

# Device Modeling Report

COMPONENTS: TRANSISTOR  
PART NUMBER: 2SA1036KT146R  
MANUFACTURER: ROHM



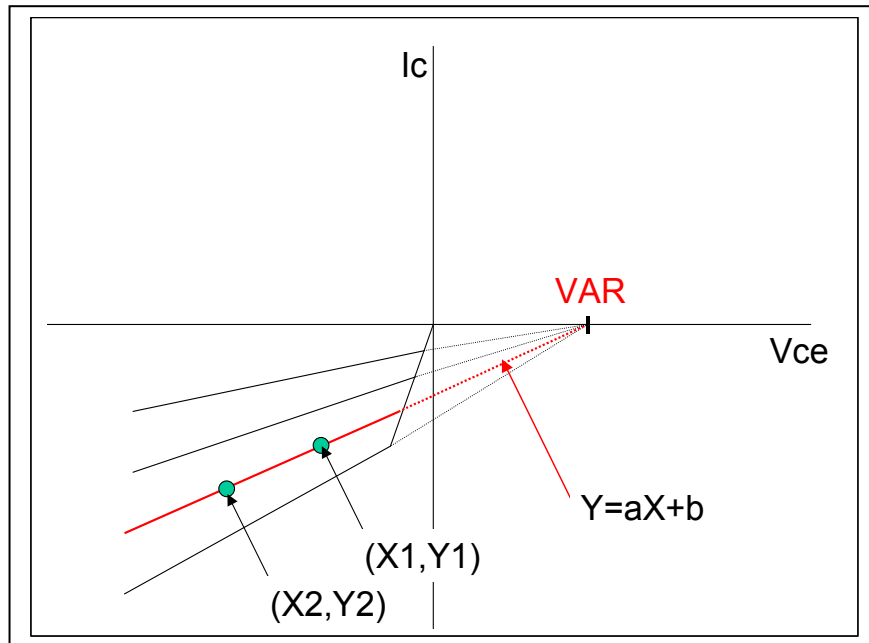
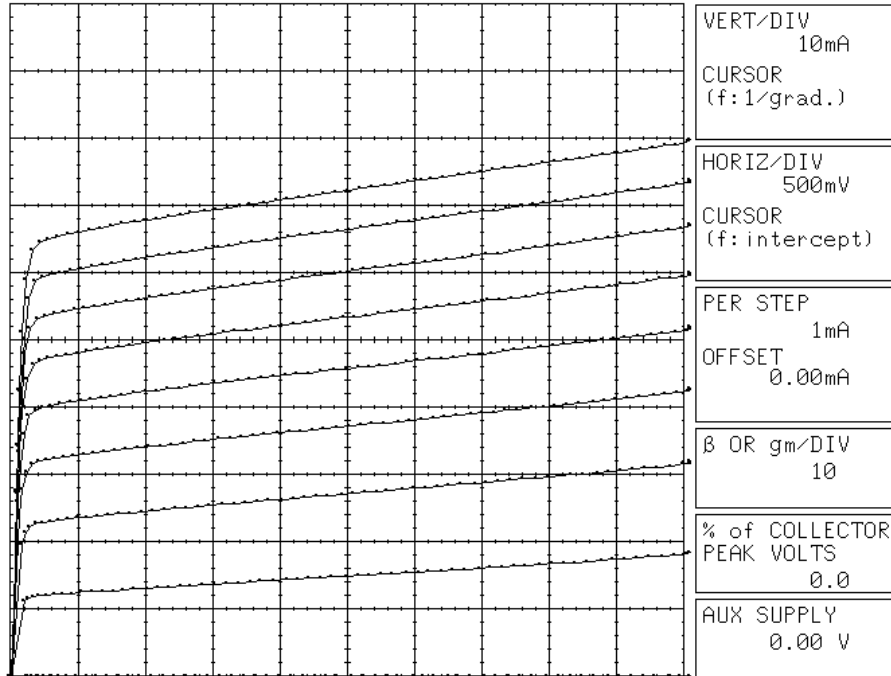
**Bee Technologies Inc.**

## TRANSISTOR MODEL

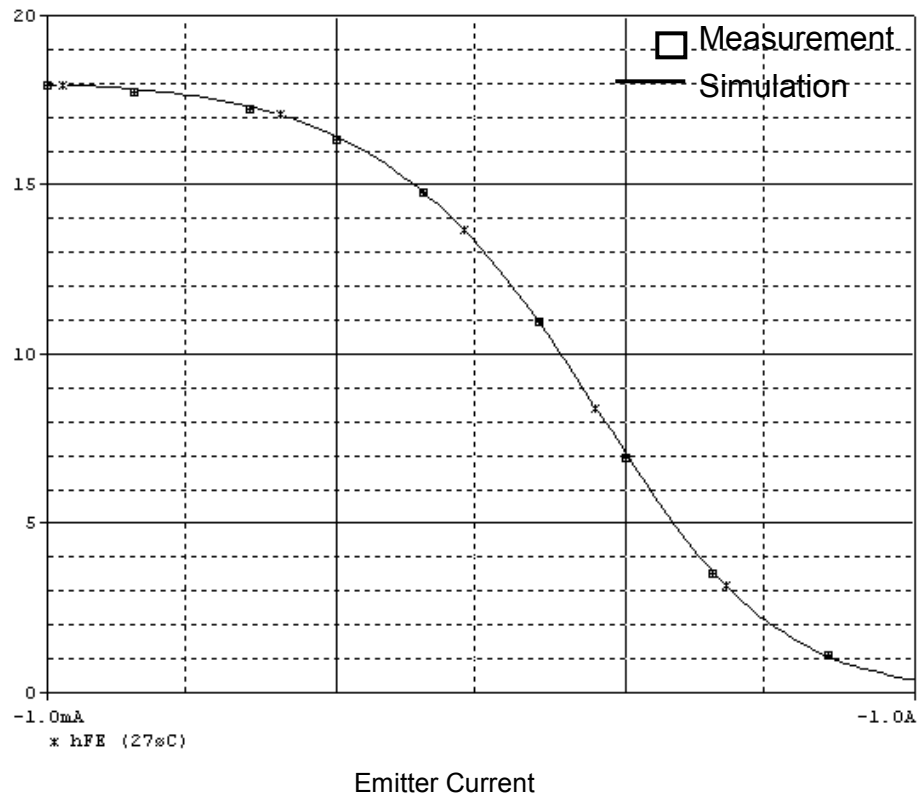
PSpice model parameter	Model description
IS	Saturation Current
BF	Ideal Maximum Forward Beta
NF	Forward Current Emission Coefficient
VAF	Forward Early Voltage
IKF	Forward Beta Roll-off Knee Current
ISE	Non-ideal Base-Emitter Diode Saturation Current
NE	Non-ideal Base-Emitter Diode Emission Coefficient
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 $f=1/2\pi*TF$
TR	Reverse Transit Time
EG	Activation Energy
XTB	Forward Beta Temperature Coefficient
XTI	Temperature Coefficient for IS

Reverse

### Reverse Early Voltage Characteristic

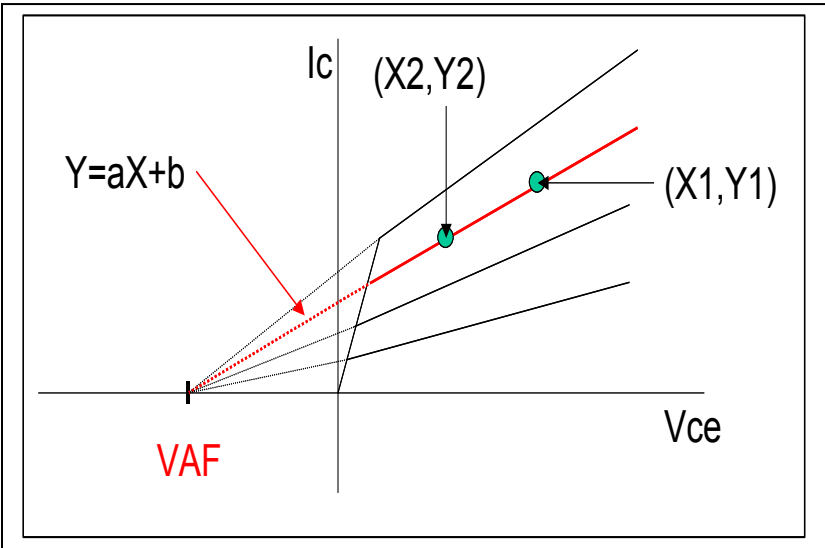
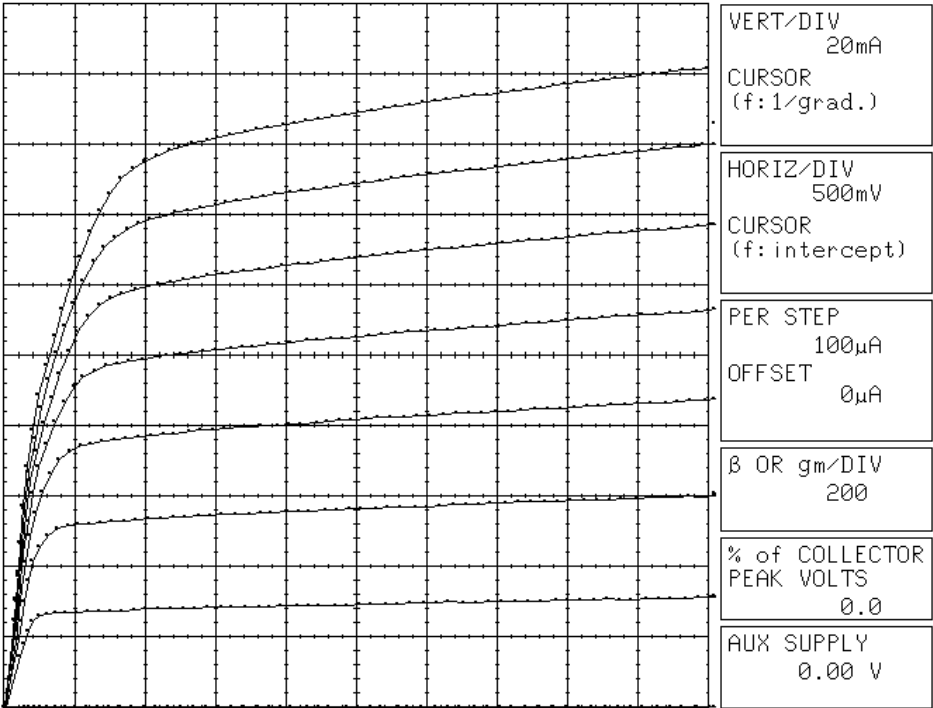


## Reverse DC Beta Characteristic ( $I_e$ vs. $h_{FE}$ )

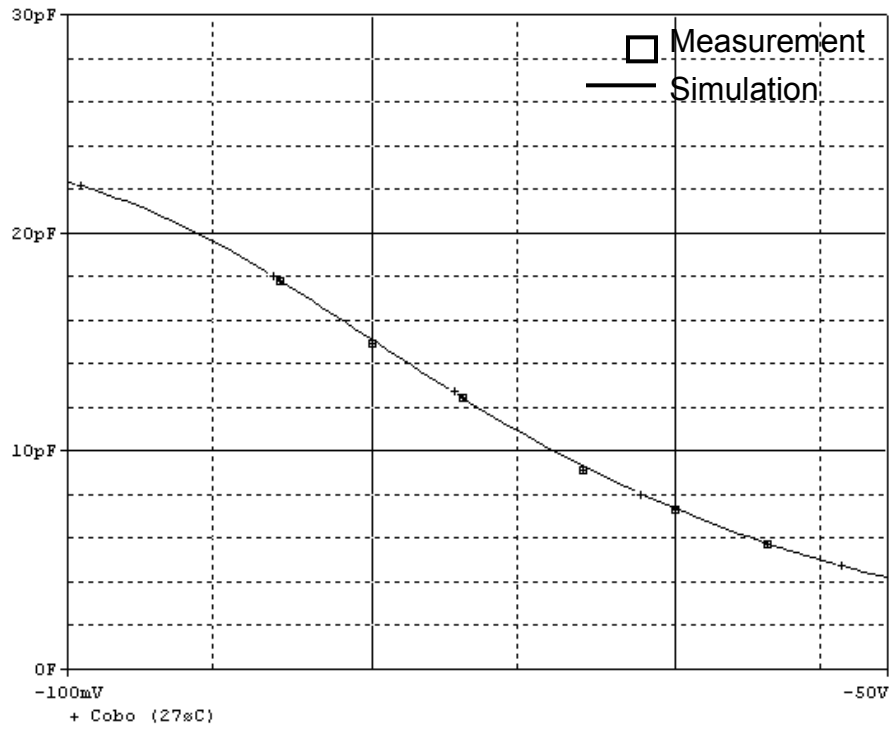


Forward

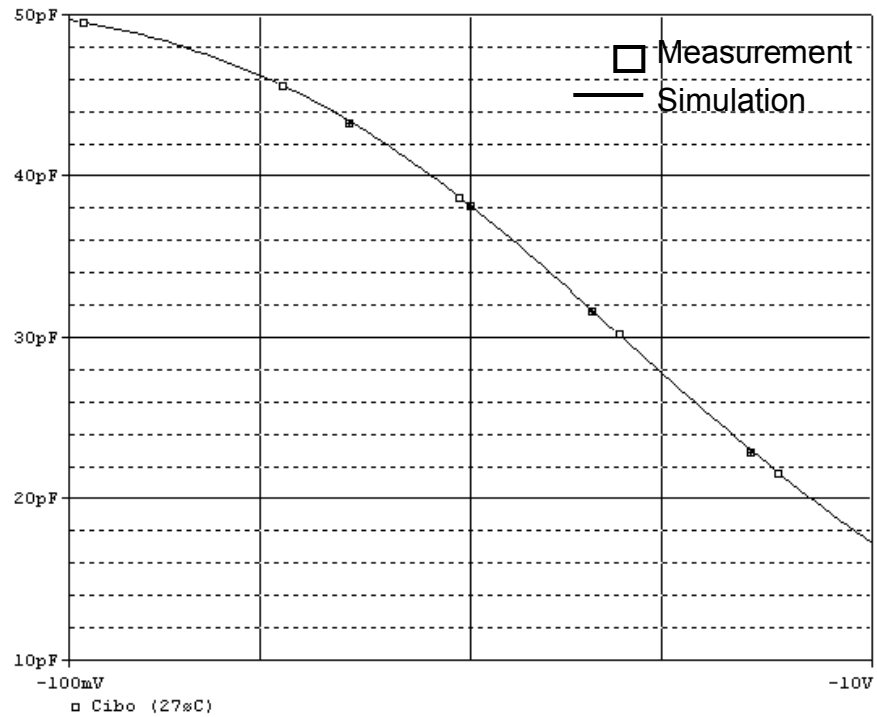
### Forward Early Voltage Characteristic



## C-B Capacitance Characteristics

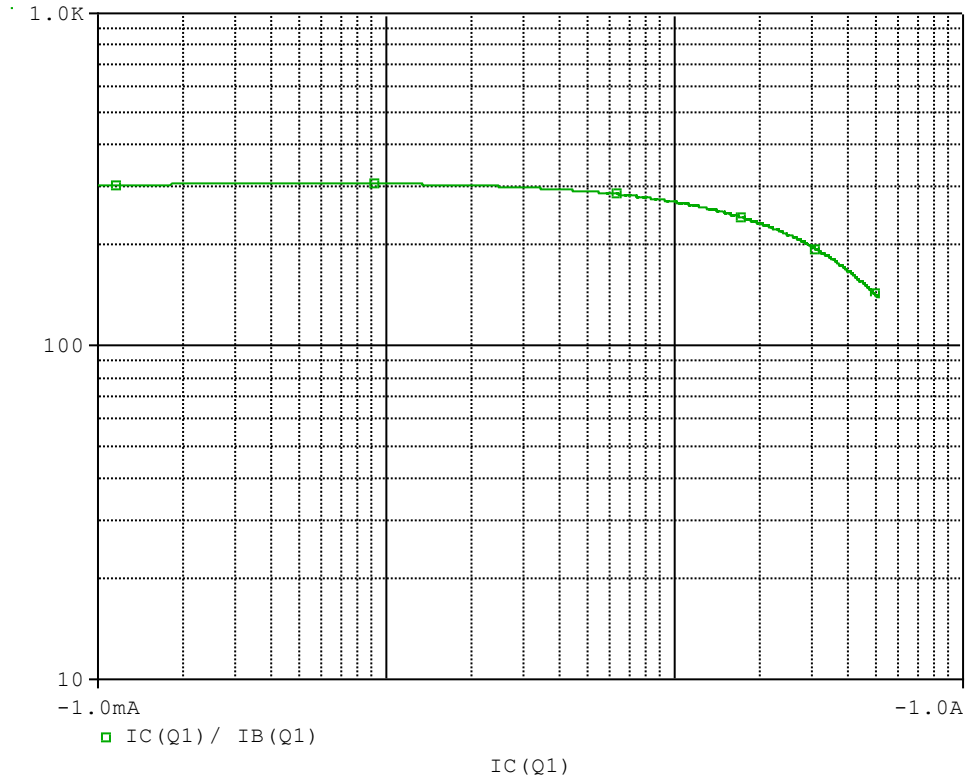


## E-B Capacitance Characteristics

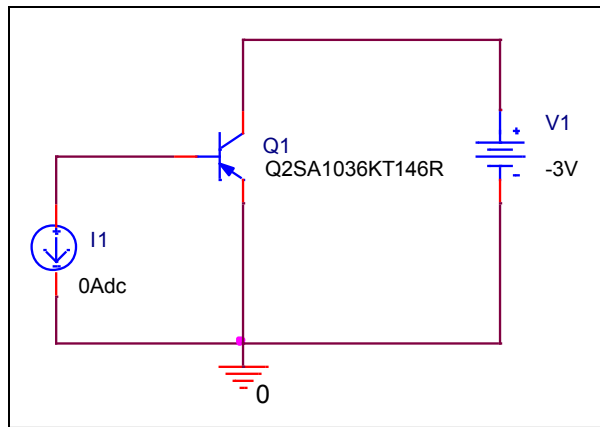


# Transistor $h_{FE}$ - $I_C$ Characteristics

## Circuit Simulation Result

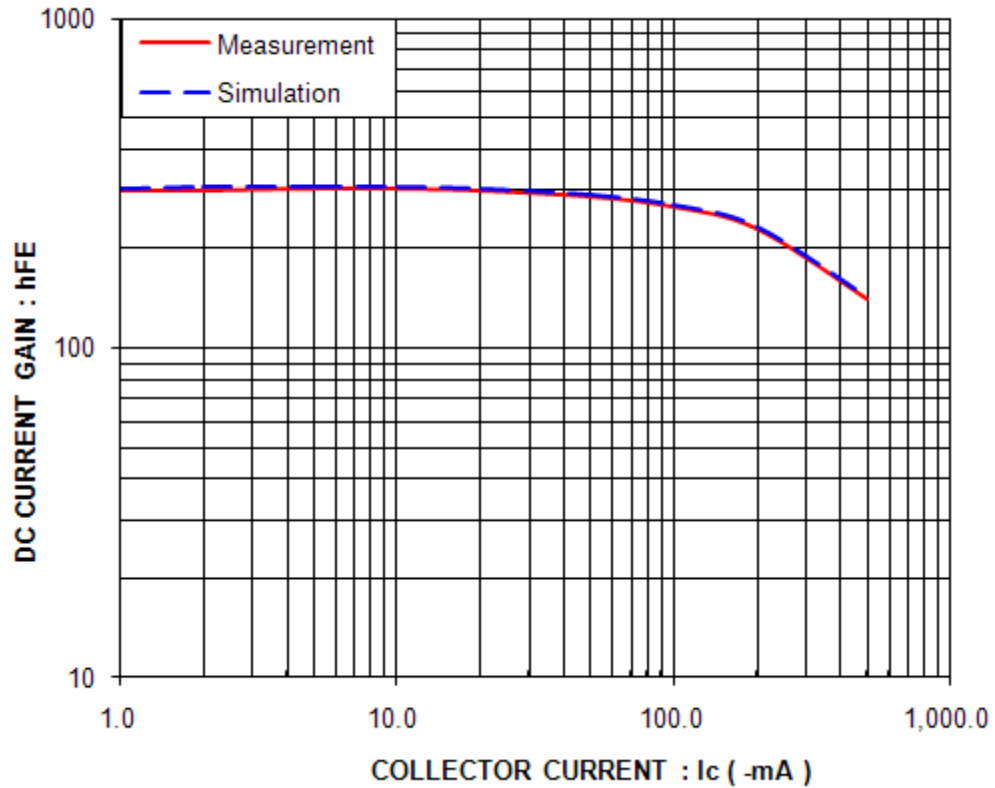


## Evaluation Circuit



## Comparison Graph

Circuit Simulation Result



