

Digital Logic

Objective

Verify proper operation of various logic gates.

Equipment List

- Computer running Windows (NI ELVIS installed)
- National Instruments DAQ board (inside computer).
- Logic IC Chips (1 each of the following):
 - 7408 Quad 2-input AND gate
 - 7432 Quad 2-input OR gate
- Wires for connecting the previous equipment together.

Discussion

Digital logic devices are the circuits that electronically perform logic operations on binary variables. The binary information is represented by high and low voltage levels, which the device processes electronically. The devices that perform the simplest of the logic operations (such as AND, OR, NAND, etc.) are called gates. For example, an AND gate electronically computes the AND of the voltage encoded binary signals appearing at its inputs and presents the voltage encoded result at its output.

The digital logic circuits used in this laboratory are contained in integrated circuit (IC) packages. Each IC is labeled (usually with an SN74xx or SN54xx number) to identify the logic it performs. The transistor-transistor logic(TTL) IC's used in this laboratory require a 5.0 volt power supply for operation. TTL inputs require a voltage greater than 2 volts to represent a binary 1 and a voltage less than 0.8 volts to represent a binary 0.

Integrated Circuits

The small integrated circuits used in this lab implement basic logic gates. Some of the pins are inputs to the gates, others are outputs, and two of them are the connectors for power (+5V) and GROUND (0V). See figure 1.

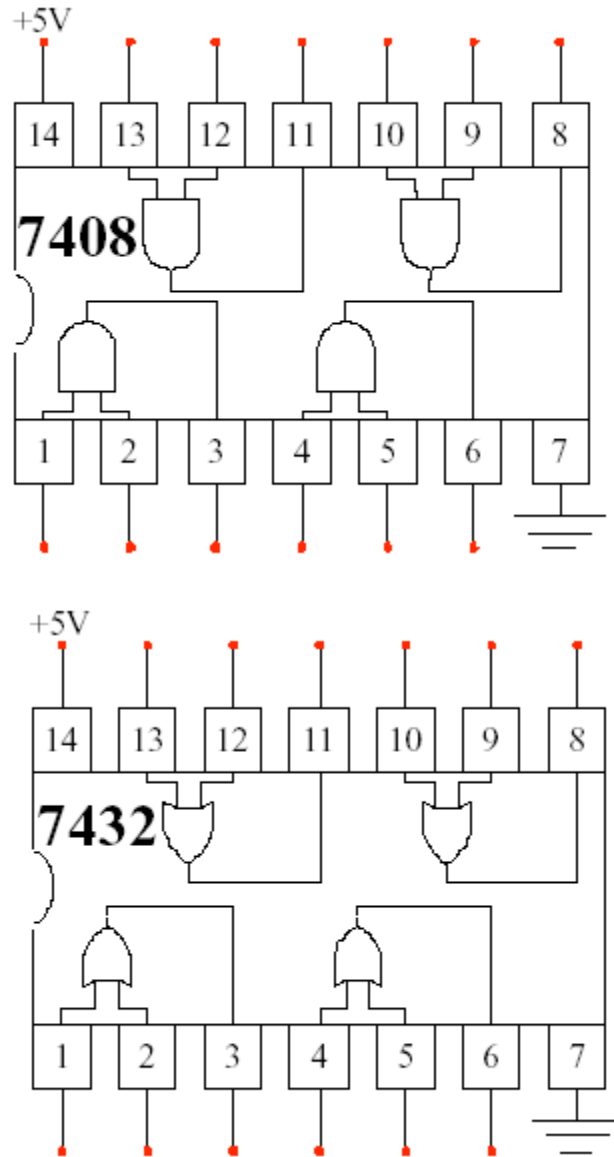


Figure 1. 7408 and 7432 Integrated Circuit Diagram

Note: In the 7408 AND gate chip and 7432 OR gate chip shown above, pin 14 is where you will apply +5V, and pin 7 will be connected to GROUND.

Procedure

1. Detect the characteristics of AND gate.
 - Connect the circuit as shown in figure 2 on the NI ELVIS Prototyping board. Pin 1 of chip 7408 is connected to DI 0 and pin 2 is connected to DI 1, output of the AND gate is connected to LED 0. Apply +5V to pin 14 and GROUND to pin 7.

