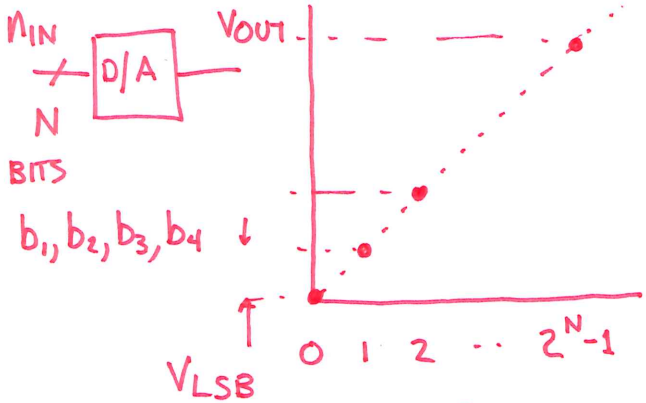
D/A Converter (I)

WANT

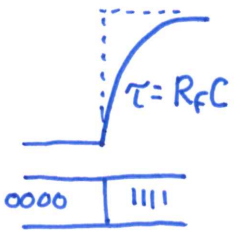


"LEAST SIGNIFICANT BIT"

DIGITAL WORD INPUT (4 BIT EXAMPLE)

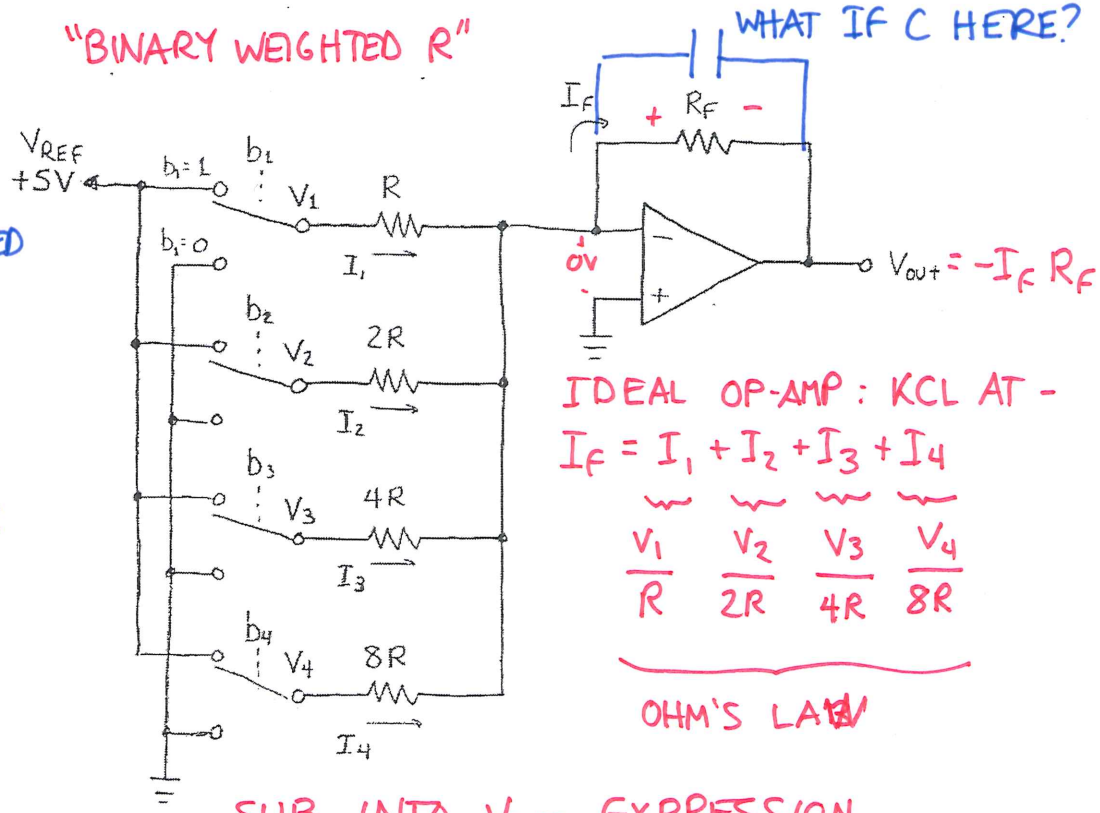
MSB			LSB		
b_1	b_2	b_3	b_4	n_{IN}	
0	0	0	0	0	0
0	0	0	1	1	1
0	0	1	0	2	2
:					
1	1	1	1	15	F

DC IN-OUT NOT AFFECTED BY C IN FEEDBACK



"BINARY WEIGHTED R"

WHAT IF C HERE?



IDEAL OP-AMP: KCL AT -

$I_F = I_1 + I_2 + I_3 + I_4$

$\frac{V_1}{R} \quad \frac{V_2}{2R} \quad \frac{V_3}{4R} \quad \frac{V_4}{8R}$

OHM'S LAW

SUB INTO V_{OUT} EXPRESSION

$$V_{OUT} = -\left(\frac{V_1}{R} + \frac{V_2}{2R} + \frac{V_3}{4R} + \frac{V_4}{8R}\right) R_F$$

