Device Modeling Report

COMPONENTS: Power MOSFET (Model parameter)
PART NUMBER: 2SK3568
MANUFACTURER: TOSHIBA
Body Diode (Model parameter) / ESD Protection Diode

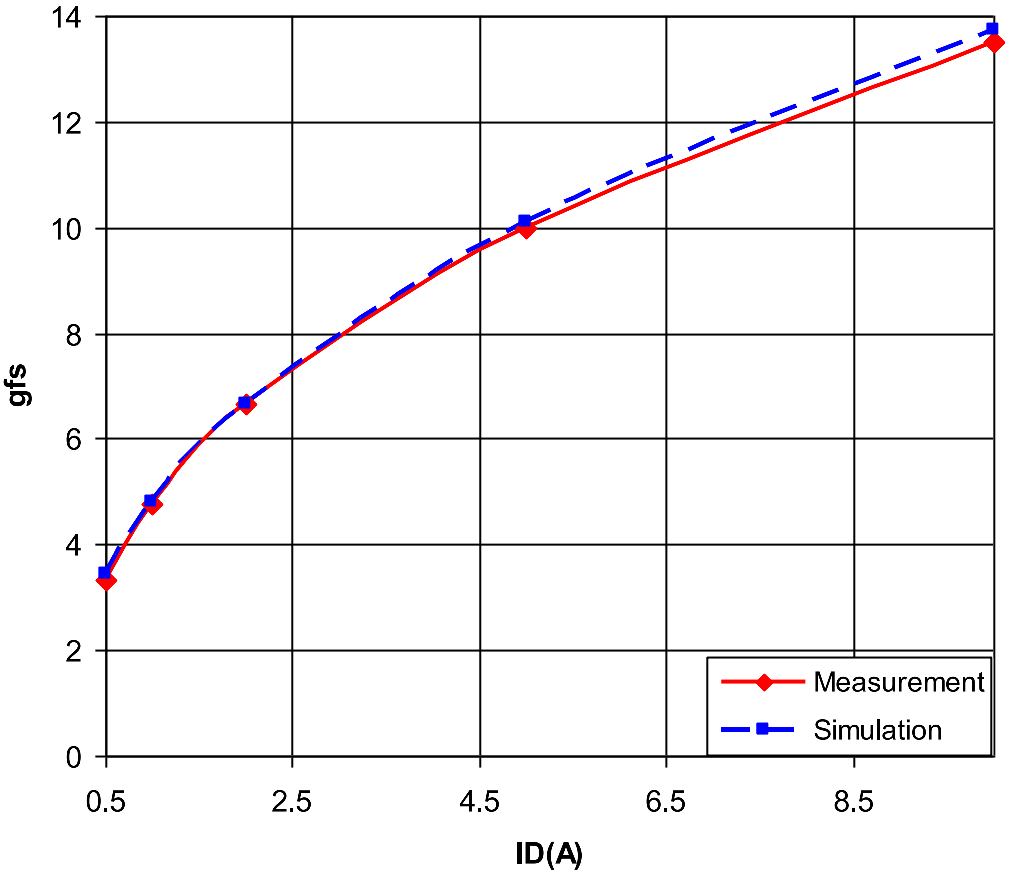
Bee Technologies Inc.

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	Mobility Modulation
KAPPA	Saturation Field Factor
VMAX	Maximum Drift Velocity of Carriers
XJ	Metallurgical Junction Depth
UO	Surface Mobility

