Brushless internal rotor motors with low-backlash planetary gears

Drive solutions | Industrial drive engineering 2018-06
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**Standards and guidelines**  
Operating factor, lifetime, efficiency  
ebm-papst around the world
Information for ECI motors.

Key figures
- 3-phase, electronically commutated internal rotor motor with high-performance magnet
- Power range between 30 and 750 watts
- High power density realized in a compact design
- High overload capacity
- Long service life
- Very quiet operation
- Detection of rotor position via Hall sensors
- Customer-specific winding layouts
- Winding insulation as per insulation class E
- Protection class IP 54 as per EN 60 034-5: up to IP 65
- Various motor types which can be combined with planetary and crown gearheads
- Optional integrated control electronics
- Optional encoder and brake modules

Approvals
- Support with the accreditation of products in different economic areas and markets
- As an experienced and competent partner we would be happy to support you
- Possible approvals include CE, CCC, UL, CSA, EAC
- Additional approvals on request
The data in this catalog contain product specifications, but are not a guarantee of particular properties.

All information is based on the measuring conditions mentioned below. Operation of motors using reference electronics at an ambient temperature of max. 40°C when attached (thermally conductive) to a free-standing steel plate of the following size: Steel plate 105 x 105 x 10 mm

The nominal operating point is the basis for the electromagnetic design of the motor from the point of view of the maximum possible continuous output of the motor and is specified by the nominal values described here.

The values mentioned are typical values for the design in question and are also subject to the tolerances included in the specifications or drawings. Unless otherwise stated, the supplements and safety notes contained in the relevant operating and assembly instructions must be kept at all times. Subject to availability and technical alterations.

Nominal output power $P_N$ [W]
The output power which the motor can produce continuously; it is calculated from nominal torque and nominal speed. For the electromagnetic design of the motor the determination of the nominal operating point is based on the fact that the nominal output power is close the maximum output power of the motor.

Nominal voltage $U_{in}, U_n, U_b$ [V DC]
The DC voltage (i.e. DC voltage range) that is applied to the commutation electronics as a system supply voltage. All nominal values listed in the technical tables of the individual motors refer to this voltage. Motor applications are, however, not restricted to this voltage.

Nominal speed $n_N$ [rpm]
The speed at which the motor may be operated continuously while delivering nominal torque at an ambient temperature of 40°C and nominal output torque. It is an operating point on the max. motor curve based on an ideal electronics with negligible losses.

Nominal torque $M_N$ [mNm]
The torque that the motor can deliver continuously at an ambient temperature of 40°C and nominal speed.

The illustrated curves are idealized representations based on the figures in the tables.

Nominal current $I_{in}$
The current that is drawn from the system supply when the motor delivers nominal torque at nominal speed.

Speed at no-load operation $n_L$ [rpm]
The speed that takes effect at the nominal voltage and with unloaded motor. The theoretical possible speed at no-load operation can, in some cases, be limited by the mechanical ceiling speed.

No-load current $I_{BL}$ [A]
Is established with nominal voltage and unloaded motor; is largely influenced by the bearing friction. For drive systems that have a separate supply for power and logic, the no-load current is called $I_L$. This no-load current is the sum of the power supply ($I_{ZK}$) and the low-power logic supply ($I_B$).

Permanant stall torque $M_{bs}$ [mNm]
Is the maximum permissible torque with which the motor may be permanently loaded when the rotor is locked.

Permissible eff. continuous stall current $I_{sn}$ [A]
Is the maximum permissible current which at a stalled motor is allowed to flow into the motor lead as an effective value.
Continuous stall power $P_{\text{ss}}$ [W]
Is an approximate value for the voltage-independent maximum permitted output ($P=U \times I$) that can be taken from the DC voltage source in holding status.

Permissible peak torque short-term $M_{\text{max}}$ [mNm]
Is the torque which the motor can usually deliver in a short time.

Permissible peak current, motor lead $I_{\text{max}}$ [A]
Is the current that must flow into the motor lead as a peak value to achieve the short-time peak torque.

Induced voltage $U_{\text{max}}$ [V/1 000 rpm]
Maximum value of the induced voltage between two motor leads at 1 000 rpm. It is a dimension for the electromagnetic utilization of the motor.

Connection resistance $R_v$ [Ohm]
The winding resistance that is measured at 20°C between any two of three winding terminations.

Connection inductance $L_v$ [mH]
The average inductance that is measured at 20°C between any two of three winding terminations using a sinusoidal waveform measuring frequency of 1 kHz.

Rotor moment of inertia $J_{\text{r}}$ [kgm²x10⁻⁶]
The mass moment of inertia of the rotor and necessary dimension for the dynamic characteristics of the motor.

Protection class
Information on the protection class; it describes protection against foreign particles (Point 1) and water (Point 2).

Permissible ambient temperature range $T_{\text{a}}$ [°C]
Defines the minimum and maximum permissible ambient temperature to which the mentioned performance values apply when the motor is in operation. The permissible winding temperature in the motor (115°C for insulation Class E, as per EN 60 034-1) <1125 should not be exceeded.

Weight $m$ [kg]
Weight of the delivered unit without additional units or packaging.

Max. shaft load $F_{\text{radial}}/F_{\text{axial}}$ [N]
The permissible forces are divided into radial and axial load values. They are based on the maximum permissible values for the motor bearing during operation at normal rating and a defined service life expectancy $L_{10}$.

