Device Modeling Report

COMPONENTS: MOSFET (Model Parameters)
PART NUMBER: 2SK2201
MANUFACTURER: TOSHIBA
Body Diode (Model Parameters) / ESD Protection diode

Bee Technologies Inc.

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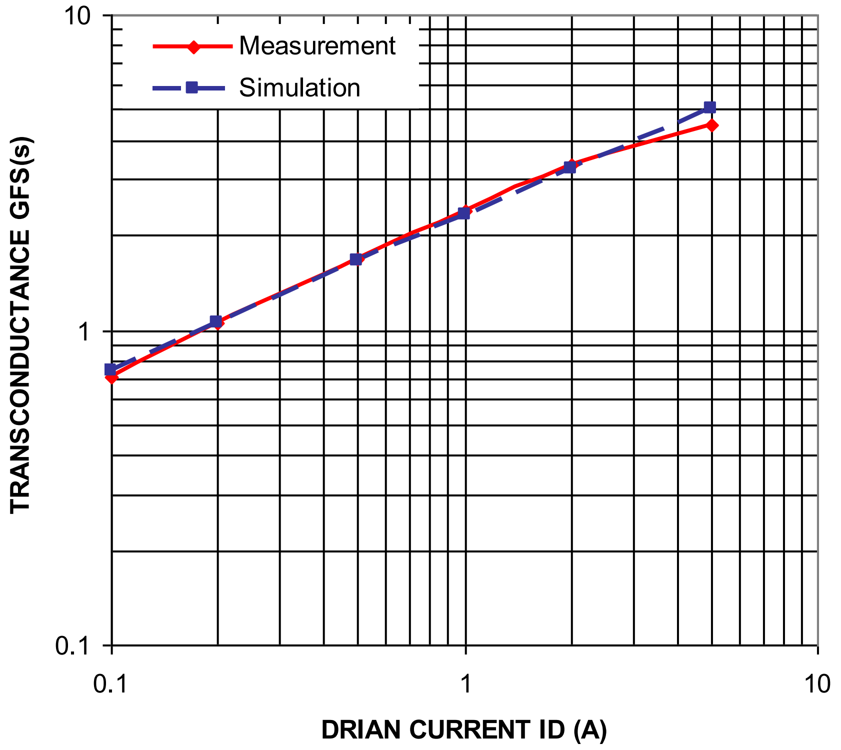
MOSFET MODEL PARAMETERS

PSpice model parameters	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

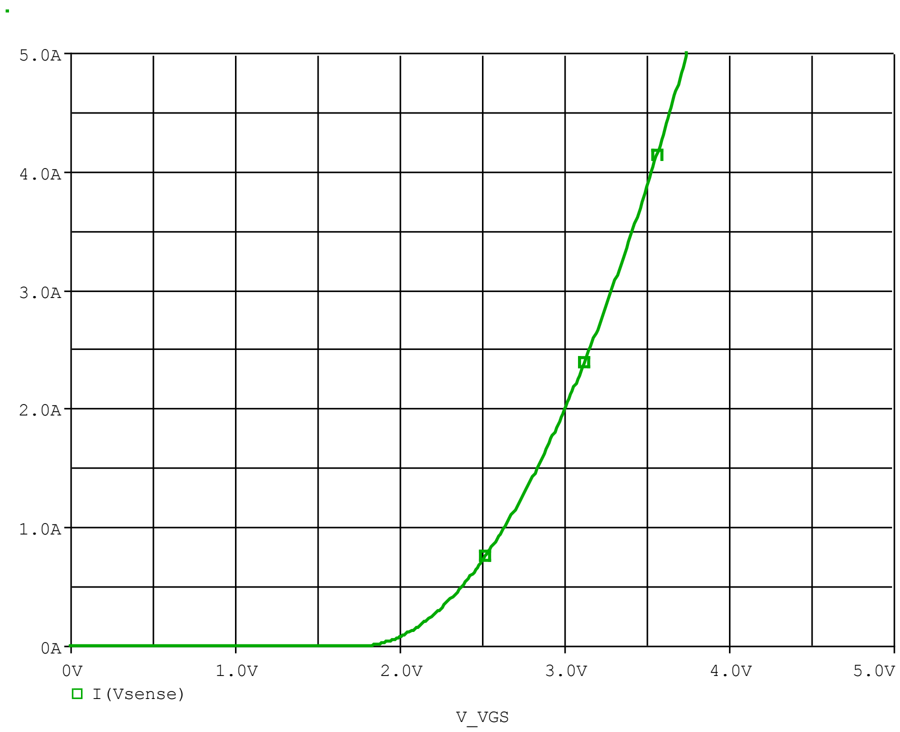


Comparison table

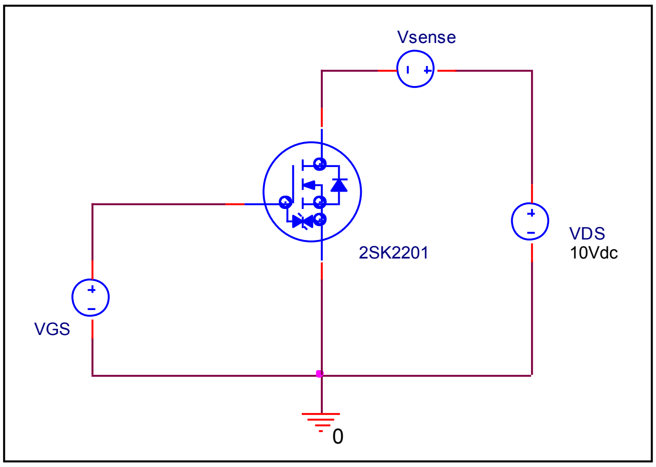
Id(A)	Gfs(S)		Error(%)
	Measurement	Simulation	
0.1	0.7140	0.7407	3.75
0.2	1.0500	1.0526	0.25
0.5	1.6700	1.6447	-1.51
1	2.3800	2.3148	-2.74
2	3.3300	3.2415	-2.66

