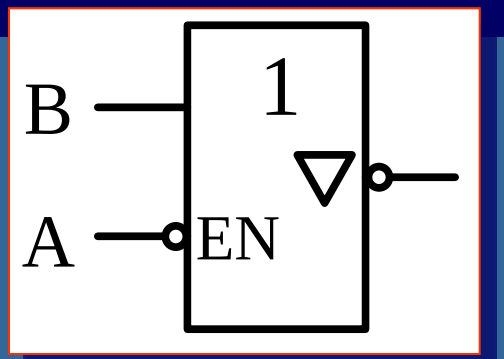
习题 3.18 已知下列各2输入门的输入波形A及B，如图所示，试画出各逻辑门的输出波形（不考虑器件传输延迟）。

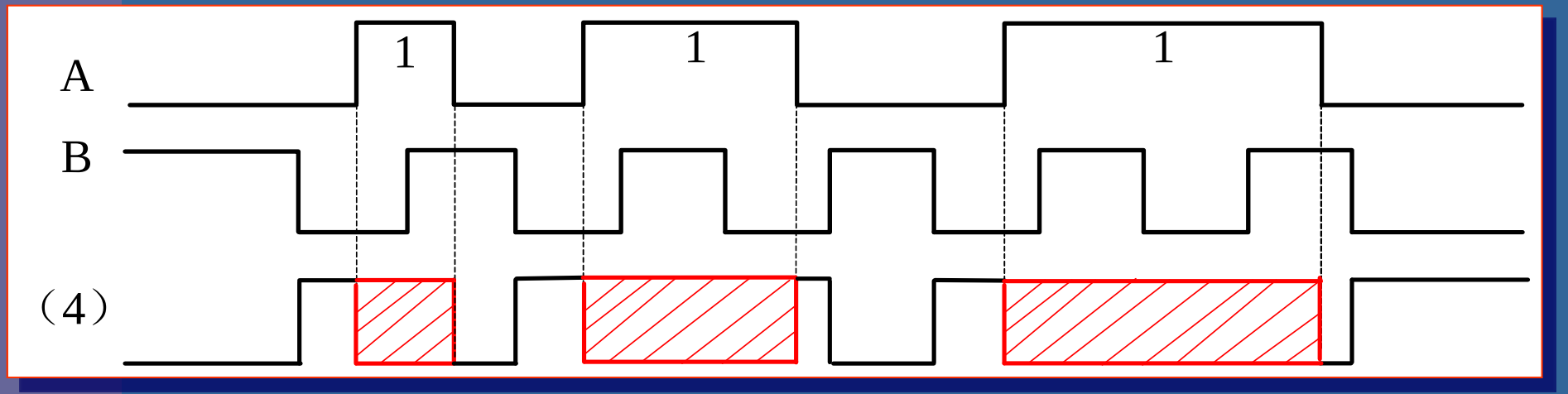
（4）非门（3S，A为使能信号，低电平有效）。

解：

逻辑符号



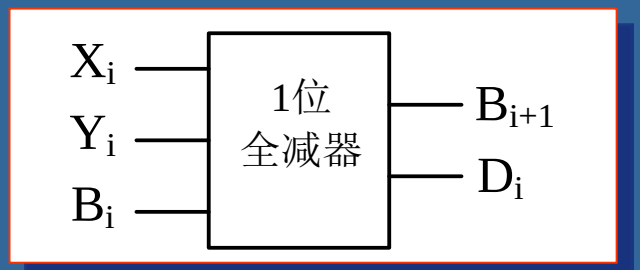
波形图



3.23 试设计一个1位全减器，X_i、Y_i为本位的被减数和减数，B_i为由低位来的借位输入；D_i和B_{i+1}为本位之差和向高位的借位。列出真值表，写出逻辑方程，用与非门实现之，并用该全减器构成4位行波借位减法器（框图表示）。

解：

1位全减器框图



真值表

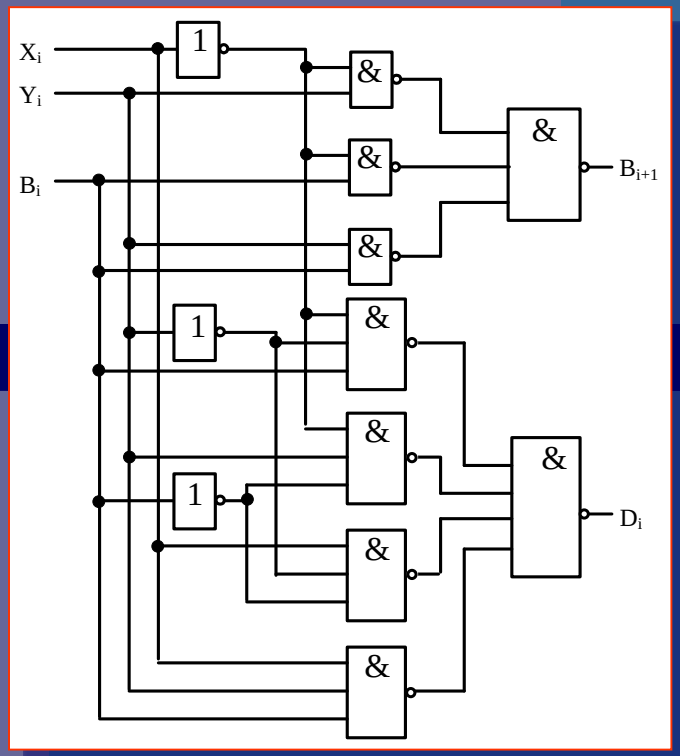
X_i	Y_i	B_i	B_{i+1}	D_i
0	0	0	0	0
0	0	1	1	1
0	1	0	1	1
0	1	1	1	0
1	0	0	0	1
1	0	1	0	0
1	1	0	0	0
1	1	1	1	1

逻辑表达式

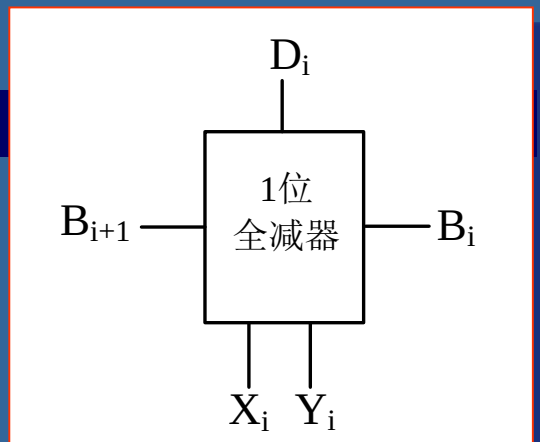
$$B_{i+1}=\bar{X}_iY_i+\bar{X}_iB_i+Y_iB_i=\overline{\overline{\bar{X}_iY_i}\cdot\overline{\bar{X}_iB_i}\cdot\overline{Y_iB_i}}$$

$$D_i=\bar{X}_i\bar{Y}_iB_i+\bar{X}_iY_i\bar{B}_i+X_i\bar{Y}_i\bar{B}_i+X_iY_iB_i=\overline{\overline{\bar{X}_i\bar{Y}_iB_i}\cdot\overline{\bar{X}_iY_i\bar{B}_i}\cdot\overline{X_i\bar{Y}_i\bar{B}_i}\cdot\overline{X_iY_iB_i}}$$

