

Device Modeling Report

COMPONENTS: Power MOSFET (Professional)
PART NUMBER: 2SK2563
MANUFACTURER: Shindengen
REMARK: Body Diode (Standard)



Bee Technologies Inc.

POWER MOSFET MODEL

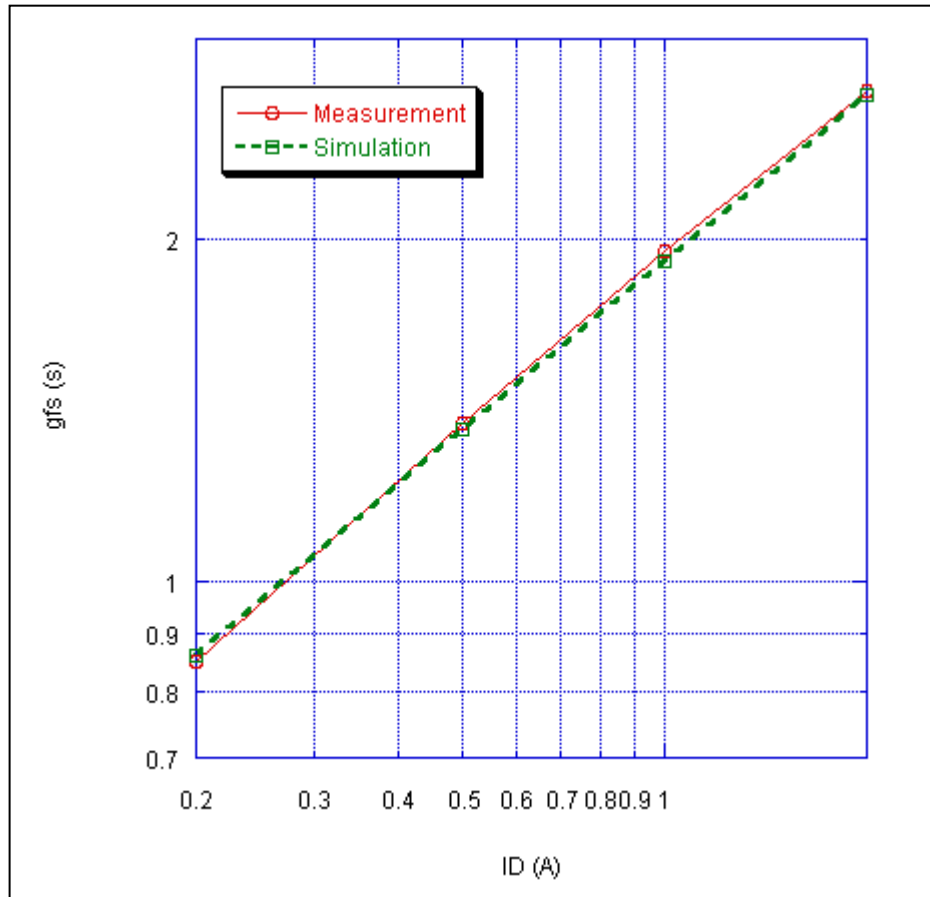
Pspice model parameter	Model description
LEVEL	
L	Channel Length
W	Channel Width
KP	Transconductance
RS	Source Ohmic Resistance
RD	Ohmic Drain Resistance
VTO	Zero-bias Threshold Voltage
RDS	Drain-Source Shunt Resistance
TOX	Gate Oxide Thickness
CGSO	Zero-bias Gate-Source Capacitance
CGDO	Zero-bias Gate-Drain 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

