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|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | ***Q3*** | | | |  |  | |  |  |  |
|  |  | ***Q1*** | |  |  | ***Q1*** | | |  |  | ***R4*** |
| ***Q4*** | ***Q2*** | ***-*** | ***-*** | ***-*** | ***-*** | ***-*** | | ***-*** | ***-*** | ***-*** |  |
| ***-*** | ***-*** | ***-*** | ***-*** | ***-*** | | ***-*** | ***-*** | ***-*** | ***X1*** |
|  | ***-*** | ***-*** | ***-*** | ***-*** | ***-*** | | ***-*** | ***1*** | ***1*** |
|  | ***-*** | ***-*** | ***-*** | ***-*** | ***-*** | | ***-*** | ***1*** | ***1*** |  |
|  | ***Q2*** | ***0*** | ***0*** | ***-*** | ***-*** | ***-*** | | ***-*** | ***-*** | ***-*** |  |
|  | ***0*** | ***0*** | ***-*** | ***-*** | ***-*** | | ***-*** | ***-*** | ***-*** | ***X1*** |
|  |  | ***-*** | ***-*** | ***-*** | ***-*** | ***-*** | | ***-*** | ***-*** | ***-*** |
|  |  | ***-*** | ***-*** | ***-*** | ***-*** | ***-*** | | ***-*** | ***-*** | ***-*** |  |
|  |  |  | ***X2*** | |  |  | | ***X2*** | |  |  |

***R4 = (Q3)***

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | ***Q3*** | | | |  |  | |  |  |  |
|  |  | ***Q1*** | |  |  | ***Q1*** | | |  |  | ***S4*** |
| ***Q4*** | ***Q2*** | ***-*** | ***-*** | ***-*** | ***-*** | ***-*** | | ***-*** | ***-*** | ***-*** |  |
| ***-*** | ***-*** | ***-*** | ***-*** | ***-*** | | ***-*** | ***-*** | ***-*** | ***X1*** |
|  | ***-*** | ***-*** | ***-*** | ***-*** | ***-*** | | ***-*** | ***0*** | ***0*** |
|  | ***-*** | ***-*** | ***-*** | ***-*** | ***-*** | | ***-*** | ***0*** | ***0*** |  |
|  | ***Q2*** | ***1*** | ***1*** | ***0*** | ***0*** | ***0*** | | ***0*** | ***0*** | ***0*** |  |
|  | ***1*** | ***1*** | ***0*** | ***0*** | ***0*** | | ***0*** | ***0*** | ***0*** | ***X1*** |
|  |  | ***0*** | ***0*** | ***0*** | ***0*** | ***0*** | | ***0*** | ***0*** | ***0*** |
|  |  | ***0*** | ***0*** | ***0*** | ***0*** | ***0*** | | ***0*** | ***0*** | ***0*** |  |
|  |  |  | ***X2*** | |  |  | | ***X2*** | |  |  |

***S4 = (Q̅2) (Q̅3) (Q3Q̅1)***

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| ***Зм****.*  ***Арк.***  ***№ докум.***  ***Підп.***  ***Дата***  ***Арк.***  ***6***  *4*  ***ІАЛЦ.463626.004 ПЗ*** |  | ***Q3*** | | | |  |  | |  |  |  |
|  |  | ***Q1*** | |  |  | ***Q1*** | | |  |  | ***R3*** |
| ***Q4*** | ***Q2*** | ***-*** | ***-*** | ***-*** | ***-*** | ***-*** | | ***-*** | ***-*** | ***-*** |  |
| ***-*** | ***-*** | ***-*** | ***-*** | ***-*** | | ***-*** | ***-*** | ***-*** | ***X1*** |
|  | ***-*** | ***-*** | ***-*** | ***-*** | ***-*** | | ***-*** | ***-*** | ***-*** |
|  | ***-*** | ***-*** | ***-*** | ***-*** | ***-*** | | ***-*** | ***-*** | ***-*** |  |
|  | ***Q2*** | ***1*** | ***1*** | ***1*** | ***1*** | ***0*** | | ***0*** | ***-*** | ***-*** |  |
|  | ***1*** | ***1*** | ***0*** | ***0*** | ***0*** | | ***0*** | ***-*** | ***-*** | ***X1*** |
|  |  | ***0*** | ***0*** | ***-*** | ***0*** | ***-*** | | ***-*** | ***-*** | ***-*** |
|  |  | ***0*** | ***0*** | ***-*** | ***0*** | ***-*** | | ***-*** | ***-*** | ***-*** |  |
|  |  |  | ***X2*** | |  |  | | ***X2*** | |  |  |

