

# Device Modeling Report

COMPONENTS : VOLTAGE COMPARATOR (CMOS)  
PART NUMBER : TC75S58FE  
MANUFACTURER : TOSHIBA



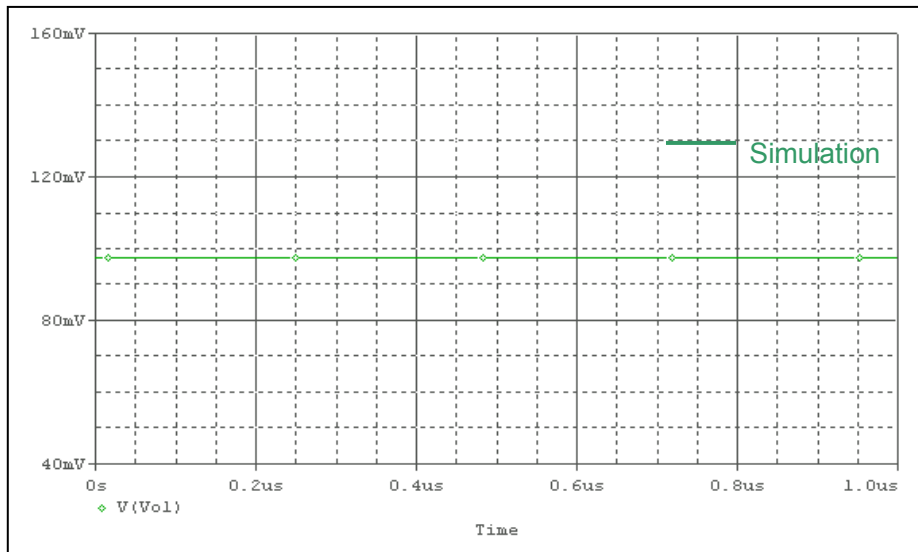
**Bee Technologies Inc.**

## MODEL PARAMETER

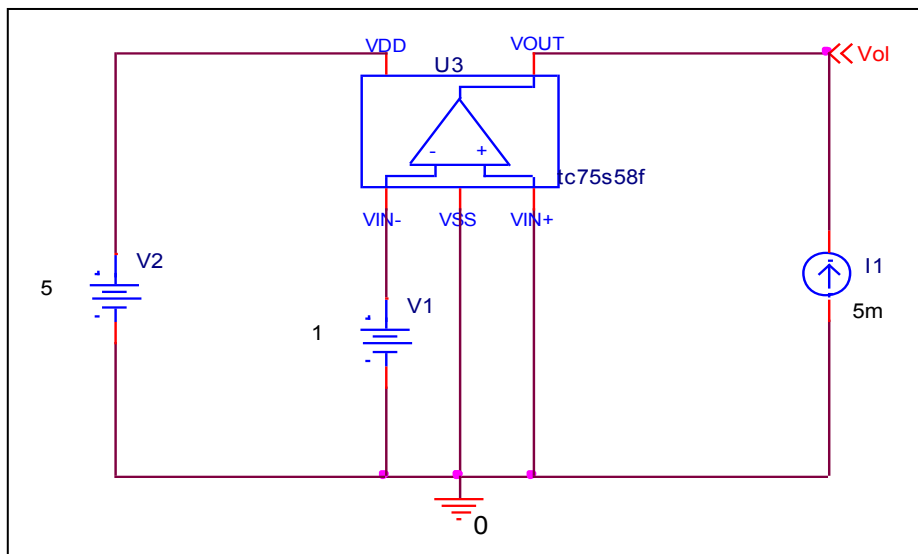
| Pspice model parameter | Model description                                  |
|------------------------|----------------------------------------------------|
| LEVEL                  |                                                    |
| L                      | Channel Length                                     |
| W                      | Channel Width                                      |
| KP                     | Transconductance                                   |
| RS                     | Source Ohmic Resistance                            |
| RD                     | Ohmic Drain Resistance                             |
| VTO                    | Zero-bias Threshold Voltage                        |
| RDS                    | Drain-Source Shunt Resistance                      |
| TOX                    | Gate Oxide Thickness                               |
| CGSO                   | Zero-bias Gate-Source Capacitance                  |
| CGDO                   | Zero-bias Gate-Drain Capacitance                   |
| CBD                    | Zero-bias Bulk-Drain Junction Capacitance          |
| MJ                     | Bulk Junction Grading Coefficient                  |
| PB                     | Bulk Junction Potential                            |
| FC                     | Bulk Junction Forward-bias Capacitance Coefficient |
| RG                     | Gate Ohmic Resistance                              |
| IS                     | Bulk Junction Saturation Current                   |
| N                      | Bulk Junction Emission Coefficient                 |
| RB                     | Bulk Series Resistance                             |
| PHI                    | Surface Inversion Potential                        |
| GAMMA                  | Body-effect Parameter                              |
| DELTA                  | Width effect on Threshold Voltage                  |
| ETA                    | Static Feedback on Threshold Voltage               |
| THETA                  | Modility Modulation                                |
| KAPPA                  | Saturation Field Factor                            |
| VMAX                   | Maximum Drift Velocity of Carriers                 |
| XJ                     | Metallurgical Junction Depth                       |
| UO                     | Surface Mobility                                   |

