

Device Modeling Report

COMPONENTS: Power MOSFET (Professional)
PART NUMBER: SSM3J16FS
MANUFACTURER: TOSHIBA
Body Diode (Professional) / ESD Protection Diode

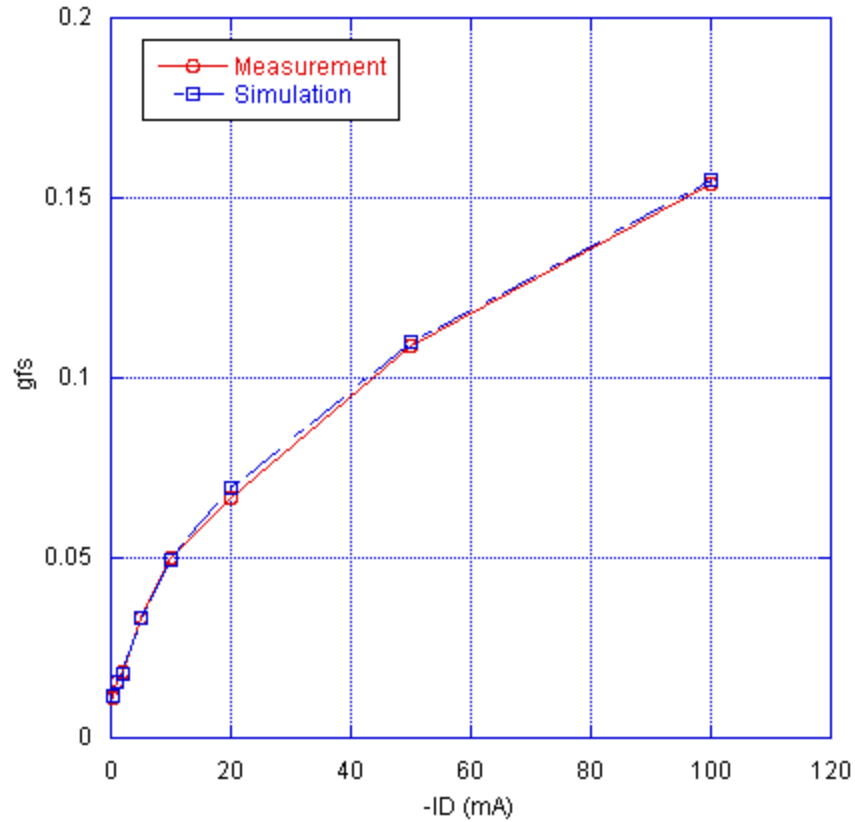


MOSFET MODEL

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

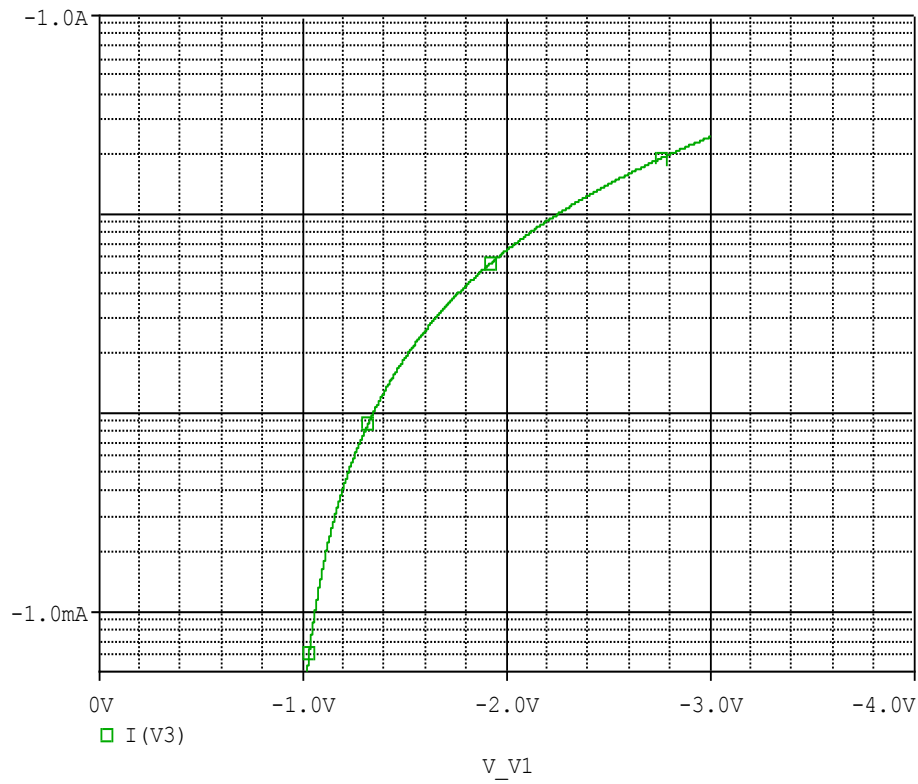


Comparison table

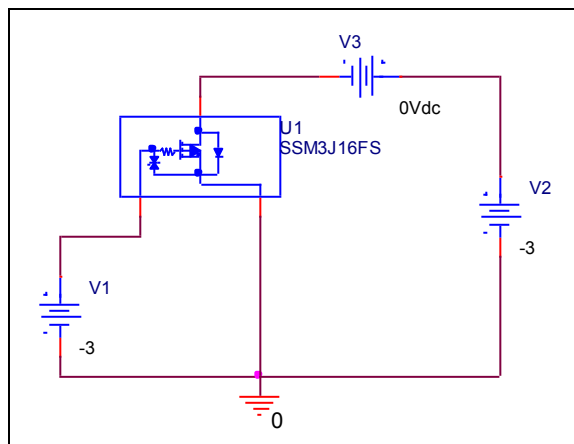
- Id(mA)	gfs		Error(%)
	Measurement	Simulation	
0.5000	0.0111	0.0116	4.5050
1.0000	0.0156	0.0154	-1.2820
2.0000	0.0182	0.0179	-1.6480
5.0000	0.0333	0.0333	0.0000
10.0000	0.0500	0.0493	-1.4000
20.0000	0.0667	0.0692	3.7480
50.0000	0.1087	0.1099	1.1040
100.0000	0.1540	0.1550	0.6490

