

Device Modeling Report

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



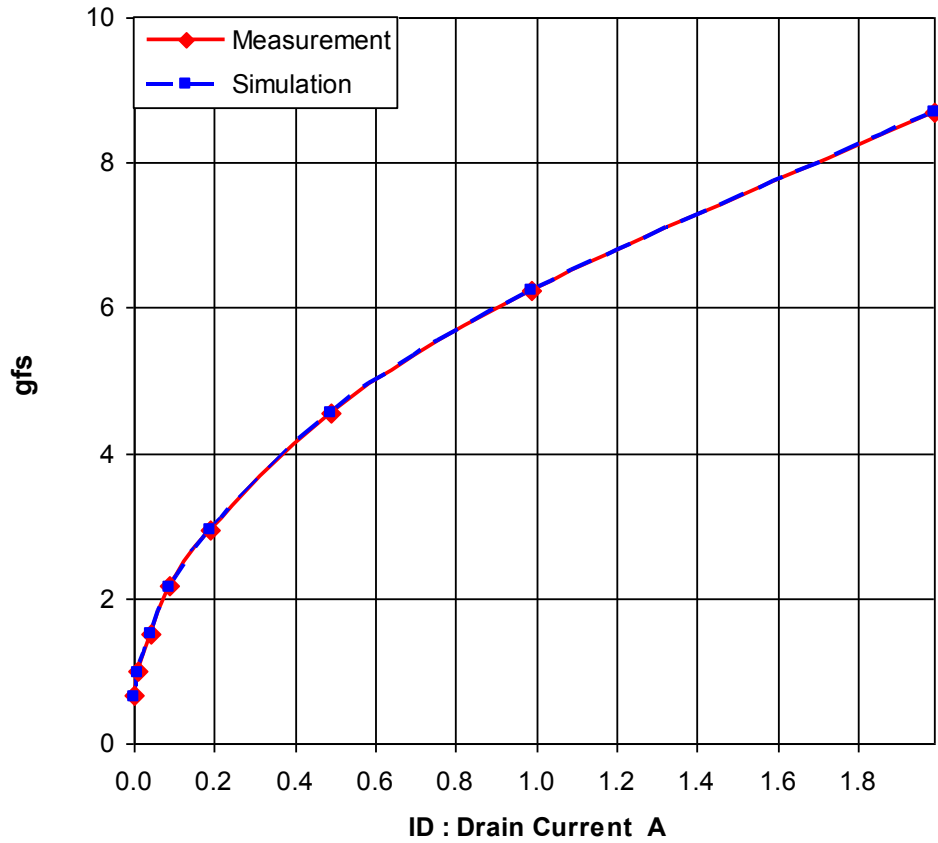
Bee Technologies Inc.

