Proiect CEL Final

Tema: ELEMENTE DE PROIECTARE PENTRU STABILIZATOARELE DE TENSIUNE CONTINUĂ

Nume: Borș Dorin
Grupa: 4LF494
Data: 01.07.2021

Date de început:

$U_1 = 8$ $U_2 = 33$

$I_1 = 0,3$ $I_2 = 4$

PROIECT I

CALCULUL TRANSFORMATORULUI DE REȚEA

1.1. $P_{uK} = U_K \cdot I_K$

$P_{u1} = 8 \cdot 0,3 = 2,4$

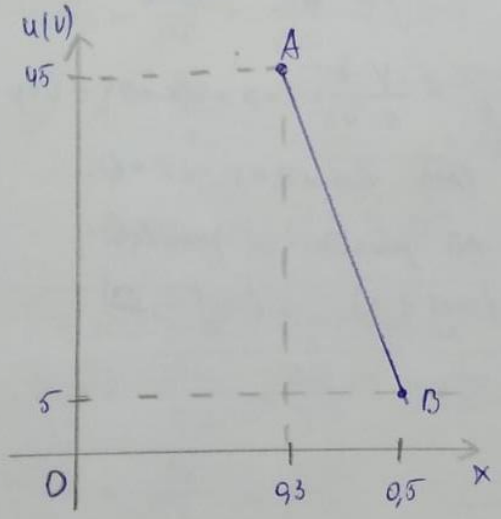
$P_{u2} = 33 \cdot 4 = 132$

1.2 $P_{tot1} = P_{u1} + (0,3 \div 0,5) P_{tot1}$

Plaja de tens. de ieșire 5...45 V

$A(0,3 ; 45)$

$B(0,5 ; 5)$



Ec. dreptei AB:

$$\frac{x - x_A}{x_B - x_A} = \frac{y - y_A}{y_B - y_A}$$

$$\frac{x - 0,3}{0,5 - 0,3} = \frac{y - 45}{5 - 45} \Rightarrow$$

$\Rightarrow -40x + 12 = 0,2y - 9 \Rightarrow$

$(AB): 40x + 0,2y - 21 = 0$

Pe dreaptă se află și punctele:

$C(coef\ 1; 8)$; $D(coef\ 2; 33)$

- $C(coef\ 1, 8) \rightarrow y = 8$

$40 \cdot coef\ 1 + 0,2 \cdot 8 - 21 = 0 \Rightarrow$

$40\ coef\ 1 = 18,4$

$coef\ 1 = 0,485$

- $D(coef\ 2, 33) \rightarrow y = 33$

$40 \cdot coef\ 2 + 0,2 \cdot 33 - 21 = 0 \Rightarrow$

$40\ coef\ 2 = 14,4$

$coef\ 2 = 0,36$

$P_{tot1} = P_{u1} + coef_1 \cdot P_{tot1} \Rightarrow$

$P_{u1} + coef_1 \cdot P_{tot1} - P_{tot1} = 0 \Rightarrow$

$P_{u1} - P_{tot1}(1 - coef_1) = 0 \Rightarrow$

$P_{u1} = P_{tot1}(1 - coef_1) \Rightarrow P_{tot1} = \dfrac{P_{u1}}{1 - coef_1}$

~~$P_{tot1} = 5$~~

$P_{tot1} = \dfrac{2,4}{1 - 0,485} = \dfrac{2,4}{0,515} = 4,66\ W$

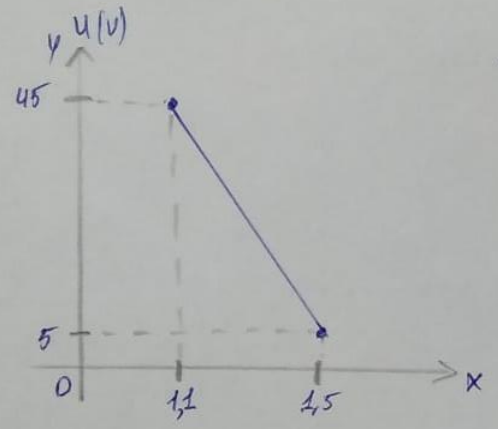
$P_{tot2} = \dfrac{132}{1 - 0,36} = \dfrac{132}{0,64} = 206,25\ W$

13 $U_{s1} = (1,1 \ldots 1,5)\, U_1$

Fie pnt $A(1,1; 45)$

$B(1,5; 5)$

Ec. d_2 : AB : $\dfrac{x - x_A}{x_B - x_A} = \dfrac{y - y_A}{y_B - y_A}$



$\dfrac{x - 1,1}{1,5 - 1,1} = \dfrac{y - 45}{5 - 45} \Rightarrow -40x + 44 = 0,4y - 18$

$(AD) : 40x + 0,4y - 62 = 0$

Pe AB plasăm cele puncte:

$C(coef\ 1,8)$; $D(coef\ 2,38)$;

(C) $40\, coef_1 + 0,4 \cdot 8 - 62 = 0$

$coef_1 = 1,47$

(D) $40\, coef_2 + 0,4 \cdot 33 - 62 = 0$

$coef_2 = 1,22$

$U_{s1} = U_1 \cdot coef_1 = 8 \cdot 1,47 \Rightarrow U_{s1} = 11,76\ V$

$U_{s2} = U_2 \cdot coef_2 = 33 \cdot 1,22 \Rightarrow U_{s2} = 40,26\ V$

1.4 $P = \dfrac{P_{tot1} + P_{tot2}}{0,9}$ $\quad P = \dfrac{4,66 + 206,25}{0,9} = 234,34\ W$

Date de inceput:

$U_{S1} = 11,76\ V$

$U_{S2} = 40,26\ V$

$P = 234,34\ W$

1.5

$S_m = 30\ cm^2$

$N_0 = 1,6$ spire/V

$N_{0II} = 1,8$ spire/V

$J = 2,5\ \frac{A}{mm^2}$

1.6 $n = N_0 \cdot 230 = 1,6 \cdot 230 = 368$ spire

$n_1 = N_{0II} \cdot U_{S1} = 1,8 \cdot 12 = 21,6$ spire

$n_2 = N_{0II} \cdot U_{S2} = 1,8 \cdot 40 = 72$ spire

1.9 $S_0 = \frac{n}{110} = \frac{368}{110} = 3,345$

$S_1 = \frac{n_1}{277} = \frac{21,6}{277} = 0,077$

$S_2 = \frac{n_2}{18} = \frac{72}{18} = 3,78$

$S_t = S_0 + S_1 + S_2 = 7,202$

1.10 $7,202 < 7.7 \Rightarrow E_{16} \Rightarrow Q = 16$

1.11 $c = \frac{S_m}{20} = \frac{30}{3,2} = 9,372$

1.12 $\rho_0 = \frac{d_0}{2} = \frac{0,75}{2} = 0,375$

$\rho_1 = \frac{d_1}{2} + d_0 = \frac{0,45}{2} + 0,75 = 0,975$

$\rho_2 = \frac{d_2}{2} + d_1 + d_0 = \frac{1,8}{2} + 0,75 + 0,45 = 2,1$

$L_{msp} = 2 * (2_0 + c) + 2\pi\rho$

$L_{msp0} = 2(2 \cdot 1,6 + 9,372) + 2 \cdot 3,14 \cdot 0,375 = 27,499$ cm

$L_{msp1} = 2(3,2 + 9,372) + 2 \cdot 3,14 \cdot 0,975 = 31,267$ cm

$L_{msp2} = 2(3,2 + 9,372) + 2 \cdot 3,14 \cdot 2,1 = 38,332$ cm

1.7 $I_p = \frac{P}{220} = \frac{234,34\ W}{220} = 1,065\ A$

$I_{S1} = \frac{P_{tot1}}{U_{S1}} = \frac{4,66\ W}{11,76\ V} = 0,396\ A$

$I_{S2} = \frac{P_{tot2}}{U_{S2}} = \frac{206,25\ W}{40,26\ V} = 5,12\ A$

1.8 $d_0 = 0,75$ mm

$d_1 = 0,45$ mm

$d_2 = 1,8$ mm

1.13 $L = n * L_{msp}$

$L_0 = 368 \cdot 27,5 = 101,2$ m

$L_1 = 21,6 \cdot 31,267 = 6,753$ m

$L_2 = 72 \cdot 38,332 = 27,6$ m

1.14

$R = L * \rho_1$

$R_0 = 101,2 \cdot 0,0384 = 3,887$

$R_1 = 6,753 \cdot 0,1082 = 0,737$

$R_2 = 27,6 \cdot 0,00684 = 0,188$

1.15 $R_{t21} = R_1 + \left(\frac{n_1}{n}\right)^2 * R_0 = 0,737 + \left(\frac{21,6}{368}\right)^2 \cdot 3,887 = 0,75\ \Omega$

$R_{t22} = R_2 + \left(\frac{n_2}{n}\right)^2 \cdot R_0 = 0,188 + \left(\frac{72}{368}\right)^2 \cdot 3,887 = 0,338\ \Omega$

$U_1 = 8$ $U_2 = 33$ $U_{S_1} = 12\,V$ $U_{S_2} = 40\,V$ Date de input:

$I_1 = 0,3$ $I_2 = 4$ $R_{t_{21}} = 0,75\,\Omega$ $R_{t_{22}} = 0,338\,\Omega$

PROIECT II CALCULUL REDRESORULUI ȘI FILTRULUI C

2.1 P/u tensiuni mari se alege redresorul punct:

$U_1 = 8\,V$ — stabilizator monoalternanță

$U_2 = 33\,V$ — stabilizatorul punct

2.2 Fie punct $A(\overset{x_A}{0,02}; \overset{y_A}{0,15})$

$B(\overset{x_B}{0,2}; \overset{y_B}{5})$

ECUAȚIA DR: $\frac{x - x_A}{x_B - x_A} = \frac{y - y_A}{y_B - y_A}$

$$\frac{x - 0,02}{0,2 - 0,02} = \frac{y - 0,15}{5 - 0,15} \Rightarrow (x - 0,02)\,4,85 = (y - 0,15)\,0,18 \Rightarrow$$

$$\Rightarrow 4,85x - 0,097 = 0,18y - 0,027 \Rightarrow$$

$$\Rightarrow 4,85x - 0,18y - 0,097 + 0,027 = 0 \Rightarrow$$

$$\Rightarrow 4,85x - 0,18y - 0,07 = 0$$

P/u dr AB se aleg punctele:

$C(I_{st_1}; 0,3)$

$D(I_{st_2}; 4)$

• $C(y = 0,3)$

$4,85x - 0,18 \cdot 0,3 - 0,07 = 0$

$4,85x = 0,124$

$x = \frac{0,124}{4,85} = 0,025\,A$

$\Rightarrow I_{st_1} = 0,025\,A$

• $D(y = 4)$

$4,85x - 0,18 \cdot 4 - 0,07 = 0$

$4,85x = 0,79$

$x = 0,162$

$I_{st_2} = 0,162\,A$

2.3

$I_{R_1} = I_1 + I_{st_1} = 0,3 + 0,025 = 0,325\,A$

$I_{R_2} = I_2 + I_{st_2} = 4 + 0,162 = 4,162\,A$

$I_{S_1} = I_{R_1} = 0,325\,A \Rightarrow$ Aleg 1N4001

$I_{S_2} = I_{R_2} = 4,162\,A \Rightarrow$ Aleg punct. KBL402

2.4

$U_{max_1} = 2 \cdot 12\,V = 24\,V$

$U_{max_2} = 2 \cdot 40\,V = 80\,V$

$R_{d_1} = \frac{\Delta U}{\Delta I} = 0,2\,\Omega$

$R_{d_2} = \frac{\Delta U}{\Delta I} = 0,025\,\Omega$

$U_{d_1} = U_{S_1} \cdot \sqrt{2} = 12 \cdot 1,414 = 16,868 \approx 17\,V$

$U_{d_2} = U_{S_2} \cdot \sqrt{2} = 40 \cdot 1,414 = 56,56 \approx 56,6\,V$

2.5

$U_{e_{1m}} = U_1 + U_{st_{1m}} = U_1 + (5 \ldots 10)\,V$

$A(5;5)$

$B(10;45)$

$\frac{x - x_A}{x_B - x_A} = \frac{y - y_A}{y_B - y_A} \Rightarrow \frac{x - 5}{10 - 5} = \frac{y - 5}{45 - 5} \Rightarrow$

