Computer Interfaced Logic IC Tester and R-C Meter

By Md. Mannaf Hossain
Southern University, Bangladesh

Abstract - Resistor, capacitor and IC logic gate are widely used in the electronic circuit, different values and types are needed to design and in practical operation. To get the proper output of the circuit the component must have accurate value, Nowadays Computer is very much available, Peoples especially students take it their everyday life partner. For this reason we want to make the computer as a versatile system. The circuit described in this paper “Computer interfaced IC logic gate tester and R-C meter” is a device that can test and measure the value of the IC and R-C by connecting directly to the computer through the parallel port and using a software that control the device is a easy process for testing the logic IC, resistor and the capacitor. It may used instead of multimeter.

Keywords : logic gate, logic gate IC, resistor, capacitor, parallel port.

GJRE-F Classification : FOR Code: 861699

Strictly as per the compliance and regulations of:

© 2013. Md. Mannaf Hossain. This is a research/review paper, distributed under the terms of the Creative Commons Attribution-Noncommercial 3.0 Unported License http://creativecommons.org/licenses/by-nc/3.0/, permitting all non commercial use, distribution, and reproduction in any medium, provided the original work is properly cited.
Computer Interfaced Logic IC Tester and R-C Meter

Md. Mannaf Hossain

Abstract: Resistor, capacitor and IC logic gate are widely used in the electronic circuit, different values and types are needed to design and in practical operation. To get the proper output of the circuit the component must have accurate value. Nowadays Computer is very much available, Peoples especially students take it their everyday life partner. For this reason we want to make the computer as a versatile system. The circuit described in this paper “Computer interfaced IC logic gate tester and R-C meter” is a device that can test and measure the value of the IC and R-C by connecting directly to the computer through the parallel port and using a software that control the device is a easy process for testing the logic IC, resistor and the capacitor. It may used instead of multimeter.

Keywords: logic gate, logic gate IC, resistor, capacitor, parallel port.

I. Introduction

To make the electronics based circuit it is very essential that the electronic components which are used that circuit must be measured accurately. Good operation of any electronic circuit totally depends on the good component. To ensure good and accurate measurement we are made possible to test and measure the logic gate IC, Resister and Capacitor by the use of Computer. By using this project we can use our PC as a versatile manner.

II. Principle of this Device

To test the logic gate we are directly put the input value sequentially to each gate of the IC and get the output value by the parallel port, compare the output value with the different gate table data and determined which gate it is by using the program. Now we describe the logic gate:

a) The OR Gate

The electronic symbol for a two-input OR gate is shown in fig 1. The two inputs have been marked as A and B and the output as C. It is worth reminding the reader that as per Boolean algebra, the three variables A, B and C can have only one of the two variables i.e. either 0 or 1. The OR gate has an output of 1 when either A or B or both are 1. In other words, it is an any-or-all gate because an output occurs when any or all the inputs are present.

b) The Exclusive OR Gate

Its electronic symbol and truth table is shown in fig 2. In this gate, output is 1 if its either input but not both, is 1. In other words, it has an output 1 when its inputs are different. The output is 0 only when inputs are the same. To put it a bit differently, this logic gate has output 0 when inputs are the same.

c) The AND Gate

The electronic symbol for a 2-input AND gate is shown in fig 3. It is worth reminding the readers once again that the three variables A, B, C can have a value of either 0 or 1. The AND gate gives an output only when all its inputs are present. The AND gate has a 1 output when both A and B are 1. Hence, this gate is an all-or-
nothing gate whose output occurs only when all its inputs are present. In True/False terminology, the output of an AND gate will be true only if all its inputs are true. Its output would be false if any of its inputs is false.

\[ A \land B = C \]

\[
\begin{array}{ccc}
A & B & C \\
0 & 0 & 0 \\
0 & 1 & 0 \\
1 & 0 & 0 \\
1 & 1 & 1 \\
\end{array}
\]

**Figure 3 (a) : Symbol and (b) truth table for and gate**

\[ A \rightarrow \neg A \]

<table>
<thead>
<tr>
<th>A</th>
<th>\neg A</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>1</td>
<td>0</td>
</tr>
</tbody>
</table>

**Figure 4 (a) : Symbol and (b) truth table for NOT gate**

The NOT gate is so called because its output is NOT the same as its input. It is also called an inverter because it inverts the input signal. It has one input and one output as shown in fig 4 (a). All it does is to invert the input as seen from its truth table of fig 4 (b).

**d) The NOT Gate**

The NOT gate is so called because its output is NOT the same as its input. It is also called an inverter because it inverts the input signal. It has one input and one output as shown in fig 4 (a). All it does is to invert the input as seen from its truth table of fig 4 (b).

