SERVIÇO PÚBLICO FEDERAL · MINISTÉRIO DA EDUCAÇÃO
UNIVERSIDADE FEDERAL DE VIÇOSA · UFV
CAMPUS FLORESTAL

# Trabalho 1 - ISL

## Implementação de Circuito Combinacional para Display de 7 Segmentos

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2024

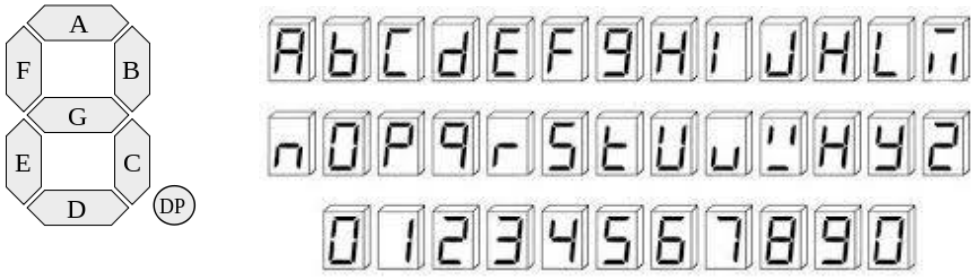
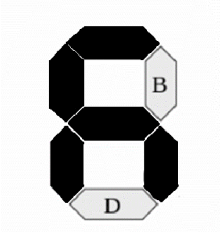



**Figura 1:** Display de sete segmentos e definição dos caracteres.




Caso esteja com o bit de paridade invalido (verificação for 0) o display irá ter essa saída: (1010111).

### 3.1 Tabela da Verdade

Para produzir a tabela da verdade, foi necessário identificar as letras e números codificados com base nos valores binários correspondentes:

| Bits | 00000 | 00001 | 00010 | 00011 | 00100 | 00101 | 00110 | 00111 | 01000 | 01001 | 01010 | 01011 | 01100 | 01101 | 01110 | 01111 | 10000 | 10001 | 10010 | 10011 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 9 | S | A | 4 | M | G | V | O | P | K | 1 | J | 9 | X | F | 7 | W | L | 3 | C | T |

