ECE 370: Digital Systems-Logic Design

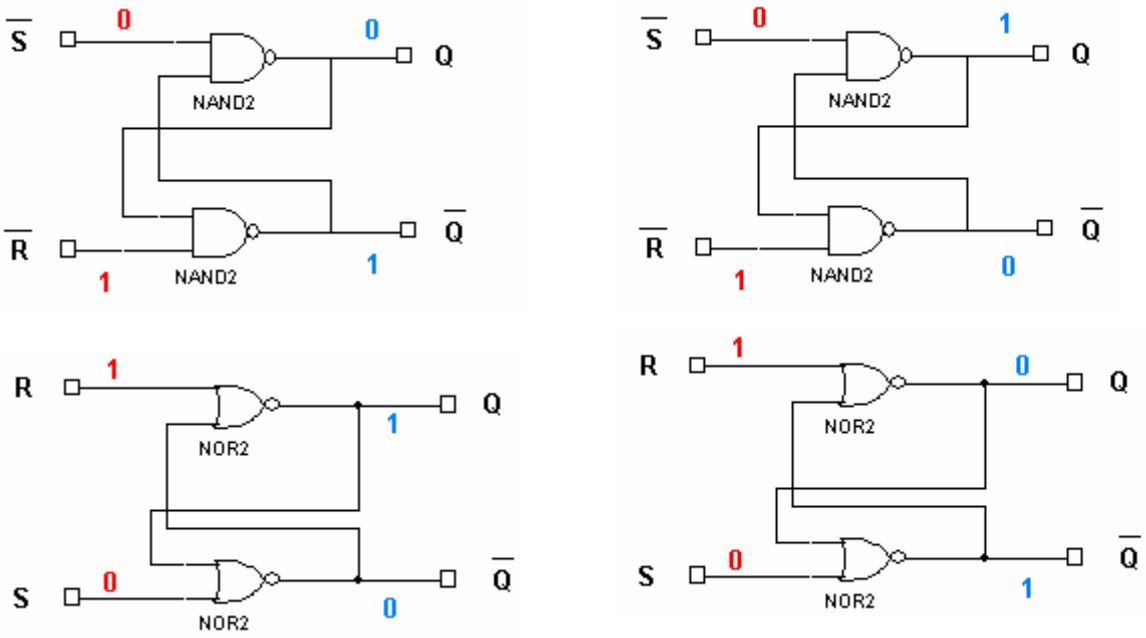
Sample Test: Chapter 7-Part 1: S-R and D Latches
Spring 2005

S-R Latches

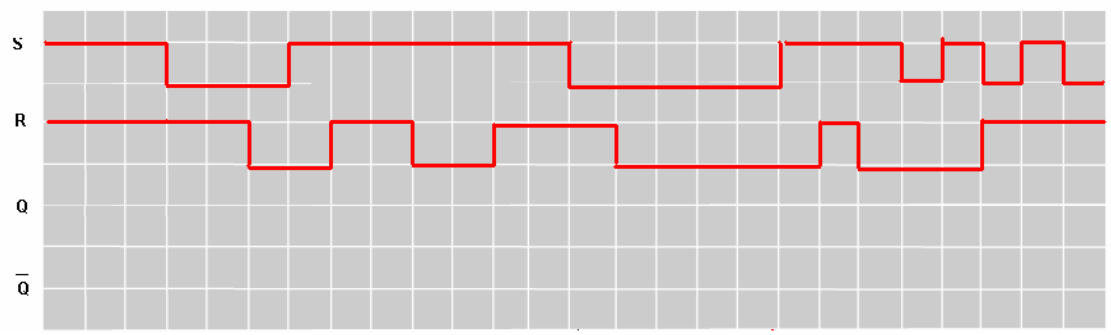
1. Describe, in detail, what an S-R Latch is and, how it functions, and generally what it is used for.

2. What are the similarities and differences between a NAND and NOR latch n terms of operation and logic-gate implementation? *Hint: Be sure to use their truth tables as a means of comparison.*

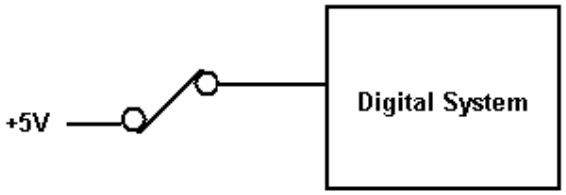
3. For the following S-R NAND and NOR Latches, what are the *next* values (states) of each circuit?



