

习题 1.3

$$(10111.110)_2$$

$$=(010111.110)_2$$

$$=(27.6)_8$$

$$(10111.110)_2$$

$$=(0001,0111,1100)_2$$

$$=(17.C)_{16}$$

习题 1.4

$$(234.125)_{10}$$

$$\begin{array}{r|l} 2 & 234 \\ \hline & 117 \\ 2 & 58 \\ \hline & 29 \\ 2 & 14 \\ \hline & 7 \\ 2 & 3 \\ \hline & 1 \end{array}$$

$$234=(11101010)_2$$

$$0.125 \times 2 = 0.25 \quad 0$$

$$0.25 \times 2 = 0.5 \quad 0$$

$$0.5 \times 2 = 1$$

$$0.125=(0.001)_2$$

$$\text{即 } (234.125)_{10}=(11101010.001)_2$$

习题 1.9

1011100 转典型格雷码.

$$0 \oplus 0 = 0$$

$$0 \oplus 1 = 1$$

$$1 \oplus 1 = 0$$

$$1 \oplus 0 = 1$$

$$0 \oplus 1 = 1$$

$$1 \oplus 0 = 1$$

$$0 \oplus 1 = 1$$

$$\Rightarrow 1111010$$

2.1. (7)

[illegible]

 $2.1(10)$

记左侧为下

$$\begin{aligned} F &= (\bar{A} + \bar{B}) \cdot (A + B) + (\bar{B} + \bar{C}) \cdot (B + C) + (\bar{C} + \bar{D}) \cdot (C + D) \\ &= \bar{A}B + \bar{B}A + \bar{B}C + \bar{C}B + \bar{C}D + \bar{D}C \\ &= \bar{A}\bar{B} + \bar{B}\bar{C} + \bar{C}\bar{D} + \bar{A}B + \bar{B}C + \bar{A}C + \bar{C}D \\ &= \bar{A}\bar{B} + \bar{B}\bar{C} + \bar{C}\bar{D} + \bar{A}D + \bar{A}B + \bar{B}C + \bar{A}C + \bar{C}D \\ &= \bar{A}\bar{B} + \bar{B}\bar{C} + \bar{C}\bar{D} + \bar{A}D + \bar{D}B + \bar{A}B + \bar{B}C + \bar{A}C + \bar{C}D + \bar{B}D \\ &= \bar{A}\bar{B} + \bar{A}C + \bar{B}\bar{C} + \bar{B}D + \bar{C}\bar{D} + \bar{A}D + \bar{D}B \\ &= \bar{A}\bar{B} + \bar{B}\bar{C} + \bar{C}\bar{D} + \bar{D}\bar{A} \end{aligned}$$

$$\therefore F = \overline{A}\overline{B} + \overline{B}\overline{C} + \overline{C}\overline{D} + \overline{D}\overline{A}$$

2.2 (2)

$$\begin{aligned}\overline{F} &= (\overline{A} + \overline{B} + \overline{C})(\overline{A} + \overline{B} + C)(\overline{A} + B + \overline{C})(\overline{A} + B + C) \\ &= A \cdot \overline{F} + \overline{A} \cdot \overline{F} = A \cdot (\overline{B} + \overline{C})(\overline{B} + C)(B + \overline{C})(B + C) + \overline{A}(1) \cdot (1) \cdot (1) \cdot (1) \\ &= \overline{A} + A \cdot (B(\overline{C}) \cdot C) \cdot 1 \cdot 1 + \overline{B} \cdot (1)(1) \cdot (\overline{C}) \cdot C \\ &= \overline{A} + A \cdot 0 = \overline{A}\end{aligned}$$

2.1.(8) 记等式左侧式子为下

~~$LHS = (Y \neq F) \cdot (\bar{Y} \neq F)$~~

$$LHS = (Y+F)(\bar{Y} + \bar{F})$$

$$= (Y + (0 + \bar{Z})(W + X)(1 + Z)(0 + Z)).$$

$$(\bar{Y} + (1 + \bar{z})(w + x)(0 + z)(1 + z))$$

$$= Y \cdot (\bar{Y} + (W+X)Z) = YZ(W+X)$$

2.3 (2)

$$F' = \overline{(A+B) + (C+\bar{B}) + (D+\bar{A}+\bar{B})}$$

$$= \bar{A}\bar{B} + \bar{C}B + \bar{D}AB$$

$$= \bar{A}\bar{B} \cdot \bar{C}B \cdot \bar{D}AB$$

$$= (A+B) \cdot (C+\bar{B}) \cdot (D+\bar{A}+\bar{B})$$

$$= B \cdot F' + \bar{B}F'$$

$$= B \cdot (A+1)(C+0)(D+\bar{A}+0) + \bar{B}(A+0)(C+1)(D+\bar{A}+1)$$

$$= BCC(D+\bar{A}) + \bar{B}A$$

$$= \bar{A}BC + BCD + \bar{B}A$$

2.6 (10)

$$F = (X+Y+Z+\bar{W})(V+X)(\bar{V}+Y+Z+\bar{W})$$

$$F' = XYZ\bar{W} + VX + \bar{V}YZ\bar{W}$$

$$= \bar{V}YZ\bar{W} + VX$$

$$\text{则 } F = (V+X) \cdot (\bar{V}+Y+Z+\bar{W})$$

2.11 (4)

BA	00	01	11	10
00	m ₁	m ₂	m ₄	m ₃
01	m ₅	m ₆	m ₈	m ₇
11	m ₁₃	m ₁₄	m ₁₆	m ₁₅
10	m ₉	m ₁₀	m ₁₂	m ₁₁

(下标不小心+13)

$$F = B\bar{D} + \bar{A}D$$

2.6 (7)

$$F = AC + \bar{A}\bar{B} + \bar{B}\bar{C}\bar{D} + BEC + \bar{C}\bar{D}\bar{E}\bar{C} + DEC$$

$$= AC + \bar{A}\bar{B} + \bar{B}\bar{C}\bar{D} + BEC + \bar{C}E$$

$$= AC + \bar{A}\bar{B} + \bar{B}\bar{C}\bar{D} + \bar{C}E$$

$$= AC + \bar{A}\bar{B} + \bar{B}(C+\bar{C}\bar{D}) + \bar{C}E$$

$$= AC + \bar{A}\bar{B} + \bar{B}C + \bar{B}\bar{D} + \bar{C}E$$

$$= AC + \bar{A}\bar{B} + \bar{B}\bar{D} + \bar{C}E$$

2.6 (8)

$$F = AC(B+\bar{C}) + \bar{A}(\bar{B}+C) + BCD + \bar{B}\bar{C}\bar{D}$$

$$= AB + \bar{A}\bar{C} + BCD + AC + \bar{A}\bar{B} + \bar{B}\bar{C}\bar{D}$$

$$= AB + \bar{A}\bar{C} + AC + \bar{A}\bar{B}$$

$$= AB(C+\bar{C}) + \bar{A}(\bar{B}+B)C + AC + \bar{A}\bar{B}$$

$$= \bar{A}\bar{B} + AC + BC$$

2.11 (5)

CB A	000	001	010	011	100	101	110	111
00	0	1	2	3	4	5	6	7
01	8	9	10	11	12	13	14	15
10	16	17	18	19	20	21	22	23
11	24	25	26	27	28	29	30	31

$$F = \bar{A}C$$

下标反了, 不影响

2.11(6)

$$F = \sum m^4(0, 2, 4, 8, 9, 11, 12)$$

BA \ DC	00	01	11	10
00	1	0	3	2
01	4	5	7	6
11	12	13	15	14
10	8	9	11	10

~~XXXXXXXXXXXXXXXXXXXX~~

$$F = \bar{A}\bar{B} + A\bar{C}D$$

2.12(5)

$$F = \sum m^4(2, 3, 6, 9, 11, 14) + \sum d(0, 5, 10, 13)$$

BA \ DC	00	01	11	10
00	X	1	3	2
01	4	X	7	6
11	12	13	X	14
10	8	9	11	X

$$F = B\bar{C} + BD + \bar{A}B + A\bar{C}D$$

4.2

$$F = \bar{B}_0 A_0 \bar{B}_1 A_1 \bar{B}_2 A_2 \cdot \bar{B}_1 A_1 B_2 \bar{A}_2 \cdot \bar{B}_2 A_2$$

$$= \bar{B}_0 A_0 (\bar{B}_1 + A_1) (\bar{B}_2 + A_2) + \bar{B}_1 A_1 (\bar{B}_2 + A_2) + \bar{B}_2 A_2$$

功能表 $A_1 A_2 \geq B_1 B_2$ $A_2 \geq B_2$ $A_2 > B_2$

$A_2 A_1 A_0$	$B_2 B_1 B_0$	F
1 x x	0 x x	1
1 1 x	x 0 x	1
x 1 x	0 0 x	1
1 1 1	x x 0	1
1 x 1	x 0 0	1
x 1 1	0 x 0	1
x x 1	0 0 0	1
其它		0

因此这是比较器(并行)

4.3

$$G_0 = B_0 \oplus B_1$$

$$G_1 = B_1 \oplus B_2$$

$$G_2 = B_2 \oplus B_3$$

$$G_3 = B_3$$

能明显发现是8421码转经典格雷码的码制译码器。

4.4.

$$C_1 = A_1 B_1 \cdot A_1 \oplus B_1 \cdot \underline{A_0 B_0}_{C_0}$$

$$S_1 = A_1 \oplus B_1 \oplus C_0$$

$$C_0 = A_0 \cdot B_0$$

$$S_0 = A_0 \oplus B_0$$

感觉原图的图有误: C_1 的门应该是或门
理论上是一个二位半加器。

4.3

K=1时

$$A_2 = B_2$$

$$A_1 = B_1 \oplus B_2$$

$$A_0 = B_0 \oplus B_1$$

三位转格雷码

K=0时

$$A_2 = B_2$$

$$A_1 = B_1 \oplus B_2$$

$$A_0 = A_1 \oplus B_0$$

$$= B_1 \oplus B_2 \oplus B_0$$

高位至低位累加和
格雷码转二进制

4-8.

$$G_i = B_i \oplus B_{i+1} \quad (i \leq 2)$$

$$G_3 = B_3$$

4-10

A	B	C	L	A	B	C	L
1	x	x	1	0	0	0	0
0	x	x	0	0	0	1	1
x	1	x	1	0	1	0	1
x	0	x	0	1	0	0	1
x	x	1	1	0	1	1	0
x	x	0	0	1	0	1	0
				1	1	0	0
				1	1	1	1

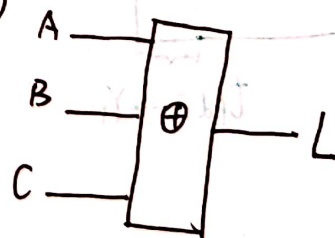
(肯定无法满足)

(规定一个初始状态)

改一个输入

(则输出翻转)

$$L = A \oplus B \oplus C$$



(奇偶检测)

4-11.

A	00
B	01
AB	10
0	11

献	受	F
00	00/10	1
01	01/10	1
10	10	1
11	00/01/10/11	1

献	受	A			
		00	01	11	10
00	C	1		1	
01	C		1	1	
11	C			1	1
10	C	1	1	1	1

$$F = \bar{C}D + AB + AC\bar{D} + \bar{A}\bar{B}\bar{C}$$

其中BA ~ 献互编码

DC ~ 献互者编码

4.6

$$A = \overline{I_1 + I_9} \cdot \overline{I_3 + I_7} \cdot \overline{I_5 + I_7}$$

$$B = \overline{I_2 + I_6} \cdot \overline{I_3 + I_7}$$

$$C = \overline{I_4 + I_6} \cdot \overline{I_5 + I_7}$$

$$D = I_8 + I_9$$

即

$$A = I_1 + I_9 + I_3 + I_7 + I_5 + I_7 = I_1 + I_9 + I_3 + I_5 + I_7$$

$$B = I_2 + I_3 + I_6 + I_7$$

$$C = I_4 + I_5 + I_6 + I_7$$

$$D = I_8 + I_9$$

编码器 (编为8421码)

4.12

(1)

S_0	S_1	Y_0	Y_1	Y_2	Y_3
0	0	D_0	D_1	D_2	D_3
0	1	D_1	D_2	D_3	D_0
1	0	D_2	D_3	D_0	D_1
1	1	D_3	D_0	D_1	D_2

(2) 数据选择器

$$Y_0 = \bar{S}_0 \bar{S}_1 D_0 + \bar{S}_0 S_1 D_1 + S_0 \bar{S}_1 D_2 + S_0 S_1 D_3$$

$$Y_1 = \bar{S}_0 \bar{S}_1 D_1 + \bar{S}_0 S_1 D_2 + S_0 \bar{S}_1 D_3 + S_0 S_1 D_0$$

$$Y_2 = \sim$$

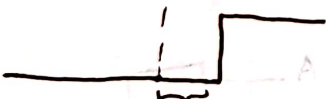
$$Y_3 = \sim$$

(4) D_1  "1"

D_2 _____ "0"

S_0 _____ "0"

S_1 

Y_1 
 $t_{pd} S_1 \rightarrow Y_1$

4.13. 2输入变量译码器.

A	B	Y_0	Y_1	Y_2	Y_3
0	0	1	0	0	0
0	1	0	1	0	0
1	0	0	0	1	0
1	1	0	0	0	1

$$Y_0 = \bar{A} \bar{B} \quad Y_1 = \bar{A} B$$

$$Y_2 = A \bar{B} \quad Y_3 = A B$$

最大延迟为3级. 最小为1级

(1) 0重叠即一个新信号变为"0"

但旧信号仍为"0"的现象

$$t_d = 8 \text{ ns}$$

~~尖峰~~

尖峰信号即信号输入偏移, 本来应该不变的信号, 先变化又变回来!

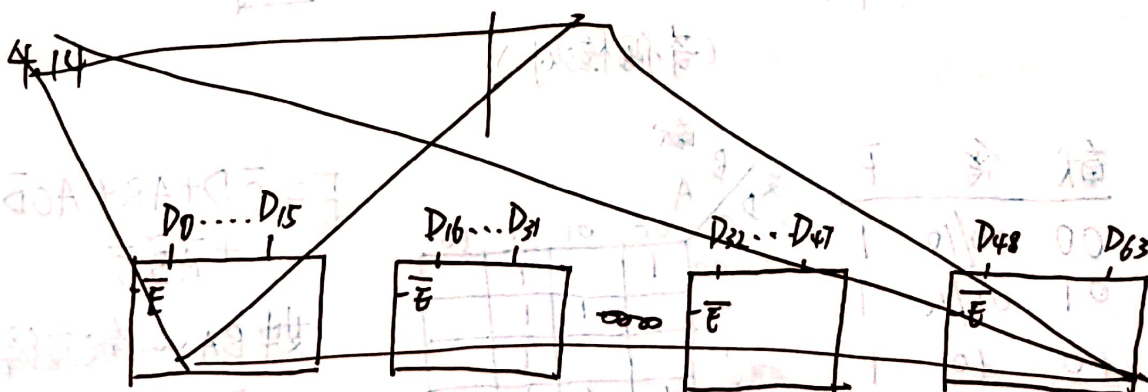
$$t_{sp} = 8 + 25 = 33 \text{ ns}$$

(2) 使能端直接加到输出门上.

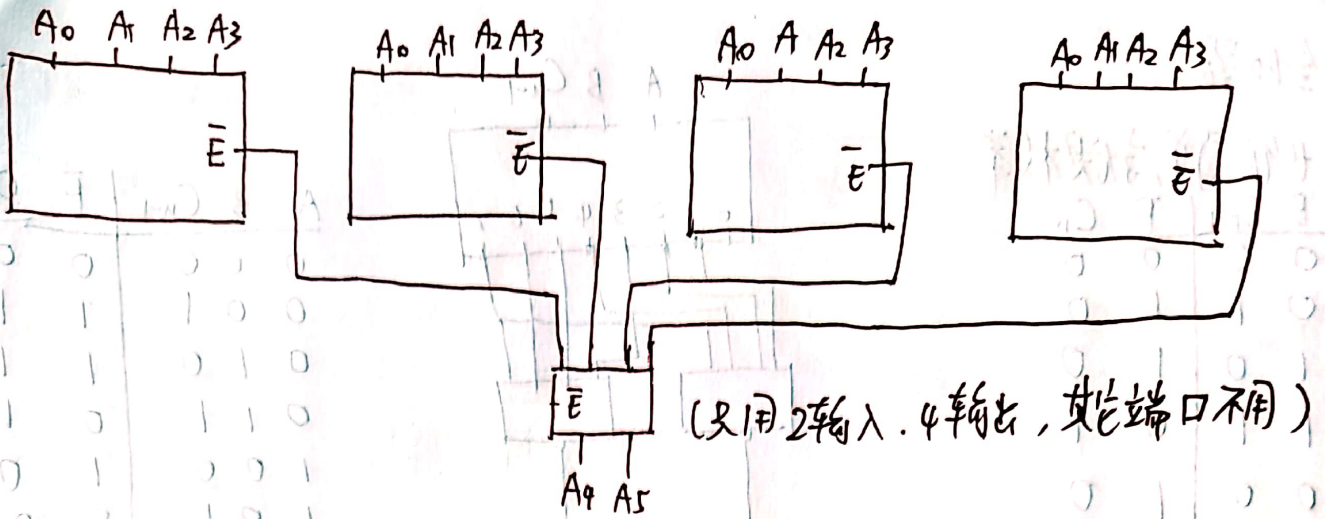
$$t_{suE} = 10 \text{ ns}$$

$$t_{hE} = 20 - 12 = 8 \text{ ns}$$

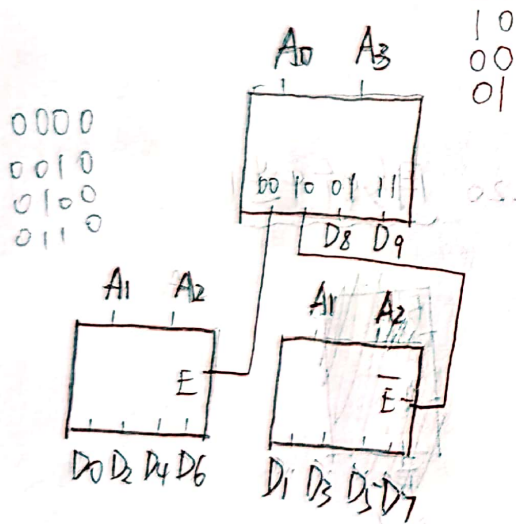
$$E = 1 \text{ 宽度为 } 0 + 8 + 25 = 33 \text{ ns}$$



