Digital Design

Lab 1

A. Objectives

In this lab an Introduction about the training kit (IDL-800) is given so that the student becomes familiar with its components and how to use it to build simple logic circuits and test it. The objectives of this lab includes:

- Learn how to use the training kit IDL-800.
- Introduce the TTL family of integrated circuits (74xx)
- Build simple logic circuits using the training kit and basic TTL chips.

B. Parts used

- IDL-800 training kit.
- 7408 (Quad 2 i/p AND)
- 7432 (Quad 2 i/p OR)
- 7400 (Quad 2 i/p NAND)
- Wires

C. Introduction

1. Digital Trainer kit

IDL-800 contains a lot of components that the student will know through different labs. In this lab the student will deal with basic components in the kit like:

- **Solderless breadboard:** it's the component where all the chips and ICs are connected to each other, through it the interface between the design elements and the IDL-800 kit happens. It consists of an array of holes in which wires or component leads can easily be inserted. Columns of six holes are electronically connected to form a single node, also the top horizontal holes forms one node as shown in Figure 1**.**

Dr. Maged Ghoneima
Eng. Islam Azzam

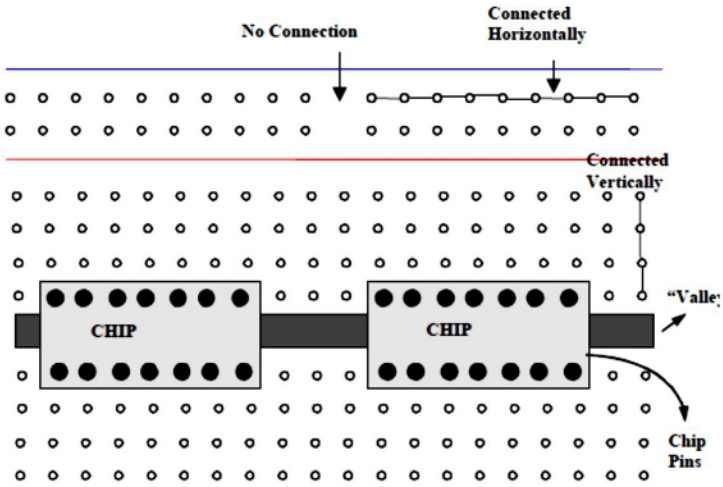
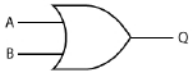
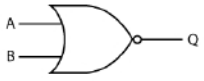
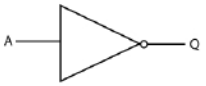


Figure 1

- **DC fixed power supply:** IDL-800 contains a power supply that can generate either variable or fixed DC voltage. It generates positive output voltage +5V and maximum output current of 1Amp.
- **LEDs:** IDL-800 has 8 LEDs for general purpose output. The LEDs are active high(Lit up when connected to +5V)
- **Data switches:** IDL-800 comes with 8 data switches (bottom right) that can be used as an input to the circuits.
- **Digital voltmeter:** The kit has a voltmeter with 4 ranges (0-199.9V,0-19.99V,0-1.999V,0-199.9mV)

2. Review on logic gates

Logic gate	AND	OR	NAND	NOR	NOT
Symbol					
Logic equation	Q=A.B	Q=A+B	Q=(A.B)'	Q=(A+B)'	Q=A'
Truth table					

A	B	Q
0	0	0
	1	0
1	0	0
1	1	1

A	B	Q
0	0	0
0	1	1
1	0	1
1	1	1

A	B	Q
0	0	1
0	1	1
1	0	1
1	1	0

A	B	Q
0	0	1
0	1	0
1	0	0
1	1	0

A	Q
0	1
1	0

Dr. Maged Ghoneima
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3. Intro to TTL chips

In this lab some basic chips from TTL (Transistor-Transistor Logic) chips 74XX series is used to build logic circuits.

The pin numbers assigned to each logic signal are shown inside brackets in the figure. The pins are numbered as shown in Figure 2. Pin 1 is usually identified as the pin to the left of an indentation or cutout in one end of the chip that is visible when the chip is viewed from the top. Occasionally, it is also identified by a printed or indented dot placed just next to it.

