Theoretically critical speed

Critical speed

In most applications, you need to check tapped spindles at their critical speed.

The critical speed is that speed which causes resonance oscillations of this spindle.

This critical speed depends on the core diameter, the free load-bearing length and on the way the tapped spindle is constructed.

Given a general safety factor of 0.8, the maximum permissible speed can be calculated as follows:

\[ n_{\text{perm}} = 392 \cdot \frac{a \cdot d_2}{L^2} \times 10^5 \]

Buckling load

The recirculating ball spindle should as far as possible be subjected only to tensile stress. If it is subjected to compressive loads, then the spindle may buckle.

With a safety factor of 3.0 against buckling, the result is

\[ F_{\text{zul}} = \frac{34 000 \cdot b \cdot d_2^4}{L_1^2} \]
Drive dimensioning

Drive torque calculation

The required drive torque is made up of:
- Load torque $M_{\text{load}}$
- Acceleration torques $M_{\text{trans}}$ and $M_{\text{rot}}$
- No load torque $M_{\text{no load}}$

$$M_A = M_{\text{load}} + M_{\text{trans}} + M_{\text{rot}} + M_{\text{no load}}$$

Load torque

$$M_{\text{last}} = \frac{F_X \cdot p}{2 \cdot \pi \cdot 1000}$$
with feed force $F_X = m \cdot g \cdot \mu$

Translational Acceleration torque

$$M_{\text{trans}} = \frac{F_a \cdot p}{2 \cdot \pi \cdot 1000}$$
with feed force $F_a = m \cdot a$

If used vertically, the mass acceleration $a$ must be added to the acceleration due to gravity $g$ (9.81 m/s²).

Rotational acceleration torque

$$M_{\text{rot}} = \frac{J_{sp} \cdot L \cdot n_{\text{max}} \cdot a \cdot 2 \cdot \pi}{V_{\text{max}} \cdot 60 \cdot 1000}$$

Drive power

$$P = \frac{M_A \cdot n_{\text{max}}}{9550}$$

Definitions

- $M_A$ [Nm] required drive torque
- $M_{\text{leer}}$ [Nm] Torque, resulting from the various loads
- $M_{\text{leer}}$ [Nm] No load torque
- $M_{\text{rot}}$ [Nm] Rotational acceleration torque
- $M_{\text{trans}}$ [Nm] translational acceleration torque
- $F_X$ [N] Feed force
- $g$ [m/s²] Acceleration due to gravity
- $v_{\text{max}}$ [m/s] maximum process speed
- $m$ [kg] The weight to be conveyed
- $a$ [m/s²] Acceleration
- $p$ [mm] Spindle pitch
- $P$ [kW] Power
- $L$ [mm] Length
- $n_{\text{max}}$ [rpm] maximum speed
- $\mu$ coefficient of friction
- $J_{sp}$ [kgm²/m] Inertial torque of inertia of the spindle per meter
- $F_a$ [N] Accelerating force

Mechanical specification

<table>
<thead>
<tr>
<th>Linear unit</th>
<th>LES 4</th>
<th>LES 5</th>
<th>LES 6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aluminium profile WxH (mm)</td>
<td>75 x 75</td>
<td>225 x 75</td>
<td>150 x 75</td>
</tr>
<tr>
<td>Guide weight (kg/m)</td>
<td>6.2</td>
<td>13.8</td>
<td>11.4</td>
</tr>
<tr>
<td>Moment of inertia $I_x$ (cm²)</td>
<td>126</td>
<td>299</td>
<td>212</td>
</tr>
<tr>
<td>Moment of inertia $I_y$ (cm²)</td>
<td>107</td>
<td>2362</td>
<td>707</td>
</tr>
<tr>
<td>Weight with spindle (kg/m)</td>
<td>7.6</td>
<td>15.2</td>
<td>12.8</td>
</tr>
<tr>
<td>Guide slides</td>
<td>1x WS 5-70</td>
<td>2x WS 5-70</td>
<td>2x WS 5-70</td>
</tr>
<tr>
<td>Slide weight (kg)</td>
<td>0.34 / 0.68</td>
<td>0.68 / 1.36</td>
<td></td>
</tr>
<tr>
<td>Spindle pitch (mm)</td>
<td>2.5 / 4 / 5 / 10 / 20</td>
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<td></td>
</tr>
<tr>
<td>Max. permissible feed force (N)</td>
<td>2626 / 3450 / 3450 / 3150 / 1425</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Repeat accuracy (mm)</td>
<td>± 0.02</td>
<td></td>
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</tr>
<tr>
<td>Process path (mm)</td>
<td>L 1 - 150 / L 1 - 280</td>
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<td></td>
</tr>
<tr>
<td>Noise level (dBA)</td>
<td>&lt; 85</td>
<td></td>
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</tr>
<tr>
<td>Storage temperature range (°C)</td>
<td>0 – 40</td>
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</tr>
<tr>
<td>Operating temperature range (°C)</td>
<td>0 – 60 (80)</td>
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<tr>
<td>Relative air humidity (%)</td>
<td>&lt; 90</td>
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</tbody>
</table>
Combination examples

