Lab 7. Digital Display

Overview of this Session

In this laboratory, you will learn:

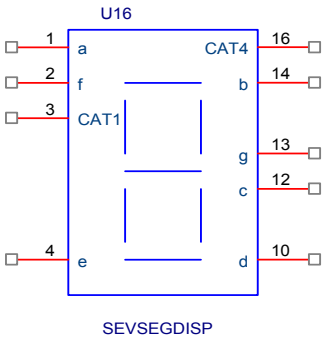
- To continue to use an oscilloscope
- How to use an LED driver chip.

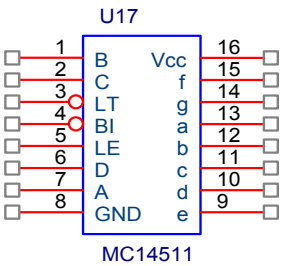
Introduction

In this lab you will hook up a counter circuit, a 555 timer circuit, and a digital display circuit to create a digital clock that counts from 0 to 59.

Background

In previous labs you have learned how to use a counter and a 555 timer. In this lab you will create a circuit that can display the numbers from 0-9. You will then create a circuit that counts from 0 to 5 or 0 to 9 (The TA will assign this). Then you will work with another group and create a 1 minute timer.





TRUTH TABLE

Inputs							Outputs							
LE	BI	LT	D	C	B	A	a	b	c	d	e	f	g	Display
X	X	0	X	X	X	X	1	1	1	1	1	1	1	8
X	0	1	X	X	X	X	0	0	0	0	0	0	0	Blank
0	1	1	0	0	0	0	1	1	1	1	1	1	0	0
0	1	1	0	0	0	1	0	1	1	0	0	0	0	1
0	1	1	0	0	1	1	1	1	1	1	0	0	1	2
0	1	1	0	0	1	1	1	1	1	1	0	0	1	3
0	1	1	0	1	0	0	0	1	1	0	0	1	1	4
0	1	1	0	1	0	1	1	0	1	1	0	1	1	5
0	1	1	0	1	1	0	0	0	1	1	1	1	1	6
0	1	1	0	1	1	1	1	1	1	0	0	0	0	7
0	1	1	1	0	0	0	1	1	1	1	1	1	1	8
0	1	1	1	0	0	1	1	1	1	0	0	1	1	9
0	1	1	1	0	1	0	0	0	0	0	0	0	0	Blank
0	1	1	1	0	1	1	0	0	0	0	0	0	0	Blank
0	1	1	1	1	0	0	0	0	0	0	0	0	0	Blank
0	1	1	1	1	0	1	0	0	0	0	0	0	0	Blank
0	1	1	1	1	1	0	0	0	0	0	0	0	0	Blank
0	1	1	1	1	1	1	0	0	0	0	0	0	0	Blank
1	1	1	X	X	X	X				*				*