Transconductance Characteristic

Circuit Simulation Result

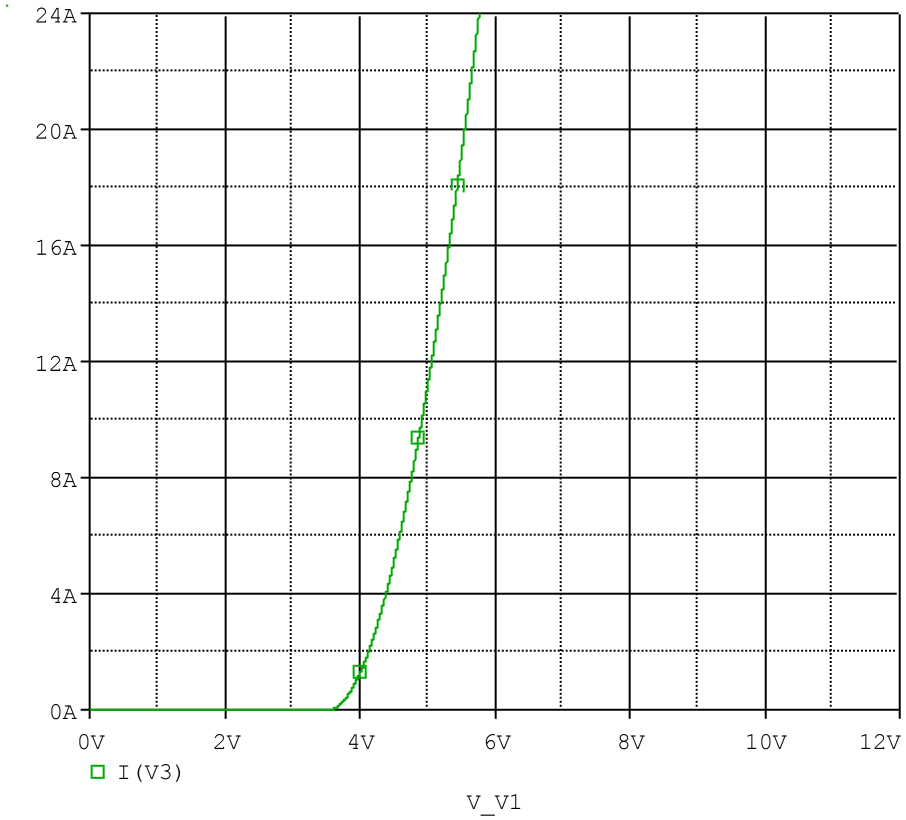


Comparison table

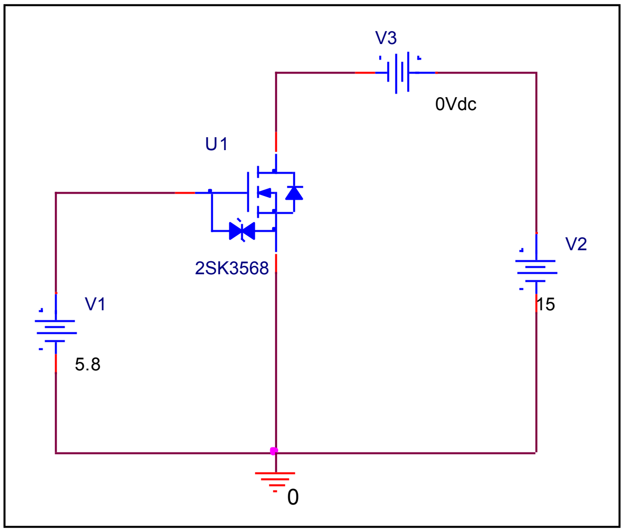
Id(A)	gfs		Error (%)
	Measurement	Simulation	
0.5	3.333	3.448	3.450
1	4.762	4.808	0.966
2	6.667	6.667	0
5	10	10.121	1.210
10	13.514	13.736	1.643

Vgs-Id Characteristic

Circuit Simulation result



Evaluation circuit



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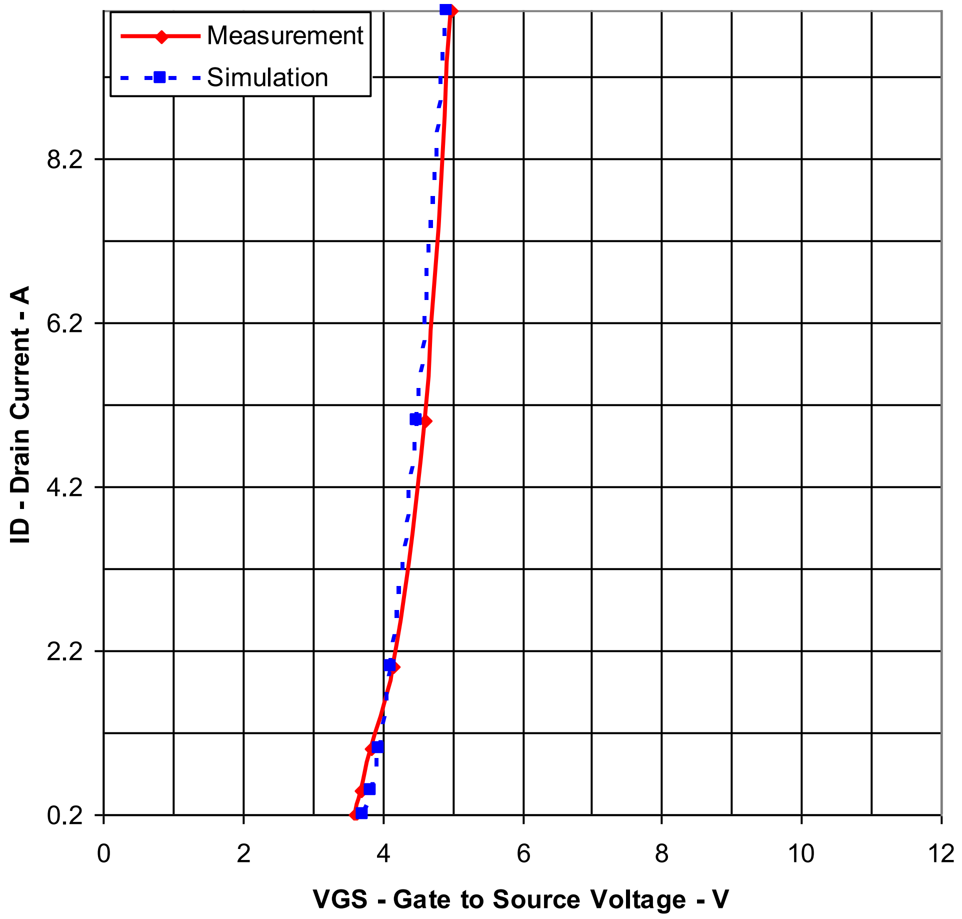
Comparison Graph