V_{gs}-I_d Characteristic

Circuit Simulation result

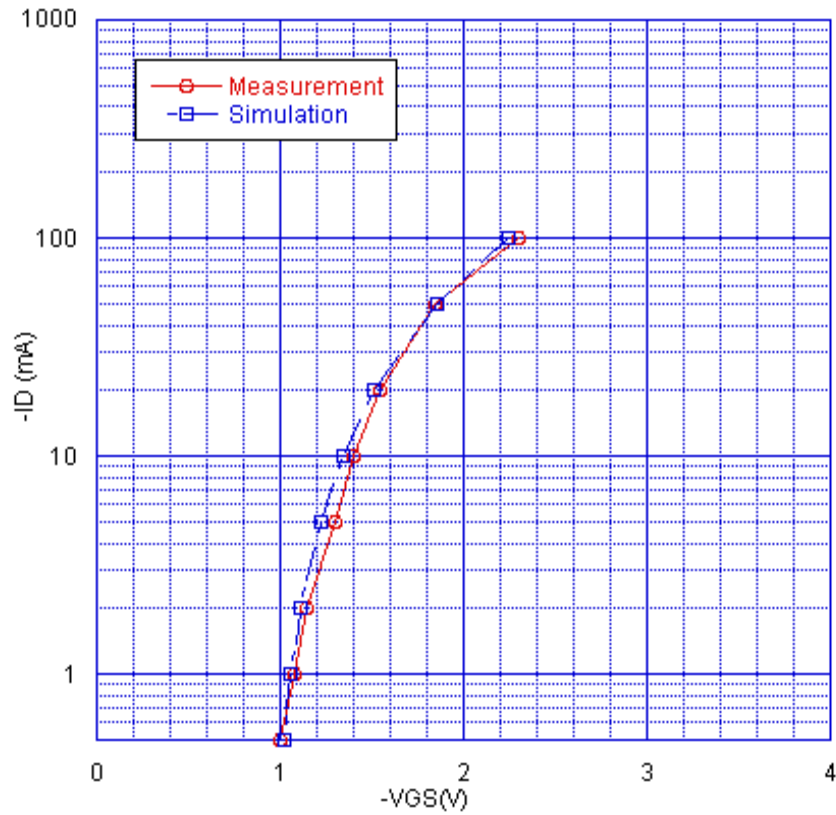


Evaluation circuit



Comparison Graph

Circuit Simulation Result

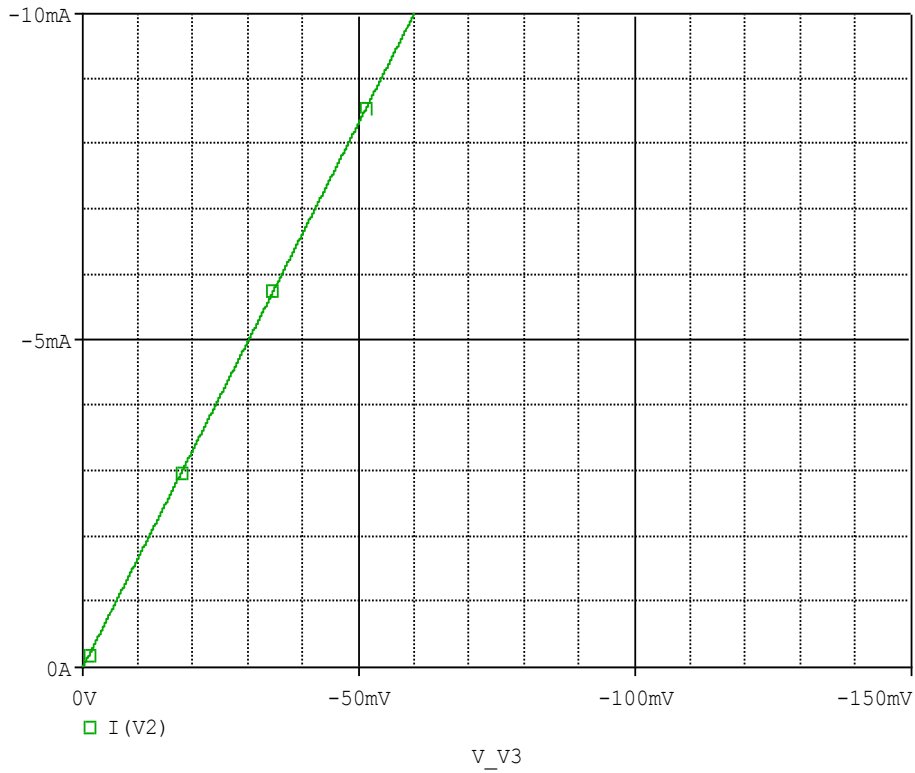


Simulation Result

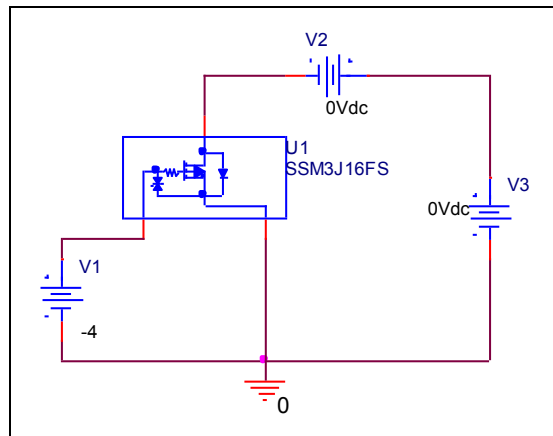
$-I_D$ (mA)	$-V_{GS}$ (V)		Error (%)
	Measurement	Simulation	
0.500	1.000	1.019	1.900
1.000	1.080	1.057	-2.130
2.000	1.150	1.110	-3.478
5.000	1.300	1.220	-6.154
10.000	1.400	1.343	-4.071
20.000	1.550	1.516	-2.194
50.000	1.850	1.860	0.541
100.000	2.300	2.248	-2.261

