

Device Modeling Report

COMPONENTS: Power MOSFET (Professional)
PART NUMBER: 2SK2962
MANUFACTURER: TOSHIBA
Body Diode (Professional) / ESD Protection Diode

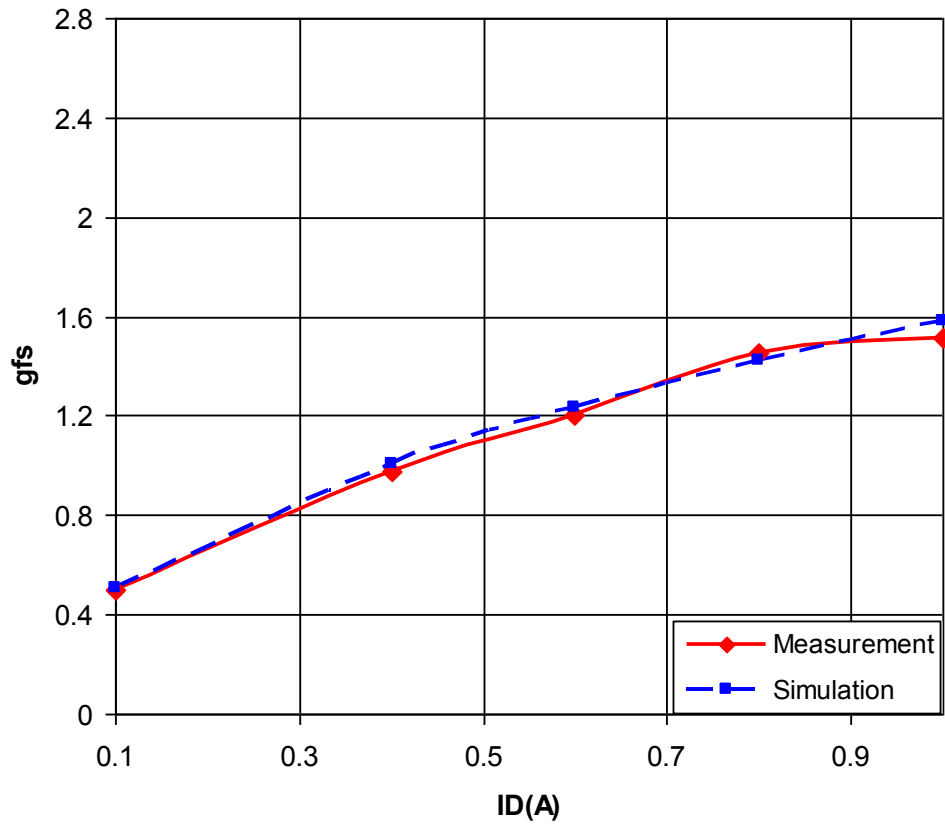


MOSFET MODEL

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

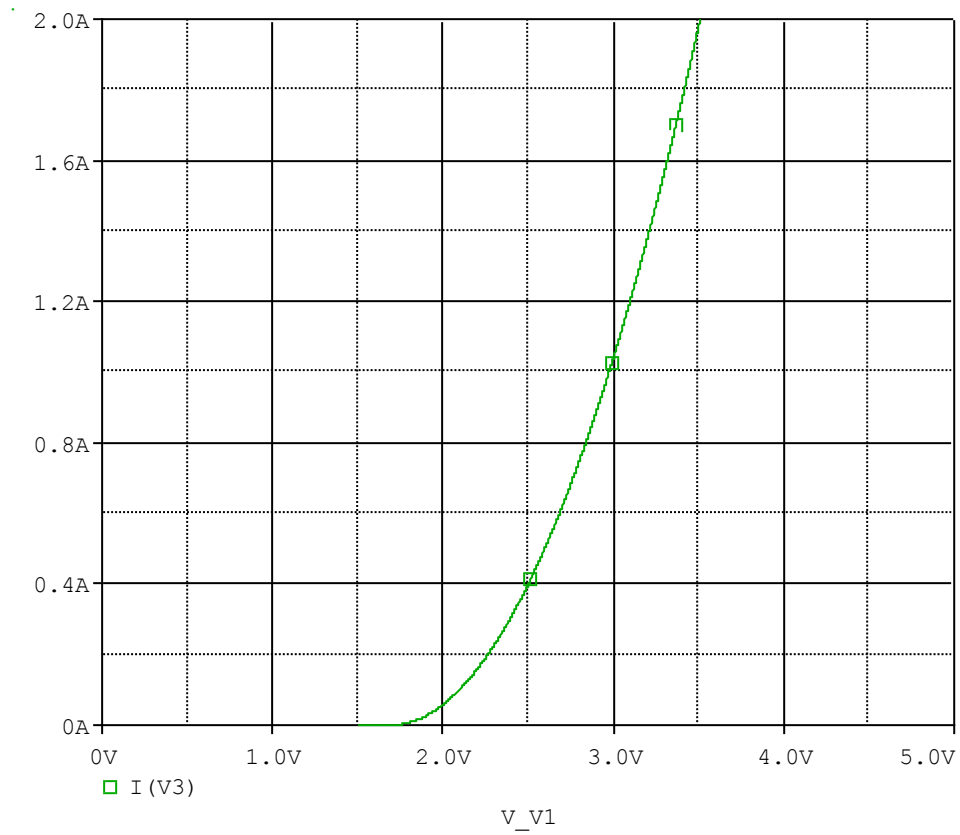


Comparison table

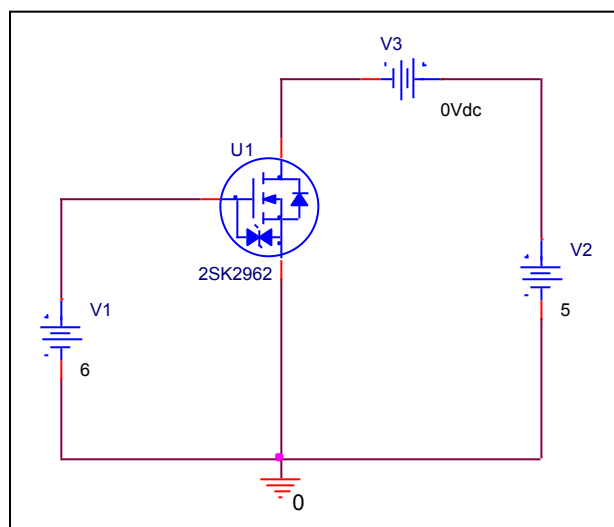
Id(A)	gfs		Error(%)
	Measurement	Simulation	
0.1	0.5	0.508	1.600
0.4	0.977	1.010	3.378
0.6	1.2	1.232	2.667
0.8	1.455	1.421	-2.337
1	1.515	1.585	4.620

Vgs-Id Characteristic

Circuit Simulation result

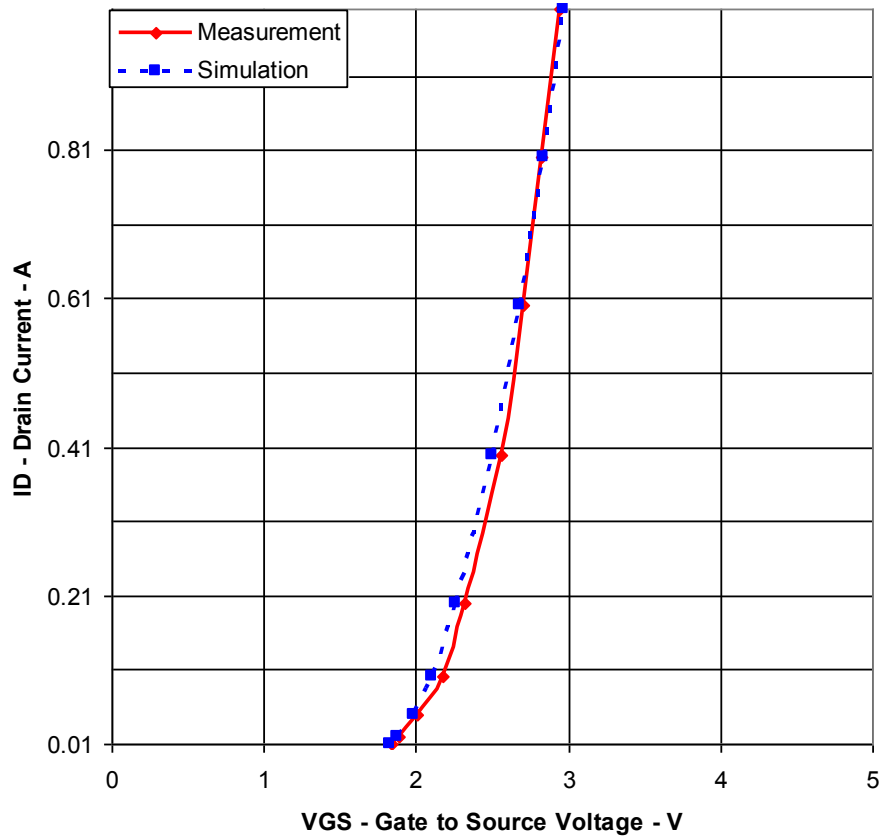


Evaluation circuit



Comparison Graph

Circuit Simulation Result

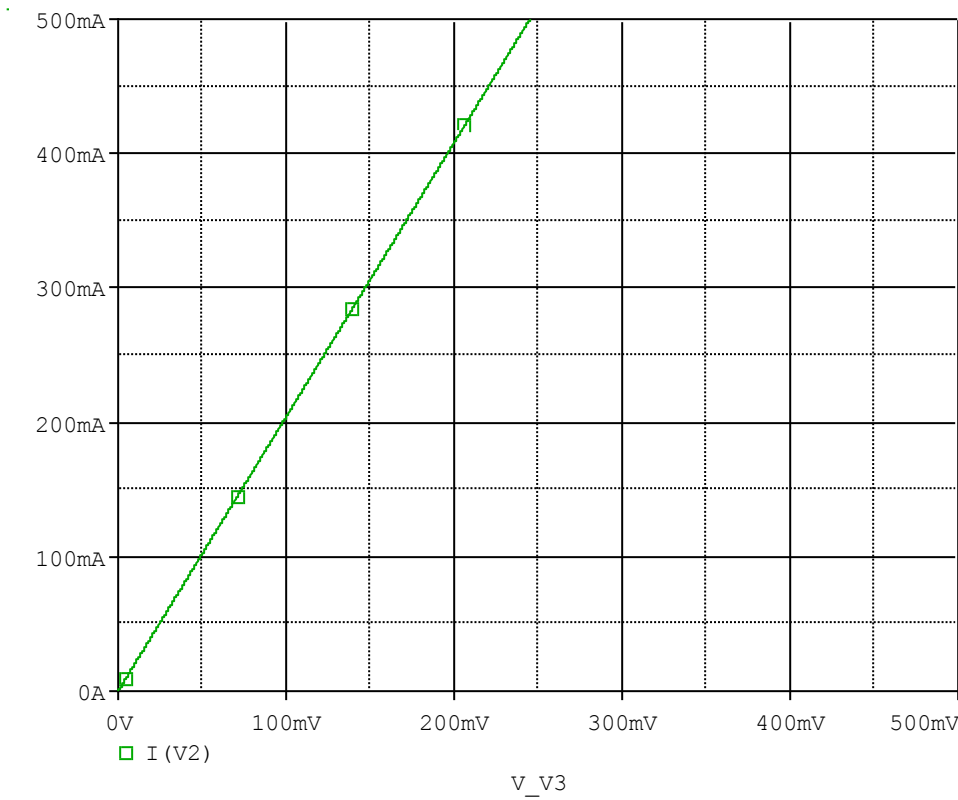


Simulation Result

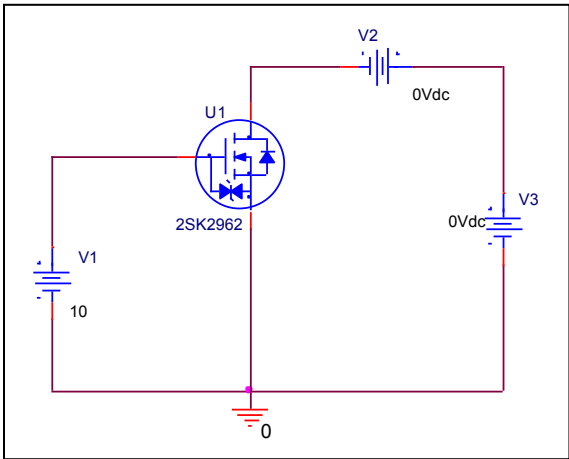
I _D (A)	V _{GS} (V)		Error (%)
	Measurement	Simulation	
0.01	1.84	1.821	-1.033
0.02	1.89	1.8723	-0.937
0.05	2.005	1.9786	-1.317
