Connection

- Open-drain connection: Can only pull the line LOW or leave it in high-Z. Can NOT drive it high, you need a pullup resistor.

Out

IC Logic ——| NMOS ——▷ Thus the IC can only pull the output to GND when the gate is ON.

When OFF, output is left at high-Z (high impedance).
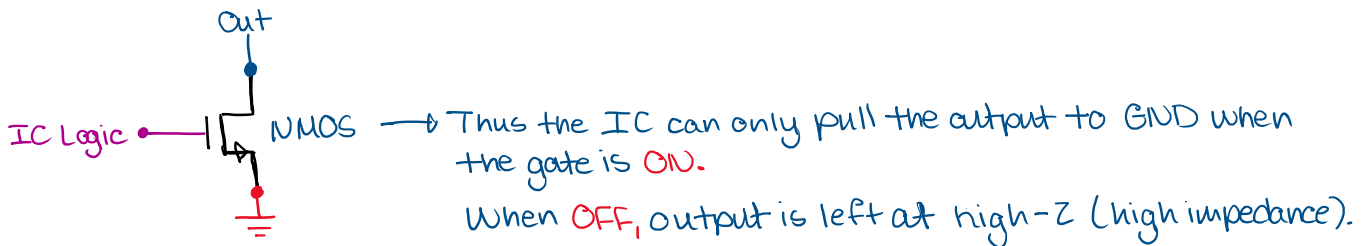
Remember for cut-off: $V_{GS} < V_T$

- Both SDA and SCL are open-drain, thus they need pull up resistors to have HIGH outputs. They both implement NMOS transistors.

5V

VDD

Pullup resistor

5V drop when NMOS is on

SDA or SCL

0V

Device I²C logic

SDA or SCL Voltage
VDD

When the NMOS turns on, SDA or SCL is pulled low

GND

GND

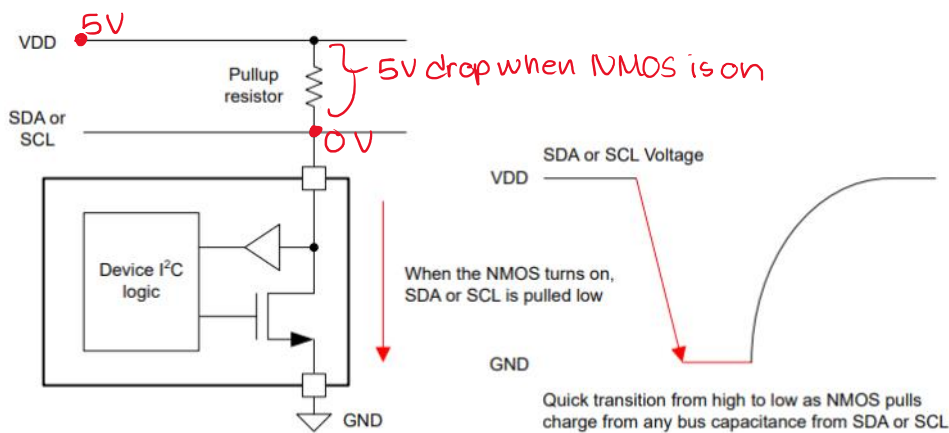Quick transition from high to low as NMOS pulls charge from any bus capacitance from SDA or SCL

Figure 2-2. Open-Drain Connection Pulls Line Low When NMOS is Turned On

- When the NMOS is ON, current is pulled through the resistor to GND. Thus we have a 5V drop across the resistor which makes the output LOW.

- When the NMOS is OFF, it acts like an open circuit, so clock/data is left HIGH.

- TLDR, you can think of the NMOS as an active-low switch.