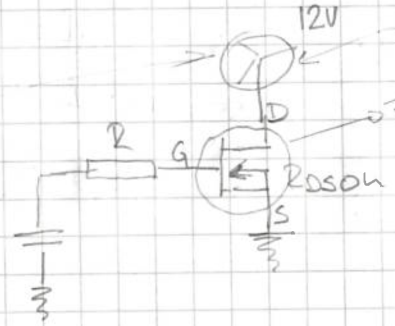
Heatsink

$R_{\theta JA} = 62{,}5\,°C/W$ } datablad
$T_{J(max)} = 175\,C$ }

$P_D = \dfrac{max(T_J - T_A)}{R_{\theta JA}}$

$P_D = \dfrac{175 - 25}{62{,}5} = 2.4\,W$ Max Disipation

$P = R \times I^2$
$= R_{DS} \times I^2$
$= 35\,m\Omega \times I^2$
$= 35\,mW$

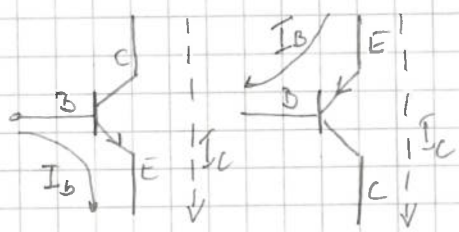


Dan D1N5 web 1A

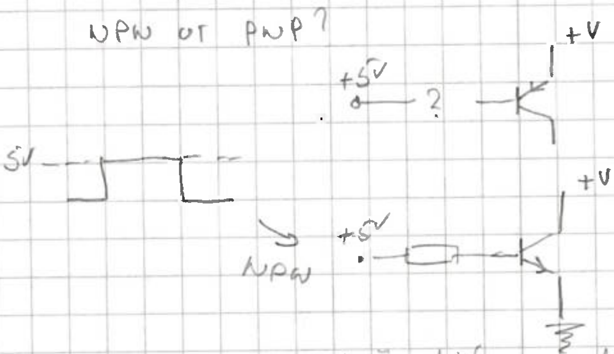
FGP30N06L

$V_{GSTH} < 5V$
(gate threshold voltage
V_{GTH} eller V_{TH})

NPN PNP



NPN or PNP?



NPN är lättare att definiera 95% av all användning på NPN

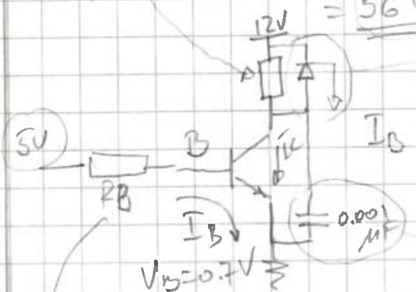
$I_c = (h_{fe})\,I_c$
Förstärknings faktor
(hittas i datablad)

$\beta = 100$ (for PN2222A)

en ventil med specifik 0.67 W vid 12 V

$\dfrac{0{,}67\,W}{12\,V} = 0{,}558\,A$
$= 56\,mA \rightarrow I_c$

Klamp diode när transistor turn off: → magnetfält ökar spänningen

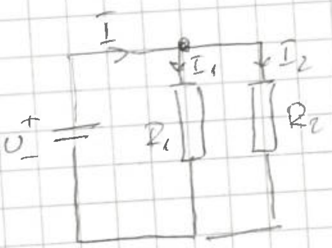


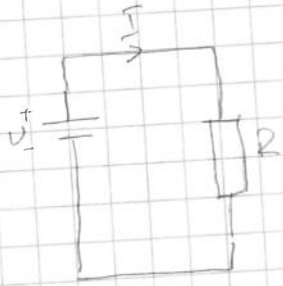
$I_B = \dfrac{56\,mA}{100} = 0.56\,uA \approx 1\,mA$
β förstärkn
tar all av

