Device Modeling Report

COMPONENTS: Power MOSFET (Professional)
PART NUMBER: TPCA8011-H
MANUFACTURER: TOSHIBA
Body Diode (Professional) / ESD Protection Diode

Bee Technologies

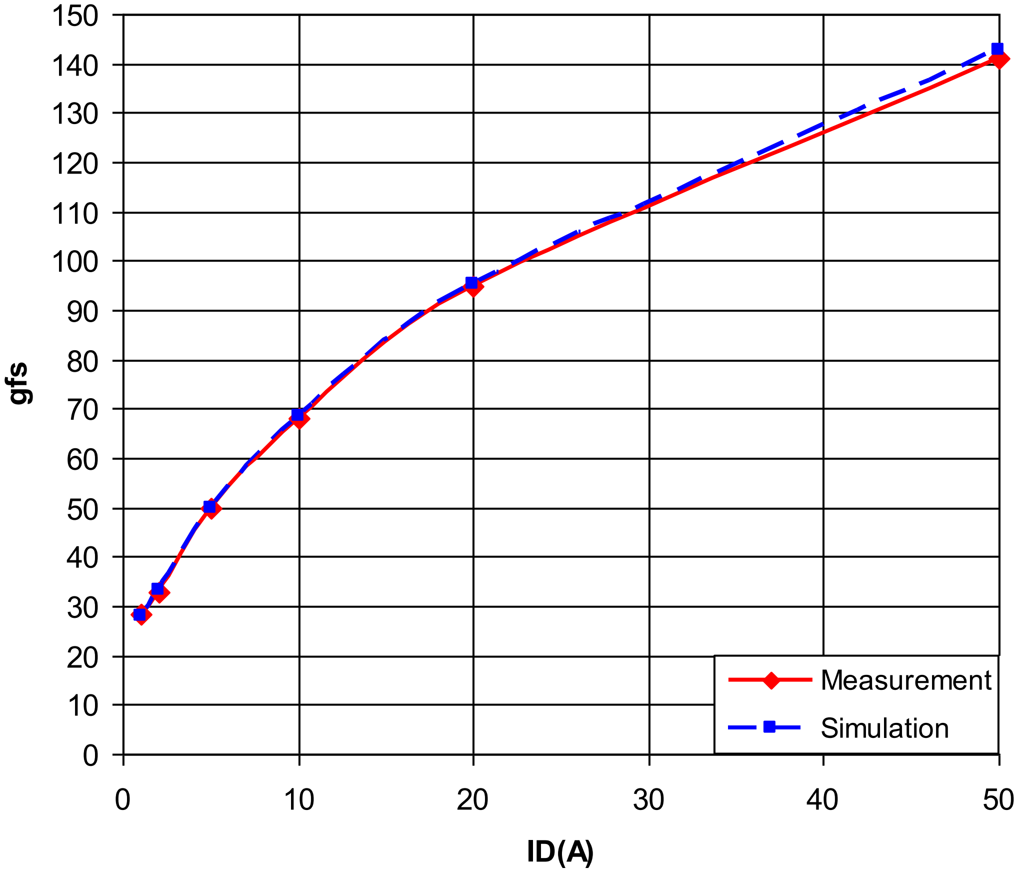
Bee Technologies Inc.

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

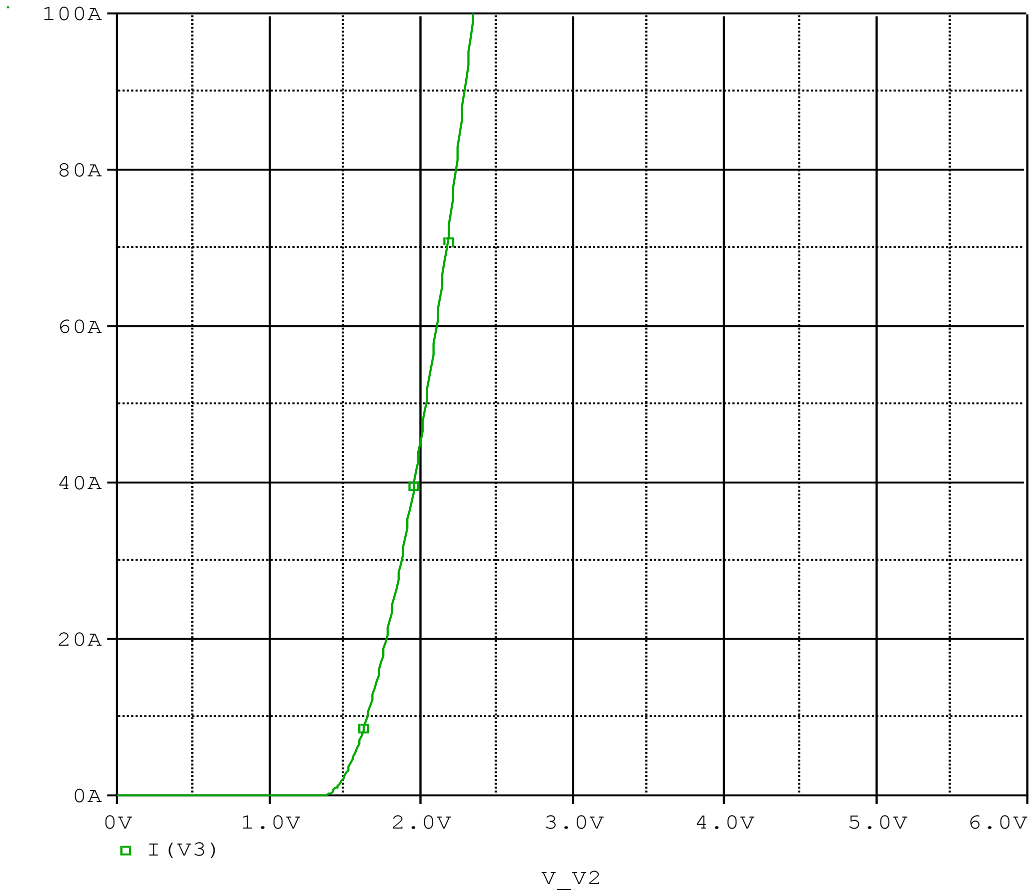


Comparison table

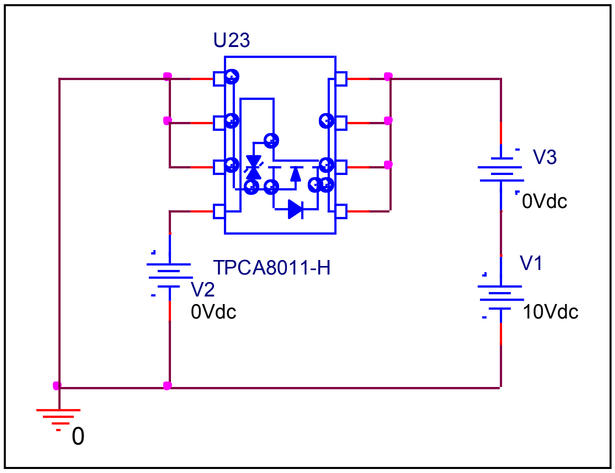
Id(A)	gfs		Error(%)
	Measurement	Simulation	
1	28.500	28.000	-1.754
2	33.000	33.333	1.010
5	50.000	50.000	0.000
10	68.000	68.667	0.980
20	95.000	95.238	0.251
50	141.000	142.857	1.317

