Device Modeling Report

COMPONENTS: Power MOSFET (Model parameter)
PART NUMBER: 2SK3109
MANUFACTURER: NEC
Body Diode (Model parameter) / ESD Protection Diode

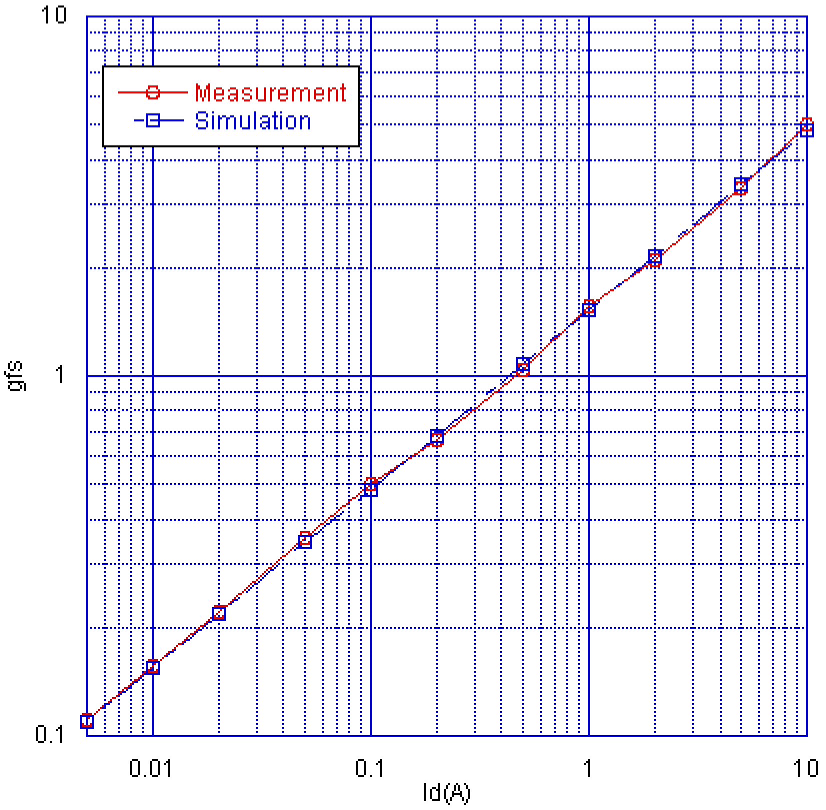
Bee Technologies Inc.

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

Transconductance Characteristic

Circuit Simulation Result

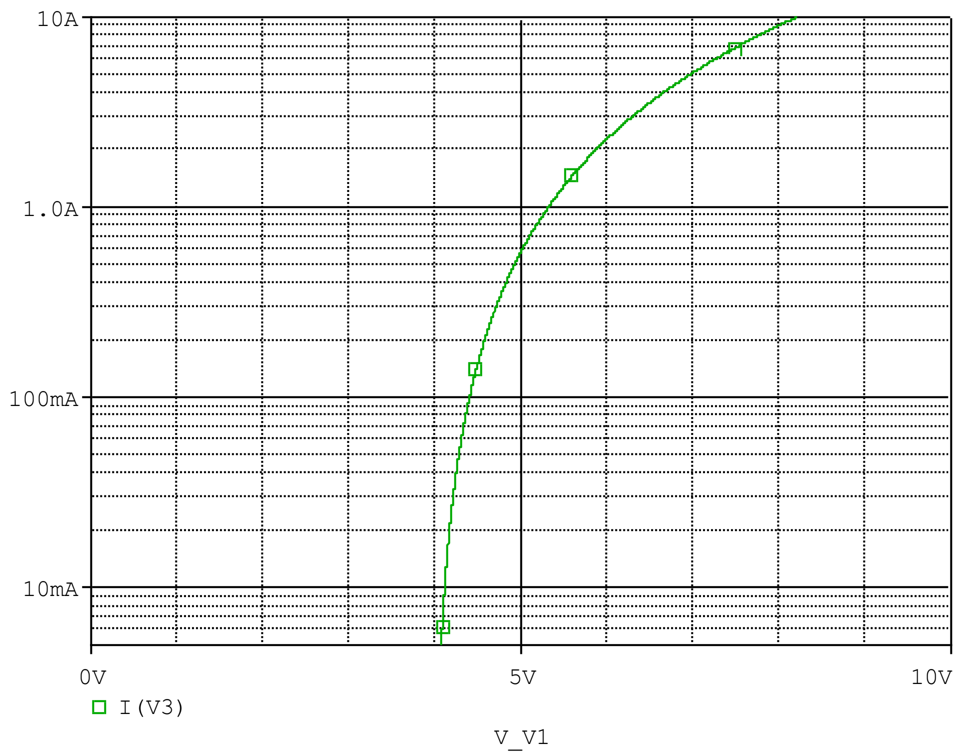


Comparison table

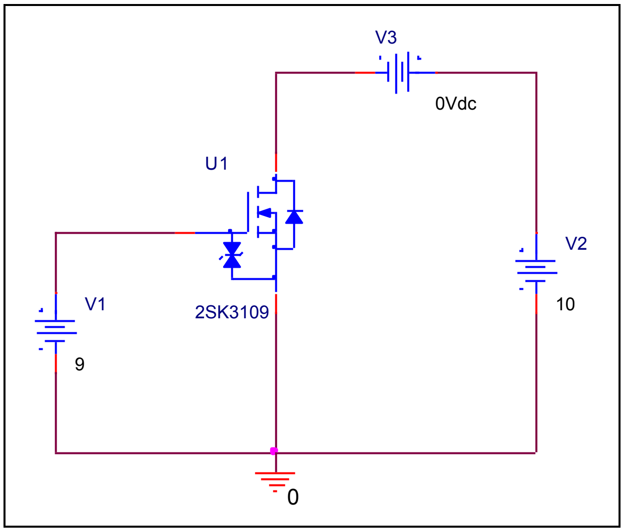
Id(A)	gfs		Error (%)
	Measurement	Simulation	
0.005	0.111	0.109	-1.802
0.01	0.156	0.154	-1.282
0.02	0.222	0.217	-2.252
0.05	0.357	0.345	-3.361
0.1	0.500	0.483	-3.400
0.2	0.667	0.685	2.699
0.5	1.042	1.085	4.127
1	1.563	1.534	-1.855
2	2.105	2.172	3.183
5	3.333	3.425	2.760
10	5.000	4.840	-3.200

