Device Modeling Report

COMPONENTS: Power MOSFET (Model Parameter)
PART NUMBER: SSM3K104TU
MANUFACTURER: TOSHIBA
Body Diode (Model Parameter) / ESD Protection Diode

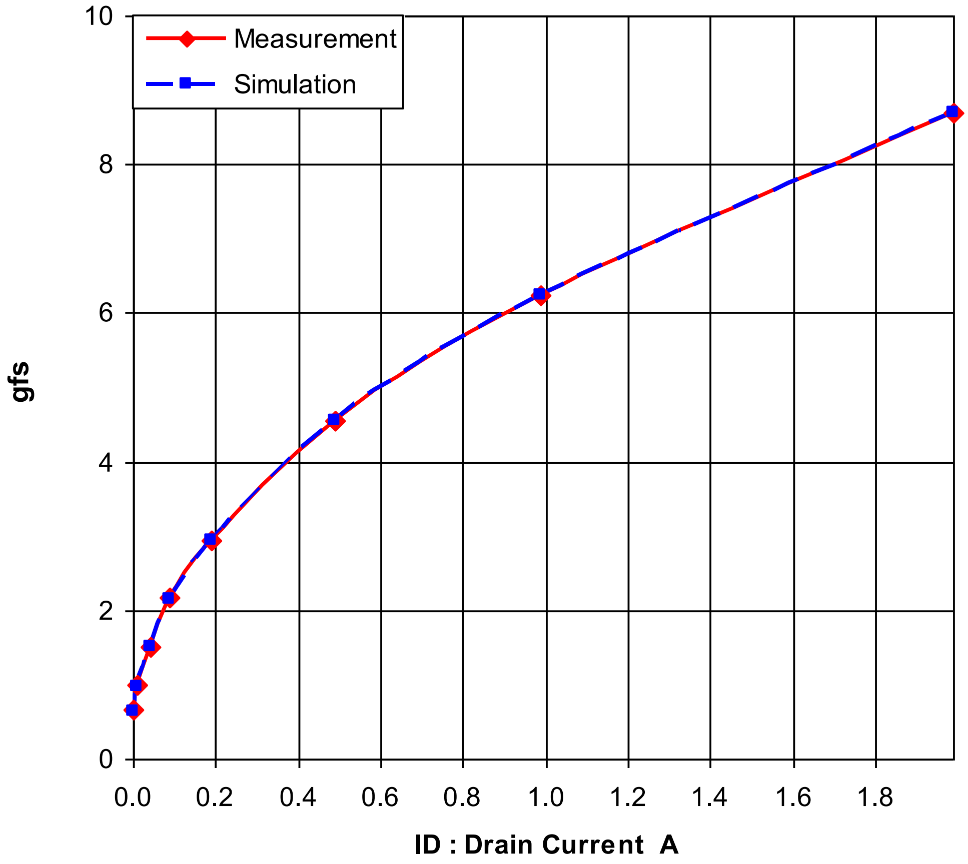
Bee Technologies Inc.

MOSFET MODEL

Pspice model parameter	Model description
LEVEL	
L	Channel Length
W	Channel Width
KP	Transconductance
RS	Source Ohmic Resistance
RD	Ohmic Drain Resistance
VTO	Zero-bias Threshold Voltage
RDS	Drain-Source Shunt Resistance
TOX	Gate Oxide Thickness
CGSO	Zero-bias Gate-Source Capacitance
CGDO	Zero-bias Gate-Drain Capacitance
CBD	Zero-bias Bulk-Drain Junction Capacitance
MJ	Bulk Junction Grading Coefficient
PB	Bulk Junction Potential
FC	Bulk Junction Forward-bias Capacitance Coefficient
RG	Gate Ohmic Resistance
IS	Bulk Junction Saturation Current
N	Bulk Junction Emission Coefficient
RB	Bulk Series Resistance
PHI	Surface Inversion Potential
GAMMA	Body-effect Parameter
DELTA	Width effect on Threshold Voltage
ETA	Static Feedback on Threshold Voltage
THETA	Modility Modulation
KAPPA	Saturation Field Factor
VMAX	Maximum Drift Velocity of Carriers
XJ	Metallurgical Junction Depth
UO	Surface Mobility

