Pololu 25D Metal Gearmotors are powerful brushed DC motors paired with 25mm-diameter spur gearboxes. They are available in a variety of different gear ratios, from 4.4:1 up to 499:1, and with five different motor options:

- **LP 6V:** Low-power, 6 V nominal operation (2.1 W max power and 2 A stall current at 6 V)
- **HP 6V:** High-power, 6 V nominal operation (7 W max power and 6 A stall current at 6 V)
- **LP 12V:** Low-power, 12 V nominal operation (1.8 W max power and 0.9 A stall current at 12 V)
- **MP 12V:** Medium-power, 12 V nominal operation (3.5 W max power and 1.8 A stall current at 12 V)
- **HP 12V:** High-power, 12 V nominal operation (10 W max power and 5 A stall current at 12 V)

Each version is available with an integrated 48 CPR quadrature encoder on the motor shaft.

**Dimensions (units: mm over [inches])**

**Motor with encoder and no gearbox** (items #4800, 4820, 4840, 4860, 4880)  
weight: 60 g

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25D Metal Gearmotors

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25D Metal Gearmotors

Gearmotor versions with encoders (items #4801-4811, 4821-4831, 4841-4851, 4861-4871, 4881-4891) weight: 95 g to 110 g

Gearmotor versions without encoders (items #1570-1577, 1581-1591, 3201-3207, 3225-3233, 3249-3258) weight: 82 g to 96 g
## 25D Metal Gearmotors

### Performance summary and table of contents

<table>
<thead>
<tr>
<th>Motor Type</th>
<th>Rated Voltage</th>
<th>Pololu Item #</th>
<th>Gear Ratio</th>
<th>Typical No Load RPM</th>
<th>Current MA</th>
<th>Effort kg mm</th>
<th>Torque kg mm</th>
<th>Current A</th>
<th>Power W</th>
<th>Efficiency %</th>
<th>Graph Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low Power</td>
<td>6 V</td>
<td>4820 (1)</td>
<td>1</td>
<td>6000</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>2.1</td>
<td>1.5</td>
<td>-</td>
<td>2.0</td>
</tr>
<tr>
<td>High Power</td>
<td>6 V</td>
<td>4800 (1)</td>
<td>1</td>
<td>10,000</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>3</td>
<td>1.8</td>
<td>-</td>
<td>5.0</td>
</tr>
<tr>
<td>Medium Power</td>
<td>12 V</td>
<td>4880 (1)</td>
<td>1</td>
<td>5600</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>1.8</td>
<td>1.4</td>
<td>-</td>
<td>2.5</td>
</tr>
<tr>
<td>High Power</td>
<td>12 V</td>
<td>4840 (1)</td>
<td>1</td>
<td>8200</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>3.5</td>
<td>1.7</td>
<td>-</td>
<td>3.5</td>
</tr>
<tr>
<td>Medium Power</td>
<td>12 V</td>
<td>4825,4863,4865</td>
<td>1</td>
<td>8000</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>8.0</td>
<td>3.0</td>
<td>-</td>
<td>1.8</td>
</tr>
<tr>
<td>High Power</td>
<td>12 V</td>
<td>4820 (1)</td>
<td>1</td>
<td>10,000</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>10.0</td>
<td>5.0</td>
<td>-</td>
<td>5.0</td>
</tr>
</tbody>
</table>

### Notes:

1. Max efficiency data and performance graphs currently unavailable for the motors without gearboxes (items #4800, 4820, 4840, 4860, and 4880).
2. Listed stall torques and currents are theoretical extrapolations; units will typically stall well before these points as the motors heat up. Stalling or overloading gearmotors can greatly decrease their lifetimes and even result in immediate damage. The recommended upper limit for continuously applied loads is 4 kg cm (55 oz-in), and the recommended upper limit for intermittently permissible torque is 8 kg cm (110 oz-in). Stalls can also result in rapid (potentially on the order of seconds) thermal damage to the motor windings and brushes, especially for the versions that use high-power (HP and HPB8) motors; a general recommendation for brushed DC motor operation is 25% or less of the stall current.
3. Output power for these units is constrained by gearbox load limits, and the theoretical maximum power point is not safely achievable.
4. The maximum efficiency point on these units occurs at loads beyond what the gearbox can safely tolerate.
Using the encoder

Versions with encoders have additional electronics mounted on the rear of the motor. Two Hall-effect sensors are used to sense the rotation of a magnetic disc on a rear protrusion of the motor shaft. The encoder electronics and magnetic disc are enclosed by a removable plastic end cap. The following pictures show what the encoder portion looks like with the end cap removed:

The quadrature encoder provides a resolution of 48 counts per revolution (CPR) of the motor shaft when counting both edges of both channels. To compute the counts per revolution of the gearbox output, multiply the gear ratio by 48.

The motor/encoder has six color-coded, 20 cm (8") leads terminated by a 1×6 female connector with a 2.54 mm (0.1") pitch. This connector works with standard 0.1" male breakaway headers and Pololu male premium jumper and precrimped wires. If this header is not convenient, the crimped wires can be pulled out of the 1×6 housing and used with different crimp connector housings instead (e.g. 1×2 for the motor power and 1×1 housings for the other four leads), or the connectors can be cut off entirely.

