Digital Logic Design Lab #4

Objectives

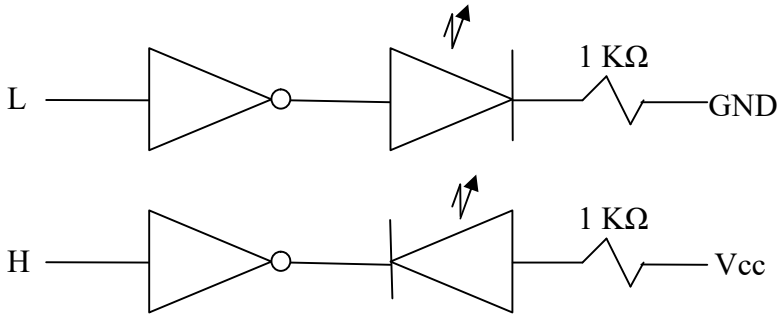
1) Application of K-map and related design techniques
2) Use of input and output devices in a digital circuit
3) Understanding of basic arithmetic unit design and implementation
4) Proficiency in requirement analysis, logic design, implementation and testing processes.

Materials

1) Textbook: Digital Logic Design
2) Course Website: www.EngrCS.com
3) Instruments: Power Supply, Function Generator and Oscilloscope
4) Supplies:
   a) Proto Board (1 unit)
   b) Jumper Wires (as needed)
   c) 7-Segment Display (1 unit)
   d) 1 kΩ resistor (4 units)
   e) 74LSxx as required by the design (consider using BCD to 7-segement driver, 74LS47)

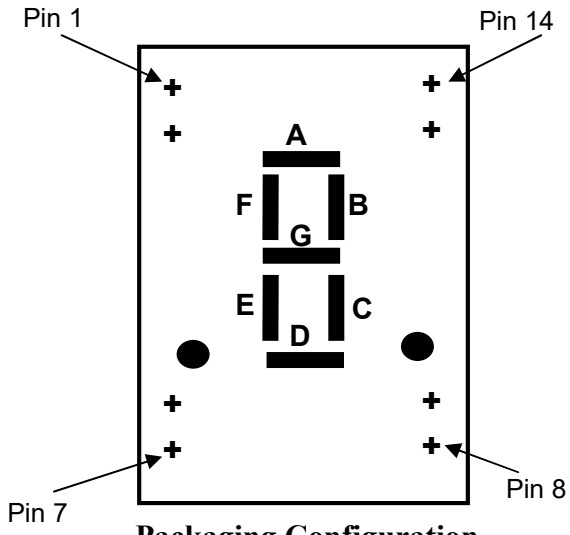
Reminder

LEDs are always used in series with resistors in order to limit the current through the LED to 3-8 mA. As shown in the following two examples:



Experiment #1. 7-Segment Design

7-Segment displays as the name implies have seven segments that may be turned on individually to form an approximation to a given letter or number. Below are the specifications for Common Anode 7-Segrment model # Lumex LDS-A304RI:



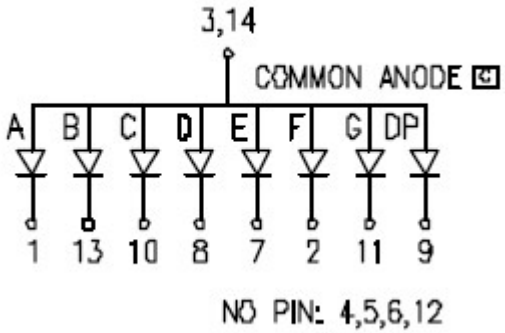
Packaging Configuration

Limit of Safe Operation

Peak I_f	< 150 mA
Steady If	< 30 mA
Power	< 105 mW

Typical

5 mA at 5V



Functional Diagram

It is important that you add a 1 KΩ resistor between Pins 3,14 and Vcc to limit the maximum current through the diodes. For this experiment:

1) Calculate the maximum combined forward current through all 8 diodes.
   Notes:
   a) Anode pins (3 &14) are connected to the Vcc through a 1 K resistor.
   b) Assume LED have 0 ohm resistor and remember V=I*R where V is voltage in Volts, I is current in Amps and R is resistance in Ohms.
2) Design and Draw the schematic for a circuit that turns on A, B, C, E, F, G segment.
3) Implement your design and document your observations.

Experiment 2. 2-bit Adder

Design a 2-bit binary adder with carry. Your circuit should allow for two 2-bit binary input (a_1a_0 & b_1b_0) through switches and display the results of the addition in decimal format using the 7-segment display.

Your deliverables include:

a) Clearly identified independent variables (input) and dependent variables (output) for the 2-bit binary adder system.
b) Truth Table for the system based on input/output defined in part a
c) Write the minimize output functions in either POS or SOP using K-map. Clearly state the literal count and corresponding number of gates to implement each of the minimized output functions.
d) Using the results from part c or your research into possible designs, draw a schematic to implement 2-bit adder with carry.
Hint: Consider using Full-adder and half-adder design.
e) Implement, test and demonstrated your design from section d.

Include the approval signature in your report:

Team Members:	LAB4 Demo Instructor Approval Signature & Date:
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Report Requirements

All reports must be computer printed (Formulas and Diagrams may be hand drawn) and at minimum include:

For each Experiment

a) Clear problem statement; specify items given and to be found.
b) Identify the theory or process used.
c) Documents resulting system diagram, schematics, tables, timing diagram, schematic and other relevant results.

For the report as a whole

a) Cover sheet with your name, course, lab, date of completion and team members' names.
b) Lessons Learned from the experiments.
c) A new experiment and expected results which provide additional opportunity to practice the concepts in this lab.