FACTOR OUT R, MULTIPLY 8/8

$$V_{OUT} = \frac{-R_F}{8R}\left(8V_1 + 4V_2 + 2V_3 + V_4\right)$$

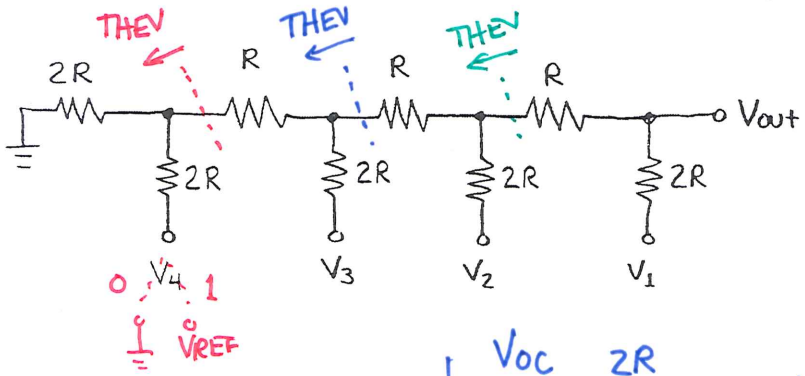
USE $V_i = b_i V_{REF}$; FACTOR OUT V_{REF}

$$V_{OUT} = \underbrace{\left[\frac{-R_F}{8R} V_{REF}\right]}_{V_{LSB}\text{ STEP SIZE}} \underbrace{\left(8b_1 + 4b_2 + 2b_3 + b_4\right)}_{\text{BINARY NUMBER!}}$$

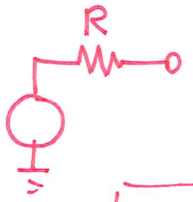
D/A Converter: R-2R Ladder

NICER: R, 2R ONLY VALUES: ONLY NEED 1:2 RATIO

ANALYSIS STRATEGY: ~~NODAL~~ TOO MANY EQS ONLY WANT V_{OUT}

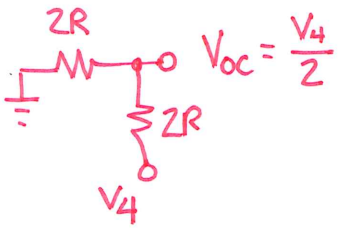


$$\frac{V_4}{16} + \frac{V_3}{8} + \frac{V_2}{4} + \frac{V_1}{2}$$

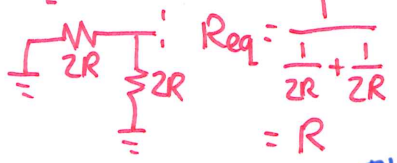


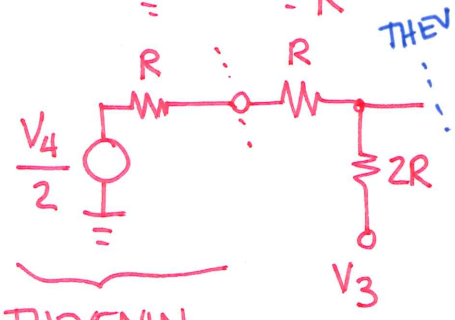
$V_i = b_i V_{REF}$

$$V_{OUT} = \underbrace{\frac{V_{REF}}{16}}_{\text{STEP SIZE (LSB)}} \underbrace{\left(8b_1 + 4b_2 + 2b_3 + b_4\right)}_{\text{BINARY NUMBER}}$$

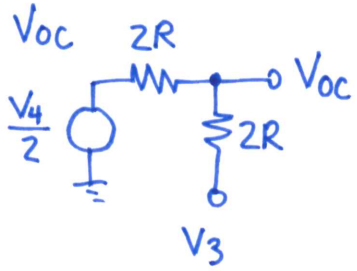


R_{eq} : SET $V_4 = 0$





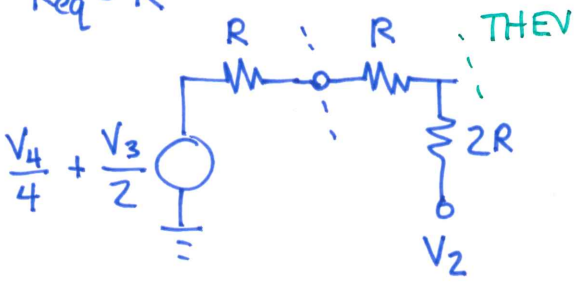
THEVENIN EQUIVALENT

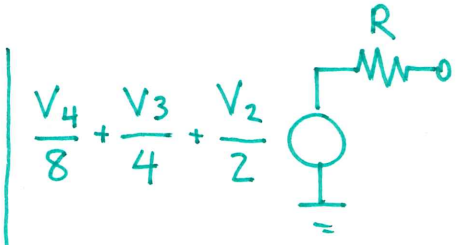


SUPERPOSITION, VOLTAGE DIV

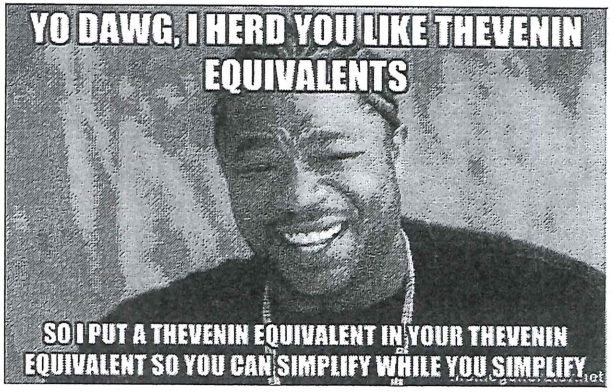
$$V_{oc} = \frac{V_4}{4} + \frac{V_3}{2}$$

$R_{eq} = R$





WPI



http://memegenerator.net/instance/18386613