Pololu Micro Metal Gearmotors are available in a variety of different gear ratios, from 5:1 up to 1000:1, and with five different motor options:

- **LP 6V**: Low-power 6 V with precious metal brushes
- **MP 6V**: Medium-power 6 V with precious metal brushes
- **HP 6V**: High-power 6 V with precious metal brushes
- **HPCB 6V**: High-power 6 V with long-life carbon brushes
- **HPCB 12V**: High-power 12 V with long-life carbon brushes

Each motor is available with an optional extended rear motor shaft to allow for the addition of an encoder such as Pololu items #4760 (https://www.pololu.com/product/4760) and #4761 (https://www.pololu.com/product/4761) Magnetic Encoder Pair Kits.

**Dimensions of versions with carbon brushes (HPCB)**

![Dimensions diagram with carbon brushes]

**Dimensions of versions with precious metal brushes (HP, MP, LP)**

![Dimensions diagram with precious metal brushes]

$L = 9 \text{ mm [0.35 in]}$ for all gear ratios except 1000:1. $L = 12.5 \text{ mm [0.49 in]}$ for the 1000:1 gear ratio. Max length for M1.6 mounting screws is 1.3 mm (from gearbox mounting surface). Approximate weight is 10 g.
## Micro Metal Gearmotors

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<tr>
<td>Medium-Power (MPCB 6V)</td>
<td>6 V</td>
<td>2362, 2376</td>
<td>4900</td>
<td>4900</td>
<td>1700  6.4  0.40  0.80  0.32  0.12  0.21  1.7  0.21  1.0</td>
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<td>Low-Power (LP 6V)</td>
<td>6 V</td>
<td>2362, 2376</td>
<td>4900</td>
<td>4900</td>
<td>1700  6.4  0.40  0.80  0.32  0.12  0.21  1.7  0.21  1.0</td>
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<tr>
<td>High-Power (HPCB 12V)</td>
<td>12 V</td>
<td>2362, 2376</td>
<td>4900</td>
<td>4900</td>
<td>1700  6.4  0.40  0.80  0.32  0.12  0.21  1.7  0.21  1.0</td>
<td>1700  6.4  0.40  0.80  0.32  0.12  0.21  1.7  0.21  1.0</td>
<td>1700  6.4  0.40  0.80  0.32  0.12  0.21  1.7  0.21  1.0</td>
<td>1700  6.4  0.40  0.80  0.32  0.12  0.21  1.7  0.21  1.0</td>
</tr>
</tbody>
</table>

### Notes:

1. Max efficiency data and performance graphs currently unavailable for all 5:1 gear ratios and LP and MP 10:1 gear ratios.
2. Stall torques and currents are theoretical extrapolations; units will 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 instantaneous torque is 25 kg mm for the 380:1 and 1000:1 gearboxes, and 20 kg mm for all other gear ratios; we strongly advise keeping applied loads well under these limits. 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 HPCB) motors. A general recommendation for brushed DC motor operation is 25% or less of the stall current.
3. Operating these versions at maximum power is likely to damage the gearboxes.

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## Exact Gear Ratios

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<th>Nominal</th>
<th>Exact</th>
<th>Nominal</th>
<th>Exact</th>
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<tbody>
<tr>
<td>5 : 1</td>
<td>27 × 37 / 20 × 10 = 4.995 : 1</td>
<td>150 : 1</td>
<td>25 × 32 × 34 × 35 × 38 / 12 × 11 × 14 × 13 × 10 ≈ 150.5828 : 1</td>
</tr>
<tr>
<td>10 : 1</td>
<td>35 × 37 / 13 × 10 ≈ 9.9615 : 1</td>
<td>210 : 1</td>
<td>25 × 34 × 34 × 35 × 38 / 12 × 9 × 13 × 13 × 10 ≈ 210.5906 : 1</td>
</tr>
<tr>
<td>15 : 1</td>
<td>25 × 34 × 31 / 12 × 9 × 16 ≈ 15.2488 : 1</td>
<td>250 : 1</td>
<td>25 × 34 × 37 × 35 × 38 / 12 × 10 × 10 × 14 × 10 ≈ 248.9792 : 1</td>
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<tr>
<td>30 : 1</td>
<td>31 × 33 × 35 × 34 / 16 × 14 × 13 × 14 ≈ 29.8609 : 1</td>
<td>298 : 1</td>
<td>25 × 34 × 37 × 35 × 38 / 12 × 9 × 10 × 13 × 10 ≈ 297.9238 : 1</td>
</tr>
<tr>
<td>50 : 1</td>
<td>32 × 33 × 35 × 38 / 15 × 14 × 13 × 10 ≈ 51.4462 : 1</td>
<td>380 : 1</td>
<td>25 × 35 × 39 × 36 × 39 / 12 × 9 × 9 × 13 × 10 = 379.15 : 1</td>
</tr>
<tr>
<td>75 : 1</td>
<td>34 × 34 × 35 × 38 / 13 × 12 × 13 × 10 ≈ 75.8126 : 1</td>
<td>1000 : 1</td>
<td>25 × 34 × 35 × 34 × 34 × 27 / 12 × 9 × 12 × 14 × 14 × 14 × 14 × 9 ≈ 986.4064 : 1</td>
</tr>
<tr>
<td>100 : 1</td>
<td>35 × 37 × 35 × 38 / 12 × 11 × 13 × 10 ≈ 100.3700 : 1</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Pololu Items #4780, #4781 (15:1 Micro Metal Gearmotor LP 6V) Performance at 6 V

