

1's & 2's complement

Informing the digital system how to treat a binary number is not very efficient. A better way is to represent negative signed numbers in their 2's complement form. Using 2's Complement form to represent signed numbers, allows direct manipulation of positive as well as negative numbers without having to worry about setting the most significant sign bit to indicate positive and negative numbers.

A 2's complement of a number is obtained by first taking the 1's complement of a number and then adding a 1 to change the 1's complement to 2's complement. 1's complement of a number is obtained by simply inverting all its bits. Obtaining the 2's complement of 13 is described in the example below.

01101	The number 13
10010	1's complement of 13 is obtained by inverting all the five bits.
+ <u>1</u>	
10011	2's complement of 13 is obtained by adding a 1 to its 1's complement.

In a 2's complement number system all negative numbers are represented in their 2's complement form and all positive numbers are represented in their actual form. Negative numbers can be readily identified by their MSBs which are set to 1. Thus in a 2's complement representation +13 is represented as 01101 and -13 is represented as 10011.

By having numbers represented in their 2's complement form addition and subtraction operations can easily be performed without having to worry about the sign bits. Thus +13 added to -13 should result in a zero value. This can be verified by directly adding the +13 and -13 in their 2's complement forms.

01101
<u>10011</u>
100000

The most significant carry bit is discarded; retaining only the first 5 bits proves that adding +13 and -13 results in a zero value. Similarly it can be shown that adding the numbers +7 and -13 results in -6.

10011	(-13)
<u>00111</u>	(+7)
11010	(-6)

The binary 2's complement number 11010 has its most significant bit set to 1 indicating that the number is negative. The actual magnitude of the negative number is determined by taking the 2's complement of 11010.

11010	Original number
00101	1's complement of Original number
<u>+ 1</u>	
00110	2's complement of Original number is equal to 6.