$40(x - 5) = 5(y - 5) \Rightarrow 40x - 5y - 175 = 0$

$C(U_{st1m}; 12)$
$D(U_{st2m}; 40)$ $\quad 40x - 5y - 175 = 0$

• $C\ (y = 12)$

$40x - 5 \cdot 12 - 175 = 0$

$x = \frac{235}{40} = 5{,}875 \Rightarrow U_{st1m} = 5{,}875\ V$

• $D\ (y = 40)$ $\qquad U_{e1m} = 12 + 5{,}875 = 17{,}875\ V$

$40x - 5 \cdot 40 - 175 = 0$

$x = \frac{375}{40} = 9{,}375\ V \Rightarrow U_{st2m} = 9{,}375\ V$

2.6

$U_{s1M} = 17\ V$ $\qquad U_{e2m} = 40 + 9{,}375\ V = 49{,}375\ V$

$U_{s2M} = 56{,}6\ V$

$$\left.\begin{aligned} U_{R_1} &= I_{R_1} \cdot R_{R_1} = 0{,}325\ A \cdot R_{R_1} \\ U_{R_1} &= \frac{U_{e1M} + U_{e1m}}{2} \end{aligned}\right\} \Rightarrow 0{,}325 \cdot R_{R_1} = \frac{U_{e1M} + U_{e1m}}{2} \Rightarrow$$

$$\Rightarrow R_{R_1} = \frac{U_{e1M} + 17{,}875\ V}{0{,}65}$$

$$U_{e1M} = \frac{(U_{s1M} - U_D) R_{R_1}}{R_{R_1} + R_{t21} + R_{d1}} = \frac{(17 - 0{,}7) \cdot R_{R_1}}{R_{R_1} + 0{,}75 + 0{,}2} = \frac{16{,}3 \cdot R_{R_1}}{0{,}85 + R_{R_1}} = \frac{16{,}3 \cdot \frac{U_{e1M} + 17{,}875}{0{,}65}}{0{,}85 + \frac{U_{e1M} + 17{,}875}{0{,}65}}$$

$$= \frac{25{,}076 (U_{e1M} + 17{,}875)}{U_{e1M} + 17{,}875 + 0{,}6175} = \frac{16{,}3 (U_{e1M} + 17{,}875)}{U_{e1M} + 18{,}5} = \frac{16{,}3\, U_{e1M} + 291{,}36}{U_{e1M} + 18{,}5}$$

$U_{e1M}(U_{e1M} + 18{,}5) = 16{,}3\, U_{e1M} + 291{,}36$

$U_{e1M}^2 + U_{e1M} 18{,}5 - 16{,}3 U_{e1M} - 291{,}36 = 0$

$U_{e1M}^2 + 2{,}2\, U_{e1M} - 291{,}36 = 0$

$\Delta = 4{,}84 - 4 \cdot (-291{,}36) \cdot 1 = 4{,}84 + 1165{,}44 = 1170{,}28$

$U_{e1M_1} = \frac{-2{,}2 - \sqrt{1170{,}28}}{2} < 0$

$U_{e1M_2} = \frac{-2{,}2 + \sqrt{1170{,}28}}{2} = \frac{-2{,}2 + 34{,}2}{2} = \frac{32}{2} = \underline{16\ V}$

$$U_{R_1} = \frac{U_{c_1M} + 17{,}875}{2} = \frac{16 + 17{,}875}{2} = 16{,}93\ V$$

$$R_{R_1} = \frac{U_{R_1}}{I_{R_1}} \Rightarrow \frac{16{,}93\ V}{0{,}325\ A} = 52{,}092\ \Omega$$

$$U_{R_2} = I_{R_2} \cdot R_{R_2} = 4{,}162\ A \cdot R_{R_2}$$

$$U_{R_2} = \frac{U_{c_2M} + U_{c_2m}}{2} \Rightarrow$$

$$4{,}162 \cdot R_{R_2} = \frac{U_{c_2M} + U_{c_2m}}{2}$$

$$R_{R_2} = \frac{U_{c_2M} + 49{,}375}{8{,}324}$$

$$U_{c_2M} = \frac{(U_{s_2M} - U_D) \cdot R_{R_2}}{R_{t_{z_2}} + R_{d_2} + R_{R_2}} = \frac{(56{,}6 - 1{,}4) \cdot R_{R_2}}{0{,}338 + 0{,}025 + R_{R_2}} = \frac{55{,}2 \cdot R_{R_2}}{0{,}364 + R_{R_2}} =$$

$$= \frac{55{,}2 \cdot \left(\frac{U_{c_2M} + 49{,}375}{8{,}324}\right)}{0{,}364 + \left(\frac{U_{c_2M} + 49{,}375}{8{,}324}\right)} = \frac{55{,}2\,(U_{c_2M} + 49{,}375)}{U_{c_2M} + 52{,}404}$$

$$U_{c_2M}(U_{c_2M} + 52{,}404) = 55{,}2\,U_{c_2M} + 2725{,}5$$

$$U_{c_2M}^2 + 52{,}404\,U_{c_2M} - 55{,}2\,U_{c_2M} - 2725{,}5 = 0$$

$$U_{c_2M}^2 - 2{,}8\,U_{c_2M} - 2725{,}5 = 0$$

$$\Delta = 7{,}84 + 10902 = 10909{,}84$$

$$U_{c_2M_1} = \frac{-b - \sqrt{\Delta}}{2a} = \frac{2{,}8 - \sqrt{\Delta}}{2} < 0$$

$$U_{c_2M_2} = \frac{2{,}8 + \sqrt{10909{,}84}}{2 \cdot 1} = \frac{2{,}8 + 104{,}45}{2} = 53{,}625\ V$$

$$U_{c_2M} = 53{,}625\ V$$

$$U_{R_2} = \frac{53{,}625 + 49{,}375}{2} = 51{,}5\ V$$

$$R_{R_2} = \frac{U_{R_2}}{I_{R_2}} = \frac{51{,}5\ V}{4{,}162\ A} = 12{,}373\ \Omega$$

