Device Modeling Report

COMPONENTS: MOSFET (Professional Model)
PART NUMBER: 2SK2410
MANUFACTURER: NEC Corporation
REMARK: Body Diode (Professional) /
ESD Protection Diode

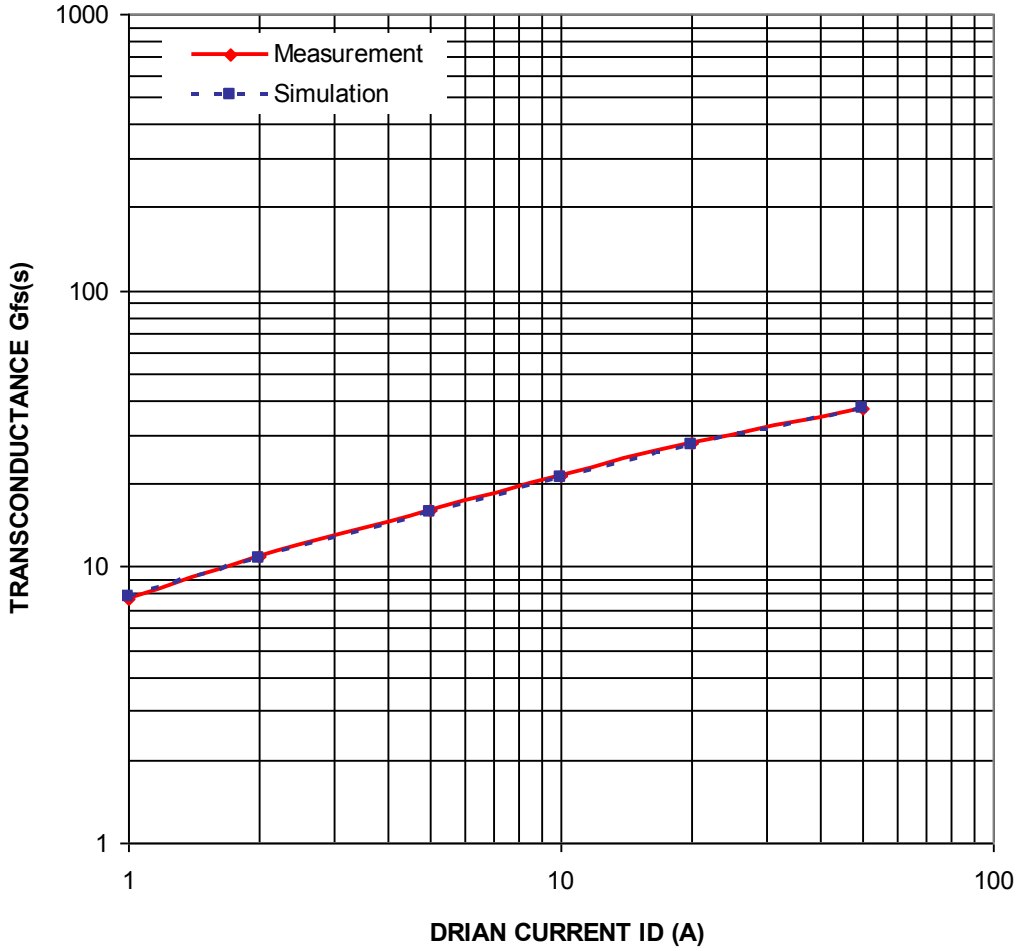
Bee Technologies Inc.

