Device Modeling Report

COMPONENTS: BIPOLAR JUNCTION TRANSISTOR
PART NUMBER: Q2SA1313
MANUFACTURER: TOSHIBA

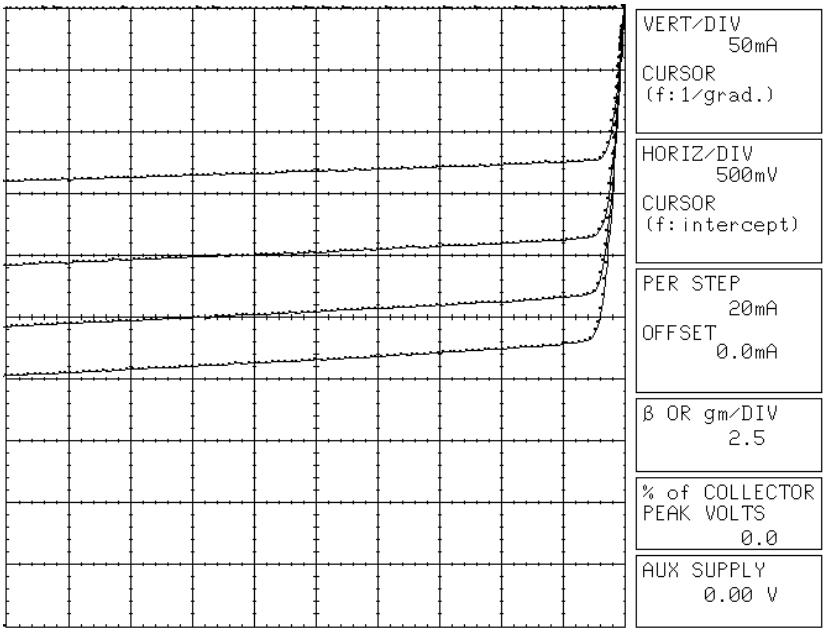
Bee Technologies Inc.

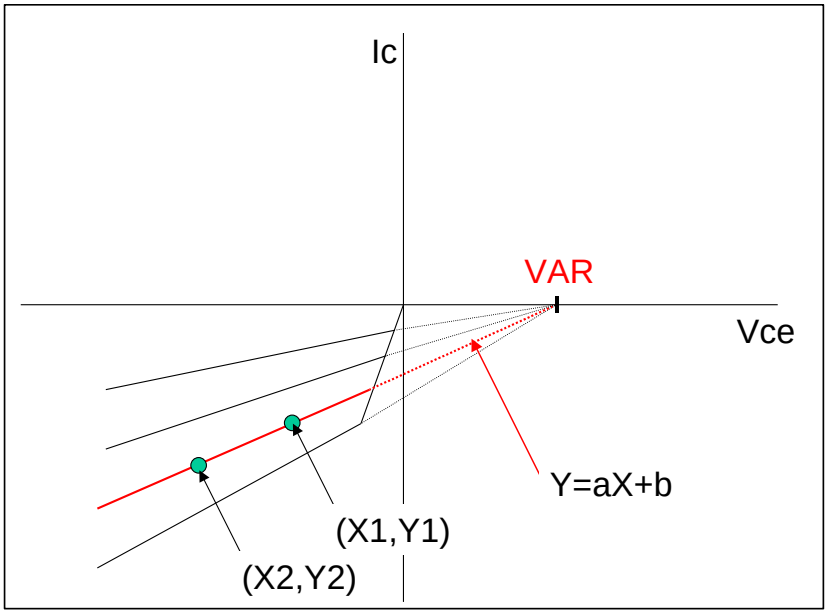
BJT SPICE Model Parameters

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

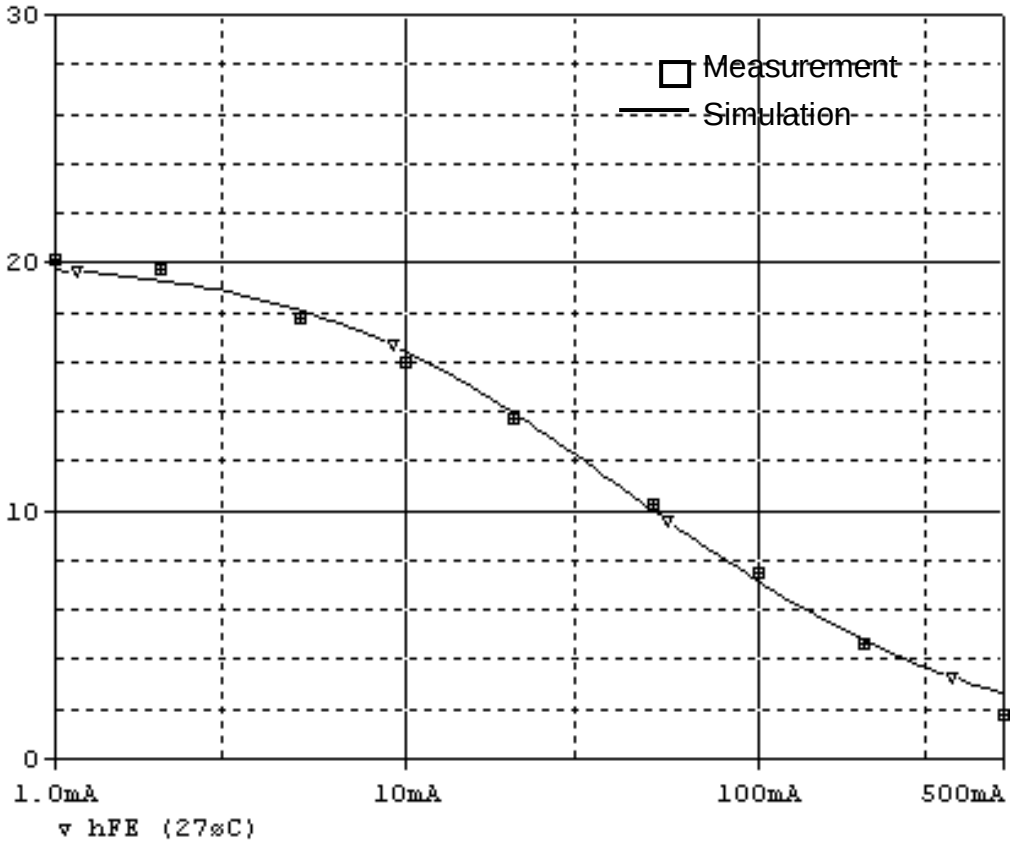
Reverse

Reverse Early Voltage Characteristic





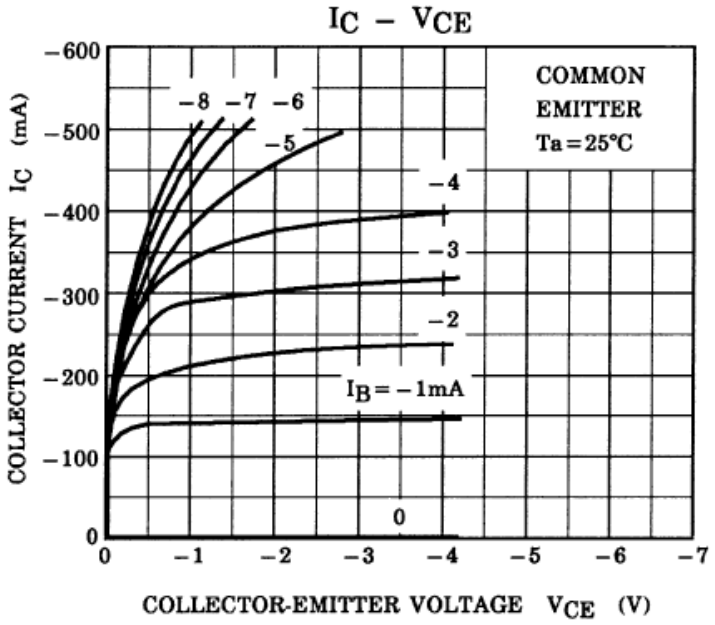
Reverse DC Beta Characteristic (I_E vs. h_{FE})

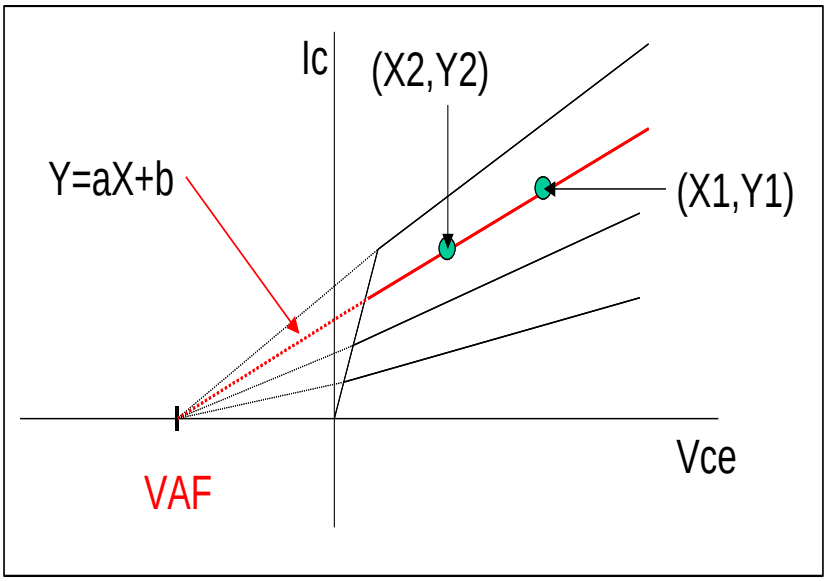


Emitter Current (A)

