Device Modeling Report

COMPONENTS: Power MOSFET (Model Parameters)
PART NUMBER: 2SK4077
MANUFACTURER: NEC
REMARK: Body Diode (Standard) /
ESD Protection Diode

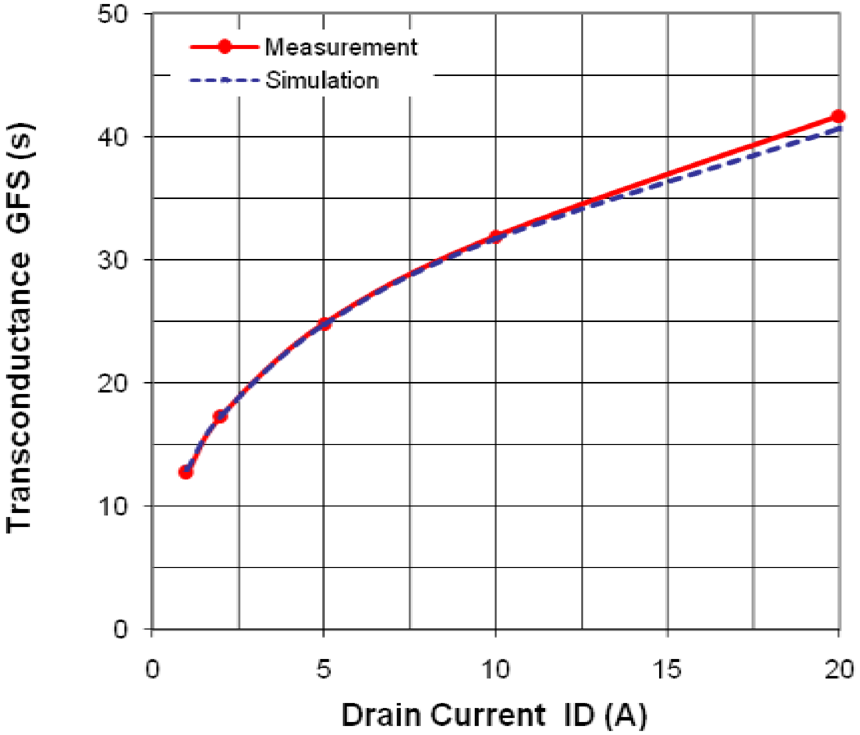
Bee Technologies Inc.

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

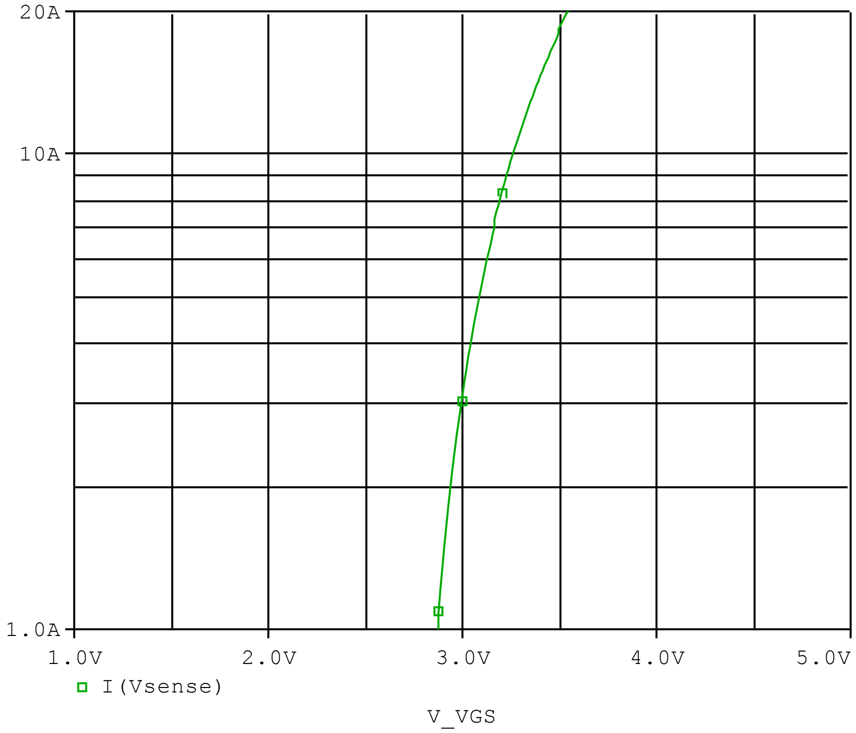


Comparison table

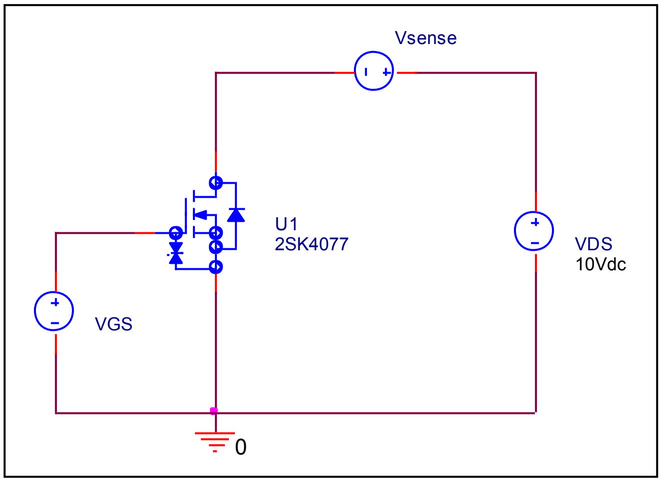
Id(A)	gfs		Error(%)
	Measurement	Simulation	
1.000	12.667	12.987	2.53
2.000	17.333	17.391	0.33
5.000	24.800	24.752	-0.19
10.000	31.880	31.676	-0.64
20.000	41.667	40.650	-2.44

