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HEAT EXCHANGER APPLICATION

1. GENERAL

This application is aimed to be used in the Vacon liquid-cooled AC drive inside the Heat exchanger unit.

The idea with the application is to maintain a constant flow of coolant through the heat exchanger and through the Vacon liquid-cooled drive.

The user sets a certain speed for the pump of the heat exchanger unit that produces a sufficient flow through the Vacon liquid-cooled drives to keep them cooled. This speed is NOT regulated but fixed by a parameter set value.

The Vacon AC drive also handles the temperature of the water in the heat exchanger unit by regulating the valve that handles the coolant intake to the heat exchanger element (from the customer's system). This regulation is based on the temperature of the water in the pipes between the outlet of the heat exchanger pump and the inlet of the cooling element of the Vacon liquid-cooled drive.

The actual value of the temperature for the regulation comes from a sensor called FSA11. This is a type of flow switch that measures both the temperature of the coolant and the flow in the pipes. If there is not enough flow in the pipe the sensor gives a signal that tells the drive to stop due to insufficient flow.

Vacon NX AC drives can be connected to the Profibus DP using a fieldbus board. The AC drive can then be controlled, monitored and programmed from the Host system. Profibus fieldbus board (OPT-C5) is normally included in the delivery of Vacon NX liquid-cooled drive Heat Exchanger Solution. The Profibus fieldbus board must be installed in slot E on the control board of the AC drive. For more information on the Profibus fieldbus board, see Vacon OPTC3/C5 Profibus Option Board User Manual.

The standard delivery also includes I/O boards OPT-A1 (placed in slot A), OPT-A2 (placed in slot B) and OPT-B5 (placed in slot C or D). The application, however, offers you more signals than the standard set of I/O boards allows you to connect. If you wish to use one additional analogue input signal and/or two additional analogue output signals, we recommend you to order Vacon I/O board OPT-B4 and place it in the last free board slot (C or D).
## 2. CONTROL I/O

### OPT-A1

<table>
<thead>
<tr>
<th>Terminal</th>
<th>Signal</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>+10Vref</td>
<td>Reference output Voltage for potentiometer, etc.</td>
</tr>
<tr>
<td>2</td>
<td>AI1+</td>
<td>Analogue input, voltage range 0—10V DC Pressure, outlet (pump)</td>
</tr>
<tr>
<td>3</td>
<td>AI1-</td>
<td>I/O Ground Ground for reference and controls</td>
</tr>
<tr>
<td>4</td>
<td>AI2+</td>
<td>Analogue input, current range 0—20mA Temperature</td>
</tr>
<tr>
<td>5</td>
<td>AI2-</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>+24V</td>
<td>Control voltage output Voltage for switches, etc. max 0.1 A</td>
</tr>
<tr>
<td>7</td>
<td>GND</td>
<td>I/O ground Ground for reference and controls</td>
</tr>
<tr>
<td>8</td>
<td>DIN1</td>
<td>Start/Stop Control place A (PID controller) Contact closed = start</td>
</tr>
<tr>
<td>9</td>
<td>DIN2</td>
<td>Flow fault NO/NC programmable</td>
</tr>
<tr>
<td>10</td>
<td>DIN3</td>
<td>External fault (programmable) Contact open = External fault</td>
</tr>
<tr>
<td>11</td>
<td>CMA</td>
<td>Common for DIN 1—DIN 3 Connect to GND or +24V</td>
</tr>
<tr>
<td>12</td>
<td>+24V</td>
<td>Control voltage output Voltage for switches (see #6)</td>
</tr>
<tr>
<td>13</td>
<td>GND</td>
<td>I/O ground Ground for reference and controls</td>
</tr>
<tr>
<td>14</td>
<td>DIN4</td>
<td>PUMP 1 Forced or single run Combined with DIN1</td>
</tr>
<tr>
<td>15</td>
<td>DIN5</td>
<td>PUMP 2 Forced or single run Combined with DIN1</td>
</tr>
<tr>
<td>16</td>
<td>DIN6</td>
<td>Sequence, 2-pump system Combined with DIN1</td>
</tr>
<tr>
<td>17</td>
<td>CMB</td>
<td>Common for DIN4—DIN6 Connect to GND or +24V</td>
</tr>
<tr>
<td>18</td>
<td>AO1+</td>
<td>Output frequency Programmable Range 0—20 mA/R, max. 500Ω</td>
</tr>
<tr>
<td>19</td>
<td>AO1-</td>
<td>Digital output READY Programmable Open collector, Is≤50mA, Us≤48 VDC</td>
</tr>
<tr>
<td>20</td>
<td>DO1</td>
<td>Digital output READY Programmable</td>
</tr>
</tbody>
</table>

### OPT-A2

<table>
<thead>
<tr>
<th>Relay output 1</th>
<th>Programmable</th>
</tr>
</thead>
<tbody>
<tr>
<td>Relay output 2</td>
<td>Programmable</td>
</tr>
</tbody>
</table>

### OPT-B5

<table>
<thead>
<tr>
<th>Relay output 1</th>
<th>COOLING OK</th>
</tr>
</thead>
<tbody>
<tr>
<td>Relay output 2</td>
<td>PUMP 1</td>
</tr>
<tr>
<td>Relay output 3</td>
<td>PUMP 2</td>
</tr>
</tbody>
</table>

### Table 1. Heat exchanger application I/O configuration example (with 2-wire transmitter).

---

**Jumper block X3:**
**CAN grounding**

- Connected to shield
- Not connected to shield

**Jumper block X4:**
**CAN termination**

- Terminated
- Not terminated

Factory default

---

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3. PARAMETER LISTS

On the next pages you will find the lists of parameters within the respective parameter groups. The parameter descriptions are given on pages 21 to 52.

**Column explanations:**
- **Code**: Location indication on the keypad; Shows the operator the present param. number
- **Parameter**: Name of parameter
- **Min**: Minimum value of parameter
- **Max**: Maximum value of parameter
- **Unit**: Unit of parameter value; Given if available
- **Default**: Value preset by factory
- **Cust**: Customer’s own setting
- **ID**: ID number of the parameter
- **=** In parameter row: Use TTF method to program these parameters.
- **=** On parameter code: Parameter value can only be changed after the FC has been stopped.

### 3.1 Monitoring values (Control keypad: menu M1)

The monitoring values are the actual values of parameters and signals as well as statuses and measurements. Monitoring values cannot be edited.

See the product’s user manual for more information.

<table>
<thead>
<tr>
<th>Code</th>
<th>Parameter</th>
<th>Unit</th>
<th>ID</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>V1.1</td>
<td>Output frequency</td>
<td>Hz</td>
<td>1</td>
<td>Output frequency to motor</td>
</tr>
<tr>
<td>V1.2</td>
<td>Frequency reference</td>
<td>Hz</td>
<td>25</td>
<td>Frequency reference to motor control</td>
</tr>
<tr>
<td>V1.3</td>
<td>Motor speed</td>
<td>rpm</td>
<td>2</td>
<td>Motor speed in rpm</td>
</tr>
<tr>
<td>V1.4</td>
<td>Motor current</td>
<td>A</td>
<td>3</td>
<td>Calculated shaft torque</td>
</tr>
<tr>
<td>V1.5</td>
<td>Motor torque</td>
<td>%</td>
<td>4</td>
<td>Shaft torque</td>
</tr>
<tr>
<td>V1.6</td>
<td>Motor power</td>
<td>%</td>
<td>5</td>
<td>Motor power</td>
</tr>
<tr>
<td>V1.7</td>
<td>Motor voltage</td>
<td>V</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>V1.8</td>
<td>DC link voltage</td>
<td>V</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>V1.9</td>
<td>Unit temperature</td>
<td>°C</td>
<td>8</td>
<td>Heatsink temperature</td>
</tr>
<tr>
<td>V1.10</td>
<td>Analogue input 1</td>
<td>V</td>
<td>13</td>
<td>AI1</td>
</tr>
<tr>
<td>V1.11</td>
<td>Analogue input 2</td>
<td>mA</td>
<td>14</td>
<td>AI2</td>
</tr>
<tr>
<td>V1.12</td>
<td>Analogue input 3</td>
<td></td>
<td></td>
<td>AI3</td>
</tr>
<tr>
<td>V1.13</td>
<td>Analog Output1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>V1.14</td>
<td>DIN1, DIN2, DIN3</td>
<td></td>
<td></td>
<td>Digital input statuses</td>
</tr>
<tr>
<td>V1.15</td>
<td>DIN4, DIN5, DIN6</td>
<td></td>
<td></td>
<td>Digital input statuses</td>
</tr>
<tr>
<td>V1.16</td>
<td>R01, R02, R03</td>
<td></td>
<td></td>
<td>Relay output statuses</td>
</tr>
<tr>
<td>V1.17</td>
<td>R04, R05, R06</td>
<td></td>
<td></td>
<td>Relay output statuses</td>
</tr>
<tr>
<td>V1.18</td>
<td>Temp reference</td>
<td>°C</td>
<td>1500</td>
<td></td>
</tr>
<tr>
<td>V1.19</td>
<td>Actual temperature</td>
<td>°C</td>
<td>1501</td>
<td></td>
</tr>
<tr>
<td>V1.20</td>
<td>Temp error value</td>
<td>°C</td>
<td>1502</td>
<td></td>
</tr>
<tr>
<td>V1.21</td>
<td>PID output</td>
<td>%</td>
<td>23</td>
<td>In % of the max. output value</td>
</tr>
<tr>
<td>V1.22</td>
<td>Inlet pressure</td>
<td>bar</td>
<td>1511</td>
<td>PT11</td>
</tr>
</tbody>
</table>

*Table 2. Monitoring values*
### 3.1.1 FB Monitor

<table>
<thead>
<tr>
<th>Code</th>
<th>Parameter</th>
<th>Unit</th>
<th>ID</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>V1.23.1</td>
<td>Motor Current</td>
<td>A</td>
<td>45</td>
<td>Motor current with one decimal</td>
</tr>
<tr>
<td>V1.23.2</td>
<td>Fault History</td>
<td></td>
<td>37</td>
<td>Last active fault code</td>
</tr>
<tr>
<td>V1.23.3</td>
<td>Status Word</td>
<td></td>
<td>43</td>
<td>Application status word</td>
</tr>
<tr>
<td>V1.23.4</td>
<td>Status Word 2</td>
<td></td>
<td>1800</td>
<td>Application status word 2</td>
</tr>
<tr>
<td>V1.23.5</td>
<td>Fault Word 1</td>
<td></td>
<td>1172</td>
<td>General fault word 1</td>
</tr>
<tr>
<td>V1.23.6</td>
<td>Fault Word 2</td>
<td></td>
<td>1173</td>
<td>General fault word</td>
</tr>
<tr>
<td>V1.23.7</td>
<td>Warning Word 1</td>
<td></td>
<td>1174</td>
<td>General warning word</td>
</tr>
<tr>
<td>V1.23.8</td>
<td>Fault Word 10</td>
<td></td>
<td>1202</td>
<td>Heat exchanger specific faults</td>
</tr>
<tr>
<td>V1.23.9</td>
<td>Warning Word 10</td>
<td></td>
<td>1269</td>
<td>Heat exchanger specific warnings</td>
</tr>
</tbody>
</table>

*Table 3. Monitoring values (G1.24 FB Monitor)*

#### 3.1.1.1 Status Word, ID43

<table>
<thead>
<tr>
<th>Description</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>b0</td>
<td></td>
</tr>
<tr>
<td>b1</td>
<td>Ready</td>
</tr>
<tr>
<td>b2</td>
<td>Run</td>
</tr>
<tr>
<td>b3</td>
<td>Fault</td>
</tr>
<tr>
<td>b4</td>
<td></td>
</tr>
<tr>
<td>b5</td>
<td></td>
</tr>
<tr>
<td>b6</td>
<td>Run enable</td>
</tr>
<tr>
<td>b7</td>
<td>Warning</td>
</tr>
<tr>
<td>b8</td>
<td></td>
</tr>
<tr>
<td>b9</td>
<td></td>
</tr>
<tr>
<td>b10</td>
<td>RO4 status</td>
</tr>
<tr>
<td>b11</td>
<td>RO5 status</td>
</tr>
<tr>
<td>b12</td>
<td>Run request</td>
</tr>
<tr>
<td>b13</td>
<td>Motor regulator active</td>
</tr>
<tr>
<td>b14</td>
<td></td>
</tr>
<tr>
<td>b15</td>
<td>Cooling OK</td>
</tr>
</tbody>
</table>

