Device Modeling Report

COMPONENTS: Power MOSFET (Model Parameter)
PART NUMBER: TPC6109-H
MANUFACTURER: TOSHIBA
REMARK: P Channel Model
Body Diode (Parameter) / ESD Protection Diode

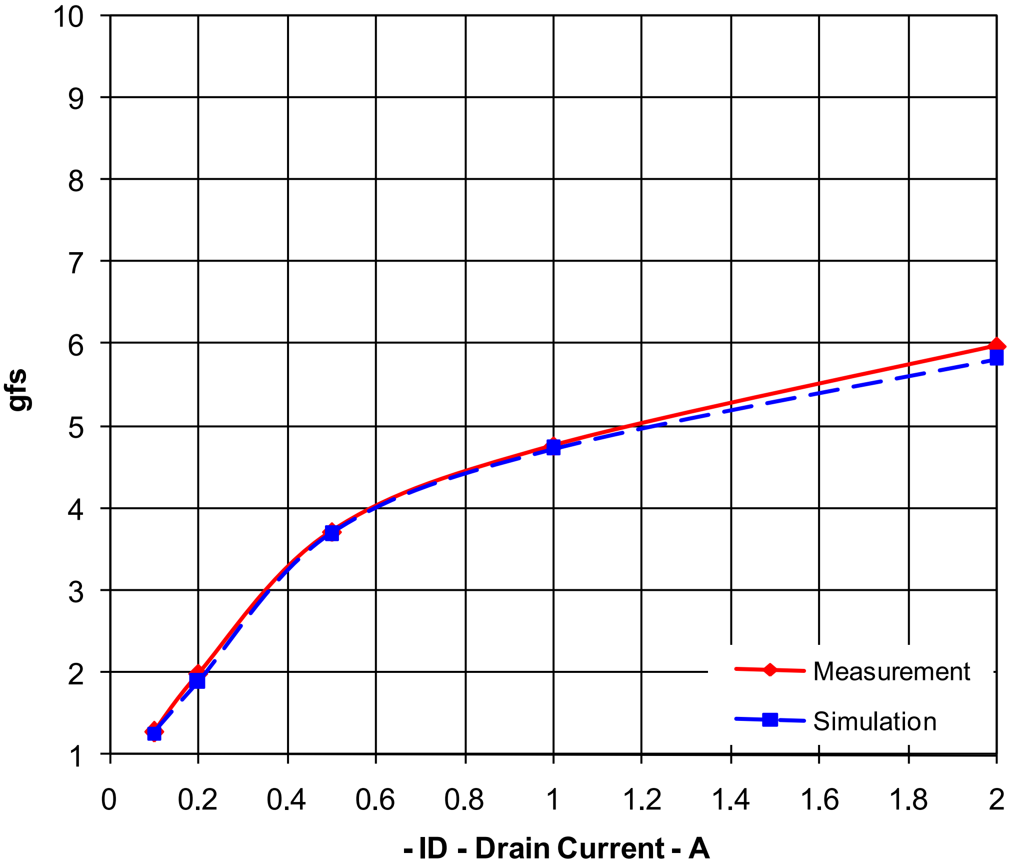
Bee Technologies Inc.

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	Modility Modulation
KAPPA	Saturation Field Factor
VMAX	Maximum Drift Velocity of Carriers
XJ	Metallurgical Junction Depth
UO	Surface Mobility

