# 25D Metal Gearmotors



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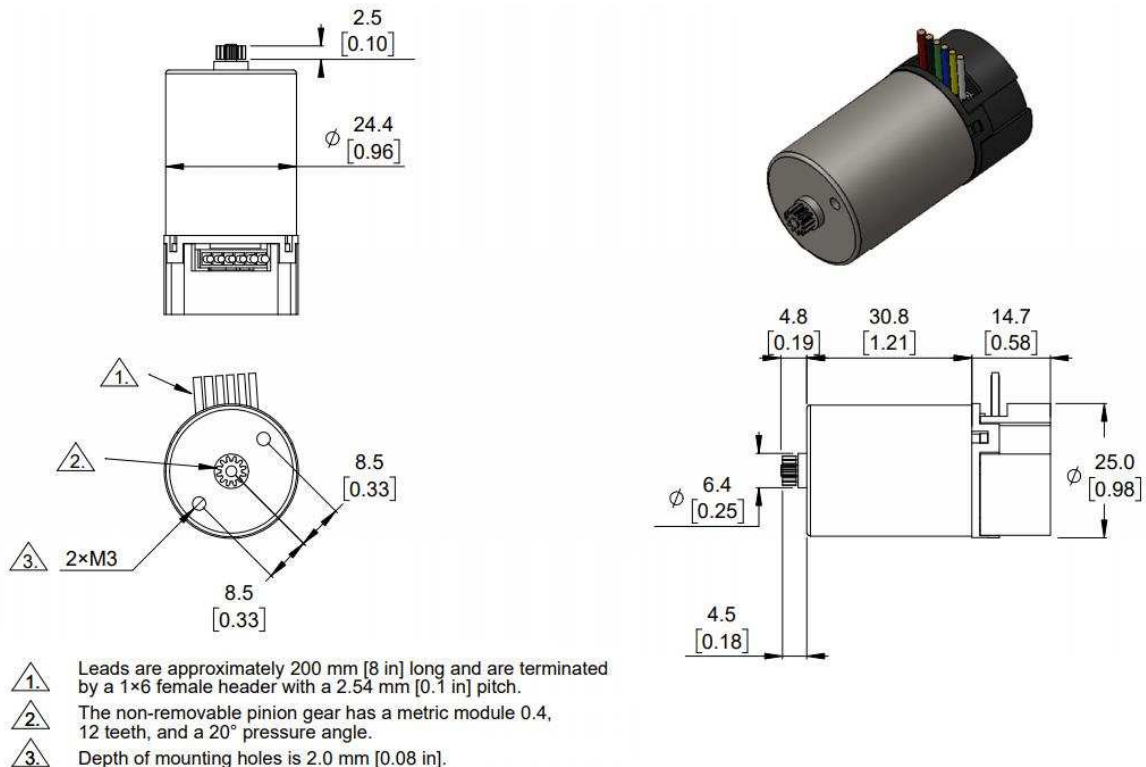
- **LP 6V:** Low-power, 6 V nominal operation (2.1 W max power and 2 A stall current at 6 V)
- **HP 6V:** High-power, 6 V nominal operation (7 W max power and 6 A stall current at 6 V)
- **LP 12V:** Low-power, 12 V nominal operation (1.8 W max power and 0.9 A stall current at 12 V)
- **MP 12V:** Medium-power,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



1. Leads are approximately 200 mm [8 in] long and are terminated by a 1×6 female header with a 2.54 mm [0.1 in] pitch.
2. The non-removable pinion gear has a metric module 0.4, 12 teeth, and a 20° pressure angle.
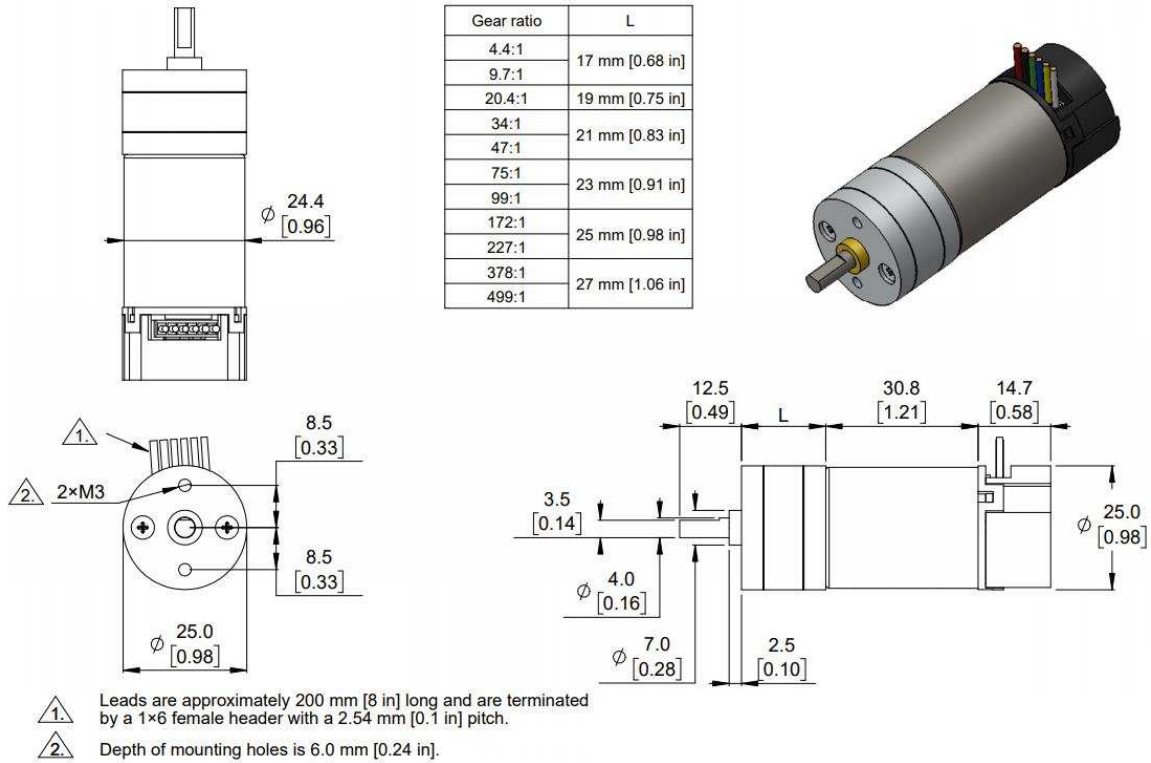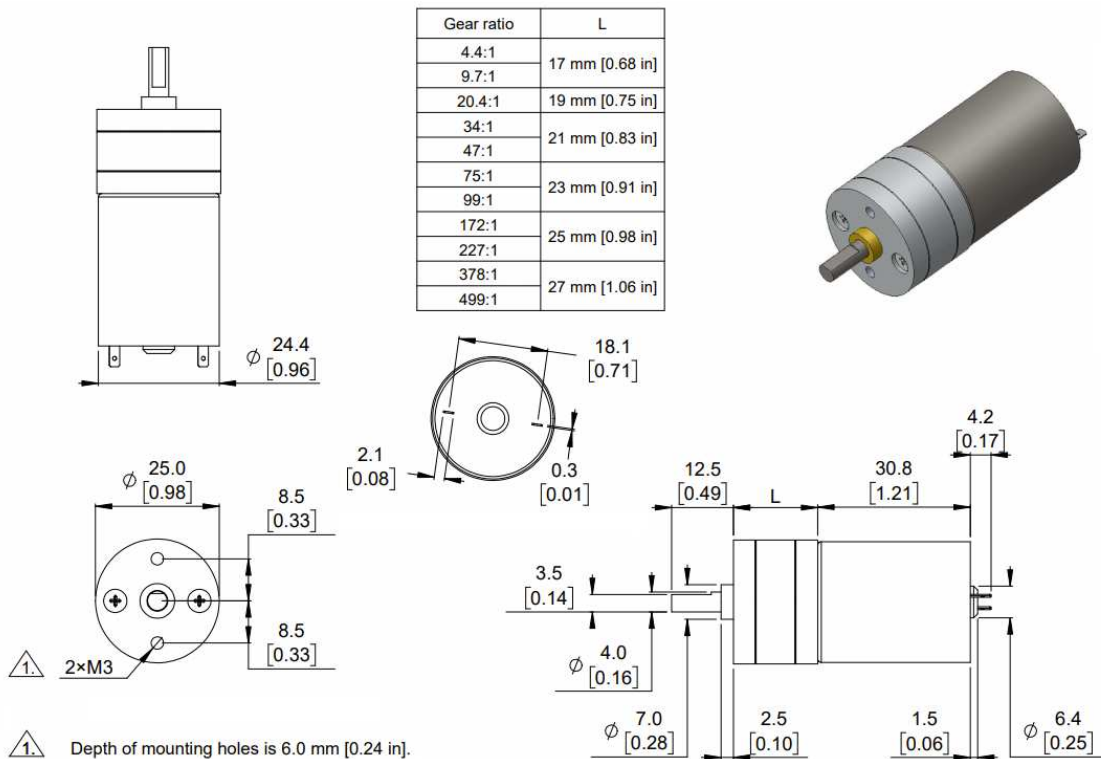3. Depth of mounting holes is 2.0 mm [0.08 in].

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

| Gear ratio | L |
|---|---|
| 4.4:1 | 17 mm [0.68 in] |
| 9.7:1 | |
| 20.4:1 | 19 mm [0.75 in] |
| 34:1 | 21 mm [0.83 in] |
| 47:1 | |
| 75:1 | 23 mm [0.91 in] |
| 99:1 | |
| 172:1 | 25 mm [0.98 in] |
| 227:1 | |
| 378:1 | 27 mm [1.06 in] |
| 499:1 | |

⚠ 1. Leads are approximately 200 mm [8 in] long and are terminated by a 1×6 female header with a 2.54 mm [0.1 in] pitch.

⚠ 2. Depth of mounting holes is 6.0 mm [0.24 in].

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

| Gear ratio | L |
|---|---|
| 4.4:1 | 17 mm [0.68 in] |
| 9.7:1 | |
| 20.4:1 | 19 mm [0.75 in] |
| 34:1 | 21 mm [0.83 in] |
| 47:1 | |
| 75:1 | 23 mm [0.91 in] |
| 99:1 | |
| 172:1 | 25 mm [0.98 in] |
| 227:1 | |
| 378:1 | 27 mm [1.06 in] |
| 499:1 | |

⚠ 1. Depth of mounting holes is 6.0 mm [0.24 in].

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**Pololu**

## Performance summary and table of contents

| Motor Type | Rated Voltage | Pololu Item # | Gear Ratio :1 | Typical No Load Speed RPM (±20%) | Typical No Load Current mA (±50%) | At Max Efficiency Speed RPM | Torque kg·mm | Current A | Output W | Efficiency % | Max Power W | Stall Extrapolation[2] Torque kg·mm | Stall Current A | Graph Page |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Low-Power (LP 6V) | 6 V | 4820 [1] | 1 | 6200 | | - | - | - | - | - | 2.1 | 1.5 | | |
| | | 1581, 4821 | 4.4 | 1300 | | 1100 | 0.82 | 0.32 | 0.94 | 49 | 2.1 | 6.3 | | 6 |
| | | 1582, 4822 | 9.68 | 630 | | 490 | 2.0 | 0.38 | 1.0 | 44 | 1.9 | 13 | | 7 |
| | | 1583, 4823 | 20.4 | 290 | 100 w/o encoder | 240 | 3.6 | 0.34 | 0.91 | 44 | 1.9 | 25 | | 8 |
| | | 1584, 4824 | 34.01 | 180 | | 150 | 5.2 | 0.31 | 0.78 | 42 | 1.7 | 39 | | 9 |
| | | 1585, 4825 | 46.85 | 130 | | 110 | 6.9 | 0.33 | 0.75 | 38 | 1.5 | 48 | 2.0 | 10 |
| | | 1586, 4826 | 74.83 | 80 | 120 with encoder | 66 | 11 | 0.33 | 0.72 | 36 | 1.5 | 75 | | 11 |
| | | 1587, 4827 | 98.78 | 61 | | 50 | 14 | 0.36 | 0.73 | 34 | 1.4 | 91 | | 12 |
| | | 1588, 4828 | 171.79 | 35 | | 29 | 21 | 0.33 | 0.63 | 31 | 1.2 | 140 | | 13 |
| | | 1589, 4829 | 226.76 | 27 | | 22 | 24 | 0.31 | 0.55 | 30 | 1.1 | 170 | | 14 |
| | | 1590, 4830 | 377.93 | 16 | | 13 | 41 | 0.34 | 0.56 | 27 | - [3] | 250 | | 15 |
| | | 1591, 4831 | 498.87 | 12 | | - [4] | - [4] | - [4] | - [4] | - [4] | - [3] | 310 | | 16 |
| High-Power (HP 6V) | 6 V | 4800 [1] | 1 | 10,000 | | - | - | - | - | - | 7 | 3 | | |
| | | 1570, 4801 | 4.4 | 2200 | | 1800 | 2.2 | 1.4 | 4.1 | 49 | 6.7 | 12 | | 17 |
| | | 1571, 4802 | 9.68 | 1000 | 420 w/o encoder | 810 | 4.5 | 1.4 | 3.8 | 44 | 5.9 | 23 | | 18 |
| | | 1572, 4803 | 20.4 | 480 | | 390 | 9.2 | 1.5 | 3.7 | 42 | 5.9 | 48 | 6.0 | 19 |
| | | 1573, 4804 | 34.01 | 290 | | 240 | 13 | 1.4 | 3.1 | 37 | 5.1 | 68 | | 20 |
| | | 1574, 4805 | 46.85 | 210 | 500 with encoder | 170 | 16 | 1.3 | 2.9 | 37 | 4.9 | 91 | | 21 |
| | | 1575, 4806 | 74.83 | 130 | | 100 | 27 | 1.4 | 2.9 | 34 | 4.5 | 140 | | 22 |
| | | 1576, 4807 | 98.78 | 99 | | 79 | 31 | 1.4 | 2.5 | 30 | 3.9 | 150 | | 23 |
| | | 1577, 4808 | 171.79 | 57 | | 46 | 52 | 1.4 | 2.5 | 30 | - [3] | 270 | | 24 |
| Low-Power (LP 12V) | 12 V | 4880 [1] | 1 | 5600 | | - | - | - | - | - | 1.8 | 1.4 | | |
| | | 3249, 4881 | 4.4 | 1200 | | 1100 | 0.60 | 0.11 | 0.69 | 51 | 1.7 | 5.3 | | 25 |
| | | 3250, 4882 | 9.68 | 580 | | 480 | 1.9 | 0.17 | 0.94 | 47 | 1.8 | 13 | | 26 |
| | | 3251, 4883 | 20.4 | 280 | 50 w/o encoder | 230 | 3.5 | 0.16 | 0.84 | 43 | 1.7 | 24 | | 27 |
| | | 3252, 4884 | 34.01 | 170 | | 140 | 5.0 | 0.14 | 0.73 | 42 | 1.6 | 37 | | 28 |
| | | 3253, 4885 | 46.85 | 120 | | 99 | 7.3 | 0.16 | 0.74 | 38 | 1.4 | 48 | 0.9 | 29 |
| | | 3254, 4886 | 74.83 | 75 | 60 with encoder | 62 | 12 | 0.17 | 0.73 | 35 | 1.4 | 71 | | 30 |
| | | 3255, 4887 | 98.78 | 57 | | 47 | 14 | 0.17 | 0.67 | 33 | 1.2 | 87 | | 31 |
| | | 3256, 4888 | 171.79 | 33 | | 28 | 19 | 0.14 | 0.54 | 31 | 1.1 | 130 | | 32 |
| | | 3257, 4889 | 226.76 | 25 | | 21 | 24 | 0.14 | 0.53 | 30 | 1.0 | 160 | | 33 |
| | | 3258, 4890 | 377.93 | 15 | | 13 | 36 | 0.15 | 0.47 | 26 | - [3] | 230 | | 34 |
| Medium-Power (MP 12V) | 12 V | 4860 [1] | 1 | 8200 | | - | - | - | - | - | 3.5 | 1.7 | | |
| | | 3225, 4861 | 4.4 | 1800 | | 1500 | 0.93 | 0.26 | 1.5 | 47 | 3.2 | 7.1 | | 35 |
| | | 3226, 4862 | 9.68 | 800 | 80 w/o encoder | 670 | 2.5 | 0.32 | 1.7 | 45 | 3.4 | 17 | | 36 |
| | | 3227, 4863 | 20.4 | 380 | | 330 | 4.3 | 0.28 | 1.5 | 43 | 3.1 | 32 | | 37 |
| | | 3228, 4864 | 34.01 | 230 | | 200 | 5.4 | 0.24 | 1.1 | 40 | 2.8 | 47 | 1.8 | 38 |
| | | 3229, 4865 | 46.85 | 170 | 100 with encoder | 140 | 8.6 | 0.28 | 1.3 | 38 | 2.8 | 64 | | 39 |
| | | 3230, 4866 | 74.83 | 100 | | 91 | 12 | 0.28 | 1.1 | 33 | 2.3 | 85 | | 40 |
| | | 3231, 4867 | 98.78 | 79 | | 68 | 16 | 0.28 | 1.1 | 34 | 2.3 | 110 | | 41 |
| | | 3232, 4868 | 171.79 | 46 | | 39 | 27 | 0.29 | 1.1 | 31 | 2.1 | 180 | | 42 |
| | | 3233, 4869 | 226.76 | 35 | | 30 | 36 | 0.28 | 1.1 | 32 | - [3] | 240 | | 43 |
| High-Power (HP 12V) | 12 V | 4840 [1] | 1 | 10,000 | | - | - | - | - | - | 10 | 4 | | |
| | | 3201, 4841 | 4.4 | 2200 | | 1700 | 3.6 | 1.2 | 6.2 | 44 | 9.4 | 17 | | 44 |
| | | 3202, 4842 | 9.68 | 1000 | 250 w/o encoder | 890 | 5.8 | 0.84 | 5.3 | 52 | 10 | 39 | | 45 |
| | | 3203, 4843 | 20.4 | 500 | | 420 | 11 | 0.88 | 4.8 | 46 | 9.4 | 74 | 5.0 | 46 |
| | | 3204, 4844 | 34.01 | 300 | | 260 | 16 | 0.82 | 4.3 | 44 | 8.9 | 110 | | 47 |
| | | 3205, 4845 | 46.85 | 220 | 300 with encoder | 180 | 23 | 0.87 | 4.4 | 42 | 8.4 | 150 | | 48 |
| | | 3206, 4846 | 74.83 | 130 | | 110 | 33 | 0.87 | 3.9 | 37 | - [3] | 220 | | 49 |
| | | 3207, 4847 | 98.78 | 100 | | 87 | 45 | 0.94 | 4.0 | 36 | - [3] | 290 | | 50 |

**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 HPCB) 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.

| Lead Color | Function |
| --- | --- |
| Red | Motor power |
| Black | Motor power |
| Green | Encoder ground |
| Blue | Encoder Vcc (3.5 V to 20 V) |
| Yellow | Encoder A output |
| White | Encoder B output |

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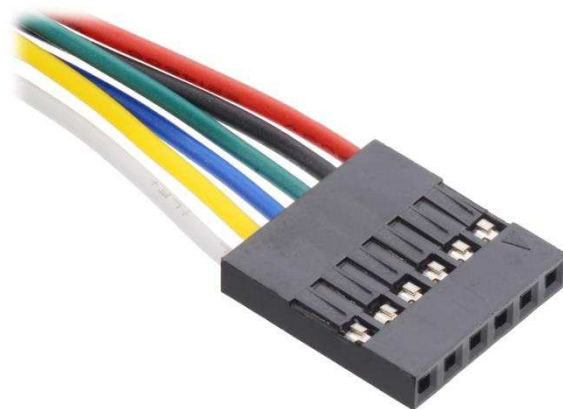
The Hall sensors require an input voltage, Vcc, between 3.5 V and 20 V and draw a maximum of 10 mA. The A and B outputs are square waves from 0 V to Vcc approximately 90° out of phase. The speed of the motor can be determined from the frequency, and the direction of rotation can be determined from the 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:
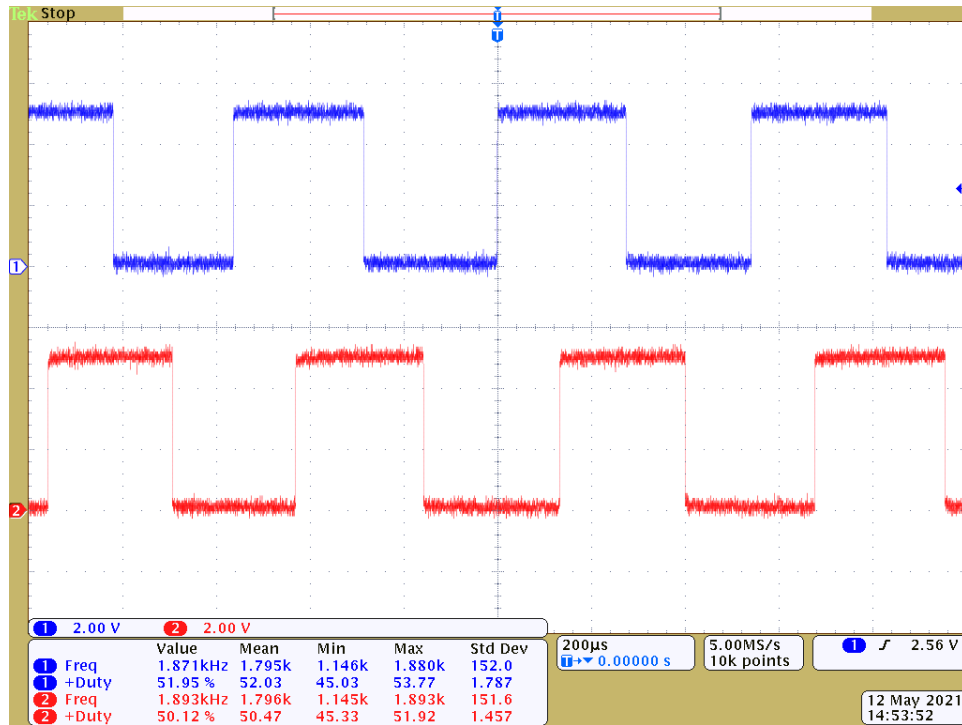


Counting both the rising and falling edges of both the A and B outputs results in 48 counts per revolution of the motor shaft. Using just a single edge of one channel results in 12 counts per revolution of the motor shaft, so the frequency of the A output in the above oscilloscope capture is 12 times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

## Exact gear ratios

| Nominal | Exact | | Nominal | Exact | |
|---|---|---|---|---|---|
| 4.4 : 1 | $\frac{22 \times 24}{12 \times 10}$ | $= 4.4 : 1$ | 99 : 1 | $\frac{22 \times 22 \times 22 \times 22 \times 22 \times 23}{12 \times 10 \times 10 \times 10 \times 10 \times 10}$ | $\approx 98.7779 : 1$ |
| 9.7 : 1 | $\frac{22 \times 22 \times 24}{12 \times 10 \times 10}$ | $= 9.68 : 1$ | 172 : 1 | $\frac{22 \times 20 \times 22 \times 22 \times 22 \times 22 \times 24}{12 \times 12 \times 10 \times 10 \times 10 \times 10 \times 10}$ | $\approx 171.7877 : 1$ |
| 20.4 : 1 | $\frac{22 \times 22 \times 22 \times 23}{12 \times 10 \times 10 \times 10}$ | $= 20.408\overline{6} : 1$ | 227 : 1 | $\frac{22 \times 22 \times 22 \times 22 \times 22 \times 22 \times 24}{12 \times 10 \times 10 \times 10 \times 10 \times 10 \times 10}$ | $\approx 226.7598 : 1$ |
| 34 : 1 | $\frac{22 \times 20 \times 22 \times 22 \times 23}{12 \times 12 \times 10 \times 10 \times 10}$ | $= 34.01\overline{4} : 1$ | 378 : 1 | $\frac{22 \times 20 \times 22 \times 22 \times 22 \times 22 \times 24}{12 \times 12 \times 10 \times 10 \times 10 \times 10 \times 10}$ | $\approx 377.9330 : 1$ |
| 47 : 1 | $\frac{22 \times 22 \times 22 \times 22 \times 24}{12 \times 10 \times 10 \times 10 \times 10}$ | $= 46.8512 : 1$ | 499 : 1 | $\frac{22 \times 22 \times 22 \times 22 \times 22 \times 22 \times 22 \times 24}{12 \times 10 \times 10 \times 10 \times 10 \times 10 \times 10 \times 10}$ | $\approx 498.8716 : 1$ |
| 75 : 1 | $\frac{22 \times 20 \times 22 \times 22 \times 22 \times 23}{12 \times 12 \times 10 \times 10 \times 10 \times 10}$ | $= 74.831\overline{7} : 1$ | | | |

# Pololu Items #1581, #4821 (4.4:1 Metal Gearmotor 25D LP 6V) Performance at 6 V



no-load speed: 1300 rpm

$f(\tau) = 1300 - 200\tau$

max power: 2.1 W
at 3.1 kg·mm,
32% efficiency,
640 rpm, 1.1 A

$I_{stall} \approx 2.1$ A

$f(\tau) = 0.048 + 0.33\tau$

max efficiency: 49%
at 0.82 kg·mm, 0.94 W,
1100 rpm, 0.32 A

$\tau_{stall} \approx$
6.3 kg·mm

no-load current: 0.090 A

efficiency (%)

power (W)

speed (rpm)

current (A)

