Device Modeling Report

COMPONENTS: MOSFET (Professional Model)
PART NUMBER: 2SK3057
MANUFACTURER: NEC Corporation
REMARK: Body Diode (Professional) /
ESD Protection Diode

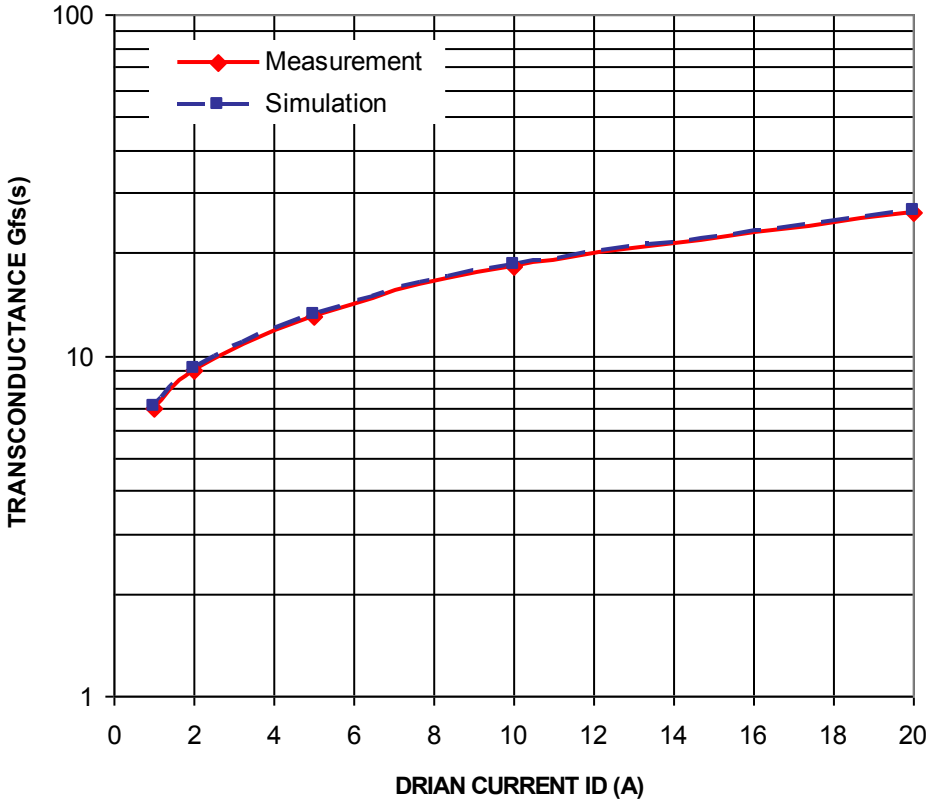
Bee Technologies Inc.

MOSFET MODEL PARAMETERS

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 Characteristics

Circuit Simulation Result

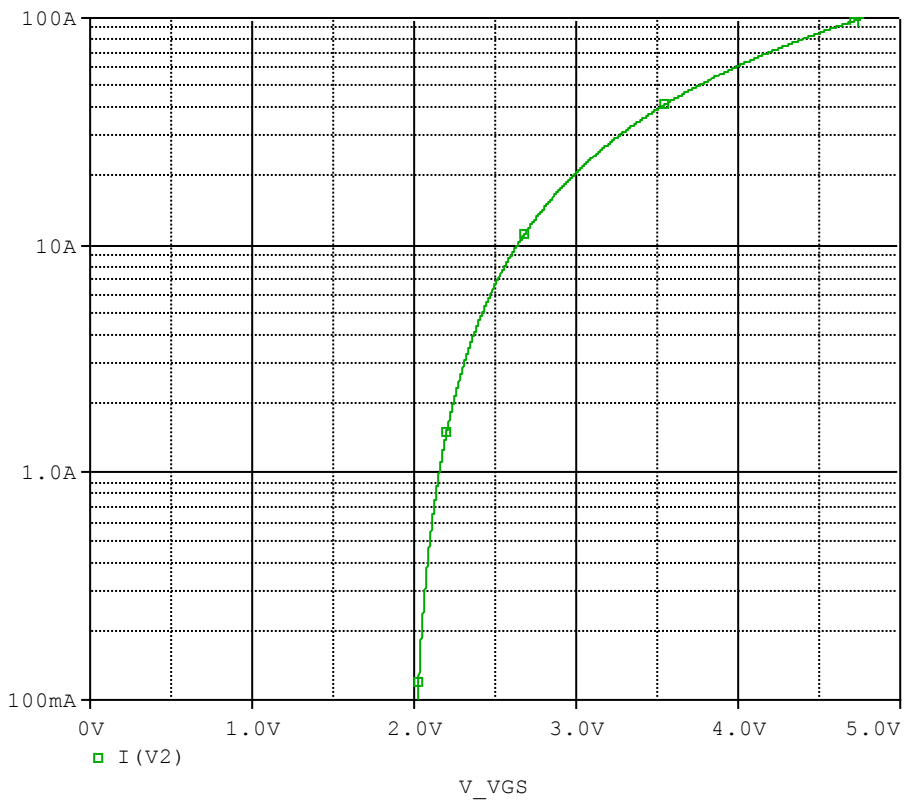


Comparison table

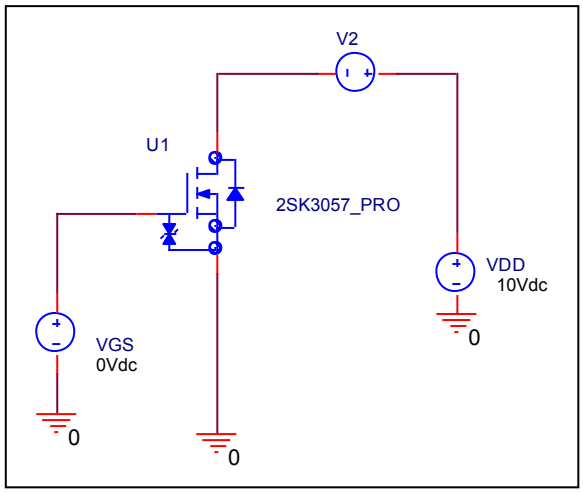
Id(A)	gfs(s)		Error(%)
	Measurement	Simulation	
1	7.00000	7.09987	1.427
2	9.00000	9.13247	1.472
5	13.00000	13.25145	1.934
10	18.24818	18.36589	0.645
20	26.14379	26.56560	1.613

Vgs-Id Characteristics

Circuit Simulation Result

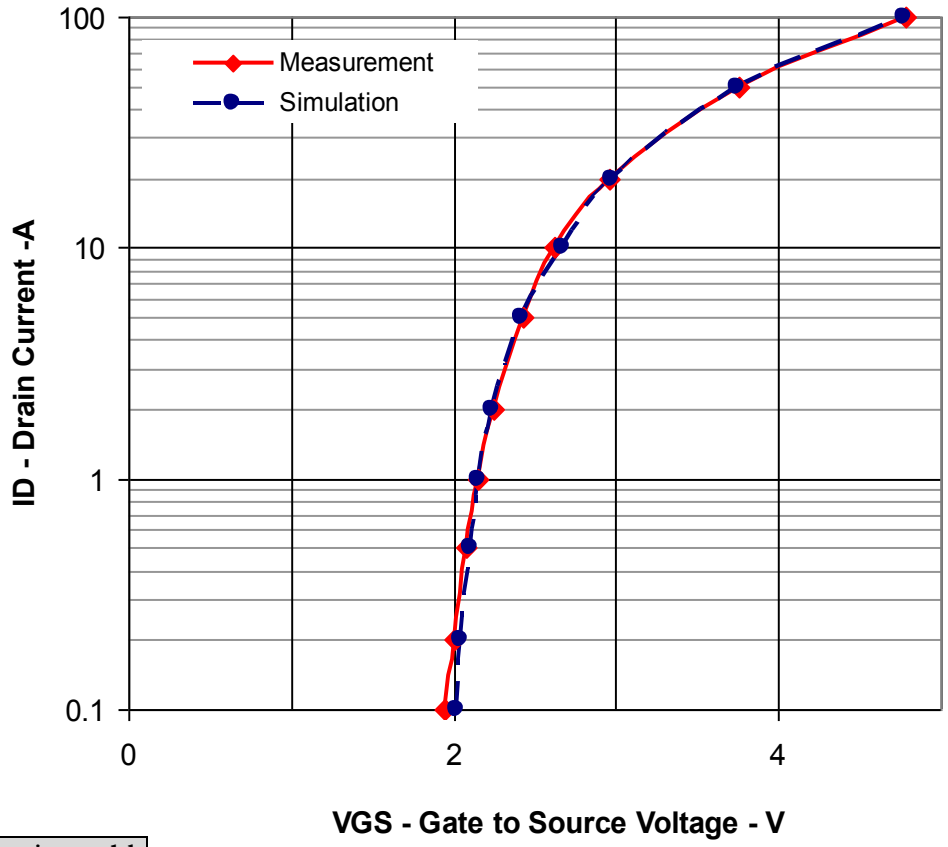


Evaluation circuit



Comparison Graph

Circuit Simulation Result

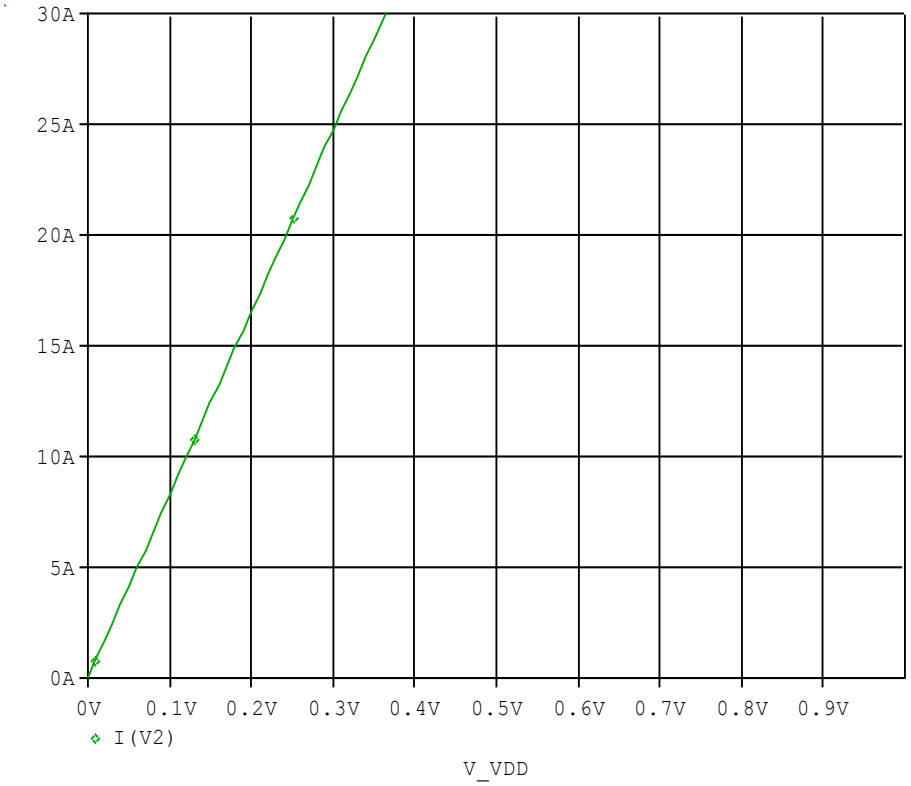


Comparison table

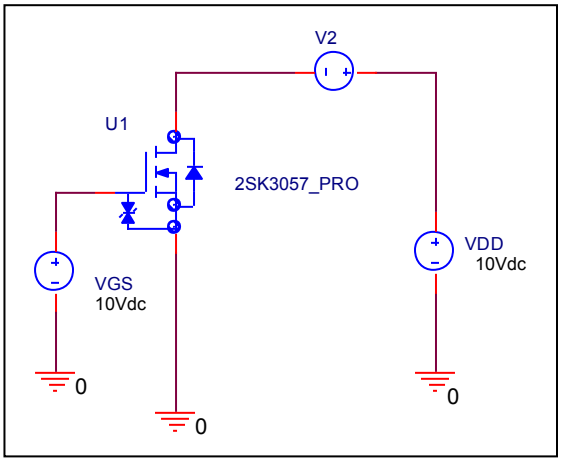
I_D(A)	V_{GS}(V)		Error (%)
	Measurement	Simulation	
0.1	1.9500	2.0221	3.6974
0.2	2.0000	2.0468	2.3400
0.5	2.0800	2.0969	0.8125
1	2.1500	2.1550	0.2326
2	2.2500	2.2401	-0.4400
5	2.4300	2.4190	-0.4527
10	2.6200	2.6638	1.6718
20	2.9600	2.9741	0.4764
50	3.7500	3.7451	-0.1307
100	4.7800	4.7758	-0.0879

*Rds(on) Characteristic

Circuit Simulation result



Evaluation circuit

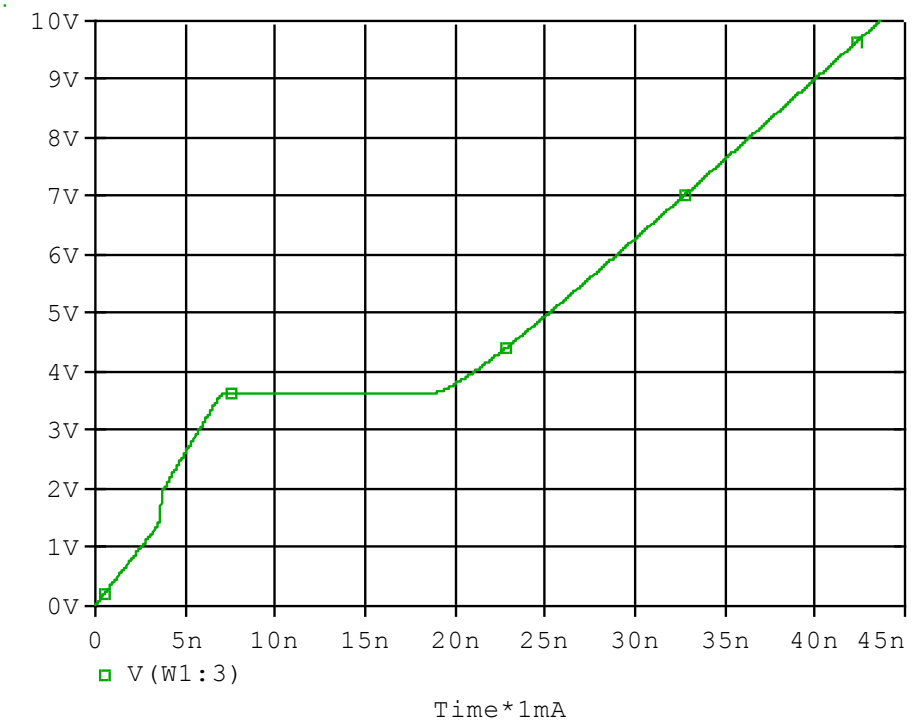


Simulation Result

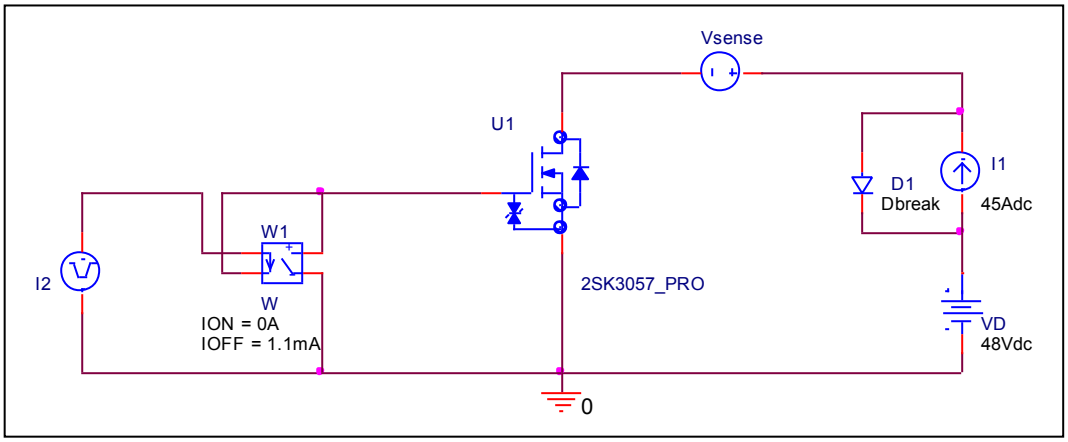
I_D=23A, V_{GS}=10V	Measurement		Simulation		Error (%)
R_{DS} (on)	0.01200	mΩ	0.01213	mΩ	1.083

Gate Charge Characteristic

Circuit Simulation result



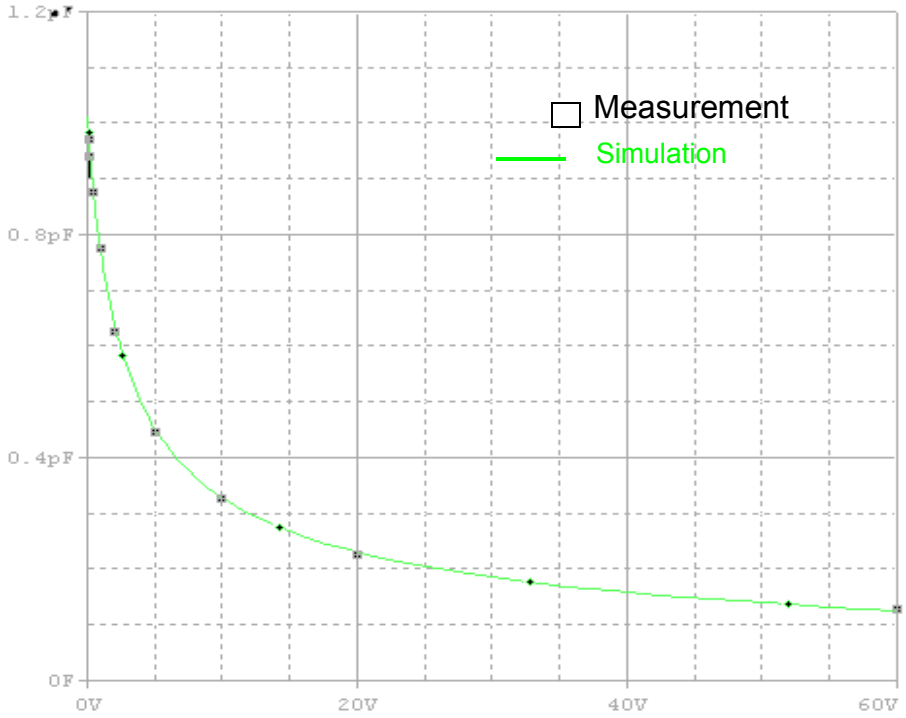
Evaluation circuit



Simulation Result

V_{DD}=48V,I_D=45A ,V_{GS}=10V	Measurement		Simulation		Error (%)
Qgs	6.700	nC	6.90000	nC	2.98507
Qgd	19.000	nC	19.01000	nC	0.05263
Qg	45.000	nC	43.50000	nC	-3.33333

Capacitance Characteristic

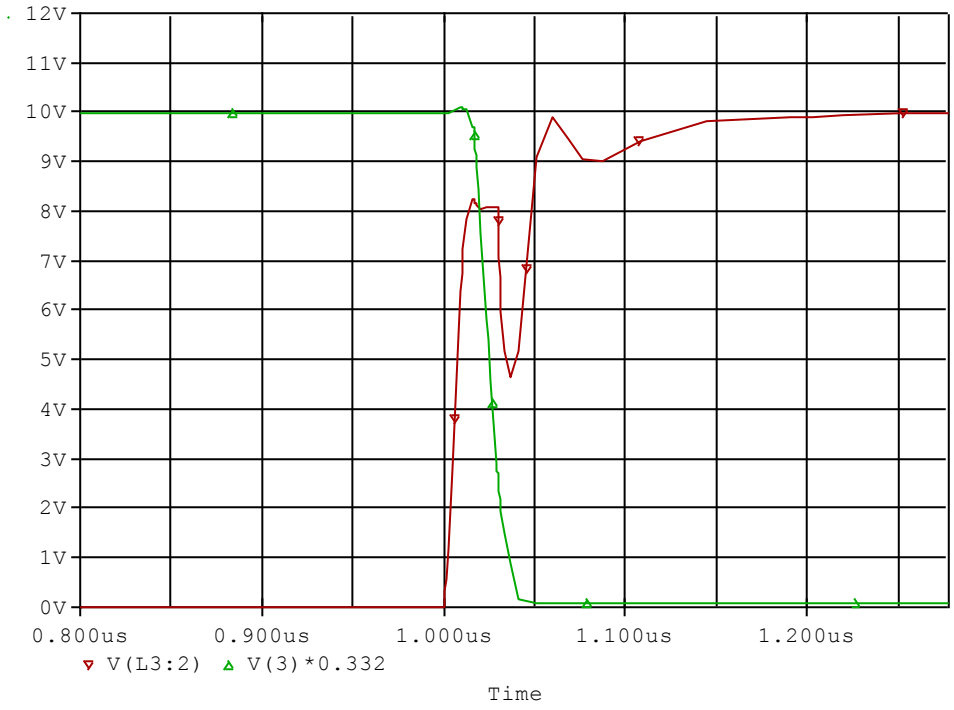


Simulation Result

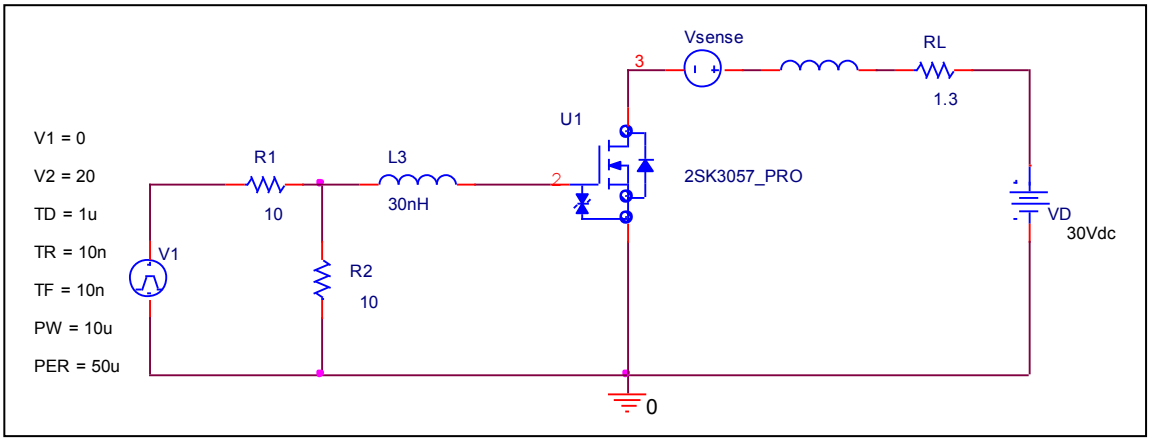
V_{DS}(V)	Cbd(pF)		Error(%)
	Measurement	Simulation	
0.1	0.97500	0.97900	0.410
0.2	0.94500	0.94800	0.317
0.5	0.88000	0.87000	-1.136
1	0.78000	0.77200	-1.026
2	0.63000	0.64000	1.587
5	0.45000	0.45200	0.444
10	0.33000	0.32800	-0.606
20	0.23000	0.23000	0.230
60	0.13000	0.12600	-3.077

Switching Time Characteristic

Circuit Simulation result



Evaluation circuit

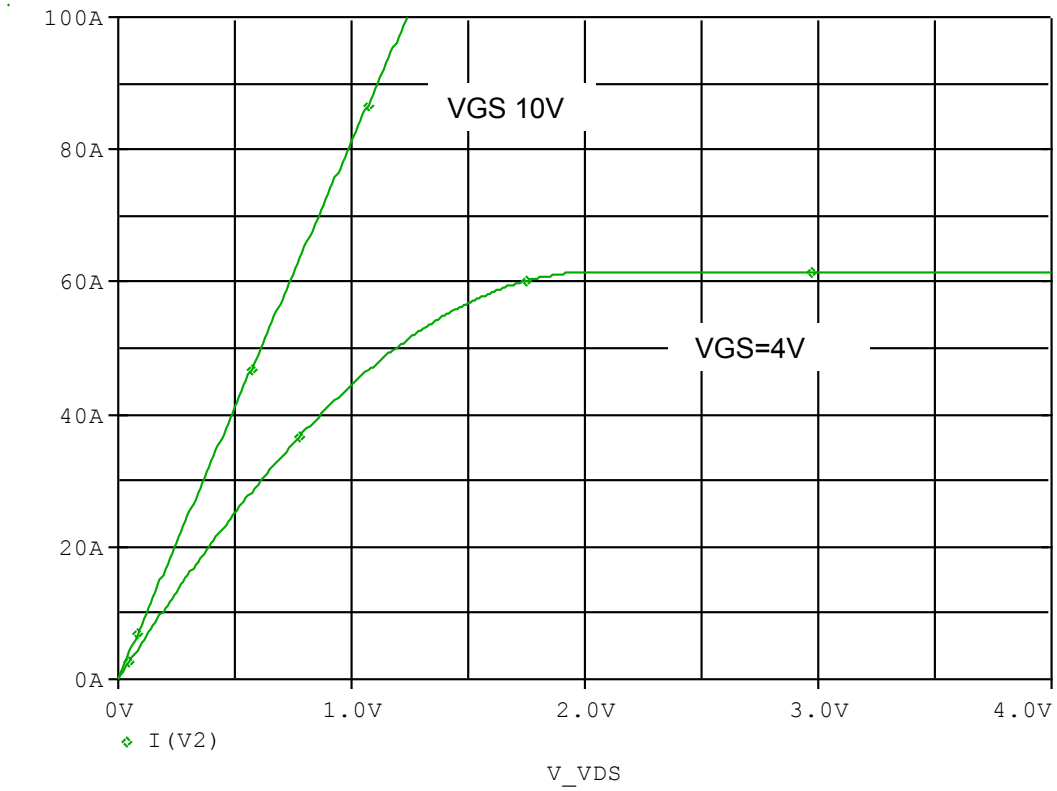


Simulation Result

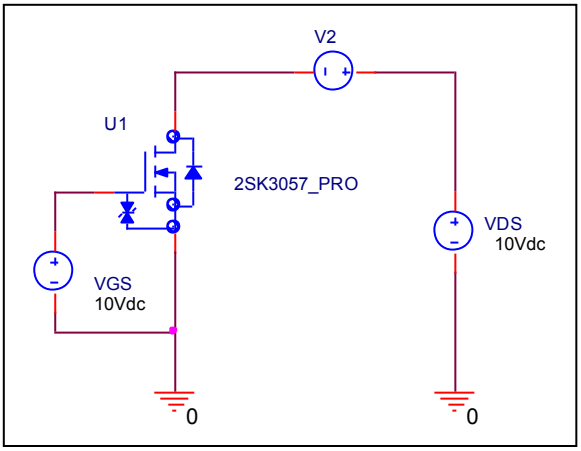
I_D=23A, V_{DD}=30V V_{GS}=0/10V	Measurement		Simulation		Error(%)
td (on)	35.000	ns	35.850	ns	-0.4166

Output Characteristic

Circuit Simulation result

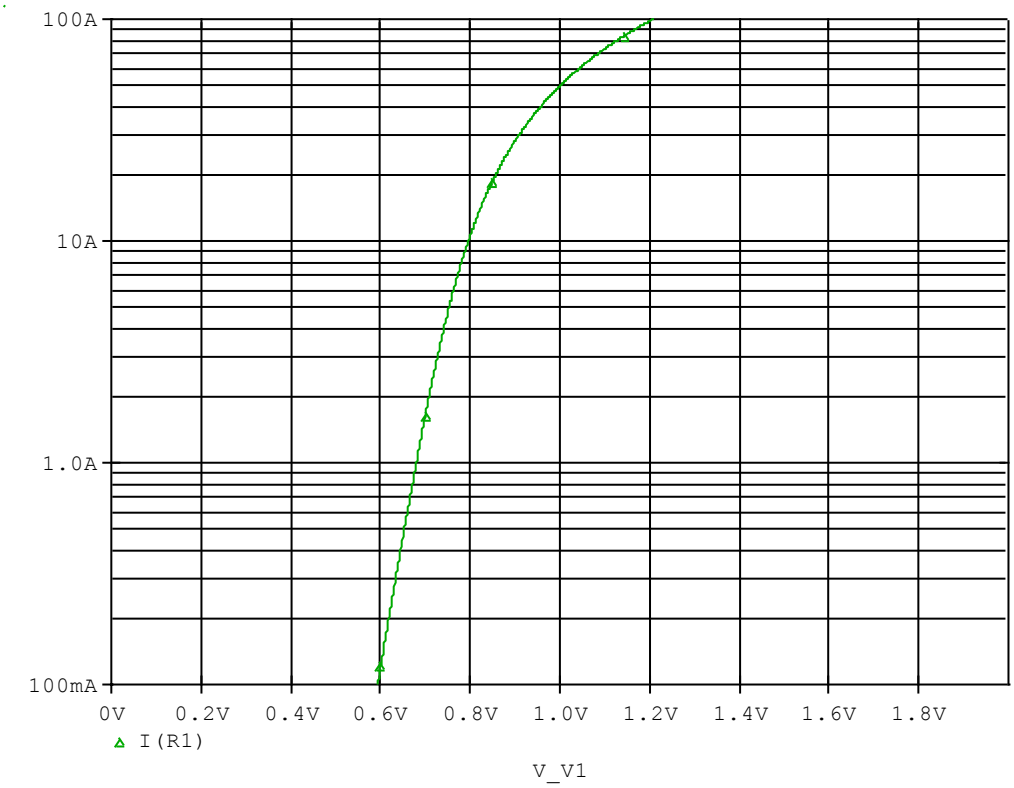


Evaluation circuit

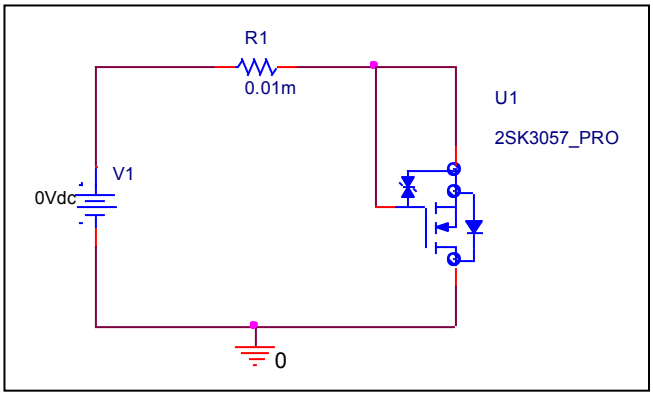


BODY DIODE SPICE MODEL
Forward Current Characteristic

Circuit Simulation Result

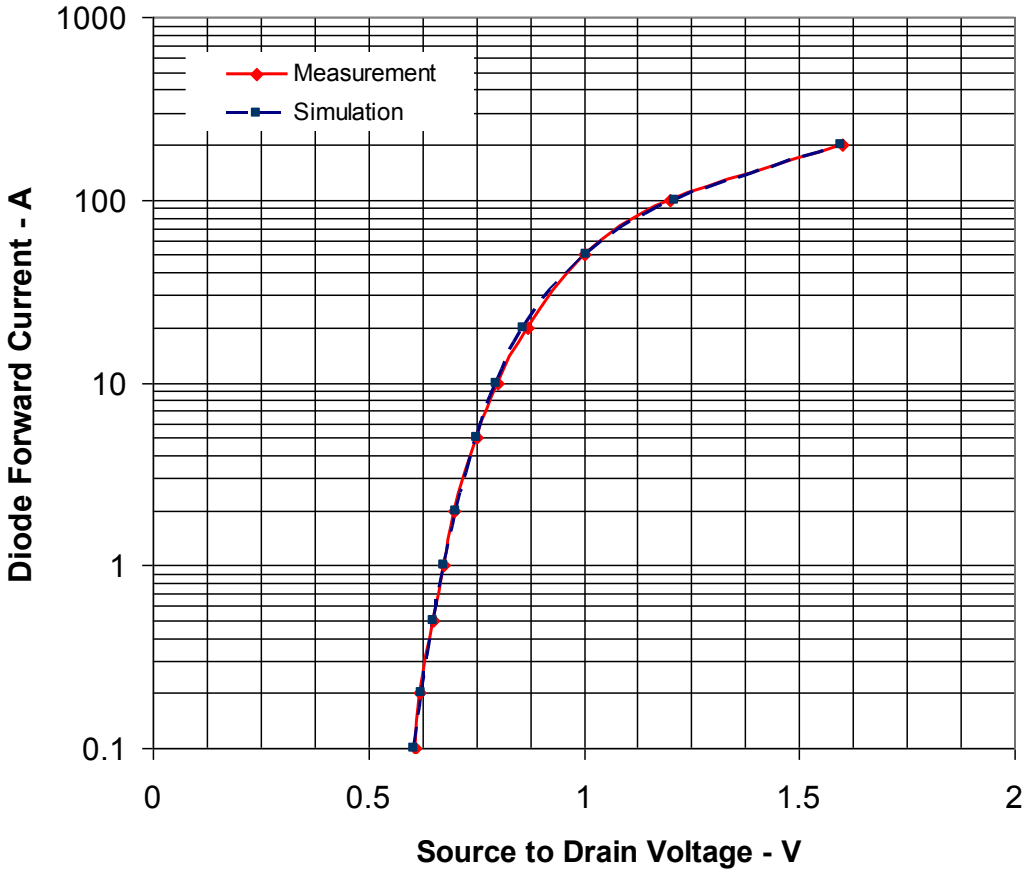


Evaluation Circuit



Comparison Graph

Circuit Simulation Result

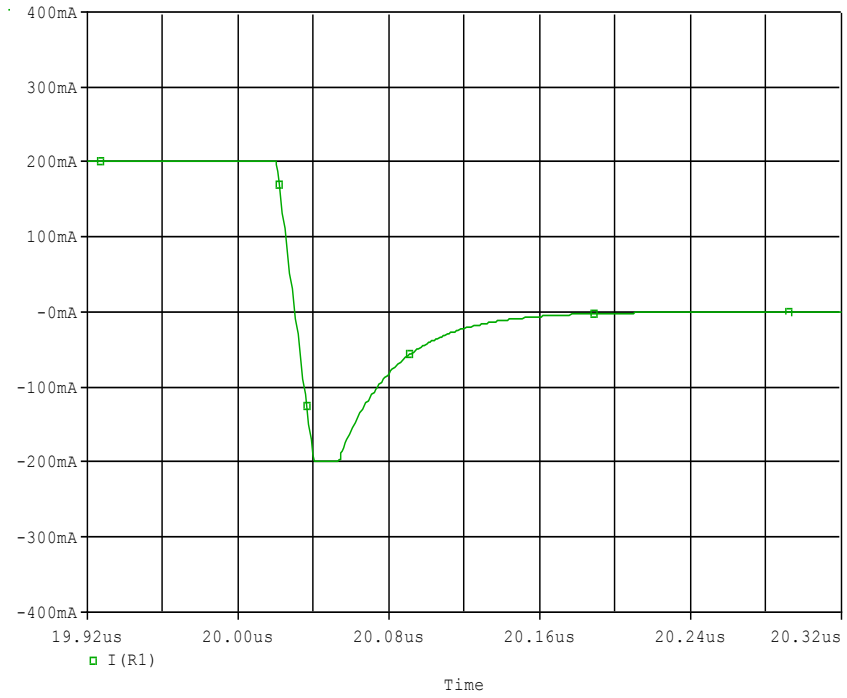


Simulation Result

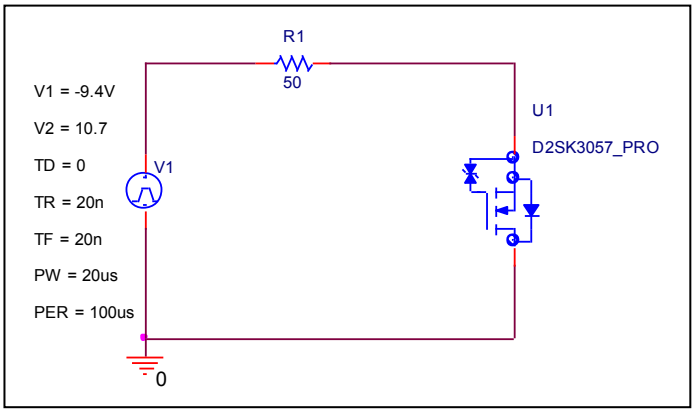
IDR(A)	VDS(V) Measurement	VDS(V) Simulation	%Error
0.1	0.6100	0.6063	-0.6066
0.2	0.6200	0.6231	0.5000
0.5	0.6500	0.6499	-0.0154
1	0.6750	0.6747	-0.0444
2	0.7000	0.7042	0.6000
5	0.7500	0.7509	0.1200
10	0.8000	0.7963	-0.4625
20	0.8700	0.8597	-1.1839
50	1.0000	1.0038	0.3800
100	1.2000	1.2108	0.9000
200	1.6000	1.5974	-0.1625

Reverse Recovery Characteristic

Circuit Simulation Result



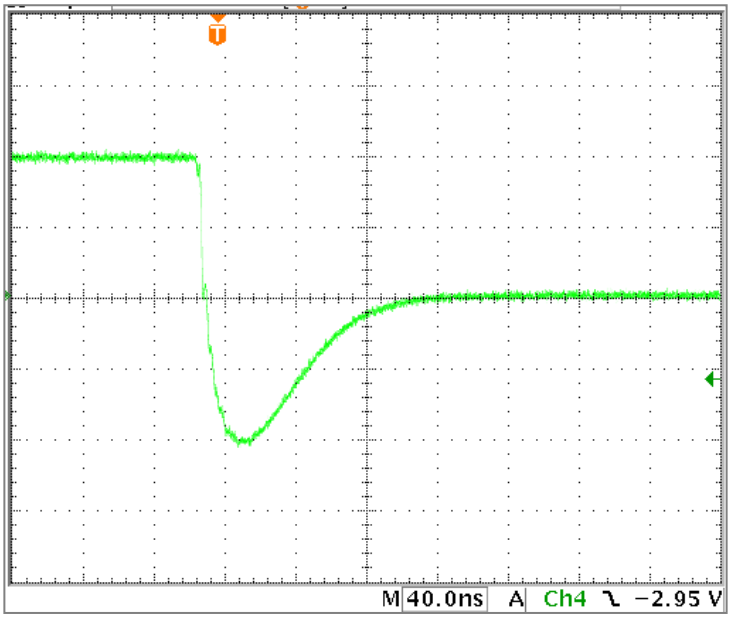
Evaluation Circuit



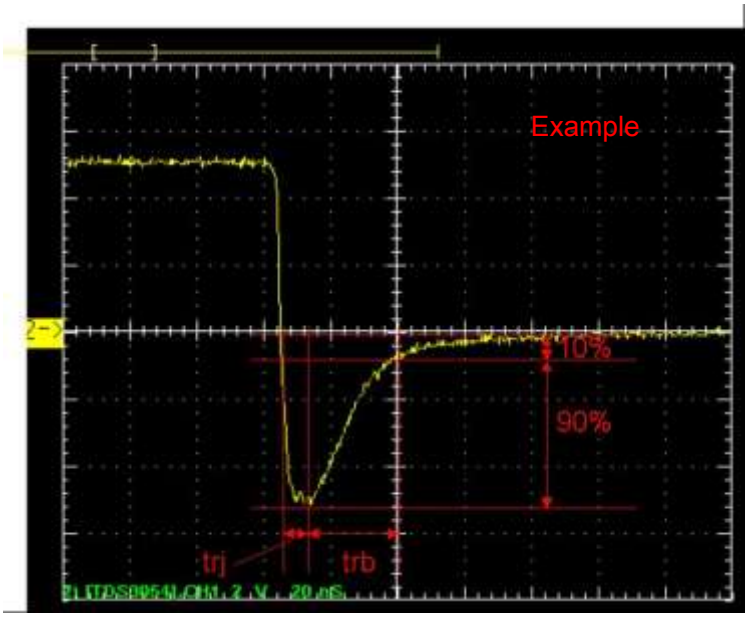
Compare Measurement vs. Simulation

	Measurement		Simulation		Error (%)
trj	**24.000**	**ns**	**23.980**	**ns**	**-0.083**
trb	**68.000**	**ns**	**68.100**	**ns**	**0.147**
trr	**92.000**	**ns**	**92.080**	**ns**	**0.087**

Reverse Recovery Characteristic Reference



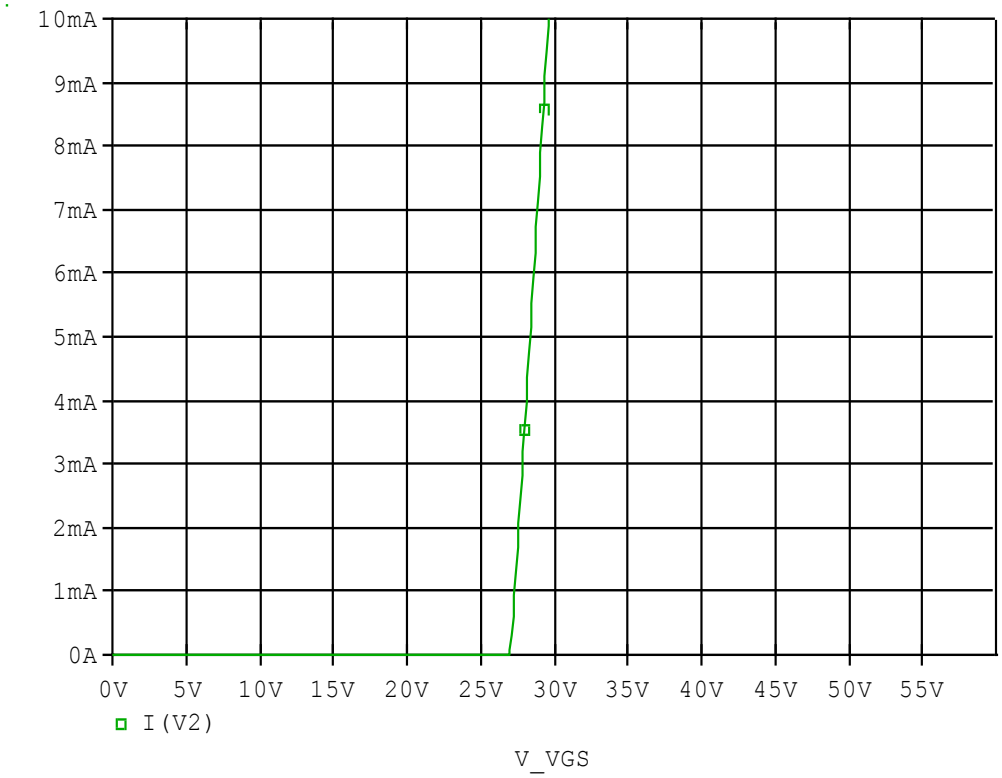
Trj=24ns)
Trb=68(ns)
Conditions:Ifwd=Irev=0.2(A),Rl=50



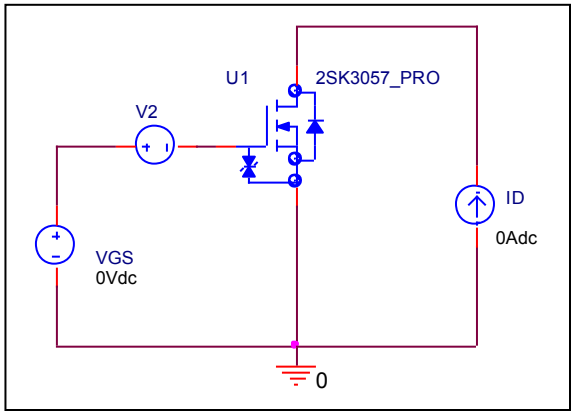
Relation between trj and trb

ESD PROTECTION DIODE SPICE MODEL
Zener Voltage Characteristic

Circuit Simulation Result



Evaluation Circuit



Zener Voltage Characteristic Reference