

Device Modeling Report

COMPONENTS: Power MOSFET (Professional)
PART NUMBER: 2SK2920
MANUFACTURER: TOSHIBA
Body Diode (Professional) / ESD Protection Diode

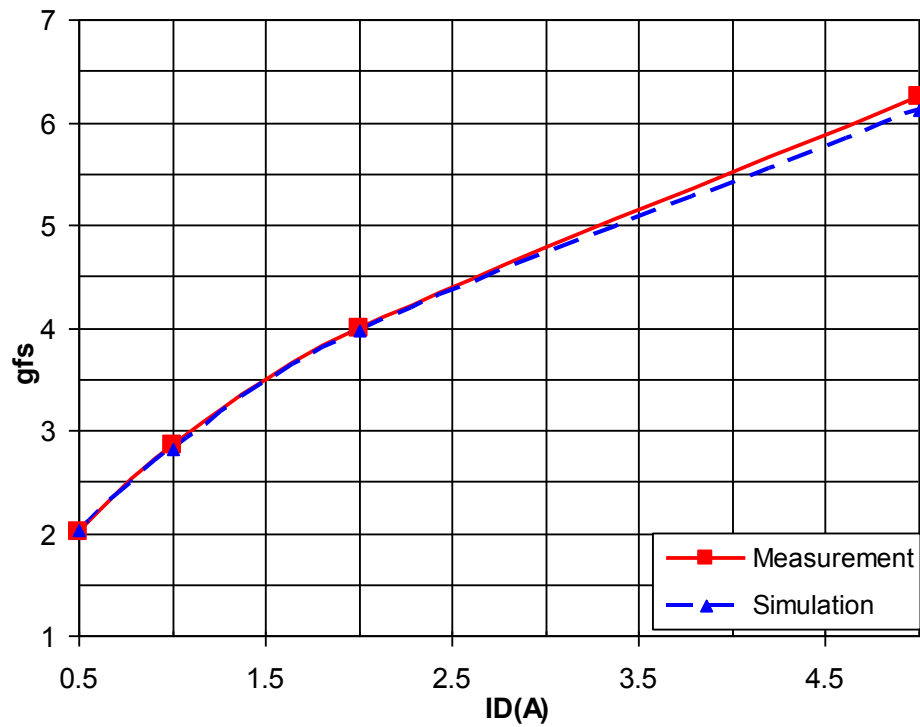


MOSFET MODEL

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

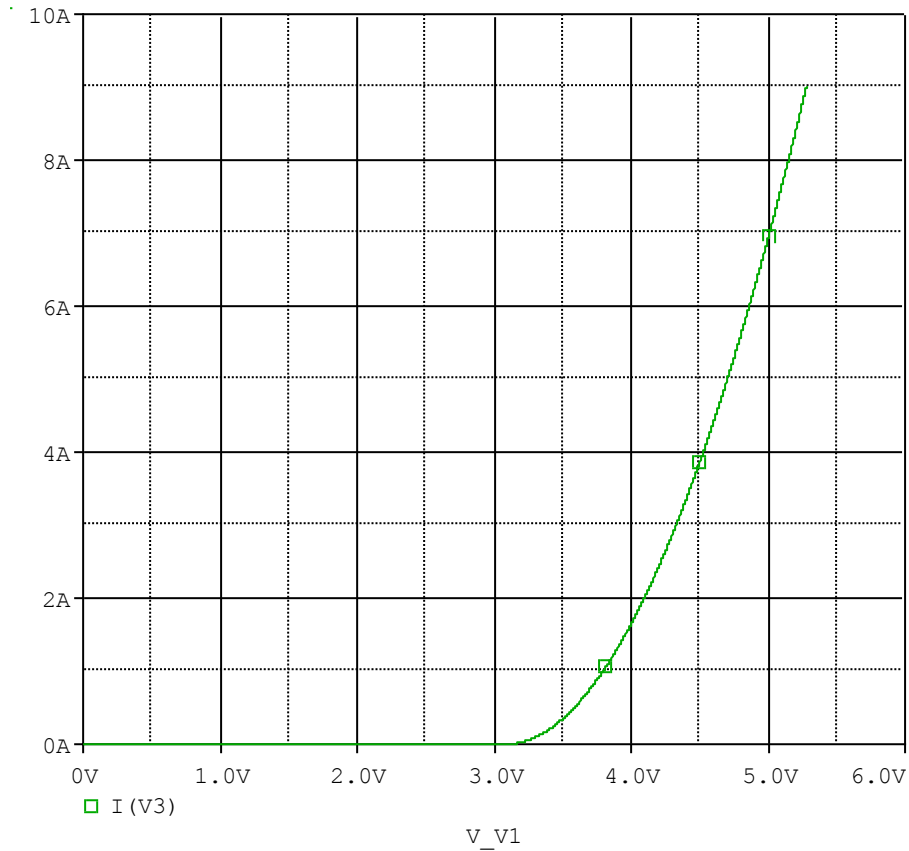


Comparison table

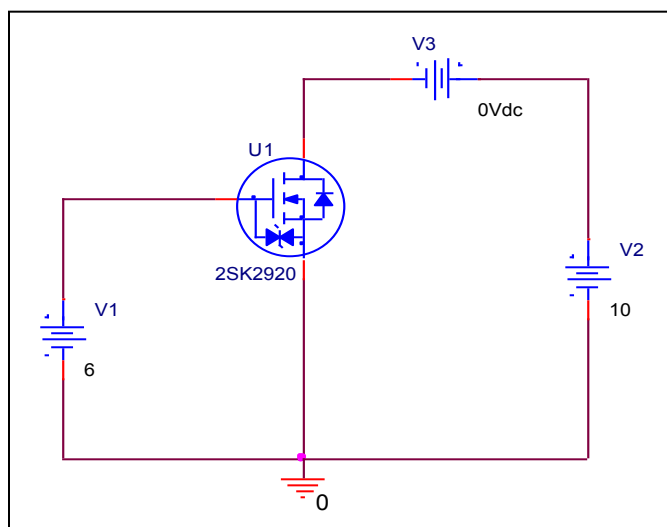
Id(A)	gfs		Error(%)
	Measurement	Simulation	
0.5	2.0054	2.028	1.127
1	2.857	2.825	-1.120
2	4	3.968	-0.800
5	6.25	6.12	-2.080

