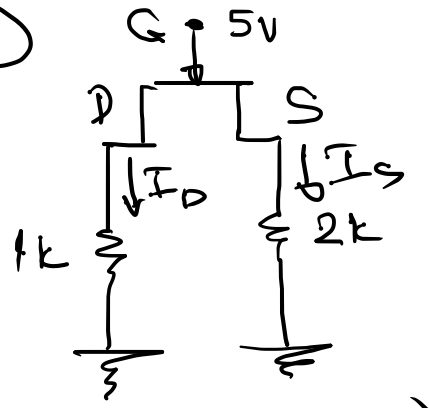
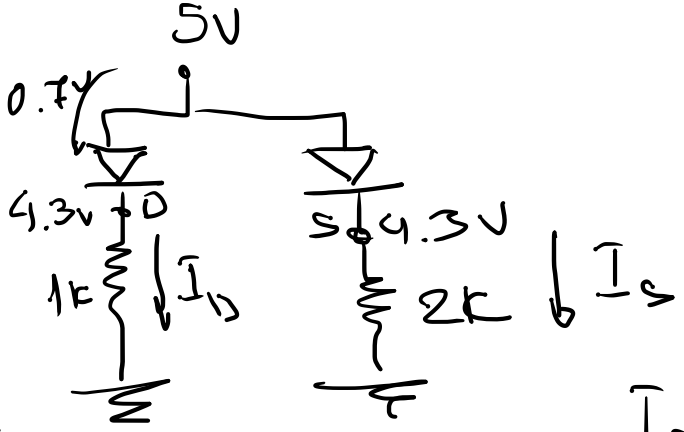
1



ΥΠΟΛΟΓΙΣΤΕ I_D, I_S

ΕΠΕΙΔΗ $V_G > V_S$ ΤΟ JFET ΛΕΙΤΟΥΡΓΕΙ

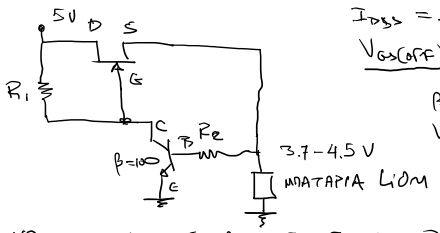
$V_G > V_D$ ΕΑΝ ΔΥΟ ΔΙΟΔΟΙ ΟΡΘΑ ΠΟΛΩΜΕΝΟΙ



$$I_D = \frac{4.3}{1k} = 4.3\,mA$$

$$I_S = \frac{4.3}{2k} \approx 2.15\,mA$$

② ΦΟΡΤΙΣΤΗΣ ΜΠΑΤΑΡΙΩΝ Li-Ion



$I_{DSS} = 1A$
$V_{GS(OFF)} = -3V$ | JFET

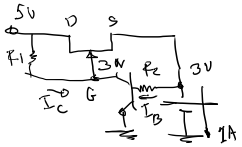
β=100
$V_{CE(SAT)} = 0.2V$ | BJT

ΥΠΟΛΟΓΙΣΕ ΤΙΣ ΑΝΤΙΣΤΑΣΕΙΣ R_1, R_2 ΕΤΣΙ Η ΣΤΕ

① ΟΤΑΝ Η ΜΠΑΤΑΡΙΑ ΕΧΕΙ ΤΑΣΗ 3V ΤΟ ΡΕΥΜΑ ΦΟΡΤΙΣΗΣ ΝΑ ΕΙΝΑΙ ΠΕΡΙΠΟΥ 1A.

② ΟΤΑΝ Η ΜΠΑΤΑΡΙΑ ΦΤΑΝΕΙ ΣΕ ΤΑΣΗ 4.5V ΤΟ ΡΕΥΜΑ ΦΟΡΤΙΣΗΣ ΝΑ ΕΙΝΑΙ ΠΡΑΚΤΙΚΑ ΜΗΔΕΝ.

ΠΕΡΙΠΤΩΣΗ 1.



$V_B = 0.7V$

R_2: $3V - 0.7V = \boxed{R_2 \cdot I_B = 2.3V}$ ①

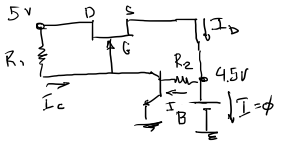
$V_G = 5V - R_1 \cdot I_C = 5V - R_1 \beta I_B$ ⇒

$I_D = I_{DSS} = 1A \Rightarrow V_{GS} = 0 = V_G - V_S = V_G - 3V = 0 \Rightarrow \boxed{V_G = 3V}$

$\Rightarrow 3V = 5V - 100 \cdot R_1 \cdot I_B \Rightarrow R_1 \cdot I_B = \frac{2V}{100} \Rightarrow \boxed{R_1 I_B = 0.02V}$ ②