Transconductance Characteristic

Circuit Simulation Result

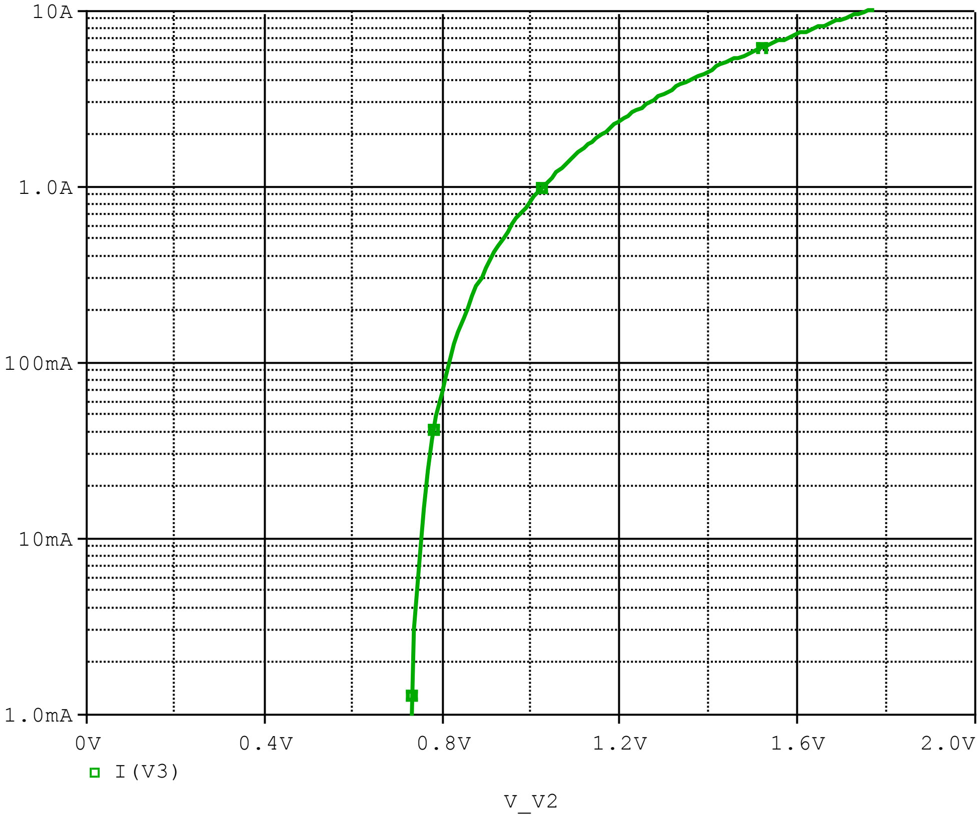


Comparison table

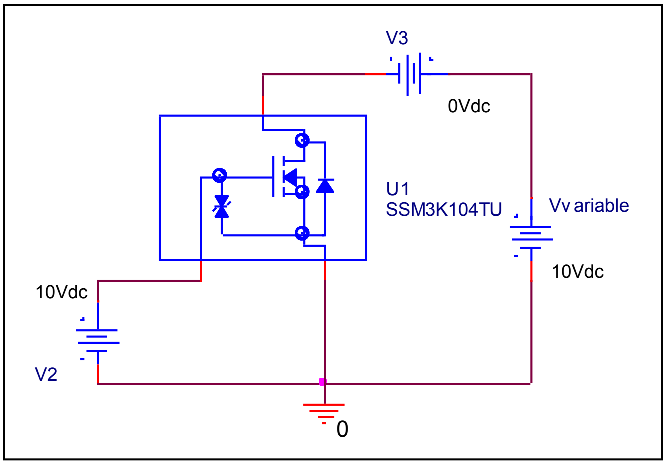
Id(A)	gfs		Error(%)
	Measurement	Simulation	
0.010	0.667	0.641	-3.898
0.020	1.000	0.968	-3.200
0.050	1.515	1.512	-0.198
0.100	2.170	2.155	-0.691
0.200	2.940	2.938	-0.068
0.500	4.545	4.544	-0.022
1.000	6.250	6.242	-0.128
2.000	8.696	8.695	-0.011