Crossbench

2 × LES 5
PS 4 with VP 2
Slide on slide assembly

Crossbench

2 × LES 5
VP 2 with PS 4

2-axis H-design

2 × LES 4, LES 5, 2 × PS 6, PS 4, gantry mode

2-axis flatbed configuration

2 x LES 4, LES 5, 2 X PS 2
2 x WV 2, PS 4, gantry mode

2-axis lifting configuration

2 × LES 5, 2 × PS 4
WV 6

2-axis boom configuration

2 × LES 5
2 × PS 4
WV 3

2-axis H-design

LES 5, 2 × LES 6, 2 x WV 7,
2 x PS 12, PS 4, gantry mode
Combination examples

3-axis boom configuration
2 × LES 5, LES 6, WV 3, 2 × PS 4, PS 7

3-axis raised boom configuration
3 × LES 5, WV 3, 2 × PS 4, VP 2

3-axis portal configuration
2 × LES 5, 2 × LES 6, 2 × WV 7, 2 × PS 4, PS 12, gantry mode

3-axis flatbed configuration
2 × LES 4, LES 5, LES 6, 2 × PS 2, 2 × WV 2, PS 4, PS 7, gantry mode

4-axis portal configuration
3 × LES 5, 2 × LES 6, 2 × WV 7, 3 × PS 4, 2 × PS 12

5-axis flatbed configuration
2 × LES 5 (Z-axis), LES 5 (2 spindle drives) 2 × LES 4, 2 × PS 2, 2 × WV 2, 2 × PS 4 with VP 2
# Motor modules

## Ordering overview

<table>
<thead>
<tr>
<th>LES 4/5/6 direct drives</th>
<th>Circular plug</th>
<th>Circular plug with brake</th>
<th>Single axis controller</th>
<th>Multiple axis controller</th>
</tr>
</thead>
<tbody>
<tr>
<td>DC servomotor DC 100</td>
<td>396112 0060</td>
<td>-</td>
<td>MC 1-10</td>
<td>iCU-DC / iPU-DC</td>
</tr>
<tr>
<td>Stepper motor MS 200 HT - 2</td>
<td>396058 0060</td>
<td>396058 0260</td>
<td>IT 116 Flash</td>
<td>iMC-P / iMC-S8</td>
</tr>
<tr>
<td>EC servomotor EC 60S</td>
<td>396415 0060</td>
<td>396415 0260</td>
<td>MC 1-20</td>
<td>iCU-EC / iPU-EC</td>
</tr>
<tr>
<td>EC servomotor EC 60L 48V</td>
<td>396423 0060</td>
<td>-</td>
<td>MC 1-20</td>
<td>iCU-EC / iPU-EC</td>
</tr>
<tr>
<td>EC servomotor EC 60L 310V</td>
<td>396423 0070</td>
<td>396423 0270</td>
<td>MC 1-40</td>
<td>iCU-EC / iPU-EC</td>
</tr>
<tr>
<td>EC servomotor EC 86L</td>
<td>396466 0070</td>
<td>-</td>
<td>MC 1-40</td>
<td>Switching cabinet</td>
</tr>
<tr>
<td>EC servomotor EC 86S</td>
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<td>-</td>
<td>MC 1-40</td>
<td>Switching cabinet</td>
</tr>
<tr>
<td>Stepper motor MS 300 HT - 2</td>
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<td>396082 0260</td>
<td>iMC-S8</td>
<td>iMC-S8</td>
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<tr>
<td>Stepper motor MS 600 HT</td>
<td>396085 0060</td>
<td>-</td>
<td>iMC-S8</td>
<td>iMC-S8</td>
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<tr>
<td>Stepper motor MS 900 HT</td>
<td>396088 0060</td>
<td>-</td>
<td>iMC-S8</td>
<td>iMC-S8</td>
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<table>
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<tr>
<th>LES 5 integrated</th>
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<th>Circular plug with brake</th>
<th>Single axis controller</th>
<th>Multiple axis controller</th>
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<tr>
<td>Stepper motor MS 200 HT - 2</td>
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<td>396058 1260</td>
<td>IT 116 Flash</td>
<td>iMC-P / iMC-S8</td>
</tr>
<tr>
<td>DC servomotor DC 100</td>
<td>396112 1060</td>
<td>-</td>
<td>MC 1-10</td>
<td>iCU-DC / iPU-DC</td>
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<tr>
<td>EC servomotor EC 60S</td>
<td>396415 1060</td>
<td>396415 1260</td>
<td>MC 1-20</td>
<td>iCU-EC / iPU-EC</td>
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<tr>
<td>EC servomotor EC 60L 48V</td>
<td>396423 1060</td>
<td>-</td>
<td>MC 1-20</td>
<td>iCU-EC / iPU-EC</td>
</tr>
<tr>
<td>EC servomotor EC 60L 310V</td>
<td>396423 1070</td>
<td>396423 1270</td>
<td>MC 1-40</td>
<td>Switching cabinet</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>LES 4/LES 6 side mounting</th>
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<th>Circular plug with brake</th>
<th>Single axis controller</th>
<th>Multiple axis controller</th>
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</thead>
<tbody>
<tr>
<td>Stepper motor MS 200 HT - 2</td>
<td>396058 2060</td>
<td>396058 2260</td>
<td>IT 116 Flash</td>
<td>iMC-P</td>
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<tr>
<td>DC servomotor DC 100</td>
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<td>MC 1-10</td>
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<td>EC servomotor EC 60S</td>
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<td>396415 2260</td>
<td>MC 1-20</td>
<td>iCU-EC</td>
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<tr>
<td>EC servomotor EC 60L 48V</td>
<td>396423 2060</td>
<td>-</td>
<td>MC 1-20</td>
<td>iCU-EC</td>
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<tr>
<td>EC servomotor EC 60L 310V</td>
<td>396423 2070</td>
<td>396423 2270</td>
<td>MC 1-40</td>
<td>iCU-EC</td>
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</table>
Motor modules

