DC Shunt Motor Speed by Field Weakening

Armature current, back EMF and speed of a shunt or separately excited DC motor when its field current is reduced, for a constant-torque load.

Method: DC machine equations with linear magnetisation

Input parameters

Unit system: SI

Parameter	Value	Unit
Armature voltage	250.00	V
Armature circuit resistance	0.060000	Ω
Armature current before	120.00	A
Speed before	1,200.0	rpm
Field current before	5.0000	A
Field current after	4.0000	A

Calculated results

Parameter	Value	Unit
Back EMF before	242.80	V
Armature current after	150.00	A
Back EMF after	241.00	V
Speed after	1,488.9	rpm
Load torque (constant)	231.86	N·m

Notes for this case

• E = Kφω and T = KφI_A. With flux proportional to field current (unsaturated) and constant load torque, weakening the field raises the armature current by φ₁/φ₂ and the speed by (E₂/E₁)(φ₁/φ₂). This is the classic way to run above base speed at constant power; too weak a field gives high armature current, poor commutation and, if the field is lost, dangerous overspeed.

Formula and method

$$E = V_T - I_A R_A, \quad I_{A2} = I_{A1}\frac{\phi_1}{\phi_2}, \quad \frac{n_2}{n_1} = \frac{E_2}{E_1}\frac{\phi_1}{\phi_2}$$

Variables

V_T	Armature voltage	V
R_A	Armature circuit resistance	Ω
I_{A1}	Armature current before	A
n_1	Speed before	rad/s
I_{F1}	Field current before	A
I_{F2}	Field current after	A
E_1	Back EMF before	V
I_{A2}	Armature current after	A
E_2	Back EMF after	V
n_2	Speed after	rad/s
T	Load torque (constant)	N·m

Method and standards

Field weakening.

Assumptions and limits

- Flux proportional to field current; constant load torque; no armature reaction.

References

DC machine equations with linear magnetisation

Report details

Report reference	FCC-SQXF-G8C5 (the same inputs always give the same reference)
Generated	23 November 2026, 18:24 UTC
Calculator	DC Shunt Motor Speed by Field Weakening
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/dc-motor-field-weakening

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.