

Device Modeling Report

COMPONENTS: Power MOSFET (Professional)
PART NUMBER: SSM6J51TU
MANUFACTURER: TOSHIBA
Body Diode (Standard) / ESD Protection Diode

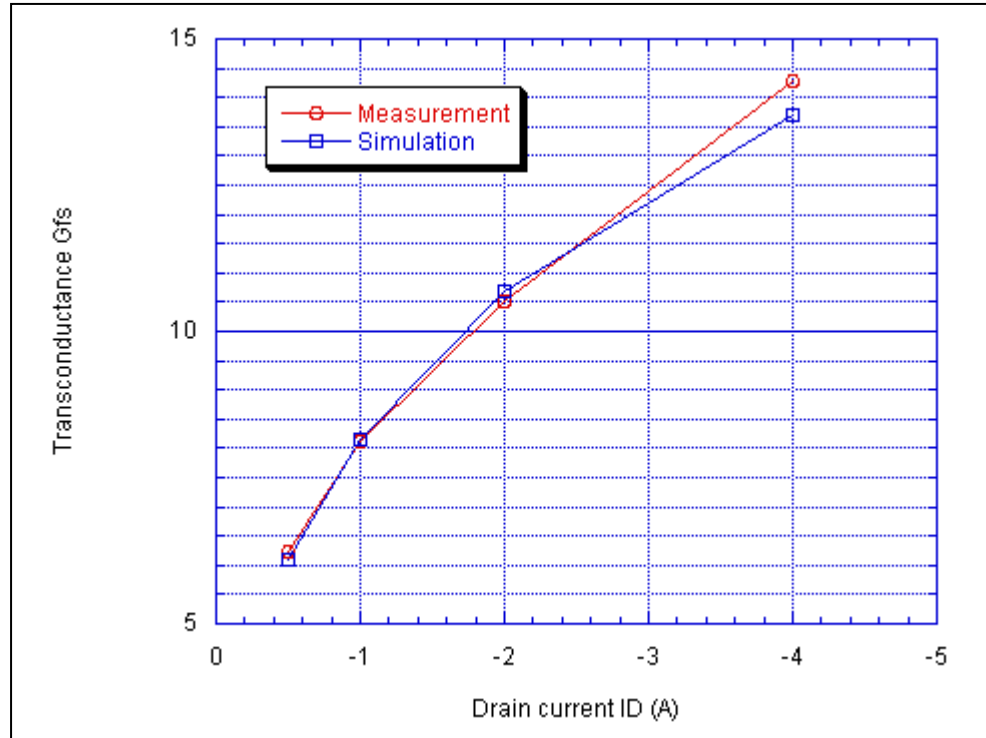


MOSFET MODEL

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

Transconductance Characteristic

Circuit Simulation Result

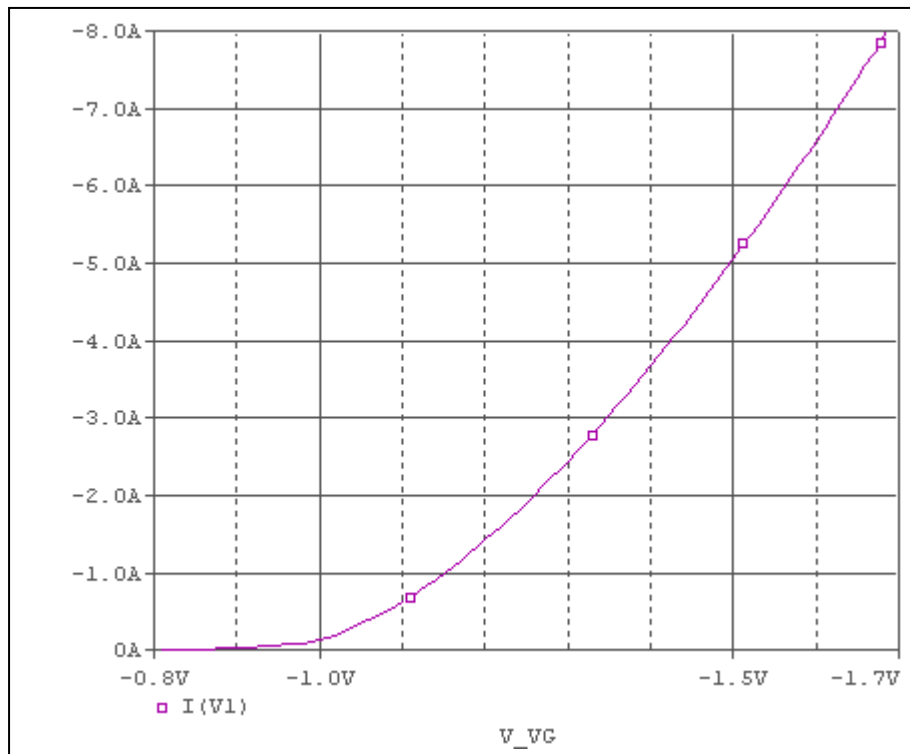


Comparison table

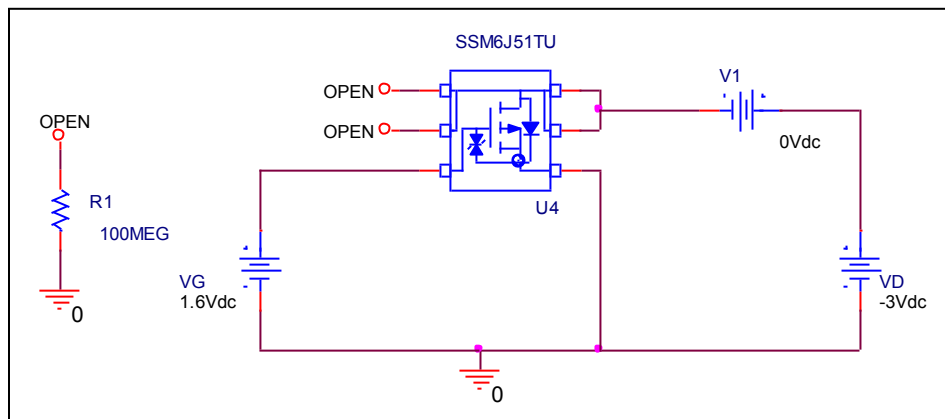
Id(A)	gfs		Error(%)
	Measurement	Simulation	
-0.500	6.250	6.108	-2.269
-1.000	8.130	8.150	0.246
-2.000	10.526	10.684	1.503
-4.000	14.286	13.695	-4.136

