

# Device Modeling Report

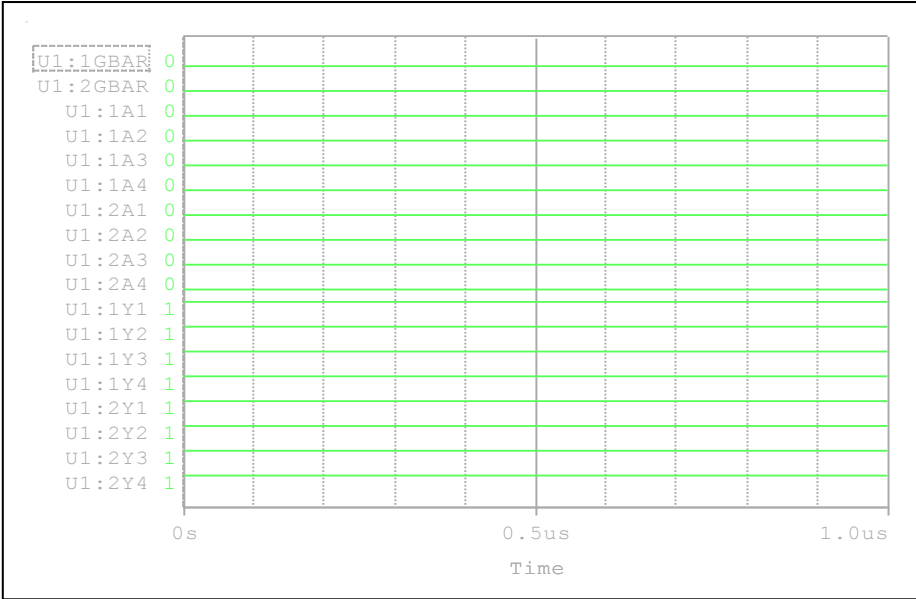
COMPONENTS : CMOS DIGITAL INTEGRATED CIRCUIT  
PART NUMBER : TC74VHC240FW  
MANUFACTURER : TOSHIBA



