Basic Transistor Circuit Examples

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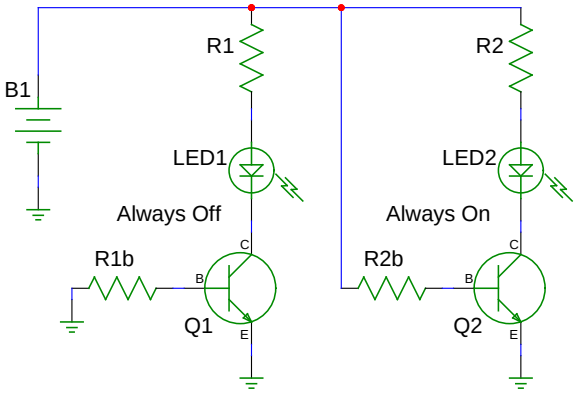
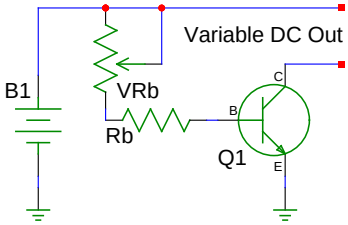


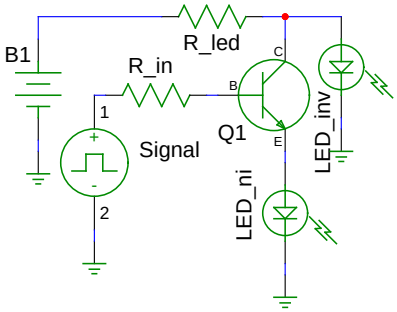
Simple transistor common-emitter switch configuration.
Q1 is always off since the base is to ground. Q2 is always on if the voltage is greater than 0.6v (turn on).
R1b and R2b protect the base from too much current (1-100k typical depending on the power level).
LED1+R1 and LED2+R2 are the loads in this example.

If load resistance is before the collector, the amp is a common emitter type (inverting with voltage gain).
If the load is after the emitter, the amp is a common collector type (non-inverting, beta+1 current gain, unity voltage gain, buffer).

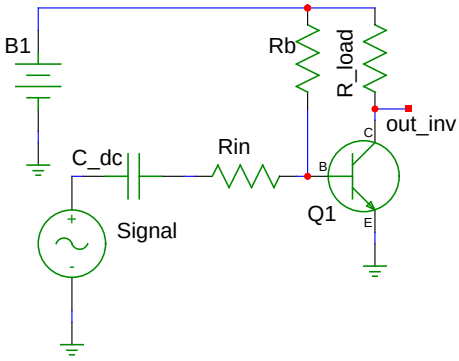
Common Emitter Gain = beta * (Rout/Rin). Rout is the load resistor. Rin is the base resistor.



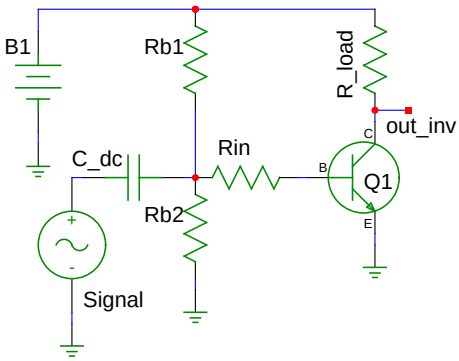
Variable DC Output
Rb is the minimum resistance to protect the base.
VRb adjusts the DC levels.



Digital/Switch Amplifier (Buffer and Inverter)
Input signal is a square wave without DC offset.
When input signal is near V+, Q1 turns on.
When input signal is near ground, Q1 turns off.
R_in protects the base from over current.
There is no bias resistor.
R_led is the current limiting resistor for the LED's.
LED_inv displays the inverting output.
LED_ni displays the non-inverting output (bypasses LED_inv).



Simple AC Amplifier (Class A, Inverted).
R_load + Q1 form a variable voltage divider. (A transistor is a kind of variable resistor.)
R_load uses Ohm's Law and converts current to voltage. Remove R_load if a speaker is attached.
A higher R_load will allow for higher gain but less signal drive. It will also move the signal down towards the bottom rail. Lower will move signal towards upper rail and be swamped by Vsupply.
C_dc blocks any DC on the input signal.
Rin is protection so that signal current does not overload base. Rin is also used in the voltage gain.
Rin can be used in place of C_dc in a direct coupling method that won't block very low frequencies.
This method will attenuate the input signal, though.
Rb should bias the base to 0.6v + 1/2 voltage of base. This holds the output above the transistor turn on voltage and gives maximum swing head room for the input signal. This will vary with supply voltage. Higher Rb will shift the signal towards the upper rail and lower gain.
The output will have the DC bias and may need a DC block capacitor depending on the situation.
out_inv is the inverted output point.
In reality, the half voltage divider of Rb doesn't work very well.



Simple AC Amplifier (Class A, Inverting)
Waveform is biased in the center of the operating zone.
C_dc blocks any DC on the signal input or from the voltage divider. C_dc will form a high pass filter and is bad for square waves.
C_dc can be removed and Rin moved in its place for direct coupling, but that may attenuate the signal more than desired.
Rin controls the voltage gain and protects the base.
This circuit adds Rb2 to form a voltage divider (Rb1+Rb2, usually 10k or higher).
Rb1+Rb2 will need to be chosen to make a 0v input signal be equal to 1/2 voltage of transistor's base operational rating.
Split the voltage divider to keep Q1 slightly on even if the input signal swings very low.
Rin and Rb2 may attenuate the input signal slightly if flipped around (forming a voltage divider).
Typical values: Rin=100k, Rb1=47k, Rb2=100k.