

Device Modeling Report

COMPONENTS: Power MOSFET (Model parameter)
PART NUMBER: 2SK3670
MANUFACTURER: TOSHIBA
Body Diode (Model parameter) / ESD Protection Diode

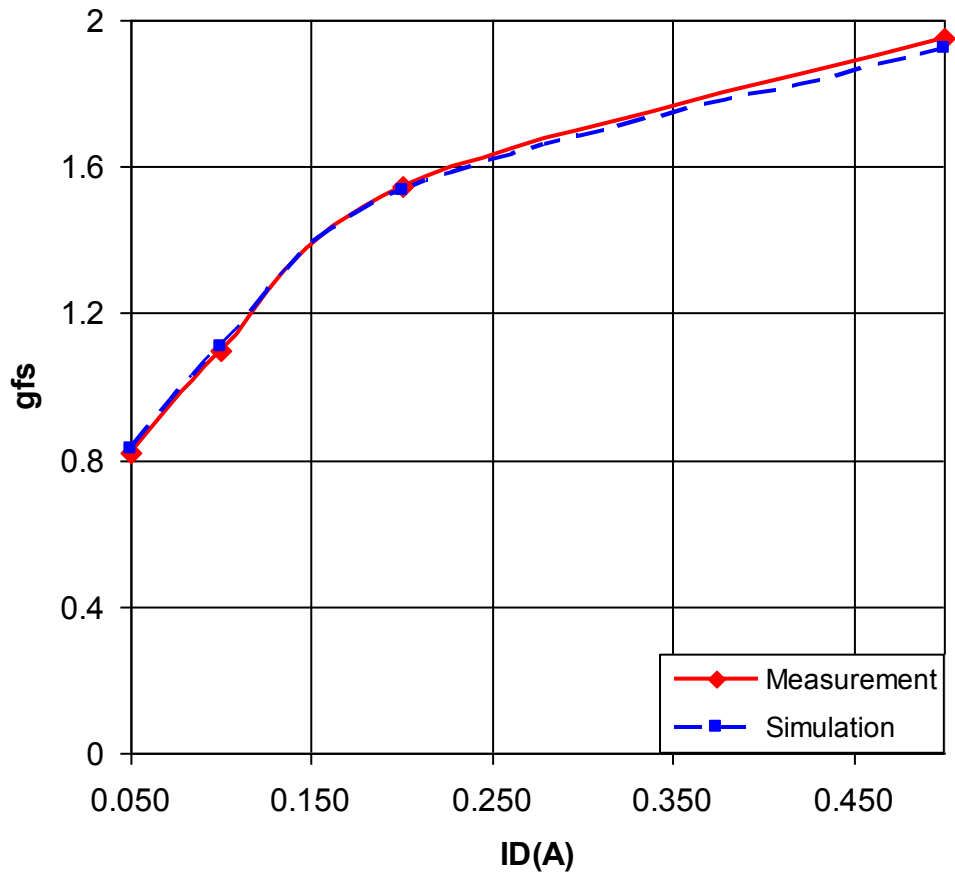


MOSFET MODEL

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

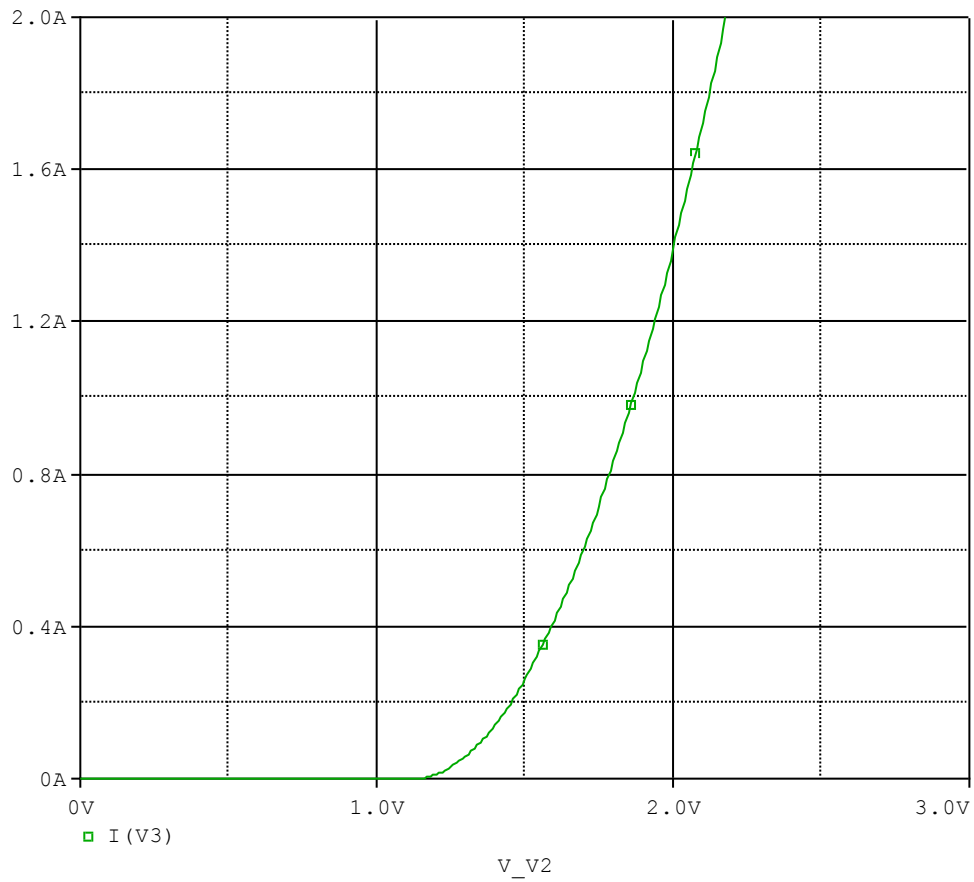


Comparison table

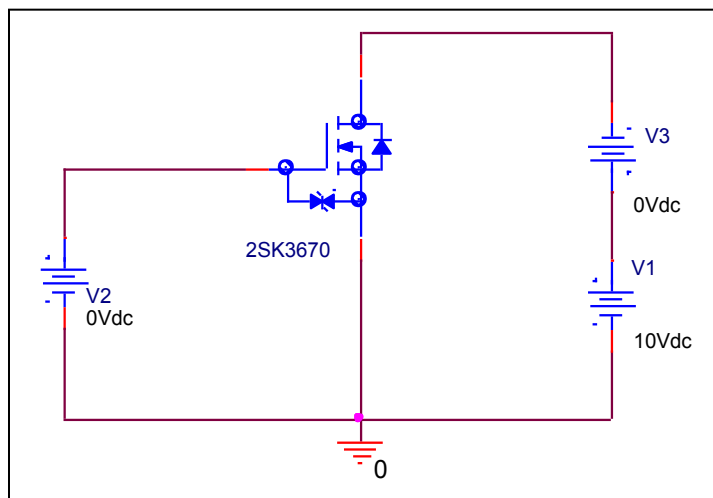
Id(A)	gfs		Error(%)
	Measurement	Simulation	
0.050	0.821	0.833	1.462
0.100	1.100	1.111	1.000
0.200	1.545	1.538	-0.453
0.500	1.950	1.923	-1.385

V_{gs}-I_d Characteristic

Circuit Simulation result

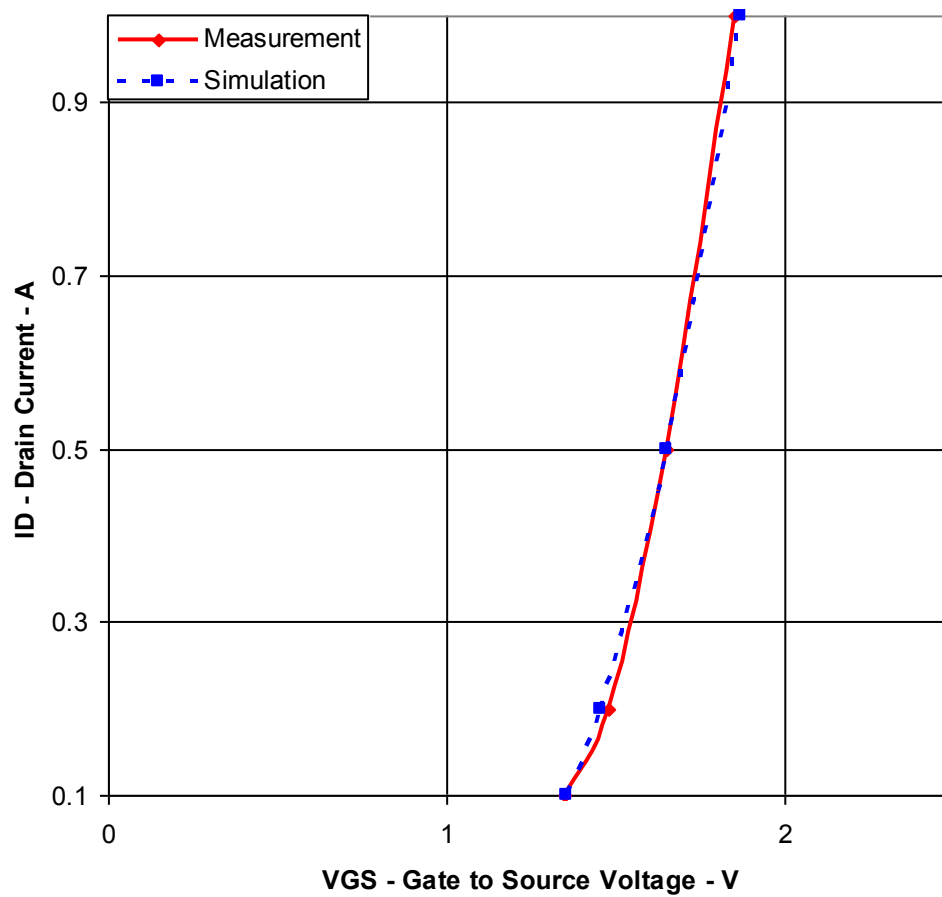


Evaluation circuit



Comparison Graph

Circuit Simulation Result

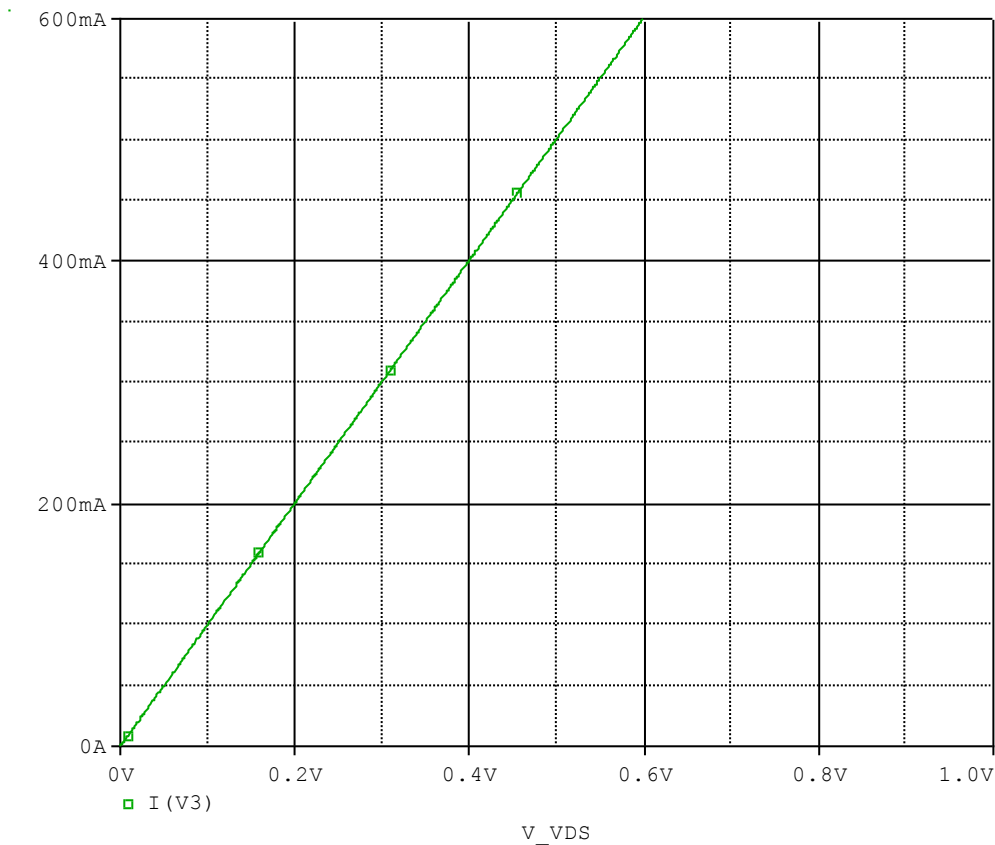


Simulation Result

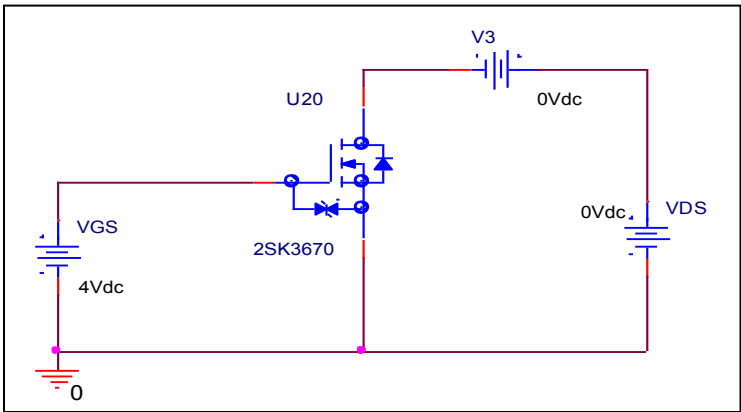
I_D (A)	V_{GS} (V)		Error (%)
	Measurement	Simulation	
0.100	1.350	1.356	0.444
