**Conversions**

1. **Rapid conversions**
2. **Substitution method**
3. **Successive divisions and multiplications**
4. **Rapid conversions:** conversions between bases which are powers of2.
   1. **Conversion from the source base p=2k , p****{4=22,8=23,16=24} into the destination base 2**

**Rule**:

**Each digit from the source number in base *p*=2*k*, the integer part and the fractional one, will be replaced by the corresponding group of *k* binary digits (adding if it is necessary insignificant zeros to the left).**

* 1. **. Conversion from base 2 into the destination base q=2k** ,  **q{4=22,8=23,16=24}**

**Rules:**

* **for the *integer/fractional part*: from *right/left* to *left/right* (relative to the decimal point) make groups of *k* binary digits (eventually we add to the *left/right* insignificant zeros to have a complete group);**
* **the groups will be replaced by the corresponding digits in base *q*=2*k .***

**Example 1:**

**14523,671 (8) = ? (2) = ? (16)**

**14523,671(8)=001 100 101 010 011, 110 111 001(2)**

**0001 1001 0101 0011,1101 1100 1000(2) = 1953,DC8(16)**

**6=4+2=2^2+2^1= 110(2)**

**D(16)=13=8+4+1= 2^3+2^2+2^0= 1101 (2)**

**100= 64+32+4= 2^6+2^5+2^2= 1100100(2)**

**Example 2:**

**03 31 20 , 01 20 (4) = 3D8,18 (16)**

**31(4)= 3\*4+1=13= D(16)**

**20(4)**

**Example 3:**

**AFED,8E (16) = 22 33 32 31, 20 32 (4)**

**A(16)=10=2\*4 + 2\*4^0=22(4)**

**F(16) = 3\*4^1 + 3\*4^0=33(4)**

**E(16) = 3\*4^1 + 2\*4^0=32(4)**

1. **Substitution method**

* **calculations in the destination base**
  + **it is recommended for *b < h*, *b* (source base), *h*(destination base)**

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***Steps:***

* **all the digits from the source representation are converted into the destination base: **
* **the base *b* is converted into base *h*: **
* **we calculate in base *h* the following sum:**

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**Example 4: with a precision of 2 digits at the fractional part in the destination representation**

**!! Calculations performed in base 8**

**1342,24 (5) = ~ 336,43...  (8)**

**1(5)=1(8), 3(5) = 3(8), 4(5) = 4(8), 2(5) = 2(8), 5=5(8)**

**1342,24(5) = 1(8)\*5(8)^3 + 3(8)\*5(8)^2 + 4(8)\*5(8)^1 + 2(8)\*5(8)^0 +**

**2(8)\*5(8)^-1 + 4(8)\*5(8)^-2 = 175(8) +113(8)+24(8)+2(8)+0,31(8)+0,12(8)=**

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| **3** | **0** |  |  | **1** | **0** | **0** |  |  | **1** | **0** | **0** |  |  | **2** | **0** |  |  |  |  |  |  |  |  |  |  |  |  |
|  | **5** | **\*** |  |  | **3** | **1** | **\*** |  |  | **3** | **1** | **\*** |  |  | **4** | **\*** |  |  |  |  |  |  |  |  |  |  |  |
|  | **5** |  |  |  |  | **5** |  |  |  |  | **3** |  |  |  | **5** |  |  |  |  |  |  |  |  |  |  |  |  |
| **3** | **1** |  |  | **1** | **7** | **5** |  |  | **1** | **1** | **3** |  |  | **2** | **4** |  |  |  |  |  |  |  |  |  |  |  |  |

**5\*5+0=25, 25 div 8= 3 , 25 mod 8= 1**

**5(8)^2=31(8)**

**5(8)^3=31(8)\*5(8) = 175(8)**

**3\*5+0=15, 15 div 8 = 1 , 15 mod8=7**

|  |  |  |
| --- | --- | --- |
| 2,00 (8)| 5(8)  / | 0,31 q  20  / 10  / | 4,00 (8) | 5(8)  / | 0,63 q  40  / 20    / | 0,63 | 5(8)  / | 0,12  6  / 13    / 1 |

**20(8) = 2 \* 8 + 0 = 16, 16 div 5 = 3, 16 mod 5 = 1**

**10(8) = 1 \* 8 = 8, 8 div 5 = 1, 8 mod 5 = 3**

**40(8) = 4 \* 8 + 0 = 32, 32 div 5 = 6, 32 mod 5 = 2**

**13(8) = 8 + 3 = 11, 11 div 5 = 2, 11 mod 5 = 1**

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| **c** | **1** | **1** | **0** |  |  |  | **+(8)** |
|  | **1** | **7** | **5** | **,** |  |  |  |
|  | **1** | **1** | **3** |  |  |  |  |
|  |  | **2** | **4** |  |  |  |  |
|  |  |  | **2** |  |  |  |  |
|  |  |  | **0** | **,** | **3** | **1** |  |
|  |  |  | **0** | **,** | **1** | **2** |  |
|  | **3** | **3** | **6** | **,** | **4** | **3** |  |

**14/8=1, 14%8=6**

**1+7+1+2=11, 11/8=1, 11%8=3**

**1+1+1=3**

**Example 5:with a precision of 2 digits at the fractional part in the destination representation**

**, (7) = ,  (16)**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
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|  |  |  |
| --- | --- | --- |
| 0, |  / |  /    / | |  / |  /    / | |  / |  /    / |

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **c** |  |  |  |  |  |  |  |
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1. **The method of successive divisions/multiplications**

* **it is recommended for *h < b*, *b* –source base and *h*- destination base.**
* **calculations in the source base**

**Integer part**: **successive divisions** by the destination base (***h***) are performed

* the process of successive divisions ends when 0 is obtained as quotient.
* the remainders, in the reverse order, are the digits of the new representation in base *h.*

**Fractional part**: **successive multiplications** by the destination base (***h***) are performed

* the fractional part is multiplied by ***b*** obtaining a number with an integer part and a fractional one;
* we continue with the multiplication of this new fractional part,...
* the process of the successive multiplications continues until one of the following conditions is satisfied:

a) the fractional part becomes 0;

b) an established number of digits of the fractional part were calculated;

c) periodicity is obtained.

* the integer parts, in the order of obtaining them during the multiplications process, are the digits of the fractional part in the destination representation.

**Example 6: with a precision of 3 digits at the fractional part in the destination representation**

**, (8) = ,  (5)**

**Conversion of the integer part**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| |  / |  /    /    /  r | |  / |  /    /    /  r | |  / |  /    /    /  r | |  / |  /    /    /  r | |  / |  /    /    /  r |

**Calculations:**

**Conversion of the fractional part**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
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| **0,** |  |  | **\*** |  |  |  |  | **\*** |  |  |  |  | **\*** |  |
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**Calculations:**

**Example 7: with a precision of 3 digits at the fractional part in the destination representation**

**, (16) = ,  (7)**

**Conversion of the integer part**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| |  / |  /    /    /  r | |  / |  /    /    /  r | |  / |  /    /    /  r | |  / |  /    /    /  r | |  / |  /    /    /  r |

**Calculations:**

**Conversion of the fractional part**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
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| **0,** |  |  | **\*** |  |  |  |  | **\*** |  |  |  |  | **\*** |  |
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**Calculations:**