Service life $L_{10}$
The values for the $L_{10}$ service life specified in conjunction with the permitted bearing loads have been calculated to DIN ISO 281. In addition to the specified values, this calculation is based on operation of the motor at nominal conditions (nominal torque, nominal speed) and an ambient temperature of max. 40°C. Therefore, the service life information is explicitly not a guarantee of service life, but strictly a theoretical quality figure.

Max. reverse voltage [V DC]
When the braking function is activated and when the set value step change is negative, the motor operates in controlled braking mode. In this operating state, the large part of the braking energy is fed back to the intermediate circuit until the max. reverse voltage is reached and the electronics prevent a further increase beyond this value by chopped braking. This behavior should be given special consideration when selecting the system supply.

Set value input
Speed setting via an analogue interface for DC voltage. Depending on the drive design, the set speed can be configured in a range from 0 ... $n_{\text{max}}$, where the minimum possible speed value (with limited control quality) is about 0 rpm (sine commutation) or approx. 50 to 100 rpm (block commutation). (Relevant only for drives with integrated operating electronics).

Recommended speed range [rpm]
Speed control range within which the speed control accuracy stipulated in the system specification is complied with.
Starting torque [mNm]
Is the torque that can be delivered over a short time when the motor is started based on the electromagnetic motor characteristics and the set current limitation.

Effective torque $M_{\text{eff}}$ [mNm]
For cycle operation (e.g. “S5” operating mode – intermittent duty with the effect of the startup losses and the losses due to electrical braking on the heating), the effective torque corresponding to continuous operation (“S1” operating mode) is determined according to the following formula:

$$M_{\text{eff}} = \sqrt{\frac{M_A \cdot t_A + M_{\text{st}} \cdot t_{\text{st}} + M_{\text{br}} \cdot t_{\text{br}}}{t_A + t_{\text{st}} + t_{\text{br}}}}$$

$M_A$ Starting torque $M_{\text{br}}$ Braking
$t_A$ Acceleration time $t_{\text{br}}$ Braking time
$M_{\text{st}}$ Load torque $t_{\text{st}}$ Standstill time
$t_{\text{st}}$ Load period

At an ambient temperature of 40°C this effective torque must not be greater than the nominal torque $M_N$ listed in the catalog for the selected motor. For intermittent operation (operating mode S3 with $t_r$ = relative on period) the following permissible load moment applies:

$$M_t = M_s \cdot \sqrt{\frac{100}{t_1}}$$

System selection
When selecting a motor and operating for a drive system, consideration should be given to the fact that the values permitted for the motor should not be exceeded by the electronics. Likewise, the relationship shown in the commutation sequences between the sequence of Hall signals and the corresponding switching times and switching states of the output stage at the phase supply lines must be observed in order to attain optimum operation of the motor.

Please contact the manufacturer if the products are operated or stored under non standard environmental conditions.
Highly dynamic 3-phase internal rotor motor with EC technology
- Low cogging torque
- Robust, noise-optimized ball bearing system for a long service life
- High efficiency and high power density realized in a compact design
- Basic motor with electronic module K1 for operation with external control electronics
- Mechanical design and interfaces designed for modular flexibility
- Protection class IP 40 (higher on request) and connection by wires

### Nominal data

<table>
<thead>
<tr>
<th>Type</th>
<th>ECI-42.20-K1-B00</th>
<th>ECI-42.20-K1-D00</th>
<th>ECI-42.40-K1-B00</th>
<th>ECI-42.40-K1-D00</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nominal voltage (Uₚ)</td>
<td>V DC 24</td>
<td>48</td>
<td>24</td>
<td>48</td>
</tr>
<tr>
<td>Nominal speed (nₚ)**</td>
<td>rpm</td>
<td>4 000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nominal torque (Mₚ)**</td>
<td>mNm 110</td>
<td>110</td>
<td>220</td>
<td>220</td>
</tr>
<tr>
<td>Nominal current (Iₚ)**</td>
<td>A 2.50</td>
<td>1.30</td>
<td>5.10</td>
<td>2.60</td>
</tr>
<tr>
<td>Nominal output power (Pₚ)**</td>
<td>W 46</td>
<td>46</td>
<td>92</td>
<td>92</td>
</tr>
<tr>
<td>Starting torque (Mₘₚ)</td>
<td>mNm 480</td>
<td>480</td>
<td>960</td>
<td>960</td>
</tr>
<tr>
<td>Permissible peak current (Iₚ)**</td>
<td>A 14 7</td>
<td>7</td>
<td>21</td>
<td></td>
</tr>
<tr>
<td>Speed at no-load operation (nₘₚ)</td>
<td>rpm 5 900</td>
<td>5 900</td>
<td>5 700</td>
<td>5 700</td>
</tr>
<tr>
<td>No-load current (Iₘₚ)</td>
<td>A 0.33</td>
<td>0.10</td>
<td>0.40</td>
<td>0.20</td>
</tr>
<tr>
<td>Permanent stall torque (Mₘₚ)</td>
<td>mNm 100</td>
<td>100</td>
<td>200</td>
<td>200</td>
</tr>
<tr>
<td>Recommended speed control range</td>
<td>rpm 0 ... 5 000</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rotor moment of inertia (Jₘₚ)</td>
<td>kgm²×10⁻⁶ 3.42</td>
<td>3.42</td>
<td>6.70</td>
<td>6.70</td>
</tr>
<tr>
<td>Motor constant (Kₘₚ)</td>
<td>mVs/rad 40.9</td>
<td>84.2</td>
<td>42.8</td>
<td>83.9</td>
</tr>
<tr>
<td>Connection resistance (Rₘₚ)</td>
<td>Ω 0.85</td>
<td>3.20</td>
<td>0.39</td>
<td>1.50</td>
</tr>
<tr>
<td>Connection inductance (Lₘₚ)</td>
<td>mH 1.10</td>
<td>4.50</td>
<td>0.50</td>
<td>1.84</td>
</tr>
<tr>
<td>Overload protection</td>
<td></td>
<td>To be implemented via the control electronics</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Permissible ambient temperature range (Tₑ)</td>
<td>°C 0 ... +40</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weight</td>
<td>kg 0.33</td>
<td>0.33</td>
<td>0.48</td>
<td>0.48</td>
</tr>
<tr>
<td>Order no. (wire interface)*</td>
<td>IP 40</td>
<td>932 4220 122</td>
<td>932 4220 123</td>
<td>932 4240 122</td>
</tr>
<tr>
<td>Subject to alterations**</td>
<td>Classification of protection class refers to installed state with sealing on the flange side</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Preferred type: ready to ship in 48 hours</td>
<td></td>
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<td></td>
<td></td>
</tr>
</tbody>
</table>

