

Device Modeling Report

COMPONENTS: Power MOSFET (Model Parameters)
PART NUMBER: 2SJ657
MANUFACTURER: SANYO
Body Diode (Model Parameters) / ESD Protection Diode



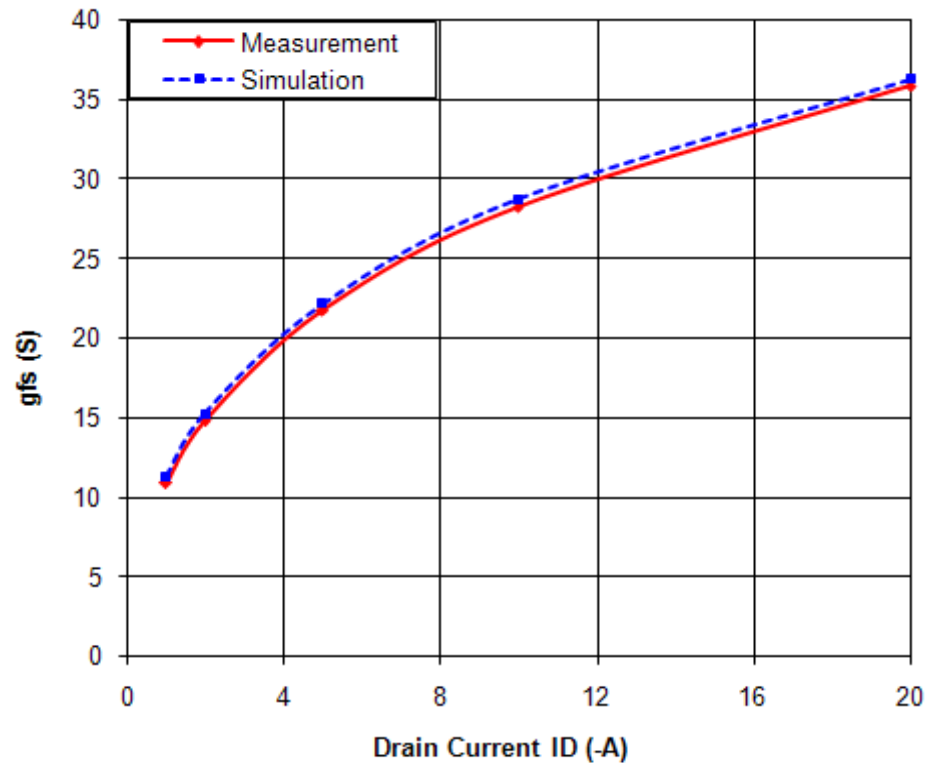
Bee Technologies Inc.

