

Device Modeling Report

COMPONENTS: Power MOSFET (Professional Model)
PART NUMBER: 2SJ654
MANUFACTURER: SANYO
Body Diode (Professional Model) / ESD Protection Diode



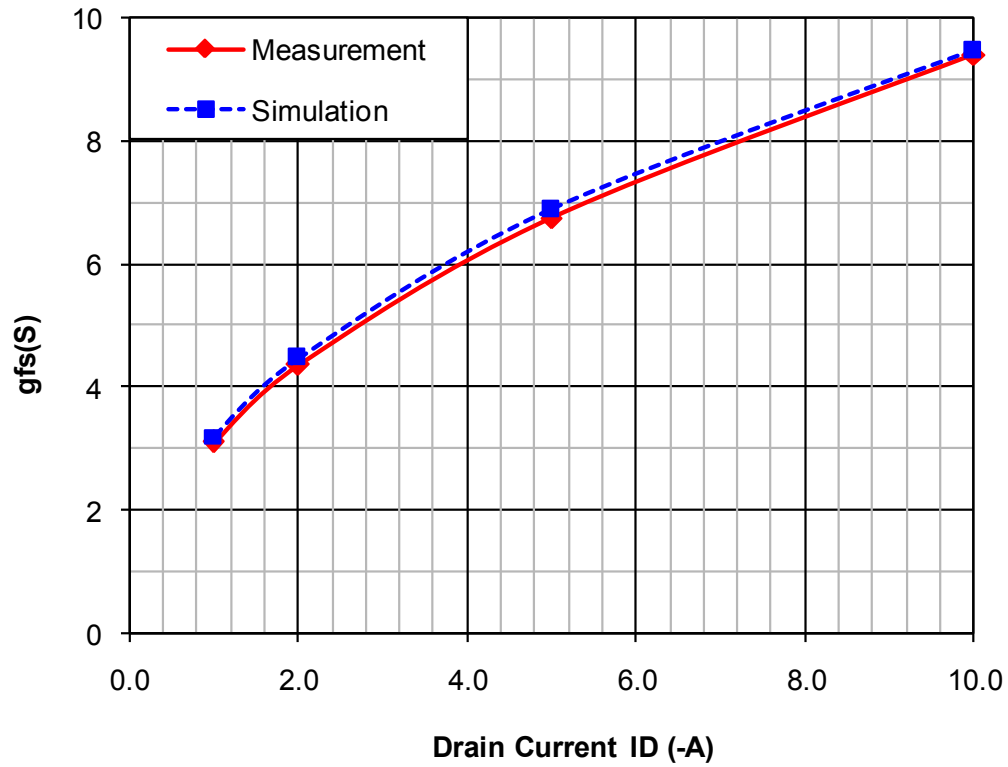
Bee Technologies Inc.

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

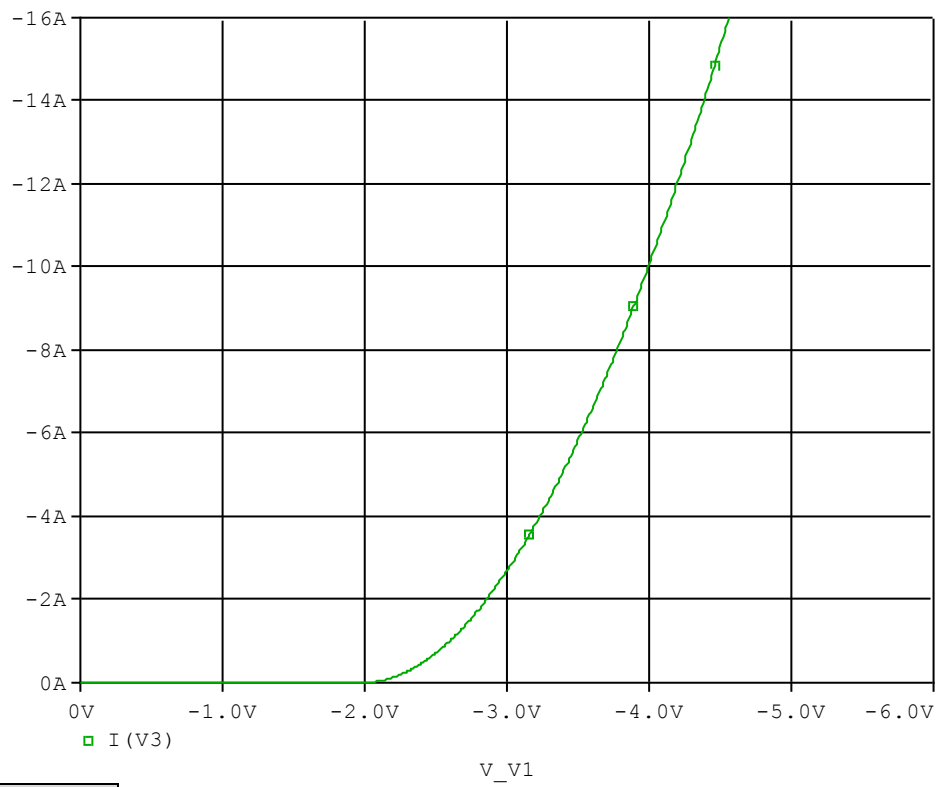


Comparison table

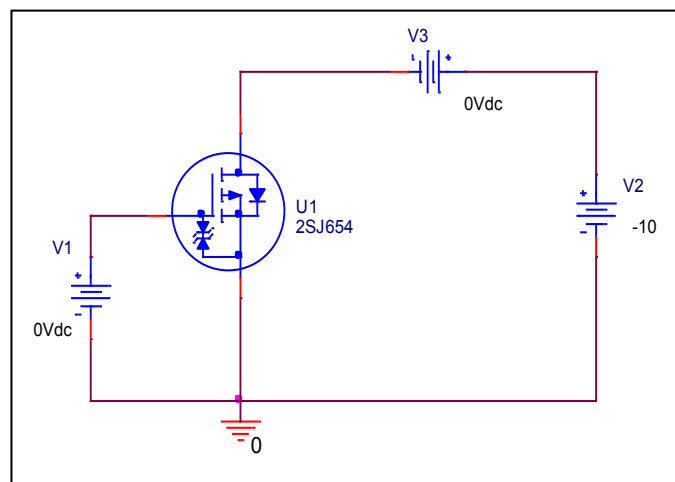
- I_D (A)	g_{fs} (S)		Error (%)
	Measurement	Simulation	
1.0000	3.100	3.200	3.21
2.0000	4.350	4.467	2.70
5.0000	6.750	6.882	1.96
10.0000	9.400	9.465	0.69

V_{gs}-I_d Characteristic

Circuit Simulation result

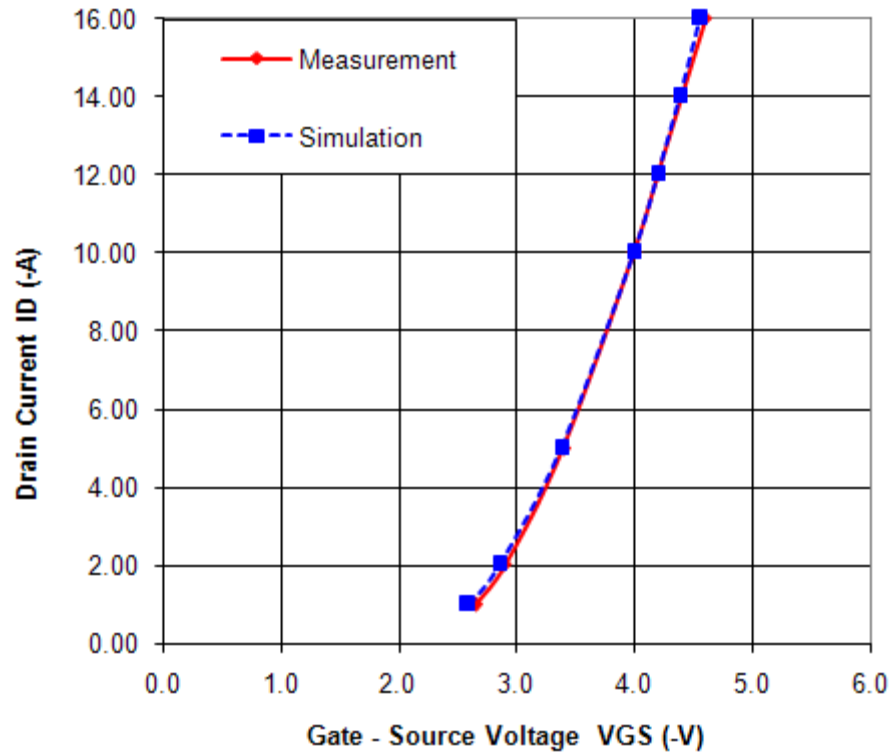


Evaluation circuit



Comparison Graph

Circuit Simulation Result

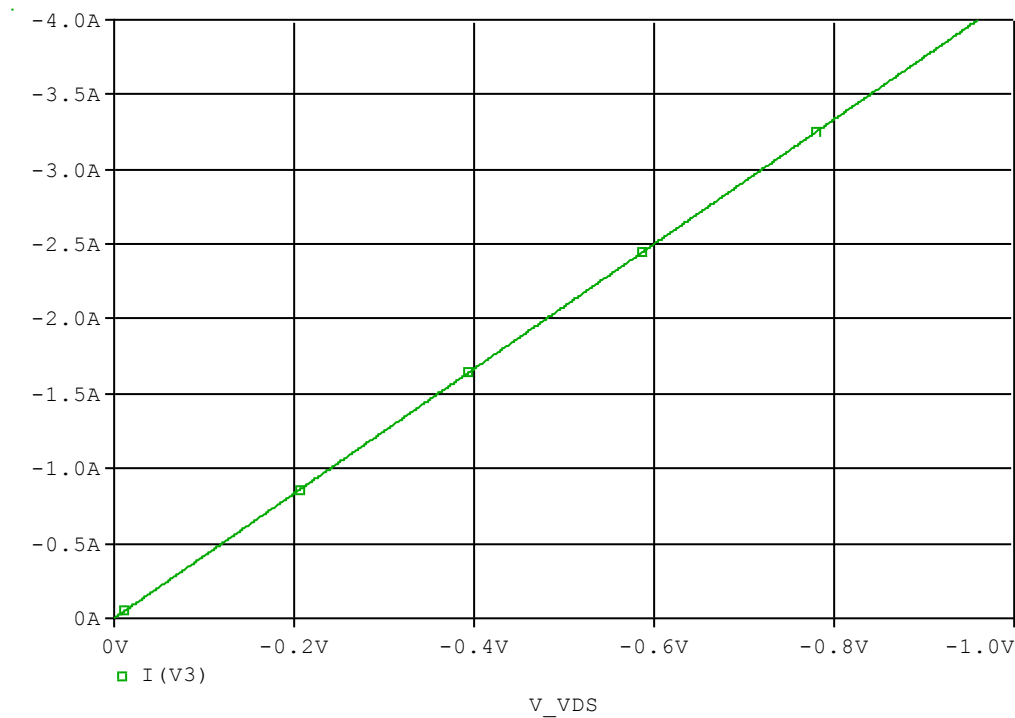


Simulation Result

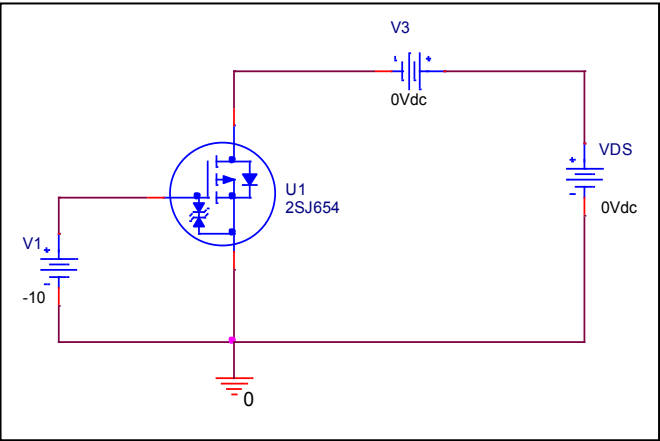
$-I_D(A)$	$-V_{GS}(V)$		Error (%)
	Measurement	Simulation	
1	2.650	2.596	-2.04
2	2.900	2.857	-1.50
5	3.400	3.384	-0.48
10	4.000	3.994	-0.15
12	4.200	4.197	-0.08
14	4.400	4.385	-0.35
16	4.600	4.561	-0.85

Rds(on) Characteristic

Circuit Simulation result



Evaluation circuit

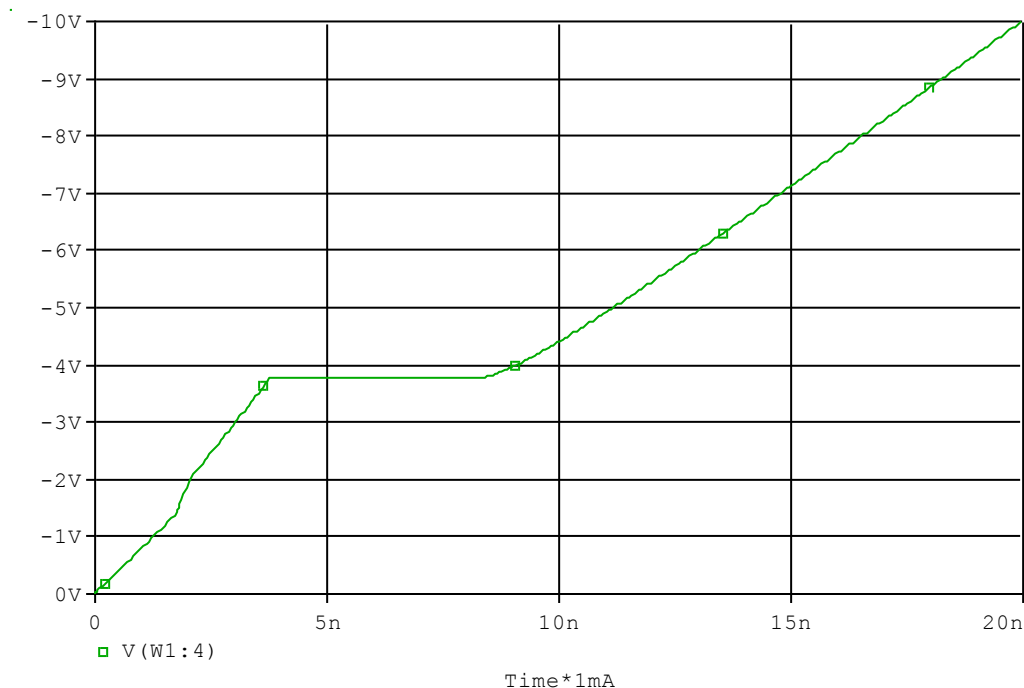


Simulation Result

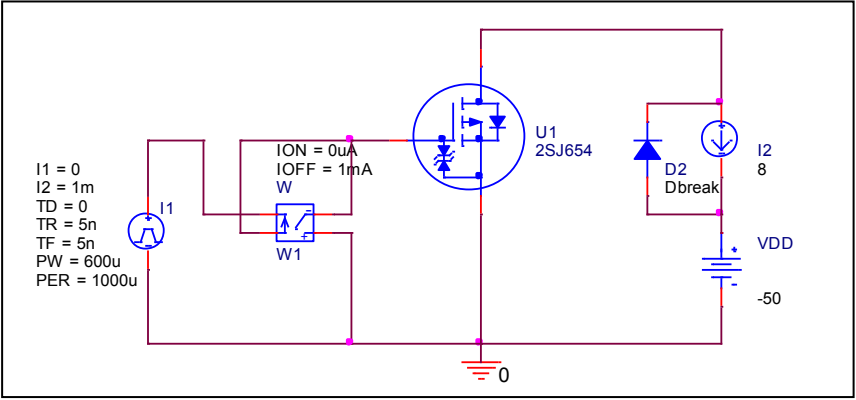
$I_D = -4A, V_{GS} = -10V$		Measurement	Simulation	Error (%)
$R_{DS} (on)$	mΩ	240.000	240.000	0.00