Vgs-Id Characteristic

Circuit Simulation result

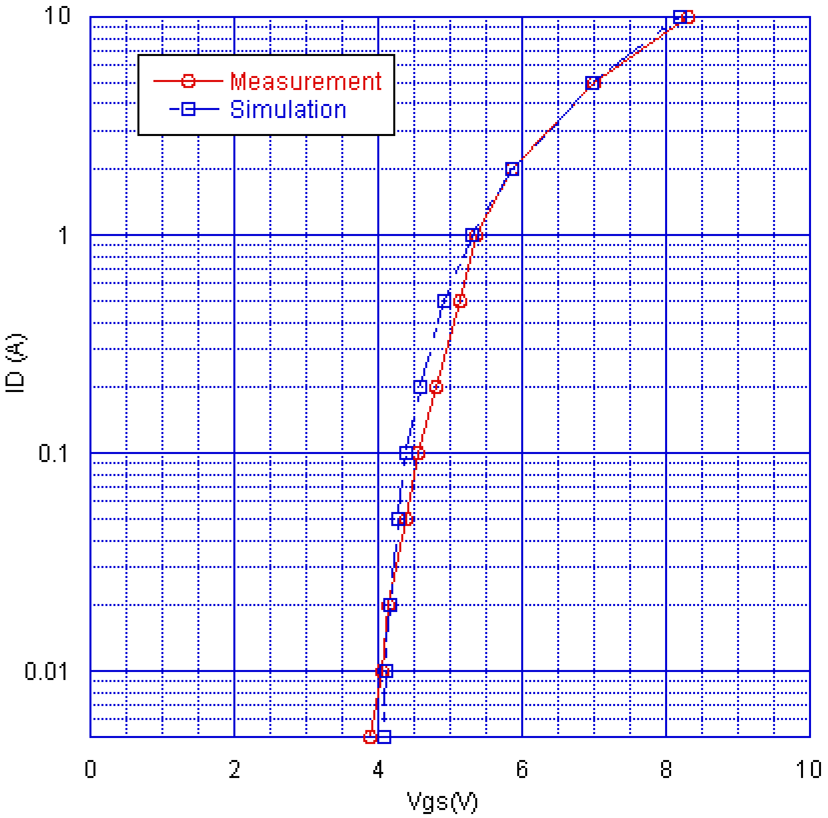


Evaluation circuit



Comparison Graph

Circuit Simulation Result

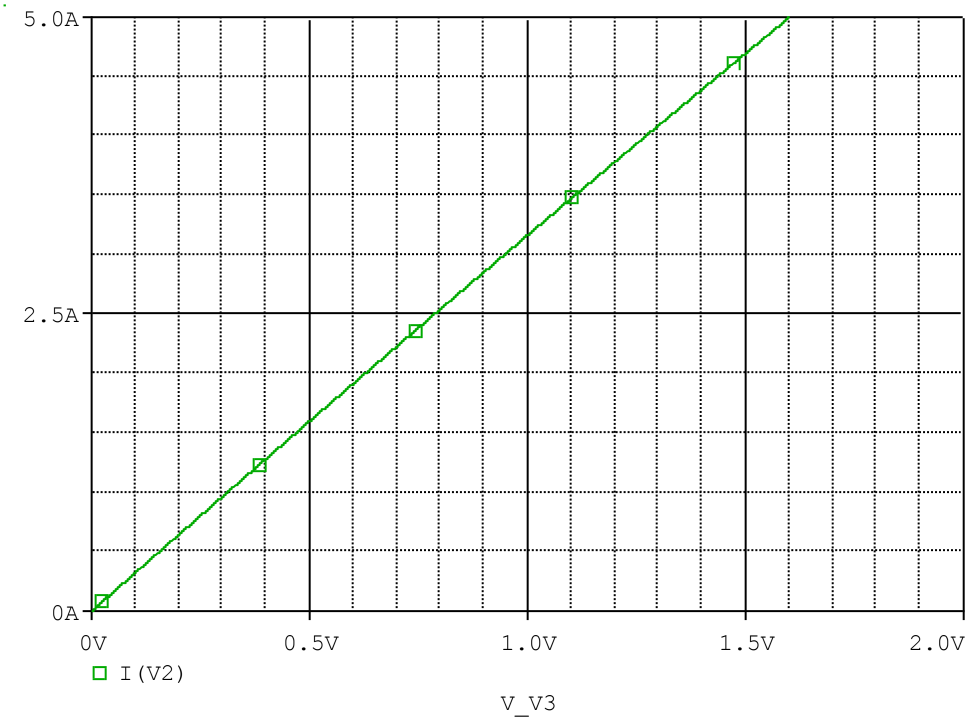


Comparison table

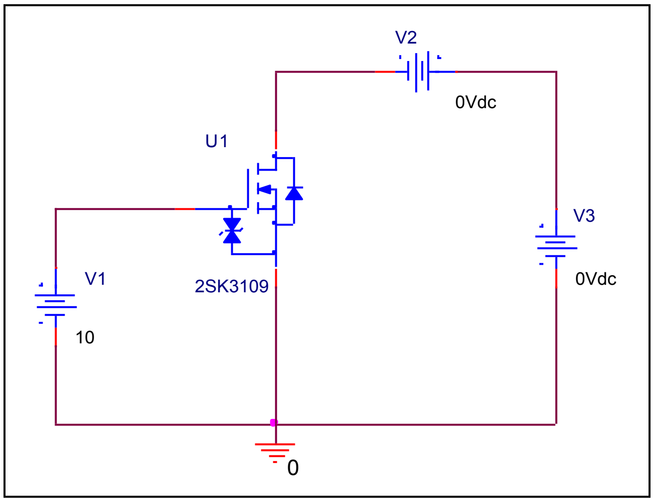
I_D(A)	V_{GS}(V)		Error (%)
	Measurement	Simulation	
0.005	3.9	4.0715	4.397
0.01	4.05	4.1107	1.499
0.02	4.15	4.1660	0.386
0.05	4.4	4.2759	-2.820
0.1	4.55	4.3996	-3.305
0.2	4.8	4.5747	-4.694
0.5	5.15	4.9221	-4.425
1	5.35	5.3136	-0.680
2	5.85	5.8675	0.299
5	7	6.9664	-0.480
10	8.3	8.2055	-1.139