R_{ds(on)} Characteristic

Circuit Simulation result



Evaluation circuit

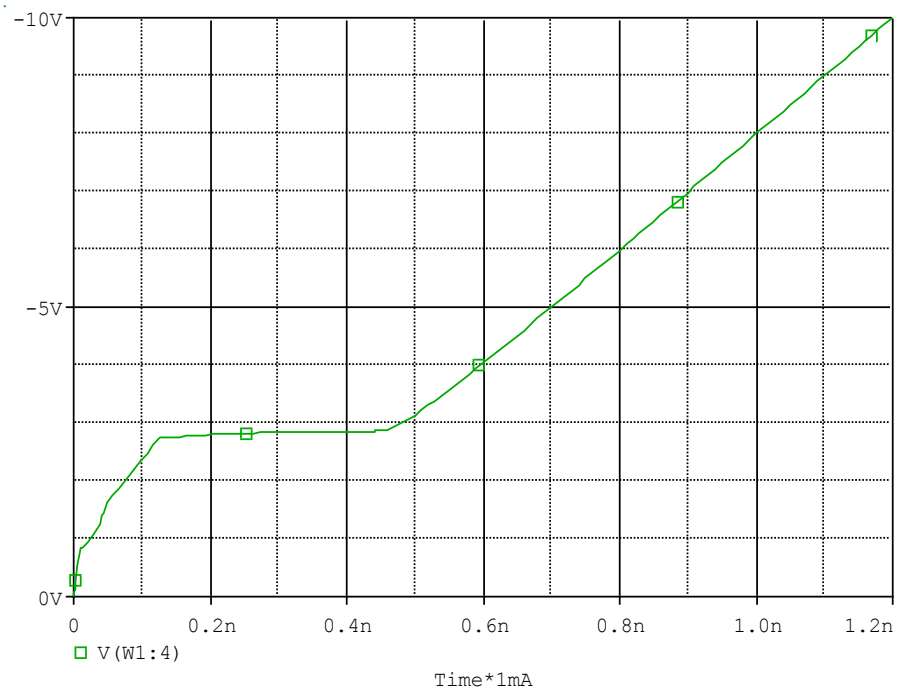


Simulation Result

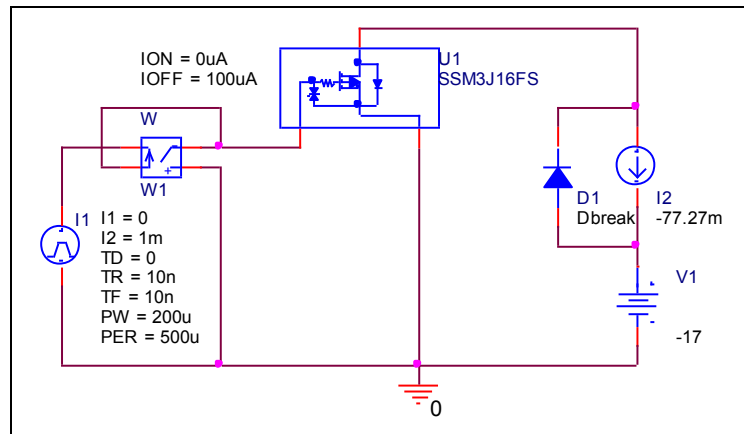
$I_D = -10\text{mA}$, $V_{GS} = -4\text{V}$	Measurement	Simulation	Error (%)
$R_{DS(on)} \Omega$	6.000	5.999	-0.017

