

Device Modeling Report

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

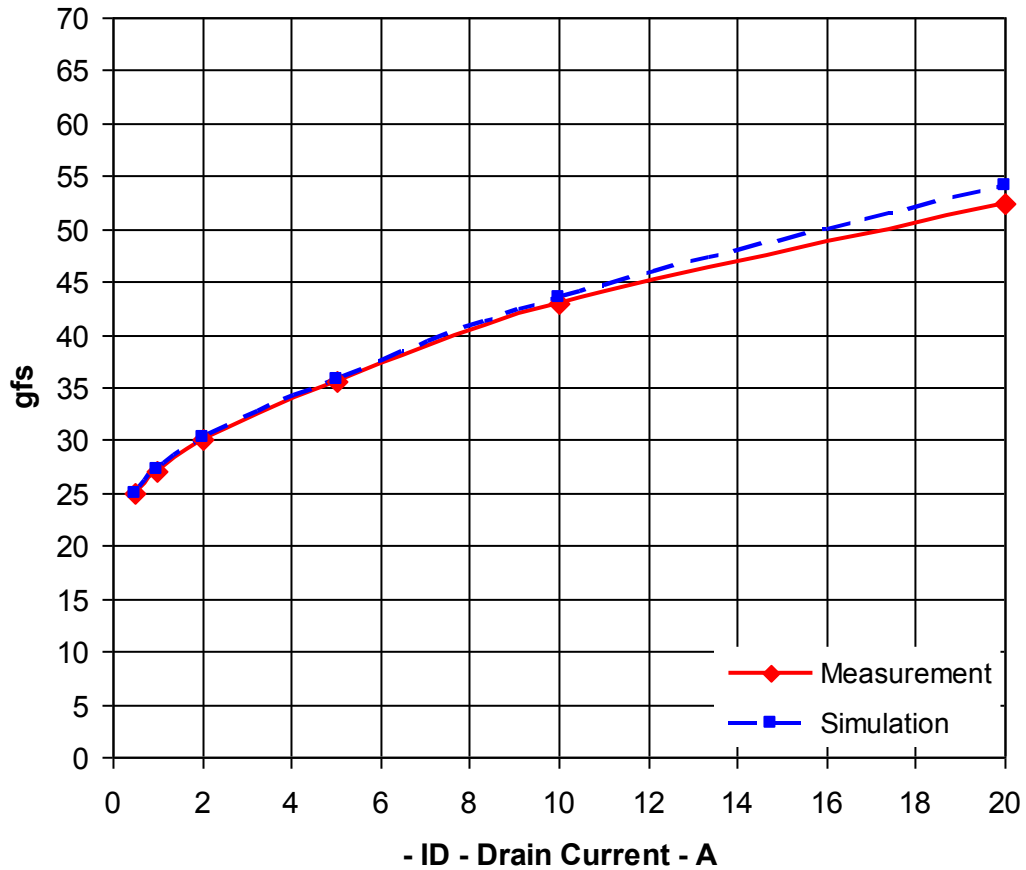


MOSFET MODEL

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

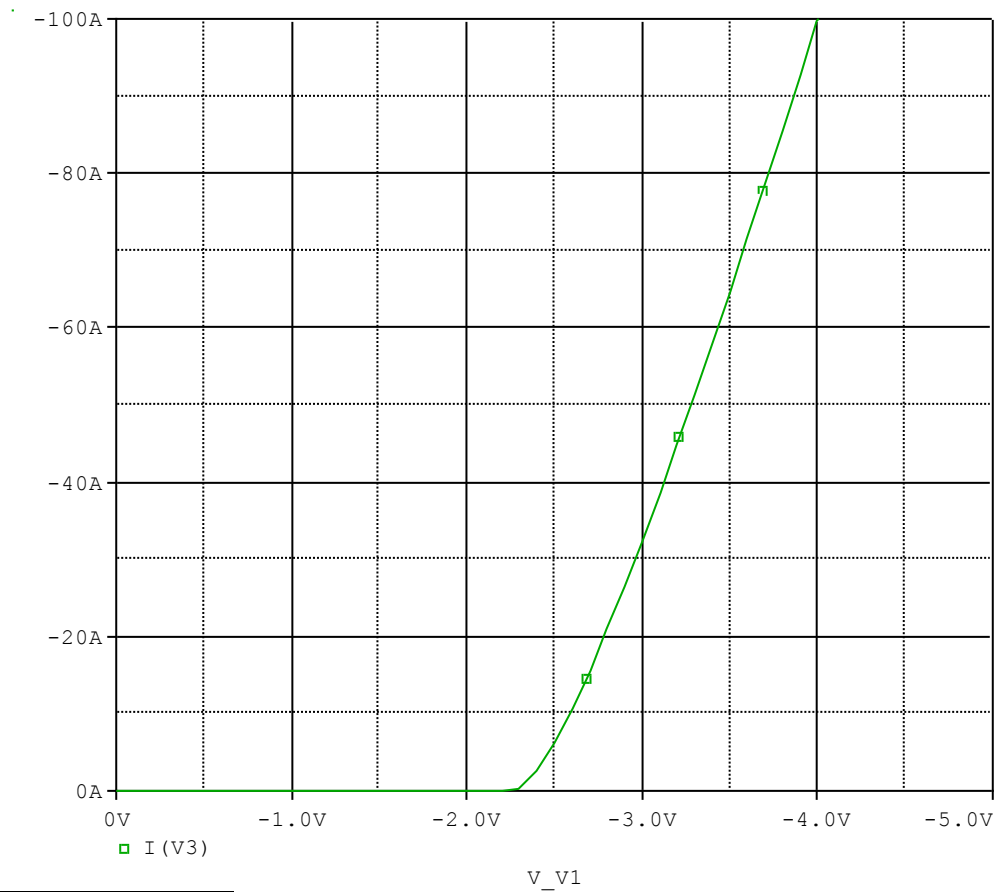


Comparison table

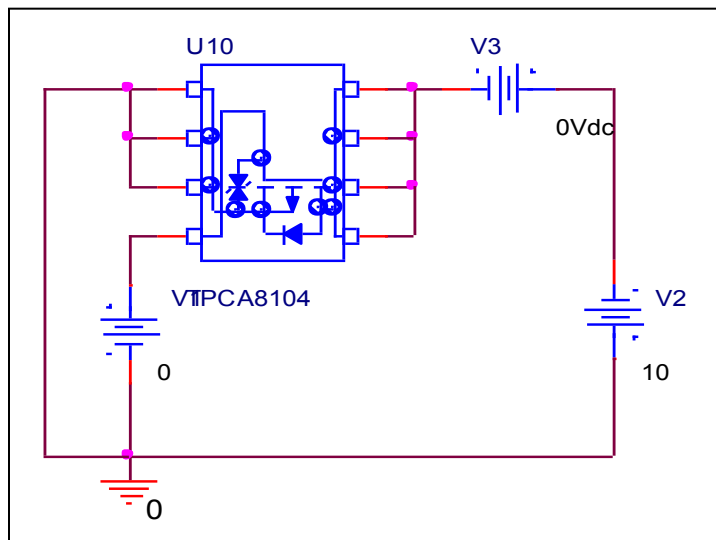
- Id(A)	gfs		Error(%)
	Measurement	Simulation	
0.5	25.000	25.000	0.000
1	27.000	27.333	1.233
2	30.000	30.333	1.110
5	35.500	35.714	0.603
10	43.000	43.455	1.058
20	52.500	54.054	2.960