Vgs-Id Characteristic

Circuit Simulation result

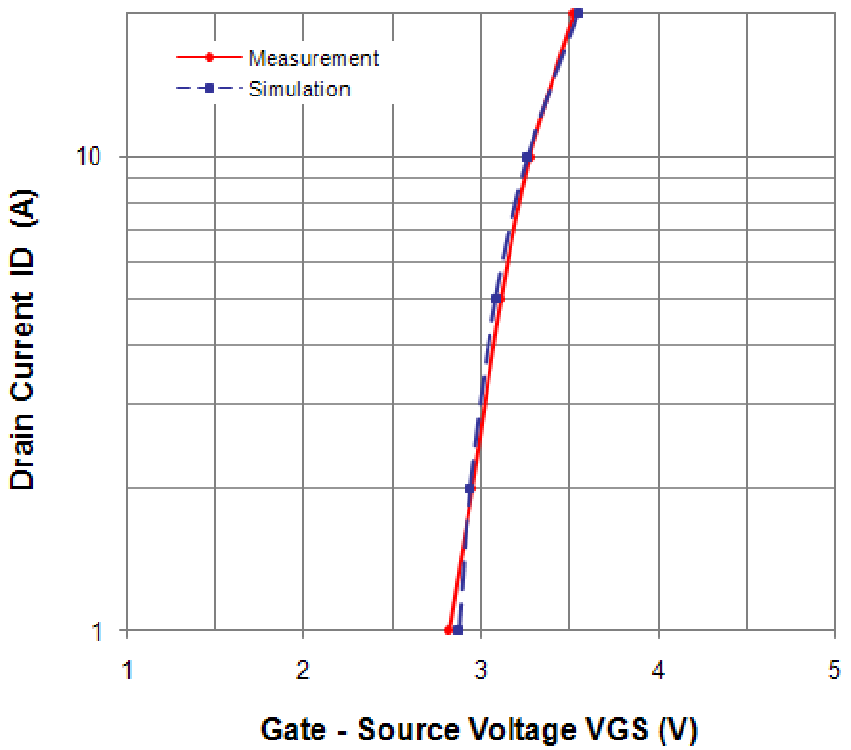


Evaluation circuit



Comparison Graph

Circuit Simulation Result

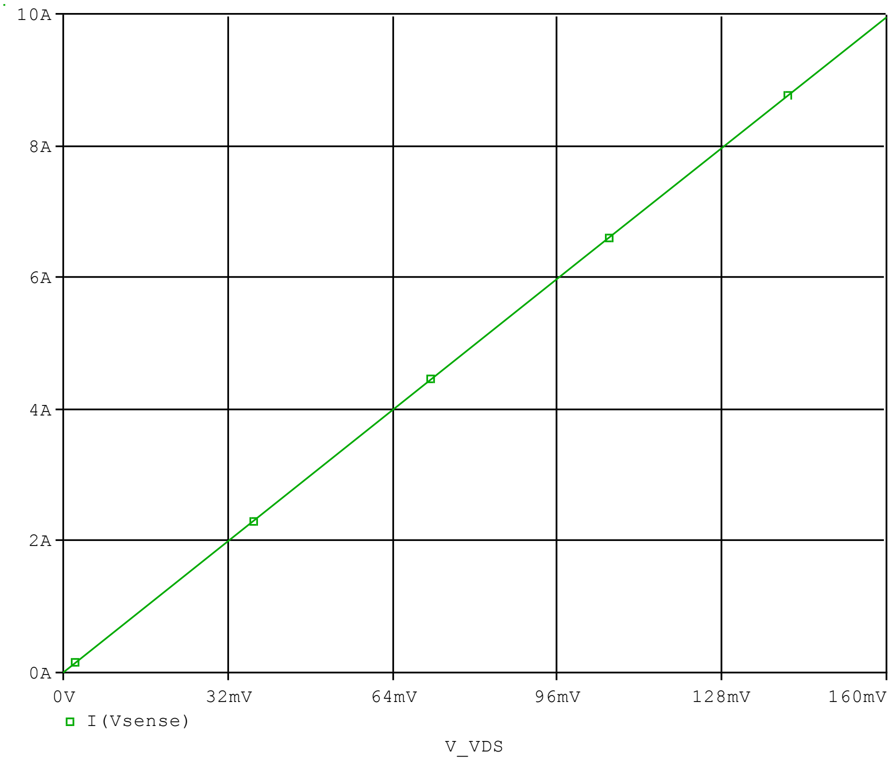


Simulation Result

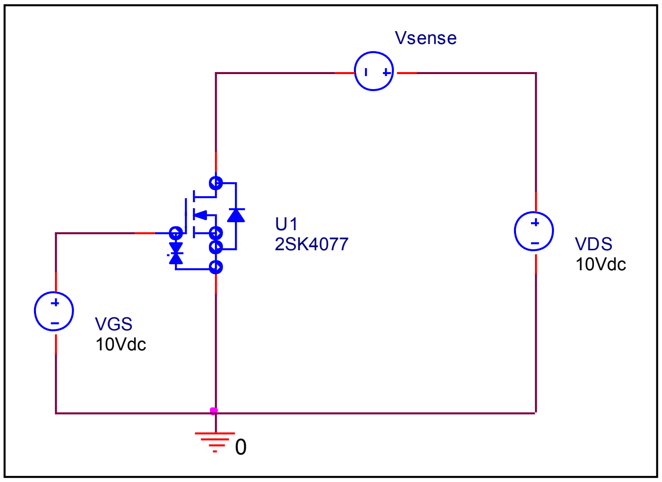
I_D(A)	V_{GS}(V)		Error (%)
	Measurement	Simulation	
1.000	2.820	2.874	1.92