Vgs-Id Characteristic

Circuit Simulation result

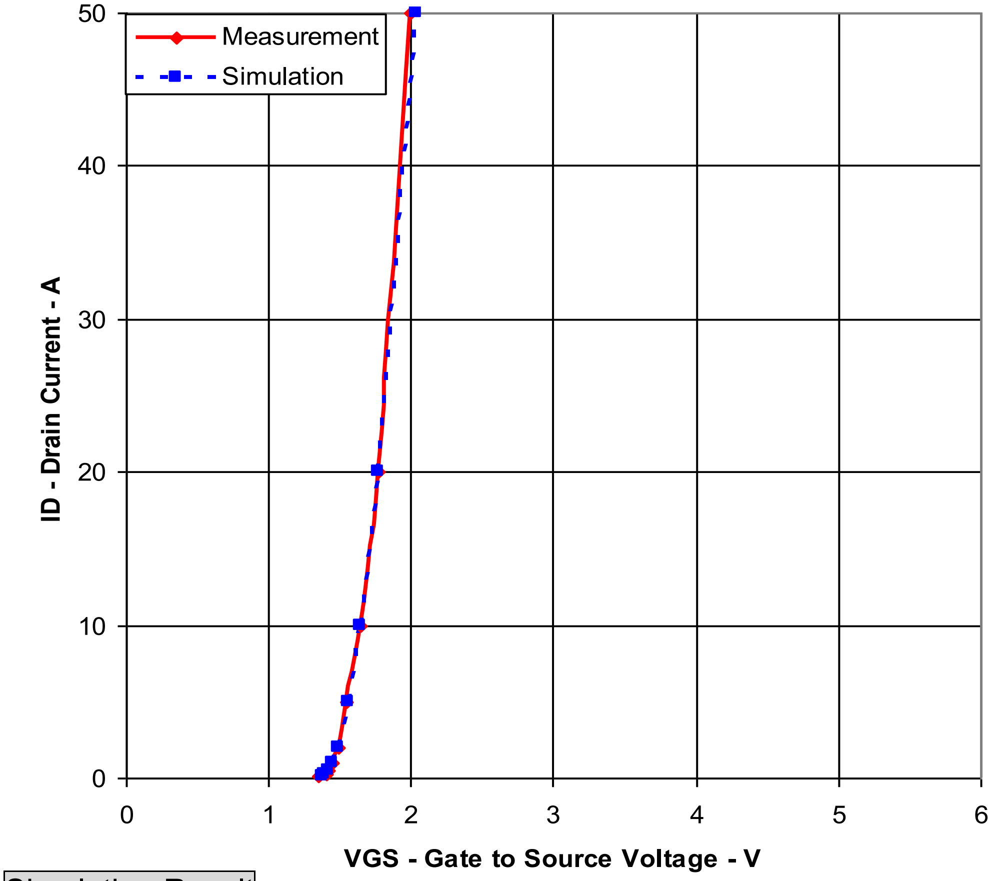


Evaluation circuit



Comparison Graph

Circuit Simulation Result

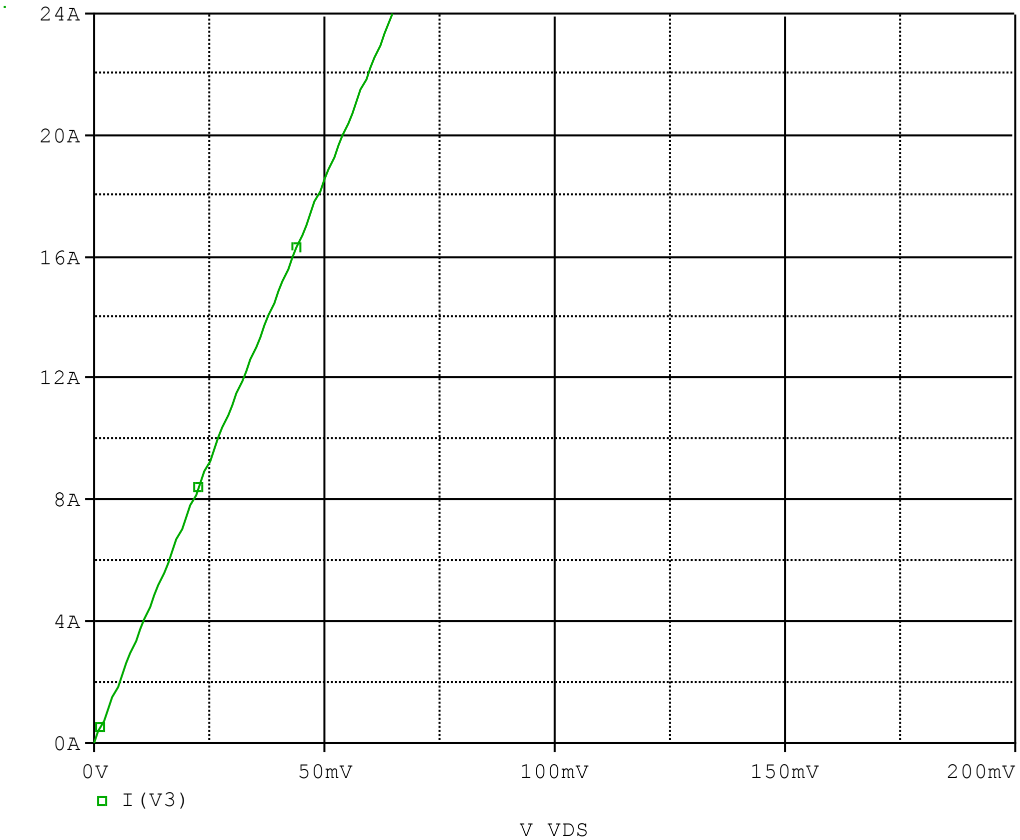


Simulation Result

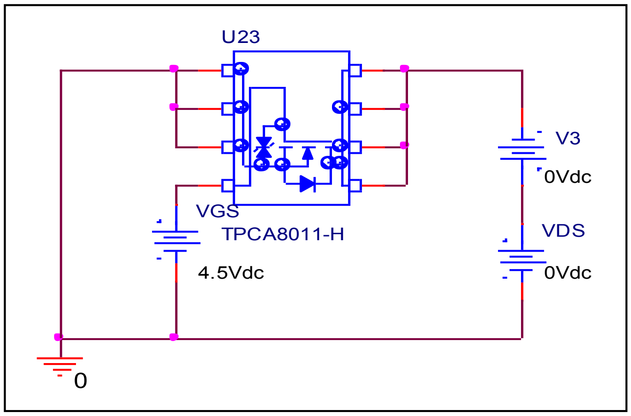
I_D(A)	V_{GS}(V)		Error (%)
	Measurement	Simulation	
0.1	1.350	1.384	2.519
0.2	1.400	1.397	-0.214
0.5	1.420	1.420	0.000