*Table 4. Status Word*

#### 3.1.1.2 Status Word 2, ID1800

Give this status word to Vacon personnel in case of problems with running the application.
3.1.1.3 Fault Word 1, ID1172

<table>
<thead>
<tr>
<th>Description</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>b0 Over current</td>
<td>F1</td>
</tr>
<tr>
<td>b1 Over voltage</td>
<td>F2</td>
</tr>
<tr>
<td>b2 Under voltage</td>
<td>F9</td>
</tr>
<tr>
<td>b3 Motor stalled</td>
<td>F15</td>
</tr>
<tr>
<td>b4 Motor underload</td>
<td>F17</td>
</tr>
<tr>
<td>b6 Unit over temperature</td>
<td></td>
</tr>
<tr>
<td>b7 Motor over temperature</td>
<td>F16</td>
</tr>
<tr>
<td>b8 Input phase</td>
<td>F10</td>
</tr>
<tr>
<td>b9</td>
<td></td>
</tr>
<tr>
<td>b10</td>
<td></td>
</tr>
<tr>
<td>b11 Keypad or PC communication</td>
<td>F52</td>
</tr>
<tr>
<td>b12 Fieldbus communication</td>
<td>F53</td>
</tr>
<tr>
<td>b13</td>
<td></td>
</tr>
<tr>
<td>b14 Slot communication</td>
<td>F54</td>
</tr>
<tr>
<td>b15 4 mA</td>
<td>F50</td>
</tr>
</tbody>
</table>

Table 5. Fault Word 1

3.1.1.4 Fault Word 2, ID1173

<table>
<thead>
<tr>
<th>Description</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>b0 Output phase</td>
<td>F11</td>
</tr>
<tr>
<td>b6 External fault</td>
<td>F51 (fault or warning)</td>
</tr>
<tr>
<td>b9 IGBT</td>
<td>F41</td>
</tr>
</tbody>
</table>

Table 6. Fault Word 2

3.1.1.5 Warning Word 1, ID1174

<table>
<thead>
<tr>
<th>Description</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>b0 Motor stalled</td>
<td>F15</td>
</tr>
<tr>
<td>b1 Motor over temperature</td>
<td>F16, F29 (fault or warn)</td>
</tr>
<tr>
<td>b2 Motor underload</td>
<td>F17</td>
</tr>
<tr>
<td>b3 Input phase</td>
<td>F10</td>
</tr>
<tr>
<td>b4 Output phase</td>
<td>F11</td>
</tr>
<tr>
<td>b8 Unit temperature</td>
<td></td>
</tr>
<tr>
<td>b9 4 mA</td>
<td>F50</td>
</tr>
<tr>
<td>b15 Keypad communication</td>
<td>F52</td>
</tr>
</tbody>
</table>

Table 7. Warning Word 1
### 3.1.1.6 Fault Word 10, ID1202

<table>
<thead>
<tr>
<th>Description</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>b0</td>
<td></td>
</tr>
<tr>
<td>b1</td>
<td></td>
</tr>
<tr>
<td>b2</td>
<td></td>
</tr>
<tr>
<td>b3</td>
<td></td>
</tr>
<tr>
<td>b4</td>
<td></td>
</tr>
<tr>
<td>b5</td>
<td>Over temperature</td>
</tr>
<tr>
<td>b6</td>
<td></td>
</tr>
<tr>
<td>b7</td>
<td>Inlet pressure low</td>
</tr>
<tr>
<td>b8</td>
<td>Flow</td>
</tr>
</tbody>
</table>

*Table 8. Fault Word 10*

### 3.1.1.7 Warning Word 10, ID1269

<table>
<thead>
<tr>
<th>Description</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>b0</td>
<td></td>
</tr>
<tr>
<td>b1</td>
<td></td>
</tr>
<tr>
<td>b2</td>
<td></td>
</tr>
<tr>
<td>b3</td>
<td>Inlet pressure low</td>
</tr>
<tr>
<td>b4</td>
<td>Over temperature</td>
</tr>
<tr>
<td>b5</td>
<td>Low temperature</td>
</tr>
<tr>
<td>b6</td>
<td></td>
</tr>
</tbody>
</table>

*Table 9. Warning Word 10*
### 3.2 Basic parameters (Control keypad: Menu M2 → G2.1)

<table>
<thead>
<tr>
<th>Code</th>
<th>Parameter</th>
<th>Min</th>
<th>Max</th>
<th>Unit</th>
<th>Default</th>
<th>Cust</th>
<th>ID</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>P2.1.1</td>
<td>Min Frequency</td>
<td>0.00</td>
<td>Par. 2.1.2 Hz</td>
<td>Hz</td>
<td>25.00</td>
<td>Cust</td>
<td>101</td>
<td>Note: If f_{max} &gt; the motor synchronous speed, check suitability for motor and drive system</td>
</tr>
<tr>
<td>P2.1.2</td>
<td>Max Frequency</td>
<td>Par. 2.1.1</td>
<td>320.00 Hz</td>
<td>Hz</td>
<td>50.00</td>
<td>Cust</td>
<td>102</td>
<td></td>
</tr>
<tr>
<td>P2.1.3</td>
<td>Acceleration time 1</td>
<td>0.1</td>
<td>3000.0 s</td>
<td>s</td>
<td>1.0</td>
<td>Cust</td>
<td>103</td>
<td>Note: If PID-controller is used, Acceleration time 2 (par. 2.4.3) is automatically applied</td>
</tr>
<tr>
<td>P2.1.4</td>
<td>Deceleration time 1</td>
<td>0.1</td>
<td>3000.0 s</td>
<td>s</td>
<td>1.0</td>
<td>Cust</td>
<td>104</td>
<td>Note: If PID-controller is used, Deceleration time 2 (par. 2.4.4) is automatically applied</td>
</tr>
<tr>
<td>P2.1.5</td>
<td>Current limit</td>
<td>0</td>
<td>2 x I_{n} A</td>
<td></td>
<td>I_{L}</td>
<td>Cust</td>
<td>107</td>
<td></td>
</tr>
<tr>
<td>P2.1.6</td>
<td>Nominal voltage of the motor</td>
<td>180</td>
<td>690 V</td>
<td>V</td>
<td>400V</td>
<td>Cust</td>
<td>110</td>
<td></td>
</tr>
<tr>
<td>P2.1.7</td>
<td>Nominal frequency of the motor</td>
<td>30.00</td>
<td>320.00 Hz</td>
<td>Hz</td>
<td>50.00</td>
<td>Cust</td>
<td>111</td>
<td>Note: If PID-controller is used, Acceleration time 2 (par. 2.4.3) is automatically applied</td>
</tr>
<tr>
<td>P2.1.8</td>
<td>Nominal speed of the motor</td>
<td>300</td>
<td>20 000 rpm</td>
<td>rpm</td>
<td>1440</td>
<td>Cust</td>
<td>112</td>
<td>The default applies for a 4-pole motor and a nominal size AC drive.</td>
</tr>
<tr>
<td>P2.1.9</td>
<td>Nominal current of the motor</td>
<td>0.4 x I_{n}</td>
<td>2 x I_{n} A</td>
<td>A</td>
<td>I_{n}</td>
<td>Cust</td>
<td>113</td>
<td>Check the rating plate of the motor.</td>
</tr>
<tr>
<td>P2.1.10</td>
<td>Motor cosϕ</td>
<td>0.30</td>
<td>1.00</td>
<td>0</td>
<td>0.85</td>
<td>Cust</td>
<td>120</td>
<td>Check the rating plate of the motor.</td>
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<tr>
<td>P2.1.11</td>
<td>Start function</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>Cust</td>
<td>105</td>
<td>0=Ramp 1=Flying start</td>
</tr>
<tr>
<td>P2.1.12</td>
<td>Stop function</td>
<td>0</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>Cust</td>
<td>106</td>
<td>0=Coasting 1=Ramp 2=Ramp+Run enable coast 3=Coast+Run enable ramp</td>
</tr>
<tr>
<td>P2.1.13</td>
<td>U/f optimization</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>Cust</td>
<td>109</td>
<td>0=Not used 1=Automatic torque boost</td>
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<td>I/O reference</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>Cust</td>
<td>117</td>
<td>0=Keypad reference 1=Fieldbus reference</td>
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<td>Preset speed 1</td>
<td>0.00</td>
<td>Par. 2.1.2 Hz</td>
<td>Hz</td>
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<td>0</td>
<td>0</td>
<td>Cust</td>
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<td>0=Not used 1=Automatic restart</td>
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<td>1</td>
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<td>Cust</td>
<td>115</td>
<td>0=All parameters visible 1=Basic group (G2.1) visible</td>
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*Table 10. Basic parameters G2.1*
# 3.3 Input signals (Control keypad: Menu M2 → G2.2)

<table>
<thead>
<tr>
<th>Code</th>
<th>Parameter</th>
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<th>Unit</th>
<th>Default</th>
<th>Cust</th>
<th>ID</th>
<th>Note</th>
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<td>0</td>
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<td>1</td>
<td>1</td>
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<td>1590</td>
<td>0=Normally open 1=Normally closed</td>
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<td>P2.2.2</td>
<td>DIN3 function</td>
<td>0</td>
<td>10</td>
<td>3</td>
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<td>301</td>
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<td>DIN6 Function</td>
<td>0</td>
<td>1</td>
<td>0</td>
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<td></td>
<td>1572</td>
<td>0=Preset Speed 1 1=Fault Reset</td>
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<td>0</td>
<td>3</td>
<td>1</td>
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<td></td>
<td>379</td>
<td>0=Signal range 0-20mA 1=Signal range 4-20mA 2=0-10V 3=2-10V</td>
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<td>%</td>
<td>0.00</td>
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<td>%</td>
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<td>10.00</td>
<td>s</td>
<td>1.00</td>
<td>378</td>
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<td></td>
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<td>0=Signal range 0-20mA 1=Signal range 4-20mA</td>
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<td>0.00</td>
<td>%</td>
<td>0.00</td>
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<td>100.00</td>
<td>%</td>
<td>100.00</td>
<td>392</td>
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<td>0</td>
<td></td>
<td></td>
<td>398</td>
<td>0=Not inverted 1=Inverted</td>
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<td>10.00</td>
<td>s</td>
<td>1.00</td>
<td>389</td>
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<td>TTF programming method</td>
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<td>P2.2.17</td>
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<td>100.00</td>
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<td>1529</td>
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<td>s</td>
<td>1.00</td>
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<td>0</td>
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<td>122</td>
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<td>Fieldbus frequency reference selection: 0=Reference from Keypad 1=FB reference</td>
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</tr>
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</table>

*Remember to place jumpers of block X2 accordingly. See the product’s user manual.*

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### 3.4 Output signals (Control keypad: Menu M2 → G2.3)

#### 3.4.1 Analogue output 1

<table>
<thead>
<tr>
<th>Code</th>
<th>Parameter</th>
<th>Min</th>
<th>Max</th>
<th>Unit</th>
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<th>Cust</th>
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<th>Note</th>
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<td></td>
<td>function</td>
<td>0</td>
<td>13</td>
<td>13</td>
<td></td>
<td></td>
<td></td>
<td>0=Not used</td>
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<tr>
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<td></td>
<td></td>
<td></td>
<td>1=Output freq. [0—f(_{\text{max}})]</td>
</tr>
<tr>
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<td>2=Freq. reference [0—f(_{\text{max}})]</td>
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<td></td>
<td></td>
<td></td>
<td>3=Motor speed [0—Motor nominal speed]</td>
</tr>
<tr>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>4=Motor current [0—i(_{\text{Motor}})]</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>5=Motor torque [0—T(_{\text{Motor}})]</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>6=Motor power [0—P(_{\text{Motor}})]</td>
</tr>
<tr>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>7=Motor voltage [0—U(_{\text{Motor}})]</td>
</tr>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>8=DC-link volt [0—1000V]</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td>9=PI controller temp ref</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>10=PI contr. act. temp.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>11=PI contr. temperature error value</td>
</tr>
<tr>
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<td></td>
<td></td>
<td></td>
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<td>12=PI controller output</td>
</tr>
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<td></td>
<td></td>
<td></td>
<td>13=Pressure from PT11, pump inlet</td>
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</table>

