Digital Systems Design
ECSE 323
Lab Report 1 16-4 Encoder

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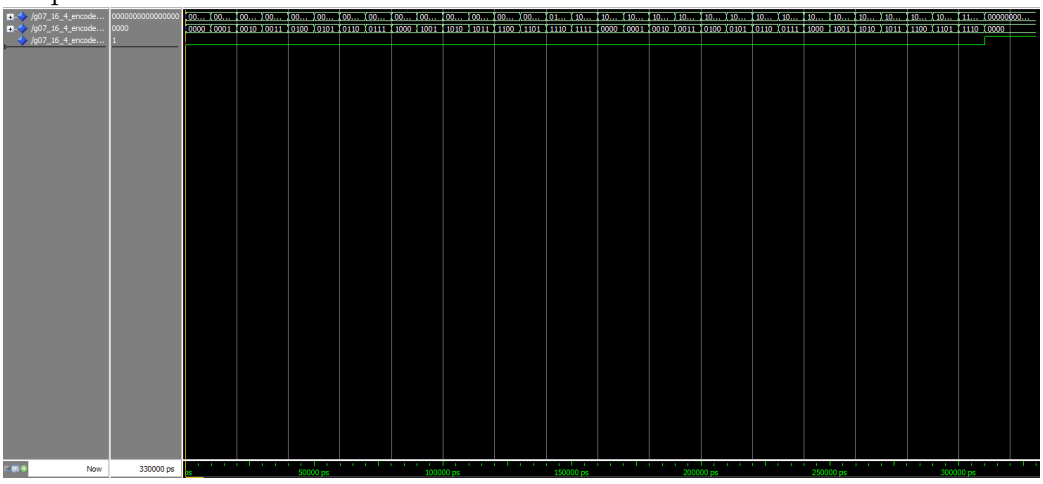
1 Circuit Explanation

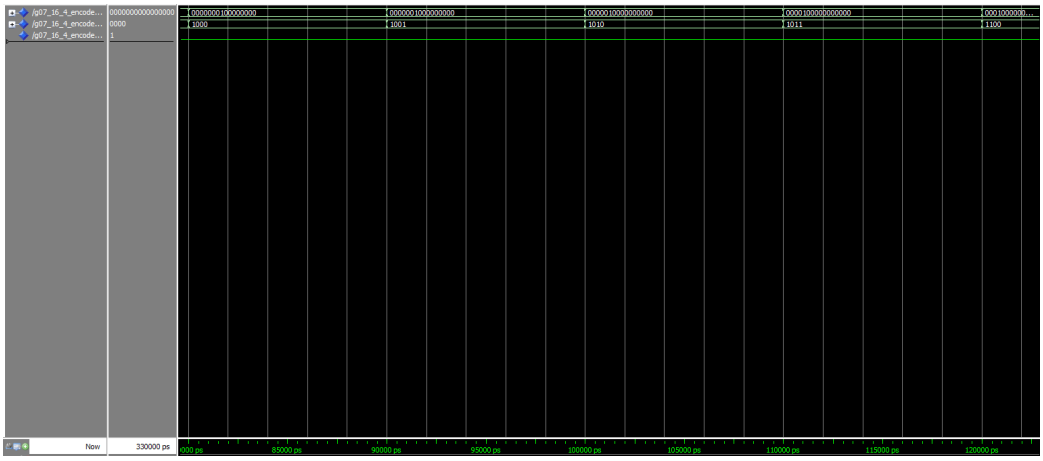
A 16:4 Encoder circuit has been used for this lab. The encoder circuit is consisted of 16 input ports and 5 output ports. The purpose of the encoder is to get the number of low input bits from 16 bit input until the first high bit appears. 4 outputs represents the number of low inputs until the first high input named CODE, and the one remaining input represents ERROR which is high when none of the input bit is high. Since we have 16 bit inputs, there are $2^{16} = 65534$ possible combinations and CODE is in range of 0 to 15.

2 Circuit Validation

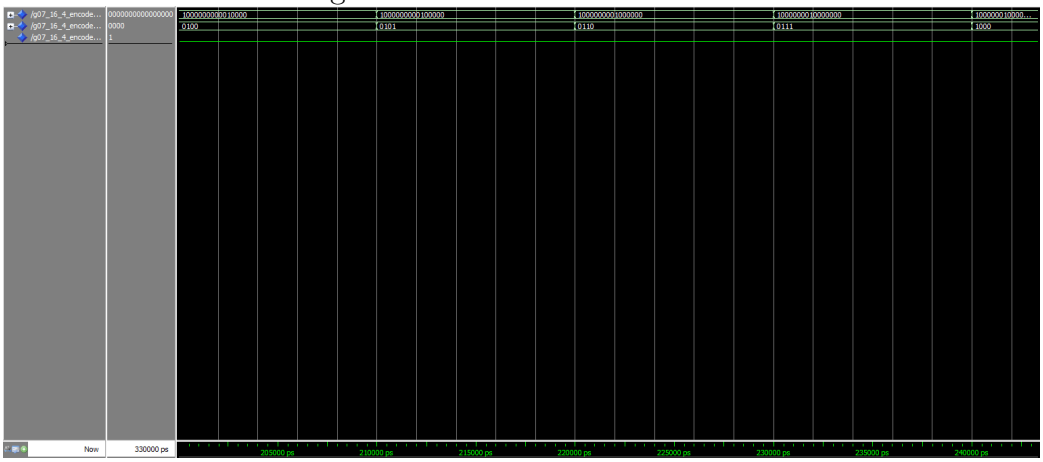
Two scripts were written to test the circuit. The first covered each of the simple cases:



With a single high bit:



The error case, where all bits were low, and then a set of more complex cases, where there were two high bits:



Because the code for the circuit should function regardless of the number of extra high bits, testing with one extra was assumed to cover all such cases. To double check, an exhaustive case was written, which generated all possible outputs. This was also run, and various points were inspected. Those were the cases from the limited test (to ensure matching results), other points, such as having all 1's except the 16th bit, and all 0's but the 16th bit, were checked to verify that the circuit was correctly handling the multiple-high cases.