Total reliability in extreme conditions.

Proven in the world’s toughest environments:

- Extreme temperatures (-55°C to 200°C)
- 25 grms vibration; 100G impact forces
- High pressure up to 1,700 bar

The EC22 HD is purpose-built to deliver flawless performance in the world’s harshest environments. Despite measuring just 22mm in diameter, this robust brushless motor is proven to withstand extremes of temperature and pressure, along with vibration and huge shock loads.

The motor can also run in air or fully submerged in oil. Running in oil actually trebles its power output rating due to additional heat dissipation.

Optional high-temperature Hall effect sensors can be fitted, allowing the motor to be run with sensors or in sensorless operation with electrical motor controllers.

Available from Electromate  Toll Free (877) 737-8698  sales@electromate.com  www.electromate.com

maxon motor
 driven by precision
Media Release

EC 22 HD
200°C / 100 G / -5'000 m / 1'700 bar – maxon motor sets new benchmark.

Brushless Servo Motors made by maxon do their job under the most difficult conditions, such as, on Mars. But not only in high altitudes or in outer space, maxon DC motors also operate in harsh ambient conditions as encountered deep underneath the earth’s surface – immaculate, dependable, efficient.

As the first manufacturer worldwide, maxon motor launches with its EC 22 HD (Heavy Duty) a standard motor for extremely harsh operating conditions. Developed for the exceptionally high requirements in deep drilling technology, the electronically commutated motor EC 22 HD resists even most extreme conditions in which “normal” motors call it quits.

Deep drilling (in the oil and gas exploration industry called “Downhole Drilling”) permits exploration of oil and gas resources from depths beyond 2'500 meters (8'200 feet). In conjunction with directional drilling (the dynamic orientation of a borehole), it allows exploration of, so far, inaccessible deposits in drilling depths of currently about 5'000 meters (16'500 feet) and bore lengths of up to 11'000 meters (36'000 feet). Today, electronics and the respective drives permit more sophisticated monitoring and control in a multitude of functions within the drilling process. For instance, the drilling head’s position and orientation can be dynamically measured and adjusted. Or, in various deep drilling tools, hydraulic valves and flaps are being operated by electro-mechanical motors.

Temperature and pressure conditions present in this depth range, in conjunction with high vibration emitted by the drilling process, make the employment of electric motors a real challenge.

The different variants of the EC 22 HD are designed for operation in air or submerged in oil (flooded in hydraulic fluid). Their assigned power rating depends on the surrounding medium and averages to 80 Watts in air and, due to remarkably higher heat dissipation, 240 Watts in oil. They are designed to cope with ambient temperatures of more than 200°C (390°F) and atmospheric pressures of up to 1'700 bar (25'000 psi). Further requirements of the 22 mm diameter motors are their capability to withstand vibration of up to 25 g<sub>max</sub> as well as impulse and impact of up to 100 G, that is 100 times gravitational acceleration – as a parallel; a Formula 1 race car encounters about 2 G, a fighter jet about 13 G. The motors feature high efficiency (in air up to 88%, in oil more than 70%) and therefore offer the best prerequisites for battery-operated applications. With their detent-free running characteristics, they possess outstanding regulation behavior and are especially suitable for high-precision positioning tasks, even at low speed. The motor unveils new possibilities in a number of applications that call for equally high requirements. It is well-prepared for the utilization in space technology or in power plants as well as in vehicle manufacturing, in the aircraft industry, in mining or in highly dynamic movements.

Available from Electromate  Toll Free (877) 737-8698  sales@electromate.com  www.electromate.com

maxon motor
driven by precision
**EC 22 Ø22 mm, brushless, 240 Watt**

Heavy Duty – for applications in oil

**Motor Data**

<table>
<thead>
<tr>
<th>Part Numbers</th>
<th>426450</th>
<th>426451</th>
</tr>
</thead>
<tbody>
<tr>
<td>A with Hall sensors</td>
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<tr>
<td>B sensorless</td>
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</table>

**Values at nominal voltage and ambient temperature °C**

1. Nominal voltage V
2. No load speed rpm
3. No load current mA
4. Nominal speed\(^1\) rpm
5. Nominal torque (max. continuous torque)\(^b\) mNm
6. Nominal current (max. continuous current) A
7. Stall torque mNm
8. Stall current A
9. Max. efficiency %

**Characteristics**

10. Terminal resistance phase to phase Ω
11. Terminal inductance phase to phase mH
12. Torque constant mNm/A
13. Speed constant rpm/V
14. Speed / torque gradient rpm/mNm
15. Mechanical time constant ms
16. Rotor inertia gcm\(^2\)

\(^1\) Values in thermal steady state.

