EV Single-Speed Reduction Ratio and Launch Traction

Largest reduction ratio that still reaches top speed at maximum motor speed, the resulting wheel force, the driven axle's traction limit and launch acceleration.

Method: Gear ratio from top speed; traction limit

Input parameters

Unit system: SI

Parameter	Value	Unit
Maximum motor speed	16,000	rpm
Top speed	160.00	km/h
Tyre dynamic radius	330.00	mm
Peak motor torque	350.00	N·m
Driveline efficiency	95.000	%
Vehicle mass	1,800.0	kg
Share of weight on driven axle	50.000	%
Road friction coefficient	0.90000	
Rolling resistance coefficient	0.010000	

Calculated results

Parameter	Value	Unit
Reduction ratio	12.441	
Wheel torque	4,136.5	N·m
Motor-limited tractive force	12.535	kN
Traction limit	7.9434	kN
Launch acceleration	4.3149	m/s²

Notes for this case

• i = ω_max·r_d/v_max sets the ratio that just reaches top speed at maximum motor speed (a power limit may cap top speed lower). F_t = T_m·i·η/r_d; launch acceleration uses the smaller of F_t and the traction limit μ·f_d·m·g. Weight transfer under acceleration loads the rear axle, so a rear-driven car can use more than its static share.

Formula and method

$$i = \frac{\omega_{max} r_d}{v_{max}}, \quad F_t = \frac{T_m i \eta}{r_d}, \quad a = \frac{\min(F_t, \mu f_d m g) - C_{rr} m g}{m}$$

Variables

n_{max}	Maximum motor speed	rad/s
v_{max}	Top speed	m/s
r_d	Tyre dynamic radius	m
T_m	Peak motor torque	N·m
η	Driveline efficiency	-
m	Vehicle mass	kg
f_d	Share of weight on driven axle	-
μ	Road friction coefficient	-
C_{rr}	Rolling resistance coefficient	-

i	Reduction ratio	-
T_w	Wheel torque	N·m
F_t	Motor-limited tractive force	N
F_μ	Traction limit	N
a	Launch acceleration	m/s²

Method and standards

Reduction ratio.

Assumptions and limits

- Flat road; no aerodynamic drag at launch; static axle load.

References

Gear ratio from top speed; traction limit

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/automotive/electric-vehicles/ev-single-speed-reduction-ratio

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Reopens the calculator with the inputs of this report.