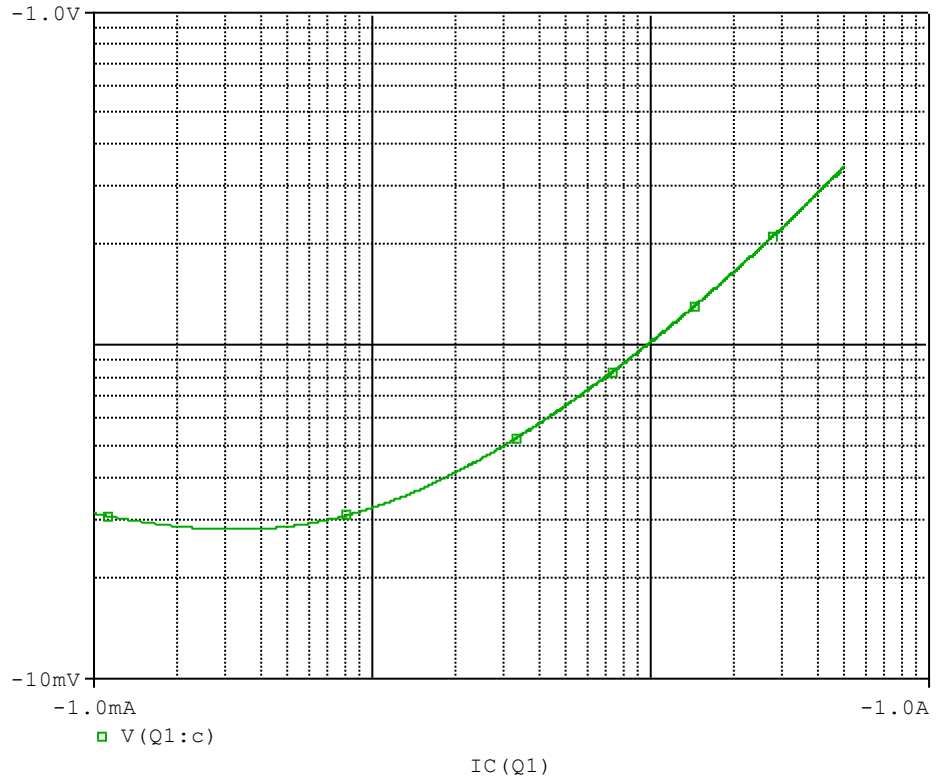
Simulation Result

Ic(mA)	hFE		Error(%)
	Measurement	Simulation	
-1.000	298.000	303.930	1.990
-2.000	301.750	306.910	1.710
-5.000	303.940	308.480	1.494
-10.000	302.180	307.597	1.793
-20.000	298.510	304.037	1.852
-50.000	287.020	291.749	1.648
-100.000	267.760	271.357	1.343
-200.000	229.830	233.281	1.502
-500.000	140.650	141.805	0.821