Circuit Simulation Result

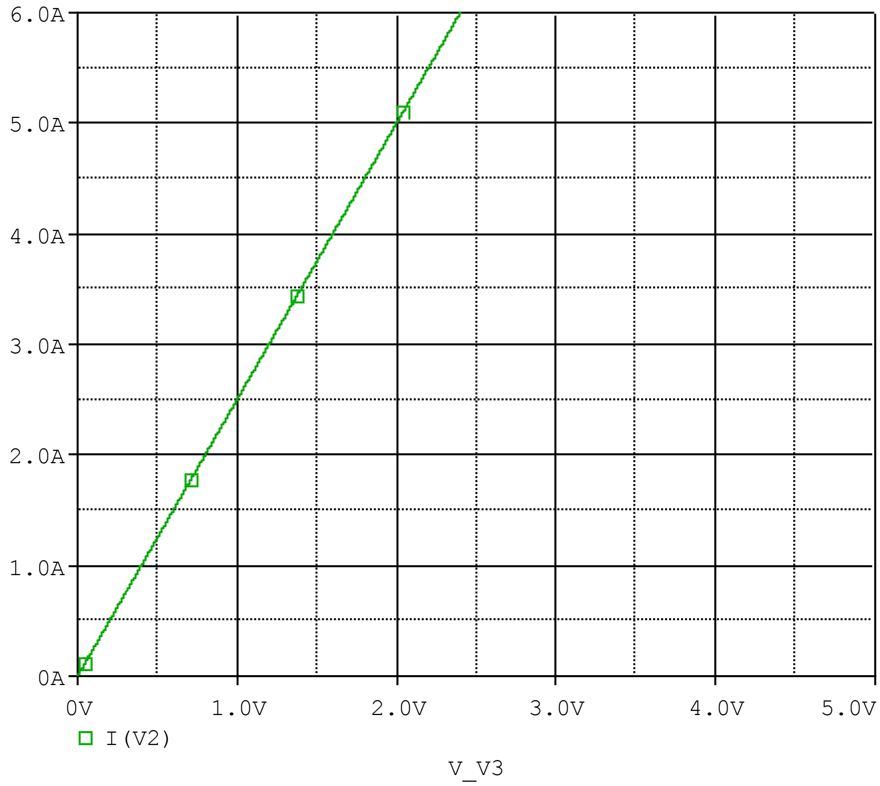


Simulation Result

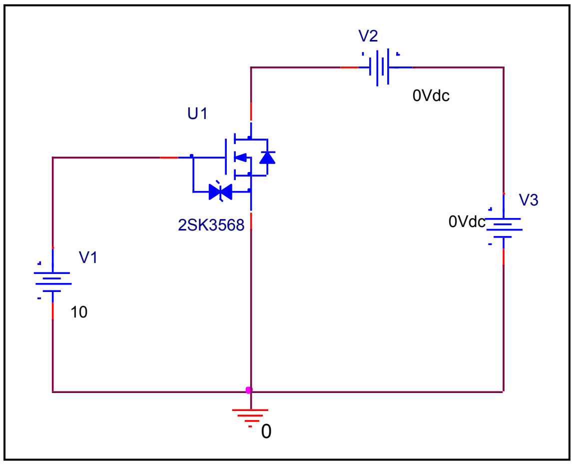
I_D(A)	**V_{GS}(V)**		**Error (%)**
	Measurement	**Simulation**	
0.2	**3.6**	**3.7216**	**3.378**
0.5	**3.7**	**3.8301**	**3.516**
1	**3.85**	**3.9539**	**2.699**
2	**4.15**	**4.1321**	**-0.431**
5	**4.6**	**4.4961**	**-2.259**
10	**4.99**	**4.9230**	**-1.343**

Rds(on) Characteristic

Circuit Simulation result



Evaluation circuit

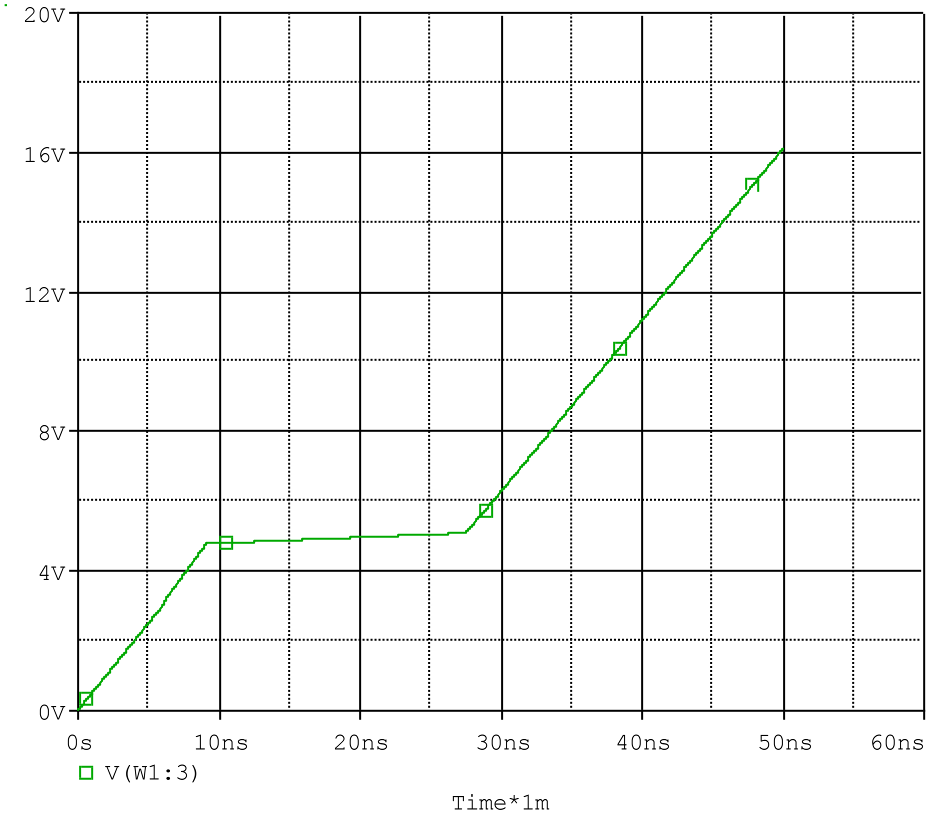


Simulation Result

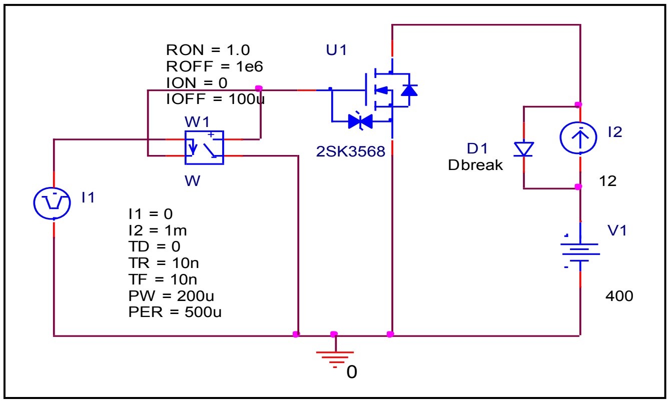
I_D=6A, V_{GS}=10V	Measurement		Simulation		Error (%)
R_{DS} (on)	0.4	Ω	0.3999	Ω	-0.025

