Device Modeling Report

COMPONENTS: Power MOSFET (Professional)
PART NUMBER: 2SK3844
MANUFACTURER: TOSHIBA
Body Diode (Professional) / ESD Protection Diode

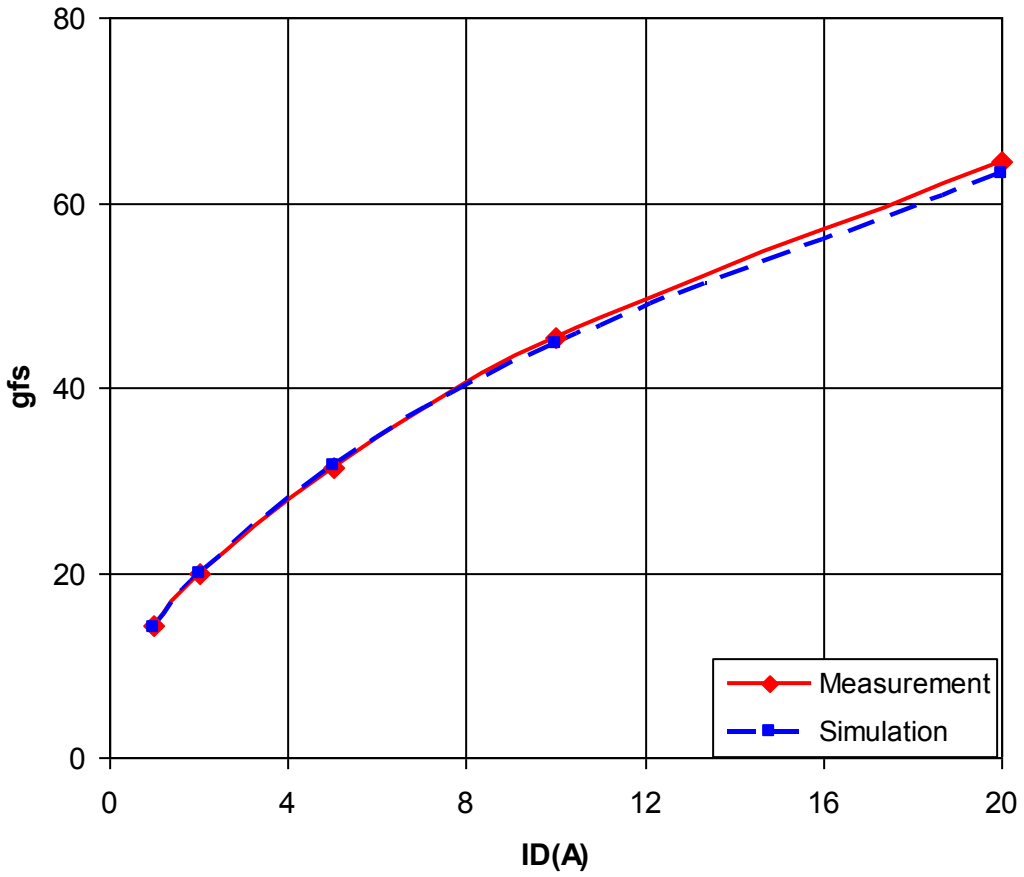
Bee Technologies Inc.

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

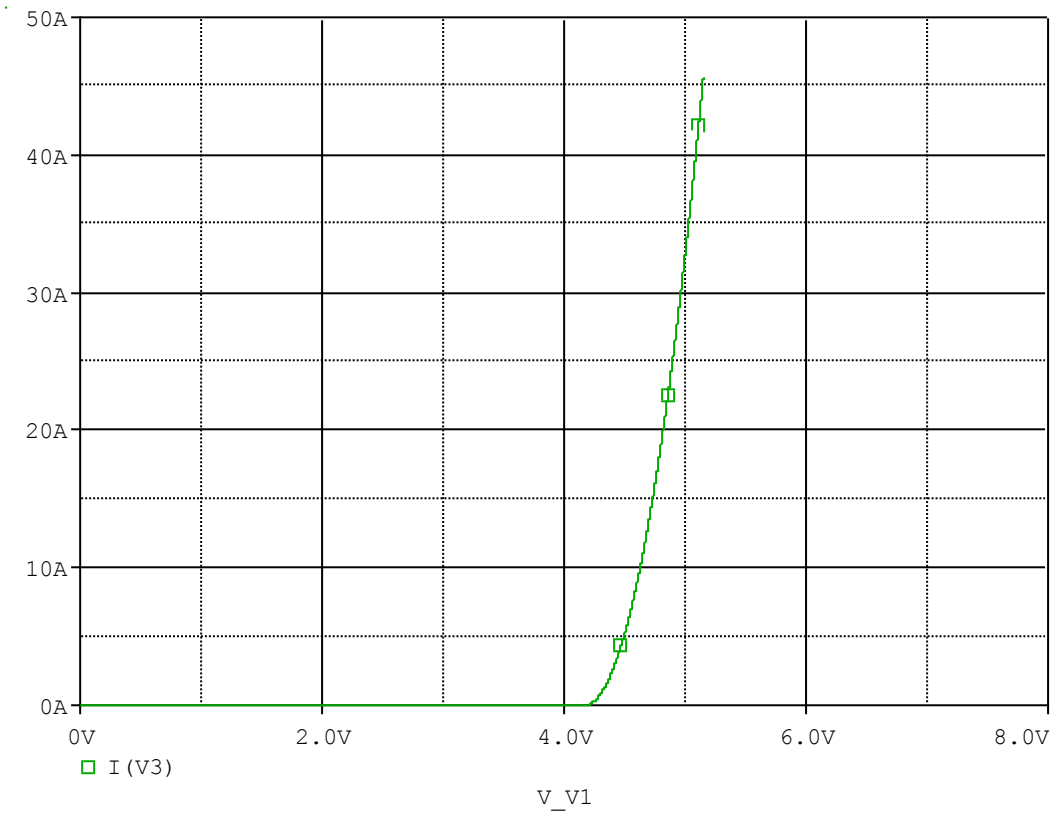


Comparison table

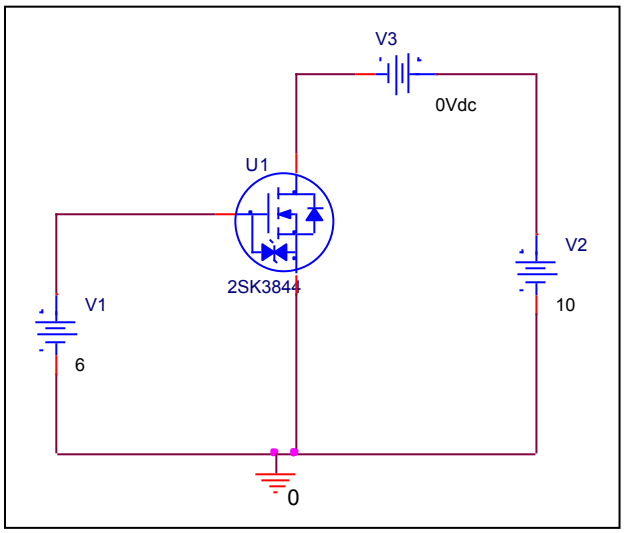
Id(A)	gfs		Error (%)
	Measurement	Simulation	
1	14.286	14.085	-1.407
2	20.000	20.000	0.000
5	31.250	31.646	1.267
10	45.455	44.843	-1.346
20	64.516	63.091	-2.209