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

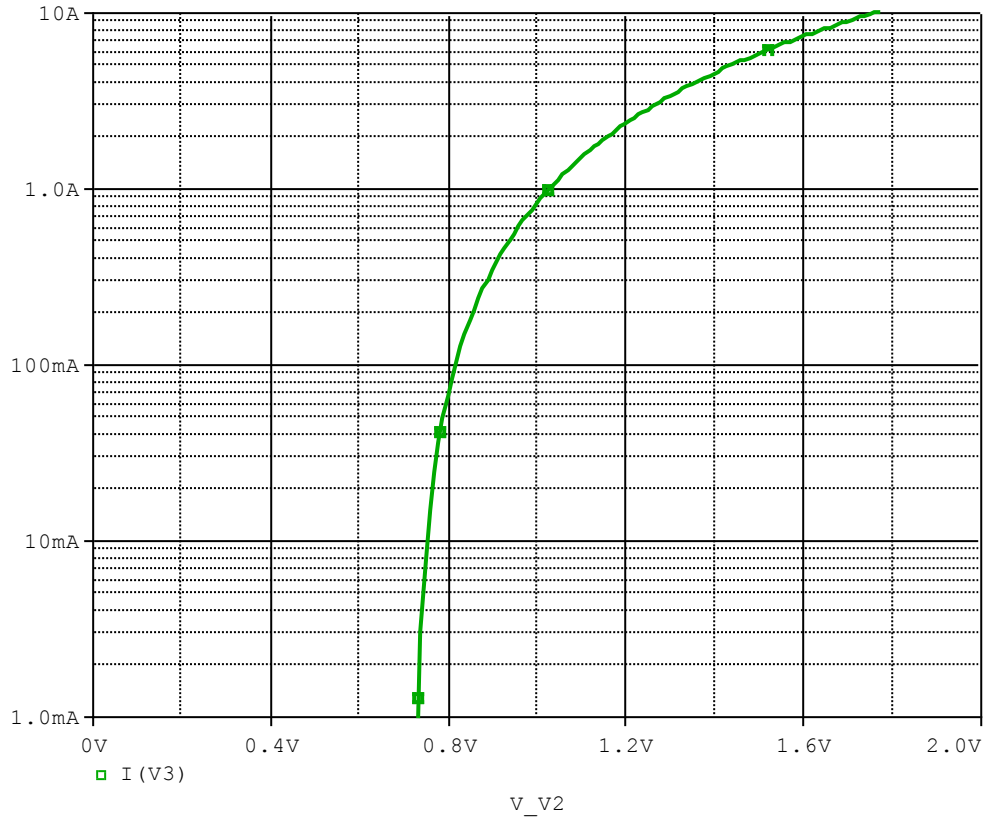


Comparison table

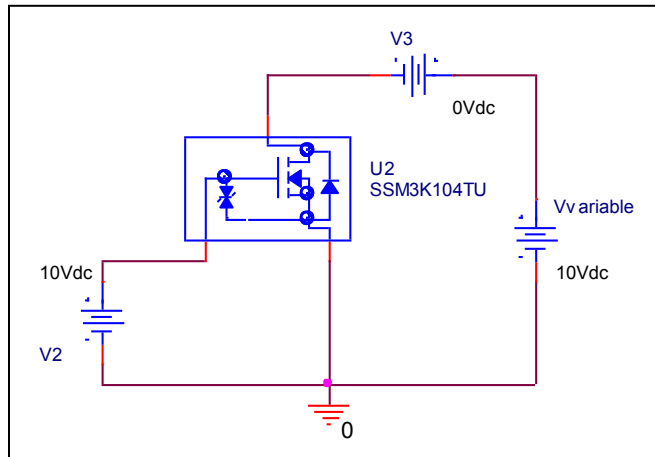
Id(A)	gfs		Error(%)
	Measurement	Simulation	
0.010	0.667	0.641	-3.898
0.020	1.000	0.968	-3.200
0.050	1.515	1.512	-0.198
0.100	2.170	2.155	-0.691
0.200	2.940	2.938	-0.068
0.500	4.545	4.544	-0.022
1.000	6.250	6.242	-0.128
2.000	8.696	8.695	-0.011

Vgs-Id Characteristic

Circuit Simulation result

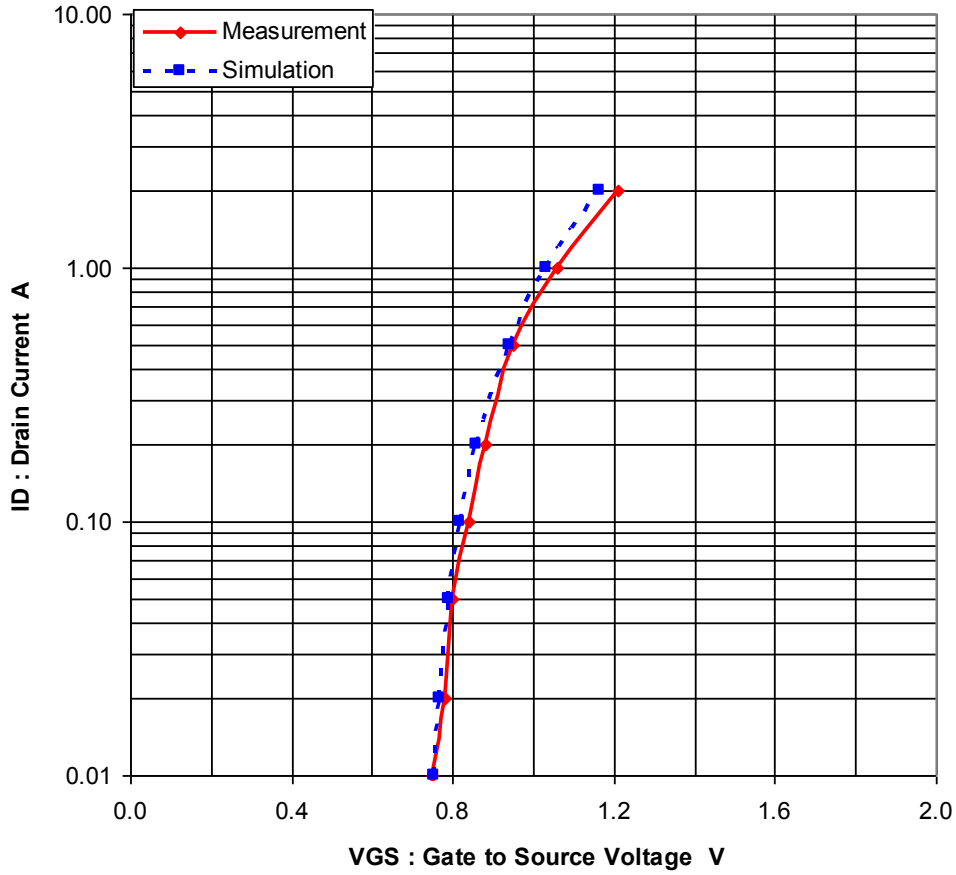


Evaluation circuit



Comparison Graph

Circuit Simulation Result

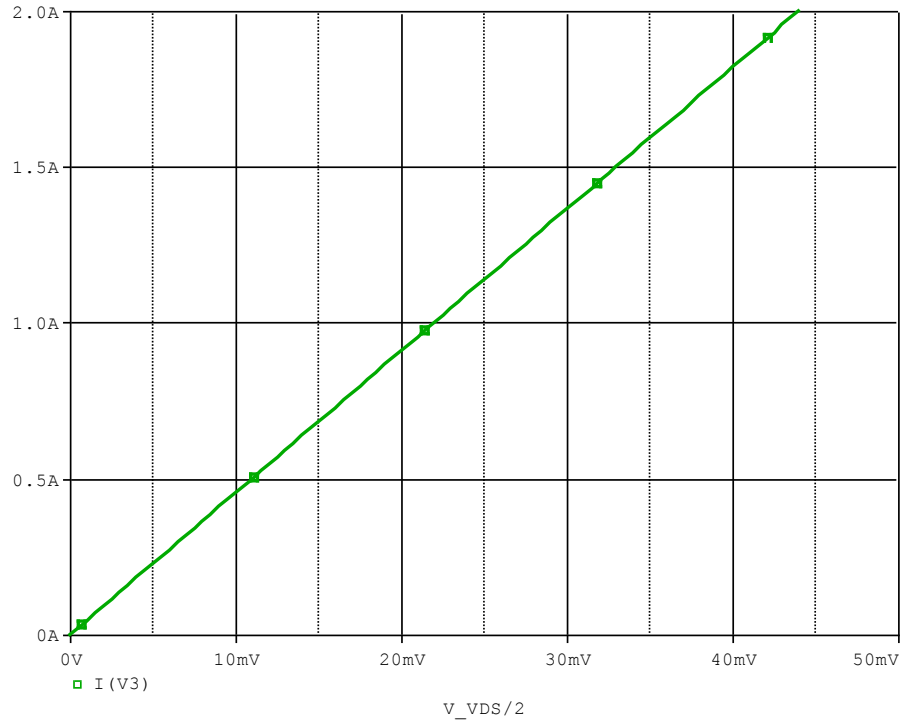


Simulation Result

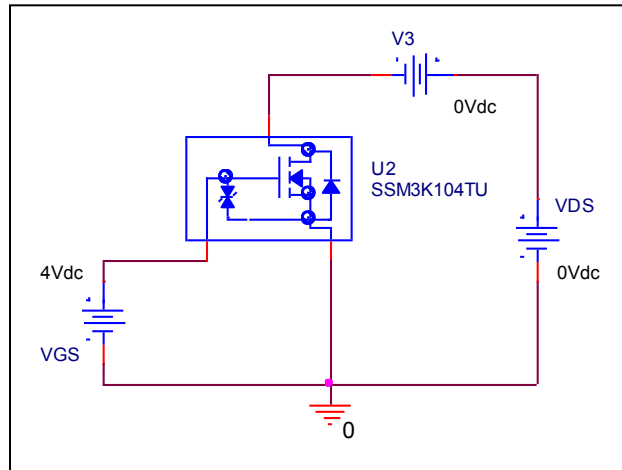
ID(A)	VGS(V)		Error (%)
	Measurement	Simulation	
0.010	0.750	0.754	0.533
0.020	0.780	0.766	-1.795
0.050	0.800	0.791	-1.125
