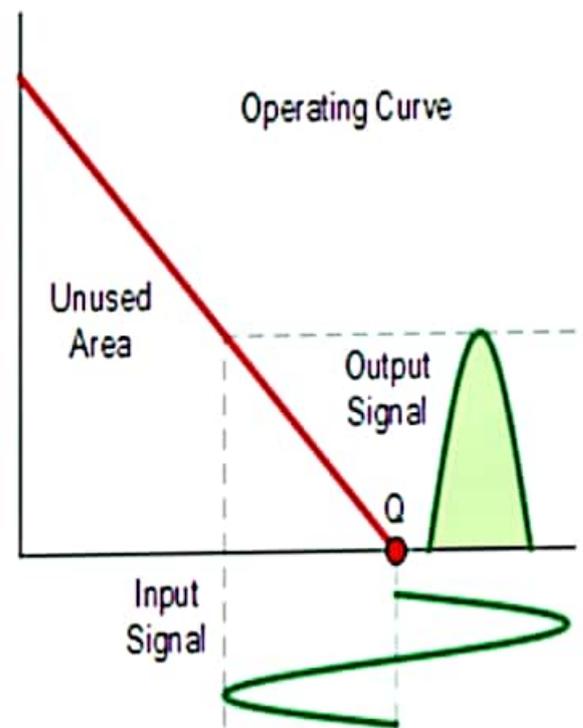
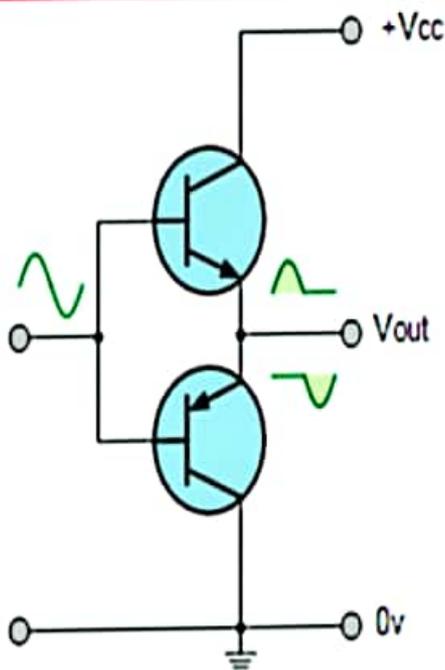


Complementary Push Pull Class B PA



$$\eta = \frac{P_o(ac)}{P_i(dc)} = \frac{V_{ce} \cdot I_{ce}}{V_{CC} \cdot I_{DC}} = \frac{\frac{V_{CC}}{2\sqrt{2}} \cdot \frac{I_{CQ}}{\sqrt{2}}}{V_{CC} \cdot \frac{I_{CQ}}{\pi}} = \frac{\pi}{4} \rightarrow \% \eta = 78.5\%$$

$$V_{CEQ} = \frac{V_{CC}}{2}$$

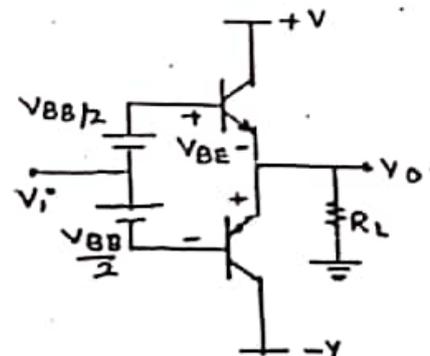
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Methods to Overcome Cross-Over Distortion

METHODS TO OVERCOME COD

COD occurs because $0.7V = V_{BE}$ of input signal is utilized by transistor for J_{BE} to become forward bias and transistor to conduct.

- (1) One method to overcome this to apply $\frac{V_{BB}}{2} = V_{BE}$ to bases of transistor. Now in this case when Q_1 is conducting $V_o = V_i + \frac{V_{BB}}{2} - V_{BE}$ since $\frac{V_{BB}}{2} = V_{BE}$

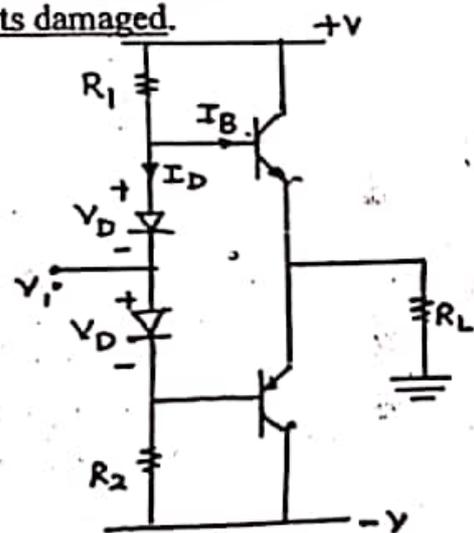


$$\boxed{V_o = V_i}$$

Same is for Q_2 . \therefore COD is eliminated. But this method suffers from one problem. As temperature increases, V_{BE} decreases, I_B increases, I_C increases, P_D in transistor in form of heat increase, further I_C increases due to thermal variation. This process continues & transistor enters in thermal run away & finally gets damaged.