0.1	2.17	2.0967	-3.378
0.2	2.32	2.2642	-2.405
0.4	2.559	2.5015	-2.247
0.6	2.7	2.684	-0.593
0.8	2.825	2.8382	0.467
1	2.944	2.9743	1.029

Rds(on) Characteristic

Circuit Simulation result



Evaluation circuit

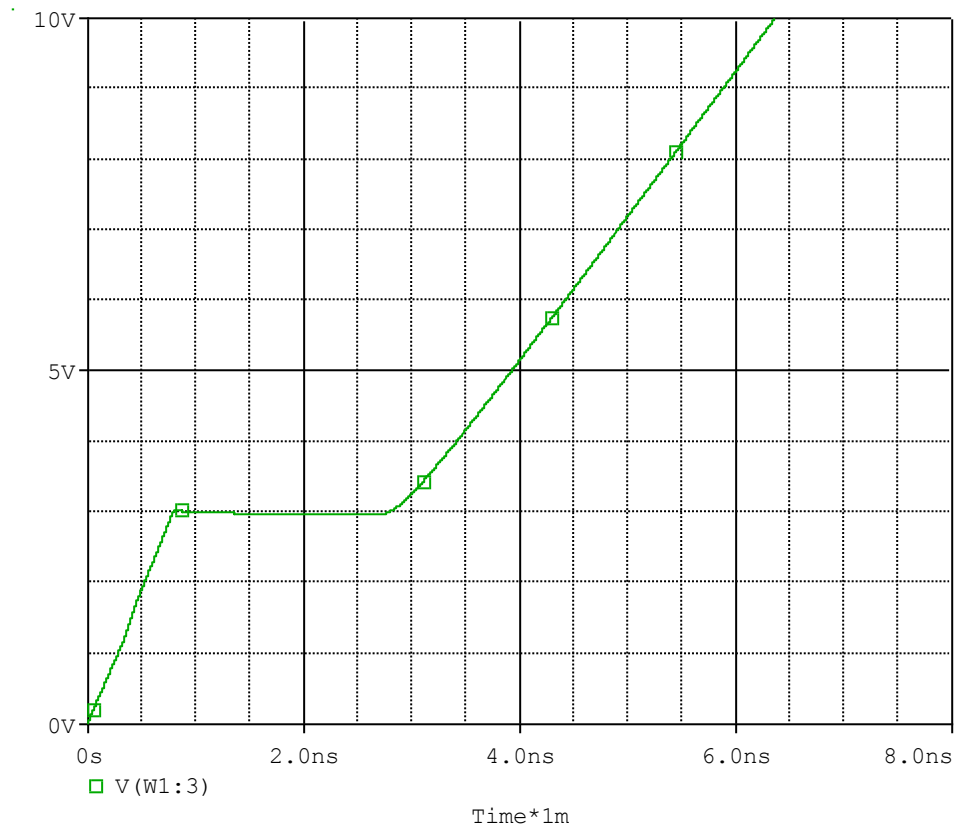


Simulation Result

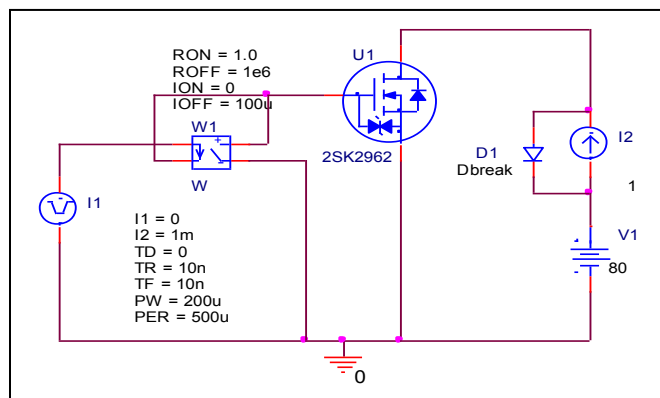
$I_D=0.5A, V_{GS}=10V$	Measurement		Simulation		Error (%)
$R_{DS(on)}$	0.5	Ω	0.49	Ω	-2

Gate Charge Characteristic

Circuit Simulation result



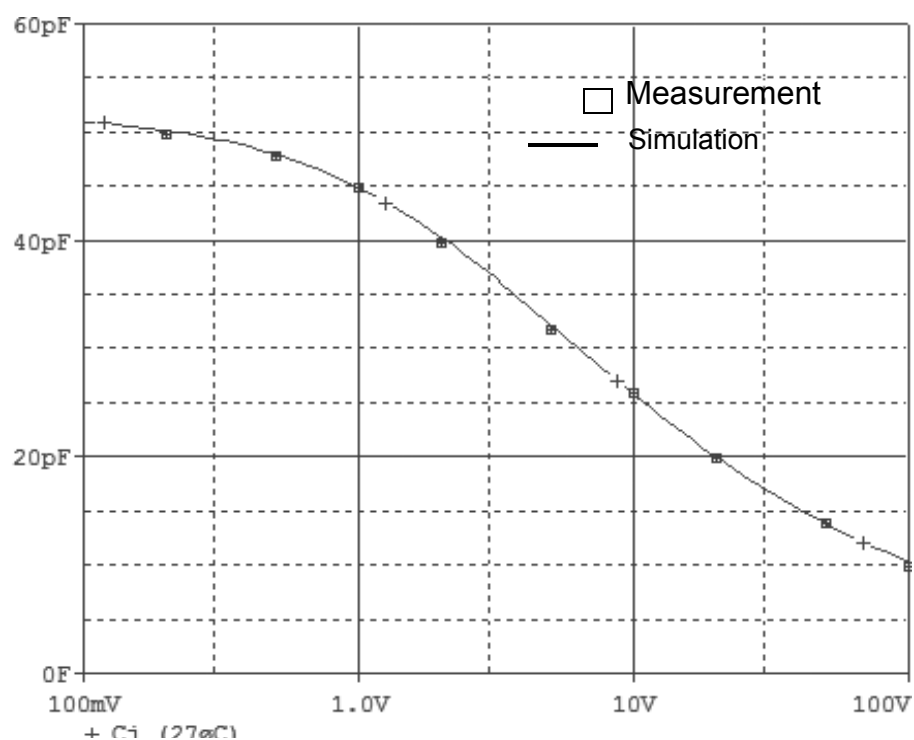
Evaluation circuit



Simulation Result

$V_{DD}=80V, I_D=1A$	Measurement		Simulation		Error (%)
Q_{gs}	0.8	nC	0.799	nC	-0.125
Q_{gd}	1.95	nC	1.9482	nC	-0.092
Q_g	6.35	nC	6.3607	nC	0.169

Capacitance Characteristic

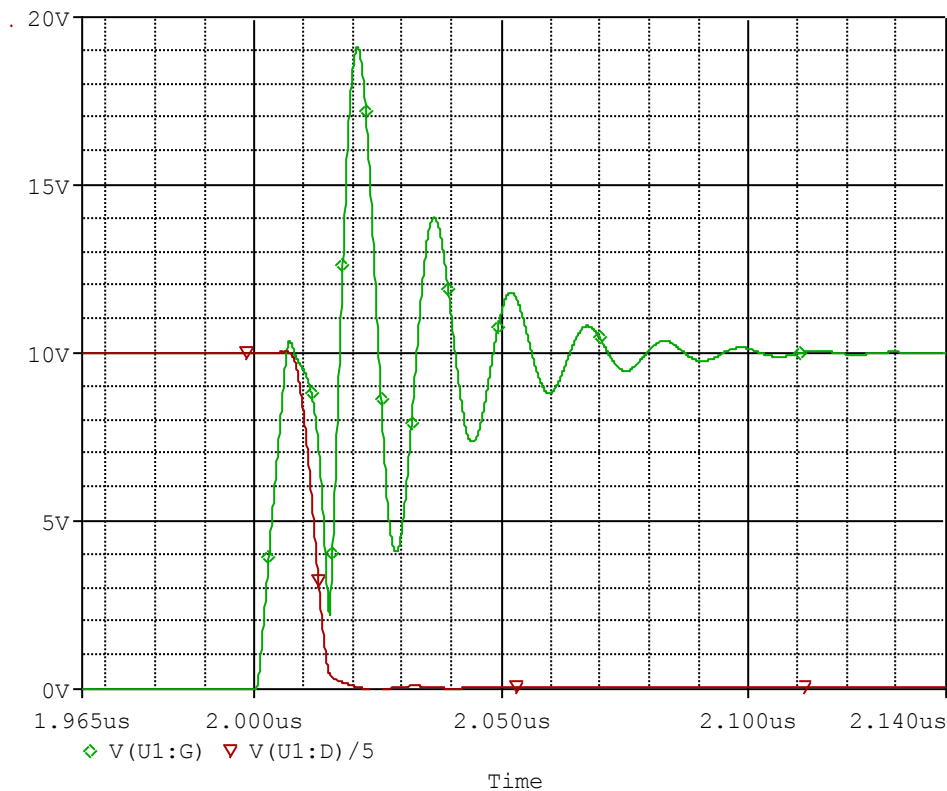


Simulation Result

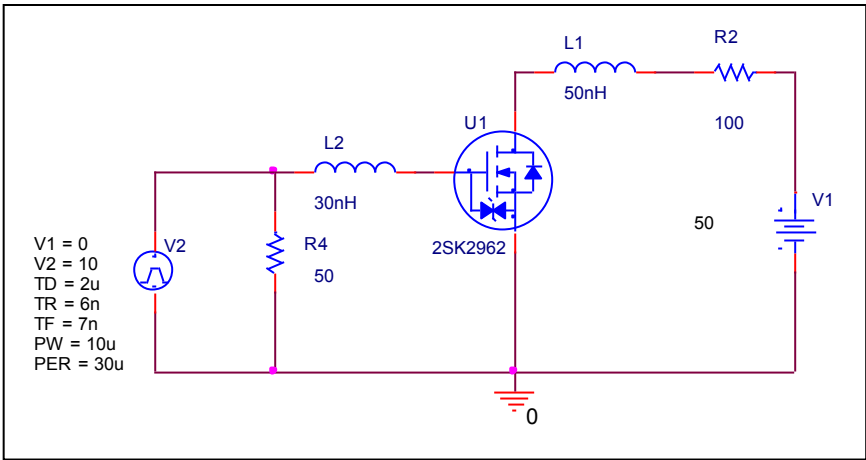
V _{DS} (V)	C _{bd} (pF)		Error(%)
	Measurement	Simulation	
0.2	50	50.2	0.400
0.5	48	47.8	-0.417
1	45	44.75	-0.556
2	40	40.2	0.500
5	32	32.2	0.625
10	26	25.8	-0.769
20	20	20	0.000
50	14	13.75	-1.786
100	10	10.2	2.000

Switching Time Characteristic

Circuit Simulation result



Evaluation circuit

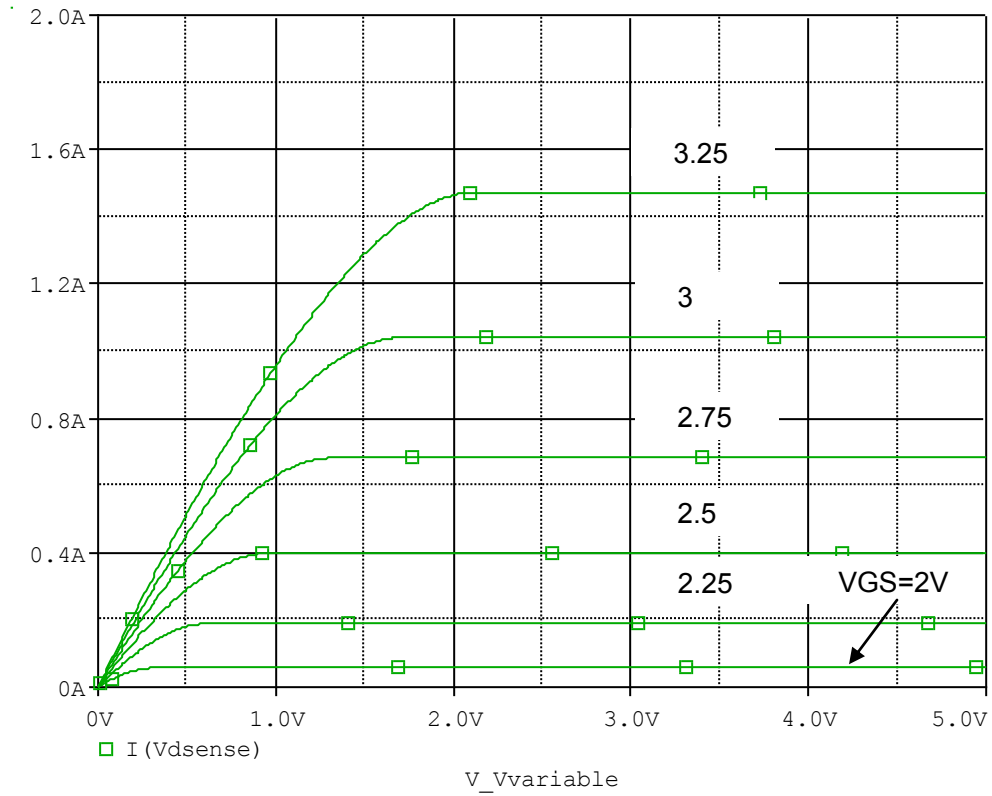


Simulation Result

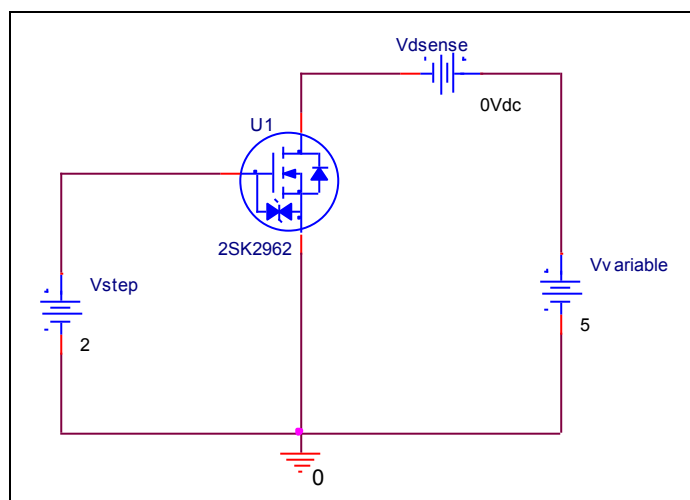
$I_D=0.5\text{ A}$, $V_{DD}=50\text{ V}$ $V_{GS}=0/10\text{ V}$	Measurement		Simulation		Error(%)
	ton	13.000 ns	13.179 ns	ns	
					1.377

Output Characteristic

Circuit Simulation result

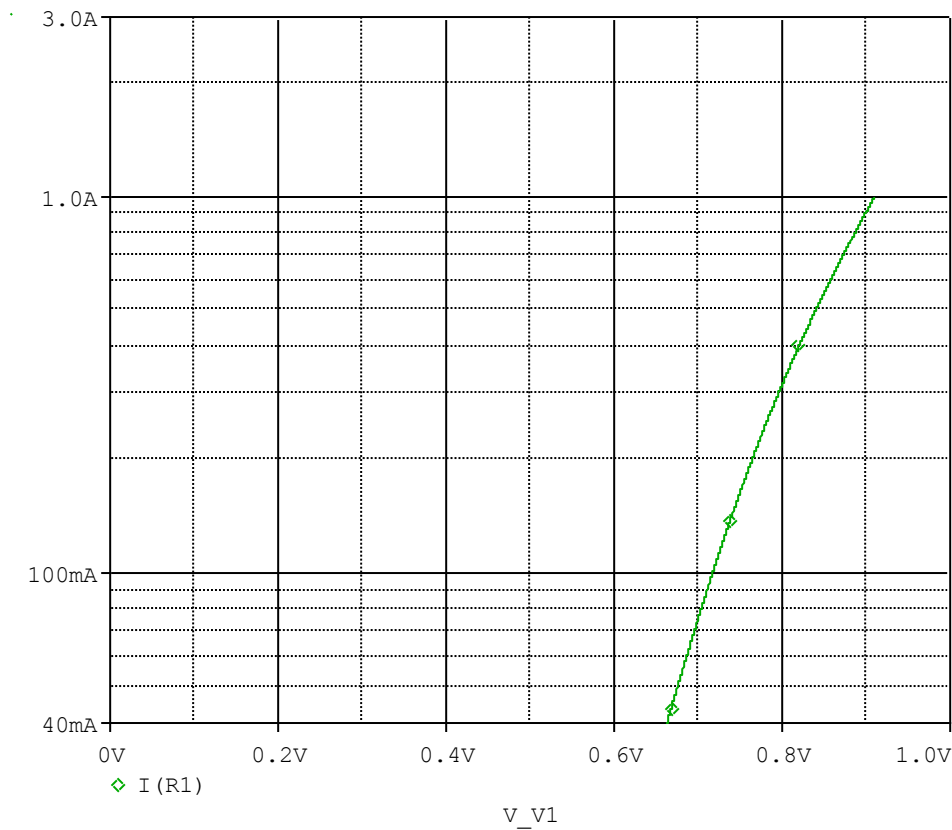


Evaluation circuit

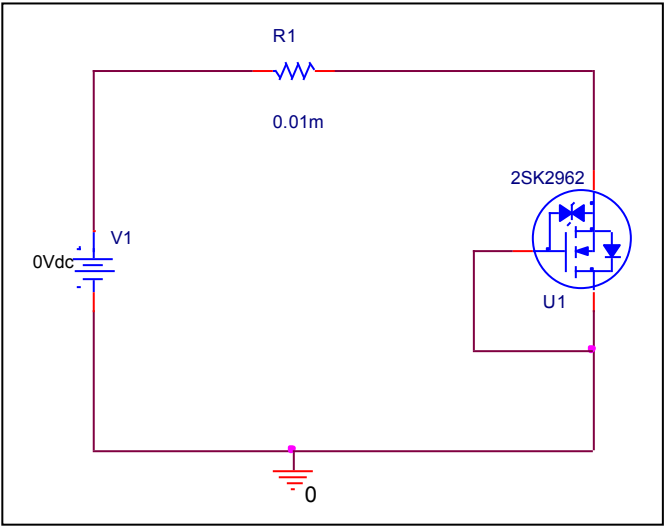


Forward Current Characteristic

Circuit Simulation Result

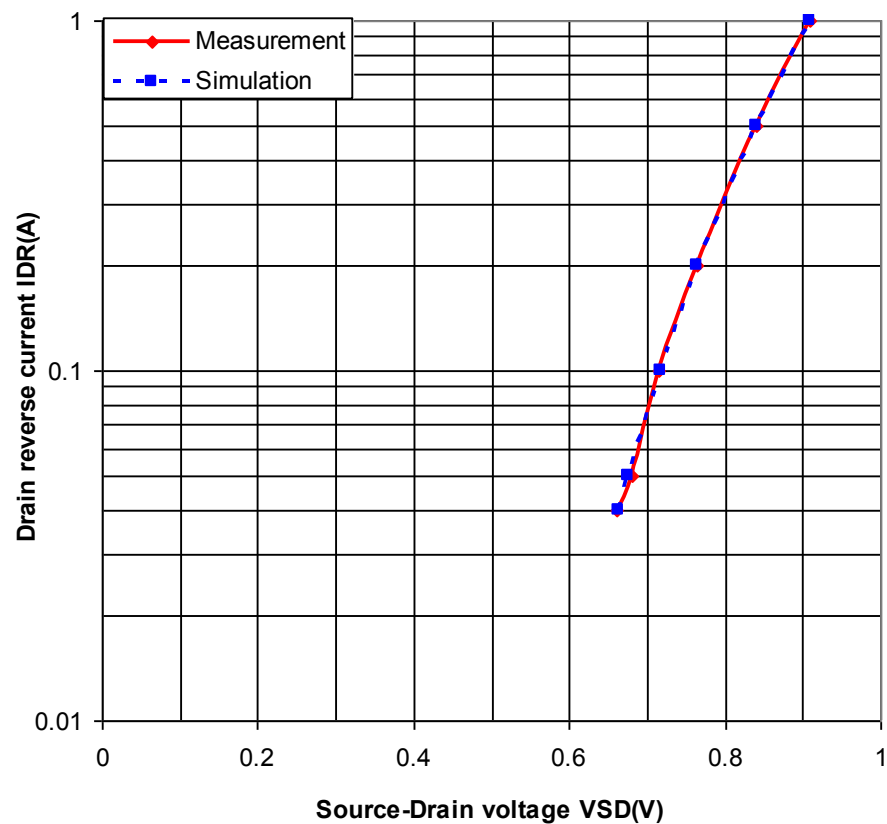


Evaluation Circuit



Comparison Graph

Circuit Simulation Result

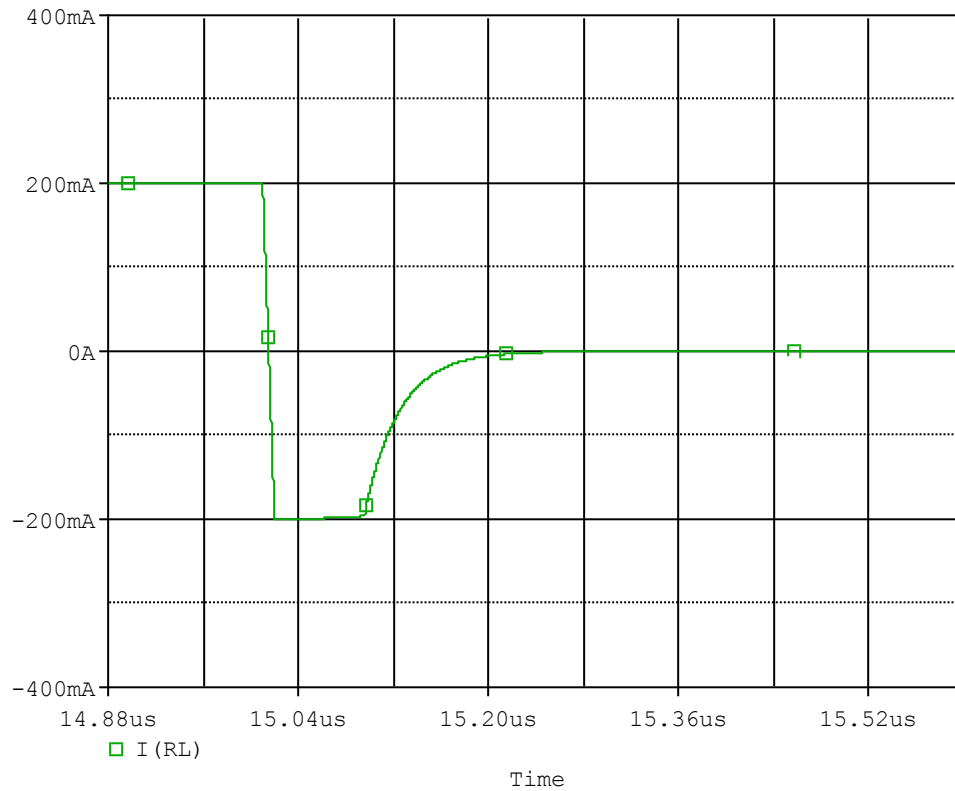


Simulation Result

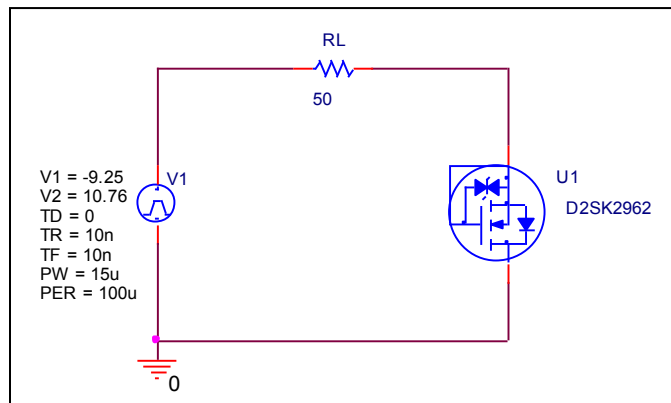