Vgs-Id Characteristic

Circuit Simulation result

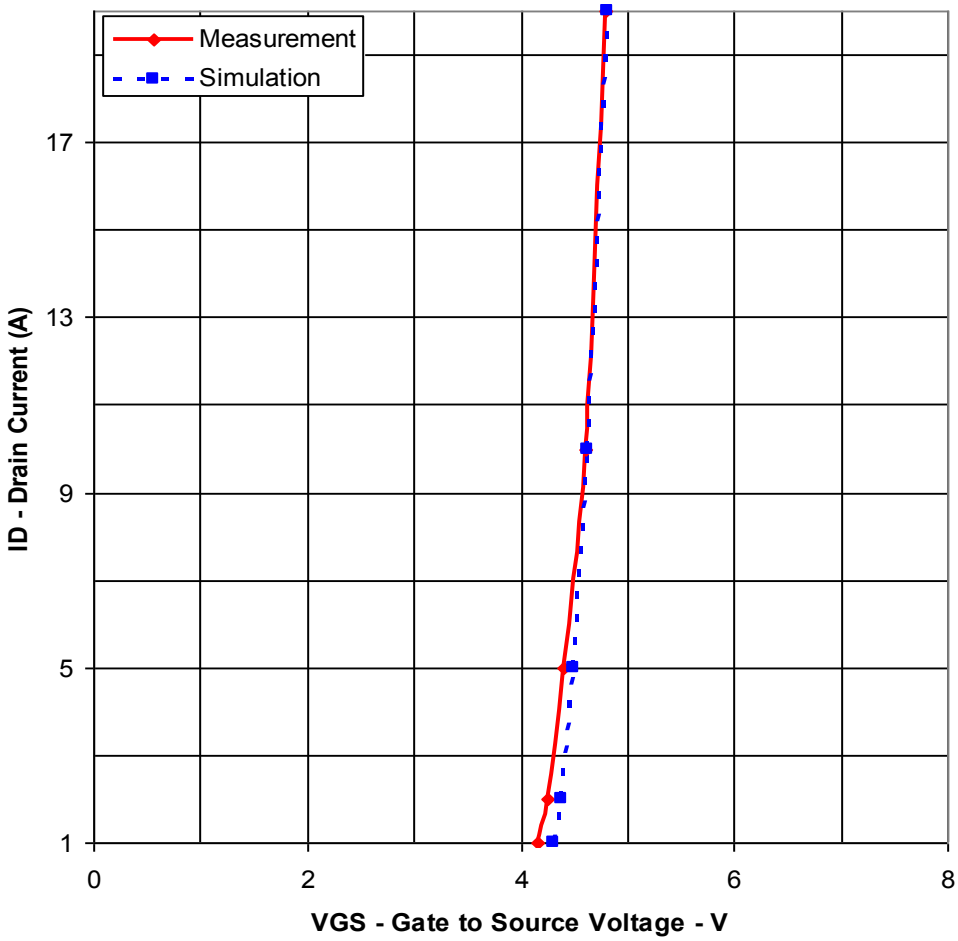


Evaluation circuit



Comparison Graph

Circuit Simulation Result

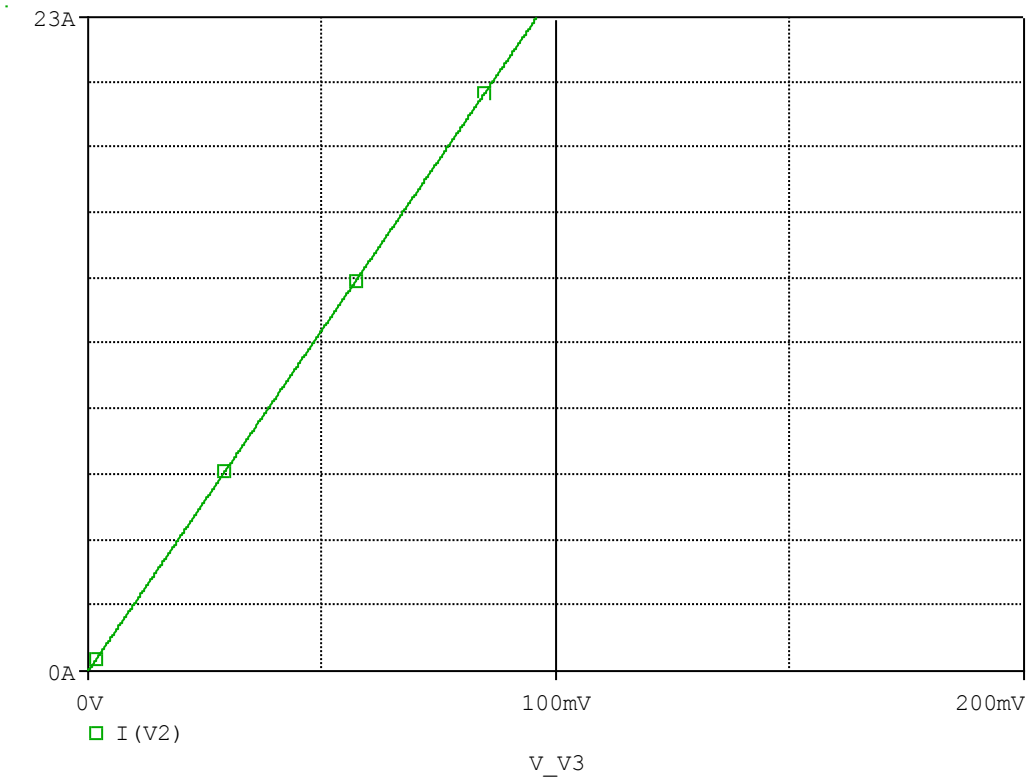


Simulation Result

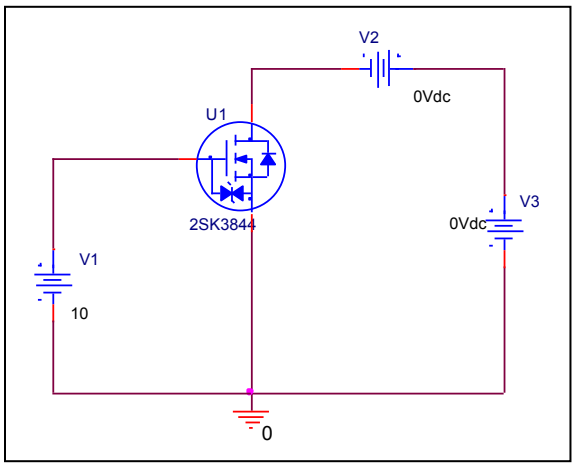
I_D(A)	V_{GS}(V)		Error (%)
	Measurement	Simulation	
1	4.15	4.315	3.976
