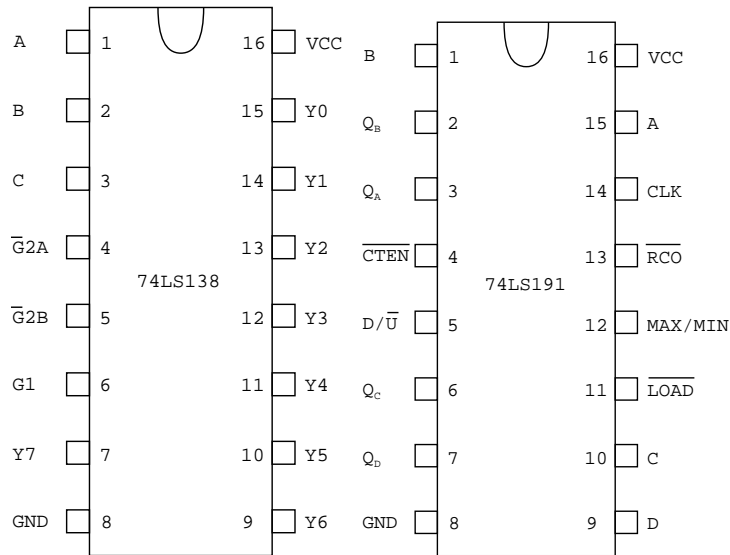


**ERG2020B: Digital Logic & Systems (Fall 2008)**  
**Lab 2 – Breadboarding & TTL Exercise II**

Time: 27 Oct, 2008 (M11-12)  
Place: SHB 122

- Objectives
  - To gain practical experience with digital laboratory equipments.
  - To observe the properties of TTL chips.
  - To gain experience in digital logic design (logic gate level).
  - To search useful information from datasheet / databook.
  
- Components
  - Individual lab exercise
  - Breadboard x 1
  - Digital Analyzer / Oscilloscope (CRO) x 1
  - 100 $\mu$ F capacitor x 1
  - Diode x 1
  - 2.2k resistor x 1
  - 74LS138 x 1  
(3 to 8 Line Decoders)
  - 74LS191 x 1  
(Loadable 4-bit Binary Up/Down Counter)
  - Connecting wires

## Chip Information



### 74LS138

SELECT			OUTPUTS							
C	B	A	Y0	Y1	Y2	Y3	Y4	Y5	Y6	Y7
0	0	0	0	1	1	1	1	1	1	1
0	0	1	1	0	1	1	1	1	1	1
0	1	0	1	1	0	1	1	1	1	1
0	1	1	1	1	1	0	1	1	1	1
1	0	0	1	1	1	1	0	1	1	1
1	0	1	1	1	1	1	1	0	1	1
1	1	0	1	1	1	1	1	1	0	1
1	1	1	1	1	1	1	1	1	1	0

To enable the decoder, give  $G1 = 1$ ,  $\overline{G2A} = 0$ ,  $\overline{G2B} = 0$ .

## 74LS191

74LS191 is a synchronous up or down 4-bit loadable counter. Study carefully the following information about the chip and the timing specification on the next page.

- Data Inputs: A(LSB), B, C, D(MSB)
- Control Inputs:
  - $\overline{\text{LOAD}}$ : 0 to load bits A, B, C and D into the counter, otherwise 1.
  - CLOCK: clock signal to the counter to control the rate of counting.
  - D/ $\overline{\text{U}}$ : 0 to count up, 1 to count down.
  - $\overline{\text{CTEN}}$ : **C**oun**T**er **E**Nable. 0 to enable the counter, 1 to stop counting.
- Outputs:
  - $Q_A$ (LSB),  $Q_B$ ,  $Q_C$ ,  $Q_D$ (MSB): Counter 4-bit output.
  - MAX/MIN: 1 when the counter counts to the largest(1111) or smallest (0000) number.
  - $\overline{\text{RCO}}$ : **R**ipple **C**lock **O**utput. Use to cascade several counters together. Not used in this lab.

