Device Modeling Report

COMPONENTS: Power MOSFET (Model parameter)
PART NUMBER: 2SK3799
MANUFACTURER: TOSHIBA
Body Diode (Model parameter) / ESD Protection Diode

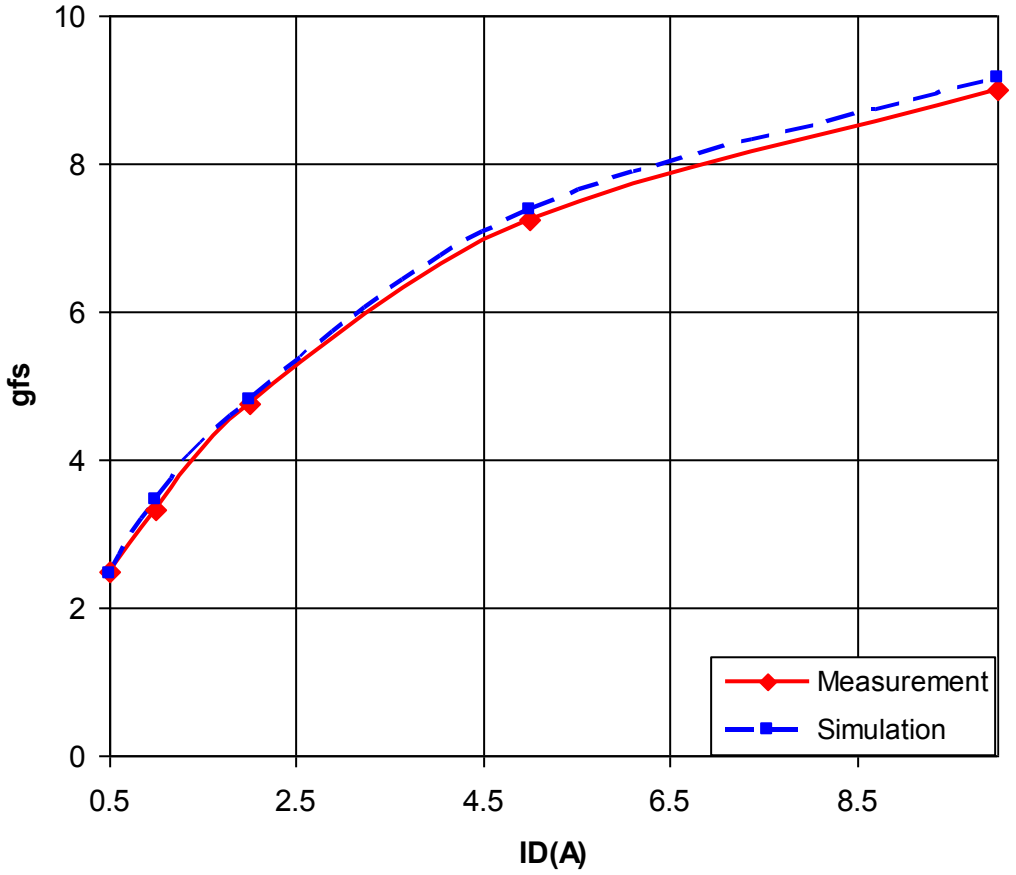
Bee Technologies Inc.

