신입생을 위한 10진 카운터

2016/03/04

로보틱스 22기 김신희

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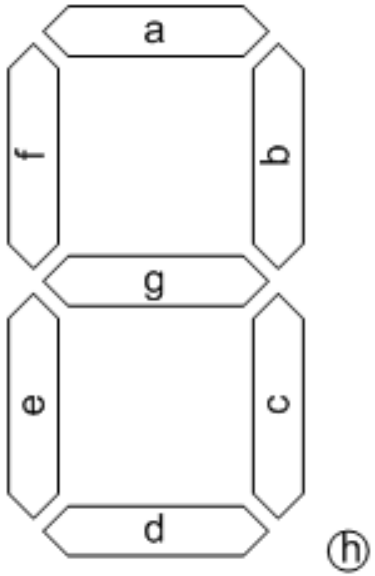
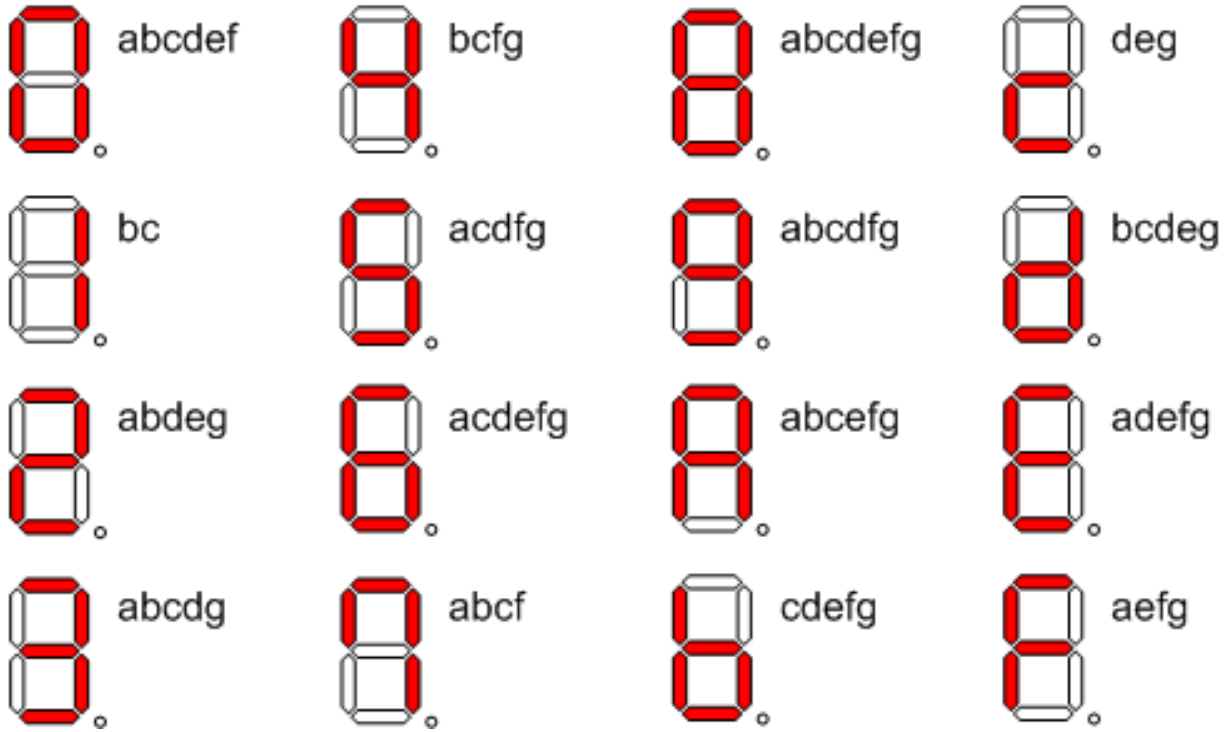
10진 카운터란?

https://www.youtube.com/watch?v=ekO-UJFuc1o

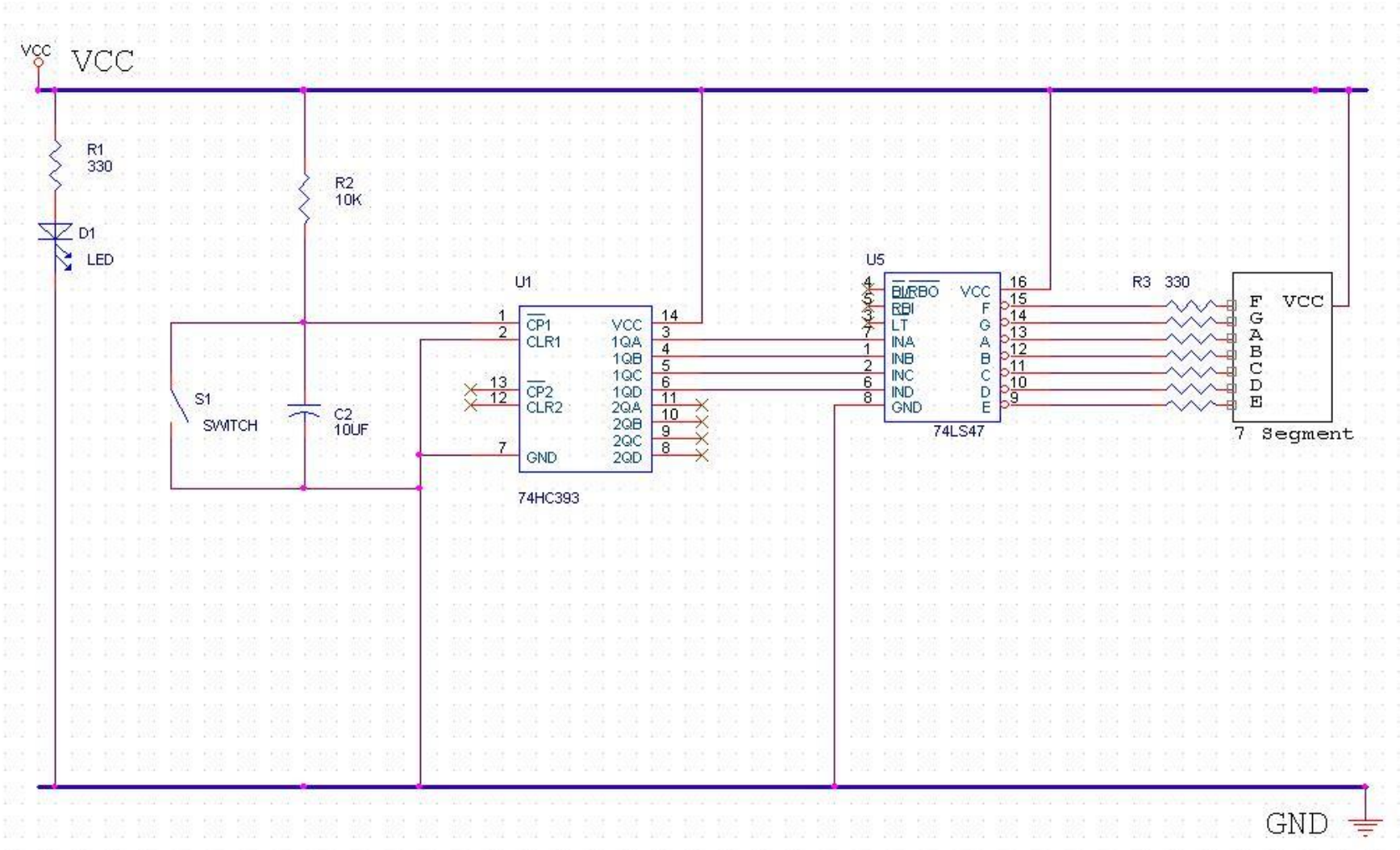
10진 카운터란?



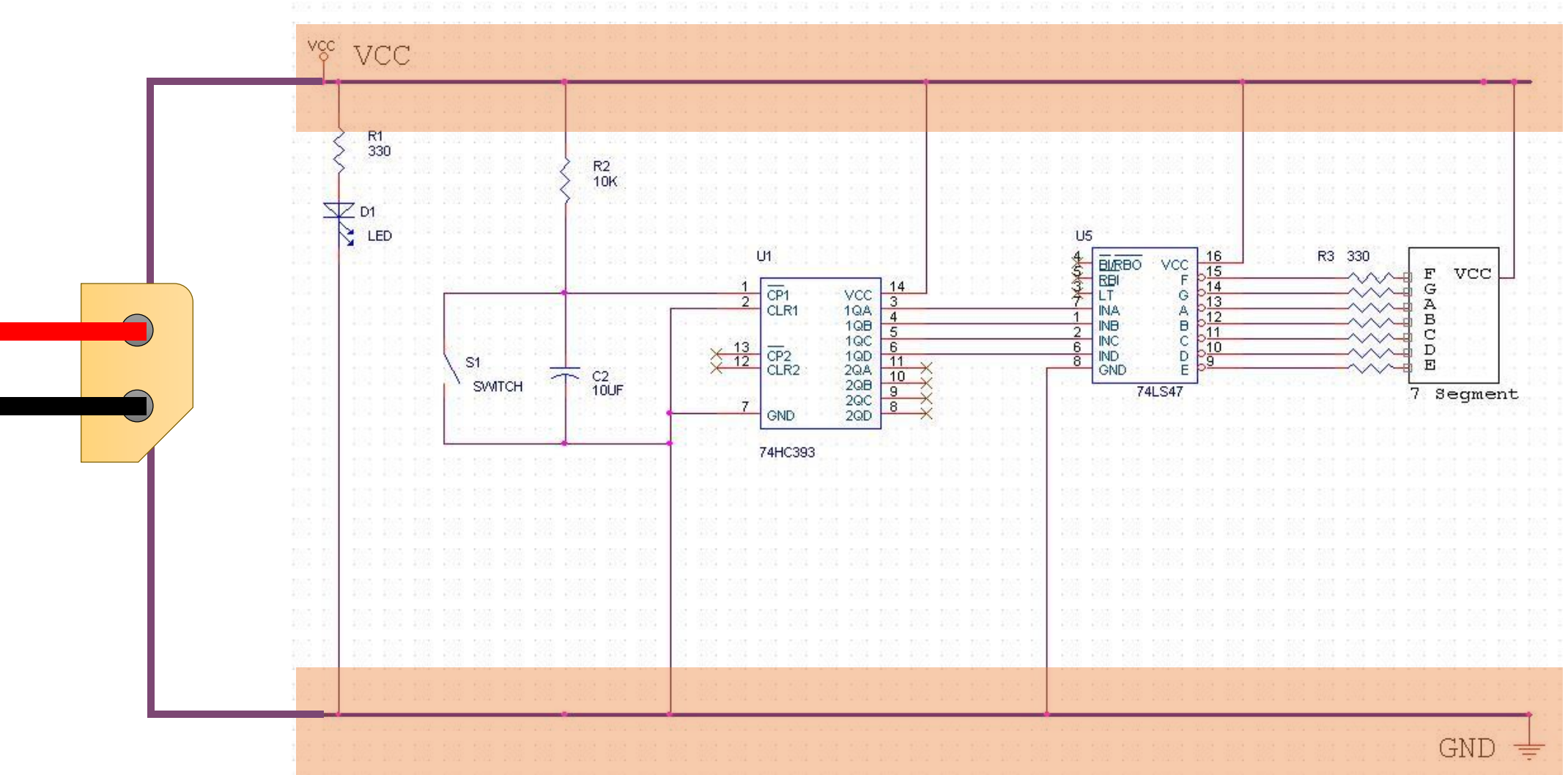


사실 로틱에서 만드는건 16진 카운터다.

기본 배경 지식_회로 보는 법



기본 배경 지식_회로 보는 법



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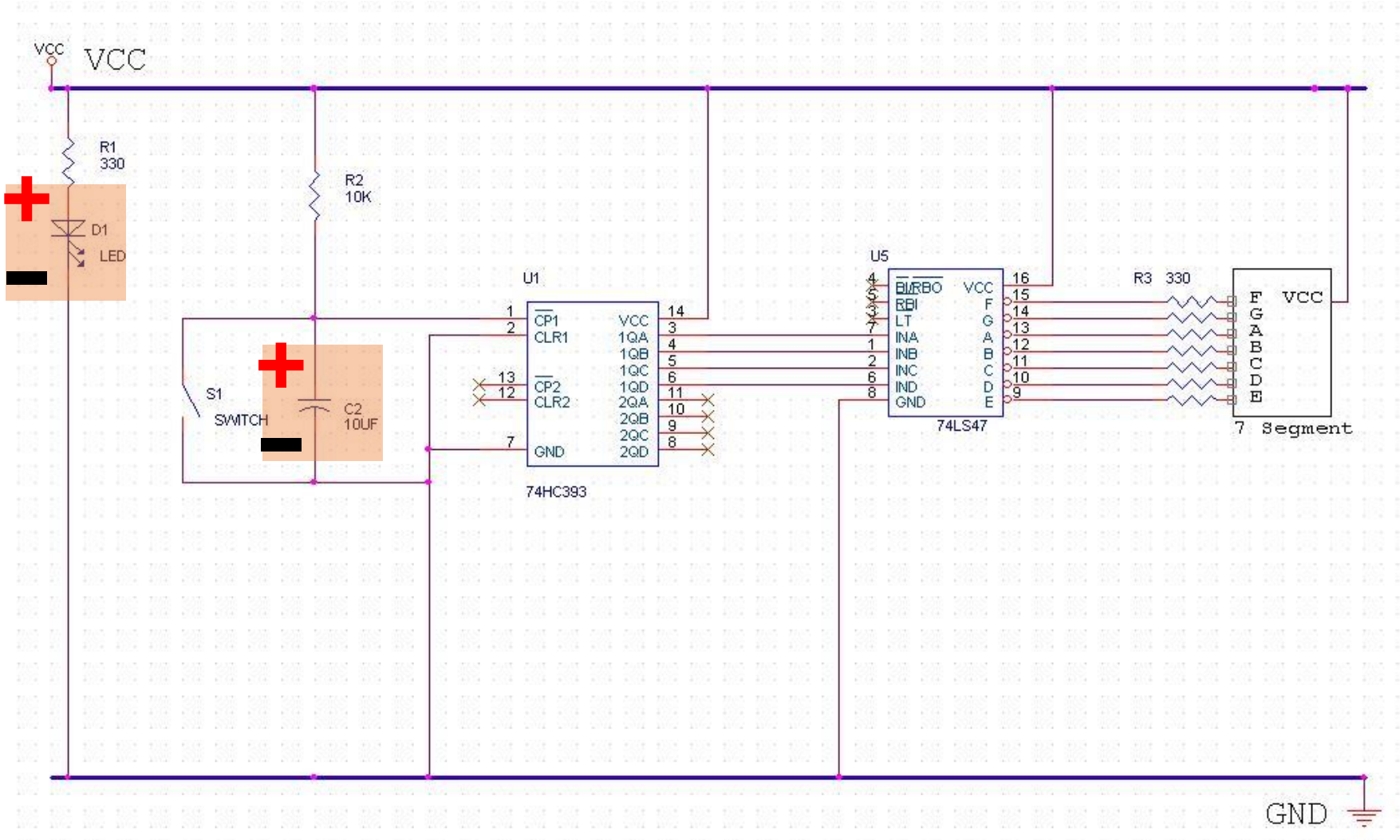