V_{gs}-I_d Characteristic

Circuit Simulation result

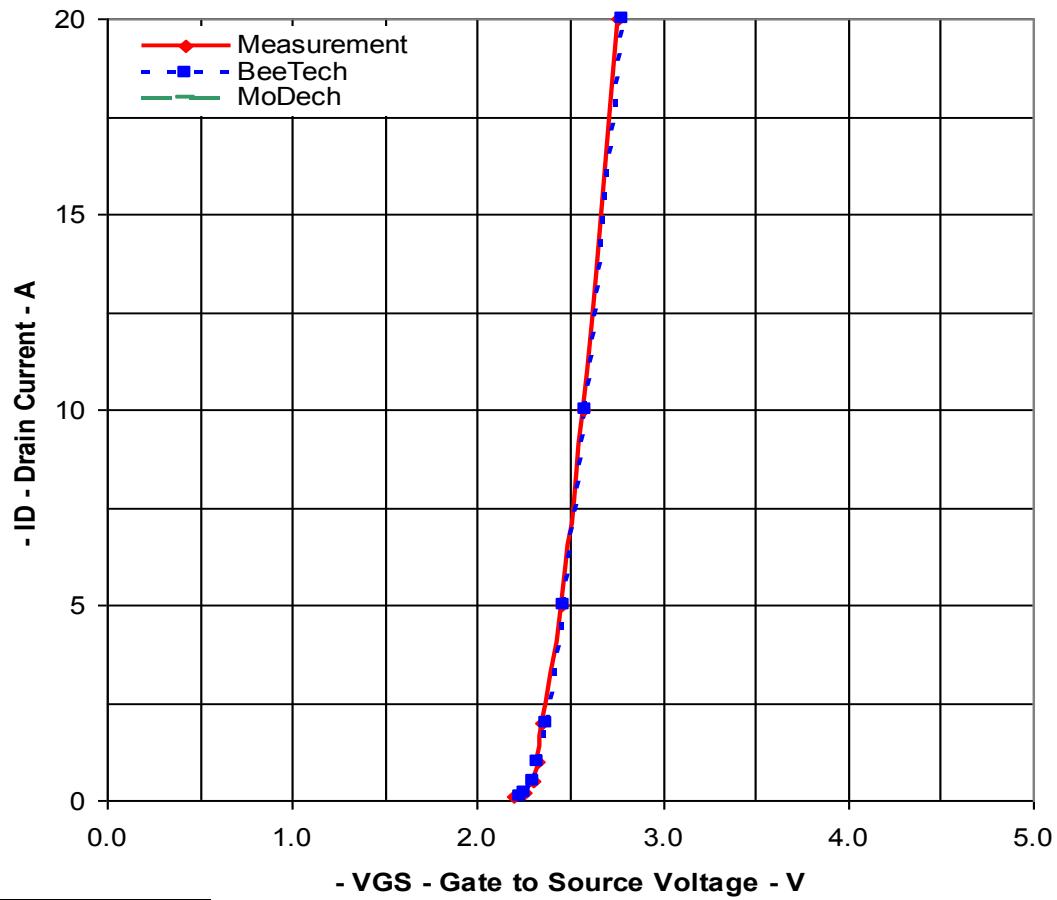


Evaluation circuit



Comparison Graph

Circuit Simulation Result

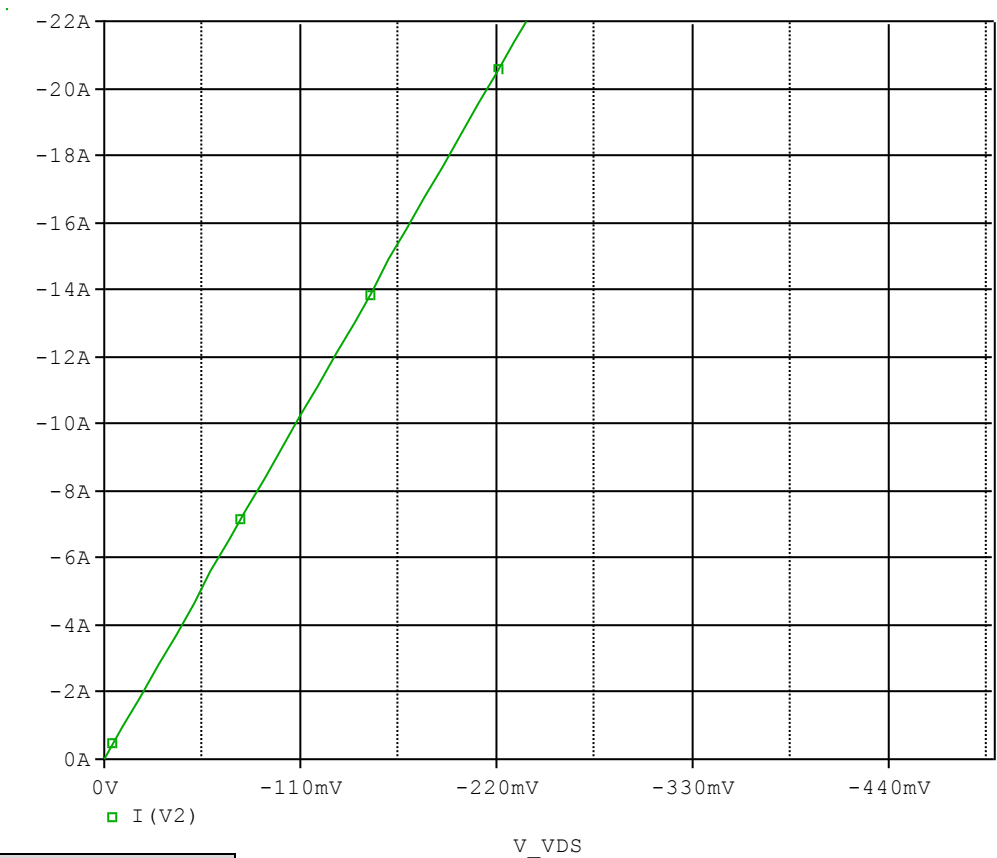


Simulation Result

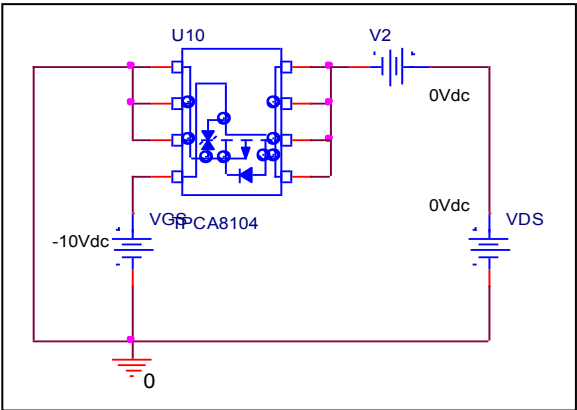
- I_D (A)	- V_{GS} (V)		Error (%)
	Measurement	Simulation	
0.1	2.200	2.227	1.227
0.2	2.250	2.255	0.222
0.5	2.300	2.305	0.217
