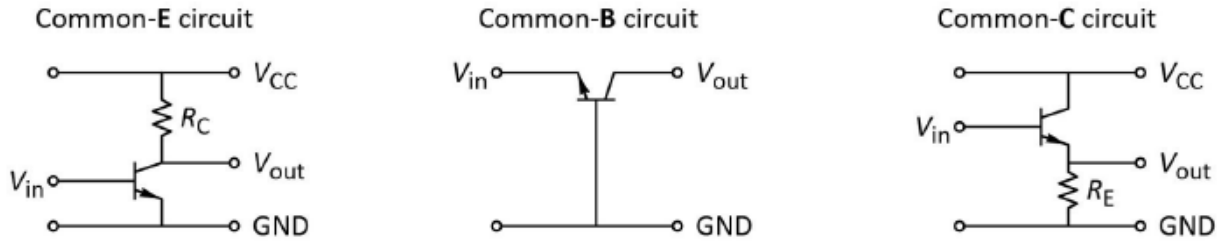
Hayden Fuller
Intro to Electronics HW6

Hi, This is incomplete, I've been traveling and there were some flight delays, I'd love to finish this with an extension if possible, thank you

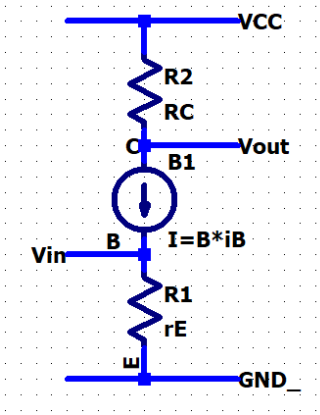
1. The figure below shows the three BJT circuits (bipolar junction transistor circuits). These circuits lack any biasing. For this reason, the circuits may be referred to as the basic BJT circuits. Let us assume that the source voltages include DC components that make the BJTs operate in their normal (forward active) mode.



   a. Define input impedance (Z In), output impedance (Z Out), open-circuit-voltage-gain (A VOC), and short-circuit-current gain (A ISC).

Zin Impedance seen by the input side, should usually be large to avoid altering the signal
Zout Impedance seen by the output side, should be small to give a more ideal source
AVOC Voltage amplification with open circuit- how it acts as a voltage source with no load
AISC Current amplification with short circuit- how it acts as a current source with no load

   b. For the common- E circuit, draw an AC small-signal equivalent circuit of the BJT circuit. Determine z in , z out , A VOC , and A ICS . Assume that the input signal has a DC component that causes the BJT to operate in the forward active regime (that is, the regular operating regime).



Zin = Vin/Iin
Iin=IB
IC=B*IB
IE=I(R2)=Vin/rE
IB=IE-IC
IB=(Vin/rE)-(B*IB)
IB+(B*IB)=(Vin/rE)
(B+1)*IB=Vin/rE
IB=Vin/(rE*(B+1))

Zin=Vin/(Vin/(rE*(B+1)))

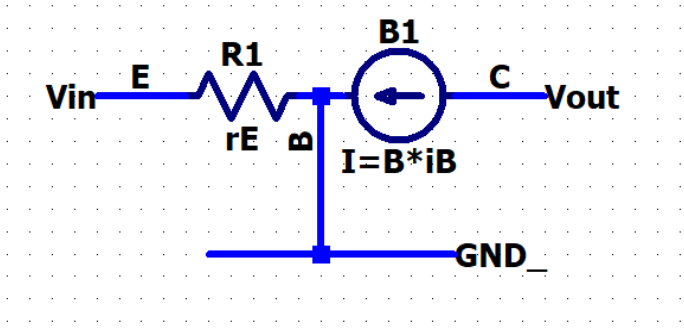
Zin=rE*(B+1))
rE=Vt/IE~=.026/.1~=.26
Zin~=.026*200~=52Ohm
Zin=rE*(B+1))~=50

Zout = Vout/Iout
Iout=I(RC) - IC
IC=B*IB
I(RC)=V(RC)/RC
Vout=VCC-I(RC)*RC
Zout=Vout/Iout

Iout=(VCC-Vout)/RC - B*IB
Iout=(VCC - Vout - B*IB*RC)/RC
Zout = Vout*RC/(VCC - Vout - B*IB*RC)