4.14



4.15 3个2输入4输出变量译码器



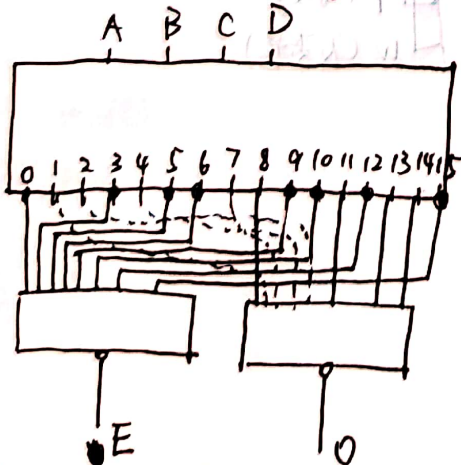
4.16

完全译码器 — 数据分配器



4.17

思路比较简单. 4位中奇数有8个. 偶数也有8个. 把对应的与在一起



输入	E	0
奇数 "1"	0	1
偶数 "1"	1	0

D	X0	X1	E	
01	23	45	67	89

不用

E	D	X0	X1	输出
1	X	X	X	均为1.
0	D	0	0	$Y_0 = D, Y_1 = \bar{D}$
0	D	1	0	$Y_2 = D, Y_3 = \bar{D}$
0	D	0	1	$Y_4 = D, Y_5 = \bar{D}$
0	D	1	1	$Y_6 = D, Y_7 = \bar{D}$

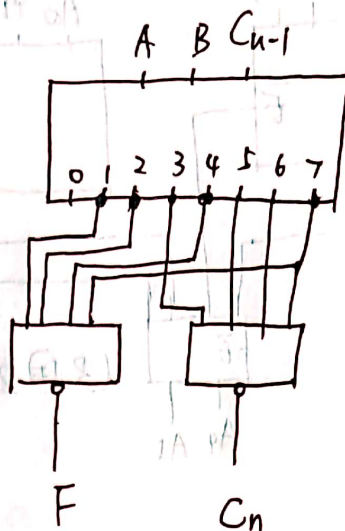
4.18

△一位全加器

思路也很简单，就是枚举

A	B	C _{n-1}	F	C _n
0	0	0	0	0
0	0	1	1	0
0	1	0	1	0
0	1	1	0	1
1	0	0	1	0
1	0	1	0	1
1	1	0	0	1
1	1	1	1	1

(全加)



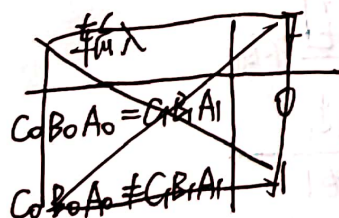
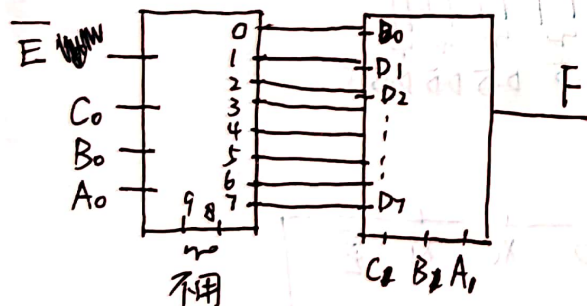
A	B	C _{n-1}	F	C _n
0	0	0	0	0
0	0	1	1	0
0	1	0	1	0
0	1	1	0	1
1	0	0	1	0
1	0	1	0	1
1	1	0	0	1
1	1	1	1	1

△一位全减器类似

4.19

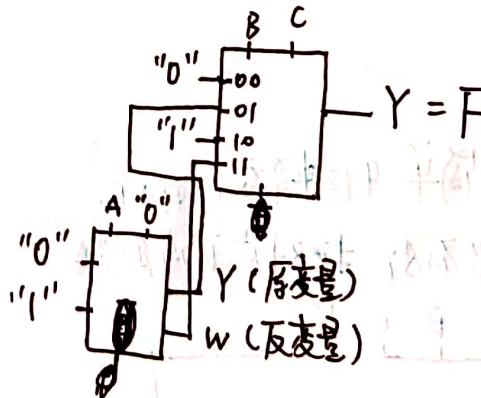
思路：BCD译码器输出一个“0”，让选择器去选。

三位一起选择——并行



E	输入	F
1	X	1
0	C ₀ B ₀ A ₀ = C ₁ B ₁ A ₁	0
0	C ₀ B ₀ A ₀ ≠ C ₁ B ₁ A ₁	1

4.20 用多个4选1



1.21
(1)

因为是8选1. 至多考虑3个变量.

X	Y	Z	F
0	0	0	0
0	0	1	0
0	1	0	0
0	1	1	0
1	0	0	0
1	0	1	0
1	1	0	0
1	1	1	0

(2) BA

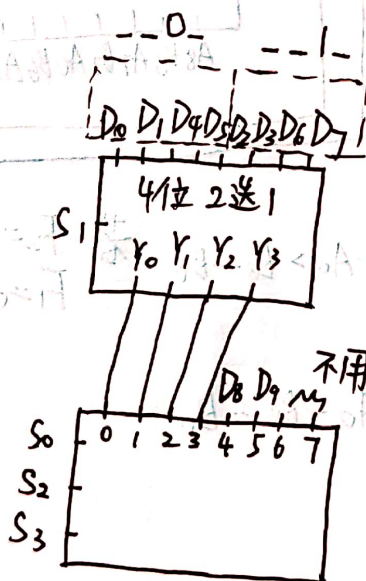
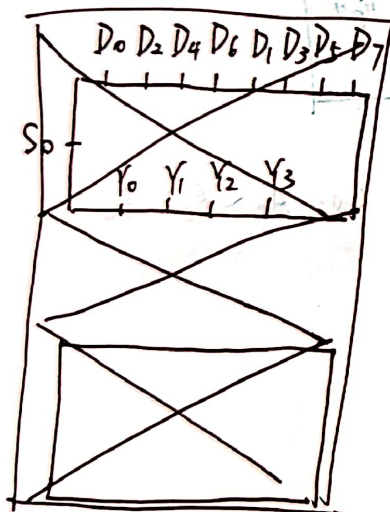
C	00	01	11	10
0	1 ₀	1 ₁	1 ₃	1 ₂
1	4	5	7	6
2	12	13	15	14
3	8	9	11	10

$$F = \bar{C}$$

直接把C送到数据端

4.22 (2)

一块8选1 + 一块4位2选1



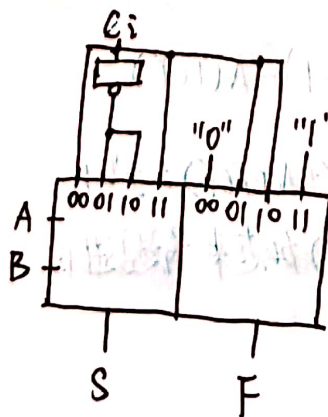
送出S₁=0与S₁=1的数据

4.23.

用A,B来选择. 恰好是双四选1.

