

# Device Modeling Report

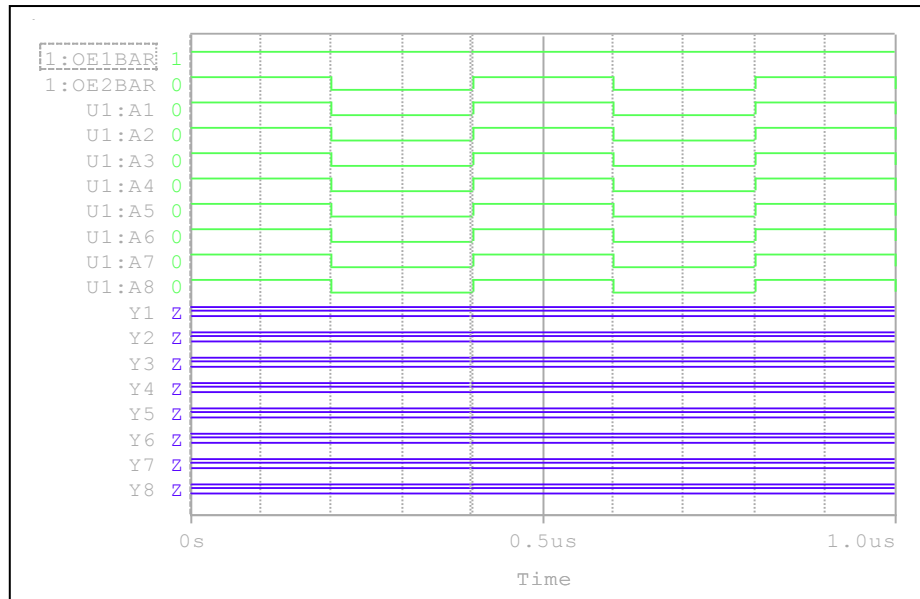
COMPONENTS : CMOS DIGITAL INTEGRATED CIRCUIT  
PART NUMBER : TC74LCX541F  
MANUFACTURER : TOSHIBA