Vgs-Id Characteristic

Circuit Simulation result



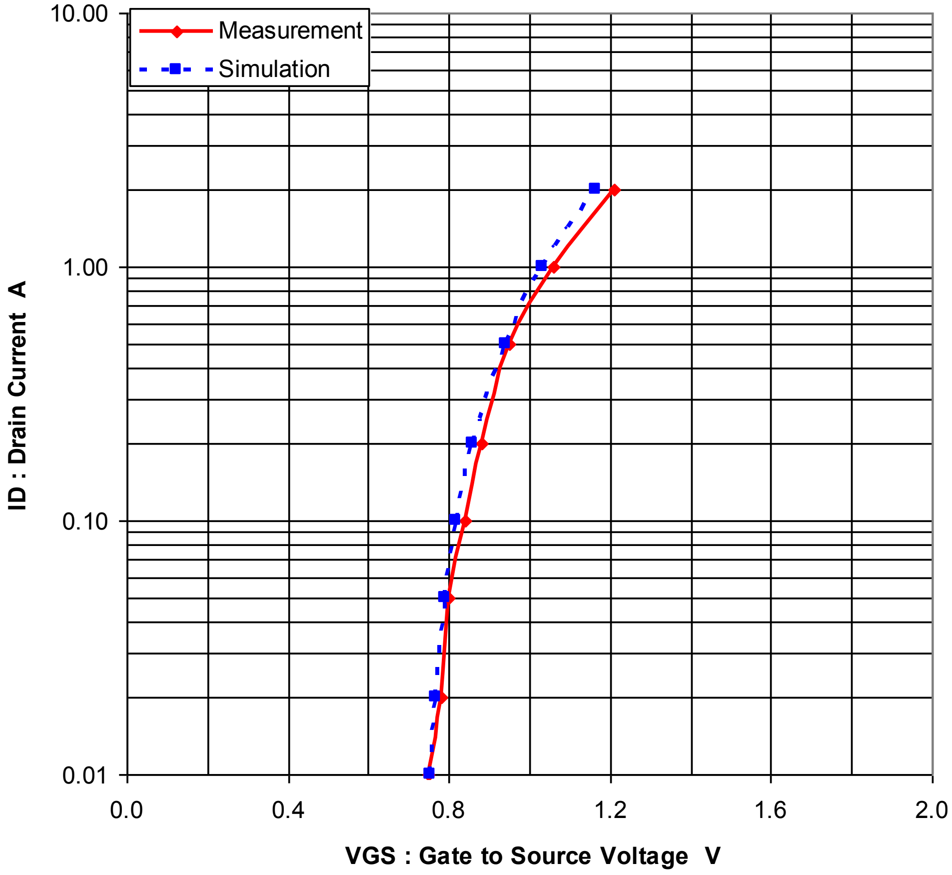
Evaluation circuit



All Rights Reserved Copyright (c) Bee Technologies Inc. 2008

Comparison Graph

Circuit Simulation Result

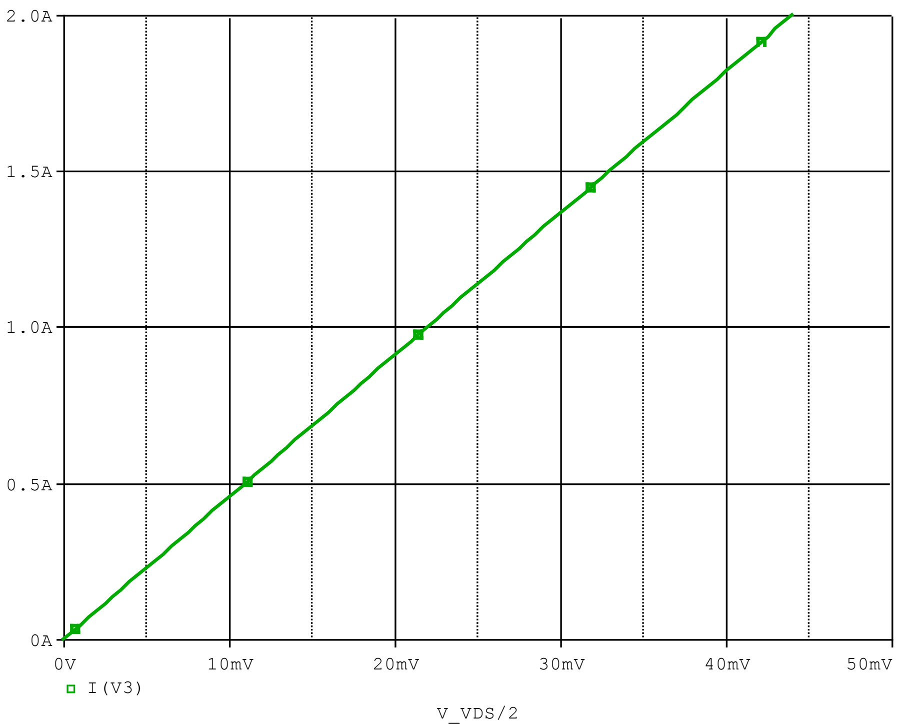


Simulation Result

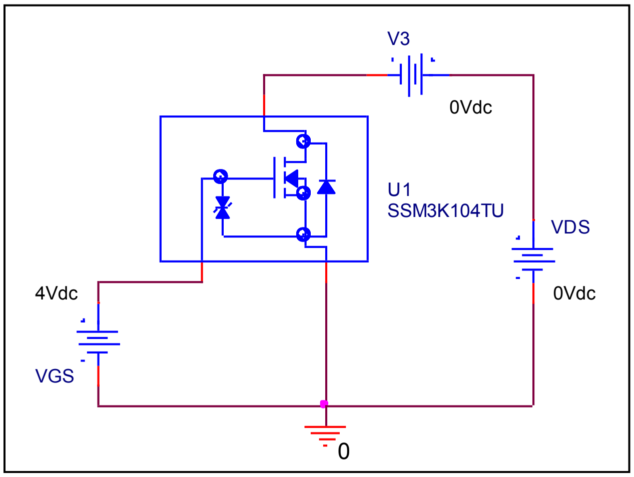
I_D(A)	V_{GS}(V)		Error (%)
	Measurement	Simulation	
0.010	0.750	0.754	0.533
0.020	0.780	0.766	-1.795
0.050	0.800	0.791	-1.125
0.100	0.840	0.819	-2.500
0.200	0.880	0.859	-2.386
0.500	0.950	0.939	-1.158
1.000	1.060	1.031	-2.736
2.000	1.210	1.165	-3.719

Rds(on) Characteristic

Circuit Simulation result



Evaluation circuit

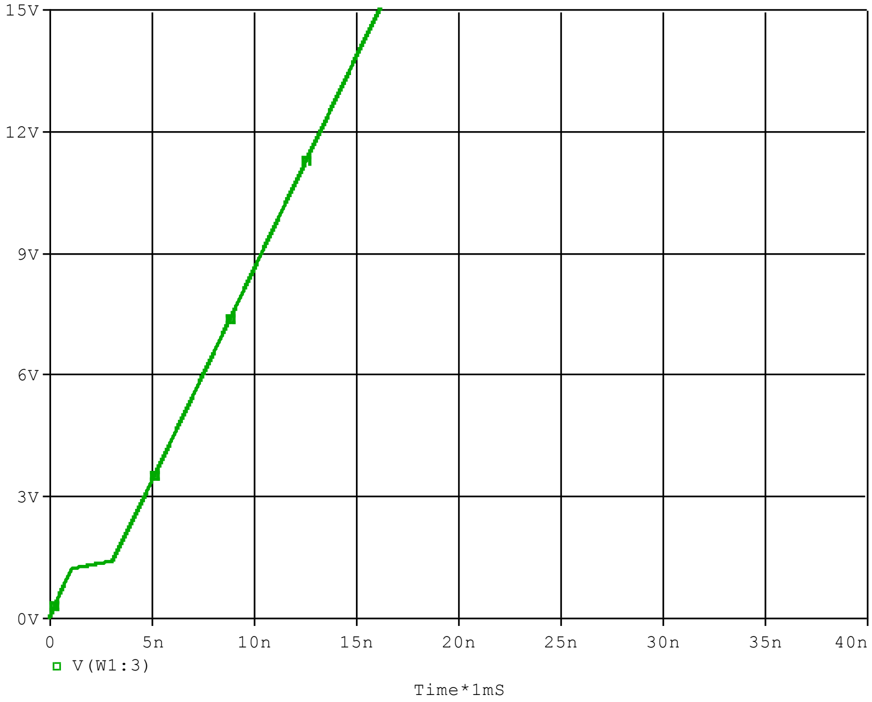


Simulation Result

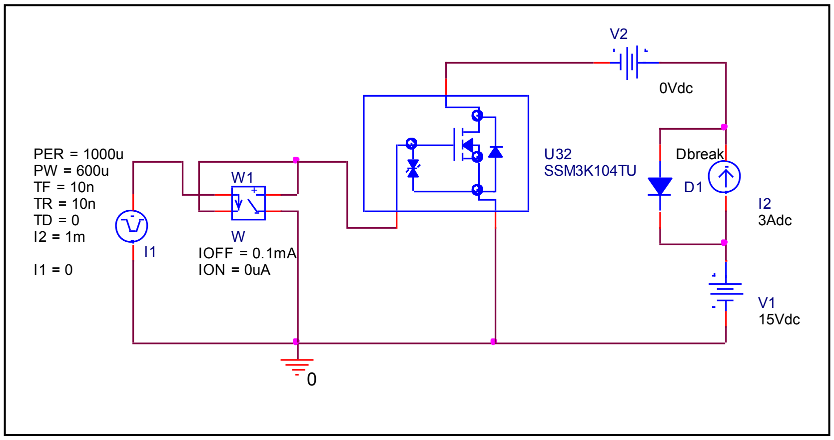
I_D=2A, V_{GS}=4V	Measurement	Simulation	Error (%)
R_{DS} (on) (Ω)	0.044	0.0440	0.068