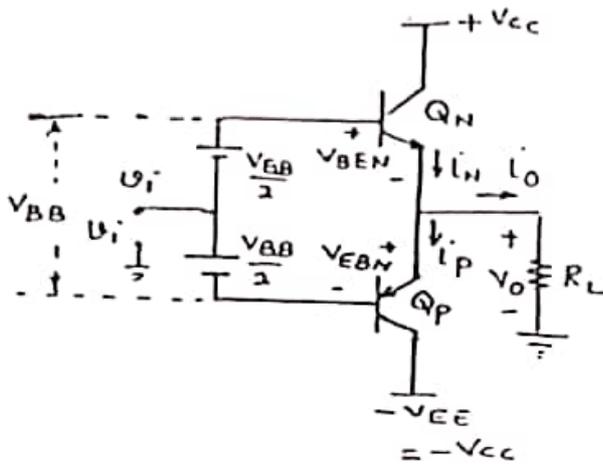
- (2) To overcome above problem diode biasing is used as shown. In the circuit diodes are having same temperature coefficient, for V_D as that of V_{BE} . In other words as temperature increase, V_{BE} & V_D decreases by same amount.

Now as temperature increases, V_{BE} decreases, I_B tries to increase but at the same time V_D also decreases by same amount hence I_D increases. This keeps I_B constant and avoids thermal runaway.

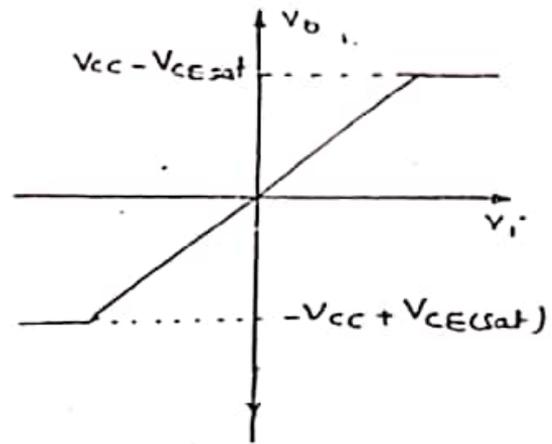


* COMPLEMENTARY SYMMETRY CLASS AB PUSH PULL PA I *

Elimination of dead zone (COD) is obtained in class AB amplifiers. In these amps, transistors are biased such that even if $V_i = 0$, they are in active region and a quiescent current I_{Q} or I_0 flows. Where I_Q is very much less than O/P peak current.



class AB output



transfer characteristics (dead zone or COD is eliminated).

For biasing, voltage V_{BB} is applied between bases of transistors. For $V_i = 0$ a voltage $V_{BB}/2$ appears across V_{BE} of Q_N and Q_P . and quiescent current I_Q flows through transistors. $I_Q = I_S e^{\frac{V_{BB}/2}{V_T}}$ or $V_{BB} = 2V_T \ln \frac{I_Q}{I_S}$ — (1)

If we choose $V_{BB}/2 = V_{BEN} = V_{EBP}$ (i.e. Cut-in voltage of transistors); then we are ensuring that both transistors are at the verge of conduction i.e. $V_o = V_i$ for $V_i = 0$. A small positive input voltage V_i will then cause Q_N to conduct, similarly a small negative input voltage cause Q_P to conduct.

Transfer characteristic The output voltage V_o is given by $V_o = V_i + \frac{V_{BB}}{2} - V_{BEN} (= V_{EBP})$
 for identical transistor $V_{BEN} = V_{EBP}$ and $V_{BEN} = \frac{V_{BB}}{2}$
 $\therefore V_o = V_i$. It mean COD is eliminated

As V_i will increase in positive direction i_n increases. Since $i_n = I_s e^{\frac{V_{BE}}{V_T}}$ or $V_{BE} = V_T \ln \frac{i_n}{I_s}$, this will increase V_{BE} . Since V_{BE} must remain constant V_{EBP} should decrease hence i_p will decrease also because $i_o = i_n + i_p$. It means sum of V_{EBP} and V_{BE} will always be equal to V_{BB} . Which can be written in equation as $V_{BB} = V_{BE} + V_{EBP}$. Now using eqns ① and ② we can write

$$2V_T \ln \frac{I_Q}{I_s} = V_T \ln \frac{i_n}{I_s} + V_T \ln \frac{i_p}{I_s} \rightarrow \text{for all } V_i$$

$$\therefore 2V_T \ln \frac{I_Q}{I_s} = V_T \ln \left(\frac{i_n i_p}{I_s^2} \right)$$

$$\therefore 2 \ln I_Q - 2 \ln I_s = \ln(i_n i_p) - 2 \ln I_s$$

$$\therefore \ln I_Q^2 = \ln(i_n i_p) \quad \therefore \boxed{i_n i_p = I_Q^2}$$

$\therefore I_Q^2 = i_n i_p$ or $I_Q^2 = i_n (i_n - i_o) = i_n^2 - i_n i_o$ which can be solved for the current i_n for any given quiescent current I_Q .

