18. What is a universal shift register ?

LAB EXERCISE 7.1
UP/DOWN Counters

Objectives

In this lab exercise we will study ripple counters. We will implement up and down counters using discrete flip-flop ICs.

Materials

LD-2 Logic Designer

74LS76 Dual J-K Flip-flops with Preset and Clear

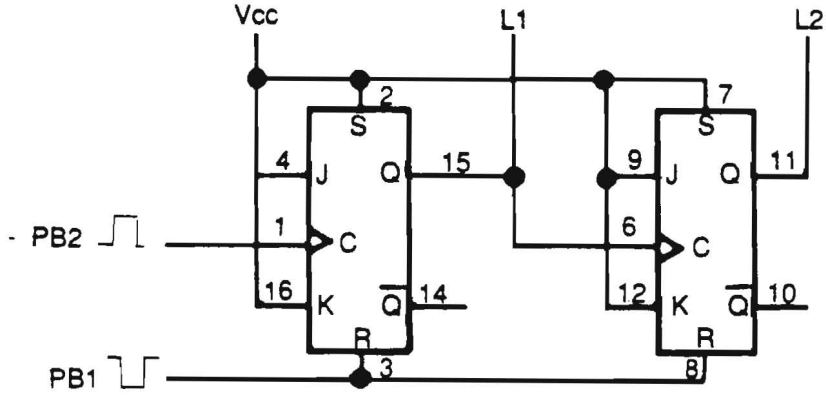
Jumper Wires

TTL Data Book

Procedure

1. In this portion of the laboratory, we will construct an up-counter using J-K flip-flops.

2. Wire the circuit shown in Figure 7-16. Use extra caution wiring the power and ground connections.



2/2 74LS76

FIGURE 7-16. Up Counter.

3. Turn-on power to the LD-2. Push PB1. All lights except for D1 should be off.

4. Use PB2 as the clock input, L1 and L2 as the 1 and 2 outputs. Record your observations of the circuit operation.

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5. Use PB2 to place a count of two on L1 and L2. Press PB1 and record your observation.

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6. Turn off power to the LD-2. Remove the wires from pin 15 of the 74LS76 and place them on pin 14.

7. Remove the wire from pin 11 of the 74LS76 and place it on pin 10.

8. Turn-on power to the circuit. Push PB1. L1, L2 and D1 should light.

9. Use PB2 as the clock input and L1 and L2 as the 1 and 2 outputs. Notice that the L1 and L2 outputs will now be LO true so that the count when both lights are ON is zero. Record your observations of the circuit operation.

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_____

Questions

1. What is the modulus of each of the counters in this laboratory ?

_____

_____ _____

2. How can the down counter be converted to display a HI true output ?

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LAB EXERCISE 7.2 Synchronous Counters

Objectives

In this lab exercise we will study synchronous counters. We will implement simple synchronous counters using flip-flop ICs. We will study both up and down counters.

Materials

LD-2 Logic Designer

74LS76 Dual J-K Flip-flops with Preset and Clear

Jumper Wires

TTL Data Book

Procedure

1. Place a 74LS76 on the LD-2 breadboard and wire the circuit shown in Figure 7-17.

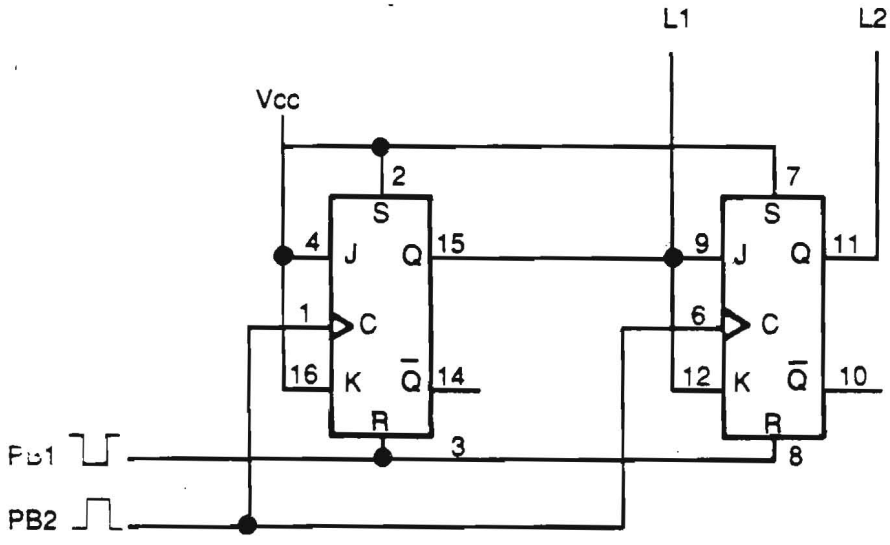

FIGURE 7-17. Synchronous Up Counter.

2. Turn on power to the LD-2 and push PB1. Only D1 should be lit.

3. Use PB2 as the count input and L1 and L2 as the count outputs. Record your observations of the operation of this circuit.

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4. Remove power from the LD-2. Remove the wires from pin 15 of the 74LS76 and wire them to pin 14.

5. Remove the wire from pin 11 of the 74LS76 and place the wire to pin 10.

6. Turn on power to the LD-2. Push PB1. L1, L2 and D1 should light.

7. Use PB2 as the count input and record your observations of the circuit operation. Again, notice that the L1 and L2 outputs are LO true.

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Questions

1. Fully describe both counter circuits in this laboratory.

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LAB EXERCISE 7.3
IC Counters

Objectives

In this lab exercise we will study IC counters. The two types of counters studied will be the 74LS90 decade counter and the 74193 synchronous 4-bit binary up/down counter.

Materials

LD-2 Logic Designer

74LS90 Decade Counter

74193 4-BIT Binary UP/DOWN Counter

Jumper Wires

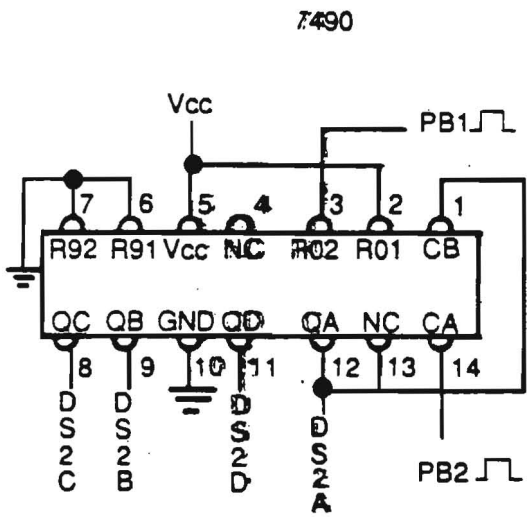
TTL Data Book

Procedure

1. The first counter IC studied will be the 74LS90. This circuit contains separate divide by two and divide by five sections. To form the decade counter we will interconnect the output of the divide by two section to the input of the divide by five section. This choice is arbitrary and the alternative method will also form a decade counter.

2. Wire the circuit shown in Figure 7-18. Notice the unconventional arrangement of the power pins. Also, wire DS2 DE to +5 VDC.

FIGURE 7-18. Decade Counter.



3. Turn on power to the LD-2. Push PB1. D1 should light and DS2 should display a zero.

4. Use PB2 as the count input and DS2 as the output. Record your observations of the operation of this counter circuit.

5. Set the counter to some non-zero count and press PB1. Record your observations.

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6. Remove power from the LD-2 and remove the 74LS90 and it's circuitry.

7. Wire the circuit shown in Figure 7-19 using the 74193 IC counter.

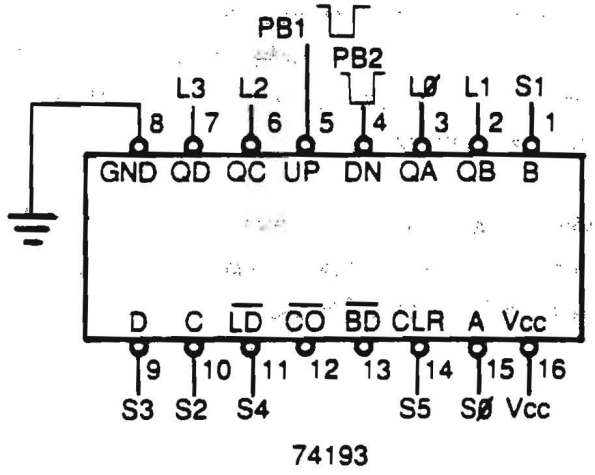

FIGURE 7-19. 4-Bit Binary Up/Down Counter.