## Output Low Voltage

### Simulation result



### Evaluation Circuit

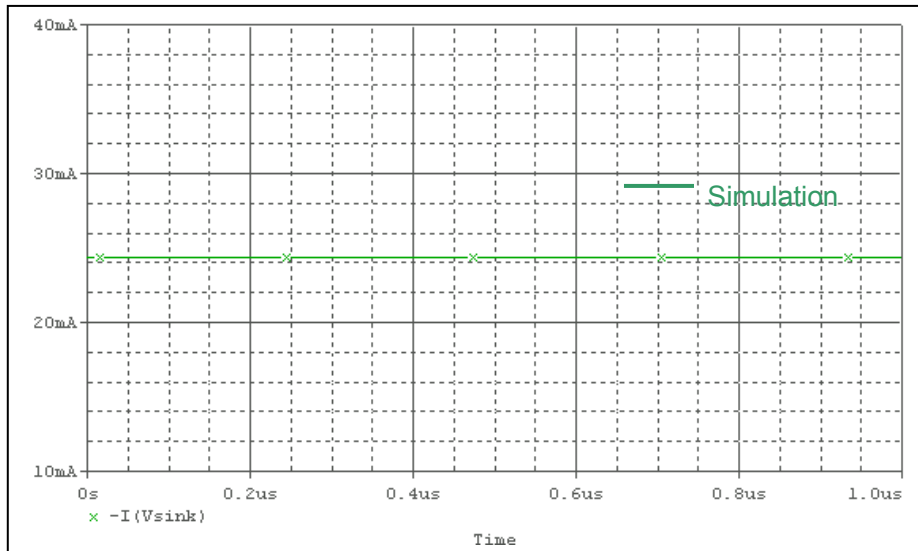


### Comparison Table

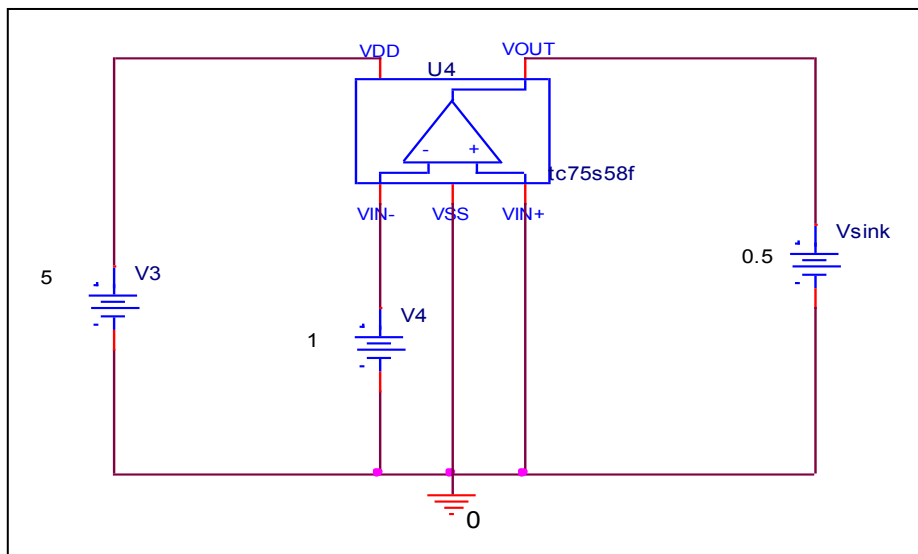
| $I_{\text{sink}}=5\text{mA}$ | Measurement | Simulation | %Error |
|------------------------------|-------------|------------|--------|
| $V_{\text{ol}} \text{ (V)}$  | 0.1         | 0.097472   | -2.528 |

