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)

<table>
<thead>
<tr>
<th>Unit</th>
<th>mm</th>
<th>inches</th>
</tr>
</thead>
<tbody>
<tr>
<td>L</td>
<td>9</td>
<td>0.35</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Unit</th>
<th>mm</th>
<th>inches</th>
</tr>
</thead>
<tbody>
<tr>
<td>L</td>
<td>12.5</td>
<td>0.49</td>
</tr>
</tbody>
</table>

$L = 9 \text{ mm} [0.35 \text{ in}]$ for all gear ratios except 1000:1. $L = 12.5 \text{ mm} [0.49 \text{ in}]$ 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**

**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>No Load RPM (±20%)</th>
<th>No Load mA (±50%)</th>
<th>At Maximum Efficiency RPM</th>
<th>Torque</th>
<th>Current</th>
<th>Efficiency</th>
<th>Max Power</th>
<th>Stall Extrapolation</th>
<th>Graph Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low Power (LP 12V)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6 V</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1100, 2200</td>
<td>4.995</td>
<td>2000</td>
<td>30</td>
<td>1000</td>
<td>0.47</td>
<td>0.21</td>
<td>0.50</td>
<td>39</td>
<td>0.70</td>
<td>2.0</td>
<td>15</td>
<td>1.6</td>
</tr>
<tr>
<td>1099, 2201</td>
<td>9.96</td>
<td>1300</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4780, 4781</td>
<td>15.25</td>
<td>860</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>993, 2202</td>
<td>29.86</td>
<td>450</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1098, 2203</td>
<td>51.45</td>
<td>270</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2360, 2204</td>
<td>75.81</td>
<td>180</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>992, 2204</td>
<td>100.37</td>
<td>120</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1097, 2205</td>
<td>150.58</td>
<td>90</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1096, 2206</td>
<td>210.59</td>
<td>65</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1095, 2207</td>
<td>248.98</td>
<td>54</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1094, 2208</td>
<td>297.92</td>
<td>45</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4790, 4791</td>
<td>379.17</td>
<td>36</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1596, 3508</td>
<td>986.41</td>
<td>13</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| Medium Power (MP 6V) | | | | | | | | | | | | | |
| 6 V | | | | | | | | | | | | | |
| 2362, 2376 | 4.995 | 4400 | 80 | | | | | | | | | | | |
| 2363, 2377 | 9.96 | 2200 | | | | | | | | | | | | |
| 4782, 4783 | 15.25 | 1400 | | | | | | | | | | | | |
| 2364, 2378 | 29.86 | 720 | | | | | | | | | | | | |
| 2365, 2379 | 51.45 | 420 | | | | | | | | | | | | |
| 2366, 2380 | 75.81 | 294 | | | | | | | | | | | | |
| 2367, 2381 | 100.37 | 220 | | | | | | | | | | | | |
| 2368, 2382 | 150.58 | 150 | | | | | | | | | | | | |
| 2369, 2383 | 210.59 | 100 | | | | | | | | | | | | |
| 2370, 2384 | 248.98 | 88 | | | | | | | | | | | | |
| 2371, 2385 | 297.92 | 73 | | | | | | | | | | | | |
| 4792, 4793 | 379.17 | 57 | | | | | | | | | | | | |
| 2372, 2395 | 986.41 | 22 | | | | | | | | | | | | |
| 1090, 2210 | 4.995 | 6100 | 120 | | | | | | | | | | | |
| 999, 2211 | 9.96 | 3100 | | | | | | | | | | | | |
| 4784, 4785 | 15.25 | 2000 | | | | | | | | | | | | |
| 1099, 2212 | 29.86 | 89 | | | | | | | | | | | | |
| 998, 2213 | 51.45 | 590 | | | | | | | | | | | | |
| 2361, 2215 | 75.81 | 410 | | | | | | | | | | | | |
| 1097, 2216 | 100.37 | 310 | | | | | | | | | | | | |
| 997, 2286 | 150.58 | 100 | | | | | | | | | | | | |
| 996, 2216 | 210.59 | 150 | | | | | | | | | | | | |
| 995, 2217 | 248.98 | 120 | | | | | | | | | | | | |
| 994, 2218 | 297.92 | 100 | | | | | | | | | | | | |
| 4794, 4795 | 379.17 | 84 | | | | | | | | | | | | |
| 1595, 2737 | 986.41 | 31 | | | | | | | | | | | | |
| 3060, 3092 | 4.995 | 6500 | 170 | | | | | | | | | | | |
| 3091, 3071 | 9.96 | 1000 | | | | | | | | | | | | |
| 4786, 4787 | 15.25 | 2100 | | | | | | | | | | | | |
| 3062, 3072 | 29.86 | 1100 | | | | | | | | | | | | |
| 3093, 3073 | 51.45 | 650 | | | | | | | | | | | | |
| 3064, 3074 | 75.81 | 430 | | | | | | | | | | | | |
| 3095, 3075 | 100.37 | 330 | | | | | | | | | | | | |
| 3066, 3076 | 150.58 | 220 | | | | | | | | | | | | |
| 3097, 3077 | 210.59 | 150 | | | | | | | | | | | | |
| 3068, 3078 | 248.98 | 130 | | | | | | | | | | | | |
| 3098, 3079 | 297.92 | 110 | | | | | | | | | | | | |
| 3070, 3080 | 986.41 | 33 | | | | | | | | | | | | |
| 3036, 3047 | 4.995 | 6800 | 100 | | | | | | | | | | | |
| 3037, 3048 | 9.96 | 3400 | | | | | | | | | | | | |
| 4788, 4789 | 15.25 | 2200 | | | | | | | | | | | | |
| 3038, 3049 | 29.86 | 1100 | | | | | | | | | | | | |
| 3099, 3050 | 51.45 | 650 | | | | | | | | | | | | |
| 3040, 3051 | 75.81 | 450 | | | | | | | | | | | | |
| 3041, 3052 | 100.37 | 330 | | | | | | | | | | | | |
| 3042, 3053 | 150.58 | 220 | | | | | | | | | | | | |
| 3043, 3054 | 210.59 | 160 | | | | | | | | | | | | |
| 3044, 3055 | 248.98 | 130 | | | | | | | | | | | | |
| 3045, 3056 | 297.92 | 110 | | | | | | | | | | | | |
| 4798, 4799 | 379.17 | 85 | | | | | | | | | | | | |
| 4604, 3057 | 986.41 | 35 | | | | | | | | | | | | |