- Max power: 0.37 W at 0.85 kg⋅mm, 31% efficiency, 420 rpm, 0.20 A torque (kg⋅mm)
- Max efficiency: 40% at 0.40 kg⋅mm, 0.27 W, 640 rpm, 0.11 A

Torque (kg⋅mm) vs. Efficiency (%)

- No-load current: 0.028 A
- Stall current ≈ 0.36 A
- Stall torque ≈ 1.7 kg⋅mm

Speed (rpm) vs. Current (A)

- No-load speed: 860 rpm
- Curves for different power levels and efficiency points are shown.
Pololu Items #993, #2202 (30:1 Micro Metal Gearmotor LP 6V) Performance at 6 V

max power: 0.31 W
at 1.4 kg⋅mm, 26% efficiency, 210 rpm, 0.20 A

max efficiency: 34%
at 0.66 kg⋅mm, 0.22 W, 320 rpm, 0.11 A

no-load speed: 450 rpm

no-load current: 0.033 A

f(τ) = 420 – 150τ
26% efficiency, 210 rpm, 0.20 A

f(τ) = 0.032 + 0.11τ
τ \approx 2.9 \text{ kg} \cdot \text{mm}

\approx 0.36 \text{ A}

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Pololu Items #1098, #2203 (50:1 Micro Metal Gearmotor LP 6V) Performance at 6 V

max power: 0.29 W
at 2.2 kg ⋅ mm,
25% efficiency,
130 rpm, 0.19 A
torque (kg ⋅ mm)

max efficiency: 34%
at 0.95 kg ⋅ mm, 0.20 W,
200 rpm, 0.10 A

no-load speed: 270 rpm

f(τ) = 260 − 59τ

f(τ) = 0.027 + 0.075τ

τstall ≈ 4.4 kg ⋅ mm

Istall ≈ 0.36 A

no-load current: 0.028 A

no-load speed: 270 rpm

no-load current: 0.028 A
Pololu Items #2360, #2209 (75:1 Micro Metal Gearmotor LP 6V) Performance at 6 V

![Graph showing performance metrics with equations and annotations]

- **Max Power**: 0.29 W at 3.2 kg-mm, 24% efficiency, 88 rpm, 0.20 A
- **Max Efficiency**: 33% at 1.3 kg-mm, 0.19 W, 140 rpm, 0.10 A

Equations:
- \( f(\tau) = 180 - 27\tau \)
- \( f(\tau) = 0.025 + 0.054\tau \)

- No-load speed: 180 rpm
- No-load current: 0.027 A
- \( \tau_{\text{stall}} \approx 6.4 \text{ kg-mm} \)
- \( I_{\text{stall}} \approx 0.37 \text{ A} \)
Pololu Items #992, #2204 (100:1 Micro Metal Gearmotor LP 6V) Performance at 6 V

- **Max Power**: 0.25 W at 3.7 kg⋅mm, 21% efficiency, 65 rpm, 0.19 A
- **Max Efficiency**: 28% at 1.7 kg⋅mm, 0.17 W, 100 rpm, 0.10 A
- **Torque (kg⋅mm)**: 
  - No-load torque: \( f(\tau) = 130 - 17\tau \)
  - Stall torque: \( f(\tau) = 0.031 + 0.044\tau \)
  - \( \tau_{\text{stall}} \approx 7.4 \text{ kg}\cdot\text{mm} \)
  - Stall current: \( I_{\text{stall}} \approx 0.36 \text{ A} \)
- **No-load Speed**: 130 rpm
- **No-load Current**: 0.028 A

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Pololu Items #1097, #2205 (150:1 Micro Metal Gearmotor LP 6V) Performance at 6 V

- **Max power:** 0.25 W at 5.7 kg⋅mm, 21% efficiency, 43 rpm, 0.20 A
- **Max efficiency:** 28% at 2.6 kg⋅mm, 0.18 W, 67 rpm, 0.11 A

No-load current: 0.029 A
No-load speed: 90 rpm

\[ f(\tau) = 87 - 7.6\tau \]
\[ f(\tau) = 0.032 + 0.029\tau \]

\( \tau_{\text{stall}} \approx 11 \text{ kg} \cdot \text{mm} \)
\( I_{\text{stall}} \approx 0.37 \text{ A} \)
Pololu Items #1096, #2206 (210:1 Micro Metal Gearmotor LP 6V) Performance at 6 V

- **max power:** 0.25 W at 8.1 kg⋅mm, 21% efficiency, 30 rpm, 0.20 A
- **max efficiency:** 27% at 4.1 kg⋅mm, 0.19 W, 46 rpm, 0.12 A
- **no-load speed:** 65 rpm
- **no-load current:** 0.027 A
- **\( f(\tau) = 61 - 3.7\tau \)**
- **\( f(\tau) = 0.040 + 0.019\tau \)**
- **\( \tau_{\text{stall}} \approx 16 \text{ kg}\cdot\text{mm} \)**
- **\( I_{\text{stall}} \approx 0.35 \text{ A} \)**
Pololu Items #1095, #2207 (250:1 Micro Metal Gearmotor LP 6V) Performance at 6 V

- Max power: 0.23 W at 8.6 kg⋅mm, 21% efficiency, 26 rpm, 0.19 A
- Max efficiency: 26% at 4.2 kg⋅mm, 0.17 W, 39 rpm, 0.11 A