$\frac{①}{②} \Rightarrow \frac{R_2}{R_1} = \frac{2.3}{0.02} \Rightarrow \boxed{R_2 = 115 \cdot R_1}$ ③

ΠΕΡΙΠΤΩΣΗ 2:



R_2: $4.5 - 0.7 = \boxed{R_2 \cdot I_B = 3.8V}$ ④

$I_D = I_B$

③+④ $\Rightarrow 115 \cdot R_1 I_B = 3.8V \Rightarrow$

$\Rightarrow R_1 I_B = \frac{3.8V}{115} \Rightarrow \boxed{R_1 \cdot I_B = 33mV}$ ⑤

$I_D = I_B = I_{DSS}\left(1 - \frac{V_{GS}}{V_{GS(OFF)}}\right)^2 =$

$I_D = I_B = (1A)\left(1 - \frac{V_G - V_S}{-3}\right)^2 = \left(1 - \frac{5 - R_1 \cdot I_C - 4.5}{-2}\right)^2 = \left(1 + \frac{0.5 - R_1 \beta I_B}{+3}\right)^2$

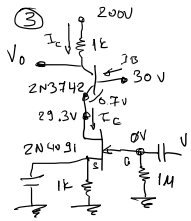
$\Rightarrow 9 I_B = \left(3.5 - 100 I_B R_1\right)^2 \Rightarrow 9 I_B = \left(3.5 - 100 I_B R_1\right)^2$ ⇒

$\Rightarrow 9 I_B = (3.5 - 3.3)^2 \Rightarrow 9 I_B = (0.2)^2 \Rightarrow$

⑤ $\Rightarrow R_1 I_B = 33mV$

$\boxed{I_B = 4.4mA}$ ⑤ $\Rightarrow R_1 = \frac{33mV}{4.4mA} = 7.5\Omega \Rightarrow \boxed{R_1 = 7.5\Omega}$

③ $\Rightarrow R_2 = 115 R_1 \Rightarrow R_2 = 115 \times 7.5\Omega \Rightarrow \boxed{R_2 = 862.5\Omega}$



DC-ΑΝΑΛΥΣΗ AC-ΑΝΑΛΥΣΗ $\frac{V_o}{V_i} = ;$

JFET 2N4091: $I_{DSS} = 30mA$, $r_{DS(ON)} = 15\Omega$, $V_{GS(OFF)} = -8V$

BJT 2N3742 $\beta \cong 50$

ΥΠΟΘΕΤΩ JFET ΣΤΗ ΕΝΕΡΓΟ ΠΕΡΙΟΧΗ:

$$I_D = I_{DSS}\left(1 - \frac{V_{GS}}{V_{GS(OFF)}}\right)^2 = 30mA\left(1 - \frac{V_G - V_S}{-8V}\right)^2 =$$

$$= (30mA)\left(1 - \frac{-V_S}{-8}\right)^2 = (30mA)\left(1 - \frac{(1k)I_D}{8}\right)^2 \Rightarrow$$

$$\boxed{I_D = (30mA)(1 - 125 I_D)^2} \Rightarrow \quad I_{D1} = \cancel{15mA}$$

$$I_{D2} = 4.8mA$$

ΑΠΟΚΛΕΙΕΤΑΙ ΔΙΟΤΙ $V_{GS} = -13V$ ΑΕΝΑΛΙΣΑΤΟ ΜΕ ΤΟ $V_{GS(OFF)} = -8V$

$V_{S1} = (1k)\cdot 13mA = 13V$

ΔΕΚΤΟ $\boxed{I_D = 4.8mA} \Rightarrow I_C = 4.8mA$

KCL $\Rightarrow I_C + I_B = I_E \Rightarrow \beta I_B + I_B = I_C \Rightarrow I_B(\beta+1) = I_E \Rightarrow$

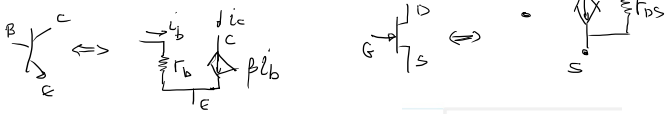
$I_B \beta = I_C$

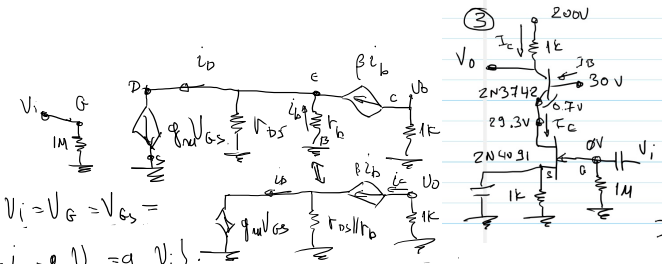
$$\frac{I_C}{I_E} = \frac{\beta}{\beta+1} \Rightarrow \boxed{I_C = \frac{\beta}{\beta+1} I_E} \Rightarrow \quad I_C = \frac{50}{51}\times 4.8 \Rightarrow \boxed{I_C = 4.7mA}$$

