37D Metal Gearmotors

Pololu 37D Metal Gearmotors are powerful brushed DC motors paired with 37mm-diameter gearboxes, and they are available with or without an integrated 64 CPR quadrature encoder on the motor shaft. The motors are intended for operation at 12 V, though in general, this kind of motor can run at voltages above and below the nominal voltage, and they can begin rotating at voltages as low as 1 V. Please note that higher voltages could start negatively affecting the lifetime of the motor. We characterized each version at 12 V and also at 6 V, and this datasheet includes performance graphs at both of these voltages.

The gearmotors are available in a variety of different gear ratios, offering many different combinations of speed and torque. The original versions of these gearmotors, denoted by "Spur Pinion" in the product names, had gearboxes with all spur gears. In August 2019, these were replaced by functionally identical "Helical Pinion" versions that feature helical gears for the first stage of the gearbox, which reduces noise and vibration and improves efficiency. The picture on the right shows the helical pinion gear and first mating gear.

Performance summary and table of contents

Rated Voltage	Pololu Item #	Gear Ratio	No Load		At Maximum Efficiency				Max Power	Stall Extrapolation		Graph Page	
			Speed	Current	Speed	Torque	Current	Output		Torque	Current		
		:1	RPM	A	RPM	kg·mm	A	W	W	kg·mm	A	6 V	12 V
12 V	2821, 4750	1	10,000	0.15						5	5.5		
	1102, 2822 4741,4751	18.75	540		470	10	0.76	5.0	12	85		5	6
	1103, 2823 4742, 4752	30	330		280	18	0.78	5.1	12	140		7	8
	1104, 2824 4743, 4753	50	200		180	22	0.66	4.0	10	210		9	10
	1105, 2825 4744, 4754	70	150		130	32	0.68	4.2	10	270		11	12
	1106, 2826 4745, 4755	102.08	100		87	42	0.72	3.8	8	340		13	14
	1107, 2827 4746, 4756	131.25	76		66	60	0.74	4.1	6	450		15	16
	2828, 2829	150	67		58	65	0.72	3.8	6	490		17	18

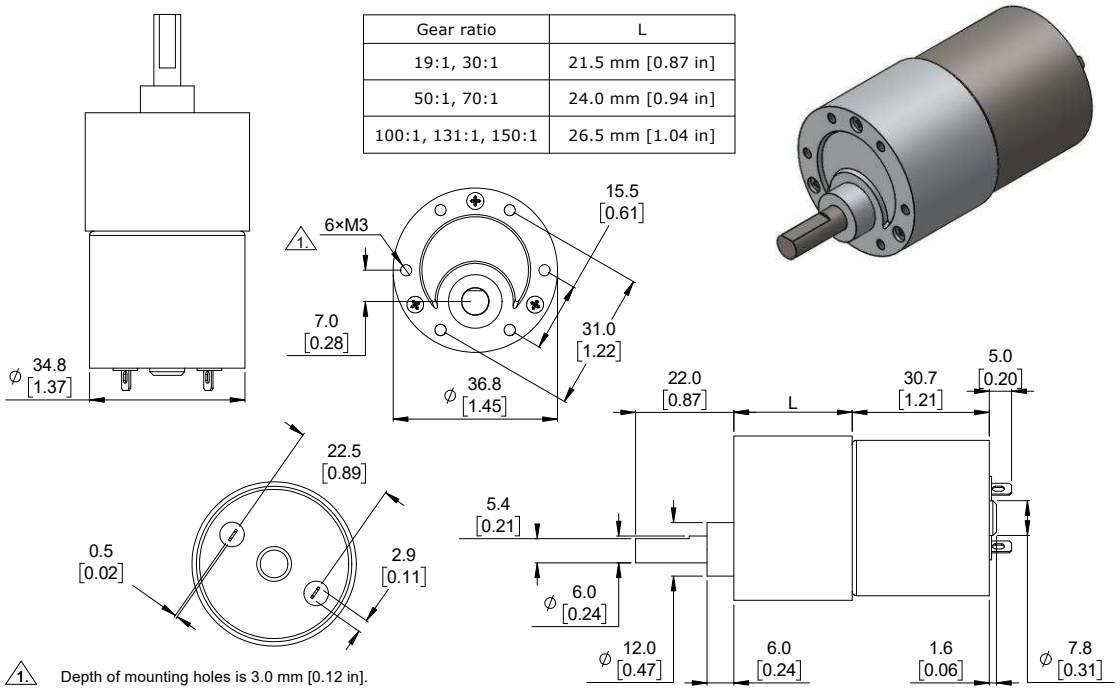
Notes:

1) Max efficiency data and performance graphs currently unavailable for the motor without gearbox (items #2821 and #4750).
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 100 kg·mm, and the recommended upper limit for instantaneous torque is 250 kg·mm. Stalls can also result in rapid (potentially on the order of seconds) thermal damage to the motor windings and brushes; a general recommendation for brushed DC motor operation is 25% or less of the stall current.

Dimensions (units: mm over [inches])

Gearmotor versions without encoders (items #1102-1107, 2829, 4741-4746) weight: 185 g to 195 g

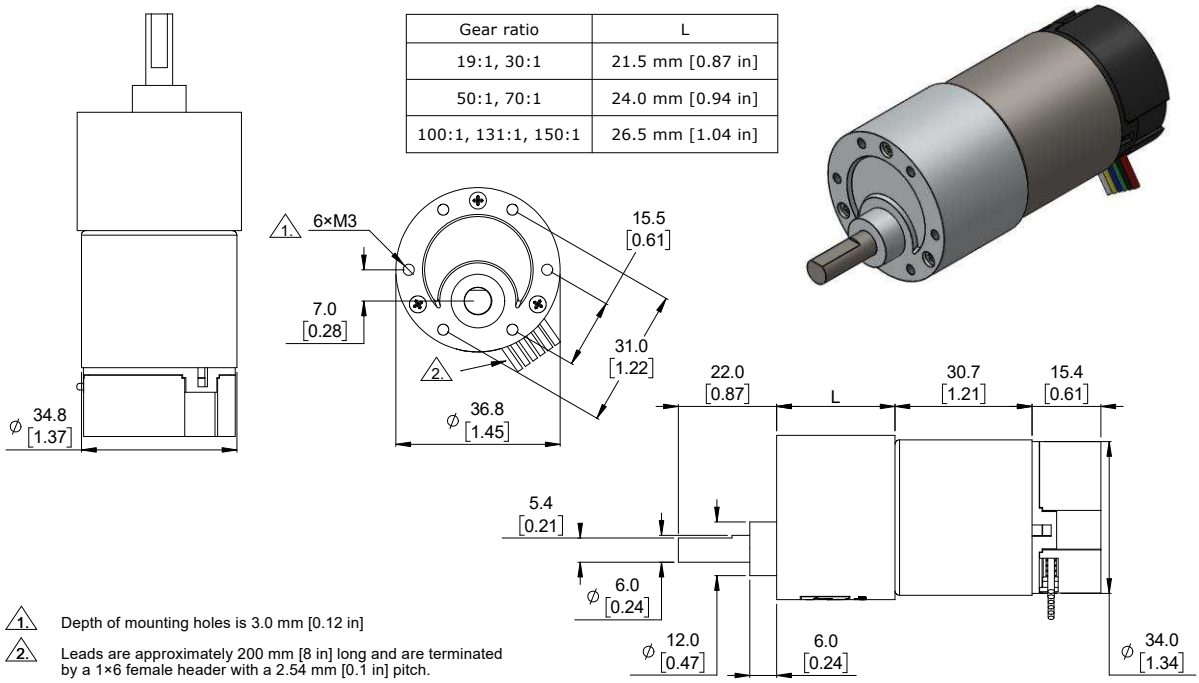
Gear ratio	L
19:1, 30:1	21.5 mm [0.87 in]
50:1, 70:1	24.0 mm [0.94 in]
100:1, 131:1, 150:1	26.5 mm [1.04 in]