Transconductance Characteristic

Circuit Simulation Result

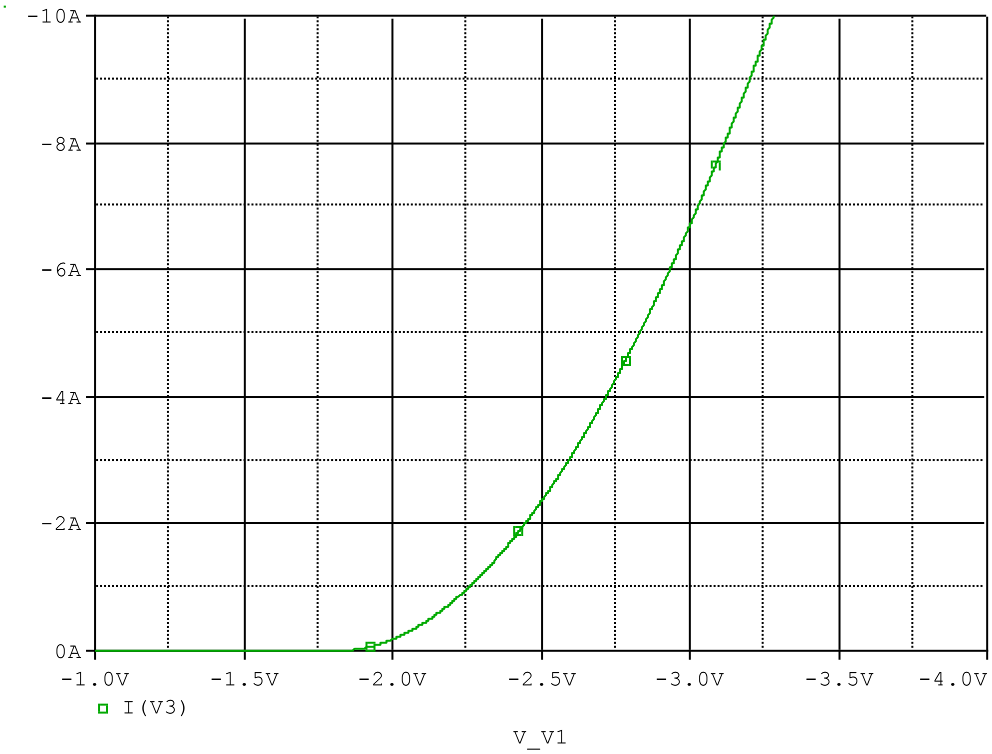


Comparison table

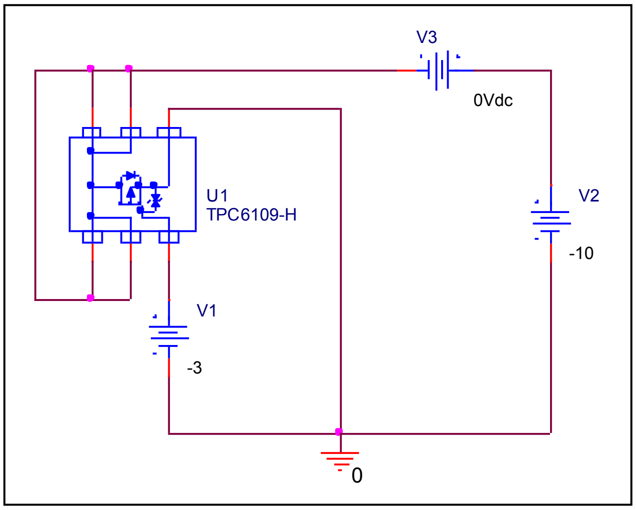
-Id(A)	gfs		Error(%)
	Measurement	Simulation	
0.100	1.275	1.266	-0.706
0.200	1.985	1.887	-4.937
0.500	3.724	3.688	-0.967
1.000	4.762	4.729	-0.693
2.000	5.982	5.821	-2.691

Vgs-Id Characteristic

Circuit Simulation result

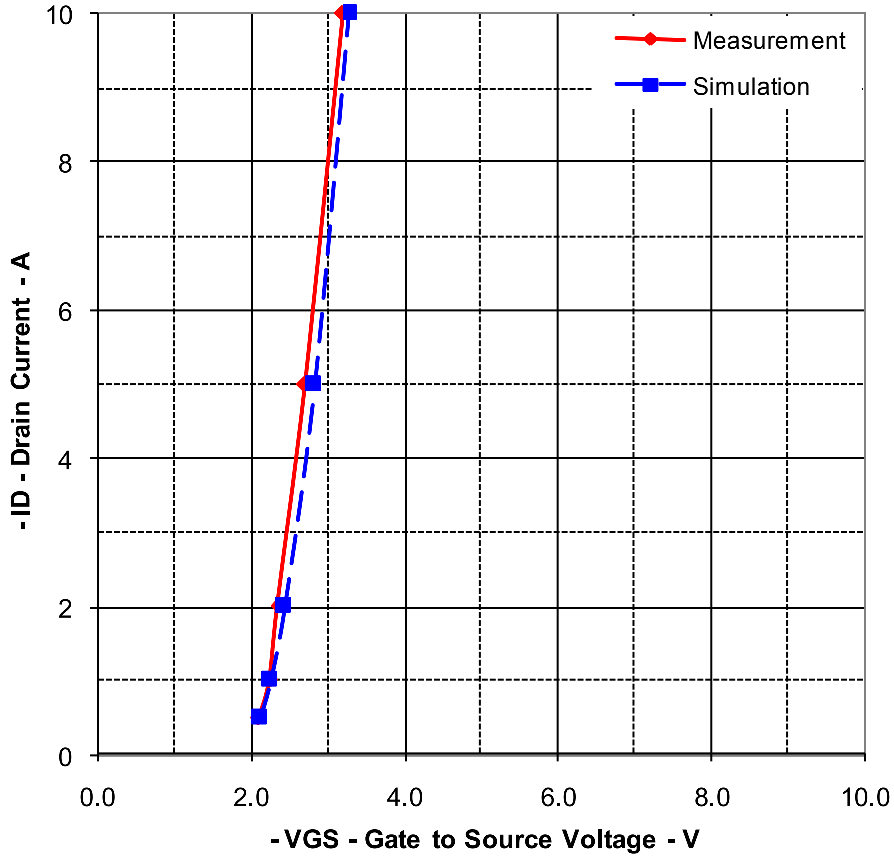


Evaluation circuit



Comparison Graph

Circuit Simulation Result

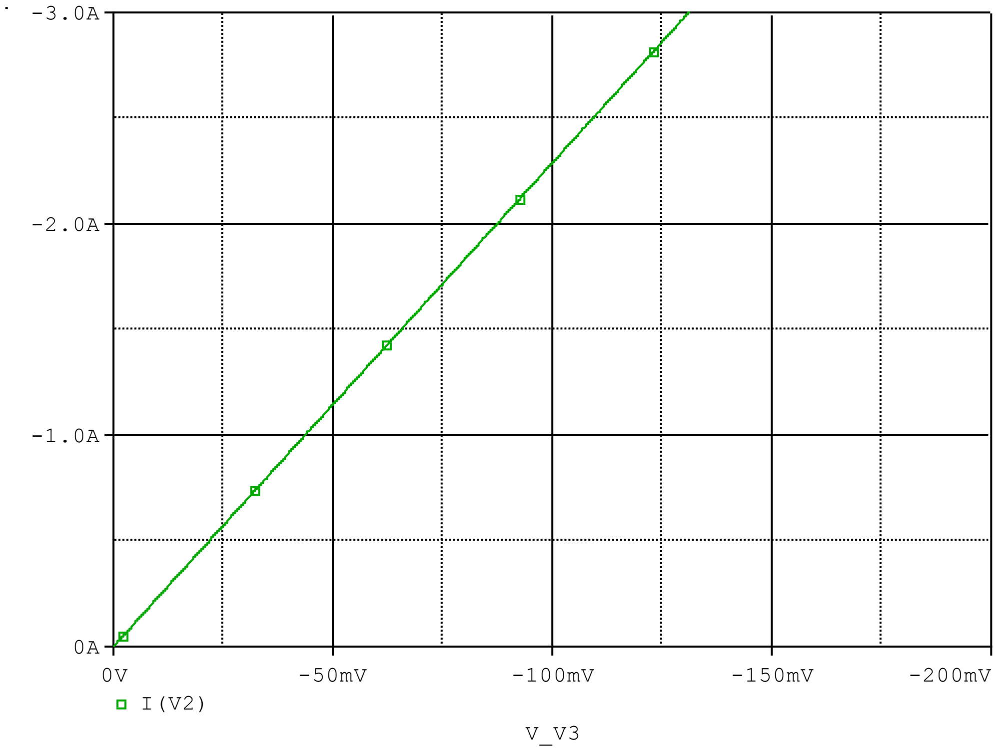


Simulation Result

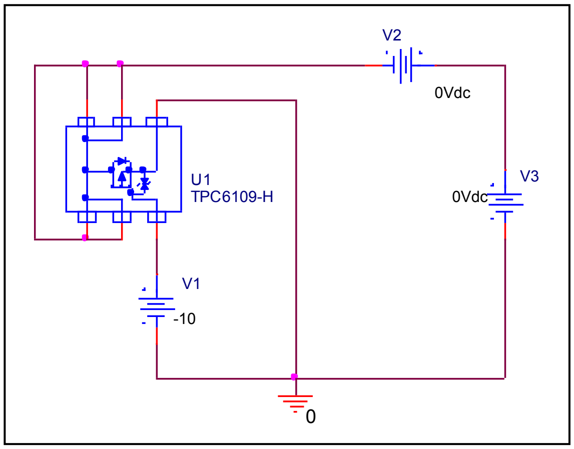
$-I_D$(A)	$-V_{GS}$(V)		Error (%)
	Measurement	Simulation	
0.500	2.100	2.123	1.095
1.000	2.250	2.256	0.267
2.000	2.350	2.444	4.000
5.000	2.700	2.831	4.852
10.000	3.200	3.282	2.563

Rds(on) Characteristic

Circuit Simulation result



Evaluation circuit

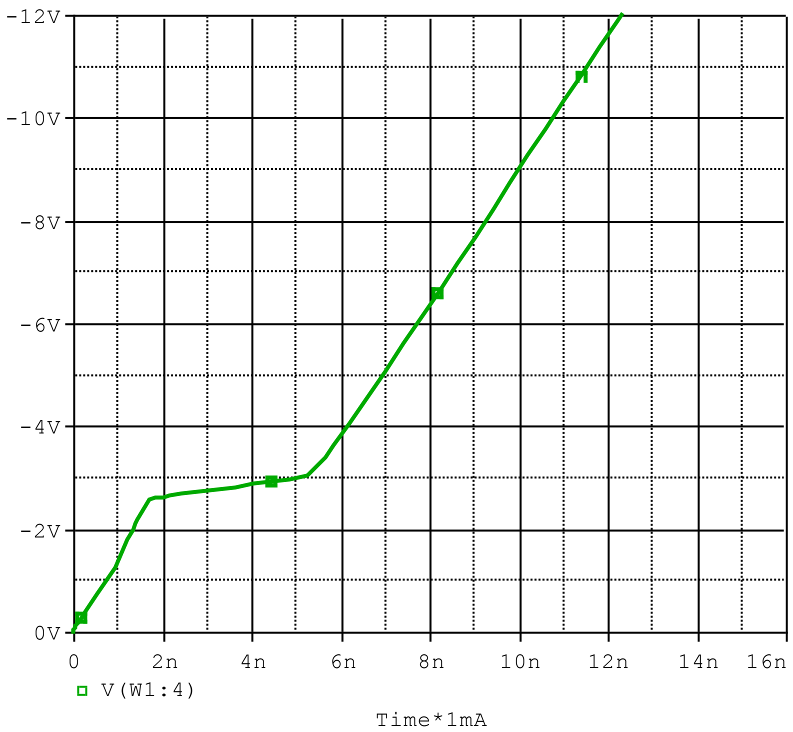


Simulation Result

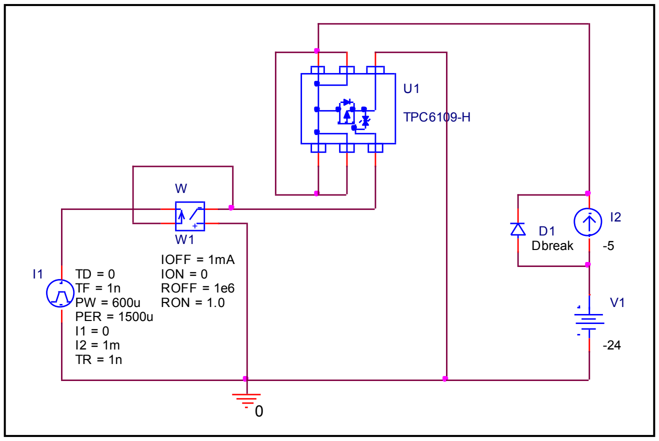
I_D=-2.5A, V_{GS}=-10V	Measurement	Simulation	Error (%)
R_{DS} (on) (mΩ)	44.000	43.700	-0.682

