Условия, при которых f = 1: -2 <= (x4x5 - x1x2x3) < 1

Условия, при которых f = d: (x4x5 - x1x2x3) = -5

**1. Составление таблицы истинности**

Таблица истинности заданной функции представлена в таблице 1.

Таблица 1

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| N | x1, x2, x3, x4, x5 | x4, x5 | (x4, x5) 10 | x1, x2, x3 | (x1, x2, x3) | (x4x5 - x1x2x3) 10 | f |
| 0 | 00000 | 00 | 0 | 000 | 0 | 0 | 1 |
| 1 | 00001 | 01 | 1 | 000 | 0 | 1 | 0 |
| 2 | 00010 | 10 | 2 | 000 | 0 | 2 | 0 |
| 3 | 00011 | 11 | 3 | 000 | 0 | 3 | 0 |
| 4 | 00100 | 00 | 0 | 001 | 1 | -1 | 1 |
| 5 | 00101 | 01 | 1 | 001 | 1 | 0 | 1 |
| 6 | 00110 | 10 | 2 | 001 | 1 | 1 | 0 |
| 7 | 00111 | 11 | 3 | 001 | 1 | 2 | 0 |
| 8 | 01000 | 00 | 0 | 010 | 2 | -2 | 1 |
| 9 | 01001 | 01 | 1 | 010 | 2 | -1 | 1 |
| 10 | 01010 | 10 | 2 | 010 | 2 | 0 | 1 |
| 11 | 01011 | 11 | 3 | 010 | 2 | 1 | 0 |
| 12 | 01100 | 00 | 0 | 011 | 3 | -3 | 0 |
| 13 | 01101 | 01 | 1 | 011 | 3 | -2 | 1 |
| 14 | 01110 | 10 | 2 | 011 | 3 | -1 | 1 |
| 15 | 01111 | 11 | 3 | 011 | 3 | 0 | 1 |
| 16 | 10000 | 00 | 0 | 100 | 4 | -4 | 0 |
| 17 | 10001 | 01 | 1 | 100 | 4 | -3 | 0 |
| 18 | 10010 | 10 | 2 | 100 | 4 | -2 | 1 |
| 19 | 10011 | 11 | 3 | 100 | 4 | -1 | 1 |
| 20 | 10100 | 00 | 0 | 101 | 5 | -5 | d |
| 21 | 10101 | 01 | 1 | 101 | 5 | -4 | 0 |
| 22 | 10110 | 10 | 2 | 101 | 5 | -3 | 0 |
| 23 | 10111 | 11 | 3 | 101 | 5 | -2 | 1 |
| 24 | 11000 | 00 | 0 | 110 | 6 | -6 | 0 |
| 25 | 11001 | 01 | 1 | 110 | 6 | -5 | d |
| 26 | 11010 | 10 | 2 | 110 | 6 | -4 | 0 |
| 27 | 11011 | 11 | 3 | 110 | 6 | -3 | 0 |
| 28 | 11100 | 00 | 0 | 111 | 7 | -7 | 0 |
| 29 | 11101 | 01 | 1 | 111 | 7 | -6 | 0 |
| 30 | 11110 | 10 | 2 | 111 | 7 | -5 | d |
| 31 | 11111 | 11 | 3 | 111 | 7 | -4 | 0 |

**2. Представление булевой функции в аналитическом виде**

КДНФ: f = **¬**x1**¬**x2**¬**x3**¬**x4¬x5 V ¬x1¬x2x3¬x4¬x5 V ¬x1¬x2x3¬x4x5 V ¬x1x2¬x3¬x4¬x5 V ¬x1x2¬x3¬x4x5 V ¬x1x2¬x3x4¬x5 V ¬x1x2x3¬x4x5 V ¬x1x2x3x4¬x5 V ¬x1x2x3x4x5 V x1¬x2¬x3x4¬x5 V x1¬x2¬x3x4x5 V x1¬x2x3x4x5

