IIT ROORKEE

NPTEL ONLINE CERTIFICATION COURSE

MICRORLECTRONICS: DEVICES TO CIRCUITS

CMOS CS/CG/CD Amplifier Configuration

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DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

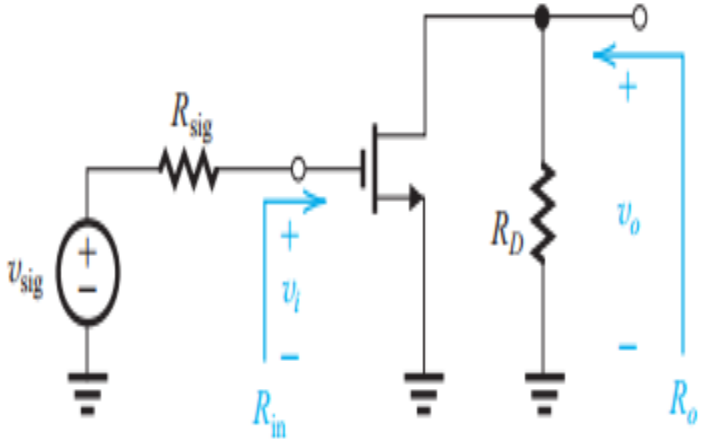


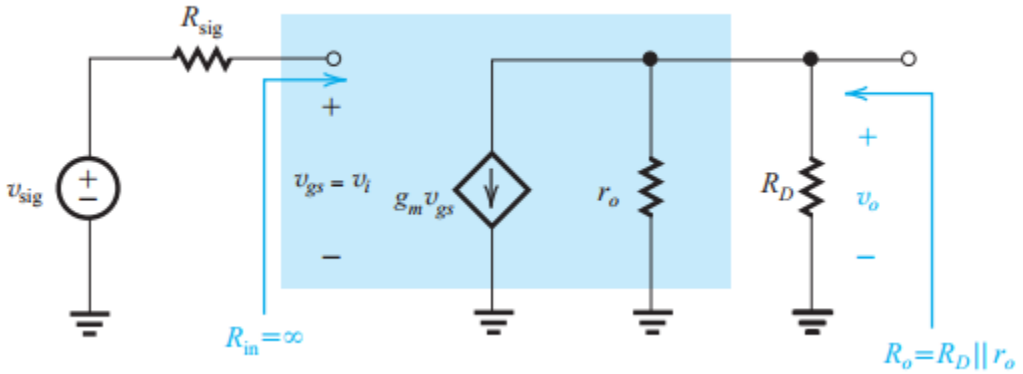
Outline

- Common source (CS) Amplifier
- Characteristics parameters of (CS) Amplifier
- (CS) Amplifier with source resistance
- Common Gate (CG) Amplifier
- Common Drain (CD) Amplifier or Source follower
- Recapitulation

Common source (CS) Amplifier

- Common –source stage is the most widely used for amplification.





Source: Microelectronics Circuits, Sedra and Smith, Fifth edition

Characteristics parameters of (CS) Amplifier

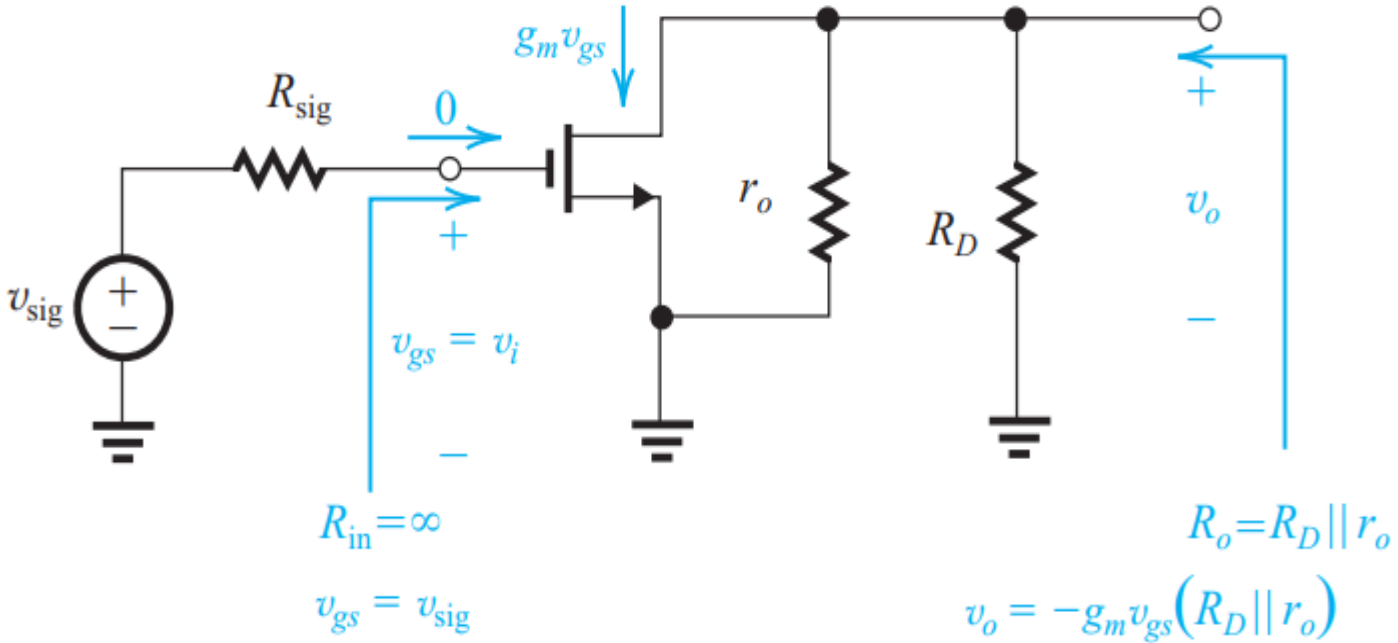
Input resistance of CS stage is $R_{in} = \infty$