Additional information regarding the attachment components can be found in the main catalog or on the IDT website (idt.ebmpapst.com).
For motor-gearbox combinations, depending on the choice of the single components, the maximum allowable torque (gearbox) can be exceeded or respectively not reached.
### Nominal data

<table>
<thead>
<tr>
<th>Gearheads</th>
<th>PE040.1</th>
<th>PE040.2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reduction ratio*</td>
<td>5</td>
<td>8</td>
</tr>
<tr>
<td>No. of stages</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Efficiency</td>
<td>0.96</td>
<td>0.94</td>
</tr>
<tr>
<td>Max. input speed (n₁), rpm</td>
<td>6 500</td>
<td>6 500</td>
</tr>
<tr>
<td>Rated output torque (Mₑ₁), Nm</td>
<td>16</td>
<td>7</td>
</tr>
<tr>
<td>Max. acceleration torque (Mₐₚₚₚ), Nm</td>
<td>25.6</td>
<td>11.62</td>
</tr>
<tr>
<td>Emergency stop torque (Mₑₑₑ), Nm</td>
<td>32</td>
<td>14</td>
</tr>
<tr>
<td>Gear play, arcmin</td>
<td>≤14</td>
<td>≤18</td>
</tr>
<tr>
<td>Permissible operating temperature (Tₑ), °C</td>
<td>-25 ... +90</td>
<td>-20 ... +80</td>
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<tr>
<td>Operating mode</td>
<td>S1</td>
<td>S1</td>
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<tr>
<td>Protection class</td>
<td>IP 64</td>
<td>IP 64</td>
</tr>
<tr>
<td>Weight, kg</td>
<td>0.4</td>
<td>0.5</td>
</tr>
<tr>
<td>Shaft load radial, N</td>
<td>165</td>
<td>165</td>
</tr>
<tr>
<td>Shaft load axial, N</td>
<td>165</td>
<td>165</td>
</tr>
<tr>
<td>Service life, h</td>
<td>30 000</td>
<td>30 000</td>
</tr>
<tr>
<td>Lubrication</td>
<td>Maintenance-free grease lubrication for life</td>
<td></td>
</tr>
<tr>
<td>Installation position</td>
<td>any</td>
<td></td>
</tr>
</tbody>
</table>

- Case-hardened and ground ring gears
- Case hardened and ground planetary and sun gears ensure increased transmission quality and a long service life
- Low torsional play
- Easiest adaptation of motor and planetary gear through exchangeable flange modular system
- High level of flexibility through proven hollow shaft drive concept
- Integrated axial longitudinal compensation for compensation of the thermally-induced longitudinal expansion of the PTO shaft
- High efficiency and low-noise operation due to high tooth flank quality, needle-mounted planetary gears and high quality lubricant
- High torsional stiffness and high emergency stop torque due to robust gear design and optimized gear geometry

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* Additional reductions and 3-stage designs on request
** Permitted for 30 000 loading cycles
*** 1 000 times during the entire service life
Technical drawing

Image of 1-stage gearhead / All dimensions in mm

Permissible shaft load at nominal speed and life expectancy $L_{10}$ (nominal operation) and operating factor $C_B = 1$ (see page 22) of 30 000 h (at $T_u 40^\circ\text{C}$).

Length of the possible motor / gearhead combinations

<table>
<thead>
<tr>
<th>Motor / gearhead</th>
<th>L - 1-stage</th>
<th>L - 2-stage</th>
<th>L - 3-stage</th>
</tr>
</thead>
<tbody>
<tr>
<td>ECI-42.20-PE040</td>
<td>mm 172</td>
<td>mm 187</td>
<td>mm 202</td>
</tr>
<tr>
<td>ECI-42.40-PE040</td>
<td>mm 192</td>
<td>mm 207</td>
<td>mm 222</td>
</tr>
<tr>
<td>ECI-63.XX-PE040</td>
<td>mm on request</td>
<td>mm on request</td>
<td>mm on request</td>
</tr>
</tbody>
</table>

Subject to alterations

4 x M4 / 6 deep
1 x M3 / 9 deep / DIN 332
ECI motor.
ECI-63.XX-K1

- Highly dynamic 3-phase internal rotor motor with EC technology
- Low cogging torque
- Robust, noise-optimized ball bearing system for a long service life
- High efficiency and high power density realized in a compact design
- Basic motor with electronic module K1 for operation with external control electronics
- Mechanical design and interfaces designed for modular flexibility
- Protection class IP 40 / IP 54 and connection by connector system

