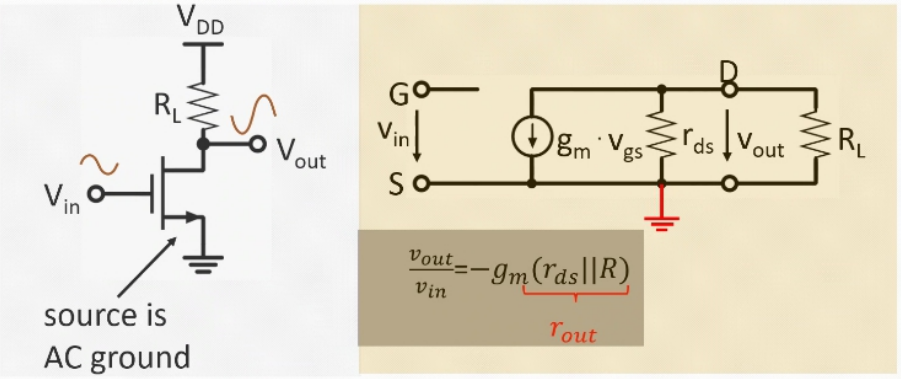
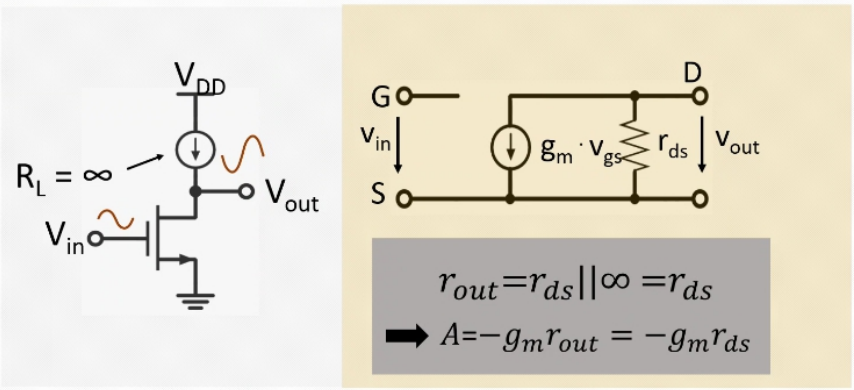
Basic Analog Blocks and Amplifiers

Common Source Amplifier



Generally we can write for an amplifier: $A=-g_m r_{out}$

Better Common Source Amplifier

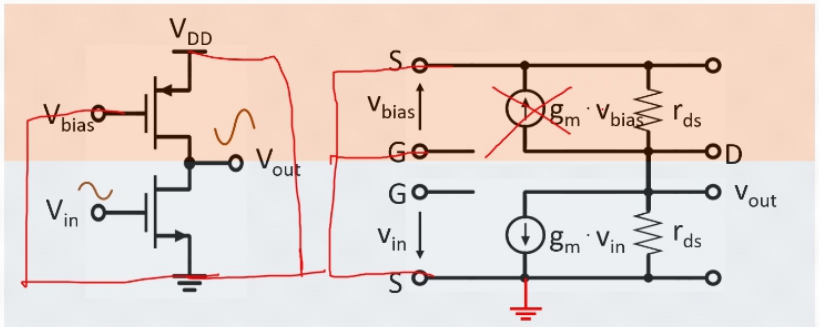


$$r_{out}=r_{ds}||\infty=r_{ds}$$

$$\Rightarrow A=-g_m r_{out}=-g_m r_{ds}$$

How to implement the current source load?

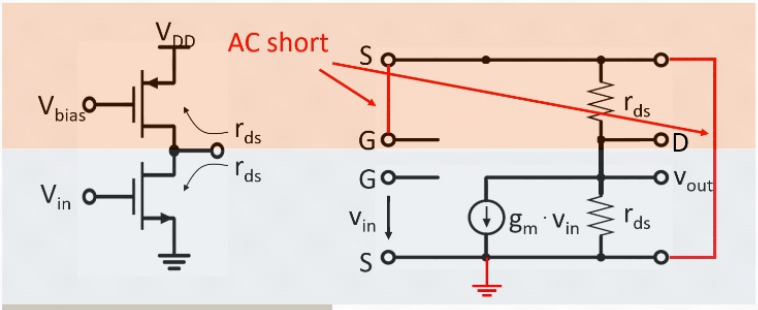
Better Common Source Amplifier



The PMOS load implements a current source with $r_{out} = r_{ds}$

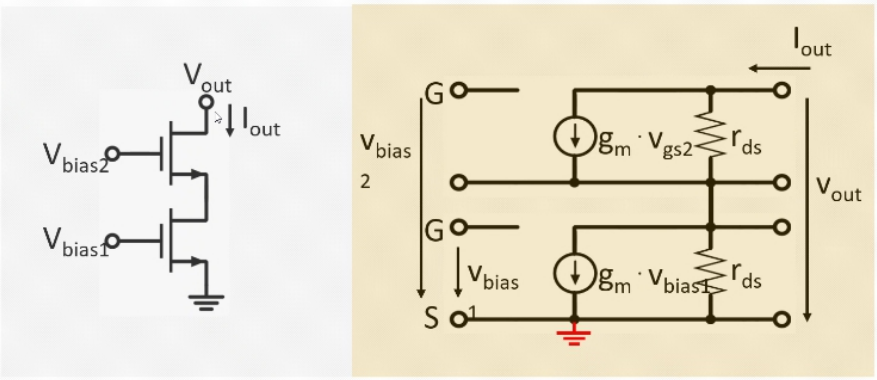
上半部分相当于提供一个大的 Rds

Better Common Source Amplifier

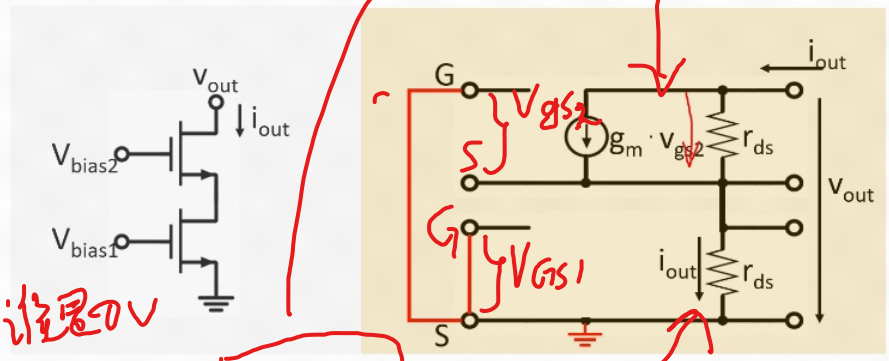


$$A=-g_m r_{out}=-g_m \frac{r_{ds}}{2}$$

Cascode Load



Cascode Load



注意这是0V

$v_{gs2}=-i_{out}r_{ds}$ $-g_m V_{GS}$

➡ $v_{out} = (i_{out} + g_m i_{out} r_{ds}) \cdot r_{ds} + i_{out} r_{ds}$

➡ $r_{out} = \frac{v_{out}}{i_{out}} = (1 + g_m r_{ds}) \cdot r_{ds} + r_{ds} \approx g_m r_{ds}^2$

$r_{ds}^2 >> 2r_{ds}$