27 $\Delta U_{c_i} = (U_{cin} - U_{cim}) = \frac{U_{cim}\,T}{R_{Ri}\,C_i}$

$$C_2 = \frac{1{,}0725}{4{,}25 \cdot 12{,}373} = 20312\ \mu F$$

$$\Delta U_{c_1} = (16 - 17{,}875) = \frac{16 \cdot 902}{52{,}092\ C_1} \Rightarrow$$

$-52{,}69\ C_1$

$-1{,}875 = 0{,}32$

$C_1 = 3276\ MF$

$U_1 = 8$ $\quad U_{c1m} = 17,875\ V$

$I_1 = 0,3$ $\quad U_{S1} = 12\ V$

Date de intrare:

PROIECT III

CALCULUL STABILIZATORULUI

2.1

$I_{cM} > I_1 = 0,3\ A$

$U_{CBO} > U_{S1M} = 17\ V$

$T \Rightarrow [BD\ 137]$

$I_c = 1,5\ A$

$V_{CBO} = 60\ V$

3.2

$$I_{BM} = \frac{I_1}{\beta_m} \qquad \beta_m = 40$$

$$I_{BM} = \frac{0,3}{40} = 0,0075\ A$$

$I_{BM} = 7,5\ mA$

3.3

$U_z = U_1 + 0,7V = 8,7\ V$ (tensiunea dioadei Zener)

3.4

$P_{DZM} = 1,5 \cdot U_z \cdot I_{BM}$

$P_{DZM} = 1,5 \cdot 8,7 \cdot (0,0075 + 0,5 \cdot 0,0075) = 0,15\ W$ (puterea disipată max pe dioda Zener)

3.5 Se alege dioda Zener:

$$\begin{cases} U = U_z = 8,7\ V \\ P_D > P_{DZM} = 0,15\ W \end{cases} \Rightarrow \text{SML 4742 (700 mW)}$$

Determinare valoare R:

$U_{Rm} = U_{c1m} - U_z > R(I_{BM} + I_{zm})$

$I_{zm} = 1\ mA$

$17,875 - 8,7 > R(7,5 + 1)$

$9,175 > R \cdot 8,5$

$R < \frac{9,175}{8,5} = 1,079\ k = 1079\ \Omega$

3.6 $U_z(U_{S1M} - U_z) / R < P_D$

$\frac{8,7(17 - 8,7)}{1079} < P_D$

$10^3 \cdot 0,0669 < 700$

$66,9 < 700\ V$

$U_2 = 33$ $\quad U_{c2m} = 49,375\ V$

$I_2 = 4$ $\quad U_{S2} = 40$

Alegerea tranzistorului T_3

4.1 $\begin{cases} I_{cM} > 1.05 \cdot I_2 = 4,2\ A \\ U_{CBO} > U_{S2M} = 56,6\ V \end{cases} \Rightarrow$

$\Rightarrow$ TIP 121 tranz. Darlington

4.2 $U_{c2m} = U_{R2m} + U_{BE3M} + U_2$

$I_{BE3M} = \frac{I_{T3M}}{\beta_{3m}} = 0,0042$

$\beta_{3M} = 1000$

$49,375 = U_{R2m} + 0,7 + 33$

$U_{R2m} = 49,375 - 33,7 = 15,675\ V$

4.3 $R_2 < U_{R2m} / I_{B3M}$

$R_2 < \frac{15,675}{0,0042} = 3732,14$

$R_2 = 2000\ \Omega$

4.6

Calculul amplificatorului de eroare

$I_{R_2M} = (U_{S2M} - U_2)/R_2 = \frac{56,6 - 33}{2000} = 0,0118\ A$ (curentul maxim prin tranzistorul T_2)

4.7 Se deg T_1 și T_2 identice:

$$\begin{cases} I_{CM} > I_{R_2M} = 11,8\ mA \\ U_{CBO} > U_{S2M} = 56,6\ V \end{cases} \rightarrow \boxed{PZT\ 3904}$$

4.8 $I_3 = I_{R_2M} = 11,8\ mA$

$U_{CE\,2m} = 3V \Rightarrow U_{R_3} = 0,7 + U_2 - 3V = 33 - 2,3 = 30,7\ V \Rightarrow$

$\Rightarrow R_3 = \frac{U_{R_3}}{I_3} = \frac{30,7\ V}{0,0118\ A} = 2601,7\ \Omega$

4.9 $R_1 = R_2 = 2000\ \Omega$

Calculul circuitului tensiunii de referință (R, D_Z)

4.10 $U_Z = U_{R_3} + 0,7V = 31,4\ V$ (Tensiunea Zener)

4.11 $\begin{cases} P = 0,5\ W \\ U_Z = 31,4\ V \end{cases} \Rightarrow \boxed{1N5256}$