2.000	2.950	2.941	-0.32
5.000	3.110	3.083	-0.86
10.000	3.280	3.262	-0.56
20.000	3.520	3.547	0.76

Rds(on) Characteristic

Circuit Simulation result



Evaluation circuit

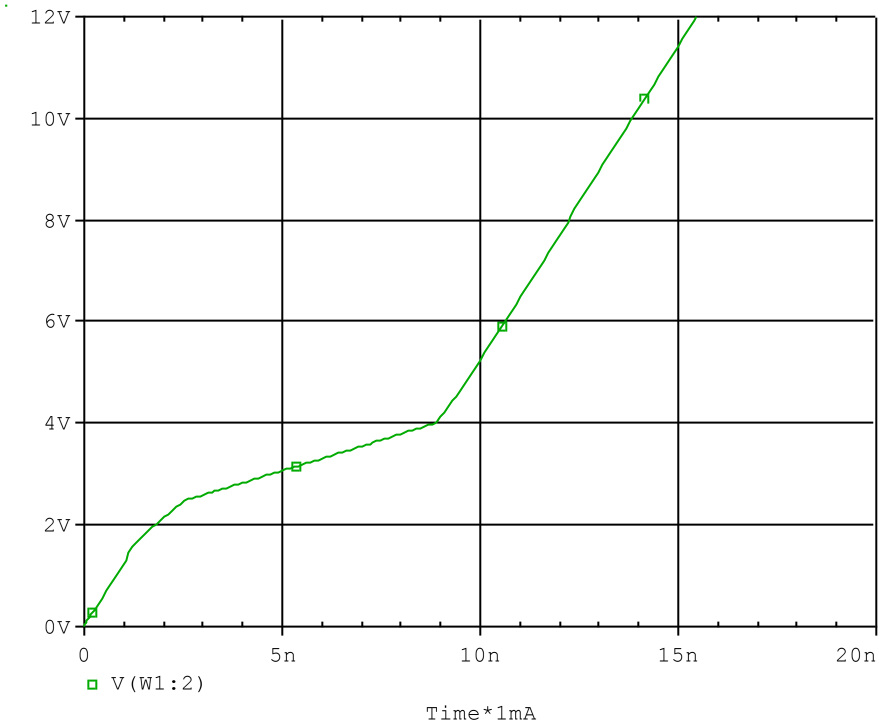


Simulation Result

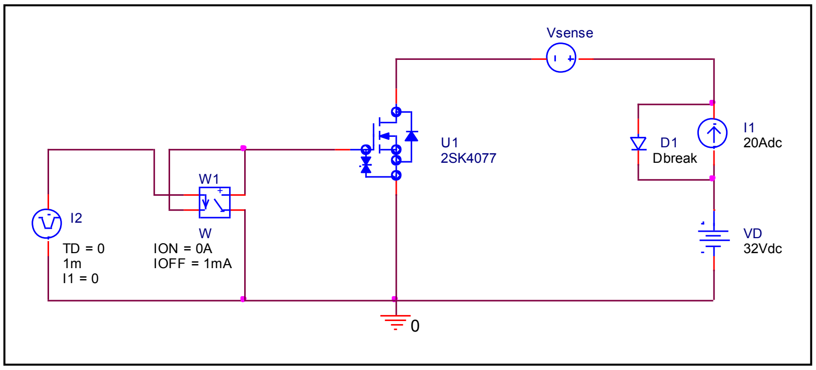
I_D = 10A, V_{GS} = 10V		Measurement	Simulation	Error (%)
R_{DS} (on)	mΩ	16	16	0.00