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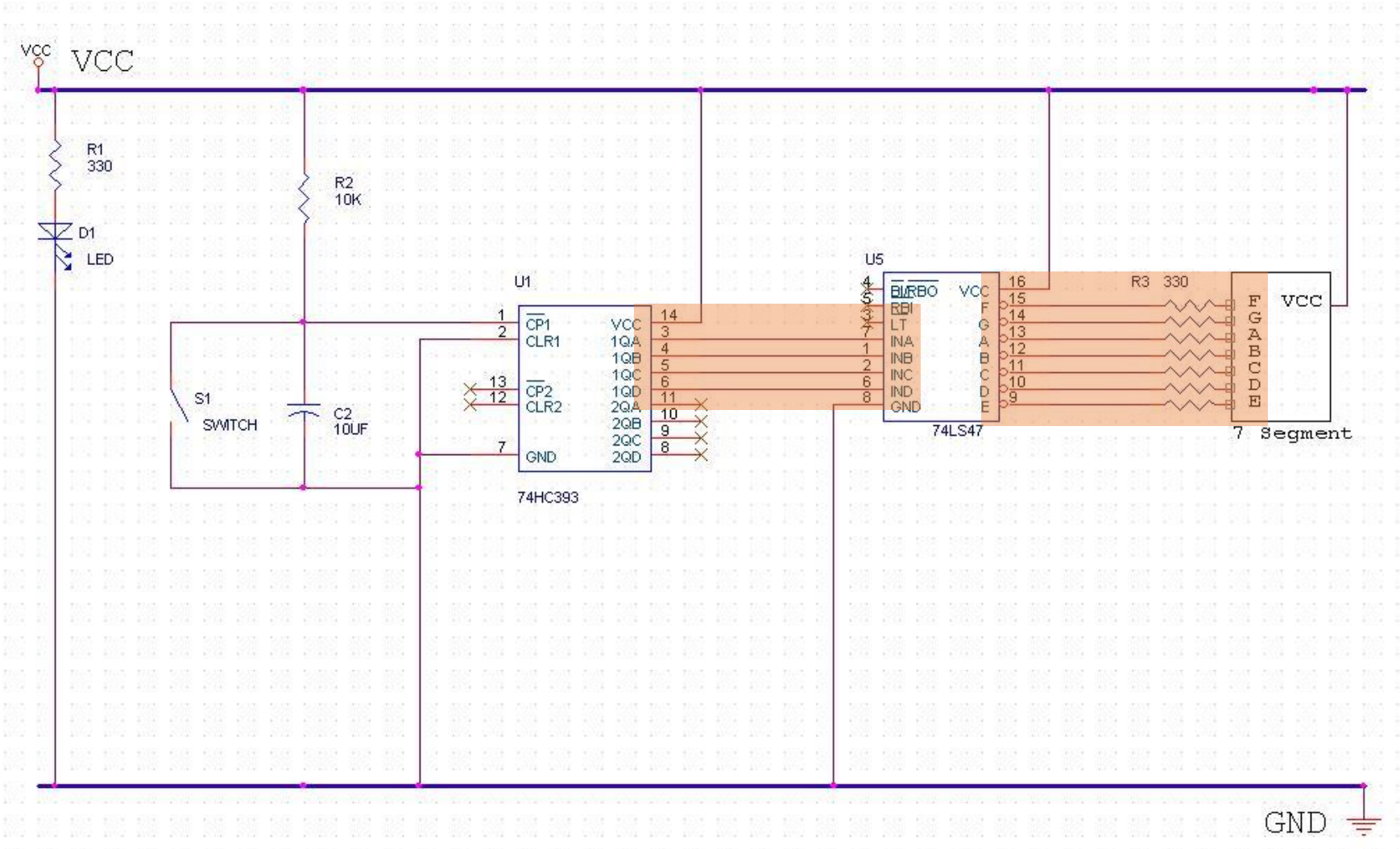
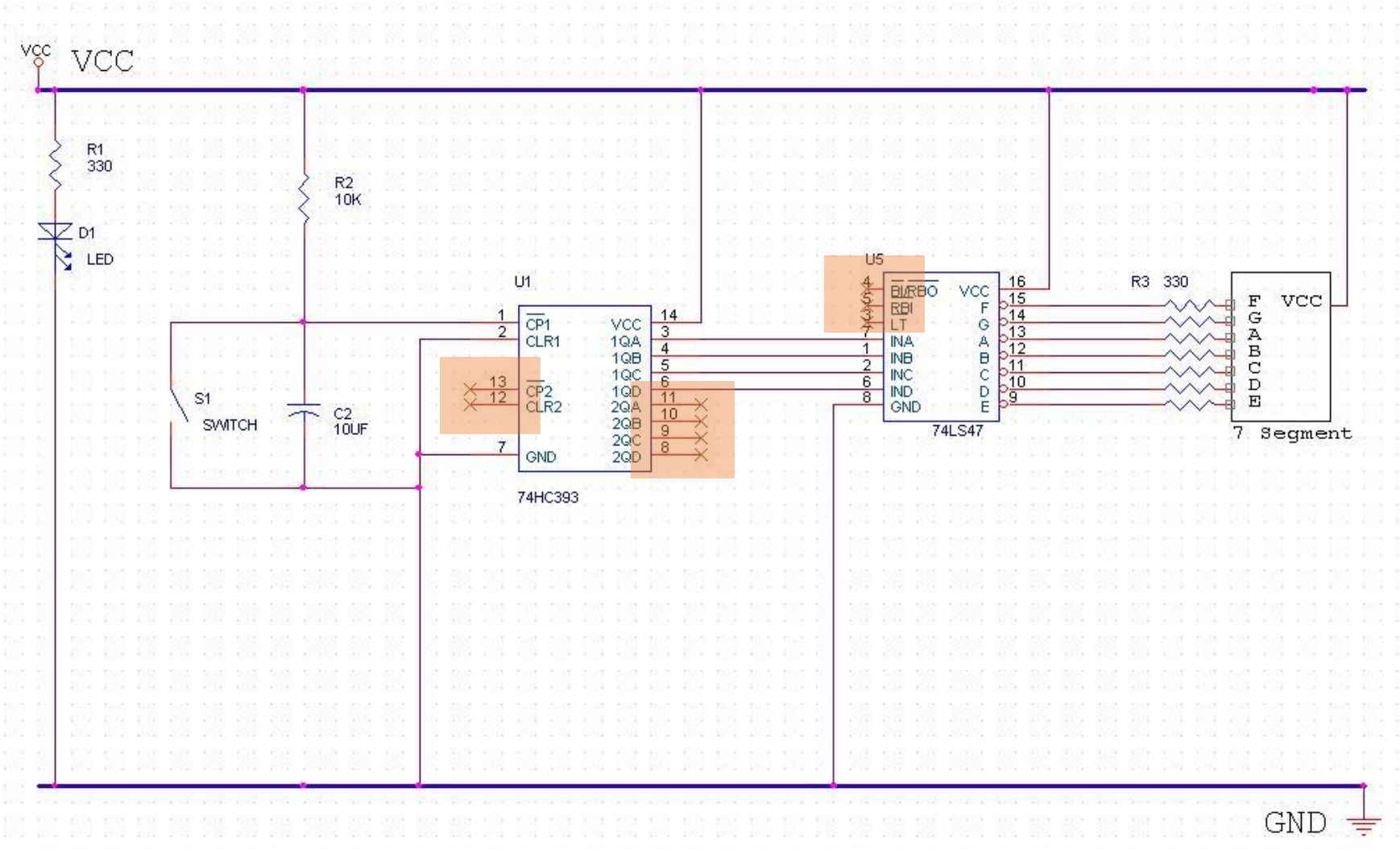
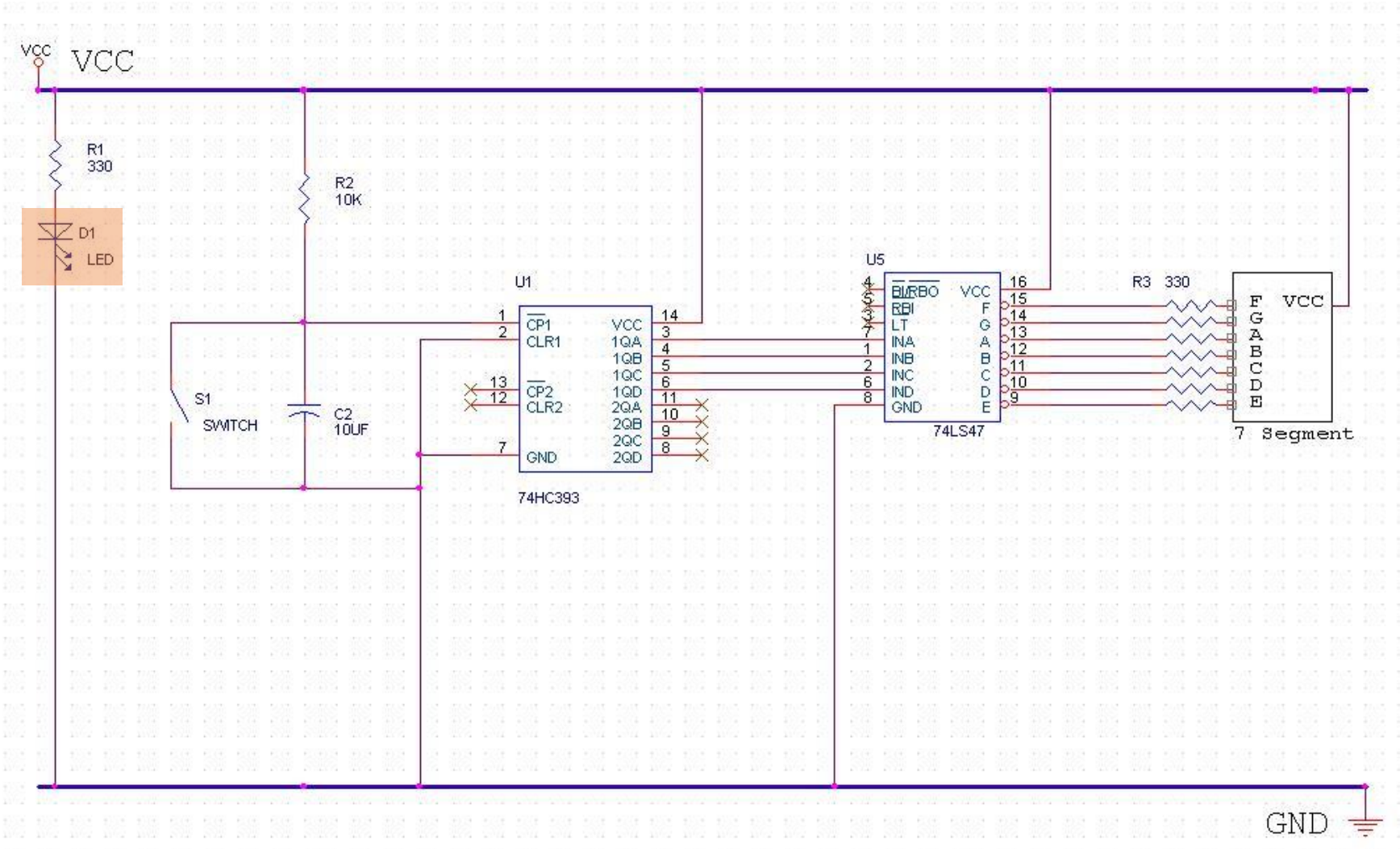


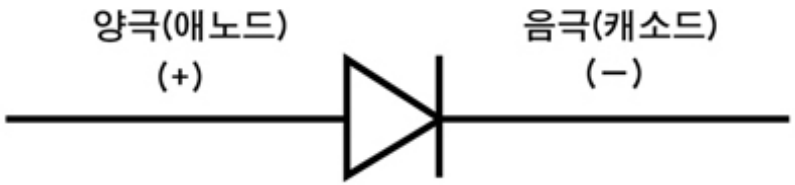
기본 배경 지식_회로 보는 법



기본 배경 지식_발광 다이오드(LED)



기본 배경 지식_발광 다이오드(LED)

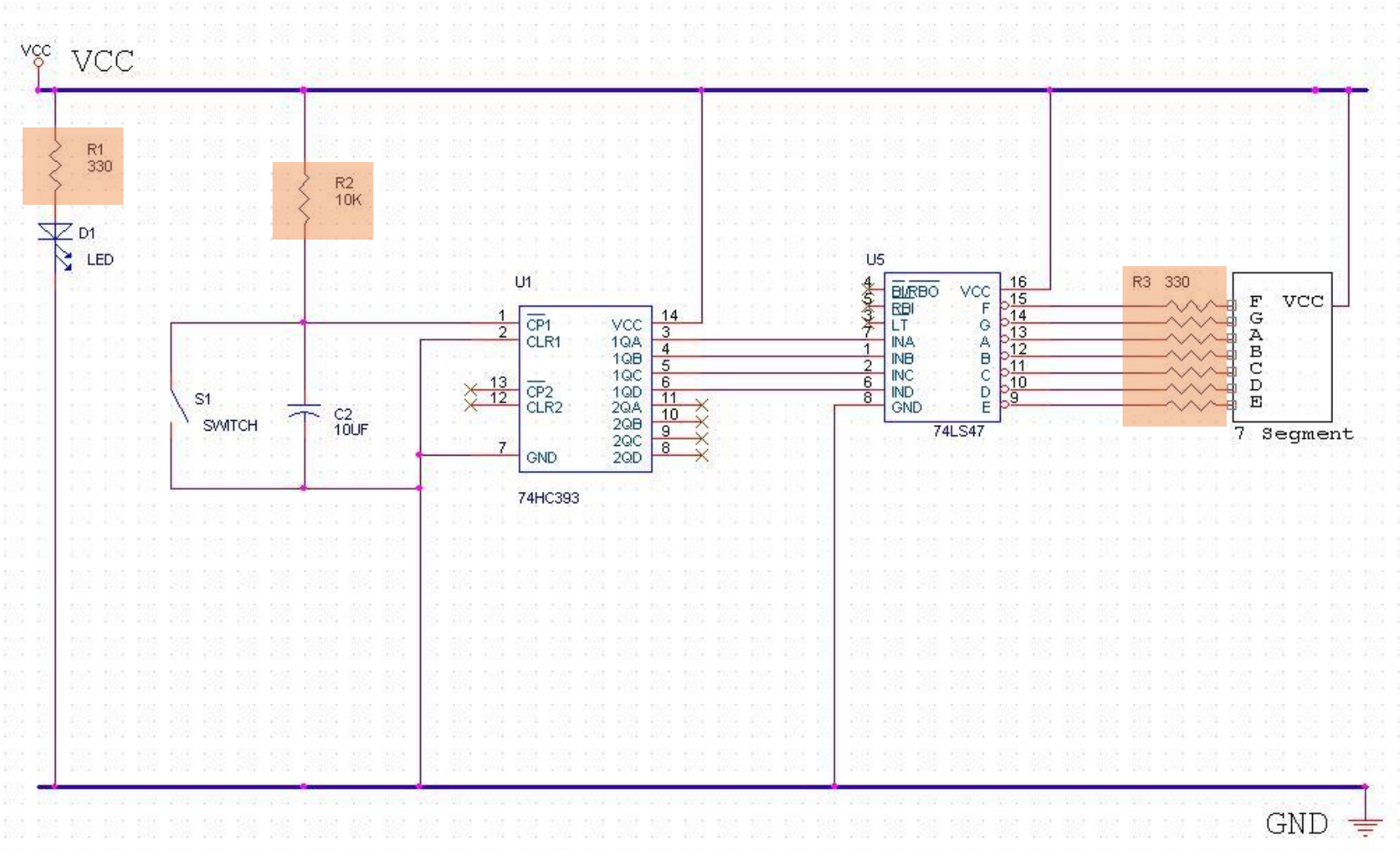


> 정의 : 전류가 순방향으로 흐르면
빛을 방출하는 다이오드

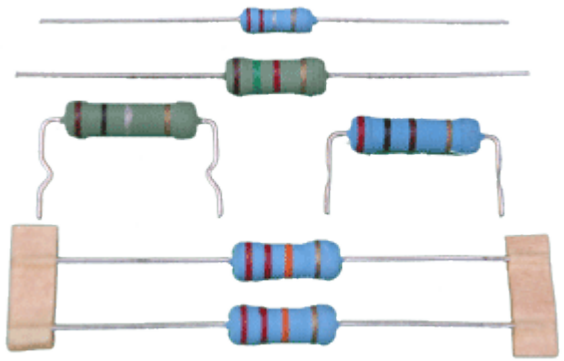
> 각 LED마다 스펙이 다르니
데이터 시트를 확인해보고 구동시키기

> 왜써 : 다양한 쓰임새..
십진카운터에선 전류가 흐르는 걸
눈으로 확인하기 위함
(전원 확인용)

기본 배경 지식_저항


VCC
VCC
R1
330
R2
10K
D1
LED
S1
SWITCH
C2
10UF
U1
CP1
CLR1
CP2
CLR2
GND
VCC
1QA
1QB
1QC
1QD
2QA
2QB
2QC
2QD
74HC393
U5
BI/RBO
RBI
LT
INA
INB
INC
IND
GND
VCC
F
G
A
B
C
D
E
74LS47
R3 330
F
G
A
B
C
D
E
VCC
7 Segment
GND

기본 배경 지식_저항

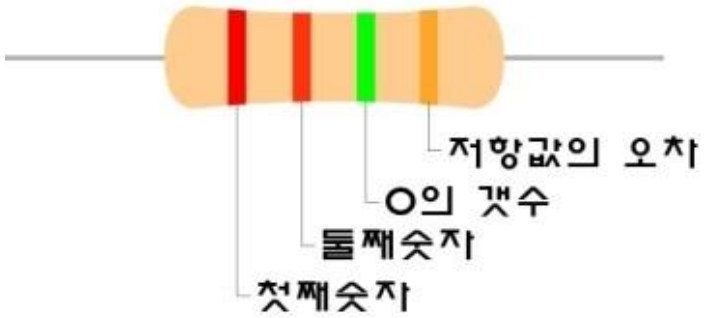


> 정의 : 전류의 흐름을 방해하는 정도를
나타내는 물리량

> 단위 : Ω (옴)