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### Nominal data

<table>
<thead>
<tr>
<th>Type</th>
<th>ECI-63.20-K1-B00</th>
<th>ECI-63.20-K1-D00</th>
<th>ECI-63.40-K1-B00</th>
<th>ECI-63.40-K1-D00</th>
<th>ECI-63.60-K1-B00</th>
<th>ECI-63.60-K1-D00</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nominal voltage (Uₜ)</td>
<td>V DC</td>
<td>24</td>
<td>48</td>
<td>24</td>
<td>48</td>
<td>24</td>
</tr>
<tr>
<td>Nominal speed (nₚ)**</td>
<td>rpm</td>
<td>4 000</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nominal torque (Mₜ)**</td>
<td>mNm</td>
<td>360</td>
<td>360</td>
<td>670</td>
<td>670</td>
<td>800</td>
</tr>
<tr>
<td>Nominal output power (Pₜ)**</td>
<td>W</td>
<td>150</td>
<td>150</td>
<td>280</td>
<td>280</td>
<td>335</td>
</tr>
<tr>
<td>Starting torque (Mₛₜ)**</td>
<td>mNm</td>
<td>1 800</td>
<td>1 800</td>
<td>3 300</td>
<td>3 300</td>
<td>5 300</td>
</tr>
<tr>
<td>Permissible peak current (Iₚ)***</td>
<td>A</td>
<td>55</td>
<td>30</td>
<td>95</td>
<td>45</td>
<td>150</td>
</tr>
<tr>
<td>Speed at no-load operation (nₜ)</td>
<td>rpm</td>
<td>5 800</td>
<td>6 800</td>
<td>5 900</td>
<td>5 900</td>
<td>6 100</td>
</tr>
<tr>
<td>No-load current (Iₙ)</td>
<td>A</td>
<td>0.50</td>
<td>0.30</td>
<td>0.70</td>
<td>0.32</td>
<td>1.30</td>
</tr>
<tr>
<td>Recommended speed control range</td>
<td>rpm</td>
<td>0 ... 5 000</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rotor moment of inertia (Jₜ)</td>
<td>kgm² x10⁻⁶</td>
<td>19</td>
<td>19</td>
<td>38</td>
<td>38</td>
<td>57</td>
</tr>
<tr>
<td>Motor constant (Kₗ)</td>
<td>mVs/rad</td>
<td>41.4</td>
<td>73.3</td>
<td>40.4</td>
<td>83.8</td>
<td>40.4</td>
</tr>
<tr>
<td>Connection resistance (Rₗ)</td>
<td>Ω</td>
<td>0.14</td>
<td>0.42</td>
<td>0.08</td>
<td>0.24</td>
<td>0.04</td>
</tr>
<tr>
<td>Connection inductance (Lₗ)</td>
<td>mH</td>
<td>0.26</td>
<td>0.88</td>
<td>0.14</td>
<td>0.57</td>
<td>0.09</td>
</tr>
<tr>
<td>Overload protection</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Permissible ambient temperature range (Tₚ)</td>
<td>°C</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weight</td>
<td>kg</td>
<td>0.90</td>
<td>0.90</td>
<td>1.20</td>
<td>1.20</td>
<td>1.50</td>
</tr>
<tr>
<td>Order no. (wire interface)*</td>
<td>IP 40</td>
<td>932 6320 103</td>
<td>932 6320 105</td>
<td>932 6340 103</td>
<td>932 6340 105</td>
<td>932 6360 106</td>
</tr>
<tr>
<td>Order No. (connector interface)*</td>
<td>IP 54</td>
<td>932 6320 100</td>
<td>932 6320 102</td>
<td>932 6340 100</td>
<td>932 6340 102</td>
<td>932 6360 102</td>
</tr>
</tbody>
</table>

- Subject to alterations
  * Classification of protection class refers to installed state with sealing on the flange side
  ** At Tₚ max. 40°C
  *** Permissible time for peak current: max. 1 sec. – to be repeated only after complete cool down

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Additional information regarding the attachment components can be found in the main catalog or on the IDT website (idt.ebmpapst.com)
Characteristic curve

ECI-63.20-K1, 24 V (at 25°C)

ECI-63.40-K1, 24 V (at 25°C)

ECI-63.60-K1, 24 V (at 25°C)

Characteristic curve 48 V on request

1) Nominal data, see table

Modular construction kit

Brake system
Spring-applied brake
BFK 457-03

Encoder system
Optical incremental encoder
HEDS 5500

Recommended external control electronics
VTD-XX.XX-K4S Speed
VTD-60.13-K5SB Position
VTD-60.35-K5SB Position

Planetary gearheads
PE060 (page 14)
PE040 (page 10)
NoiselessPlus 63
Performax® 63
Performax®Plus 63
Optimax 63

Crown gearheads
ElaCrown® 75
ElaCrown®Plus 63
Planetary gearheads.

