Amplification stages are classified according to the characteristics of the collector (output) current waveform with an applied input. These classes are defined as Class A, Class B, Class AB and Class C.

Class A Operation

The Class A output stage reproduces the input signal in its entirety as shown in the figure to the left. The transistor of a Class A amplifier conducts for the entire cycle of the input signal or, the collector current is non-zero 100% of the time (except for the instantaneous zero crossings). The output, $i_c(t)$, is an amplified reproduction of the applied input $i_b(t)$. The letter designations (a) through (e) in the figure serve to represent the same instants in time on the $i_b(t)$ and $i_c(t)$ curves.

Class B Operation

Class B operation requires the use of two transistor amplifiers to produce a complete output waveform. One amplifier is used to amplify the positive half cycle of the input signal while the second is used to amplify the negative half-cycle. Each transistor is biased at a zero quiescent current ($I_{CQ}=0$) instead of in the active region as in a Class A stage. The advantage of this configuration is that each transistor dissipates zero, or almost zero, power in the quiescent condition. The Class B configuration is also known as push-pull or complementary symmetry, and it is extremely important that the two transistors are perfectly matched so that the positive and negative portions of the input are amplified by the same amount.

Crossover Distortion: Disadvantage of Class B

- Crossover distortion occurs at the point where the transistor switches from the active region to the cutoff region. This results in a non-linear output that does not accurately reproduce the input signal.
Reason: Since the transistors are biased at ICQ=0, the operating range includes the nonlinear cutoff region.

Class AB Amplifier

- Class A configuration offers the better linearity (smaller distortion), but has pretty lousy efficiency (power dissipation).
- Class B stage does well with efficiency, but has rotten linearity.

Class AB operation still uses two transistor amplifiers, one for the positive going portion of the input and one for the negative going input, but the bias of the individual transistors is between the extremes of Class A and Class B. In this strategy, each transistor is biased at a Q-point that is slightly above the cutoff region. Biasing each transistor in this fashion does two things:
  1. The Q-point remains in the linear region of the characteristic curves, which avoids the nonlinear distortion of the cutoff region; and
  2. Each transistor conducts for an interval slightly longer than a half-cycle.

Class C Amplifier

These amplifiers are usually employed in RF (radio-frequency) power amplification and are capable of providing large amounts of power, but are somewhat application specific.
A transistor in a Class C stage is biased such that it conducts for an interval of less than a half-cycle of the input. The result is a waveform that pulsates periodically with the period of the input signal. If the input is a sinusoid, the output is a series of "blips" that contain the frequency of the input as the fundamental, plus higher frequency harmonics. The output may then be passed through an LC (inductor-capacitor) circuit tuned to the frequency of the input sinusoid. This tuned circuit acts as a bandpass filter and yields a sinusoid at the output that is approximately the same frequency as the input (the narrower the passband, the closer the approximation).

\[ f_r = \frac{1}{2\pi\sqrt{LC}} \]

Class C amplifier is always intended to amplify a narrow band of frequencies. \( f_r \) is usually an integer multiple of the input signal frequency.