Rds(on) Characteristic

Circuit Simulation result



Evaluation circuit

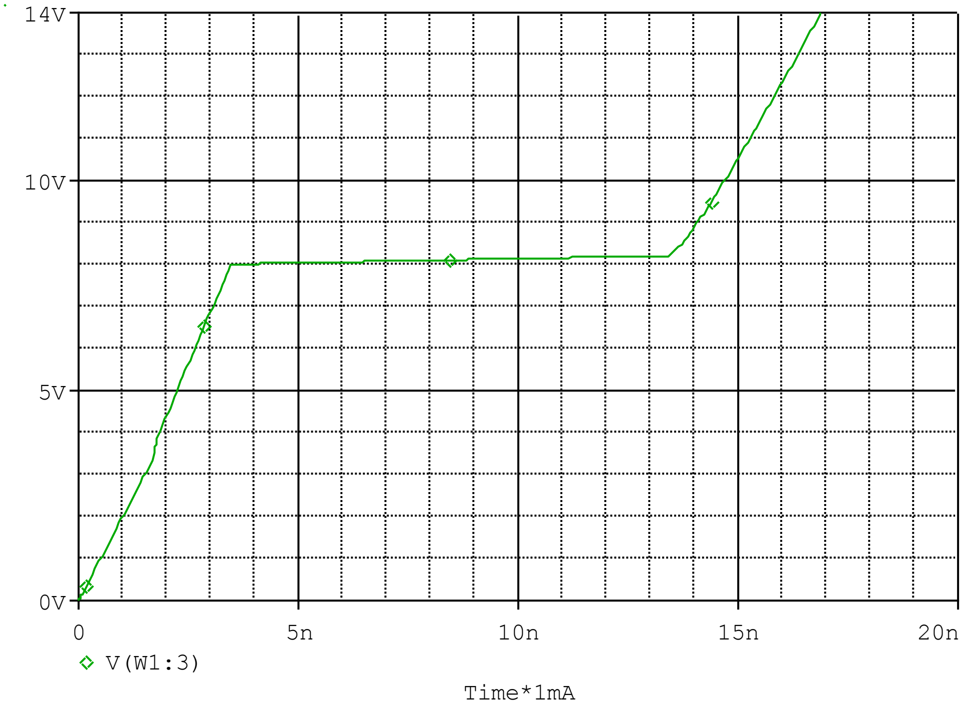


Comparison table

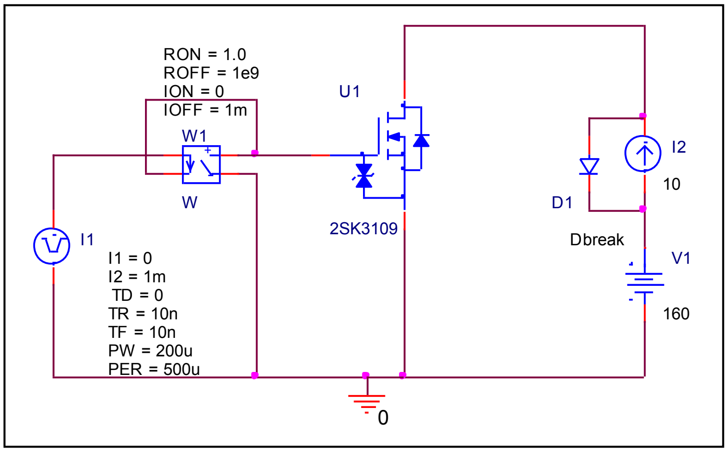
I_D=5A, V_{GS}=10V	Measurement	Simulation	Error (%)
R_{DS} (on) Ω	0.32	0.3202	0.062

Gate Charge Characteristic

Circuit Simulation result



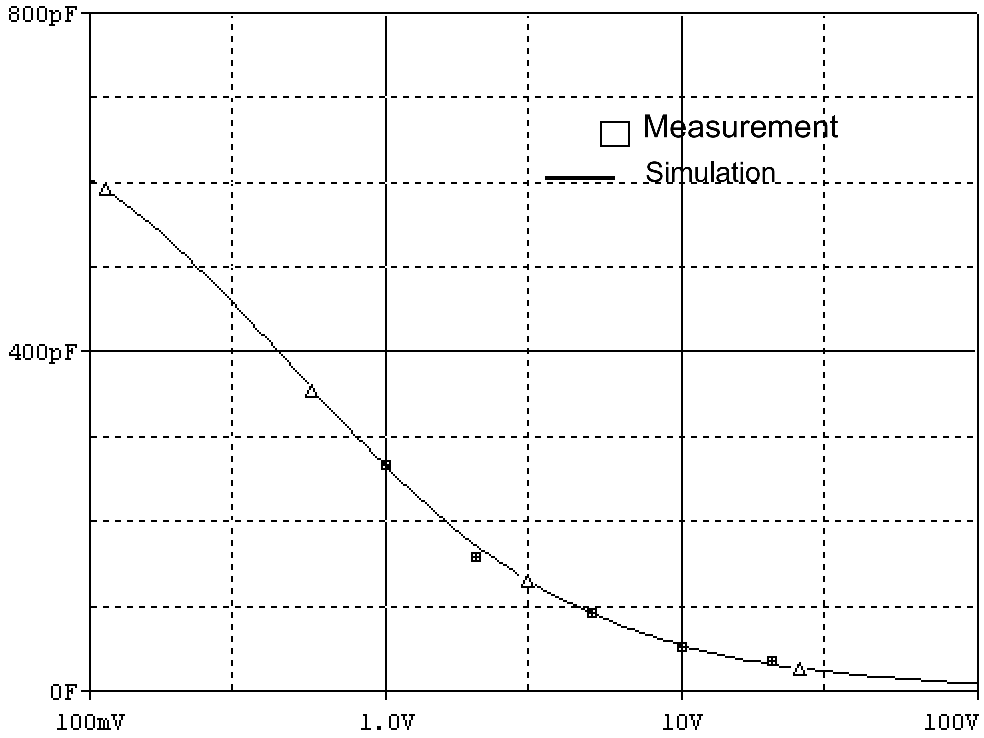
Evaluation circuit



Comparison table

V_{DD}=160V,I_D=10A,V_G=10V	Measurement	Simulation	Error (%)
Qgs (nC)	3.5	3.5276	0.789
Qgd (nC)	10	9.937	-0.630
Qg (nC)	18	14.693	-18.372

