Technical Information

Proportional Valves
PVED-CC, Series 5 CANopen

www.danfoss.com
## Revision history

<table>
<thead>
<tr>
<th>Date</th>
<th>Changed</th>
<th>Rev</th>
</tr>
</thead>
<tbody>
<tr>
<td>March 2020</td>
<td>Changed NodeID range notes on page 13.</td>
<td>0606</td>
</tr>
<tr>
<td>November 2019</td>
<td>Added EMC proof cable to code numbers section</td>
<td>0605</td>
</tr>
<tr>
<td>October 2017</td>
<td>Correction - AMP connector</td>
<td>0604</td>
</tr>
<tr>
<td>July 2017</td>
<td>Correction to image ‘AMP 2x 4pin AMT Junior Power Timer.’</td>
<td>0603</td>
</tr>
<tr>
<td>March 2017</td>
<td>Updated AMP 2x4 drawing</td>
<td>0602</td>
</tr>
<tr>
<td>September 2016</td>
<td>Updated list of configurable parameters</td>
<td>0601</td>
</tr>
<tr>
<td>May 2016</td>
<td>Updated list of configurable parameters; Updated to Engineering Tomorrow design</td>
<td>0501</td>
</tr>
<tr>
<td>March 2016</td>
<td>List of configurable and read-only parameters updated</td>
<td>0401</td>
</tr>
<tr>
<td>February 2016</td>
<td>Configurable parameter, Temperature dependent spool timeout float addon: Ranges and defaults updated</td>
<td>0301</td>
</tr>
<tr>
<td>February 2016</td>
<td>Corrected configurable parameter range for parameter: Manufacturer Specific Set Point 8bit</td>
<td>0201</td>
</tr>
<tr>
<td>December 2015</td>
<td>First edition</td>
<td>0101</td>
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</tbody>
</table>
Technical Information

PVED-CC Series 5 CANopen

Contents

Introduction

Product overview................................................................................................................................. 4
PVED-CC CANbus code numbers......................................................................................................... 4

Data

Operating data overview...................................................................................................................... 5
Connectors............................................................................................................................................... 6
LED coloring for PVED-CC Series 5..................................................................................................... 7
Physical dimensions............................................................................................................................... 7
PVED-CC Hysteresis and Ripple............................................................................................................ 8
PVED-CC Reaction Times...................................................................................................................... 8

Communication

State machine.......................................................................................................................................... 9
State transition overview...................................................................................................................... 9
PVED-CC CANopen message overview................................................................................................ 10
Network Management (NMT)................................................................................................................. 11
Boot-up protocol.................................................................................................................................. 11
NMT services....................................................................................................................................... 11
Layer Setting Service (LSS).................................................................................................................. 11
PVED-CC switch state global.............................................................................................................. 11
PVED-CC switch state selective......................................................................................................... 11
Inquire nodeID.................................................................................................................................... 13
Configure nodeID............................................................................................................................... 13
Configure bit timing............................................................................................................................ 13
Activate bit timing parameters.......................................................................................................... 14
PVED-CC store configurations........................................................................................................... 14
Inquire vendor ID............................................................................................................................... 14
Inquire product code number........................................................................................................... 15
Inquire revision number.................................................................................................................... 15
Inquire serial number......................................................................................................................... 15
PVED-CC identify non-configured remote slave............................................................................... 16
Fastscan............................................................................................................................................... 16
Process Data Object (PDO).................................................................................................................. 17
RxPDO1.................................................................................................................................................. 17
RxPDO2.................................................................................................................................................. 17
Controlling a PVED using RxPDO1....................................................................................................... 17
TxPDO1.................................................................................................................................................. 18
TxPDO2.................................................................................................................................................. 18
PDO mapping....................................................................................................................................... 19
PDO mapping example........................................................................................................................ 19
Sync message....................................................................................................................................... 21
PVED-CC heartbeat protocol.............................................................................................................. 21
Emergency messages.......................................................................................................................... 21
Emergency producer.......................................................................................................................... 21
PVED emergency consumer............................................................................................................... 22

Parameters

Service Data Object (SDO)..................................................................................................................... 23
SDO command..................................................................................................................................... 23
SDO response....................................................................................................................................... 23
List of configurable parameters......................................................................................................... 24
List of read-only parameters.............................................................................................................. 27

Diagnosis

PVED-CC (CANopen) Diagnostics log ............................................................................................... 28
Diagnostic history............................................................................................................................... 30
Temperature histogram...................................................................................................................... 30
Product overview

The PVED-CC Series 5 CANopen is a high performance digital actuator for the valve families PVG 32 and PVG 100.

The PVED-CC Series 5 CANopen offers CAN bus control through loop cables simplifying the wire harness and build-in intelligence where actuator specific features tailor the actuator behavior to the exact function need.

PVED-CC CANbus code numbers

<table>
<thead>
<tr>
<th>Connector type</th>
<th>Code number</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>DEUTSCH</td>
<td>11172734</td>
<td>PVED-CC</td>
</tr>
<tr>
<td></td>
<td>11007498</td>
<td>4 m cable</td>
</tr>
<tr>
<td></td>
<td>11095741</td>
<td>4 m EMC proof cable (twisted pair)</td>
</tr>
<tr>
<td></td>
<td>11007531</td>
<td>0.1 m loop cable</td>
</tr>
<tr>
<td></td>
<td>11111916</td>
<td>0.3 m loop cable</td>
</tr>
<tr>
<td></td>
<td>11095622</td>
<td>0.175 m loop cable</td>
</tr>
<tr>
<td></td>
<td>11007561</td>
<td>CAN bus terminator</td>
</tr>
<tr>
<td>AMP</td>
<td>11169142</td>
<td>PVED-CC</td>
</tr>
<tr>
<td></td>
<td>157B4994</td>
<td>4 m cable with gray connector</td>
</tr>
<tr>
<td></td>
<td>157B4995</td>
<td>4 m cable with black connector</td>
</tr>
<tr>
<td></td>
<td>11095740</td>
<td>4 m EMC proof cable (twisted pair)</td>
</tr>
<tr>
<td></td>
<td>157B4987</td>
<td>0.1 m loop cable</td>
</tr>
<tr>
<td></td>
<td>11095581</td>
<td>0.175 m loop cable</td>
</tr>
<tr>
<td></td>
<td>11163647</td>
<td>CAN bus terminator with gray connector</td>
</tr>
<tr>
<td></td>
<td>157B4988</td>
<td>CAN bus terminator with black connector</td>
</tr>
</tbody>
</table>
Operating data overview

### Electrical data

<table>
<thead>
<tr>
<th>Parameter</th>
<th>12 V&lt;sub&gt;DC&lt;/sub&gt;</th>
<th>24 V&lt;sub&gt;DC&lt;/sub&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Voltage</td>
<td>12 V&lt;sub&gt;DC&lt;/sub&gt;</td>
<td>24 V&lt;sub&gt;DC&lt;/sub&gt;</td>
</tr>
<tr>
<td>Current consumption</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Operating</td>
<td>520 mA</td>
<td>260 mA</td>
</tr>
<tr>
<td>Neutral - Power state</td>
<td>80 mA</td>
<td>45 mA</td>
</tr>
<tr>
<td>Energy consumption</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Operating</td>
<td>6.24 W</td>
<td>6.24 W</td>
</tr>
<tr>
<td>Neutral - Power state</td>
<td>1 W</td>
<td>1.1 W</td>
</tr>
<tr>
<td>Supply voltage (V&lt;sub&gt;bat&lt;/sub&gt;)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nominal</td>
<td>11 – 32 V&lt;sub&gt;DC&lt;/sub&gt;</td>
<td>9 – 35.9 V&lt;sub&gt;DC&lt;/sub&gt;</td>
</tr>
<tr>
<td>Range</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maximum ripple</td>
<td>5%</td>
<td></td>
</tr>
<tr>
<td>CAN bus</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alive</td>
<td>5.5 – 36 V&lt;sub&gt;DC&lt;/sub&gt;</td>
<td></td>
</tr>
</tbody>
</table>

*PVED communicating on CAN bus, but not fully operable.

### Temperature range

<table>
<thead>
<tr>
<th>Temperature</th>
<th>Min.</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ambient</td>
<td>–40°C</td>
<td>90°C</td>
</tr>
<tr>
<td>Oil</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Storage</td>
<td></td>
<td>110°C</td>
</tr>
</tbody>
</table>

### Hydraulic data

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pilot pressure</td>
<td>13.5 ± 1.5 bar</td>
</tr>
<tr>
<td>Tank pressure</td>
<td></td>
</tr>
<tr>
<td>Continues</td>
<td>25 bar</td>
</tr>
<tr>
<td>Intermittent</td>
<td>40 bar</td>
</tr>
<tr>
<td>Oil consumption</td>
<td></td>
</tr>
<tr>
<td>Electrical de-energized</td>
<td>0 l/min</td>
</tr>
<tr>
<td>Spool locked position</td>
<td></td>
</tr>
<tr>
<td>Continuous changing spool position</td>
<td>0.7 l/min</td>
</tr>
<tr>
<td>Contamination (ISO 4406)</td>
<td>23/19/16</td>
</tr>
<tr>
<td>Viscosity range</td>
<td></td>
</tr>
<tr>
<td>Nominal</td>
<td>12 – 75 mm&lt;sup&gt;2&lt;/sup&gt;/s</td>
</tr>
<tr>
<td>Minimum</td>
<td>4.2 – 12 mm&lt;sup&gt;2&lt;/sup&gt;/s*</td>
</tr>
<tr>
<td>Maximum</td>
<td>75 – 1000 mm&lt;sup&gt;2&lt;/sup&gt;/s</td>
</tr>
</tbody>
</table>

*PVED have reduced operating performance

### Government regulations

<table>
<thead>
<tr>
<th>Description</th>
<th>Standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low Voltage</td>
<td>2006/95/EC</td>
</tr>
<tr>
<td>EMC Directive</td>
<td>2004/108/EC</td>
</tr>
<tr>
<td>Safety</td>
<td>ISO4413:2010</td>
</tr>
</tbody>
</table>
Connectors

Available 2x4 pin connectors: AMP Junior Power Timer and DEUTSCH DT06-4S-E003. Pins are internally connected in pairs between connectors. Mating connectors are not supplied by Danfoss.