一个输出为S. 另一个为Ci

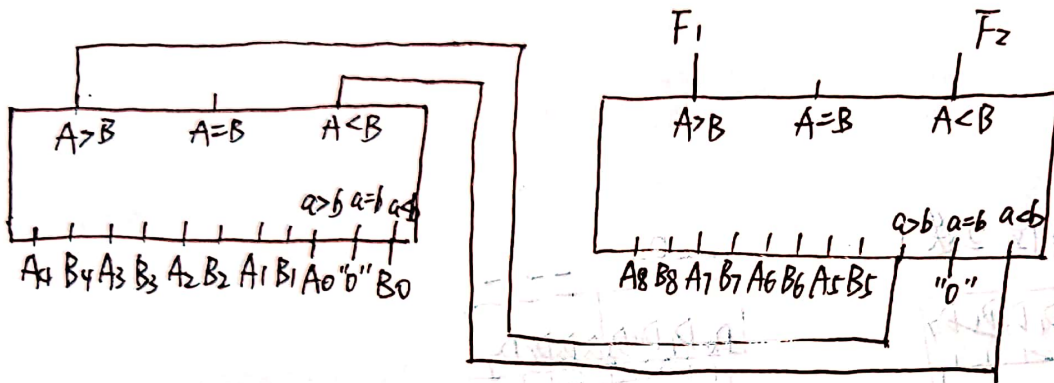
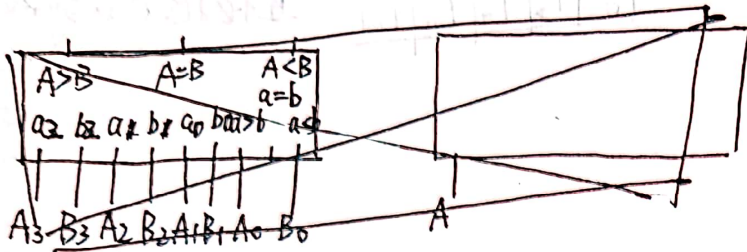
A	B	S	C _i
0	0	C _{i-1}	0
0	1	$\overline{C_{i-1}}$	C _{i-1}
1	0	$\overline{C_{i-1}}$	C _{i-1}
1	1	C _{i-1}	1



4.24

实现9位并行数据比较

输入并行, 不要求并行比较。



若 $(A > B) = F_1 = 1$
 $(A < B) = F_2 = 0$

则 $A_8 \dots A_0 > B_8 \dots B_0$

若 $F_2 = 1$
 $F_1 = 0$

则 $A_8 \dots A_0 < B_8 \dots B_0$

若 $F_1 = F_2 = 1$ 则 $A_8 \dots A_0 = B_8 \dots B_0$

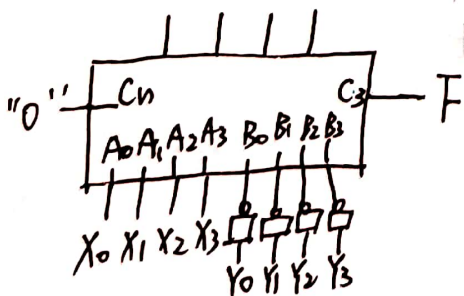
4.25 4位二进制比较器

② 这道题很难

首先一个4位二进制数 $Y = (2^4 - 1) - \text{NOT}(Y)$

因此欲比较 $X > Y$ 即 $X + \text{NOT}(Y) > 2^4 - 1$

∴ 使用加法器把 $X + \text{NOT}(Y)$ 加起来, 看是否进位



$F = 1$ 表明 $X > Y$

$F = 0$ 表明 $X \leq Y$

(只需交换 X, Y 位置, 可判断

$Y > X$, 若两次判断 $F = 0$

则 $X = Y$)

X	Y	F
0	0	0
0	1	0
1	0	1
1	1	0

4-26.

余3码转8421码.

实际上是想做减法

$$8421\text{码} = \text{余3码} - 3$$

有了4-25的经验.

$$X - 3 = X + \text{NOT}(3) - (2^4 - 1)$$

$$= X + 1100 - 1111$$

~~余3码 $X \geq 0011$~~

$$= X + 1101 - 10000$$

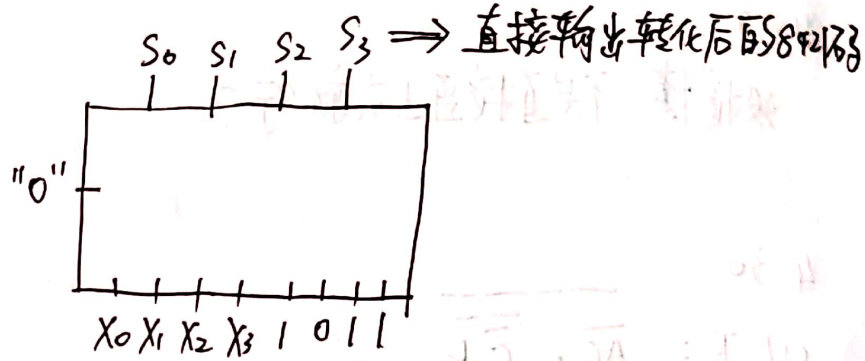
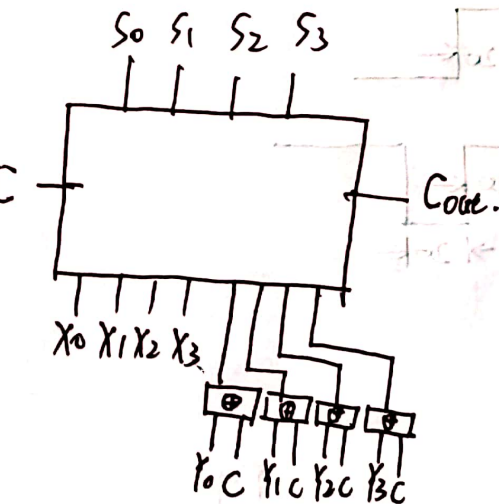
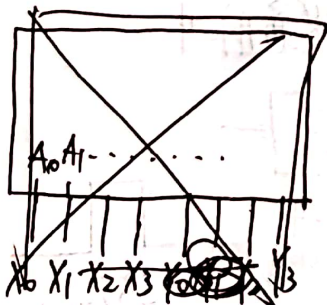
$\therefore$ 余3码 $X \geq 0011$

$\therefore X + 1101$ 必有进位

$$\therefore = (X + 1101)_{\text{低4位}}$$

4.27.

此处认为被减数 $>$ 减数.



4.29.

没搞懂，不是直接连上去就行？

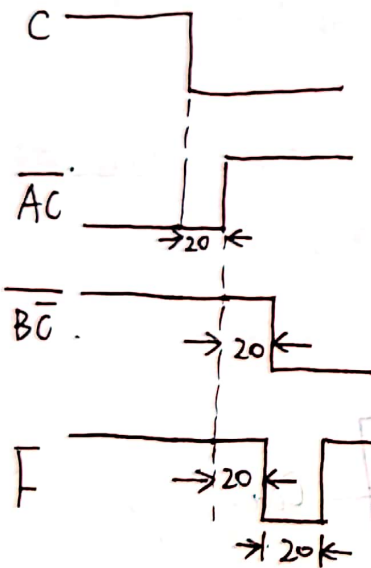
4.30

$$c1) F = \overline{AC} \cdot \overline{CB}$$

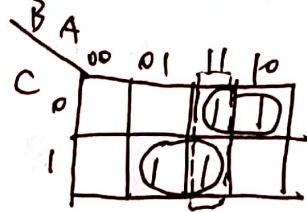
$$= AC + \overline{CB}$$

(2) 同一信号经过不同路径，前后参差的加在同一门电路输入上，为竞争而产生错误输出为冒险。

$A=B=1$ 时 $F=C+\overline{C}$ 会产生险象。



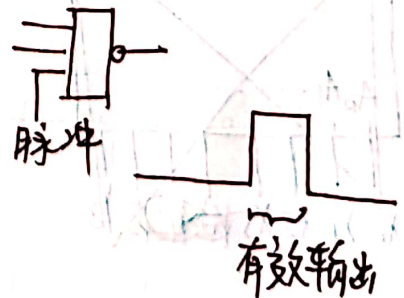
(3) ① 增加冗余项



$$F = AC + \overline{C}B + AB$$

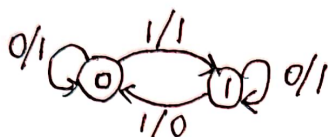
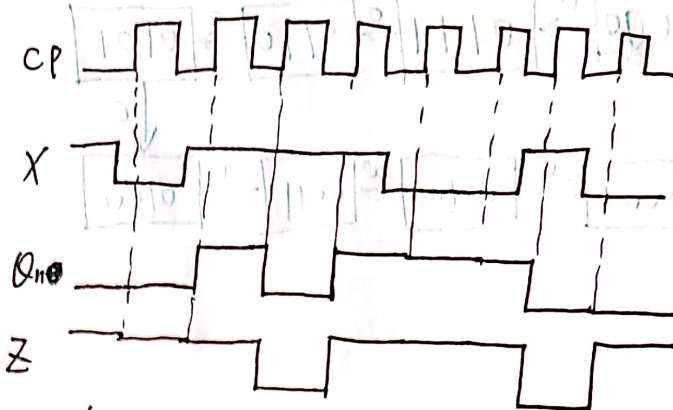
② 电容滤波，F接一个RC电路