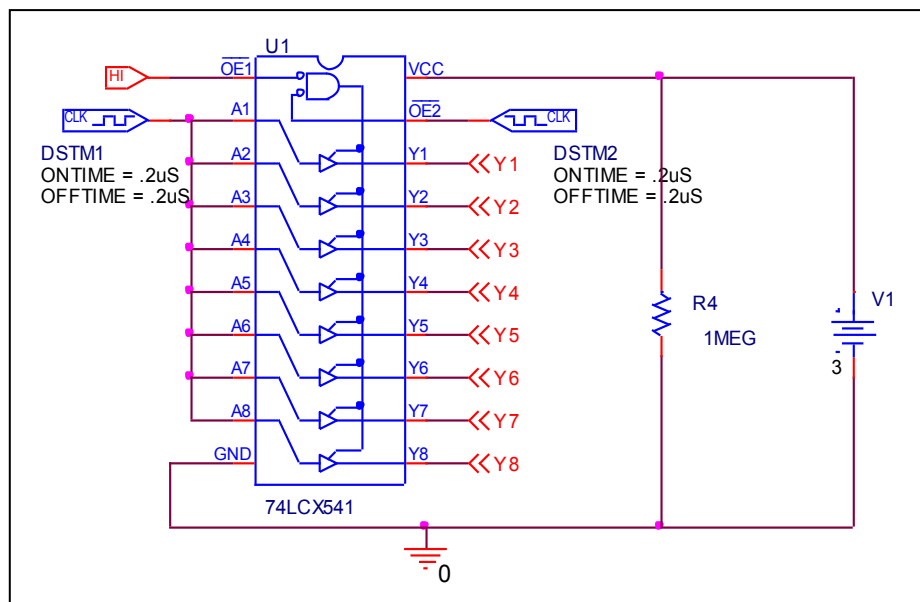
**Bee Technologies Inc.**

## Truth Table

### Circuit simulation result



### Evaluation circuit

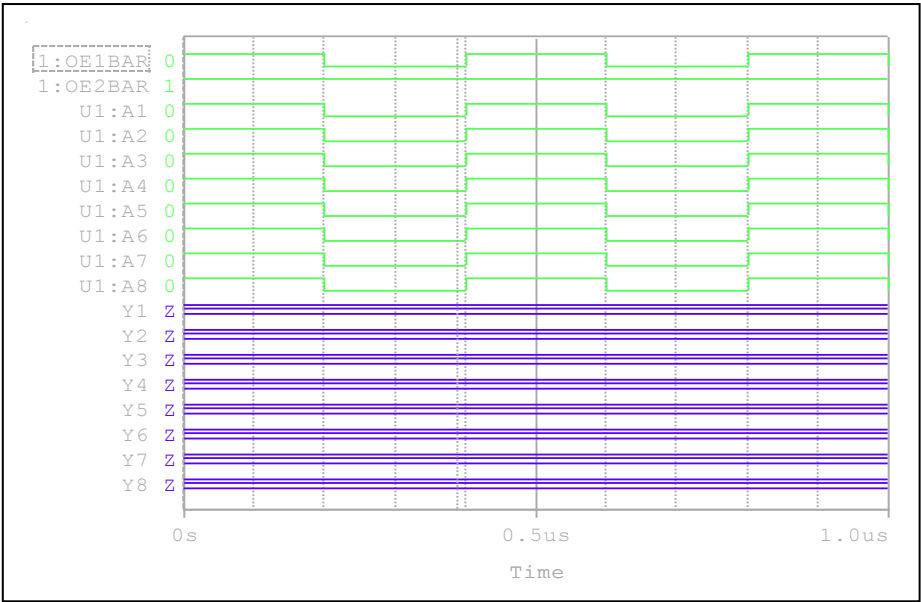


### Comparison table

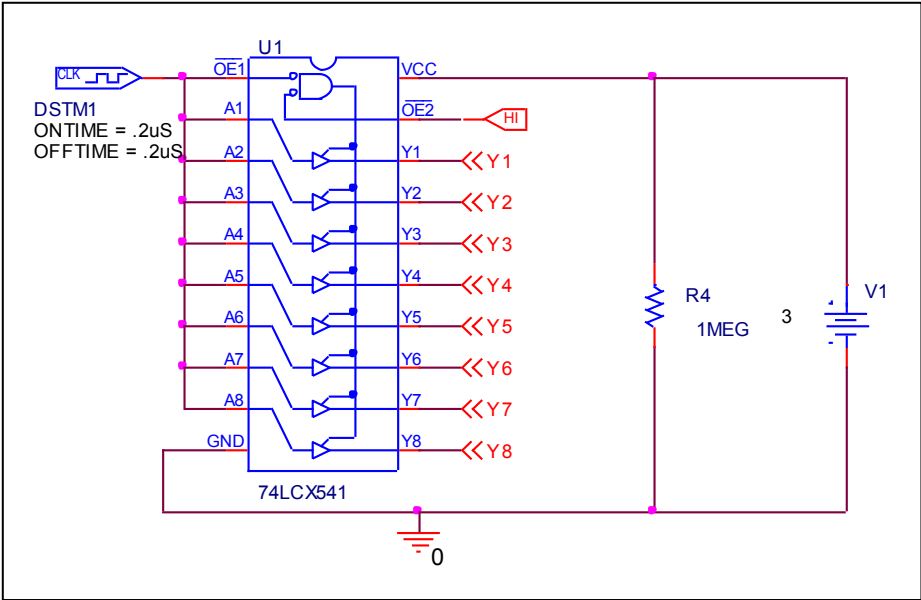
| Input |     |    | Output           |                 | %Error |
|-------|-----|----|------------------|-----------------|--------|
| OE1   | OE2 | An | Yn (Measurement) | Yn (Simulation) |        |
| H     | X   | X  | Z                | Z               | 0      |

