|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| BOOT | | | | | | | | | | | |
| State | **Inputs** | | | | **Next state** | | | **Outputs** | | | |
| ABC | SW1 | SW2 | SW3 | SW4 | A | B | C | Led1 | Led2 | Led3 | Led4 |
| 000 | X | 0 | X | X | 0 | 1 | 0 | 0 | | | |
| X | 1 | X | X | 0 | 0 | 1 |

* **Equations:**

**States:**

A = 0

B = SW2’ (A’B’C’)

C = SW2 (A’B’C’)

**LEDs:**

Led1 = 0

Led2 = 0

Led3 = 0

Led4 = 0

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Locked | | | | | | | | | | | |
| State | **Inputs** | | | | **Next state** | | | **Outputs** | | | |
| ABC | SW1 | SW2 | SW3 | SW4 | A | B | C | Led1 | Led2 | Led3 | Led4 |
| 001 | 0 | 0 | 0 | 0 | 001 | | | 0 | 0 | 0 | 0 |
| 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 |
| 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 |
| 0 | 0 | 1 | 1 | 0 | 0 | 1 | 1 |
| 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 |
| 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 |
| 0 | 1 | 1 | 0 | 0 | 1 | 1 | 0 |
| 0 | 1 | 1 | 1 | 0 | 1 | 1 | 1 |
| 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 |
| 1 | 0 | 0 | 1 | 1 | 0 | 0 | 1 |
| 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 |
| 1 | 0 | 1 | 1 | 1 | 0 | 1 | 1 |
| 1 | 1 | 0 | 0 | 1 | 1 | 0 | 0 |
| 1 | 1 | 0 | 1 | 1 | 1 | 0 | 1 |
| 1 | 1 | 1 | 0 | 1 | 1 | 1 | 0 |
| 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |

* **Equations:**

**States:**

A = 0

B = 0

C = 1 (A’B’C)

**LEDs:**

Led1 = SW1 (A’B’C)

Led2 = SW2 (A’B’C)

Led3 = SW3 (A’B’C)

Led4 = SW4 (A’B’C)

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| State | Flag | | Next state | | | Outputs | | | |
| ABC | F1 | F2 | A | B | C | Led1 | Led2 | Led3 | Led4 |
| 010 | 0 | 0 | 0 | 1 | 1 | 0 | | | |
| 0 | 1 | 1 | 0 | 0 |
| 1 | 0 | 1 | 0 | 1 |
| 1 | 1 | 1 | 1 | 0 |

The switches are don’t cares

* **Equations:**

**States:**

A = (F1+F2) (A’BC’)

B = ((F1.F2) + (F1’.F2’)) (A’BC’) or (F1 XNOR F2)(A’BC’)

C = F2’ (A’BC’)

**LEDs:**

Led1 = 0

Led2 = 0

Led3 = 0

Led4 = 0

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Sequence 1 | | | | | | | | | | | | |  |
| State | |  | **Inputs** | | | | **Next state** | | | **Outputs** | | | |  |
| ABC | | Treset | SW1 | SW2 | SW3 | SW4 | A | B | C | Led1 | Led2 | Led3 | Led4 | Flag |
| 011 | | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 |  |
| 1 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 |  |
| 0 | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 0 | 0 | 0 | 1 | 11 |
| 0 | 0 | 0 | 1 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 0 | 10 |
| 0 | 0 | 0 | 1 | 1 | 0 | 1 | 1 | 0 | 0 | 1 | 1 |  |
| 0 | 0 | 1 | 0 | 0 | 0 | 1 | 1 | 0 | 1 | 0 | 0 | 01 |
| 0 | 0 | 1 | 0 | 1 | 0 | 1 | 1 | 0 | 1 | 0 | 1 |  |
| 0 | 0 | 1 | 1 | 0 | 0 | 1 | 1 | 0 | 1 | 1 | 0 |  |
| 0 | 0 | 1 | 1 | 1 | 0 | 1 | 1 | 0 | 1 | 1 | 1 |  |
| 0 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 00 |
| 0 | 1 | 0 | 0 | 1 | 0 | 1 | 1 | 1 | 0 | 0 | 1 |  |
| 0 | 1 | 0 | 1 | 0 | 0 | 1 | 1 | 1 | 0 | 1 | 0 |  |
| 0 | 1 | 0 | 1 | 1 | 0 | 1 | 1 | 1 | 0 | 1 | 1 |  |
| 0 | 1 | 1 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 0 |  |
| 0 | 1 | 1 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 0 | 1 |  |
| 0 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 0 |  |
| 0 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 |  |

* **Equations:**

**States:**

A = 0

B = 1 (A’BC)

C = Treset’ (A’BC)