Vgs-Id Characteristic

Circuit Simulation result

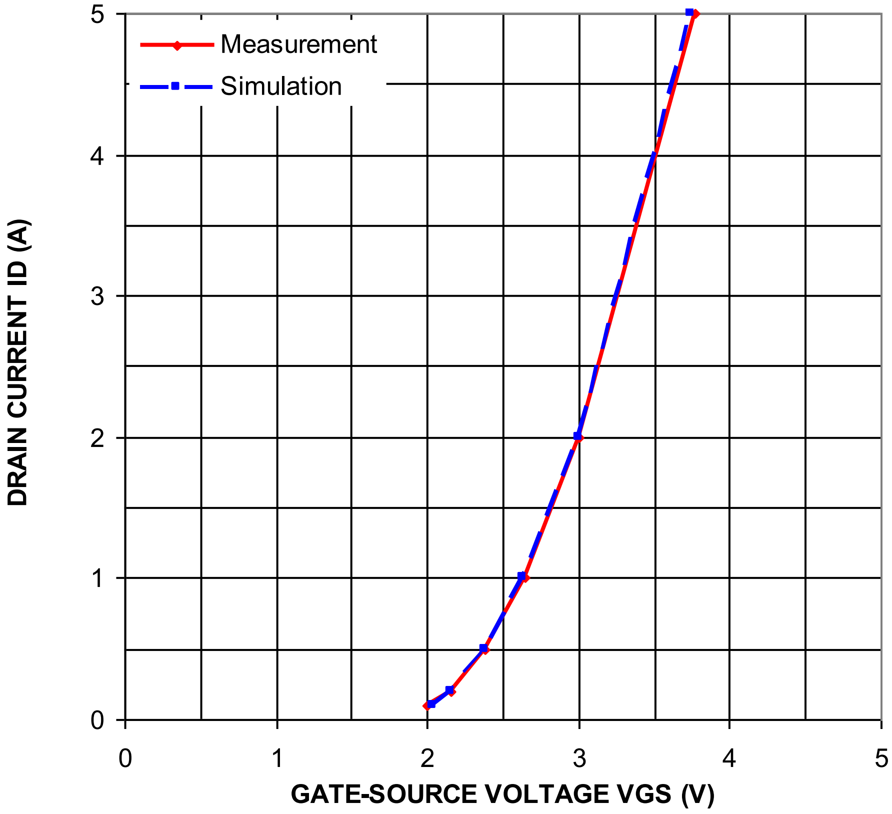


Evaluation circuit



Comparison Graph

Circuit Simulation Result

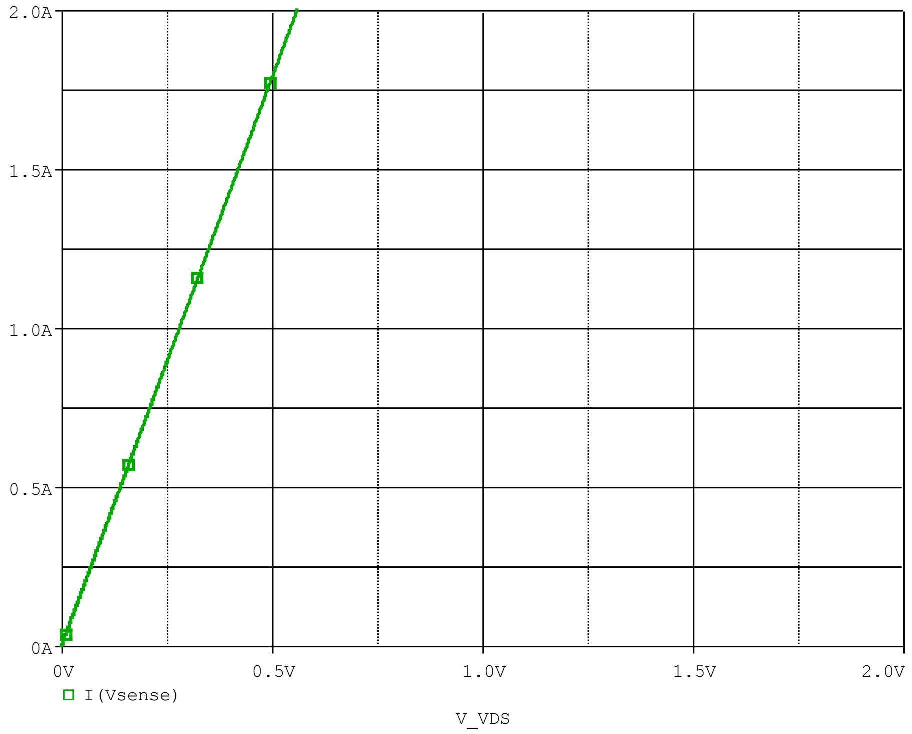


Simulation Result

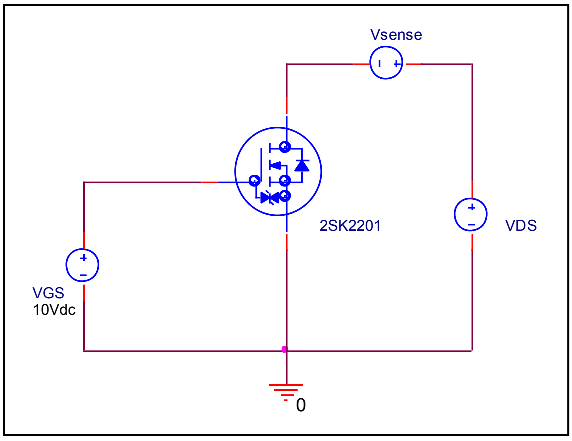
I_D(A)	V_{GS}(V)		Error (%)
	Measurement	Simulation	
0.1	2.0000	2.0364	1.82
0.2	2.15	2.1506	0.03
0.5	2.375	2.3780	0.13
1	2.65	2.6361	-0.52
2	3	3.0042	0.14
5	3.77	3.7453	-0.66

