

$$N_{DE} := 10^{19} \text{ cm}^{-3} \quad N_{AB} := 10^{17} \text{ cm}^{-3} \quad N_{DC} := 10^{15} \text{ cm}^{-3}$$

$$\tau_{pe} := 1 \cdot 10^{-7} \text{ s} \quad \tau_{np} := 1 \cdot 10^{-6} \text{ s} \quad \tau_{pc} := 1 \cdot 10^{-7} \text{ s}$$

$$\text{Area} := 10^{-4} \text{ cm}^2$$

$$L_E := 10 \cdot 10^{-4} \text{ cm} \quad L_B := 10 \cdot 10^{-4} \text{ cm} \quad L_C := 100 \cdot 10^{-4} \text{ cm}$$

$$n_i := 9.65 \cdot 10^9 \text{ cm}^{-3}$$

$$V_{oeb} := .0259 \text{ V} \cdot \ln\left(\frac{N_{DE} \cdot N_{AB}}{n_i^2}\right) \quad V_{oeb} = 0.956 \text{ V}$$

$$V_{obc} := .0259 \text{ V} \cdot \ln\left(\frac{N_{AB} \cdot N_{DC}}{n_i^2}\right) \quad V_{obc} = 0.717 \text{ V}$$

$$\varepsilon_{Si} := 11.9 \cdot 8.85 \cdot 10^{-14} \frac{\text{F}}{\text{cm}} \quad V_{BE} := 0 \text{ V} \quad V_{BC} := 0 \text{ V} \quad q := 1.6 \cdot 10^{-19} \text{ C}$$

$$X_{peb} := \left[\frac{2 \cdot \varepsilon_{Si} \cdot (V_{oeb} - V_{BE})}{q} \cdot \left[\frac{N_{DE}}{N_{AB} \cdot (N_{AB} + N_{DE})} \right] \right]^{\frac{1}{2}}$$

$$X_{peb} = 1.116 \times 10^{-5} \text{ cm}$$

$$X_{pbc} := \left[\frac{2 \cdot \varepsilon_{Si} \cdot (V_{obc} - V_{BC})}{q} \cdot \left[\frac{N_{DC}}{N_{AB} \cdot (N_{AB} + N_{DC})} \right] \right]^{\frac{1}{2}}$$

$$X_{pbc} = 1.116 \times 10^{-6} \text{ cm}$$

$$W_B := L_B - X_{peb} - X_{pbc} \quad W_B = 9.877 \times 10^{-4} \text{ cm}$$

$$E_{FNE} := .0259 \text{ V} \cdot \ln\left(\frac{N_{DE}}{n_i}\right) \quad E_{FNE} = 0.538 \text{ V} \quad E_{FPB} := .0259 \cdot \text{V} \cdot \ln\left(\frac{N_{AB}}{n_i}\right) \quad E_{FPB} = 0.418 \text{ V}$$

$$E_{FNC} := .0259 \text{ V} \cdot \ln\left(\frac{N_{DC}}{n_i}\right) \quad E_{FNC} = 0.299 \text{ V}$$

$$V_{BC} := -5V \quad V_{BE} := 0.65V$$

$$X_{peb} := \left[\frac{2 \cdot \epsilon_{Si} \cdot (V_{oeb} - V_{BE})}{q} \cdot \left[\frac{N_{DE}}{N_{AB} \cdot (N_{AB} + N_{DE})} \right] \right]^{\frac{1}{2}}$$

$$X_{peb} = 6.316 \times 10^{-6} \text{ cm}$$

$$X_{pbc} := \left[\frac{2 \cdot \epsilon_{Si} \cdot (V_{oeb} - V_{BC})}{q} \cdot \left[\frac{N_{DC}}{N_{AB} \cdot (N_{AB} + N_{DC})} \right] \right]^{\frac{1}{2}}$$

$$X_{pbc} = 2.786 \times 10^{-6} \text{ cm}$$

$$W_B := L_B - X_{peb} - X_{pbc} \quad W_B = 9.909 \times 10^{-4} \text{ cm} \quad W_{BFA} := W_B$$