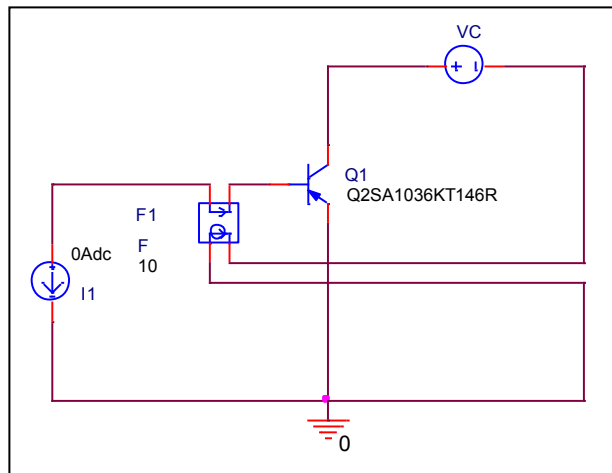


# $V_{CE(Sat)}$ - $I_C$ Characteristics

Circuit Simulation Result

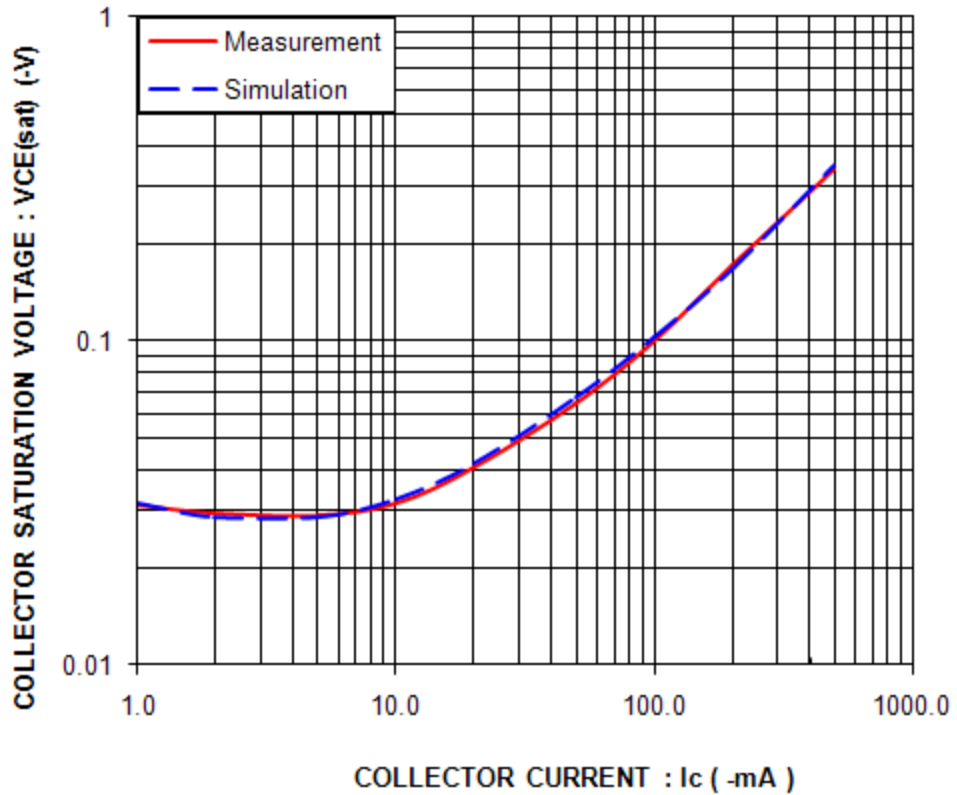


Evaluation Circuit



## Comparison Graph

Circuit Simulation Result

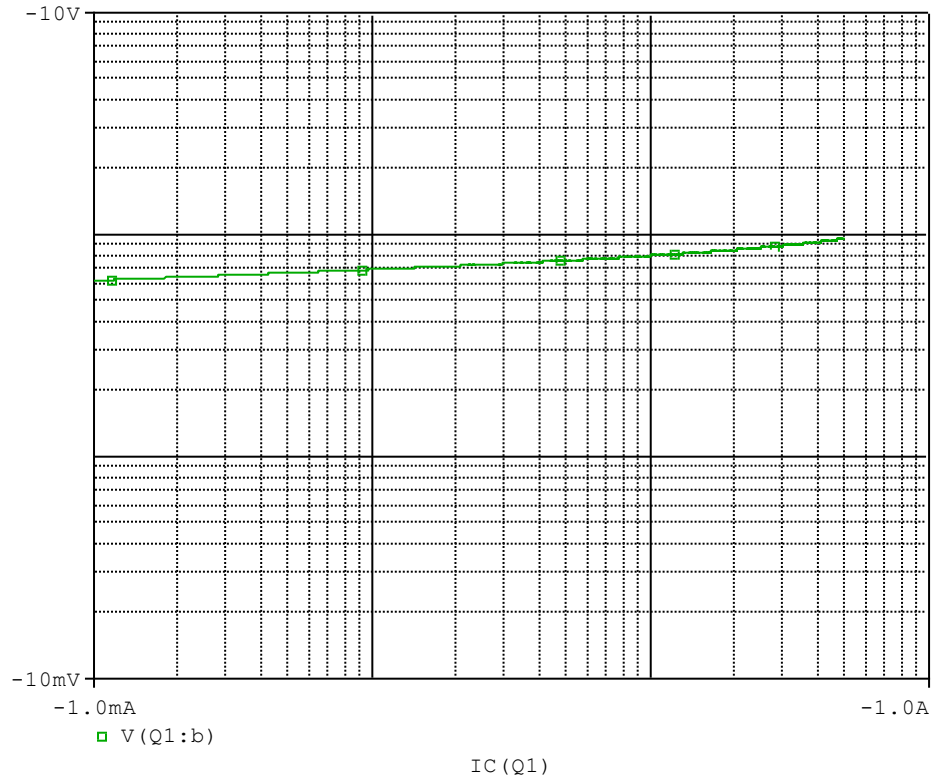


Simulation Result

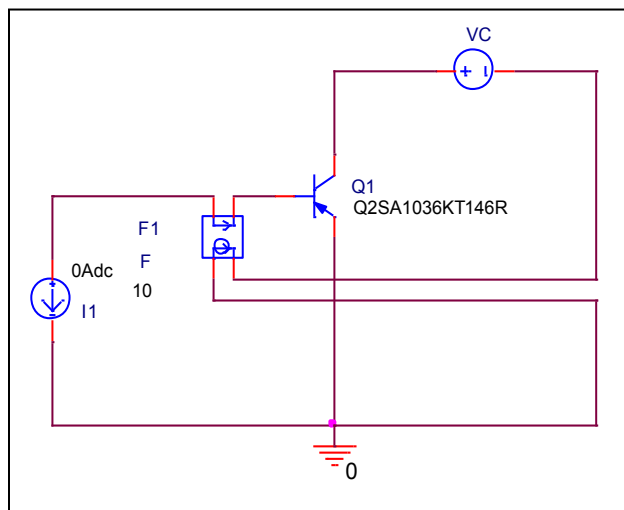
IC(mA)	VCE(sat)(V)		Error(%)
	Measurement	Simulation	
-1.000	-0.0310	-0.0314	1.1290
-2.000	-0.0295	-0.0287	-2.8508
-5.000	-0.0290	-0.0287	-1.2000
-10.000	-0.0315	-0.0326	3.4667
-20.000	-0.0405	-0.0417	2.9259
-50.000	-0.0645	-0.0665	3.1395
-100.000	-0.1000	-0.1025	2.5140
-200.000	-0.1700	-0.1673	-1.5694
-500.000	-0.3400	-0.3455	1.6144