V_{gs}-I_d Characteristic

Circuit Simulation result

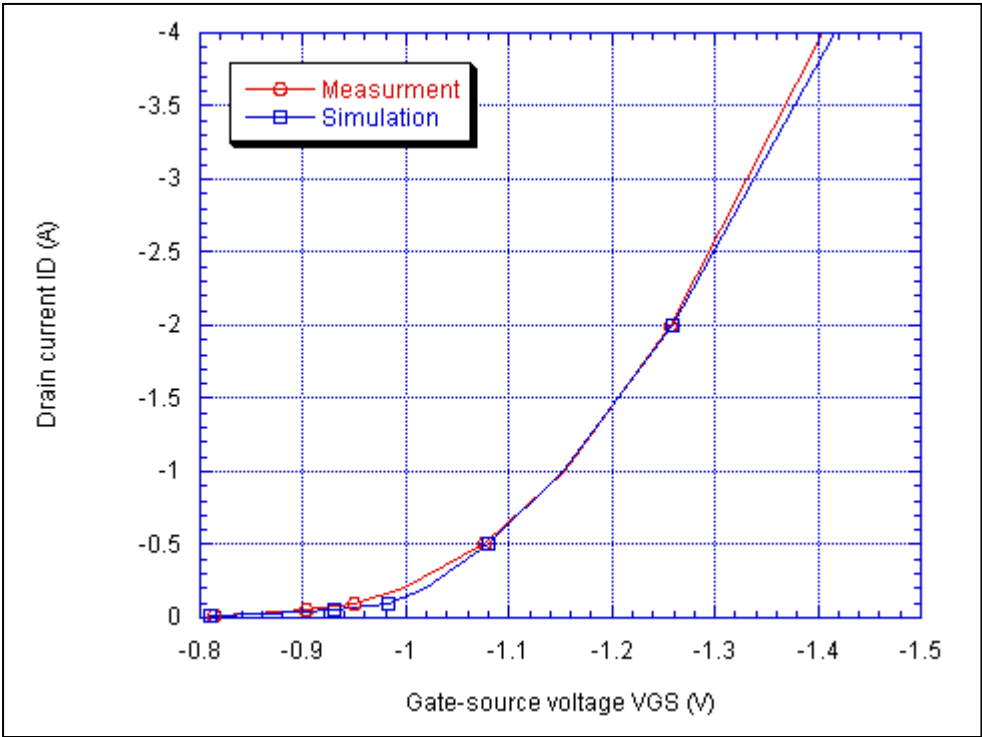


Evaluation circuit



Comparison Graph

Circuit Simulation Result

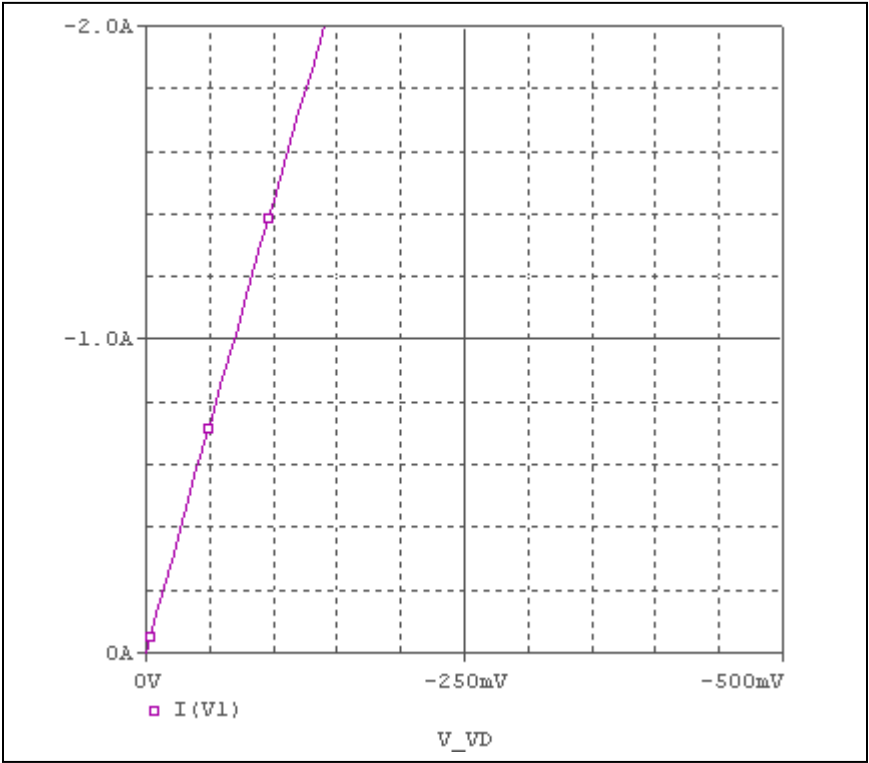


Simulation Result

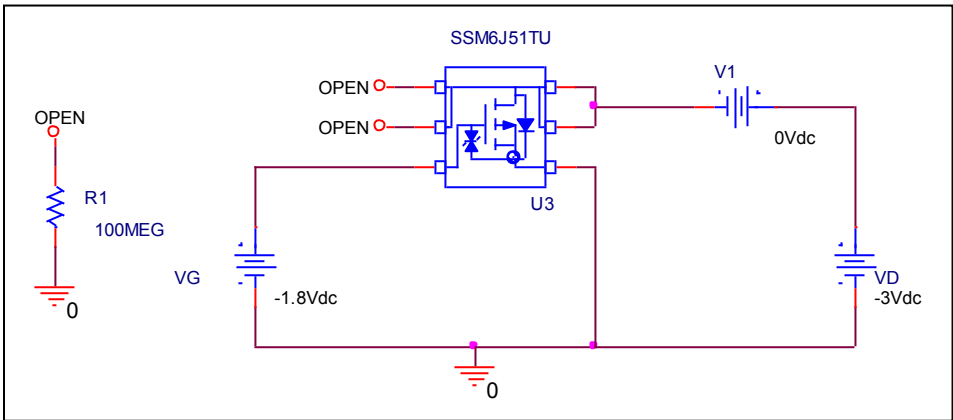
I_D (A)	V_{GS} (V)		Error (%)
	Measurement	Simulation	
-0.010	-0.813	-0.811	-0.303
-0.020	-0.850	-0.862	1.395
-0.050	-0.902	-0.930	3.113
-0.100	-0.950	-0.982	3.344
-0.200	-0.998	-1.020	2.154
-0.500	-1.076	-1.080	0.335
-1.000	-1.153	-1.151	-0.173
-2.000	-1.257	-1.259	0.143
-5.000	-1.479	-1.496	1.149

Id-Rds(on) Characteristic

Circuit Simulation result



Evaluation circuit

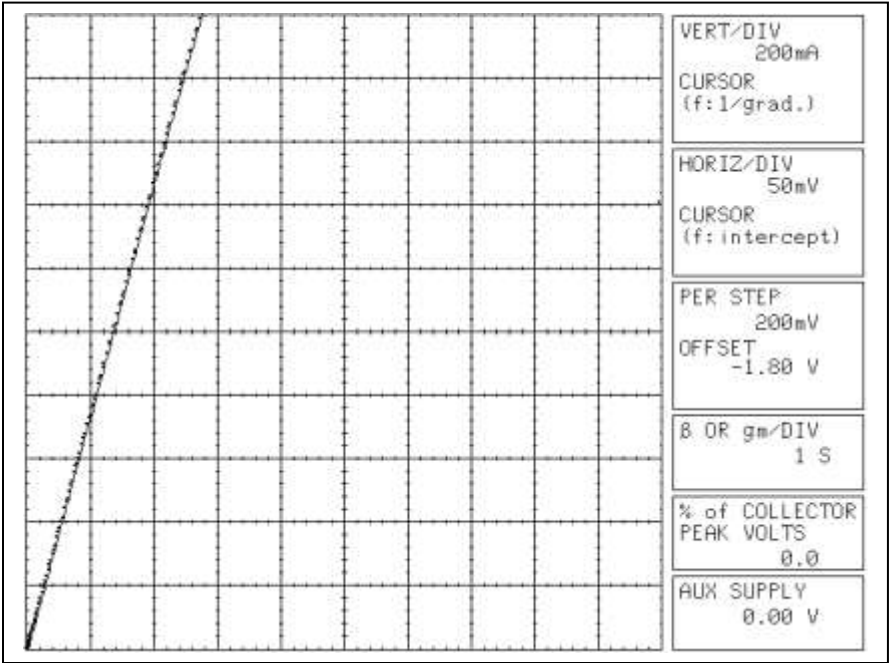


Simulation Result

$I_D=1.0A$, $V_{GS}=1.8V$	Measurement		Simulation		Error (%)
$R_{DS(on)}$	68.7755	mΩ	64.78	mΩ	0.0065