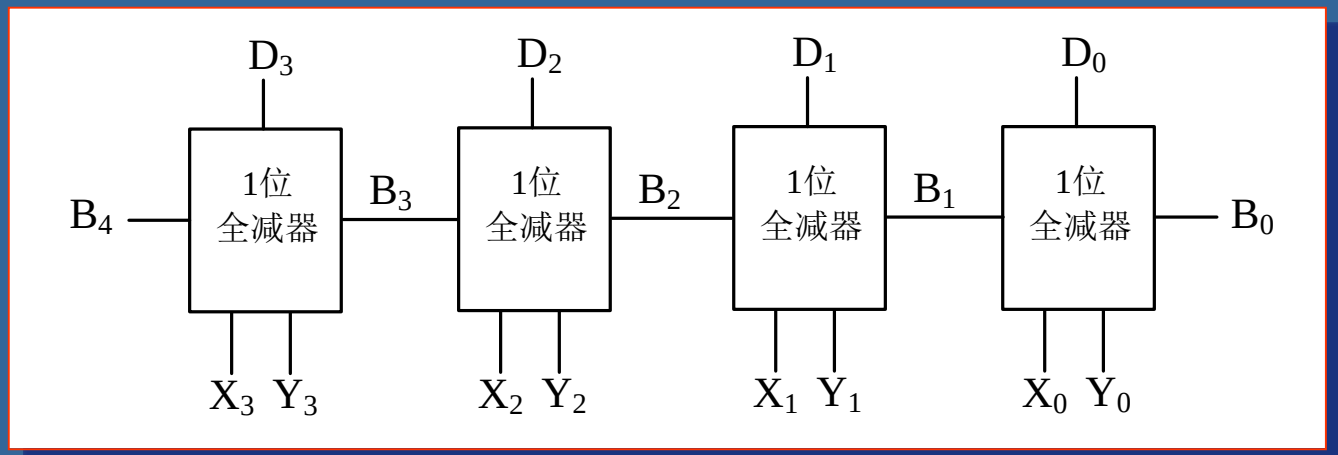
用与非门实现的全减器逻辑图



现把1位全减器框图改画成



则4位行波借位减法器为

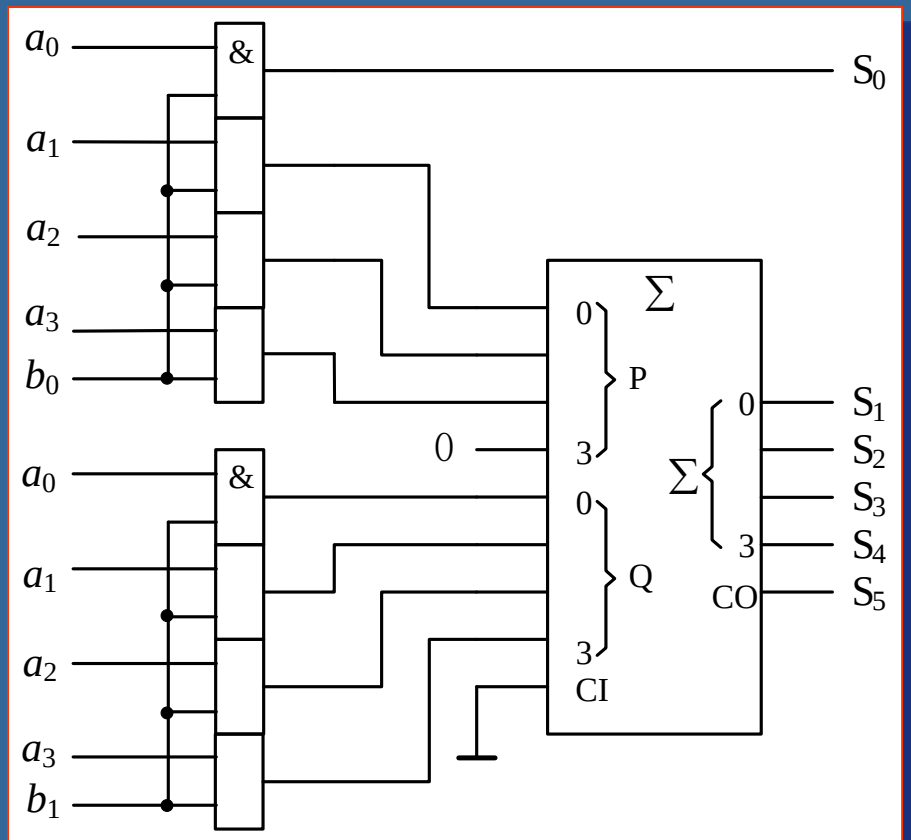


3.30 试用74283（4位二进制加法器）再辅以适当门电路构成4×2乘法器A×B，其中A＝$a_3\,a_2\,a_1\,a_0$，B=b_1b_0。

解：运算式

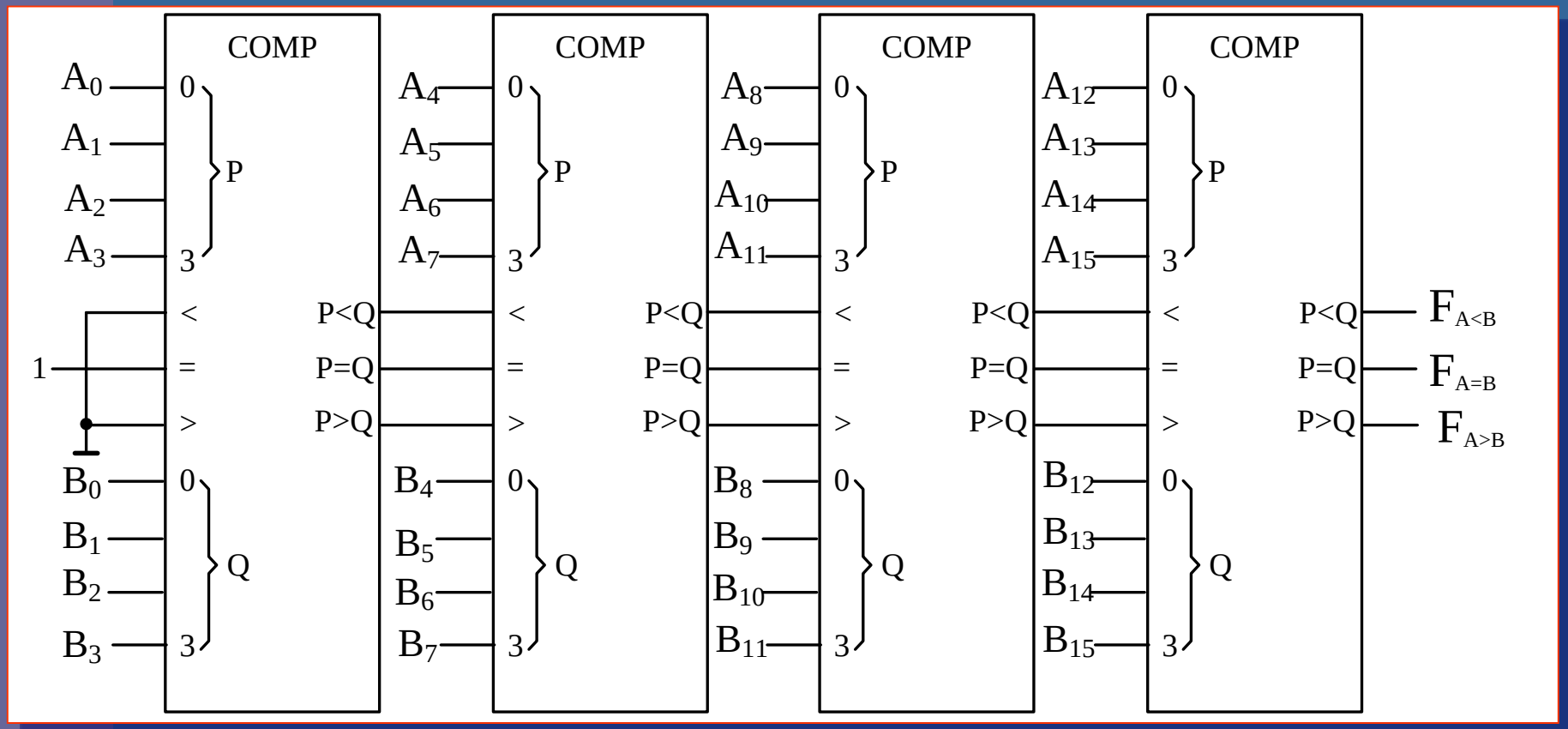
		a_3	a_2	a_1	a_0
×				b_1	b_0
	0	a_3b_0	a_2b_0	a_1b_0	a_0b_0
+	a_3b_1	a_2b_1	a_1b_1	a_0b_1	0
	S_5	S_4	S_3	S_2	S_1	S_0