2	4.25	4.3751	2.944
5	4.4	4.4944	2.145
10	4.6	4.6288	0.626
20	4.8	4.8188	0.392

Rds(on) Characteristic

Circuit Simulation result



Evaluation circuit

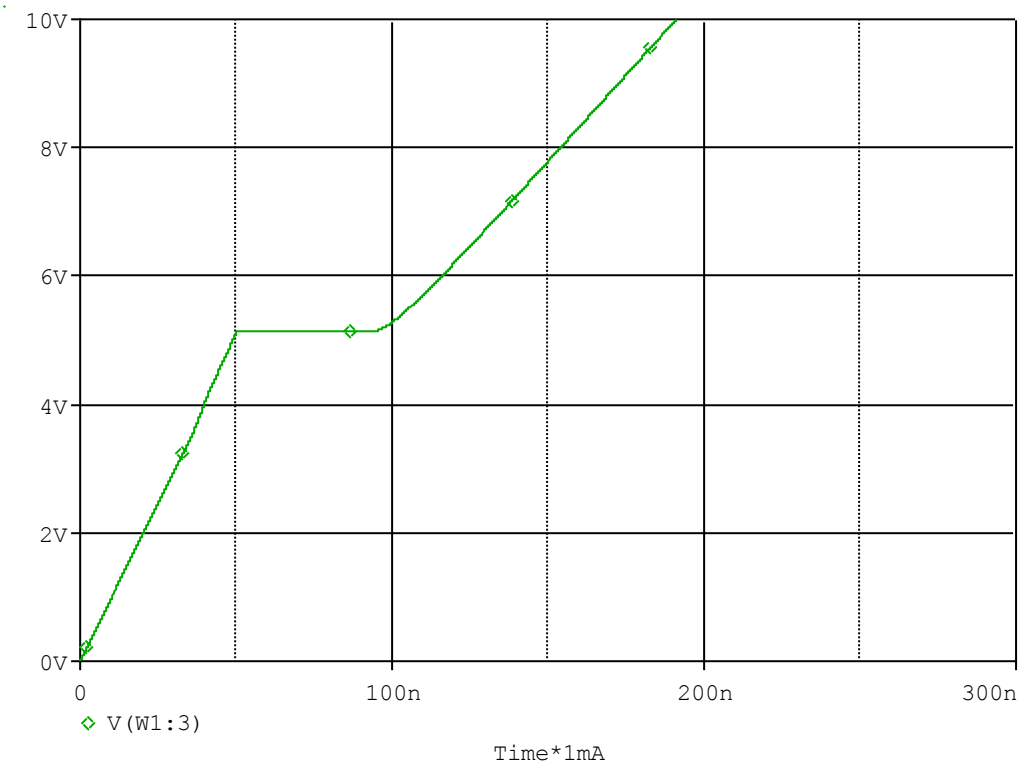


Simulation Result

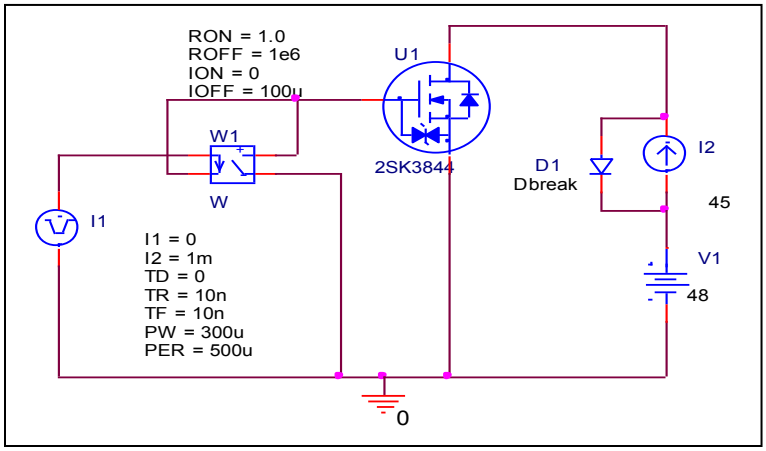
I_D=23A, V_{GS}=10V	Measurement		Simulation		Error (%)
R_{DS} (on)	4.1	mΩ	4.171	mΩ	1.732