Gate Charge Characteristic

Circuit Simulation result



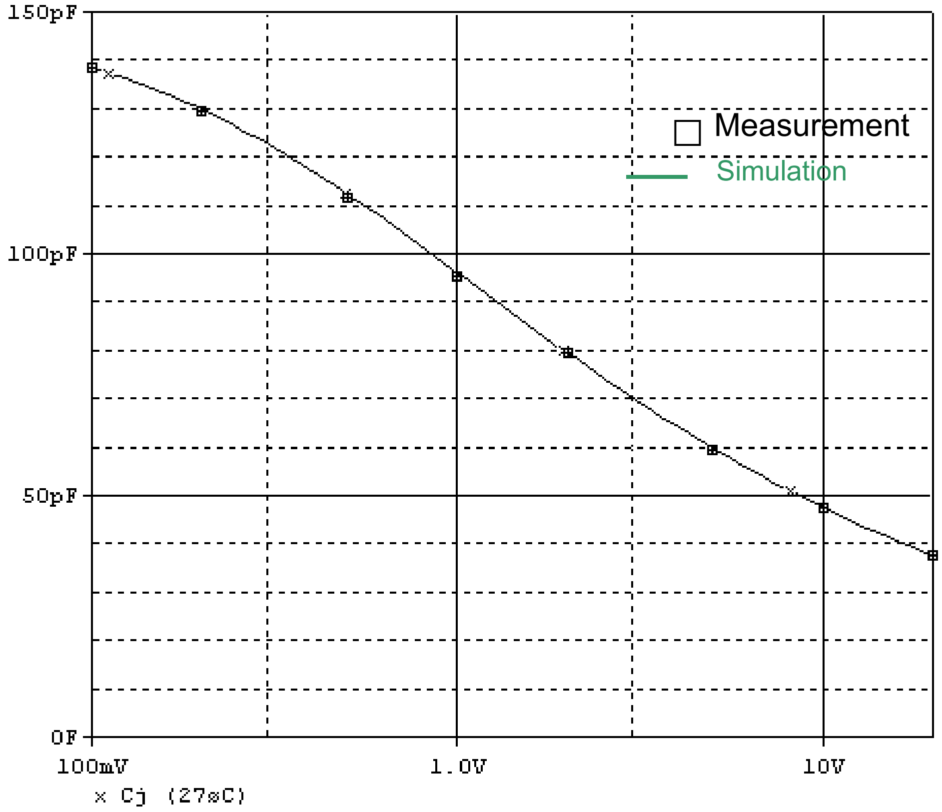
Evaluation circuit



Simulation Result

V_{DD}=-24V,I_D=-5A ,V_{GS}=-10V	Measurement	Simulation	Error (%)
Qgs(nC)	1.700	1.697	-0.176
Qgd(nC)	3.600	3.557	-1.194
Qg(nC)	12.800	10.775	-15.820

Capacitance Characteristic

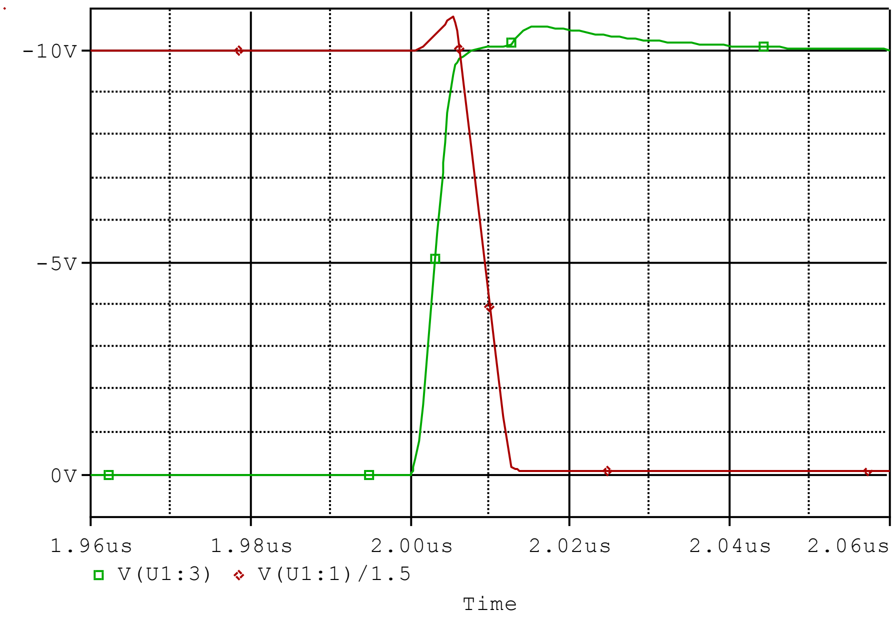


Simulation Result

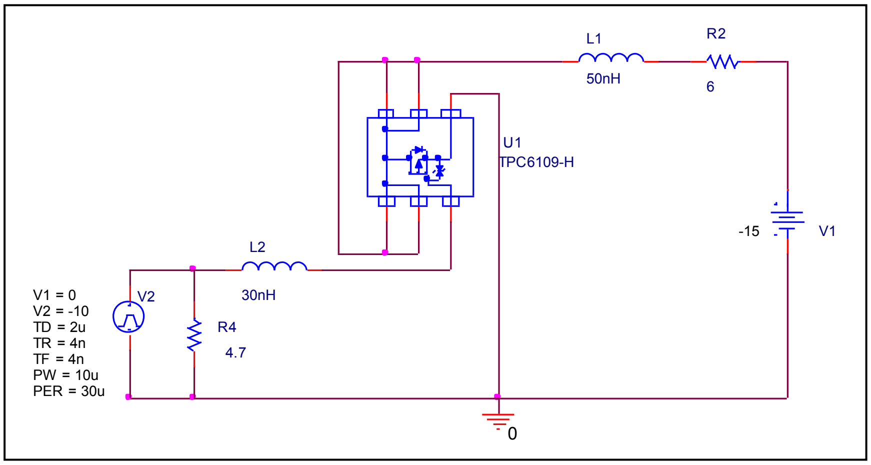
V_{DS}(V)	Cbd(pF)		Error(%)
	Measurement	Simulation	
0.100	139.000	138.400	-0.417
0.200	130.000	129.800	-0.192
0.500	112.000	112.400	0.357
1.000	958.000	958.500	0.052
2.000	800.000	795.000	-0.625
5.000	600.000	599.000	-0.167
10.000	480.000	475.000	-1.042
20.000	380.000	375.000	-1.316

Switching Time Characteristic

Circuit Simulation result



Evaluation circuit

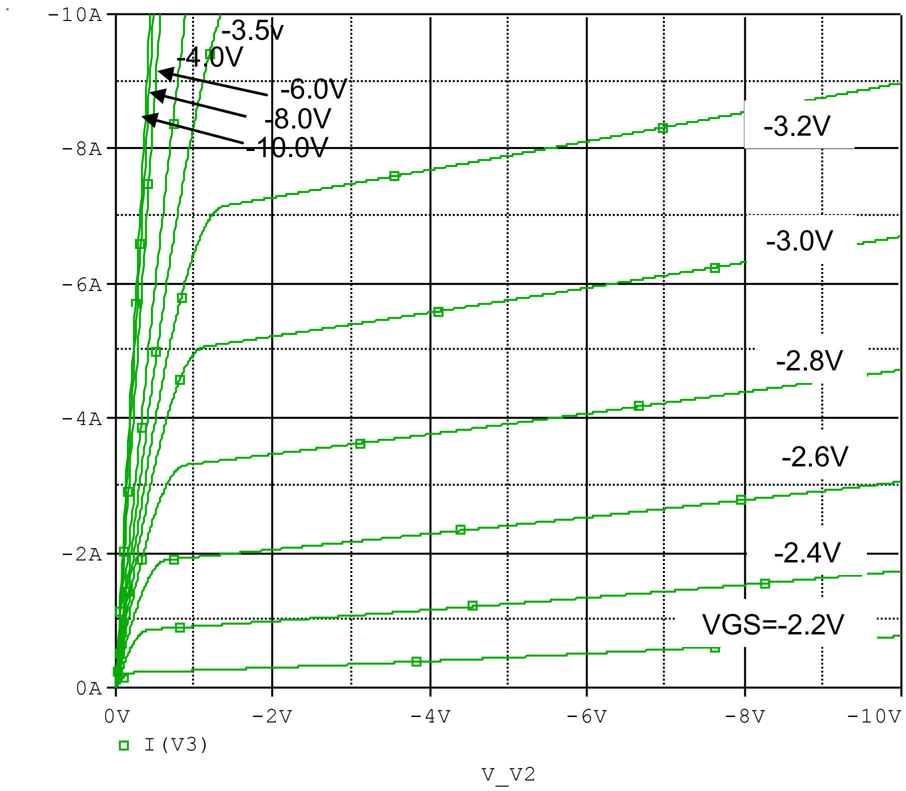


Simulation Result

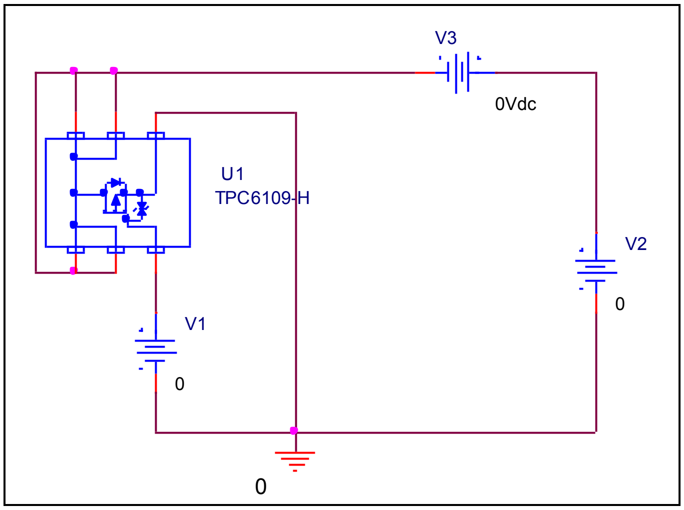
I_D=-2.5A, V_{DD}=-15V V_{GS}=0/10V	**Measurement**	**Simulation**	**Error(%)**
Ton(ns)	**10.700**	**10.698**	**-0.019**

Output Characteristic

Circuit Simulation result

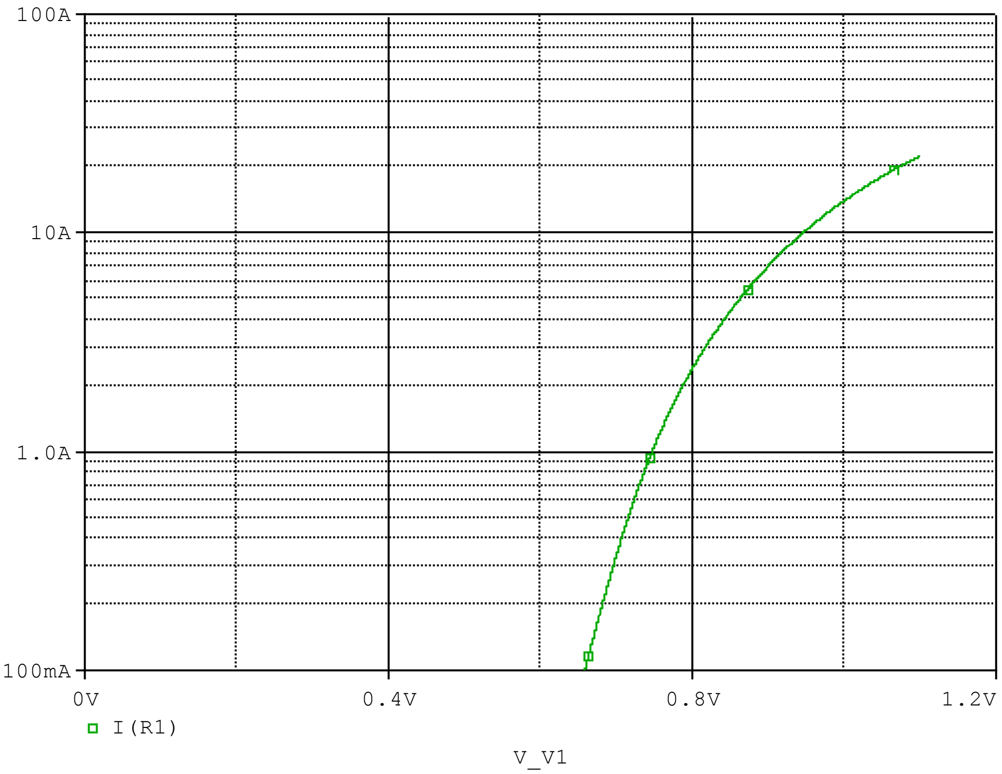


Evaluation circuit

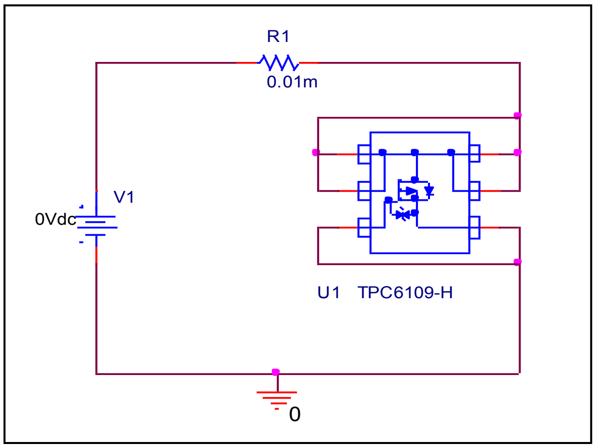


BODY DIODE SPICE MODEL
Forward Current Characteristic

Circuit Simulation Result

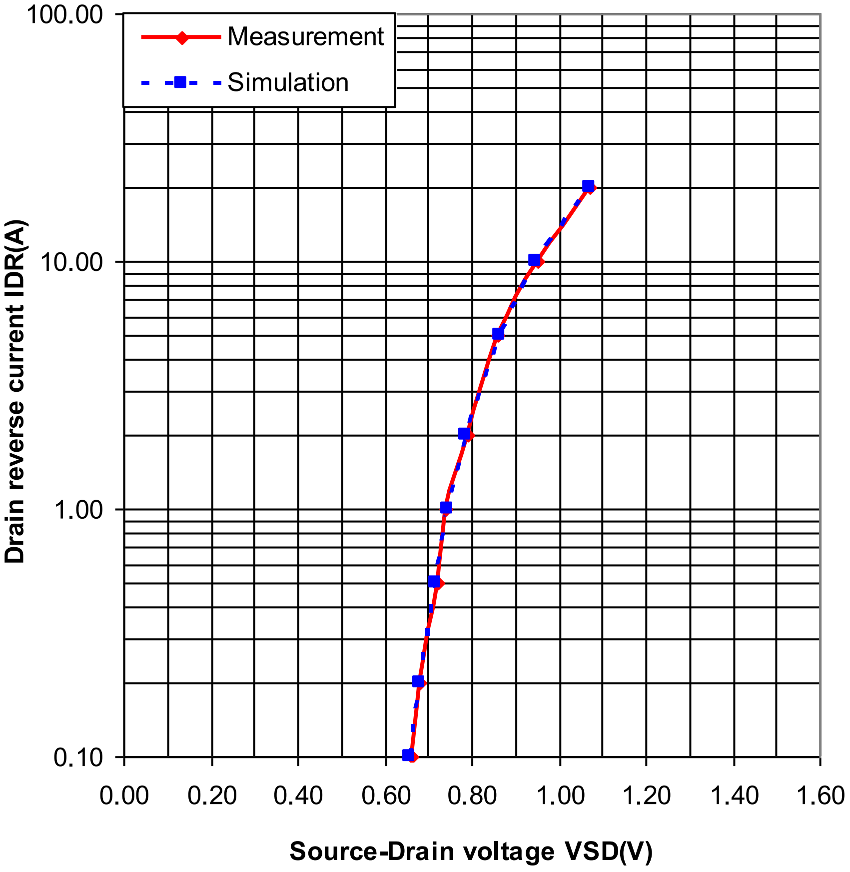


Evaluation Circuit



Comparison Graph

Circuit Simulation Result

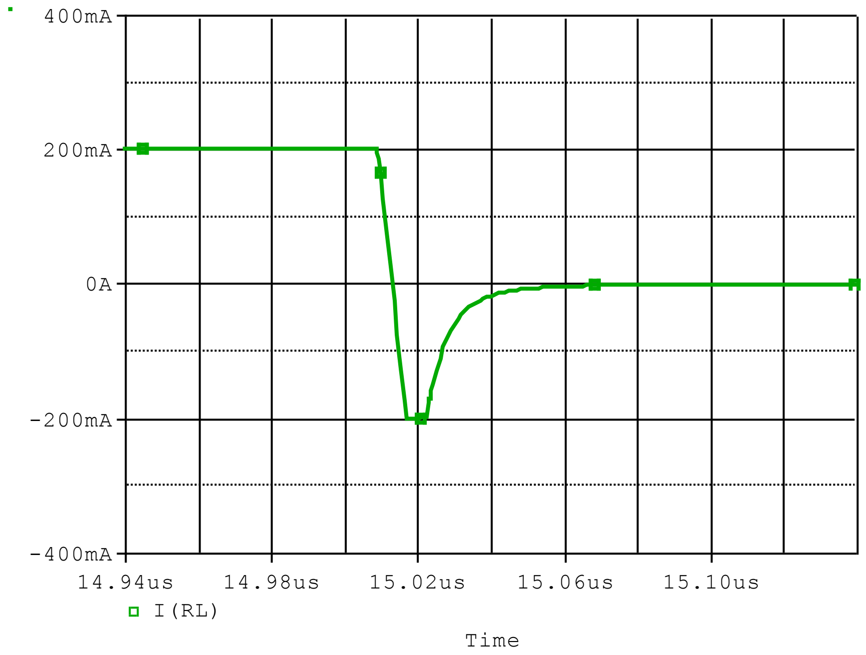


Simulation Result

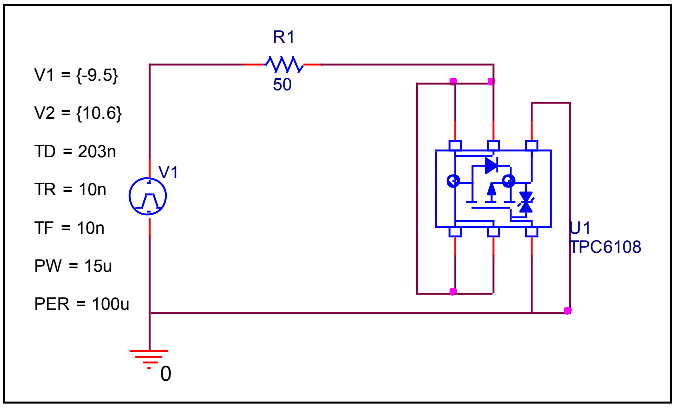
IDR(A)	VDS(V) Measurement	VDS(V) Simulation	%Error
0.100	0.660	0.659	-0.227
0.200	0.680	0.681	0.147
0.500	0.720	0.716	-0.611
1.000	0.740	0.747	0.946
2.000	0.790	0.788	-0.316
5.000	0.860	0.863	0.349
10.000	0.950	0.946	-0.453
20.000	1.070	1.071	0.093

Reverse Recovery Characteristic

Circuit Simulation Result



Evaluation Circuit

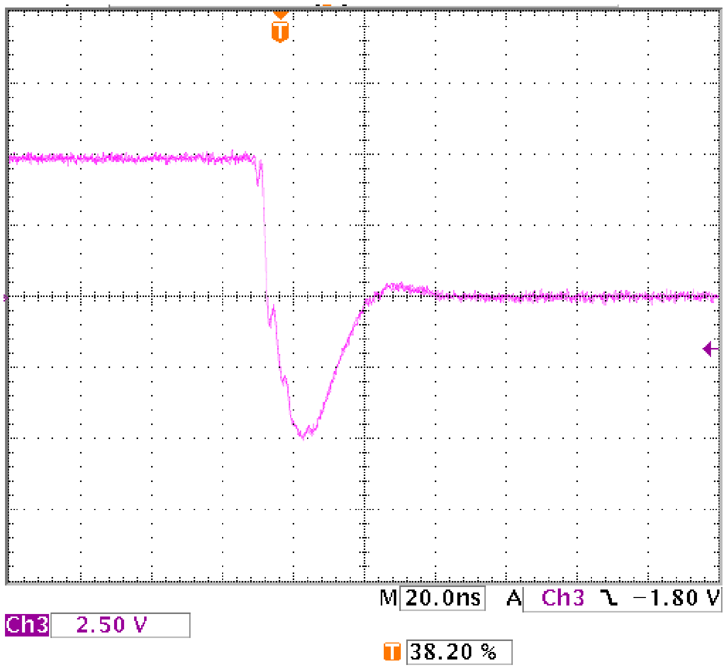


Compare Measurement vs. Simulation

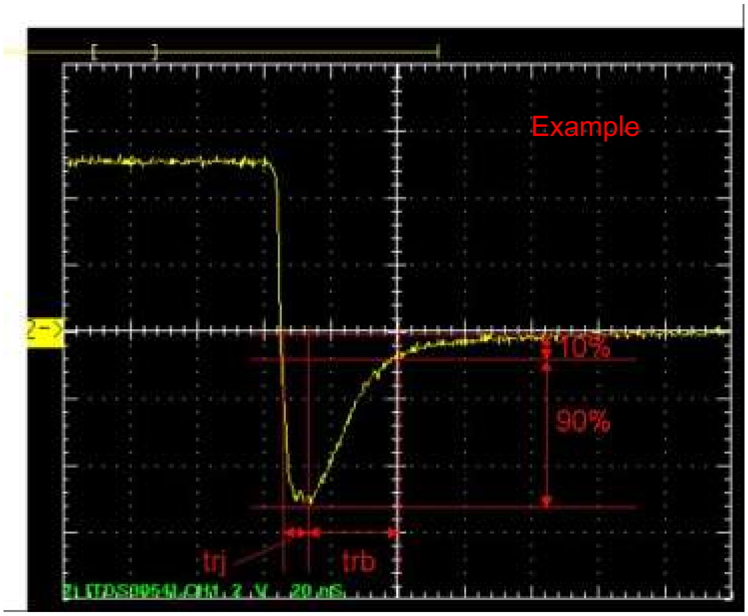
	Measurement	Simulation	Error (%)
Trj(ns)	10.000	9.586	-4.140
Trb(ns)	15.600	15.954	2.269
Trr(ns)	25.600	25.540	-0.234

Reverse Recovery Characteristic

Reference



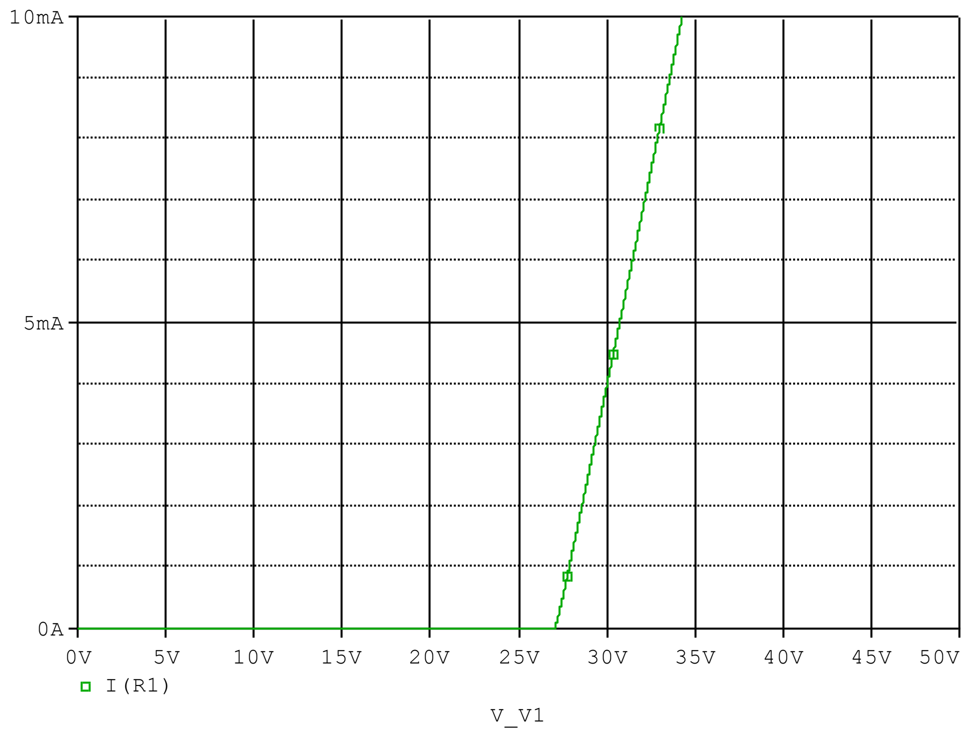
Trj=10(ns)
Trb=15.6(ns)
Conditions:Ifwd=Irev=0.2(A),Rl=50



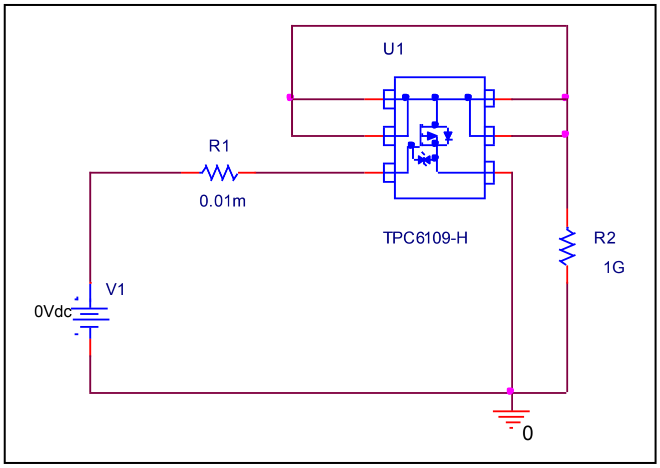
Relation between trj and trb

ESD PROTECTION DIODE SPICE MODEL
Zener Voltage Characteristic

Circuit Simulation Result



Evaluation Circuit



Zener Voltage Characteristic **Reference**