

# Lab #8

Ver 2.51

## D-Latch vs D-Flip Flop

### Background

The 7475 is a D-type Latch with the following TT

Inputs		Outputs	
D	C	Q	$\bar{Q}$
L	H	L	H
H	H	H	L
X	L	$Q_0$	$\bar{Q}_0$

While the 7474 is a D-type Flip-flop with the following TT

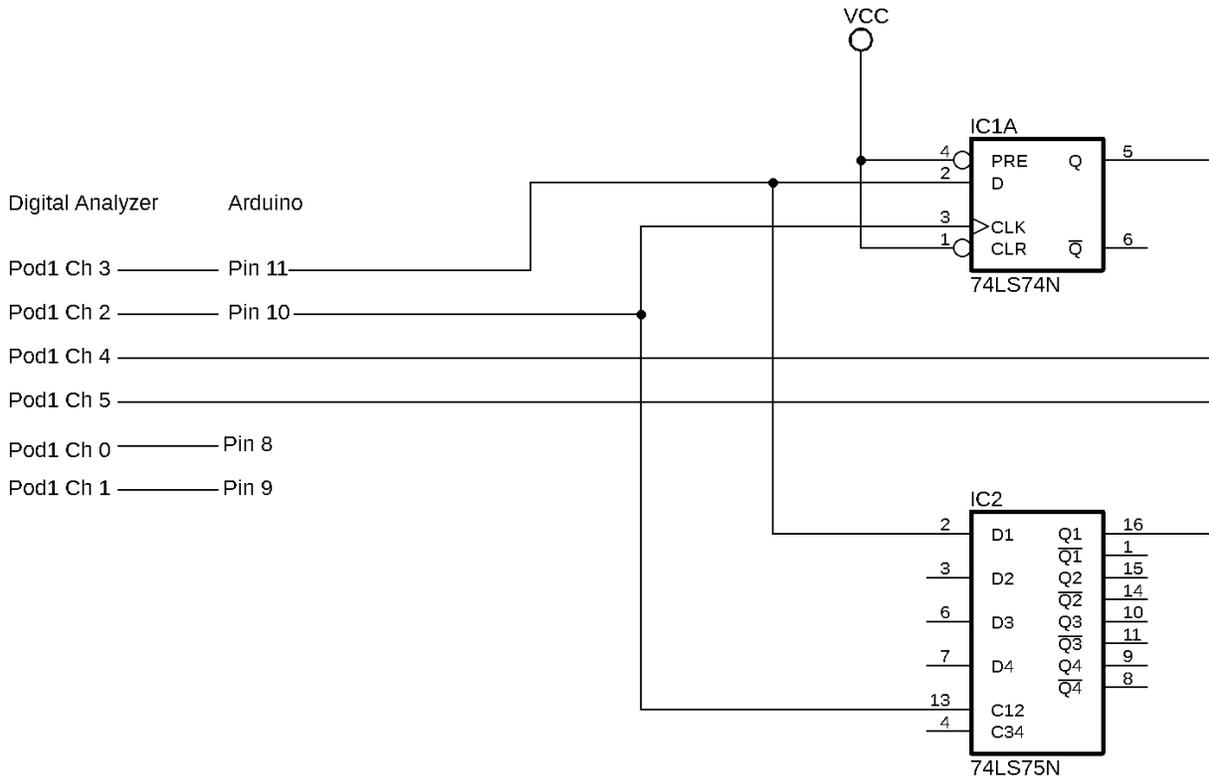
Inputs				Outputs	
PRE	$\overline{CLR}$	CLK	D	Q	$\bar{Q}$
L	H	X	X	H	L
H	L	X	X	L	H
L	L	X	X	H (Note 6)	H (Note 6)
H	H	$\uparrow$	H	H	L
H	H	$\uparrow$	L	L	H
H	H	L	X	$Q_0$	$\bar{Q}_0$

Other than the additional inputs of  $\overline{PRE}$  and  $\overline{CLR}$ , the only other difference is that the 7474 is a RISING EDGE trigger clock.

This lab will investigate the differences of a High and Rising Edge triggered device.

**Procedure:**

Build the following Circuit:



Make sure you have a common ground between your circuit, the arduino and the digital analyzer

[Please note – in the PDF of the full sized schematic, pins C12 and C34 on the 7475 are shown as an edge trigger (ie arrow). This is NOT correct. It has been corrected above. ]

Connect the pre-programmed Arduino as shown above (ensure you have a common ground from your circuit to the Arduino. The Arduino acts as a “Signal Generator” for this lab.

