
数字世界精彩无限

Unit 9

——Registers and Counters

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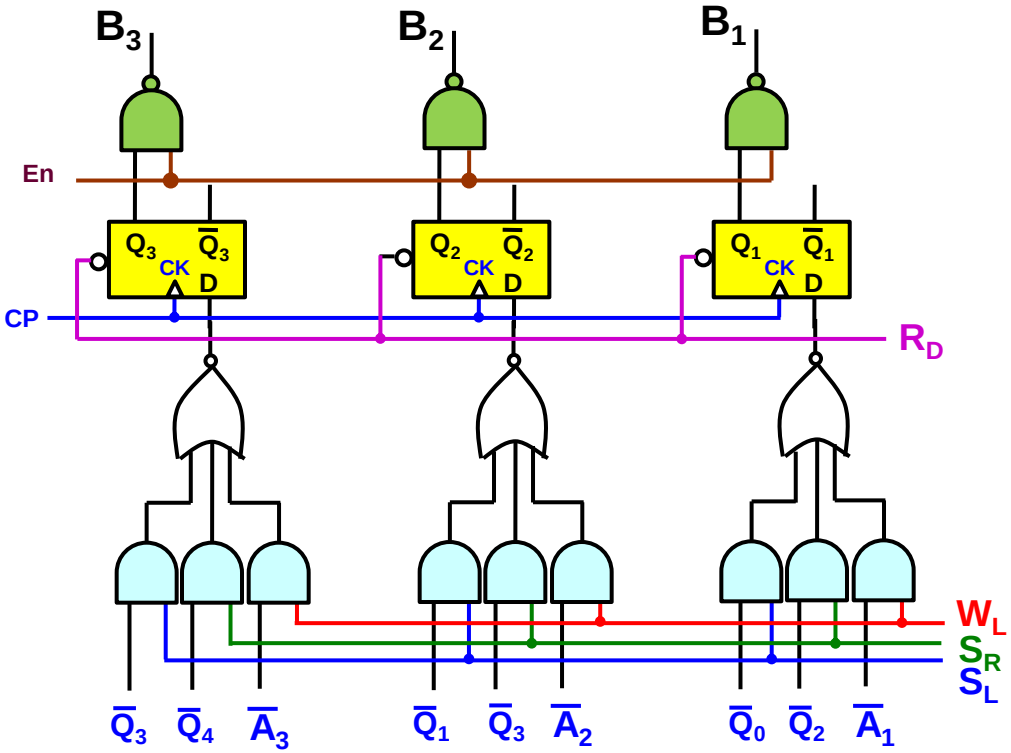
9.3 双向移位寄存器



R_d——异步清零； W_L——写入使能
S_R——右移使能； S_L——左移使能
En——输出使能

输入方程

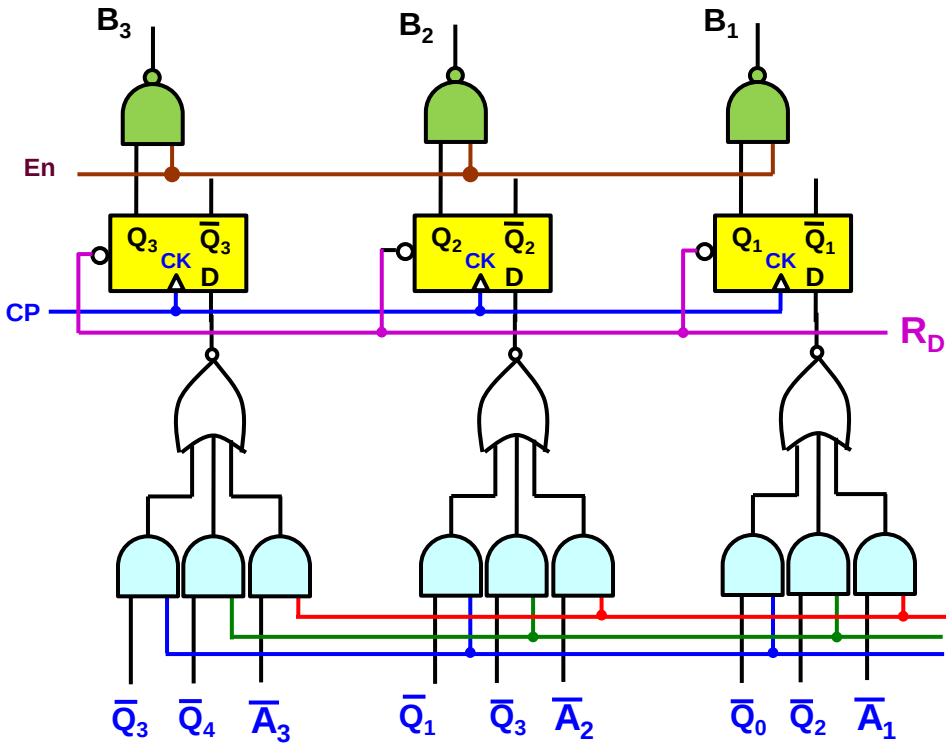
$$\begin{cases} D_3 = \overline{\overline{A_3}\,W_L + \overline{Q_4}\,S_R + \overline{Q_2}S_L} \\ D_2 = \overline{\overline{A_2}\,W_L + \overline{Q_3}\,S_R + \overline{Q_1}S_L} \\ D_1 = \overline{\overline{A_1}W_L + \overline{Q_2}S_R + \overline{Q_0}S_L} \end{cases}$$