8. Set S5 to LO and S4 to HI. These are the CLEAR and LOAD inputs respectively. Turn on power to the LD-2. Place S5 from LO to HI then back to LO. Only D1 should be lit.

9. This circuit requires some explanation. S0-S4 are data inputs which are loaded as presets to the counter under command of the LOAD control line (S4). Use PB1 & PB2 to count up or down respectively. Another way to observe the operation of this counter is by changing S0-S5 from HI to LO. Record the difference of the two operations.

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10. Remove power from the LD-2 and answer the questions below.

Questions

1. Will the counter count with the load input active ?

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2. Can the counter be loaded with the clear input active ?

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3. What is the modulus of this counter ?

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4. How could you make a counter of modulus 7 using the 74193 ?

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LAB EXERCISE 7.4
Shift Registers

Objectives

In this lab exercise you will study two types of shift registers. You will use the 74174 IC to construct both parallel-in/parallel-out and serial-in/serial-out shift registers.

Materials

LD-2 Logic Designer

74174 Hex D Flip-flops with Clear IC

74LS08 Quadruple 2 Input Positive AND Gate

74LS32 Quadruple 2 Input Positive OR Gate

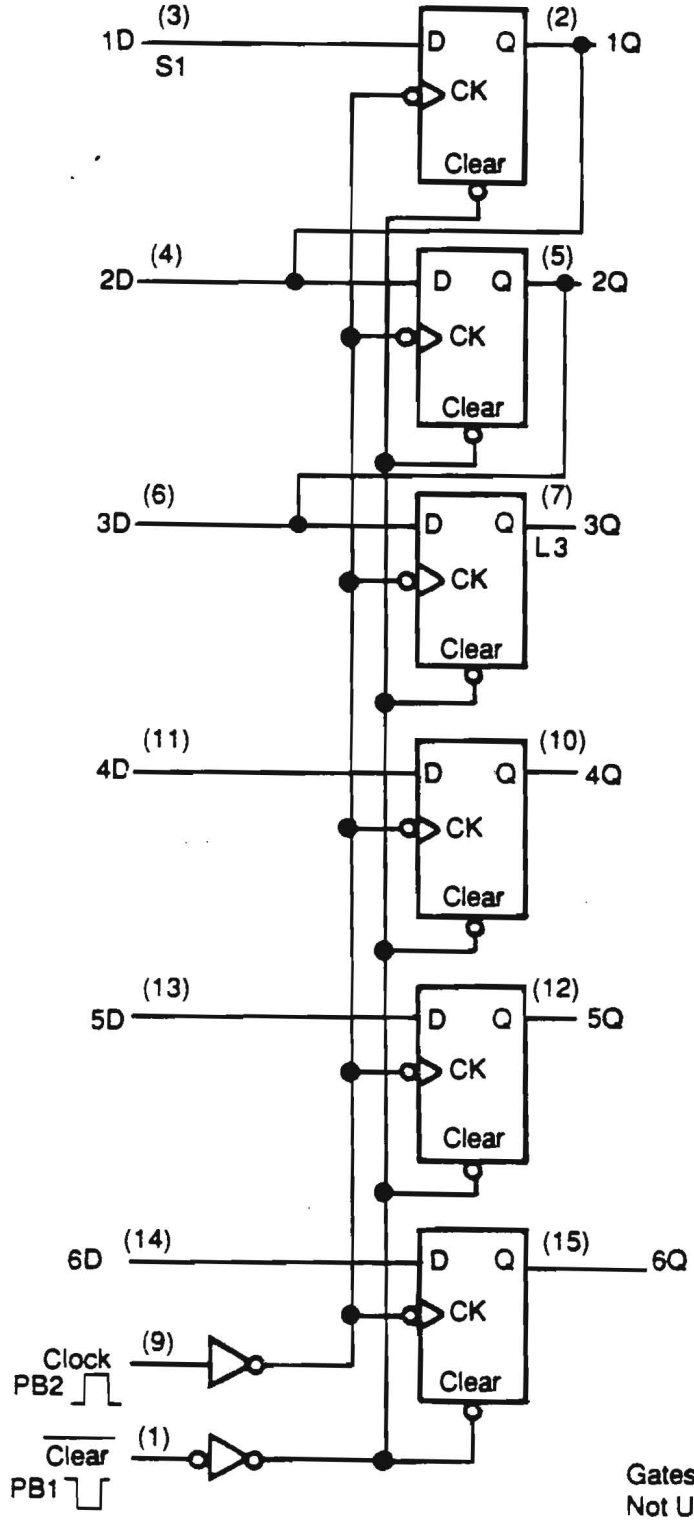
Jumper Wires

TTL Data Book

Procedure

1. You will study the SISO configuration of the 74174 first. Wire the circuit shown in Figure 7-20.
2. Turn on power and push PB1. D1 should light.

FIGURE 7-20. SISO Shift Register.



3. Use S1 as the input bit, PB2 as the clock pulse and L3 as the output. Record your observation of the operation of this circuit.

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4. Press PB1. Place S1 to HI and press PB2 until L3 lights. Now press PB1. Record your observations.

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5. Some additional circuitry will be required to allow us to use the 74174 as a parallel loading shift register. Wire the circuit shown in Figure 7-21.

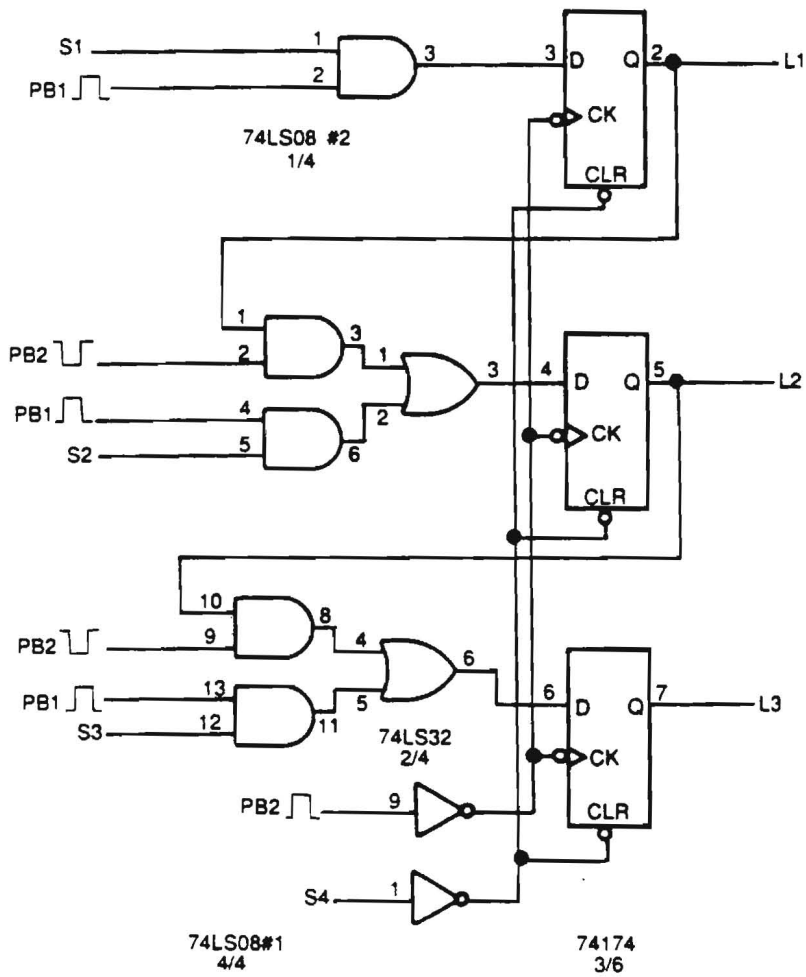

FIGURE 7-21. 74174 PIPO Shift Register.

6. Place all S1-S4 to off. Turn on power. D1 should light.

7. Use S1-S3 as the parallel inputs, S4 as the clear input, PB1 as the load enable input, PB2 as the clock input and L1-L3 as the parallel outputs. Observe the operation of this circuit and record your observations. Notice that to load the parallel data you must hold the enable pushbutton down.