逻辑电路图



3.35 设用7485（4位并行比较器）构成16位无符号数的比较器。

解： 逻辑电路图

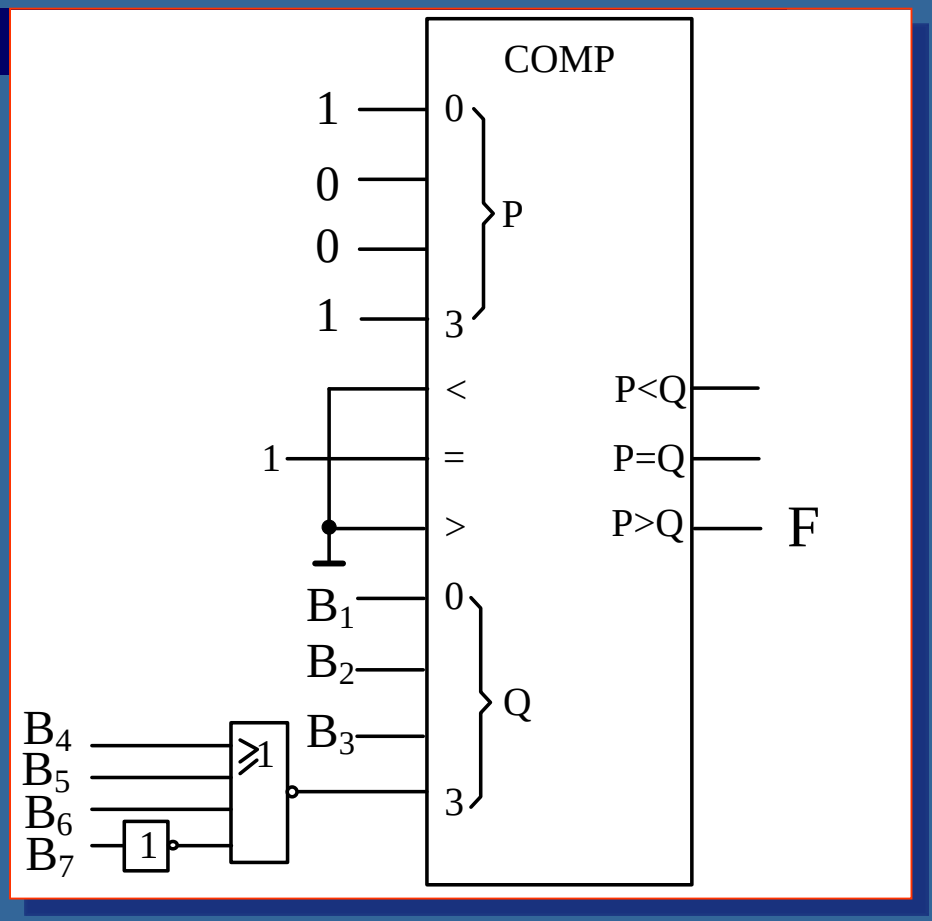


3.37 试用7485再辅以适当门电路构成字符分选电路。当输入为字符A、B、C、D、E、F、G的7位ASCII码（ASCII码请参见教材P30表1-2-4）时，分选电路输出Z=0，反之，Z=1。

解： 查教材P19表1.5知，A～G的ASCII码$B_7B_6B_5B_4B_3B_2B_1$为：

字母	B_7	B_6	B_5	B_4	B_3	B_2	B_1
A	1	0	0	0	0	0	1
B	1	0	0	0	0	1	0
C	1	0	0	0	0	1	1
D	1	0	0	0	1	0	0
E	1	0	0	0	1	0	1
F	1	0	0	0	1	1	0
G	1	0	0	0	1	1	1

逻辑电路图



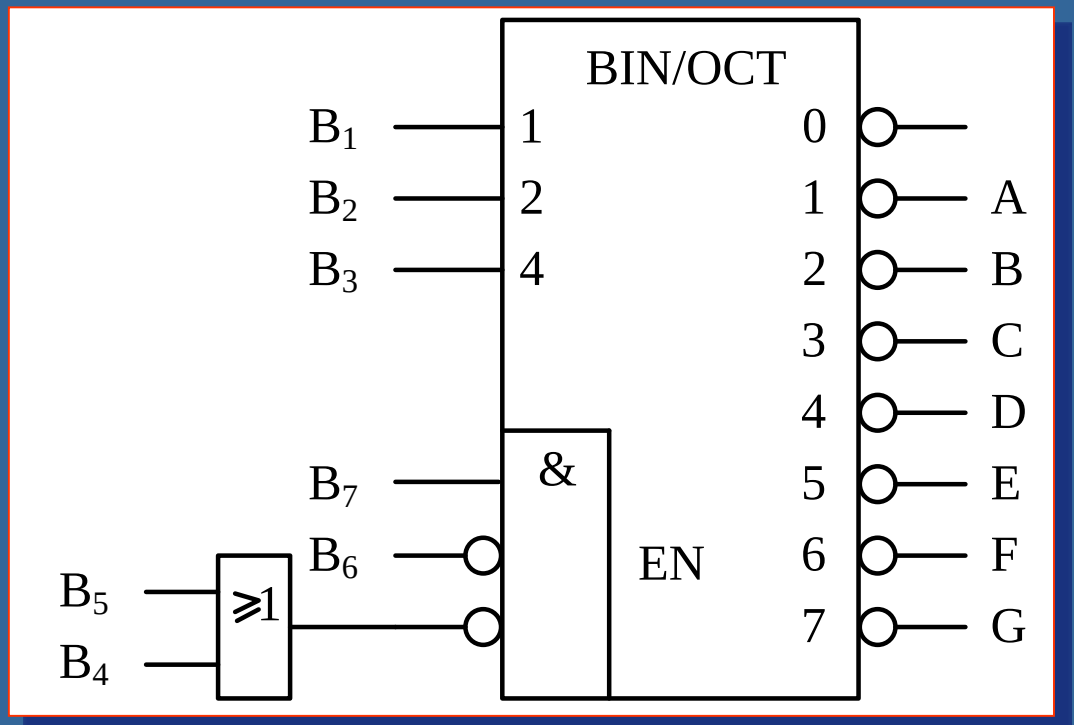
3.47 试构成一个字符识别电路，它可以识别A、B、C、D、E、F、G 7个字符的ASCII码，并指出为何字符。