6. Given the following input waveforms to an S-R Latch, what are the output waveforms for the *Q* outputs assuming the initial state of the output is *Q = 0*.



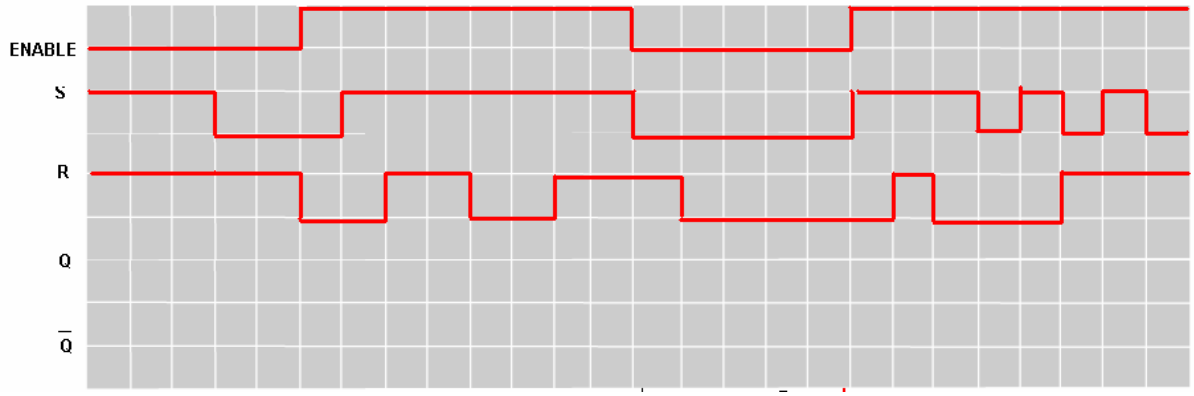
7. Mechanical switches, or push buttons, found on electrical equipment, oscillate when they are "switched" ON or OFF, causing voltage and current oscillations in a system. This is because the switch "bounces" around, somewhat like a spring, when it switches over from one position to another. Show how to use a S-R Latch to "eliminate" the "bouncing" performed by the switch below.



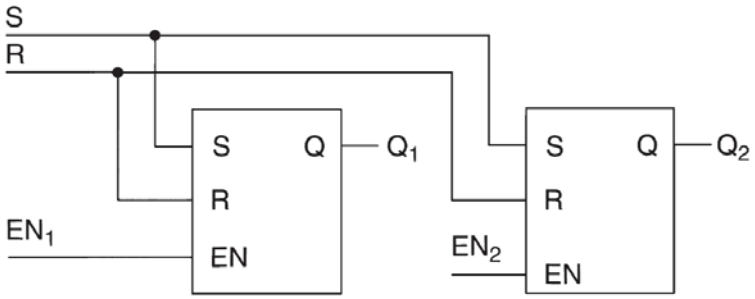
Gated S-R Latches

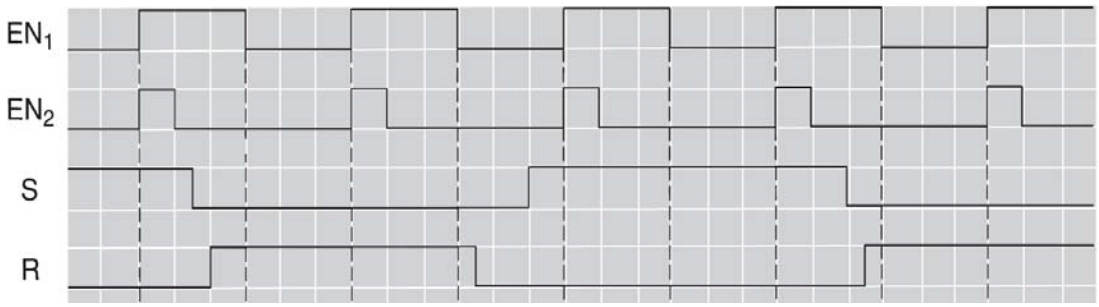
8. What is the difference between a gated S-R latch and non-gated S-R Latch? Show a detailed schematic of how to "*add*" to the gate level implementation of an active high S-R latch to make it a gated S-R Latch.

