Common Gate Amplifier

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A common gate amplifier is a type of field-effect transistor (FET) amplifier configuration. In this circuit, the gate terminal of the FET is a common connection to both the input and output of the amplifier, hence the name "common gate." Common gate amplifiers are often used to provide voltage gain and impedance matching between different stages of a circuit. Here's the theory of operation for a common gate amplifier:

Components: The common gate amplifier consists of an N-channel enhancement-mode FET (such as a MOSFET), resistors, capacitors, and a power supply.

Biasing: Proper biasing is essential to ensure the FET operates in its active region. This typically involves setting a DC voltage at the source terminal (Vss) and at the drain terminal (Vdd) while connecting the gate to a common ground (0V or GND). Biasing sets the quiescent operating point (Q-point) of the FET.

Signal Input: The input signal is applied to the source terminal (Vin). This AC signal is superimposed on the DC bias voltage. The input resistor (Rs) limits the source current and helps match the input impedance of the amplifier.

FET Action: The FET amplifies the input signal. When a positive voltage is applied at the source (Vin increases), it causes an increase in the source-drain voltage (Vsd), which, in turn, causes an increase in the drain current (Id). The FET operates in its active region, and its drain current is controlled by the gate-source voltage.

Drain Load Resistor: A drain load resistor (Rd) is connected to the drain terminal. It converts the change in drain current into an amplified output voltage. The voltage across Rd is the amplified signal (Vout).

Source Resistor (Rs): The source resistor (Rs) is used to set the source current and, in some cases, to provide negative feedback, which can improve linearity and stability.

Output Signal: The amplified signal appears at the drain terminal. The output is typically taken as the voltage across the drain resistor (Vout = Id * Rd).

Output Coupling Capacitor (Optional): If a DC component is present at the drain, it is blocked using an output coupling capacitor (Cout) to ensure that only the AC component of the signal is passed to the next stage of the circuit.

Gain and Phase: The common gate amplifier provides voltage gain that depends on the values of the drain resistor and the transconductance of the FET. The output signal is typically in phase with the input signal.

Common gate amplifiers are often used as buffer or impedance matching stages between different parts of a circuit, such as between a high-impedance signal source and a low-impedance load. They are also suitable for applications where voltage gain is required, and the input impedance needs to be relatively low. Proper biasing and component values are essential to ensure proper operation and meet specific performance requirements.

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Revision History

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