PE060

- Case-hardened and ground ring gears
- Case hardened and ground planetary and sun gears ensure increased transmission quality and a long service life
- Low torsional play
- Easiest adaptation of motor and planetary gear through exchangeable flange modular system
- High level of flexibility through proven hollow shaft drive concept
- Integrated axial longitudinal compensation for compensation of the thermally-induced longitudinal expansion of the PTO shaft
- High efficiency and low-noise operation due to high tooth flank quality, needle-mounted planetary gears and high quality lubricant
- High torsional stiffness and high emergency stop torque due to robust gear design and optimized gear geometry

**Nominal data**

<table>
<thead>
<tr>
<th>Gearheads</th>
<th>PE040.1</th>
<th>PE040.2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reduction ratio*</td>
<td>5</td>
<td>8</td>
</tr>
<tr>
<td>No. of stages</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Efficiency</td>
<td>0.96</td>
<td></td>
</tr>
<tr>
<td>Max. input speed (n₁) rpm</td>
<td>6 500</td>
<td></td>
</tr>
<tr>
<td>Rated output torque (Mₐ) Nm</td>
<td>40</td>
<td>20</td>
</tr>
<tr>
<td>Max. acceleration torque (Mₐ)'' Nm</td>
<td>64</td>
<td>32</td>
</tr>
<tr>
<td>Emergency stop torque (Mₐ)''' Nm</td>
<td>80</td>
<td>40</td>
</tr>
<tr>
<td>Gear play arcmin</td>
<td>≤9</td>
<td>≤11</td>
</tr>
<tr>
<td>Permissible operating temperature (Tₘ) °C</td>
<td>-25 ... +90</td>
<td>-20 ... +80</td>
</tr>
<tr>
<td>Operating mode</td>
<td>S1</td>
<td></td>
</tr>
<tr>
<td>Protection class</td>
<td>IP 64</td>
<td></td>
</tr>
<tr>
<td>Weight kg</td>
<td>1.0</td>
<td></td>
</tr>
<tr>
<td>Shaft load radial N</td>
<td>350</td>
<td></td>
</tr>
<tr>
<td>Shaft load axial N</td>
<td>450</td>
<td></td>
</tr>
<tr>
<td>Service life h</td>
<td>30 000</td>
<td></td>
</tr>
<tr>
<td>Lubrication</td>
<td>Maintenance-free grease lubrication for life</td>
<td></td>
</tr>
<tr>
<td>Installation position</td>
<td>any</td>
<td></td>
</tr>
</tbody>
</table>

Subject to alterations
* Additional reductions and 3-stage designs on request
** Permitted for 30 000 loading cycles
*** 1 000 times during the entire service life
Technical drawing

Image of 1-stage gearhead / All dimensions in mm

Length of the possible motor / gearhead combinations

<table>
<thead>
<tr>
<th>Motor / gearhead</th>
<th>L - 1-stage</th>
<th>L - 2-stage</th>
<th>L - 3-stage</th>
</tr>
</thead>
<tbody>
<tr>
<td>ECI-63.20-PE060</td>
<td>mm 192.1</td>
<td>mm 207.1</td>
<td>mm 222.1</td>
</tr>
<tr>
<td>ECI-63.40-PE060</td>
<td>mm 212.1</td>
<td>mm 227.1</td>
<td>mm 242.1</td>
</tr>
<tr>
<td>ECI-63.60-PE060</td>
<td>mm 232.1</td>
<td>mm 247.1</td>
<td>mm 262.1</td>
</tr>
</tbody>
</table>

Subject to alterations

Faxial  165 N
Fradial  165 N
L1 17.5 mm

Permissible shaft load at nominal speed and life expectancy L_{10} (nominal operation) and operating factor C_{op} = 1 (see page 22) of 30 000 h (at T_{a} 40°C).
### Nominal data

<table>
<thead>
<tr>
<th>Type</th>
<th>ECI-80.20-K1</th>
<th>ECI-80.20-K1</th>
<th>ECI-80.40-K1</th>
<th>ECI-80.40-K1</th>
<th>ECI-80.60-K1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nominal voltage (U&lt;sub&gt;n&lt;/sub&gt;)</td>
<td>V DC</td>
<td>24</td>
<td>48</td>
<td>24</td>
<td>48</td>
</tr>
<tr>
<td>Nominal speed (n&lt;sub&gt;N&lt;/sub&gt;)*</td>
<td>rpm</td>
<td>4 000</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nominal torque (M&lt;sub&gt;N&lt;/sub&gt;)*</td>
<td>mNm</td>
<td>700</td>
<td>700</td>
<td>1 200</td>
<td>1 200</td>
</tr>
<tr>
<td>Nominal current (I&lt;sub&gt;N&lt;/sub&gt;)*</td>
<td>A</td>
<td>13.5</td>
<td>7.50</td>
<td>25.0</td>
<td>12.0</td>
</tr>
<tr>
<td>Nominal output power (P&lt;sub&gt;N&lt;/sub&gt;)*</td>
<td>W</td>
<td>293</td>
<td>293</td>
<td>503</td>
<td>503</td>
</tr>
<tr>
<td>Starting torque (M&lt;sub&gt;s&lt;/sub&gt;)*</td>
<td>mNm</td>
<td>2 400</td>
<td>2 500</td>
<td>3 900</td>
<td>5 000</td>
</tr>
<tr>
<td>Permissible peak current (I&lt;sub&gt;p&lt;/sub&gt;)**</td>
<td>A</td>
<td>100</td>
<td>60</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Permanent stall torque (M&lt;sub&gt;n&lt;/sub&gt;)</td>
<td>mNm</td>
<td>700</td>
<td>700</td>
<td>1 200</td>
<td>1 200</td>
</tr>
<tr>
<td>Speed at no-load operation (n&lt;sub&gt;L&lt;/sub&gt;)</td>
<td>rpm</td>
<td>4 800</td>
<td>4 800</td>
<td>4 700</td>
<td>4 850</td>
</tr>
<tr>
<td>Speed at no-load operation (n&lt;sub&gt;L&lt;/sub&gt;)</td>
<td>rpm</td>
<td>1.00</td>
<td>0.70</td>
<td>1.50</td>
<td>0.90</td>
</tr>
<tr>
<td>No-load current (I&lt;sub&gt;L&lt;/sub&gt;)</td>
<td>A</td>
<td>0 ... 4 000</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rotor moment of inertia (J&lt;sub&gt;r&lt;/sub&gt;)</td>
<td>kgm^2 x10^-6</td>
<td>54</td>
<td>54</td>
<td>104</td>
<td>104</td>
</tr>
<tr>
<td>Motor constant (K&lt;sub&gt;e&lt;/sub&gt;)</td>
<td>mVs/rad</td>
<td>47.2</td>
<td>94.1</td>
<td>48.2</td>
<td>96.0</td>
</tr>
<tr>
<td>Connection resistance (R&lt;sub&gt;c&lt;/sub&gt;)</td>
<td>Ω</td>
<td>0.07</td>
<td>0.30</td>
<td>0.03</td>
<td>0.10</td>
</tr>
<tr>
<td>Connection inductance (L&lt;sub&gt;c&lt;/sub&gt;)</td>
<td>mH</td>
<td>0.30</td>
<td>1.30</td>
<td>0.20</td>
<td>0.60</td>
</tr>
<tr>
<td>Overload protection</td>
<td>integrated</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Permissible ambient temperature range (T&lt;sub&gt;U&lt;/sub&gt;)</td>
<td>°C</td>
<td>-30 ... +40</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weight</td>
<td>kg</td>
<td>1.40</td>
<td>1.40</td>
<td>2.10</td>
<td>2.10</td>
</tr>
<tr>
<td>Order no. (wire interface)***</td>
<td>IP 40</td>
<td>932 8020 103</td>
<td>932 8020 105</td>
<td>932 8040 103</td>
<td>932 8040 105</td>
</tr>
<tr>
<td>Order no. (cable routing)***</td>
<td>IP 54</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

---

- Highly dynamic 3-phase internal rotor motor with EC technology
- Low cogging torque
- Robust, noise-optimized ball bearing system for a long service life
- High efficiency and high power density realized in a compact design
- Protection class IP 40/IP 54 and connection by connector system
- Basic motor with electronic module K1 for operation with external control electronics
- Mechanical design and interfaces designed for modular flexibility
Characteristic curve

ECI-80.20-K1, 24 V (at 25°C)

ECI-80.40-K1, 24 V (at 25°C)

ECI-80.60-K1, 48 V (at 25°C)

1) Nominal data, see table

Characteristic curve 48 V on request

Modular construction kit

Brake system
on request

Encoder system
on request

Recommended external control electronics
VTD-XX.XX-K4S Speed
VTD-60.35-KSSB Position

Basic motor

Planetary gearhead
PED80 (page 18)
Performax®Plus 63
Optimax 63

ECI-80.20-K1, 24 V (at 25°C)

ECI-80.40-K1, 24 V (at 25°C)

ECI-80.60-K1, 48 V (at 25°C)

1) Nominal data, see table

Characteristic curve 48 V on request
Planetary gearheads.

PE080

Image of 1-stage gearhead

− Case-hardened and ground ring gears
− Case hardened and ground planetary and sun gears ensure increased transmission quality and a long service life
− Low torsional play
− Easiest adaptation of motor and planetary gear through exchangeable flange modular system
− High level of flexibility through proven hollow shaft drive concept
− Integrated axial longitudinal compensation for compensation of the thermally-induced longitudinal expansion of the PTO shaft
− High efficiency and low-noise operation due to high tooth flank quality, needle-mounted planetary gears and high quality lubricant
− High torsional stiffness and high emergency stop torque due to robust gear design and optimized gear geometry

<table>
<thead>
<tr>
<th>Nenndaten</th>
<th>PE080.1</th>
<th>PE080.2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reduction ratio*</td>
<td>5</td>
<td>8</td>
</tr>
<tr>
<td>No. of stages</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Efficiency</td>
<td>0.96</td>
<td>0.94</td>
</tr>
<tr>
<td>Max. input speed (n₁) rpm</td>
<td>6 500</td>
<td>6 500</td>
</tr>
<tr>
<td>Rated output torque (Mₑ₁) Nm</td>
<td>115</td>
<td>55</td>
</tr>
<tr>
<td>Max. acceleration torque (Mₑ₂)** Nm</td>
<td>184</td>
<td>88</td>
</tr>
<tr>
<td>Emergency stop torque (Mₑ₃)*** Nm</td>
<td>230</td>
<td>110</td>
</tr>
<tr>
<td>Gear play arcmin</td>
<td>≤7</td>
<td>≤9</td>
</tr>
<tr>
<td>Permissible operating temperature (Tₑ) °C</td>
<td>-25 ... +90</td>
<td>-20 ... +80</td>
</tr>
<tr>
<td>Operating mode</td>
<td>S1</td>
<td>S1</td>
</tr>
<tr>
<td>Protection class</td>
<td>IP</td>
<td>64</td>
</tr>
<tr>
<td>Weight kg</td>
<td>2.3</td>
<td>2.8</td>
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<tr>
<td>Shaft load radial N</td>
<td>750</td>
<td>750</td>
</tr>
<tr>
<td>Shaft load axial N</td>
<td>900</td>
<td>900</td>
</tr>
<tr>
<td>Service life h</td>
<td>30 000</td>
<td>30 000</td>
</tr>
<tr>
<td>Lubrication</td>
<td>Maintenance-free grease lubrication for life</td>
<td></td>
</tr>
<tr>
<td>Installation position</td>
<td>any</td>
<td></td>
</tr>
<tr>
<td>Subject to alterations</td>
<td>* Additional reductions and 3-stage designs on request</td>
<td></td>
</tr>
<tr>
<td></td>
<td>** Permitted for 30 000 loading cycles</td>
<td></td>
</tr>
<tr>
<td></td>
<td>*** 1 000 times during the entire service life</td>
<td></td>
</tr>
</tbody>
</table>
Permissible shaft load at nominal speed and life expectancy $L_{10}$ (nominal operation) and operating factor $C_p = 1$ (see page 22) of 30 000 h (at $T_i = 40°C$).

