

UNIVERSITY OF GAZIANTEP

ELECTRICAL AND ELECTRONICS ENGINEERING DEPARTMENT

EEE 441 DIGITAL DESIGN II

LABORATORY EXPERIMENT 5

SEQUENTIAL CIRCUIT DESIGN II

1. OBJECT

In this experiment you will design, construct and test various ripple and synchronous counter circuits. Use J-K flip-flops (IC 7476) in your designs.

2. PRELIMINARY WORK

(P1) Draw the circuit diagram of a 4-bit (MOD-16) ripple counter. Derive the sequence of states for the circuit.

(P2) Draw the circuit diagram of synchronous 4-bit binary counter. Derive the sequence of states for the circuit.

(P3) Design a synchronous BCD counter that counts from 0000 to 1001. Determine whether it is self starting.

3. EXPERIMENTAL PROCEDURE

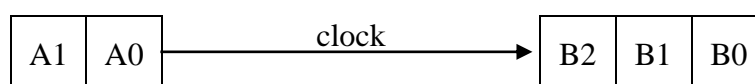
(E1) Wire up the circuit you derived in P1 and connect all asynchronous CLR and PRE inputs to logic-1. Connect the count pulse input to a pulse generator and check the counter for proper operation. Using the oscilloscope observe and plot the waveforms at the flip-flop outputs. Include at least one full counter cycle in your graph.

(E2) Construct the circuit you designed in P2 and verify its operation. Using the oscilloscope observe and plot the waveforms at the flip-flop outputs. Include at least one full counter cycle in your graph.

(E3) Construct the circuit you designed in P3 and check the circuit operation for the required count sequence. Test if it is self-starting. This can be done by initializing the circuit to each of the six unused states by means of the PRE and CLR inputs and then applying pulse to see if the counter reaches to one of the valid states.

4. QUESTIONS

(Q1) How many states does the combined counter circuit given below have?



2-bit ripple counter

3-bit synchronous binary counter

Combined counter

(Q2) An 8-MHz square wave clocks a 5-bit ripple counter. What is the frequency of the last PP? Draw the waveforms to the output of each flip-flop. What could be the frequency of the waveform at the last flip-flop if the counter were expanded to 8 bits?

(Q3) What are the advantages and disadvantages of the ripple counter with respect to the synchronous counter?

5 EQUIPMENT LIST

7408 quad 2-input AND gate

7476 dual JK master-slave flip-flops