**AMP connector**

**AMP Junior Power Timer (2x4 pin)**

<table>
<thead>
<tr>
<th>Terminal</th>
<th>Seal</th>
<th>Housing</th>
<th>IP rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>929930-1 (4 pcs)</td>
<td>828901-1 (4 pcs)</td>
<td>2-967059-1 (gray) or 1-967059-1 (black)</td>
<td>IP66</td>
</tr>
</tbody>
</table>

* There is no black/gray coding of the connector

**DEUTSCH connector**

**DT06-4S-E003 (2x4 pin)**

Pinout:
1. CAN High
2. CAN Low
3. Vbat+
4. GND

* IP rating: IP67; IP69K without connector
LED coloring for PVED-CC Series 5

<table>
<thead>
<tr>
<th>Color</th>
<th>LED Characteristic</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Green constant</td>
<td>![Green LED]</td>
<td>No error – Actuating</td>
</tr>
<tr>
<td>Green flashing @ 1.5 Hz</td>
<td>![Green Blinking]</td>
<td>Neutral – Power save</td>
</tr>
<tr>
<td>Red constant</td>
<td>![Red LED]</td>
<td>Internal error</td>
</tr>
<tr>
<td>Red flashing @ 1.5 Hz</td>
<td>![Red Blinking]</td>
<td>External or Float error</td>
</tr>
<tr>
<td>Yellow</td>
<td>![Yellow LED]</td>
<td>Disable mode</td>
</tr>
</tbody>
</table>

Physical dimensions

<table>
<thead>
<tr>
<th>Depth</th>
<th>Width</th>
<th>Height</th>
</tr>
</thead>
<tbody>
<tr>
<td>85 mm</td>
<td>45 mm</td>
<td>116 mm</td>
</tr>
<tr>
<td>[3.35 in]</td>
<td>[1.77 in]</td>
<td>[4.57 in]</td>
</tr>
</tbody>
</table>

* Excluding connector height
Data

PVED-CC Hysteresis and Ripple

Definition of hysteresis

<table>
<thead>
<tr>
<th>Hysteresis (h)</th>
<th>Rated [%]</th>
<th>1.45%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Steady state ripple at constant command signal</td>
<td>Rated [%]</td>
<td>0.29%</td>
</tr>
</tbody>
</table>

PVED-CC Reaction Times

Definition of Step Response

<table>
<thead>
<tr>
<th>Reaction</th>
<th>Time (nominal)</th>
</tr>
</thead>
<tbody>
<tr>
<td>T0 – Boot-up</td>
<td>440 ms*</td>
</tr>
<tr>
<td>T1 – Constant PFC command</td>
<td>177 ms</td>
</tr>
<tr>
<td>T2 – Constant PFC command</td>
<td>114 ms</td>
</tr>
</tbody>
</table>

*Including Power-On-Self-Test (POST) and safety sub-system initialization.
Communication

State machine

The PVED-CC Series 5 CANopen operates according to the device state machine defined in VDMAPROP chapter 5.2 and the CANopen communication state machine defined in CiA301 chapter 9.4.

Relationship between the state machines

Device State Machine (DSM)

Communication State Machine (CSM)

State transition overview

Device state machine transitions

<table>
<thead>
<tr>
<th>Transition number</th>
<th>Transition</th>
<th>Device control word</th>
</tr>
</thead>
<tbody>
<tr>
<td>D1</td>
<td>Not_ready to Init</td>
<td>Automatic transition after boot-up</td>
</tr>
<tr>
<td>D8</td>
<td>Any state to Fault Hold and Fault</td>
<td>Automatic transition on active fault occurrence</td>
</tr>
<tr>
<td>D2</td>
<td>Init to Disabled</td>
<td>0b1001 0x09</td>
</tr>
<tr>
<td>D3</td>
<td>Disabled to Hold</td>
<td>0b1011 0x0B</td>
</tr>
<tr>
<td>D4</td>
<td>Hold to Device_Mode_Active</td>
<td>0b1111 0xFF</td>
</tr>
<tr>
<td>D5</td>
<td>Device_Mode_Active to Hold</td>
<td>0b1011 0x0B</td>
</tr>
<tr>
<td>D6</td>
<td>Hold to Disabled</td>
<td>0b1001 0x09</td>
</tr>
<tr>
<td>D7</td>
<td>Disabled to Init</td>
<td>0b1000 0x08</td>
</tr>
<tr>
<td>D11</td>
<td>Fault_Hold to Hold</td>
<td>0b1011 / 0b0011 0x0B / 0x03</td>
</tr>
</tbody>
</table>
## Communication

### Communication state machine transitions

<table>
<thead>
<tr>
<th>CSM transition</th>
<th>DSM impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>C1, C13 and C12</td>
<td>Change to <code>Fault_Hold</code></td>
</tr>
<tr>
<td>C5</td>
<td>Change to <code>Fault_Hold</code></td>
</tr>
<tr>
<td>C8</td>
<td>Change to <code>Fault_Hold</code></td>
</tr>
<tr>
<td>C9, C10 and C11</td>
<td>Change to <code>Init</code></td>
</tr>
</tbody>
</table>

### Actuator behavior dependent on state

<table>
<thead>
<tr>
<th>State</th>
<th>Transmit TPDO</th>
<th>Spool monitoring</th>
<th>Spool is controlled by PVED-CC</th>
<th>Setpoint timeguarding</th>
</tr>
</thead>
<tbody>
<tr>
<td>Not_Ready</td>
<td>N/A</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Init</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Disabled</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Hold</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Device_Mode_Active (CAN controlled)</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Device_Mode_Active (Hand operation)</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Fault_Disabled</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Fault_Hold</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
</tbody>
</table>

### PVEC-CC CANopen message overview

<table>
<thead>
<tr>
<th>Message ID</th>
<th>Message type</th>
<th>Translation</th>
<th>Direction (from controller)</th>
<th>Timing</th>
</tr>
</thead>
<tbody>
<tr>
<td>0x700 + nodeID</td>
<td>Boot-up protocol on page 11</td>
<td>Boot-up message on CANbus</td>
<td>Rx</td>
<td>On power-up</td>
</tr>
<tr>
<td>0x000</td>
<td>NMT services on page 11</td>
<td>Network Management</td>
<td>Tx</td>
<td>Controller dependant</td>
</tr>
<tr>
<td>0x7E5</td>
<td>Layer Setting Service (LSS) on page 11</td>
<td>Layer Setting Service command</td>
<td>Tx</td>
<td>Controller dependant</td>
</tr>
<tr>
<td>0x7E4</td>
<td>Layer Setting Service (LSS) on page 11</td>
<td>Layer Setting Service response</td>
<td>Rx</td>
<td>On request</td>
</tr>
<tr>
<td>0x200 + nodeID</td>
<td>RxPDO1 on page 17</td>
<td>Read Process Data Object 1</td>
<td>Tx</td>
<td>Controller dependant</td>
</tr>
<tr>
<td>0x300 + nodeID</td>
<td>RxPDO2 on page 17</td>
<td>Read Process Data Object 2</td>
<td>Tx</td>
<td>Controller dependant</td>
</tr>
<tr>
<td>0x180 + nodeID</td>
<td>TxPDO1 on page 18</td>
<td>Transmit Process Data Object 1</td>
<td>Rx</td>
<td>Configurable</td>
</tr>
<tr>
<td>0x280 + nodeID</td>
<td>TxPDO2 on page 18</td>
<td>Transmit Process Data 2</td>
<td>Rx</td>
<td>Configurable</td>
</tr>
<tr>
<td>0x600 + nodeID</td>
<td>SDO command on page 23</td>
<td>Service Data Object command</td>
<td>Tx</td>
<td>Controller dependant</td>
</tr>
<tr>
<td>0x580 + nodeID</td>
<td>SDO response on page 23</td>
<td>Service Data Object response</td>
<td>Rx</td>
<td>On request</td>
</tr>
<tr>
<td>0x080</td>
<td>Sync message on page 21</td>
<td>Synchronize message</td>
<td>Tx</td>
<td>Controller dependant</td>
</tr>
<tr>
<td>0x700 + nodeID</td>
<td>PVED-CC heartbeat protocol on page 21</td>
<td>Heartbeat message</td>
<td>Rx</td>
<td>Once at power-up/configurable</td>
</tr>
<tr>
<td>0x080 + nodeID</td>
<td>Emergency producer on page 21</td>
<td>Emergency message</td>
<td>Rx</td>
<td>Event triggered</td>
</tr>
</tbody>
</table>

*nodeID range: 0x01 to 0x7E
Network Management (NMT)

Boot-up protocol

Upon power-up the PVED will log onto the CAN bus network by broadcasting the nodeID it has been given upon parametrization.

Frame format

<table>
<thead>
<tr>
<th>Msg ID</th>
<th>DLC</th>
<th>Byte 0</th>
</tr>
</thead>
<tbody>
<tr>
<td>0x700 + nodeID</td>
<td>1</td>
<td>NMT State</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0x00</td>
</tr>
</tbody>
</table>

NMT services

NMT messages are used to navigate the Communication State Machine (CSM).

Frame format

<table>
<thead>
<tr>
<th>Msg ID</th>
<th>DLC</th>
<th>Byte 0</th>
<th>Byte 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>0x000</td>
<td>2</td>
<td>NMT Command specifier</td>
<td>Destination nodeID</td>
</tr>
</tbody>
</table>

NMT data

<table>
<thead>
<tr>
<th>Byte 0</th>
<th>NMT Command specifier</th>
<th>Enter Operational mode (CAN controlled) = 0x01</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Enter Stopped mode = 0x02</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Enter Preoperational mode = 0x80</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Reset application = 0x81</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Reset communication = 0x82</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Byte 1</th>
<th>Destination nodeID</th>
<th>Slave nodeID of the PVED-CC CANopen</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>0x00 for global messages</td>
</tr>
</tbody>
</table>

Layer Setting Service (LSS)

LSS is used to parametrize the nodeID and bit timing as well as inquire vendor ID, code number, revision and serial number of the PVED.

LSS mode works only in Stopped Mode.

PVED-CC switch state global

This is an unconfirmed service that sets the device to LSS configuration mode.

Frame format

<table>
<thead>
<tr>
<th>Msg ID</th>
<th>DLC</th>
<th>Byte 0</th>
<th>Byte 1</th>
<th>Byte 2</th>
<th>Byte 3</th>
<th>Byte 4</th>
<th>Byte 5</th>
<th>Byte 6</th>
<th>Byte 7</th>
</tr>
</thead>
<tbody>
<tr>
<td>0x7E5</td>
<td>8</td>
<td>CS</td>
<td>Mode*</td>
<td>Reserved</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0x04</td>
<td></td>
<td>0x00</td>
<td>0x00</td>
<td>0x00</td>
<td>0x00</td>
<td></td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

*0x00 Switch to LSS wait state, 0x01 Switch to LSS configuration mode.

PVED-CC switch state selective

This switches LSS slave device into LSS configuration state by using the LSS address consisting of vendor ID, Product code, revision number and serial number.
Communication

**Request frame format**

<table>
<thead>
<tr>
<th>Msg ID</th>
<th>DLC</th>
<th>Byte 0</th>
<th>Byte 1</th>
<th>Byte 2</th>
<th>Byte 3</th>
<th>Byte 4</th>
<th>Byte 5</th>
<th>Byte 6</th>
<th>Byte 7</th>
</tr>
</thead>
<tbody>
<tr>
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<td>8</td>
<td>CS 0x40</td>
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<tr>
<td>0x7E5</td>
<td>8</td>
<td>CS 0x41</td>
<td>Product code</td>
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<td>0x00</td>
<td>0x00</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>0x7E5</td>
<td>8</td>
<td>CS 0x42</td>
<td>Revision number</td>
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<td>0x00</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>0x7E5</td>
<td>8</td>
<td>CS 0x43</td>
<td>Serial number</td>
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**Response frame format**

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<th>Byte 1</th>
<th>Byte 2</th>
<th>Byte 3</th>
<th>Byte 4</th>
<th>Byte 5</th>
<th>Byte 6</th>
<th>Byte 7</th>
</tr>
</thead>
<tbody>
<tr>
<td>0x7E4</td>
<td>8</td>
<td>CS 0x44</td>
<td>Reserved</td>
<td>0x00</td>
<td>0x00</td>
<td>0x00</td>
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</tbody>
</table>

**LSS switch state selective data**

<table>
<thead>
<tr>
<th>CS 0x40</th>
<th>Byte 0</th>
<th>CS (0x40)</th>
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</thead>
<tbody>
<tr>
<td>Byte 1</td>
<td>Vendor ID</td>
<td>OD 1018, sub 0x01</td>
</tr>
<tr>
<td>Byte 2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Byte 3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Byte 4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Byte 5</td>
<td>Reserved (0x00)</td>
<td></td>
</tr>
<tr>
<td>Byte 6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Byte 7</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>CS 0x41</th>
<th>Byte 0</th>
<th>CS (0x41)</th>
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<tbody>
<tr>
<td>Byte 1</td>
<td>Product code</td>
<td>OD 1018, sub 0x02</td>
</tr>
<tr>
<td>Byte 2</td>
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<td></td>
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<tr>
<td>Byte 3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Byte 4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Byte 5</td>
<td>Reserved (0x00)</td>
<td></td>
</tr>
<tr>
<td>Byte 6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Byte 7</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>CS 0x42</th>
<th>Byte 0</th>
<th>CS (0x42)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Byte 1</td>
<td>Revision number</td>
<td>OD 1018, sub 0x03</td>
</tr>
<tr>
<td>Byte 2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Byte 3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Byte 4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Byte 5</td>
<td>Reserved (0x00)</td>
<td></td>
</tr>
<tr>
<td>Byte 6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Byte 7</td>
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</tbody>
</table>
**Communication**

**LSS switch state selective data (continued)**

<table>
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<th>CS 0x43</th>
<th>Byte 0</th>
<th>CS (0x43)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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<td>Serial number</td>
</tr>
<tr>
<td></td>
<td>Byte 2</td>
<td>OD 1018, sub 0x04</td>
</tr>
<tr>
<td></td>
<td>Byte 3</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Byte 4</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Byte 5</td>
<td>Reserved (0x00)</td>
</tr>
<tr>
<td></td>
<td>Byte 6</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Byte 7</td>
<td></td>
</tr>
</tbody>
</table>

**Inquire nodeID**

By this command the PVED nodeID can be inquired.

