SNS COLLEGE OF TECHNOLOGY

Coimbatore-35
An Autonomous Institution

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Approved by AICTE, New Delhi & Affiliated to Anna University, Chennai

DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING

19ECB231 – DIGITAL ELECTRONICS

II YEAR/ III SEMESTER

UNIT 2 – COMBINATIONAL CIRCUITS

TOPIC - CODE CONVERTERS

What is the purpose of code converter?

➢A converter is needed to convert the information in to the code which we need.

➢These are basically encoders and decoders which converts the data in to an encoded form.

➢ Coding is the process of translating the input information which can be understandable by the machine or a particular device.

➢ Coding can be used for security purpose to protect the information from steeling or interrupting.
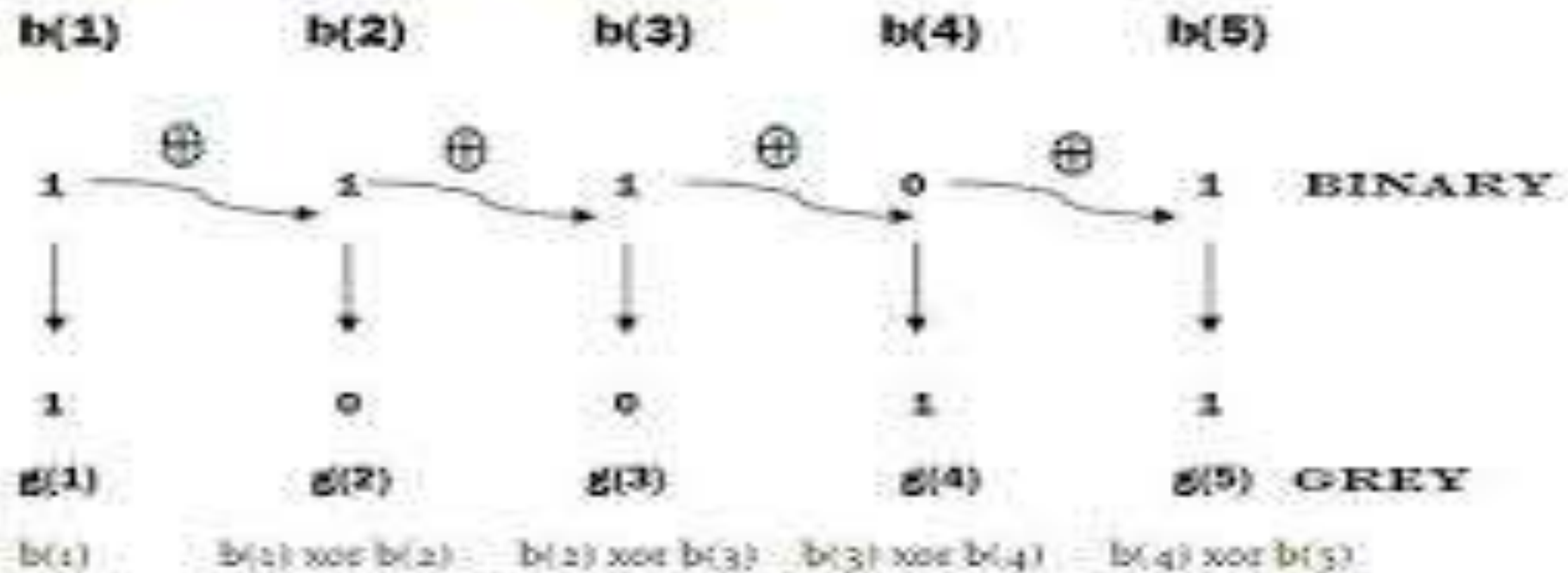
Types of Code Conversion

- Binary to Gray code
- Gray to Binary code
- BCD to Excess-3 code
- Excess-3 to BCD
- BCD to Gray code
- Gray to BCD code

Binary to Grey Code Conversion

Convert the binary 11101_2 to its equivalent Grey code

Binary to Grey Code – Truth Table

Natural-binary code				Gray code			
B3	B2	B1	B0	G3	G2	G1	G0
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