Gate Charge Characteristic

Circuit Simulation result



Evaluation circuit

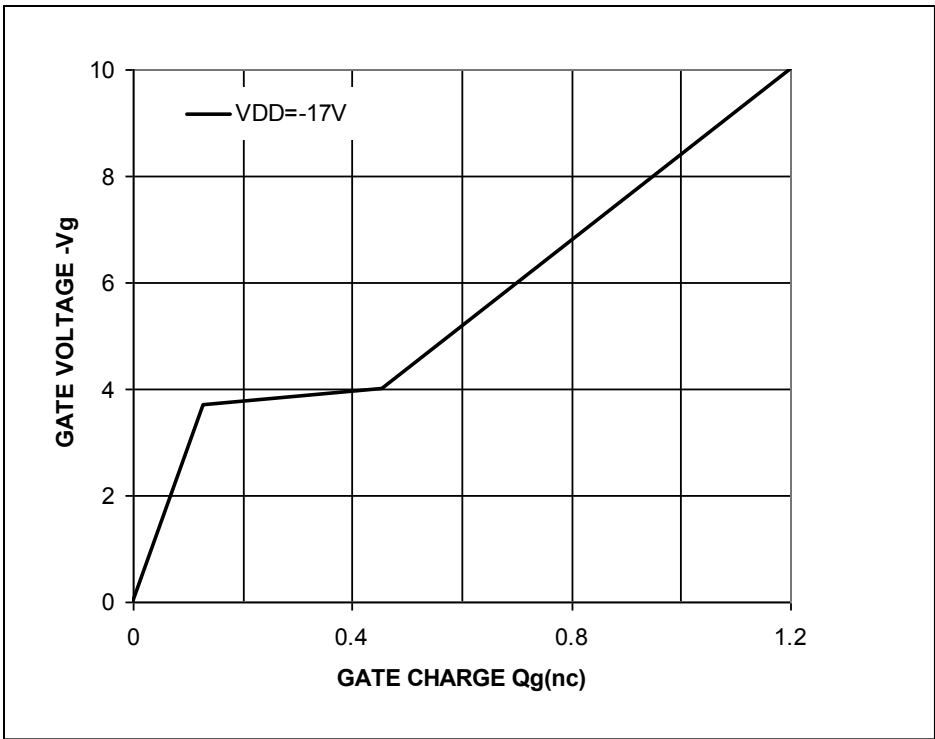


Simulation Result

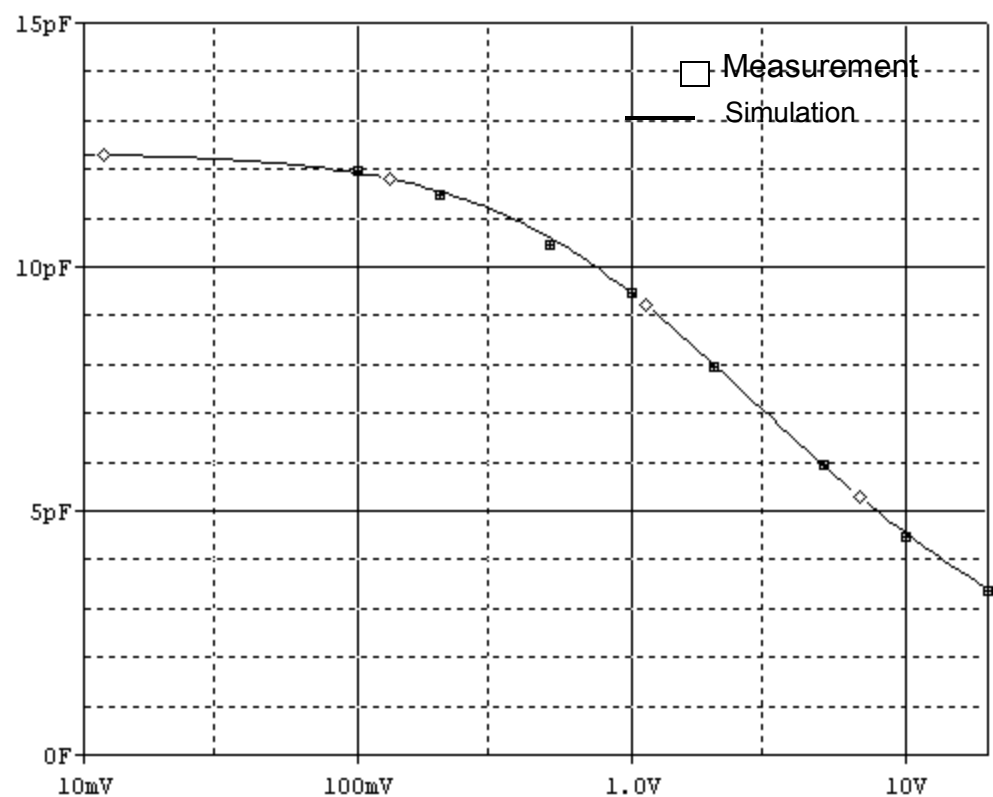
$V_{DD}=-17V, I_D=-77.27mA$ $V_{GS}=-10V$	Measurement	Simulation	Error (%)
$Q_{gs}(nC)$	0.1280	0.1281	0.0620
$Q_{gd}(nC)$	0.3280	0.3270	-0.2590
$Q_g(nC)$	1.2000	1.2000	0.0000

