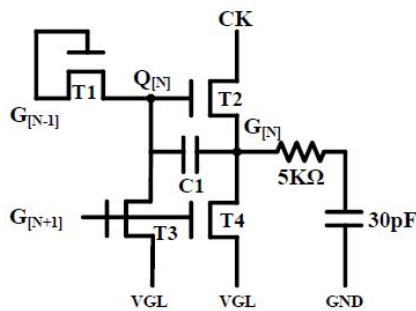


## HW1 TFT LCD Simulation

### 1. Dynamic Shift Register (Single-type MOS device)

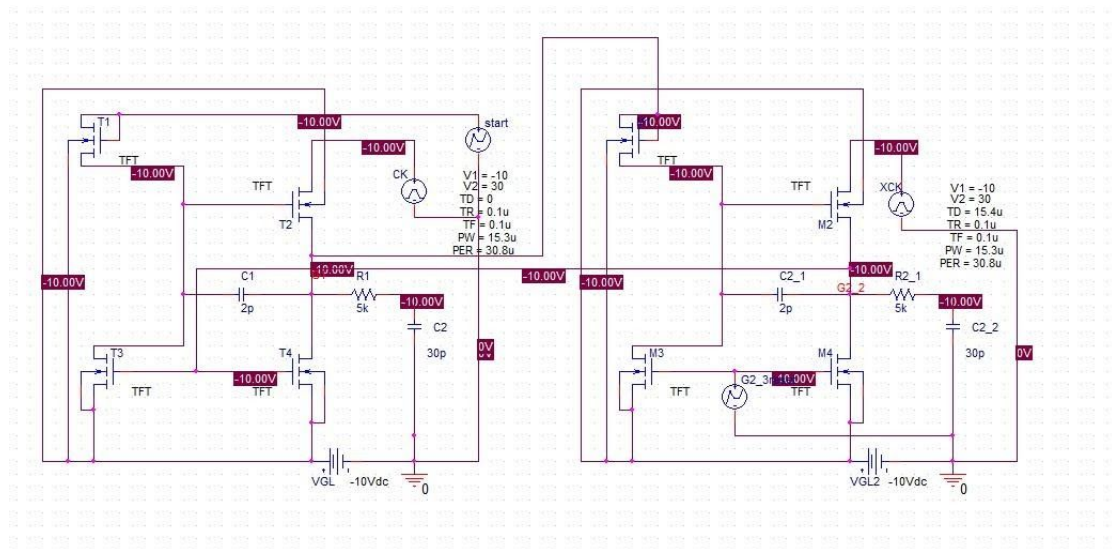
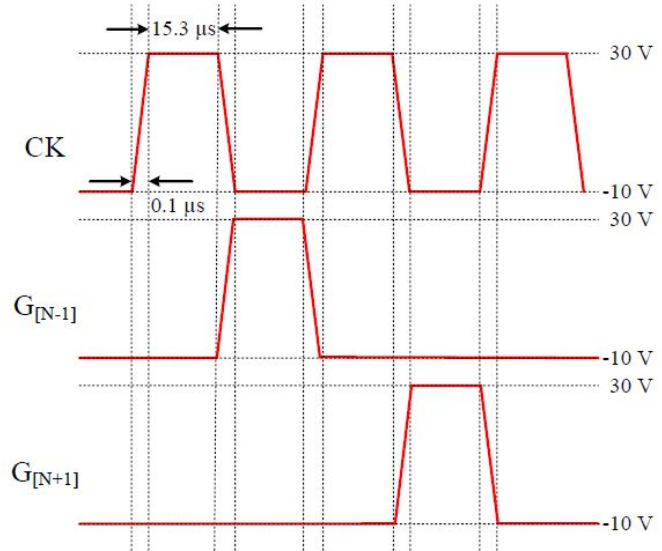


Simulated parameter:

VGL = -10 V    C1 = 2 pF

$M_{T1} = 50$      $M_{T3} = 50$

$M_{T2} = 300$      $M_{T4} = 300$



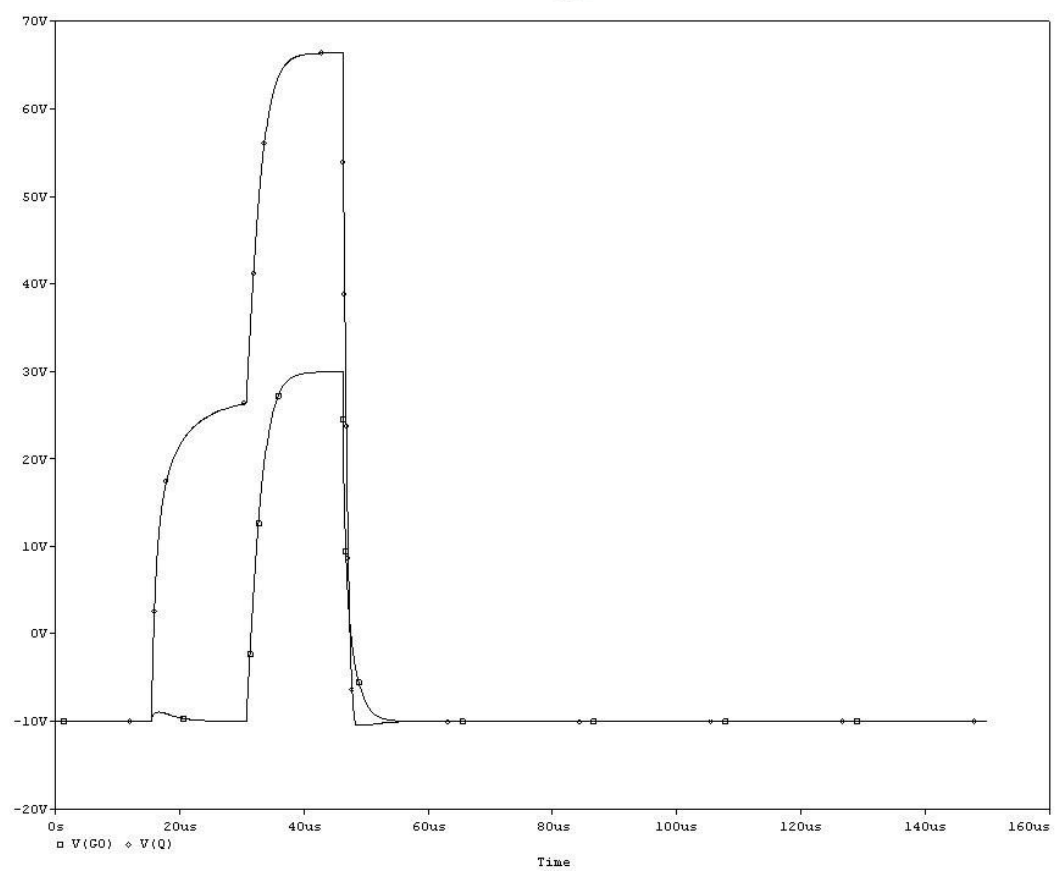