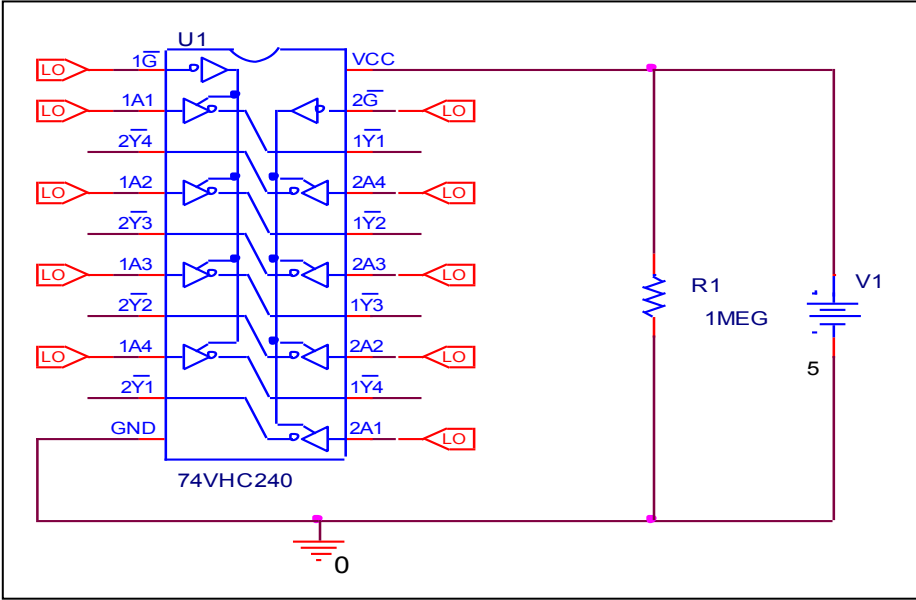
**Bee Technologies Inc.**

# Truth Table

## Circuit simulation result



## Evaluation circuit

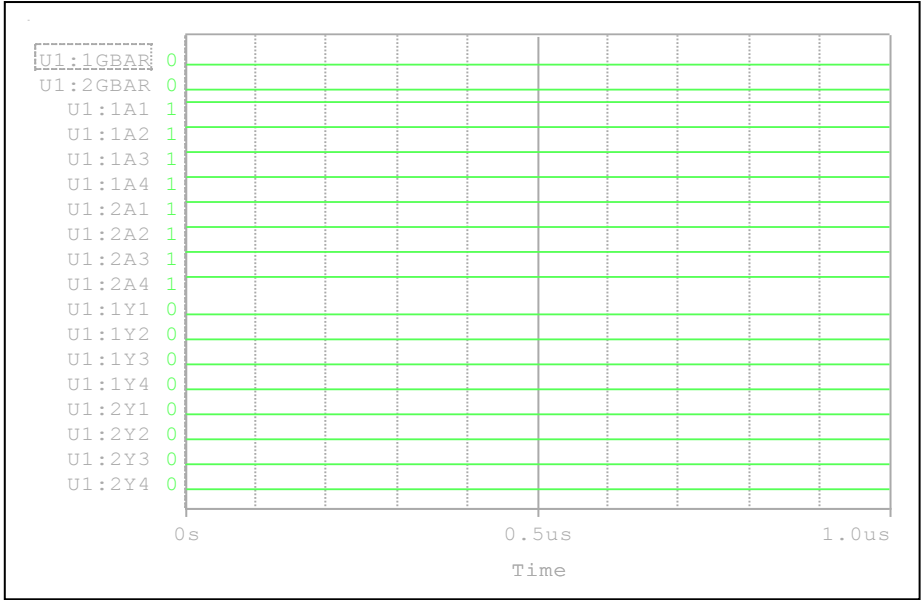


## Comparison table

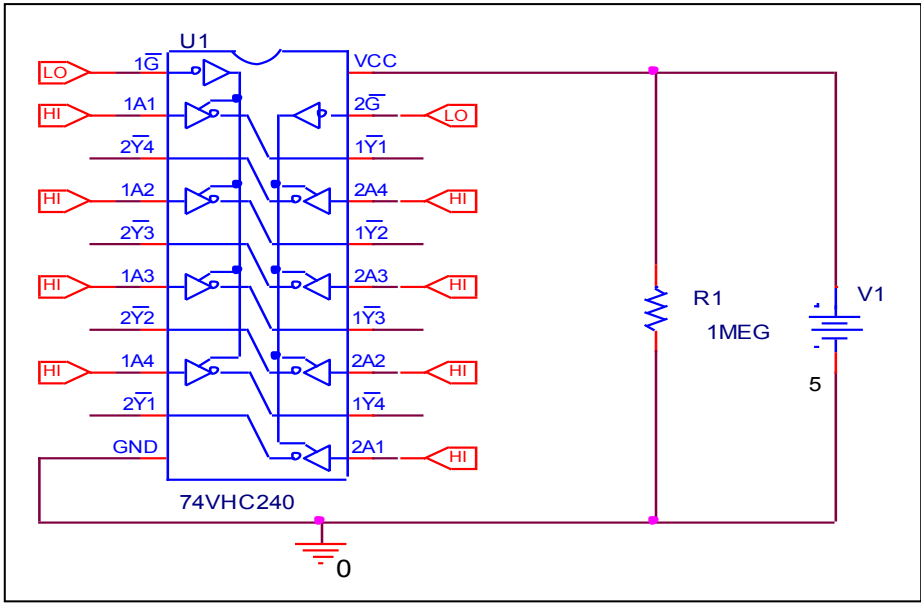
| Input     |    | Output                    |                          | %Error |
|-----------|----|---------------------------|--------------------------|--------|
| $\bar{G}$ | An | $\bar{Y}_n$ (Measurement) | $\bar{Y}_n$ (Simulation) |        |
| L         | L  | H                         | H                        | 0      |