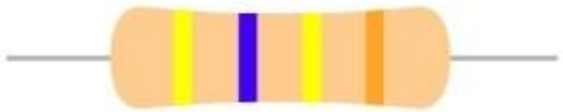
> 왜써 : 전압 강하를 위해
= 원하는 만큼의 전압을 주기위해
= input V를 각자 다르게 하기 어려움

기본 배경 지식_저항



3, 3, 2 (0이 2개란 의미)

3300Ω = 3.3kΩ

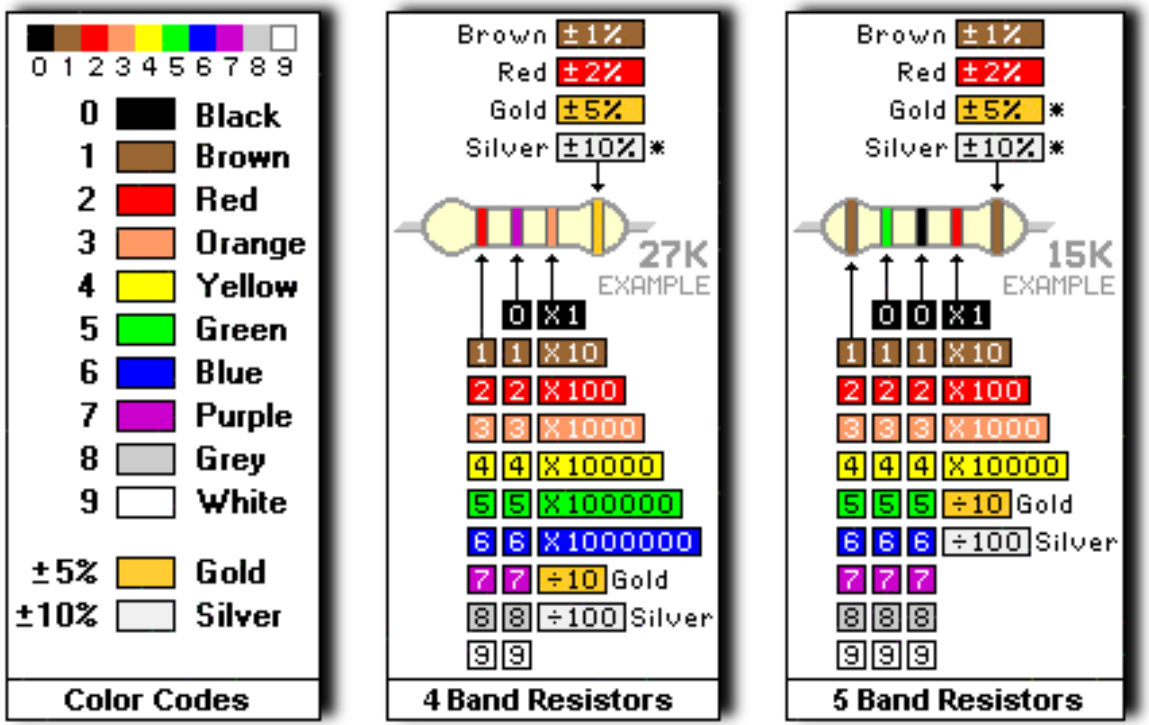


4, 7, 4 (0이 4개란 의미)

470000Ω = 470kΩ

색	값
검정색	0
갈 색	1
빨강색	2
주황색	3
노란색	4
초록색	5
파란색	6
보라색	7
회 색	8
하얀색	9
은 색	±10%
금 색	± 5%

기본 배경 지식_저항

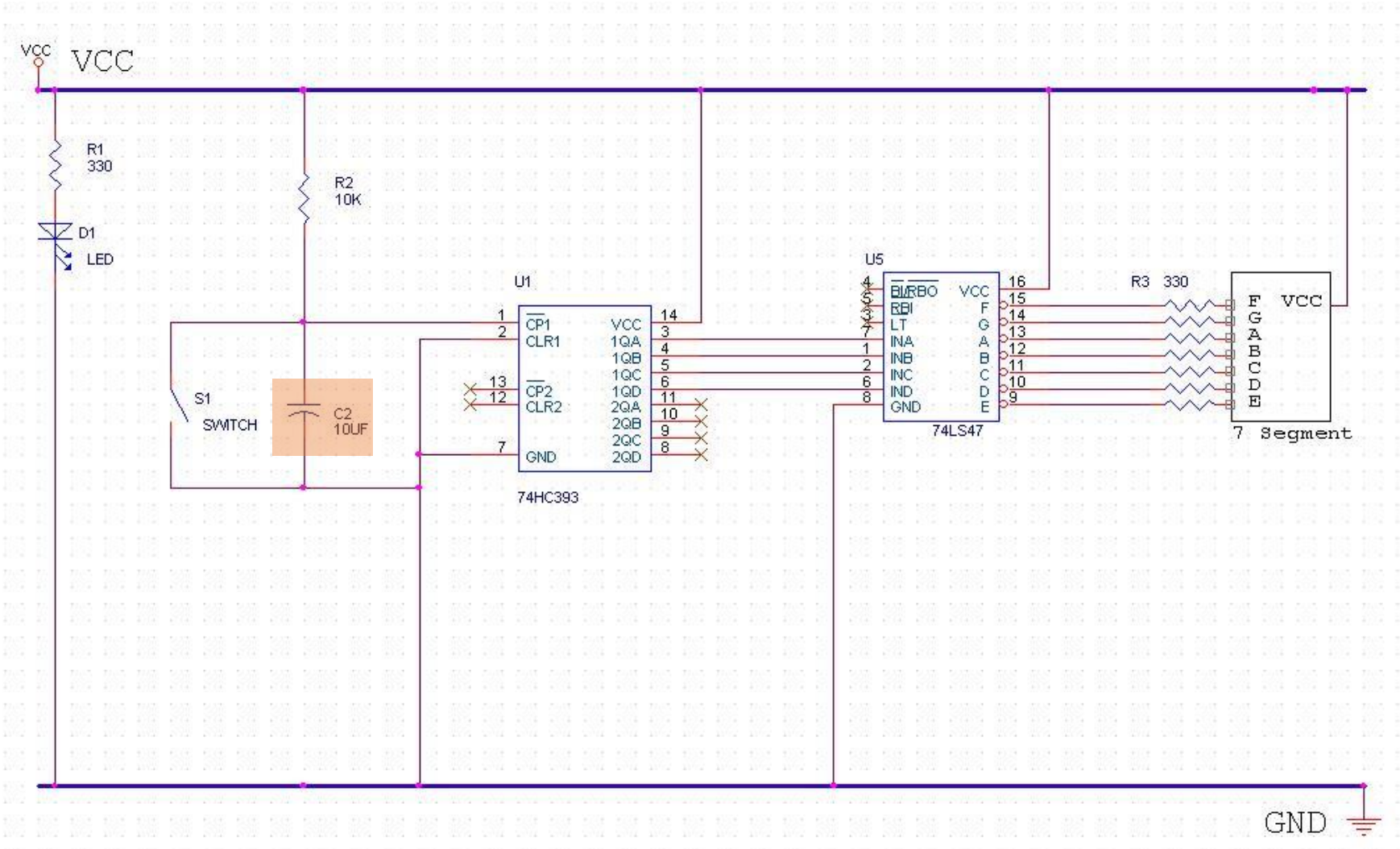

0 1 2 3 4 5 6 7 8 9
0 Black
1 Brown
2 Red
3 Orange
4 Yellow
5 Green
6 Blue
7 Purple
8 Grey
9 White
±5% Gold
±10% Silver
Color Codes
Brown ±1%
Red ±2%
Gold ±5%
Silver ±10% *
27K
EXAMPLE
0 X1
1 1 X10
2 2 X100
3 3 X1000
4 4 X10000
5 5 X100000
6 6 X1000000
7 7 ÷10 Gold
8 8 ÷100 Silver
9 9
4 Band Resistors
Brown ±1%
Red ±2%
Gold ±5% *
Silver ±10% *
15K
EXAMPLE
0 0 X1
1 1 1 X10
2 2 2 X100
3 3 3 X1000
4 4 4 X10000
5 5 5 ÷10 Gold
6 6 6 ÷100 Silver
7 7 7
8 8 8
9 9 9
5 Band Resistors

기본 배경 지식_부록

자주 쓰는 숫자 SI 접두어

M	10^{6}	**μ**	10^{-6}
k	10^{3}	**n**	10^{-9}
m	10^{-3}	**p**	10^{-12}

기본 배경 지식_캐패시터


VCC
VCC
R1
330
D1
LED
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10K
S1
SWITCH
C2
10UF
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CLR1
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D
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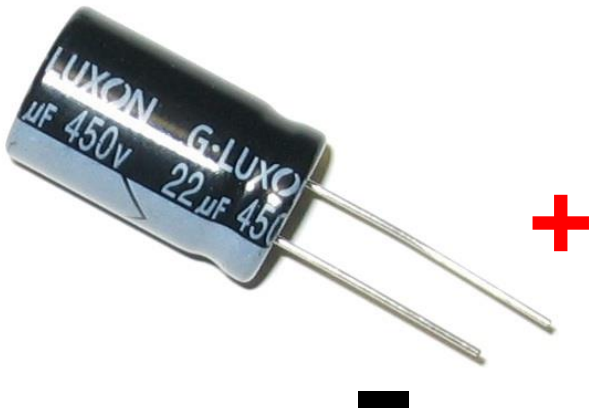
7 Segment
GND

기본 배경 지식_캐패시터

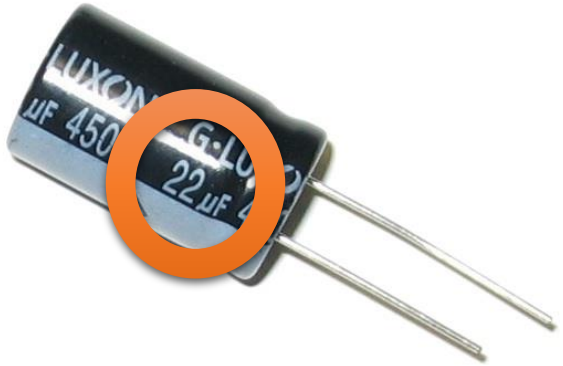


> 정의 : 전하를 저장하는 장치
> 직류는 통과 x, 교류는 통과 o
> 콘덴서, 축전기 라고도 함

> 단위 : pF (패럿)

> 왜써 : 전원부 리플 제거 – 정전기 등 제거
> 커플링 – 원하는 신호만 통과
> 디커플링 – 원하지 않는 신호는 제거
> 필터 설계 – HPF, LPF ..

기본 배경 지식_캐패시터



콘덴서 값 읽기

10	=	10	pF
101	=	100	pF
102	=	.001	µF
103	=	.01	µF
104	=	.1	µF
105	=	1	µF
222	=	.0022	µF
223	=	.022	µF
332	=	.0033	µF
333	=	.033	µF
472	=	.0047	µF
473	=	.047	µF