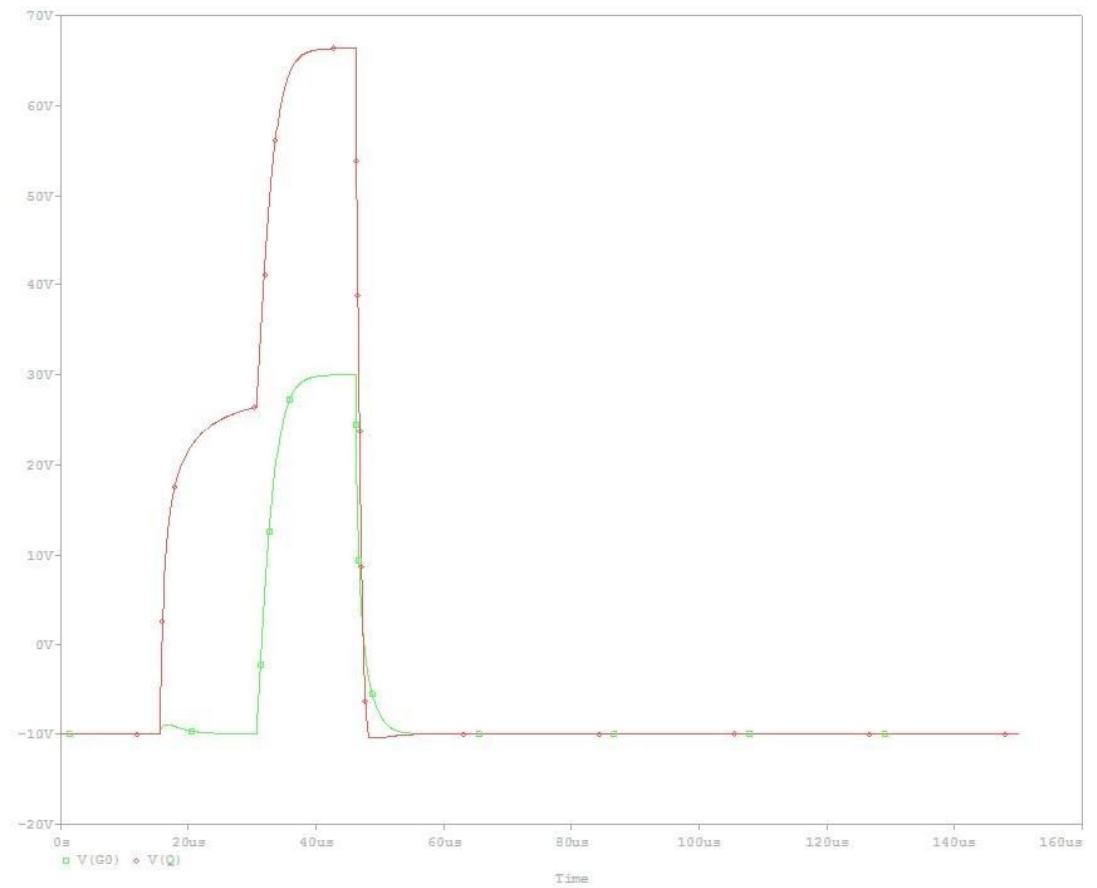
- I. Please explain how the shift register generates the high level of  $G[N]$ . (Hint: investigate  $Q[N]$  waveform)

