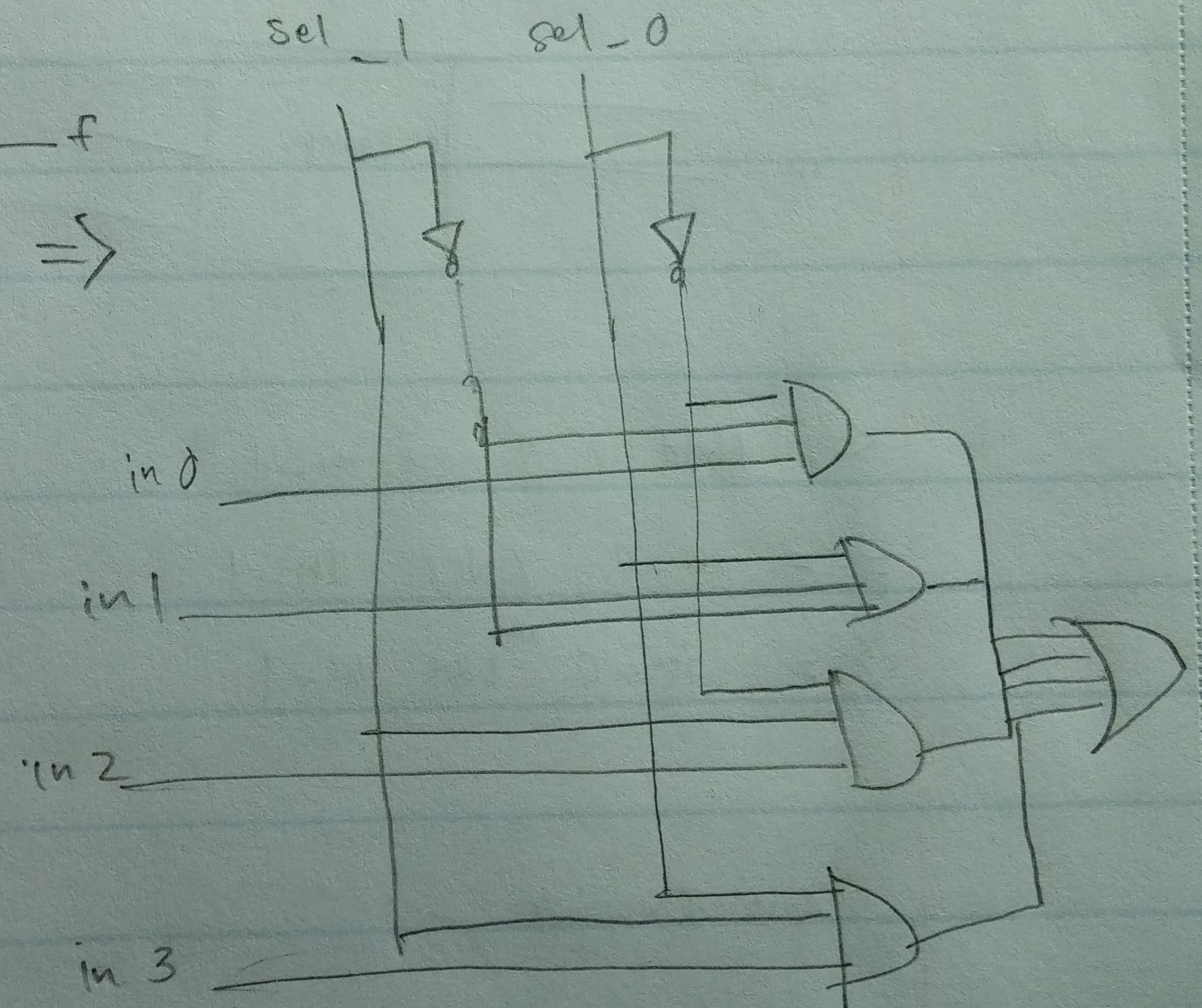
4-to-1 Multiplexer (MUX):

The 4-to-1 multiplexer is a circuit that takes in 4 inputs and sends a signal out depending on which select gate is switched on or off.