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. 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 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.
3. Operating these versions at maximum power is likely to damage the gearboxes.

## Exact gear ratios

<table>
<thead>
<tr>
<th>Nominal</th>
<th>Nominal</th>
<th>Exact</th>
<th>Nominal</th>
<th>Nominal</th>
</tr>
</thead>
<tbody>
<tr>
<td>5 : 1</td>
<td>25 : 1</td>
<td>(\frac{27 \times 37}{20 \times 10} = 4.995 : 1)</td>
<td>150 : 1</td>
<td>(\frac{25 \times 32 \times 34 \times 35 \times 38}{12 \times 11 \times 14 \times 13 \times 10} \approx 150.5828 : 1)</td>
</tr>
<tr>
<td>10 : 1</td>
<td>210 : 1</td>
<td>(\frac{35 \times 37}{13 \times 10} \approx 9.9615 : 1)</td>
<td>210 : 1</td>
<td>(\frac{25 \times 34 \times 35 \times 38}{12 \times 9 \times 13 \times 13 \times 10} \approx 210.5906 : 1)</td>
</tr>
<tr>
<td>15 : 1</td>
<td>250 : 1</td>
<td>(\frac{25 \times 34 \times 31}{12 \times 9 \times 16} \approx 15.2488 : 1)</td>
<td>250 : 1</td>
<td>(\frac{25 \times 34 \times 37 \times 35 \times 38}{12 \times 10 \times 10 \times 14 \times 10} \approx 248.9792 : 1)</td>
</tr>
<tr>
<td>30 : 1</td>
<td>298 : 1</td>
<td>(\frac{31 \times 33 \times 35 \times 34}{16 \times 14 \times 13 \times 14} \approx 29.8609 : 1)</td>
<td>298 : 1</td>
<td>(\frac{25 \times 34 \times 37 \times 35 \times 38}{12 \times 9 \times 10 \times 13 \times 10} \approx 297.9238 : 1)</td>
</tr>
<tr>
<td>50 : 1</td>
<td>380 : 1</td>
<td>(\frac{32 \times 33 \times 35 \times 38}{15 \times 14 \times 13 \times 10} \approx 51.4462 : 1)</td>
<td>380 : 1</td>
<td>(\frac{25 \times 35 \times 39 \times 36 \times 39}{12 \times 9 \times 9 \times 13 \times 10} = 379.16 : 1)</td>
</tr>
<tr>
<td>75 : 1</td>
<td>1000 : 1</td>
<td>(\frac{34 \times 34 \times 35 \times 38}{13 \times 12 \times 13 \times 10} \approx 75.8126 : 1)</td>
<td>1000 : 1</td>
<td>(\frac{25 \times 34 \times 35 \times 34 \times 34 \times 27}{12 \times 9 \times 12 \times 14 \times 14 \times 9} \approx 986.4064 : 1)</td>
</tr>
<tr>
<td>100 : 1</td>
<td>100 : 1</td>
<td>(\frac{35 \times 37 \times 35 \times 38}{12 \times 11 \times 13 \times 10} \approx 100.3700 : 1)</td>
<td>100 : 1</td>
<td>(\frac{25 \times 34 \times 35 \times 34 \times 34 \times 27}{12 \times 9 \times 12 \times 14 \times 14 \times 9} \approx 986.4064 : 1)</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

max efficiency: 40% at 0.40 kg⋅mm, 0.27 W, 640 rpm, 0.11 A

f(τ) = 850 - 500τ
f(τ) = 0.035 + 0.19τ

τ_{stall} \approx 1.7 \text{ kg⋅mm}
I_{stall} \approx 0.36 \text{ A}

no-load speed: 860 rpm
no-load current: 0.028 A
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

