|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Middle** |  |  |  |  |
| **A** | **B** | **C** | **D** | **Out** |
| 0 | 0 | 0 | 0 | 0 |
| 0 | 0 | 0 | 1 | 0 |
| 0 | 0 | 1 | 0 | 1 |
| 0 | 0 | 1 | 1 | 1 |
| 0 | 1 | 0 | 0 | 1 |
| 0 | 1 | 0 | 1 | 1 |
| 0 | 1 | 1 | 0 | 1 |
| 0 | 1 | 1 | 1 | 0 |
| 1 | 0 | 0 | 0 | 1 |
| 1 | 0 | 0 | 1 | 1 |
| 1 | 0 | 1 | 0 | D |
| 1 | 0 | 1 | 1 | D |
| 1 | 1 | 0 | 0 | D |
| 1 | 1 | 0 | 1 | D |
| 1 | 1 | 1 | 0 | D |
| 1 | 1 | 1 | 1 | D |

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

**A + CD’ + B’C + BC’**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Top** |  |  |  |  |
| **A** | **B** | **C** | **D** | **Out** |
| 0 | 0 | 0 | 0 | 1 |
| 0 | 0 | 0 | 1 | 0 |
| 0 | 0 | 1 | 0 | 1 |
| 0 | 0 | 1 | 1 | 1 |
| 0 | 1 | 0 | 0 | 0 |
| 0 | 1 | 0 | 1 | 1 |
| 0 | 1 | 1 | 0 | 1 |
| 0 | 1 | 1 | 1 | 1 |
| 1 | 0 | 0 | 0 | 1 |
| 1 | 0 | 0 | 1 | 1 |
| 1 | 0 | 1 | 0 | D |
| 1 | 0 | 1 | 1 | D |
| 1 | 1 | 0 | 0 | D |
| 1 | 1 | 0 | 1 | D |
| 1 | 1 | 1 | 0 | D |
| 1 | 1 | 1 | 1 | D |

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

**A + C + B’D’ + BD**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Bottom** |  |  |  |  |
| **A** | **B** | **C** | **D** | **Out** |
| 0 | 0 | 0 | 0 | 1 |
| 0 | 0 | 0 | 1 | 0 |
| 0 | 0 | 1 | 0 | 1 |
| 0 | 0 | 1 | 1 | 1 |
| 0 | 1 | 0 | 0 | 0 |
| 0 | 1 | 0 | 1 | 1 |
| 0 | 1 | 1 | 0 | 1 |
| 0 | 1 | 1 | 1 | 0 |
| 1 | 0 | 0 | 0 | 1 |
| 1 | 0 | 0 | 1 | 1 |
| 1 | 0 | 1 | 0 | D |
| 1 | 0 | 1 | 1 | D |
| 1 | 1 | 0 | 0 | D |
| 1 | 1 | 0 | 1 | D |
| 1 | 1 | 1 | 0 | D |
| 1 | 1 | 1 | 1 | D |

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

**A + CD’ + B’D’ + B’C + BC’D**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Top Left Side** |  |  |  |  |
| **A** | **B** | **C** | **D** | **Out** |
| 0 | 0 | 0 | 0 | 1 |
| 0 | 0 | 0 | 1 | 0 |
| 0 | 0 | 1 | 0 | 0 |
| 0 | 0 | 1 | 1 | 0 |
| 0 | 1 | 0 | 0 | 1 |
| 0 | 1 | 0 | 1 | 1 |
| 0 | 1 | 1 | 0 | 1 |
| 0 | 1 | 1 | 1 | 0 |
| 1 | 0 | 0 | 0 | 1 |
| 1 | 0 | 0 | 1 | 1 |
| 1 | 0 | 1 | 0 | D |
| 1 | 0 | 1 | 1 | D |
| 1 | 1 | 0 | 0 | D |
| 1 | 1 | 0 | 1 | D |
| 1 | 1 | 1 | 0 | D |
| 1 | 1 | 1 | 1 | D |

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

**A + C’D’ + BD’ + BC’**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Bottom Left Side** |  |  |  |  |
| **A** | **B** | **C** | **D** | **Out** |
| 0 | 0 | 0 | 0 | 1 |
| 0 | 0 | 0 | 1 | 0 |
| 0 | 0 | 1 | 0 | 1 |
| 0 | 0 | 1 | 1 | 0 |
| 0 | 1 | 0 | 0 | 0 |
| 0 | 1 | 0 | 1 | 0 |
| 0 | 1 | 1 | 0 | 1 |
| 0 | 1 | 1 | 1 | 0 |
| 1 | 0 | 0 | 0 | 1 |
| 1 | 0 | 0 | 1 | 0 |
| 1 | 0 | 1 | 0 | D |
| 1 | 0 | 1 | 1 | D |
| 1 | 1 | 0 | 0 | D |
| 1 | 1 | 0 | 1 | D |
| 1 | 1 | 1 | 0 | D |
| 1 | 1 | 1 | 1 | D |

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

**CD’ + B’D’**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Top Right Side** |  |  |  |  |
| **A** | **B** | **C** | **D** | **Out** |
| 0 | 0 | 0 | 0 | 1 |
| 0 | 0 | 0 | 1 | 1 |
| 0 | 0 | 1 | 0 | 1 |
| 0 | 0 | 1 | 1 | 1 |
| 0 | 1 | 0 | 0 | 1 |
| 0 | 1 | 0 | 1 | 0 |
| 0 | 1 | 1 | 0 | 0 |
| 0 | 1 | 1 | 1 | 1 |
| 1 | 0 | 0 | 0 | 1 |
| 1 | 0 | 0 | 1 | 1 |
| 1 | 0 | 1 | 0 | D |
| 1 | 0 | 1 | 1 | D |
| 1 | 1 | 0 | 0 | D |
| 1 | 1 | 0 | 1 | D |
| 1 | 1 | 1 | 0 | D |
| 1 | 1 | 1 | 1 | D |

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

**A + B’ + C’D’ + CD**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Bottom**  **Right Side** |  |  |  |  |
| **A** | **B** | **C** | **D** | **Out** |
| 0 | 0 | 0 | 0 | 1 |
| 0 | 0 | 0 | 1 | 1 |
| 0 | 0 | 1 | 0 | 0 |
| 0 | 0 | 1 | 1 | 1 |
| 0 | 1 | 0 | 0 | 1 |
| 0 | 1 | 0 | 1 | 1 |
| 0 | 1 | 1 | 0 | 1 |
| 0 | 1 | 1 | 1 | 1 |
| 1 | 0 | 0 | 0 | 1 |
| 1 | 0 | 0 | 1 | 1 |
| 1 | 0 | 1 | 0 | D |
| 1 | 0 | 1 | 1 | D |
| 1 | 1 | 0 | 0 | D |
| 1 | 1 | 0 | 1 | D |
| 1 | 1 | 1 | 0 | D |
| 1 | 1 | 1 | 1 | D |

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

**A + C’ + D + B**

**Common Expressions in Gates**

**A + B + C’ + D**

**A + C’D’ + B’ + CD**

**B’D’ + CD’**

**A + C’D’ + BC’ + BD’**

**A + CD’ + B’C + BC’**

**A + B’D’ + C + BD**

**A + CD’ + B’C + B’D’ + BC’D**