输出方程

$$\begin{cases} B_3 = \overline{Q_3\,E_n} \\ B_2 = \overline{Q_2\,E_n} \\ B_1 = \overline{Q_1 E_n} \end{cases}$$

次态方程

$$\begin{cases} Q_3^{n+1} = D_3 \\ Q_2^{n+1} = D_2 \\ Q_1^{n+1} = D_1 \end{cases}$$



功能

（1）写入：将 $A_1 \sim A_3$ 存放在寄存器中

Let: $W_L = 1$, $S_R = S_L = 0$

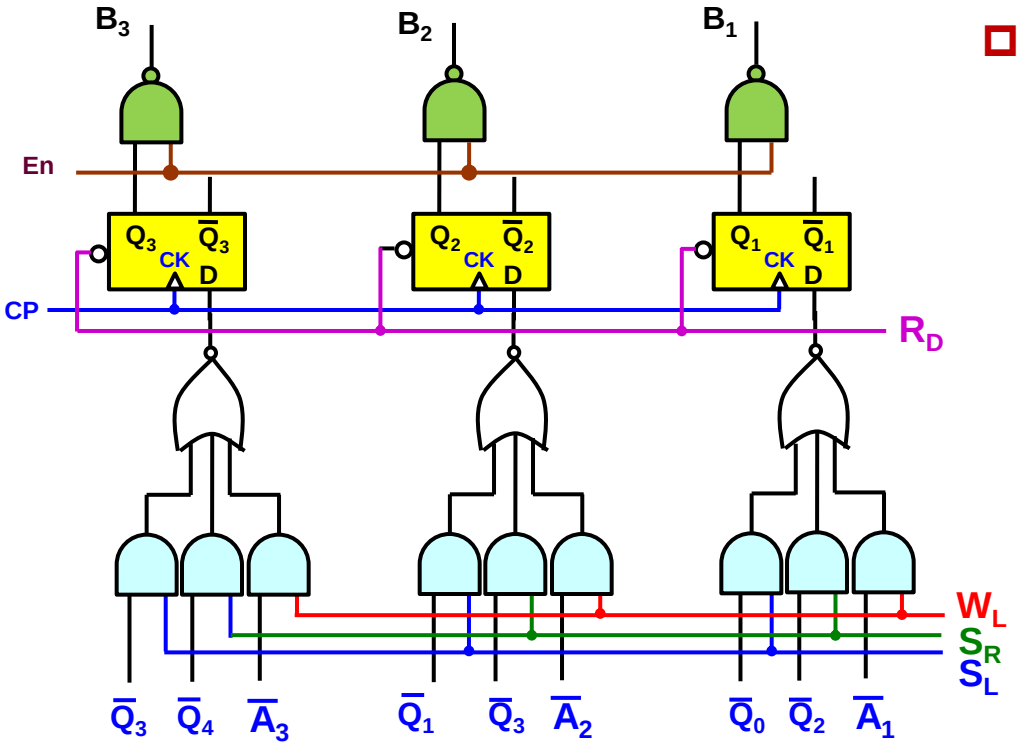
当 cp ↑ 上升沿到来时：

次态方程

$$\begin{cases} Q_3^{n+1} = D_3 = A_3 \\ Q_2^{n+1} = D_2 = A_2 \\ Q_1^{n+1} = D_1 = A_1 \end{cases}$$