dimensioned drawing
Motor module 1

<table>
<thead>
<tr>
<th>Part no.</th>
<th>Motor module</th>
<th>Length L</th>
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</thead>
<tbody>
<tr>
<td>396415 0260</td>
<td>EC 60S with brake</td>
<td>99 mm</td>
</tr>
<tr>
<td>396415 0060</td>
<td>EC 60S without brake</td>
<td>99 mm</td>
</tr>
<tr>
<td>396423 0080</td>
<td>EC 60L 48V</td>
<td>120 mm</td>
</tr>
<tr>
<td>396423 0070</td>
<td>EC 60L 310V</td>
<td>120 mm</td>
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</table>

dimensioned drawing
EC 60

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<th>Part no.</th>
<th>Motor module</th>
<th>Length L</th>
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<tr>
<td>396112 0060</td>
<td>DC 100</td>
<td>185 mm</td>
</tr>
<tr>
<td>396058 0360</td>
<td>MS 200 HT-2 with brake</td>
<td>165 mm</td>
</tr>
<tr>
<td>396058 0060</td>
<td>MS 200 HT-2 without brake</td>
<td>105 mm</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Part no.</th>
<th>Motor module</th>
<th>Length L</th>
</tr>
</thead>
<tbody>
<tr>
<td>396085 0960</td>
<td>MS 600HT</td>
<td>96 mm</td>
</tr>
<tr>
<td>396088 0060</td>
<td>MS 900 HT</td>
<td>126 mm</td>
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dimensioned drawing
Motor module 2
Clutch housing

Connection options
Direct drive preparation

<table>
<thead>
<tr>
<th>Connecting options</th>
<th>LES 4</th>
<th>LES 6</th>
<th>LES 5</th>
<th>Angular gear fixing 0°</th>
<th>Angular gear fixing 90°</th>
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<tbody>
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<tr>
<td>MS 200 HT-2 DC 100 EC 60</td>
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<td></td>
<td>Coupling casing 1 long sleeve</td>
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<tr>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MS 600 HT MS 900 HT EC 86</td>
<td></td>
<td></td>
<td></td>
<td>Coupling casing 2 long sleeve</td>
<td></td>
</tr>
<tr>
<td>Angular gear fixing 0°</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>split coupling casing short sleeve</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>with adequate shaft coupling</td>
</tr>
<tr>
<td>Angular gear fixing 90°</td>
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<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>split coupling casing short sleeve</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>with adequate shaft coupling</td>
</tr>
<tr>
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<td></td>
</tr>
</tbody>
</table>

