

Device Modeling Report

COMPONENTS: MOSFET (Professional Model)
PART NUMBER: 2SK4101LS
MANUFACTURER: SANYO
REMARK: Body Diode (Professional Model)



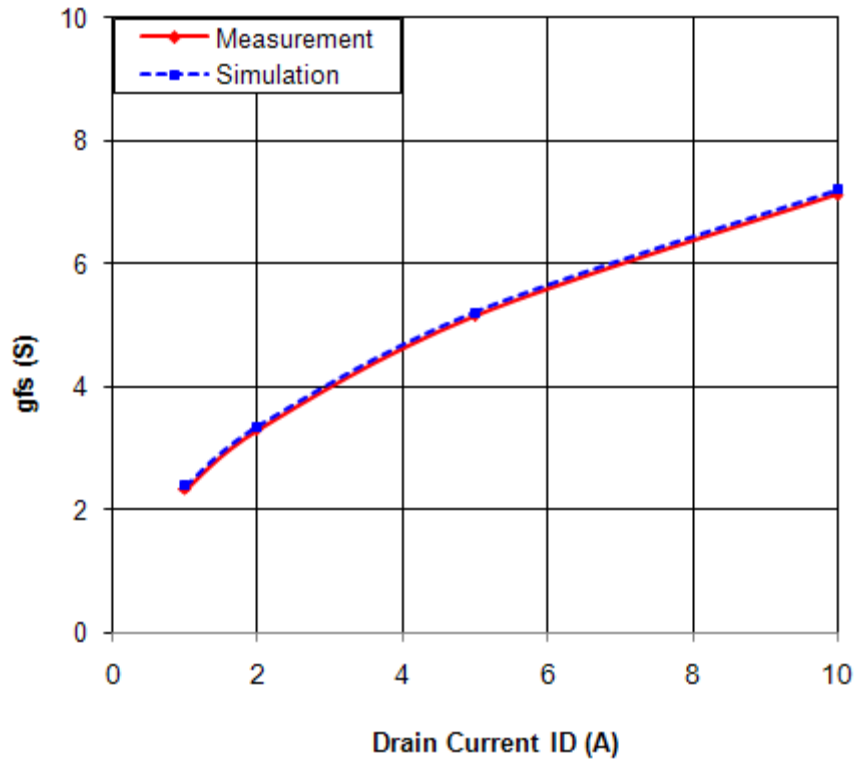
Bee Technologies Inc.