Gate Charge Characteristic

Circuit Simulation result



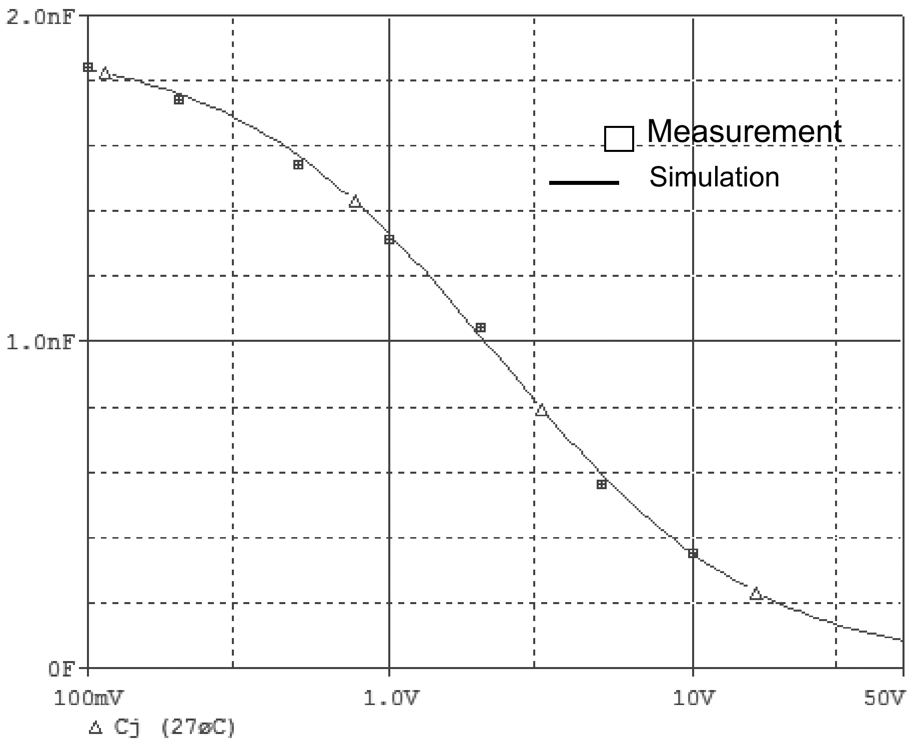
Evaluation circuit



Simulation Result

V_{DD}=400V,I_D=12A	Measurement		Simulation		Error (%)
Qgs	9	nC	9.0864	nC	0.960
Qgd	18	nC	18.335	nC	1.861
Qg	41	nC	37.576	nC	-8.351

Capacitance Characteristic

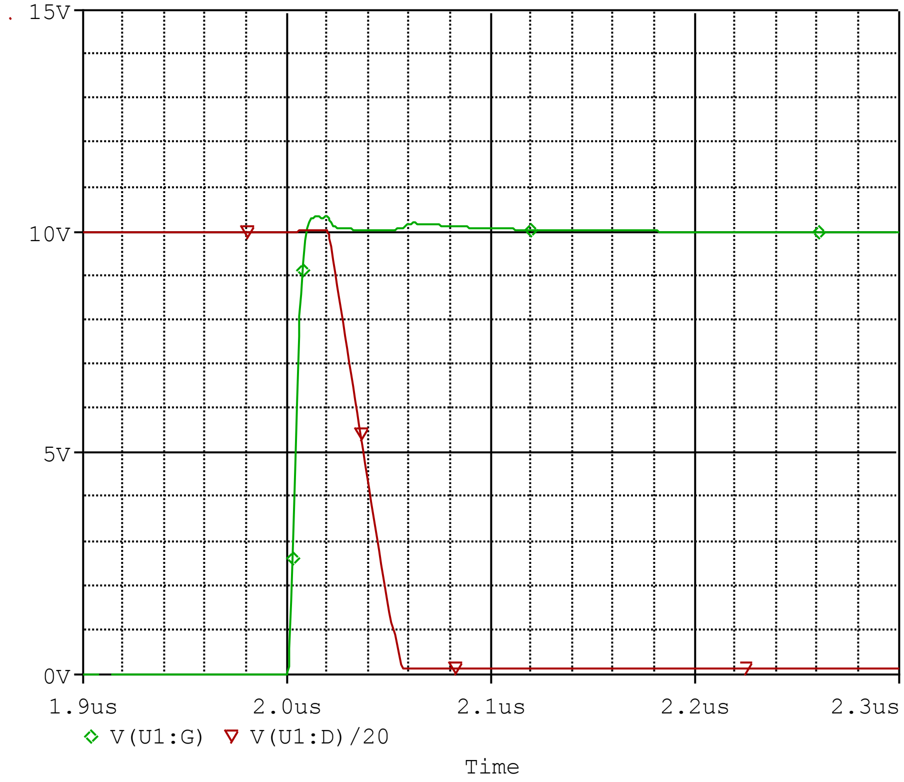


Simulation Result

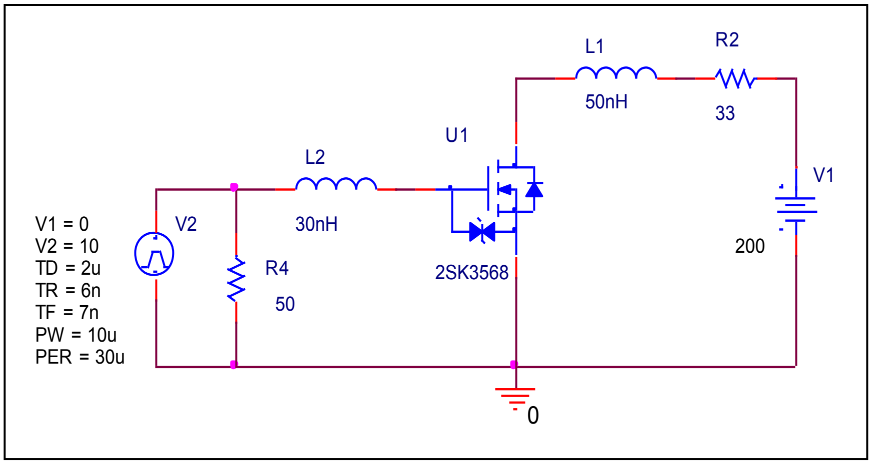
V_{DS}(V)	Cbd(pF)		Error(%)
	Measurement	Simulation	
0.1	1850	1830	-1.081
0.2	1750	1760	0.571
0.5	1550	1570	1.290
1	1320	1325	0.379
2	1050	1010	-3.810
5	570	595	4.386
10	360	350	-2.778