ККНФ: f = (x1 V x2 V x3 V x4 V ¬x5)( x1 V x2 V x3 V ¬x4 V x5)(x1 V x2 V x3 V ¬x4 V ¬x5)(x1 V x2 V ¬x3 V ¬x4 V x5)( x1 V x2 V ¬x3 V ¬x4 V ¬x5)(x1 V ¬x2 V x3 V ¬x4 V ¬x5)( x1 V ¬x2 V ¬x3 V x4 V x5)(¬x1 V x2 V x3 V x4 V x5)( ¬x1 V x2 V x3 V x4 V ¬x5)(¬x1 V x2 V ¬x3 V x4 V ¬x5)( ¬x1 V x2 V ¬x3 V ¬x4 V x5)( ¬x1 V ¬x2 V x3 V x4 V x5)(¬x1 V ¬x2 V x3 V ¬x4 V x5)( ¬x1 V ¬x2 V x3 V ¬x4 V ¬x5)( ¬x1 V ¬x2 V ¬x3 V x4 V x5)( ¬x1 V ¬x2 V ¬x3 V x4 V ¬x5)( ¬x1 V ¬x2 V ¬x3 V ¬x4 V ¬x5)

**3. Минимизация булевой функции методом Квайна-МакКласки**

- Нахождение максимальных кубов

Таблица 2

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| N | K0 UN(f) | \* | N | K1(f) | \* |  | N | Z(f) |
| 1 | 00000 | \* | 1 | 00x00 |  | 1-2 | 1 | 00x00 |
| 2 | 00100 | \* | 2 | 0x000 |  | 1-3 | 2 | 0x000 |
| 3 | 01000 | \* | 3 | 0010x |  | 2-4 | 3 | 0010x |
| 4 | 00101 | \* | 4 | x0100 |  | 2-8 | 4 | x0100 |
| 5 | 01001 | \* | 5 | 0100x |  | 3-5 | 5 | 0100x |
| 6 | 01010 | \* | 6 | 010x0 |  | 3-6 | 6 | 010x0 |
| 7 | 10010 | \* | 7 | 0x101 |  | 4-9 | 7 | 0x101 |
| 8 | 10100 |  | 8 | 01x01 |  | 5-9 | 8 | 01x01 |
| 9 | 01101 | \* | 9 | x1001 |  | 5-12 | 9 | x1001 |
| 10 | 01110 | \* | 10 | 01x10 |  | 6-10 | 10 | 01x10 |
| 11 | 10011 | \* | 11 | 1001x |  | 7-11 | 11 | 1001x |
| 12 | 11001 | \* | 12 | 011x1 |  | 9-13 | 12 | 011x1 |
| 13 | 01111 | \* | 13 | 0111x |  | 10-13 | 13 | 0111x |
| 14 | 10111 | \* | 14 | x1110 |  | 10-15 | 14 | x1110 |
| 15 | 11110 | \* | 15 | 10x11 |  | 11-14 | 15 | 10x11 |

- Составление импликантной таблицы

Таблица 3

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | 00000 | 00100 | 01000 | 00101 | 01001 | 01010 | 10010 | 01101 | 01110 | 10011 | 01111 | 10111 |
| 00x00 | \* | \* |  |  |  |  |  |  |  |  |  |  |
| 0x000 | \* |  | \* |  |  |  |  |  |  |  |  |  |
| 0010x |  | \* |  | \* |  |  |  |  |  |  |  |  |
| x0100 |  | \* |  |  |  |  |  |  |  |  |  |  |
| 0100x |  |  | \* |  | \* |  |  |  |  |  |  |  |
| 010x0 |  |  | \* |  |  | \* |  |  |  |  |  |  |
| 0x101 |  |  |  | \* |  |  |  | \* |  |  |  |  |
| 01x01 |  |  |  |  | \* |  |  | \* |  |  |  |  |
| x1001 |  |  |  |  | \* |  |  |  |  |  |  |  |
| 01x10 |  |  |  |  |  | \* |  |  | \* |  |  |  |
| 1001x |  |  |  |  |  |  | ( \* ) |  |  | \* |  |  |
| 011x1 |  |  |  |  |  |  |  | \* |  |  | \* |  |
| 0111x |  |  |  |  |  |  |  |  | \* |  | \* |  |
| x1110 |  |  |  |  |  |  |  |  | \* |  |  |  |
| 10x11 |  |  |  |  |  |  |  |  |  | \* |  | ( \* ) |