***R3 = (Q̅1X1) (Q̅2) (Q̅3)***

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | ***Q3*** | | | |  |  | |  |  |  |
|  |  | ***Q1*** | |  |  | ***Q1*** | | |  |  | ***S3*** |
| ***Q4*** | ***Q2*** | ***-*** | ***-*** | ***-*** | ***-*** | ***-*** | | ***-*** | ***-*** | ***-*** |  |
| ***-*** | ***-*** | ***-*** | ***-*** | ***-*** | | ***-*** | ***-*** | ***-*** | ***X1*** |
|  | ***-*** | ***-*** | ***-*** | ***-*** | ***-*** | | ***-*** | ***0*** | ***0*** |
|  | ***-*** | ***-*** | ***-*** | ***-*** | ***-*** | | ***-*** | ***0*** | ***0*** |  |
|  | ***Q2*** | ***0*** | ***0*** | ***0*** | ***0*** | ***1*** | | ***1*** | ***0*** | ***0*** |  |
|  | ***0*** | ***0*** | ***-*** | ***-*** | ***1*** | | ***1*** | ***0*** | ***0*** | ***X1*** |
|  |  | ***-*** | ***-*** | ***-*** | ***-*** | ***0*** | | ***0*** | ***0*** | ***0*** |
|  |  | ***-*** | ***-*** | ***-*** | ***-*** | ***0*** | | ***0*** | ***0*** | ***0*** |  |
|  |  |  | ***X2*** | |  |  | | ***X2*** | |  |  |

***S3 = (Q̅1) (Q3) (Q̅2)***

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | ***Q3*** | | | |  |  | |  |  |  |
|  |  | ***Q1*** | |  |  | ***Q1*** | | |  |  | ***R2*** |
| ***Q4*** | ***Q2*** | ***-*** | ***-*** | ***-*** | ***-*** | ***-*** | | ***-*** | ***-*** | ***-*** |  |
| ***-*** | ***-*** | ***-*** | ***-*** | ***-*** | | ***-*** | ***-*** | ***-*** | ***X1*** |
|  | ***-*** | ***-*** | ***-*** | ***-*** | ***-*** | | ***-*** | ***-*** | ***-*** |
|  | ***-*** | ***-*** | ***-*** | ***-*** | ***-*** | | ***-*** | ***-*** | ***-*** |  |
|  | ***Q2*** | ***1*** | ***1*** | ***1*** | ***1*** | ***1*** | | ***1*** | ***0*** | ***0*** |  |
|  | ***1*** | ***1*** | ***1*** | ***1*** | ***1*** | | ***1*** | ***0*** | ***0*** | ***X1*** |
|  |  | ***0*** | ***0*** | ***-*** | ***-*** | ***0*** | | ***0*** | ***-*** | ***-*** |
|  |  | ***0*** | ***0*** | ***-*** | ***-*** | ***-*** | | ***-*** | ***-*** | ***-*** |  |
|  |  |  | ***X2*** | |  |  | | ***X2*** | |  |  |

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***R2 = (Q̅2) (Q̅3Q̅1)***

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | ***Q3*** | | | |  |  | |  |  |  |
|  |  | ***Q1*** | |  |  | ***Q1*** | | |  |  | ***S2*** |
| ***Q4*** | ***Q2*** | ***-*** | ***-*** | ***-*** | ***-*** | ***-*** | | ***-*** | ***-*** | ***-*** |  |
| ***-*** | ***-*** | ***-*** | ***-*** | ***-*** | | ***-*** | ***-*** | ***-*** | ***X1*** |
|  | ***-*** | ***-*** | ***-*** | ***-*** | ***-*** | | ***-*** | ***0*** | ***0*** |
|  | ***-*** | ***-*** | ***-*** | ***-*** | ***-*** | | ***-*** | ***0*** | ***0*** |  |
|  | ***Q2*** | ***0*** | ***0*** | ***0*** | ***0*** | ***0*** | | ***0*** | ***-*** | ***-*** |  |
|  | ***0*** | ***0*** | ***-*** | ***-*** | ***0*** | | ***0*** | ***-*** | ***-*** | ***X1*** |
|  |  | ***1*** | ***1*** | ***-*** | ***0*** | ***1*** | | ***1*** | ***0*** | ***0*** |
|  |  | ***1*** | ***1*** | ***-*** | ***0*** | ***0*** | | ***0*** | ***0*** | ***0*** |  |
|  |  |  | ***X2*** | |  |  | | ***X2*** | |  |  |