1	2.320	2.327	0.302
2	2.350	2.371	0.894
5	2.450	2.464	0.571
10	2.570	2.585	0.584
20	2.760	2.783	0.833

Rds(on) Characteristic

Circuit Simulation result



Evaluation circuit

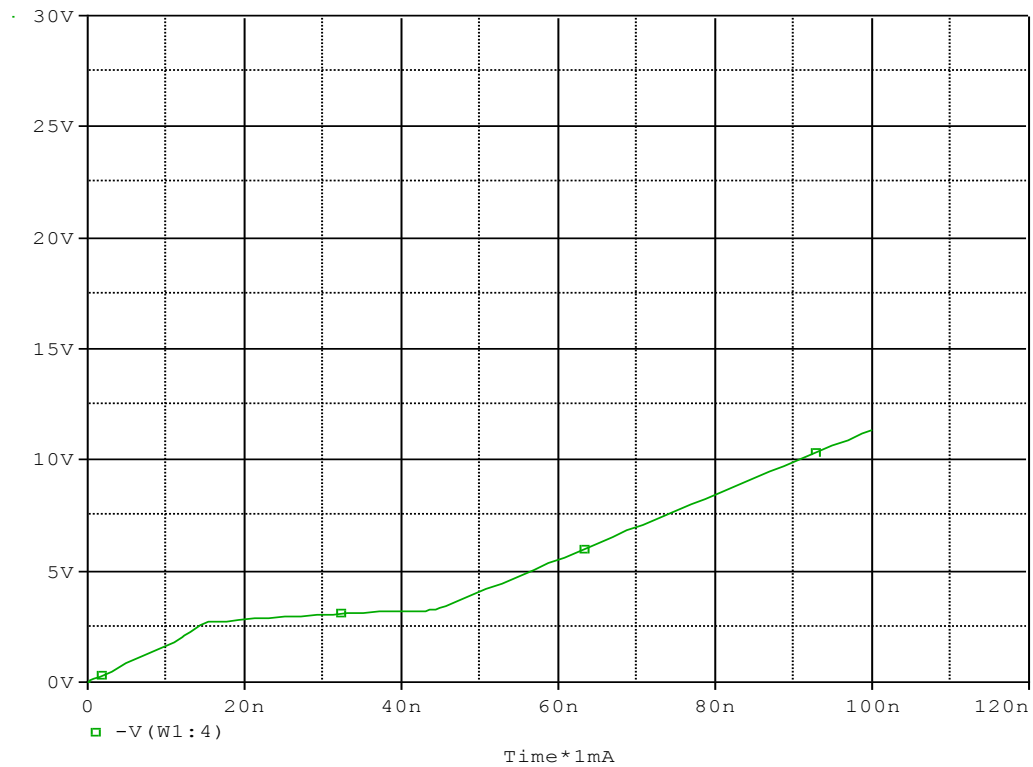


Simulation Result

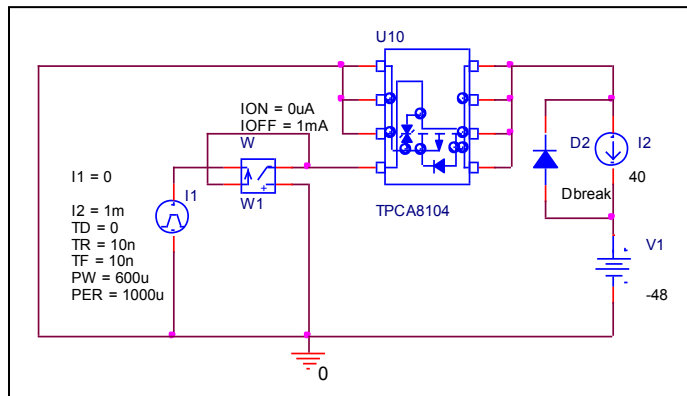
$I_D = -20A, V_{GS} = -10V$	Measurement	Simulation	Error (%)
$R_{DS(on)}$	0.011	0.0107	-2.707