Now go to one of the digital analyzer stations. Find Pod 1 and Connect grd (black) to the COMMON GROUND (your circuit and the arduino’s ground). Connect the rest of Pod1’s channels as show above.

Power the arduino with the USB provide (and plug it into a nearby computer....NOT the Digital Analyzer!)

### For the Agilent 16801A Logic Analyzer

Power up the digital analyzer. When asked, the login is

Name: User 1 (with a space)

Password: la168xx (first character is a small L and the 3<sup>rd</sup> is a ONE)

Copy the file from the USB (Provided by the instructor) onto the desktop. Then click on the file. This will automatically set up the analyzer for this experiment. (if an error “eye finder data...” Occurs it can be ignored)

Find the box that says “Simple Trigger”, place a 1 in the text box directly below it. This will set up to capture starting at waveform 1. Press the “Single Run” Button to capture a timing diagram similar to Figure 1 (but with the missing signals from 7474 and 7475 ic’s shown)

### For the Hewlett Packard 54645D and 54620A

Power up the device. Once on, press the setup key. Under the screen there are six buttons...press the left most button. Use the Entry dial to select Setup Memory 10 and then press the button under the screen marked RECALL. This should set up the device for the experiment.

Now find the area that is marked “Trigger” on the panel of the device. Press “Pattern” button. At the bottom of the screen should be “Pattern =” with one of the items highlighted. Use the “Entry” dial to move that cursor to the LSB and select a H for that bit then move left one bit and select a low. Now it will trigger to the same waveform as Fig 1 (note that your Bit00 and Bit01 make up the Waveform count in the images below....on this device you cannot combine signals like you can on the newer devices).

Press the “Single” Button to capture a timing diagram similar to Figure 1 (but with the missing signals from 7474 and 7475 ic’s shown)

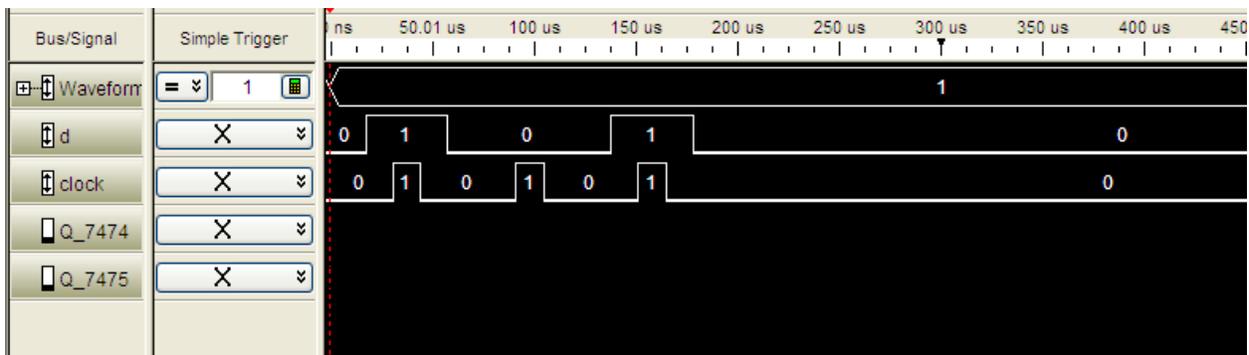


Figure 1

Capture the waveform (16801A users can use “Print Screen” then paste it into paint and save the file (please use the instructors USB to move it to another computer. Those using other equipment and use a cell phone image)

For the 16801A, find the box that says “Simple Trigger”, place a 2 in the text box directly below it. This will set up to capture starting at waveform 2. Press the “Single Run” Button to capture a timing diagram similar to Figure 2.

For the other devices, use the pattern button and, using the same procedure as before, set the bottom two bits to HL. Press the “Single” Button to capture a timing diagram similar to Figure 2.