Switching Time Characteristic

Circuit Simulation result



Evaluation circuit

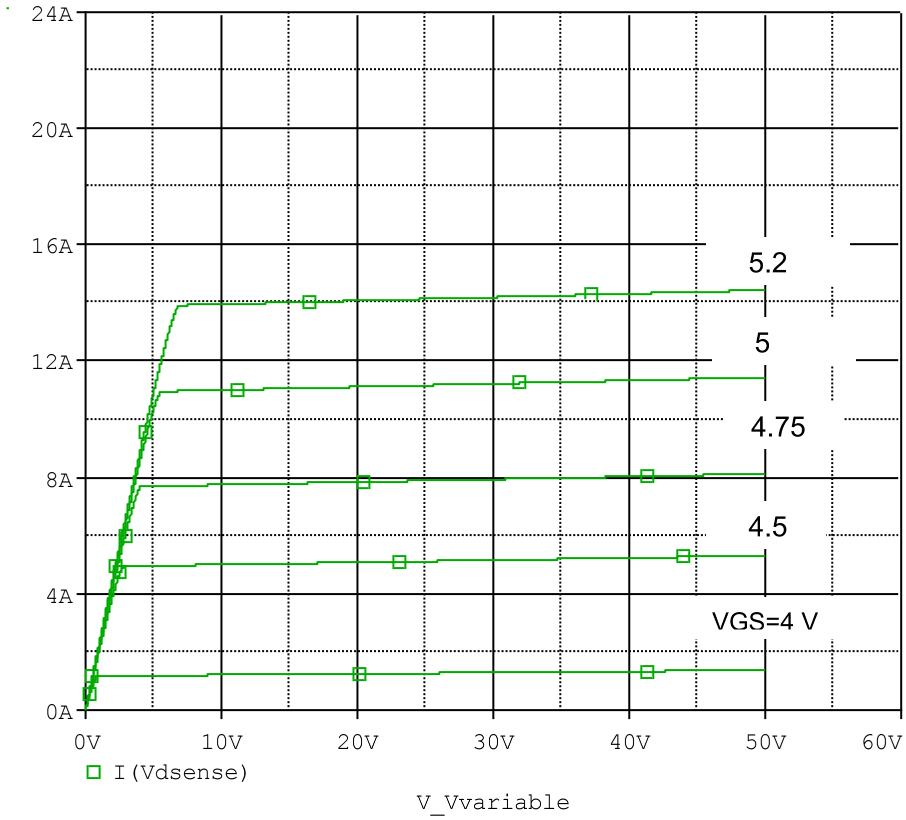


Simulation Result

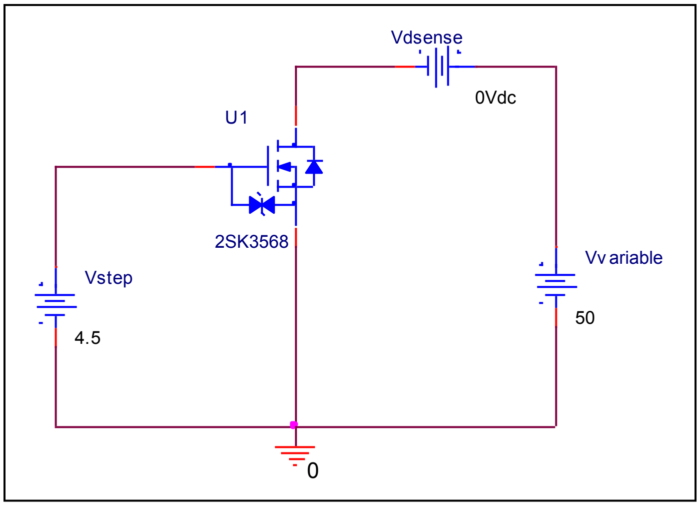
I_D=6 A, V_{DD}=200V V_{GS}=0/10V	Measurement		Simulation		Error(%)
ton	50.000	ns	50.521	ns	1.042