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

## Circuit Simulation Result

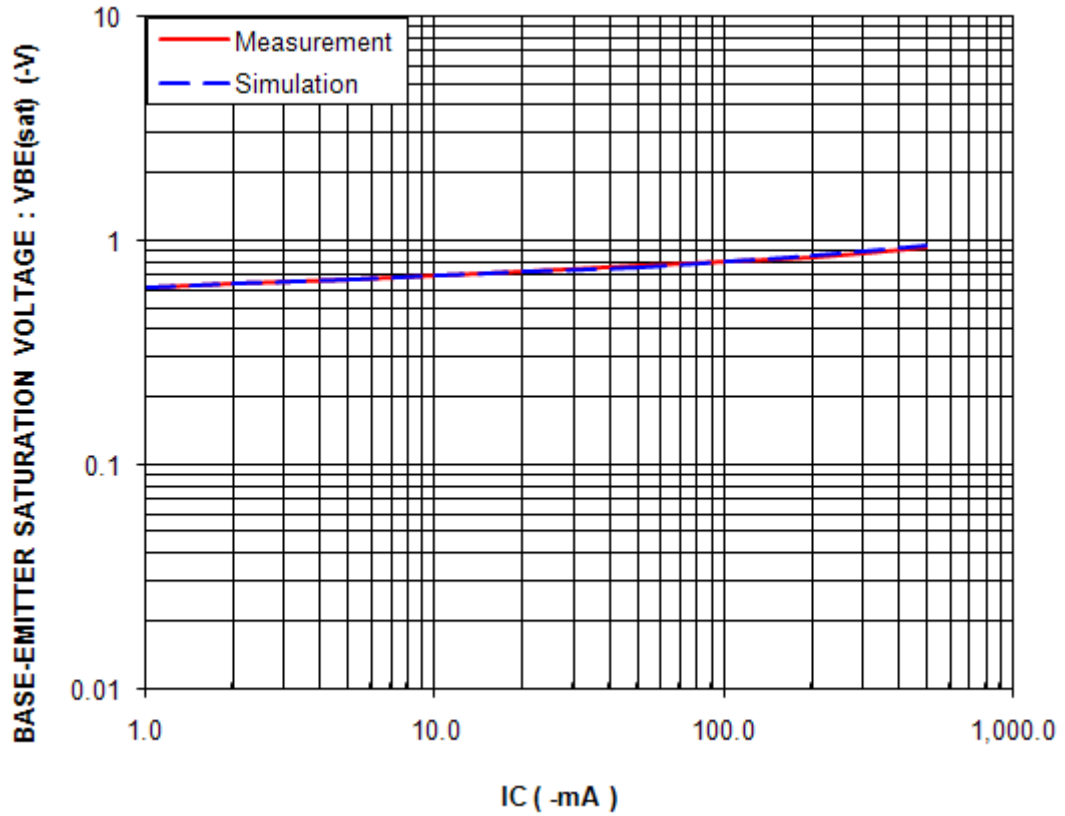


## Evaluation Circuit



## Comparison Graph

Circuit Simulation Result

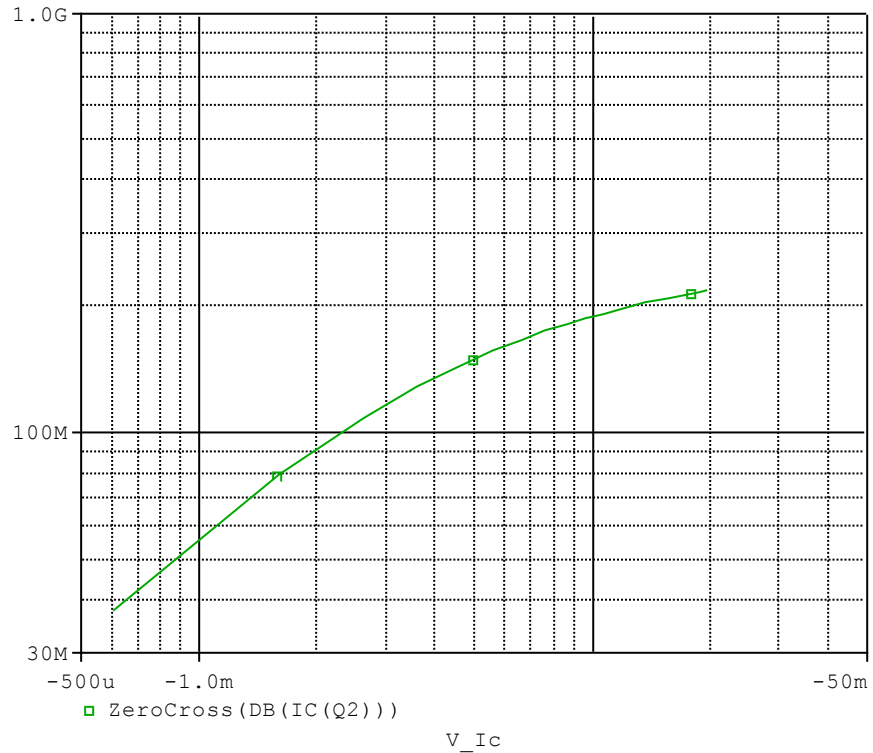


Simulation Result

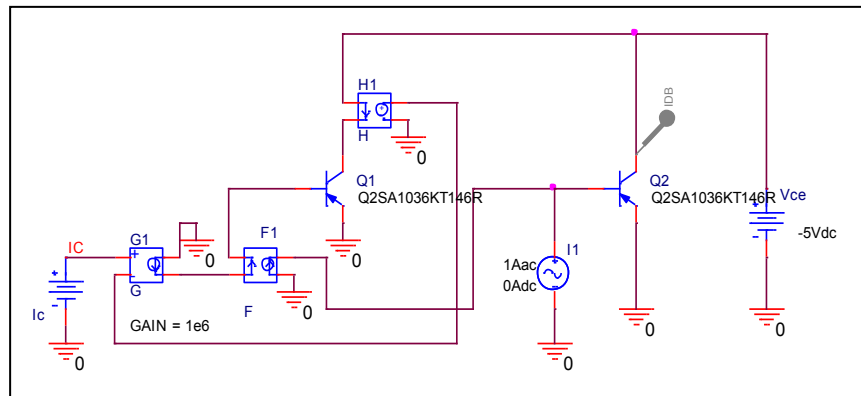
IC(mA)	VBE(sat)(V)		Error(%)
	Measurement	Simulation	
-1.000	-0.6220	-0.6223	0.0455
-2.000	-0.6440	-0.6434	-0.0995
-5.000	-0.6760	-0.6728	-0.4741
-10.000	-0.7020	-0.6970	-0.7094
-20.000	-0.7300	-0.7239	-0.8412
-50.000	-0.7720	-0.7653	-0.8692