$$V_{eb_barrier} := V_{oeb} - V_{BE} \quad V_{eb_barrier} = 0.306 \text{ V}$$

$$V_{bc_barrier} := V_{obc} - V_{BC} \quad V_{bc_barrier} = 5.717 \text{ V}$$

$$V_{BC} := .65V \quad V_{BE} := -5V$$

$$X_{peb} := \left[\frac{2 \cdot \epsilon_{Si} \cdot (V_{oeb} - V_{BE})}{q} \cdot \left[\frac{N_{DE}}{N_{AB} \cdot (N_{AB} + N_{DE})} \right] \right]^{\frac{1}{2}}$$

$$X_{peb} = 2.786 \times 10^{-5} \text{ cm}$$

$$X_{\text{pbc}} := \left[\frac{2 \cdot \epsilon_{\text{Si}} \cdot (V_{\text{oeb}} - V_{\text{BC}})}{q} \cdot \left[\frac{N_{\text{DC}}}{N_{\text{AB}} \cdot (N_{\text{AB}} + N_{\text{DC}})} \right] \right]^{\frac{1}{2}}$$

$$X_{\text{pbc}} = 6.316 \times 10^{-7} \text{ cm}$$

$$W_{\text{B}} := L_{\text{B}} - X_{\text{peb}} - X_{\text{pbc}} \quad W_{\text{B}} = 9.715 \times 10^{-4} \text{ cm} \quad W_{\text{BRA}} := W_{\text{B}}$$

$$V_{\text{eb_barrier}} := V_{\text{oeb}} - V_{\text{BE}} \quad V_{\text{eb_barrier}} = 5.956 \text{ V}$$

$$V_{\text{bc_barrier}} := V_{\text{obc}} - V_{\text{BC}} \quad V_{\text{bc_barrier}} = 0.067 \text{ V}$$

$$W_{\text{BFA}} = 9.909 \times 10^{-4} \text{ cm} \quad W_{\text{BRA}} = 9.715 \times 10^{-4} \text{ cm}$$

$$\mu_{\text{nb}} := 1000 \frac{\text{cm}^2}{\text{V}\cdot\text{s}} \quad L_{\text{N}} := \sqrt{\mu_{\text{nb}} \cdot 0.0259 \text{ V} \cdot \tau_{\text{np}}} \quad L_{\text{N}} = 5.089 \times 10^{-3} \text{ cm}$$

$$\mu_{\text{pe}} := 100 \frac{\text{cm}^2}{\text{V}\cdot\text{s}} \quad L_{\text{PE}} := \sqrt{\mu_{\text{pe}} \cdot 0.0259 \text{ V} \cdot \tau_{\text{pe}}} \quad L_{\text{PE}} = 5.089 \times 10^{-4} \text{ cm}$$

$$\mu_{\text{pc}} := 500 \frac{\text{cm}^2}{\text{V}\cdot\text{s}} \quad L_{\text{PC}} := \sqrt{\mu_{\text{pc}} \cdot 0.0259 \text{ V} \cdot \tau_{\text{pc}}} \quad L_{\text{PC}} = 1.138 \times 10^{-3} \text{ cm}$$

$$\alpha_{\text{TFA}} := 1 - \frac{1}{2} \cdot \frac{W_{\text{BFA}}^2}{L_{\text{N}}^2} \quad \alpha_{\text{TFA}} = 0.981 \quad \alpha_{\text{TRA}} := 1 - \frac{1}{2} \cdot \frac{W_{\text{BRA}}^2}{L_{\text{N}}^2} \quad \alpha_{\text{TRA}}$$

$$\gamma_{\text{FA}} := \left(1 + \frac{W_{\text{BFA}} \cdot N_{\text{AB}} \cdot \mu_{\text{pe}}}{L_{\text{PE}} \cdot N_{\text{DE}} \cdot \mu_{\text{nb}}} \right)^{-1} \quad \gamma_{\text{FA}} = 0.998$$