Ans:

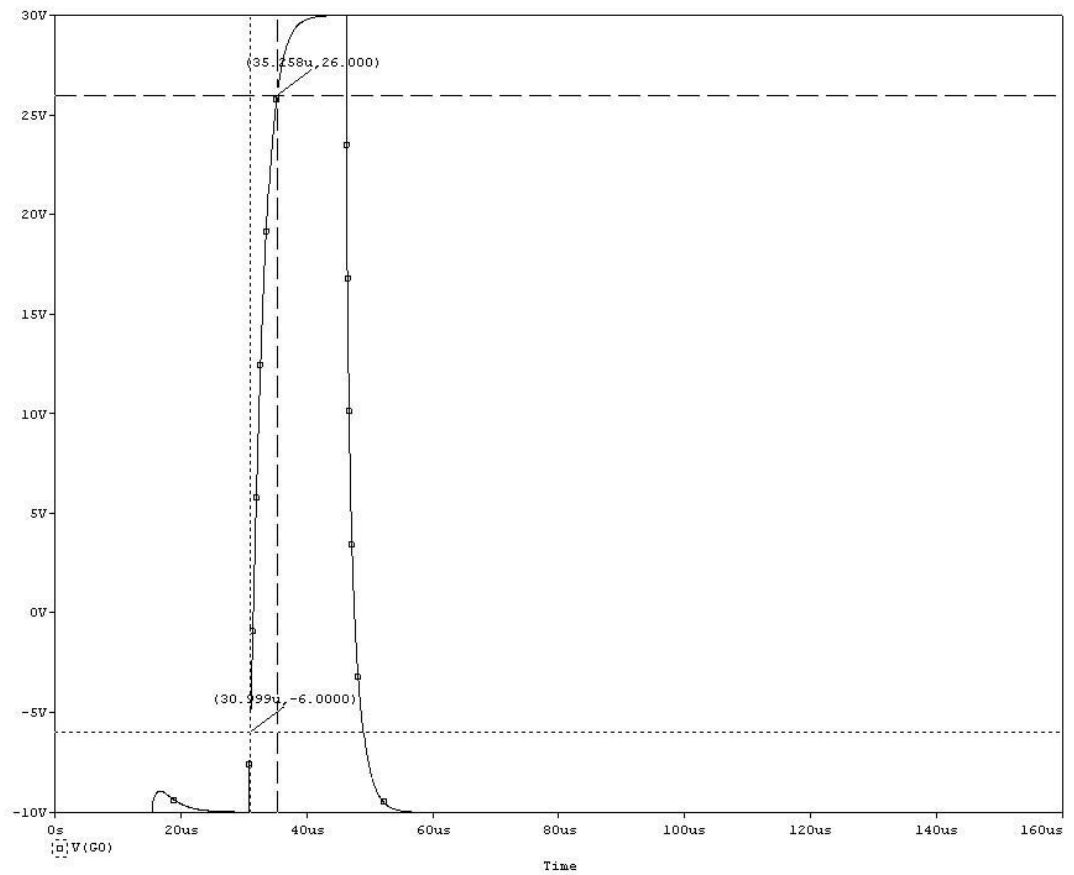
$G[N-1]$  為 high 時, T1 會充電至  $Q[N]$ ;  $G[N-1]$  為 low 時, T1 關閉。