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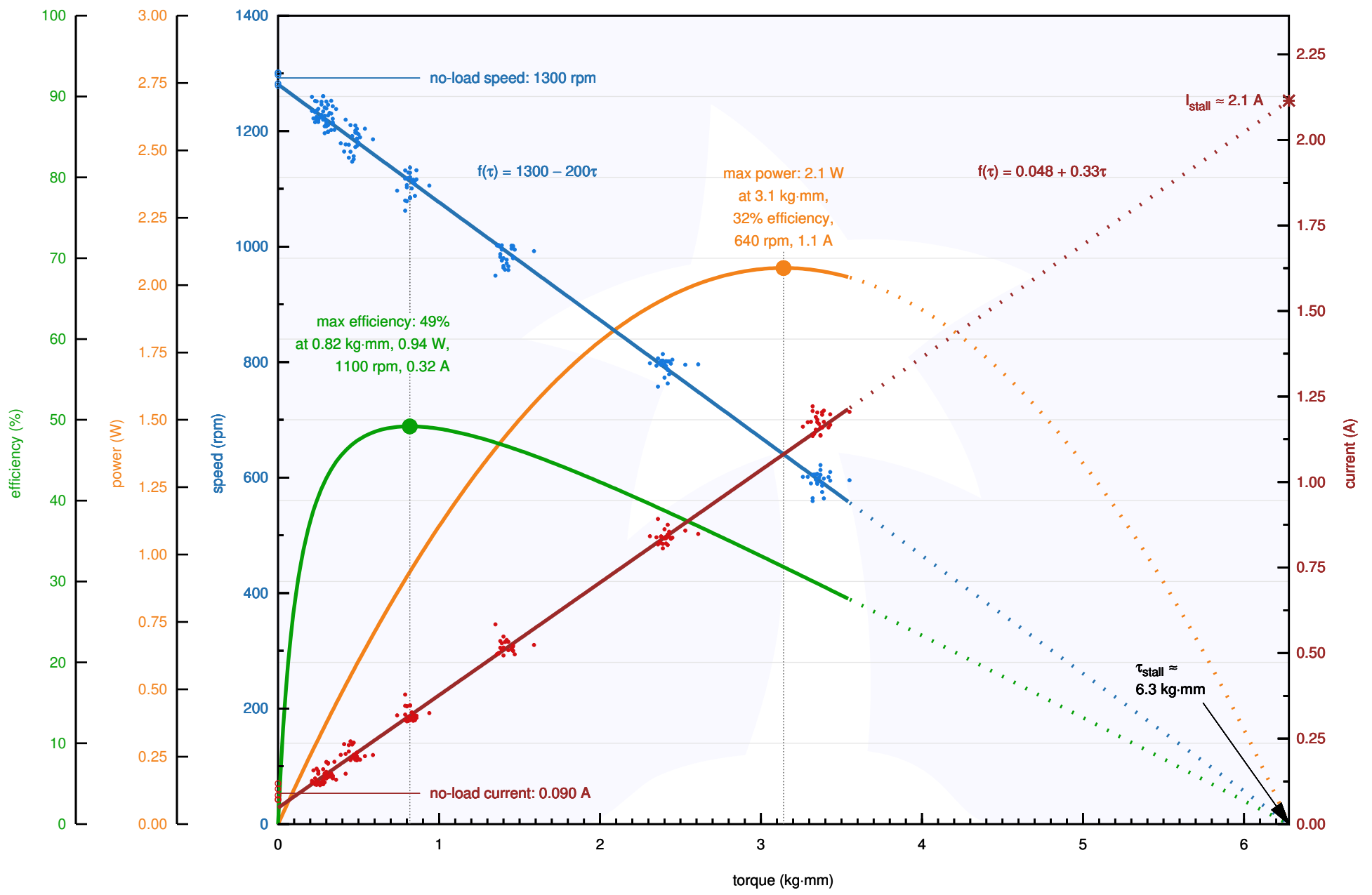
# Pololu Items #1582, #4822 (9.7:1 Metal Gearmotor 25D LP 6V) Performance at 6 V



no-load speed: 630 rpm

$f(\tau) = 580 - 46\tau$

max power: 1.9 W
at 6.3 kg·mm,
30% efficiency,
290 rpm, 1.0 A

$f(\tau) = 0.070 + 0.15\tau$

$I_{stall} \approx 2.0$ A

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

$\tau_{stall} \approx$
13 kg·mm

no-load current: 0.090 A

efficiency (%)

power (W)

speed (rpm)

current (A)

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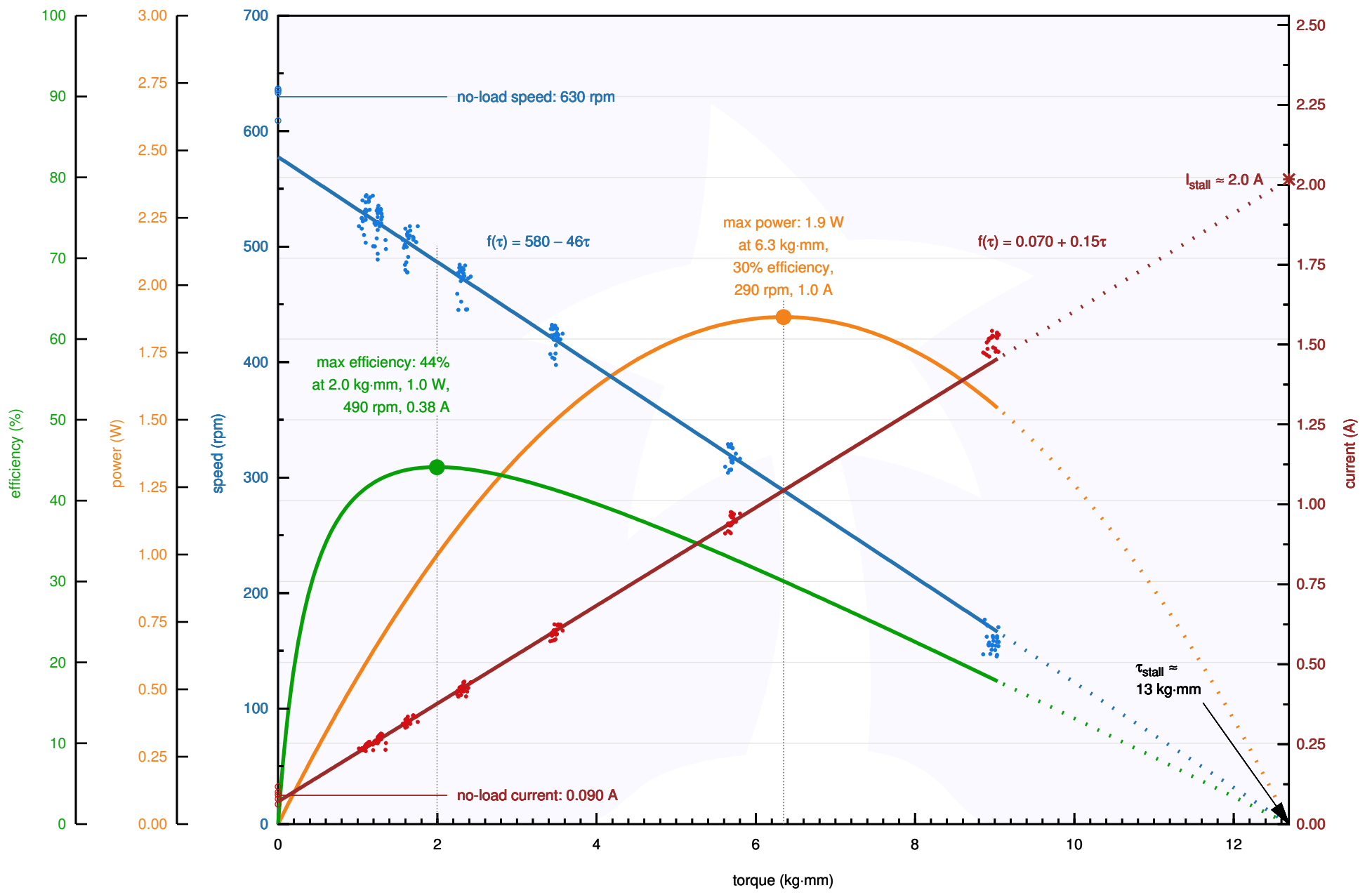
# Pololu Items #1583, #4823 (20.4:1 Metal Gearmotor 25D LP 6V) Performance at 6 V



no-load speed: 290 rpm

$I_{stall} \approx 2.1\ A$

$f(\tau) = 280 - 11\tau$

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

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 current: 0.086 A

$\tau_{stall} \approx$ 25 kg·mm

efficiency (%)

power (W)

speed (rpm)

current (A)

torque (kg·mm)
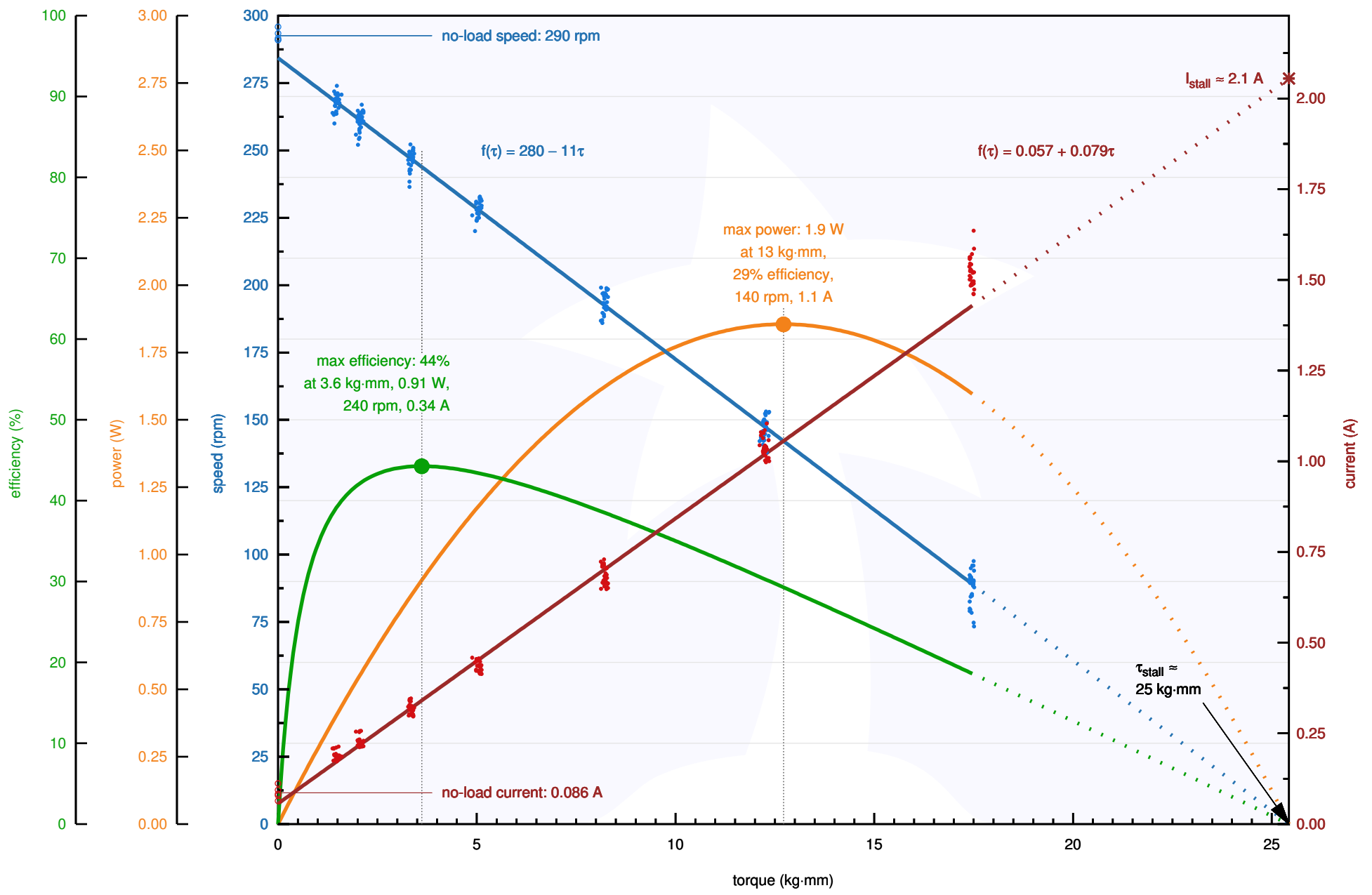
# Pololu Items #1584, #4824 (34:1 Metal Gearmotor 25D LP 6V) Performance at 6 V



no-load speed: 180 rpm

$f(\tau) = 170 - 4.4\tau$

$f(\tau) = 0.048 + 0.051\tau$

$I_{stall} \approx 2.0$ A

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

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

$\tau_{stall} \approx$
39 kg·mm

no-load current: 0.087 A

efficiency (%)

power (W)

speed (rpm)

current (A)

torque (kg·mm)
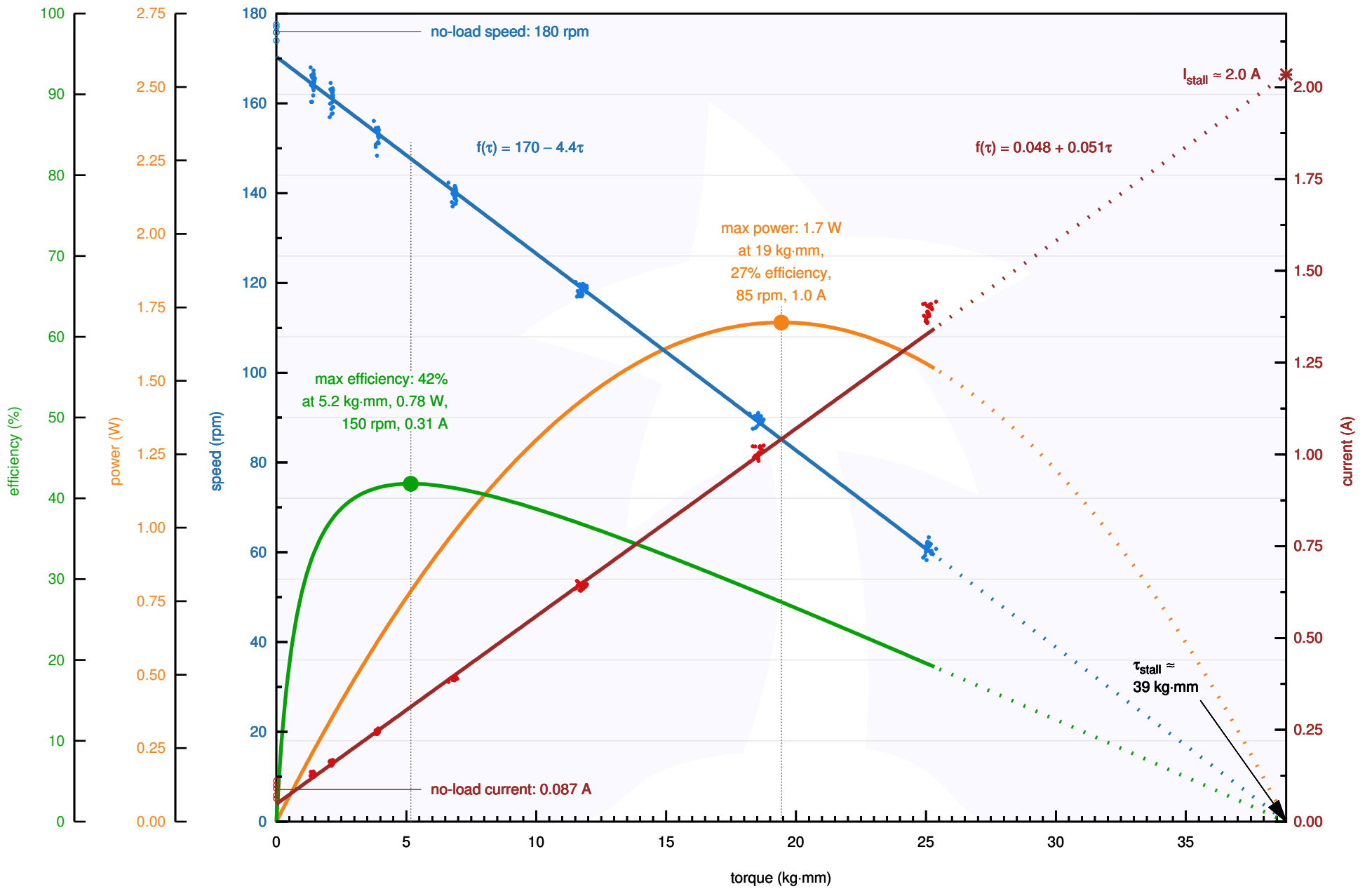
# Pololu Items #1585, #4825 (47:1 Metal Gearmotor 25D LP 6V) Performance at 6 V



no-load speed: 130 rpm

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

$I_{stall} \approx 1.9\ A$

$f(\tau) = 120 - 2.6\tau$

$f(\tau) = 0.055 + 0.040\tau$

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

no-load current: 0.085 A

$\tau_{stall} \approx$
48 kg·mm

efficiency (%)

power (W)

speed (rpm)

current (A)

torque (kg·mm)

# Pololu Items #1586, #4826 (75:1 Metal Gearmotor 25D LP 6V) Performance at 6 V



no-load speed: 80 rpm

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

$f(\tau) = 77 - 1.0\tau$

$f(\tau) = 0.054 + 0.026\tau$

$I_{stall} \approx 2.0$ A

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

$\tau_{stall} \approx$
75 kg·mm

no-load current: 0.092 A

efficiency (%) | power (W) | speed (rpm) | torque (kg·mm) | current (A)

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



no-load speed: 61 rpm

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

$f(\tau) = 59 - 0.65\tau$

$f(\tau) = 0.067 + 0.021\tau$

$I_{stall} \approx 2.0$ A

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

$\tau_{stall} \approx$ 91 kg·mm

no-load current: 0.077 A

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



no-load speed: 35 rpm

$f(\tau) = 34 - 0.24\tau$

$f(\tau) = 0.058 + 0.013\tau$

$I_{stall} \approx 1.9$ A

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 current: 0.081 A

$\tau_{stall} \approx$
140 kg·mm

efficiency (%)

power (W)

speed (rpm)

current (A)

torque (kg·mm)
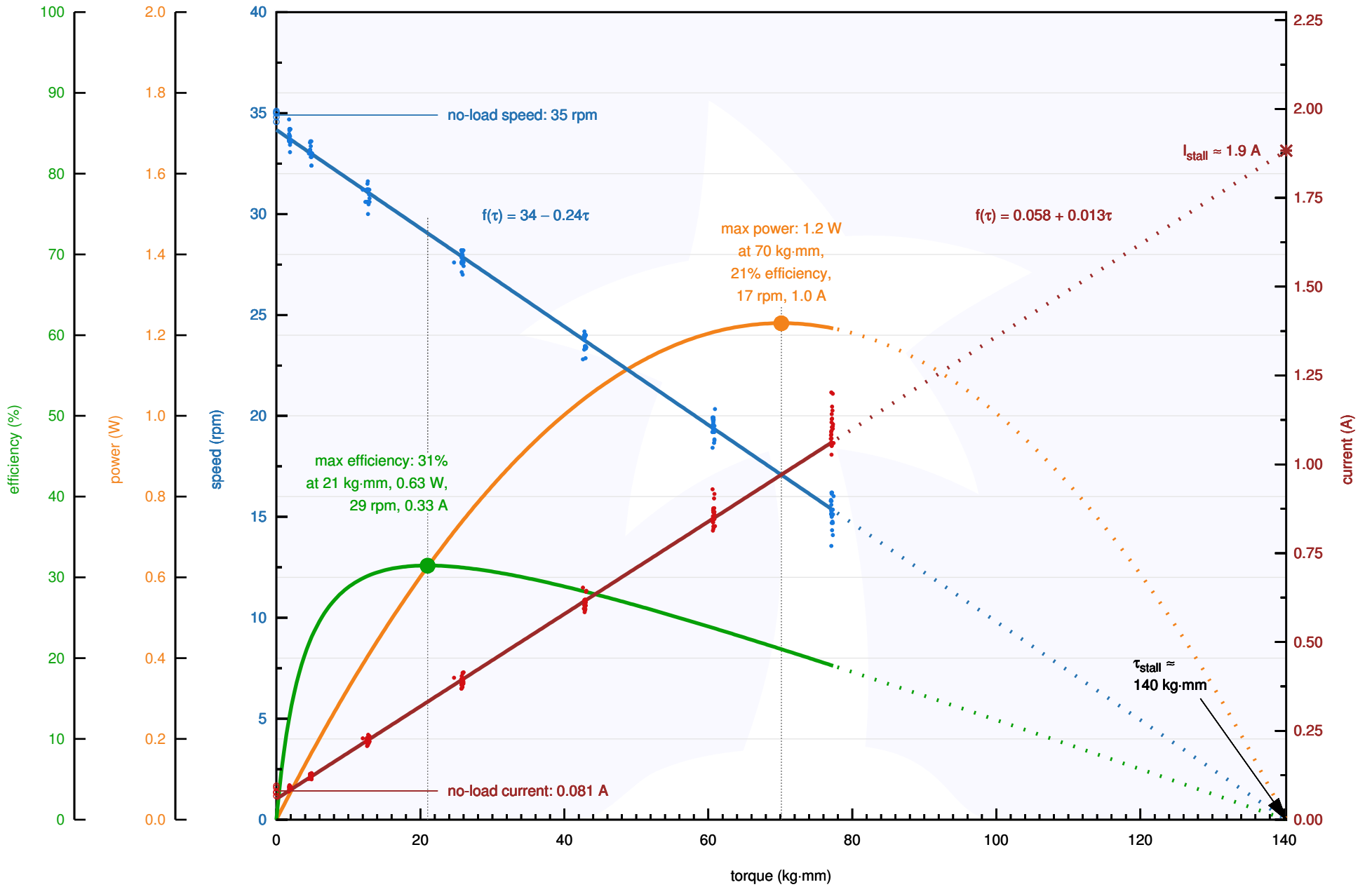
# Pololu Items #1589, #4829 (227:1 Metal Gearmotor 25D LP 6V) Performance at 6 V



no-load speed: 27 rpm

$f(\tau) = 26 - 0.16\tau$

$f(\tau) = 0.052 + 0.011\tau$

$I_{stall} \approx 1.9\ A$

max power: 1.1 W
at 84 kg·mm,
20% efficiency,
13 rpm, 1.0 A

max efficiency: 30%
at 24 kg·mm, 0.55 W,
22 rpm, 0.31 A

$\tau_{stall} \approx$
170 kg·mm

no-load current: 0.074 A

efficiency (%)

power (W)

speed (rpm)

current (A)

torque (kg·mm)
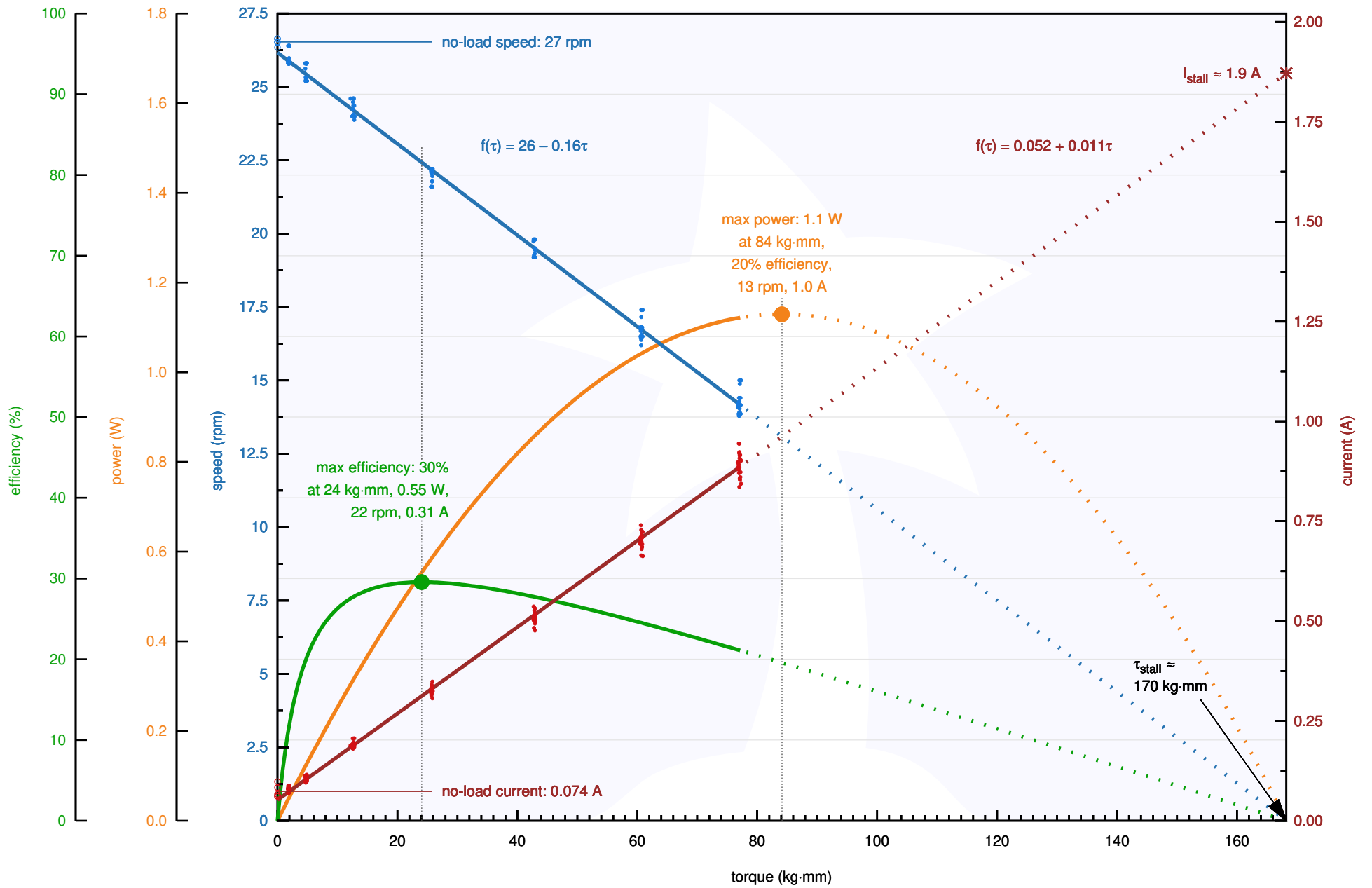
# Pololu Items #1590, #4830 (378:1 Metal Gearmotor 25D LP 6V) Performance at 6 V



no-load speed: 16 rpm

$f(\tau) = 16 - 0.063\tau$

$I_{stall} \approx 1.8$ A

$f(\tau) = 0.066 + 0.0068\tau$

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

$\tau_{stall} \approx$ 250 kg·mm

no-load current: 0.080 A

efficiency (%)

power (W)

speed (rpm)

current (A)

torque (kg·mm)
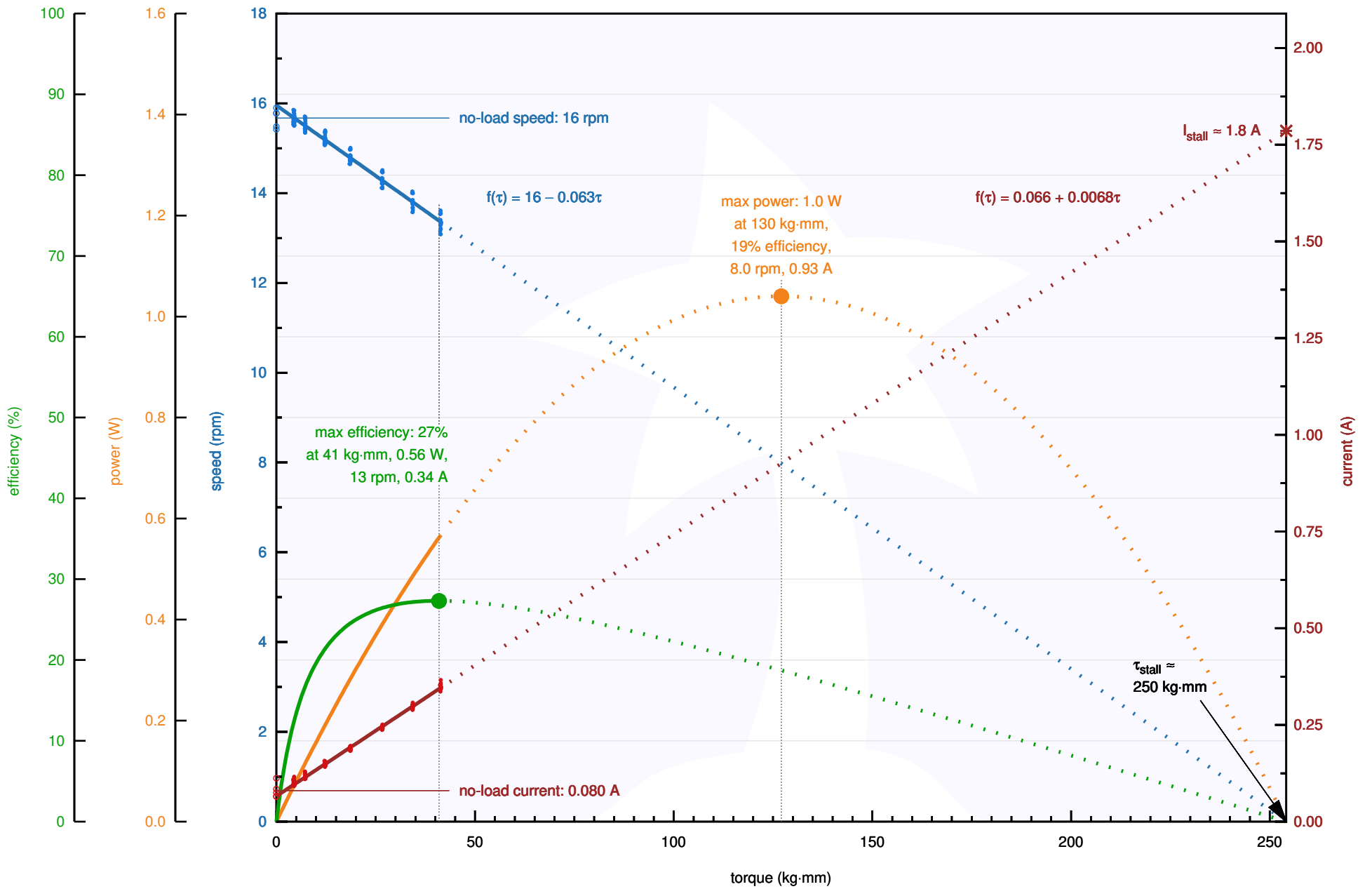
# Pololu Items #1591, #4831 (499:1 Metal Gearmotor 25D LP 6V) Performance at 6 V