| NÚMERO | E1 | E2 | E3 | E4 | E5 | P | Verificação | A | B | C | D | E | F | G | Representa |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 1 | 1 | 1 | Erro |
| 1 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 1 | 1 | 0 | 1 | 1 | S |
| 2 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | A |
| 2 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 1 | 1 | Erro |
| 3 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 1 | 1 | 0 | 0 | 1 | 1 | 4 |
| 3 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 1 | 1 | Erro |
| 4 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 0 | 1 | 0 | 1 | 1 | 1 | Erro |
| 4 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 1 | 0 | 0 | M |
| 5 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | G |
| 5 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 1 | 1 | Erro |
| 6 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 1 | 0 | 1 | 0 | 1 | 1 | 1 | Erro |
| 6 | 0 | 0 | 1 | 0 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | V |
| 7 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 1 | 1 | 1 | Erro |
| 7 | 0 | 0 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | O |
| 8 | 0 | 0 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 1 | P |
| 8 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 1 | 1 | Erro |
| 9 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 0 | 1 | 1 | 1 | K |
| 9 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 1 | 1 | Erro |
| 10 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 1 | 0 | 1 | 1 | 1 | Erro |
| 10 | 0 | 1 | 0 | 0 | 1 | 1 | 1 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 1 |
| 11 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 1 | 1 | 1 | Erro |
| 11 | 0 | 1 | 0 | 1 | 0 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | J |
| 12 | 0 | 1 | 0 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 9 |
| 12 | 0 | 1 | 0 | 1 | 1 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 1 | 1 | Erro |
| 13 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 1 | 1 | 1 | Erro |
| 13 | 0 | 1 | 1 | 0 | 0 | 1 | 1 | 0 | 1 | 1 | 0 | 1 | 1 | 1 | X |
| 14 | 0 | 1 | 1 | 0 | 1 | 0 | 1 | 1 | 0 | 0 | 0 | 1 | 1 | 1 | F |
| 14 | 0 | 1 | 1 | 0 | 1 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 1 | 1 | Erro |
| 15 | 0 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 7 |
| 15 | 0 | 1 | 1 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 1 | 1 | Erro |
| 16 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 0 | 1 | 0 | 1 | 1 | 1 | Erro |
| 16 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | W |
| 17 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | L |
| 17 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 1 | 1 | Erro |
| 18 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 1 | 0 | 1 | 1 | 1 | Erro |
| 18 | 1 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 3 |
| 19 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 1 | 1 | 1 | Erro |
| 19 | 1 | 0 | 0 | 1 | 0 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 0 | C |
| 20 | 1 | 0 | 0 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | T |
| 20 | 1 | 0 | 0 | 1 | 1 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 1 | 1 | Erro |
| 21 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 1 | 1 | 1 | Erro |
| 21 | 1 | 0 | 1 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | Vazio |
| 22 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | Vazio |
| 22 | 1 | 0 | 1 | 0 | 1 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 1 | 1 | Erro |
| 23 | 1 | 0 | 1 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | Vazio |
| 23 | 1 | 0 | 1 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 1 | 1 | Erro |
| 24 | 1 | 0 | 1 | 1 | 1 | 0 | 0 | 1 | 0 | 1 | 0 | 1 | 1 | 1 | Erro |
| 24 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | Vazio |
| 25 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 1 | 1 | 1 | Erro |
| 25 | 1 | 1 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | Vazio |
| 26 | 1 | 1 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | Vazio |
| 26 | 1 | 1 | 0 | 0 | 1 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 1 | 1 | Erro |
| 27 | 1 | 1 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | Vazio |
| 27 | 1 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 1 | 1 | Erro |
| 28 | 1 | 1 | 0 | 1 | 1 | 0 | 0 | 1 | 0 | 1 | 0 | 1 | 1 | 1 | Erro |
| 28 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | Vazio |
| 29 | 1 | 1 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | Vazio |
| 29 | 1 | 1 | 1 | 0 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 1 | 1 | Erro |
| 30 | 1 | 1 | 1 | 0 | 1 | 0 | 0 | 1 | 0 | 1 | 0 | 1 | 1 | 1 | Erro |
| 30 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | Vazio |
| 31 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 1 | 1 | 1 | Erro |
| 31 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | Vazio |
| 32 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | Vazio |
| 32 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 1 | 1 | Erro |

### 3.2 Mapas de Karnaugh

Inicialmente é necessário visualizar o mapa de Karnaugh da Paridade:

Gerador Paridade

| | 000 | 001 | 011 | 010 | 110 | 111 | 101 | 100 |
|---|---|---|---|---|---|---|---|---|
| 00 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 |
| 01 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 |
| 11 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 |
| 10 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 |

Após verificar o modulo da paridade, é necessário fazer o mapa de Karnaugh para todas as saídas do display:

A

| | 000 | 001 | 011 | 010 | 110 | 111 | 101 | 100 |
|---|---|---|---|---|---|---|---|---|
| 00 | 1 | 1 | 1 | 0 | 1 | 1 | 0 | 1 |
| 01 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 0 |
| 11 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 10 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 |

B

| | 000 | 001 | 011 | 010 | 110 | 111 | 101 | 100 |
|---|---|---|---|---|---|---|---|---|
| 00 | 0 | 1 | 0 | 1 | 1 | 1 | 0 | 1 |
| 01 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 |
| 11 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 10 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |

C

| | 000 | 001 | 011 | 010 | 110 | 111 | 101 | 100 |
|---|---|---|---|---|---|---|---|---|
| 00 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 1 |
| 01 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 1 |
| 11 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 10 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |

D

| | 000 | 001 | 011 | 010 | 110 | 111 | 101 | 100 |
|---|---|---|---|---|---|---|---|---|
| 00 | 1 | 0 | 0 | 0 | 1 | 0 | 1 | 1 |
| 01 | 0 | 0 | 1 | 1 | 0 | 1 | 0 | 0 |
| 11 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 10 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 |

E

| | 000 | 001 | 011 | 010 | 110 | 111 | 101 | 100 |
|---|---|---|---|---|---|---|---|---|
| 00 | 0 | 1 | 1 | 0 | 1 | 1 | 1 | 0 |
| 01 | 1 | 0 | 0 | 1 | 0 | 0 | 1 | 1 |
| 11 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 10 | 1 | 0 | 1 | 1 | 0 | 0 | 0 | 0 |

F

| | 000 | 001 | 011 | 010 | 110 | 111 | 101 | 100 |
|---|---|---|---|---|---|---|---|---|
| 00 | 1 | 1 | 0 | 1 | 1 | 1 | 0 | 1 |
| 01 | 1 | 0 | 1 | 0 | 0 | 1 | 1 | 1 |
| 11 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 10 | 1 | 0 | 1 | 1 | 0 | 0 | 0 | 0 |

G

| | 000 | 001 | 011 | 010 | 110 | 111 | 101 | 100 |
|---|---|---|---|---|---|---|---|---|
| 00 | 1 | 1 | 0 | 1 | 0 | 1 | 0 | 1 |
| 01 | 1 | 0 | 1 | 0 | 0 | 0 | 1 | 1 |
| 11 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 10 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 |

Dessa forma a simplificação de cada Mapa de Karnaugh fica:

**P:** $E1\,\overline{E2}\,E3\,\overline{E4}\,\overline{E5} + E1\,\overline{E2}\,E3\,E4\,E5 + E1\,\overline{E2}\,\overline{E3}\,E4\,\overline{E5} + E1\,\overline{E2}\,\overline{E3}\,\overline{E4}\,E5 + E1\,E2\,E3\,\overline{E4}\,E5 + E1\,E2\,E3\,E4\,\overline{E5} + E1\,E2\,\overline{E3}\,E4\,E5 + E1\,E2\,\overline{E3}\,\overline{E4}\,\overline{E5} + \overline{E1}\,E2\,E3\,\overline{E4}\,\overline{E5} + \overline{E1}\,E2\,E3\,E4\,E5 + \overline{E1}\,E2\,\overline{E3}\,E4\,\overline{E5} + \overline{E1}\,E2\,\overline{E3}\,\overline{E4}\,E5 + \overline{E1}\,\overline{E2}\,E3\,\overline{E4}\,E5 + \overline{E1}\,\overline{E2}\,E3\,E4\,\overline{E5} + \overline{E1}\,\overline{E2}\,\overline{E3}\,E4\,E5 + \overline{E1}\,\overline{E2}\,\overline{E3}\,\overline{E4}\,\overline{E5}$

**A:** $\overline{E1}\,E3\,E4\,\overline{E5} + \overline{E1}\,\overline{E2}\,E3\,E4 + \overline{E1}\,\overline{E3}\,E4\,E5 + \overline{E2}\,\overline{E3}\,\overline{E4}\,E5 + \overline{E1}\,\overline{E2}\,\overline{E4}\,\overline{E5} + E1\,\overline{E2}\,\overline{E3}\,E4\,\overline{E5} + \overline{E1}\,E2\,E3\,\overline{E4}\,E5$

**B:** $\overline{E1}\,E2\,\overline{E3} + \overline{E1}\,E3\,\overline{E5} + \overline{E1}\,E3\,E4 + \overline{E1}\,E4\,\overline{E5} + \overline{E2}\,\overline{E3}\,\overline{E4}\,E5$

