Lecture 10 Op Amp Limitations

Last week focussed on ideal op amp behavior

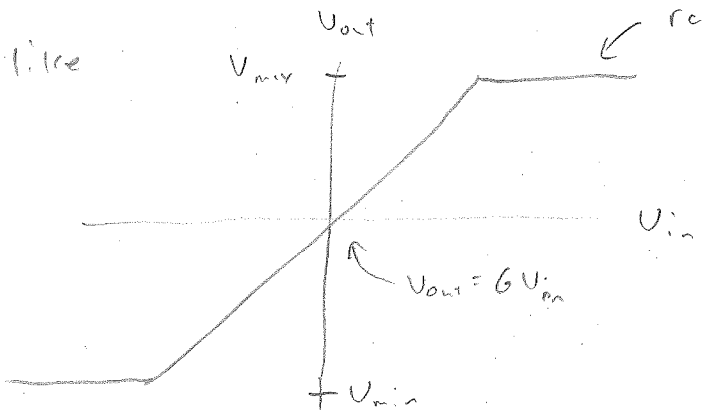
This week, look at some limitations

One important constraint: output current & voltage are limited

Voltage: V_{out} can't exceed output range

Typically close to supply voltage range

Amplifier looks like

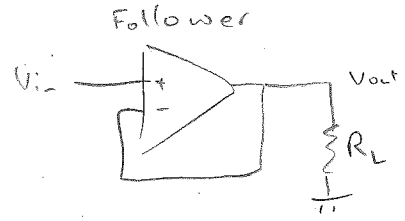


When nominal $V_{out} = G V_{in}$ exceeds limits,

say that op amp is railed, clamped, clipped, saturated

all same

Current is also limited



$V_{out} = V_{in}$

$I_{out} = V_{out}/R_L$

Typically $|I_{max}| \simeq 30\,mA$

If nominal I_{out} is larger, voltage will be clamped at $I_{max} R_L$

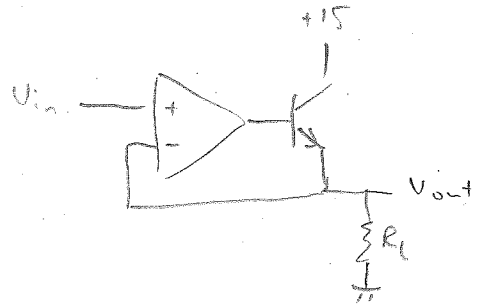
So if $R_{load} < \frac{15V}{30mA} = 500\,\Omega$, op amp is limited by voltage, not current

In many cases, 30 mA is insufficient

Driving motors, speakers, magnet coils

Use transistors to boost current higher

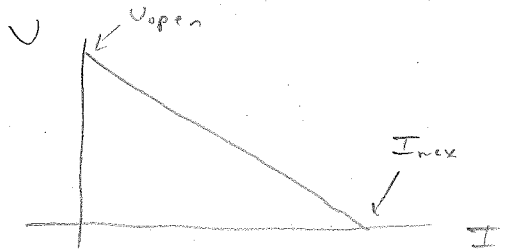
Example:



Op amp keeps $V_{out} = V_{in}$, transistor supplies lots of current

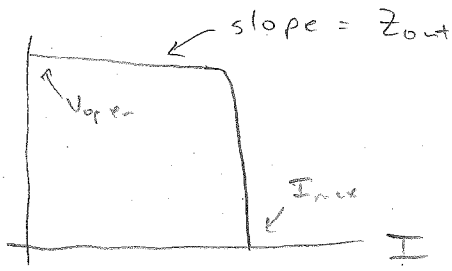
In lab, you will plot V_{out} vs I_{out}

Thevenin model predicts $V_{out} = V_{open} - I_{out} Z_{out}$



But op amps (& most real supplies) aren't linear

Typically see



Get very small Z_{out}, but max current still limited

Often easiest to approximate as "box": $Z_{out} \approx 0$

V_{out} indep of I for $I < I_{max}$

~ ideal source