Output Characteristic

Circuit Simulation result

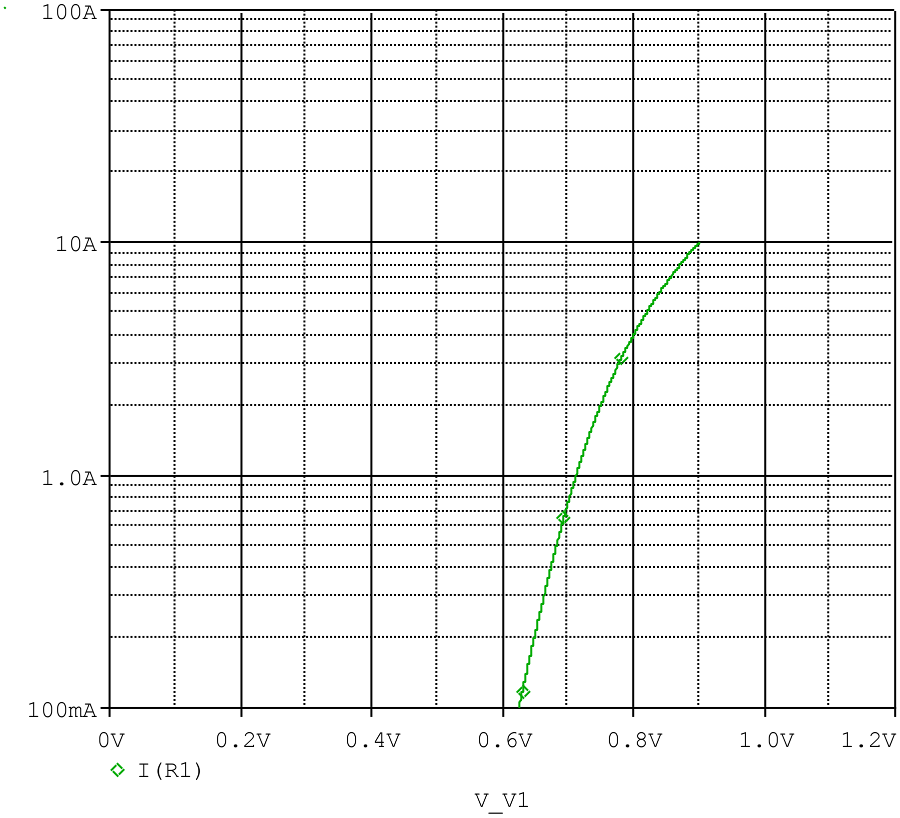


Evaluation circuit

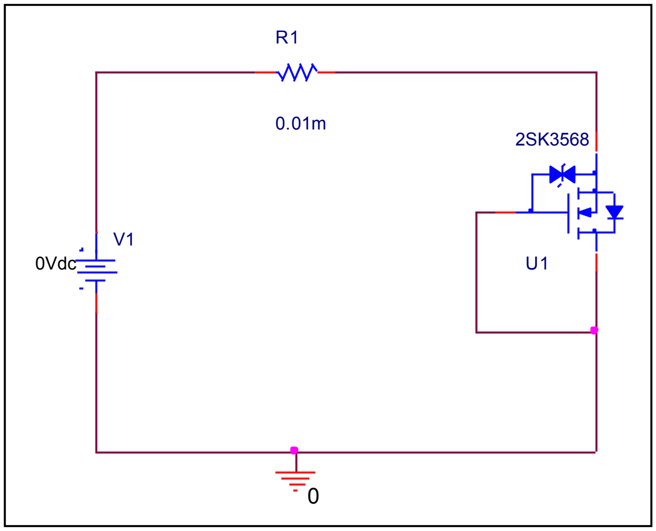


BODY DIODE
Forward Current Characteristic

Circuit Simulation Result

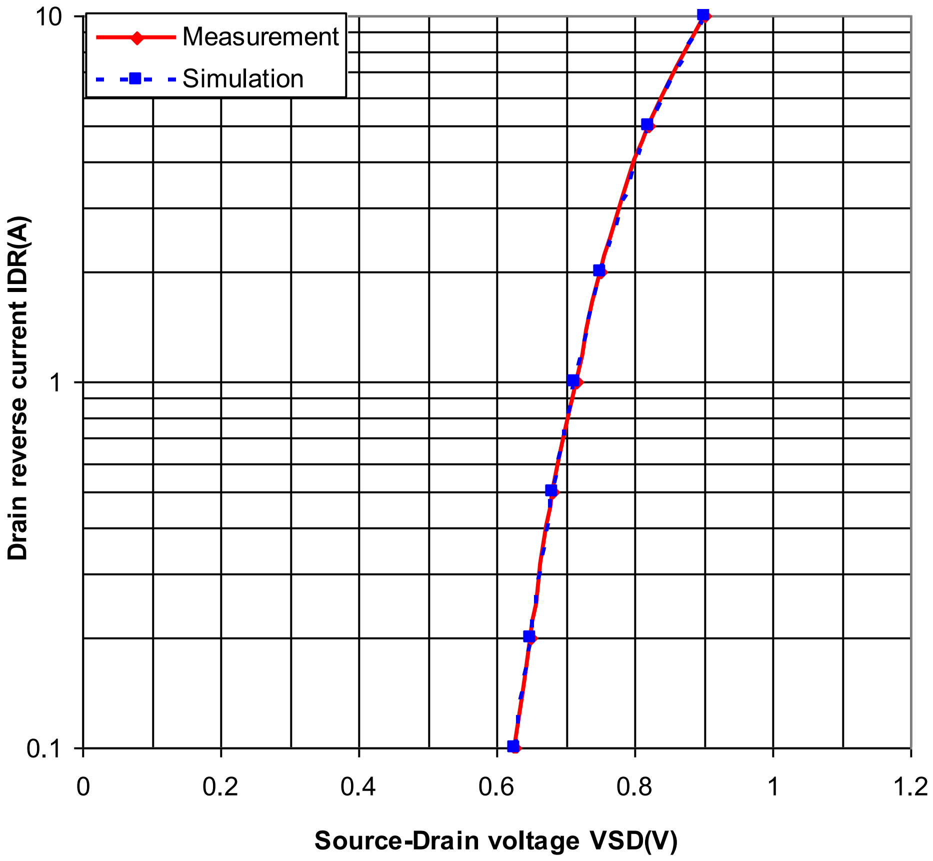


Evaluation Circuit



Comparison Graph

