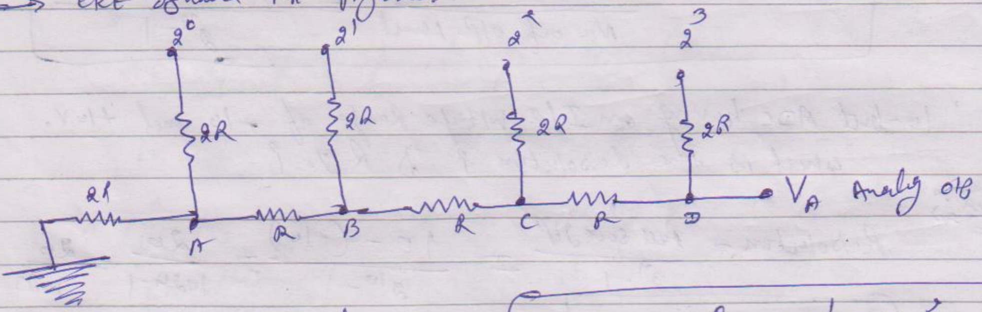
R-2R Ladder D/A Converter

→ It overcomes the drawback of Resistive network in which different value of Resistance are used

→ but in case of R-2R Ladder make the use of two values of Resistor R and 2R.

→ ckt shown in figure:



It uses the formula
$$\boxed{V_A = \frac{V_0 2^0 + V_1 2^1 + V_2 2^2 + V_3 2^3 + \dots}{2^n}}$$

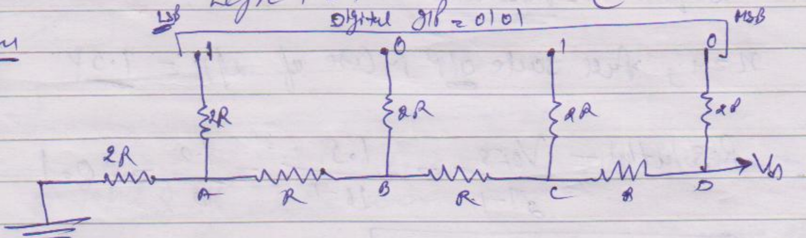
Let us Take an example:

If digital data is 0101 (4-bit data)

Let us assume Logic 0 = 0V
Logic 1 = +16V

$[2^4 = 16$ for 4-bit$]$

ckt diagram



$$V_A = \frac{V_0 2^0 + V_1 2^1 + V_2 2^2 + V_3 2^3}{2^n}$$

MSB			LSB
0	1	0	1
V_3	V_2	V_1	V_0
2^3	2^2	2^1	2^0

$$V_A = \frac{1\times 2^0 + 0 + 1\times 2^2 + 0}{2^4} \Rightarrow \frac{16\times 1 + 16\times 4}{16}$$

$$V_A = \frac{16+64}{16} = \frac{80}{16} = 5V$$

$$\boxed{V_A = 5V}$$ Analog O/P Voltage.

Q: A 6-bit R-2R Ladder D/A Converter has Reference voltage of 6.5 V. It Means standard Linearity find out ⇒ (I) Resolution in volt and Percentage

(II) full scale voltage

(III) O/P for 011100

Resolution: Resolution is the Reciprocal of number of Discrete steps in the D/A O/Ps, Resolution depends on the number of bits in digital systems. It is given by the eq^n

$$\boxed{R = \frac{1}{2^N - 1}}$$, where N = Number of bits

% of Resolution is given by: $\boxed{\%R = \frac{1}{(2^N-1)} \times 100}$

put N = 1, 2, 3 —— we get the appropriate percentage Resolution.

(12)

Ans (1) Resolution = $\frac{1}{2^n-1}$, for $n=6$ for 6-bit

% Resolution = $\frac{1}{2^6-1} \times 100 = \frac{1}{64-1} \times 100$

$\% R = \frac{1}{63} \times 100 \Rightarrow \boxed{\% R = 1.578\%}$

Resolution in volt = $\frac{V_{Ref}}{2^n} = \frac{6.5}{2^6} = \frac{6.5}{64} = 0.1V$

(2) full scale voltage (FSV) $\Rightarrow$ $\boxed{FSV = V_{Ref}\frac{(2^n-1)}{2^n}}$

$= \frac{6.5 \times (2^6-1)}{2^6} = \frac{6.5 \times 63}{64}$

$FSV = 6.398 \cong$ $\boxed{FSV = 6.4V}$

(3) o/p for 011100 is given by

$\boxed{V_{out} = \frac{V_0 2^0 + V_1 2^1 + V_2 2^2 + V_3 2^3 + V_4 2^4 + V_5 2^5}{2^n}}$

2^5	2^4	2^3	2^2	2^1	2^0
0	1	1	1	0	0
V_5	V_4	V_3	V_2	V_1	V_0

and $n=6$

$V_{out} = \frac{0 + 0 + 1 \times 2^2 + 1 \times 2^3 + 1 \times 2^4 + 0}{2^6} =$

Here
Logic 1 = +6.5V
Logic = 0V
Below, $V_2 = 6.5V$

$V_{out} = \frac{6.5 \times 2^2 + 6.5 \times 2^3 + 6.5 \times 2^4}{64}$

$V_{out} = \frac{6.5 \times 28}{64} = 2.84V$

$\boxed{V_{out} = 2.84V}$ Ans