<table>
<thead>
<tr>
<th>Lead Color</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>Red</td>
<td>Motor power</td>
</tr>
<tr>
<td>Black</td>
<td>Motor power</td>
</tr>
<tr>
<td>Green</td>
<td>Encoder ground</td>
</tr>
<tr>
<td>Blue</td>
<td>Encoder Vcc (3.5 V to 20 V)</td>
</tr>
<tr>
<td>Yellow</td>
<td>Encoder A output</td>
</tr>
<tr>
<td>White</td>
<td>Encoder B output</td>
</tr>
</tbody>
</table>
The Hall sensors require an input voltage, Vcc, between 3.5 V and 20 V and draw a maximum of 10 mA. The A and B outputs are square waves from 0 V to Vcc approximately 90° out of phase. The speed of the motor can be determined from the frequency, and the direction of rotation can be determined from the order of the transitions. The following oscilloscope capture shows the A and B (yellow and white) encoder outputs using a 6 V HP motor at 6 V and a Hall sensor Vcc of 5 V:

Counting both the rising and falling edges of both the A and B outputs results in 48 counts per revolution of the motor shaft. Using just a single edge of one channel results in 12 counts per revolution of the motor shaft, so the frequency of the A output in the above oscilloscope capture is 12 times the motor rotation frequency.