för att bli säkert
Transistor kan load

kapacitor tar bort pols spik bort / dämpa

$R_B = ? \Rightarrow I_B = \dfrac{5 - 0.7}{R_B} \Rightarrow R_B = \dfrac{5 - 0.7}{0.001} = 4300\,\Omega$





$$\frac{1}{R'} = \frac{1}{R_1} + \frac{1}{R_2} = \frac{R_1 R_2}{R_1 + R_2}$$

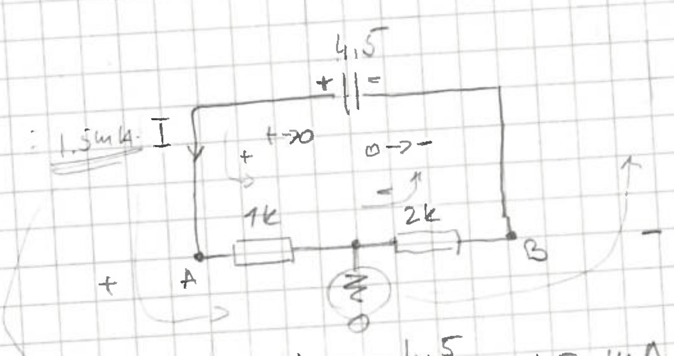
$$U = I_1 \cdot R_1 = I \cdot R' = I \; \frac{R_1 R_2}{R_1 + R_2}$$

Division med R_1

$$I_1 = \frac{U}{R_1} = \frac{I \frac{R_1 R_2}{R_1 + R_2}}{R_1} = \frac{R_2}{R_1 + R_2} I$$

Division med R_2

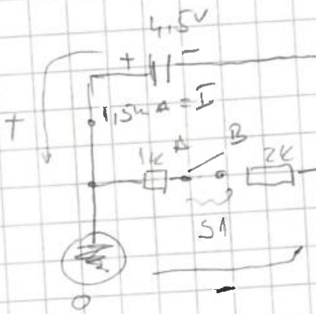
$$I_2 = \frac{U}{R_2} = \frac{I \frac{R_1 R_2}{R_1 + R_2}}{R_2} = \frac{R_1}{R_1 + R_2} I$$



$$I = \frac{U}{1k + 2k} = \frac{4,5}{3k} = 1.5 \text{ mA}$$

$$U_A = I \cdot R = 1k \cdot 1,5 \text{ mA} = 1,5V$$

$$U_B = -I \cdot R = 2k \cdot 1,5 \text{ mA} = -3V$$



S_1 = öppen
A = 0
B = 4,5 V

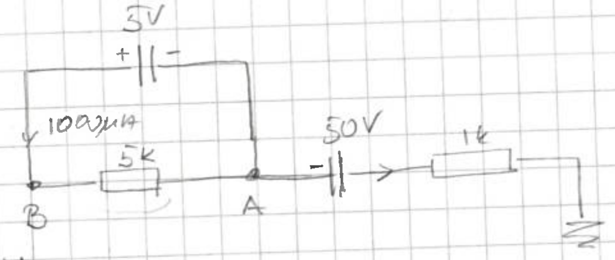
S_2 = stängd
A = -1,5 V
B = -1,5 V

$$I = \frac{U}{1k + 2k} = \frac{4,5}{3k} = 1,5 \text{ mA}$$

$$U_A = -I \cdot R = -1,5 \text{ mA} \cdot 1k = -1,5 V$$

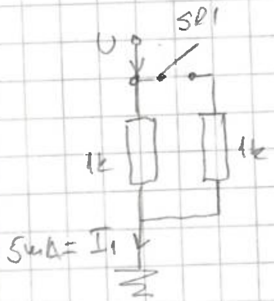
$$U_A = U_B$$

$$U_C = -I \cdot R = -1,5 \text{ mA} \cdot 2k = 3V$$



$U_A = -50V$

$U_B = I \cdot R - U_A = 1mA \cdot 5k - 50V = 5 - 50V = -45V$



$U = \frac{I}{R} = \frac{5mA}{1k} = \frac{5mA}{1k} - 5V$

När SP1 är stängd:

$R_1 // R_2 = \frac{R_1 R_2}{R_1 + R_2} = \frac{1 \cdot 1}{1 + 1} = 0,5\ kohm = 500\Omega$

$\frac{1}{R} = \frac{R_1 + R_2}{R_1 R_2} \Rightarrow R = \frac{R_1 R_2}{R_1 + R_2}$

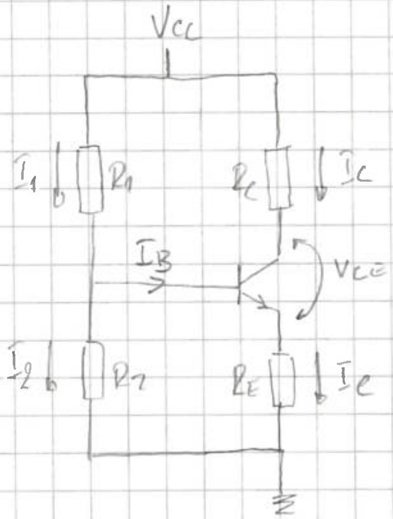
$I = \frac{U}{R} = \frac{5V}{500} = 10mA$

parallel resistor koplig → minska resistor ⇒ öka ström

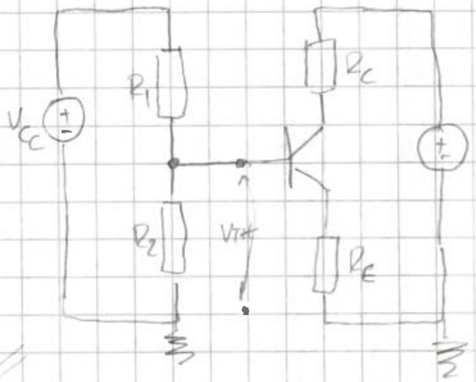
→ öka resistor ⇒ minska ström

→ serie resistor koplig

Voltag Devider Bias Circuit I

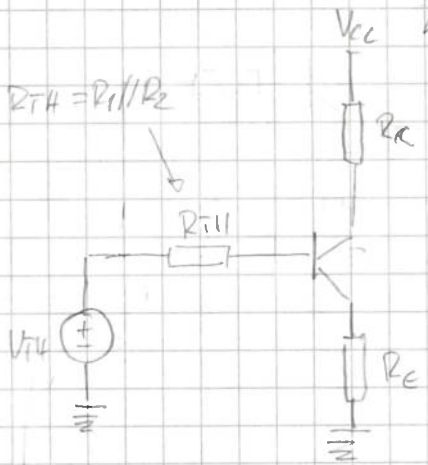


⇒



$$V_{TH} = V_{CC} \frac{R_2}{R_1 + R_2}$$

$$R_{TH} = R_1 // R_2$$



$$V_{TH} = \frac{R_2}{R_1 + R_2} V_{CC}$$

⇒

* $V_{TH} - I_B R_{TH} - V_{BE} - I_E R_E = 0$ jord

$V_{TH} - I_B R_{TH} - V_{BE} - (\beta + 1) R_E = 0$

$$I_B = \frac{V_{TH} - V_{BE}}{R_{TH} + (\beta + 1) R_E}$$

$I_C = \beta I_B$

$I_E = (\beta + 1) I_B$

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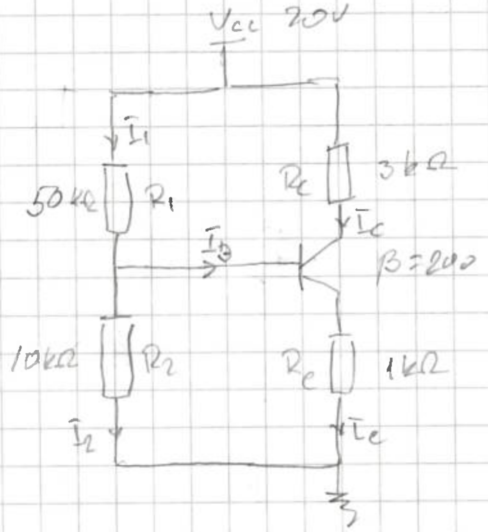
* $V_{CC} - I_C R_C - V_{CE} - I_E R_E = 0$