4.12 $I_{Zm} \Rightarrow I_3 / \beta_{1m} = \frac{11,8}{60} = 0,196\ mA$

$U_{Rm} = U_{C_2m} - U_Z = 49,375 - 31,4 = 18\ V$

$R = \frac{U_{Rm}}{I_{Zm}} = \frac{18}{0,196 \cdot 10^{-3}} = 91,8\ K\Omega$

Calculul divizorului rezistiv

4.13 $0,05 \cdot I_2 > I_4 \Rightarrow I_{T_2M} / \beta_{2m}$

$I_4 < 0,05 \cdot 4 = 0,2\ A$

$I_4 \Rightarrow I_{T_2M} / \beta_{2m} = \frac{0,4}{60} = 0,0066\ mA$

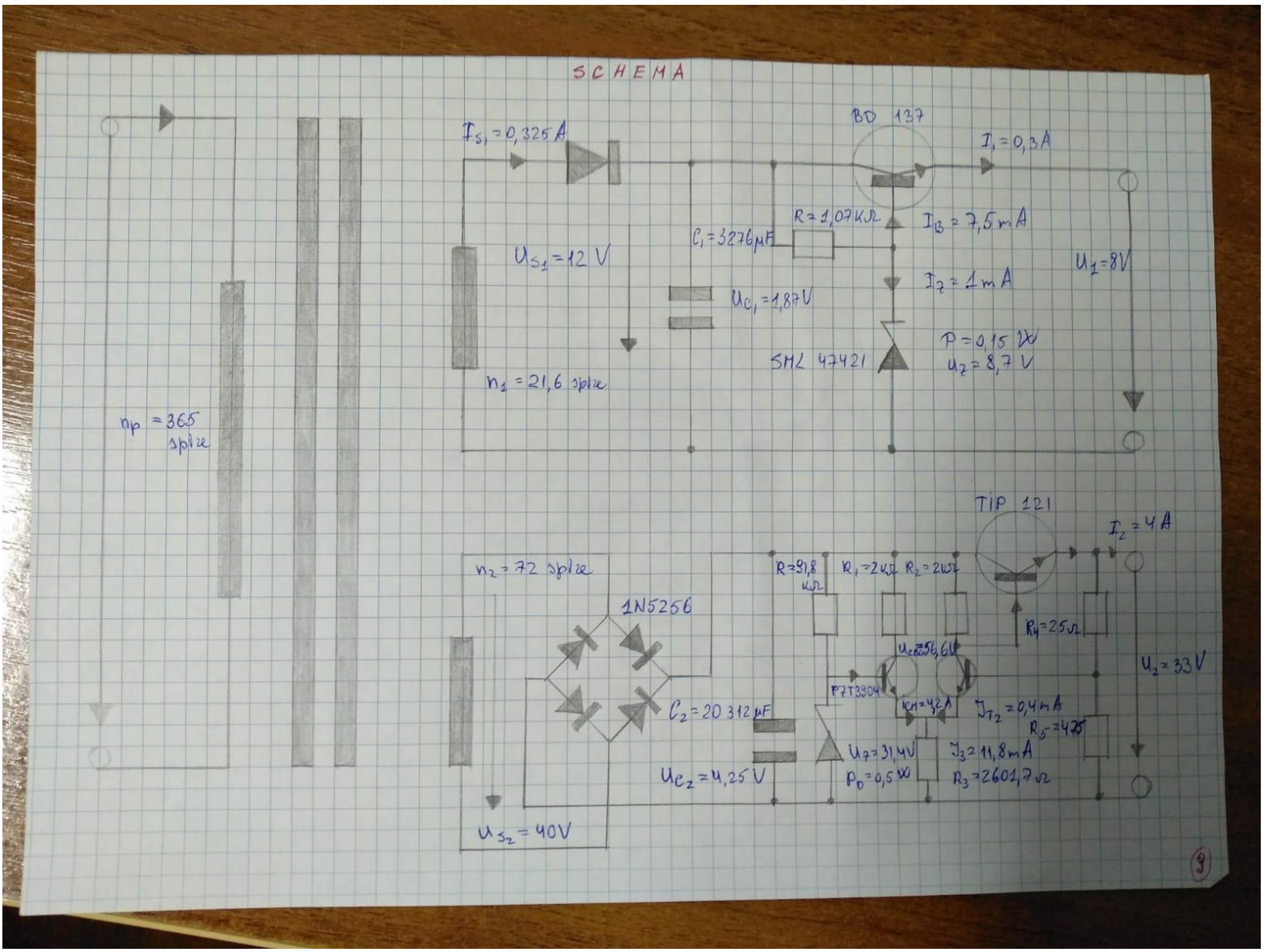
$I_4 = 66\ mA$

4.14 $R_4 + R_5 = \frac{U_2}{I_4}$

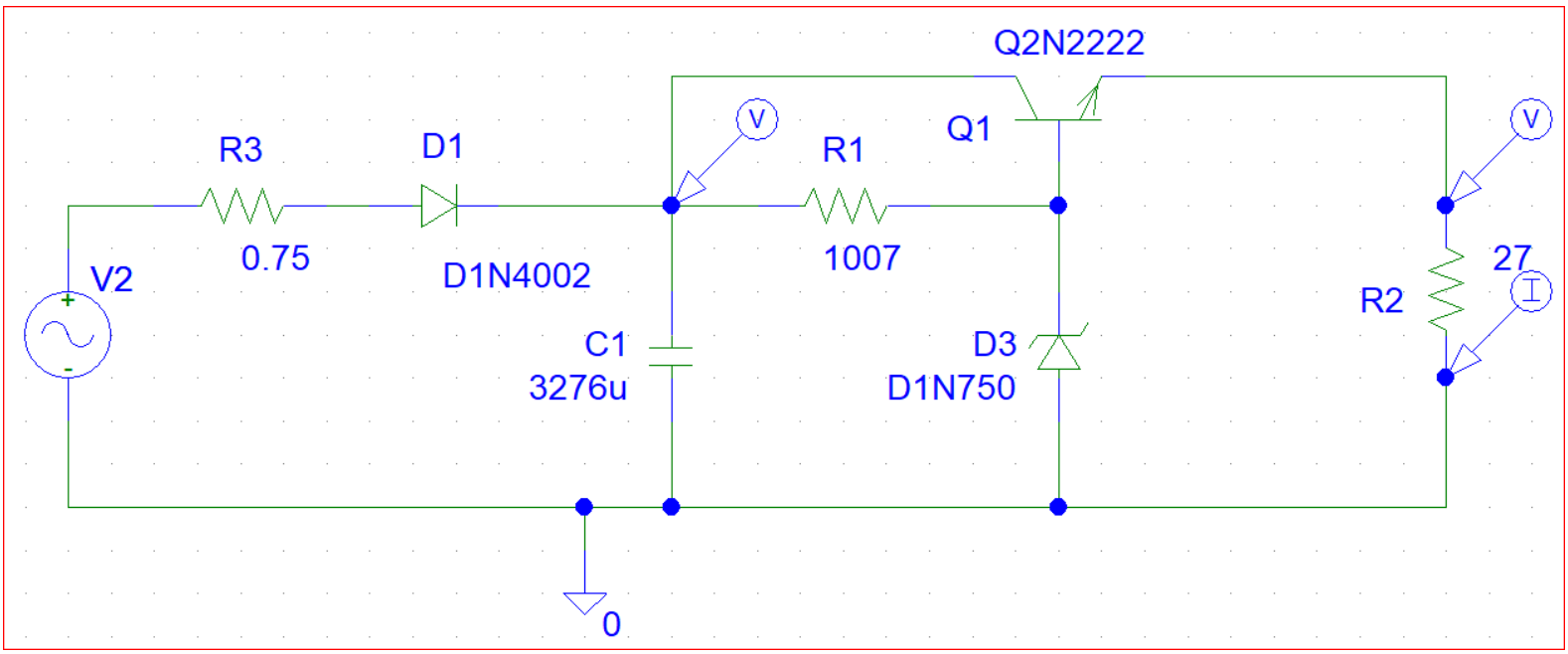
$R_5 = \frac{U_{R5}}{I_4} = \frac{31,4}{66m} = \frac{31,4}{0,066} = 475\ \Omega$