Gate Charge Characteristic

Circuit Simulation result



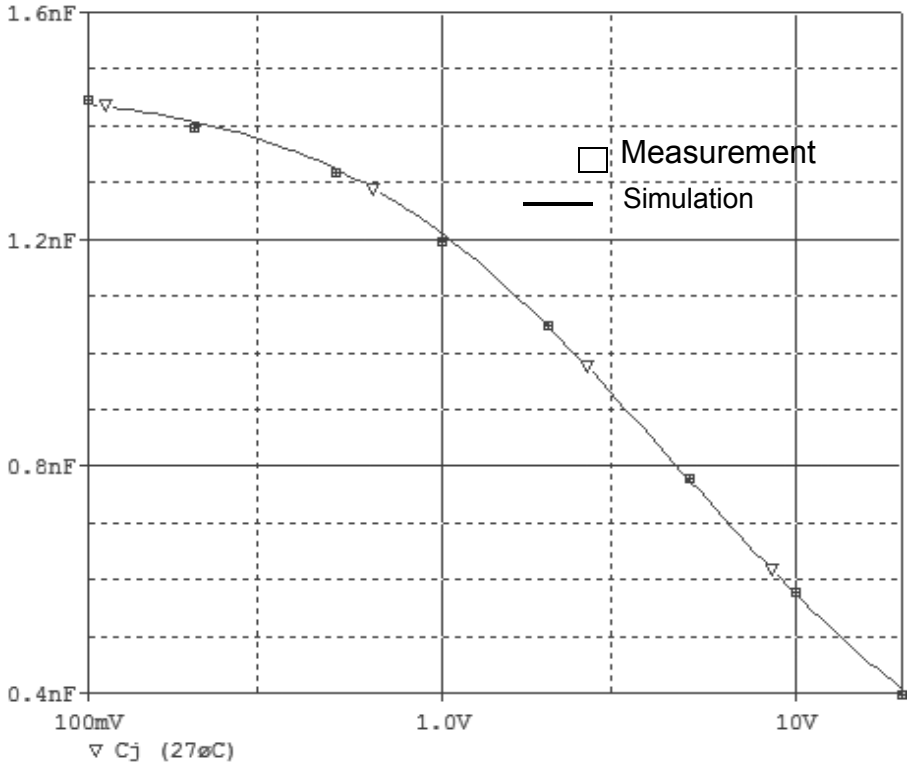
Evaluation circuit



Simulation Result

V_{DD}=48V,I_D=45A	Measurement		Simulation		Error (%)
Qgs	50	nC	50.368	nC	0.736
Qgd	45	nC	44.564	nC	-0.969
Qg	190	nC	191.119	nC	0.589

