Truth table for 4 inputs and 7 outputs. The output values in the bottom 6 rows (decimal input values 10 – 15) are marked ‘d’ because it does not matter what the output is for these inputs.

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| z | y | x | w | 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 | 1 | 0 | 1 | 1 |
| 1 | 0 | 1 | 0 | d | d | d | d | d | d | d |
| 1 | 0 | 1 | 1 | d | d | d | d | d | d | d |
| 1 | 1 | 0 | 0 | d | d | d | d | d | d | d |
| 1 | 1 | 0 | 1 | d | d | d | d | d | d | d |
| 1 | 1 | 1 | 0 | d | d | d | d | d | d | d |
| 1 | 1 | 1 | 1 | d | d | d | d | d | d | d |

Karnaugh maps for each of the outputs:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| a | xw | | | | |
| zy |  | 00 | 01 | 11 | 10 |
| 00 | 1 |  | 1 | 1 |
| 01 |  | 1 | 1 | 1 |
| 11 | d | d | d | d |
| 10 | 1 | 1 | d | d |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| b | xw | | | | |
| zy |  | 00 | 01 | 11 | 10 |
| 00 | 1 | 1 | 1 | 1 |
| 01 | 1 |  | 1 |  |
| 11 | d | d | d | d |
| 10 | 1 | 1 | d | d |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| c | xw | | | | |
| zy |  | 00 | 01 | 11 | 10 |
| 00 | 1 | 1 | 1 |  |
| 01 | 1 | 1 | 1 | 1 |
| 11 | d | d | d | d |
| 10 | 1 | 1 | d | d |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| d | xw | | | | |
| zy |  | 00 | 01 | 11 | 10 |
| 00 | 1 |  | 1 | 1 |
| 01 |  | 1 |  | 1 |
| 11 | d | d | d | d |
| 10 | 1 | 1 | d | d |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| e | xw | | | | |
| zy |  | 00 | 01 | 11 | 10 |
| 00 | 1 |  |  | 1 |
| 01 |  |  |  | 1 |
| 11 | d | d | d | d |
| 10 | 1 |  | d | d |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| f | xw | | | | |
| zy |  | 00 | 01 | 11 | 10 |
| 00 | 1 |  |  |  |
| 01 | 1 | 1 |  | 1 |
| 11 | d | d | d | d |
| 10 | 1 | 1 | d | d |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| g | xw | | | | |
| zy |  | 00 | 01 | 11 | 10 |
| 00 |  |  | 1 | 1 |
| 01 | 1 | 1 |  | 1 |
| 11 | d | d | d | d |
| 10 | 1 | 1 | d | d |

AND gates which are repeated and can therefore be reused in the circuit:

|  |  |  |  |
| --- | --- | --- | --- |
|  |  |  |  |
| a, d, e | d, e, g | d, g | f, g |

Screen-prints of the circuit showing each of the 10 decimal digits on the 7-segment display for the relevant binary input.



