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

Transconductance Characteristic

Circuit Simulation Result

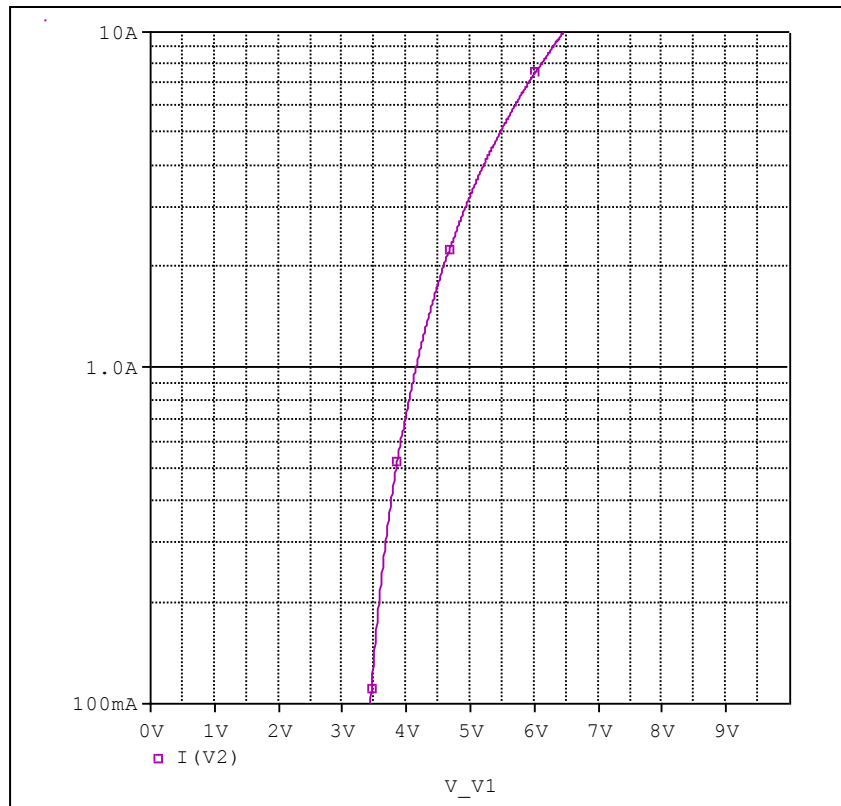


Comparison table

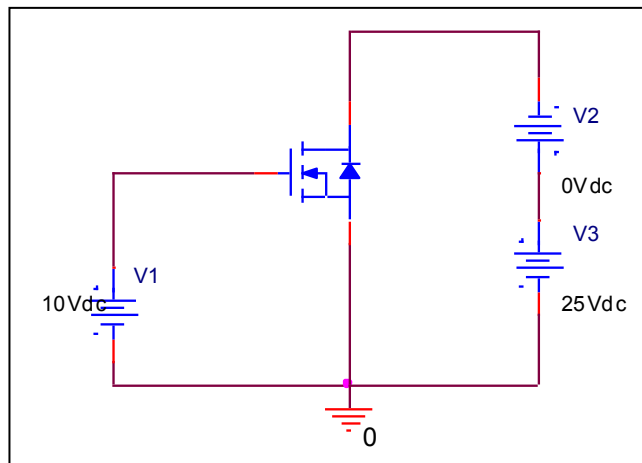
I_D (A)	V_{GS} (V)		Error (%)
	Measurement	Simulation	
0.200	0.850	0.860	1.176
0.500	1.380	1.360	-1.449
1.000	1.950	1.910	-2.051
2.000	2.700	2.680	-0.741

