Sequential Logic Design

Register

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Introduction

- Flip flop can store 1 bit of digital information
- It is also referred as 1 – bit register

- To increase the storage capacity , we have to use group of flip flop. This group of ff is known as Register

- E.g. Intel's 8085 microprocessor chip contains:
  - Seven 8 – bit registers = General Purpose Register
  - Five 1 – bit registers = flags

- The data can be entered and retrieved in serial and parallel form
- Data in serial form is referred as Temporal Code (Time arrangement of bits)
- Data in parallel form is referred as Spacial Code

Introduction (contd..)

- Registers are classified depending upon the way in which data are entered and retrieved

- The 4 possible modes of operation are

1. Serial–in, Serial–out(SISO)
2. Serial–in, Parallel–out(SIPO)
3. Parallel–in, Serial–out(PISO)
4. Parallel–in, Parallel–out(PIPO)

Shift Registers

- Registers in which data are entered and/or taken out in serial form are referred to as **Shift Registers**
- Bits are shifted in flip flop with occurrence of clock pulses either in right direction (right shift register) or in the left direction (left shift register)
- In the bi-directional shift register, data can be shifted from left to right as well as in reverse direction, using the mode control. e.g IC 74295A is a bi-directional shift register
- A register is referred to as a **Universal register** if it can be operated in all 4 possible modes and also as a bi-directional register. E.g. 74194 is a universal register
- Shift registers are available in 54/74 TTL and CMOS logic families

Shift Registers (Contd..)

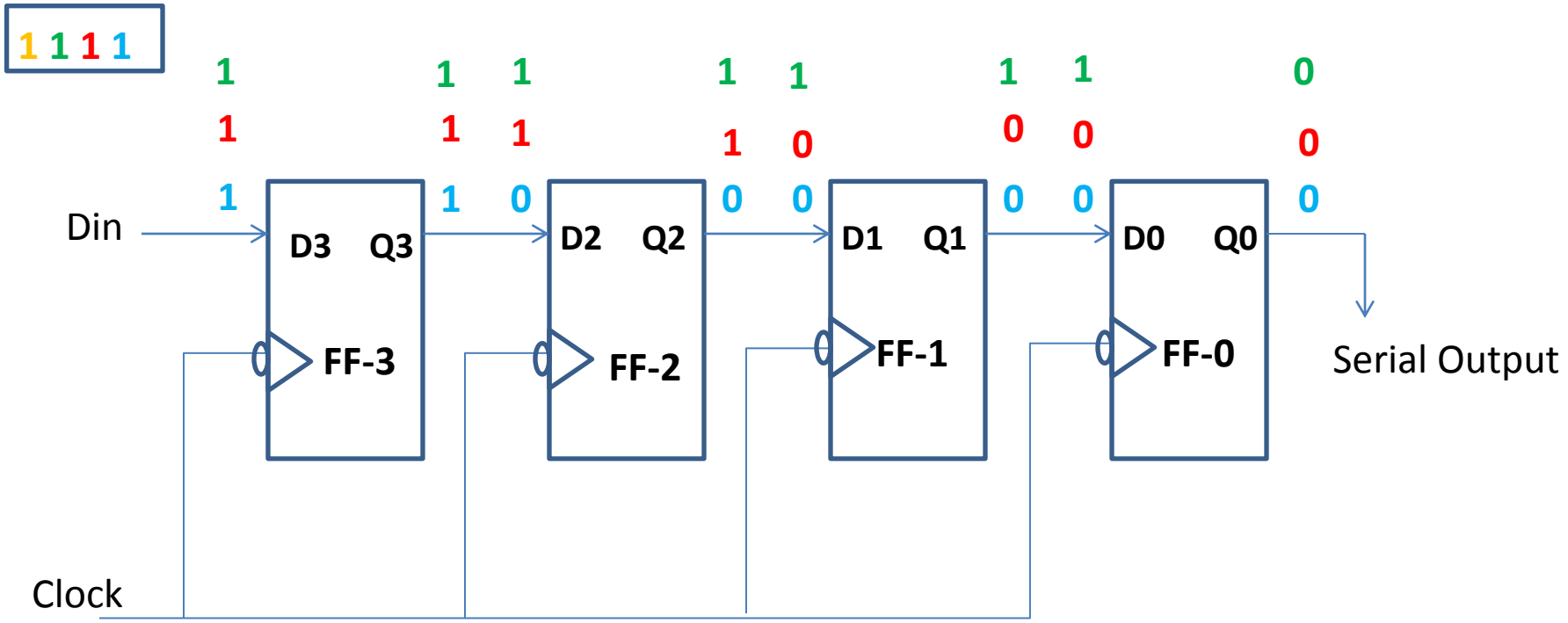
Shift Registers available in 54/74 TTL and CMOS families

