

Device Modeling Report

COMPONENTS: TRANSISTOR
PART NUMBER: 2SC2334-AZ
MANUFACTURER: NEC



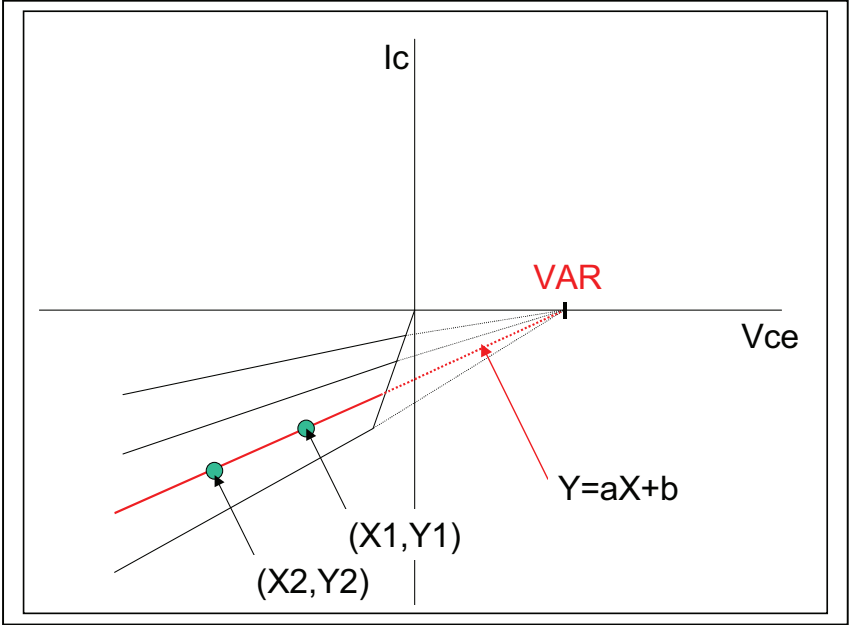
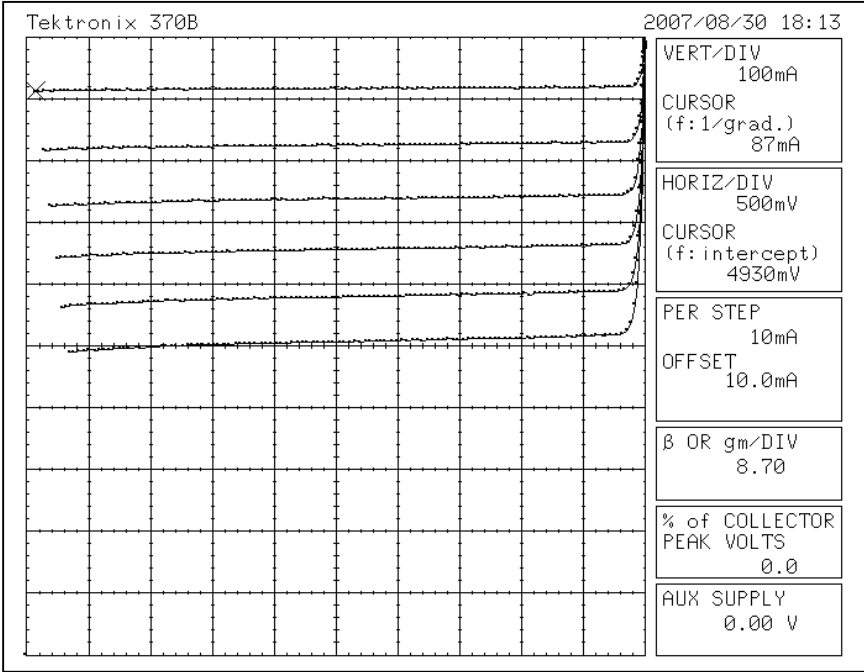
Bee Technologies Inc.

TRANSISTOR MODEL

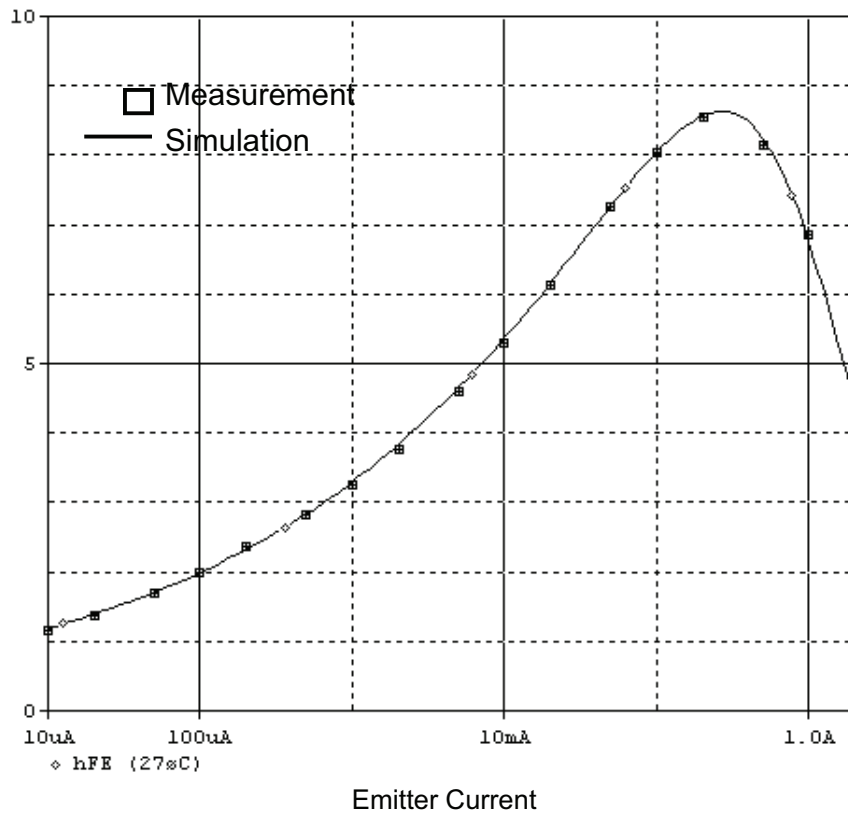
| PSpice model parameter | Model description |
|------------------------|---|
| IS | Saturation Current |
| BF | Ideal Maximum Forward Beta |
| NF | Forward Current Emission Coefficient |
| VAF | Forward Early Voltage |
| IKF | Forward Beta Roll-off Knee Current |
| ISE | Non-ideal Base-Emitter Diode 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

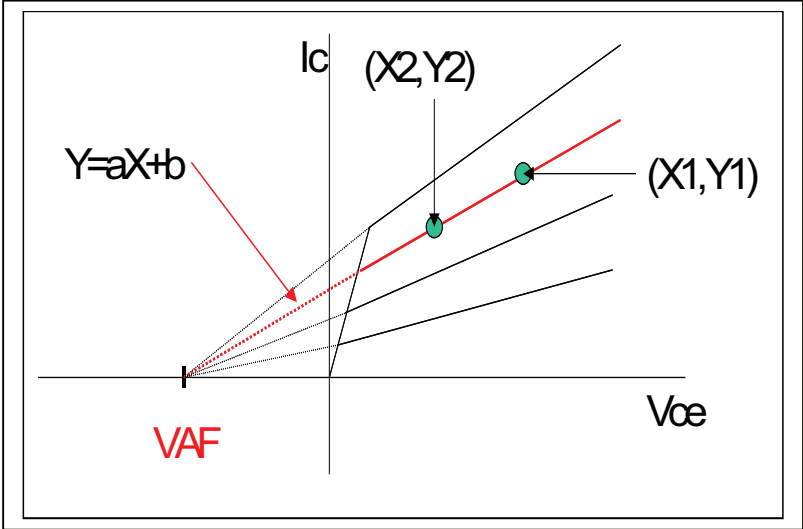
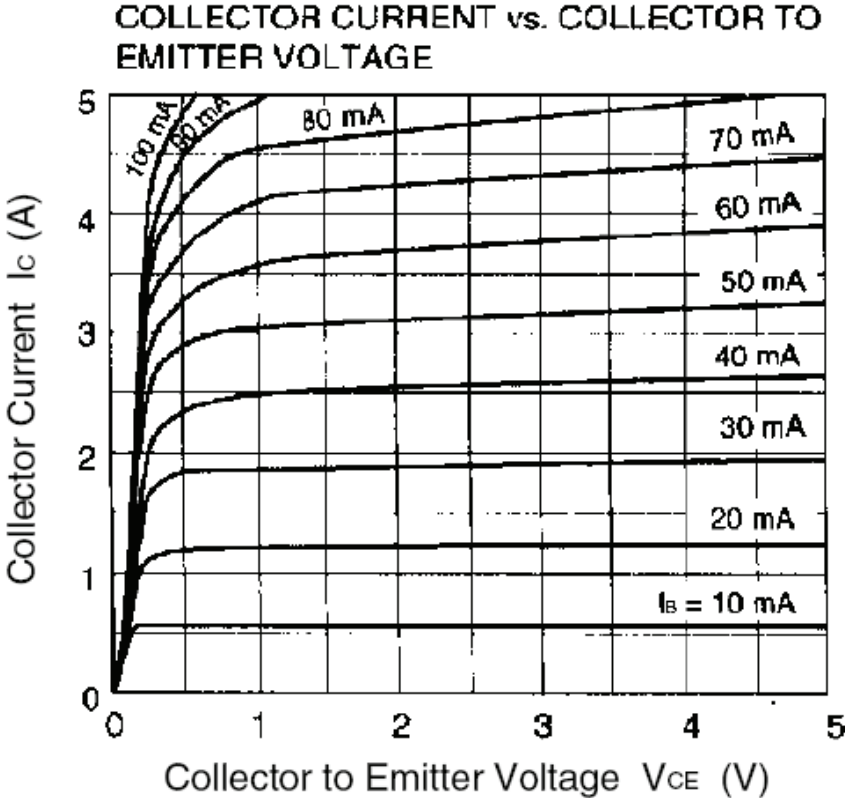


Reverse DC Beta Characteristic (I_e vs. h_{FE})

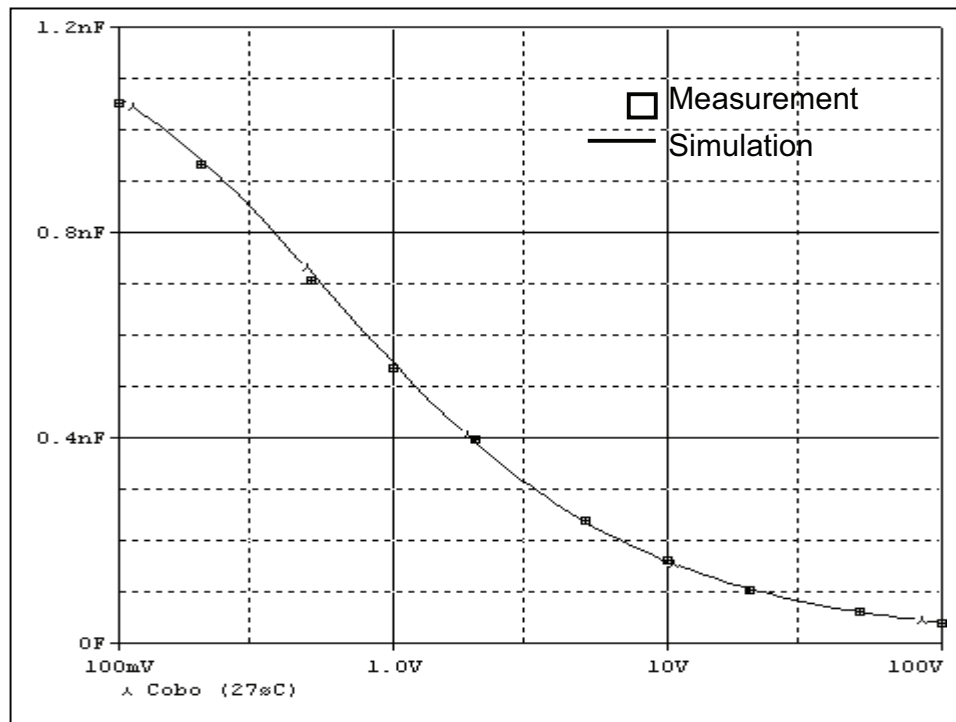


Forward

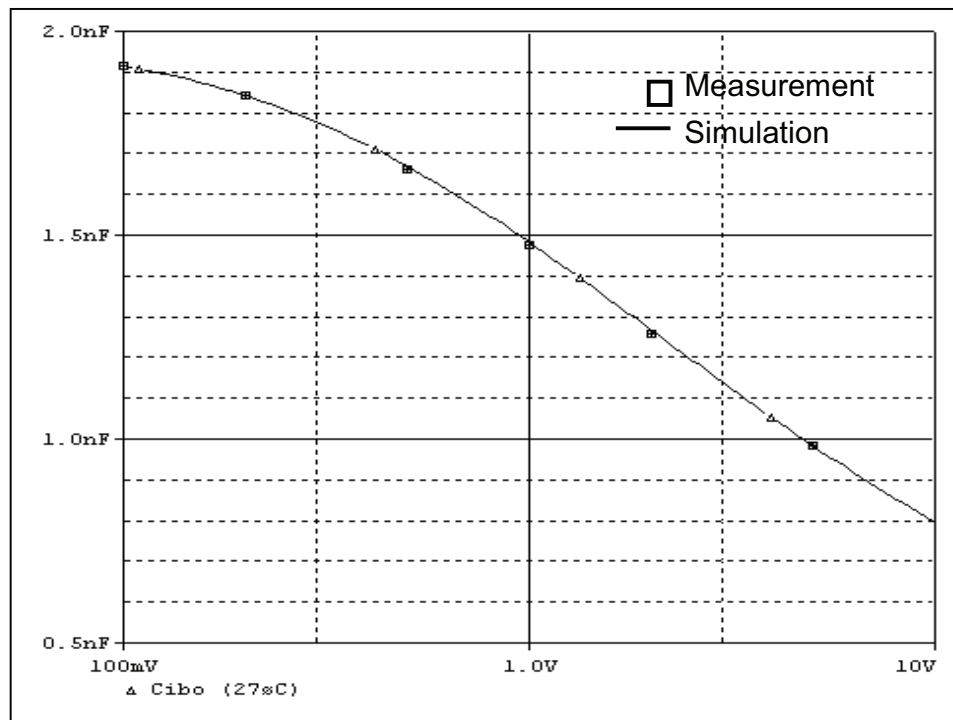
Forward Early Voltage Characteristic



C-B Capacitance Characteristics

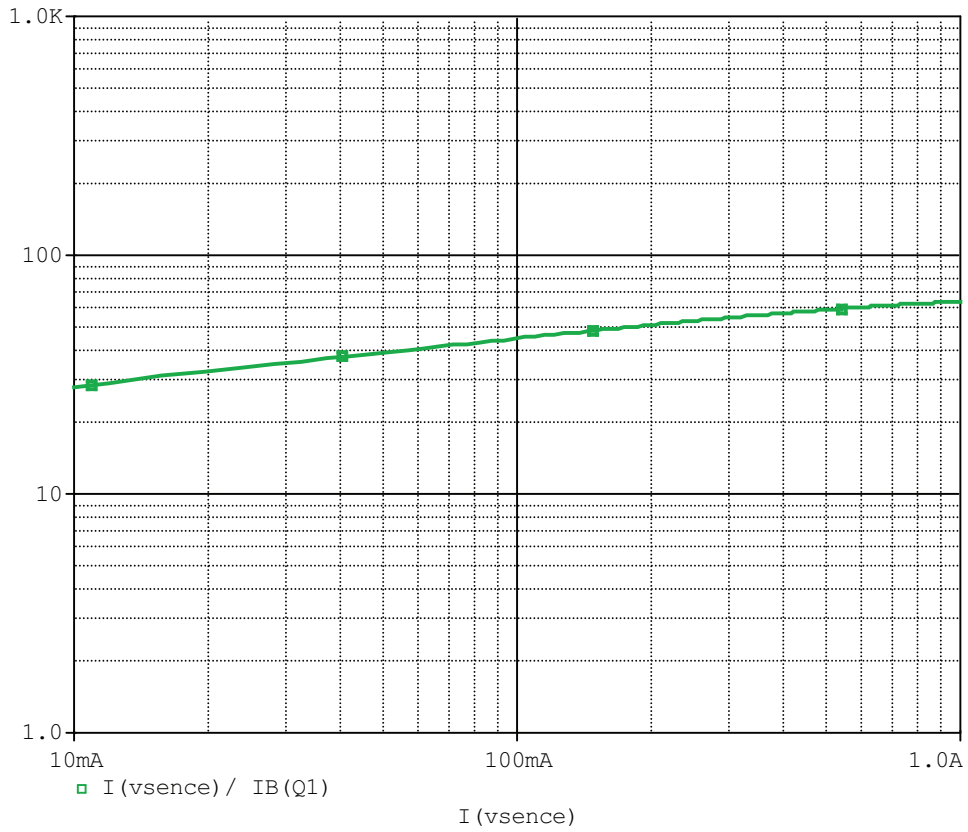


E-B Capacitance Characteristics

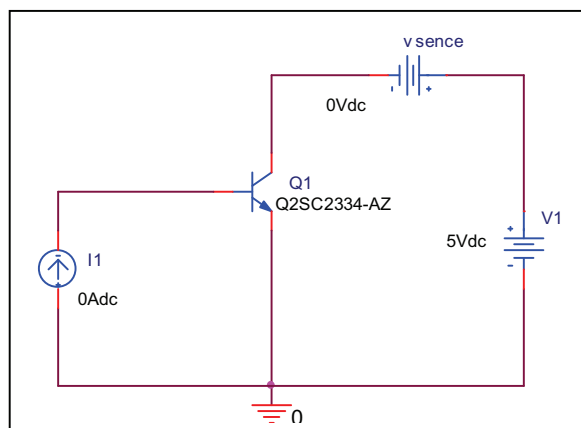


Transistor h_{FE} - I_C Characteristics

Circuit Simulation Result

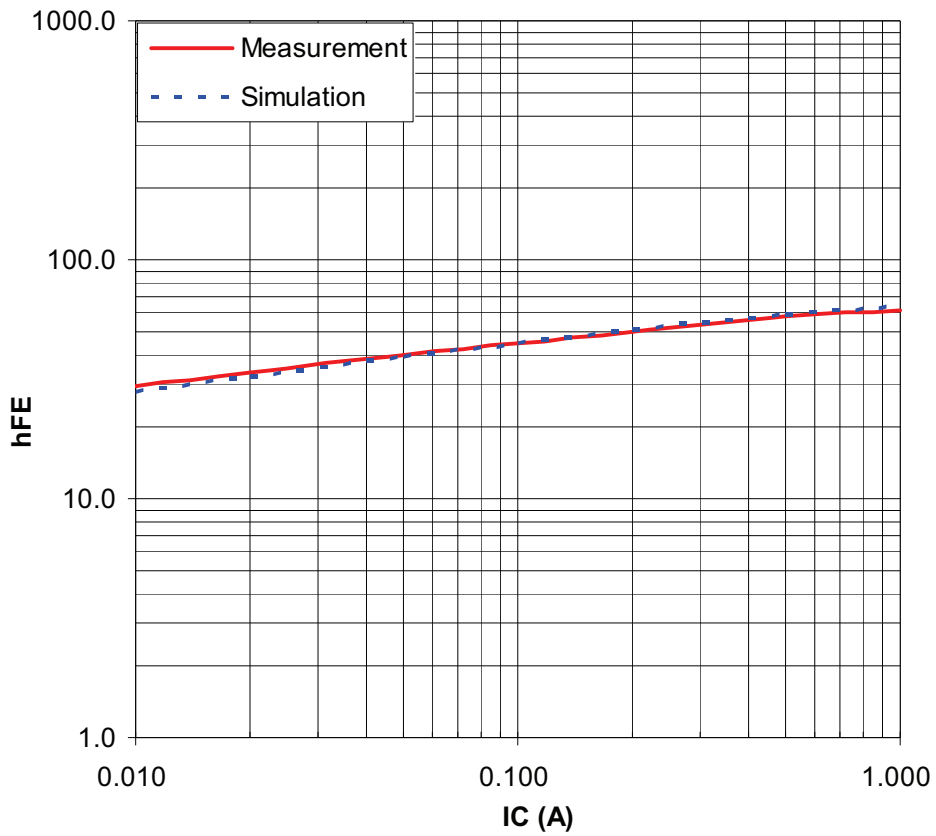


Evaluation Circuit



Comparison Graph

Circuit Simulation Result

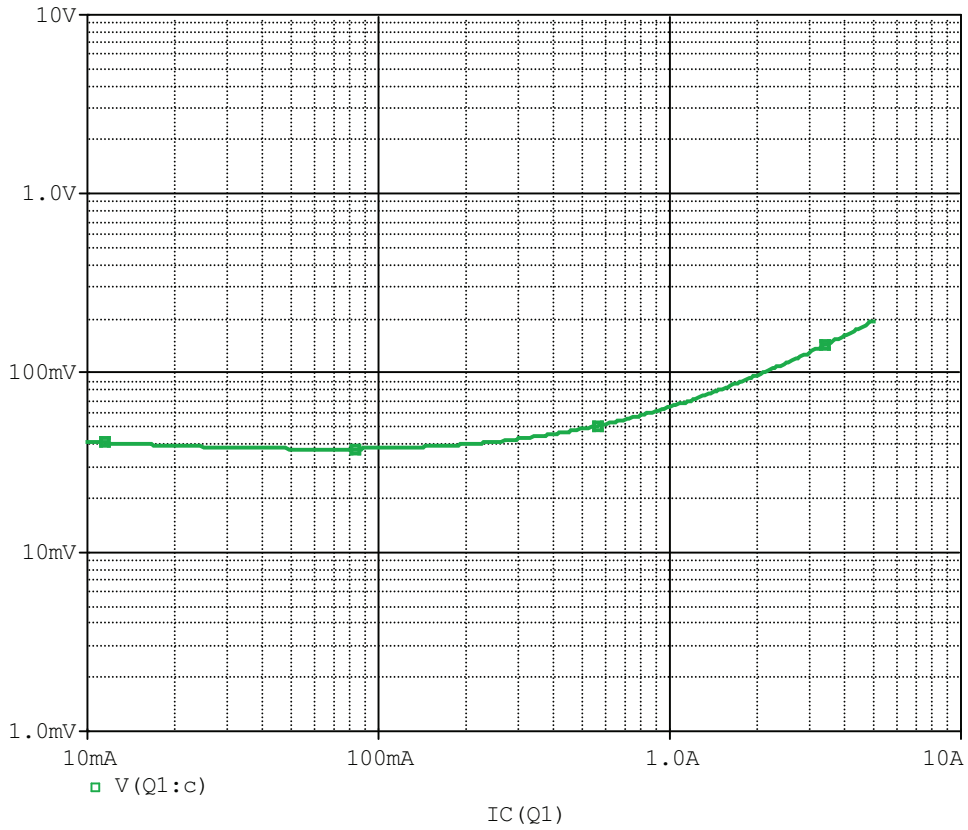


Simulation Result

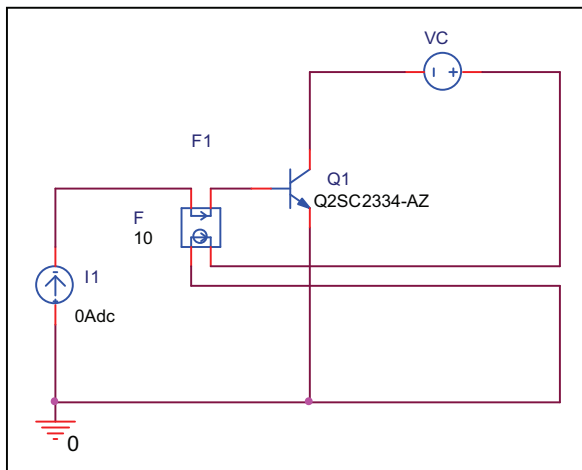
| I_C (A) | hFE | | Error(%) |
|--------------|---------------|---------------|---------------|
| | Measurement | Simulation | |
| 0.010 | 29.500 | 28.156 | -4.556 |
| 0.020 | 33.500 | 32.554 | -2.824 |
| 0.050 | 40.000 | 39.188 | -2.030 |
| 0.100 | 44.500 | 44.841 | 0.766 |
| 0.200 | 50.000 | 50.928 | 1.856 |
| 0.500 | 58.500 | 59.061 | 0.959 |
| 1.000 | 61.000 | 63.914 | 4.777 |

$V_{CE(sat)}$ - I_c Characteristics

Circuit Simulation Result

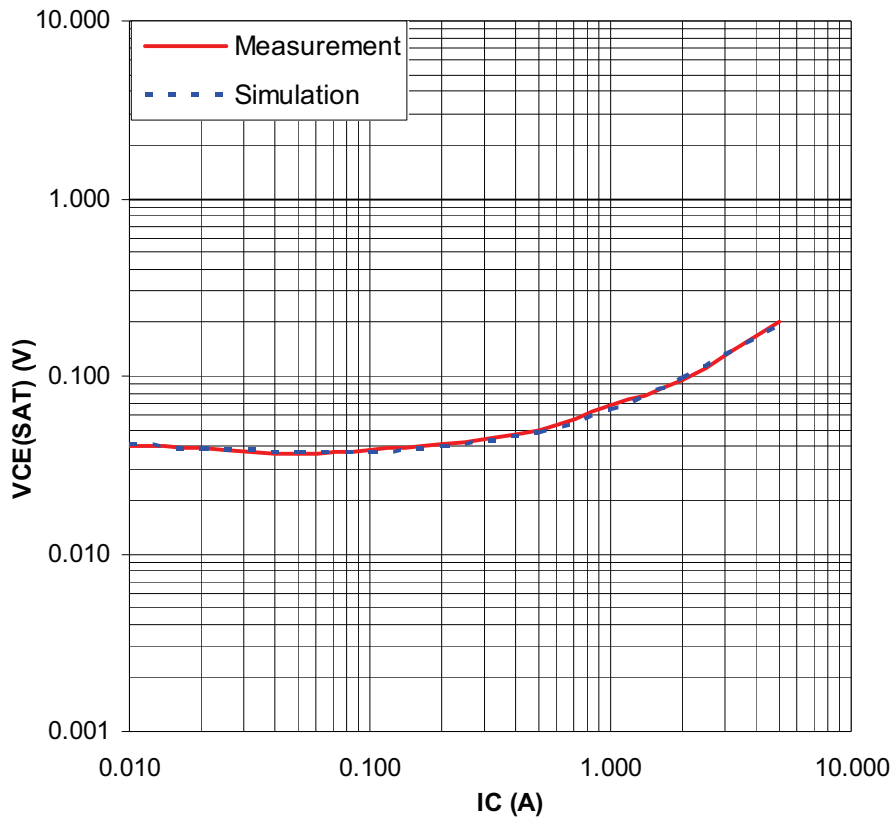


Evaluation Circuit



Comparison Graph

Circuit Simulation Result

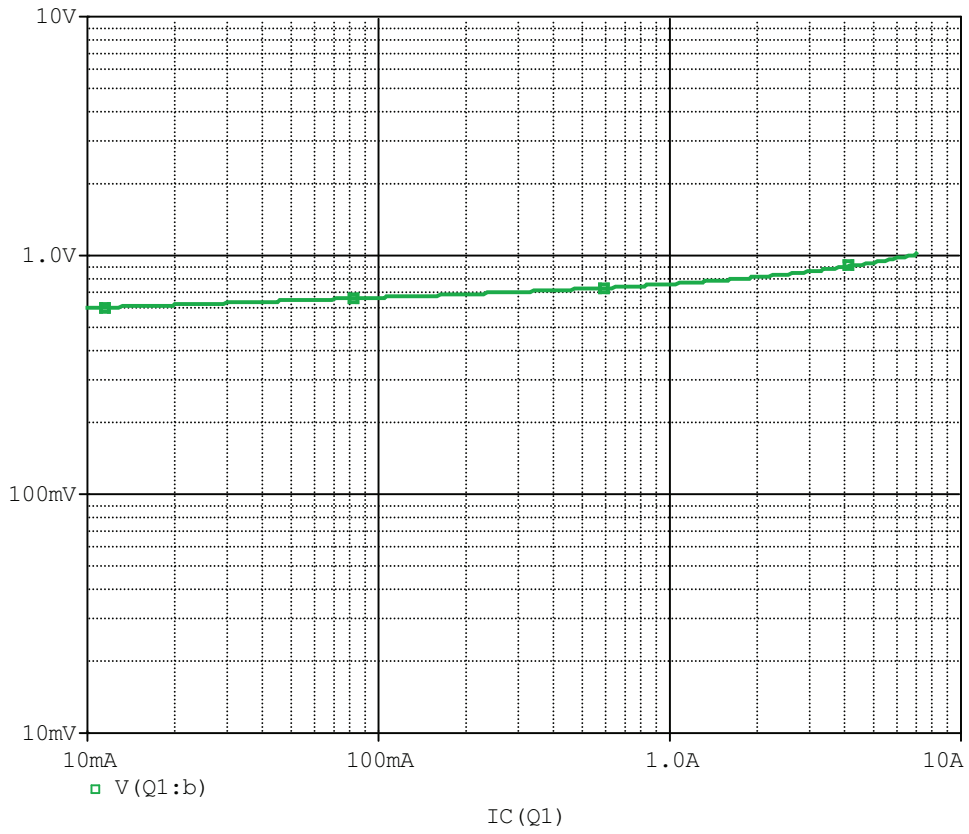


Simulation Result

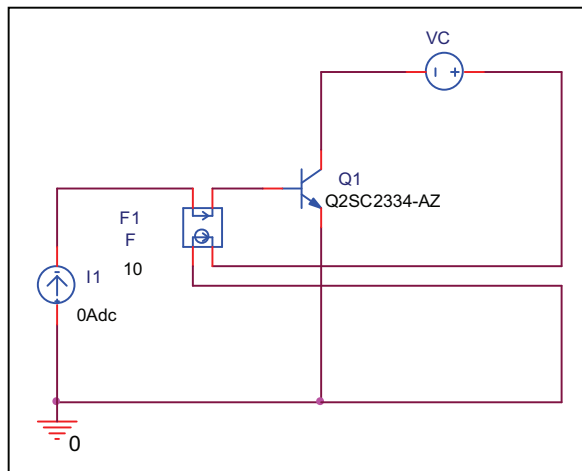
| IC(A) | VCE(sat)(V) | | Error(%) |
|-------|-------------|------------|----------|
| | Measurement | Simulation | |
| 0.010 | 0.040 | 0.041 | 3.000 |
| 0.020 | 0.039 | 0.039 | 0.513 |
| 0.050 | 0.037 | 0.038 | 1.892 |
| 0.100 | 0.038 | 0.038 | -0.263 |
| 0.200 | 0.041 | 0.040 | -2.195 |
| 0.500 | 0.050 | 0.049 | -2.400 |
| 1.000 | 0.068 | 0.065 | -4.706 |
| 2.000 | 0.095 | 0.098 | 2.632 |
| 5.000 | 0.200 | 0.194 | -2.900 |

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

Circuit Simulation Result

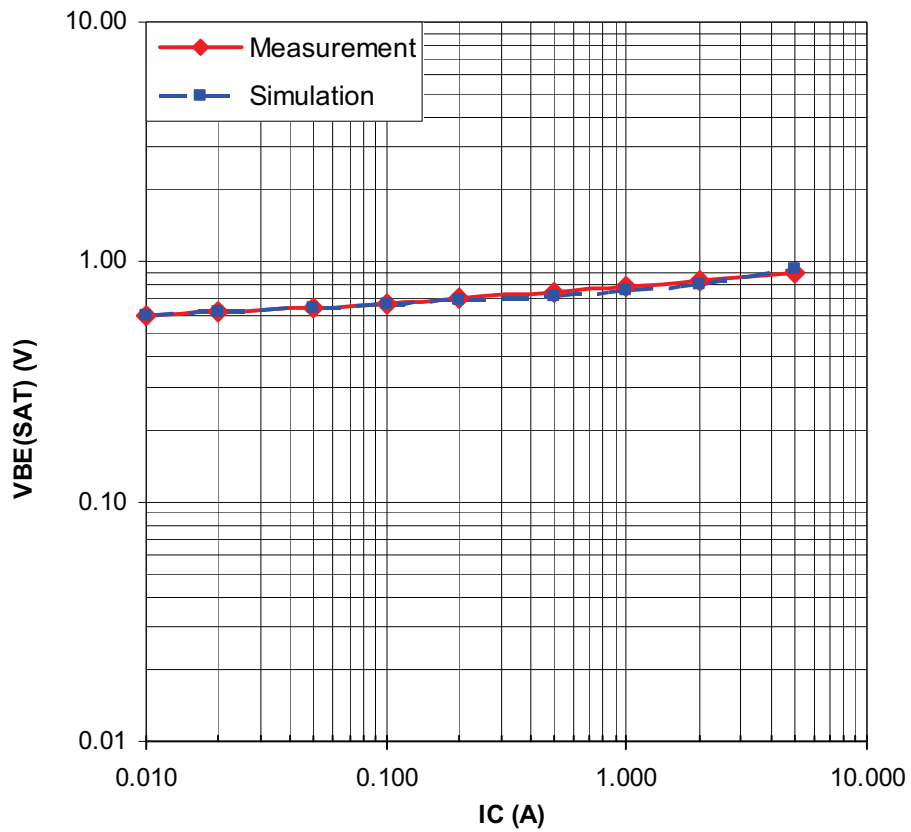


Evaluation Circuit



Comparison Graph

Circuit Simulation Result

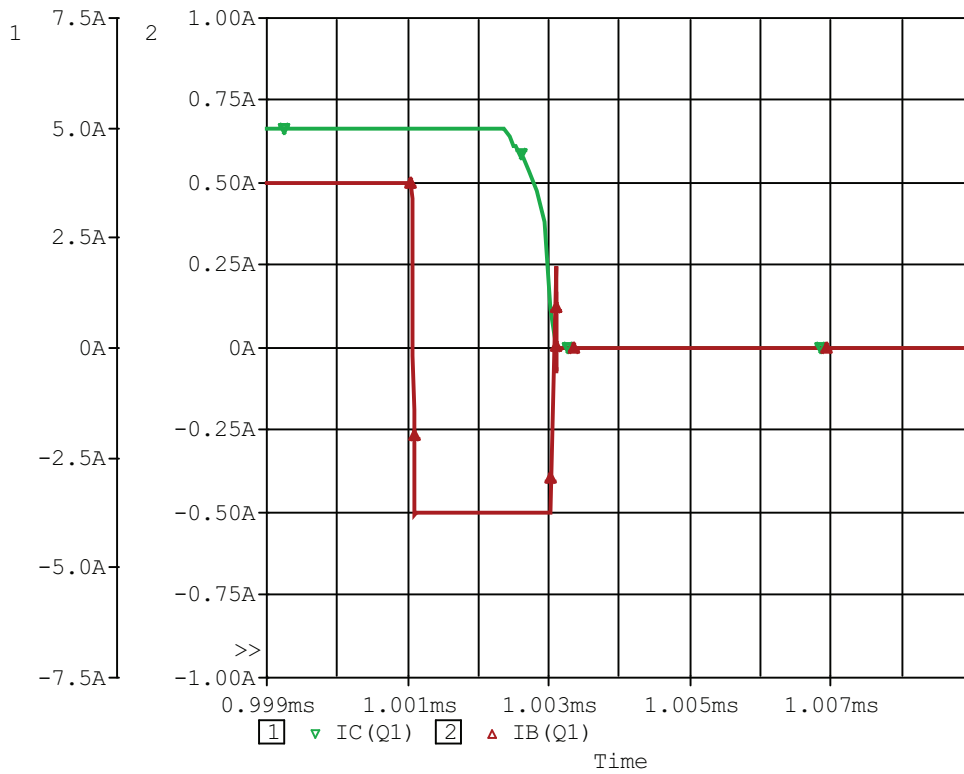


Simulation Result

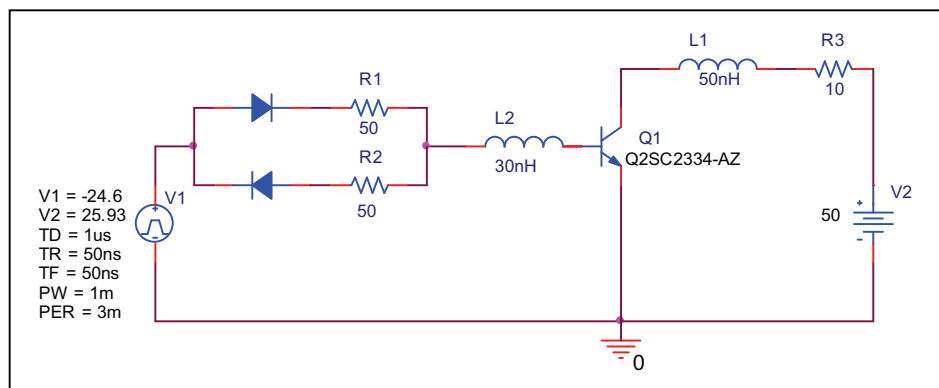
| IC(A) | VBE(sat)(V) | | Error(%) |
|-------|-------------|------------|----------|
| | Measurement | Simulation | |
| 0.010 | 0.595 | 0.601 | 1.008 |
| 0.020 | 0.618 | 0.621 | 0.485 |
| 0.050 | 0.640 | 0.647 | 1.031 |
| 0.100 | 0.666 | 0.667 | 0.135 |
| 0.200 | 0.705 | 0.689 | -2.284 |
