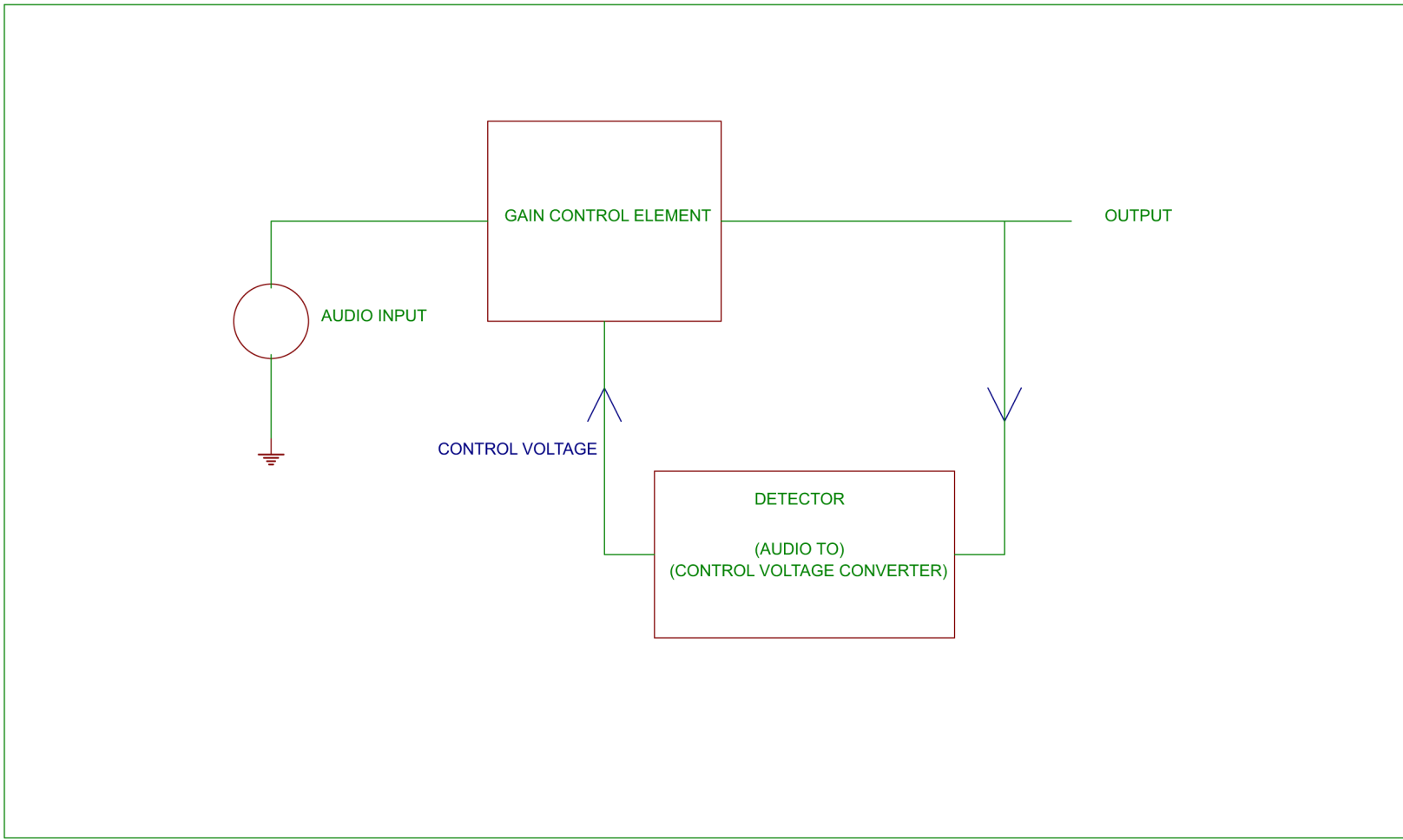


ANALOG COMPRESSORS AND SOME OF THE BITS THAT MAKE THEM WHAT THEY ARE

by Dave Hill for Audio Days Paris March 2012

This is not a complete list and are very simplified. Things like signal level and its scaling to make the circuits work correctly are not included in this doc.

The important thing to think about is what are the non ideal effects, The errors in the circuits. These come in the form of distortion at a fixed gain, distortion when gain is changing, control voltage feed through (control voltage appearing in the audio path), frequency response errors, and noise. They all affect the the color of the device.



FEEDBACK COMPRESSOR TOPOLOGY

The control voltage to gain reduction relationship, or law does not have to be an accurate relationship in a feedback type compressor

Time or latency through the audio path and the side chain will affect the fastest response and can cause stability issues

This is a self adapting circuit – self correcting

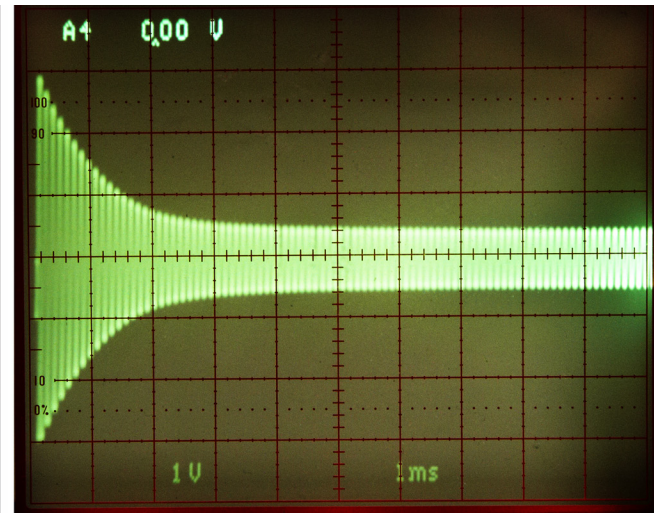
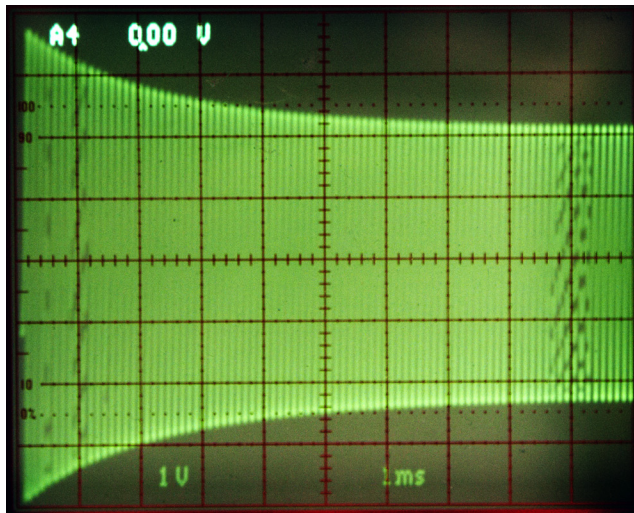
The Attack and Release times can not be strictly defined