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

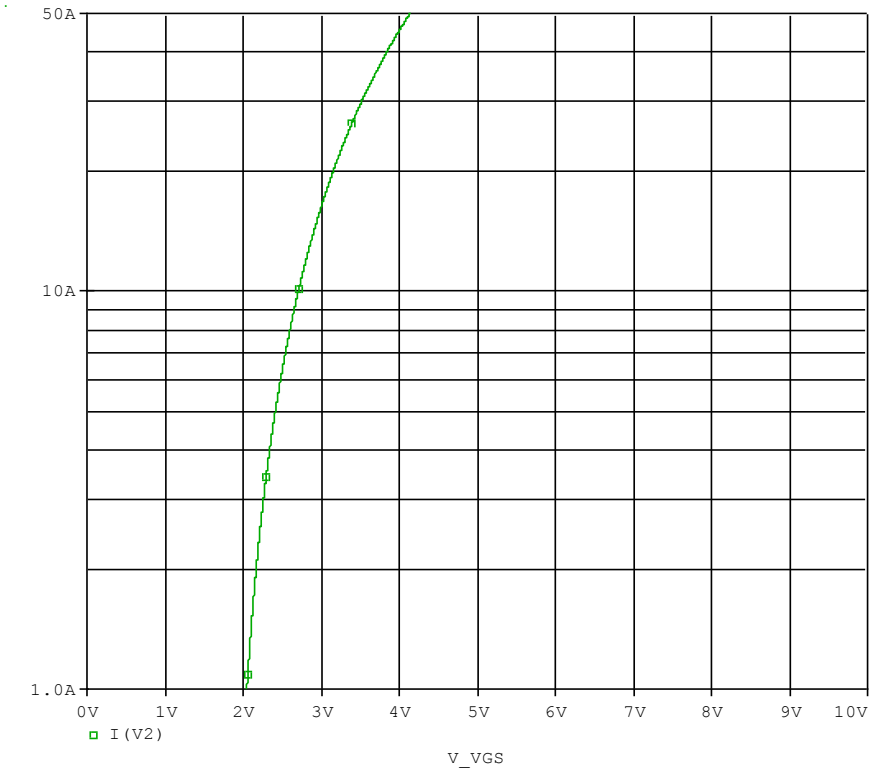


Comparison table

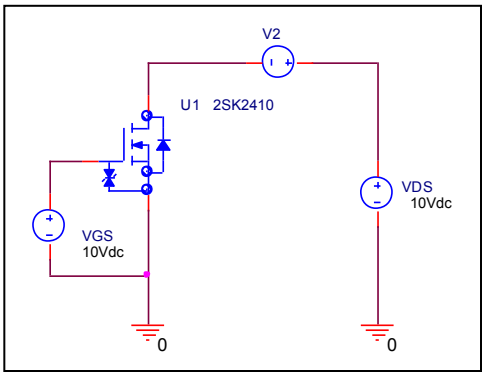
Id(A)	gfs(s)		Error(%)
	Measurement	Simulation	
1	7.7125	7.8125	1.2966
2	10.8487	10.6952	-1.4148
5	15.9856	15.8730	-0.7043
10	21.2215	21.0970	-0.5867
20	27.8542	27.4725	-1.3701
50	37.6421	37.4251	-0.5764