***S2 = (Q2) (Q̅3Q̅2X̅1) (Q̅1)***

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | ***Q3*** | | | |  |  | |  |  |  |
|  |  | ***Q1*** | |  |  | ***Q1*** | | |  |  | ***R1*** |
| ***Q4*** | ***Q2*** | ***-*** | ***-*** | ***-*** | ***-*** | ***-*** | | ***-*** | ***-*** | ***-*** |  |
| ***-*** | ***-*** | ***-*** | ***-*** | ***-*** | | ***-*** | ***-*** | ***-*** | ***X1*** |
|  | ***-*** | ***-*** | ***-*** | ***-*** | ***-*** | | ***-*** | ***-*** | ***-*** |
|  | ***-*** | ***-*** | ***-*** | ***-*** | ***-*** | | ***-*** | ***-*** | ***-*** |  |
|  | ***Q2*** | ***1*** | ***1*** | ***-*** | ***-*** | ***1*** | | ***0*** | ***0*** | ***0*** |  |
|  | ***1*** | ***1*** | ***0*** | ***0*** | ***1*** | | ***0*** | ***0*** | ***0*** | ***X1*** |
|  |  | ***1*** | ***1*** | ***-*** | ***-*** | ***1*** | | ***1*** | ***0*** | ***0*** |
|  |  | ***1*** | ***1*** | ***-*** | ***-*** | ***0*** | | ***0*** | ***0*** | ***0*** |  |
|  |  |  | ***X2*** | |  |  | | ***X2*** | |  |  |

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***R1 = (Q̅1) (Q̅3Q2X2) (Q̅3Q̅2X̅1)***

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | ***Q3*** | | | |  |  | |  |  |  |
|  |  | ***Q1*** | |  |  | ***Q1*** | | |  |  | ***S1*** |
| ***Q4*** | ***Q2*** | ***-*** | ***-*** | ***-*** | ***-*** | ***-*** | | ***-*** | ***-*** | ***-*** |  |
| ***-*** | ***-*** | ***-*** | ***-*** | ***-*** | | ***-*** | ***-*** | ***-*** | ***X1*** |
|  | ***-*** | ***-*** | ***-*** | ***-*** | ***-*** | | ***-*** | ***0*** | ***0*** |
|  | ***-*** | ***-*** | ***-*** | ***-*** | ***-*** | | ***-*** | ***0*** | ***0*** |  |
|  | ***Q2*** | ***0*** | ***0*** | ***0*** | ***0*** | ***0*** | | ***-*** | ***1*** | ***1*** |  |
|  | ***0*** | ***0*** | ***1*** | ***1*** | ***0*** | | ***-*** | ***1*** | ***1*** | ***X1*** |
|  |  | ***0*** | ***0*** | ***0*** | ***0*** | ***0*** | | ***0*** | ***1*** | ***1*** |
|  |  | ***0*** | ***0*** | ***0*** | ***0*** | ***-*** | | ***-*** | ***1*** | ***1*** |  |
|  |  |  | ***X2*** | |  |  | | ***X2*** | |  |  |

***S1 = (Q3Q̅2) (Q3Q2X̅1) (Q1) (Q4)***

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
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| ***Q4*** | ***-*** | ***-*** | ***-*** | ***0*** |  |
| ***-*** | ***-*** | ***-*** | ***-*** | ***Q2*** |
|  | ***0*** | ***0*** | ***0*** | ***0*** |
|  | ***0*** | ***1*** | ***0*** | ***0*** |  |
|  |  | ***Q1*** | |  |  |

***Y4 = (Q̅1) (Q̅3) (Q2)***

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | ***Q3*** | |  |  | ***Y3*** |
| ***Q4*** | ***-*** | ***-*** | ***-*** | ***0*** |  |
| ***-*** | ***-*** | ***-*** | ***-*** | ***Q2*** |
|  | ***0*** | ***0*** | ***0*** | ***0*** |
|  | ***1*** | ***0*** | ***0*** | ***0*** |  |
|  |  | ***Q1*** | |  |  |