Gate Charge Characteristic

Circuit Simulation result



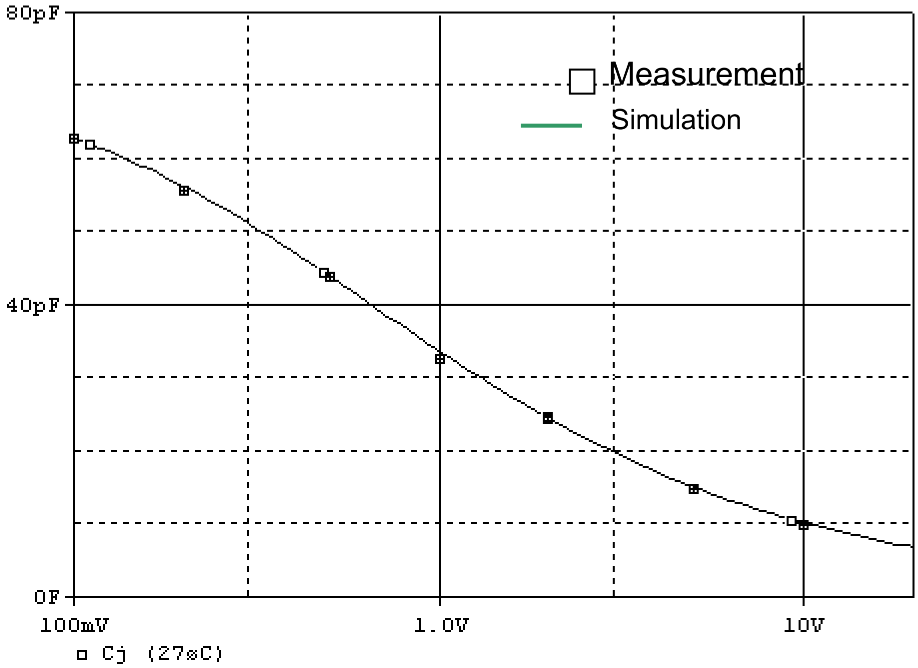
Evaluation circuit



Simulation Result

V_{DD}=15V,I_D=3A ,V_{GS}=10V	Measurement	Simulation	Error (%)
Qgs(nc)	1.040	1.048	0.769
Qgd(nc)	2.000	2.016	0.800
Qg(nc)	20.800	11.356	-45.404

Capacitance Characteristic

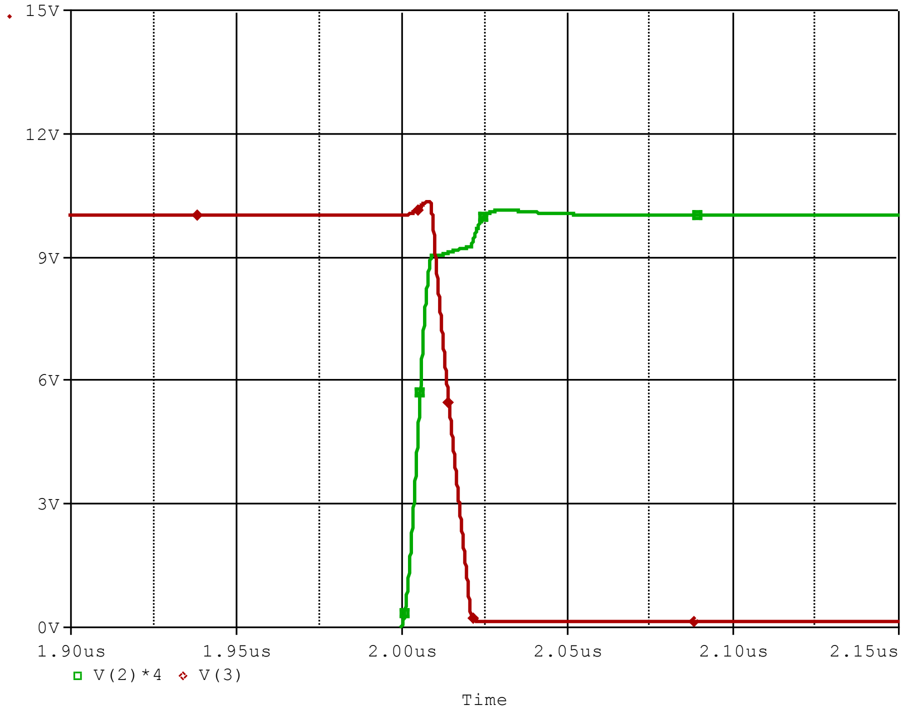


Simulation Result

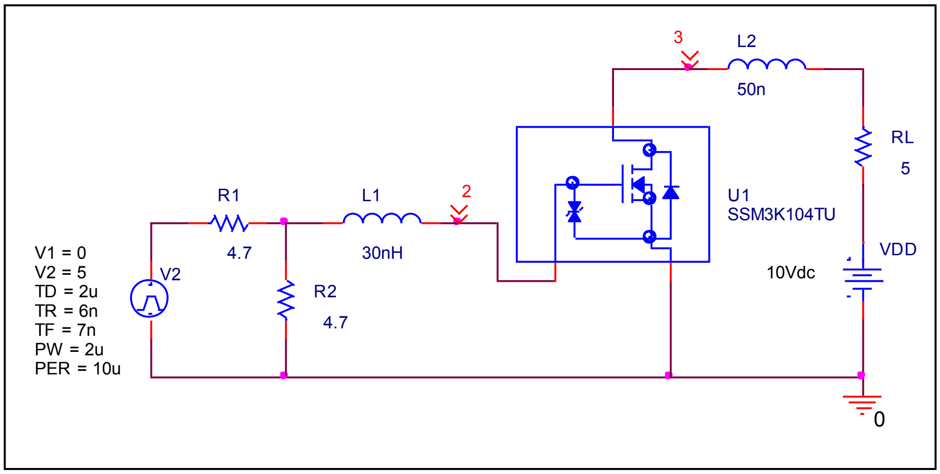
V_{DS}(V)	Cbd(pF)		Error(%)
	Measurement	Simulation	
0.100	63.000	62.800	-0.317
0.200	56.000	56.200	0.357
0.500	44.000	43.900	-0.227
1.000	33.000	33.700	2.121
2.000	25.000	24.500	-2.000
5.000	15.000	15.000	0.000
10.000	10.000	10.000	2.000
20.000	7.000	6.900	-1.429