Rds(on) Characteristic

Circuit Simulation result



Evaluation circuit

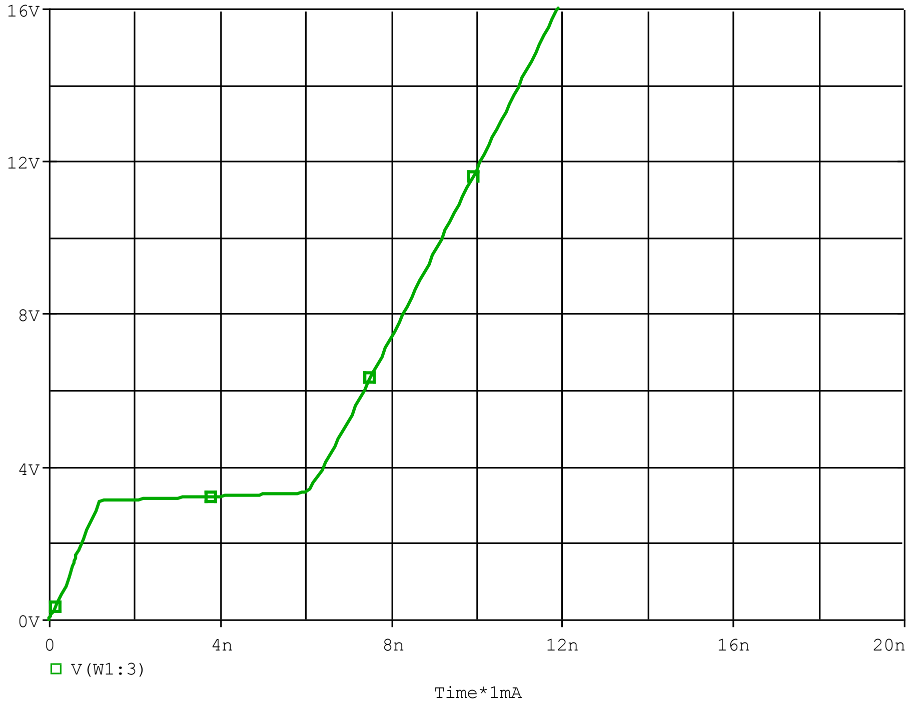


Simulation Result

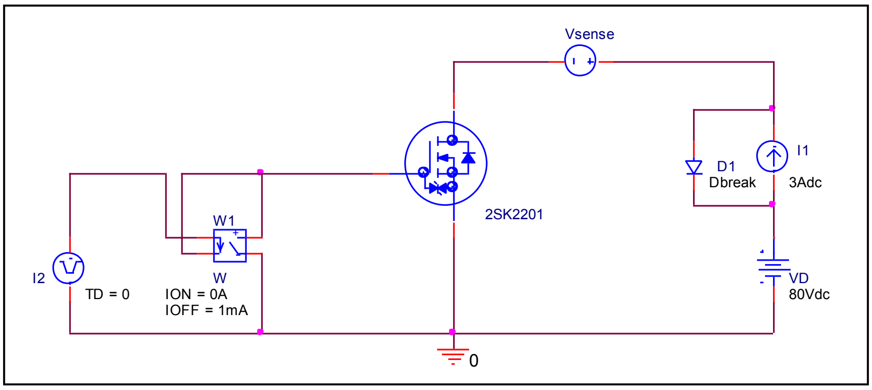
I_D=2A, V_{GS}=10V	Measurement		Simulation		Error (%)
R_{DS} (on)	0.28	Ω	0.28	Ω	0.0

Gate Charge Characteristic

Circuit Simulation result



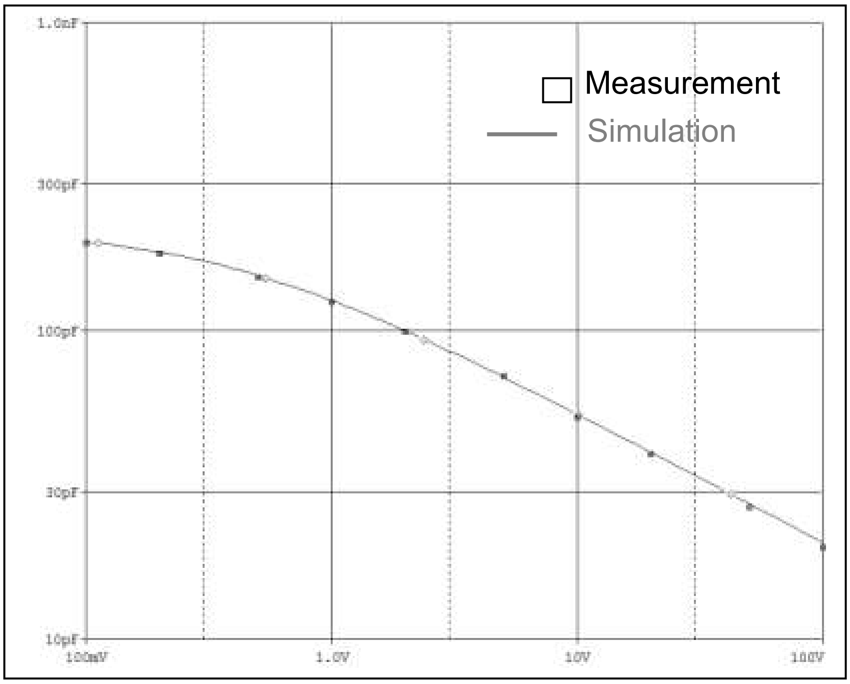
Evaluation circuit



Simulation Result

V_{DD}=80V, I_D= 3A	Measurement		Simulation		Error (%)
Qgs	1.2	nC	1.2105	nC	0.87
Qgd	4.8	nC	4.807	nC	0.15

