

EV 动力总成工程速查包 • 免费精简版

EV Powertrain Engineering Quick Reference — Free Lite

中英双语 • Bilingual Chinese / English • 2026-11

本精简版包含 / Inside: 电机与电池核心公式 + 示例、单位换算、40 条中英术语。配套 Excel: EV_Powertrain_QuickRef_Lite.xlsx。

完整版另含 / Full version adds: 道路负载与能耗、爬坡度、热管理计算，126 条术语，19 项 GB / UNECE / EU 法规标准索引（附官方公开来源）。

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1 · 核心公式与示例 Core formulas & worked examples

示例数值与 Excel 默认输入一致，均为通用假设值。Example values match the spreadsheet defaults (generic assumptions).

电机 Motor

项目 Item	公式 Formula	示例 Example
机械功率 Mechanical power	$P[\text{kW}] = T[\text{Nm}] \times n[\text{rpm}] \times 2\pi / 60 / 1000$ $\approx T \times n / 9549$	250 Nm @ 4000 rpm → 104.72 kW
功率→转矩 Torque from power	$T = P / \omega, \omega = 2\pi \cdot n / 60$	150 kW @ 12000 rpm → 119.4 Nm
电频率 Electrical frequency	$f_e = n \times p / 60$	4000 rpm, p = 4 → 266.7 Hz
直流输入功率与电流 DC power & current	$P_{dc} = P / (\eta_m \times \eta_{inv}); I_{dc} = P_{dc} / U_{dc}$	104.72 kW, 0.95×0.98, 400 V → 112.5 kW, 281.2 A
轮端转矩与驱动力 Wheel torque & force	$T_w = T \times i \times \eta_g; F = T_w / r$	250 Nm × 9 × 0.97 → 2182.5 Nm; r = 0.33 m → 6614 N
车速 Vehicle speed	$v[\text{km/h}] = n / i \times 2\pi \cdot r \times 60 / 1000$	4000 rpm, i = 9 → 55.3 km/h; 16000 rpm → 221.2 km/h

电池 Battery

项目 Item	公式 Formula	示例 Example
电池包电压/能量 Pack voltage & energy	$U = U_{cell} \times S; E[\text{kWh}] = U \times Ah_{cell} \times P / 1000$	3.65 V × 108S, 150 Ah → 394.2 V, 59.13 kWh
续航 Range	$\text{Range} = E \times SOC_{window} \times 1000 / (\text{Wh/km})$	59.13 × 0.92 / 150 Wh/km → 363 km
充电倍率与电流 C-rate & current	$C = P_{charge} / E; I = P / U$	150 kW → 2.54C, 380.5 A
内阻与发热 Resistance & heat	$R_{pack} = R_{cell} \times S / P; Q = I^2 \cdot R$	0.6 mΩ × 108 → 64.8 mΩ → 9.38 kW
理想充电时间 Ideal charge time	$t[\text{min}] = E \times \Delta SOC / P \times 60$	10–80 %: 16.6 min (恒功率假设)

单位换算 Unit conversions

换算 Conversion	系数 Factor
kW ↔ PS	1 PS = 0.73549875 kW
kW ↔ hp	1 hp = 0.745699872 kW
Nm ↔ lbf · ft	1 Nm = 0.737562149 lbf · ft
km ↔ mi	1 mi = 1.609344 km
kWh/100km → mi/kWh	$\text{mi/kWh} = 100 / (\text{kWh}/100\text{km} \times 1.609344)$
kWh/100km → MPGe	$\text{MPGe} = 33.705 \times \text{mi/kWh}$ (EPA: 1 gal = 33.705 kWh)
rpm → rad/s	$\omega = n \times 2\pi / 60$
kg ↔ lb	1 lb = 0.45359237 kg

2 · 中英术语表 Bilingual glossary (40)

电机 Motor

中文	English	缩写	说明 / Note
永磁同步电机	Permanent magnet synchronous motor	PMSM	转子用永磁体励磁的同步电机，乘用车驱动主流方案 Synchronous motor excited by rotor magnets; mainstream for passenger EV traction
内置式永磁同步电机	Interior permanent magnet motor	IPM	磁钢嵌入转子铁心，可利用磁阻转矩，弱磁范围宽 Magnets buried in rotor core; adds reluctance torque, wide field-weakening range
交流异步电机	AC induction motor	IM / ACIM	转子感应电流产生转矩，无稀土，常用于副驱 Torque from induced rotor current; rare-earth free, often used on secondary axle
电励磁同步电机	Electrically excited synchronous motor	EESM	转子绕组励磁，可调磁、免稀土 Wound-rotor excitation; adjustable field, no rare earth magnets
轴向磁通电机	Axial flux motor	AFM	磁通沿轴向，扁平、高转矩密度 Flux flows axially; flat package with high torque density
定子	Stator	—	电机静止部分，含铁心与绕组 Stationary part with core and windings
转子	Rotor	—	电机旋转部分 Rotating part of the motor
扁线绕组	Hairpin winding	—	矩形截面导体成型绕组，槽满率高 Formed rectangular conductors; high slot fill factor
槽满率	Slot fill factor	—	导体截面积占槽面积比例 Ratio of conductor area to slot area
极对数	Pole pairs	p	电频率 $f = n \cdot p/60$ Electrical frequency $f = n \cdot p/60$