解：

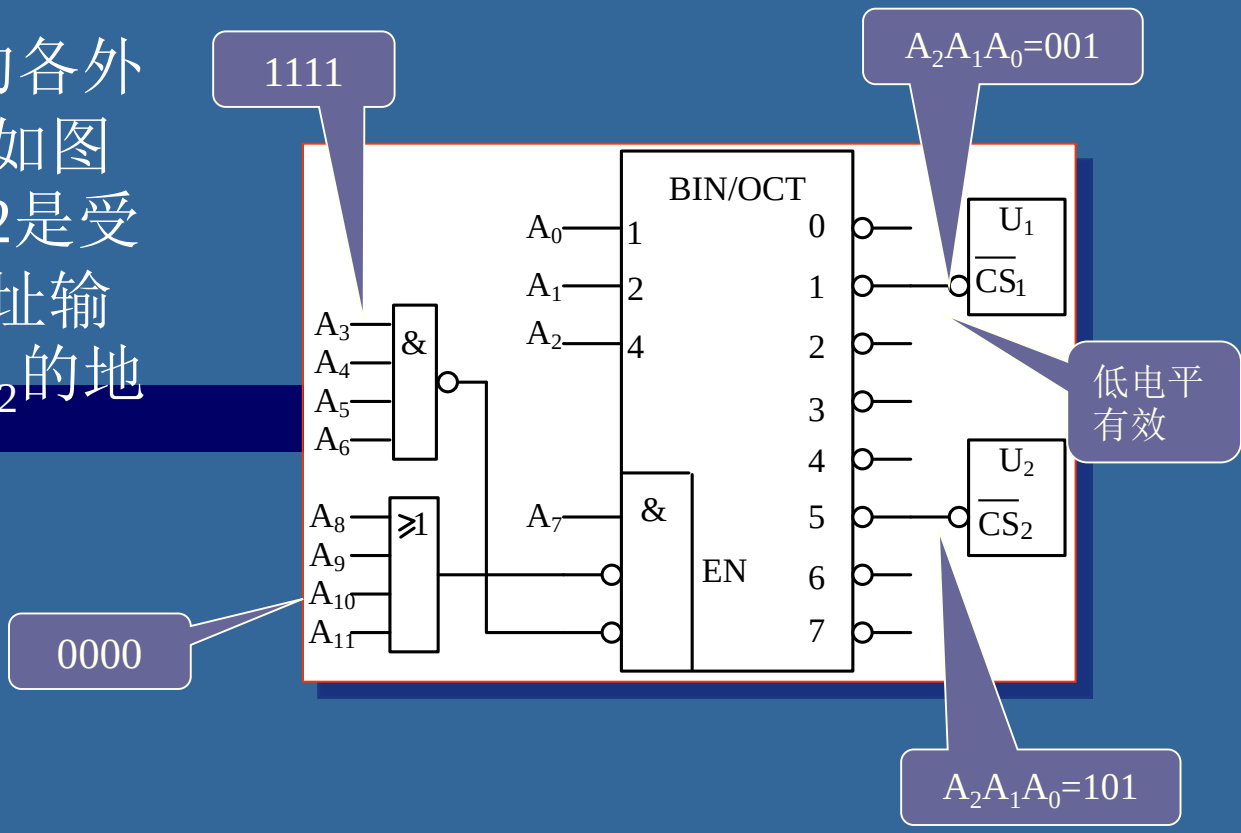
显然高4位相同，可将此用于译码器的使能控制，低3位连接到译码器的数据端进行译码输出。

字母	B_7	B_6	B_5	B_4	B_3	B_2	B_1
A	1	0	0	0	0	0	1
B	1	0	0	0	0	1	0
C	1	0	0	0	0	1	1
D	1	0	0	0	1	0	0
E	1	0	0	0	1	0	1
F	1	0	0	0	1	1	0
G	1	0	0	0	1	1	1

逻辑电路图



习题3.48 某计算机的各外部设备地址译码电路如图所示，图中的U1、U2是受管理的两个设备，地址输入为A_{11}～A_0，U_1、U_2的地址码为多少?

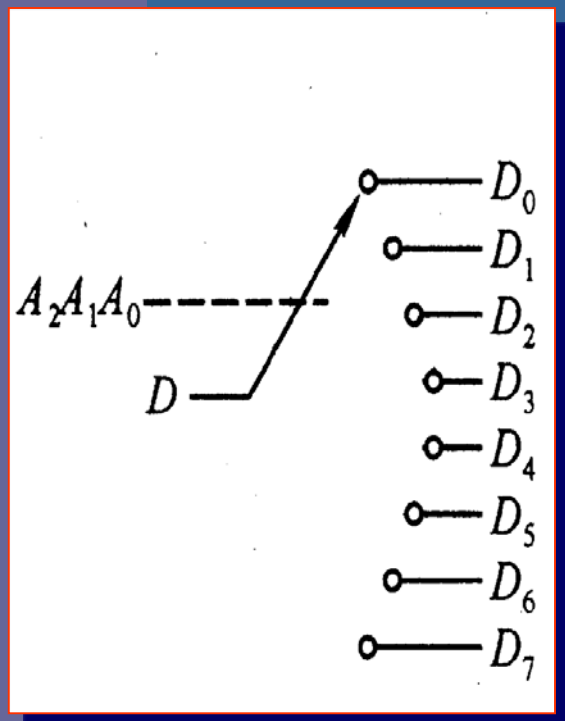


解： 地址变量12位．作用于译码器地址和使能端，译码器输出0用于选通受管理的设备。

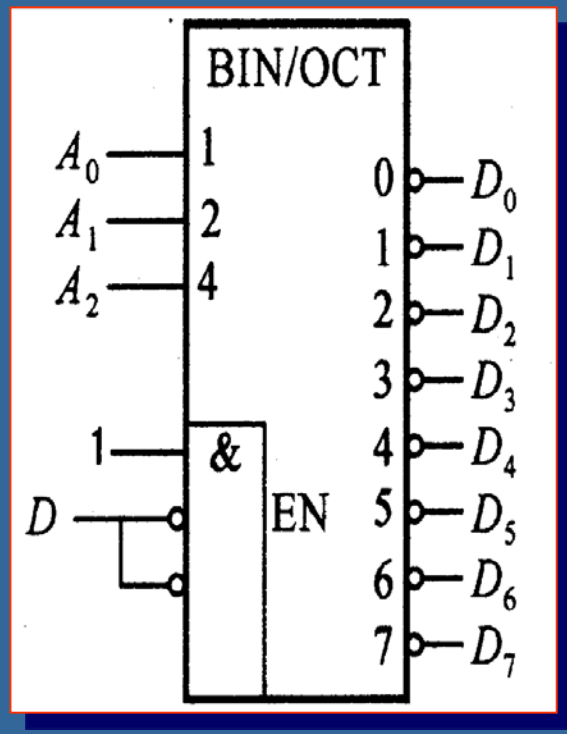
U_1：A_{11}~A_0=000011111001=$(0F9)_H$

U_2：A_{11}~A_0=000011111101=$(0FD)_H$

译码器的应用（3） 用变量译码器构成数据分配器

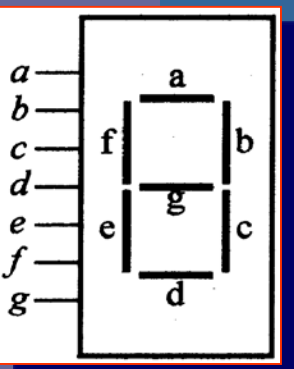


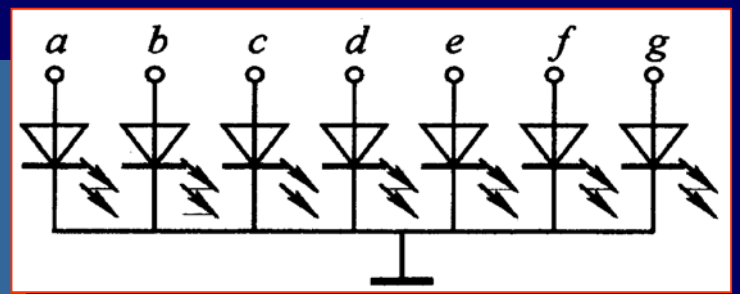
A_2	A_1	A_0	功能
0	0	0	$D \rightarrow D_0$
0	0	1	$D \rightarrow D_1$
0	1	0	$D \rightarrow D_2$
0	1	1	$D \rightarrow D_3$
1	0	0	$D \rightarrow D_4$
1	0	1	$D \rightarrow D_5$
1	1	0	$D \rightarrow D_6$
1	1	1	$D \rightarrow D_7$