Capacitance Characteristic

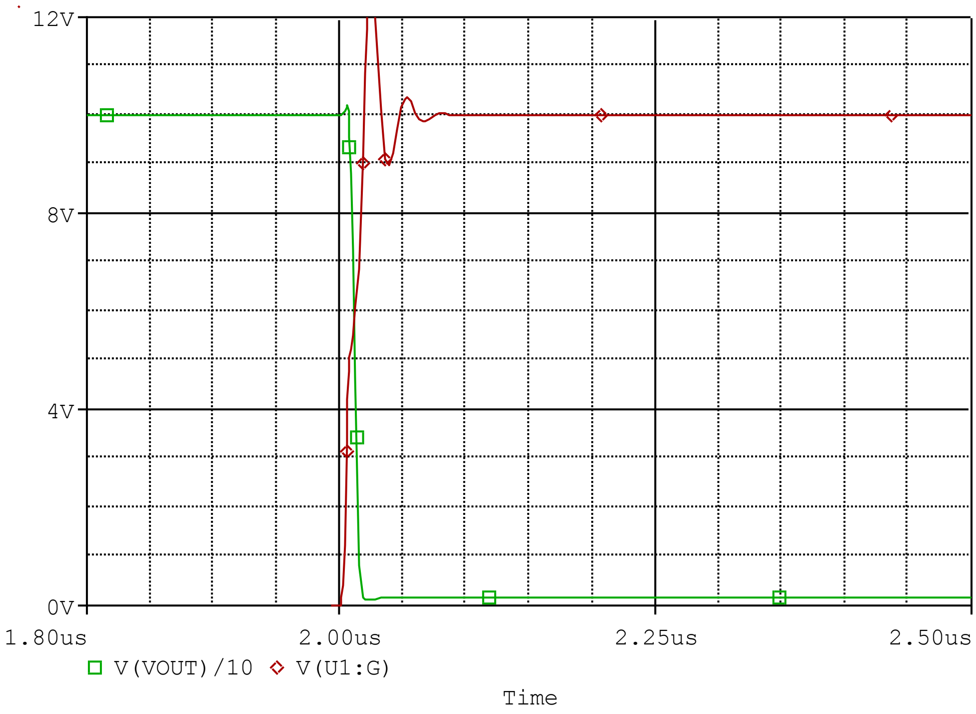


Comparison table

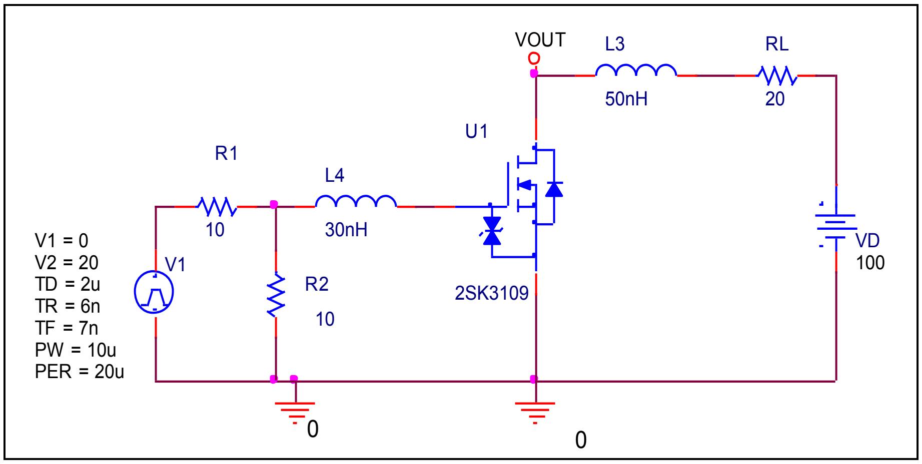
V_{DS}(V)	Cbd(pF)		Error(%)
	Measurement	**Simulation**	
1	**270**	**265**	**-1.852**
2	**160**	**168**	**4.375**
5	**95**	**93**	**-2.105**
10	**55**	**56**	**1.818**
20	**37**	**35**	**-4.054**