Capacitance Characteristic

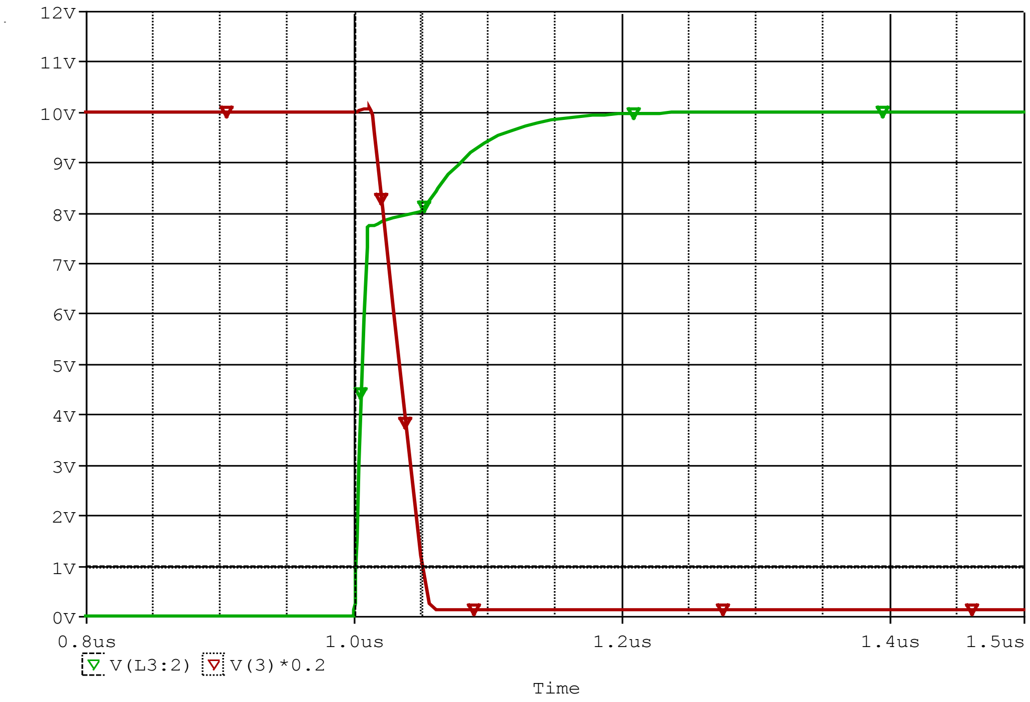


Simulation Result

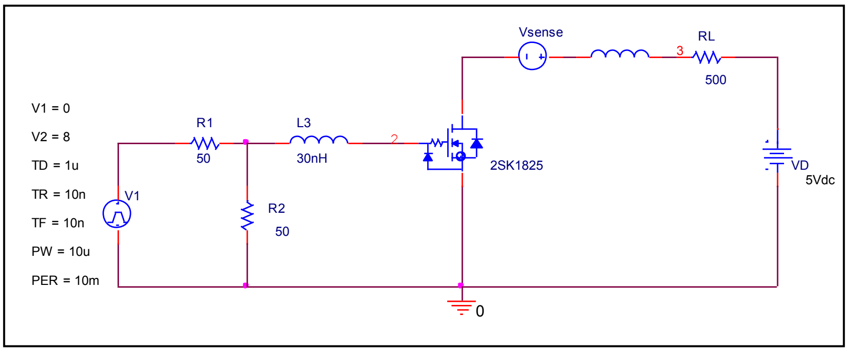
V_{DS}(V)	Cbd(pF)		Error(%)
	Measurement	Simulation	
1	125	124.9700	-0.02
2	100	99.7500	-0.25
5	72	70.5000	-2.08
10	53	53.5000	0.94
20	40	40.3500	0.88
50	27	27.4000	1.48
100	20	20.5000	2.50

