Device Modeling Report

COMPONENTS: Power MOSFET (Professional)
PART NUMBER: 2SK3561
MANUFACTURER: TOSHIBA
Body Diode (Professional) / ESD Protection Diode

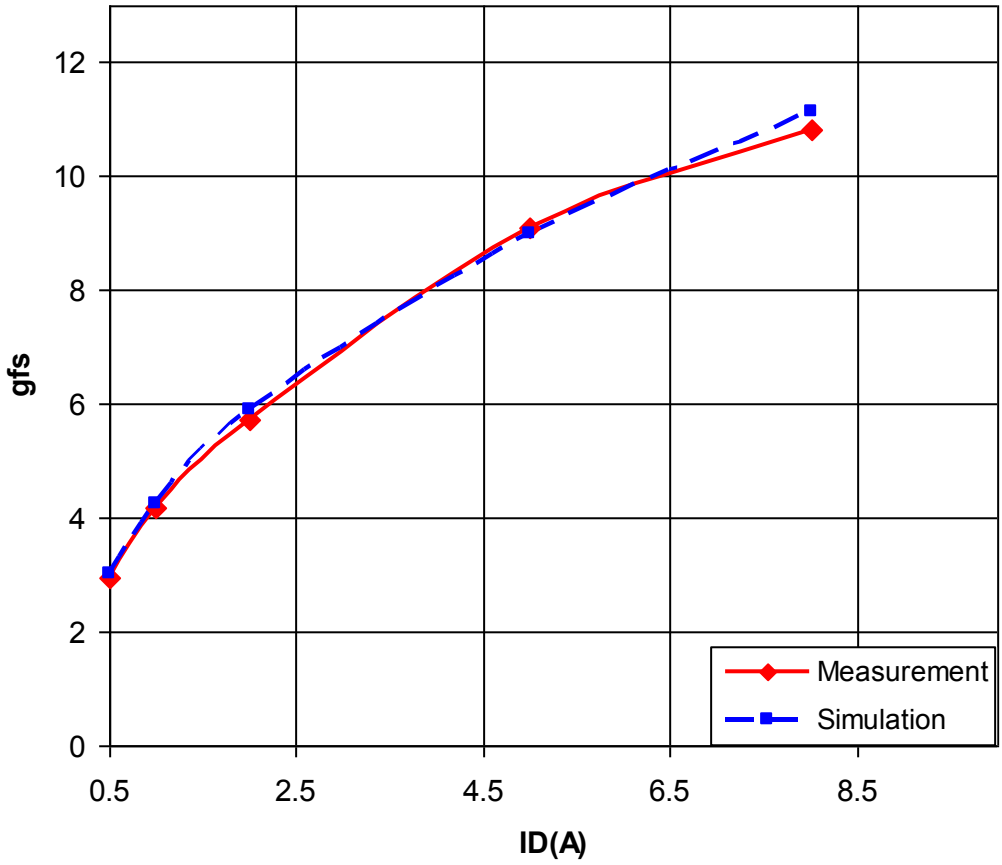
Bee Technologies Inc.