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

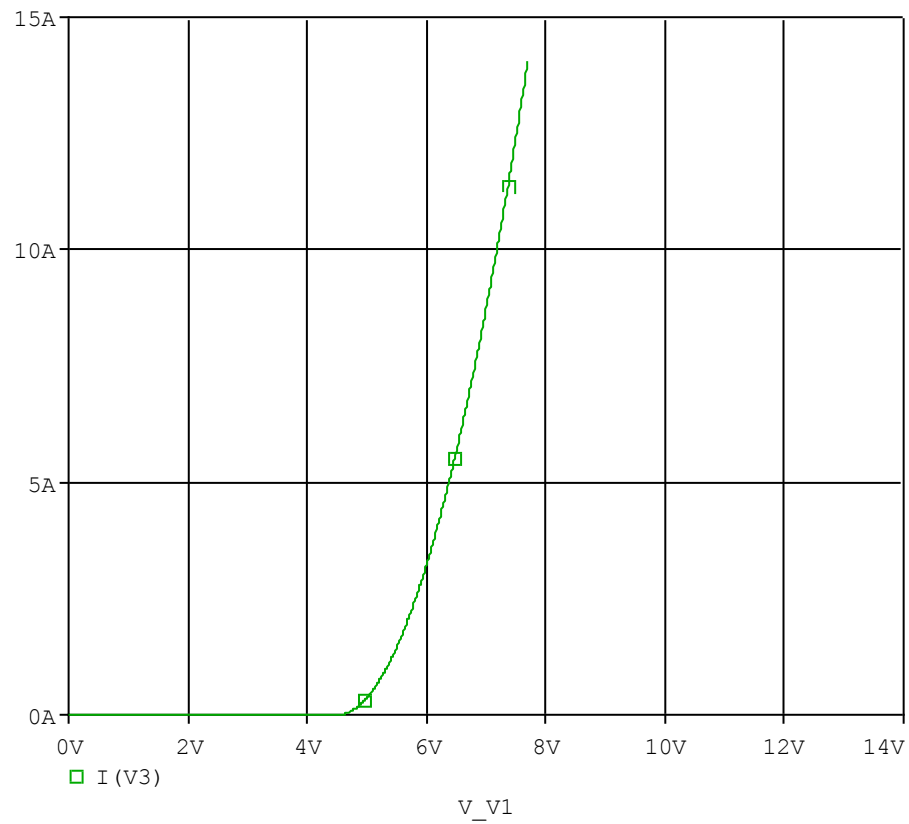


Comparison table

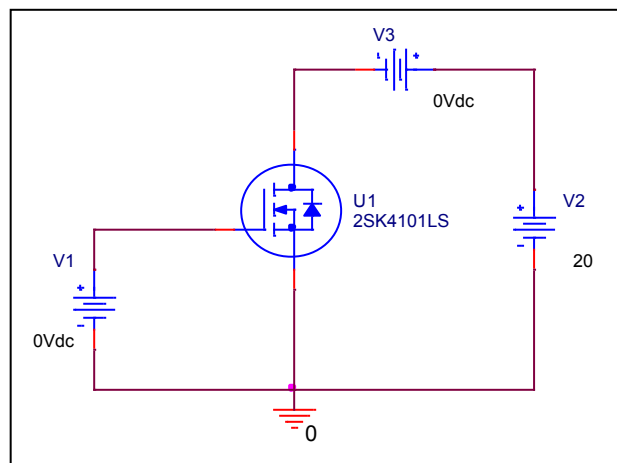
Id(A)	gfs (S)		Error (%)
	Measurement	Simulation	
1	2.330	2.396	2.83
2	3.300	3.355	1.67
5	5.150	5.203	1.03
10	7.125	7.204	1.11