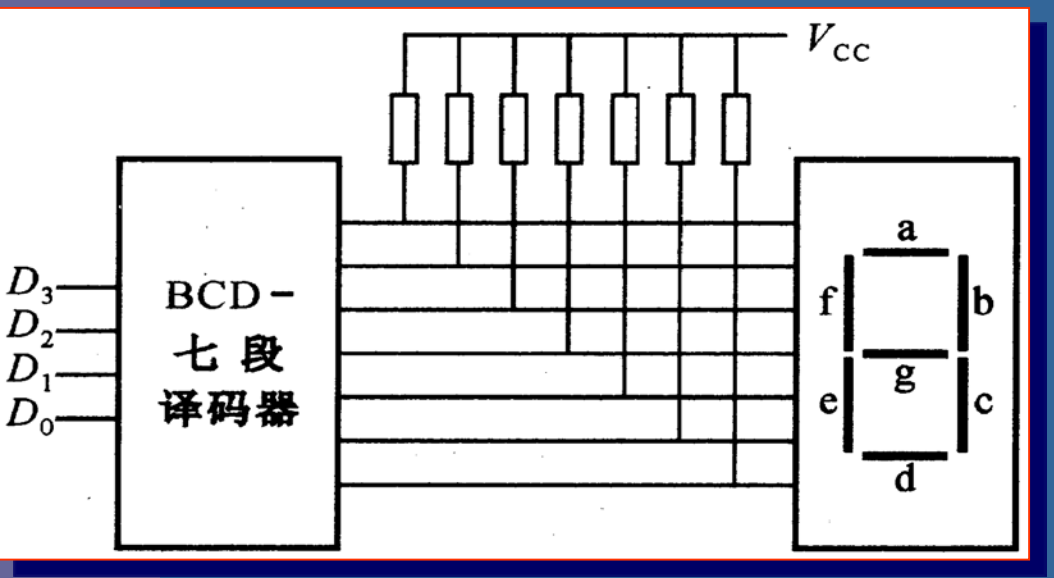


小概念：在数字系统中，当A=1时，B=1；A=0时，B=0，即认为A=B。

显示译码器







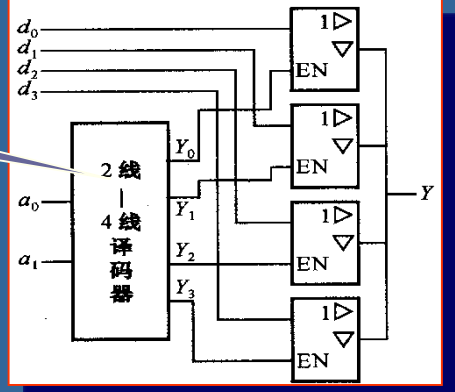
功 能 表

D_3	D_2	D_1	D_0	a	b	c	d	e	f	g	数码
0	0	0	0	1	1	1	1	1	1	0	0
0	0	0	1	0	1	1	0	0	0	0	1
0	0	1	0	1	1	0	1	1	0	1	2
0	0	1	1	1	1	1	1	0	0	1	3
0	1	0	0	0	1	1	0	0	1	1	4
0	1	0	1	1	0	1	1	0	1	1	5
0	1	1	0	1	0	1	1	1	1	1	6
0	1	1	1	1	1	1	0	0	0	0	7
1	0	0	0	1	1	1	1	1	1	1	8
1	0	0	1	1	1	1	1	0	1	1	9