1. Depth of mounting holes is 3.0 mm [0.12 in].

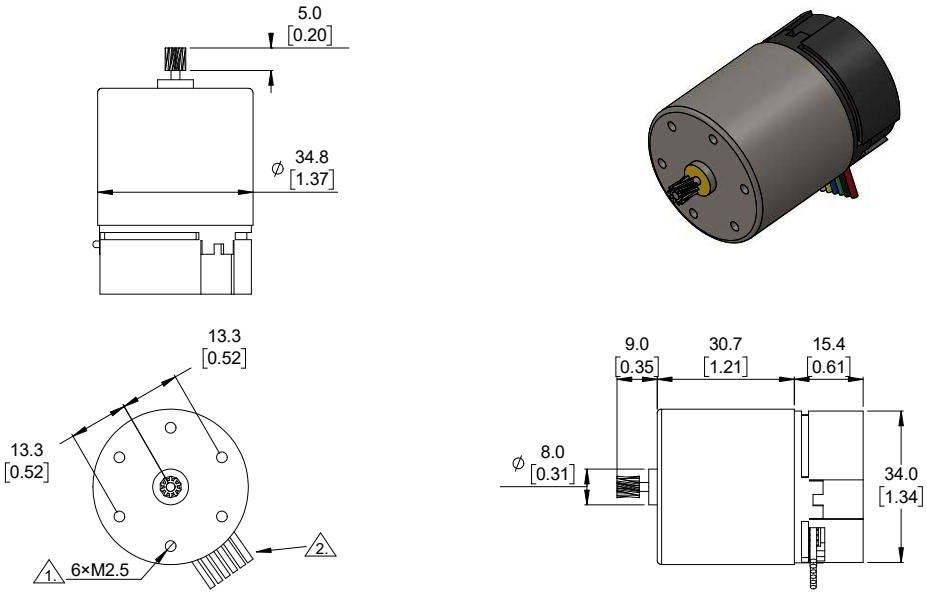
Gearmotor versions with encoders (items #2822-2828, 4751-4756) weight: 200 g to 210 g

Gear ratio	L
19:1, 30:1	21.5 mm [0.87 in]
50:1, 70:1	24.0 mm [0.94 in]
100:1, 131:1, 150:1	26.5 mm [1.04 in]



1. Depth of mounting holes is 3.0 mm [0.12 in]
2. 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.

Motor with encoder and no gearbox (items #2821, 4750) weight: 110 g



1. Depth of mounting holes is 3.5 mm [0.14 in].
2. 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.

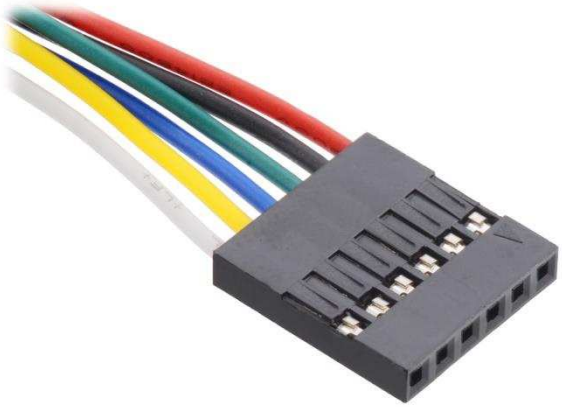
Using the encoder

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:

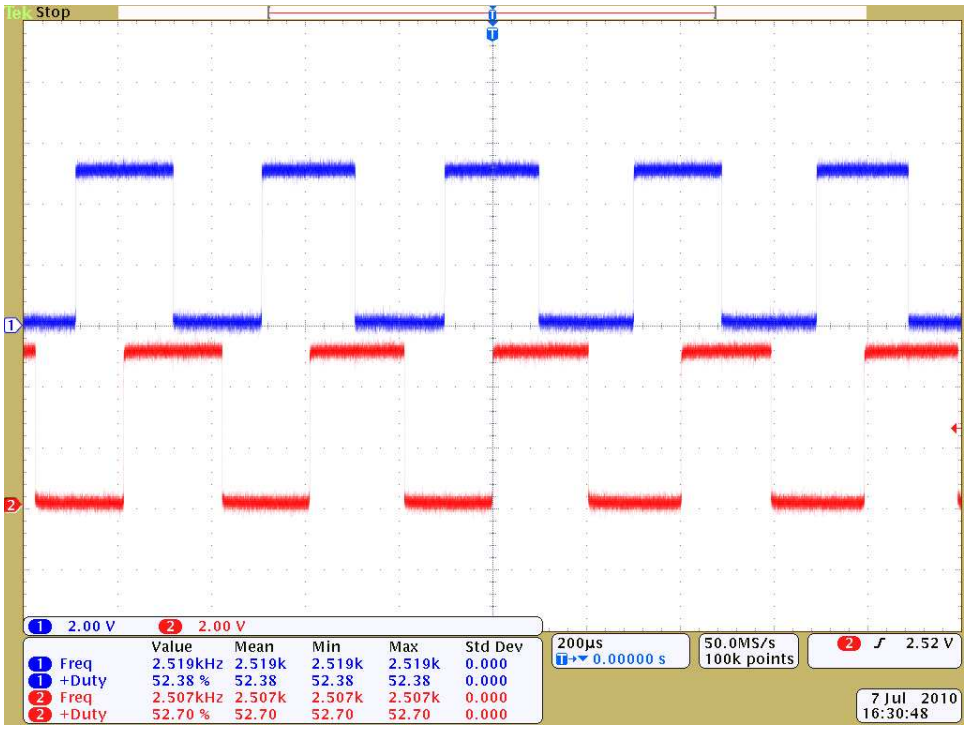
The quadrature encoder provides a resolution of 64 counts per revolution (CPR) of the motor shaft when counting both edges of both channels. To compute the counts per revolution of the gearbox output, multiply the gear ratio by 64.

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 our 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