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

Transconductance Characteristic

Circuit Simulation Result

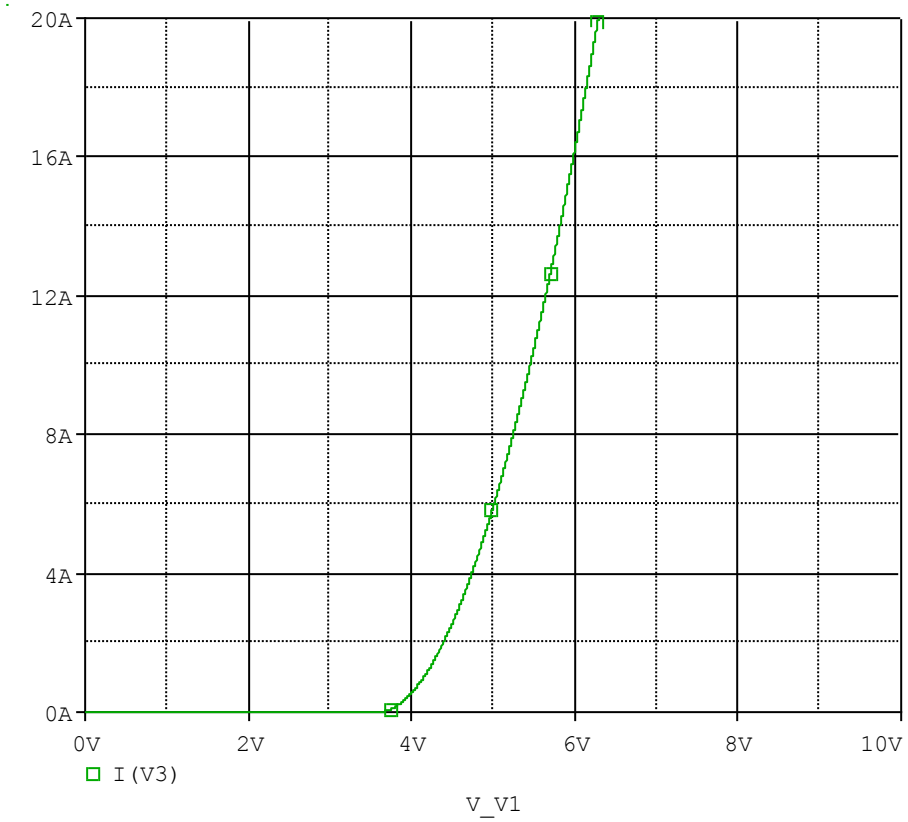


Comparison table

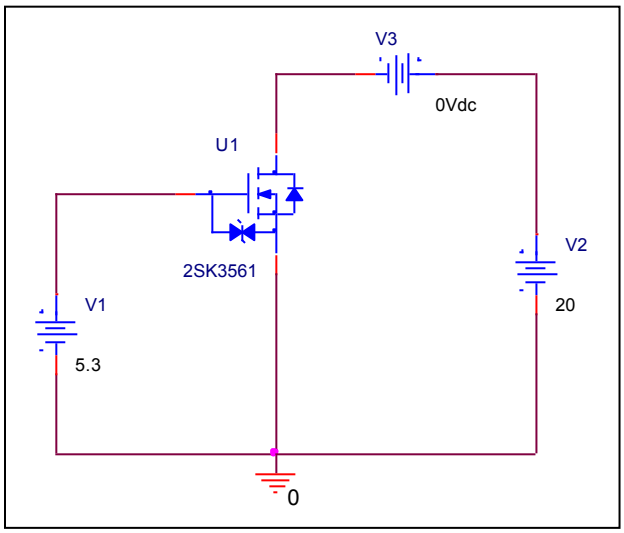
Id(A)	gfs		Error(%)
	Measurement	Simulation	
0.5	2.941	3.030	3.026
1	4.167	4.255	2.112
2	5.714	5.900	3.255
5	9.091	9.009	-0.902
8	10.811	11.127	2.923