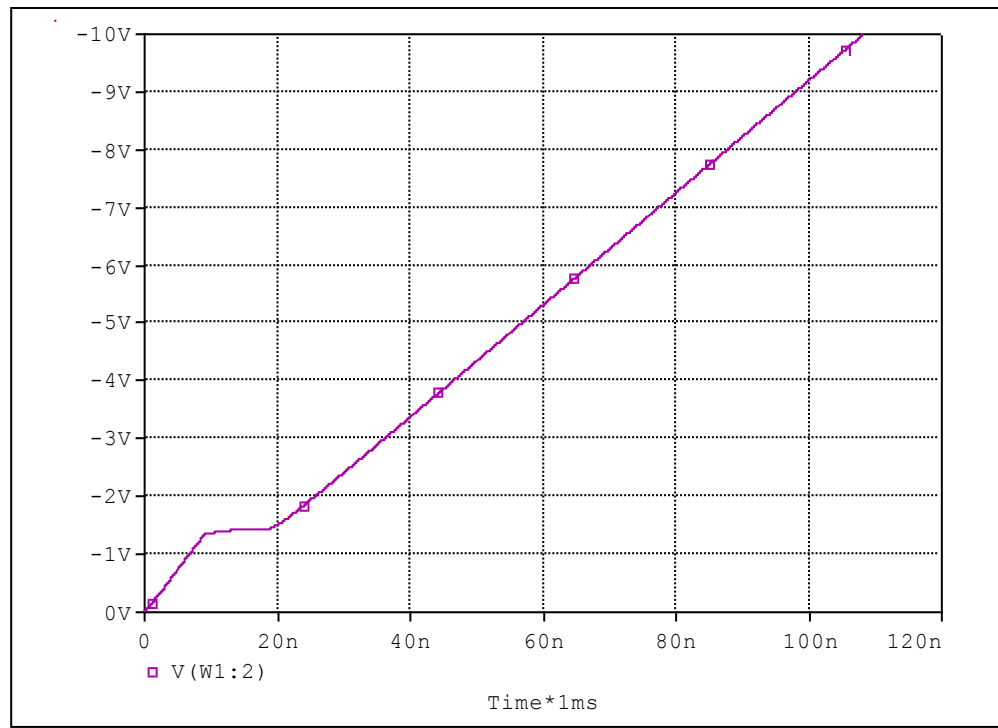
Id-Rds(on) Characteristic

Reference

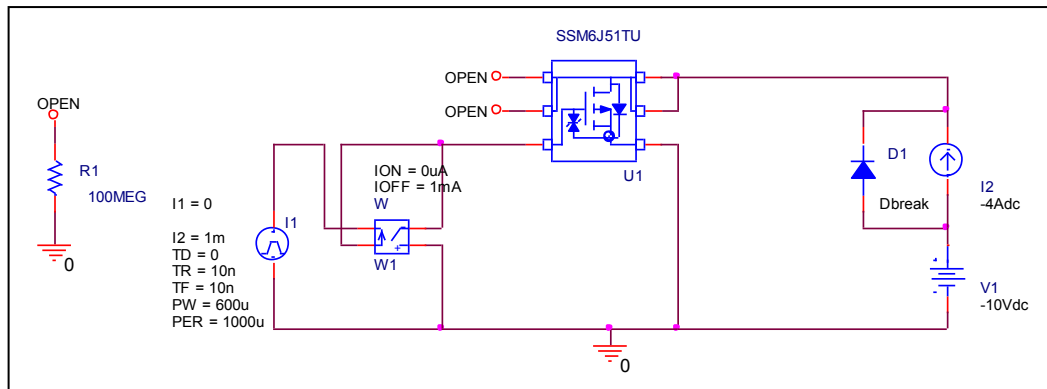


Gate Charge Characteristic

Circuit Simulation result



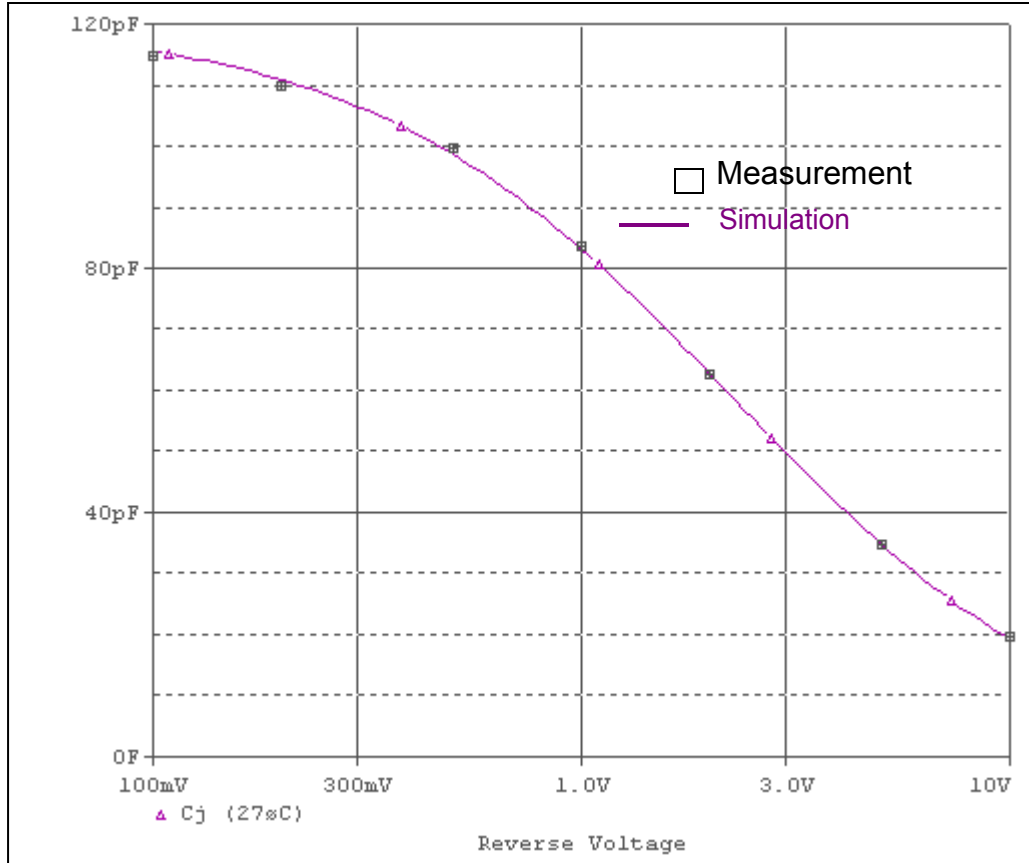
Evaluation circuit



Simulation Result

$V_{DD}=-10V, I_D=-4A$ $, V_{GS}=-5V$	Measurement		Simulation		Error (%)
Qgs	7.500	nC	7.463	nC	-0.497
Qgd	10.000	nC	10.088	nC	0.880
Qg	57.000	nC	56.871	nC	-0.226

Capacitance Characteristic

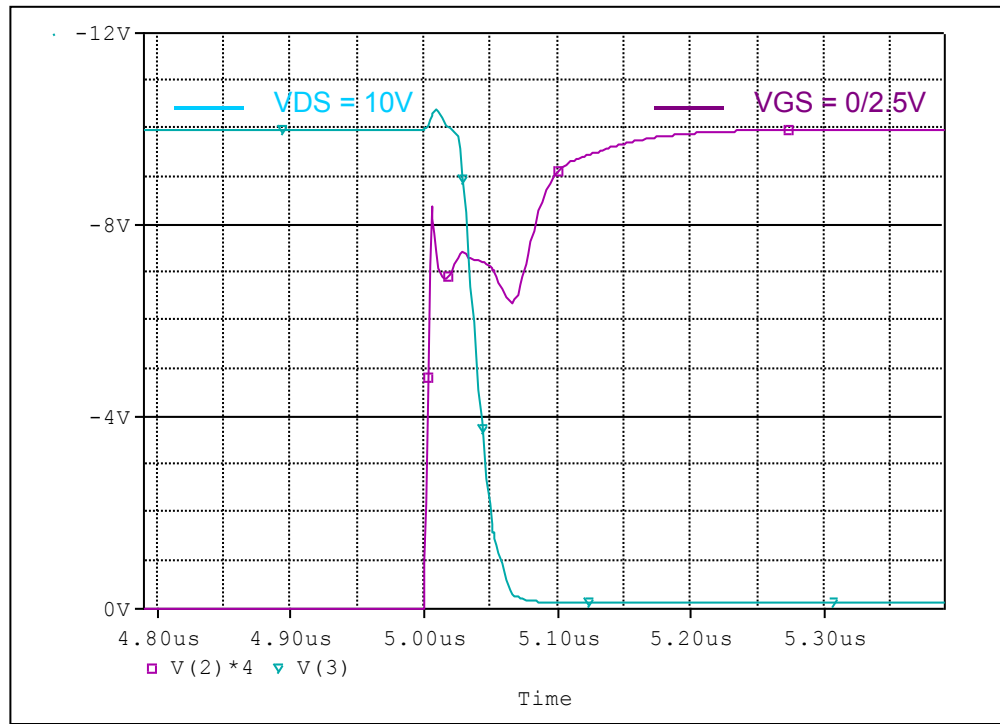


Simulation Result

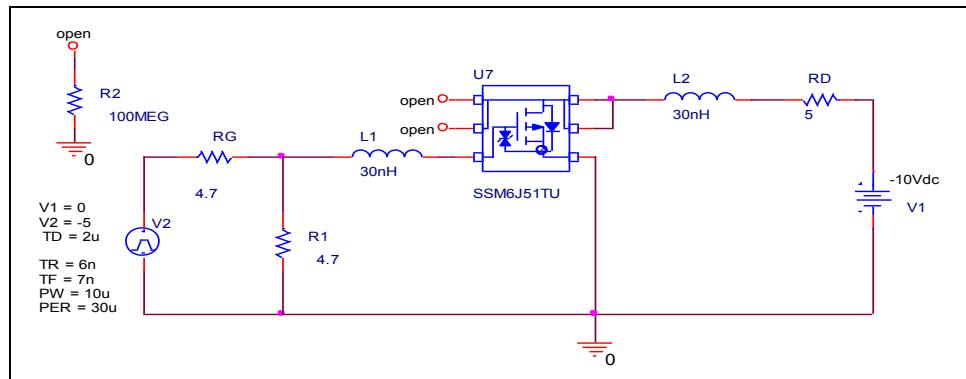
$V_{DS}(V)$	Cbd(pF)		Error(%)
	Measurement	Simulation	
0.100	115.000	115.700	0.609
0.200	110.000	110.900	0.818
0.500	100.000	99.000	-1.000
1.000	84.000	83.500	-0.595
2.000	63.000	62.650	-0.555
5.000	35.000	35.020	0.057
10.000	20.000	19.500	-2.500

