Experiment # 1- Clock and Periodic Signal Generation

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1.1

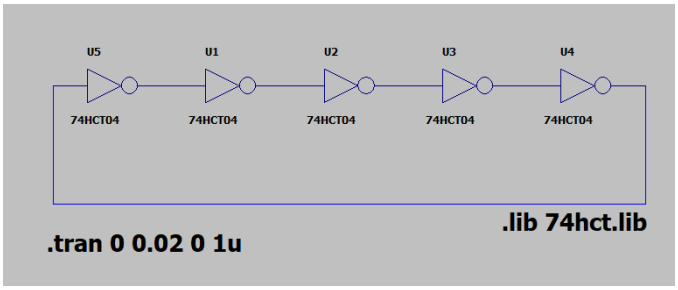
1.10 ns

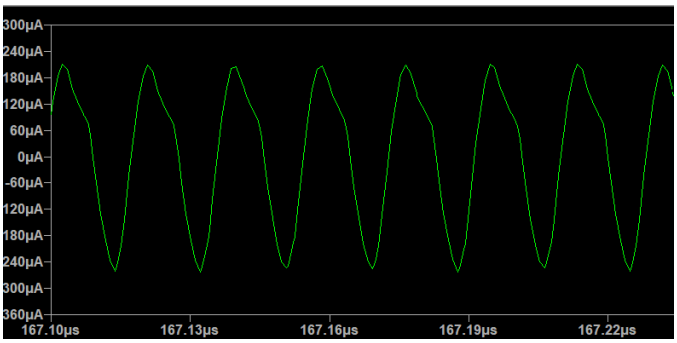
2.2 * N * $Delay_{inv}$ = 20ns

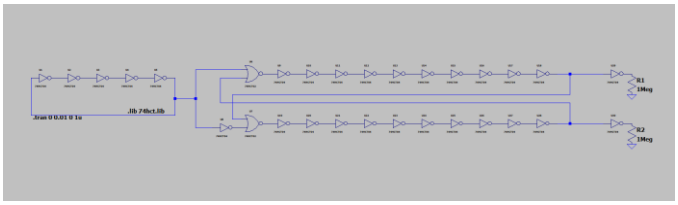
N = 5

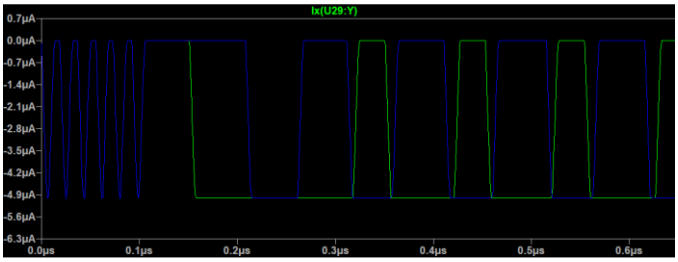
2 * N = 10

$Delay_{inv}$ = 2ns









1.2

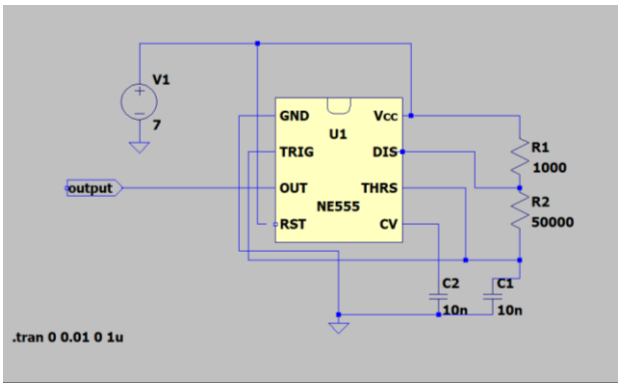


Fig. 3 LM555

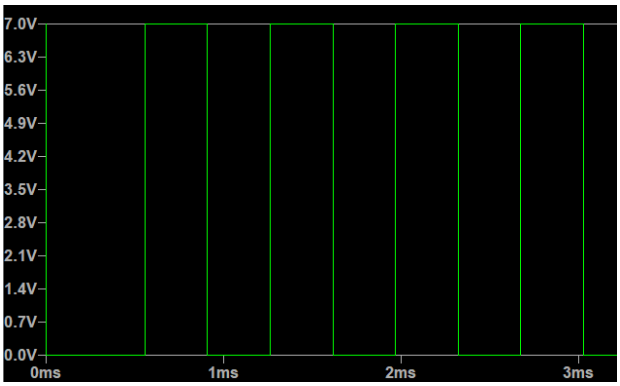


Fig. 4 wave form of the output

1. Clock frequency: 1 / T

T = T_1 + T_2 = 0.693 * (R_1 + 2R_2) * C

= 0.693 * (101000) * 10 * 10^{-9} = 0.699930 * 10 s