0.100	0.840	0.819	-2.500
0.200	0.880	0.859	-2.386
0.500	0.950	0.939	-1.158
1.000	1.060	1.031	-2.736
2.000	1.210	1.165	-3.719

Rds(on) Characteristic

Circuit Simulation result



Evaluation circuit

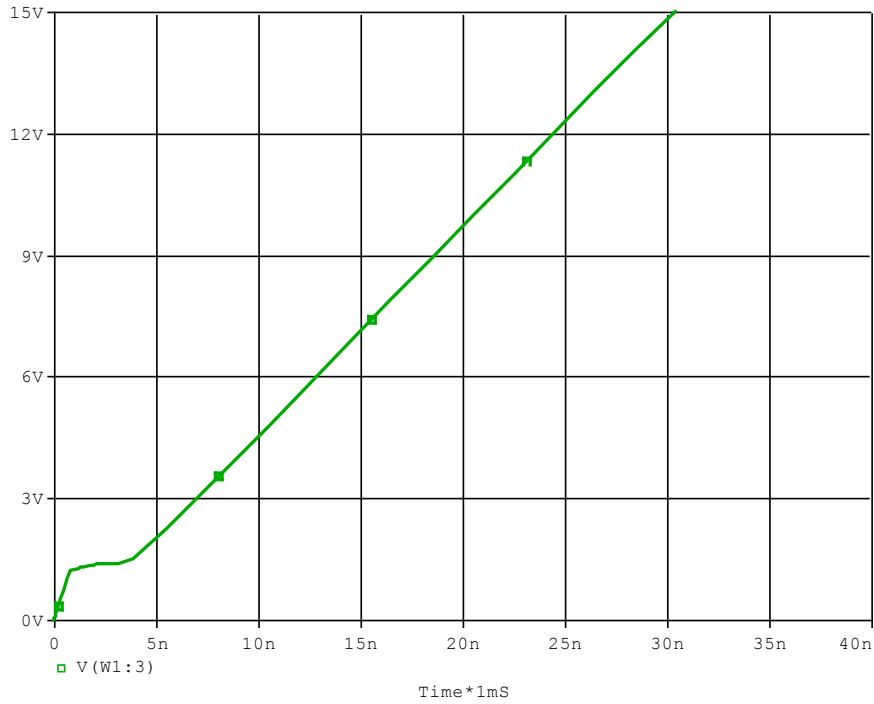


Simulation Result

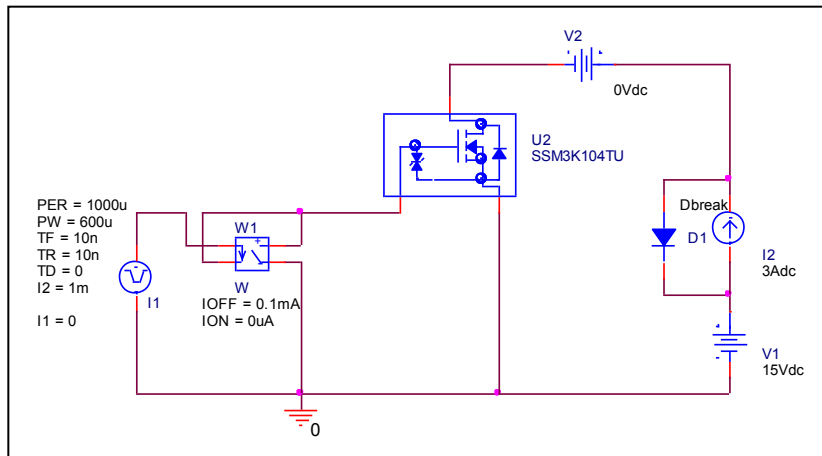
$I_D=2A, V_{GS}=4V$	Measurement	Simulation	Error (%)
$R_{DS} (on) (\Omega)$	0.044	0.0440	0.068

Gate Charge Characteristic

Circuit Simulation result



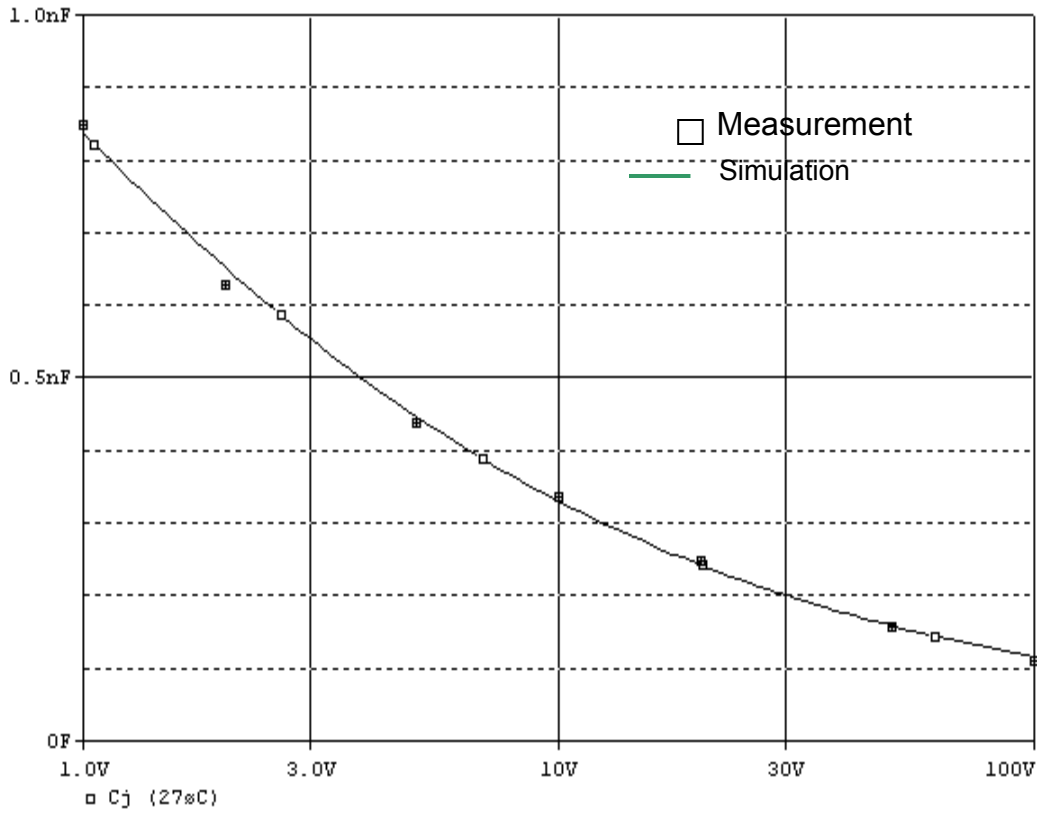
Evaluation circuit



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	20.806	0.029

Capacitance Characteristic

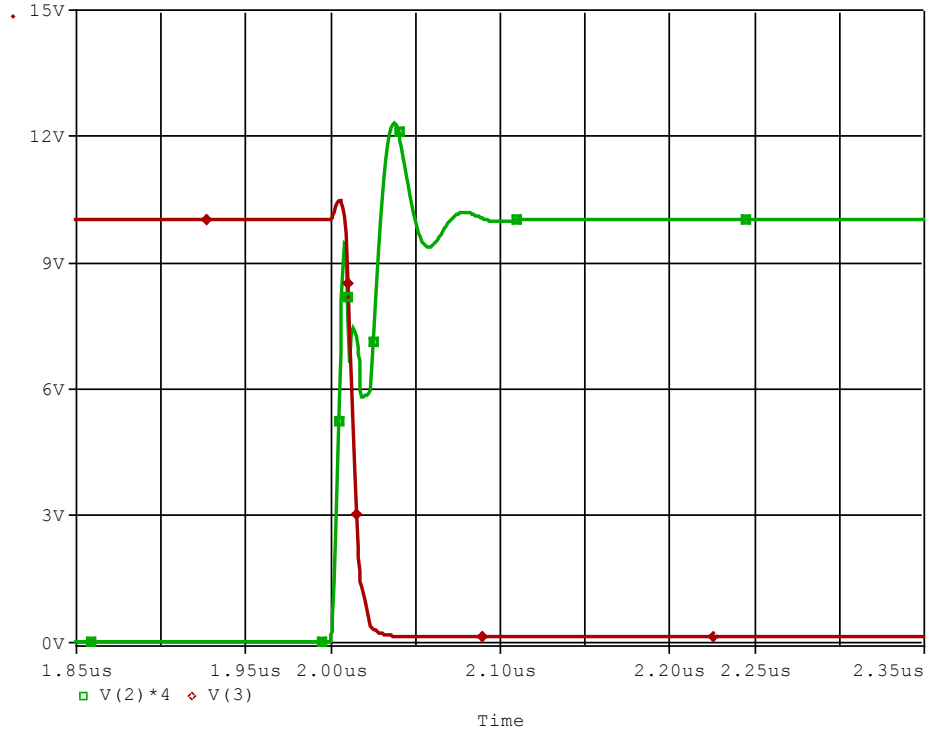


Simulation Result

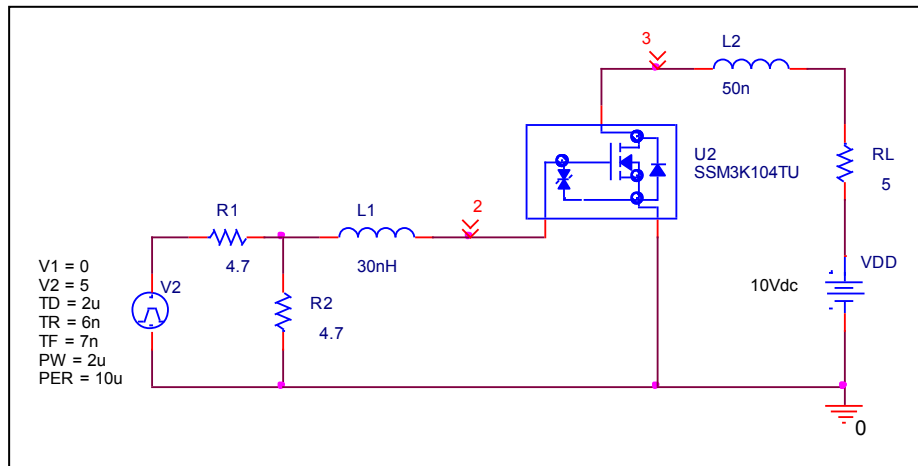
V _{DS} (V)	Cbd(pF)		Error(%)
	Measurement	Simulation	
1.000	850.000	849.000	-0.118
2.000	620.000	640.000	3.226