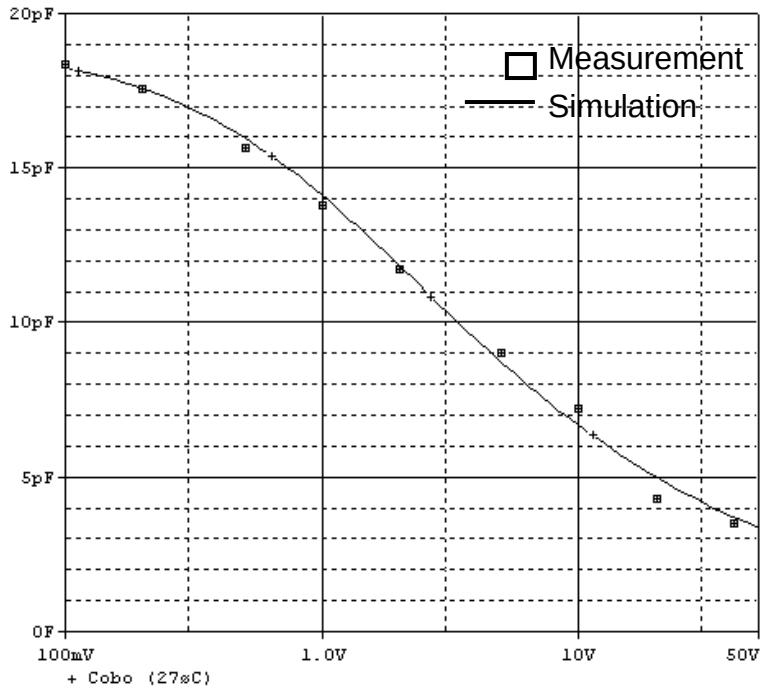
Forward

Forward Early Voltage Characteristic



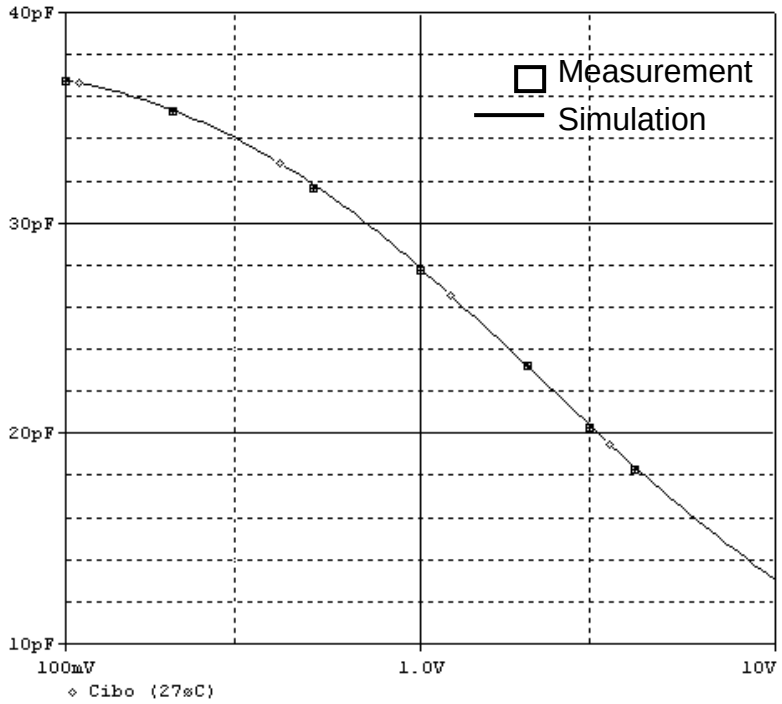


C-B Capacitance Characteristics



REVERSE VOLTAGE VR (V)