### Exact gear ratios

```
<table>
<thead>
<tr>
<th>Nominal</th>
<th>Exact</th>
<th>Nominal</th>
<th>Exact</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.4 : 1</td>
<td>(\frac{22 \times 24}{12 \times 10}) = 4.4 : 1</td>
<td>99 : 1</td>
<td>(\frac{22 \times 22 \times 22 \times 22 \times 22 \times 23}{12 \times 10 \times 10 \times 10 \times 10 \times 10}) (\approx 98.7779 : 1)</td>
</tr>
<tr>
<td>9.7 : 1</td>
<td>(\frac{22 \times 22 \times 24}{12 \times 10 \times 10}) = 9.68 : 1</td>
<td>172 : 1</td>
<td>(\frac{22 \times 22 \times 22 \times 22 \times 22 \times 22 \times 24}{12 \times 10 \times 10 \times 10 \times 10 \times 10 \times 10}) (\approx 171.7877 : 1)</td>
</tr>
<tr>
<td>20.4 : 1</td>
<td>(\frac{22 \times 22 \times 22 \times 23}{12 \times 10 \times 10 \times 10}) = 20.4086 : 1</td>
<td>227 : 1</td>
<td>(\frac{22 \times 22 \times 22 \times 22 \times 22 \times 22 \times 22 \times 24}{12 \times 10 \times 10 \times 10 \times 10 \times 10 \times 10 \times 10}) (\approx 226.7598 : 1)</td>
</tr>
<tr>
<td>34 : 1</td>
<td>(\frac{22 \times 20 \times 22 \times 22 \times 23}{12 \times 12 \times 10 \times 10 \times 10}) = 34.014 : 1</td>
<td>378 : 1</td>
<td>(\frac{22 \times 20 \times 22 \times 22 \times 22 \times 22 \times 22 \times 22 \times 24}{12 \times 12 \times 10 \times 10 \times 10 \times 10 \times 10 \times 10 \times 10}) (\approx 377.9330 : 1)</td>
</tr>
<tr>
<td>47 : 1</td>
<td>(\frac{22 \times 22 \times 22 \times 22 \times 24}{12 \times 10 \times 10 \times 10 \times 10}) = 46.8512 : 1</td>
<td>499 : 1</td>
<td>(\frac{22 \times 22 \times 22 \times 22 \times 22 \times 22 \times 22 \times 22 \times 22 \times 24}{12 \times 10 \times 10 \times 10 \times 10 \times 10 \times 10 \times 10 \times 10 \times 10}) (\approx 498.8716 : 1)</td>
</tr>
<tr>
<td>75 : 1</td>
<td>(\frac{22 \times 20 \times 22 \times 22 \times 22 \times 23}{12 \times 12 \times 10 \times 10 \times 10 \times 10}) = 74.8317 : 1</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Pololu Items #1581, #4821 (4.4:1 Metal Gearmotor 25D LP 6V) Performance at 6 V

- **max power**: 2.1 W at 3.1 kg⋅mm, 32% efficiency, 640 rpm, 1.1 A
- **max efficiency**: 49% at 0.82 kg⋅mm, 0.94 W, 1100 rpm, 0.32 A

**Mathematical functions**:
- \( f(\tau) = 1300 - 200\tau \)
- \( f(\tau) = 0.048 + 0.33\tau \)

- **Stall Torque**: \( \tau_{\text{stall}} \approx 6.3 \text{ kg}\cdot\text{mm} \)
- **Stall Current**: \( I_{\text{stall}} \approx 2.1 \text{ A} \)

- **No-load Speed**: 1300 rpm
- **No-load Current**: 0.090 A
max power: 1.9 W at 6.3 kg⋅mm, 30% efficiency, 290 rpm, 1.0 A
torque (kg⋅mm)

Pololu Items #1582, #4822 (9.7:1 Metal Gearmotor 25D LP 6V) Performance at 6 V

max efficiency: 44% at 2.0 kg⋅mm, 1.0 W, 490 rpm, 0.38 A

f(τ) = 580 − 48τ
f(τ) = 0.070 + 0.15τ
τ_{stall} ≈ 13 kg⋅mm
I_{stall} ≈ 2.0 A

no-load speed: 630 rpm
no-load current: 0.090 A

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Pololu Items #1583, #4823 (20.4:1 Metal Gearmotor 25D LP 6V) Performance at 6 V

max power: 1.9 W
at 13 kg⋅mm,
29% efficiency,
140 rpm, 1.1 A

max efficiency: 44%
at 3.6 kg⋅mm, 0.91 W,
240 rpm, 0.34 A

no-load speed: 290 rpm

max efficiency: 44%
at 3.6 kg⋅mm, 0.91 W,
240 rpm, 0.34 A

no-load speed: 290 rpm
no-load current: 0.086 A

$\tau_{\text{stall}} \approx 25 \text{ kg⋅mm}$
$I_{\text{stall}} \approx 2.1 \text{ A}$

$f(\tau) = 0.057 + 0.079\tau$

\[ f(\tau) = 280 - 11\tau \]

\[ f(\tau) = 0.057 + 0.079\tau \]
Pololu Items #1584, #4824 (34:1 Metal Gearmotor 25D LP 6V) Performance at 6 V

- max power: 1.7 W at 19 kg⋅mm,
- 27% efficiency,
- 85 rpm, 1.0 A