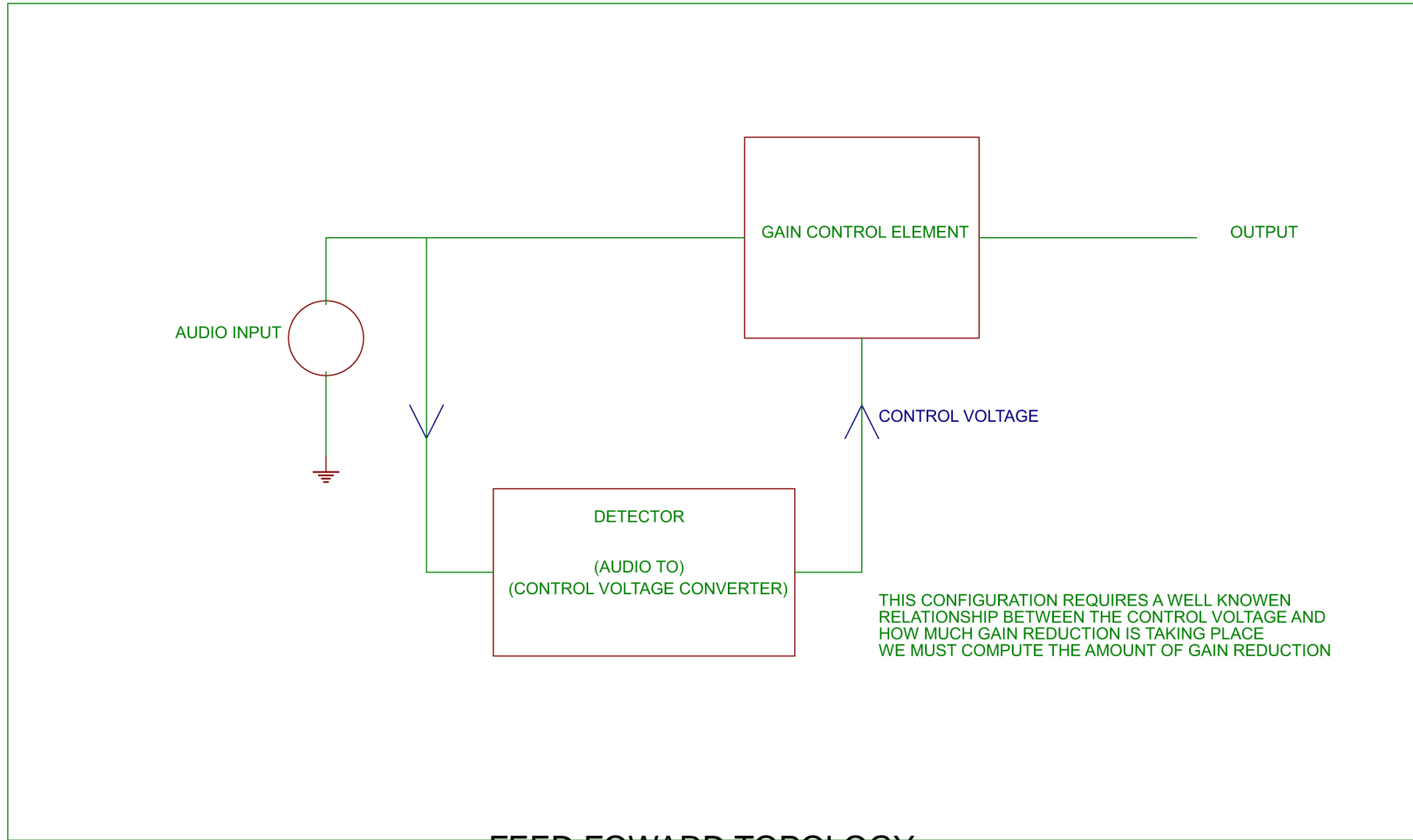
The Ratio can not be strictly defined

These parameters will change with the operation of the feed back loop

The Threshold setting will change the gain of the feedback loop and will change the parameters.