Ordering overview
Clutch housing

Clutch housing 1

- short sleeve
  - Part no.: 218 100 0001

- long sleeve
  - Part no.: 218 100 0002

Clutch housing 2

- short sleeve
  - Part no.: 218 100 1001

- long sleeve
  - Part no.: 218 100 1002

Split clutch housing

- short sleeve
  - Part no.: 218 100 2001

- long sleeve
  - Part no.: 218 100 2002

Clutches

<table>
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<tr>
<th>coupling</th>
<th>Item no.:</th>
<th>( d_1 )</th>
<th>( d_2 )</th>
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<tbody>
<tr>
<td>20/30</td>
<td>218 001 5060</td>
<td>5,0</td>
<td>6,0</td>
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<tr>
<td></td>
<td>218 001 9999</td>
<td>from 4 to 7 mm</td>
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</tr>
<tr>
<td>30/40</td>
<td>218 002 6380</td>
<td>6,35</td>
<td>8,0</td>
</tr>
<tr>
<td></td>
<td>218 002 8080</td>
<td>8,0</td>
<td>8,0</td>
</tr>
<tr>
<td></td>
<td>218 002 9999</td>
<td>from 6 to 13 mm</td>
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<tr>
<td>40/60</td>
<td>218 003 9580</td>
<td>9,52</td>
<td>8,0</td>
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<tr>
<td></td>
<td>218 003 9999</td>
<td>from 8 to 18 mm</td>
<td></td>
</tr>
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</table>
**Clutch housing**

**Drive element accessories**

**dimensioned drawing**
Coupling casing 1

*4 clamping screws M6 x 75 100*

*) Measures refer to the dimensions with long sleeves

$d_1$ = engine shaft diameter 6.35/8/9 mm

Suitable shaft coupling WK 40/60 on page 2-68 (not included in scope of delivery)

**dimensioned drawing**
Coupling casing 2

*4 clamping screws M6 x 75 100*

*) Measures refer to the dimensions with long sleeves

$d_1$ = engine shaft diameter 6.35/8/9 mm

Suitable shaft coupling WK 40/60 on page 2-68 (not included in scope of delivery)

**dimensioned drawing**
Split coupling casing

*) Measures refer to the dimensions with long sleeves

Suitable shaft coupling WK 40/60 on page 2-68 (not included in scope of delivery)
Motor pin assignments

Pin assignment for stepper motors

Motor connection

<table>
<thead>
<tr>
<th>M23 12-pin Pin</th>
<th>Motor connection</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Motor phase 1A</td>
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</tr>
<tr>
<td>2 Motor phase 1B</td>
<td>2 Motor phase 1B</td>
</tr>
<tr>
<td>3 Motor phase 2A</td>
<td>3 Motor phase 2A</td>
</tr>
<tr>
<td>4 Motor phase 2B</td>
<td>4 Motor phase 2B</td>
</tr>
<tr>
<td>5 +24V switch</td>
<td>5 +24V switch</td>
</tr>
<tr>
<td>6 +24V brake</td>
<td>6 +24V brake</td>
</tr>
<tr>
<td>7 GND switch</td>
<td>7 Limit switch 1</td>
</tr>
<tr>
<td>8 GND brake</td>
<td>8 GND brake</td>
</tr>
<tr>
<td>9 Limit switch 1</td>
<td>9 Limit switch 1</td>
</tr>
<tr>
<td>10 Limit switch 2</td>
<td>10 Limit switch 2</td>
</tr>
<tr>
<td>11 ---</td>
<td>11 ---</td>
</tr>
<tr>
<td>12 ---</td>
<td>12 ---</td>
</tr>
</tbody>
</table>

Housing - cable shield

Pin assignment for DC servo motors with brushes (BDC)

Motor connection

<table>
<thead>
<tr>
<th>M23 9-pol. (8+1) pin</th>
<th>Motor connection</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Motor phase 1 (V+)</td>
<td>1 Motor phase 1 (V+)</td>
</tr>
<tr>
<td>2 Motor phase 1 (V-)</td>
<td>2 Motor phase 1 (V-)</td>
</tr>
<tr>
<td>3 Motor phase 1 (V+)*</td>
<td>3 Motor phase 1 (V+)*</td>
</tr>
<tr>
<td>4 Motor phase 1 (V-)*</td>
<td>4 Motor phase 1 (V-)*</td>
</tr>
<tr>
<td>5 +24V brake</td>
<td>5 +24V brake</td>
</tr>
<tr>
<td>6 GND brake</td>
<td>6 GND brake</td>
</tr>
<tr>
<td>7 ---</td>
<td>7 ---</td>
</tr>
<tr>
<td>8 ---</td>
<td>8 ---</td>
</tr>
<tr>
<td>9 Earthing lead</td>
<td>9 Earthing lead</td>
</tr>
</tbody>
</table>