Capacitance Characteristic

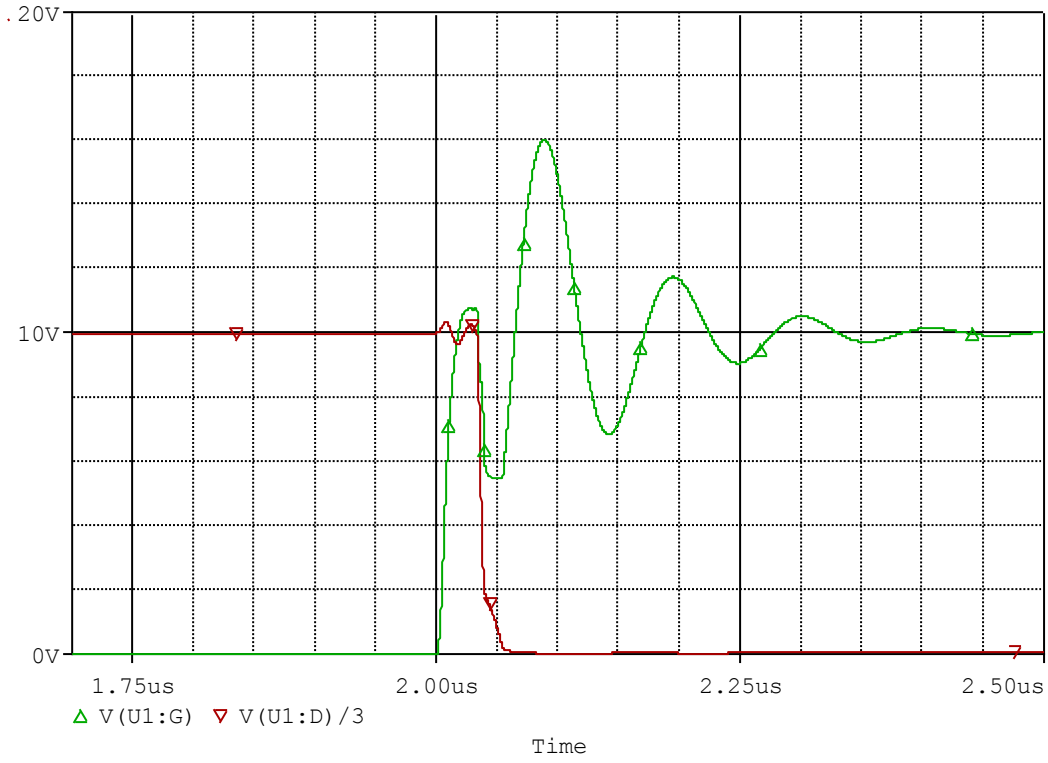


Simulation Result

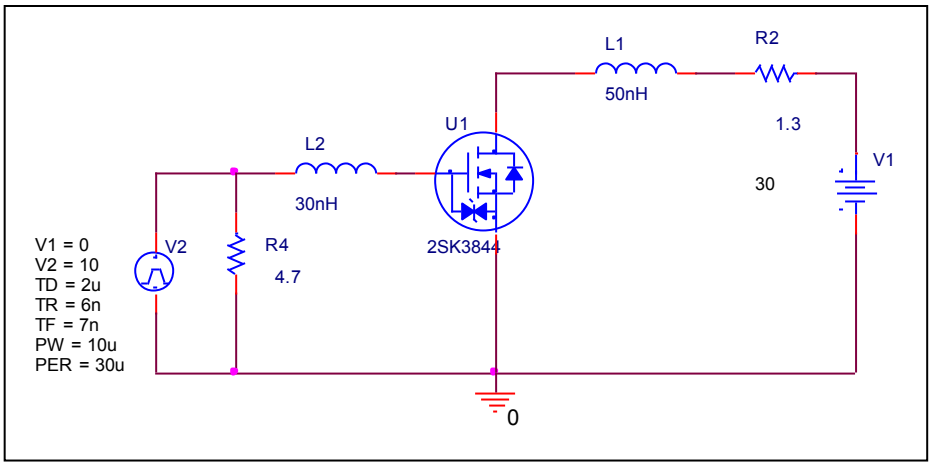
V_{DS}(V)	Cbd(pF)		Error(%)
	Measurement	Simulation	
0.1	1450	1440	-0.690
0.2	1400	1405	0.357
0.5	1320	1323	0.227
1	1200	1220	1.667
2	1050	1045	-0.476
5	780	785	0.641
10	580	575	-0.862
20	400	410	2.500

Switching Time Characteristic

Circuit Simulation result



Evaluation circuit

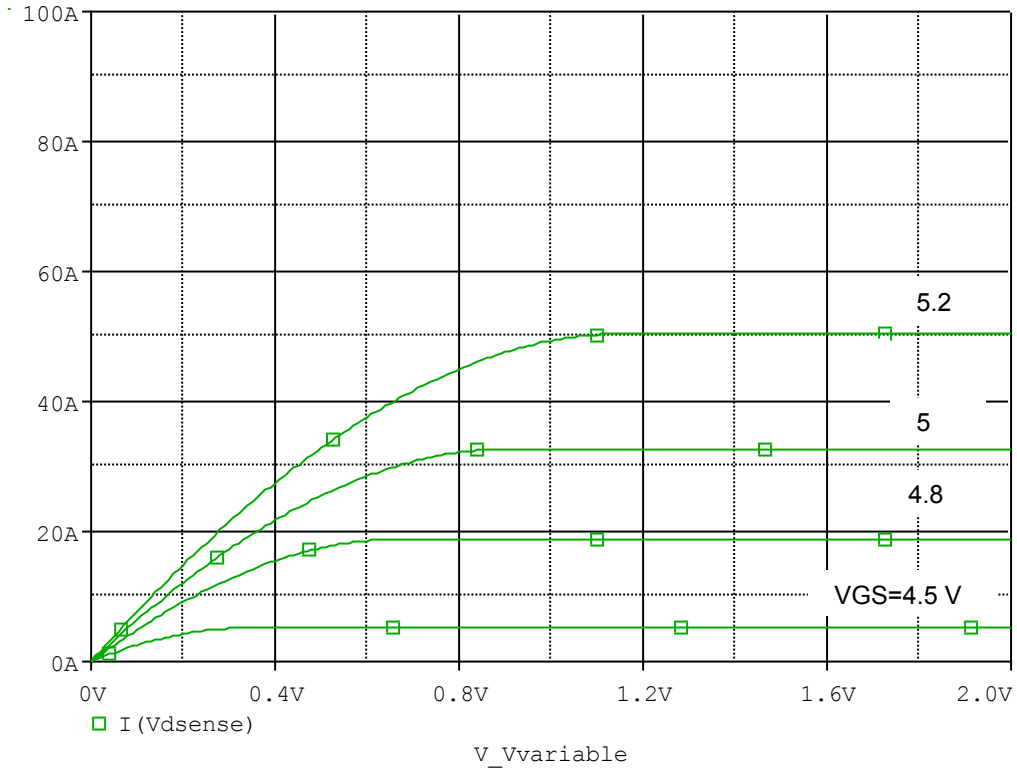


Simulation Result

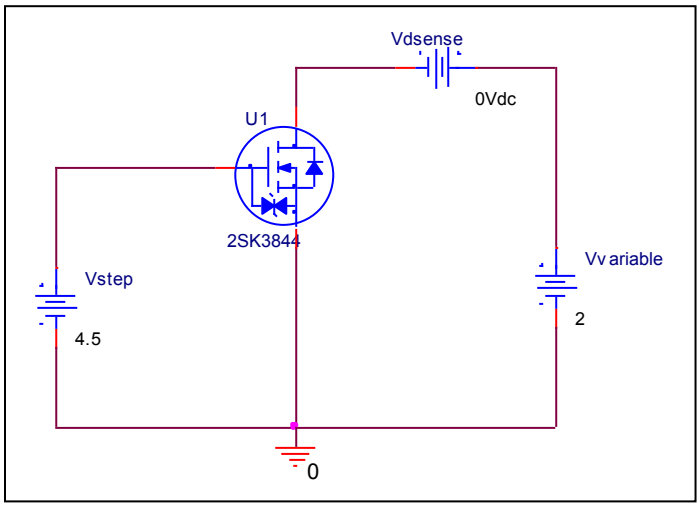
I_D=23 A, V_{DD}=30V V_{GS}=0/10V	Measurement		Simulation		Error(%)
ton	45.000	ns	45.384	ns	0.853