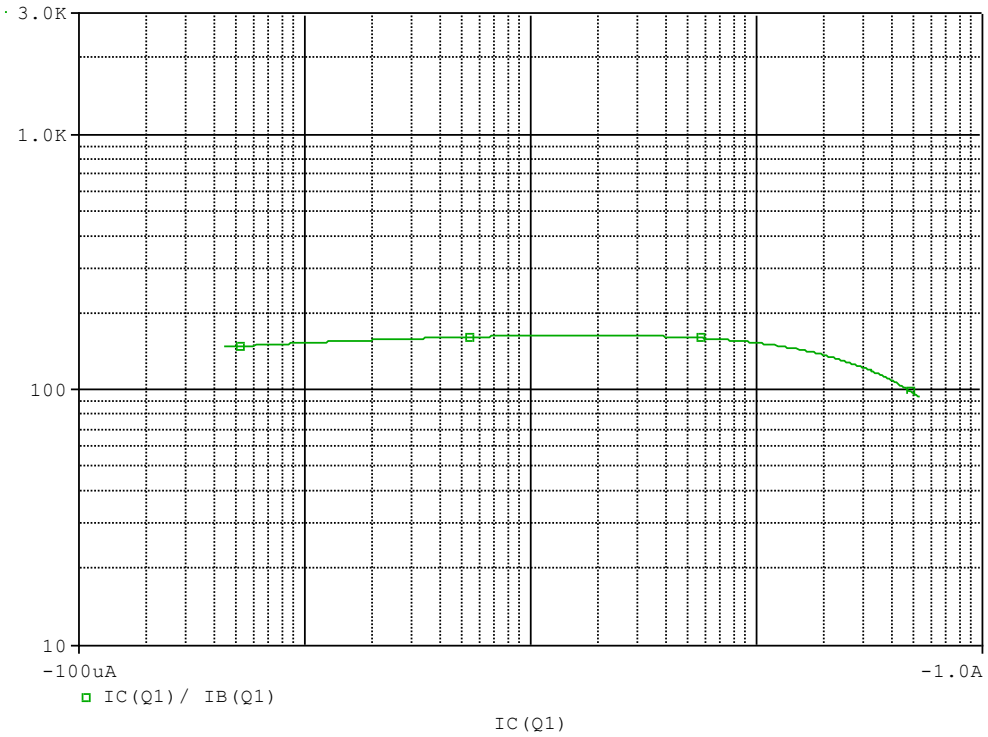
E-B Capacitance Characteristics



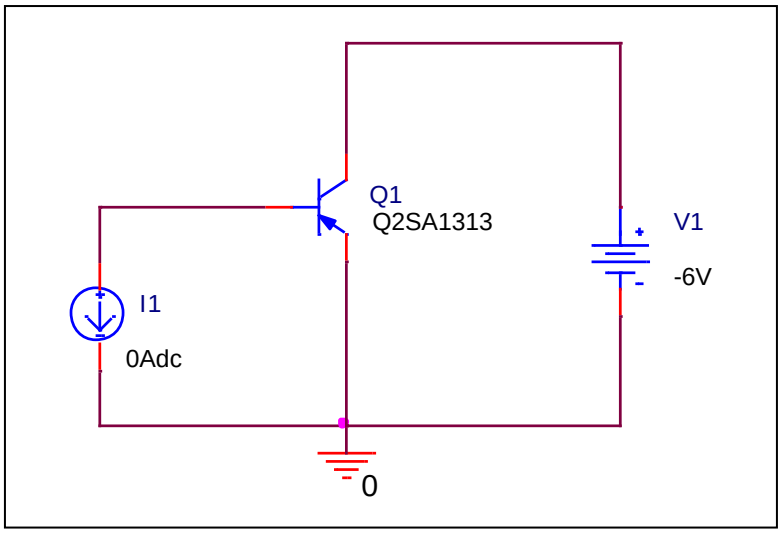
REVERSE VOLTAGE VR (V)

