FREQUENTLY ASKED QUESTIONS

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Content Questions

Can you clarify the "Transistor Man" concept?

The idea is that the simplified behavior of a transistor can be described as if there's a little guy inside, who controls the current between collector and emitter, I_c, according to the current he reads at the base I_b. Of course this is just a model, but the "Transistor Man equation", $I_c = h_{FE} I_b$ (or its AC equivalent, $i_c = h_{fe} i_b$) works reasonably well for most cases we'll deal with.

How does the voltage divider in combination with a transistor cause clipping not to occur? Does it just set V_b sufficiently high to be above the clipping point?

Basically, yes— the voltage divider providing the DC bias at the input provides a DC offset sufficiently high that the most negative part of the signal will never go below a volt or so. If the DC bias is properly set, the transistor will always be "on", i.e., in the linear active region, for every part of the input signal's swing. In this case, there will be no clipping.

If the transistor's base is DC biased, it still sees a fluctuating signal, but is always in linear operating mode?

Right. If the DC offset at the base is sufficiently high, even for the most negative part of a sinusoid input will the base be at least V_{pn} higher than the emitter, so that the transistor will be in the linear active region.

How do you get from the simplified transistor model to the one with two resistors and a constant current source? The AC signal generator seemingly just goes away.

For all models, there's always an AC generator at the input.

The slightly more complicated AC transistor model that we covered in Lecture 14 is shown in Figure 4.18 of Eggleston. In this model, the input sees an effective extra AC voltage v_{ce} with proportionality constant h_{re}, the "voltage feedback ratio" or "reverse voltage ratio", in series with it. However h_{re} tends to be a very small number ($\sim 10^{-4}$). So often we can just drop this term in our description of what the input sees and still get a reasonable answer. This is the simplified transistor model that Eggleston uses (and that we will also primarily use going forward). This model, with the $h_{re}v_{ce}$ component shorted out, is shown in Fig. 4.17.

Regarding "viewing the circuit from the input"... why would we in real-life situations?

In real life, it usually matters what the source you are connecting up to the input of your 4-terminal circuit "sees"– for example, the input impedance tells you what current gets drawn for a given input voltage signal. In today's examples of basic common emitter amplifier designs (which are real-life, albeit somewhat simplified, circuits), thinking about what the input "sees" allows us to compute the circuit parameters (as for the question above).

What are common emitter amplifiers used for?

Well, basically, to amplify (i.e., make signals bigger in voltage or current or both). The common emitter amplifier is a kind of basic amplifier, with low input impedance. It can produce both voltage gain and current gain.

What exactly is the use of R_c, R_e at the emitter and collector? Can we use a transistor without them?

For transistor amplifiers, these resistors affect the amplifier properties, i.e., the gains and impedances (we saw today that for the CE amplifier example, the gains and impedances depend on R_e and R_c. We will see other examples.) You choose these resistors to select the amplifier properties you want.

In some cases these resistors can be omitted. You can make a CE amp without an emitter resistor; to find the properties you just set $R_E = 0$. (It turns out that it's actually a good idea to put the emitter resistor in there to make the biasing more stable; if it's not there, the base resistor choice becomes highly dependent on β, which can vary a lot from transistor to transistor. But if you use an emitter resistor you end up with biasing voltages less sensitive to β.)

You don't really want to omit R_c for a CE amp (and a CB amp, as we'll see) since that would just put the output at V_{CC} which would not be useful. But we'll see later that in the CC amp case there's no collector resistor.

Is there a simple way to fix the common emitter amplifer to not invert the signal and only amplify it?

Yes, there are ways to make non-inverting amplifiers, and we'll see some. (In practice, you would usually use an op-amp to make an amplifier, and we'll see how to make both inverting and non-inverting amplifiers out of them).