Gate Charge Characteristic

Circuit Simulation result



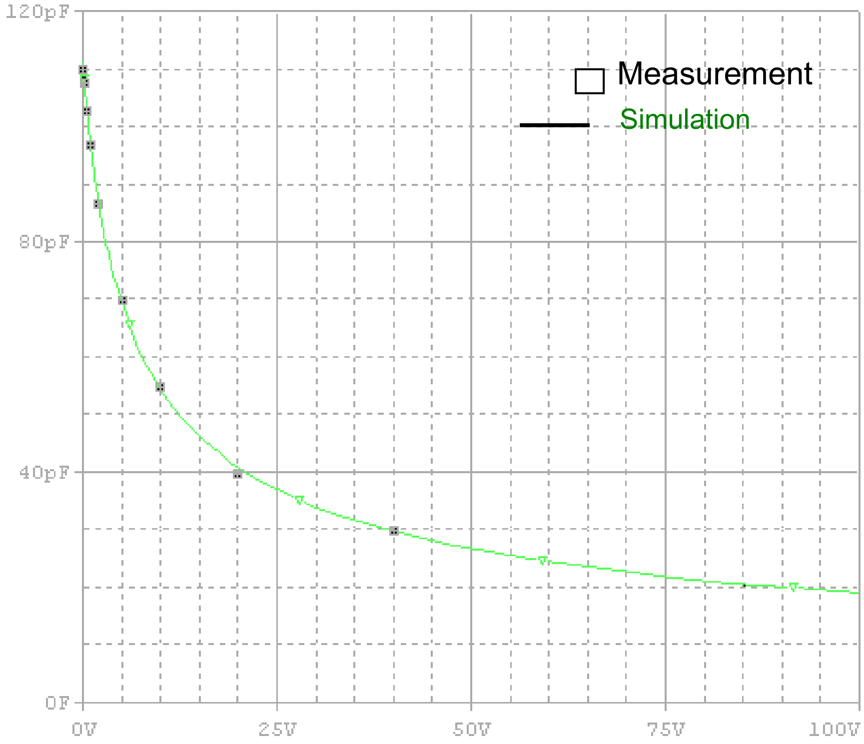
Evaluation circuit



Simulation Result

V_{DD}=32V, I_D=20A, V_{GS}=10V		Measurement	Simulation	Error (%)
Qgs	nC	3.00	2.97	-1.00
Qgd	nC	6.00	5.98	-0.33
Qg	nC	18.00	13.84	-23.11

Capacitance Characteristic

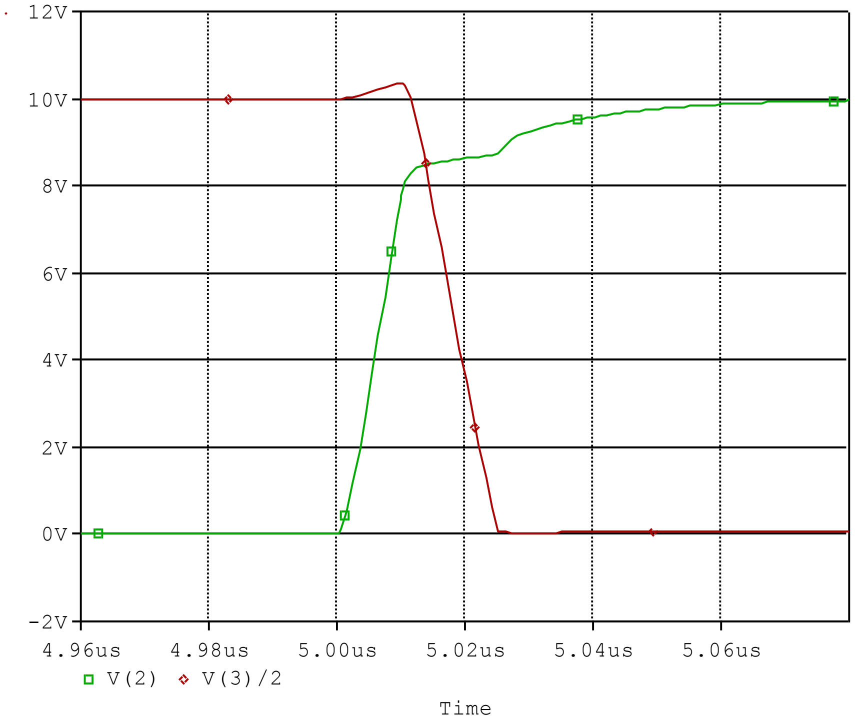


Simulation Result

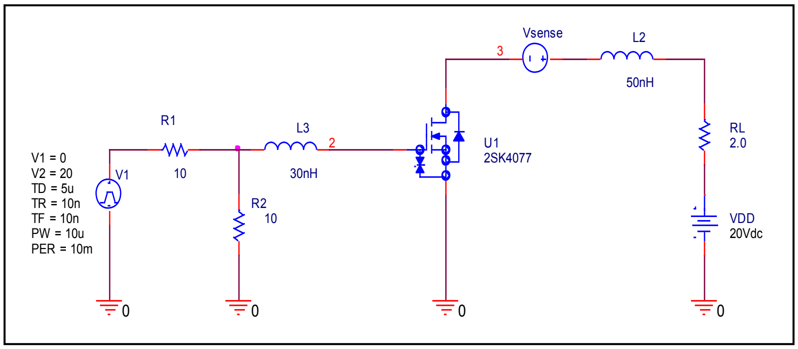
V_{DS} (V)	Cbd (pF)		Error(%)
	Measurement	Simulation	
0.100	110.00	106.00	3.77
0.200	108.00	110.00	-1.82
0.500	100.00	101.00	-0.99
1.000	90.00	91.00	-1.10
2.000	82.00	84.00	-2.38
5.000	70.00	69.00	1.45
10.000	55.00	54.00	1.85
20.000	40.00	41.50	-3.61
40.000	28.00	27.60	1.45