# Truth Table

Circuit simulation result



Evaluation circuit

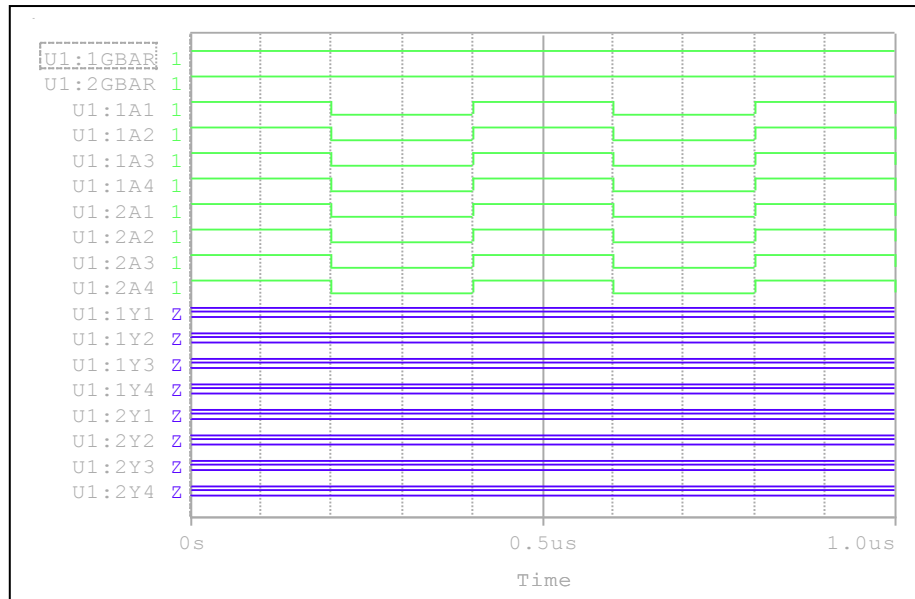


Comparison table

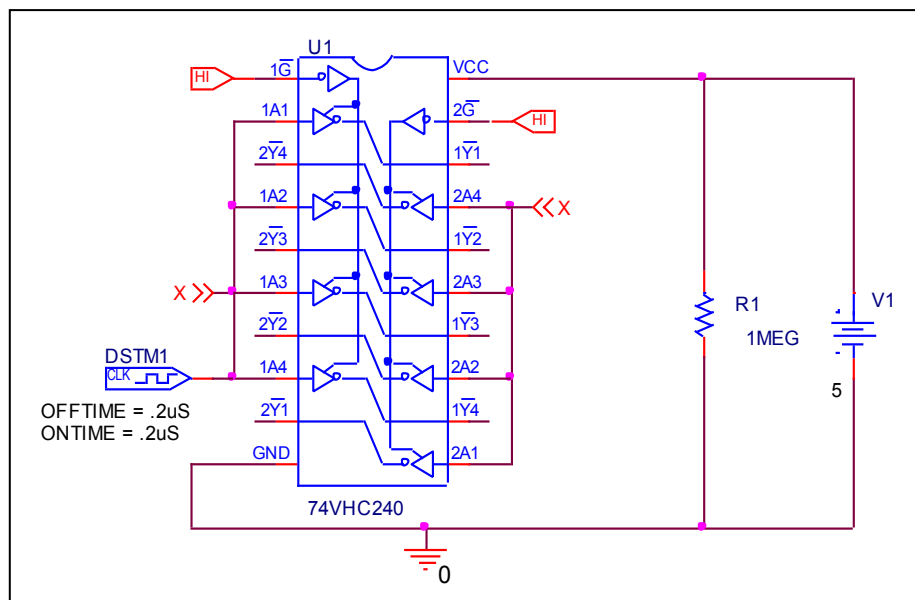
| Input          |    | Output                         |                               | %Error |
|----------------|----|--------------------------------|-------------------------------|--------|
| $\overline{G}$ | An | $\overline{Y}_n$ (Measurement) | $\overline{Y}_n$ (Simulation) |        |
| L              | H  | L                              | L                             | 0      |

## Truth Table

### Circuit simulation result



## Evaluation circuit

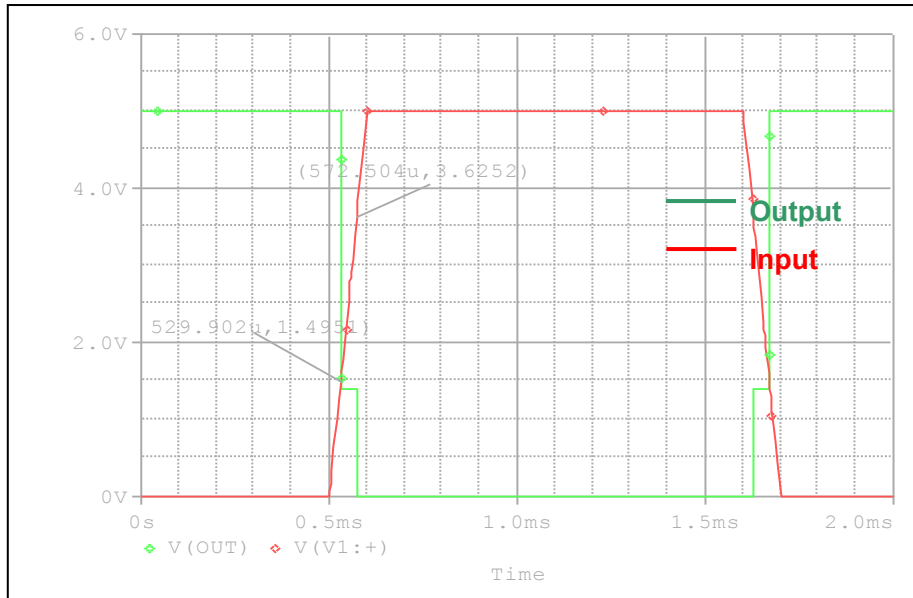


## Comparison table

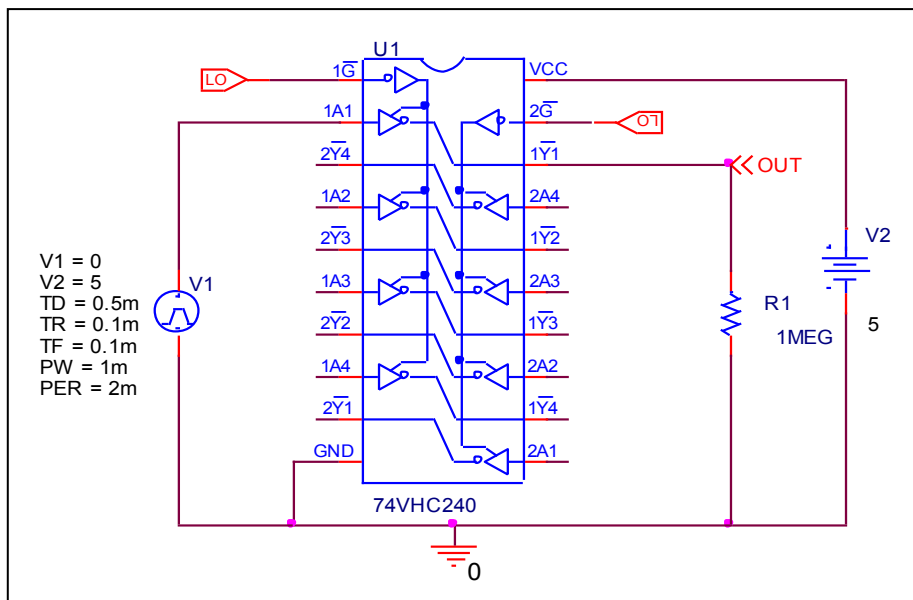
| Input          |       | Output                         |                               | %Error |
|----------------|-------|--------------------------------|-------------------------------|--------|
| $\overline{G}$ | $A_n$ | $\overline{Y}_n$ (Measurement) | $\overline{Y}_n$ (Simulation) |        |
| H              | X     | Z                              | Z                             | 0      |

# High Level and Low Level Input Voltage

## Circuit simulation result



## Evaluation circuit

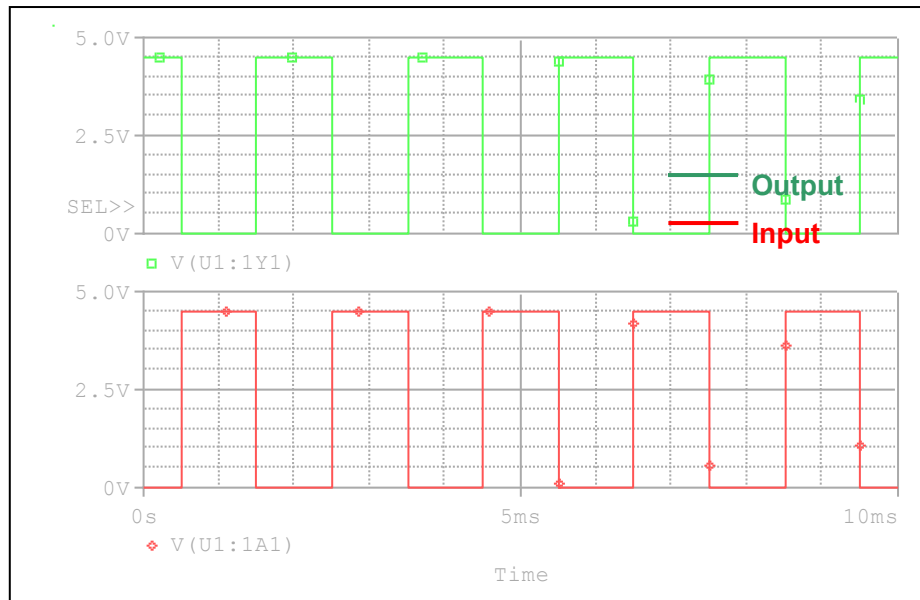


## Comparison table

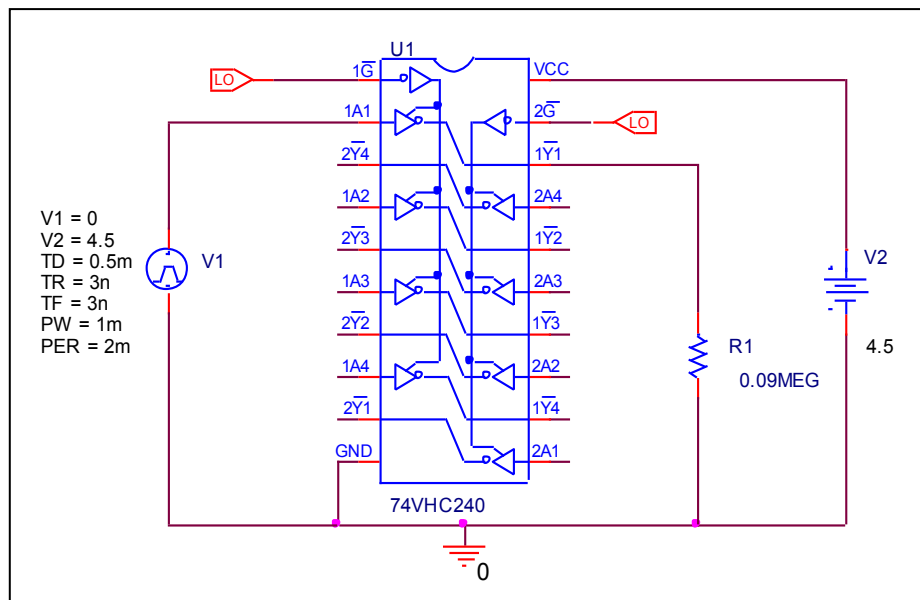
| $V_{CC} = 5\text{ V}$                      | Measurement | Simulation | %Error |
|--------------------------------------------|-------------|------------|--------|
| Min $V_{IH} = (V_{CC} \cdot 0.7)\text{ V}$ | 3.5         | 3.6252     | 3.577  |
| Min $V_{IL} = (V_{CC} \cdot 0.3)\text{ V}$ | 1.5         | 1.4951     | -0.327 |

