8 Project Planning for AC Motors with Inverter

8.1 Operation on inverter

The extensive product range of SEW-EURODRIVE inverters is available for designing electronically controlled drives. SEW-EURODRIVE offers the following inverter series:

- **MOVITRAC® B**: Compact and inexpensive frequency inverter for the power range 0.3-175HP. Single-phase and three-phase supply connection for 230 $V_{AC}$ and three-phase supply connection for 460 $V_{AC}$.

- **MOVIDRIVE® MDX60/61B**: High-performance drive inverter for dynamic drives in the power range 0.75-175HP. Great diversity of applications due to extensive-expansion options with technology and communication options. Three phase supply connection for 230 $V_{AC}$ and 460 $V_{AC}$.

![Figure 79: Range of inverters for AC motors](image-url)
The following table lists the most important product characteristics for the various inverter series. The overview of product characteristics can help you to choose the suitable inverter series for your application.

<table>
<thead>
<tr>
<th>Product characteristics</th>
<th>MOVITRAC® B</th>
<th>MOVIDRIVE® MDX60/61B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Voltage range</td>
<td>1 x 200 ... 240 V&lt;sub&gt;AC&lt;/sub&gt; (limited power range)</td>
<td>3 x 200 ... 240 V&lt;sub&gt;AC&lt;/sub&gt; (limited power range)</td>
</tr>
<tr>
<td></td>
<td>3 x 200 ... 240 V&lt;sub&gt;AC&lt;/sub&gt; (limited power range)</td>
<td>3 x 380 ... 500 V&lt;sub&gt;AC&lt;/sub&gt;</td>
</tr>
<tr>
<td>Power range</td>
<td>0.3-175HP</td>
<td>0.75-175HP</td>
</tr>
<tr>
<td>Overload capacity</td>
<td>150% I&lt;sub&gt;N&lt;/sub&gt;&lt;sup&gt;1)&lt;/sup&gt; briefly and 125% I&lt;sub&gt;N&lt;/sub&gt; permanently during operation without overload</td>
<td></td>
</tr>
<tr>
<td>4Q capable</td>
<td>Yes, with integrated brake chopper as standard.</td>
<td></td>
</tr>
<tr>
<td>Integrated line filter</td>
<td>At 1 x 200 ... 240 V&lt;sub&gt;AC&lt;/sub&gt; according to class B limit</td>
<td>Sizes 0, 1 and 2 according to class A limit</td>
</tr>
<tr>
<td></td>
<td>At 3 x 200 ... 240 V&lt;sub&gt;AC&lt;/sub&gt; und 3 x 380 ... 500 V&lt;sub&gt;AC&lt;/sub&gt; sizes 0, 1 and 2 according to class A limit</td>
<td></td>
</tr>
<tr>
<td>TF input</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>Control mode</td>
<td>U/f or voltage-controlled flux vector control (VFC)</td>
<td>U/f or voltage-controlled flux vector control (VFC), with speed feedback speed control and current-controlled flux vector control (CFC).</td>
</tr>
<tr>
<td>Speed feedback</td>
<td>No</td>
<td>Option</td>
</tr>
<tr>
<td>Integrated positioning and sequence control system</td>
<td>No</td>
<td>Standard</td>
</tr>
<tr>
<td>Serial interfaces</td>
<td>System bus (SBus) and RS-485</td>
<td></td>
</tr>
<tr>
<td>Fieldbus interfaces</td>
<td>Optional via gateway PROFIBUS, INTERBUS, CANopen, DeviceNet, Ethernet</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Optional PROFIBUS-DP, INTERBUS, INTERBUS LWL, CANopen, DeviceNet, Ethernet</td>
<td></td>
</tr>
<tr>
<td>Technology options</td>
<td>IEC 61131 control</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Input/output card, Synchronous operation, Absolute encoder card, IEC 61131 control</td>
<td></td>
</tr>
<tr>
<td>Safe stop</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Approvals</td>
<td>UL and cUL approval, C-tick</td>
<td></td>
</tr>
</tbody>
</table>

1) Only for MOVIDRIVE® MDX60/61B: The short-time overload capacity is 200% I<sub>N</sub> for units of size 0 (0005 ...0014).
8.2 Drive properties

The required drive properties are the main factors determining the selection of the inverter. The following illustration serves as assistance for inverter selection.

<table>
<thead>
<tr>
<th>Positioning accuracy of the motor shaft</th>
<th>Setting range (reference 3000 rpm)</th>
<th>Control</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; ±360°</td>
<td>1:200</td>
<td>Pos. reg.</td>
</tr>
<tr>
<td>&lt; ±5°...45°</td>
<td>1:800</td>
<td>n reg.</td>
</tr>
<tr>
<td>&lt; ±1°</td>
<td>&gt; 1:800</td>
<td>M reg.</td>
</tr>
</tbody>
</table>

- **U/f without encoder or voltage-controlled flux vector control (VFC) without encoder.**
  - MOVITRAC® B
  - MOVIDRIVE® MDX60/61B

- **U/f with encoder or voltage-controlled flux vector control (VFC) with encoder.**
  - MOVIDRIVE® MDX61B with DEH11B option

- **Current-controlled flux vector control (CFC) with encoder.**
  - MOVIDRIVE® MDX61B with DEH11B option