Pololu Items #1095, #2207 (250:1 Micro Metal Gearmotor LP 6V) Performance at 6 V

- Max power: 0.23 W at 8.6 kg⋅mm, 21% efficiency, 26 rpm, 0.19 A
- Max efficiency: 26% at 4.2 kg⋅mm, 0.17 W, 39 rpm, 0.11 A

\[ f(\tau) = 51 - 3.0\tau \]
\[ f(\tau) = 0.035 + 0.017\tau \]

\( \tau_{\text{stall}} \approx 17 \text{ kg}\cdot\text{mm} \)
\( I_{\text{stall}} \approx 0.34 \text{ A} \)

No-load speed: 54 rpm
No-load current: 0.027 A
max power: 0.22 W at 10 kg⋅mm, 21% efficiency, 22 rpm, 0.18 A

max efficiency: 27% at 4.4 kg⋅mm, 0.15 W, 34 rpm, 0.094 A

f(τ) = 44 − 2.2τ

f(τ) = 0.027 + 0.015τ

τ\text{stall} \approx 20 \text{ kg}\cdot\text{mm}

I_{\text{stall}} \approx 0.33 \text{ A}

no-load speed: 45 rpm

no-load current: 0.028 A

f(τ) = 44 - 2.2τ
Pololu Items #4790, #4791 (380:1 Micro Metal Gearmotor LP 6V) Performance at 6 V

- **Max power:** 0.27 W at 15 kg⋅mm, 24% efficiency, 18 rpm, 0.18 A
- **Torque:** (kg⋅mm)
- **Max efficiency:** 34% at 5.4 kg⋅mm, 0.16 W, 29 rpm, 0.080 A
- **No-load speed:** 36 rpm
- **No-load current:** 0.025 A
- **Stall torque:** \( \tau_{\text{stall}} \approx 29 \text{ kg}\cdot\text{mm} \)
- **Stall current:** \( I_{\text{stall}} \approx 0.35 \text{ A} \)

\[ f(\tau) = 36 - 1.2\tau \]
\[ f(\tau) = 0.018 + 0.011\tau \]
Pololu Items #1596, #3058 (1000:1 Micro Metal Gearmotor LP 6V) Performance at 6 V

- max efficiency: 24%
- at 12 kg mm, 0.12 W, 10 rpm, 0.088 A
- no-load speed: 13 rpm
- no-load current: 0.028 A
- \( \tau_{\text{stall}} \approx 55 \text{ kg mm} \)
- \( I_{\text{stall}} \approx 0.33 \text{ A} \)

\[
f(\tau) = 13 - 0.24\tau
\]
\[
f(\tau) = 0.023 + 0.0056\tau
\]
Pololu Items #4782, #4783 (15:1 Micro Metal Gearmotor MP 6V) Performance at 6 V

max power: 0.70 W at 1.0 kg⋅mm, 31% efficiency, 680 rpm, 0.38 A

torque (kg⋅mm)

max efficiency: 39% at 0.47 kg⋅mm, 0.50 W, 1000 rpm, 0.21 A

f(τ) = 1400 − 670τ
f(τ) = 0.066 + 0.31τ

τ_{stall} ≈ 2.0 kg⋅mm
I_{stall} ≈ 0.69 A

no-load speed: 1400 rpm

no-load current: 0.053 A

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Pololu Items #2364, #2378 (30:1 Micro Metal Gearmotor MP 6V) Performance at 6 V

- **Max power**: 0.57 W at 1.7 kg⋅mm, 26% efficiency, 330 rpm, 0.37 A torque (kg⋅mm)
- **Max efficiency**: 33% at 0.80 kg⋅mm, 0.41 W, 510 rpm, 0.21 A
- **Torque (τ)**: 
  - **Stall**: τ_{stall} ≈ 3.3 kg⋅mm, I_{stall} ≈ 0.67 A
  - **No-load**: τ_{no-load} = 660 - 200τ, f(τ) = 0.066 + 0.18τ
- **No-load speed**: 720 rpm
- **No-load current**: 0.064 A
Pololu Items #2365, #2379 (50:1 Micro Metal Gearmotor MP 6V) Performance at 6 V

- **max power:** 0.55 W at 2.7 kg \(\cdot\) mm, 25% efficiency, 200 rpm, 0.36 A
- **torque (kg \(\cdot\) mm):**
- **max efficiency:** 33% at 1.2 kg \(\cdot\) mm, 0.38 W, 310 rpm, 0.19 A
- **no-load speed:** 420 rpm
- **no-load current:** 0.052 A
- \(f(\tau) = 390 - 72\tau\)
- \(f(\tau) = 0.053 + 0.11\tau\)
- \(\tau_{\text{stall}} \approx 5.4 \text{ kg mm}\)
- \(I_{\text{stall}} \approx 0.67 \text{ A}\)

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Pololu Items #2366, #2380 (75:1 Micro Metal Gearmotor MP 6V) Performance at 6 V

- **max power**: 0.54 W at 3.9 kg⋅mm, 25% efficiency, 140 rpm, 0.36 A torque (kg⋅mm)
- **max efficiency**: 34% at 1.6 kg⋅mm, 0.35 W, 220 rpm, 0.17 A

- **torque (kg⋅mm)**
- **current (A)**
- **speed (rpm)**

\[ f(\tau) = 270 - 35\tau \]
\[ f(\tau) = 0.044 + 0.080\tau \]

- **I_{\text{stall}}** ≈ 0.67 A
- **τ_{\text{stall}}** ≈ 7.8 kg⋅mm

- **no-load speed**: 290 rpm
- **no-load current**: 0.054 A

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Pololu Items #2367, #2381 (100:1 Micro Metal Gearmotor MP 6V) Performance at 6 V