Vgs-Id Characteristic

Circuit Simulation result

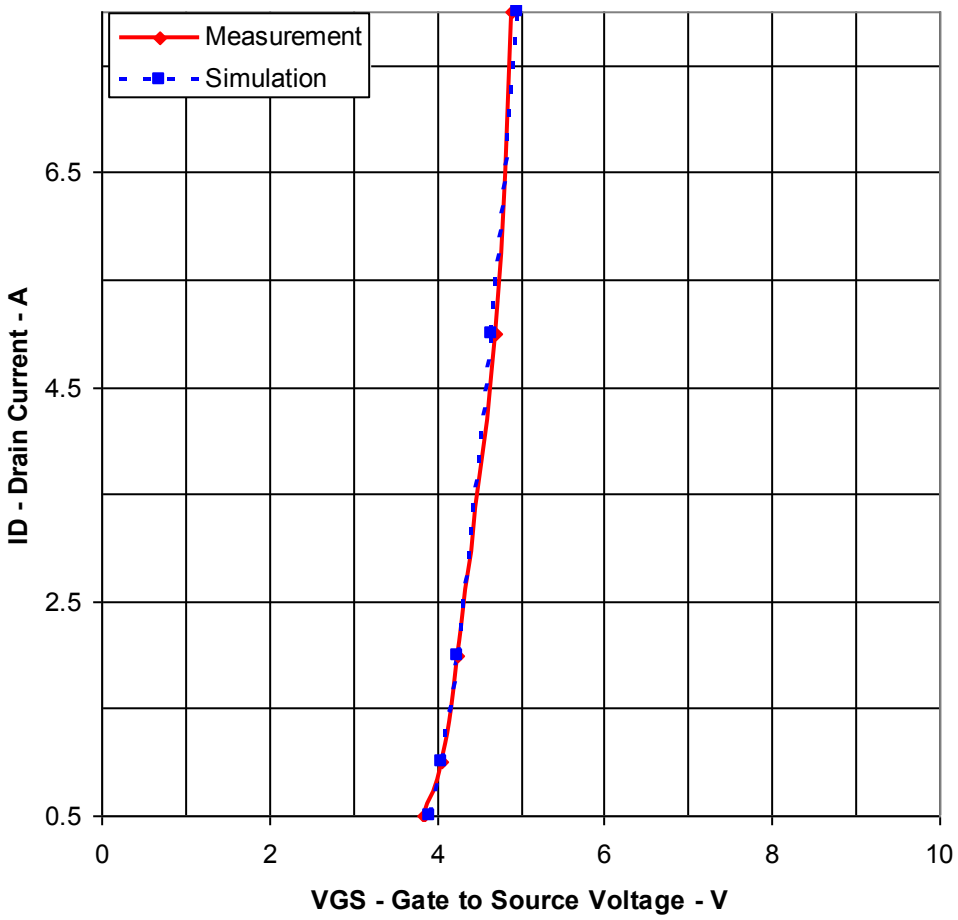


Evaluation circuit



Comparison Graph

Circuit Simulation Result

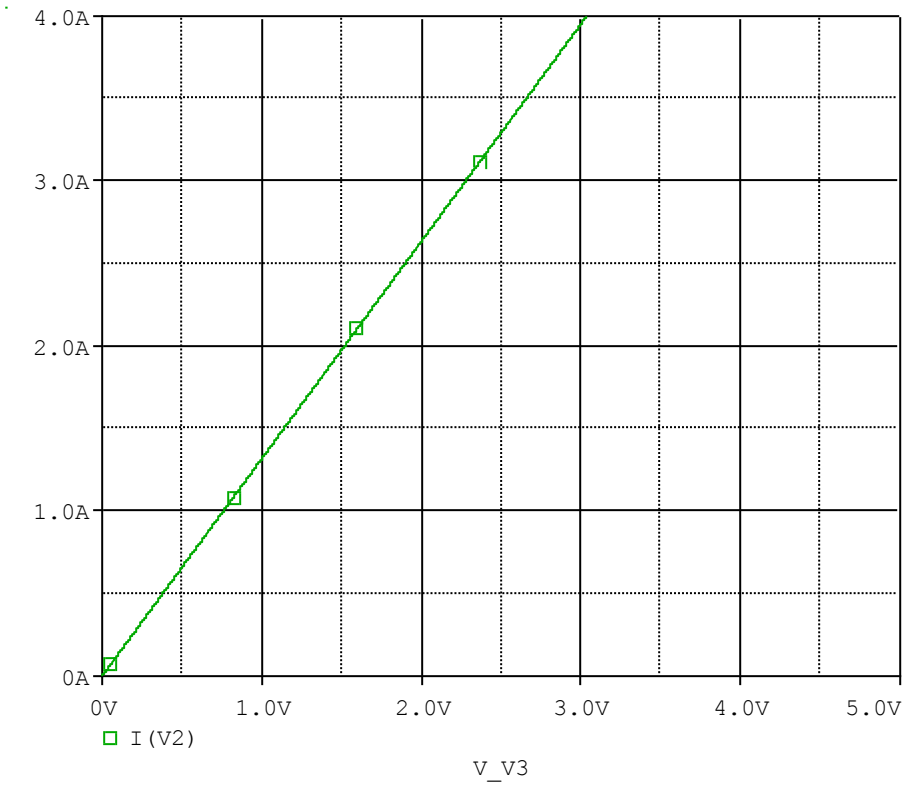


Simulation Result

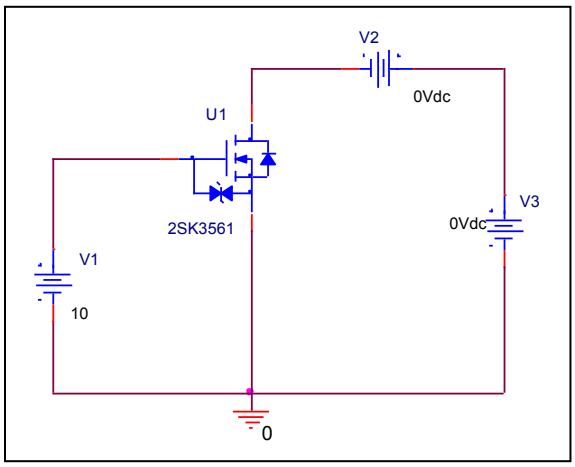
I_D(A)	V_{GS}(V)		Error (%)
	Measurement	Simulation	
0.5	3.85	3.9070	1.481