输入方程

$$\begin{cases} D_3 = \overline{\overline{A_3} W_L + \overline{Q_4} S_R + \overline{Q_2} S_L} = \overline{A_3 \cdot 1 + Q_4 \cdot 0 + Q_2 \cdot 0} = A_3 \\ D_2 = \overline{\overline{A_2} W_L + \overline{Q_3} S_R + \overline{Q_1} S_L} = \overline{A_2 \cdot 1 + Q_3 \cdot 0 + Q_1 \cdot 0} = A_2 \\ D_1 = \overline{\overline{A_1} W_L + \overline{Q_2} S_R + \overline{Q_0} S_L} = \overline{A_1 \cdot 1 + Q_2 \cdot 0 + Q_0 \cdot 0} = A_1 \end{cases}$$



功能——

（2）右移

Let: $S_R = 1$, $W_L = S_L = 0$

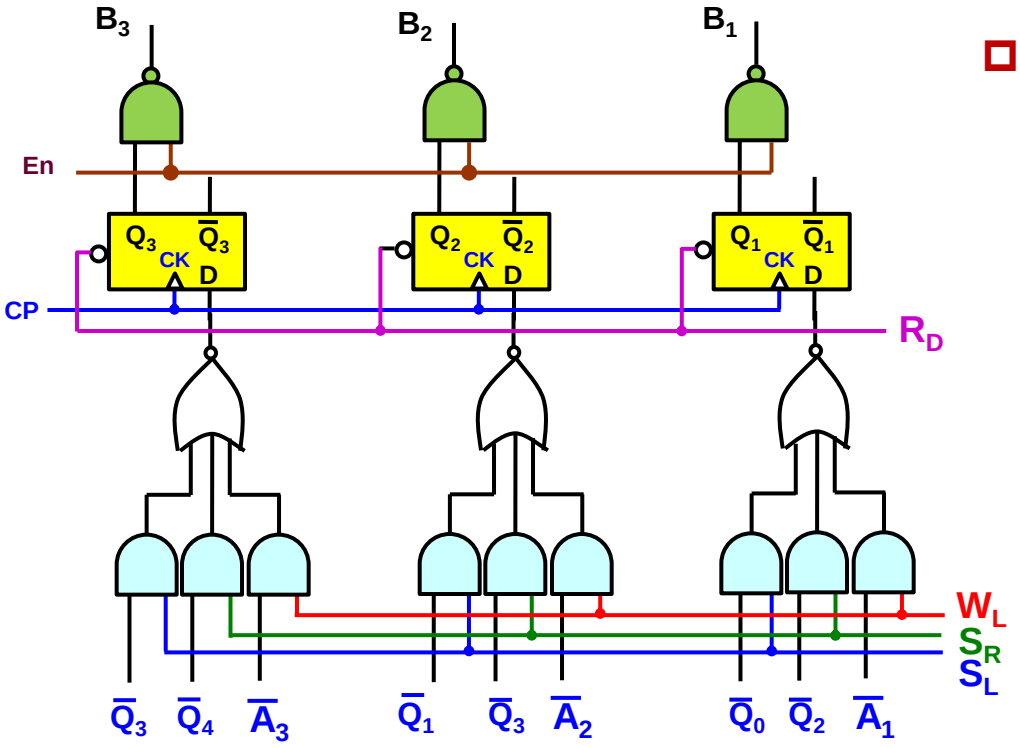
当 cp ↑ 上升沿到来时：

次态方程

$$\begin{cases} Q_3^{n+1} = D_3 = Q_4 \\ Q_2^{n+1} = D_2 = Q_3 \\ Q_1^{n+1} = D_1 = Q_2 \end{cases}$$