- no-load speed: 180 rpm
- f(τ) = 170 − 4.4τ

- max efficiency: 42%
  at 5.2 kg-mm, 0.78 W,
  150 rpm, 0.31 A

- τstall ≈ 39 kg-mm
- Istall ≈ 2.0 A

- no-load current: 0.087 A
Pololu Items #1585, #4825 (47:1 Metal Gearmotor 25D LP 6V) Performance at 6 V

max power: 1.5 W at 24 kg⋅mm, 25% efficiency, 62 rpm, 1.0 A

max efficiency: 38% at 6.9 kg⋅mm, 0.75 W, 110 rpm, 0.33 A

no-load speed: 130 rpm

no-load current: 0.085 A

f(τ) = 120 − 2.6τ

f(τ) = 0.055 + 0.040τ

τ_{stall} ≈ 48 kg⋅mm

I_{stall} ≈ 1.9 A
Pololu Items #1586, #4826 (75:1 Metal Gearmotor 25D LP 6V) Performance at 6 V

max power: 1.5 W
at 38 kg-mm, 24% efficiency,
38 rpm, 1.0 A

torque (kg-mm)

max efficiency: 36%
at 11 kg-mm, 0.72 W,
66 rpm, 0.33 A

f(τ) = 77 - 1.0τ

f(τ) = 0.054 + 0.026τ

τ_{stall} ≈ 75 kg-mm

I_{stall} ≈ 2.0 A

no-load speed: 80 rpm

no-load current: 0.092 A

speed (rpm)
current (A)

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11
max power: 1.4 W
at 45 kg⋅mm,
23% efficiency,
30 rpm, 1.0 A

max efficiency: 34%
at 14 kg⋅mm, 0.73 W,
50 rpm, 0.36 A

no-load speed: 61 rpm

f(τ) = 59 − 0.85τ

f(τ) = 0.067 + 0.021τ

τ_{stall} ≈ 91 kg⋅mm

I_{stall} ≈ 2.0 A

no-load current: 0.077 A

no-load speed: 61 rpm

Pololu Items #1587, #4827 (99:1 Metal Gearmotor 25D LP 6V) Performance at 6 V
Pololu Items #1588, #4828 (172:1 Metal Gearmotor 25D LP 6V) Performance at 6 V

max power: 1.2 W at 70 kg⋅mm, 21% efficiency, 17 rpm, 1.0 A

max efficiency: 31% at 21 kg⋅mm, 0.63 W, 29 rpm, 0.33 A

no-load speed: 35 rpm

no-load current: 0.081 A

f(\tau) = 34 - 0.24\tau

f(\tau) = 0.058 + 0.013\tau

\tau_{\text{stall}} \approx 140 \text{ kg}\cdot\text{mm}

I_{\text{stall}} \approx 1.9 \text{ A}
Pololu Items #1589, #4829 (227:1 Metal Gearmotor 25D LP 6V) Performance at 6 V

- Max power: 1.1 W at 84 kg⋅mm, 20% efficiency, 13 rpm, 1.0 A
- Torque: (kg⋅mm)
  - Stall: \( \tau_{\text{stall}} \approx 170 \text{ kg} \cdot \text{mm} \)
  - No-load: \( \tau_{\text{no-load}} \approx 1.9 \text{ A} \)

- No-load speed: 27 rpm
- No-load current: 0.074 A
- Max efficiency: 30%
  - At 24 kg⋅mm, 0.55 W, 22 rpm, 0.31 A

\[ f(\tau) = 26 - 0.16\tau \]

\[ f(\tau) = 0.052 + 0.011\tau \]
Pololu Items #1590, #4830 (378:1 Metal Gearmotor 25D LP 6V) Performance at 6 V

- **Max Power:** 1.0 W at 130 kg⋅mm, 19% efficiency, 8.0 rpm, 0.93 A
- **Max Efficiency:** 27% at 41 kg⋅mm, 0.56 W, 13 rpm, 0.34 A

**No-Load Speed:** 16 rpm

**No-Load Current:** 0.080 A

**Stall Torque:** 250 kg⋅mm

**Stall Current:** ≈ 1.8 A

**f(τ) = 16 − 0.083τ**

**f(τ) = 0.086 + 0.0068τ**
Pololu Items #1591, #4831 (499:1 Metal Gearmotor 25D LP 6V) Performance at 6 V

- Max power: 1.0 W at 160 kg mm, 18% efficiency, 6.1 rpm, 0.90 A
- Max efficiency: 27% at 45 kg mm, 0.48 W, 10 rpm, 0.30 A

f(τ) = 12 − 0.039τ
f(τ) = 0.050 + 0.0055τ

τ_{stall} ≈ 310 kg mm
I_{stall} ≈ 1.7 A

No-load speed: 12 rpm
No-load current: 0.083 A

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Pololu Items #1570, #4801 (4.4:1 Metal Gearmotor 25D HP 6V) Performance at 6 V

- Max power: 6.7 W at 5.9 kg⋅mm, 35% efficiency, 1100 rpm, 3.2 A
- Torque (kg⋅mm)

Pololu Items #1570, #4801 (4.4:1 Metal Gearmotor 25D HP 6V) Performance at 6 V

- Max efficiency: 49% at 2.2 kg⋅mm, 4.1 W, 1800 rpm, 1.4 A

- No-load speed: 2200 rpm
- No-load current: 0.40 A

\[ f(\tau) = 2200 - 190\tau \]
\[ f(\tau) = 0.33 + 0.48\tau \]

\[ I_{\text{stall}} \approx 6.0 \text{ A} \]
\[ \tau_{\text{stall}} \approx 12 \text{ kg} \cdot \text{mm} \]
Pololu Items #1571, #4802 (9.7:1 Metal Gearmotor 25D HP 6V) Performance at 6 V