**Table 12. Analogue output 1 signals**

#### 3.4.2 Analogue output 2

<table>
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<tr>
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<th>Parameter</th>
<th>Min</th>
<th>Max</th>
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<th>Note</th>
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<td>function</td>
<td>0</td>
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<td>10</td>
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<td></td>
<td></td>
<td>0=Not used</td>
</tr>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>1=Output freq. [0—f(_{\text{max}})]</td>
</tr>
<tr>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2=Freq. reference [0—f(_{\text{max}})]</td>
</tr>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3=Motor speed [0—Motor nominal speed]</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>4=Motor current [0—i(_{\text{Motor}})]</td>
</tr>
<tr>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
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<td>5=Motor torque [0—T(_{\text{Motor}})]</td>
</tr>
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<td></td>
<td>6=Motor power [0—P(_{\text{Motor}})]</td>
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<td>7=Motor voltage [0—U(_{\text{Motor}})]</td>
</tr>
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<td></td>
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<td>8=DC-link volt [0—1000V]</td>
</tr>
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<td>9=PID controller ref. value</td>
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<td>10=PI contr. act. temp.</td>
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<td>11=PI contr. temperature error value</td>
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<td>12=PI controller output</td>
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<td>13=Pressure from PT11, pump inlet</td>
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**Table 13. Analogue output 2 signals**
### 3.4.3 Analogue output 3

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<td>2=Freq. reference (0-f_{\text{max}})</td>
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<td>3=Motor speed (0-\text{Motor nominal speed})</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>4=Motor current (0-\text{Motor})</td>
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<td>5=Motor torque (0-\text{TnMotor})</td>
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<td>6=Motor power (0-\text{PnMotor})</td>
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<td>7=Motor voltage (0-\text{U}_{\text{Motor}})</td>
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<td>8=DC-link volt (0-1000V)</td>
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<td></td>
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<td>9=PID controller ref. value</td>
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<td>10=PI contr. act. temp</td>
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<td>12=PID controller output</td>
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<td>13=Pressure from PT11, pump inlet</td>
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<td>10.00</td>
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<td>1.00</td>
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<td>0=No filtering</td>
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<td>0=Not inverted 1=Inverted</td>
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<td>P2.3.3.4</td>
<td>Analogue output 3 minimum</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>1538</td>
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<td></td>
<td>0=0 mA 1=4 mA</td>
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<td>P2.3.3.5</td>
<td>Analogue output 3 scale</td>
<td>10</td>
<td>1000</td>
<td>%</td>
<td>100</td>
<td>1539</td>
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</table>

Table 14. Analogue output 3 signals

### 3.4.4 Relay output 1

<table>
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<tr>
<th>Code</th>
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<th>Max</th>
<th>Unit</th>
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<th>Cust</th>
<th>ID</th>
<th>Note</th>
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<tbody>
<tr>
<td>P2.3.4.1</td>
<td>Relay output 1 signal selection</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0=Not used 1=Ready</td>
</tr>
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<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
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<td>2=Run</td>
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<td>3=Fault</td>
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<td></td>
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<td></td>
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<td>4=Fault inverted</td>
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<td></td>
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<td></td>
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<td></td>
<td></td>
<td></td>
<td>5=FC overheat warning</td>
</tr>
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<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>6=Ext. fault or warning</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td>7=Ref. fault or warning</td>
</tr>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>8=Warning</td>
</tr>
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<td></td>
<td></td>
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<td></td>
<td></td>
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<td>9=Reversed</td>
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<td>10=Preset speed 1</td>
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<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>11=At speed</td>
</tr>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>12=Mot. regulator active</td>
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<td></td>
<td></td>
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<td>13=OP freq. limit superv.1</td>
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<td></td>
<td></td>
<td></td>
<td>14=Control place: IO</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>15=Thermistor fault/warn.</td>
</tr>
<tr>
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<td></td>
<td></td>
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<td>16=Actual value supervision</td>
</tr>
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<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>17=Cooling OK</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>18=Alarm latched</td>
</tr>
<tr>
<td>P2.3.4.2</td>
<td>Relay output 1 function</td>
<td>0</td>
<td>18</td>
<td>2</td>
<td>313</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>P2.3.4.3</td>
<td>Relay output 1 inversion</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>1540</td>
<td></td>
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<td>0=Not inverted 1=Inverted</td>
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Table 15. Relay output 1 signals
### 3.4.5 Relay output 2

<table>
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<tr>
<th>Code</th>
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<th>Unit</th>
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<th>Cust</th>
<th>ID</th>
<th>Note</th>
</tr>
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<tbody>
<tr>
<td>P2.3.5.1</td>
<td>Relay output 2 signal selection</td>
<td></td>
<td></td>
<td>B.2</td>
<td></td>
<td></td>
<td>1550</td>
<td>0=Not used, 1=Ready, 2=Run, 3=Fault, 4=Fault inverted, 5=FC overhear warning, 6=Ext. fault or warning, 7=Ref. fault or warning, 8=Warning, 9=Reversed, 10=Preset speed 1, 11=At speed, 12=Mot. regulator active, 13=OP freq. limit superv.1, 14=Control place: IO, 15=Thermistor fault/warn., 16=Actual value supervision, 17=Cooling OK, 18=Alarm latched</td>
</tr>
<tr>
<td></td>
<td>Relay output 2 function</td>
<td>0</td>
<td>18</td>
<td>3</td>
<td></td>
<td></td>
<td>1513</td>
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<tr>
<td>P2.3.5.3</td>
<td>Relay output 2 inversion</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td></td>
<td></td>
<td>1541</td>
<td>0=Not inverted, 1=Inverted</td>
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</table>

*Table 16. Relay output 2 signals*

### 3.4.6 Relay output 3

<table>
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<th>Code</th>
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<th>Min</th>
<th>Max</th>
<th>Unit</th>
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<th>Cust</th>
<th>ID</th>
<th>Note</th>
</tr>
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<tbody>
<tr>
<td>P2.3.6.1</td>
<td>Relay output 3 signal selection</td>
<td></td>
<td></td>
<td>D.1</td>
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<td></td>
<td>1551</td>
<td>0=Not used, 1=Cooling OK</td>
</tr>
<tr>
<td></td>
<td>Relay output 3 function</td>
<td>0</td>
<td>3</td>
<td>1</td>
<td></td>
<td></td>
<td>1515</td>
<td>0=Not used, 1=Cooling OK, 2=Pump 1, 3=Pump 2</td>
</tr>
<tr>
<td>P2.3.6.3</td>
<td>Relay output 3 inversion</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td></td>
<td></td>
<td>1542</td>
<td>0=Not inverted, 1=Inverted</td>
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*Table 17. Relay output 3 signals*

### 3.4.7 Relay output 4

<table>
<thead>
<tr>
<th>Code</th>
<th>Parameter</th>
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<th>Cust</th>
<th>ID</th>
<th>Note</th>
</tr>
</thead>
<tbody>
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<td>P2.3.7.1</td>
<td>Relay output 4 signal selection</td>
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<td></td>
<td>D.2</td>
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<td></td>
<td>1552</td>
<td>0=Not used, 1=Cooling OK</td>
</tr>
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<td>Relay output 4 function</td>
<td>0</td>
<td>3</td>
<td>2</td>
<td></td>
<td></td>
<td>1553</td>
<td>0=Not used, 1=Cooling OK, 2=Pump 1, 3=Pump 2</td>
</tr>
<tr>
<td>P2.3.7.3</td>
<td>Relay output 4 inversion</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td></td>
<td></td>
<td>1554</td>
<td>0=Not inverted, 1=Inverted</td>
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*Table 18. Relay output 4 signals*
### 3.4.8 Relay output 5

<table>
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<th>Cust</th>
<th>ID</th>
<th>Note</th>
</tr>
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<tr>
<td>P2.3.8.1</td>
<td>Relay output 5 signal selection</td>
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<td>D.3</td>
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<td>Relay output 5 function</td>
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<td></td>
<td>1556</td>
<td>0=Not used</td>
</tr>
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<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>1=Cooling OK</td>
</tr>
<tr>
<td></td>
<td></td>
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<td></td>
<td></td>
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<td>2=Pump 1</td>
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<tr>
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<td></td>
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<td></td>
<td></td>
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<td>3=Pump 2</td>
</tr>
<tr>
<td>P2.3.8.3</td>
<td>Relay output 5 inversion</td>
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<td>1</td>
<td></td>
<td>0</td>
<td></td>
<td>1557</td>
<td>0=Not inverted</td>
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<td></td>
<td></td>
<td>1=Inverted</td>
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*Table 19. Relay output 5 signals*

### 3.4.9 Relay output 6

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<th>Note</th>
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<td>Relay output 6 function</td>
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<td>1567</td>
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<td></td>
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<td>1=Ready</td>
</tr>
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<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
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<td>2=Run</td>
</tr>
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<td></td>
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<td></td>
<td></td>
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<td>3=Fault</td>
</tr>
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<td>4=Fault inverted</td>
</tr>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>5=FC overheat warning</td>
</tr>
<tr>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>6=Ext. fault or warning</td>
</tr>
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<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
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<td>7=Ref. fault or warning</td>
</tr>
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<td>8=Warning</td>
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<td></td>
<td></td>
<td></td>
<td>9=Reversed</td>
</tr>
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<td>10=Preset speed 1</td>
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<td></td>
<td></td>
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<td>11=At speed</td>
</tr>
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<td></td>
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<td>12=Mot. regulator active</td>
</tr>
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<td></td>
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<td>13=OP freq. limit superv.1</td>
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<td></td>
<td></td>
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<td>14=Control place: IO</td>
</tr>
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<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>15=Thermistor fault/warn.</td>
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<td></td>
<td></td>
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<td>16=Actual value supervision</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>17=Cooling OK</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>18=Alarm latched</td>
</tr>
<tr>
<td>P2.3.9.3</td>
<td>Relay output 6 inversion</td>
<td>0</td>
<td>1</td>
<td></td>
<td>0</td>
<td></td>
<td>1568</td>
<td>0=Not inverted</td>
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<td></td>
<td></td>
<td></td>
<td>1=Inverted</td>
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</table>

*Table 20. Relay output 6 signals*
3.5 Drive control parameters (Control keypad: Menu M2 \(\rightarrow\) G2.4)

<table>
<thead>
<tr>
<th>Code</th>
<th>Parameter</th>
<th>Min</th>
<th>Max</th>
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<th>Default</th>
<th>Cust</th>
<th>ID</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>P2.4.1</td>
<td>Ramp shape</td>
<td>0.0</td>
<td>10.0</td>
<td>s</td>
<td>0.0</td>
<td></td>
<td>500</td>
<td>0=Linear (\rightarrow) 5=S-curve ramp time</td>
</tr>
<tr>
<td>P2.4.2</td>
<td>Brake chopper</td>
<td>0</td>
<td>3</td>
<td></td>
<td>0</td>
<td></td>
<td>504</td>
<td>0=Disabled 1=Used when running 2=External brake chopper 3=Used when stopped/running</td>
</tr>
<tr>
<td>P2.4.3</td>
<td>DC braking current</td>
<td>0.4xI(_i)</td>
<td>2xI(_i)</td>
<td>A</td>
<td>I(_i)</td>
<td></td>
<td>507</td>
<td></td>
</tr>
<tr>
<td>P2.4.4</td>
<td>DC braking time at stop</td>
<td>0.00</td>
<td>600.00</td>
<td>s</td>
<td>0.00</td>
<td></td>
<td>508</td>
<td>0=DC brake is off at stop</td>
</tr>
<tr>
<td>P2.4.5</td>
<td>Frequency to start DC braking during ramp stop</td>
<td>0.10</td>
<td>10.00</td>
<td>Hz</td>
<td>1.50</td>
<td></td>
<td>515</td>
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<tr>
<td>P2.4.6</td>
<td>DC braking time at start</td>
<td>0.00</td>
<td>600.00</td>
<td>s</td>
<td>0.00</td>
<td></td>
<td>516</td>
<td>0=DC brake is off at start</td>
</tr>
<tr>
<td>P2.4.7</td>
<td>Flux brake</td>
<td>0</td>
<td>1</td>
<td></td>
<td>0</td>
<td></td>
<td>520</td>
<td>0=Off 1=On</td>
</tr>
<tr>
<td>P2.4.8</td>
<td>Flux braking current</td>
<td>0.4xI(_i)</td>
<td>2xI(_i)</td>
<td>A</td>
<td>I(_i)</td>
<td></td>
<td>519</td>
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</tbody>
</table>

