counters to 0 regardless of the spool position at boot-up.
Problem	Due to an issue in software 1.95 release PVED-CLS will not enter service mode upon request if the valve type is EH/OSPE and the spool is not in neutral at boot-up. If the spool is not in neutral, PVED-CLS will enter safe state and send SPN: 520204 FMI: 28
Occurrence	This issue will happen every time the spool is out of neutral and service mode is requested. If PVED-CLS is physically mounted on a valve (EH/OSPE) this issue will not be seen.
Impact	Minor, issue will only be seen if PVED-CLS is not mounted on a valve physically
Work around	None, spool must be in neutral
Seen on SW version	1.95
Solved in SW version	1.96

6.4.2.4 SEHS-1065: PLUS+1 Service tool shows not-existing error in WAS auto-calibration

JIRA ID	SEHS-1065
Severity	Cosmetic
Introduction	PVED-CLS has implemented a function to auto-calibrate the wheel angles which can be invoked by the service tool. Further information can be found in the user manual for 1.95, section 9.1 Wheel angle sensor calibration.
Problem	The WAS auto-calibration page in the service tool has a field "Error code" which shows the default value "Necessary input signals not available to MainUC" until a calibration status message containing this signal has been received. This may be confusing to the operator. The red square around the field indicates that a CAN message containing this signal has not been received yet. The value displayed is therefore not valid until the red square disappears.
Occurrence	This error message will be visible every time the WAS auto-calibration is started from the service tool.
Impact	The field "Error code" should be ignored a long as the red square is visible around the field.
Work around	None
Seen on SW version	1.92, 1.93, 1.95
Solved in SW version	1.96

6.5 CHANGELOG 1.95

6.5.1 New implementations

6.5.1.1 SEHS-411: Dual Auto guidance interface implemented

From 1.95 PVED-CLS can handle 2 independent auto-guidance controllers simultaneously. The MMI controls which auto-guidance controller is active and can take control over the steering. More info can be found in the user manual section 12 and the communication protocol section 8 (Auto-Guidance messages) and section 11 (MMI messages). The new implementation is fully backwards compatible to existing auto-guidance implementations.

Impact to existing applications: None
Safety Impact: None

6.5.1.2 SEHS-742: AUX open loop joystick flow limit changed to flow scaling

In software versions prior to 1.95 the AUX Joystick flow limit implementation has limited the flow by limiting the usable joystick position range
From 1.95 PVED-CLS scales the maximum allowed flow to the maximum joystick position which hereby gives better controllability at high vehicle speeds.
More information can be found in the user manual in section 11.8.

$$\frac{\Delta\text{Joystick Flow Request}}{\Delta\text{Joystick position}} = Constant \rightarrow \frac{\Delta\text{Joystick Flow Request}}{\Delta\text{Joystick position}} = Vehicle\ speed\ dependent$$

Impact to existing applications: Medium, applications using the joystick functions in earlier versions than 1.95 will be impacted by this change and might need to reconsider the parameter settings.
Safety Impact: Medium, joystick applications will behave differently compared to 1.93 SW version and the functionality shall therefore be revalidated by the OEM.

6.5.1.3 SEHS-622: In case wrong firmware is downloaded to PVED-CLS, PVED-CLS will stay in bootloader

Prior to 1.95 when downloading main controller software into safety controller and vice versa PVED-CLS stopped all communication and the only way to get in contact again was to use the recover ECU function in the PLUS+1 service tool. In 1.95 PVED-CLS will go back to boot loader, mark the downloaded application as invalid and wait for a new firmware download. If PVED-CLS is power cycled in this stage it will enter bootloader directly after boot.

Impact to existing applications: None
Safety Impact: None

6.5.1.4 SEHS-676: Spool monitoring execution in service mode – Spool calibration

Spool monitoring is now executed in Service mode – Spool calibration as an additional monitoring feature, which aborts spool calibration in case of failures.

Impact to existing applications: None, in all software versions it is at any time possible to abort spool calibration by turning the STW.
Safety Impact: None, additional monitoring added to spool calibration – hence positive impact on safety.

6.5.2 Corrected defects

6.5.2.1 SEHS-675: Robustness improvement of Spool calibration

Fixed an issue where in some applications error code 12 (Timeout occurred at move to max point) occurred during spool calibration.

Affected applications: Whether an application will see this or not, depends on several factors such as temperature, tyre friction, other imperfections of hydraulics etc. Today a single application is showing this issue.

Severity: Medium, the robustness of spool calibration algorithm is improved - applications where this did not occur up to 1.93 will not be affected as the measurement method itself is not modified.
Safety Impact: None

6.5.2.2 SEHS-759: Robustness improvement of Flow command crosscheck

Fixed an issue where false alarms occurred (SPN: 520214 FMI: 25) during auto-guidance and STW mode. The issues observed primarily affect applications where anti-jerk functionality is enabled in STW mode or the Flow filter is enabled (P3484 ≠0) in auto-guidance mode. In software versions prior to 1.95 this issue could be provoked by applying large step sizes in excessive stress testing with simulated input. (Larger than what is considered possible in a real world application) in terms of STW velocity in STW mode or curvature commands in auto-guidance mode. Although the flow command crosscheck algorithm was strongly improved, some residual problematic signal conditions are left which are caused by architectural constraints in PVED-CLS.

Affected applications: Applications using the Anti-jerk function or the auto-guidance flow filter.

Severity: Low, because the step sizes required to provoke the false alarm are larger than what is considered possible in a real world application. The issue could only be provoked in excessive stress testing with simulated input.
Safety Impact: None

6.5.2.3 SEHS-766 & SEHS-765: Bugfix in Anti-jerk Ramp calculations in STW and AUX

Fixed an issue where PVED-CLS did not initialize the anti-jerk ramp calculation parameters correctly and enters safe state (SPN: 520214 FMI: 25) when re-entering any STW or AUX program. This issue only affects applications where Anti-jerk is used for STW or AUX and could be provoked by applying a STW/AUX velocity significantly away from neutral while entering the STW or AUX program.

Affected applications: Applications using Anti-Jerk function in STW or AUX

Severity: Low, because the STW velocity must be significantly away from neutral to provoke the false alarm while entering any STW or AUX mini wheel program.
Safety Impact: None

6.5.2.4 SEHS-677: Cut-off valve open circuit detection

The cut-off valve open circuit detection has specified a confidence period of 100ms, but the implementation in the software shows a confidence period of 200ms instead of the specified 100ms in software versions prior to 1.95. In case the open circuit failure mode gets present in the system, PVED-CLS showed a delayed reaction compared to the specification. This issue is now corrected in 1.95.

Affected applications: All applications utilizing a cut-off valve

Severity: Medium, the open circuit failure will be captured 100ms faster compared to older software versions.
Safety Impact: None, the impact on systems using earlier software versions than 1.95, the open-circuit failure mode is a safe failure (no current to the cut-off solenoid valve).
The open-circuit failure mode is not affecting the safety functions nor their response time. The failure will be diagnosed 100ms later than the specification.

6.5.2.5 SEHS-659: PSM error (SPN: 298966 FMI: 11) is logged in error history, when soft reset is executed

Fixed an issue where PVED-CLS prior to 1.95 sometimes logged a false alarm (SPN: 298966 FMI: 11) in the internal error buffer when soft reset was executed. This false alarm was not visible on the CAN bus and PVED-CLS started up normally. For applications not using the internal error buffer in PVED-CLS this issue was not visible.

Affected applications: This defect is limited to applications using the internal error buffer of PVED-CLS.

Severity: Low, workaround can be implemented for ignoring this DTC.
Safety Impact: None

7 Contact

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