

NUMBER SYSTEMS

A NUMBER SYSTEM CAN BE BASED ON ANY NUMBER OF DIGITS. THE COMMON DECIMAL SYSTEM HAS 10 DIGITS. THE BINARY SYSTEM HAS 2 DIGITS; THE HEXADECIMAL SYSTEM HAS 16 DIGITS. NUMBERS ARE WRITTEN AS SUCCESSIVE POWERS OF THE BASE OF THE NUMBER SYSTEM. THUS:

$$\begin{array}{r}
 4 \ 3 \ 2 \ 7_{10} \\
 \begin{array}{l}
 \rightarrow 7 \times 10^0 = 7 \times 1 = 7 \\
 \rightarrow 2 \times 10^1 = 2 \times 10 = 20 \\
 \rightarrow 3 \times 10^2 = 3 \times 100 = 300 \\
 \rightarrow 4 \times 10^3 = 4 \times 1000 = 4000
 \end{array} \\
 \hline
 4327
 \end{array}$$

BINARY NUMBERS

IN ELECTRONIC CIRCUITS DECIMAL NUMBERS ARE USUALLY REPRESENTED BY BINARY NUMBERS. BINARY NUMBERS ALSO SERVE AS CODES THAT REPRESENT LETTERS OF THE ALPHABET, VOLTAGES, COMPUTER INSTRUCTIONS, ETC. A BINARY 0 OR 1 IS A BIT. A PATTERN OF 4 BITS IS A NIBBLE. A PATTERN OF 8 BITS IS A BYTE OR WORD.

BINARY TO DECIMAL

$$\begin{array}{r}
 1 \ 0 \ 0 \ 1 \ 1 \\
 \begin{array}{l}
 \rightarrow 1 \times 2^0 = 1 \\
 \rightarrow 1 \times 2^1 = 2 \\
 \rightarrow 0 \times 2^2 = 0 \\
 \rightarrow 0 \times 2^3 = 0 \\
 \rightarrow 1 \times 2^4 = 16
 \end{array} \\
 \hline
 19
 \end{array}$$

DECIMAL TO BINARY

$$\begin{array}{l}
 19 \div 2 = 9 + 1 \\
 9 \div 2 = 4 + 1 \\
 4 \div 2 = 2 + 0 \\
 2 \div 2 = 1 + 0 \\
 \quad \quad \quad 1^* \\
 19 = 10011
 \end{array}$$

* FINAL QUOTIENT IS FINAL REMAINDER

BINARY CODED DECIMAL (BCD): A SYSTEM IN WHICH EACH DECIMAL DIGIT IS ASSIGNED ITS BINARY EQUIVALENT (19 = 0001 1001).

NUMBER SYSTEM EQUIVALENTS

DEC (DECIMAL) BIN (BINARY)
BCD (BINARY CODED DECIMAL) HEX (HEXADECIMAL)

DEC	BIN	BCD	HEX
0	0	0000 0000	0
1	1	0000 0001	1
2	10	0000 0010	2
3	11	0000 0011	3
4	100	0000 0100	4
5	101	0000 0101	5
6	110	0000 0110	6
7	111	0000 0111	7
8	1000	0000 1000	8
9	1001	0000 1001	9
10	1010	0001 0000	A
11	1011	0001 0001	B
12	1100	0001 0010	C
13	1101	0001 0011	D
14	1110	0001 0100	E
15	1111	0001 0101	F
16	10000	0001 0110	10
17	10001	0001 0111	11
18	10010	0001 1000	12
19	10011	0001 1001	13
20	10100	0010 0000	14
21	10101	0010 0001	15
22	10110	0010 0010	16
23	10111	0010 0011	17
24	11000	0010 0100	18
25	11001	0010 0101	19
26	11010	0010 0110	1A
27	11011	0010 0111	1B
28	11100	0010 1000	1C
29	11101	0010 1001	1D
30	11110	0011 0000	1E
31	11111	0011 0001	1F
32	100000	0011 0010	20
64	1000000	0110 0100	40
96	1100000	1001 0110	60
99	1100011	1001 1001	63