Switching Time Characteristic

Circuit Simulation result



Evaluation circuit

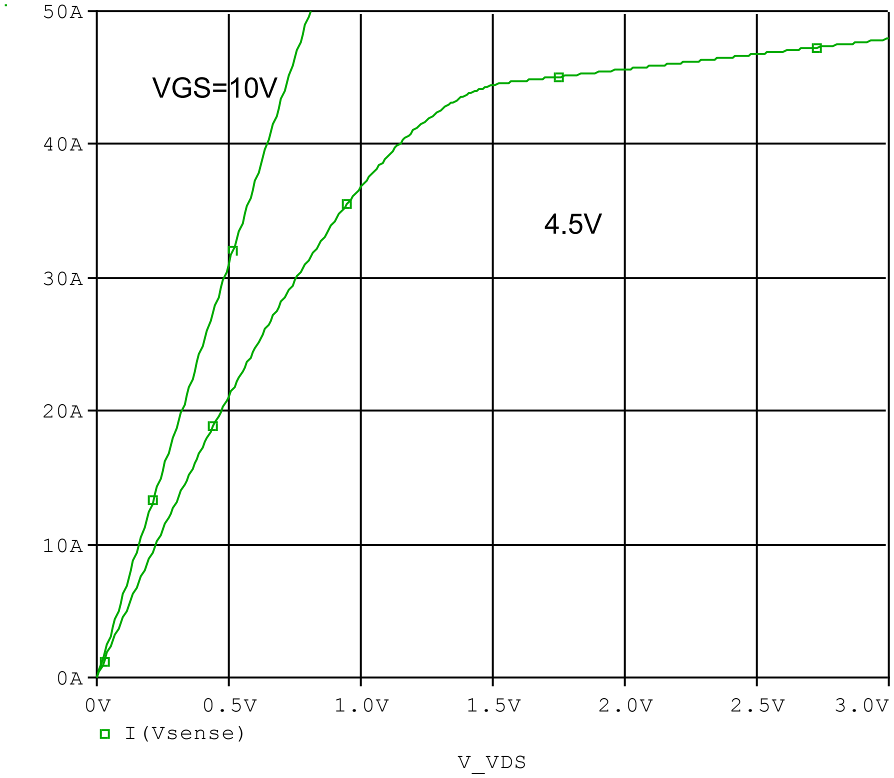


Simulation Result

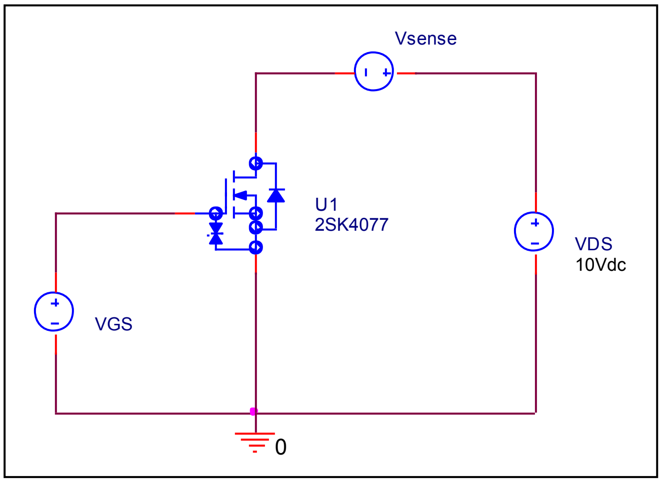
I_D=10 A, V_{DD}=20V V_{GS}=0/10V		Measurement	Simulation	Error(%)
td(on)	ns	11.00	10.94	-0.55