## High Level and Low Level Output Voltage

### Circuit simulation result



### Evaluation circuit

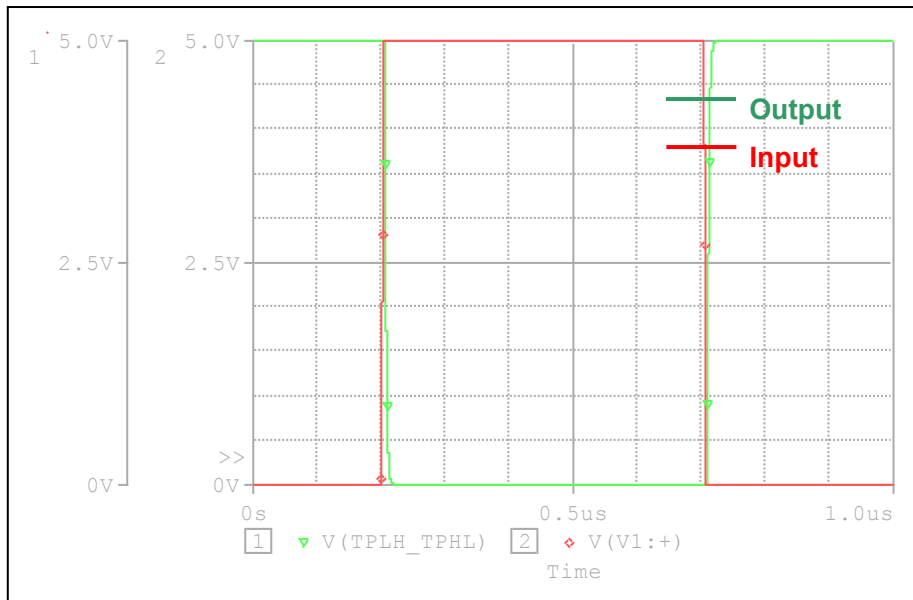


### Comparison table

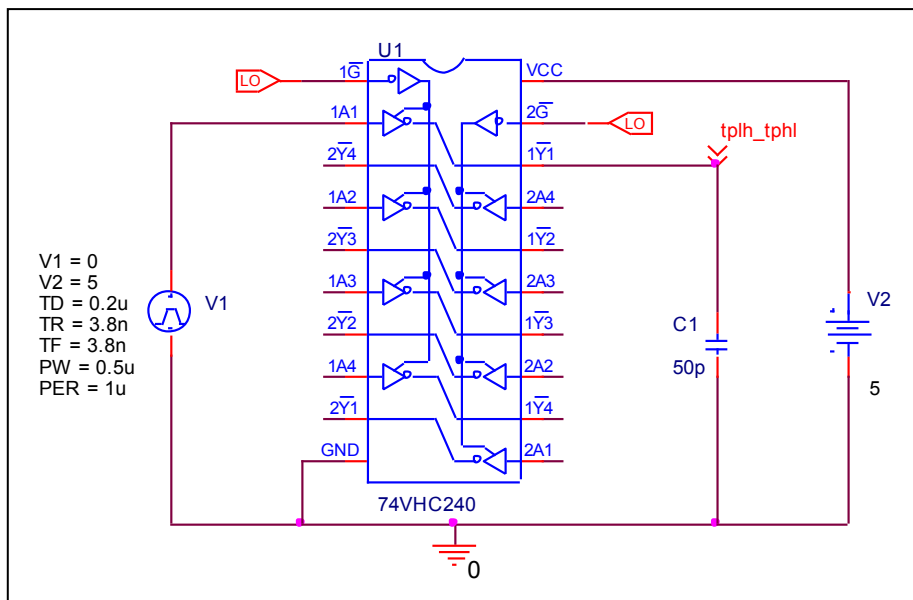
| $V_{CC} = 4.5V$ | Measurement | Simulation | %Error |
|-----------------|-------------|------------|--------|
| $V_{OH} (V)$    | 4.5         | 4.4978     | -0.049 |
| $V_{OL} (V)$    | 0           | 0          | 0      |