③ 加一个选通脉冲



5.1

X	Q _n	Q _{n+1}	Z
0	0	0	1
0	1	1	1
1	0	1	1
1	1	0	0



5.2

$$J_0 = X$$

$$K_0 = Q_1 X$$

$$J_1 = Q_0 X$$

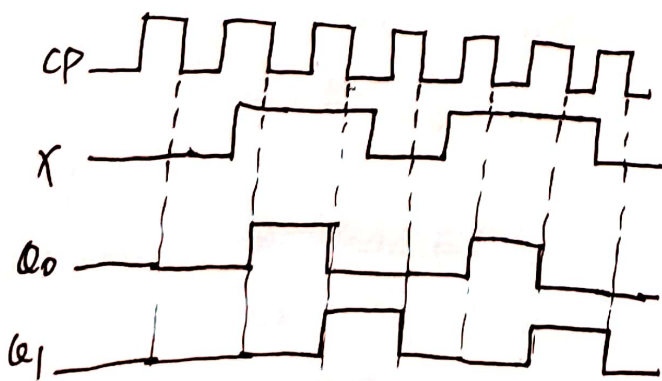
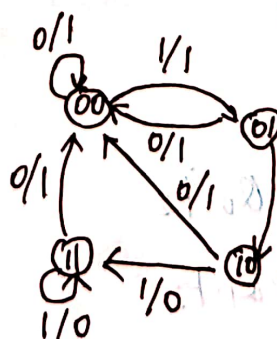
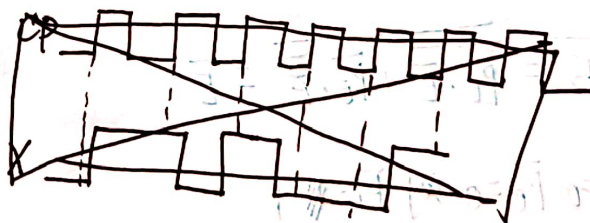
$$K_1 = \bar{X}$$

$$Z = \bar{J}_1 Q_1$$

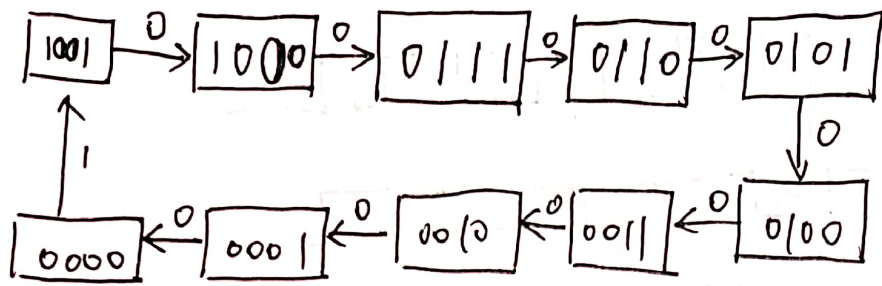
状态表

X	0	1
Q ₁ Q ₀		
00	00/1	01/1
01	00/1	10/1
11	00/1	11/0
10	00/1	11/1

X	Q ₀ ⁿ	Q ₁ ⁿ	J ₀	K ₀	J ₁	K ₁	Q ₀ ⁿ⁺¹	Q ₁ ⁿ⁺¹	Z
0	0	0	0	1	0	1	0	0	1
1	0	0	1	1	0	0	1	0	1
0	1	0	0	1	0	1	0	0	1
1	1	0	1	1	1	0	0	1	1
0	0	1	0	1	0	1	0	0	1
1	0	1	1	0	0	0	1	1	1
0	1	1	0	1	0	1	0	0	1
1	1	1	1	0	1	0	1	1	0



5-5



$$J_1 = K_1 = 1$$

$$J_2 = (Q_3 + Q_4) \cdot \bar{Q}_1 \quad K_2 = \bar{Q}_1$$

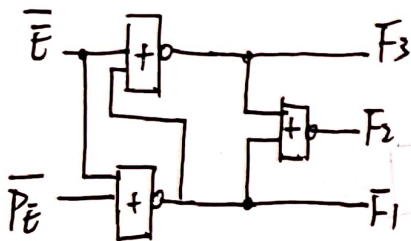
$$J_3 = Q_4 \cdot \bar{Q}_1 \quad K_3 = \bar{Q}_1 \cdot \bar{Q}_2$$

$$J_4 = \bar{Q}_3 \cdot \bar{Q}_2 \cdot \bar{Q}_1 \quad K_4 = \bar{Q}_1$$

$$Z = \bar{Q}_4 \cdot \bar{Q}_3 \cdot \bar{Q}_2 \cdot \bar{Q}_1$$

5-6

首先 $\bar{P}_E$ 是异步置零



$$F_1 = \overline{\bar{P}_E + \bar{E}} = \bar{P}_E \cdot \bar{E}$$

$$F_3 = (\overline{\bar{P}_E \cdot \bar{E}}) + \bar{E} = \overline{\bar{P}_E + \bar{E}} = \bar{P}_E \cdot \bar{E}$$

$$F_2 = \overline{F_1 + F_3} = \overline{\bar{P}_E \cdot \bar{E} + \bar{P}_E \cdot \bar{E}} = \bar{E}$$

因此 $\bar{E} = 0, \bar{P}_E = 0$ 则 $F_1 = 1$

$\bar{E} = 0, \bar{P}_E = 1$ 则 $F_3 = 1$

$\bar{E} = 1$ 则 $F_2 = 1$

$$DF_0 = F_1 \cdot D_0 + F_3 \cdot D_5 + Q_0 \cdot F_2$$

$$DF_1 = F_1 \cdot D_1 + F_3 \cdot Q_0 + Q_1 \cdot F_2$$

$$DF_2 = F_1 \cdot D_2 + F_3 \cdot Q_1 + Q_2 \cdot F_2$$

$$DF_3 = F_1 \cdot D_3 + F_3 \cdot Q_2 + Q_3 \cdot F_2$$

因此可知

$\bar{E} = 1$ 时. 状态保持

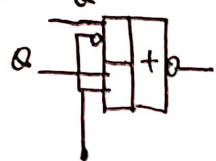
$\bar{E} = 0, \bar{P}_E = 0$ 时. 置数为 $D_3 D_2 D_1 D_0$

$\bar{E} = 0, \bar{P}_E = 1$ 时. 移位(右移)

画图省略.

5-8

Q



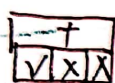
$U/\bar{D}$

$$\text{输出} = \overline{U/\bar{D}} \cdot Q + U/\bar{D} \cdot \bar{Q}$$

一个数据选择

1. 若 $L=0$. 则 D_A, D_B, D_C, D_D 进入 D , 为置数.

2. $\bar{P}=1$ 或 $\bar{T}=1$ 时 ($L=1$)

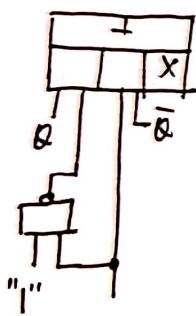


三选一的中间门被锁住.

而左侧门打开

此时: 左侧门直接让本位 Q 进入 D . 因此保持

3. $\bar{P}=0, \bar{T}=0$ 且 $L=1$ 时



若 $U/\bar{D}=1$ 则

$$D = Q \cdot Q + \bar{Q} \cdot \bar{Q} = Q$$

更简单 $D_A = \bar{Q}_A$

$$D_{FB} = Q_A \cdot \bar{Q}_B + \bar{Q}_A \cdot Q_B$$

$$D_{FC} = Q_B \cdot \bar{Q}_A \cdot \bar{Q}_C + \bar{Q}_B \cdot Q_A \cdot Q_C$$

$$D_{FD} = Q_C \cdot \bar{Q}_B \cdot \bar{Q}_A \cdot \bar{Q}_D + \bar{Q}_C \cdot Q_B \cdot Q_A \cdot Q_D$$

显然此时是加法二进制计数

若 $U/\bar{D}=0$ 时

$$D_{FA} = \bar{Q}_A$$

$$D_{FB} = \bar{Q}_B \cdot \bar{Q}_A + Q_B \cdot Q_A$$

$$D_{FC} = \bar{Q}_C \cdot \bar{Q}_B \cdot \bar{Q}_A + Q_C \cdot Q_B \cdot Q_A$$

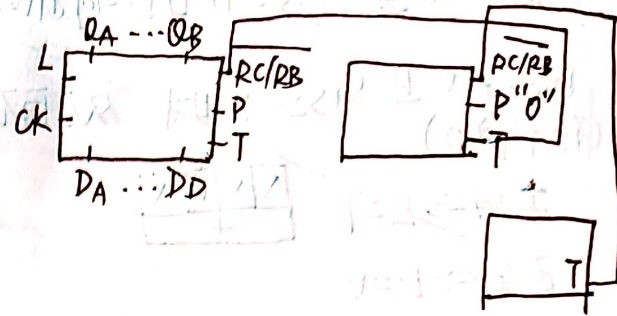
$$D_{FD} = \bar{Q}_D \cdot \bar{Q}_C \cdot \bar{Q}_B \cdot \bar{Q}_A + Q_D \cdot Q_C \cdot Q_B \cdot Q_A$$

同时 $\bar{T}=1$ 时. $R_C/R_B \equiv 1$

$\bar{P}=1$ 时 R_C/R_B 正常保持.