**LEDs:**

Led1 = SW1 (A’BC)

Led2 = SW2 (A’BC)

Led3 = SW3 (A’BC)

Led4 = SW4 (A’BC)

**Flag:**

F1 = 1’2’3’4 + 1’2’34’

F2 = 1’2’3’4 + 1’23’4’

-Use a flipflop to store the values with an enabler of (12'3'4' + 1'23'4' + 1'2'34' + 1'2'3'4) (since they will disappear when you change the switches)

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Sequence 2 | | | | | | | | | | | | |
| State | |  | **Inputs** | | | | **Next state** | | | **Outputs** | | | |
| ABC | | Treset | SW1 | SW2 | SW3 | SW4 | A | B | C | Led1 | Led2 | Led3 | Led4 |
| 100 | | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 |
| 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 0 | 0 | 0 |
| 0 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 |
| 0 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 1 | 0 | 0 | 1 |
| 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 0 |
| 0 | 0 | 1 | 0 | 1 | 1 | 0 | 0 | 1 | 0 | 1 | 0 |
| 0 | 0 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 1 |
| 0 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 0 | 1 | 1 |
| 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 |
| 0 | 1 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 1 | 0 | 0 |
| 0 | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 1 |
| 0 | 1 | 0 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 0 | 1 |
| 0 | 1 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 1 | 0 |
| 0 | 1 | 1 | 0 | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 0 |
| 0 | 1 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 1 | 1 | 1 |
| 0 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 1 |

* **Equations:**

**States:**

A = Treset’(AB’C’)

B = Treset (AB’C’)

C = 0

**LEDs:**

Led1 = 4(AB’C’)

Led2 = 1(AB’C’)

Led3 = 2(AB’C’)

Led4 = 3(AB’C’)

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Sequence 3 | | | | | | | | | | | | |
| State | |  | **Inputs** | | | | **Next state** | | | **Outputs** | | | |
| ABC | | Treset | SW1 | SW2 | SW3 | SW4 | A | B | C | Led1 | Led2 | Led3 | Led4 |
| 101 | | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 |
| 1 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 |
| 0 | 0 | 0 | 0 | 1 | 1 | 0 | 1 | 0 | 1 | 0 | 0 |
| 0 | 0 | 0 | 1 | 0 | 1 | 0 | 1 | 1 | 0 | 0 | 0 |
| 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 |
| 0 | 0 | 1 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 1 |
| 0 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 1 |
| 0 | 0 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 1 |
| 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 |
| 0 | 1 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 1 | 0 |
| 0 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 0 |
| 0 | 1 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 0 | 1 | 0 |
| 0 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 |
| 0 | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 1 | 1 |
| 0 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 1 |
| 0 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 0 | 1 | 1 |
| 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 1 |

* **Equations:**

**States:**

A = Treset’ (AB’C)

B = (Treset + 12 + 13 + 14 + 23 + 24 +34) (AB’C)

C = Treset’ (AB’C)

**LEDs:**

Led1 = 3(AB’C)

Led2 = 4(AB’C)

Led3 = 1(AB’C)

Led4 = 2(AB’C)

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Sequence 4 | | | | | | | | | | | | |
| State | |  | **Inputs** | | | | **Next state** | | | **Outputs** | | | |
| ABC | | Treset | SW1 | SW2 | SW3 | SW4 | A | B | C | Led1 | Led2 | Led3 | Led4 |
| 110 | | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 |
| 1 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 |
| 0 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 1 | 0 | 0 | 0 |
| 0 | 0 | 0 | 1 | 0 | 1 | 1 | 0 | 0 | 1 | 0 | 0 |
| 0 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 0 | 0 |
| 0 | 0 | 1 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 1 | 0 |
| 0 | 0 | 1 | 0 | 1 | 1 | 1 | 0 | 1 | 0 | 1 | 0 |
| 0 | 0 | 1 | 1 | 0 | 1 | 1 | 0 | 0 | 1 | 1 | 0 |
| 0 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 0 |
| 0 | 1 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 1 |
| 0 | 1 | 0 | 0 | 1 | 1 | 1 | 0 | 1 | 0 | 0 | 1 |
| 0 | 1 | 0 | 1 | 0 | 1 | 1 | 0 | 0 | 1 | 0 | 1 |
| 0 | 1 | 0 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 0 | 1 |
| 0 | 1 | 1 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 1 | 1 |
| 0 | 1 | 1 | 0 | 1 | 1 | 1 | 0 | 1 | 0 | 1 | 1 |
| 0 | 1 | 1 | 1 | 0 | 1 | 1 | 0 | 0 | 1 | 1 | 1 |
| 0 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 1 | 1 |