# Truth Table

## Circuit simulation result



## Evaluation circuit

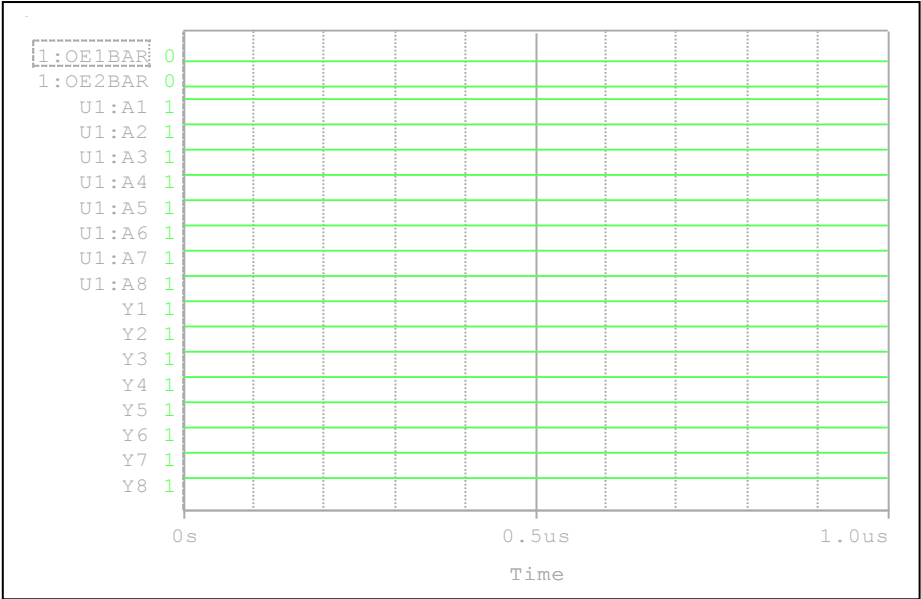


## Comparison table

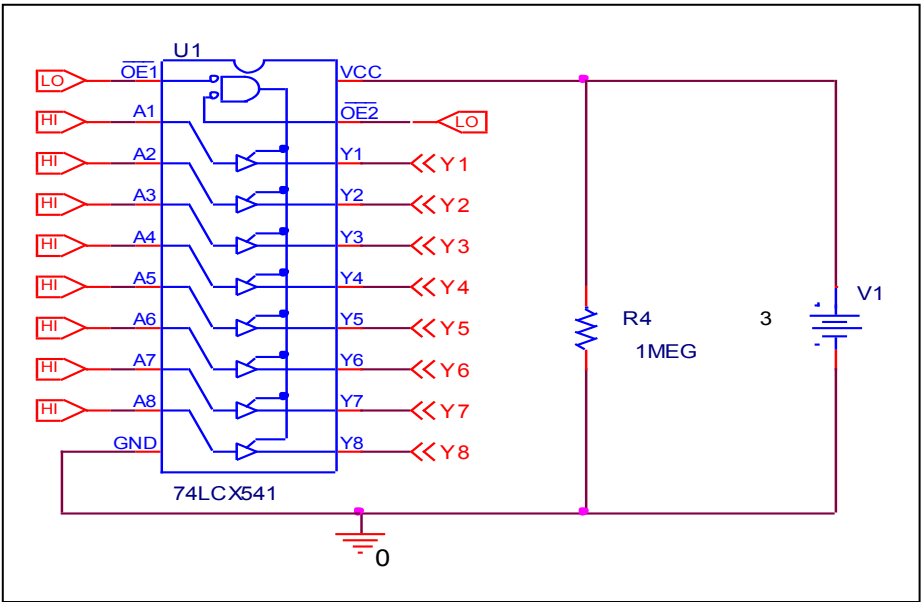
| Input |     |    | Output           |                 | %Error |
|-------|-----|----|------------------|-----------------|--------|
| OE1   | OE2 | An | Yn (Measurement) | Yn (Simulation) |        |
| X     | H   | X  | Z                | Z               | 0      |

# Truth Table

## Circuit simulation result



## Evaluation circuit

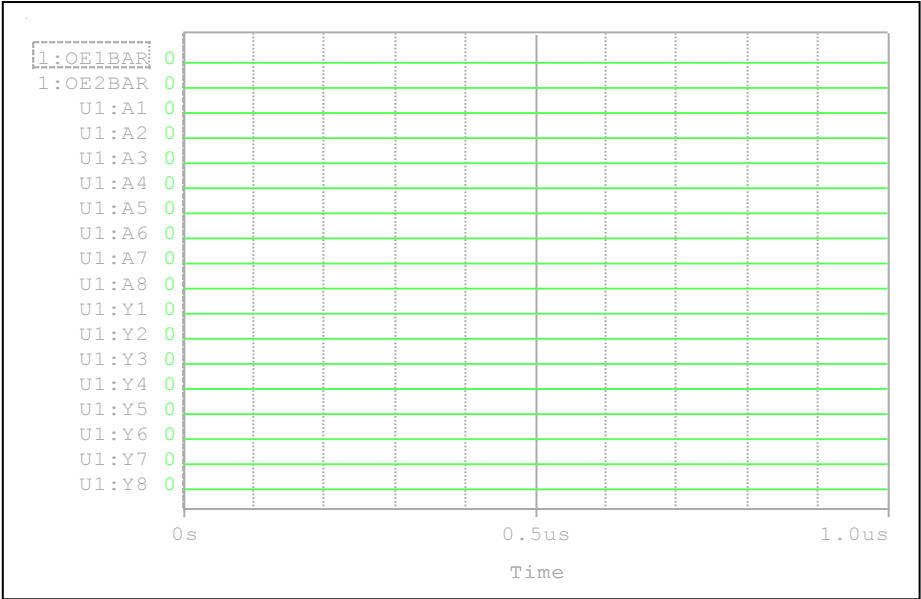


## Comparison table

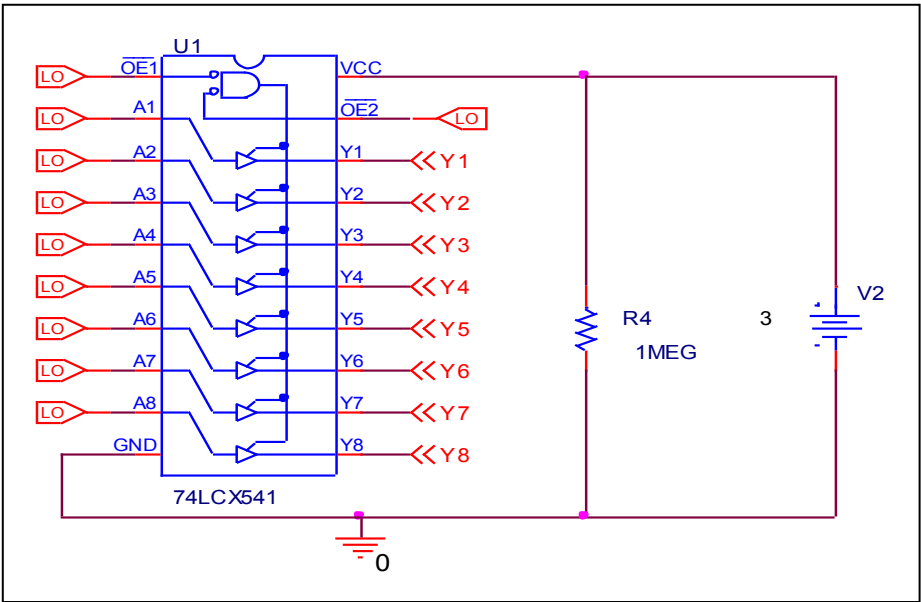
| Input |     |    | Output           |                 | %Error |
|-------|-----|----|------------------|-----------------|--------|
| OE1   | OE2 | An | Yn (Measurement) | Yn (Simulation) |        |
| L     | L   | H  | H                | H               | 0      |

