

# Device Modeling Report

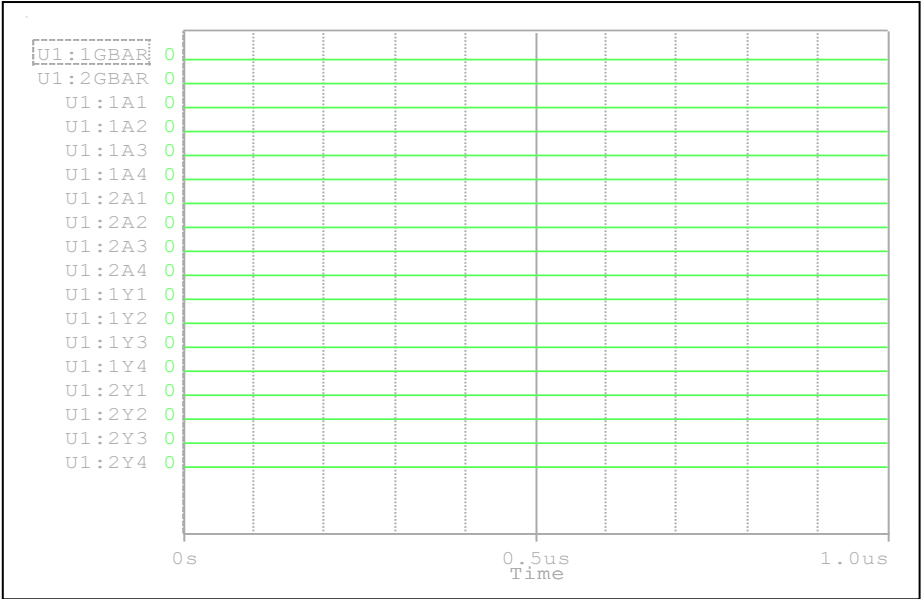
COMPONENTS : CMOS DIGITAL INTEGRATED CIRCUIT  
PART NUMBER : TC74VHCT244AF  
MANUFACTURER : TOSHIBA



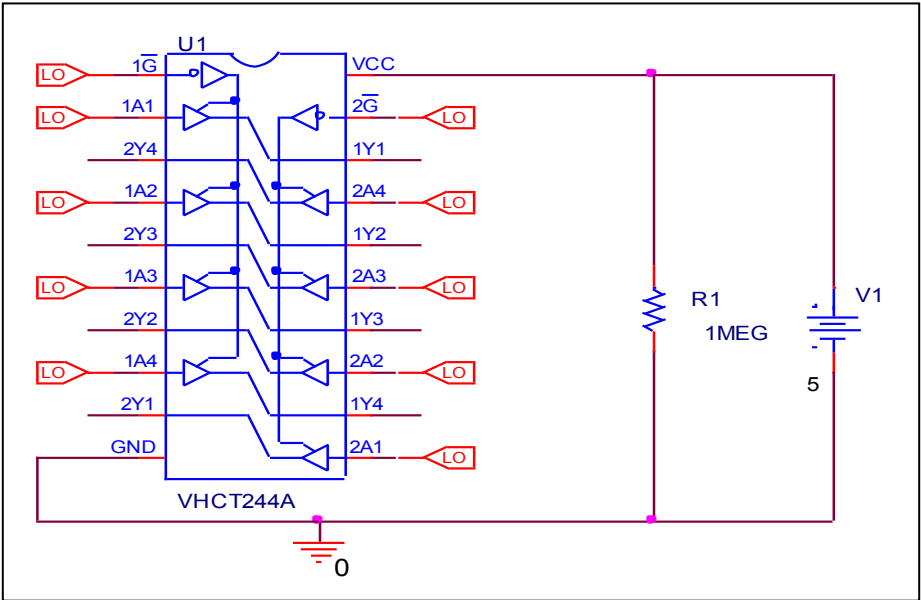
**Bee Technologies Inc.**

# Truth Table

Circuit simulation result



Evaluation circuit

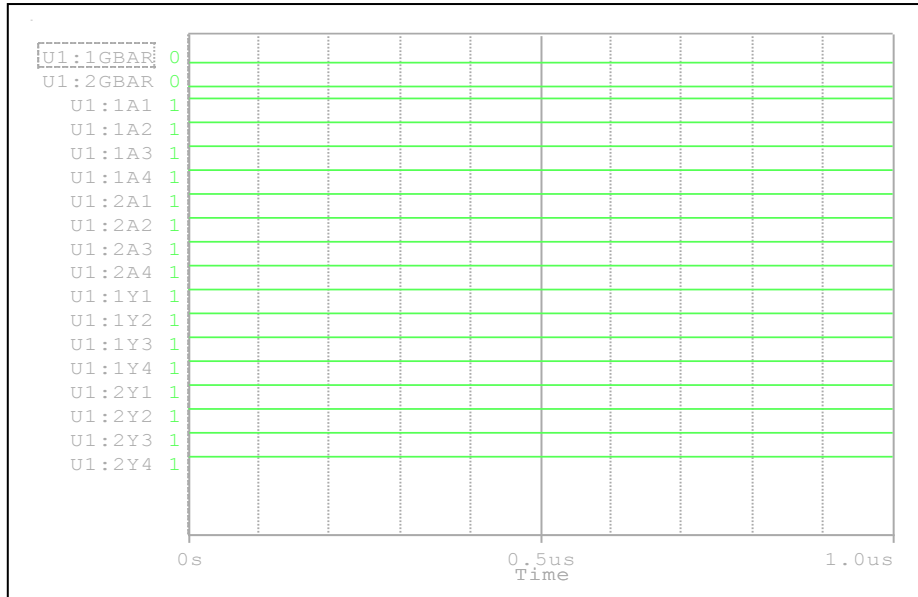


Comparison table

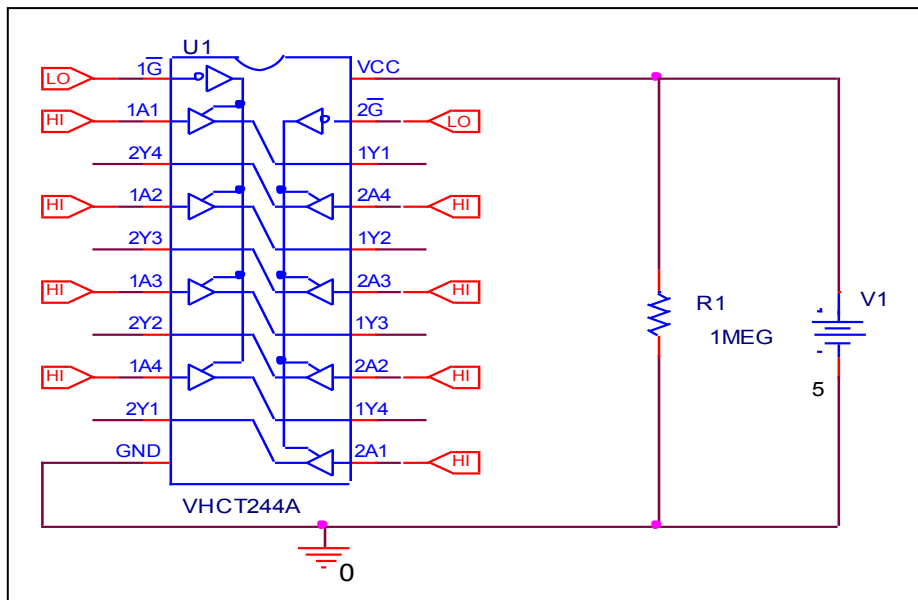
| Input          |    | Output           |                 | %Error |
|----------------|----|------------------|-----------------|--------|
| $\overline{G}$ | An | Yn (Measurement) | Yn (Simulation) |        |
| L              | L  | L                | L               | 0      |

## Truth Table

### Circuit simulation result



### Evaluation circuit

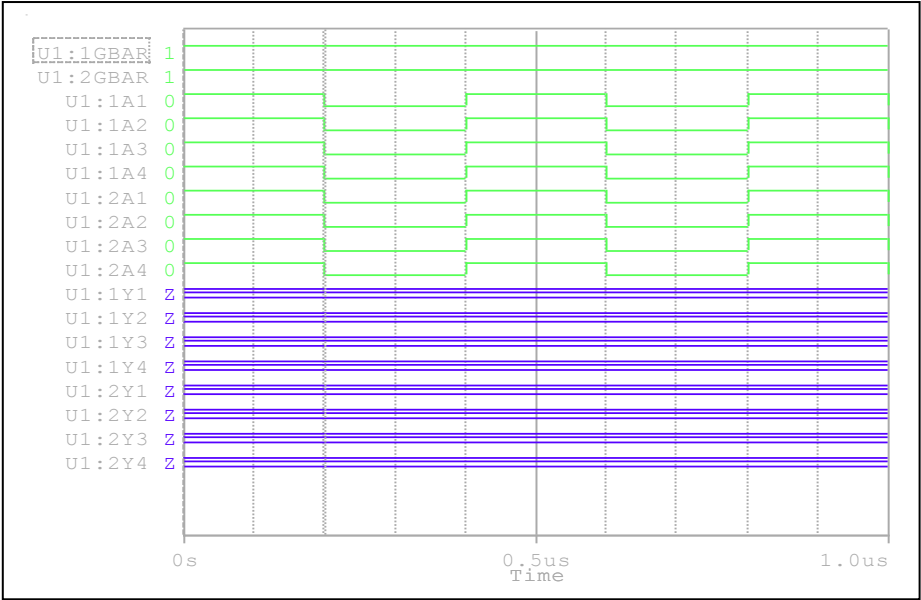


### Comparison table

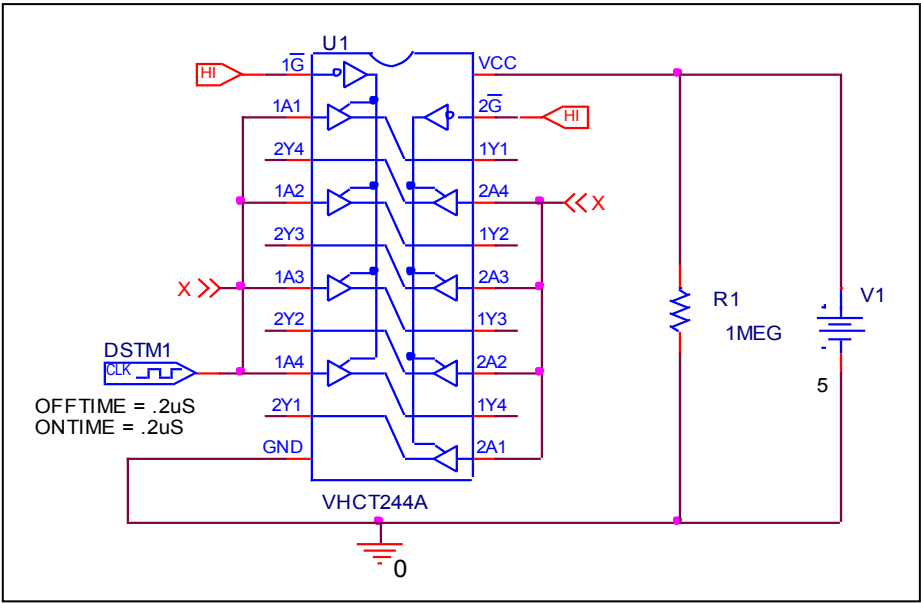
| Input          |    | Output           |                 | %Error |
|----------------|----|------------------|-----------------|--------|
| $\overline{G}$ | An | Yn (Measurement) | Yn (Simulation) |        |
| L              | H  | H                | H               | 0      |

# Truth Table

Circuit simulation result



Evaluation circuit

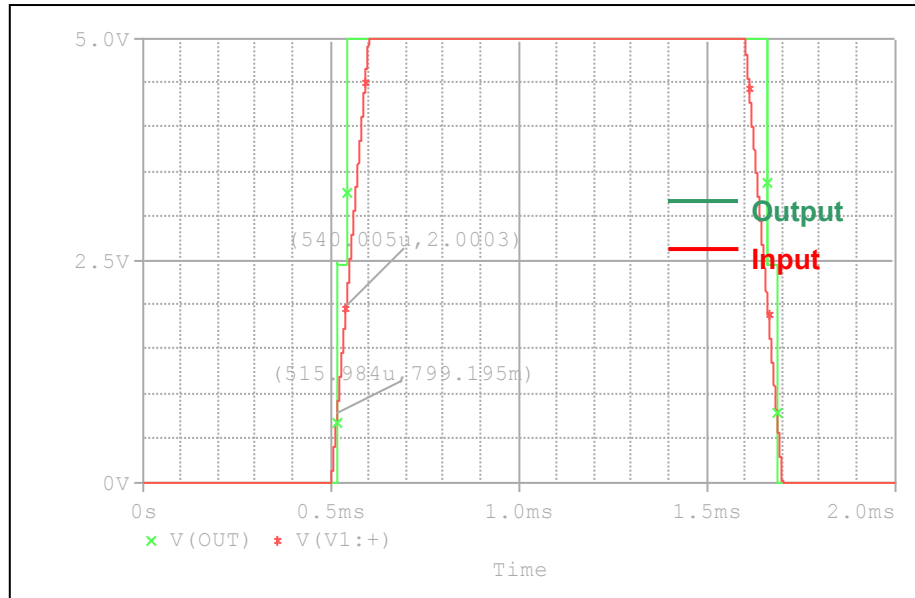


Comparison table

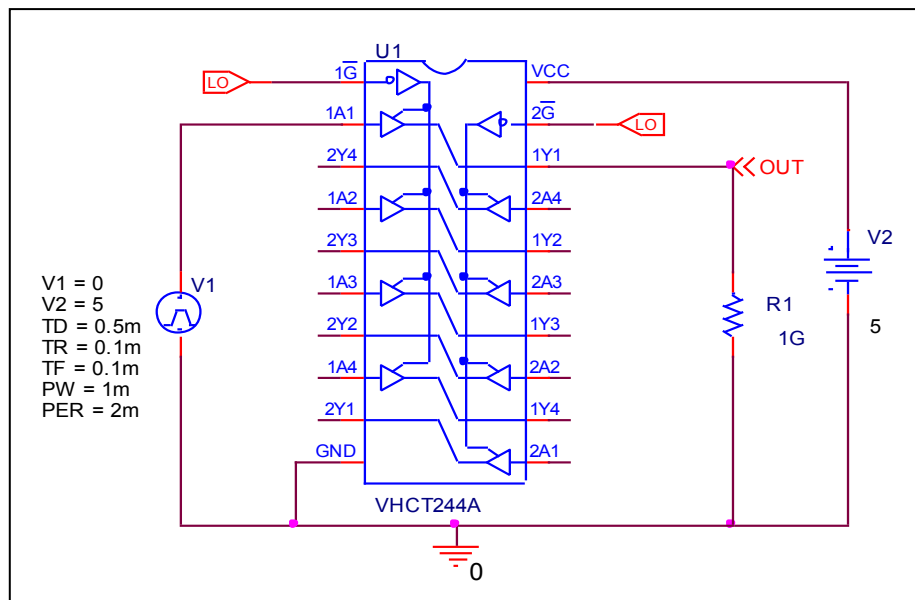
| Input          |       | Output              |                    | %Error |
|----------------|-------|---------------------|--------------------|--------|
| $\overline{G}$ | $A_n$ | $Y_n$ (Measurement) | $Y_n$ (Simulation) |        |
| H              | X     | Z                   | Z             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

## High Level and Low Level Input Voltage

### Circuit simulation result



### Evaluation circuit

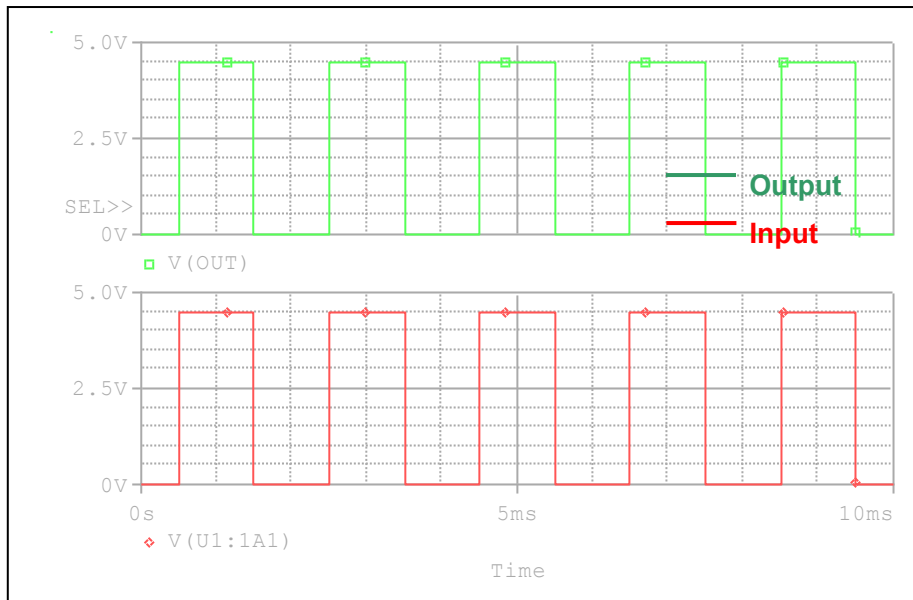


### Comparison table

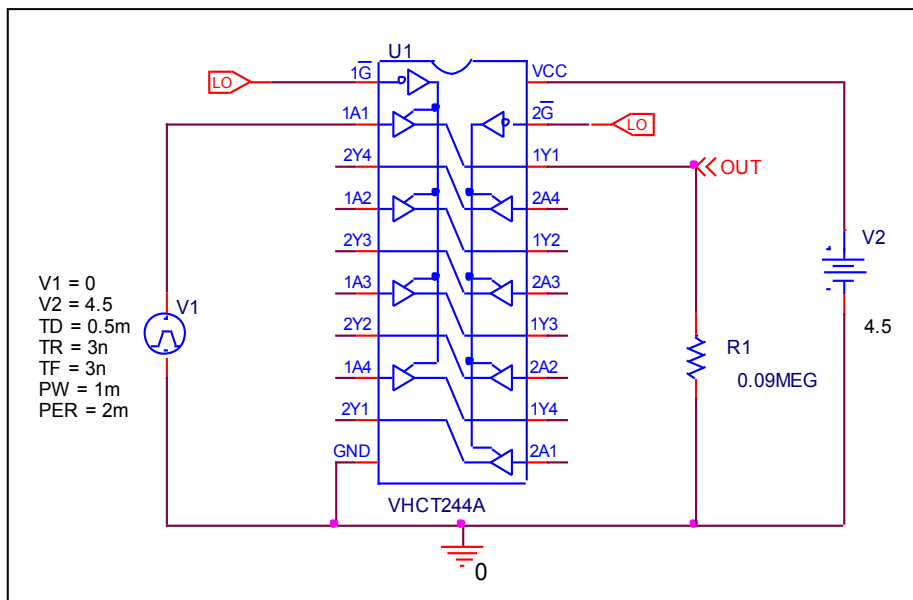
| $V_{CC} = 5V$ | Measurement | Simulation | %Error |
|---------------|-------------|------------|--------|
| $V_{IH} (V)$  | 2           | 2          | 0      |
| $V_{IL} (V)$  | 0.8         | 0.799195   | -0.101 |

## High Level and Low Level Output Voltage

### Circuit simulation result



### Evaluation circuit

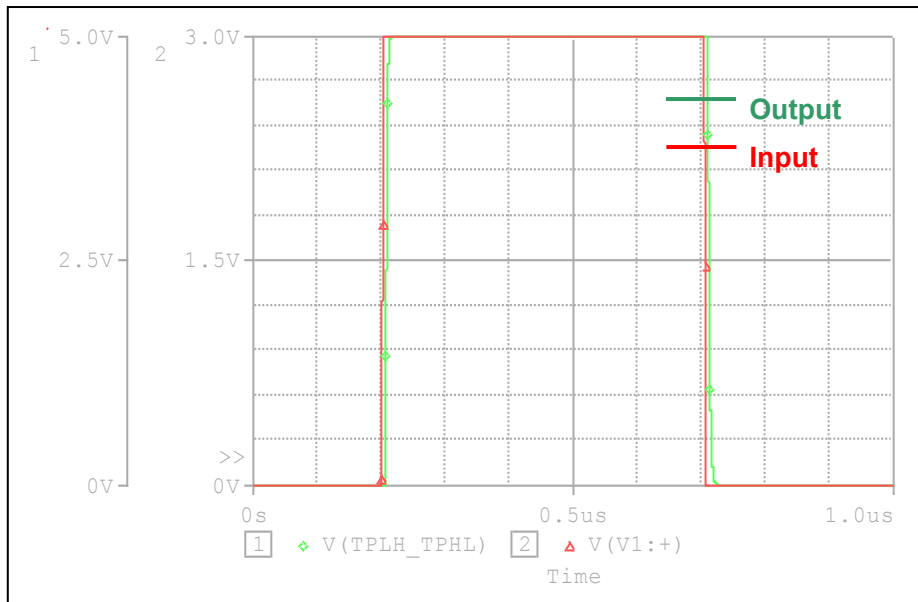


### Comparison table

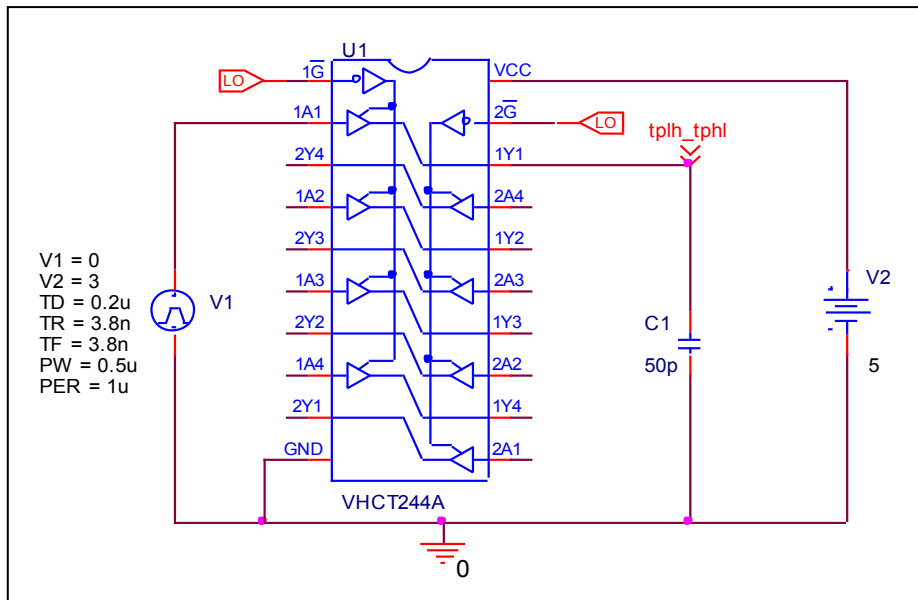
| $V_{CC} = 4.5V$ | Measurement | Simulation | %Error |
|-----------------|-------------|------------|--------|
| $V_{OH} (V)$    | 4.5         | 4.4976     | -0.053 |
| $V_{OL} (V)$    | 0           | 0          | 0      |

## Propagation Delay Time

### Circuit simulation result



### Evaluation circuit

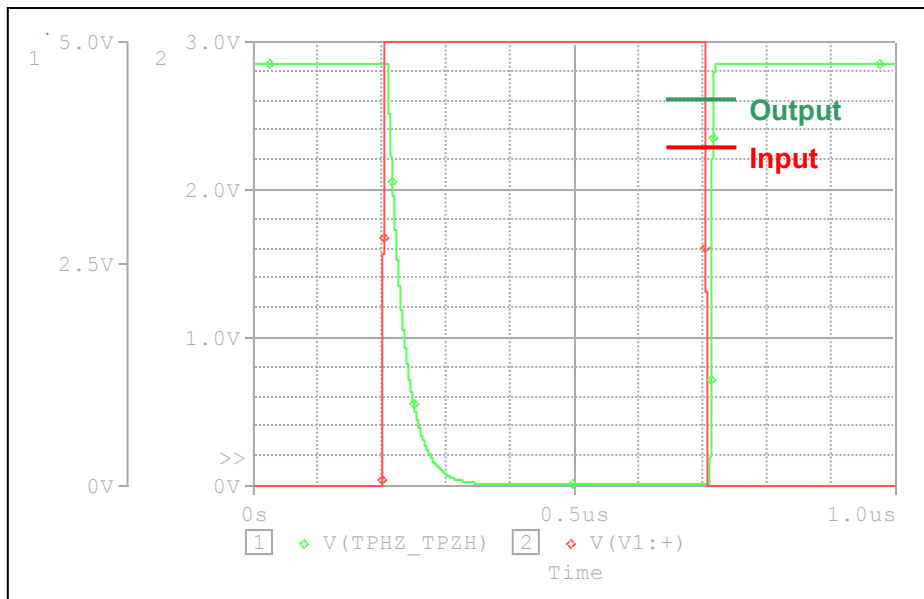


### Comparison table $C_L = 50 \text{ pF}$

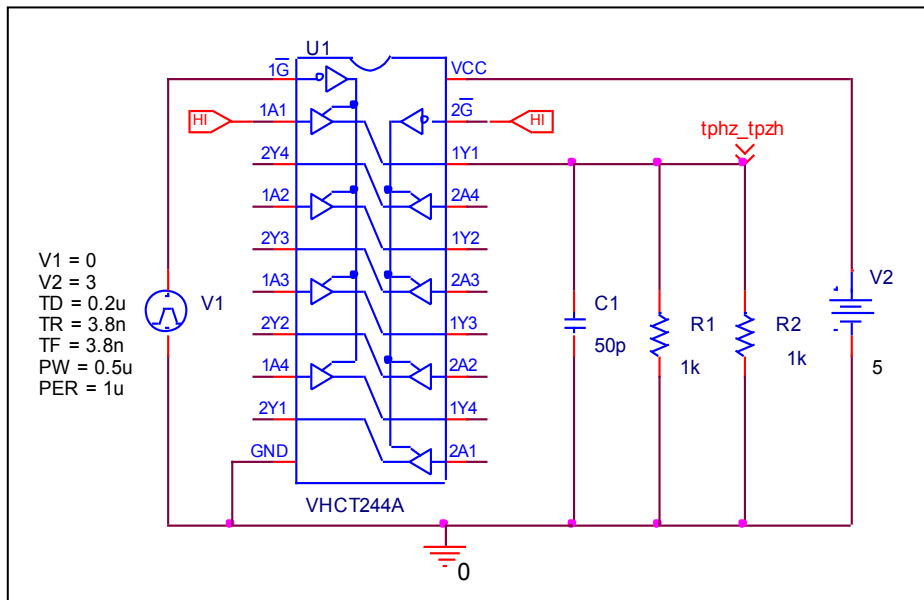
| $t_r = t_f = 3 \text{ ns}$ | Measurement | Simulation | %Error |
|----------------------------|-------------|------------|--------|
| $t_{PLH} \text{ (ns)}$     | 5.9         | 5.9782     | 1.325  |
| $t_{PHL} \text{ (ns)}$     | 5.9         | 5.9327     | 0.554  |

**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**

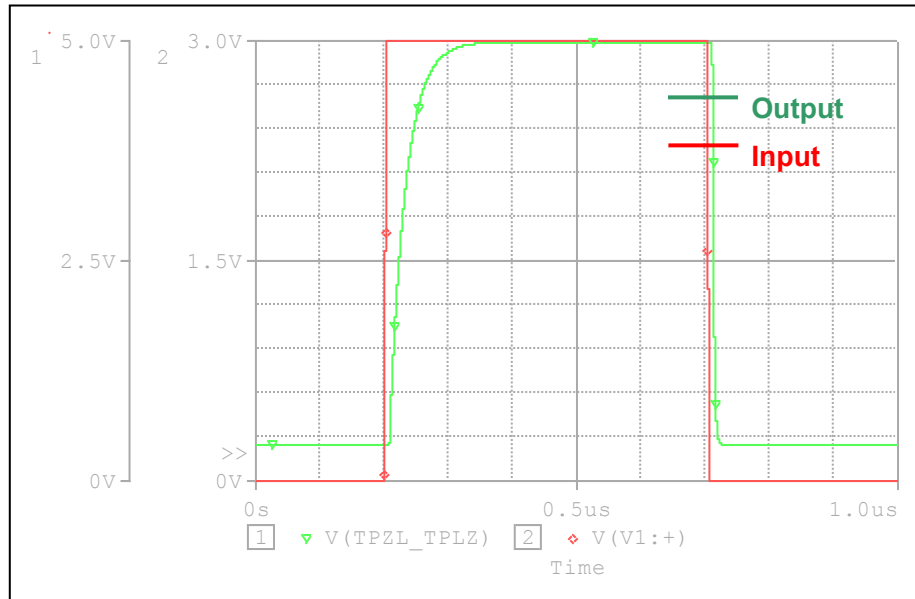


**Comparison table**  $C_L = 50 \text{ pF}$ ,  $R_L = 1 \text{ K}\Omega$

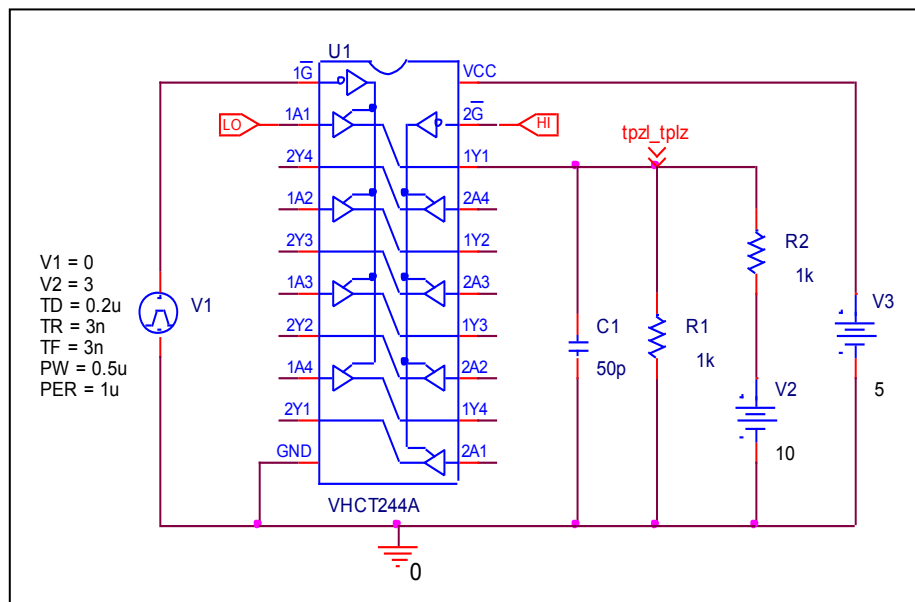
| $t_r = t_f = 3 \text{ ns}$ | Measurement | Simulation | %Error |
|----------------------------|-------------|------------|--------|
| $t_{PZH} \text{ (ns)}$     | 8.2         | 8.2441     | 0.538  |
| $t_{PHZ} \text{ (ns)}$     | 8.8         | 8.9224     | 1.391  |

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

| $t_r = t_f = 3 \text{ ns}$ | Measurement | Simulation | %Error |
|----------------------------|-------------|------------|--------|
| $t_{PZL} \text{ (ns)}$     | 8.2         | 8.2238     | 0.290  |
| $t_{PLZ} \text{ (ns)}$     | 8.8         | 8.8277     | 0.315  |