*Table 21. Drive control parameters, G2.4*

3.6 Prohibit frequency parameters (Control keypad: Menu M2 \(\rightarrow\) G2.5)

<table>
<thead>
<tr>
<th>Code</th>
<th>Parameter</th>
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<th>Max</th>
<th>Unit</th>
<th>Default</th>
<th>Cust</th>
<th>ID</th>
<th>Note</th>
</tr>
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<tbody>
<tr>
<td>P2.5.1</td>
<td>Prohibit frequency range 1 low limit</td>
<td>0.00</td>
<td>Par. 2.5.2</td>
<td>Hz</td>
<td>0.00</td>
<td></td>
<td>509</td>
<td>0=Not used</td>
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<tr>
<td>P2.5.2</td>
<td>Prohibit frequency range 1 high limit</td>
<td>0.00</td>
<td>Par. 2.1.2</td>
<td>Hz</td>
<td>0.00</td>
<td></td>
<td>510</td>
<td>0=Not used</td>
</tr>
<tr>
<td>P2.5.3</td>
<td>Prohibit acc./dec. ramp</td>
<td>0.1</td>
<td>10.0</td>
<td>Times</td>
<td>1.0</td>
<td></td>
<td>518</td>
<td></td>
</tr>
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<td>P2.5.4</td>
<td>Output frequency limit 1 supervision</td>
<td>0</td>
<td>2</td>
<td></td>
<td>0</td>
<td></td>
<td>315</td>
<td>0=No limit 1=Low limit supervision 2=High limit supervision</td>
</tr>
<tr>
<td>P2.5.5</td>
<td>Output frequency limit 1; Supervised value</td>
<td>0.00</td>
<td>Par. 2.1.2</td>
<td>Hz</td>
<td>0.00</td>
<td></td>
<td>316</td>
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</tr>
</tbody>
</table>

*Table 22. Prohibit frequency parameters, G2.5*
### 3.7 Motor control parameters (Control keypad: Menu M2 → G2.6)

<table>
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<tr>
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<th>Parameter</th>
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<th>Max</th>
<th>Unit</th>
<th>Default</th>
<th>Cust</th>
<th>ID</th>
<th>Note</th>
</tr>
</thead>
</table>
| P2.6.1 | Motor control mode                 | 0   | 1   |      | 0       | 600  |     | 0=Frequency control  
1=Speed control                                                   |
| P2.6.2 | U/f ratio selection                | 0   | 3   |      | 0       | 108  |     | 0=Linear  
1=Squared  
2=Programmable  
3=Linear with flux optim.                                          |
| P2.6.3 | Field weakening point              | 8.00| 320.00| Hz   | 50.00   | 602  |     |                                                                       |
| P2.6.4 | Voltage at field weakening point   | 10.00| 200.00| %    | 100.00  | 603  |     | n% x U_{nmot}                                                        |
| P2.6.5 | U/f curve midpoint frequency       | 0.00| par. P2.6.4| Hz | 50.00   | 604  |     |                                                                       |
| P2.6.6 | U/f curve midpoint voltage         | 0.00| 100.00| %    | 100.00  | 605  |     | n% x U_{nmot} Parameter max. value = par. 2.6.5                    |
| P2.6.7 | Output voltage at zero frequency  | 0.00| 40.00| %    | Varies  | 606  |     | n% x U_{nmot}                                                        |
| P2.6.8 | Switching frequency               | 1.0 | Varies| kHz  | Varies  | 601  |     | See Table 31 for exact values                                      |
| P2.6.9 | Overvoltage controller             | 0   | 1   |      | 1       | 607  |     | 0=Not used  
1=Used (no ramping)                                                 |
| P2.6.10| Undervoltage controller            | 0   | 1   |      | 1       | 608  |     | 0=Not used  
1=Used                                                              |

*Table 23. Motor control parameters, G2.6*
### 3.8 Protections (Control keypad: Menu M2 → G2.7)

<table>
<thead>
<tr>
<th>Code</th>
<th>Parameter</th>
<th>Min</th>
<th>Max</th>
<th>Unit</th>
<th>Default</th>
<th>Cust</th>
<th>ID</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>P2.7.1</td>
<td>Response to 4mA reference fault</td>
<td>0</td>
<td>3</td>
<td></td>
<td>1</td>
<td></td>
<td>700</td>
<td>0=No response 1=Warning 2=Fault,stop acc. to 2.1.12 3=Fault,stop by coasting</td>
</tr>
<tr>
<td>P2.7.2</td>
<td>Response to external fault</td>
<td>0</td>
<td>3</td>
<td></td>
<td>1</td>
<td></td>
<td>701</td>
<td>See par. ID700</td>
</tr>
<tr>
<td>P2.7.3</td>
<td>Input phase supervision</td>
<td>0</td>
<td>3</td>
<td></td>
<td>0</td>
<td></td>
<td>730</td>
<td>See par. ID700</td>
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<td>P2.7.4</td>
<td>Response to undervoltage fault</td>
<td>1</td>
<td>3</td>
<td></td>
<td>2</td>
<td></td>
<td>727</td>
<td>1=Warning 2=Fault,stop acc. to 2.1.12 3=Fault,stop by coasting</td>
</tr>
<tr>
<td>P2.7.5</td>
<td>Output phase supervision</td>
<td>0</td>
<td>3</td>
<td></td>
<td>2</td>
<td></td>
<td>702</td>
<td>See par. ID700</td>
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<tr>
<td>P2.7.6</td>
<td>Earth fault protection</td>
<td>0</td>
<td>3</td>
<td></td>
<td>2</td>
<td></td>
<td>703</td>
<td>See par. ID700</td>
</tr>
<tr>
<td>P2.7.7</td>
<td>Thermal protection of the motor</td>
<td>0</td>
<td>3</td>
<td></td>
<td>2</td>
<td></td>
<td>704</td>
<td>See par. ID700</td>
</tr>
<tr>
<td>P2.7.8</td>
<td>Motor ambient temperature factor</td>
<td>-100.0</td>
<td>100.0</td>
<td>%</td>
<td>0.0</td>
<td></td>
<td>705</td>
<td></td>
</tr>
<tr>
<td>P2.7.9</td>
<td>Motor cooling factor at zero speed</td>
<td>0.0</td>
<td>150.0</td>
<td>%</td>
<td>40.0</td>
<td></td>
<td>706</td>
<td></td>
</tr>
<tr>
<td>P2.7.10</td>
<td>Motor thermal time constant</td>
<td>1</td>
<td>200</td>
<td>min</td>
<td>2</td>
<td></td>
<td>707</td>
<td></td>
</tr>
<tr>
<td>P2.7.11</td>
<td>Motor duty cycle</td>
<td>0</td>
<td>100</td>
<td>%</td>
<td>100</td>
<td></td>
<td>708</td>
<td></td>
</tr>
<tr>
<td>P2.7.12</td>
<td>Stall protection</td>
<td>0</td>
<td>3</td>
<td></td>
<td>1</td>
<td></td>
<td>709</td>
<td>See par. ID700</td>
</tr>
<tr>
<td>P2.7.13</td>
<td>Stall current</td>
<td>0.1</td>
<td>1(\times)</td>
<td>A</td>
<td>1(\times)</td>
<td></td>
<td>710</td>
<td></td>
</tr>
<tr>
<td>P2.7.14</td>
<td>Stall time limit</td>
<td>1.00</td>
<td>120.0</td>
<td>s</td>
<td>15.00</td>
<td></td>
<td>711</td>
<td></td>
</tr>
<tr>
<td>P2.7.15</td>
<td>Stall frequency limit</td>
<td>1.0</td>
<td>Par. 2.1.2</td>
<td>Hz</td>
<td>25.0</td>
<td></td>
<td>712</td>
<td></td>
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<td>P2.7.16</td>
<td>Underload protection</td>
<td>0</td>
<td>3</td>
<td></td>
<td>0</td>
<td></td>
<td>713</td>
<td>See par. ID700</td>
</tr>
<tr>
<td>P2.7.17</td>
<td>Field weakening area load</td>
<td>10</td>
<td>150</td>
<td>%</td>
<td>50</td>
<td></td>
<td>714</td>
<td></td>
</tr>
<tr>
<td>P2.7.18</td>
<td>Zero frequency load</td>
<td>5.0</td>
<td>150.0</td>
<td>%</td>
<td>10.0</td>
<td></td>
<td>715</td>
<td></td>
</tr>
<tr>
<td>P2.7.19</td>
<td>Underload protection time limit</td>
<td>2</td>
<td>600</td>
<td>s</td>
<td>20</td>
<td></td>
<td>716</td>
<td></td>
</tr>
<tr>
<td>P2.7.20</td>
<td>Response to thermistor fault</td>
<td>0</td>
<td>3</td>
<td></td>
<td>0</td>
<td></td>
<td>732</td>
<td>See par. ID700</td>
</tr>
<tr>
<td>P2.7.21</td>
<td>Response to fieldbus fault</td>
<td>0</td>
<td>3</td>
<td></td>
<td>2</td>
<td></td>
<td>733</td>
<td>See par. ID700</td>
</tr>
<tr>
<td>P2.7.22</td>
<td>Resp. to slot fault</td>
<td>0</td>
<td>3</td>
<td></td>
<td>2</td>
<td></td>
<td>734</td>
<td>See par. ID700</td>
</tr>
<tr>
<td>P2.7.23</td>
<td>Actual value supervision function</td>
<td>0</td>
<td>4</td>
<td></td>
<td>0</td>
<td></td>
<td>735</td>
<td>0=Not used 1=If below limit: Warning 2=If above limit: Warning 3=If below limit: Fault 4=If above limit: Fault</td>
</tr>
<tr>
<td>P2.7.24</td>
<td>Actual value supervision limit</td>
<td>0</td>
<td>100.0</td>
<td>%</td>
<td>10.0</td>
<td></td>
<td>736</td>
<td></td>
</tr>
<tr>
<td>P2.7.25</td>
<td>Actual value supervision delay</td>
<td>0</td>
<td>3600</td>
<td>s</td>
<td>5</td>
<td></td>
<td>737</td>
<td></td>
</tr>
</tbody>
</table>

*Table 24. Protections, G2.7*
3.9 Autorestart parameters (Control keypad: Menu M2 → G2.8)

<table>
<thead>
<tr>
<th>Code</th>
<th>Parameter</th>
<th>Min</th>
<th>Max</th>
<th>Unit</th>
<th>Default</th>
<th>Cust</th>
<th>ID</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>P2.8.1</td>
<td>Wait time</td>
<td>0.10</td>
<td>10.00</td>
<td>s</td>
<td>0.50</td>
<td></td>
<td>717</td>
<td>0=Ramp</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1=Flying start</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>719</td>
<td>2=According to par. 2.1.11</td>
</tr>
</tbody>
</table>

Table 25. Autorestart parameters, G2.8

3.10 PID control parameters (Control keypad: Menu M2 → G2.9)

<table>
<thead>
<tr>
<th>Code</th>
<th>Parameter</th>
<th>Min</th>
<th>Max</th>
<th>Unit</th>
<th>Default</th>
<th>Cust</th>
<th>ID</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>P2.9.1</td>
<td>PID activation</td>
<td>0</td>
<td>1</td>
<td></td>
<td>1</td>
<td>163</td>
<td></td>
<td>0=Not used</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1=PID control activated</td>
</tr>
<tr>
<td>P2.9.2</td>
<td>PID reference</td>
<td>0</td>
<td>2</td>
<td></td>
<td>0</td>
<td>332</td>
<td></td>
<td>0=PID ref from Keypad control page, par. 3.4</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1=PID ref from Keypad control page, par. 3.5</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2=PID ref from fieldbus ProcessDataIN 1</td>
</tr>
<tr>
<td>P2.9.3</td>
<td>Actual value 1 selection</td>
<td>0</td>
<td>2</td>
<td>1</td>
<td>334</td>
<td></td>
<td>0=AI1 signal (c-board)</td>
<td>1=AI2 signal (c-board)</td>
</tr>
<tr>
<td>P2.9.4</td>
<td>PID controller gain</td>
<td>0.0</td>
<td>1000.0</td>
<td>%</td>
<td>100.0</td>
<td>118</td>
<td>0=No part P used</td>
<td></td>
</tr>
<tr>
<td>P2.9.5</td>
<td>PID controller I-time</td>
<td>0.00</td>
<td>320.00</td>
<td>s</td>
<td>5.00</td>
<td>119</td>
<td>320.00=No part I used</td>
<td></td>
</tr>
<tr>
<td>P2.9.6</td>
<td>PID controller D-time</td>
<td>0.00</td>
<td>10.00</td>
<td>s</td>
<td>0.00</td>
<td>132</td>
<td>0=No part D used</td>
<td></td>
</tr>
<tr>
<td>P2.9.7</td>
<td>Actual value 1 minimum scale</td>
<td>−1000.0</td>
<td>1000.0</td>
<td>%</td>
<td>0.0</td>
<td>336</td>
<td>0=No minimum scaling</td>
<td></td>
</tr>
<tr>
<td>P2.9.8</td>
<td>Actual value 1 maximum scale</td>
<td>−1000.0</td>
<td>1000.0</td>
<td>%</td>
<td>100.0</td>
<td>337</td>
<td>100=No maximum scaling</td>
<td></td>
</tr>
<tr>
<td>P2.9.9</td>
<td>Error value inversion</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>340</td>
<td>0=No inversion</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1=Inversion</td>
</tr>
<tr>
<td>P2.9.10</td>
<td>Dead band</td>
<td>0</td>
<td>10.00</td>
<td>°C</td>
<td>0.0</td>
<td>1575</td>
<td>0=Not Used</td>
<td></td>
</tr>
<tr>
<td>P2.9.11</td>
<td>Dead band delay</td>
<td>0</td>
<td>100.00</td>
<td>s</td>
<td>10.0</td>
<td>1576</td>
<td></td>
<td>0=Not Used</td>
</tr>
</tbody>
</table>