104
0000 pF
10

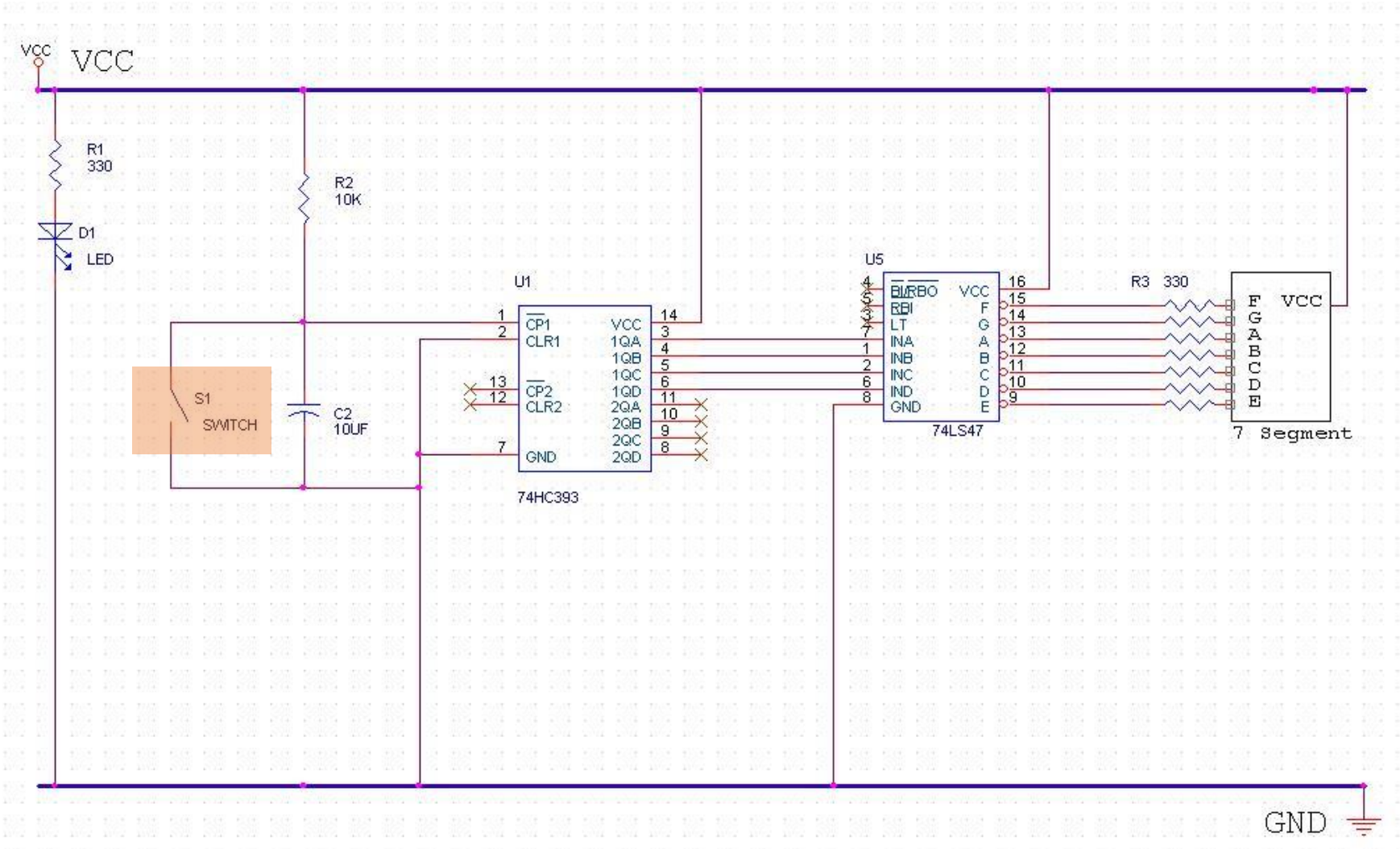
100,000 pF = .1 µF

333
000 pF
33

33,000 pF = 0.033 µF

1,000,000 pF = 1 µF

기본 배경 지식_버튼 스위치

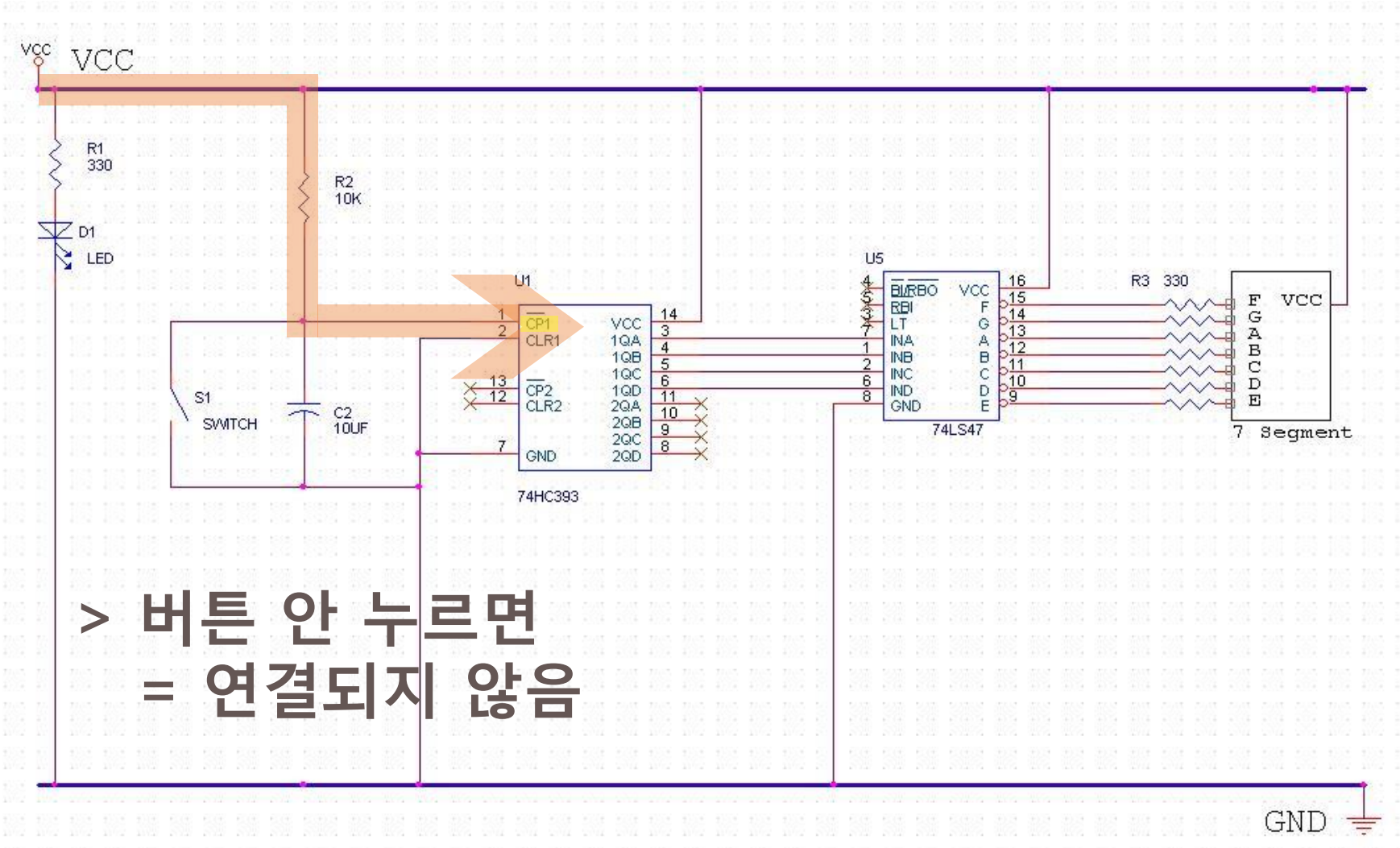


기본 배경 지식_버튼 스위치

> 정의 : 버튼을 누름으로써 접점을 개폐하는 스위치
회로의 절단/접속을 하는 스위치

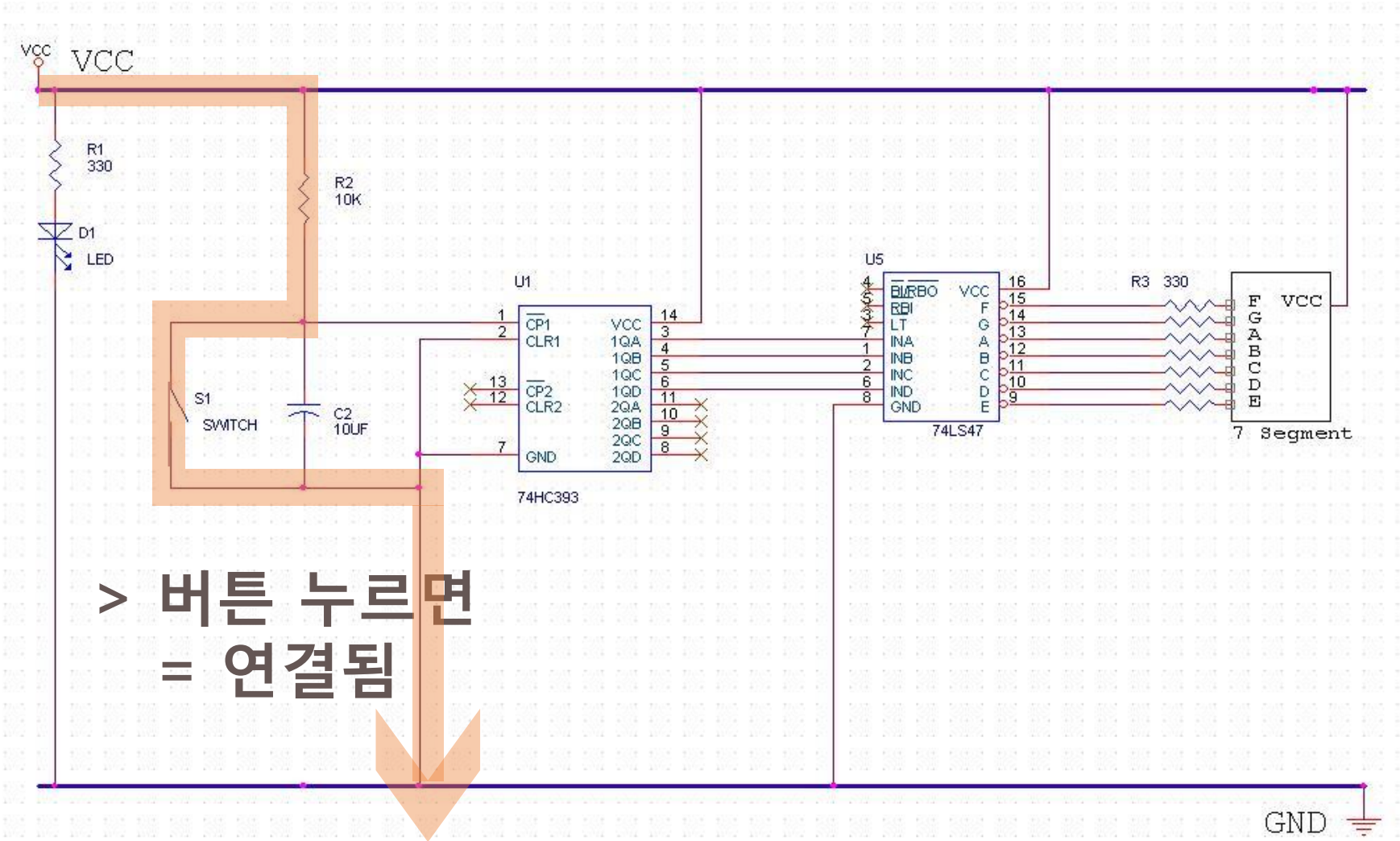
> 왜써 : 다양한 쓰임새..
십진카운터에선 한 번 누를 때 마다 1씩 증가하는 것을 카운터 하기 위함

기본 배경 지식_버튼 스위치

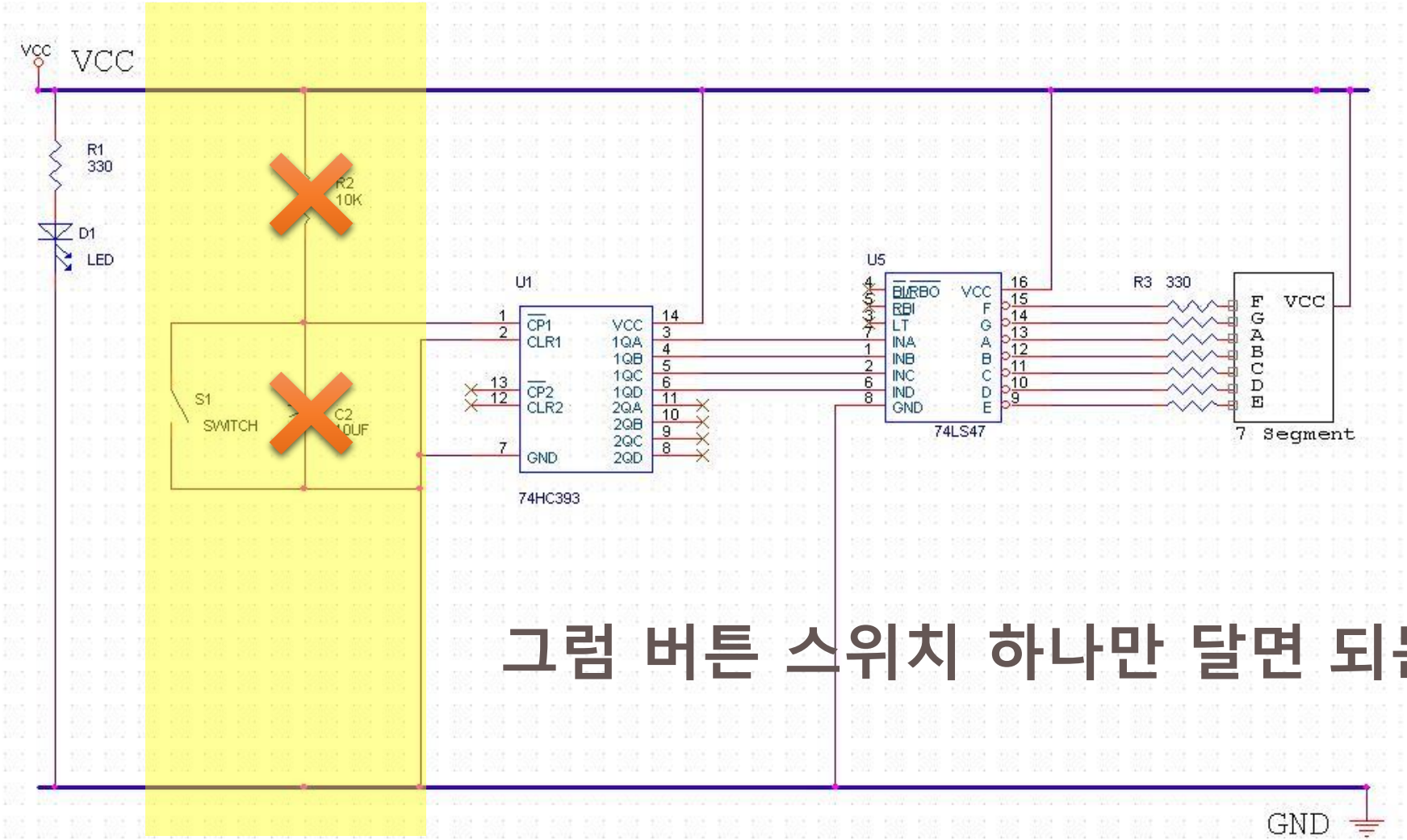


> 버튼 안 누르면
> = 연결되지 않음

기본 배경 지식_버튼 스위치



기본 배경 지식_버튼 스위치



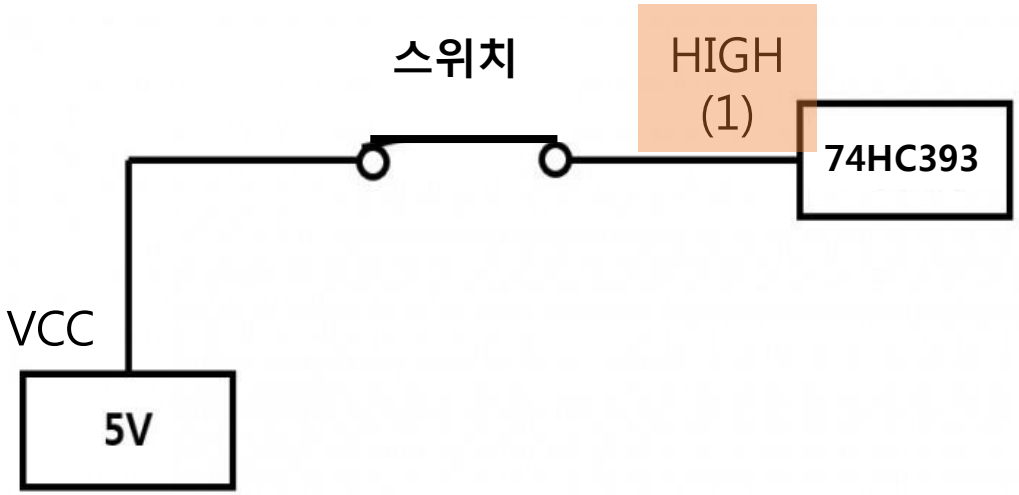
그럼 버튼 스위치 하나만 달면 되는거 아님?

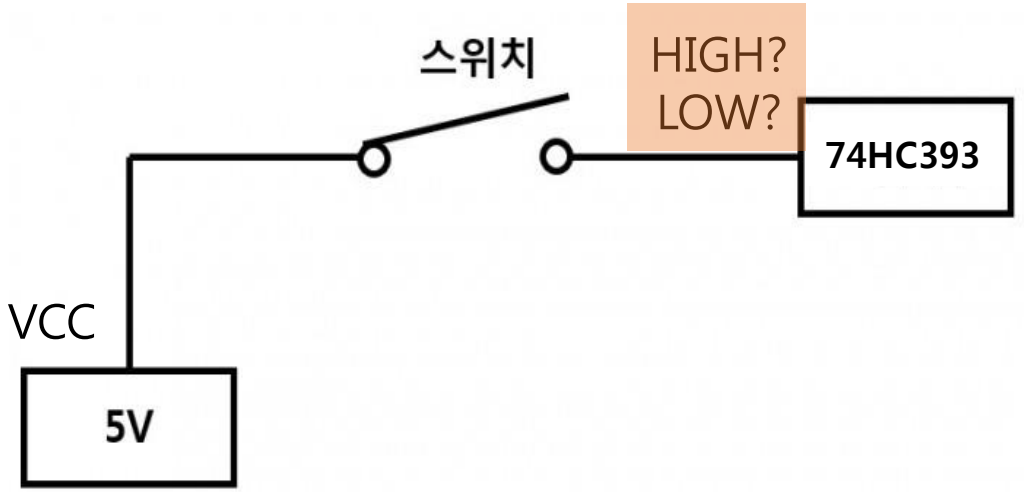
기본 배경 지식_버튼 스위치

> 스위치에 왜 저항을 직렬로 달아?

: High(1)/Low(0) 상태를 확실히 하기 위해
(풀업/풀다운 저항)

기본 배경 지식_버튼 스위치



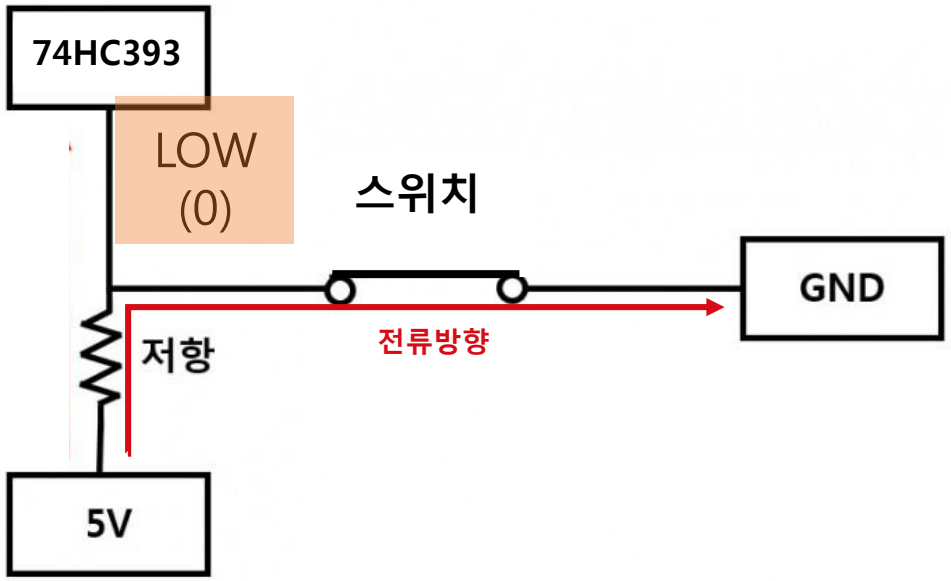


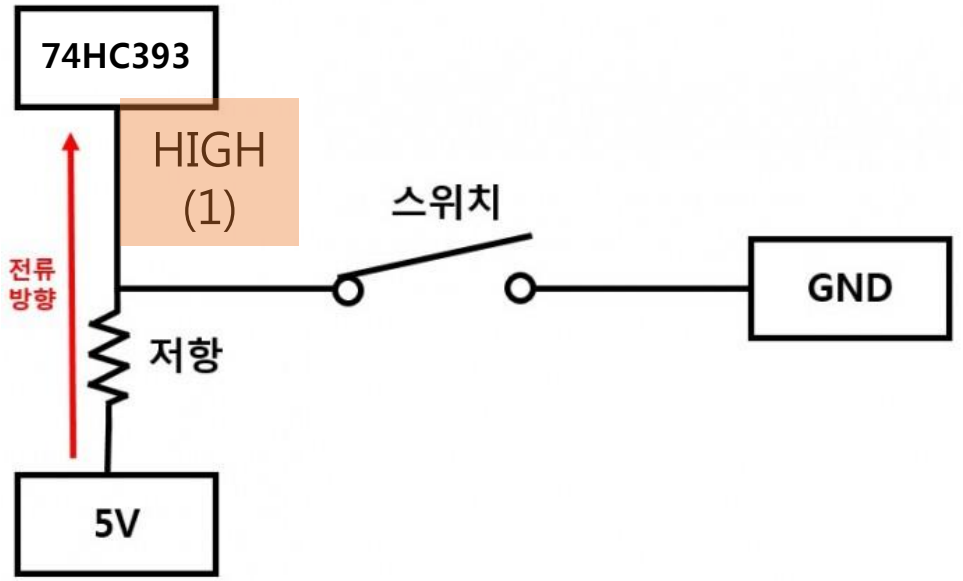
> 스위치 ON

> 스위치 OFF

>> 플로팅(Floating) 상태
: LOW(0)와 HIGH(1) 사이를 부유하는 상태

기본 배경 지식_버튼 스위치





> 스위치 ON

> 스위치 OFF

>> LOW(0)와 HIGH(1) 상태가 확실해짐

기본 배경 지식_버튼 스위치

> 스위치에 왜 캐패시터를 병렬로 달아?