# Truth Table

## Circuit simulation result



## Evaluation circuit

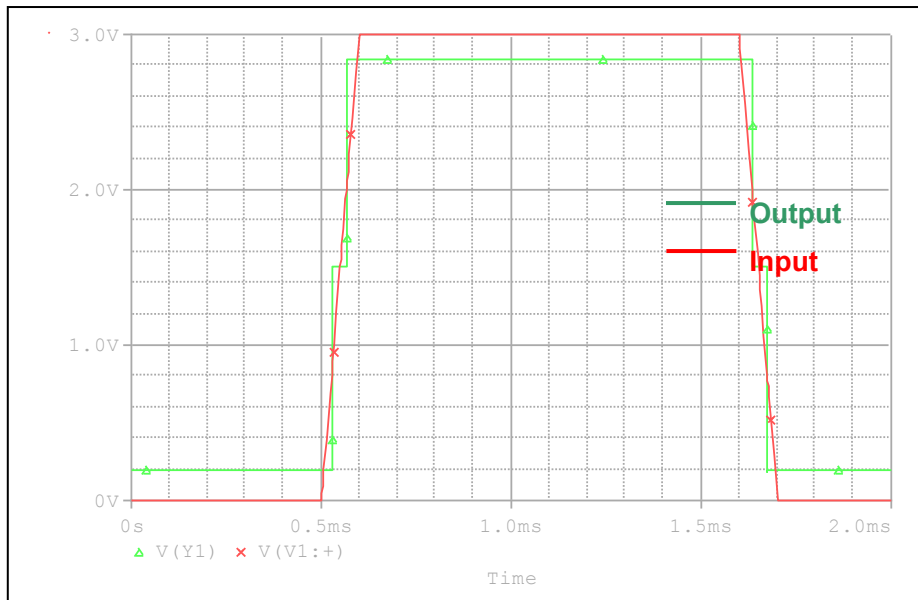


## Comparison table

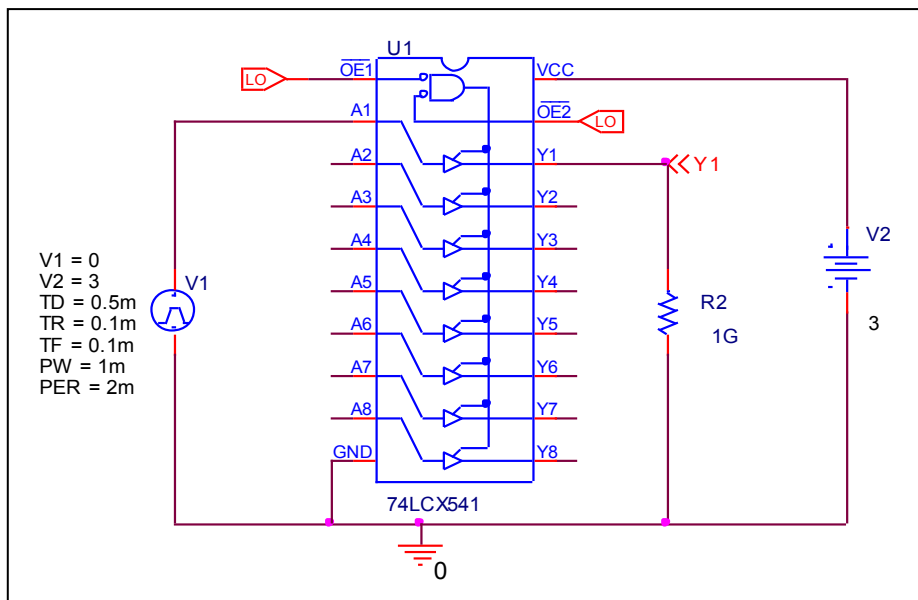
| Input |     |    | Output           |                 | %Error |
|-------|-----|----|------------------|-----------------|--------|
| OE1   | OE2 | An | Yn (Measurement) | Yn (Simulation) |        |
| L     | L   | L  | L                | L               | 0      |

## High Level and Low Level Input Voltage

### Circuit simulation result



## Evaluation circuit

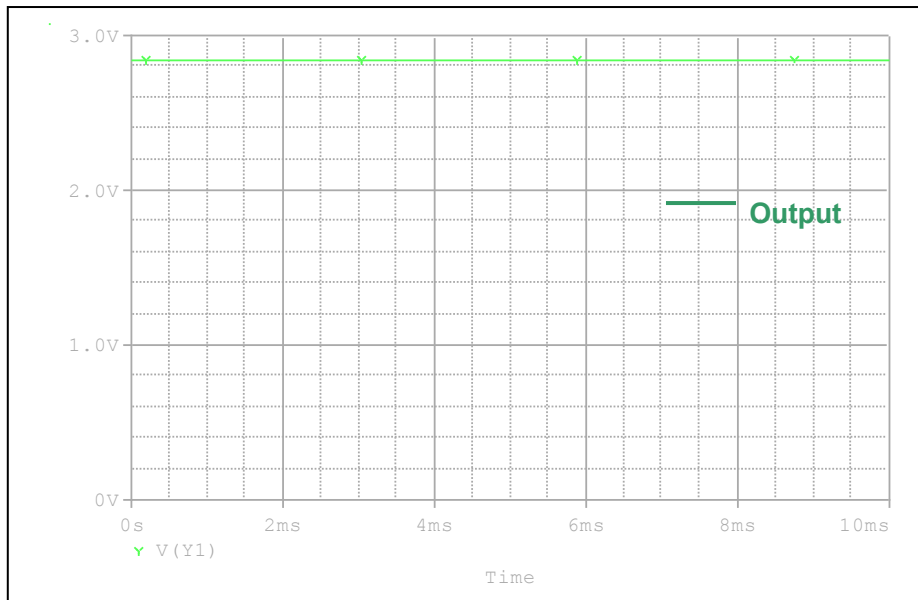


## Comparison table

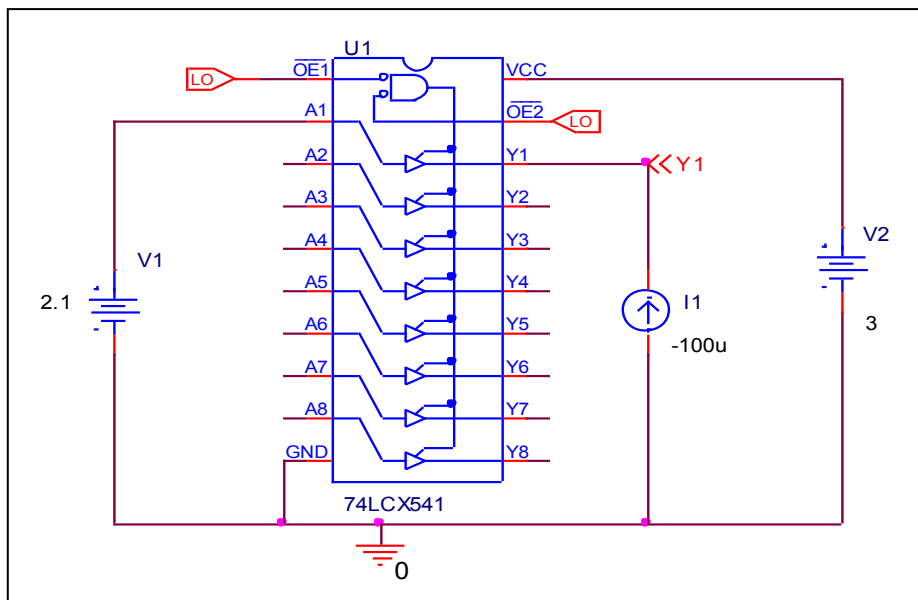
| <b>V<sub>CC</sub> = 3V</b> | <b>Measurement</b> | <b>Simulation</b> | <b>%Error</b> |
|----------------------------|--------------------|-------------------|---------------|
| <b>V<sub>IH</sub> (V)</b>  | 2                  | 2                 | 0             |
| <b>V<sub>IL</sub> (V)</b>  | 0.8                | 0.799173          | -0.103        |

