Device Modeling Report

COMPONENTS: Power MOSFET (Model Parameters)
PART NUMBER: TPCA8104
MANUFACTURER: TOSHIBA
Body Diode (Model parameters) / ESD Protection Diode

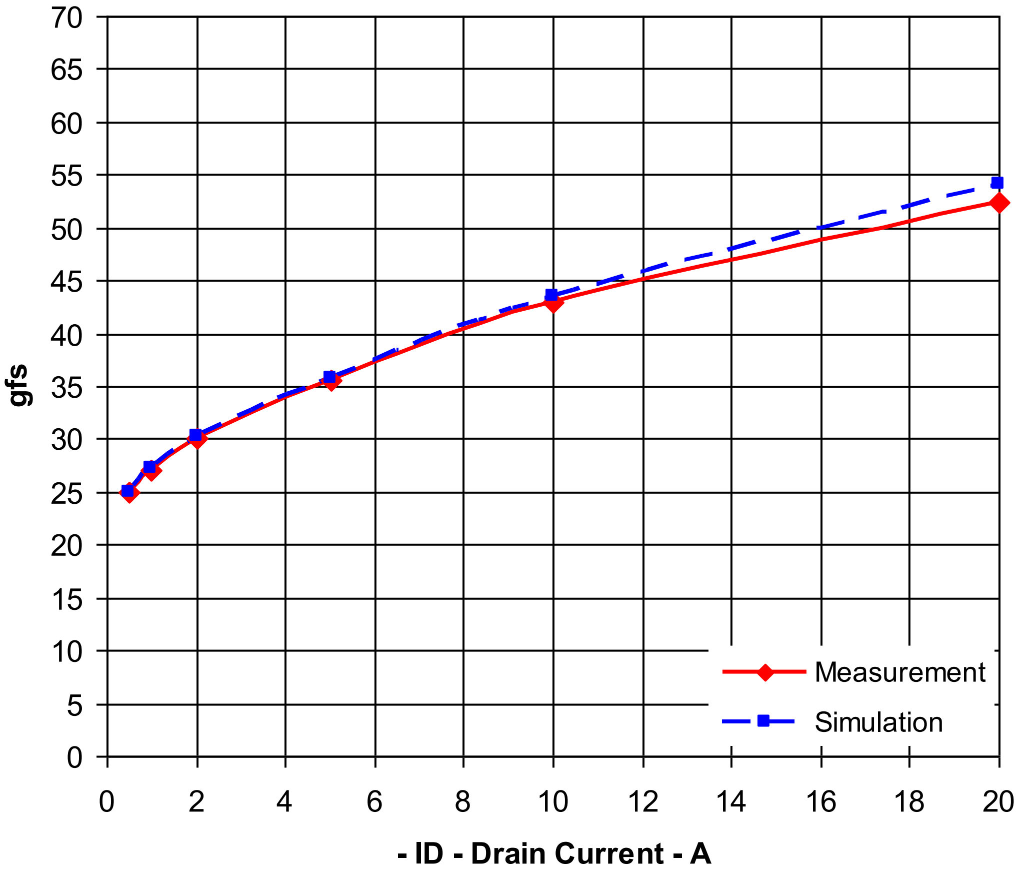
Bee Technologies Inc.

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

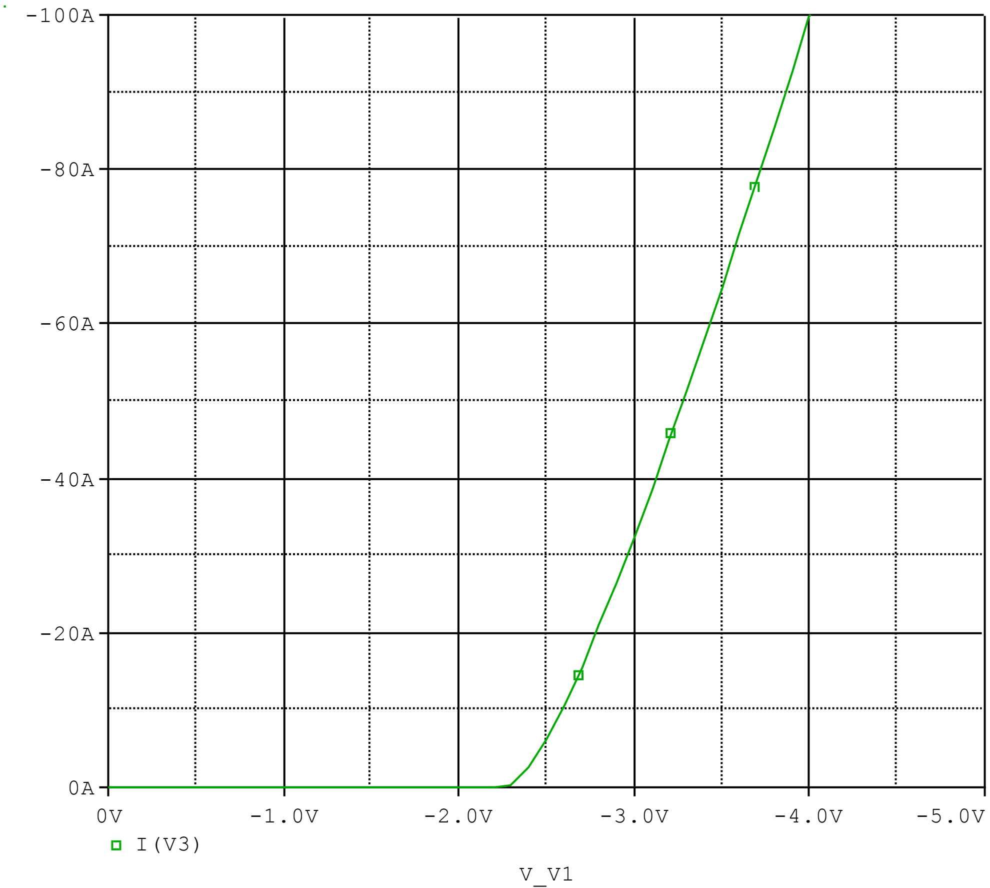


Comparison table

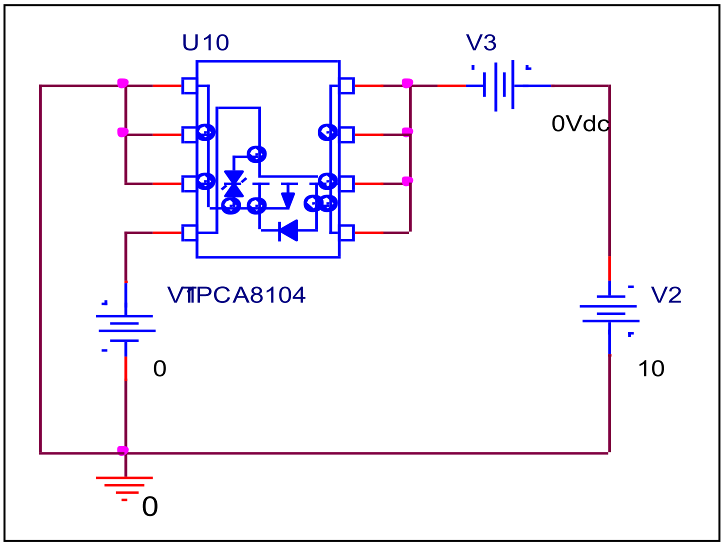
- Id(A)	gfs		Error(%)
	Measurement	Simulation	
0.5	25.000	25.000	0.000
1	27.000	27.333	1.233
2	30.000	30.333	1.110
5	35.500	35.714	0.603
10	43.000	43.455	1.058
20	52.500	54.054	2.960

Vgs-Id Characteristic

Circuit Simulation result



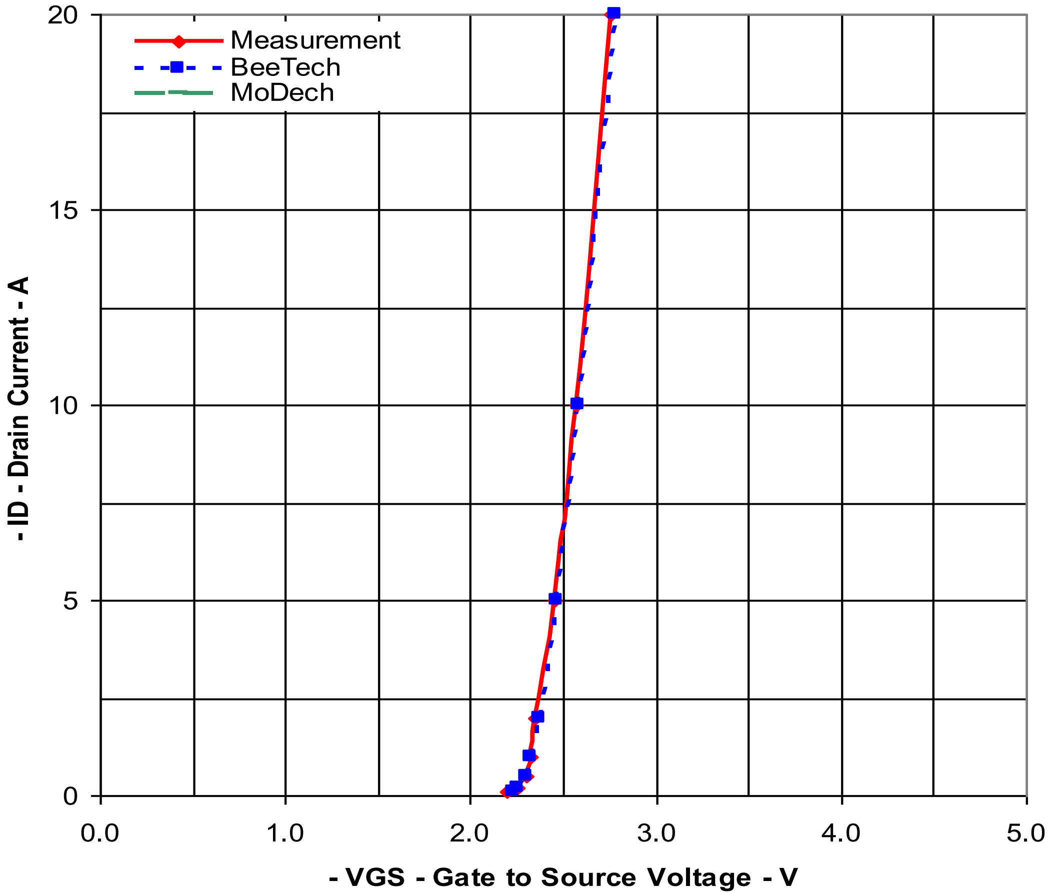
Evaluation circuit



All Rights Reserved Copyright (c) Bee Technologies Inc. 2006

Comparison Graph

Circuit Simulation Result

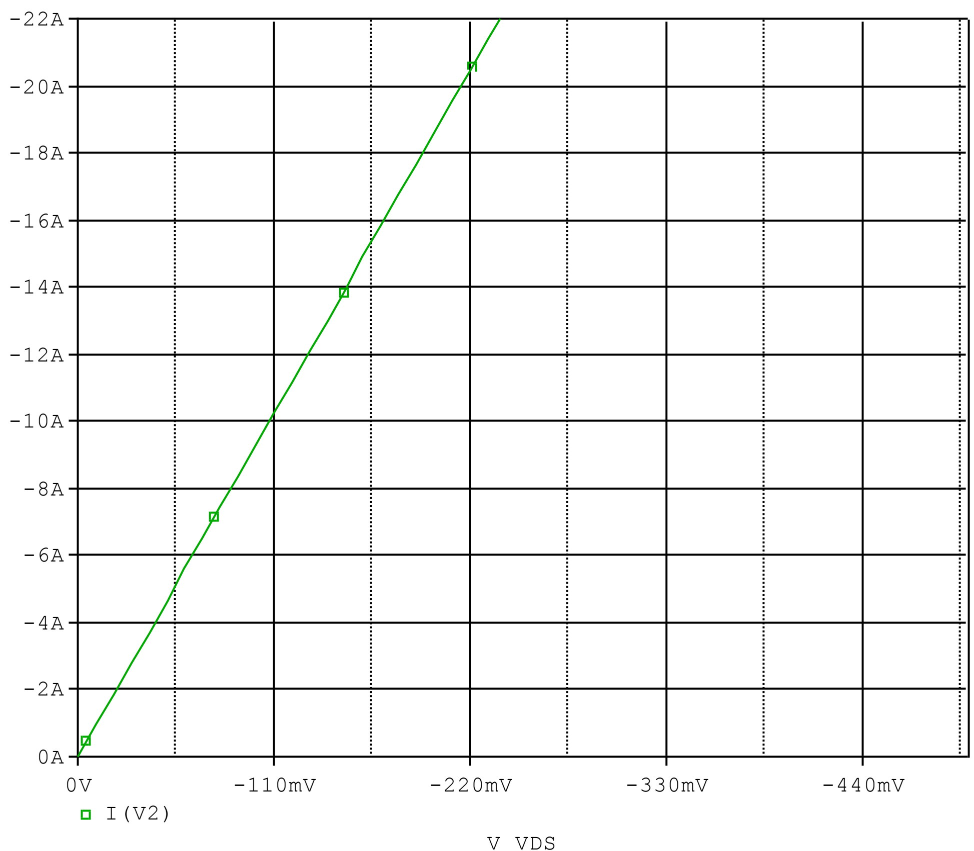


Simulation Result

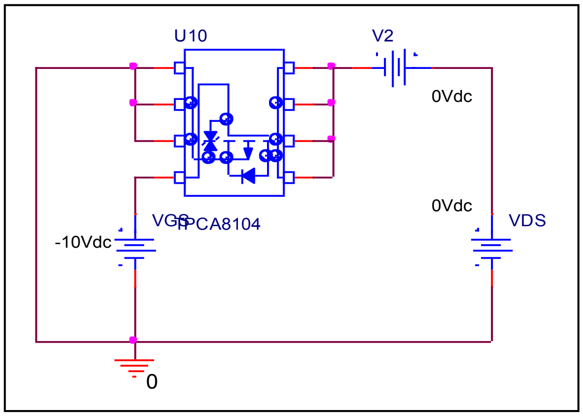
- I_D(A)	- V_{GS}(V)		Error (%)
	Measurement	**Simulation**	
0.1	**2.200**	**2.227**	**1.227**
0.2	**2.250**	**2.255**	**0.222**
0.5	**2.300**	**2.305**	**0.217**
1	**2.320**	**2.327**	**0.302**
2	**2.350**	**2.371**	**0.894**
5	**2.450**	**2.464**	**0.571**
10	**2.570**	**2.585**	**0.584**
20	**2.760**	**2.783**	**0.833**

Rds(on) Characteristic

Circuit Simulation result



Evaluation circuit

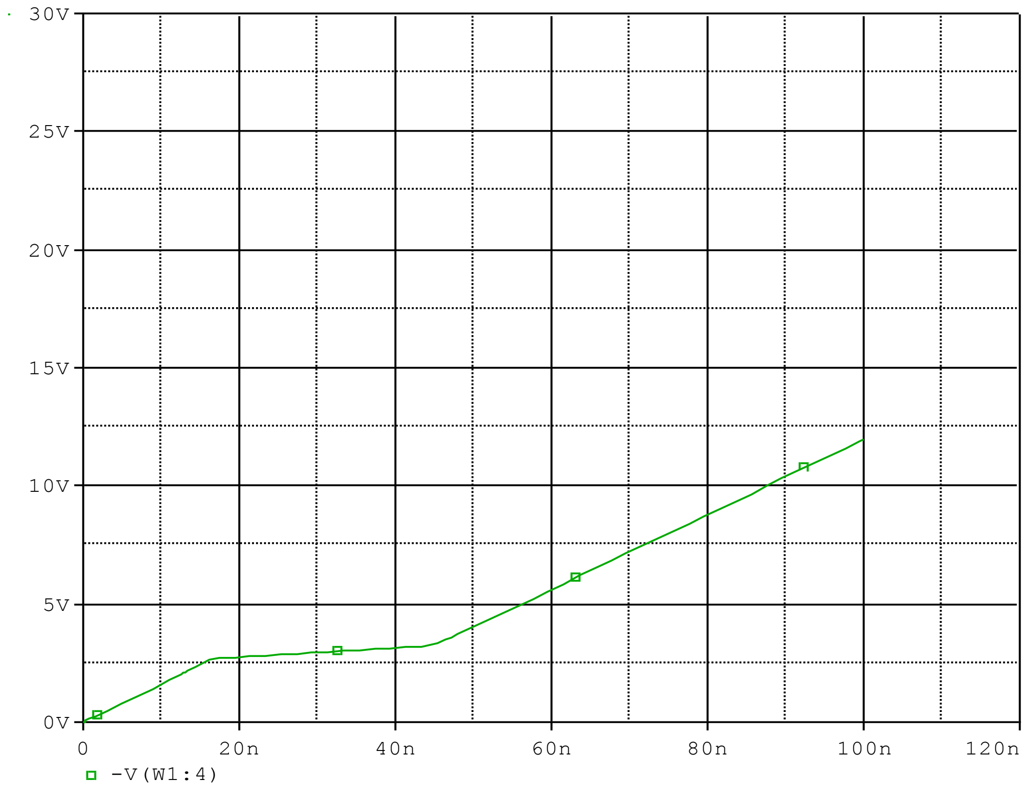


Simulation Result

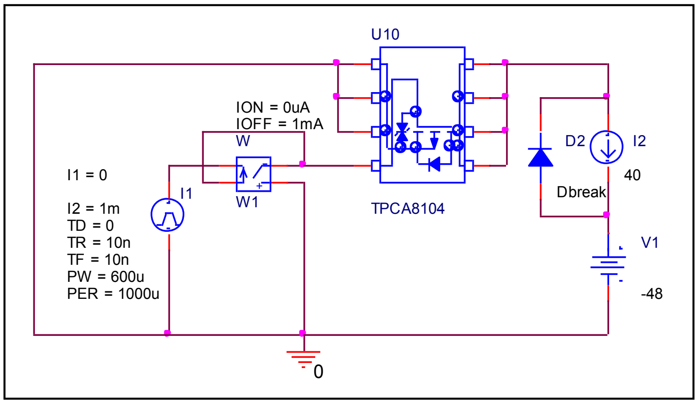
I_D=-20A, V_{GS}=-10V	Measurement	Simulation	Error (%)
R_{DS} (on)	0.011	0.0107	-2.707

Gate Charge Characteristic

Circuit Simulation result



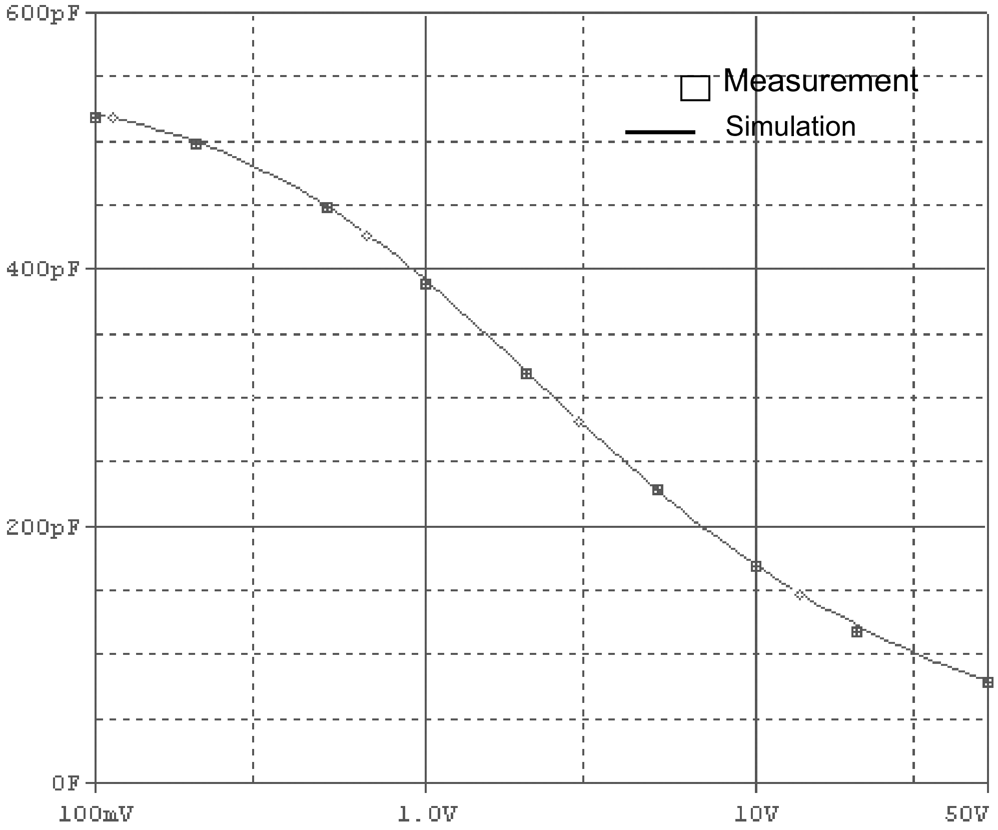
Evaluation circuit



Simulation Result

V_{DD}=-48V,I_D=-40A ,V_{GS}=-10V	Measurement	Simulation	Error (%)
Qgs(nC)	16.000	15.979	-0.131
Qgd(nC)	28.000	27.949	-0.182
Qg(nC)	90.000	87.946	-2.282

Capacitance Characteristic

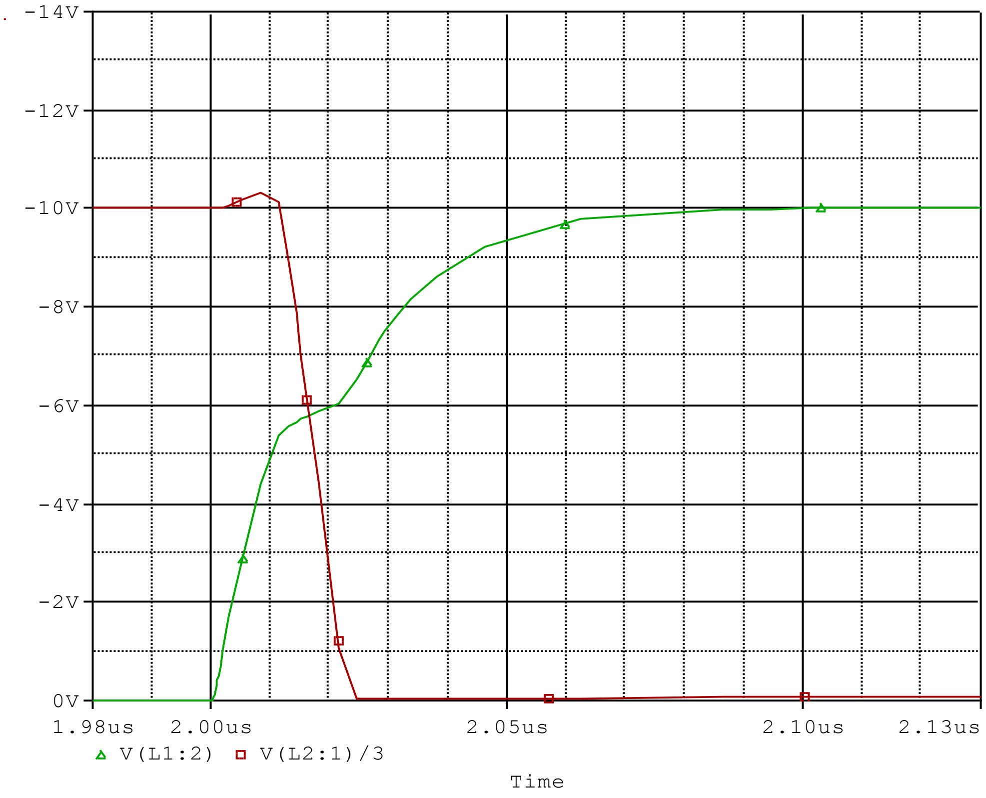


Simulation Result

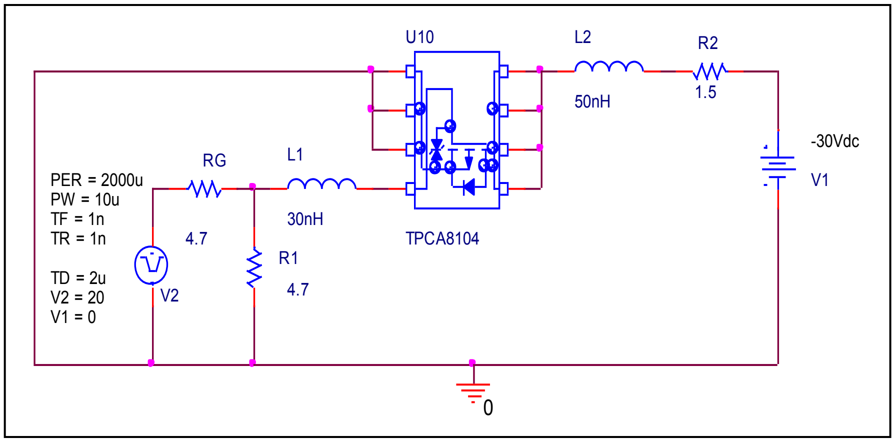
- V_{DS}(V)	Cbd(pF)		Error(%)
	Measurement	Simulation	
0.1	520.000	521.000	0.192
0.2	500.000	500.000	0.000
0.5	450.000	450.400	0.089
1	390.000	391.000	0.256
2	320.000	320.000	0.000
5	230.000	230.000	0.000
10	170.000	170.000	0.000
20	120.000	122.000	1.667
50	80.000	80.000	0.000

Switching Time Characteristic

Circuit Simulation result



Evaluation circuit

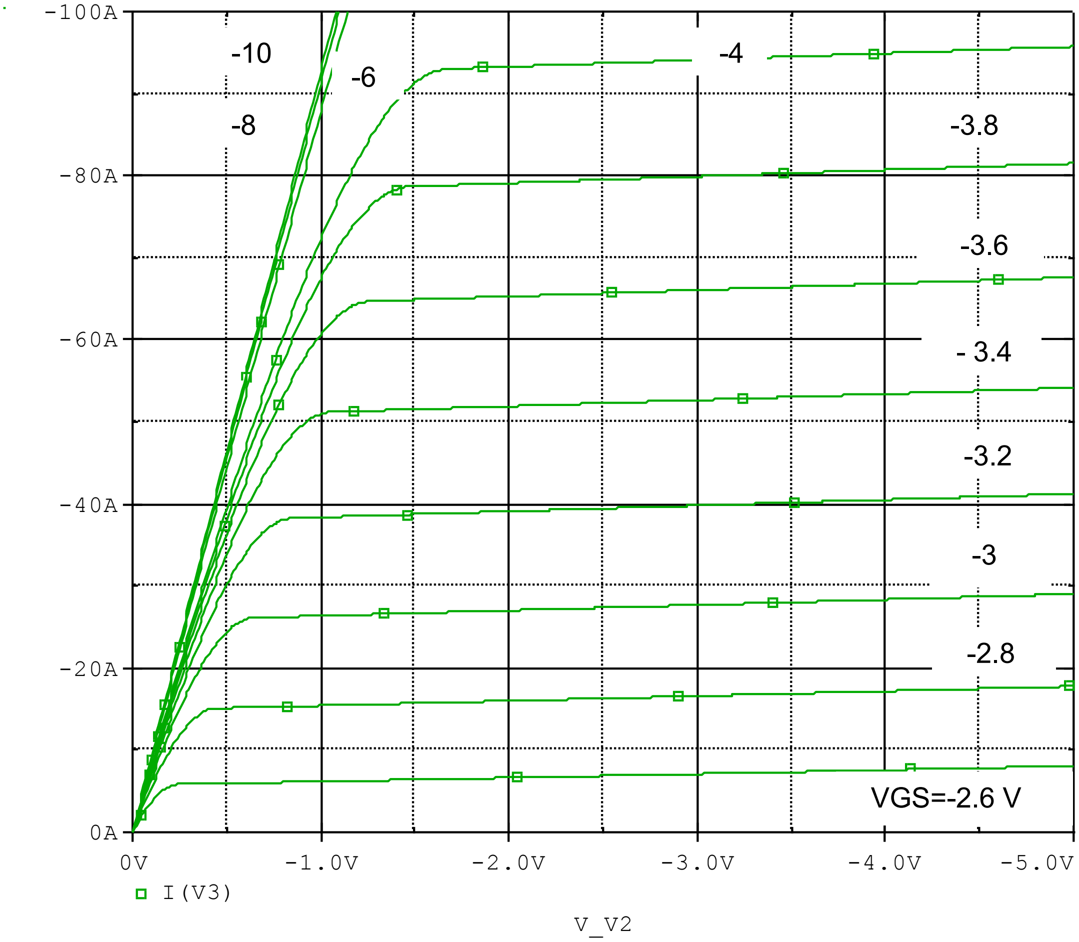


Simulation Result

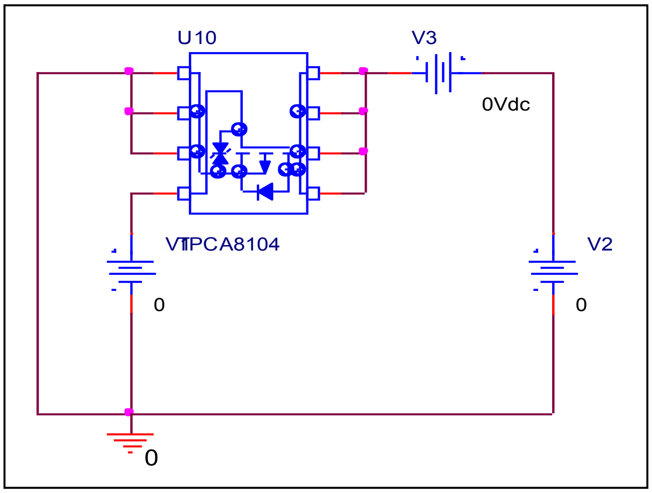
I_D=-20A, V_{DD}=-300V V_{GS}=0/-10V	Measurement	Simulation	Error(%)
Ton(ns)	20.000	19.949	-0.255

Output Characteristic

Circuit Simulation result

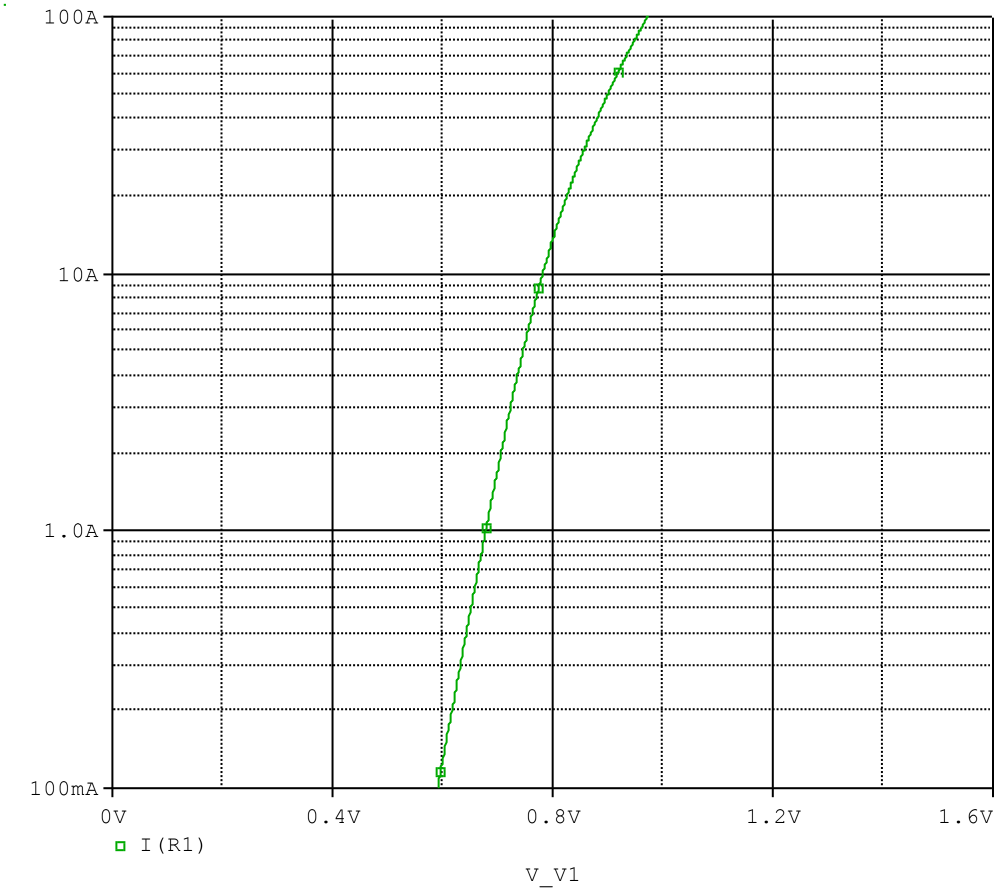


Evaluation circuit

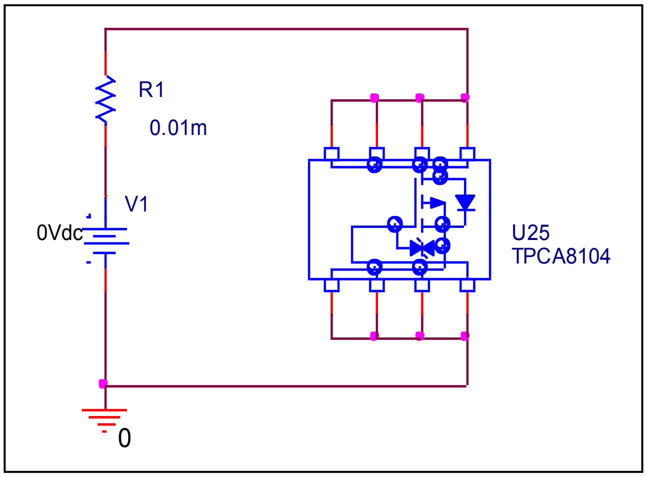


BODY DIODE
Forward Current Characteristic

Circuit Simulation Result

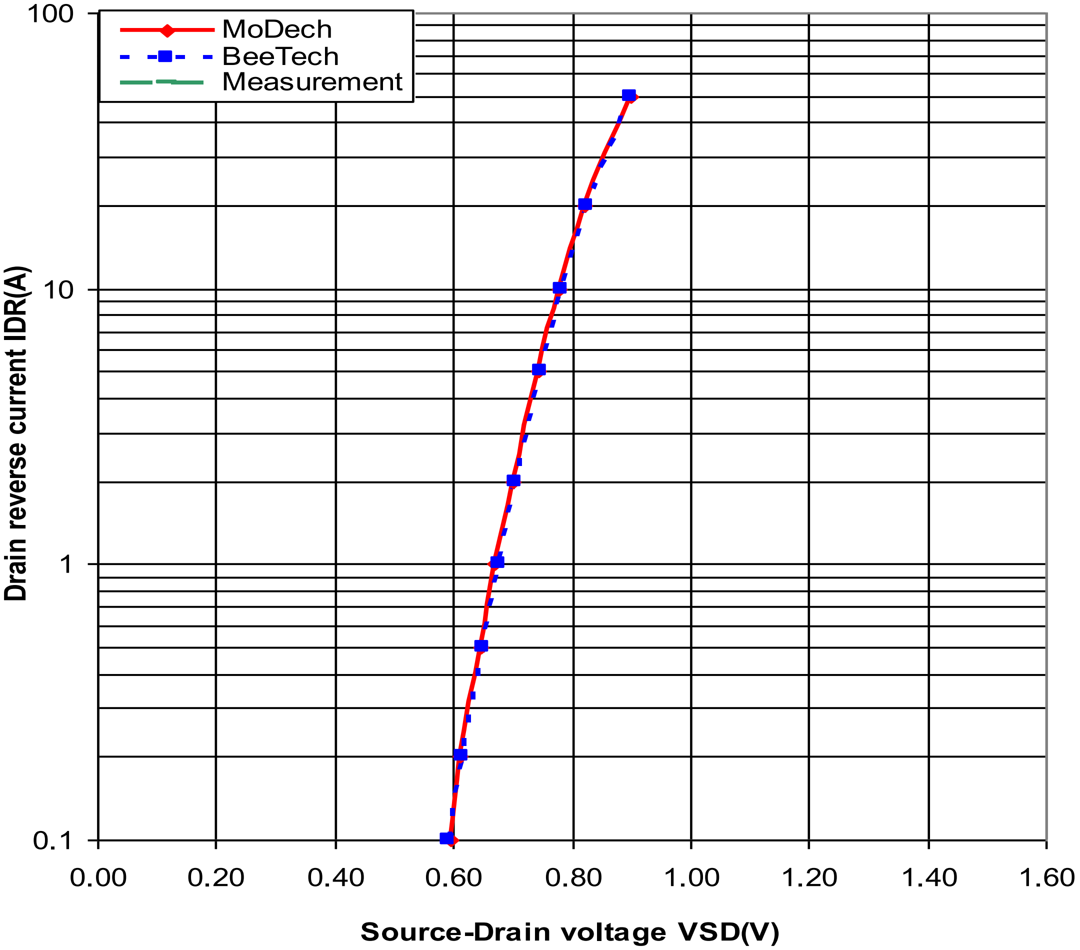


Evaluation Circuit



Comparison Graph

Circuit Simulation Result

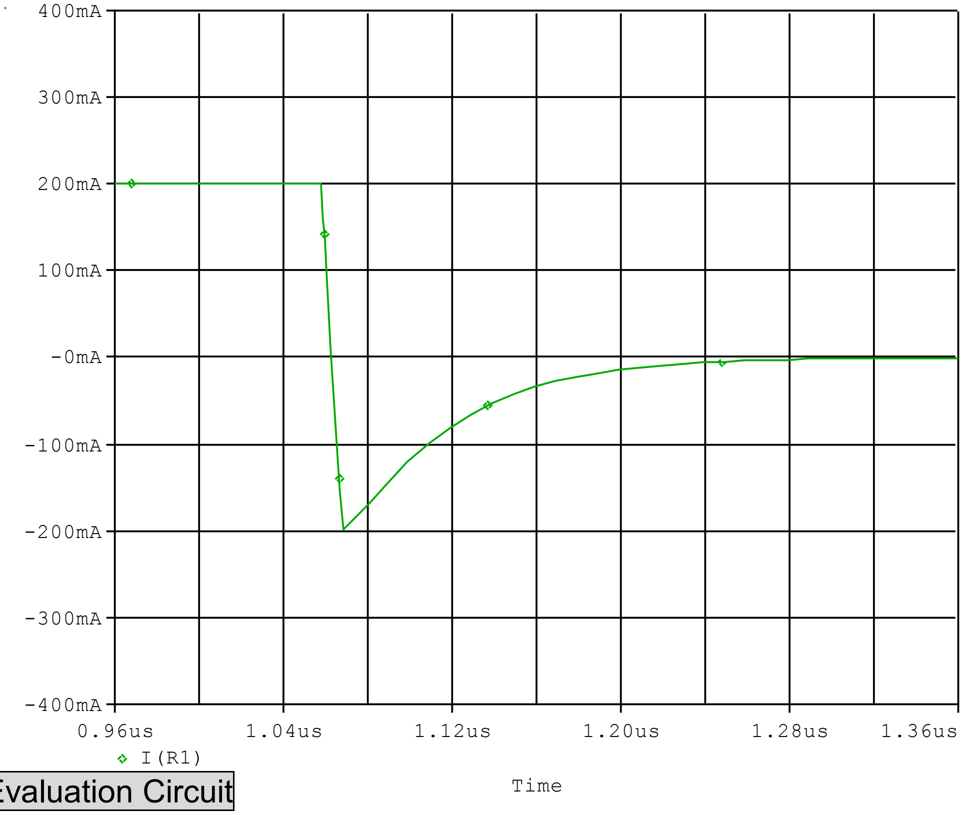


Simulation Result

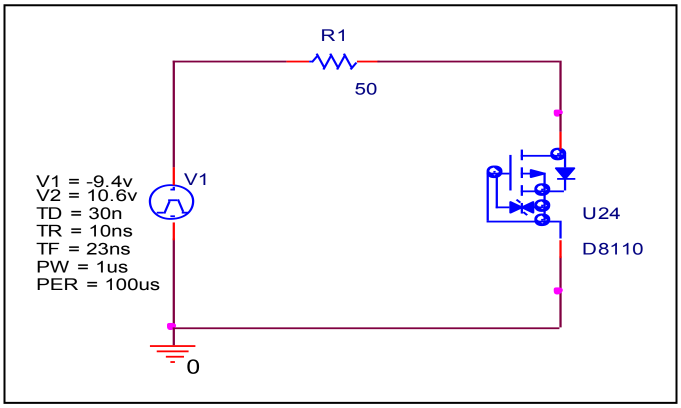
IDR(A)	VSD(V)		%Error
	Measuremen	Simulation	
0.1	0.595	0.590	-0.840
0.2	0.610	0.616	0.984
0.5	0.645	0.651	0.930
1	0.670	0.678	1.194
2	0.700	0.705	0.714
5	0.745	0.746	0.134
10	0.780	0.781	0.128
20	0.820	0.825	0.610
50	0.900	0.900	0.000

Reverse Recovery Characteristic

Circuit Simulation Result



Evaluation Circuit

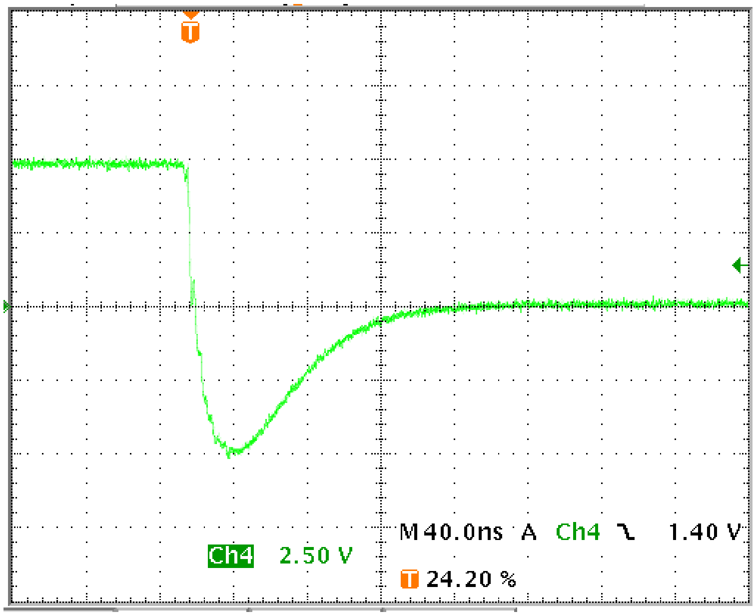


Compare Measurement vs. Simulation

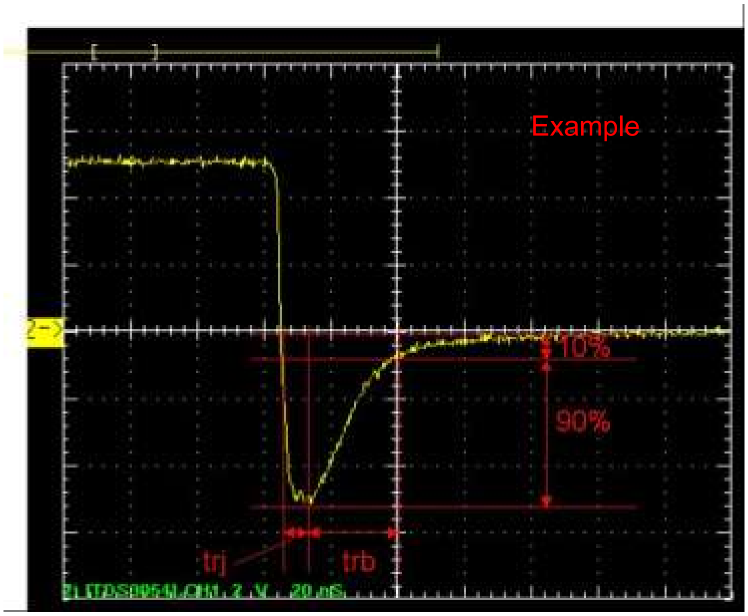
Trr	Measurement	Simulation	Error (%)
Trj+Trb(ns)	83.000	86.846	4.634

Reverse Recovery Characteristic

Reference



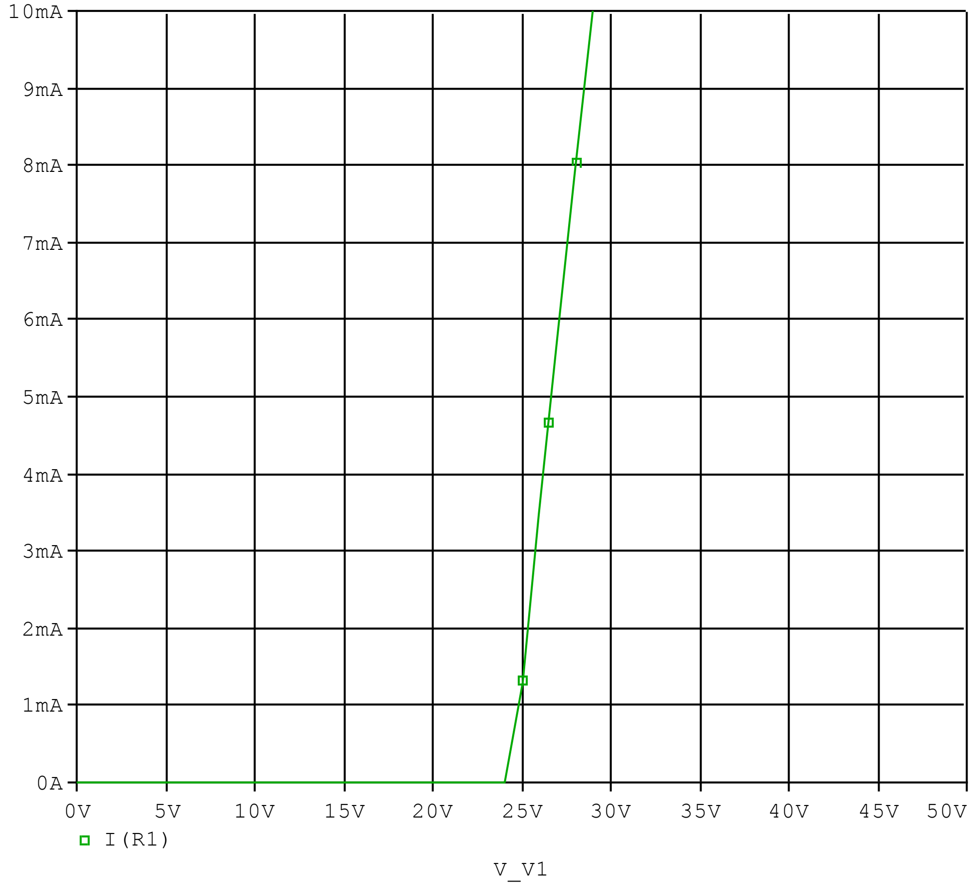
Trj=14(ns)
Trb=69(ns)
Conditions:Ifwd=Irev=0.2(A),Rl=50



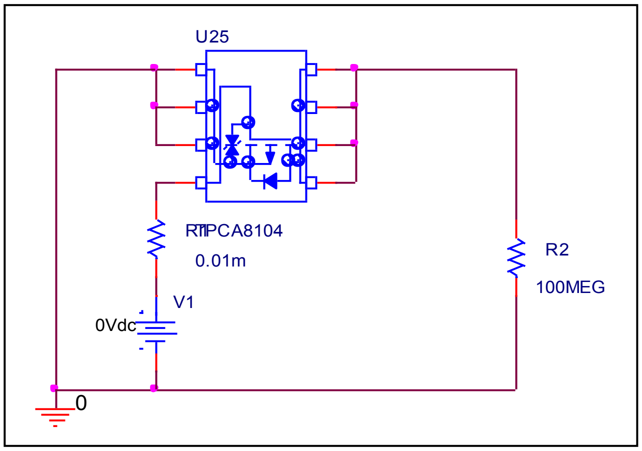
Relation between trj and trb

ESD PROTECTION DIODE
Zener Voltage Characteristic

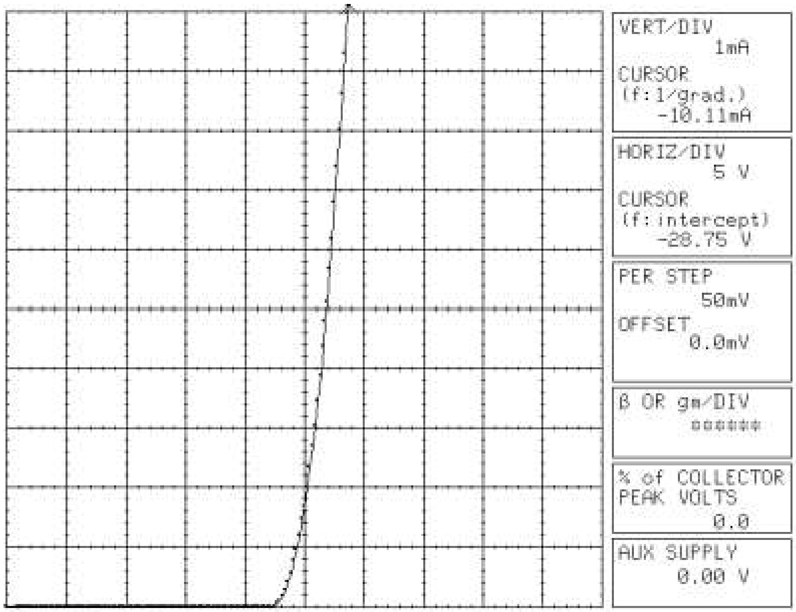
Circuit Simulation Result



Evaluation Circuit



Zener Voltage Characteristic Reference


VERT/DIV
1mA
CURSOR
(f:1/grad.)
-10.11mA

HORIZ/DIV
5 V
CURSOR
(f:intercept)
-28.75 V

PER STEP
50mV
OFFSET
0.0mV

β OR gm/DIV
******

% of COLLECTOR
PEAK VOLTS
0.0

AUX SUPPLY
0.00 V