V_{gs}-I_d Characteristic

Circuit Simulation result

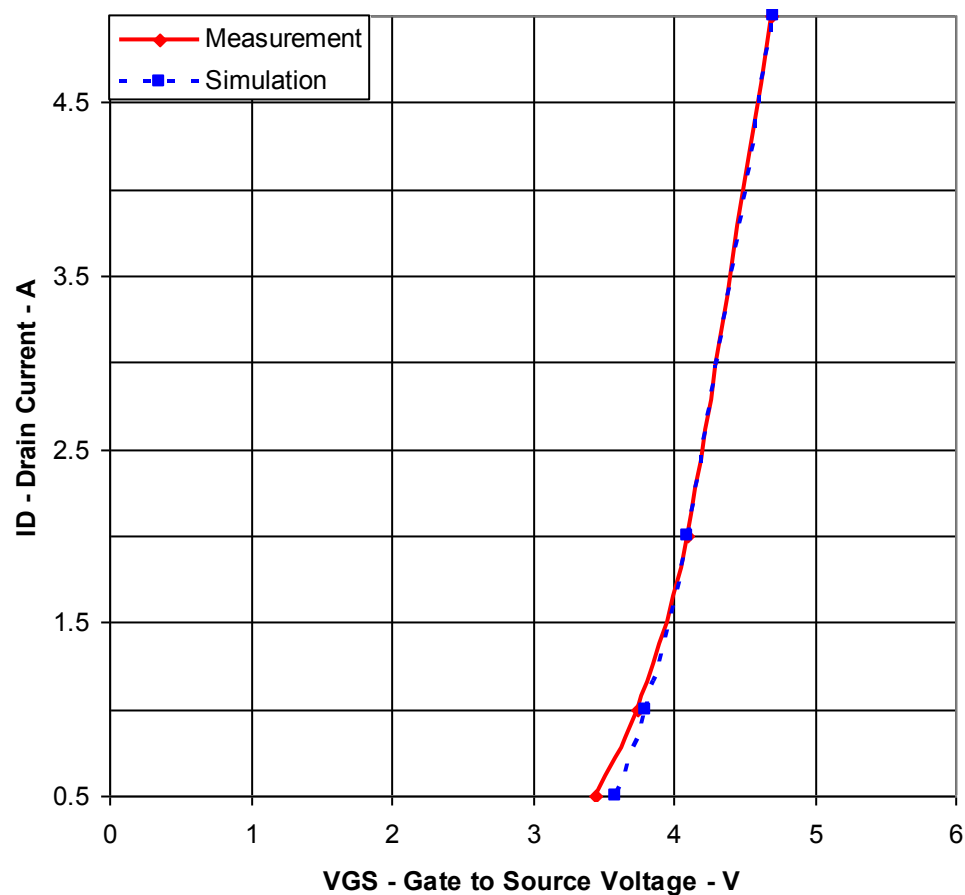


Evaluation circuit



Comparison Graph

Circuit Simulation Result

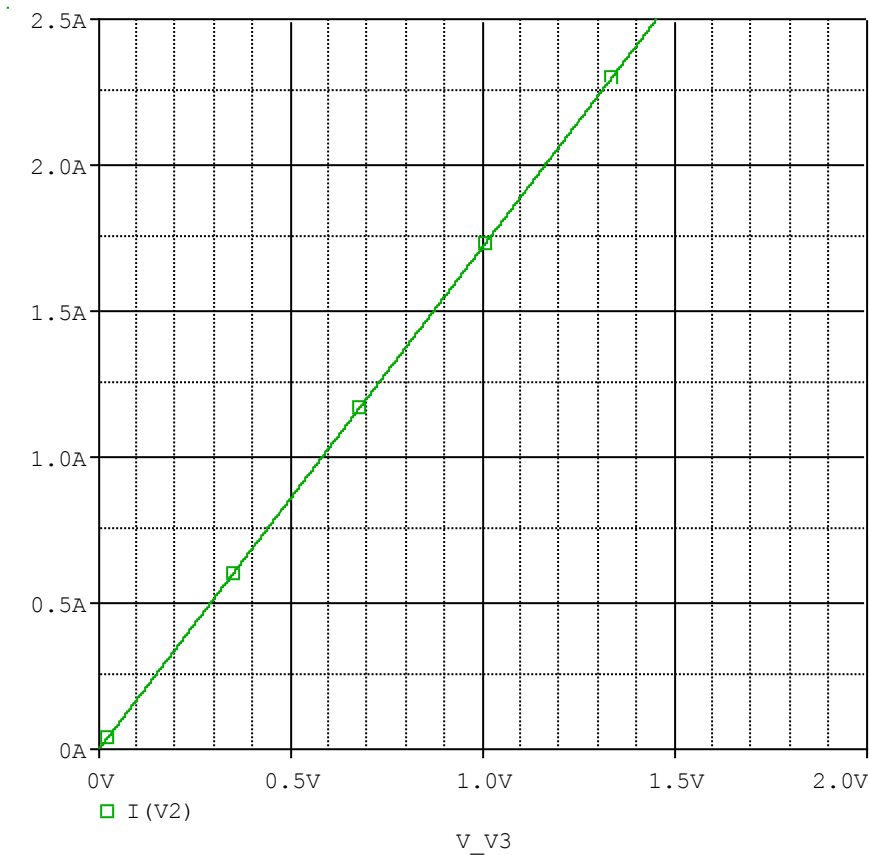


Simulation Result

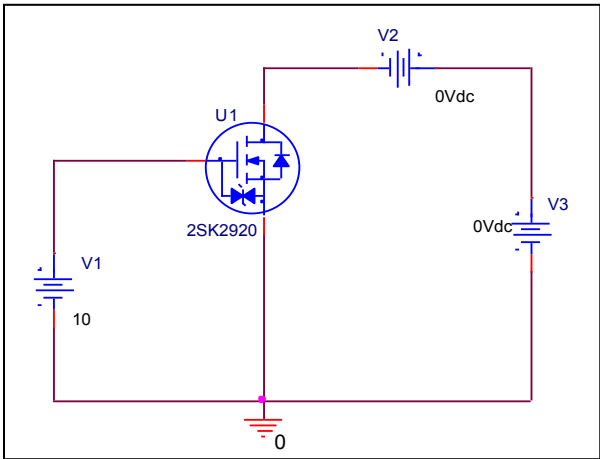
ID(A)	VGS(V)		Error (%)
	Measurement	Simulation	
0.5	3.45	3.5843	3.893