Switching Time Characteristic

Circuit Simulation result



Evaluation circuit

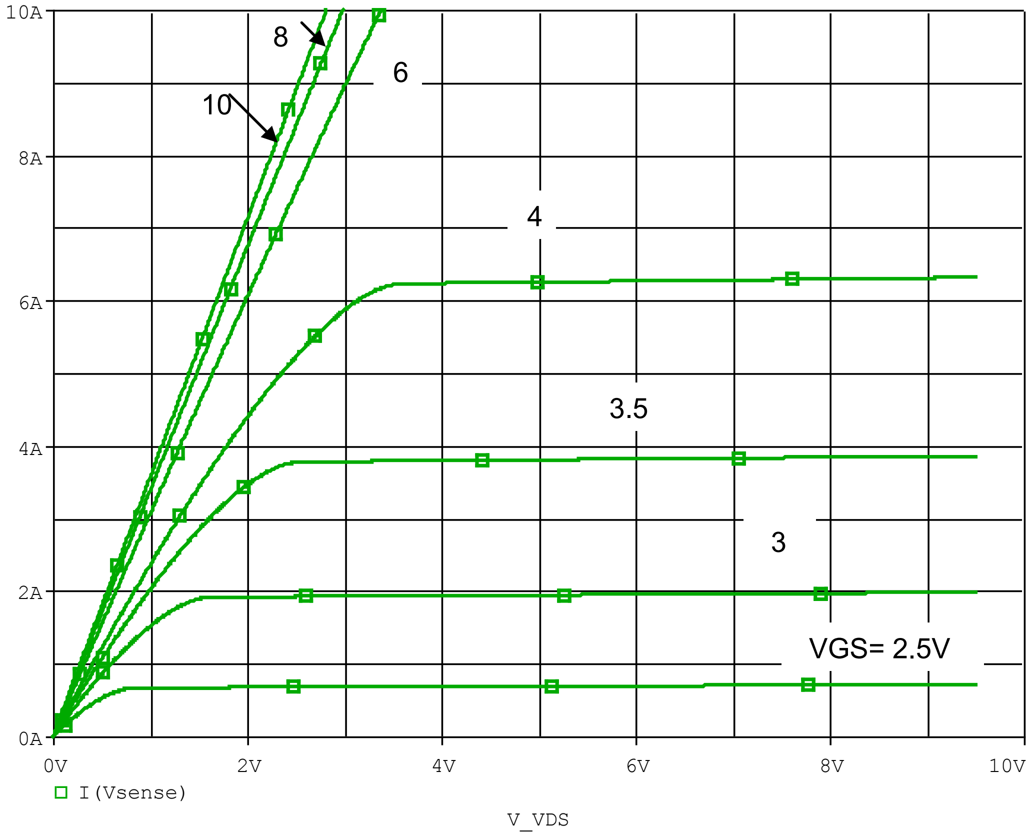


Simulation Result

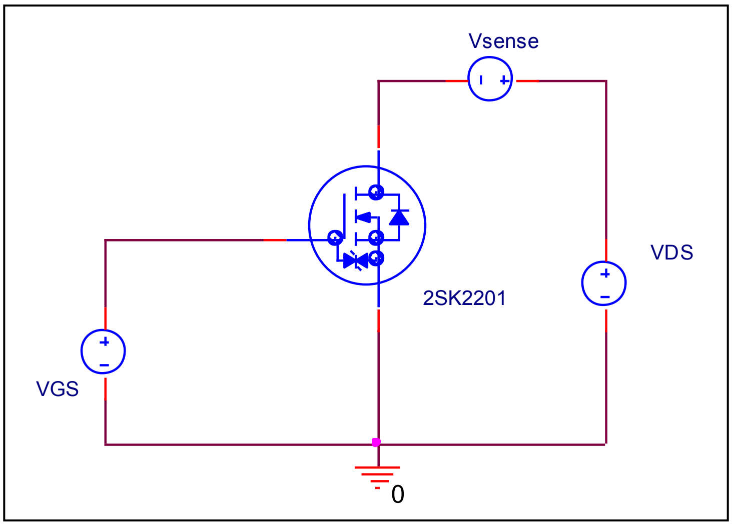
I_D=2A, V_{DD}= 50V, V_{GS}=0/10V	Measurement		Simulation		Error (%)
ton	50	ns	51.039	ns	2.08