Gate Implementation:



Truth Table:

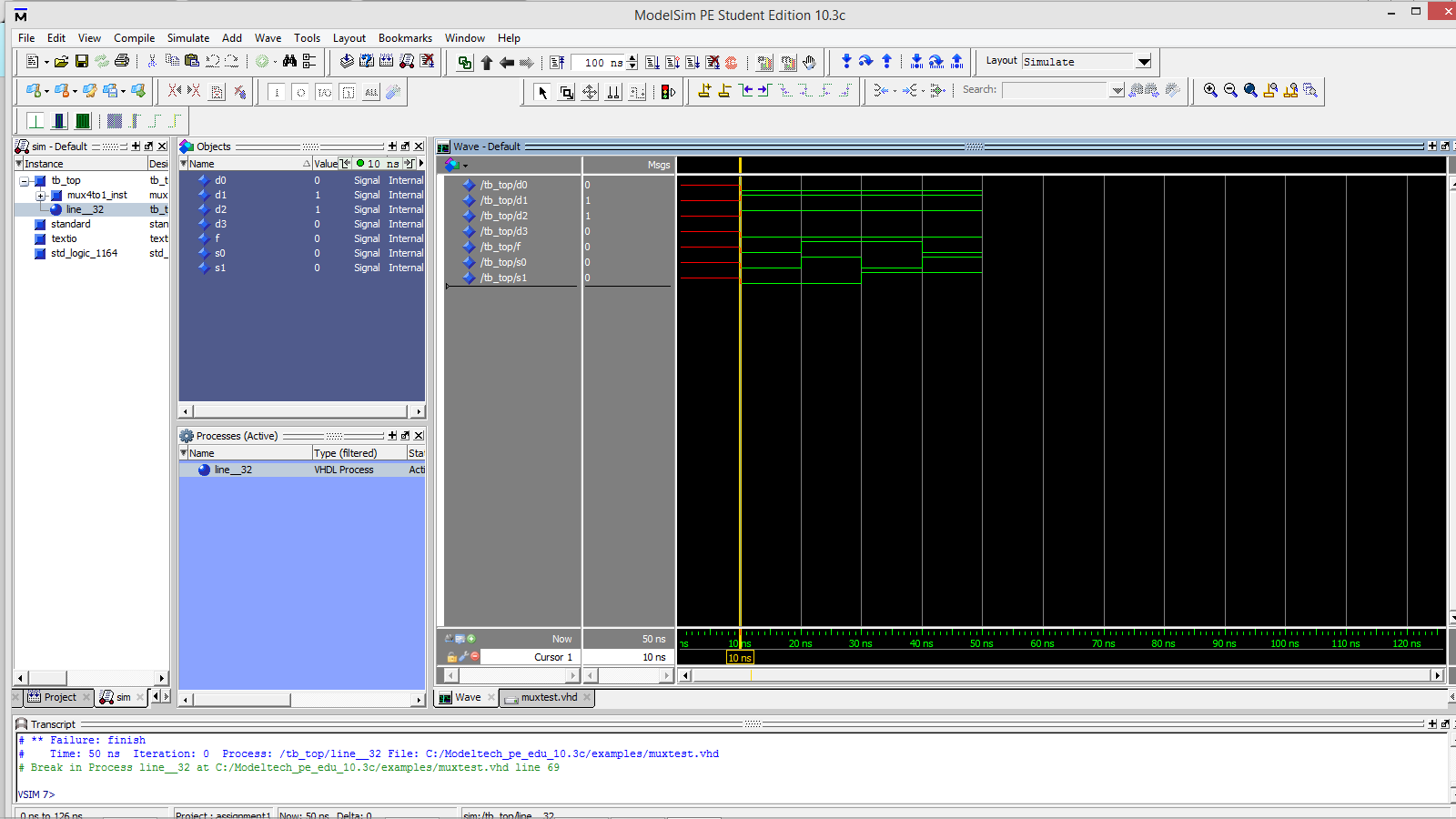
|  |  |  |
| --- | --- | --- |
| **Sel\_1** | **Sel\_0** | **f** |
| 0 | 0 | In\_0 |
| 0 | 1 | In\_1 |
| 1 | 0 | In\_2 |
| 1 | 1 | In\_3 |

K-Map; Boolean Expressions:

f = (in\_0\*sel\_0’\*sel\_1’) + (in\_1\*sel\_0’\*sel\_1) + (in\_2\*sel\_0sel\_1’) + (in\_3\*sel\_0\*sel\_1)

|  |  |  |
| --- | --- | --- |
| **Sel\_0**  **Sel\_1** | **0** | **1** |
| 0 | In\_0 | In\_1 |
| 1 | In\_2 | In\_3 |

Waveforms:



Full Adder/Subtractor :

The full adder and subtractor is a circuit that takes in 2 1-bit binary numbers and either add or subtract them depending on the signal which the circuit is designed to choose. In my circuit 0 is add and 1 is subtract. What makes a fuller adder and subtractor different from the half adder and subtractor is that in a full adder and subtractor, carry ins and carry outs are taken in consideration during the mathematical process.