1	4.05	4.0475	-0.062
2	4.25	4.249	-0.024
5	4.7	4.659	-0.872
8	4.9	4.9629	1.284

Rds(on) Characteristic

Circuit Simulation result



Evaluation circuit

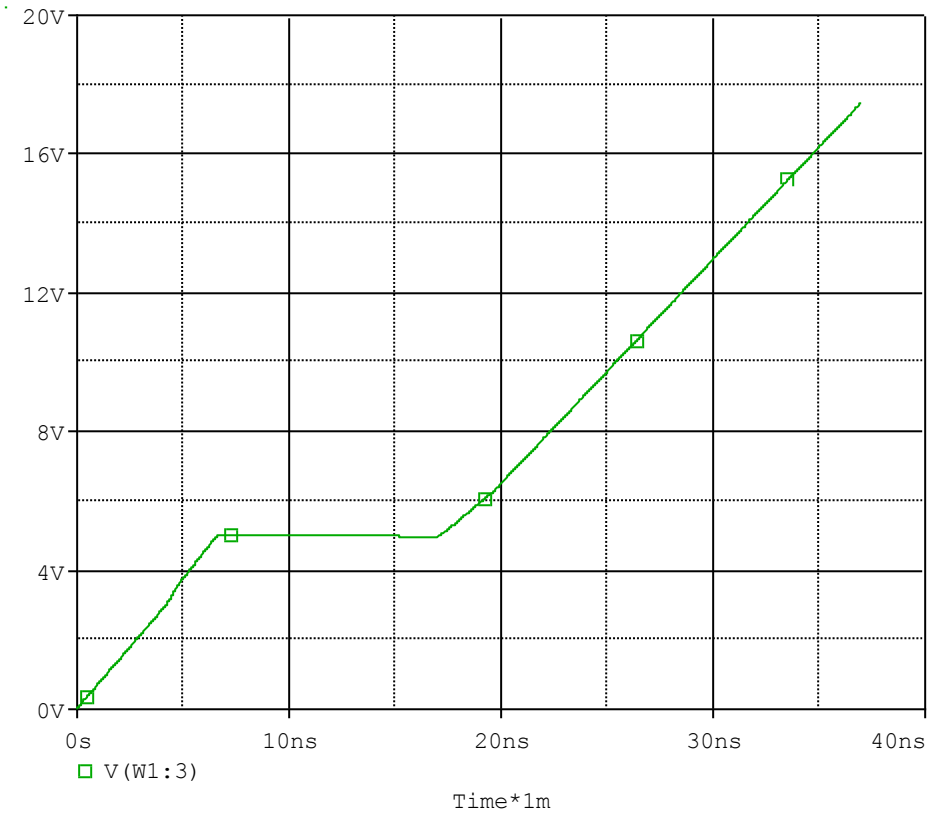


Simulation Result

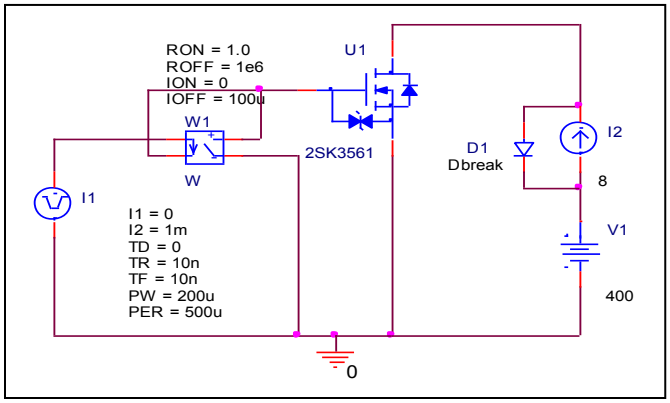
I_D=4A, V_{GS}=10V	Measurement		Simulation		Error (%)
R_{DS} (on)	0.75	Ω	0.759	Ω	1.2