-100.000	-0.8080	-0.8040	-0.4986
-200.000	-0.8520	-0.8545	0.2958
-500.000	-0.9360	-0.9589	2.4435

# F<sub>t</sub> - I<sub>C</sub> Characteristics

## Circuit Simulation Result



## Evaluation Circuit

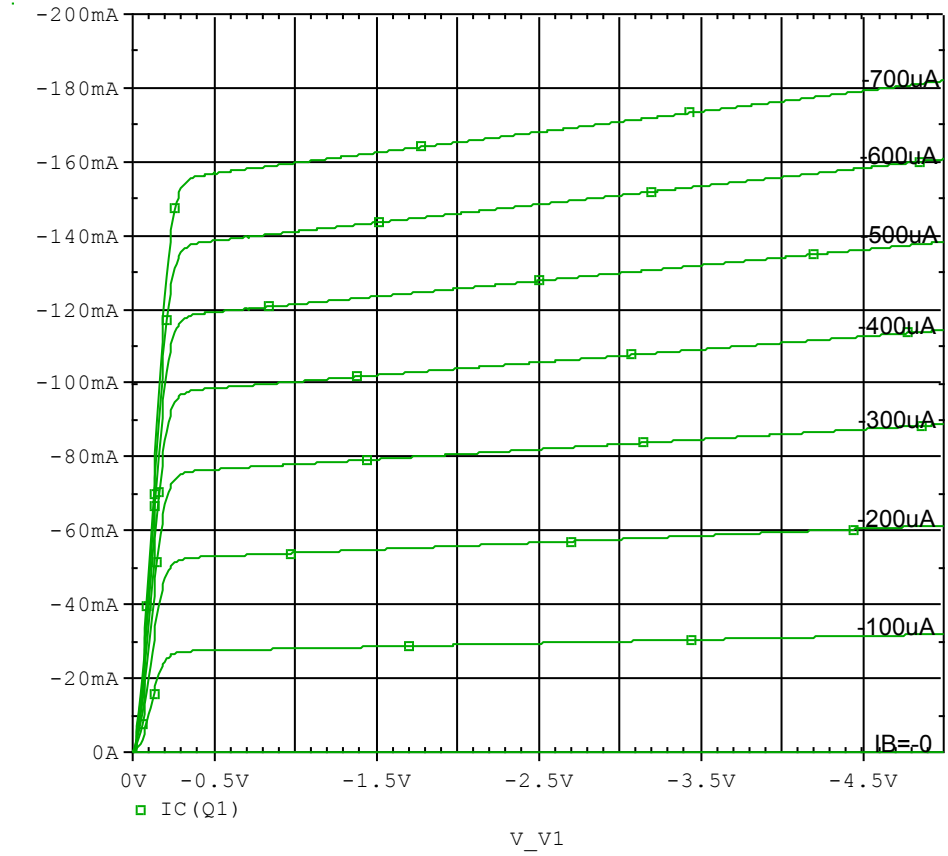


## Simulation Result

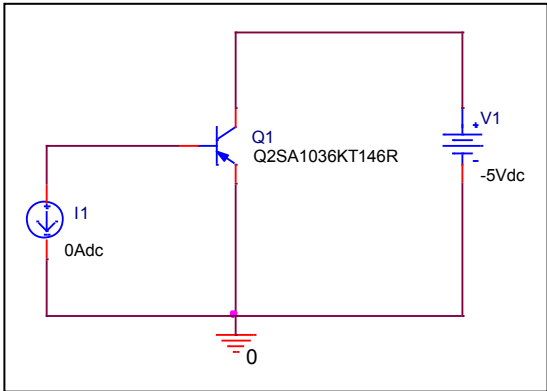
-I <sub>C</sub> (mA)	F <sub>T</sub> (MHz)		Error(%)
	Measurement	Simulation	
20.000	220.000	217.120	-1.309

# Output Characteristics

## Circuit Simulation Result



## Evaluation Circuit



# Output Characteristics

# Reference