Transistor h_{FE}-I_C Characteristics

Simulation result

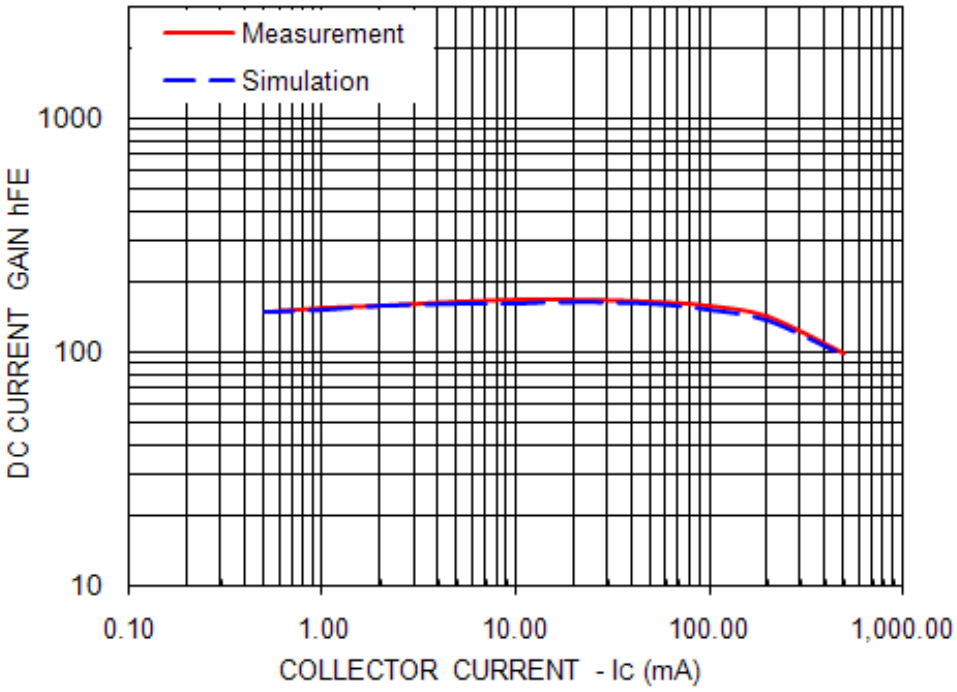


Evaluation circuit



Comparison Graph

Simulation result

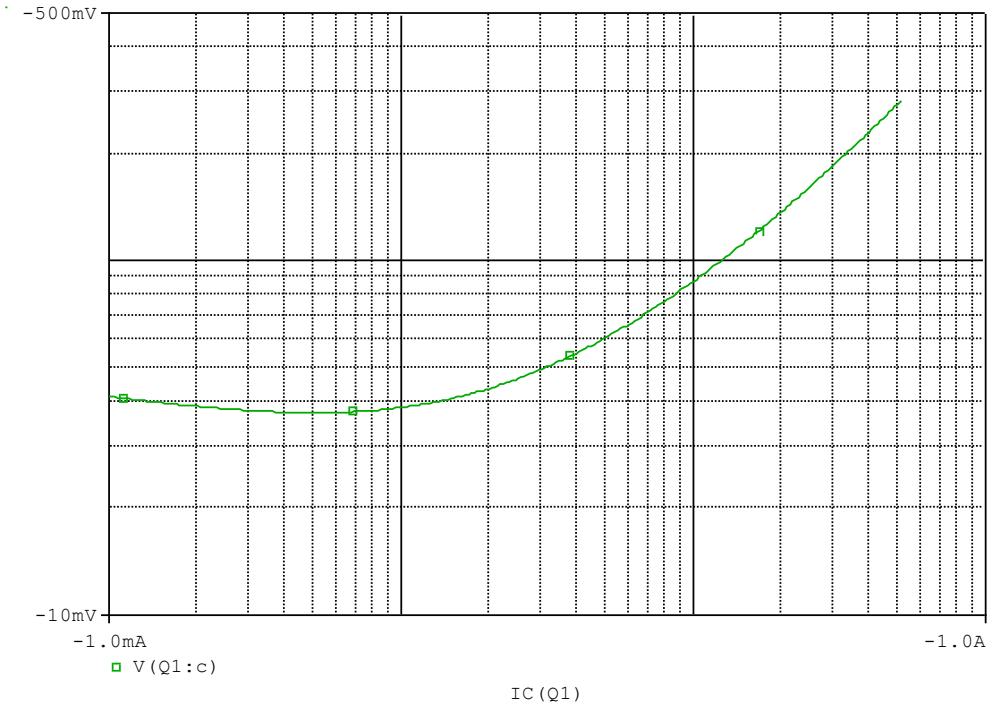


Comparison table

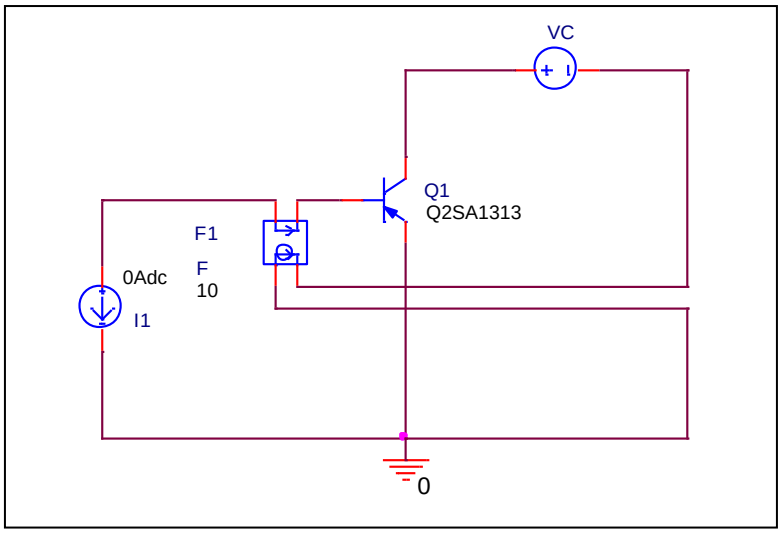
- Ic(mA)	h_{FE}		%Error
	Measurement	Simulation	
0.5	150.000	148.455	-1.03
1	155.000	153.203	-1.16
2	160.000	157.250	-1.72
5	165.000	161.411	-2.18
10	168.000	163.432	-2.72
20	169.000	164.017	-2.95
50	166.000	160.946	-3.04
100	159.000	153.238	-3.62
200	142.000	137.201	-3.38
500	100.000	96.681	-3.32