Gate Charge Characteristic

Reference



Capacitance Characteristic

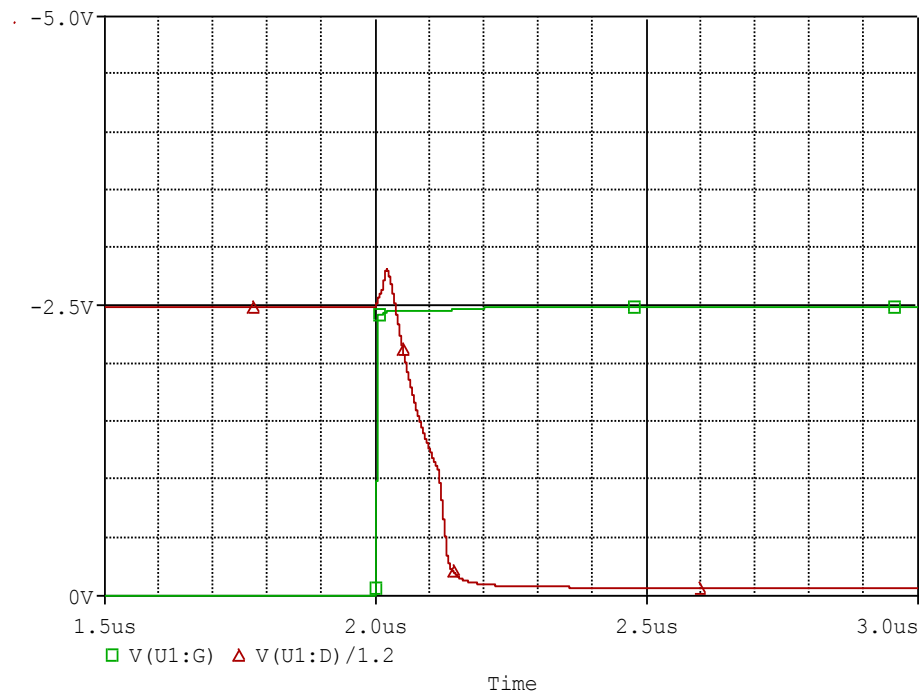


Simulation Result

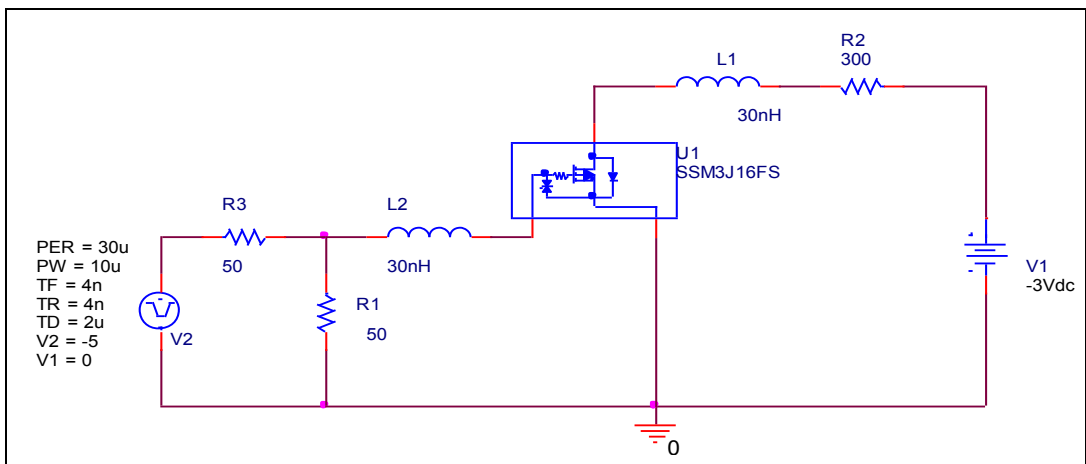
$V_{DS}(V)$	Cbd(pF)		Error(%)
	Measurement	Simulation	
0.100	12.000	11.920	-0.667
0.200	11.500	11.550	0.435
0.500	10.500	10.600	0.952
1.000	9.500	9.450	-0.526
2.000	8.000	8.000	0.000
5.000	6.000	5.950	-0.833
10.000	4.500	4.520	0.444
20.000	3.400	3.400	0.000

Switching Time Characteristic

Circuit Simulation result



Evaluation circuit

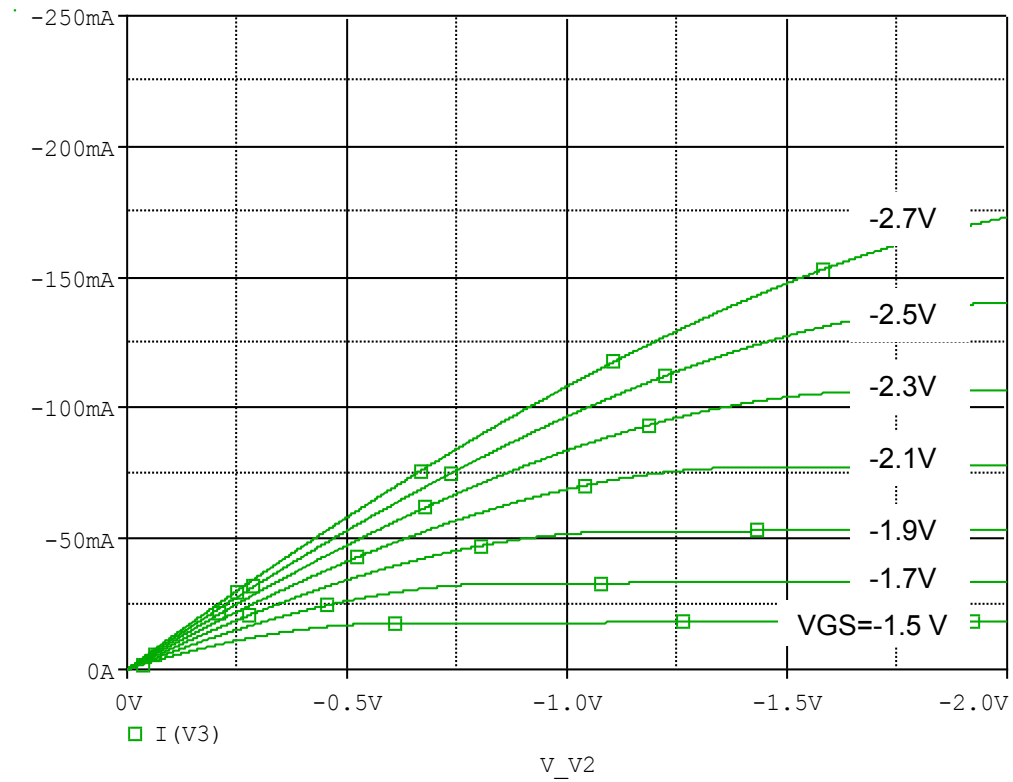


Simulation Result

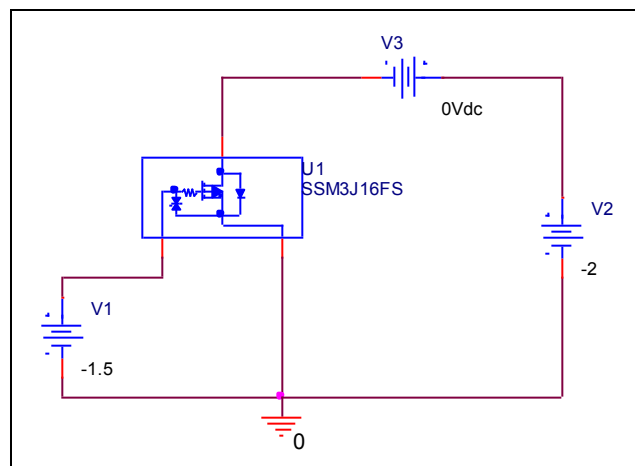
$I_D = -10\text{mA}$, $V_{DD} = -3\text{V}$ $V_{GS} = 0/-2.5\text{V}$	Measurement	Simulation	Error(%)
Ton(ns)	130.000	132.615	2.012

Output Characteristic

Circuit Simulation result

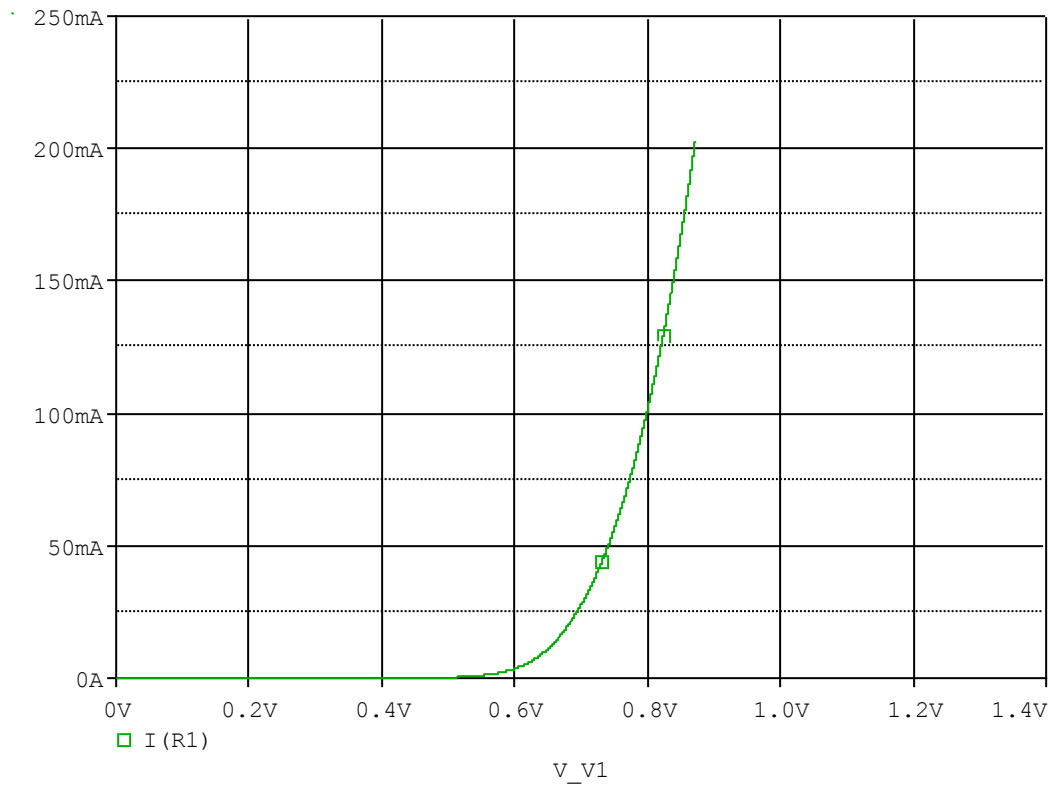


Evaluation circuit

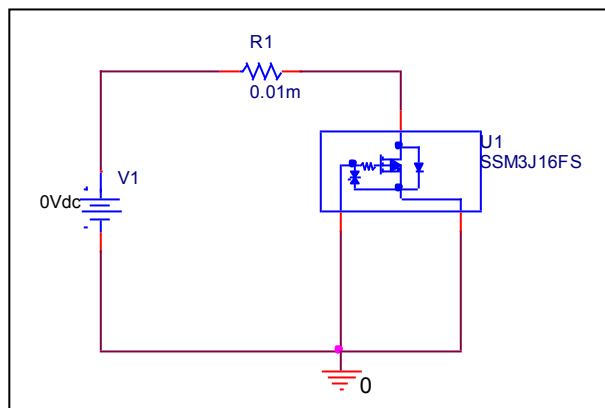


Forward Current Characteristic

Circuit Simulation Result

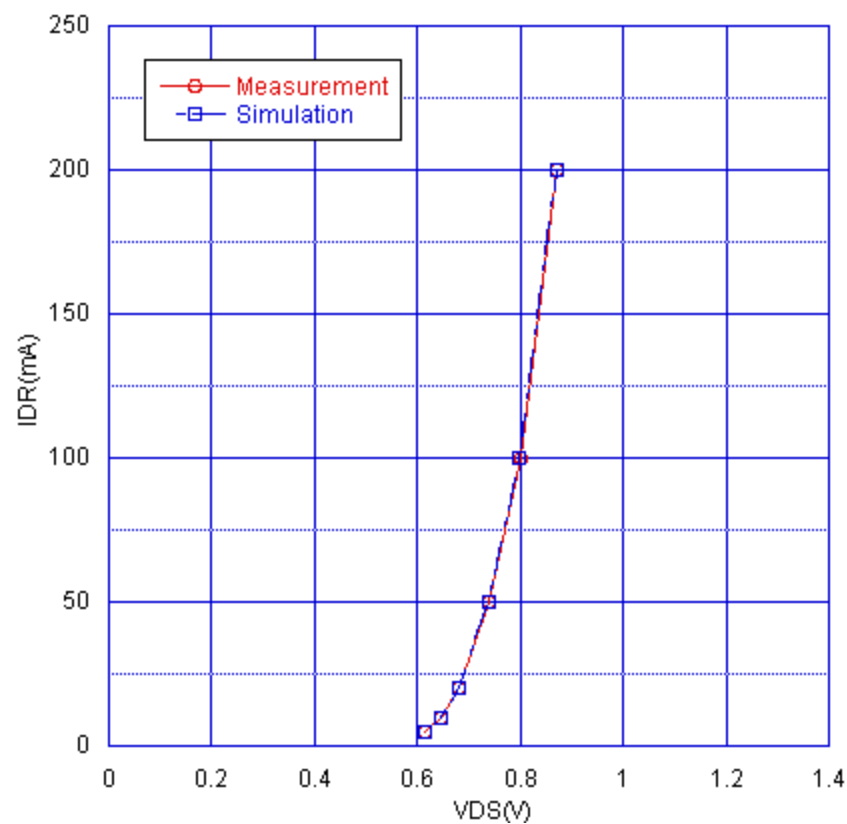


Evaluation Circuit



Comparison Graph

Circuit Simulation Result

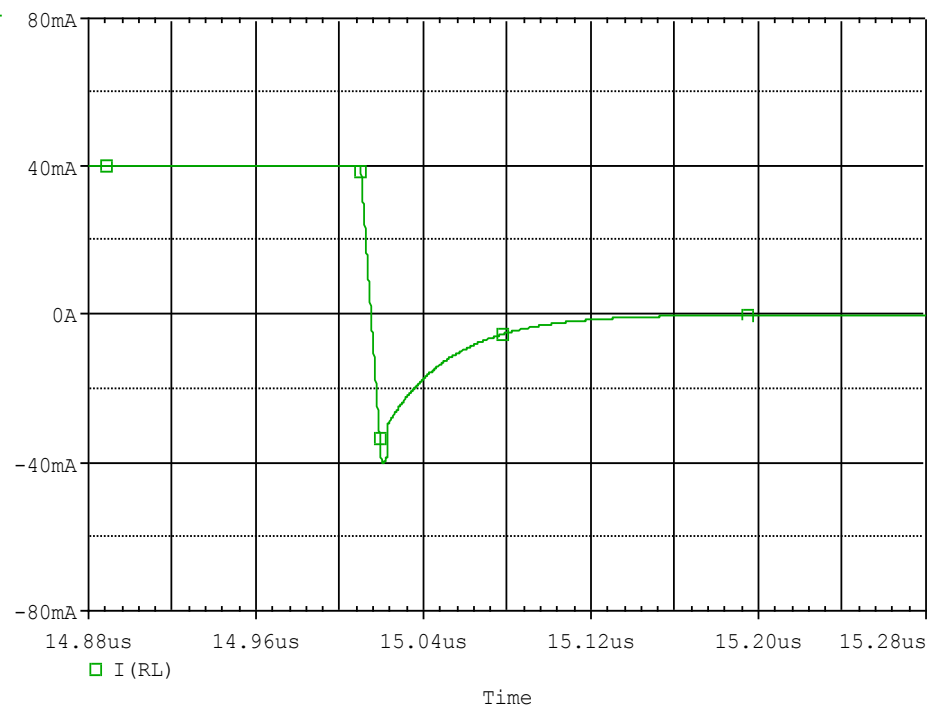


Simulation Result

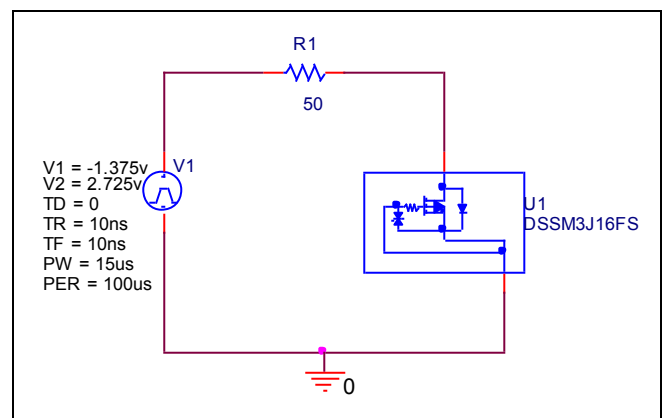
IDR(mA)	VDS(V)		%Error