1	3.75	3.7947	1.192
2	4.1	4.0955	-0.110
5	4.7	4.7024	0.051

R_{ds(on)} Characteristic

Circuit Simulation result



Evaluation circuit

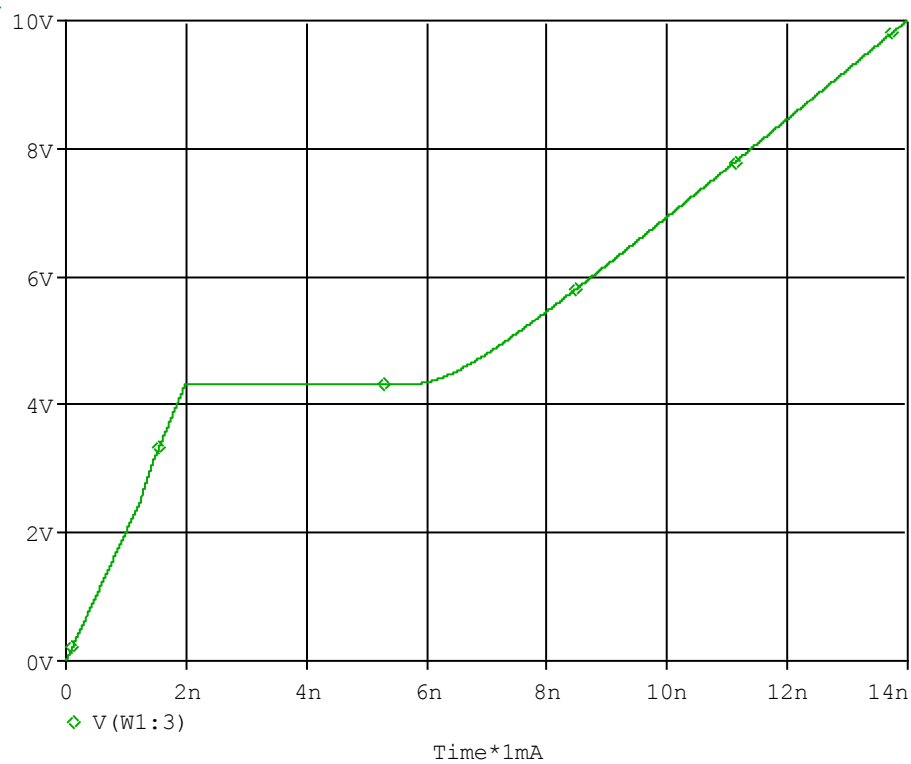


Simulation Result

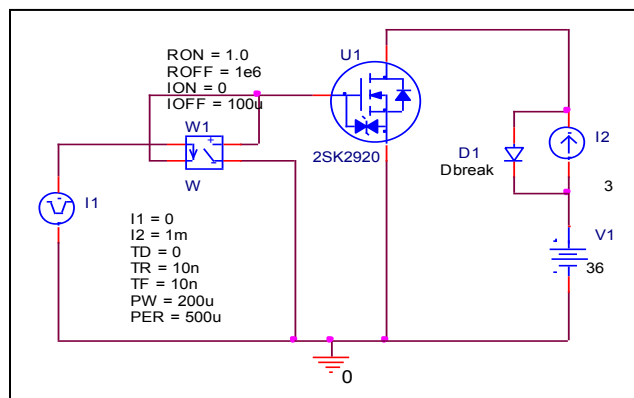
$I_D=2.5A, V_{GS}=10V$	Measurement		Simulation		Error (%)
$R_{DS(on)}$	0.56	Ω	0.581	Ω	3.75