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Binary to Grey Code – K map

➢B3 B2 B1 B0 - inputs

➢G3 G2 G1 G0 - outputs

K-map for G₀

B_3B_2 \ B_1B_0	00	01	11	10
00	0	1	0	1
01	0	1	0	1
11	0	1	0	1
10	0	1	0	1

$$G_0 = B_1' B_0 + B_1 B_0'$$

$$G_0 = B_0 \oplus B_1$$

K-map for G₁

B_3B_2 \ B_1B_0	00	01	11	10
00	0	0	1	1
01	1	1	0	0
11	1	1	0	0
10	0	0	1	1

$$G_1 = B_1' B_2 + B_1 B_2'$$

$$G_2 = B_1 \oplus B_2$$

K-map for G₂

B_3B_2 \ B_1B_0	00	01	11	10
00	0	0	0	0
01	1	1	1	1
11	0	0	0	0
10	1	1	1	1

$$G_2 = B_3' B_2 + B_3 B_2'$$

$$G_2 = B_2 \oplus B_3$$

Binary to Grey Code

Binary to Gray Converter

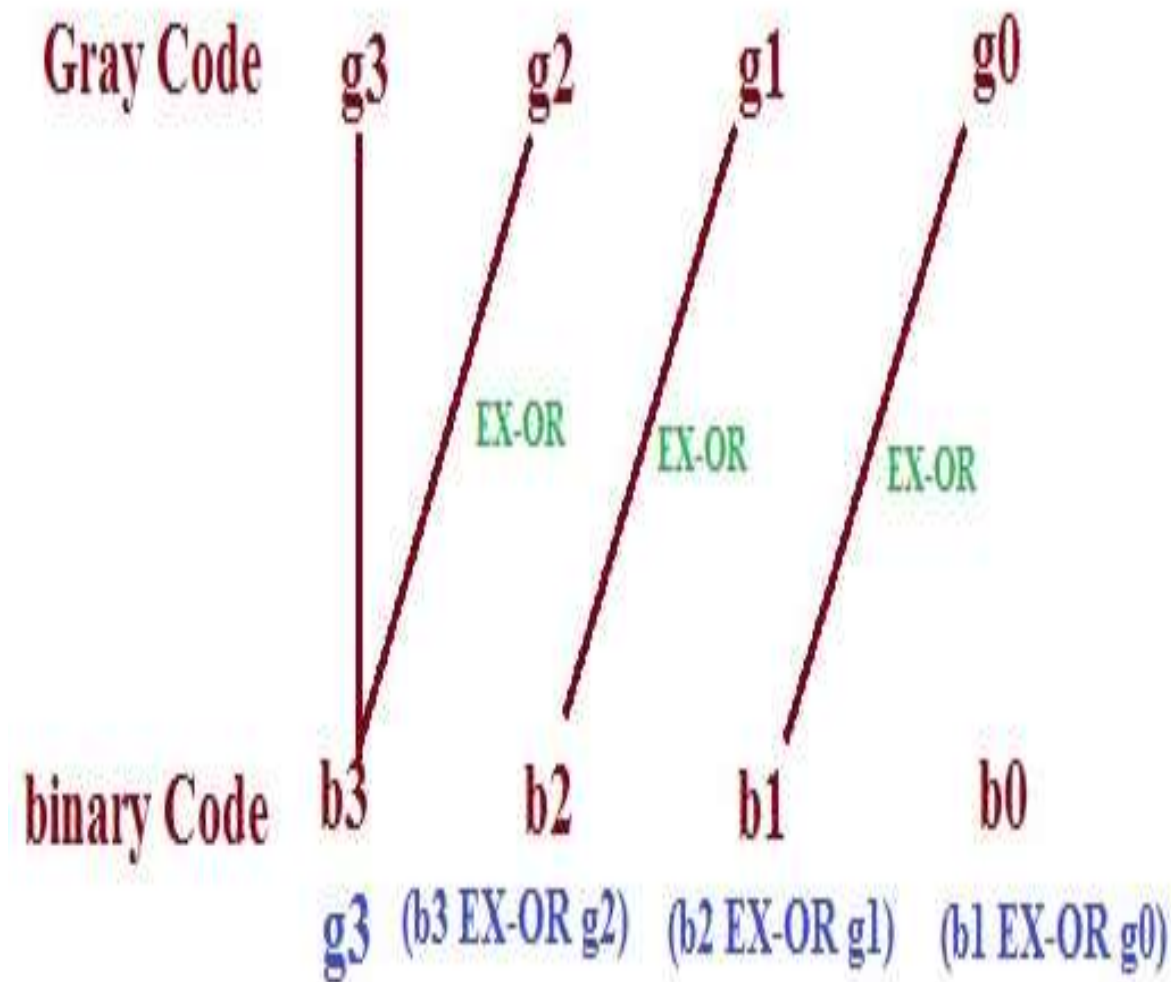CODE CONVERTERS /19ECB231/ Digital Electronics / K.SURIYA/ECE/SNSCT
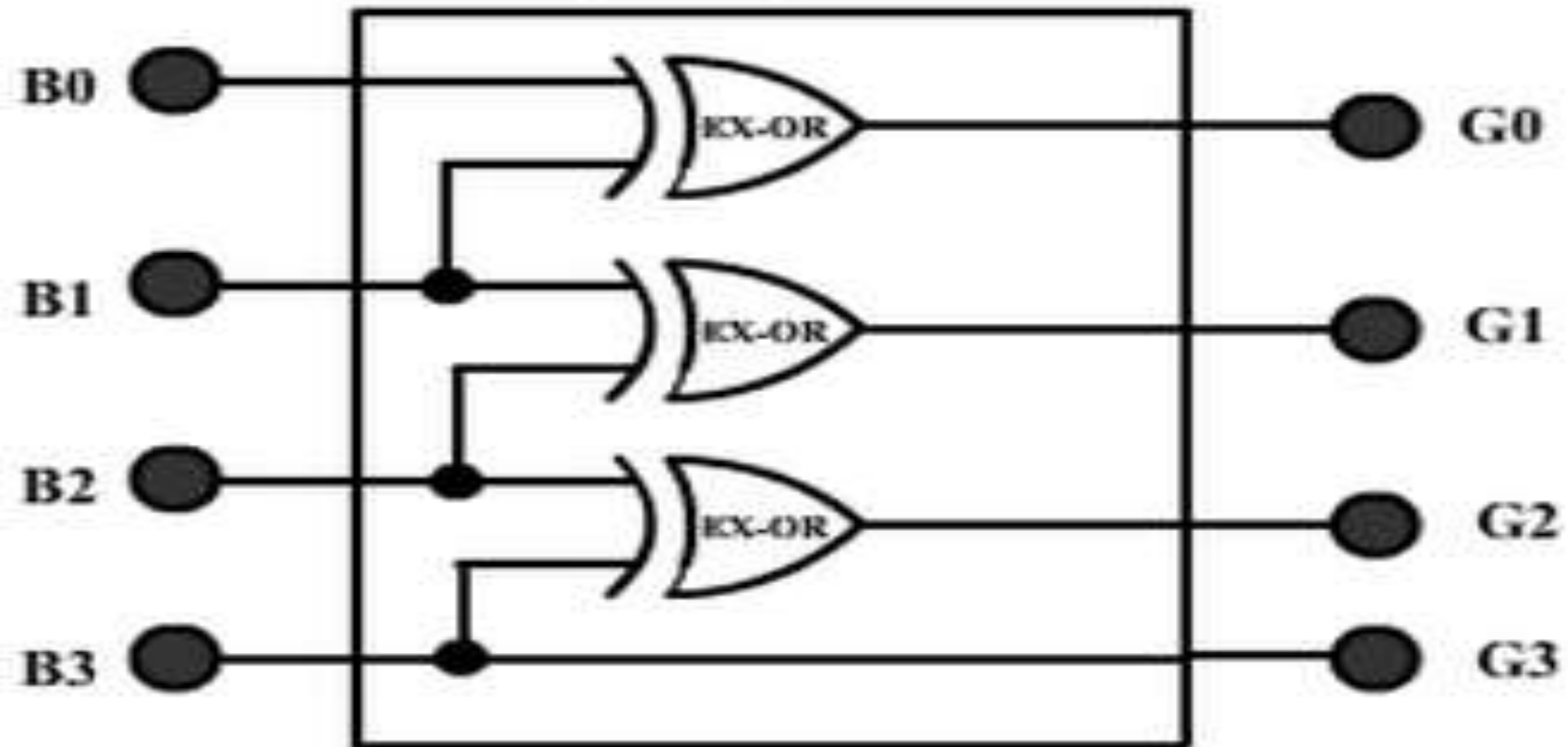
Gray to Binary Code

➢ Once the converted code (now in Gray form) is processed, we want the processed data back in binary representation.