The graph shows the performance characteristics of the motor, including speed, current, and efficiency as functions of torque. The equation for the no-load speed is $f(\tau) = 420 - 150\tau$ with a no-load speed of 450 rpm and no-load current of 0.033 A. The stall torque is approximately 2.9 kg⋅mm with an estimated stall current of 0.36 A.
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
- **Max efficiency:** 34% at 0.95 kg⋅mm, 0.20 W, 200 rpm, 0.10 A

### Torque and Speed Trade-offs

- **No-load speed:** 270 rpm
- **No-load current:** 0.028 A
- **Stall torque:** ≈ 4.4 kg⋅mm
- **Stall current:** ≈ 0.36 A

### Performance Equations

\[ f(\tau) = 260 - 59 \tau \]
\[ f(\tau) = 0.027 + 0.075 \tau \]

\[ \tau_{stall} \approx 4.4 \text{ kg}\cdot\text{mm} \]
\[ I_{stall} \approx 0.36 \text{ A} \]
Pololu Items #2360, #2209 (75:1 Micro Metal Gearmotor LP 6V) Performance at 6 V

- **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

**No-Load Speed**: 180 rpm, no-load current: 0.027 A

**F(t)** = 180 - 27t

**F(t)** = 0.025 + 0.054t

**τ_{stall} ≈ 6.4 kg·mm**

**I_{stall} ≈ 0.37 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

**Pololu Items #992, #2204 (100:1 Micro Metal Gearmotor LP 6V)**

- No-load speed: 130 rpm
- No-load current: 0.028 A
- 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

**Equations**

\[ f(\tau) = 130 - 17\tau \]
\[ f(\tau) = 0.031 + 0.044\tau \]

**Stall**

\[ I_{\text{stall}} \approx 0.36 \text{ A} \]
\[ T_{\text{stall}} \approx 7.4 \text{ kg} \cdot \text{mm} \]
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

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

- Torque (kg⋅mm)
- Efficiency (%)
- Speed (rpm)
- Current (A)

**Torque Equation**: $f(\tau) = 87 - 7.6\tau$

**Efficiency Equation**: $f(\tau) = 0.032 + 0.029\tau$

**Stall Torque**: $\tau_{stall} \approx 11 \text{ kg}\cdot\text{mm}$

**Stall Current**: $I_{stall} \approx 0.37 \text{ A}$

**No-Load Speed**: 90 rpm

**No-Load Current**: 0.029 A

**February 2022 – Rev 5.1 © Pololu Corporation | www.pololu.com | 920 Pilot Rd., Las Vegas, NV 89119, USA**
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

The graph shows the relationship between torque (kg⋅mm) and speed (rpm) with efficiency and current as additional axes. The no-load speed is 65 rpm, and the no-load current is 0.027 A. The stall torque is approximately 16 kg⋅mm, and the stall current is approximately 0.35 A. A polynomial equation, $f(t) = 61 - 3.7\tau$, is used to model the speed-torque relationship.
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

The torque (kg⋅mm) vs. speed (rpm) graph shows:

- **No-load speed:** 54 rpm
- **No-load current:** 0.027 A
- **Stall torque:** 17 kg⋅mm
- **Stall current:** 0.34 A

The graph also includes the following equations:

1. \( f(t) = 51 - 3.0r \)
2. \( f(t) = 0.035 + 0.017r \)

These equations likely represent different curves or thresholds in the motor's performance characteristics.
Pololu Items #1094, #2208 (298:1 Micro Metal Gearmotor LP 6V) Performance at 6 V

- Max power: 0.22 W at 10 kg⋅mm, 21% efficiency, 22 rpm, 0.18 A
- Torque (kg⋅mm)

- Max efficiency: 27% at 4.4 kg⋅mm, 0.15 W, 34 rpm, 0.094 A
- No-load current: 0.028 A
- No-load speed: 45 rpm

\[ f(t) = 44 - 2.2t \]
\[ f(t) = 0.027 + 0.015t \]

\[ T_{\text{stall}} \approx 20 \text{ kg:mm} \]
\[ I_{\text{stall}} \approx 0.33 \text{ A} \]
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
- **Max efficiency**: 34% at 5.4 kg⋅mm, 0.16 W, 29 rpm, 0.080 A

**F(t)** equations:
- No-load speed: 36 rpm
- Max power: \( f(t) = 36 - 1.2t \) at 15 kg⋅mm, 24% efficiency, 18 rpm, 0.18 A
- Max efficiency: \( f(t) = 0.018 + 0.011t \) at 5.4 kg⋅mm, 0.16 W, 29 rpm, 0.080 A

**Stall**
- Torque: \( T_{\text{stall}} \approx 29 \text{ kg}⋅\text{mm} \)
- Current: \( I_{\text{stall}} \approx 0.35 \text{ A} \)