## Output Sink Current

### Simulation result



### Evaluation Circuit

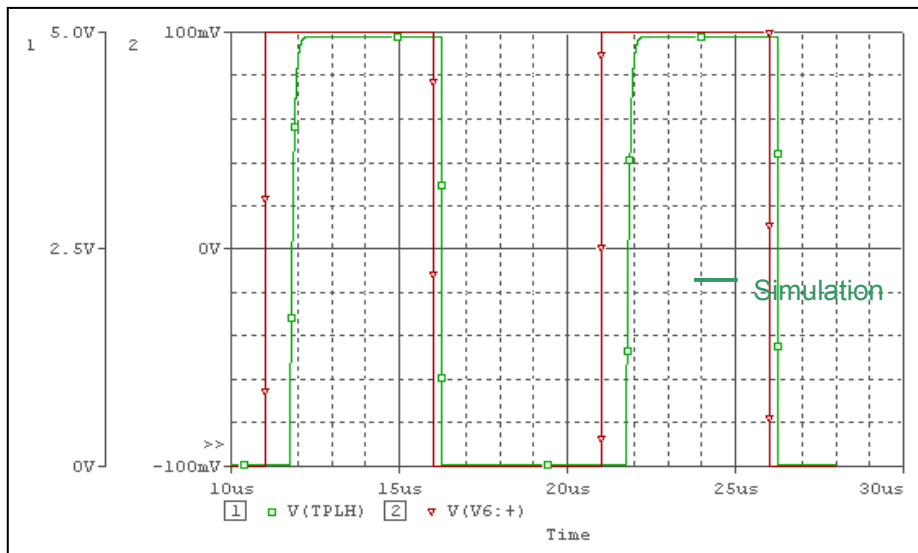


### Comparison Table

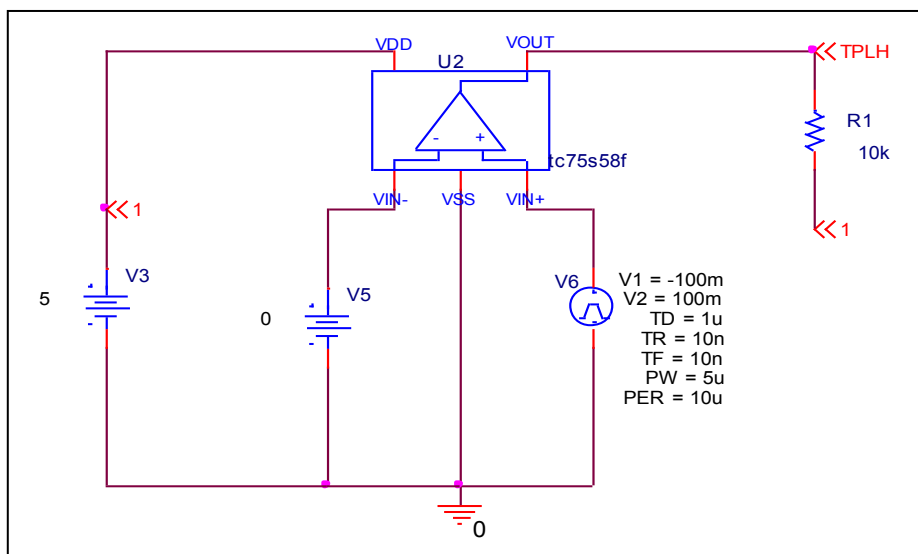
| $V_{OL} = 0.5\text{ V}$       | Measurement | Simulation | %Error |
|-------------------------------|-------------|------------|--------|
| $I_{\text{sink}}\text{ (mA)}$ | 25          | 24.375     | -2.50  |

## Propagation Delay Time and Response Time

### Simulation result



### Evaluation Circuit

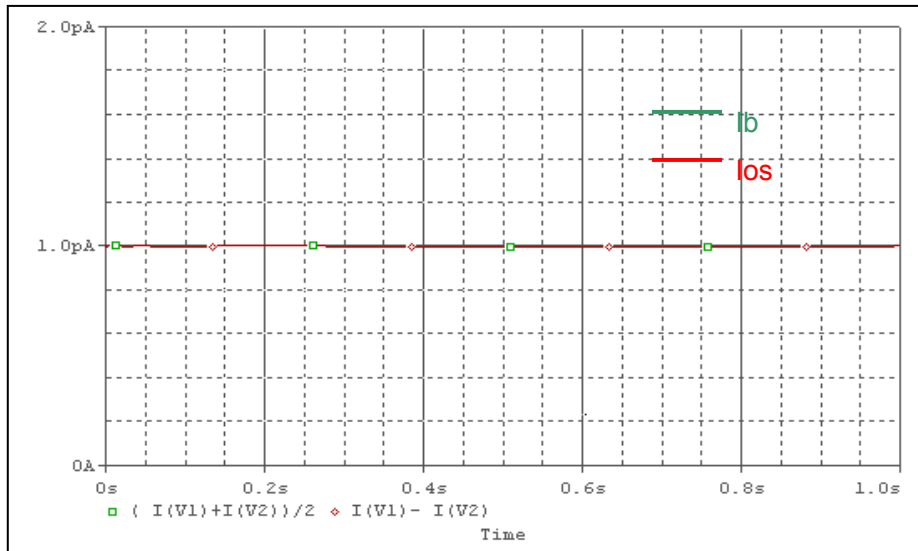


### Comparison Table

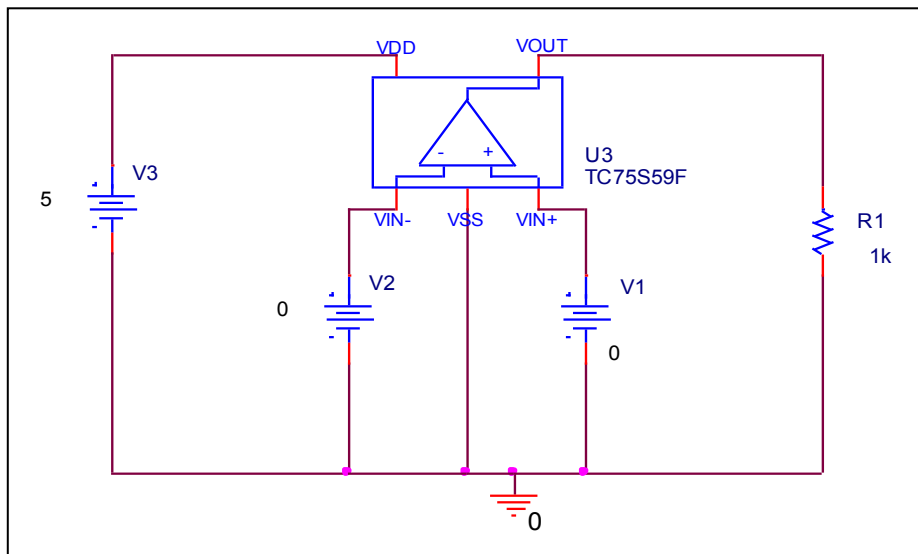
| Over drive=100mV | Measurement | Simulation | %Error |
|------------------|-------------|------------|--------|
| $t_{PLH}$ (ns)   | 800         | 811.041    | 1.380  |
| $t_{PHL}$ (ns)   | 230         | 235.854    | 2.545  |
| $t_r$ (ns)       | 190         | 193.854    | 2.028  |
| $t_f$ (ns)       | 6           | 5.8936     | -1.773 |

# Input Bias Current and Input Offset Current Characteristics

## Simulation result



## Evaluation Circuit

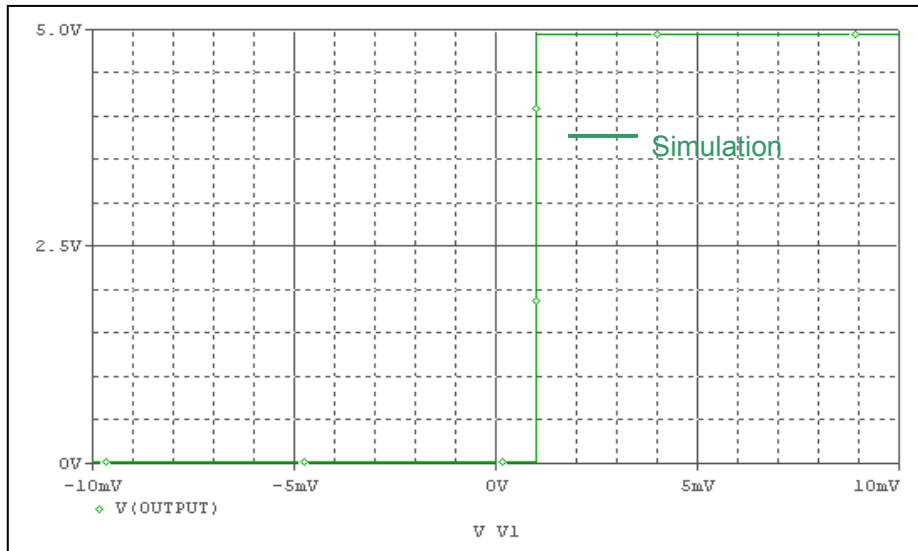


## Comparison Table

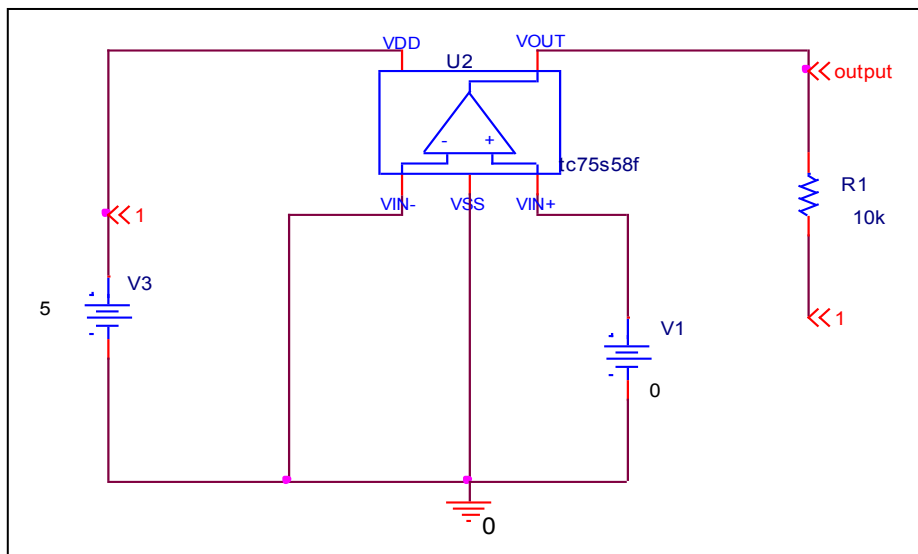
|               | Measurement | Simulation | %Error |
|---------------|-------------|------------|--------|
| $I_b$ (pA)    | 1           | 0.9988     | -0.120 |
| $I_{os}$ (pA) | 1           | 0.9983     | -0.170 |