➢ Since we need a converter that would perform reverse operation to that of earlier converter called as Gray-to-Binary converter
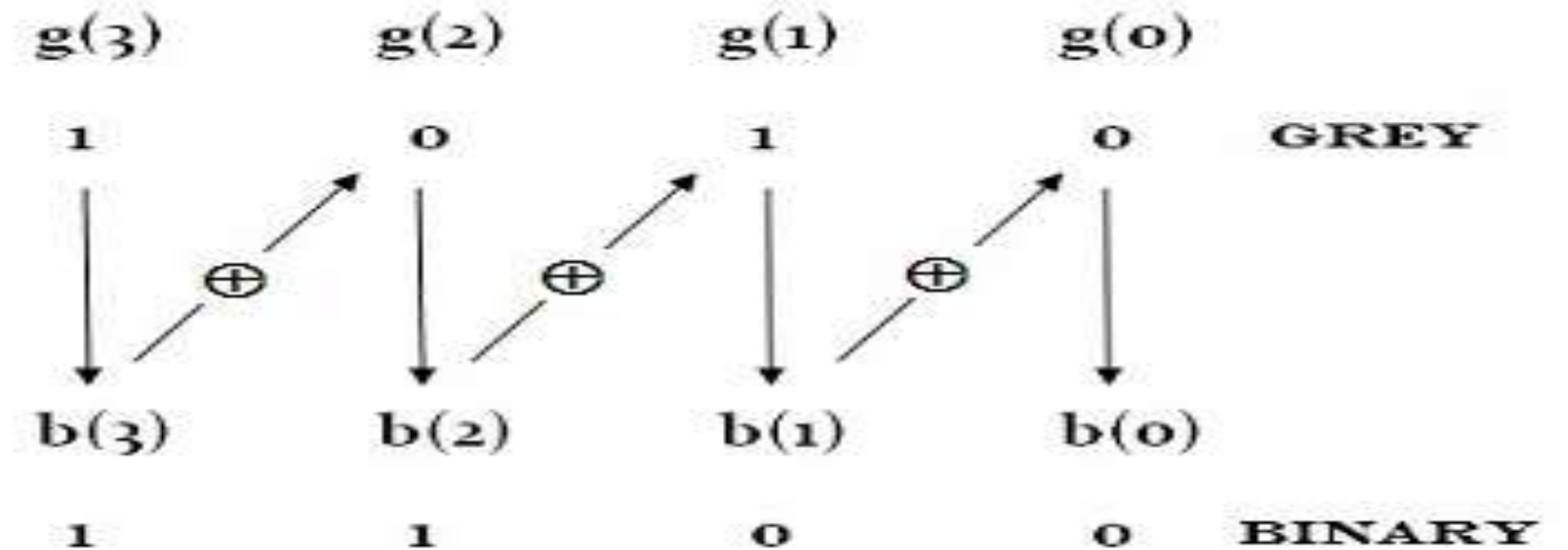
Grey Code to Binary Conversion

Convert the Grey code 1010 to its equivalent Binary

$g(3)$ $g(2)$ $g(1)$ $g(0)$

1   0   1   0   GREY

$b(3)$ $b(2)$ $b(1)$ $b(0)$

1   1   0   0   BINARY

i.e

$$b(3) = g(3)$$
$$b(2) = b(3) \oplus g(2)$$
$$b(1) = b(2) \oplus g(1)$$
$$b(0) = b(1) \oplus g(0)$$

Gray Code   g3   g2   g1   g0

EX-OR   EX-OR   EX-OR

binary Code   b3   b2   b1   b0

g3   (b3 EX-OR g2)   (b2 EX-OR g1)   (b1 EX-OR g0)

Gray to Binary Code

GRAY CODE INPUT				BINARY OUTPUT			
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	1	0	0	1	0
0	0	1	0	0	0	1	1
0	1	1	0	0	1	0	0
0	1	1	1	0	1	0	1
0	1	0	1	0	1	1	0
0	1	0	0	0	1	1	1
1	1	0	0	1	0	0	0
1	1	0	1	1	0	0	1
1	1	1	1	1	0	1	0
1	1	1	0	1	0	1	1
1	0	1	0	1	1	0	0
1	0	1	1	1	1	0	1
1	0	0	1	1	1	1	0
1	0	0	0	1	1	1	1