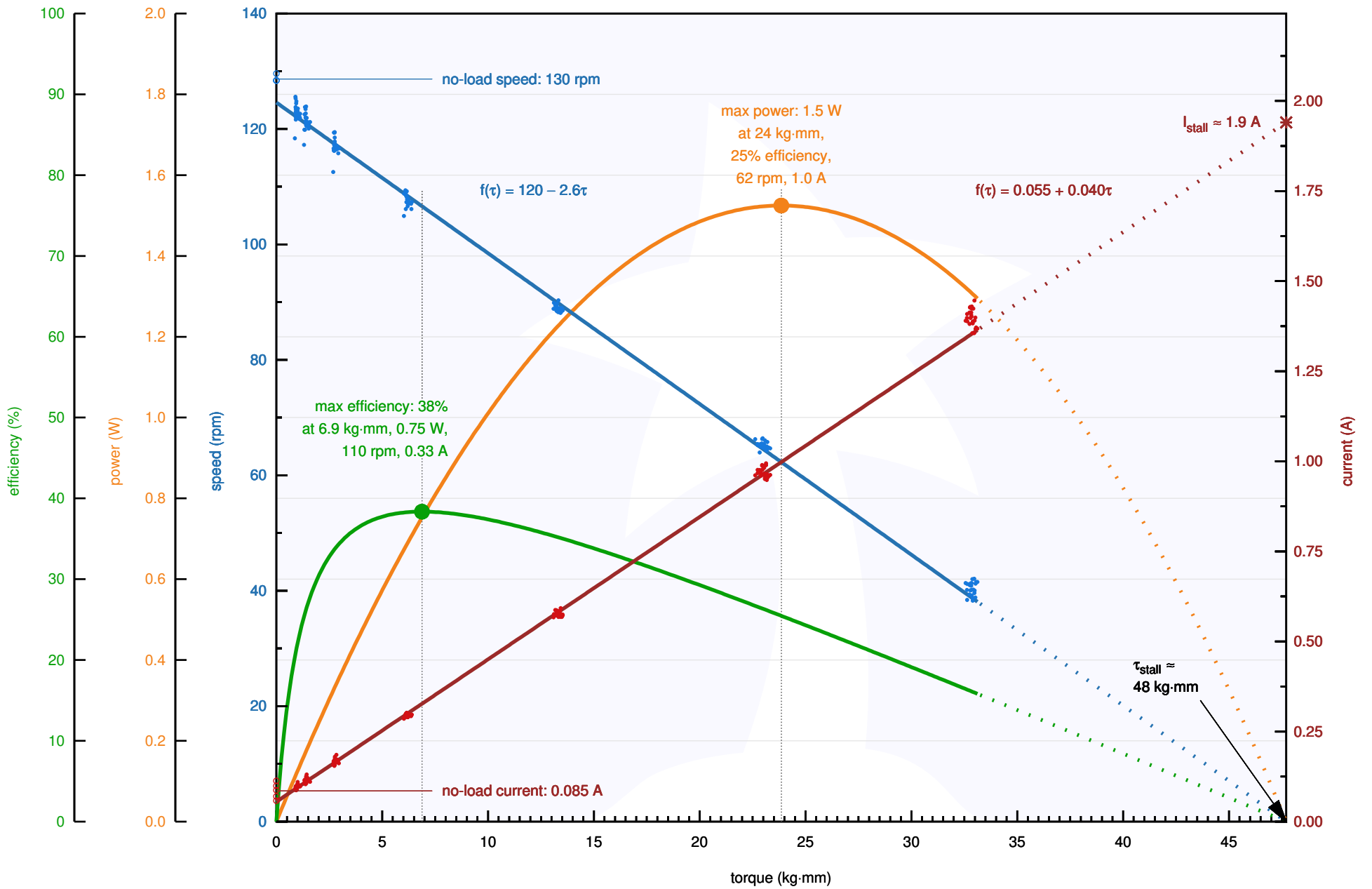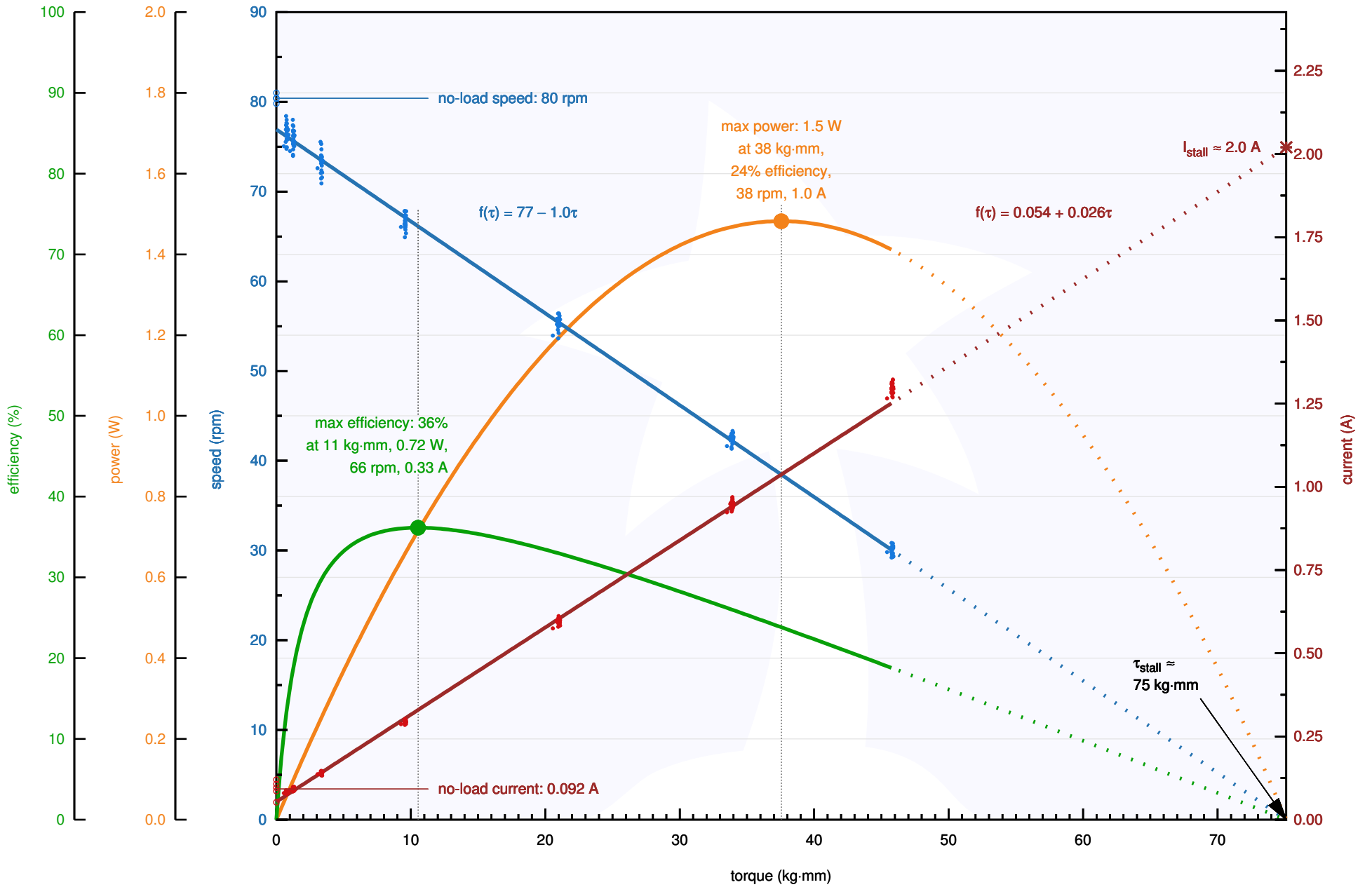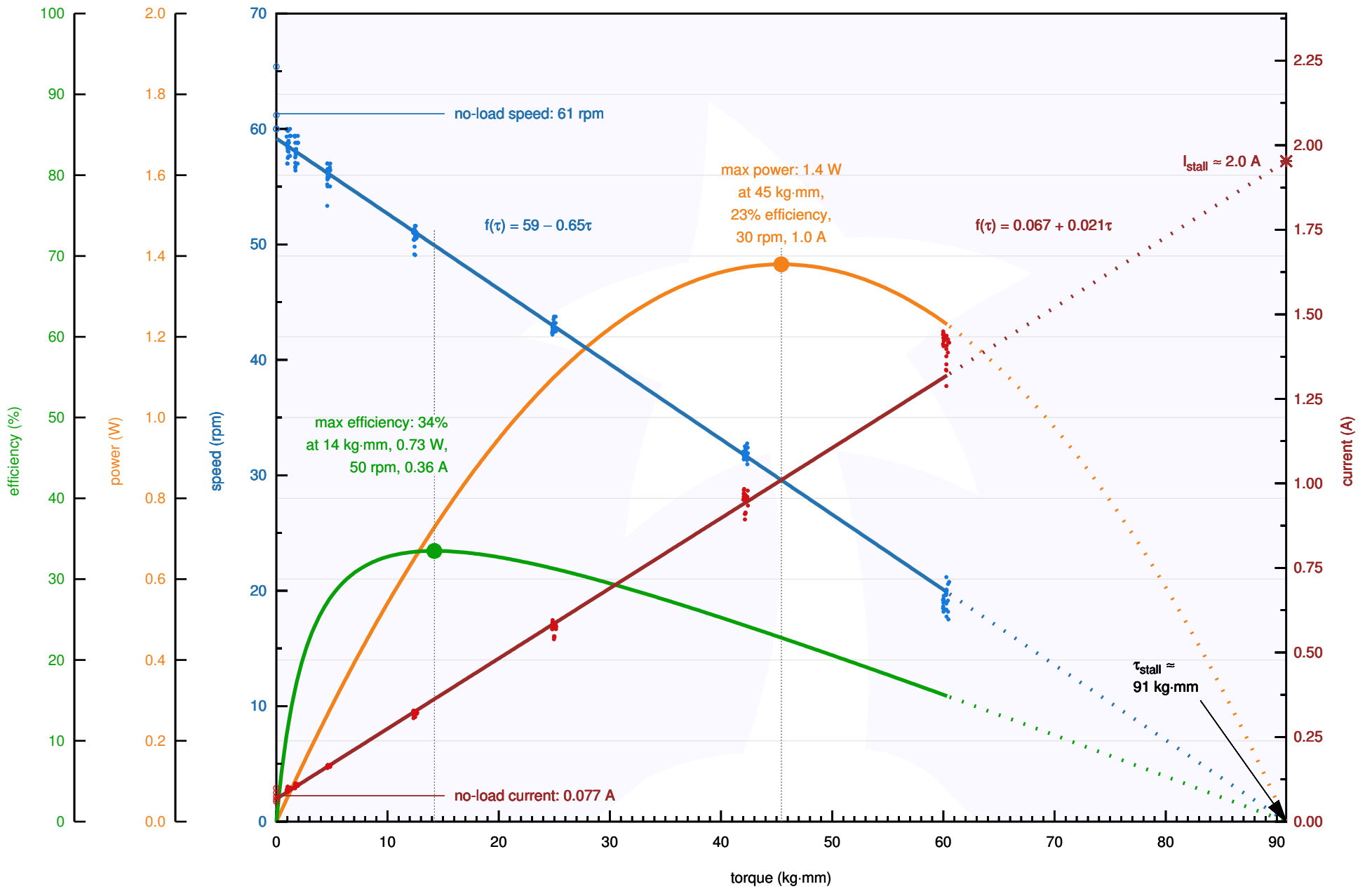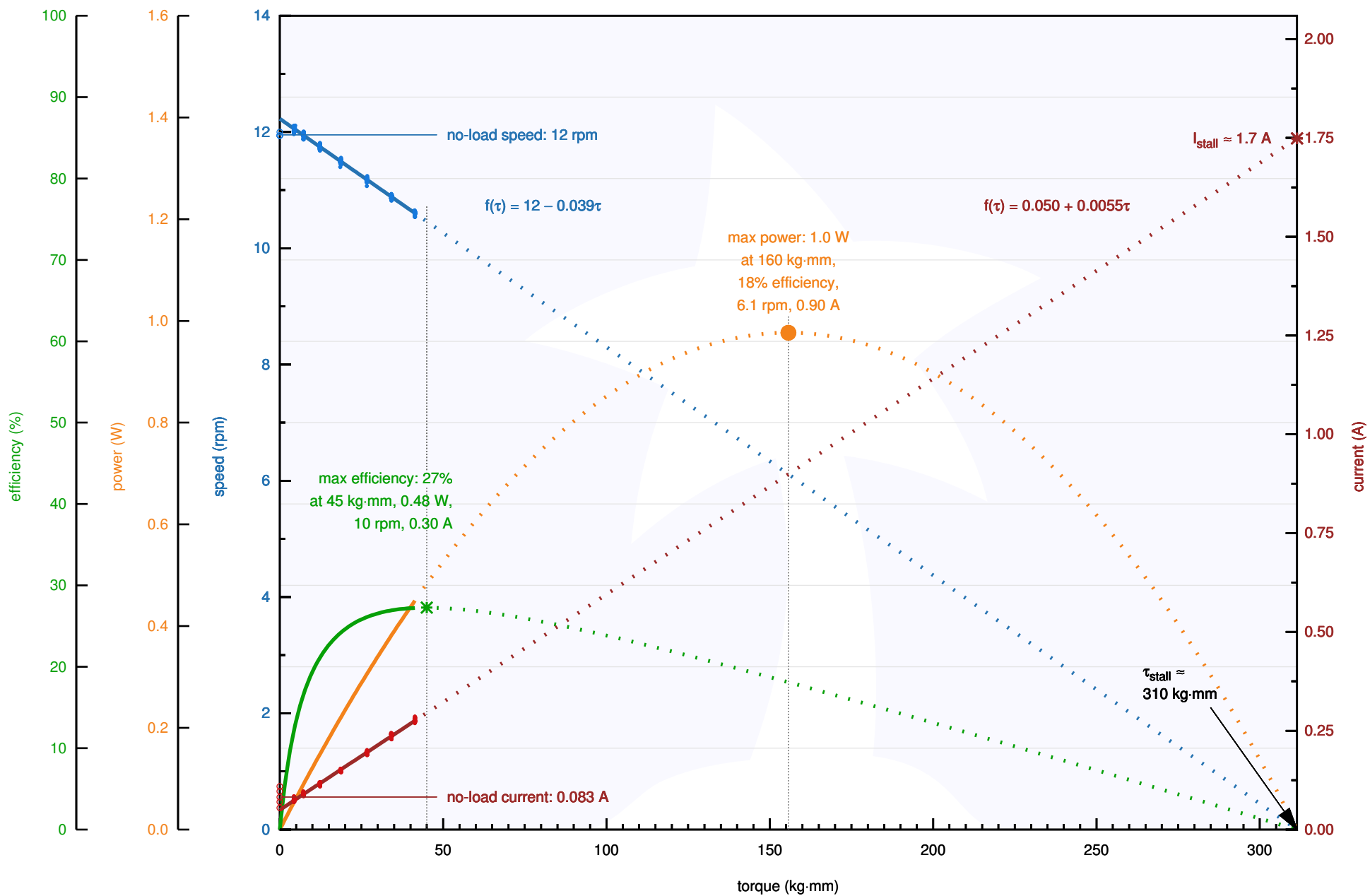# Pololu Items #1570, #4801 (4.4:1 Metal Gearmotor 25D HP 6V) Performance at 6 V



no-load speed: 2200 rpm

$f(\tau) = 2200 - 190\tau$

max power: 6.7 W
at 5.9 kg·mm,
35% efficiency,
1100 rpm, 3.2 A

$f(\tau) = 0.33 + 0.48\tau$

$I_{stall} \approx 6.0$ A

max efficiency: 49%
at 2.2 kg·mm, 4.1 W,
1800 rpm, 1.4 A

$\tau_{stall} \approx$
12 kg·mm

no-load current: 0.40 A

efficiency (%)

power (W)

speed (rpm)

current (A)

torque (kg·mm)
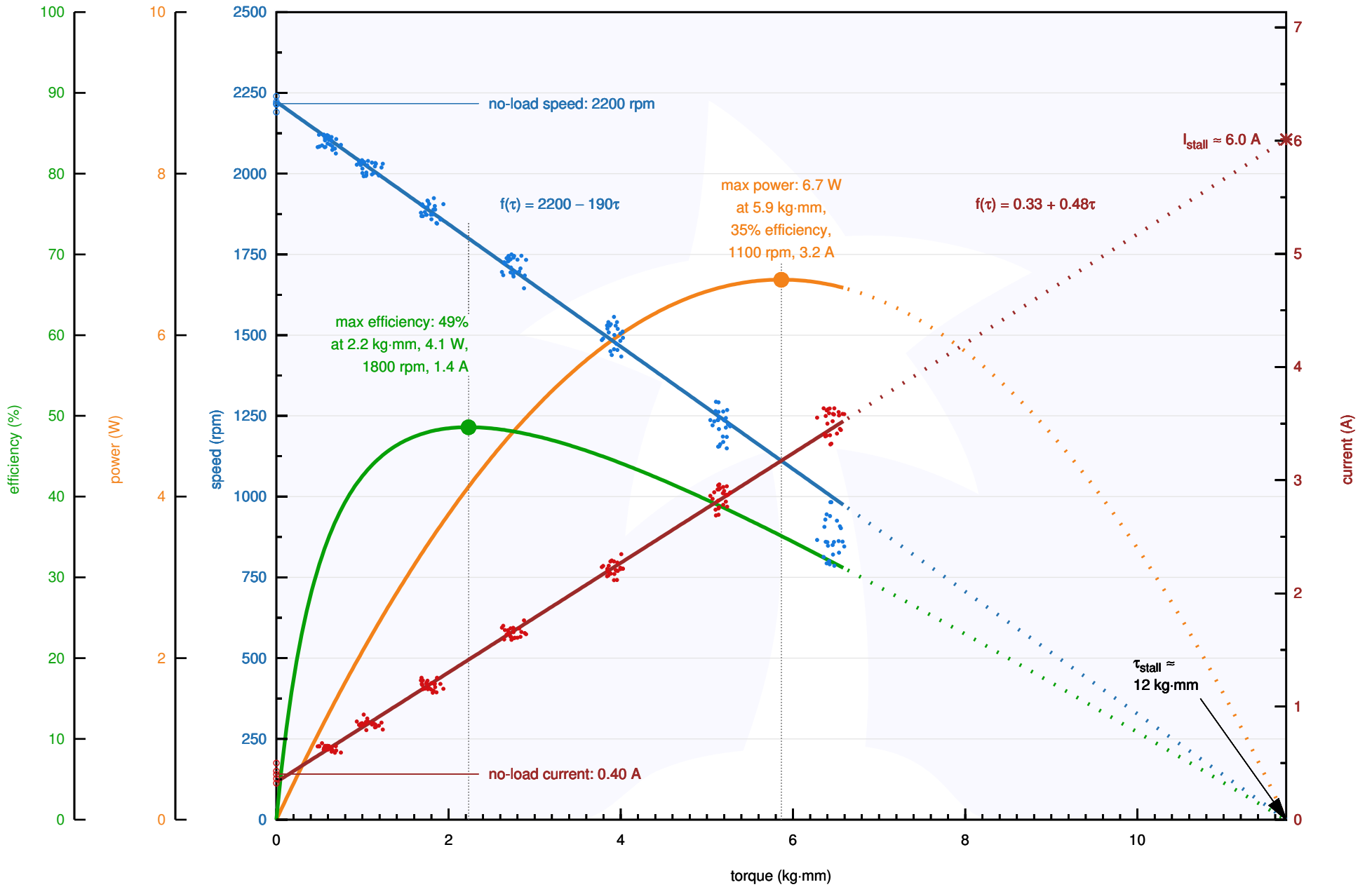
Pololu Items #1571, #4802 (9.7:1 Metal Gearmotor 25D HP 6V) Performance at 6 V

no-load speed: 1000 rpm

$f(\tau) = 1000 - 44\tau$

max power: 5.9 W
at 11 kg·mm,
32% efficiency,
510 rpm, 3.1 A

$f(\tau) = 0.35 + 0.24\tau$

$I_{stall} \approx 5.8$ A

max efficiency: 44%
at 4.5 kg·mm, 3.8 W,
810 rpm, 1.4 A

no-load current: 0.40 A

$\tau_{stall} \approx$ 23 kg·mm

efficiency (%)
power (W)
speed (rpm)
current (A)
torque (kg·mm)
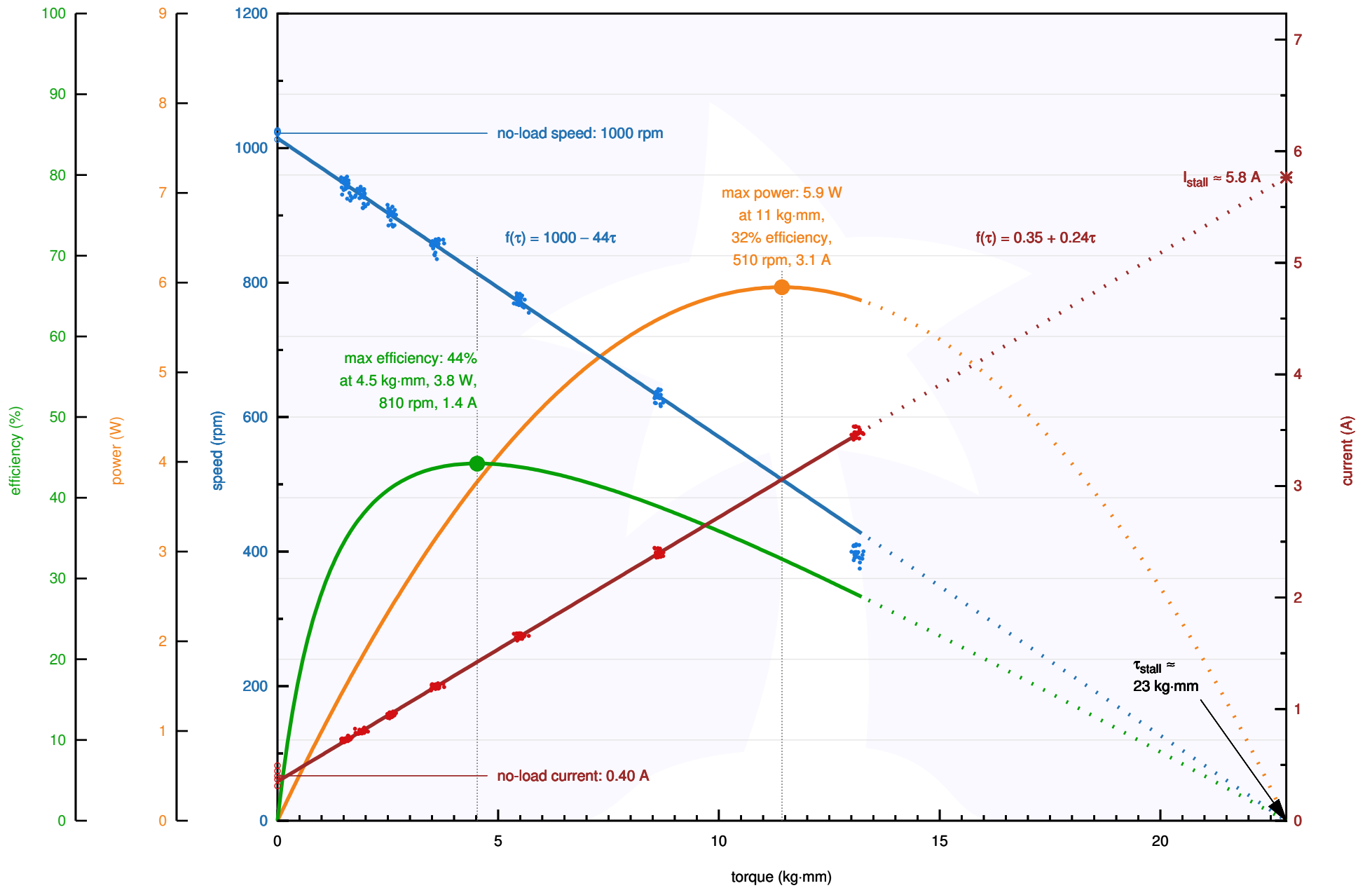
# Pololu Items #1572, #4803 (20.4:1 Metal Gearmotor 25D HP 6V) Performance at 6 V



no-load speed: 480 rpm

$f(\tau) = 480 - 10\tau$

$f(\tau) = 0.35 + 0.12\tau$

$I_{stall} \approx 6.0\ A$

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 current: 0.41 A

$\tau_{stall} \approx$ 48 kg·mm

efficiency (%)