- **Max power:** 0.50 W at 4.7 kg⋅mm, 24% efficiency, 100 rpm, 0.35 A
- **Max efficiency:** 33% at 1.9 kg⋅mm, 0.32 W, 170 rpm, 0.17 A

**Mathematical equations:**
- $f(\tau) = 210 - 22\tau$
- $f(\tau) = 0.042 + 0.065\tau$

**No-load speed:** 220 rpm
**No-load current:** 0.048 A

- **Stall torque:** $\tau_{\text{stall}} \approx 9.4$ kg⋅mm
- **Stall current:** $I_{\text{stall}} \approx 0.66$ A
Pololu Items #2368, #2382 (150:1 Micro Metal Gearmotor MP 6V) Performance at 6 V

- **max power**: 0.48 W at 6.5 kg⋅mm, 24% efficiency, 71 rpm, 0.33 A
- **torque**: (kg⋅mm)
- **max efficiency**: 33% at 2.6 kg⋅mm, 0.30 W, 110 rpm, 0.15 A

**No-load speed**: 150 rpm

**No-load current**: 0.051 A

\[ f(\tau) = 140 - 11\tau \]
\[ f(\tau) = 0.038 + 0.045\tau \]

\( \tau_{\text{stall}} \approx 13 \text{ kg}\cdot\text{mm} \)

\( I_{\text{stall}} \approx 0.63 \text{ A} \)
Pololu Items #2369, #2383 (210:1 Micro Metal Gearmotor MP 6V) Performance at 6 V

max power: 0.46 W at 8.7 kg⋅mm, 23% efficiency, 52 rpm, 0.34 A torque (kg⋅mm)

max efficiency: 31% at 3.4 kg⋅mm, 0.29 W, 83 rpm, 0.16 A

no-load speed: 100 rpm

no-load current: 0.049 A

I_{stall} \approx 0.64 A

\tau_{stall} \approx 17 \text{ kg⋅mm}

f(\tau) = 100 - 6.0\tau

f(\tau) = 0.039 + 0.035\tau
Pololu Items #2370, #2384 (250:1 Micro Metal Gearmotor MP 6V) Performance at 6 V

- **Max Power:** 0.48 W at 11 kg⋅mm, 23% efficiency, 43 rpm, 0.35 A
- **Max Efficiency:** 31% at 4.5 kg⋅mm, 0.31 W, 69 rpm, 0.17 A

**Torque (kg⋅mm):**
- Max power: 0.48 W at 11 kg⋅mm
- Torque: 22 kg⋅mm

**Current (A):**
- No-load current: 0.055 A
- Stall current: ≈ 0.65 A

**Speed (rpm):**
- No-load speed: 88 rpm
- Stall speed: ≈ 22 rpm

**Equations:**
- \( f(\tau) = 87 - 4.0\tau \)
- \( f(\tau) = 0.043 + 0.028\tau \)
Pololu Items #4792, #4793 (380:1 Micro Metal Gearmotor MP 6V) Performance at 6 V

- **max power**: 0.53 W at 18 kg⋅mm, 24% efficiency, 28 rpm, 0.36 A
- **max efficiency**: 34% at 6.9 kg⋅mm, 0.33 W, 46 rpm, 0.16 A

*Note: τ = τstall ≈ 36 kg⋅mm, Istall ≈ 0.68 A*
Pololu Items #2372, #3059 (1000:1 Micro Metal Gearmotor MP 6V) Performance at 6 V

- **Max efficiency**: 24% at 13 kg⋅mm, 0.23 W, 17 rpm, 0.16 A
- **No-load speed**: 22 rpm
- **No-load current**: 0.054 A
- **Stall torque**: ≈ 67 kg⋅mm
- **Stall current**: ≈ 0.66 A

**Theoretical maximum power**

\[
f(\tau) = 21 - 0.32\tau
\]

\[
f(\tau) = 0.037 + 0.0093\tau
\]
Pololu Items #999, #2211 (10:1 Micro Metal Gearmotor HP 6V) Performance at 6 V

- Max power: 1.6 W at 1.1 kg mm, 32% efficiency, 1500 rpm, 0.85 A
- Max efficiency: 43% at 0.46 kg mm, 1.1 W, 2300 rpm, 0.42 A

Torque (kg mm): τ
Current (A): I
Power (W): P
Efficiency (%): η
Speed (rpm): ω

\[ f(\tau) = 2900 - 1400\tau \]
\[ f(\tau) = 0.11 + 0.68\tau \]

τ_{stall} ≈ 2.2 kg mm
I_{stall} ≈ 1.6 A

No-load speed: 3100 rpm
No-load current: 0.085 A
Pololu Items #4784, #4785 (15:1 Micro Metal Gearmotor HP 6V) Performance at 6 V

- Max power: 1.5 W at 1.5 kg-mm, 31% efficiency, 990 rpm, 0.83 A
- Max efficiency: 42% at 0.58 kg-mm, 0.95 W, 1600 rpm, 0.37 A

Torque (kg-mm) vs. Efficiency (%)

- Stall torque $\approx 3.0$ kg-mm
- Stall current $\approx 1.6$ A
- No-load current: 0.084 A
- No-load speed: 2000 rpm

Mathematical equations:

- $f(\tau) = 2000 - 650\tau$
- $f(\tau) = 0.090 + 0.49\tau$

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Pololu Items #1093, #2212 (30:1 Micro Metal Gearmotor HP 6V) Performance at 6 V

- Max power: 1.5 W at 2.8 kg⋅mm, 29% efficiency, 510 rpm, 0.86 A
- Max efficiency: 41% at 1.0 kg⋅mm, 0.89 W, 830 rpm, 0.36 A

Torque 

\[ f(\tau) = 1000 - 180\tau \]

\[ f(\tau) = 0.081 + 0.27\tau \]

\[ \tau_{\text{stall}} \approx 5.7 \text{ kg⋅mm} \]

\[ I_{\text{stall}} \approx 1.6 \text{ A} \]

No-load speed: 1000 rpm

No-load current: 0.088 A
Pololu Items #998, #2213 (50:1 Micro Metal Gearmotor HP 6V) Performance at 6 V

- **max power**: 1.3 W at 4.3 kg mm, 27% efficiency, 300 rpm, 0.81 A
- **max efficiency**: 38% at 1.5 kg mm, 0.75 W, 490 rpm, 0.32 A

\[
f(t) = 590 - 68t \\
f(t) = 0.067 + 0.17t
\]

- **torque (kg mm)**
  - \(\tau_{\text{stall}} \approx 8.6 \text{ kg mm}\)
  - \(I_{\text{stall}} \approx 1.6 \text{ A}\)

- **no-load speed**: 590 rpm
- **no-load current**: 0.084 A
Pololu Items #2361, #2215 (75:1 Micro Metal Gearmotor HP 6V) Performance at 6 V

- **Max power:** 1.4 W at 6.5 kg⋅mm, 28% efficiency, 210 rpm, 0.82 A
- **Max efficiency:** 40% at 2.3 kg⋅mm, 0.80 W, 340 rpm, 0.34 A

The graph shows the relationship between torque (kg⋅mm) and speed (rpm) for different operational conditions. The gearmotor can operate at high speeds with low torque or high torque with lower speeds, depending on the application.

The equation for the no-load speed is:

\[ f(t) = 410 - 32\tau \]

The equation for the stall current is:

\[ f(t) = 0.073 + 0.11\tau \]

The stall torque is approximately 13 kg⋅mm, and the stall current is approximately 1.6 A.

No-load speed: 410 rpm

No-load current: 0.10 A
Pololu Items #1101, #2214 (100:1 Micro Metal Gearmotor HP 6V) Performance at 6 V

- **max power**: 1.3 W at 8.4 kg⋅mm, 26% efficiency, 150 rpm, 0.84 A
- **max efficiency**: 37% at 2.9 kg⋅mm, 0.73 W, 250 rpm, 0.33 A

- **f(τ)** = \(300 - 18τ\)
- **f(τ)** = \(0.067 + 0.091τ\)

- **no-load speed**: 310 rpm
- **no-load current**: 0.10 A

- **τ_{stall} ≈ 17 kg⋅mm
- **I_{stall} ≈ 1.6 A

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Pololu Items #997, #2386 (150:1 Micro Metal Gearmotor HP 6V) Performance at 6 V

max power: 1.2 W at 12 kg⋅mm, 26% efficiency, 100 rpm, 0.81 A

torque (kg⋅mm)

max efficiency: 37% at 3.9 kg⋅mm, 0.68 W, 170 rpm, 0.31 A

no-load speed: 210 rpm

no-load current: 0.087 A

f(τ) = 200 − 8.5τ

f(τ) = 0.060 + 0.063τ

τ_{stall} ≈ 24 kg⋅mm

I_{stall} ≈ 1.6 A

no-load speed: 210 rpm

no-load current: 0.087 A
Pololu Items #996, #2216 (210:1 Micro Metal Gearmotor HP 6V) Performance at 6 V

- Max power: 1.1 W at 15 kg mm, 22% efficiency, 72 rpm, 0.82 A
- Max efficiency: 32% at 5.0 kg mm, 0.62 W, 120 rpm, 0.32 A
- Torque (kg mm)
- Speed (rpm)
- Current (A)
- Efficiency (%)
- No-load speed: 150 rpm
- No-load current: 0.081 A
- $f(\tau) = 140 - 4.9\tau$
- $f(\tau) = 0.086 + 0.051\tau$
- $\tau_{\text{stall}} \approx 30$ kg mm
- $I_{\text{stall}} \approx 1.6$ A
- No-load speed: 150 rpm
- No-load current: 0.081 A
- Torque (kg mm)
- Efficiency (%)
- Current (A)
- Speed (rpm)
Pololu Items #995, #2217 (250:1 Micro Metal Gearmotor HP 6V) Performance at 6 V

max power: 1.1 W at 17 kg⋅mm, 22% efficiency, 62 rpm, 0.81 A

max efficiency: 32% at 5.5 kg⋅mm, 0.59 W, 100 rpm, 0.30 A

f(τ) = 120 − 3.7τ

f(τ) = 0.059 + 0.044τ

τ_{stall} ≈ 34 kg⋅mm

I_{stall} ≈ 1.6 A

no-load speed: 120 rpm

no-load current: 0.081 A
Pololu Items #4794, #4795 (380:1 Micro Metal Gearmotor HP 6V) Performance at 6 V

max efficiency: 36% at 8.4 kg⋅mm, 0.61 W, 70 rpm, 0.28 A

no-load speed: 84 rpm

no-load current: 0.077 A
Pololu Items #1595, #2373 (1000:1 Micro Metal Gearmotor HP 6V) Performance at 6 V

- Efficiency: 28%
- Max efficiency at 20 kg⋅mm, 0.53 W, 26 rpm, 0.32 A
- No-load speed: 31 rpm
- No-load current: 0.084 A
- Stall torque: ≈ 120 kg⋅mm
- Stall current: ≈ 1.6 A
Pololu Items #3061, #3071 (10:1 Micro Metal Gearmotor HPCB 6V) Performance at 6 V

max power: 1.3 W at 0.84 kg-mm, 26% efficiency, 1500 rpm, 0.85 A

max efficiency: 33% at 0.42 kg-mm, 1.0 W, 2300 rpm, 0.51 A

no-load speed: 3300 rpm

no-load current: 0.14 A

f(τ) = 3100 - 1800τ

f(τ) = 0.17 + 0.82τ

τ_{stall} ≈ 1.7 kg-mm

I_{stall} ≈ 1.5 A
Pololu Items #4786, #4787 (15:1 Micro Metal Gearmotor HPCB 6V) Performance at 6 V

- **max power:** 1.3 W at 1.2 kg⋅mm, 25% efficiency, 1000 rpm, 0.85 A
- **torque:** 
  - \( f(\tau) = 2000 - 820\tau \)
  - \( f(\tau) = 0.16 + 0.56\tau \)
- **max efficiency:** 32% at 0.60 kg⋅mm, 0.94 W, 1500 rpm, 0.49 A
- **no-load speed:** 2100 rpm
- **no-load current:** 0.13 A
- **\( \tau_{\text{stall}} \approx 2.5 \text{ kg}\cdot\text{mm} \)**
- **\( I_{\text{stall}} \approx 1.5 \text{ A} \)**
Pololu Items #3062, #3072 (30:1 Micro Metal Gearmotor HPCB 6V) Performance at 6 V

- Max power: 1.2 W at 2.2 kg mm, 25% efficiency, 540 rpm, 0.82 A
- Max efficiency: 33% at 1.0 kg mm, 0.85 W, 840 rpm, 0.43 A
- Torque stall ≈ 4.5 kg mm
- I_{stall} ≈ 1.5 A
- No-load speed: 1100 rpm
- No-load current: 0.13 A
- Speed (rpm) vs. current (A)
- Efficiency (%) vs. power (W)
Pololu Items #3063, #3073 (50:1 Micro Metal Gearmotor HPCB 6V) Performance at 6 V

- **Max power**: 1.2 W at 3.7 kg⋅mm, 24% efficiency, 310 rpm, 0.81 A
- **Max efficiency**: 32% at 1.6 kg⋅mm, 0.80 W, 490 rpm, 0.42 A
- **No-load speed**: 850 rpm
- **No-load current**: 0.13 A
- **Torque (τ) stall**: ≈ 7.4 kg⋅mm
- **Current (I) stall**: ≈ 1.5 A

The graph shows the performance characteristics of the gearmotor, including efficiency, power, speed, and current as functions of torque.
max power: 1.3 W
at 5.7 kg⋅mm,
26% efficiency,
220 rpm, 0.81 A

Pololu Items #3064, #3074 (75:1 Micro Metal Gearmotor HPCB 6V) Performance at 6 V

max efficiency: 34%
at 2.5 kg⋅mm, 0.87 W,
330 rpm, 0.43 A

no-load speed: 430 rpm

f(τ) = 430 – 38τ
f(τ) = 0.12 + 0.12τ
τ_{stall} ≈ 11 kg⋅mm
I_{stall} ≈ 1.5 A

no-load current: 0.13 A

no-load speed: 430 rpm
no-load current: 0.13 A
Pololu Items #3065, #3075 (100:1 Micro Metal Gearmotor HPCB 6V) Performance at 6 V

- **Max power:** 1.3 W at 7.9 kg-mm, 25% efficiency, 160 rpm, 0.89 A
- **Max efficiency:** 33% at 3.3 kg-mm, 0.86 W, 260 rpm, 0.44 A

**Power and Efficiency Graph**

- No-load speed: 330 rpm
- Max power: 1.3 W at 7.9 kg-mm, 25% efficiency, 160 rpm, 0.89 A
- Max efficiency: 33% at 3.3 kg-mm, 0.86 W, 260 rpm, 0.44 A
- No-load current: 0.13 A

**Torque and Speed Graph**

- Stall torque \( \tau_{\text{stall}} \approx 16 \text{ kg-mm} \)
- Stall current \( I_{\text{stall}} \approx 1.7 \text{ A} \)

**Equations**

- \( f(\tau) = 320 - 21\tau \)
- \( f(\tau) = 0.11 + 0.10\tau \)
Pololu Items #3066, #3076 (150:1 Micro Metal Gearmotor HPCB 6V) Performance at 6 V

- **Max power**: 1.1 W at 10 kg⋅mm, 23% efficiency, 110 rpm, 0.82 A
- **Max efficiency**: 31% at 4.1 kg⋅mm, 0.73 W, 170 rpm, 0.39 A

\[ f(\tau) = 220 - 11\tau \]
\[ f(\tau) = 0.10 + 0.071\tau \]

- **No-load speed**: 220 rpm
- **No-load current**: 0.13 A
- **Stall torque**: \( \tau_{\text{stall}} \approx 20 \text{ kg} \cdot \text{mm} \)
- **Stall current**: \( I_{\text{stall}} \approx 1.5 \text{ A} \)
Pololu Items #3067, #3077 (210:1 Micro Metal Gearmotor HPCB 6V) Performance at 6 V

- No-load speed: 160 rpm
- Max efficiency: 31% at 5.9 kg-mm, 0.74 W, 120 rpm, 0.40 A
- Max power: 1.1 W at 14 kg-mm, 23% efficiency, 78 rpm, 0.80 A
- Stall torque: \( \tau_{\text{stall}} \approx 28 \text{ kg-mm} \)
- Stall current: \( I_{\text{stall}} \approx 1.5 \text{ A} \)
- No-load current: 0.12 A

\[ f(\tau) = 160 - 5.5\tau \]
\[ f(\tau) = 0.10 + 0.05\tau \]
Pololu Items #3068, #3078 (250:1 Micro Metal Gearmotor HPCB 6V) Performance at 6 V

- Max power: 1.1 W at 16 kg⋅mm, 22% efficiency, 66 rpm, 0.82 A
- Max efficiency: 29% at 6.6 kg⋅mm, 0.71 W, 100 rpm, 0.40 A

- No-load speed: 130 rpm
- No-load current: 0.12 A

- $f(\tau) = 130 - 4.1\tau$
- $f(\tau) = 0.11 + 0.045\tau$

- $I_{\text{stall}} \approx 1.5$ A
- $\tau_{\text{stall}} \approx 32$ kg⋅mm
Pololu Items #3069, #3079 (298:1 Micro Metal Gearmotor HPCB 6V) Performance at 6 V

- **max power**: 1.0 W at 17 kg⋅mm, 20% efficiency, 54 rpm, 0.81 A
- **max efficiency**: 26% at 7.4 kg⋅mm, 0.65 W, 85 rpm, 0.42 A
- **no-load speed**: 110 rpm
- **no-load current**: 0.12 A
- **f(τ) = 110 − 3.2τ**
- **f(τ) = 0.11 + 0.041τ**
- **τ_{stall} ≈ 34 kg⋅mm**
- **I_{stall} ≈ 1.5 A**
Pololu Items #4796, #4797 (380:1 Micro Metal Gearmotor HPCB 6V) Performance at 6 V

max efficiency: 30%
at 10 kg mm, 0.71 W, 68 rpm, 0.40 A

no-load speed: 85 rpm

f(τ) = 85 − 1.7τ
f(τ) = 0.10 + 0.029τ

τ_{stall} = 50 kg mm
I_{stall} = 1.5 A

no-load current: 0.12 A

no-load speed: 85 rpm

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Pololu Items #3070, #3080 (1000:1 Micro Metal Gearmotor HPCB 6V) Performance at 6 V

- **Max Efficiency**: 25% at 22 kg⋅mm, 0.59 W, 26 rpm, 0.39 A
- **No-load current**: 0.12 A
- **No-load speed**: 33 rpm
- **Stall torque**: ≈110 kg⋅mm
- **Stall current**: ≈1.6 A

Theoretical max power:

\[ f(\tau) = 33 - 0.30\tau \]

\[ f(\tau) = 0.10 + 0.013\tau \]
Pololu Items #3037, #3048 (10:1 Micro Metal Gearmotor HPCB 12V) Performance at 12 V

- Max power: 1.5 W at 0.86 kg⋅mm, 29% efficiency, 1700 rpm, 0.42 A torque (kg⋅mm)

Pololu Items #3037, #3048 (10:1 Micro Metal Gearmotor HPCB 12V) Performance at 12 V

- Max efficiency: 37% at 0.43 kg⋅mm, 1.1 W, 2500 rpm, 0.25 A

- No-load speed: 3400 rpm

- No-load current: 0.070 A

- Max stall torque: ≈ 1.7 kg⋅mm

- Stall current: ≈ 0.75 A

- Torque (τ) vs. Speed (rpm)

- Efficiency (%) vs. Power (W)

- Current (A) vs. Speed (rpm)

- Torque (kg⋅mm) vs. Efficiency (%)
Pololu Items #4788, #4789 (15:1 Micro Metal Gearmotor HPCB 12V) Performance at 12 V

max power: 1.4 W at 1.2 kg⋅mm, 29% efficiency, 1100 rpm, 0.40 A

max efficiency: 37% at 0.59 kg⋅mm, 1.0 W, 1700 rpm, 0.23 A

no-load speed: 2200 rpm

f(τ) = 2200 – 880τ
f(τ) = 0.070 + 0.27τ

τ_stall ≈ 2.5 kg⋅mm
I_stall ≈ 0.73 A

no-load current: 0.073 A

no-load speed: 2200 rpm

no-load current: 0.073 A
Pololu Items #3038, #3049 (30:1 Micro Metal Gearmotor HPCB 12V) Performance at 12 V

max power: 1.1 W at 2.0 kg⋅mm, 24% efficiency, 560 rpm, 0.39 A

max efficiency: 30% at 0.95 kg⋅mm, 0.82 W, 840 rpm, 0.23 A

no-load speed: 1100 rpm

no-load current: 0.070 A

τ_{stall} ≈ 3.9 kg⋅mm

τ_{stall} ≈ 0.71 A

f(τ) = 1100 − 280τ

f(τ) = 0.073 + 0.16τ

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Pololu Items #3039, #3050 (50:1 Micro Metal Gearmotor HPCB 12V) Performance at 12 V

- **Max Power**: 1.1 W at 3.4 kg⋅mm, 24% efficiency, 320 rpm, 0.39 A.

- **Max Efficiency**: 31% at 1.5 kg⋅mm, 0.79 W, 500 rpm, 0.22 A.

- **Torque (kg⋅mm)**: 
  - Stall: ≈ 6.7 kg⋅mm
  - No-load: 0.72 A

- **No-load Current**: 0.071 A

- **No-load Speed**: 650 rpm

- **Current (A)**: 
  - Stall: 0.065 + 0.10τ
  - No-load: 650 - 97τ

- **Graphs**:
  - Efficiency vs. Torque
  - Speed vs. Torque
  - Power vs. Current
Pololu Items #3040, #3051 (75:1 Micro Metal Gearmotor HPCB 12V) Performance at 12 V

- Max power: 1.1 W at 4.9 kg\(\cdot\)mm, 24% efficiency, 220 rpm, 0.39 A
- Max efficiency: 31% at 2.1 kg\(\cdot\)mm, 0.76 W, 350 rpm, 0.20 A

\[
f(\tau) = 440 - 46\tau \\
f(\tau) = 0.056 + 0.069\tau
\]

- Torque (kg\(\cdot\)mm): Stall \(\approx 10\) kg\(\cdot\)mm, No-load \(\approx 0.72\) A
- No-load speed: 450 rpm, No-load current: 0.075 A

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Pololu Items #3041, #3052 (100:1 Micro Metal Gearmotor HPCB 12V) Performance at 12 V

- **Max power:** 1.1 W at 6.4 kg⋅mm, 24% efficiency, 170 rpm, 0.39 A
- **Max efficiency:** 31% at 2.9 kg⋅mm, 0.78 W, 260 rpm, 0.21 A

**Torque (kg⋅mm):**
- **Stall torque:** \( \tau_{\text{stall}} \approx 13 \text{ kg} \cdot \text{mm} \)
- **No-load current:** 0.065 A

**No-load speed:** 330 rpm

**Graph:**
- Efficiency (%) vs. power (W)
- Speed (rpm) vs. current (A)
- Torque (kg⋅mm) vs. speed (rpm)
- Torque (kg⋅mm) vs. current (A)

\[
f(\tau) = 340 - 26\tau \\
f(\tau) = 0.060 + 0.051\tau
\]
Pololu Items #3042, #3053 (150:1 Micro Metal Gearmotor HPCB 12V) Performance at 12 V

- Max power: 1.0 W at 9.0 kg⋅mm, 22% efficiency, 110 rpm, 0.39 A
- Max efficiency: 28% at 4.2 kg⋅mm, 0.73 W, 170 rpm, 0.22 A

f(τ) = 220 − 12τ
f(τ) = 0.066 + 0.036τ

No-load speed: 220 rpm
No-load current: 0.064 A

I_{stall} ≈ 0.72 A
τ_{stall} ≈ 18 kg⋅mm
Pololu Items #3043, #3054 (210:1 Micro Metal Gearmotor HPCB 12V) Performance at 12 V

- **Max Power:** 1.0 W at 13 kg⋅mm, 22% efficiency, 80 rpm, 0.39 A

- **Max Efficiency:** 28% at 5.6 kg⋅mm, 0.71 W, 120 rpm, 0.21 A

- **Torque (kg⋅mm):**
  - No-load: 0.070 A
  - Stall: 0.72 A

- **No-load Speed:** 160 rpm

- **Graphs:**
  - Efficiency vs. Torque
  - Speed vs. Current
  - Torque vs. Angle

Equations:
- \( f(\tau) = 160 - 6.3\tau \)
- \( f(\tau) = 0.060 + 0.026\tau \)
Pololu Items #3044, #3055 (250:1 Micro Metal Gearmotor HPCB 12V) Performance at 12 V

- max power: 1.1 W at 15 kg⋅mm, 22% efficiency, 67 rpm, 0.40 A
- max efficiency: 29% at 6.6 kg⋅mm, 0.72 W, 110 rpm, 0.21 A

Maximum stall torque: 30 kg⋅mm, I_{stall} ≈ 0.75 A
No-load current: 0.066 A, no-load speed: 130 rpm

\[ f(\tau) = 130 - 4.4\tau \]
\[ f(\tau) = 0.058 + 0.023\tau \]
Pololu Items #3045, #3056 (298:1 Micro Metal Gearmotor HPCB 12V) Performance at 12 V

max power: 0.95 W
at 17 kg⋅mm,
20% efficiency,
56 rpm, 0.40 A

max efficiency: 26%
at 7.3 kg⋅mm, 0.65 W,
87 rpm, 0.21 A

no-load speed: 110 rpm
no-load current: 0.065 A

f(τ) = 110 – 3.4τ
f(τ) = 0.060 + 0.021τ

τ_{stall} ≈ 33 kg⋅mm
I_{stall} ≈ 0.74 A
Pololu Items #4798, #4799 (380:1 Micro Metal Gearmotor HPCB 12V) Performance at 12 V

- Max efficiency: 31%
- At 11 kg-mm, 0.75 W, 67 rpm, 0.20 A
- No-load speed: 85 rpm
- No-load current: 0.064 A
- $f(\tau) = 86 - 1.7\tau$
- $f(\tau) = 0.056 + 0.013\tau$
- $\tau_{\text{stall}} \approx 50 \text{ kg-mm}$
- $I_{\text{stall}} \approx 0.72 \text{ A}$

Theoretical max power:

- $f(\tau) = 86 - 1.7\tau$
Pololu Items #3046, #3057 (1000:1 Micro Metal Gearmotor HPCB 12V) Performance at 12 V

- Max efficiency: 25%
- At 21 kg⋅mm, 0.59 W, 27 rpm, 0.19 A
- No-load speed: 35 rpm
- No-load current: 0.069 A
- Stall torque: ≈100 kg⋅mm
- Stall current: ≈0.75 A