Clock frequency: 1 / (0.699930 * 10^{-3})

= 1428.714

Duty cycle: (R_1 + R_2) / (R_1 + 2R_2) = 51 / 101

= 50.49%

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2. If R_2 = 1kΩ:

T = 0.693 * (3000) * 10 * 10^{-9} = 0.2079 * 10^{-4}s

Clock frequency: 1 / (0.2079 * $10^{-4)}$ = 48100.04

Duty cycle: 2 / 3 = 66.67%

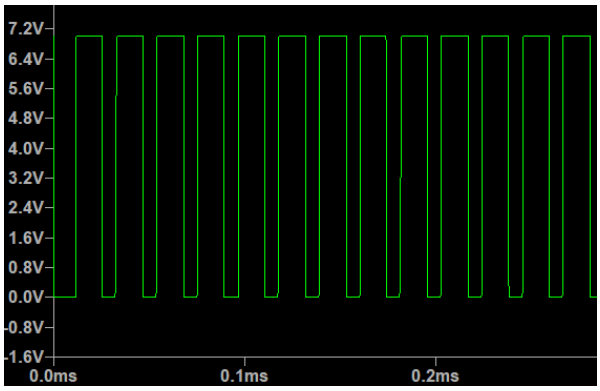
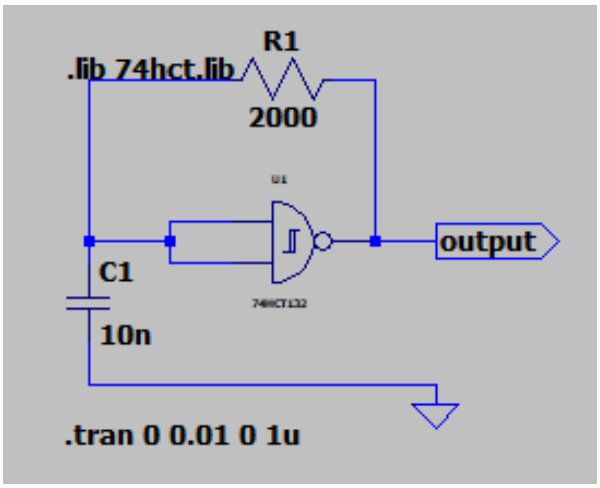


Fig. 5 R_2 = 1kΩ



If R_2 = 10kΩ:
T = 0.693 * (21000) * 10 * 10^{-9} = 0.14553 * 10^{-3}s
Clock frequency: 1 / (0.14553 * 10^{-3}s) = 6871.435
Duty cycle: 11 / 21 = 52.38%

