**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:**

**7452,164(8) = ? (2) = ? (16)**

**7452,164(8)=111 100 101 010, 001 110 100(2)**

**1111 0010 1010, 0011 1010 0000(2)= F2A, 3A(16)**

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

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

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

**Example 2:**

**02 30 12,23 10(4)= 2C6,B4 (16)**

**Example 3:**

**A5E,973(16) = 22 11 32,21 13 03(4)**

**10=8+2=2\*4+2=22(4)**

**5=4+1=1\*4+1=11(4)**

**14=12+2=3\*4+2=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:q***

* **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 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) = 2(8)\*5(8)^0 + 4(8)\*5(8)^1 + 3(8)\*5(8)^2 + 1(8)\*5(8)^3 + 2(8)\*5(8)^(-1) + 4(8) \* 5(8)^(-2) = 2(8)+24(8) +113(8) + 175(8)+0,31(8)+0,12(8) =336,43(8)**

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

**4\*5=20, 20 div 8=2 , 20 mod 8=4**

**4(8)\*5(8)=24(8)**

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

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

**3\*5(8)^2=31(8)\*3(8)=113(8)**

**3\*3+0=9, 9 div 8=1, 9 mod 8=1**

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

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| 2,00 (8) |5 (8)  / ` | 0,31 q  20  / 10  /  3 | 4,00(8) | 5 (8)  / | 0, 63 q q  40  / 20 | 0,63 (8) | 5 (8)  / | 0, 12 q  6  /  13  / 1 |

**20(8)=2\*8+0=16(10), 16 div 5 = 3, 16 mod 5 = 1**

**10(8)=1\*8+0=8(10), 8 div 5 = 1, 8 mod 5 = 3**

**40(8) = 4\*8 + 0 = 32(10), 32 div 5 = 6, 32 mod 5 = 2**

**13(8) = 1\*8 + 3 = 11(10), 11 div 5 = 2, 11 mod 5 = 1**

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|  | **1** | **1** | **0** |  | **0** | **0** | **+** |
|  |  |  | **2** | **,** |  |  |  |
|  |  | **2** | **4** | **,** |  |  |  |
|  | **1** | **1** | **3** | **,** |  |  |  |
|  | **1** | **7** | **5** | **,** |  |  |  |
|  |  |  | **0** | **,** | **3** | **1** |  |
|  |  |  | **0** | **,** | **1** | **2** |  |
| **s** | **3** | **3** | **6** | **,** | **4** | **3** |  |

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

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

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

|  |  |  |  |  |  |  |  |
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| **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:**