**f) Astable Multivibrator**

The astable multivibrator is also called free-running relaxation oscillator. It has no stable state but only two quasi-stable states between which it keeps oscillating continuously of its own accord without any external excitation.

In this circuit, neither of the two transistors reaches a stable state. When one is ON, the other is OFF and they continuously switch back and forth at a rate depending on the RC time constant in the circuit. Hence, it oscillates and produces pulses of certain mark-to-space ratio. Moreover, two outputs are available.

**g) Pulse of astable multivibrator**

The output of astable multivibrator (fig. 6) is varying with the value of the resistor and capacitor, by calculating the variation we can easily get the value of the resistor and the

\[ t_1 \rightarrow t_2 \]

**Figure 6 : Output pulse astable multivibrator**

In our project we are calculating the time width of t2 shown in fig 6 by the parallel port by using appropriate program.

### III. Description of The Project

To describe our project easily we are dividing the project into two sections. These are:

- Hardware section.
- Software section

**a) Hardware Section**

In hardware section NE 555 with appropriate arrangement are used as astable multivibrator. The functional diagram of the 555 IC timer is shown in fig. (7).

**Figure 5 : Multivibrator**

There are three basic types of multivibrators distinguished by the type of coupling network employed:

- Astable multivibrator.
- Monostable multivibrator.
- Bistable multivibrator.

**Figure 7 : Functional diagram off the 555 timer IC**
The strings of three resistors bridged between the supply voltage Vcc and ground provides reference voltages for the two comparators. The reference voltage for comparator 1 is Vcc /3 and for comparator 2 is 2Vcc /3. These reference voltages have control over the timings. In applications where timings are to be varied by an external signal, the control voltage input terminal is used. In other applications this input capacitively bypassed to ground.

On the negative going transition of the trigger input and when the trigger voltage passes through Vcc /3, the outputs of Comp.2 sets the flip-flop. On a positive going transition of threshold voltage 2Vcc /3, the output of Comp.1 reset the flip-flop. The reset input of the 555 provides a mechanism to reset the flip-flop in a manner which over-rides the effect of any set input from Comp.2. This overriding effect is obtained when the reset input is less than about 0.4 v. When not used, it should be return to Vcc. The transistor T2 serves as a buffer to isolate the reset input from the flip-flop and the transistor T1. The output buffer stage is able to source currents as high as 200mA and provides logic levels compatible with TTL logic.

An external timing capacitor may be connected between the discharge terminal and ground. When the flip-flop is in reset state, the output is in logic 1 state. The transistor T1 is in saturation and the charging cycle starts when the flip-flop goes to set state and is T1 is off. The external capacitor is then free to charge through the external resistor. The connection of 555 as an astable multivibrator is shown in fig (8).

According to the astable multivibrator frequency oscillation principle if the capacitor C (2200µF) is keeping fixed and if we collect the value of T2 by the computer through the parallel port then the unknown R2 can be measured by the following relation.

\[ R_2 = \frac{T_2}{0.7 \times C} \]

Where T2 and C are known.

We are using the following (fig 9) astable multivibrator circuit.

![Figure 8: Astable multivibrator](image)

![Figure 9: Measuring the Resistor](image)

The capacitor C charges through R1 and R2 till its voltage reaches 2Vcc /3 when the capacitor is discharged through Rb. The discharging continues till the voltage across C just falls below Vcc /3. The cycle is repeated. The charge and discharge times are:

\[ T_1 = 0.7 \times (R_1 + R_2) \times C \]
\[ T_2 = 0.7 \times R_2 \times C \]

respectively.

The frequency of oscillation is given by:

\[ f = \frac{1}{0.7 \times (R_1 + 2R_2) \times C} \]

For logic gate IC test description we are considering the 7432 that is a two input four OR gate IC the internal structure of 7432 is shown in fig 11.

![Figure 10: Measuring the Capacitor](image)
We have seen from the fig 11 that each gate has two input and one output so we are giving the sequential value to the input by the parallel port (Data pin) and get the output from the output pin and check the output value by the parallel port (Stack pin), if the value are appropriate for the OR gate truth table then show the gates are perform well. The truth table for 7432 OR gates IC are shown in fig 12.

