**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:**

**(8) = ? (2) = ? (16)**

**423,56(8)=100 010 011, 101 110 (2)=0001 0001 0011, 1011 1000**

**=113,B8**

**Example 2:**

**3201,1322 (4) = 32 01, 13 22 (4)= E1,7A ? (16)**

**32(4) = 3\*4 + 2 = 14 = E(16)**

**Example 3:**

**A1C,35C (16) = ? (4)**

**A1C,35C(16)=22 01 30, 03 11 30(4)**

1. **Substitution method**

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

****

***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:**

****

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

**4301,23 (5) = ,  (8)**

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

**4+3+01,23(5) = 4(8) \* 5(8) ^ 3 + 3(8)\*5(8)^2+0(8)\*5(8)+1(8)+2(8)\*5(8)^(-1)+3(8)\*5(8)^(-2)=**

**=764(8) + 113(8) + 1(8) + 0,31(8) + 0,07(8) = 1100,40**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **c** |  | **3** | **0** |  |  | **1** | **0** | **0** |  |  |  | **3** | **2** |  |  |  | **1** | **0** |  |  |  |  |  |  |  |  |  |
|  |  |  | **5** | **\*** |  |  | **3** | **1** | **\*** |  |  | **1** | **7** | **5** | **\*** |  |  | **3** | **1** | **\*** |  |  |  |  |  |  |  |
|  |  |  | **5** |  |  |  |  | **5** |  |  |  |  |  | **4** |  |  |  |  | **3** |  |  |  |  |  |  |  |  |
|  |  | **3** | **1** |  |  | **1** | **7** | **5** |  |  |  | **7** | **6** | **4** |  |  | **1** | **1** | **3** |  |  |  |  |  |  |  |  |

**5 \* 5 = 25, 25 / 8 = 3, 25%8 = 1**

**3\* 5 = 15, 15 / 8 = 1, 15 % 8 = 7**

**5 \* 4 = 20, 20 / 8 = 2, 20 % 8 = 4**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **2,00** | **:5(8)** | **3,00** | **:5(8)** | **0,46** | **:5(8)** |  |
|  | **0,31** |  | **0,46** |  | **0,07** |
| **20** | | **30** | | **4** | |
| **10** | | **40** | | **46** | |
| **3** | | **2** | | **3** | |
|  | |  | |  | |
|  | |  | |  | |
|  | |  | |  | |
|  | |  | |  | |
|  | |  | |  | |

**20(8)=16(10) 16%5=1, 16/5=3**

**10(8)=8(10) 8%5=3, 8/5=1**

**30 (8)=24(10) 24%5=4 24/5=4**

**40(8)=32(10) 32%5=2 32/5=6**

**4(8)=4(10) 4%5=4, 4/5=0**

**46(8)=38(10) 38%5=3, 38/5=7**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **c1** | **1** | **1** |  | **,** | **1** |  | **+** |
|  | **7** | **6** | **4** | **,** | **0** | **0** |  |
|  | **1** | **1** | **3** | **,** | **0** | **0** |  |
|  |  |  | **1** | **,** | **0** | **0** |  |
|  |  |  | **0** | **,** | **3** | **1** |  |
|  |  |  | **0** | **,** | **0** | **7** |  |
|  |  |  |  |  |  |  |  |
| **1** | **1** | **0** | **0** |  | **4** | **0** |  |

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

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

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  |  |  |
|  |  |  |  |  |  |
|  | |  | |  | |
|  | |  | |  | |
|  | |  | |  | |
|  | |  | |  | |
|  | |  | |  | |
|  | |  | |  | |
|  | |  | |  | |
|  | |  | |  | |

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **c** |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |

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**

**346, 12 (8) = 1410, 03 ,  (5)**

**Conversion of the integer part**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| 346(8) | 5(8)  / | 56  34  /  36    /  0  /  r | 56 | 5(8)  / |11  5  / 6    / 1    /  r | 11 | 5(8)  / | 1  4 /    /    /  r | 1 | 5(8)  / | 0  1 /    /    /  r | 5000 | 6  / 3 0 | 744  30  3  /    /    /  r |

**Calculations: 50(9)=45(10),45%6=3,45/6=7**

**34(8)=28(10), 28%5=3 28/5=5**

**36(8)=30(10), 30%5=0 30/5=**

**5(8)=5(10), 5%5=0 5/5=1**

**6(8)=6(10),6%5=1 6/5=1**

**11(8)=9(10),9%5=4 9/5=1**

**Conversion of the fractional part**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **1** |  |  |  | **3** | **1** |  |  |  |  |  |  |  |  |
| **0,** | **1** | **2** | **\*** |  | **0,** | **6** | **2** | **\*** |  |  |  |  | **\*** |  |
|  |  | **5** |  |  |  |  | **5** |  |  |  |  |  |  |  |
| **0,** | **6** | **2** |  |  | **3,** | **7** | **2** |  |  |  |  |  |  |  |

**Calculations:**

**0,12(8) \* 5(8) = 0,62(8)**

**0,62\*5(8) = 3,72**

**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**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| **0,** |  |  | **\*** |  |  |  |  | **\*** |  |  |  |  | **\*** |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |

**Calculations:**