# Device Modeling Report

COMPONENTS:BIPOLAR JUNCTION TRANSISTOR
PART NUMBER:2SD1782K
MANUFACTURER: ROHM

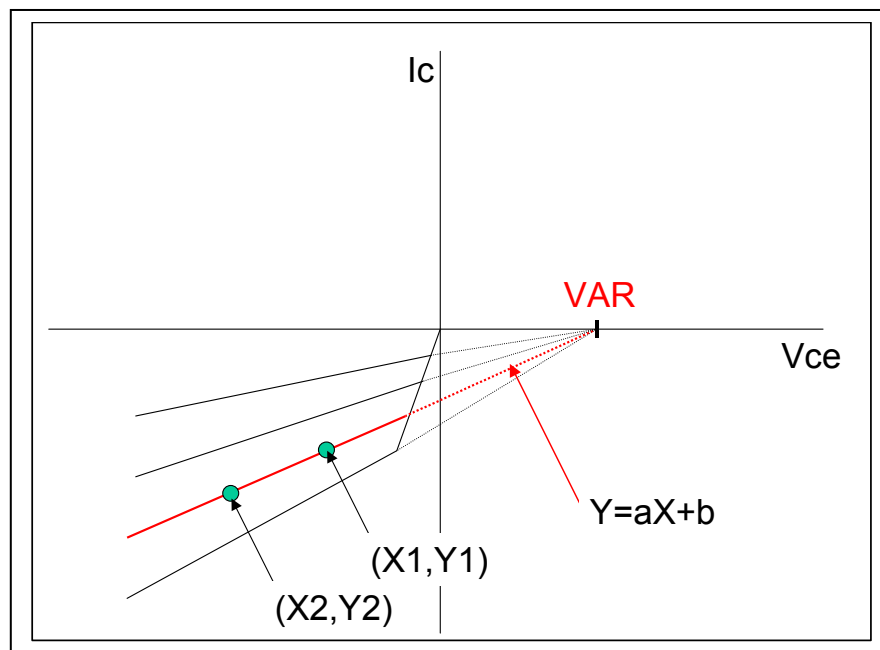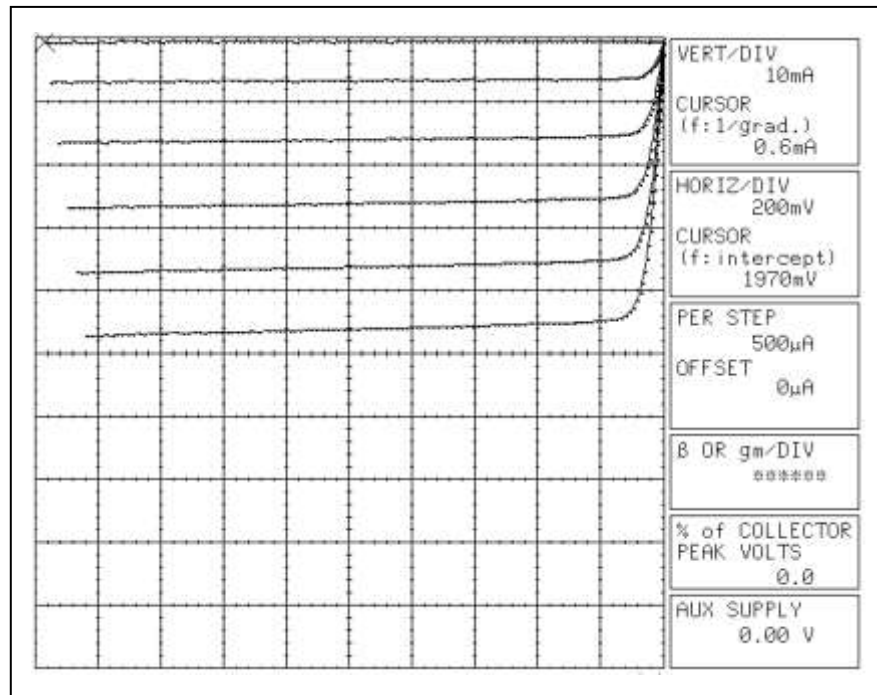**Bee Technologies Inc.**
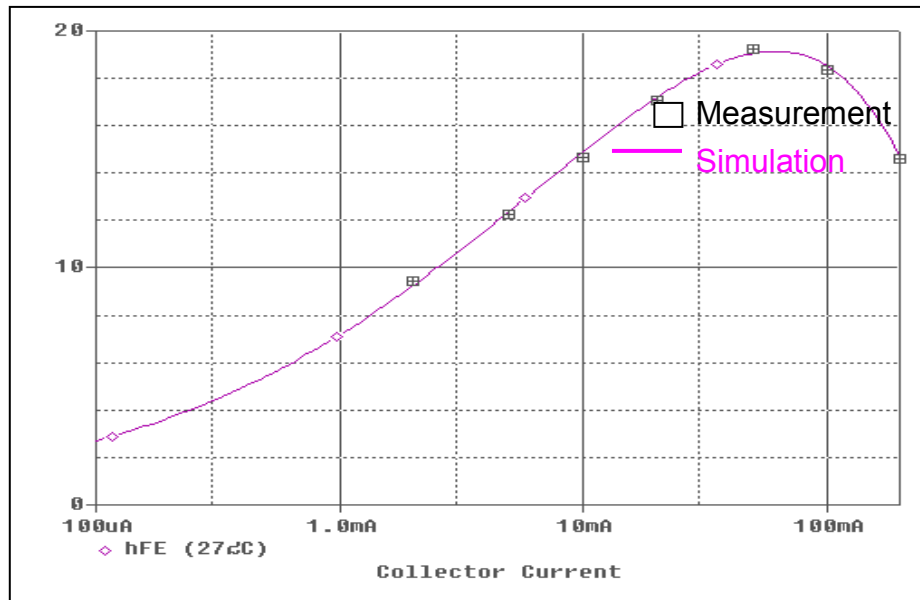
# TRANSISTOR MODEL

| 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=1/2pi*TF |
| TR | Reverse Transit Time |
| EG | Activation Energy |
| XTB | Forward Beta Temperature Coefficient |
| XTI | Temperature Coefficient for IS |

# Reverse Early Voltage Characteristic



```
VERT/DIV
        10mA
CURSOR
(f:1/grad.)
        0.6mA

HORIZ/DIV
        200mV
CURSOR
(f:intercept)
        1970mV

PER STEP
        500µA
OFFSET
        0µA

β OR gm/DIV
        ******

% of COLLECTOR
PEAK VOLTS
        0.0

AUX SUPPLY
        0.00 V
```
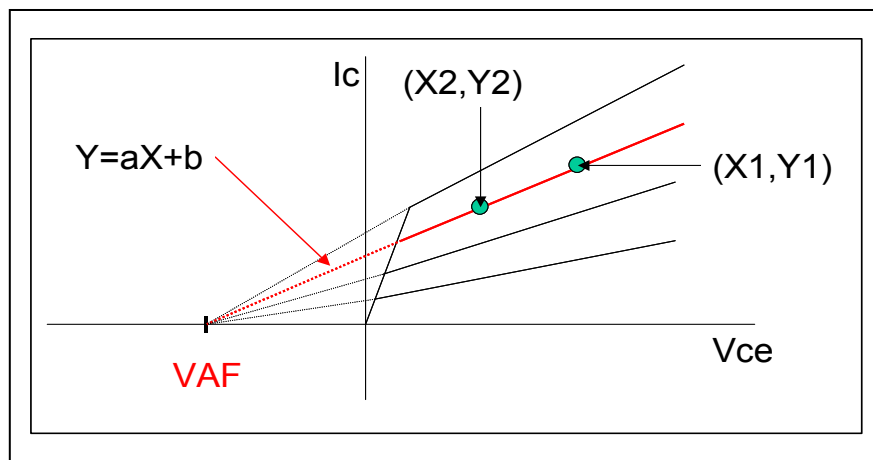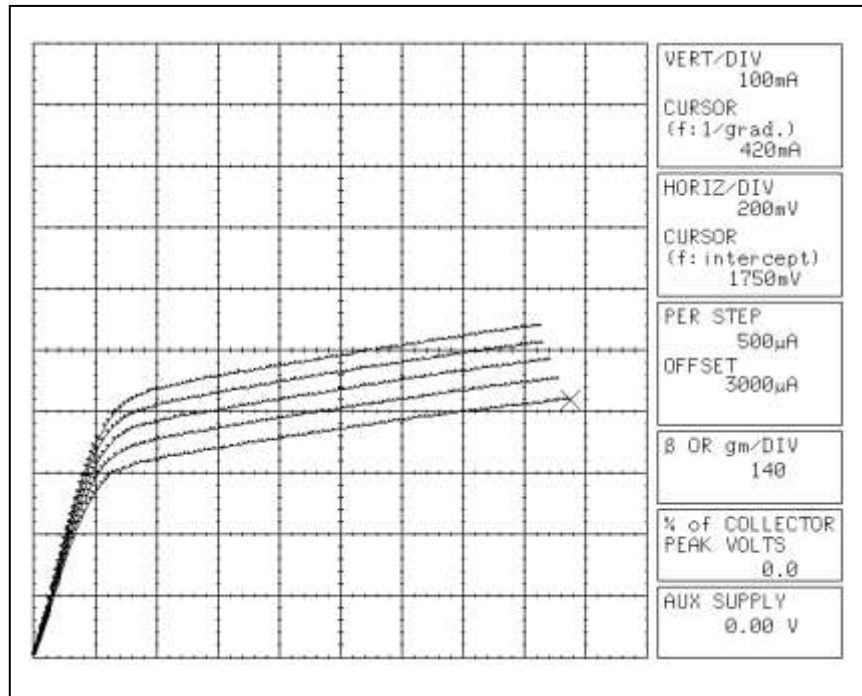


Ic

VAR

Vce

Y=aX+b

(X1,Y1)

(X2,Y2)

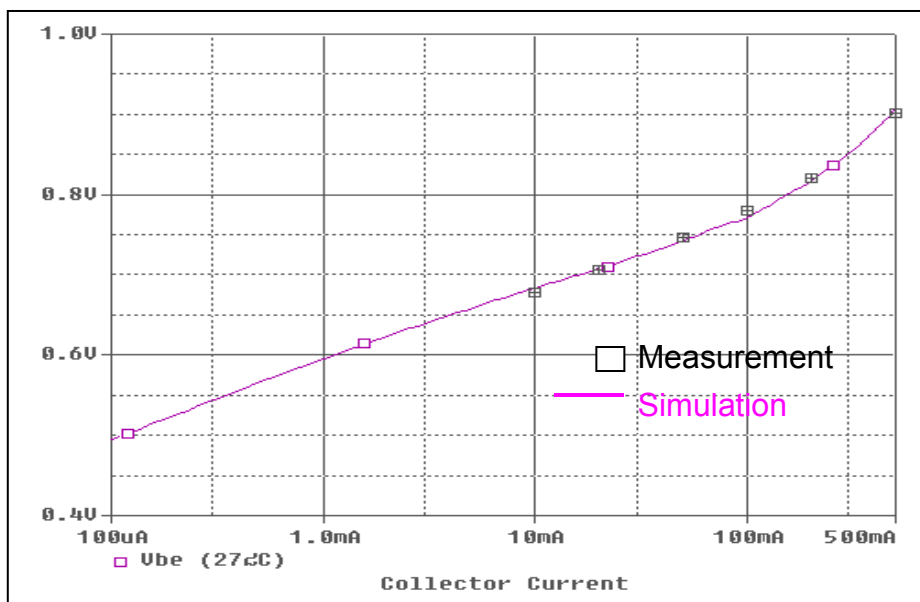## Reverse DC Beta Characteristic (Ie vs. h<sub>FE</sub>)

# Forward Characteristic

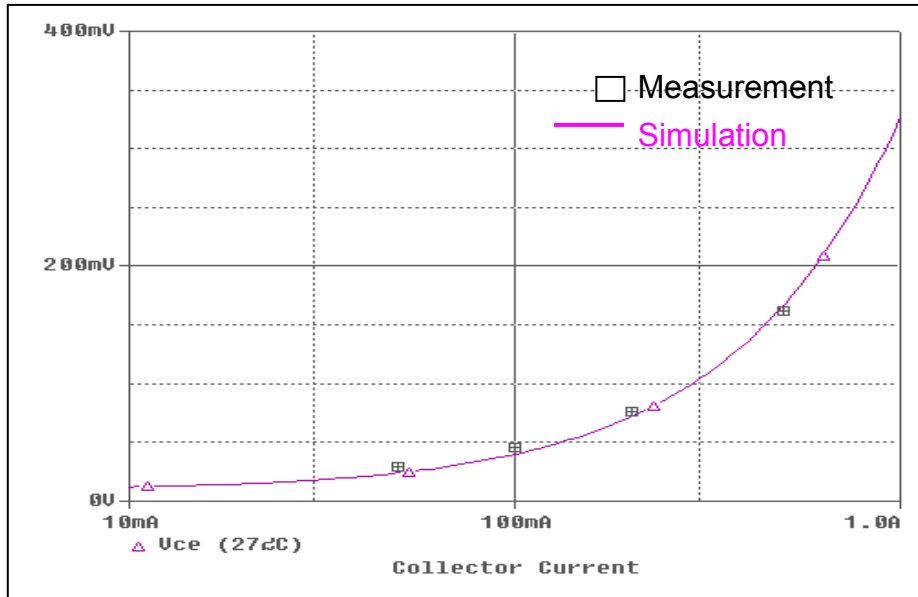## Forward Early Voltage Characteristic
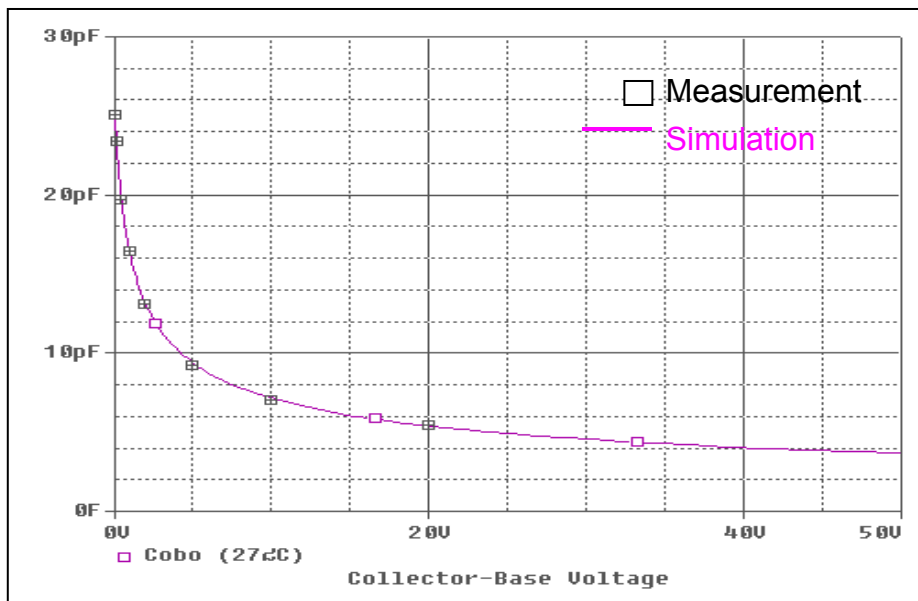
## Forward DC Beta Characteristic



## Vbe(sat) Voltage Characteristic
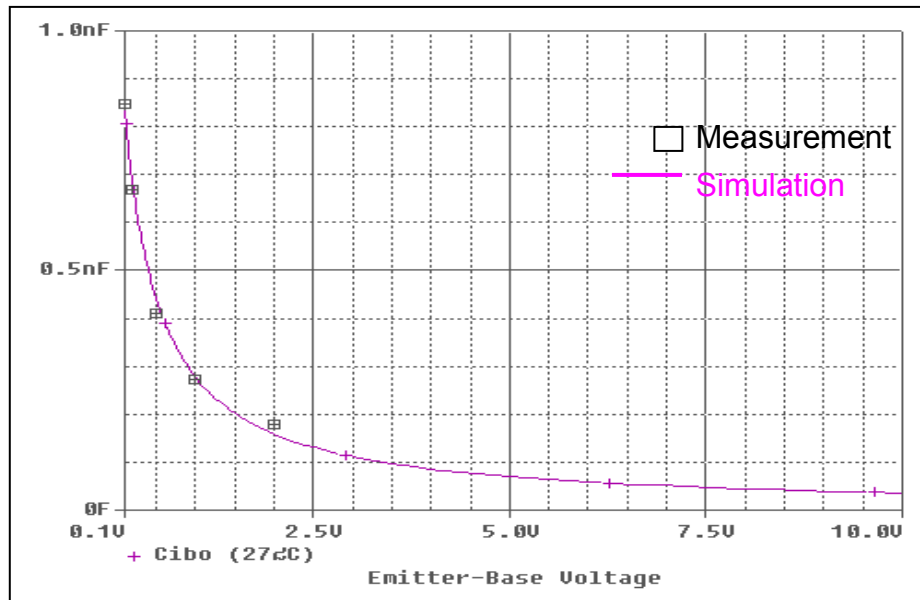
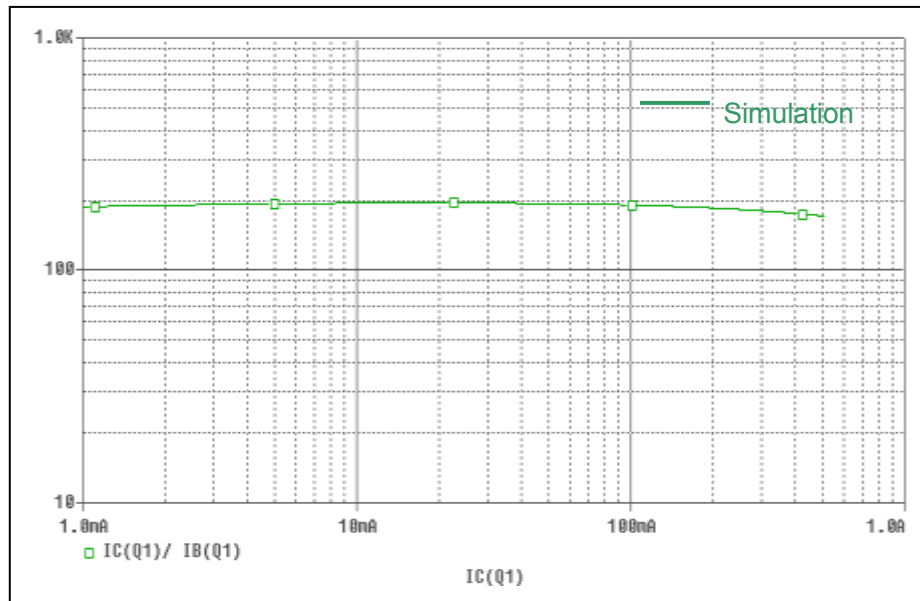## Vce(sat) Voltage Characteristic



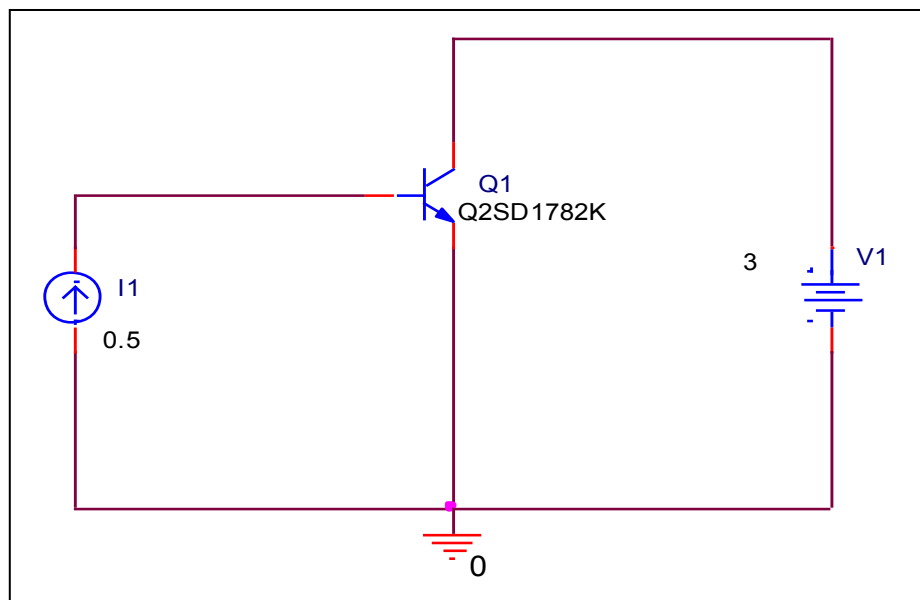## C-B Capacitance Characteristic

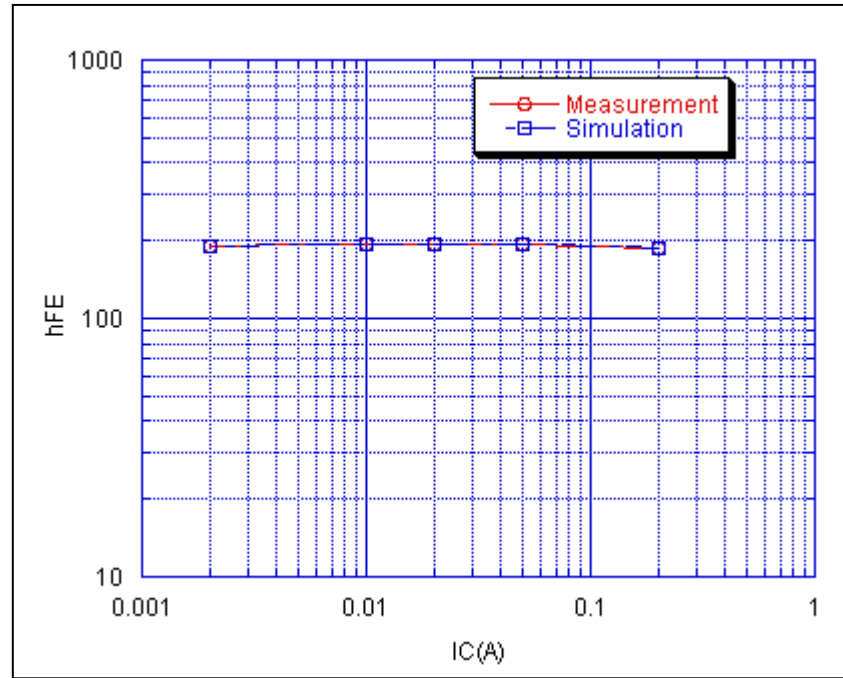# E-B Capacitance Characteristic

# BJT Ic-hFE Characteristics

## Comparison graph



## Comparison Table

| I$_C$(A) | h$_{FE}$ | | %Error |
| :---: | :---: | :---: | :---: |
| | Measurement | Simulation | |
| 0.002 | 190.48 | 190.539 | -0.031 |
| 0.005 | 193.8 | 193.405 | 0.204 |
| 0.01 | 194.55 | 194.583 | -0.017 |
| 0.02 | 194.93 | 194.917 | 0.007 |
| 0.05 | 194.55 | 193.727 | 0.423 |
| 0.1 | 191.57 | 190.932 | 0.333 |
| 0.2 | 186.22 | 185.408 | 0.436 |

