Matthew Liu Lab Report 3 ECE 2031 L09 5 February 2019

TABLE 1PROPAGATION DELAYS FOR TEXAS INSTRUMENT ICS

Device	T _{PLH} , ns	T _{PHL} , ns	T _{PMAX} , ns
74HCT00	25	25	25
74HCT20	42	42	42
74HCT04	25	25	25





TABLE 2

TRUTH TABLE WITH WORST CASE PROPAGATION DELAY PAIR





Figure 2. Tri-state Quartus diagram created with lpm_bustri megafunction. The file is programmed to control LEDs on DE2 board with switches (0-3 and 17-14) for inputs and push button for an enable signal (key 0).



Figure 3. Oscilloscope capture for measuring period of V_{out} (downloaded waveform: "Lab3-DE2.sof" with an input of a birthdate) with vertical tracers (period = 3.585 microseconds).



Figure 4. Oscilloscope capture for measuring positive duty cycle of V_{out} (downloaded waveform "Lab3-DE2.sof" with an input of a birthdate) with vertical tracers measuring a high time of 1.538 microseconds (positive duty cycle = 100% * high time / period = 42.90%).



Figure 5. Oscilloscope capture for measuring rise time of $Y_{output} = ((/C+D)*(/B+D)*(A+B+C)*(B+/C+D))$ with vertical tracers measuring a rise time of 3.05 ns (0% point: 0 V; 100% point: 5.02 V).



Figure 6. Oscilloscope capture for measuring fall time of $Y_{output} = ((/C+D)*(/B+D)*(A+B+C)*(B+/C+D))$ with vertical tracers measuring a rise time of 3.35 ns. (0% point: 0 V; 100% point: 5.02 V).



Figure 7. Oscilloscope capture for measuring propagation delay (high to low) of Y = ((/C+D)*(/B+D)*(A+B+C)*(B+/C+D)) (PHL = 28 ns). Transition levels for clock and output are 2.22 V and 2.56 V respectively.



Figure 8. Oscilloscope capture for measuring propagation delay (low to high) of Y = ((/C+D)*(/B+D)*(A+B+C)*(B+/C+D)) (PLH = 21.6 ns). Transition levels for clock and output are 2.22 V and 2.56 V respectively.