Output Characteristic

Circuit Simulation result

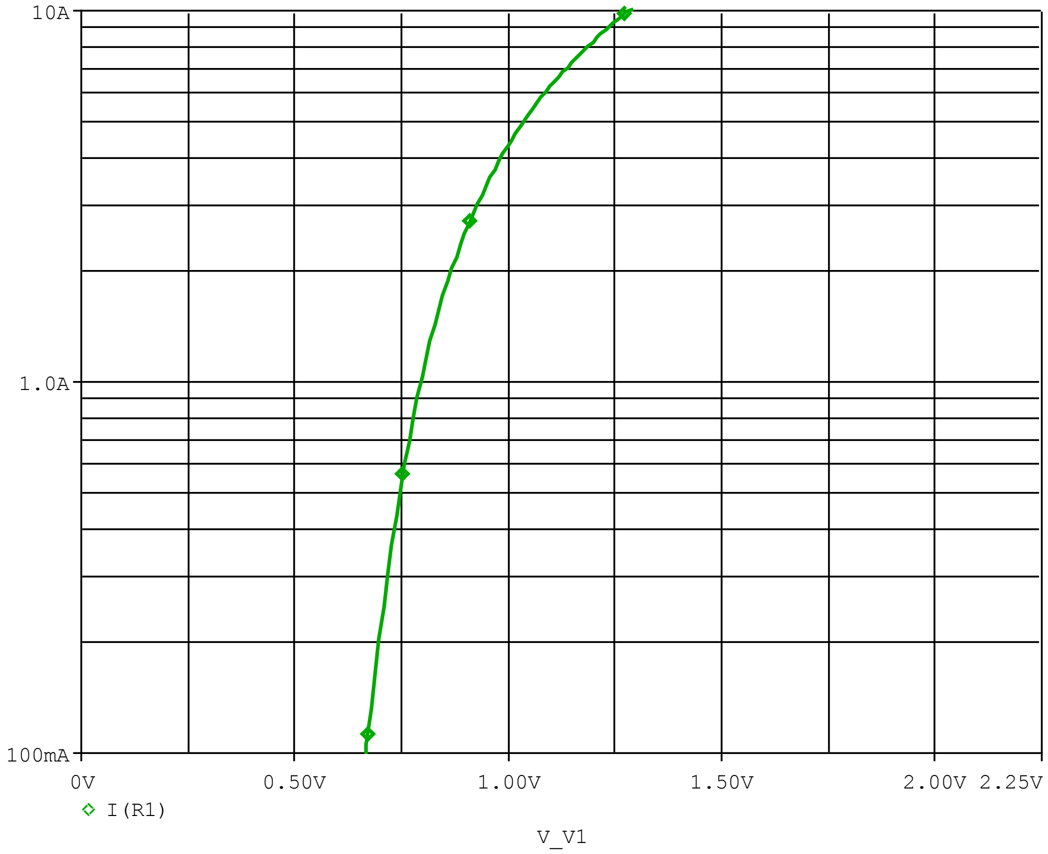


Evaluation circuit

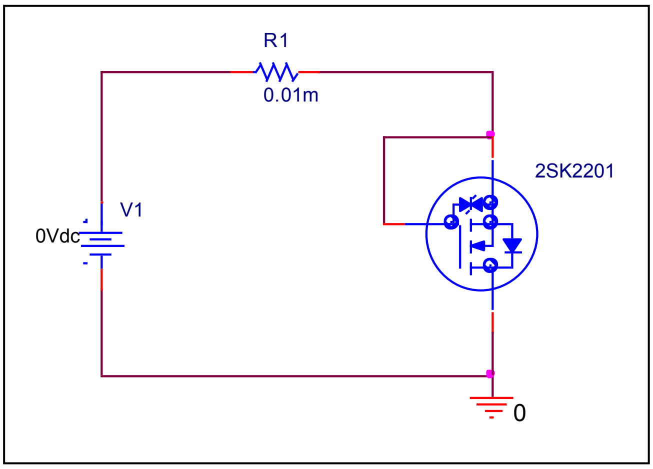


BODY DIODE SPICE MODEL
Forward Current Characteristic

Circuit Simulation Result

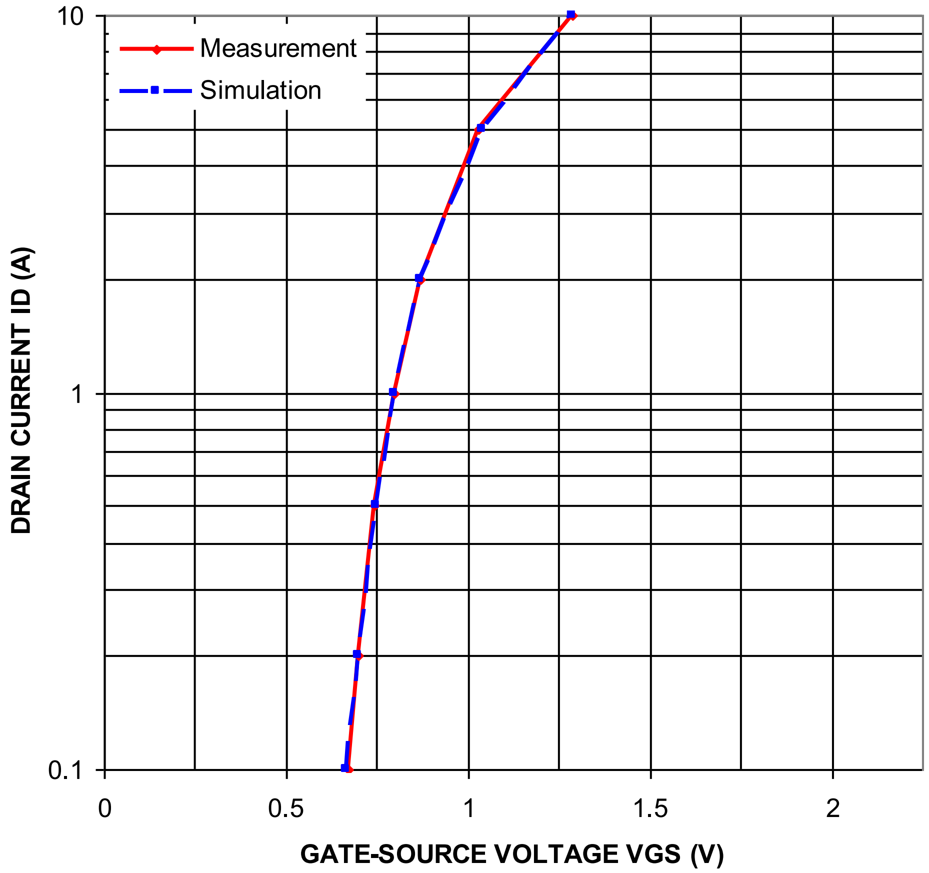


Evaluation Circuit



Comparison Graph

Circuit Simulation Result

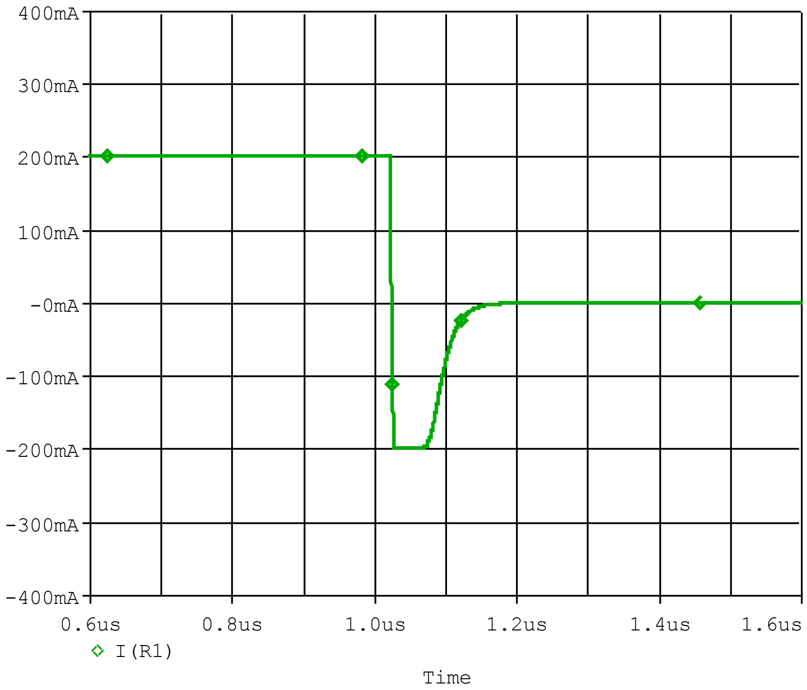


Simulation Result

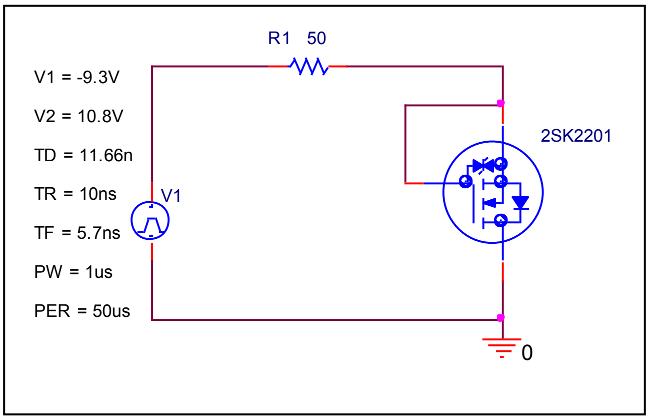
I_{DR}(A)	V_{SD}(V)		Error (%)
