

Level Shifting

Electrical Engineering

Five ways to join parts on different logic voltages, and where each fails.

Direction and speed decide which method is actually usable.

Method	Direction	Notes
Direct connection	Only if levels overlap	Check V_{IH} and V_{OH} first
Resistor divider	High to low only	Slow; RC rounds the edges
MOSFET and pull-ups	Both directions	The standard I2C answer
Dedicated shifter IC	Fixed or automatic	Fastest and most reliable
Open drain to a rail	Low to high	Only on open-drain outputs

A 5 V output into a 3.3 V pin conducts through the protection diode and can damage the part quietly, while appearing to work.