Gate Charge Characteristic

Circuit Simulation result



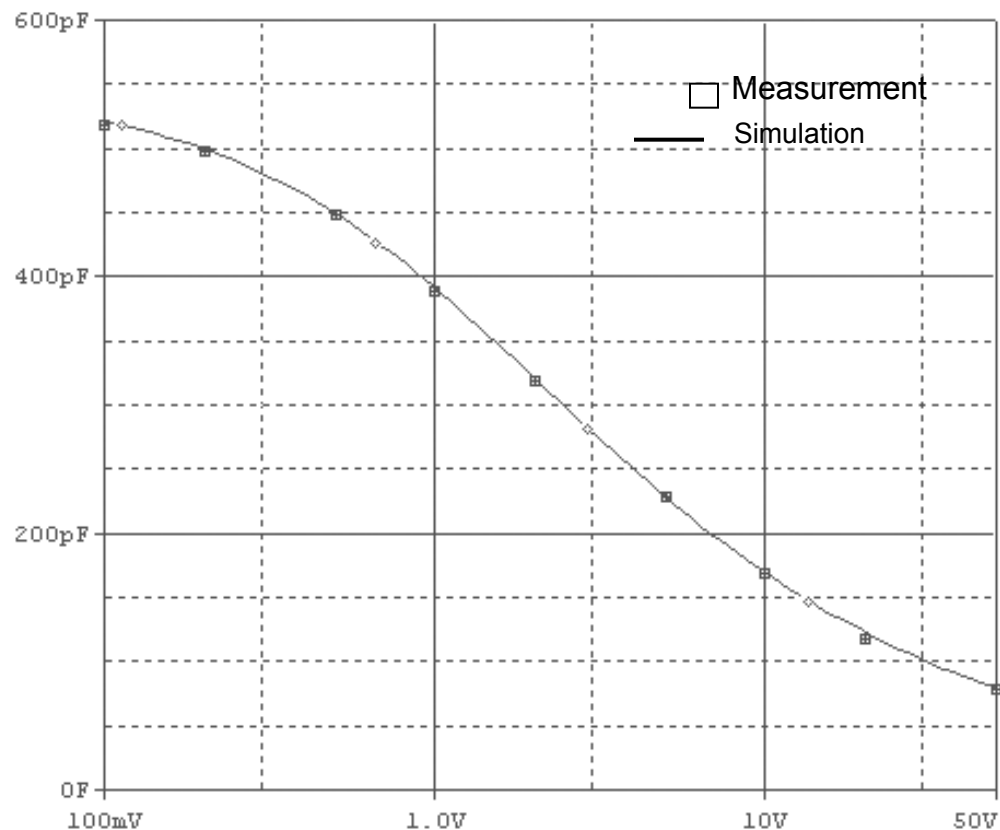
Evaluation circuit



Simulation Result

V_{DD}=-48V, I_D=-40A , V_{GS}=-10V	Measurement	Simulation	Error (%)
Q_{gs}(nC)	16.000	15.979	-0.131
Q_{gd}(nC)	28.000	28.041	0.146
Q_g(nC)	90.000	90.928	1.031