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

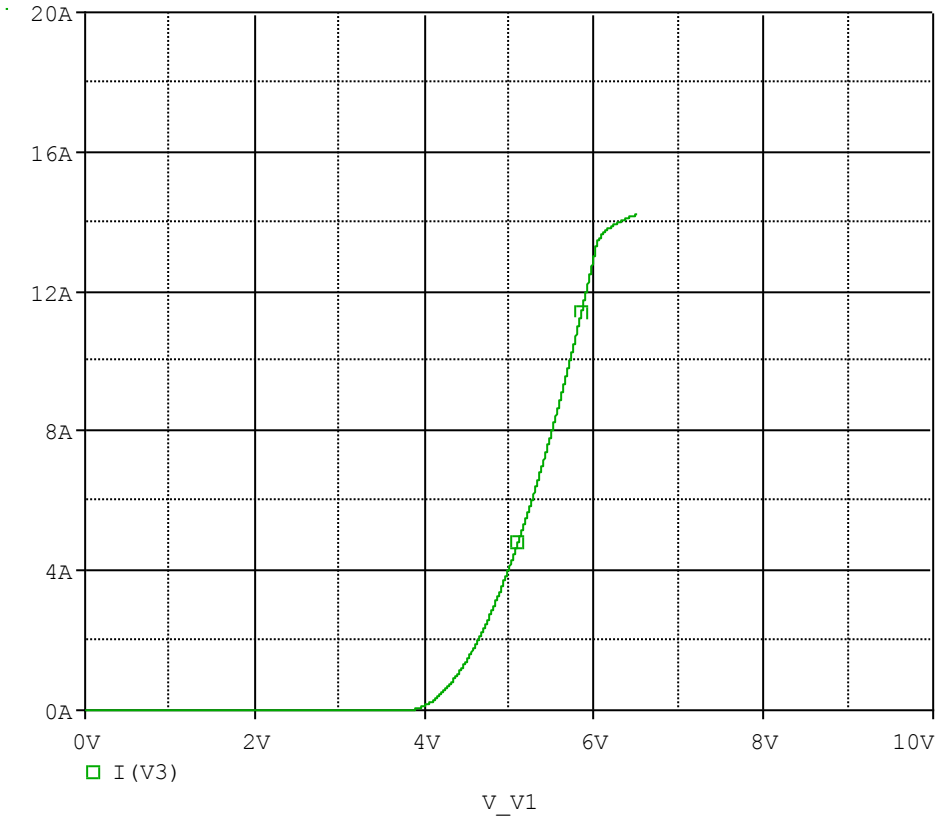


Comparison table

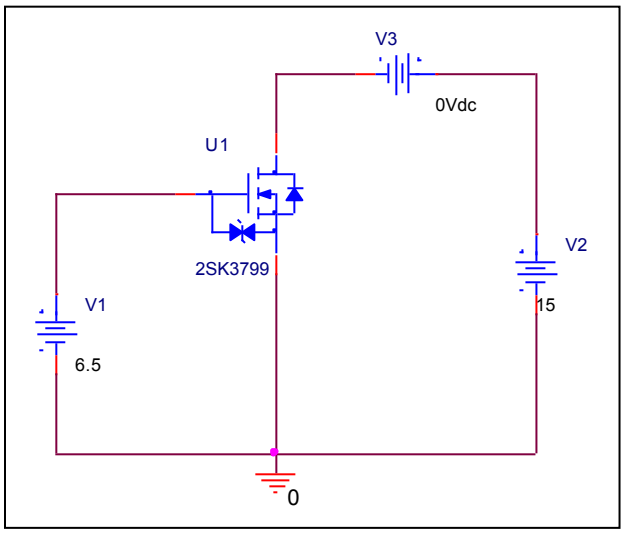
Id(A)	gfs		Error (%)
	Measurement	Simulation	
0.5	2.5	2.463	-1.480
1	3.333	3.448	3.450
2	4.762	4.808	0.966
5	7.246	7.386	1.932
10	8.989	9.164	1.947