*Request frame format*

<table>
<thead>
<tr>
<th>Msg ID</th>
<th>DLC</th>
<th>Byte 0</th>
<th>Byte 1</th>
<th>Byte 2</th>
<th>Byte 3</th>
<th>Byte 4</th>
<th>Byte 5</th>
<th>Byte 6</th>
<th>Byte 7</th>
</tr>
</thead>
<tbody>
<tr>
<td>0x7E4</td>
<td>8</td>
<td>CS</td>
<td>0x00</td>
<td>0x00</td>
<td>0x00</td>
<td>0x00</td>
<td>0x00</td>
<td>0x00</td>
<td></td>
</tr>
</tbody>
</table>

NodeID range: 0x01 to 0x7E. 0x20 is used as spare part nodeID.

*Request frame format*

<table>
<thead>
<tr>
<th>Msg ID</th>
<th>DLC</th>
<th>Byte 0</th>
<th>Byte 1</th>
<th>Byte 2</th>
<th>Byte 3</th>
<th>Byte 4</th>
<th>Byte 5</th>
<th>Byte 6</th>
<th>Byte 7</th>
</tr>
</thead>
<tbody>
<tr>
<td>0x7E4</td>
<td>8</td>
<td>CS</td>
<td>NodeID*</td>
<td>0x00</td>
<td>0x00</td>
<td>0x00</td>
<td>0x00</td>
<td>0x00</td>
<td></td>
</tr>
</tbody>
</table>

* NodeID range: 0x01 to 0x7E.

**Configure nodeID**

With this command the PVED as LSS slave is configured to the new nodeID.

*Response frame format*

<table>
<thead>
<tr>
<th>Msg ID</th>
<th>DLC</th>
<th>Byte 0</th>
<th>Byte 1</th>
<th>Byte 2</th>
<th>Byte 3</th>
<th>Byte 4</th>
<th>Byte 5</th>
<th>Byte 6</th>
<th>Byte 7</th>
</tr>
</thead>
<tbody>
<tr>
<td>0x7E5</td>
<td>8</td>
<td>CS</td>
<td>0x11</td>
<td>0x00</td>
<td>0x00</td>
<td>0x00</td>
<td>0x00</td>
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</tr>
</tbody>
</table>

* NodeID range: 0x01 to 0x7E. 0x20 is used as spare part nodeID.

*Response frame format*

<table>
<thead>
<tr>
<th>Msg ID</th>
<th>DLC</th>
<th>Byte 0</th>
<th>Byte 1</th>
<th>Byte 2</th>
<th>Byte 3</th>
<th>Byte 4</th>
<th>Byte 5</th>
<th>Byte 6</th>
<th>Byte 7</th>
</tr>
</thead>
<tbody>
<tr>
<td>0x7E4</td>
<td>8</td>
<td>CS</td>
<td>Error code*</td>
<td>0x00</td>
<td>0x00</td>
<td>0x00</td>
<td>0x00</td>
<td>0x00</td>
<td></td>
</tr>
</tbody>
</table>

* 0x00 no error, 0x01 NodeID out of range.

**Configure bit timing**

With this command the baud rate can be changed from default 250kbps.
Communication

Request frame format

<table>
<thead>
<tr>
<th>Msg ID</th>
<th>DLC</th>
<th>Byte 0</th>
<th>Byte 1</th>
<th>Byte 2</th>
<th>Byte 3</th>
<th>Byte 4</th>
<th>Byte 5</th>
<th>Byte 6</th>
<th>Byte 7</th>
</tr>
</thead>
<tbody>
<tr>
<td>0x7E5</td>
<td>8</td>
<td>CS</td>
<td>Table selector</td>
<td>Table index</td>
<td>Reserved</td>
<td>0x00</td>
<td>0x00</td>
<td>0x00</td>
<td>0x00</td>
</tr>
<tr>
<td>0x13</td>
<td>0x00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*0x00 = 1000kbps, 0x02 = 500kbps, 0x03 = 250kbps (default), 0x04 = 125kbps

Request frame format

<table>
<thead>
<tr>
<th>Msg ID</th>
<th>DLC</th>
<th>Byte 0</th>
<th>Byte 1</th>
<th>Byte 2</th>
<th>Byte 3</th>
<th>Byte 4</th>
<th>Byte 5</th>
<th>Byte 6</th>
<th>Byte 7</th>
</tr>
</thead>
<tbody>
<tr>
<td>0x7E4</td>
<td>8</td>
<td>CS</td>
<td>Error code</td>
<td>Reserved</td>
<td>0x00</td>
<td>0x00</td>
<td>0x00</td>
<td>0x00</td>
<td>0x00</td>
</tr>
<tr>
<td>0x13</td>
<td>0x00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*0x00 no error, 0x01 Bit rate not supported.

Activate bit timing parameters

This service activates simultaneously the bit rate at the LSS communication interface of all CANopen devices in the network.

LSS Cmd

<table>
<thead>
<tr>
<th>COB-ID</th>
<th>DLC</th>
<th>Byte 0</th>
<th>Byte 1</th>
<th>Byte 2</th>
<th>Byte 3</th>
<th>Byte 4</th>
<th>Byte 5</th>
<th>Byte 6</th>
<th>Byte 7</th>
</tr>
</thead>
<tbody>
<tr>
<td>0x7E5</td>
<td>8</td>
<td>CS</td>
<td>Switch Delay</td>
<td>Reserved</td>
<td>0x00</td>
<td>0x00</td>
<td>0x00</td>
<td>0x00</td>
<td>0x00</td>
</tr>
<tr>
<td>0x15</td>
<td>LSB</td>
<td>MSB</td>
<td>0x00</td>
<td>0x00</td>
<td>0x00</td>
<td>0x00</td>
<td>0x00</td>
<td>0x00</td>
<td></td>
</tr>
</tbody>
</table>

Each LSS slave device copies the pending bit rate to the active bit rate value, after ‘Switch Delay’ (given in ms, in multiples of 1 ms) has elapsed. Therefore in response to this service device changes its bit rate after ‘Switch Delay’.

PVED-CC store configurations

By this command the configured local layer settings are stored to EEPROM.

Request frame format

<table>
<thead>
<tr>
<th>Msg ID</th>
<th>DLC</th>
<th>Byte 0</th>
<th>Byte 1</th>
<th>Byte 2</th>
<th>Byte 3</th>
<th>Byte 4</th>
<th>Byte 5</th>
<th>Byte 6</th>
<th>Byte 7</th>
</tr>
</thead>
<tbody>
<tr>
<td>0x7E5</td>
<td>8</td>
<td>CS</td>
<td>Reserved</td>
<td>0x00</td>
<td>0x00</td>
<td>0x00</td>
<td>0x00</td>
<td>0x00</td>
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<td></td>
<td></td>
</tr>
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NodeID range: 0x01 to 0x7E

Request frame format

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<th>Byte 1</th>
<th>Byte 2</th>
<th>Byte 3</th>
<th>Byte 4</th>
<th>Byte 5</th>
<th>Byte 6</th>
<th>Byte 7</th>
</tr>
</thead>
<tbody>
<tr>
<td>0x7E4</td>
<td>8</td>
<td>CS</td>
<td>Error code</td>
<td>Reserved</td>
<td>0x00</td>
<td>0x00</td>
<td>0x00</td>
<td>0x00</td>
<td>0x00</td>
</tr>
<tr>
<td>0x5E</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*0x00 no error, 0x01 storage configuration not supported, 0x02 storage media access error.

Inquire vendor ID

By this command the PVED vendor ID can be inquired.
### Communication

#### Request frame format

<table>
<thead>
<tr>
<th>Msg ID</th>
<th>DLC</th>
<th>Byte 0</th>
<th>Byte 1</th>
<th>Byte 2</th>
<th>Byte 3</th>
<th>Byte 4</th>
<th>Byte 5</th>
<th>Byte 6</th>
<th>Byte 7</th>
</tr>
</thead>
<tbody>
<tr>
<td>0x7E5</td>
<td>8</td>
<td>CS</td>
<td>Reserved</td>
<td>0x00</td>
<td>0x00</td>
<td>0x00</td>
<td>0x00</td>
<td>0x00</td>
<td>0x00</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Msg ID</th>
<th>DLC</th>
<th>Byte 0</th>
<th>Byte 1</th>
<th>Byte 2</th>
<th>Byte 3</th>
<th>Byte 4</th>
<th>Byte 5</th>
<th>Byte 6</th>
<th>Byte 7</th>
</tr>
</thead>
<tbody>
<tr>
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<td>CS</td>
<td>Reserved</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Msg ID</th>
<th>DLC</th>
<th>Byte 0</th>
<th>Byte 1</th>
<th>Byte 2</th>
<th>Byte 3</th>
<th>Byte 4</th>
<th>Byte 5</th>
<th>Byte 6</th>
<th>Byte 7</th>
</tr>
</thead>
<tbody>
<tr>
<td>0x7E4</td>
<td>8</td>
<td>CS</td>
<td>Vendor ID</td>
<td>0x5A</td>
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<td>0x00</td>
<td>0x00</td>
<td>0x01</td>
<td>0x00</td>
</tr>
</tbody>
</table>

#### Inquire product code number

By this command the PVED product code can be inquired.

<table>
<thead>
<tr>
<th>Msg ID</th>
<th>DLC</th>
<th>Byte 0</th>
<th>Byte 1</th>
<th>Byte 2</th>
<th>Byte 3</th>
<th>Byte 4</th>
<th>Byte 5</th>
<th>Byte 6</th>
<th>Byte 7</th>
</tr>
</thead>
<tbody>
<tr>
<td>0x7E5</td>
<td>8</td>
<td>CS</td>
<td>Reserved</td>
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<td>0x00</td>
<td>0x00</td>
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<td>0x00</td>
<td>0x00</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Msg ID</th>
<th>DLC</th>
<th>Byte 0</th>
<th>Byte 1</th>
<th>Byte 2</th>
<th>Byte 3</th>
<th>Byte 4</th>
<th>Byte 5</th>
<th>Byte 6</th>
<th>Byte 7</th>
</tr>
</thead>
<tbody>
<tr>
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<td>8</td>
<td>CS</td>
<td>Product Code</td>
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<td>0x00</td>
<td>0x00</td>
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</tr>
</tbody>
</table>

#### Inquire revision number

By this command the PVED revision number can be inquired.