Vgs-Id Characteristic

Circuit Simulation result

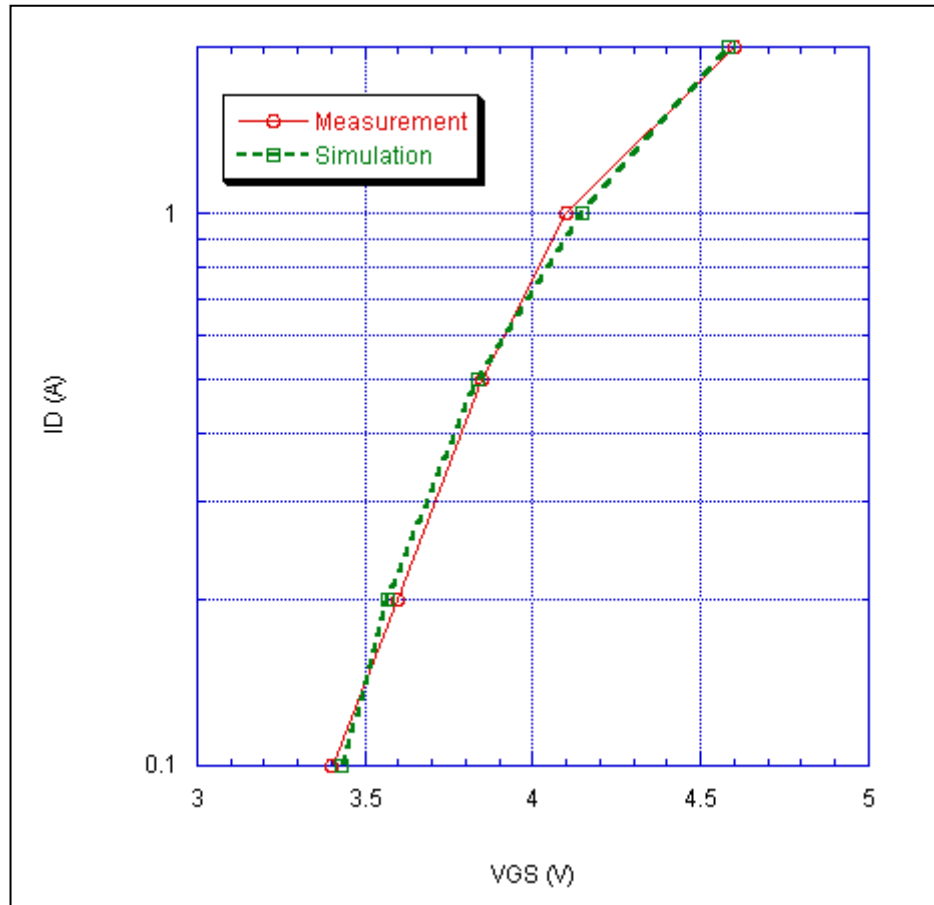


Evaluation circuit



Comparison Graph

Circuit Simulation Result

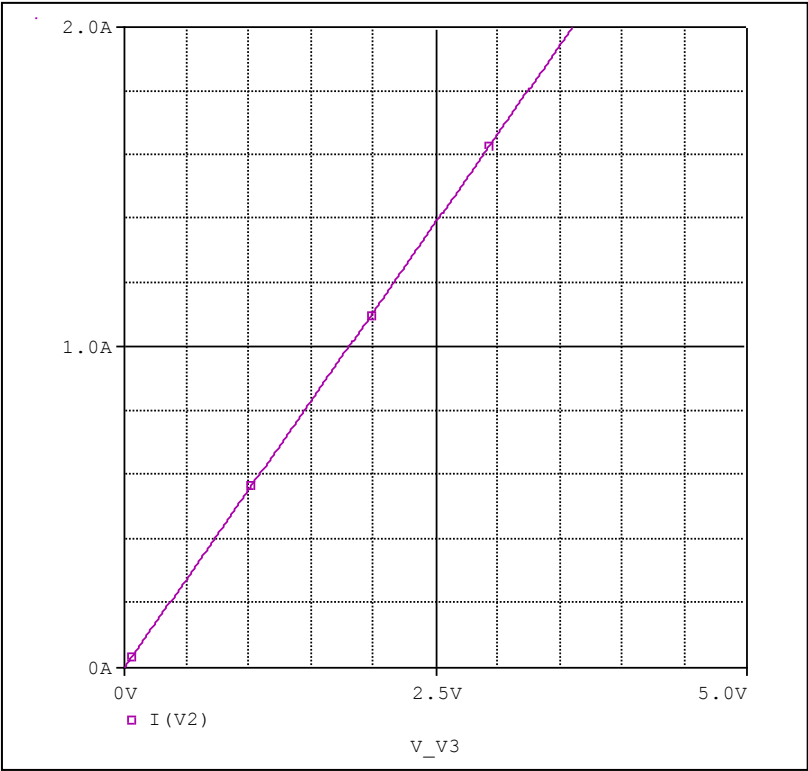


Simulation Result

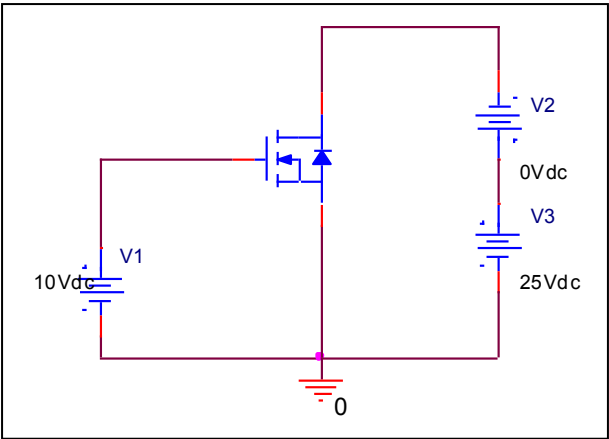
I_D (A)	V_{GS} (V)		Error (%)
	Measurement	Simulation	
0.100	3.400	3.431	0.918
0.200	3.600	3.568	-0.892
0.500	3.850	3.839	-0.291
1.000	4.100	4.145	1.107
2.000	4.600	4.582	-0.391