Vgs-Id Characteristic

Circuit Simulation result

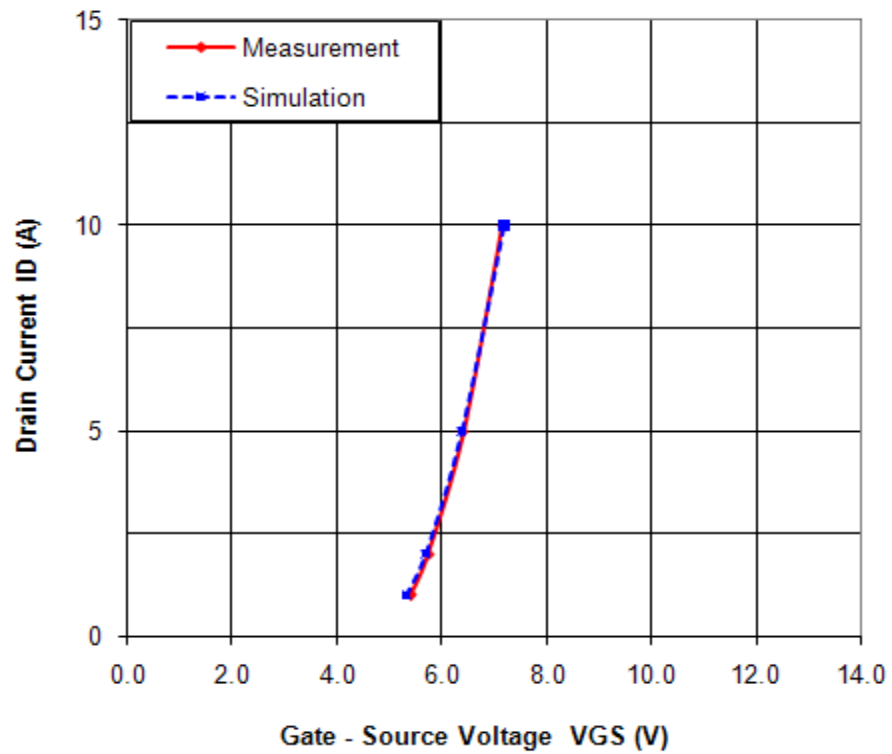


Evaluation circuit



Comparison Graph

Circuit Simulation Result

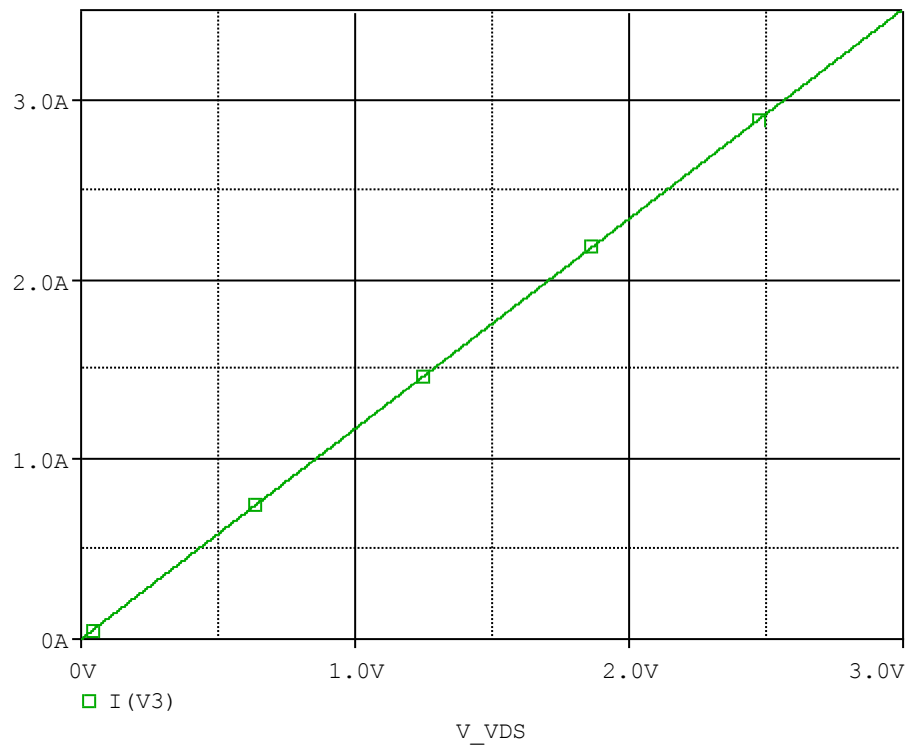


Simulation Result

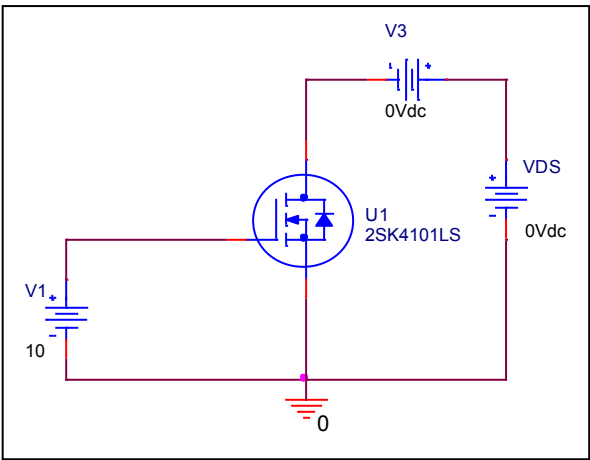
I_D (A)	V_{GS} (V)		Error (%)
	Measurement	Simulation	
1	5.400	5.329	-1.315
2	5.750	5.677	-1.270
5	6.400	6.377	-0.359
10	7.150	7.181	0.434