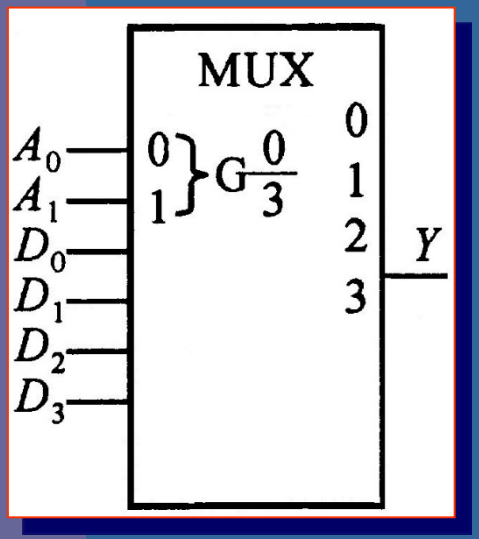
数据选择器

数据选择器

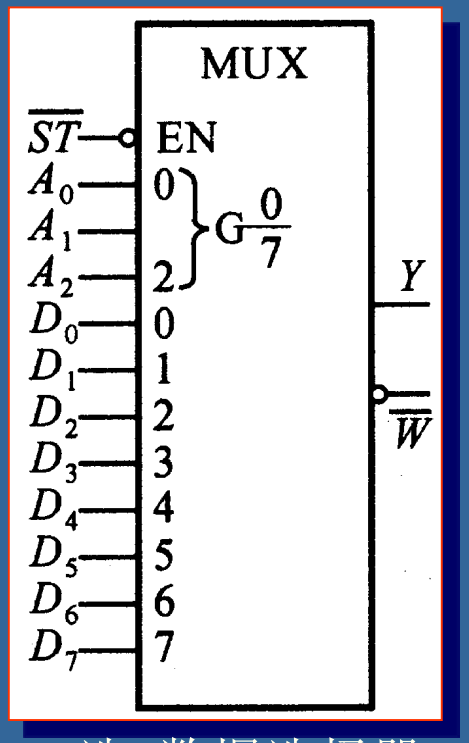
多路选择开关



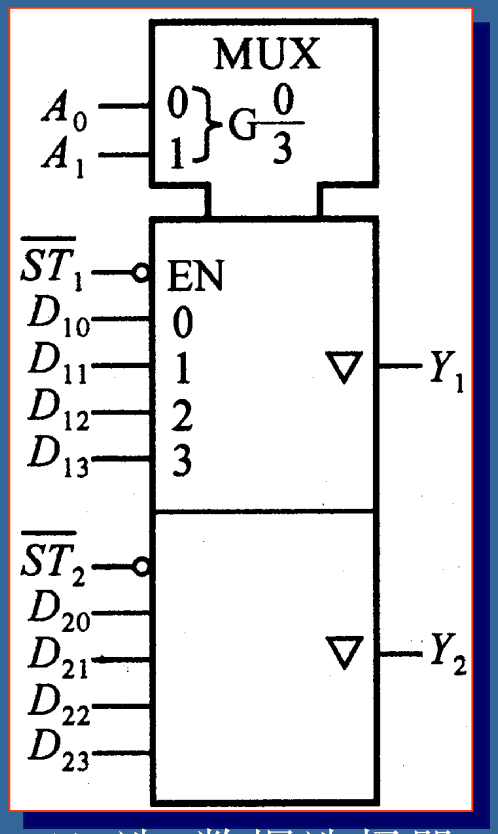
典型的数据选择器



4选1数据选择器

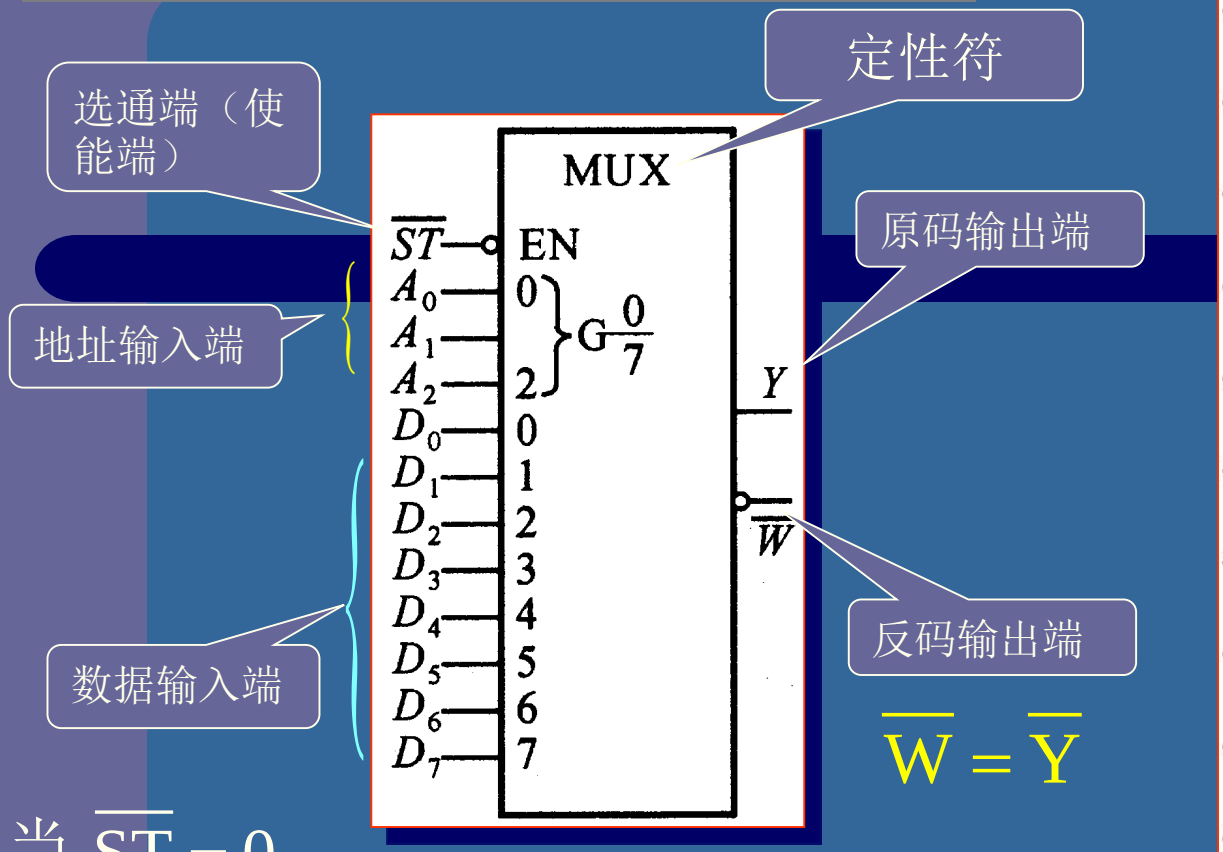


8选1数据选择器
(74151)



双4选1数据选择器
(74253)

8选1数据选择器(74151)



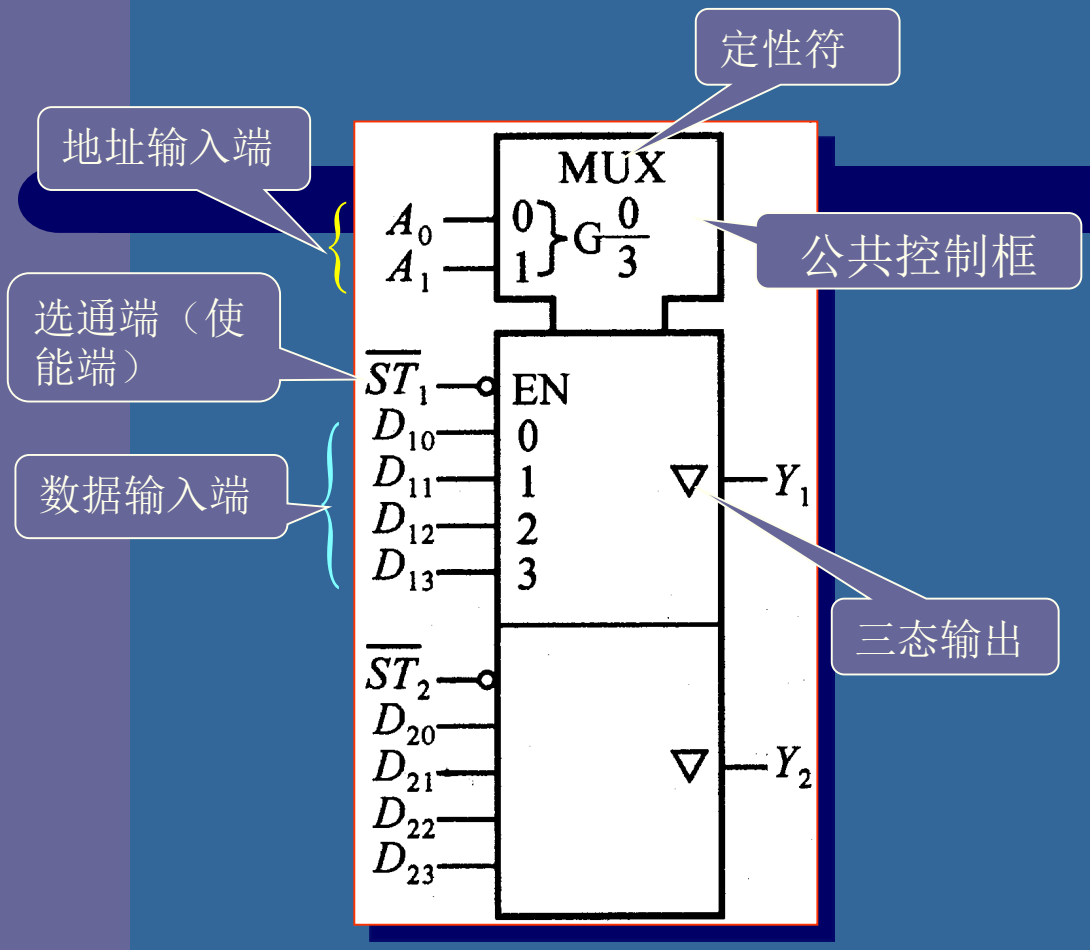
功 能 表

输 入				输 出	
$\overline{ST}$	A_2	A_1	A_0	Y	$\overline{W}$
1	×	×	×	0	1
0	0	0	0	D_0	$\overline{D}_0$
0	0	0	1	D_1	$\overline{D}_1$
0	0	1	0	D_2	$\overline{D}_2$
0	0	1	1	D_3	$\overline{D}_3$
0	1	0	0	D_4	$\overline{D}_4$
0	1	0	1	D_5	$\overline{D}_5$
0	1	1	0	D_6	$\overline{D}_6$
0	1	1	1	D_7	$\overline{D}_7$

当 $\overline{ST} = 0$

$$Y = \overline{A}_2\overline{A}_1\overline{A}_0D_0 + \overline{A}_2\overline{A}_1A_0D_1 + \overline{A}_2A_1\overline{A}_0D_2 + \overline{A}_2A_1A_0D_3$$
$$+ A_2\overline{A}_1\overline{A}_0D_4 + A_2\overline{A}_1A_0D_5 + A_2A_1\overline{A}_0D_6 + A_2A_1A_0D_7$$
$$= m_0D_0 + m_1D_1 + D_2 + m_3D_3 + m_4D_4 + m_5D_5 + m_6D_6 + m_7D_7 = \sum_{i=0}^{7} m_iD_i$$