The graphs are with different Threshold settings, no other changes





FEED FOWARD TOPOLOGY

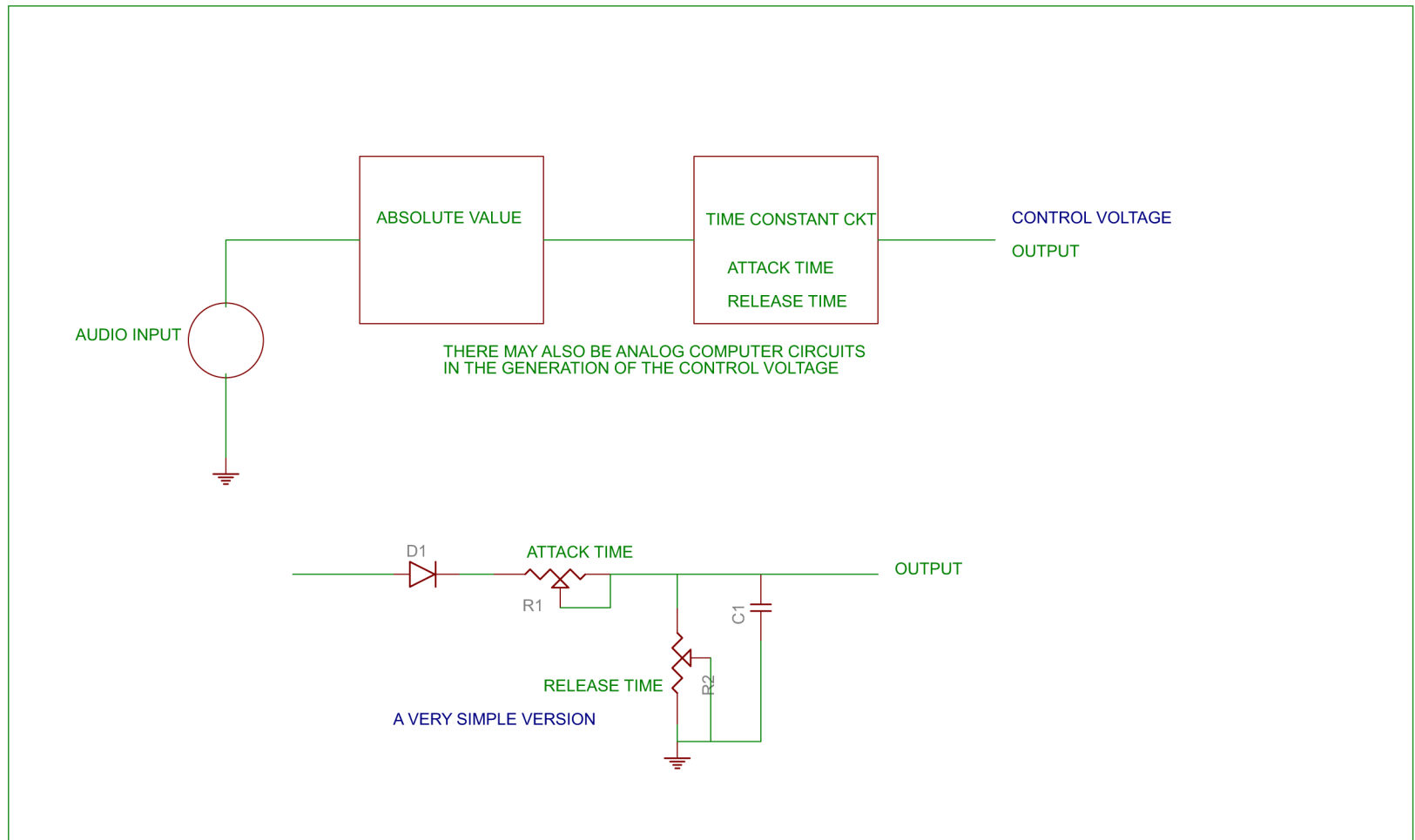
The relationship between control voltage and gain reduction must be accurate. It requires a precise law.

The side chain must calculate the gain reduction that is to take place

Time or latency through the side chain will affect the fastest response time, over shoot or under shoot from incorrect calculation can have audio side effects

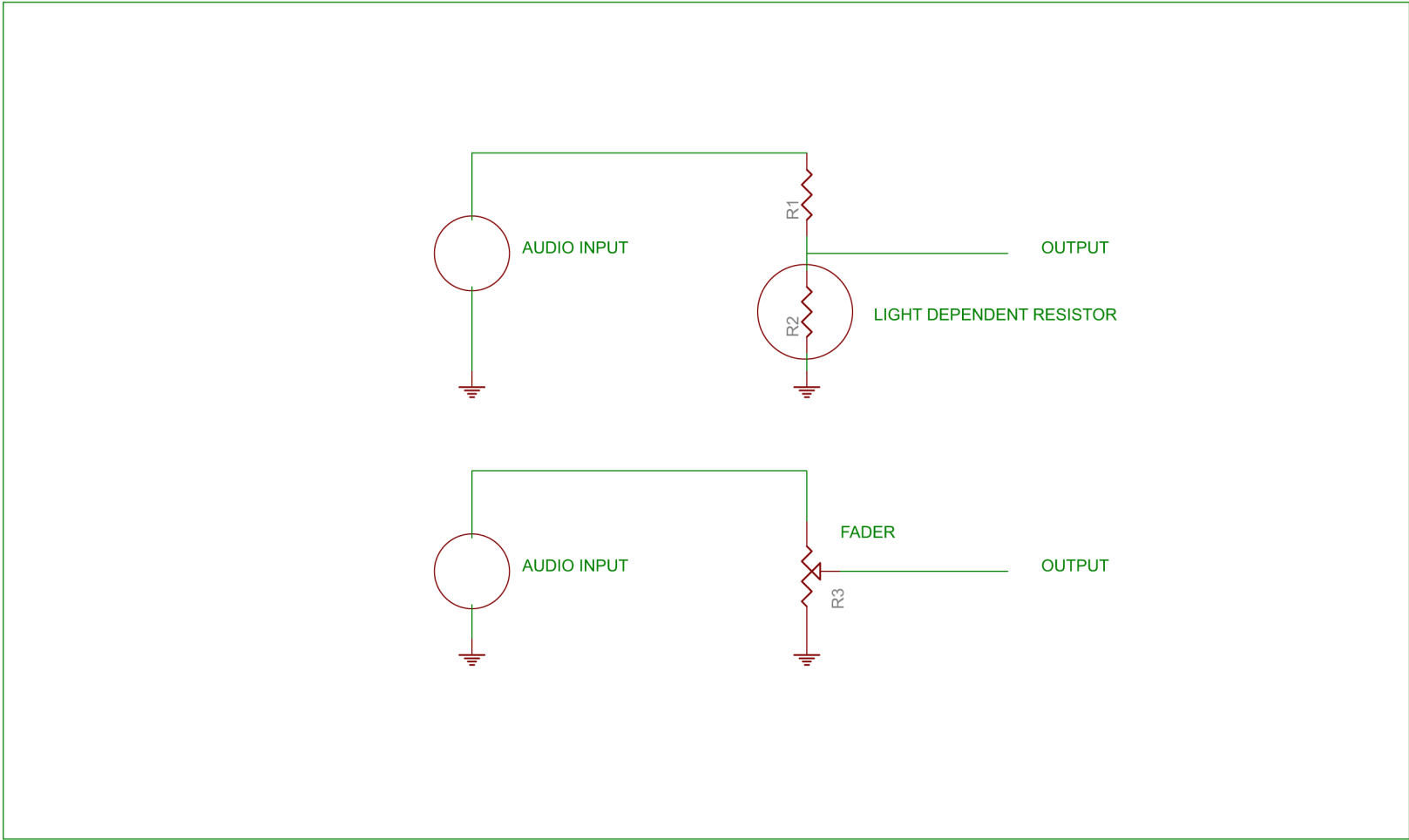
The Attack and Release times, and Ratio can be strictly defined

