Digital Electronics 2
Lab 1

Circuit Schematic

VCC
5.0V

S1

R1 10kΩ R2 10kΩ R3 10kΩ R4 10kΩ

C1_0 XNOR1_0
S1_0
XNOR2
C1_1 XNOR1_1
S1_1
XNOR2
C1_2 XNOR1_2
S1_2
XNOR2
C1_3 XNOR1_3
S1_3
XNOR2

BCD: 1000
MATCH_BCD1
AND4

S2

R5 10kΩ R6 10kΩ R7 10kΩ R8 10kΩ

C2_0 XNOR2_0
S2_0
XNOR2
C2_1 XNOR2_1
S2_1
XNOR2
C2_2 XNOR2_2
S2_2
XNOR2
C2_3 XNOR2_3
S2_3
XNOR2

BCD: 0100
MATCH_BCD2
AND4

MATCH_CODE
AND3

S3

R9 10kΩ R10 10kΩ R11 10kΩ R12 10kΩ

C3_0 XNOR3_0
S3_0
XNOR2
C3_1 XNOR3_1
S3_1
XNOR2
C3_2 XNOR3_2
S3_2
XNOR2
C3_3 XNOR3_3
S3_3
XNOR2

BCD: 0111
MATCH_BCD3
AND4

PB
Key = Space

R21 10kΩ

VALIDATION
AND2

U18 NOT

R14 330Ω

LED1_PROBE
2.5V R13 330Ω LED1 LED

LED2_PROBE
2.5V R15 330Ω LED2 LED

7SEG
CK
A B C D E F G H

R16 330Ω
R17 330Ω
R18 330Ω
R19 330Ω
R20 330Ω

Truth Table + Boolean Expressions

| MATCH_CODE	PUSH BUTTON	LED1	LED2	UNLOCKED / "U" (7seg: b, c, d, e, f)	LOCKED / "-" (7seg: g)
0	0	0	0	0	1
0	1	0	0	0	1
1	0	1	0	0	1
1	1	1	1	1	0

Let "M" be MATCH_CODE and P be "PUSHBUTTON"...
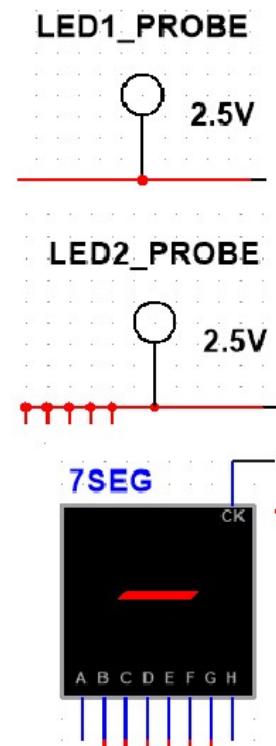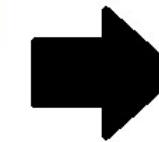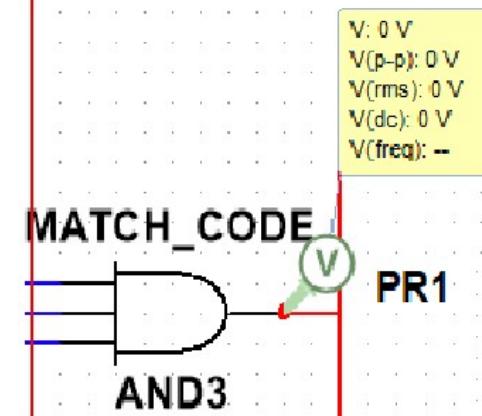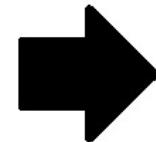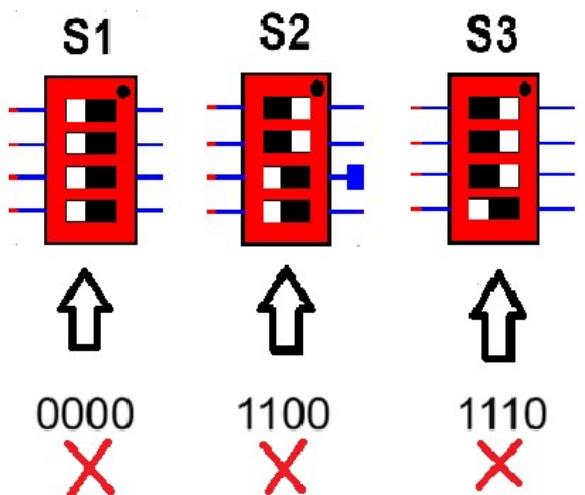
LED1 = M
LED2 = MP
UNLOCKED = MP
LOCKED = $\overline{M} + \overline{P}$

