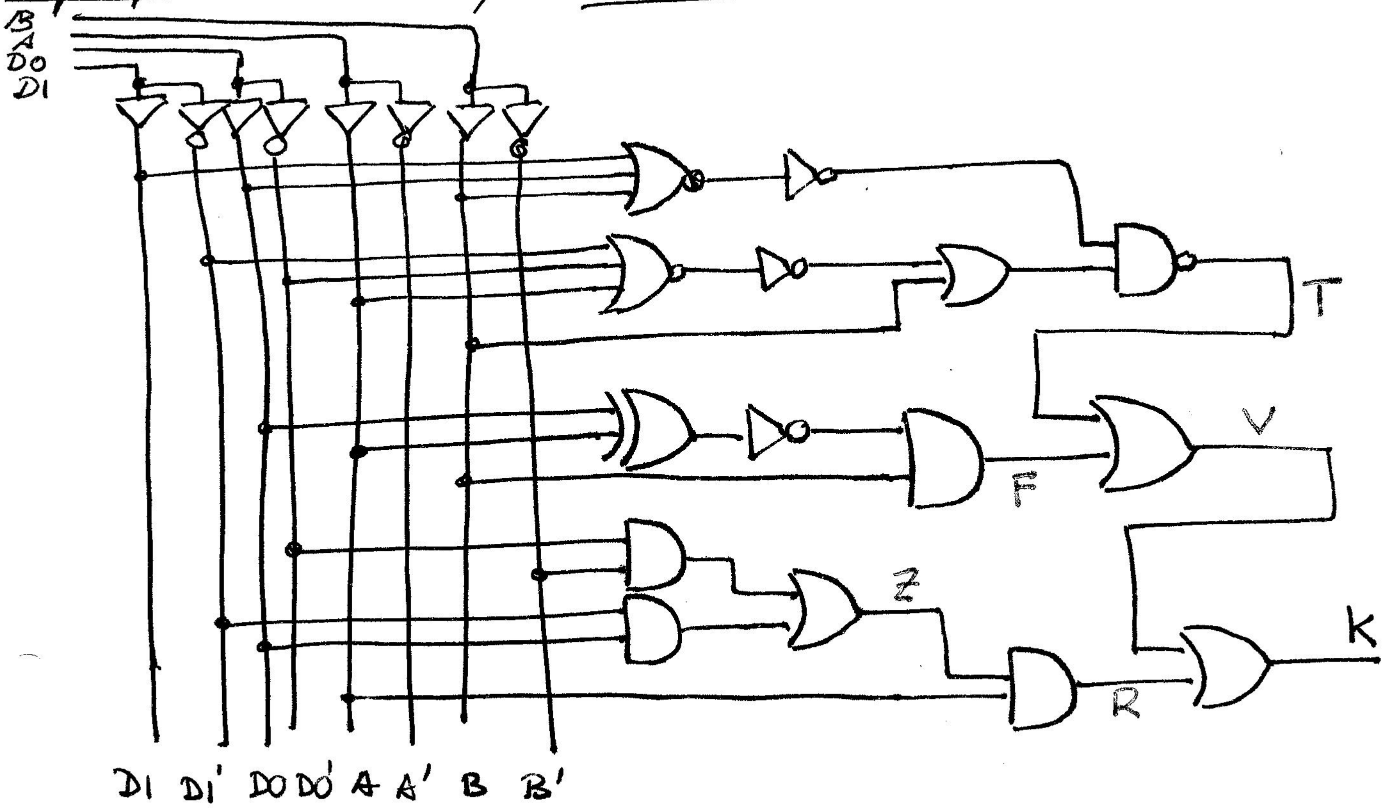
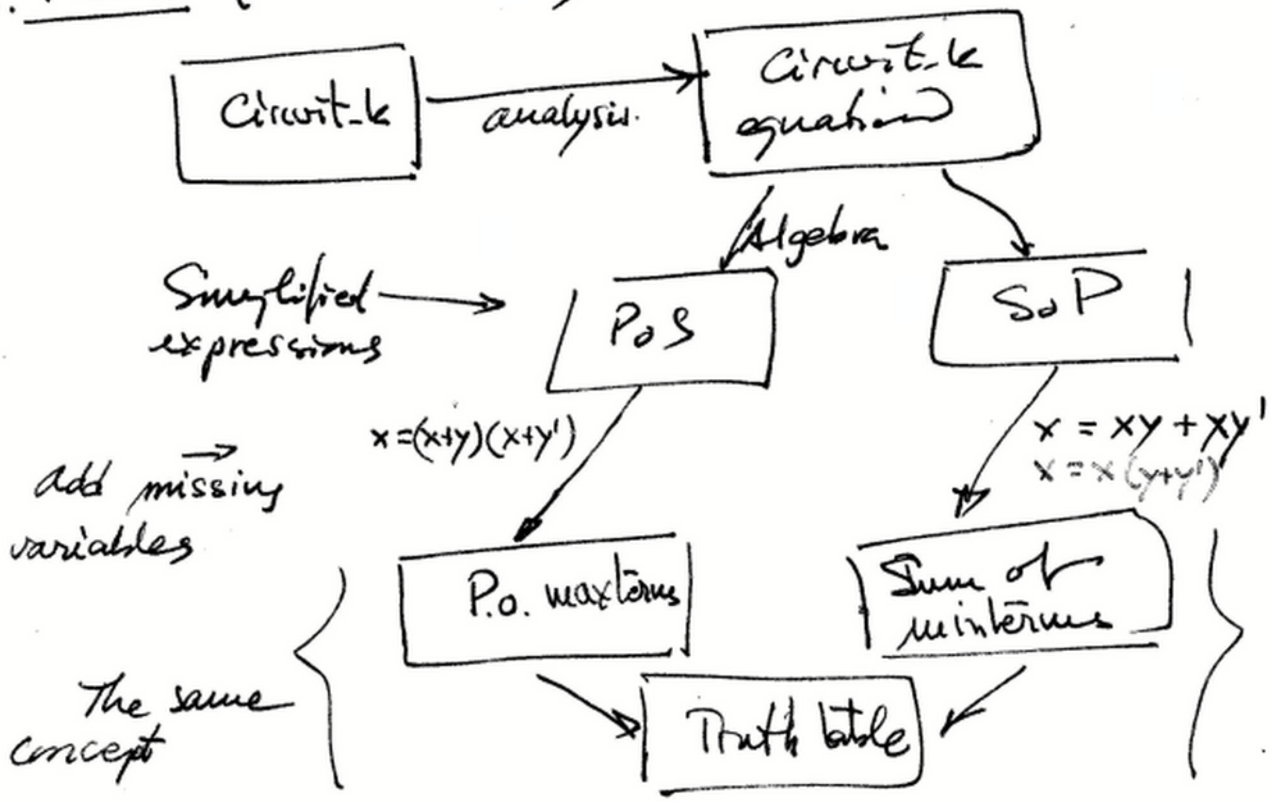
1 Specifications : Analyse Circuit-K



