LARGE SIGNAL AMPLIFIER

BY PARDEEP NANDAL

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- One method used to distinguish the electrical characteristics of different types of amplifiers is by "class", and as such amplifiers are classified according to their circuit configuration and method of operation.

- Amplifier Classes represent the amount of the output signal which varies within the amplifier circuit over one cycle of operation when excited by a sinusoidal input signal.
- The classification of amplifiers range from entirely linear operation (for use in high-fidelity signal amplification) with very low efficiency, to entirely non-linear (where a faithful signal reproduction is not so important) operation but with a much higher efficiency, while others are a compromise between the two.

S.NO	Voltage amplifier	Power amplifier
1	Transistor chosen should have high value of β about 100	Transistor should have small value of β about 20 to 50.
2	Load resistance Rc has high value about 10KΩ	Load has small value 10Ω to 20Ω
3	Input voltage is low approx few mV	Input voltage is high about few volt
4	It has low power output & high voltage output.	It has high power output and low voltage output .
5	Collector current has low value 100mA.	Collector current has high value.
6	Output impedance of voltage amplifier has high value.	Output impedance has low value.
7	Usually R-C coupling is used.	Transformer or tuned circuit is always used

PERFORMANCE QUANTITES OF POWER AMPLIFIER

(*i*) Collector efficiency

The ratio of a.c. output power to the zero signal power (i.e. d.c. power) supplied by the battery of a power amplifier is known as **collector efficiency**.

(*ii*) Distortion

The change of output wave shape from the input wave shape of an amplifier is known as **distortion.**