## High Level Output Voltage

### Circuit simulation result



Evaluation circuit

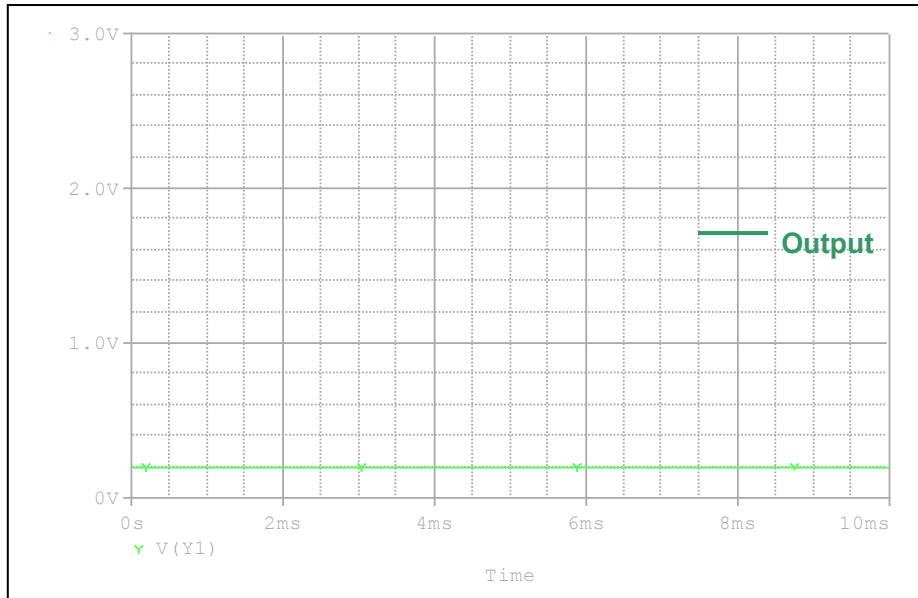


## Comparison table

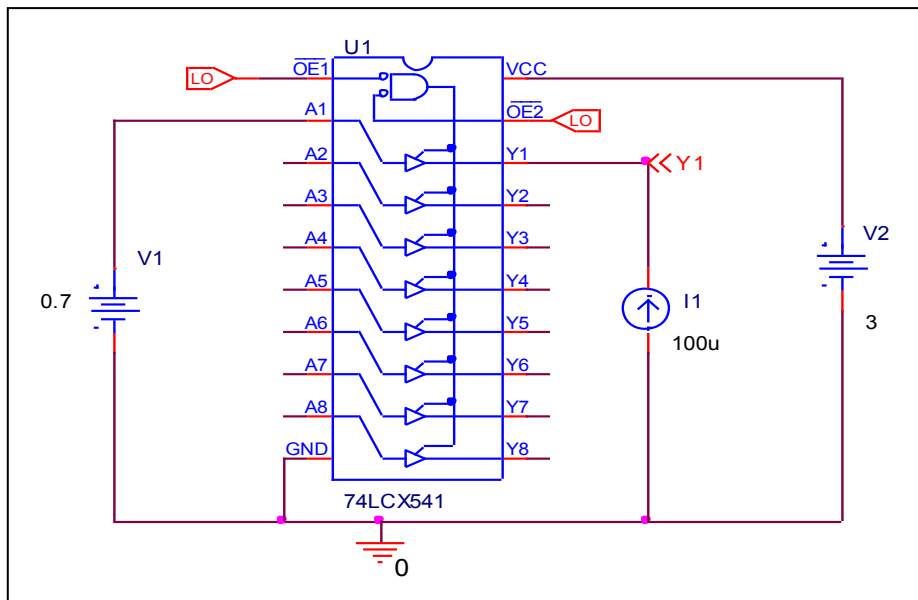
| $V_{IN} = V_{IH}, V_{CC} = 3\text{ V}$ | Measurement | Simulation | %Error |
|----------------------------------------|-------------|------------|--------|
| Min $V_{OH} = (V_{CC} - 0.2)\text{ V}$ | 2.8         | 2.8340     | 1.214  |

## Low Level Output Voltage

### Circuit simulation result



### Evaluation circuit

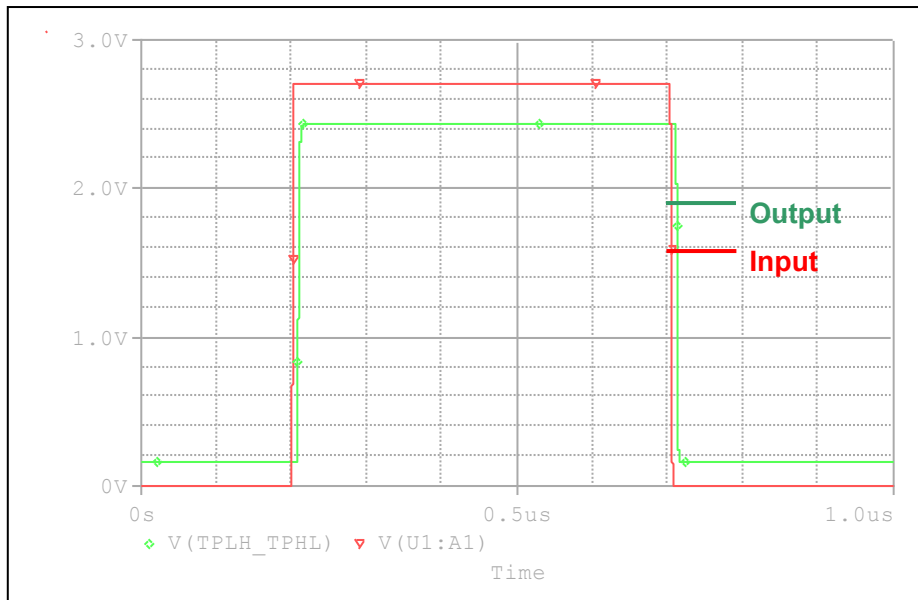


### Comparison table

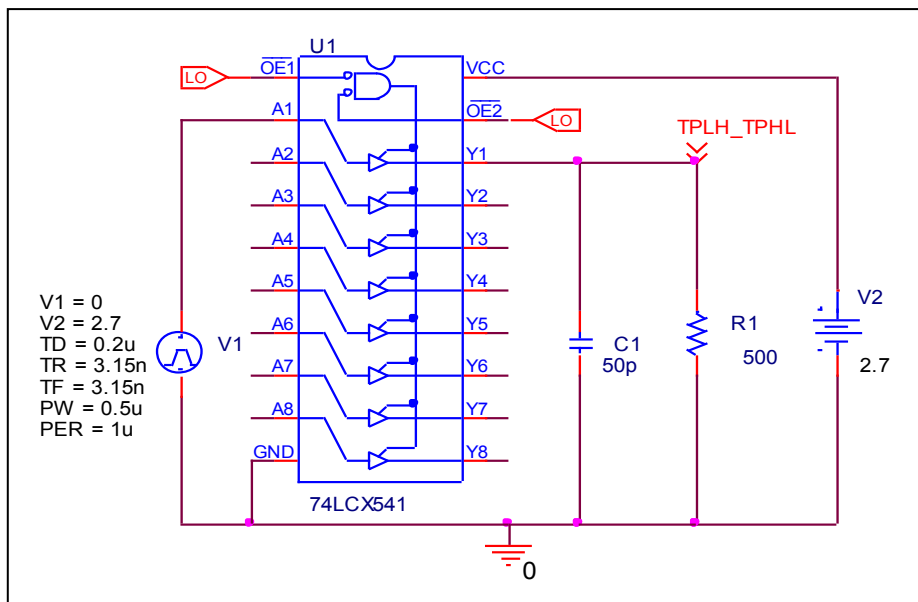
| $V_{IN} = V_{IL}, V_{CC} = 3\text{ V}$ | Measurement | Simulation | %Error |
|----------------------------------------|-------------|------------|--------|
| $V_{OL}\text{ (V)}$                    | 0.2         | 0.191208   | -4.396 |