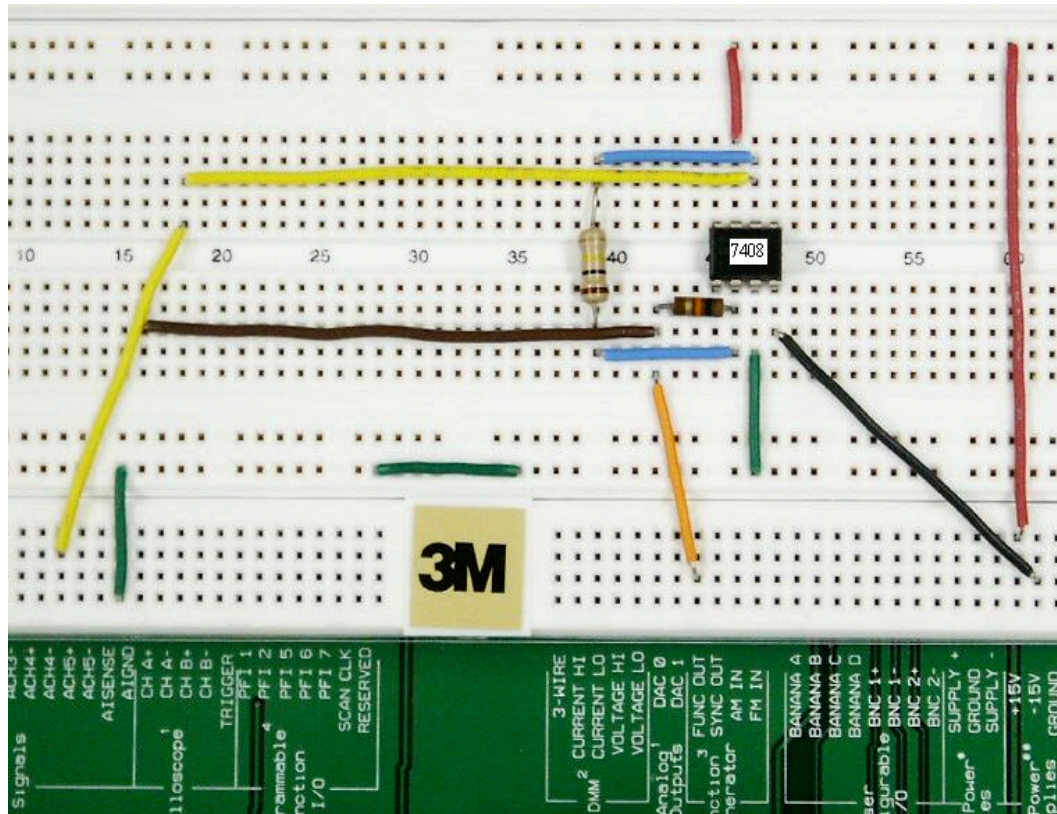


Figure 2. Component Layout for AND gate

- Turn on the NI ELVIS Benchtop Workstation, select **Start»Programs»National Instruments»NI ELVIS 1.0»NI ELVIS**, or select **NI ELVIS on the desktop**.
- Click the **Digital Writer** on the **NI ELVIS** software, as figure 3 shown. Set DO 0 and DO1 as shown in table 1, observe the output of the LED 0. If LED 0 light is on, that means logic 1, and if it is off that means logic 0. Whenever set a digital value of DO 0 and DO 1, click **Write** to write the logic value to DI 0 and DI 1 of the prototyping board.
- Observe the Output (LED 0) on the Prototyping Board; write the output to Table 1.