power (W)

speed (rpm)

current (A)

torque (kg·mm)
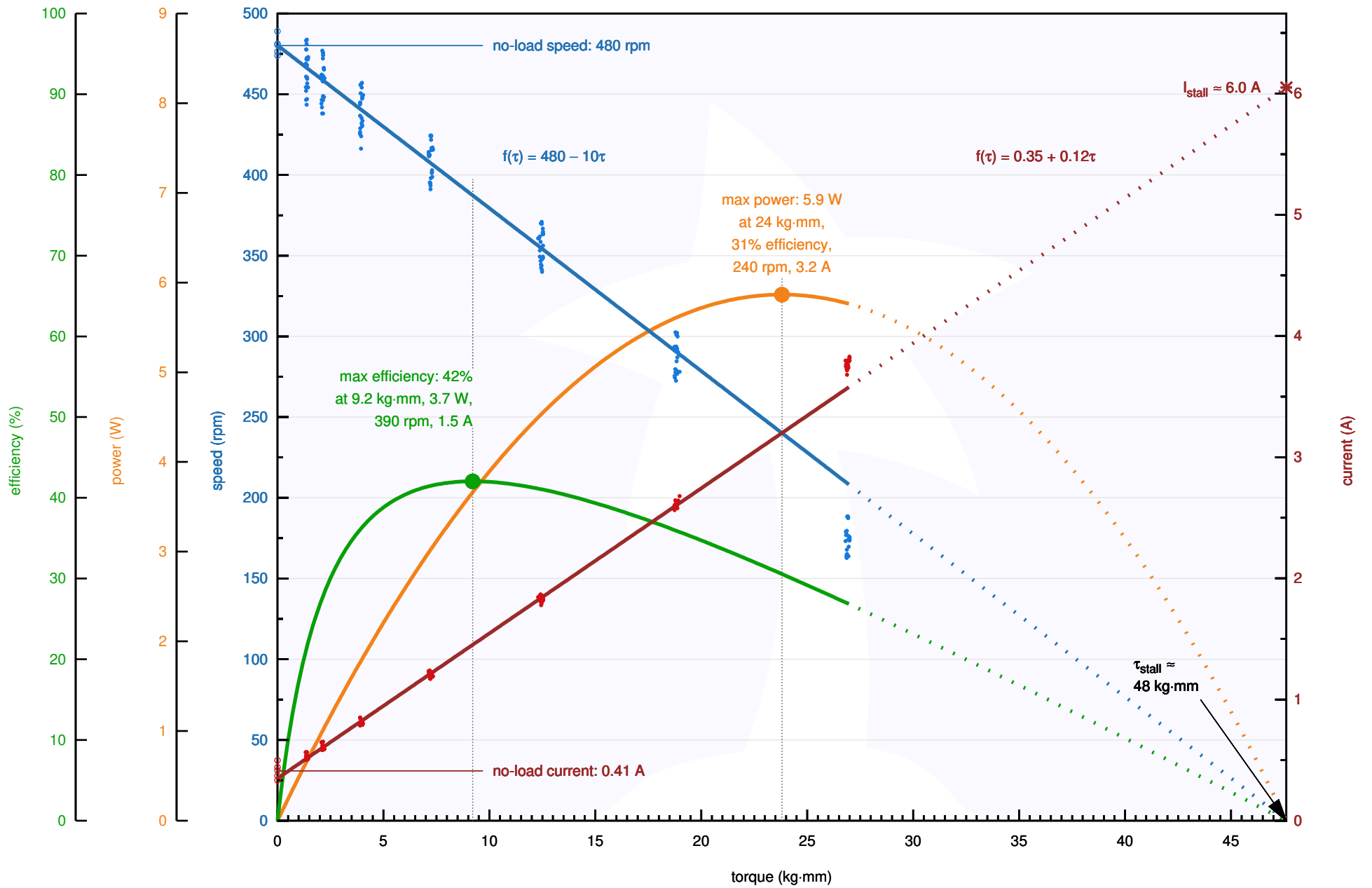
# Pololu Items #1573, #4804 (34:1 Metal Gearmotor 25D HP 6V) Performance at 6 V



no-load speed: 290 rpm

$f(\tau) = 290 - 4.3\tau$

$f(\tau) = 0.32 + 0.085\tau$

$I_{stall} \approx 6.1$ A

max power: 5.1 W
at 34 kg·mm,
26% efficiency,
150 rpm, 3.2 A

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

$\tau_{stall} \approx$ 68 kg·mm

no-load current: 0.39 A

efficiency (%)

power (W)

speed (rpm)

torque (kg·mm)

current (A)
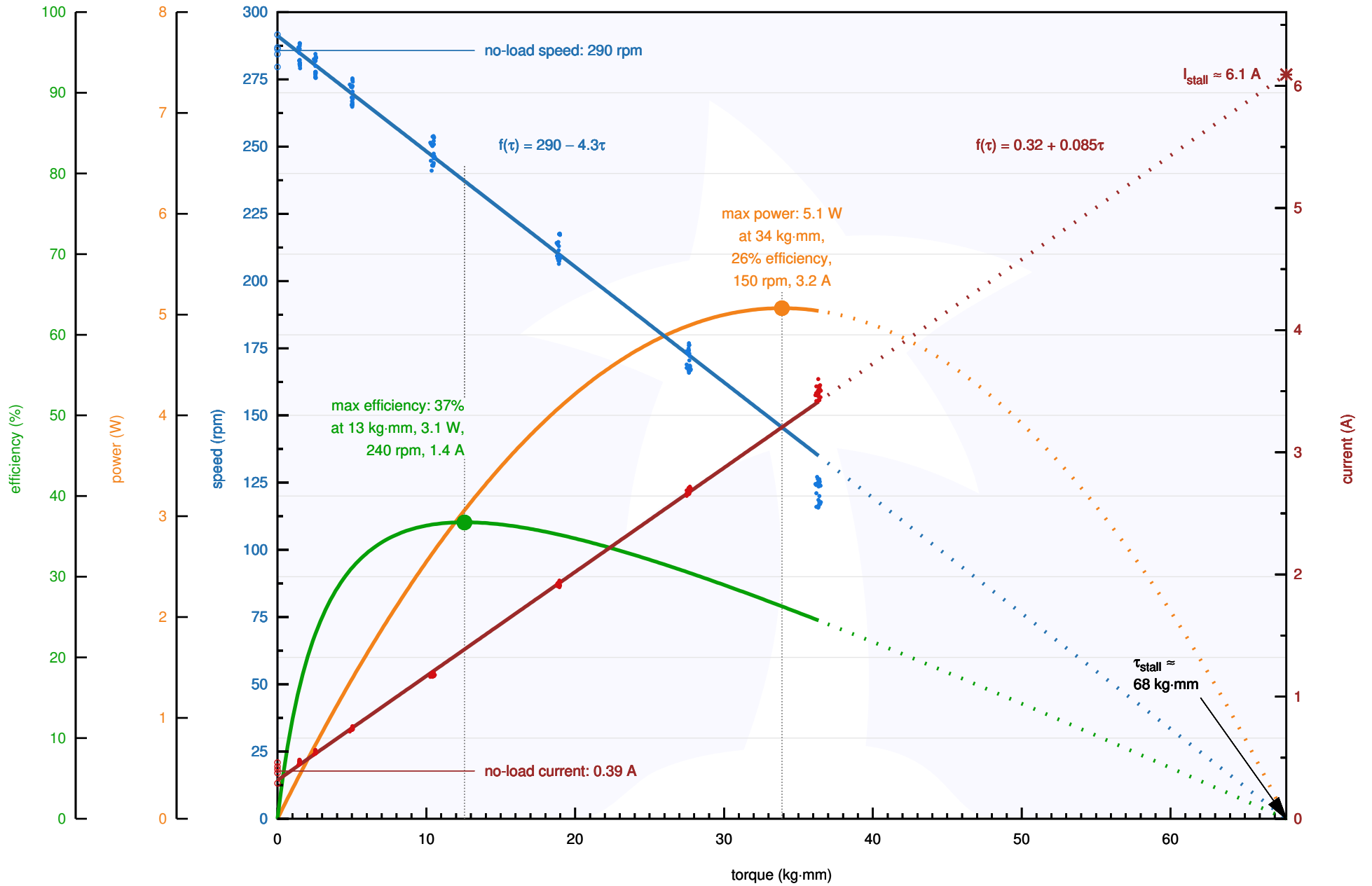
# Pololu Items #1574, #4805 (47:1 Metal Gearmotor 25D HP 6V) Performance at 6 V



no-load speed: 210 rpm

$f(\tau) = 210 - 2.3\tau$

$f(\tau) = 0.29 + 0.062\tau$

$I_{stall} \approx 5.9$ A

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

$\tau_{stall} \approx$
91 kg·mm

no-load current: 0.37 A

efficiency (%)

power (W)

speed (rpm)

current (A)

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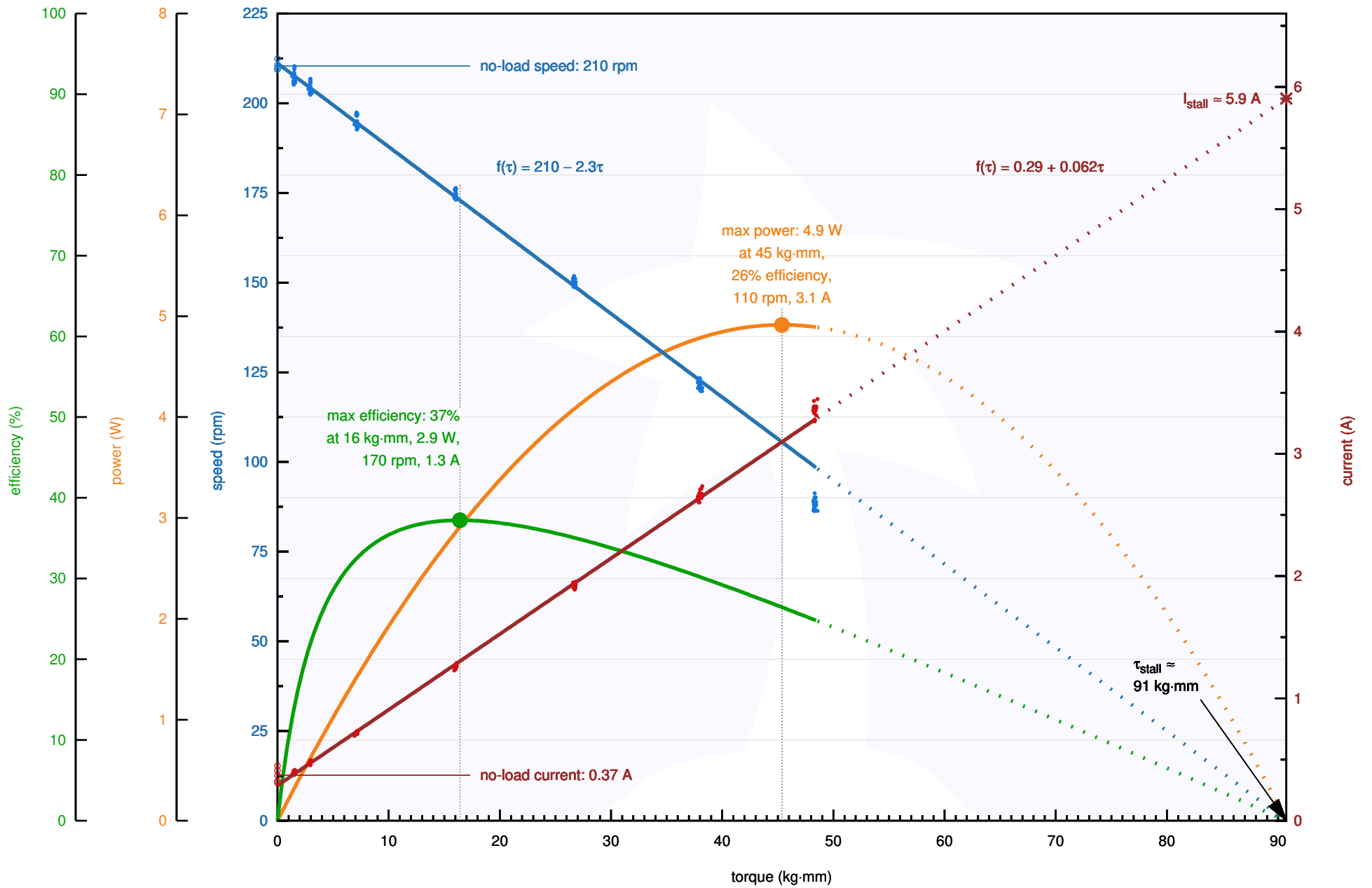
# Pololu Items #1575, #4806 (75:1 Metal Gearmotor 25D HP 6V) Performance at 6 V



no-load speed: 130 rpm

$f(\tau) = 130 - 0.95\tau$

$f(\tau) = 0.35 + 0.040\tau$

$I_{stall} \approx 5.8$ A

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

$\tau_{stall} \approx$
140 kg·mm

no-load current: 0.41 A
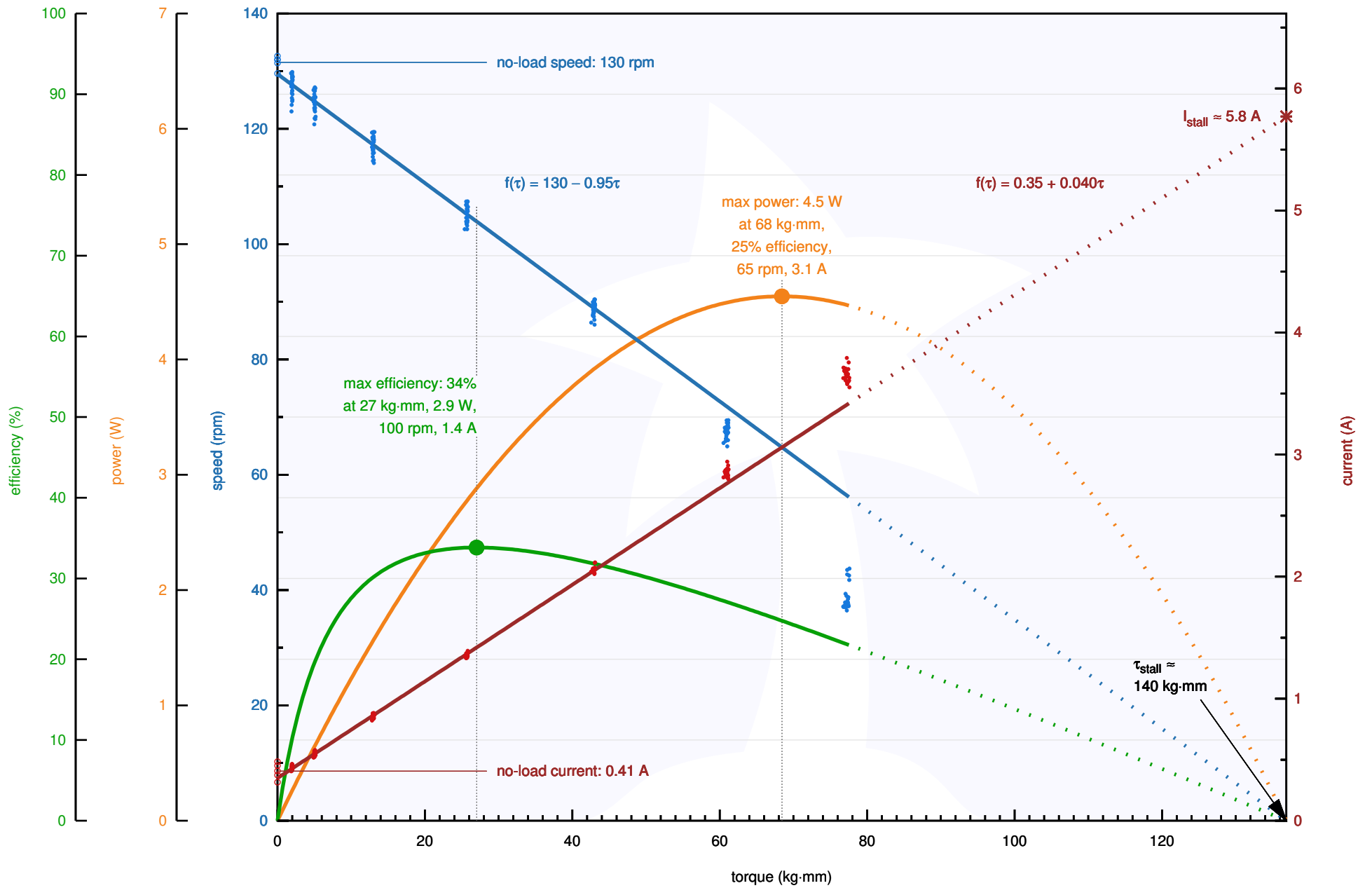
# Pololu Items #1576, #4807 (99:1 Metal Gearmotor 25D HP 6V) Performance at 6 V



no-load speed: 99 rpm

$f(\tau) = 99 - 0.64\tau$

max power: 3.9 W
at 77 kg·mm,
22% efficiency,
49 rpm, 2.9 A

$f(\tau) = 0.34 + 0.033\tau$

$I_{stall} \approx 5.5$ A

max efficiency: 30%
at 31 kg·mm, 2.5 W,
79 rpm, 1.4 A

$\tau_{stall} \approx$
150 kg·mm

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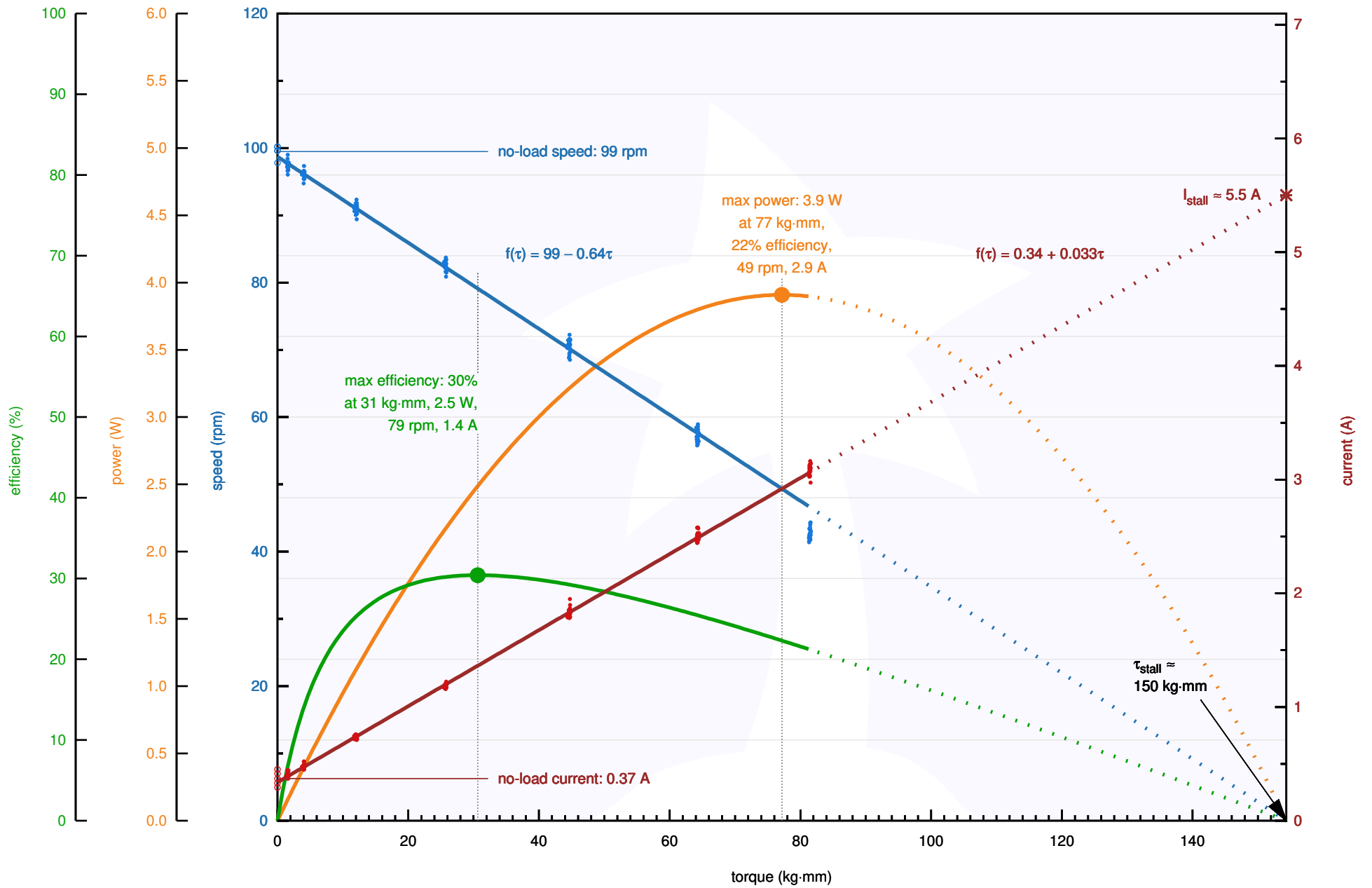
Pololu Items #1577, #4808 (172:1 Metal Gearmotor 25D HP 6V) Performance at 6 V

no-load speed: 57 rpm

$f(\tau) = 57 - 0.22\tau$

$I_{stall} \approx 5.6$ A

$f(\tau) = 0.34 + 0.020\tau$

max power: 3.9 W
at 130 kg·mm,
22% efficiency,
29 rpm, 3.0 A

max efficiency: 30%
at 52 kg·mm, 2.5 W,
46 rpm, 1.4 A

$\tau_{stall} \approx$
270 kg·mm

no-load current: 0.41 A

efficiency (%)

power (W)

speed (rpm)

current (A)

torque (kg·mm)
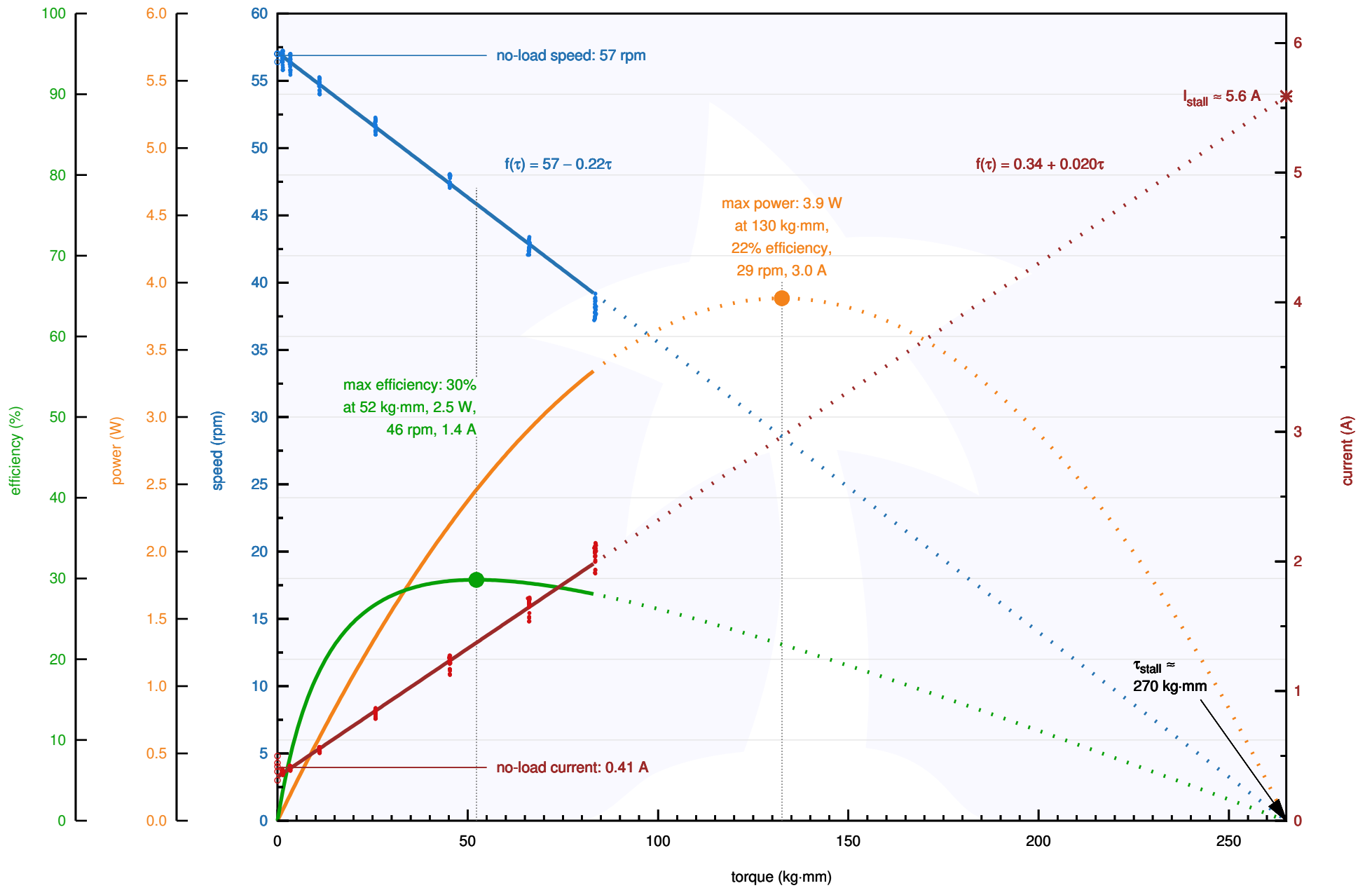
# Pololu Items #3249, #4881 (4.4:1 Metal Gearmotor 25D LP 12V) Performance at 12 V



no-load speed: 1200 rpm

$f(\tau) = 1300 - 240\tau$

$f(\tau) = 0.014 + 0.16\tau$

$I_{stall} \approx 0.88$ A

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 current: 0.045 A

$\tau_{stall} \approx$
5.3 kg·mm

efficiency (%)

power (W)

speed (rpm)

current (A)