Housing - cable shield

Encoder connection

<table>
<thead>
<tr>
<th>Sub-D 15-pin Pin</th>
<th>Encoder connection</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 ---</td>
<td>1 ---</td>
</tr>
<tr>
<td>2 +5V encoder</td>
<td>2 +5V encoder</td>
</tr>
<tr>
<td>3 Encoder track/Z</td>
<td>3 Encoder track/Z</td>
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<tr>
<td>4 Encoder track/B</td>
<td>4 Encoder track/B</td>
</tr>
<tr>
<td>5 Encoder track/A</td>
<td>5 Encoder track/A</td>
</tr>
<tr>
<td>6 +24V switch</td>
<td>6 +24V switch</td>
</tr>
<tr>
<td>7 Limit switch 1</td>
<td>7 Limit switch 1</td>
</tr>
<tr>
<td>8 GND switch</td>
<td>8 GND switch</td>
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<tr>
<td>9 ---</td>
<td>9 ---</td>
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<tr>
<td>10 GND encoder</td>
<td>10 GND encoder</td>
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<tr>
<td>11 Encoder track Z</td>
<td>11 Encoder track Z</td>
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<td>12 Encoder track B</td>
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<td>14 Reference switch</td>
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</tr>
<tr>
<td>15 Limit switch 2</td>
<td>15 Limit switch 2</td>
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</table>

Housing - cable shield

Pin assignment for brushless EC servo motors (BLDC) 48V

Motor connection

<table>
<thead>
<tr>
<th>M23 9-pol. (8+1) pin</th>
<th>Motor connection</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Motor phase U</td>
<td>1 Motor phase U</td>
</tr>
<tr>
<td>2 Motor phase V</td>
<td>2 Motor phase V</td>
</tr>
<tr>
<td>3 Motor phase W</td>
<td>3 Motor phase W</td>
</tr>
<tr>
<td>4 ---</td>
<td>4 ---</td>
</tr>
<tr>
<td>5 +24V brake</td>
<td>5 +24V brake</td>
</tr>
<tr>
<td>6 GND brake</td>
<td>6 GND brake</td>
</tr>
<tr>
<td>7 ---</td>
<td>7 ---</td>
</tr>
<tr>
<td>8 ---</td>
<td>8 ---</td>
</tr>
<tr>
<td>9 Earthing lead</td>
<td>9 Earthing lead</td>
</tr>
</tbody>
</table>

Housing - cable shield

Encoder connection

<table>
<thead>
<tr>
<th>Sub-D 15-pin Pin</th>
<th>Encoder connection</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Hall signal A</td>
<td>1 Hall signal A</td>
</tr>
<tr>
<td>2 +5V encoder/Hall</td>
<td>2 +5V encoder/Hall</td>
</tr>
<tr>
<td>3 Encoder track/Z</td>
<td>3 Encoder track/Z</td>
</tr>
<tr>
<td>4 Encoder track/B</td>
<td>4 Encoder track/B</td>
</tr>
<tr>
<td>5 Encoder track/A</td>
<td>5 Encoder track/A</td>
</tr>
<tr>
<td>6 +24V switch</td>
<td>6 +24V switch</td>
</tr>
<tr>
<td>7 Limit switch 1</td>
<td>7 Limit switch 1</td>
</tr>
<tr>
<td>8 GND switch</td>
<td>8 GND switch</td>
</tr>
<tr>
<td>9 Hall signal B</td>
<td>9 Hall signal B</td>
</tr>
<tr>
<td>10 GND encoder</td>
<td>10 GND encoder</td>
</tr>
<tr>
<td>11 Encoder track Z</td>
<td>11 Encoder track Z</td>
</tr>
<tr>
<td>12 Encoder track B</td>
<td>12 Encoder track B</td>
</tr>
<tr>
<td>13 Encoder track A</td>
<td>13 Encoder track A</td>
</tr>
<tr>
<td>14 Hall signal C</td>
<td>14 Hall signal C</td>
</tr>
<tr>
<td>15 Limit switch 2</td>
<td>15 Limit switch 2</td>
</tr>
</tbody>
</table>

Housing - cable shield
## Overview of motor leads for stepper, DC servo and EC motors*