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

Simulation result

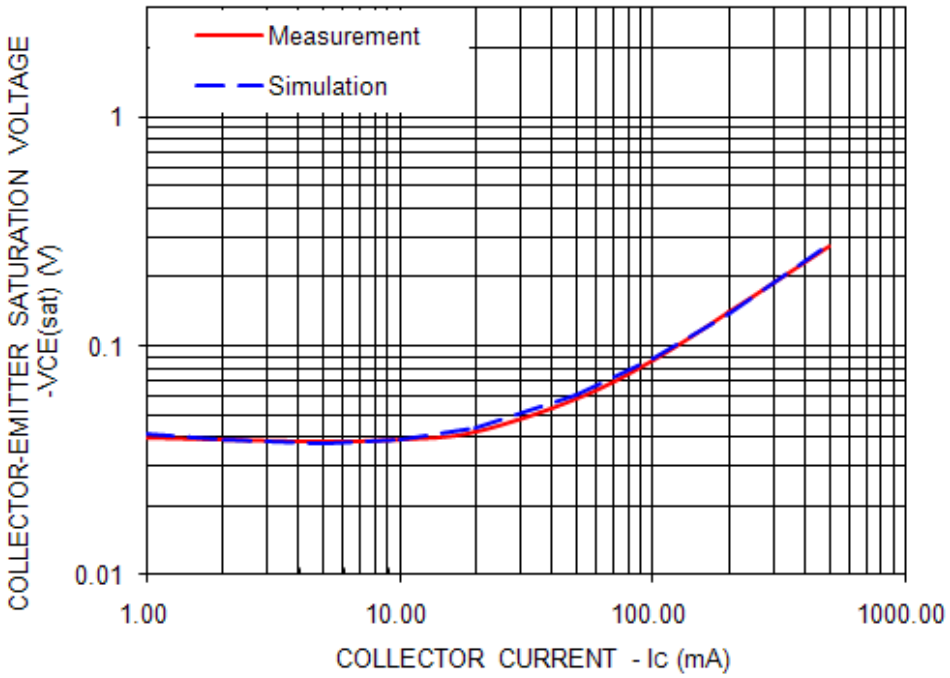


Evaluation circuit



Comparison Graph

Simulation result

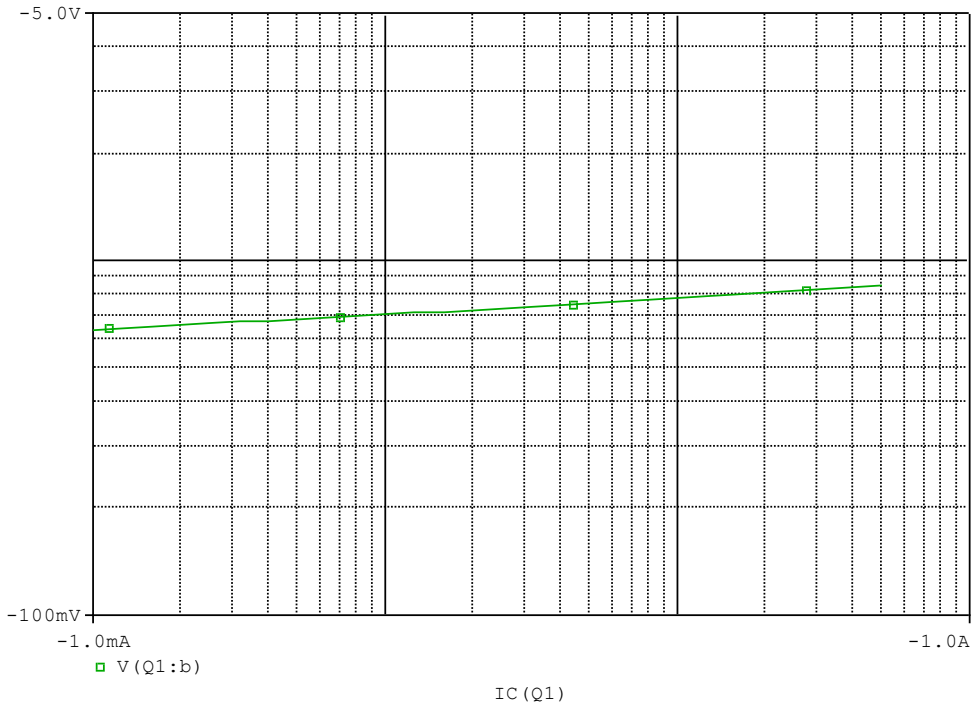


Comparison table

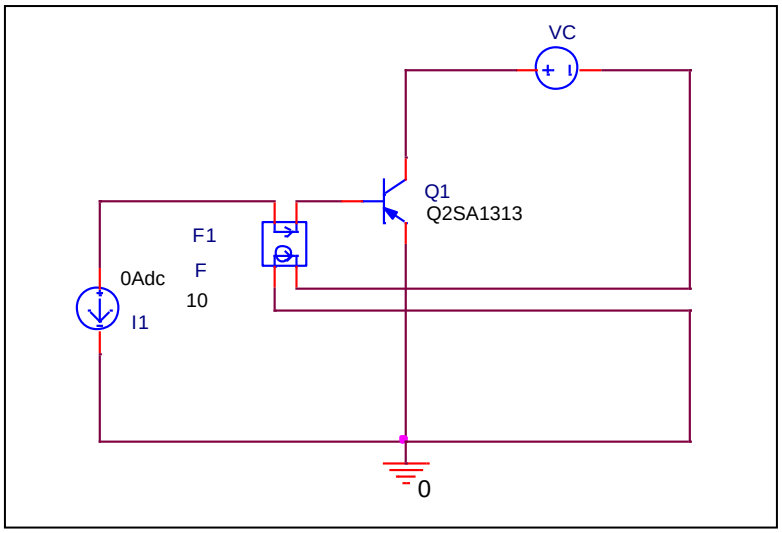
- Ic(mA)	$V_{CE(sat)}$ (-V)		%Error
	Measurement	Simulation	
1	0.0400	0.0414	3.43
2	0.0390	0.0388	-0.45
5	0.0380	0.0373	-1.93
10	0.0390	0.0386	-1.14
20	0.0420	0.0436	3.86
50	0.0585	0.0606	3.61
100	0.0870	0.0875	0.60
200	0.1400	0.1375	-1.82
500	0.2750	0.2767	0.63