Rds(on) Characteristic

Circuit Simulation result



Evaluation circuit

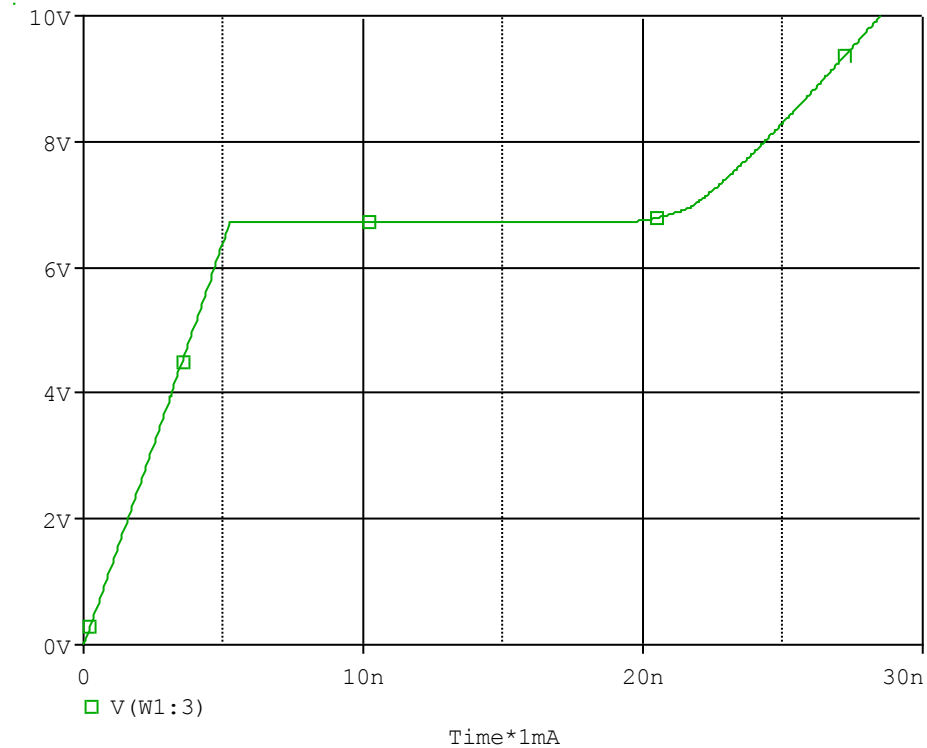


Simulation Result

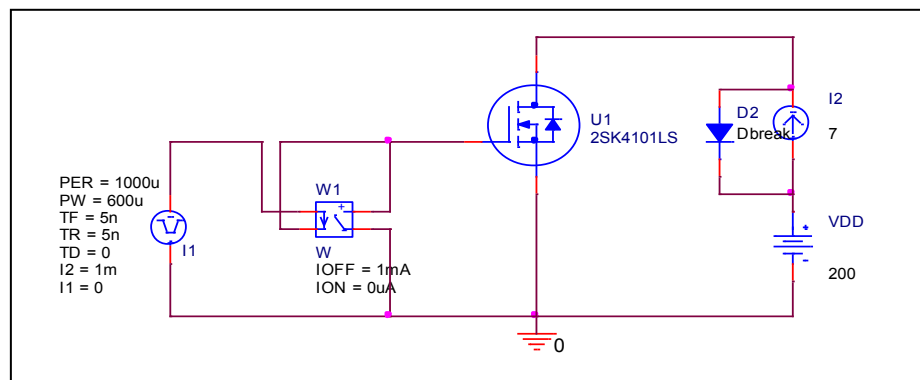
$I_D = 3.5A, V_{GS} = 10V$		Measurement	Simulation	Error (%)
$R_{DS(on)}$	Ω	0.850	0.844	-0.706

Gate Charge Characteristic

Circuit Simulation result



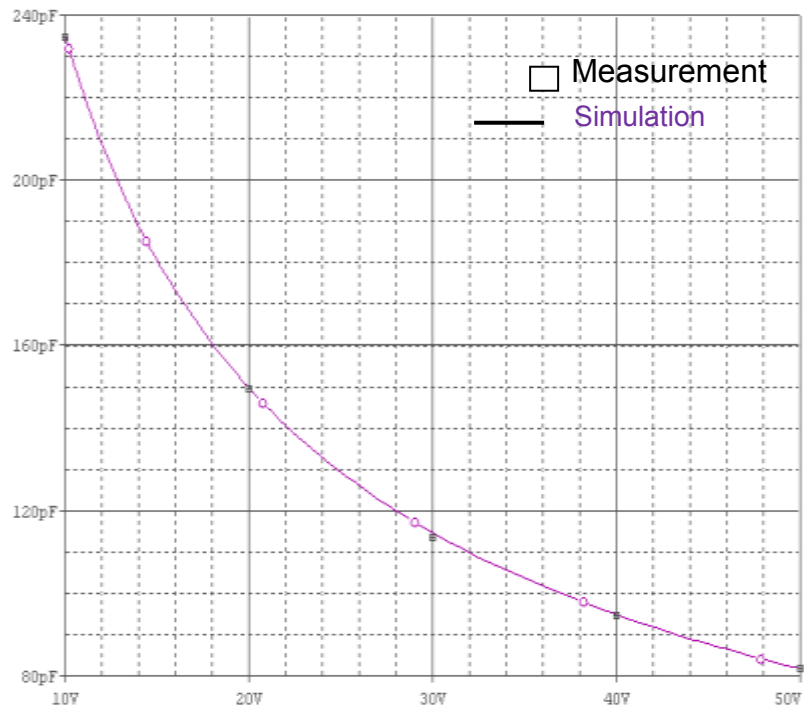
Evaluation circuit



Simulation Result

$V_{DD}=200V, I_D=7A,$ $V_{GS}=10V$		Measurement	Simulation	Error (%)
Qgs	nC	5.200	5.224	0.46
Qgd	nC	16.000	16.078	0.48
Qg	nC	28.500	28.497	-0.01