5.000	440.000	448.000	1.818
10.000	340.000	330.000	-2.941
20.000	250.000	243.000	-2.800
50.000	160.000	159.000	-0.625
100.000	114.000	113.000	-0.877

Switching Time Characteristic

Circuit Simulation result



Evaluation circuit

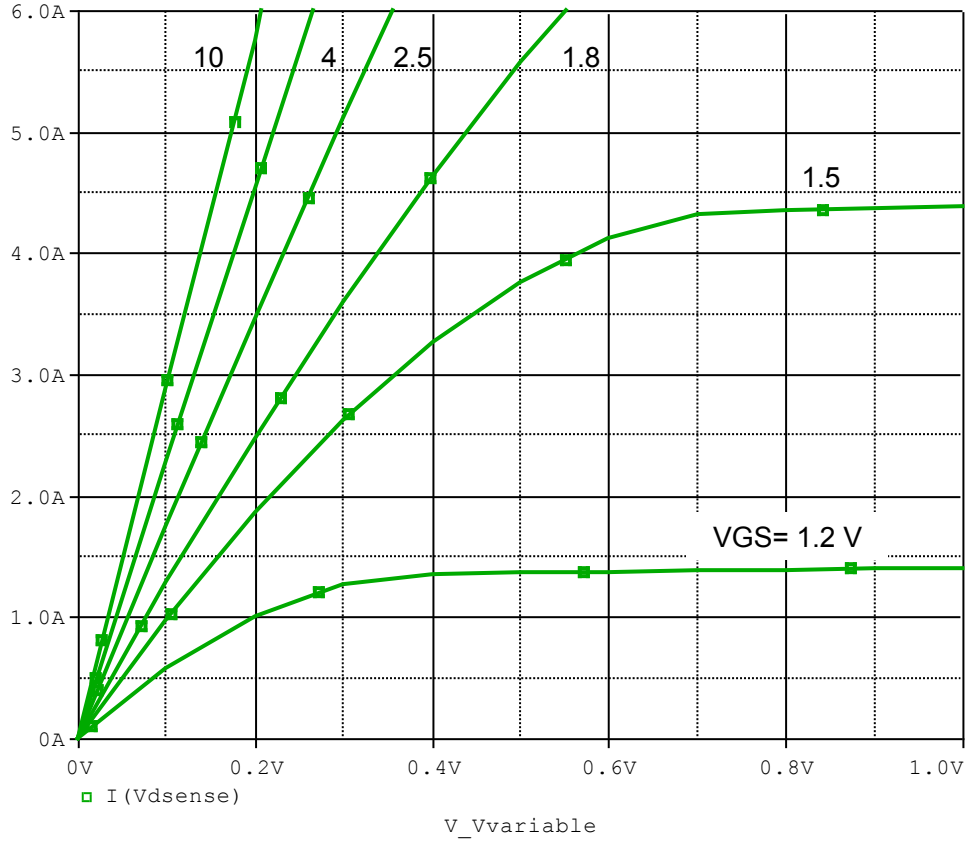


Simulation Result

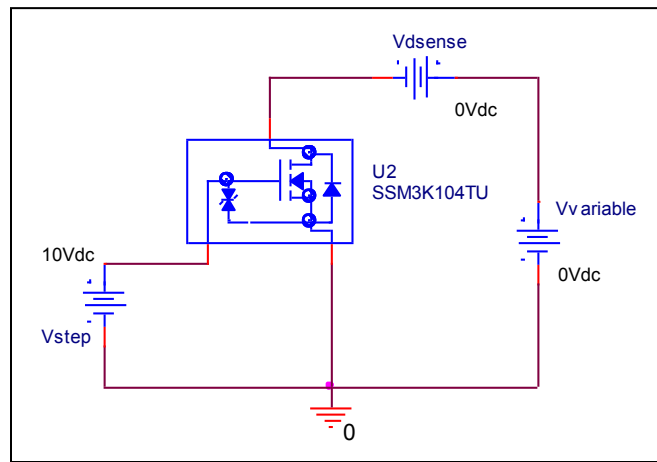
$I_D=2A, V_{DD}=10V$ $V_{GS}=2.5V$	Measurement	Simulation	Error(%)
Ton(ns)	18.000	18.360	2.000