Gate Charge Characteristic

Circuit Simulation result



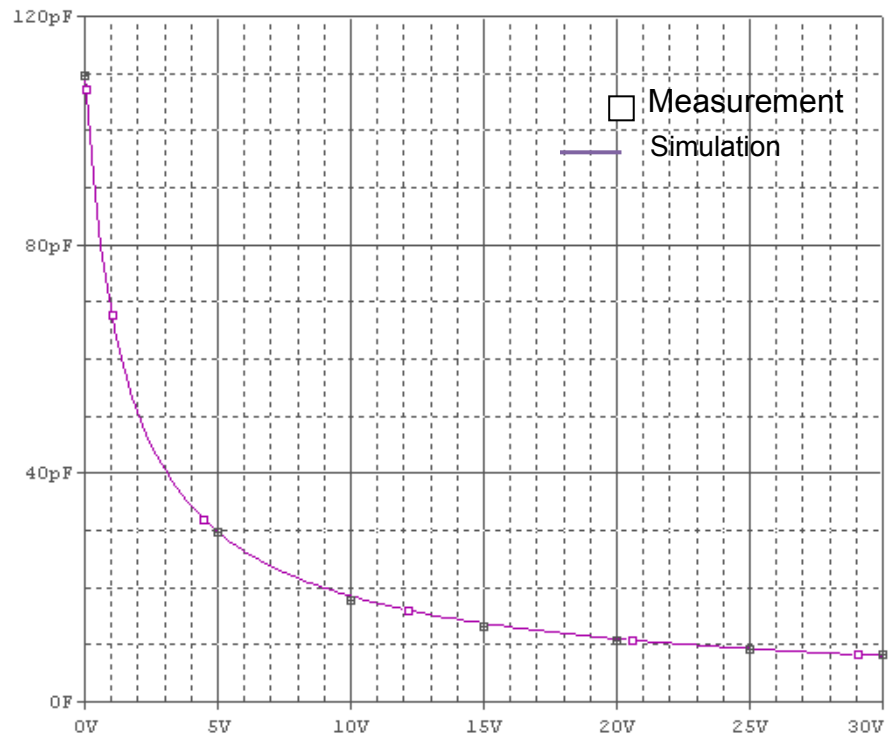
Evaluation circuit



Simulation Result

V _{DD} =-50V, I _D =-8A , V _{GS} =-10V		Measurement	Simulation	Error (%)
Q _{gs}	nC	3.800	3.772	-0.74
Q _{gd}	nC	4.500	4.509	0.20
Q _g	nC	20.000	19.977	-0.11