- **Max power**: 5.9 W at 11 kg⋅mm, 32% efficiency, 510 rpm, 3.1 A
- **Max efficiency**: 44% at 4.5 kg⋅mm, 3.8 W, 810 rpm, 1.4 A

No-load speed: 1000 rpm

No-load current: 0.40 A

Torque (kg⋅mm)

Efficiency (%)

Power (W)

Current (A)

f(τ) = 1000 − 44τ

f(τ) = 0.35 + 0.24τ

τ_{stall} ≈ 23 kg⋅mm

I_{stall} ≈ 5.8 A
Pololu Items #1572, #4803 (20.4:1 Metal Gearmotor 25D HP 6V) Performance at 6 V

- **max power**: 5.9 W at 24 kg⋅mm, 31% efficiency, 240 rpm, 3.2 A

- **max efficiency**: 42% at 9.2 kg⋅mm, 3.7 W, 390 rpm, 1.5 A

- **no-load speed**: 480 rpm
- **no-load current**: 0.41 A

- **$f(\tau) = 480 - 10\tau$**
- **$f(\tau) = 0.35 + 0.12\tau$**

- **$\tau_{\text{stall}} \approx 48$ kg⋅mm
- **$I_{\text{stall}} \approx 6.0$ A
max power: 5.1 W
at 34 kg
\cdot mm,
26% efficiency,
150 rpm, 3.2 A

max efficiency: 37%
at 13 kg
\cdot mm, 3.1 W,
240 rpm, 1.4 A

no-load speed: 290 rpm

\tau\text{stall} \approx 68 \text{ kg} \cdot \text{mm}
I_{\text{stall}} \approx 6.1 \text{ A}

no-load current: 0.39 A

\begin{align*}
f(\tau) &= 290 - 4.3\tau \\
 f(\tau) &= 0.32 + 0.085\tau
\end{align*}
Pololu Items #1574, #4805 (47:1 Metal Gearmotor 25D HP 6V) Performance at 6 V

- Max power: 4.9 W at 45 kg⋅mm, 26% efficiency, 110 rpm, 3.1 A
- Max efficiency: 37% at 16 kg⋅mm, 2.9 W, 170 rpm, 1.3 A

$f(\tau) = 210 - 2.3\tau$
$f(\tau) = 0.29 + 0.062\tau$

- Torque (kg⋅mm): $\tau_{\text{stall}} \approx 91 \text{ kg} \cdot \text{mm}$
- No-load current: 0.37 A
- No-load speed: 210 rpm
- Stall current: $I_{\text{stall}} \approx 5.9 \text{ A}$

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Pololu Items #1575, #4806 (75:1 Metal Gearmotor 25D HP 6V) Performance at 6 V

- Max power: 4.5 W at 68 kg⋅mm, 25% efficiency, 65 rpm, 3.1 A
- Max efficiency: 34% at 27 kg⋅mm, 2.9 W, 100 rpm, 1.4 A
- No-load speed: 130 rpm
- No-load current: 0.41 A
- Torque (kg⋅mm)
- Current (A)
- Efficiency (%)
Pololu Items #1576, #4807 (99:1 Metal Gearmotor 25D HP 6V) Performance at 6 V

- Max power: 3.9 W at 77 kg⋅mm, 22% efficiency, 49 rpm, 2.9 A
- Max efficiency: 30% at 31 kg⋅mm, 2.5 W, 79 rpm, 1.4 A

f(τ) = 99 – 0.64τ
f(τ) = 0.34 + 0.033τ

τ_{stall} ≈ 150 kg⋅mm
I_{stall} ≈ 5.5 A

No-load speed: 99 rpm
No-load current: 0.37 A
Pololu Items #1577, #4808 (172:1 Metal Gearmotor 25D HP 6V) Performance at 6 V

- Maximum power: 3.9 W at 130 kg⋅mm, 22% efficiency, 29 rpm, 3.0 A
- Maximum efficiency: 30% at 52 kg⋅mm, 2.5 W, 46 rpm, 1.4 A

Torque (kg⋅mm): 
- Stall torque: \( \tau_{\text{stall}} \approx 270 \, \text{kg} \cdot \text{mm} \)
- No-load current: \( I_{\text{no-load}} \approx 5.6 \, \text{A} \)

No-load speed: 57 rpm
No-load current: 0.41 A

Mathematical functions:
- \( f(\tau) = 57 - 0.22\tau \)
- \( f(\tau) = 0.34 + 0.020\tau \)
Pololu Items #3249, #4881 (4.4:1 Metal Gearmotor 25D LP 12V) Performance at 12 V

- **max power:** 1.7 W
- **at 2.7 kg⋅mm,** 32% efficiency, 630 rpm, 0.45 A

- **max efficiency:** 51%
- **at 0.60 kg⋅mm,** 0.69 W, 1100 rpm, 0.11 A

- **no-load speed:** 1200 rpm
- **no-load current:** 0.045 A

- **
  \[ f(\tau) = 1300 - 240\tau \]
  \[ f(\tau) = 0.014 + 0.16\tau \]

- **\( \tau_{\text{stall}} \approx 5.3 \text{ kg} \cdot \text{mm} \)**
- **\( I_{\text{stall}} \approx 0.88 \text{ A} \)**

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Pololu Items #3250, #4882 (9.7:1 Metal Gearmotor 25D LP 12V) Performance at 12 V

- **Max power:** 1.8 W at 6.3 kg⋅mm, 31% efficiency, 280 rpm, 0.48 A
- **Max efficiency:** 47% at 1.9 kg⋅mm, 0.94 W, 480 rpm, 0.17 A
- **No-load current:** 0.042 A
- **No-load speed:** 580 rpm
- **Stall torque:** $\tau_{\text{stall}} \approx 13 \text{ kg} \cdot \text{mm}$