IC Number	Description
7491, 7491A	8-bit Serial-in, serial-out
7494	4-bit Parallel-in, serial-out
7495	4-bit Serial/Parallel-in, Parallel-out (right-shift , left-shift)
7496	5-bit Parallel-in/Parallel-out, serial-in/serial-out
7499	4-bit bi-directional (Universal)
74164	8-bit Serial-in, Parallel-out
74165	8-bit Serial/Parallel-in, Serial-out
74166	8-bit Serial/Parallel-in, Serial-out
74178, 74179	4-bit bi-directional (Universal)
74194	4-bit bi-directional (Universal)

Basic Shift Registers

1. Serial–in, Serial–out(SISO)
2. Serial–in, Parallel–out(SIPO)
3. Parallel–in, Serial–out(PISO)
4. Parallel–in, Parallel–out(PIPO)

Serial–in, Serial–out(SISO)



Data at the input will be delayed by four clock periods from the input to the output of the shift register

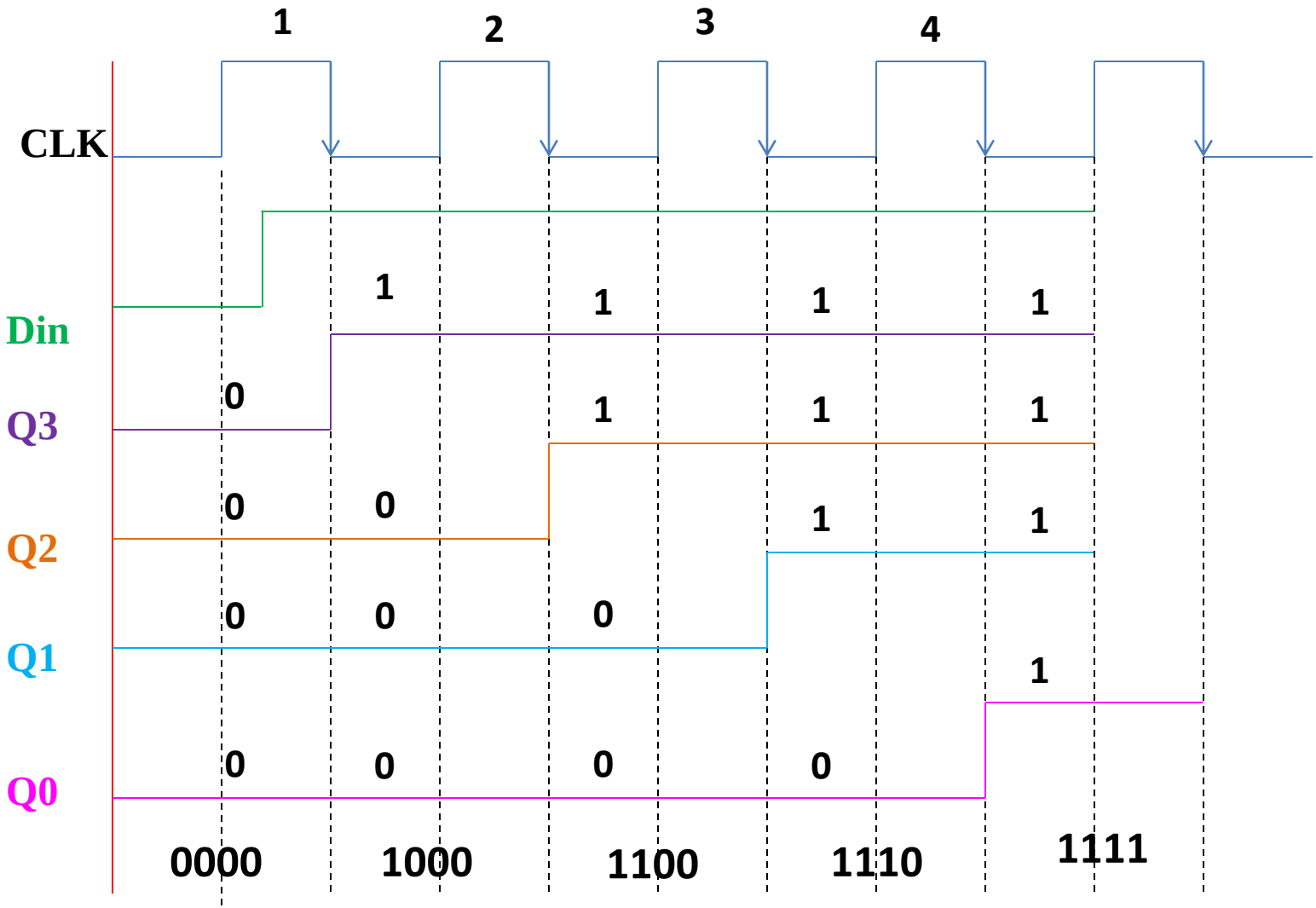
Serial–in, Serial–out(SISO) (Contd..)

CLK	Q3	Q2	Q1	Q0
Initially	0	0	0	0
↓	1	0	0	0
↓	1	1	0	0
↓	1	1	1	0
↓	1	1	1	1

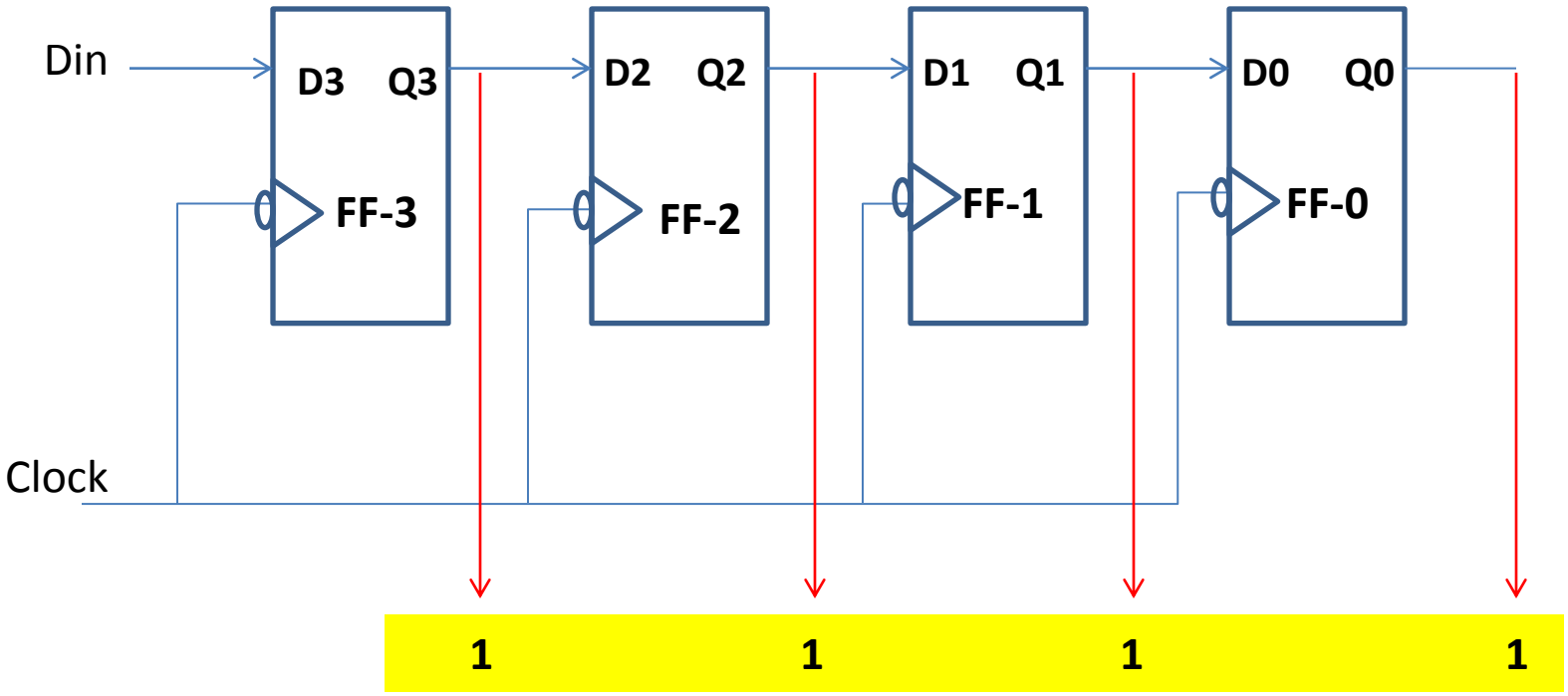
TT for D Flip Flop

CLK	D	Qn+1
0	X	Qn
1	0	0
1	1	1

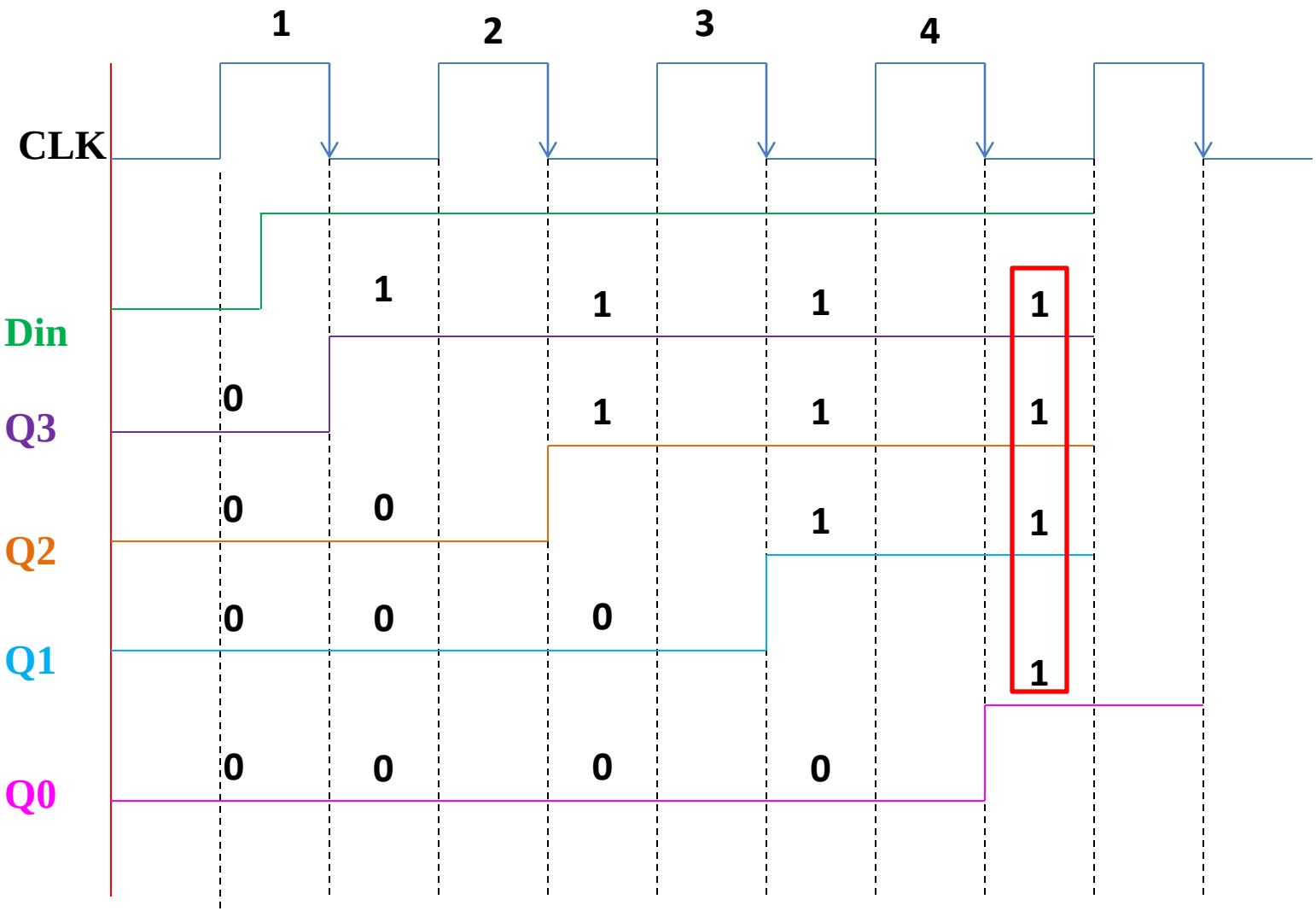
Serial–in, Serial–out(SISO) (Contd..)