Vgs-Id Characteristic

Circuit Simulation result

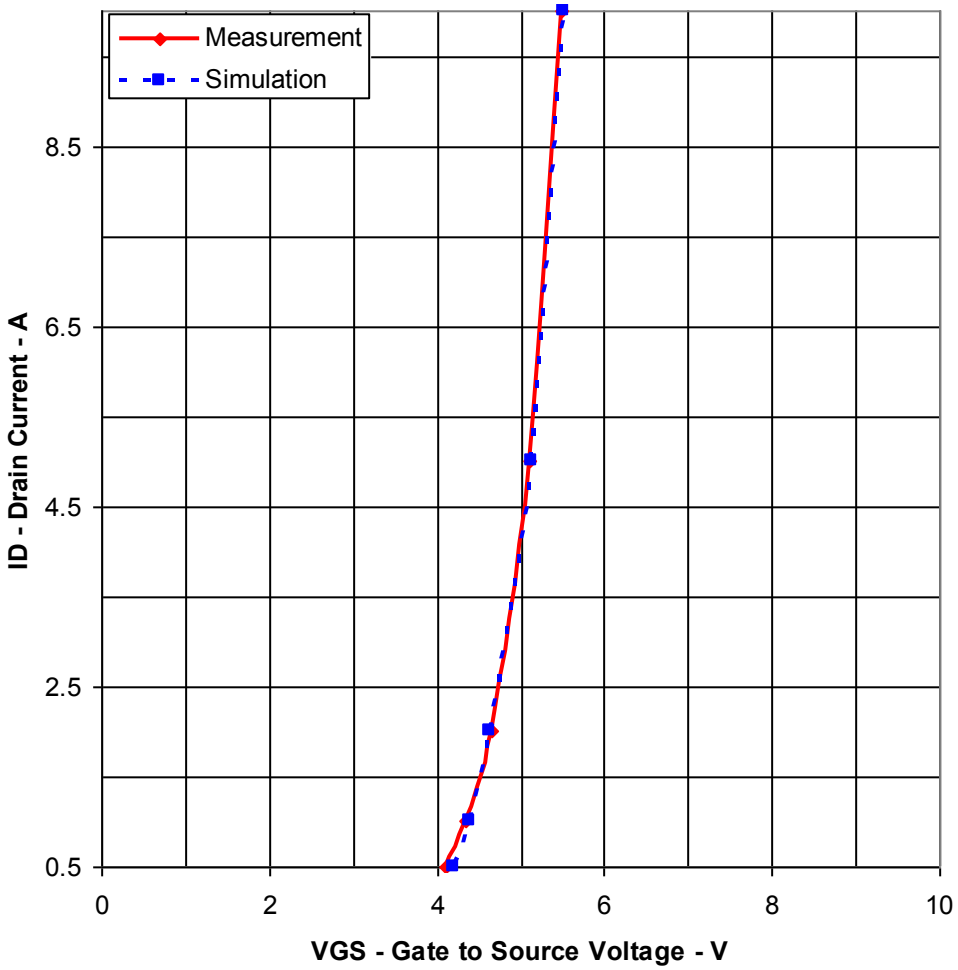


Evaluation circuit



Comparison Graph

Circuit Simulation Result

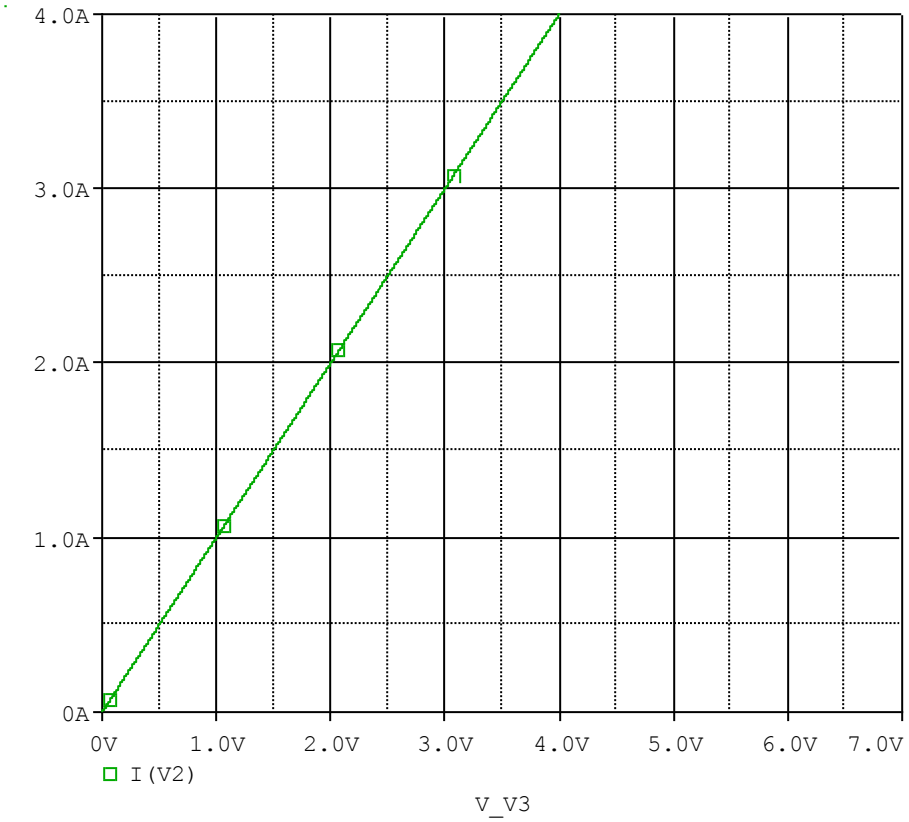


Simulation Result

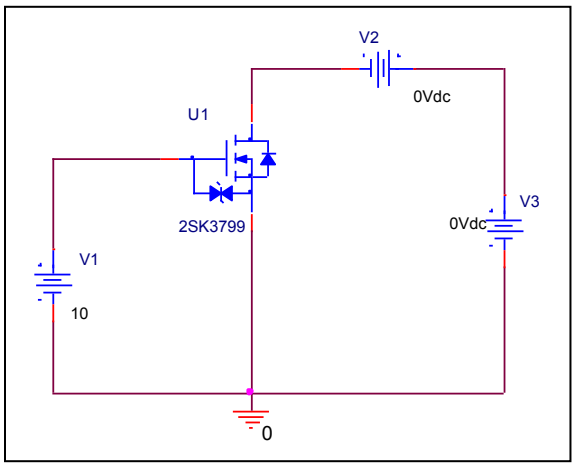
I_D(A)	V_{GS}(V)		Error (%)
	Measurement	Simulation	
0.5	4.1	4.2106	2.698