1. 扩展连接

① $U/\bar{D}=1$. 加法计数时

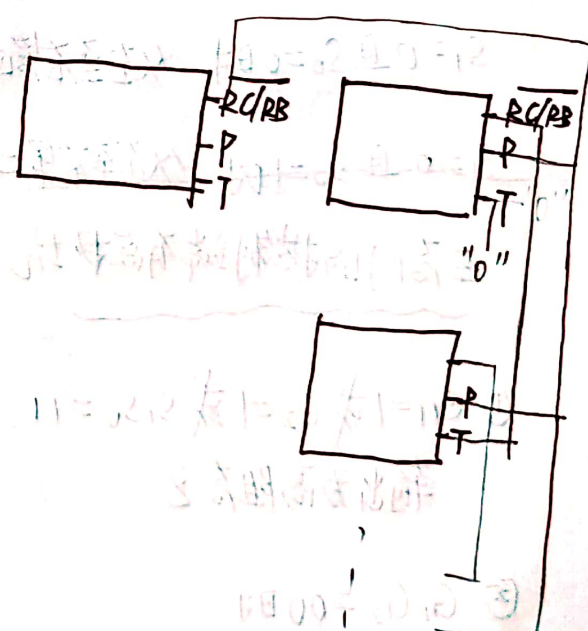


把进位指示接到 T 上.

而 P 始终为 "0"

② $U/\bar{D}=0$ 时. 接法类似.

2. 扩展连接



减法计数.

当第二片为 0000 时. 进位就会开始传递

5.9 看图感觉很像移位寄存器

~~首先 G_1, G_2 中有一个为1~~

~~$G_1 G_2 = 00$ 且 $S_1 S_2 = 11$ 时. 输出高阻态~~

~~$G_1 G_2 \neq 00$ 且 $S_1 S_2 = 11$ 时. 从左向右第三个数据选中. 接收本位数据, 保持 (有一个不为0)~~

~~高阻 $\Rightarrow E=1$~~

~~| | | | |
|---|---|---|---|
| X | X | ✓ | X |
| + | | | |~~

~~正常 $\Rightarrow E=0$~~

~~$S_1 S_2 = 10$ 时.~~

① $G_1 = 0$ 且 $G_2 = 0$ 且 S_1, S_0 中至少有一个0时.
三态门控制端为1. 输出高阻态

② $S_1 = 1$ 且 $S_0 = 1$ 时. 三态门控制端为0
正常工作, 此时从左至右第三个输入被选中
保持

X	X	✓	X
+			

③ G_1, G_2 中至少有一个1时. 三态门正常工作

$S_1 = 0$ 且 $S_0 = 0$ 时. 从左至右第四个门选中. 输出为保持

$S_1 = 0$ 且 $S_0 = 1$ 时. 从左至右第二个门选中

三态门的控制端有点坑

① $G_1 = 1$ 或 $G_2 = 1$ 或 $S_1 S_0 = 11$. 三态门控制端为0
输出为高阻态

1	2	3	4
+			

② $G_1 G_2 = 00$ 时

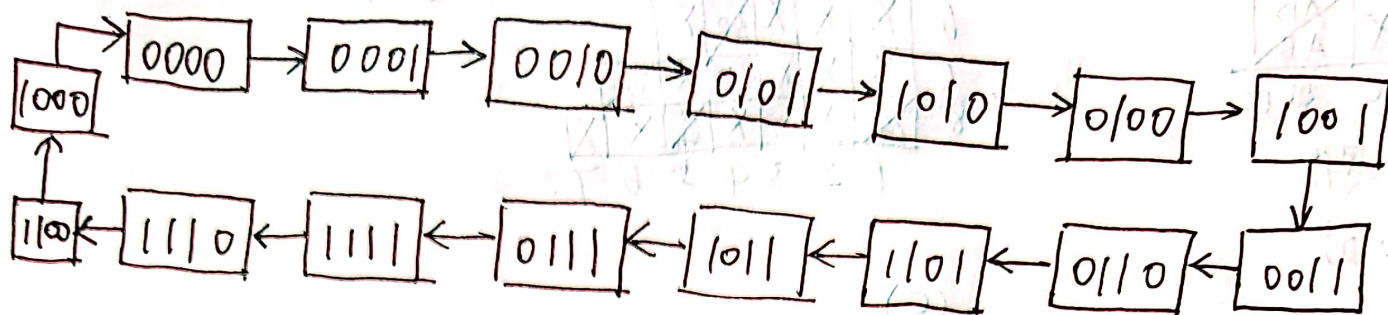
① $S_1 = 0$ 且 $S_0 = 0$ 4号门选中. 输出为保持.

② $S_1 = 0$ 且 $S_0 = 1$ 2号门选中. 为左移

③ $S_1 = 1$ 且 $S_0 = 0$ 1号门选中. 为右移.

(1) 发现

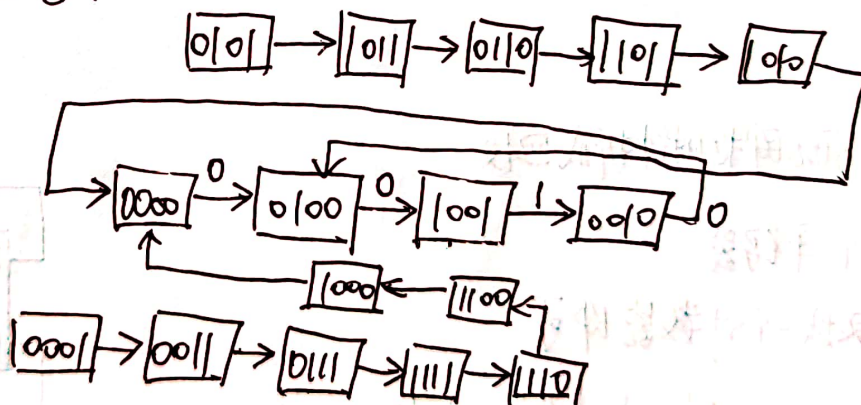
$$J = \overline{Q_D}, \quad \overline{K} = (Q_B Q_D) \oplus Q_D$$



(2) 注意移位寄存器在负边沿发生转换 (R-S 主从触发器)

5-15.

$0000\ 0000 \rightarrow 1\ 000\ 0000 \rightarrow 11\ 00\ 0000 \rightarrow 111\ 0\ 0000 \rightarrow \dots \rightarrow 1111\ 1111 \rightarrow 0\ 111\ 1111 \rightarrow 1\ 0\ 111\ 111$
 $11\ 01\ 01\ 01 \leftarrow 1\ 01\ 01\ 01 \leftarrow 0\ 10\ 10\ 10 \leftarrow 1\ 01\ 01\ 01 \leftarrow 0\ 10\ 10\ 11 \leftarrow 1\ 01\ 01\ 11 \leftarrow 0\ 10\ 11\ 11$
 $\downarrow$
 ② 不会了，变长了吧。



能够再启动。0010 序列发生器。

5.16

$$\overline{J} = K = \overline{Q_D}$$

$$F = Q_d$$

$$L = Q_A + Q_C + Q_P$$

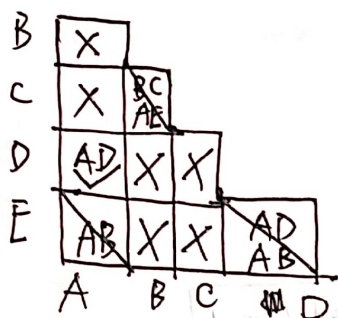
$$A = B = D = 0$$

$$C = \overline{Q_B}$$

0000 $\xrightarrow[F=0]{L=0}$ ~~0000~~ 0/00 $\xrightarrow[F=0]{L=1}$ 100 $\xrightarrow[F=1]{L=1}$ 00/0 $\xrightarrow[F=0]{L=0}$ 0000 4循环

$$000 \xrightarrow[F=0]{L=1} 001 \xrightarrow[F=0]{L=1} 011 \xrightarrow[F=0]{L=1} 111 \xrightarrow[F=1]{L=1} 110 \xrightarrow[F=1]{L=1} 100 \xrightarrow[F=1]{L=1} 000$$
$$0|0| \xrightarrow[F=0]{L=1} |0|| \xrightarrow[F=1]{L=1} 0||0 \xrightarrow[F=0]{L=1} ||0| \xrightarrow[F=1]{L=1} |0|0 \xrightarrow[F=1]{L=1} 0|00$$