而 CK 為 low 時,  $G[N]$  因 T2 而維持 low; CK 為 high 則 CK 由 T2 充電至  $G[N]$  並藉由 C1 將  $Q[N]$  耦合至更高電位。

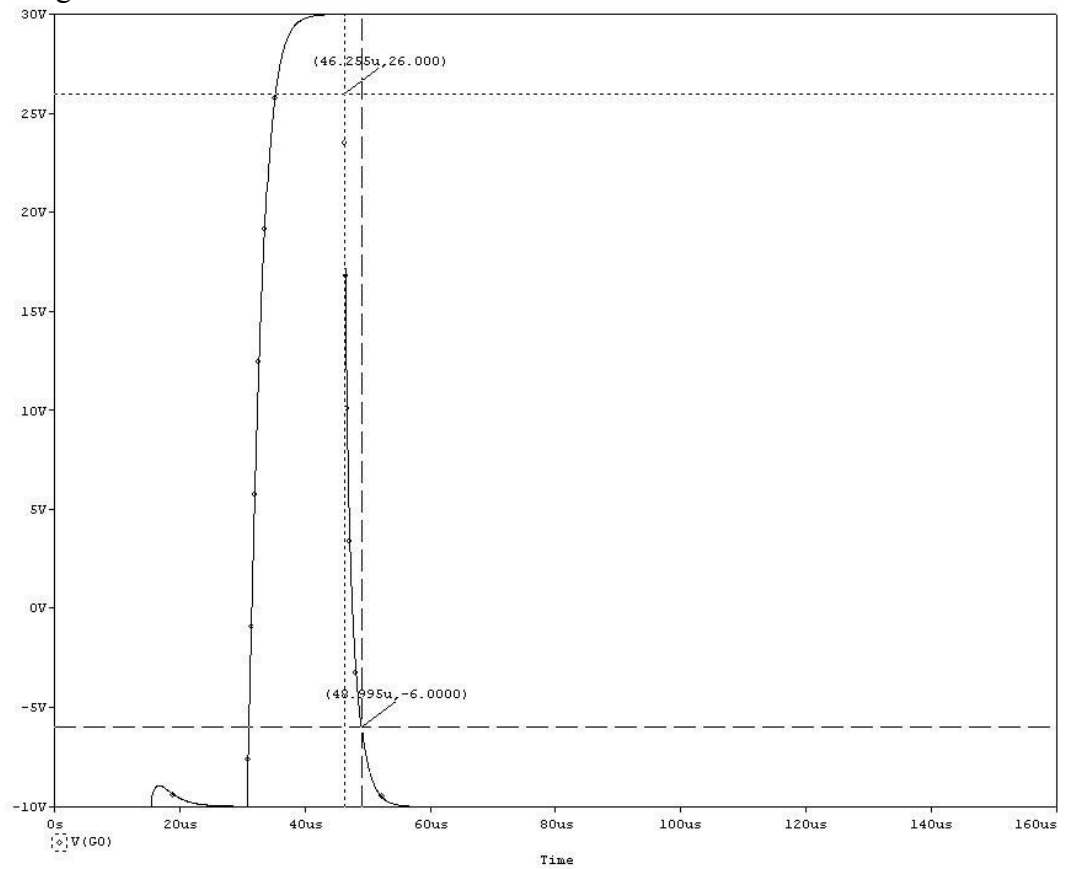
$G[N+1]$  為 low 則使得 T3 及 T4 關閉;  $G[N+1]$  為 high 則開啟 T3 及 T4, 並將  $Q[N]$  及  $G[N]$  放電至 VGL。