	Measurement	Simulation	
5.000	0.615	0.614	-0.163
10.000	0.645	0.645	0.000
20.000	0.680	0.681	0.147
50.000	0.740	0.741	0.135
100.000	0.800	0.799	-0.125
200.000	0.870	0.870	0.000

Reverse Recovery Characteristic

Circuit Simulation Result



Evaluation Circuit

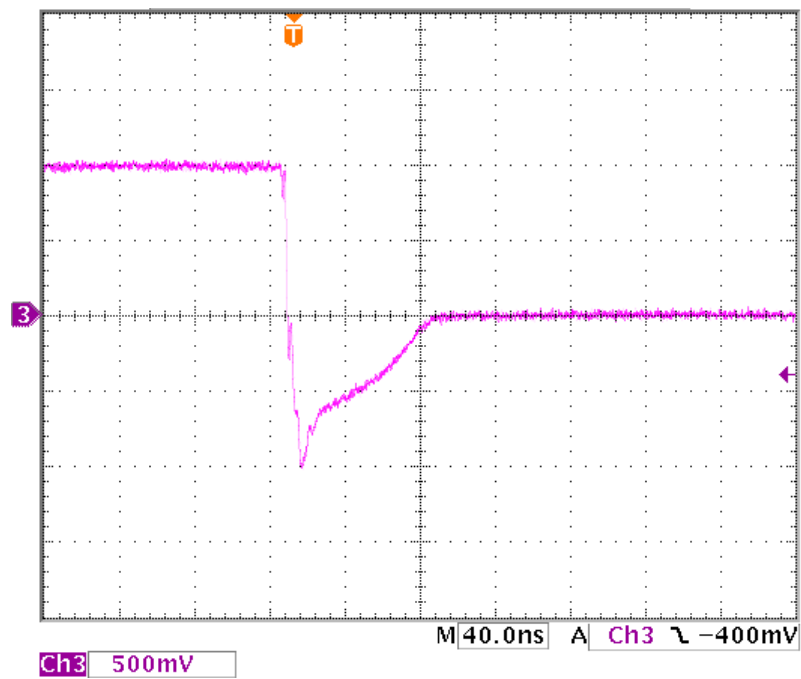


Simulation Result

	Measurement	Simulation	Error (%)
Trj(ns)	7.000	7.002	0.029
Trb(ns)	64.000	64.399	0.623
Trr(ns)	71.000	71.401	0.565