: 채터링 현상을 막아주기 위해

기본 배경 지식_버튼 스위치

버튼 스위치가 가진 단점..

>채터링

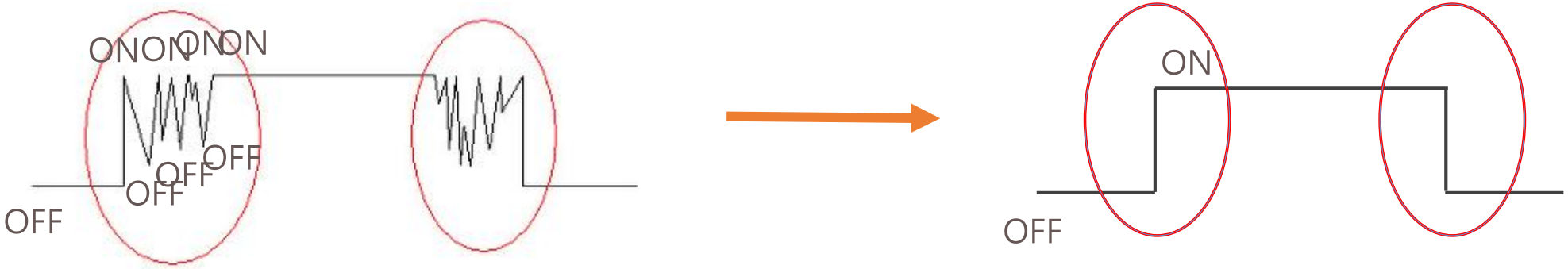
: 스위치 등의 접점이 개폐될 때 기계에서 발생하는 진동

: 농구공을 떨어뜨렸을 때, 몇 번 튀고 난 뒤 정지하는 것처럼 on/off를 몇 번 반복한 후 on 또는 off상태가 됨

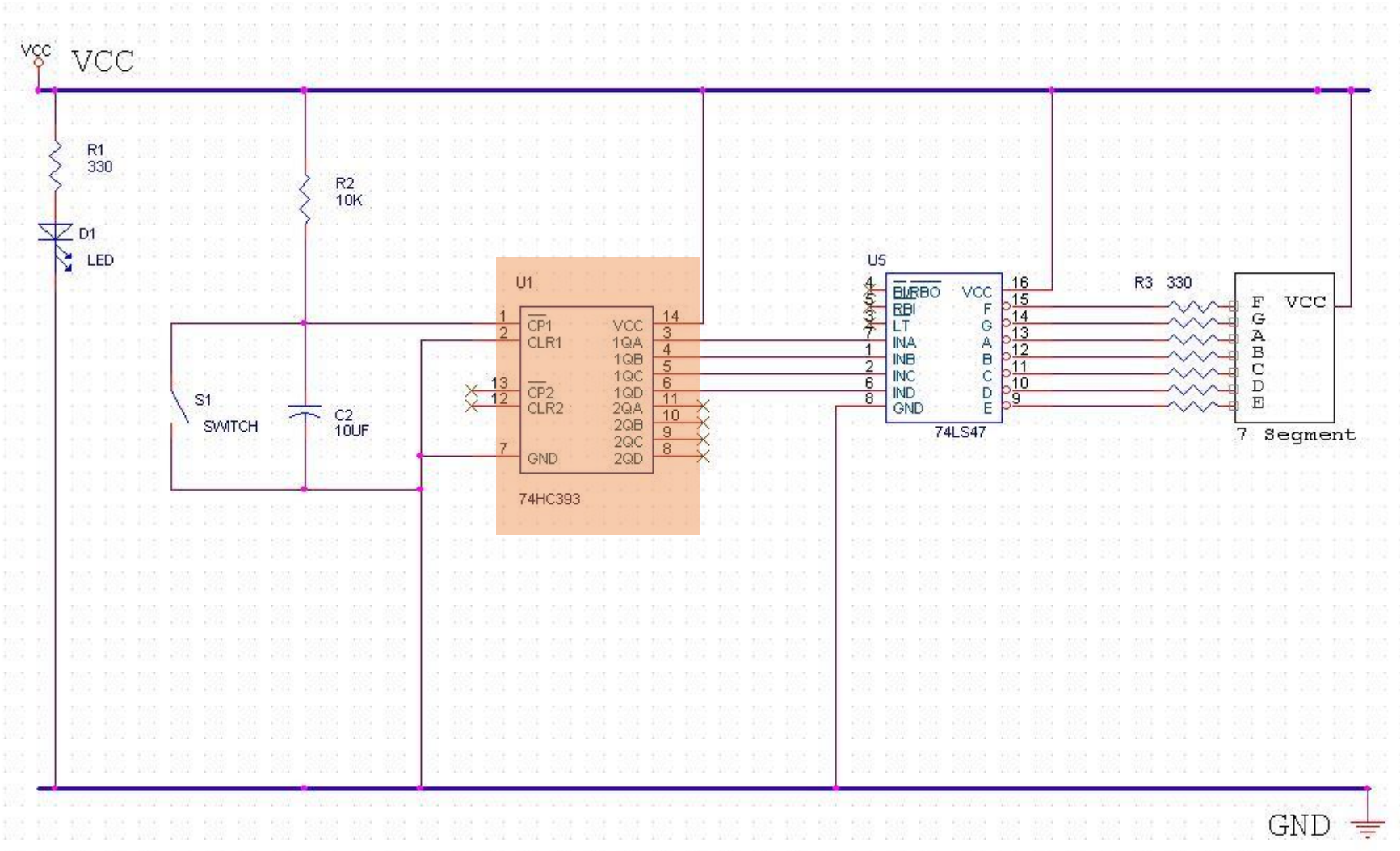
: 짧은 시간 동안 스위치를 여러 번 누르는 오동작이 될 수 있음

기본 배경 지식_버튼 스위치

> 그래서 스위치에 왜 캐패시터를 병렬로 달아?
: 채터링 현상을 막아주기 위해



소자들_74HC393


VCC
VCC
R1
330
D1
LED
R2
10K
S1
SWITCH
C2
10UF
U1
CP1
CLR1
CP2
CLR2
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F
G
A
B
C
D
E
74LS47
R3 330
F
G
A
B
C
D
E
VCC
7 Segment
GND

소자들_74HC393

> 정의 : Dual 4-bit binary ripple counter
> 2진 리플 카운터가 2개

> 왜써 : 16까지 숫자를 세려고 씀

소자들_74HC393

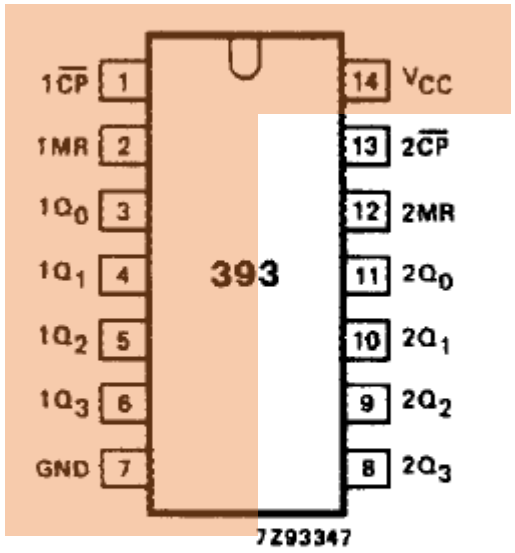


Fig.1 Pin configuration.

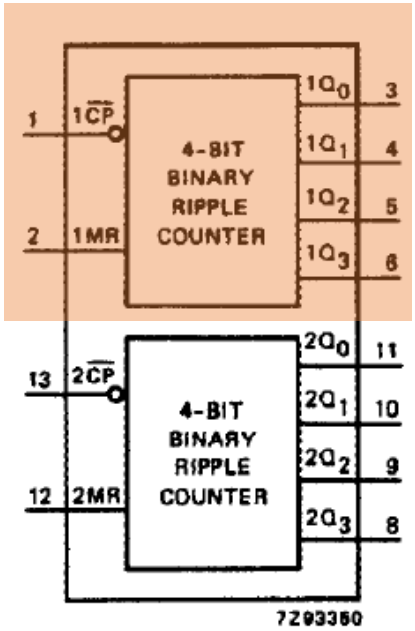


Fig.4 Functional diagram.

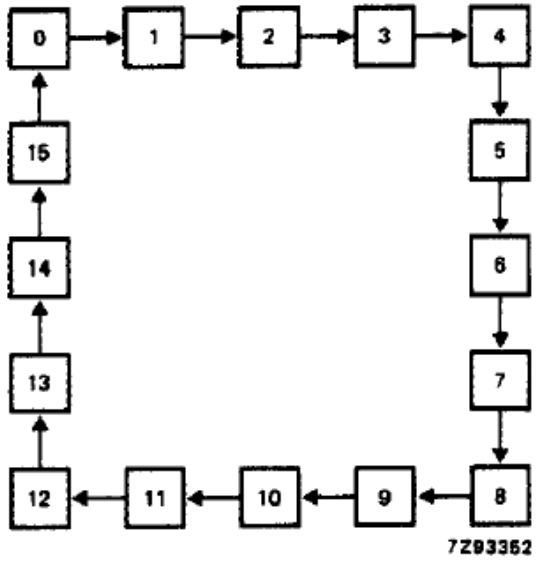


Fig.5 State diagram.

소자들_74HC393

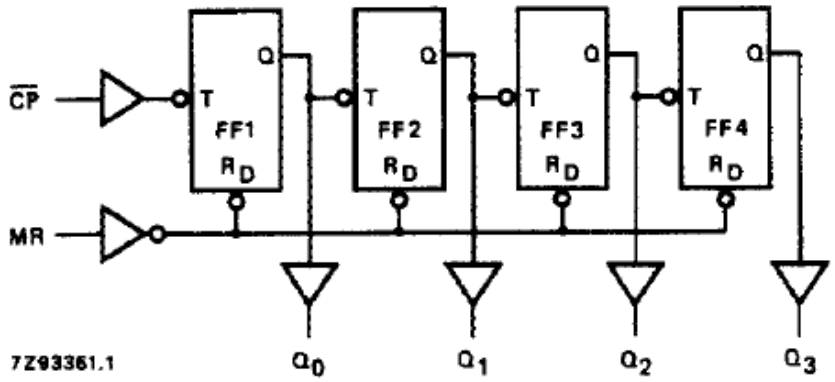


Fig.6 Logic diagram (one counter).

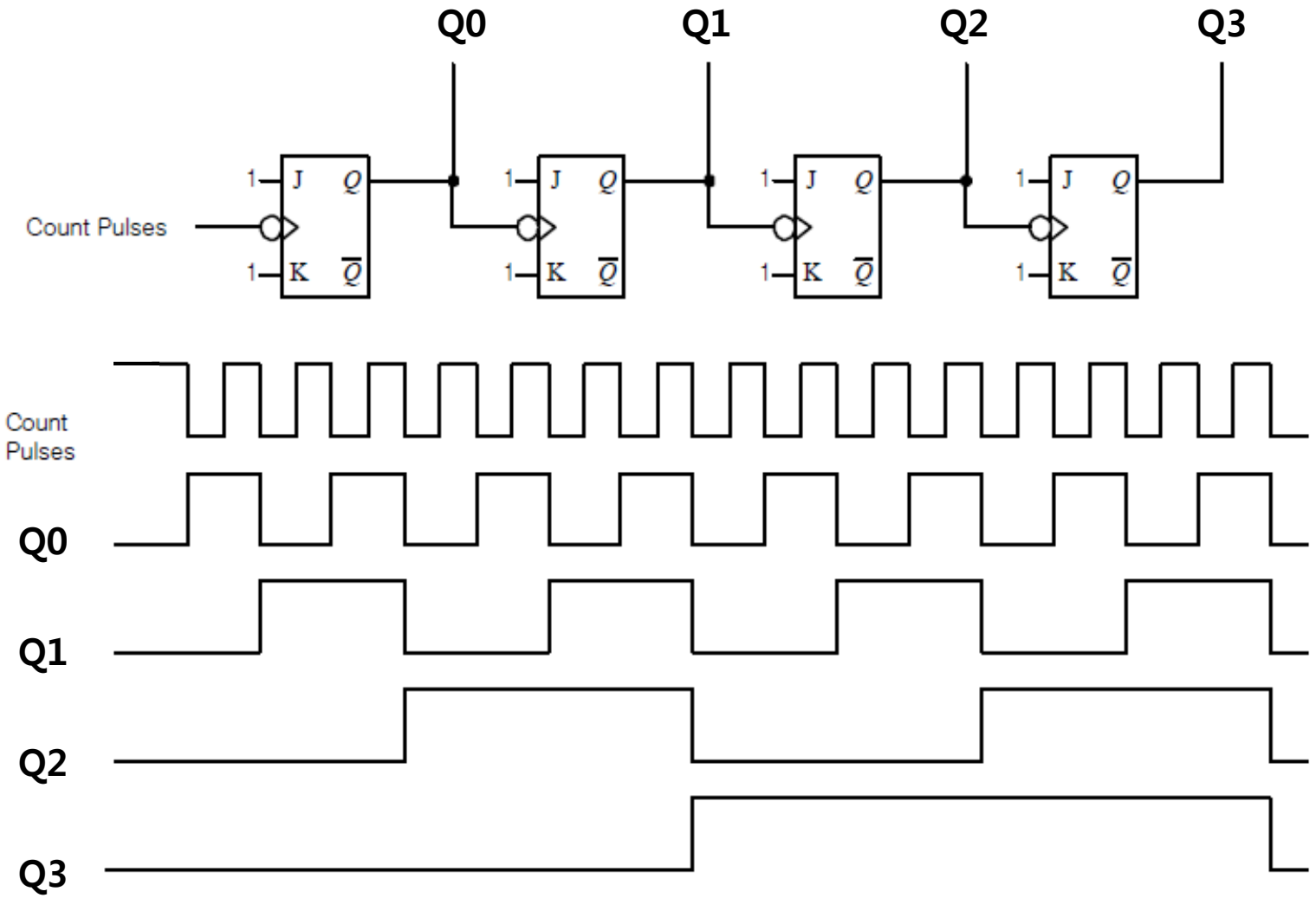
COUNT SEQUENCE FOR 1 COUNTER

COUNT	OUTPUTS			
	Q_0	Q_1	Q_2	Q_3
0	L	L	L	L
1	H	L	L	L
2	L	H	L	L
3	H	H	L	L
4	L	L	H	L
5	H	L	H	L
6	L	H	H	L
7	H	H	H	L
8	L	L	L	H
9	H	L	L	H
10	L	H	L	H
11	H	H	L	H
12	L	L	H	H
13	H	L	H	H
14	L	H	H	H
15	H	H	H	H