**C:** $\overline{E1}\,\overline{E5} + \overline{E1}\,\overline{E3} + \overline{E1}\,\overline{E2}\,\overline{E4} + \overline{E2}\,\overline{E3}\,\overline{E4}\,E5$

**D:** $E1\,\overline{E2}\,\overline{E3} + \overline{E1}\,E2\,E4\,E5 + \overline{E1}\,E2\,\overline{E3}\,E4 + \overline{E1}\,\overline{E2}\,E3\,\overline{E4} + \overline{E1}\,\overline{E2}\,E3\,\overline{E5} + \overline{E2}\,\overline{E3}\,\overline{E4}\,\overline{E5}$

**E:** $\overline{E1}\,\overline{E2}\,E5 + E1\,\overline{E2}\,\overline{E3}\,E4 + E1\,\overline{E2}\,\overline{E3}\,\overline{E5} + \overline{E1}\,E2\,E3\,\overline{E4} + \overline{E1}\,E2\,\overline{E3}\,\overline{E5} + \overline{E1}\,\overline{E2}\,E3\,E4$

**F:** $\overline{E1}\,\overline{E2}\,\overline{E3}\,\overline{E4} + \overline{E1}\,\overline{E4}\,\overline{E5} + \overline{E2}\,\overline{E3}\,\overline{E5} + \overline{E1}\,\overline{E2}\,E3\,E4 + \overline{E1}\,E2\,E4\,E5 + \overline{E1}\,E2\,E3\,\overline{E4} + E1\,\overline{E2}\,\overline{E3}\,E4$

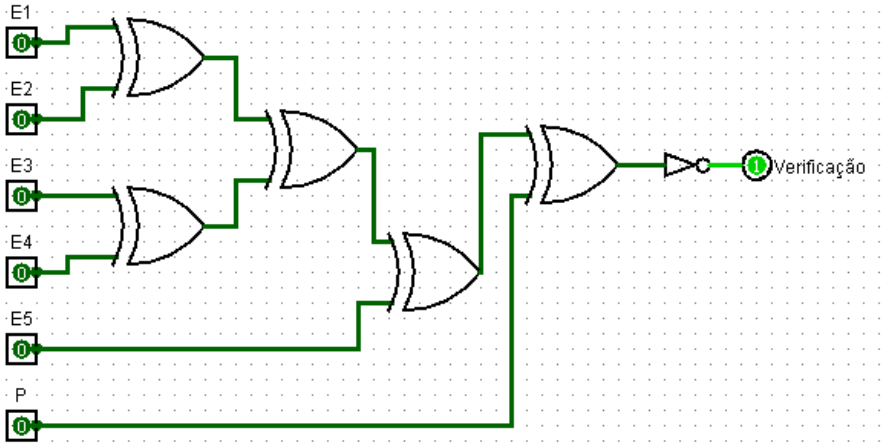
**G:** $\overline{E1}\,\overline{E2}\,\overline{E3}\,E4 + \overline{E1}\,\overline{E2}\,\overline{E3}\,\overline{E5} + \overline{E1}\,\overline{E4}\,\overline{E5} + \overline{E1}\,\overline{E2}\,E3\,E4\,E5 + \overline{E1}\,E2\,\overline{E3}\,E4\,E5 + \overline{E1}\,E2\,E3\,\overline{E4} + E1\,\overline{E2}\,\overline{E3}\,E5$