X = Don't Care

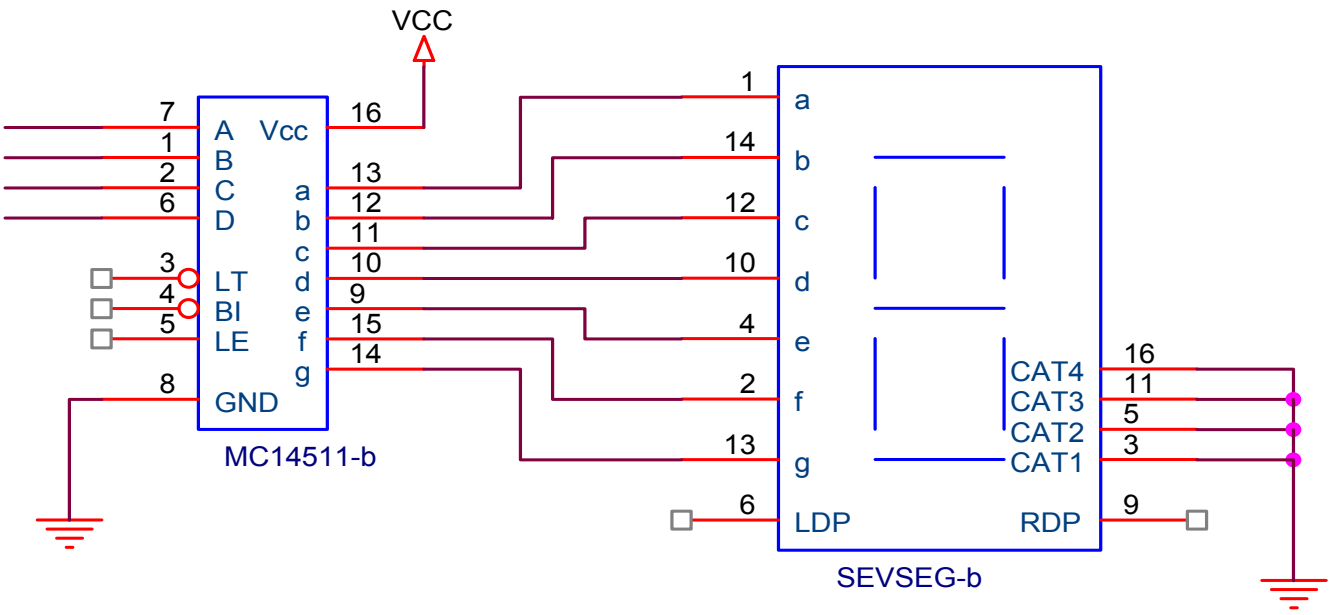
*Depends upon the BCD code previously applied when LE = 0

Oscilloscope Measurements

7.1 Connect the signal from the function generator to the oscilloscope and determine the type of signal present, the frequency, amplitude, and the DC offset.

PART 1: The Display Circuit

Build this circuit.



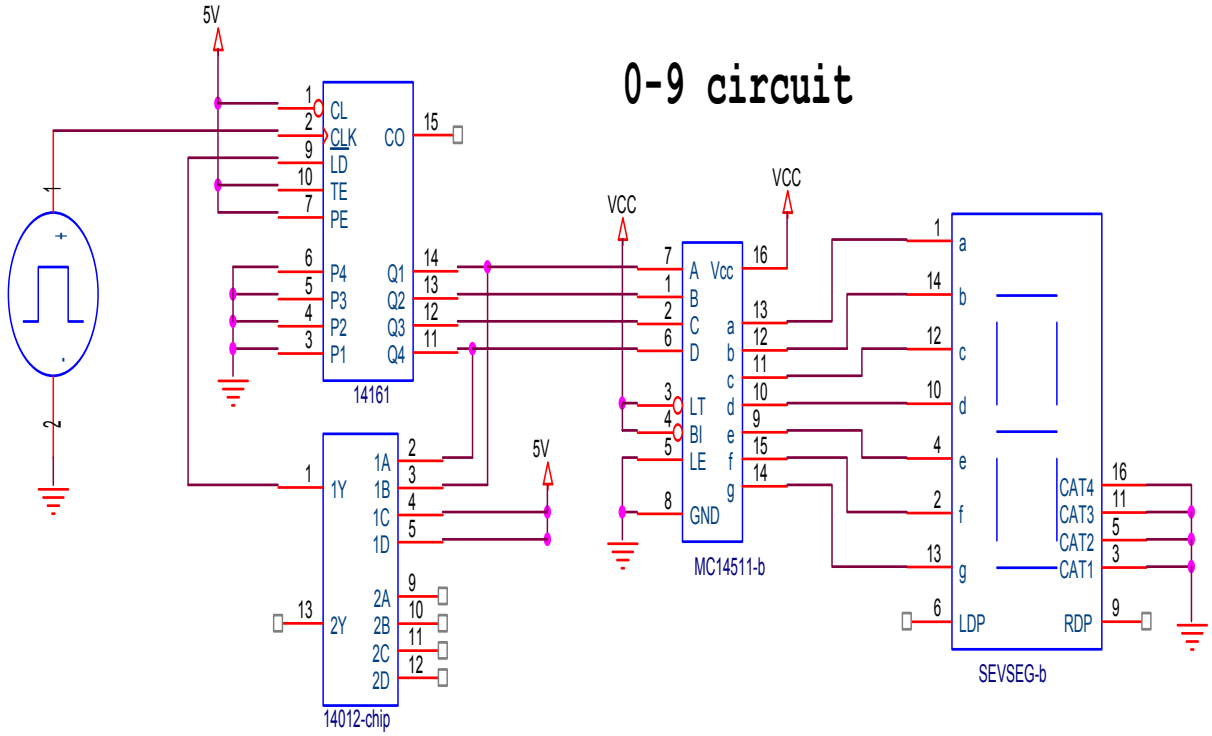
7.2 Experiment with the driver chip by fixing the A-D pins to either 5 volts or ground to input the binary number 7, with LE grounded and BI and LT at 5 volts. Record the result. Connect BI to ground. Record what the display does. Next connect BI to 5 volts and connect LT to ground. Record the result.