Capacitance Characteristic

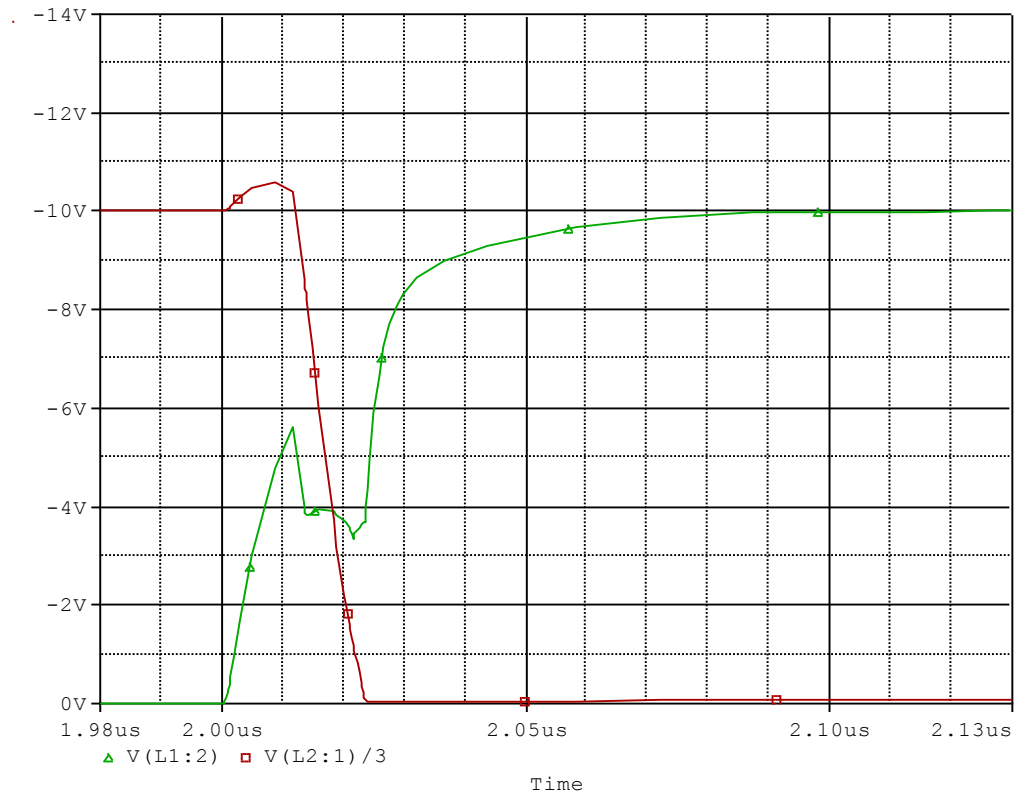


Simulation Result

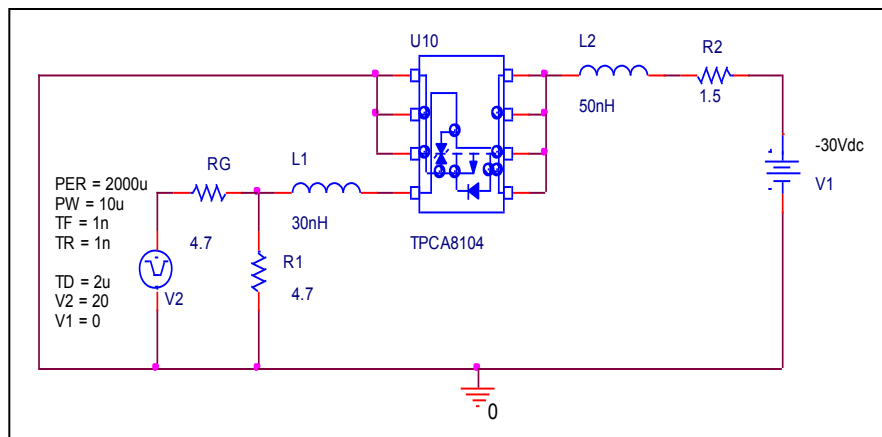
- V _{DS} (V)	Cbd(pF)		Error(%)
	Measurement	Simulation	
0.1	520.000	521.000	0.192
0.2	500.000	500.000	0.000
0.5	450.000	450.400	0.089
1	390.000	391.000	0.256
2	320.000	320.000	0.000
5	230.000	230.000	0.000
10	170.000	170.000	0.000
20	120.000	122.000	1.667
50	80.000	80.000	0.000

Switching Time Characteristic

Circuit Simulation result



Evaluation circuit

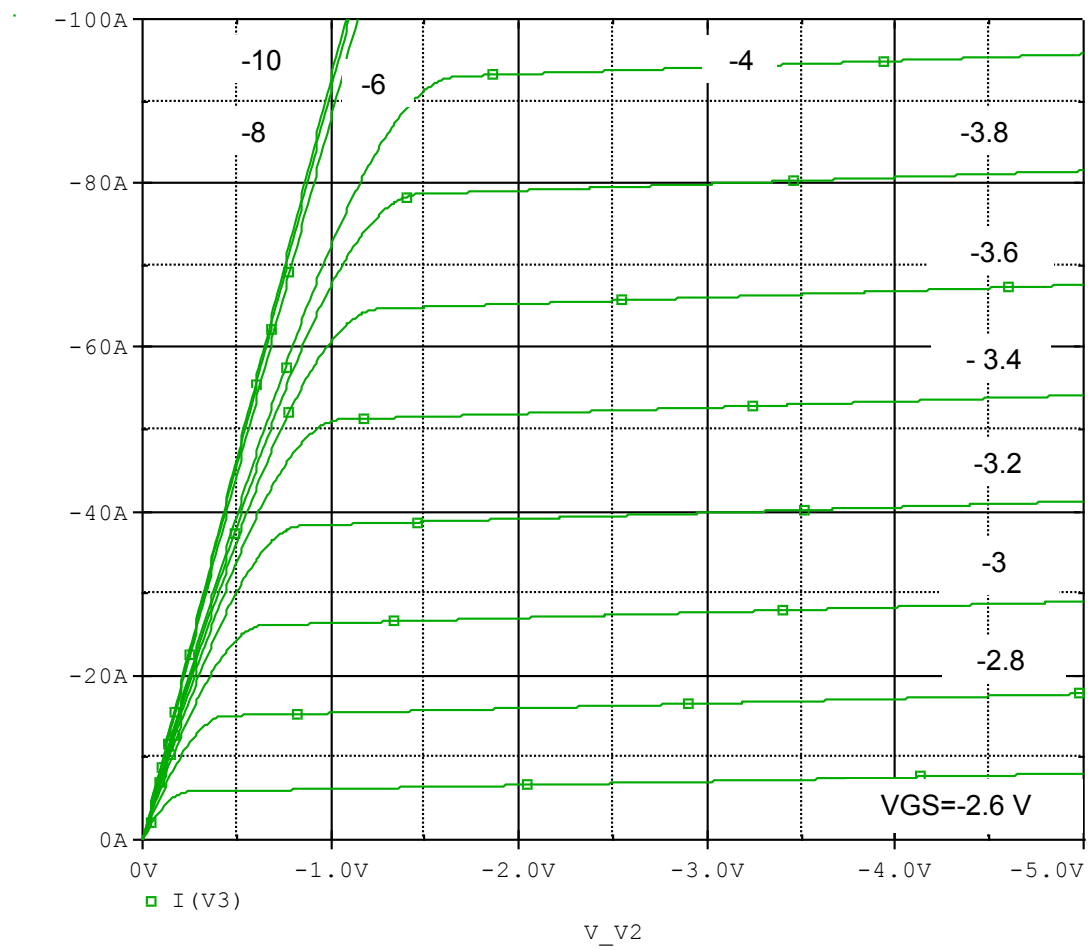


Simulation Result

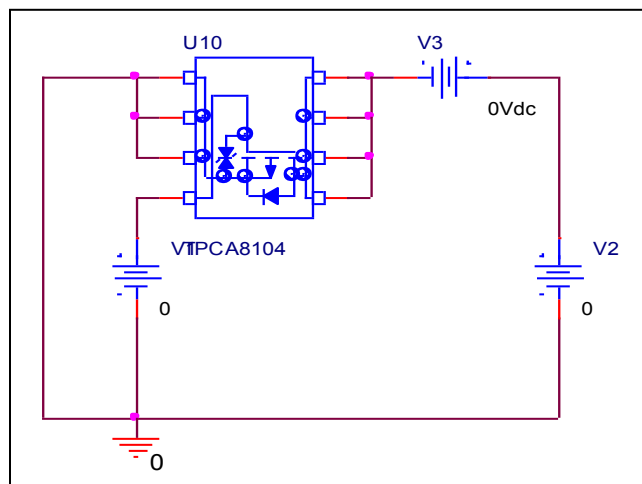
$I_D = -20A$, $V_{DD} = -300V$ $V_{GS} = 0/-10V$	Measurement	Simulation	Error(%)
Ton(ns)	20.000	19.936	-0.320