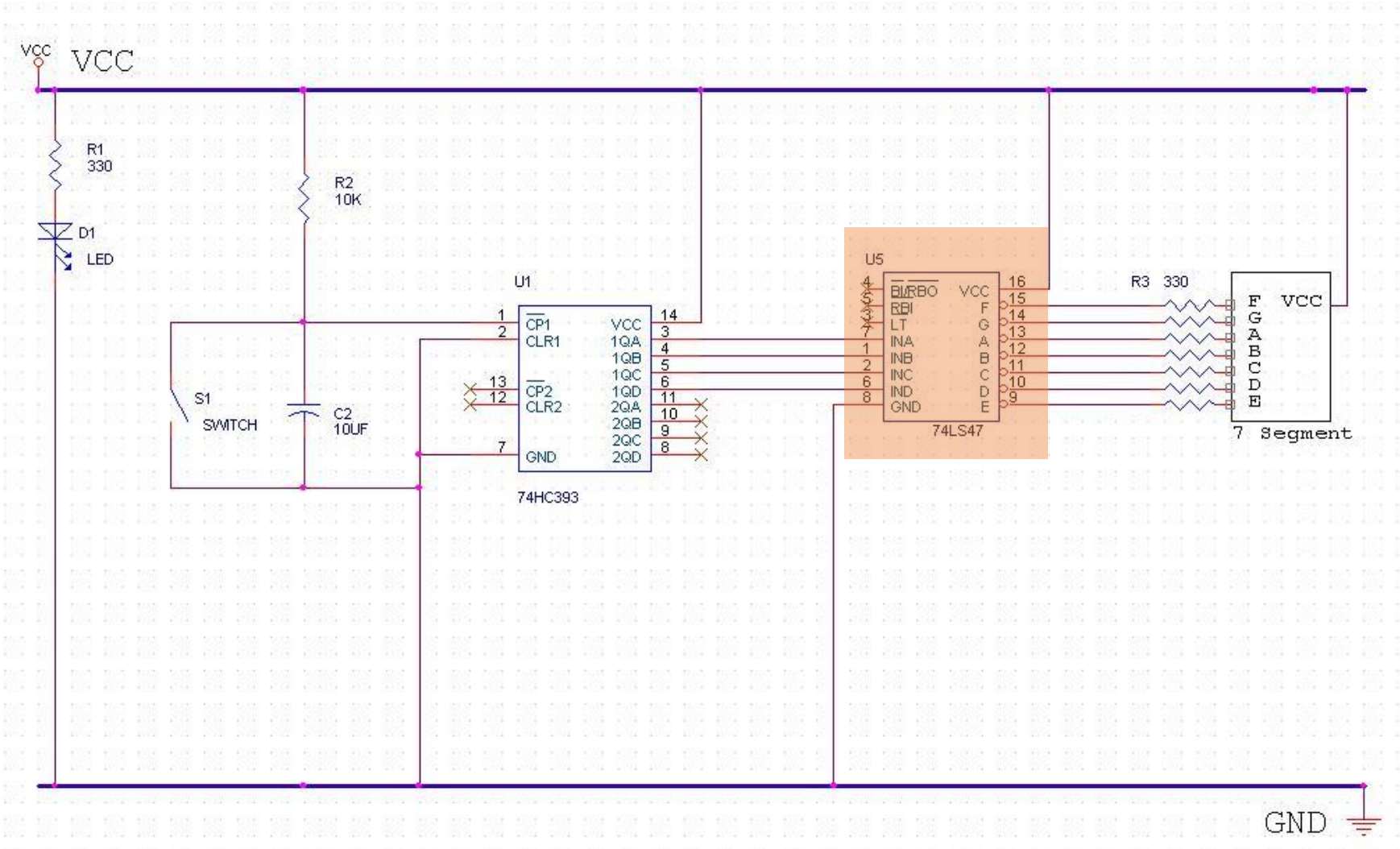
Notes

1. H = HIGH voltage level
   L = LOW voltage level

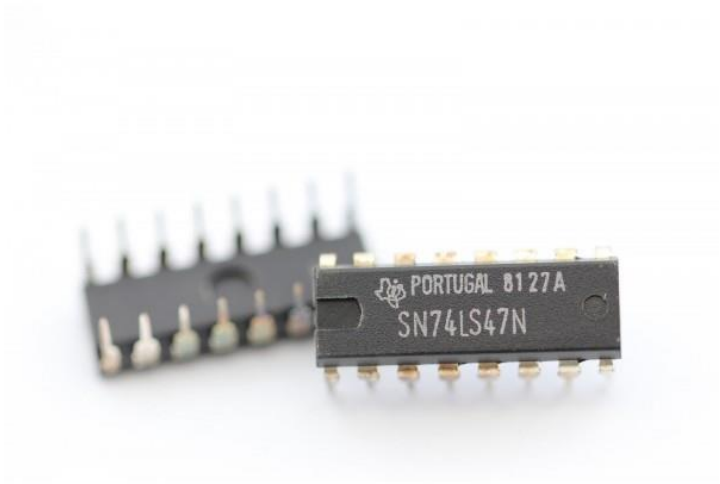
소자들_74HC393


Q0
Q1
Q2
Q3
Count Pulses
J
K
Q
$\overline{Q}$
1
Count Pulses
Q0
Q1
Q2
Q3

소자들_74LS47


VCC
VCC
R1
330
D1
LED
R2
10K
S1
SWITCH
C2
10UF
U1
CP1
CLR1
CP2
CLR2
GND
VCC
1QA
1QB
1QC
1QD
2QA
2QB
2QC
2QD
74HC393
U5
BI/RBO
RBI
LT
INA
INB
INC
IND
GND
VCC
F
G
A
B
C
D
E
74LS47
R3 330
F
G
A
B
C
D
E
VCC
7 Segment
GND

소자들_74LS47

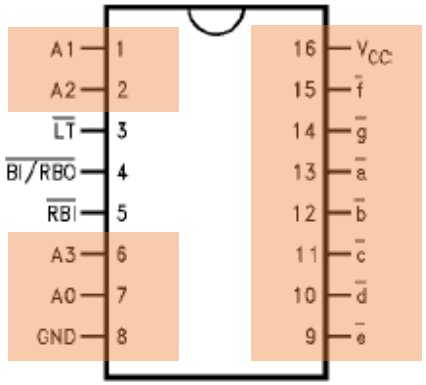


> 정의 : BCD to 7-segment Decoder/Driver
이진수를 받아 십진수로 바꾼 뒤,
7-segment를 위한 신호를 출력해줌

> 왜써 : 카운터 된 숫자를 7-segment로
표현해주기 위해

소자들_74LS47

Connection Diagram



Pin Descriptions

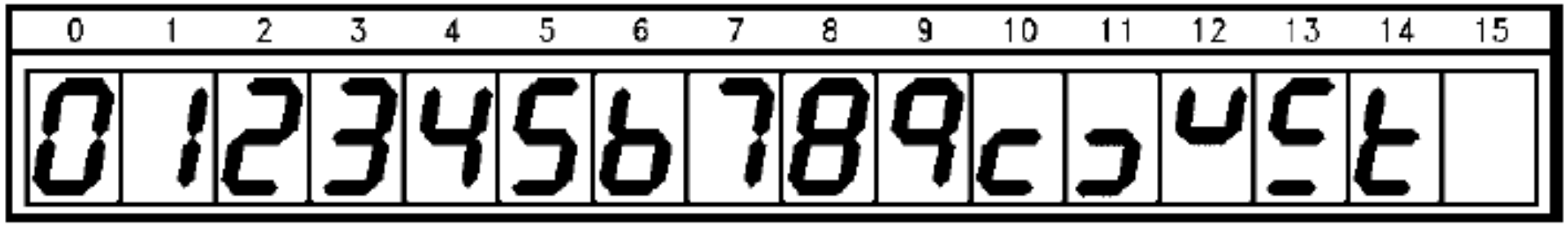
Pin Names	Description
A0–A3	BCD Inputs
$\overline{RBI}$	Ripple Blanking Input (Active LOW)
$\overline{LT}$	Lamp Test Input (Active LOW)
$\overline{BI}/\overline{RBO}$	Blanking Input (Active LOW) or Ripple Blanking Output (Active LOW)
$\overline{a}$ –$\overline{g}$	Segment Outputs (Active LOW) (Note 1)

Note 1: OC—Open Collector

Truth Table

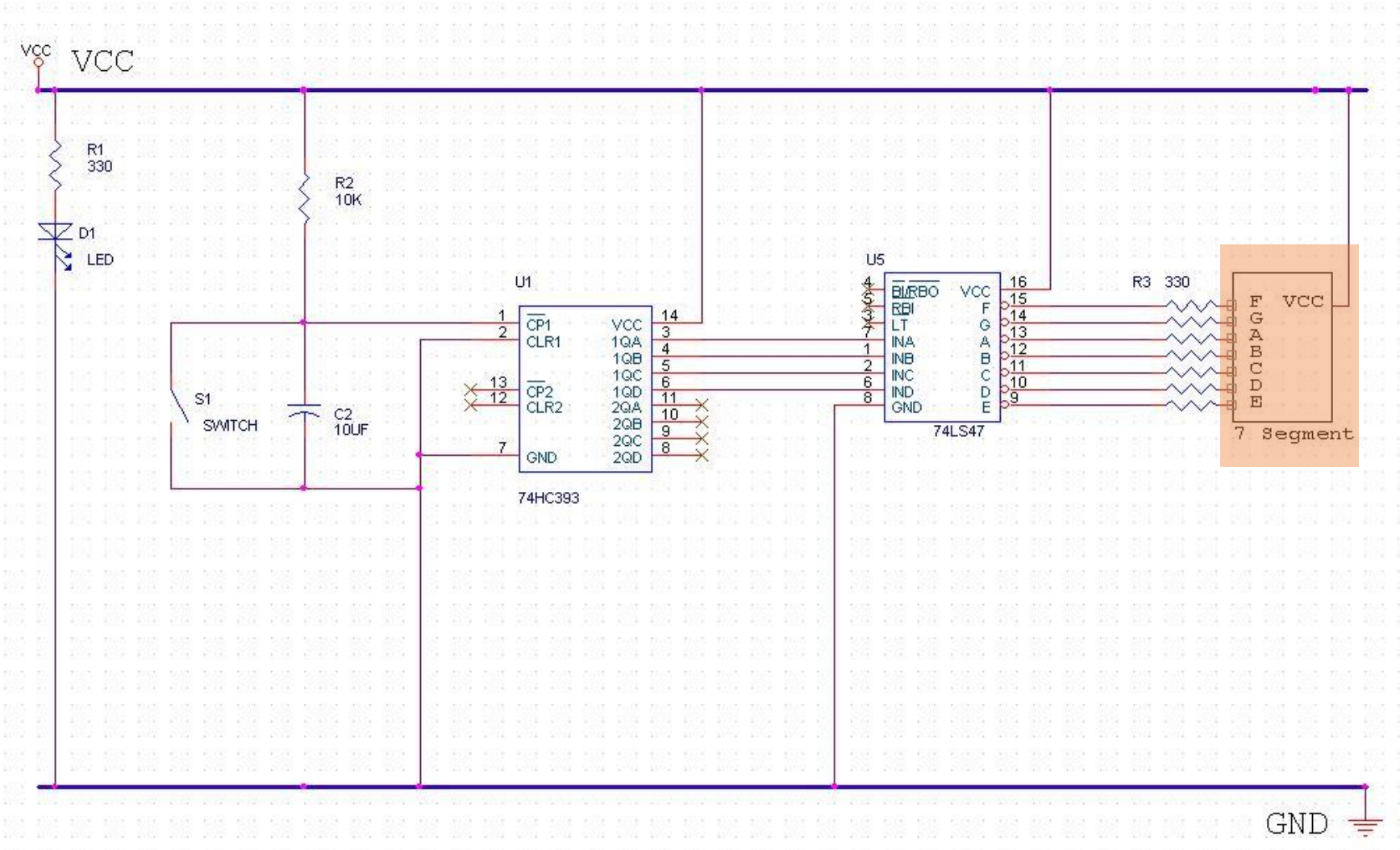
Decimal or Function	Inputs							Outputs							Note
	$\overline{LT}$	$\overline{RBI}$	A3	A2	A1	A0	$\overline{BI}/\overline{RBO}$	$\overline{a}$	$\overline{b}$	$\overline{c}$	$\overline{d}$	$\overline{e}$	$\overline{f}$	$\overline{g}$	
0	H	H	L	L	L	L	H	L	L	L	L	L	L	H	(Note 2)
1	H	X	L	L	L	H	H	H	L	L	H	H	H	H	(Note 2)
2	H	X	L	L	H	L	H	L	L	H	L	L	H	L	
3	H	X	L	L	H	H	H	L	L	L	L	H	H	L	
4	H	X	L	H	L	L	H	H	L	L	H	H	L	L	
5	H	X	L	H	L	H	H	L	H	L	L	H	L	L	
6	H	X	L	H	H	L	H	H	H	L	L	L	L	L	
7	H	X	L	H	H	H	H	L	L	L	H	H	H	H	
8	H	X	H	L	L	L	H	L	L	L	L	L	L	L	
9	H	X	H	L	L	H	H	L	L	L	H	H	L	L	
10	H	X	H	L	H	L	H	H	H	H	L	L	H	L	
11	H	X	H	L	H	H	H	H	H	L	L	H	H	L	
12	H	X	H	H	L	L	H	H	L	H	H	H	L	L	
13	H	X	H	H	L	H	H	L	H	H	L	H	L	L	
14	H	X	H	H	H	L	H	H	H	H	L	L	L	L	
15	H	X	H	H	H	H	H	H	H	H	H	H	H	H	
$\overline{BI}$	X	X	X	X	X	X	L	H	H	H	H	H	H	H	(Note 3)
$\overline{RBI}$	H	L	L	L	L	L	L	H	H	H	H	H	H	H	(Note 4)
$\overline{LT}$	L	X	X	X	X	X	H	L	L	L	L	L	L	L	(Note 5)

소자들_74LS47

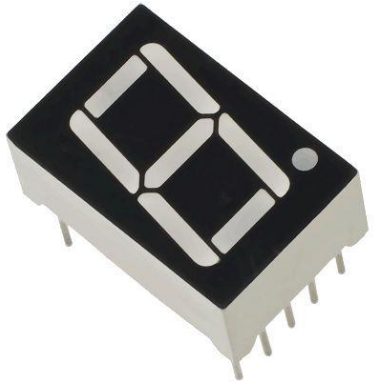


> 7-segment의 결과

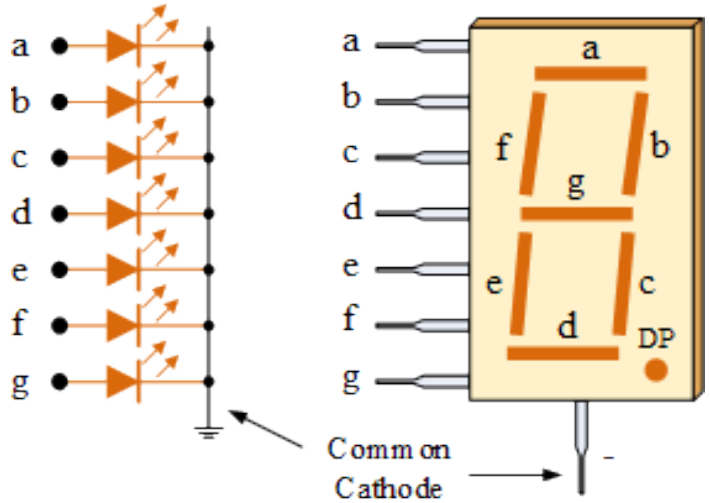
기본 배경 지식_7 segment



기본 배경 지식_7 segment



> 정의 : 표시장치의 일종
7개의 획으로 숫자나 문자 표현
각 획이 발광 다이오드임

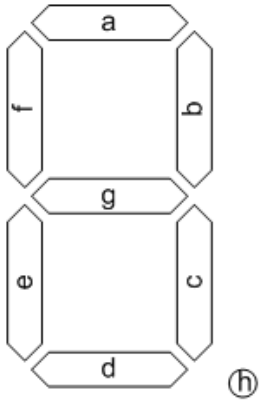


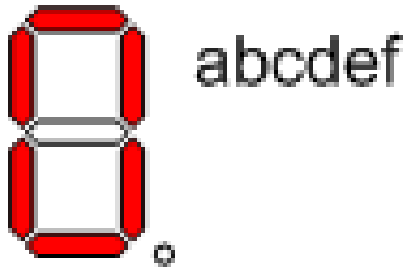
> 왜써 : 숫자나 문자 등을 표현하려고
십진카운터에선 몇 번 째까지
셌는지 표시하기 위해