Id-Rds(on) Characteristic

Circuit Simulation result



Evaluation circuit

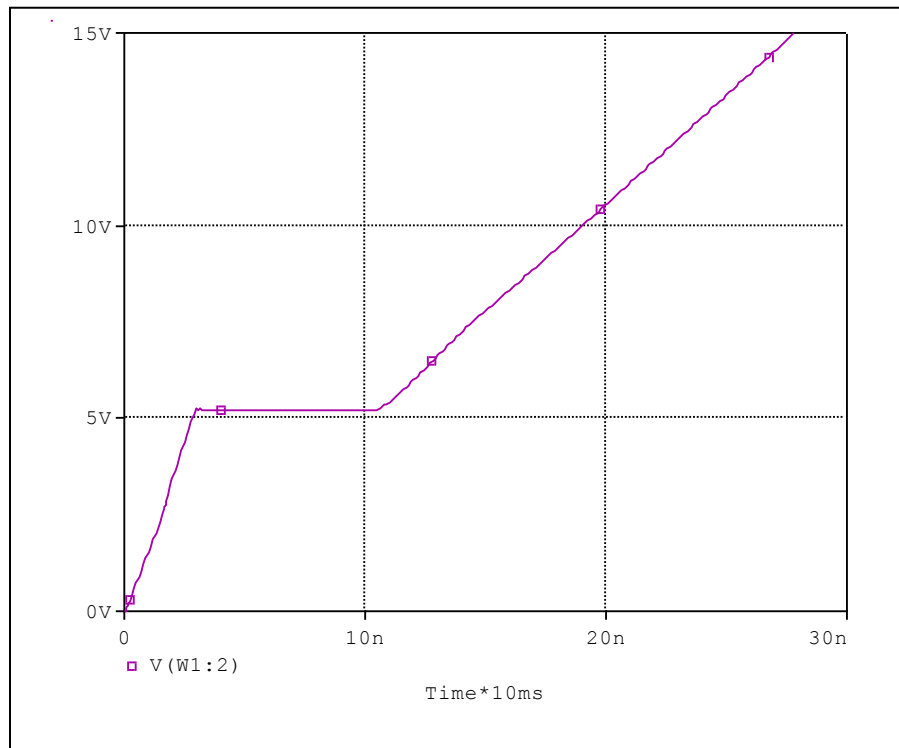


Simulation Result

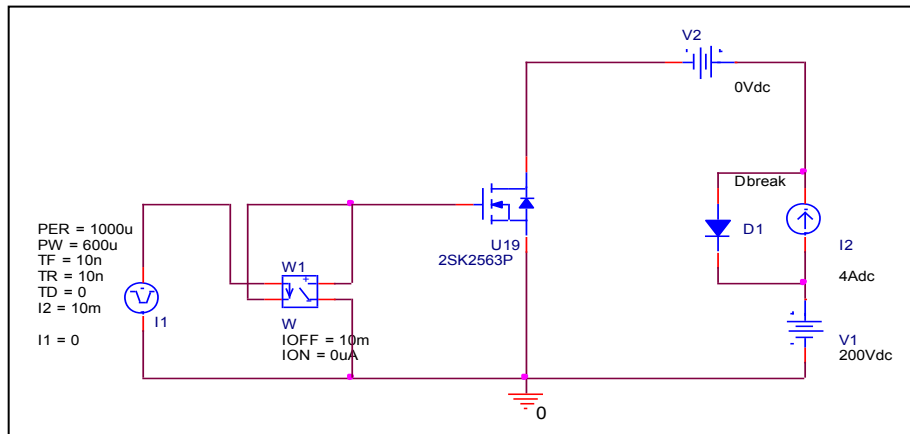
$I_D=2A, V_{GS}=10V$	Measurement		Simulation		Error (%)
$R_{DS} (on)$	1.800	Ω	1.800	Ω	0.000

Gate Charge Characteristic

Circuit Simulation result



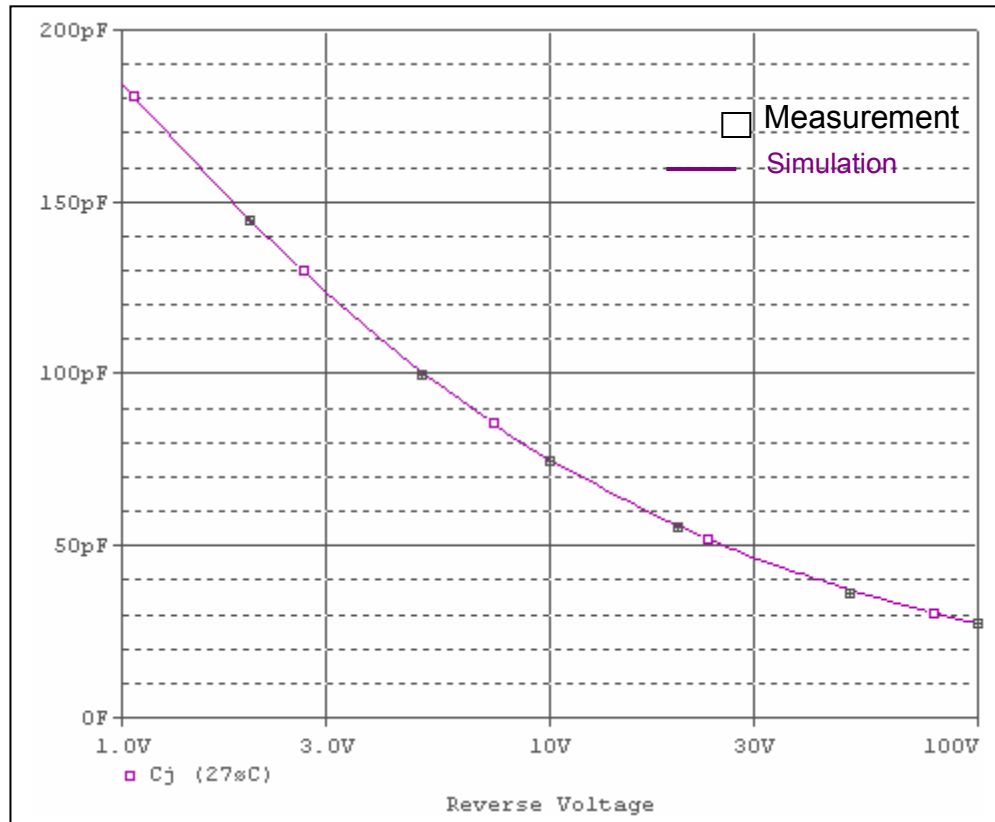
Evaluation circuit



Simulation Result

$V_{DD}=200V$ $I_D=4A$	Measurement		Simulation		Error (%)
Qgs	3.000	nC	3.018	nC	0.600
Qgd	7.500	nC	7.556	nC	0.747
Qg	19.000	nC	18.995	nC	-0.026

Capacitance Characteristic (Vds vs. Cbd)

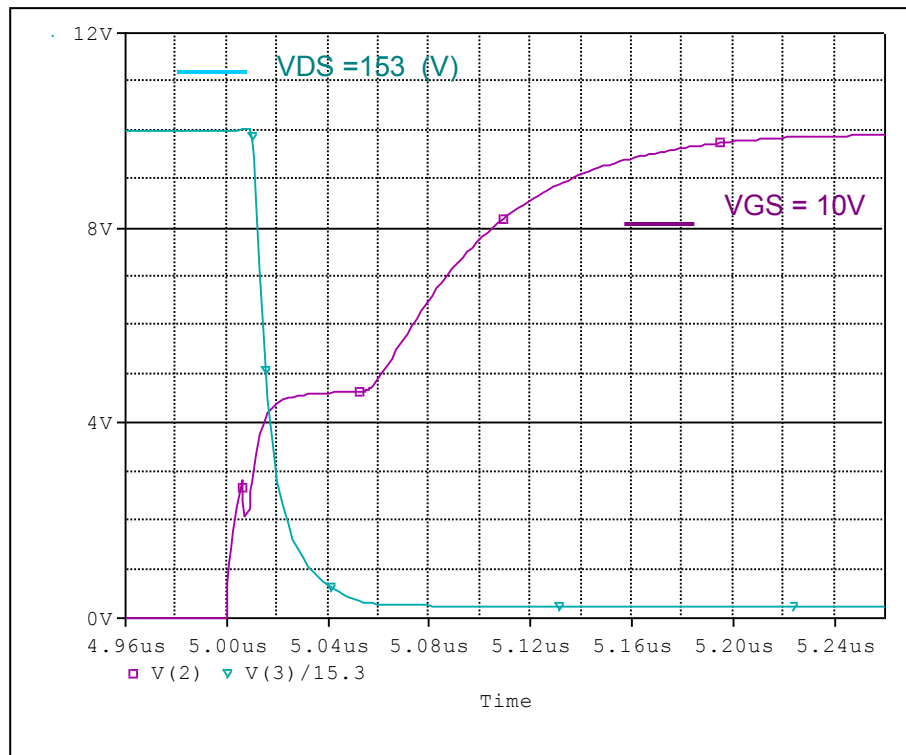


Simulation Result

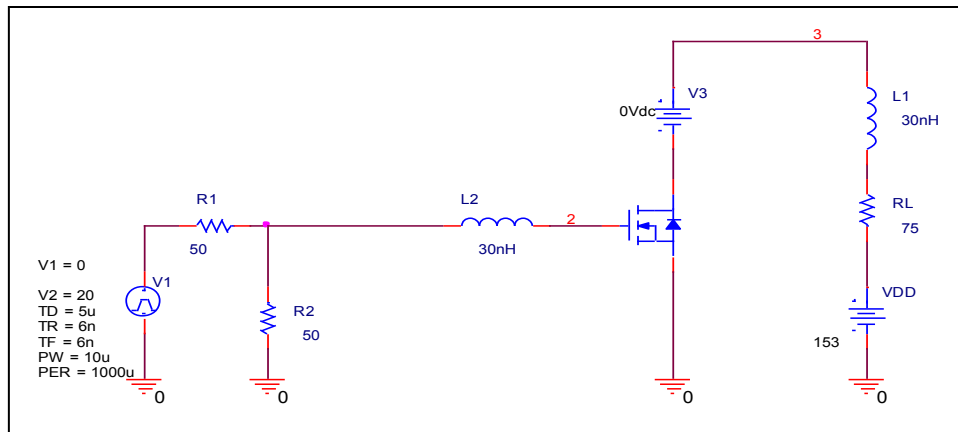
V _{DS} (V)	Cbd(pF)		Error(%)
	Measurement	Simulation	
2.000	145.000	144.000	-0.690
5.000	100.000	101.400	1.400
10.000	75.000	75.180	0.240
20.000	56.000	55.400	-1.071
50.000	37.000	37.600	1.622
100.000	28.000	27.400	-2.143