(But when does the ear care about math anyway, math is an attempt to describe nature)



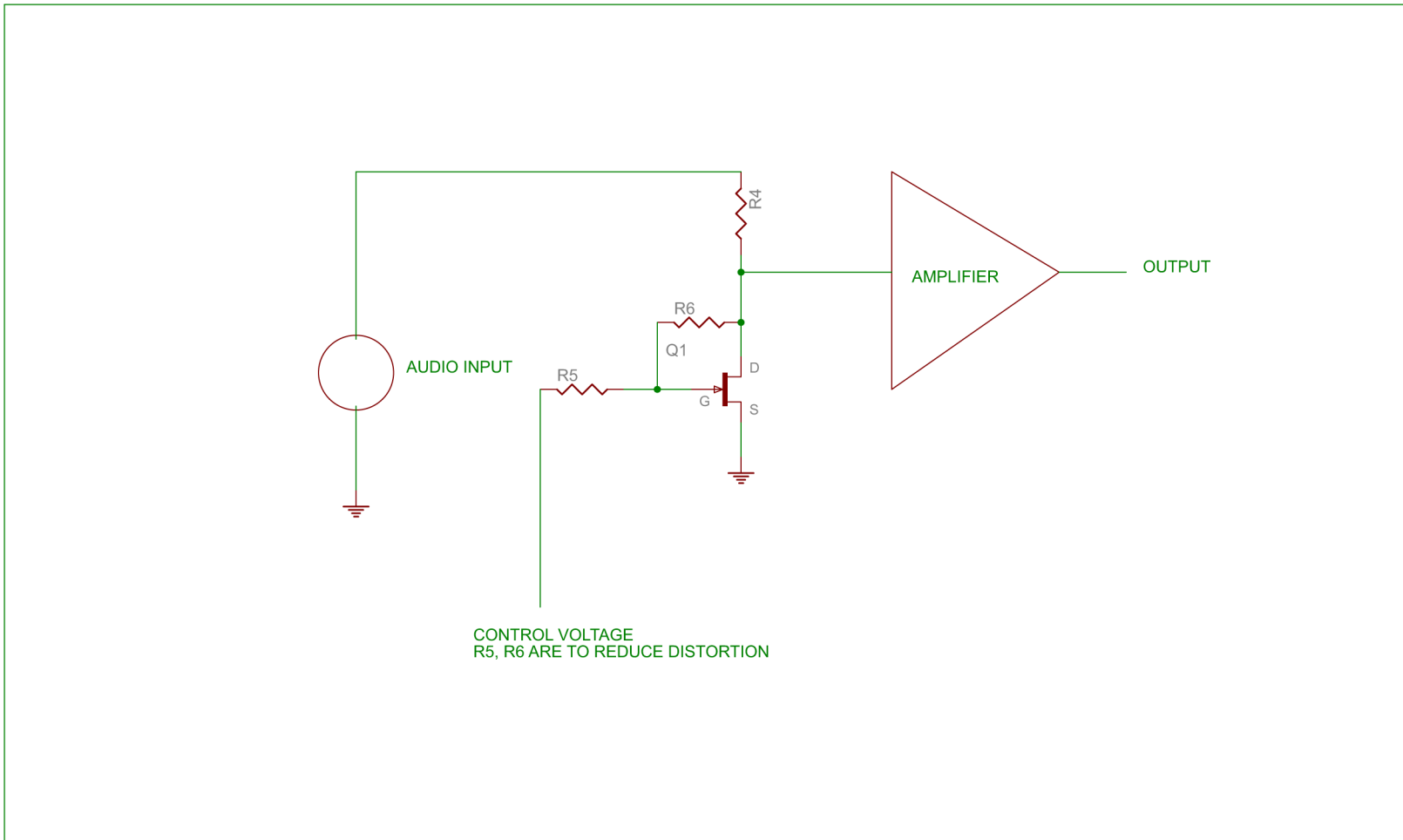
A SIMPLE SIDE CHAIN

It is a rectifier to change the audio (an AC signal to a DC signal, one with one polarity)
 And a time control circuit. A more complex circuit may contain a RMS convertor, and or analog computing circuits



OPTICAL GAIN CONTROL

Compared with a fader. It is a basic resistor voltage divider
One could use a motorized pot if you was fast enough and had enough life in it