**No-load**
- Speed: 36 rpm
- Current: 0.025 A
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

Theoretical max power and torque relationships:

\[ f(\tau) = 13 - 0.24\tau \]

\[ f(\tau) = 0.023 + 0.0056\tau \]

- Stall torque \( \approx 55 \text{ kg} \cdot \text{mm} \)
- Stall current \( \approx 0.33 \text{ A} \)

No-load speed: 13 rpm
No-load current: 0.028 A

February 2022 – Rev 5.1 © Pololu Corporation | www.pololu.com | 920 Pilot Rd., Las Vegas, NV 89119, USA
Pololu Items #4782, #4783 (15:1 Micro Metal Garmotor MP 6V) Performance at 6 V

- **Max Power:** 0.70 W at 1.0 kg\(\cdot\)mm,
- **Efficiency:** 31% at 1.0 kg\(\cdot\)mm,
- **Speed:** 680 rpm, 0.38 A torque (kg\(\cdot\)mm)

- **Max Efficiency:** 39% at 0.47 kg\(\cdot\)mm, 0.50 W,
- **Speed:** 1000 rpm, 0.21 A

\[ f(r) = 1400 - 670r \]
\[ f(r) = 0.066 + 0.31r \]

- **Stall Torque:** \(I_{\text{stall}} = 0.69 \text{ A}\)
- **No-Load Current:** 0.053 A
- **No-Load Speed:** 1400 rpm
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 (kg⋅mm):
- \( f(\tau) = 660 - 200\tau \) for no-load current: 0.064 A.
- \( f(\tau) = 0.066 + 0.18\tau \) for stall current: 0.67 A.

Stall torque: \( \approx 3.3 \) kg⋅mm.

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⋅mm, 25% efficiency, 200 rpm, 0.36 A
- max efficiency: 33% at 1.2 kg⋅mm, 0.38 W, 310 rpm, 0.19 A
- no-load speed: 420 rpm
- no-load current: 0.052 A

Torque (kg⋅mm):
- Stall torque: \( T_{\text{stall}} \approx 5.4 \text{ kg} \cdot \text{mm} \)
- No-load torque: \( T_{\text{no-load}} \approx 0.67 \text{ A} \)

Pololu Corporation | www.pololu.com | 920 Pilot Rd., Las Vegas, NV 89119, USA
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
- **Max efficiency**: 34% at 1.6 kg⋅mm, 0.35 W, 220 rpm, 0.17 A

Mathematical equations:
- $f(r) = 270 - 35r$
- $f(r) = 0.044 + 0.080r$

Graphs showing:
- No-load speed: 290 rpm
- Max power output at different conditions
- Max efficiency at different conditions
- Torque (kg⋅mm) vs. speed (rpm) curves
- Current (A) vs. torque (kg⋅mm) curves

- No-load current: 0.054 A
- Stall current: 0.67 A
- Stall torque: 7.8 kg⋅mm

February 2022 – Rev 5.1 © Pololu Corporation | www.pololu.com | 920 Pilot Rd., Las Vegas, NV 89119, USA
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

Torque (kg⋅mm) vs. Speed (rpm) graph:
- No-load speed: 220 rpm
- No-load current: 0.048 A
- Max efficiency curve
- Max power curve
- Torque curve
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
- **Max Efficiency:** 33% at 2.6 kg⋅mm, 0.30 W, 110 rpm, 0.15 A

**Graph Notes:**
- **No-load Speed:** 150 rpm
- **Max Power Equation:** $f(\tau) = 140 - 11\tau$
- **Max Efficiency Equation:** $f(\tau) = 0.038 + 0.045\tau$
- **Stall Torque:** $\approx 13$ kg⋅mm
- **Stall Current:** $\approx 0.63$ A
- **No-load Current:** 0.051 A
- **No-load Speed:** 150 rpm
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
- Max efficiency: 31% at 3.4 kg⋅mm, 0.29 W, 83 rpm, 0.16 A

The graph shows the relationship between efficiency, speed, and current for the gearmotor. The equations for the lines are:

\[ f(\tau) = 100 - 6.0r \]

\[ f(\tau) = 0.039 + 0.035r \]

\[ \tau_{\text{stall}} \approx 17 \text{ kg}\cdot\text{mm} \]

\[ I_{\text{stall}} \approx 0.64 \text{ A} \]

No-load speed: 100 rpm
No-load current: 0.049 A
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): $T_{\text{stall}} \approx 22$ kg⋅mm

No-load current: 0.055 A

No-load speed: 88 rpm

Speed (rpm) vs. Current (A) trendlines:
- $f(T) = 87 - 4.0r$
- $f(T) = 0.043 + 0.028r$

Efficiency (%) vs. Torque (kg⋅mm) trendlines:
- $f(T) = 87 - 4.0r$
- $f(T) = 0.043 + 0.028r$
Pololu Items #2371, #2385 (298:1 Micro Metal Gearmotor MP 6V) Performance at 6 V