1	1.450	1.446	-0.276
2	1.490	1.484	-0.403
5	1.550	1.560	0.645
10	1.650	1.647	-0.182
20	1.770	1.774	0.226
50	2.000	2.036	1.800

Rds(on) Characteristic

Circuit Simulation result



Evaluation circuit

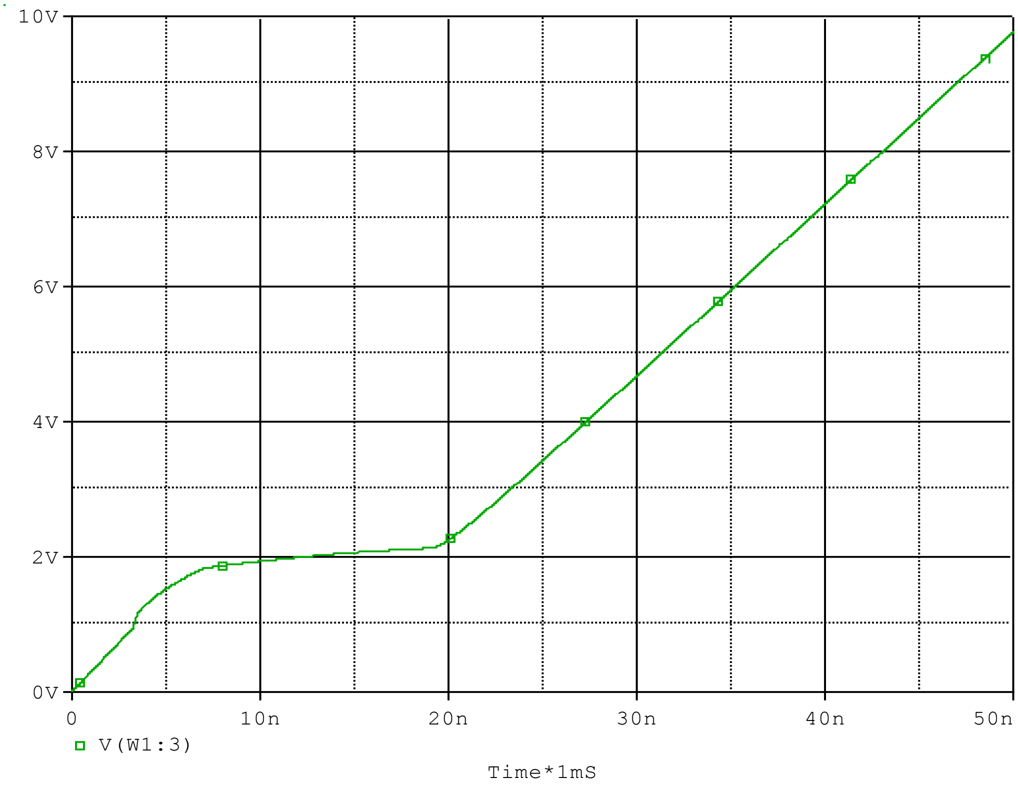


Simulation Result

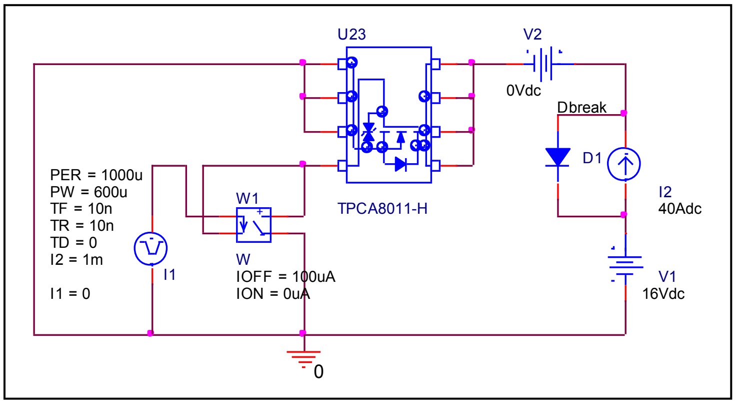
I_D=20A, V_{GS}=10V	Measurement		Simulation		Error (%)
R_{DS} (on)	2.700	mΩ	2.698	mΩ	-0.074

Gate Charge Characteristic

Circuit Simulation result



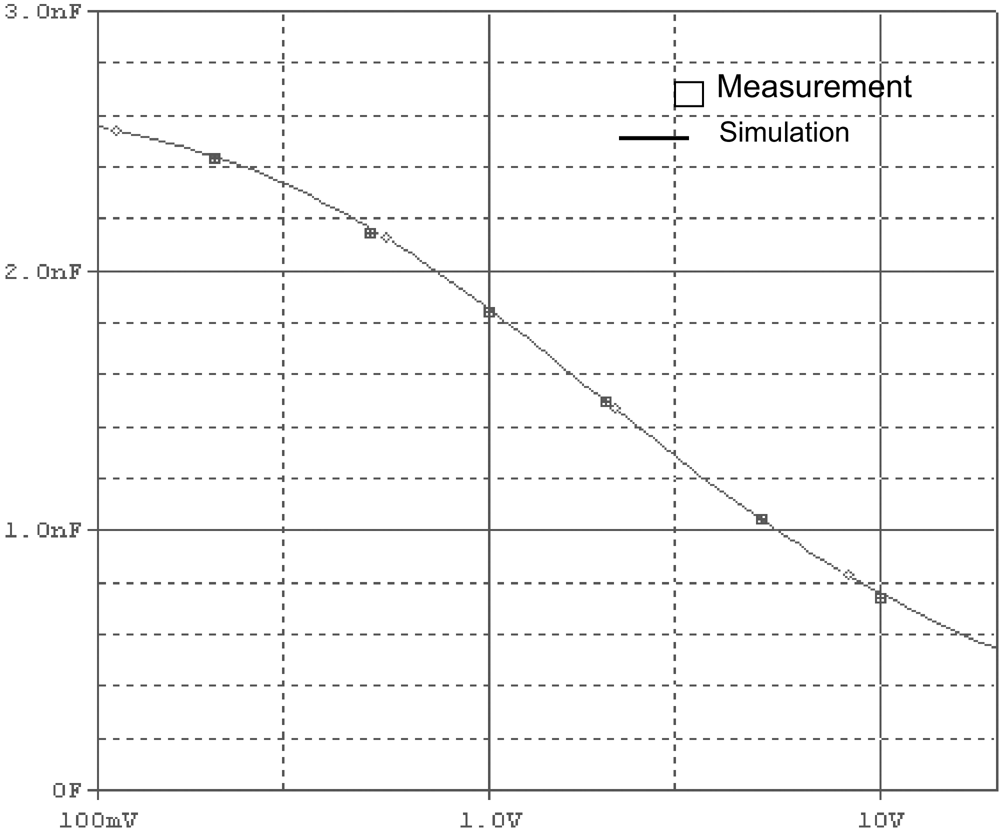
Evaluation circuit



Simulation Result

V_{DD}=16V,I_D=40A ,V_{GS}=5V	Measurement	Simulation	Error (%)
Qgs(nC)	7.700	7.684	-0.208
Qgd(nC)	11.000	11.053	0.482
Qg	32.000	31.368	-1.975

Capacitance Characteristic

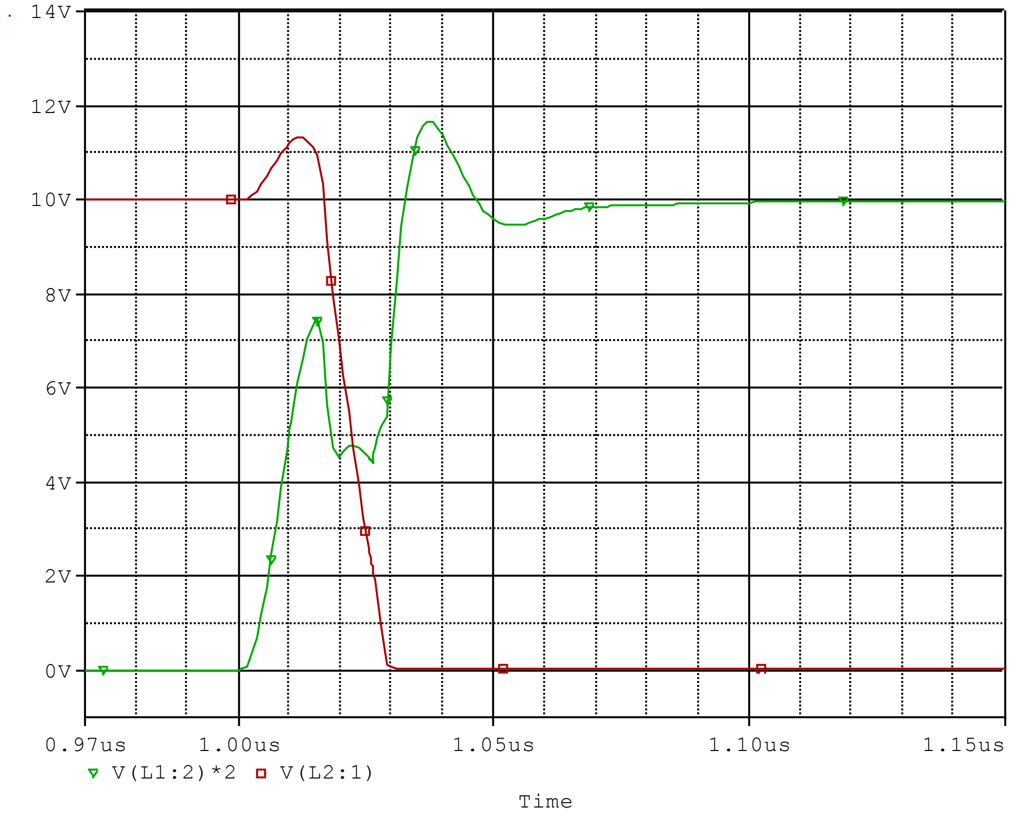


Simulation Result

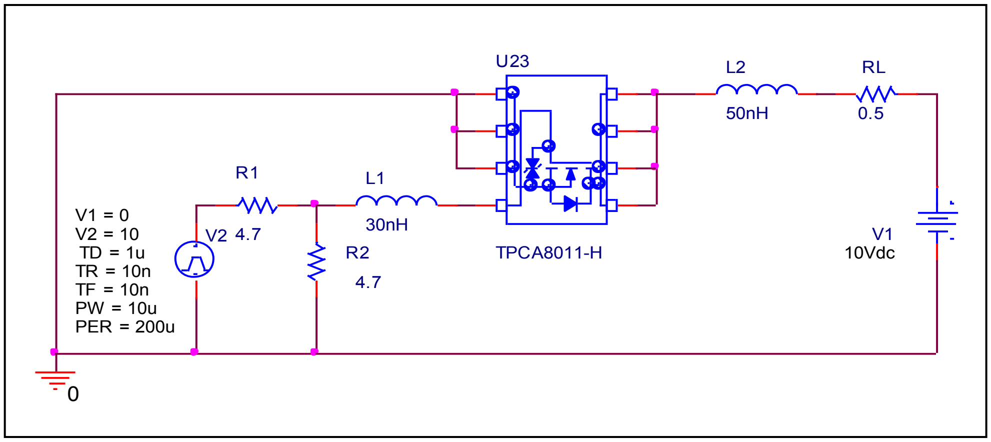
V_{DS}(V)	Cbd(pF)		Error(%)
	Measurement	**Simulation**	
0.2	**2440**	**2445**	**0.205**
0.5	**2130**	**2150**	**0.939**
1	**1820**	**1850**	**1.648**
2	**1480**	**1500**	**1.351**
5	**1050**	**1050**	**0.000**
10	**750**	**750**	**0.000**
20	**550**	**540**	**-1.818**

Switching Time Characteristic

Circuit Simulation result



Evaluation circuit

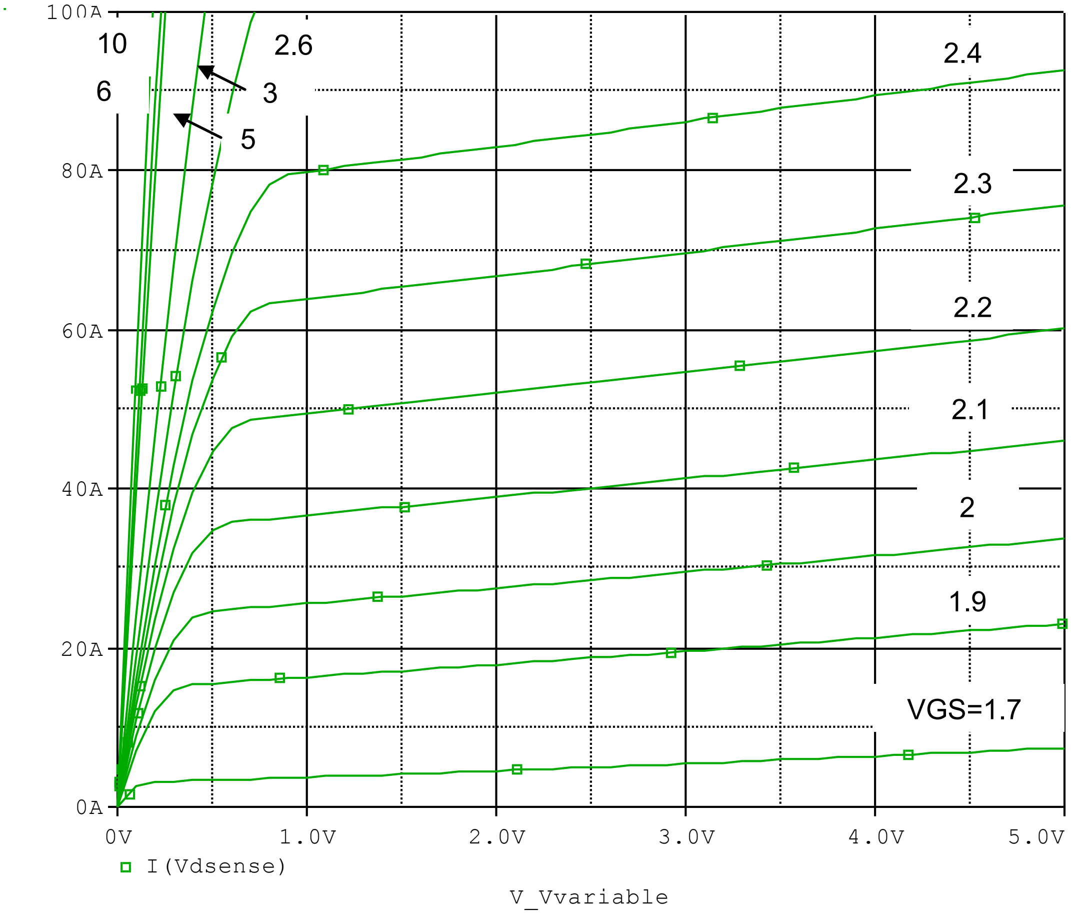


Simulation Result

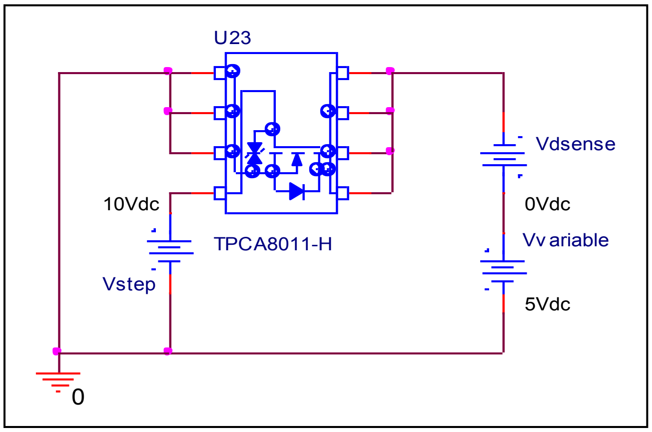
I_D=20 A, V_{DD}=15V V_{GS}=0/10V	Measurement	Simulation	Error(%)
Ton(ns)	24.000	23.722	-1.158

