

Device Modeling Report

COMPONENTS: Power MOSFET (Professional)
PART NUMBER: 2SK2611
MANUFACTURER: TOSHIBA
Body Diode (Professional) / ESD Protection Diode



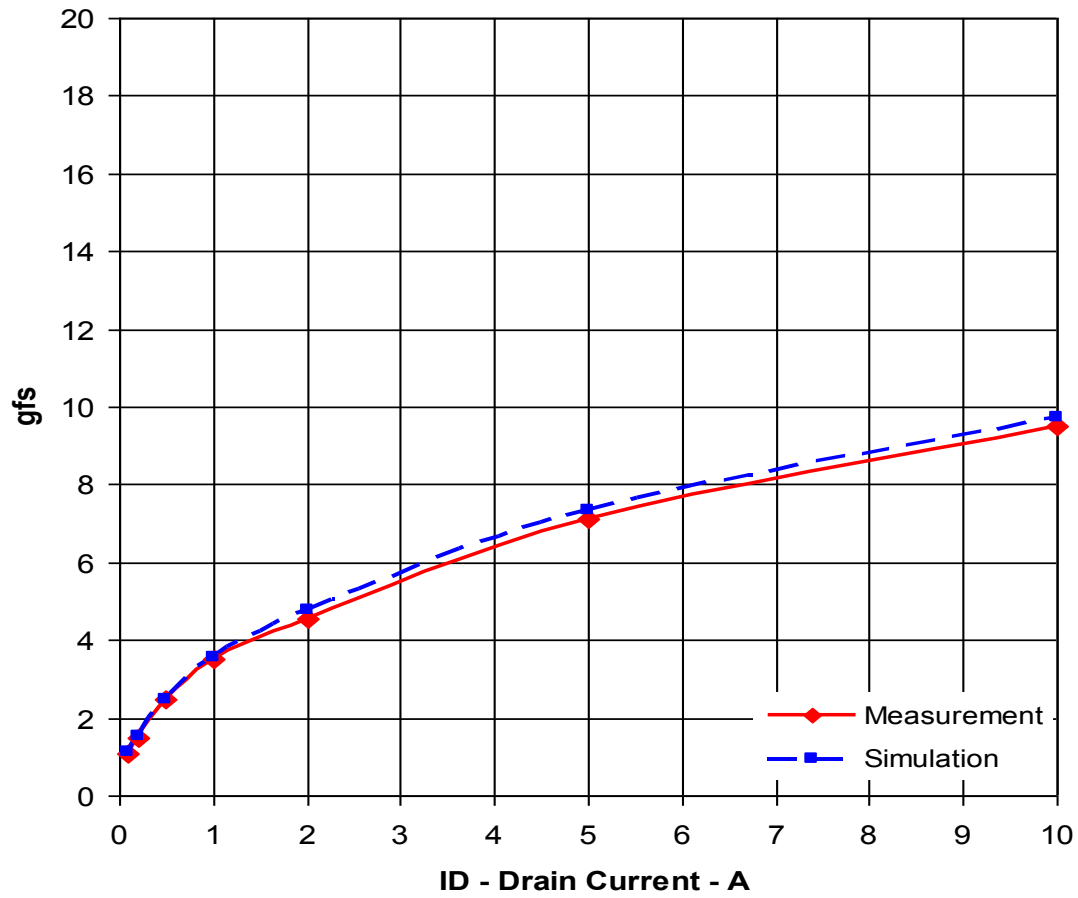
Bee Technologies Inc.