Output Characteristic

Circuit Simulation result

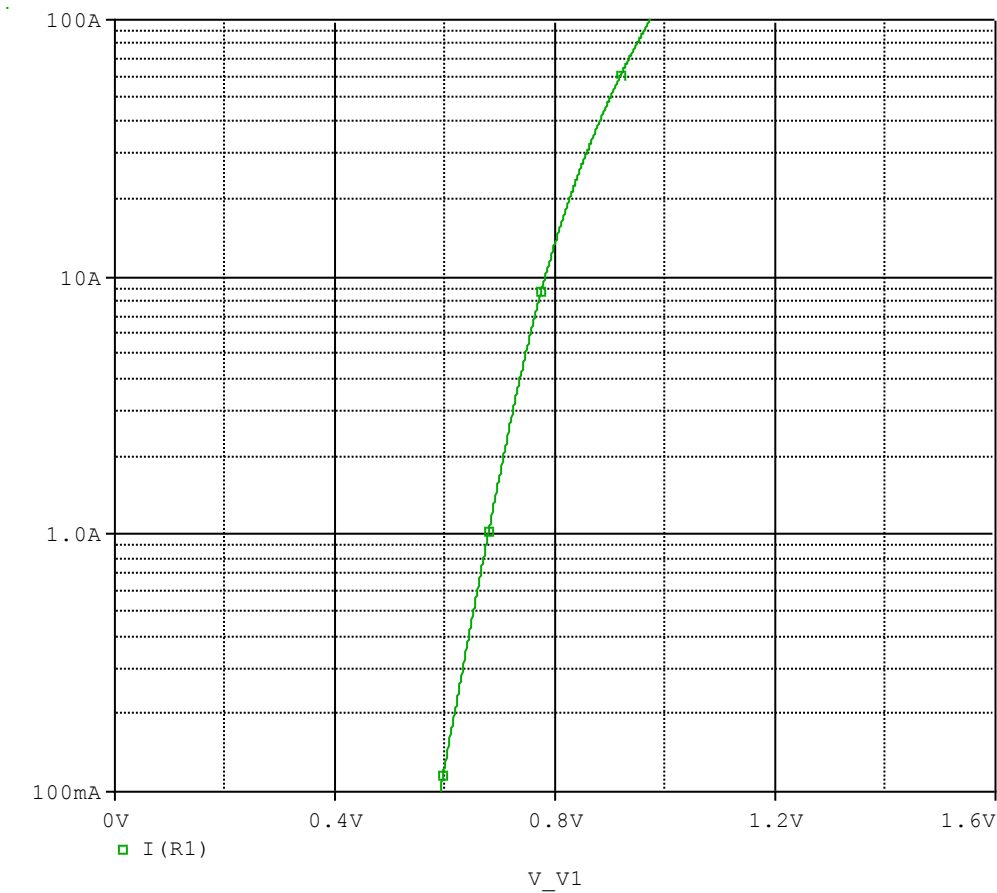


Evaluation circuit

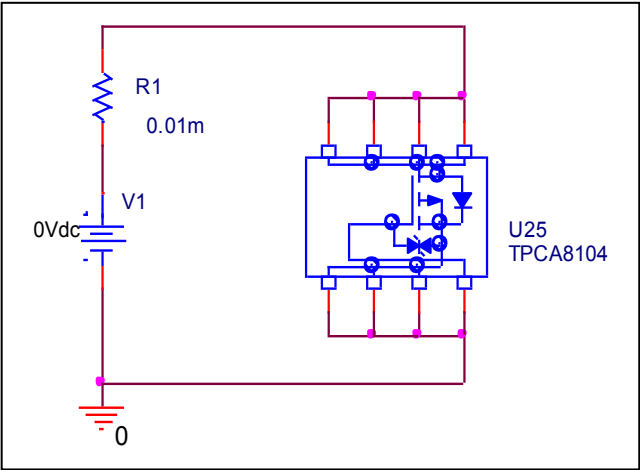


Forward Current Characteristic

Circuit Simulation Result

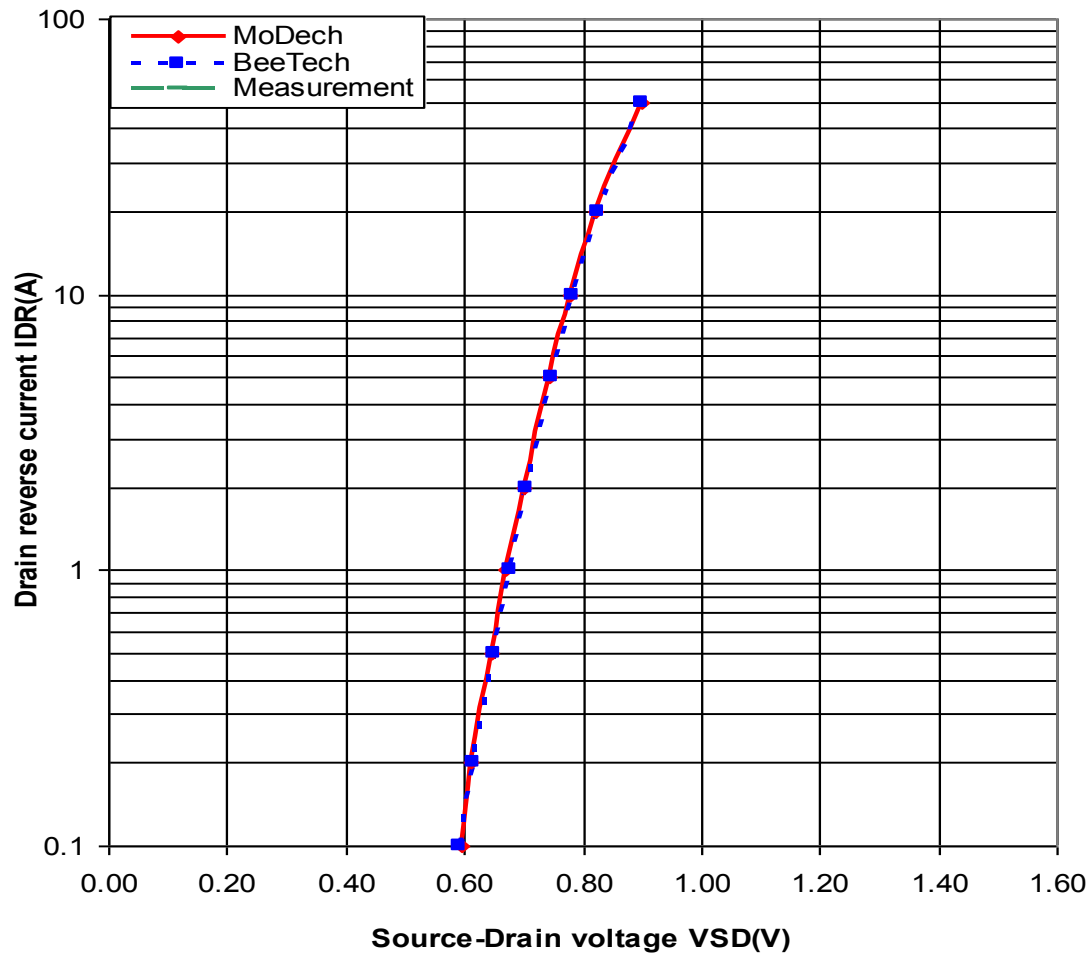


Evaluation Circuit



Comparison Graph

Circuit Simulation Result

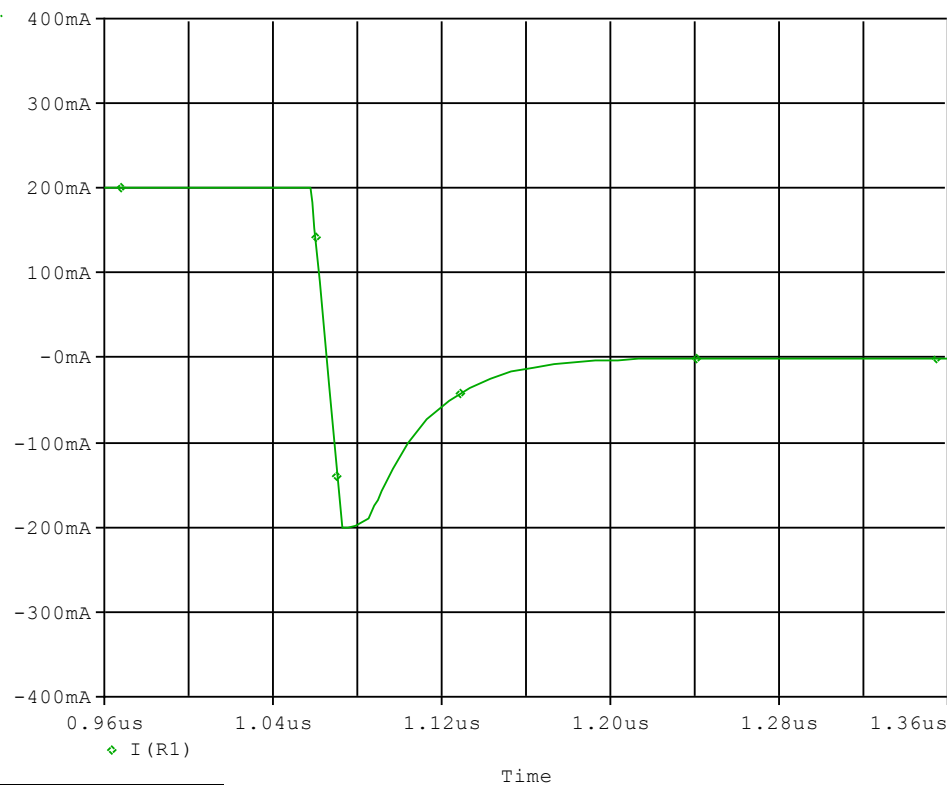


Simulation Result

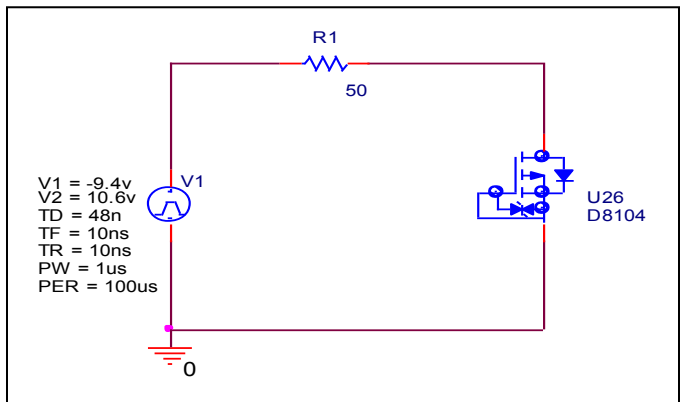
IDR(A)	VSD(V)		%Error
	Measuremen	Simulation	