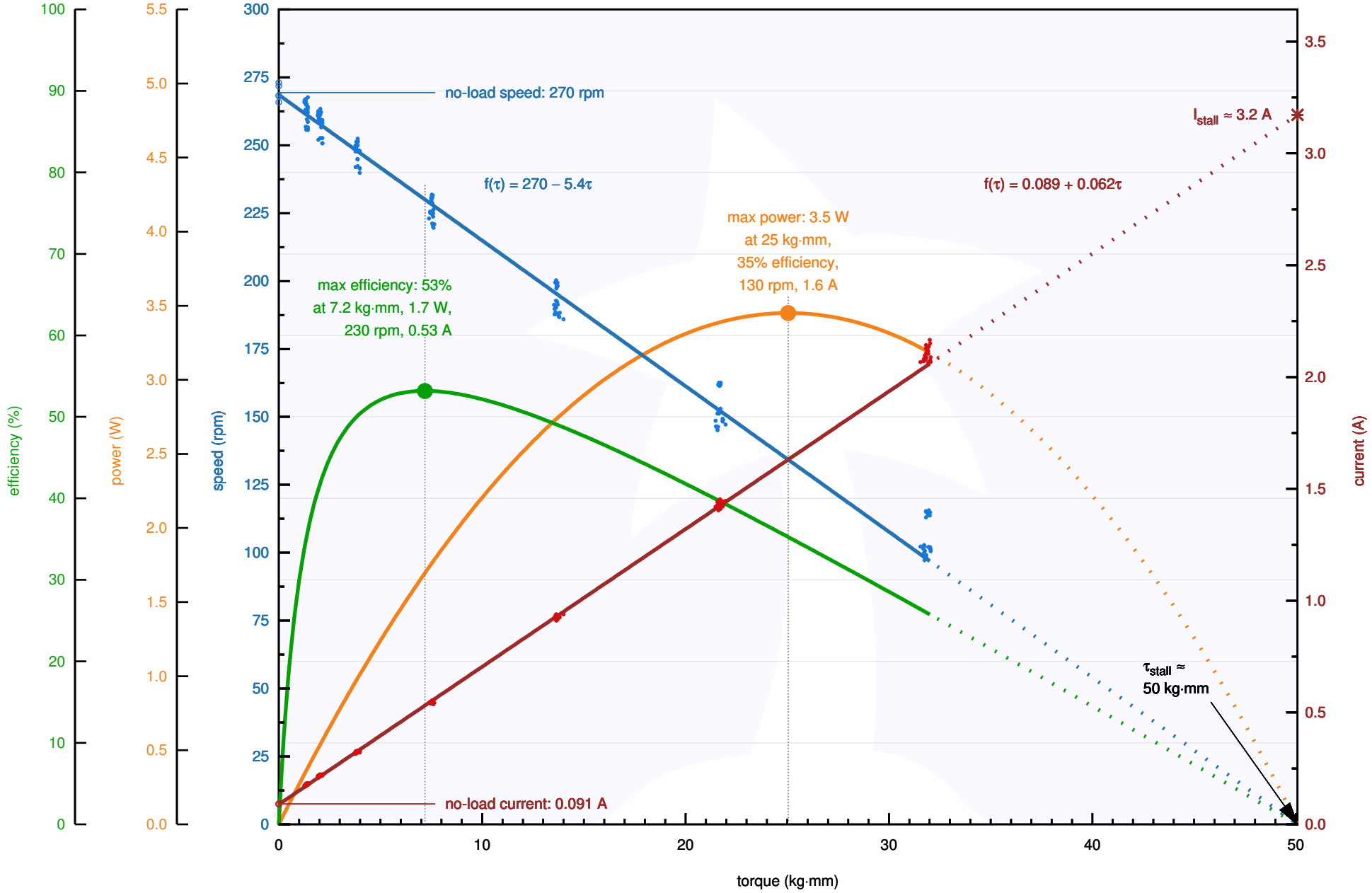


The Hall sensors require an input voltage, Vcc, between 3.5 V and 20 V and draw a maximum of 10 mA. The A and B outputs are square waves from 0 V to Vcc approximately 90° out of phase. The speed of the motor can be determined from the frequency of the, and the direction of rotation can be determined from the order of the transitions. The following oscilloscope capture shows the A and B (yellow and white) encoder outputs using a motor voltage of 12 V and a Hall sensor Vcc of 5 V:

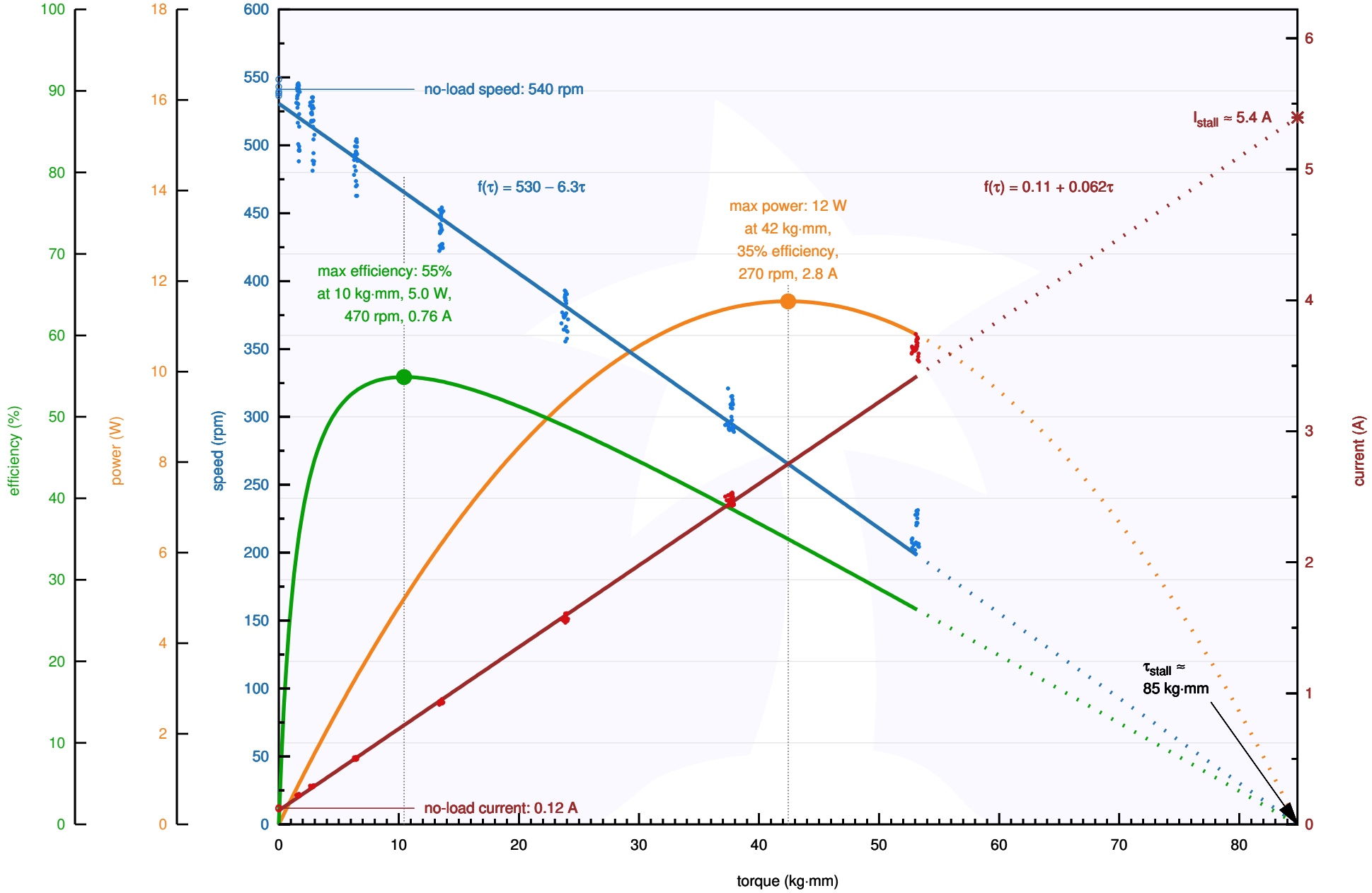


By counting both the rising and falling edges of both the A and B outputs, it is possible to get 64 counts per revolution of the motor shaft. Using just a single edge of one channel results in 16 counts per revolution of the motor shaft, so the frequency of the A output in the above oscilloscope capture is 16 times the motor rotation frequency.

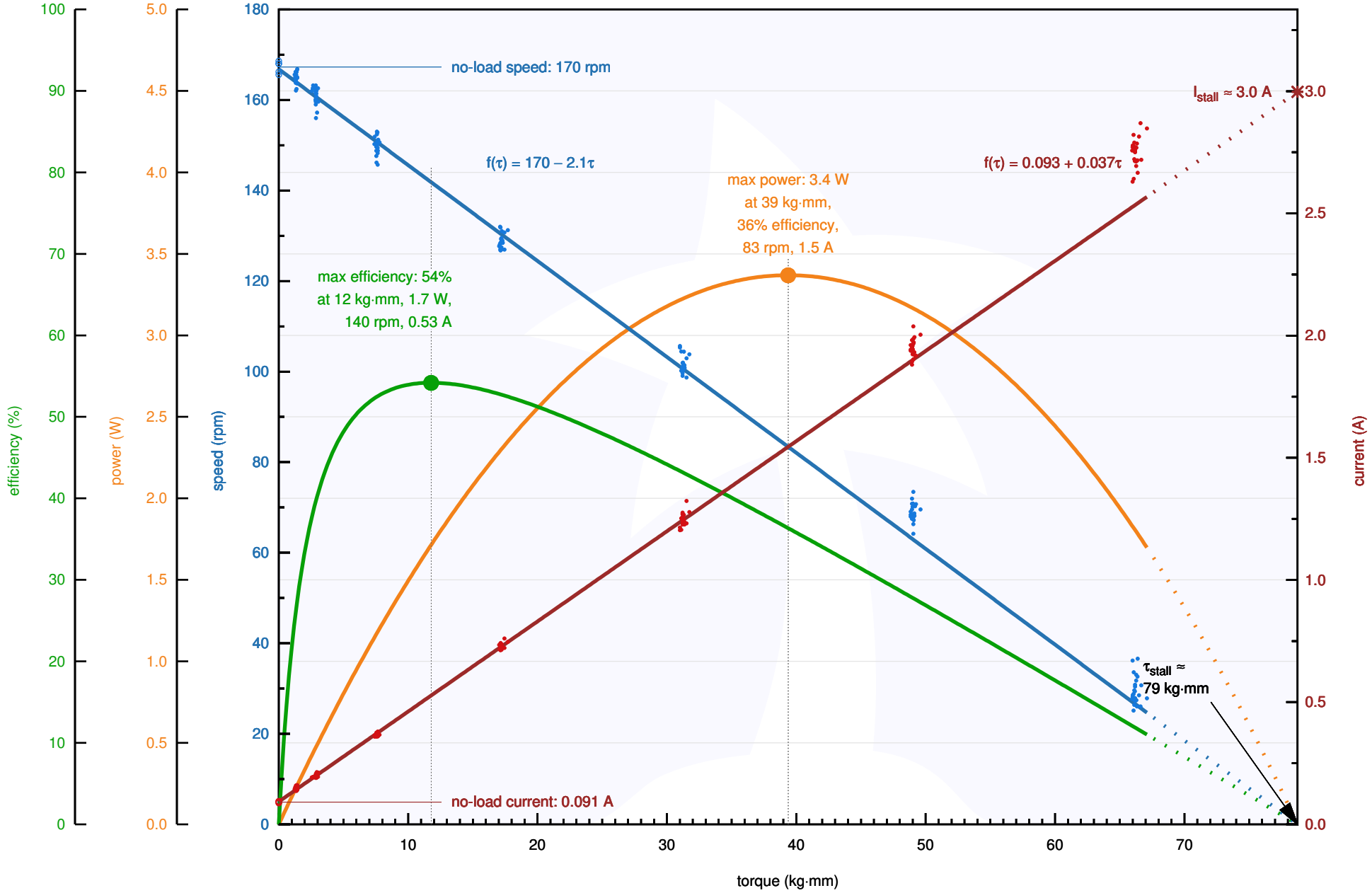
Pololu Items #1102, #2822, #4741, #4751 (19:1 Metal Gearmotor 37D) Performance at 6 V



