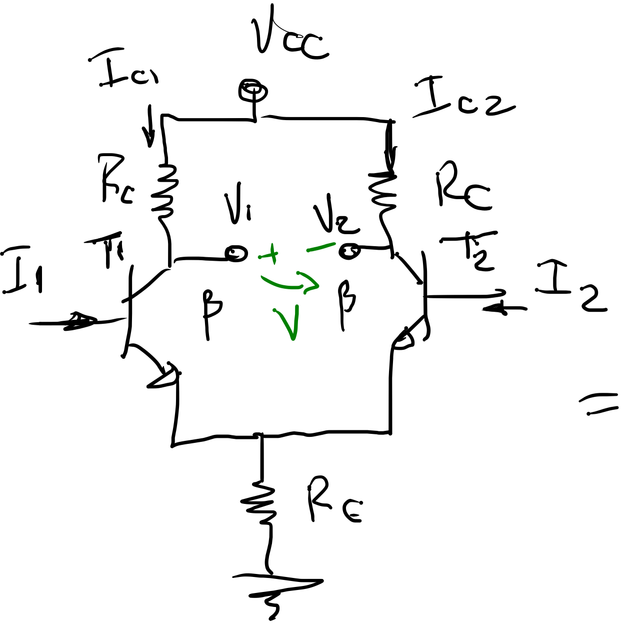
BJT : ΕΝΕΡΓΟΣ ΠΕΡΙΟΧΗ

ΙΔΙΑ T_1 T_2



$$V = V_1 - V_2 =$$

$$= (V_{CC} - R_C I_{C1}) - (V_{CC} - R_C I_{C2}) =$$

$$= \cancel{V_{CC}} - R_C I_{C1} - \cancel{V_{CC}} + R_C I_{C2} =$$

$$= R_C (I_{C2} - I_{C1})$$

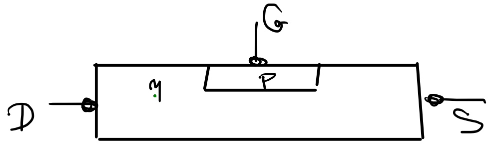
$$I_{C1} = \beta I_1$$

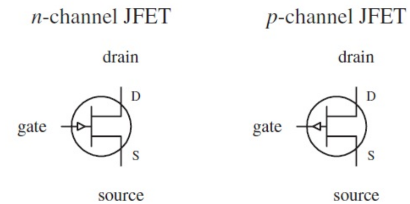
$$I_{C2} = \beta I_2$$

$$\Rightarrow V = R_C (\beta I_2 - \beta I_1)$$

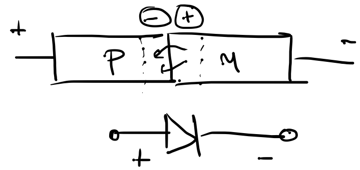
$$\Rightarrow V = R_C \beta (I_2 - I_1)$$