Questions

1. Explain the operation of the gating circuits appearing between flip-flops in Figure 7-21.

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2. Do you have to reset the 74174 in step seven to load parallel data ?

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3. Could you make a PIPO shift register using only the 74174 and the two OR gates? What would be the operational restrictions on such a circuit ?

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LAB EXERCISE 7.5
The 74165

Objectives

In this lab exercise you will study the 74165 IC. You will implement a PISO shift register using the 74165 and observe it's use as a SISO.

Materials

LD-2 Logic Designer

74165 Parallel Load Eight-bit Shift Register

Jumper Wires

TTL Data Book

Procedure

1. Install a 74165 IC on the LD-2 breadboard and wire the circuit shown in Figure 7-22.

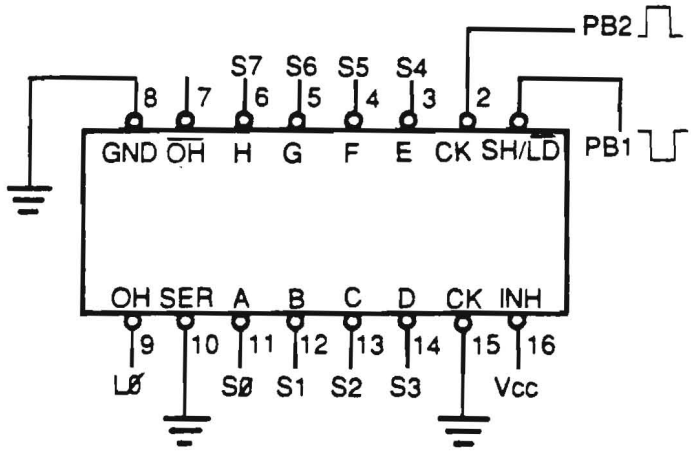

FIGURE 7-22. 74165 PISO Shift Register.

2. Place all logic switches to off. Turn on power. D1 should light.

3. Use PB1 as the load input, PB2 as the clock input, S0-S7 as the data input and L0 as the output. Record your observations about the operation of this circuit.

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4. Turn off power and remove the wire connecting pin 10 to ground. Place all logic switches to off. Again observe the circuit operation and record your observations.

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Questions

1. How does the 74165 determine which input to receive it's data from. Describe how each data input is activated.

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LAB EXERCISE 7.6
The 74164

Objectives

In this lab exercise we will study the 74164 IC. You will use the 74164 to implement a SIPO shift register.

Materials

LD-2 Logic Designer

74164 8-Bit Parallel Output Serial Shift Register

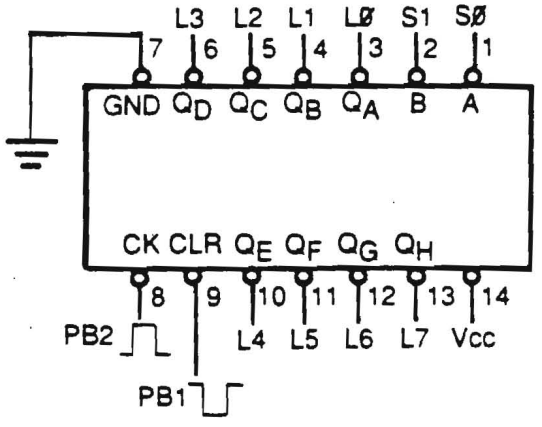
Jumper Wires

TTL Data Book

Procedure

1. Insert a 74164 IC into the LD-2 breadboard and wire the circuit shown in Figure 7-23.

FIGURE 7-23. 74164 SIPO Shift Register.



2. Turn all logic switches to off. Turn on power. D1 should light.

3. Place S1 to on. Use S0 as the data input, PB1 as the clear input, PB2 as the clock input and L0-L7 as the outputs. Observe the operation of this circuit and record your observations.

4. Place S0 to on and use S1 for the data input. Observe the circuit operation and record your observations.

Questions

1. What happens if both S0 and S1 are LO ?

2. How would you use this circuit as a SISO register ?