<table>
<thead>
<tr>
<th>Motor / gearhead</th>
<th>L - 1-stage</th>
<th>L - 2-stage</th>
<th>L - 3-stage</th>
</tr>
</thead>
<tbody>
<tr>
<td>ECI-80.20-PE080</td>
<td>mm</td>
<td>208</td>
<td>222.5</td>
</tr>
<tr>
<td>ECI-80.40-PE080</td>
<td>mm</td>
<td>228</td>
<td>242.5</td>
</tr>
<tr>
<td>ECI-80.60-PE080</td>
<td>mm</td>
<td>248</td>
<td>262.5</td>
</tr>
</tbody>
</table>

Subject to alterations
Basic information on standards and guidelines for electrical small-power motors and drive systems operated with a DC voltage of max. 75 V DC (nominal voltage):

The ECI series described in this catalog are direct current motors in an electronically commutated design, which are designed and specified for a nominal voltage of max. 75 V DC. Thus the supply voltage of these drives is within the range of safety extra-low voltage (SELV). On this basis, ebm-papst would like to provide some information intended to help you understand the classification of the motors from the relevant EC Directives and the resulting consequences.

The CE label
In order to ensure a uniform safety level in the European internal market, the European commission has implemented a new approach for technical harmonization. This has been welcomed by all relevant parties and is visible in many products as a CE label giving proof of agreement with the harmonized provisions.

What does CE actually mean? Why don’t all products bear the CE label?
CE is the abbreviation for “Communauté Européenne”. The harmonized statutory provisions are a framework directive and belong to the so-called New Approach. This framework directive defines the basic requirements, putting in circulation and operation as well as the applicable conformity assessment process. The manufacturer of a product must now decide which framework directive applies to which product. For electrical small-powered motors the following framework directive can be applied:

1) Machinery Directive 2006/42/EC
2) Low Voltage Directive 2014/35/EU
3) EMC Directive 2014/30/EU

Based on these directives, ebm-papst St. Georgen GmbH & Co. KG does not mark the electric motors and drive systems described with the “CE” mark and does not issue an EC Declaration of Conformity. The reason for this is consideration of the relevant EC Directives and the definitions of the terms used, “Electric motor” and “Drive system”, by ebm-papst St. Georgen GmbH & Co. KG.

Definition of the electric motor
An electric motor is a motor without electronics or a motor with integrated electronics of low complexity, such as commutation sensors, simple commutation electronics or commutation electronics with simple speed control with a voltage range of <75 V DC (nominal voltage) for use by customers who incorporate them into end devices.

According to this definition, electric motors include, for example, the ECI-XX.XX-K1 series.

Definition of drive systems
Drive systems are motors with built-in electronic control systems that have a certain degree of complexity. These include electronic control systems which, in addition to a speed control, offer other functions such as current control or position control. This also includes electronic control systems which, for example, have a CANopen interface or that can be operated via programmable sequential controls. For these drive systems, the voltage range of <75 V DC (nominal voltage) and the intended use by customers who will use the systems in end devices also apply. Drive systems include the ECI-XX.XX-K3, ECI-XX.XX-K4 and ECI-XX.XX-K5 series, for example.

Reasons according to the Machinery Directive 2006/42/EC
Electric motors are expressly exempt in Art. 1, Par. (2), lit. k) and thus are NOT given the CE mark.

According to the definition of the term in Art. 2, lit. g), a drive system is an “incomplete machine” and thus does not receive a CE mark, but falls under the process for incomplete machines according to Art. 13.

Installation instructions to Annex IV and a Declaration of Incorporation to Annex II, Part 1, Section B are available for each drive system. The specific technical documents to Art. 13, Par. (1), lit. a) have been created in-house and are archived for the government agencies of the individual countries.

Based on this directive, the machine manufacturer is responsible for verifying and ensuring compliance with the basic requirements of the Machinery Directive.

Reasons according to the Low Voltage Directive 2014/35/EU
Due to the voltage ranges (nominal voltage), the specified electric motors and drive systems do not fall under the application area of the low voltage directive according to Art. 1.
Reasons according to the EMC Directive 2014/30/EU
Because they are sold exclusively to customers who incorporate them into end devices and not to the end user, the specified electric motors and drive systems do not fall under the application area of the EMC directive according to the definition of the term in Art. 3, Par. (2), 1: As the small motors are supplied to companies who incorporate them into end devices and not to the end user, ebm-papst has no control over further use of the pre-fabricated components in devices, machines or installations. Therefore, ebm-papst provides express notice that the system manufacturer must provide a suitable EMC circuit when selecting the power supply and must provide for EMC-compliant installation and use in the devices. For more information about EMC-compliant installation and EMC safety measures, refer to resources such as the IEC 61000-5-x series (Installation and Mitigation Guidelines).