Capacitance Characteristic

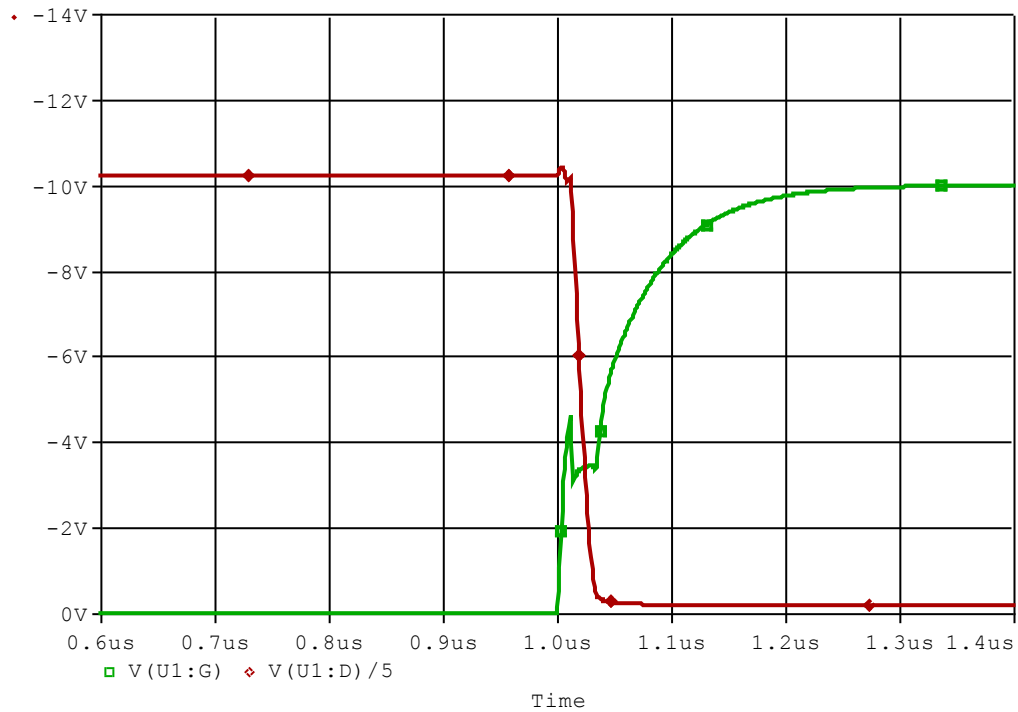


Simulation Result

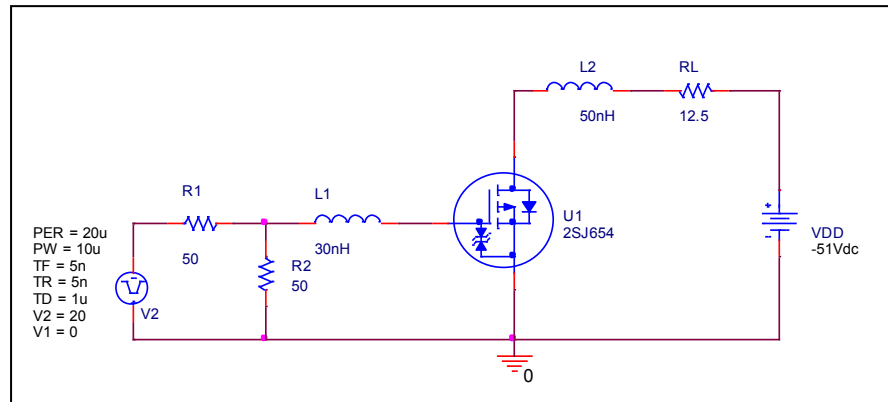
V _{SD} (V)	Cbd(pF)		Error(%)
	Measurement	Simulation	
0	110.000	110.000	0.000
5	30.000	29.735	-0.883
10	18.500	18.478	-0.119
15	13.500	13.723	1.652
20	11.000	11.047	0.427
25	9.500	9.312	-1.979
30	8.000	8.087	1.088

Switching Time Characteristic

Circuit Simulation result



Evaluation circuit

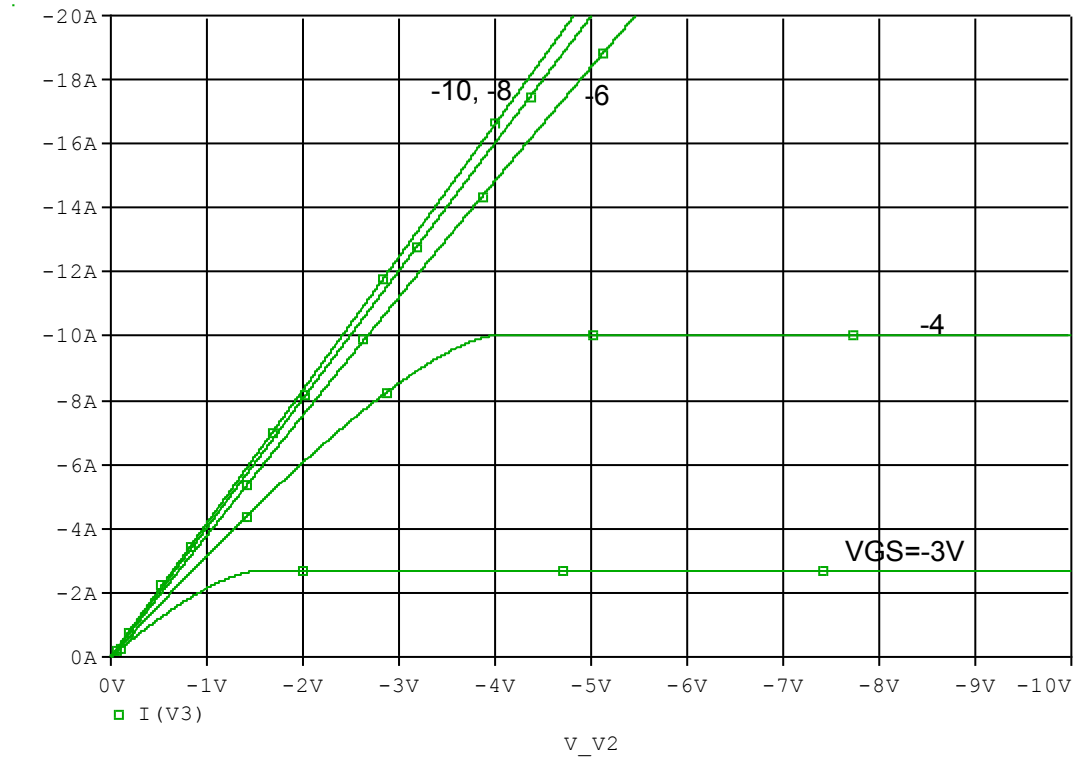


Simulation Result

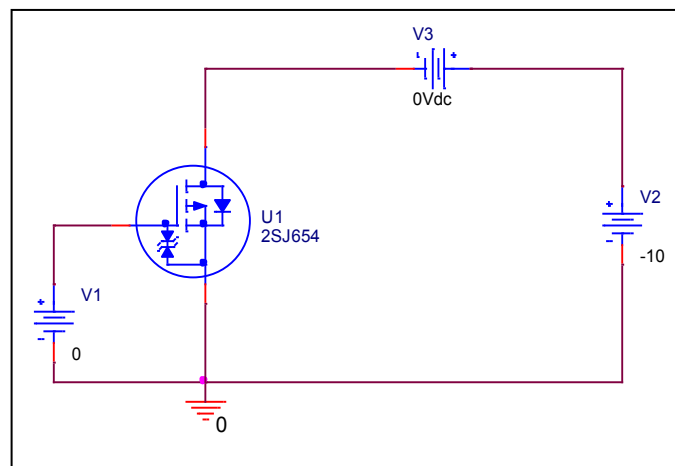
$I_D = -4A$, $V_{DD} = -50V$ $V_{GS} = 0/-10V$		Measurement	Simulation	Error(%)
td(on)	ns	12.000	11.992	-0.07

Output Characteristic

Circuit Simulation result



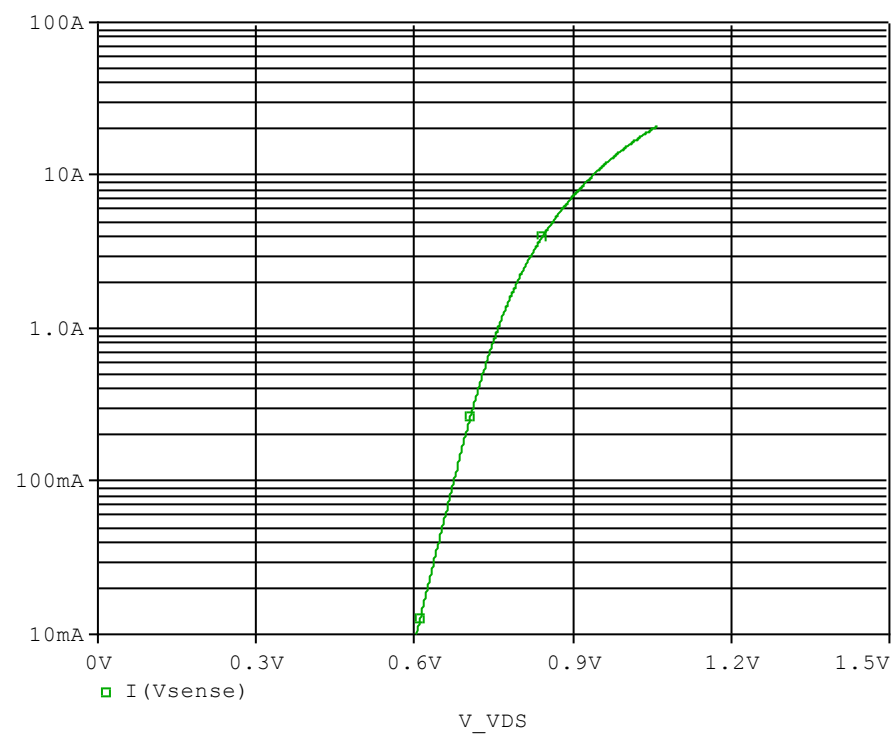
Evaluation circuit



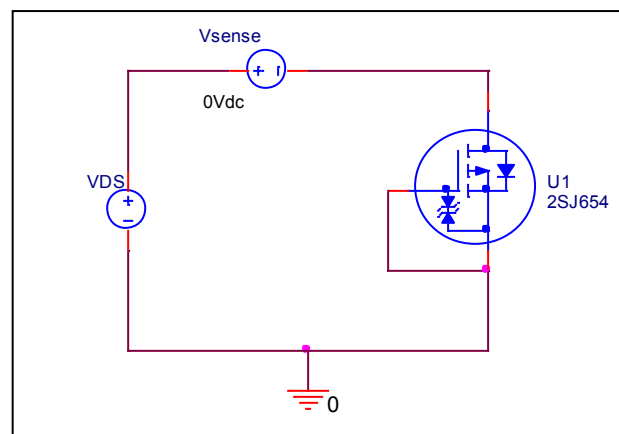
BODY DIODE SPICE MODEL

Forward Current Characteristic

Circuit Simulation Result

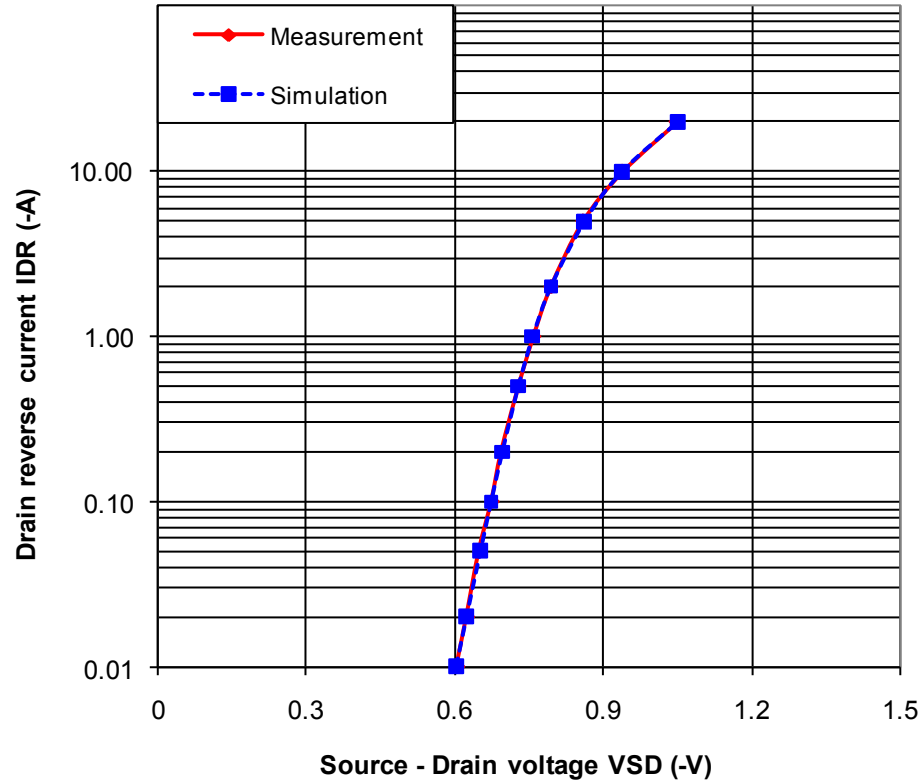


Evaluation Circuit



Comparison Graph

Circuit Simulation Result

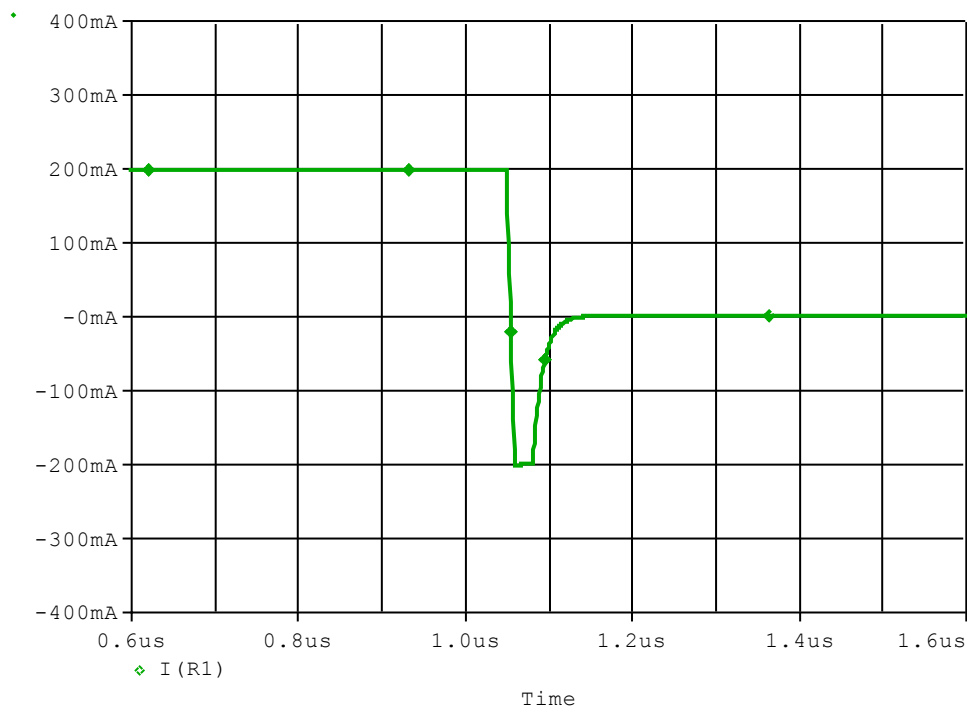


Simulation Result

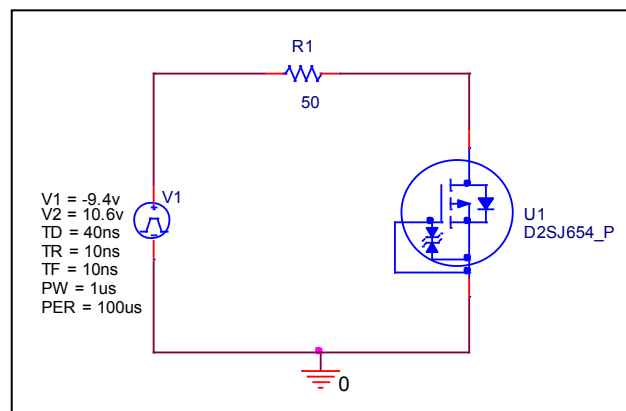
IDR(-A)	VSD(-V)		%Error
	Measurement	Simulation	
0.01	0.6050	0.6036	-0.24