**Verificador Paridade:** $\overline{E1 \oplus E2 \oplus E3 \oplus E4 \oplus E5 \oplus P}$

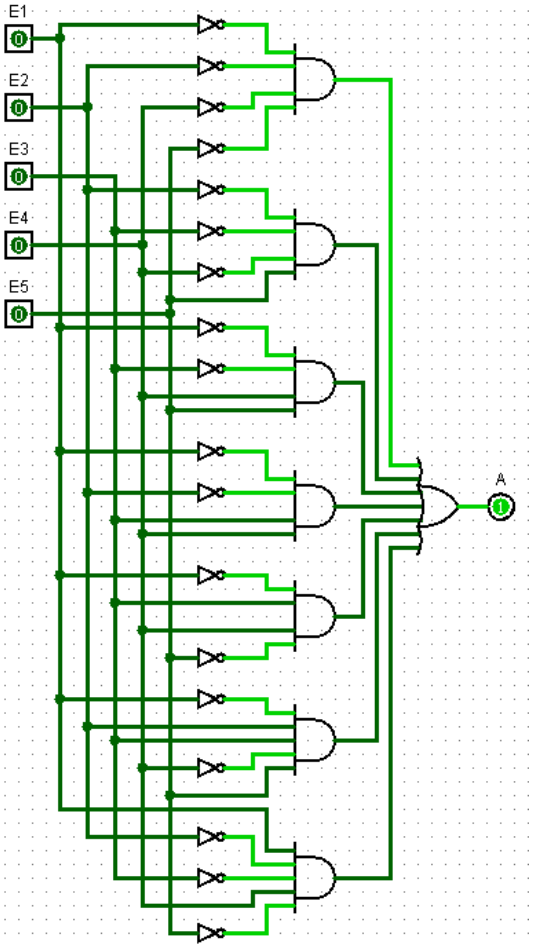
### 3.3 Diagramas de portas lógicas

Após descobrir a função booleana minimizada do gerador de paridade e da verificação de paridade e de cada saída, transformamos em portas lógicas com o auxílio do programa Logisim

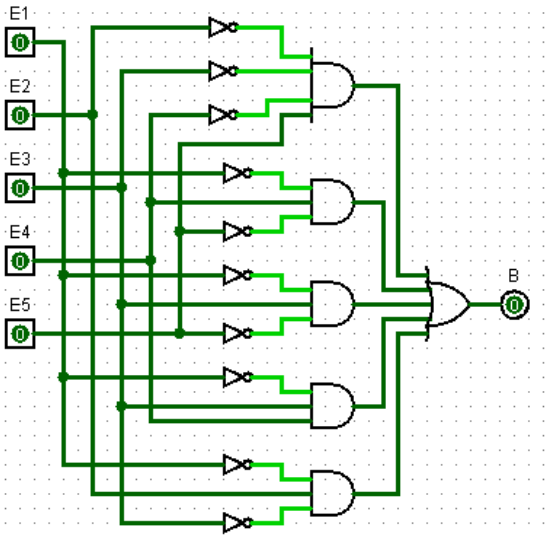
Verificador paridade:



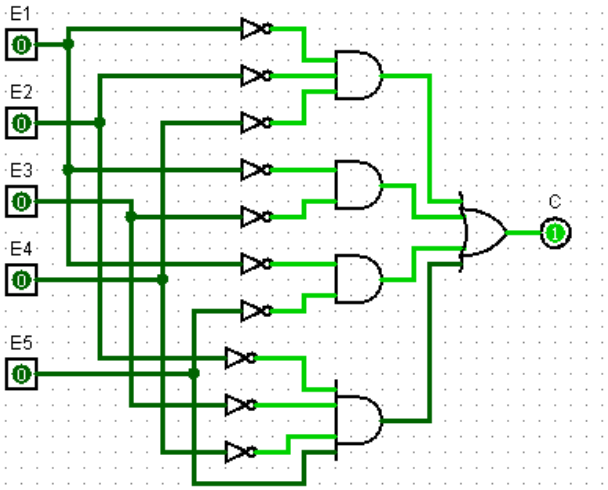

Saída A:



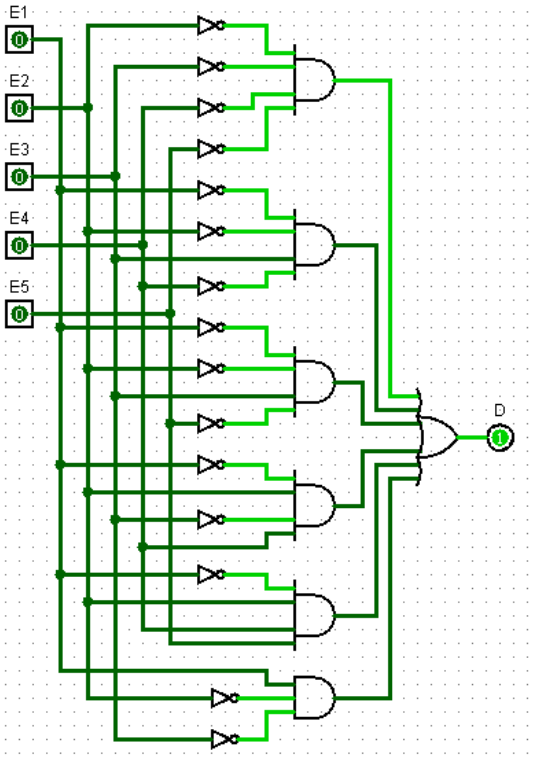
Saída B:



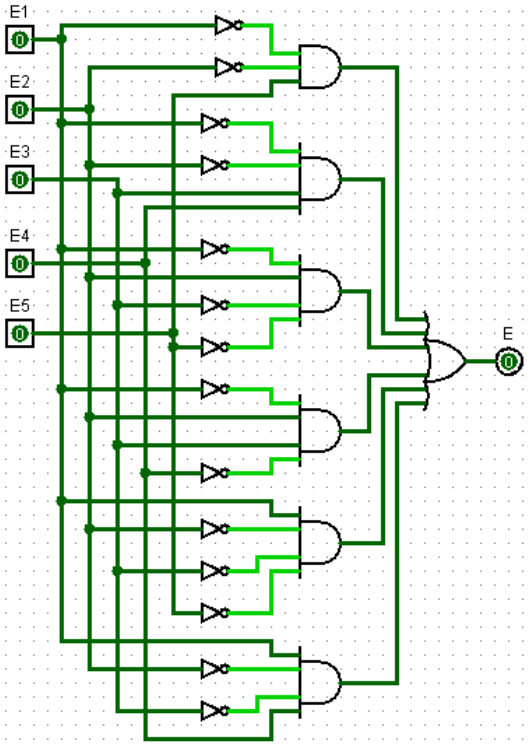

Saída C:



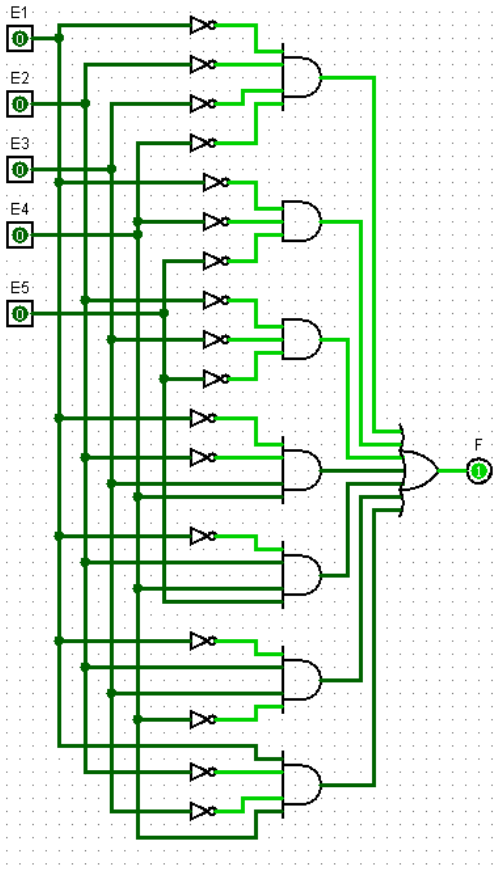

Saída D:




Saída E:



Saída F:




Saída G: