

# Device Modeling Report

COMPONENTS: TRANSISTOR  
PART NUMBER: 2SC6102  
MANUFACTURER: SANYO



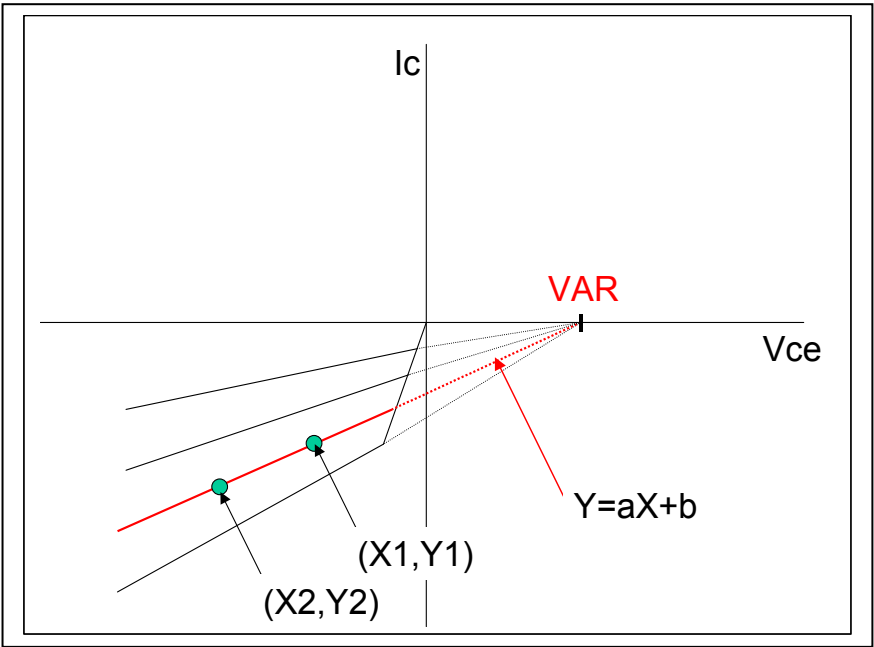
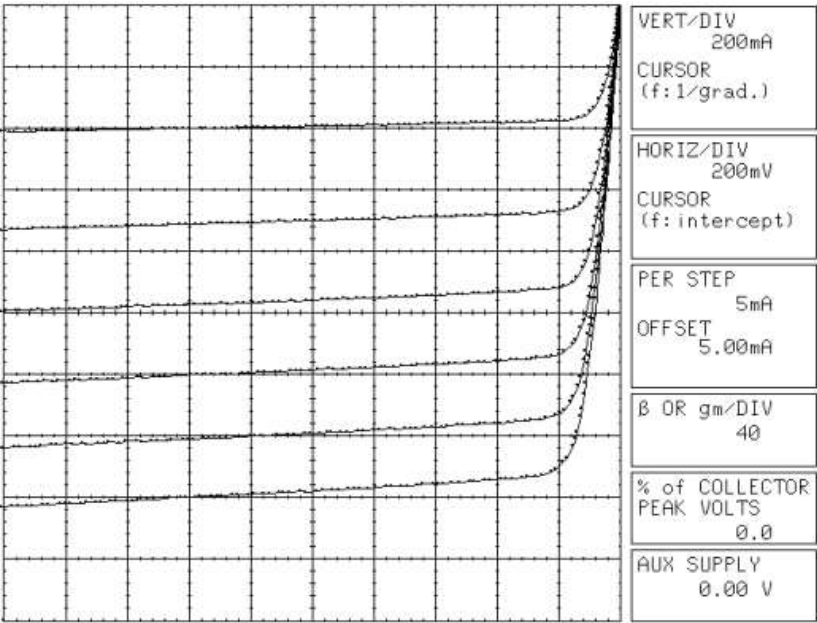
**Bee Technologies Inc.**

## TRANSISTOR MODEL

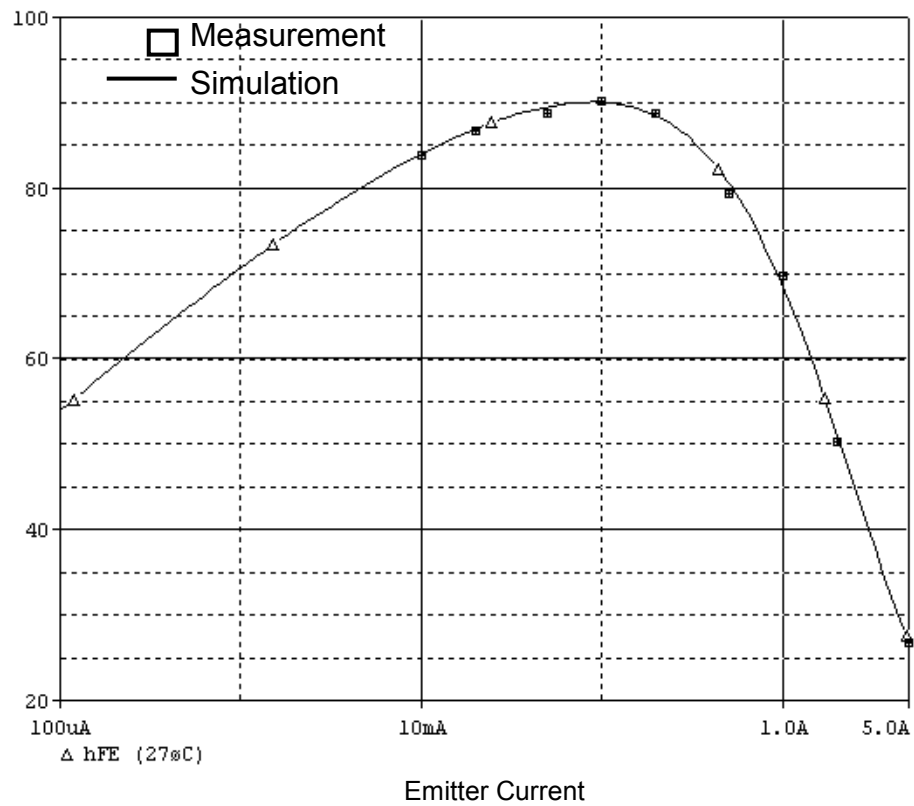
| PSpice model parameter | Model description                                           |
|------------------------|-------------------------------------------------------------|
| IS                     | Saturation Current                                          |
| BF                     | Ideal Maximum Forward Beta                                  |
| NF                     | Forward Current Emission Coefficient                        |
| VAF                    | Forward Early Voltage                                       |
| IKF                    | Forward Beta Roll-off Knee Current                          |
| ISE                    | Non-ideal Base-Emitter Diode Saturation Current             |
| NE                     | Non-ideal Base-Emitter Diode Emission Coefficient           |
| BR                     | Ideal Maximum Reverse Beta                                  |
| NR                     | Reverse Emission Coefficient                                |
| VAR                    | Reverse Early Voltage                                       |
| IKR                    | Reverse Beta Roll-off Knee Current                          |
| ISC                    | Non-ideal Base-Collector Diode Saturation Current           |
| NC                     | Non-ideal Base-Collector Diode Emission Coefficient         |
| NK                     | Forward Beta Roll-off Slope Exponent                        |
| RE                     | Emitter Resistance                                          |
| RB                     | Base Resistance                                             |
| RC                     | Series Collector Resistance                                 |
| CJE                    | Zero-bias Emitter-Base Junction Capacitance                 |
| VJE                    | Emitter-Base Junction Potential                             |
| MJE                    | Emitter-Base Junction Grading Coefficient                   |
| CJC                    | Zero-bias Collector-Base Junction Capacitance               |
| VJC                    | Collector-base Junction Potential                           |
| MJC                    | Collector-base Junction Grading Coefficient                 |
| FC                     | Coefficient for Onset of Forward-bias Depletion Capacitance |
| TF                     | Forward Transit Time                                        |
| XTF                    | Coefficient for TF Dependency on Vce                        |
| VTF                    | Voltage for TF Dependency on Vce                            |
| ITF                    | Current for TF Dependency on Ic                             |
| PTF                    | Excess Phase at $f=1/2\pi*TF$                               |
| TR                     | Reverse Transit Time                                        |
| EG                     | Activation Energy                                           |
| XTB                    | Forward Beta Temperature Coefficient                        |
| XTI                    | Temperature Coefficient for IS                              |

Reverse

Reverse Early Voltage Characteristic

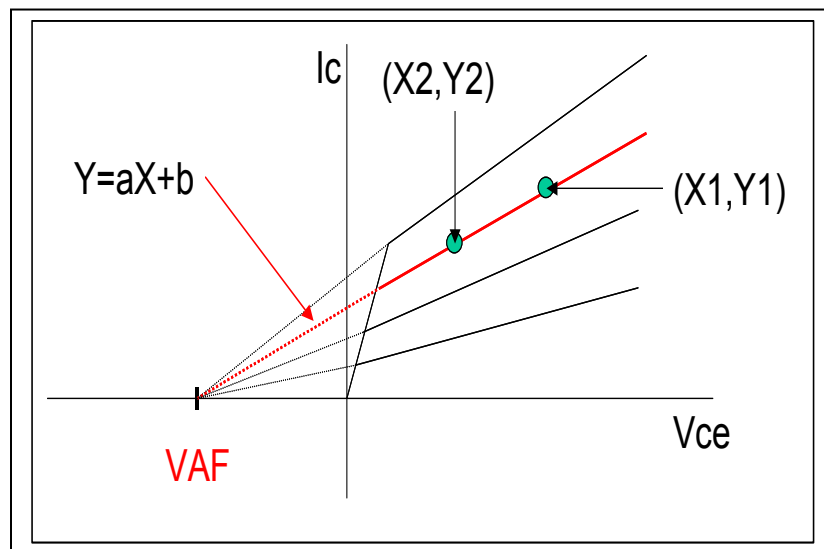
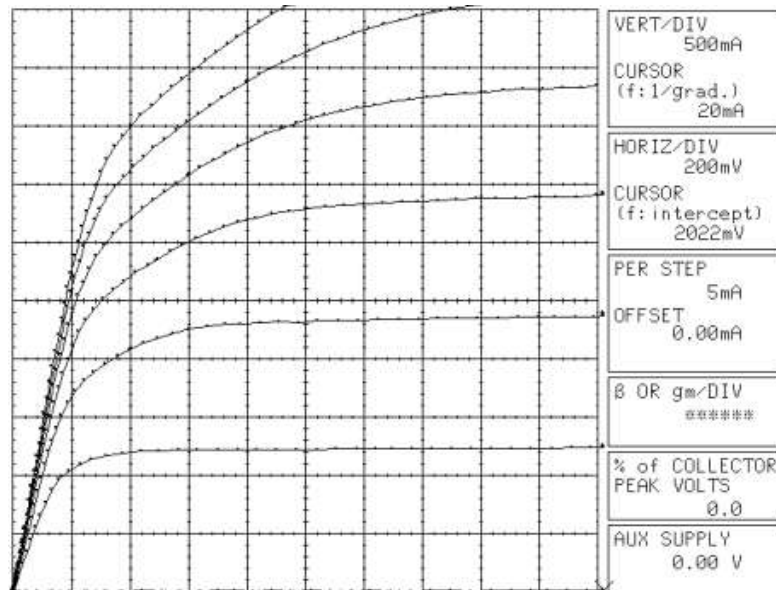


## Reverse DC Beta Characteristic (I<sub>e</sub> vs. h<sub>FE</sub>)

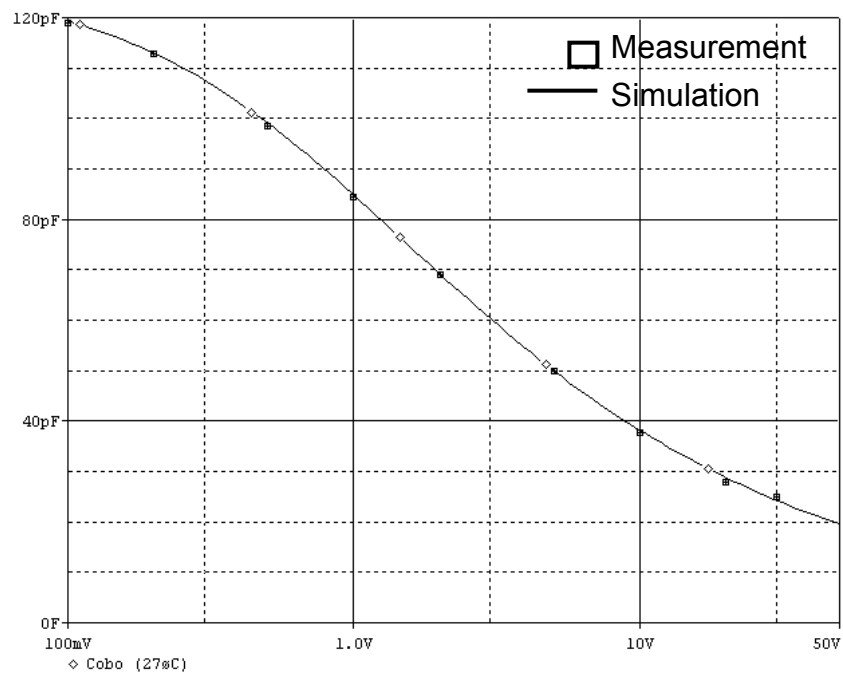


Forward

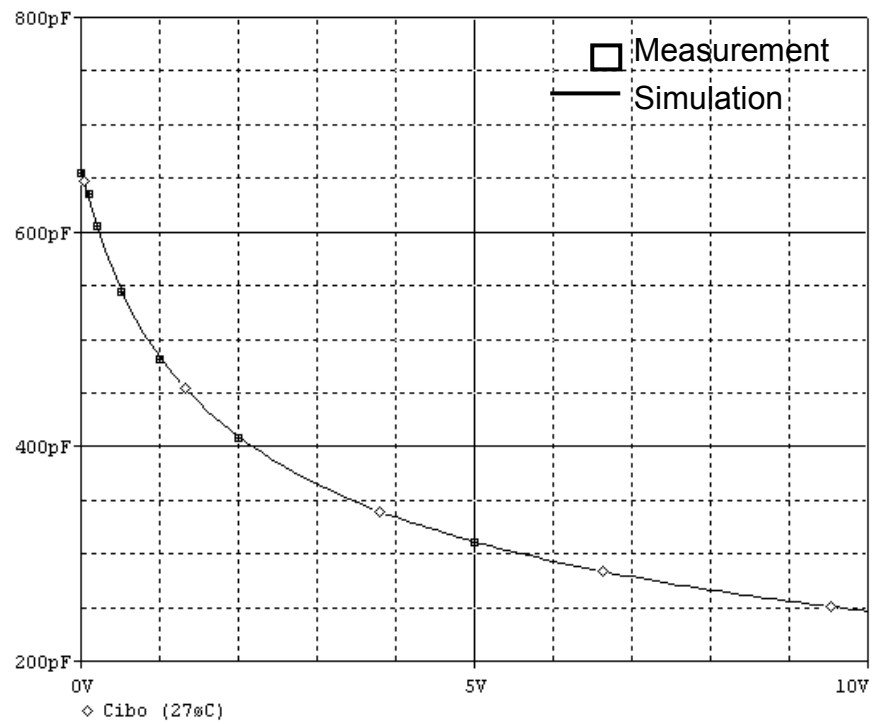
## Forward Early Voltage Characteristic



## C-B Capacitance Characteristics

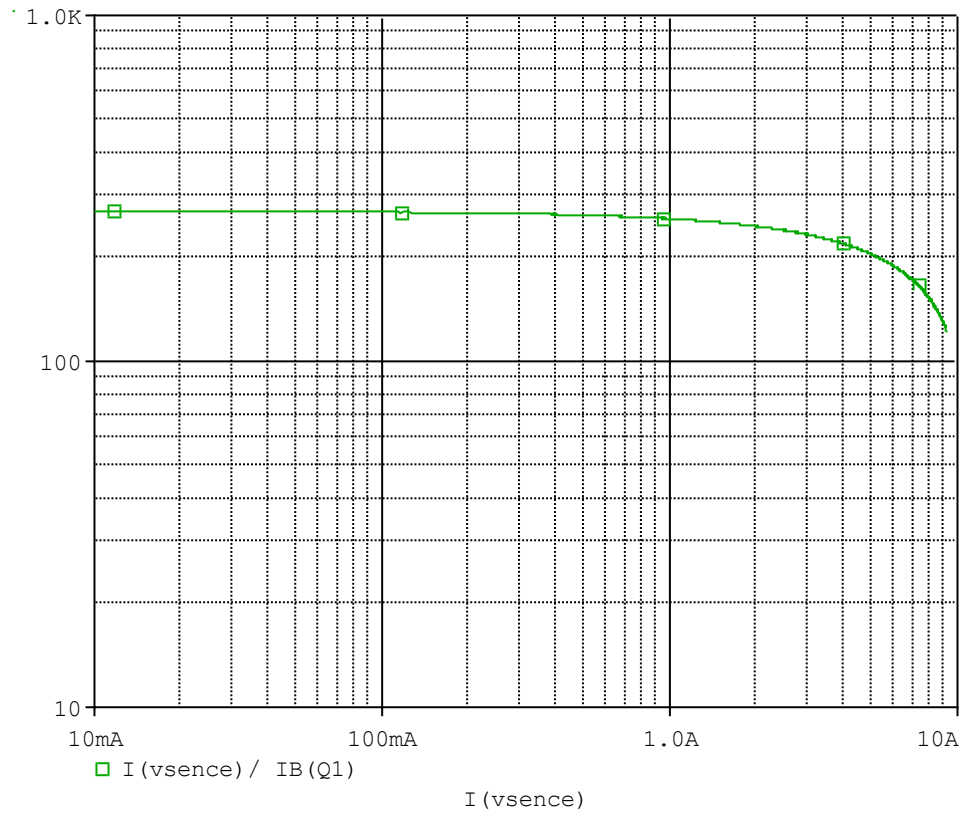


## E-B Capacitance Characteristics

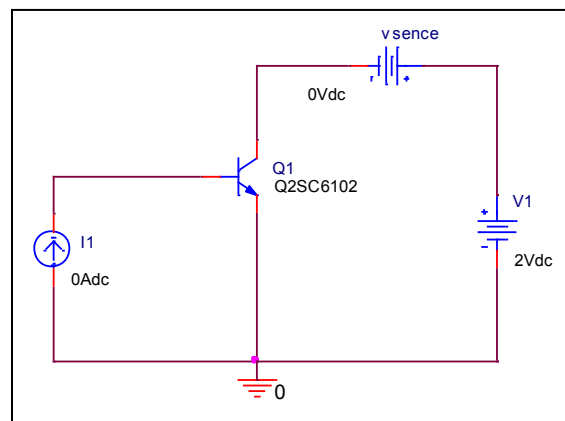


## Transistor $h_{FE}$ - $I_C$ Characteristics

### Circuit Simulation Result

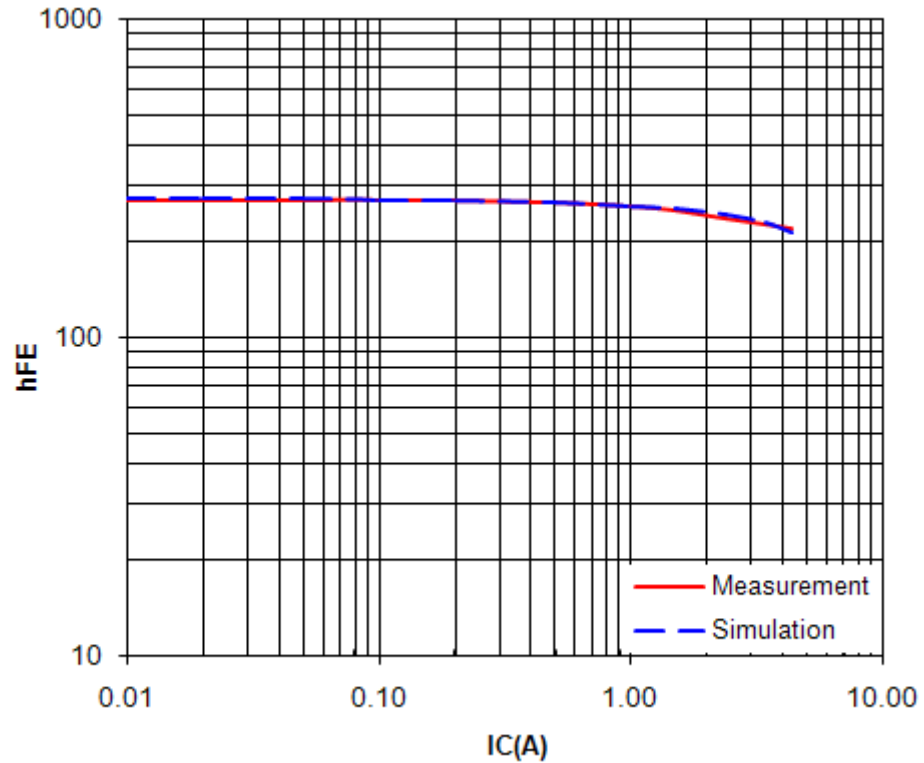