Capacitance Characteristic

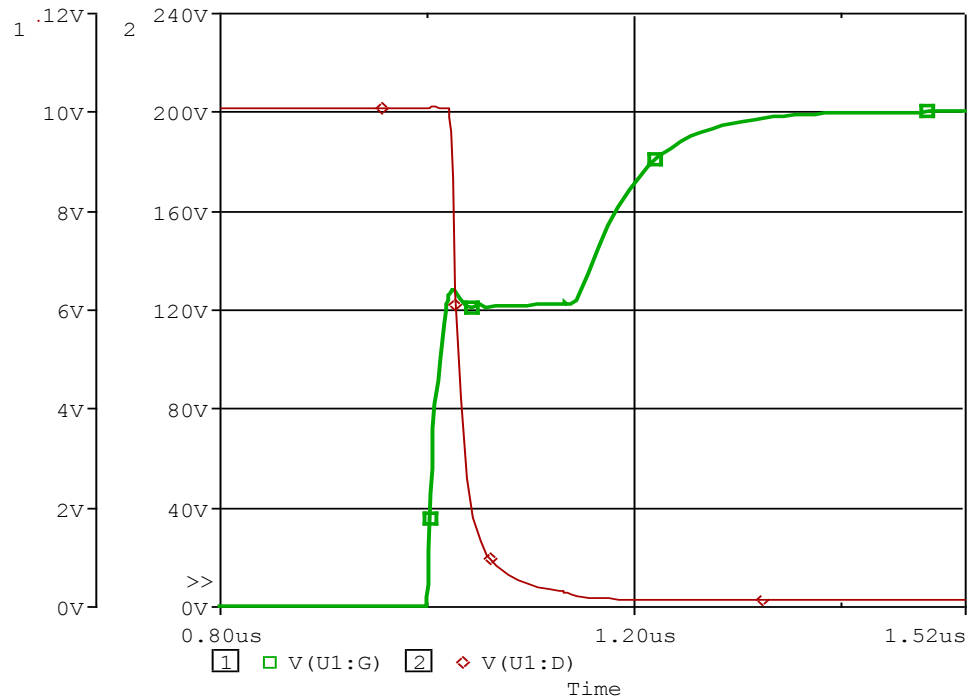


Simulation Result

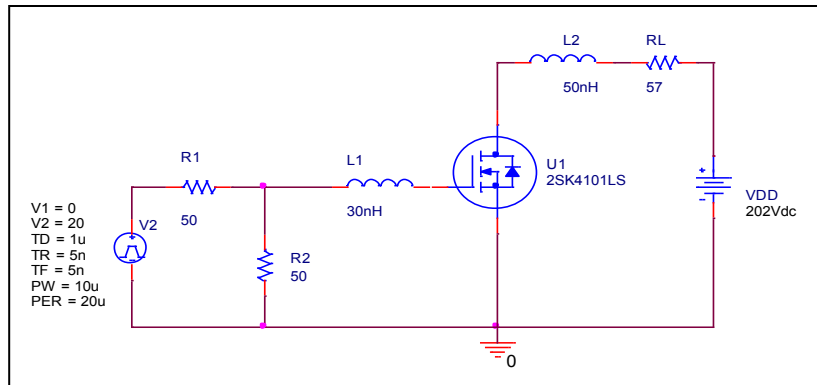
V_{DS} (V)	Cbd (pF)		Error (%)
	Measurement	Simulation	
10.0	235.00	234.000	-0.43
20.0	150.00	150.750	0.50
30.0	114.00	114.570	0.50
40.0	96.00	95.450	-0.57
50.0	82.00	82.370	0.45