Case 1

- If any of the BCD codes are entered
incorrectly, MATCH_CODE remains at logic
LOW and therefore both LEDs do not light up
and the 7seg display indicates a locked state

(Correct code = 847 or 1000 0100 0111 in BCD)

S1   **S2**   **S3**

0000   1100   1110
✗   ✗   ✗

V: 0 V
V(p–p): 0 V
V(rms): 0 V
V(dc): 0 V
V(freq): --

MATCH_CODE

PR1

AND3

LED1_PROBE

2.5V

LED2_PROBE

2.5V

7SEG

CK

A B C D E F G H
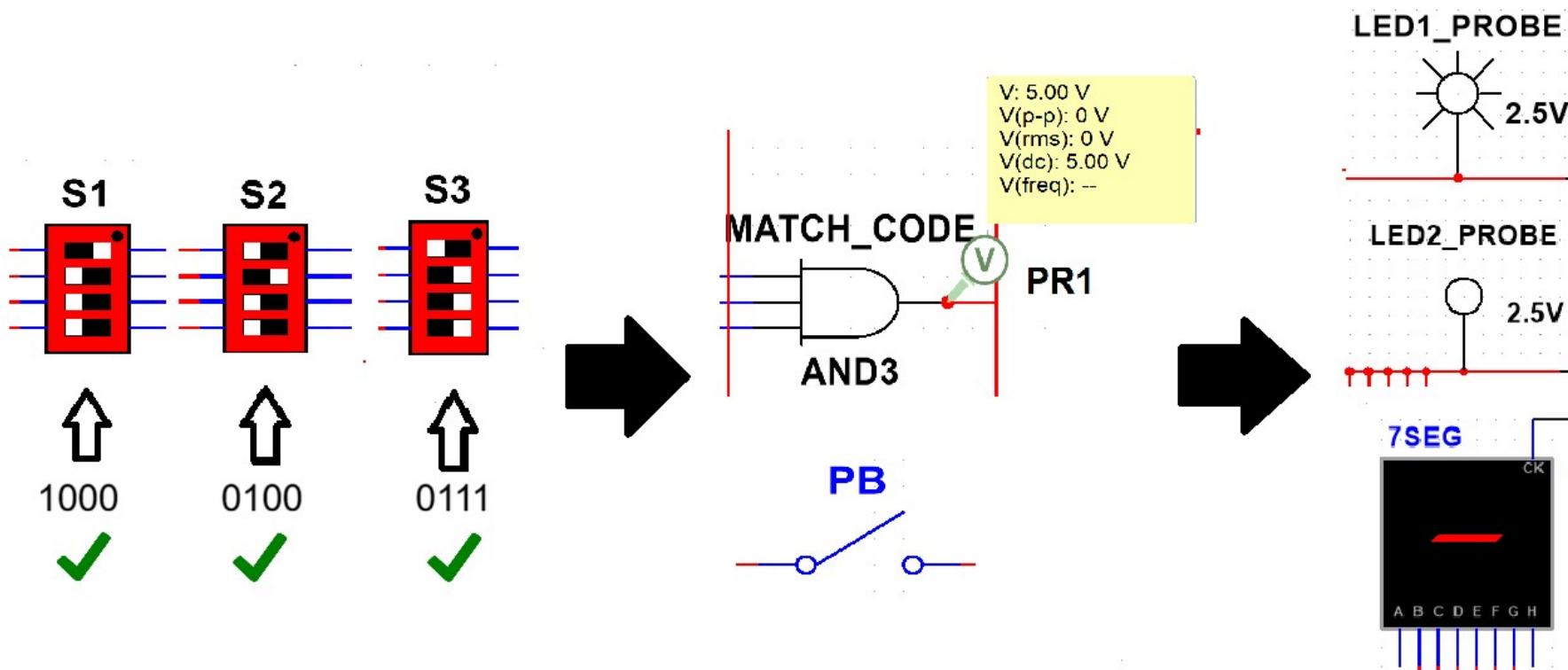
Case 2

Each DIP switch matches its correct BCD code, therefore MATCH_CODE produces logic HIGH and LED1 lights up. However, the push button (PB) remains open and as such, LED2 still does not light up and the 7segment display still indicates a locked state

(Correct code = 847 or 1000 0100 0111 in BCD)

Case 3

Each DIP switch matches its correct BCD code, therefore MATCH_CODE produces logic HIGH. Also, the pushbutton (PB) is closed and as such allows the "VALIDATION" AND gate to produce logic HIGH. Now, LED2 lights up and the 7segment display shows the letter U (segments b-f)

(Correct code = 847 or 1000 0100 0111 in BCD)