**Thermal data**

17. Thermal resistance housing-ambient 0.793 K/W
18. Thermal resistance winding-housing 0.754 K/W
19. Thermal time constant winding 4.78 s
20. Thermal time constant motor 40.2 s
21. Ambient temperature -55...+200°C
22. Max. winding temperature +240°C

**Operating Range**

<table>
<thead>
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<th>n [rpm]</th>
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<th>200 W</th>
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<td>200</td>
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</tbody>
</table>

**Application**

- extreme temperature applications
- vibration tested according to MIL-STD810F/Jan2000 Fig. 014.5C-10
- operation in oil and high pressure (only minimal lubrication, therefore use under rated ambient conditions is not suggested)

**Oil & Gas Industry**

- oil, gas and geothermal wells

This motor contains leaded solder. It therefore does not fulfill the requirements for the permitted maximum concentration of hazardous substances in accordance with the EC directive 2011/65/EC (RoHS) for all applications. The motor may therefore only be used for devices that are not subject to this directive.

**Reference medium:** Shell Tellus oil T15

Operation in oil of different viscosity will affect the motor data.

**Planetary Gearhead**

Ø22 mm

2.0 – 4.0 Nm

Page 344
Planetary Gearhead GP 22 HD \( \varnothing 22 \text{ mm}, 2.0–4.0 \text{ Nm} \)

Heavy Duty – for application in oil

### Technical Data

- **Planetary Gearhead**
  - **straight teeth**
- **Output shaft**: stainless steel, hardened
- **Bearings at output**: ball bearing
- **Radial play, 10 mm from flange**: max. 0.2 mm
- **Axial play**: max. 0.1 mm
- **Max. axial load (dynamic)**: 100 N
- **Max. force for press fits**: 100 N
- **Direction of rotation, drive to output**:
  - **Max. continuous input speed**: 11'000 rpm
- **Recommended temperature range**: -55...+200°C
- **Extended range as option**: -55...+260°C
- **Number of stages**: 1, 2, 3, 4, 5
- **Max. radial load, 10 mm from flange**: 55 N
- **Max. motor shaft diameter**: 65 mm
- **Max. motor shaft diameter**: 82 mm
- **Max. motor shaft diameter**: 96 mm
- **Max. motor shaft diameter**: 110 mm
- **Max. motor shaft diameter**: 128 mm
- **Max. motor shaft diameter**: 151 mm
- **Max. motor shaft diameter**: 182 mm

### Part Numbers

<table>
<thead>
<tr>
<th>Gearhead Data (provisional)</th>
<th>410657</th>
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<th>410558</th>
<th>416698</th>
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</tbody>
</table>

### Application

- **General**
  - **vibration tested according to MIL-STD810F**
  - **Jan2000 Fig. 514.5C-10**
- **Oil & Gas Industry**
  - **operation in oil and high pressure**
- **Oil & Gas Industry**
  - **oil, gas and geothermal wells**

### Important Notice

This gearhead has been designed for applications in oil and is only equipped with minimum lubrication. Therefore it is not permitted to use it under normal air conditions.
**EC-4pole 32 ** Ø32 mm, brushless, 480 Watt

**Heavy Duty – for applications in oil**

**Motor Data (provisional)**

<table>
<thead>
<tr>
<th>Values at nominal voltage and ambient temperature °C</th>
<th>25</th>
<th>100</th>
<th>150</th>
<th>200</th>
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<td>482</td>
<td>222</td>
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<td>4 Nominal speed rpm</td>
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<td>2150</td>
<td>1860</td>
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<td>8 Stall current A</td>
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<td>36.7</td>
<td>31.9</td>
<td>28.1</td>
</tr>
<tr>
<td>9 Max. efficiency %</td>
<td>82</td>
<td>85</td>
<td>85</td>
<td>84</td>
</tr>
</tbody>
</table>

**Characteristics**

| Terminal resistance phase to phase Ω                | 1.01| 1.31| 1.51| 1.71|
| Torque constant mNm/A                              | 0.298| 0.298| 0.298| 0.298|
| Speed constant rpm/V                               | 70.5| 68.7| 67.4| 66.2|
| Speed / torque gradient rpm/mNm                    | 135 | 139 | 142 | 144 |
| Mechanical time constant ms                         | 1.94| 2.65| 3.16| 3.71|
| Rotor inertia gcm²                                  | 2.85| 3.88| 4.64| 5.45|

**Thermal data**

| Thermal resistance housing-ambient 0.3 K/W          |
| Thermal resistance winding-housing 0.53 K/W        |
| Thermal time constant winding 17 s                 |
| Thermal time constant motor 129 s                  |
| Ambient temperature -55...+200°C                   |
| Max. winding temperature +240°C                    |