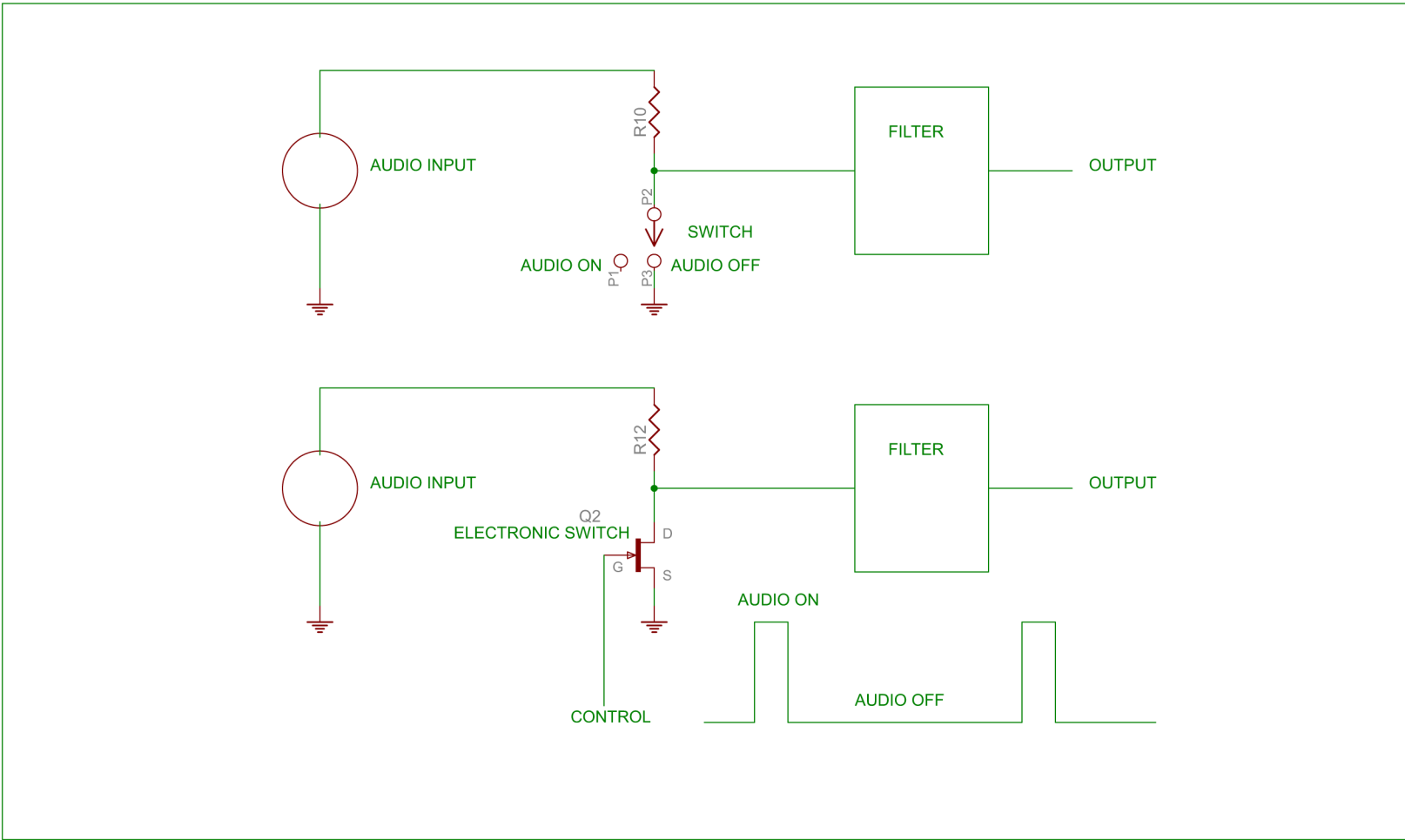
FET GAIN CONTROL

Compare this to the basic voltage divider with resistors

The FET works as a voltage controlled resistor

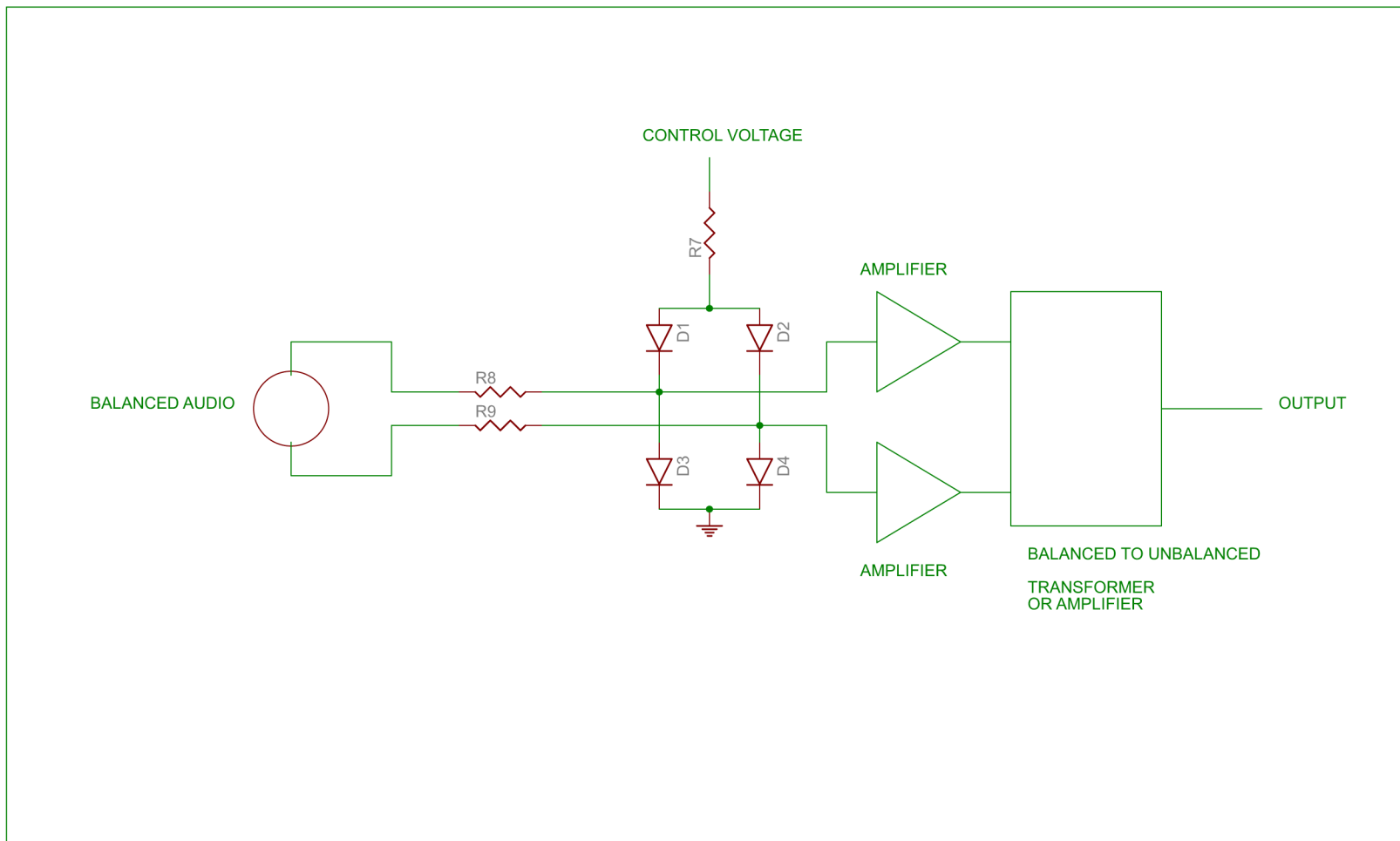
There are FETs selected for the purpose of being used as a voltage controlled resistor