Vgs-Id Characteristics

Circuit Simulation Result

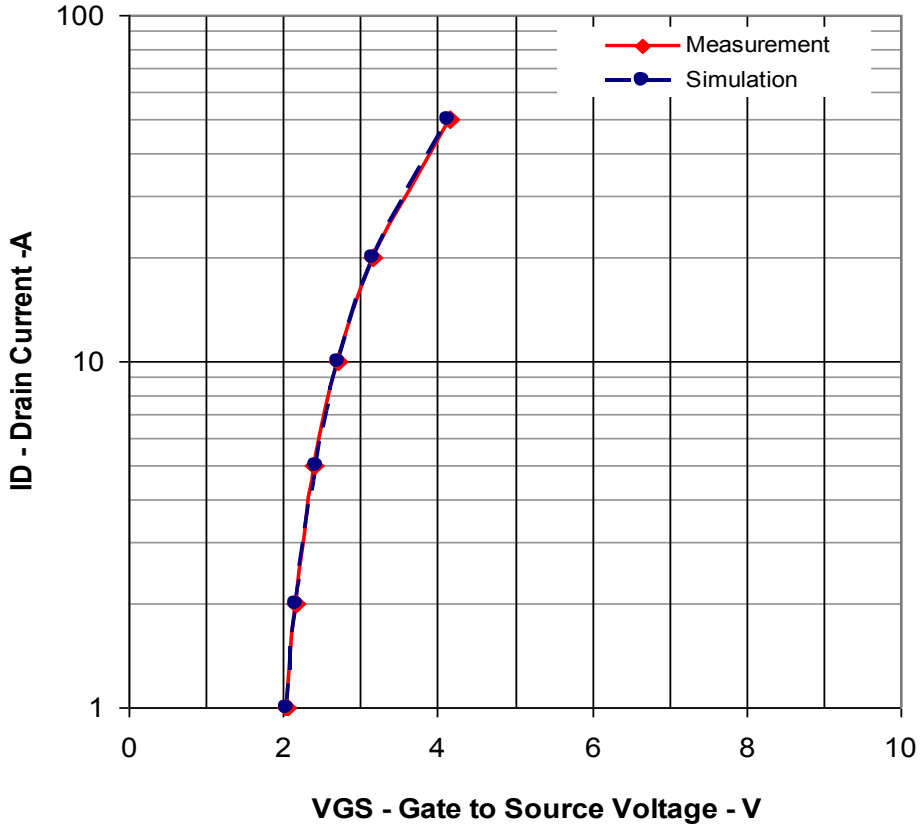


Evaluation circuit



Comparison Graph

Circuit Simulation Result

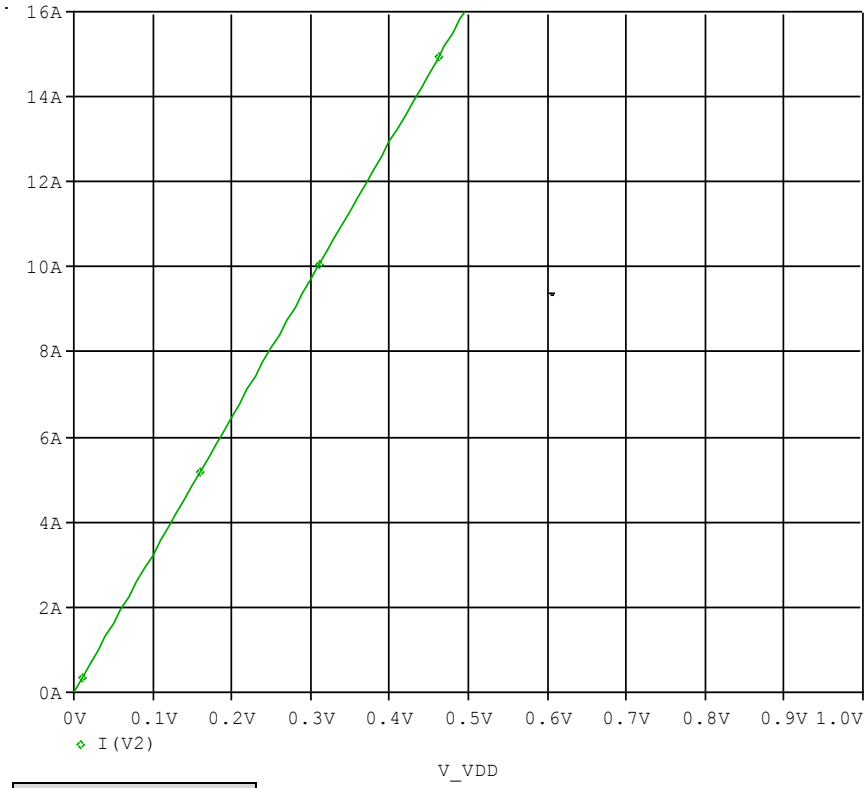


Comparison table

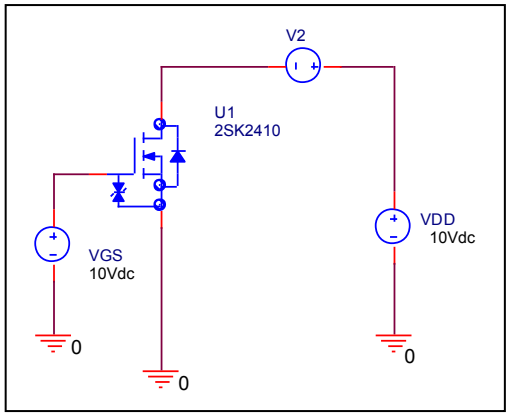
Id(A)	gfs(s)		Error(%)
	Measurement	Simulation	
1	2.0500	2.0482	-0.0878
2	2.1500	2.1672	0.8000
5	2.4000	2.4136	0.5667
10	2.7000	2.7074	0.2741
20	3.1500	3.1552	0.1651
50	4.1500	4.1372	-0.3084

*Rds(on) Characteristic

Circuit Simulation result



Evaluation circuit

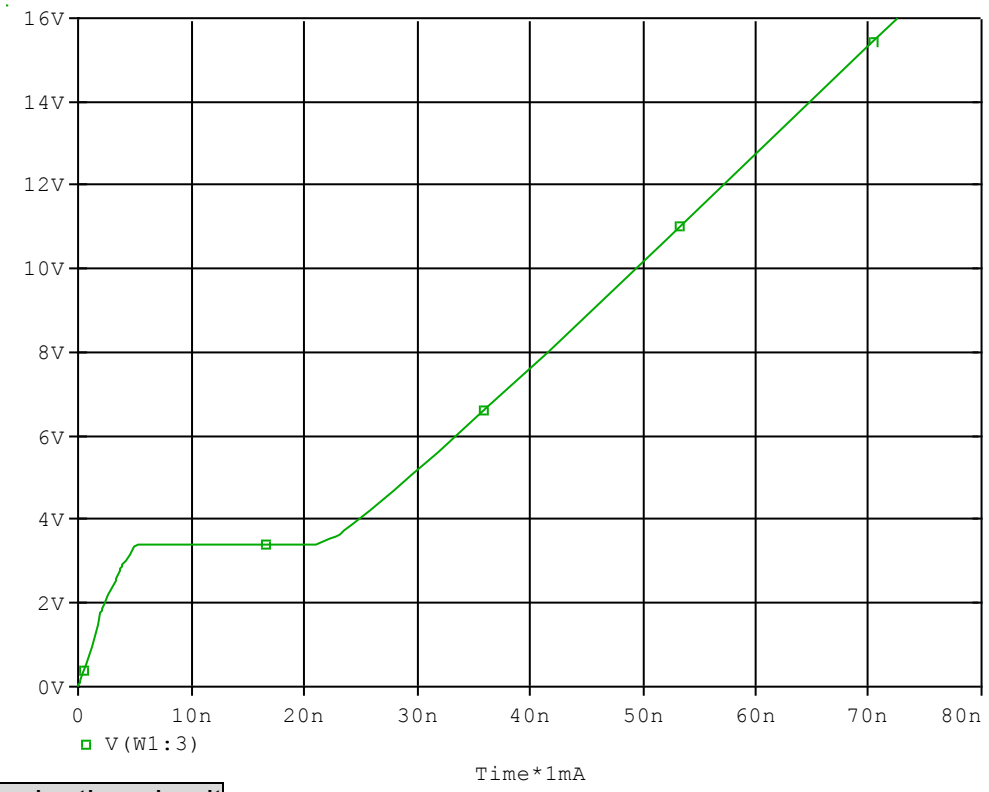


Simulation Result

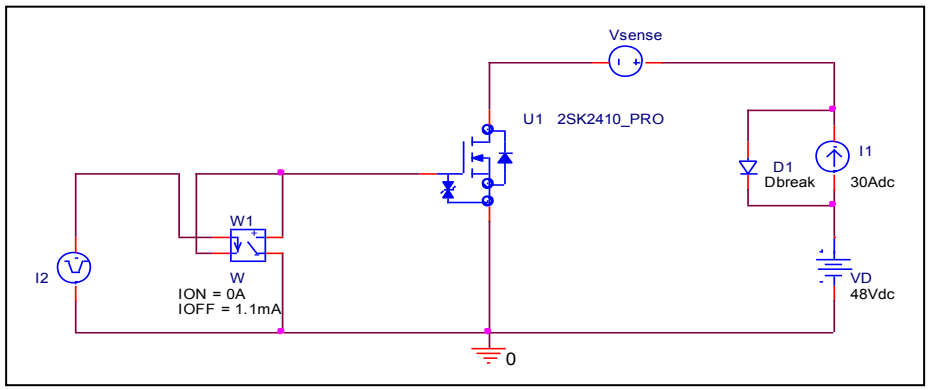
I_D=15A, V_{GS}=10V	Measurement		Simulation		Error (%)
R_{DS} (on)	31.000	mΩ	30.985	mΩ	-0.0484

