Brushless DC Motor: Kv, Kt, Speed, Torque and Efficiency

Torque constant from a BLDC or brushed DC motor's Kv rating, no-load and loaded speed, torque, output power and efficiency, and the current at peak efficiency.

Method: Permanent-magnet DC motor model

Input parameters

Unit system: SI

Parameter	Value	Unit
Speed constant (rpm per volt)	920.00	
Supply voltage	14.800	V
Winding resistance (phase to phase)	0.080000	Ω
No-load current	0.60000	A
Operating current	15.000	A

Calculated results

Parameter	Value	Unit
Torque constant (N·m/A)	0.010380	
No-load speed	13,572	rpm
Speed at the current	12,512	rpm
Shaft torque	0.14947	N·m
Shaft power	195.84	W
Efficiency	88.216	%
Current at peak efficiency	10.536	A

Notes for this case

• For a permanent-magnet DC or BLDC motor the back-EMF and torque constants are the same number in SI: K_t [N·m/A] = 1/K_v [rad/s per V] = 60/(2πK_v [rpm/V]). Speed ω = K_v(V − IR); torque = K_t(I − I₀), the no-load current covering friction and iron losses. Efficiency peaks at I ≈ √(I₀·V/R) = √(I₀I_stall). Controller losses and the trapezoidal/sinusoidal drive constant (about 5–10 %) are ignored.

Formula and method

$$K_t = \frac{60}{2\pi K_v}, \quad \omega = K_v(V - IR_m), \quad T = K_t(I - I_0), \quad I_{\eta,max} = \sqrt{I_0 \frac{V}{R_m}}$$

Variables

K_v	Speed constant (rpm per volt)	-
V	Supply voltage	V
R_m	Winding resistance (phase to phase)	Ω
I_0	No-load current	A
I	Operating current	A
K_t	Torque constant (N·m/A)	-
n_0	No-load speed	rad/s
n	Speed at the current	rad/s
T	Shaft torque	N·m
P_{out}	Shaft power	W

η	Efficiency	-
$I_{\eta,max}$	Current at peak efficiency	A

Method and standards

Motor constants.

Assumptions and limits

- Linear motor model; constant resistance; ideal controller.

References

Permanent-magnet DC motor model

Report details

Report reference	FCC-Y9G8-E99A (the same inputs always give the same reference)
Generated	23 November 2026, 18:24 UTC
Calculator	Brushless DC Motor: Kv, Kt, Speed, Torque and Efficiency
Method last reviewed	17 November 2026
Software release	FireCAD Calc, release of 22 November 2026
Release checks	3 reference cases of this calculator, computed independently, are checked on every release

Results are for engineering estimation. Verify critical designs against the referenced standards and your own data.

This calculator online

https://calc.firecad.com/electrical/motors/bldc-motor-constants

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.