Open loop gain of the CS stage is $A_{vo} = -g_m(R_D \| r_o)$

Output resistance of the CS stage is $R_o = (R_D \| r_o)$

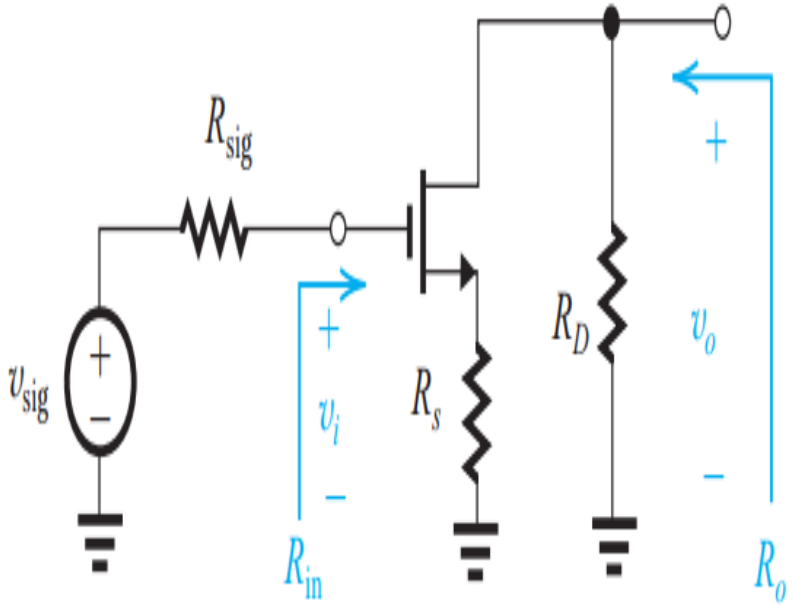
- Input resistance is ideally infinite.
- The out put resistance moderate to high (in kilo-ohm range).
- The open circuit voltage gain can be high.
- The bandwidth if CS stage is severely limited.

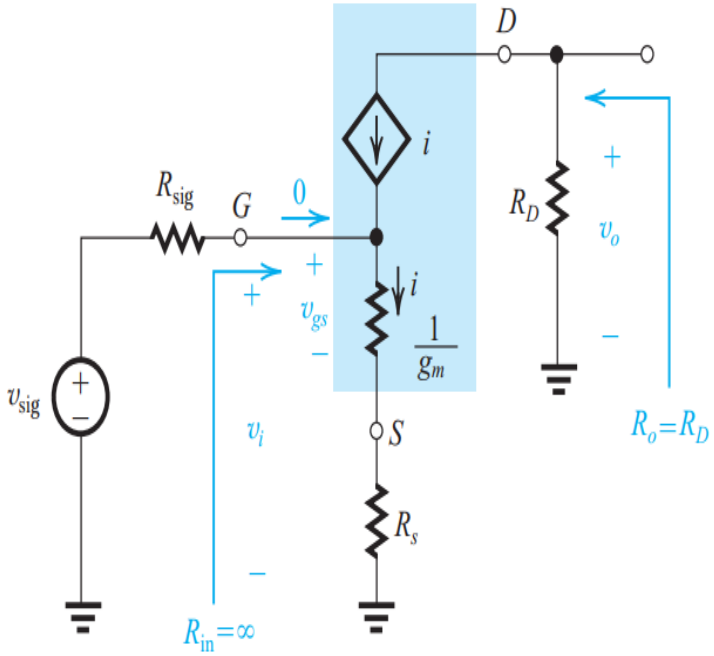
Source: Microelectronics Circuits, Sedra and Smith, Fifth edition