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Gray to Binary Code – K map

K-map for B₀

$G_1 G_0$

$G_3 G_2$	00	01	11	10
00	0	1	0	1
01	1	0	1	0
11	1	0	1	0
10	0	1	0	1

K-map for B₁

$G_1 G_0$

$G_3 G_2$	00	01	11	10
00	0	0	1	1
01	1	1	0	0
11	0	0	1	1
10	1	1	0	0

K-map for B₂

$G_1 G_0$

$G_3 G_2$	00	01	11	10
00	0	0	0	0
01	1	1	1	1
11	0	0	0	0
10	1	1	1	1

$$B_0 = G_2 G_1' G_0' + G_2' G_1 G_0' + G_2' G_1' G_0 + G_2 G_1 G_0$$

$$= G_0' (G_1' G_2 + G_1 G_2') + G_0 (G_1 G_2 + G_1' G_2')$$

$$= G_0' (G \oplus G_2) + G_0 (G_1 \oplus G_2)' = G_0 \oplus G_1 \oplus G_2$$

$$B_1 = G_3' G_2' G_1 + G_3' G_2 G_1' + G_3 G_2 G_1 + G_3 G_2' G_1'$$

$$= G_3' (G_2 \oplus G_1) + G_3 (G_2 \oplus G_1)'$$

$$= G_1 \oplus G_2 \oplus G_3$$

$$B_2 = G_3' G_2 + G_3 G_2'$$

$$= G_3 \oplus G_2$$

Gray to Binary Code

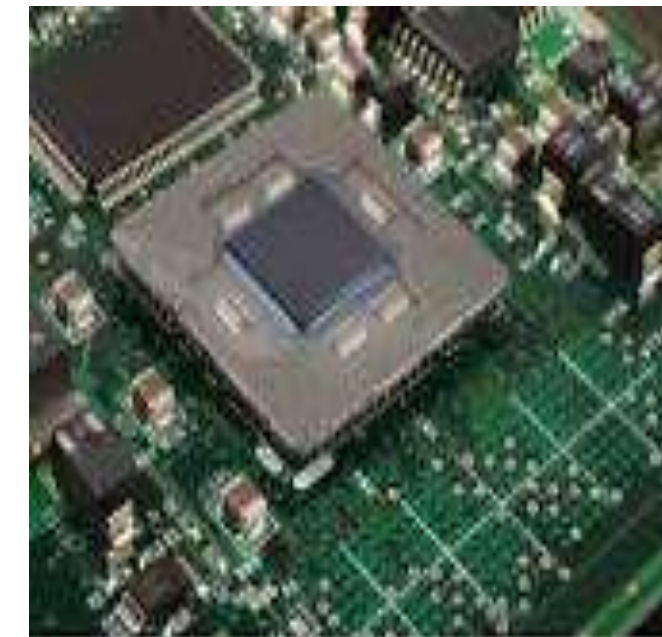Gray to Binary Converter
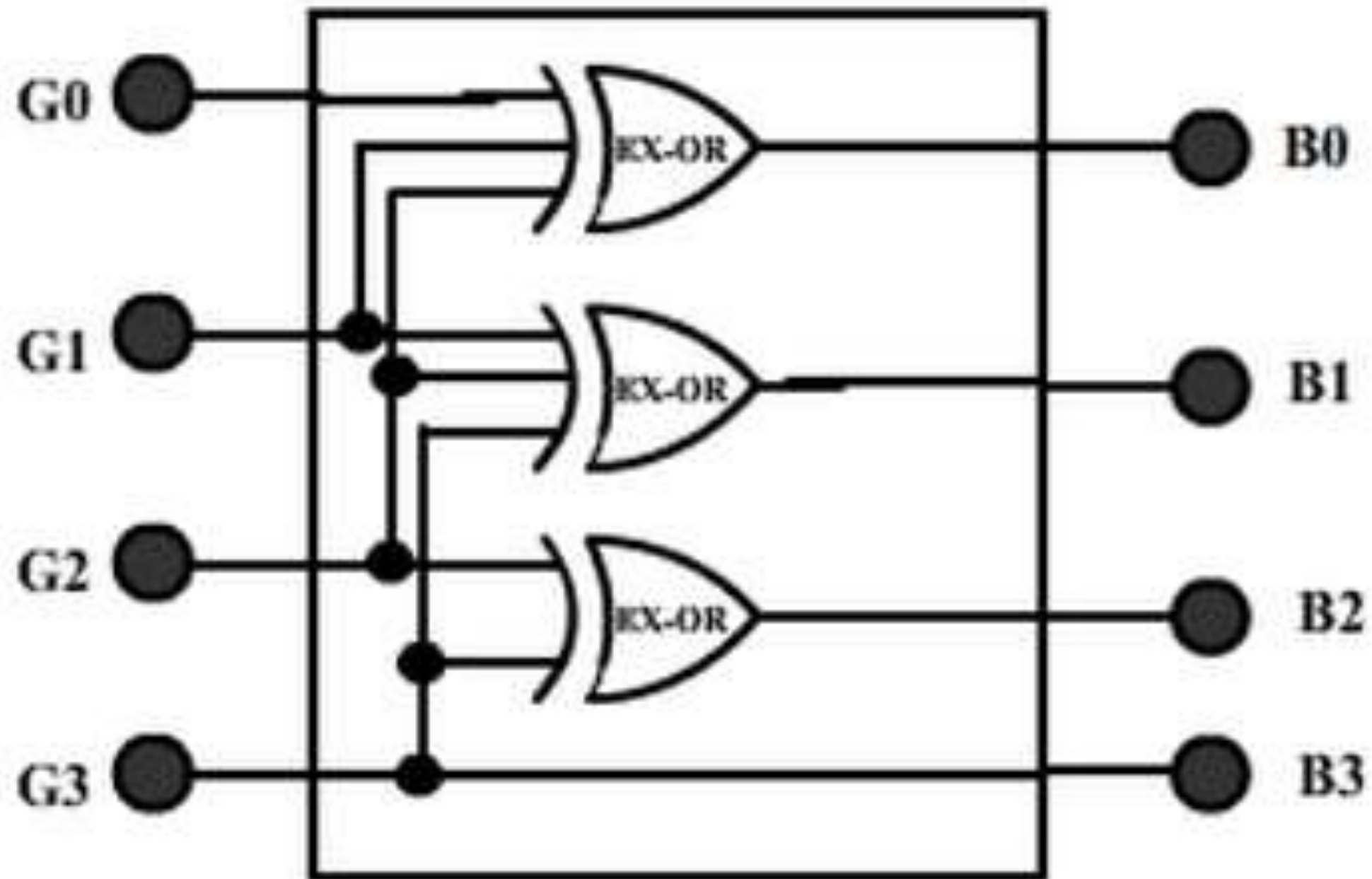
Applications of Code Converters

Computers

Digital electronics

Microprocessors