Gate Charge Characteristic

Circuit Simulation result

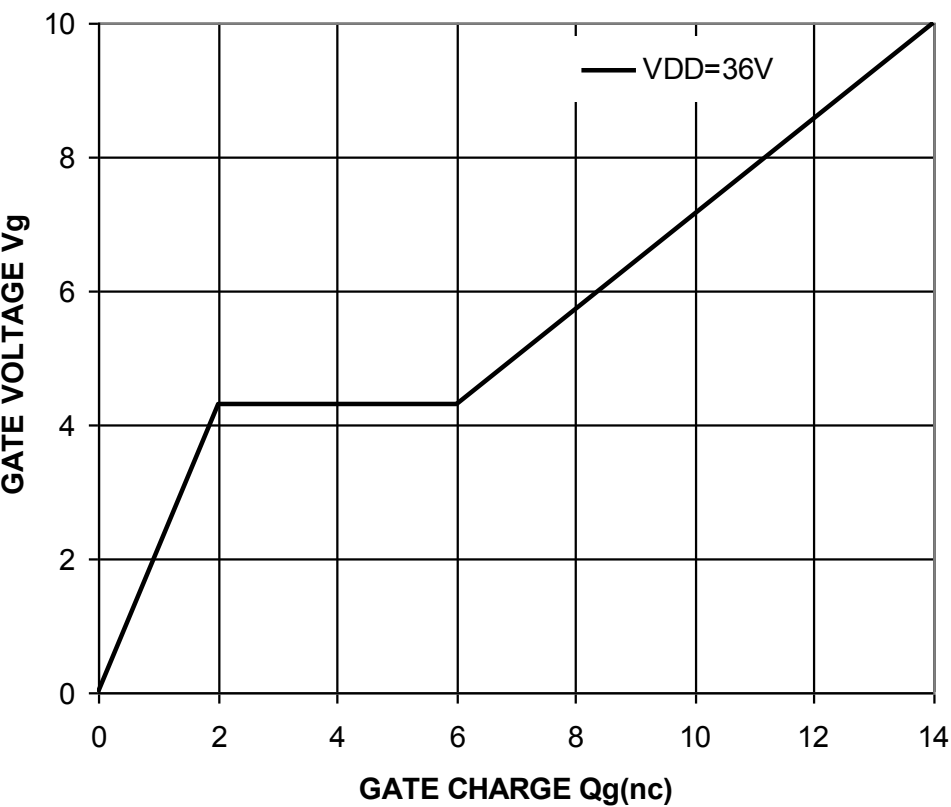


Evaluation circuit

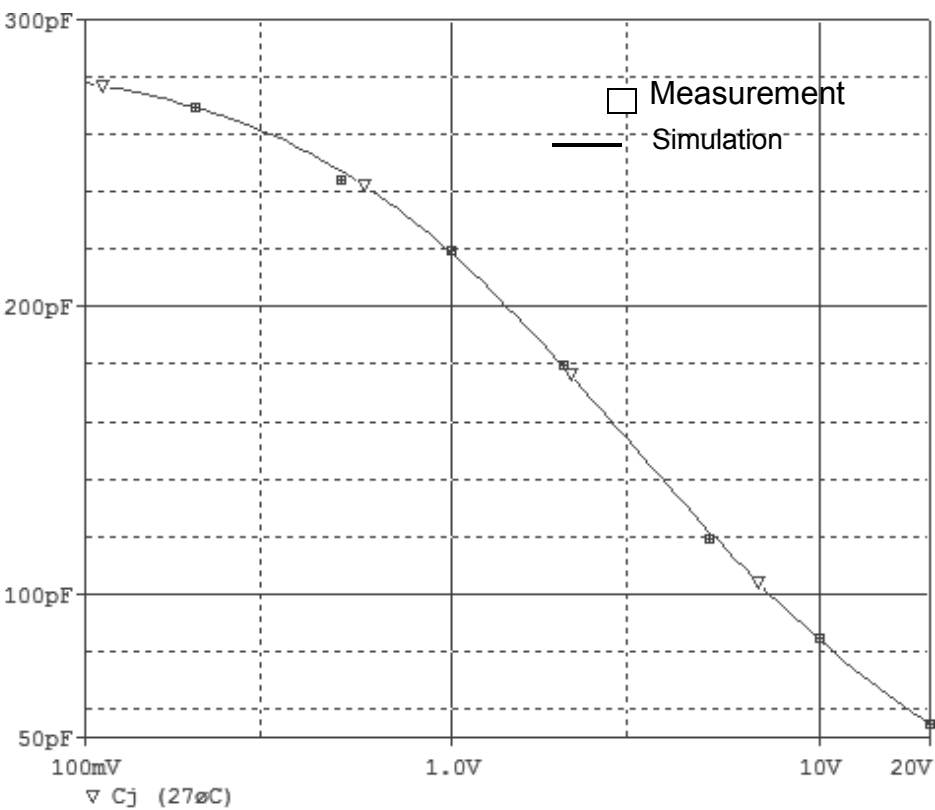


Simulation Result

$V_{DD}=36V, I_D=3A$	Measurement		Simulation		Error (%)
Q_{gs}	2	nC	2	nC	0
Q_{gd}	4	nC	4	nC	0
Q_g	14	nC	13.991	nC	-0.064



Capacitance Characteristic

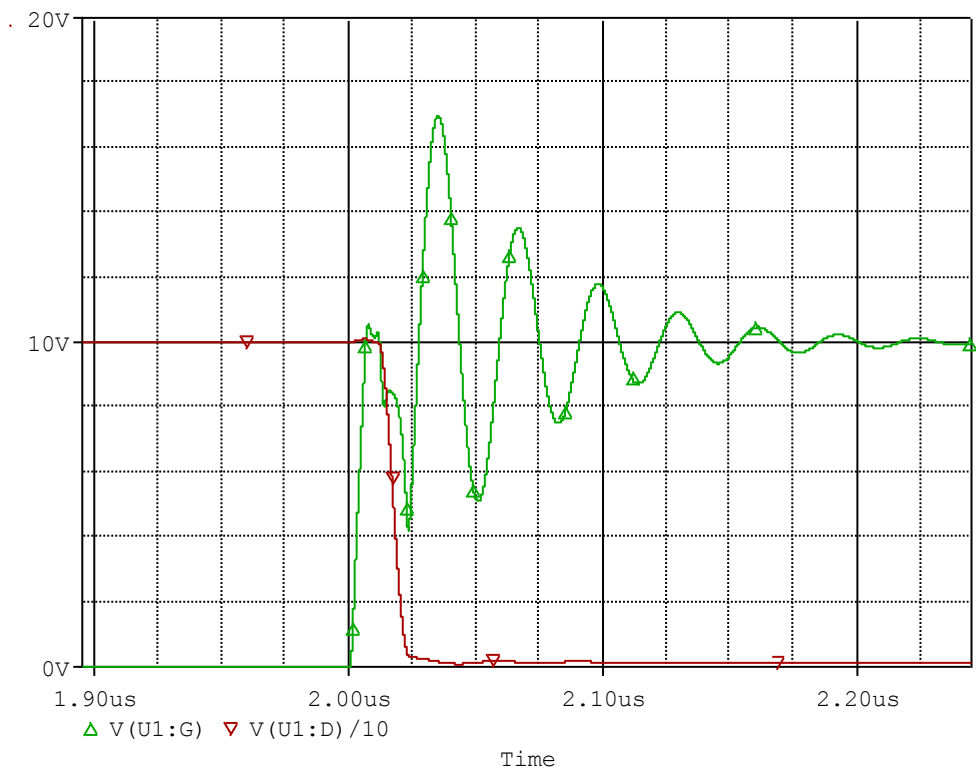


Simulation Result

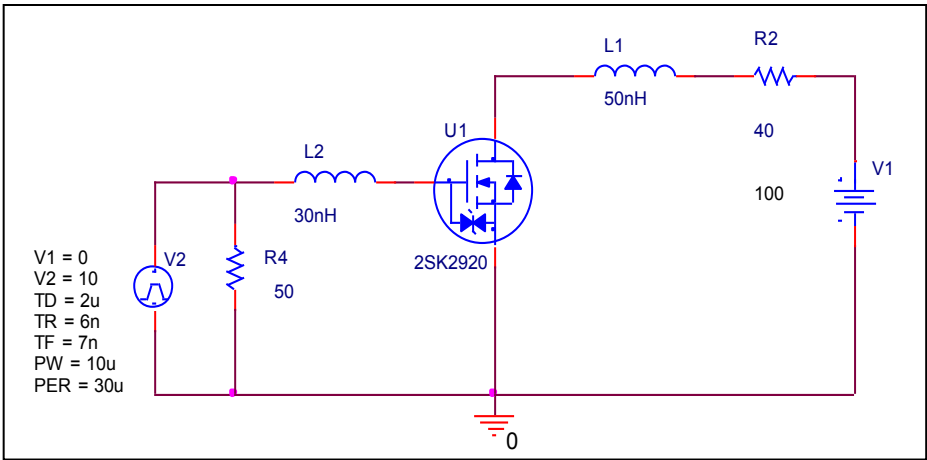
$V_{DS}(V)$	Cbd(pF)		Error(%)
	Measurement	Simulation	
0.2	270	269	-0.370
0.5	245	247	0.816
1	220	218	-0.909
2	180	179.5	-0.278
5	120	122	1.667
10	85	84	-1.176

Switching Time Characteristic

Circuit Simulation result



Evaluation circuit

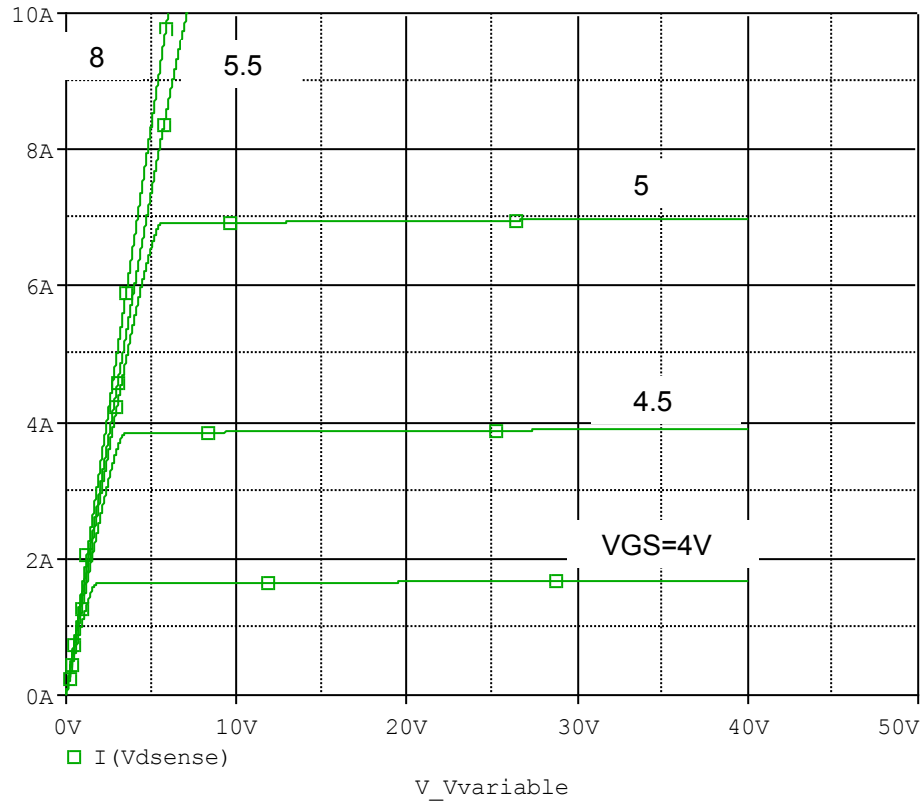


Simulation Result

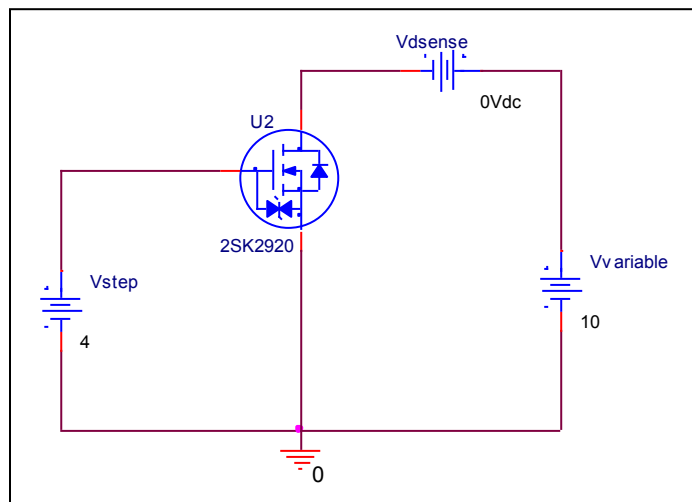
$I_D=5\text{ A}$, $V_{DD}=100\text{ V}$ $V_{GS}=0/10\text{ V}$	Measurement		Simulation		Error(%)
	ton	20.000 ns	20.132 ns	ns	
					0.66

Output Characteristic

Circuit Simulation result

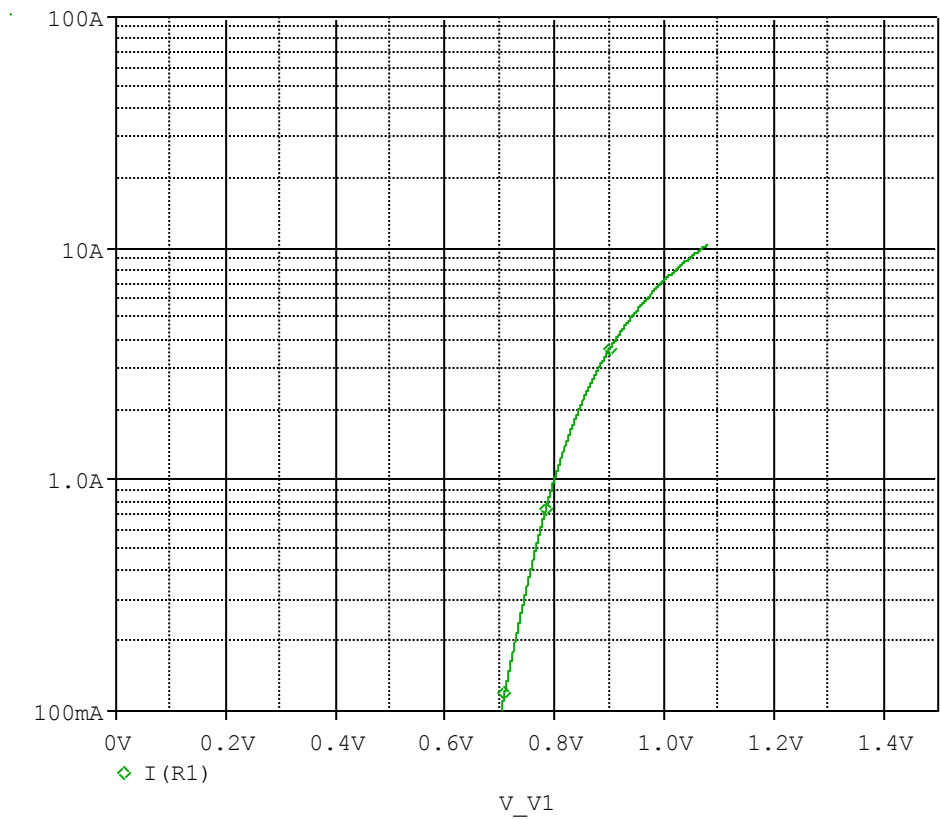


Evaluation circuit

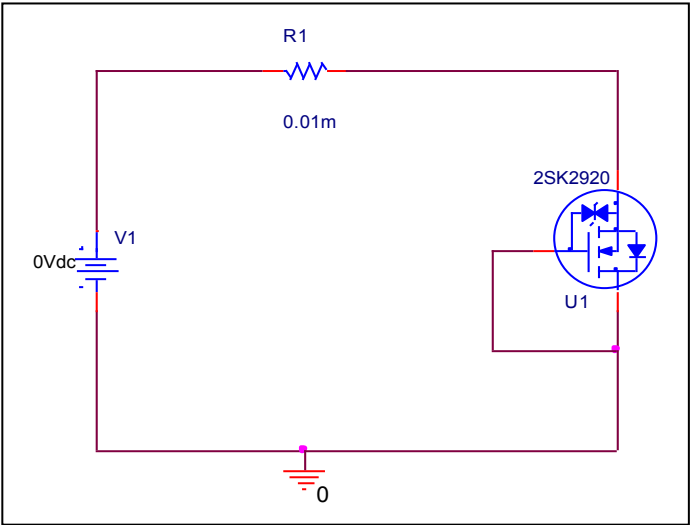


Forward Current Characteristic

Circuit Simulation Result

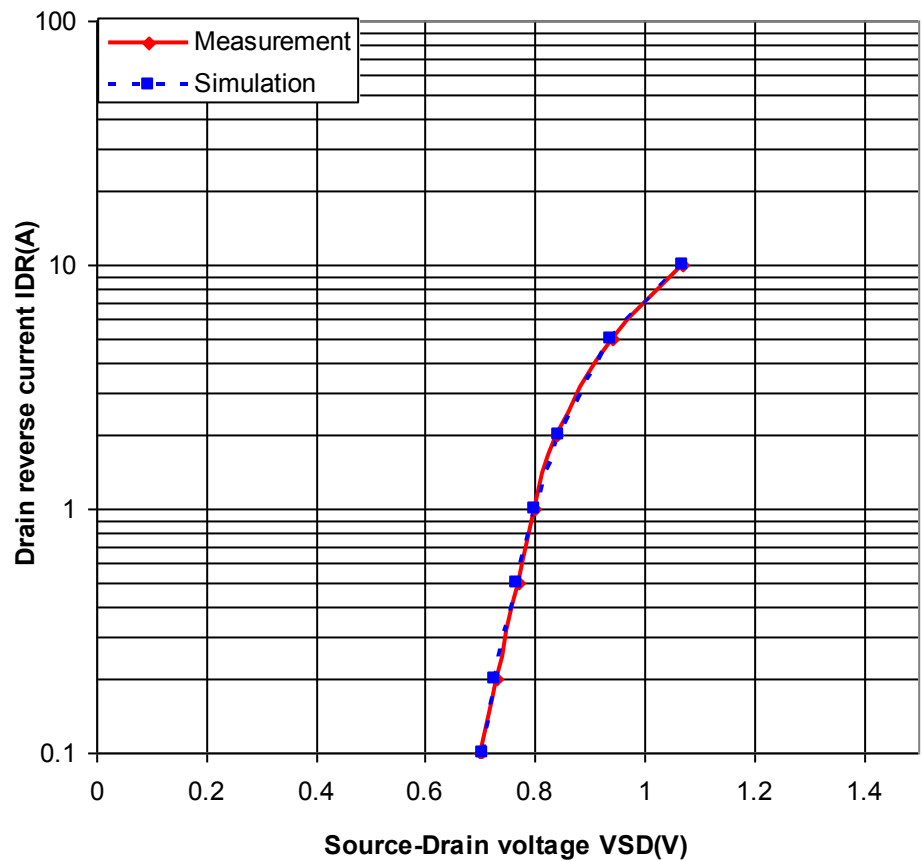


Evaluation Circuit



Comparison Graph

Circuit Simulation Result

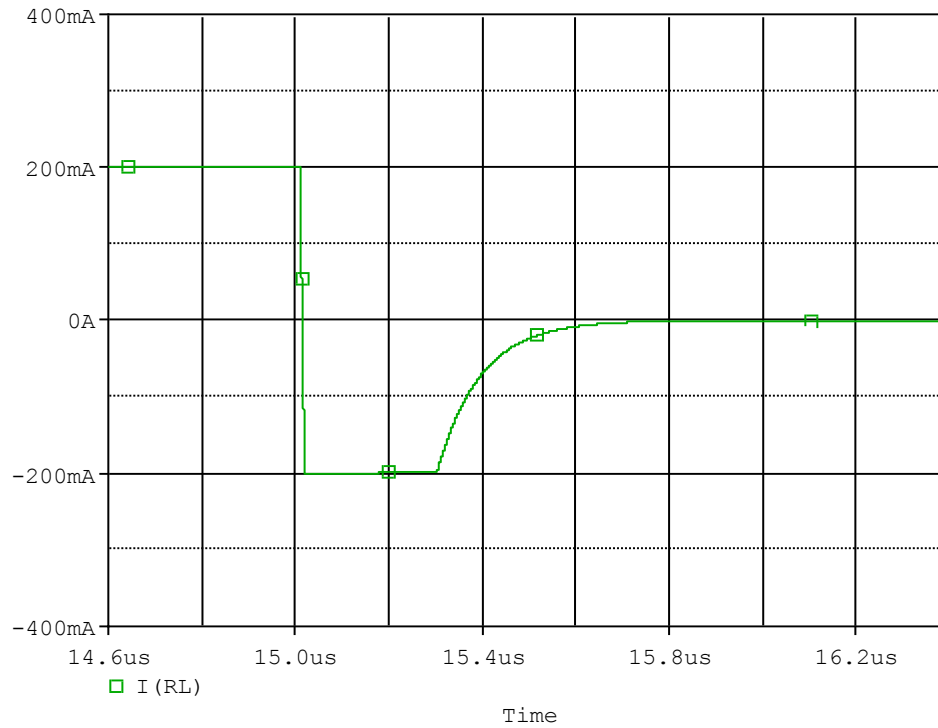


Simulation Result

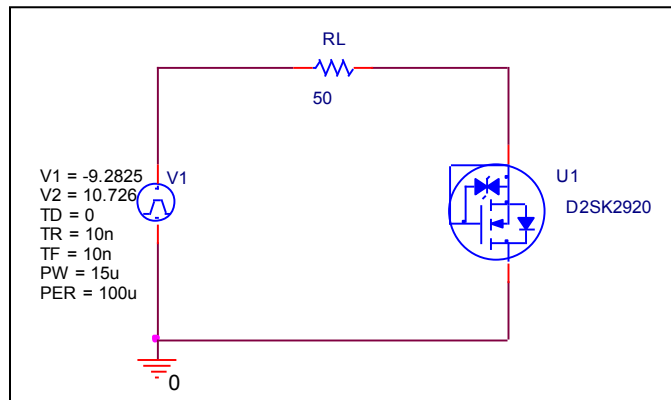
Ifwd(A)	VSD(V)		%Error