7.3 Change the A-D inputs to enter the binary number 8. Make sure the display shows the number 8.

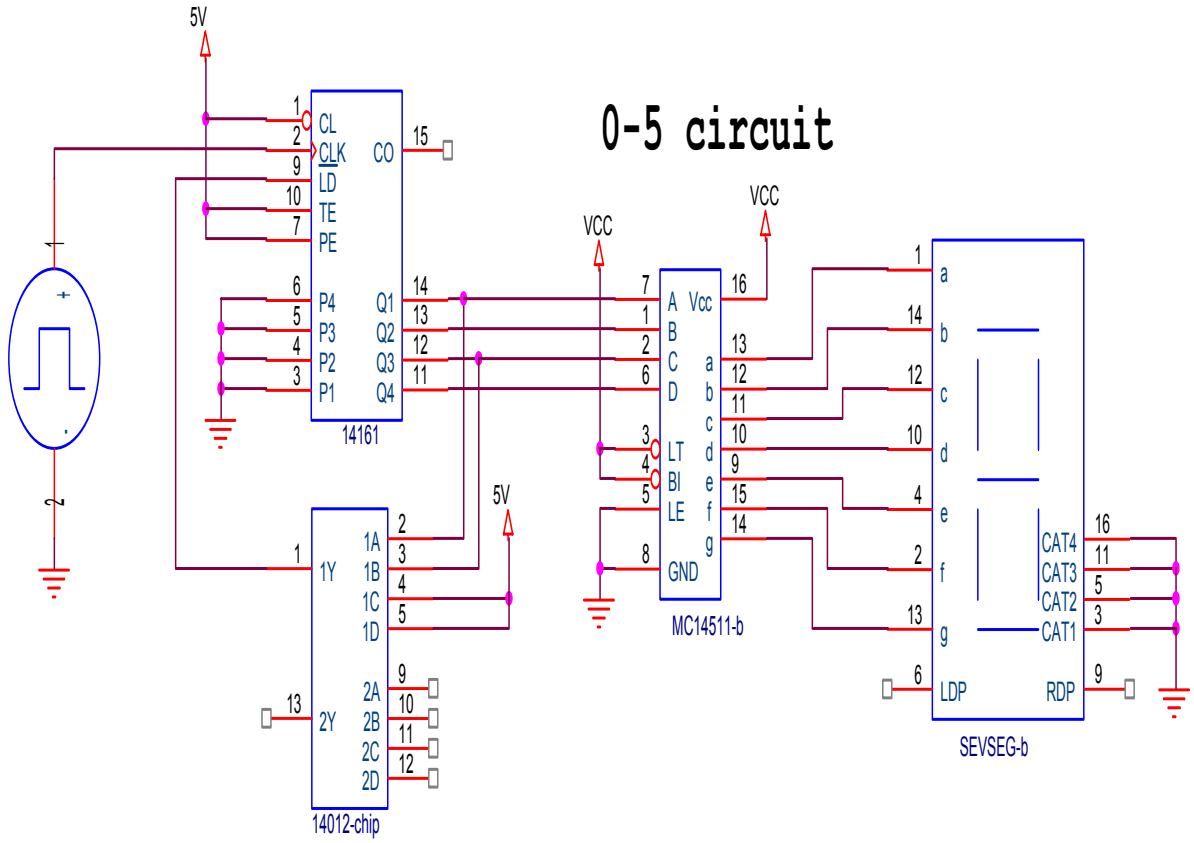
PART 2: Digital clock

Build one of these circuits:

This circuit displays 0-9.