0.02	0.6250	0.6246	-0.07
0.05	0.6500	0.6526	0.40
0.1	0.6750	0.6743	-0.11
0.2	0.6950	0.6968	0.25
0.5	0.7300	0.7292	-0.11
1	0.7600	0.7581	-0.24
2	0.7950	0.7945	-0.06
5	0.8600	0.8626	0.30
10	0.9400	0.9380	-0.22
20	1.0500	1.0505	0.05

Reverse Recovery Characteristic

Circuit Simulation Result



Evaluation Circuit

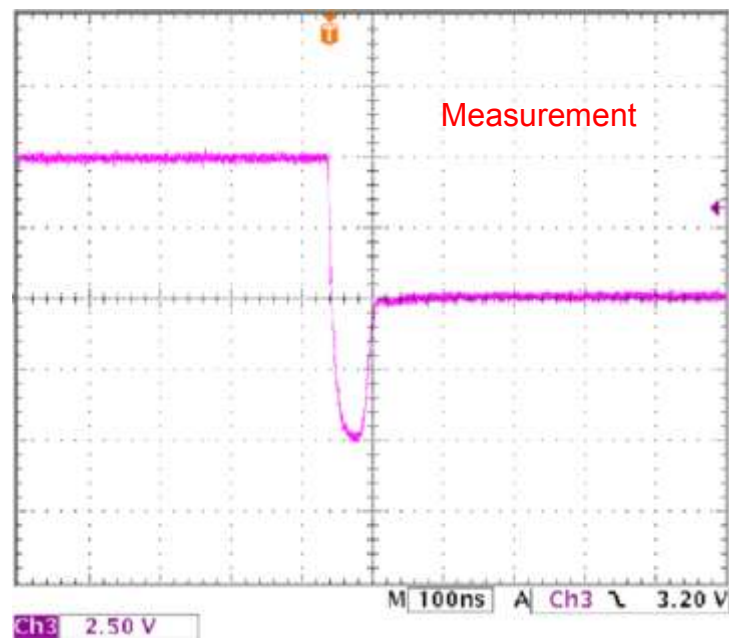


Compare Measurement vs. Simulation

		Measurement	Simulation	Error (%)
trj	ns	26.000	26.125	0.48
trb	ns	28.000	28.006	0.02
trr	ns	54.000	54.131	0.24