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

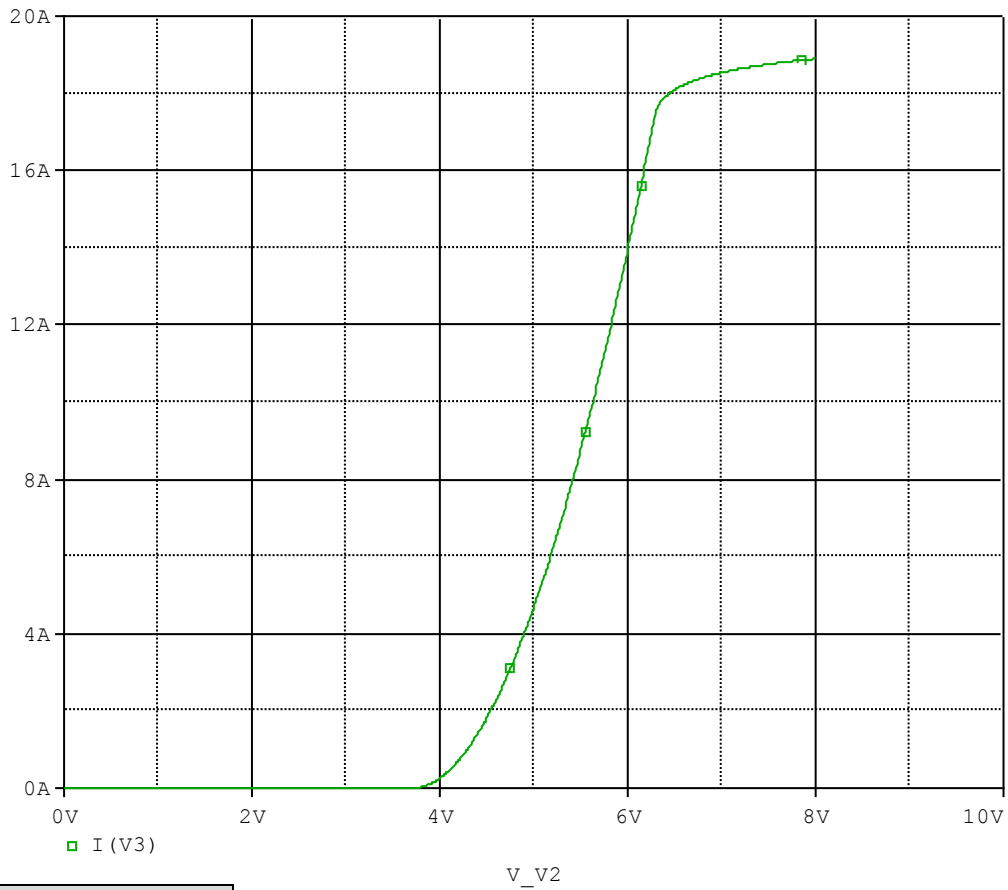


Comparison table

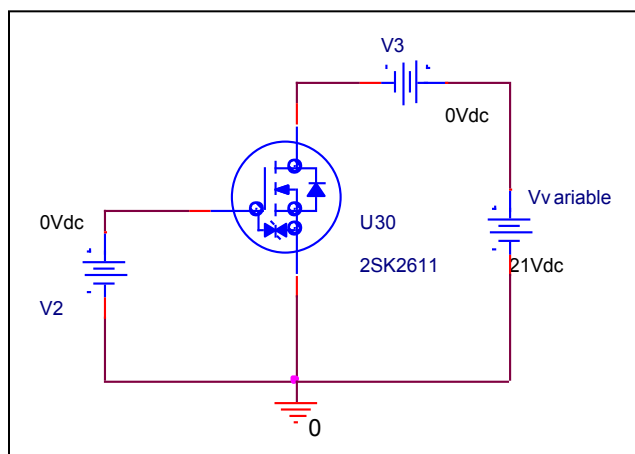
Id(A)	gfs		Error(%)
	Measurement	Simulation	
0.1	1.100	1.111	1.000
0.2	1.500	1.538	2.533
0.5	2.500	2.500	0.000
1	3.500	3.571	2.029
2	4.550	4.762	4.659
5	7.100	7.353	3.563
10	9.500	9.709	2.200