<table>
<thead>
<tr>
<th>Msg ID</th>
<th>DLC</th>
<th>Byte 0</th>
<th>Byte 1</th>
<th>Byte 2</th>
<th>Byte 3</th>
<th>Byte 4</th>
<th>Byte 5</th>
<th>Byte 6</th>
<th>Byte 7</th>
</tr>
</thead>
<tbody>
<tr>
<td>0x7E5</td>
<td>8</td>
<td>CS</td>
<td>Reserved</td>
<td>0x00</td>
<td>0x00</td>
<td>0x00</td>
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<td>0x00</td>
<td>0x00</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Msg ID</th>
<th>DLC</th>
<th>Byte 0</th>
<th>Byte 1</th>
<th>Byte 2</th>
<th>Byte 3</th>
<th>Byte 4</th>
<th>Byte 5</th>
<th>Byte 6</th>
<th>Byte 7</th>
</tr>
</thead>
<tbody>
<tr>
<td>0x7E4</td>
<td>8</td>
<td>CS</td>
<td>Revision Number</td>
<td>0x00</td>
<td>0x00</td>
<td>0x00</td>
<td>0x00</td>
<td>0x00</td>
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</tr>
</tbody>
</table>

#### Inquire serial number

By this command the PVED serial number can be inquired.

<table>
<thead>
<tr>
<th>Msg ID</th>
<th>DLC</th>
<th>Byte 0</th>
<th>Byte 1</th>
<th>Byte 2</th>
<th>Byte 3</th>
<th>Byte 4</th>
<th>Byte 5</th>
<th>Byte 6</th>
<th>Byte 7</th>
</tr>
</thead>
<tbody>
<tr>
<td>0x7E5</td>
<td>8</td>
<td>CS</td>
<td>Reserved</td>
<td>0x00</td>
<td>0x00</td>
<td>0x00</td>
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</tr>
</tbody>
</table>
**Request frame format**

<table>
<thead>
<tr>
<th>(Msg ID</th>
<th>DLC</th>
<th>Byte 0</th>
<th>Byte 1</th>
<th>Byte 2</th>
<th>Byte 3</th>
<th>Byte 4</th>
<th>Byte 5</th>
<th>Byte 6</th>
<th>Byte 7</th>
</tr>
</thead>
<tbody>
<tr>
<td>0x7E4</td>
<td>8</td>
<td>0x5D</td>
<td>0x18</td>
<td>0x87</td>
<td>0xAF</td>
<td>0xE6</td>
<td>0x5D</td>
<td>0x00</td>
<td>0x00</td>
</tr>
</tbody>
</table>

**Serial number conversion key**

The serial number is read from byte 1 to 4 as a hexadecimal number ordered from LSB to MSB. Converting the hexadecimal serial number to decimal number will give the serial number in the following layout:

ww yy d ssss

- **ww**: week of the year (1-52)
- **yy**: year
- **d**: day of the week (1-7)
- **ssss**: running unique number of the day (0000 – 9999)

As an example:
- Week = 41 (ww = 41)
- Year = 2015 (yy = 15)
- Day = Thursday (d = 4) Unique number = 5574 (ssss = 5574)

The serial number is combined to 411545574.

Serial number converted to hexadecimal = 1887AFE6

The serial number response to the inquire serial number command from the master will then be:

<table>
<thead>
<tr>
<th>Msg ID</th>
<th>DLC</th>
<th>Byte 0</th>
<th>Byte 1</th>
<th>Byte 2</th>
<th>Byte 3</th>
<th>Byte 4</th>
<th>Byte 5</th>
<th>Byte 6</th>
<th>Byte 7</th>
</tr>
</thead>
<tbody>
<tr>
<td>0x7E4</td>
<td>8</td>
<td>0x5D</td>
<td>0x00</td>
<td>0x00</td>
<td>0x00</td>
<td>0x00</td>
<td>0x00</td>
<td>0x00</td>
<td>0x00</td>
</tr>
</tbody>
</table>

**PVED-CC identify non-configured remote slave**

By this command the master can identify any slaves that got stuck in NMT initialization and therefore are not configured (meaning do not have an active nodeID). Only non-configured slaves will respond to the command.

**Request frame format**

<table>
<thead>
<tr>
<th>Msg ID</th>
<th>DLC</th>
<th>Byte 0</th>
<th>Byte 1</th>
<th>Byte 2</th>
<th>Byte 3</th>
<th>Byte 4</th>
<th>Byte 5</th>
<th>Byte 6</th>
<th>Byte 7</th>
</tr>
</thead>
<tbody>
<tr>
<td>0x7E5</td>
<td>8</td>
<td>0x4C</td>
<td>0x00</td>
<td>0x00</td>
<td>0x00</td>
<td>0x00</td>
<td>0x00</td>
<td>0x00</td>
<td>0x00</td>
</tr>
</tbody>
</table>

**Response frame format**

<table>
<thead>
<tr>
<th>Msg ID</th>
<th>DLC</th>
<th>Byte 0</th>
<th>Byte 1</th>
<th>Byte 2</th>
<th>Byte 3</th>
<th>Byte 4</th>
<th>Byte 5</th>
<th>Byte 6</th>
<th>Byte 7</th>
</tr>
</thead>
<tbody>
<tr>
<td>0x7E4</td>
<td>8</td>
<td>0x50</td>
<td>0x00</td>
<td>0x00</td>
<td>0x00</td>
<td>0x00</td>
<td>0x00</td>
<td>0x00</td>
<td>0x00</td>
</tr>
</tbody>
</table>

**Fastscan**

The PVED supports Fastscan according to CiA 305.
Communication

Process Data Object (PDO)

The PVED support two RxPDO messages as well as send out two TxPDO messages.

The PVED requires periodical RxPDO messages containing process data inputs.

Based on the transmission type configured the PVED can send out TxPDO containing process data.

RxPDO1

The RxPDO1 is, by default, mapped to the following two process data inputs:

* Dummy object (OD 0x3472)
* Vpoc Set Point (OD 0x6300 sub 0x01)

Frame format

<table>
<thead>
<tr>
<th>Msg ID</th>
<th>DLC</th>
<th>Byte 0</th>
<th>Byte 1</th>
<th>Byte 2</th>
<th>Byte 3</th>
<th>Byte 4</th>
<th>Byte 5</th>
<th>Byte 6</th>
<th>Byte 7</th>
</tr>
</thead>
<tbody>
<tr>
<td>0x200 + nodeID</td>
<td>8</td>
<td>Dummy object</td>
<td>Vpoc Set Point (Set point)*</td>
<td>Reserved</td>
<td>0x00</td>
<td>0x00</td>
<td>0x00</td>
<td>0x00</td>
<td></td>
</tr>
</tbody>
</table>

* Range: -16384 to 16384 (corresponding to -100% to 100% spool travel), Float state = 32767 or – 32767.

The valve behavior to setpoint messages and the time guarding of RxPDO1 is configured in OD 0x1400.

RxPDO1 behavior

<table>
<thead>
<tr>
<th>OD 0x1400, sub 0x01</th>
<th>COB-ID</th>
<th>COB-ID to control the PVED</th>
</tr>
</thead>
<tbody>
<tr>
<td>OD 0x1400, sub 0x02</td>
<td>Transmission Type</td>
<td>Range: 0x00 to 0xF0 (synchronies, used together with Sync messages as trigger for sending PDO)</td>
</tr>
<tr>
<td>OD 0x1400, sub 0x05</td>
<td>Event Timer</td>
<td>Timeout of the RPDO message</td>
</tr>
</tbody>
</table>

RxPDO2

The RxPDO2 is, by default, mapped to the following two process data inputs:

* Device Control Word (OD 0x6040)
* Device Mode (OD 0x6042)

Frame format

<table>
<thead>
<tr>
<th>Msg ID</th>
<th>DLC</th>
<th>Byte 0</th>
<th>Byte 1</th>
<th>Byte 2</th>
<th>Byte 3</th>
<th>Byte 4</th>
<th>Byte 5</th>
<th>Byte 6</th>
<th>Byte 7</th>
</tr>
</thead>
<tbody>
<tr>
<td>0x300 + nodeID</td>
<td>8</td>
<td>Device Control Word</td>
<td>Device Mode*</td>
<td>Reserved</td>
<td>0x00</td>
<td>0x00</td>
<td>0x00</td>
<td>0x00</td>
<td>0x00</td>
</tr>
</tbody>
</table>

* 0x01 CAN controlled, 0x02 hand operational mode.

The valve behavior to setpoint messages and the time guarding of RxPDO2 is configured in OD 0x1401.

RxPDO2 behavior

<table>
<thead>
<tr>
<th>OD 0x1401, sub 0x01</th>
<th>COB-ID</th>
<th>COB-ID to control the PVED</th>
</tr>
</thead>
<tbody>
<tr>
<td>OD 0x1401, sub 0x02</td>
<td>Transmission Type</td>
<td>Range: 0x00 to 0xF0 (synchronies, used together with Sync messages as trigger for sending PDO)</td>
</tr>
<tr>
<td>OD 0x1401, sub 0x05</td>
<td>Event Timer</td>
<td>Timeout of the RPDO message</td>
</tr>
</tbody>
</table>

Controlling a PVED using RxPDO1

The PVED can be controlled in one of two ways:

* Activating a single PVED with a single CANbus message
Communication

- For activating a single PVED the RxPDO COB-ID must be COB-ID + PVED nodeID (default = 0x200 + nodeID/0x300 + nodeID for RxPDO1 and RxPDO2 respectively)
- For activating multiple PVED’s with a single message they must all have the same COB-ID (default = 0x200/0x300 for RxPDO1 and RxPDO2 respectively) and be mapped to listen to a specific byte in the RxPDO that contain their setpoints.

- Creating a mapping that will activate multiple PVED’s with a single CANbus message

**TxPDO1**

The TxPDO1 is, by default, mapped to the following two process data outputs:

- Device Status Word, DSW (OD 0x6041)
- Vpoc Actual Value, Spool Position (OD 0x6301, sub 0x01)

**Frame format**

<table>
<thead>
<tr>
<th>Msg ID</th>
<th>DLC</th>
<th>Byte 0</th>
<th>Byte 1</th>
<th>Byte 2</th>
<th>Byte 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>0x180 + nodeID</td>
<td>4</td>
<td>Device Status Word</td>
<td>Vpoc Actual Value (Spool position)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Range: -16384 to 16384 (corresponding to -100 to 100% spool travel).

The behavior of TxPDO1 is configured in OD 0x1800.