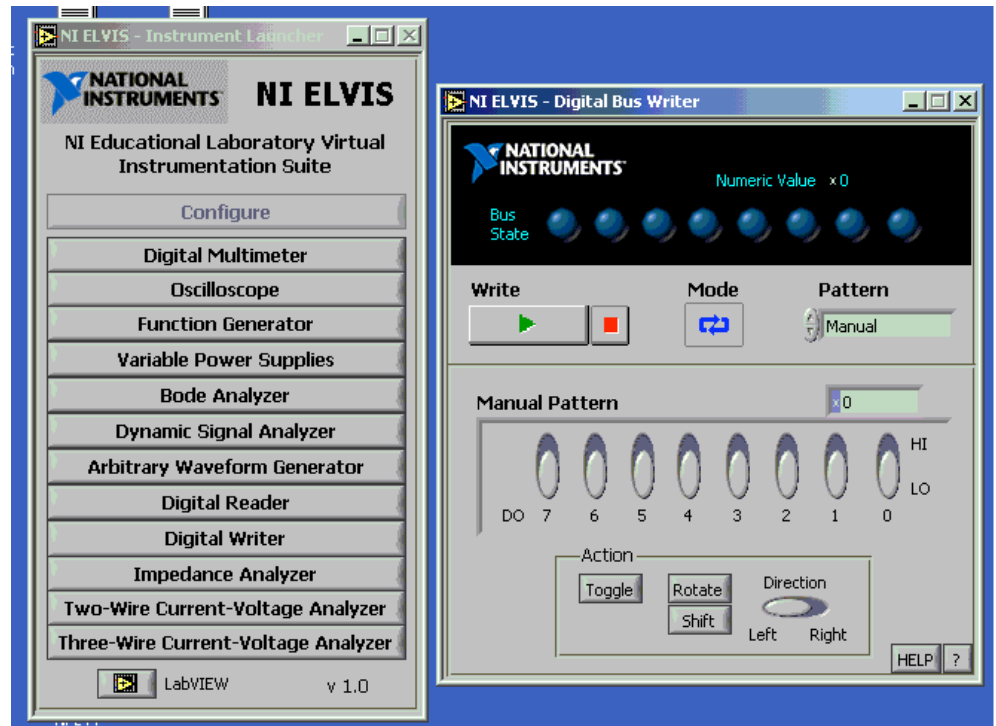


Figure 3. Digital Writer

Table 1. AND gate Character

DO 0	DO 1	Output (LED 0)
0	0	
0	1	
1	0	
1	1	

- Turn off the Prototyping Board Power.
2. Build a simple logic circuit using both AND and OR gate.
 $F = AB + C$
- Connect the circuit as shown in figure 4 on the NI ELVIS Prototyping board. Pin 1 of chip 7432 is connected to pin 3 of chip 7408, and pin 2 is connected to DI 2, output of the OR gate pin 3 of chip 7432 is connected to LED 0. Apply +5V to pin 14 and GROUND to pin 7.

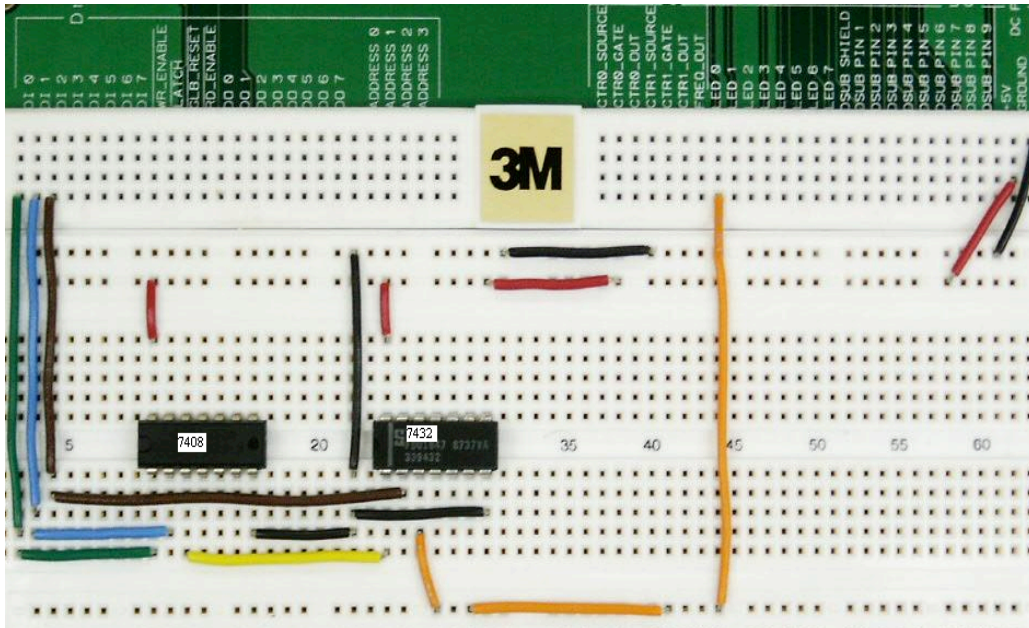


Figure 4. Component Layout for AND and OR gate circuit

- Turn on the Prototyping Board Power. Set the DO 0, DO1 and DO2 of **Digital Writer** as shown in table 2. Observe the output of LED 0.
- Observe the Output (LED 0) on the Prototyping Board; write the output to Table 2.

Table 2. $F=AB+C$ logic

DO 0	DO1	DO2	Output (LED 0)
0	0	0	
0	0	1	
0	1	0	
0	1	1	
1	0	0	
1	0	1	
1	1	0	
1	1	1	