- Упрощенная импликантная таблица

Таблица 4

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | 00000 | 00100 | 01000 | 00101 | 01001 | 01010 | 01101 | 01110 | 01111 |
| 00x00 | A | \* | \* |  |  |  |  |  |  |  |
| 0x000 | B | \* |  | \* |  |  |  |  |  |  |
| 0010x | C |  | \* |  | \* |  |  |  |  |  |
| x0100 | D |  | \* |  |  |  |  |  |  |  |
| 0100x | E |  |  | \* |  | \* |  |  |  |  |
| 010x0 | F |  |  | \* |  |  | \* |  |  |  |
| 0x101 | G |  |  |  | \* |  |  | \* |  |  |
| 01x01 | H |  |  |  |  | \* |  | \* |  |  |
| x1001 | I |  |  |  |  | \* |  |  |  |  |
| 01x10 | J |  |  |  |  |  | \* |  | \* |  |
| 011x1 | K |  |  |  |  |  |  | \* |  | \* |
| 0111x | L |  |  |  |  |  |  |  | \* | \* |
| x1110 | M |  |  |  |  |  |  |  | \* |  |

- Ядро покрытия

T = { 1001X}

{ 10X11}

- Определение минимально покрытия

Y = (A v B)(A v C v D)(B v E v F)(C v G)(E v H v I)(F v J)(G v H v K)(J v L v M)(K v L)

Y = AEFJL v AEGHL v BCFJK v BCGHKM v AEGIKM v ABEHJK v BDEFJK v BDEIJK v BCFGKL v ACGIKL v BDEFGL v BDEFGKM v BCHJK v AEFGL v AEGIL v ACGHJK v AEGHKM v BCEIJL v ABEHGL

- Варианты покрытия

C1 = {T A E F J L} S1a = 20, S1b = 25

C2 = {T A E G H L} S1a = 20, S1b = 25

C3 = {T B C F J K} S1a = 20, S2b = 25

C4 = {T B C G H K M} S1a = 24, S2b = 30

C5 = {T A E G I K M} S1a = 24, S2b = 30

C6 = {T A B E H J K} S1a = 24, S2b = 30

C7 = {T B D E F J K} S1a = 24, S2b = 30

C8 = {T B D E I J K} S1a = 24, S2b = 30

C9 = {T B C F J K L} S1a = 24, S2b = 30

C10 = {T A C G I K L} S1a = 24, S2b = 30

C11 = {T B D E F G L } S1a = 24, S2b = 30

C12 = {T B D E F G K M} S1a = 28, S2b = 35

C13 = {T B C H J K} S1a = 20, S2b = 25

C14 = {T A E F G L} S1a = 20, S2b = 25

C15 = {T A E G I L} S1a = 20, S2b = 25

C16 = {T A C G H J K} S1a = 24, S2b = 30

C17 = {T A E G H K M} S1a = 24, S2b = 30

C18 = {T B C E I J L} S1a = 24, S2b = 30

C19 = {T A B E H G L} S1a = 24, S2b = 30

- Минимально покрытие функции – C2

Cmin(f) = {00X00} S1a = 20, S1b = 25

{0X101}

{010X0}

{01X01}

{0111X}

Эта функция соответствует МДНФ следующего вида:

f = ¬x1¬x2¬x4¬x5 V

¬x1x3¬x4x5 V ¬x1x2¬x3¬x5 V ¬x1x2¬x4x5 V ¬x1x2x3x4

**4. Определение МКНФ**