Cascaded Amplifiers

A cascade amplifier is a two-port network designed with amplifiers which are connected in series when every amplifier transmits its o/p to the second amplifiers input in a daisy chain. The problem in measuring the gain of the cascaded stage is the non-perfect coupling among two stages because of loading.

The two stages of cascaded CE (common-emitter) are shown in the following circuit. Here the voltage divider can be formed by using the input and output resistances of the first and next stage. The complete gain cannot be the result of the individual stages in Figure 2.7.1.

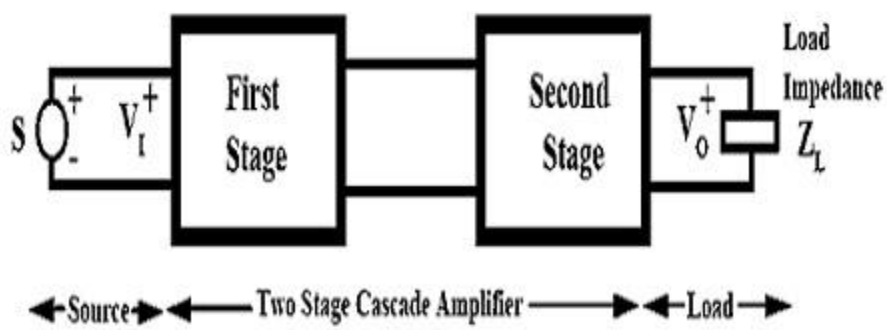

Figure 2.7.1 Two Stage Cascade Amplifier

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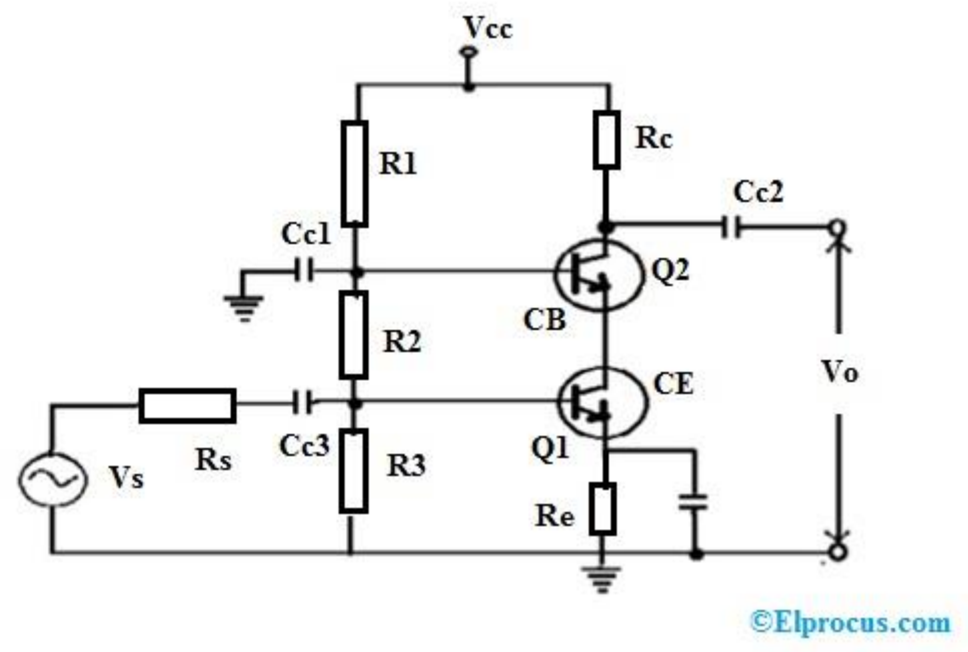
Cascade Amplifier Circuit

The circuit diagram of cascade amplifier is shown below figure 2.7.2. The circuit can be designed with two configurations of a transistor namely CE (common-emitter) and CB (common base). The CB (common base) configuration provides a good high-frequency operation.



cascade-amplifier-circuit

Figure 2.7.2 Two Stage Cascade Amplifier

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The current gain, as well as the i/p resistance of the cascade arrangement, is equivalent to the related value of a common emitter single-stage amplifier. The o/p resistance can be equivalent to the common base configuration in figure 2.7.2. The miller's capacitor shunting the common emitter input stage is extremely small.

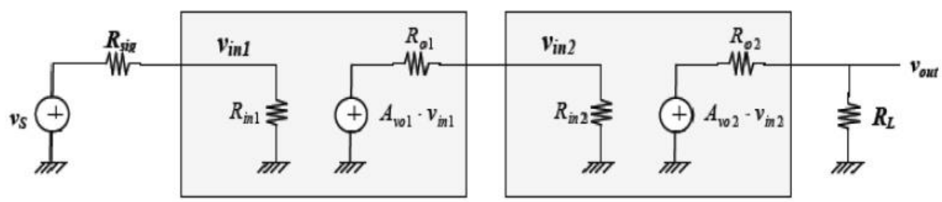

Fig3.20 small signal model of Cascaded ***Configuration of MOSFET***

Figure 2.7.3 Small Signal Model of Cascaded Configuration

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$$A_{vo1} = -\frac{g_{m1} \cdot R_2}{1 + g_{m1} \cdot R_3}$$

$$A_{vo2} = g_{m2} \cdot R_4$$

$$R_{o1} = R_2$$

$$R_{o2} = R_4$$

$$R_{in1} = R_1$$

$$R_{in2} = \frac{1}{g_{m2}}$$

.

By grouping the different factors in this expression, we can find a physical interpretation for the cascading in figure 2.7.3. This physical interpretation can be used to guide simulation or analysis of the different stages separately, before combining them into a cascaded amplifier.

$$\frac{v_{out}}{v_S} = \frac{v_1}{v_S} \cdot \frac{v_{out}}{v_2} = \underbrace{\left[\frac{R_{in1}}{R_{in1} + R_S} \cdot A_{vo1} \cdot \frac{R_{in2}}{R_{in2} + R_{o1}} \right]}_{\substack{\text{Gain of stage 1 with} \\ \text{actual source and} \\ \text{loaded by stage 2}}} \cdot \underbrace{\left[A_{vo2} \cdot \frac{R_L}{R_L + R_{o2}} \right]}_{\substack{\text{Gain of stage 2 with} \\ \text{ideal source and} \\ \text{loaded by } R_L}}$$

This amplifier is used to enhance the strength of a signal in a TV receiver. In this amplifier, the primary stage of the amplifier can be connected to the secondary stage of the amplifier. To build a practical electronic system, a single-stage amplifier is not enough. Even though the amplifier's gain mainly depends on parameters of the device as well as components of the circuit, there exists a higher limit of gain which can be attained from a single-stage amplifier. Therefore, the gain of this amplifier cannot be sufficient in practical application.

To conquer this trouble, we require this amplifier's two or more stages to amplify the overall amplifier's voltage gain. As above one stage is used within series it is named as a multi-stage amplifier. The main drawback of the cascade amplifier is when several stages increases then the bandwidth will decrease.

The applications of the cascade amplifier include the following.

- This amplifier is used in tuned RF amplifiers within television circuits.
- This amplifier can also be used as a wideband amplifier.
- The isolation offered among input & output with these amplifiers is extremely high.