V_{gs}-I_d Characteristic

Circuit Simulation result

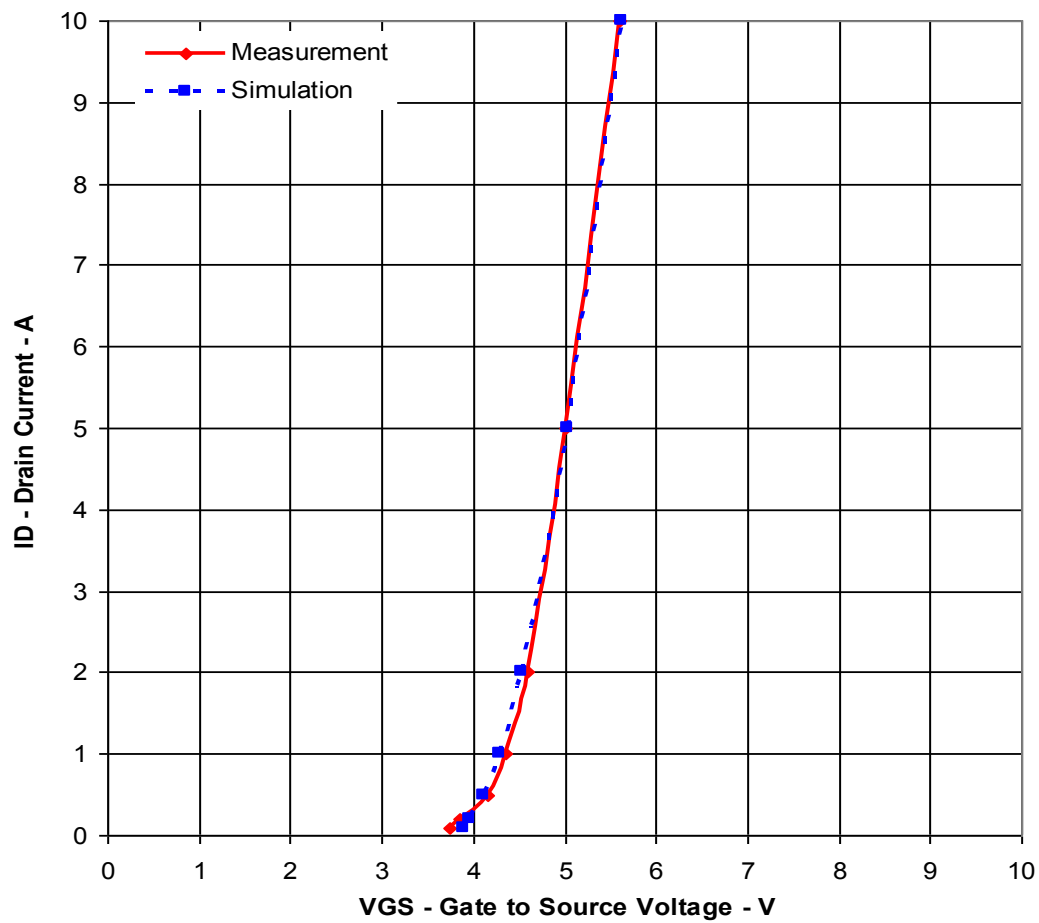


Evaluation circuit



Comparison Graph

Circuit Simulation Result

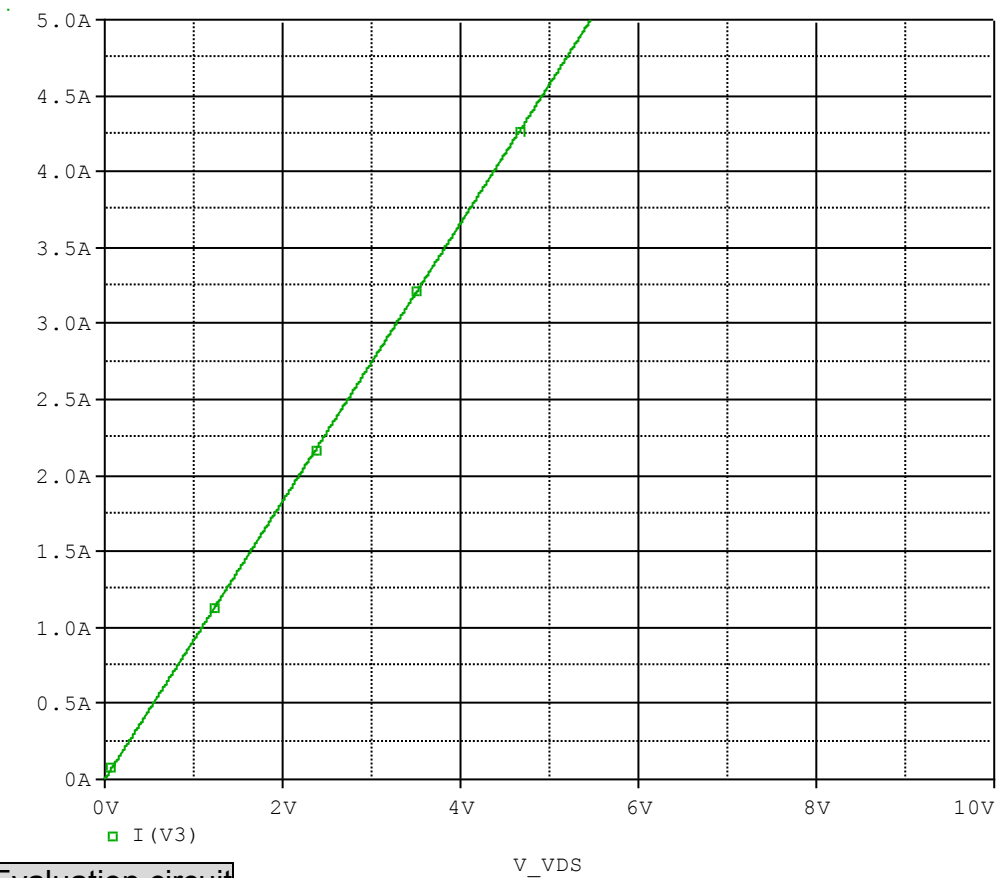


Simulation Result

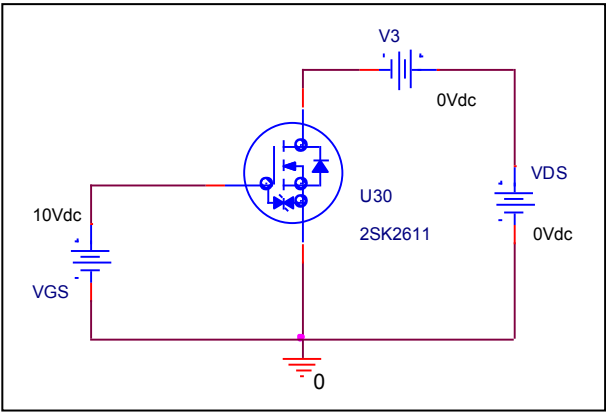
I _D (A)	V _{GS} (V)		Error (%)
	Measurement	Simulation	
0.1	3.750	3.888	3.680
0.2	3.850	3.964	2.961
0.5	4.150	4.117	-0.795
1	4.350	4.290	-1.379
2	4.600	4.539	-1.326
5	5.000	5.043	0.860
10	5.600	5.624	0.429

Rds(on) Characteristic

Circuit Simulation result



Evaluation circuit

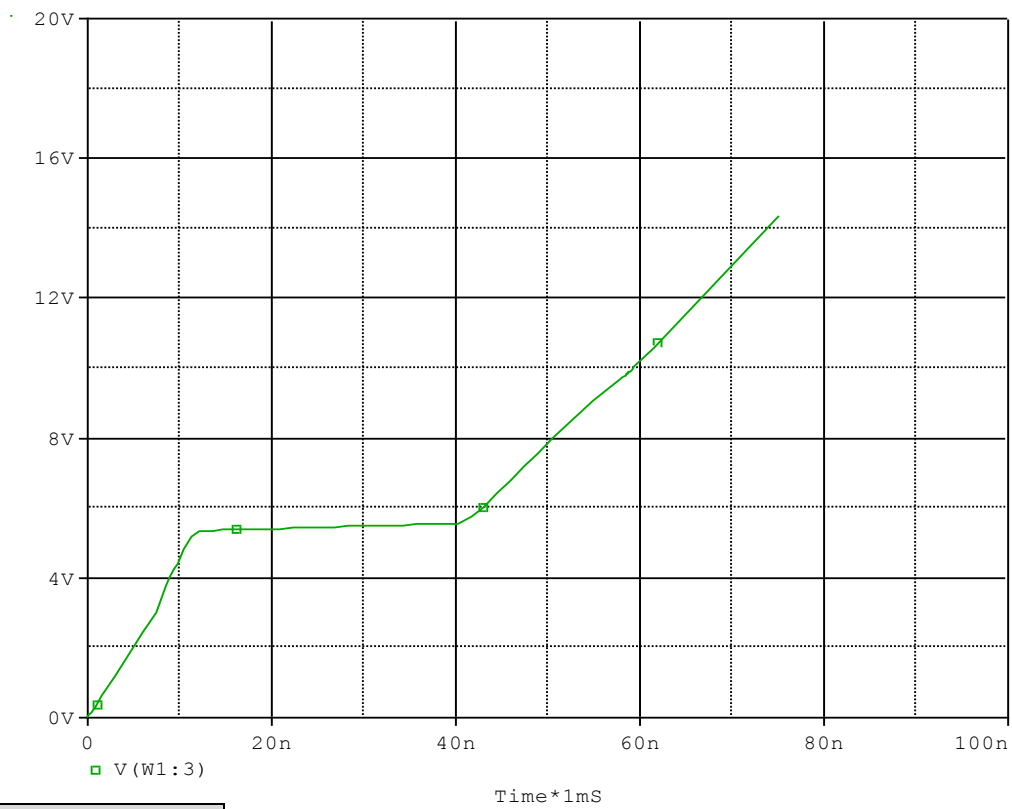


Simulation Result

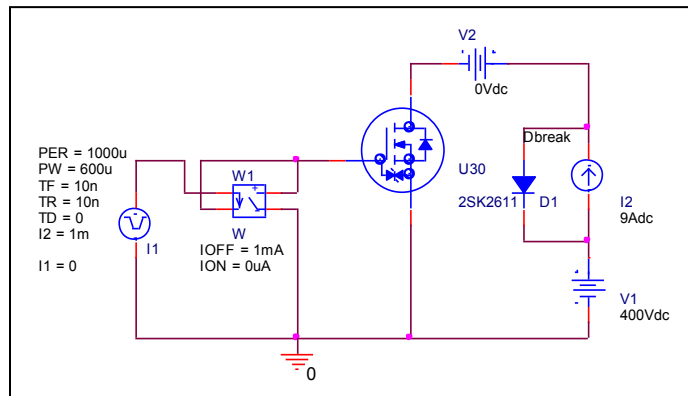
$I_D=4A, V_{GS}=10V$	Measurement		Simulation		Error (%)
$R_{DS} (on)$	1.100	Ω	1.093	Ω	-0.636