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

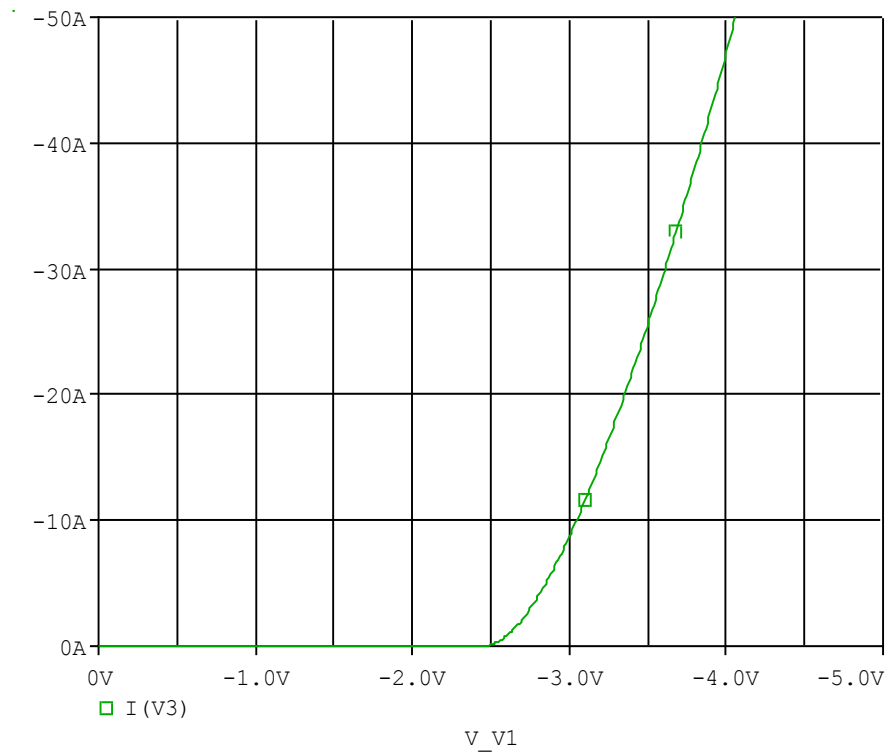


Comparison table

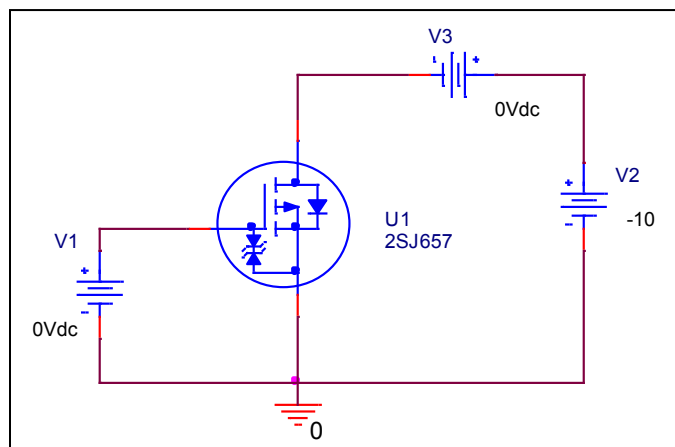
- I_D (A)	g_{fs} (S)		Error (%)
	Measurement	Simulation	
1	10.850	11.282	3.98
2	14.800	15.243	2.99
5	21.700	22.139	2.02
10	28.250	28.683	1.53
20	35.800	36.253	1.27