➢The Excess-3 code can be derived from the natural BCD code by adding 3 to each coded number

BCD TO EXCESS-3 CODE

BCD INPUT				EXCESS-3 OUPUT			
B3	B2	B1	B0	E3	E2	E1	E0
0	0	0	0	0	0	1	1
0	0	0	1	0	1	0	0
0	0	1	0	0	1	0	1
0	0	1	1	0	1	1	0
0	1	0	0	0	1	1	1
0	1	0	1	1	0	0	0
0	1	1	0	1	0	0	1
0	1	1	1	1	0	1	0
1	0	0	0	1	0	1	1
1	0	0	1	1	1	0	0
1	0	1	0	X	X	X	X
1	0	1	1	X	X	X	X
1	1	0	0	X	X	X	X
1	1	0	1	X	X	X	X
1	1	1	0	X	X	X	X
1	1	1	1	X	X	X	X

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$$E_3 = B_3 + B_2(B_0 + B_1)$$

$$E_2 = B_2\,\overline{B_1}\,\overline{B_0} + \overline{B_2}(B_0 + B_1)$$

$$E_1 = \overline{B_1}\,\overline{B_0} + B_1 B_0 = \overline{B_1 \oplus B_0}$$

$$E_0 = \overline{B_0}$$

BCD TO EXCESS-3 CODE

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1.What is code converter?
2.How is converting grey code to binary code?
3.List the applications of Code converter.
4.Explain binary to grey code conversion process.

THANK YOU

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