- II. Please record the rising time and falling time of G[N].  
Rising time: 4.26 us



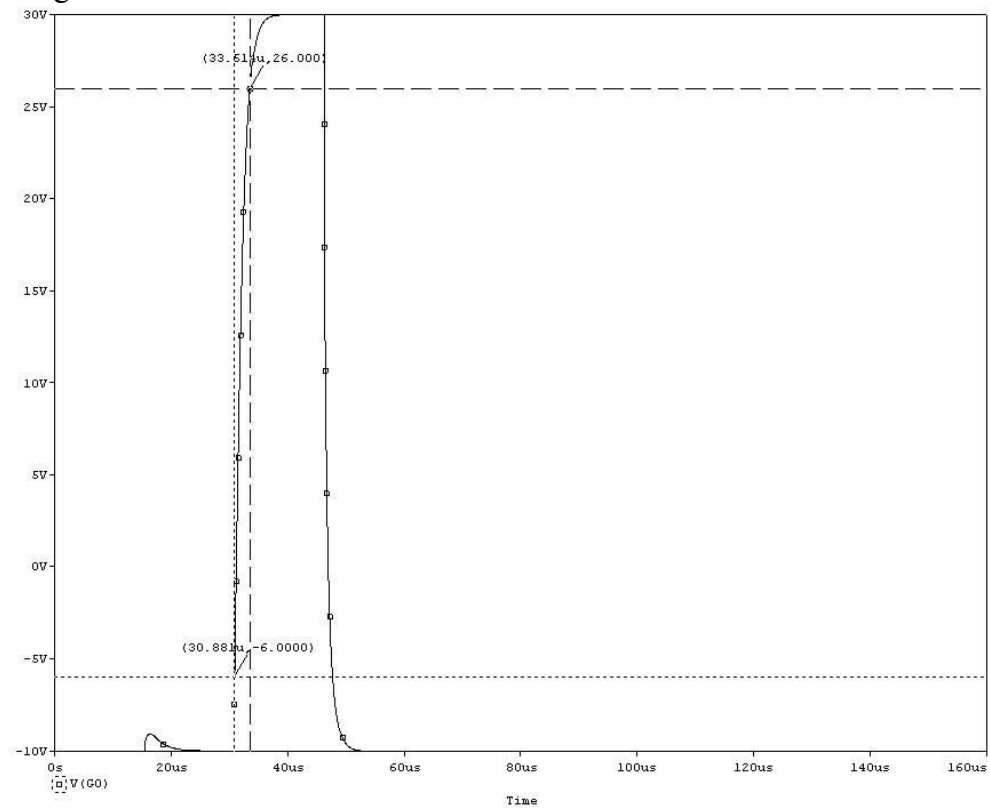
Falling time: 2.74 us



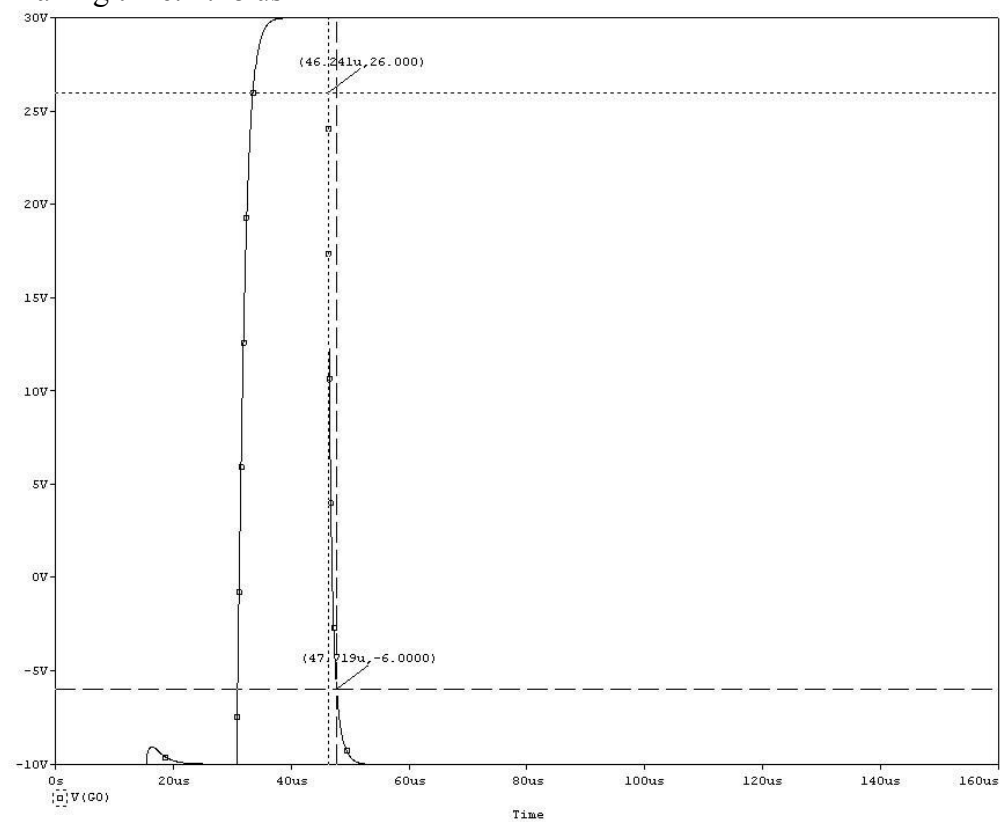
III. Change MT2 and MT4 to 500, and record the rising time and falling time of

G[N] again. What's the difference from question ii, and why?