Output Characteristic

Circuit Simulation result

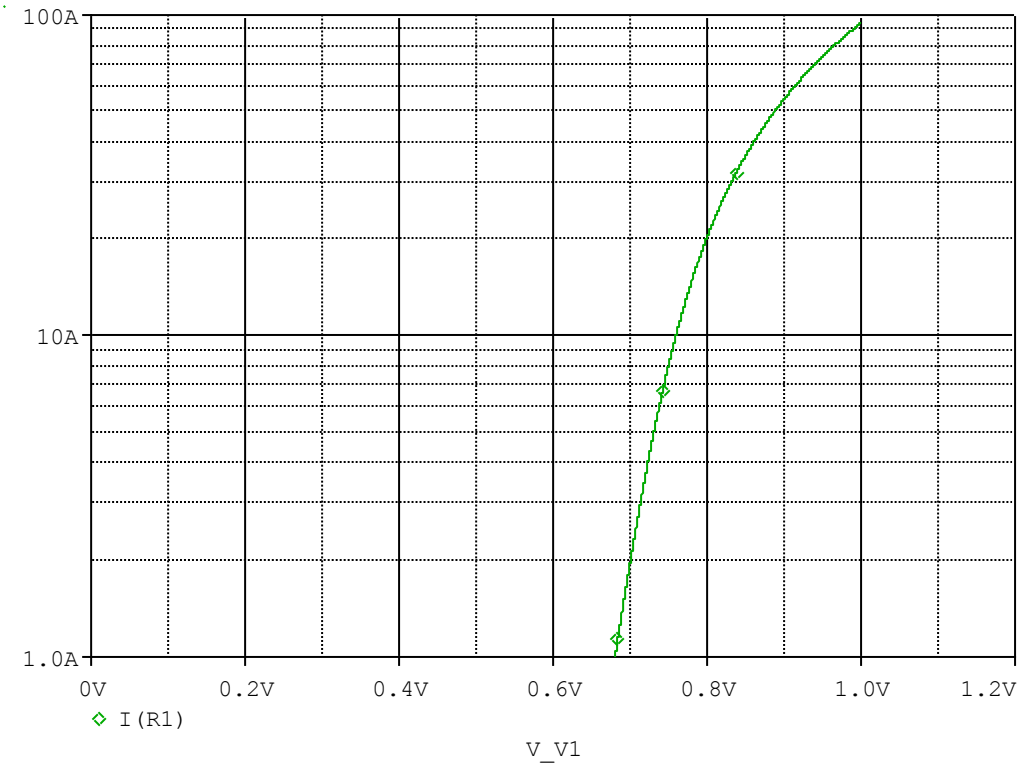


Evaluation circuit

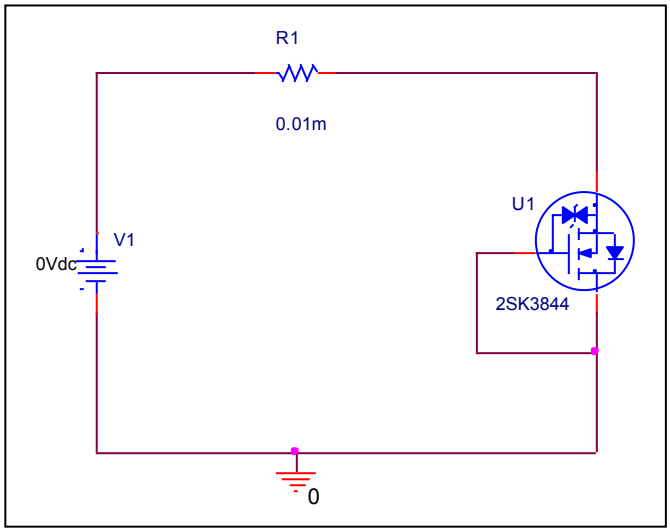


Forward Current Characteristic

Circuit Simulation Result

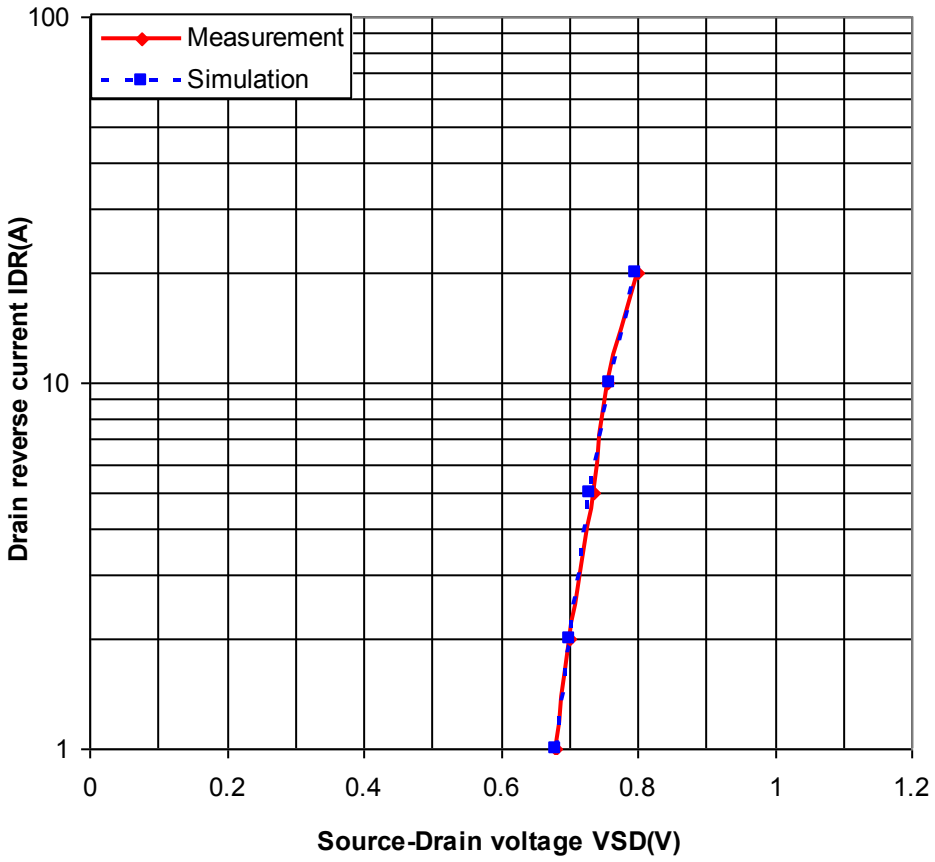


Evaluation Circuit



Comparison Graph

Circuit Simulation Result

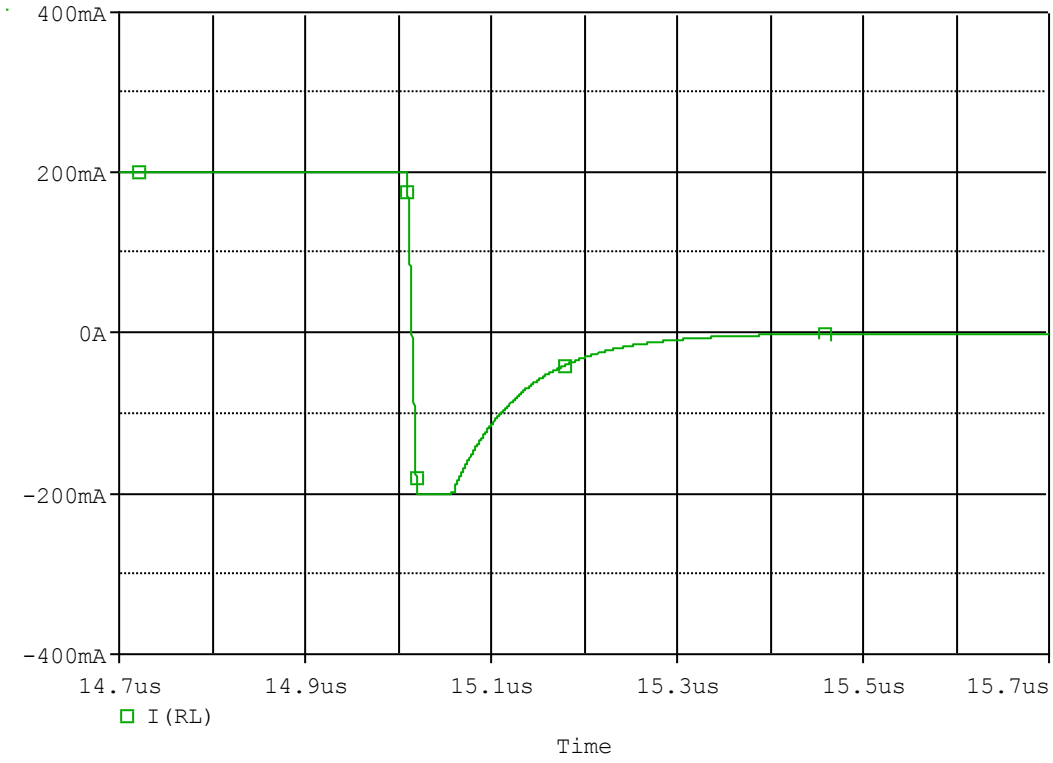


Simulation Result

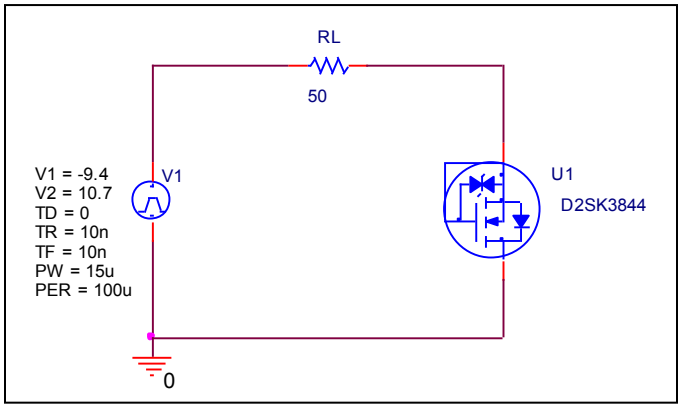
Ifwd(A)	VSD(V)		%Error
	Measurement	Simulation	
1	0.68	0.681	0.147
2	0.7	0.701	0.143
5	0.735	0.731	-0.544
10	0.755	0.759	0.530
20	0.8	0.799	-0.125

