## Revision history

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<table>
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<tr>
<th>Date</th>
<th>Changed</th>
<th>Rev</th>
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<tbody>
<tr>
<td>November 2019</td>
<td>First edition</td>
<td>0101</td>
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General information

Demo kit components and ordering

Included in the kit:
- PVED-CLS actuator
- DM430E display (with Steering Simulation PLUS+1® program)
- 3D printed case
- DB09 9 pin CAN port access with 120 ohm resistor
- Internal 12V, 5.0A power supply (C13 power cable not included)

Block diagram

Ordering information

<table>
<thead>
<tr>
<th>Description</th>
<th>Material number</th>
</tr>
</thead>
<tbody>
<tr>
<td>PVED-CLS demo kit</td>
<td>11235004</td>
</tr>
</tbody>
</table>

PVED-CLS demo kit warranty

The PVED-CLS demo kit is not covered by warranty. Danfoss is not liable for any damages to any component in the PVED-CLS demo kit.

For more information, contact your Danfoss representative.
General information

Glossary

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AUX</td>
<td>Auxiliary</td>
</tr>
<tr>
<td>CAN</td>
<td>Controller Area Network</td>
</tr>
<tr>
<td>DM430E</td>
<td>A Danfoss Display Controller</td>
</tr>
<tr>
<td>EH</td>
<td>Electro-hydraulic</td>
</tr>
<tr>
<td>FMI</td>
<td>Failure Mode Identifier</td>
</tr>
<tr>
<td>GPS</td>
<td>Global Positioning System (auto-guidance command)</td>
</tr>
<tr>
<td>HMI/MMI</td>
<td>Human Machine Interface/Man Machine Interface</td>
</tr>
<tr>
<td>PVED-CLS</td>
<td>Proportional Valve Electronic Digital - Closed Loop Steering (CLS for short)</td>
</tr>
<tr>
<td>SASA</td>
<td>Steering Angle Sensor - Absolute</td>
</tr>
<tr>
<td>SPN</td>
<td>Suspect Parameter Number</td>
</tr>
<tr>
<td>VSP</td>
<td>Vehicle Speed</td>
</tr>
<tr>
<td>WAS</td>
<td>Wheel Angle Sensor</td>
</tr>
</tbody>
</table>

PVED-CLS literature references

For other PVED-CLS documentation (including certificates), please visit the product's webpage: PVED-CLS.

For more information, please contact your Danfoss representative.
General information

Demo kit purpose

The PVED-CLS demo kit provides tools that serve a variety of purposes.

The demo kit allows the user to:
- Simulate steering behaviors
- Demonstrate functional safety features of PVED-CLS
- Troubleshoot
- Train

Steering simulation in action
Modes and features demonstration

On-road and off-road modes

The on-road and off-road modes represent specific operating conditions.

**Off-road mode** Operating condition when the PVED-CLS allows to transition electrical steering inputs (such as GPS or joystick command).

**On-road mode** Operating condition when only the hydraulic input from the steering column will be allowed to control steering.

Steering wheel and auxiliary programs

The PVED-CLS can store steering wheel and auxiliary programs in its memory. These are profiles that determine the sensitivity of steering devices at different vehicle speeds.

These profiles adjust the number of turns it takes to steer from left end-stop to right end-stop (or lock to lock). This safety feature allows faster wheel turning at slow vehicle speed and limit wheel turning speed at high vehicle speed. Changing the speed value (up and down arrows) will change the lock to lock value shown on the right side of the screen when in this mode.
Safe state

This mode will appear if necessary CAN messaging is lost, or vehicle speed exceeds safety limits set in the CLS.

The display will read out the SPN (suspect parameter number) and FMI (Failure mode identifier) for the given error. These error codes are described in detail in the *PVED-CLS user manual* found in each firmware release package.

Safe state and error reporting

For more information on the CLS modes and transitions, refer to the state machine diagrams in the *PVED-CLS user manual* found in each firmware release package.
Button interface and modes

Buttons and icons

The selected mode will be highlighted in green.