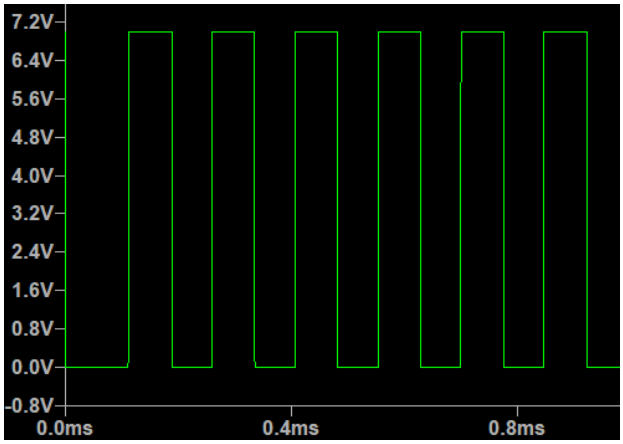


Fig. 6 R_2= 10kΩ

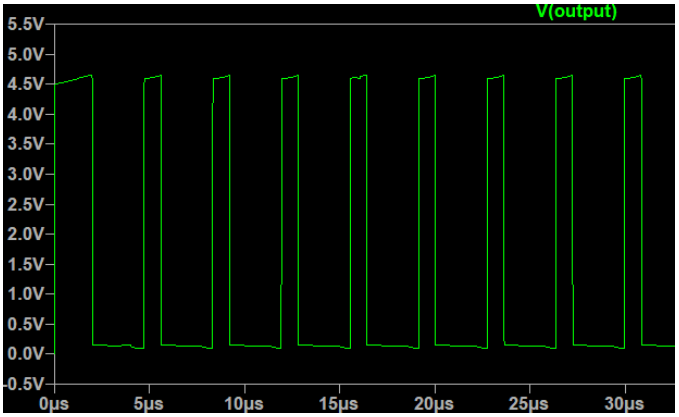


Fig. 8 R = 470Ω

T = 3.6×10^{-6} → f = $10^6/3.6 = 2.7\times10^5$
a = f×RC = $2.7\times10^5\times470\times10\times10^{-9}$ = 1.3

If R_2 = 200kΩ:
T = 0.693 * (401000) * 10 * 10^{-9} = 0.277893 * 10^{-2}s
Clock frequency: 1 / (0.277893 * 10^{-2}s) = 359.850
Duty cycle: 201 / 401 = 50.12%

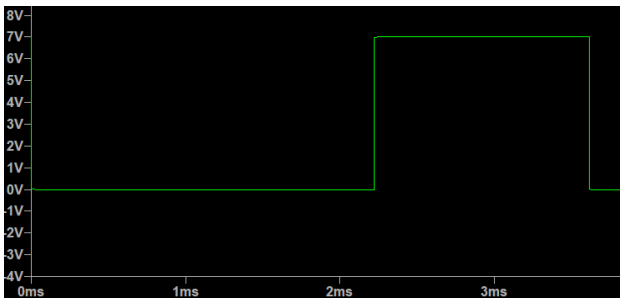


Fig. 7 R_2 = 200kΩ

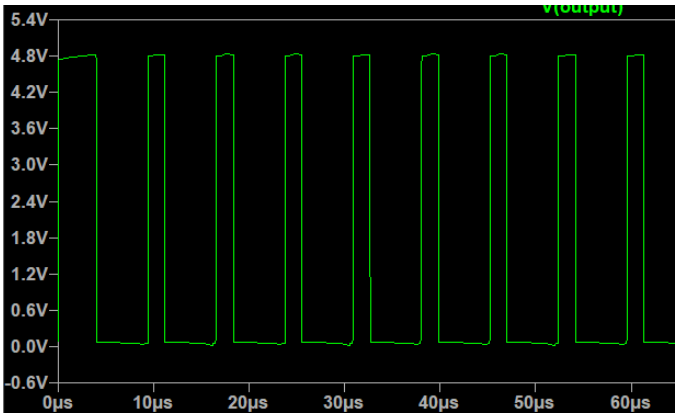


Fig. 9 R = 1000Ω

T = 7.2×10^{-6} → f = $10^6/7.2 = 1.4\times10^5$
a = f×RC = $1.4\times10^5\times1000\times10\times10^{-9}$ = 1.4