Gate Charge Characteristic

Circuit Simulation result



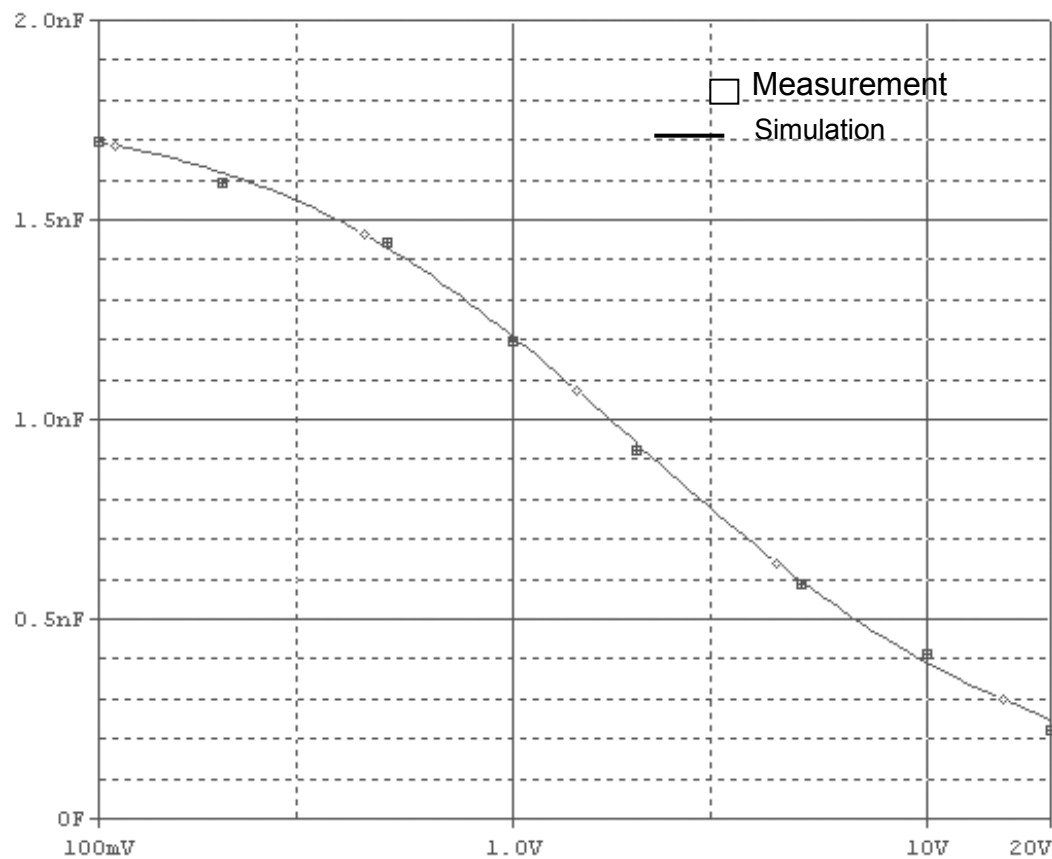
Evaluation circuit



Simulation Result

$V_{DD}=400V, I_D=9A$ $V_{GS}=10V$	Measurement	Simulation	Error (%)
$Q_{gs}(nC)$	12.000	12.069	0.575
$Q_{gd}(nC)$	28.000	28.017	0.061
Q_g	58.000	59.397	2.409