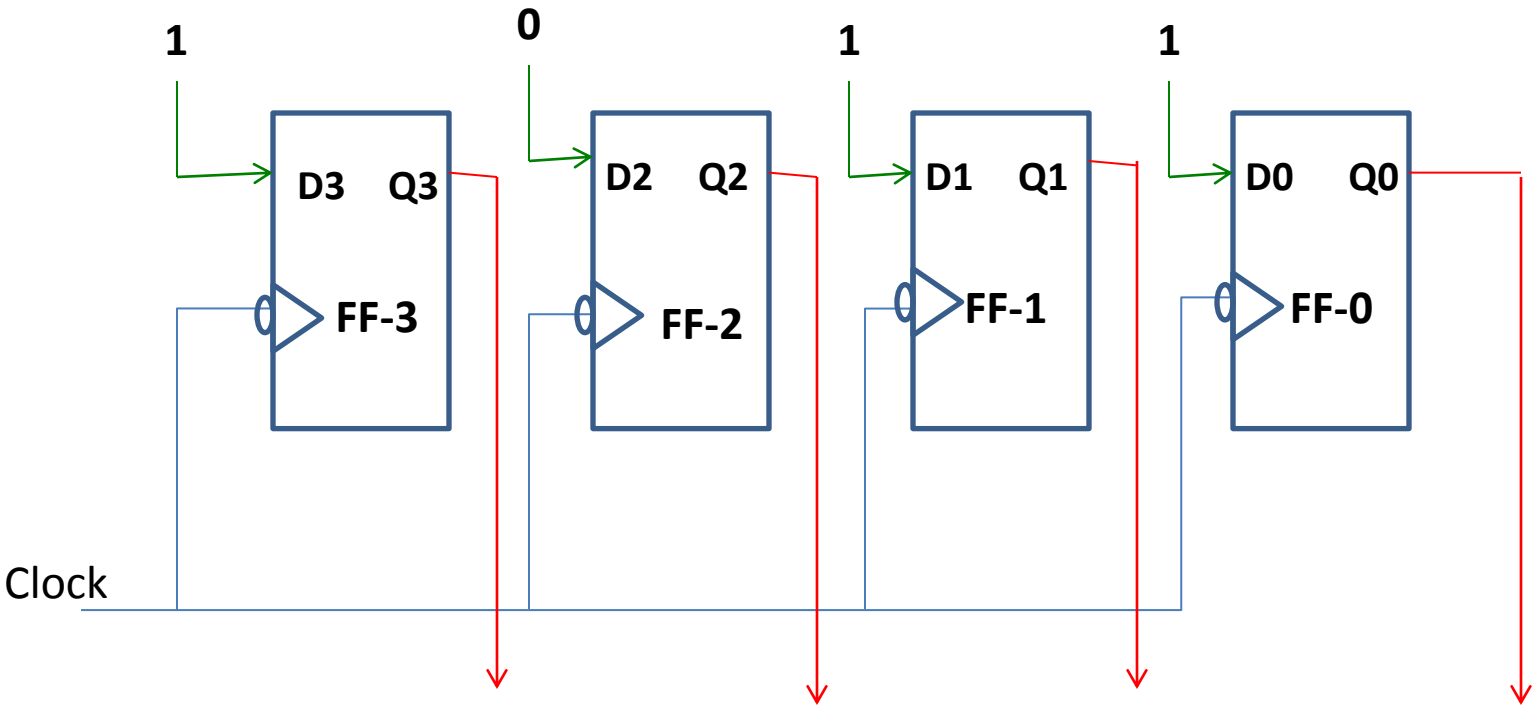
Serial–in, Parallel–out(SIPO)