Output Characteristic

Circuit Simulation result

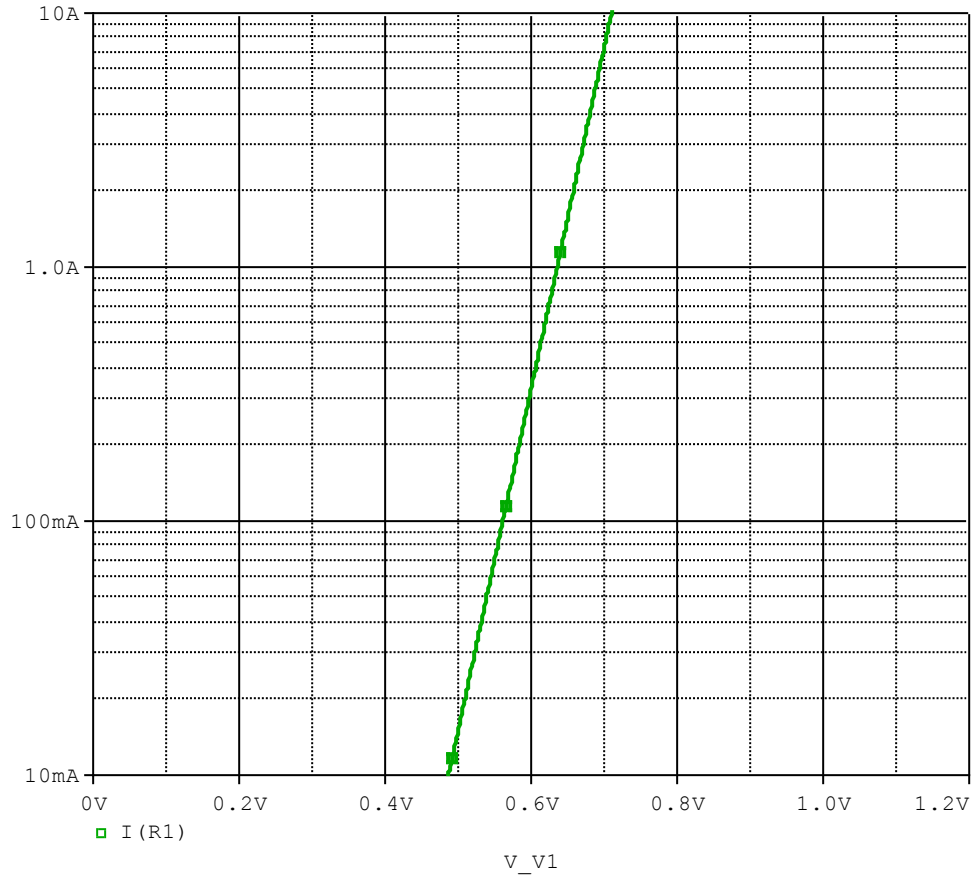


Evaluation circuit

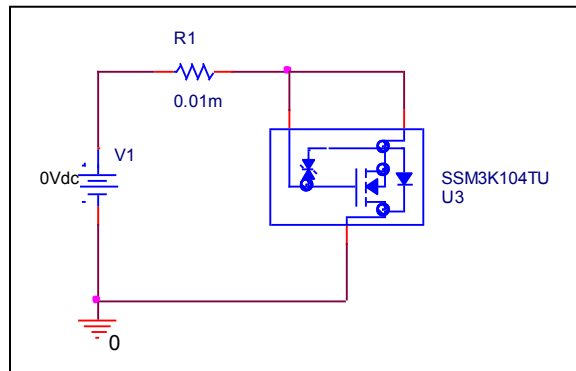


Forward Current Characteristic

Circuit Simulation Result

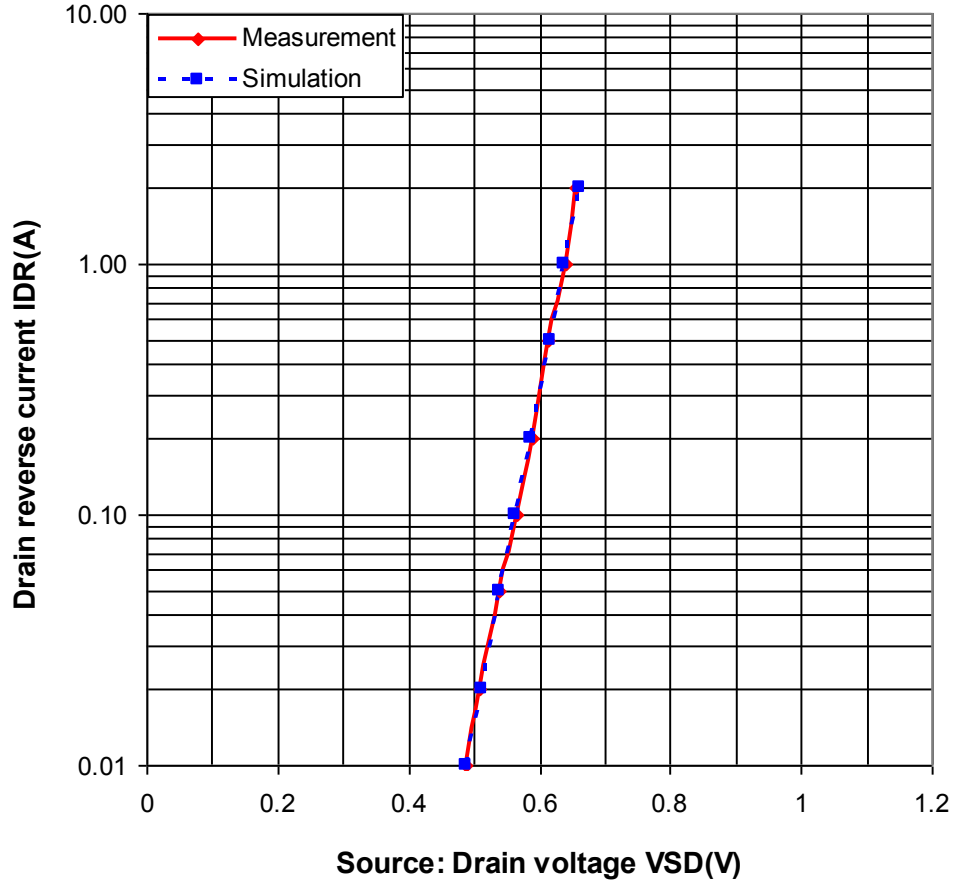


Evaluation Circuit



Comparison Graph

Circuit Simulation Result

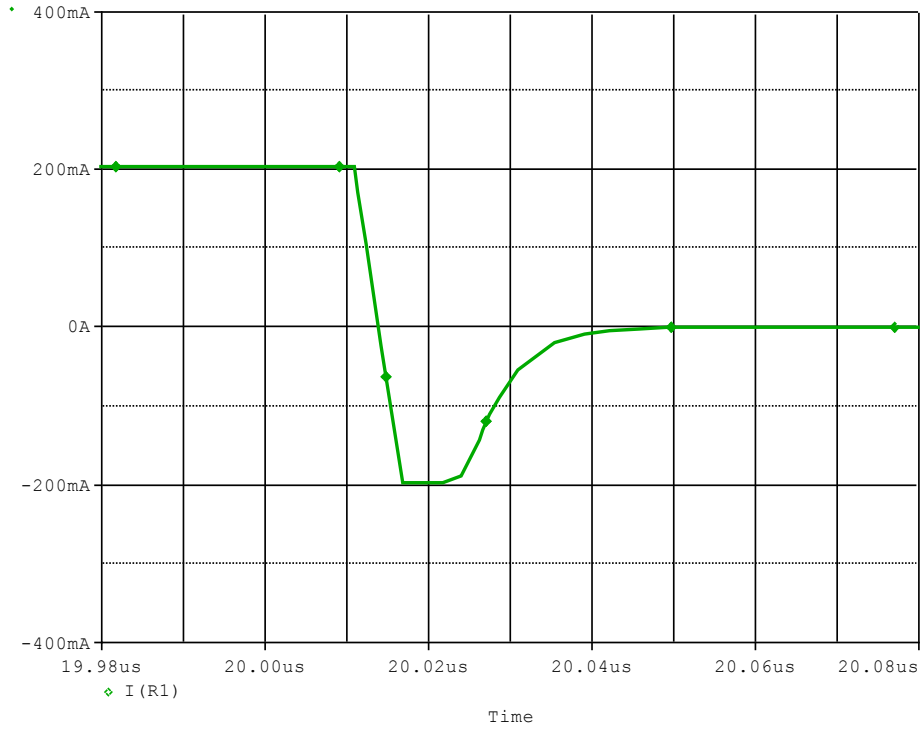


Simulation Result

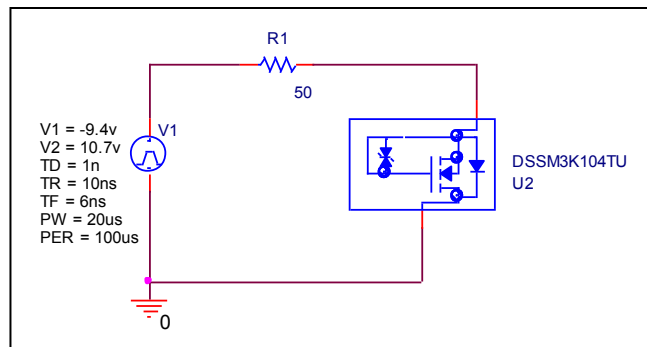
IDR(A)	VDS(V) Measurement	VDS(V) Simulation	%Error
0.010	0.488	0.489	0.205
0.020	0.509	0.511	0.393
0.050	0.539	0.540	0.186
0.100	0.565	0.563	-0.354
0.200	0.590	0.586	-0.678
0.500	0.614	0.615	0.163
1.000	0.640	0.638	-0.313
2.000	0.655	0.660	0.763