9. Given the following waveforms as inputs to an S-R Latch, draw the waveforms for *Q* outputs assuming that the initial state of the S-R Latch is *Q=0*.



10. Given the following two latches sharing the same *SET and RESET* inputs, but two *ENABLE* inputs, draw the output waveforms for Q_1 and Q_2. Describe how the length of each enable input affects the output of each latch, assuming that the goal of each circuit is to synchronize the output changes to the beginning of the input pulse.



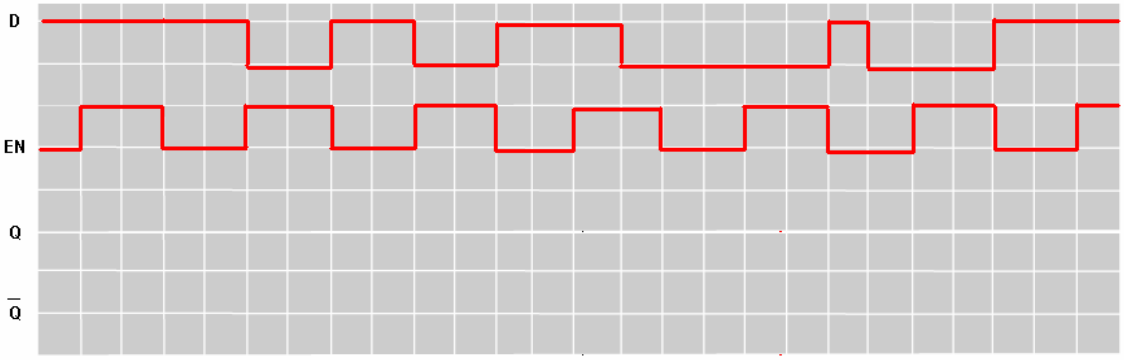


Transparent (Data) Latches

11. What is the difference between a D Latch and a S-R Latch? How does a D Latch improve on the design of an S-R Latch?

12. Show how to implement a D Latch, gated or un-gated, using an S-R Latch.

13. Given the following input waveforms to a gated D-Latch, draw the output waveforms for Q assuming that the initial $Q = 0$.

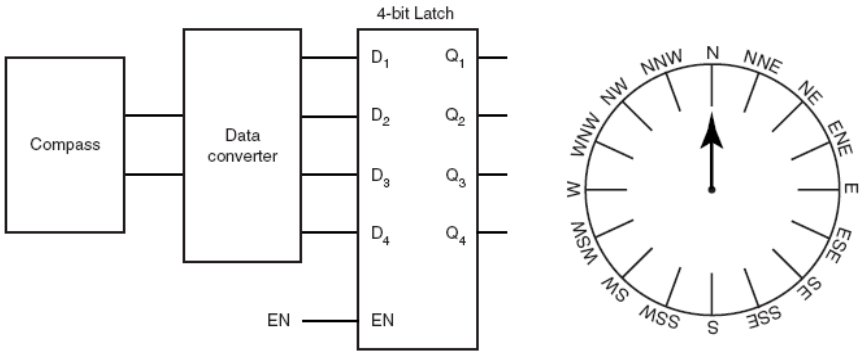


14. An electronic direction finder aboard an aircraft uses a 4-bit binary number to distinguish between 16 different compass points as follows:

Direction	N	NNE	NE	ENE	E	ESE	SE	SSE
Code	0000	0001	0011	0010	0110	0111	0101	0100

Direction	S	SSW	SW	WSW	W	WNW	NW	NNW
Code	110	1101	1111	1110	1010	1011	1001	1000

The output of the direction finder is stored in a 4-bit D-Latch so that the flight path can be logged by a computer system. The latch is periodically updated by a pulse-like enable input. The diagram of the system is shown below.



Given the following waveforms for the system based on the compass and data converter, what are the output waveforms for the *Q* outputs? Sketch a rough path that the aircraft took based on the output waveforms.