- **Max Power**: 0.44 W at 12 kg⋅mm, 21% efficiency, 35 rpm, 0.34 A
- **Max Efficiency**: 29% at 5.0 kg⋅mm, 0.29 W, 56 rpm, 0.17 A

**Torque (kg⋅mm)**

- No-load current: 0.057 A
- Torque stall: 24 kg⋅mm

**No-load speed**: 73 rpm

**Graph**

- Efficiency vs. speed
- Speed vs. current
- Torque vs. current
- Torque vs. efficiency

**Equations**

- \( f(\tau) = 70 - 2.9\tau \)
- \( f(\tau) = 0.043 + 0.025\tau \)

**Additional Information**

- No-load current: 0.057 A
- Torque stall: 24 kg⋅mm
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

\[ f(t) = 56 - 1.6t \]

\[ f(t) = 0.038 + 0.018t \]

\[ T_{\text{stall}} \approx 36 \text{ kg} \cdot \text{mm} \]

\[ I_{\text{stall}} \approx 0.68 \text{ A} \]

No-load speed: 57 rpm
No-load current: 0.054 A
Pololu Items #2372, #3059 (1000:1 Micro Metal Gearmotor MP 6V) Performance at 6 V

- Theoretical max power:
  - Torque (kg⋅mm)
  - Max efficiency: 24%
  - At 13 kg⋅mm, 0.23 W, 17 rpm, 0.16 A

- Pololu Items #2372, #3059 (1000:1 Micro Metal Gearmotor MP 6V)
  - No-load speed: 22 rpm
  - No-load current: 0.054 A

- Max efficiency: 24%
  - At 13 kg⋅mm, 0.23 W, 17 rpm, 0.16 A

- Torque formula: \( f(\tau) = 21 - 0.32\tau \)
- Speed formula: \( f(\tau) = 0.037 + 0.0093\tau \)
- Stall torque: \( T_{\text{stall}} = 67 \text{ kg} \cdot \text{mm} \)
- Stall current: \( I_{\text{stall}} = 0.66 \text{ A} \)
Pololu Items #999, #2211 (10:1 Micro Metal Gearmotor HP 6V) Performance at 6 V
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

**f(τ) = 2000 - 650τ**

**f(τ) = 0.090 + 0.49τ**

**T_{stall} ≈ 3.0 kg⋅mm**

**I_{stall} ≈ 1.6 A**

**No-load Speed**: 2000 rpm

**No-load Current**: 0.084 A
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 (kg⋅mm)

No-load speed: 1000 rpm

\( f(t) = 1000 - 180t \)
\( f(t) = 0.081 + 0.27t \)

Stall torque: 5.7 kg⋅mm
Stall current: 1.6 A

No-load current: 0.088 A
No-load speed: 1000 rpm
Pololu Items #998, #2213 (50:1 Micro Metal Gearmotor HP 6V) Performance at 6 V

- **Max power**: 1.3 W at 4.3 kg\(\cdot\)mm, 27% efficiency, 300 rpm, 0.81 A
- **Max efficiency**: 38% at 1.5 kg\(\cdot\)mm, 0.75 W, 490 rpm, 0.32 A

\[
\begin{align*}
f(\tau) &= 590 - 68\tau \\
f(\tau) &= 0.067 + 0.17\tau
\end{align*}
\]

- **Stall torque**: \(T_{\text{stall}} = 8.6 \text{ kg}\cdot\text{mm}\)
- **Stall current**: \(I_{\text{stall}} = 1.6 \text{ A}\)
- **No-load speed**: 590 rpm
- **No-load current**: 0.084 A

\[
\begin{align*}
f(\tau) &= 590 - 68\tau \\
f(\tau) &= 0.067 + 0.17\tau
\end{align*}
\]
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

**Torque (kg⋅mm)**

- No-load speed: 410 rpm
- 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

**Current (A)**

- No-load current: 0.10 A
- Stall current: ≈ 1.6 A

**T_{stall} = 13 kg⋅mm**

Pololu Corporation | www.pololu.com | 920 Pilot Rd., Las Vegas, NV 89119, USA
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

No-load speed: 310 rpm

f(τ) = 300 - 18τ

f(τ) = 0.067 + 0.091τ

τ_{stall} ≈ 17 kg-mm

I_{stall} ≈ 1.6 A

No-load current: 0.10 A

No-load speed: 310 rpm

Current (A) vs. Torque (kg-mm)

Efficiency (%) vs. Power (W)

Speed (rpm) vs. Current (A)
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
- **Max Efficiency:** 37% at 3.9 kg⋅mm, 0.68 W, 170 rpm, 0.31 A

f(τ) = 200 - 8.5r
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

February 2022 – Rev 5.1 © Pololu Corporation | www.pololu.com | 920 Pilot Rd., Las Vegas, NV 89119, USA
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