Reverse Recovery Characteristic

Circuit Simulation Result



Evaluation Circuit

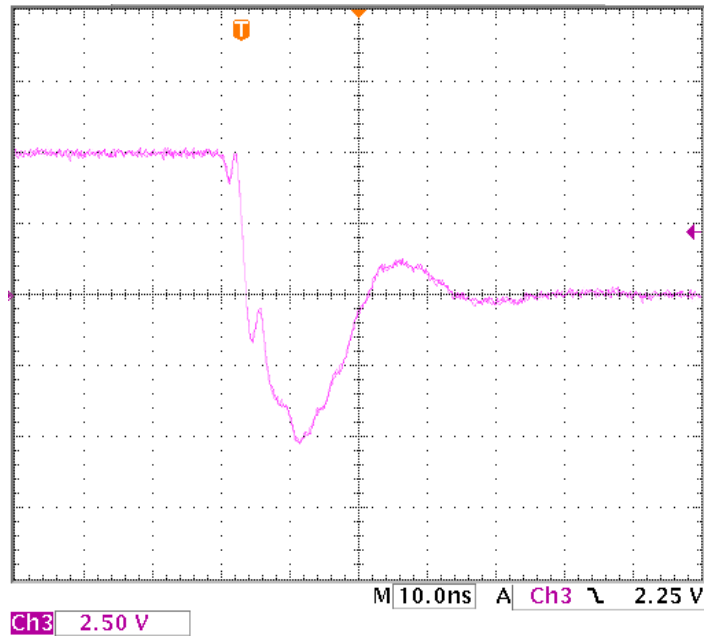


Compare Measurement vs. Simulation

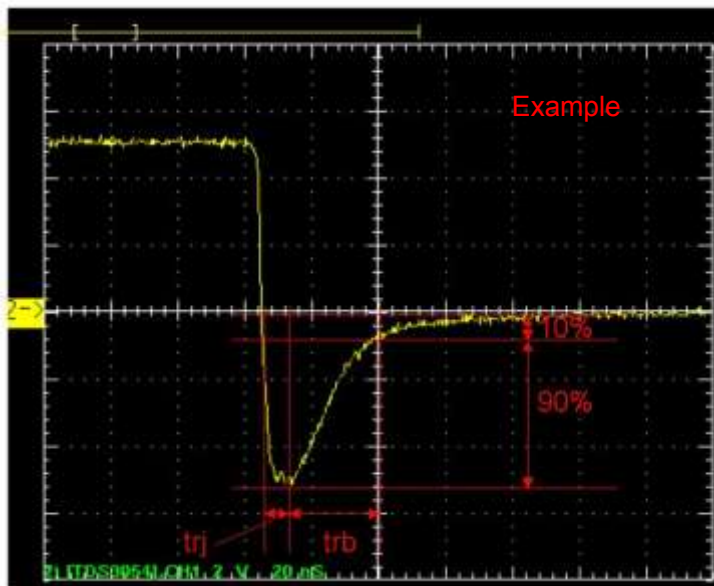
	Measurement	Simulation	Error (%)
Trj(ns)	10.000	10.129	1.290
trb(ns)	11.500	11.633	1.157
trr(ns)	21.500	21.762	1.219

Reverse Recovery Characteristic

Reference



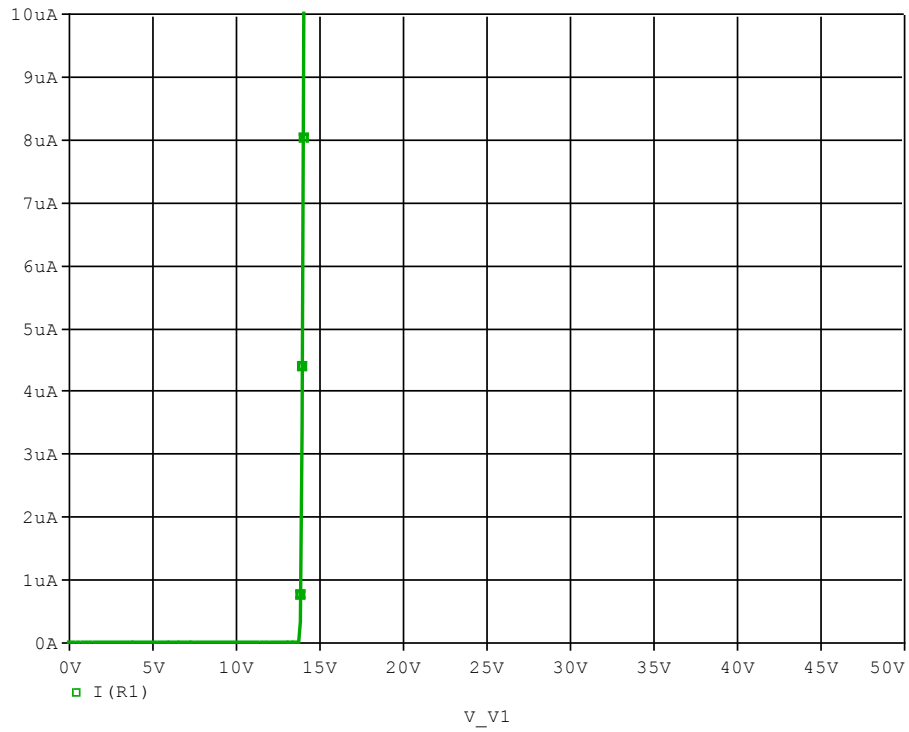
$T_{rj}=10(\text{ns})$
 $T_{rb}=11.5(\text{ns})$
Conditions: $I_{fwd}=I_{rev}=0.2(\text{A}), R_I=50$



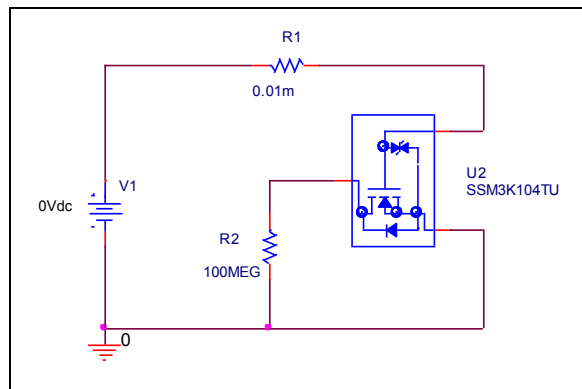
Relation between t_{rj} and t_{rb}

Zener Voltage Characteristic

Circuit Simulation Result



Evaluation Circuit



Zener Voltage Characteristic

Reference