## Propagation Delay Time

### Circuit simulation result



### Evaluation circuit

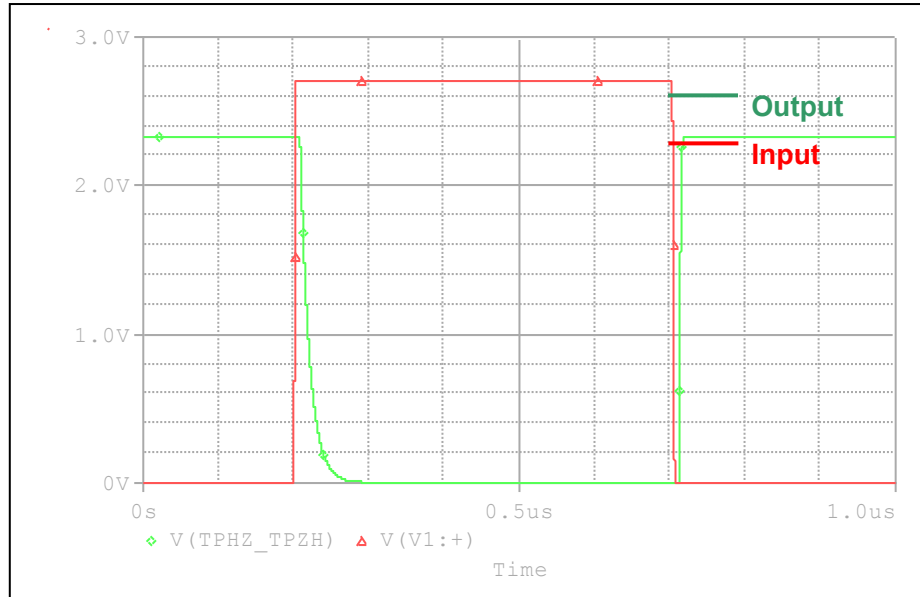


### Comparison table $C_L = 50 \text{ pF}$ , $R_L = 500 \Omega$

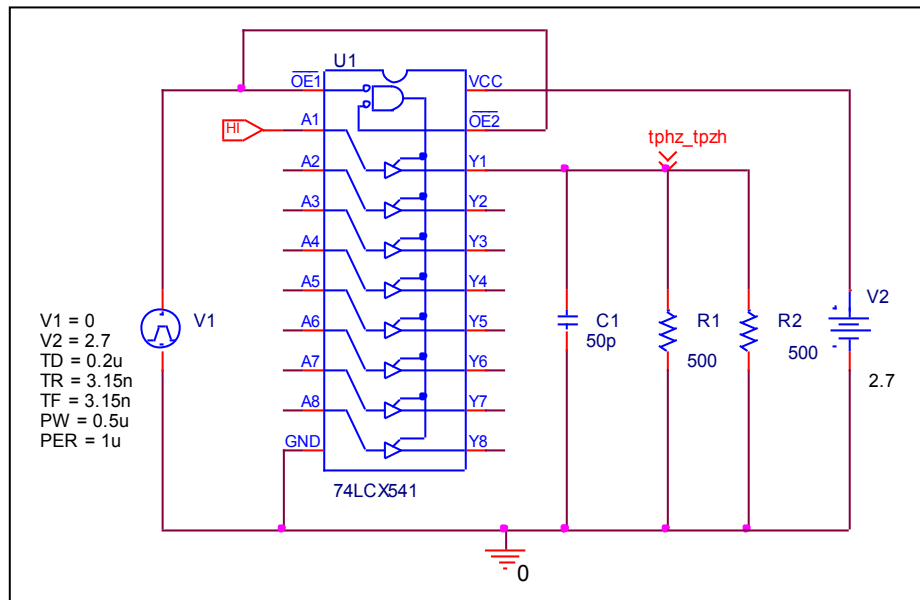
| $V_{CC} = 2.7 \text{ V}$ , $t_r=t_f = 2.5 \text{ ns}$ | Measurement | Simulation | %Error |
|-------------------------------------------------------|-------------|------------|--------|
| $t_{pLH} \text{ (ns)}$                                | 7.5         | 7.4215     | -1.047 |
| $t_{pHL} \text{ (ns)}$                                | 7.5         | 7.4696     | -0.405 |