Ifwd(A)	VSD(V)		%Error
	Measuremen	Simulation	
0.04	0.66	0.663	0.455
0.05	0.68	0.676	-0.588
0.1	0.715	0.717	0.280
0.2	0.765	0.764	-0.131
0.5	0.84	0.840	0
1	0.91	0.91	0

Reverse Recovery Characteristic

Circuit Simulation Result



Evaluation Circuit

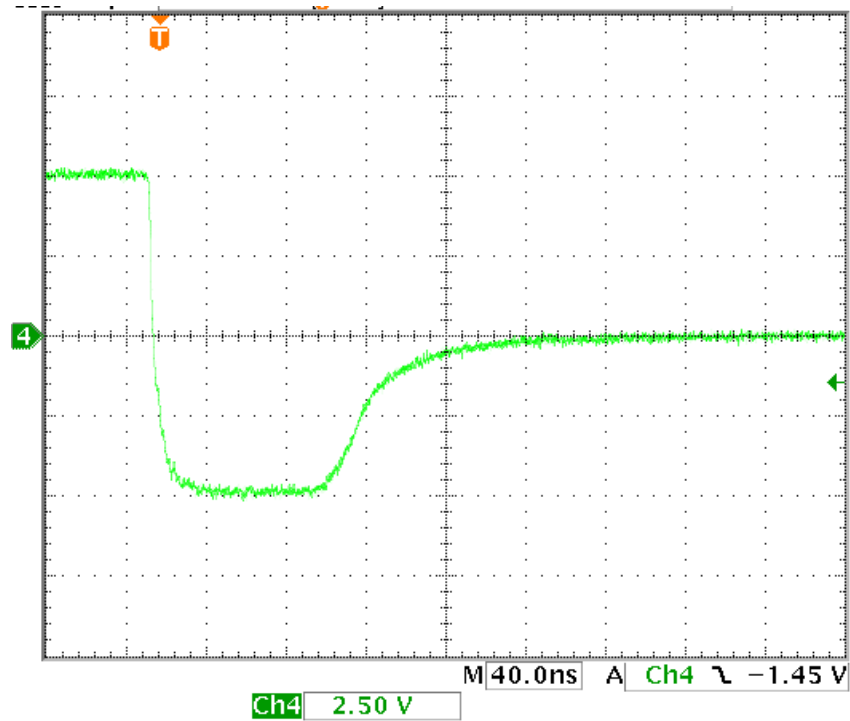


Compare Measurement vs. Simulation

	Measurement	Simulation	Error (%)
Trj(ns)	79.2	79.228	0.035
Trb(ns)	67.2	67.74	0.804
Trr(ns)	146.4	146.968	0.388