0.200	1.480	1.452	-1.892
0.500	1.650	1.646	-0.242
1.000	1.850	1.865	0.811

Rds(on) Characteristic

Circuit Simulation result



Evaluation circuit

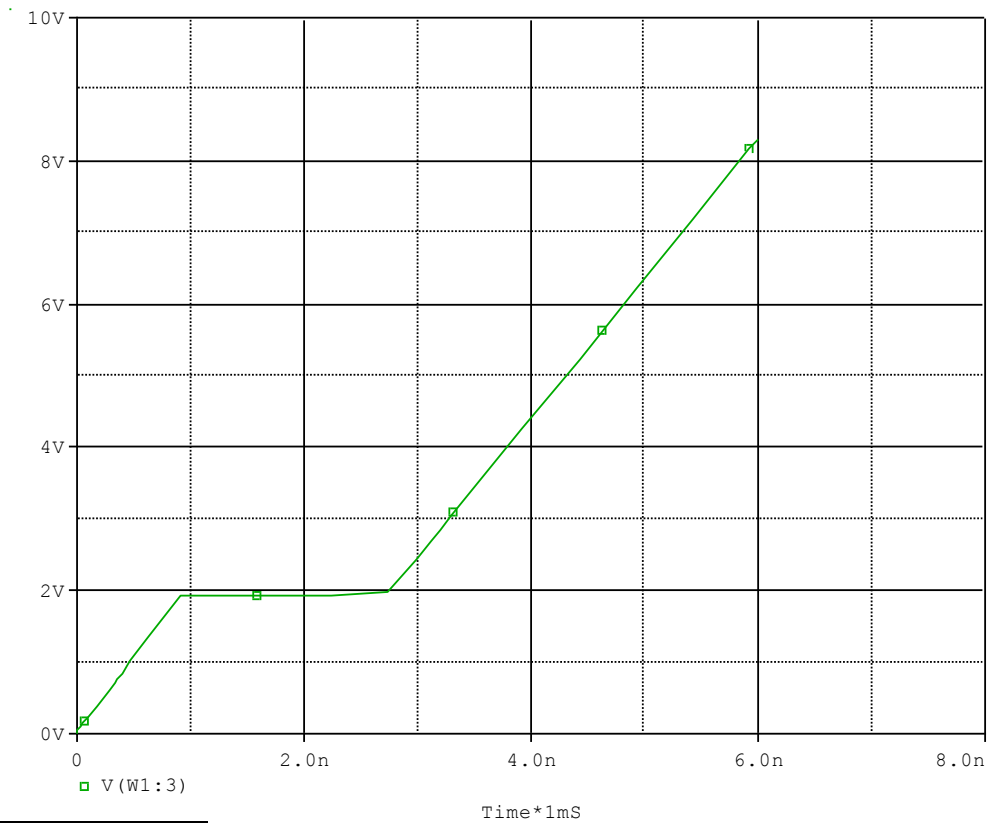


Simulation Result

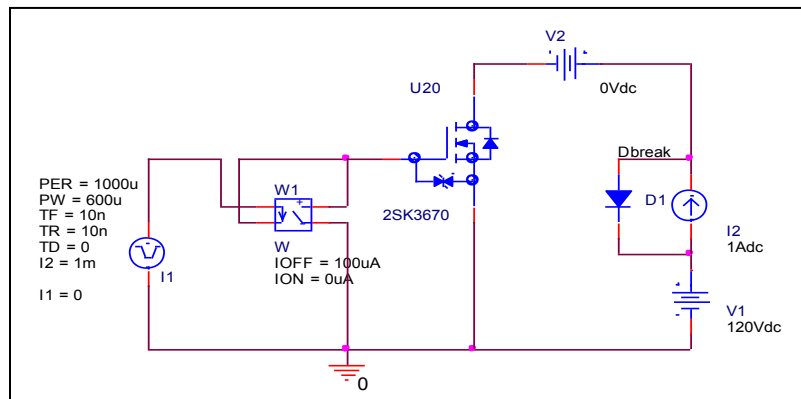
$I_D=0.5A, V_{GS}=4V$	Measurement		Simulation		Error (%)
$R_{DS(on)}$	1.000	Ω	0.998	Ω	0.200

Gate Charge Characteristic

Circuit Simulation result



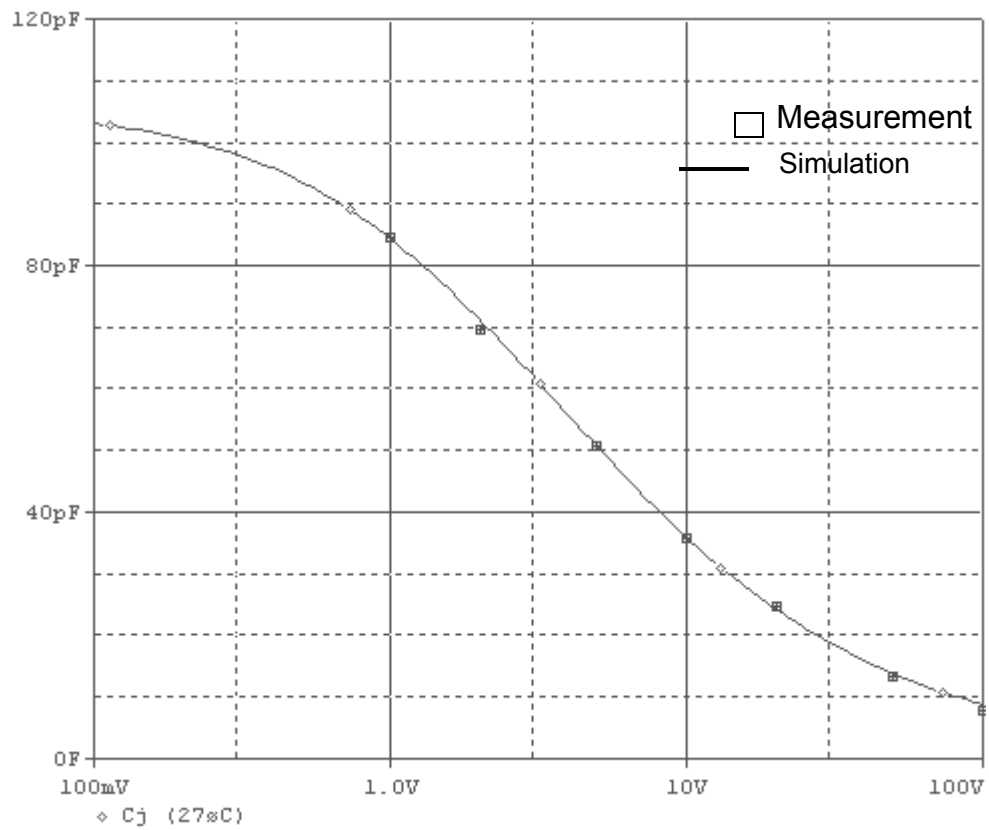
Evaluation circuit



Simulation Result

$V_{DD}=120V, I_D=1A$ $V_{GS}=5V$	Measurement		Simulation		Error (%)
Qgs	1.000	nC	1.008	nC	0.800
Qgd	1.700	nC	1.709	nC	0.529
Qg	4.600	nC	4.300	nC	-6.522

Capacitance Characteristic

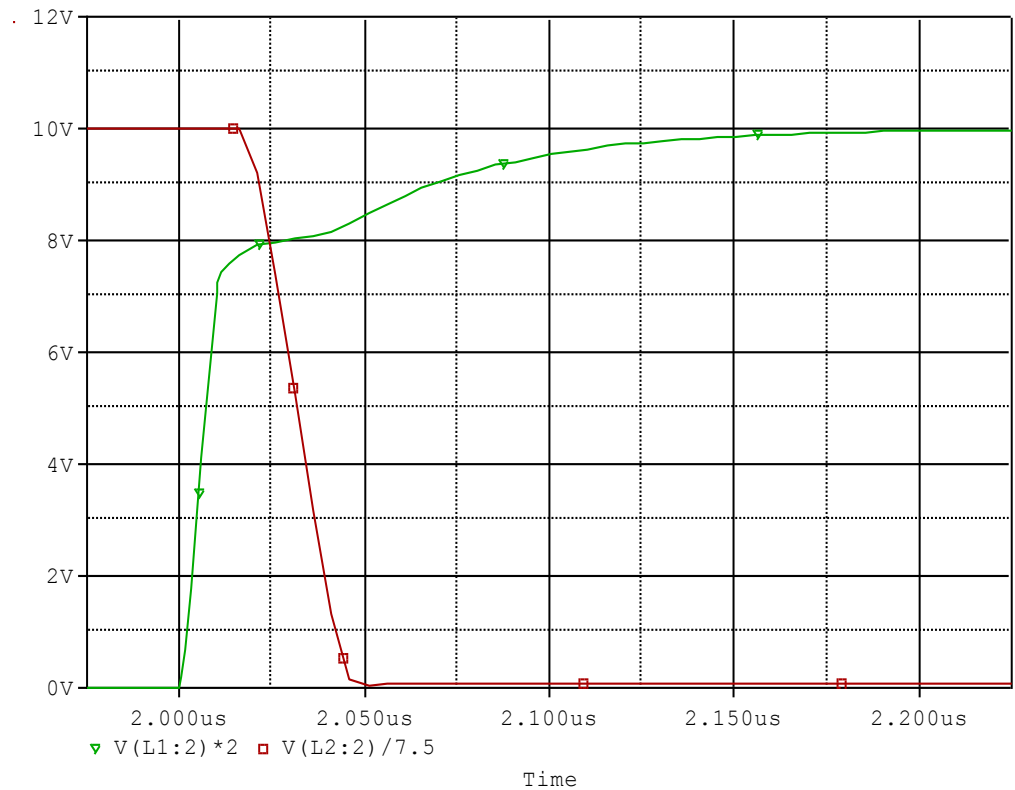


Simulation Result

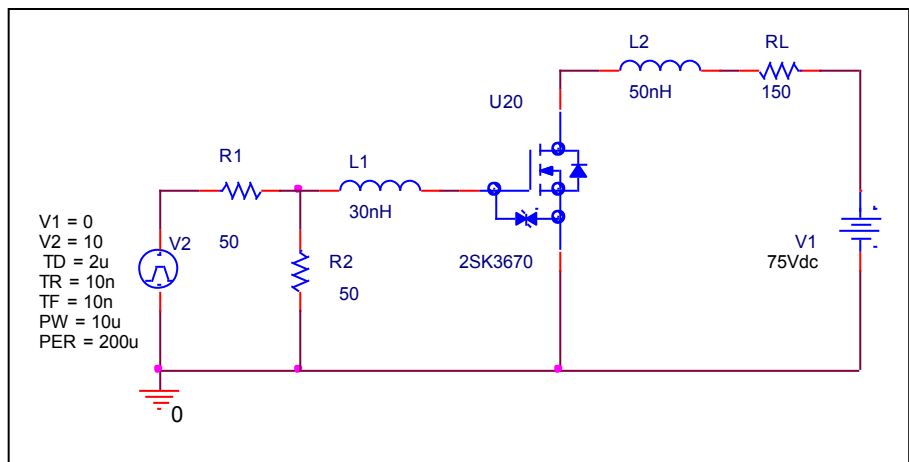
V _{DS} (V)	Cbd(pF)		Error(%)
	Measurement	Simulation	
1.000	85.000	85.213	0.250
2.000	70.000	70.700	1.000
5.000	51.000	51.200	0.392
10.000	36.000	36.158	0.438
20.000	25.000	24.716	1.136
50.000	13.500	13.600	0.740
100.000	8.000	8.195	2.437

Switching Time Characteristic

Circuit Simulation result



Evaluation circuit

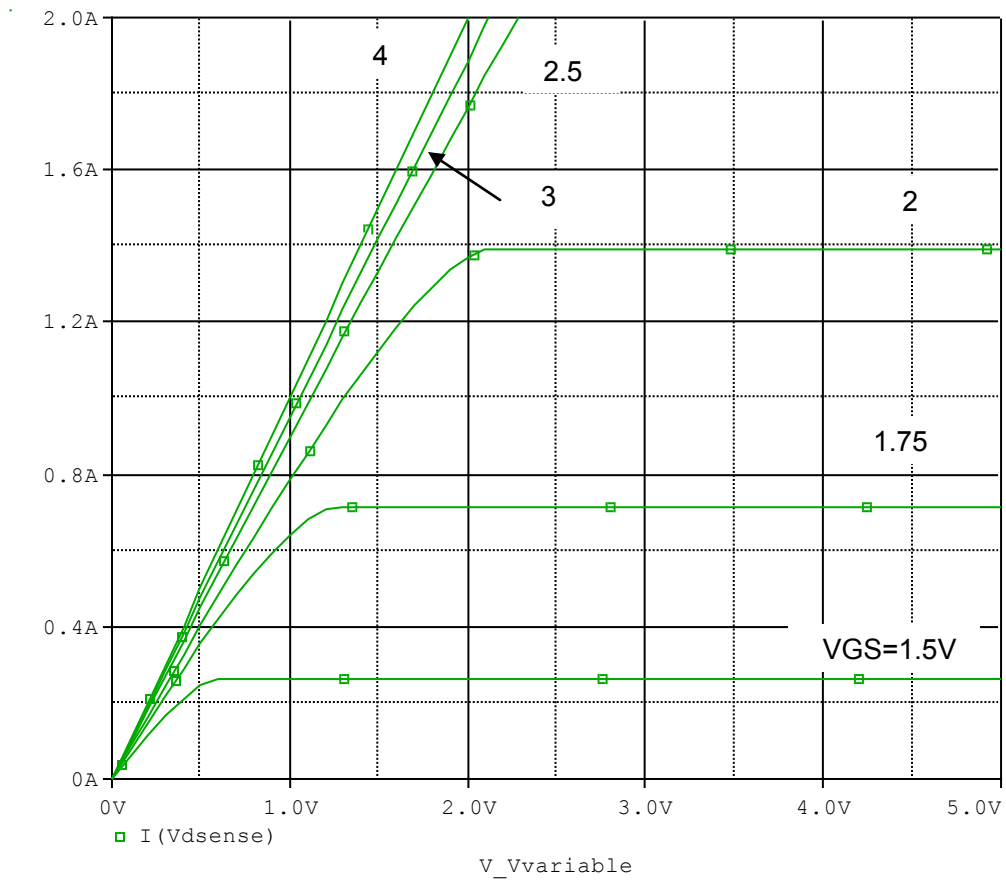


Simulation Result

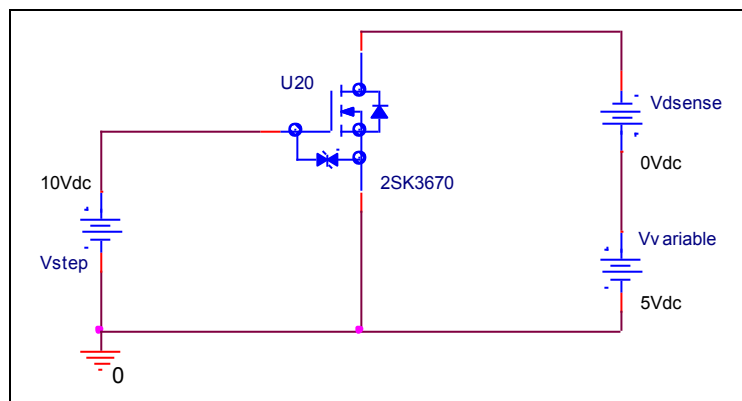
$I_D=0.5\text{ A}$, $V_{DD}=75\text{ V}$ $V_{GS}=0/10\text{ V}$	Measurement		Simulation		Error(%)
	ton	40.000 ns	40.645 ns	ns	

Output Characteristic

Circuit Simulation result



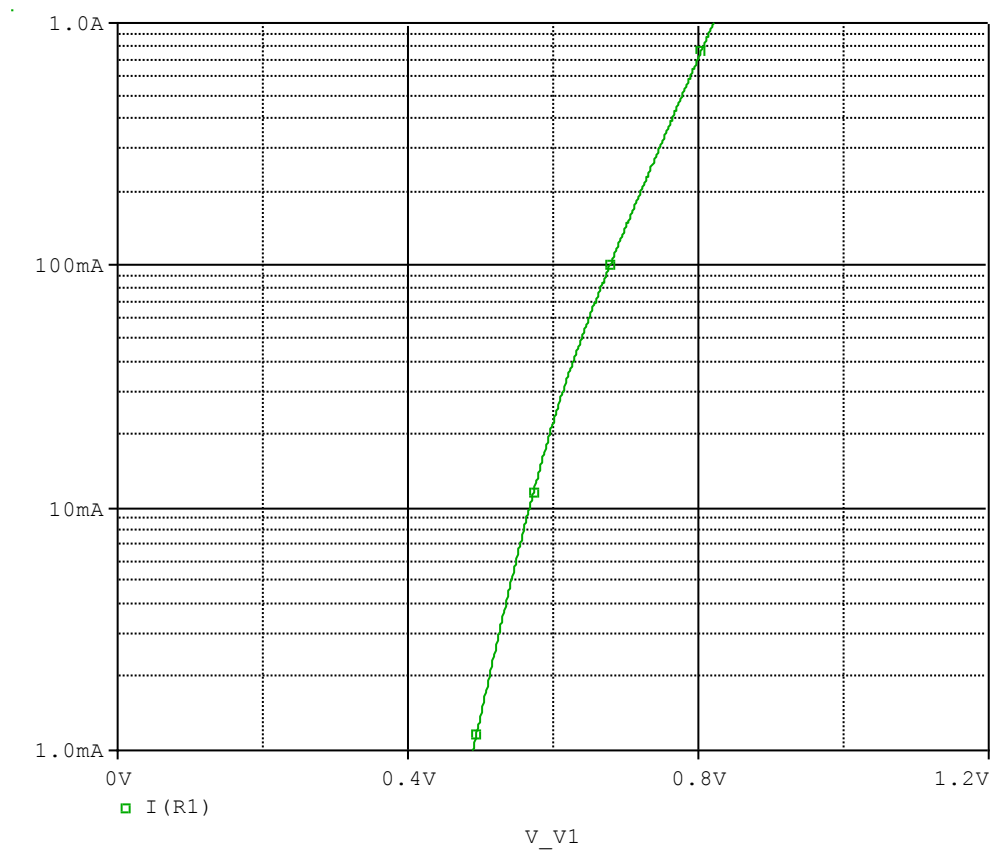
Evaluation circuit



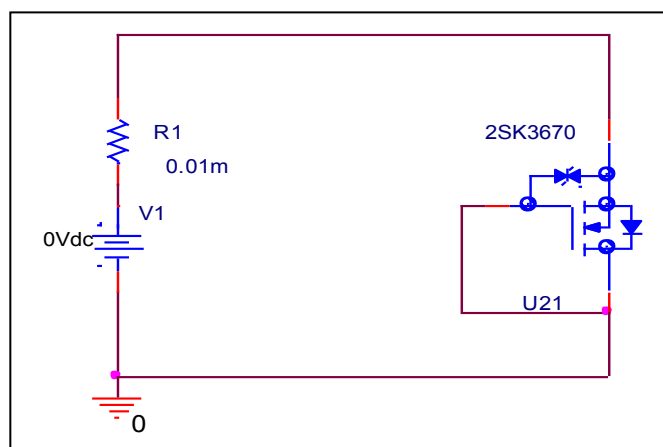
BODY DIODE

Forward Current Characteristic

Circuit Simulation Result

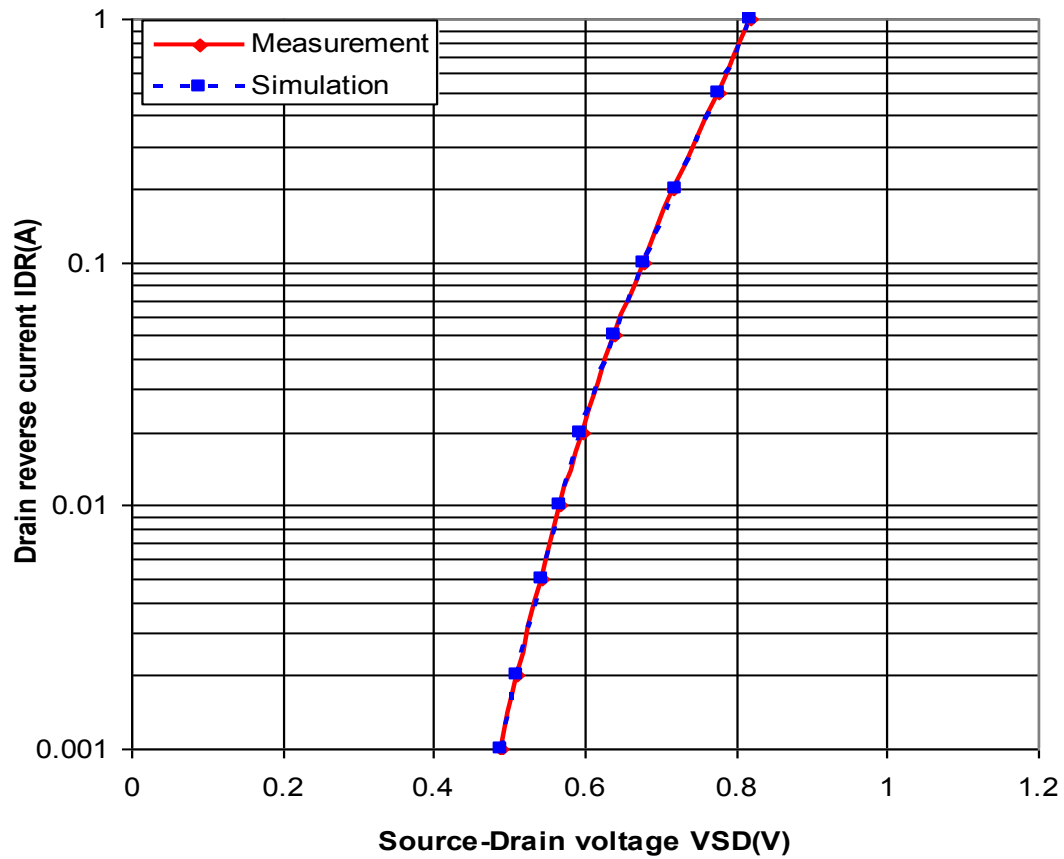


Evaluation Circuit



Comparison Graph

Circuit Simulation Result

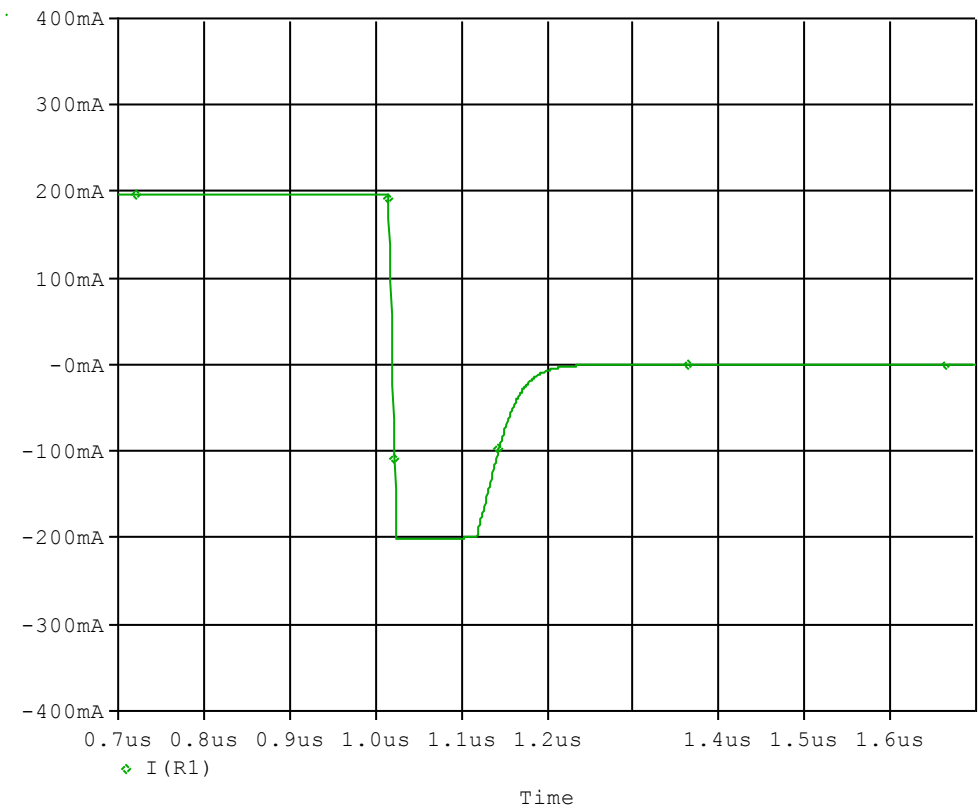


Simulation Result

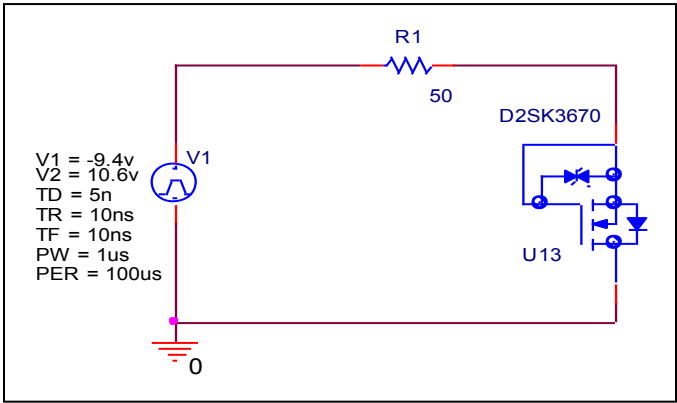
Ifwd(A)	VSD(V)		%Error
	Measuremen	Simulation	
0.001	0.490	0.489	-0.204
0.002	0.510	0.511	0.196
0.005	0.542	0.542	0.000
0.01	0.566	0.567	0.177
0.02	0.598	0.594	-0.669
0.05	0.640	0.639	-0.156
0.1	0.678	0.678	0.000
0.2	0.718	0.720	0.279
0.5	0.778	0.777	-0.129