<table>
<thead>
<tr>
<th>Gate no</th>
<th>Input</th>
<th>Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gate 1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Gate 2</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Gate 3</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Gate 4</td>
<td>0</td>
<td>1</td>
</tr>
</tbody>
</table>

![Figure 11: Internal structure of 7432 IC](image1)

![Figure 12: Table for 7432 IC](image2)

IV. MAIN CIRCUIT OPERATION

In the section of socket 1 the two input logic gate IC are tested. For this purpose D0, D1 for gate1 D2, D3 for gate2 D4, D5 for gate3 and D6, D7 pins for gate4 of parallel port are used for giving input value sequentially. Our testing criteria is to check first gate then other get for this purpose when a get is tested then the input of the other gates are given such a value that the outputs are high. The outputs of the gates are connected to S4, S5, S6, and S7 (stack pin) of the parallel port, these pins read the condition of the output pin of the IC and use these data the program test the IC.

In the section of socket 2 the four input logic gate IC are tested. For this purpose D0, D1, D2, D3 pin for gate1 and D4, D5, D6, D7 pin for gate2 of parallel port are used for giving input value sequentially. Our testing criteria is to check first gate then other get for this purpose when a get is tested then the input of the other gates are given such a value that the outputs are high. The outputs of the gates are connected to S4 and
S5 (stack pin) of the parallel port, these pins read the condition of the output pin of the IC and using these data the program test the IC.

In the section of resistor measuring, the 555 arranging astable multivibrator the capacitor C (2200µF) value is fixed but the resistor R2 is testing as shown in fig 13, the output (pin 3) is connected to the stack pin S4 of the parallel port and measured the time duration between the low to high state. Therefore calculating the value using the equation:

\[ R2 = \frac{T2}{0.7 \times 2200} \]

In the section of capacitor measuring, the 555 arranging astable multivibrator the resistor R2 (20MΩ) value is fixed but the capacitor C is testing as shown in fig 13, the output (pin 3) is connected to the stack pin S5 of the parallel port and measured the time duration between the low to high state. Therefore calculating the value using the equation:

\[ C = \frac{T2}{0.7 \times 20} \]

\[ \text{Figure 14 : PC parallel port} \]

\[ \text{Figure 15 : Pin Configuration of the parallel port} \]

The parallel port had the capability to transfer 8 bits of data at a time. As technology progressed and the need for greater external connectivity increased, the parallel port became the means by which one could connect higher performance peripherals. These peripherals now range from printer sharing devices, portable disk drives and tape backup to local area network adapters and CD ROM players. The pin configurations of the parallel port are shown below.
Table 1.1: Pin Assignments of the D-Type 25 pin Parallel Port Connector Parallel Port pins Addresses

<table>
<thead>
<tr>
<th>Pin lines</th>
<th>Address</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data lines</td>
<td>0x378</td>
</tr>
<tr>
<td>Control lines</td>
<td>0x37a</td>
</tr>
<tr>
<td>Status lines</td>
<td>0x379</td>
</tr>
</tbody>
</table>

The port is composed of 4 control lines, 5 status lines and 8 data lines. Each type of lines has its separate pin address and these address codes are used to control the pin. These are listed in table 2, below.

### IV. Algorithm of the Program

1. Start.
2. Check the parallel port condition.
3. If parallel port pin condition are ok then go to step 4 else terminate the program.
4. Want the option of operation, for IC test go to step 5, for measuring the resister go to step 8, for measuring the Capacitor go to step 10, for terminating the program go to step 12.
5. Want the IC number.
6. Then give the proper input through the parallel port (Data pin D0-D7).
7. Then read the output through the parallel port (stack pin S3, S4, S5, S6) and check the data and display. Return to step 4.
8. Wait for press the Enter.
9. Then read the output for resistor through the parallel port (stack pin S4) and calculate the data and display then return to step 4.
10. Wait for press the Enter.
11. Then read the output for capacitor through the parallel port (stack pin S5) and calculate the data and display then return to step 4.
12. Terminate the program.
Flow chart:

Start

Check the Parallel port condition

Yes

Get the option

No

If IC

Yes

Get the IC number

No

If match

Yes

Check the IC and display

No

Display the warning.

If Resistor

Yes

Read the pin S4 then calculate and Display.

No

If Capacitor

Yes

Read the pin S5 then calculate and Display.

No

If not match

Yes

If out

No

END

No
V. HOW OPERATE THE HARDWARE AND PROGRAM

The main hardware is operated by +5 volt dc so at first the hardware is connected to the dc supply then connected with the computer through the parallel and run the software. The handle the program is shown step by step in fig 16, 17, 18, 19.

Figure 16: Checking the parallel ports condition

Figure 17: Want the required command for operation

Figure 18: IC operation works
VI. Conclusion

At last we see that the process is able to test and measure the logic gate IC and the testing resistor and capacitor. Furthermore, develop this process and principle we can also measure the other electronic components and different IC’s.

REFERENCES