DC Shunt Motor Back EMF, Power, Torque and Speed

Back EMF, developed power and torque of a DC shunt motor from supply voltage, armature current and resistance, and its speed at another armature current.

Method: DC machine equations E_b = V − I_a R_a; N ∝ E_b / Φ (textbook)

Input parameters

Unit system: SI

Parameter	Value	Unit
Supply voltage	220.00	V
Armature current	40.000	A
Armature resistance	0.25000	Ω
Speed at that current	1,000.0	rpm
New armature current	60.000	A

Calculated results

Parameter	Value	Unit
Back EMF V − I_a R_a	210.00	V
Power developed E_b I_a	8.4000	kW
Torque developed	80.214	N·m
Back EMF at the new current	205.00	V
Speed at the new current (constant flux)	976.19	rpm

Notes for this case

- Shunt or separately excited motor with constant field flux; brush drop and armature reaction are neglected.

Formula and method

$$E_b = V - I_a R_a, \quad P_d = E_b I_a, \quad T = \frac{P_d}{2\pi N}, \quad \frac{N_2}{N_1} = \frac{E_{b2}}{E_{b1}}$$

Variables

V	Supply voltage	V
I_a	Armature current	A
R_a	Armature resistance	Ω
N_1	Speed at that current	1/s
I_{a2}	New armature current	A
E_b	Back EMF V − I_a R_a	V
P_d	Power developed E_b I_a	W
T	Torque developed	N·m
E_{b2}	Back EMF at the new current	V
N_2	Speed at the new current (constant flux)	1/s

Method and standards

DC machine voltage and torque equations at constant flux.

Assumptions and limits

- Constant flux; no brush drop. Shunt and separately excited motors only: in a series motor the flux follows the armature current, so the speed relation differs.

References

- DC machine equations E_b = V − I_a R_a
- N ∝ E_b / Φ (textbook)

Report details

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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/dc-motor-back-emf

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Reopens the calculator with the inputs of this report.