Proper use
All drives in this catalog are determined for installation in permanently connected, stationary end devices and machines in the industrial area and must be operated on electricity only when in installed condition! Operation is prohibited until it has been ascertained that this product, along with the machine into which this product is to be installed, complies with the protective requirements of the Machinery Directive. If, when using our drives, market or application-specific product standards apply, compliance with these must be verified and ensured by the device manufacturer. This product is not intended for the end consumer.

RoHS
European Directive EC No. 2011/65/EU (RoHS)
Legally regulated substances
As an innovative company and trendsetter in the world of air technology and drive engineering, ebm-papst feels a special obligation towards the environment. Accordingly, under the GreenTech logo, we have implemented a comprehensive concept that extends from the origin to the use of our products. This includes, of course, protecting our environment and using natural resources in a way that conserves them. This applies equally to our manufacturing processes and to our products.
When developing our products, we already take into consideration any possible negative consequences they may have for the environment.

Our goal is to prevent such environmental impact—even beyond the extent mandated by law— or to reduce it to a minimum, and thus to ensure sustainable development of our products. Thus we ensure that our products are free of materials and substances that are prohibited by law.

Of course, all current products have been designed for conformity with European Directive 2011/65/EU (RoHS). All older products that do not yet conform to these directives or parts thereof will be consistently redesigned. Our suppliers are required to provide us only with goods that conform to the directives. Thus we can confirm that basically, all of our products listed in this catalog conform to the above-mentioned directive. We are also available to help with any other questions you may have on both these topics.

REACH Directive (EC No. 1907/2006)
The EU legal regulation for Registration, Evaluation, Authorization and Restriction of Chemical substances (REACH) entered into force on 1 June 2007. This is a chemicals law intended to provide maximum protection to health and the environment. As defined by the REACH directive, ebm-papst is a downstream user. The units you purchase from us are products as defined by REACH and thus do not require registration. However, in our own interest and to ensure a high degree of product safety, we track the implementation of REACH and the resulting requirements as part of our duty to provide information. To comply with the requirements of REACH, we are in contact with all suppliers from whom we obtain chemicals (substances), preparations and components that we use as part of our production process. Within this framework, ebm-papst fulfills the obligations set forth in the REACH regulation. If you have any other questions about the implementation of the REACH directive in our company, please do not hesitate to contact us.
Operating factor $c_B$
To achieve a uniform lifetime for the gearheads and motors, the necessary torques $M$ must be increased by the respective operating factor $c_B$ under the various operating loads so as not to exceed the maximum permissible gearhead torque $M_{2\text{ max}}$ (see table below).

### Operating modes

<table>
<thead>
<tr>
<th>Operating mode</th>
<th>Load</th>
<th>Operating period in h/days</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>even</td>
<td>gradual</td>
</tr>
<tr>
<td>One rotation direction</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>Rotation direction change</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>One rotation direction</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>Rotation direction change</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>One rotation direction</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>Rotation direction change</td>
<td>*</td>
<td></td>
</tr>
</tbody>
</table>

### Efficiency $\eta$ (eta)

The efficiency per gear stage is at least 90%. Depending on the tooth configuration and on the manufacturing quality, far better levels of efficiency can also be achieved. The following overall efficiencies were obtained for multi-stage gearheads:

<table>
<thead>
<tr>
<th>Overall efficiency</th>
<th>$\eta$</th>
</tr>
</thead>
<tbody>
<tr>
<td>for 1-stage gearhead</td>
<td>$\eta = 0.9$</td>
</tr>
<tr>
<td>for 2-stage gearhead</td>
<td>$\eta = 0.9^2 = 0.81$</td>
</tr>
<tr>
<td>for 3-stage gearhead</td>
<td>$\eta = 0.9^3 = 0.73$</td>
</tr>
<tr>
<td>for 4-stage gearhead</td>
<td>$\eta = 0.9^4 = 0.66$</td>
</tr>
<tr>
<td>for 5-stage gearhead</td>
<td>$\eta = 0.9^5 = 0.59$</td>
</tr>
</tbody>
</table>

### Operating factor, lifetime, efficiency.

**Operating mode**

It is necessary to define the operating mode under which a gear motor can be operated with certain nominal values in order to avoid overloading the motor and/or the gearhead. The values stated in this catalog refer to S1 operation (continuous operation). This means that the gear motor can be constantly operated with the stated values, but can also have a higher load placed on it for a short time. Please contact us if you require more information about this.

**Lifetime**

Lifetime is limited by the various components in the drive. If frequently overloaded, the gearhead components are subjected to more wear than under nominal load. Extreme ambient and operating conditions cause a reduction in the lifetime guaranteed for operation under operating ratio $c_B = 1$. 

Efficiency $\eta$ (eta)
ebm-papst around the world.

**Germany**
- **Northern region**
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  - Udo Wildenblanck
  - Regional Sales Manager – Drive Technology
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  - 22844 Norderstedt
  - Phone +49 9123 945-291
  - Fax +49 9123 945-5291
  - Udo.Wildenblanck@de.ebmpapst.com

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  - Fax +49 9123 945-5292
  - Henry.Saemisch@de.ebmpapst.com

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  - Fax +49 9123 945-5293
  - Markus.Psik@de.ebmpapst.com

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  - Fax +49 9123 945-5294
  - Michael.Weber@de.ebmpapst.com

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  - Fax +49 9123 945-5295
  - Patrick.Christleven@de.ebmpapst.com

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  - Fax +33 3 88 66 88 03
  - info@ebmpapst.fr
  - www.ebmpapst.fr

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  - Fax +7 795 5140924
  - info@ebmpapst.ru
  - www.ebmpapst.ru