	Measuremen	Simulation	
0.1	0.7	0.703	0.429
0.2	0.73	0.728	-0.274
0.5	0.77	0.766	-0.519
1	0.8	0.8	0.000
2	0.84	0.844	0.476
5	0.94	0.939	-0.106
10	1.07	1.0698	-0.019

Reverse Recovery Characteristic

Circuit Simulation Result



Evaluation Circuit

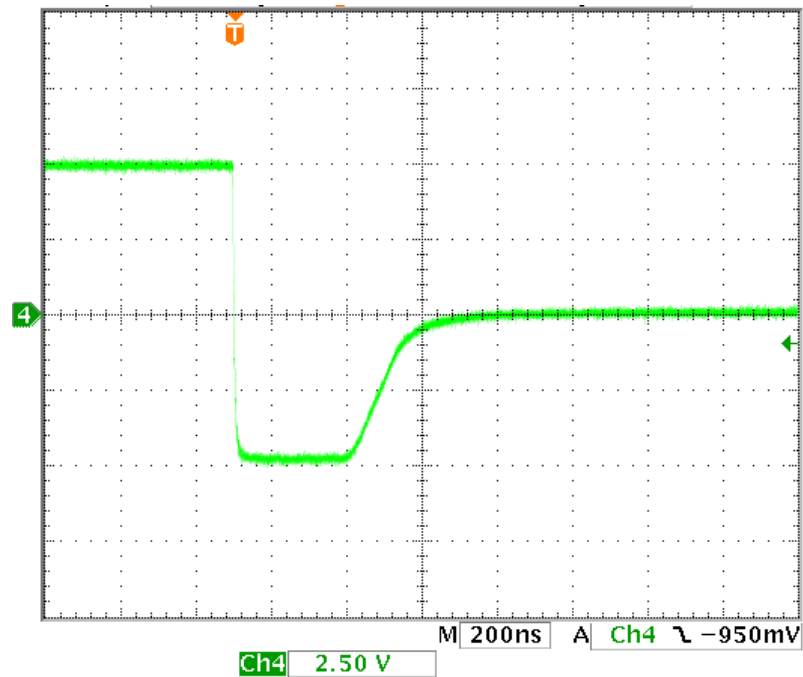


Compare Measurement vs. Simulation

	Measurement	Simulation	Error (%)
Trj(ns)	284	284.014	0.005
Trb(ns)	216	216.928	0.430
Trr(ns)	500	500.942	0.188

