

1.3 - Binary Point Numbers

What are they?

Binary point numbers are the way numbers like

42.625_{10}

are represented in binary.

But first, we'll start the other way

Take a number like:

$$1101.101_2$$

And remember our columns?

Example: Binary point number to decimal

$$\begin{array}{ccccccc} 2^3 & 2^2 & 2^1 & 2^0 & 2^{-1} & 2^{-2} & 2^{-3} \\ 1 & 1 & 0 & 1 & . & 1 & 0 & 1_2 \\ = 8 & + & 4 & + & 0 & + & 1 & + & 0.5 & + & 0 & + & 0.125 \\ = 13.625_{10} \end{array}$$

You try: Binary point number to decimal

$$\begin{array}{cccccccc} 2^3 & 2^2 & 2^1 & 2^0 & 2^{-1} & 2^{-2} & 2^{-3} & 2^{-4} \\ 1 & 0 & 1 & 1 & . & 0 & 0 & 1 & 1_2 \\ = 8 & + & 0 & + & 2 & + & 1 & + & 0 & + & 0 & + & 0.125 & + & 0.0625 \\ = 11.1875_{10} \end{array}$$

And finally the reverse

Rules:

- Use only the fractional part (to the right of the decimal)
- Multiply by 2
- Take the fractional part and repeat until the fractional part is zero.
- Read the numbers DOWNWARD

ex: 0.375_{10} to binary

$$\begin{array}{l} 0.375 \quad * 2 = 0.75 \\ 0.75 \quad * 2 = 1.5 \\ 0.5 \quad * 2 = 1.0 \\ \\ = 0.011_2 \end{array}$$

Another Example

Convert 42.125_{10} to binary

1 $42_{10} = 101010_2$
the usual way (div by 2)

2 $0.125 * 2 = 0.25$
 $0.25 * 2 = 0.5$
 $0.5 * 2 = 1.0$

$= 101010.001_2$

Sometimes it gets funky...

Convert 0.4_{10} to binary

$= 0.0110011001100..._2$

$= \overline{0.0110}_2$

0.4	$* 2 = 0.8$
0.8	$* 2 = 1.6$
0.6	$* 2 = 1.2$
0.2	$* 2 = 0.4$
0.4	$* 2 = 0.8$
0.8	$* 2 = 1.6$
0.6	$* 2 = 1.2$
.....	

Practice

- Convert the following to their decimal equivalents.
a) 10.01_2 b) 101.101_2 c) 1010.1001_2 d) 101.0011_2
- Convert to binary
a) 8.375 b) 13.5625 c) 9.875 d) 8.1875
- Convert to binary
a) 1.1 b) 2.2 c) 3.3 d) 4.4

Practice

- Convert the following to their decimal equivalents.
a) 10.01_2 **2.25** b) 101.101_2 **5.625** c) 1010.1001_2 **10.5625** d) 101.0011_2 **5.1875**
- Convert to binary
a) 8.375 **1000.011** b) 13.5625 **1101.1001** c) 9.875 **1001.111** d) 8.1875 **1000.0011**
- Convert to binary
a) 1.1 **100.011** b) 2.2 **10.0011** c) 3.3 **11.01001** d) 4.4 **100.0110**

$$= 1.00011$$

$$= 10.0011$$

$$c) 11.01001$$

$$d)$$

$$100.0110$$