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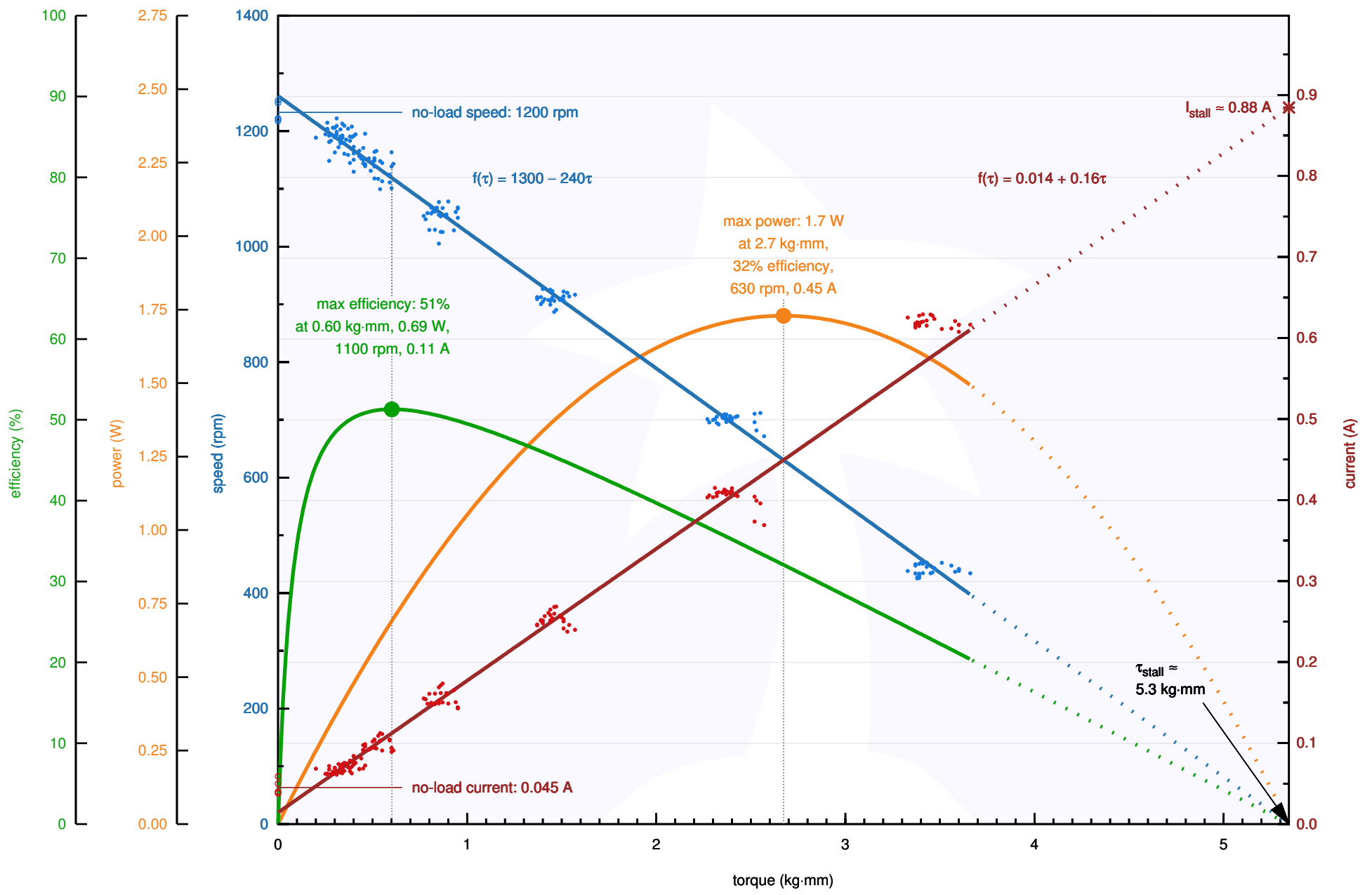
# Pololu Items #3250, #4882 (9.7:1 Metal Gearmotor 25D LP 12V) Performance at 12 V



no-load speed: 580 rpm

$I_{stall} \approx 0.93$ A

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

$f(\tau) = 0.030 + 0.072\tau$

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

$\tau_{stall} \approx$
13 kg·mm

no-load current: 0.042 A

efficiency (%)

power (W)

speed (rpm)

current (A)

torque (kg·mm)
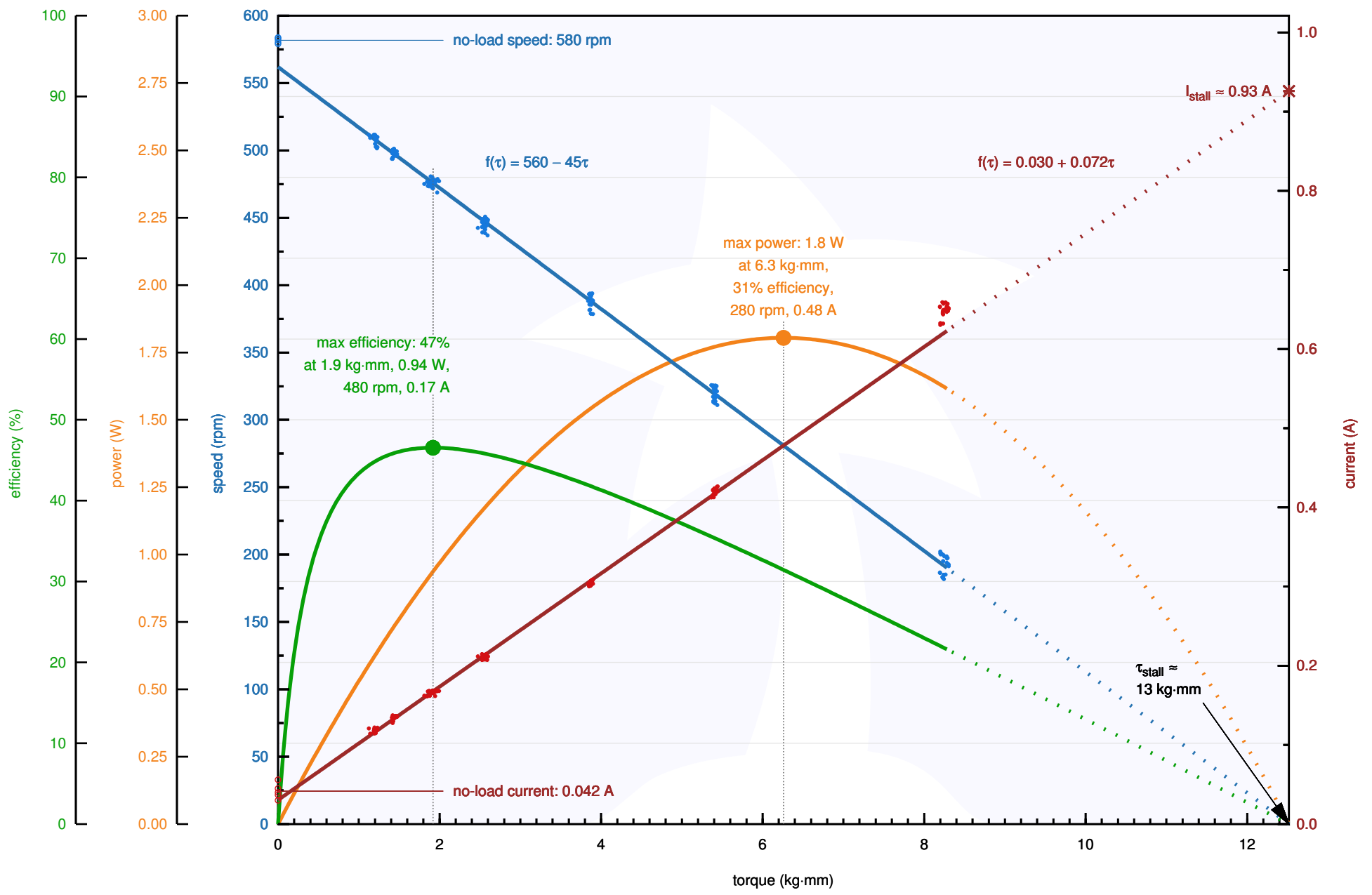
Pololu Items #3251, #4883 (20.4:1 Metal Gearmotor 25D LP 12V) Performance at 12 V

no-load speed: 280 rpm

$I_{stall} \approx 0.94$ A

$f(\tau) = 270 - 11\tau$

$f(\tau) = 0.028 + 0.038\tau$

max power: 1.7 W
at 12 kg·mm,
29% efficiency,
140 rpm, 0.49 A

max efficiency: 43%
at 3.5 kg·mm, 0.84 W,
230 rpm, 0.16 A

no-load current: 0.038 A

$\tau_{stall} \approx$
24 kg·mm

efficiency (%)

power (W)

speed (rpm)

current (A)

torque (kg·mm)
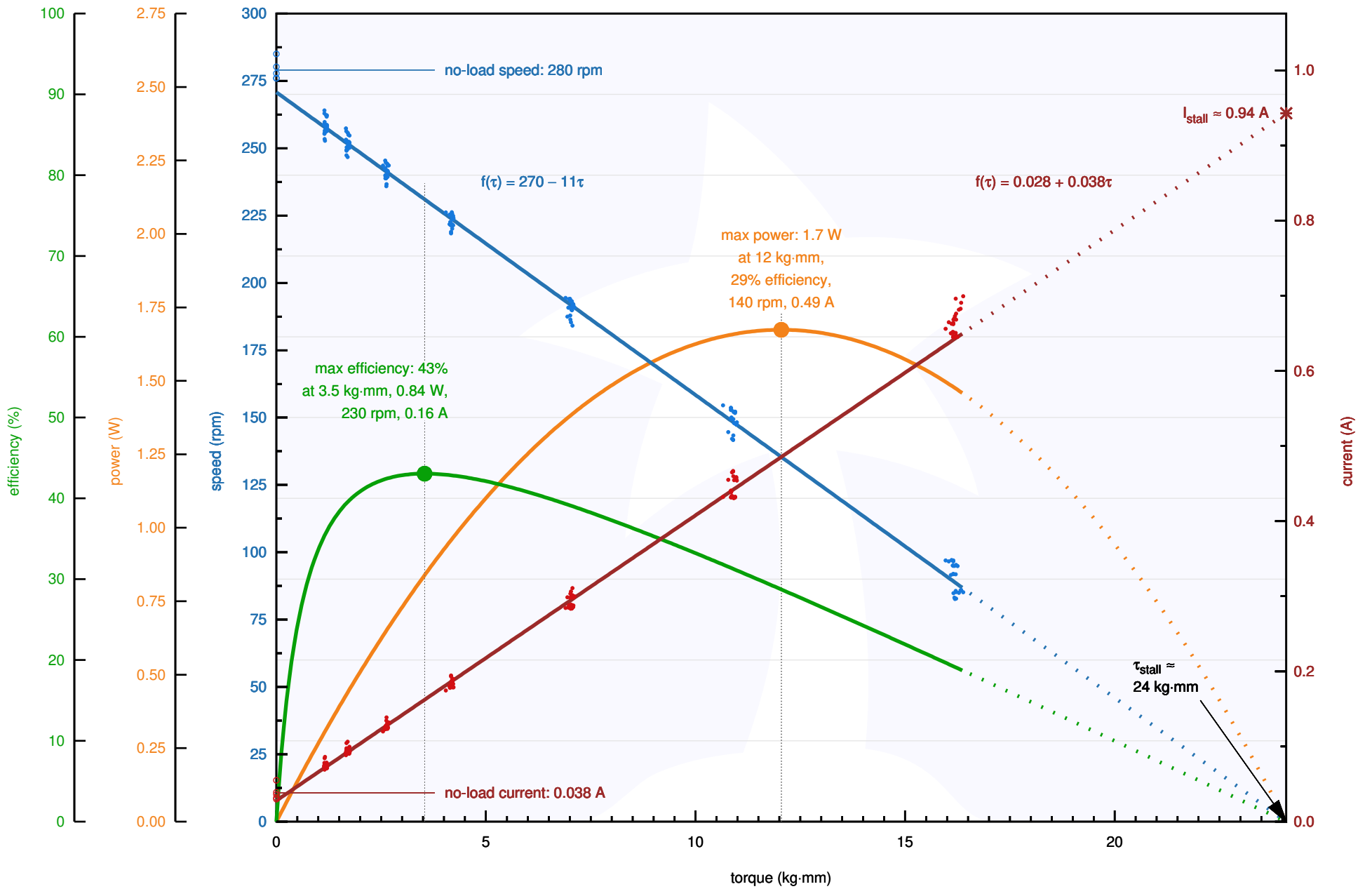
Pololu Items #3252, #4884 (34:1 Metal Gearmotor 25D LP 12V) Performance at 12 V

no-load speed: 170 rpm

$f(\tau) = 160 - 4.4\tau$

$f(\tau) = 0.022 + 0.025\tau$

$I_{stall} \approx 0.93$ A

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

$\tau_{stall} \approx$ 37 kg·mm

no-load current: 0.038 A
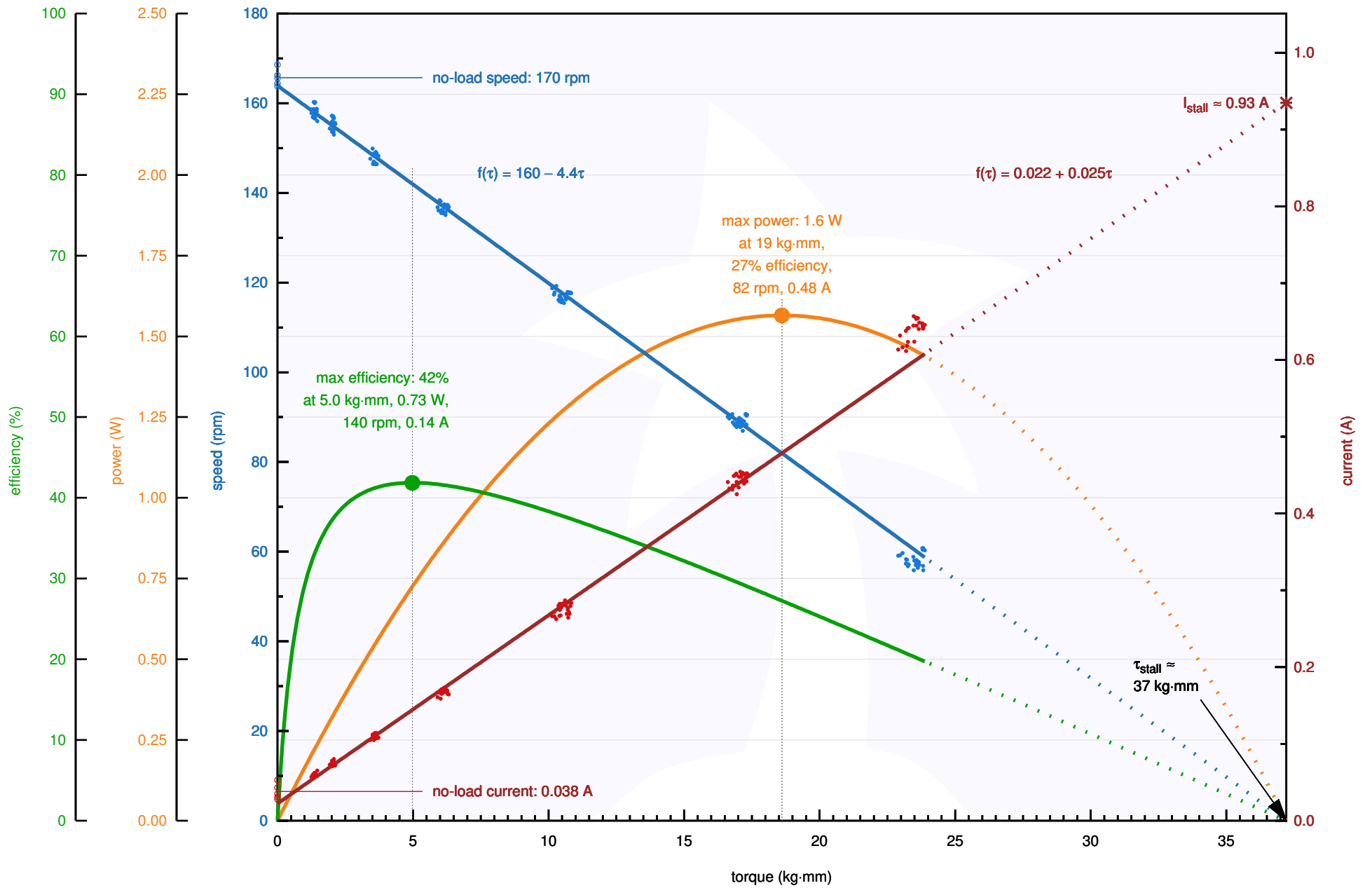
Pololu Items #3253, #4885 (47:1 Metal Gearmotor 25D LP 12V) Performance at 12 V

no-load speed: 120 rpm

max power: 1.4 W
at 24 kg·mm,
25% efficiency,
58 rpm, 0.47 A

$I_{stall} \approx 0.92$ A

$f(\tau) = 120 - 2.4\tau$

$f(\tau) = 0.029 + 0.018\tau$

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

$\tau_{stall} \approx$ 48 kg·mm

no-load current: 0.045 A

efficiency (%)

power (W)

speed (rpm)

current (A)

torque (kg·mm)
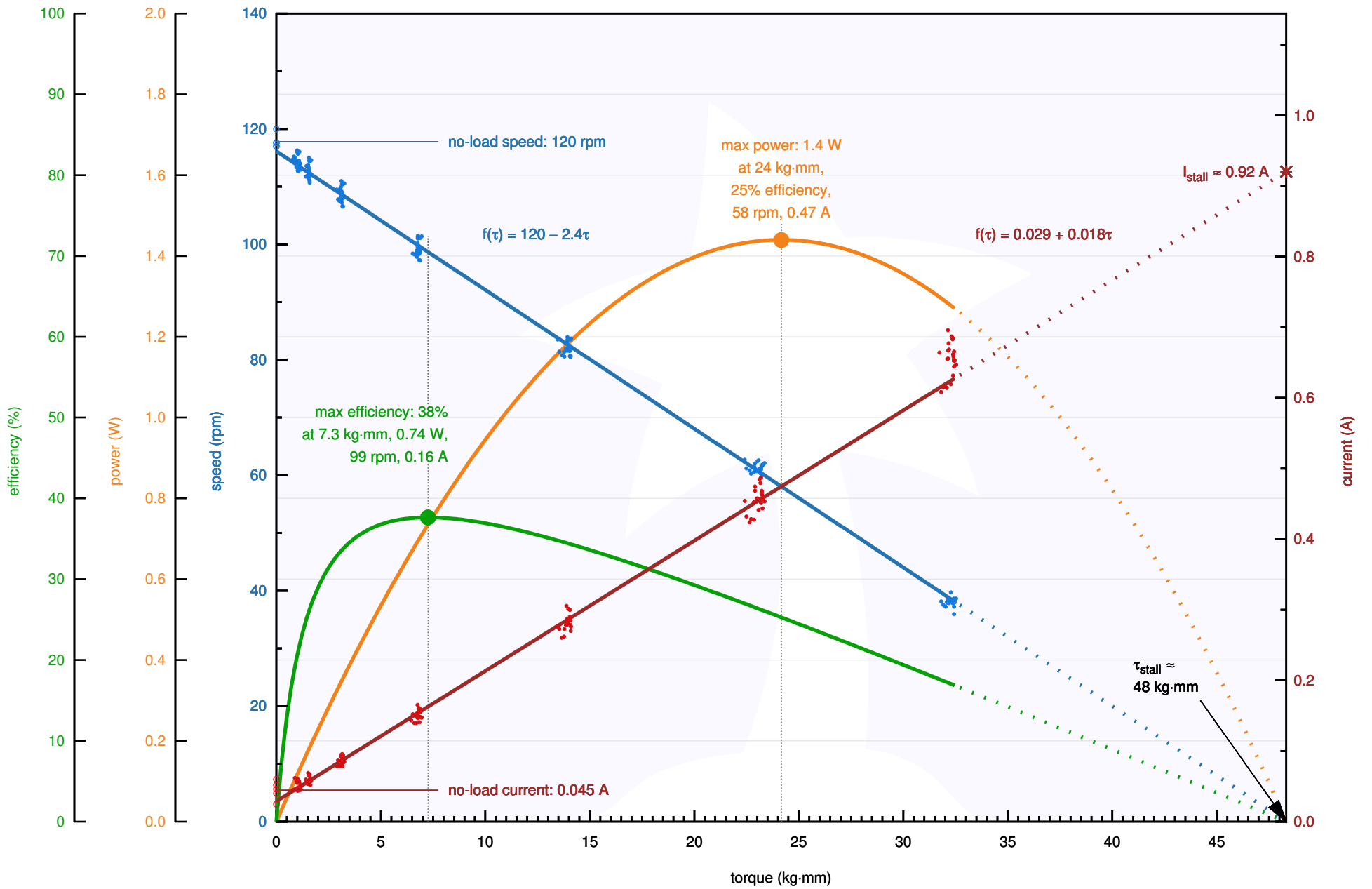
# Pololu Items #3254, #4886 (75:1 Metal Gearmotor 25D LP 12V) Performance at 12 V



no-load speed: 75 rpm

$I_{stall} \approx 0.89$ A

$f(\tau) = 74 - 1.0\tau$

$f(\tau) = 0.033 + 0.012\tau$

max power: 1.4 W
at 36 kg·mm,
24% efficiency,
37 rpm, 0.46 A

max efficiency: 35%
at 12 kg·mm, 0.73 W,
62 rpm, 0.17 A

$\tau_{stall} \approx$
71 kg·mm

no-load current: 0.044 A

efficiency (%)

power (W)

speed (rpm)

current (A)

torque (kg·mm)
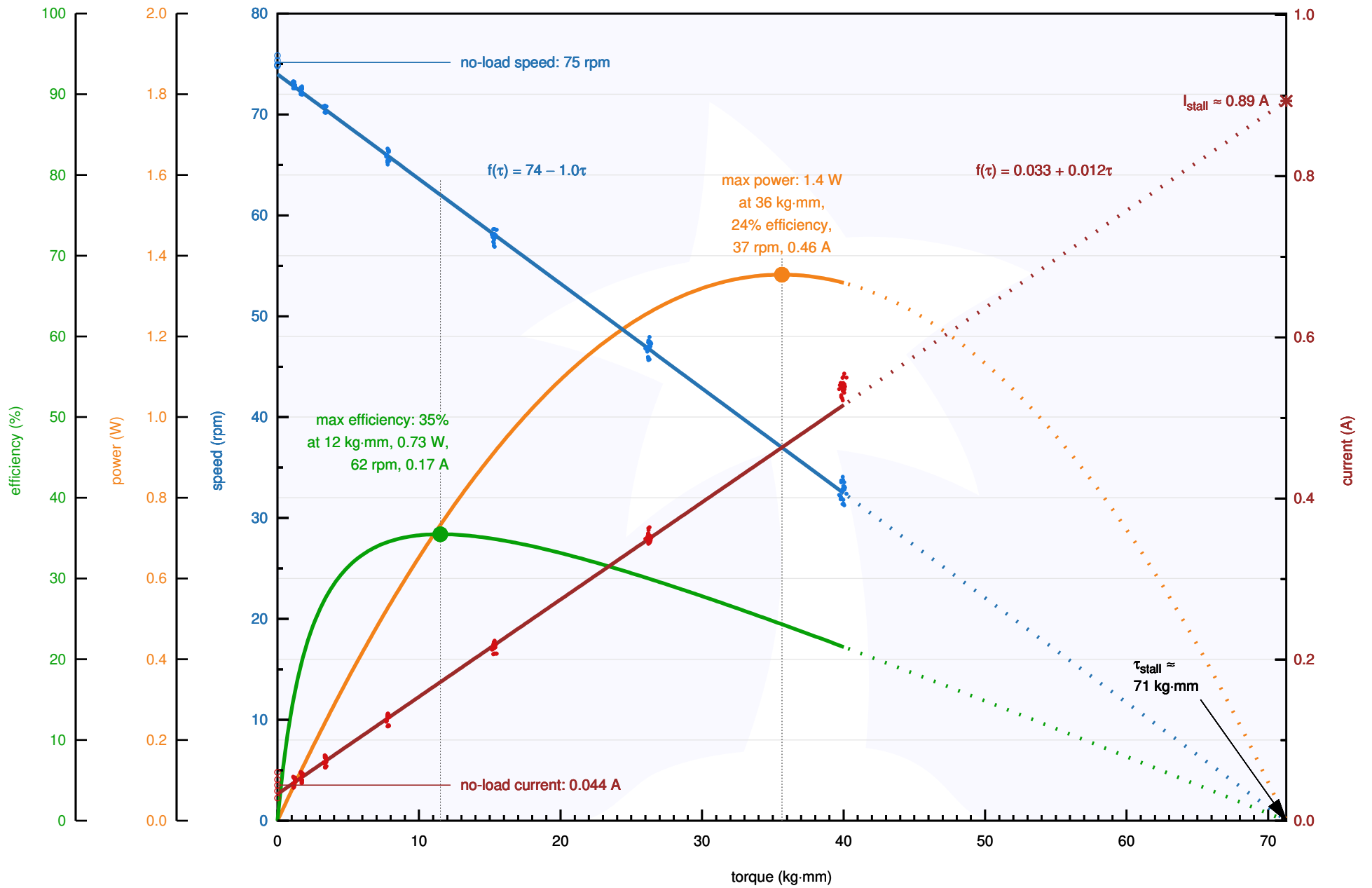
Pololu Items #3255, #4887 (99:1 Metal Gearmotor 25D LP 12V) Performance at 12 V

no-load speed: 57 rpm

$I_{stall} \approx 0.90\ A$

$f(\tau) = 56 - 0.64\tau$

$f(\tau) = 0.032 + 0.010\tau$

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

$\tau_{stall} \approx$
87 kg·mm

no-load current: 0.041 A

efficiency (%)

power (W)

speed (rpm)

current (A)

torque (kg·mm)
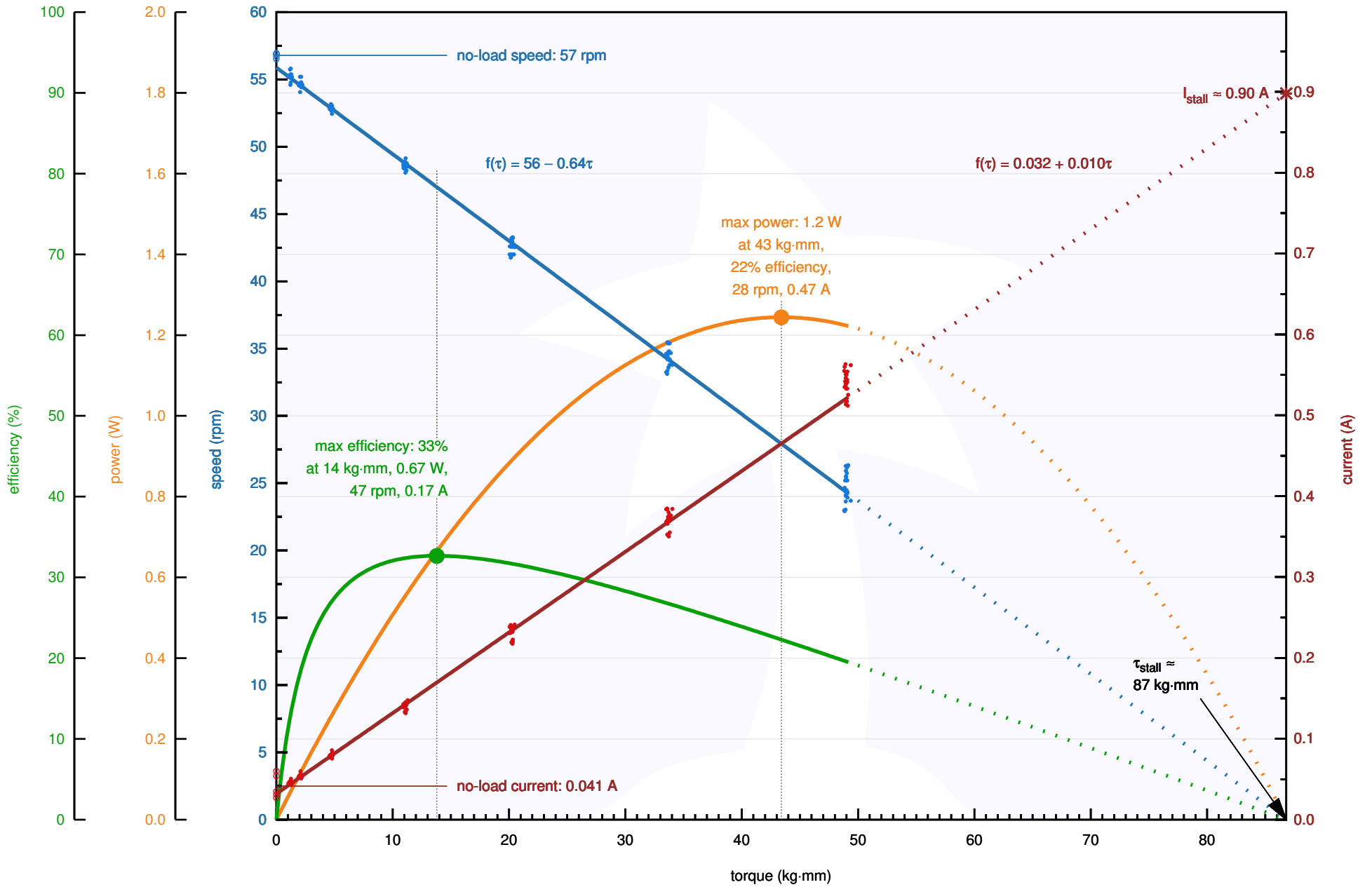
Pololu Items #3256, #4888 (172:1 Metal Gearmotor 25D LP 12V) Performance at 12 V

no-load speed: 33 rpm

$f(\tau) = 33 - 0.26\tau$

$f(\tau) = 0.025 + 0.0064\tau$

$I_{stall} \approx 0.85$ A

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

$\tau_{stall} \approx$
130 kg·mm

no-load current: 0.036 A

efficiency (%)
power (W)
speed (rpm)
current (A)
torque (kg·mm)
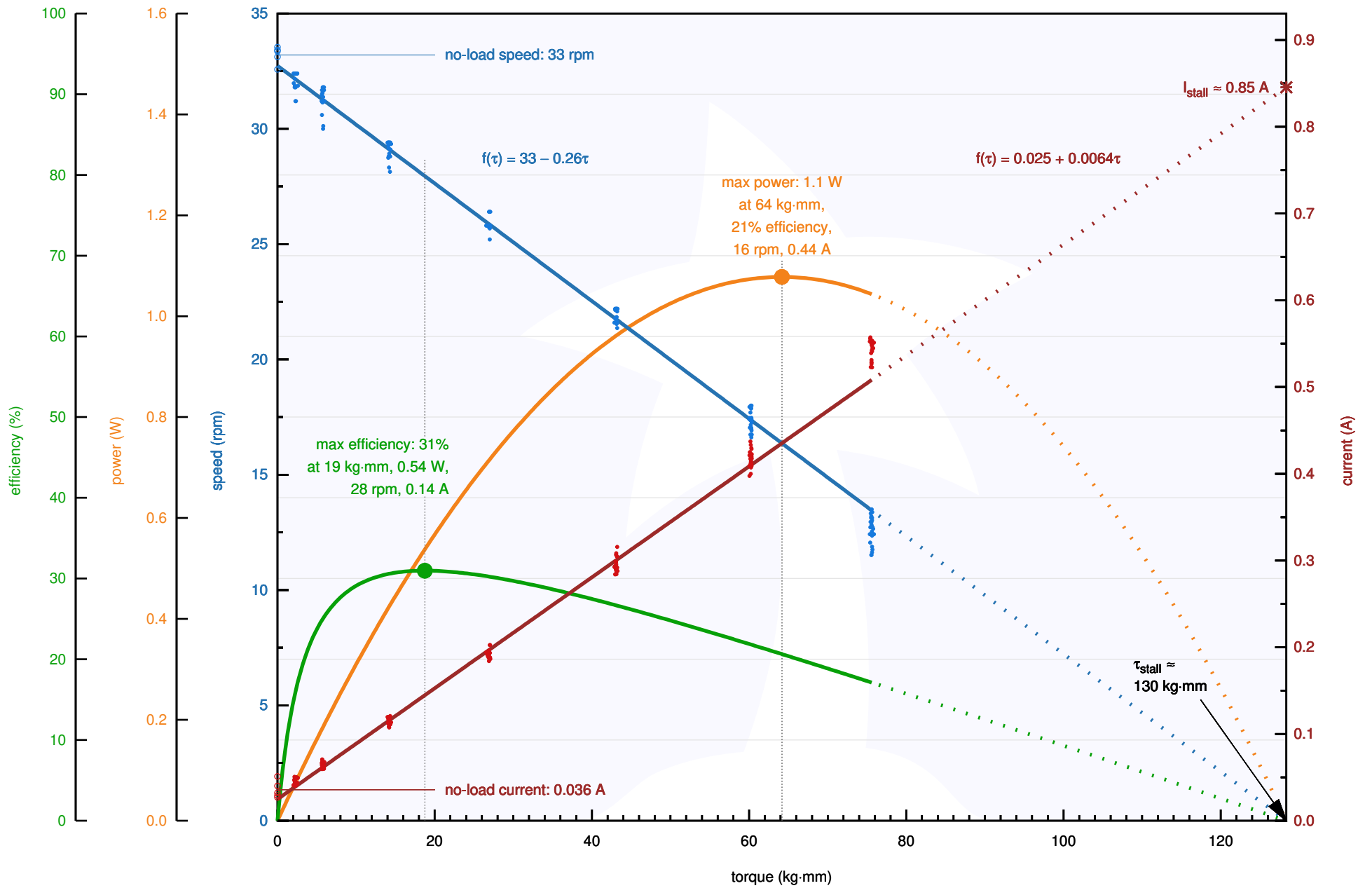
# Pololu Items #3257, #4889 (227:1 Metal Gearmotor 25D LP 12V) Performance at 12 V



no-load speed: 25 rpm

$f(\tau) = 25 - 0.15\tau$

$f(\tau) = 0.025 + 0.0049\tau$

$I_{stall} \approx 0.83$ A

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

$\tau_{stall} \approx$
160 kg·mm

no-load current: 0.041 A

efficiency (%)

power (W)

speed (rpm)

current (A)

torque (kg·mm)
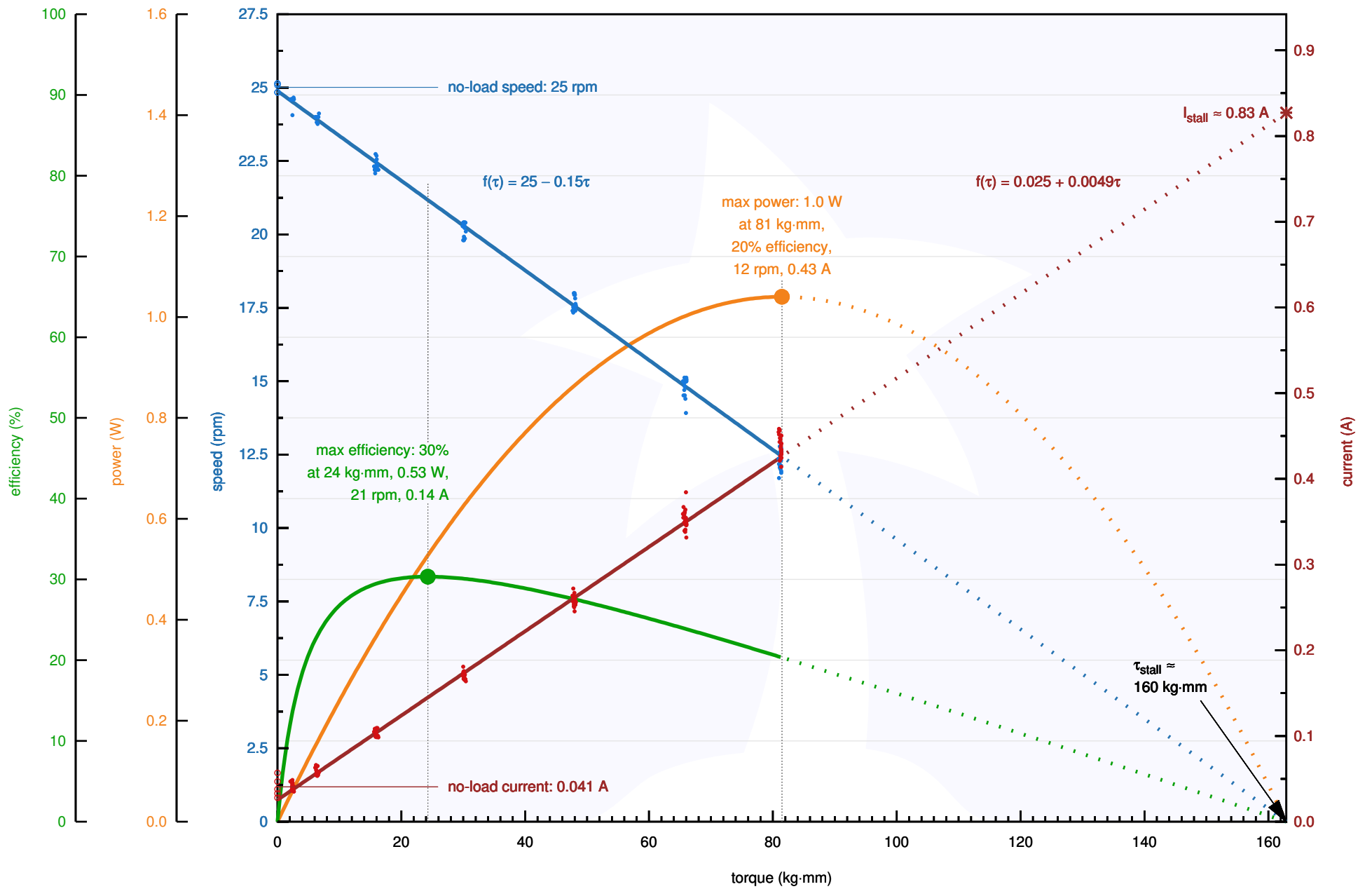
# Pololu Items #3258, #4890 (378:1 Metal Gearmotor 25D LP 12V) Performance at 12 V



no-load speed: 15 rpm

$f(\tau) = 15 - 0.066\tau$

$I_{stall} \approx 0.79$ A

$f(\tau) = 0.028 + 0.0034\tau$

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

$\tau_{stall} \approx$
230 kg·mm

no-load current: 0.044 A

efficiency (%)

power (W)

speed (rpm)

current (A)

torque (kg·mm)
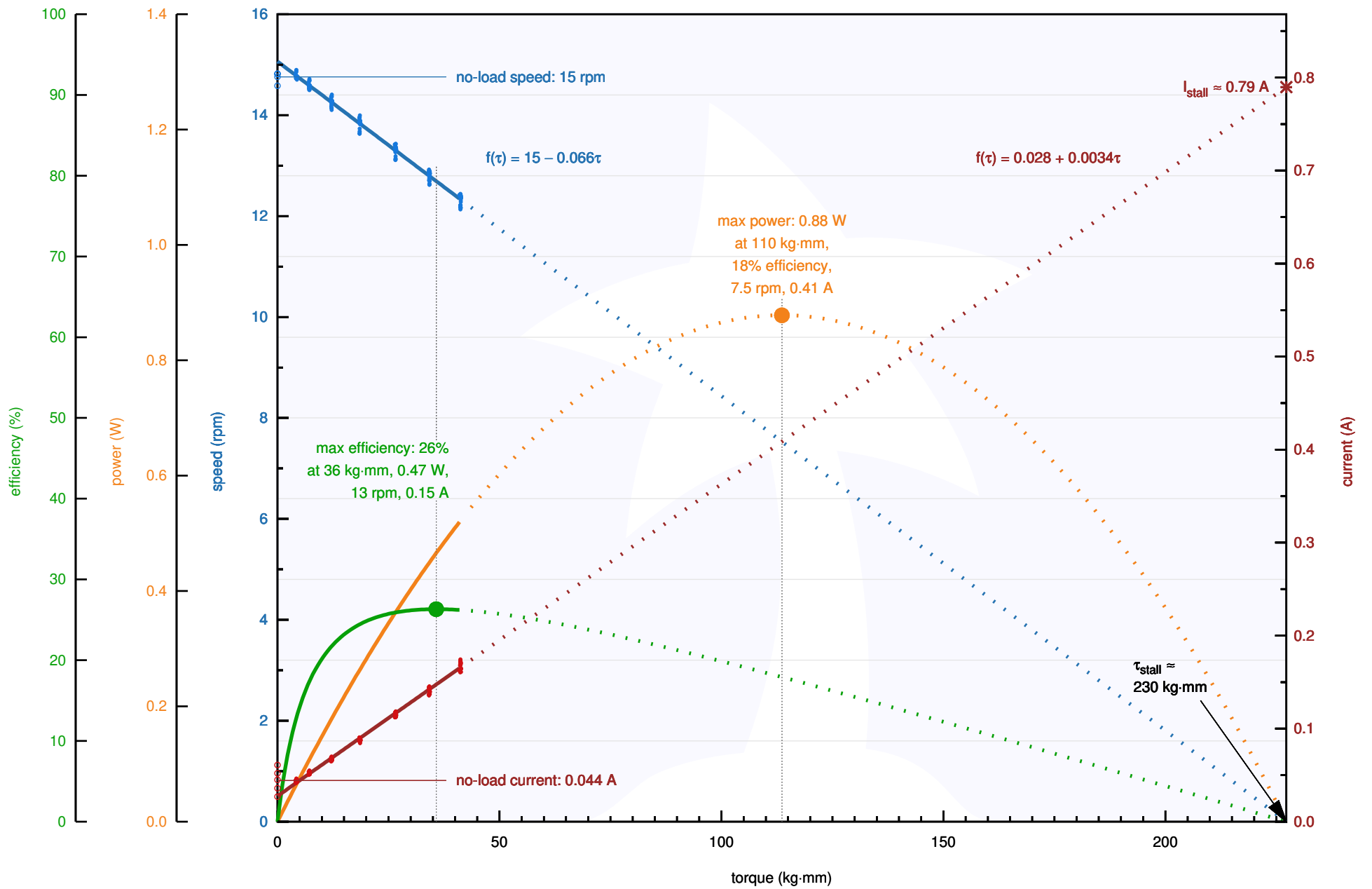
# Pololu Items #3225, #4861 (4.4:1 Metal Gearmotor 25D MP 12V) Performance at 12 V



no-load speed: 1800 rpm

$f(\tau) = 1800 - 250\tau$

$f(\tau) = 0.039 + 0.24\tau$

$I_{stall} \approx 1.7$ A

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

no-load current: 0.075 A

$\tau_{stall} \approx$ 7.1 kg·mm

efficiency (%)

power (W)

speed (rpm)

current (A)

torque (kg·mm)
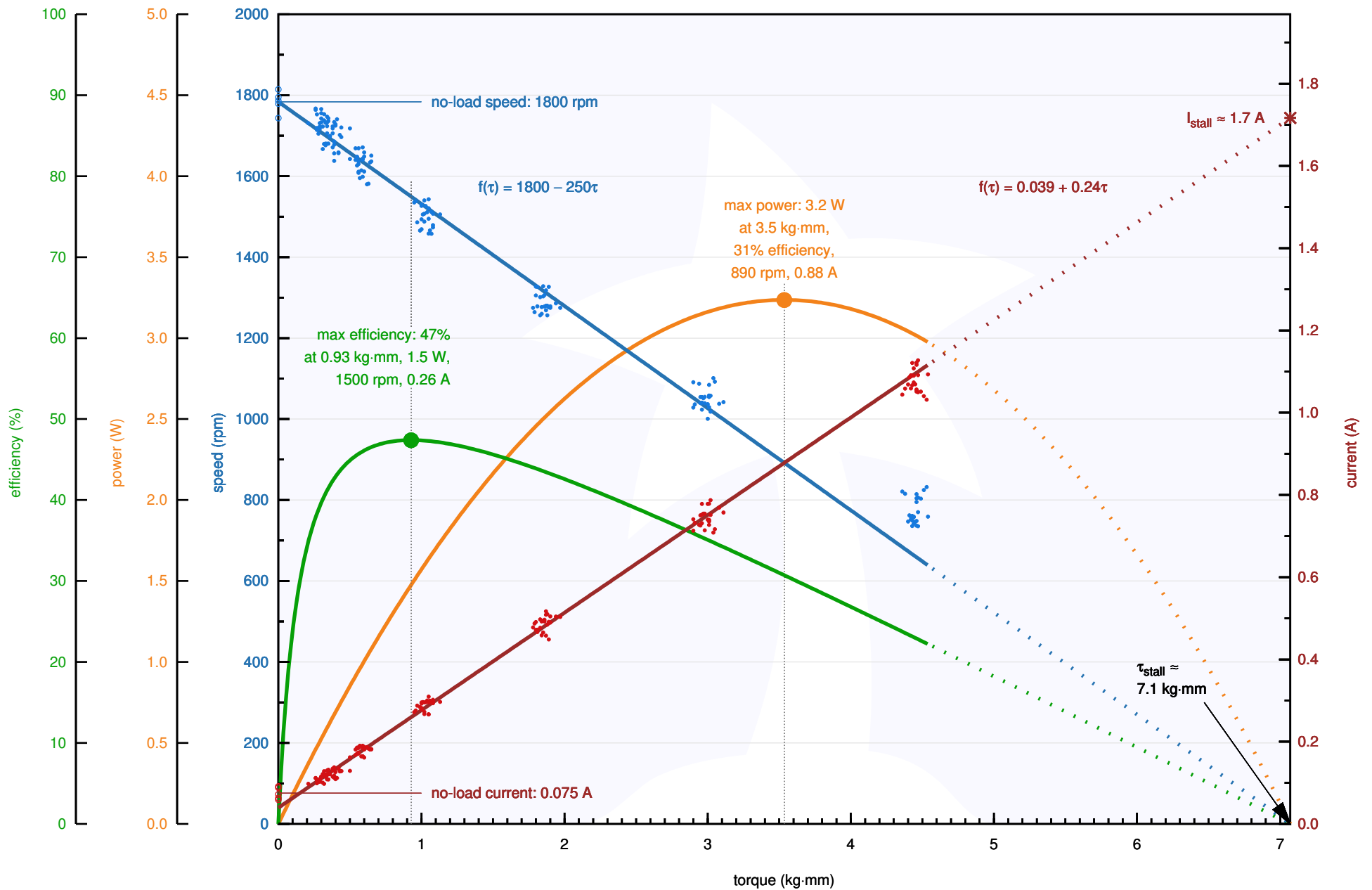
Pololu Items #3226, #4862 (9.7:1 Metal Gearmotor 25D MP 12V) Performance at 12 V

no-load speed: 800 rpm

$f(\tau) = 780 - 47\tau$

$I_{stall} \approx 1.8$ A

$f(\tau) = 0.056 + 0.11\tau$

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

$\tau_{stall} \approx$
17 kg·mm

no-load current: 0.077 A

efficiency (%)

power (W)

speed (rpm)

current (A)

torque (kg·mm)
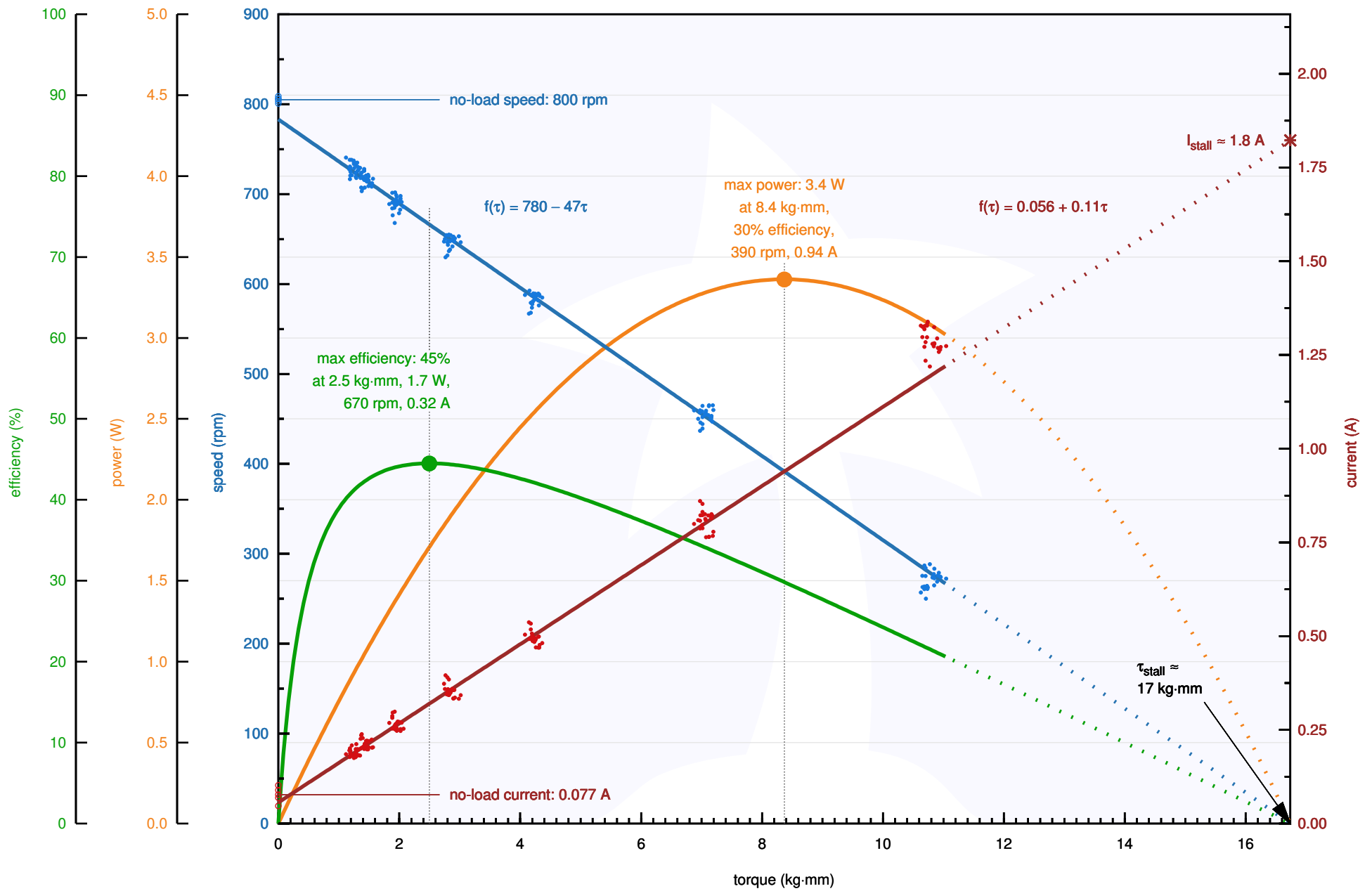
# Pololu Items #3227, #4863 (20.4:1 Metal Gearmotor 25D MP 12V) Performance at 12 V



no-load speed: 380 rpm

$f(\tau) = 380 - 12\tau$

$f(\tau) = 0.045 + 0.055\tau$

$I_{stall} \approx 1.8$ A

max power: 3.1 W
at 16 kg·mm,
28% efficiency,
190 rpm, 0.91 A

max efficiency: 43%
at 4.3 kg·mm, 1.5 W,
330 rpm, 0.28 A

$\tau_{stall} \approx$
32 kg·mm

no-load current: 0.085 A

efficiency (%)

power (W)

speed (rpm)

current (A)

torque (kg·mm)
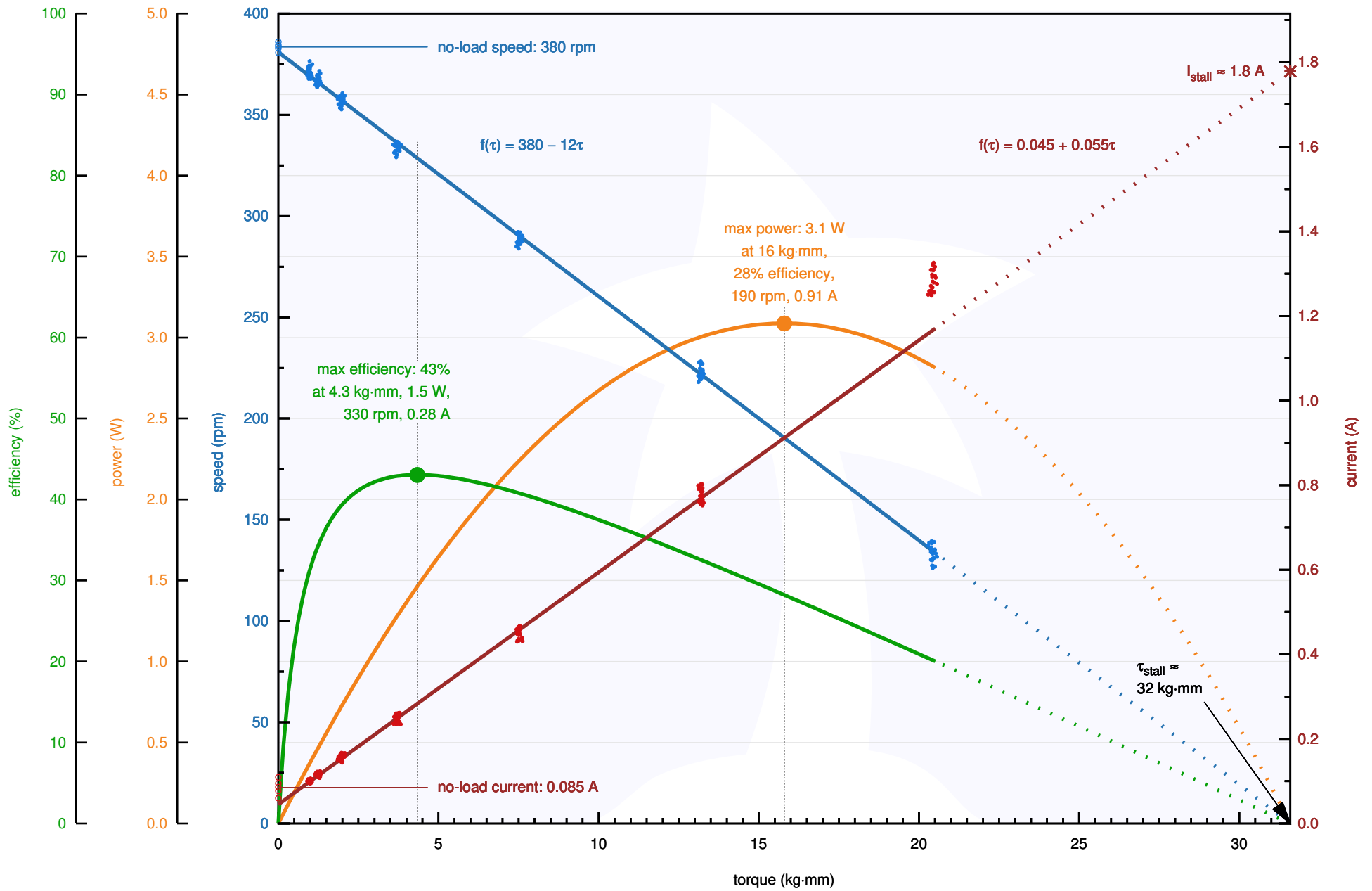
Pololu Items #3228, #4864 (34:1 Metal Gearmotor 25D MP 12V) Performance at 12 V

no-load speed: 230 rpm

$f(\tau) = 230 - 4.9\tau$

$f(\tau) = 0.031 + 0.038\tau$

$I_{stall} \approx 1.8$ A

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

$\tau_{stall} \approx$
47 kg·mm

no-load current: 0.077 A

efficiency (%)
power (W)
speed (rpm)
current (A)
torque (kg·mm)
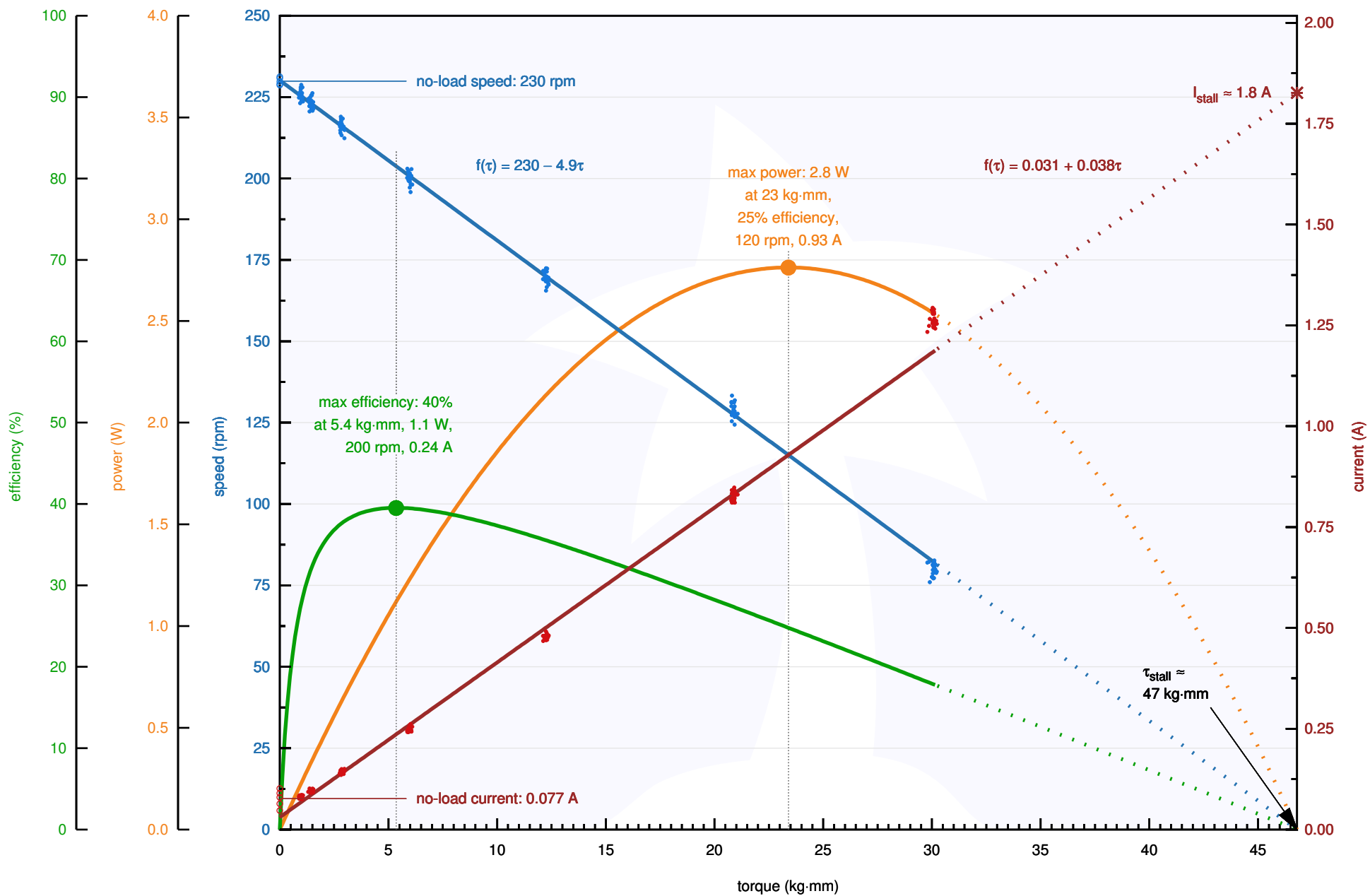
# Pololu Items #3229, #4865 (47:1 Metal Gearmotor 25D MP 12V) Performance at 12 V



no-load speed: 170 rpm

$f(\tau) = 170 - 2.6\tau$

max power: 2.8 W
at 32 kg·mm,
25% efficiency,
83 rpm, 0.92 A

$f(\tau) = 0.042 + 0.027\tau$

$I_{stall} \approx 1.8$ A

max efficiency: 38%
at 8.6 kg·mm, 1.3 W,
140 rpm, 0.28 A

no-load current: 0.076 A

$\tau_{stall} \approx$
64 kg·mm

efficiency (%)

power (W)

speed (rpm)

current (A)

torque (kg·mm)
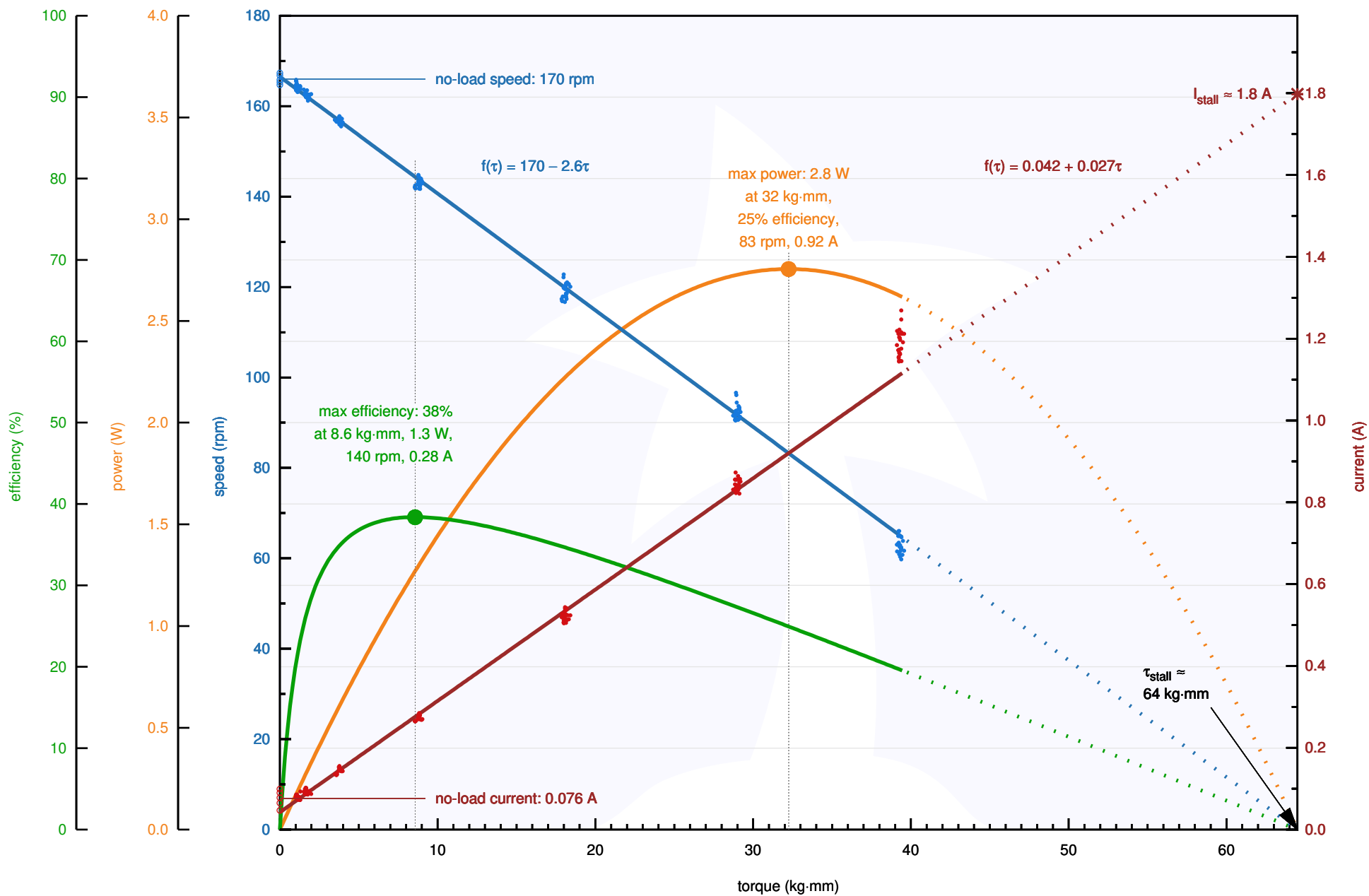
# Pololu Items #3230, #4866 (75:1 Metal Gearmotor 25D MP 12V) Performance at 12 V



no-load speed: 100 rpm

$f(\tau) = 100 - 1.2\tau$

max power: 2.3 W
at 43 kg·mm,
21% efficiency,
52 rpm, 0.89 A

$f(\tau) = 0.044 + 0.020\tau$

$I_{stall} \approx 1.7$ A

max efficiency: 33%
at 12 kg·mm, 1.1 W,
91 rpm, 0.28 A

$\tau_{stall} \approx$
85 kg·mm

no-load current: 0.074 A

efficiency (%)

power (W)

speed (rpm)

current (A)

torque (kg·mm)
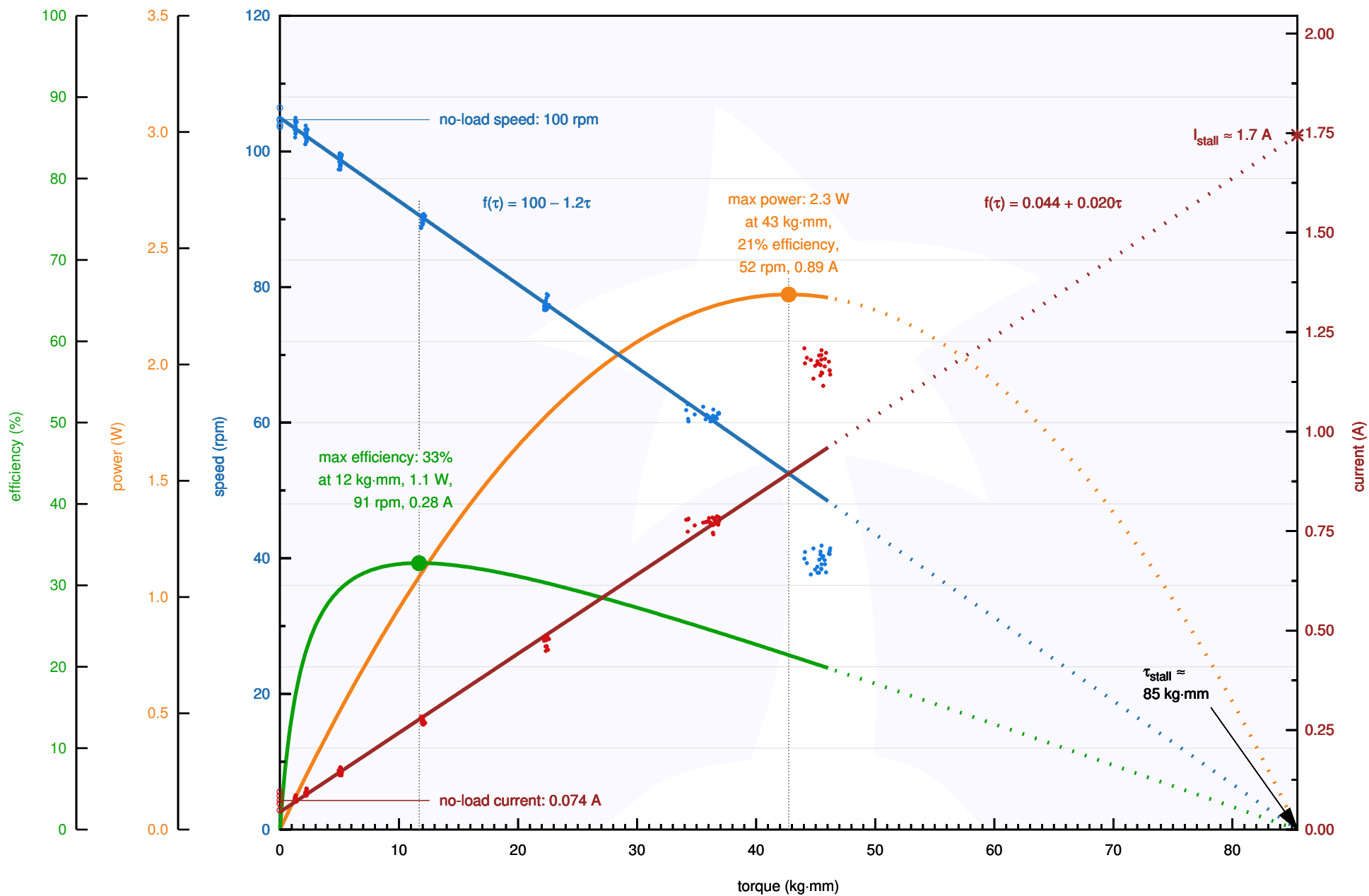
# Pololu Items #3231, #4867 (99:1 Metal Gearmotor 25D MP 12V) Performance at 12 V



no-load speed: 79 rpm

$f(\tau) = 80 - 0.70\tau$

$f(\tau) = 0.046 + 0.015\tau$

$I_{stall} \approx 1.7$ A

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

$\tau_{stall} \approx$
110 kg·mm

no-load current: 0.065 A

efficiency (%)

power (W)

speed (rpm)

current (A)

torque (kg·mm)
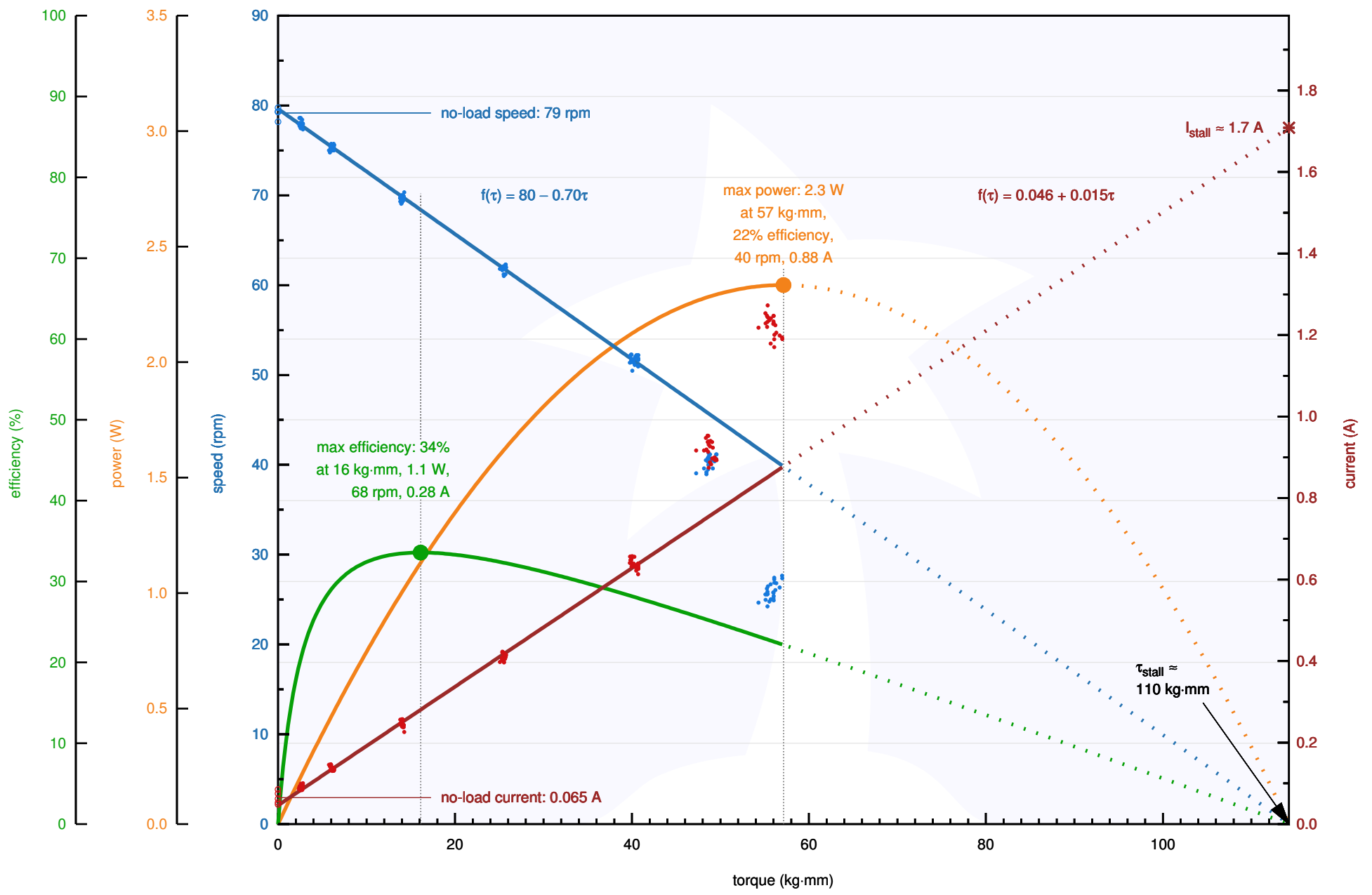
# Pololu Items #3232, #4868 (172:1 Metal Gearmotor 25D MP 12V) Performance at 12 V



no-load speed: 46 rpm

$f(\tau) = 46 - 0.26\tau$

max power: 2.1 W
at 90 kg·mm,
21% efficiency,
23 rpm, 0.84 A

$f(\tau) = 0.052 + 0.0088\tau$

$I_{stall} \approx 1.6$ A

max efficiency: 31%
at 27 kg·mm, 1.1 W,
39 rpm, 0.29 A

$\tau_{stall} \approx$
180 kg·mm

no-load current: 0.079 A

efficiency (%)

power (W)

speed (rpm)

current (A)

torque (kg·mm)
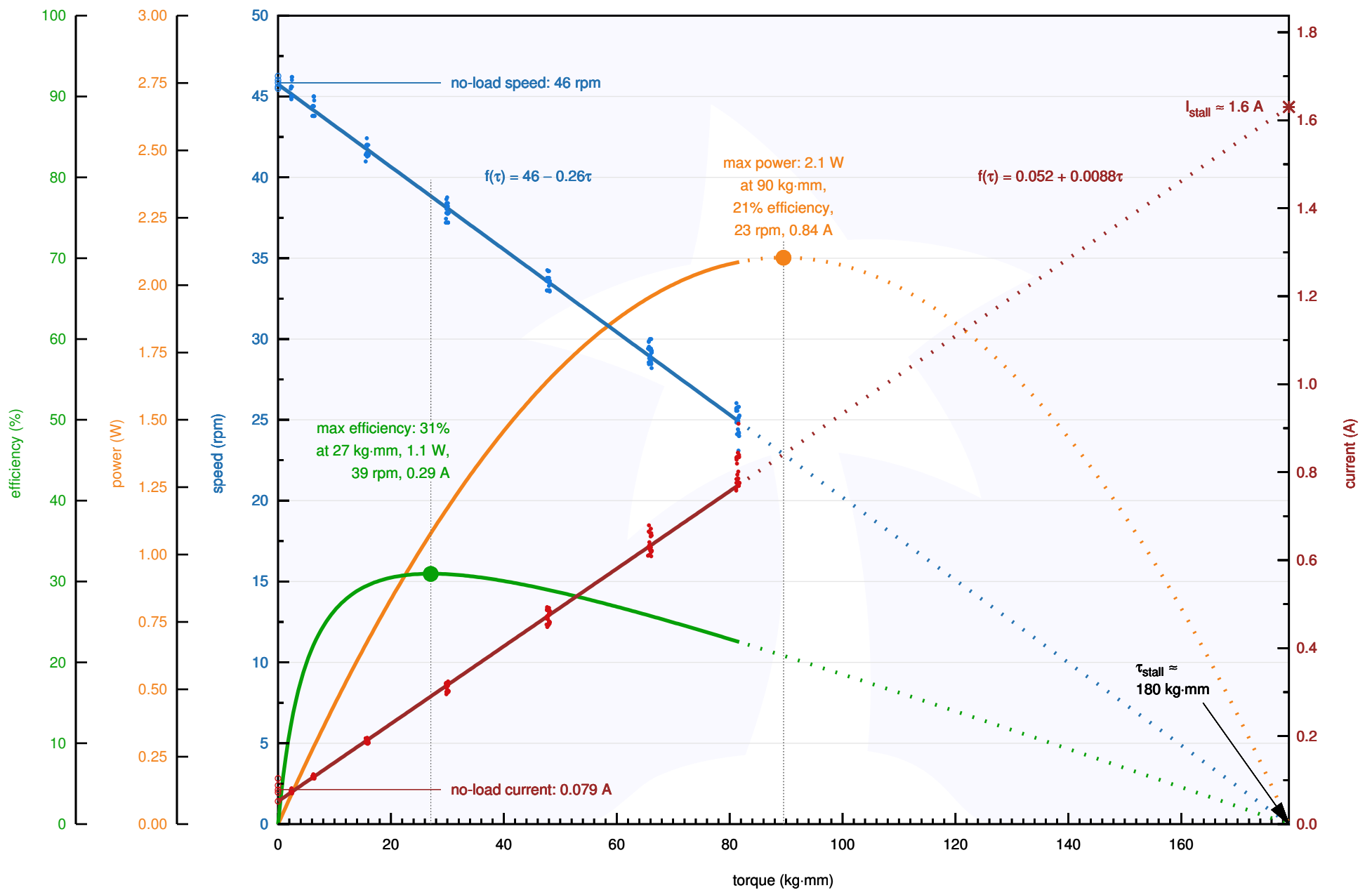
# Pololu Items #3233, #4869 (227:1 Metal Gearmotor 25D MP 12V) Performance at 12 V



no-load speed: 35 rpm

$f(\tau) = 35 - 0.15\tau$

max power: 2.1 W
at 120 kg·mm,
21% efficiency,
17 rpm, 0.83 A

$I_{stall} \approx 1.6$ A

$f(\tau) = 0.050 + 0.0065\tau$

max efficiency: 32%
at 36 kg·mm, 1.1 W,
30 rpm, 0.28 A

$\tau_{stall} \approx$
240 kg·mm

no-load current: 0.081 A

efficiency (%)

power (W)

speed (rpm)

current (A)

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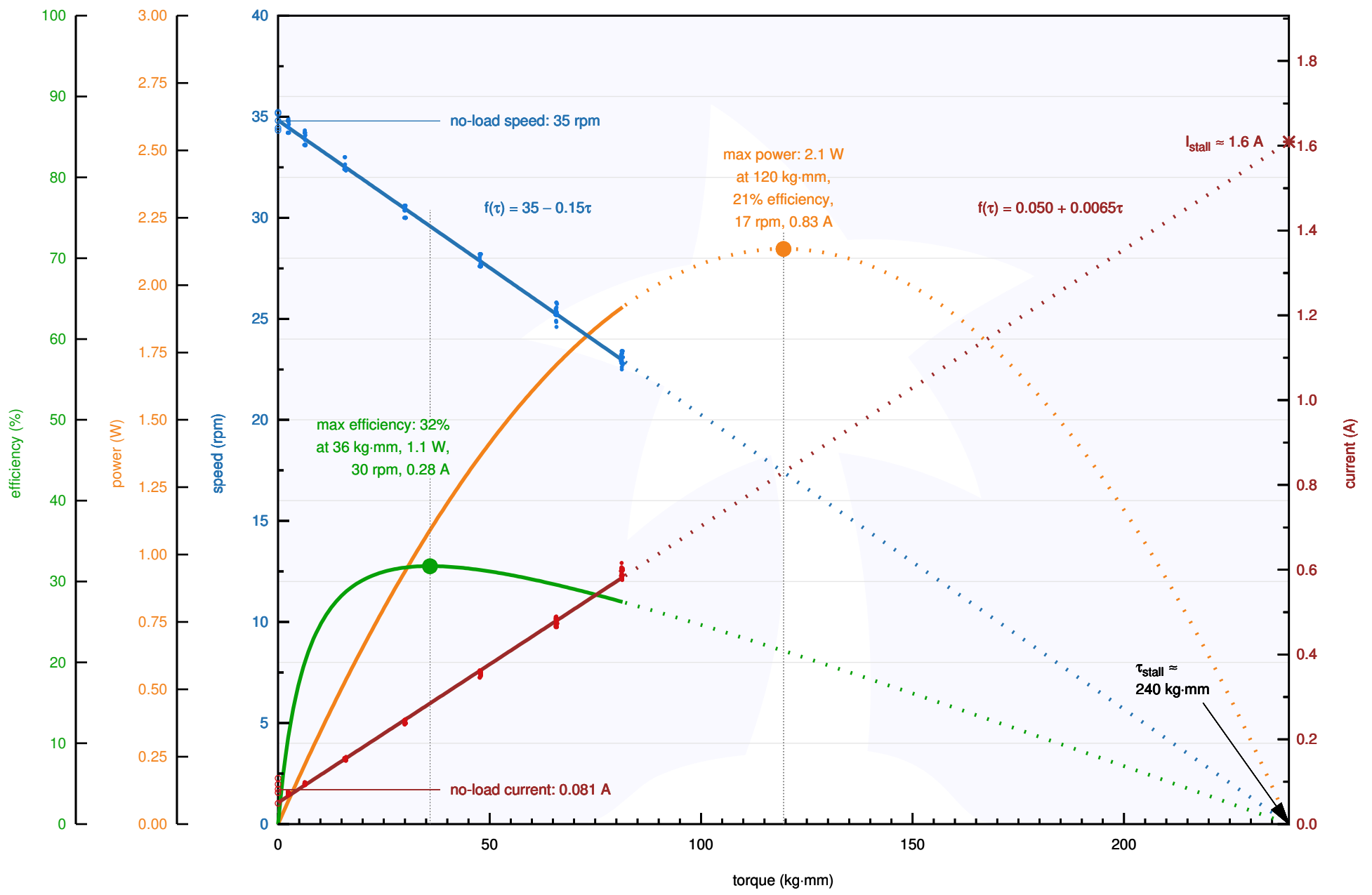
# Pololu Items #3201, #4841 (4.4:1 Metal Gearmotor 25D HP 12V) Performance at 12 V



no-load speed: 2200 rpm

$f(\tau) = 2100 - 120\tau$

max power: 9.4 W
at 8.7 kg·mm,
33% efficiency,
1000 rpm, 2.4 A

$f(\tau) = 0.31 + 0.24\tau$

$I_{stall} \approx 4.4$ A

max efficiency: 44%
at 3.6 kg·mm, 6.2 W,
1700 rpm, 1.2 A

$\tau_{stall} \approx$
17 kg·mm

no-load current: 0.23 A

efficiency (%) — power (W) — speed (rpm) — current (A) — torque (kg·mm)
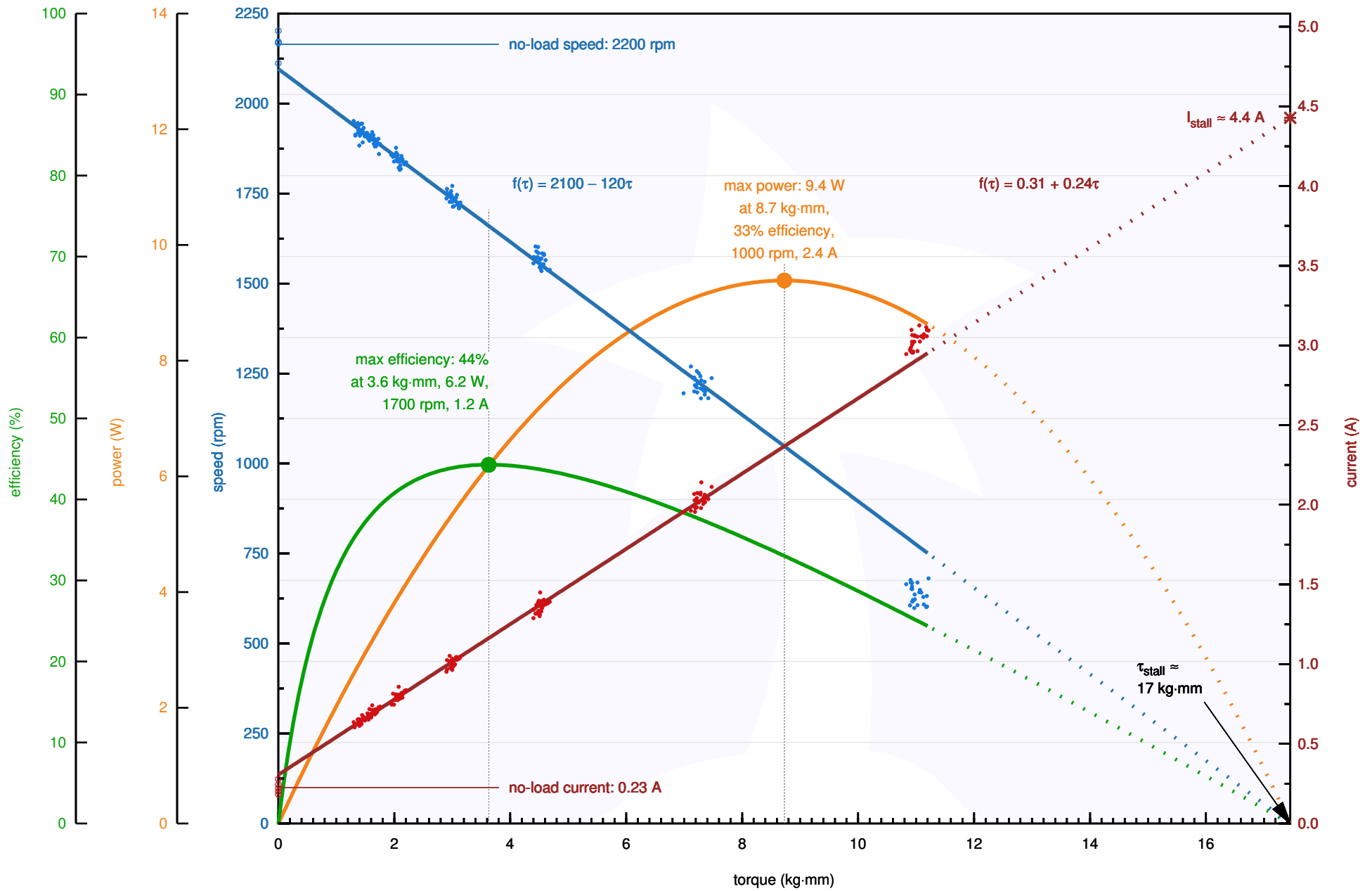
# Pololu Items #3202, #4842 (9.7:1 Metal Gearmotor 25D HP 12V) Performance at 12 V



no-load speed: 1000 rpm

$f(\tau) = 1000 - 27\tau$

max power: 10 W
at 19 kg·mm,
35% efficiency,
520 rpm, 2.5 A

$f(\tau) = 0.15 + 0.12\tau$

$I_{stall} \approx 4.8$ A

max efficiency: 52%
at 5.8 kg·mm, 5.3 W,
890 rpm, 0.84 A

$\tau_{stall} \approx$
39 kg·mm

no-load current: 0.20 A

efficiency (%)

power (W)

speed (rpm)

current (A)

torque (kg·mm)
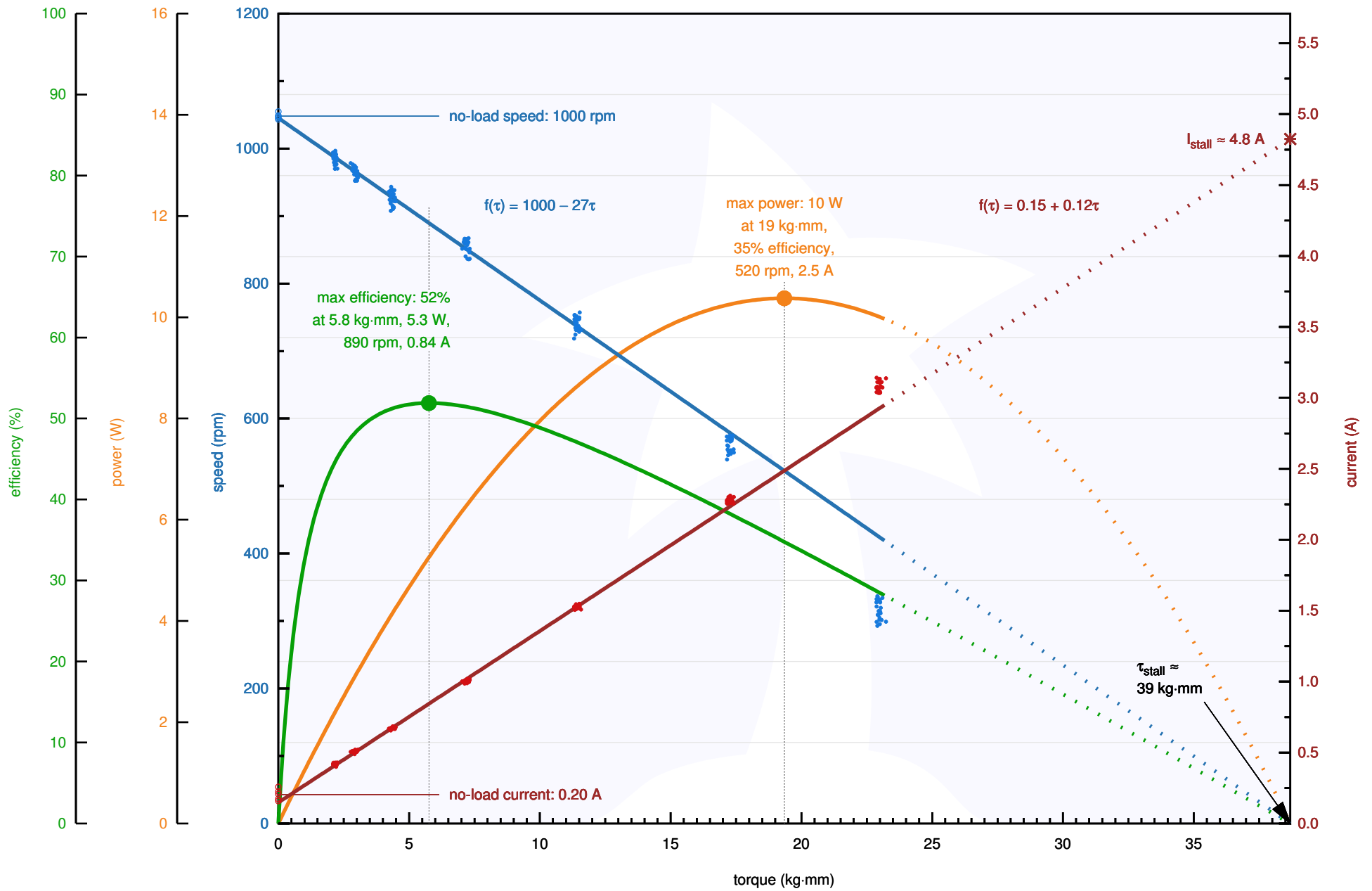
# Pololu Items #3203, #4843 (20.4:1 Metal Gearmotor 25D HP 12V) Performance at 12 V



no-load speed: 500 rpm

$f(\tau) = 500 - 6.7\tau$

max power: 9.4 W
at 37 kg·mm,
31% efficiency,
250 rpm, 2.6 A

$f(\tau) = 0.15 + 0.065\tau$

$I_{stall} \approx 5.0$ A

max efficiency: 46%
at 11 kg·mm, 4.8 W,
420 rpm, 0.88 A

$\tau_{stall} \approx$
74 kg·mm

no-load current: 0.22 A

torque (kg·mm)

efficiency (%)

power (W)

speed (rpm)

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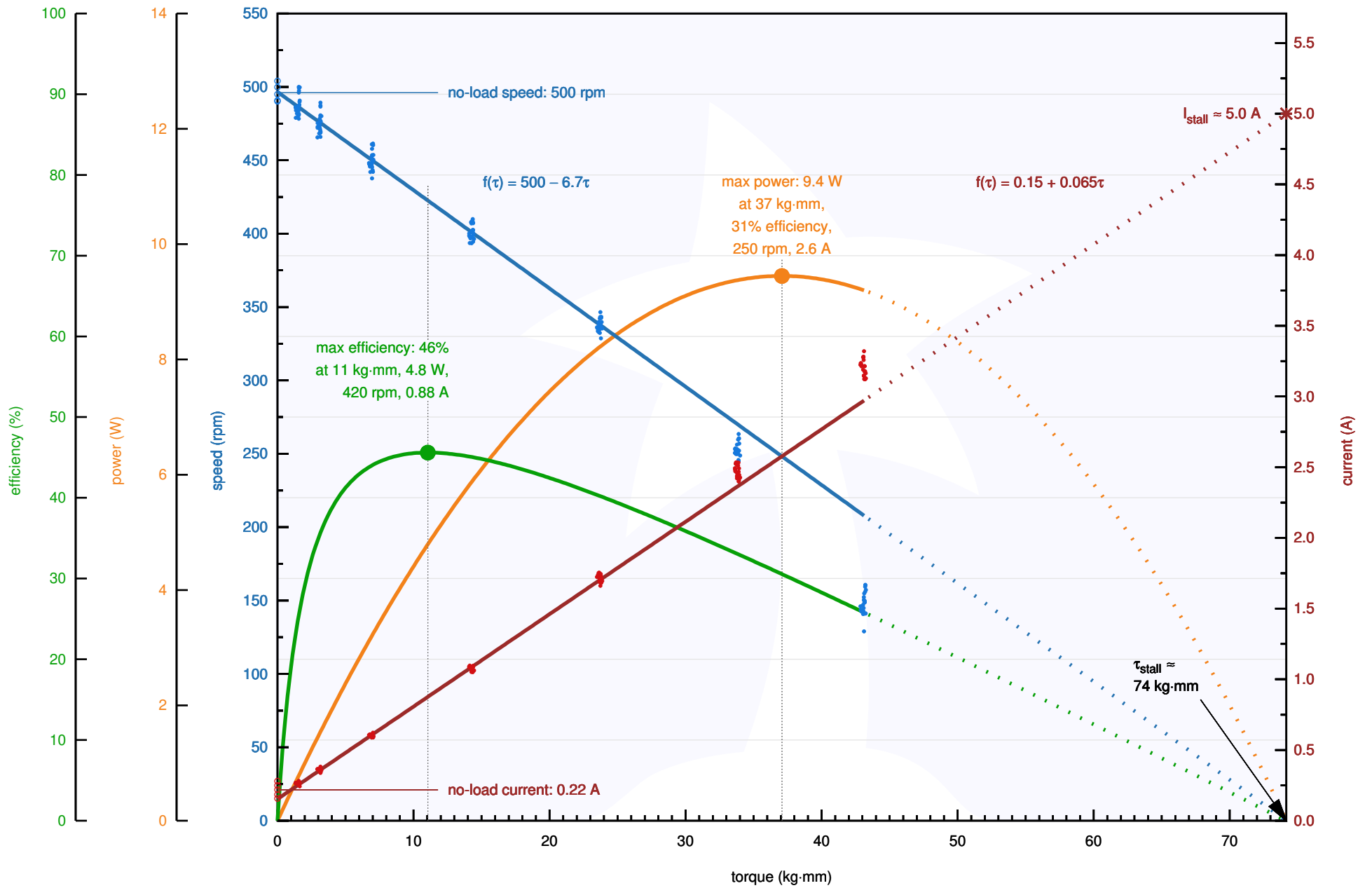
Pololu Items #3204, #4844 (34:1 Metal Gearmotor 25D HP 12V) Performance at 12 V

no-load speed: 300 rpm

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

$f(\tau) = 0.14 + 0.042\tau$

$I_{stall} \approx 4.9\ A$

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

$\tau_{stall} \approx$
110 kg·mm

no-load current: 0.22 A

efficiency (%)
power (W)
speed (rpm)
current (A)

torque (kg·mm)
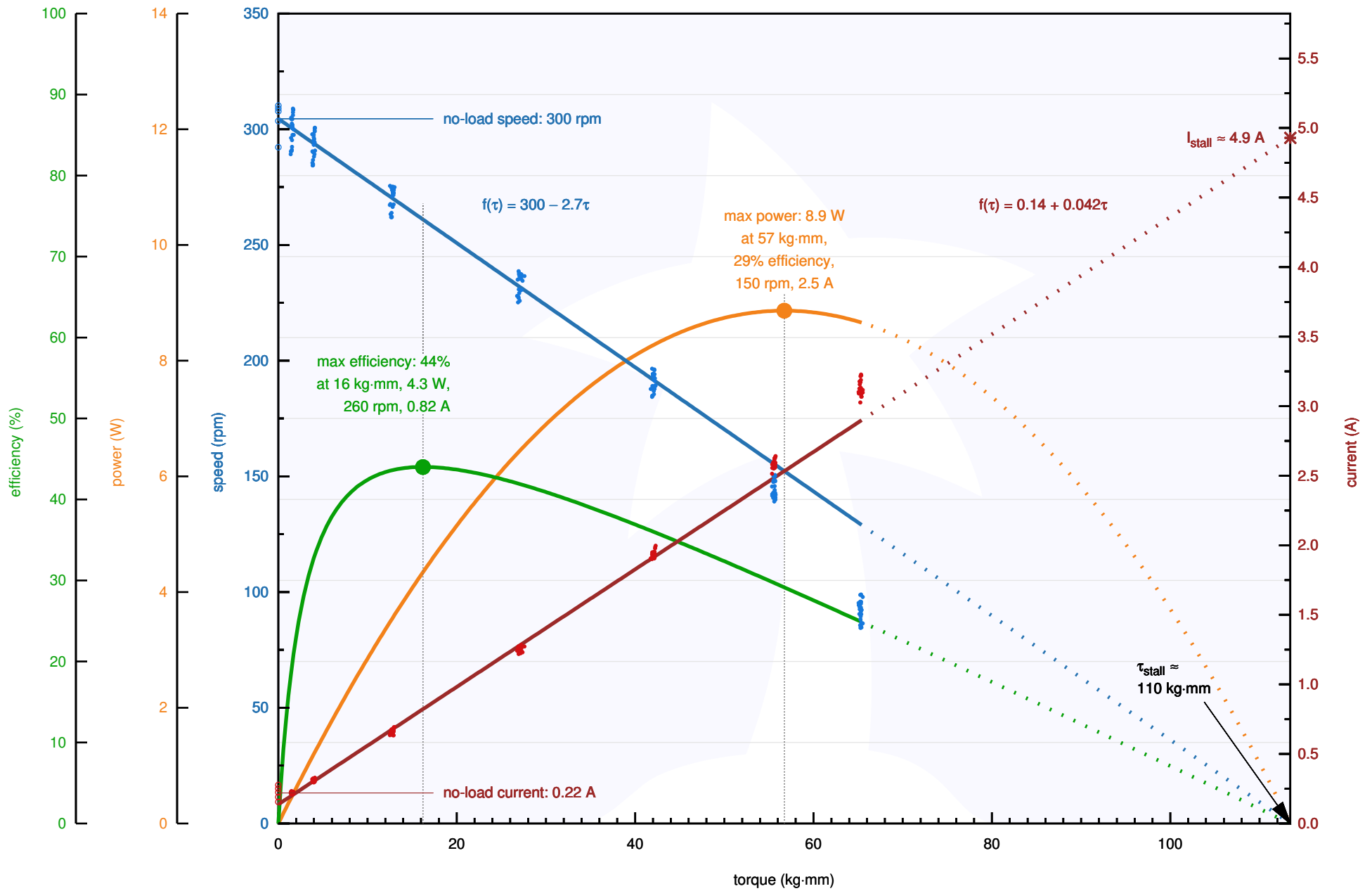
# Pololu Items #3205, #4845 (47:1 Metal Gearmotor 25D HP 12V) Performance at 12 V

no-load speed: 220 rpm

$I_{stall} \approx 4.9$ A

$f(\tau) = 220 - 1.4\tau$

$f(\tau) = 0.16 + 0.031\tau$

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

$\tau_{stall} \approx$ 150 kg·mm

no-load current: 0.20 A

efficiency (%)

power (W)

speed (rpm)

current (A)

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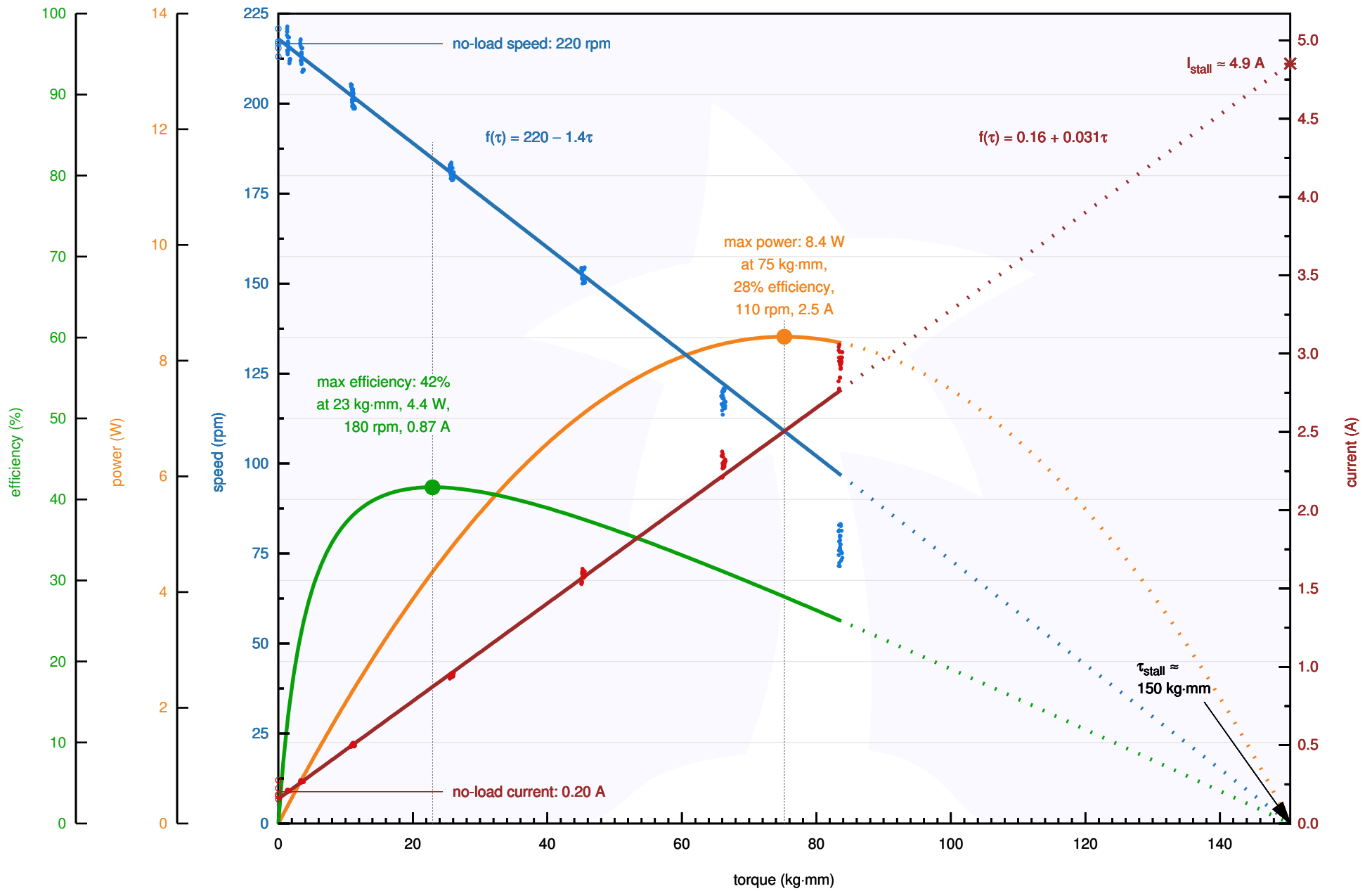
# Pololu Items #3206, #4846 (75:1 Metal Gearmotor 25D HP 12V) Performance at 12 V



no-load speed: 130 rpm

$f(\tau) = 130 - 0.62\tau$

$f(\tau) = 0.16 + 0.022\tau$

$I_{stall} \approx 4.9$ A

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

$\tau_{stall} \approx$ 220 kg·mm

no-load current: 0.20 A

efficiency (%)

power (W)

speed (rpm)

current (A)

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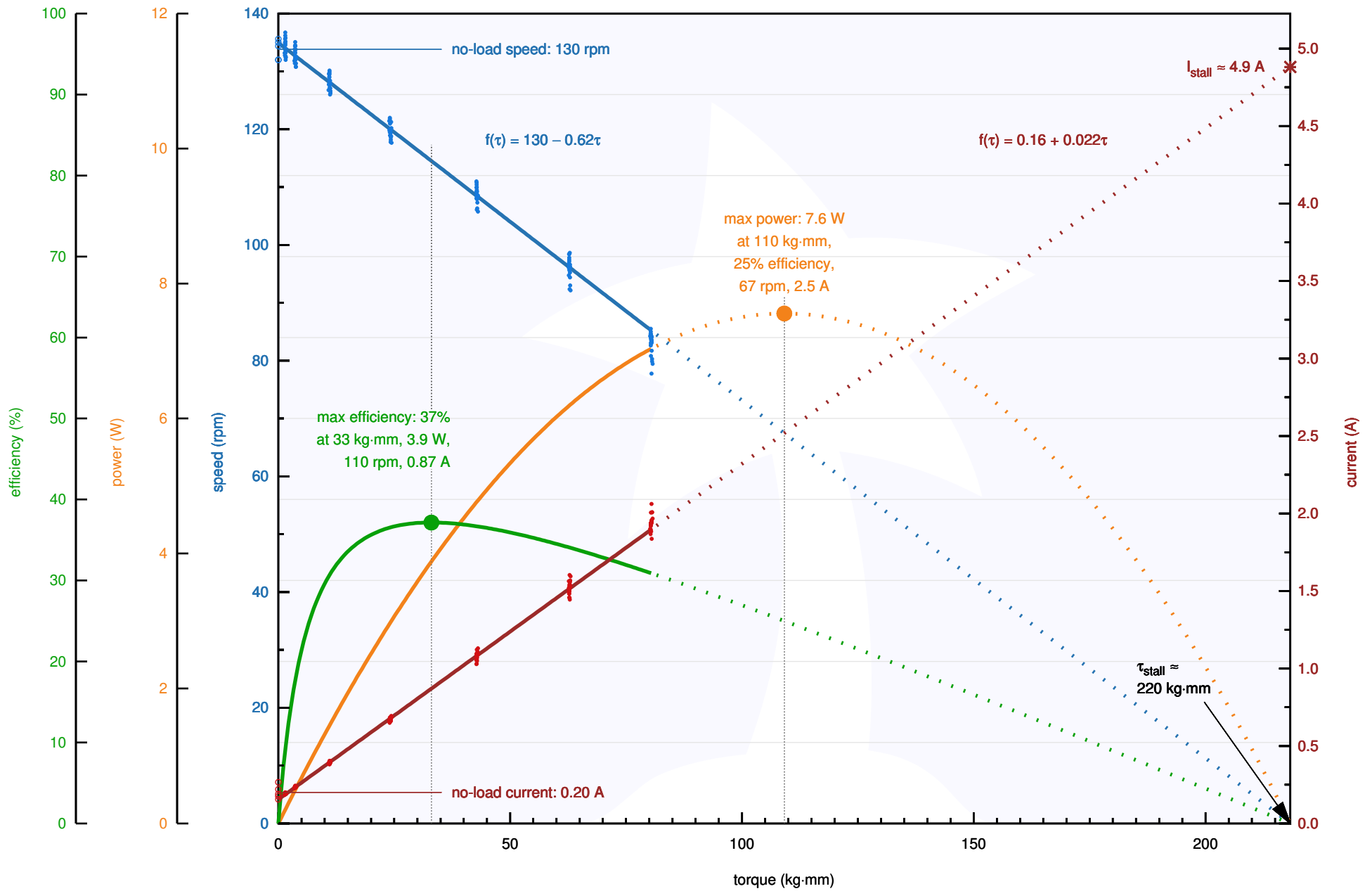
# Pololu Items #3207, #4847 (99:1 Metal Gearmotor 25D HP 12V) Performance at 12 V



no-load speed: 100 rpm

$f(\tau) = 100 - 0.36\tau$

max power: 7.6 W
at 140 kg·mm,
24% efficiency,
51 rpm, 2.6 A

$f(\tau) = 0.18 + 0.017\tau$

$I_{stall} \approx 5.0$ A

max efficiency: 36%
at 45 kg·mm, 4.0 W,
87 rpm, 0.94 A

$\tau_{stall} \approx$ 290 kg·mm

no-load current: 0.21 A

efficiency (%)

power (W)

speed (rpm)

current (A)

torque (kg·mm)