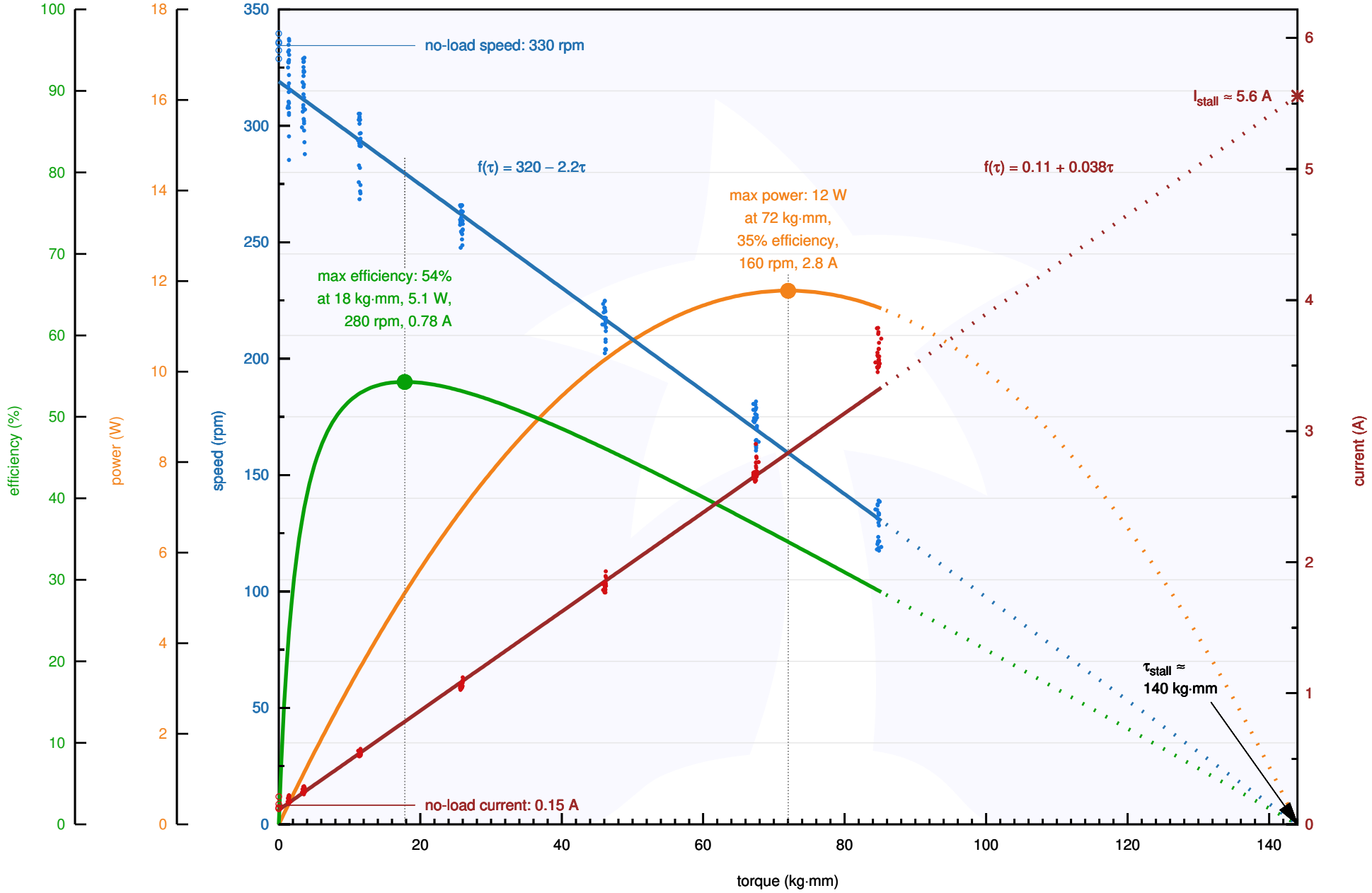
Pololu Items #1102, #2822, #4741, #4751 (19:1 Metal Gearmotor 37D) Performance at 12 V



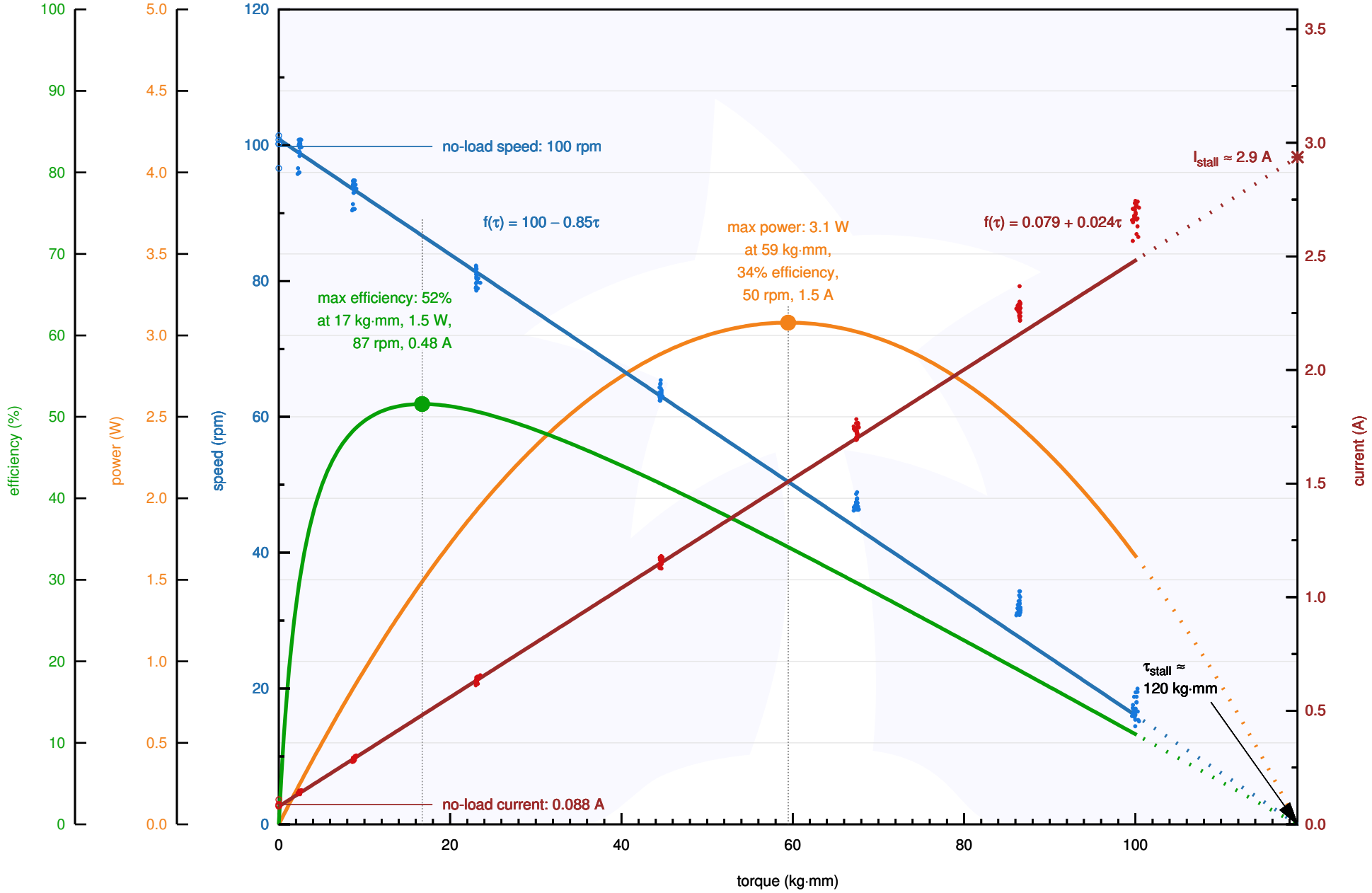
Pololu Items #1103, #2823, #4742, #4752 (30:1 Metal Gearmotor 37D) Performance at 6 V



