

## Code Converters – Binary to/from Gray Code

| Binary         |                |                |                | Gray Code      |                |                |                |
|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|
| b <sub>3</sub> | b <sub>2</sub> | b <sub>1</sub> | b <sub>0</sub> | g <sub>3</sub> | g <sub>2</sub> | g <sub>1</sub> | g <sub>0</sub> |
| 0              | 0              | 0              | 0              | 0              | 0              | 0              | 0              |
| 0              | 0              | 0              | 1              | 0              | 0              | 0              | 1              |
| 0              | 0              | 1              | 0              | 0              | 0              | 1              | 1              |
| 0              | 0              | 1              | 1              | 0              | 0              | 1              | 0              |
| 0              | 1              | 0              | 0              | 0              | 1              | 1              | 0              |
| 0              | 1              | 0              | 1              | 0              | 1              | 1              | 1              |
| 0              | 1              | 1              | 0              | 0              | 1              | 0              | 1              |
| 0              | 1              | 1              | 1              | 0              | 1              | 0              | 0              |
| 1              | 0              | 0              | 0              | 1              | 1              | 0              | 0              |
| 1              | 0              | 0              | 1              | 1              | 1              | 0              | 1              |
| 1              | 0              | 1              | 0              | 1              | 1              | 1              | 1              |
| 1              | 0              | 1              | 1              | 1              | 1              | 1              | 0              |
| 1              | 1              | 0              | 0              | 1              | 0              | 1              | 0              |
| 1              | 1              | 0              | 1              | 1              | 0              | 1              | 1              |
| 1              | 1              | 1              | 0              | 1              | 0              | 0              | 1              |
| 1              | 1              | 1              | 1              | 1              | 0              | 0              | 0              |

To find the corresponding digital circuit, we will use the K-Map technique for each of the gray code bits as output with all of the binary bits as input.

|                                |    |                                |    |    |    |
|--------------------------------|----|--------------------------------|----|----|----|
|                                |    | b <sub>1</sub> ,b <sub>0</sub> |    |    |    |
|                                |    | 00                             | 01 | 11 | 10 |
| b <sub>3</sub> ,b <sub>2</sub> | 00 | 0                              | 1  | 0  | 1  |
|                                | 01 | 0                              | 1  | 0  | 1  |
|                                | 11 | 0                              | 1  | 0  | 1  |
|                                | 10 | 0                              | 1  | 0  | 1  |

|                                |    |                                |    |    |    |
|--------------------------------|----|--------------------------------|----|----|----|
|                                |    | b <sub>1</sub> ,b <sub>0</sub> |    |    |    |
|                                |    | 00                             | 01 | 11 | 10 |
| b <sub>3</sub> ,b <sub>2</sub> | 00 | 0                              | 0  | 1  | 1  |
|                                | 01 | 1                              | 1  | 0  | 0  |
|                                | 11 | 1                              | 1  | 0  | 0  |
|                                | 10 | 0                              | 0  | 1  | 1  |

|       |    | b1,b0 |    |    |    |
|-------|----|-------|----|----|----|
|       |    | 00    | 01 | 11 | 10 |
| b3,b2 | 00 | 0     | 0  | 0  | 0  |
|       | 01 | 1     | 1  | 1  | 1  |
|       | 11 | 0     | 0  | 0  | 0  |
|       | 10 | 1     | 1  | 1  | 1  |

|       |    | b1,b0 |    |    |    |
|-------|----|-------|----|----|----|
|       |    | 00    | 01 | 11 | 10 |
| b3,b2 | 00 | 0     | 0  | 0  | 0  |
|       | 01 | 0     | 0  | 0  | 0  |
|       | 11 | 1     | 1  | 1  | 1  |
|       | 10 | 1     | 1  | 1  | 1  |

Now you try

| Gray Code |    |    |    | Binary |    |    |    |
|-----------|----|----|----|--------|----|----|----|
| g3        | g2 | g1 | g0 | b3     | b2 | b1 | b0 |
| 0         | 0  | 0  | 0  | 0      | 0  | 0  | 0  |
| 0         | 0  | 0  | 1  | 0      | 0  | 0  | 1  |
| 0         | 0  | 1  | 0  | 0      | 0  | 1  | 1  |
| 0         | 0  | 1  | 1  | 0      | 0  | 1  | 0  |
| 0         | 1  | 0  | 0  | 0      | 1  | 1  | 1  |
| 0         | 1  | 0  | 1  | 0      | 1  | 1  | 0  |
| 0         | 1  | 1  | 0  | 0      | 1  | 0  | 0  |
| 0         | 1  | 1  | 1  | 0      | 1  | 0  | 1  |
| 1         | 0  | 0  | 0  | 1      | 1  | 1  | 1  |
| 1         | 0  | 0  | 1  | 1      | 1  | 1  | 0  |
| 1         | 0  | 1  | 0  | 1      | 1  | 0  | 0  |
| 1         | 0  | 1  | 1  | 1      | 1  | 0  | 1  |
| 1         | 1  | 0  | 0  | 1      | 0  | 0  | 0  |
| 1         | 1  | 0  | 1  | 1      | 0  | 0  | 1  |
| 1         | 1  | 1  | 0  | 1      | 0  | 1  | 1  |
| 1         | 1  | 1  | 1  | 1      | 0  | 1  | 0  |

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| Gray Code      |                |                |                | Binary         |                |                |                |
|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|
| g <sub>3</sub> | g <sub>2</sub> | g <sub>1</sub> | g <sub>0</sub> | b <sub>3</sub> | b <sub>2</sub> | b <sub>1</sub> | b <sub>0</sub> |
| 0              | 0              | 0              | 0              | 0              | 0              | 0              | 0              |
| 0              | 0              | 0              | 1              | 0              | 0              | 0              | 1              |
| 0              | 0              | 1              | 0              | 0              | 0              | 1              | 1              |
| 0              | 0              | 1              | 1              | 0              | 0              | 1              | 0              |
| 0              | 1              | 0              | 0              | 0              | 1              | 1              | 1              |
| 0              | 1              | 0              | 1              | 0              | 1              | 1              | 0              |
| 0              | 1              | 1              | 0              | 0              | 1              | 0              | 0              |
| 0              | 1              | 1              | 1              | 0              | 1              | 0              | 1              |
| 1              | 0              | 0              | 0              | 1              | 1              | 1              | 1              |
| 1              | 0              | 0              | 1              | 1              | 1              | 1              | 0              |
| 1              | 0              | 1              | 0              | 1              | 1              | 0              | 0              |
| 1              | 0              | 1              | 1              | 1              | 1              | 0              | 1              |
| 1              | 1              | 0              | 0              | 1              | 0              | 0              | 0              |
| 1              | 1              | 0              | 1              | 1              | 0              | 0              | 1              |
| 1              | 1              | 1              | 0              | 1              | 0              | 1              | 1              |
| 1              | 1              | 1              | 1              | 1              | 0              | 1              | 0              |

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