- **Stall current:** $I_{\text{stall}} \approx 0.93 \text{ A}$

**Equations:**

$$f(\tau) = 560 - 45\tau$$

$$f(\tau) = 0.030 + 0.072\tau$$
Pololu Items #3251, #4883 (20.4:1 Metal Gearmotor 25D LP 12V) Performance at 12 V

- **Max power**: 1.7 W at 12 kg mm, 29% efficiency, 140 rpm, 0.49 A torque (kg mm)

- **Max efficiency**: 43% at 3.5 kg mm, 0.84 W, 230 rpm, 0.16 A

- **Torque stall**: $\tau_{\text{stall}} \approx 24$ kg mm

- **Current stall**: $I_{\text{stall}} \approx 0.94$ A

- **No-load speed**: 280 rpm

- **No-load current**: 0.038 A

- **Power functional relationship**: $f(\tau) = 270 - 11\tau$

- **Efficiency functional relationship**: $f(\tau) = 0.028 + 0.038\tau$
Pololu Items #3252, #4884 (34:1 Metal Gearmotor 25D LP 12V) Performance at 12 V

- Max power: 1.6 W at 19 kg mm, 27% efficiency, 82 rpm, 0.48 A
- Max efficiency: 42% at 5.0 kg mm, 0.73 W, 140 rpm, 0.14 A
- Torque (kg mm):
  - Stall: \( T_{\text{stall}} \approx 37 \text{ kg mm} \)
  - No-load: \( T_{\text{no-load}} \approx 0.93 \text{ A} \)

- No-load speed: 170 rpm
- No-load current: 0.038 A

- Speed (rpm) vs. Current (A) graph:
  - Blue line: \( f(\tau) = 160 - 4.4\tau \)
  - Orange line: \( f(\tau) = 0.022 + 0.025\tau \)

- Efficiency (%)

- Power (W)

- Torque (kg mm)
max power: 1.4 W at 24 kg⋅mm, 25% efficiency, 58 rpm, 0.47 A

Pololu Items #3253, #4885 (47:1 Metal Gearmotor 25D LP 12V) Performance at 12 V

max efficiency: 38% at 7.3 kg⋅mm, 0.74 W, 99 rpm, 0.16 A

f(τ) = 120 − 2.4τ

f(τ) = 0.029 + 0.018τ

τ\text{stall} ≈ 48 kg⋅mm

I\text{stall} ≈ 0.92 A

no-load speed: 120 rpm

no-load current: 0.045 A

f(τ) = 120 − 2.4τ
Pololu Items #3254, #4886 (75:1 Metal Gearmotor 25D LP 12V) Performance at 12 V

- **Max Power:** 1.4 W at 36 kg-mm, 24% efficiency, 37 rpm, 0.46 A
- **Efficiency:** 35% at 12 kg-mm, 0.73 W, 62 rpm, 0.17 A
- **No-Load Current:** 0.044 A
- **No-Load Speed:** 75 rpm
- **Stall Torque:** 71 kg-mm

\[ f(\tau) = 74 - 1.0\tau \quad \text{at} \quad 24\% \text{ efficiency, } 37 \text{ rpm, } 0.46 \text{ A} \]
\[ f(\tau) = 0.033 + 0.012\tau \quad \text{at} \quad 35\% \text{ efficiency, } 12 \text{ kg-mm, } 0.73 \text{ W} \]
Pololu Items #3255, #4887 (99:1 Metal Gearmotor 25D LP 12V) Performance at 12 V

max power: 1.2 W at 43 kg⋅mm, 22% efficiency, 28 rpm, 0.47 A

max efficiency: 33% at 14 kg⋅mm, 0.67 W, 47 rpm, 0.17 A

no-load speed: 57 rpm

f(τ) = 56 – 0.64τ

f(τ) = 0.032 + 0.010τ

τ_{stall} = 87 kg⋅mm

I_{stall} = 0.90 A

no-load current: 0.041 A

no-load current: 0.041 A
Pololu Items #3256, #4888 (172:1 Metal Gearmotor 25D LP 12V) Performance at 12 V

max power: 1.1 W
at 64 kg⋅mm,
21% efficiency,
16 rpm, 0.44 A

max efficiency: 31%
at 19 kg⋅mm, 0.54 W,
28 rpm, 0.14 A

no-load speed: 33 rpm
f(τ) = 33 − 0.26τ
f(τ) = 0.025 + 0.0064τ

max power: 1.1 W
at 64 kg⋅mm,
21% efficiency,
16 rpm, 0.44 A

no-load current: 0.036 A

I_{stall} \approx 0.85 A
τ_{stall} \approx 130 kg⋅mm

no-load current: 0.036 A
Pololu Items #3257, #4889 (227:1 Metal Gearmotor 25D LP 12V) Performance at 12 V

max power: 1.0 W
at 81 kg⋅mm, 20% efficiency, 12 rpm, 0.43 A

max efficiency: 30%
at 24 kg⋅mm, 0.53 W, 21 rpm, 0.14 A

f(τ) = 25 − 0.15τ
f(τ) = 0.025 + 0.0049τ

τ_{stall} ≈ 160 kg⋅mm
I_{stall} ≈ 0.83 A

no-load speed: 25 rpm
no-load current: 0.041 A

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max power: 0.88 W at 110 kg⋅mm, 18% efficiency, 7.5 rpm, 0.41 A

max efficiency: 26% at 36 kg⋅mm, 0.47 W, 13 rpm, 0.15 A

no-load speed: 15 rpm

I_{stall} ≈ 0.79 A

f(τ) = 15 − 0.086τ
f(τ) = 0.028 + 0.0034τ