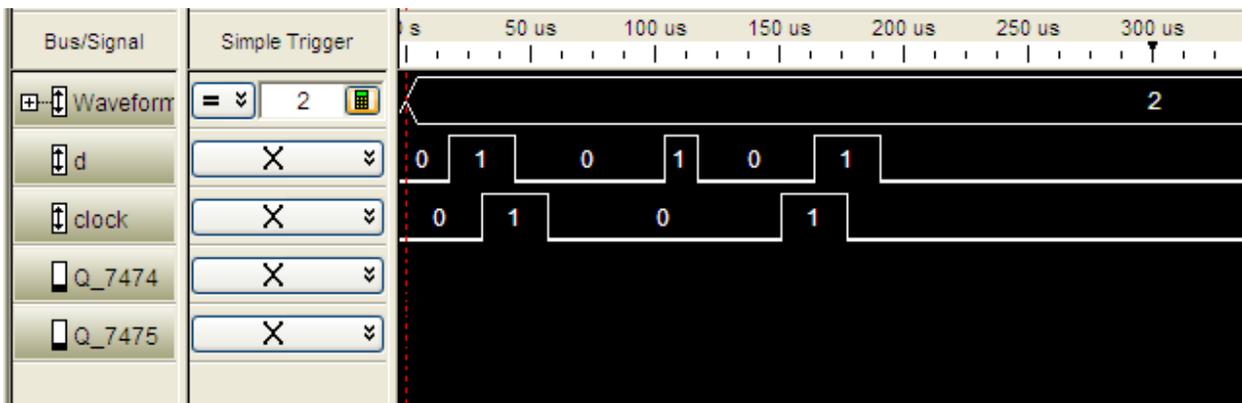


Figure 2

Capture the waveform (16801A users can use “Print Screen” then paste it into paint and save the file (please use the instructors USB to move it to another computer. Those using other equipment and use a cell phone image)

For the 16801A, find the box that says “Simple Trigger”, place a 3 in the text box directly below it. This will set up to capture starting at waveform 2. Press the “Single Run” Button to capture a timing diagram similar to Figure 3.

For the other devices, use the pattern button and, using the same procedure as before, set the bottom two bits to HH. Press the “Single” Button to capture a timing diagram similar to Figure 3.

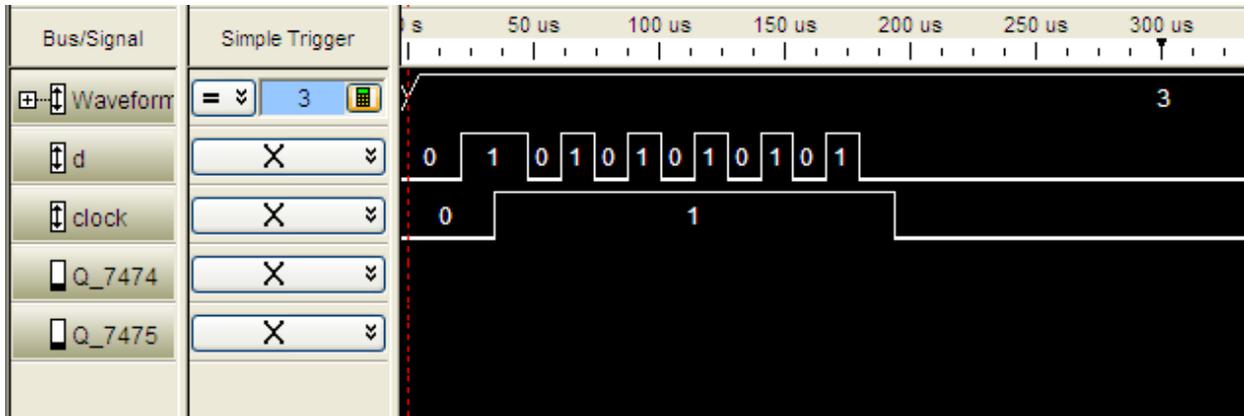


Figure 3

Capture the waveform (16801A users can use “Print Screen” then paste it into paint and save the file (please use the instructors USB to move it to another computer. Those using other equipment and use a cell phone image)

**Each student** is to produce a document with the following:

- 1) Cover page (see report format for appropriate cover page info)
- 2) A capture of Image 1 and an explanation of why the 7474 and 7475 produced the same output (ie explain how the D and clk inputs produced the same output on the two different devices)
- 3) A capture of Image 2 and an explanation of why the 7474 and 7475 produced different outputs (ie explain how the D and clk inputs produced their given output in FORMAL PARAGRAPH FORM).
  - a. Produce two copies of image 2 and using a graphics editor (eg Paint\*), add lines indicating when D is copied to Q. One image for the 7474 and one for the 7475 (please label these images)
- 4) A capture of image 3 and analyze in the same manner as the previous waveform.

Submit via online submission the created document. Make sure to include your name within the document.

\* HELPFUL HINT: Using PAINT’s line tool while holding down the shift key will allow you to easily draw horizontal lines on the images.