Reverse Recovery Characteristic

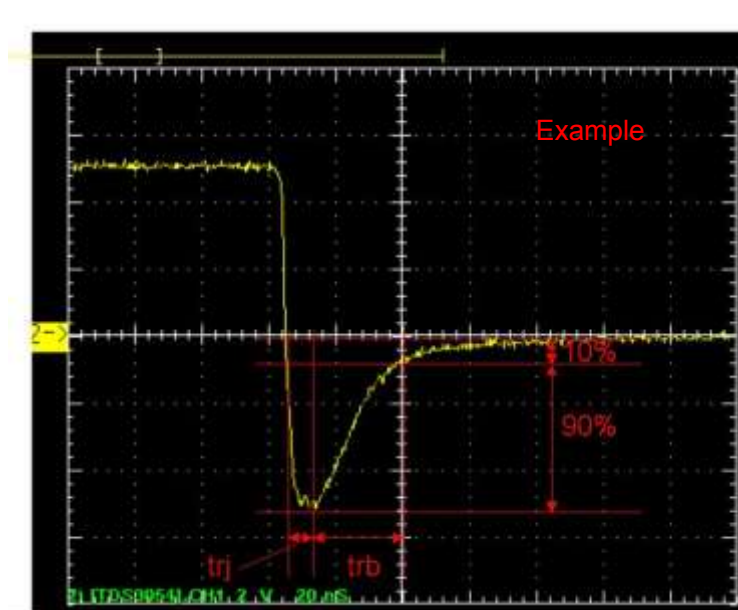
Reference



$T_{rr}=79.2(\text{ns})$

$T_{rb}=67.2(\text{ns})$

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

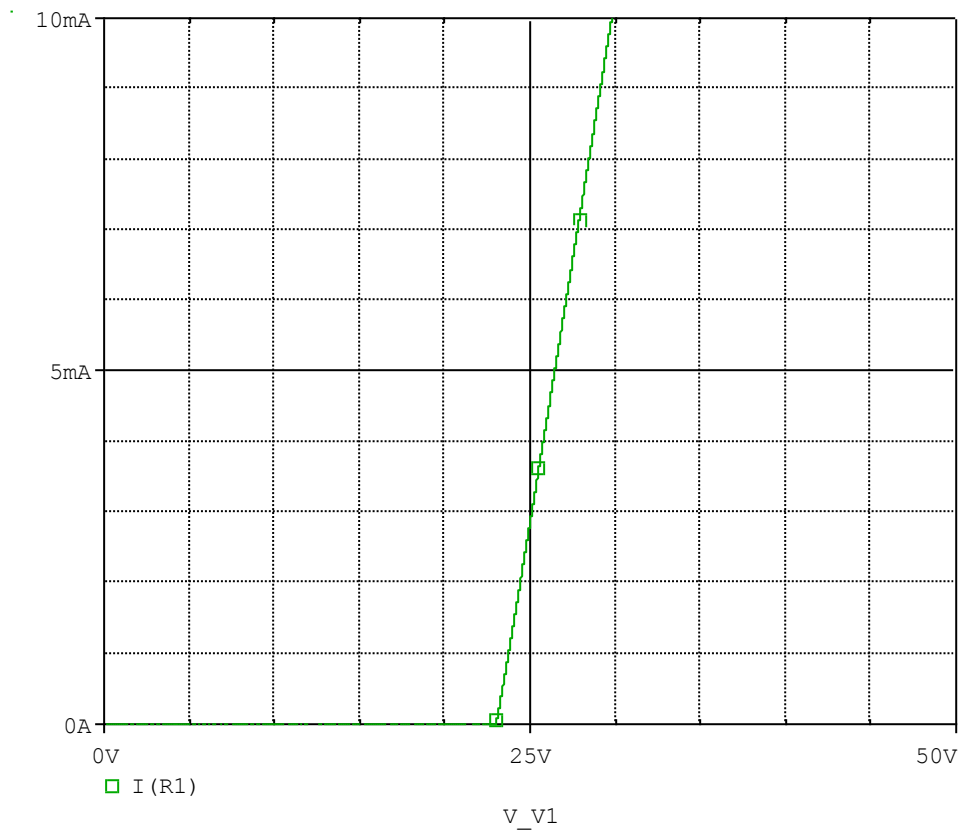


Relation between t_{rr} and t_{rb}

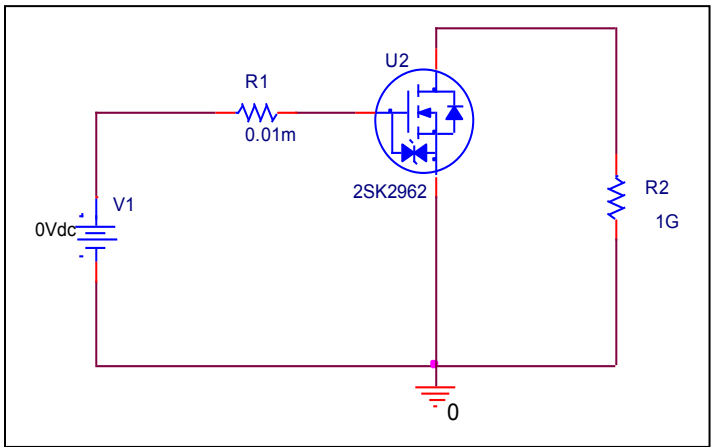
ESD PROTECTION DIODE

Zener Voltage Characteristic

Circuit Simulation Result



Evaluation Circuit



Zener Voltage Characteristic

Reference