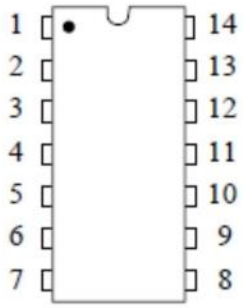
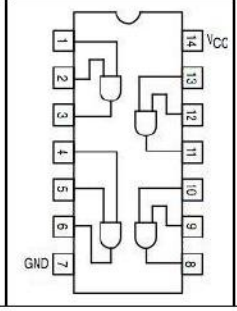
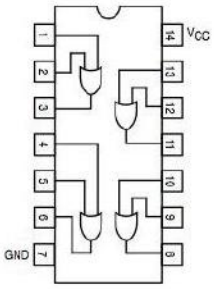
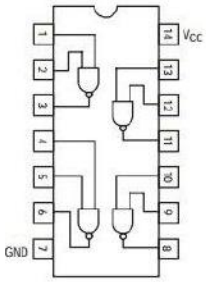
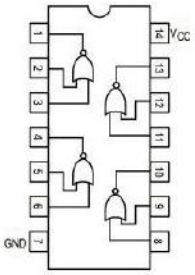
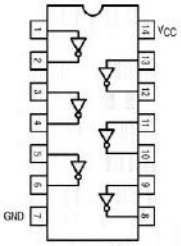


Figure 2

Pin 7 is usually connected to ground (Gnd), and pin 14 is usually connected to the 5V power supply (Vcc). These connections must be made to power up the chip.

In this Lab the following chips are used:

ICs	7408	7432	7400	7402	7404
Description	IC contains 4 independent 2-input AND gates	IC contains 4 independent 2-input OR gates	IC contains 4 independent 2-input NAND gates	IC contains 4 independent 2-input NOR gates	IC contains 8 single input NOT gates
Schematics					

4. Wiring Guidelines

- Turn off the Digital trainer kit before wiring your circuit.
- Keep the wires flat on the bread board.
- After wiring the circuit, use voltmeter to make sure the wiring is correct with no short circuit.
- If the chip got hot Turn off the power supply immediately, there's short circuit then!

D. Experiments

1. Implement AND circuit
   a) Connect the inputs A and B of AND gate to switches
   b) Connect the output F of AND gate to LED
   c) Turn on the Power supply after making sure that no short circuit in your connection
   d) Record the output of the given inputs in Table 1.

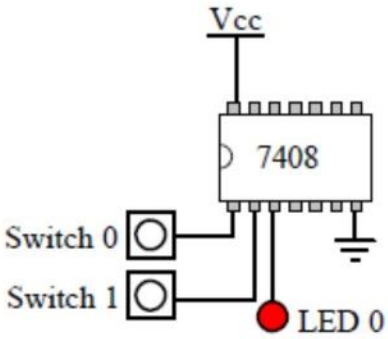


Figure 3

Inputs		Output
A	B	F = A ·B
0	0	
0	1	
1	0	
1	1	

Table 1

2. Implement F = (A.B) + C circuit and record the results in Table 2.

Inputs			Output
A	B	C	F = AB + C
0	0	0	
0	0	1	
0	1	0	
0	1	1	
1	0	0	
1	0	1	
1	1	0	
1	1	1	

Table 2

3. Using the available chips to build the circuit shown in Fig. 4
   a. Connect the inputs to switches and the output to LED
   b. Write a Boolean expression for the output as a function of the inputs.
   c. Record the output for the input combinations in Table 3

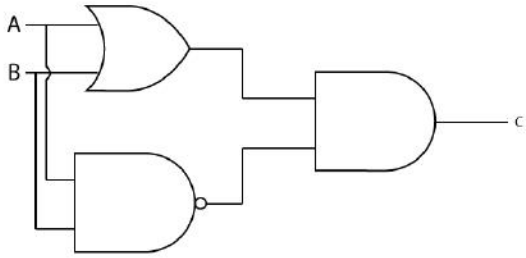


Figure 4

Inputs		Output
A	B	C
0	0	
0	1	
1	0	
1	1	

Table 3

Dr. Maged Ghoneima
Eng. Islam Azzam