## Propagation Delay Time

### Circuit simulation result



### Evaluation circuit

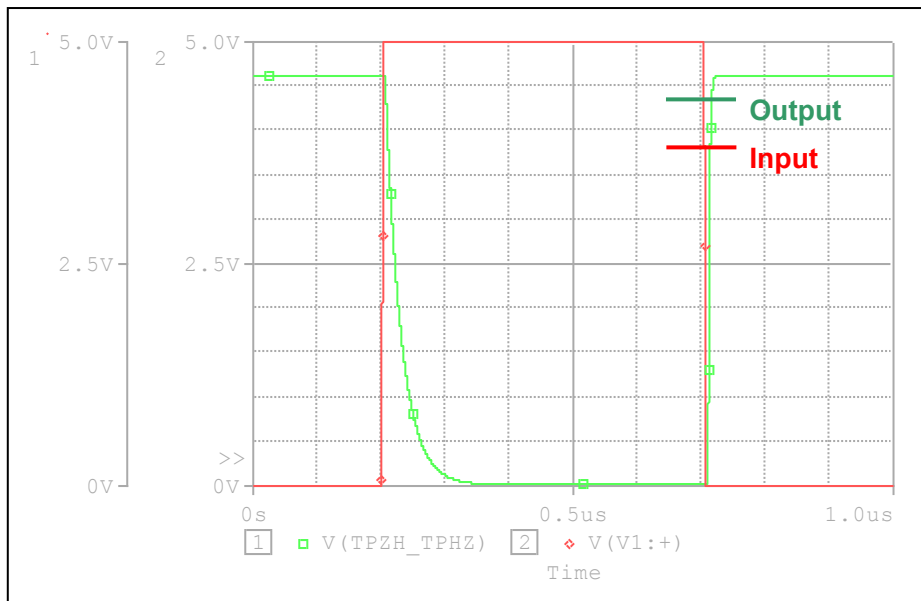


### Comparison table $C_L = 50 \text{ pF}$

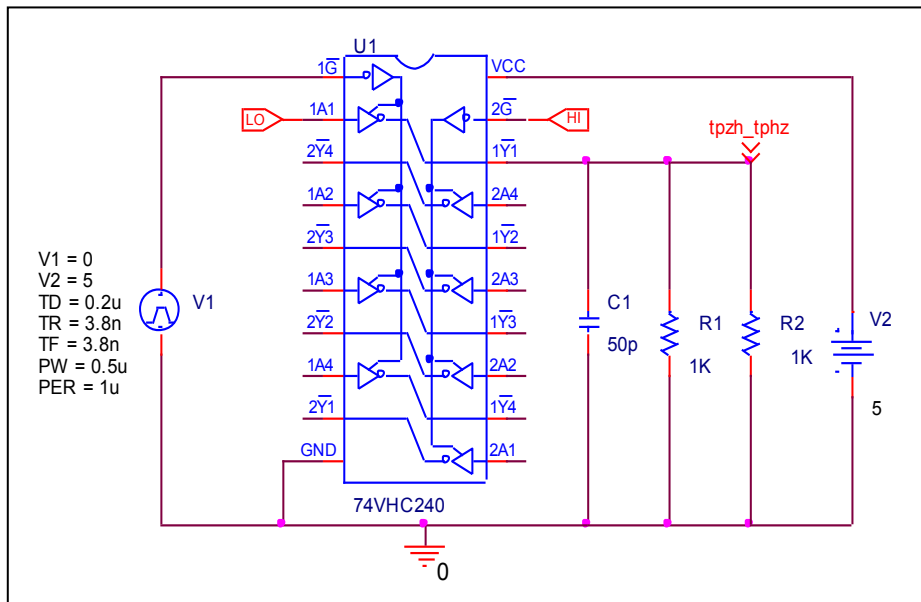
| $V_{CC} = 5 \text{ V}$ $t_r = t_f = 3 \text{ ns}$ | Measurement | Simulation | %Error |
|---------------------------------------------------|-------------|------------|--------|
| $t_{PLH} \text{ (ns)}$                            | 5.1         | 5.1476     | 0.933  |
| $t_{PHL} \text{ (ns)}$                            | 5.1         | 5.1714     | 1.400  |