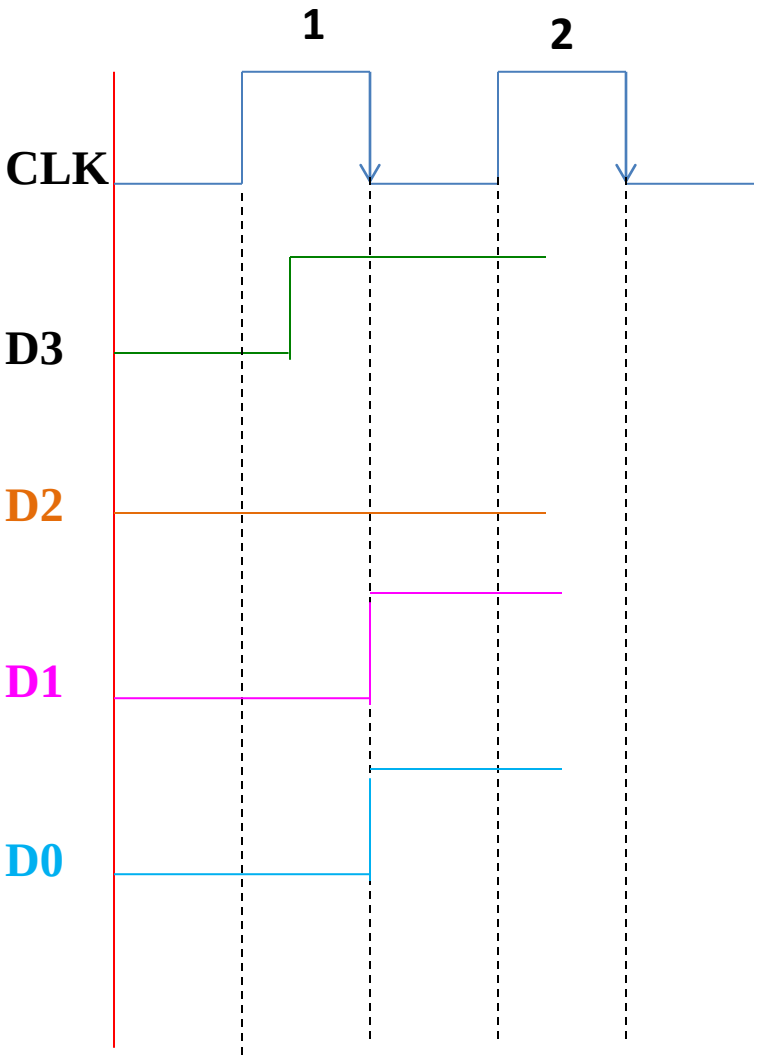
Serial–in, Parallel–out(SIPO) (Contd..)