**Mechanical data (preloaded ball bearings)**

| Max. speed 12000 rpm                              |
| Axial play at axial load < 20 N                  |
| Radial play preload                               |
| Max. axial load (dynamic) 16 N                    |
| Max. force for press fits (static) 80 N           |
| Max. radial load, 5 mm from flange 75 N           |

**Other specifications**

| Number of pole pairs 25                         |
| Number of phases 30                            |
| Weight of motor 860 g                          |

**Connection A, motor cable PTFE (AWG 14)**

| red | Motor winding 1 |
| black | Motor winding 2 |
| white | Motor winding 3 |

**Connection A, sensors cable PTFE (AWG 24)**

| green | Vm = 4.5...24 V |
| red | Hall sensor 1 |
| black | Hall sensor 2 |
| white | Hall sensor 3 |

**Connection B, motor cable PTFE (AWG 14)**

| red | Motor winding 1 |
| black | Motor winding 2 |
| white | Motor winding 3 |

**Wiring diagram for Hall sensors see p. 45**

**Planetary Gearhead**

| Ø32 mm | 3.0 - 8.0 Nm |
| Page 358 |

**Planetary Gearhead**

| Ø42 mm | 10 - 50 Nm |
| Page 364 |
Planetary Gearhead GP 32 HD \(\varnothing32\) mm, 3.0–8.0 Nm

**Technical Data**
- **Planetary Gearhead**: straight teeth
- **Output shaft**: stainless steel
- **Bearing at output**: ball bearing
- **Radial play, 10 mm from flange**: max. 0.14 mm
- **Axial play**: max. 0.4 mm
- **Max. axial load (dynamic)**: 120 N
- **Max. force for press fits**: max. 0.14 mm
- **Direction of rotation, drive to output**: =
- **Max. continuous input speed**: < 8000 rpm
- **Recommended temperature range**: -55…+200°C
- **Extended range as option**: -55…+260°C
- **Number of stages**: 1 2 3 4 5
- **Max. radial load, 10 mm from flange**: 120 N 200 N 250 N 300 N 300 N

**Part Numbers**
- **Gearhead Data (provisional)**
  - 1. Reduction
  - 2. Absolute reduction
  - 3. Max. motor shaft diameter mm
  - **Part Numbers**
    - 526078 526087 526093 526096 526102 526107 526113 526118 526124
  - 4.8.1 18.1 66.1 132.1 246.1 531.1 914.1 1828.1 2623.1
  - 5. Max. motor shaft diameter mm
    - 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6
  - **Part Numbers**
    - 526083 526089
  - 6. Reduction
    - 28.1 103.1 28.1 103.1 28.1 103.1 28.1 103.1 28.1
  - 7. Absolute reduction
    - 18.5 58.5 18.5 58.5 18.5 58.5 18.5 58.5 18.5
  - 8. Max. motor shaft diameter mm
    - 4.6 4.6 4.6 4.6 4.6 4.6 4.6 4.6 4.6
  - **Part Numbers**
    - 526099
  - 9. Reduction
    - 33.1 111.1 45.1 152.6 1 365.6 1
  - 10. Absolute reduction
    - 3 3 3 3 3 3 3 3 3
  - 11. Max. motor shaft diameter mm
    - 3.4 3.4 3.4 3.4 3.4 3.4 3.4 3.4 3.4
  - 12. Number of stages
    - 2 3 3 4 4 5 5 5 5
  - 13. Max. continuous torque Nm
    - 3 4 8 8 8 8 8 8 8
  - 14. Max. intermittent torques at gear output Nm
    - 4.5 6 12 12 12 12 12 12 12
  - 15. Max. overload torque 1) Nm
    - 9 12 24 24 24 24 24 24 24
  - 16. Max. efficiency %
    - 95 87 78 78 65 65 53 53 53 53
  - 17. Weight g
  - 18. Average backlash no load °
    - 0.8 0.8 0.8 0.8 0.8 0.8 0.8 0.8 0.8 0.8
  - 19. Mass inertia gcm²
    - 1.59 1.59 1.45 1.45 1.45 1.45 1.45 1.45 1.45 1.45
  - 20. Gearhead length L1 mm
    - 32.9 45.3 55.1 55.1 61.6 61.6 68.1 68.1 68.1 68.1
  - 21. Max. transmittable power (continuous) W
    - 350 200 80 80 80 80 40 40 40 40
  - 22. Max. transmittable power (intermittent) W
    - 480 300 120 120 120 120 60 60 60 60

**Technical Notice**
- This gearhead has been designed for applications in oil and is only equipped with minimum lubrication.