V_{gs}-I_d Characteristic

Circuit Simulation result

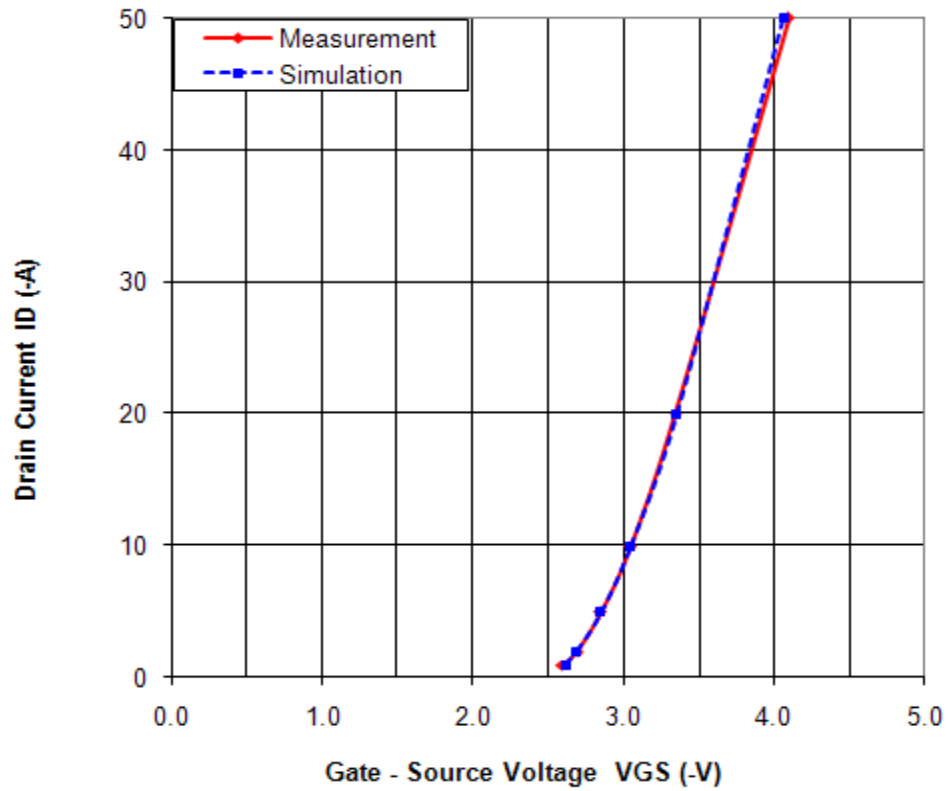


Evaluation circuit



Comparison Graph

Circuit Simulation Result

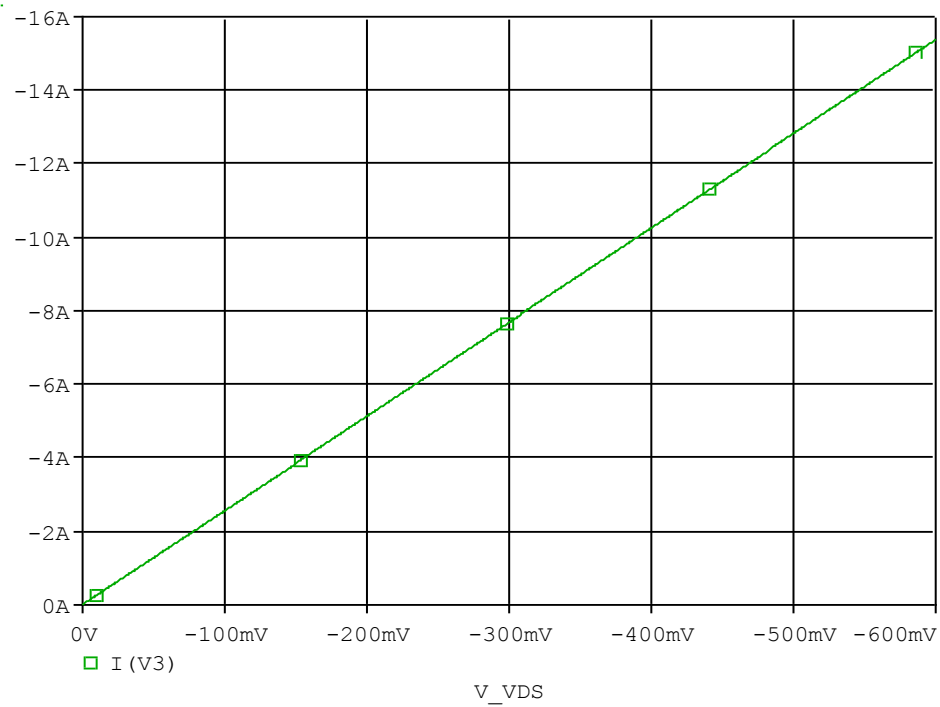


Simulation Result

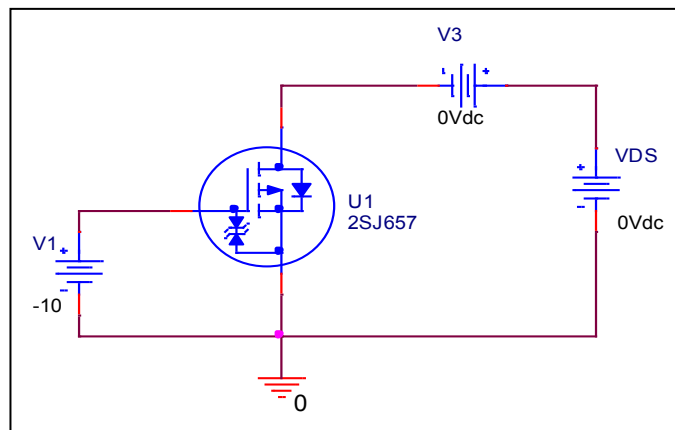
$-I_D(A)$	$-V_{GS}(V)$		Error (%)
	Measurement	Simulation	
1	2.600	2.616	0.62
2	2.700	2.691	-0.33