# SN54191, SN54LS191, SN74191, SN74LS191 SYNCHRONOUS UP/DOWN COUNTERS WITH DOWN/UP MODE CONTROL

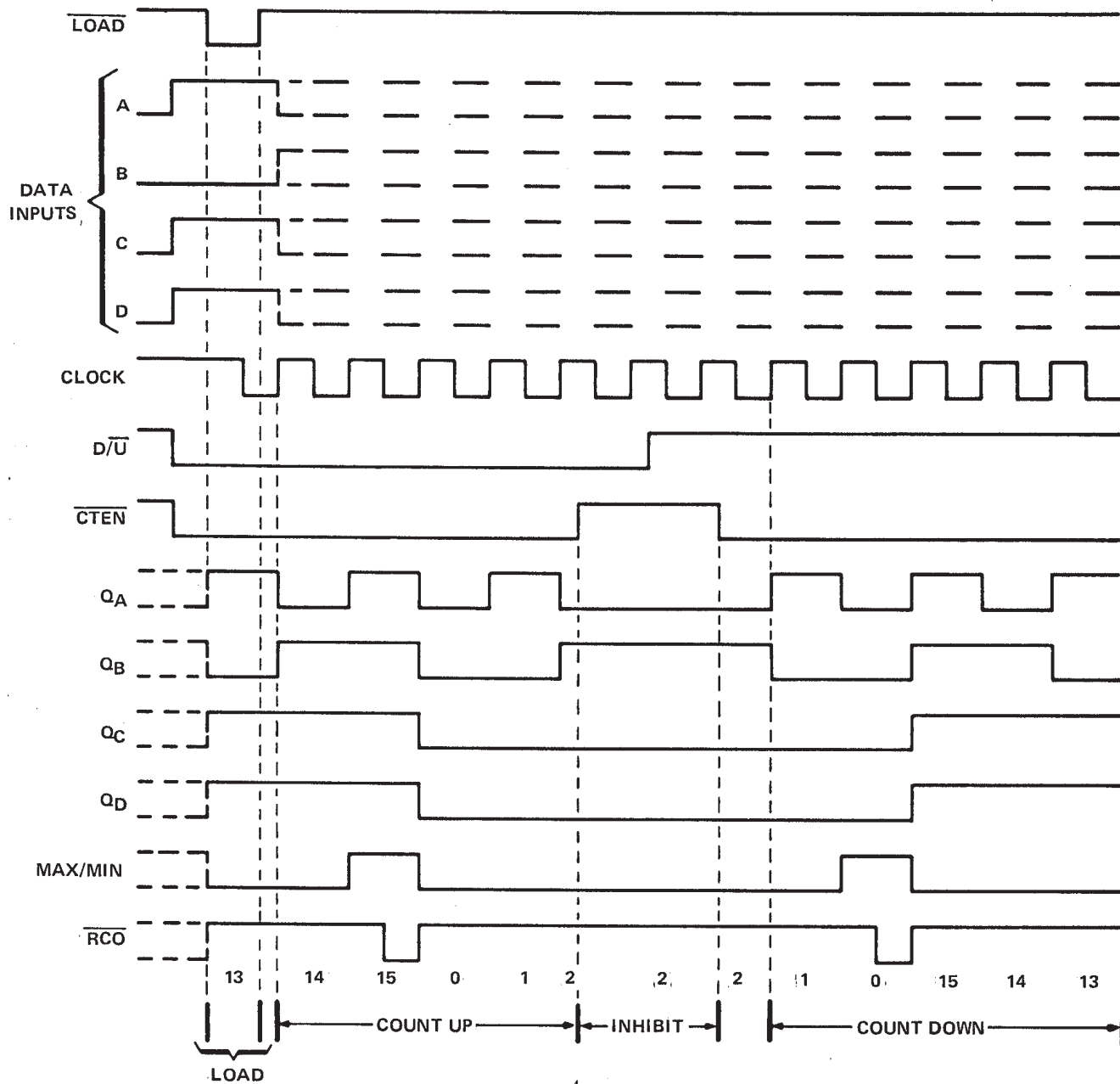
SDLS072 – DECEMBER 1972 – REVISED MARCH 1988

## '191, 'LS191 BINARY COUNTERS

typical load, count, and inhibit sequences

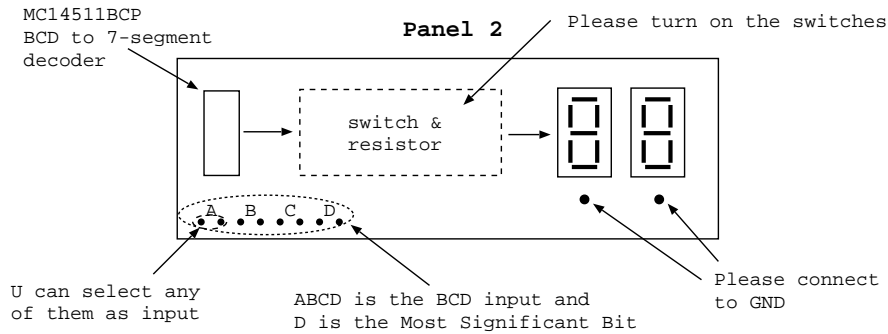
Illustrated below is the following sequence:

1. Load (preset) to binary thirteen.
2. Count up to fourteen, fifteen (maximum), zero, one, and two.
3. Inhibit.
4. Count down to one, zero (minimum), fifteen, fourteen, and thirteen.



## Exercise 1: Basic Usage of 74LS191

In this exercise, you need to load a number on the 7-segment display and count up from that number using a 74LS191 chip.



Specification:

- CAUTION: Make sure the power is off when you make the connections.
- Use the 7-segment display on panel 2 of the breadboard.
- You need to construct a clock rectifier to generate a correct clock signal for the chip. (refer to lab 1 ex. 2 for the construction)
- Adjust the clock frequency to around 2-3 Hz when you test your circuit (so that you can check the counting).
- The circuit is controlled by a switch. When the switch is low, the last digit of your student ID should be loaded on the 7-segment display.
- When the switch is high, the circuit counts up from that digit and up to 9.
- You do not need to consider the states after 9.
- When you finish this exercise, please ask tutors to check if you have done correctly.

Guide Questions [2 pts each]:

1. What logic values should you assign to the control inputs? (0, 1 or switch)

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2. Will you use all outputs for this exercise?

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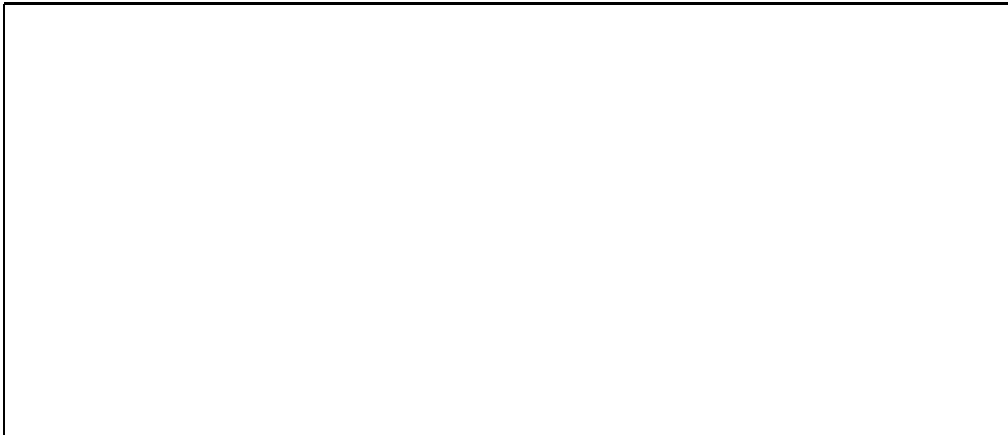
3. Where should the outputs be connected to?

