



Find closed-loop gain and I/O impedances.

Recognise a common gate amplifier with open loop gain $A_1 = g_m (R_D \parallel [R_1 + R_2])$
 $\approx g_m R_D$
 because $R_1 + R_2 \gg R_D$.

To find the loop gain, notice that M_1 acts as a common source stage with respect to V_{test} .

∴ Gain through M_1 is $-g_m R_D$.
 ∴ Loop gain $= -\frac{V_{out}}{V_{test}} = + \left(\frac{R_2}{R_1 + R_2} \right) g_m R_D$

∴ Closed-loop gain $= \frac{g_m R_D}{1 + \left(\frac{R_2}{R_1 + R_2} \right) g_m R_D}$

Open-loop input impedance $= \frac{1}{g_m}$.
 ∴ Closed-loop input impedance $= \frac{1}{g_m} \left(1 + \frac{R_2}{R_1 + R_2} g_m R_D \right)$.

Open-loop output impedance $= R_D$

∴ Closed-loop output impedance $= \frac{R_D}{1 + \frac{R_2}{R_1 + R_2} g_m R_D}$