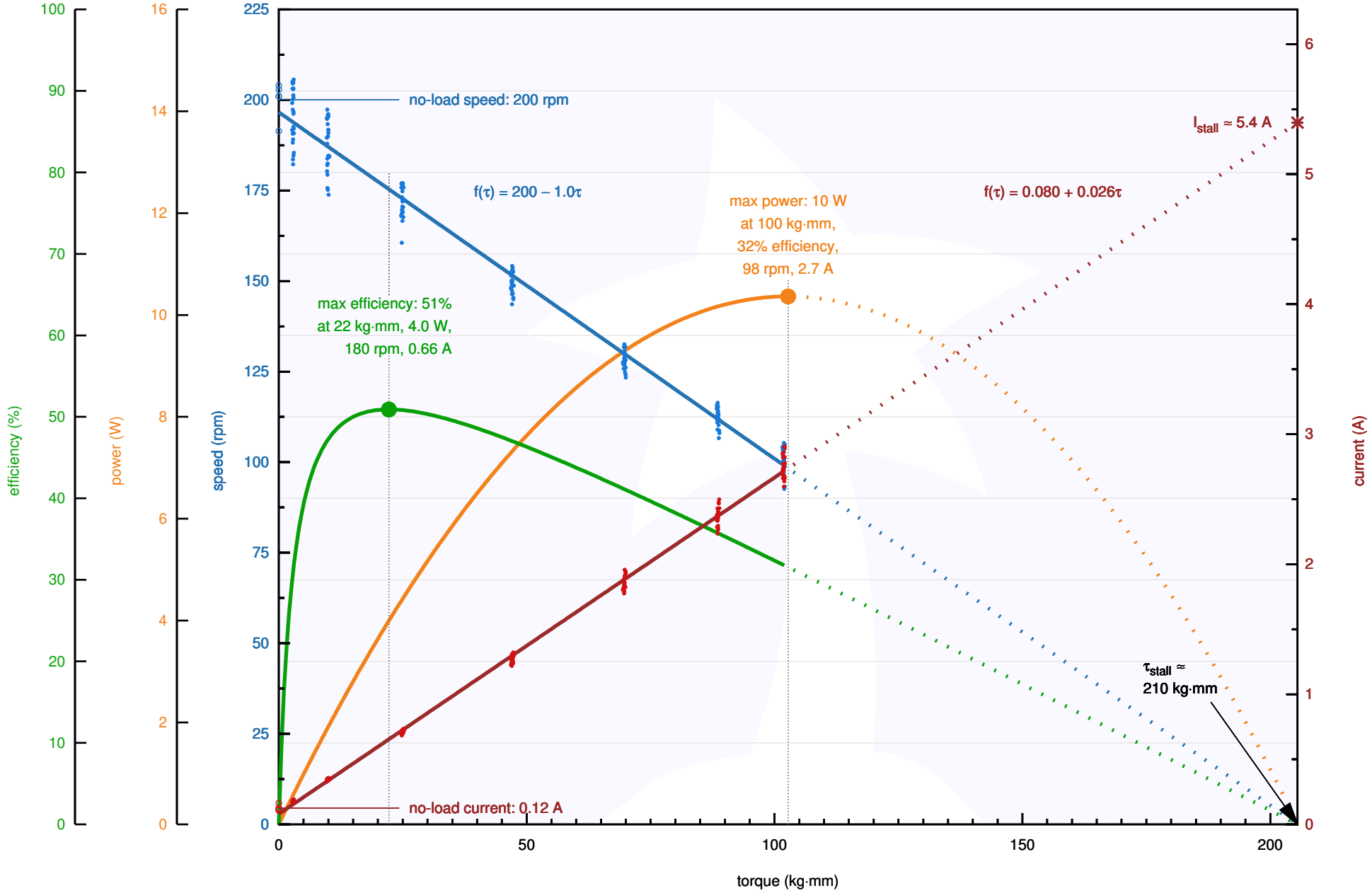
Pololu Items #1103, #2823, #4742, #4752 (30:1 Metal Gearmotor 37D) Performance at 12 V



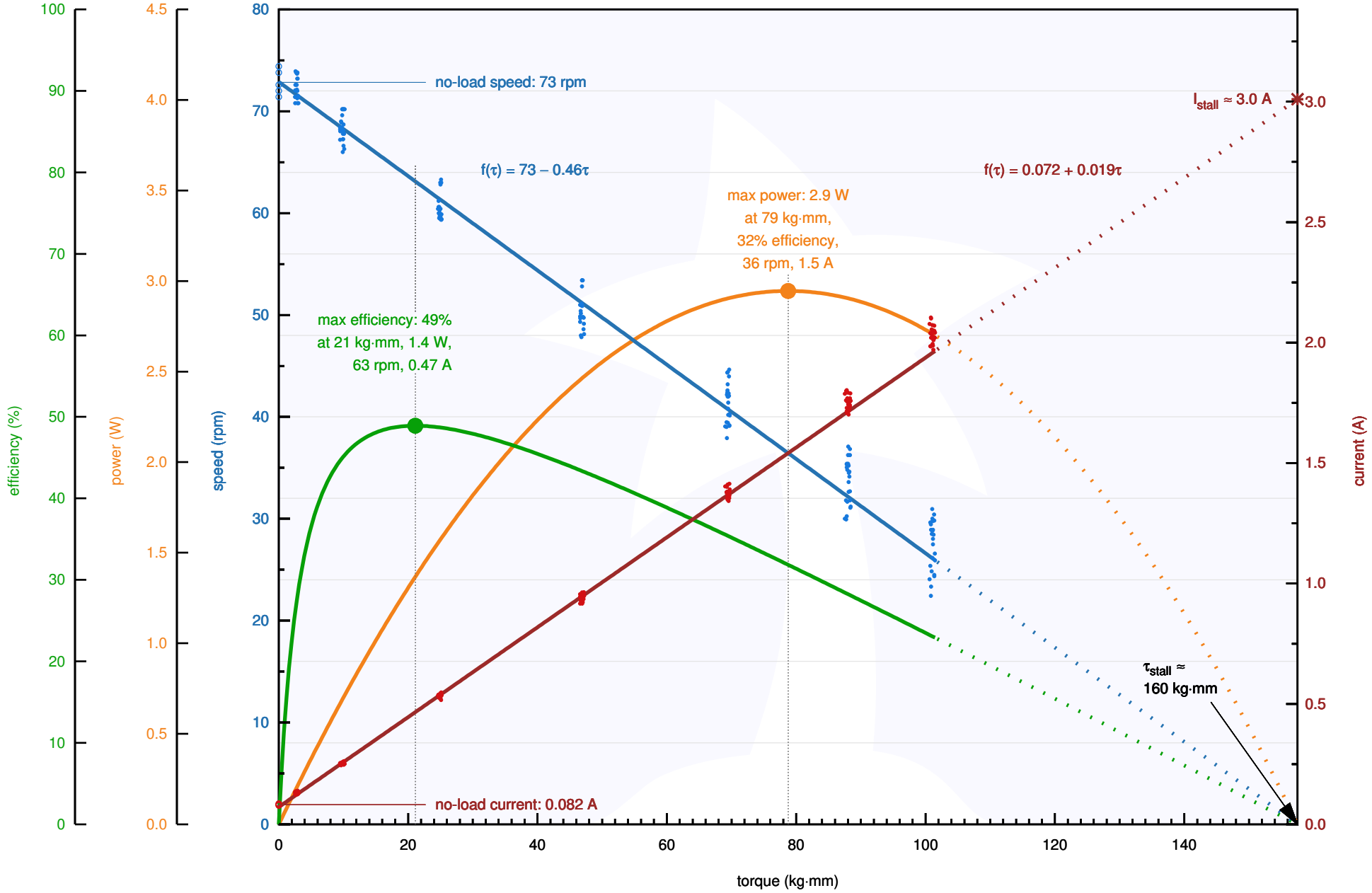
Pololu Items #1104, #2824, #4743, #4753 (50:1 Metal Gearmotor 37D) Performance at 6 V