Table 26. PID control parameters, G2.9
### 3.11 Flow control parameters (Control keypad: Menu M2 → G2.10)

<table>
<thead>
<tr>
<th>Code</th>
<th>Parameter</th>
<th>Min</th>
<th>Max</th>
<th>Unit</th>
<th>Default</th>
<th>Cust</th>
<th>ID</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>P2.10.1</td>
<td>Constant speed</td>
<td>Par. 2.1.1</td>
<td>Par. 2.1.1</td>
<td>Hz</td>
<td>50.00</td>
<td></td>
<td>1514</td>
<td></td>
</tr>
<tr>
<td>P2.10.2</td>
<td>Coolant inlet pressure, minimum</td>
<td>0.00</td>
<td>Par. 2.10.3</td>
<td>bar</td>
<td>0.00</td>
<td></td>
<td>1504</td>
<td></td>
</tr>
<tr>
<td>P2.10.3</td>
<td>Coolant inlet pressure, maximum</td>
<td>Par. 2.10.2</td>
<td>30.00</td>
<td>bar</td>
<td>10.00</td>
<td></td>
<td>1505</td>
<td></td>
</tr>
<tr>
<td>P2.10.4</td>
<td>Coolant inlet pressure, alarm limit</td>
<td>0.00</td>
<td>100.00</td>
<td>bar</td>
<td>1.00</td>
<td></td>
<td>1570</td>
<td></td>
</tr>
<tr>
<td>P2.10.5</td>
<td>Coolant inlet pressure, fault limit</td>
<td>0.00</td>
<td>100.00</td>
<td>bar</td>
<td>2.00</td>
<td></td>
<td>1571</td>
<td></td>
</tr>
<tr>
<td>P2.10.6</td>
<td>Coolant inlet pressure, supervision</td>
<td>0</td>
<td>1</td>
<td></td>
<td>0</td>
<td></td>
<td>1569</td>
<td>0=Off [No sensor] 1=On [Sensor installed]</td>
</tr>
<tr>
<td>P2.10.7</td>
<td>Temperature sensor, minimum value</td>
<td>0.00</td>
<td>Par. 2.10.7</td>
<td>°C</td>
<td>0.00</td>
<td></td>
<td>1509</td>
<td></td>
</tr>
<tr>
<td>P2.10.8</td>
<td>Temperature sensor, maximum value</td>
<td>Par. 2.10.6</td>
<td>100.00</td>
<td>°C</td>
<td>100.00</td>
<td></td>
<td>1510</td>
<td></td>
</tr>
<tr>
<td>P2.10.9</td>
<td>Coolant outlet temperature alarm, lower limit</td>
<td>0.00</td>
<td>100.00</td>
<td>°C</td>
<td>22.00</td>
<td></td>
<td>1591</td>
<td></td>
</tr>
<tr>
<td>P2.10.10</td>
<td>Coolant outlet temperature alarm, higher limit</td>
<td>0.00</td>
<td>100.00</td>
<td>°C</td>
<td>30.00</td>
<td></td>
<td>1594</td>
<td></td>
</tr>
<tr>
<td>P2.10.11</td>
<td>Coolant outlet temperature fault, higher limit</td>
<td>0.00</td>
<td>100.00</td>
<td>°C</td>
<td>40.00</td>
<td></td>
<td>1595</td>
<td></td>
</tr>
<tr>
<td>P2.10.12</td>
<td>Autochange interval</td>
<td>0</td>
<td>169</td>
<td>h</td>
<td>169</td>
<td></td>
<td>1599</td>
<td>0=Test mode 169=Single motor, no change</td>
</tr>
<tr>
<td>P2.10.13</td>
<td>Delayed fault</td>
<td>1</td>
<td>30</td>
<td>s</td>
<td>2</td>
<td></td>
<td>1503</td>
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</tr>
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</table>

*Table 27. Flow control parameters, G2.10*
### 3.12 Fieldbus parameters (Control Keypad: Menu M2 -> G2.11)

<table>
<thead>
<tr>
<th>Code</th>
<th>Parameter</th>
<th>Min</th>
<th>Max</th>
<th>Unit</th>
<th>Default</th>
<th>Cust ID</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>P2.11.1</td>
<td>Fieldbus data out 1 selection</td>
<td>0</td>
<td>10000</td>
<td></td>
<td>1501</td>
<td>852</td>
<td>Choose monitoring data with parameter ID</td>
</tr>
<tr>
<td>P2.11.2</td>
<td>Fieldbus data out 2 selection</td>
<td>0</td>
<td>10000</td>
<td></td>
<td>2</td>
<td>853</td>
<td>Choose monitoring data with parameter ID</td>
</tr>
<tr>
<td>P2.11.3</td>
<td>Fieldbus data out 3 selection</td>
<td>0</td>
<td>10000</td>
<td></td>
<td>45</td>
<td>854</td>
<td>Choose monitoring data with parameter ID</td>
</tr>
<tr>
<td>P2.11.4</td>
<td>Fieldbus data out 4 selection</td>
<td>0</td>
<td>10000</td>
<td></td>
<td>1511</td>
<td>855</td>
<td>Choose monitoring data with parameter ID</td>
</tr>
<tr>
<td>P2.11.5</td>
<td>Fieldbus data out 5 selection</td>
<td>0</td>
<td>10000</td>
<td></td>
<td>1</td>
<td>856</td>
<td>Choose monitoring data with parameter ID</td>
</tr>
<tr>
<td>P2.11.6</td>
<td>Fieldbus data out 6 selection</td>
<td>0</td>
<td>10000</td>
<td></td>
<td>4</td>
<td>857</td>
<td>Choose monitoring data with parameter ID</td>
</tr>
<tr>
<td>P2.11.7</td>
<td>Fieldbus data out 7 selection</td>
<td>0</td>
<td>10000</td>
<td></td>
<td>5</td>
<td>858</td>
<td>Choose monitoring data with parameter ID</td>
</tr>
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<td>P2.11.8</td>
<td>Fieldbus data out 8 selection</td>
<td>0</td>
<td>10000</td>
<td></td>
<td>37</td>
<td>859</td>
<td>Choose controlled data with parameter ID</td>
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*Table 28. Fieldbus parameters, G2.11*
3.13 Keypad control (Control keypad: Menu M3)

The parameters for the selection of control place and direction on the keypad are listed below. See the Keypad control menu in the product’s User Manual.

<table>
<thead>
<tr>
<th>Code</th>
<th>Parameter</th>
<th>Min</th>
<th>Max</th>
<th>Unit</th>
<th>Default</th>
<th>Cust ID</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>P3.1</td>
<td>Control place</td>
<td>1</td>
<td>3</td>
<td></td>
<td>1</td>
<td>125</td>
<td>1=I/O terminal, 2=Keypad, 3=Fieldbus</td>
</tr>
<tr>
<td>R3.2</td>
<td>Keypad reference</td>
<td>Par. 2.1.1</td>
<td>Par. 2.1.2</td>
<td>Hz</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>P3.3</td>
<td>Direction (on keypad)</td>
<td>0</td>
<td>1</td>
<td></td>
<td>0</td>
<td>123</td>
<td>0=Forward, 1=Reverse</td>
</tr>
<tr>
<td>R3.6</td>
<td>Stop button</td>
<td>0</td>
<td>1</td>
<td></td>
<td>1</td>
<td>114</td>
<td>0=Limited function of Stop button, 1=Stop button always enabled</td>
</tr>
<tr>
<td>R3.4</td>
<td>PID reference</td>
<td>Par. 2.10.6</td>
<td>Par. 2.10.7</td>
<td>°C</td>
<td>25.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>R3.5</td>
<td>PID reference 2</td>
<td>Par. 2.10.6</td>
<td>Par. 2.10.7</td>
<td>°C</td>
<td>0.00</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 29. Keypad control parameters, M3

3.14 System menu (Control keypad: M6)

For parameters and functions related to the general use of the AC drive, such as application and language selection, customised parameter sets or information about the hardware and software, see the product’s User manual.

3.15 Expander boards (Control keypad: Menu M7)

The M7 menu shows the expander and option boards attached to the control board and board-related information. For more information, see the product’s User Manual.
4. Description of Parameters

On the following pages you will find the parameter descriptions arranged according to the individual ID number of the parameter. A shaded parameter ID number [e.g. 418 Motor potentiometer UP] indicates that the TTF programming method is applied to this parameter [see All-in-One Application Manual].

Some parameter names are followed by a number code indicating the “All in One” applications in which the parameter is included. If no code is shown the parameter is available in all applications. See below. The parameter numbers under which the parameter appears in different applications are also given.

101 Minimum frequency (2.1.1)
102 Maximum frequency (2.1.2)

Defines the frequency limits of the AC drive.
The maximum value for these parameters is 320 Hz.
The software will automatically check the values of parameters ID105, ID106 and ID728.

103 Acceleration time 1 (2.1.3)
104 Deceleration time 1 (2.1.4)

These limits correspond to the time required for the output frequency to accelerate from the zero frequency to the set maximum frequency [par. ID102].

105 Preset speed 1 (2.1.15)

Parameter values are automatically limited between the minimum and maximum frequencies [par. ID101, ID102].

107 Current limit (2.1.5)

This parameter determines the maximum motor current from the AC drive. The parameter value range differs from size to size. When this parameter is changed the stall current limit (ID710) is internally calculated to 90% of current limit.

108 U/f ratio selection (2.6.2)

Linear: The voltage of the motor changes linearly with the frequency in the constant flux area from 0 Hz to the field weakening point where the nominal voltage is supplied to the motor. Linear U/f ration should be used in constant torque applications. **Use this default setting if there is no special need for another setting.**

Squared: The voltage of the motor changes following a squared curve form with the frequency in the area from 0 Hz to the field weakening point where the nominal voltage is also supplied to the motor. The motor runs undermagnetised below the field weakening point and produces less torque and electro-mechanical noise. Squared U/f ratio can be used in applications where torque demand of the load is proportional to the square of the speed, e.g. in centrifugal fans and pumps.
Programmable U/f curve:

2 The U/f curve can be programmed with three different points. Programmable U/f curve can be used if the other settings do not satisfy the needs of the application.

Linear with flux optimisation:

3 The AC drive starts to search for the minimum motor current in order to save energy, lower the disturbance level and the noise. This function can be used in applications with constant motor load, such as fans, pumps etc.

109 U/f optimisation (2.1.13)

Automatic torque boost The voltage to the motor changes automatically which makes the motor produce sufficient torque to start and run at low frequencies. The voltage increase depends on the motor type and power. Automatic torque boost can be used in applications where starting torque due to starting friction is high, e.g. in conveyors.
EXAMPLE:

What changes are required to start with load from 0 Hz?

♦ First set the motor nominal values (Parameter group 2.1).

Option 1: Activate the Automatic torque boost.

Option 2: Programmable U/f curve
To get torque you need to set the zero point voltage and midpoint voltage/frequency (in parameter group 2.6) so that the motor takes enough current at low frequencies. First set par. ID108 to Programable U/f curve (value 2). Increase zero point voltage (ID606) to get enough current at zero speed. Set then the midpoint voltage (ID605) to 1.4142*ID606 and midpoint frequency (ID604) to value ID606/100%*ID111.

NOTE! In high torque – low speed applications – it is likely that the motor will overheat. If the motor has to run a prolonged time under these conditions, special attention must be paid to cooling the motor. Use external cooling for the motor if the temperature tends to rise too high.

110 Nominal voltage of motor (2.1.6)
Find this value $U_n$ on the rating plate of the motor. This parameter sets the voltage at the field weakening point (ID603) to 100% * $U_{nMotor}$. Note also used connection Delta/Star.

111 Nominal frequency of motor (2.1.7)
Find this value $f_n$ on the rating plate of the motor. This parameter sets the field weakening point (ID602) to the same value.