	Measurement	Simulation	
0.1	0.6700	0.6679	-0.31
0.2	0.7000	0.6996	-0.06
0.5	0.7450	0.7487	0.49
1	0.8000	0.7980	-0.25
2	0.8700	0.8695	-0.06
5	1.0300	1.0386	0.83
10	1.2900	1.2878	-0.17

Reverse Recovery Characteristic (Body Diode)

Circuit Simulation Result



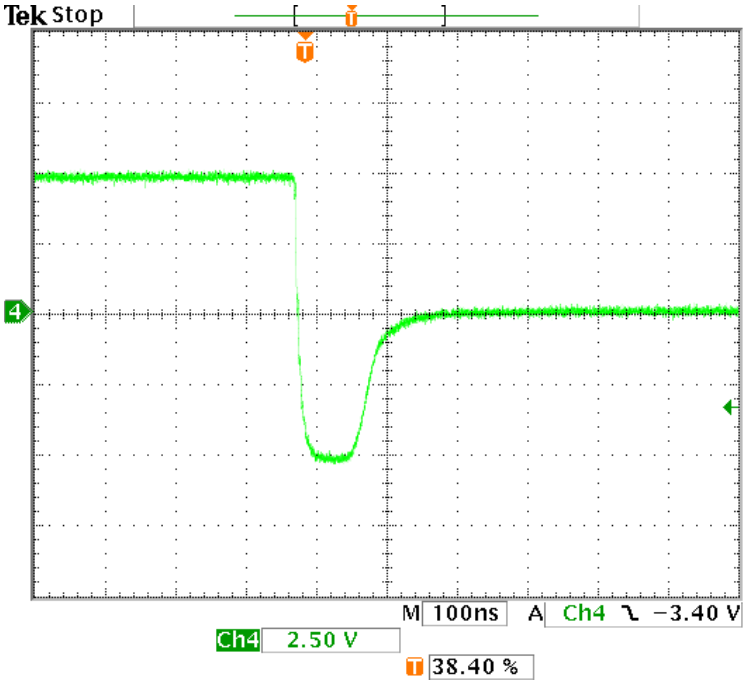
Evaluation Circuit



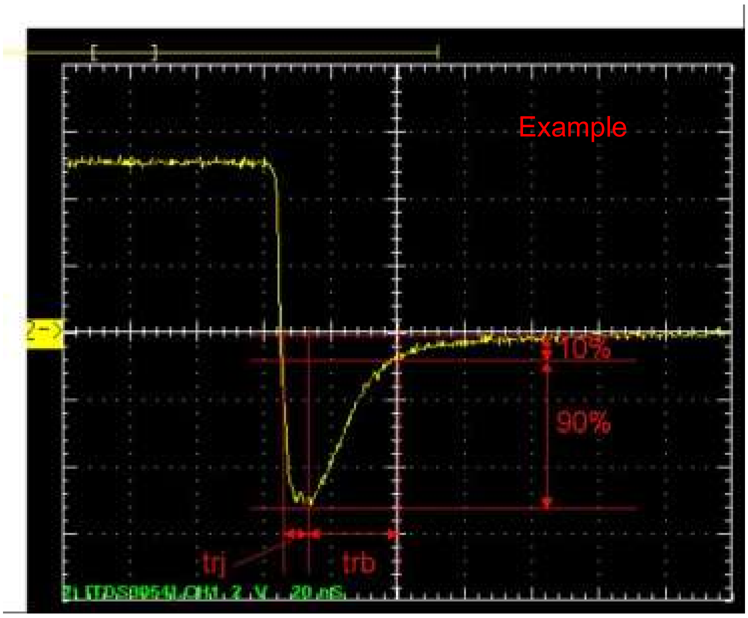
Compare Measurement vs. Simulation

	Measurement		Simulation		Error (%)
trj+trb=trr	**118.8**	**ns**	**101.171**	**ns**	**-14.84**

