

8-Bit R-2R Digital to Analog Converter

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analog output voltages
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binary input (bits)
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The experiment yielded good results as the calculated percentage errors fell below 1% in all but one of the randomly obtained binary values.

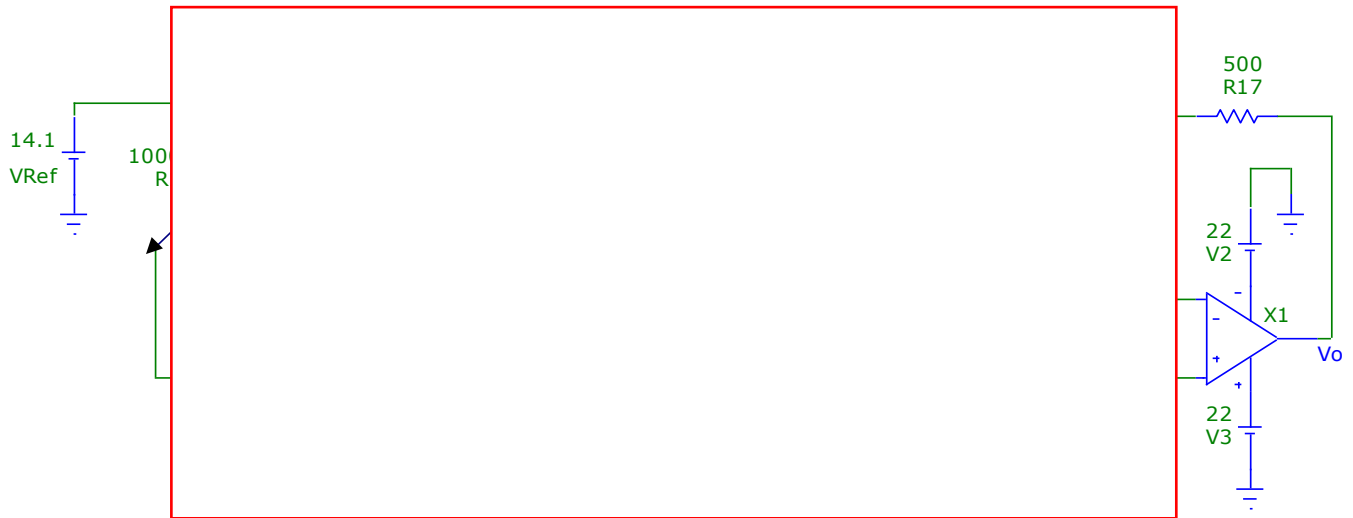


Figure 1: Digital to analog converter circuit.

Expected values and error calculation

Six binary values were picked at random then the expected values of their corresponding analog voltages calculated. The expected values of their corresponding analog voltages and percentage error are shown in the table below.

Binary Value	Expected Analog Voltage (V _o)	Percentage Error
1. For 0101101	$V_o = \left(\frac{14.1}{100} \times \left(1 + \frac{b_8}{256} \right) \right)$	0.00%
2. For 0101101	$V_o = \left(\frac{14.1}{100} \times \left(1 + \frac{b_8}{256} \right) \right)$	0.00%

