

Transistors / MOSFETs

Electronics / GPIO -> load

Switch a larger DC load with a low-side transistor circuit.

01 N-channel MOSFET

Connections

Supply + -> load -> drain; source -> GND; MCU GND -> supply GND.

Gate

GPIO -> small series resistor (~100 ohm) -> gate; ~10 kohm gate-to-source pull-down.

Selection

Choose a logic-level part with $R_{DS(on)}$ specified at your actual 3.3 V or 5 V gate drive.

02 NPN alternative

Connections

Load to collector; emitter to GND; base driven through a calculated resistor.

Base resistor

Estimate sufficient base current for saturation, then $R_{base} = (V_{gpio} - V_{BE}) / I_{base}$.
Respect GPIO limits.

Dissipation

Check current, voltage and thermal ratings; a small signal transistor cannot drive every motor.

03 Inductive loads

Flyback diode

Across load: cathode at supply +, anode at transistor drain/collector.

Power loss

MOSFET conduction loss $\sim I^2 \times R_{DS(on)}$, plus switching loss.

Startup

Pull-down keeps the load off while GPIO floats at reset.

Before you power on

Gate threshold voltage is not the fully-on voltage. A single low-side switch cannot reverse a motor.

Transistors / MOSFETs / continued

Electronics / GPIO -> load

Datasheets & further reading

SparkFun transistor guide

<https://learn.sparkfun.com/tutorials/transistors/all>