### Evaluation Circuit



## Comparison Graph

### Circuit Simulation Result



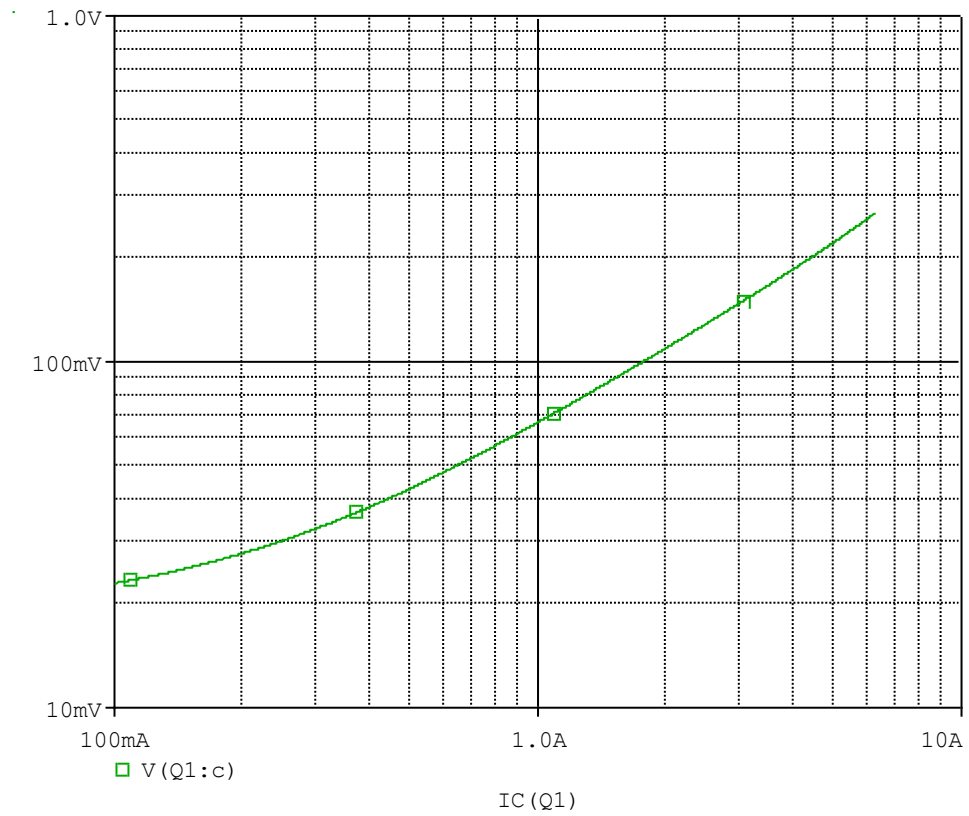
### Simulation Result

| IC(A) | hFE         |            | Error(%) |
|-------|-------------|------------|----------|
|       | Measurement | Simulation |          |
| 0.01  | 270.270     | 271.105    | 0.309    |
| 0.02  | 270.260     | 271.108    | 0.314    |
| 0.05  | 270.204     | 270.969    | 0.283    |
| 0.10  | 270.270     | 270.549    | 0.103    |
| 0.20  | 268.158     | 268.417    | 0.097    |
| 0.50  | 263.410     | 264.699    | 0.489    |
| 1.00  | 258.158     | 258.451    | 0.114    |
| 1.50  | 250.000     | 252.187    | 0.875    |
| 2.37  | 237.000     | 241.587    | 1.935    |
| 3.40  | 227.000     | 227.508    | 0.224    |
| 4.37  | 218.500     | 213.909    | -2.101   |

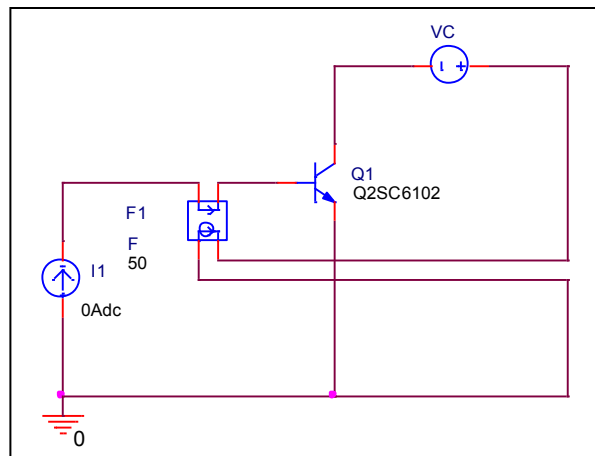


## $V_{CE(Sat)}$ - $I_C$ Characteristics

### Circuit Simulation Result

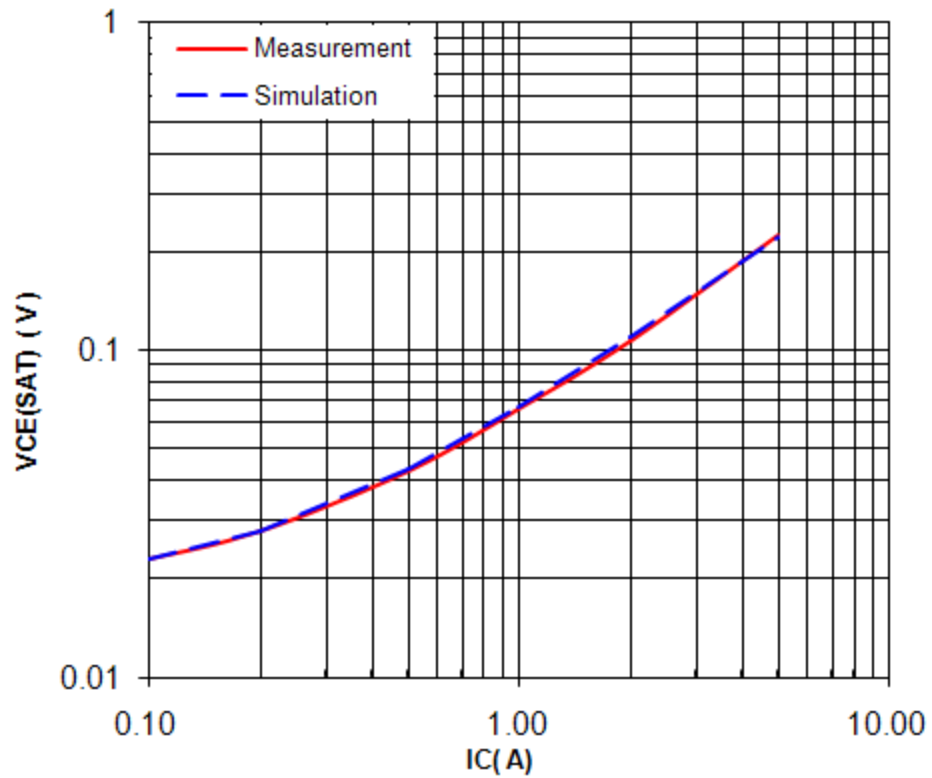


### Evaluation Circuit



## Comparison Graph

Circuit Simulation Result

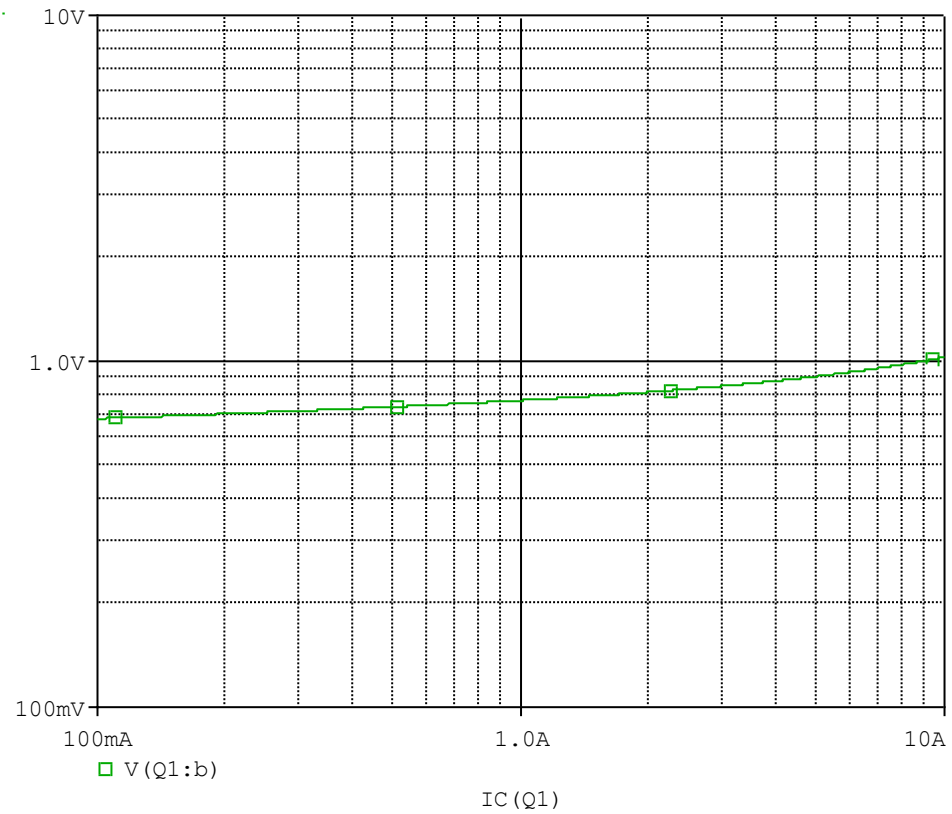


Simulation Result

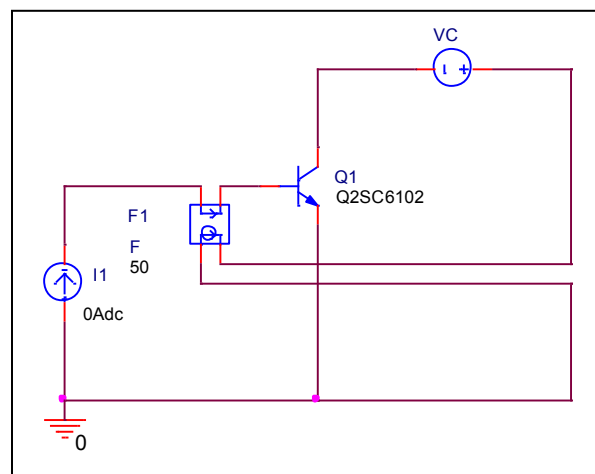
| IC(A) | VCE(sat)(V) |            | Error(%) |
|-------|-------------|------------|----------|
|       | Measurement | Simulation |          |
| 0.10  | 0.023       | 0.023      | -0.48    |
| 0.20  | 0.028       | 0.028      | -0.34    |
| 0.50  | 0.043       | 0.043      | 1.18     |
| 1.00  | 0.066       | 0.067      | 1.98     |
| 2.00  | 0.107       | 0.109      | 2.15     |
| 5.00  | 0.225       | 0.221      | -1.78    |

