

Conversion of fractional numbers from one number system to another

- **Fractional Decimal to fractional Binary and Vice-Versa**
- **Fractional Decimal to fractional Octal and Vice-Versa**
- **Fractional Decimal to fractional Hexadecimal and Vice-Versa**
- **Fractional Octal To fractional Binary and Vice-Versa**
- **Fractional Hexadecimal To fractional Binary and Vice-Versa**
- **Fractional Octal to fractional Hexadecimal and Vice-Versa**

a) **Conversion between fractional binary and fractional decimal number**

To convert a fractional binary number to a fractional decimal number, we proceed as follows:

- First, write the place values starting from the left hand side.
- Write each digit under its reciprocal of place value.
- Multiply each digit by its corresponding reciprocal place value.
- Add up the products. The answer will be the decimal fractional number in base ten.

EXAMPLE

Convert 0.101101_2 to base 10(or decimal) number

Multiply each digit by its place value

$$N_{10}=(1 \times 2^{-1}) +(0 \times 2^{-2})+(1 \times 2^{-3})+(1 \times 2^{-4})+(0 \times 2^{-5})+(1 \times 2^{-6})$$

$$N_{10}=(1/2)+0+(1/8) + (1/16) + 0+(1/64)$$

$$=0.5+0.125+0.0625+0.015625$$

$$=(0.703125)_{10}$$

$$(11011001.11001)_2 \rightarrow (128+64+0+16+8+0+0+1).(1/2+1/4+1/32)$$

$$\rightarrow (217.78125)_{10}$$

Converting Decimal to binary

The Process of conversion is :

multiply the fractional decimal number by 2 (base) continuously by keeping the decimal value before decimal point and making the new fractional value as multiplier fractional number till it be zero fractional or repetition of first fractional number . Finally arrange all decimal value before decimal point in their coming series. Resultant will be binary number of fractional decimal.

For example

	. 703125 x 2	1.406250
1	. 406250 x2	0.812500
0	.812500 x 2	1.625000
1	.625000 x 2	1.250000
1	.250000 x2	0.500000
0	.500000 x2	1.000000
1	.0000000	

$$(0.703125)_{10} - (0.101101)_2$$

$$(56.056)_{10} - (111000).(0000111)_2$$

b) Converting fractional decimal to fractional octal :

multiply the fractional decimal number by 8 (base) continuously by keeping the decimal value before decimal point and making the new fractional value as multiplier fractional number till it be zero fractional or repetition of first fractional number . Finally arrange all decimal value before decimal point in their coming series. Resultant will be octal fractional number of fractional decimal.

For example

	. 98 x 8	7.84
7	. 84 x 8	6.72
6	.72 x 8	5.76
5	.76 x 8	6.08
6	.08 x 8	.64

$$(0.98)_{10} - (0.7656)_8$$

Octal to decimal :

Find sum of multiplication of each digit and reciprocal of Place value (negative power of 8 : starting from 1 to n) of octal number . where n is the place number of the octal number digit . result will be the fractional decimal number.

i.e

$$(N)_8 = \sum od \times 8^{-n} \quad \text{where } n=1 \text{ to place number}$$

Example :-

$$(0.567)_8 = 5 \times 8^{-1} + 6 \times 8^{-2} + 7 \times 8^{-3}$$

$$= 0.625 + 0.09375 + 0.013671875 = (0.732421875)_{10}$$

$$(603.065)_8 = 6 \times 8^2 + 3 \times 8^0 + (6/64 + 5/512) = (387.103156)_{10}$$

c) fractional Decimal to fractional Hexadecimal :

multiply the fractional decimal number by 16 (base) continuously by keeping the decimal value before decimal point and making the new fractional value as multiplier fractional number till it be zero fractional or repetition of first fractional number . Finally arrange all decimal value before decimal point in their coming series. Resultant will be hexadecimal fractional number of fractional decimal.

	. 981 x 16	15.696
15(F)	. 696 x 16	11.136
11(B)	.136 x 16	2.176
2	.176 x 16	2.816
2	.816 x 16	

$$(0.981)_{10} - (0.FB22)_{16}$$

$$(0.0112)_{10} \rightarrow (0.02DE)_{16}$$

Hexadecimal to decimal :

Find sum of multiplication of each digit and reciprocal of Place value (negative power of 16 : starting from 1 to n) of fractional hexadecimal number . where n is the place number of the

fractional hexadecimal number digit . result will be the fractional decimal number.

i.e

$$(N)_{10} = \sum hd \times 16^{-n} \quad n= 1\dots$$

Example :-

$$\begin{aligned} (.568)_{16} &= 5 \times 16^{-1} + 6 \times 16^{-2} + 8 \times 16^{-3} \\ &= 0.3125 + 0.0234375 + .00195312 = (0.337890)_{10} \end{aligned}$$

$$(D01.F0D)_{16} = (3329.94067)$$

d) Conversion fractional octal to fractional Binary :

Convert each fractional octal digit into 3-bit binary number the resultant binary bit combination will be the fractional binary value of octal number.

Example:

$$(0.675)_8 = (0. 6 7 5)_8 = (0. 110 111 101)_2$$

$$(0.106)_8 \rightarrow (0. 001 000 110)_2$$

Conversion of fractional Binary to fractional Octal :

Group the binary digit in combination of three bit from left most bit, then convert each group of bit in corresponding octal digit. The resultant will be fractional Octal Number .

$$(.11110111101)_2 = (.111 101 111 010)_2 = (. 7 5 7 2)_8$$

$$(11001.0011100)_2 \rightarrow (31.160)_8$$

e) Conversion Hexadecimal to binary

Convert each fractional Hexadecimal digit into 4-bit binary number from left side, the resultant binary bit combination will be the fractional binary value of Hexadecimal number.

Example

$$(0.6A5D)_{16} = (0.6 \ A \ 5 \ D)_{16} = (.0110101001011101)_2$$

Conversion of fractional Binary to fractional Hexadecimal :

Group the fractional binary digit in combination of four bit from right left most bit, then convert each group of bit in corresponding Hexadecimal digit. The resultant will be fractional Hexadecimal Number .

$$(0.1111011101)_2 = (1111 \ 0111 \ 101)_2 = (0.F75)_{16}$$

f) Conversion of fractional Hexadecimal to fractional Octal

The Simplest way to Convert fractional Hexadecimal to fractional Octal is

Fractional Hexadecimal \rightarrow fractional Binary \rightarrow fractional Octal

Example :

$$(0.7BB)_{16} \rightarrow (.011110111011)_2 \rightarrow (.011110111011)_2 \rightarrow (3673)_8$$

Similarly

Fractional Octal to fractional Hexadecimal

Fractional Octal \rightarrow fractional Binary \rightarrow fractional Hexadecimal

$(.3\ 6\ 7\ 5)_8 \rightarrow (.0\underline{11}\ \underline{110}\ \underline{111}\ \underline{101})_2 \rightarrow (.0111\ 1011\ 1101)_2 \rightarrow (.7\ B\ D)_{16}$