1.3

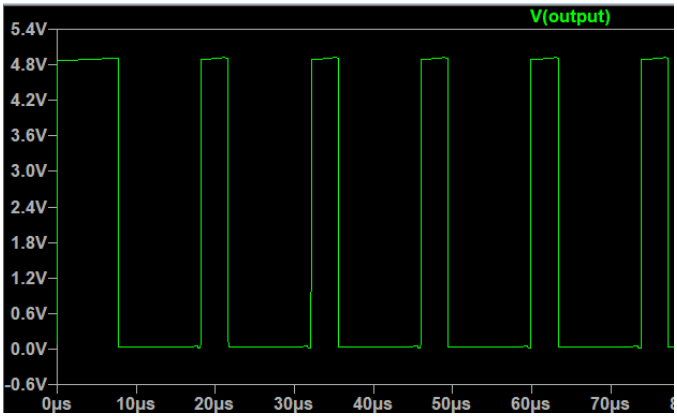


Fig. 10 R = 2000Ω

$T = 14\times10^{-6} \rightarrow f = 10^{6}/14 = 7.1\times10^{4}$

$a = f\times RC = 7.1\times10^{4}\times2000\times10\times10^{-9} = 1.4$

2.1

$T = 2 * 5 * Delay_{inv} = 20ns$

Ring oscillator frequency = $1 / T = 1 / (20 * 10^{-9})$

$= 5 * 10^{7}$

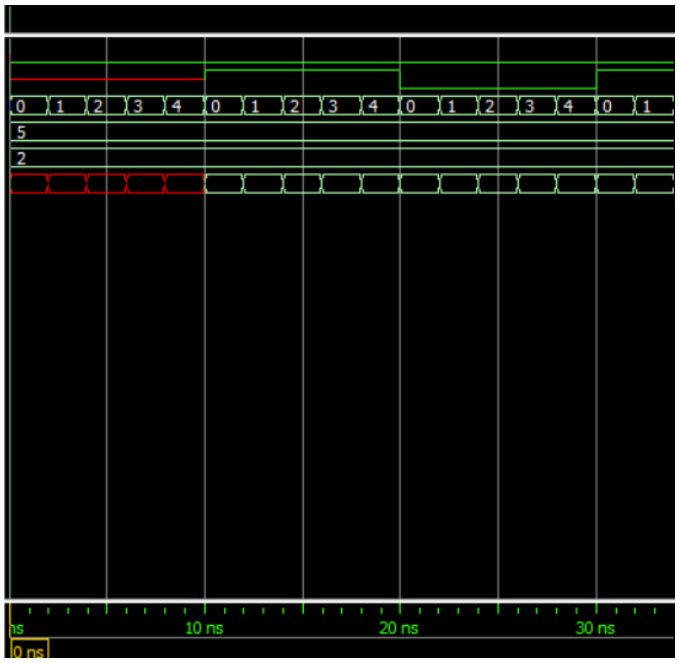


Fig. 11 waveforms of inputs and outputs