5.20 (a)



所以 A-D 等价

$$A' = \{A, D\}$$

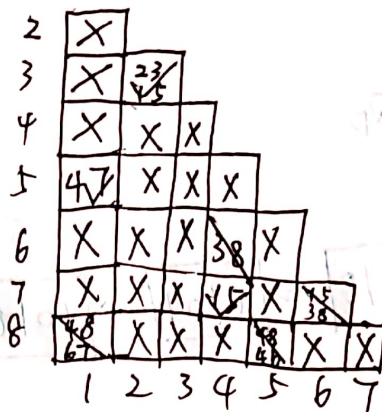
$$B' = B$$

$$C' = C$$

$$D' = E$$

Y \ X	0	1
A'	A/0	B/0
B'	C/1	A/0
C'	B/1	D/0
D'	A/0	A/0

(b)

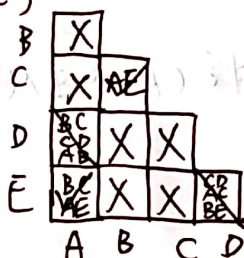


15 等价

23 等价

47 等价

(c)



AE 等价

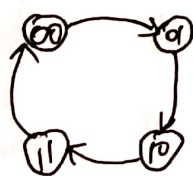
BC 等价

5-26.

4相时钟分配即把时钟拆成四段

∴ 有 2-4 译码器

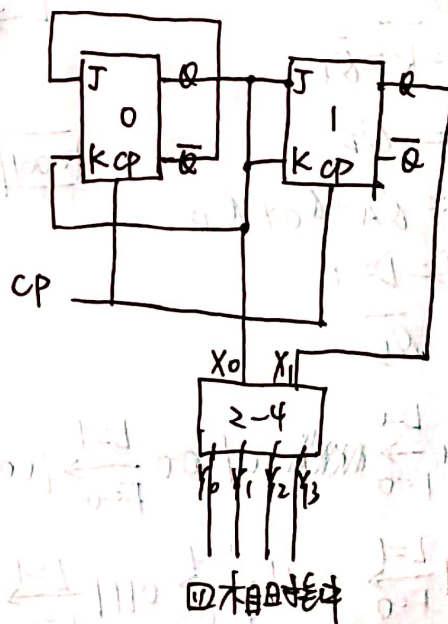
∴ 只需实现一个计数器即可



$Q_n^1 Q_n^0$	$Q_{n+1}^1 Q_{n+1}^0$	$J_1 K_1$	$J_0 K_0$
0 0	0 1	0 X	1 X
0 1	1 0	1 X	X 1
1 0	1 1	X 0	1 X
1 1	0 0	X 1	X 1

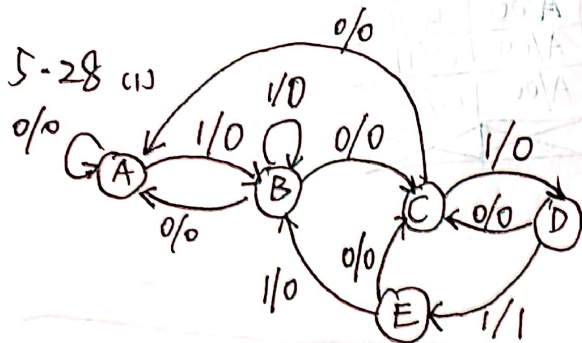
$$J_1 = Q_0 \quad K_1 = Q_0$$

$$J_0 = \overline{Q_0} \quad K_0 = Q_0$$



5-2

分开设计, 应用一个数据选择即可



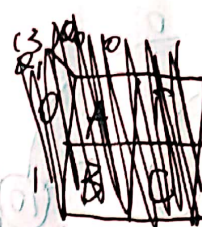
(2)

X	0	1
A	A/0	B/0
B	C/0	B/0
C	A/0	D/0
D	E/0	E/1
E	C/0	B/0

化简
BE合并 C'

X	0	1
A'	A'/0	B'/0
B'	C'/0	B'/0
A'	A'/0	D'/0
D'	C'/0	B'/1

这里只给一种状态分配, 用两个J-K触发器实现



$Q_1 \backslash Q_0$	0	1
0	A	C
1	B	D

X	Q_1^n	Q_0^n	Q_1^{n+1}	Q_0^{n+1}	J_1	K_1	J_0	K_0	Z
0	0	0	0	0	0	X	0	X	0
1	0	0	1	0	1	X	0	X	0
0	1	0	0	1	X	1	1	X	0
1	1	0	1	0	X	0	0	X	0
0	0	1	0	0	0	X	X	1	0
1	0	1	1	1	1	X	X	0	0
0	1	1	0	1	X	1	X	0	0
1	1	1	1	0	X	0	X	1	1

即 $J_1 = X$ $K_1 = \bar{X}$

$J_0 = \bar{X}Q_1$ $K_1 = \overline{X \oplus Q_1}$

$Z = XQ_1Q_0$

5-29

和十进制计数器设计一样

5-30

本质上是一个计数器, 周期为6个CP周期
分别设置三个输出 ϕ_1, ϕ_2, ϕ_3

②也可直接把 ϕ_1, ϕ_2, ϕ_3 作为

5-31 比较基础

5-32. 先给出功能表

Y_1	Y_2	Z	X	Y_1	Y_2	Z
0	0	0	0	1	1	0
1	1	0	0	0	1	0
0	1	0	0	1	0	1
1	0	1	0	0	0	0
0	0	0	1	1	0	0

Y_1	Y_2	Z	X	Y_1	Y_2	Z
1	0	0	1	0	1	1
0	1	1	1	1	1	0
1	1	0	1	0	0	0
0	0	0	0	1	1	0

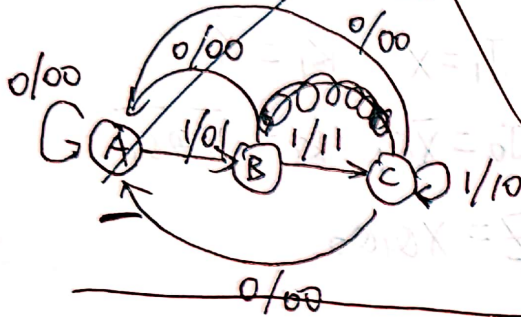
状态没有冲突

可以直接把 Y_1, Y_2, Z

设计成触发器输出

00	00/00	01/01
01	00/00	11/11
10	00/00	10/10
11	00/00	10/10

评价

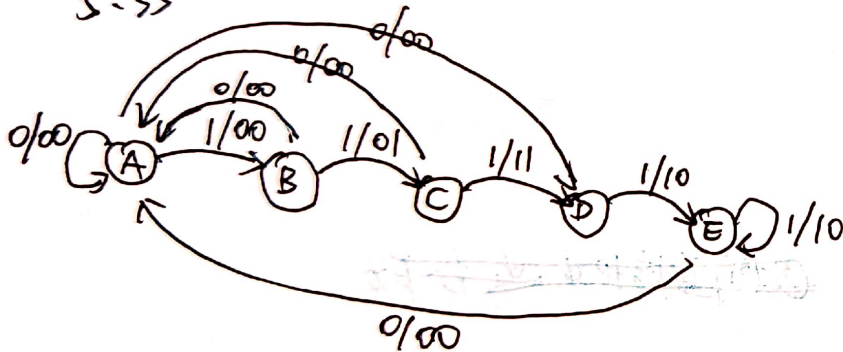


X	0	1
$00 \leftarrow A'$	A'/00	B'/00
$10 \leftarrow B'$	A'/00	C'/01
$11 \leftarrow C'$	A'/00	D'/11
$01 \leftarrow D'$	A'/00	D'/10

∴ 使用D触发器

∴ $Q_i^{n+1} = D_i$

S-33

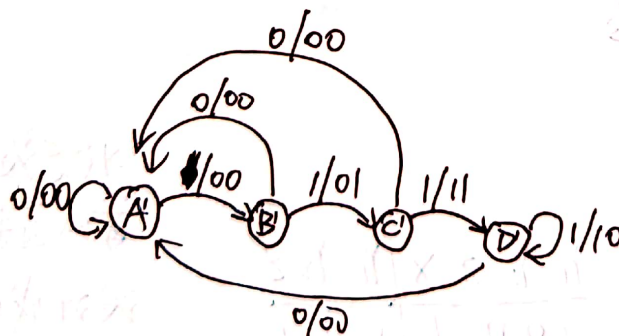


X	Q_1^n	Q_0^n	D_1^n	D_0^n	Z_1	Z_0
0	0	0	0	0	0	0
0	0	1	0	0	0	0
0	1	0	0	0	0	0
0	1	1	0	0	0	0
1	0	0	1	0	0	0
1	0	1	0	1	1	0
1	1	0	1	1	0	1
1	1	1	0	1	1	1

基础状态表

X	0	1
A	A/00	B/00
B	A/00	C/01
C	A/00	D/11
D	A/00	E/10
E	A/00	E/10

评价



$$D_1 = X \bar{Q}_0$$

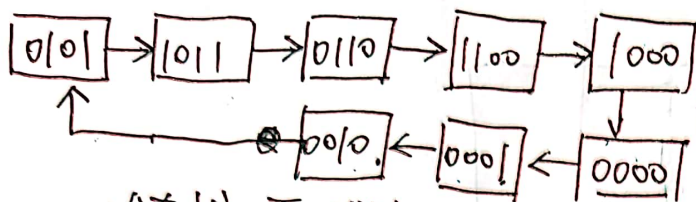
$$D_0 = X(Q_1 + Q_0)$$

$$Z_1 = X Q_0$$

$$Z_0 = X Q_1$$

3.34 无堵塞 自启动

(1) 0101000, 0101000



没有冲突. 可以设计.

