

# Common drain

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In electronics, a **common-drain** amplifier, also known as a **source follower**, is one of three basic single-stage field effect transistor (FET) amplifier topologies, typically used as a voltage buffer. In this circuit the gate terminal of the transistor serves as the input, the source is the output, and the drain is common to both (input and output), hence its name. The analogous bipolar junction transistor circuit is the common-collector amplifier.

In addition, this circuit is used to transform impedances. For example, the Thévenin resistance of a combination of a voltage follower driven by a voltage source with high Thévenin resistance is reduced to only the output resistance of the voltage follower, a small resistance. That resistance reduction makes the combination a more ideal voltage source. Conversely, a voltage follower inserted between a small load resistance and a driving stage presents an infinite load to the driving stage, an advantage in coupling a voltage signal to a small load.

## Characteristics

At low frequencies, the source follower pictured at right has the following small signal characteristics.<sup>[1]</sup>

**Voltage gain:**

$$A_v = \frac{v_{\text{out}}}{v_{\text{in}}} = \frac{g_m R_S}{g_m R_S + 1} \approx 1 \quad (g_m R_S \gg 1)$$

**Current gain:**

$$A_i = \infty$$

**Input impedance:**

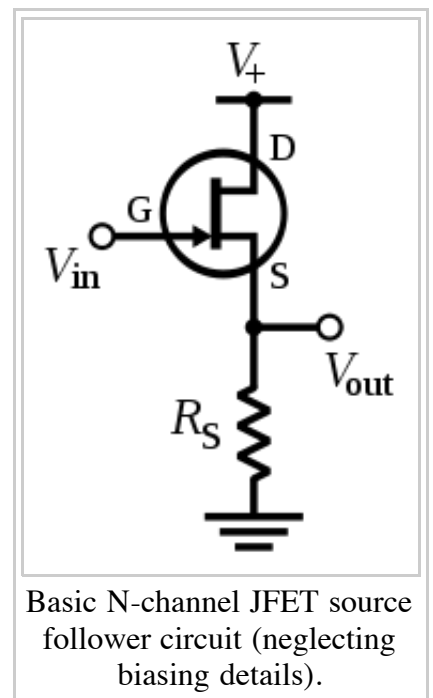
$$r_{\text{in}} = \infty$$

**Output impedance:** (the parallel notation  $A \parallel B$  indicates the impedance of components  $A$  and  $B$  that are connected in parallel)

$$r_{\text{out}} = R_S \parallel \frac{1}{g_m} = \frac{\frac{R_S}{g_m}}{R_S + \frac{1}{g_m}} = \frac{R_S}{g_m R_S + 1} \approx \frac{1}{g_m} \quad (g_m R_S \gg 1)$$

The variable  $g_m$  that is not listed in Figure 1 is the transconductance of the device (usually given in units of siemens).

## References



1. ^ Common Drain Amplifier or Source Follower  
(<http://webpages.eng.wayne.edu/cadence/ECE7570/doc/cdrain3.pdf>) —Circuit analysis, low frequency, high frequency, and impedance calculations.

## See also

- Buffer amplifier
- Common collector

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