Gate Charge Characteristic

Circuit Simulation result



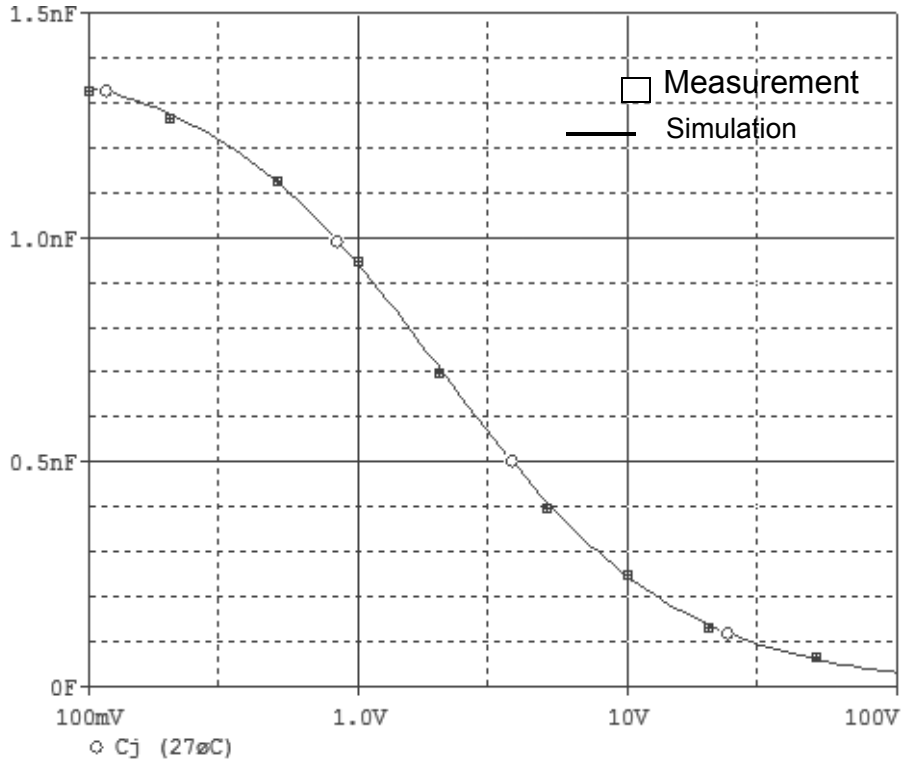
Evaluation circuit



Simulation Result

V_{DD}=400V,I_D=8A	Measurement		Simulation		Error (%)
Qgs	6.5	nC	6.6038	nC	1.597
Qgd	10	nC	10.377	nC	3.770
Qg	26.5	nC	25.409	nC	-4.117