Q_3^n	Q_2^n	Q_1^n	Q_0^n	D_3^{n+1}	D_2^{n+1}	D_1^{n+1}	D_0^{n+1}
0	0	0	0	0	0	0	1
0	0	0	1	0	0	1	0
0	0	1	0	0	1	0	1
0	1	0	1	1	0	1	1
1	0	1	1	0	1	1	0
1	1	0	0	1	0	0	0
1	0	0	0	0	0	0	0
0	1	1	0	1	1	0	0
				1	1	1	0

$$D_3 = Q_2$$

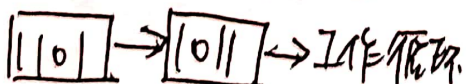
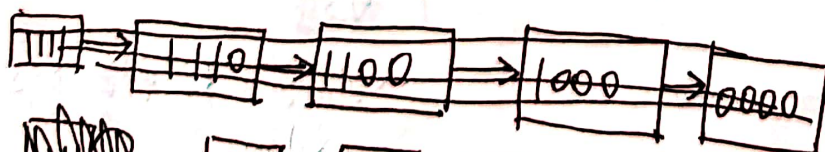
Q_3	Q_2	Q_1	Q_0
00	0	0	0
01	1	1	1
11	1	1	1
10	0	0	0

$$D_2 = Q_1$$

Q_3	Q_2	Q_1	Q_0
00	0	0	0
01	0	1	1
11	0	1	1
10	0	1	1

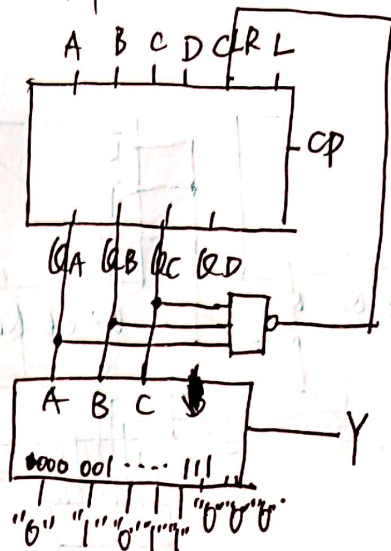
$$D_3 = Q_2$$

类似 $D_2 = Q_1$, $D_1 = Q_0$. $D_0 = Q_2 Q_0 + \bar{Q}_3 \bar{Q}_2 \bar{Q}_0$
检查自启动



$$\therefore D_0 = \bar{Q}_3 \bar{Q}_2 \bar{Q}_0 + \bar{Q}_3 Q_2 Q_0 \checkmark$$

(2) 有计数器了就比较容易 (自带循环 自启动)



(3) 使用位移寄存器构造 (必掌握)

Q_3	Q_2	Q_1	Q_0
0	0	0	0
1	0	0	0
0	1	0	0
1	0	1	0
0	1	1	0
1	0	0	1
0	1	0	1
1	0	1	1
0	0	0	1

没有冲突了

Q_3	Q_2	Q_1	Q_0
00	1	0	1
01	1	1	0
11	0	1	1
10	0	0	1

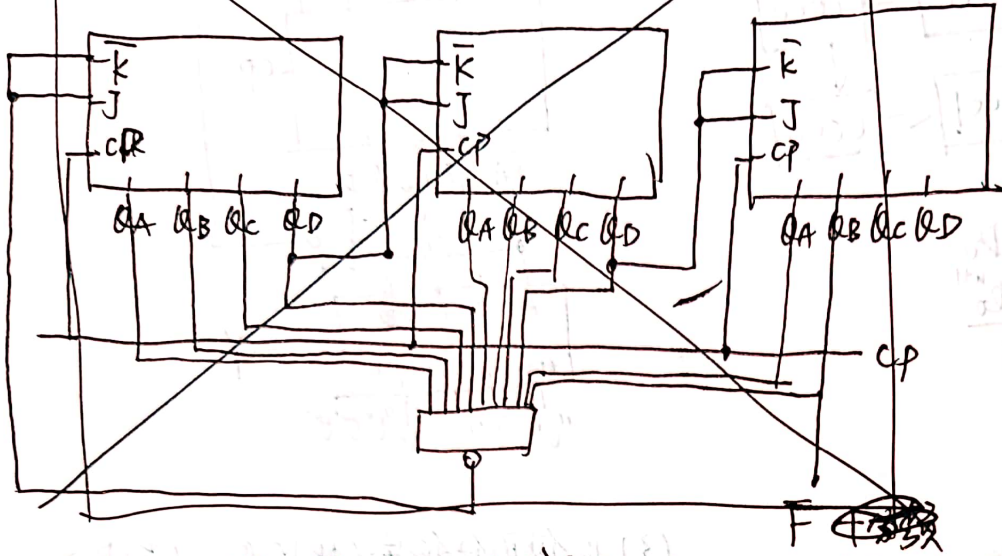
$$J = \bar{K} = Q_2 Q_0 + \bar{Q}_3 \bar{Q}_2 \bar{Q}_0$$

类似 (1) 有自循环. 改成

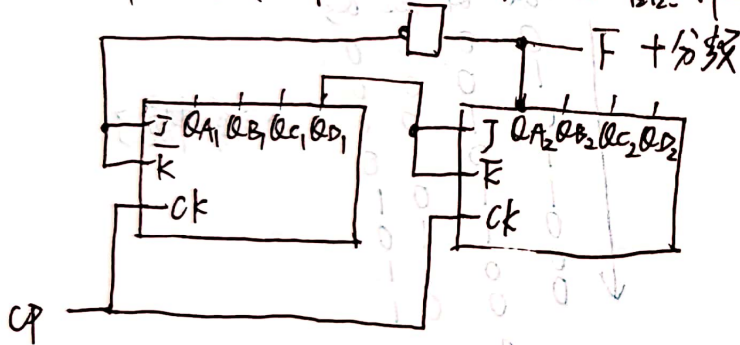
$$J = \bar{K} = \bar{Q}_3 \bar{Q}_2 \bar{Q}_0 + \bar{Q}_3 Q_2 Q_0$$

5.35

移位寄存器设计10分频. 当00000000为时, 下周期00000001



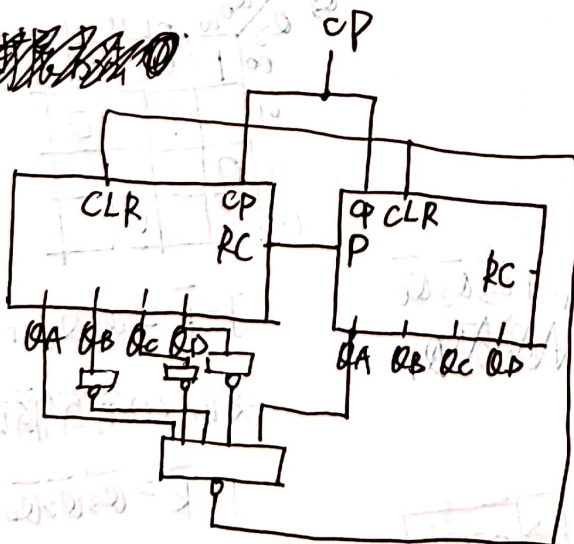
设计10分频. 即0000011111 信号发生器 需要5位移位寄存器



当 $Q_{A2}=0$ 时, 向移位寄存器中输入1

5.36 ~~移位寄存器~~

6A



5.38

个人理解是输出为0011. 则

表示(1,2)通电

输出0110 则表示(4,1)通电.

5.39. 可参考

<<全加器在乘法电路中的应用>

刘丽

5.37 与或非门来做数据选择
变量译码器作功能选择