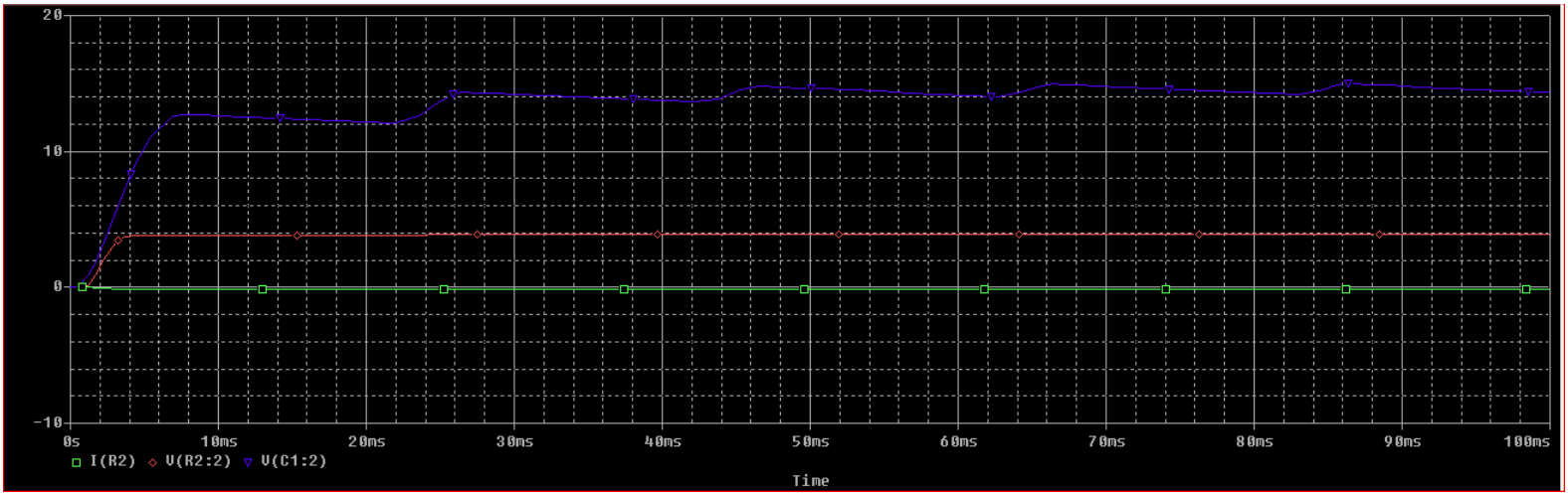
$R_4 + 475 = \frac{33}{0,066} \Rightarrow R_4 = 500 - 475 = 25\ \Omega$

SCHEMA

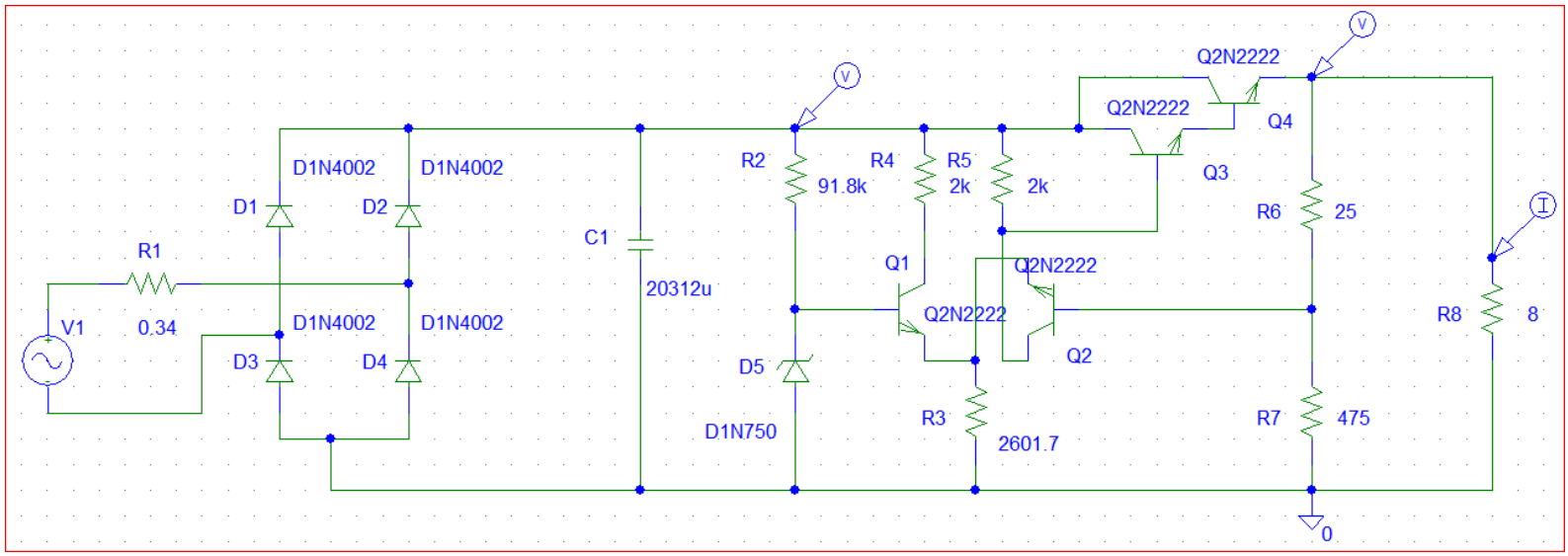

BD 137
$I_{S_1} = 0,325\,A$
$I_1 = 0,3\,A$
$R = 1,07\,k\Omega$
$I_B = 7,5\,mA$
$C_1 = 3276\,\mu F$
$U_{S_1} = 12\,V$
$U_1 = 8\,V$
$I_Z = 1\,mA$
$U_{C_1} = 1,87\,V$
$P = 0,15\,W$
$U_Z = 8,7\,V$
SML 47421
$n_1 = 21,6$ spire
$n_p = 365$ spire
TIP 121
$I_2 = 4\,A$
$n_2 = 72$ spire
$R = 31,8\,k\Omega$
$R_1 = 2\,k\Omega$
$R_2 = 2\,k\Omega$
1N5256
$R_4 = 25\,\Omega$
$U_{C_2} = 36,6\,V$
$U_2 = 33\,V$
PZT3904
$I_{C_1} = 42\,A$
$I_{T_2} = 0,4\,mA$
$R_5 = 42\,\Omega$
$C_2 = 20\,312\,\mu F$
$U_Z = 31,4\,V$
$I_3 = 11,8\,mA$
$P_D = 0,5\,W$
$R_3 = 2601,7\,\Omega$
$U_{C_2} = 4,25\,V$
$U_{S_2} = 40\,V$

