X330994

UNIVERISTY OF NORTH CAROLINA AT CHARLOTTE

Department of Electrical Engineering

Experiment No._____ Mechanical Switch De-bouncing in Digital Applications

INTRODUCTION

Pulse generation and processing in logic circuits is nearly as basic as combinational logic. An ideal pulse waveform is shown in Figure 1. Figure 2 indicates what may happen when an attempt is made to produce such a pulse with a mechanical switch. The purpose of this experiment is to investigate the bouncing effect of several different types of mechanical switches and to examine various ways of de-bouncing them.

PRELIMINARY

P-1. Obtain the manufacturer's specification for the following TTL logic devices:

7400 - Quad Two-input NAND Gates

VCCmax = 5.25

TA (Range) = 0 - 70 degree C

Fanout
- Input High/Low 40 / -- 1.6 mA
- Output High/Low -- 0.4 / 16

Power Supply Current
- VIN Grounded = 8 mA
- VIN Open = 22 mA

Propagation Delay
- tpLH = 11 & 22ns max
- tpHL = 7 & 15 ns max

Pinout: (Sketch for "P"):

LM555 Timer

VCCmax = 18 V

VCCmin = 4.5 V

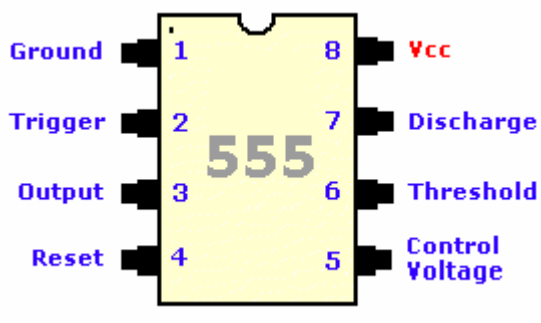
TA (Range) = 0 – 70°C

Output :
Isink = 8mA – 85mA
Isource = 100 Ma

Rise Time of Output = 100 nS

Fall Time of Output = 100 Ns

Pinout (Sketch)



Other Pertinent Information:

7493 - Four-bit Binary Counter

VCCmax = 5.25

TA (Range) = 0 to 70 deg C

Fanout | Output High/Low -- 800 / 16 uA

Power Supply Current Max = 39 mA

Maximum Count Frequency | $\overline{CP_0}$ Input = 0 to 32 Hz

$\overline{CP_1}$ Input = 0 to 16 Hz

MODE SELECTION

Reset Inputs		Outputs			
MR1	MR2	Q0	Q2	Q3	Q4
H	H	L	L	L	L
L	X	C	0		
X	L	C	0		

Pinout (Sketch): refer IC manual

Other pertinent information:

Instructor's Signature_____ Date_____

PROCEDURE

F-1. Connect the circuit of Figure 3 using first a push-button, normally-open switch and then a toggle switch. Connect the output of the circuit to both the vertical and external trigger input of an oscilloscope. Adjust the oscilloscope to trigger on the falling edge of the waveform. Observe the output waveform, estimating the time it takes for the waveform to stabilize (this takes a bit of patience since the sweeprate must be carefully adjusted so as to view the bounces).Repeat a number of times for each switch.

F-2. Now obtain an actual count of the number of bounces observed in F-1 above by connecting the output of the circuit in Figure3 to a cascade of 7493 binary counters (whatever is needed to get an accurate count).Cycle the switches several times making sure the counters are reset before each cycle.

F-3. Connect a capacitor from the output of the circuit in Figure 3 to ground.Again cycle the switches increasing the value of the capacitance if necessary until no bouncing is observed. Note the value of the capacitor and also sketch the output waveform.

F-4. Connect the circuit in Figure 4. Make R and C such that the one-shot time period is at least as long as the maximum switch settling time. Again cycle the switches, sketching the output waveform and noting if any bouncing is occurring.

REPORT

R-1. Make the following observations from F-1 and F-2 above:

a. Are the number of bounces observed essentially constant?
b. Does the bounce period stay essentially constant?

R-2. What size capacitance is needed in F-3 above to “de-bounce” the switch? Discuss what is happening.

R-3. Discuss the output waveforms observed in F-3 and F-4

R-4. Discuss the operation of the circuit of F-4

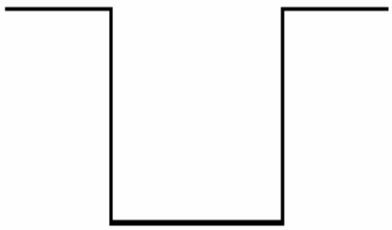


Figure 1.

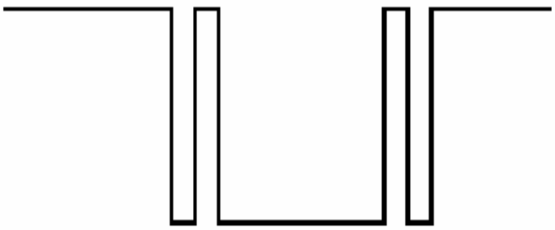


Figure 2.

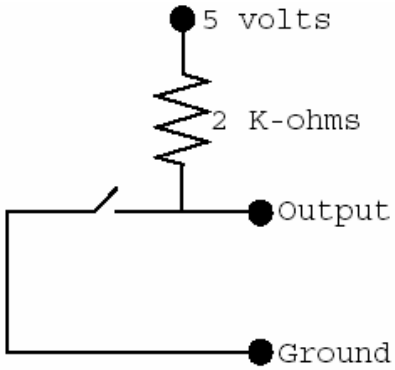


Figure 3.

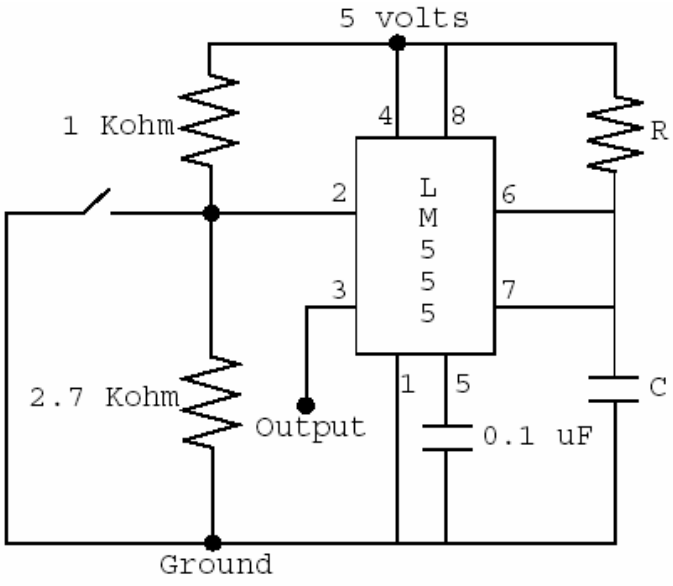


Figure 4.