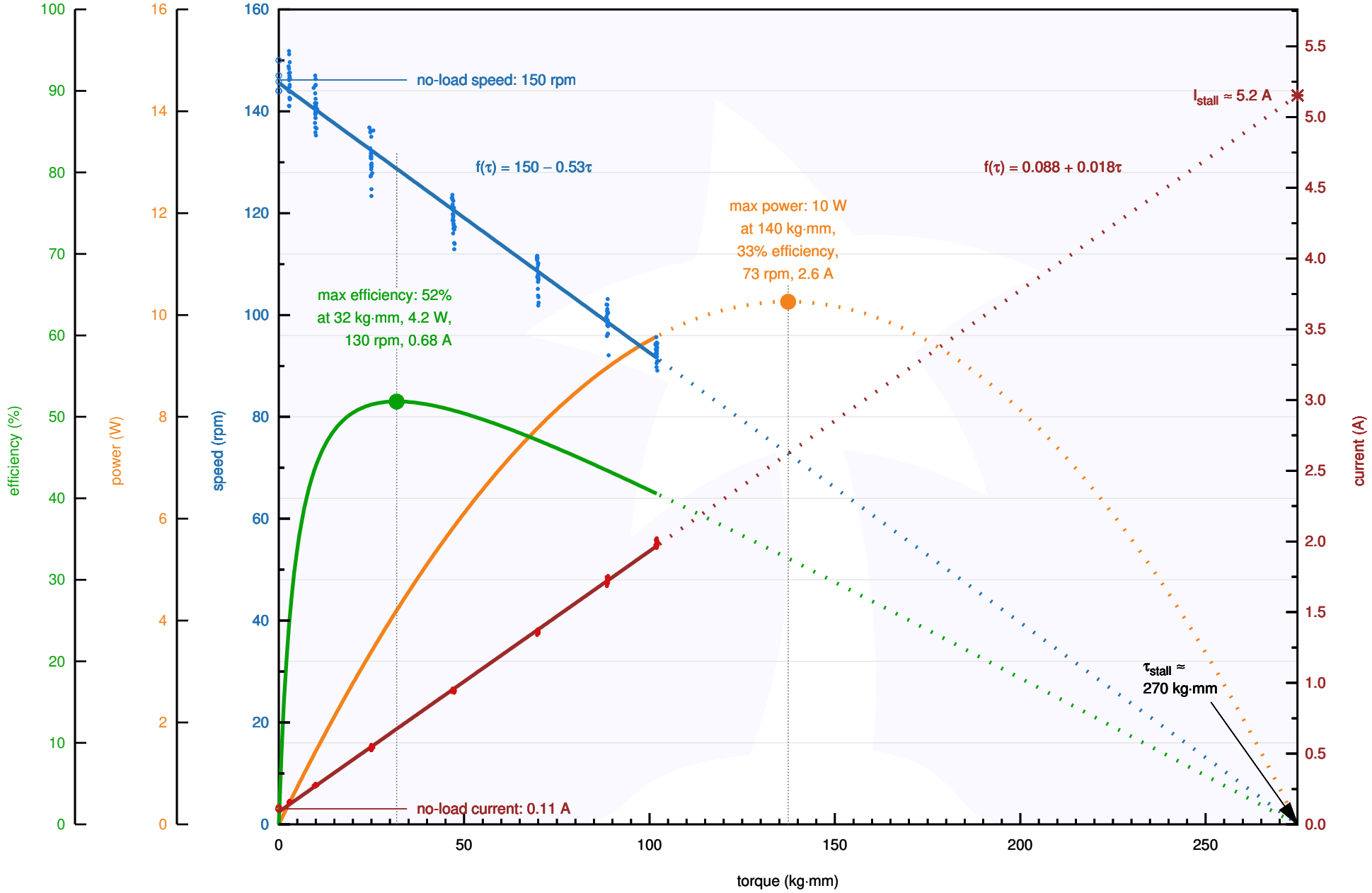
Pololu Items #1104, #2824, #4743, #4753 (50:1 Metal Gearmotor 37D) Performance at 12 V



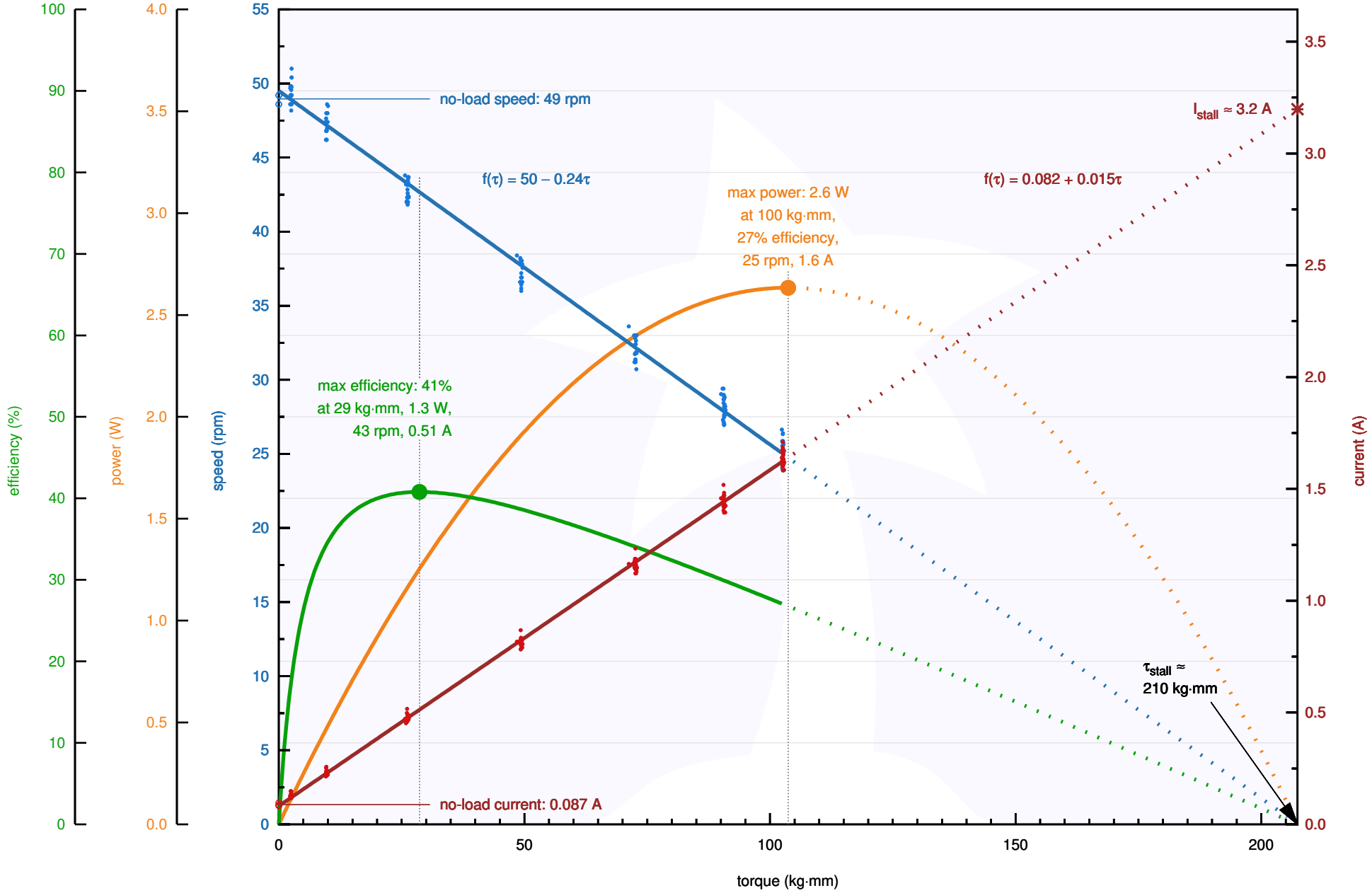
Pololu Items #1105, #2825, #4744, #4754 (70:1 Metal Gearmotor 37D) Performance at 6 V