1	4.35	4.3839	0.779
2	4.65	4.6318	-0.391
5	5.1	5.134	0.667
10	5.5	5.5044	0.080

Rds(on) Characteristic

Circuit Simulation result



Evaluation circuit

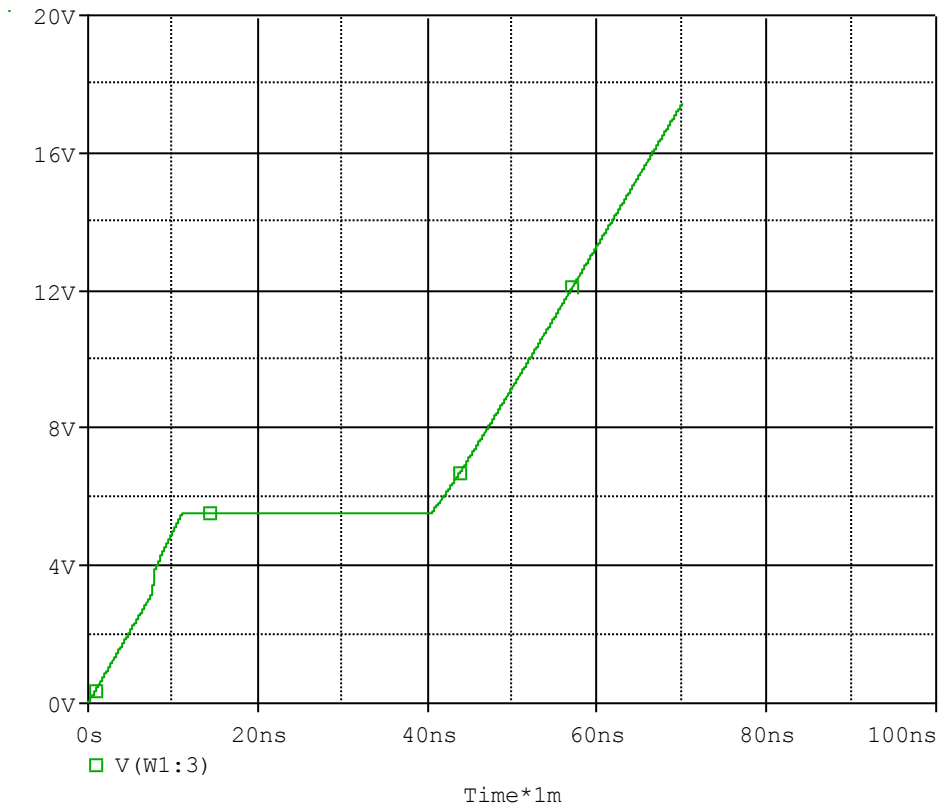


Simulation Result

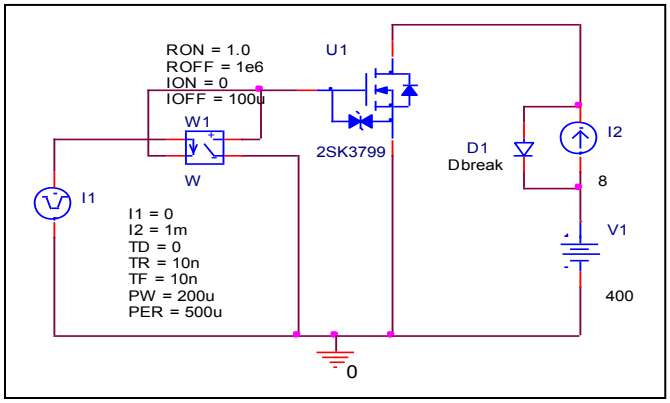
I_D=4A, V_{GS}=10V	Measurement		Simulation		Error (%)
R_{DS} (on)	1	Ω	1	Ω	0

Gate Charge Characteristic

Circuit Simulation result



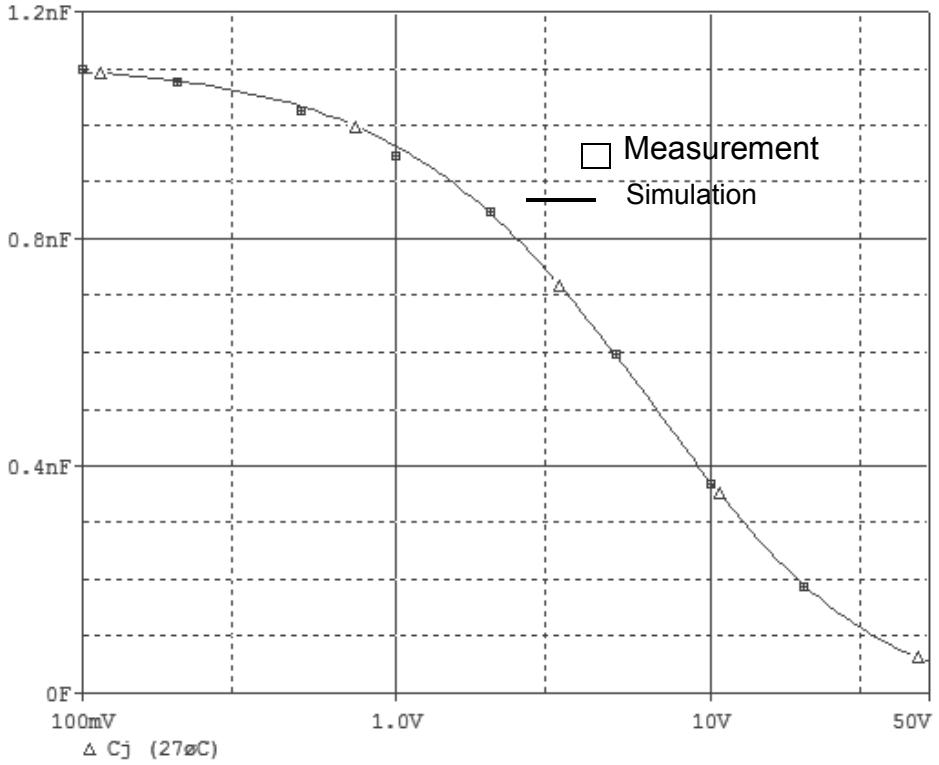
Evaluation circuit



Simulation Result

V_{DD}=400V,I_D=8A	Measurement		Simulation		Error (%)
Qgs	11	nC	11.107	nC	0.973
Qgd	29	nC	29.195	nC	0.672
Qg	62	nC	52.036	nC	-16.071

Capacitance Characteristic

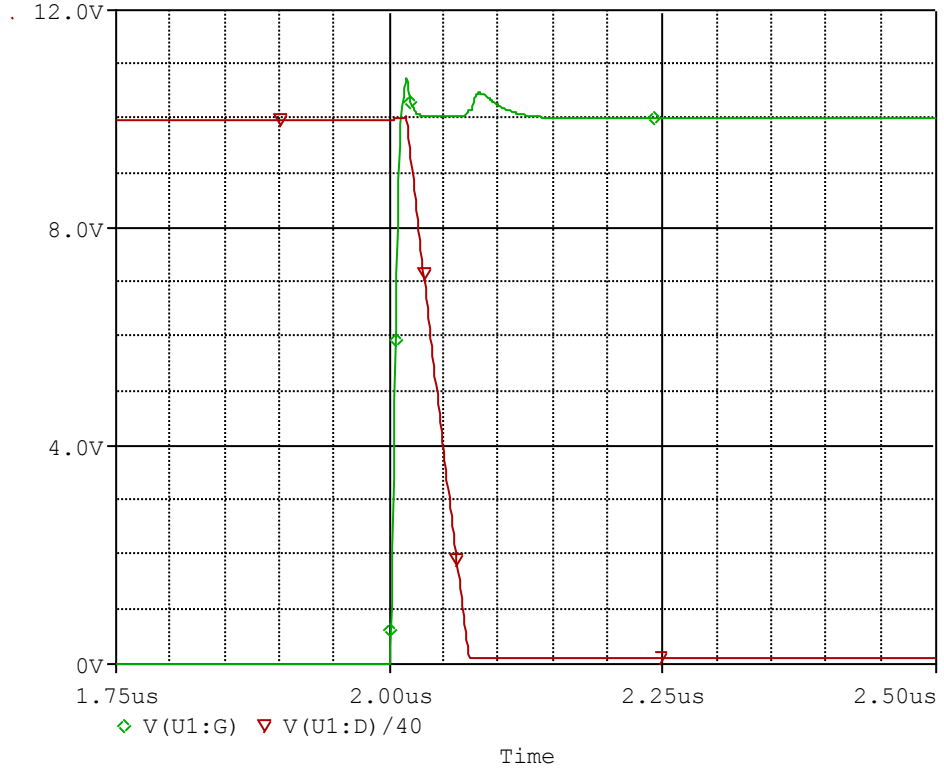


Simulation Result

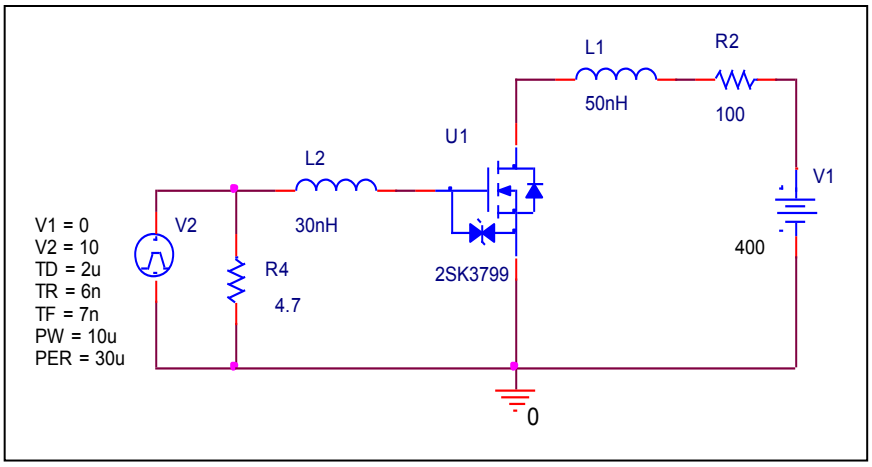
V_{DS}(V)	Cbd(pF)		Error(%)
	Measurement	Simulation	
0.1	1100	1095	-0.455
0.2	1080	1078	-0.185
0.5	1030	1032	0.194
1	950	963	1.368
2	850	845	-0.588
5	600	595	-0.833
10	370	375	1.351
20	190	190	0

Switching Time Characteristic

Circuit Simulation result



Evaluation circuit

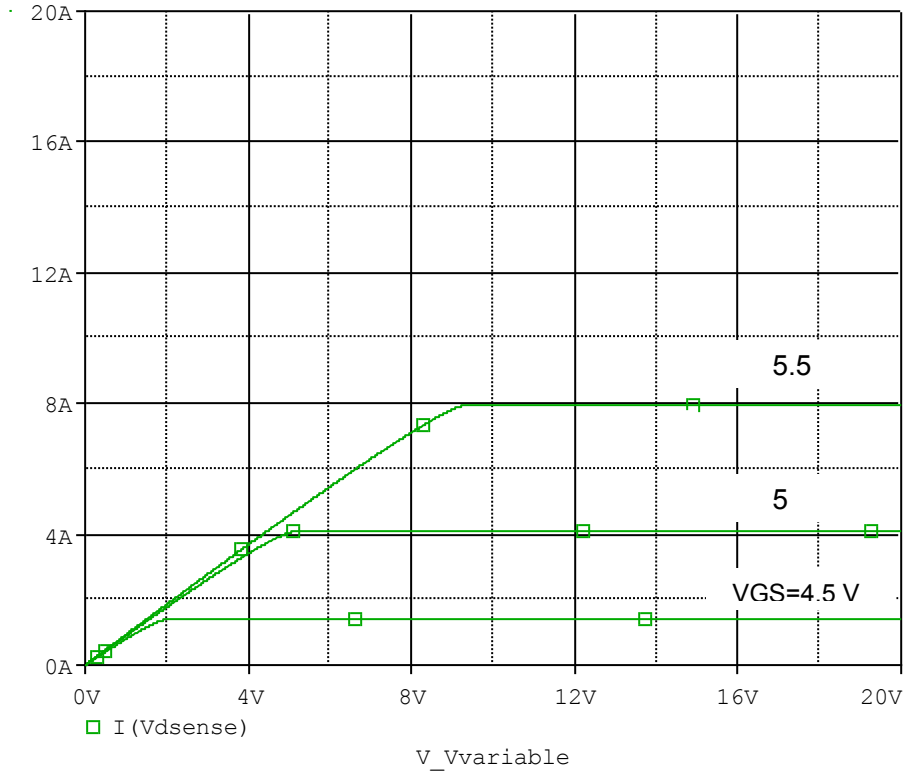


Simulation Result

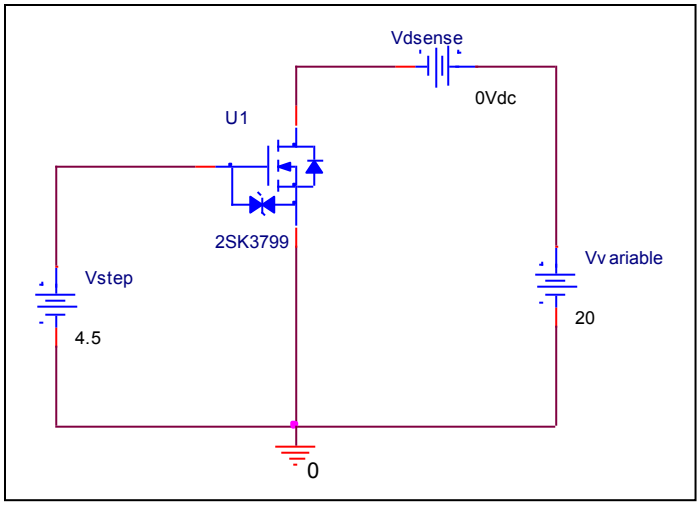
I_D=4 A, V_{DD}=400V V_{GS}=0/10V	Measurement		Simulation		Error(%)
ton	65.000	ns	65.045	ns	0.069