소자들_74LS47

Truth Table

Decimal or Function	Inputs							Outputs							Note
	$\overline{LT}$	$\overline{RBI}$	A3	A2	A1	A0	$\overline{BI/RBO}$	$\overline{a}$	$\overline{b}$	$\overline{c}$	$\overline{d}$	$\overline{e}$	$\overline{f}$	$\overline{g}$	
0	H	H	L	L	L	L	H	L	L	L	L	L	L	H	(Note 2)
1	H	X	L	L	L	H	H	H	L	L	H	H	H	H	(Note 2)
2	H	X	L	L	H	L	H	L	L	H	L	L	H	L	
3	H	X	L	L	H	H	H	L	L	L	L	H	H	L	
4	H	X	L	H	L	L	H	H	L	L	H	H	L	L	
5	H	X	L	H	L	H	H	L	H	L	L	H	L	L	
6	H	X	L	H	H	L	H	H	H	L	L	L	L	L	
7	H	X	L	H	H	H	H	L	L	L	H	H	H	H	
8	H	X	H	L	L	L	H	L	L	L	L	L	L	L	
9	H	X	H	L	L	H	H	L	L	L	H	H	L	L	
10	H	X	H	L	H	L	H	H	H	H	L	L	H	L	
11	H	X	H	L	H	H	H	H	H	L	L	H	H	L	
12	H	X	H	H	L	L	H	H	L	H	H	H	L	L	
13	H	X	H	H	L	H	H	L	H	H	L	H	L	L	
14	H	X	H	H	H	L	H	H	H	H	L	L	L	L	
15	H	X	H	H	H	H	H	H	H	H	H	H	H	H	
$\overline{BI}$	X	X	X	X	X	X	L	H	H	H	H	H	H	H	(Note 3)
$\overline{RBI}$	H	L	L	L	L	L	L	H	H	H	H	H	H	H	(Note 4)
$\overline{LT}$	L	X	X	X	X	X	H	L	L	L	L	L	L	L	(Note 5)

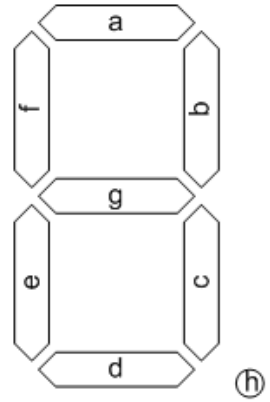


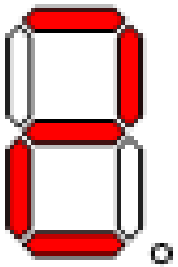


소자들_74LS47

Truth Table

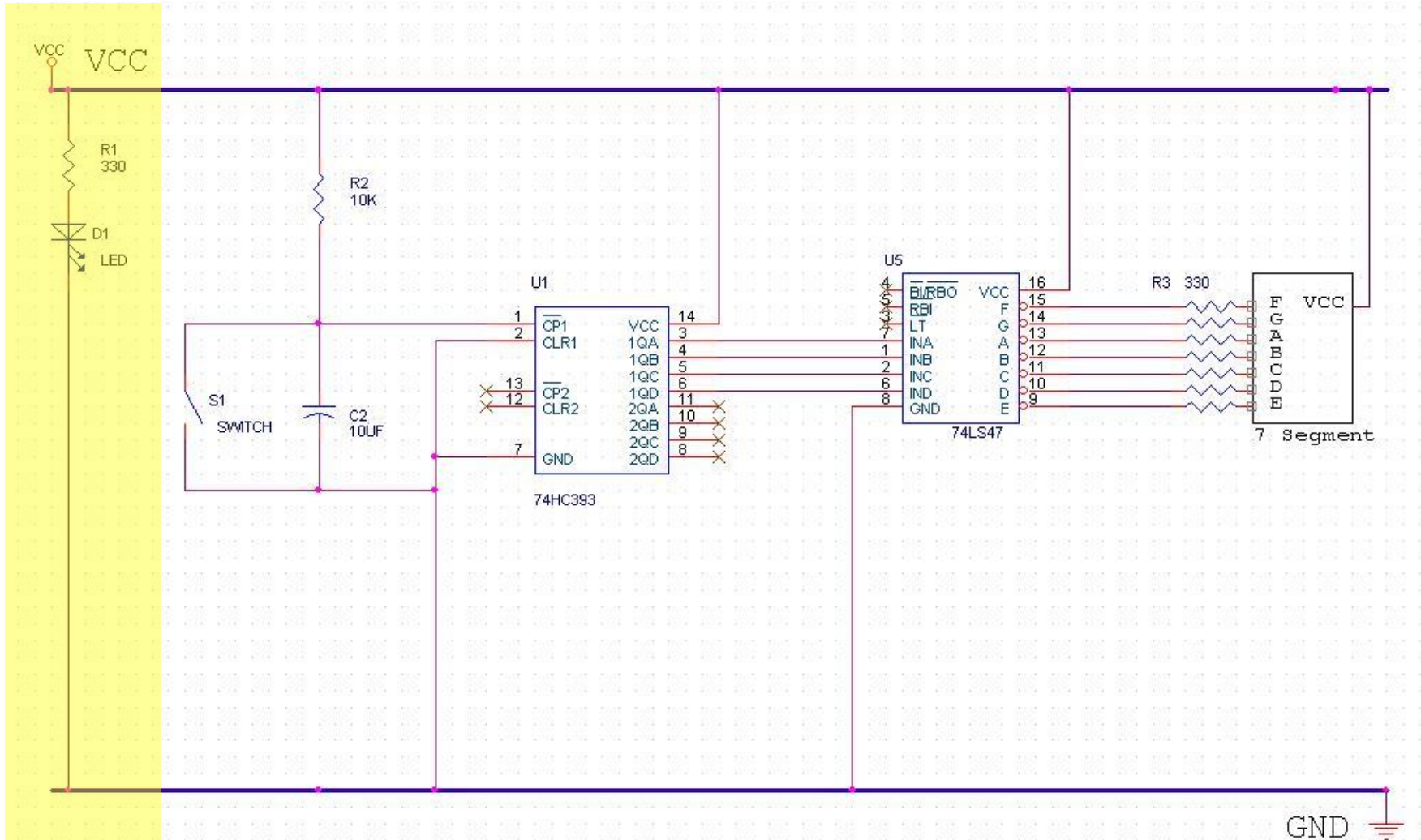
Decimal or Function	Inputs							Outputs							Note
	$\overline{LT}$	$\overline{RBI}$	A3	A2	A1	A0	$\overline{BI/RBO}$	$\overline{a}$	$\overline{b}$	$\overline{c}$	$\overline{d}$	$\overline{e}$	$\overline{f}$	$\overline{g}$	
0	H	H	L	L	L	L	H	L	L	L	L	L	L	H	(Note 2)
1	H	X	L	L	L	H	H	H	L	L	H	H	H	H	(Note 2)
2	H	X	L	L	H	L	H	L	L	H	L	L	H	L	
3	H	X	L	L	H	H	H	L	L	L	L	H	H	L	
4	H	X	L	H	L	L	H	H	L	L	H	H	L	L	
5	H	X	L	H	L	H	H	L	H	L	L	H	L	L	
6	H	X	L	H	H	L	H	H	H	L	L	L	L	L	
7	H	X	L	H	H	H	H	L	L	L	H	H	H	H	
8	H	X	H	L	L	L	H	L	L	L	L	L	L	L	
9	H	X	H	L	L	H	H	L	L	L	H	H	L	L	
10	H	X	H	L	H	L	H	H	H	H	L	L	H	L	
11	H	X	H	L	H	H	H	H	H	L	L	H	H	L	
12	H	X	H	H	L	L	H	H	L	H	H	H	L	L	
13	H	X	H	H	L	H	H	L	H	H	L	H	L	L	
14	H	X	H	H	H	L	H	H	H	H	L	L	L	L	
15	H	X	H	H	H	H	H	H	H	H	H	H	H	H	
$\overline{BI}$	X	X	X	X	X	X	L	H	H	H	H	H	H	H	(Note 3)
$\overline{RBI}$	H	L	L	L	L	L	L	H	H	H	H	H	H	H	(Note 4)
$\overline{LT}$	L	X	X	X	X	X	H	L	L	L	L	L	L	L	(Note 5)



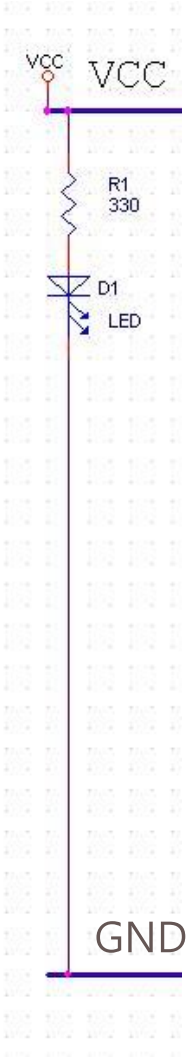


abdeg

동작원리_LED 파트


VCC
VCC
R1
330
D1
LED
R2
10K
S1
SWITCH
C2
10UF
U1
CP1
CLR1
CP2
CLR2
GND
VCC
1QA
1QB
1QC
1QD
2QA
2QB
2QC
2QD
74HC393
U5
BI/RBO
RBI
LT
INA
INB
INC
IND
GND
VCC
F
G
A
B
C
D
E
74LS47
R3 330
F
G
A
B
C
D
E
VCC
7 Segment
GND

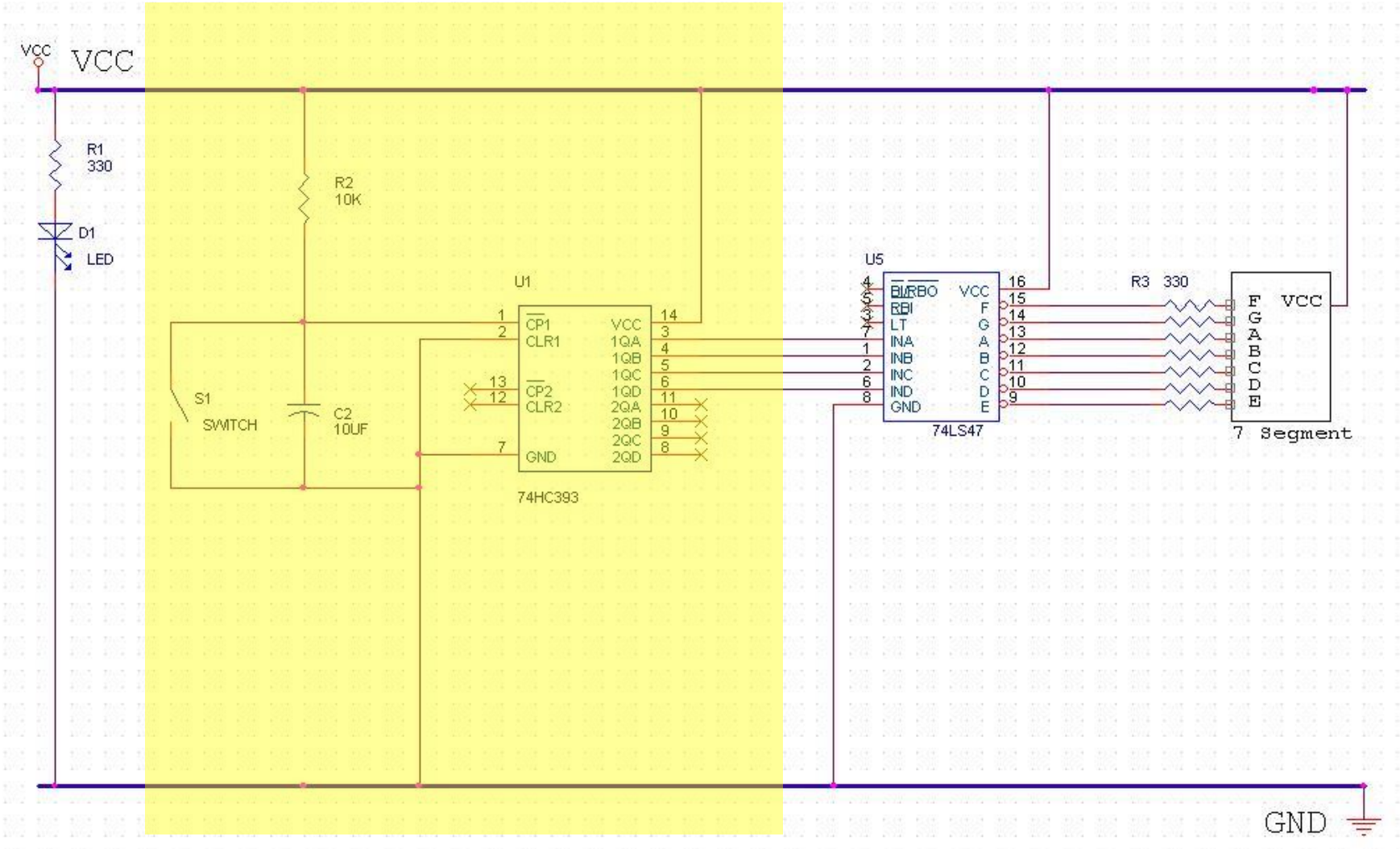
동작원리_LED 파트



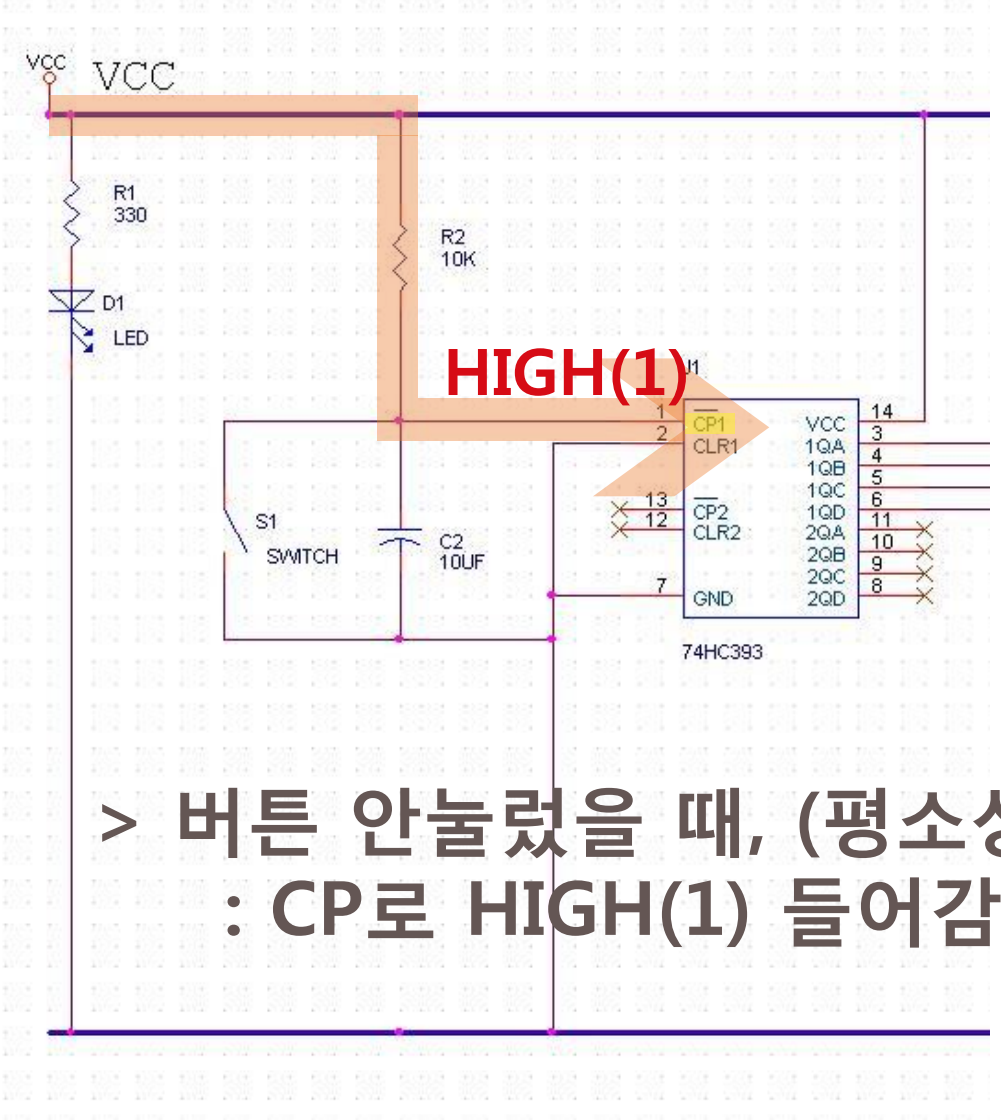
> V = I*R
> R = V/I
> LED의 적정 전류는 15mA, 입력 전압은 5V
> R = 5V/15mA
> 즉, R ≒ 330 Ω

> LED엔 15mA가 흐르게 되고,
> 적절하게 발광하게 됨.