Switching Time Characteristic

Circuit Simulation result



Evaluation circuit

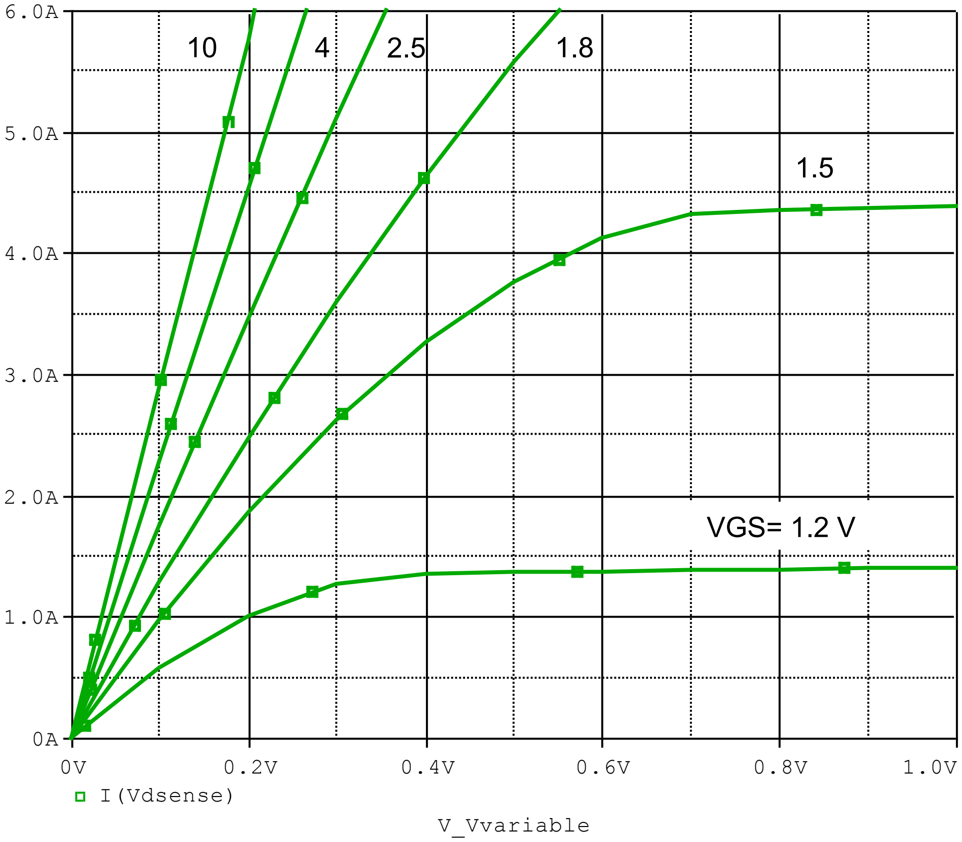


Simulation Result

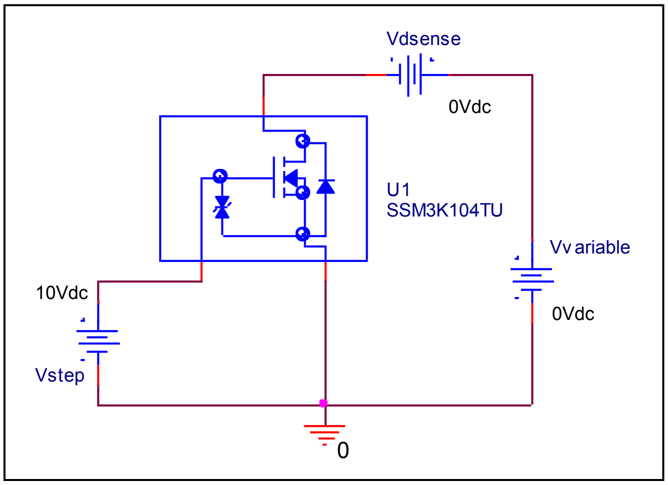
I_D=2A, V_{DD}=10V V_{GS}=2.5V	Measurement	Simulation	Error(%)
Ton(ns)	18.000	18.006	0.033