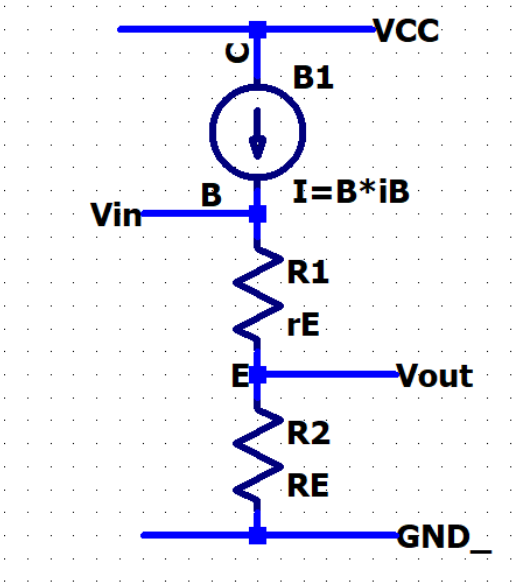
AVOC = Vout/Vin
Vout =
AICS

c. Answer the previous question for the common- B circuit.



Zin
Zout
AVOC
AICS

d. Answer the previous question for the common- C circuit.



Zin
Zout
AVOC
AICS

e. Which one of the three circuits has the lowest input impedance? Is low input impedance desirable?

No, low input impedance is not desirable in most situations, as that can affect the input side of the circuit

f. Which one of the three circuits has the lowest output impedance? Is low output impedance desirable? Note: Two circuits may be similar with respect to output impedance.

Yes, low output impedance is desirable so that it acts more like a perfect source

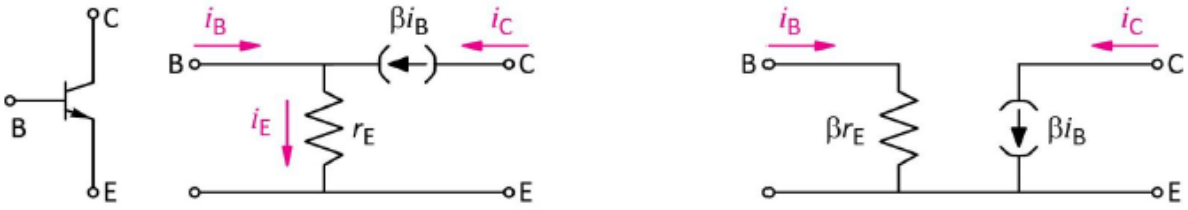
g. Which of the three circuits has the lowest A VOC ?

h. Which of the three circuits has the lowest A ISC ?

i. Name a specific application for which each one of the three BJT circuits is particularly well suited for.

2. The figure below shows the small-signal equivalent circuit of a BJT that is configured in the common-emitter configuration. The LHS (left-hand side) circuit was derived in class; it is referred to as a “ T ” equivalent circuit. The RHS (right-hand side) circuit is identical

to the LHS circuit with respect to its behavior at its three terminals B, E, and C; the circuit is referred to as " π " equivalent circuit.



a. Draw the " T " and " π " equivalent circuits and indicate all relevant quantities. Articulate three conditions (relating to input resistance, output resistance, and short-circuit current amplification A ISC) that must be satisfied by the RHS circuit, if the RHS circuit is identical to the LHS circuit with respect to its behavior at the terminals B, E, and C.

b. Show that the RHS circuit meets the three conditions that you have articulated under the previous question. It is acceptable to assume $\beta + 1 \approx \beta$.

c. Can you articulate an advantage of the LHS circuit? Can you articulate an advantage of the RHS circuit?

3. Are the following statements true or false ? Explain your answer.
   a. A BJT under normal operating conditions will have a DC BE voltage of 0.7 V and an AC BE voltage << 0.7 V (BE = Base-Emitter).

   b. The large-signal equivalent circuit of a BJT, valid for all operating conditions, must include two pn-junction diodes.

   c. A BJT amplifier circuit having the common- C configuration can attain high values of both A VOC and A ISC .

   d. The common- B configuration of the BJT is frequently used, whereas the common- E configuration of the BJT is rarely used.