Rising time: 2.73  $\mu\text{s}$



Falling time: 1.48  $\mu\text{s}$



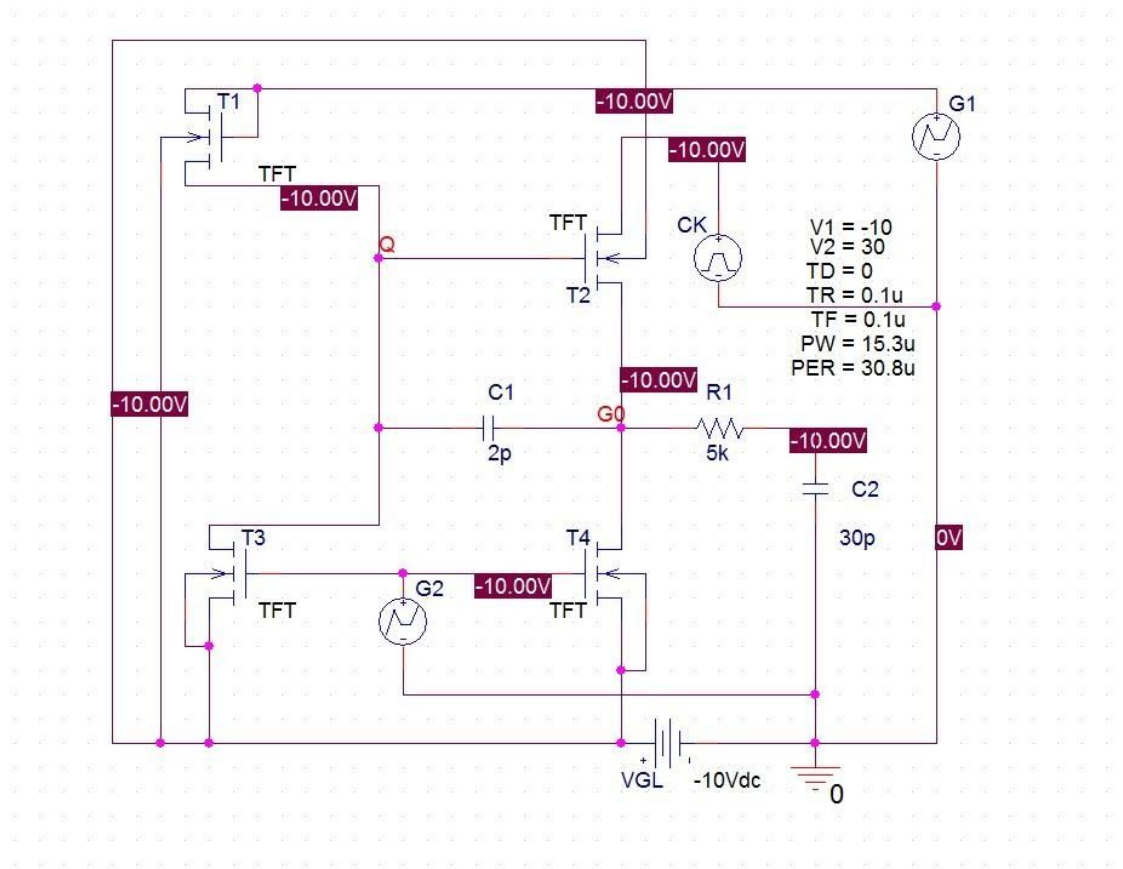
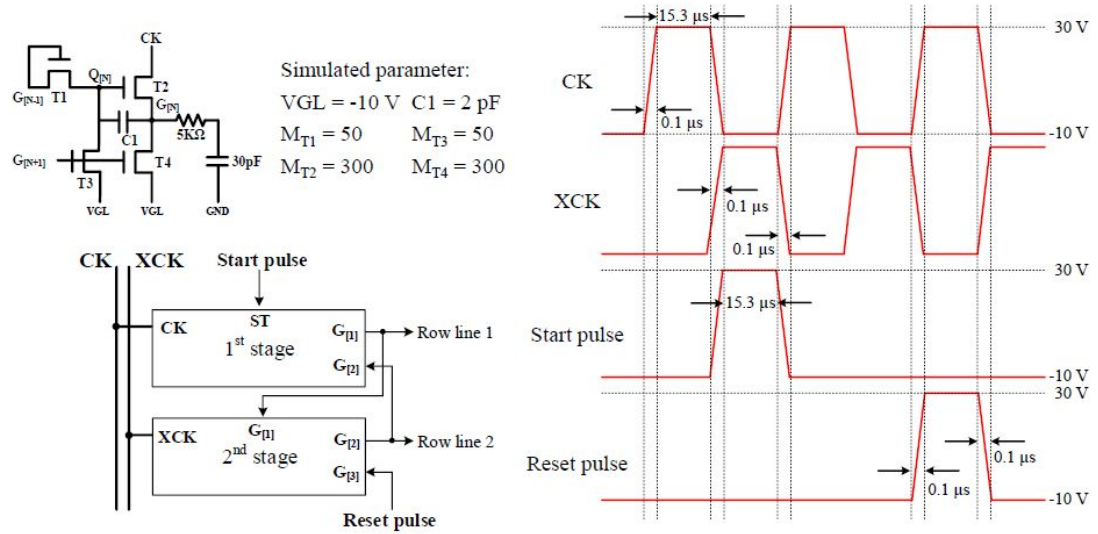
Ans:

$M_{T2}$ , $M_{T4}$	Rising time	Falling time
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300	4.26 us	2.74 us
500	2.73 us	1.48 us