Button reference

<table>
<thead>
<tr>
<th>Button</th>
<th>Icon</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td><img src="image_url" alt="On-road" /></td>
<td>The CLS is powered on but is locked out of EH (electrohydraulic) steering functions. Only the hydraulic simulation will take place, via steering wheel SASA input. AUX, GPS, and Variable Rate Steering are disabled.</td>
</tr>
<tr>
<td>2</td>
<td><img src="image_url" alt="Off-road non reaction" /></td>
<td>The CLS will allow EH steering functions and the wheels are prevented from straightening due to reaction forces.</td>
</tr>
</tbody>
</table>
## Button interface and modes

### Button reference (continued)

<table>
<thead>
<tr>
<th>Button</th>
<th>Icon</th>
<th>Function</th>
</tr>
</thead>
</table>
| 3      | ![Icon](image1.png) **Off-road reaction/auxiliary program cycle** | **Off-road reaction**: The CLS will allow EH steering functions and wheels will try to straighten due to reaction forces.  
**Auxiliary program cycle**: If an auxiliary steering device is enabled (via HMI message) and activated by its use, the CLS will change to the most recent Aux program it accessed; additional button 3 presses will cycle through the 5 auxiliary steering programs stored in the CLS parameters. |
| 4      | ![Icon](image2.png) **Steering wheel programs cycle** | Pressing button 4 consecutively will cycle through the 5 variable rate steering wheel programs stored in the CLS parameters. |
| 5      | ![Icon](image3.png) **Navigation keys** | **Up and down arrows**: Increases (up) or decreases (down) vehicle speed per speedometer on main screen; navigate up or down menu items on the HOME menu.  
**Right and left arrows**: Turns steering wheel to the right or left on the main screen; navigate right of left on the HOME menu.  
**Enter**: Toggles HOME menu items on or off via check mark symbol. |
| Escape | ESC | Issues a soft reset command to the PVED-CLS; soft reset works similarly to a power cycle and may be needed after correcting an error condition. |
| Home   | HOME | Navigates user to a menu that controls the CAN messaging from the display controller to the PVED-CLS. |
CAN messaging

Configuring CAN message communication

Home button menu controlling CAN messaging

All CAN messages sent from the display controller to the PVED-CLS can be toggled on and off. This allows for other devices sending equivalent messages to be placed on CAN.

Pressing enter on the “communication” option causes the display controller to read the relevant parameters from the CLS to apply to the simulation. This should be used after making parameter changes within the PVED-CLS.

Messages coming from DM430E display controller

<table>
<thead>
<tr>
<th>Message</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Steering Wheel Angle and Velocity (SASA)</td>
<td>Pressing the left and right arrow keys rotates the on-screen steering wheel.</td>
</tr>
<tr>
<td>Vehicle Speed (VSP)</td>
<td>Pressing the up and down arrow keys adjusts the speedometer on left side of the screen.</td>
</tr>
<tr>
<td>Human-Machine Interface (HMI/ MMI)</td>
<td>Requests the steering mode and enables/disables eSteering devices.</td>
</tr>
<tr>
<td>CAN based wheel angle (WAS)</td>
<td>Wheel Angle simulated based on SASA, AUX (auxiliary), or GPS (curvature command) steering input. The on-screen wheels represent the value generated.</td>
</tr>
</tbody>
</table>

For more information, please see the CAN message content in the PVED-CLS communication protocol document found in each firmware release package.

Contact your Danfoss representative to access and update the PLUS+1® display program.
Danfoss Power Solutions is a global manufacturer and supplier of high-quality hydraulic and electric components. We specialize in providing state-of-the-art technology and solutions that excel in the harsh operating conditions of the mobile off-highway market as well as the marine sector. Building on our extensive applications expertise, we work closely with you to ensure exceptional performance for a broad range of applications. We help you and other customers around the world speed up system development, reduce costs and bring vehicles and vessels to market faster.

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- Electric machines
- Electric motors
- Gear motors
- Gear pumps
- Hydrostatic motors
- Hydrostatic pumps
- Orbital motors
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- PLUS+1® displays
- PLUS+1® joysticks and pedals
- PLUS+1® operator interfaces
- PLUS+1® sensors
- PLUS+1® software
- PLUS+1® software services, support and training
- Position controls and sensors
- PVG proportional valves
- Steering components and systems
- Telematics

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