Output Characteristic

Circuit Simulation result

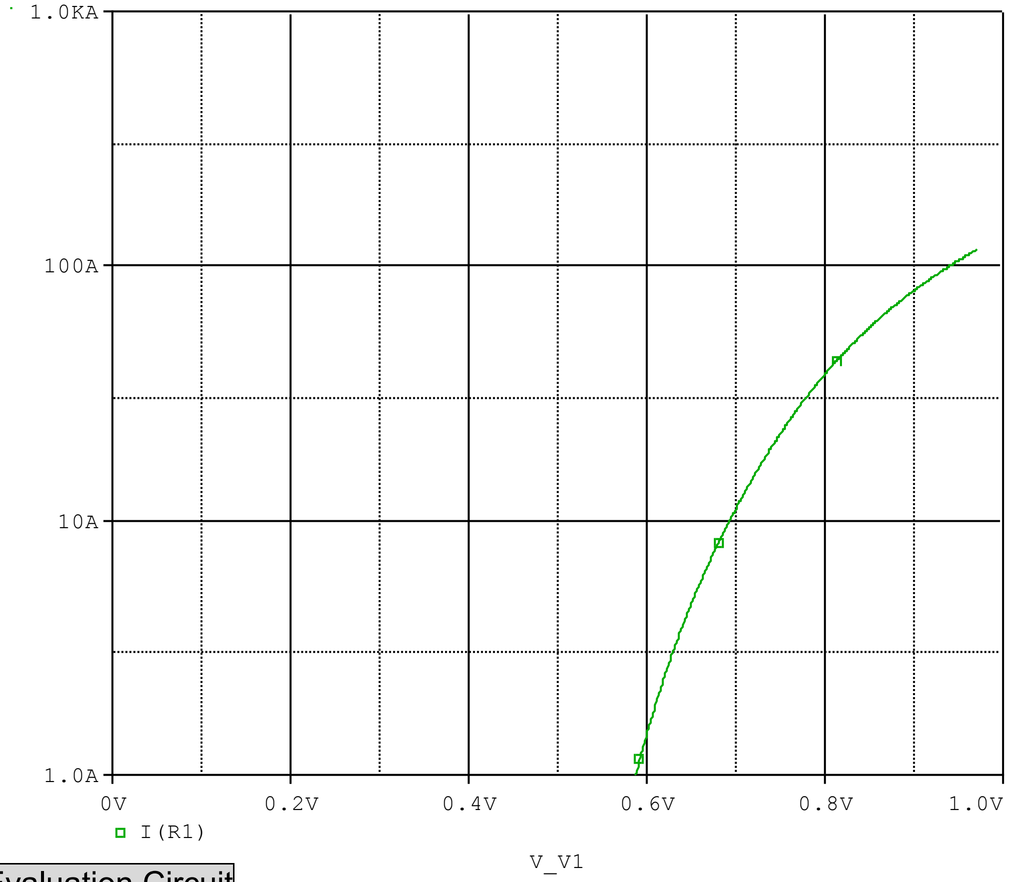


Evaluation circuit

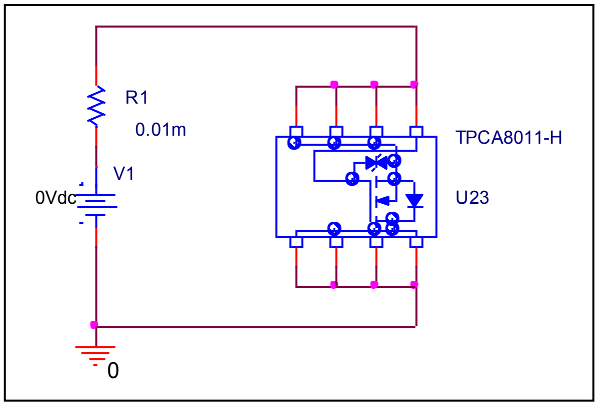


Forward Current Characteristic

Circuit Simulation Result

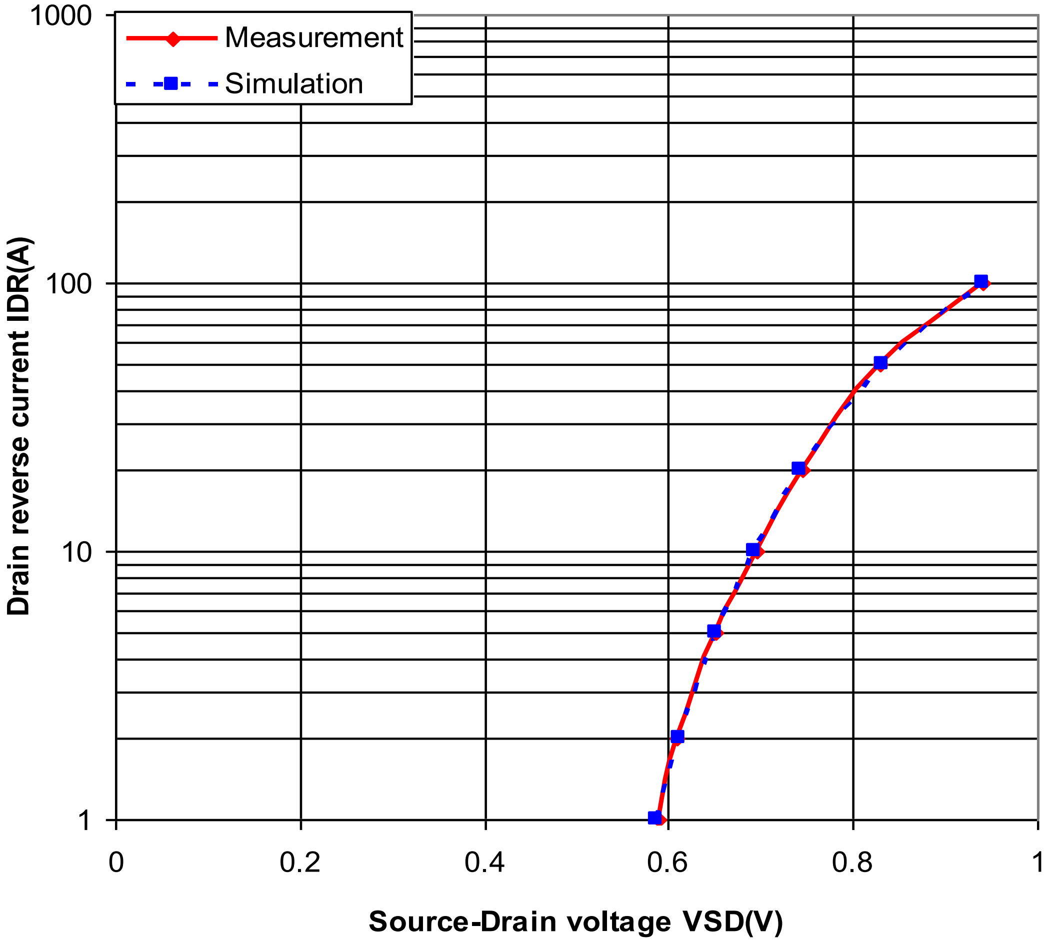


Evaluation Circuit



Comparison Graph

Circuit Simulation Result

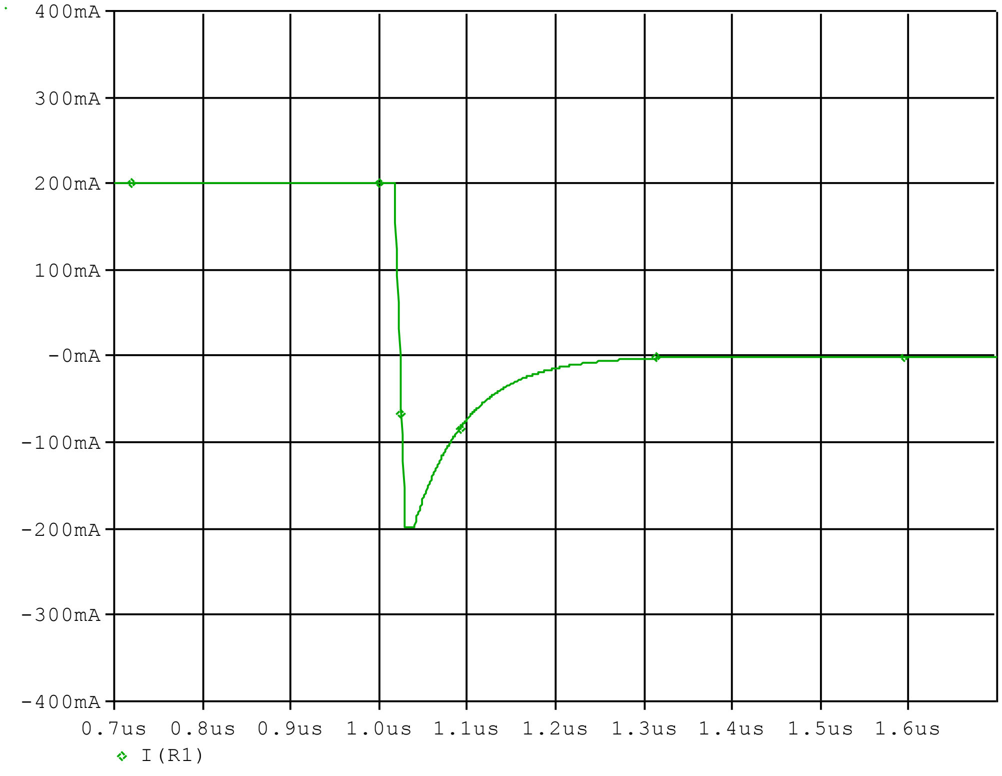


Simulation Result

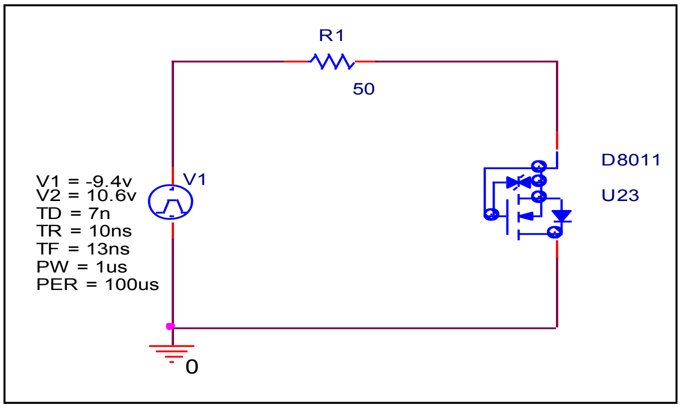
IDR(A)	VSD(V)		%Error
	Measuremen	Simulation	
