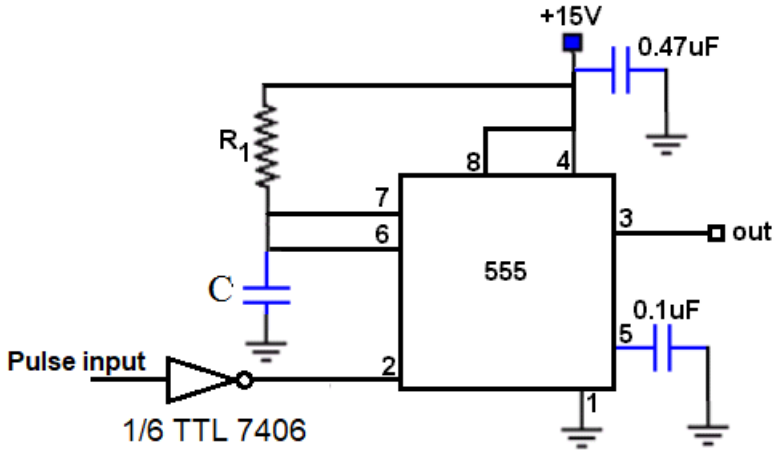
Electronics

One shot with a 555 chip

Problem 1.- In an application for a soda expending machine you need that a valve to open for 2.25s each time a *positive* pulse is received. Design a circuit that takes the input signal and produces a TTL output that will control the relay for the valve.

Solution: One solution is to use the 555 chip in the mono-stable configuration (one-shot) but after inverting the pulse to make it a negative one. We select the capacitor and resistance to obtain the 2.25 seconds.



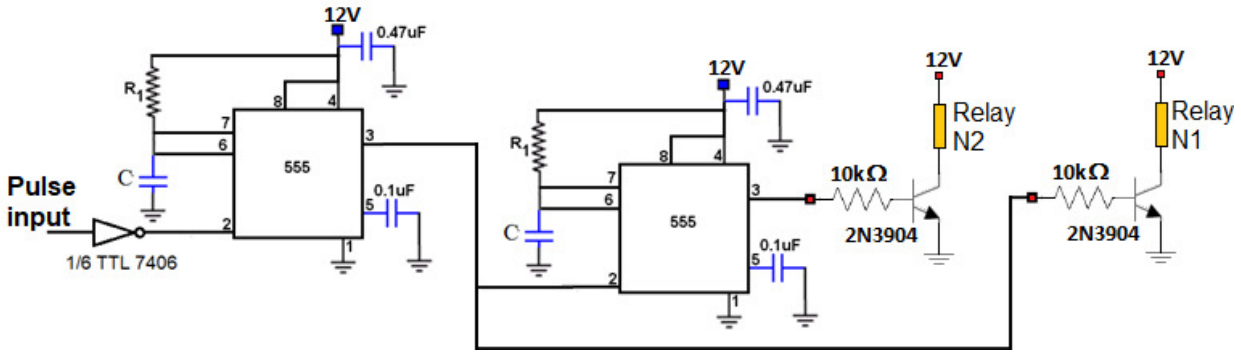
The values should be such that

$$2.25s = \ln(3)R_1C$$

For example 47μF and 43kohm.

Problem 2.- Consider the following application for a potato chips bagging device: When pressing a button, relay N1 (filling) has to be on for 1s and after it turns off, relay N2 (sealing) also turn on for 1s.
Design a circuit that follows that sequence. The relays require 40mA at 12V.

Solution: There are multiple possible solutions to this problem. Here is one idea: Two "one-shot" circuits of 1 second each, where the first one triggers the second.



To obtain the required time we need:

$$T = \ln(3) R_1 C \rightarrow R_1 C = 0.91 s$$

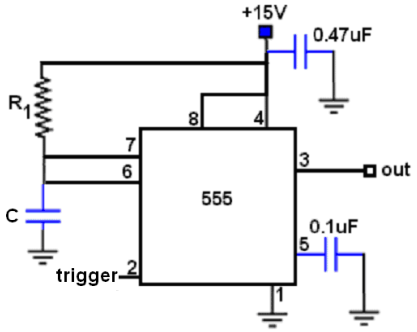
This could be done with 100μF and 9.1kΩ.
Notice that the relays take their current from the collector of 2N3904 transistors, which are taken to saturation by the 555 chips outputs.

Problem 3.- Design a circuit that triggers a 10ms output when receiving a short input pulse

Problem 4.- In a coffee expending machine it is required that when pressing a button, a valve is open for 10 seconds (to let coffee fill a cup) and another valve for two seconds (to add the cream). Design a circuit with this behavior. The output can be relays or open collectors that can handle 40mA.

Problem 5.- In a safety device in a re-tiring factory, a motor needs to be reversed in an emergency when a security bar is pressed. To do this you need to design a circuit that, when a pulse is received the output should be on for three seconds regardless of the width of the input pulse.

Solution: The solution can be done using the chip 555 in a one-shot configuration as shown below:



After a pulse is received at pin 2, the output turns on during a time given by:

$$t_{width} = R_1 C \ln(3) = 1.1 R_1 C$$

If we need a pulse width of 3s we can select C=4.7μF and

$$R_1 = \frac{t_{width}}{C\ln(3)} = \frac{3s}{1.1(4.7\times10^{-6}F)} = 580\text{k}\Omega$$

A commercial value close to this is 560kΩ.

Problem 5a.- Design a one-shot circuit with a width of 50ms. Sketch the circuit and select the values of the components.

Solution: The following circuit behaves as a one-shot with a width of

$$t_{width} = R_1 C\ln(3) = 1.1R_1C$$

If we want 50ms we can select C = 1μF and $R_1 = \frac{t_{width}}{C\ln(3)} = \frac{50\times10^{-3}s}{1.1(1\times10^{-6}F)} = 45\text{k}\Omega$