| 0.500 | 0.740 | 0.723 | -2.243 |
| 1.000 | 0.790 | 0.759 | -3.937 |
| 2.000 | 0.830 | 0.811 | -2.265 |
| 5.000 | 0.900 | 0.934 | 3.778 |

Switching Characteristics

Circuit simulation result



Evaluation circuit

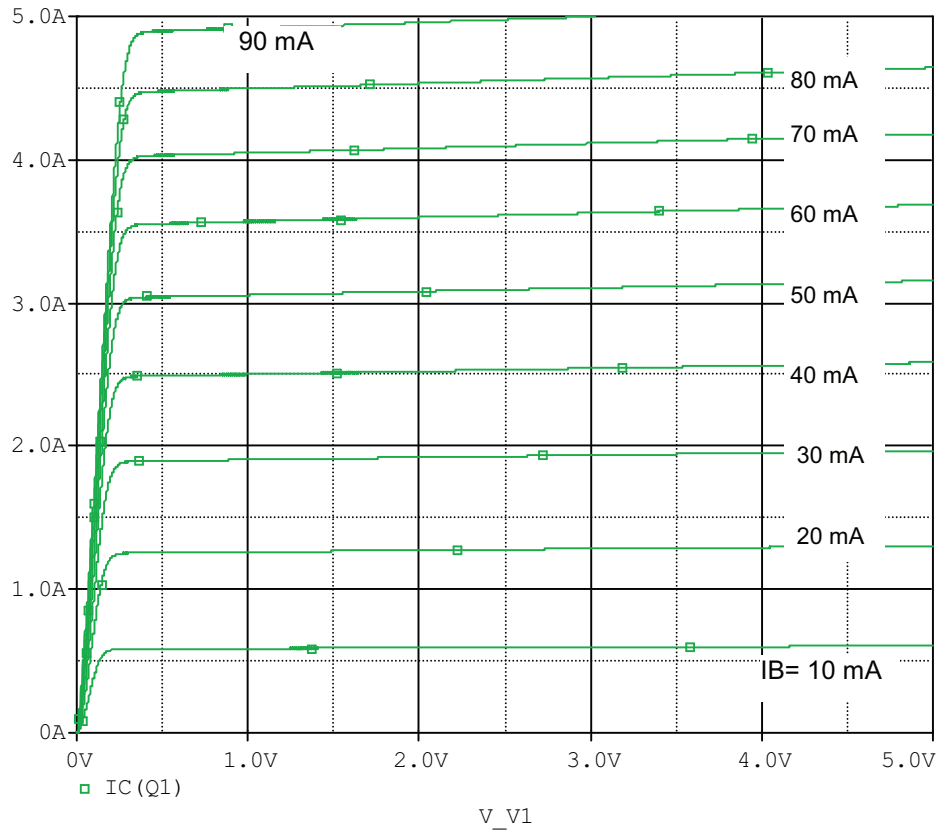


Simulation result

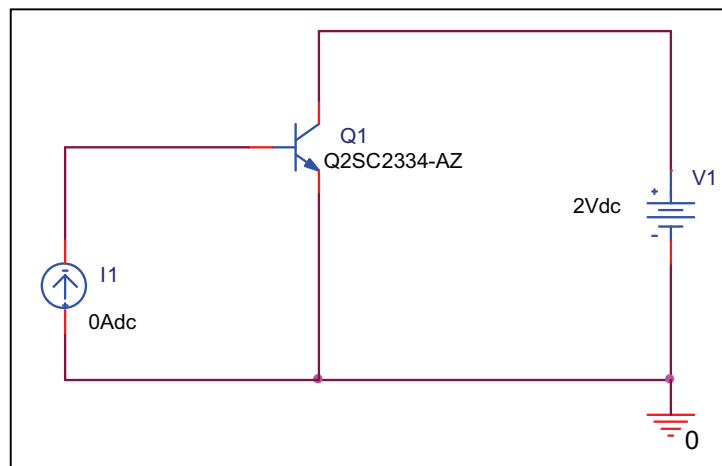
| | Measurement | Simulation | %Error |
|----------------|-------------|------------|--------|
| t_{stg} (us) | 1.500 | 1.502 | 0.160 |
| t_f (us) | 0.500 | 0.501 | 0.180 |

Output Characteristics

Circuit Simulation Result



Evaluation Circuit



Output Characteristics

Reference