Output Characteristic

Circuit Simulation result



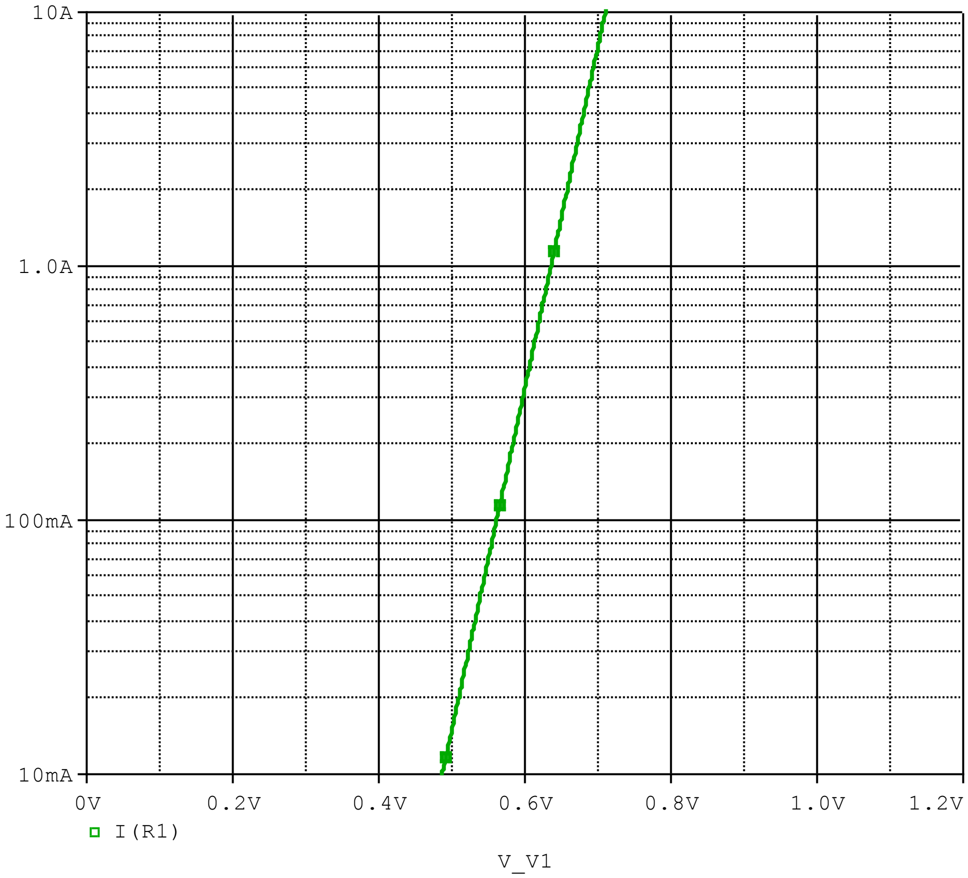
Evaluation circuit



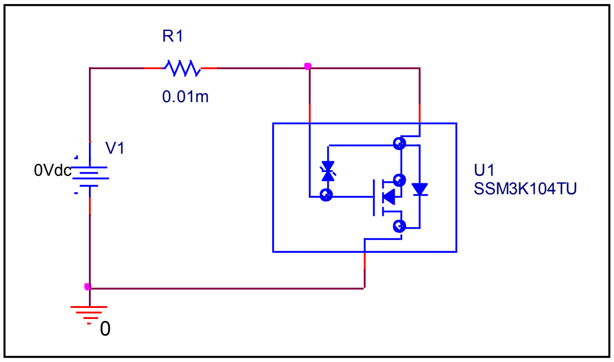
All Rights Reserved Copyright (c) Bee Technologies Inc. 2008