Reverse Recovery Characteristic

Circuit Simulation Result



Evaluation Circuit

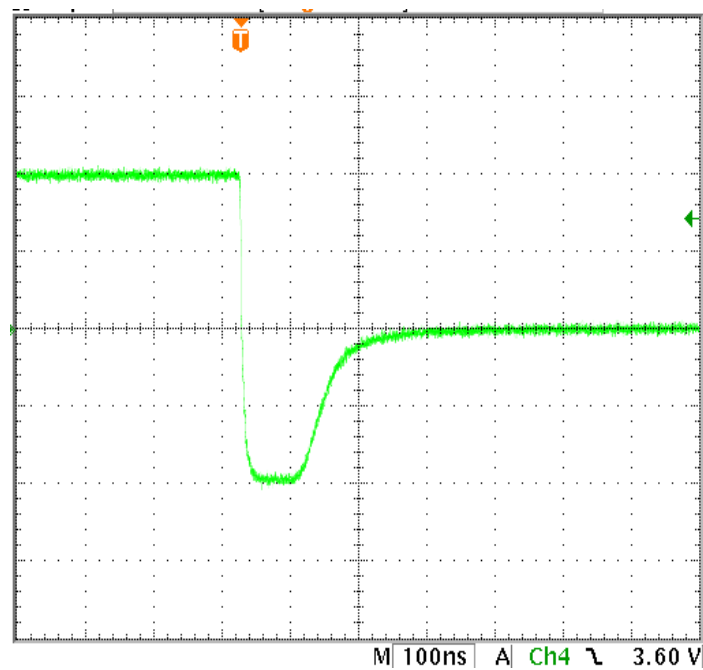


Compare Measurement vs. Simulation

Trr(ns)	Measurement	Simulation	Error (%)
Trj+Trb (ns)	159.000	159.464	0.292

Reverse Recovery Characteristic

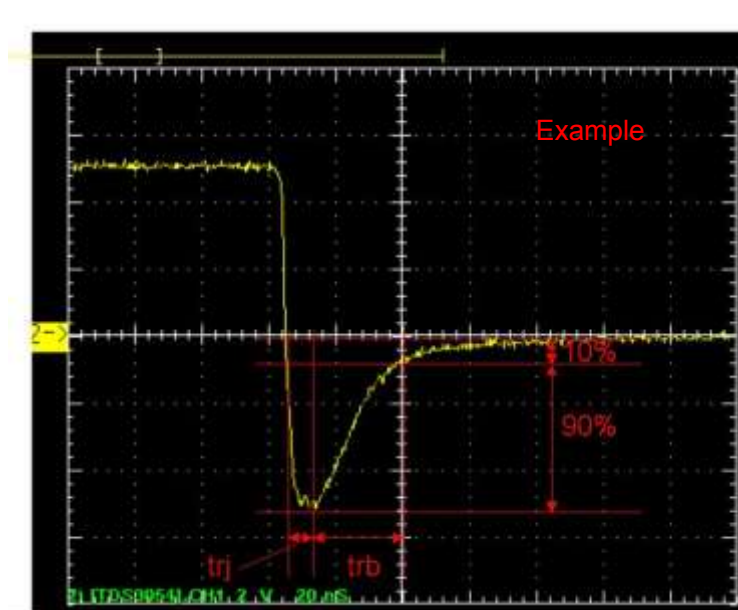
Reference



$T_{rr}=76(\text{ns})$

$T_{rb}=83(\text{ns})$

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

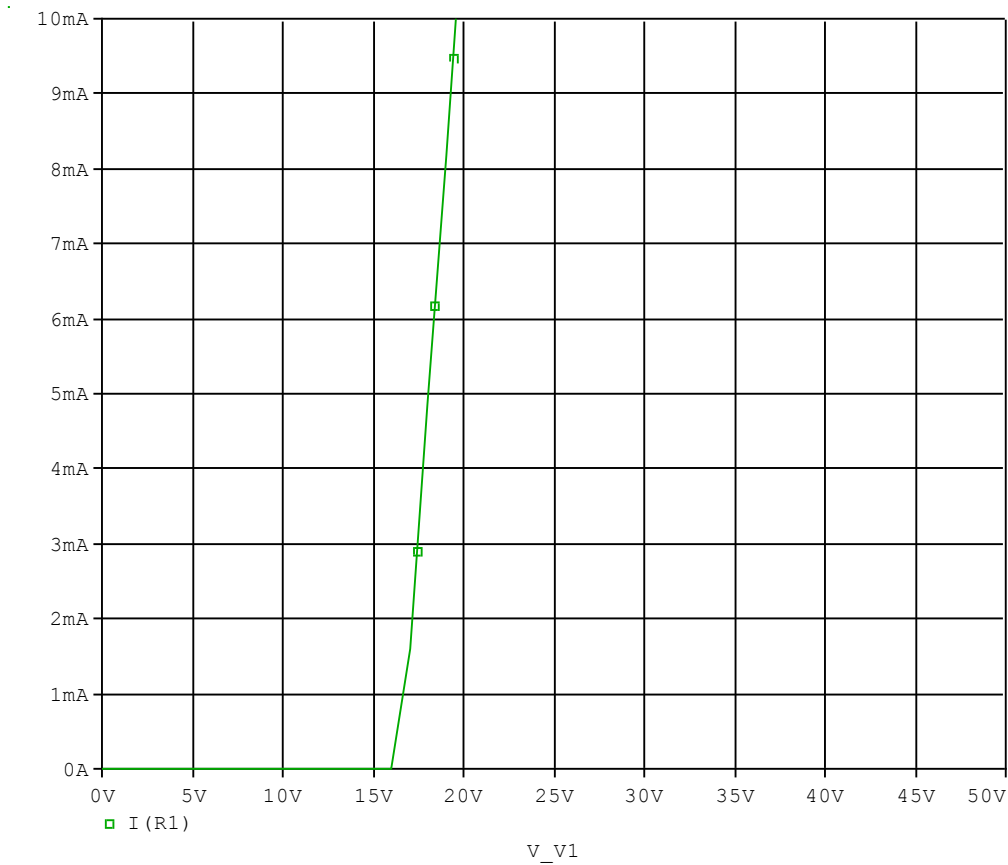


Relation between t_{rr} and t_{rb}

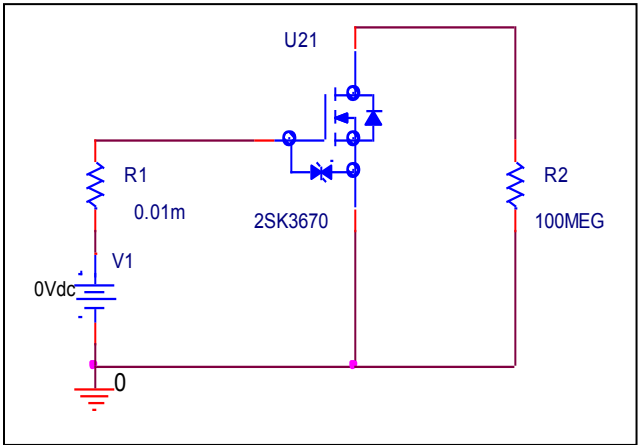
ESD PROTECTION DIODE

Zener Voltage Characteristic

Circuit Simulation Result



Evaluation Circuit



Zener Voltage Characteristic

Reference