Capacitance Characteristic

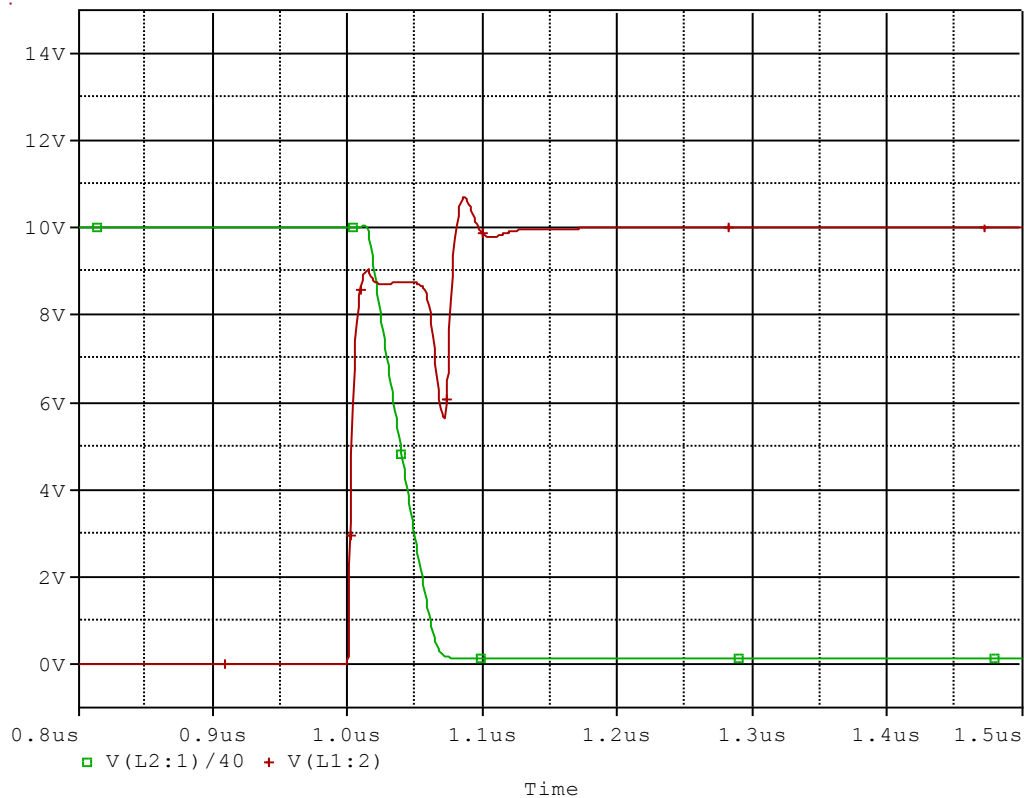


Simulation Result

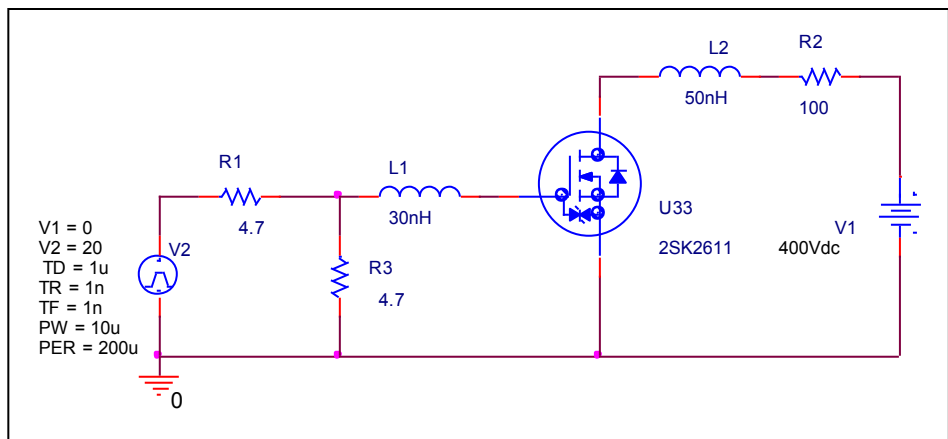
V _{DS} (V)	Cbd(pF)		Error(%)
	Measurement	Simulation	
0.1	1700.000	1688.000	0.118
0.2	1600.000	1620.000	-0.706
0.5	1450.000	1440.000	1.250
1	1200.000	1205.000	-0.690
2	930.000	945.000	0.417
5	595.000	598.000	1.613
10	420.000	393.000	0.504
20	225.000	236.000	-3.095

Switching Time Characteristic

Circuit Simulation result



Evaluation circuit

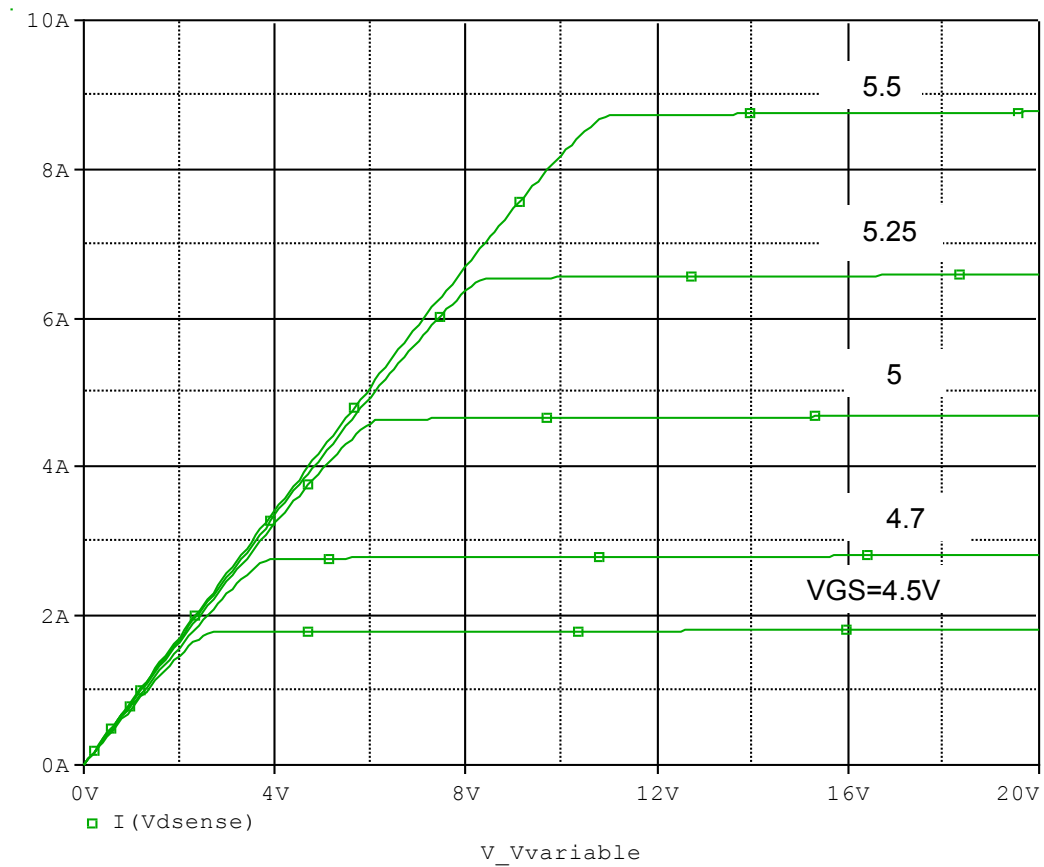


Simulation Result

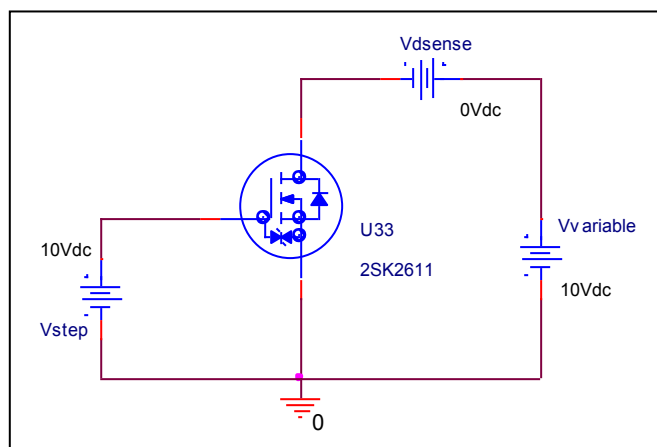
$I_D=4A$, $V_{DD}=400V$ $V_{GS}=0/10V$	Measurement	Simulation	Error(%)
Ton(ns)	60.000	60.071	0.118