BODY DIODE SPICE MODEL
Forward Current Characteristic

Circuit Simulation Result

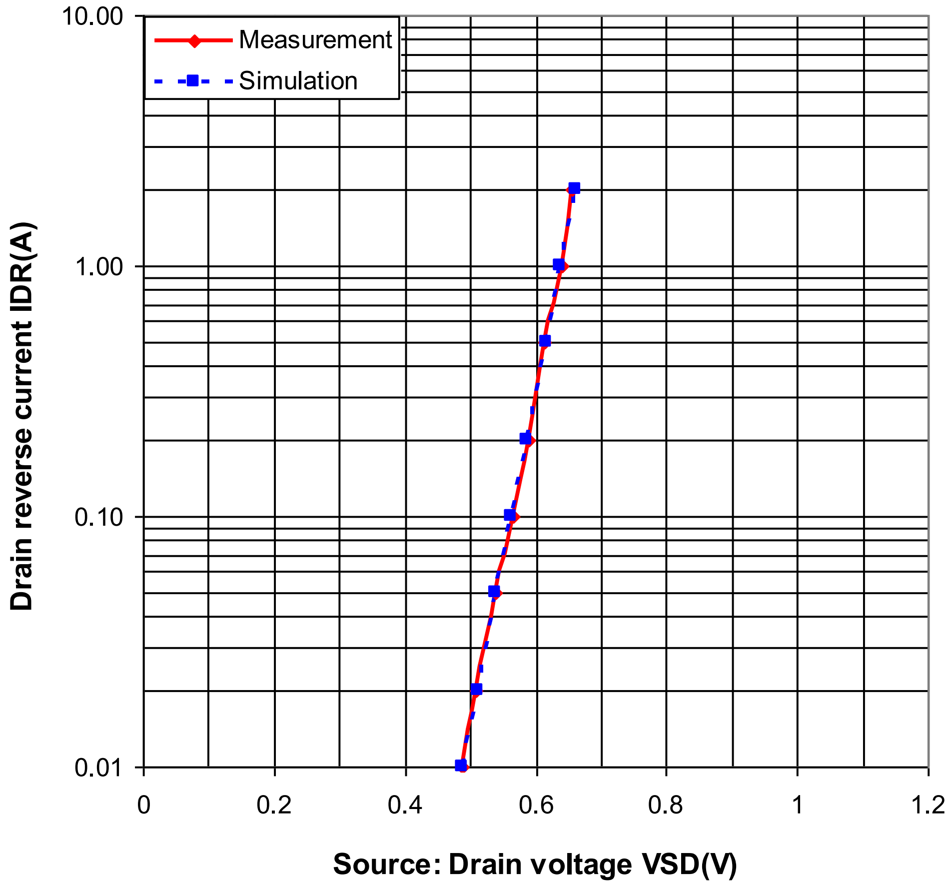


Evaluation Circuit



Comparison Graph

Circuit Simulation Result

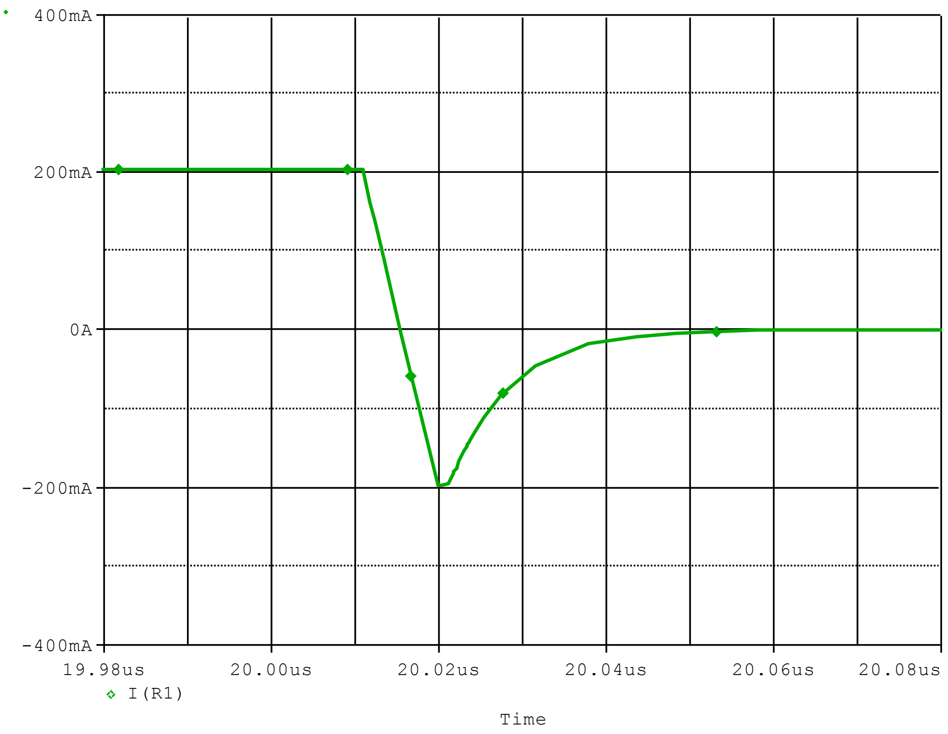


Simulation Result

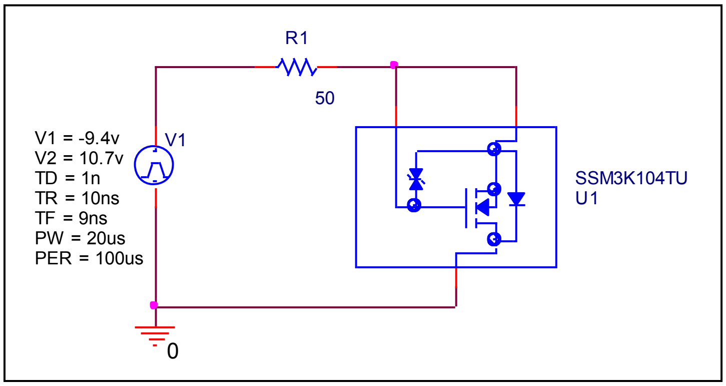
IDR(A)	VDS(V) Measurement	VDS(V) Simulation	%Error
0.010	0.488	0.489	0.205
0.020	0.509	0.511	0.393
0.050	0.539	0.540	0.186
0.100	0.565	0.563	-0.354
0.200	0.590	0.586	-0.678
0.500	0.614	0.615	0.163
1.000	0.640	0.638	-0.313
2.000	0.655	0.660	0.763

Reverse Recovery Characteristic

Circuit Simulation Result



Evaluation Circuit

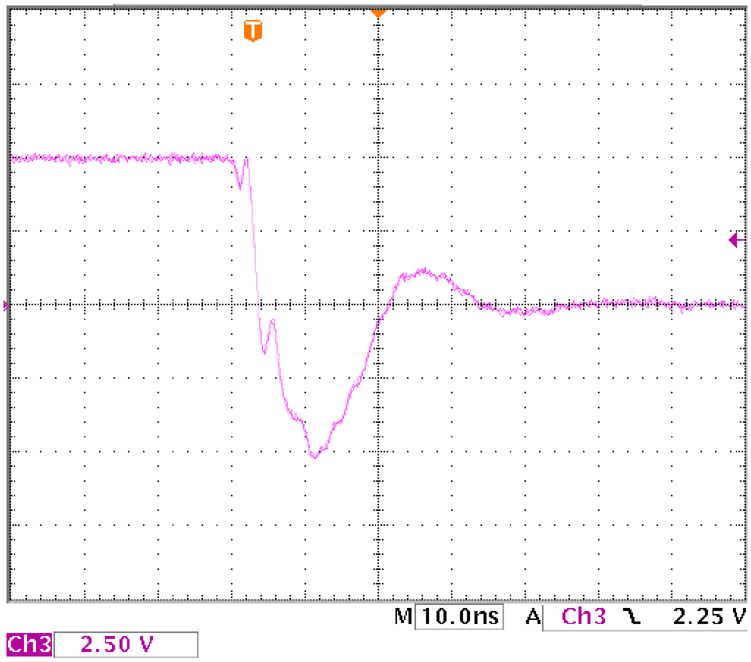


Compare Measurement vs. Simulation

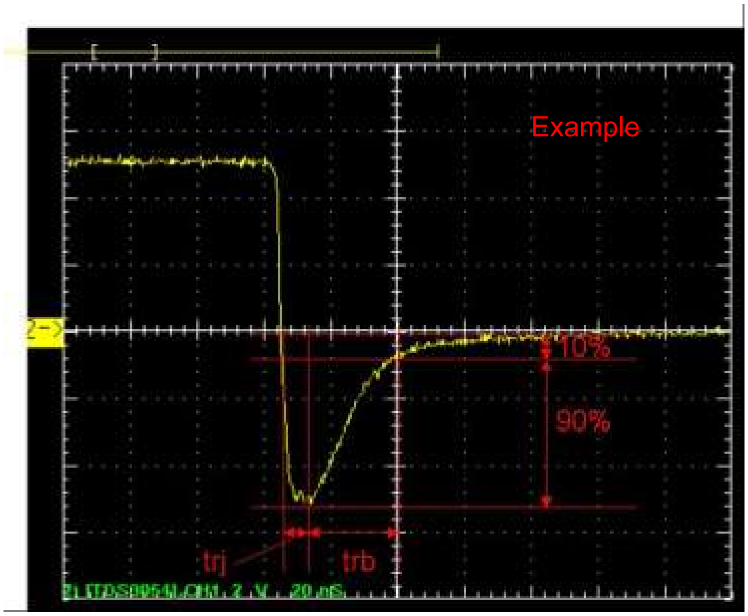
	Measurement	Simulation	Error (%)
Trr(ns)	21.500	21.550	0.233

