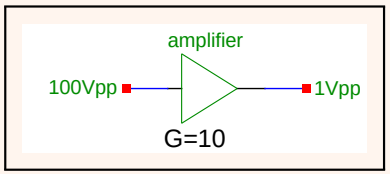
Amplifier Parameters

- An electronic amplifier takes an input (voltage, current or power) and multiplies it by some value, usually positive.
- A voltage amplifier might look like this:



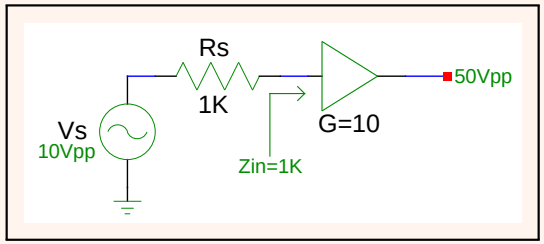
- A voltage amplifier with a gain of 10, takes a 100mVpp input voltage and amplifies it to 1Vpp.
- We could likewise have a current amplifier with an input current, and multiply to some larger value.

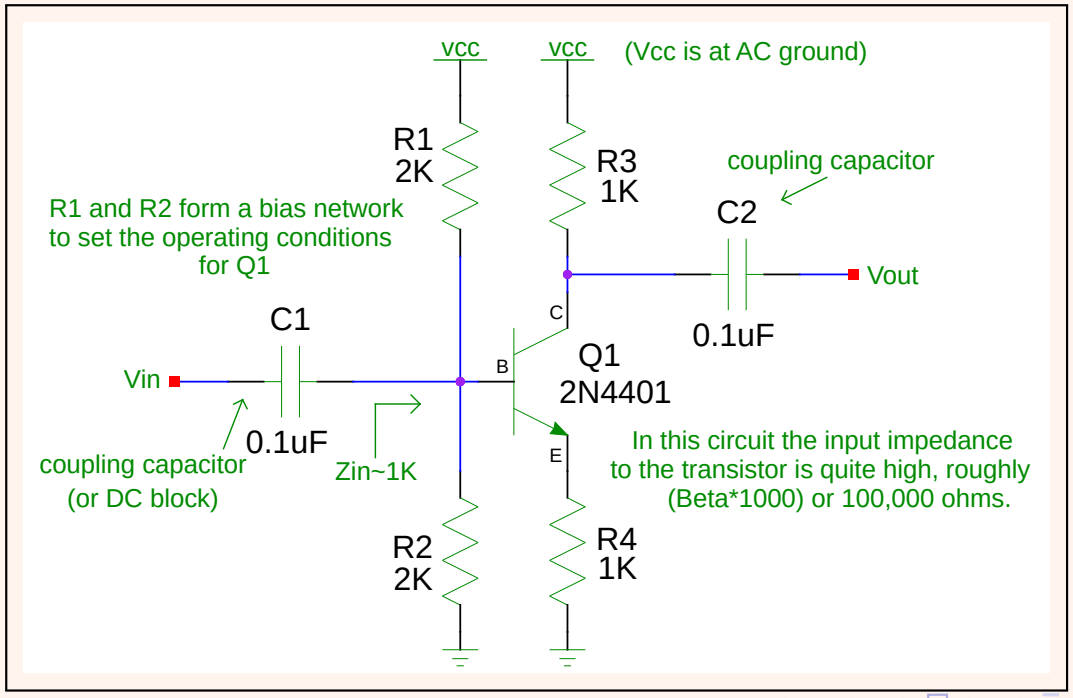
Amplifier Parameters

- Sometimes we are interested in power gain. In that case we may have an amplifier whose input impedance matches the source's output impedance (for max power transfer) and has an output impedance matching the load.
- Power gain is expressed typically in $G_{db} = 10log_{10}(\frac{P_{out}}{P_{in}})$
- To compute power gain with voltages we must use $G_{db} = 20log_{10}(\frac{V_{out}}{V_{in}})$; where both V_{out} and V_{in} are measured relative to the same resistance value. Otherwise, we are not computing power correctly.

Amplifier Parameters

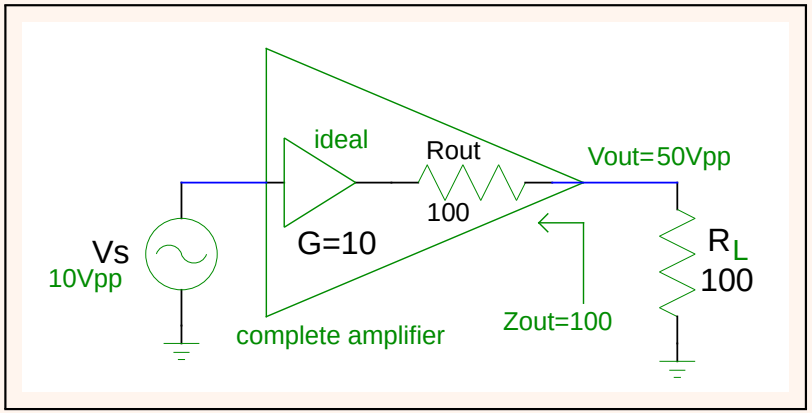
- Gain is only one parameter we are interested in. There can be many! Here's just a few for voltage amplifiers.
- input impedance: for the most voltage gain, we want this high, so we don't load the source.





Amplifier Parameters

- output impedance: depends on the load, generally, lower is better.



Amplifier Parameters

- linearity/distortion: Well, that takes some explaining. Hang on, digressing....
- Distortion can occur because the device characteristic is not linear or because the circuit elements and devices respond to the input signal differently at various frequencies. When distortion occurs, the output will not be an exact duplicate (except for magnitude) of the input signal. So distortion is caused by non-linearities and frequency response.
- Put mathematically, $y(t) = kx(t - t_0)$ where:
  $y(t)$ = output signal
  $x(t)$ = input signal
  k = amplitude scale factor, constant for all frequencies of interest
  t_0 = time delay in the system, constant for all frequencies of interest

Amplifier Parameters

- A system with a constant k factor has a straight line or linear characteristic. A plot of $y(t)$ that isn't a straight line is nonlinear and that system will introduce distortion. That is, k is not a constant. The nonlinear function will impact the shape of the waveform and produce distortion. In the time domain, the distortion appears as a change in waveform shape. (Think about the Fourier series expansion of the waveform.) In the frequency domain, the frequency content of waveform changes (the Fourier coefficients), typically introducing harmonic distortion or intermodulation distortion.
- Is distortion all bad? NO! See: https://en.wikipedia.org/wiki/fuzz_face Try the recordings!
- Last parameter, Bandwidth: just enough to cover the frequencies of interest. More is NOT better. Goldilocks preferred porridge that was neither too hot nor too cold, but just right!