Gate Charge Characteristic

Circuit Simulation result



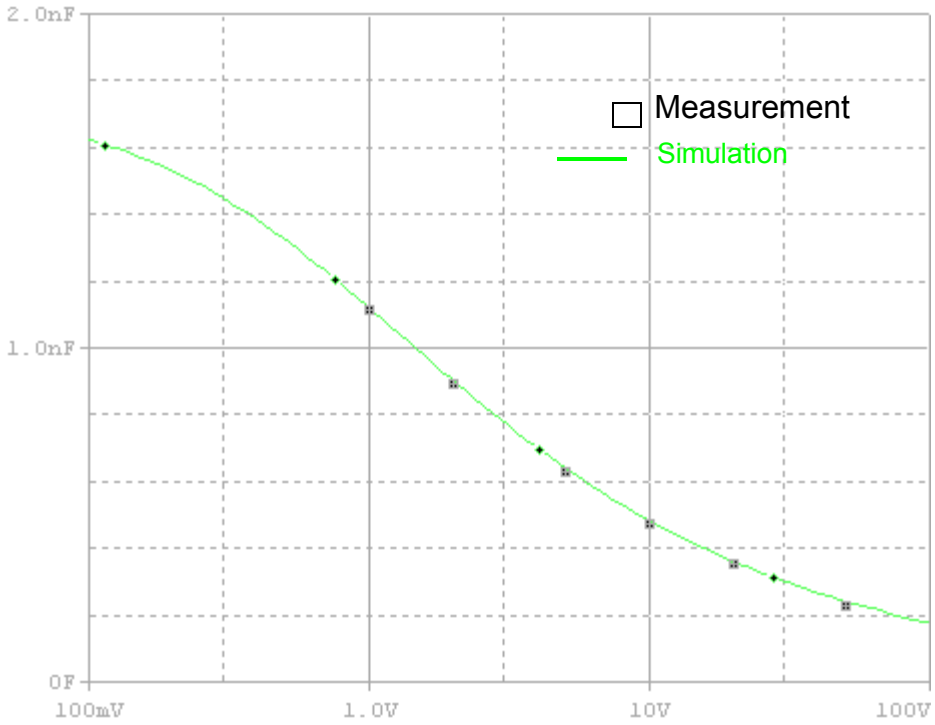
Evaluation circuit



Simulation Result

V_{DD}=48V,I_D=30A ,V_{GS}=10V	Measurement		Simulation		Error (%)
Qgs	4.800	nC	4.770	nC	-0.625
Qgd	20.000	nC	20.060	nC	0.300
QG	50.000	nC	49.320	nC	-1.360