Switching Time Characteristic

Circuit Simulation result



Evaluation circuit

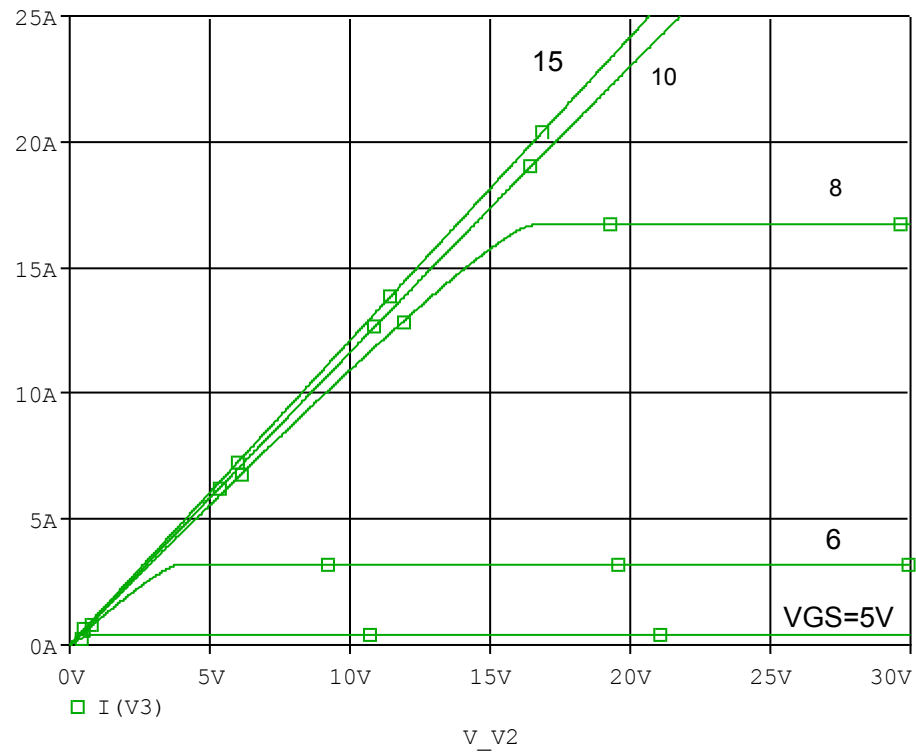


Simulation Result

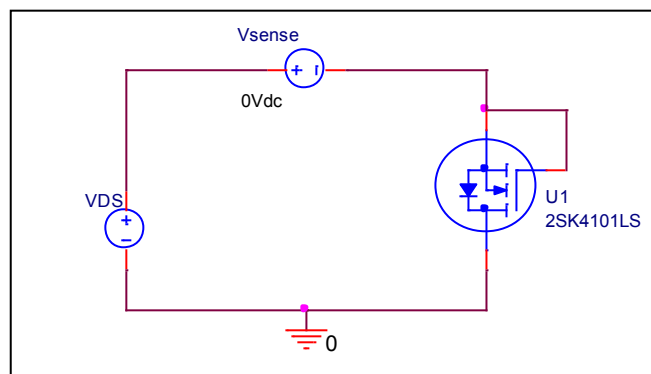
$I_D=3.5A$, $V_{DD}=200V$ $V_{GS}=0/10V$		Measurement	Simulation	Error(%)
t_{on}	ns	21.000	21.046	0.219

Output Characteristic

Circuit Simulation result

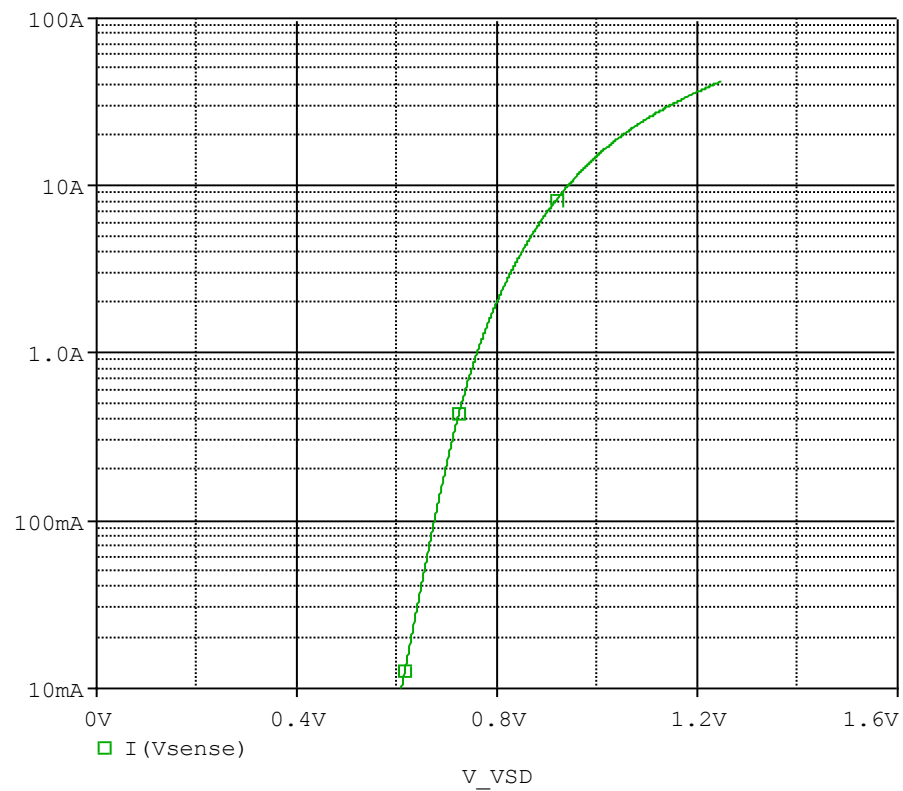


Evaluation circuit

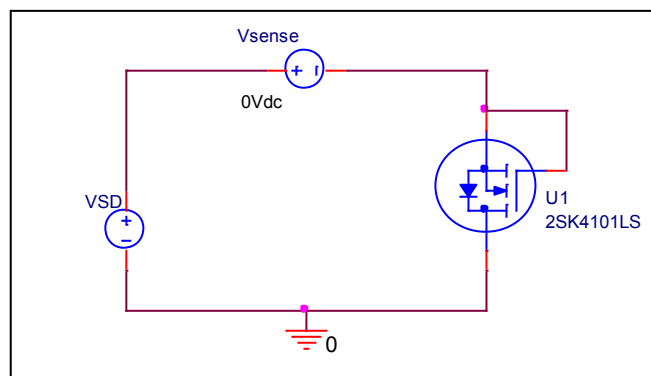


Forward Current Characteristic

Circuit Simulation Result

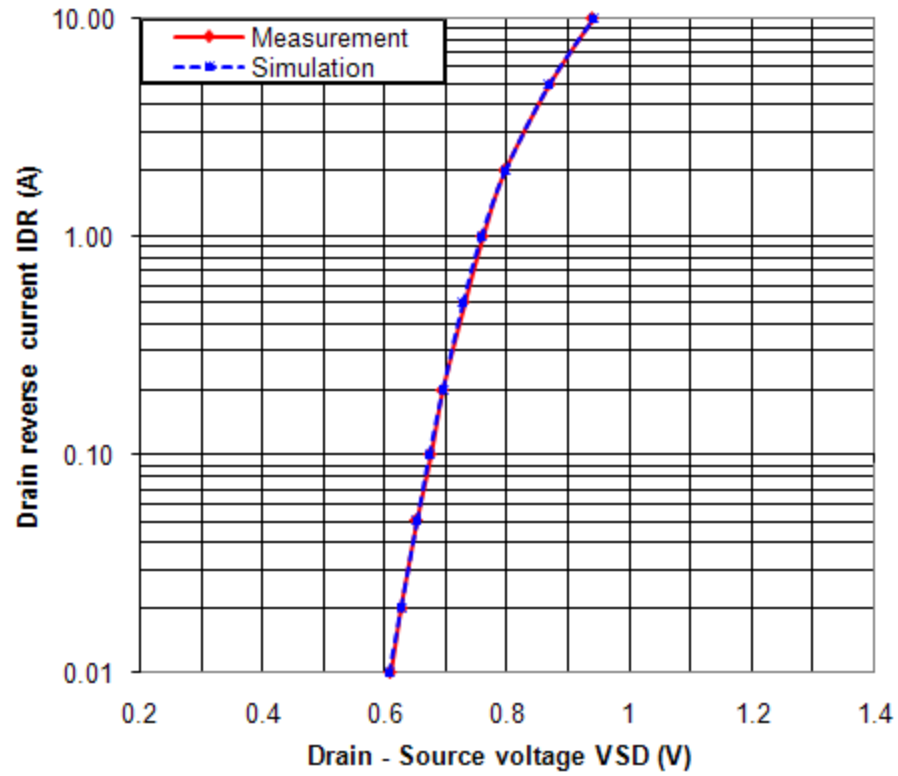


Evaluation Circuit



Comparison Graph

Circuit Simulation Result

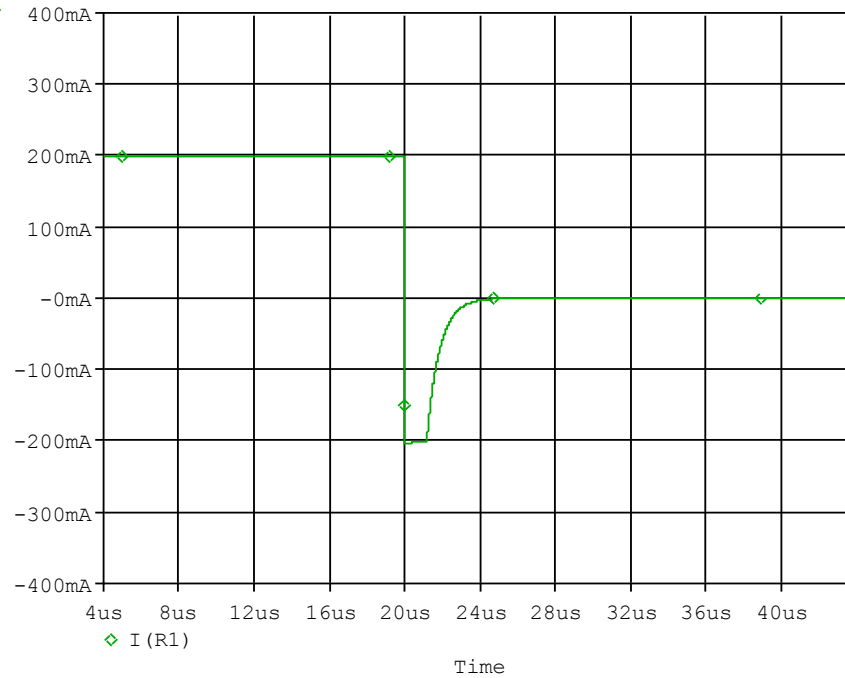


Simulation Result

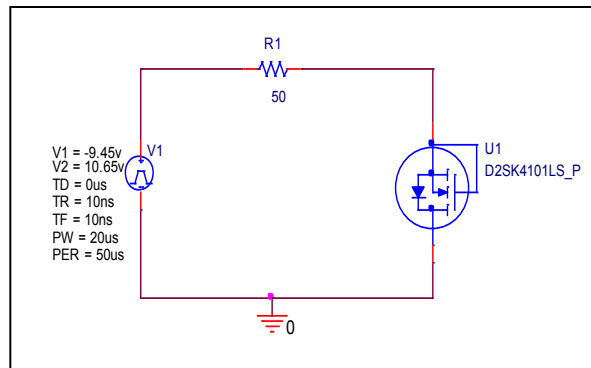
IDR(A)	VSD(V)		%Error
	Measurement	Simulation	
0.01	0.610	0.608	-0.33
0.02	0.627	0.628	0.11
0.05	0.652	0.653	0.15
0.10	0.675	0.674	-0.15
0.20	0.695	0.696	0.12
0.50	0.730	0.728	-0.27