Output Characteristic

Circuit Simulation result

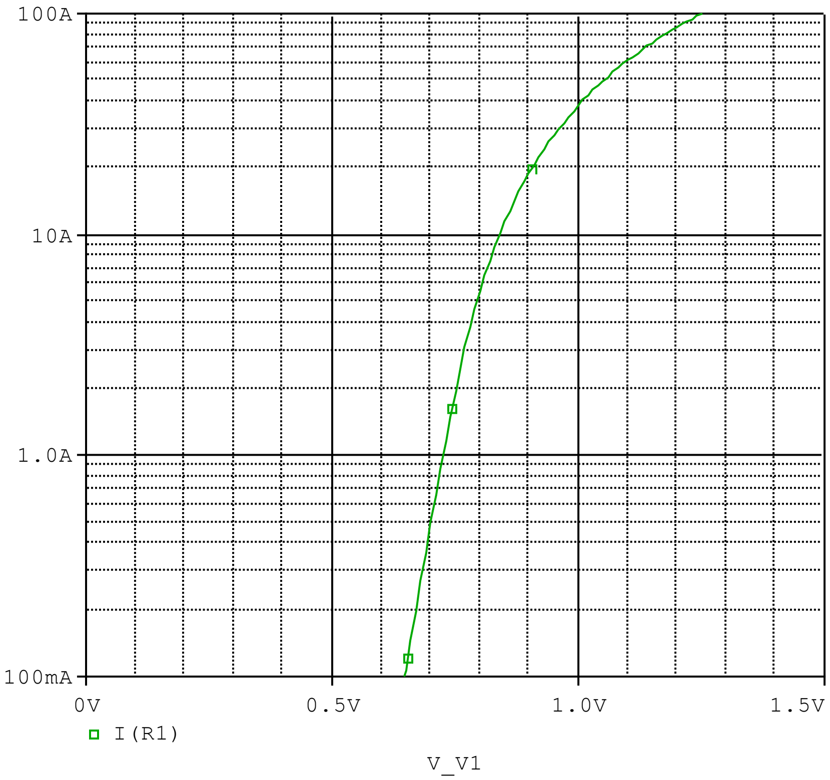


Evaluation circuit

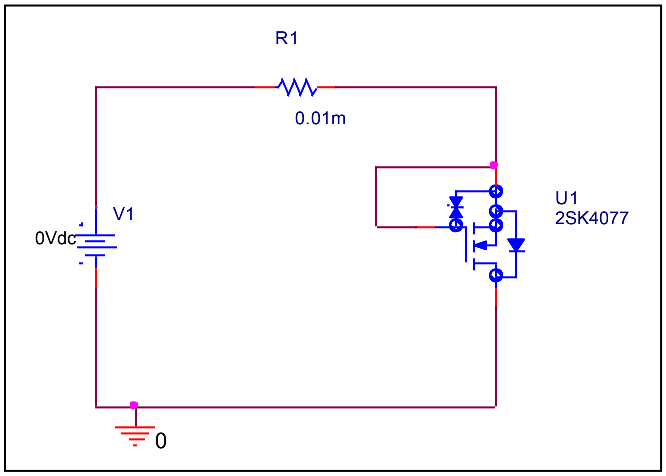


Forward Current Characteristic

Circuit Simulation Result

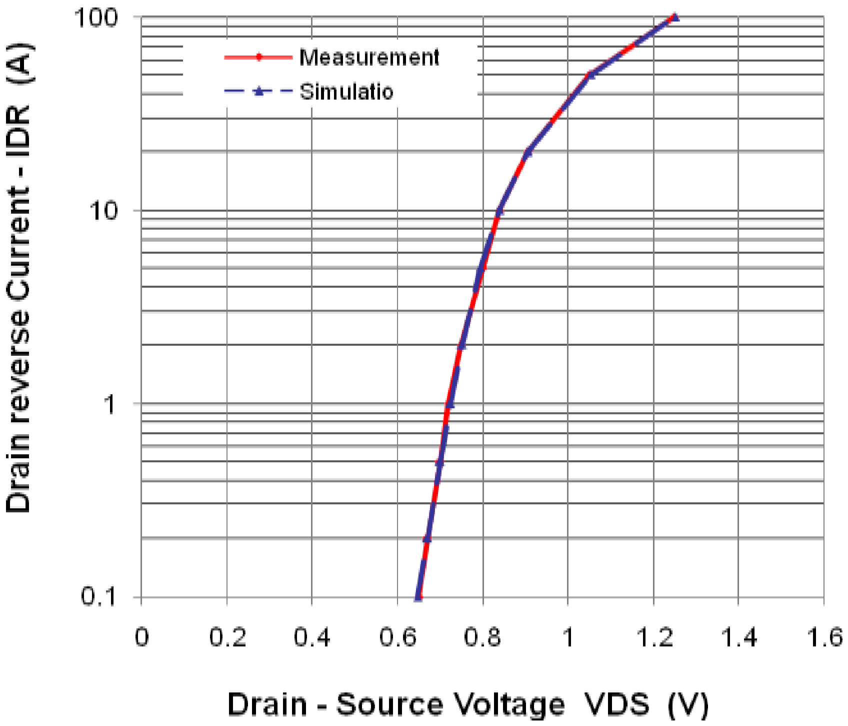


Evaluation Circuit



Comparison Graph

Circuit Simulation Result

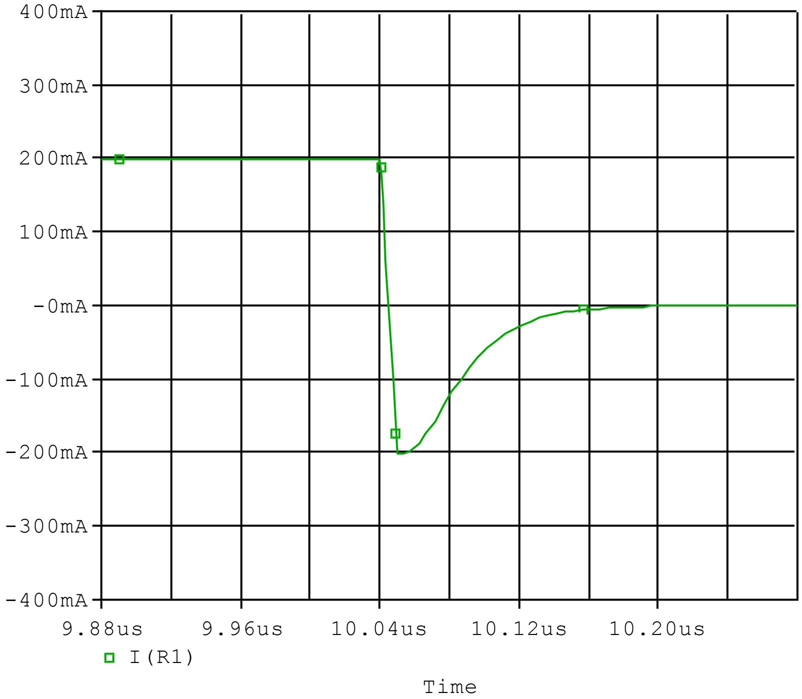


Simulation Result

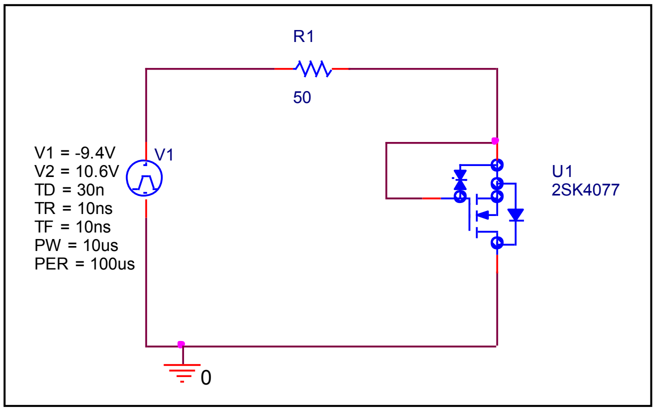
IDR(A)	VSD(V)		%Error
	Measurement	Simulation	
0.10	0.650	0.648	-0.34
0.20	0.670	0.670	0.03
0.50	0.700	0.700	0.00
1.00	0.720	0.724	0.56
2.00	0.750	0.751	0.15
5.00	0.800	0.794	-0.72
10.00	0.840	0.840	-0.05
20.00	0.905	0.906	0.08
50.00	1.050	1.052	0.22
100.00	1.250	1.250	0.02

Reverse Recovery Characteristics (Body Diode)