<table>
<thead>
<tr>
<th>Part number</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>392750 0500</td>
<td>5-metre stepper motor lead M23 12-pin plug - socket 1:1</td>
</tr>
<tr>
<td>392755 0500</td>
<td>5-metre stepper motor lead D-sub 9-pin plug - M23 12-pin socket</td>
</tr>
<tr>
<td>392781 0500</td>
<td>5-metre stepper motor lead D-sub 9-pin plug - socket 1:1</td>
</tr>
<tr>
<td>392759 0500</td>
<td>5-metre DC/EC servo motor lead M23 9-pin (8 + PE) plug - socket 1:1</td>
</tr>
<tr>
<td>392760 0500</td>
<td>5-metre DC/EC servo motor lead M23 9-pin (8+PE) socket - wire end ferrules</td>
</tr>
<tr>
<td>392740 0500</td>
<td>5-metre encoder lead D-sub 15-pin plug - socket 1:1</td>
</tr>
<tr>
<td>392325 0500</td>
<td>5-metre encoder lead M23 17-pin socket - D-sub 15-pin plug</td>
</tr>
<tr>
<td>392305 0500</td>
<td>3-metre EC/AC servo motor lead M23 310V (4+3+PE) socket - wire end ferrules</td>
</tr>
<tr>
<td>392307 0500</td>
<td>5-metre EC servo motor lead M23 (4+3+PE) plug - socket 1:1</td>
</tr>
</tbody>
</table>

All listed motor and encoder leads are fit for use with tow chains.

* Different lengths available on request!
Installation kit with angular transmission

Installation alternatives

Clutch housing kit 90°

Clutch housing kit 0°

1. Angular gear
2. Split coupling casing with shaft coupling WK 40/60
3. LES 4, LES 6 or LES 5 (preparation for direct drive)
4. Coupling for transmission shaft Ø 25
5. Transmission shaft Ø 25
6. Pedestal bearing - recommendable from transmission shaft length of 1,500 mm up

Dimensioned drawing

Angular transmission

Ordering overview

Installation kit with angular transmission

for H-design on LES 4/LES 6/LES 5,
0° mounting
Scope of delivery: 2 x 1, 2 x 2, 2 x 4
Part no.: 216150 0001
for H-design on LES 4/LES 6/LES 5,
90° mounting
Scope of delivery: 2 x 1, 2 x 2, 2 x 4
Part no.: 216150 0002
For matching direct drive modules LES 4/5/6 see table on page 2-66

Transmission shaft

Hollow shaft Ø 25 mm × 4 mm, blank
1000 mm
Part no.: 219001 0125
Hollow shaft Ø 25 mm × 4 mm, blank
2000 mm
Part no.: 219001 0225

Coupling/stationary bearing

Coupling for transmission shaft
12 to 25 mm adaptor, VE 2 units
Part no.: 218050 0002
Stationary bearing for transmission shaft
VE 1 unit
Part no.: 896202 5562

For matching direct drive modules LES 4/5/6 see table on page 2-66

made by isel®
Installation kit with angular transmission

Dimensioned drawing and technical specification

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transmissible torque</td>
<td>18 Nm</td>
</tr>
<tr>
<td>Weight of coupling</td>
<td>0.3 kg</td>
</tr>
<tr>
<td>Weight of shaft</td>
<td>0.540 kg/m</td>
</tr>
<tr>
<td>Moment of inertia of both couplings</td>
<td>2.68 * 10^-4 kgm^2</td>
</tr>
<tr>
<td>Moment of inertia of shaft</td>
<td>8.171 * 10^-7 kgm^2/100 mm</td>
</tr>
</tbody>
</table>

Dimensioned drawing - coupling
Slide/crossbench plates

Hole diagram, slide plate PS 1
L 125 x W 70 x H 7.7 mm
Mounting on: LES 4 with 1 x WS 5/70
Part no.: 277001

Hole diagram, slide plate PS 2
L 255 x W 70 x H 7.7 mm
Mounting on: LES 5 with 2 x WS 5/70
Connecting cross 2 x LES 4
Fixing option for: Angle bracket WV 2 / WV 5
Part no.: 277002

Hole diagram, slide plate PS 3
L 220 x W 125 x H 7.5 mm
Mounting on: LES 5 with 2 x WS 5/70
Part no.: 277003

Hole diagram, slide plate PS 4
L 225 x W 220 x H 7.5 mm
Mounting on: LES 5 with 4 x WS 5/70
Mounting on crossbench: LES 5 with LES 5 (in conjunction with VP 2) Fixing option for: Angle bracket WV 3 / WV 6
Part no.: 277004