输入方程

$$\begin{cases} D_3 = \overline{\bar{A}_3 W_L + \bar{Q}_4 S_R + \bar{Q}_2 S_L} = \overline{A_3 \cdot 0 + Q_4 \cdot 1 + Q_2 \cdot 0} = Q_4 \\ D_2 = \overline{\bar{A}_2 W_L + \bar{Q}_3 S_R + \bar{Q}_1 S_L} = \overline{A_2 \cdot 0 + Q_3 \cdot 1 + Q_1 \cdot 0} = Q_3 \\ D_1 = \overline{\bar{A}_1 W_L + \bar{Q}_2 S_R + \bar{Q}_0 S_L} = \overline{A_1 \cdot 0 + Q_2 \cdot 1 + Q_0 \cdot 0} = Q_2 \end{cases}$$



功能——

（3）左移

Let: $S_L = 1$, $W_L = S_R = 0$

当 cp ↑ 上升沿到来时：

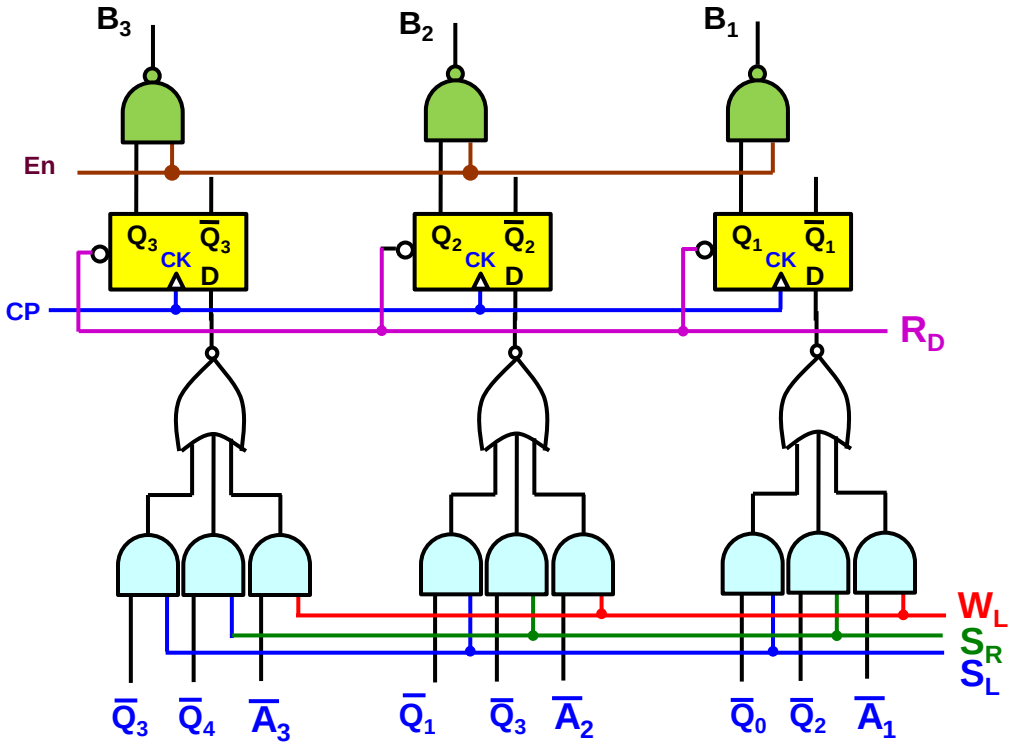
次态方程

$$\begin{cases} Q_3^{n+1} = D_3 = Q_2 \\ Q_2^{n+1} = D_2 = Q_1 \\ Q_1^{n+1} = D_1 = Q_0 \end{cases}$$

输入方程

$$\begin{cases} D_3 = \overline{\bar{A}_3 W_L + \bar{Q}_4 S_R + \bar{Q}_2 S_L} = \overline{A_3 \cdot 0 + Q_4 \cdot 0 + Q_2 \cdot 1} = Q_2 \\ D_2 = \overline{\bar{A}_2 W_L + \bar{Q}_3 S_R + \bar{Q}_1 S_L} = \overline{A_2 \cdot 0 + Q_3 \cdot 0 + Q_1 \cdot 1} = Q_1 \\ D_1 = \overline{\bar{A}_1 W_L + \bar{Q}_2 S_R + \bar{Q}_0 S_L} = \overline{A_1 \cdot 0 + Q_2 \cdot 0 + Q_0 \cdot 1} = Q_0 \end{cases}$$