Output Characteristic

Circuit Simulation result

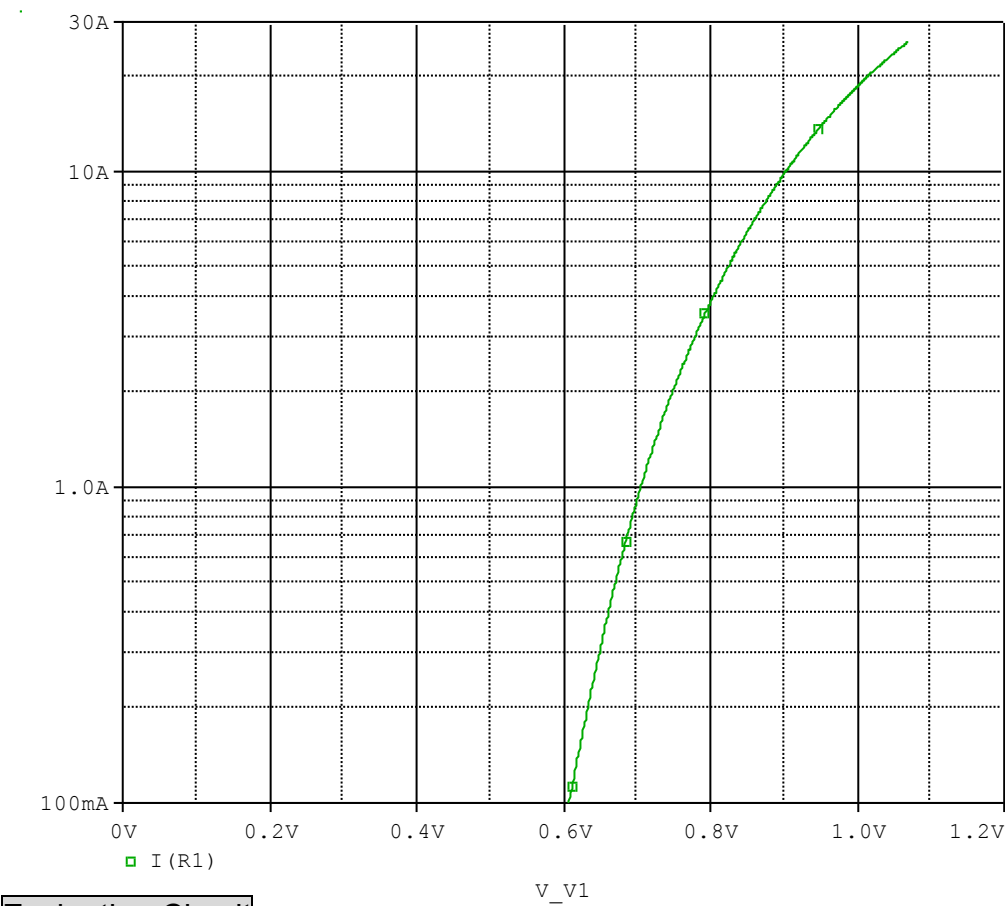


Evaluation circuit

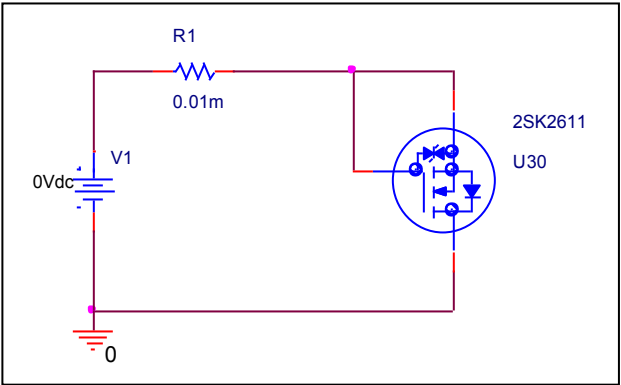


Forward Current Characteristic

Circuit Simulation Result

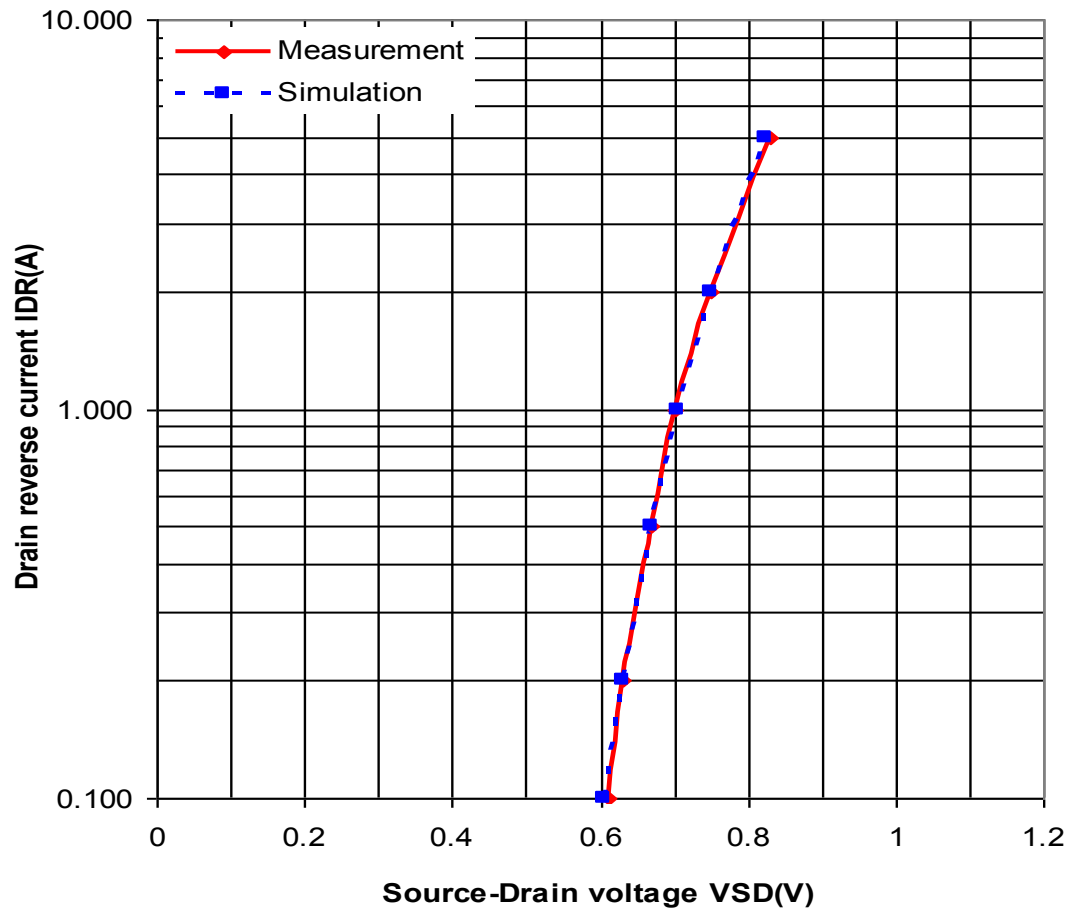


Evaluation Circuit



Comparison Graph

Circuit Simulation Result

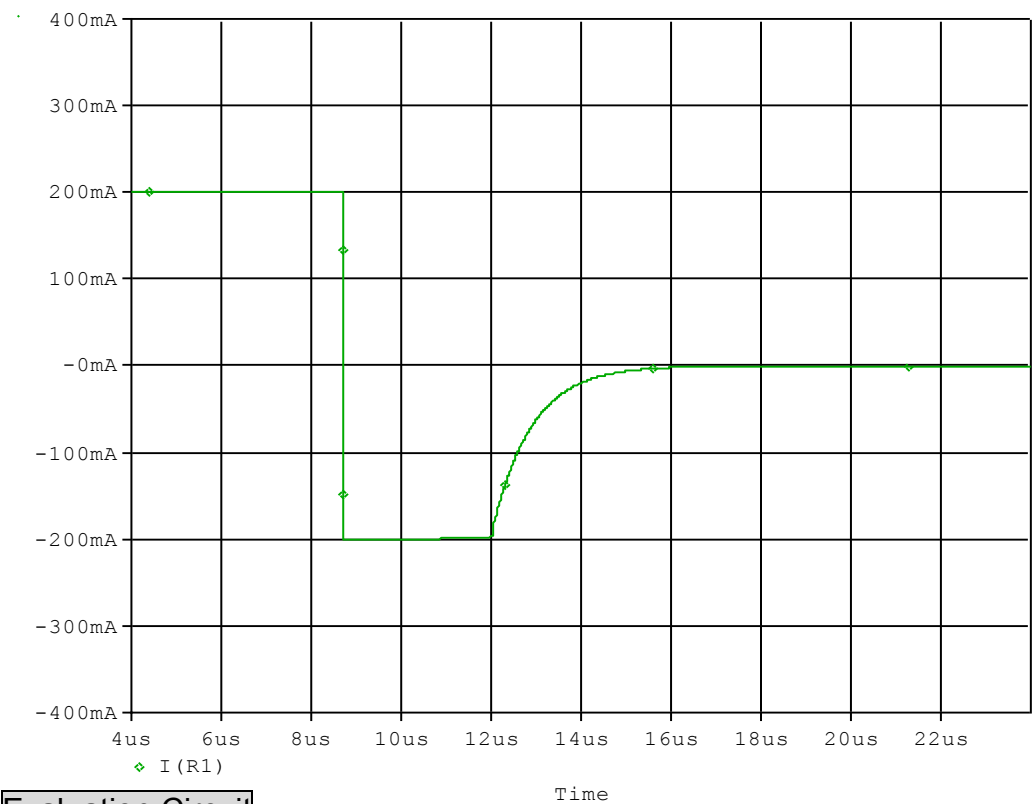


Simulation Result

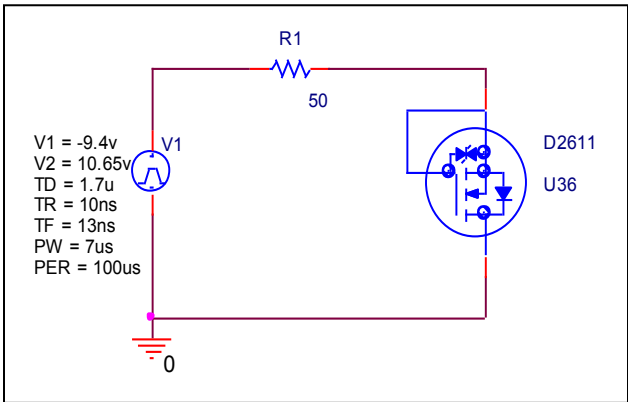
