

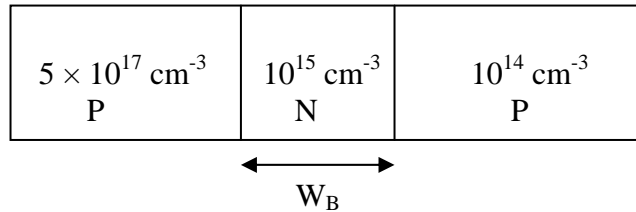
ECSE-2210 Microelectronics Technology
Fall 2005
Class Activity 19

1. The base region in a BJT is narrow. What is the precise definition of “narrow”?
2. Why is it necessary for the base region of a BJT to be narrow?
3. Complete the table below by indicating the polarity (+ or -) of the input and output voltages associated with each of the four biasing modes for the npn transistor.

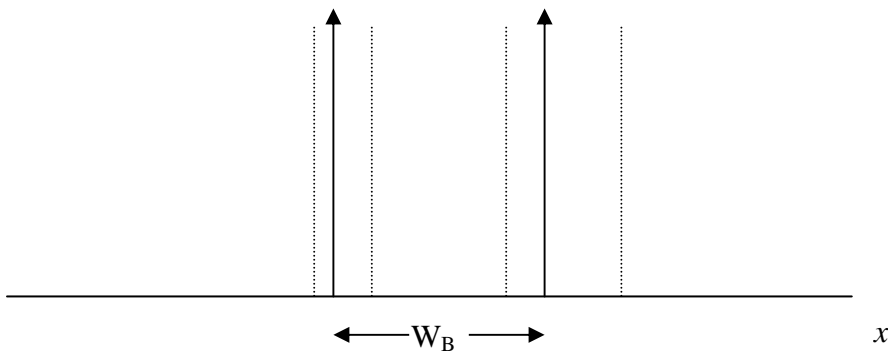
npn BJT

Mode	V_{BE}	V_{BC}
Active		
Inverted		
Saturation		
Cutoff		

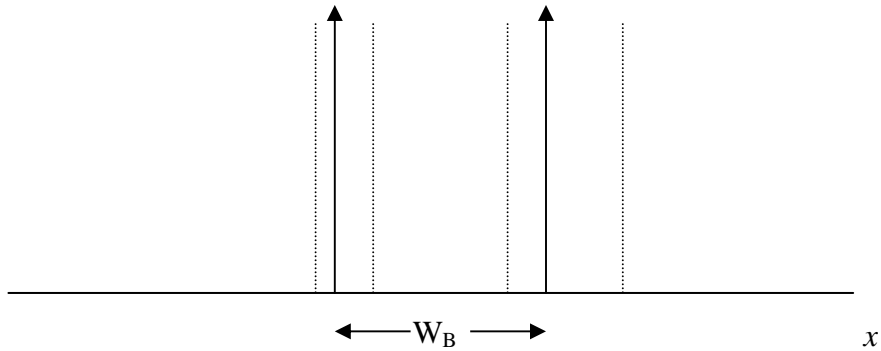
4. Consider a Si pnp BJT with $N_{AE} = 5 \times 10^{17} \text{ cm}^{-3}$, $N_{DB} = 10^{15} \text{ cm}^{-3}$, and $N_{AC} = 10^{14} \text{ cm}^{-3}$.



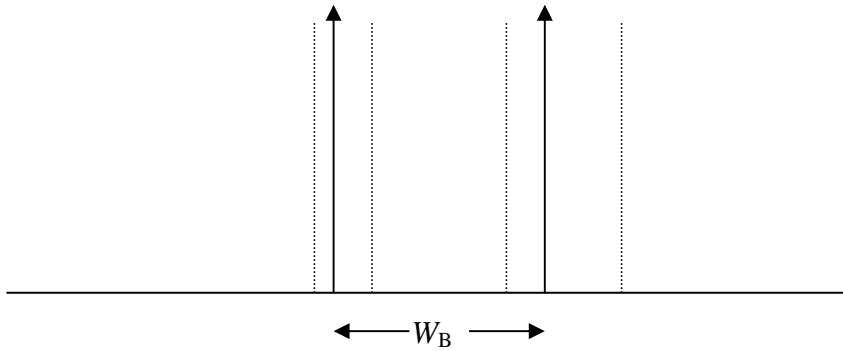
- a. Calculate the equilibrium majority and minority carrier concentrations in the emitter, base and collector of the transistor. Plot them in the figure below.



- b. Roughly sketch (qualitative) the carrier distribution (both holes and electrons) in the base, emitter and collector of this transistor under forward active biasing mode when $W/L_p \gg 1$.



- c. Repeat part b when $W/L_p \ll 1$. (Note: part b corresponds to a back-to-back diode whereas part c corresponds to a real transistor).



5. What are the typical values for γ , α_T , α_{dc} and β_{dc} ? What do these symbols stand for?