Capacitance Characteristic

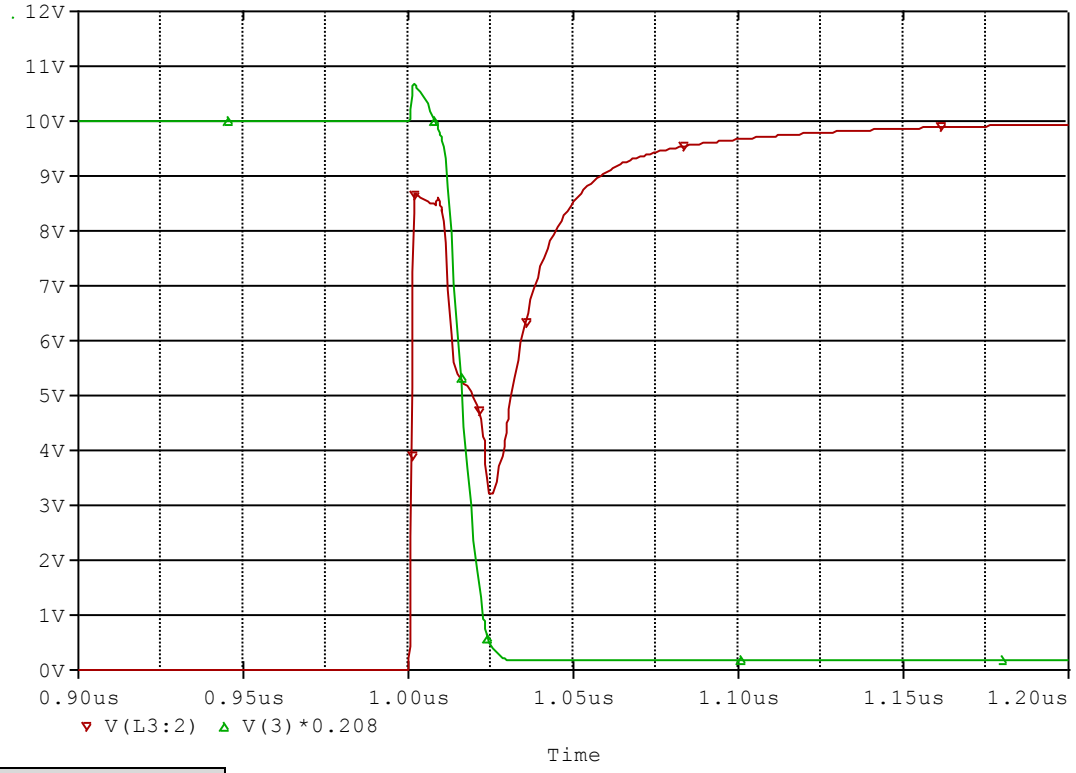


Simulation Result

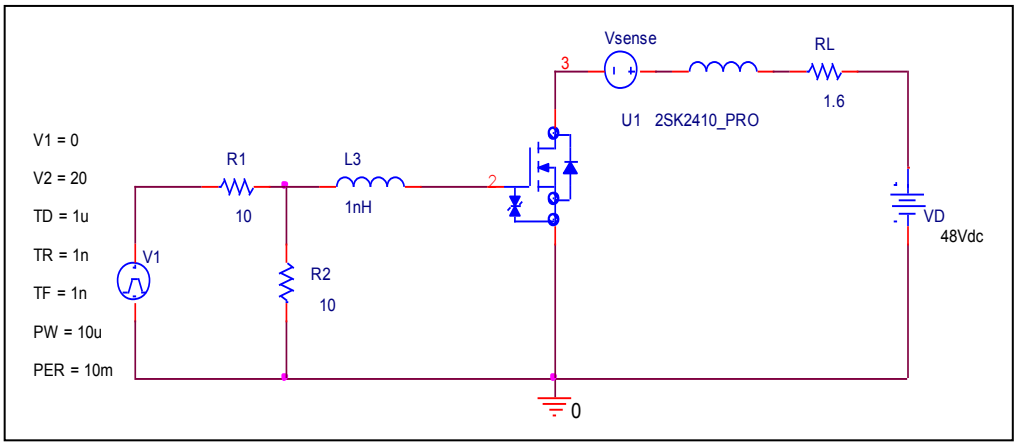
V_{DS}(V)	Cbd(pF)		Error(%)
	Measurement	Simulation	
1	1120.000	1175.000	4.911
2	900.000	922.300	2.478
5	635.000	643.800	1.386
10	480.000	483.000	0.625
20	360.000	358.610	-0.386
50	235.000	240.660	2.409

Switching Time Characteristic

Circuit Simulation result



Evaluation circuit

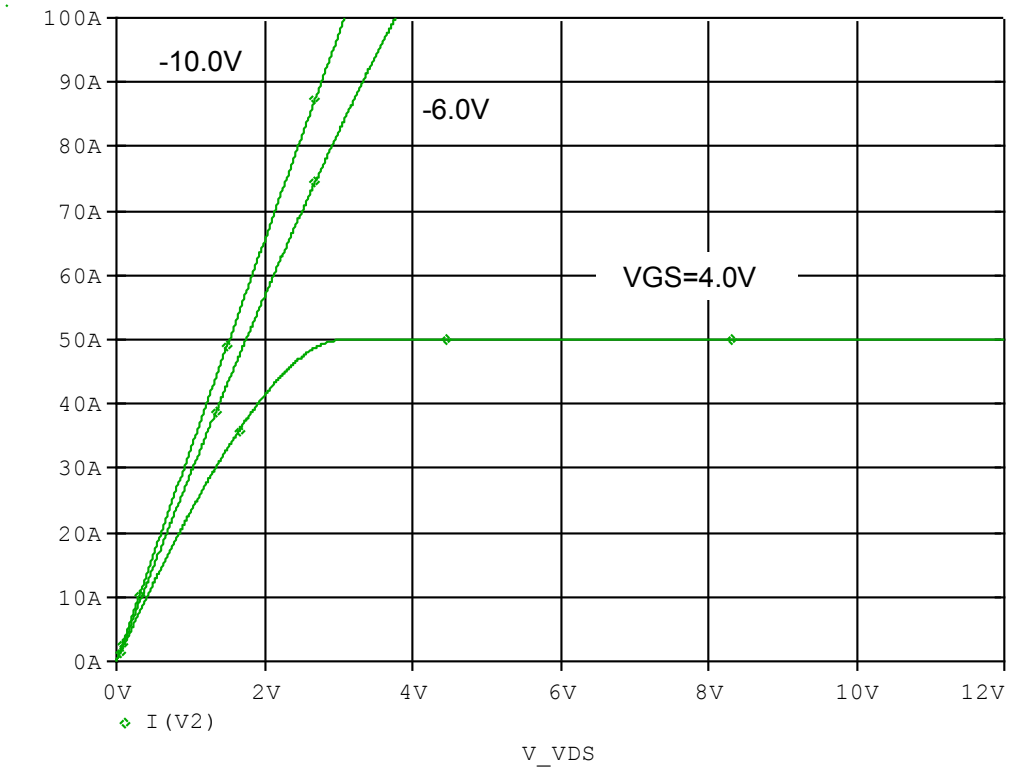


Simulation Result

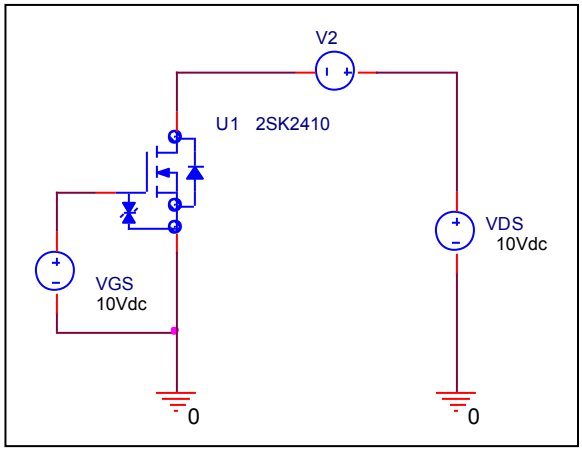
I_D=15A, V_{DD}=30V V_{GS}=0/10V	Measurement		Simulation		Error(%)
ton	22.000	ns	22.261	ns	1.186