**Application**
- General
  - extreme temperature applications
    - vibration tested according to MIL-STD810F/
    - Jan2000 Fig. 514.5C-10
  - operation in oil and high pressure
    - Oil & Gas Industry
      - oil, gas and geothermal wells

**Important Notice**
- This gearhead has been designed for applications in oil and is only equipped with minimum lubrication. Therefore it is not permitted to use it under normal air conditions.
### Technical Data

**Planetary Gearhead**
- Gear type: straight teeth
- Output shaft: stainless steel
- Bearing at output: ball bearing
- Radial play: 12 mm from flange
- Maximal radial play: max. 0.05 mm
- Axial play: max. 0.2 mm
- Max. axial load (dynamic): 250 N
- Max. force for press fits: 450 N
- Direction of rotation, drive to output: M
- Max. continuous input speed: <8000 rpm
- Recommended temperature range: -55...+200°C
- Extended range as option: -55...+260°C
- Number of stages: 1 2 3 4
- Max. radial load, 12 mm from flange: 250 N 480 N 720 N 720 N

### Gearhead Data (provisional)

<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
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<th>10</th>
<th>11</th>
<th>12</th>
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</thead>
<tbody>
<tr>
<td>Reduction</td>
<td>12:1</td>
<td>43:1</td>
<td>81:1</td>
<td>150:1</td>
<td>285:1</td>
<td>441:1</td>
<td>7/2</td>
<td>49/4</td>
<td>343/8</td>
<td>2197/27</td>
<td>2401/16</td>
<td>15379/54</td>
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<tr>
<td>Mass inertia [g cm²]</td>
<td>17.5</td>
<td>29</td>
<td>35.5</td>
<td>23.9</td>
<td>41.3</td>
<td>33.1</td>
<td>30.6</td>
<td>10</td>
<td>10</td>
<td>8</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Max. motor shaft diameter [mm]</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>8</td>
<td>10</td>
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<tr>
<td>Reduction</td>
<td>15:1</td>
<td>53:1</td>
<td>91:1</td>
<td>186:1</td>
<td>319:1</td>
<td>488:1</td>
<td>13/3</td>
<td>91/6</td>
<td>637/12</td>
<td>91/1</td>
<td>4459/24</td>
<td>637/2</td>
</tr>
<tr>
<td>Mass inertia [g cm²]</td>
<td>11.1</td>
<td>23.3</td>
<td>31.8</td>
<td>25.4</td>
<td>37.6</td>
<td>34.2</td>
<td>26.3</td>
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<td>Max. motor shaft diameter [mm]</td>
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### Part Numbers

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<tr>
<th>Gearhead Data (provisional)</th>
<th>454742</th>
<th>454744</th>
<th>454745</th>
<th>476936</th>
<th>454280</th>
<th>476945</th>
<th>476949</th>
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</thead>
<tbody>
<tr>
<td>Overall length [mm] = Motor length + gearhead length + (sensor/brake) + assembly parts</td>
<td></td>
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<td>M 1:4</td>
<td>235</td>
<td>221.3</td>
<td>243.5</td>
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<td>EC-4pole 32 HD oil, A</td>
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<td>201.3</td>
<td>223.5</td>
<td>245.8</td>
<td>245.8</td>
<td>260.5</td>
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<tr>
<td>EC-4pole 32 HD oil, B</td>
<td>235</td>
<td>201.3</td>
<td>223.5</td>
<td>245.8</td>
<td>245.8</td>
<td>260.5</td>
<td>260.5</td>
</tr>
</tbody>
</table>

### Application

**General**
- Extreme temperature applications
- Vibration tested according to MIL-STD810F/Jan2000 Fig. 514.5C-10
- Operation in oil and high pressure

**Important Notice**
- This gearhead has been designed for applications in oil and is only equipped with minimum lubrication. Therefore it is not permitted to use it under normal air conditions.
- Oil & Gas Industry
- Oil and geothermal wells
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Intelligent compact drives with a maximum 60 watts output. Maxon’s compact drives feature controllers, sensors and motors in a modern aluminium casing.

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Brushless DC motors in a flat design with outer or inner rotor: Ø9.2 - 90 mm, 0.2 - 90 watts.

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Brushless DC motors with maximum service life; autoclavable versions available: Ø6 - 60 mm, 1.2 - 400 watts.

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DC motors with moving coil rotor and strong permanent magnets: Ø6 - 65 mm, 0.3 - 250 watts.

**maxon sensor**
High-resolution digital encoders, DC tachos and resolvers.

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DC and brushless DC micro drives with diameters < 10 mm: Ø6 - 9.2 mm, 0.2 - 2 watts.

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