**Motor selection for U/f and VFC**
- Max. torque < 150 % $T_N$
- Max. speed < 140 % $n_{trans}$
- Thermal load (setting range, cyclic duration factor)
- Selection of the correct encoder (if necessary)

**Motor selection for CFC**
- Max. torque < 300 % $T_N$ for asynchronous servomotors and < 180 % $Y_N$ for AC gearmotors
- R.m.s. torque < $T_N$ at average speed
- Torque characteristic curves
- Selecting the correct encoder (for example Hiperface® encoder only with MCH units)

**Key**
- Pos. reg. = Positioning control
- n reg. = Speed control
- T reg. = Torque control
- VFC = Voltage flux control
- CFC = Current flux control
- $T_N$ = Rated torque of the motor
- $n_{trans}$ = Rated speed (transition speed) of the motor
8.3 Selecting the inverter

Drive categories The large number of different drive applications can be divided into five categories. The five categories are listed below together with the recommended inverter. The assignment is based on the required setting range and the resulting control process.

1. Drives with a base load and a speed dependent load, such as conveyor drives.
   - Low requirements on the setting range.
     - MOVITRAC® B
     - MOVIDRIVE® MDX60/61B
   - High requirements on the setting range (motor with encoder).
     - MOVIDRIVE® MDX61B with DEH11B option

2. Dynamic load, e.g. trolleys; brief high torque demand for acceleration followed by low load.
   - Low requirements on the setting range.
     - MOVITRAC® B
     - MOVIDRIVE® MDX60/61B
   - High requirements on the setting range (motor with encoder).
     - MOVIDRIVE® MDX61B with DEH11B option
   - High dynamic properties required (motor with encoder, preferably sin/cos encoder).
     - MOVIDRIVE® MDX61B with DEH11B option

3. Static load, e.g. hoists; mainly steady high static load with overload peaks.
   - Low requirements on the setting range.
     - MOVITRAC® B
     - MOVIDRIVE® MDX60/61B
   - High requirements on the setting range (motor with encoder).
     - MOVIDRIVE® MDX61B with DEH11B option

4. Load falling in inverse proportion to speed, e.g. winding or coil drives.
   - Torque control (motor with encoder, preferably sin/cos encoder).
     - MOVIDRIVE® MDX61B with DEH11B option

5. Variable torque load, e.g. fans and pumps.
   - Low load at low speeds and no load peaks, 125% utilization ($I_D = 125\% I_N$).
     - MOVITRAC® B
     - MOVIDRIVE® MDX60/61B
Further selection criteria

- Power range
- Communication options (serial interfaces, fieldbus)
- Expansion options (such as synchronous operation)
- PLC functionality (IPOSplus®, application modules)

Additional documentation

For detailed information and additional project planning instructions on the individual inverter series, refer to the manuals and catalogs of electronically controlled drives. The SEW-EURODRIVE homepage (http://www.seweurodrive.com) provides links to a wide selection of our documentation in various languages for download as PDF files.

Electronics documentation

Other documents that are of interest in terms of project planning are given below. You can order these publications from SEW-EURODRIVE.

- MOVITRAC® B system manual
- MOVIDRIVE® MDX60/61B system manual

Motor selection

Note the thermally approved torque when selecting the motor. Section 14.3 lists the torque limiting curves of 4-pole asynchronous AC motor DR, DT, DV. Use these limiting curves to determine the thermally approved torque.
8.4 Torque limit curves with inverter operation

Thermally approved torque

Note thermally approved torque in project planning for operation of DR, DT, DV asynchronous AC motors with frequency inverter. The following factors determine the thermally permitted torque:

- Duty type
- Type of cooling: Self-ventilation or forced cooling
- Base frequency $f_{\text{base}} = 60$ Hz (460 V / 60 Hz) or $f_{\text{base}} = 120$ Hz (230 V / 120 Hz)

Use the torque limit curves to determine the thermally permitted torque. The projected, effective torque has to be less than the limit curve value. The following illustration shows the limit curves for 4-pole DR, DT, DV asynchronous AC motors with $f_{\text{base}} = 60$ Hz and $f_{\text{base}} = 120$ Hz. The following peripheral conditions apply to the shown limit curves:

- Duty type S1
- Supply voltage of the inverter $U_{\text{supply}} = 3 \times 460$ V$_{\text{AC}}$
- Motor in thermal class F

$f_{\text{base}} = 60$ Hz (460 V / 60 Hz)

The following diagram shows the limit curves for operation at $f_{\text{base}} = 60$ Hz. The curves are different for those motors with self-ventilation and those with forced cooling (= optional forced cooling fan).

*Figure 80: Torque limit curves for $f_{\text{base}} = 60$ Hz*

1. S1 operation with self-ventilation (= without forced cooling fan)
2. S1 operation with forced cooling (= with forced cooling fan)
3. Mechanical limitations for gearmotors
The following diagram shows the limit curves for operation at $f_{\text{base}} = 120$ Hz. The curves are different for those motors with self-ventilation and those with forced cooling (= optional forced cooling fan).

Figure 81: Torque limit curves for $f_{\text{base}} = 120$ Hz

1. S1 operation with self-ventilation (= without forced cooling fan)
2. S1 operation with forced cooling (= with forced cooling fan)
3. S1 operation with self-ventilation (+without forced cooling fan)>160M
4. Mechanical limitations for gearmotors