Resistors R5, R6 are an attempt to reduce distortion due to how the audio modulates the resistance of the FET



PULSE WIDTH MODULATOR PWM

It works by the on to off ratio and must be switched very fast
 The filter averages out the switching rate -- Average energy through the switch
 Note: compare this to the basic resistor voltage divider

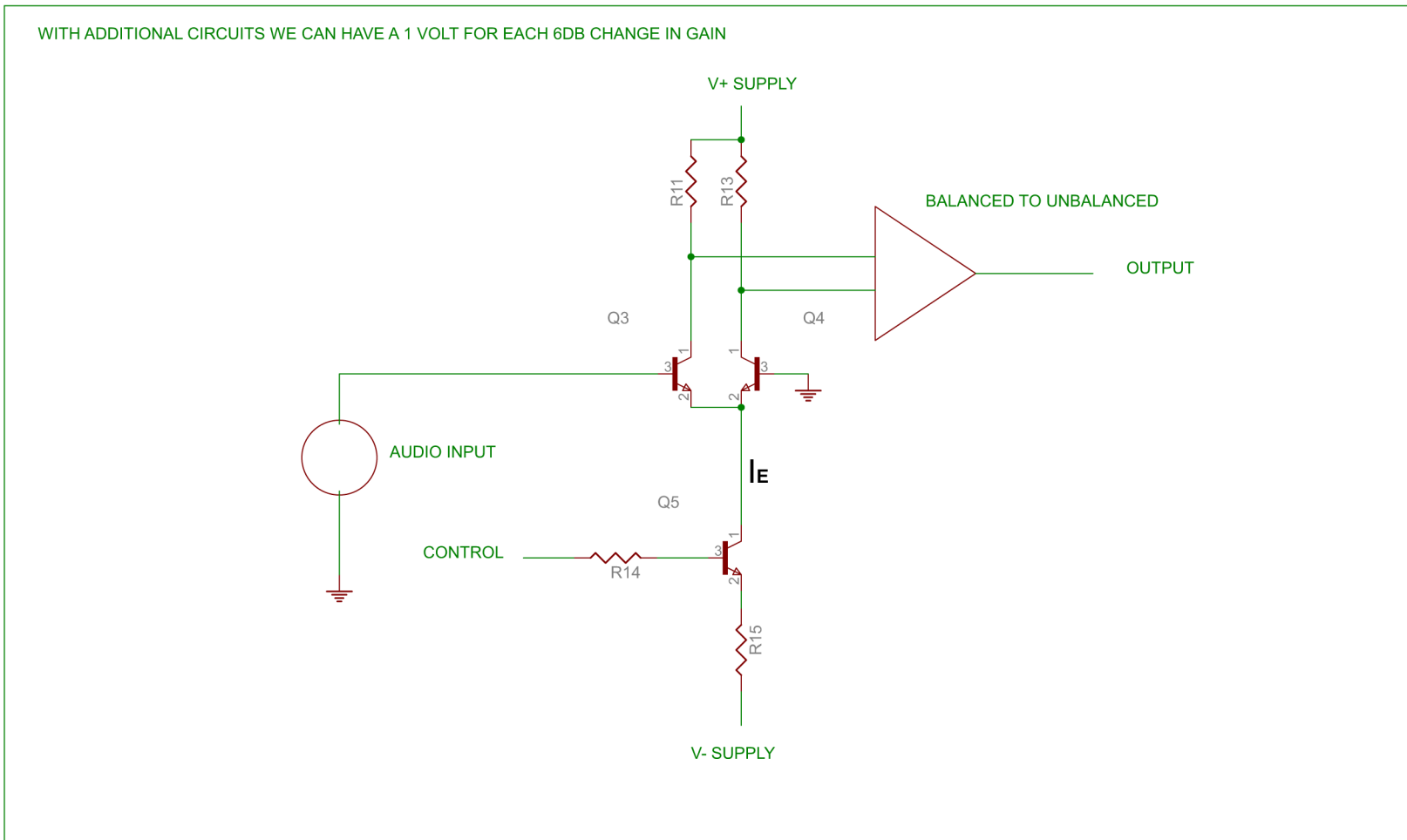


DIODE BRIDGE

A number of compressors designed in the 60's used this basic design. The diodes can be thought of as variable impedance

It must be balanced in design to avoid a large DC component on its output. Diode matching is critical.

