## 4.3 Hexadecimal System

Hexadecimal In addition to the binary system, the hexadecimal system is of great importance in com-

This word is derived from puter science. This system is often used in digital data processing because it allows a com-

Hexadecimal therefore isancient Greek and Latin:word for “six” and “deci- digits are used for representation: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, A, B, C, D, E, F. Hexadecihexa is the Ancient Greek fortable representation of binary numbers. In the hexadecimal system, sixteen different mal” is Latin for “tenth”. mal numbers are therefore represented using the base 16.

6 + 10, or a number sysrespective digit Numbers are represented in the hexadecimal system byJust as with binary numbers, there is no leading sign. The index with m, n ∈ ℕ and h hi h h …hh h ·h h …h 16 . i .

tem based on 16. m m−1 1 0 −1 −2 −n i

Correspondingly, the (decimal) value of a hexadecimal number is determined by the sum of powers of base 16. The digits before the decimal point are multiplied accordingly by powers of sixteen with non-negative exponents and the digits after the decimal point by powers of sixteen with negative exponents and summed up. Here the digits A to F stand for the factors 10 to 15. The value of a hexadecimal number can thus be calculated as follows: h = i =∑m−nhi ·16i 160 as the subscript index, forxA3 2F 0x2F 0x is

example The relation to the binary system is as follows. The base of the hexadecimal system is theTo indicate a number in hexadecimal notation, we use a systems—one A316 or often2F uses an equivalent notation: Instead of the subscript, the prefix 16. In computer science—especially in the programming of A3 is written as or software. added to the number and then, for example, 16 16 as

2fourth power of two 4 states. This means that a hexadecimal digit can always represent exactly one nibble. A24 = 16. A nibble, i.e., 4 bits of a binary number, can represent exactly

byte can therefore be represented by two hexadecimal digits. The following table illustrates this relationship.

Table 4: Representation of numbers in decimal, binary and hexadecimal systems

Source: Brückmann, 2013.

Example: Hexadecimal system ED243F161616=14·16=224+13=2·16=32+15=47=4·16=64+3=671010 111+15·16+3·16+13·16000

Finally, let us briefly consider the relationship between the binary and hexadecimal sys-B7A516=11·16=47013=45056+1792+160+510=2373 +7·1610 2 +10·161 +5·160

tems. The (decimal) value of the number A316is given by

163 A3160011=10·16=160+3=163 1010 00111 +3·16 = 3 0

as a binary number, we get 10

binary system and the hexadecimal system becomes clear when we look at the individualIf we write 10 2, and the connection between the ues down one hexadecimal numbers and then simply putting them together in sequence, you get thenibbles: It is 1010after2 = 10 the other you get 10 = A16 and A316. So by writing the nibbles of a binary number as2 =310 16, and if you simply write these valfor example, you can convert each hexadecimal digit into a nibble in turn from can be converted to the hexadecimal system very easily and without great computationalPlease calculate and check that together you get the binary representation of this number as F16 = 1111 It’s just as easy to do the opposite: If you look at the hexadecimal number 2, 416 = 01002, 916 = 1001F49C162 = 62620 and C16 = 110010 = 1111 0100 1001 11002. By simply joining these nibbles1111 0100 1001 11002. left to right:F49C 2. hexadecimal representation of a binary number. In this way, even long binary numbers

effort. 16,