0.1	0.595	0.590	-0.840
0.2	0.610	0.616	0.984
0.5	0.645	0.651	0.930
1	0.670	0.678	1.194
2	0.700	0.705	0.714
5	0.745	0.746	0.134
10	0.780	0.781	0.128
20	0.820	0.825	0.610
50	0.900	0.900	0.000

Reverse Recovery Characteristic

Circuit Simulation Result



Evaluation Circuit

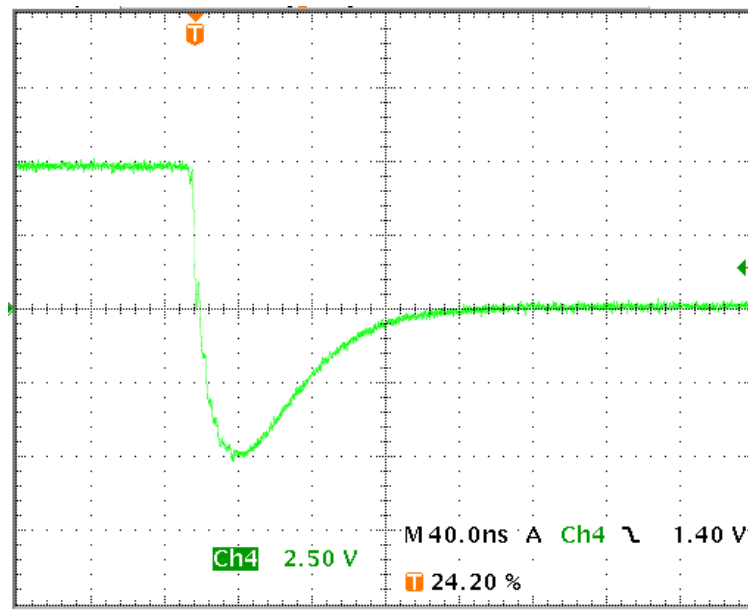


Compare Measurement vs. Simulation

	Measurement	Simulation	Error (%)
Trj(ns)	14.000	14.086	0.614
Trb(ns)	69.000	69.123	0.178
Trr(ns)	83.000	83.209	0.252