Circuit Simulation Result



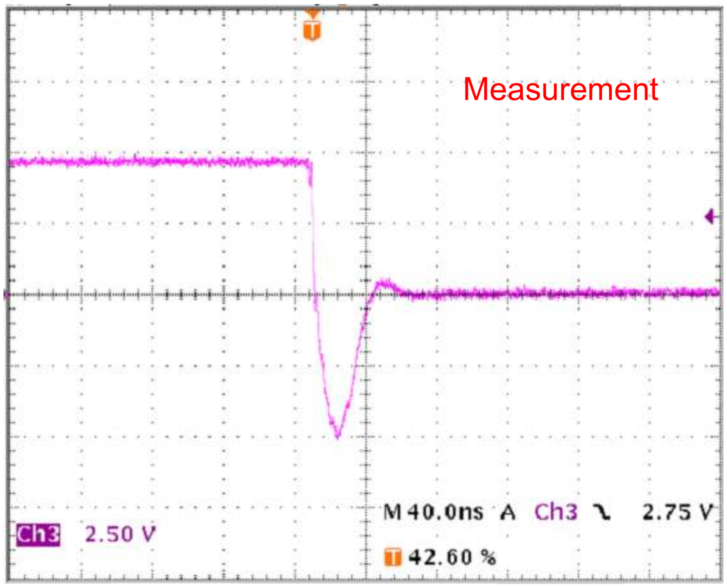
Evaluation Circuit



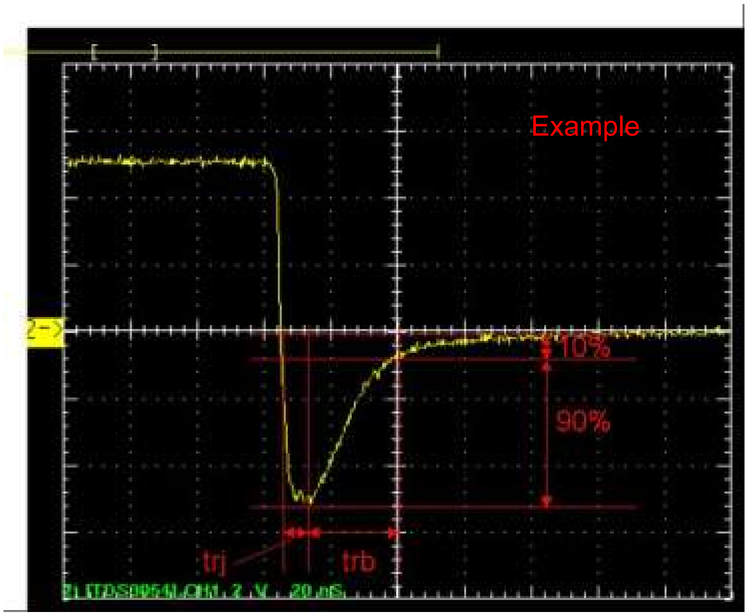
Compare Measurement vs. Simulation

		Measurement	Simulation	Error (%)
trj	ns	12.80	12.78	-0.16

Reverse Recovery Characteristic Reference



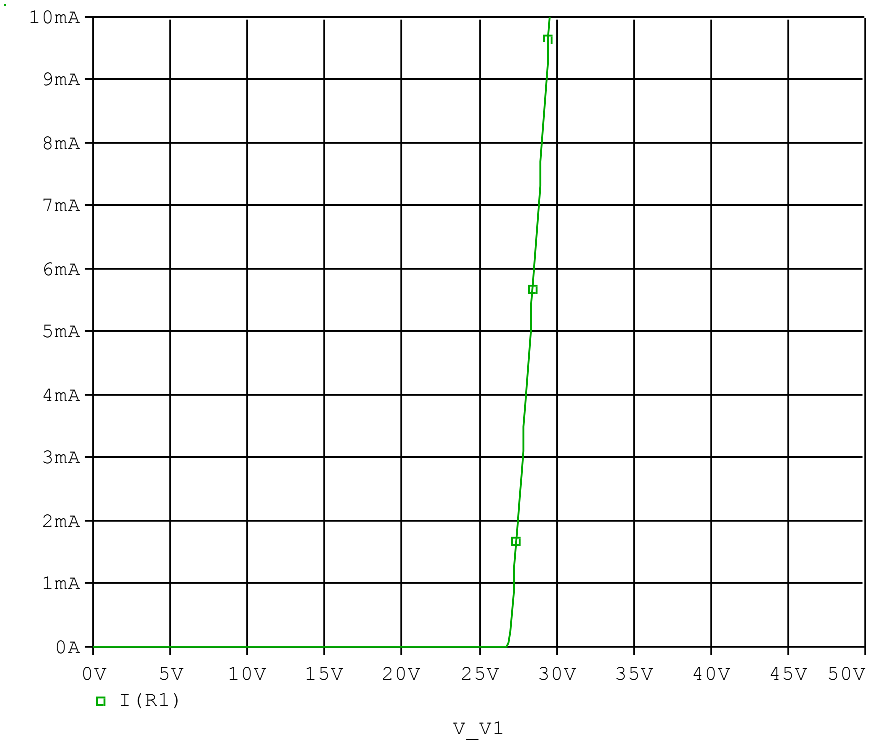
Trj=12.8(ns)
Trb=16.8(ns)
Conditions:Ifwd=Irev=0.2(A),Rl=50



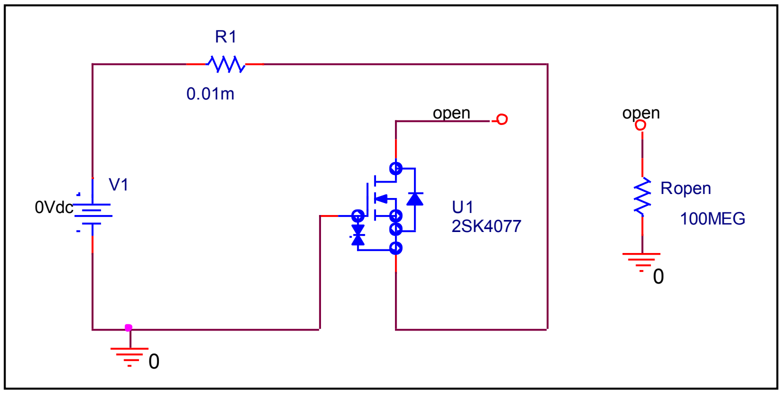