112 Nominal speed of motor (2.1.8)
Find this value $n_n$ on the rating plate of the motor.

113 Nominal current of motor (2.1.9)
Find this value $I_n$ on the rating plate of the motor.

115 Parameter conceal
With this parameter you can hide all other parameter groups except the basic parameter group (P2.1).

Note! The factory default of this parameter is 1, i.e. all parameter groups except P2.1 are hidden. The other parameter groups cannot be browsed or edited before the value of this parameter is set to 0.

0 = Disabled (all parameter groups can be browsed with the keypad)
1 = Enabled (only the basic parameters, P2.1, can be browsed with the keypad)
24 • vacon

Description of parameters

117  I/O frequency reference selection  (2.1.14)
Defines which frequency reference source is selected when controlled from the I/O
control place.

0 = Keypad reference (Menu M3)
1 = Fieldbus reference

118  PID controller gain  (2.9.4)
This parameter defines the gain of the PID controller. If the value of the parameter is set
to 100% a change of 10% in the error value causes the controller output to change by
10%. If the parameter value is set to 0 the PID controller operates as ID-controller.
See examples at parameter ID132 below.

119  PID controller I-time  (2.9.5)
The parameter ID119 defines the integration time of the PID controller. If this parameter
is set to 1.00 second a change of 10% in the error value causes the controller output to
change by 10.00%/s. If the parameter value is set to 0.00 s the PID controller will operate
as PD controller.
See examples at parameter ID132 below.

120  Motor cos phi  (2.1.10)
Find this value "cos phi" on the rating plate of the motor.

121  Keypad frequency reference selection  (2.2.22)
Defines which frequency reference source is selected when controlled from the keypad.

0  Reference from keypad (Freq Ref)
1  Reference from fieldbus

122  Fieldbus frequency reference selection  (2.2.23)
Defines which frequency reference source is selected when controlled from the fieldbus.

0  Reference from keypad (Freq Ref)
1  Reference from fieldbus

132  PID controller D-time  (2.9.6)
The parameter ID132 defines the derivation time of the PID controller. If this parameter
is set to 1.00 second a change of 10% in the error value during 1.00 s causes the
controller output to change by 10.00%. If the parameter value is set to 0.00 s the PID
controller will operate as PI controller.
See examples below.
Example 1:
In order to reduce the error value to zero, with the given values, the AC drive output behaves as follows:

Given values:
Par. 2.1.12, P = 0%
Par. 2.1.13, I-time = 1.00 s
Par. 2.1.14, D-time = 0.00 s
Min freq. = 0 Hz
Max freq. = 50 Hz

Error value (setpoint – process value) = 10.00%

In this example, the PID controller operates practically as I-controller only. According to the given value of parameter 2.1.13 (I-time), the PID output increases by 5 Hz (10% of the difference between the maximum and minimum frequency) every second until the error value is 0.

Example 2:
Given values:
Par. 2.1.12, P = 100%
Par. 2.1.13, I-time = 1.00 s
Par. 2.1.14, D-time = 1.00 s
Min freq. = 0 Hz
Max freq. = 50 Hz

Error value (setpoint – process value) = ±10%

As the power is switched on, the system detects the difference between the setpoint and the actual process value and starts to either raise or decrease (in case the error value is negative) the PID output according to the I-time. Once the difference between the setpoint and the process value has been reduced to 0 the output is reduced by the amount corresponding to the value of parameter 2.1.13.

In case the error value is negative, the AC drive reacts reducing the output correspondingly. See Figure 4.
Example 3:

Given values:

- Par. 2.1.12, P = 100%
- Par. 2.1.13, I-time = 0.00 s
- Par. 2.1.14, D-time = 1.00 s
- Min freq. = 0 Hz
- Max freq. = 50 Hz
- Error value (setpoint – process value) = ±10%/s

As the error value increases, also the PID output increases according to the set values (D-time = 1.00s)

PID activation (2.9.1)

Activate the PID control by setting value 1 for this parameter.
301  **DIN3 function**  
(2.2.2)

This parameter has 10 selections. The default value is 3.

0  Motor potentiometer UP  
   Contact closed: Reference increases until the contact is opened.

1  Enable PID reference 2  
   Contact open: PID controller reference selected with parameter R3.4.  
   Contact closed: PID controller keypad reference 2 selected with parameter R3.5.

2  External fault  
   Contact closed: Fault is displayed and motor stopped when the input is active.

3  External fault  
   Contact open: Fault is displayed and motor stopped when the input is not active.

4  Fault reset  
   Contact closed: All faults reset.

5  Run enable  
   Contact open: Start of motor disabled.  
   Contact closed: Start of motor enabled.

6  Preset speed

7  DC-braking command  
   Contact closed: In Stop mode, the DC braking operates until the contact is opened.

8  PID disable

9  PID disabled; go to Preset speed

10  PID keypad reference 2

---

**Analogue output 1 function**  
(2.3.1.1)

This parameter selects the desired function for the analogue output 1 signal.

0  Not used

1  Output frequency [0—f_max]

2  Frequency reference [0—f_max]

3  Motor speed [0—Motor nominal speed]

4  Motor current [0—Motor nominal current]

5  Motor torque [0—Motor nominal torque]

6  Motor power [0—Motor nominal power]

7  Motor voltage [0—Motor nominal voltage]

8  DC-link voltage [0—Motor nominal voltage]
Description of parameters

9  PI controller temperature reference
10 PI controller actual temperature (from FSA11)
11 PI controller error value of the temperature
12 PI controller output
13 Pressure from PT11, pump inlet

308 Analogue output 1 filter time (2.3.1.2)
Defines the filtering time of the analogue output signal. Setting this parameter value 0 will deactivate filtering.

309 Analogue output 1 inversion (2.3.1.3)
Inverts the analogue output signal:

Maximum output signal = Minimum set value
Minimum output signal = Maximum set value

See parameter ID311 below.

310 Analogue output 1 minimum (2.3.1.4)
Defines the signal minimum to either 0 mA or 4 mA (living zero). Note the difference in analogue output scaling in parameter ID311 (Figure 7).

0  Set minimum value to 0 mA
1  Set minimum value to 4 mA

311 Analogue output 1 scale (2.3.1.5)
Scaling factor for analogue output.

Figure 7. Analogue output scaling
### Description of parameters

**313 Relay output 1 function (2.3.4.2)**

<table>
<thead>
<tr>
<th>Setting value</th>
<th>Signal content</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 = Not used</td>
<td>Out of operation</td>
</tr>
<tr>
<td>1 = Ready</td>
<td>The AC drive is ready to operate</td>
</tr>
<tr>
<td>2 = Run</td>
<td>The AC drive operates (motor is running)</td>
</tr>
<tr>
<td>3 = Fault</td>
<td>A fault trip has occurred</td>
</tr>
<tr>
<td>4 = Fault inverted</td>
<td>A fault trip has not occurred</td>
</tr>
<tr>
<td>5 = FC overheat warning</td>
<td>The heat-sink temperature exceeds +70°C</td>
</tr>
<tr>
<td>6 = External fault or warning</td>
<td>Fault or warning depending on par. ID701</td>
</tr>
<tr>
<td>7 = Reference fault or warning</td>
<td>Fault or warning depending on par. ID700 - if analogue reference is 4—20 mA and signal is &lt;4mA</td>
</tr>
<tr>
<td>8 = Warning</td>
<td>Always if warning exists</td>
</tr>
<tr>
<td>9 = Reversed</td>
<td>The reverse command has been selected</td>
</tr>
<tr>
<td>10 = Preset speed 1</td>
<td>The preset speed has been selected with digital input</td>
</tr>
<tr>
<td>11 = At speed</td>
<td>The output frequency has reached the set reference</td>
</tr>
<tr>
<td>12 = Motor regulator activated</td>
<td>Overvoltage or overcurrent regulator was activated</td>
</tr>
<tr>
<td>13 = Output frequency limit supervision</td>
<td>The output frequency goes outside the set supervision low limit/high limit (see parameter ID’s 315 and 316 below)</td>
</tr>
<tr>
<td>14 = Control from I/O terminals</td>
<td>I/O control mode selected (in menu M3)</td>
</tr>
<tr>
<td>15 = Thermistor fault or warning (Appl.2)</td>
<td>The thermistor input of option board indicates over-temperature. Fault or warning depending on par. ID732.</td>
</tr>
<tr>
<td>16 = Actual value supervision</td>
<td>Actual value supervision is active</td>
</tr>
<tr>
<td>17 = Cooling OK</td>
<td></td>
</tr>
</tbody>
</table>

Table 30. Output signals via relay outputs RO1 and RO2.

**315 Output frequency limit supervision function (2.5.4)**

<table>
<thead>
<tr>
<th>0</th>
<th>No supervision</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Low limit supervision</td>
</tr>
<tr>
<td>2</td>
<td>High limit supervision</td>
</tr>
</tbody>
</table>

If the output frequency goes under/over the set limit (ID316) this function generates a warning message via the relay output RO1 or RO2 depending on the settings of parameters ID313 and ID1513.
**316 Output frequency limit supervision value** (2.5.5)

Selects the frequency value supervised by parameter ID315. See Figure 8.

![Figure 8. Output frequency supervision](image)

**332 PID controller reference signal** (2.9.2)

Defines which frequency reference place is selected for the PID controller.

- 0 Reference from keypad (PID reference 1, Menu M3, par. R3.4)
- 1 Reference from keypad (PID reference 2, Menu M3, par. R3.5)
- 2 Fieldbus reference (FBProcessDataIN1)

**334 Actual value selection** (2.9.3)

- 0 AI1 (control board)
- 1 AI2 (control board)
- 2 Fieldbus (FBProcessDataIN2)

**336 Actual value 1 minimum scale** (2.9.7)

Sets the minimum scaling point for Actual value. See Figure 9.

**337 Actual value 1 maximum scale** (2.9.8)

Sets the maximum scaling point for Actual value. See Figure 9.

![Figure 9. Example of actual value signal scaling](image)
340  **PID error value inversion (2.9.9)**

This parameter allows you to invert the error value of the PID controller (and thus the operation of the PID controller).

0  No inversion
1  Inverted

378  **AI1 signal filter time (2.2.8)**

When this parameter is given a value greater than 0 the function that filters out disturbances from the incoming analogue signal is activated.

Long filtering time makes the regulation response slower. See Figure 10.

![Figure 10. AI1 signal filtering](image)

379  **AI1 signal range (2.2.3)**

0  Signal range 0...20 mA
1  Signal range 4...20 mA
2  Signal range 0...10 V
3  Signal range 2...10 V

380  **AI1 custom setting minimum (2.2.5)**

381  **AI1 custom setting maximum (2.2.6)**

These parameters set the analogue input signal for any input signal span between 0.00...100.00%. However, the max value of par. ID380 cannot be greater than the value set for parameter ID381, and the min value of par. ID381 cannot be smaller than the max value of par. ID380.

**Note:** Parameter ID379 *AI1 signal range* is inactivated if ID380 ≠ 0% or ID381 ≠ 100%.

See also Figure 11.
**387 Al1 signal inversion**  
*(2.2.7)*

If this parameter = 0, no inversion of analogue signal takes place.

![Figure 11. Al1 no signal inversion](image1)

If this parameter = 1 inversion of analogue signal takes place.

![Figure 12. Al1 signal inversion](image2)

**389 Al2 signal filter time**  
*(2.2.14)*

See parameter ID378.

**390 Al2 signal range**  
*(2.2.9)*

- 0  Signal range 0...20 mA
- 1  Signal range 4...20 mA
391  **AI2 custom setting minimum**  \( (2.2.11) \)

392  **AI2 custom setting maximum**  \( (2.2.12) \)

See parameters ID380 and ID381.

398  **AI2 signal inversion**  \( (2.2.13) \)

See parameter ID387.

500  **Acceleration/Deceleration ramp 1 shape**  \( (2.4.1) \)

The start and end of acceleration and deceleration ramps can be smoothed with these parameters. Setting value 0 gives a linear ramp shape which causes acceleration and deceleration to act immediately to the changes in the reference signal. Setting a value 0.1...10 seconds for this parameter produces an S-shaped acceleration/deceleration. The acceleration time is determined with parameters ID103/ID104.