Switching Time Characteristic

Circuit Simulation result



Evaluation circuit



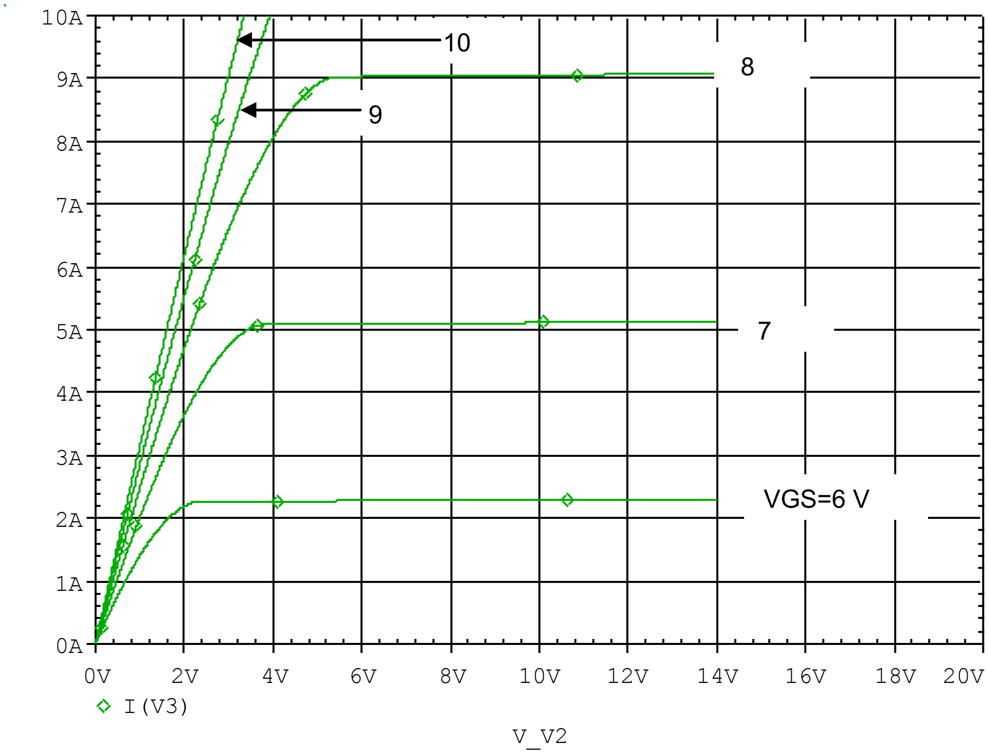
Comparison table

I_D=5A, V_{DD}=100V, V_{GS}=0V~10V	Measurement	Simulation	Error(%)
ton (ns)	12	12.170	1.417