Reverse Recovery Characteristic

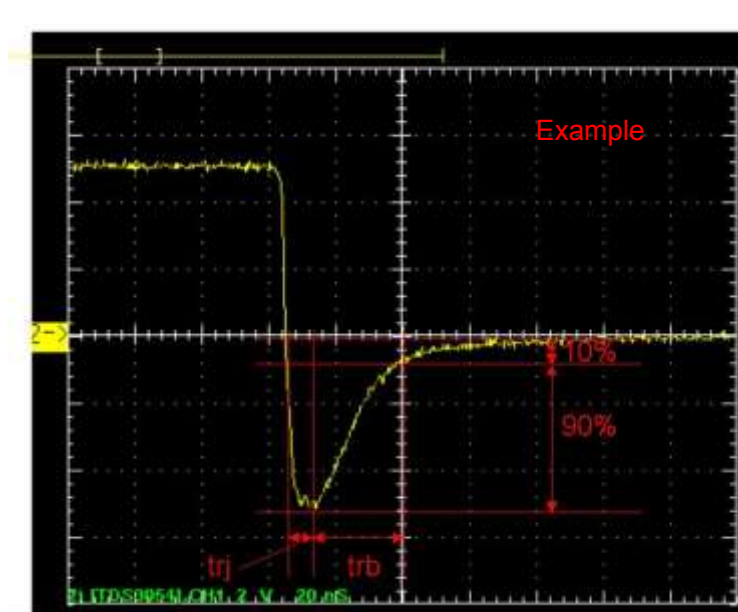
Reference



$t_{rr} = 7(\text{ns})$

$t_{rb} = 64(\text{ns})$

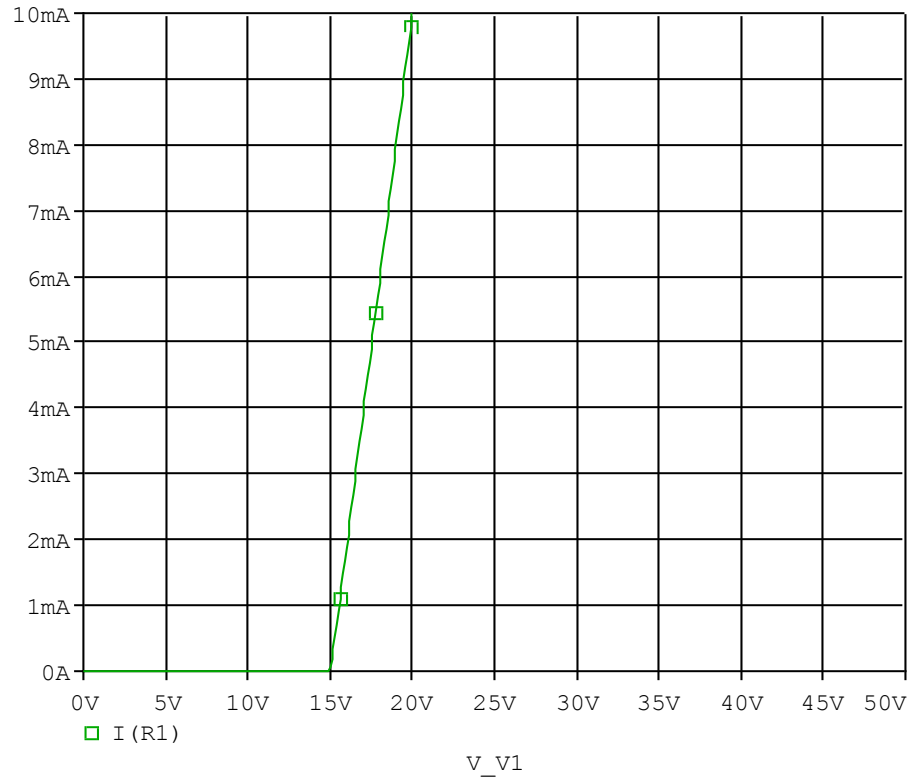
Conditions: $I_{fwd} = I_{rev} = 0.04(\text{A})$, $R_L = 50$



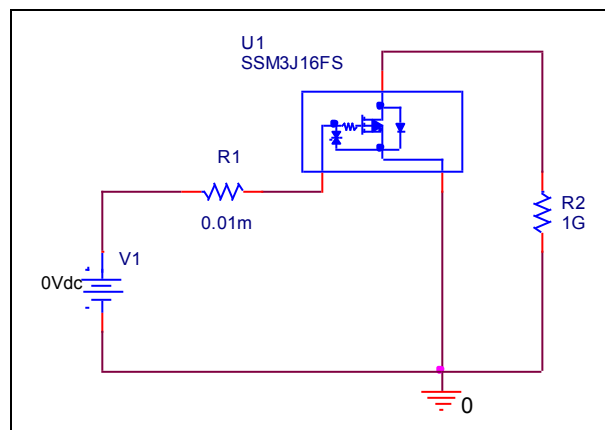
Relation between t_{rr} and t_{rb}

Zener Voltage Characteristic

Circuit Simulation Result



Evaluation Circuit



Zener Voltage Characteristic

Reference