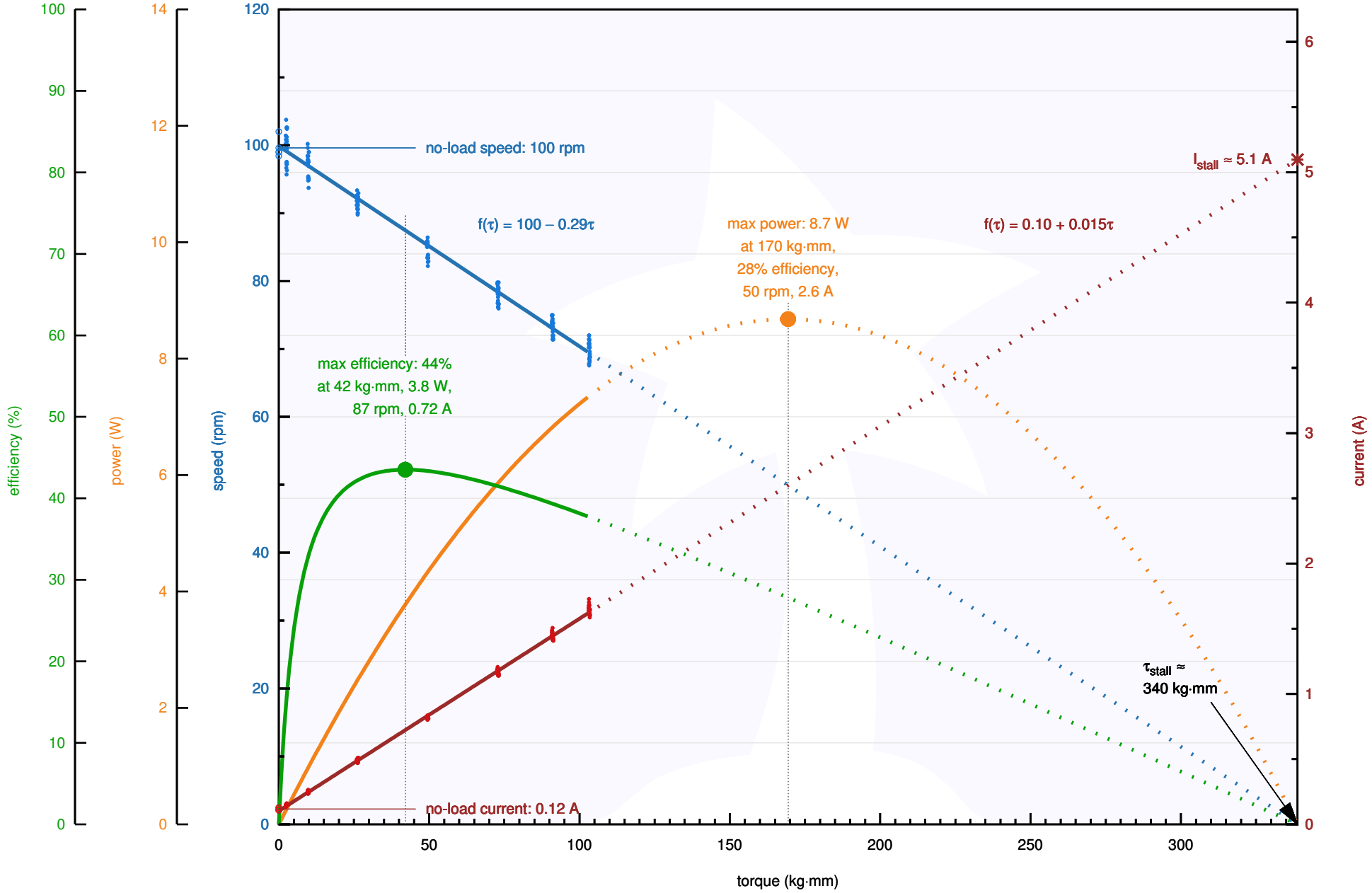
Pololu Items #1105, #2825, #4744, #4754 (70:1 Metal Gearmotor 37D) Performance at 12 V



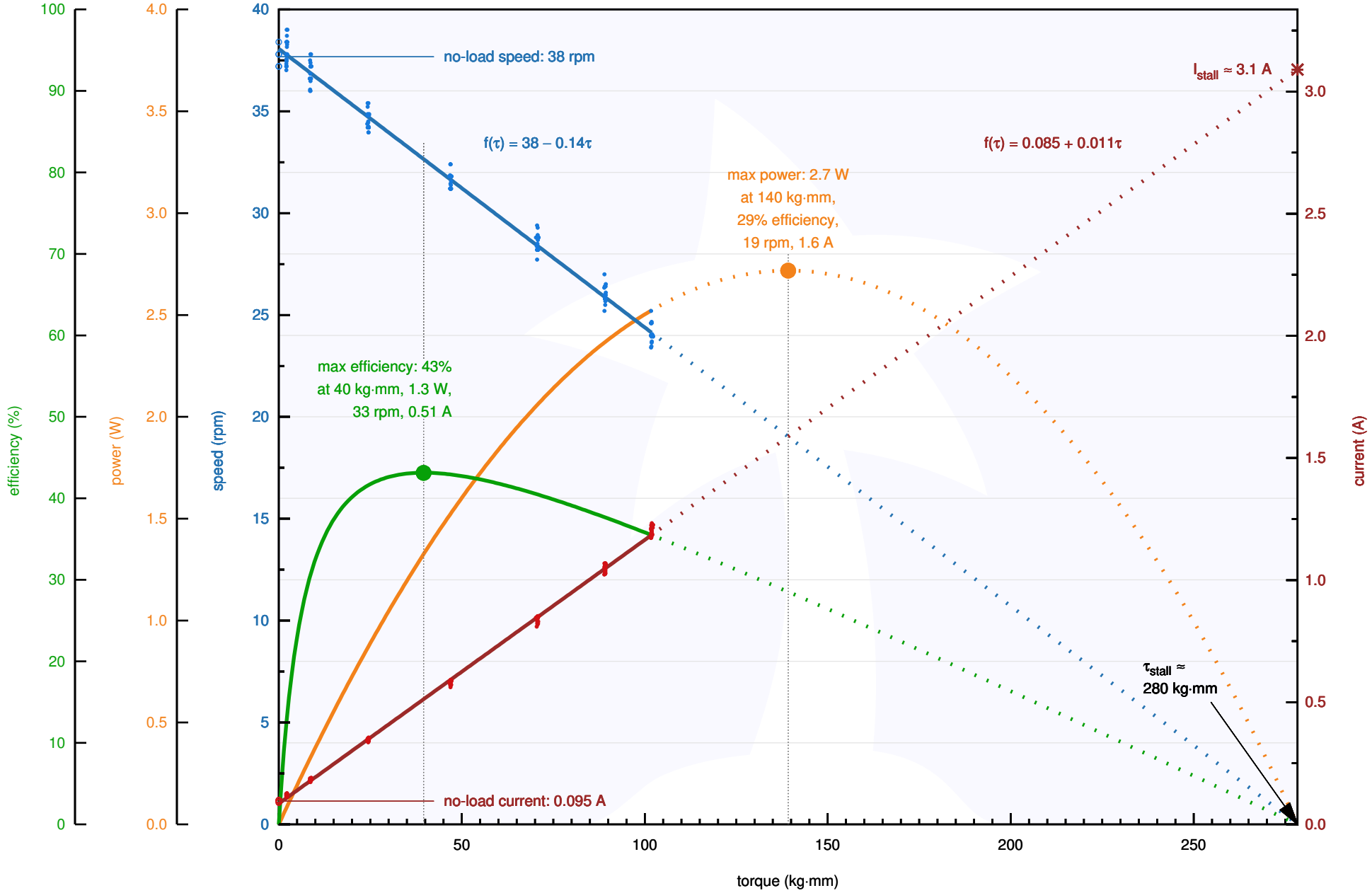
Pololu Items #1106, #2826, #4745, #4755 (100:1 Metal Gearmotor 37D) Performance at 6 V