Switching Time Characteristic

Circuit Simulation result



Evaluation circuit

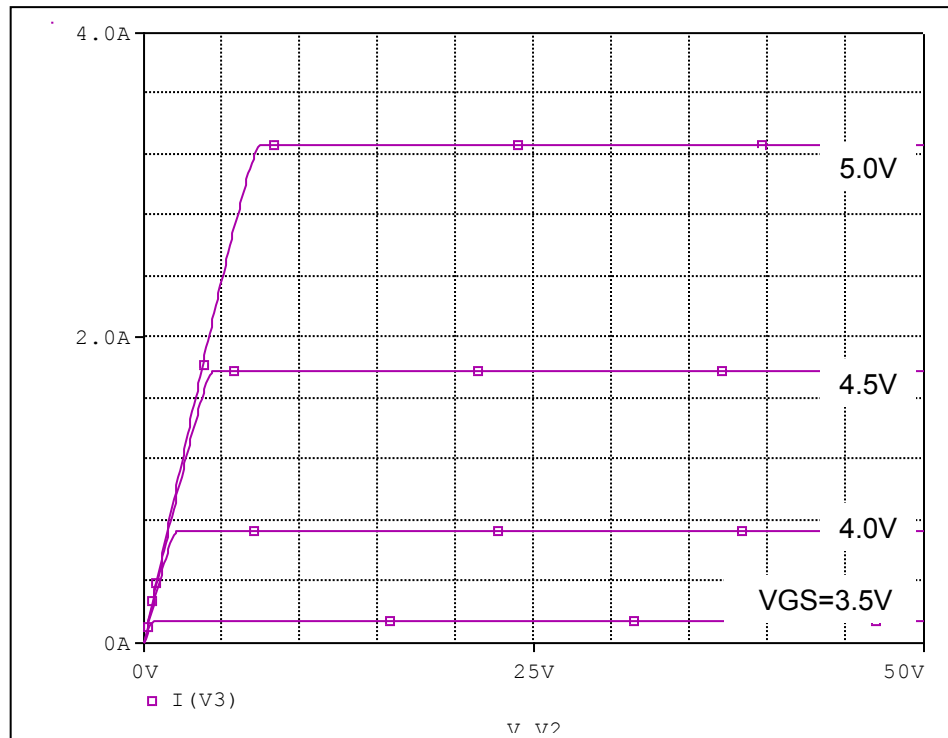


Simulation Result

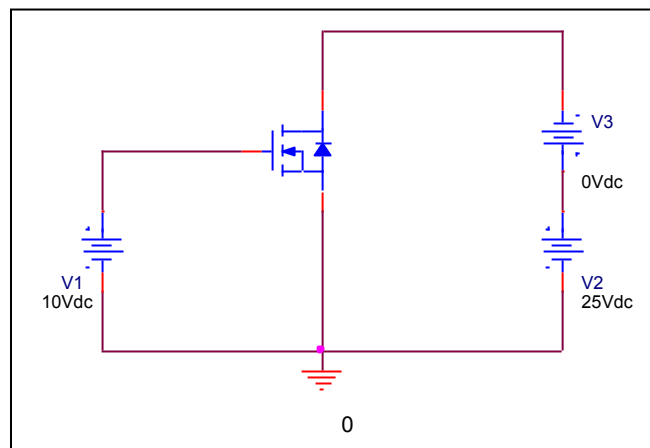
$I_D=2A$, $V_{DD}=153V$ $V_{GS}=0/10V$	Measurement		Simulation		Error(%)
ton	28.00	ns	28.31	ns	1.11