Reverse Recovery Characteristic

Reference



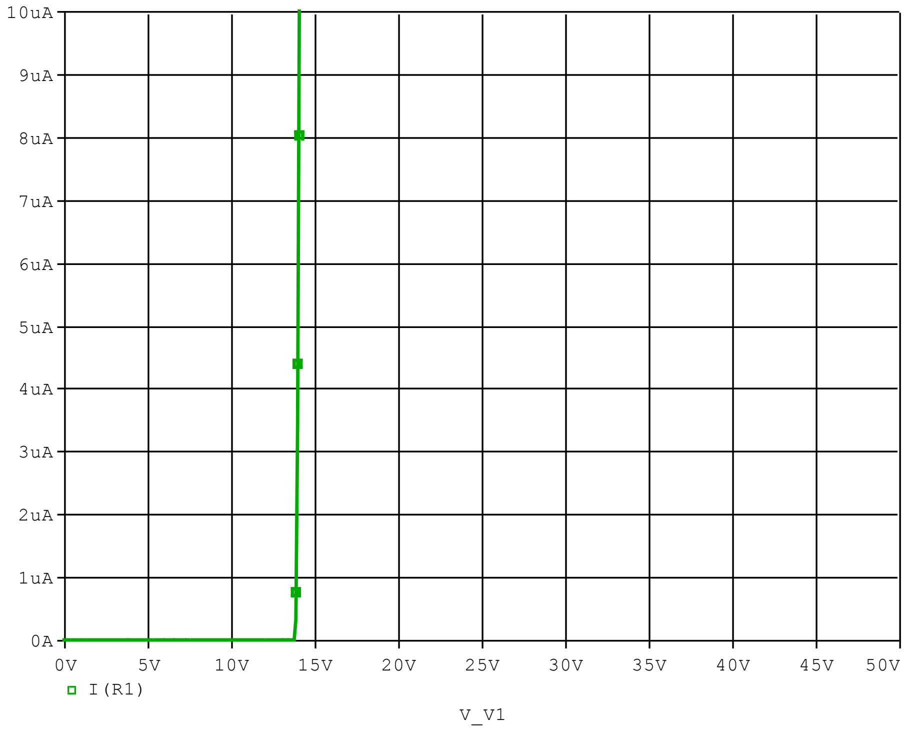
Trj= 10 (ns)
Trb= 11.5 (ns)
Conditions:Ifwd=Irev=0.2(A),Rl=50



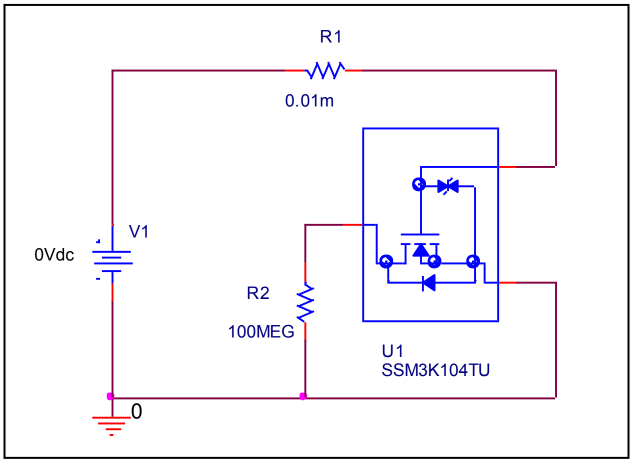
Relation between trj and trb

ESD PROTECTION DIODE SPICE MODEL
Zener Voltage Characteristic

Circuit Simulation Result

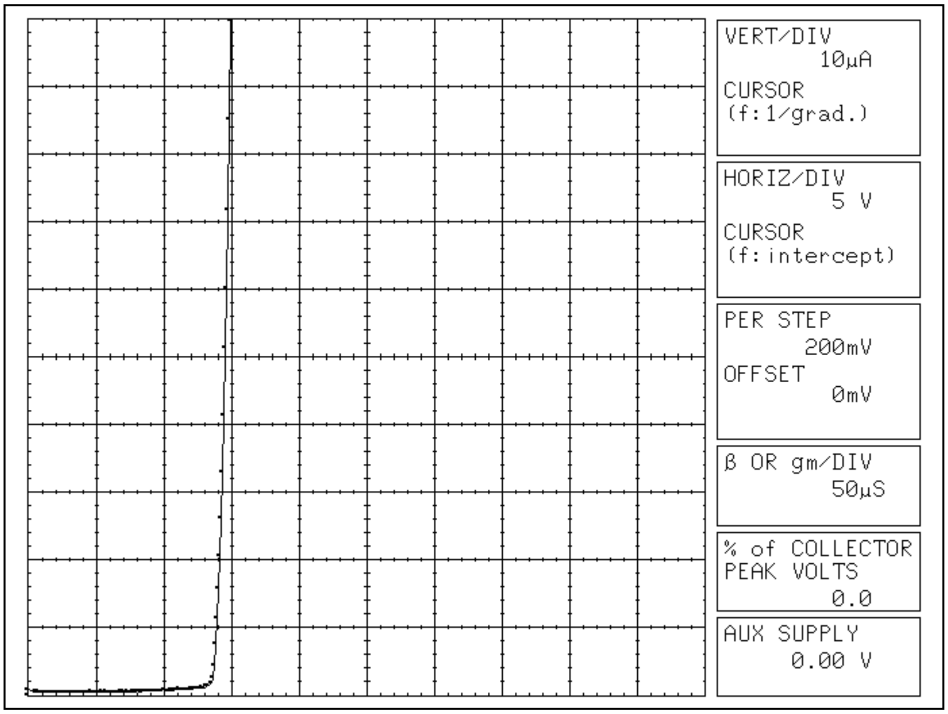


Evaluation Circuit



Zener Voltage Characteristic

Reference



VERT/DIV
10µA
CURSOR
(f:1/grad.)

HORIZ/DIV
5 V
CURSOR
(f:intercept)

PER STEP
200mV
OFFSET
0mV

β OR gm/DIV
50µS

% of COLLECTOR
PEAK VOLTS
0.0

AUX SUPPLY
0.00 V