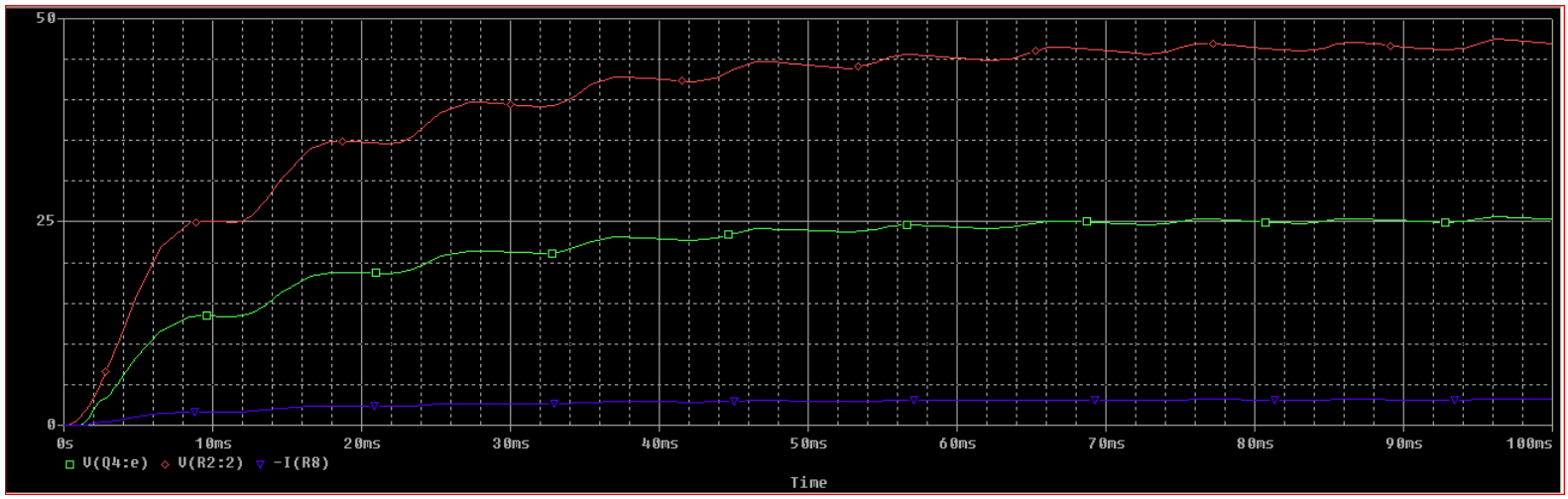
Schema și simularea 1





Schema și simularea 2





Foi de catalog

TIP120/121/122
TIP125/126/127

COMPLEMENTARY SILICON POWER DARLINGTON TRANSISTORS

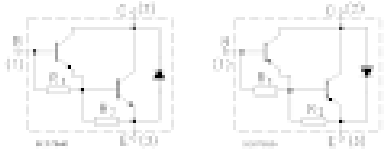
- STMicroelectronics PREFERRED SALESTYPES

DESCRIPTION

The TIP120, TIP121 and TIP122 are silicon Epitaxial-Base NPN power transistors in monolithic Darlington configuration mounted in Jedec TO-220 plastic package. They are intented for use in power linear and switching applications. The complementary PNP types are TIP125, TIP126 and TIP127, respectively.

TO-220

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter		Value			Unit
		NPN	TIP120	TIP121	TIP122	
		PNP	TIP125	TIP126	TIP127	
V_{CBO}	Collector-Base Voltage (I_C = 0)		60	80	100	V
V_{CEO}	Collector-Emitter Voltage (I_B = 0)		60	80	100	V
V_{EBO}	Emitter-Base Voltage (I_C = 0)		5			V
I_C	Collector Current		5			A
I_{CM}	Collector Peak Current		8			A
I_B	Base Current		0.1			A
P_{tot}	Total Dissipation at $T_{case} \leq 25$ °C $T_{amb} \leq 25$ °C		65 2			W W
T_{stg}	Storage Temperature		-65 to 150			°C
T_j	Max. Operating Junction Temperature		150			°C

*For PNP types voltage and current values are negative.

Micro Commercial Components
21201 Itasca Street Chatsworth
CA 91311
Phone: (818) 701-4933
Fax: (818) 701-4939

1N5221 THRU 1N5281

500 mW Zener Diode 2.4 to 200 Volts

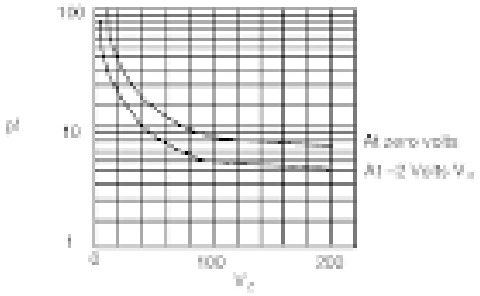
Features

- Wide Voltage Range Available
- Glass Package
- High Temp Soldering: 250°C for 10 Seconds At Terminals