Capacitance Characteristic

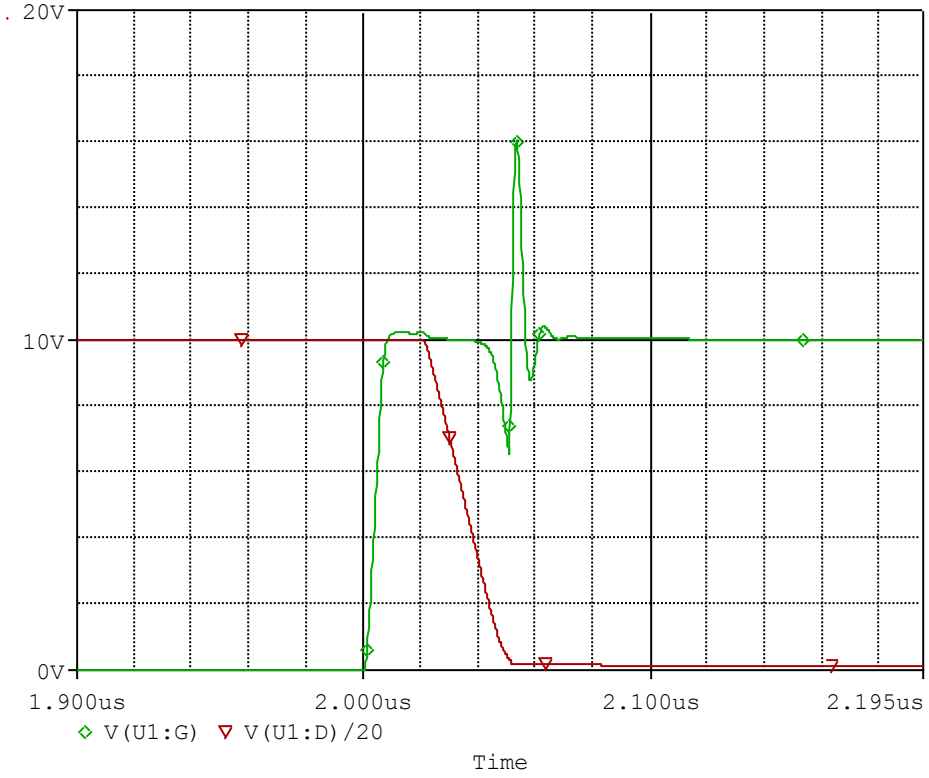


Simulation Result

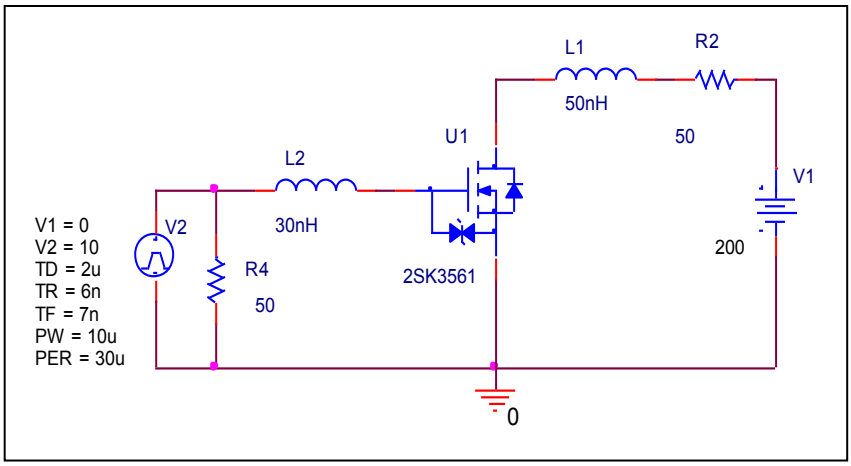
V_{DS}(V)	Cbd(pF)		Error(%)
	Measurement	Simulation	
0.1	1330	1335	0.376
0.2	1270	1275	0.394
0.5	1130	1120	-0.885
1	950	940	-1.053
2	700	710	1.429
5	400	410	2.500
10	255	245	-3.922
20	134	137	2.239

Switching Time Characteristic

Circuit Simulation result



Evaluation circuit

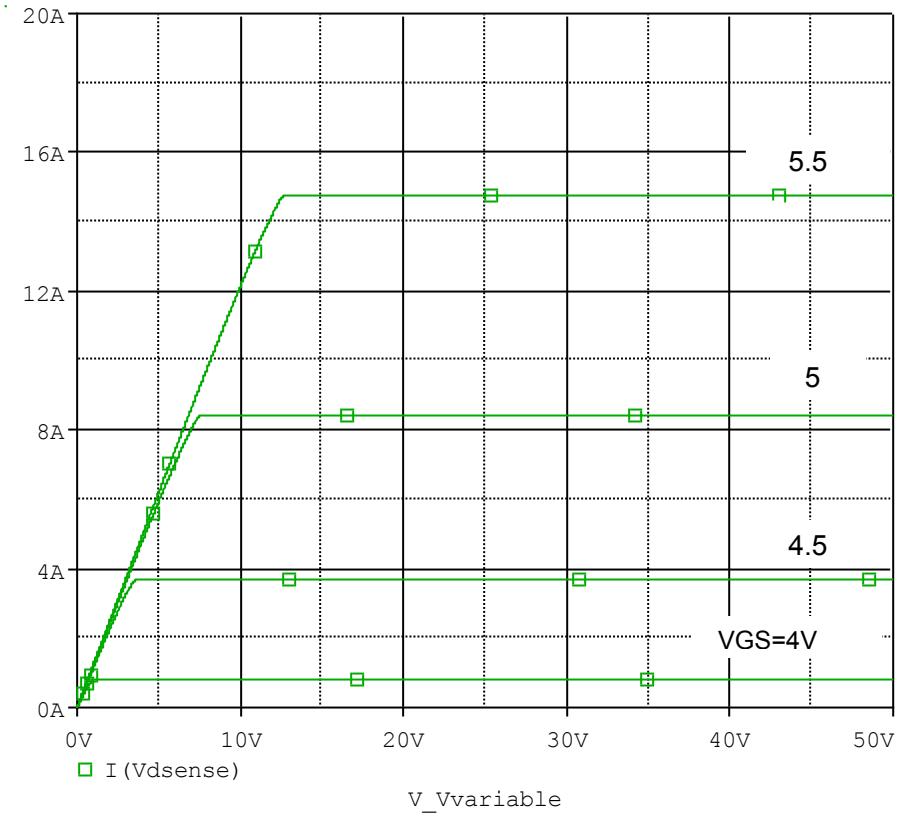


Simulation Result

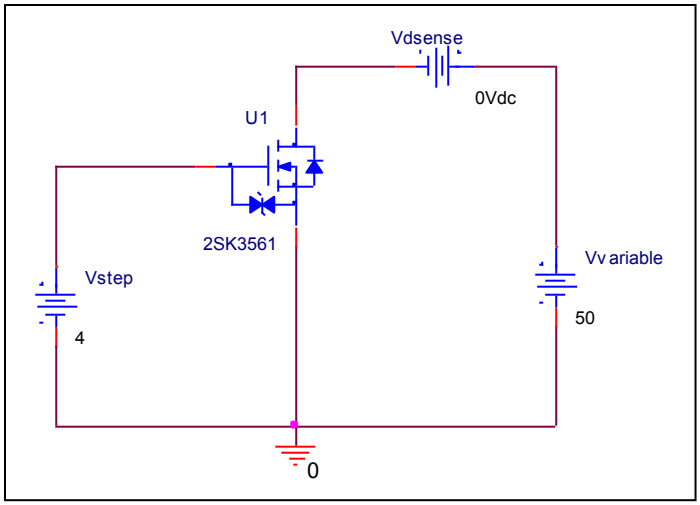
I_D=4 A, V_{DD}=200V V_{GS}=0/10V	Measurement		Simulation		Error(%)
ton	45.000	ns	45.513	ns	1.140