No-load speed: 150 rpm
No-load current: 0.081 A

Torque (kg⋅mm): 30 kg⋅mm
I_{stall} ≈ 1.6 A

Motor characteristics:
- f(τ) = 140 − 4.9τ
- f(τ) = 0.066 + 0.051τ

February 2022 – Rev 5.1 © Pololu Corporation | www.pololu.com | 920 Pilot Rd., Las Vegas, NV 89119, USA
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

![Graph showing performance characteristics](graph.png)

- **no-load speed**: 120 rpm
- **no-load current**: 0.081 A
- **T_{stall}**: 34 kg⋅mm
- **I_{stall}**: 1.6 A
- **f(τ) = 120 - 3.7τ**
- **f(τ) = 0.059 + 0.044τ**

Pololu Corporation | www.pololu.com | 920 Pilot Rd., Las Vegas, NV 89119, USA
max power: 1.1 W at 20 kg⋅mm,
21% efficiency,
52 rpm, 0.83 A
max efficiency: 31% at 6.5 kg⋅mm, 0.58 W,
87 rpm, 0.31 A

Pololu Items #994, #2218 (298:1 Micro Metal Gearmotor HP 6V) Performance at 6 V

\[ f(t) = 100 - 2.6t \]
\[ f(t) = 0.059 + 0.038t \]
\[ T_{\text{stall}} = 40 \text{ kg⋅mm} \]
\[ I_{\text{stall}} = 1.6 \text{ A} \]

no-load speed: 100 rpm
no-load current: 0.081 A
Pololu Items #4794, #4795 (380:1 Micro Metal Gearmotor HP 6V) Performance at 6 V

- Theoretical max power:
  - Torque: 8.4 kg⋅mm, Efficiency: 36%
  - Power: 0.61 W, Speed: 70 rpm, Current: 0.28 A

- No-load speed: 84 rpm
- No-load current: 0.077 A

- Maximum efficiency: 36%
  - At 8.4 kg⋅mm, 0.61 W, 70 rpm, 0.28 A

- f(τ) = 83 − 1.5τ
- f(τ) = 0.052 + 0.028τ

- Stall torque: ≈ 55 kg⋅mm
- Stall current: ≈ 1.6 A
Pololu Items #1595, #2373 (1000:1 Micro Metal Gearmotor HP 6V) Performance at 6 V

- Max efficiency: 28%
- Torque: 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

**Graph:**
- **No-load speed**: 3300 rpm
- **F(t)** = 3100 − 1800t
- **F(t)** = 0.17 + 0.82t
- **T_{stall} ≈ 1.7 kg⋅mm
- **I_{stall} ≈ 1.5 A
- **No-load current**: 0.14 A
- **No-load speed**: 3300 rpm
- **No-load current**: 0.14 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
- Max efficiency: 32% at 0.60 kg-mm, 0.94 W, 1500 rpm, 0.49 A

\[ f(\tau) = 2000 - 820\tau \]

\[ f(\tau) = 0.16 + 0.56\tau \]

Torque (kg-mm)

- Stall torque: ≈ 2.5 kg-mm
- Stall current: ≈ 1.5 A
- No-load speed: 2100 rpm
- No-load current: 0.13 A

\[ f(\tau) = 2000 - 820\tau \]

\[ f(\tau) = 0.16 + 0.56\tau \]

Efficiency (%)

- Max efficiency: 32% at 0.60 kg-mm, 0.94 W, 1500 rpm, 0.49 A

Speed (rpm)

- Max power: 1.3 W at 1.2 kg-mm, 25% efficiency, 1000 rpm, 0.85 A

Current (A)

- Max efficiency: 32% at 0.60 kg-mm, 0.94 W, 1500 rpm, 0.49 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

No-load speed: 1100 rpm
No-load current: 0.13 A

\[ f(t) = 1100 - 240t \]
\[ f(t) = 0.12 + 0.31t \]

\( T_{\text{stall}} \approx 4.5 \text{ kg⋅mm} \)
\( I_{\text{stall}} \approx 1.5 \text{ A} \)
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

torque (kg⋅mm)

max efficiency: 32%
at 1.6 kg⋅mm, 0.80 W, 490 rpm, 0.42 A

f(t) = 620 − 85t

f(t) = 0.11 + 0.19t

T_{stall} ≈ 7.4 kg⋅mm

I_{stall} ≈ 1.5 A

no-load speed: 650 rpm

no-load current: 0.13 A

February 2022 – Rev 5.1 © Pololu Corporation | www.pololu.com | 920 Pilot Rd., Las Vegas, NV 89119, USA
Pololu Items #3064, #3074 (75:1 Micro Metal Gearmotor HPCB 6V) Performance at 6 V

- Max power: 1.3 W at 5.7 kg⋅mm, 26% efficiency, 220 rpm, 0.81 A
- Max efficiency: 34% at 2.5 kg⋅mm, 0.87 W, 330 rpm, 0.43 A

Torque (kg⋅mm)