Output Characteristic

Circuit Simulation result

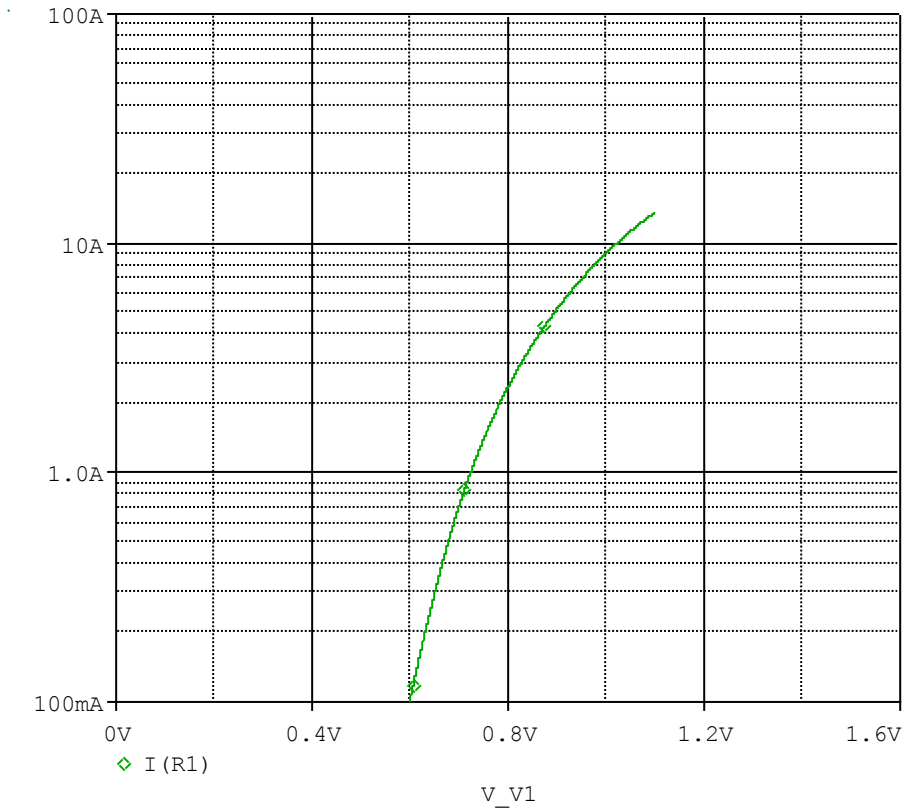


Evaluation circuit

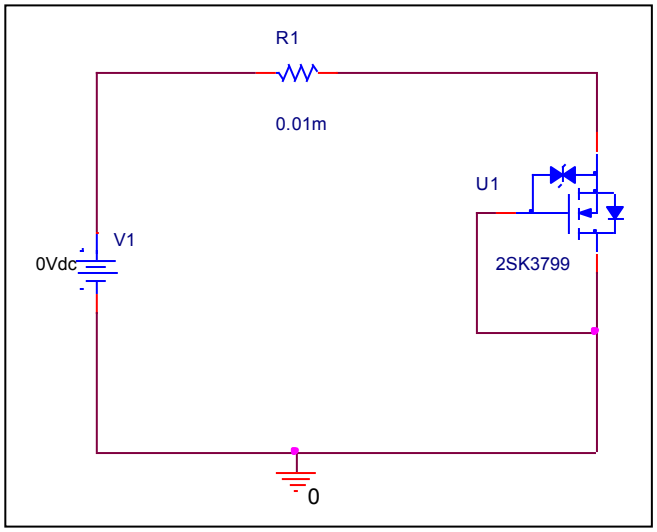


BODY DIODE
Forward Current Characteristic

Circuit Simulation Result

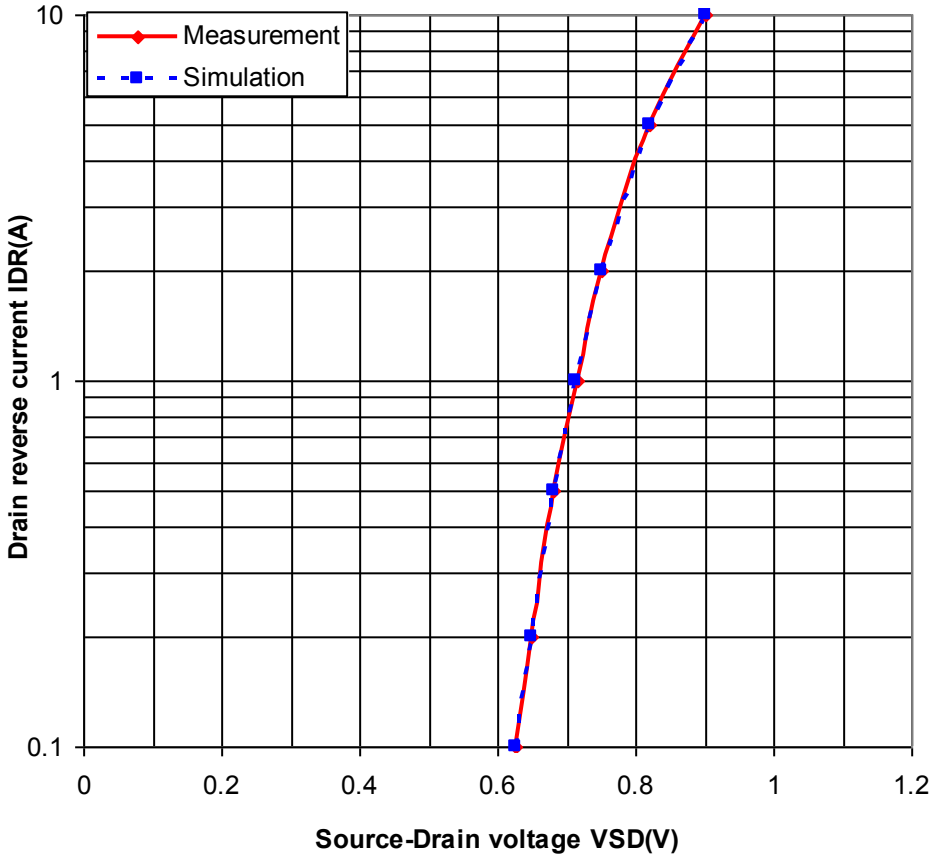


Evaluation Circuit



Comparison Graph

Circuit Simulation Result

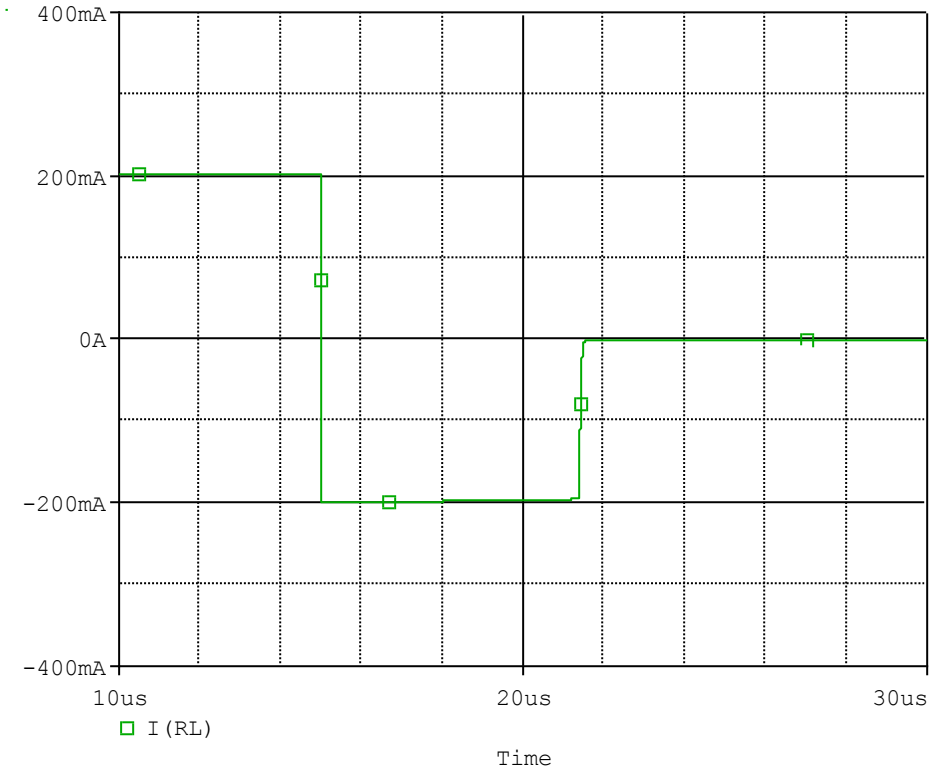


Simulation Result

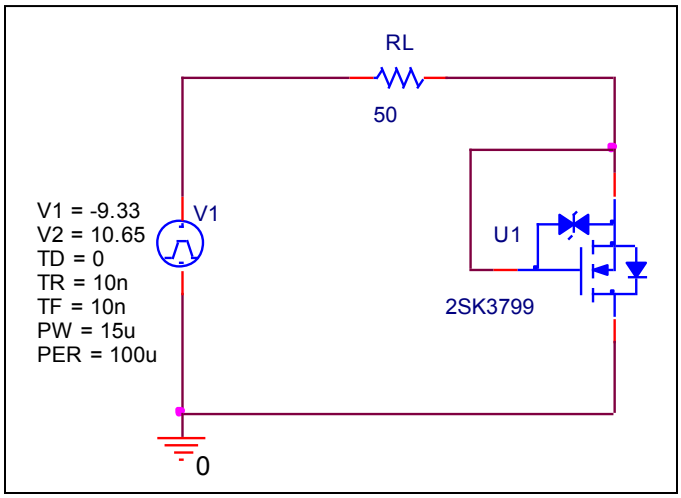
Ifwd(A)	VSD(V)		%Error
	Measurement	Simulation	
0.1	0.6	0.599	-0.167
0.2	0.63	0.63	0
0.5	0.68	0.678	-0.294
1	0.72	0.723	0.417
2	0.78	0.783	0.385
5	0.9	0.895	-0.556
10	1.02	1.022	0.196