![Figure 13. Acceleration/Deceleration (S-shaped)](image)

504  **Brake chopper**  \( (2.4.2) \)

0  =  No brake chopper used

1  =  Brake chopper in use and tested when running. Can be tested also in READY state

2  =  External brake chopper (no testing)

3  =  Used and tested in READY state and when running

When the AC drive is decelerating the motor, the inertia of the motor and the load are fed into an external brake resistor. This enables the AC drive to decelerate the load with a torque equal to that of acceleration (provided that the correct brake resistor has been selected). See separate Brake resistor installation manual.
505 Start function (2.1.11)
Ramp:
0 The AC drive starts from 0 Hz and accelerates to the set reference frequency within the set acceleration time. (Load inertia or starting friction may cause prolonged acceleration times).

Flying start:
1 The AC drive is able to start into a running motor by applying a small torque to motor and searching for the frequency corresponding to the speed the motor is running at. Searching starts from the maximum frequency towards the actual frequency until the correct value is detected. Thereafter, the output frequency will be increased/decreased to the set reference value according to the set acceleration/deceleration parameters.

Use this mode if the motor is coasting when the start command is given. With the flying start it is possible to ride through short mains voltage interruptions.

506 Stop function (2.1.12)
Coasting:
0 The motor coasts to a halt without any control from the AC drive, after the Stop command.

Ramp:
1 After the Stop command, the speed of the motor is decelerated according to the set deceleration parameters. If the regenerated energy is high it may be necessary to use an external braking resistor for faster deceleration.

Normal stop: Ramp/ Run Enable stop: coasting
2 After the Stop command, the speed of the motor is decelerated according to the set deceleration parameters. However, when Run Enable is selected, the motor coasts to a halt without any control from the AC drive.

Normal stop: Coasting/ Run Enable stop: ramping
3 The motor coasts to a halt without any control from the AC drive. However, when Run Enable signal is selected, the speed of the motor is decelerated according to the set deceleration parameters. If the regenerated energy is high it may be necessary to use an external braking resistor for faster deceleration.

507 DC-braking current (2.4.3)
Defines the current injected into the motor during DC-braking.
**508 DC-braking time at stop (2.4.4)**

Determines whether braking is ON or OFF and the braking time of the DC-brake when the motor is stopping. The function of the DC-brake depends on the stop function, parameter ID506.

0 DC-brake is not used

>0 DC-brake is in use and its function depends on the Stop function, (param. ID506). The DC-braking time is determined with this parameter.

**Par. ID506 = 0; Stop function = Coasting:**

After the stop command, the motor coasts to a stop without control of the AC drive.

With DC-injection, the motor can be electrically stopped in the shortest possible time, without using an optional external braking resistor.

The braking time is scaled according to the frequency when the DC-braking starts. If the frequency is ≥ the nominal frequency of the motor, the set value of parameter ID508 determines the braking time. When the frequency is ≤10% of the nominal, the braking time is 10% of the set value of parameter ID508.

![Figure 14. DC-braking time when Stop mode = Coasting.](nx12k21)

**Par. ID506 = 1; Stop function = Ramp:**

After the Stop command, the speed of the motor is reduced according to the set deceleration parameters, as fast as possible, to the speed defined with parameter ID515, where the DC-braking starts.

The braking time is defined with parameter ID508. If high inertia exists, it is recommended to use an external braking resistor for faster deceleration. See Figure 15.

![Figure 15. DC-braking time when Stop mode = Ramp](nx12k23)
**Description of Parameters**

**509**  *Prohibit frequency area 1; Low limit*  
510  *Prohibit frequency area 1; High limit*  

In some systems it may be necessary to avoid certain frequencies because of mechanical resonance problems. With these parameters it is possible to set limits for the "skip frequency" region. See Figure 16.

**515**  *DC-braking frequency at stop*  

The output frequency at which the DC-braking is applied. See Figure 16.

**516**  *DC-braking time at start*  

DC-brake is activated when the start command is given. This parameter defines the time before the brake is released. After the brake is released, the output frequency increases according to the set start function by parameter ID505.

**518**  *Acceleration/deceleration ramp speed scaling ratio between prohibit frequency limits*  

Defines the acceleration/deceleration time when the output frequency is between the selected prohibit frequency range limits (parameters ID509 and ID510). The ramping speed (selected acceleration/ deceleration time 1 or 2) is multiplied with this factor. E.g. value 0.1 makes the acceleration time 10 times shorter than outside the prohibit frequency range limits.

---

*Figure 16. Example of prohibit frequency area setting.*
519 \textit{Flux braking current} (2.4.8)  
Defines the flux braking current value. The value setting range depends on the used application.

520 \textit{Flux brake} (2.4.7)  
Instead of DC braking, flux braking is a useful way to raise the braking capacity in cases where additional brake resistors are not needed. When braking is needed, the frequency is reduced and the flux in the motor is increased, which in turn increases the motor’s capability to brake. Unlike DC braking, the motor speed remains controlled during braking.

The flux braking can be set ON or OFF.

0 = Flux braking OFF  
1 = Flux braking ON

\textbf{Note}: Flux braking converts the energy into heat at the motor, and should be used intermittently to avoid motor damage.

600 \textit{Motor control mode} (2.6.1)  
0 Frequency control: The I/O terminal and keypad references are frequency references and the AC drive controls the output frequency (output frequency resolution = 0.01 Hz)

1 Speed control: The I/O terminal and keypad references are speed references and the AC drive controls the motor speed compensating the motor slip (accuracy ± 0.5%).
**601 Switching frequency** *(2.6.8)*

Motor noise can be minimised using a high switching frequency. Increasing the switching frequency reduces the capacity of the AC drive unit.

The range of this parameter depends on the size of the AC drive:

<table>
<thead>
<tr>
<th>Type</th>
<th>Min. [kHz]</th>
<th>Max. [kHz]</th>
<th>Default [kHz]</th>
</tr>
</thead>
<tbody>
<tr>
<td>0016—0061 NX_5</td>
<td>1.0</td>
<td>10.0</td>
<td>10.0</td>
</tr>
<tr>
<td>0072—2300 NX_5</td>
<td>1.0</td>
<td>10.0</td>
<td>3.6</td>
</tr>
<tr>
<td>0170—1500 NX_6</td>
<td>1.0</td>
<td>6.0</td>
<td>1.5</td>
</tr>
</tbody>
</table>

*Table 31: Size-dependent switching frequencies*

**Note!** The actual switching frequency might be reduced down to 1.5kHz by thermal management functions. This has to be considered when using sine wave filters or other output filters with a low resonance frequency.

**602 Field weakening point** *(2.6.3)*

The field weakening point is the output frequency at which the output voltage reaches the set (ID603) maximum value.

**603 Voltage at field weakening point** *(2.6.4)*

Above the frequency at the field weakening point, the output voltage remains at the set maximum value. Below the frequency at the field weakening point, the output voltage depends on the setting of the U/f curve parameters. See parameters ID109, ID108, ID604 and ID605.

When the parameters ID110 and ID111 (nominal voltage and nominal frequency of the motor) are set, the parameters ID602 and ID603 are automatically given the corresponding values. If you need different values for the field weakening point and the maximum output voltage, change these parameters after setting the parameters ID110 and ID111.

**604 U/f curve, middle point frequency** *(2.6.5)*

If the programmable U/f curve has been selected with parameter ID108 this parameter defines the middle point frequency of the curve. See Figure 2.

**605 U/f curve, middle point voltage** *(2.6.6)*

If the programmable U/f curve has been selected with the parameter ID108 this parameter defines the middle point voltage of the curve. See Figure 2.

**606 Output voltage at zero frequency** *(2.6.7)*

If the programmable U/f curve has been selected with the parameter ID108 this parameter defines the zero frequency voltage of the curve. **NOTE:** If the value of parameter ID108 is changed this parameter is set to zero. See Figure 2.
607  **Overvoltage controller**  (2.6.9)

These parameters allow the under-/overvoltage controllers to be switched out of operation. This may be useful, for example, if the mains supply voltage varies more than −15% to +10% and the application will not tolerate this over-/undervoltage. In this case, the regulator controls the output frequency taking the supply fluctuations into account.

0  Controller switched off
1  Controller switched on = Minor adjustments of OP frequency are made

608  **Undervoltage controller**  (2.6.10)

See par. ID607.

**Note:** Over-/undervoltage trips may occur when controllers are switched out of operation.

0  Controller switched off
1  Controller switched on = Minor adjustments of OP frequency are made

700  **Response to the 4mA reference fault**  (2.7.1)

0  = No response
1  = Warning
2  = Fault, stop mode after fault according to ID506
3  = Fault, stop mode after fault always by coasting

A warning or a fault action and message is generated if the 4…20 mA reference signal is used and the signal falls below 3.5 mA for 5 seconds or below 0.5 mA for 0.5 seconds. The information can also be programmed into relay outputs RO1 or RO2.

701  **Response to external fault**  (2.7.2)

0  = No response
1  = Warning
2  = Fault, stop mode after fault according to ID506
3  = Fault, stop mode after fault always by coasting

A warning or a fault action and message is generated from the external fault signal in the programmable digital input DIN3. The information can also be programmed into relay outputs RO1 or RO2.

702  **Output phase supervision**  (2.7.5)

0  = No response
1  = Warning
2  = Fault, stop mode after fault according to ID506
3  = Fault, stop mode after fault always by coasting

Output phase supervision of the motor ensures that the motor phases have an approximately equal current.
703 **Earth fault protection**  

0 = No response  
1 = Warning  
2 = Fault, stop mode after fault according to ID506  
3 = Fault, stop mode after fault always by coasting

Earth fault protection ensures that the sum of the motor phase currents is zero. The overcurrent protection is always working and protects the AC drive from earth faults with high currents.

704 **Motor thermal protection**  

0 = No response  
1 = Warning  
2 = Fault, stop mode after fault according to ID506  
3 = Fault, stop mode after fault always by coasting

If tripping is selected the drive will stop and activate the fault stage. Deactivating the protection, i.e. setting parameter to 0, will reset the thermal stage of the motor to 0%.

705 **Motor thermal protection: Motor ambient temp. factor**  

The factor can be set between -100.0%...100.0%.

706 **Motor thermal protection: Motor cooling factor at zero speed**  

The current can be set between 0—150.0% x InMotor. This parameter sets the value for thermal current at zero frequency. See Figure 18.

The default value is set assuming that there is no external fan cooling the motor. If an external fan is used this parameter can be set to 90% (or even higher).

**Note:** The value is set as a percentage of the motor name plate data, par. ID113 (Nominal current of motor), not the drive’s nominal output current. The motor’s nominal current is the current that the motor can withstand in direct on-line use without being overheated.

If you change the parameter Nominal current of motor, this parameter is automatically restored to the default value.

Setting this parameter does not affect the maximum output current of the drive which is determined by parameter ID107 alone.

![Figure 18. Motor thermal current I_T curve](image-url)
707 Motor thermal protection: Time constant (2.7.10)
This time can be set between 1 and 200 minutes.

This is the thermal time constant of the motor. The bigger the motor, the bigger the time constant. The time constant is the time within which the calculated thermal stage has reached 63% of its final value.

The motor thermal time is specific to the motor design and it varies between different motor manufacturers.

If the motor’s t6-time (t6 is the time in seconds the motor can safely operate at six times the rated current) is known (given by the motor manufacturer) the time constant parameter can be set basing on it. As a rule of thumb, the motor thermal time constant in minutes equals to 2xt6. If the drive is in stop stage the time constant is internally increased to three times the set parameter value. The cooling in the stop stage is based on convection and the time constant is increased. See also Figure 19.

708 Motor thermal protection: Motor duty cycle (2.7.11)
Defines how much of the nominal motor load is applied. The value can be set to 0%...100%.

709 Stall protection (2.7.12)
0 = No response
1 = Warning
2 = Fault, stop mode after fault according to ID506
3 = Fault, stop mode after fault always by coasting

Setting the parameter to 0 will deactivate the protection and reset the stall time counter.
**710 Stall current limit** *(2.7.13)*

The current can be set to 0.0...2*I_n. For a stall stage to occur, the current must have exceeded this limit. See Figure 20. The software does not allow entering a greater value than 2*I_n. If parameter **ID107 Nominal current limit of motor** is changed, this parameter is automatically calculated to 90% of the current limit.

![Figure 20. Stall characteristics settings](image)

**711 Stall time** *(2.7.14)*

This time can be set between 1.0 and 120.0s. This is the maximum time allowed for a stall stage. The stall time is counted by an internal up/down counter. If the stall time counter value goes above this limit the protection will cause a trip (see **ID709**).

![Figure 21. Stall time count](image)

**712 Stall frequency limit** *(2.7.15)*

The frequency can be set between 1-f_max (**ID102**). For a stall state to occur, the output frequency must have remained below this limit.