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4. What you have to do if you want to count down instead of up?

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Block Diagram [12 pts]:



## Exercise 2: Design and Construct a 8-bit Ripple LED

Specification:

- Caution: Make sure the power is off when you make the connections.
- You should choose both 74LS191 and 74LS138 to complete this exercise.
- Study the data sheet and check the functionality of each chip.
- You need to construct a clock rectifier to generate a correct clock signal for 74LS191. (refer to lab 1 ex. 2 for the construction)
- Adjust the clock frequency to around 2-3 Hz when you test your circuit (so that you can check the ripple).
- In this exercise, you should design a circuit to give a 8-bit active low ripple (e.g. the sequence of 4-bit active low ripple is 1110, 1101, 1011, 0111, 1110, you can see that the '0' is shifted from right to left).
- The LED lights will be turned off in sequence from right side to left side. No more than one LED turn off at the same time.
- There is a switch to pause / continue the low ripple. When the switch is low, the low ripple moves. When the switch is high, the low ripple pauses.
- When you finish this exercise, please ask tutors to check if you have done correctly.

Guide Questions [2 pts each]:

1. What logic values should you assign to the control inputs of 74LS191? (0, 1 or switch)

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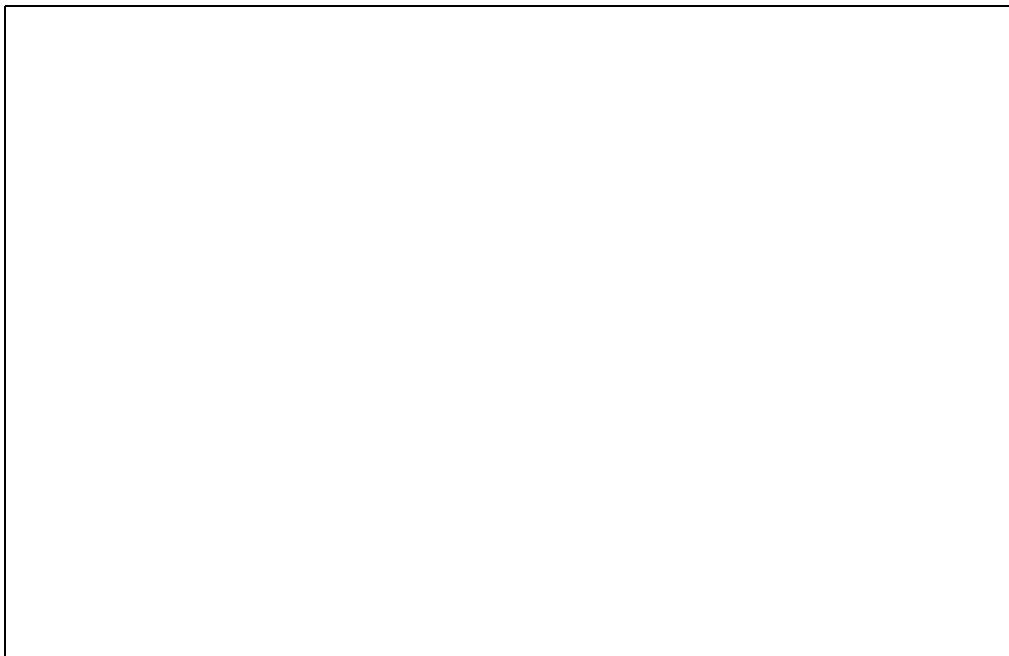
2. Which outputs from 74LS191 should be used for this exercise?

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3. What pins from which chip should be connected to the LEDs?

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Block Diagram [14 pts]:



- END OF LAB 2 -