**TxPDO1 behavior**

<table>
<thead>
<tr>
<th>OD 0x1800, sub 0x02</th>
<th>Transmission Type</th>
<th>Range: 0x00 to 0xF0 (synchronies, used together with Sync messages as trigger for sending PDO)</th>
<th>Default: 0xFF event driven (asynchronies)</th>
</tr>
</thead>
<tbody>
<tr>
<td>OD 0x1800, sub 0x03</td>
<td>Inhibit time (used with synchronies transmission time)</td>
<td>Minimum time between two consecutive TxPDO1</td>
<td></td>
</tr>
<tr>
<td>OD 0x1800, sub 0x05</td>
<td>Transmission Time (used with synchronies transmission time)</td>
<td>Maximum time between two consecutive TxPDO1</td>
<td></td>
</tr>
</tbody>
</table>

**TxPDO2**

The TxPDO2 is, by default, mapped to the following four process data outputs:

- Demand value (OD 0x6310)
- Manufacturer specific spool position actual value – 8bit (OD 0x3301)
- Manufacturer specific spool position actual inverted value – 8bit (OD 0x3302)
- Manufacturer specific spool position actual value – 16bit (OD 0x3304)

**Frame format**

<table>
<thead>
<tr>
<th>Msg ID</th>
<th>DLC</th>
<th>Byte 0</th>
<th>Byte 1</th>
<th>Byte 2</th>
<th>Byte 3</th>
<th>Byte 4</th>
<th>Byte 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>0x280 + nodeID</td>
<td>6</td>
<td>Demand value</td>
<td>Manufacturer specific spool position actual value – 8bit</td>
<td>Manufacturer specific spool position actual inverted value – 8bit</td>
<td>Manufacturer specific spool position actual value – 16bit</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**TxPDO2 data**

<table>
<thead>
<tr>
<th>Byte 0</th>
<th>Demand value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>-1000 to 1000 corresponding to -100% to 100% spool travel</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Byte 1</th>
<th>Manufacturer specific spool position actual value – 8bit</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>-127 to 127 corresponding to -100% to 100% spool travel</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Byte 2</th>
<th>Manufacturer specific spool position actual inverted value – 8bit</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>-127 to 127 corresponding to -100% to 100% spool travel</td>
</tr>
</tbody>
</table>
Communication

**TxPDO2 data (continued)**

<table>
<thead>
<tr>
<th>Byte 4</th>
<th>Manufacturer specific spool position actual value – 16bit</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>-1000 to 1000 corresponding to -100% to 100% spool travel</td>
</tr>
<tr>
<td>Float</td>
<td>represented by value 0</td>
</tr>
</tbody>
</table>

The behavior of TxPDO2 is configured in OD 0x1801.

**TxPDO2 behavior**

<table>
<thead>
<tr>
<th>OD 0x1801, sub 0x02</th>
<th>Transmission Type</th>
<th>Range: 0x00 to 0xFF (synchronies, used together with Sync messages as trigger for sending PDO)</th>
</tr>
</thead>
<tbody>
<tr>
<td>OD 0x1801, sub 0x03</td>
<td>Inhibit time</td>
<td>Minimum time between two consecutive TxPDO2</td>
</tr>
<tr>
<td>OD 0x1801, sub 0x05</td>
<td>Transmission Time</td>
<td>Maximum time between two consecutive TxPDO2</td>
</tr>
</tbody>
</table>

**PDO mapping**

The following procedure is recommended for changing the mapping of a PDO. It makes use of SDO commands to perform the mapping.

1. Disable the PDO by setting PDO Parameter, Object Dictionary sub 0x01, bit 31 to 0x01
2. Disable mapping by setting PDO Mapping, Object Dictionary sub 0x00 to 0x00
3. Modify the mapping in PDO Mapping, Object Dictionary
4. Create the PDO by setting PDO Parameter, Object Dictionary sub 0x01, bit 31 to 0x00

**PDO mapping example**

The following example shows how to map `vpoc_actual_value` and `PCB_temperature` to TPDO1 for a PVED with nodeID = 0x20 to TxPDO1.

1. **DisableTxPDO1**

<table>
<thead>
<tr>
<th>Msg ID</th>
<th>DLC</th>
<th>Byte 0</th>
<th>Byte 1</th>
<th>Byte 2</th>
<th>Byte 3</th>
<th>Byte 4</th>
<th>Byte 5</th>
<th>Byte 6</th>
<th>Byte 7</th>
</tr>
</thead>
<tbody>
<tr>
<td>0x620</td>
<td>8</td>
<td>0x23</td>
<td>0x00</td>
<td>0x18</td>
<td>0x01</td>
<td>0xA0</td>
<td>0x01</td>
<td>0x00</td>
<td>0x80</td>
</tr>
</tbody>
</table>

   **Response from PVED**

<table>
<thead>
<tr>
<th>Msg ID</th>
<th>DLC</th>
<th>Byte 0</th>
<th>Byte 1</th>
<th>Byte 2</th>
<th>Byte 3</th>
<th>Byte 4</th>
<th>Byte 5</th>
<th>Byte 6</th>
<th>Byte 7</th>
</tr>
</thead>
<tbody>
<tr>
<td>0x6A0</td>
<td>8</td>
<td>0x60</td>
<td>0x00</td>
<td>0x18</td>
<td>0x01</td>
<td>0x00</td>
<td>0x00</td>
<td>0x00</td>
<td>0x00</td>
</tr>
</tbody>
</table>

2. **Disable mapping**

<table>
<thead>
<tr>
<th>Msg ID</th>
<th>DLC</th>
<th>Byte 0</th>
<th>Byte 1</th>
<th>Byte 2</th>
<th>Byte 3</th>
<th>Byte 4</th>
<th>Byte 5</th>
<th>Byte 6</th>
<th>Byte 7</th>
</tr>
</thead>
<tbody>
<tr>
<td>0x620</td>
<td>8</td>
<td>0x2F</td>
<td>0x00</td>
<td>0x1A</td>
<td>0x00</td>
<td>0x00</td>
<td>0x00</td>
<td>0x00</td>
<td>0x00</td>
</tr>
</tbody>
</table>

   **Response from PVED**

<table>
<thead>
<tr>
<th>Msg ID</th>
<th>DLC</th>
<th>Byte 0</th>
<th>Byte 1</th>
<th>Byte 2</th>
<th>Byte 3</th>
<th>Byte 4</th>
<th>Byte 5</th>
<th>Byte 6</th>
<th>Byte 7</th>
</tr>
</thead>
<tbody>
<tr>
<td>0x6A0</td>
<td>8</td>
<td>0x60</td>
<td>0x00</td>
<td>0x1A</td>
<td>0x00</td>
<td>0x00</td>
<td>0x00</td>
<td>0x00</td>
<td>0x00</td>
</tr>
</tbody>
</table>
### Communication

3. Modify mapping: a) Map parameter vpoc_actual_value, 16bit (0x6301, sub 0x01)

<table>
<thead>
<tr>
<th>Msg ID</th>
<th>DLC</th>
<th>Byte 0</th>
<th>Byte 1</th>
<th>Byte 2</th>
<th>Byte 3</th>
<th>Byte 4</th>
<th>Byte 5</th>
<th>Byte 6</th>
<th>Byte 7</th>
</tr>
</thead>
<tbody>
<tr>
<td>0x620</td>
<td>8</td>
<td>Control Byte</td>
<td>OD Index</td>
<td>OD sub index</td>
<td>Data</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0x23</td>
<td>0x00</td>
<td>0x1A</td>
<td>0x01</td>
<td>0x10</td>
<td>0x01</td>
<td>0x01</td>
<td>0x63</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Response from PVED

<table>
<thead>
<tr>
<th>Msg ID</th>
<th>DLC</th>
<th>Byte 0</th>
<th>Byte 1</th>
<th>Byte 2</th>
<th>Byte 3</th>
<th>Byte 4</th>
<th>Byte 5</th>
<th>Byte 6</th>
<th>Byte 7</th>
</tr>
</thead>
<tbody>
<tr>
<td>0x5A0</td>
<td>8</td>
<td>Control Byte</td>
<td>OD Index</td>
<td>OD sub index</td>
<td>Data</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0x60</td>
<td>0x00</td>
<td>0x1A</td>
<td>0x02</td>
<td>0x10</td>
<td>0x00</td>
<td>0x00</td>
<td>0x00</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

3. Modify mapping: b) Map parameter PCB_temperature, 16bit (0x3468, sub 0x00)

<table>
<thead>
<tr>
<th>Msg ID</th>
<th>DLC</th>
<th>Byte 0</th>
<th>Byte 1</th>
<th>Byte 2</th>
<th>Byte 3</th>
<th>Byte 4</th>
<th>Byte 5</th>
<th>Byte 6</th>
<th>Byte 7</th>
</tr>
</thead>
<tbody>
<tr>
<td>0x620</td>
<td>8</td>
<td>Control Byte</td>
<td>OD Index</td>
<td>OD sub index</td>
<td>Data</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0x23</td>
<td>0x00</td>
<td>0x18</td>
<td>0x01</td>
<td>0xA0</td>
<td>0x01</td>
<td>0x00</td>
<td>0x40</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Response from PVED

<table>
<thead>
<tr>
<th>Msg ID</th>
<th>DLC</th>
<th>Byte 0</th>
<th>Byte 1</th>
<th>Byte 2</th>
<th>Byte 3</th>
<th>Byte 4</th>
<th>Byte 5</th>
<th>Byte 6</th>
<th>Byte 7</th>
</tr>
</thead>
<tbody>
<tr>
<td>0x5A0</td>
<td>8</td>
<td>Control Byte</td>
<td>OD Index</td>
<td>OD sub index</td>
<td>Data</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0x60</td>
<td>0x00</td>
<td>0x18</td>
<td>0x01</td>
<td>0x00</td>
<td>0x00</td>
<td>0x00</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

3. Modify mapping: c) Map 2 entries (vpoc_actual_value and PCB_temperature)

<table>
<thead>
<tr>
<th>Msg ID</th>
<th>DLC</th>
<th>Byte 0</th>
<th>Byte 1</th>
<th>Byte 2</th>
<th>Byte 3</th>
<th>Byte 4</th>
<th>Byte 5</th>
<th>Byte 6</th>
<th>Byte 7</th>
</tr>
</thead>
<tbody>
<tr>
<td>0x620</td>
<td>8</td>
<td>Control Byte</td>
<td>OD Index</td>
<td>OD sub index</td>
<td>Data</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0x2F</td>
<td>0x00</td>
<td>0x1A</td>
<td>0x00</td>
<td>0x02</td>
<td>0x00</td>
<td>0x00</td>
<td>0x00</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Response from PVED

<table>
<thead>
<tr>
<th>Msg ID</th>
<th>DLC</th>
<th>Byte 0</th>
<th>Byte 1</th>
<th>Byte 2</th>
<th>Byte 3</th>
<th>Byte 4</th>
<th>Byte 5</th>
<th>Byte 6</th>
<th>Byte 7</th>
</tr>
</thead>
<tbody>
<tr>
<td>0x5A0</td>
<td>8</td>
<td>Control Byte</td>
<td>OD Index</td>
<td>OD sub index</td>
<td>Data</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0x60</td>
<td>0x00</td>
<td>0x1A</td>
<td>0x00</td>
<td>0x00</td>
<td>0x00</td>
<td>0x00</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

4. Create the TxPDO1 with new mapping

<table>
<thead>
<tr>
<th>Msg ID</th>
<th>DLC</th>
<th>Byte 0</th>
<th>Byte 1</th>
<th>Byte 2</th>
<th>Byte 3</th>
<th>Byte 4</th>
<th>Byte 5</th>
<th>Byte 6</th>
<th>Byte 7</th>
</tr>
</thead>
<tbody>
<tr>
<td>0x620</td>
<td>8</td>
<td>Control Byte</td>
<td>OD Index</td>
<td>OD sub index</td>
<td>Data</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0x23</td>
<td>0x00</td>
<td>0x18</td>
<td>0x01</td>
<td>0xA0</td>
<td>0x01</td>
<td>0x00</td>
<td>0x40</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Response from PVED

<table>
<thead>
<tr>
<th>Msg ID</th>
<th>DLC</th>
<th>Byte 0</th>
<th>Byte 1</th>
<th>Byte 2</th>
<th>Byte 3</th>
<th>Byte 4</th>
<th>Byte 5</th>
<th>Byte 6</th>
<th>Byte 7</th>
</tr>
</thead>
<tbody>
<tr>
<td>0x5A0</td>
<td>8</td>
<td>Control Byte</td>
<td>OD Index</td>
<td>OD sub index</td>
<td>Data</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0x60</td>
<td>0x00</td>
<td>0x18</td>
<td>0x01</td>
<td>0x00</td>
<td>0x00</td>
<td>0x00</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Resulting new TxPDO1

<table>
<thead>
<tr>
<th>Msg ID</th>
<th>DLC</th>
<th>Byte 0</th>
<th>Byte 1</th>
<th>Byte 2</th>
<th>Byte 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>0x1A0</td>
<td>4</td>
<td>Vpoc_actual_value</td>
<td>PCB_temperature</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Communication

Sync message

The PVED uses the Sync message as trigger for sending TxPDO when transmission type is configured as Synchronies.