Reverse Recovery Characteristic

Circuit Simulation Result



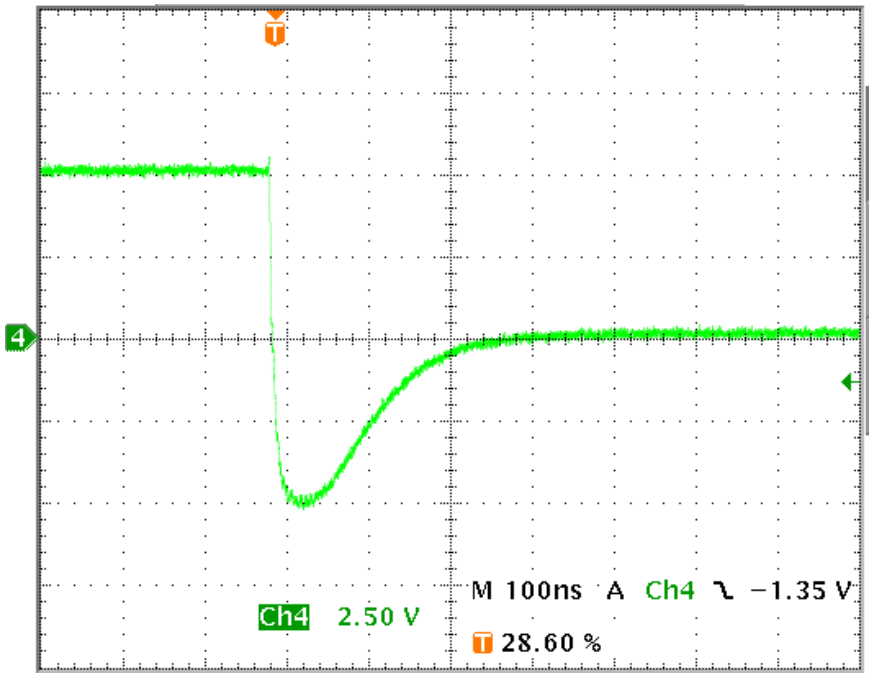
Evaluation Circuit



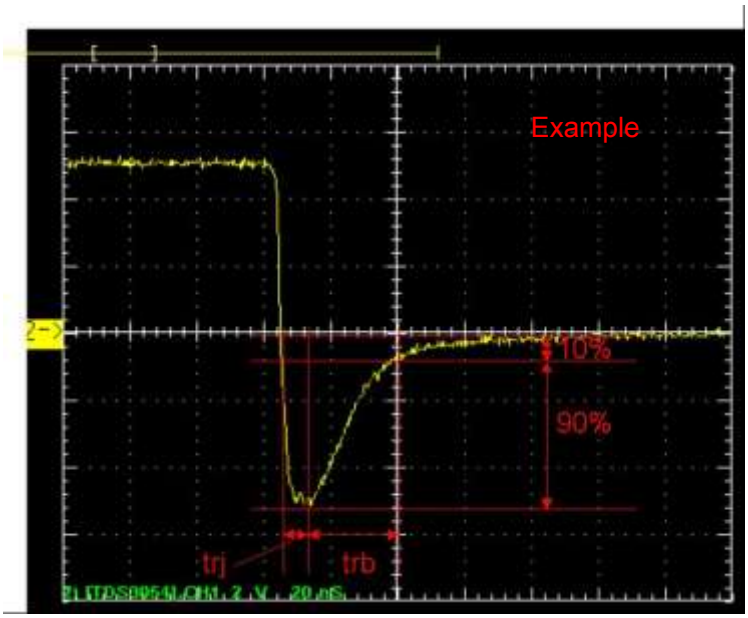
Compare Measurement vs. Simulation

	Measurement	Simulation	Error (%)
Trj(ns)	**42**	**42.153**	**0.364**
Trb(ns)	**174**	**174.019**	**0.011**
Trr(ns)	**216**	**216.172**	**0.080**

Reverse Recovery Characteristic Reference



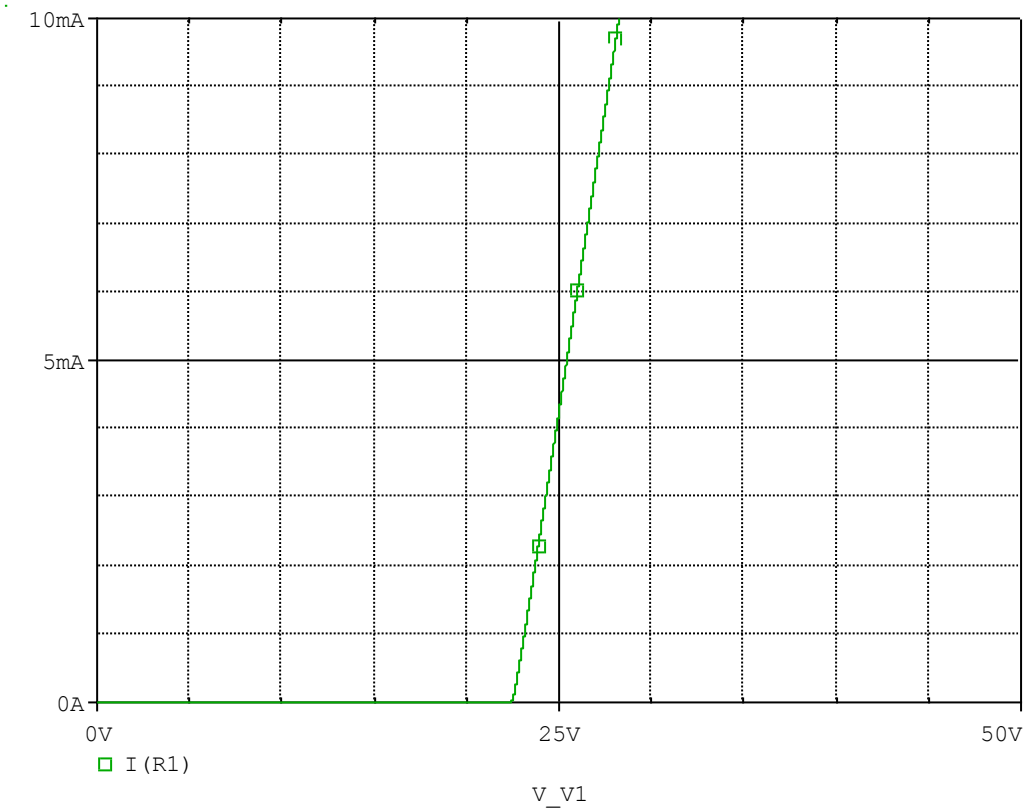
Trj=42(ns)
Trb=174(ns)
Conditions:Ifwd=Irev=0.2(A),Rl=50



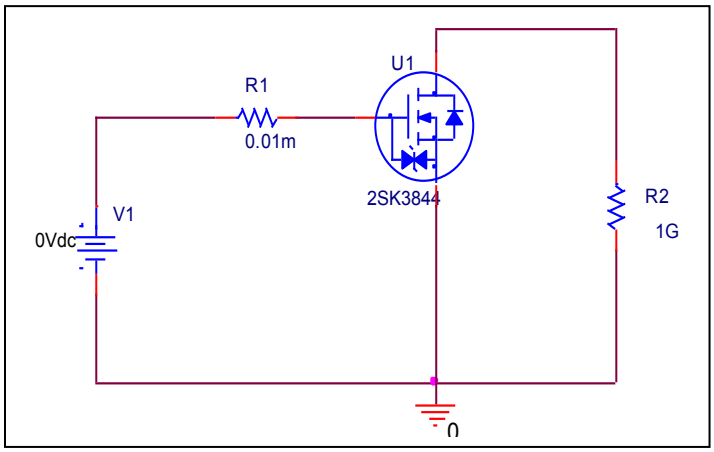
Relation between trj and trb

ESD PROTECTION DIODE
Zener Voltage Characteristic

Circuit Simulation Result



Evaluation Circuit



Zener Voltage Characteristic Reference