Jefferson Bui

CMPEN 271

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HW #5

# BCD to 7-Segment Display

Design a minimum BCD to 7-segment LED display decoder circuit. The input is a 4-bit BCD value, and there are 7 outputs –one output for each segment of the 7-segment display. The circuit should generate the appropriate display on the 7-segment display for each input BCD value. If the output for a given display segment is 1, then assume the display segment will be illuminated, otherwise the segment will be dark. Use output labels as provided below. Include truth table, K-maps, circuit.

Truth Table

Inputs: Outputs:

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| A  (MSB) | B | C | D  (LSB) | A | B | C | D | E | F | G |
| 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 0 |
| 0 | 0 | 0 | 1 | 0 | 1 | 1 | 0 | 0 | 0 | 0 |
| 0 | 0 | 1 | 0 | 1 | 1 | 0 | 1 | 1 | 0 | 1 |
| 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 1 |
| 0 | 1 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 1 |
| 0 | 1 | 0 | 1 | 1 | 0 | 1 | 1 | 0 | 1 | 1 |
| 0 | 1 | 1 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 1 |
| 0 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 |
| 1 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 1 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 1 |
| 1 | 0 | 1 | 0 | X | X | X | X | X | X | X |
| 1 | 0 | 1 | 1 | X | X | X | X | X | X | X |
| 1 | 1 | 0 | 0 | X | X | X | X | X | X | X |
| 1 | 1 | 0 | 1 | X | X | X | X | X | X | X |
| 1 | 1 | 1 | 0 | X | X | X | X | X | X | X |
| 1 | 1 | 1 | 1 | X | X | X | X | X | X | X |

K-Map A:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | C’D’ | C’D | CD | CD’ |
| A’B’ | 1 | 0 | 1 | 1 |
| A’B | 0 | 1 | 1 | 1 |
| AB | X | X | X | X |
| AB’ | 1 | 1 | X | X |

F = C + A + BD + B’D’

K-Map B:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | C’D’ | C’D | CD | CD’ |
| A’B’ | 1 | 1 | 1 | 1 |
| A’B | 1 | 0 | 1 | 0 |
| AB | X | X | X | X |
| AB’ | 1 | 1 | X | X |

F = B’ + C’D’ + CD

K-Map C:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | C’D’ | C’D | CD | CD’ |
| A’B’ | 1 | 1 | 1 | 0 |
| A’B | 1 | 1 | 1 | 1 |
| AB | X | X | X | X |
| AB’ | 1 | 1 | X | X |

F = C’ + D + B

K-Map D:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | C’D’ | C’D | CD | CD’ |
| A’B’ | 1 | 0 | 1 | 1 |
| A’B | 0 | 1 | 0 | 1 |
| AB | X | X | X | X |
| AB’ | 1 | 0 | X | X |

F = BC’D + B’D’ + CD’ + B’C

K-Map E:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | C’D’ | C’D | CD | CD’ |
| A’B’ | 1 | 0 | 0 | 1 |
| A’B | 0 | 0 | 0 | 1 |
| AB | X | X | X | X |
| AB’ | 1 | 0 | X | X |

F = B’D’ + CD’

K-Map F:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | C’D’ | C’D | CD | CD’ |
| A’B’ | 1 | 0 | 0 | 0 |
| A’B | 1 | 1 | 0 | 1 |
| AB | X | X | X | X |
| AB’ | 1 | 1 | X | X |

F = C’D’ + A + BC’ + BD’

K-Map G:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | C’D’ | C’D | CD | CD’ |
| A’B’ | 0 | 0 | 1 | 1 |
| A’B | 1 | 1 | 0 | 1 |
| AB | X | X | X | X |
| AB’ | 1 | 1 | X | X |

F = BC’ + B’C + CD’ + A

Circuit:



Test Cases (0-9):



