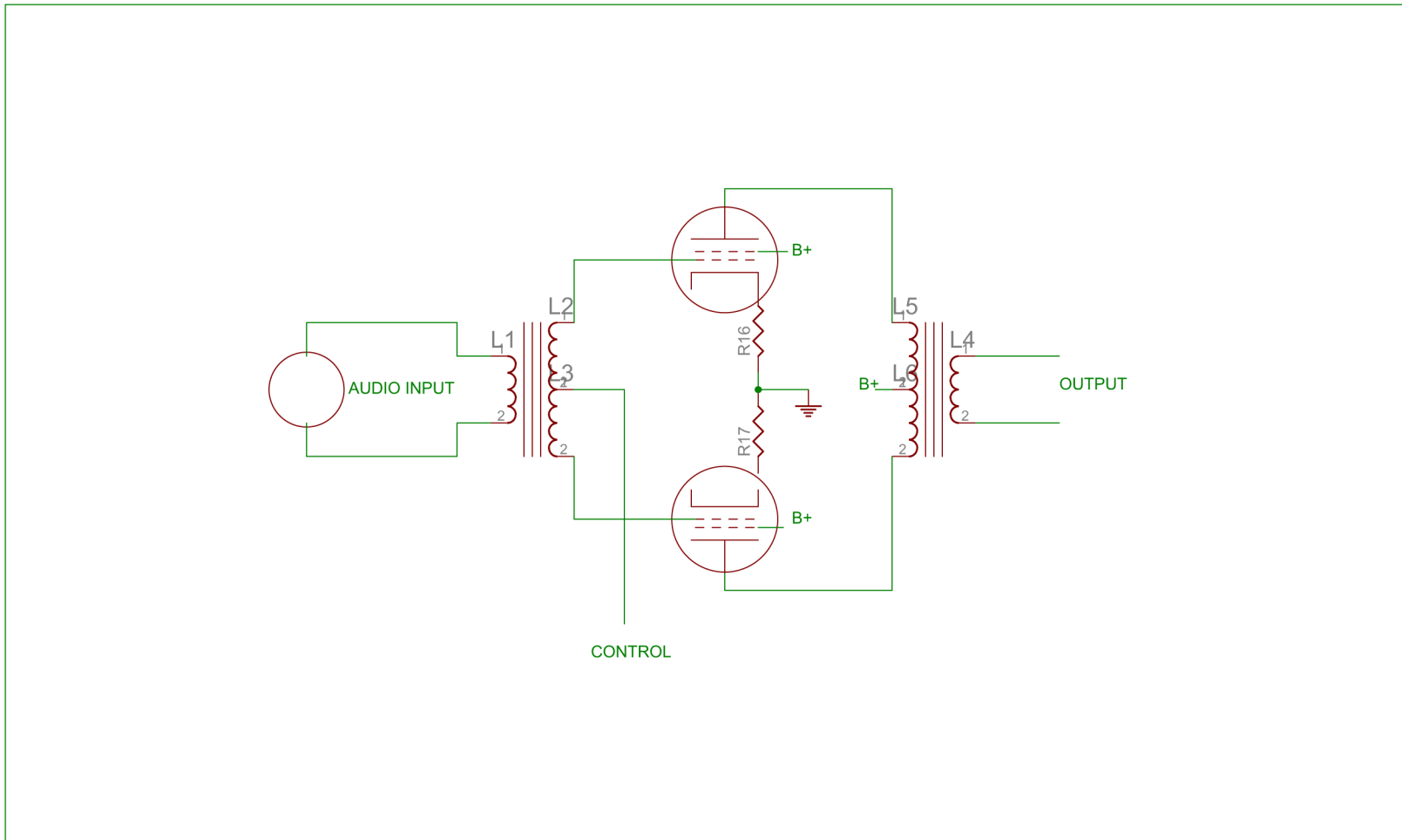
If it is driven to high levels large amounts of 3rd harmonic distortion will result



A SIMPLE TRANSISTOR VOLTAGE CONTROLLED AMPLIFIER

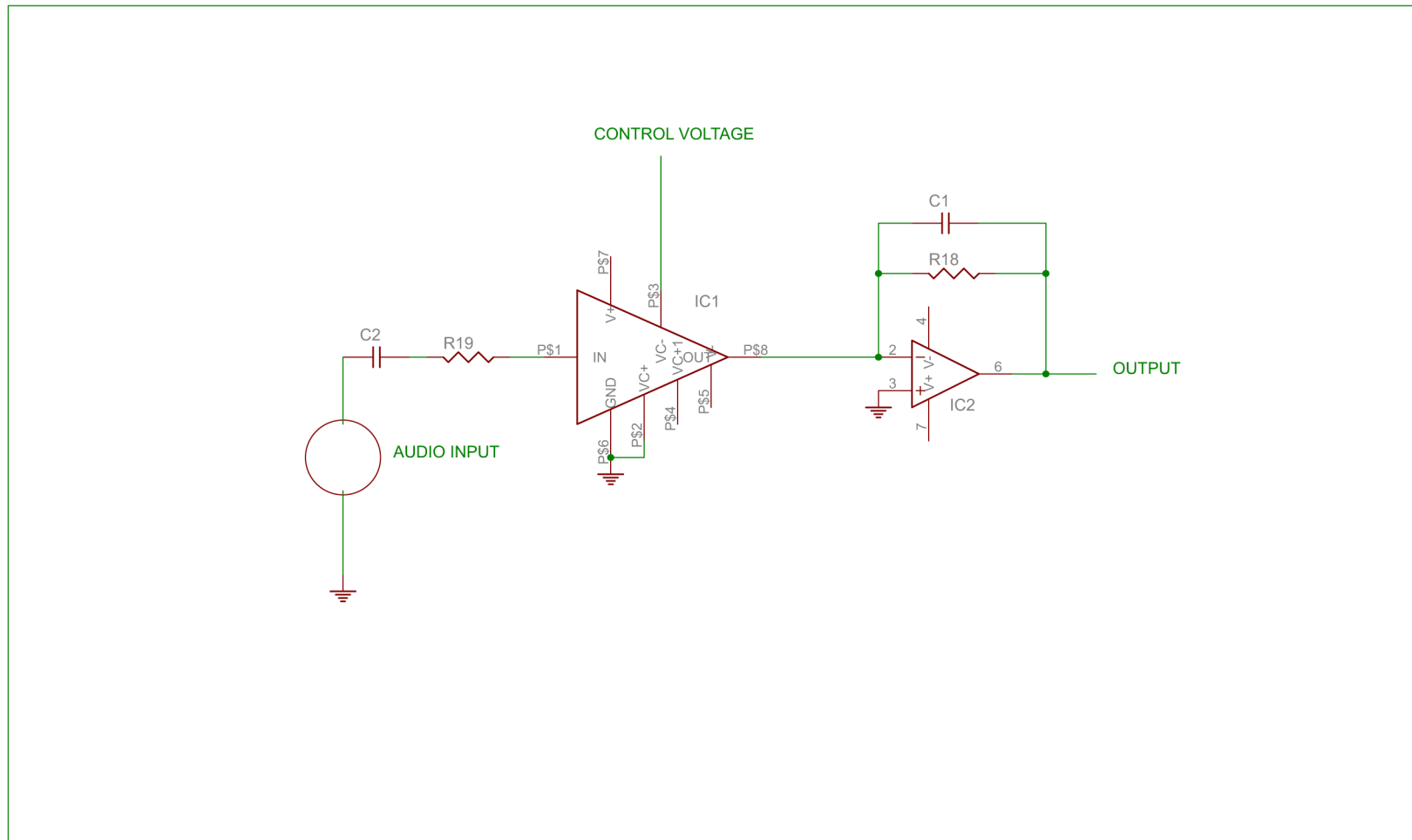
Very basic circuit. A simple transistor differential gain control circuit. It is a multiplier.
 I_E , the emitter current controls the gain of the circuit
 With added circuits, one can make a vca with a db / volt relationship

This basic circuit is used in some synthesizers.



BASIC TUBE GAIN CONTROL

In the better designs the tubes are Var-Mu or variable mu (in the tubes books, also known as remote cut off). The 6386 tube being the most popular part. The gain changes with the change in grid to cathode voltage.

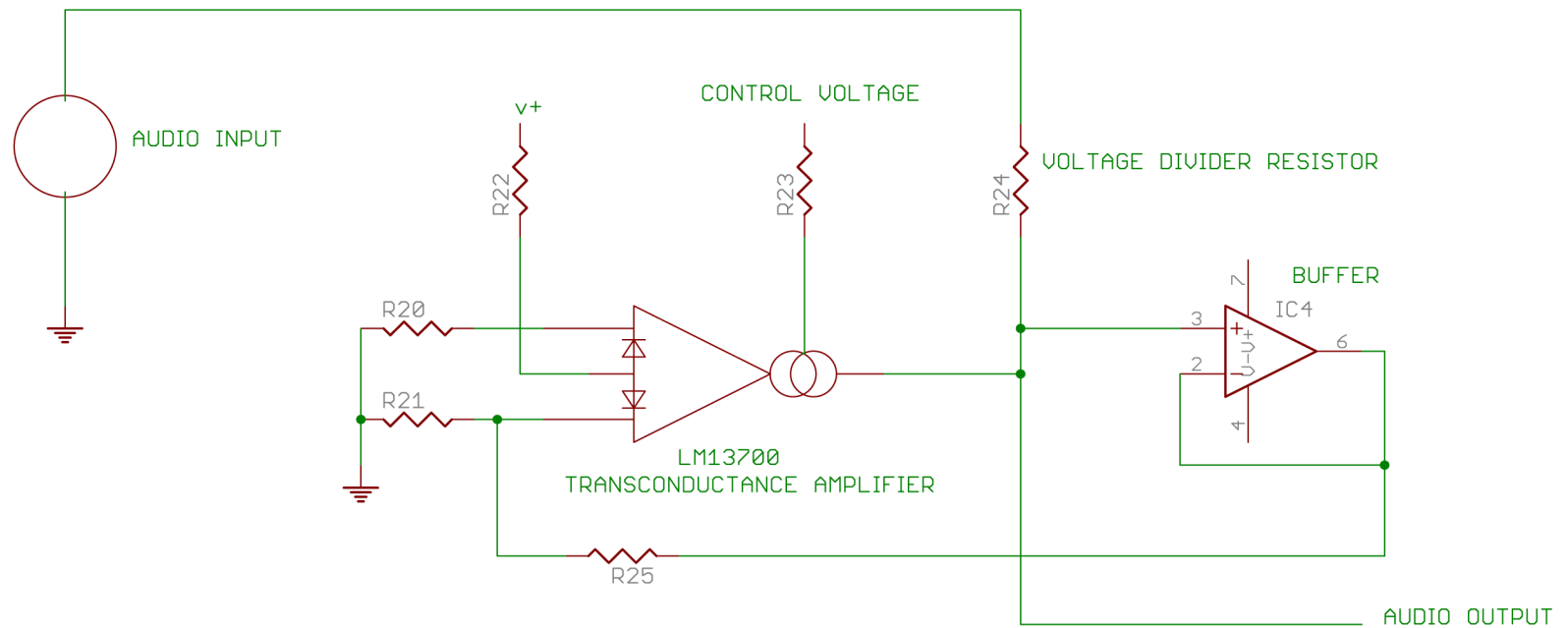


IC VOLTAGE CONTROLLED AMPLIFIER

This type of circuit was the first practical topology that made forward feed designs possible. The relationship between control voltage and gain reduction is accurate, a precise law.

The circuit that has outlasted other designs was designed by David Blackmer of dbx. It is the what the THAT Corp VCA chip is based on. That Corp has a bit of the history on this on line.

There were also voltage controlled amplifier circuits that were Log – Anti Log amplifiers
Try a log of a negative value



TRANSCONDUCTANCE AMPLIFIER AS A VOLTAGE CONTROLLED RESISTOR

Compare this to the basic voltage divider with resistors
 The circuit works as a voltage controlled resistor