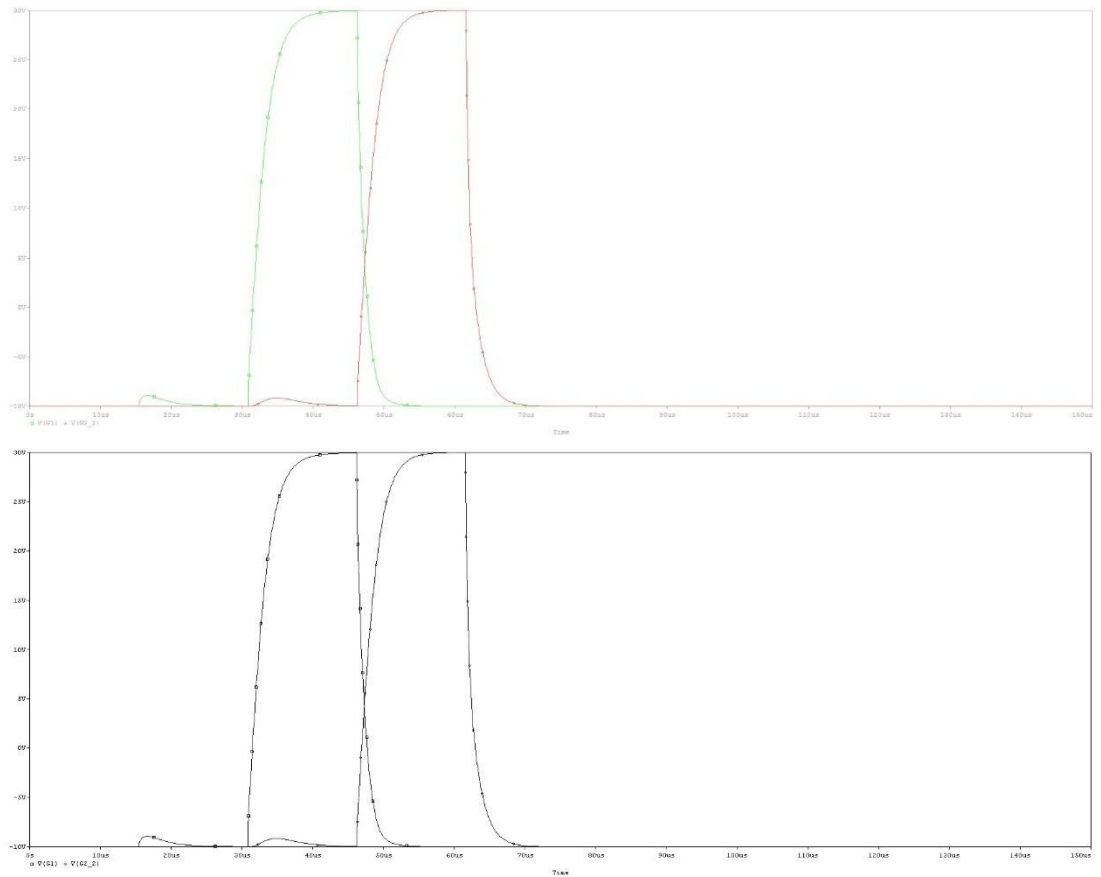
M代表並聯的TFT個數，提高M值使得寬度增加，而TFT電流和寬度成正比，因此電流增加使得效率便大，因此rising 與falling time變快。

## 2. Dynamic Shift Register (Two-stage operation)



I. Please save the sequential output waveforms of two stages.(G[1]and G[2])

綠色線條為G[1]，紅色線條為G[2]



II. What are the functions of “start pulse” and “reset pulse”?

Ans:

Start pulse為第一級的G[N-1], Reset pulse則是第二級的G[N+1]。  
Start pulse為high時, T1會充電至Q[N], 提高Q[N]電壓使T2打開而開啟整個過程; 而Reset pulse則使得T3及T4打開, 讓Q[N]及G[N]電壓受到VGL影響而下降。

綠色線條為start pulse, 紅色線條為reset pulse