Output Characteristic

Circuit Simulation result

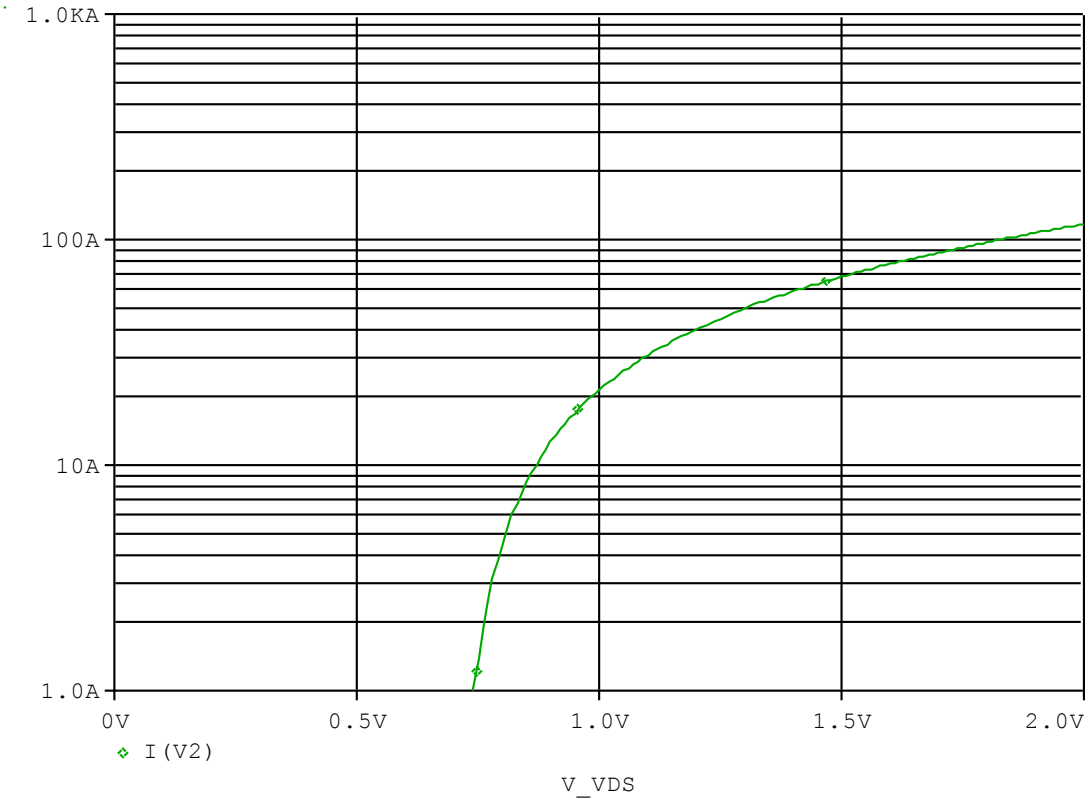


Evaluation circuit

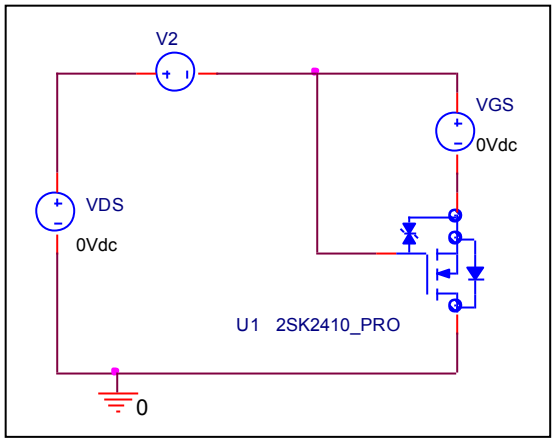


BODY DIODE SPICE MODEL
Forward Current Characteristic

Circuit Simulation Result

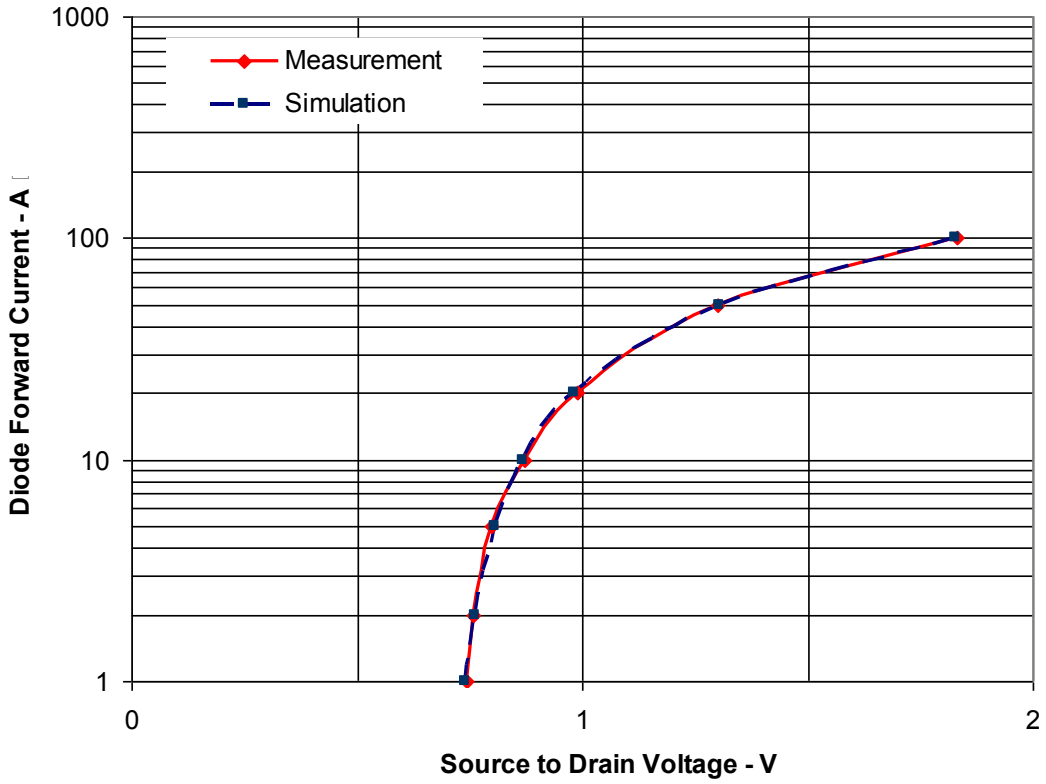


Evaluation Circuit



Comparison Graph