5	2.850	2.851	0.04
10	3.050	3.046	-0.13
20	3.350	3.352	0.06
50	4.100	4.062	-0.93

R_{ds(on)} Characteristic

Circuit Simulation result



Evaluation circuit

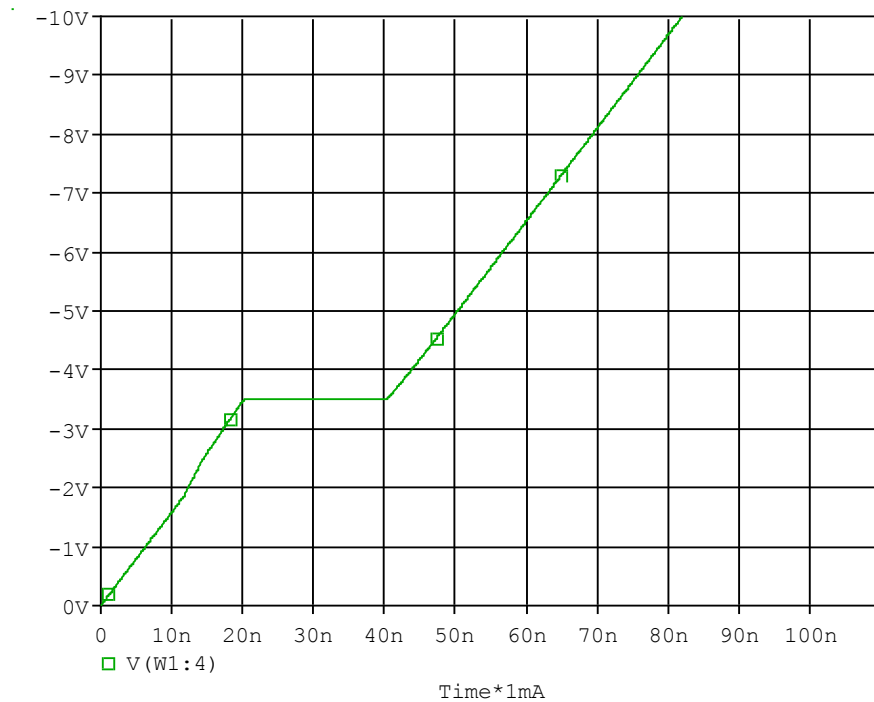


Simulation Result

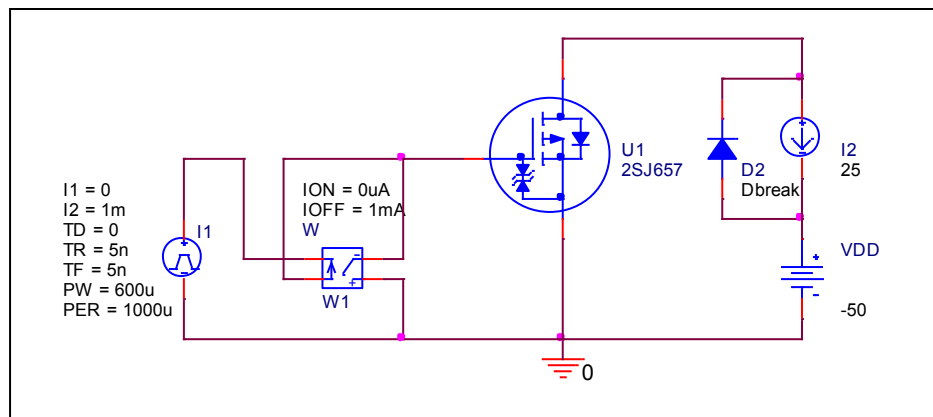
$I_D = -13A, V_{GS} = -10V$		Measurement	Simulation	Error (%)
$R_{DS(on)}$	m Ω	39.000	39.000	0.00

Gate Charge Characteristic

Circuit Simulation result



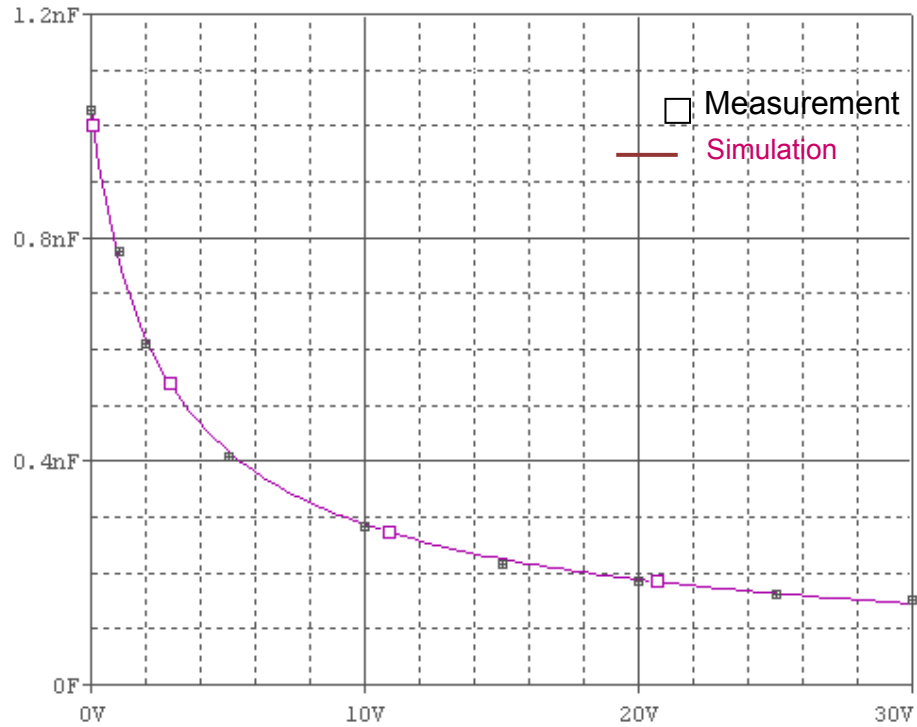
Evaluation circuit



Simulation Result

$V_{DD} = -50V, I_D = -25A$ $V_{GS} = -10V$		Measurement	Simulation	Error (%)
Qgs	nC	20.000	20.065	0.33
Qgd	nC	20.000	20.031	0.15
Qg	nC	110.000	82.018	-25.44

Capacitance Characteristic

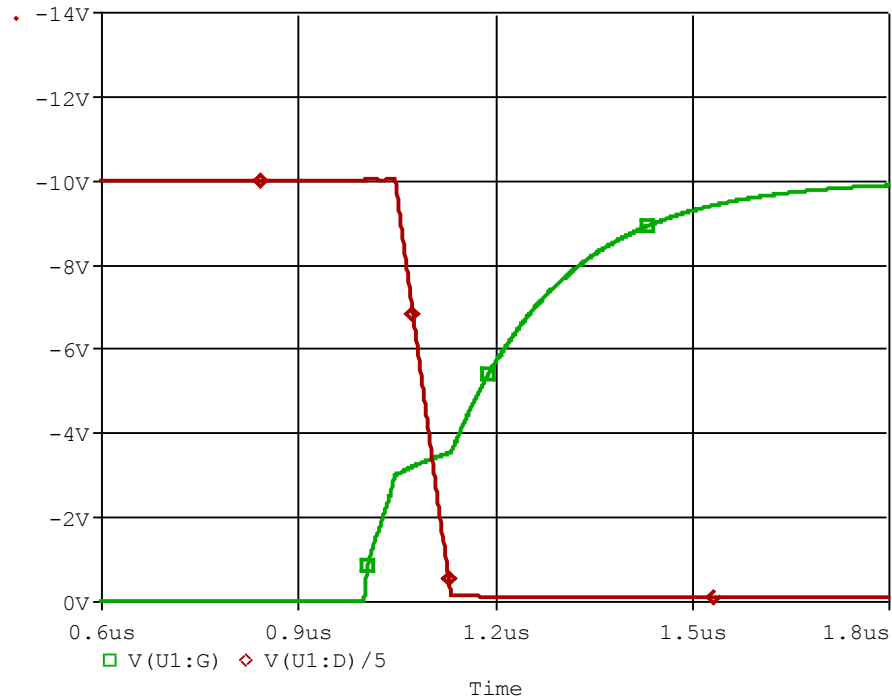


Simulation Result

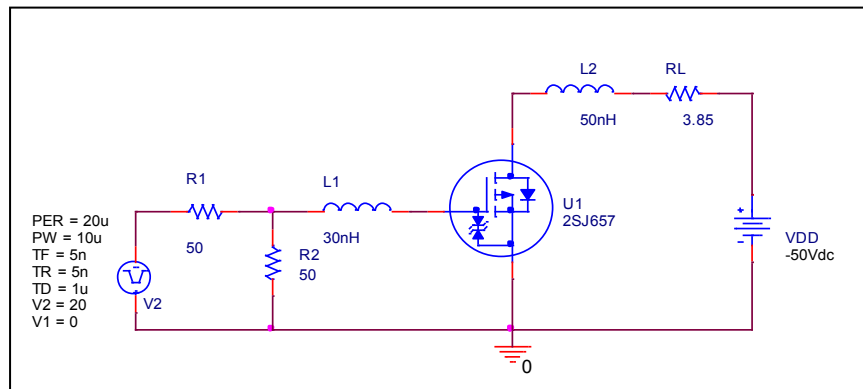
V_{SD} (V)	Cbd(pF)		Error(%)
	Measurement	Simulation	
0.0	1030.000	1035.000	0.49
1.0	780.000	770.000	-1.28
2.0	615.000	620.000	0.81
5.0	412.000	416.000	0.97
10.0	285.000	287.000	0.70
15.0	220.000	223.000	1.36
20.0	190.000	188.000	-1.05
25.0	165.000	163.000	-1.21
30.0	155.000	152.000	-1.94

Switching Time Characteristic

Circuit Simulation result



Evaluation circuit

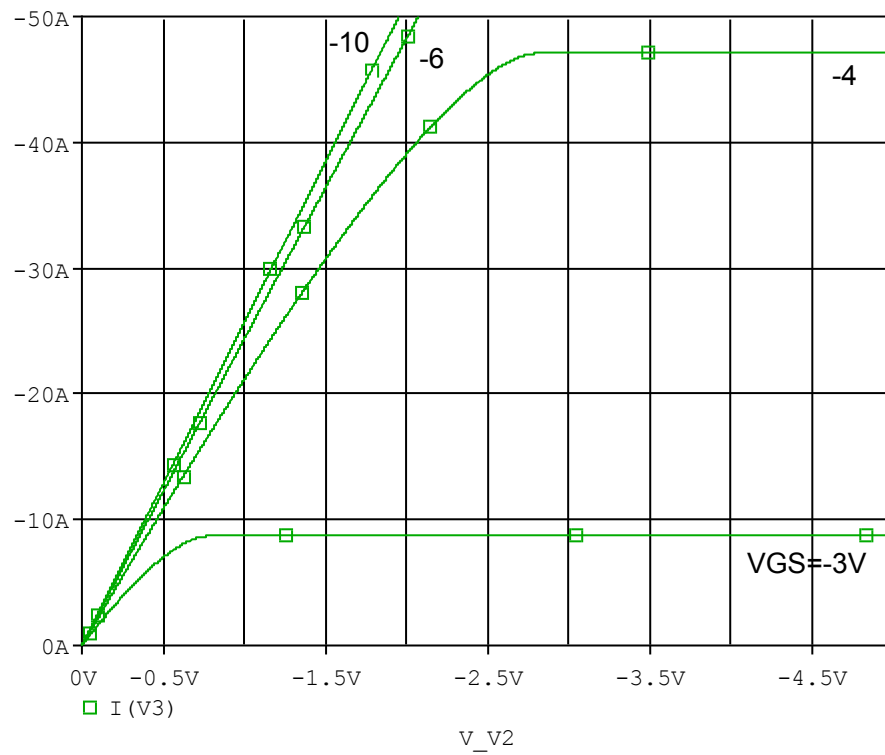


Simulation Result

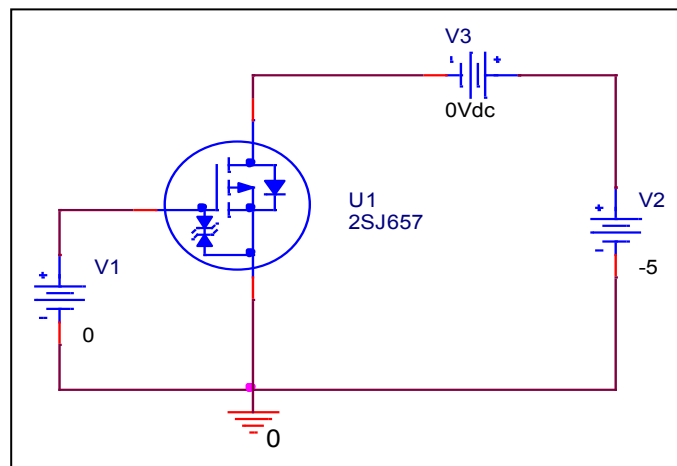
$I_D = -13A$, $V_{DD} = -50V$ $V_{GS} = 0/-10V$		Measurement	Simulation	Error(%)
$t_d(on)$	ns	47.000	47.050	0.11

Output Characteristic

Circuit Simulation result

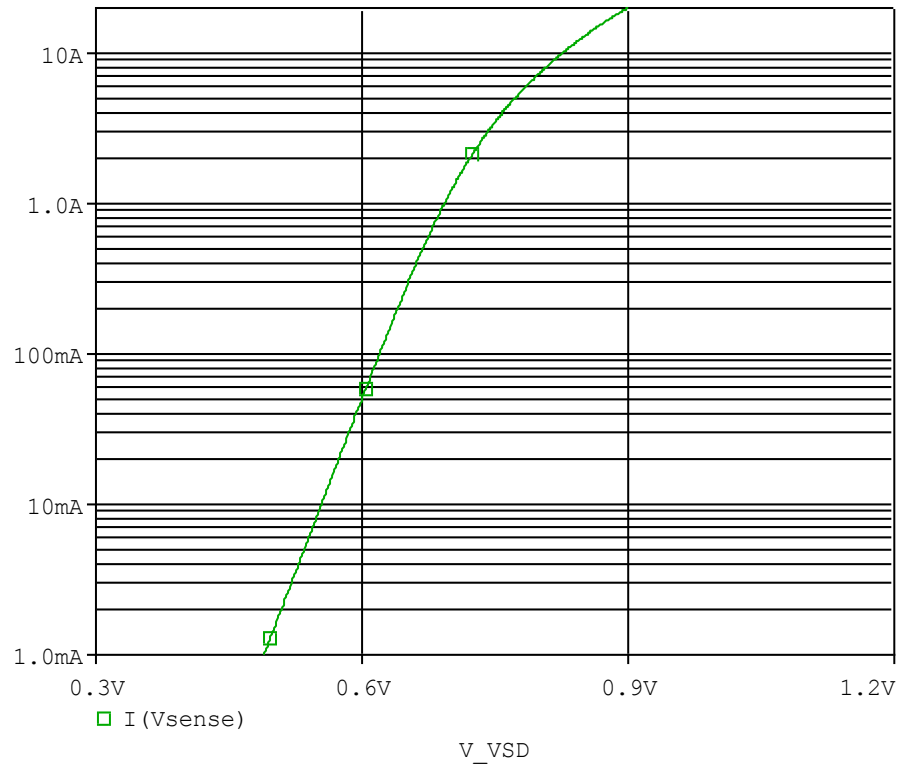


Evaluation circuit

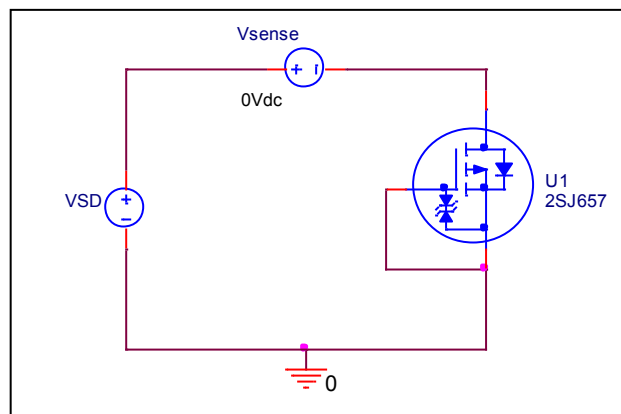


BODY DIODE SPICE MODEL Forward Current Characteristic

Circuit Simulation Result

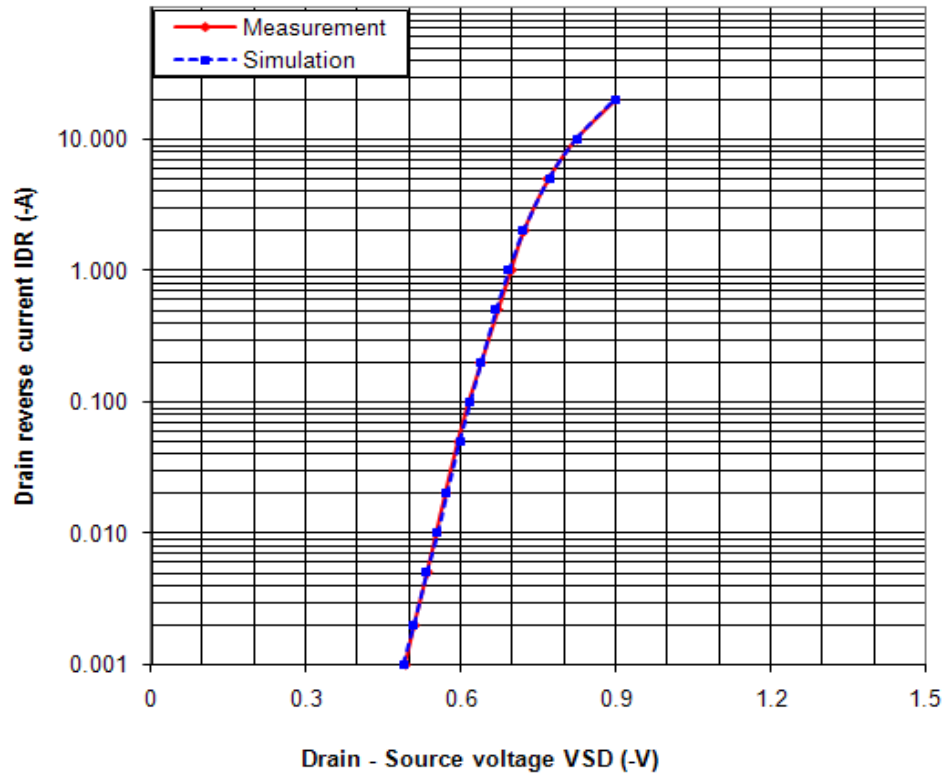


Evaluation Circuit



Comparison Graph

Circuit Simulation Result

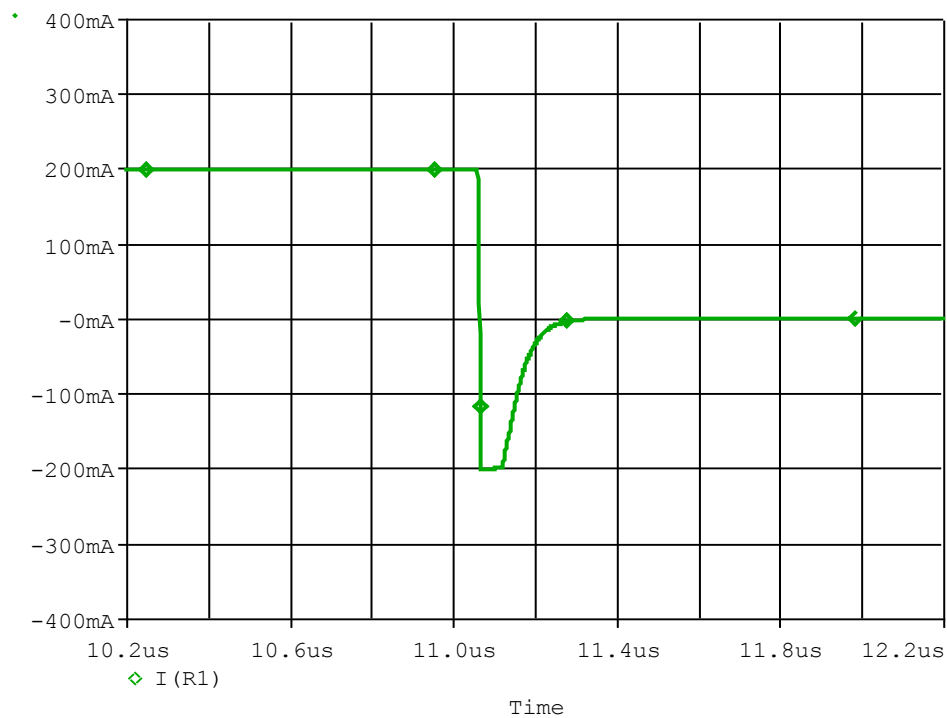


Simulation Result

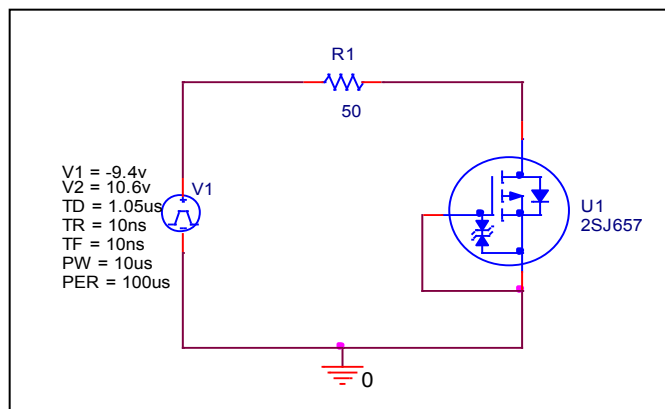
IDR(-A)	VSD (-V)		%Error
	Measurement	Simulation	
0.001	0.492	0.489	-0.61
0.01	0.553	0.554	0.18
0.100	0.617	0.619	0.32
1.000	0.697	0.693	-0.57
2.000	0.723	0.721	-0.28
5.000	0.770	0.772	0.26
10.000	0.825	0.825	0.00
20.000	0.900	0.899	-0.11

Reverse Recovery Characteristic

Circuit Simulation Result



Evaluation Circuit

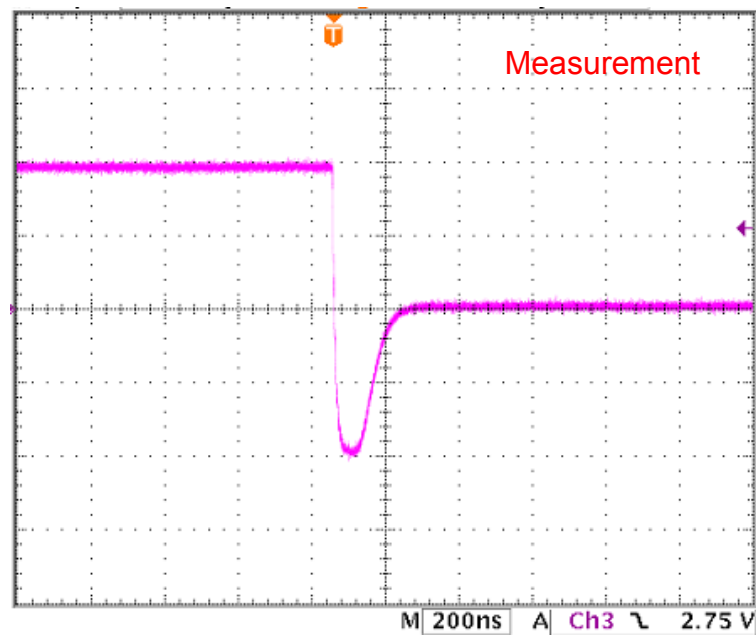


Compare Measurement vs. Simulation

		Measurement	Simulation	Error (%)
trj	ns	53.000	53.358	0.68

Reverse Recovery Characteristic

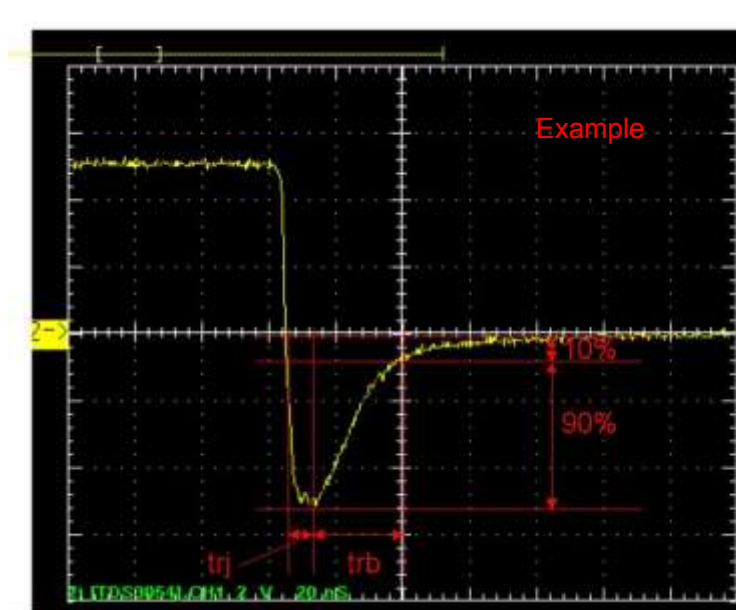
Reference



$T_{rj} = 53.00 \text{ (ns)}$

$T_{rb} = 84.00 \text{ (ns)}$

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

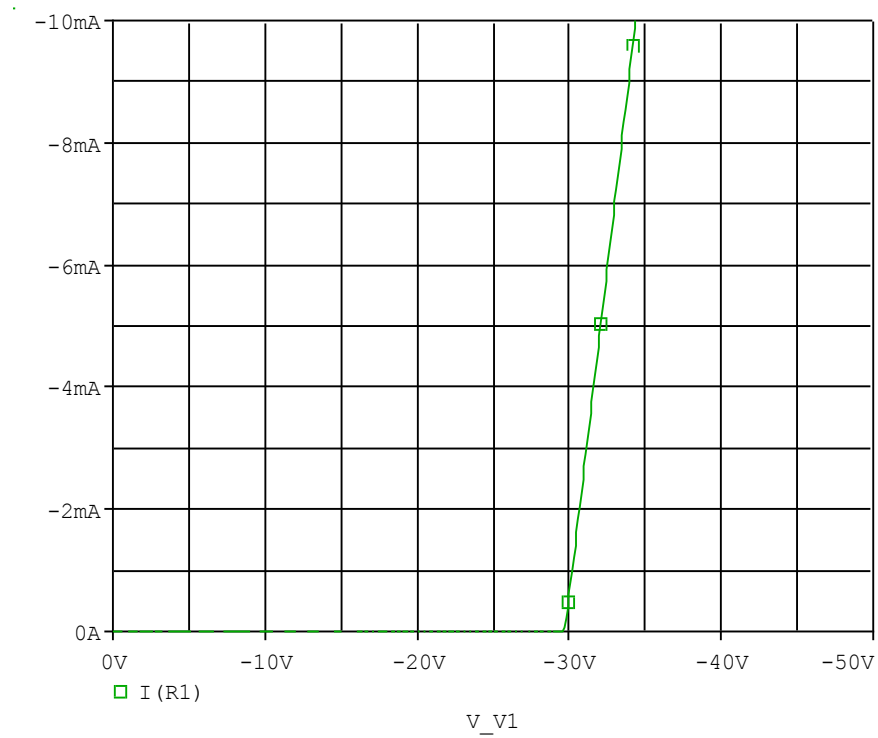


Relation between t_{rj} and t_{rb}

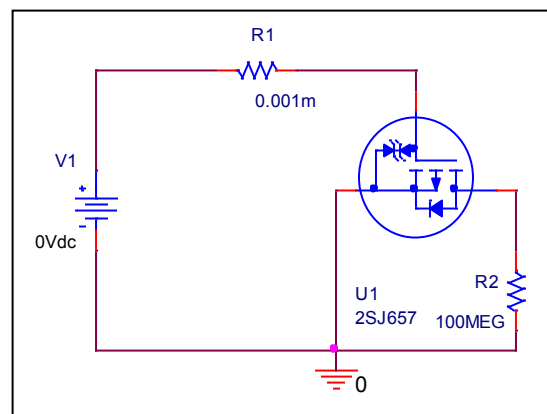
ESD PROTECTION DIODE SPICE MODEL

Zener Voltage Characteristic

Circuit Simulation Result



Evaluation Circuit



Zener Voltage Characteristic

Reference