Relation between trj and trb

ESD PROTECTION DIODE SPICE MODEL
Zener Voltage Characteristic

Circuit Simulation Result

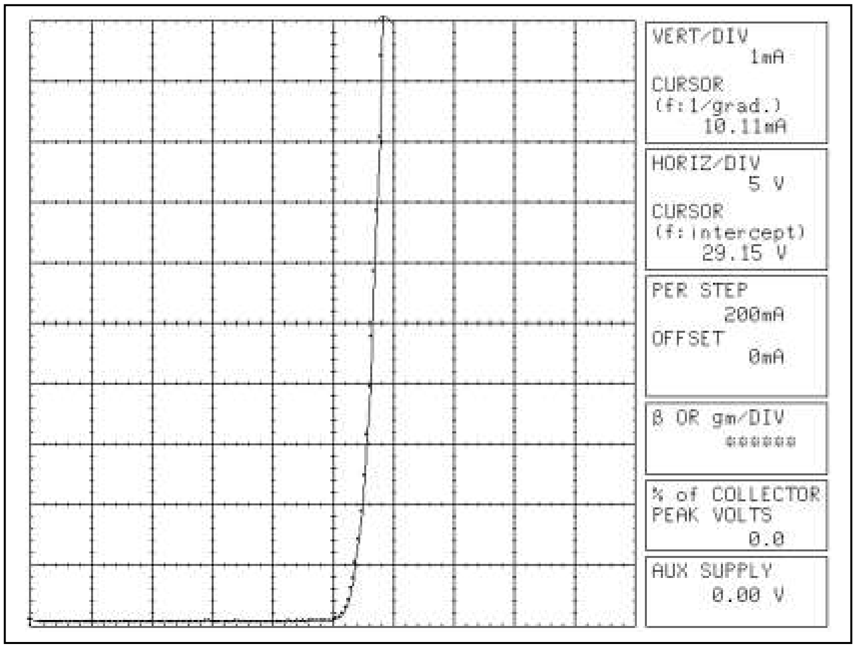


Evaluation Circuit



Zener Voltage Characteristic

Reference



VERT/DIV
1mA
CURSOR
(f:1/grad.)
10.11mA

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

PER STEP
200mA
OFFSET
0mA

β OR gm/DIV
******

% of COLLECTOR
PEAK VOLTS
0.0

AUX SUPPLY
0.00 V