

A Digital to Analog Converter (DAC)

Your **task** is to design, construct, debug, and test a crude DAC. Your circuit will have four “digital” input lines. The voltage relative to GND will be either 5 V or 0 V as supplied by the DATA SWITCHES on your breadboard. The input lines are called “digital” as 5 V stands for a logical ONE (high state) and 0 V stands for a logical ZERO (low state). With this convention we can use the DATA SWITCHES to produce 4 bit binary numbers at the input of our circuit as listed in the table below:

binary input:				decimal equivalent:
line 4	line 3	line 2	line 1	
0	0	0	0	0
0	0	0	1	1
0	0	1	0	2
0	0	1	1	3
0	1	0	0	4
0	1	0	1	5
0	1	1	0	6
0	1	1	1	7
1	0	0	0	8
1	0	0	1	9
1	0	1	0	10
1	0	1	1	11
1	1	0	0	12
1	1	0	1	13
1	1	1	0	14
1	1	1	1	15

If you are not familiar with other numbering systems than the base 10 or decimal one that we use in everyday life, please study at least the binary or base 2 system as it is used in computers. This is needed to prepare you for digital electronics later in this course. For the moment you can survive just trusting us when we say that the left hand side of above table is the one-to-one binary equivalent of the decimal numbers listed to the right. Note that it does really take four digits to write maximally 16 different numbers, whereas with only two decimal digits you can write many more numbers than 16 (100, to be precise).

The output of a DAC is to be a voltage proportional to the numerical (binary) input. The decimal equivalent in the above table thus tells you how much your output voltage should be for every input DATA SWITCH setting if 15 corresponds to your full scale output voltage (which cannot be higher than the supply voltage to your IC...). Be sure to choose a reasonable scale. A quick glance at your input line numbers will tell you that your circuit must be eight times as sensitive to a high

state (5 V) on your input line 4 as it is to a high state on your input line 1.

Be sure to construct your circuit with a minimum input impedance (resistance) of $50\text{ k}\Omega$ on each input line. Be sure to document all the calculations that go into your circuit design so that you can show them to the TA.