# BJT Vce(sat) voltage& Vbe(sat) voltage Characteristics
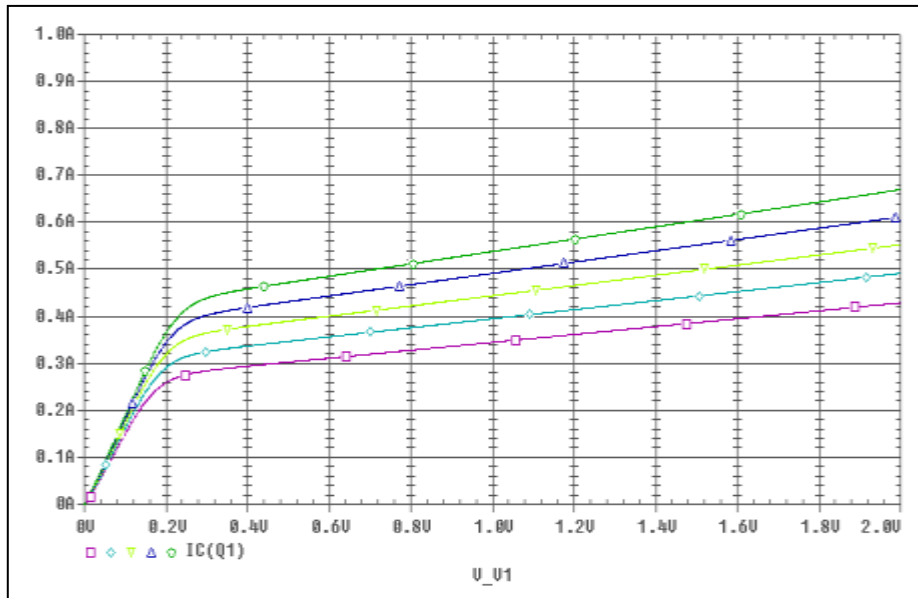
Circuit simulation result



Evaluation circuit



Comparison Table
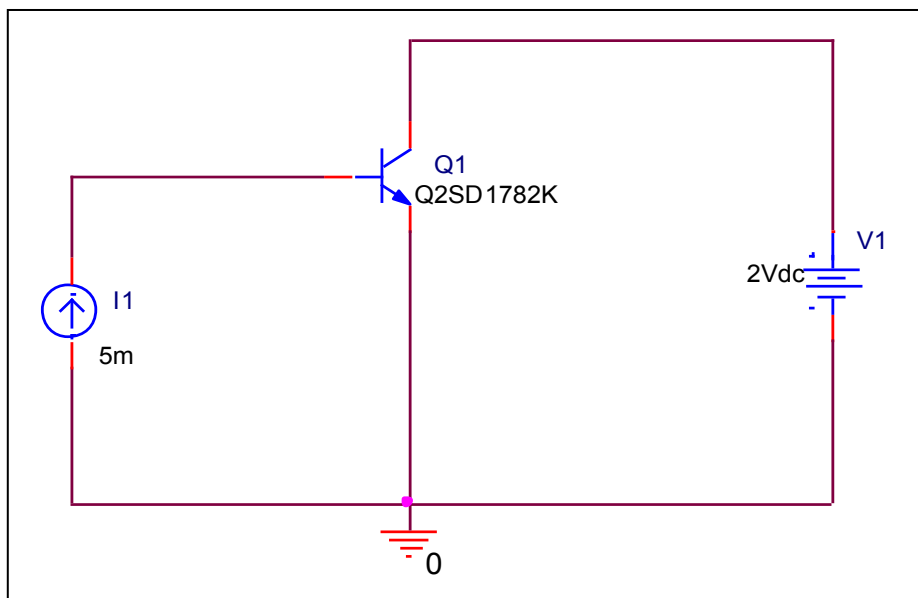
| Ic=0.5A,Ib=0.05A | Measurement | Simulation | %Error |
|---|---|---|---|
| Vce(sat) (V) | 0.1635 | 0.168031 | -2.771 |
| Vbe(sat) (V) | 0.904 | 0.923744 | -2.184 |

# BJT Output Characteristic

# Reference



| VERT/DIV | |
|---|---|
| | 100mA |
| CURSOR (f:1/grad.) | |
| | 420mA |
| HORIZ/DIV | |
| | 200mV |
| CURSOR (f:intercept) | |
| | 1750mV |
| PER STEP | |
| | 500µA |
| OFFSET | |
| | 3000µA |
| ß OR gm/DIV | |
| | 140 |
| % of COLLECTOR PEAK VOLTS | |
| | 0.0 |
| AUX SUPPLY | |
| | 0.00 V |