Logic Design

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2's Complement Two Bit Multiplier

We will refer to the first two bits as number A and the second two bits as number B.

Functions s, h, f, g will refer to the sign, the third bit, the second bit and the first bit respectively.

We have the following truth table for the 15 different inputs:

$A_1A_2B_1B_2$	A x B	s	h	f	g
00 00	0 x 0	0	0	0	0
00 01	0 x 1	0	0	0	0
00 10	0 x -2	0	0	0	0
00 11	0 x -1	0	0	0	0
01 00	1 x 0	0	0	0	0
01 01	1 x 1	0	0	0	1
01 10	1 x -2	1	0	1	0
01 11	1 x -1	1	0	0	1
10 00	-2 x 0	0	0	0	0
10 01	-2 x 1	1	0	1	0
10 10	-2 x -2	0	1	0	0
10 11	-2 x -1	0	0	1	0
11 00	-1 x 0	0	0	0	0
11 01	-1 x 1	1	0	0	1
11 10	-1 x -2	0	0	1	0
11 11	-1 x -1	0	0	0	1

Now, all we have to do is simplify the functions using Karnaugh's Map.

s($A_1A_2B_1B_2$) = $\sum m(6,7,9,13) = A_1\bar{B}_1B_2 + \bar{A}_1A_2B_1$

h($A_1A_2B_1B_2$) = $\sum m(10) = A_1\bar{A}_2B_1\bar{B}_2$

f($A_1A_2B_1B_2$) = $\sum m(6,9,11,14) = A_2B_1\bar{B}_2 + A_1\bar{A}_2B_2$

g($A_1A_2B_1B_2$) = $\sum m(5,7,13,15) = A_2B_2$

Function s

$B_1B_2\backslash A_1A_2$	00	01	11	10
00				
01			1	1
11		1		
10		1		

Function f

$B_1B_2\backslash A_1A_2$	00	01	11	10
00				
01				1
11				1
10		1	1	

Function g

$B_1B_2\backslash A_1A_2$	00	01	11	10
00				
01		1	1	
11		1	1	
10				