Maximum Ratings

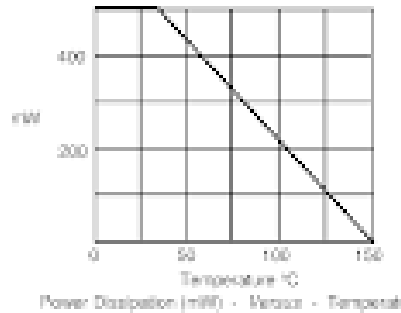
- Operating Temperature: -55°C to +150°C
- Storage Temperature: -55°C to +150°C
- 500 mWatt DC Power Dissipation
- Power Derating: 4.0mW/°C above 50°C
- Forward Voltage @ 200mA: 1.1 Volts

Figure 1 - Typical Capacitance



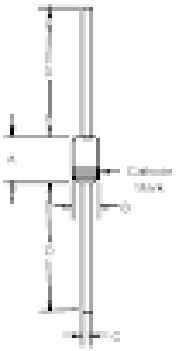
Typical Capacitance (pf) – versus – Zener voltage (V_z)

Figure 2 - Derating Curve



Power Dissipation (mW) - Versus - Temperature °C

DO-35



DIMENSIONS					
	INCHES		MM		
DIM	MIN	MAX	MIN	MAX	NOTE
A	---	1.00	---	4.0	
B	---	.079	---	2.00	
C	---	.060	---	.52	
D	1.000	---	25.40	---	

FAIRCHILD
SEMICONDUCTOR®

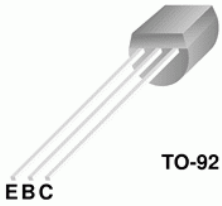
October 2011

2N3904 / MMBT3904 / PZT3904
NPN General Purpose Amplifier

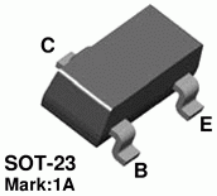
Features

- This device is designed as a general purpose amplifier and switch.
- The useful dynamic range extends to 100 mA as a switch and to 100 MHz as an amplifier.

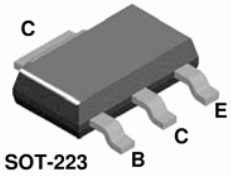
2N3904



MMBT3904



PZT3904



Absolute Maximum Ratings* T_a = 25°C unless otherwise noted

Symbol	Parameter	Value	Units
V_{CEO}	Collector-Emitter Voltage	40	V
V_{CBO}	Collector-Base Voltage	60	V
V_{EBO}	Emitter-Base Voltage	6.0	V
I_C	Collector Current - Continuous	200	mA
$T_{J,}$ T_{stg}	Operating and Storage Junction Temperature Range	-55 to +150	°C

* These ratings are limiting values above which the serviceability of any semiconductor device may be impaired.

NOTES:

1) These ratings are based on a maximum junction temperature of 150 degrees C.

2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.

Thermal Characteristics T_a = 25°C unless otherwise noted

Symbol	Parameter	Max.			Units
		2N3904	*MMBT3904	**PZT3904	
P_D	Total Device Dissipation Derate above 25°C	625 5.0	350 2.8	1,000 8.0	mW mW/°C
$R_{\theta JC}$	Thermal Resistance, Junction to Case	83.3			°C/W
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient	200	357	125	°C/W

* Device mounted on FR-4 PCB 1.6" X 1.6" X 0.06".

** Device mounted on FR-4 PCB 36 mm X 18 mm X 1.5 mm; mounting pad for the collector lead min. 6 cm^2.

SILICON NPN EPITAXIAL TYPE (PCT PROCESS)

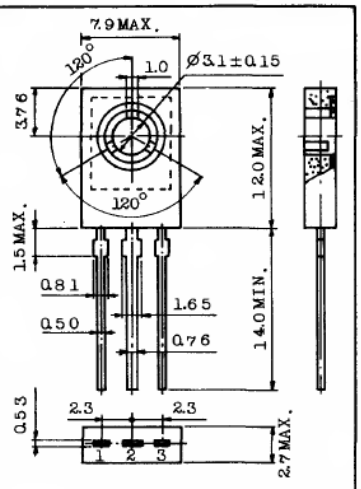
BD135
BD137
BD139

MEDIUM POWER AMPLIFIER APPLICATIONS.

FEATURES:

. Designed for Complementary Use with BD136, BD138 and BD140.

Unit in mm



1. EMITTER
2. COLLECTOR (HEAT SINK)
3. BASE

JEDEC	TO-126
EIAJ	—
TOSHIBA	2-8F1A

Weight : 0.72g

MAXIMUM RATINGS (Ta=25°C)

CHARACTERISTIC		SYMBOL	RATING	UNIT
Collector-Base Voltage	BD135	V_{CBO}	45	V
	BD137		60	
	BD139		80	
Collector-Emitter Voltage	BD135	V_{CEO}	45	V
	BD137		60	
	BD139		80	
Emitter-Base Voltage		V_{EBO}	5	V
Collector Current	DC	I_C	0.5	A
	Peak	I_{CM}	1.5	
Collector Power Dissipation	Ta=25°C	P_C	1	W
	Tc≦60°C		6.5	
Junction Temperature		T_j	150	°C
Storage Temperature Range		T_{stg}	-55 ~ 150	°C

ELECTRICAL CHARACTERISTICS (Ta=25°C)

CHARACTERISTIC		SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Collector Cut-off Current		I_{CBO}	V_{CB}=30V, I_E=0	-	-	0.1	μA
			V_{CB}=30V, I_E=0, Ta=125°C	-	-	10	
Emitter Cut-off Current		I_{EBO}	V_{EB}=5V, I_C=0	-	-	10	μA
Collector-Emitter Breakdown Voltage	BD135	$V_{(BR)CEO}$	I_C=30mA, I_B=0	45	-	-	V
	BD137			60	-	-	
	BD139			80	-	-	
DC Current Gain		$h_{FE(1)}$	V_{CE}=2V, I_C=5mA	25	-	-	
		$h_{FE(2)}$	V_{CE}=2V, I_C=150mA	40	-	250	
		$h_{FE(3)}$	V_{CE}=2V, I_C=500mA	25	-	-	
Collector-Emitter Saturation Voltage		$V_{CE(sat)}$	I_C=500mA, I_B=50mA	-	-	0.5	V
Base-Emitter Voltage		V_{BE}	V_{CE}=2V, I_C=500mA	-	-	1.0	V
Transition Frequency		f_T	V_{CE}=2V, I_C=50mA	50	250	-	MHz