Gate Implementation:

Full Adder Gate:



Full Subtractor Gate:



Truth Table :

Adder



Subtractor



K-Map

Sum:



Adder cout



Subtractor cout



Boolean Equations:

Full Adder:

Sum = in\_0 xor in\_1 xor cin

Cout = (in\_0\*in\_1) + (in\_0\*cin) + (in\_1 \*cin)

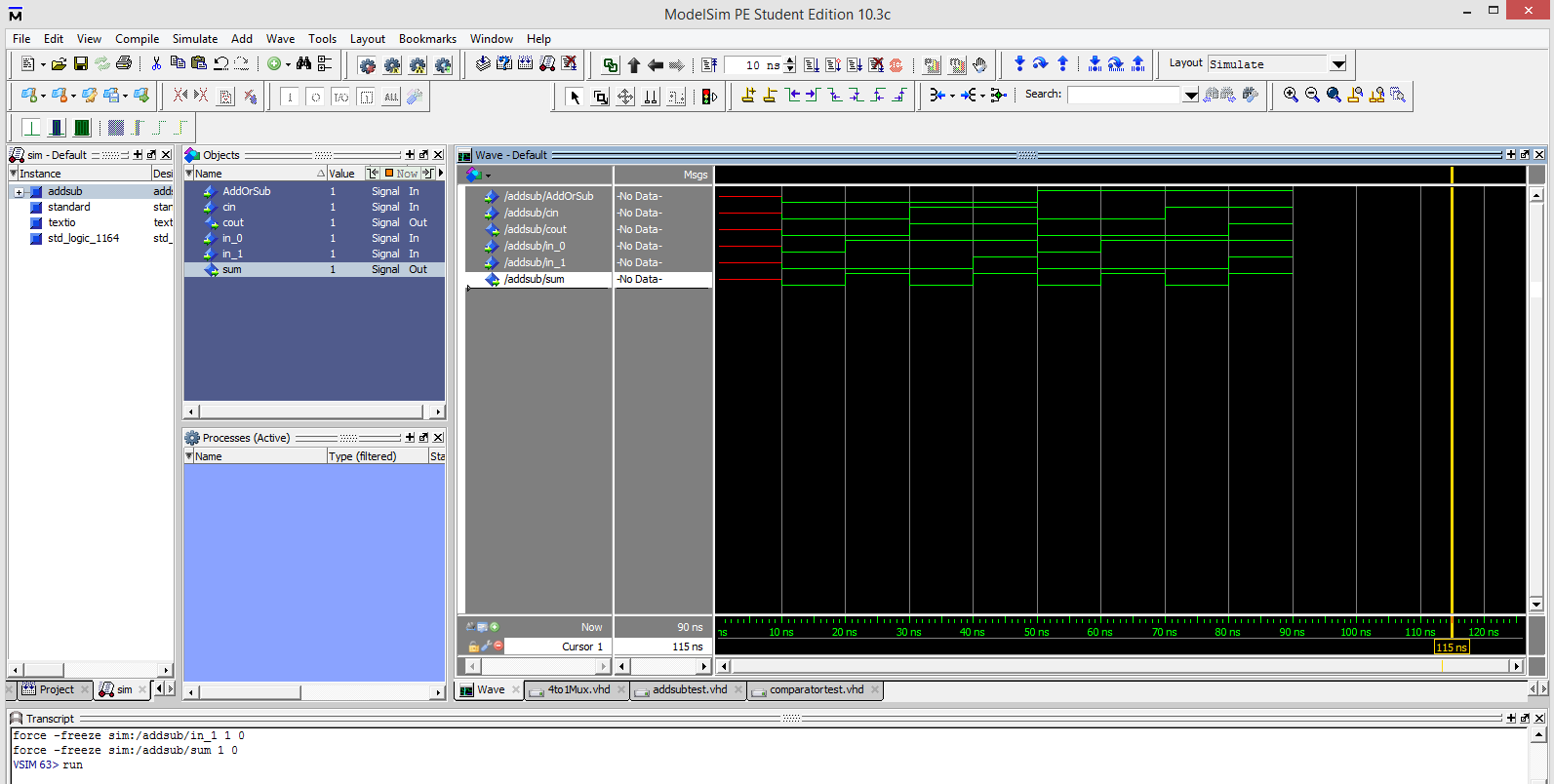
Full Subtractor:

Sum = in\_0 xor in\_1 xor cin

Cout = (in\_0’ \* in\_1) + (in\_0’ \* cin) + (in\_1 \* cin)

Wave map:

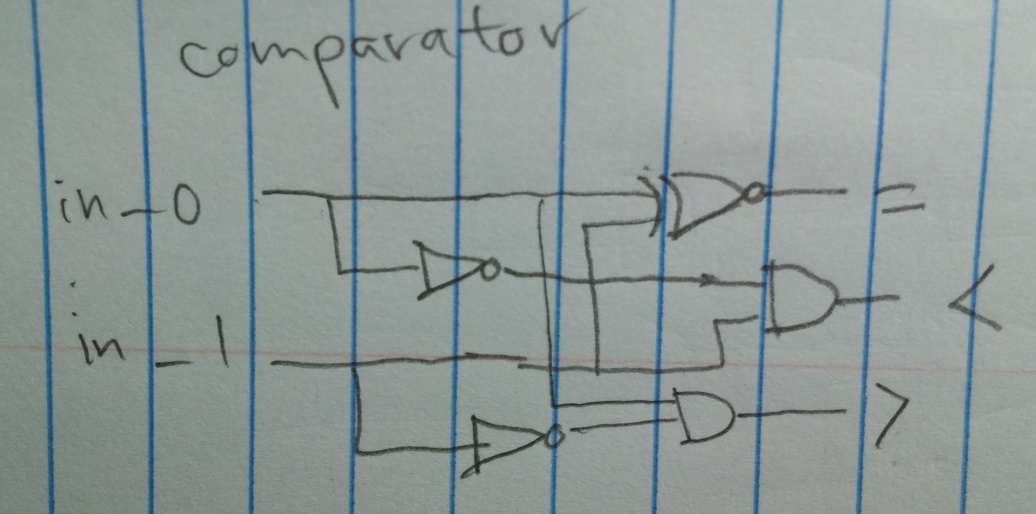
:



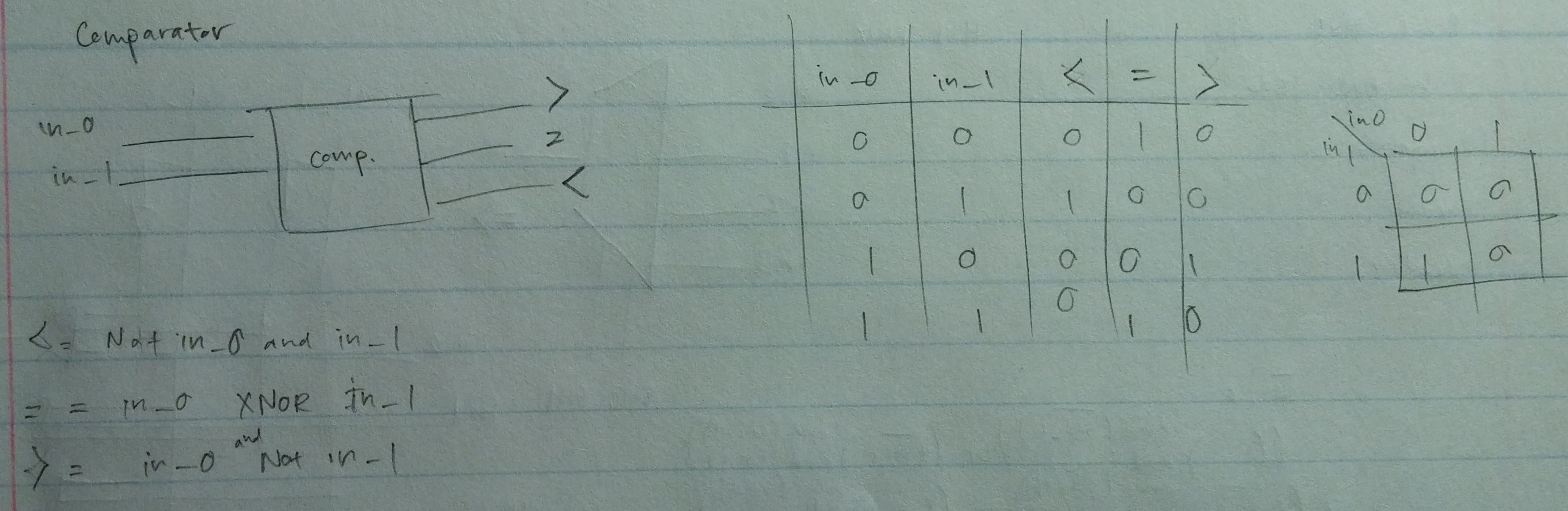
Comparator:

The comparator is a circuit that compares two 1-bit numbers and sends a signal through the gate corresponding to whether the 1st bit is either greater than, equal to, or less than the 2nd bit.

Gate Implementation:

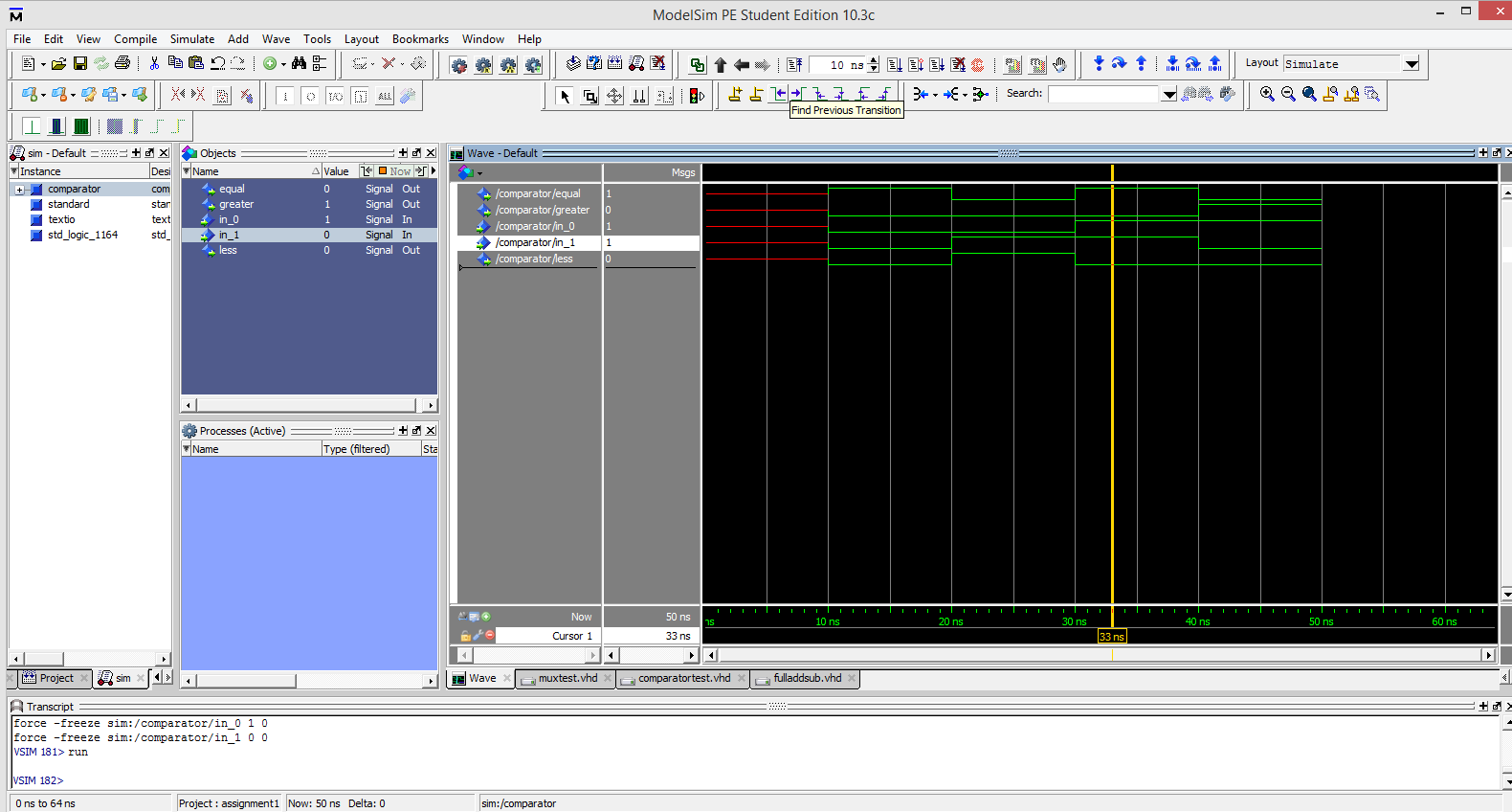


Gate Truth Table K-Map



Boolean Equations

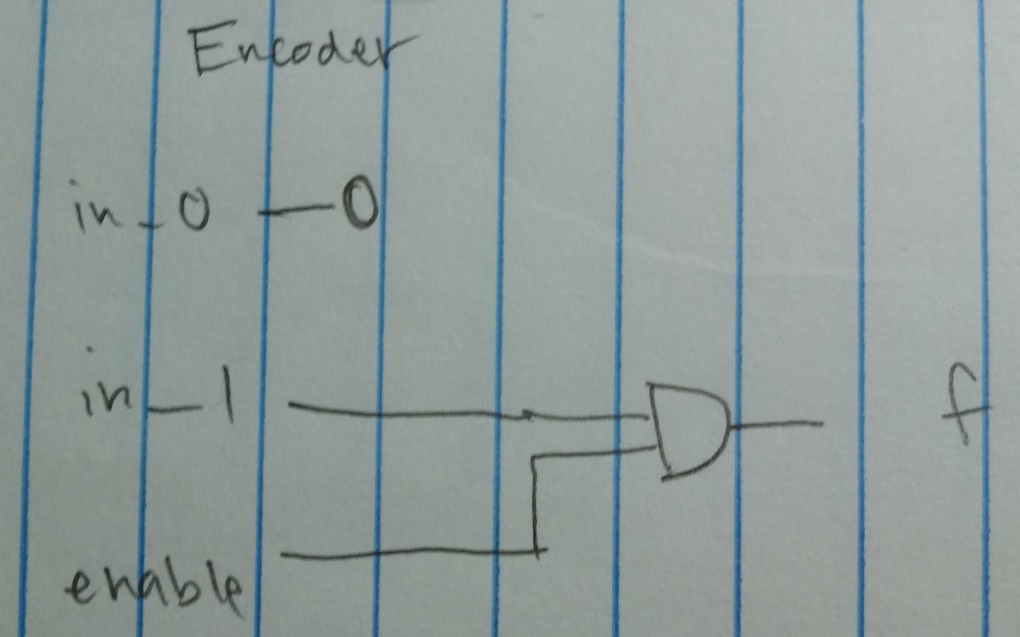
Wave Map:



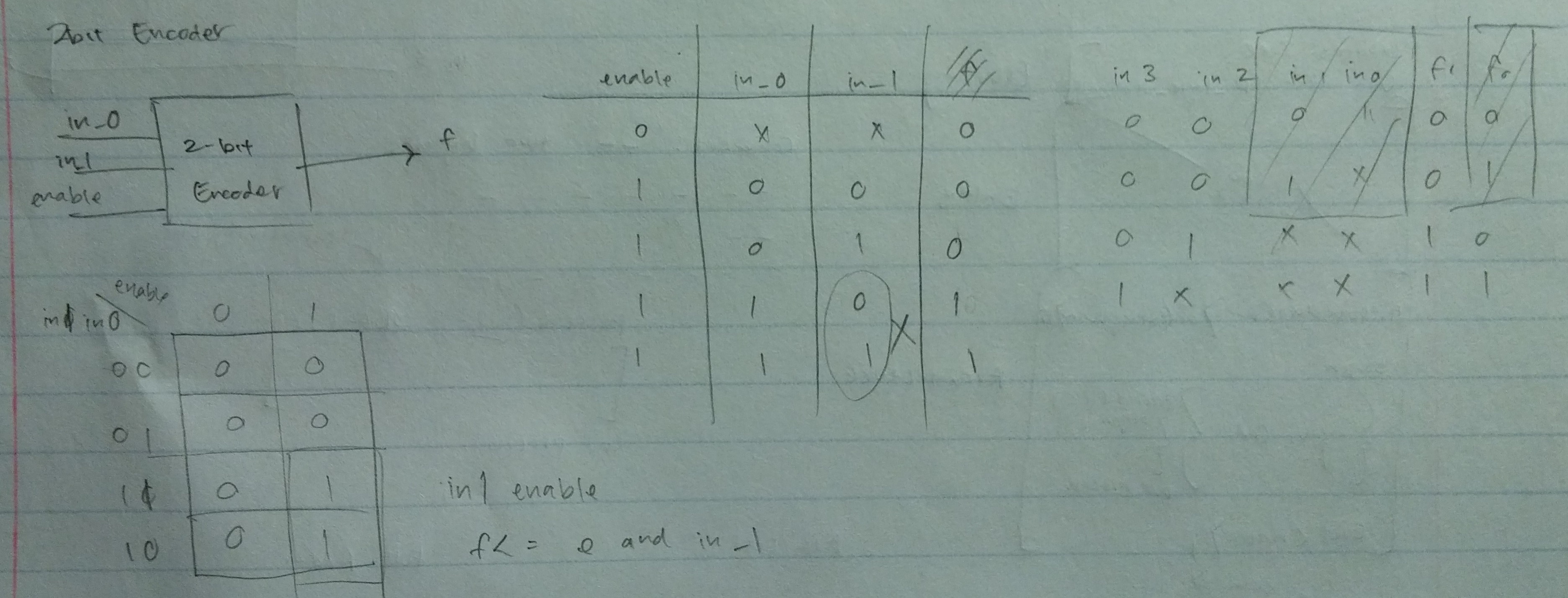
Encoder:

The encoder is a circuit that takes in a decimal number and transcribes it into a binary number.

Gate Implementation:

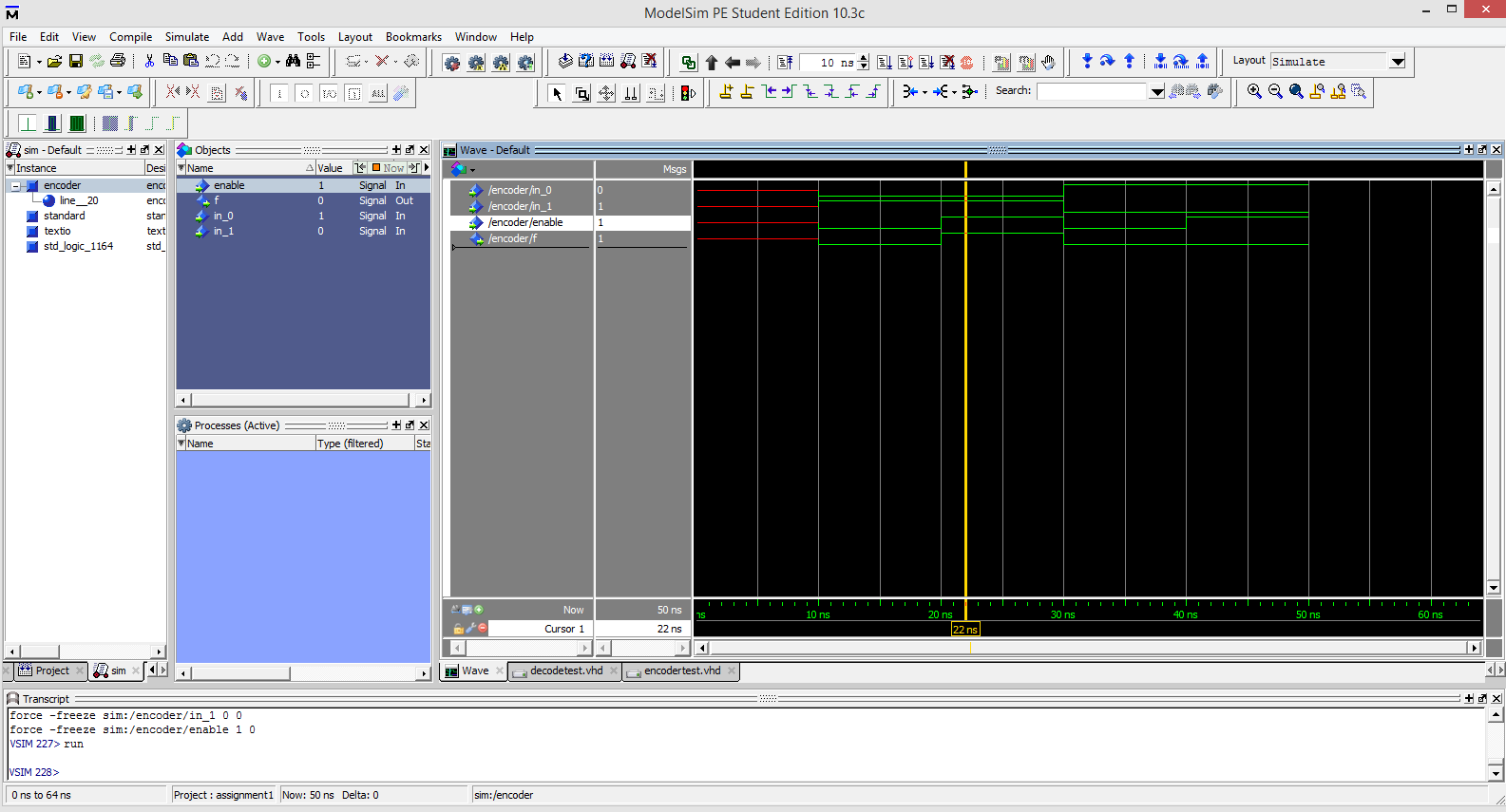


Gate Truth Table



K- Map Boolean Equation

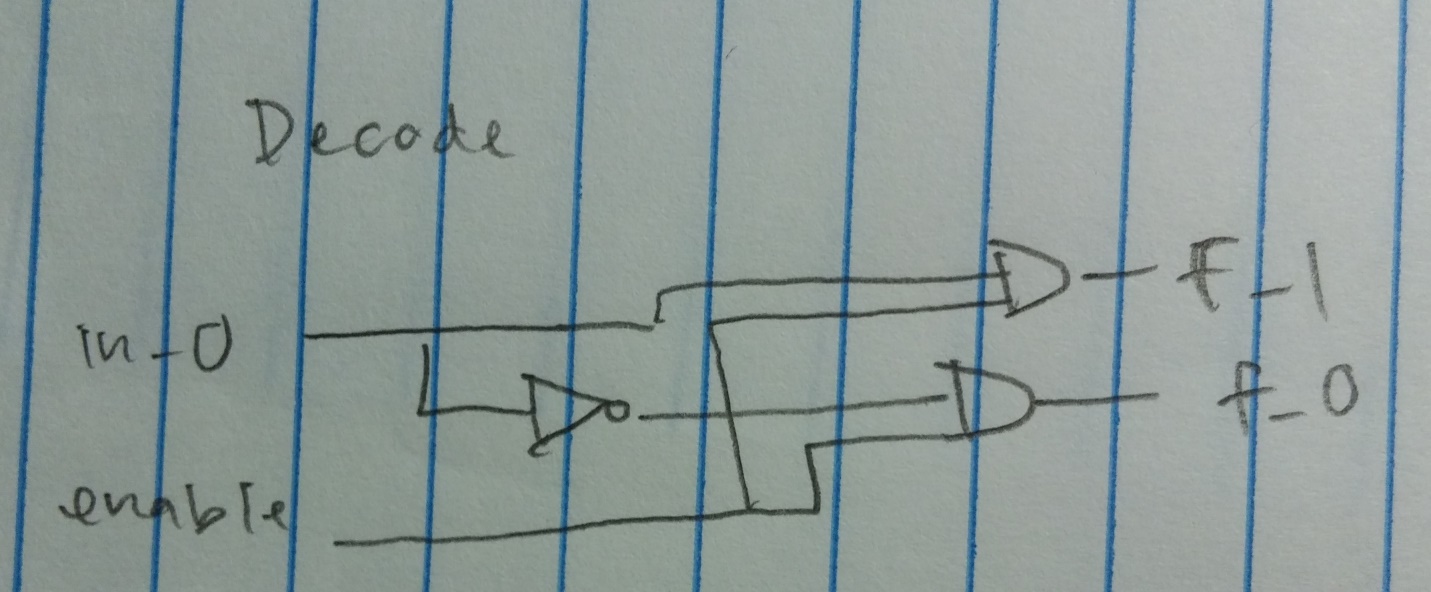
Wave Map:



Decoder:

The decoder is a circuit that takes a binary number and transcribes it into a decimal number, It is the opposite of an encoder.

Gate Implementation:



Gate Truth Table



K- Map Boolean Equation

Wave Map:

