Device Modeling Report

COMPONENTS: Power MOSFET (Professional) / Schottky Rectifier (Professional)
PART NUMBER: SSM5H05TU
MANUFACTURER: TOSHIBA
Body Diode (Standard) / ESD Protection Diode

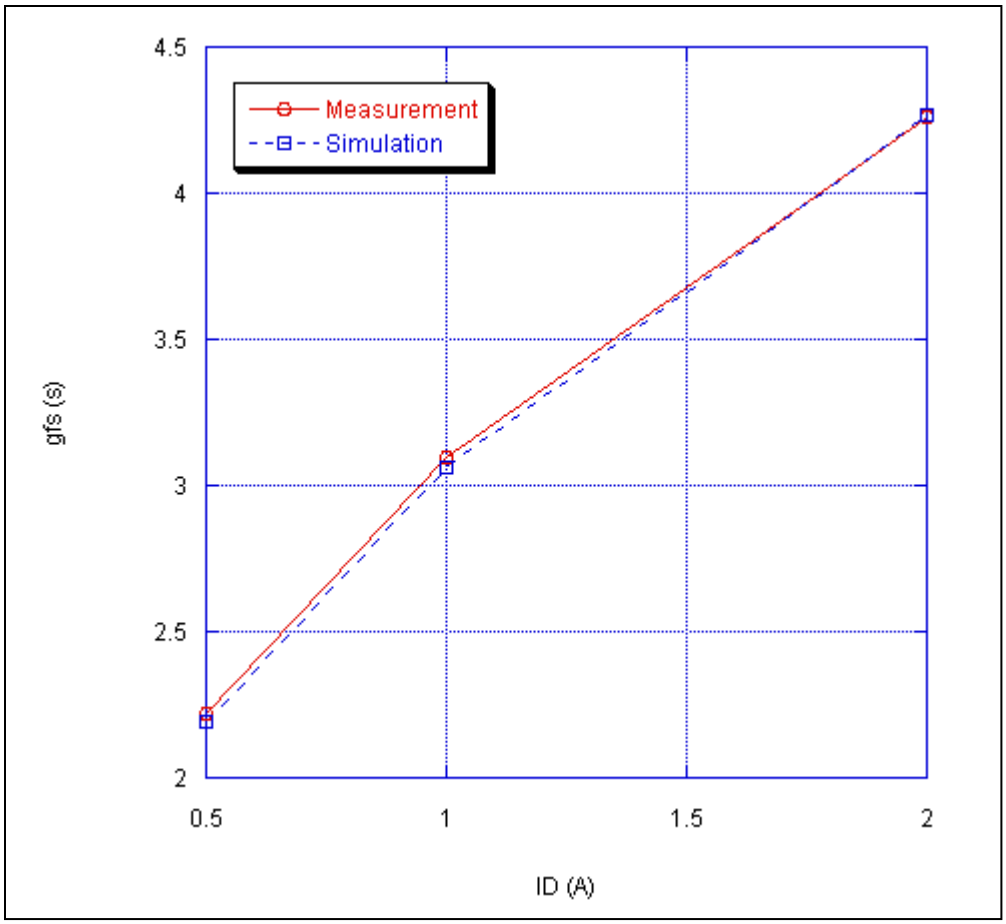
Bee Technologies Inc.

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

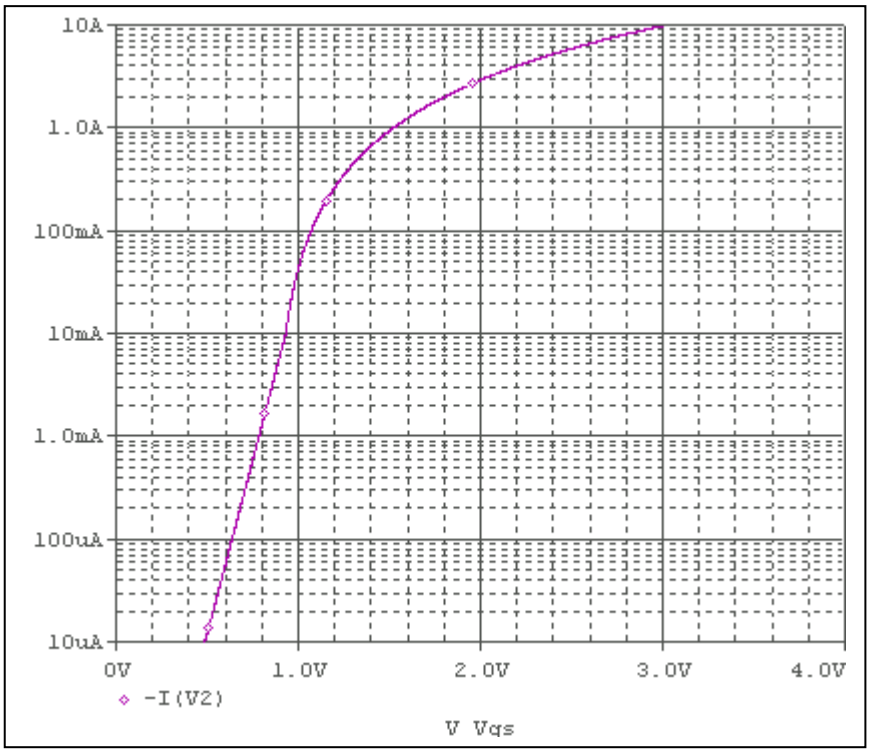


Comparison table

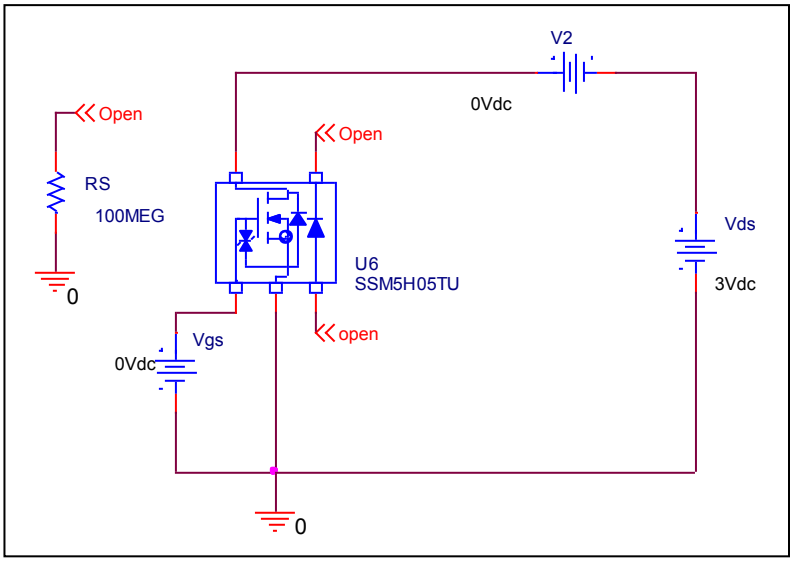
I_D(A)	Gfs		Error (%)
	Measurement	Simulation	
0.500	2.220	2.190	-1.351
1.000	3.100	3.064	-1.161
2.000	4.260	4.266	0.141

Vgs-Id Characteristic

Circuit Simulation result

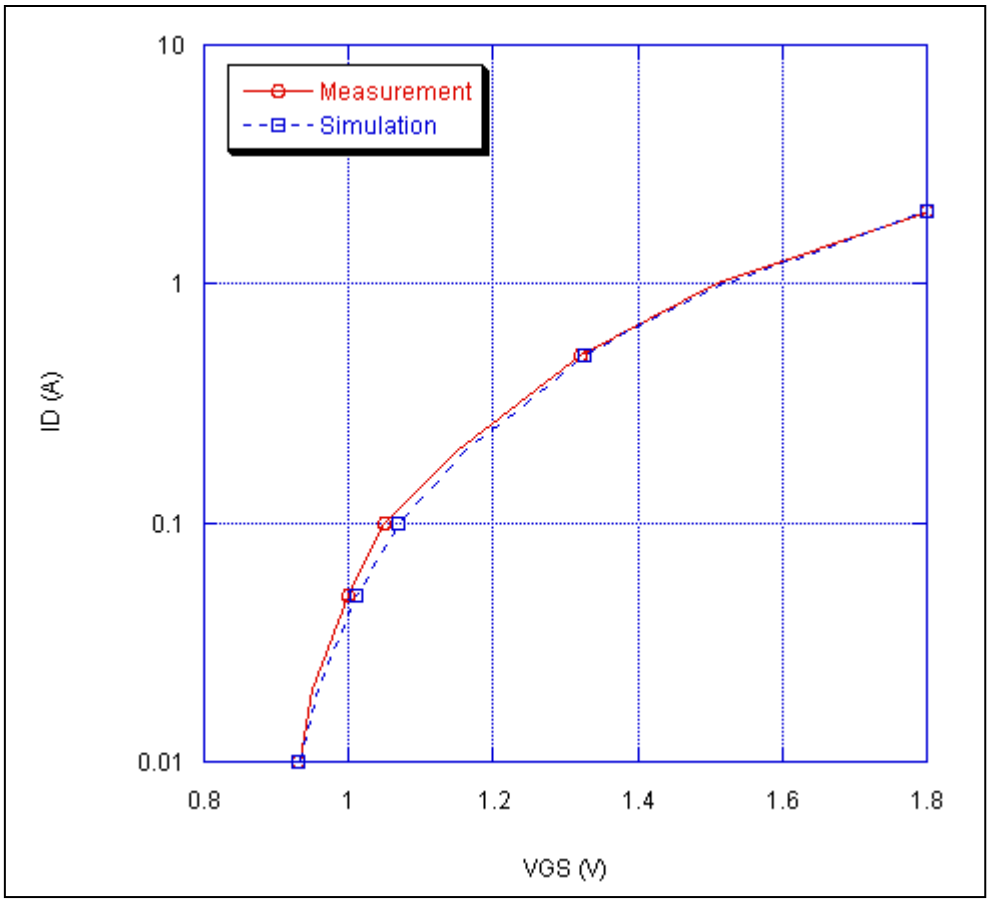


Evaluation circuit



Comparison Graph

Circuit Simulation Result

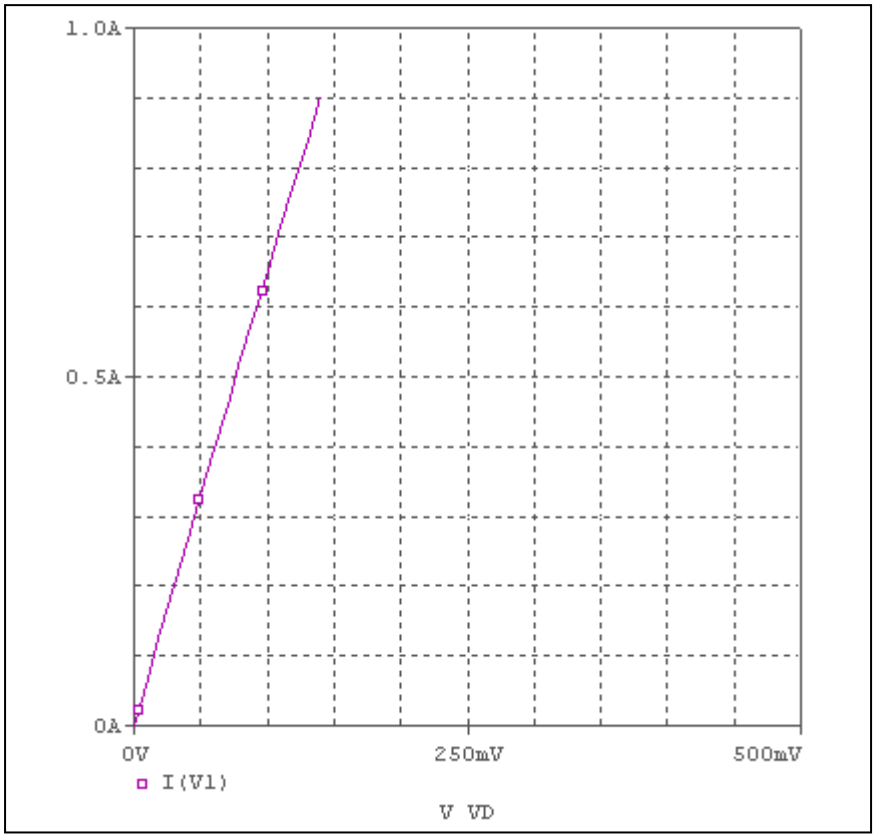


Simulation Result

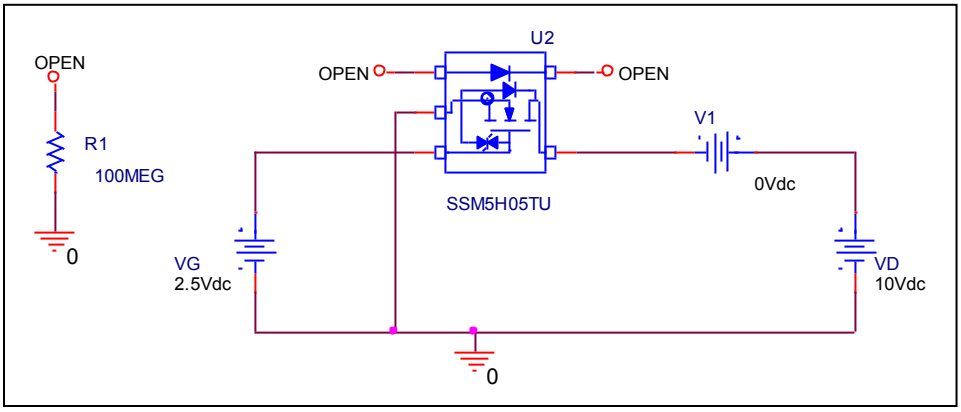
I_D(A)	V_{GS}(V)		Error (%)
	Measurement	Simulation	
0.010	0.930	0.931	0.107
0.020	0.950	0.957	0.736
0.050	1.000	1.010	1.000
0.100	1.050	1.070	1.904
0.200	1.150	1.159	0.782
0.500	1.320	1.327	0.530
1.000	1.510	1.520	0.662
2.000	1.800	1.800	0.000

Id-Rds(on) Characteristic

Circuit Simulation result



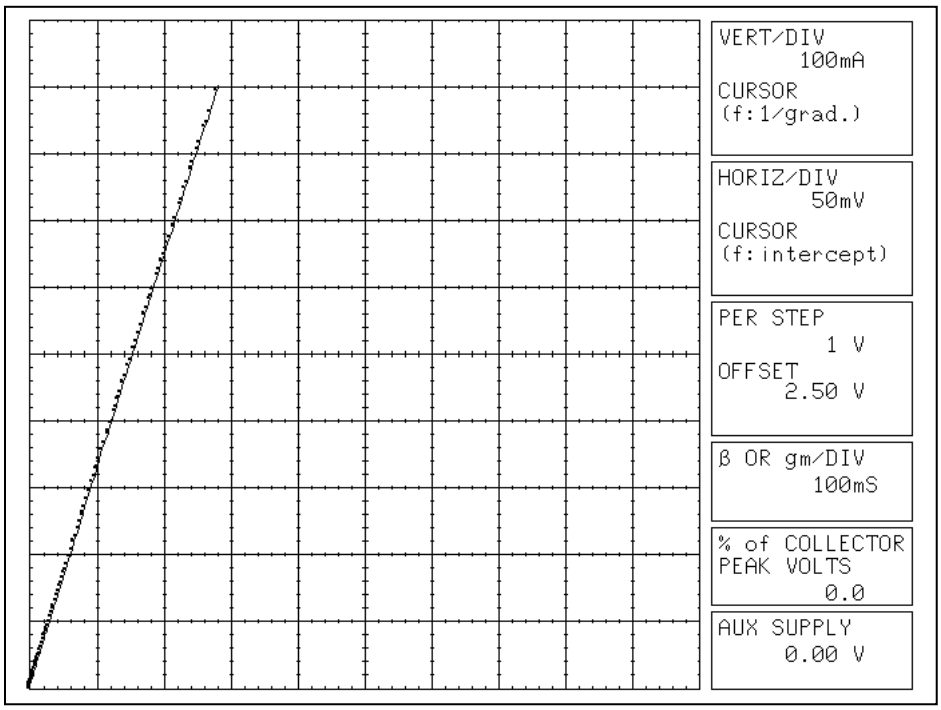
Evaluation circuit



Simulation Result

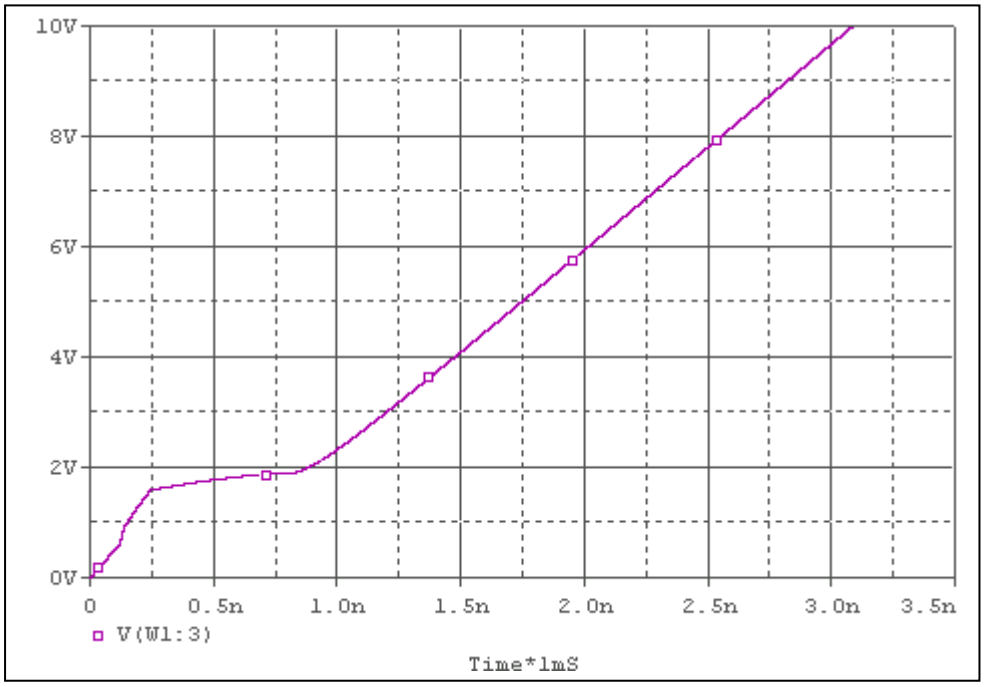
I_D=0.75A, V_{GS}=2.5V	Measurement		Simulation		Error (%)
R_{DS} (on)	154.00	mΩ	154.00	mΩ	0.00

Id-Rds(on) Characteristic Reference

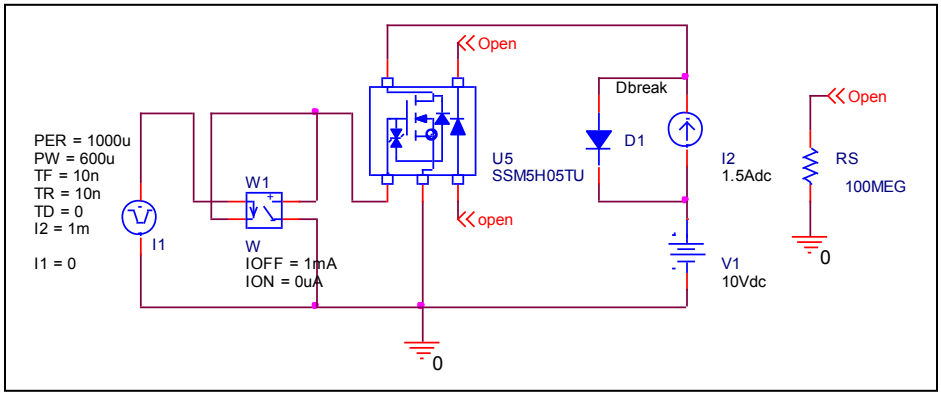


Gate Charge Characteristic

Circuit Simulation result



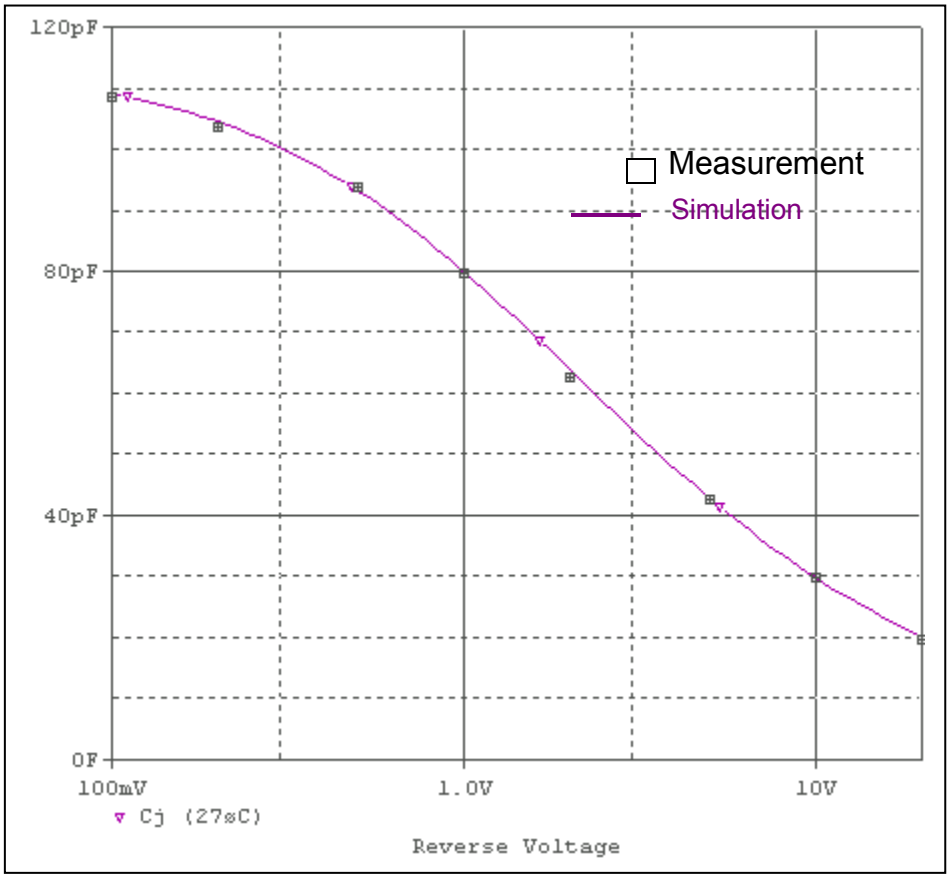
Evaluation circuit



Simulation Result

V_{DD}=10V,I_D=1.5A	Measurement		Simulation		Error (%)
Qgs	0.250	nC	0.245	nC	-2.000
Qgd	0.565	nC	0.560	nC	-0.885
Qg	3.100	nC	3.080	nC	-0.645

Capacitance Characteristic

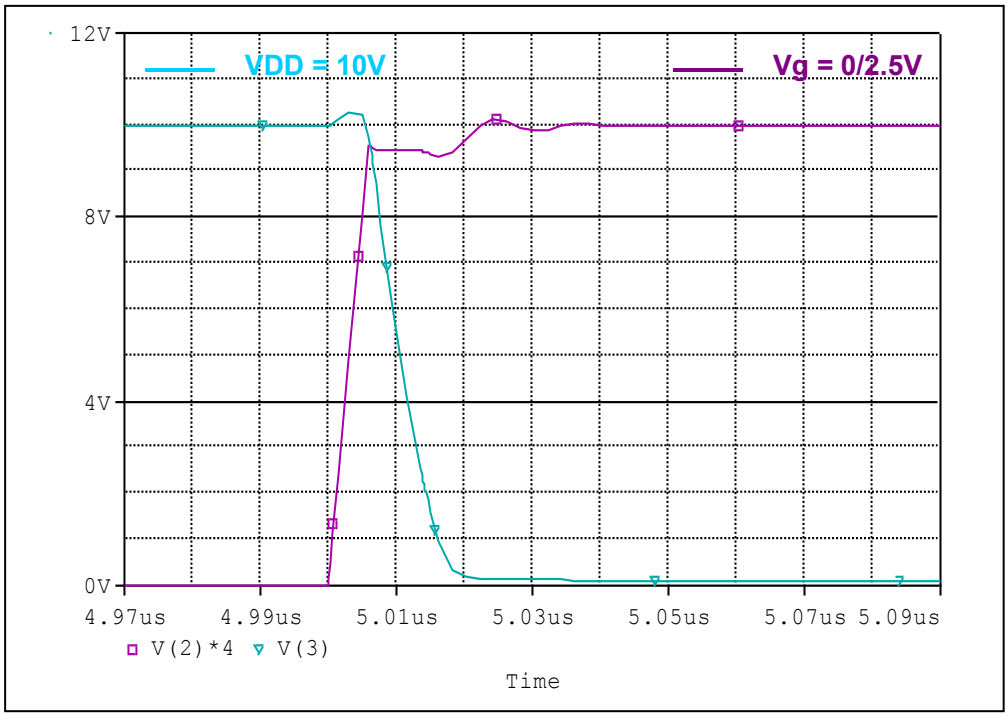


Simulation Result

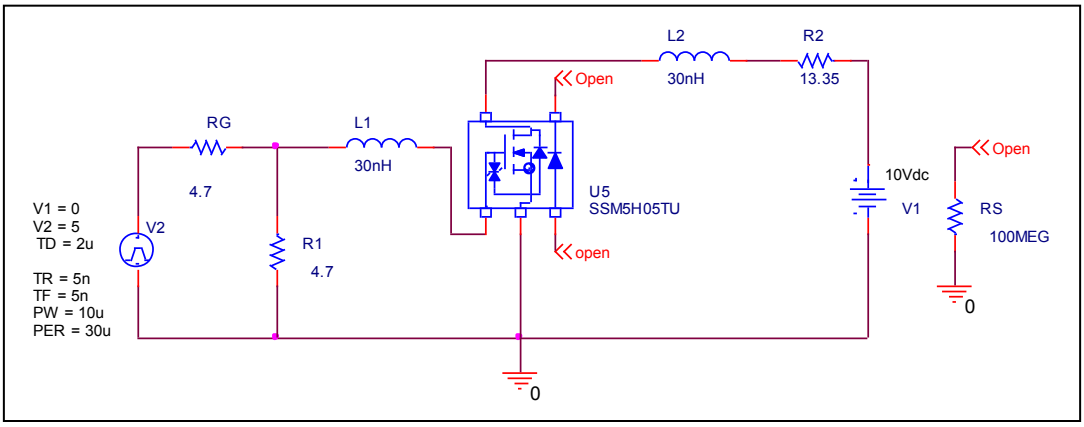
V_{DS}(V)	Cbd(pF)		Error(%)
	Measurement	Simulation	
0.10	109.00	109.80	0.73
0.20	104.00	104.70	0.67
0.50	94.00	93.62	-0.40
1.00	80.00	80.23	0.29
2.00	63.00	64.13	1.79
5.00	43.00	43.04	0.09
10.00	30.00	30.11	0.37
20.00	20.00	20.25	1.25