电力电子 Power electronics

中文	English	缩写	说明 / Note
逆变器	Inverter	INV	将直流转为三相交流驱动电机 Converts DC to three-phase AC for the motor
电机控制器	Motor control unit	MCU	包含逆变器与控制软件的控制器 Controller incl. inverter and control software
绝缘栅双极型晶体管	Insulated-gate bipolar transistor	IGBT	硅基功率开关器件 Silicon power switching device
碳化硅 MOSFET	Silicon carbide MOSFET	SiC	开关损耗低，适合 800V 平台 Low switching loss; suited to 800 V platforms
开关频率	Switching frequency	fsw	功率器件每秒开关次数 Number of switching events per second
脉宽调制	Pulse width modulation	PWM	通过占空比合成电压 Synthesizes voltage via duty cycle

电池 Battery

中文	English	缩写	说明 / Note
电芯	Cell	—	电池最小单元 Smallest electrochemical unit

模组	Module	—	多个电芯组合的中间级 Intermediate assembly of cells
电池包	Battery pack	—	含电芯、BMS、热管理、壳体的总成 Assembly with cells, BMS, thermal system and housing
无模组 / 电芯到包	Cell-to-pack	CTP	省去模组层级直接集成到包 Cells integrated directly into pack, no modules
电芯到车身	Cell-to-body	CTB / CTC	电池包上盖兼作车身地板 Pack lid doubles as body floor
可充电储能系统	Rechargeable electrical energy storage system	REESS	UN R100 术语，含动力电池 UN R100 term covering traction batteries
电池管理系统	Battery management system	BMS	监测电压温度电流、估算 SOC、均衡与保护 Monitors V/T/I, estimates SOC, balances and protects
荷电状态	State of charge	SOC	剩余电量占额定容量比例 Remaining charge as share of capacity
健康状态	State of health	SOH	当前容量或内阻相对新品的比例 Capacity or resistance relative to new
功率状态	State of power	SOP	当前可用充放电功率 Currently available charge/discharge power
放电深度	Depth of discharge	DOD	已放出电量占容量比例 Share of capacity discharged
可用能量	Usable energy	—	SOC 窗口内可实际使用的能量 Energy available within the SOC window

热管理 Thermal

中文	English	缩写	说明 / Note
液冷板	Cold plate	—	冷却液流过的换热板 Heat exchanger plate carrying coolant
乙二醇冷却液	Ethylene glycol coolant	EG/W	常用 50/50 乙二醇水溶液 Typically 50/50 glycol-water
热泵	Heat pump	HP	逆向循环制热，提升冬季续航 Reverse cycle heating, improves winter range

整车与测试 Vehicle & test

中文	English	缩写	说明 / Note
纯电动汽车	Battery electric vehicle	BEV	仅由电池驱动 Battery-only propulsion
插电式混合动力	Plug-in hybrid electric vehicle	PHEV	可外接充电的混动 Hybrid that can be plugged in
增程式电动车	Extended-range electric vehicle	EREV	发动机仅发电，电机驱动 Engine only generates power; motor drives
滚动阻力系数	Rolling resistance coefficient	Crr	轮胎滚阻与法向载荷之比 Tyre rolling force divided by normal load
风阻系数	Drag coefficient	Cd	空气阻力无量纲系数 Dimensionless aerodynamic drag coefficient

充电 Charging

中文	English	缩写	说明 / Note
交流充电	AC charging	—	经车载充电机充电 Charging via the on-board charger

直流快充	DC fast charging	DCFC	充电桩直接输出直流 Charger supplies DC directly
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认证 Homologation

中文	English	缩写	说明 / Note
型式认证	Type approval	TA	车辆/零部件上市前的法规符合性认证 Pre-market regulatory approval
生产一致性	Conformity of production	COP	量产产品与认证样品一致 Production matches approved type

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