$V_O = 200 - (1k) I_C = 200 - (4.7mA)(1k) = 200 - 4.7V \Rightarrow$

$$\Rightarrow \boxed{V_o = 195.3V}$$

AC-ΑΝΑΛΥΣΗ.





$V_i = V_G = V_{GS} =$

$i_e = i_D = g_m V_{GS} = g_m V_i$

$i_c = \beta i_b = -\frac{V_o}{1K}$

$$\frac{i_c}{i_e} = \frac{\beta}{\beta+1} = \frac{-\frac{V_o}{1K}}{g_m V_i} \Rightarrow \frac{V_o}{(1k) g_m V_i} = -\frac{\beta}{\beta+1} \Rightarrow$$

$$\boxed{\frac{V_o}{V_i} = -\frac{\beta}{\beta+1}(1k) g_m} \quad (A)$$

$$g_m = \left|\frac{2 I_{DSS}}{V_{GS(OFF)}}\right|\left(1 - \frac{V_{GS}}{V_{GS(OFF)}}\right) \Rightarrow$$

DC ΑΝΑΛΥΣΗ $I_D = 4.8mA \Rightarrow V_{GS} = -I_D \cdot 1K \Rightarrow$

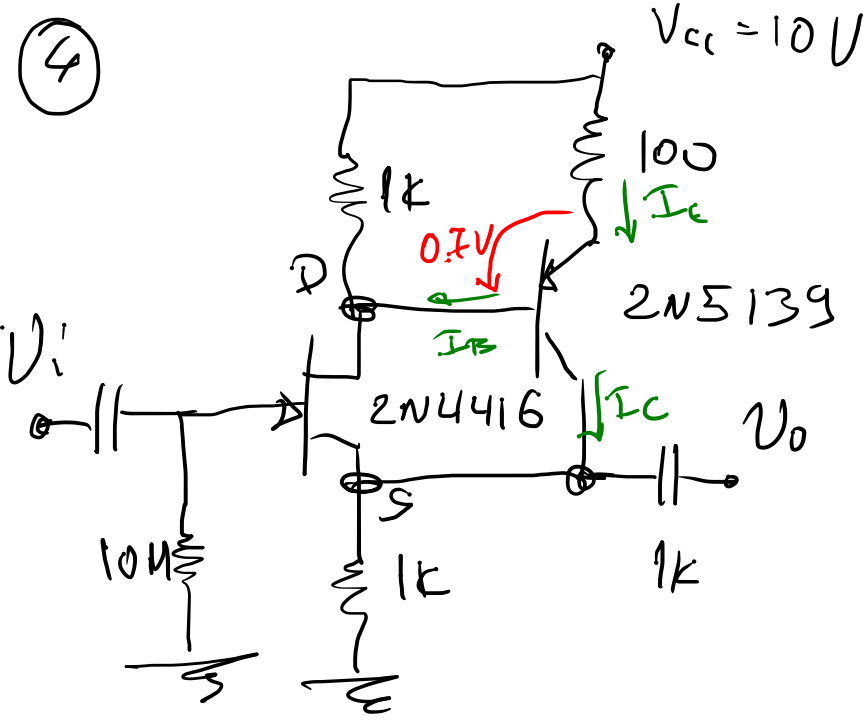
$\Rightarrow V_{GS} = -4.8V$

$$\Rightarrow g_m = \frac{2\times 30mA}{8}\left(1 - \frac{-4.8}{-8}\right) \Rightarrow$$

$$\Rightarrow g_m = \frac{30mA}{4}(0.4) \Rightarrow \boxed{g_m = 3mS} \quad (B)$$

$(A) \to (B) \Rightarrow \frac{V_o}{V_i} = -\frac{50}{51}(1k)\times 3mS \Rightarrow \boxed{\frac{V_o}{V_i} = -2.94}$

(4)



2N4416

$I_{DSS} = 10\,mA$

$V_{GS(off)} = -5\,V$

$V_{DS(on)} \simeq 150\,\Omega$ max

DC-ANALYSIS

2N5139

$\beta \simeq 50$

$r_b \simeq 20\,\Omega$

AC-ANALYSIS

$\frac{V_o}{V_i} = ?$