Switching Time Characteristic

Circuit Simulation result



Evaluation circuit

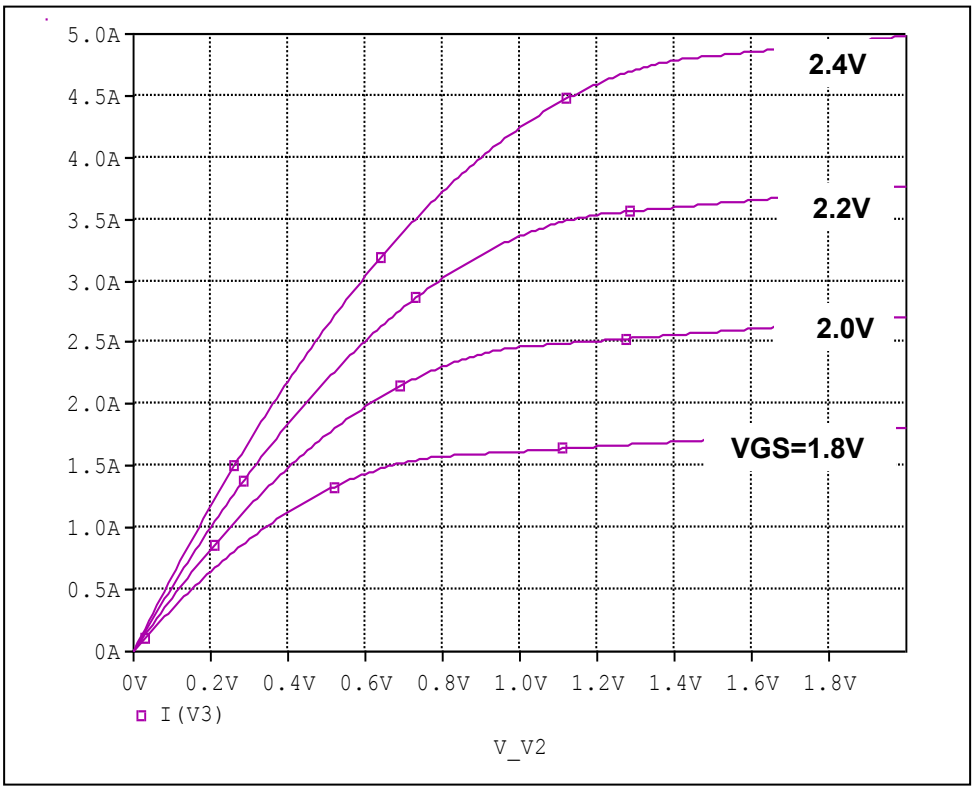


Simulation Result

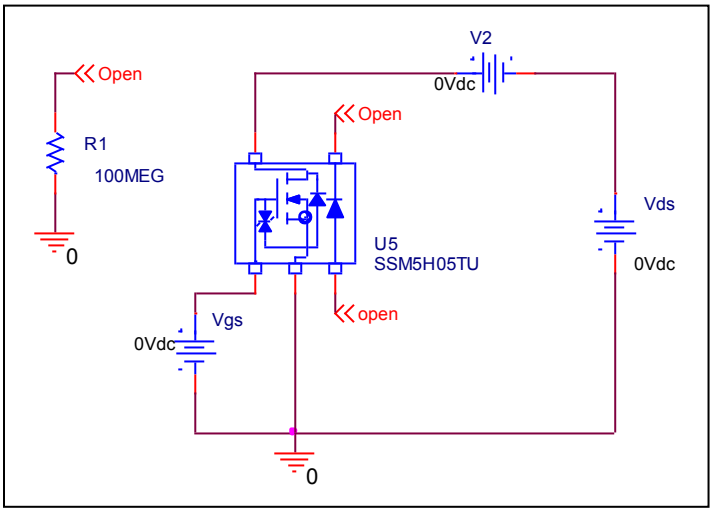
I_D=0.75A, V_{DD}=10V V_{GS}=2.5V	Measurement		Simulation		Error(%)
ton	15.5	ns	15.55	ns	0.322

Output Characteristic

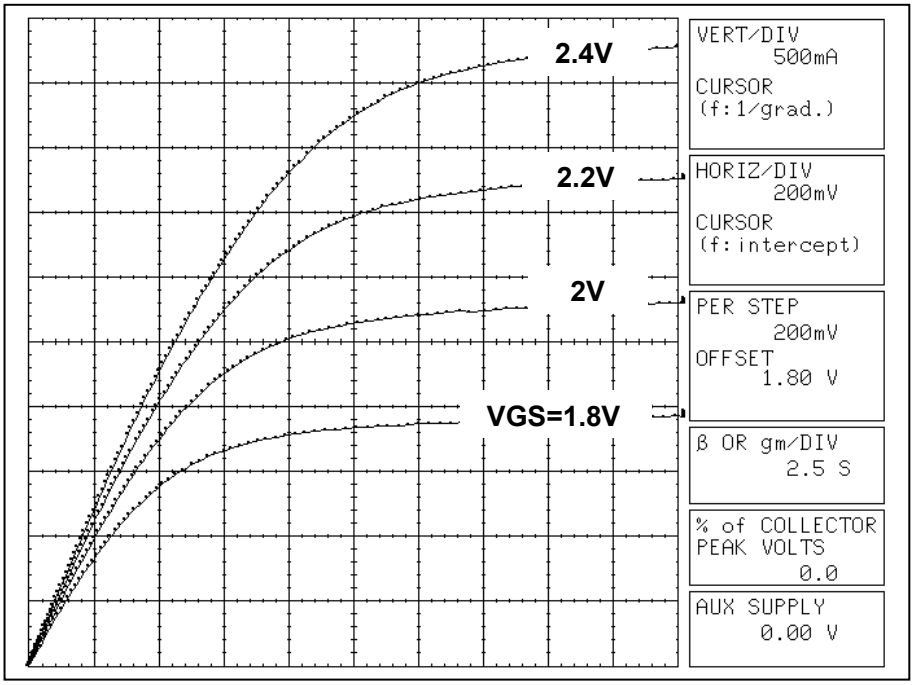
Circuit Simulation result



Evaluation circuit



Output Characteristic Reference

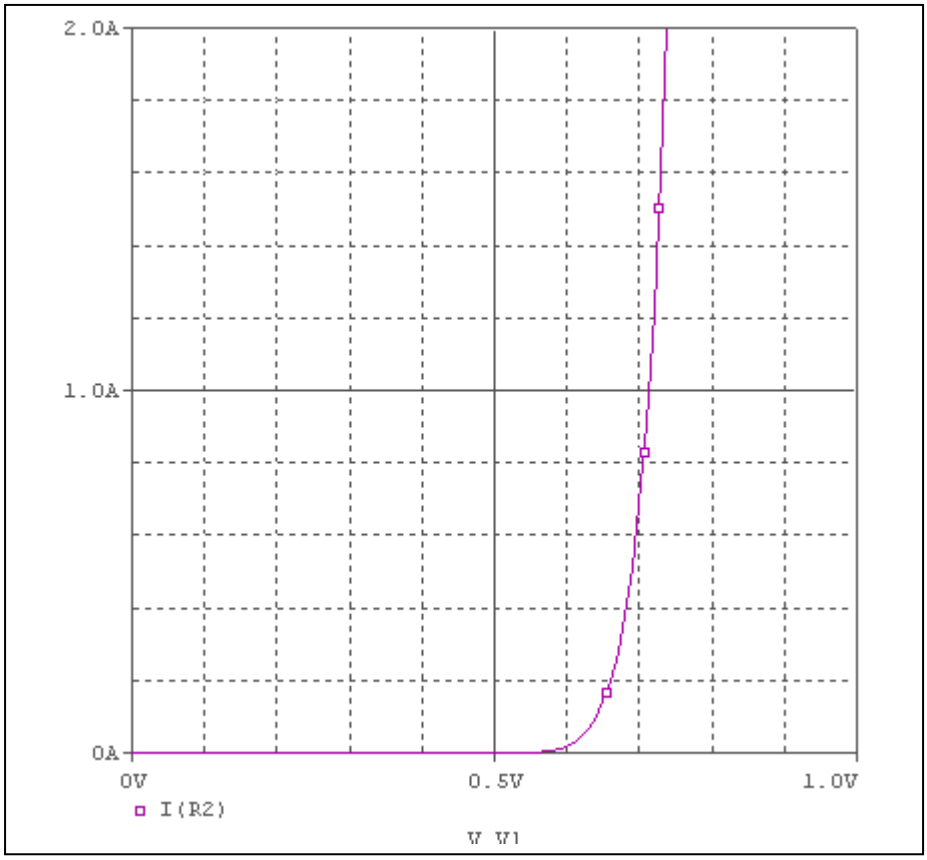


Body Diode Model

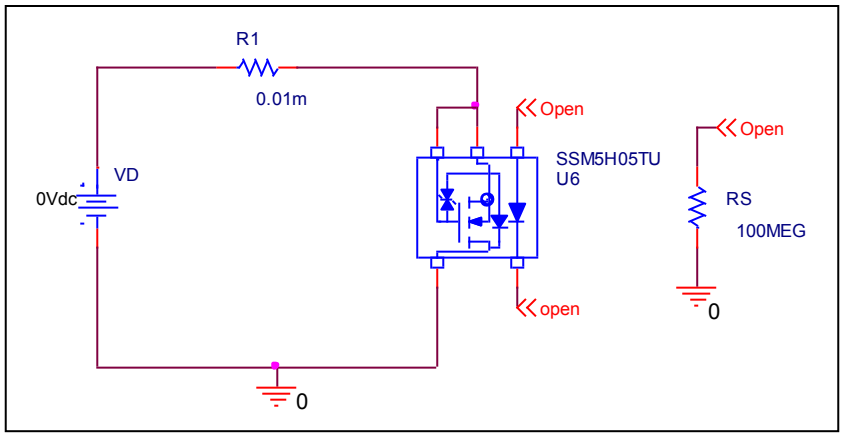
Pspice model parameter	Model description
IS	Saturation Current
N	Emission Coefficient
RS	Series Resistance
IKF	High-injection Knee Current
CJO	Zero-bias Junction Capacitance
M	Junction Grading Coefficient
VJ	Junction Potential
ISR	Recombination Current Saturation Value
BV	Reverse Breakdown Voltage(a positive value)
IBV	Reverse Breakdown Current(a positive value)
TT	Transit Time