Circuit Simulation Result

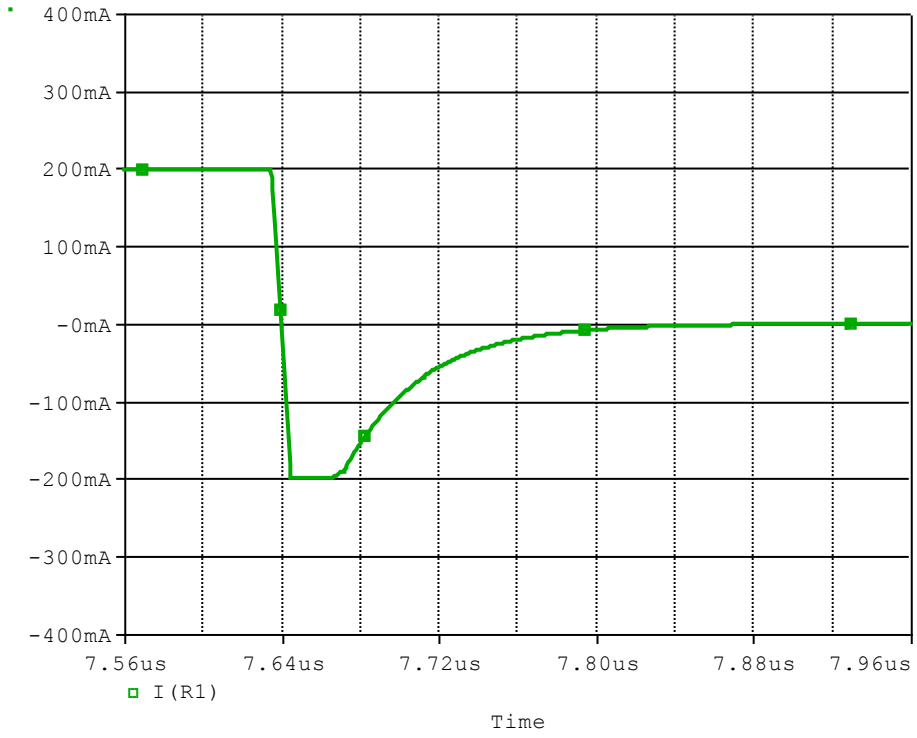


Simulation Result

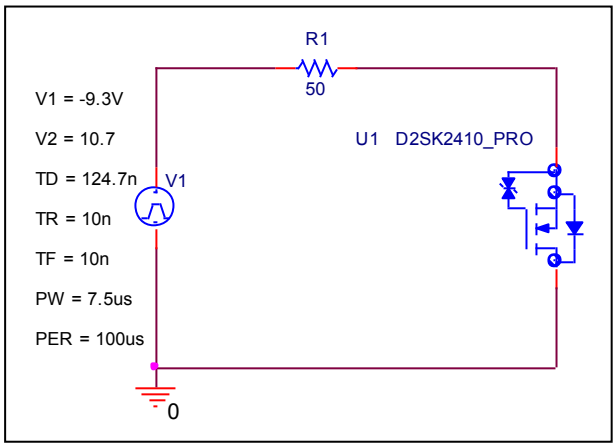
ISD(A)	VDS(V)		%Error
	Measurement	Simulation	
1	0.7450	0.7404	-0.6174
2	0.7600	0.7616	0.2105
5	0.8000	0.8069	0.8625
10	0.8700	0.8692	-0.0920
20	0.9900	0.9828	-0.7273
50	1.3000	1.3050	0.3846
100	1.8300	1.8284	-0.0874

