Device Modeling Report

COMPONENTS: Power MOSFET (Standard)
PART NUMBER: SSM5H08TU
MANUFACTURER: TOSHIBA
Body Diode (Standard) / ESD Protection Diode
Schottky Barrier Diode (Professional)

Bee Technologies Inc.

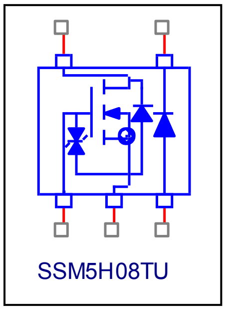
MOSFET MODEL

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

Body Diode Model

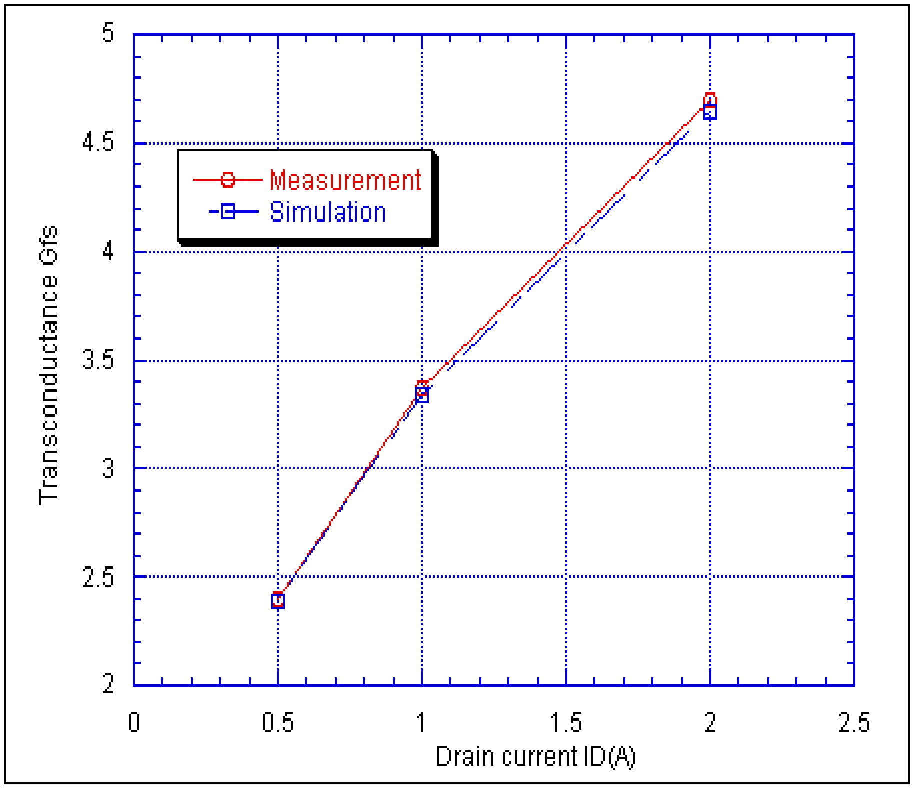
Pspice model parameter	Model description
IS	Saturation Current
N	Emission Coefficient
RS	Series Resistance
IKF	High-injection Knee Current
CJO	Zero-bias Junction Capacitance
M	Junction Grading Coefficient
VJ	Junction Potential
ISR	Recombination Current Saturation Value
BV	Reverse Breakdown Voltage(a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

Circuit Configuration



Transconductance Characteristic

Circuit Simulation Result

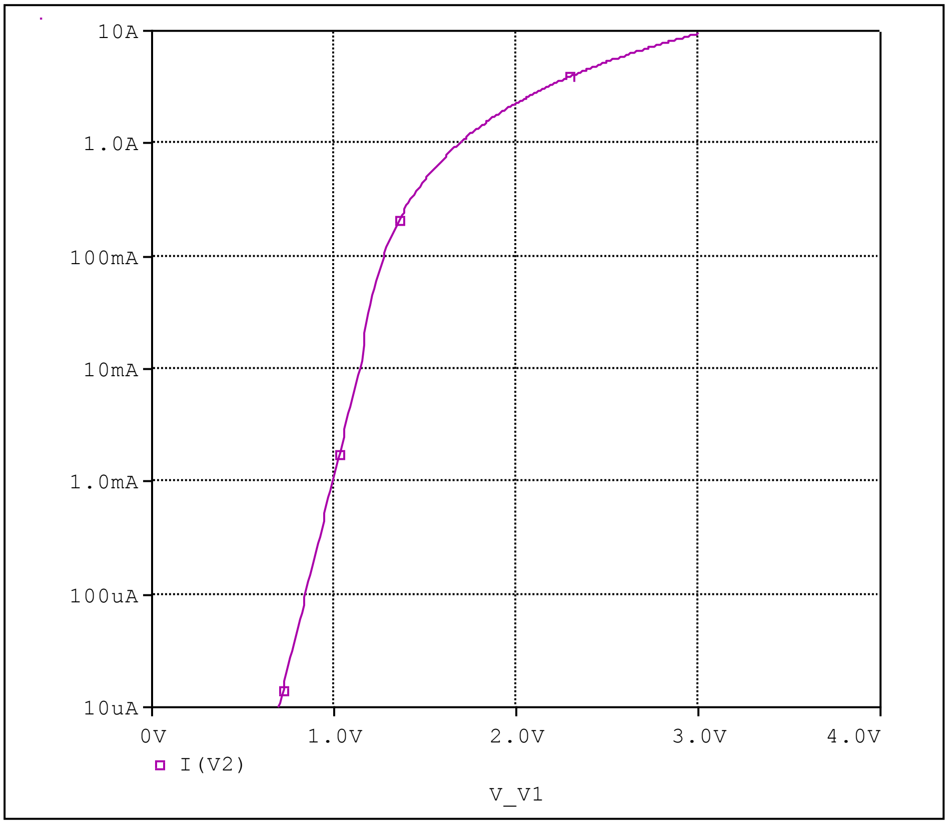


Comparison table

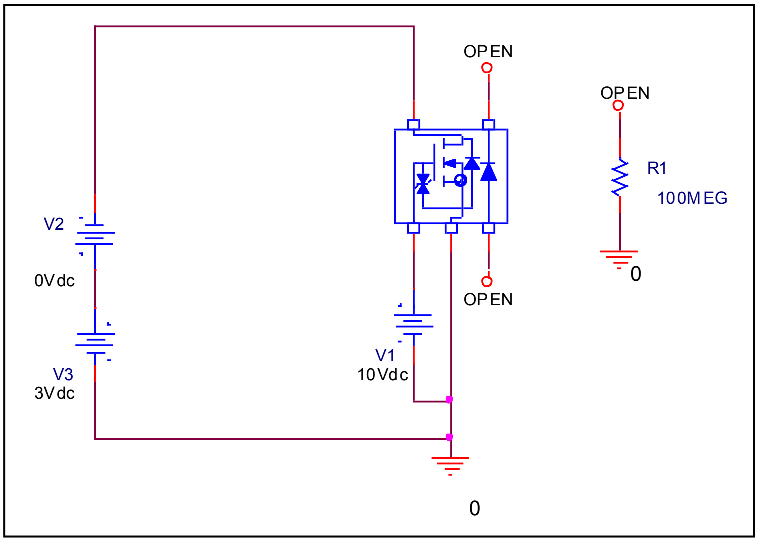
I_D(A)	gfs		Error (%)
	Measurement	Simulation	
0.50	2.40	2.39	-0.46
1.00	3.37	3.34	-0.92
2.00	4.70	4.64	-1.19

Vgs-Id Characteristic

Circuit Simulation result

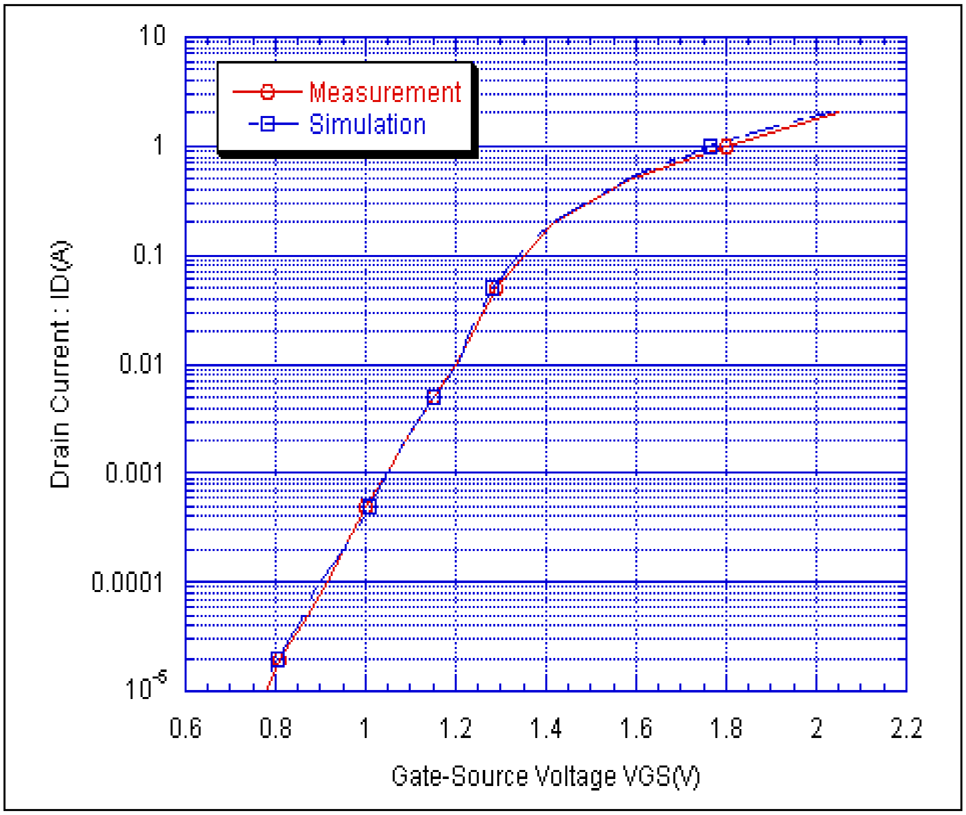


Evaluation circuit



Comparison Graph

Circuit Simulation Result

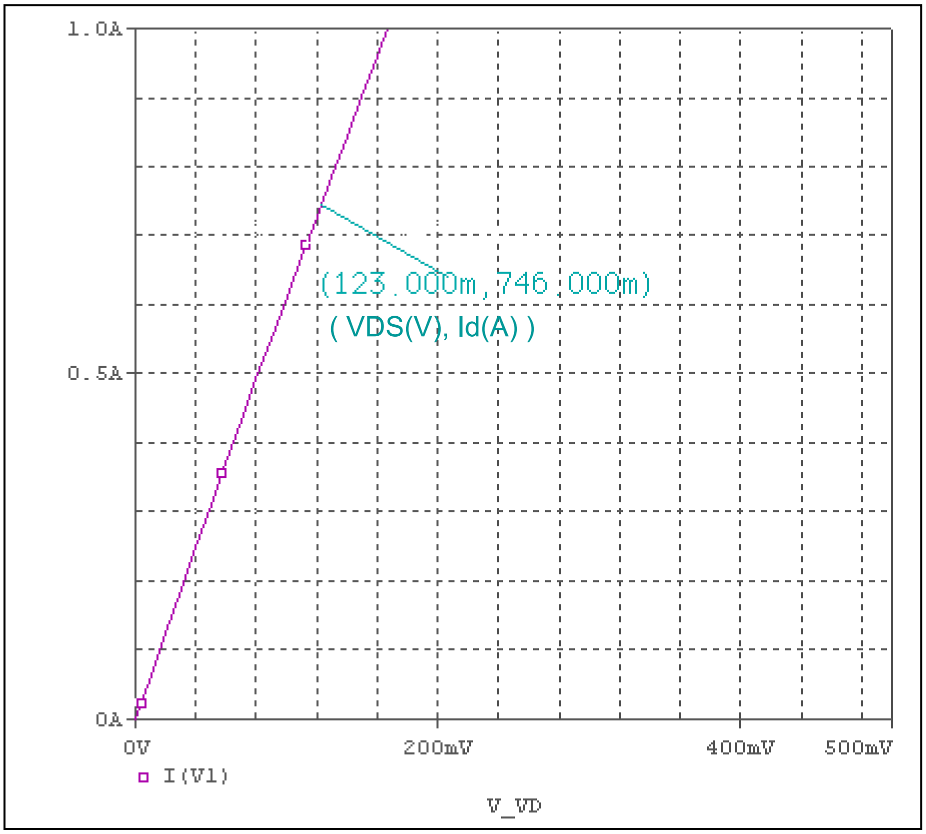


Simulation Result

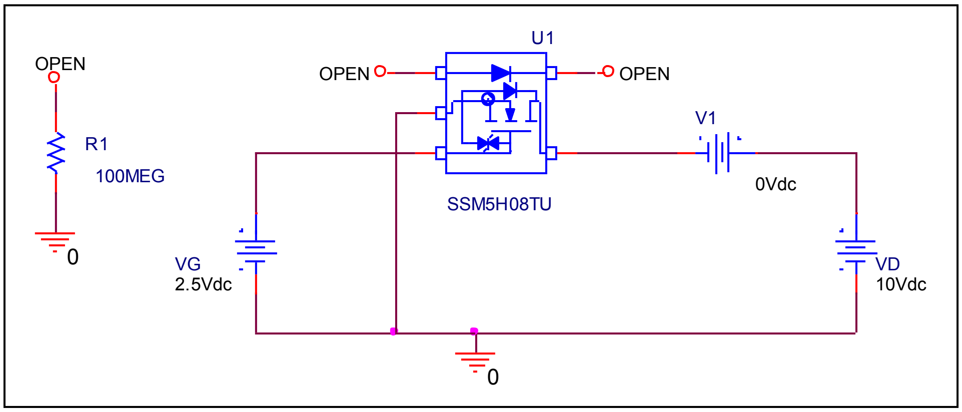
I_D(A)	V_{GS}(V)		Error (%)
	Measurement	Simulation	
0.01	1.13	1.14	0.80
0.02	1.16	1.17	0.69
0.05	1.20	1.21	0.83
0.10	1.26	1.27	0.79
0.20	1.35	1.35	0.00
0.50	1.49	1.50	0.67
1.00	1.67	1.68	0.60
2.00	1.92	1.94	1.04

Id-Rds(on) Characteristic

Circuit Simulation result



Evaluation circuit

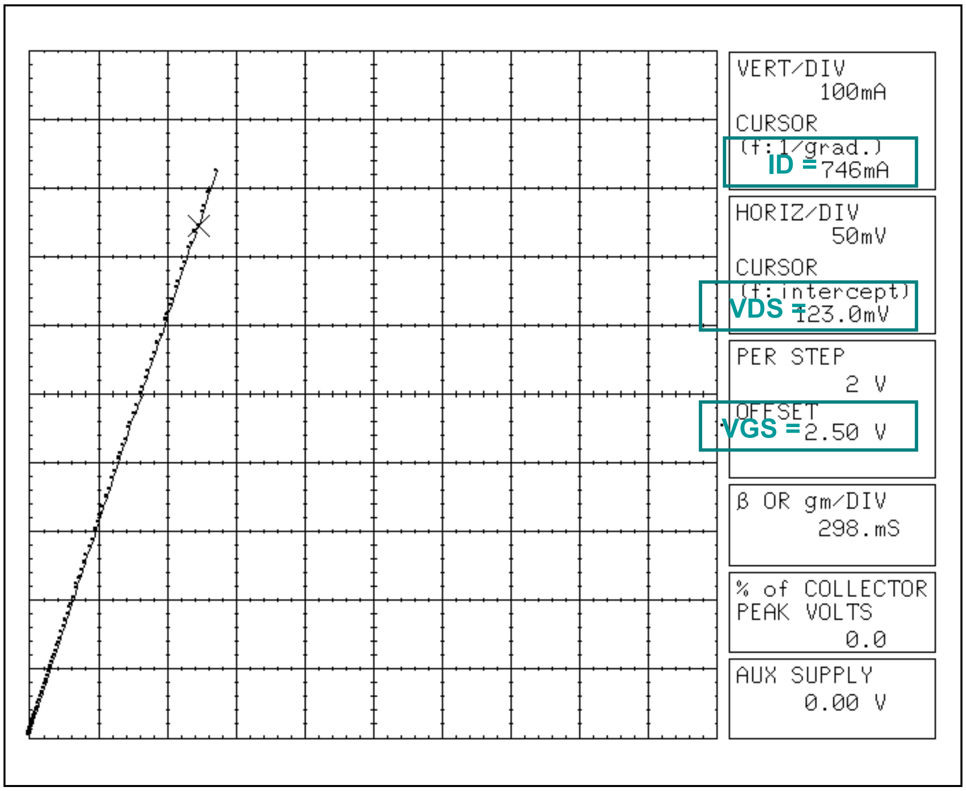


Simulation Result

I_D=0.756A, V_{GS}=2.5V	Measurement		Simulation		Error (%)
R_{DS} (on)	164.88	mΩ	164.88	mΩ	0.00

Id-Rds(on) Characteristic

Reference



VERT/DIV
100mA
CURSOR
(f:1/grad.)
ID = 746mA

HORIZ/DIV
50mV
CURSOR
(f:intercept)
VDS = 123.0mV

PER STEP
2 V
OFFSET
VGS = 2.50 V

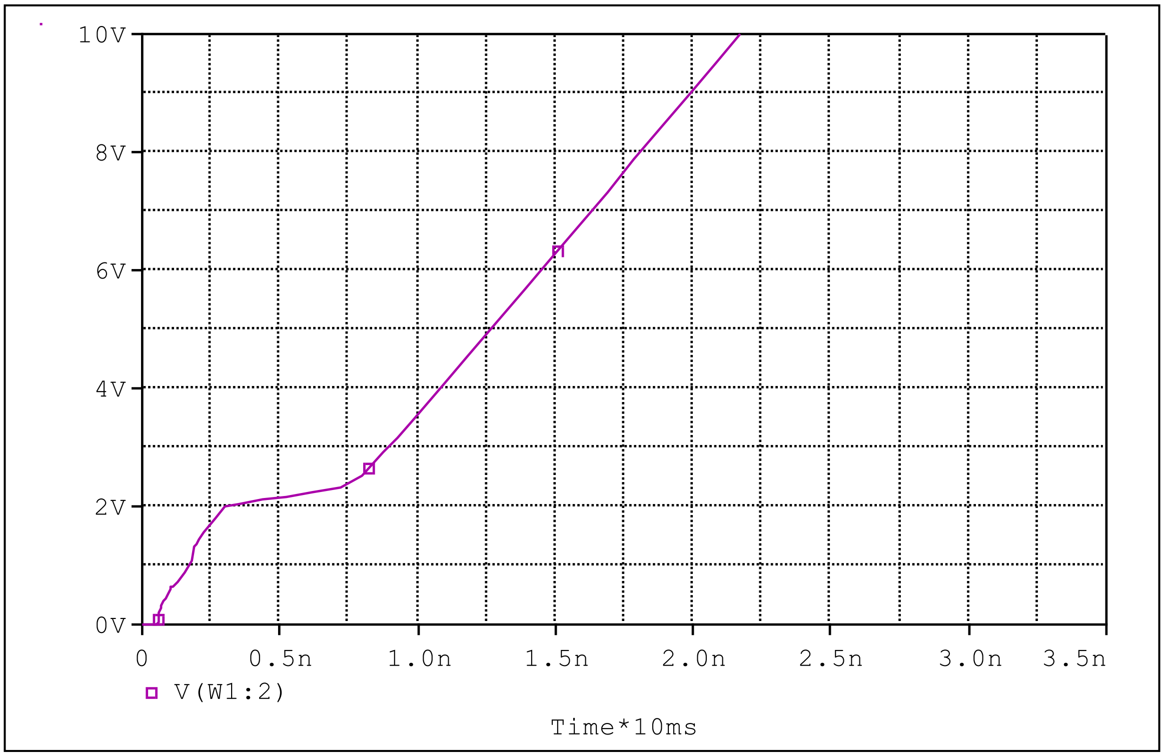
β OR gm/DIV
298.mS

% of COLLECTOR
PEAK VOLTS
0.0

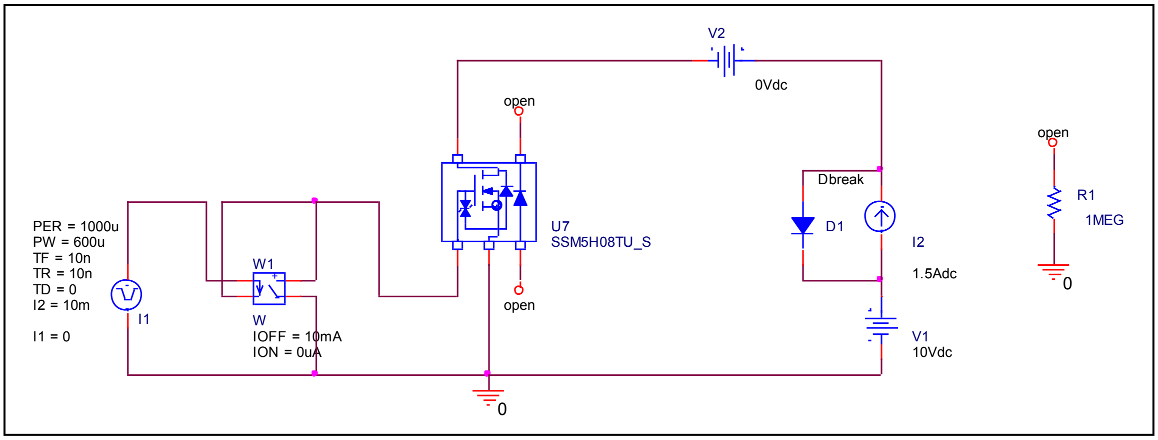
AUX SUPPLY
0.00 V

Gate Charge Characteristic

Circuit Simulation result



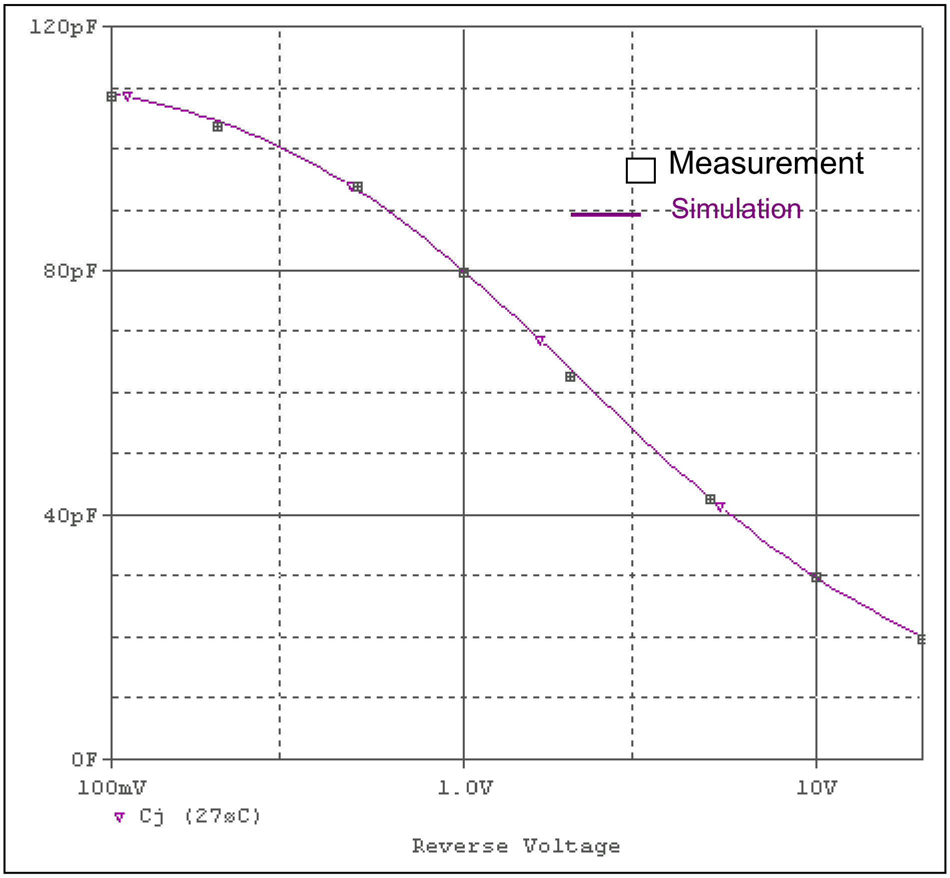
Evaluation circuit



Simulation Result

V_{DD}=10V,I_D=1.5A	Measurement		Simulation		Error (%)
Qgs	0.250	nC	0.257	nC	2.800
Qgd	0.565	nC	0.552	nC	-2.301

Capacitance Characteristic

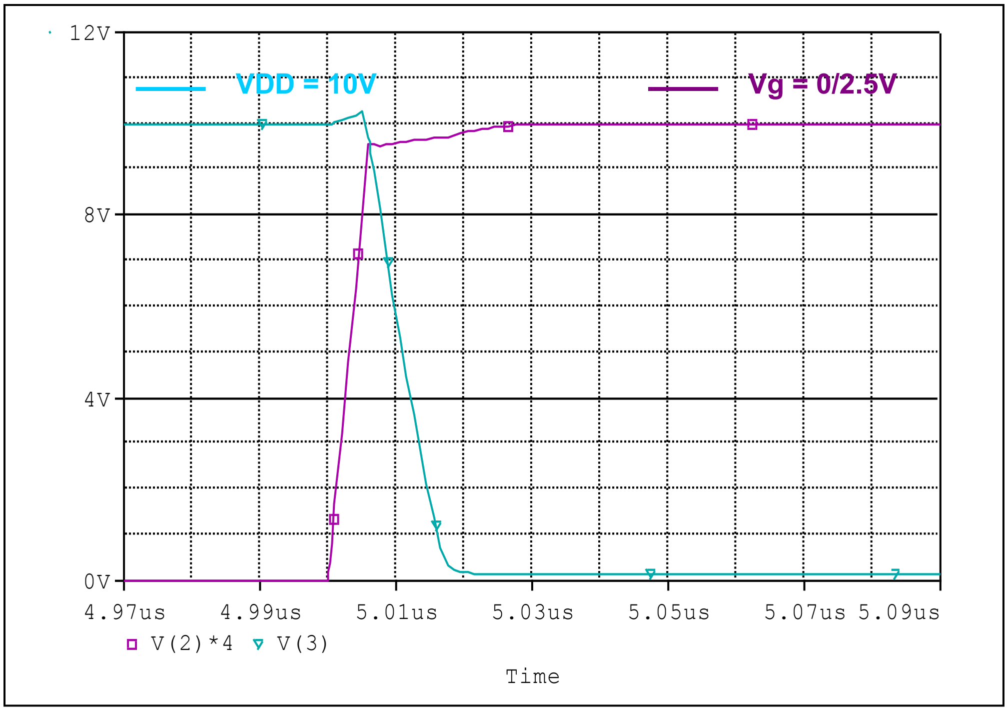


Simulation Result

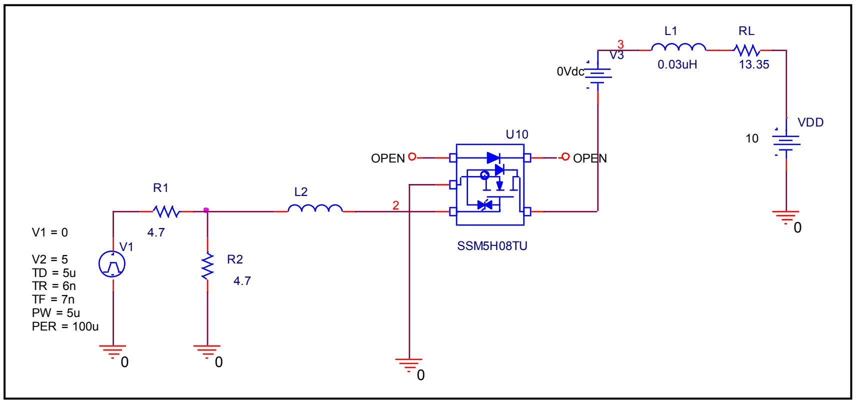
V_{DS}(V)	Cbd(pF)		Error(%)
	Measurement	Simulation	
0.10	109.00	109.80	0.73
0.20	104.00	104.70	0.67
0.50	94.00	93.62	-0.40
1.00	80.00	80.23	0.29
2.00	63.00	64.13	1.79
5.00	43.00	43.04	0.09
10.00	30.00	30.11	0.37
20.00	20.00	20.25	1.25

Switching Time Characteristic

Circuit Simulation result



Evaluation circuit

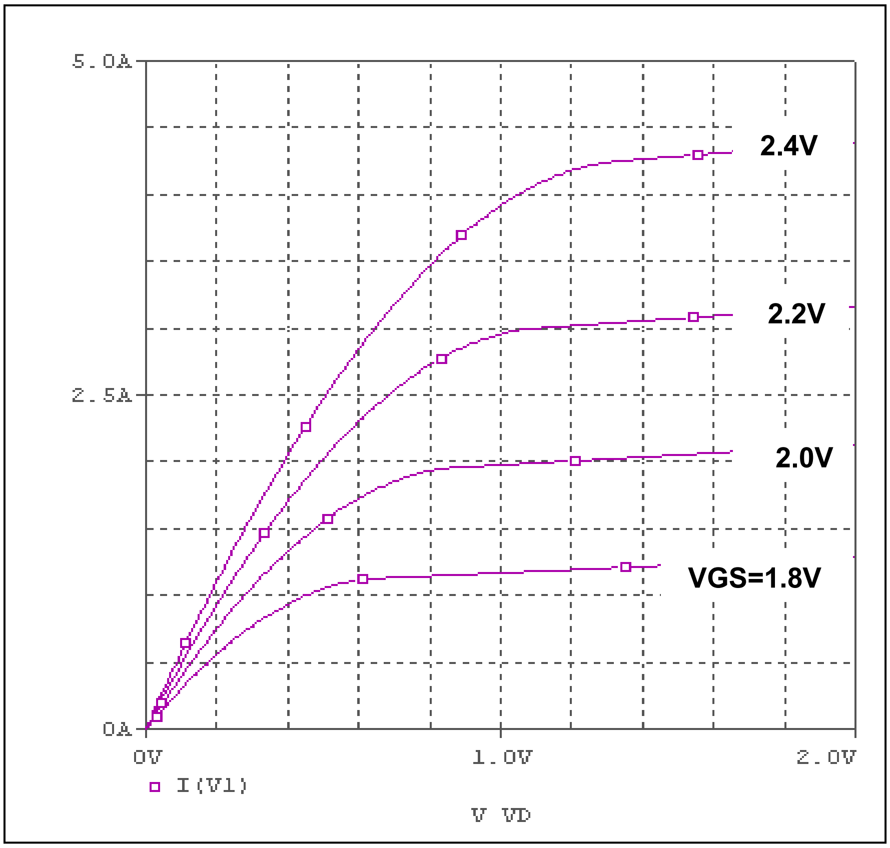


Simulation Result

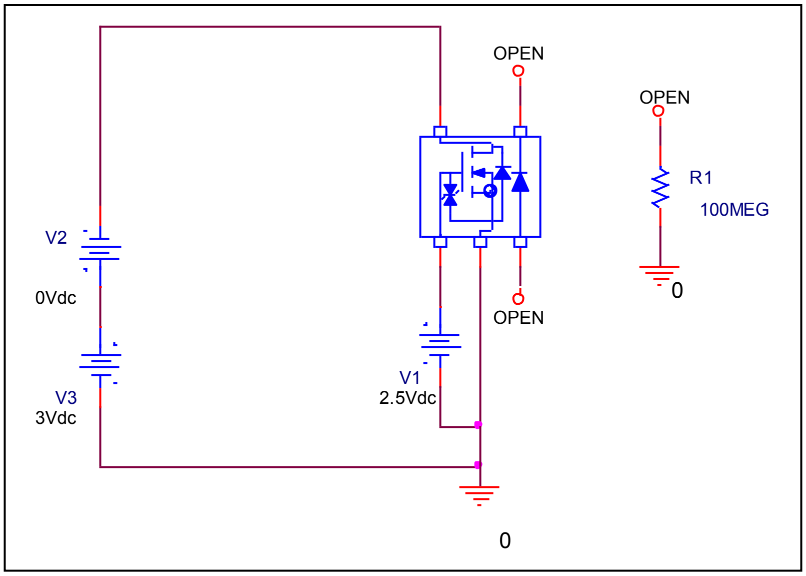
I_D=0.75A, V_{DD}=10V V_{GS}=2.5V	Measurement		Simulation		Error(%)
ton	15.50	ns	15.52	ns	0.13

Output Characteristic

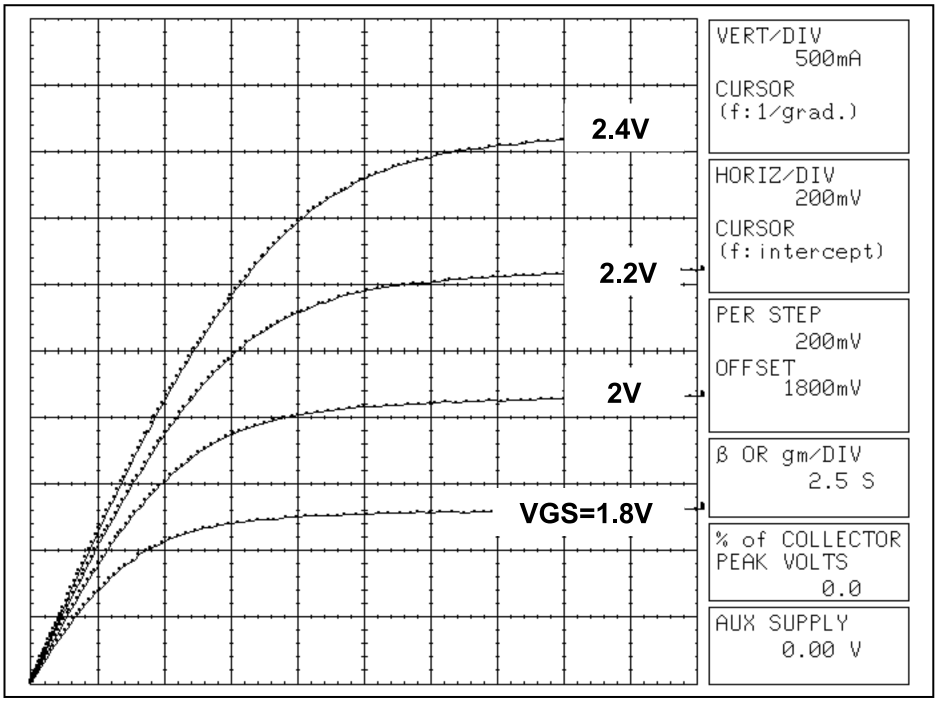
Circuit Simulation result



Evaluation circuit

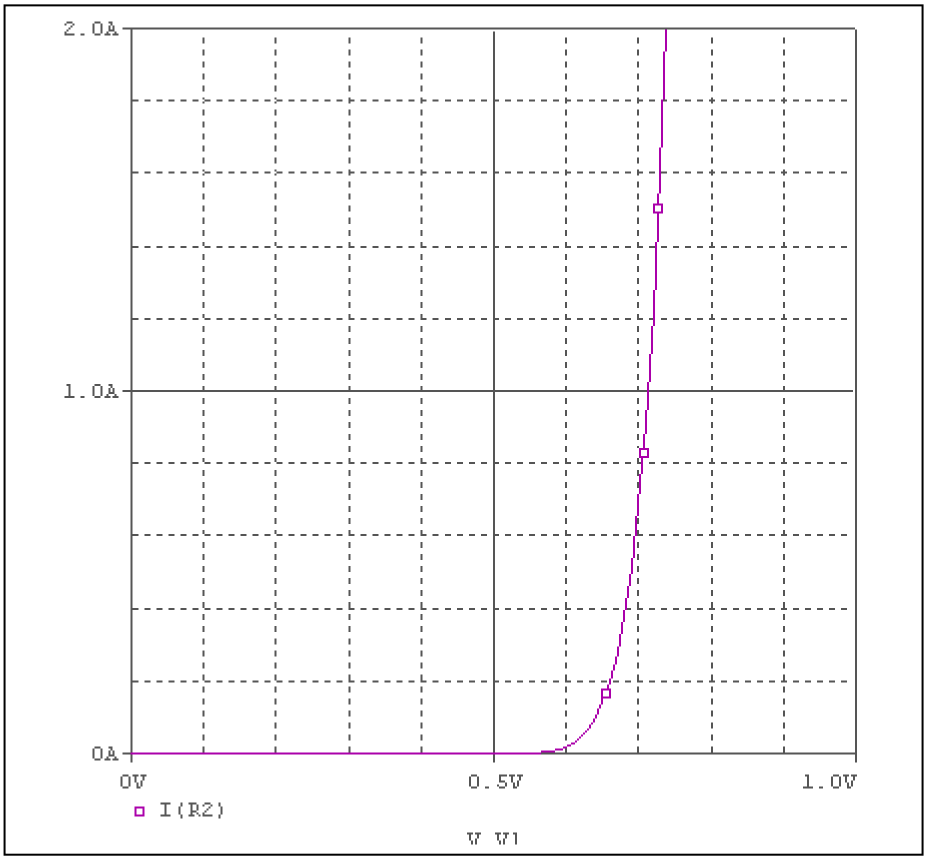


Output Characteristic **Reference**

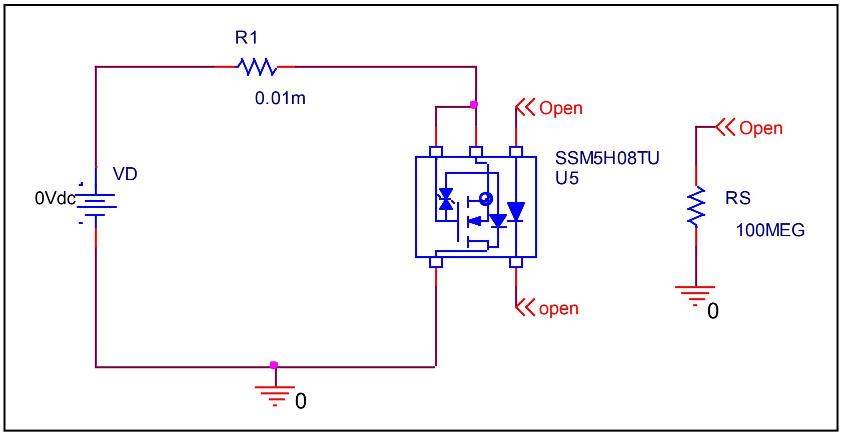


BODY DIODE SPICE MODEL
Forward Current Characteristic

Circuit Simulation Result

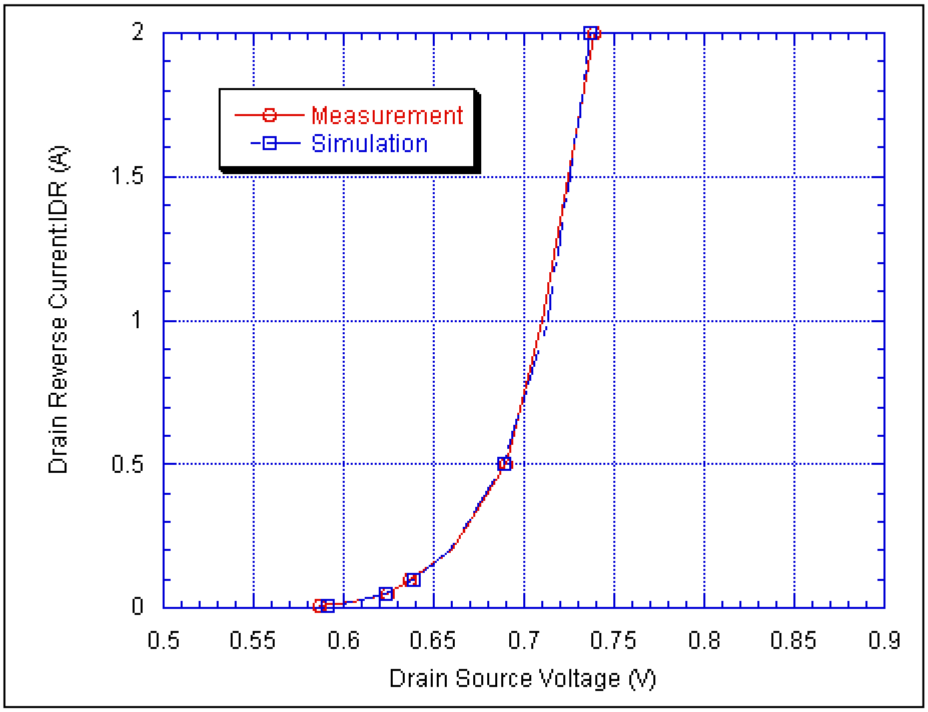


Evaluation Circuit



Comparison Graph

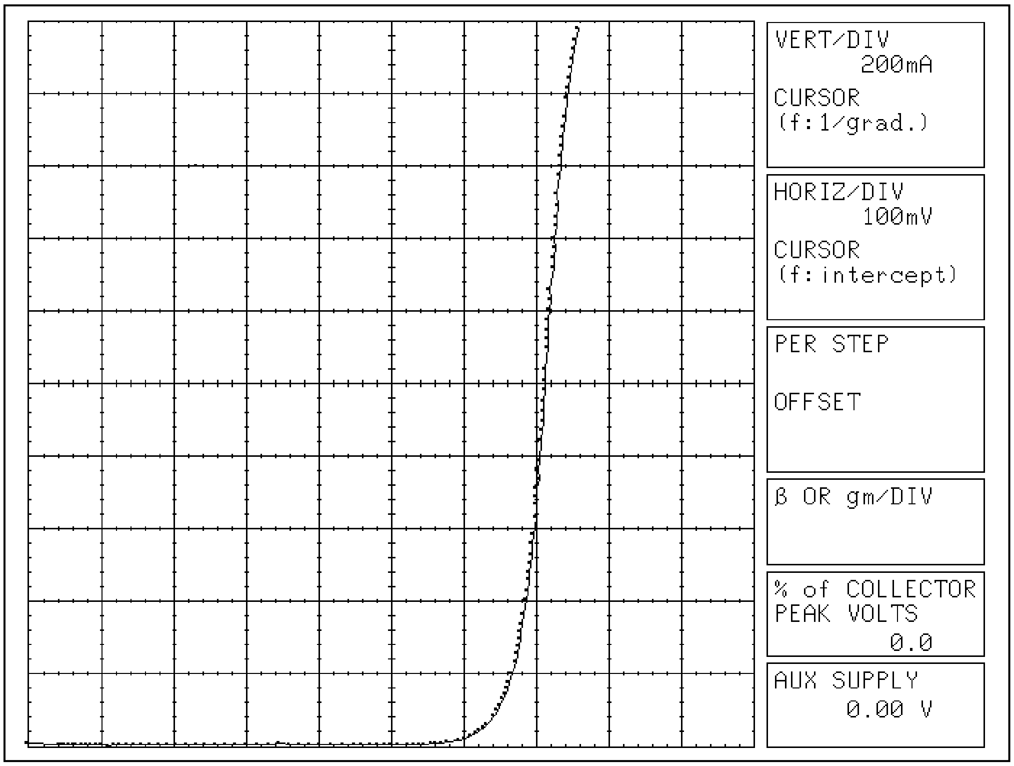
Circuit Simulation Result



Simulation Result

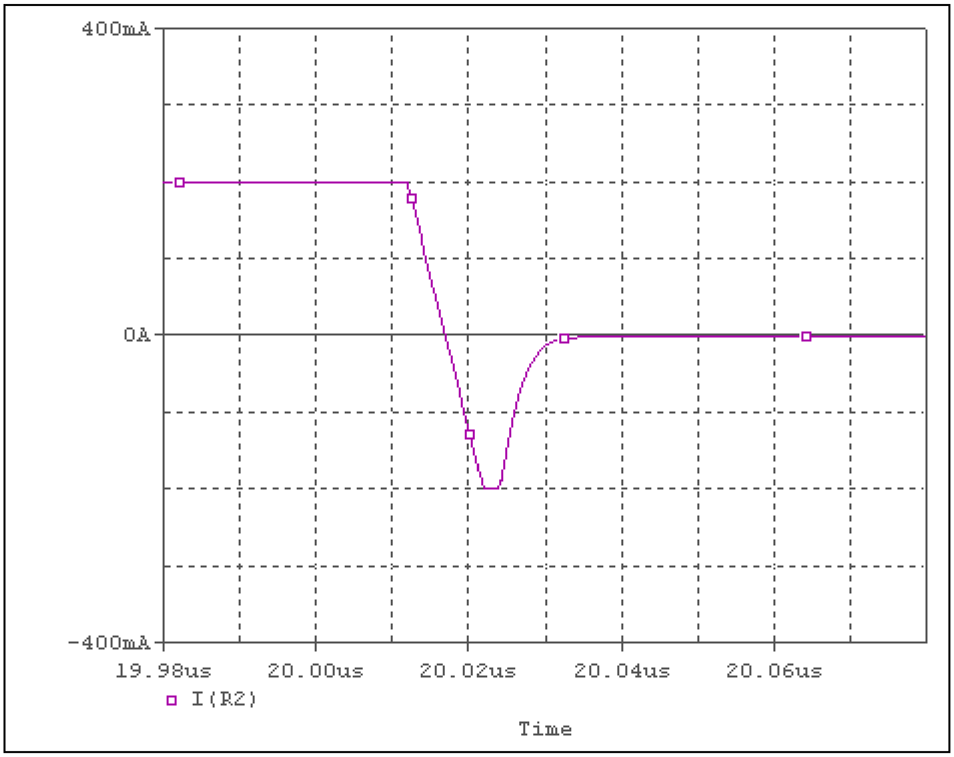
Ifwd(A)	Vfwd(V) Measurement	Vfwd(V) Simulation	%Error
0.010	0.587	0.591	0.681
0.020	0.605	0.604	-0.165
0.050	0.625	0.623	-0.320
0.100	0.637	0.639	0.314
0.200	0.660	0.659	-0.152
0.500	0.690	0.689	-0.145
1.000	0.710	0.713	0.423
2.000	0.739	0.737	-0.271

Forward Current Characteristic **Reference**

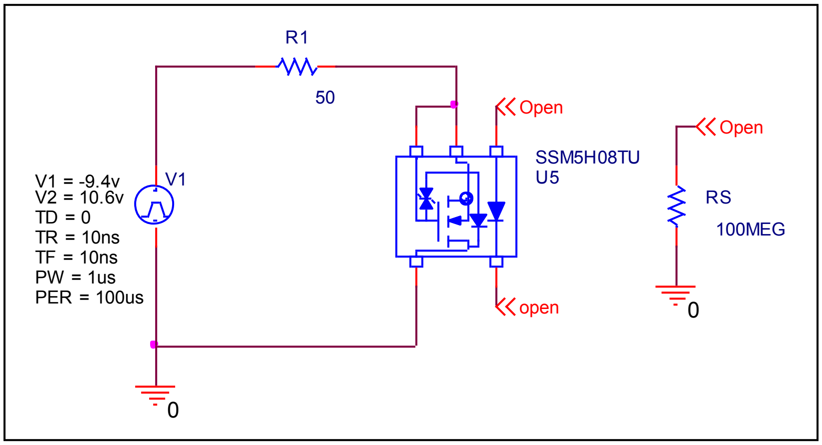


Reverse Recovery Characteristic

Circuit Simulation Result



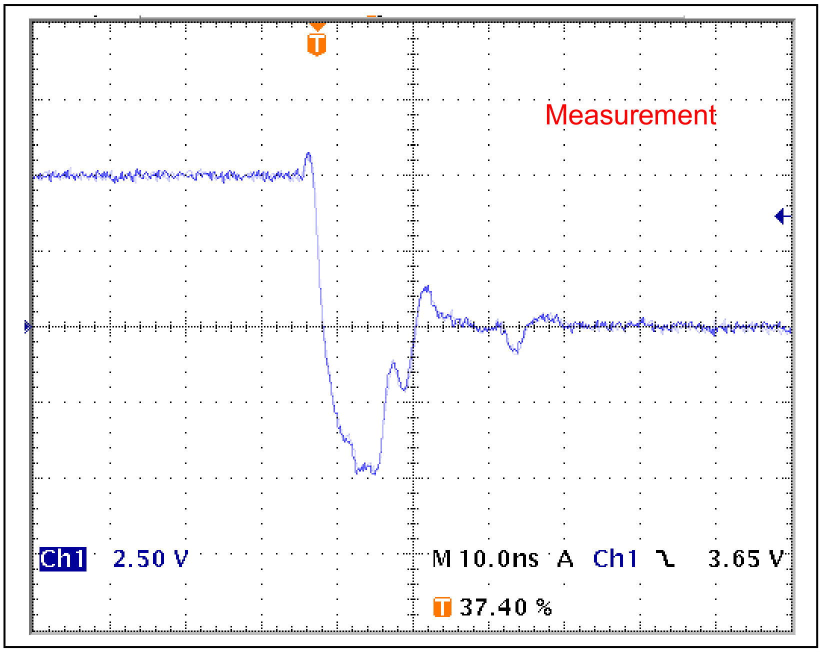
Evaluation circuit



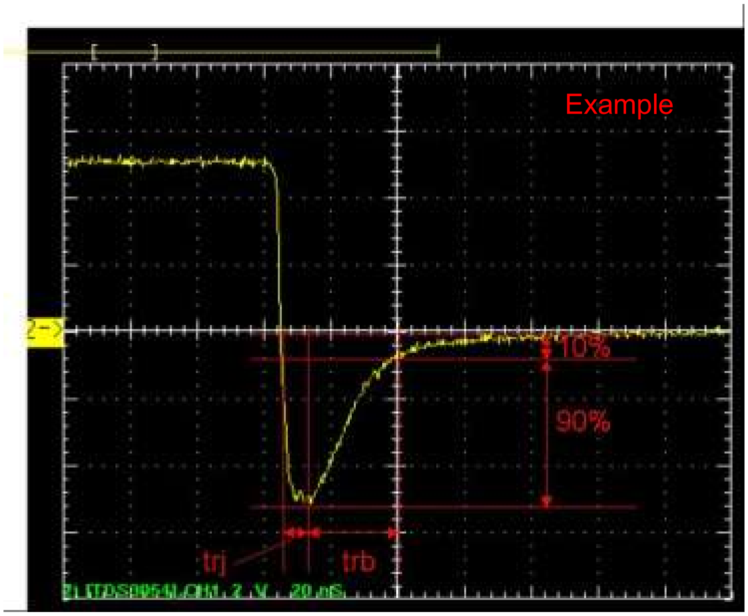
Compare Measurement vs. Simulation

Trr	Measurement		Simulation		Error(%)
Trj+Trb	11.6	ns	11.594	ns	-0.05172

Reverse Recovery Characteristic **Reference**



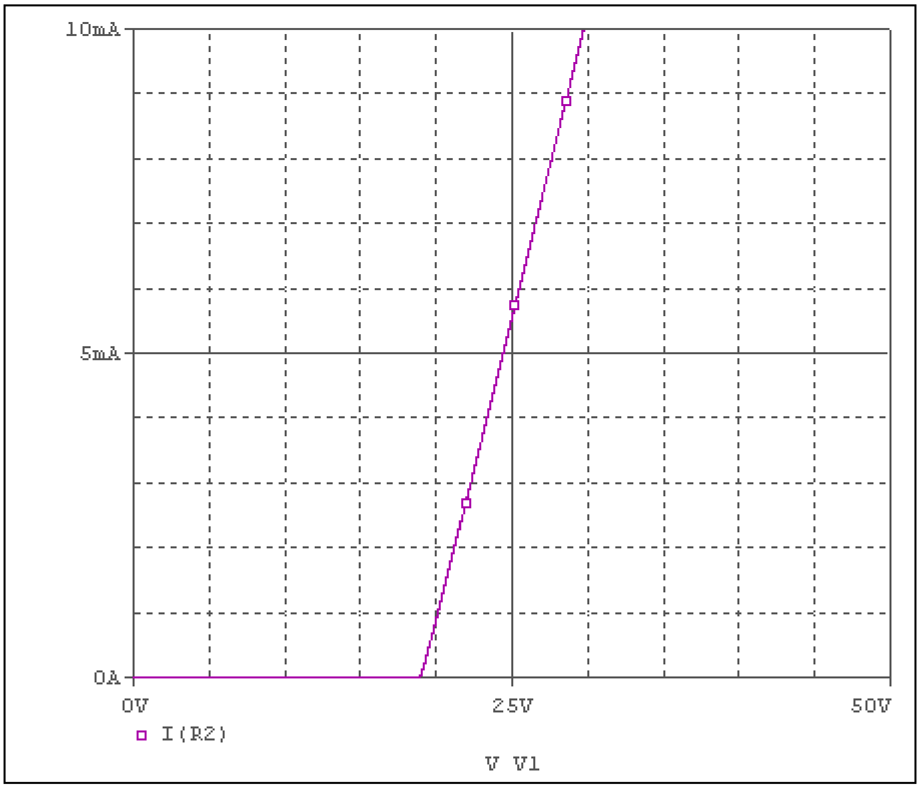
trj=6.4(ns)
trb=5.2(ns)
Conditions:Ifwd=Irev=0.2(A),Rl=50



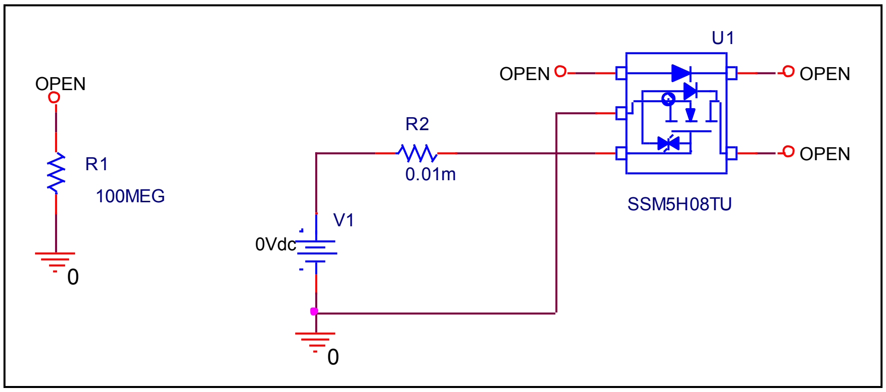
Relation between trj and trb

ESD PROTECTION DIODE SPICE MODEL
Zener Voltage Characteristic

Circuit Simulation Result

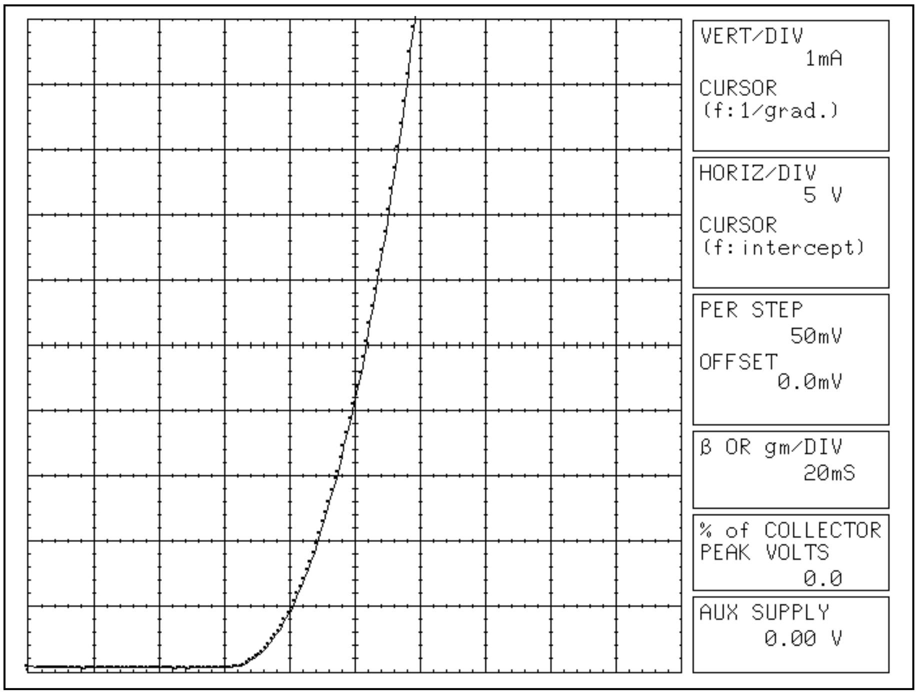


Evaluation Circuit



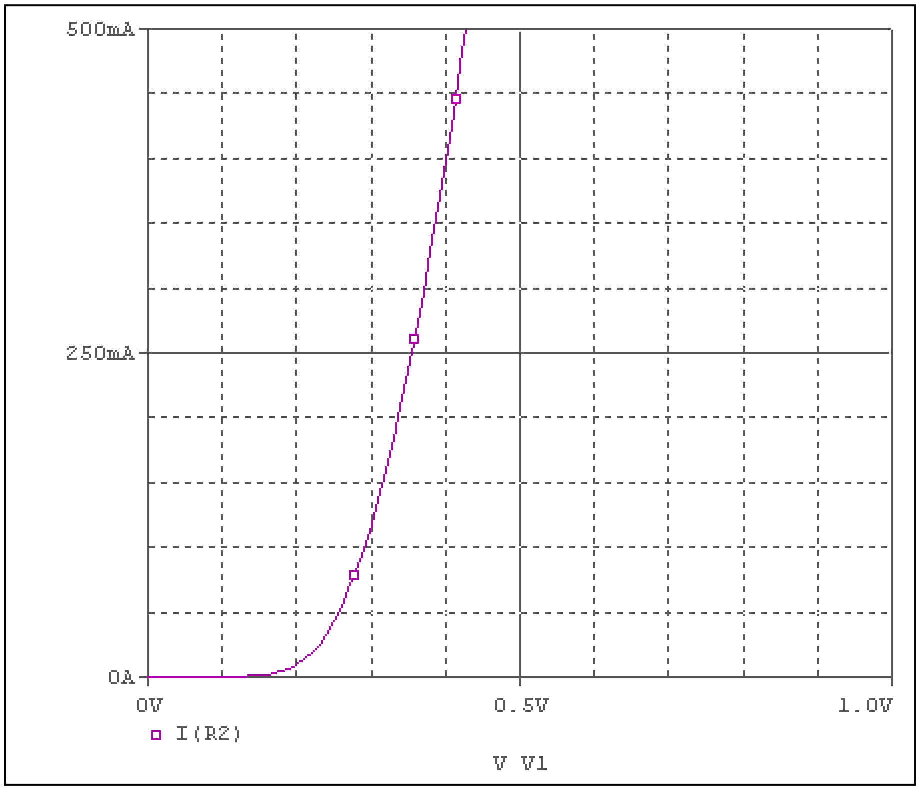
Zener Voltage Characteristic

Reference

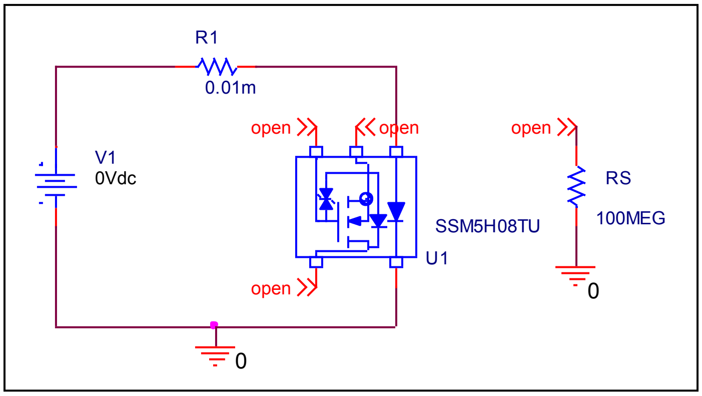


DIODE SCHOTTKY SPICE MODEL
Forward Current Characteristic

Circuit Simulation Result

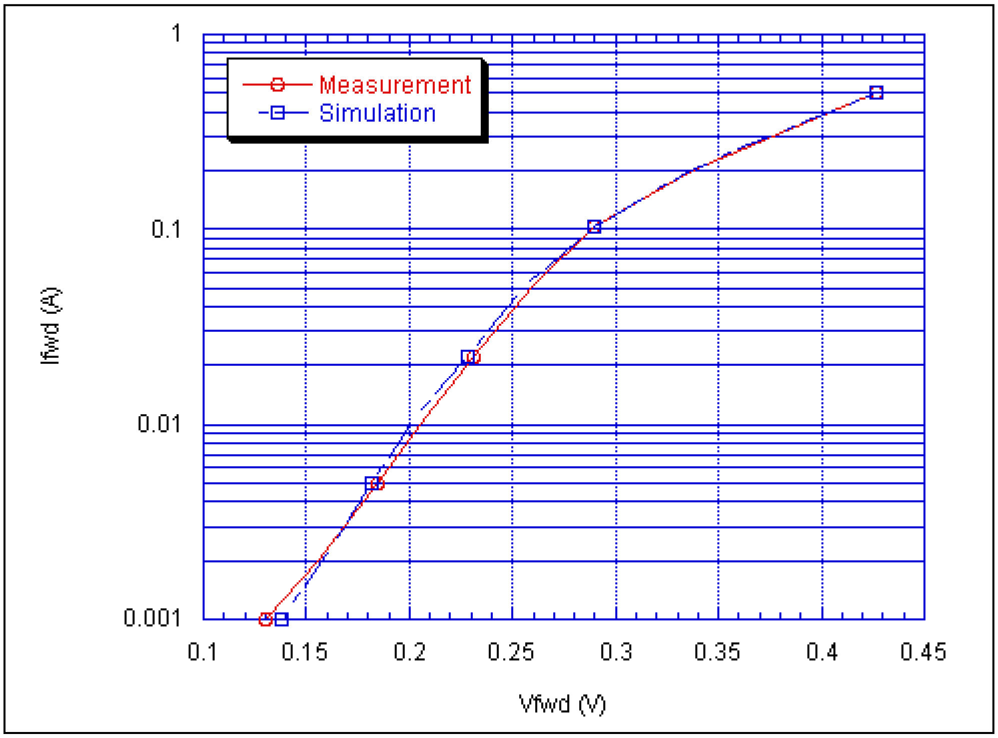


Evaluation Circuit



Comparison Graph

Circuit Simulation Result

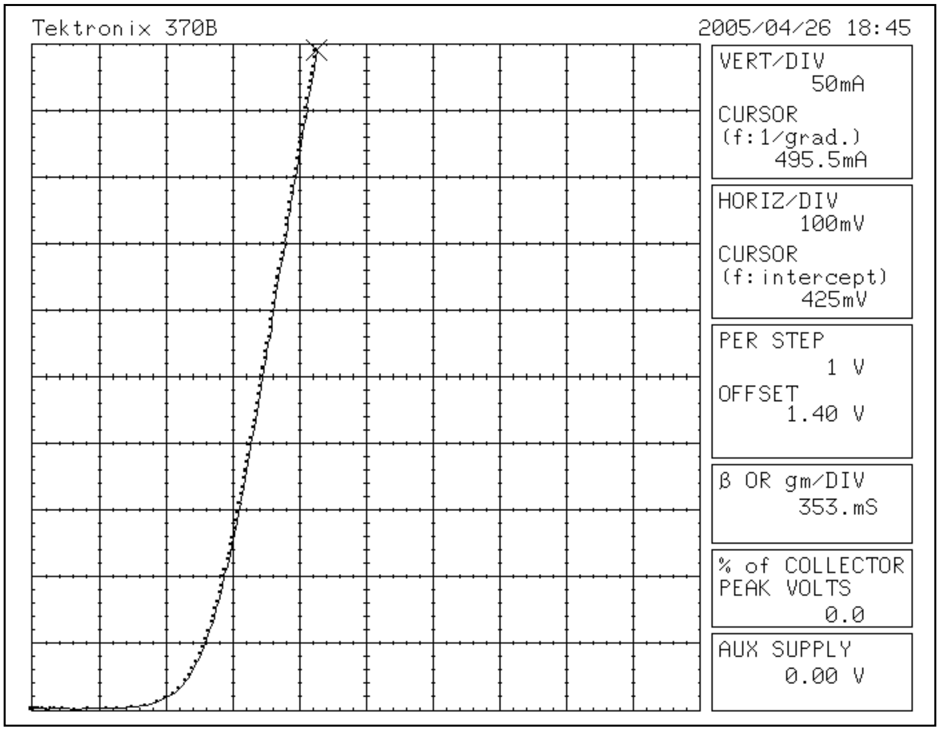


Simulation Result

Ifwd (A)	Vfwd (V)		%Error
	Measurement	Simulation	
0.001	0.130	0.138	6.154
0.002	0.155	0.157	1.290
0.005	0.185	0.182	-1.622
0.011	0.208	0.203	-2.404
0.022	0.231	0.228	-1.299
0.052	0.260	0.257	-1.154
0.104	0.290	0.290	0.000
0.202	0.337	0.336	-0.297
0.499	0.427	0.427	0.000

Forward Current Characteristic

Reference



Tektronix 370B

2005/04/26 18:45

VERT/DIV
50mA

CURSOR
(f:1/grad.)
495.5mA

HORIZ/DIV
100mV

CURSOR
(f:intercept)
425mV

PER STEP
1 V

OFFSET
1.40 V

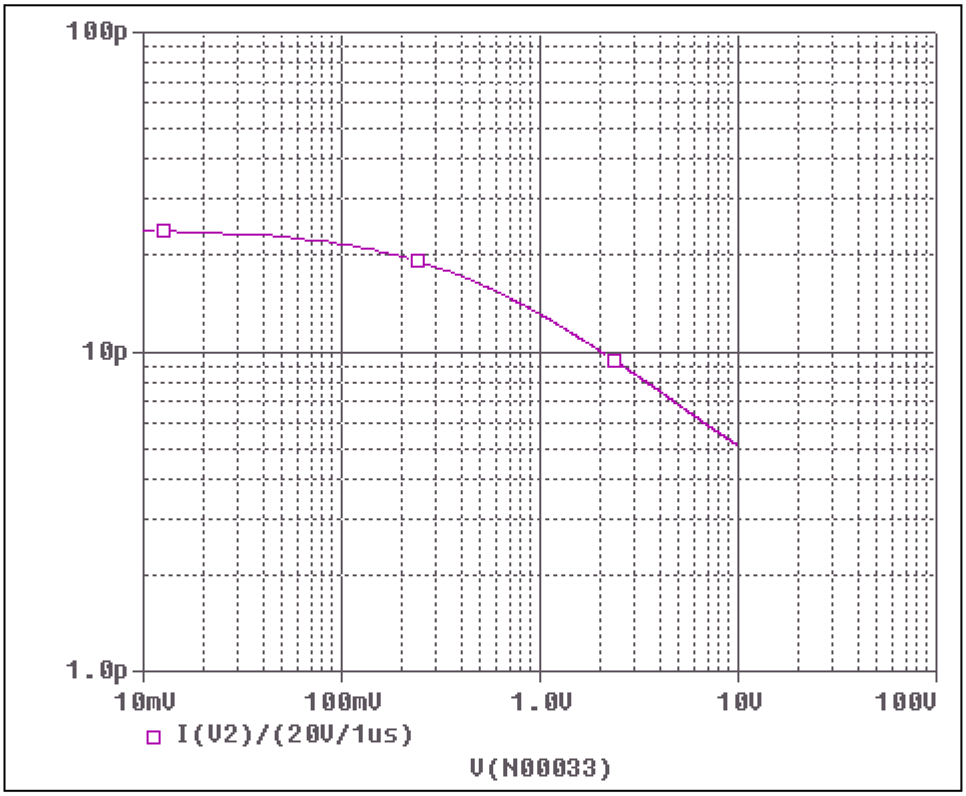
ß OR gm/DIV
353.mS

% of COLLECTOR PEAK VOLTS
0.0

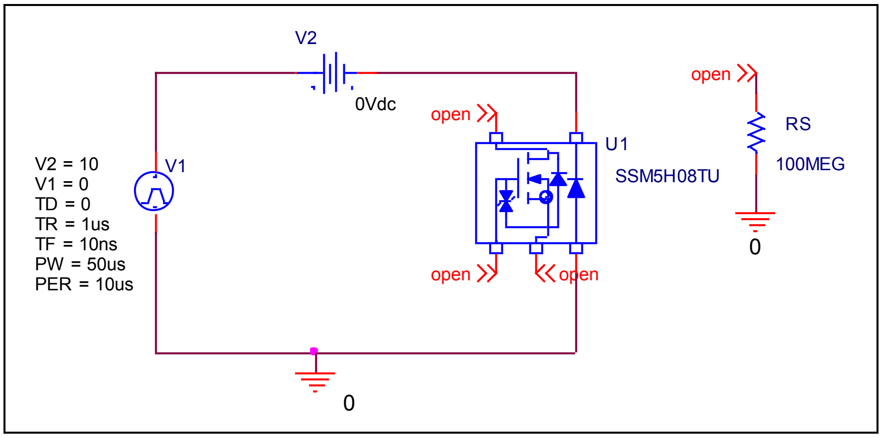
AUX SUPPLY
0.00 V

Junction Capacitance Characteristic

Circuit Simulation Result

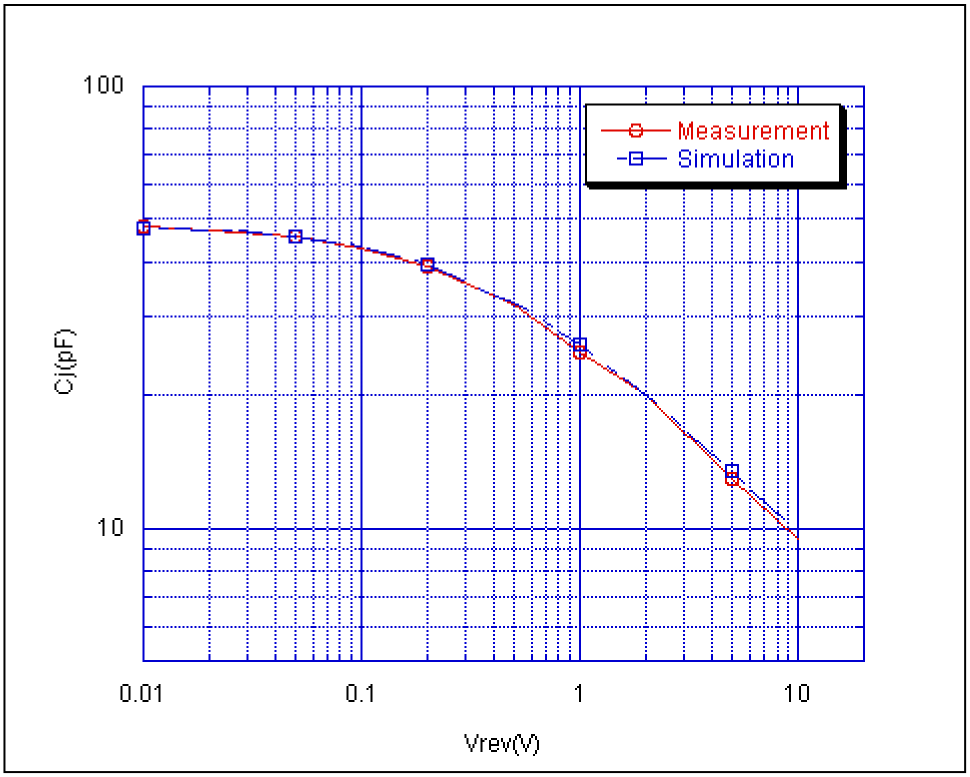


Evaluation Circuit



Comparison Graph

Circuit Simulation Result

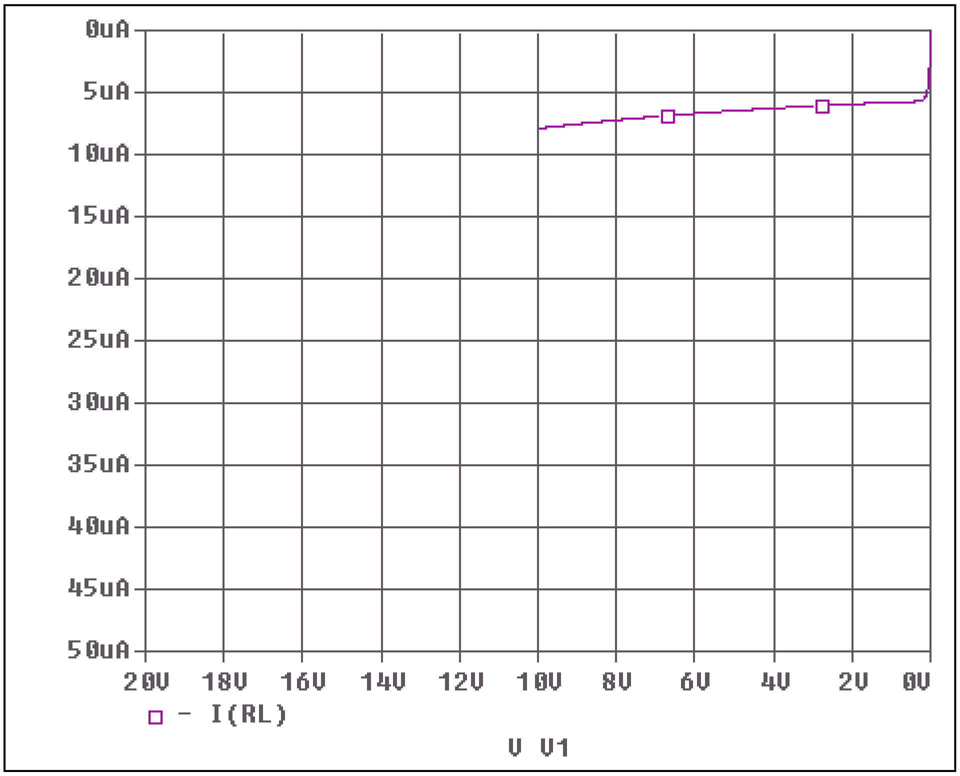


Simulation Result

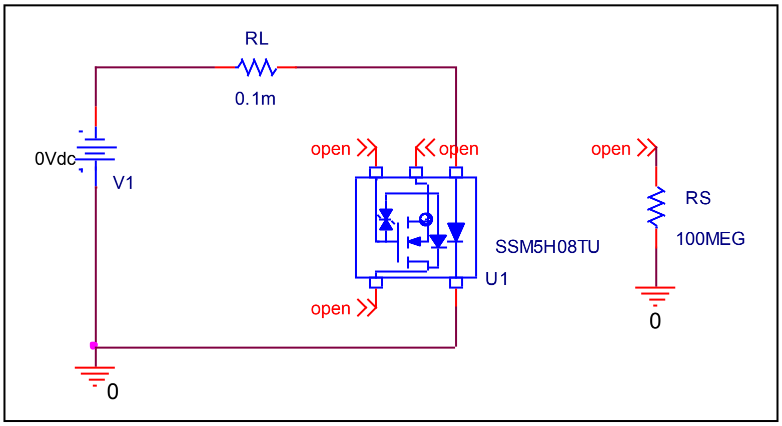
Vrev(V)	Cj(pF)		%Error
	Measurement	Simulation	
0.010	48.000	47.844	-0.325
0.020	47.000	47.377	0.802
0.050	45.500	45.864	0.800
0.100	43.000	43.573	1.333
0.200	39.000	39.690	1.769
0.500	32.000	32.453	1.416
1.000	25.000	26.085	4.340
2.000	20.000	20.018	0.090
5.000	13.000	13.457	3.515
10.000	9.500	9.841	3.589

Reverse Characteristic

Circuit Simulation Result

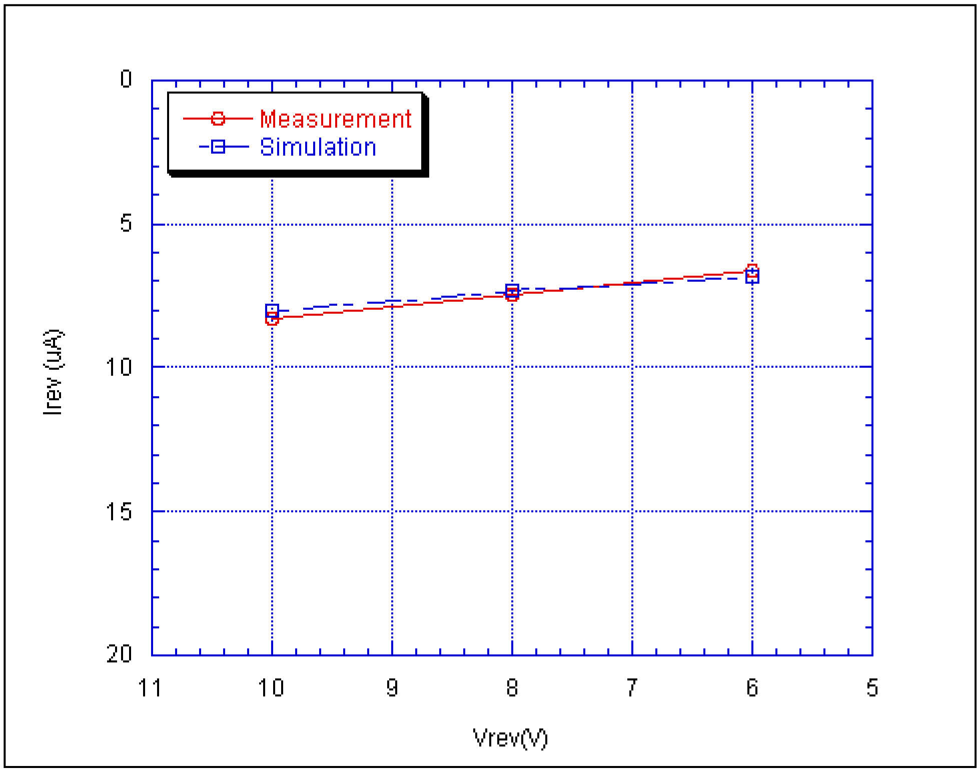


Evaluation Circuit



Comparison Graph

Circuit Simulation Result



Simulation Result

Vrev(V)	Irev (uA)		%Error
	Measurement	Simulation	
6.000	6.650	6.800	2.256
8.000	7.450	7.320	-1.745
10.000	8.300	8.000	-3.614

Reverse Current Characteristic Reference