Output Characteristic

Circuit Simulation result

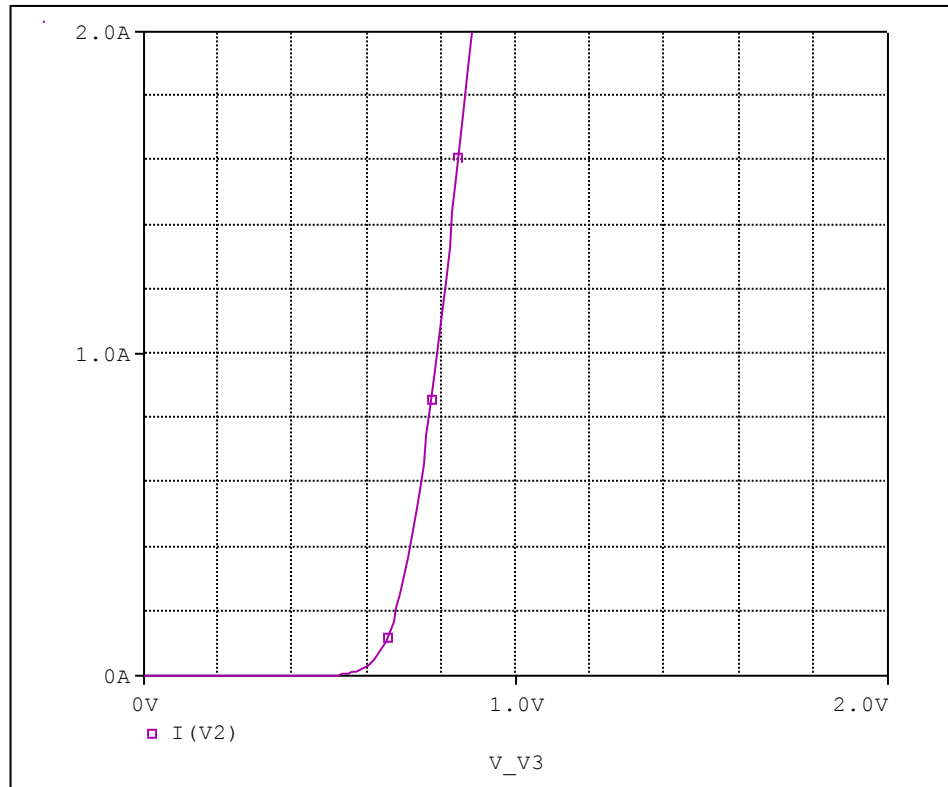


Evaluation circuit

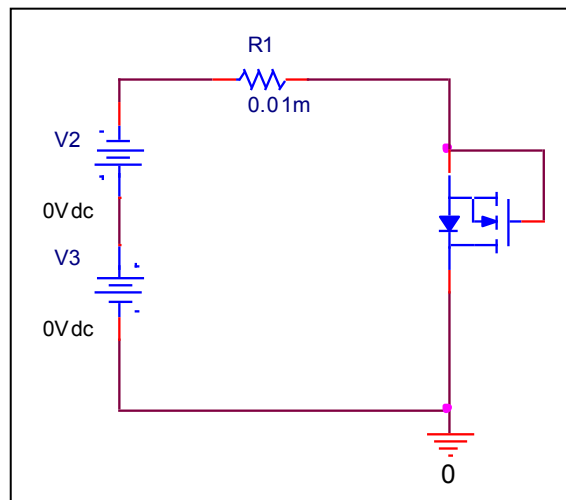


Forward Current Characteristic of Reverse Diode

Circuit Simulation Result

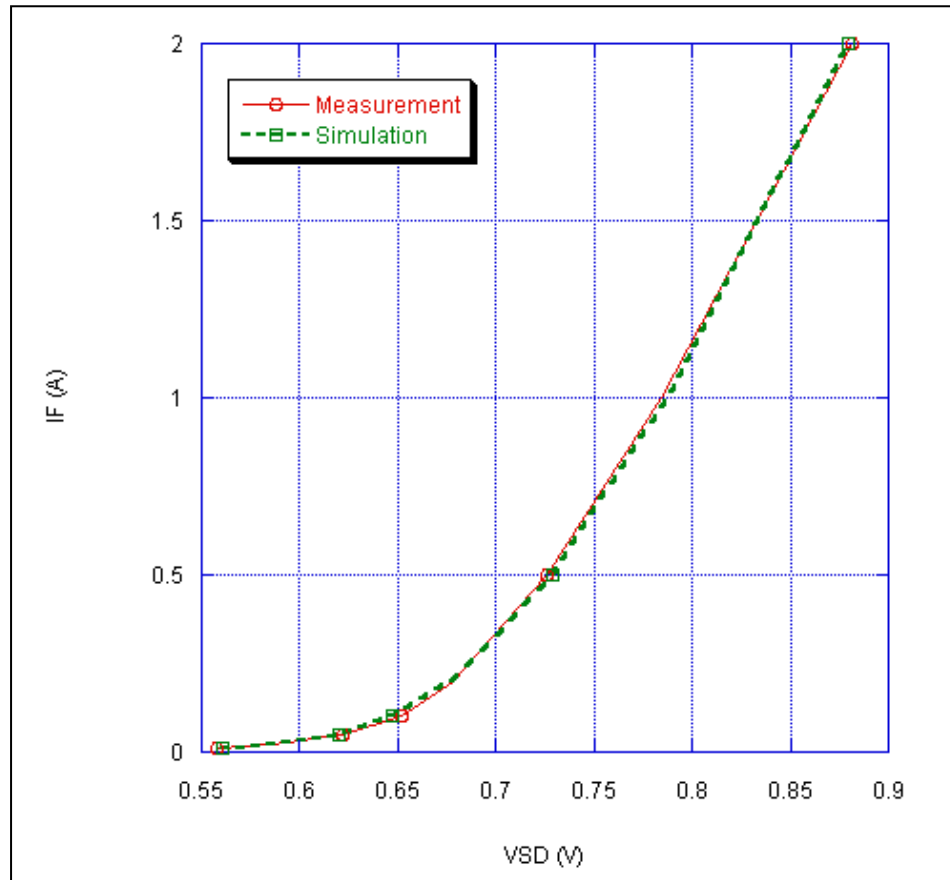


Evaluation Circuit



Comparison Graph

Circuit Simulation Result

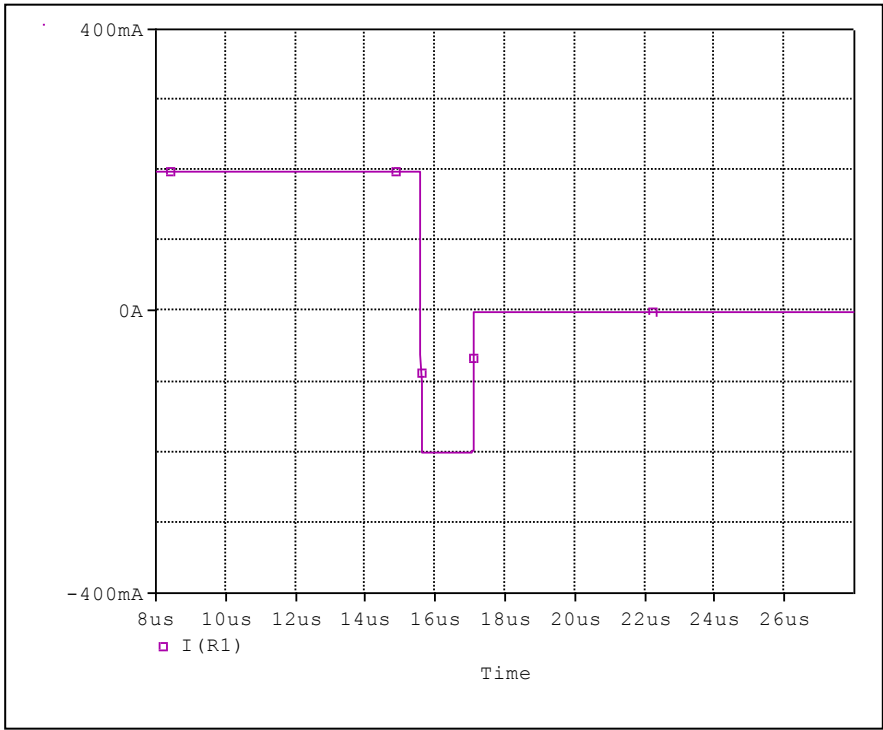


Simulation Result

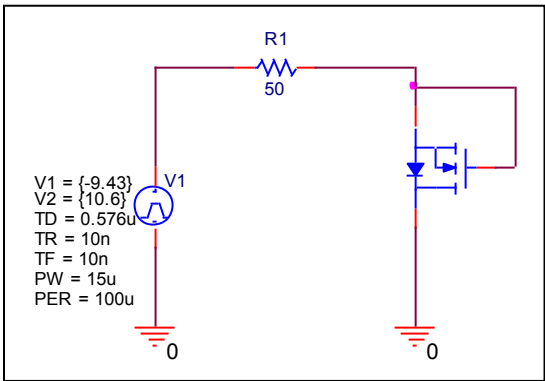
Ifwd(A)	Vfwd(V) Measurement	Vfwd(V) Simulation	%Error
0.010	0.558	0.561	0.538
0.020	0.586	0.586	-0.004
0.050	0.622	0.620	-0.322