Forward Current Characteristic

Circuit Simulation Result

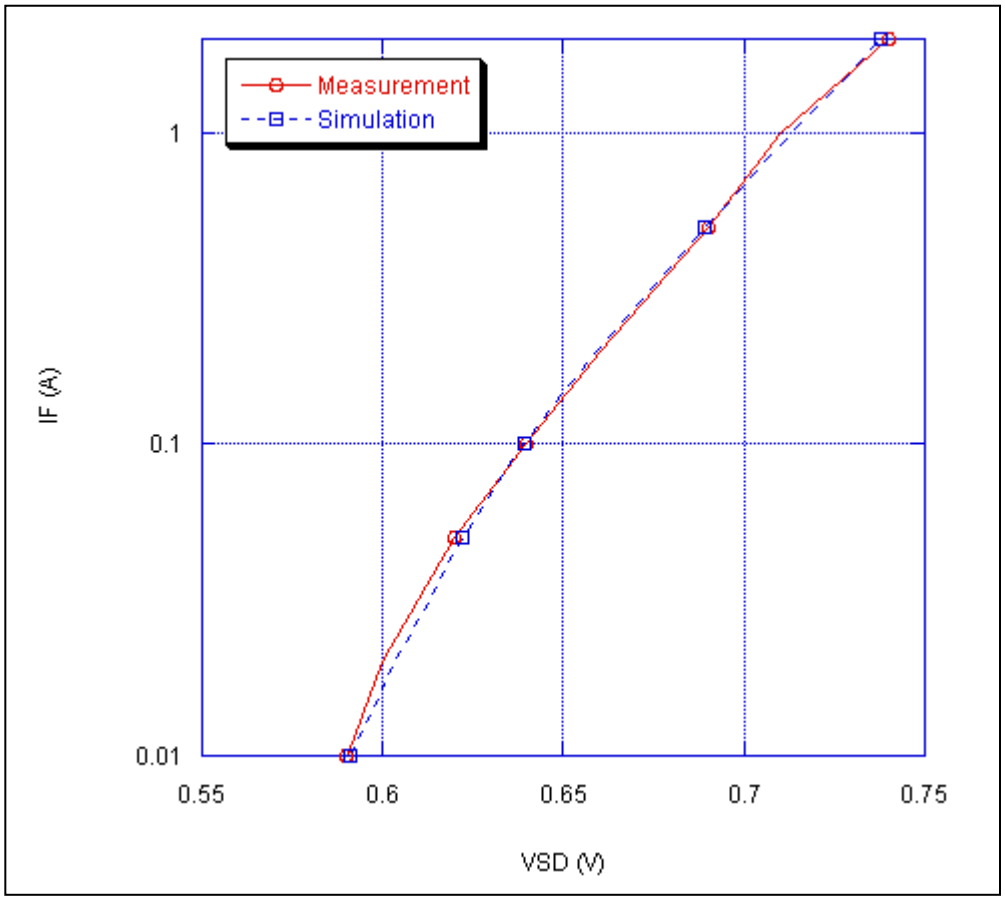


Evaluation Circuit



Comparison Graph

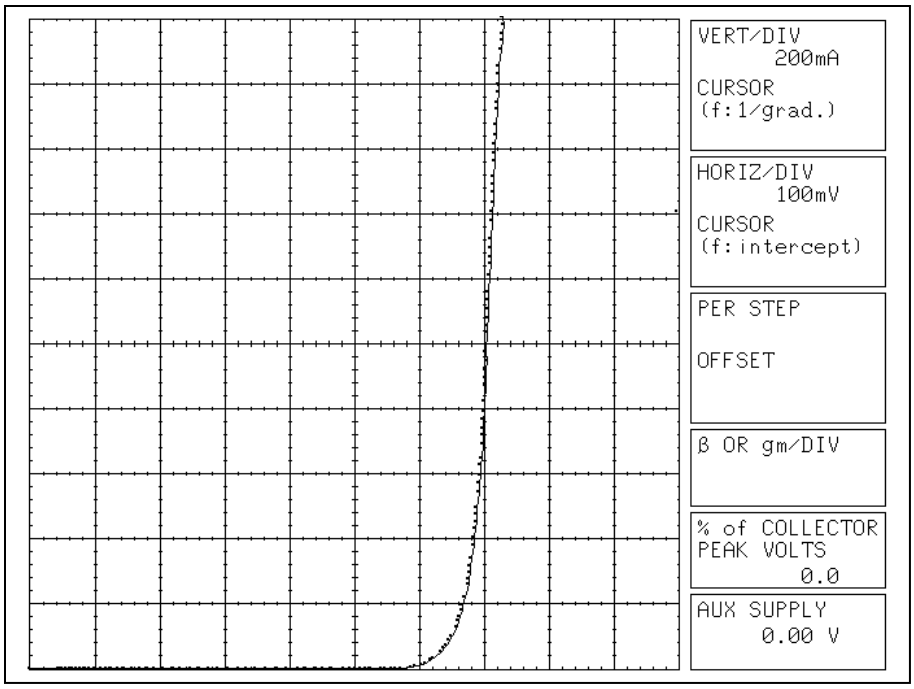
Circuit Simulation Result



Simulation Result

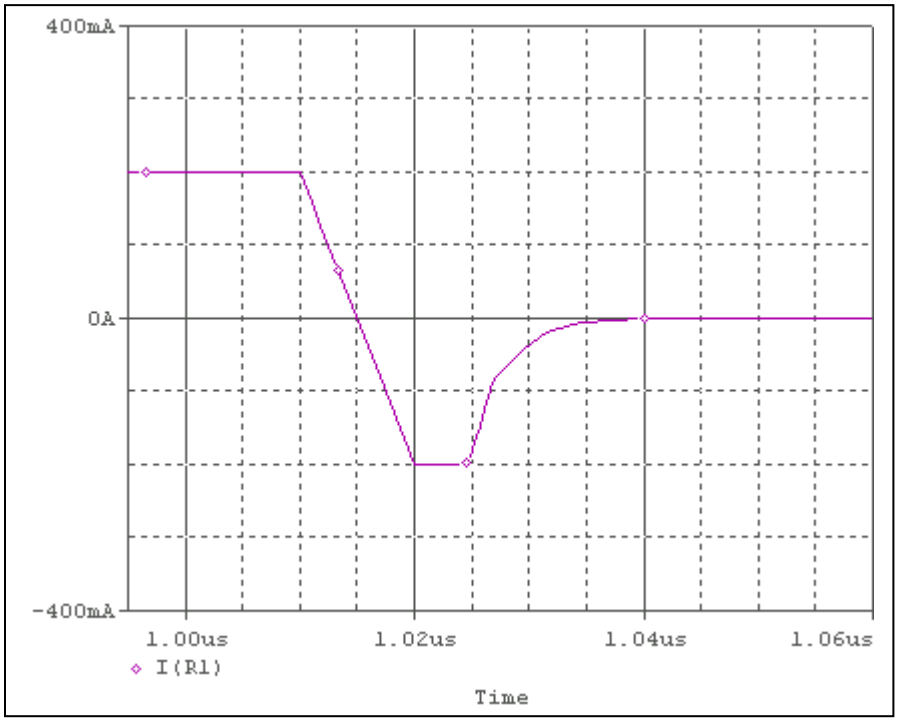
Ifwd(A)	Vfwd(V) Measurement	Vfwd(V) Simulation	%Error
0.010	0.590	0.591	0.169
0.020	0.600	0.603	0.500
0.050	0.620	0.622	0.323
0.100	0.640	0.639	-0.156
0.200	0.660	0.659	-0.152
0.500	0.690	0.689	-0.145
1.000	0.710	0.713	0.423
2.000	0.740	0.738	-0.270

Forward Current Characteristic Reference

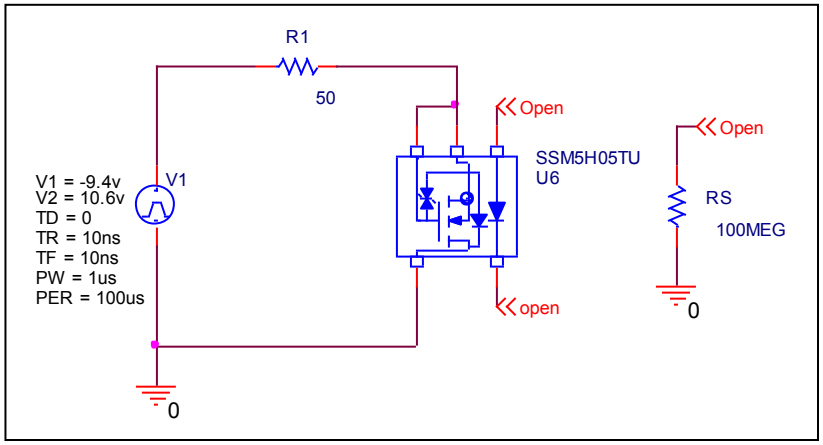


Reverse Recovery Characteristic

Circuit Simulation Result



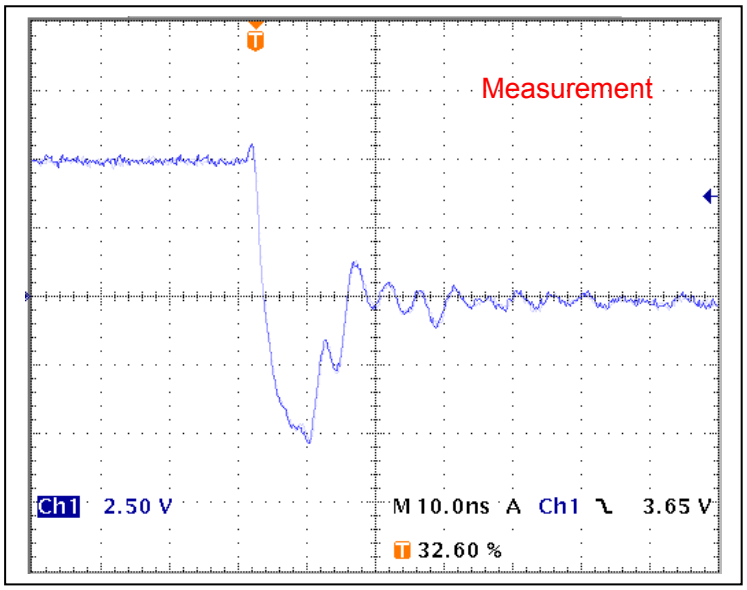
Evaluation circuit



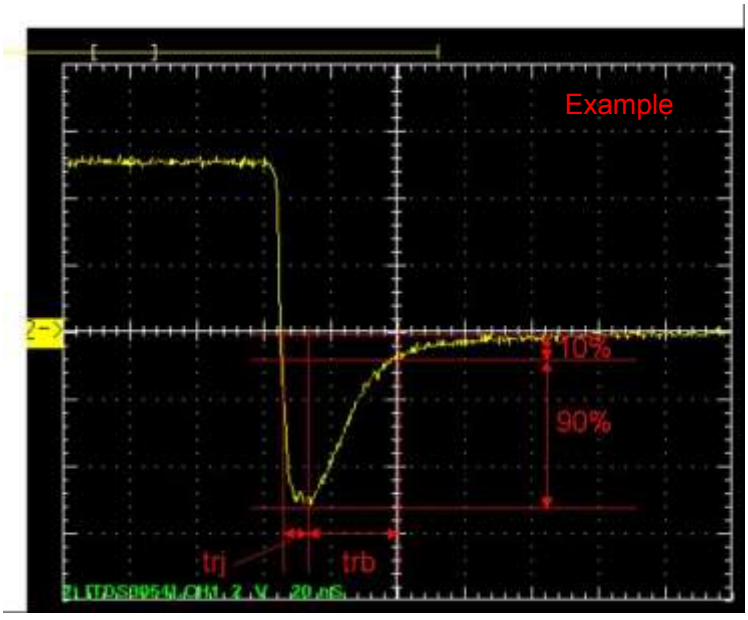
Compare Measurement vs. Simulation

trr	Measurement		Simulation		Error(%)
trj+trb	16	ns	16	ns	0

Reverse Recovery Characteristic Reference



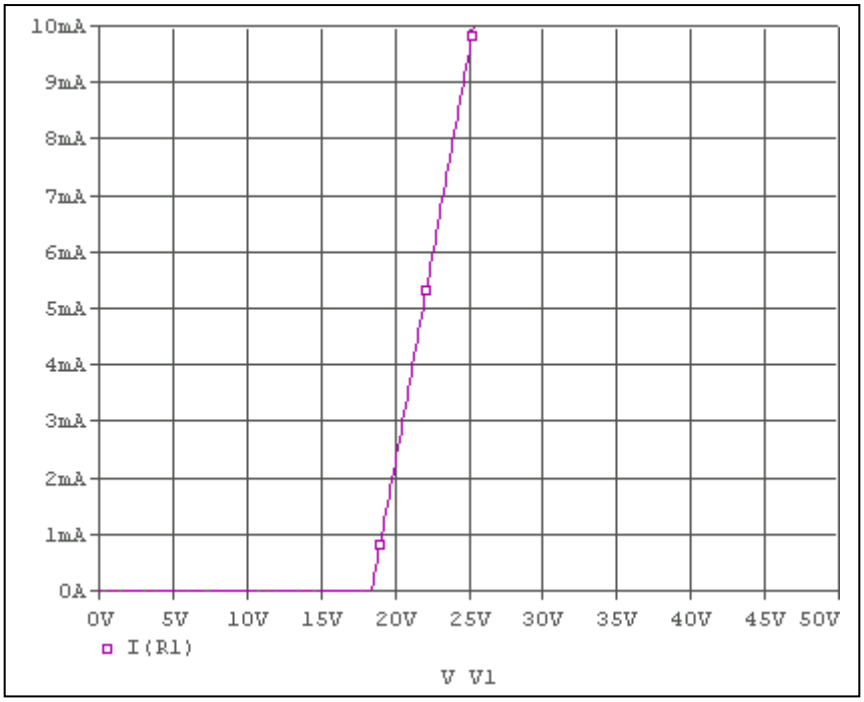
trj=6.4(ns)
trb=9.6(ns)
Conditions:Ifwd=Irev=0.2(A),Rl=50



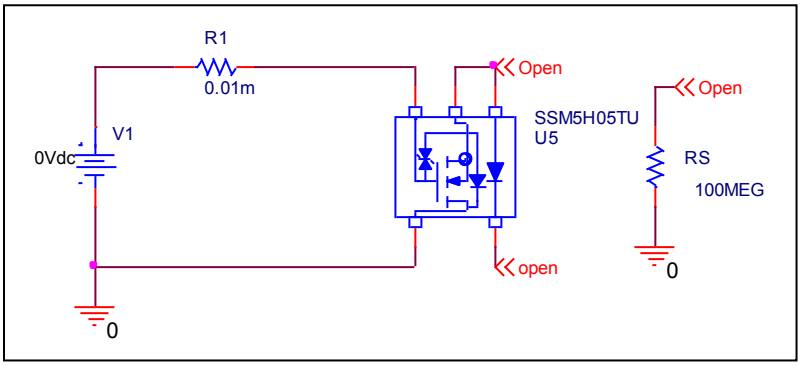
Relation between trj and trb

Zener Voltage Characteristic

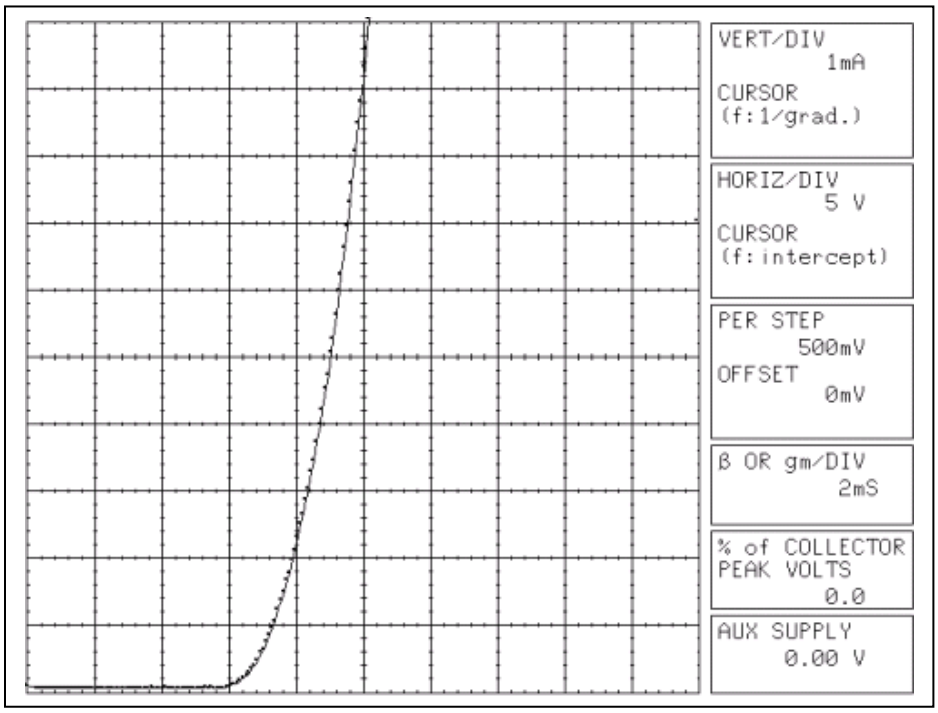
Circuit Simulation Result



Evaluation Circuit

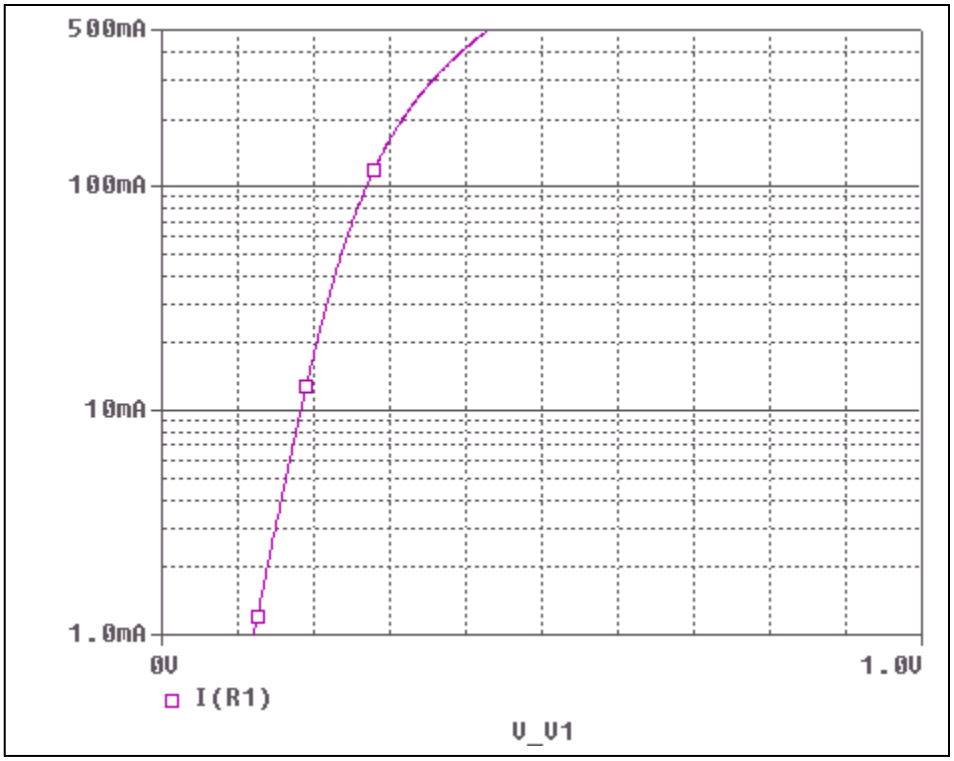


Zener Voltage Characteristic Reference

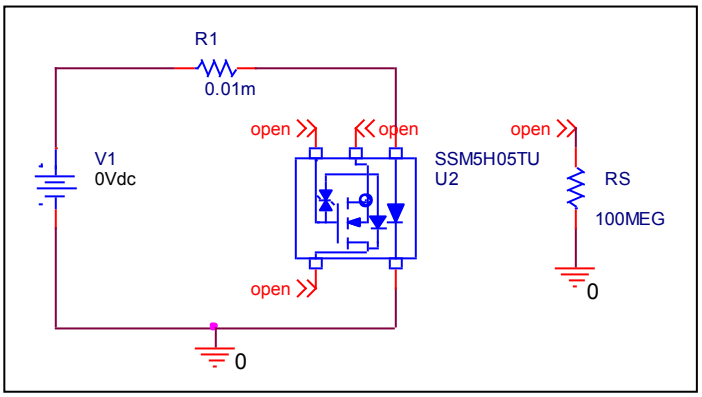


Forward Current Characteristic

Circuit Simulation Result

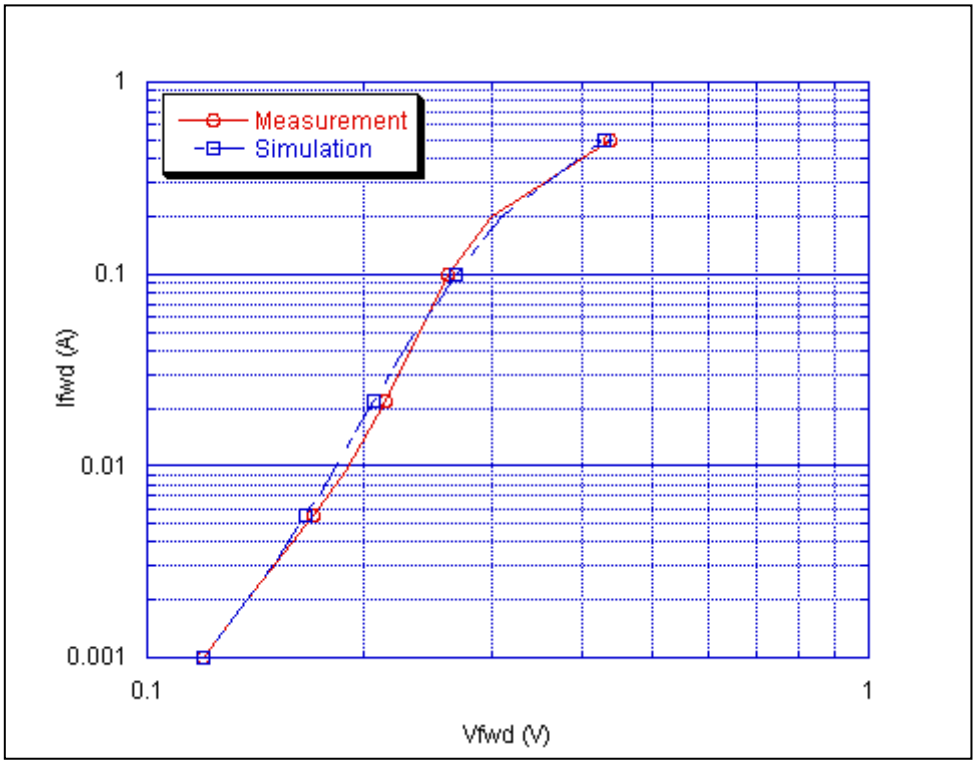


Evaluation Circuit



Comparison Graph

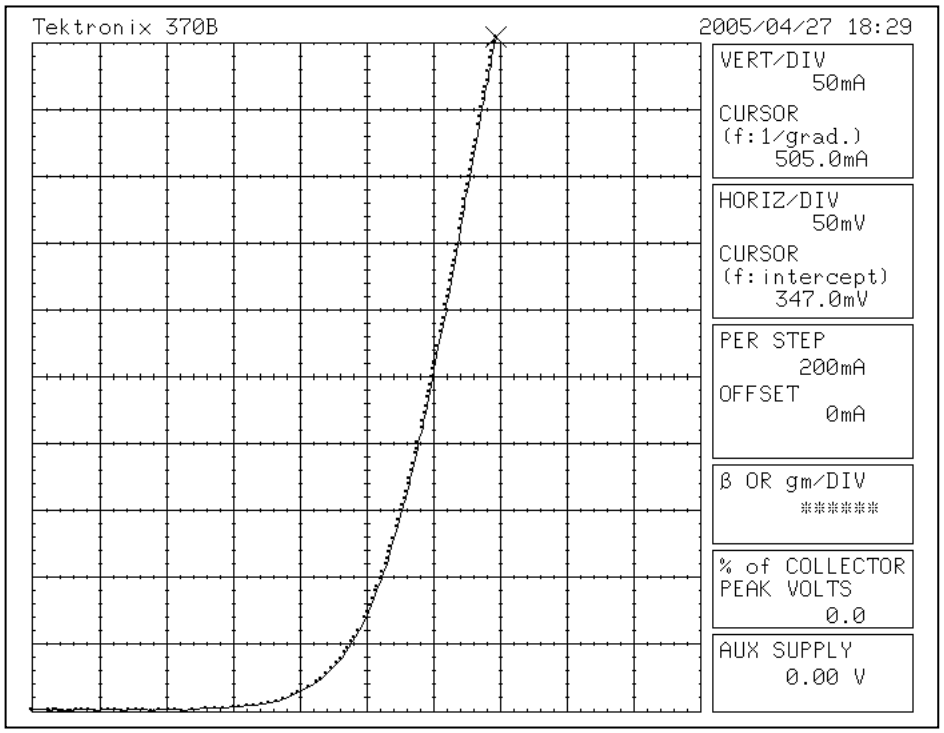
Circuit Simulation Result



Simulation Result

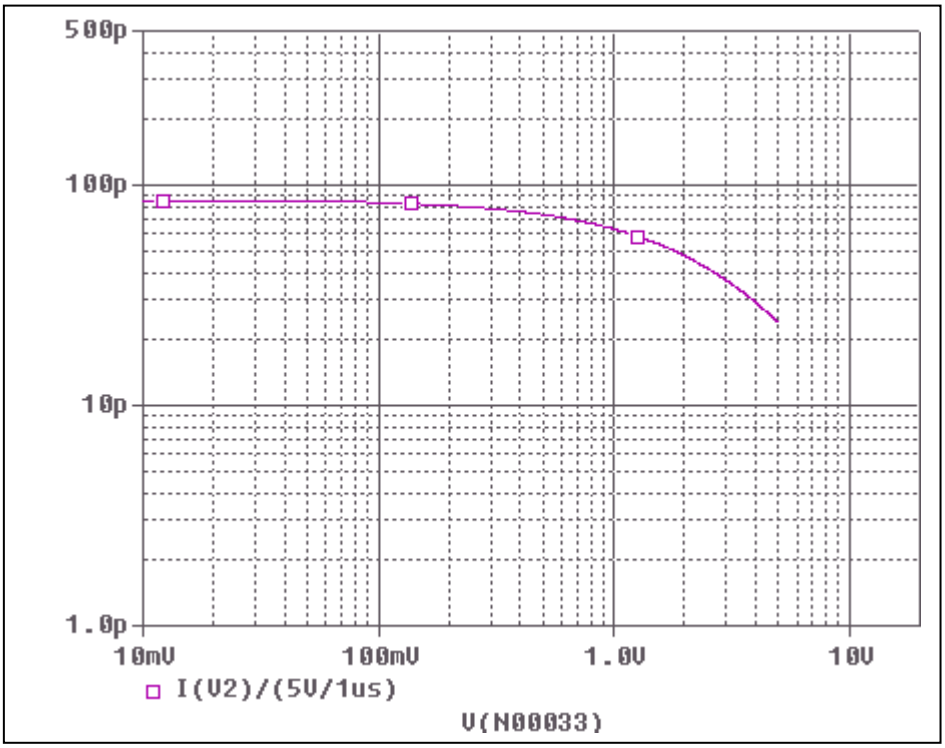
Ifwd (A)	Vfwd (V)		%Error
	Measurement	Simulation	
0.001	0.120	0.120	0.000
0.002	0.138	0.138	0.364
0.006	0.170	0.166	-2.353
0.010	0.188	0.182	-3.298
0.022	0.214	0.207	-3.185
0.052	0.240	0.238	-0.668
0.099	0.261	0.269	2.874
0.200	0.300	0.310	3.333
0.500	0.437	0.429	-1.739

Forward Current Characteristic Reference

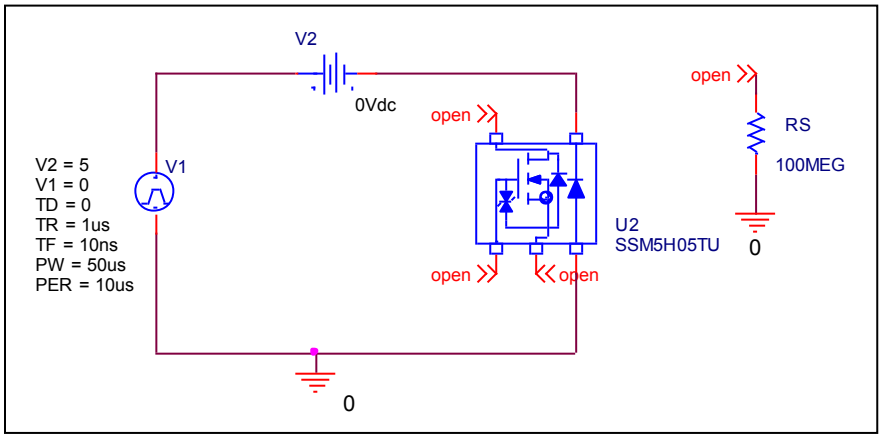


Junction Capacitance Characteristic

Circuit Simulation Result

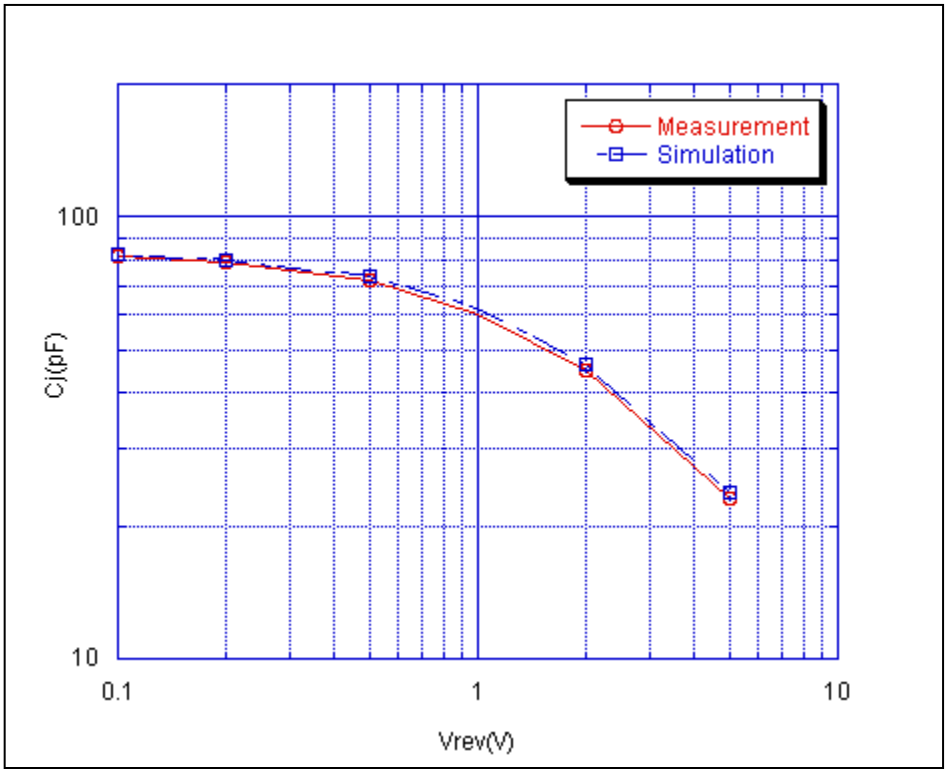


Evaluation Circuit



Comparison Graph

Circuit Simulation Result

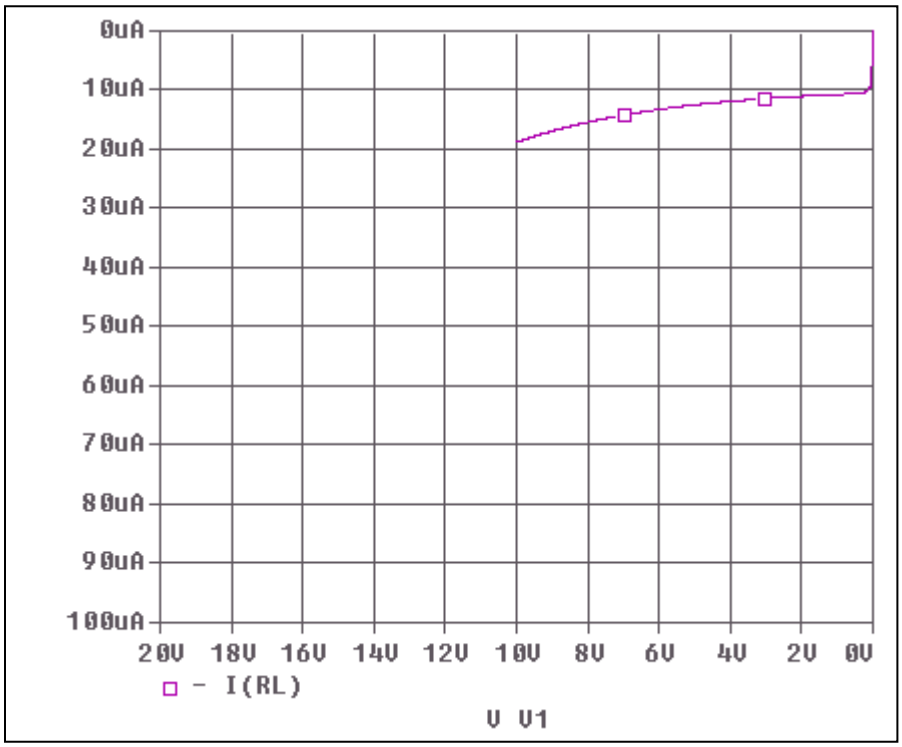


Simulation Result

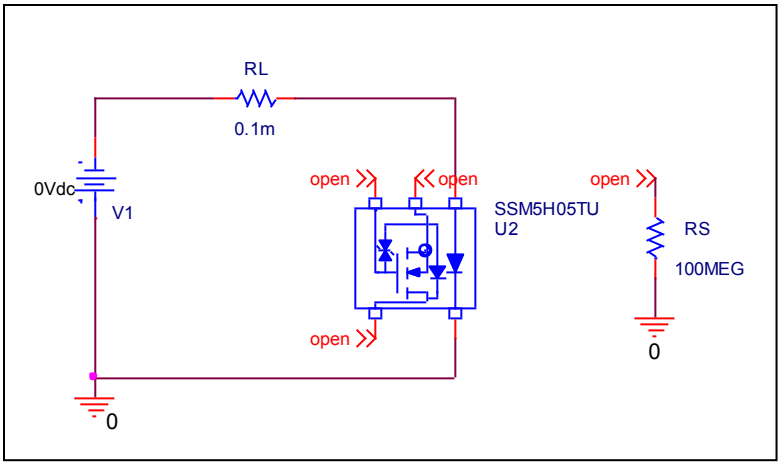
Vrev(V)	Cj(pF)		%Error
	Measurement	Simulation	
0.000	83.209	83.209	0.000
0.100	81.209	82.242	1.272
0.200	79.273	80.200	1.169
0.500	72.172	73.355	1.639
1.000	60.129	62.007	3.123
2.000	44.904	46.502	3.559
5.000	23.041	23.742	3.042

Reverse Characteristic

Circuit Simulation Result

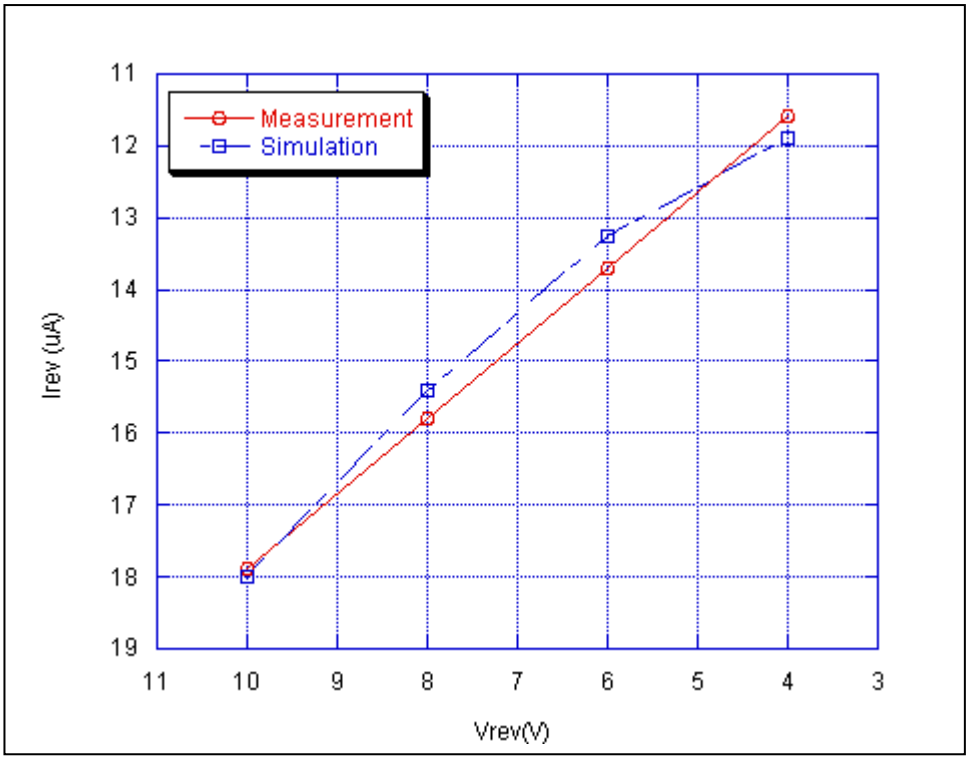


Evaluation Circuit



Comparison Graph

Circuit Simulation Result



Simulation Result

Vrev(V)	Irev (uA)		%Error
	Measurement	Simulation	
4.00	11.60	11.89	2.50
6.00	13.70	13.25	-3.28
8.00	15.80	15.41	-2.47
10.00	17.90	18.00	0.56

Reverse Current Characteristic Reference