3. For the decimal value of 93 which is 01011101 in binary:

$$V_o = 14.$$

$$V_o = 5.1$$

$$\%error$$

4. For the d

$$V_o = 14.$$

$$V_o = 7.4$$

$$\%error$$

5. For the d

$$V_o = 14.$$

$$V_o = 10.$$

$$\%error$$

6. For the d

$$V_o = 14.$$

$$V_o = 14.$$

$$\%error = 8.4556\%$$

Experimental and expected values and plots

Digital In	Expected Vout	Actual Vout	Digital In	Expected Vout	Actual Vout	Digital In	Expected Vout	Actual Vout
0	0	0.002174	85	4.6816	4.7038	171	9.4184	9.4225
1	0.0551	0.05858	87	4.7918	4.8141	173	9.5285	9.5285
3	0.1652	0.17015	89	4.9020	4.925	175	9.6387	9.6396
5	0.2754	0.27996	91	5.0121	5.0344	177	9.7488	9.7532
7	0.3855	0.3905	93	5.1223	5.143	179	9.8590	9.8629
9	0.4957	0.50171	95	5.2324	5.2525	181	9.9691	9.9727
11	0.6059	0.61296	97	5.3426	5.367	183	10.0793	10.0823
13	0.7160	0.7217	99	5.4527	5.4777	185	10.1895	10.1911
15	0.8262	0.83184	101	5.5629	5.5845	187	10.2996	10.301
17	0.9363	0.9456	103	5.6730	5.6951	189	10.4098	10.407
19	1.0465	1.0561	105	5.7832	5.8082	191	10.5199	10.5076
21	1.1566	1.1654	107	5.8934	5.9166	193	10.6301	10.6106
23	1.2668	1.2759	109	6.0035	6.0271	195	10.7402	10.7003
25	1.3770	1.3986	111	6.1137	6.137	197	10.8504	10.7934
27	1.4871	1.5132	113	6.2238	6.2493	199	10.9605	10.8852
29	1.5973	1.6068	115	6.3340	6.36	201	11.0707	10.972
31	1.7074	1.7167	117	6.4441	6.4682	203	11.1809	11.0546
33	1.8176	1.8338	119	6.5543	6.578	205	11.2910	11.139
35	1.9277	1.9487	121	6.6645	6.6894	207	11.4012	11.2292
37	2.0379	2.052	123	6.7746	6.7999	209	11.5113	11.3125
39	2.1480	2.1624	125	6.8848	6.907	211	11.6215	11.387
41	2.2582	2.2784	127	6.9949	7.017	213	11.7316	11.457
43	2.3684	2.3937	129	7.1051	7.0852	215	11.8418	11.5423
45	2.4785	2.493	131	7.2152	7.1946	217	11.9520	11.6156
47	2.5887	2.6034	133	7.3254	7.3022	219	12.0621	11.6833
49	2.6988	2.7162	135	7.4355	7.433	221	12.1723	11.7614
51	2.8090	2.8275	137	7.5457	7.5474	223	12.2824	11.8433
53	2.9191	2.9363	139	7.6559	7.6578	225	12.3926	11.93
55	3.0293	3.0464	141	7.7660	7.7658	227	12.5027	11.982
57	3.1395	3.1583	143	7.8762	7.8758	229	12.6129	12.044
59	3.2496	3.2688	145	7.9863	7.9882	231	12.7230	12.109
61	3.3598	3.3765	147	8.0965	8.0981	233	12.8332	12.17
63	3.4699	3.4793	149	8.2066	8.2074	235	12.9434	12.242
65	3.5801	3.6005	151	8.3168	8.3172	237	13.0535	12.31
67	3.6902	3.7115	153	8.4270	8.43	239	13.1637	12.38
69	3.8004	3.8213	155	8.5371	8.5412	241	13.2738	12.448
71	3.9105	3.9315	157	8.6473	8.6468	243	13.3840	12.489
73	4.0207	4.0429	159	8.7574	8.7562	245	13.4941	12.566
75	4.1309	4.1524	161	8.8676	8.8716	247	13.6043	12.646
77	4.2410	4.2622	163	8.9777	8.9822	249	13.7145	12.696
79	4.3512	4.3719	165	9.0879	9.0901	251	13.8246	12.77
81	4.4613	4.4835	167	9.1980	9.1995	253	13.9348	12.842
83	4.5715	4.5941	169	9.3082	9.3125	255	14.0449	12.95

Table 1: Input decimal values converted to binary and used to obtain the analog output voltage

```
clear all
close all
clc

[v,T,vT] = xlsread('Data_1.xlsx');
D_input = v(:,1);
A_out = v(:,2);

[v,T,vT] = xlsread('Data_2.xlsx');
D_input2 = v(:,1);
A_out2 = v(:,2);

figure
hold on
plot(D_input, A_out, 'r')

hold on
stairs(D_input2, A_out2, 'b')
```