Reverse Recovery Characteristic (Body Diode) **Reference**



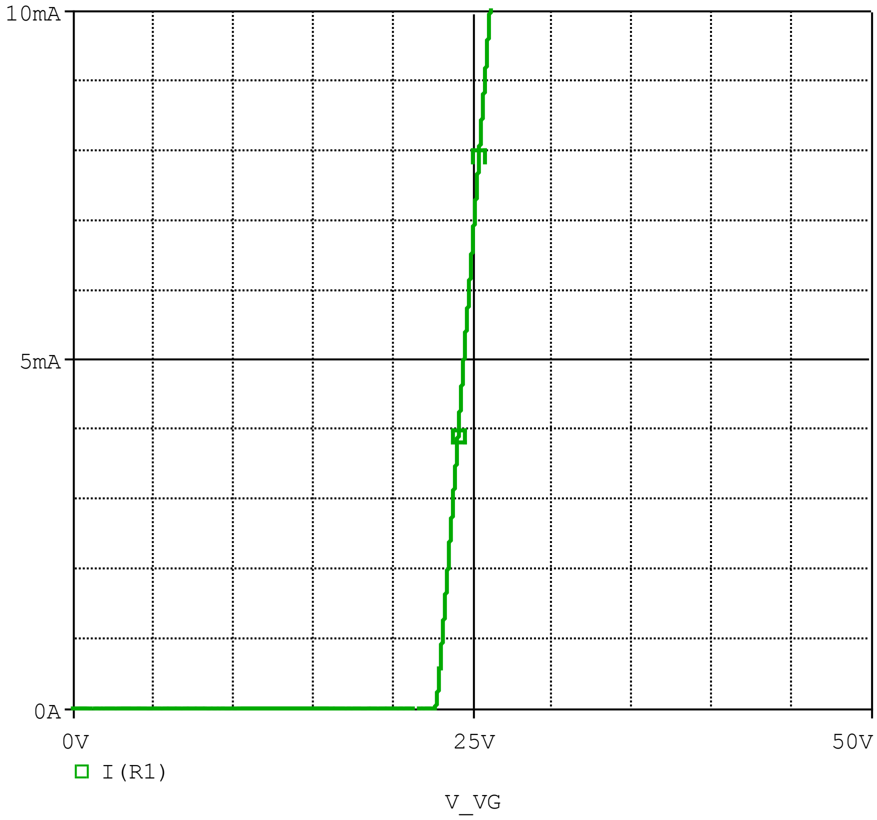
Trj= 48(ns)
Trb= 70.8(ns)
Conditions:Ifwd=Irev=0.2(A),Rl=50



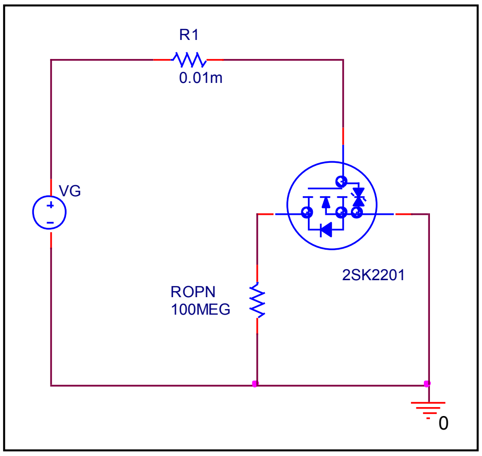
Relation between trj and trb

ESD PROTECTION DIODE
Zener Voltage Characteristic

Circuit Simulation Result

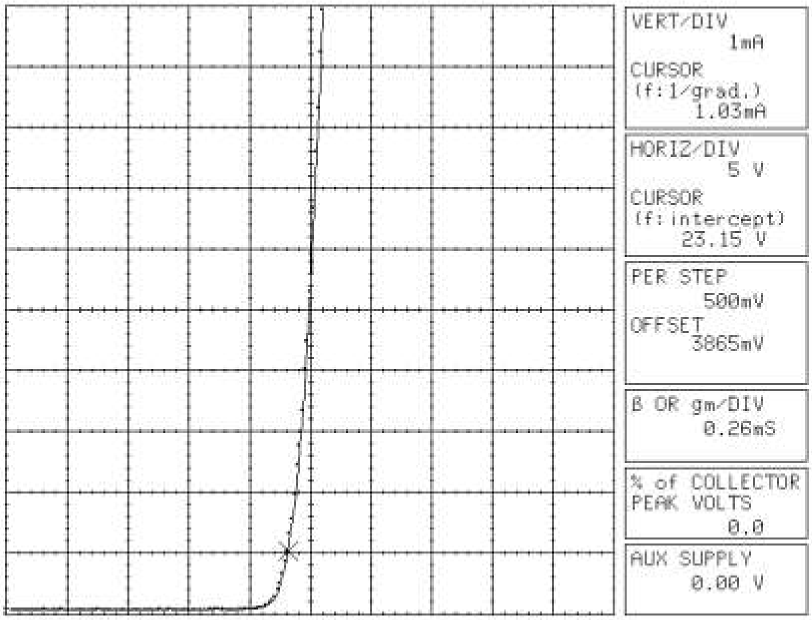


Evaluation Circuit



Zener Voltage Characteristic

Reference



VERT/DIV
1mA
CURSOR
(f:1/grad.)
1.03mA

HORIZ/DIV
5 V
CURSOR
(f:intercept)
23.15 V

PER STEP
500mV
OFFSET
3865mV

β OR gm/DIV
0.26mS

% of COLLECTOR
PEAK VOLTS
0.0

AUX SUPPLY
0.00 V