JFET

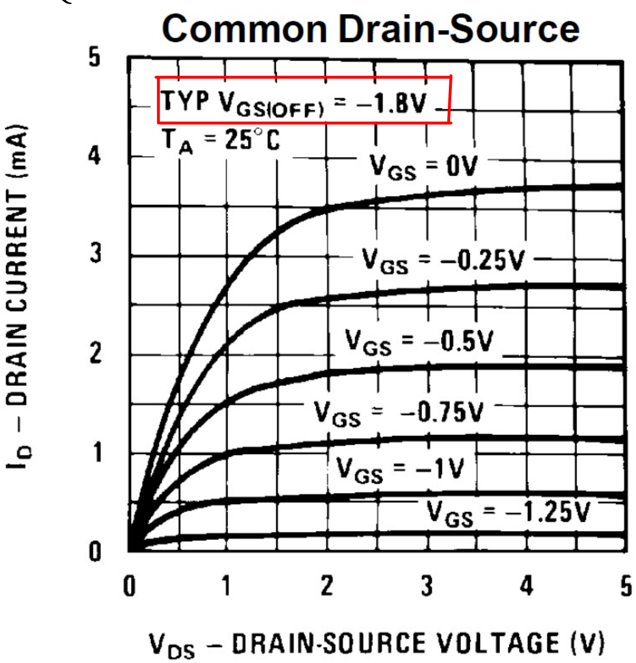


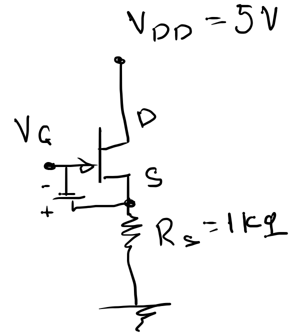


ΔΙΟΔΟΣ



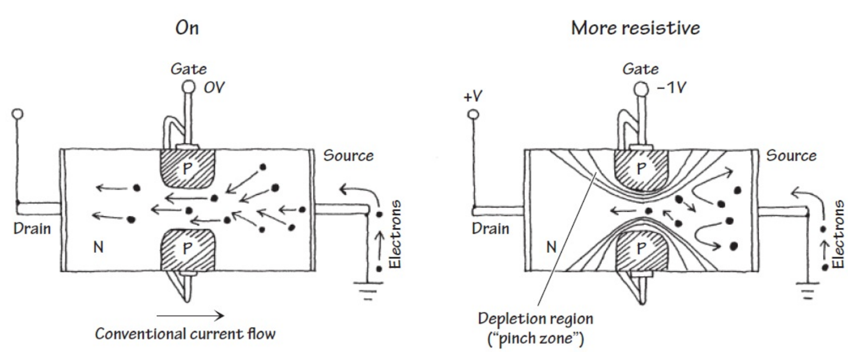
(2N5457)



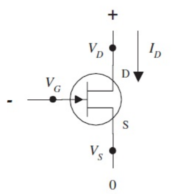


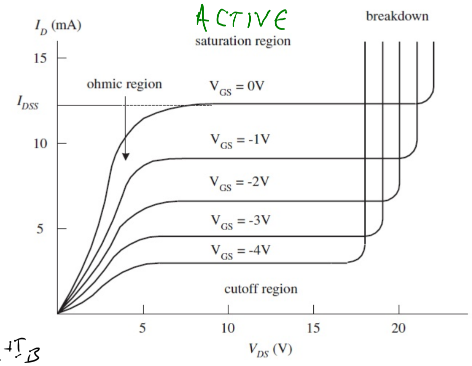
Αν $V_{GS} = 0 \Rightarrow I_D = I_{DSS}$

Αν $I_D = 0 \Leftarrow V_{GS(OFF)}$
ΕΙΝΑΙ Η ΕΛΑΧΙΣΤΗ
ΤΑΣΗ V_{GS} ΠΟΥ
ΚΑΝΕΙ ΤΟ $I_D = 0$.



n-channel





$I_E = I_C + I_B$

DRAIN CURRENT (OHMIC REGION)

$$I_D = I_{DSS}\left[2\left(1-\frac{V_{GS}}{V_{GS,\text{off}}}\right)\frac{V_{DS}}{-V_{GS,\text{off}}}-\left(\frac{V_{DS}}{V_{GS,\text{off}}}\right)^2\right]$$

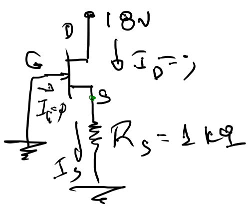
DRAIN CURRENT (ACTIVE REGION)

$$I_D = I_{DSS}\left(1-\frac{V_{GS}}{V_{GS,\text{off}}}\right)^2$$

$$V_{GS} = V_G - V_S \quad (V_G \to \emptyset)$$

ΠΑΡΑΔΕΙΓΜΑ: ΓΙΑ ΤΟ JFET ΓΝΩΡΙΖΩ $I_{DSS} = 8mA$

$V_{GS,OFF} = -4V$



ΥΠΟΛΟΓΙΣΕ ΤΟ I_D

ΥΠΟΘΕΤΩ JFET ΣΤΗΝ ΕΝΕΡΓΟ ΠΕΡΙΟΧΗ.

ΤΟΤΕ $I_D = I_{DSS}\left(1-\frac{V_{GS}}{V_{GS,off}}\right)^2 = 8mA\left(1-\frac{V_{GS}}{-4V}\right)^2 =$

$I_D = 8mA\left(1+\frac{V_{GS}}{2}+\frac{V_{GS}^2}{16}\right)$

ΕΧΩ $V_{GS} = V_G - V_S = \emptyset - V_S$, $I_D = I_S = \frac{V_S}{R_S} = \frac{V_S}{1k\Omega}$ ⇒

$\frac{V_S}{1k\Omega} = 8mA\left(1+\frac{-V_S}{2}+\frac{V_S^2}{16}\right) \Rightarrow V_S^2 - 10V_S + 16 = \emptyset \Rightarrow$

$V_S = 2V$, $V_S = 8V \Rightarrow V_{GS} = -V_S \Rightarrow V_{GS} = -8V$ ΑΔΥΝΑΤΟΝ ΔΙΟΤΙ $V_{GS,OFF} = -4V$