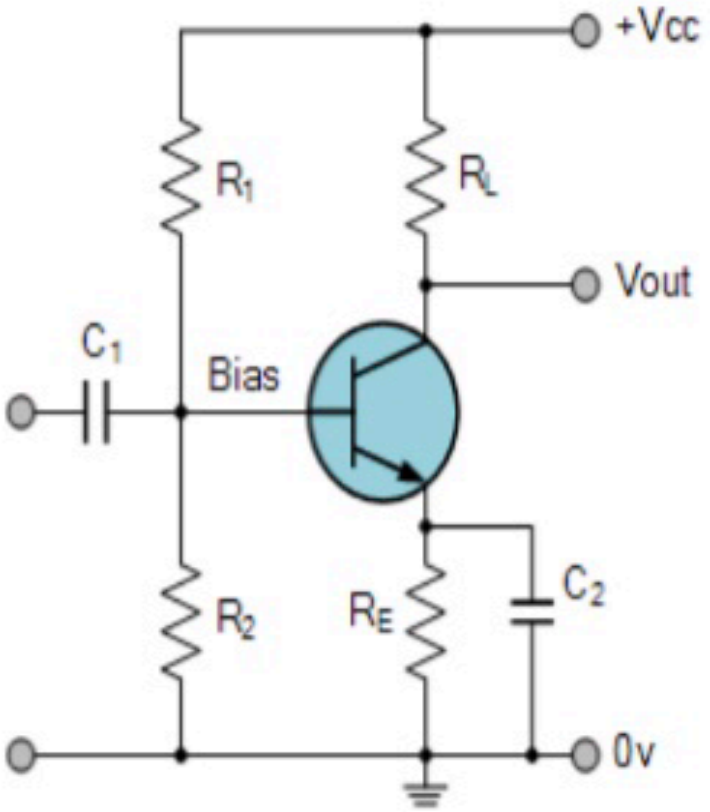
(*iii*) Power dissipation capability

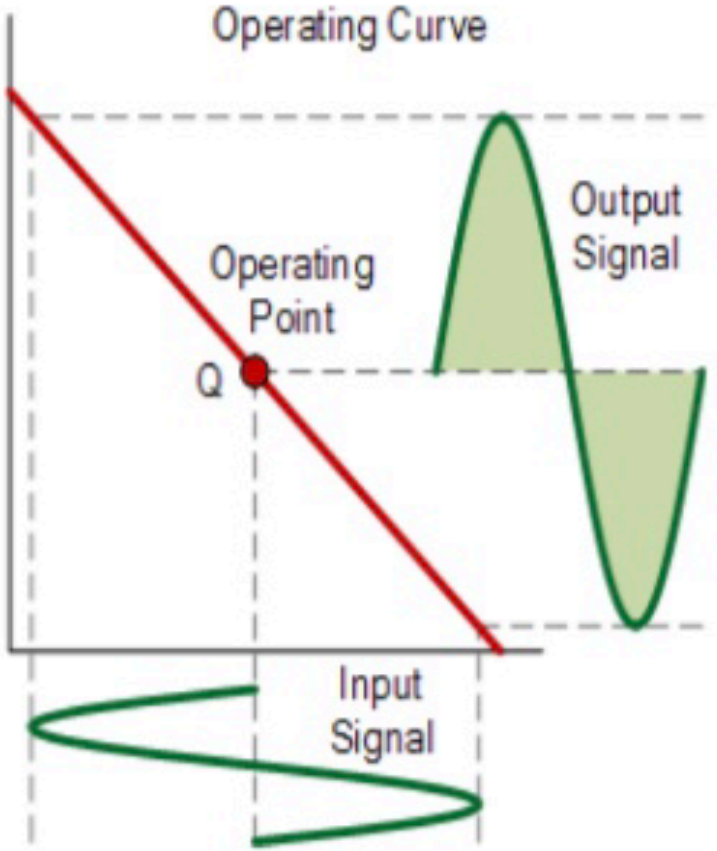
The ability of a power transistor to dissipate heat is known as **power dissipation capability.**