**Output enable time, high impedance (off) to high output ( $t_{pZH}$ )**  
**Output disable time, high to high impedance (off) output ( $t_{pHZ}$ )**

Circuit simulation result



Evaluation circuit

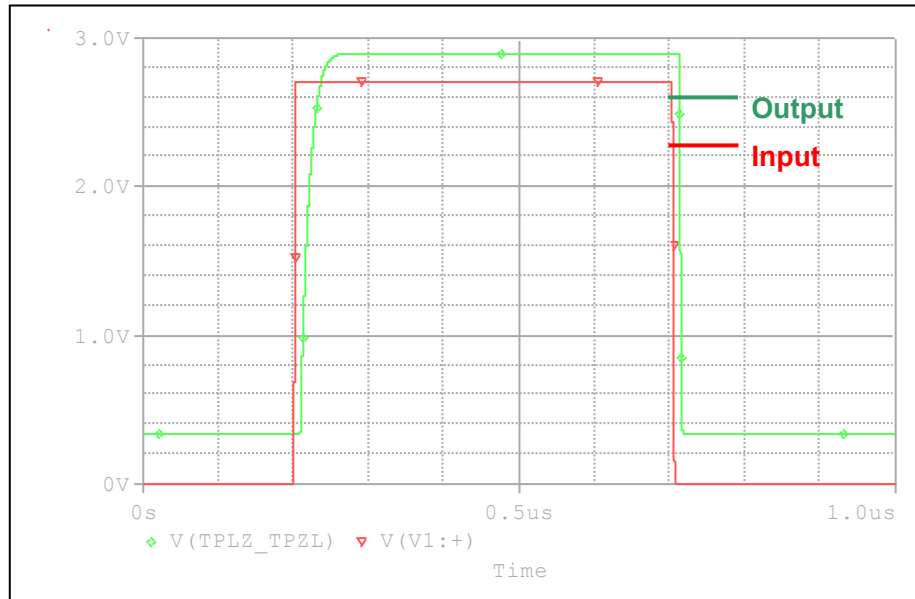


Comparison table  $C_L = 50 \text{ pF}$ ,  $R_L = 500 \Omega$

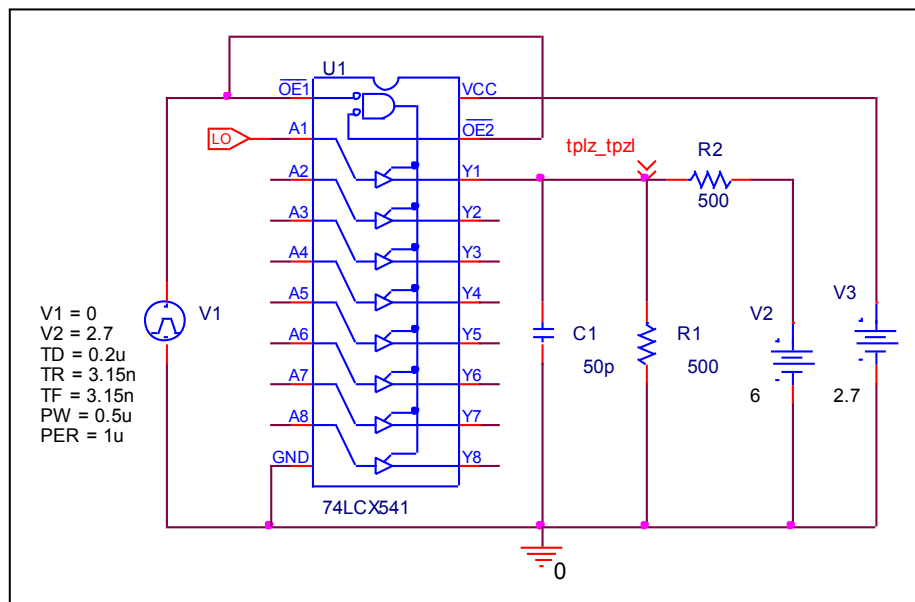
| $V_{CC} = 2.7 \text{ V}$ , $t_r=t_f = 2.5 \text{ ns}$ | Measurement | Simulation | %Error |
|-------------------------------------------------------|-------------|------------|--------|
| $t_{pHZ} \text{ (ns)}$                                | 8.5         | 8.3687     | -1.545 |
| $t_{pZH} \text{ (ns)}$                                | 9.5         | 9.4711     | -0.304 |

**Output enable time, high impedance (off) to low output ( $t_{PZL}$ )**  
**Output disable time, low to high impedance (off) output ( $t_{PLZ}$ )**

**Circuit simulation result**



**Evaluation circuit**



**Comparison table**  $C_L = 50 \text{ pF}$ ,  $R_L = 500 \Omega$

| $V_{CC} = 2.7 \text{ V}$ , $t_r = t_f = 2.5 \text{ ns}$ | Measurement | Simulation | %Error |
|---------------------------------------------------------|-------------|------------|--------|
| $t_{PLZ} \text{ (ns)}$                                  | 8.5         | 8.4395     | -0.712 |
| $t_{PZL} \text{ (ns)}$                                  | 9.5         | 9.583      | 0.874  |