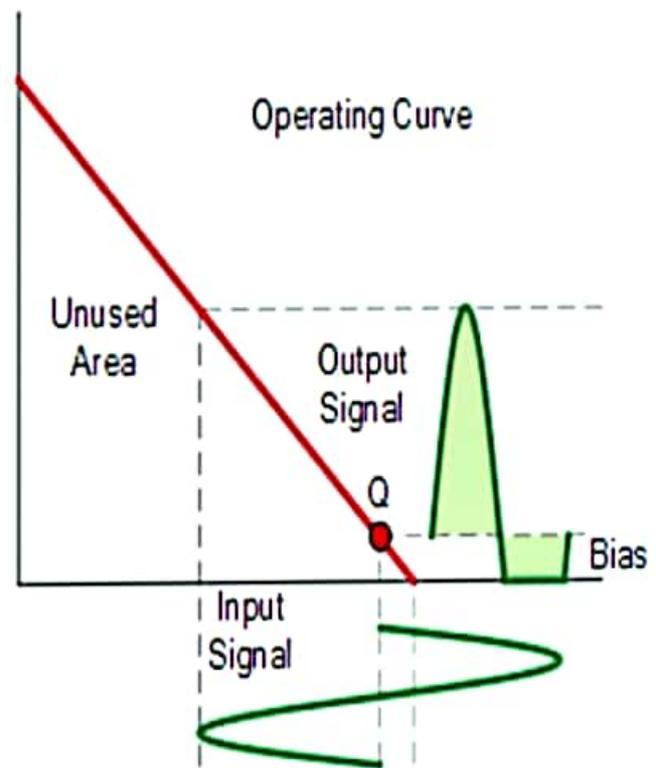
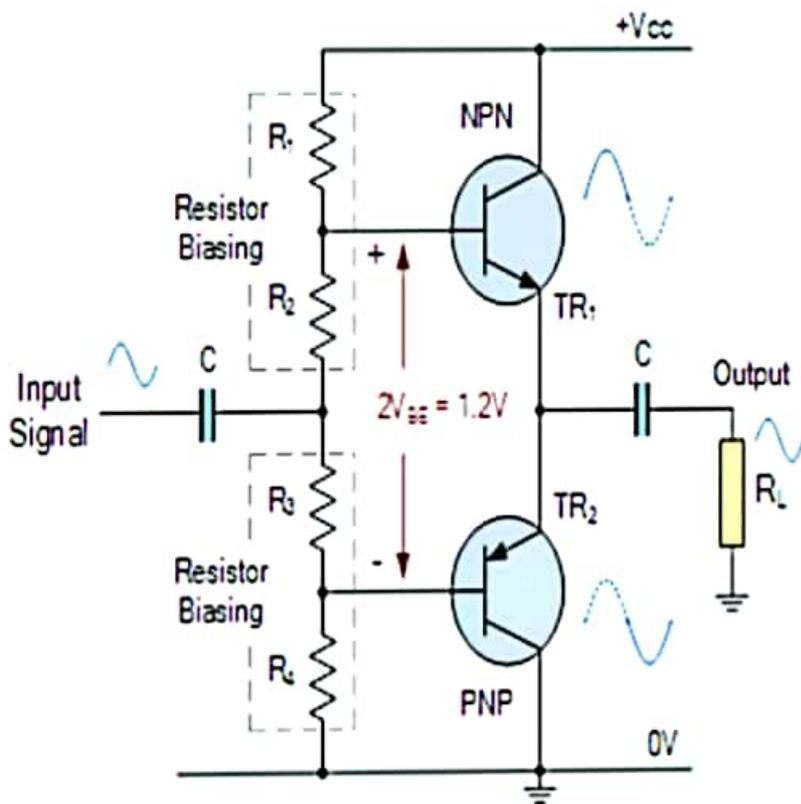
As V_i becomes positive, Q_n acts as emitter follower, delivering output power and Q_p conducts a small current. When V_i is -ve the opposite occurs. The circuit operates in class AB mode because both transistors remain ON and operate in active region.

OUTPUT POWER AND EFFICIENCY OF CLASS AB PA
ALL relations for class AB remain same as in class B. only an additional power $I_Q V_{CC}$ is dissipated by each transistor.

$$\therefore P_{DC} = V_{CC} I_{DC} + V_{CC} I_Q \quad \leftarrow \text{Term due to, Class AB operation}$$

$$\boxed{P_{DC} = \frac{2 I_m V_{CC}}{\pi} + V_{CC} I_Q}$$

Resistor Biased Class AB – Push Pull PA



<https://www.electronics-tutorials.ws/amplifier/amp25.gif>