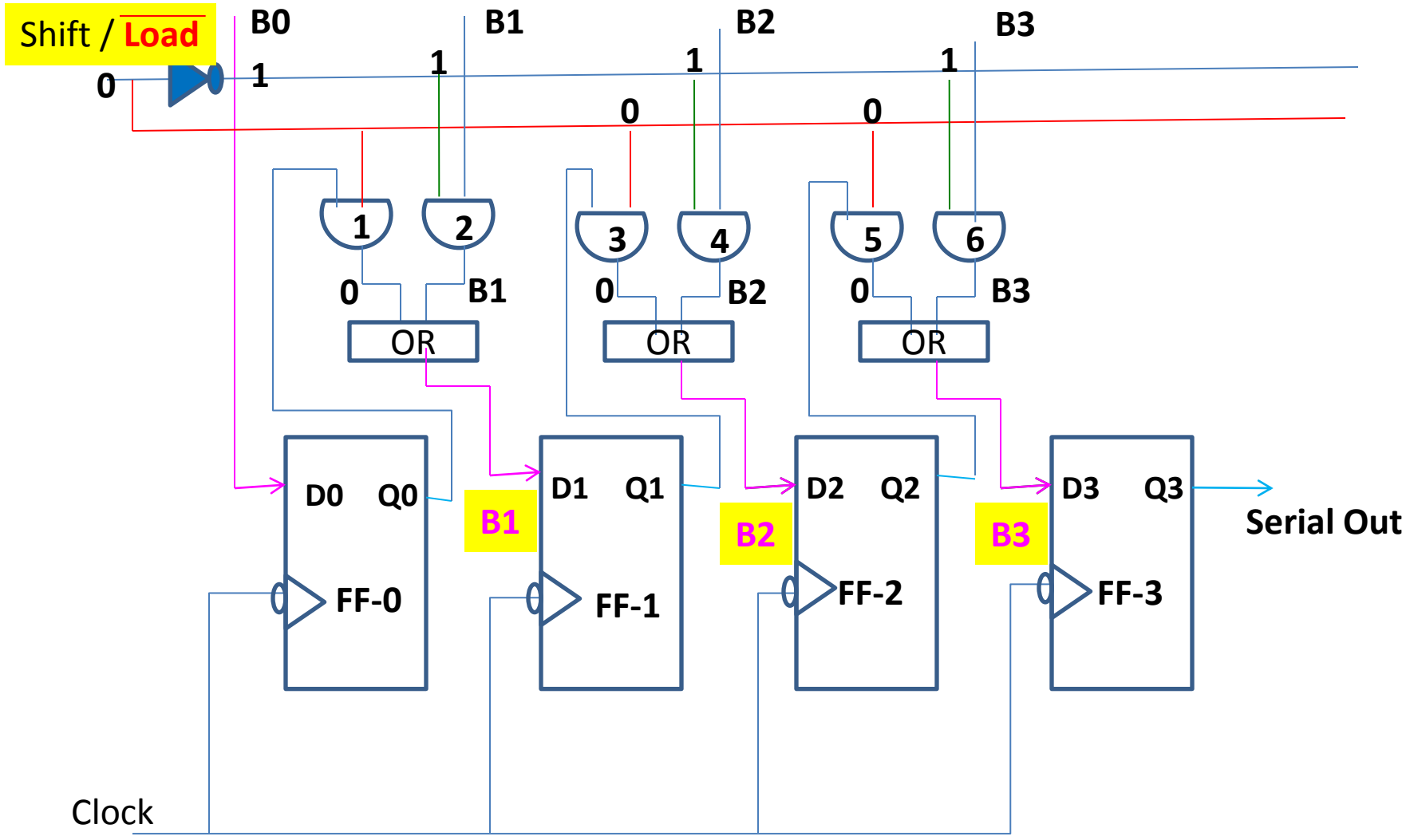
Parallel–in, Parallel–out(PIPO)



Parallel–in, Parallel–out(PIPO) (Contd..)



Parallel–in, Serial–out(PISO)



Parallel–in, Serial–out(PISO) (Contd..)