Reverse Recovery Characteristic

Circuit Simulation Result



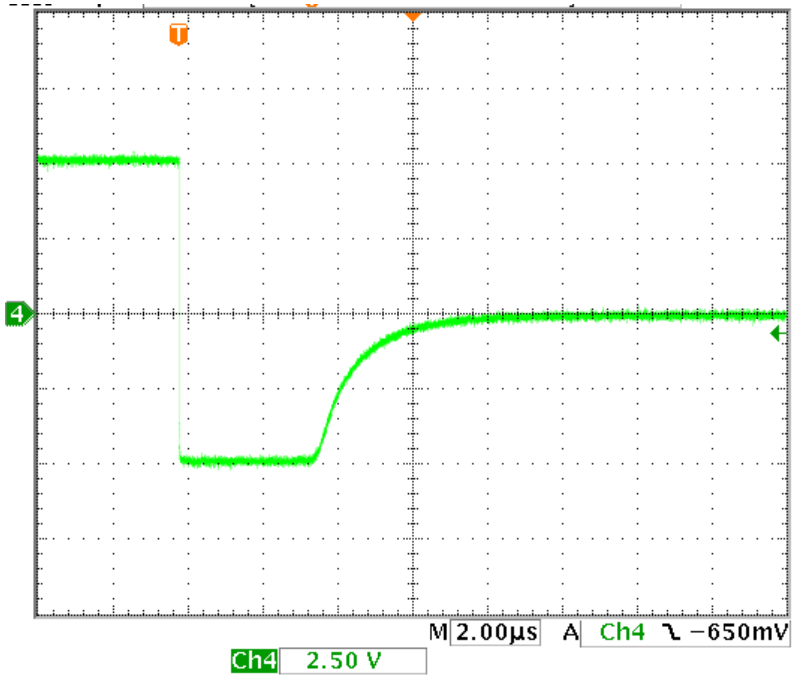
Evaluation Circuit



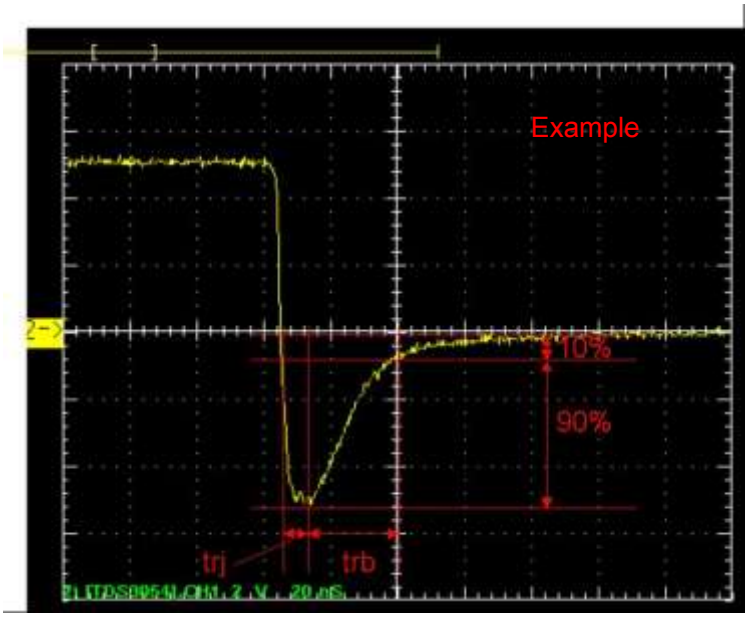
Compare Measurement vs. Simulation

Trr(ns)	Measurement	Simulation	Error (%)
Trj+Trb (us)	6.44	6.4475	0.116

Reverse Recovery Characteristic Reference



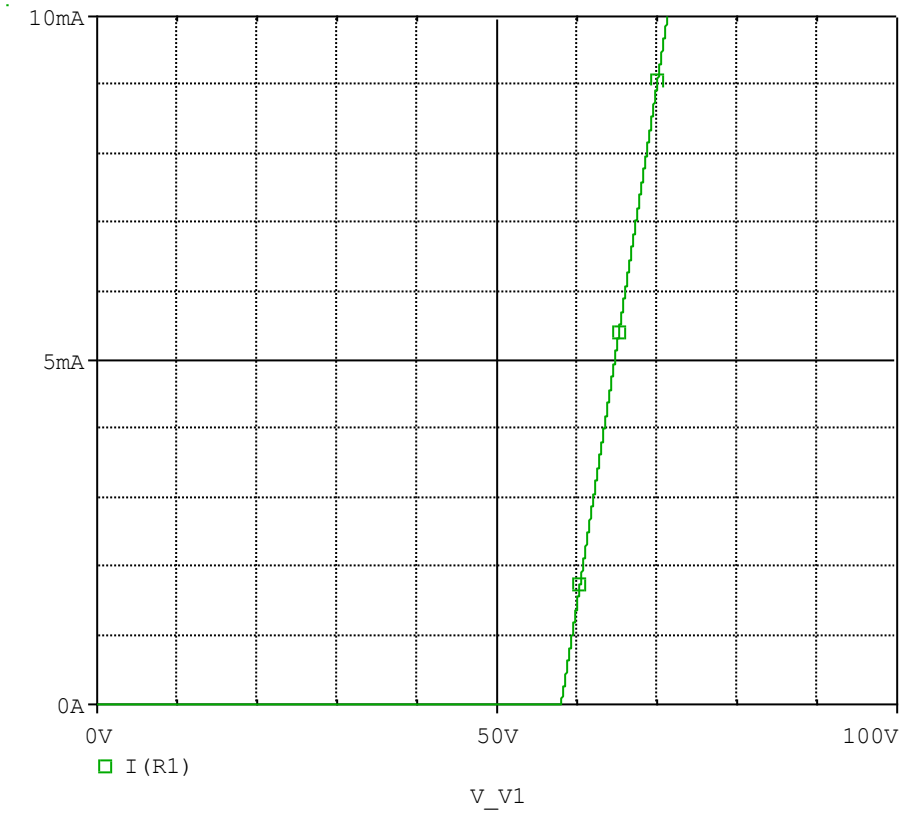
Trj=3.32(us)
Trb=3.12(us)
Conditions:Ifwd=Irev=0.2(A),Rl=50



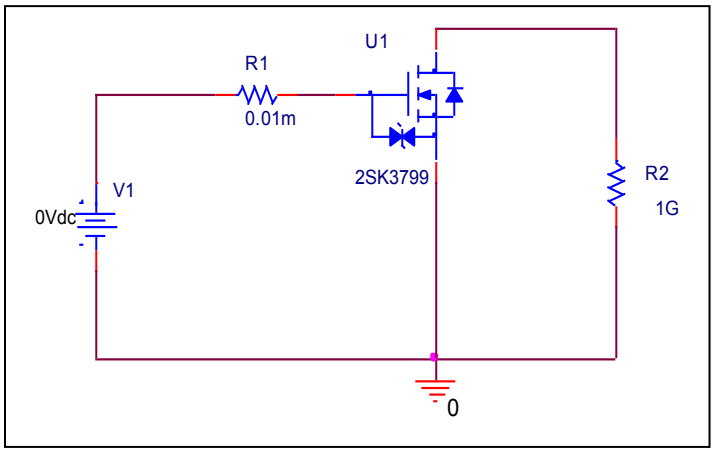
Relation between trj and trb

ESD PROTECTION DIODE
Zener Voltage Characteristic

Circuit Simulation Result



Evaluation Circuit



Zener Voltage Characteristic Reference