## $V_{BE(Sat)}-I_C$ Characteristics

### Circuit Simulation Result

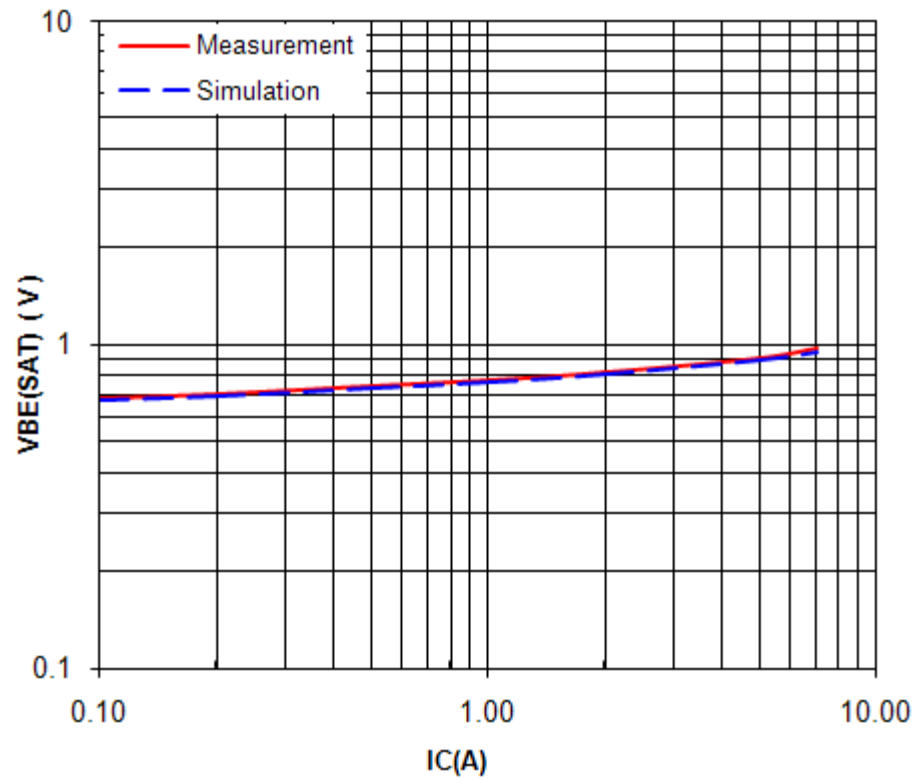


### Evaluation Circuit



## Comparison Graph

Circuit Simulation Result

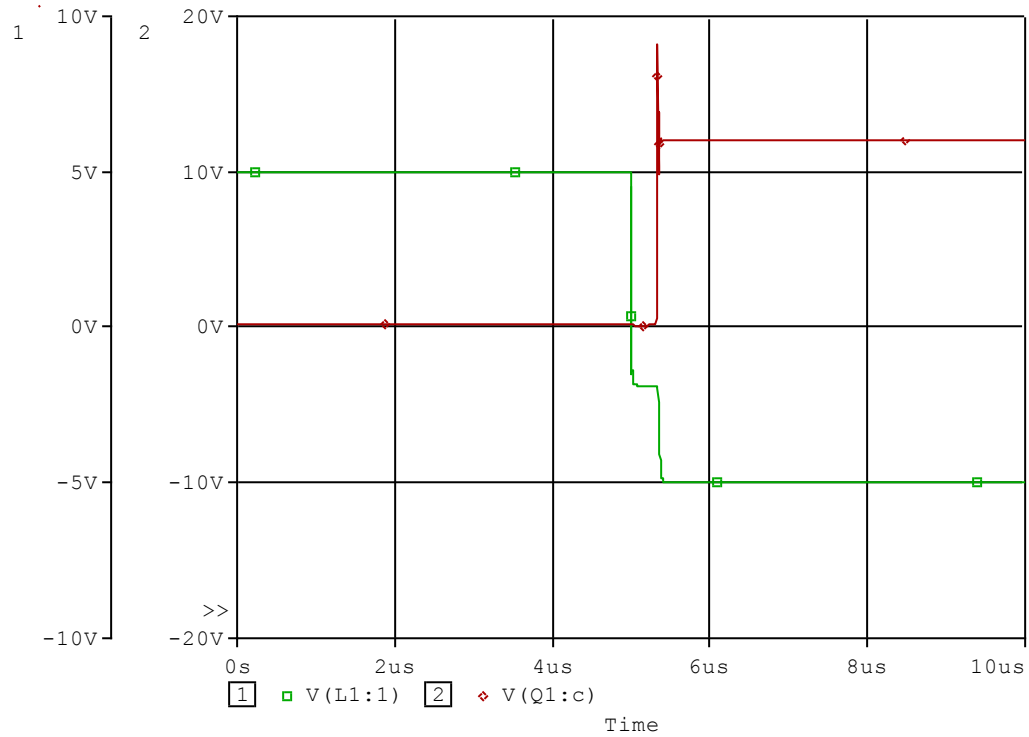


Simulation Result

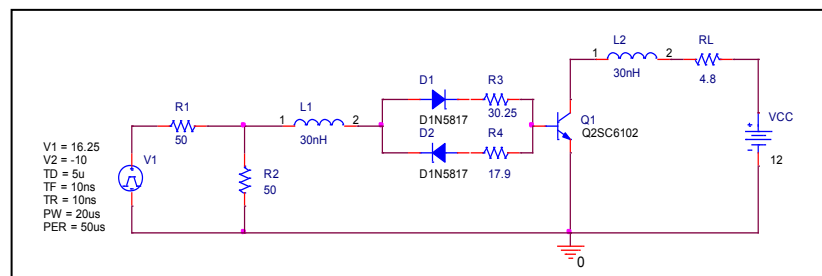
| IC(A) | VBE(sat)(V) |            | Error(%) |
|-------|-------------|------------|----------|
|       | Measurement | Simulation |          |
| 0.10  | 0.680       | 0.677      | -0.39    |
| 0.20  | 0.705       | 0.699      | -0.91    |
| 0.50  | 0.750       | 0.732      | -2.40    |
| 1.00  | 0.780       | 0.765      | -1.92    |
| 2.00  | 0.820       | 0.810      | -1.22    |