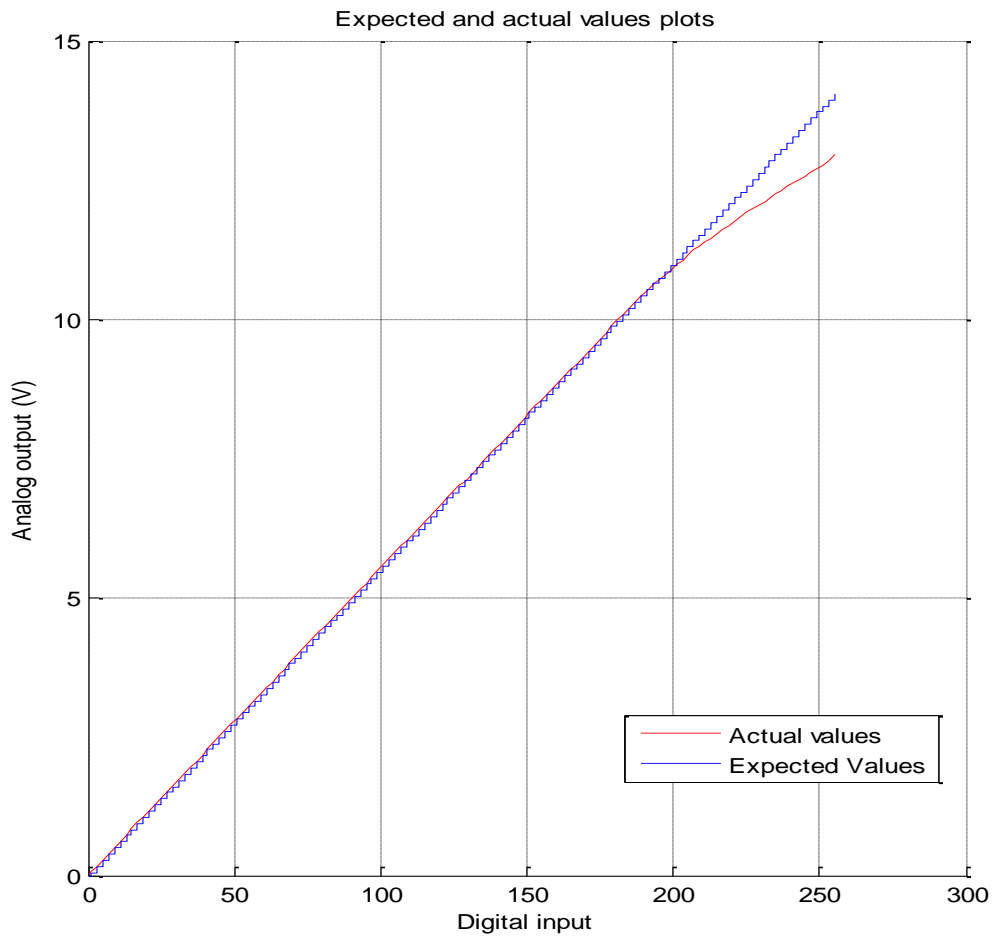


Figure 2: Plots of expected values and the actual values.

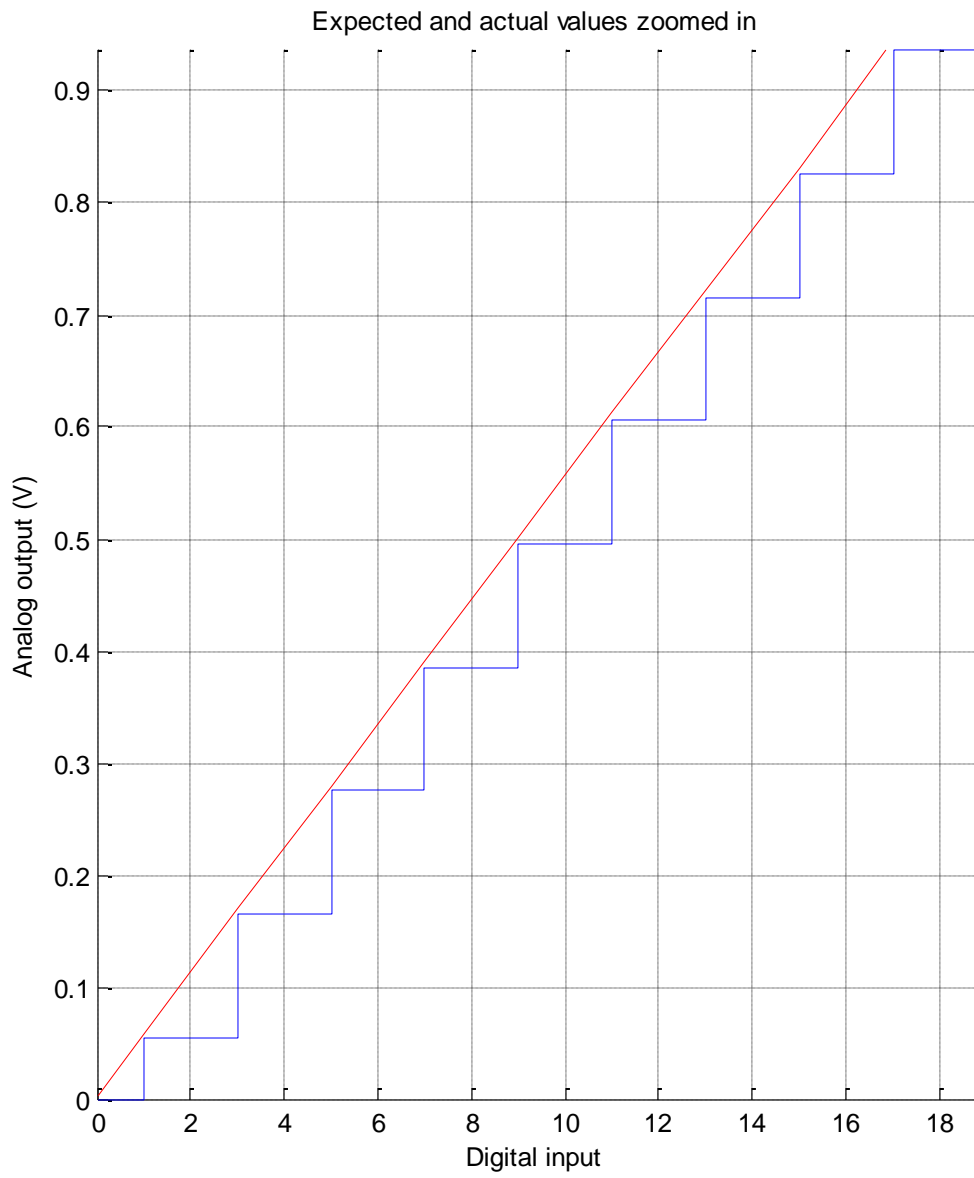


Figure 3: Plots of expected values and the actual values zoomed in.