**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



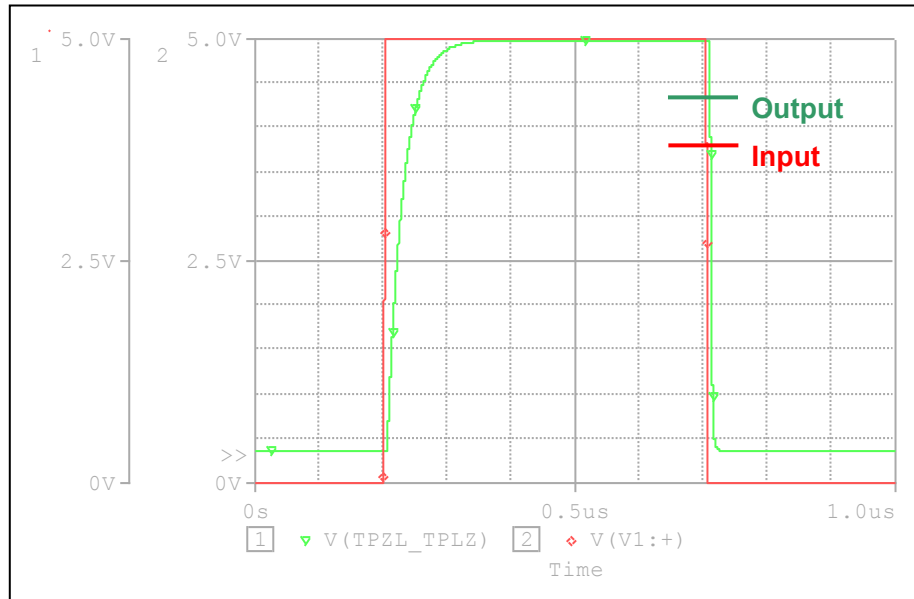
# Comparison table

$C_L = 50 \text{ pF}$ ,  $R_L = 1 \text{ k}\Omega$

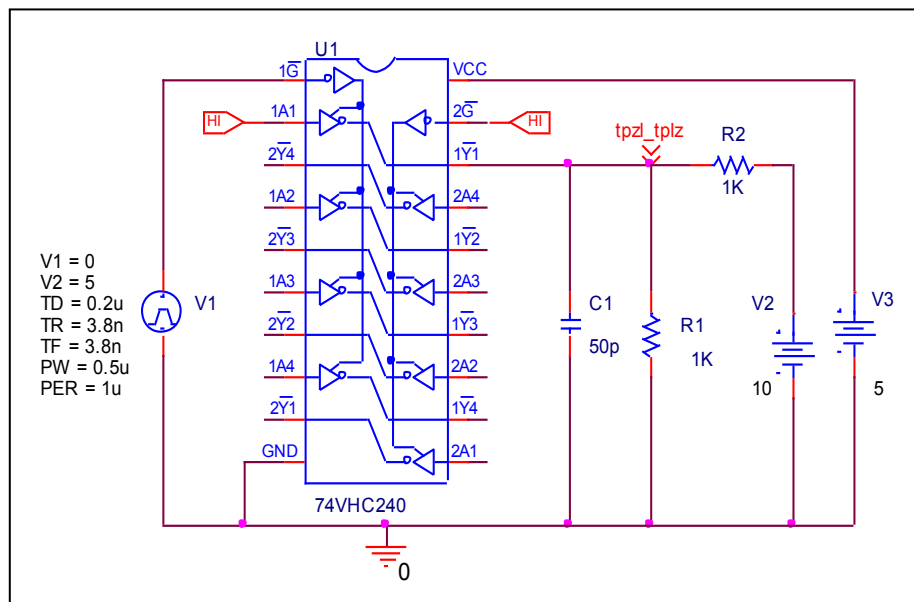
| $V_{CC} = 5 \text{ V}$ , $t_r = t_f = 3 \text{ ns}$ | Measurement | Simulation | %Error |
|-----------------------------------------------------|-------------|------------|--------|
| $t_{PZH} \text{ (ns)}$                              | 6.2         | 6.2419     | 0.676  |
| $t_{PHZ} \text{ (ns)}$                              | 6.7         | 6.7540     | 0.806  |

**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**  $C_L = 50 \text{ pF}$ ,  $R_L = 1 \text{ k}\Omega$

| $V_{CC} = 5 \text{ V}$ $t_r = t_f = 3 \text{ ns}$ | Measurement | Simulation | %Error |
|---------------------------------------------------|-------------|------------|--------|
| $t_{PZL} \text{ (ns)}$                            | 6.2         | 6.2156     | 0.252  |
| $t_{PLZ} \text{ (ns)}$                            | 6.7         | 6.7531     | 0.793  |