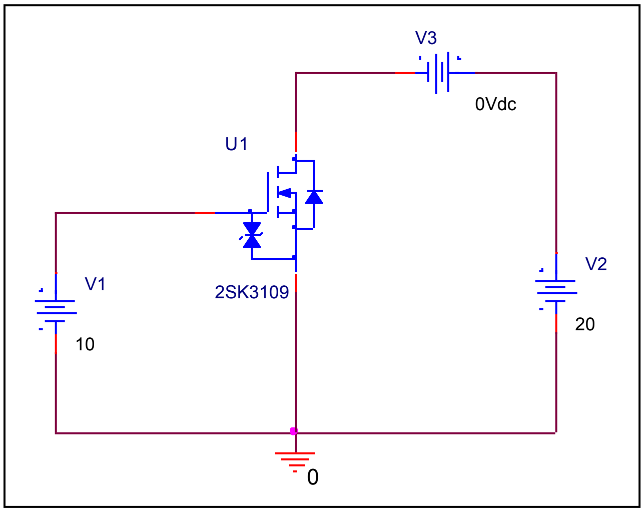
Output Characteristic

Circuit Simulation result

6.8

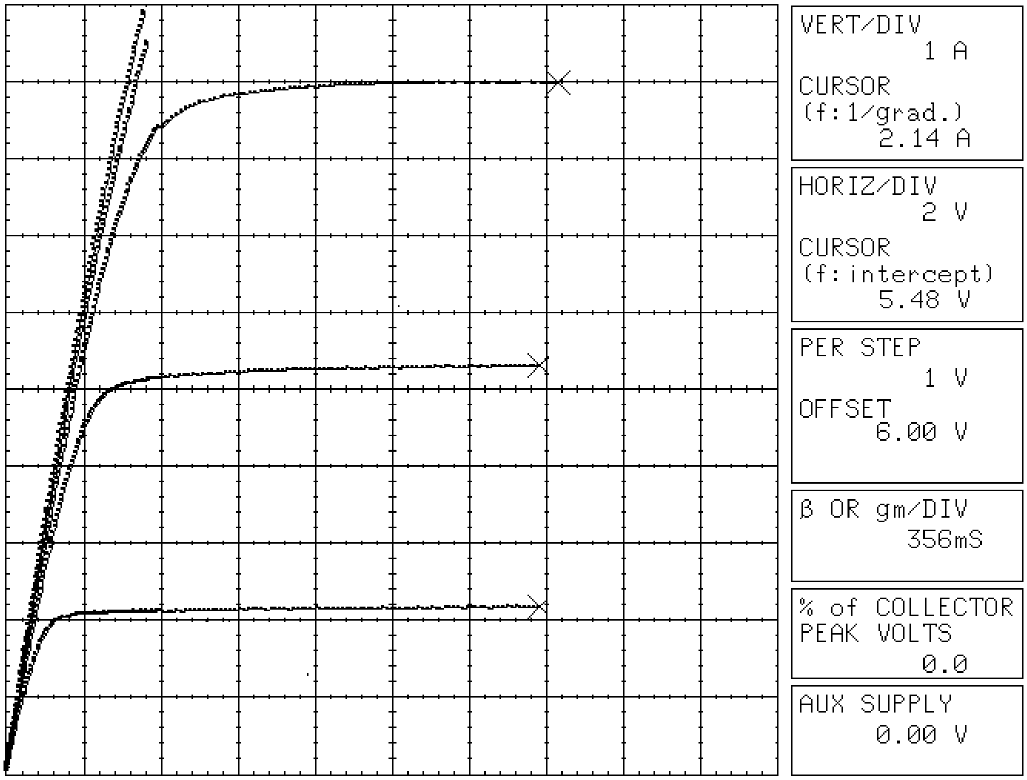


Evaluation circuit



Output Characteristic

Reference



VERT/DIV
1 A
CURSOR
(f:1/grad.)
2.14 A

HORIZ/DIV
2 V
CURSOR
(f:intercept)
5.48 V

PER STEP
1 V
OFFSET
6.00 V

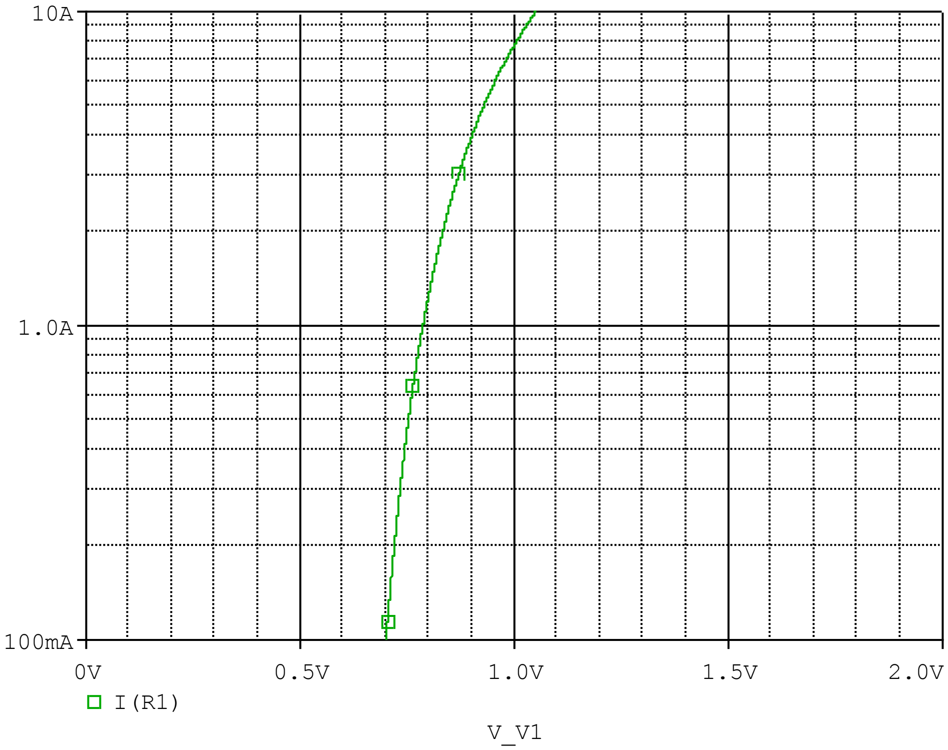
β OR gm/DIV
356mS

% of COLLECTOR
PEAK VOLTS
0.0

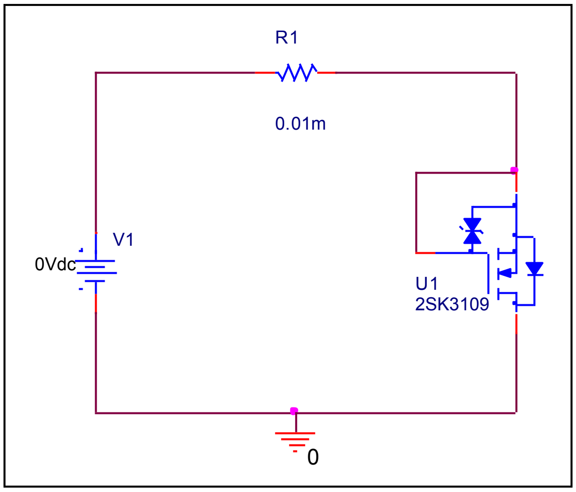
AUX SUPPLY
0.00 V

BODY DIODE