$$\gamma_{\text{RA}} := \left(1 + \frac{W_{\text{BRA}} \cdot N_{\text{AB}} \cdot \mu_{\text{pc}}}{L_{\text{PC}} \cdot N_{\text{DC}} \cdot \mu_{\text{nb}}} \right)^{-1} \quad \gamma_{\text{RA}} = 0.023$$

$$\alpha_{\text{FA}} := \alpha_{\text{TFA}} \cdot \gamma_{\text{FA}} \quad \alpha_{\text{FA}} = 0.979$$

$$\alpha_{\text{RA}} := \alpha_{\text{TRA}} \cdot \gamma_{\text{RA}} \quad \alpha_{\text{RA}} = 0.022$$

$$\beta_{\text{FA}} := \frac{\alpha_{\text{FA}}}{1 - \alpha_{\text{FA}}} \quad \beta_{\text{FA}} = 46.935$$

$$\beta_{RA} := \frac{\alpha_{RA}}{1 - \alpha_{RA}} \quad \beta_{RA} = 0.023$$

$$V_{BC} := \text{data}^{(0)} \cdot V$$

$$N_{DC} := 10^{19} \text{ cm}^{-3}$$

$$\text{data} :=$$

$$V_{BE} := 0.65V$$

$$X_{peb} := \left[\frac{2 \cdot \epsilon_{Si} \cdot (V_{oeb} - V_{BE})}{q} \cdot \left[\frac{N_{DE}}{N_{AB} \cdot (N_{AB} + N_{DE})} \right] \right]^{\frac{1}{2}}$$

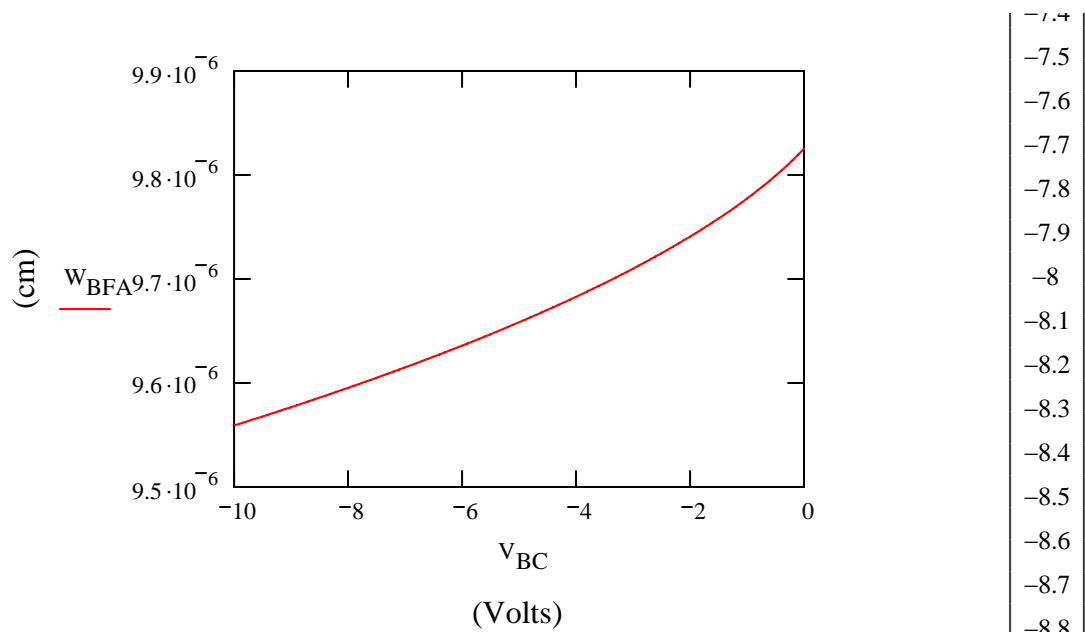
$$X_{peb} = 6.316 \times 10^{-6} \text{ cm}$$

$$X_{pbc} := \left[\frac{2 \cdot \epsilon_{Si} \cdot (V_{oeb} - V_{BC})}{q} \cdot \left[\frac{N_{DC}}{N_{AB} \cdot (N_{AB} + N_{DC})} \right] \right]^{\frac{1}{2}}$$