0.100	0.652	0.647	-0.767
0.200	0.678	0.677	-0.086
0.500	0.726	0.729	0.413
1.000	0.784	0.787	0.383
2.000	0.882	0.880	-0.227

Reverse Recovery Characteristic

Circuit Simulation Result



Evaluation Circuit

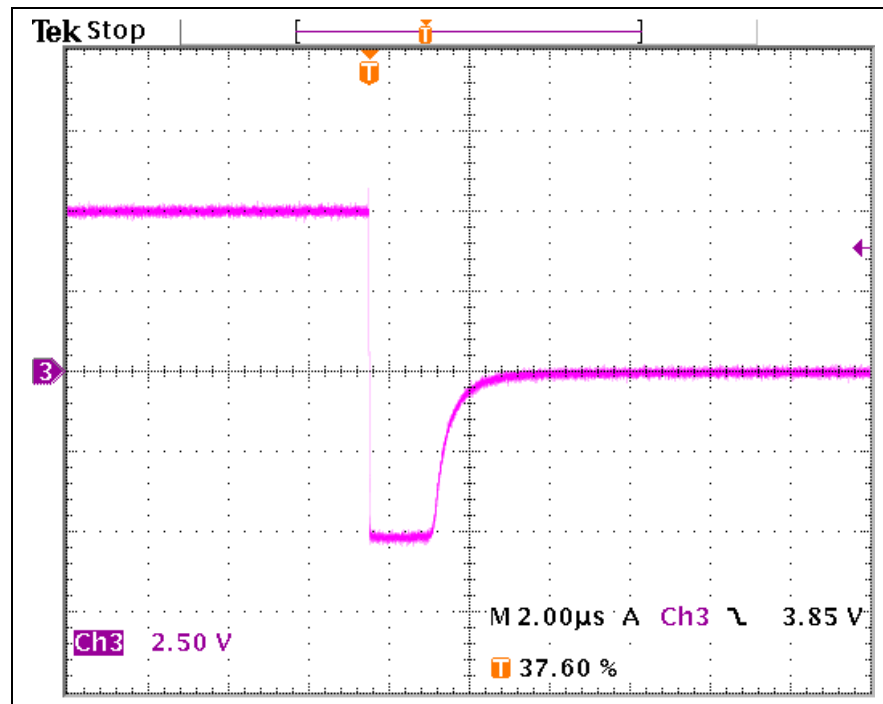


Compare Measurement vs. Simulation

	Measurement		Simulation		Error (%)
trj	1.520	us	1.521	us	0.066

Reverse Recovery Characteristic

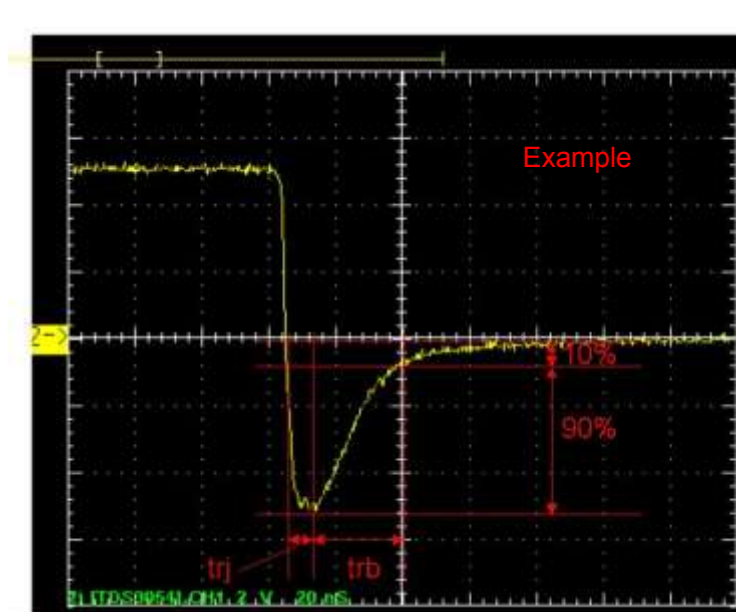
Reference



$T_{rj}=1.52(\mu s)$

$T_{rb}=0.88(\mu s)$

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



Relation between t_{rj} and t_{rb}