Hole diagram, slide plate PS 5
L 220 x W 125 x H 7.5 mm
Mounting on: LES 4 with 2 x WS 5/70
Mounting on crossbench: LES 4 with LES 5 (in conjunction with PS 3). Fixing option for: LES 4/LES 5
Part no.: 277011

Hole diagram, slide plate PS 6
L 220 x W 125 x H 7.5 mm
Mounting on: LES 4 with 2 x WS 5/70
Part no.: 277016

Hole diagram, slide plate PS 7
L 225 x W 220 x H 7.5 mm
Mounting on: LES 6 with 4 x WS 5/70
Mounting on crossbench: LES 6 with LES 5 (in conjunction with PS 4)
Part no.: 277016

Connectors

Connecting cross 2 x LES 4
Part no.: 277007
**Slide/crossbench plates**

**Hole diagram, slide plate PS 8**
L 125 × W 145 × H 7.7 mm
Mounting on: LES 6 with 2 × WS 5/70
Part no.: 277017

**Hole diagram, slide plate PS 9**
L 250 × W 145 × H 7.5 mm
Mounting on: LES 6 with 4 × WS 5/70
Fixing option for: Angle bracket WV 7
Part no.: 277018

**Hole diagram, slide plate PS 10**
L 210 × W 215 × H 7.5 mm
Mounting on: LES 6 with 4 × WS 5/70
Mounting on crossbench: LES 6 with LES 6 (in conjunction with PS 11)
Part no.: 277019

**Hole diagram, slide plate PS 11**
L 210 × W 215 × H 7.5 mm
Mounting on: LES 6 with 4 × WS 5/70
Mounting on crossbench: LES 6 with LES 4 (in conjunction with PS 10)
Fixing option for: LES 6
Part no.: 277020

**Hole diagram, slide plate PS 12**
L 220 × W 180 × H 7.5 mm
Mounting on: LES 6 with 4 × WS 5/70
Fixing option for: LES 5
Part no.: 277021

**Hole diagram, connection plate VP 2**
L 255 × W 220 × H 7.5 mm
Mounting on: LES 5 with 4 × WS 5/70
Fixing option for: LES 5
Part no.: 277006
Slide/crossbench plates

Hole diagram, slide plate set for crossbench LES 4
L 100 x W 100 x H 8 mm
Mounting on: LES 4
Fixing option for: LES 4
Part no.: 277008

Crossbench connection plates 1

2 × L 255 × W 220 x H 8 mm
one set from PS 4 and VP 2,
for right-angled connection
two linear guides LES 5
Part no.: 277010

Crossbench connection plates 2

2 x L 220 x W 125 x H 8 mm
one set from PS 3 and PS 6,
for right-angled connection
one linear guide LES 5 with one
linear guide LES 4
Part no.: 277012

Additional combination examples

Crossbench LES 5 and LES 6
PS 4 and PS 7
Crossbench 2 × LES 6
PS 10 and PS 11
Crossbench LES 4 and LES 6
PS 11 and PS 10
T-slot slide plates

Hole pattern T-slot plate PT 25 × 250 for LES 4
L 100 x W 75 x H 20 mm
Mounting on: LES 4 with 1 x WS 5/70
Part no.: 277030 0001

Hole pattern T-slot plate PT 25 × 250 for LES 6
L 100 x W 125 x H 20 mm
Mounting on: LES 6 with 2 x WS 5/70
Part no.: 277030 0003

Hole pattern T-slot plate PT 25 × 250 for LES 5
L 100 x W 250 x H 20 mm
Mounting on: LES 5 with 2 x WS 5/70
Part no.: 277030 0005

Connectors

Hole pattern T-slot plate PT 25 × 250 for LES 5
L 200 x W 75 x H 20 mm
Mounting on: LES 4 with 2 x WS 5/70
Part no.: 277030 0002

Hole pattern T-slot plate PT 25 × 250 for LES 6
L 200 x W 125 x H 20 mm
Mounting on: LES 6 with 4 x WS 5/70
Part no.: 277030 0004

Hole pattern T-slot plate PT 25 × 250 for LES 5
L 200 x W 250 x H 20 mm
Mounting on: LES 5 with 4 x WS 5/70
Part no.: 277030 0006
## Angle brackets