no-load current: 0.044 A

τ_{stall} ≈ 230 kg⋅mm
Pololu Items #3225, #4861 (4.4:1 Metal Gearmotor 25D MP 12V) Performance at 12 V

- Max power: 3.2 W at 3.5 kg mm, 31% efficiency, 890 rpm, 0.88 A
- Max efficiency: 47% at 0.93 kg mm, 1.5 W, 1500 rpm, 0.26 A

Torque (kg mm):
- Stall torque: ≈ 7.1 kg mm
- No-load current: 0.075 A

No-load speed: 1800 rpm

Current (A):
- Stall current: ≈ 1.7 A

f(τ) = 1800 − 25τ

f(τ) = 0.039 + 0.24τ
Pololu Items #3226, #4862 (9.7:1 Metal Gearmotor 25D MP 12V) Performance at 12 V

- **Max power**: 3.4 W at 8.4 kg⋅mm, 30% efficiency, 390 rpm, 0.94 A
- **Max efficiency**: 45% at 2.5 kg⋅mm, 1.7 W, 670 rpm, 0.32 A

Torque (kg⋅mm) vs. Efficiency (%)

- Torque stall ≈ 17 kg⋅mm
- No-load current: 0.077 A
- No-load speed: 800 rpm

\[ f(\tau) = 780 - 47\tau \]
\[ f(\tau) = 0.056 + 0.11\tau \]
Pololu Items #3227, #4863 (20.4:1 Metal Gearmotor 25D MP 12V) Performance at 12 V

- **Max power**: 3.1 W at 16 kg mm, 28% efficiency, 190 rpm, 0.91 A torque (kg mm)
- **Max efficiency**: 43% at 4.3 kg mm, 1.5 W, 330 rpm, 0.28 A
- **No-load speed**: 380 rpm
- **No-load current**: 0.085 A
- **Stall torque**: ≈ 32 kg mm
- **Stall current**: ≈ 1.8 A

The graph shows the performance characteristics of the gearmotor at 12 V, including efficiency and power curves as functions of torque and current.
Pololu Items #3228, #4864 (34:1 Metal Gearmotor 25D MP 12V) Performance at 12 V

- Max power: 2.8 W at 23 kg⋅mm, 25% efficiency, 120 rpm, 0.93 A
- Max efficiency: 40% at 5.4 kg⋅mm, 1.1 W, 200 rpm, 0.24 A
- Torque (kg⋅mm):
  - Stall torque: ≈ 47 kg⋅mm
  - Stall current: ≈ 1.8 A
- No-load speed: 230 rpm
- No-load current: 0.077 A

Graphical representation of performance metrics:
- Efficiency (%)
- Power (W)
- Speed (rpm)
- Current (A)
- Torque (kg⋅mm)
Pololu Items #3229, #4865 (47:1 Metal Gearmotor 25D MP 12V) Performance at 12 V

- Max power: 2.8 W at 32 kg⋅mm, 25% efficiency, 83 rpm, 0.92 A

- Max efficiency: 38% at 8.6 kg⋅mm, 1.3 W, 140 rpm, 0.28 A

- No-load speed: 170 rpm
- No-load current: 0.076 A

- Torque stall: 64 kg⋅mm
- Current stall: 1.8 A

- Handwritten equations:
  \[ f(\tau) = 170 - 2.6\tau \]
  \[ f(\tau) = 0.042 + 0.027\tau \]
Pololu Items #3230, #4866 (75:1 Metal Gearmotor 25D MP 12V) Performance at 12 V

- **Max power:** 2.3 W at 43 kg⋅mm, 21% efficiency, 52 rpm, 0.89 A
- **Torque (kg⋅mm):** 
- **Max efficiency:** 33% at 12 kg⋅mm, 1.1 W, 91 rpm, 0.28 A
- **No-load speed:** 100 rpm
- **No-load current:** 0.074 A
- **Stall torque:** ≈ 85 kg⋅mm
- **Stall current:** ≈ 1.7 A

- **F(τ) = 100 − 1.2τ**
- **F(τ) = 0.044 + 0.020τ**
Pololu Items #3231, #4867 (99:1 Metal Gearmotor 25D MP 12V) Performance at 12 V

- **No-load speed**: 79 rpm
- **Max power**: 2.3 W
  - at 57 kg⋅mm, 22% efficiency, 40 rpm, 0.88 A
- **Max efficiency**: 34%
  - at 16 kg⋅mm, 1.1 W, 68 rpm, 0.28 A
- **Stall torque**: ≈110 kg⋅mm
- **Stall current**: ≈1.7 A
- **No-load current**: 0.065 A
Pololu Items #3232, #4868 (172:1 Metal Gearmotor 25D MP 12V) Performance at 12 V

- Max power: 2.1 W at 90 kg⋅mm, 21% efficiency, 23 rpm, 0.84 A
- Max efficiency: 31% at 27 kg⋅mm, 1.1 W, 39 rpm, 0.29 A

\[ f(\tau) = 46 - 0.26\tau \]
\[ f(\tau) = 0.052 + 0.0088\tau \]

No-load speed: 46 rpm
No-load current: 0.079 A

\[ \tau_{\text{stall}} \approx 180 \text{ kg} \cdot \text{mm} \]
\[ I_{\text{stall}} \approx 1.6 \text{ A} \]
Pololu Items #3233, #4869 (227:1 Metal Gearmotor 25D MP 12V) Performance at 12 V

- **Max power**: 2.1 W at 120 kg-mm, 21% efficiency, 17 rpm, 0.83 A torque (kg-mm)
- **Max efficiency**: 32% at 36 kg-mm, 1.1 W, 30 rpm, 0.28 A