CLASSIFICATION OF LARGE SIGNAL AMPLIFIERS

- Class A
- Class B
- Class C
- Class AB

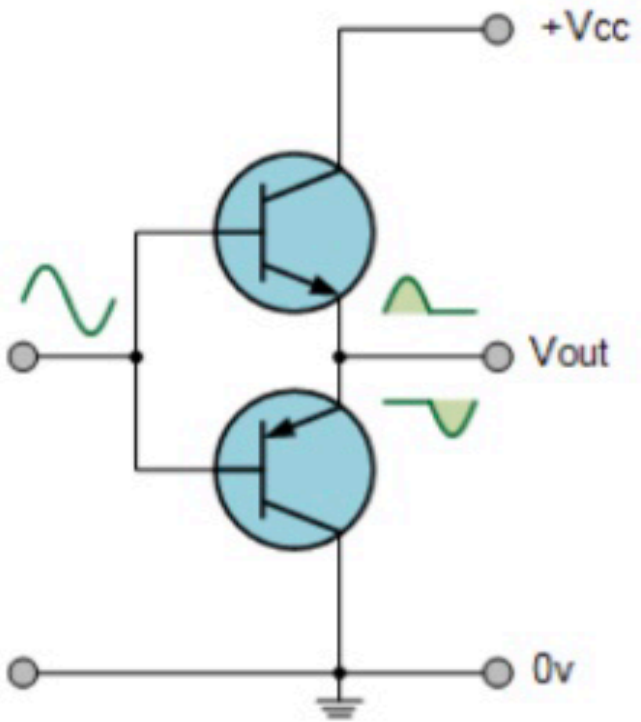
Class A Amplifier

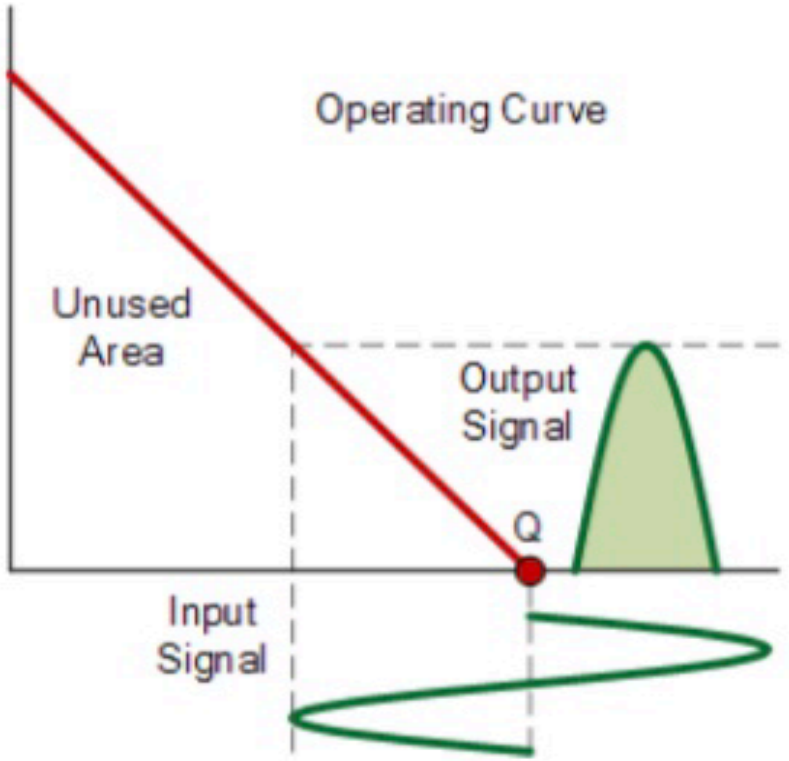




- To achieve high linearity and gain, the output stage of a class A amplifier is biased "ON" (conducting) all the time. Then for an amplifier to be classified as "Class A" the zero signal idle current in the output stage must be equal to or greater than the maximum load current (usually a loudspeaker) required to produce the largest output signal.
- As a class A amplifier operates in the linear portion of its characteristic curves, the single output device conducts through a full 360 degrees of the output waveform. Then the class A amplifier is equivalent to a current source.

Class B Amplifier

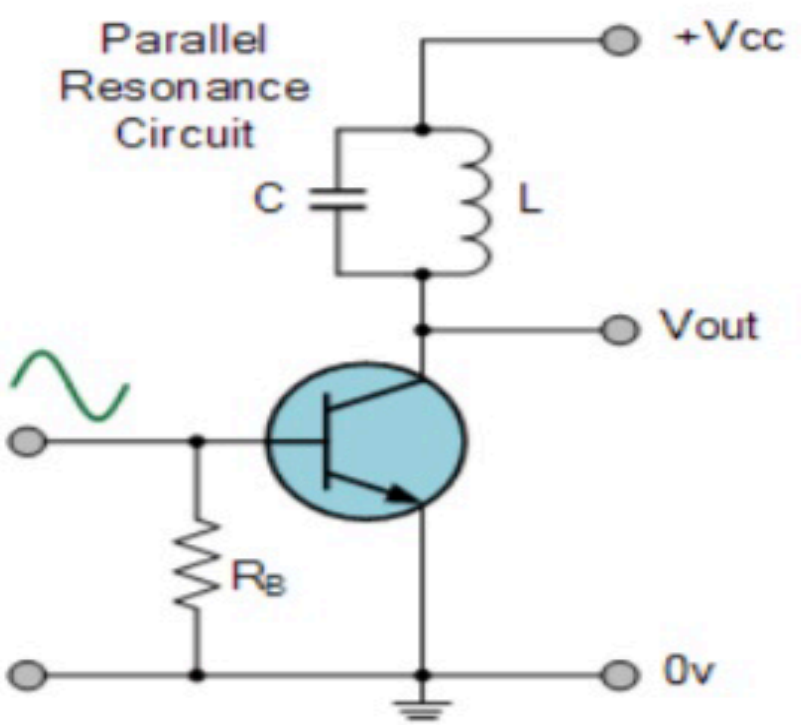


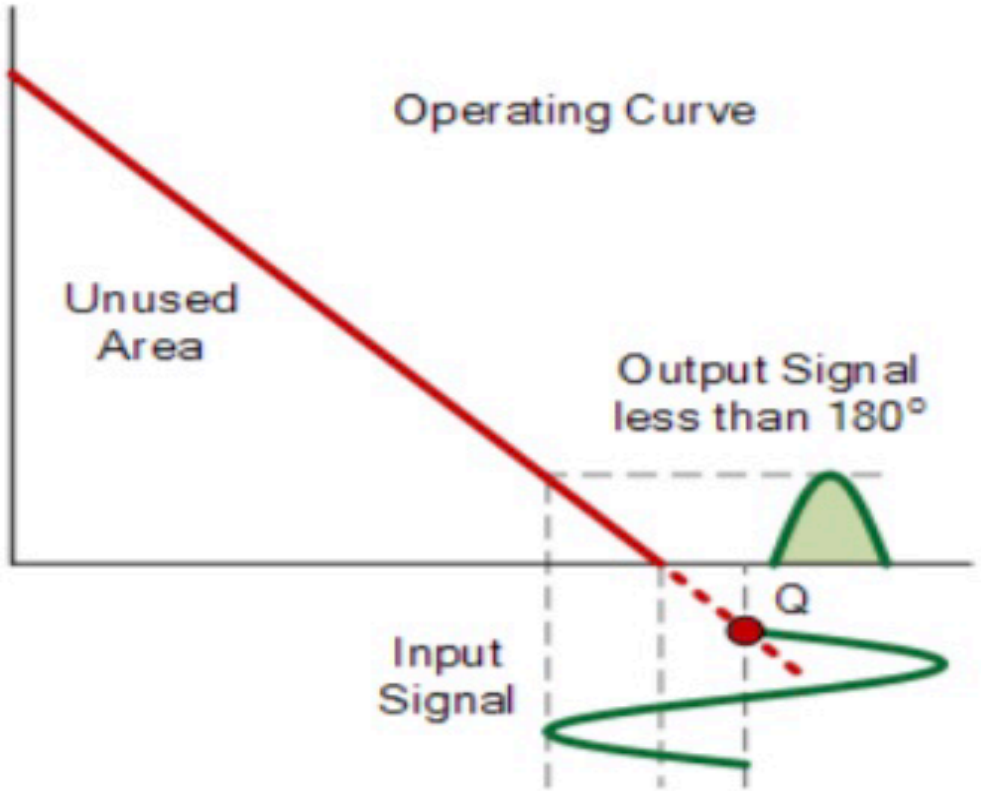


Class B Amplifier

- **Class B amplifiers** were invented as a solution to the efficiency and heating problems associated with the previous class A amplifier.
- The basic class B amplifier uses two complimentary transistors either bipolar of FET for each half of the waveform with its output stage configured in a "push-pull" type arrangement, so that each transistor device amplifies only half of the output waveform.

