

# Digital to Analog Converter (8A)

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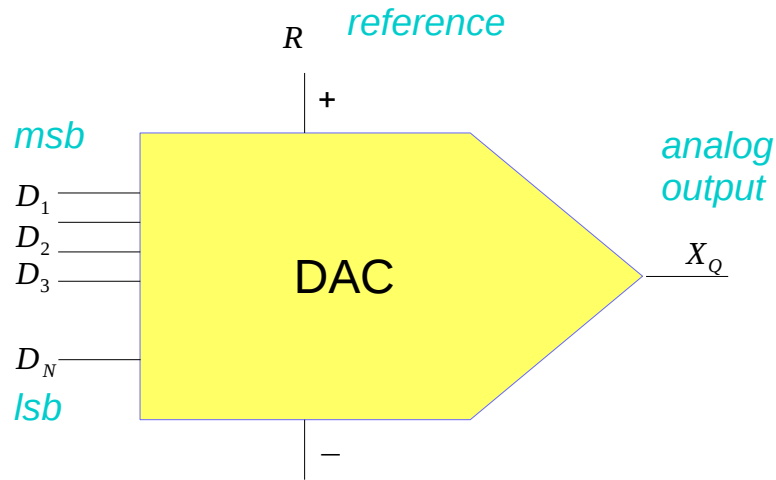
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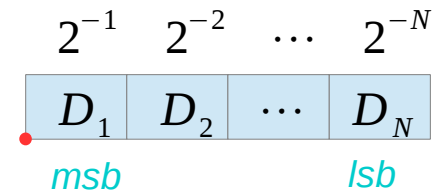
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# DAC



## Unipolar Natural Binary

$$X_Q = R(D_1 2^{-1} + D_2 2^{-2} + \dots + D_N 2^{-N})$$



$D = [0, 0, \dots, 0]$  minimum level

$$X_Q = 0$$

$D = [0, 0, \dots, 1]$  the lsb pattern

$$X_Q = R 2^{-N} = Q \quad \text{the smallest non-zero level}$$

$D = [1, 0, \dots, 0]$  the msb pattern

$$X_Q = R 2^{-1}$$

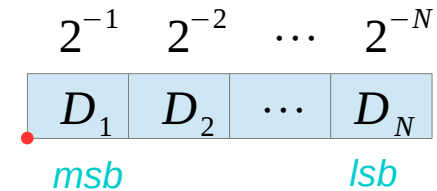
$D = [1, 1, \dots, 1]$  the maximum level

$$X_Q = R(2^{-1} + 2^{-2} + \dots + 2^{-N}) = R(1 - 2^{-N}) = R - Q$$

# DAC – unipolar natural binary

## Unipolar Natural Binary

$$X_Q = R(D_1 2^{-1} + D_2 2^{-2} + \dots + D_N 2^{-N})$$



$$D = [0, 0, \dots, 0] \quad \text{minimum level} \quad X_Q = 0$$

$$D = [0, 0, \dots, 1] \quad \text{the lsb pattern} \quad X_Q = R 2^{-N} = Q \quad \text{the smallest non-zero level}$$

$$D = [1, 0, \dots, 0] \quad \text{the msb pattern} \quad X_Q = R 2^{-1}$$

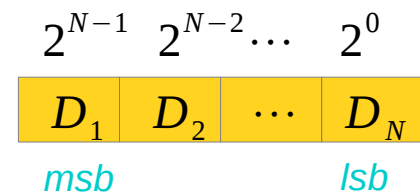
$$D = [1, 1, \dots, 1] \quad \text{the maximum level} \quad X_Q = R(2^{-1} + 2^{-2} + \dots + 2^{-N}) = R(1 - 2^{-N}) = R - Q$$

$$Q = R 2^{-N} \quad \text{quantization width}$$

$$X_Q = R 2^{-N} (D_1 2^{N-1} + D_2 2^{N-2} + \dots + D_N 2^0)$$

$$X_Q = Q m$$

$$m = (D_1 2^{N-1} + D_2 2^{N-2} + \dots + D_N 2^0)$$





## References

- [1] <http://en.wikipedia.org/>
- [2] <http://planetmath.org/>
- [3] M.L. Boas, "Mathematical Methods in the Physical Sciences"