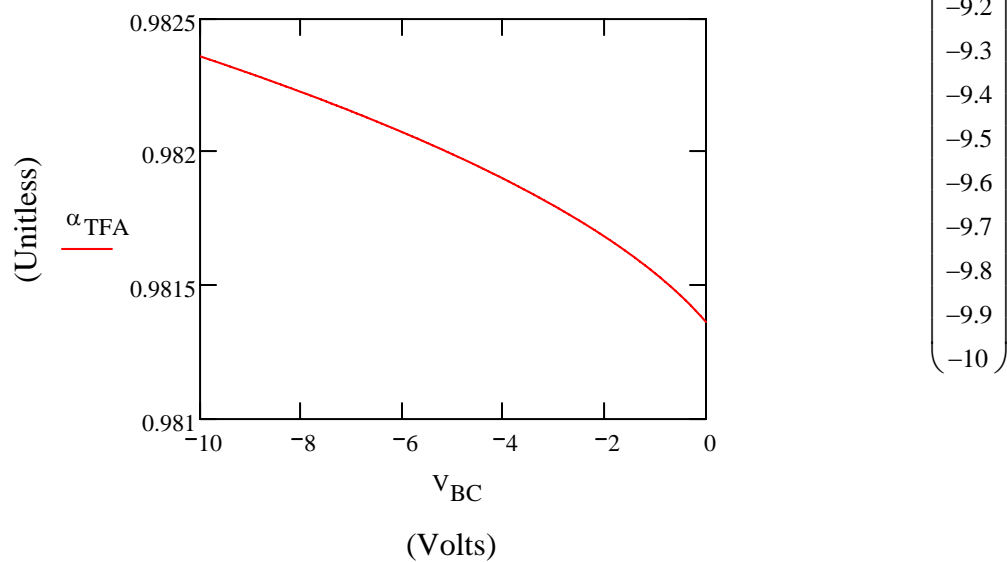
$$W_B := L_B - X_{peb} - X_{pbc}$$

$$W_{BFA} := W_B$$

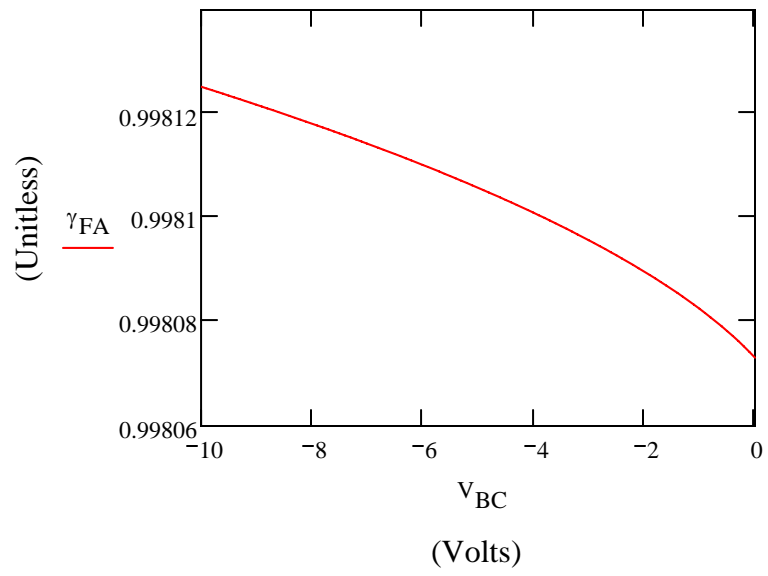
-3.7
-3.8
-3.9
-4
-4.1
-4.2
-4.3
-4.4
-4.5
-4.6
-4.7
-4.8
-4.9
-5
-5.1
-5.2
-5.3
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-5.5
-5.6
-5.7
-5.8
-5.9
-6
-6.1
-6.2
-6.3
-6.4
-6.5
-6.6
-6.7
-6.8
-6.9
-7
-7.1
-7.2
-7.3
7.4