Class C Amplifier

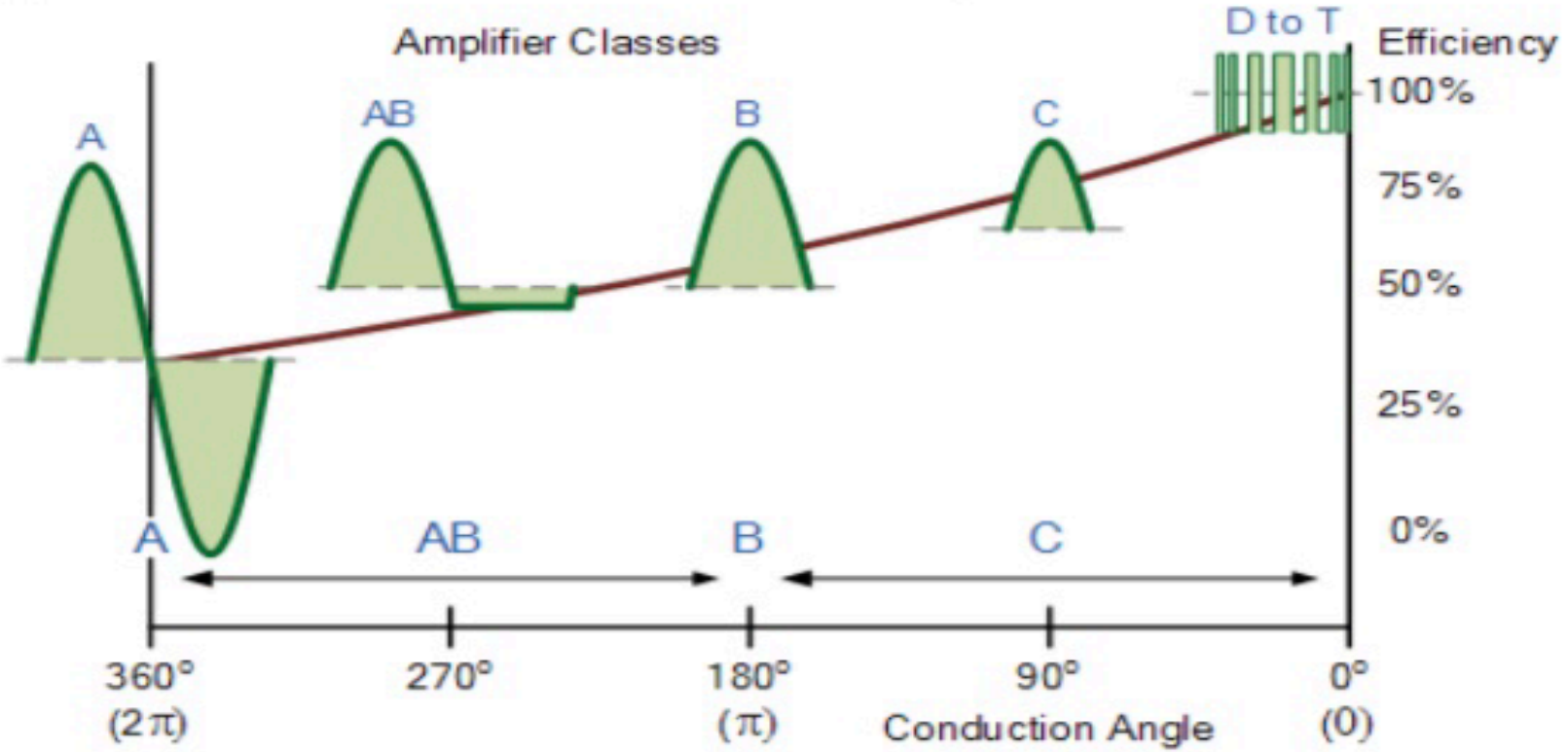




Class C Amplifier

- The **Class C Amplifier** design has the greatest efficiency but the poorest linearity of the classes of amplifiers mentioned here.
- The previous classes, A, B and AB are considered linear amplifiers, as the output signals amplitude and phase are linearly related to the input signals amplitude and phase.
- However, the class C amplifier is heavily biased so that the output current is zero for more than one half of an input sinusoidal signal cycle with the transistor idling at its cut-off point.