Switching Time Characteristic

Circuit Simulation result



Evaluation circuit

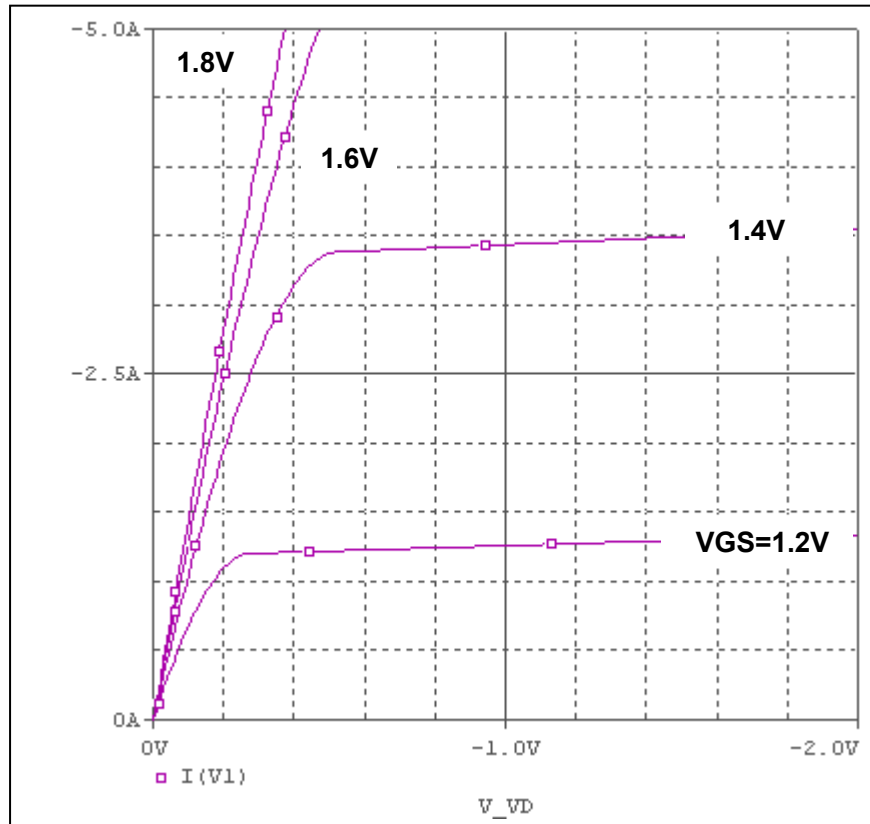


Simulation Result

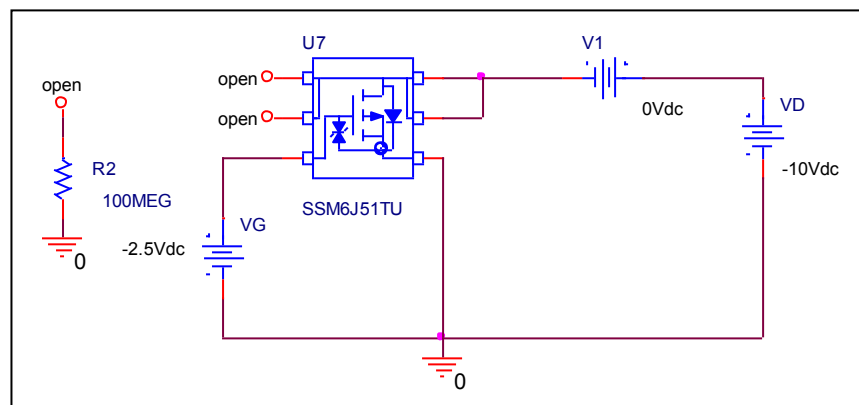
$I_D = 2.0A$, $V_{DD} = -10V$ $V_{GS} = 0/-2.5V$	Measurement		Simulation		Error(%)
t_{on}	57.00	ns	57.11	ns	0.19

Output Characteristic

Circuit Simulation result

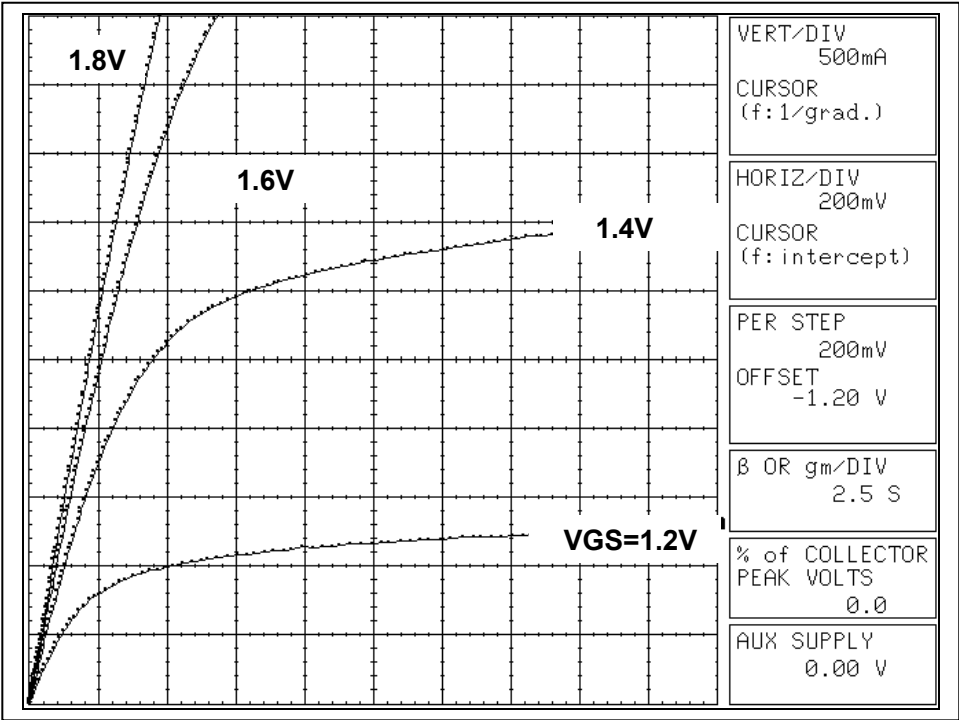


Evaluation circuit



Output Characteristics

Reference

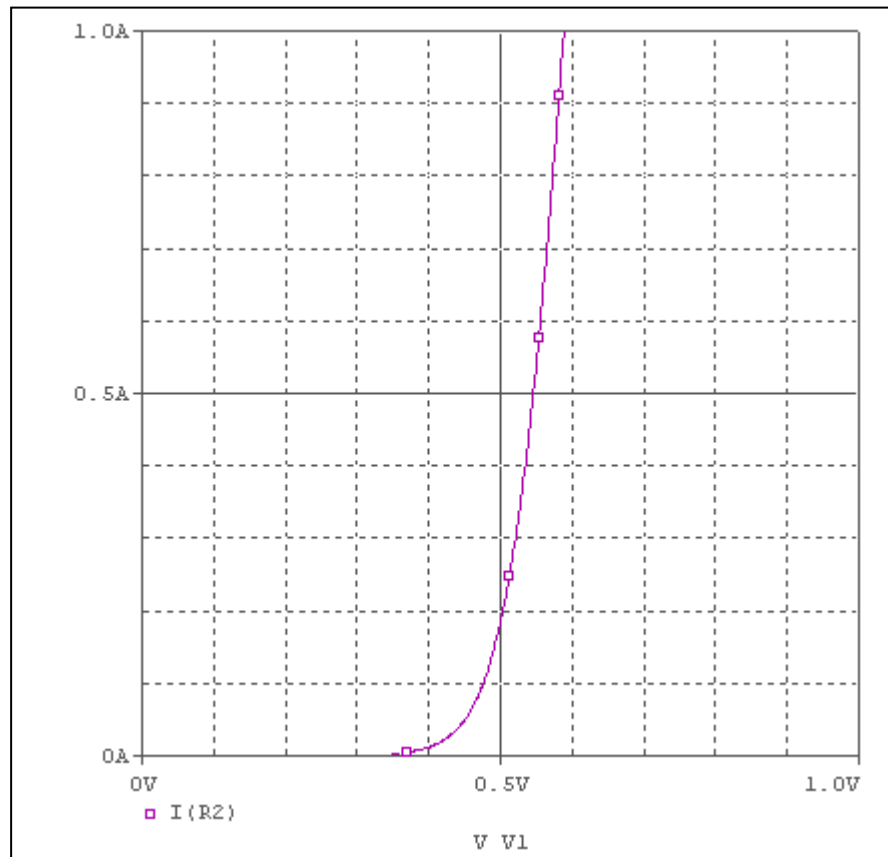


Body Diode Model

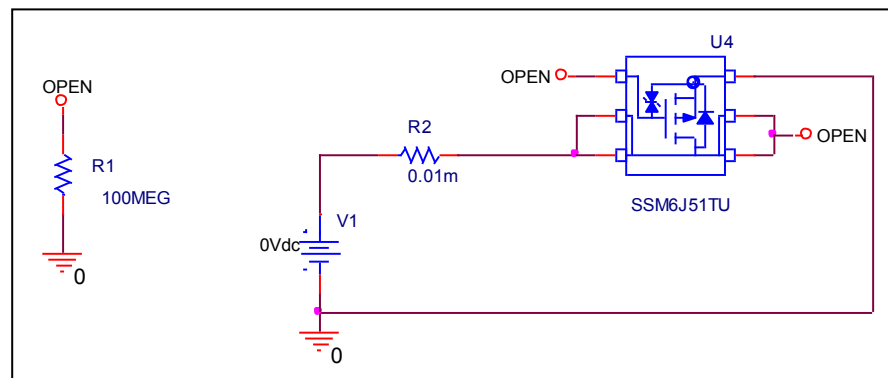
Pspice model parameter	Model description
IS	Saturation Current
N	Emission Coefficient
RS	Series Resistance
IKF	High-injection Knee Current
CJO	Zero-bias Junction Capacitance
M	Junction Grading Coefficient
VJ	Junction Potential
ISR	Recombination Current Saturation Value
BV	Reverse Breakdown Voltage(a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

Forward Current Characteristic

Circuit Simulation Result

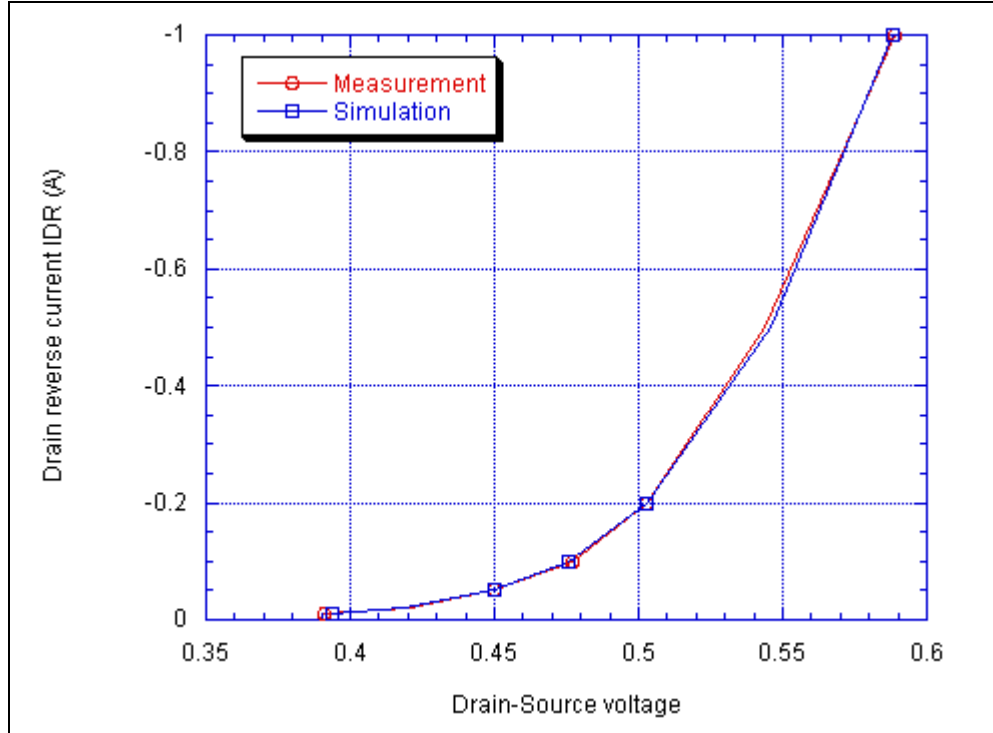


Evaluation Circuit



Comparison Graph

Circuit Simulation Result

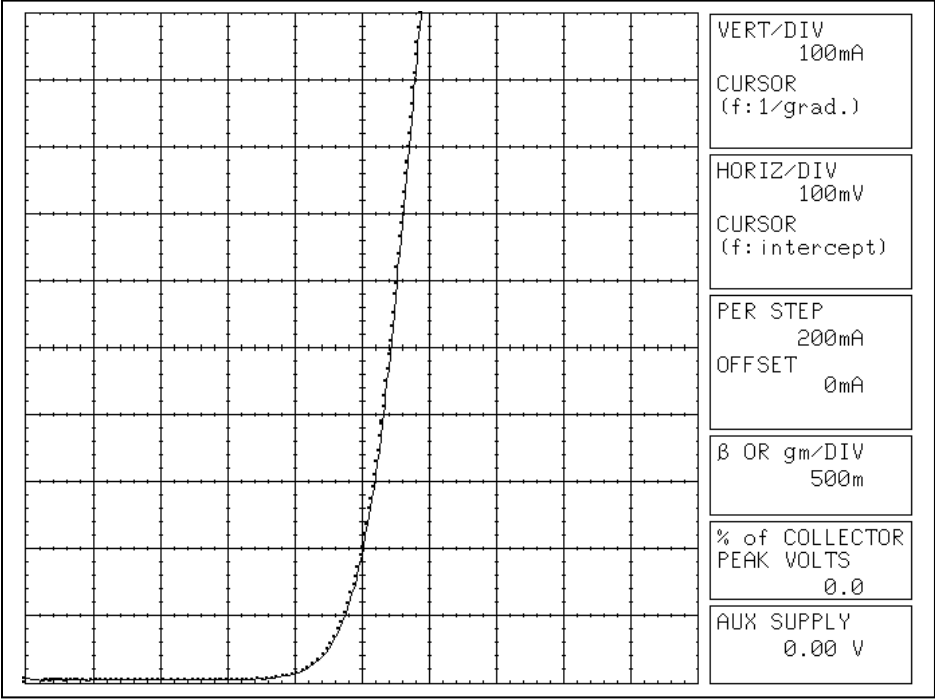


Simulation Result

Ifwd(A)	Vfwd(V) Measurement	Vfwd(V) Simulation	%Error
0.010	0.391	0.394	0.730
0.020	0.421	0.419	-0.476
0.050	0.450	0.450	0.024
0.100	0.477	0.476	-0.275
0.200	0.503	0.503	0.025
0.500	0.544	0.546	0.344
1.000	0.589	0.588	-0.141