Reverse Recovery Characteristic

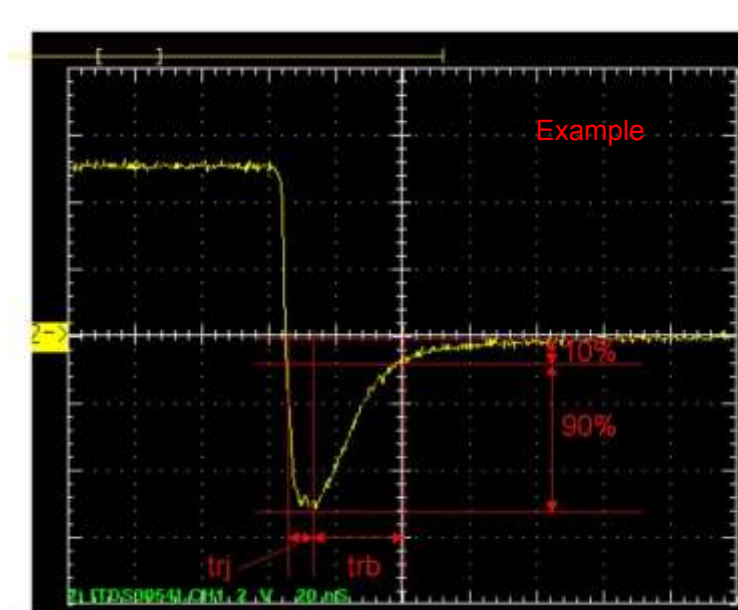
Reference



$T_{rr}=284(\text{ns})$

$T_{rb}=216(\text{ns})$

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

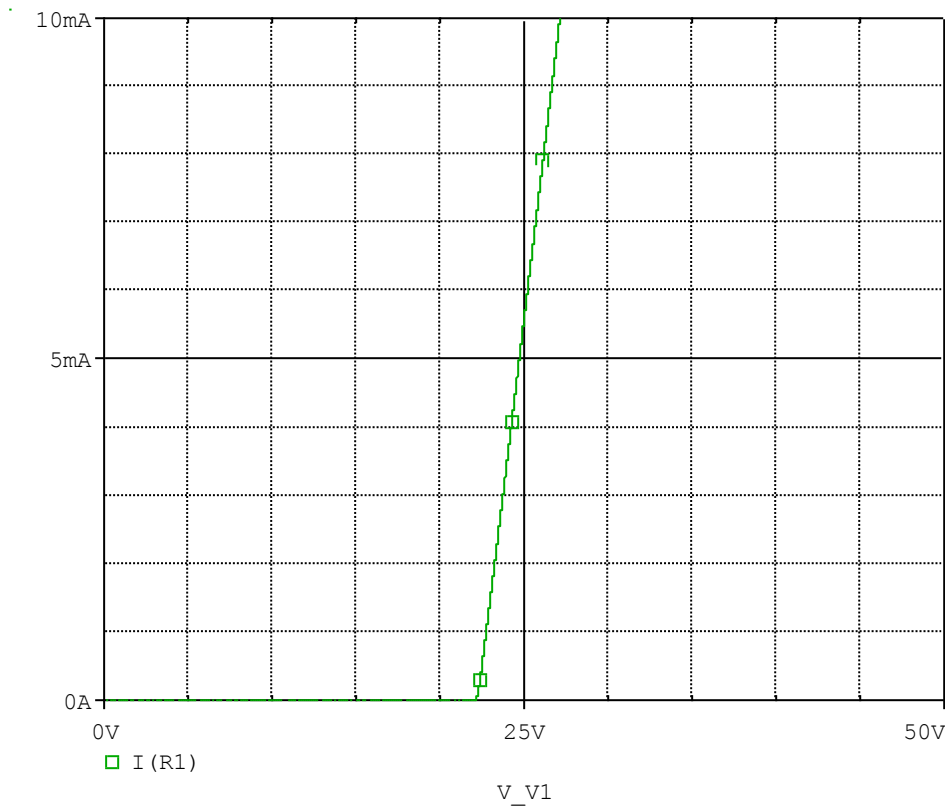


Relation between t_{rr} and t_{rb}

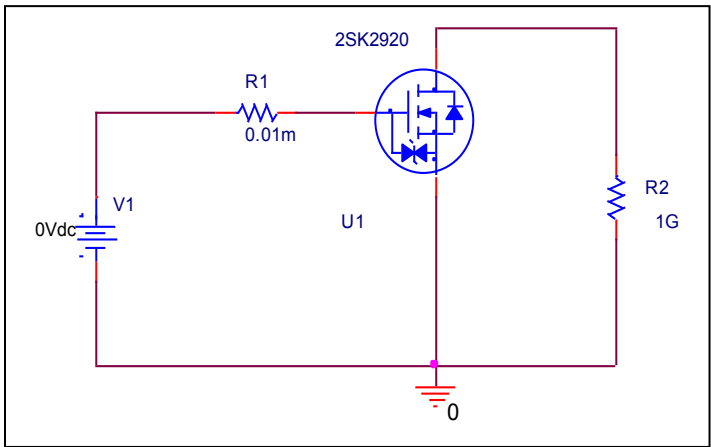
ESD PROTECTION DIODE

Zener Voltage Characteristic

Circuit Simulation Result



Evaluation Circuit



Zener Voltage Characteristic

Reference