Reverse Recovery Characteristic

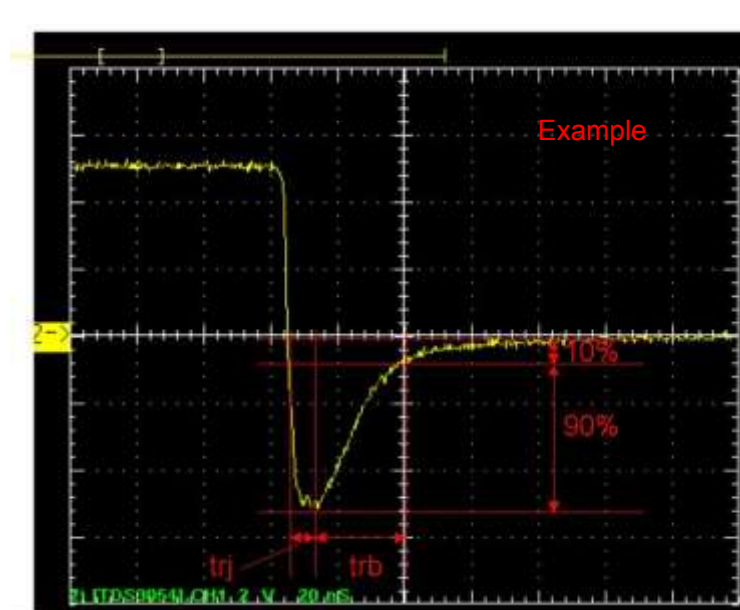
Reference



$t_{rr} = 14(\text{ns})$

$t_{rb} = 69(\text{ns})$

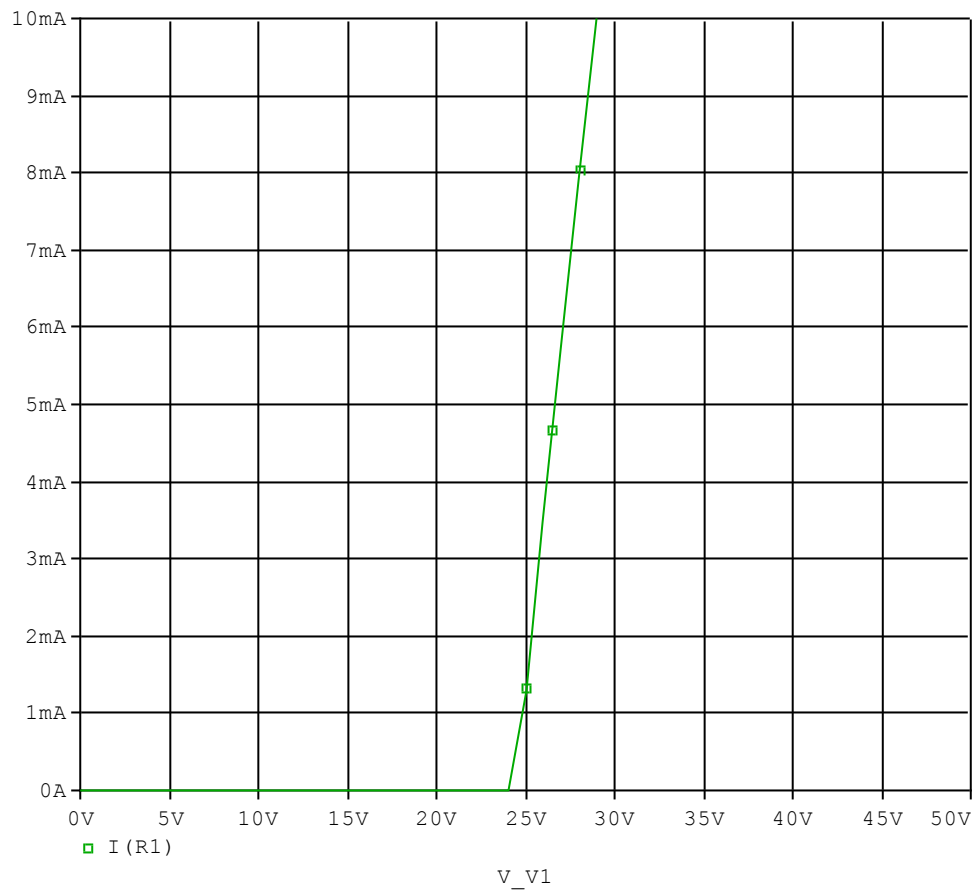
Conditions: $I_{fwd} = I_{rev} = 0.2(\text{A})$, $R_I = 50$



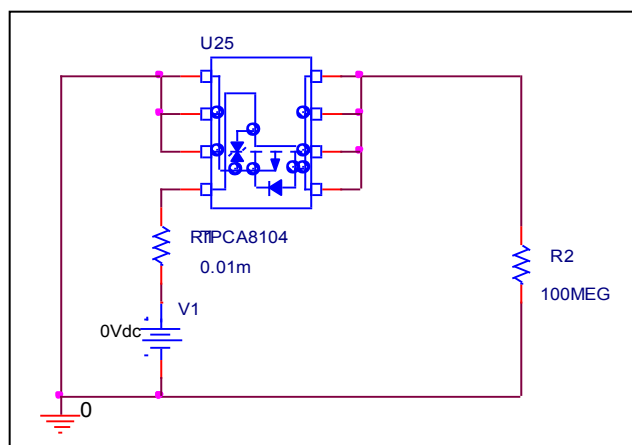
Relation between t_{rr} and t_{rb}

Zener Voltage Characteristic

Circuit Simulation Result



Evaluation Circuit



Zener Voltage Characteristic

Reference