$V_{CE} = V_{CC} - I_C (R_C + R_E)$

$I_C = I_E$ ej exakt korrekt pga I_E är lite större än I_C (aproximation)

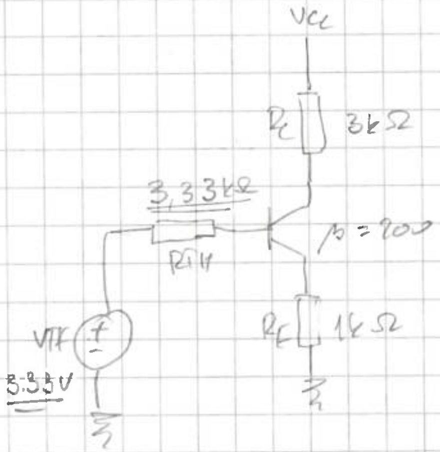
Voltage Devider Bias Circuit II



$$V_{TH} = \frac{R_2}{R_1+R_2} V_{CC} = \frac{10k}{10k+20k} \cdot 20V$$

$$\underline{V_{TH} = 3.33V}$$

$$R_{TH} = 10k // 20k = \frac{10k \cdot 20k}{10k+20k} = 8.33k$$



$$I_B = \frac{V_{TH} - V_{BE}}{R_{TH} + (\beta+1)R_E} = \frac{3.33V - 0.7V}{8330\Omega + 201 \cdot 1000\Omega}$$

$$\underline{I_B = 12.56\mu A}$$

$$I_C = \beta \cdot I_B = 200 \cdot 12.56\mu A = 2.513 mA$$

$$V_{CE} = V_{CC} - I_C(R_C + R_E) = 9.948V$$

Q point : $I_C = 2.513mA$

$V_{CE} = 9.948V$

if $\beta = 100 \Rightarrow I_C = 2.405mA$

$V_{CE} = 10.38V$

if $\beta = 300 \Rightarrow I_C = 2.551 mA$

$V_{CE} = 9.796V$

Method :

if $\boxed{R_2 \leq \frac{1}{10} \beta R_E}$

$$V_B = \frac{R_2}{R_1+R_2} V_{CC}$$

$$V_E = V_B - 0.7$$

$$I_E = \frac{V_E}{R_E} = I_C$$

$$V_{CC} = I_C R_C - V_{CE} - I_E R_E = 0$$

$$V_{CE} = V_{CC} - I_C(R_C + R_E)$$

Ex :

$$R_2 \leq \frac{1}{10} \beta R_E$$

$$10k\Omega \leq 20k\Omega$$

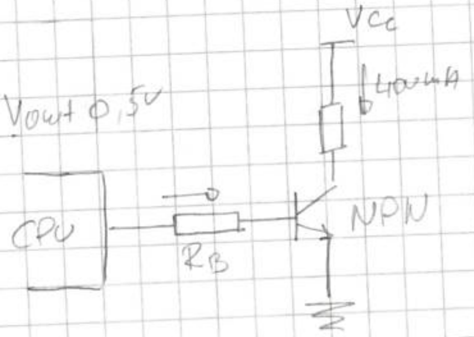
$\Rightarrow$ vi kan use den Method.