Number of consecutive Sync messages between TxPDO transmitted is configured in TxPDO Object Dictionaries.

<table>
<thead>
<tr>
<th>Sync frame format</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Msg ID</strong></td>
</tr>
<tr>
<td>0x80</td>
</tr>
</tbody>
</table>

PVED-CC heartbeat protocol

The PVED supports heartbeat protocol for error control services.

Heartbeat mechanism can be established by configuring the PVED as a heartbeat producer in OD 0x1017. Resolution is 10ms and value 0 will disable heartbeat producer.

<table>
<thead>
<tr>
<th>Heartbeat frame format</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Msg ID</strong></td>
</tr>
<tr>
<td>0x700 + nodeID</td>
</tr>
</tbody>
</table>

Heartbeat data

<table>
<thead>
<tr>
<th>Byte 0</th>
<th>State</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0x00 = Bootup</td>
</tr>
<tr>
<td></td>
<td>0x04 = Stopped</td>
</tr>
<tr>
<td></td>
<td>0x05 = Operational</td>
</tr>
<tr>
<td></td>
<td>0x7F = Preoperational</td>
</tr>
</tbody>
</table>

Emergency messages

Emergency producer

Emergency messages are used to broadcast diagnostic codes to the CANbus network.

<table>
<thead>
<tr>
<th>Emergency producer frame format</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Msg ID</strong></td>
</tr>
<tr>
<td>0x080 + nodeID</td>
</tr>
</tbody>
</table>

Emergency producer data

<table>
<thead>
<tr>
<th>Byte 0</th>
<th>EMCY code*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Byte 1</td>
<td></td>
</tr>
<tr>
<td>Byte 2</td>
<td>Error register*</td>
</tr>
<tr>
<td>Byte 3</td>
<td>Occurrence Counter</td>
</tr>
<tr>
<td>Byte 4</td>
<td>Fault ID*</td>
</tr>
<tr>
<td>Byte 5</td>
<td>Reserved (0x00)</td>
</tr>
<tr>
<td>Byte 6</td>
<td></td>
</tr>
</tbody>
</table>
Emergency producer data (continued)

<table>
<thead>
<tr>
<th>Byte 7</th>
<th>Severity level¹</th>
<th>0x00 = Info</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>0x10 = Warning</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0x20 = Critical</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0x30 = Severe</td>
</tr>
</tbody>
</table>

¹ Refer to the PVED-CC (CANopen) Diagnostics log on page 28 for more information on specific faults.

Emergency severity level

<table>
<thead>
<tr>
<th>Severity level</th>
<th>DSM transition</th>
<th>Action and recovery</th>
</tr>
</thead>
<tbody>
<tr>
<td>Info (0x00)</td>
<td>No change</td>
<td>The PVED does not take any action</td>
</tr>
<tr>
<td>Warning (0x10)</td>
<td>Fault_Hold</td>
<td>Shutdown of PVED until the fault is no longer active</td>
</tr>
<tr>
<td>Critical (0x20)</td>
<td>Fault</td>
<td>Shutdown of PVED. Power reset needed after fault is no longer active</td>
</tr>
<tr>
<td>Severe (0x30)</td>
<td>Fault</td>
<td></td>
</tr>
</tbody>
</table>

PVED emergency consumer

The PVED uses Emergency Consumer as emergency stop message from external sources.

The Emergency consumer is configured in OD0x1028 and has 14 allowed slots.

Emergency consumer frame format

<table>
<thead>
<tr>
<th>Msg ID</th>
<th>DLC</th>
<th>Byte 0</th>
<th>Byte 1</th>
<th>Byte 2</th>
<th>Byte 3</th>
<th>Byte 4</th>
<th>Byte 5</th>
<th>Byte 6</th>
<th>Byte 7</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>8</td>
<td>Emergency Code</td>
<td>Error Register</td>
<td>MSEF</td>
<td>Internal Error Code</td>
<td>Reserved</td>
<td>Severity Level (don't care)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Emergency consumer data

<table>
<thead>
<tr>
<th>Byte 0</th>
<th>EMCY code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Byte 1</td>
<td></td>
</tr>
<tr>
<td>Byte 2</td>
<td>Error register</td>
</tr>
<tr>
<td>Byte 3</td>
<td>Manufacturer Specific Error Field</td>
</tr>
<tr>
<td>Byte 4</td>
<td>Fault ID</td>
</tr>
<tr>
<td>Byte 5</td>
<td>Reserved (0x00)</td>
</tr>
<tr>
<td>Byte 6</td>
<td></td>
</tr>
<tr>
<td>Byte 7</td>
<td>Severity level (don't care)</td>
</tr>
</tbody>
</table>
Service Data Object (SDO)

SDO provide access to entries into the Object Dictionary.

**SDO command**

**SDO command frame format**

<table>
<thead>
<tr>
<th>Msg ID</th>
<th>DLC</th>
<th>Byte 0</th>
<th>Byte 1</th>
<th>Byte 2</th>
<th>Byte 3</th>
<th>Byte 4</th>
<th>Byte 5</th>
<th>Byte 6</th>
<th>Byte 7</th>
</tr>
</thead>
<tbody>
<tr>
<td>0x600 + nodeID</td>
<td>8</td>
<td>Control Byte</td>
<td>OD index</td>
<td>OD sub index</td>
<td>Data</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**SDO command data**

<table>
<thead>
<tr>
<th>Byte 0</th>
<th>Control Byte</th>
<th>0x2F: write 1 byte data</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>0x2B: write 2 byte data</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0x23: write 4 byte data</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0x22: write 4 byte or less</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0x40: read command</td>
</tr>
<tr>
<td>Byte 1</td>
<td>Object Dictionary index</td>
<td></td>
</tr>
<tr>
<td>Byte 2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Byte 3</td>
<td>Object Dictionary sub-index</td>
<td></td>
</tr>
<tr>
<td>Byte 4</td>
<td>Data (LSB first)</td>
<td></td>
</tr>
<tr>
<td>Byte 5</td>
<td>Must always be 0x00 for SDO read command!</td>
<td></td>
</tr>
<tr>
<td>Byte 6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Byte 7</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**SDO response**

**SDO response frame format**

<table>
<thead>
<tr>
<th>Msg ID</th>
<th>DLC</th>
<th>Byte 0</th>
<th>Byte 1</th>
<th>Byte 2</th>
<th>Byte 3</th>
<th>Byte 4</th>
<th>Byte 5</th>
<th>Byte 6</th>
<th>Byte 7</th>
</tr>
</thead>
<tbody>
<tr>
<td>0x580 + nodeID</td>
<td>8</td>
<td>Control Byte</td>
<td>OD index</td>
<td>OD sub index</td>
<td>Data</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**SDO response data**

<table>
<thead>
<tr>
<th>Byte 0</th>
<th>Control Byte</th>
<th>0x43: SDO read acknowledge</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>0x60: SDO write acknowledge</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0x80: SDO abort</td>
</tr>
<tr>
<td>Byte 1</td>
<td>Object Dictionary index</td>
<td></td>
</tr>
<tr>
<td>Byte 2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Byte 3</td>
<td>Object Dictionary sub-index</td>
<td></td>
</tr>
<tr>
<td>Byte 4</td>
<td>Data (LSB first)</td>
<td></td>
</tr>
<tr>
<td>Byte 5</td>
<td>If Control byte = 0x43, Data read in OD</td>
<td></td>
</tr>
<tr>
<td>Byte 6</td>
<td>If Control byte = 0x60, Data = 0x00</td>
<td></td>
</tr>
<tr>
<td>Byte 7</td>
<td>If Control byte = 0x80, Data = SDO abort codes acc. CiA 301</td>
<td></td>
</tr>
</tbody>
</table>
# Parameters