**713 Underload protection** *(2.7.16)*

- 0 = No response
- 1 = Warning
- 2 = Fault, stop mode after fault according to **ID506**
- 3 = Fault, stop mode after fault always by coasting

If tripping is set active the drive will stop and activate the fault stage. Deactivating the protection by setting the parameter to 0 will reset the underload time counter to zero.
**714**  
*Underload protection, field weakening area load*  
(2.7.17)

The torque limit can be set between 10.0—150.0 % × T_nMotor.  
This parameter gives the value for the minimum torque allowed when the output frequency is above the field weakening point. See Figure 22.

If you change parameter ID113 (Motor nominal current) this parameter is automatically restored to the default value.

**715**  
*Underload protection, zero frequency load*  
(2.7.18)

The torque limit can be set between 5.0—150.0 % × T_nMotor.  
This parameter gives value for the minimum torque allowed with zero frequency. See Figure 22.

If you change the value of parameter ID113 (Motor nominal current) this parameter is automatically restored to the default value.

**716**  
*Underload time*  
(2.7.19)

This time can be set between 2.0 and 600.0 s.  
This is the maximum time allowed for an underload state to exist. An internal up/down counter counts the accumulated underload time. If the underload counter value goes above this limit the protection will cause a trip according to parameter ID713. If the drive is stopped the underload counter is reset to zero. See Figure 23.
**Automatic restart: Wait time** *(2.8.1)*

Defines the time before the AC drive tries to automatically restart the motor after the fault state has disappeared.

**Automatic restart: Trial time** *(2.8.2)*

The Automatic restart function restarts the AC drive when the fault state has disappeared and the waiting time has elapsed.

The trial time count starts from the first autorestart. If the number of faults occurring during the trial time exceeds 3, the fault state becomes active. Otherwise the fault is cleared after the trial time has elapsed and the next fault starts the trial time count again.

If a single fault remains during the trial time, a fault state is true.

**Automatic restart: Start function** *(2.8.3)*

The Start function for Automatic restart is selected with this parameter. The parameter defines the start mode:

- 0 = Start with ramp
- 1 = Flying start
- 2 = Start according to ID505

**Response to undervoltage fault** *(2.7.4)*

- 0 = No response
- 1 = Warning
- 2 = Fault, stop mode after fault according to ID506
- 3 = Fault, stop mode after fault always by coasting

For the undervoltage limits, see the product’s user manual.

**Input phase supervision** *(2.7.3)*

- 0 = No response
- 1 = Warning
- 2 = Fault, stop mode after fault according to ID506
- 3 = Fault, stop mode after fault always by coasting

The input phase supervision ensures that the input phases of the AC drive have an approximately equal current.

**Automatic restart** *(2.1.16)*

The Automatic restart is taken into use with this parameter.

- 0 = Disabled
- 1 = Enabled

The function resets the following faults (max. three times) (see the product’s user manual):
- Overcurrent (F1)
- Overvoltage (F2)
- Undervoltage (F9)
- AC drive overtemperature (F14)
- Motor overtemperature (F16)
- Reference fault (F50)

732  **Response to thermistor fault**  (2.7.20)

0 = No response  
1 = Warning  
2 = Fault, stop mode after fault according to ID506  
3 = Fault, stop mode after fault always by coasting

Setting the parameter to 0 will deactivate the protection.

733  **Response to fieldbus fault**  (2.7.21)

Set here the response mode for the fieldbus fault if a fieldbus board is used. For more information, see the respective Fieldbus Board Manual.

See parameter ID732.

734  **Response to slot fault**  (2.7.22)

Set here the response mode for a board slot fault due to missing or broken board.

See parameter ID732.

735  **Actual value supervision function**  (2.7.22)

0 = Not used  
1 = Warning, if actual value falls below the limit set with par. ID736  
2 = Warning, if actual value exceeds the limit set with par. ID736  
3 = Fault, if actual value falls below the limit set with par. ID736  
4 = Fault, if actual value exceeds the limit set with par. ID736

736  **Actual value supervision limit**  (2.7.24)

With this parameter you can set the limit (in percent) of actual value supervised by par. ID735.

737  **Actual value supervision delay**  (2.7.25)

Set here the delay for the actual value supervision function (par. ID735)  
If this parameter is in use, the function of par. ID735 will be active only when the actual value stays outside the defined limit for the time determined by this parameter.
Using these parameters, you can monitor any monitoring or parameter value from the fieldbus. Enter the ID number of the item you wish to monitor for the value of these parameters.

Some typical values:

<table>
<thead>
<tr>
<th>No.</th>
<th>Description</th>
<th>ID</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Output frequency</td>
<td>15</td>
</tr>
<tr>
<td>2</td>
<td>Motor speed</td>
<td>16</td>
</tr>
<tr>
<td>3</td>
<td>Motor current</td>
<td>17</td>
</tr>
<tr>
<td>4</td>
<td>Motor torque</td>
<td>25</td>
</tr>
<tr>
<td>5</td>
<td>Motor power</td>
<td>26</td>
</tr>
<tr>
<td>6</td>
<td>Motor voltage</td>
<td>27</td>
</tr>
<tr>
<td>7</td>
<td>DC link voltage</td>
<td>28</td>
</tr>
<tr>
<td>8</td>
<td>Unit temperature</td>
<td>31</td>
</tr>
<tr>
<td>9</td>
<td>Motor temperature</td>
<td>32</td>
</tr>
<tr>
<td>13</td>
<td>AI1</td>
<td>37</td>
</tr>
<tr>
<td>14</td>
<td>AI2</td>
<td>45</td>
</tr>
</tbody>
</table>

Table 4-32.

1503  
**Delayed fault** (2.10.12)

If the sensor signals of too low a coolant flow in the system and the duration of this state exceeds the time set with this parameter, a fault is activated. Additionally, the Cooling OK signal is removed and the AC drive stops.

1504  
**Coolant inlet pressure, minimum** (2.10.2)

1505  
**Coolant inlet pressure, maximum** (2.10.3)

With these parameters, you can define the value for the minimum and maximum coolant inflow pressures of the pressure range in bar.

1509  
**Temperature sensor, minimum value** (2.10.6)

1510  
**Temperature sensor, maximum value** (2.10.7)

1513  
**Relay output 2 function** (2.3.5.2)

See Table 30 at parameter ID313.

1514  
**Constant speed** (2.10.1)

The constant speed reference can be set with this parameter when the PID control is enabled.
1515  **Relay output 3 function**  

<table>
<thead>
<tr>
<th>Setting value</th>
<th>Signal content</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 = Not used</td>
<td>Out of operation</td>
</tr>
<tr>
<td>1 = Cooling OK</td>
<td></td>
</tr>
<tr>
<td>2 = Pump 1</td>
<td></td>
</tr>
<tr>
<td>3 = Pump 2</td>
<td></td>
</tr>
</tbody>
</table>

Table 33. Output signals via relay outputs RO3 and RO4.

1517  **AI3 custom setting minimum**  
1518  **AI3 custom setting maximum**

See parameters ID380 and ID381.

1520  **AI3 signal range**

| 0 | Signal range 0...20 mA |
| 1 | Signal range 4...20 mA |

1526  **AI3 signal filter time**

See parameter ID378.

1529  **AI3 signal inversion**

See parameter ID387.

1530  **Analogue output 2 function**
1531  **Analogue output 2 filter time**
1532  **Analogue output 2 inversion**
1533  **Analogue output 2 minimum**
1534  **Analogue output 2 scale**

See respective parameters 307 to 311 at Analogue output 1.

1535  **Analogue output 3 function**
1536  **Analogue output 3 filter time**
1537  **Analogue output 3 inversion**
1538  **Analogue output 3 minimum**
1539  **Analogue output 3 scale**

See respective parameters 307 to 311 at Analogue output 1.

1540  **Relay output 1 inversion**
1541  **Relay output 2 inversion**
1542  **Relay output 3 inversion**

If the values of these parameters = 0, no inversion of the respective relay output signal takes place.

1544  **Analogue input 1 supervision**
1545  **Analogue input 2 supervision**
1546  **Analogue input 3 supervision**

The signal level of the respective analogue input is supervised if value 1 is given to this parameter.
1549  Relay output 1, signal selection  (2.3.4.1)  
1550  Relay output 2, signal selection  (2.3.5.1)  
1551  Relay output 3, signal selection  (2.3.6.1)  
1552  Relay output 4, signal selection  (2.3.7.1)  

Connect the RO signal to the relay output of your choice with this parameter using the TTF programming method. More information on the TTF method in Vacon All in One Application manual. You will find the relay output signal contents on page 29.

1553  Relay output 4 function  (2.3.7.2)  
See Table 33.

1554  Relay output 4 inversion  (2.3.7.3)  
See par. ID1540.

1555  Relay output 5, signal selection  (2.3.8.1)  
See par. ID1549.

1556  Relay output 5 function  (2.3.8.2)  
See Table 33.

1557  Relay output 5 inversion  (2.3.8.3)  
See par. ID1540.

1558  AI3 signal selection  (2.2.15)  
Connect the AI3 signal to the analogue input of your choice with this parameter using the TTF programming method. More information on the TTF method in Vacon All in One Application manual.

1567  Relay output 6 function  (2.3.9.2)  
See Table 33.

1568  Relay output 6 inversion  (2.3.9.3)  
See par. ID1540.

1569  Coolant inlet pressure supervision  (2.10.5)  
If the system is equipped with a pressure sensor set value 1 for this parameter and 0 if no sensor is installed.

1570  Coolant inlet pressure alarm limit  (2.10.4)  
When the inlet pressure drops below the limit set with this parameter, a warning is triggered. A pressure sensor must be installed in the system.

1572  DIN6 function  (2.2.3)  
This parameter has 2 selections. The default value is 0.
0  Preset Speed 1
1  Fault reset
    Contact closed: All faults reset

1573  Relay output 6, signal selection  (2.3.9.1)
See par. ID1549.

1590  DIN2 input  (2.2.1)
This parameter changes the default status of the digital input.

0 = Digital input ‘normally open’
1 = Digital input ‘normally closed’

1591  Coolant outlet temperature alarm, lower limit  (2.10.8)
1594  Coolant outlet temperature alarm, upper limit  (2.10.9)
Set here the temperature minimum and maximum limits for the coolant. If the temperature goes below or exceeds the set limits a warning is triggered.

1595  Coolant outlet temperature fault, upper limit  (2.10.10)
Set here the temperature maximum limit for the coolant. If the temperature exceeds the set limits, a temperature fault is triggered.

1599  Autochange interval  (2.10.11)
After the expiry of the time defined with this parameter, the autochange function takes place. The available time range for the autochange varies from 1 to 168 hours.

0  Test mode; Autochange after 30 seconds
1 to 168  Time range for autochange in hours
169  Single motor used; no autochange

•  The time count is activated only if the Start/Stop request is active.
•  The time count is reset after the autochange has taken place.
This function is designed to prevent wear and unwanted movements of the actuators, for example valves.

Use Dead band parameter to define dead band area around the PID setpoint value (temperature setpoint). The output of the PID controller will be locked, if the actual temperature (measured temperature) stays in the dead band area for the set time.

Use Dead band delay parameter to set the time that the actual temperature must stay in the dead band area, before the output of the PID controller is locked.

The output of the PID controller will be released, if the actual temperature goes outside of the dead band area.

**Note:** This function is disabled when Dead Band = 0.
4.1 Keypad control parameters

Unlike the parameters listed above, these parameters are located in the M3 menu of the control keypad. The reference parameters do not have an ID number.

114  **Stop button activated**  
*3.4*

If you wish to make the Stop button a “hotspot” which always stops the drive regardless of the selected control place, give this parameter the value 1. See also parameter ID125.

125  **Control place**  
*3.1*

The active control place can be changed with this parameter. For more information, see the product’s user manual. Pushing the *Start button* for 3 seconds selects the control keypad as the active control place and copies the Run status information (Run/Stop, direction and reference).

123  **Keypad direction**  
*3.3*

0  Forward: The rotation of the motor is forward, when the keypad is the active control place.
1  Reverse: The rotation of the motor is reversed, when the keypad is the active control place.

For more information, see the product’s user manual.

R3.2  **Keypad Reference**  
*3.2*

The frequency reference can be adjusted from the keypad with this parameter. The output frequency can be copied as the keypad reference by pushing the *Stop button* for 3 seconds when you are on any of the pages of menu M3. For more information, see the product’s user manual.

R3.4  **PID reference 1**  
*3.4*

With this parameter, you can set the desired temperature for the coolant circulating in the system.

R3.5  **PID reference 2**  
*3.5*

With this parameter, you can set another, optional temperature for the coolant circulating in the system. The value is activated by setting the value 10 for parameter ID301. See page 27.