Output Characteristic

Circuit Simulation result

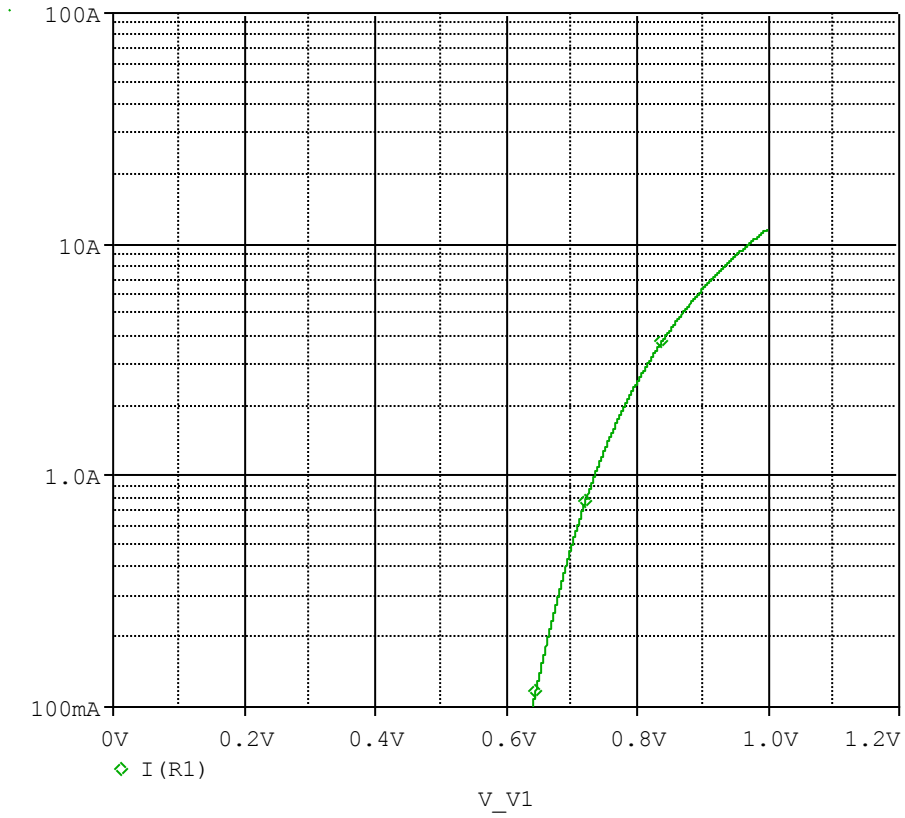


Evaluation circuit

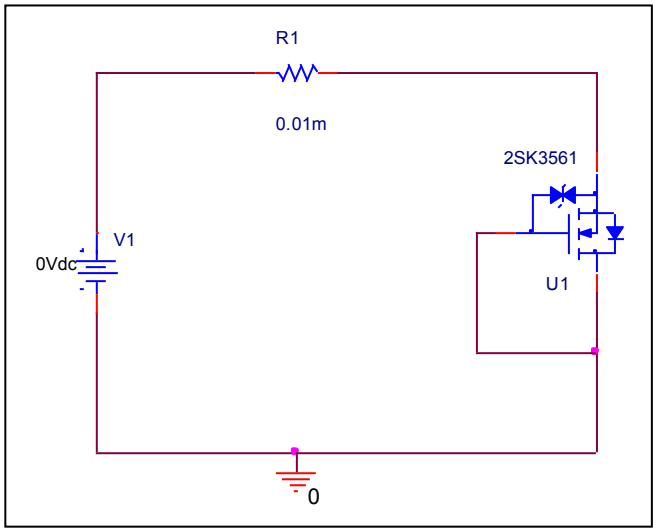


Forward Current Characteristic

Circuit Simulation Result

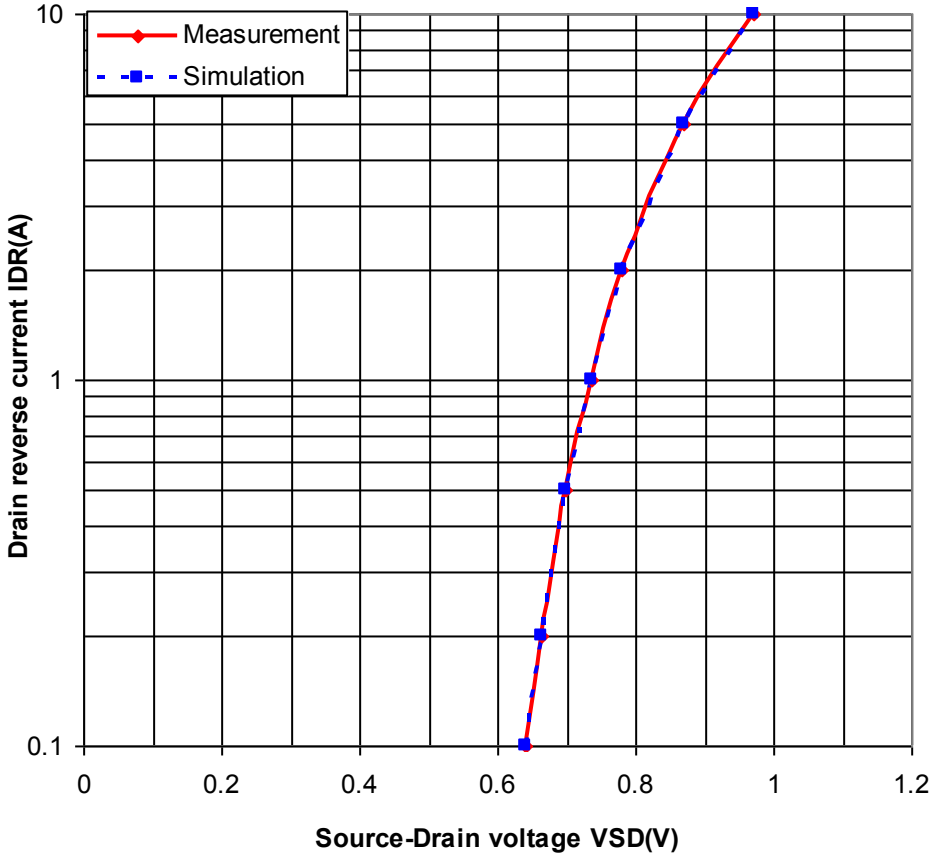


Evaluation Circuit



Comparison Graph

Circuit Simulation Result

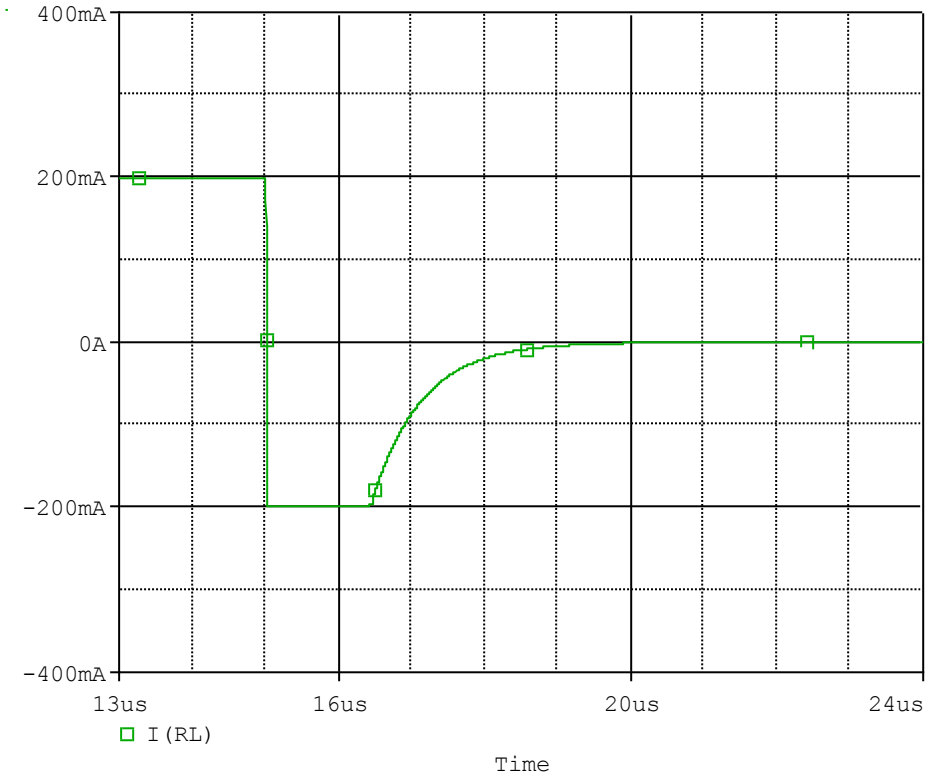


Simulation Result

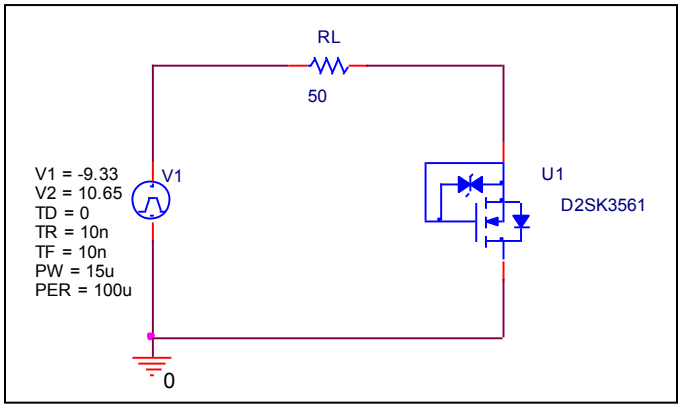
Ifwd(A)	VSD(V)		%Error
	Measuremen	Simulation	
0.1	0.64	0.64	0
0.2	0.665	0.664	-0.150
0.5	0.7	0.7	0
1	0.735	0.735	0
2	0.78	0.781	0.128
5	0.87	0.869	-0.115
10	0.97	0.971	0.103

Reverse Recovery Characteristic

Circuit Simulation Result



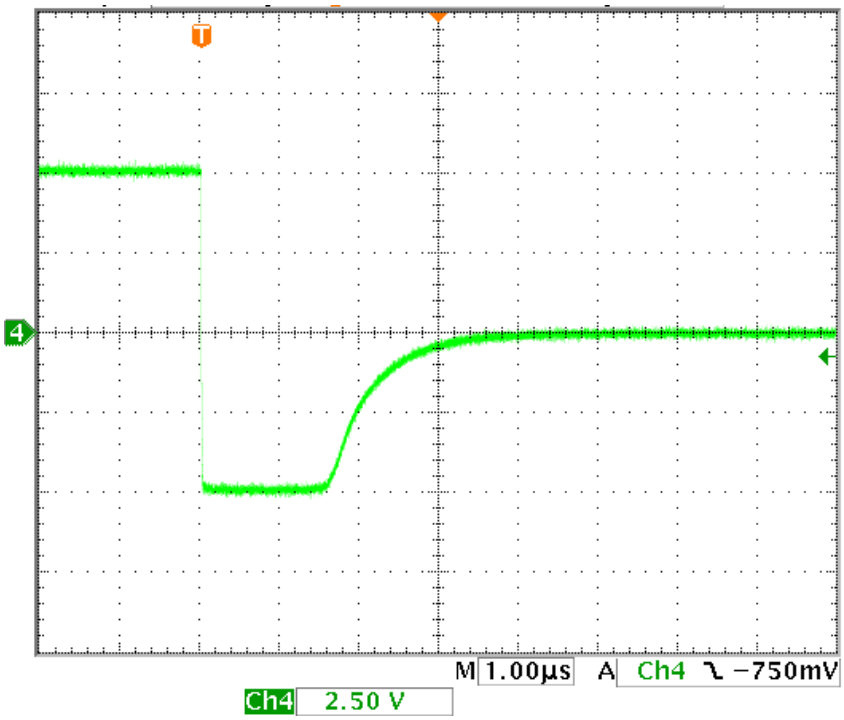
Evaluation Circuit



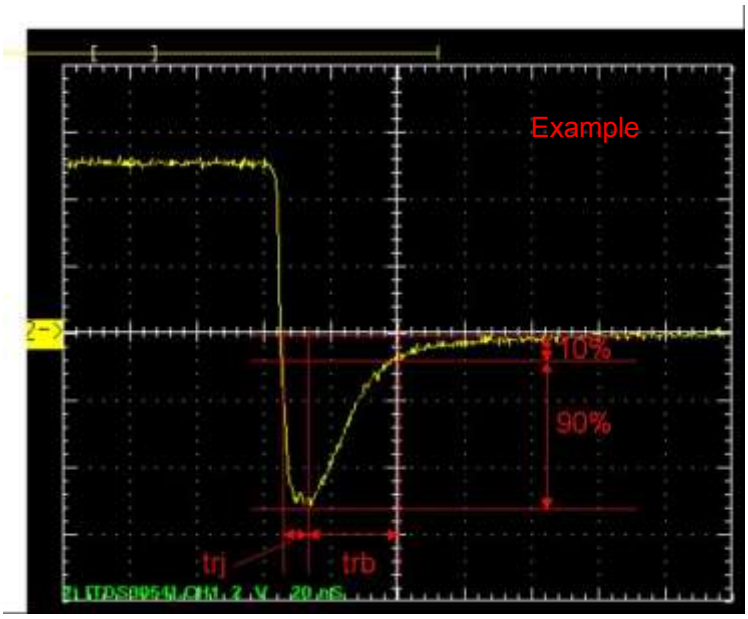
Compare Measurement vs. Simulation

	Measurement	Simulation	Error (%)
Trj(us)	**1.44**	**1.4402**	**0.014**
Trb(us)	**1.52**	**1.5374**	**1.145**
Trr(us)	**2.96**	**2.9776**	**0.595**

Reverse Recovery Characteristic Reference



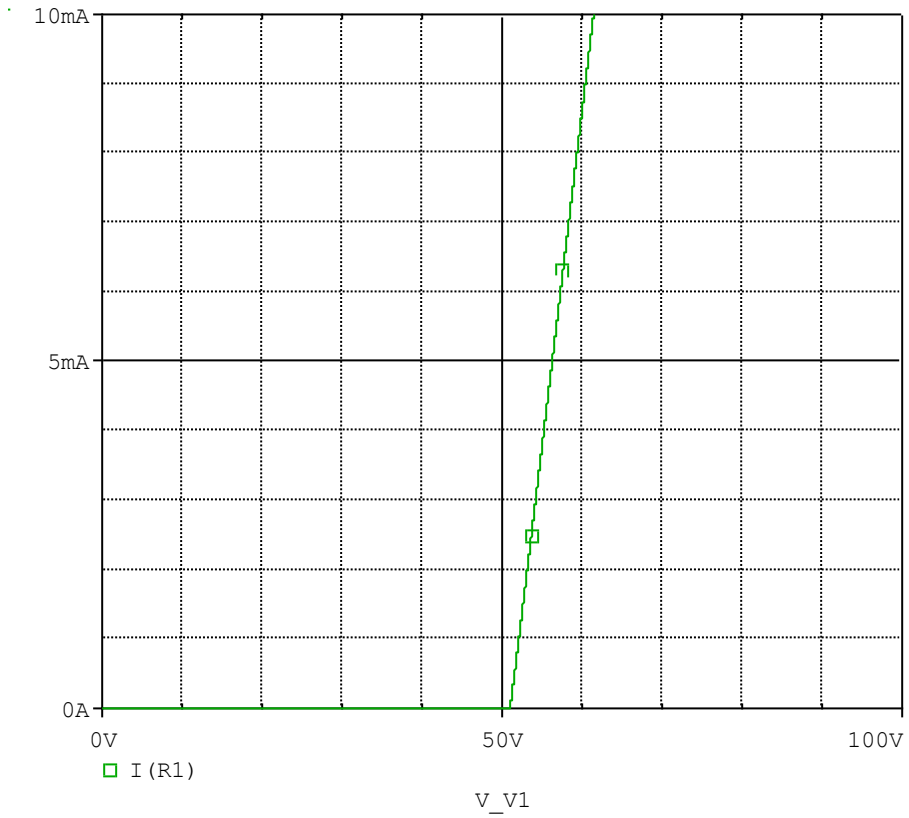
Trj=1.44(us)
Trb=1.52(us)
Conditions:Ifwd=Irev=0.2(A),Rl=50



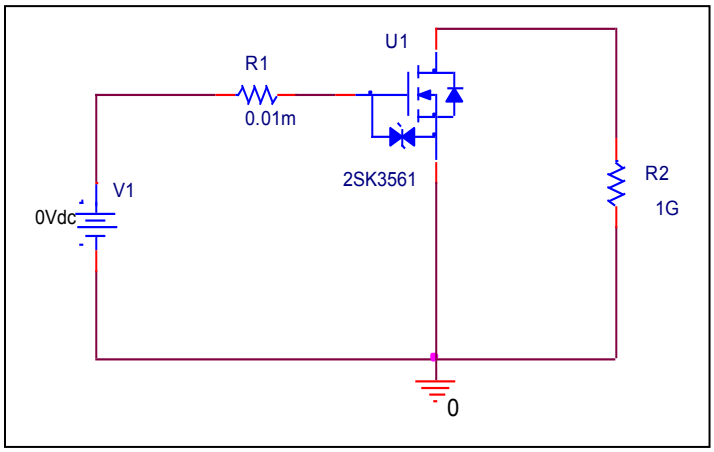
Relation between trj and trb

ESD PROTECTION DIODE
Zener Voltage Characteristic

Circuit Simulation Result



Evaluation Circuit



Zener Voltage Characteristic Reference