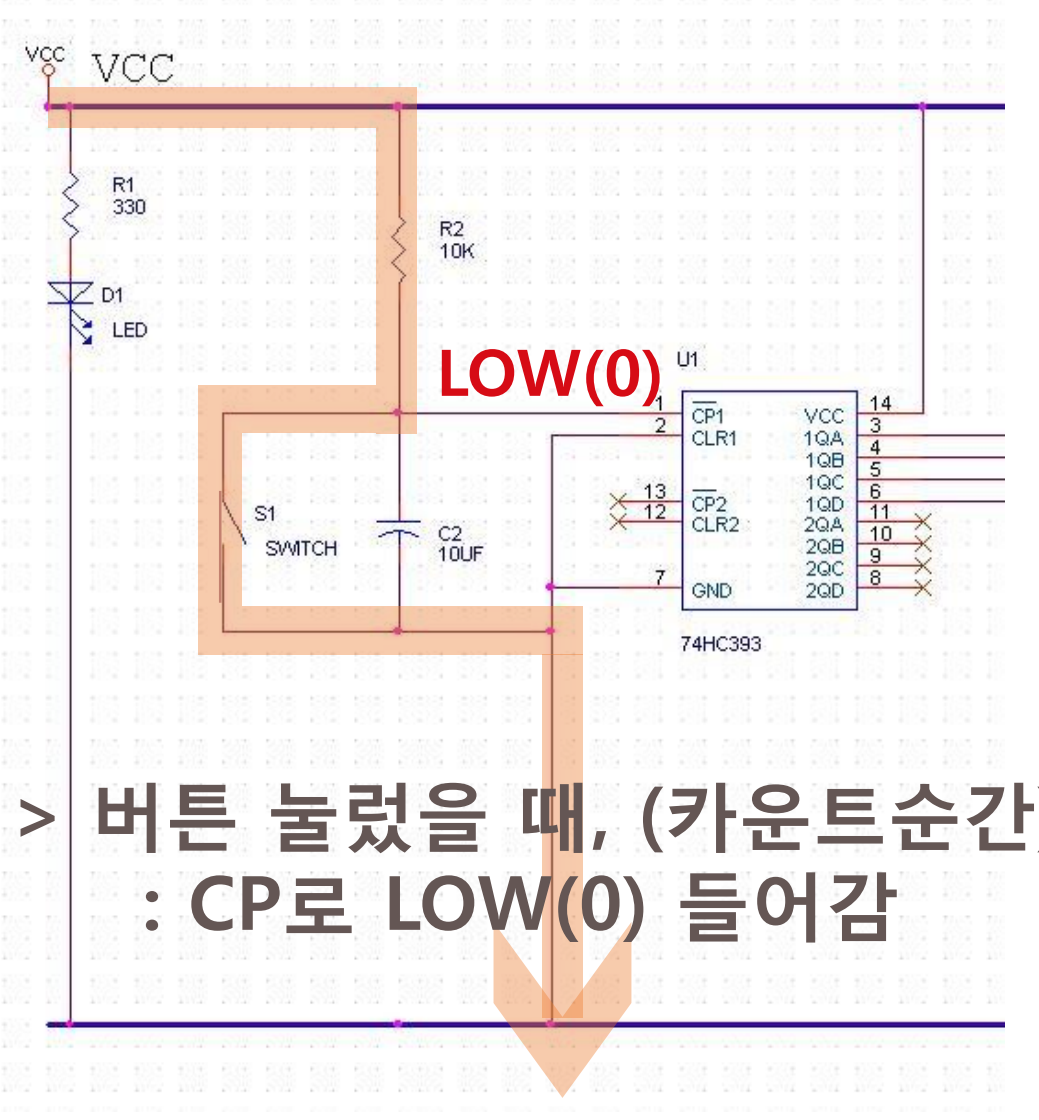
동작원리_스위치+74HC393 파트



동작원리_스위치+74HC393 파트



> 버튼 안눌렀을 때, (평소상태)
> : CP로 HIGH(1) 들어감



> 버튼 눌렀을 때, (카운트순간)
> : CP로 LOW(0) 들어감

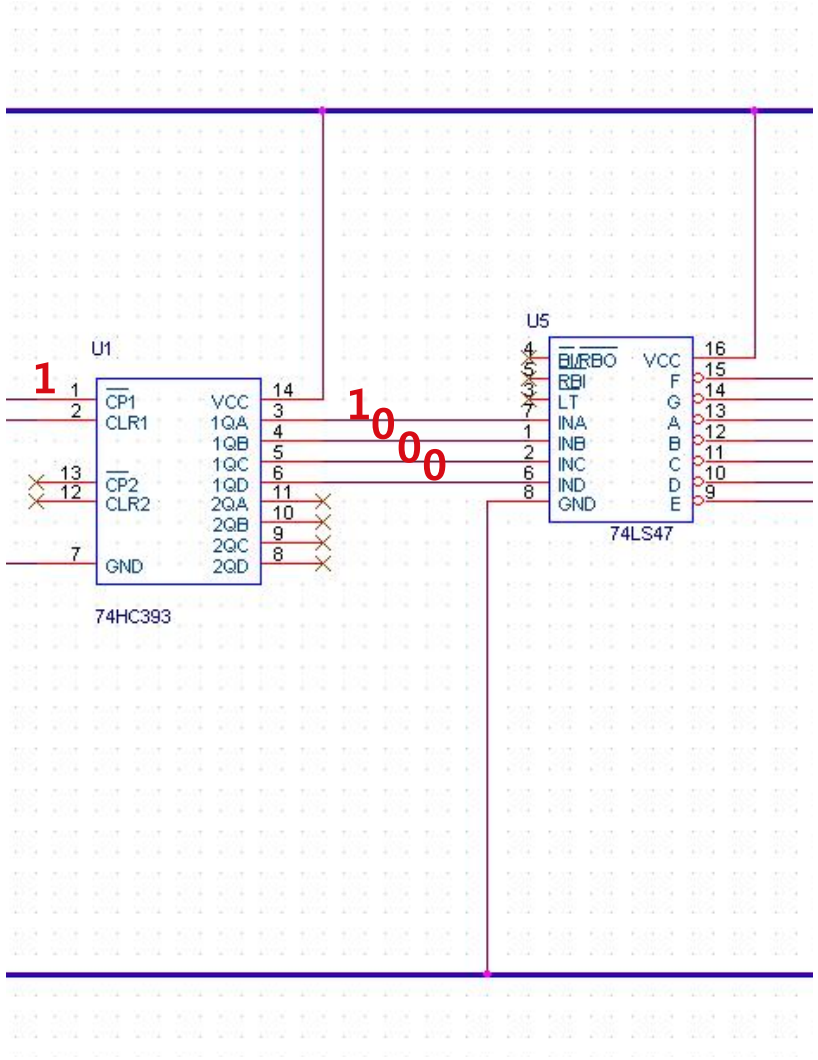
동작원리_74HC393 + 74LS47 파트

COUNT SEQUENCE FOR 1 COUNTER

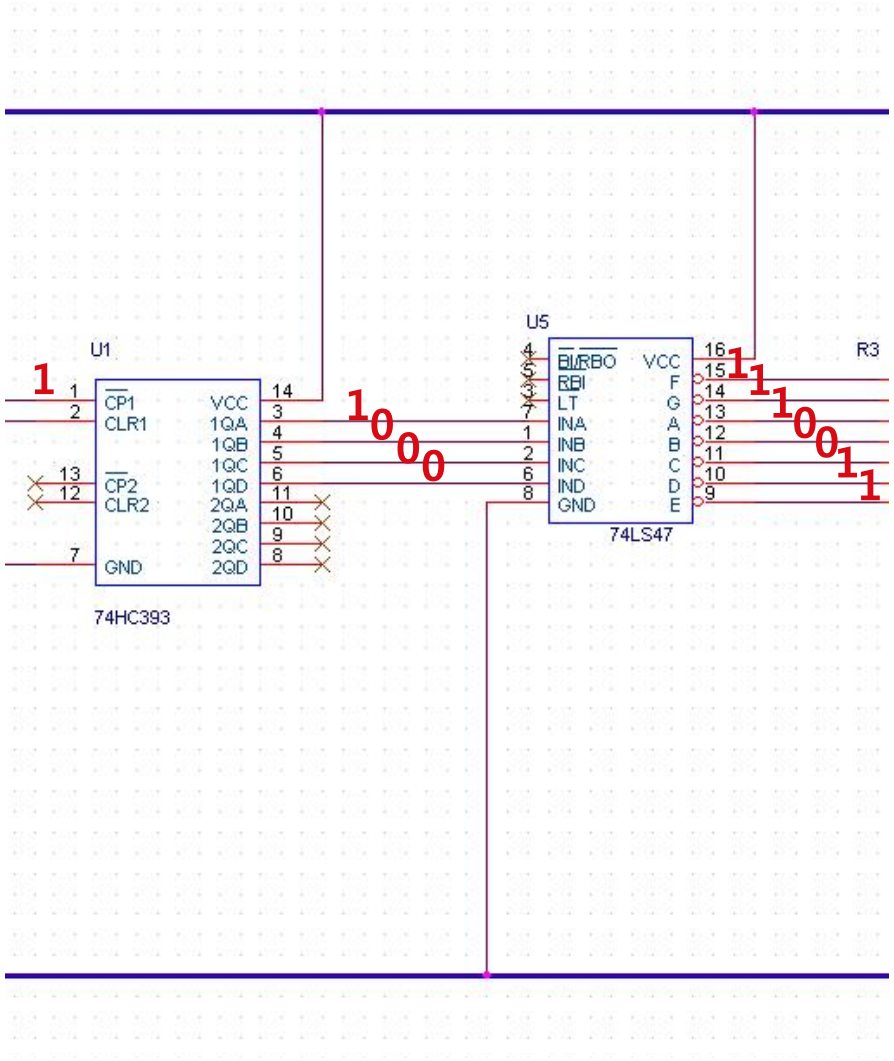
COUNT	OUTPUTS			
	Q_0	Q_1	Q_2	Q_3
0	L	L	L	L
1	H	L	L	L
2	L	H	L	L
3	H	H	L	L
4	L	L	H	L
5	H	L	H	L
6	L	H	H	L
7	H	H	H	L
8	L	L	L	H
9	H	L	L	H
10	L	H	L	H
11	H	H	L	H
12	L	L	H	H
13	H	L	H	H
14	L	H	H	H
15	H	H	H	H

Notes

1. H = HIGH voltage level
   L = LOW voltage level



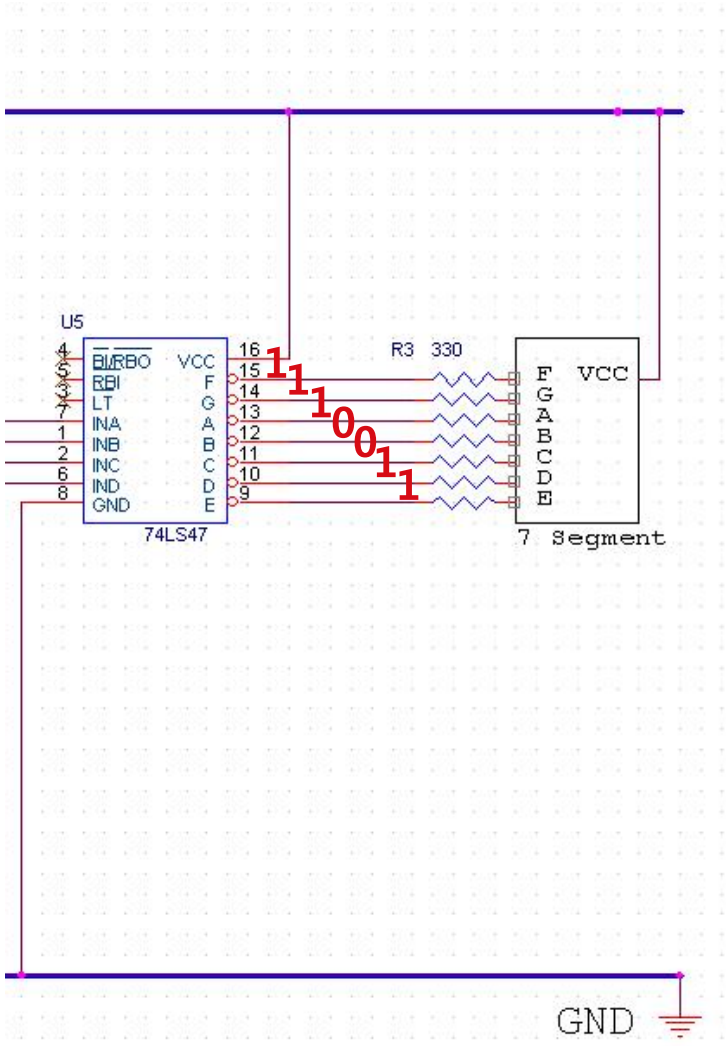
동작원리_74HC393 + 74LS47 파트



Truth Table

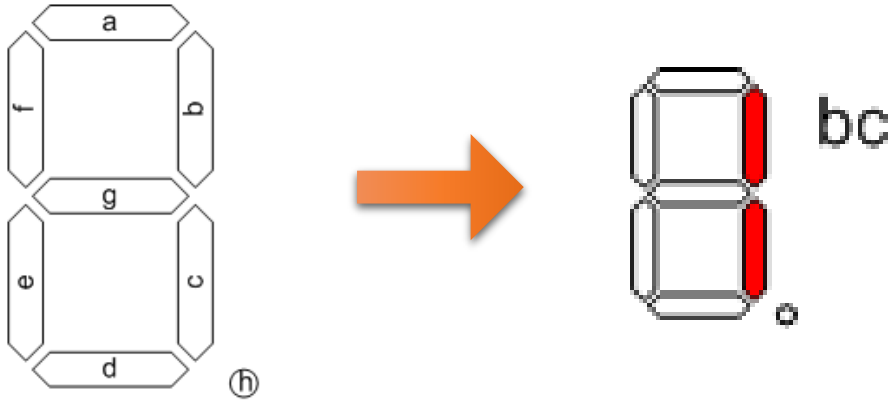
Decimal or Function	Inputs							Outputs							Note
	$\overline{LT}$	$\overline{RBI}$	A3	A2	A1	A0	$\overline{BI/RBO}$	$\overline{a}$	$\overline{b}$	$\overline{c}$	$\overline{d}$	$\overline{e}$	$\overline{f}$	$\overline{g}$	
0	H	H	L	L	L	L	H	L	L	L	L	L	L	H	(Note 2)
1	H	X	L	L	L	H	H	H	L	L	H	H	H	H	(Note 2)
2	H	X	L	L	H	L	H	L	L	H	L	L	H	L	
3	H	X	L	L	H	H	H	L	L	L	L	H	H	L	

동작원리_74HC393 + 7 segment 파트



Truth Table

Decimal or Function	Inputs							Outputs							Note
	$\overline{LT}$	$\overline{RBI}$	A3	A2	A1	A0	$\overline{BI/RBO}$	$\overline{a}$	$\overline{b}$	$\overline{c}$	$\overline{d}$	$\overline{e}$	$\overline{f}$	$\overline{g}$	
0	H	H	L	L	L	L	H	L	L	L	L	L	L	H	(Note 2)
1	H	X	L	L	L	H	H	H	L	L	H	H	H	H	(Note 2)
2	H	X	L	L	H	L	H	L	L	H	L	L	H	L	
3	H	X	L	L	H	H	H	L	L	L	L	H	H	L	



오늘은 이것만 기억하자능

- ✓ 납땜 연습
- ✓ VCC, GND 개념 (+둘이 연결되면 과전류가 흘러요)
- ✓ 디지털 세계에선 5V랑 4.5V의 차이를 몰라요
  - > HIGH(1)
  - > LOW(0)
- ✓ 검갈빨주노초파보회흰 / 330 = 주주갈
- ✓ www.alldatasheet.com
  cafe.naver.com/carroty
  robotics.ssu.ac.kr

참고

- ✓ 74HC393 datasheet
  http://pdf1.alldatasheet.co.kr/datasheet-pdf/view/15596/PHILIPS/74HC393.html
- ✓ 74LS47 datasheet
  http://pdf1.alldatasheet.co.kr/datasheet-pdf/view/51080/FAIRCHILD/74LS47.html
- ✓ 위키백과
  https://ko.wikipedia.org/
- ✓ 구글 (사진 다운)
  www.google.co.kr
- ✓ VCC, GND에 대해
  http://blog.naver.com/as_start/40004532871
- ✓ 캐패시터에 대해
  http://www.headphoneamp.co.kr/53685

참고

- ✓ 전원부 (VCC-GND간의) 쇼트 관련
  http://blog.naver.com/ajoo92/150177001805

- ✓ 풀업/풀다운 저항 관련
  http://rainer.tistory.com/77
  http://www.kocoafab.cc/tutorial/view/526

- ✓ 2진 리플 카운터
  http://rnrlehddl.tistory.com/169
  http://artoa.hanbat.ac.kr/lecture_data/digital_system/19.pdf

Q&A

감사합니다