IDR(A)	VSD(V)		%Error
	Measuremen	Simulation	
0.1	0.610	0.606	-0.656
0.2	0.630	0.632	0.317
0.5	0.670	0.670	0.000
1	0.700	0.705	0.714
2	0.750	0.748	-0.267
5	0.830	0.824	-0.723

Reverse Recovery Characteristic

Circuit Simulation Result



Evaluation Circuit

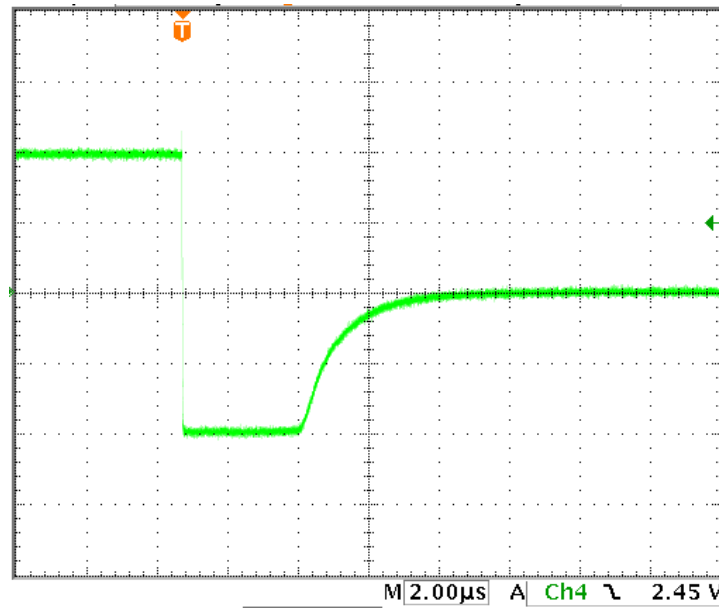


Compare Measurement vs. Simulation

	Measurement	Simulation	Error (%)
Trj(us)	3.200	3.282	2.563
Trb(us)	2.000	2.000	0.000
Trr(us)	5.200	5.282	1.577