双4选1数据选择器(74253)



$$\overline{ST_1} = \overline{ST_2} = 0$$

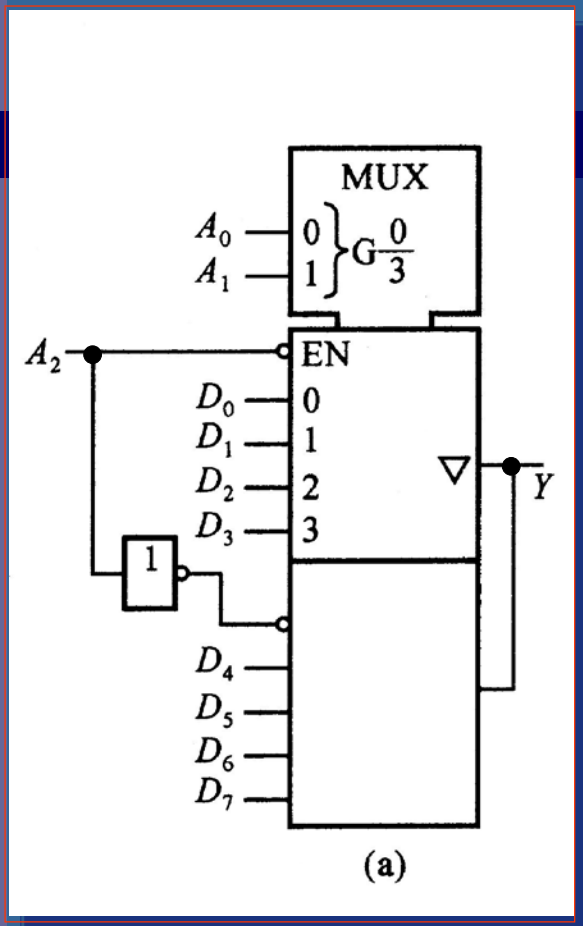
$$\Rightarrow Y_1 = \Sigma(m_i D_{1i})$$

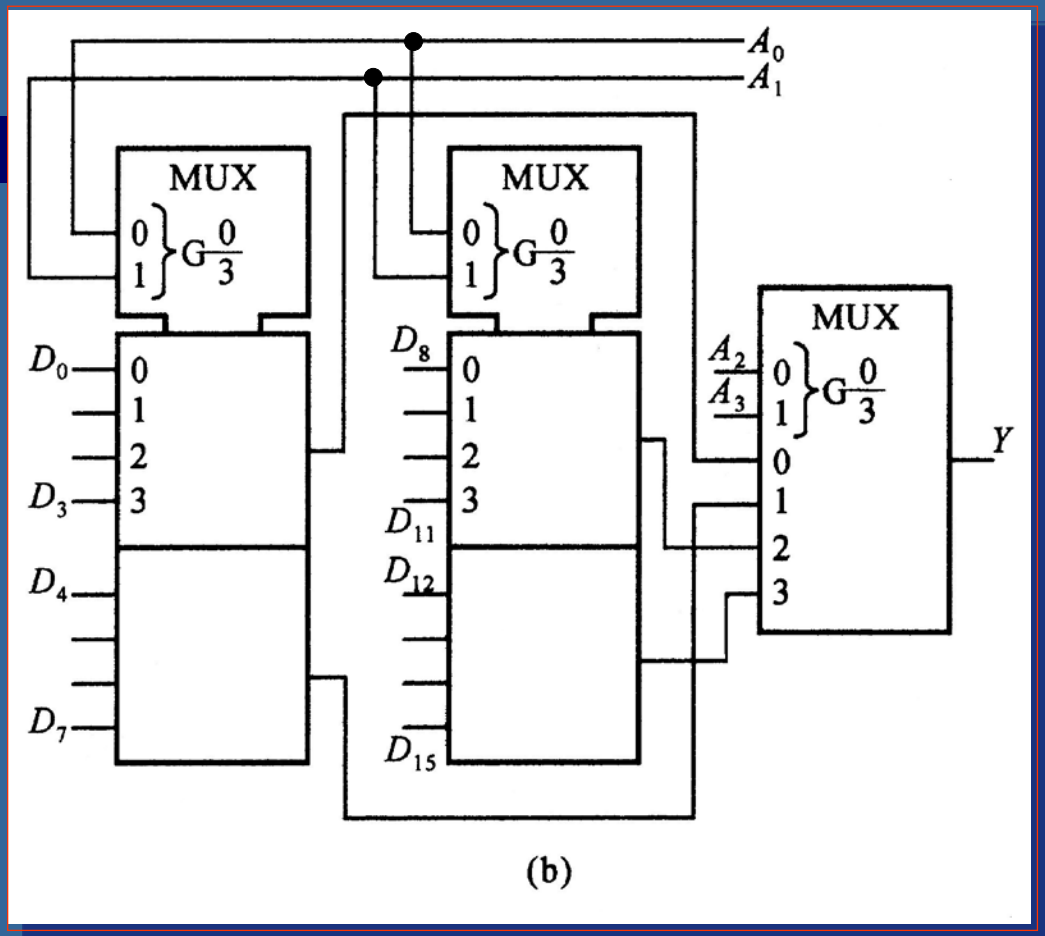
$$Y_2 = \Sigma(m_i D_{2i})$$

$\overline{ST_1} = 1 \Rightarrow Y_1$高阻

$\overline{ST_2} = 1 \Rightarrow Y_2$高阻

数据选择器的扩展


MUX
A_0
A_1
0
1
G
0
3
A_2
EN
D_0
D_1
D_2
D_3
0
1
2
3
1
D_4
D_5
D_6
D_7
Y
(a)


A_0
A_1
MUX
MUX
MUX
A_2
A_3
D_0
D_3
D_4
D_7
D_8
D_{11}
D_{12}
D_{15}
Y
(b)

MUX 实现组合函数

设某组合逻辑函数

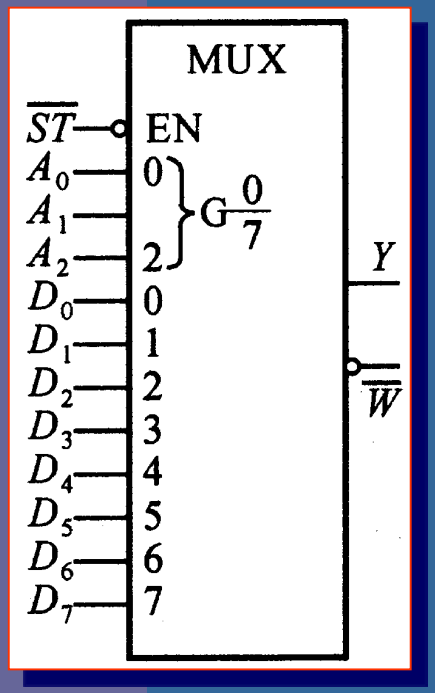
$$F(x_2,x_1,x_0)=\Sigma m(0,1,3,6)$$

$$=m_0\cdot 1+m_1\cdot 1+m_2\cdot 0+m_3\cdot 1+m_4\cdot 0+m_5\cdot 0+m_6\cdot 1+m_7\cdot 0$$

$$\uparrow \quad \uparrow \quad \uparrow \quad \uparrow \quad \uparrow \quad \uparrow \quad \uparrow \quad \uparrow$$

