

Definition

BCD or **binary-coded decimal** is a special kind of representation of a decimal number in binary numbers. In binary-coded decimal each individual digit of a number is converted into a binary number, and then by combining them all, the BCD code is generated. But always remember that a binary-coded decimal is not a binary representation of a decimal number.



Examples

The **BCD** or **binary-coded decimal** of the number **15** is 00010101. The 0001 is the binary code of 1 and 0101 is the binary code of 5.

Any single decimal numeral [0-9] can be represented by a four bit pattern. The procedure of encoding digits is called "**Natural BCD**" (**NBCD**), where each decimal digit is represented by its corresponding four-bit binary value.

Decimal	Binary
0	0000
1	0001
2	0010
3	0011
4	0100
5	0101
6	0110
7	0111
8	1000
9	1001

Types

Generally there are 2 types of BCD: unpacked and packed.

Unpacked BCD: In the case of unpacked BCD numbers, each four-bit BCD group corresponding to a decimal digit is stored in a separate register inside the machine. In such a case, if the registers are eight bits or wider, the register space is wasted.

Packed BCD: In the case of packed BCD numbers, two BCD digits are stored in a single eight-bit register. The process of combining two BCD digits so that they are stored in one eight-bit register involves shifting the number in the upper register to the left 4 times and then adding the numbers in the upper and lower registers.

There is the another one which is not really considered as BCD:

Invalid BCD: There are some numbers are not considered as BCD. They are 1010, 1011, 1100, 1101, 1110, 1111.

Differences Between BCD And Simple Binary Representation

In simple binary representation of any number we just convert the whole number into its binary form by repeatedly dividing 2 again and again. But in the case of BCD, we need not to do this. If anyone knows the binary representation of the numbers 0 to 9, he/she can make a BCD code of any number because, in BCD, we just convert each individual digit of any number to binary and then write them together.

In the case of **946**, the **binary representation** of this number is 01110110010. Here we convert the total number into its binary form. But when we form the **BCD** code of the number 946, that'll be

$9=1001, 4=0100, 6=0110 \Rightarrow 100101000110$. $9=1001, 4=0100, 6=0110 \Rightarrow 100101000110$.

Use Of Binary-Coded Decimal

The use of BCD can be summarized as follows:

- BCD takes more space and more time than standard binary arithmetic.
- It is used extensively in applications that deal with currency because floating point representations are inherently inexact.
- Database management systems offer a variety of numeric storage options; “Decimal” means that numbers are stored internally either as BCD or as fixed-point integers
- BCD offers a relatively easy way to get around size limitations on integer arithmetic.

How many bits would be required to encode decimal numbers 0 to 9999 in straight binary and BCD codes? What would be the BCD equivalent of decimal 27 in 16-bit representation?

- Total number of decimals to be represented = $10\ 000 = 10^4 = 2^{13.29}$.

BCD-BINARY CODED DECIMAL

- Therefore, the number of bits required for straight binary encoding = 14.
- The number of bits required for BCD encoding = 16.
- The BCD equivalent of 27 in 16-bit representation = **00000000010011**.