1. Ф = ((((a+b)&c) →¬d) ~a) ⊕ b;

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Ф = ((((a+b)&c) →¬d) ~a) ⊕ b | | | | | | | | | | | | | | | |
| Ф(a/0) = ¬ ((b&c) →¬d) ⊕ b | | | | | | | | Ф(a/1) = (c →¬d) ⊕ b | | | | | | | |
| Ф(b/0) = 0 | | | | Ф(b/1) = c →¬d | | | | Ф(b/0) = c →¬d | | | | Ф(b/1) = ¬ (c →¬d) | | | |
|  | |  | | Ф(c/0) =1 | | Ф(c/1) =¬d | | Ф(c/0) =1 | | Ф(c/1) =¬d | | Ф(c/0) =0 | | Ф(c/1) =d | |
|  |  |  |  |  |  | Ф(d/0) =1 | Ф(d/1) =0 |  |  | Ф(d/0) =1 | Ф(d/1) =0 |  |  | Ф(d/0) =0 | Ф(d/1) =1 |

Двоичная диаграмма

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| a | | | | | | | | | | | | | | | |
| B | | | | | | | | b | | | | | | | |
| C | | | | c | | | | c | | | | c | | | |
| d | | D | | D | | d | | d | | d | | d | | d | |
| 1 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 0 |

Левая ветвь, переменная на уровень выше =1

Правая ветвь, переменная на уровень выше=0;

Bdd

a b b c c d d

1 0

2)

A)По методу Девиса-Патнема:

Ф = ((a→(b+c))&a&¬b) →c;

Преобразуем формулу:

Ф = ((a→(b+c))&a&¬b) →c = ¬((a→(b+c))&a&¬b) + с =¬ (a→(b+c))+ ¬a+ b+c=

=¬(¬a+b+c) + ¬a+ b+c = a&¬b&¬c + ¬a+ b+c;

По методу Квайна, пусть b=1, тогда

Ф=1;

Получили пустую формулу, значит Ф выполнима, пример Ф(a,b,c)=Ф(1,1,1)=1;

Б)

По методу Девиса-Патнема:

Ф = (a⊕c) + (¬a⊕c) + b;

¬Ф= ¬((a⊕c) + (¬a⊕c) + b) = ¬(a⊕c)&¬(¬a⊕c)&¬b=

=¬(¬a¬c + ac)&¬( a¬c + ¬ac)&¬b = ¬(¬a¬c)&¬ (ac)&¬ (a¬c)&¬ (¬ac)&¬b=

=(a+c)&( ¬a+¬c)&( ¬a+c)&(a+¬c)&¬b

По методу Квайна, пусть a=1, тогда

¬Ф =1&¬c&c&1&¬b=¬c&c&¬b;

Мы нашли противоречивые дизъюнктыc&¬cзначит ¬Ф противоречива, а

Ф – общезначима.

3)

А)

(a→b)&(a⊕b)&(c~ (¬d+c))

Таблица Истинности:

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| |  | | --- | | A | | |  | | --- | | B | | |  | | --- | | C | | |  | | --- | | D | | |  |  |  | | --- | --- | --- | | A | → | B | | |  |  |  | | --- | --- | --- | | A | ⊕ | B | | |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | ( | A | → | B | ) | ∨ | ( | A | ⊕ | B | ) | | |  | | --- | |  | | D | | |  |  |  | | --- | --- | --- | |  |  |  | | D | ∨ | C | | |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | |  |  |  |  |  |  |  | | C | ~ | ( | D | ∨ | C | ) | | |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | ( | ( | A | → | B | ) | ∨ | ( | A | ⊕ | B | ) | ) |  | ( | C | ~ | ( | D | ∨ | C | ) | ) | |
| 0 | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 1 | 0 | 0 |
| 0 | 0 | 0 | 1 | 1 | 0 | 1 | 0 | 0 | 1 | 1 |
| 0 | 0 | 1 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 1 |
| 0 | 0 | 1 | 1 | 1 | 0 | 1 | 0 | 1 | 1 | 1 |
| 0 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 0 |
| 0 | 1 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 1 |
| 0 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 0 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 1 |
| 1 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 0 |
| 1 | 0 | 0 | 1 | 0 | 1 | 1 | 0 | 0 | 1 | 1 |
| 1 | 0 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 |
| 1 | 0 | 1 | 1 | 0 | 1 | 1 | 0 | 1 | 1 | 1 |
| 1 | 1 | 0 | 0 | 1 | 0 | 1 | 1 | 1 | 0 | 0 |
| 1 | 1 | 0 | 1 | 1 | 0 | 1 | 0 | 0 | 1 | 1 |
| 1 | 1 | 1 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 1 |
| 1 | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 1 | 1 | 1 |

Наборы значений формулы при разных значениях A и B одинаковы, следовательно, эти переменные фиктивны

Б)Ф = d→ ((a⊕b)(a~b)( ¬c+a));

Таблица Истинности:

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| |  | | --- | | A | | |  | | --- | | B | | |  | | --- | | C | | |  | | --- | | D | | |  |  |  | | --- | --- | --- | | A | ⊕ | B | | |  |  |  | | --- | --- | --- | | A | ~ | B | | |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | ( | A | ⊕ | B | ) |  | ( | A | ~ | B | ) | | |  | | --- | |  | | C | | |  |  |  | | --- | --- | --- | |  |  |  | | C | ∨ | A | | |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | ( | A | ⊕ | B | ) |  | ( | A | ~ | B | ) |  | ( | C | ∨ | A | ) | | |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | D | → | ( | ( | A | ⊕ | B | ) |  | ( | A | ~ | B | ) |  | ( | C | ∨ | A | ) | ) | |
| 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 0 | 1 |
| 0 | 0 | 0 | 1 | 0 | 1 | 0 | 1 | 1 | 0 | 0 |
| 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 1 |
| 0 | 0 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 |
| 0 | 1 | 0 | 0 | 1 | 0 | 0 | 1 | 1 | 0 | 1 |
| 0 | 1 | 0 | 1 | 1 | 0 | 0 | 1 | 1 | 0 | 0 |
| 0 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 |
| 0 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 1 | 0 | 1 |
| 1 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 1 | 0 | 0 |
| 1 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 1 |
| 1 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 1 | 0 | 0 |
| 1 | 1 | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 0 | 1 |
| 1 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 1 | 0 | 0 |
| 1 | 1 | 1 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 1 |
| 1 | 1 | 1 | 1 | 0 | 1 | 0 | 0 | 1 | 0 | 0 |

Наборы значений формулы при разных значениях A, B и C одинаковы, следовательно, эти переменные фиктивны

4)

Ф = ¬ ((¬a+b) → ( ¬b+c))&(c+d)&(a+e)&( ¬b+¬e)

Преобразуемформулу

Ф = (¬a+b)&¬b&c&(c+d)&(a+e)&( ¬b+¬e)

Исключим aпо правилу резолюций

Ф = (b+e)&¬b&c&(c+d)&( ¬b+¬e)

Исключим bпо правилу резолюций

Ф = (e+¬e)&¬b&c&(c+d)

Избавимся от тавтологии

Ф = ¬b&c&(c+d)

5) ¬(A+B+C)