- No-load current: 0.13 A
- Stall torque: ≈ 11 kg⋅mm
- Stall current: ≈ 1.5 A

- No-load speed: 430 rpm
- f(τ) = 430 \(-38τ\)
- \(f(τ) = 0.12 + 0.12τ\)

Efficiency (%) vs. Torque (kg⋅mm)

Power (W) vs. Torque (kg⋅mm)

Current (A) vs. Torque (kg⋅mm)

February 2022 – Rev 5.1 © Pololu Corporation | www.pololu.com | 920 Pilot Rd., Las Vegas, NV 89119, USA
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

**Torque Curve**

- **no-load speed**: 330 rpm
- **max power** equation: \( f(r) = 320 - 21r \)
- **max efficiency** equation: \( f(r) = 0.11 + 0.10r \)
- **stall torque**: \( T_{\text{stall}} \approx 16 \) kg⋅mm
- **stall current**: \( I_{\text{stall}} \approx 1.7 \) A
- **no-load current**: 0.13 A
- **no-load speed**: 330 rpm

**Speed vs. Current**

- **f(r)** function: \( f(r) = 0.11 + 0.10r \)
- **max power** at 7.9 kg⋅mm, 25% efficiency, 160 rpm, 0.89 A
- **max efficiency** at 3.3 kg⋅mm, 0.86 W, 260 rpm, 0.44 A

February 2022 – Rev 5.1 © Pololu Corporation | www.pololu.com | 920 Pilot Rd., Las Vegas, NV 89119, USA
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

**Torque (kg⋅mm)**

- No-load speed: 220 rpm
- f(τ) = 220 − 11τ
- f(τ) = 0.10 + 0.071τ
- τ_{stall} ≈ 20 kg⋅mm
- I_{stall} ≈ 1.5 A
- No-load current: 0.13 A
- No-load speed: 220 rpm

**Current (A)**

- τ = 20 kg⋅mm
- τ = 1.5 A

**Speed (rpm)**

- τ = 1.5 A
- τ = 20 kg⋅mm

February 2022 – Rev 5.1 © Pololu Corporation | www.pololu.com | 920 Pilot Rd., Las Vegas, NV 89119, USA
Pololu Items #3067, #3077 (210:1 Micro Metal Gearmotor HPCB 6V) Performance at 6 V

- **Max power:** 1.1 W at 14 kg⋅mm, 23% efficiency, 78 rpm, 0.80 A
- **Max efficiency:** 31% at 5.9 kg⋅mm, 0.74 W, 120 rpm, 0.40 A

**Torque (kg⋅mm) - Speed (rpm) Relationship:**

- Max power: $f(r) = 160 - 5.5r$
- Max efficiency: $f(r) = 0.10 + 0.050r$
- Stall torque: $T_{stall} = 28$ kg⋅mm
- Stall current: $I_{stall} = 1.5$ A

**No-load Speed:** 160 rpm

**No-load Current:** 0.12 A
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

Equations:

- **No-load speed**: 130 rpm
- **Stall torque**: \( T_{\text{stall}} \approx 32 \text{ kg·mm} \)
- **Stall current**: \( I_{\text{stall}} \approx 1.5 \text{ A} \)
- **No-load current**: 0.12 A

Equations:

- **Efficiency equation**: \( f(\tau) = 0.11 + 0.045 \tau \)
- **Power equation**: \( f(\tau) = 130 - 4.1 \tau \)
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

**Equations**:

- **f(τ)** = 110 − 3.2τ
- **f(τ)** = 0.11 + 0.041τ

**Values**:
- **Stall Torque**: I_s ≈ 1.5 A
- **No-Load Speed**: 110 rpm
- **No-Load Current**: 0.12 A

**Graph**:
- Efficiency vs. Torque
- Speed vs. Current
- Torque vs. Speed
Pololu Items #4796, #4797 (380:1 Micro Metal Gearmotor HPCB 6V) Performance at 6 V

Theoretical max power at 10 kg⋅mm, 0.71 W, 68 rpm, 0.40 A.

Max efficiency: 30%

No-load speed: 85 rpm

Torque stall ≈ 50 kg⋅mm

Stall current ≈ 1.5 A

No-load current: 0.12 A

No-load speed: 85 rpm

No-load current: 0.12 A

\[ f(\tau) = 85 - 1.7\tau \]

\[ f(\tau) = 0.10 + 0.029\tau \]
Pololu Items #3070, #3080 (1000:1 Micro Metal Gearmotor HPCB 6V) Performance at 6 V

- Theoretical max power:
  - Torque: 110 kg⋅mm
  - Efficiency: 25%
  - Power: 0.59 W
  - Speed: 26 rpm
  - Current: 0.39 A

- No-load speed: 33 rpm
- No-load current: 0.12 A
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
- **Max efficiency**: 37% at 0.43 kg⋅mm, 1.1 W, 2500 rpm, 0.25 A

- **Stall torque**: \( \tau_{\text{stall}} \approx 1.7 \text{ kg} \cdot \text{mm} \)
- **Stall current**: \( I_{\text{stall}} \approx 0.75 \text{ A} \)
- **No-load speed**: 3400 rpm
- **No-load current**: 0.070 A

The graph shows the relationship between speed, current, and torque, with equations for the corresponding curves:

- Speed: \( f(r) = 3300 - 1900r \)
- Efficiency: \( f(r) = 0.084 + 0.38r \)
- Torque: \( \tau_{\text{stall}} = 1.7 \text{ kg} \cdot \text{mm} \)
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

**Equations**:
- \( f(\tau) = 2200 - 880\tau \)
- \( f(\tau) = 0.070 + 0.27\tau \)

**Graph Notes**:
- **No-load speed**: 2200 rpm
- **No-load current**: 0.073 A
- **Stall torque**: 2.5 kg-mm
- **Stall current**: 0.73 A

February 2022 – Rev 5.1 © Pololu Corporation | www.pololu.com | 920 Pilot Rd., Las Vegas, NV 89119, USA
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

f(τ) = 1100 − 280τ

f(τ) = 0.073 + 0.16τ

τ_{stall} ≈ 3.9 kg⋅mm

I_{stall} ≈ 0.71 A

No-load speed: 1100 rpm

No-load current: 0.070 A
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)**

**no-load speed:** 650 rpm

**no-load current:** 0.071 A

**f(τ) = 650 − 97τ**

**f(τ) = 0.065 + 0.10τ**

**τ_{\text{stall}} ≈ 6.7 kg⋅mm**

**I_{\text{stall}} ≈ 0.72 A**

**no-load speed: 650 rpm**

**no-load current: 0.071 A**

f(τ) = 650 − 97τ
Pololu Items #3040, #3051 (75:1 Micro Metal Gearmotor HPCB 12V) Performance at 12 V

- **Max Power**: 1.1 W at 4.9 kg-mm, 24% efficiency, 220 rpm, 0.39 A
- **Max Efficiency**: 31% at 2.1 kg-mm, 0.76 W, 350 rpm, 0.20 A

**Equations**

- Torque: \( f(\tau) = 440 - 46\tau \)
- Speed: \( f(\tau) = 0.056 + 0.069\tau \)

**Other Parameters**

- No-load speed: 450 rpm
- No-load current: 0.075 A
- Stall torque: \( T_{\text{stall}} \approx 10 \) kg-mm
- Stall current: \( I_{\text{stall}} \approx 0.72 \) A

**Graphs**

- Efficiency vs. Torque
- Speed vs. Current
- Efficiency vs. Speed

February 2022 – Rev 5.1 © Pololu Corporation | www.pololu.com | 920 Pilot Rd., Las Vegas, NV 89119, USA
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): $f(\tau) = 340 - 26\tau$

Current (A) at stall:
- $I_{\text{stall}} \approx 0.72$ A

No-load speed: 330 rpm
No-load current: 0.065 A

February 2022 – Rev 5.1 © Pololu Corporation | www.pololu.com | 920 Pilot Rd., Las Vegas, NV 89119, USA
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

- **no-load speed:** 220 rpm
- **no-load current:** 0.064 A

- **f(t) = 220 − 12r**
- **f(t) = 0.066 + 0.036r**

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

- **Torque (kg⋅mm)**
- **Efficiency (%)**
- **Speed (rpm)**
- **Current (A)**

- **f(τ) = 130 − 4.4τ**
- **f(τ) = 0.058 + 0.023τ**

- **τ_stall ≈ 30 kg⋅mm**
- **I_stall ≈ 0.75 A**

- **no-load speed**: 130 rpm
- **no-load current**: 0.066 A
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

\[ f(t) = 110 - 3.4t \]
\[ f(t) = 0.060 + 0.021t \]

Torque (kg⋅mm)

Efficiency (%)

Current (A)

No-load speed: 110 rpm

Stall torque: 33 kg⋅mm

Stall current: 0.74 A

No-load current: 0.065 A

No-load speed: 110 rpm
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
- Stall torque: ≈ 50 kg-mm
- Stall current: ≈ 0.72 A

Equations:

\[ f(\tau) = 86 - 1.7\tau \]
\[ f(\tau) = 0.056 + 0.013\tau \]
Pololu Items #3046, #3057 (1000:1 Micro Metal Gearmotor HPCB 12V) Performance at 12 V

- Theoretical max power
- Torque (kg⋅mm): max efficiency: 25%
- 21 kg⋅mm, 0.59 W, 27 rpm, 0.19 A
- Efficiency:
  - no-load speed: 35 rpm
  - f(τ) = 35 - 0.34τ
  - (τ) = 0.051 + 0.0069τ
- Max efficiency:
  - at 21 kg⋅mm, 0.59 W, 27 rpm, 0.19 A
- No-load current: 0.069 A
- Stall current: 0.75 A
- Stall torque: 100 kg⋅mm
- No-load speed: 35 rpm

The graph shows the performance characteristics of the gearmotor at 12 V.