

Mini Project : Photocopying (Xerox) Machine

1. Background

This mini project will implement 3 different components as a basis of a Xerox Machine Circuit Design:

1. Count Up Counter (4 or 5-bit)
2. Comparator (4 or 5-bit)
3. Clock Disabler

2. Problem:

User will initially enter amount of copies, the counter will count the number of copies that has been photocopied. The machine will stop once the required number of copies produced.

3. Proposed Solution:

A block diagram of a component required is shown in Figure1. Three core components are counter, comparator and clock disabler. Counter will determine the number of copies that has been made while the comparator will determine whether the required number of copies has been met. Once the number of copies has been met, the clock disabler will disable the clock and stop the counter from counting. The machine will display the required number of copies and the amount that has been produced.

To implement this, the user has to key in the required number of copies by using 3 switches, which allow the required number from 0 to 7 (don't ask me why so few, if you can produce a zillion copies by using the kit in the lab then I will give you an A+ for this subject). He/she will reset the counter (assuming pressing a START button), the counter will count and it's output will be compared with the value of the switches, if the value is not the same it will continue counting up. A signal will be generated to stop the counting if the output of the counter has the same value as the digital value of the switches.

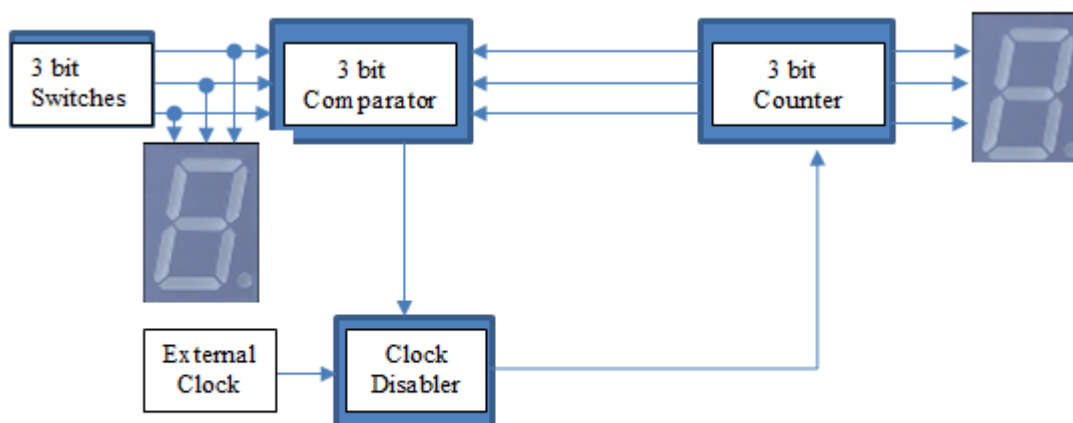


Figure1. A block diagram of a complete system

4. Components & Requirement:

- ✓ **Switches:** to set the required no of copies
- ✓ **Counter:** to count the number of copies that has been made
- ✓ **Comparator:** to compare the number of copies required with the number of copies produced

Comparator

A comparator is a combinational circuit that can be designed using *XNOR* gate. Figure 2 shows a 2 bit equality Comparator, you need to modify this circuit to suit the requirement of your design.

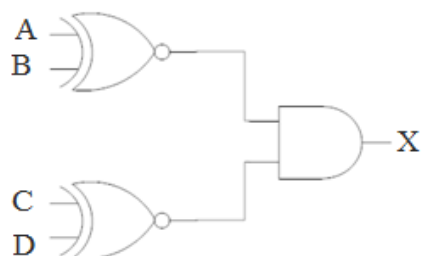


Figure 2. 2bits Equality Comparator

Design simple comparator equality counter using XNOR:

Eg 2 bit counter

A = Desired printed value

B = output of printer (current printing value)

$X = A \text{ XNOR } B$

- $X = 1$ if output of the printer (current printing value) is equal to the desired printing amount. Otherwise, $X=0$.

✓ **Clock Disabler:** to stop the operation of the counter

*If Copies produced < Required Copies, Counter will count up
Else*

Counter will stop counting

Clock Disabler is a circuit to disable the clock so that the counter will stop counting. Design your own Clock Disabler.

5. Operational of Xerox Machine

The possible standard operation of the printing process will depend on the advanced feature of the machine. Starting with basic machine with basic printing or advance feature such as embedded with biometric security, networking function with social media interaction, and many other sophisticated features:

Typical operation as follows:

1. Input desired printing value.
2. Input password to operate
3. Select ink, either black/white or Color.
4. Select suitable paper size A4/A3/etc.
5. Select mode, either Local or Network Printer
6. Clock Enable & Start printing

6. Project Execution:

1. This project is a group project. Each group will consist of two (2) students ONLY.
2. Appoint the leader of the group and the design task of the project must be shown clearly.
3. Each of the component design must be discussed in details in the report.
4. Each group should present their project using deeds simulator via Webex/Online Meeting Tools (which will be scheduled later)
5. Each group will prepare project report in details and must be submitted before the due date. Will be advised later.
6. To simplify the design, this project will be divided into two (2) parts, which are part A and Part B.

Part A: To simulate number 1 & 6 only (refer to typical operation of Xerox Machine)

1. Choose 4, or 5 bit counter.
2. Design count up Asynchronous counter - this is to simulate process of printing count up.
3. Clock Enable and Start Printing

This is to simulate the printing process is running (count up) by comparing the current printing value is NOT equal with the DESIRED printing value.

If NOT equal

Printing is running

ELSE

Printing is stopped

Part B: To simulate advanced and modern features number 2 to 5 only (refer to typical operation of Xerox Machine)

Apply any component in Chap 6 to the circuit for design advancement

- Pattern detector (Decoder) - to simulate password authentication
- Mux - to simulate resource usage for multiple input to single output
- Demux - to simulate single input to multiple output (Resource Selection)
- .. any other component

Hint: In order to add more features in your printer circuit.. you can add item 2 to 5 in your Clock Enabler circuit.

The marks will be given based on the original idea (especially in advanced features) and complexity of the circuit.

Due date:

15 July 2020