| 5.00  | 0.910       | 0.903      | -0.77    |
| 7.00  | 0.980       | 0.955      | -2.55    |

## Switching Characteristics

### Circuit simulation result



### Evaluation circuit

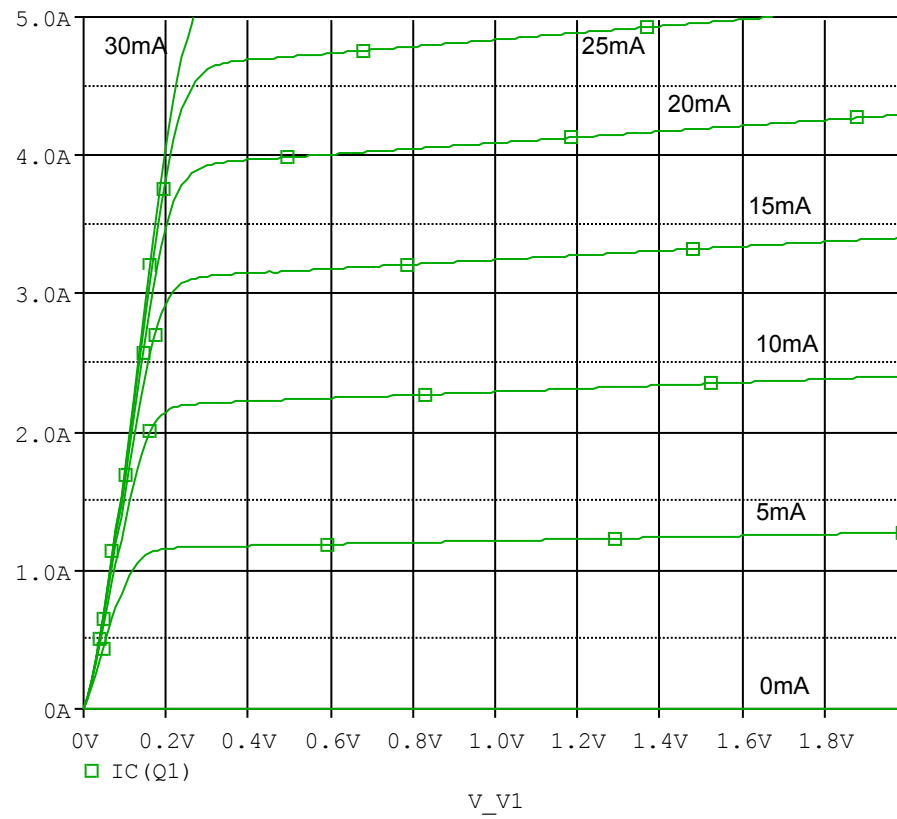


### Simulation result

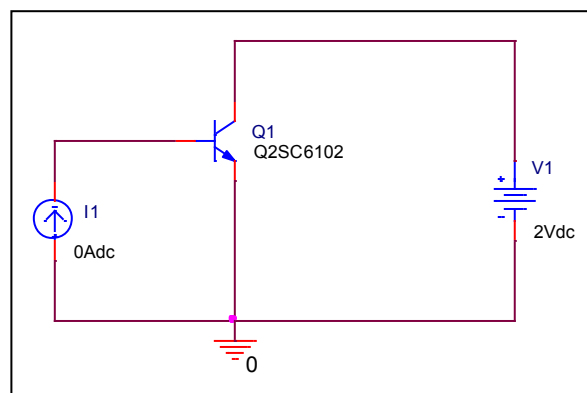
|                | Measurement | Simulation | %Error |
|----------------|-------------|------------|--------|
| $t_{stg}$ (ns) | 320.000     | 319.058    | -0.294 |
| $t_f$ (ns)     | 14.000      | 14.278     | 1.986  |

## Output Characteristics

### Circuit Simulation Result



### Evaluation Circuit



## Output Characteristics

## Reference