ΕΠΟΜΕΝΩΣ $\boxed{V_{GS} = -V_S = -2V}$

$I_S = I_D = \frac{+V_S}{R_S} = \frac{2V}{1k\Omega} = 2mA \Rightarrow \boxed{I_D = 2mA}$

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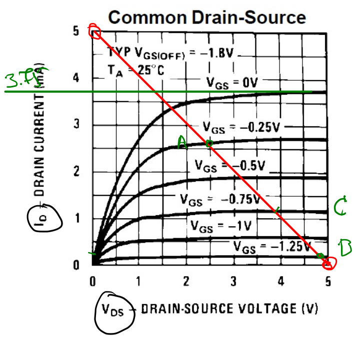

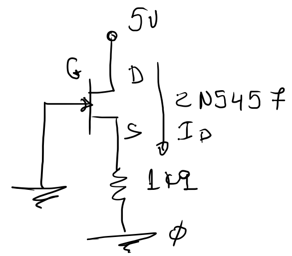

$V_G = \emptyset$

KVL ⇒ $5V = V_{DS} + I_D \cdot (1k\Omega)$ ⇒

$5V = V_{DS} + (1k\Omega) I_D$

$I_D = \emptyset \Rightarrow V_{DS} = 5V$ $\quad V_{DS} = \emptyset \Rightarrow I_D = \frac{5V}{1k\Omega} = 5mA$

ΕΣΤΩ ΟΤΙ ΕΙΜΑΙ ΣΤΟ Α. → $V_{GS} = -0.25V \Rightarrow V_S = 0.25V$

ΓΡΑΦΙΚΗ ΕΠΙΛΥΣΗ → ☺ $\quad$ (A) $I_D = \frac{0.25}{1k\Omega} = \frac{250\,mV}{1\,k\Omega} = 250\mu A$

[illegible] B ↘ $V_{GS} = -1.25 \Rightarrow V_S = 1.25V$

(B) $I_D = \frac{1.25}{1k\Omega} = 1.25mA$ $\quad$ ΠΡΟΣΠΑΘΩ [illegible] ΝΑ ΤΟ ΠΕΤΥΧΩ

ΓΝΩΡΙΖΩ $V_{GS,off} = -1.8V$

ΑΡΙΘΜΗΤΙΚΗ ΕΠΙΛΥΣΗ. $\quad I_{DSS} = 3.75mA$ $\quad I_D = I_{DSS}\left(1 - \frac{V_{GS}}{V_{GS,off}}\right)^2 \Rightarrow I_D = (3.75mA)\left(1 - \frac{V_{GS}}{-1.8}\right)^2$

$\Rightarrow I_D = (3.75mA)\left(\frac{-1.8 - V_{GS}}{-1.8}\right)^2 = \frac{(3.75mA)}{(1.8)^2}(V_{GS} + 1.8)^2 \Rightarrow$

$V_{GS} = \emptyset - V_S = -(1k\Omega) \cdot I_D$ ⇒

$I_D = (1.15)(-1k\Omega \cdot I_D + 1.8)^2 \, 10^{-3} \Rightarrow 10^3 I_D = 1.15(1.8^2 - 2(1.8)10^3 I_D +$

$1000^2 \cdot I_D^2 \Rightarrow 10^3 I_D = 1.15 \times 1.8^2 - 3.6 \cdot 10^3 I_D + (1000 \cdot I_D)^2$ ⇒

ΘΑ ΥΠΟΛΟΓΙΣΩ ΤΟ I_D ΣΕ mA

I_D(mA) ⇒ $I_D = 3.762 - 3.6 I_D + I_D^2 \Rightarrow I_D^2 - 4.6 I_D + 3.762 = \emptyset \Rightarrow$

$\Rightarrow$ $\boxed{I_D \cong 1mA \;\vee\; I_D \cong 3.54mA}$

ΕΧΩ ΔΥΟ ΛΥΣΕΙΣ.
Η ΔΕΥΤΕΡΗ ΛΥΣΗ ΕΙΝΑΙ ΚΟΝΤΑ ΣΤΟ I_{DSS} (3.75mA) ΟΠΟΤΕ ΕΠΙΛΕΓΩ ΤΗΝ

ΠΡΩΤΗ ΛΥΣΗ ⇒ $I_D \cong 1mA$ $\quad$ ΟΠΟΤΕ $V_{GS} = -V_S = -I_D \cdot 1k\Omega = -1V$ ⇒

⇒ $V_{GS} = -1V$