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Group 47

g47_5_26_Decoder

Description:
Our decoder circuit takes a 5-bit binary number input (INDEX), representing a number from 0 to 31, and decodes it to assert one of 26 output lines (D). The circuit produces an error signal if the decoded input is greater than 25 (ERROR).

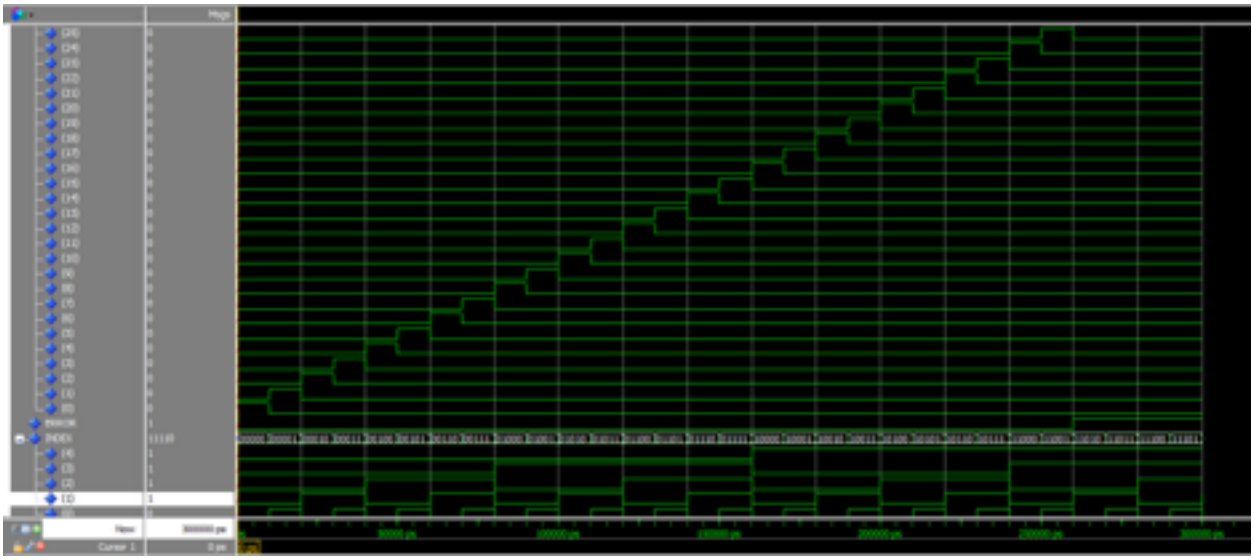
Input:
INDEX signal (5 bits) - binary number to be decoded

Output:
D signal (26 bits) - separate (decoded) output lines
ERROR signal (1 bit) - Error signal (for numbers outside of range)

Diagram:

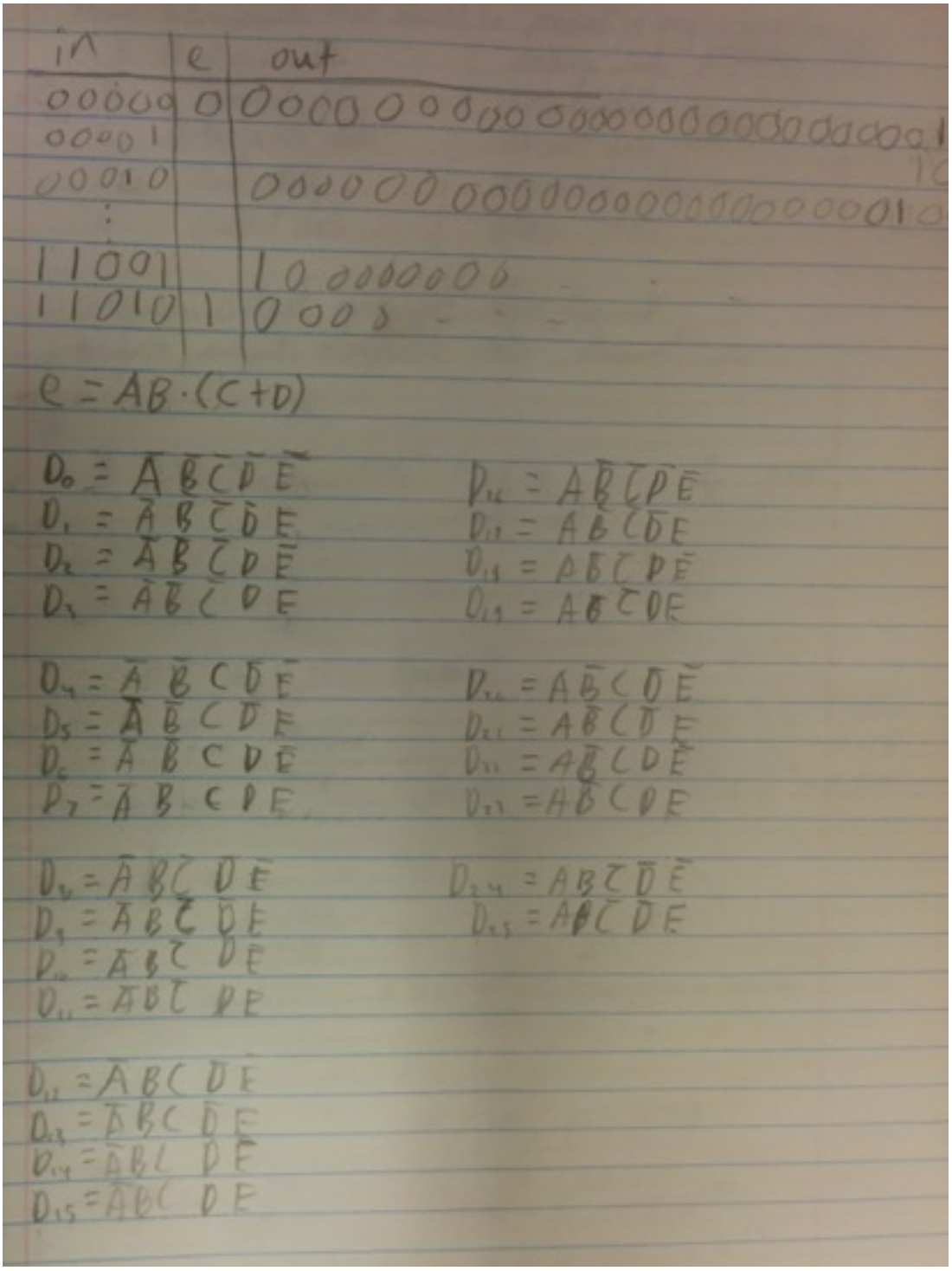
Schematic:

Testing:
In order to test our circuit, we used exhaustive testing by observing the output of every valid input. We know the circuit works correctly because, according to the image below, every input provides the desired output. That is to say that each decoded input value from 0 to 25 selects a one bit output from our signal D, and further values (to 31) drive our ERROR signal.



Appendix:

A (Boolean Equations):



in	e	out
00000	0	0000000000000000000000000001
00001		
00010		0000000000000000000000000010
⋮		
11001		10000000
11010	1	0000

$e = AB \cdot (C + D)$

$D_0 = \bar{A}\bar{B}\bar{C}\bar{D}\bar{E}$
$D_1 = \bar{A}\bar{B}\bar{C}\bar{D}E$
$D_2 = \bar{A}\bar{B}\bar{C}D\bar{E}$
$D_3 = \bar{A}\bar{B}\bar{C}DE$

$D_4 = \bar{A}\bar{B}C\bar{D}\bar{E}$
$D_5 = \bar{A}\bar{B}C\bar{D}E$
$D_6 = \bar{A}\bar{B}CD\bar{E}$
$D_7 = \bar{A}\bar{B}CDE$

$D_8 = \bar{A}B\bar{C}\bar{D}\bar{E}$
$D_9 = \bar{A}B\bar{C}\bar{D}E$
$D_{10} = \bar{A}B\bar{C}D\bar{E}$
$D_{11} = \bar{A}B\bar{C}DE$

$D_{12} = \bar{A}BC\bar{D}\bar{E}$
$D_{13} = \bar{A}BC\bar{D}E$
$D_{14} = \bar{A}BCD\bar{E}$
$D_{15} = \bar{A}BCDE$

$D_{16} = A\bar{B}\bar{C}\bar{D}\bar{E}$
$D_{17} = A\bar{B}\bar{C}\bar{D}E$
$D_{18} = A\bar{B}\bar{C}D\bar{E}$
$D_{19} = A\bar{B}\bar{C}DE$

$D_{20} = A\bar{B}C\bar{D}\bar{E}$
$D_{21} = A\bar{B}C\bar{D}E$
$D_{22} = A\bar{B}CD\bar{E}$
$D_{23} = A\bar{B}CDE$

$D_{24} = AB\bar{C}\bar{D}\bar{E}$
$D_{25} = AB\bar{C}\bar{D}E$

Gate Level Schematic Diagram: