Group C

Simple Calculator

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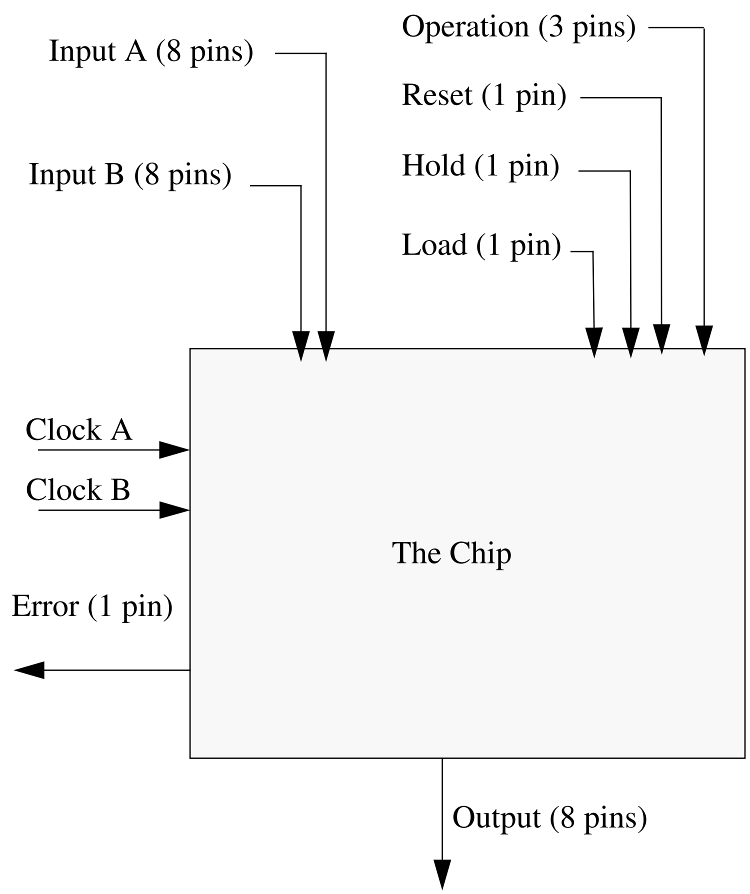
Functional Description



Review of Operations

Inputs are 8 bits and inputed simultaneously
The numbers are in 2's complement form

The Operations are:
Add
Subtract
Shift Left and Append
Shift Right and Append
NOT
AND
OR
XOR

Functional Test Add & Subtract

1. loads 01001100 for A and 00101111 for B
2. Adds 01001100 to 00101111 should get 01111011 hold output.
3. Subtracts 01000011 from 01111011 should get 00111000 hold output
4. Adds 01101010 to 00111000 should get 10100010 and error, hold output
5. Subtracts 01111011 from 10100010 should get 00100111 and error, hold output
6. Subtracts 10111001 from 00100111 should get 01101110 and error.
7. Subtracts 10111001 from 01010110 should get 1001101 and error.

Functional Test Logic

1. loads 10101010 for A and 00111010 for B
2. Computes 10101010 AND 00111010 should get 00101010 hold output.
3. Computes NOT 00101010 should get 11010101 hold output.
4. Computes 11010101 OR 11001100 should get 11011101 hold output
5. Computes 11011101 XOR 01010110 should get 10001011 hold output.

Functional Test : Shifters.

1. Load 00000000 into A.
2. Shift 00000000 right 4 bits add 1111 should get 11110000 and hold.
3. Shift 11110000 left 2 bits add 11 should get 11000011 and hold.
4. Shift 11000011 left 4 bits add 1100 should get 00111100 and hold.
5. Shift 00111100 right 3 bits add 001 should get 00100111 and hold.
6. Shift 00100111 right 1 bit add 1 should get 10010011 and hold.

Speed Test Results

Predicted Speed : 70 ns.

Table 1:

Clock Cycle	Measured Speeds	Results
34 MHz (non-overlapping)	117.6 ns	Correct
17 MHz (overlapping)	117.6 ns	Correct
34 MHz (overlapping)	58.8 ns	In-Correct

Which agrees with what we predicted.

Yield

Number of fully working devices : 2
Number of working adders and subtractors : 4
Number of working shifters : 3
Number of working logic circuits : 4

The errors:

Chip 1 Appended input IN9 for rightshift and Appended input IN8 and IN10 for leftshift were stuck at “0”.
Chip 2 One outpu pin is stuck at “1” for all the operations.

Reasons for failure

Chip 1 Fabrication error at the input boost inverters.
Chip 2 Fabrication error on output latch.