## List of configurable parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Object Dictionary</th>
<th>Sub index</th>
<th>Description</th>
<th>Range</th>
<th>Default</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heartbeat</td>
<td>0x1017</td>
<td>—</td>
<td>Time between heartbeat messages transmitted from the PVED</td>
<td>Resolution: 10ms</td>
<td>1000 ms</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0-1000ms</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0-100</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0x00 - 0x64</td>
<td></td>
</tr>
<tr>
<td>Emergency Consumer</td>
<td>0x1028</td>
<td>0x01 - 0x0E</td>
<td>Emergency Consumer ID of external sources to which PVED must react with a fault</td>
<td>0x81 - 0xFF</td>
<td>0x81 - 0x8E</td>
</tr>
<tr>
<td>Emergency Consumer no. Obj.</td>
<td>0x1028</td>
<td>0x00</td>
<td>No. of Emergency Consumers to which PVED must react with a fault</td>
<td>0x00 - 0xFF</td>
<td>0</td>
</tr>
<tr>
<td>RPDO1 parameters</td>
<td>0x1400</td>
<td>0x01</td>
<td>COB-ID for RPDO1</td>
<td>0x181 - 0x57F</td>
<td>0x200 + nodeID</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0x02</td>
<td>Transmission type for RPDO1</td>
<td>0x0 - 0xFF</td>
<td>0xFF</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0x05</td>
<td>Timeout for receiving RPDO1</td>
<td>0x0 - 0xFFFF</td>
<td>0x0</td>
</tr>
<tr>
<td>RPDO1 mapping</td>
<td>0x1600</td>
<td>0x01</td>
<td>Mapping of the RPDO1</td>
<td>0x1000 - 0x9FFF</td>
<td>0x30010</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0x02</td>
<td></td>
<td>0x1000 - 0x9FFF</td>
<td>0x63000110</td>
</tr>
<tr>
<td>RPDO2 parameters</td>
<td>0x1401</td>
<td>0x01</td>
<td>COB-ID for RPDO2</td>
<td>0x181 - 0x57F</td>
<td>0x300 + nodeID</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0x02</td>
<td>Transmission type for RPDO2</td>
<td>0x0 - 0xFF</td>
<td>0xFF</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0x05</td>
<td>Timeout for receiving RPDO2</td>
<td>0x0 - 0xFFFF</td>
<td>0x0</td>
</tr>
<tr>
<td>RPDO2 mapping</td>
<td>0x1601</td>
<td>0x01</td>
<td>Mapping of RPDO2</td>
<td>0x1000 - 0x9FFF</td>
<td>0x6040010</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0x02</td>
<td></td>
<td>0x1000 - 0x9FFF</td>
<td>0x60420008</td>
</tr>
<tr>
<td>TPDO1</td>
<td>0x1800</td>
<td>0x01</td>
<td>Message ID for TPDO1</td>
<td>0x181 - 0x1FF</td>
<td>0x180 + nodeID</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0x02</td>
<td>Transmission type. Synchronies or asynchronies (event driven) transmission of TPDO</td>
<td>0x0 - 0xFF</td>
<td>0xFF (event driven)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0x03</td>
<td>Inhibit time. Minimum between two TPDO if event driven</td>
<td>0x0 - 0xFFFF</td>
<td>0x0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0x05</td>
<td>Event timer. Maximum time between two TPDO if event driven</td>
<td>0x0 - 0xFFFF</td>
<td>0x64</td>
</tr>
<tr>
<td>TPDO1 mapping</td>
<td>0x1A00</td>
<td>0x01</td>
<td>Mapping of TPDO1</td>
<td>0x1000 - 0x9FFF</td>
<td>0x60410010</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0x02</td>
<td></td>
<td>0x1000 - 0x9FFF</td>
<td>0x63010110</td>
</tr>
<tr>
<td>TPDO2</td>
<td>0x1801</td>
<td>0x01</td>
<td>Message ID for TPDO2</td>
<td>0x281 - 0x2FF</td>
<td>0x280 + nodeID</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0x02</td>
<td>Transmission type. Synchronies or asynchronies (event driven) transmission of TPDO</td>
<td>0x0 - 0xFF</td>
<td>0xFF (event driven)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0x03</td>
<td>Inhibit time. Minimum between two TPDO if event driven</td>
<td>0x0 - 0xFFFF</td>
<td>0x0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0x05</td>
<td>Event timer. Maximum time between two TPDO if event driven</td>
<td>0x0 - 0xFFFF</td>
<td>0x64</td>
</tr>
</tbody>
</table>
## Configurable parameters (continued)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Object Dictionary</th>
<th>Sub index</th>
<th>Description</th>
<th>Range</th>
<th>Default</th>
</tr>
</thead>
<tbody>
<tr>
<td>TPDO2 mapping</td>
<td>0x1A01</td>
<td>0x01</td>
<td>Mapping of TPDO2</td>
<td>0x1000 - 0x9FFF</td>
<td>0x34800010</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0x02</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>0x03</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>0x04</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Scaling – Extend</td>
<td>0x3454</td>
<td>-</td>
<td>Scaling of the spool stroke. 100% scaling = 7mm spool stroke</td>
<td>0-100%</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0-250</td>
<td>250</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0x00 - 0xFA</td>
<td>0xFA</td>
</tr>
<tr>
<td>Scaling - Retract</td>
<td>0x3455</td>
<td>-</td>
<td>Scaling of the spool stroke. 100% scaling = 7mm spool stroke</td>
<td>0-100%</td>
<td>100%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0 250</td>
<td>250</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0x00 - 0xFA</td>
<td>0xFA</td>
</tr>
<tr>
<td>Dead band offset – Extend</td>
<td>0x3456</td>
<td>-</td>
<td>Spool stroke upon receiving smallest set point</td>
<td>0-100%</td>
<td>0%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0-100</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0x00-0x64</td>
<td>0x00</td>
</tr>
<tr>
<td>Dead band offset – Retract</td>
<td>0x3457</td>
<td>-</td>
<td>Spool stroke upon receiving smallest set point</td>
<td>0-100%</td>
<td>0%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0-100</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0x00-0x64</td>
<td>0x64</td>
</tr>
<tr>
<td>Ramp up - Extend</td>
<td>0x3458</td>
<td>-</td>
<td>Time to stroke spool from, neutral to full stroke (full stroke is defined by the scaling parameter)</td>
<td>0-4000ms</td>
<td>0ms</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0-250</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0x00-0xFA</td>
<td>0x00</td>
</tr>
<tr>
<td>Ramp down - Extend</td>
<td>0x3459</td>
<td>-</td>
<td>Time to stroke spool from, neutral to full stroke (full stroke is defined by the scaling parameter)</td>
<td>0-4000ms</td>
<td>0ms</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0-250</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0x00-0xFA</td>
<td>0x00</td>
</tr>
<tr>
<td>Ramp up – Retract</td>
<td>0x3460</td>
<td>-</td>
<td>Time to stroke spool from, neutral to full stroke (full stroke is defined by the scaling parameter)</td>
<td>0-4000ms</td>
<td>0ms</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0-250</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0x00-0xFA</td>
<td>0x00</td>
</tr>
<tr>
<td>Ramp down - Retract</td>
<td>0x3461</td>
<td>-</td>
<td>Time to stroke spool from, neutral to full stroke (full stroke is defined by the scaling parameter)</td>
<td>0-4000ms</td>
<td>0ms</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0-250</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0x00-0xFA</td>
<td>0x00</td>
</tr>
<tr>
<td>Invert port</td>
<td>0x3462</td>
<td>-</td>
<td>Inverts setpoint command</td>
<td>Inverted/not inverted</td>
<td>Not inverted</td>
</tr>
<tr>
<td>Float Threshold</td>
<td>0x3463</td>
<td>-</td>
<td>Minimum setpoint command needed to be received by the PVED before allowed to enter float</td>
<td>0-100%</td>
<td>0%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0-250</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0x00-0xFA</td>
<td>0x00</td>
</tr>
<tr>
<td>Float ramp time</td>
<td>0x347A</td>
<td>-</td>
<td>Ramp time from full flow to float position. Valid range: 0-500ms</td>
<td>0-500ms</td>
<td>0ms</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Default: 0 = ramping disabled</td>
<td>0-500</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0x00-0x1F4</td>
<td>0x00</td>
</tr>
<tr>
<td>Power Save</td>
<td>0x3464</td>
<td>-</td>
<td>Reduce power consumption by making the PVED enter a sleep mode when in neutral (time delay configurable)</td>
<td>ON/OFF</td>
<td>ON</td>
</tr>
</tbody>
</table>
Configurable parameters (continued)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Object Dictionary</th>
<th>Sub index</th>
<th>Description</th>
<th>Range</th>
<th>Default</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power Save entry delay</td>
<td>0x3465</td>
<td>—</td>
<td>Time the spool has to stay in neutral position before power save mode is entered</td>
<td>0-8000ms</td>
<td>500ms</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0-80</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0x00-0x50</td>
<td>0x05</td>
</tr>
<tr>
<td>Low voltage reaction delay*</td>
<td>—</td>
<td>—</td>
<td>Time from voltage drops below acceptable limit (9VDC) to EMCY message is transmitted</td>
<td>0-2000ms</td>
<td>1000ms</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0-20</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0x00-0x14</td>
<td>0x0A</td>
</tr>
<tr>
<td>Temperature dependent spool timeout*</td>
<td>—</td>
<td>—</td>
<td>Allowed time to stroke the spool from full stroke to neutral in a 100°C temperature interval from -40 to +1300°C</td>
<td>0x00-0xFF</td>
<td>See graph below</td>
</tr>
<tr>
<td>Temperature dependent spool timeout float add-on*</td>
<td>—</td>
<td>—</td>
<td>Time added to temperature dependent timeout to reach float position</td>
<td>0-100%</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0-255</td>
<td>255</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0x00-0xFF</td>
<td>0xFF</td>
</tr>
<tr>
<td>Baud rate</td>
<td>—</td>
<td>—</td>
<td>Communication baud rate</td>
<td>125k8d</td>
<td>250k8d</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>250k8d</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>500k8d</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1000k8d</td>
<td></td>
</tr>
</tbody>
</table>

* Only configurable via PVED Series 5 PLUS+1® Service Tool.

Timeout as function of temperature

After changing one or more parameters the new data must be saved to the EEPROM with an SDO save command.

<table>
<thead>
<tr>
<th>Msg ID</th>
<th>DLC</th>
<th>Byte 0</th>
<th>Byte 1</th>
<th>Byte 2</th>
<th>Byte 3</th>
<th>Byte 4</th>
<th>Byte 5</th>
<th>Byte 6</th>
<th>Byte 7</th>
</tr>
</thead>
<tbody>
<tr>
<td>0x600 + nodeID</td>
<td>8</td>
<td>0x23</td>
<td>0x10</td>
<td>0x10</td>
<td>0x01</td>
<td>0x73</td>
<td>0x61</td>
<td>0x76</td>
<td>0x65</td>
</tr>
</tbody>
</table>
## Parameters

### List of read-only parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Object Dictionary</th>
<th>Sub index</th>
<th>Description</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Current PCB temperature</td>
<td>0x3468</td>
<td>—</td>
<td>Temperature of the PCB measured by the onboard temperature sensor in °C (°F)</td>
<td>-40° C to 120° C (-40° F to 248° F)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0-65535</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0x00-0xFFFF</td>
</tr>
<tr>
<td>Battery voltage</td>
<td>0x3469</td>
<td>—</td>
<td>Battery voltage measured by the PVED in steps of 0.1 V</td>
<td>9 V to 35.5 V</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0-65535</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0x00-0x163</td>
</tr>
<tr>
<td>8 bit dummy object</td>
<td>0x0002</td>
<td>—</td>
<td>The dummy unsigned 8 bit object to map in RxPDO</td>
<td>—</td>
</tr>
<tr>
<td>16 bit dummy object</td>
<td>0x0003</td>
<td>—</td>
<td>The dummy unsigned 16 bit object to map in RxPDO</td>
<td>—</td>
</tr>
<tr>
<td>32 bit dummy object</td>
<td>0x0004</td>
<td>—</td>
<td>The dummy unsigned 32 bit object to map in RxPDO</td>
<td>—</td>
</tr>
</tbody>
</table>
Diagnosis

PVED-CC (CANopen) Diagnostics log

The PVED-CC Series 5 CANopen contains a diagnostic log that saves occurrence of all faults listed below. The faults are transmitted onto the CANbus through EMCY messages upon occurrence and previously active faults can be inquired through SDO message to the EDS. The complete list of active and previously active faults can be seen in the PLUS+1® Service Tool.