**Angle bracket with clamping surfaces milled flat**

<table>
<thead>
<tr>
<th>Angle bracket</th>
<th>Specifications</th>
<th>Part no.</th>
</tr>
</thead>
<tbody>
<tr>
<td>WV 1</td>
<td>Blank, Aluminium casting (0.2 kg), L71 × W75 × H71</td>
<td>209110 0010</td>
</tr>
<tr>
<td>WV 2</td>
<td>Blank, Aluminium casting (2.6 kg), L221 × W75 × H446</td>
<td>209110 0022</td>
</tr>
<tr>
<td>WV 3</td>
<td>Blank, Aluminium casting (5.8 kg), L221 × W221 × H446</td>
<td>209110 0032</td>
</tr>
<tr>
<td>WV 6</td>
<td>Blank, Aluminium, welded (13.3 kg), L220 × W220 × H670</td>
<td>209110 0060</td>
</tr>
<tr>
<td>WV 7</td>
<td>Blank, Aluminium, welded (10.8 kg), L220 × W145 × H670</td>
<td>209110 0070</td>
</tr>
<tr>
<td>WV 8</td>
<td>Blank, Aluminium, welded (7.4 kg), L222 × W145 × H446</td>
<td>209110 0080</td>
</tr>
<tr>
<td>WV 19</td>
<td>Blank, Aluminium, welded (2.5 kg), L150 × W221 × H300</td>
<td>209110 0190</td>
</tr>
</tbody>
</table>

## Matching cover plates

- **Cover plate for WV 2**
  - Naturally anodised
  - Aluminium sheet, weight 0.8 kg
  - Part no.: 209110 0021

- **Cover plate for WV 3**
  - Naturally anodised
  - Aluminium sheet, weight 1.15 kg
  - Part no.: 209110 0031

- **Cover plate for WV 6**
  - Naturally anodised
  - Aluminium sheet, weight 1.8 kg
  - Part no.: 209110 0061

- **Cover plate for WV 7**
  - Naturally anodised
  - Aluminium sheet, weight 1.5 kg
  - Part no.: 209110 0071

- **Cover plate for WV 8**
  - Naturally anodised
  - Aluminium sheet, weight 1 kg
  - Part no.: 209110 0081
Angle bracket

Hole diagram
Angle bracket WV 1
L 71 x W 75 x H 71 mm

Hole diagram
Angle bracket WV 2
L 221 x W 75 x H 446 mm

Hole diagram
Angle bracket WV 3
L 221 x W 221 x H 446 mm

made by isel®
Angle brackets

Hole diagram
Angle bracket WV 6
L 220 x W 220 x H 670 mm

Hole pattern FRONT

Hole pattern BOTTOM

Hole diagram
Angle bracket WV 7
L 220 x W 145 x H 670 mm

Hole pattern FRONT

Hole pattern BOTTOM

Hole diagram
Angle bracket WV 8
L 222 x W 145 x H 446 mm

Hole pattern FRONT

Hole pattern BOTTOM

Hole diagram
Angle bracket WV 19
L 150 x W 221 x H 300 mm

Hole pattern FRONT

Hole pattern BOTTOM
Accessories

Energy guidance chain

Energy guide chain 3
- VE 1 unit at 1 m
Part no.: 219204 1000

Connectors for energy chain 3
- with strain relief
- VE 1 kit
Part no.: 219205 0002

Dimensioned drawing

Tapped strips/sliding nuts

Tapped strips M6 (no figure)
- Galvanised
- Ra 50 mm
- 3 x VE 1 m piece
Part no.: 209011

Sliding nut 2 × M6 (Figure 2)
- Galvanised
- VE 50 pieces
Part no.: 209002 0004

Special angle sliding nut 3 × M6 (Figure 3)
- Galvanised
- VE 25 pieces
Part no.: 209022 0003

Sliding nut M6 (Figure 1)
- Galvanised
- VE 100 pieces
Part no.: 209001 0005

Angle sliding nut 2 × M6 (Figure 4)
- Galvanised
- VE 25 pieces
Part no.: 209021 0003

Attachment kits

Gas strut attachment kit
- Hub 220 mm
- Nominal length 490 mm
Part no.: 216450 0001

Gas strut attachment kit for LES 4
- for external limit switches
- Process path reduction by approx. 40 mm
Part no.: 216460 0001

Limit switch attachment kit LES 6
- for external limit switches
- Process path reduction by approx. 40 mm
Part no.: 216460 0003

Limit switch attachment kit LES 5
- for external limit switches
- Process path reduction by approx. 40 mm
Part no.: 216460 0002

Limit switch attachment kit LES 5
- for external limit switches
- Process path reduction by approx. 40 mm
Part no.: 216460 0002

Mounting set for sealing air
- for LES4 - LES6
Part no.: 216460 0006