$$a_0 \quad a_1 \quad a_2 \quad a_3 \quad a_4 \quad a_5 \quad a_6 \quad a_7$$

$$=\sum_{i=0}^{7} m_i\cdot a_i$$



$$Y(A_2,A_1,A_0)=\sum_{i=0}^{7} m_i D_i$$

若令$D_i=a_i$

同时有 $A_2=x_2$，$A_1=x_1$，$A_0=x_0$

$F(x_2,x_1,x_0)$可用$Y(A_2,A_1,A_0)$表示

例1 试用8选1MUX实现

$$F(U,V,W)=\bar{U}VW+U\bar{V}W+UV\bar{W}+UVW$$

解：

$$F(U,V,W)=\Sigma m(3,5,6,7)$$

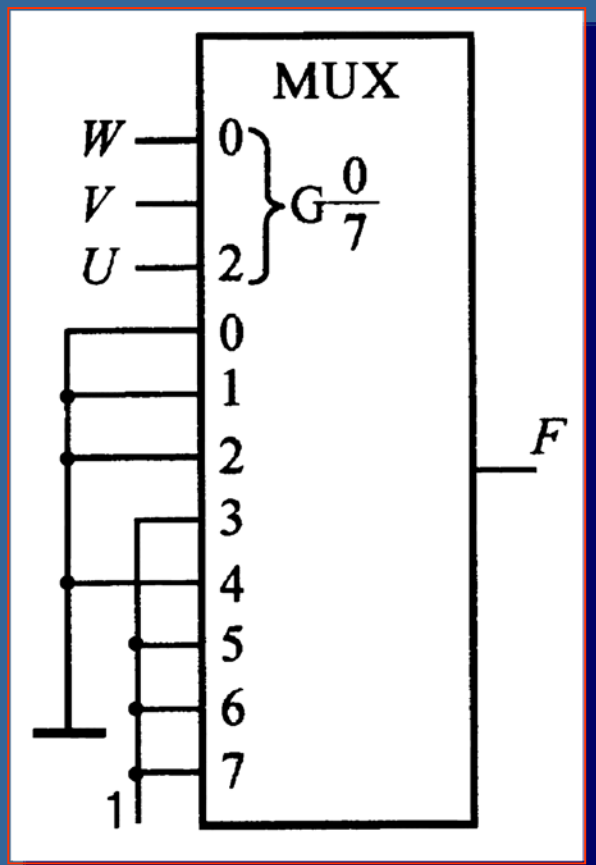
$$=m_0\cdot 0+m_1\cdot 0+m_2\cdot 0+m_3\cdot 1$$

$$+m_4\cdot 0+m_5\cdot 1+m_6\cdot 1+m_7\cdot 1$$

即 $a_0=a_1=a_2=a_4=0$ $a_3=a_5=a_6=a_7=1$

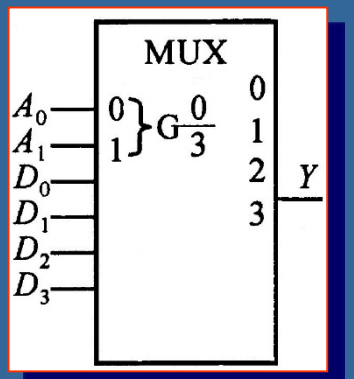
从而令

$D_0=D_1=D_2=D_4=0$ $D_3=D_5=D_6=D_7=1$



例2　试用4选1MUX实现

$$F(U,V,W)=\bar{U}VW+U\bar{V}W+UV\bar{W}+UVW$$

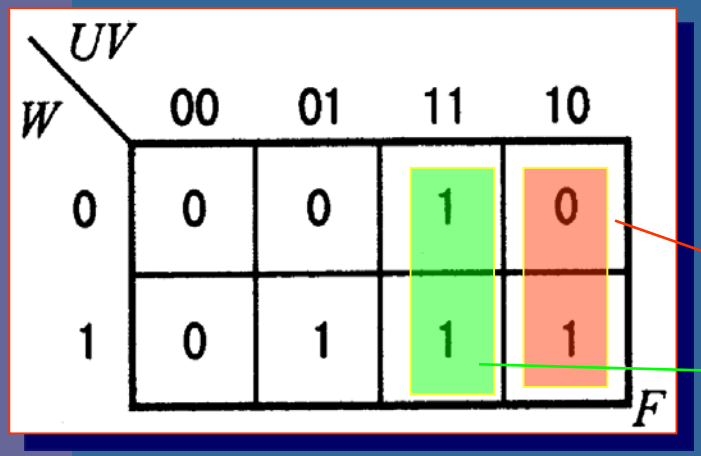


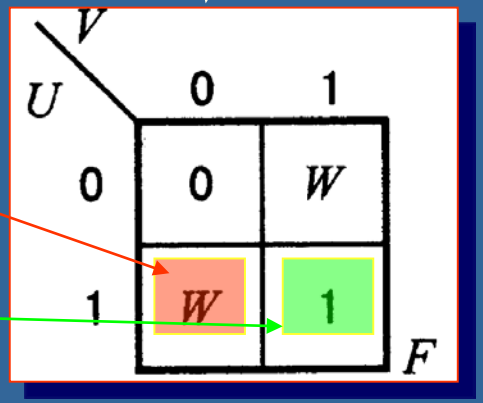
解：

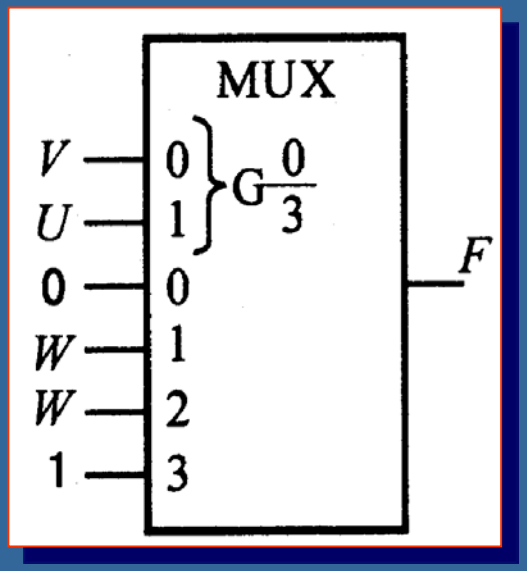
$$F(U,V,W)=\bar{U}\bar{V}\times 0+\bar{U}V\times W+U\bar{V}\times W+UV\times(\bar{W}+W)$$

$$=m_0\times 0+m_1\times W+m_2\times W+m_3\times 1$$

降维

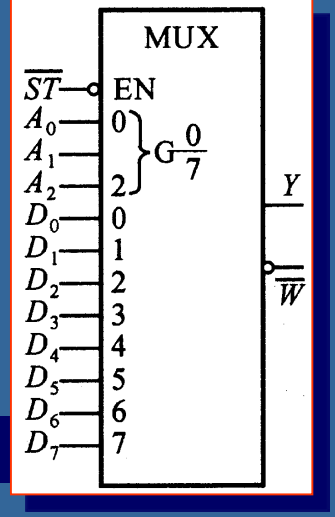






MUX 实现组合函数

例3 试用8选1MUX实现函数 $X=t_4t_3t_2+t_4t_3t_1t_0$



t_4t_3 \ $t_2t_1t_0$	000	001	011	010	110	111	101	100
00	0	0	0	0	0	0	0	0
01	0	0	0	0	0	0	0	0
11	0	0	1	0	1	1	1	1
10	0	0	0	0	0	0	0	0

t_4t_3 \ t_2t_1	00	01	11	10
00	0	0	0	0
01	0	0	0	0
11	0	t_0	1	1
10	0	0	0	0

t_4t_3 \ t_2	0	1
00	0	0
01	0	0
11	t_1t_0	1
10	0	0

降2维