Reverse Recovery Characteristic

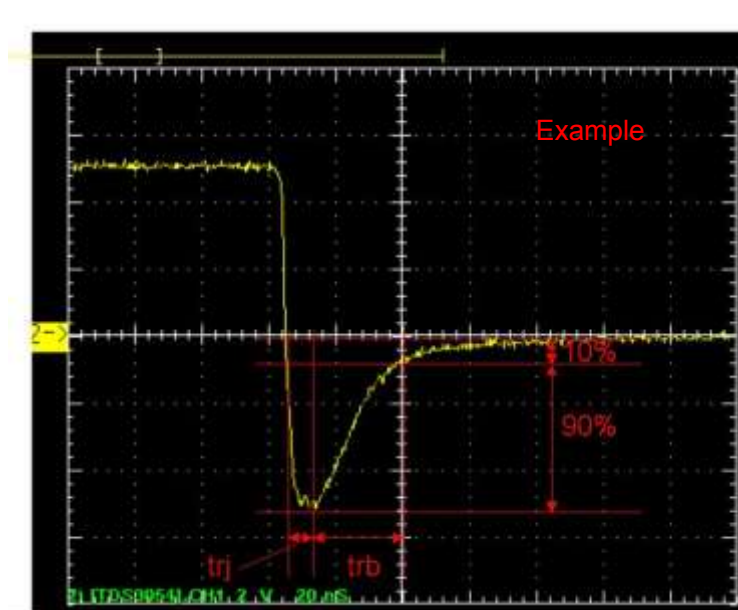
Reference



$T_{rr}=3.200\text{ (us)}$

$T_{rb}=2.000\text{ (us)}$

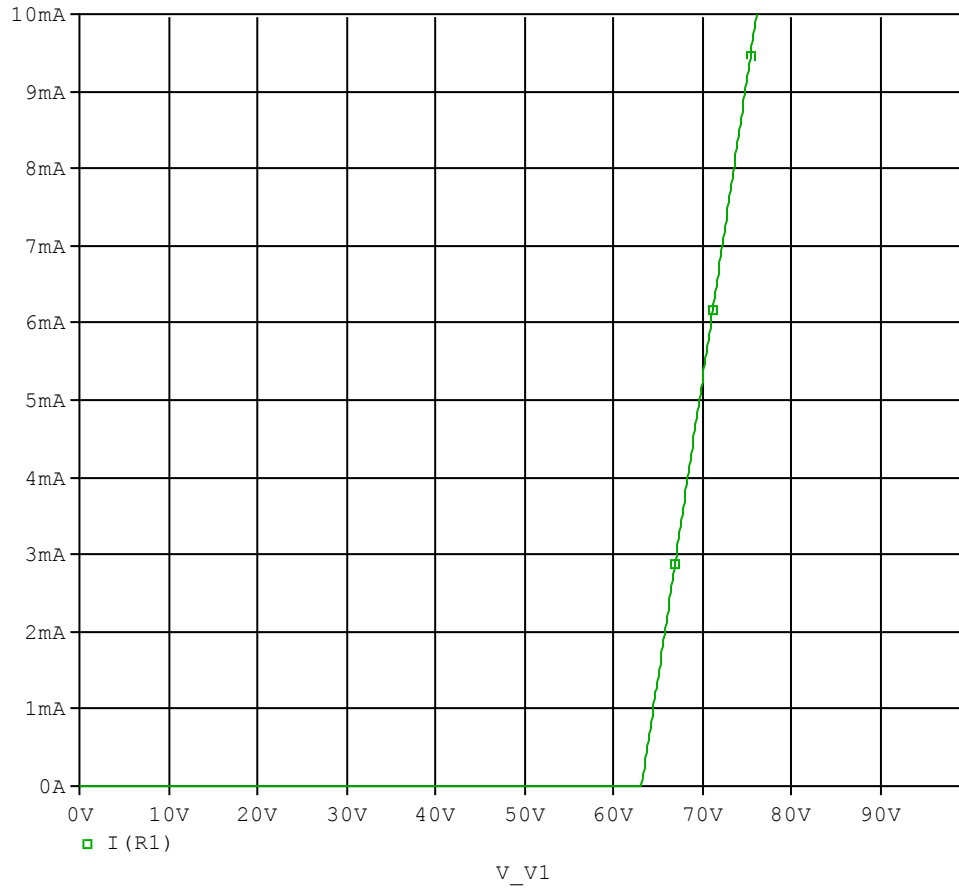
Conditions: $I_{fwd}=I_{rev}=0.2\text{ (A)}$, $R_I=50$



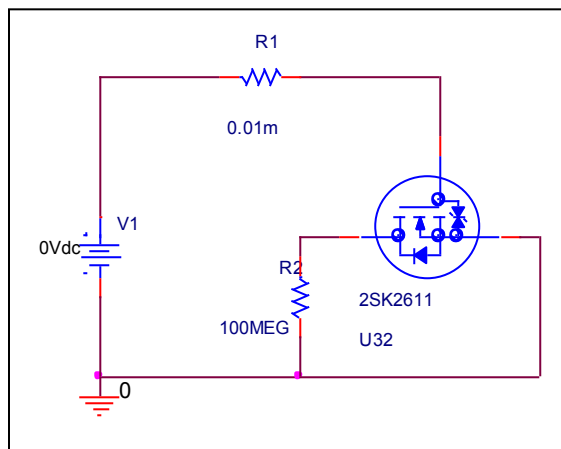
Relation between t_{rr} and t_{rb}

Zener Voltage Characteristic

Circuit Simulation Result



Evaluation Circuit



Zener Voltage Characteristic

Reference