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

Simulation result

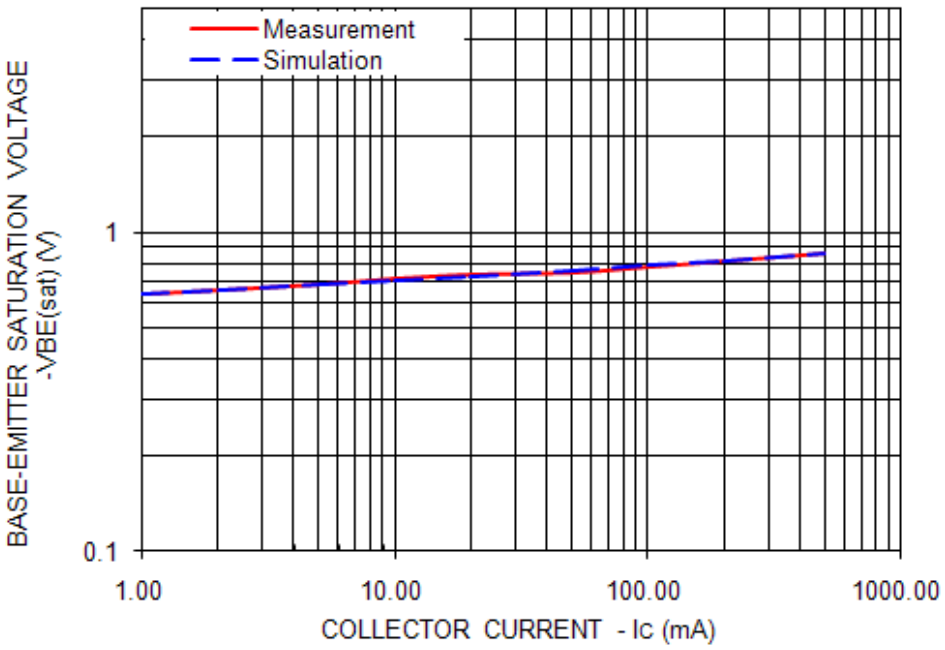


Evaluation circuit



Comparison Graph

Simulation result

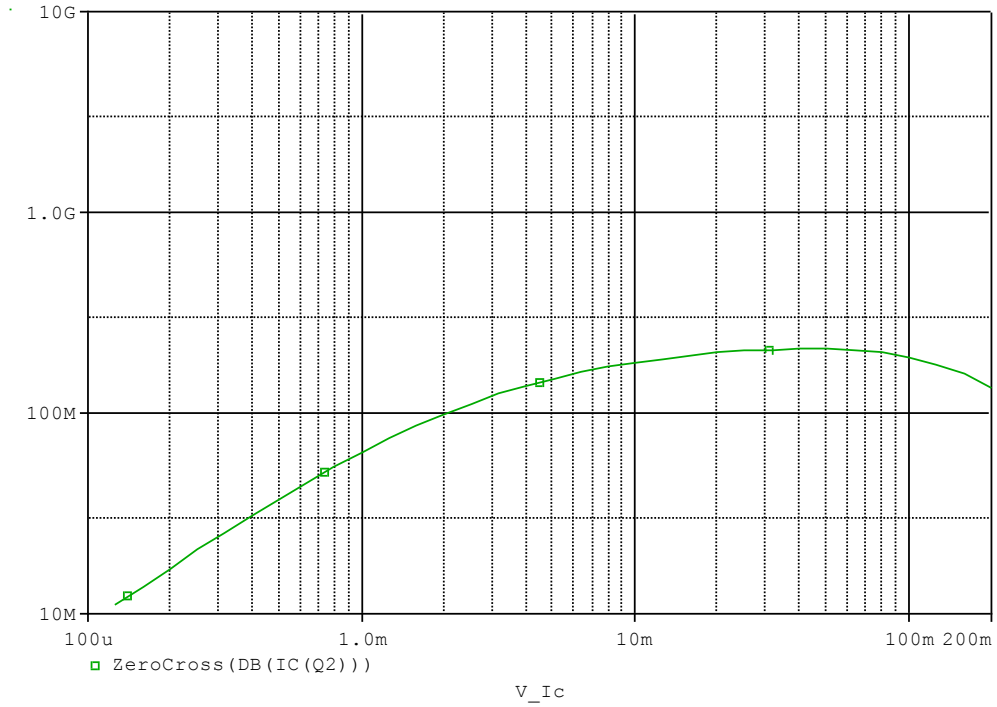


Comparison table

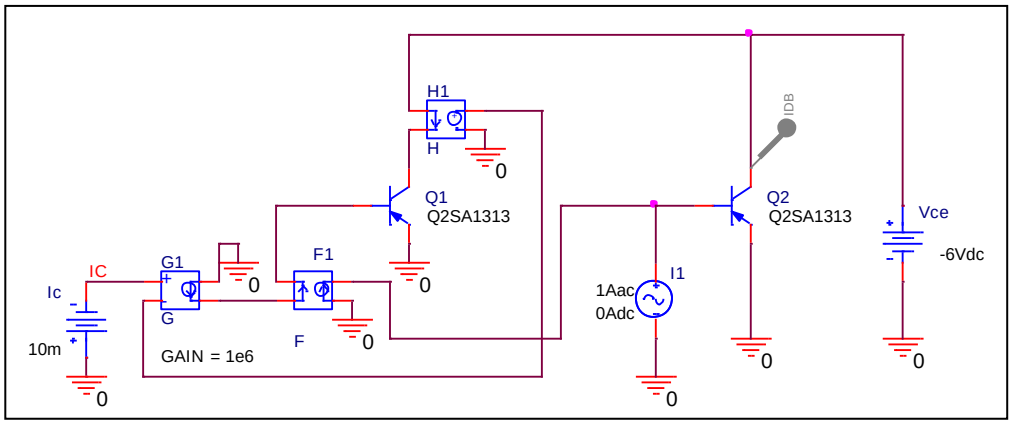
- Ic(mA)	- $V_{BE(sat)}$ (V)		%Error
	Measurement	Simulation	
1	0.638	0.639	0.13
2	0.658	0.658	0.01
5	0.688	0.684	-0.55
10	0.712	0.705	-0.99
20	0.738	0.727	-1.49
50	0.750	0.759	1.17