Source: Microelectronics Circuits, Sedra and Smith, Fifth edition

(CS) Amplifier with source resistance





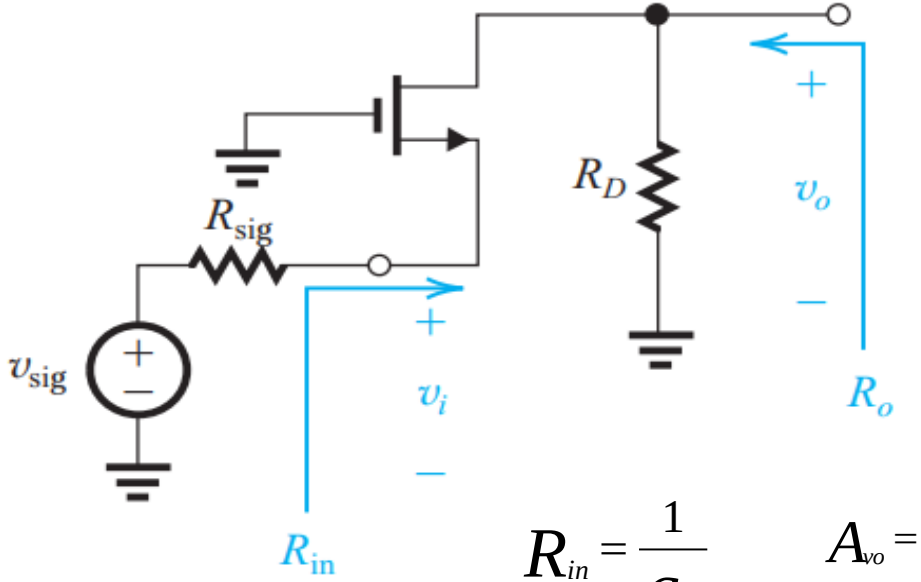
Source: Microelectronics Circuits, Sedra and Smith, Fifth edition

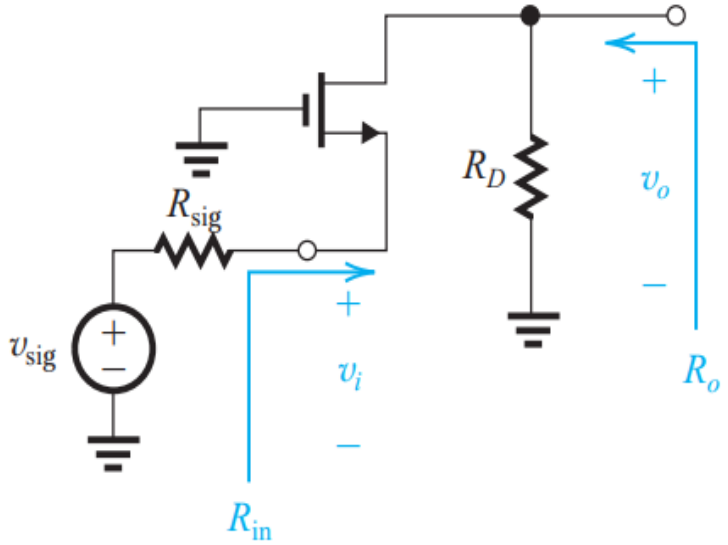
$$A_{vo} = -\frac{g_m R_D}{1 + g_m R_S}$$

- The resistance R_S reduces the voltage gain by the factor $1 + g_m R_S$.
- The factor $1 + g_m R_S$ is the amount of negative feedback introduce by R_S
- Negative- feedback action of R_S known as source-degeneration resistance.
- Bandwidth increased by factor of $1 + g_m R_S$.