### Faults

<table>
<thead>
<tr>
<th>Fault ID</th>
<th>Fault Description</th>
<th>EMCY code</th>
<th>Severity</th>
<th>Error register</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Software Initialization fault</td>
<td>0x6200</td>
<td>Severe</td>
<td>0x81</td>
</tr>
<tr>
<td>1</td>
<td>Internal calculation fault</td>
<td>0x6201</td>
<td>Severe</td>
<td>0x81</td>
</tr>
<tr>
<td>2</td>
<td>Parameter truncation change</td>
<td>0x6203</td>
<td>Severe</td>
<td>0x81</td>
</tr>
<tr>
<td>3</td>
<td>Interpolation fault</td>
<td>0x6204</td>
<td>Severe</td>
<td>0x81</td>
</tr>
<tr>
<td>4</td>
<td>Supply voltage above upper limit</td>
<td>0x3411</td>
<td>Warning</td>
<td>0x05</td>
</tr>
<tr>
<td>5</td>
<td>Supply voltage below lower limit</td>
<td>0x3412</td>
<td>Warning</td>
<td>0x05</td>
</tr>
<tr>
<td>6</td>
<td>5V PSU out of range</td>
<td>0x3414</td>
<td>Severe</td>
<td>0x05</td>
</tr>
<tr>
<td>7</td>
<td>Spool position calculation fault</td>
<td>0x620B</td>
<td>Severe</td>
<td>0x81</td>
</tr>
<tr>
<td>8</td>
<td>V reference signal out of range</td>
<td>0x3413</td>
<td>Severe</td>
<td>0x05</td>
</tr>
<tr>
<td>9</td>
<td>GND signal unstable</td>
<td>0x3415</td>
<td>Severe</td>
<td>0x05</td>
</tr>
<tr>
<td>10</td>
<td>Demodulator A: signal out of range</td>
<td>0x5235</td>
<td>Severe</td>
<td>0x21</td>
</tr>
<tr>
<td>11</td>
<td>Demodulator B: signal out of range</td>
<td>0x5236</td>
<td>Severe</td>
<td>0x21</td>
</tr>
<tr>
<td>12</td>
<td>Handshake not received by safeUC</td>
<td>0x610D</td>
<td>Severe</td>
<td>0x81</td>
</tr>
<tr>
<td>13</td>
<td>Transducer signal frequency out of range</td>
<td>0x610E</td>
<td>Severe</td>
<td>0x81</td>
</tr>
<tr>
<td>14</td>
<td>Safety demodulator A: signal out of range</td>
<td>0x6108</td>
<td>Severe</td>
<td>0x81</td>
</tr>
<tr>
<td>15</td>
<td>Safety demodulator B: signal out of range</td>
<td>0x6109</td>
<td>Severe</td>
<td>0x81</td>
</tr>
<tr>
<td>16</td>
<td>Safety –controller PSU out of range</td>
<td>0x610F</td>
<td>Severe</td>
<td>0x81</td>
</tr>
<tr>
<td>17</td>
<td>Safety-controller: voltage reference out of range</td>
<td>0x6110</td>
<td>Severe</td>
<td>0x81</td>
</tr>
<tr>
<td>18</td>
<td>Safety-controller fuse bit fault</td>
<td>0x6101</td>
<td>Severe</td>
<td>0x81</td>
</tr>
<tr>
<td>19</td>
<td>Safety-controller spool position cross validation fault</td>
<td>0x610A</td>
<td>Severe</td>
<td>0x81</td>
</tr>
<tr>
<td>20</td>
<td>Safety switch state fault</td>
<td>0x6111</td>
<td>Severe</td>
<td>0x81</td>
</tr>
<tr>
<td>21</td>
<td>Safety-controller initialization fault</td>
<td>0x6211</td>
<td>Severe</td>
<td>0x81</td>
</tr>
<tr>
<td>22</td>
<td>Safety switch status fault</td>
<td>0x6112</td>
<td>Severe</td>
<td>0x81</td>
</tr>
<tr>
<td>23</td>
<td>Handshake not received by mainUC</td>
<td>0x6205</td>
<td>Severe</td>
<td>0x81</td>
</tr>
<tr>
<td>24</td>
<td>Handshake bootup fault</td>
<td>0x6113</td>
<td>Warning</td>
<td>0x81</td>
</tr>
</tbody>
</table>
## Faults (continued)

<table>
<thead>
<tr>
<th>Fault ID</th>
<th>Fault Description</th>
<th>EMCY code</th>
<th>Severity</th>
<th>Error register</th>
</tr>
</thead>
<tbody>
<tr>
<td>25</td>
<td>POST fault</td>
<td>0x620C</td>
<td>Severe</td>
<td>0x81</td>
</tr>
<tr>
<td>26</td>
<td>Safety controller task scheduling</td>
<td>0x6114</td>
<td>Severe</td>
<td>0x81</td>
</tr>
<tr>
<td>27</td>
<td>Spool position cross validation fault</td>
<td>0x8006</td>
<td>Severe</td>
<td>0x81</td>
</tr>
<tr>
<td>28</td>
<td>Memory (RAM) corrupted</td>
<td>0x5511</td>
<td>Severe</td>
<td>0x81</td>
</tr>
<tr>
<td>29</td>
<td>Memory (EEPROM) invalid parameter</td>
<td>0x6322</td>
<td>Severe</td>
<td>0x81</td>
</tr>
<tr>
<td>30</td>
<td>Memory (Flash) corrupted</td>
<td>0x5521</td>
<td>Severe</td>
<td>0x81</td>
</tr>
<tr>
<td>31</td>
<td>SPI communication fault</td>
<td>0x5002</td>
<td>Critical</td>
<td>0x81</td>
</tr>
<tr>
<td>32</td>
<td>Fault overload</td>
<td>0xFF06</td>
<td>Severe</td>
<td>0x81</td>
</tr>
<tr>
<td>33</td>
<td>PWM calibration</td>
<td>0x6233</td>
<td>Severe</td>
<td>0x81</td>
</tr>
<tr>
<td>34</td>
<td>Memory (EEPROM) communication fault</td>
<td>0x5532</td>
<td>Severe</td>
<td>0x81</td>
</tr>
<tr>
<td>35</td>
<td>PSM operation fault</td>
<td>0x6209</td>
<td>Severe</td>
<td>0x81</td>
</tr>
<tr>
<td>36</td>
<td>Config sector CRC fault</td>
<td>0x5533</td>
<td>Severe</td>
<td>0x81</td>
</tr>
<tr>
<td>37</td>
<td>Diagnostic sector CRC fault</td>
<td>0x5536</td>
<td>Info</td>
<td>0x81</td>
</tr>
<tr>
<td>38</td>
<td>PSM buffer overload</td>
<td>0x620A</td>
<td>Severe</td>
<td>0x81</td>
</tr>
<tr>
<td>39</td>
<td>Average operating temp above limit</td>
<td>0x4227</td>
<td>Warning</td>
<td>0x09</td>
</tr>
<tr>
<td>40</td>
<td>Current temp above upper limit</td>
<td>Critical</td>
<td>0x4224</td>
<td>0x09</td>
</tr>
<tr>
<td>41</td>
<td>Current temp below lower limit</td>
<td>0x4225</td>
<td>Critical</td>
<td>0x09</td>
</tr>
<tr>
<td>42</td>
<td>Main spool cannot return to neutral</td>
<td>0x8310</td>
<td>Critical</td>
<td>0x81</td>
</tr>
<tr>
<td>43</td>
<td>Float not reached</td>
<td>0x8311</td>
<td>Critical</td>
<td>0x81</td>
</tr>
<tr>
<td>44</td>
<td>Main spool not in neutral at bootup</td>
<td>0x8307</td>
<td>Critical</td>
<td>0x81</td>
</tr>
<tr>
<td>45</td>
<td>Actual main spool position exceeds set point received</td>
<td>0x8312</td>
<td>Critical</td>
<td>0x81</td>
</tr>
<tr>
<td>46</td>
<td>Transducer signal frequency out of range</td>
<td>0x5237</td>
<td>Severe</td>
<td>0x21</td>
</tr>
<tr>
<td>47</td>
<td>SPI buffer overload</td>
<td>0x620F</td>
<td>Info</td>
<td>0x81</td>
</tr>
<tr>
<td>48</td>
<td>SPI communication fault</td>
<td>0x6210</td>
<td>Severe</td>
<td>0x81</td>
</tr>
<tr>
<td>49</td>
<td>Loss and recovery of CAN bus connection</td>
<td>0x8140</td>
<td>Warning</td>
<td>0x11</td>
</tr>
<tr>
<td>50</td>
<td>Flow command not received within timeout period</td>
<td>0x8003</td>
<td>Warning</td>
<td>0x91</td>
</tr>
<tr>
<td>51</td>
<td>Safety switch status fault</td>
<td>0x6212</td>
<td>Severe</td>
<td>0x81</td>
</tr>
</tbody>
</table>
Faults (continued)

<table>
<thead>
<tr>
<th>Fault ID</th>
<th>Fault</th>
<th>Description</th>
<th>EMCY code</th>
<th>Severity</th>
<th>Error register</th>
</tr>
</thead>
<tbody>
<tr>
<td>52</td>
<td>Float threshold setpoint not given</td>
<td>Setpoint less than float threshold given when commanded into float position</td>
<td>0x8313</td>
<td>Warning</td>
<td>0x81</td>
</tr>
<tr>
<td>53</td>
<td>Solenoid driver validation fault</td>
<td>Actuator component fault</td>
<td>0x6213</td>
<td>Critical</td>
<td>0x81</td>
</tr>
<tr>
<td>54</td>
<td>Stack usage &gt;90%</td>
<td>Actuator component fault</td>
<td>0x620D</td>
<td>Critical</td>
<td>0x81</td>
</tr>
<tr>
<td>55</td>
<td>CRC fault</td>
<td>The Operator has not approved the data change</td>
<td>0x5537</td>
<td>Severe</td>
<td>0x81</td>
</tr>
<tr>
<td>56</td>
<td>Invalid hardware version</td>
<td>Actuator component fault</td>
<td>0x5001</td>
<td>Severe</td>
<td>0x81</td>
</tr>
<tr>
<td>57</td>
<td>COMM: running number validation</td>
<td>The running number for communication between controller and actuator could not be validated</td>
<td>0x809</td>
<td>Critical</td>
<td>0x91</td>
</tr>
<tr>
<td>58</td>
<td>Corrupted data received by Inlet actuator</td>
<td>CRC or DLC data received from Inlet actuator is corrupted</td>
<td>0x8008</td>
<td>Critical</td>
<td>0x91</td>
</tr>
<tr>
<td>59</td>
<td>TPDO from Work Function actuator not received within timeout period</td>
<td>TPDO not received from Work Function actuators by Inlet actuator before timeout specified</td>
<td>Warning</td>
<td>0x8001</td>
<td>0x91</td>
</tr>
<tr>
<td>60</td>
<td>RPDO received invalid</td>
<td>RPDO input received by actuator is invalid</td>
<td>Warning</td>
<td>0x8211</td>
<td>0x11</td>
</tr>
<tr>
<td>61</td>
<td>RPDO not received within timeout period</td>
<td>RPDO not received by actuator before timeout specified</td>
<td>Warning</td>
<td>0x81FF</td>
<td>0x11</td>
</tr>
</tbody>
</table>

Diagnostic history

In addition to the diagnostic log, the PVED-CC Series 5 CANopen holds a record of the last 16 faults occurred. The faults are stored in a FIFO buffer.

Besides the fault code the history also contains more information on the behavior and state of the valve upon fault occurrence. The diagnostic history can be seen in the PLUS+1® Service Tool.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fault ID</td>
<td>ID number of the fault raised</td>
</tr>
<tr>
<td>Valve State</td>
<td>State of device upon fault occurrence</td>
</tr>
<tr>
<td>Current set point</td>
<td>Set point upon fault occurrence</td>
</tr>
<tr>
<td>Current spool position</td>
<td>Spool position upon fault occurrence</td>
</tr>
<tr>
<td>Battery voltage</td>
<td>Battery voltage upon fault occurrence</td>
</tr>
<tr>
<td>Operating time</td>
<td>Operating time upon fault occurrence</td>
</tr>
<tr>
<td>Setpoint and spool position history</td>
<td>Last 9 setpoint and spool positions prior to fault occurrence</td>
</tr>
<tr>
<td>Temperature</td>
<td>Temperature upon fault occurrence</td>
</tr>
</tbody>
</table>

* Operating time is logged every 6 minutes when the power to the PVED is ON
† Temperature is either received through PGN: VFT or onboard PCB temperature sensor

Temperature histogram

The PVED-CC Series 5 CANopen logs the temperature and time each 6 minutes. This temperature record is used to make a temperature histogram.

The temperature used is the one received in the PGN: Vehicle Fluid Temperature. If no PGN:VFT is received the PVED uses the onboard PCB temperature sensor.

The Temperature Histogram can be seen in the PLUS+1® Service Tool.
**Products we offer:**
- DCV directional control valves
- Electric converters
- Electric machines
- Electric motors
- Gear motors
- Gear pumps
- Hydrostatic motors
- Hydrostatic pumps
- Orbital motors
- PLUS+1® controllers
- 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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