100	0.778	0.785	0.90
200	0.808	0.813	0.63
500	0.856	0.854	-0.27

Transition Frequency Characteristics

Simulation result



Evaluation circuit

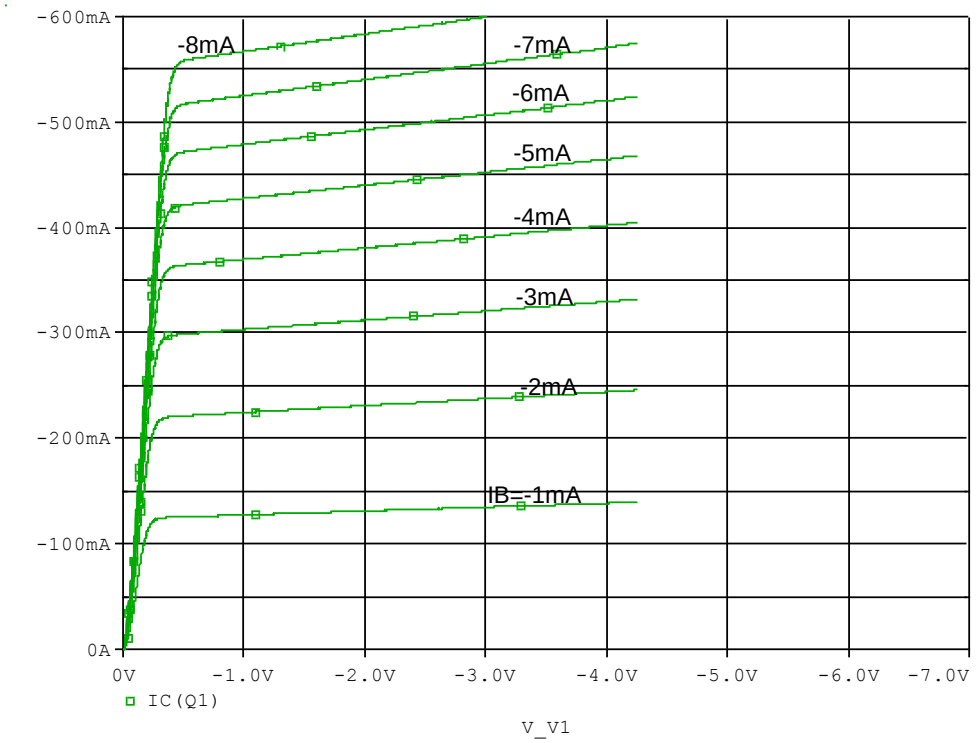


Comparison table

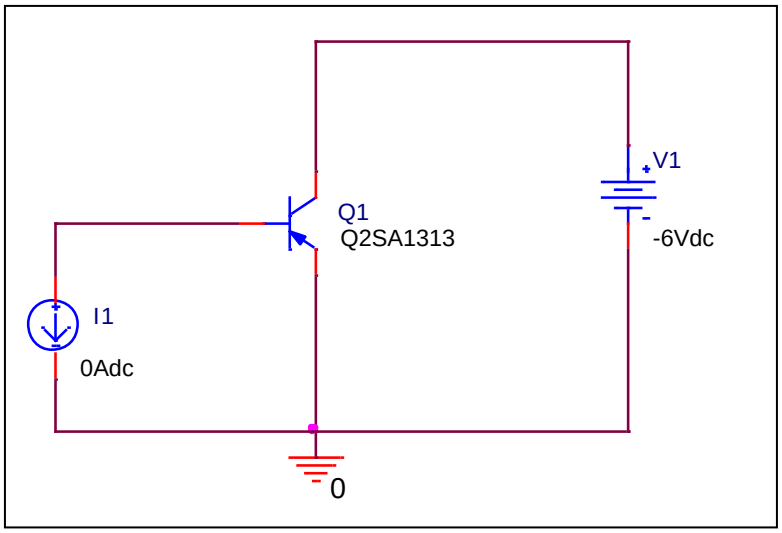
Parameter	Measurement	Simulation	%Error
F_t (MHz) at IC=-20mA	**200.000**	**199.156**	**-0.422**

Output Characteristics

Simulation result



Evaluation circuit



Output Characteristics Reference