***Y3 = (Q̅3) (Q2) (Q1)***

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | ***Q3*** | |  |  | ***Y2*** |
| ***Q4*** | ***-*** | ***-*** | ***-*** | ***1*** |  |
| ***-*** | ***-*** | ***-*** | ***-*** | ***Q2*** |
|  | ***0*** | ***1*** | ***1*** | ***1*** |
|  | ***0*** | ***0*** | ***0*** | ***0*** |  |
|  |  | ***Q1*** | |  |  |

***Y2 = (Q2Q̅1) (Q̅4Q̅2)***

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | ***Q3*** | |  |  | ***Y1*** |
| ***Q4*** | ***-*** | ***-*** | ***-*** | ***0*** |  |
| ***-*** | ***-*** | ***-*** | ***-*** | ***Q2*** |
|  | ***0*** | ***1*** | ***1*** | ***0*** |
|  | ***0*** | ***0*** | ***1*** | ***0*** |  |
|  |  | ***Q1*** | |  |  |

***Y1 = (Q̅2Q3) (Q̅1)***

***2.6. Побудова схеми автомата в заданому базисі***

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***Отриманих після мінімізації даних достатньо для побудови***

***комбінаційних схем функцій збудження тригерів і функцій сигналів***

***виходів, таким чином, і всієї комбінаційної схеми. Автомат будуємо на***

***RS-тригерах. Автомат є синхронним, так як його роботу синхронізує***

***генератор, а RS-тригер керований перепадом сигналу.***

***3. Синтез комбінаційних схем***

***3.1. Представлення функції f4 в канонічних формах алгебр***

***Буля, Шеффера, Пірса та Жегалкіна***

***Алгебра Буля {І, АБО, НЕ}***

***f4ДДНФ= (X̅4X̅3X̅2X1) v (X̅4X̅3X2X1) v (X4X̅3X̅2X1) v (X4X3X̅2X̅1) v (X4X3X2X1)***

***f4ДКНФ= (X̅4vX̅3vX̅2vX̅1) ∙ (X̅4vX̅3vX2vX̅1) ∙ (X̅4vX3vX̅2vX̅1) ∙ (X̅4vX3vX2vX̅1) ∙ (X4vX̅3vX̅2vX̅1) ∙ (X4vX̅3vX2vX̅1) ∙ (X4vX̅3vX2vX1) ∙ (X̅4vX3vX̅2vX1) ∙  
(X̅4vX3vX2vX1) ∙ (X4X3X̅2X1) ∙ (X4X3X2X̅1)***

***Алгебра Шеффера {І-НЕ}***

***f4 = ((X4/X4)(X3/X3)(X2/X2)(X1))/((X4/X4)(X3/X3)(X2)(X1))/((X4)/(X3/X3)***

***(X2/X2)(X1))/((X4)(X3)(X2/X2)(X1/X1))/((X4)(X3)(X2)(X1))***

***Алгебра Пірса {АБО-НЕ}***

***f4 = ((X4↓X4)↓(X3↓X3)↓(X2↓X2) ↓(X1↓X1))↓((X4↓X4)↓(X3↓X3)↓(X2)↓(X1↓X1))↓  
((X4↓X4)↓(X3)↓(X2↓X2)↓(X1↓X1))↓((X4↓X4)↓(X3)↓(X2)↓(X1↓X1))↓((X4)↓  
↓(X3↓X3)↓(X2↓X2)↓(X1↓X1)↓((X4)↓(X3↓X3)↓(X2)↓(X1↓X1))↓((X4)↓(X3↓X3)  
↓(X2)↓(X1))↓((X4↓X4)↓(X3)↓( X2↓X2)↓(X1))↓((X4↓X4)↓(X3)↓(X2)↓(X1))  
↓((X4)↓(X3)↓(X2↓X2)↓(X1))↓(( X4)↓(X3)↓(X2)↓(X1↓X1)).   
Алгебра Жегалкіна {ВИКЛЮЧНЕ АБО, І, const 1}***

***f4 = (X4⊕1)(X3⊕1)(X2⊕1)X1⊕(X4⊕1)(X3⊕1)X2X1⊕X4(X3⊕1)(***

***X2⊕1)X1 ⊕X4X3(X2⊕1)( X1⊕1) ⊕X4X3X2X1 = X4X3X2X1⊕***

***X3X2X1⊕X4X3X2⊕X4X3⊕X3X1⊕X1***