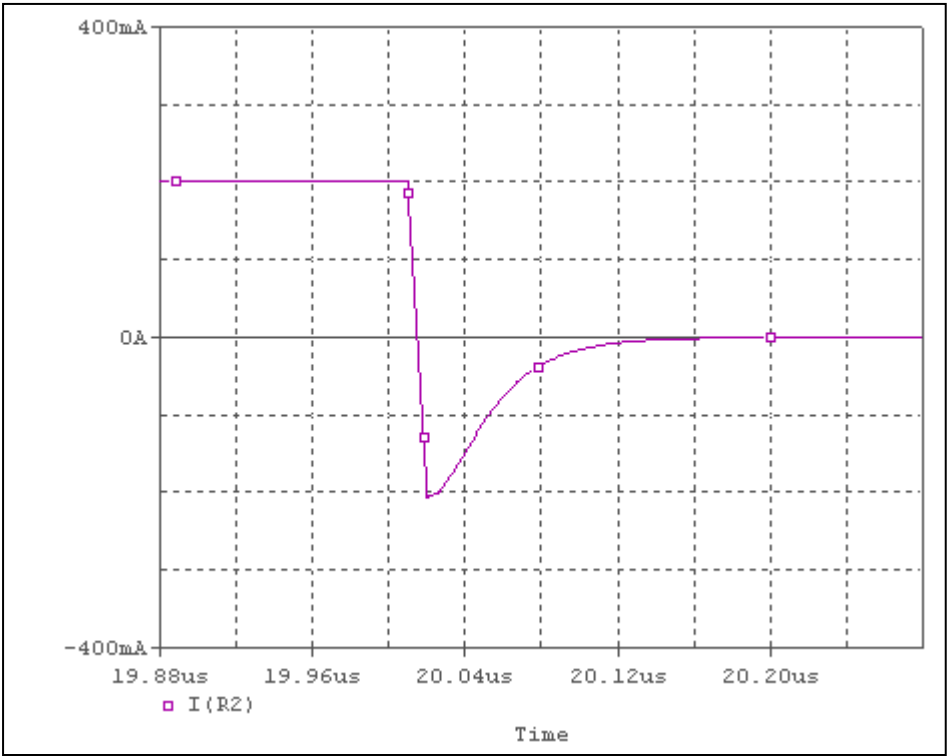
Forward Current Characteristic

Reference

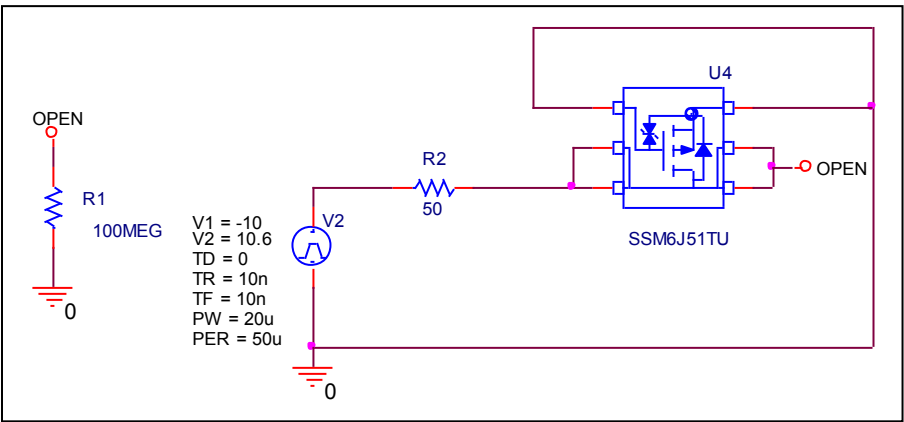


Reverse Recovery Characteristic

Circuit Simulation Result



Evaluation Circuit

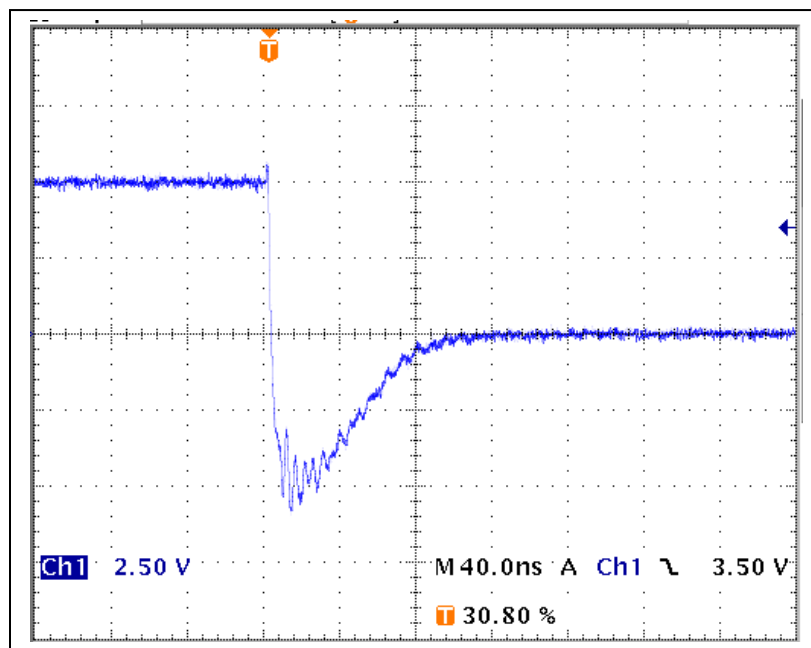


Compare Measurement vs. Simulation

	Measurement		Simulation		Error (%)
$t_{rr}=t_{rj}+t_{rb}$	76.800	ns	76.824	ns	0.031

Reverse Recovery Characteristic

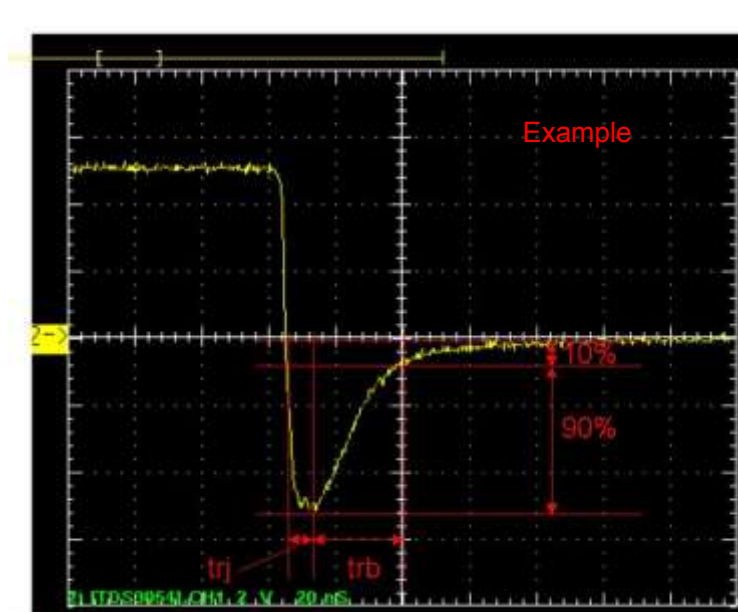
Reference



$Trj=13.6(ns)$

$Trb=63.2(ns)$

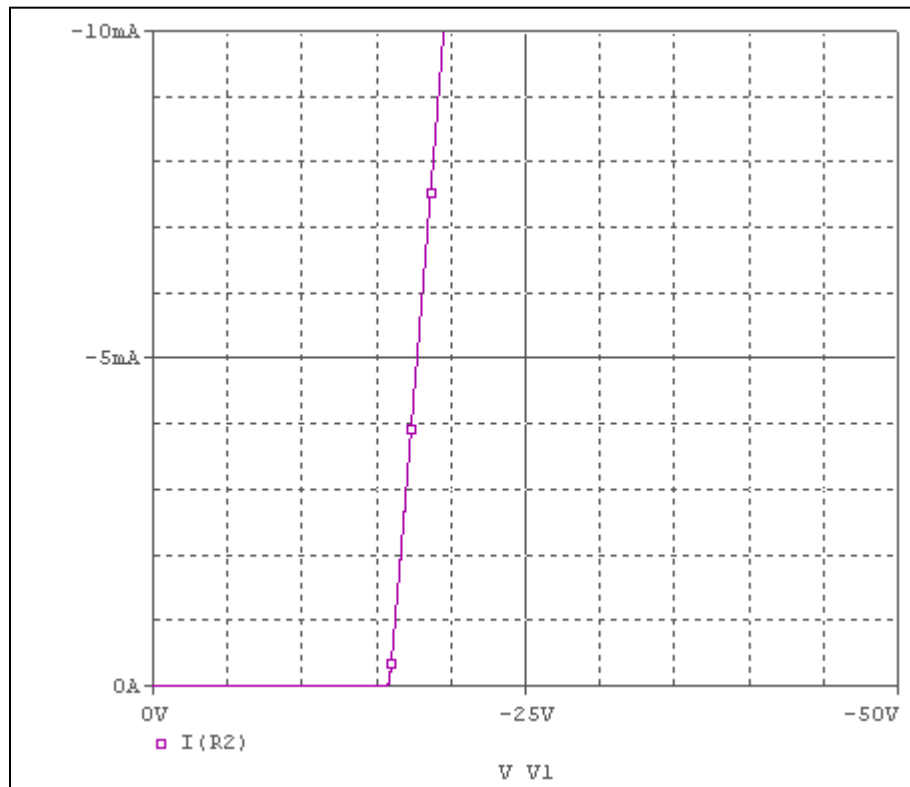
Conditions: $I_{fwd}=I_{rev}=0.2(A)$, $R_I=50$



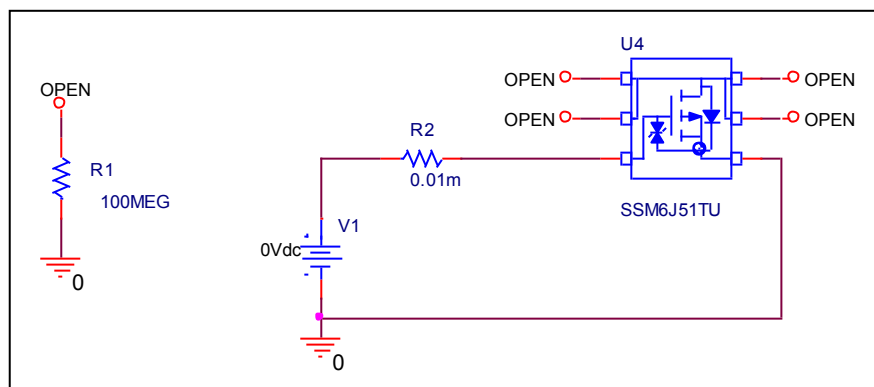
Relation between trj and trb

Zener Voltage Characteristic

Circuit Simulation Result



Evaluation Circuit



Zener Voltage Characteristic

Reference