1.00	0.760	0.759	-0.13
2.00	0.795	0.798	0.38
5.00	0.870	0.867	-0.34
10.00	0.940	0.941	0.09

Reverse Recovery Characteristics

Circuit Simulation Result



Evaluation Circuit

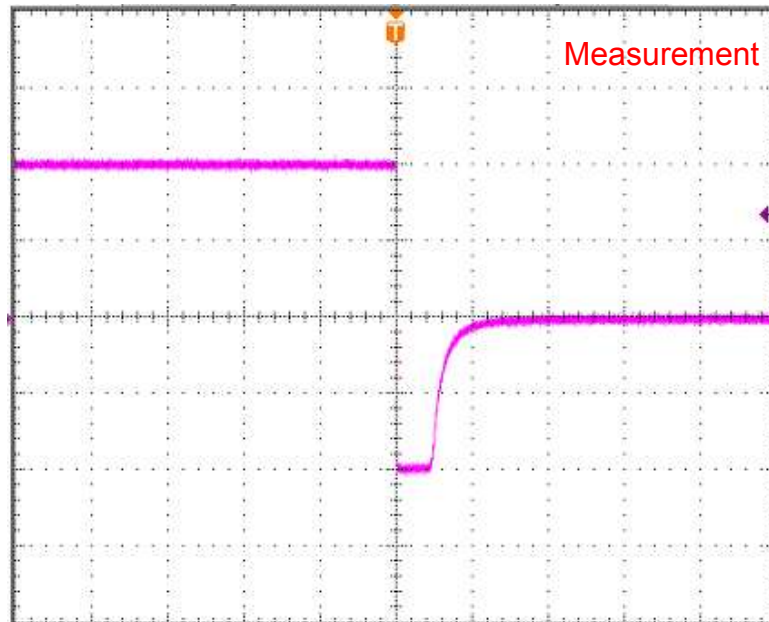


Compare Measurement vs. Simulation

		Measurement	Simulation	Error (%)
trj	us	1.120	1.131	0.98
trb	us	1.520	1.523	0.19
trr	us	2.640	2.654	0.53

Reverse Recovery Characteristic

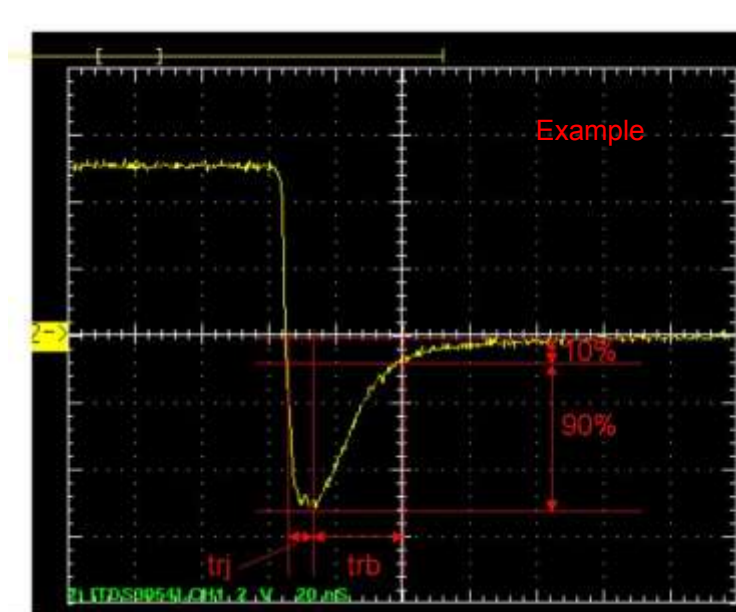
Reference



$T_{rr} = 1.12 \text{ (}\mu\text{s)}$

$T_{rb} = 1.52 \text{ (}\mu\text{s)}$

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



Relation between t_{rr} and t_{rb}