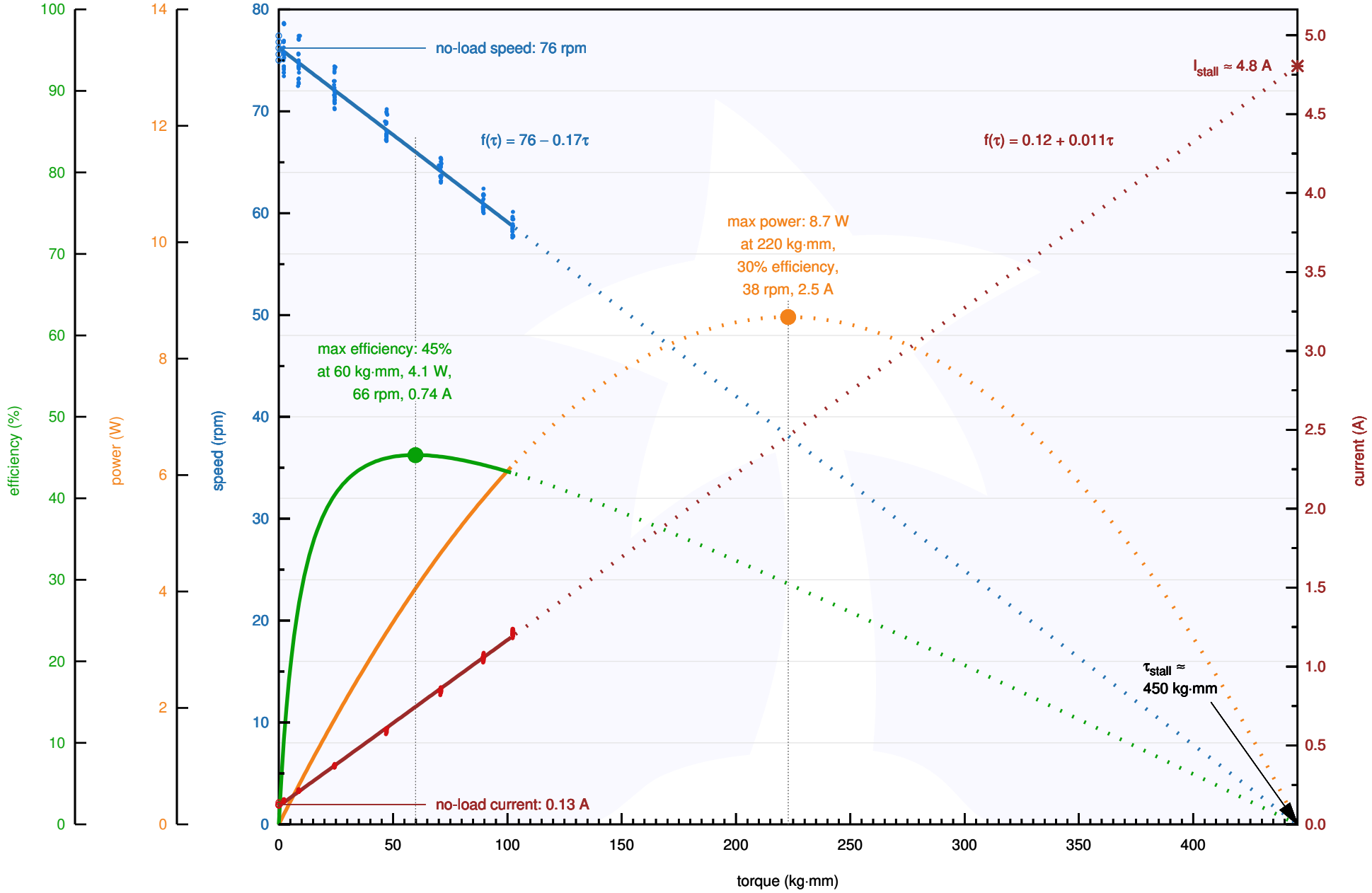
Pololu Items #1106, #2826, #4745, #4755 (100:1 Metal Gearmotor 37D) Performance at 12 V



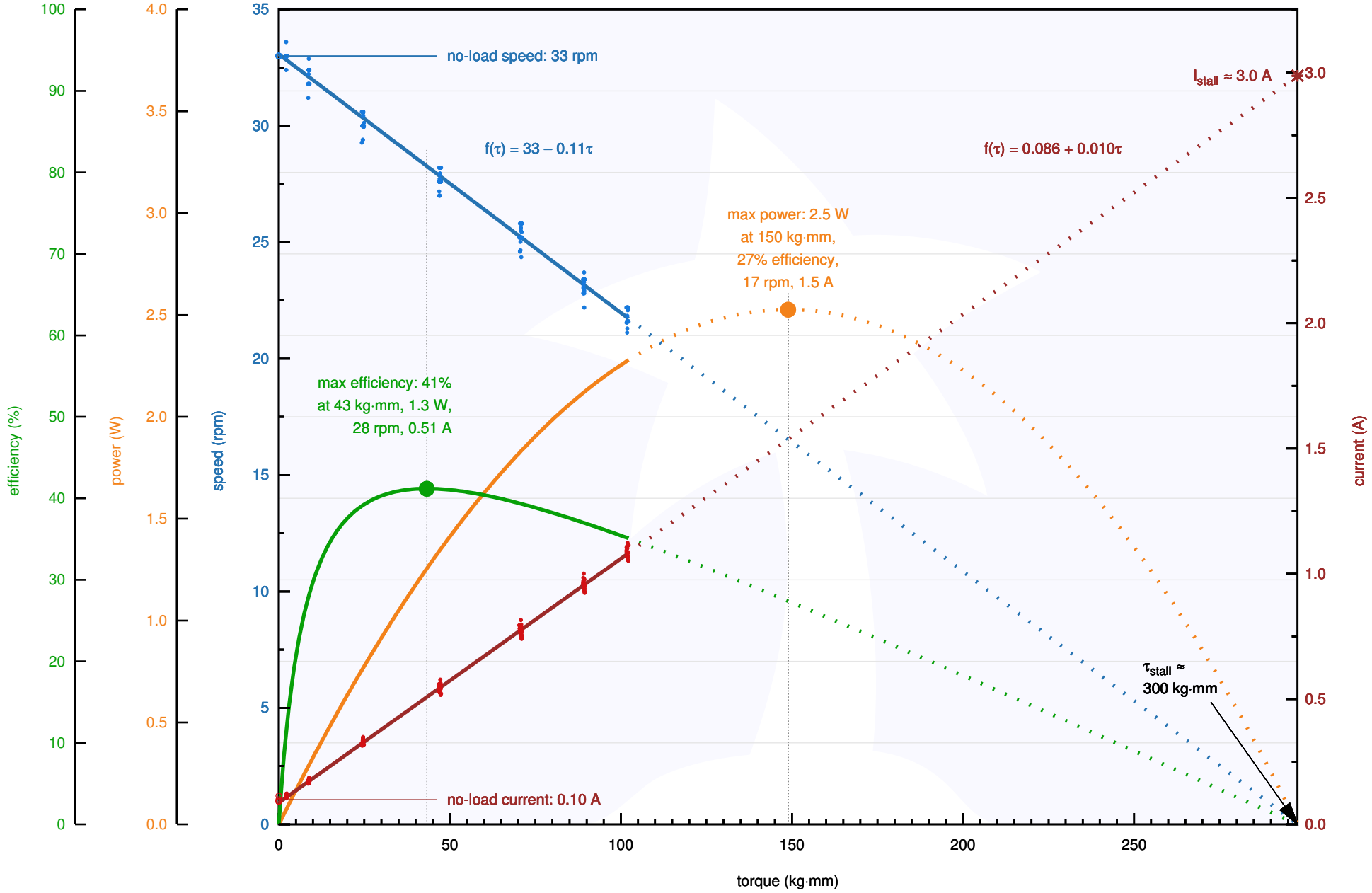
Pololu Items #1107, #2827, #4746, #4756 (131:1 Metal Gearmotor 37D) Performance at 6 V



Pololu Items #1107, #2827, #4746, #4756 (131:1 Metal Gearmotor 37D) Performance at 12 V



Pololu Items #2829, #2828, #150:1 Metal Gearmotor 37D , # () Performance at 6 V



Pololu Items #2829, #2828, #150:1 Metal Gearmotor 37D , # () Performance at 12 V