## Input Offset Voltage Characteristics

### Simulation result



### Evaluation Circuit

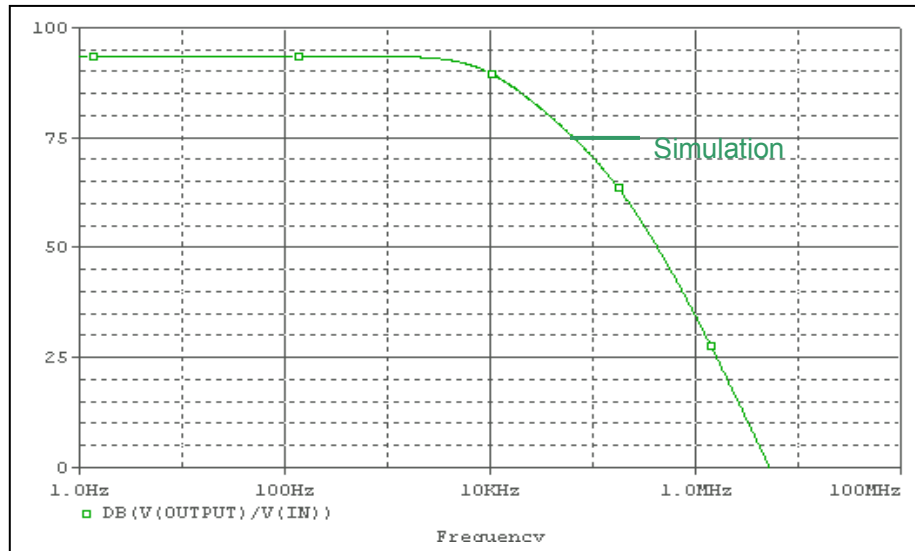


### Comparison Table

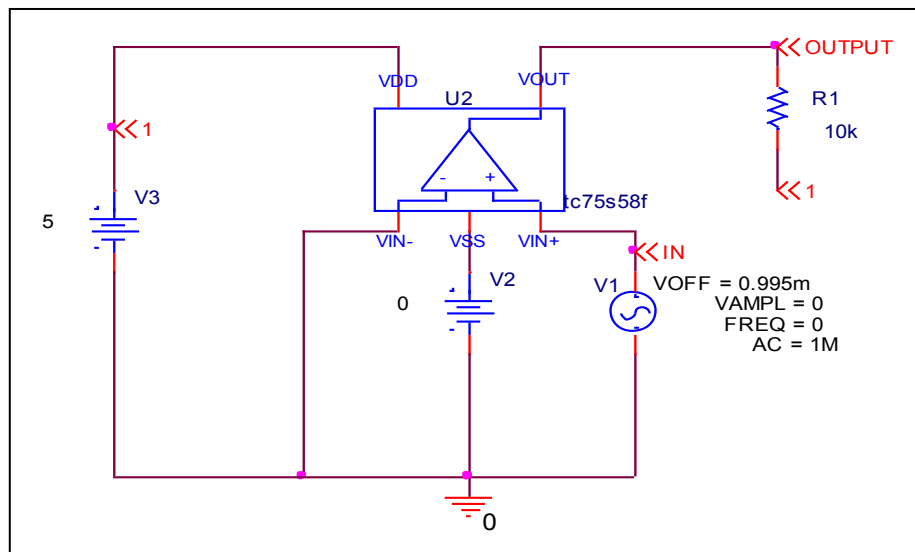
|              | Measurement | Simulation | %Error |
|--------------|-------------|------------|--------|
| $V_{io}(mV)$ | 1           | 0.995      | -0.5   |

## Voltage Gain Characteristics

### Simulation result



### Evaluation Circuit



### Comparison Table

|         | Measurement | Simulation | %Error |
|---------|-------------|------------|--------|
| Av (dB) | 94          | 93.542     | -0.487 |