$$\alpha_{TFA} := 1 - \frac{1}{2} \cdot \frac{W_{BFA}^2}{L_N^2}$$



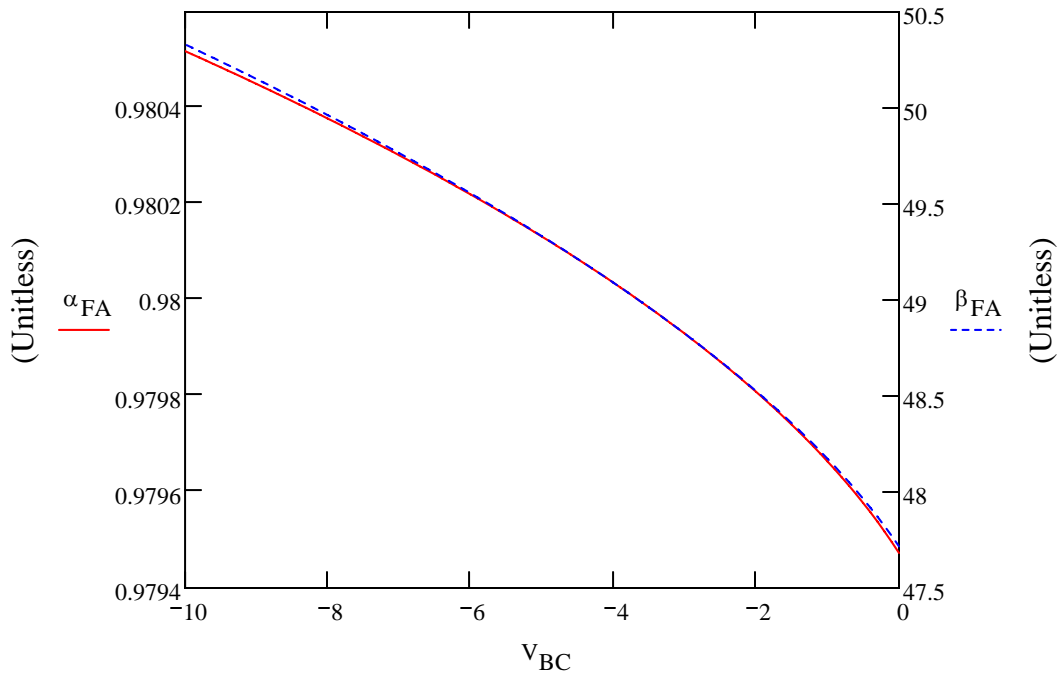
$$\gamma_{FA} := \left(1 + \frac{W_{BFA} \cdot N_{AB} \cdot \mu_{pe}}{L_{PE} \cdot N_{DE} \cdot \mu_{nb}} \right)^{-1}$$



i := 0..100

$$\alpha_{FA_i} := \alpha_{TFA_i} \cdot \gamma_{FA_i}$$

$$\beta_{FA_i} := \frac{\alpha_{FA_i}}{1 - \alpha_{FA_i}}$$



$\alpha_{FA} =$

	0
0	0.979473
1	0.979496
2	0.979517
3	0.979538
4	0.979558
5	0.979577
6	0.979595
7	0.979613
8	0.97963
9	0.979647
10	0.979664
11	0.97968
12	0.979695
13	0.97971
14	0.979725
15	0.97974

(Volts)

$\beta_{FA} =$

	0
0	47.716
1	47.77
2	47.821
3	47.871
4	47.918
5	47.964
6	48.008
7	48.051
8	48.093
9	48.133
10	48.173
11	48.212
12	48.249
13	48.286
14	48.322
15	48.358

$$V_{WB_GOES_TO_ZERO} := V_{oeb} - (L_B - X_{peb})^2 \cdot \frac{q \cdot N_{AB} \cdot (N_{DC} + N_{AB})}{2N_{DC} \cdot \epsilon_{Si}}$$

$$V_{WB_GOES_TO_ZERO} = -7.575 \times 10^3 \text{ V}$$

The break down voltage of the CB junction is around 10 Volts, so this condition would never happen.