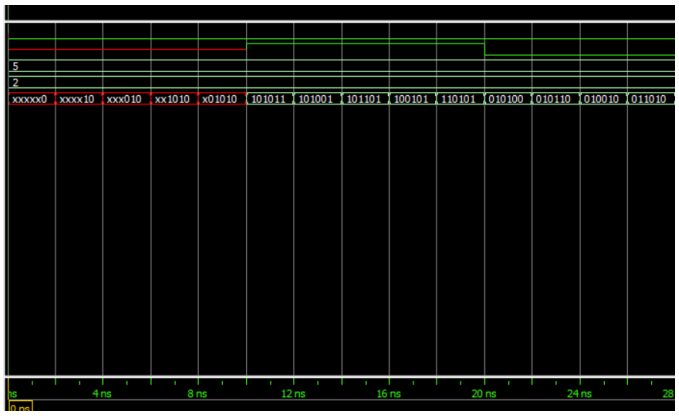


Fig. 12 waveforms of inputs and outputs

2.2

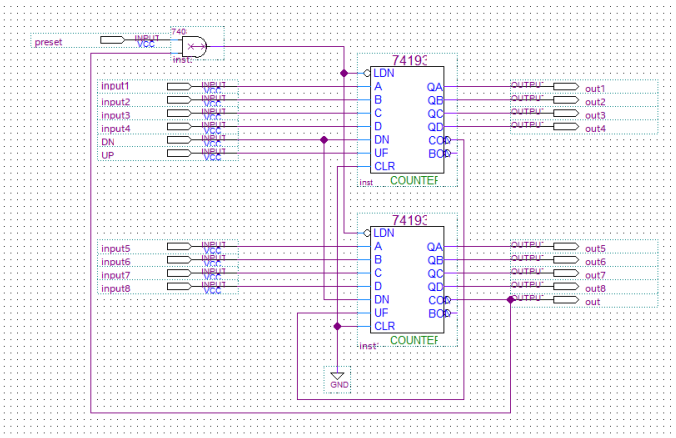


Fig. 13 frequency divider

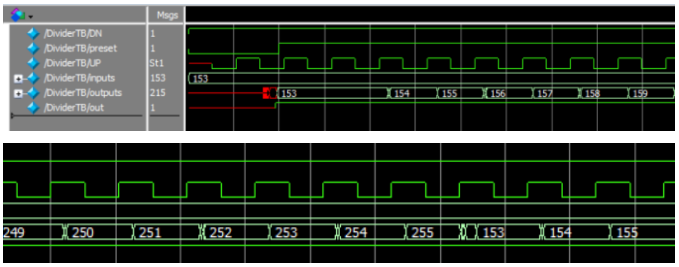


Fig. 14 output waveform

2.3

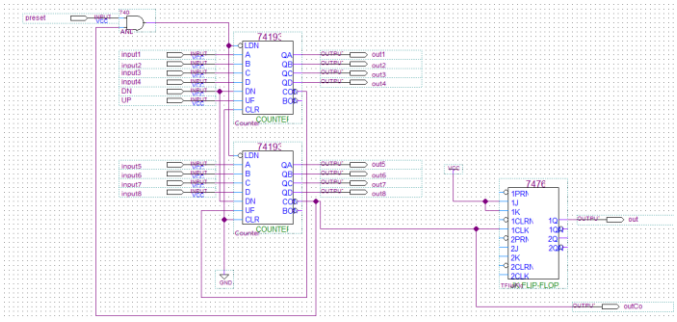


Fig. 15 circuit with T flip flop

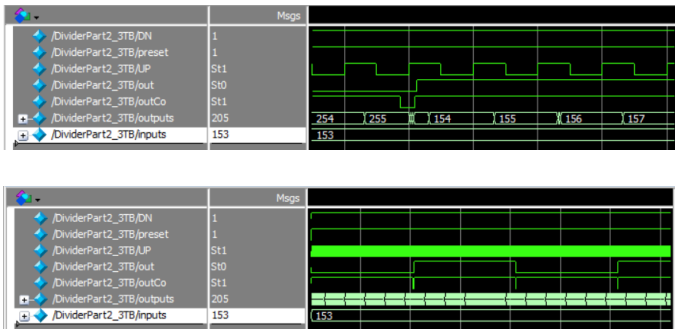


Fig. 16 output waveform

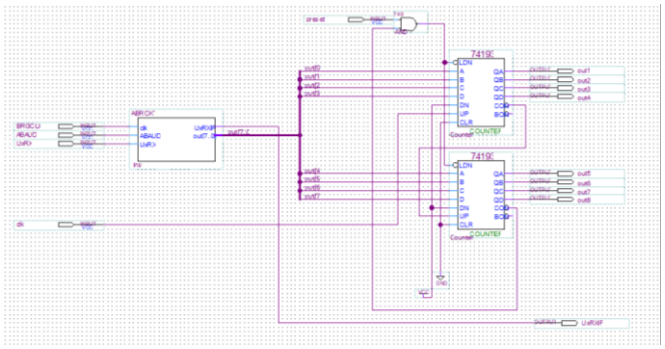


Fig. 17 Final circuit