9.3 双向移位寄存器



功能——

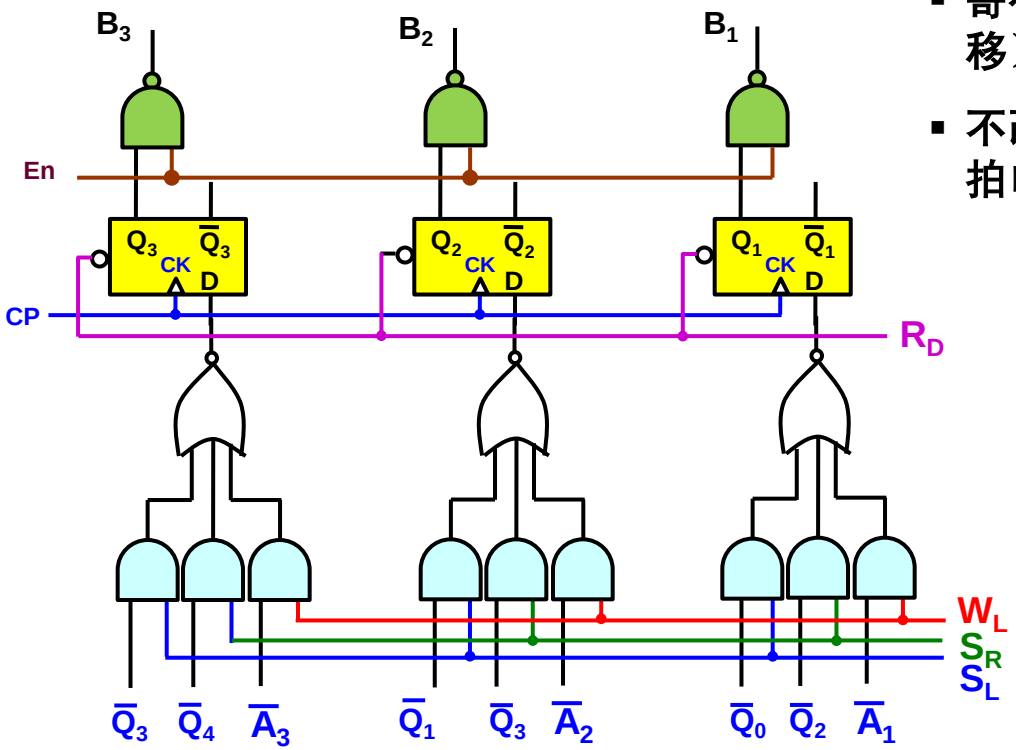
（4）读出

Let：$E_n=1$

输出方程

$$\begin{cases} B_3 = \overline{Q_3 E_n} = \overline{Q}_3 \\ B_2 = \overline{Q_2 E_n} = \overline{Q}_2 \\ B_1 = \overline{Q_1 E_n} = \overline{Q}_1 \end{cases}$$

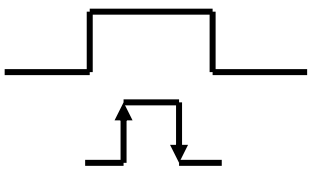
9.3 双向移位寄存器



- 寄存器的每一个操作（写入、读出、左移、右移）都是在节拍的控制下完成的。
- 不改变触发器状态的操作（读出），只需要节拍电位。

必须保证节拍脉冲的边沿被节拍电位的有效电平完全覆盖

节拍：一种控制信号



节拍电位

节拍脉冲

节拍

例如：

- 写入操作，需要 $W_L = 1$，同时CP ↑
- 左移操作，需要 $S_L = 1$，同时CP ↑
- 读出操作，只需要 En=1

9.3 双向移位寄存器

寄存器总结

- 主要功能：存放二进制数据（存储的二进制位数由里面触发器的数量决定）
- 寄存器操作：写入、读出、保持、清零。
- 移位寄存器还可以：将数据依次左移或右移1位
- 特点：寄存器的每一个操作（写入、读出、左移、右移）都是在节拍的控制下完成的