Circuit Simulation Result

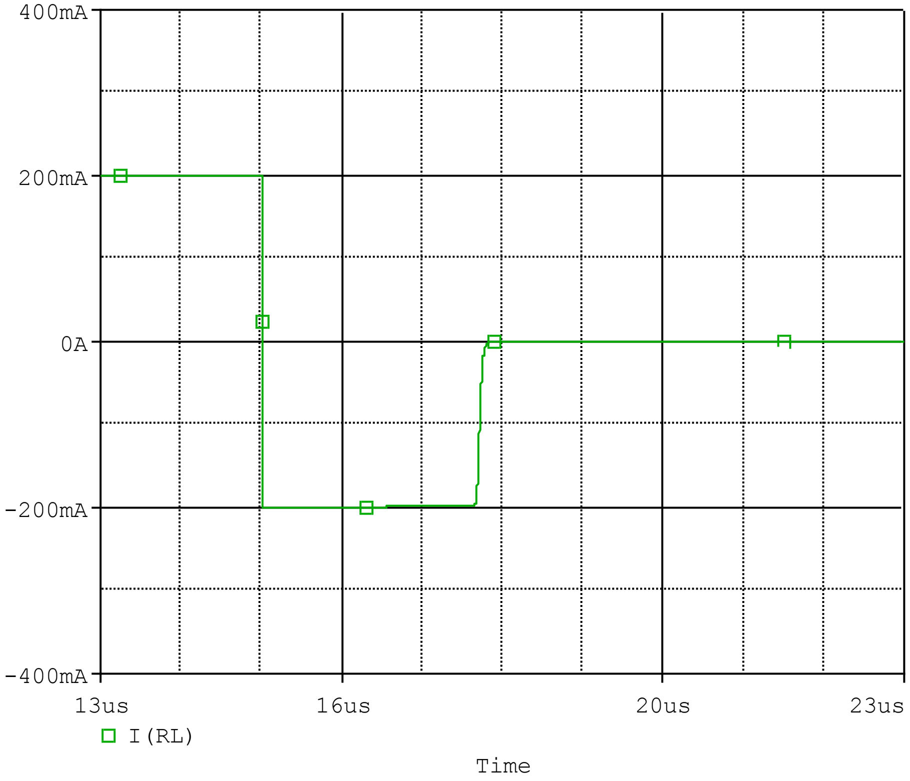


Simulation Result

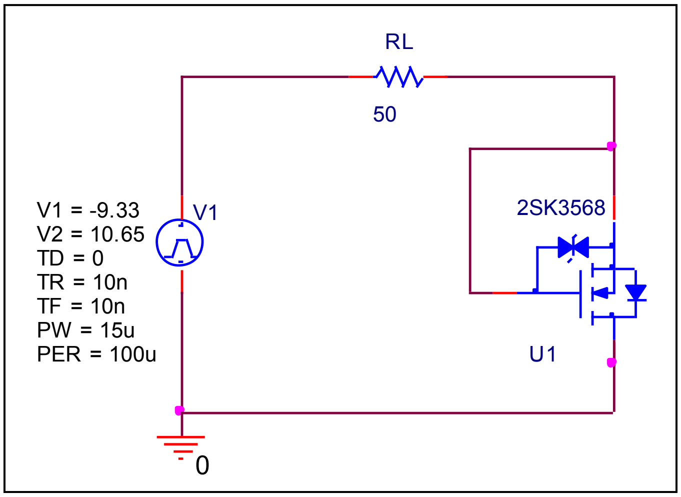
Ifwd(A)	VSD(V)		%Error
	Measurement	Simulation	
0.1	0.625	0.625	0
0.2	0.65	0.649	-0.154
0.5	0.68	0.682	0.294
1	0.715	0.713	-0.280
2	0.75	0.75	0
5	0.82	0.82	0
10	0.9	0.9	0