**Pololu Items #3233, #4869 (227:1 Metal Gearmotor 25D MP 12V)**

- **Max power**: 2.1 W at 120 kg-mm, 21% efficiency, 17 rpm, 0.83 A torque (kg-mm)
- **Max efficiency**: 32% at 36 kg-mm, 1.1 W, 30 rpm, 0.28 A

**Graphs**

- **F(t) = 35 - 0.15t**
- **F(t) = 0.050 + 0.0065t**
- **T_{stall} ≈ 240 kg-mm**
- **I_{stall} ≈ 1.6 A**
- **No-load speed**: 35 rpm
- **No-load current**: 0.081 A

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Pololu Items #3201, #4841 (4.4:1 Metal Gearmotor 25D HP 12V) Performance at 12 V

- **Max power**: 9.4 W at 8.7 kg mm, 33% efficiency, 1000 rpm, 2.4 A
- **Max efficiency**: 44% at 3.6 kg mm, 6.2 W, 1700 rpm, 1.2 A
- **Torque**: 
  - No-load current: 0.23 A
  - Stall torque: ≈ 17 kg mm

**Equations**

\[ f(\tau) = 2100 - 120\tau \]

\[ f(\tau) = 0.31 + 0.24\tau \]
Pololu Items #3202, #4842 (9.7:1 Metal Gearmotor 25D HP 12V) Performance at 12 V

- **max power**: 10 W at 19 kg⋅mm, 35% efficiency, 520 rpm, 2.5 A
- **max efficiency**: 52% at 5.8 kg⋅mm, 5.3 W, 890 rpm, 0.84 A
- **no-load speed**: 1000 rpm
- **no-load current**: 0.20 A

\[ f(\tau) = 1000 - 27\tau \]
\[ f(\tau) = 0.15 + 0.12\tau \]
\[ \tau_{\text{stall}} \approx 39 \text{ kg} \cdot \text{mm} \]
\[ I_{\text{stall}} \approx 4.8 \text{ A} \]
Pololu Items #3203, #4843 (20.4:1 Metal Gearmotor 25D HP 12V) Performance at 12 V

- **Max power**: 9.4 W at 37 kg⋅mm, 31% efficiency, 250 rpm, 2.6 A
- **Torque (kg⋅mm)**
- **Max efficiency**: 46% at 11 kg⋅mm, 4.8 W, 420 rpm, 0.88 A
- **No-load speed**: 500 rpm
- **No-load current**: 0.22 A
- **Stall current**: $I_{\text{stall}} \approx 5.0$ A
- **Stall torque**: $\tau_{\text{stall}} \approx 74$ kg⋅mm

$f(\tau) = 500 - 6.7\tau$
$f(\tau) = 0.15 + 0.065\tau$

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Pololu Items #3204, #4844 (34:1 Metal Gearmotor 25D HP 12V) Performance at 12 V

- **max power**: 8.9 W at 57 kg⋅mm, 29% efficiency, 150 rpm, 2.5 A
- **max efficiency**: 44% at 16 kg⋅mm, 4.3 W, 260 rpm, 0.82 A

- **no-load speed**: 300 rpm
- **no-load current**: 0.22 A
- **τ_{stall}**: 110 kg⋅mm
- **I_{stall}**: 4.9 A

$f(\tau) = 300 - 2.7\tau$

$f(\tau) = 0.14 + 0.042\tau$
Pololu Items #3205, #4845 (47:1 Metal Gearmotor 25D HP 12V) Performance at 12 V

max power: 8.4 W at 75 kg mm, 28% efficiency, 110 rpm, 2.5 A

max efficiency: 42% at 23 kg mm, 4.4 W, 180 rpm, 0.87 A

no-load speed: 220 rpm

\[ f(\tau) = 220 - 1.4\tau \]

\[ f(\tau) = 0.16 + 0.031\tau \]

\( \tau_{\text{stall}} \approx 150 \text{ kg mm} \)

\( I_{\text{stall}} \approx 4.9 \text{ A} \)

no-load current: 0.20 A

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Pololu Items #3206, #4846 (75:1 Metal Gearmotor 25D HP 12V) Performance at 12 V

- **max power**: 7.6 W at 110 kg-mm, 25% efficiency, 67 rpm, 2.5 A
- **max efficiency**: 37% at 33 kg-mm, 3.9 W, 110 rpm, 0.87 A

- **no-load speed**: 130 rpm
- **no-load current**: 0.20 A
- **τ_{stall} ≈ 220 kg-mm
- **I_{stall} ≈ 4.9 A

\[ f(τ) = 130 - 0.62τ \]
\[ f(τ) = 0.16 + 0.022τ \]
Pololu Items #3207, #4847 (99:1 Metal Gearmotor 25D HP 12V) Performance at 12 V

- **Max power:** 7.6 W at 140 kg⋅mm, 24% efficiency, 51 rpm, 2.6 A
- **Torque:** (kg⋅mm)

**Pololu Items #3207, #4847 (99:1 Metal Gearmotor 25D HP 12V) Performance at 12 V**

- **Max efficiency:** 36% at 45 kg⋅mm, 4.0 W, 87 rpm, 0.94 A
- **Stall:**
  - $f(\tau) = 100 - 0.36\tau$
  - $f(\tau) = 0.18 + 0.017\tau$
  - $\tau_{\text{stall}} \approx 290$ kg⋅mm
  - $I_{\text{stall}} \approx 5.0$ A
- **No-load speed:** 100 rpm
- **No-load current:** 0.21 A

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