Amplifier Classes and Efficiency



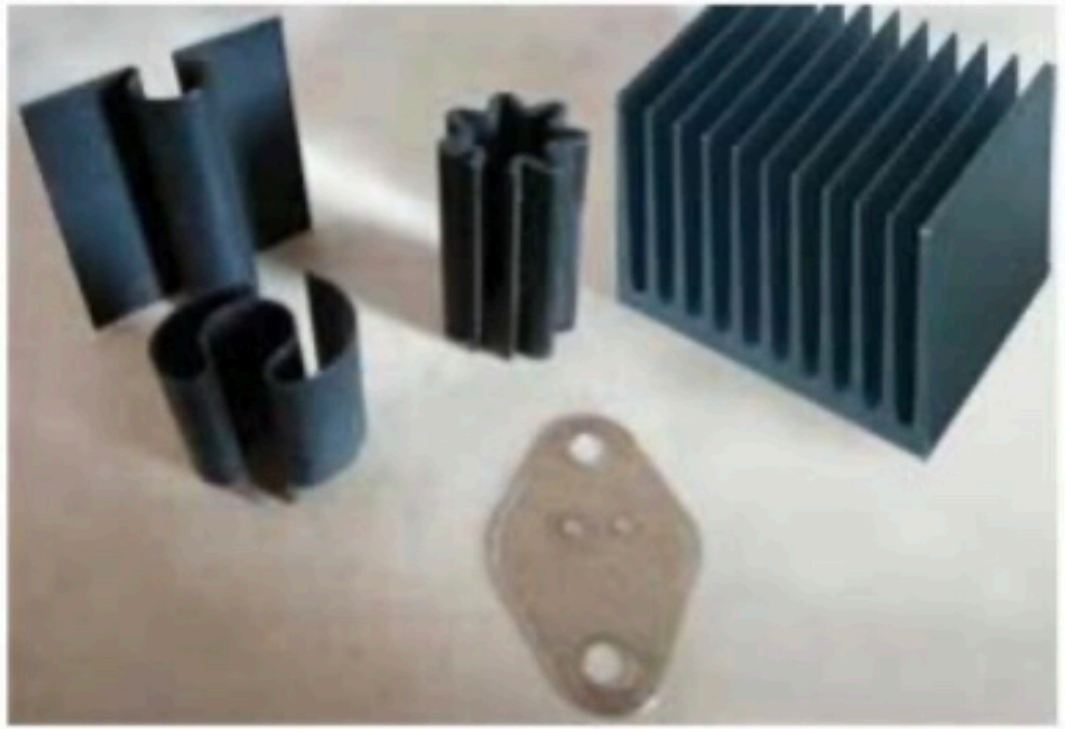
Thermal stability of Power amplifiers

- Each heat-sink has a parameter called its Thermal Resistance (Rth) measured in °C/Watt and the lower the value of Rth the faster heat is dissipated.
- Other factors affecting heat dissipation include the power (in Watts) being dissipated by the transistor, the efficiency of heat transfer between the internal transistor junction and the transistor case, and the case to the heat-sink.
- The difference between the temperature of the heatsink and the air temperature surrounding the heat-sink (the ambient temperature) must also be taken into account.
- The main criterion is that the heat-sink should be efficient enough, too efficient is not a problem.

Heat Sinks

- A heat-sink is designed to remove heat from a transistor and dissipate it into the surrounding air as efficiently as possible.
- Heat-sinks take many different forms, such as finned aluminium or copper sheets or blocks, often painted or anodised matt black to help dissipate heat more quickly..

Heat Sinks



- Good physical contact between the transistor and heat-sink is essential, and a heat transmitting grease (heat-sink compound) is smeared on the contact area before clamping the transistor to the heat-sink.
- Where it is necessary to maintain electrical insulation between transistor and heat-sink a mica layer is used between the heat-sink and transistor.
- Mica has excellent insulation and very good heat conducting properties.

Push Pull Amplifiers

- Transistors all exhibit a nonlinear characteristic that causes distortion of the input signal levels. Such distortion can be eliminated by push-pull amplifier

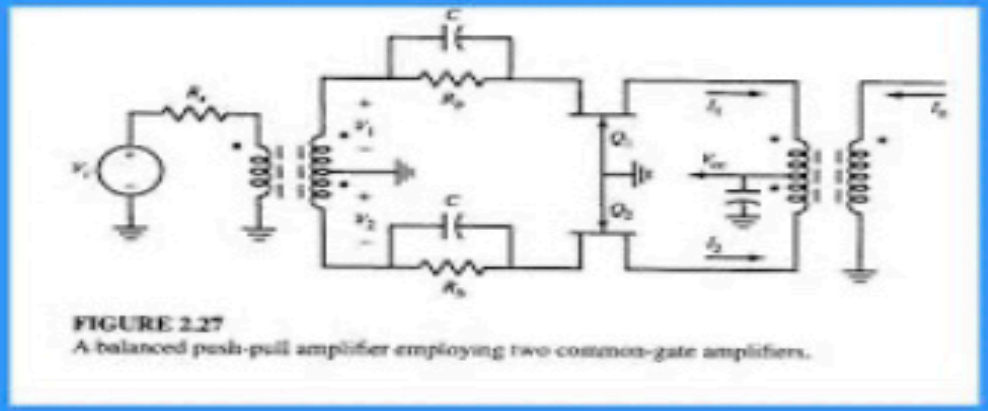


FIGURE 2.27
A balanced push-pull amplifier employing two common-gate amplifiers.

- The above example uses 2 center-tapped transformers. The input transformer separates the input signal into 2 signal 180° out of phase. The output transformer is used to sum the output currents of the two transistors.
- Hence $I_1^- = -I_2^-$ and

$$I_0 = K_1(I_1 - I_2)$$

- If the input signal is $I_i^- = A\cos\omega t$

Advantages of push-Pull amplifier

- Circuit efficiency of a class-B push-pull amplifier is 78.5%.
- No power is drawn from the d.c. supply under no signal condition.
- Eliminates even order harmonics in a.c. output signal.
- Due to the absence of even harmonics the circuit gives more output per device, for a given amount of distortion.
- No d.c. component in the out put signal.

THANK YOU