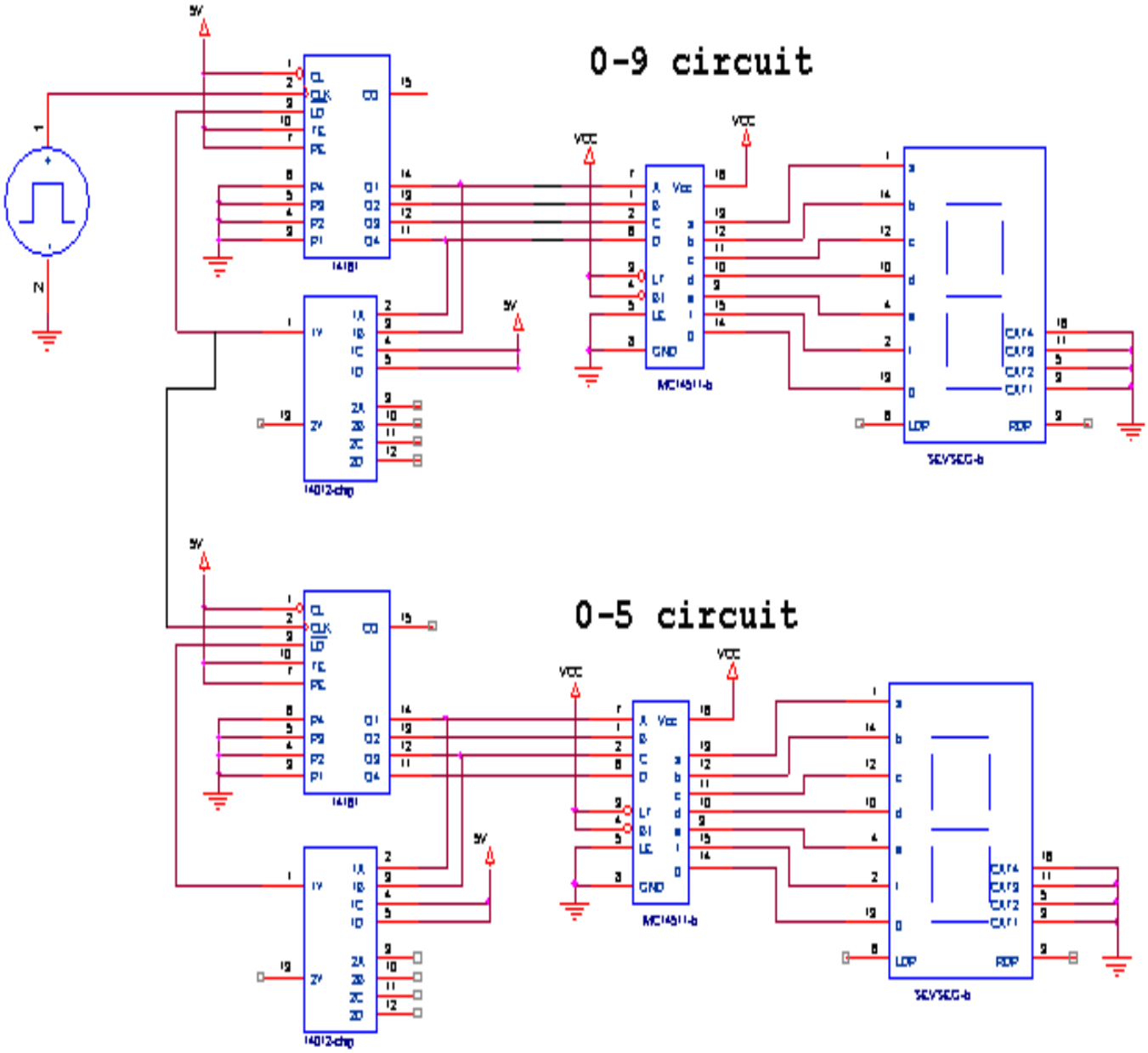
This circuit displays 0-5.