1	0.590	0.587	-0.508
2	0.610	0.611	0.164
5	0.650	0.652	0.308
10	0.695	0.693	-0.288
20	0.745	0.742	-0.403
50	0.830	0.832	0.241

Reverse Recovery Characteristic

Circuit Simulation Result



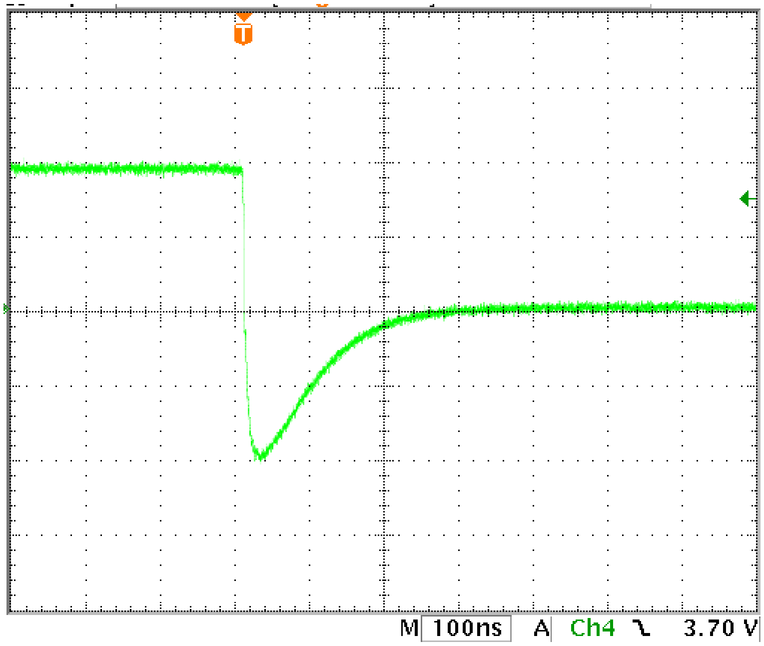
Evaluation Circuit



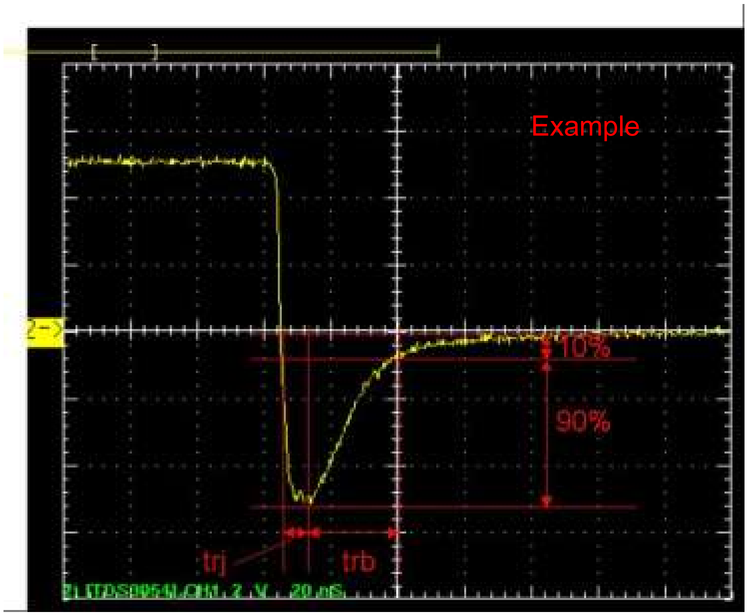
Compare Measurement vs. Simulation

	Measurement	Simulation	Error (%)
Trj(ns)	16.500	16.542	0.255
Trb(ns)	140.000	138.301	-1.214
Trr(ns)	156.500	154.843	-1.059