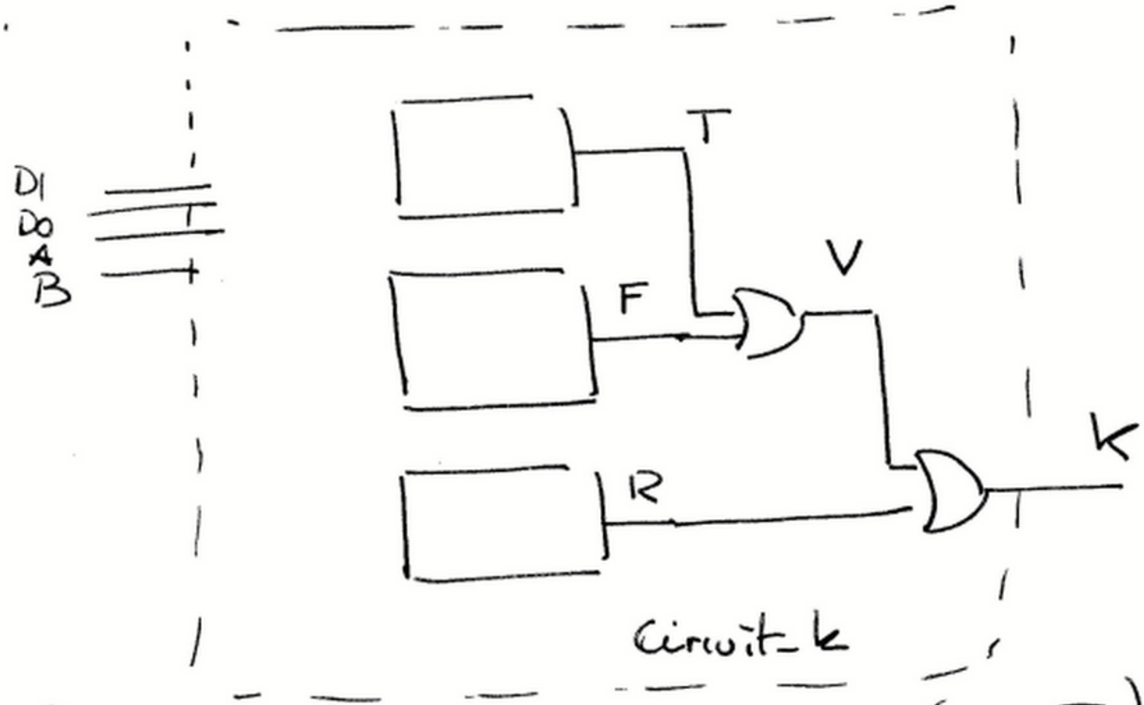
⇒ Find circuit's truth table using a pen-and-paper method (1)

$$K = f(D_1, D_0, A, B)$$

2. Plan (method I) analyse section by section



→ This is the idea of solving it using smaller circuit sections



$$K = R + V = R + (F + T)$$

3. Development

1. Find circuit's general equation

Naming wires:

$$K = f(D_1, D_0, A, B) = \underbrace{R}_{A \cdot Z} \overset{OR}{+} V$$

$$T + F = V$$

$$Z = \left[(D_0' \cdot B') + (D_1' \cdot D_0) \right]$$

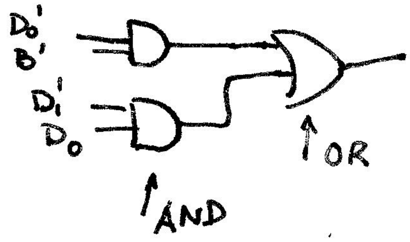
$$F = (D_0 \oplus A)' \underset{AND}{\cdot} B$$

$$T = \left[\left[((D_1' + D_0' + A)')' + B \right] \cdot ((D_1 + D_0 + B)')' \right]'$$

$$\boxed{K = \left[\left[((D_1' + D_0' + A)')' + B \right] \cdot ((D_1 + D_0 + B)')' \right]' + B \cdot (D_0 \oplus A)' + A\left((D_0' \cdot B') + (D_1' \cdot D_0) \right)}$$

This equation is the same as the circuit K representation

For instance: $(D_0' \cdot B') + (D_1' \cdot D_0)$



Simplification term by term

$$\left(\underbrace{(D_1'+D_0'+A+B)(D_1+D_0+B)}_{(x\;\cdot\;y)'}\right)' + B\underbrace{(D_0A'+D_0'A)'}_{XOR} +$$

$$+ A\cdot D_0'\cdot B' + A\cdot D_1'\cdot D_0 =$$

$$(x\cdot y)' = x'+y' \quad \rightarrow \text{De Morgan's Law}$$
$$(x+y)' = x'\cdot y'$$

$$= (D_1''+D_0'+A+B)' + (D_1+D_0+B)' + B\left((D_0A')'\cdot(D_0'A)'\right) +$$

$$+ AD_0'B' + AD_1'D_0 =$$

$$= D_1''\cdot D_0''\cdot A'\cdot B' + D_1'\cdot D_0'\cdot B' + B\left((D_0'+A)\cdot(D_0+A')\right)$$

$$+ AD_0'B' + AD_1'D_0 =$$

$$= D_1\cdot D_0A'B' + D_1'D_0'B' + B(\underbrace{D_0'D_0}_{0} + D_0'A' + AD_0 + \underbrace{AA'}_{0}) +$$

$$+ AD_0'B' + AD_1'D_0$$

$$K = D_1D_0A'B' + D_1'D_0'B' + BD_0'A' + BAD_0 +$$
$$+ AD_0'B' + AD_1'D_0$$

K= is a sum of six products

$\boxed{\text{SoP}}$

adding missing variables

Now, let's convert products into minterms

$x = x(y+y')$

$xy+xy'$

$D1\,D0\,A'B' \rightarrow$ minterm $m_{1100} = m_{12}$

$$D_1'D_0'B' = D_1'D_0'B'\underbrace{(A+A')}_{'1'} = D_1'D_0'B'A + D_1'D_0'B'A'$$

reorder variables $\Rightarrow D_1'D_0'AB' + D_1'D_0'A'B'$

$$m_{0010} + m_{0000}$$

$$m_2 + m_0$$

And so, in the same way all the other terms (products)

$$BD_0'A' = (D_1+D_1')D_0'A'B = D_1D_0'A'B + D_1'D_0'A'B$$

$\rightarrow m_9 + m_1$ $\quad m_{1001} + m_{0001}$

$$BAD_0 = (D_1+D_1')D_0AB = D_1D_0AB + D_1'D_0AB$$

$\rightarrow m_{15} + m_7$ $\quad m_{1111} + m_{0111}$

$$AD_0'B' = (D_1+D_1')D_0'AB' = D_1D_0'AB' + D_1'D_0'AB'$$

$\rightarrow m_{10} + m_2$ $\quad m_{1010} + m_{0010}$

$$AD_1'D_0 = D_1'D_0A(B+B') = D_1'D_0AB + D_1'D_0AB'$$

$\rightarrow m_7 + m_6$ $\quad m_{0111} + m_{0110}$

$$K = f(D_1, D_0, A, B) = m_{12} + m_2 + m_0 + m_9 + m_1 + m_{15} + m_7 + m_{10} + m_2 + m_7 + m_6$$

$m_7 + m_7 = m_7$

$$\boxed{K = \sum m(0,1,2,6,7,9,10,12,15)}$$

This sum of minterms equation is the same as the other: <u>product</u> of <u>maxterms</u>

$$K = f(D_1, D_0, A, B) = \prod M(3, 4, 5, 8, 11, 13, 14)$$

And the <u>truth table</u>

	D_1	D_0	A	B	K
0	0	0	0	0	1
1	0	0	0	1	1
2	0	0	1	0	1
3	0	0	1	1	0
4	0	1	0	0	0
5	0	1	0	1	0
6	0	1	1	0	1
7	0	1	1	1	1
8	1	0	0	0	0
9	1	0	0	1	1
10	1	0	1	0	1
11	1	0	1	1	0
12	1	1	0	0	1
13	1	1	0	1	0
14	1	1	1	0	0
15	1	1	1	1	1

4 → <u>Test</u> ⇒ We have solved the circuit using <u>method I</u>

and method IV

(numerical engine Wolfram Alpha)