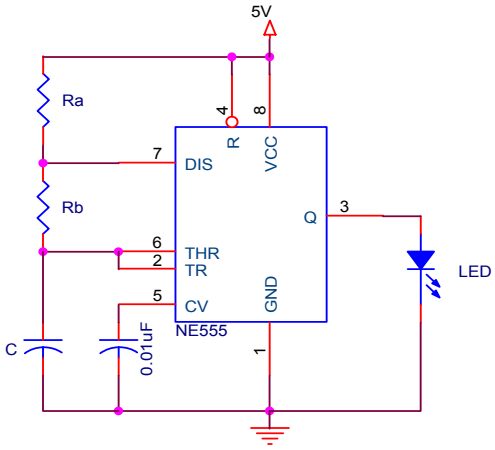
7.4 Set the function generator to create a 0-5 volt squarewave that has a frequency of 1 Hz.

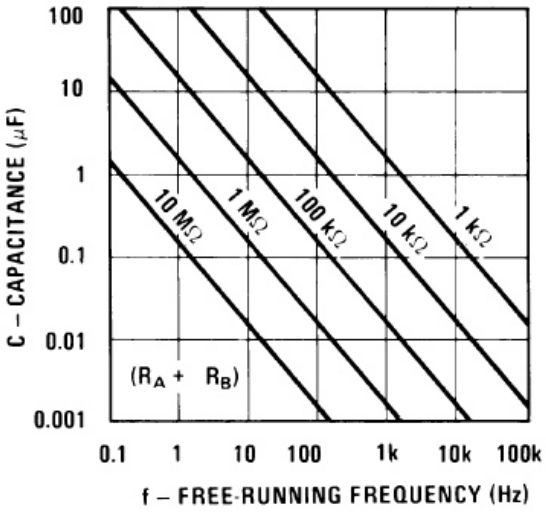
7.5 Make sure that your circuit is behaving properly.

7.6 Next, find a group that has built the alternative circuit from the one you built and hook them up in the following manner.


0-9 circuit
0-5 circuit
5V
VCC
14181
14012-chip
MC14511-b
SEV5EG-b
GND
LDP
RDP

7.7 Instead of using the Function generator, use a 555 timer to trigger your clock circuit.





MC14511B

BCD-To-Seven Segment Latch/Decoder/Driver

The MC14511B BCD–to–seven segment latch/decoder/driver is constructed with complementary MOS (CMOS) enhancement mode devices and NPN bipolar output drivers in a single monolithic structure. The circuit provides the functions of a 4–bit storage latch, an 8421 BCD–to–seven segment decoder, and an output drive capability. Lamp test ($\overline{LT}$), blanking ($\overline{BI}$), and latch enable (LE) inputs are used to test the display, to turn–off or pulse modulate the brightness of the display, and to store a BCD code, respectively. It can be used with seven–segment light–emitting diodes (LED), incandescent, fluorescent, gas discharge, or liquid crystal readouts either directly or indirectly.

Applications include instrument (e.g., counter, DVM, etc.) display driver, computer/calculator display driver, cockpit display driver, and various clock, watch, and timer uses.

- Low Logic Circuit Power Dissipation
- High–Current Sourcing Outputs (Up to 25 mA)
- Latch Storage of Code
- Blanking Input
- Lamp Test Provision
- Readout Blanking on all Illegal Input Combinations
- Lamp Intensity Modulation Capability
- Time Share (Multiplexing) Facility
- Supply Voltage Range = 3.0 V to 18 V
- Capable of Driving Two Low–power TTL Loads, One Low–power Schottky TTL Load or Two HTL Loads Over the Rated Temperature Range
- Chip Complexity: 216 FETs or 54 Equivalent Gates
- Triple Diode Protection on all Inputs

Lab 7 Digital Display Answer Sheet

Name:_____ Section Number:_____
TA init:_____ Date:_____

7.1 Draw the waveform shown on the oscilloscope. What is the name of this waveform? What is the amplitude, frequency, and DC offset? Show all your calculations.

7.2 What number showed up in the display? What are the effects of the BI and the LT pins?

7.3 How were the A-D pins hooked up to show the number 8?

7.6 Show a TA that you have gotten the 1 minute timer to work.

TA init:_____

7.7 What were the values of Ra, Rb and C that you used?