Reverse Recovery Characteristic

Circuit Simulation Result



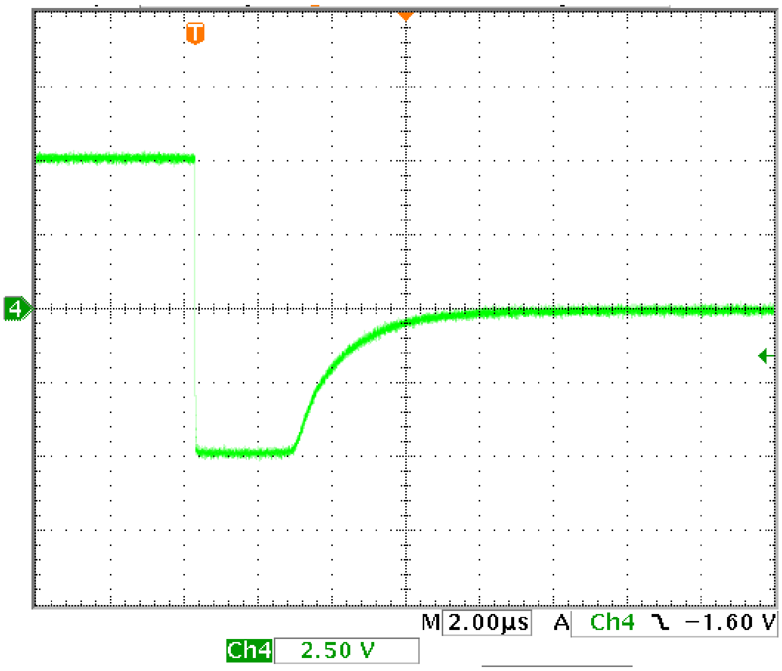
Evaluation Circuit



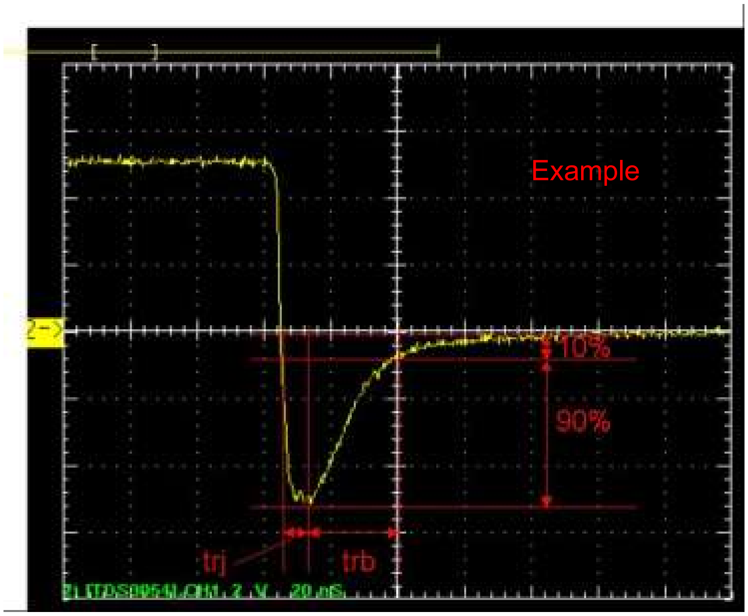
Compare Measurement vs. Simulation

Trr(ns)	Measurement	Simulation	Error (%)
Trj+Trb (us)	2.74	2.7456	0.204

Reverse Recovery Characteristic Reference



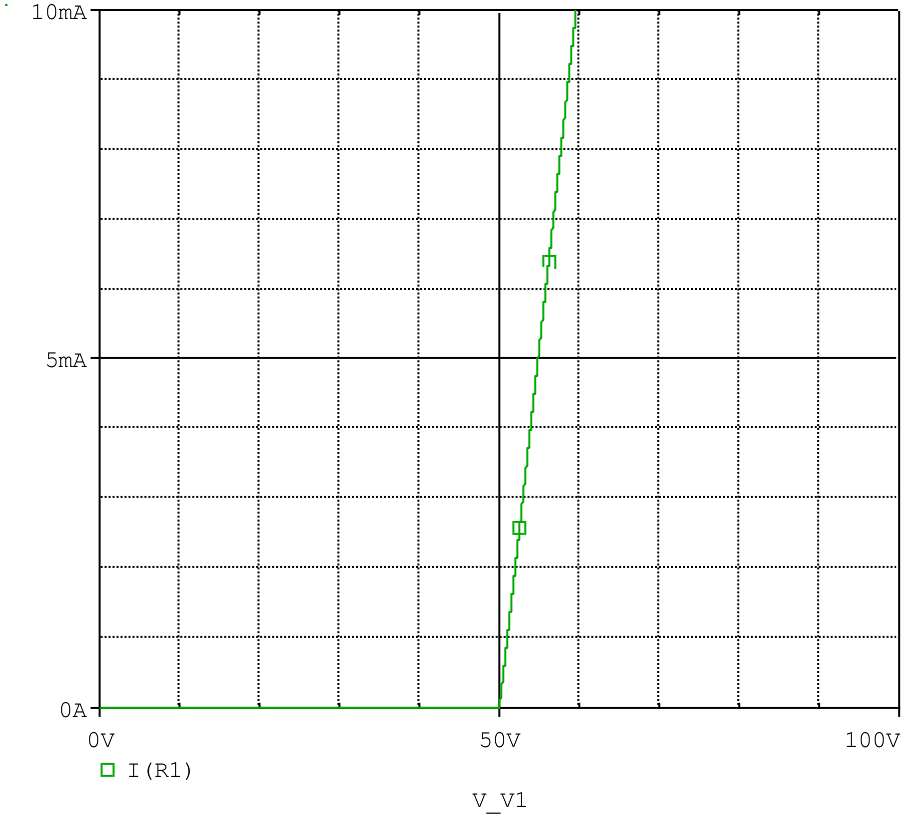
Trj=1.36(us)
Trb=1.38(us)
Conditions:Ifwd=Irev=0.2(A),Rl=50



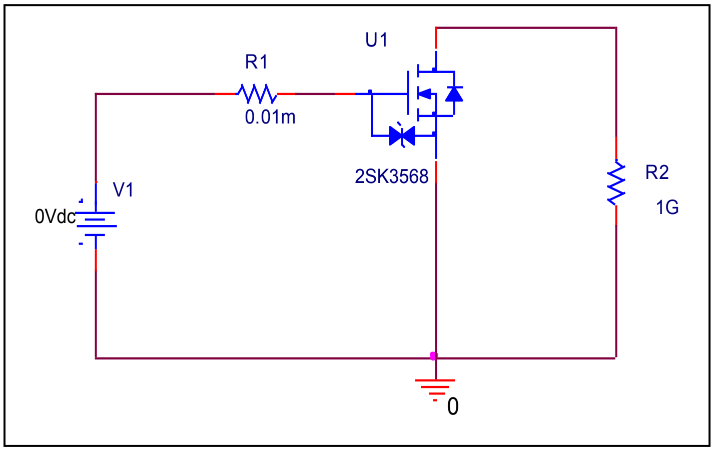
Relation between trj and trb

ESD PROTECTION DIODE
Zener Voltage Characteristic

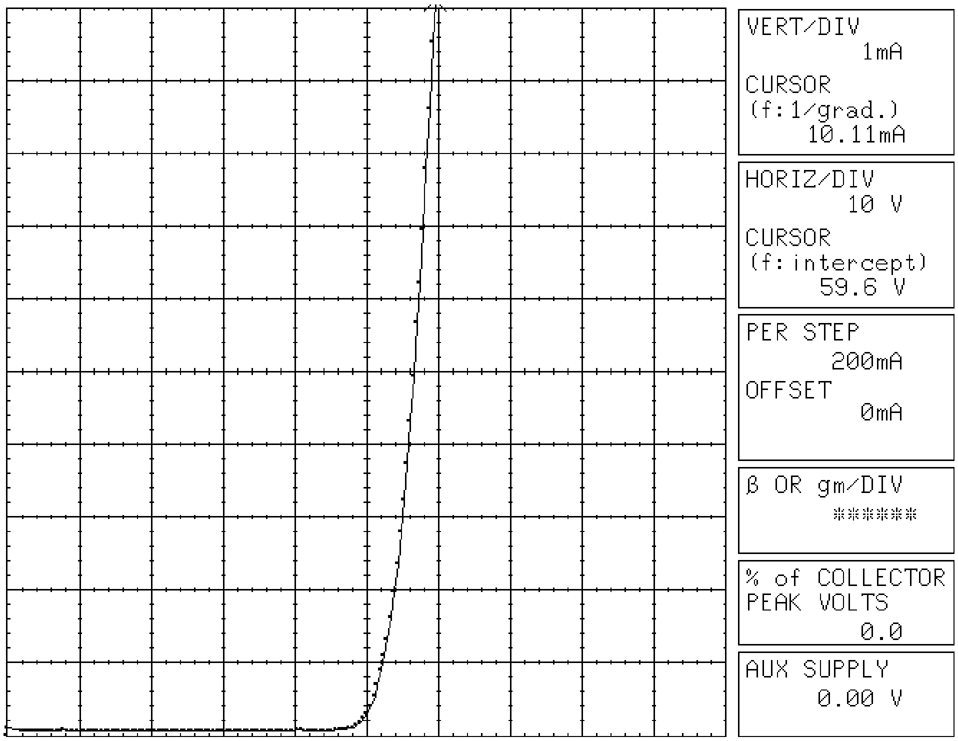
Circuit Simulation Result



Evaluation Circuit



Zener Voltage Characteristic Reference



VERT/DIV
1mA
CURSOR
(f:1/grad.)
10.11mA

HORIZ/DIV
10 V
CURSOR
(f:intercept)
59.6 V

PER STEP
200mA
OFFSET
0mA

ß OR gm/DIV
******

% of COLLECTOR
PEAK VOLTS
0.0

AUX SUPPLY
0.00 V