Forward Current Characteristic

Circuit Simulation Result

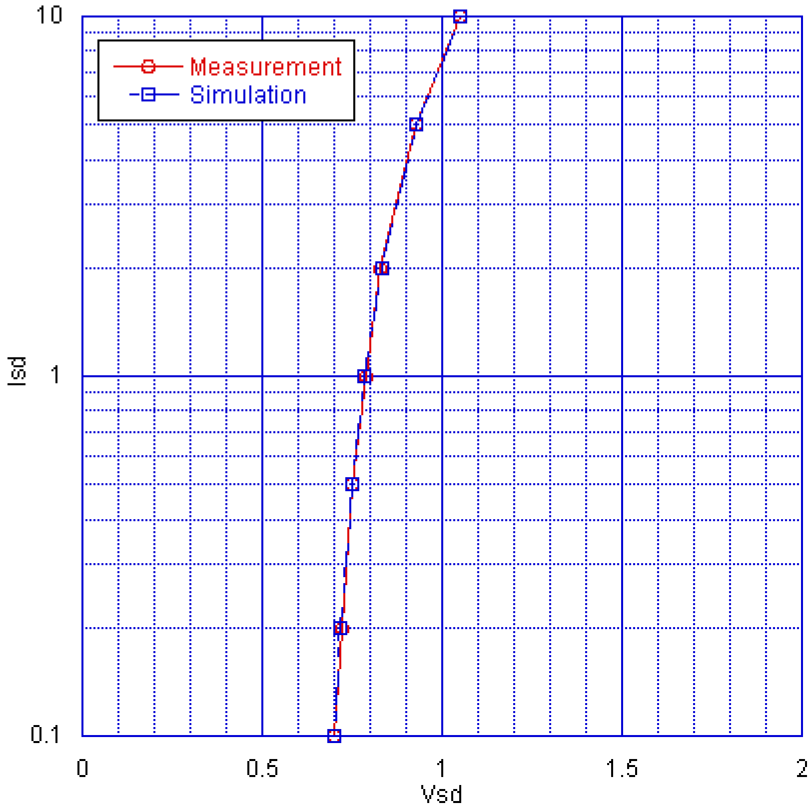


Evaluation Circuit



Comparison Graph

Circuit Simulation Result

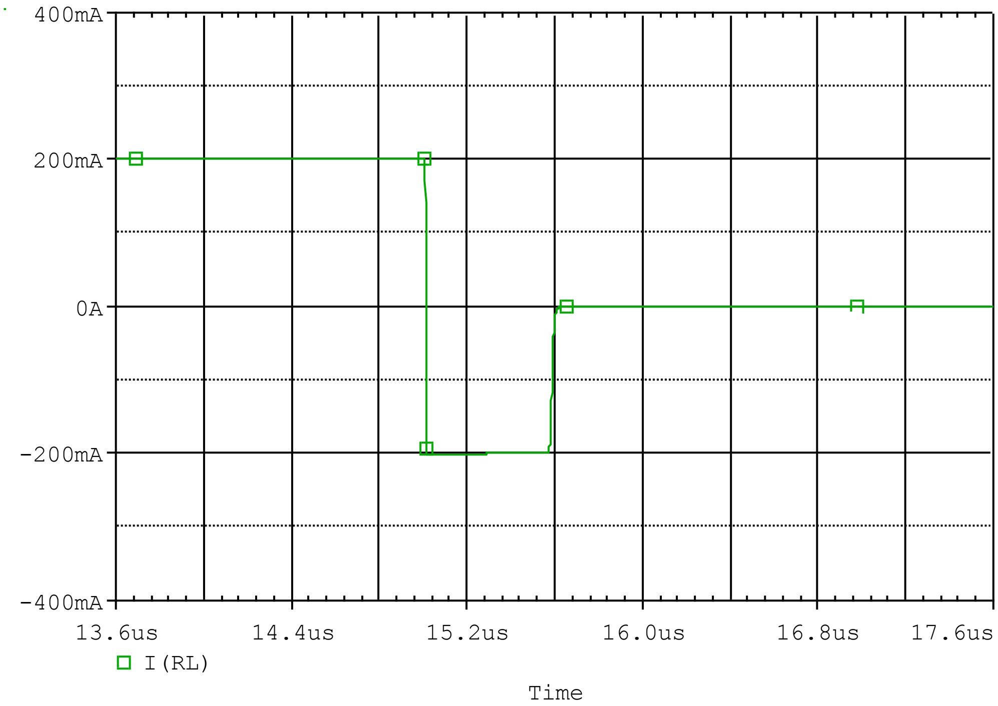


Comparison table

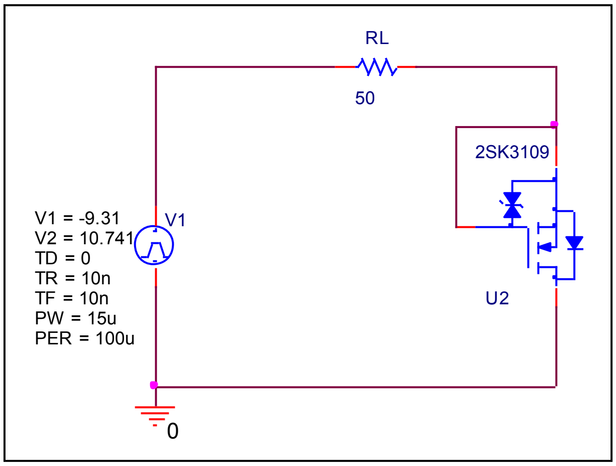
I_{SD}(A)	VSD(V)		%Error
	Measurement	Simulation	
0.1	0.7	0.6997	-0.043
0.2	0.72	0.7196	-0.056
0.5	0.75	0.752	0.267
1	0.79	0.786	-0.506
2	0.83	0.833	0.361
5	0.93	0.928	-0.215
10	1.05	1.051	0.095

Reverse Recovery Characteristic

Circuit Simulation Result



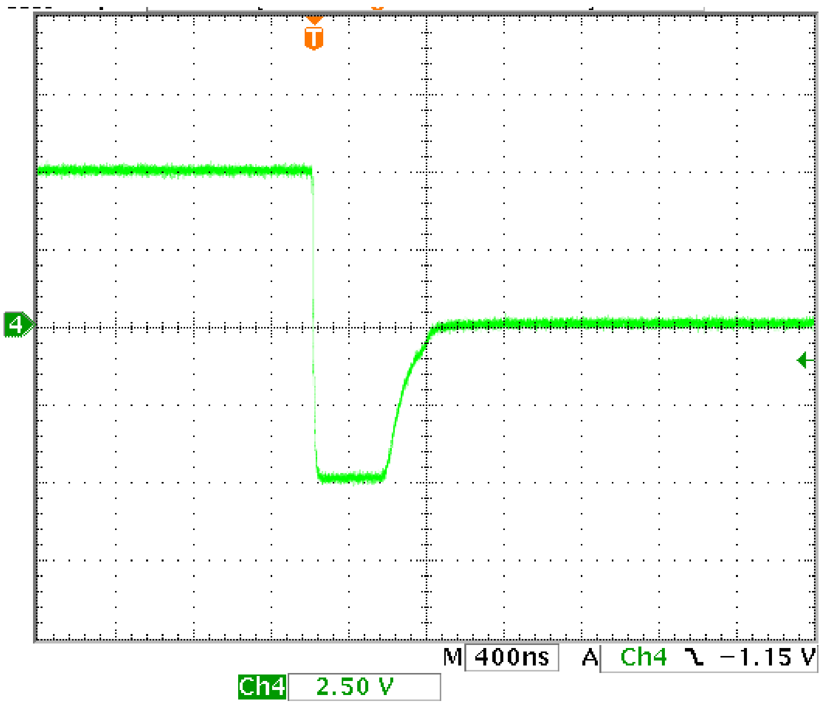
Evaluation Circuit



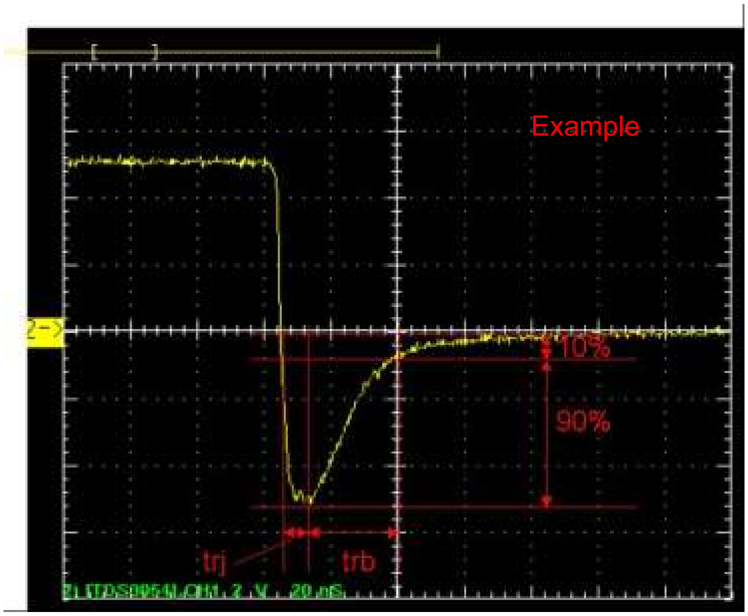
Comparison table

Trr(ns)	Measurement	Simulation	Error (%)
Trj+Trb (ns)	584	584.140	0.024

Reverse Recovery Characteristic **Reference**



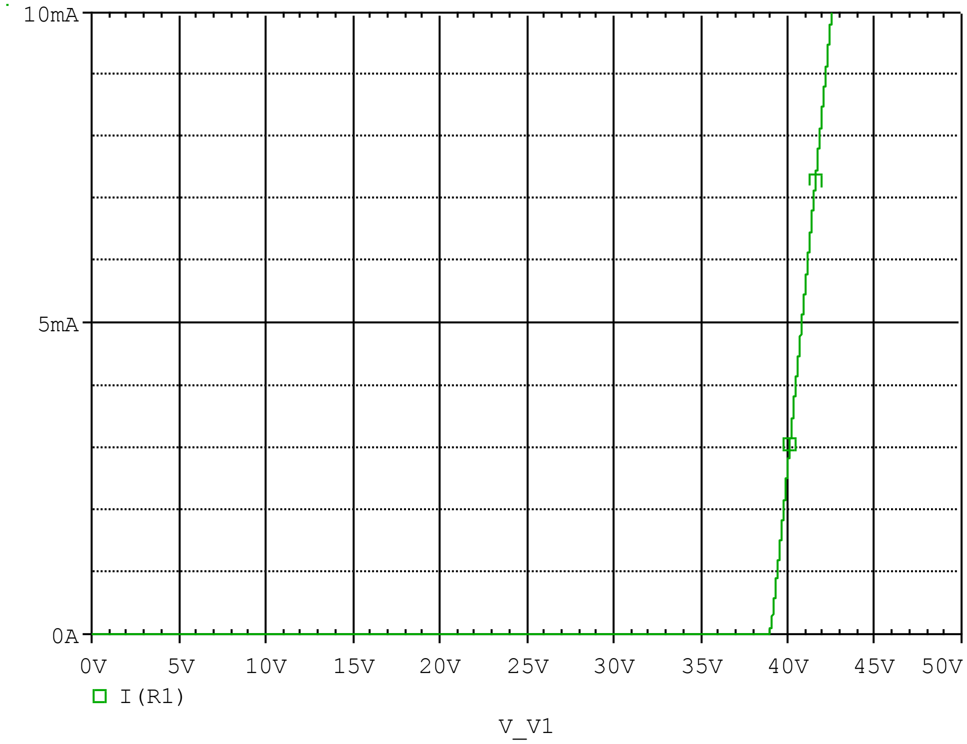
Trj=344(ns)
Trb=240(ns)
Conditions:Ifwd=Irev=0.2(A),Rl=50



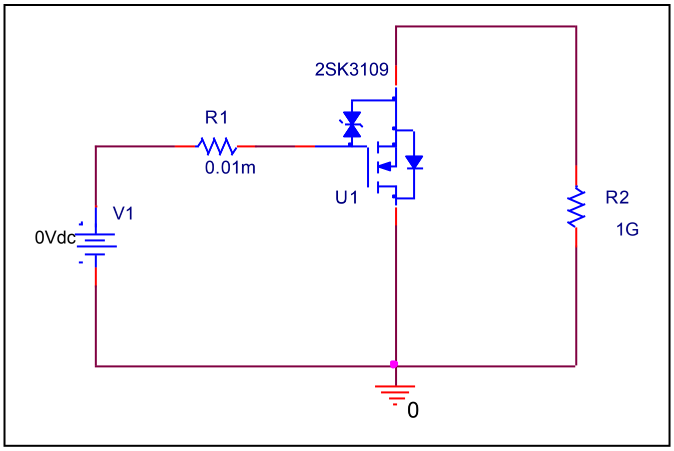
Relation between trj and trb

ESD PROTECTION DIODE
Zener Voltage Characteristic

Circuit Simulation Result



Evaluation Circuit



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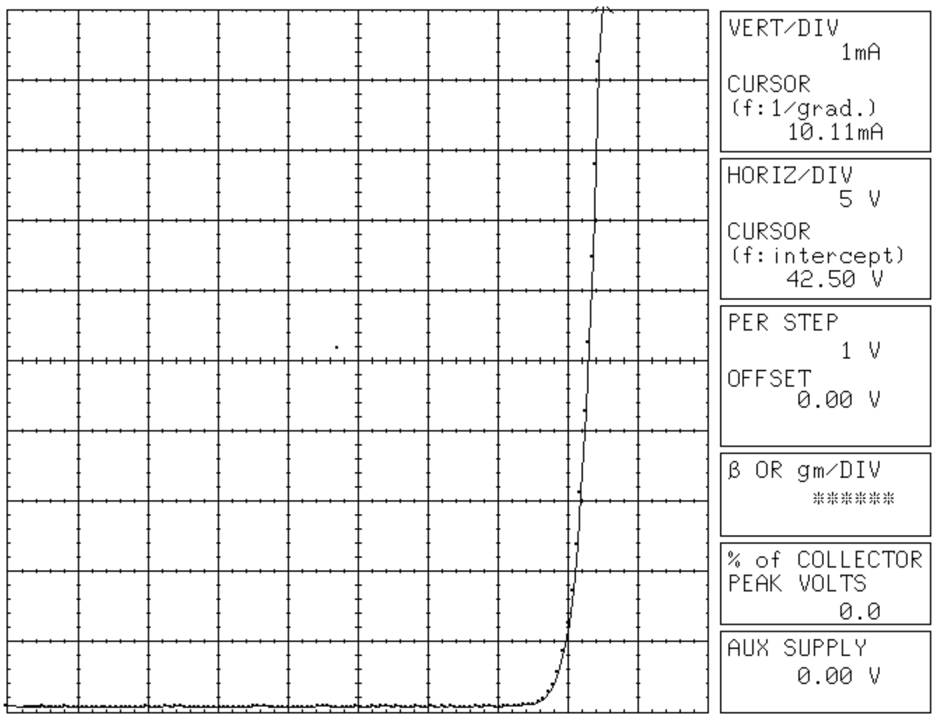
Zener Voltage Characteristic **Reference**



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

HORIZ/DIV
5 V
CURSOR
(f:intercept)
42.50 V

PER STEP
1 V
OFFSET
0.00 V

β OR gm/DIV
******

% of COLLECTOR
PEAK VOLTS
0.0

AUX SUPPLY
0.00 V