Reverse Recovery Characteristic

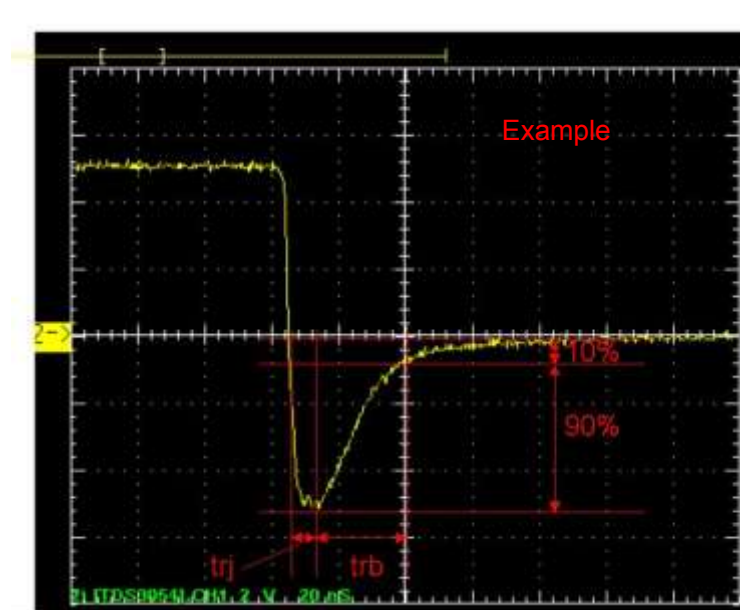
Reference



$T_{rr}=26.00(\text{ns})$

$T_{rb}=28.00(\text{ns})$

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

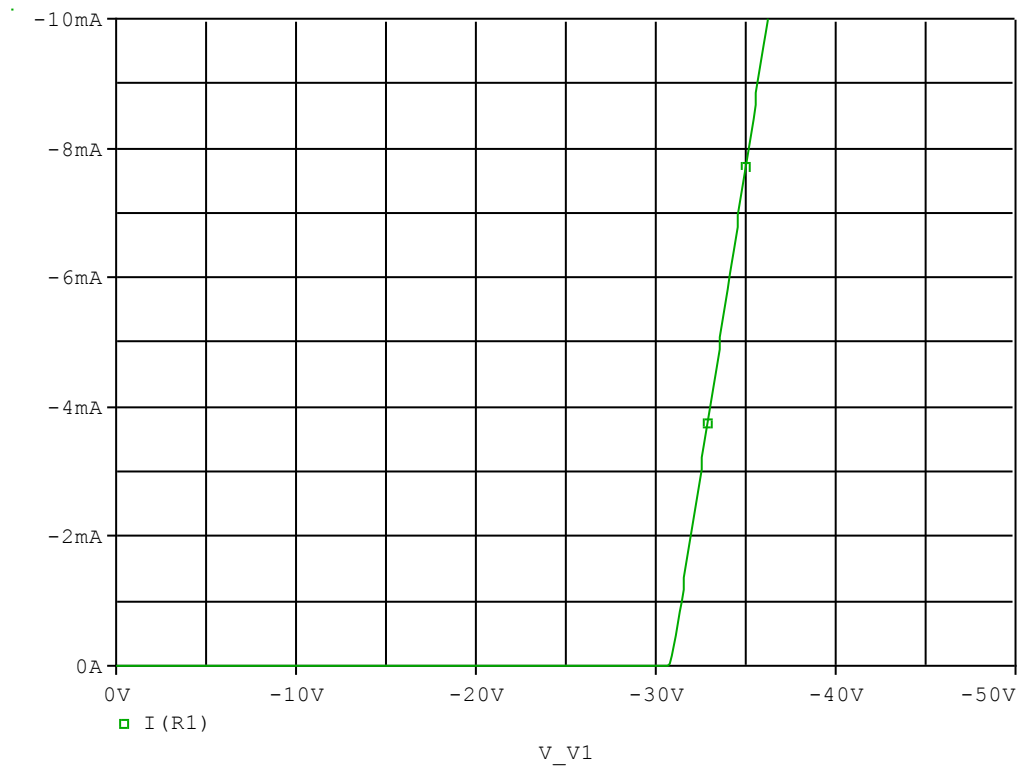


Relation between t_{rr} and t_{rb}

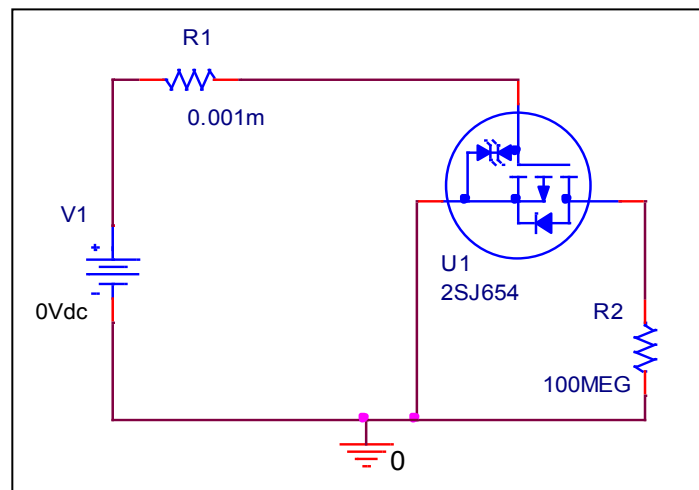
ESD PROTECTION DIODE SPICE MODEL

Zener Voltage Characteristic

Circuit Simulation Result



Evaluation Circuit



Zener Voltage Characteristic

Reference