Source: Microelectronics Circuits, Sedra and Smith, Fifth edition

Common Gate (CG) Amplifier





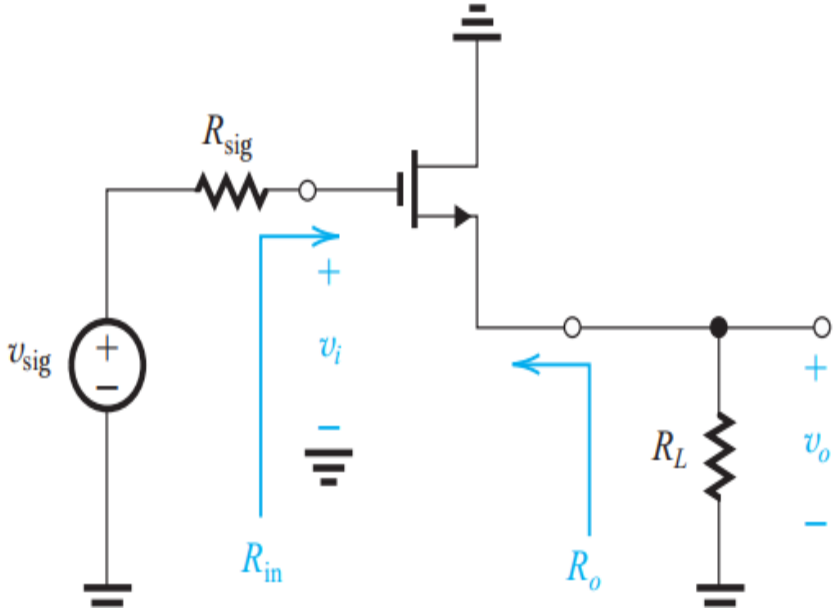
$$R_{in} = \frac{1}{g_m}$$

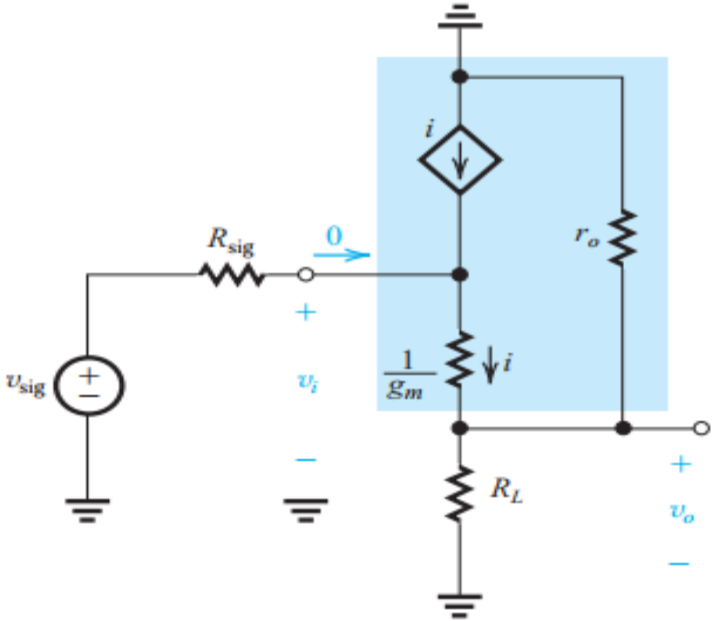
$$A_{vo} = g_m R_D$$

$$R_o = R_D$$

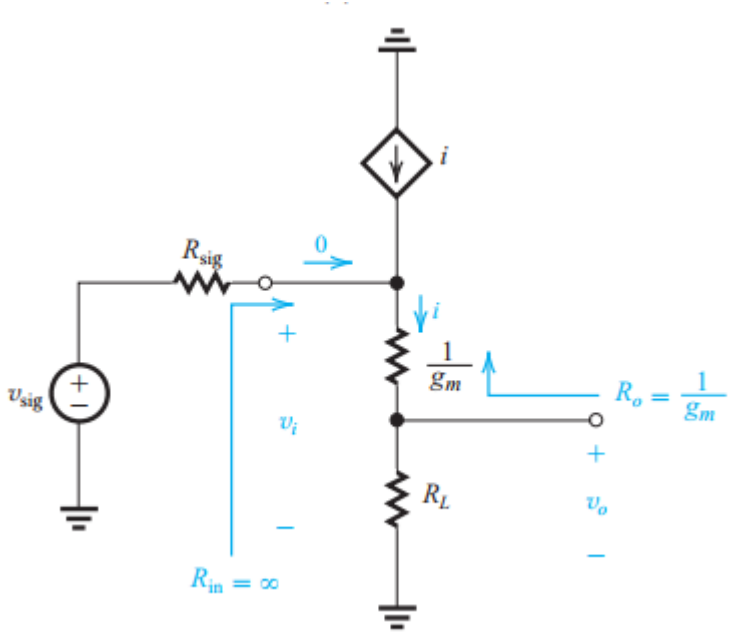
Source: Microelectronics Circuits, Sedra and Smith, Fifth edition

Common Drain (CD) Amplifier or Source follower





Source: Microelectronics Circuits, Sedra and Smith, Fifth edition



$$R_o = \frac{1}{g_m}$$

$$A_{vo} = 1$$

$$R_{in} = \infty$$

Source: Microelectronics Circuits, Sedra and Smith, Fifth edition

Recapitulation

Configuration	Voltage gain	Current gain	Input resistance	Output resistance
Common source	$A_v > 1$	—	R_{TH}	Moderate to high
Source follower	$A_v \cong 1$	—	R_{TH}	Low
Common gate	$A_v > 1$	$A_i \cong 1$	Low	Moderate to high

Source: Microelectronics Circuit Analysis and Design Donald A. Neamen, Fourth edition

Thank You