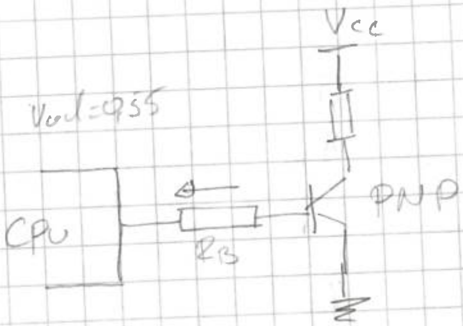
$V_B = 3.33V$

$V_E = 2.63V$

$I_E = 2.63mA = I_C$

BJT - Switc Circuit





Opozit

NPN PNP

if $V_{out} = 0V$
$I_B = 0A$
$I_c = 0A$

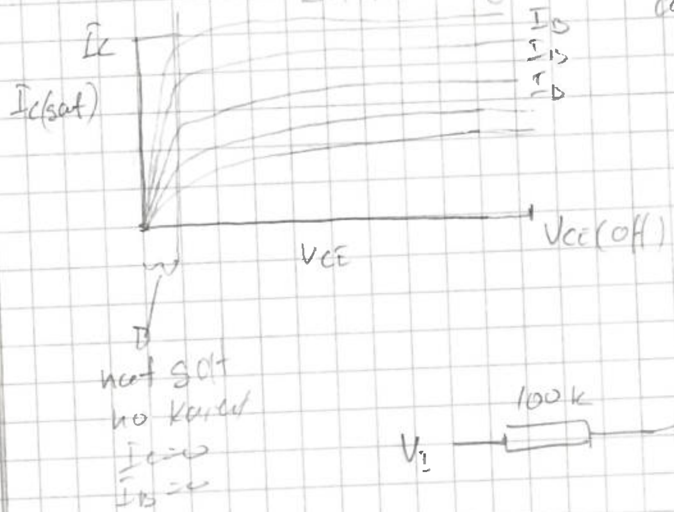
if $V_{out} = 5V$
$I_B > 0A$
$I_c >> 0A$

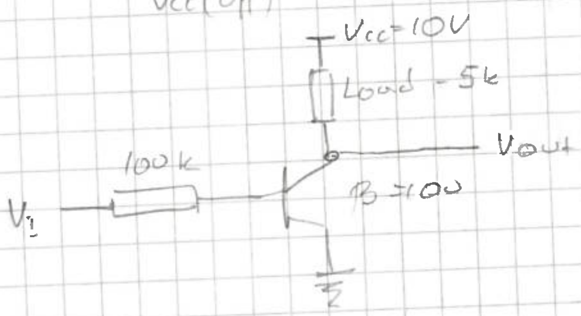
if $V_{out} = 0V$
$I_B > 0A$
$I_c >> 0A$

if $V_{out} = 5V$
$I_B = 0A$
$I_c = 0A$

Saturation region

Saturation region -> pik value a collector I_c





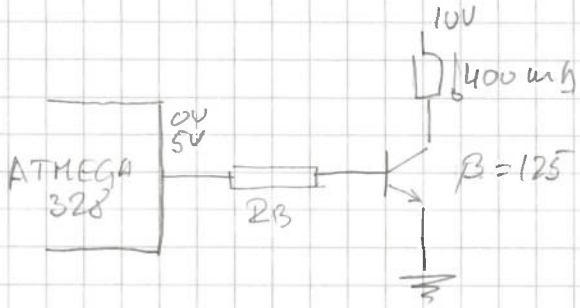
När $V_I = 0V$
$I_B = 0V$
$I_c = 0V$
$V_{out} = 10V$

När $V_I = 10V$

$$I_B = \frac{10V - 0.7V}{100k} = 93\,\mu A$$

$$I_c = \frac{10V - 0}{5k} = 2\,mA$$

In saturatie område: $\left\{ I_B > \frac{I_c}{\beta} \Rightarrow 93\,\mu A > \frac{2\,mA}{100} \right.$



$$I_B >> \frac{I_C}{\beta}$$

$$I_B >> \frac{400 mA}{125}$$

$$I_B >> 3,2 mA$$

Välj: $I_B = 5 \cdot 3,2 mA = 16 mA$

$$I_B = 16 mA = \frac{5V - 0.7V}{R_B}$$

$$R_B = \frac{4.3V}{16 mA} = \underline{268.75 \Omega}$$

Välj mindre pga $\underline{\underline{I_B}}$