Reverse Recovery Characteristic

Circuit Simulation Result



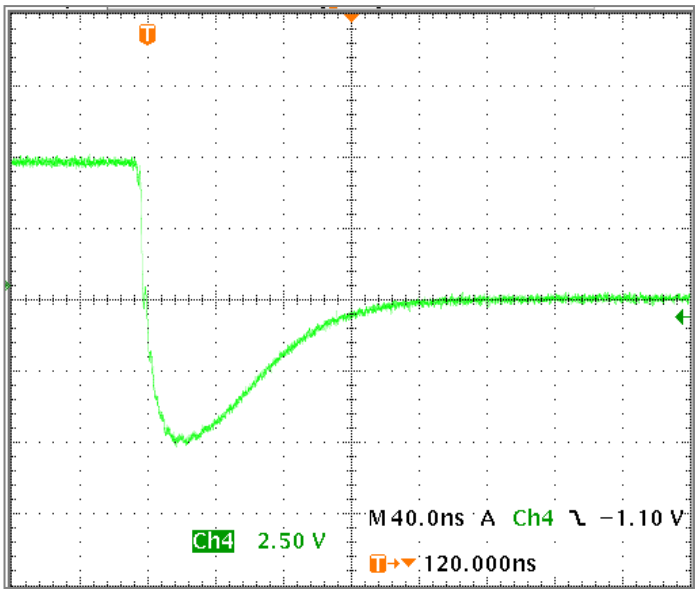
Evaluation Circuit



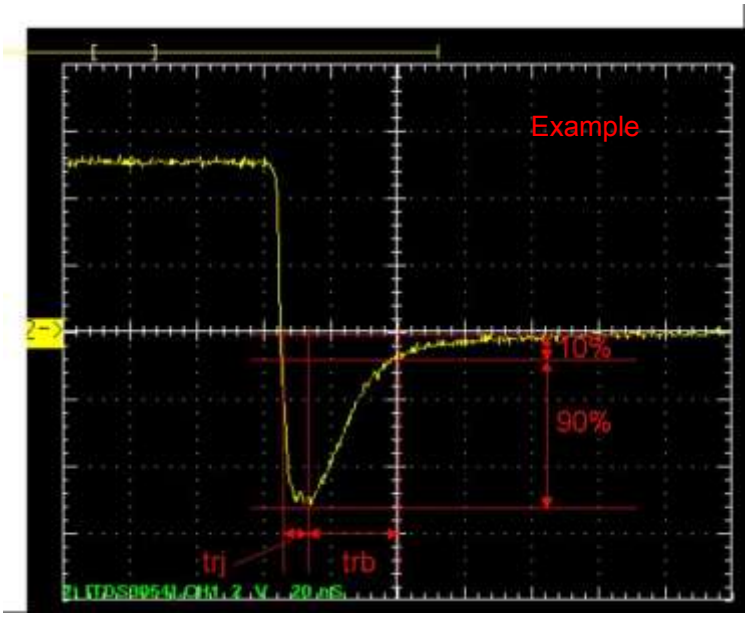
Compare Measurement vs. Simulation

	Measurement		Simulation		Error (%)
trj	**32.000**	**ns**	**31.999**	**ns**	**-0.003**
trb	**88.000**	**ns**	**88.120**	**ns**	**0.136**
trr	**120.000**	**ns**	**119.395**	**ns**	**-0.504**

Reverse Recovery Characteristic Reference



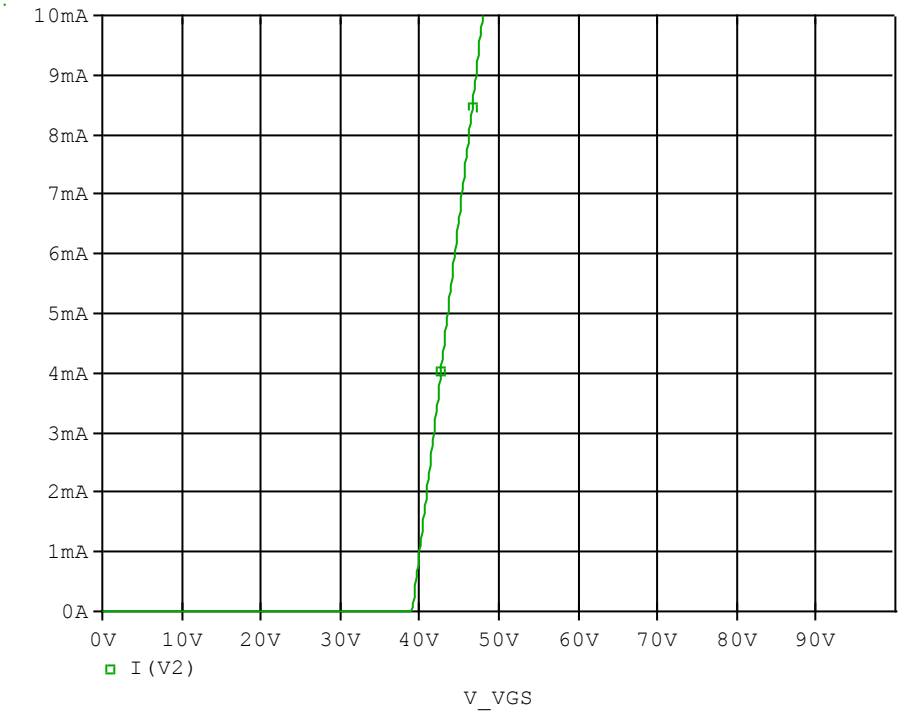
Trj=32(ns)
Trb=88(ns)
Conditions:Ifwd=Irev=0.2(A),Rl=50



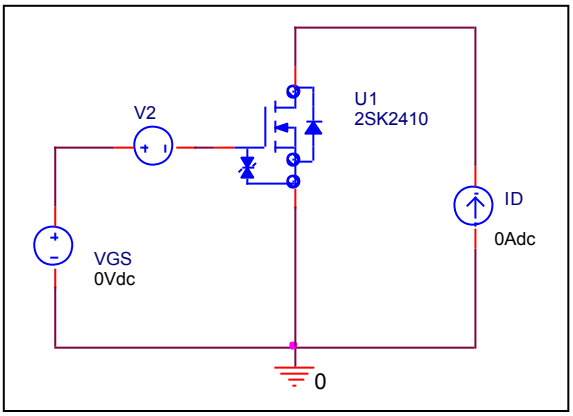
Relation between trj and trb

ESD PROTECTION DIODE SPICE MODEL
Zener Voltage Characteristic

Circuit Simulation Result



Evaluation Circuit



Zener Voltage Characteristic Reference