* **Equations:**

**States:**

A = Treset’ (ABC’)

B = 1 (ABC’)

C = 0

**LEDs:**

Led1 = 4(ABC’)

Led2 = 3(ABC’)

Led3 = 2(ABC’)

Led4 = 1(ABC’)

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Special Trick | | | | | | | | | | | | |
| State | |  | **Inputs** | | | | **Next state** | | | **Outputs** | | | |
| ABC | | Treset | SW1 | SW2 | SW3 | SW4 | A | B | C | Led1 | Led2 | Led3 | Led4 |
| 111 | | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 0 |
| 1 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 |
| 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 0 |
| 0 | 0 | 0 | 1 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 0 |
| 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 0 |
| 0 | 0 | 1 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 1 |
| 0 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 1 |
| 0 | 0 | 1 | 1 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 1 |
| 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 1 |
| 0 | 1 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 1 | 0 |
| 0 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 0 |
| 0 | 1 | 0 | 1 | 0 | 1 | 1 | 1 | 0 | 0 | 1 | 0 |
| 0 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 0 |
| 0 | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 1 | 1 |
| 0 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 1 |
| 0 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 0 | 0 | 1 | 1 |
| 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 1 |

* **Equations:**

**States:**

A = C = Treset’ (ABC)

B = 1 (ABC)

**LEDs:**

Led1 = 0

Led2 = 4(ABC)

Led3 = 1(ABC)

Led4 = 2(ABC)

Treset:

Input I is = (1 + 2 + 3 + 4)' (A'B'C' + A'B'C + A'BC')'

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  |  |  |  |  |  |
| Present State | | **Input** | **Next State** | | **Output** |
| A | B | I | A | B | Y |
| 0 | 0 | 0 | 0 | 0 | 0 |
| 0 | 0 | 1 | 0 | 1 | 0 |
| 0 | 1 | 0 | 0 | 0 | 0 |
| 0 | 1 | 1 | 1 | 0 | 0 |
| 1 | 0 | 0 | 0 | 0 | 0 |
| 1 | 0 | 1 | 1 | 1 | 0 |
| 1 | 1 | 0 | 0 | 0 | 0 |
| 1 | 1 | 1 | 1 | 1 | 1 |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **BI**  **A** | 00 | 01 | 11 | 10 |
| **0** | 0 | 0 | 1 | 0 |
| **1** | 0 | 1 | 1 | 0 |

We derive the equation for A:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **BI**  **A** | 00 | 01 | 11 | 10 |
| **0** | 0 | 1 | 0 | 0 |
| **1** | 0 | 1 | 1 | 0 |

We derive the equation for B:

We derive the equation for Y:

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Inputs | | | Display | | | | | | |
| A | **B** | **C** | **a** | **b** | **c** | **d** | **e** | **f** | **g** |
| 0 | 0 | 0 | X | X | X | X | X | X | X |
| 0 | 0 | 1 | X | X | X | X | X | X | X |
| 0 | 1 | 0 | X | X | X | X | X | X | X |
| 0 | 1 | 1 | 0 | 1 | 1 | 0 | 0 | 0 | 0 |
| 1 | 0 | 0 | 1 | 1 | 0 | 1 | 1 | 0 | 1 |
| 1 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 1 |
| 1 | 1 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 1 |
| 1 | 1 | 1 | X | X | X | X | X | X | X |

a=d

b=1

c=e’

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Output a | | | |
|  | **00** | **01** | **11** | **10** |
| **0**  **A** | x | x | 0 | x |
| **1**  **BC** | 1 | 1 | x | 0 |

From this Karnaugh Map, we get the following equation for Output a and d:

a= d = B’

b = 1

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Output c | | | |
|  | **00** | **01** | **11** | **10** |
| **0**  **A** | x | X | 1 | x |
| **1**  **BC** | 0 | 1 | X | 1 |

From this Karnaugh Map,

we get the following equation for Output c :

c =  B+C

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Output f | | | |
|  | **00** | **01** | **11** | **10** |
| **0** | x | x | 0 | x |
| **1** | 0 | 0 | X | 1 |

From this Karnaugh Map, we get the following equation for Output f:

f = BC’

**A**

**BC**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Output e | | | |
|  | **00** | **01** | **11** | **10** |
| **0**  **A** | x | X | 0 | X |
| **1**  **BC** | 1 | 0 | **X** | **0** |

From this Karnaugh Map, we get the following equation for Output e:

e = (B+C)’ =B’C’

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Output g | | | |
|  | **00** | **01** | **11** | **10** |
| **0** | x | x | 0 | x |
| **1** | 1 | 1 | X | 1 |

From this Karnaugh Map, we get the following equation for Output g:

g = A

**A**

**BC**