Reverse Recovery Characteristic Reference



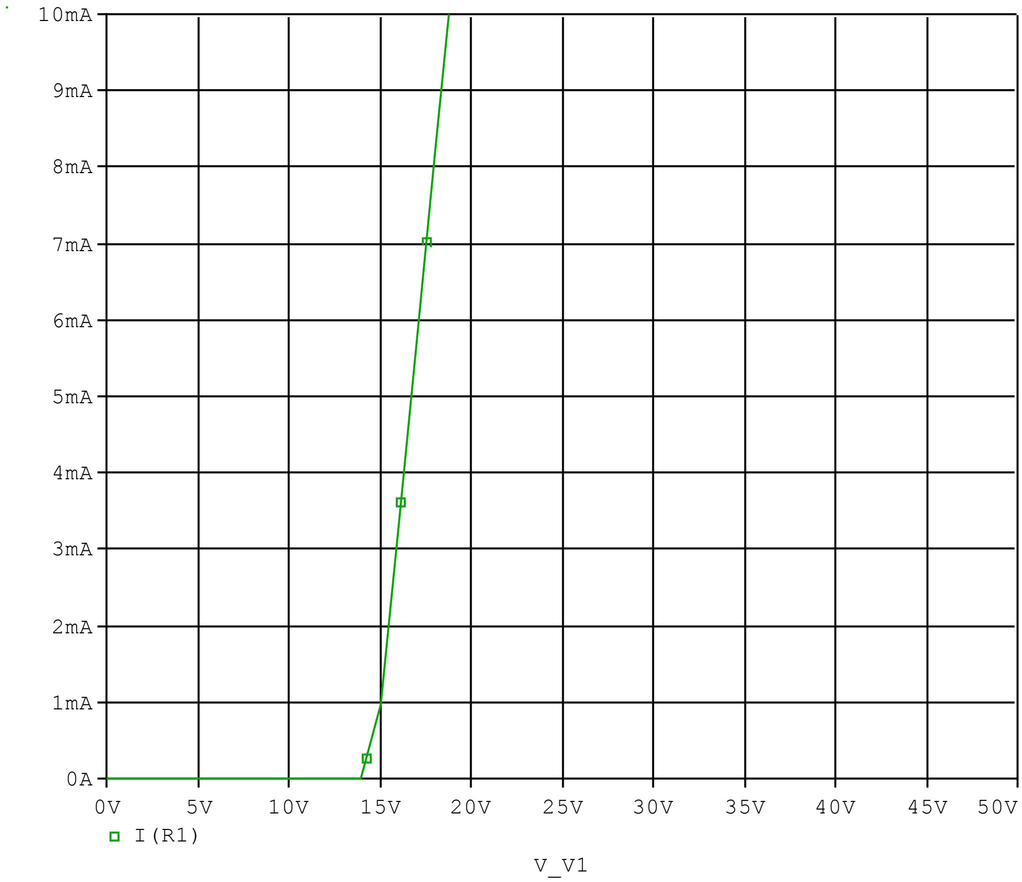
Trj=16.5(ns)
Trb=140ns)
Conditions:Ifwd=Irev=0.2(A),Rl=50



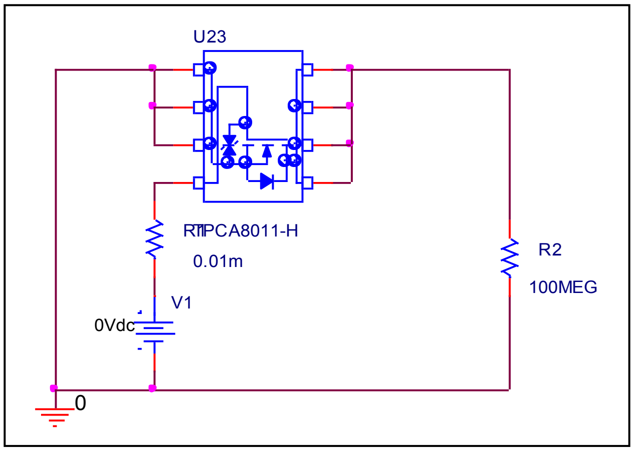
Relation between trj and trb

Zener Voltage Characteristic

Circuit Simulation Result

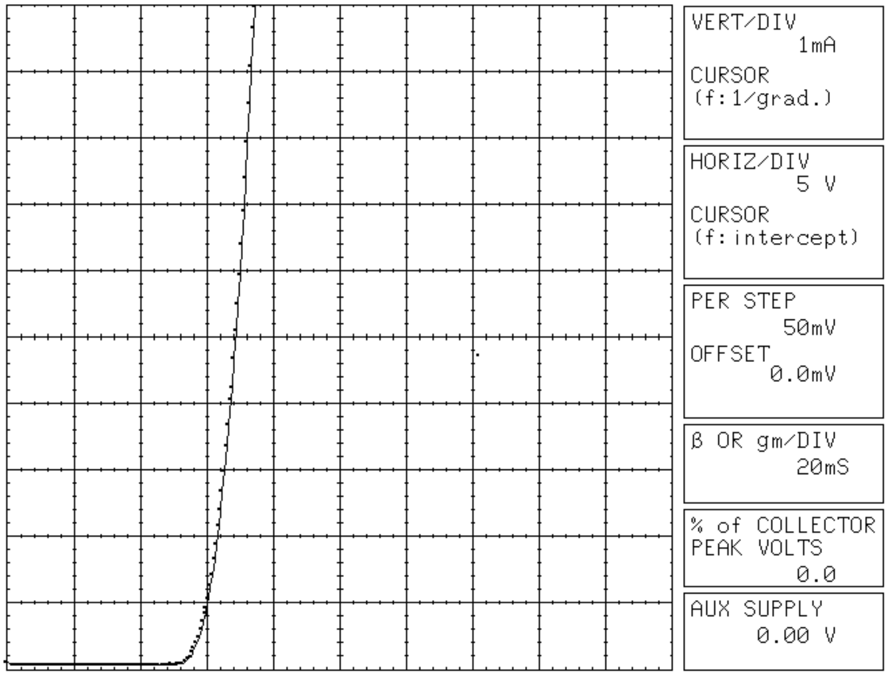


Evaluation Circuit



Zener Voltage Characteristic

Reference



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

HORIZ/DIV
5 V
CURSOR
(f:intercept)

PER STEP
50mV
OFFSET
0.0mV

β OR gm/DIV
20mS

% of COLLECTOR
PEAK VOLTS
0.0

AUX SUPPLY
0.00 V