

Device Modeling Report

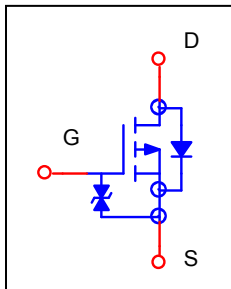
COMPONENTS: Power MOSFET (Model parameters)
PART NUMBER: 2SJ492
MANUFACTURER: NEC
REMARK: P Channel Model
Body Diode (Model parameters) / ESD Protection Diode



SPIICE MODEL

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*$
*PART NUMBER: 2SJ492
*MANUFACTURER: NEC
*VDSS=-60V, ID=-20A
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.SUBCKT 2SJ492 D G S
M_M1 D G S S M2SJ492
X_U1 S G DZ2SJ492
D_D1 D S D2SJ492
.ENDS
.MODEL M2SJ492 PMOS
+LEVEL=3 L=1.9200E-6 W=1.1135 KP=9.500E-6 RS=10.000E-3
+ RD=38.000E-3 VTO=-1.5300 RDS=1.0000E6 TOX=140.00E-9
+ CGSO=0.8068E-9 CGDO=500.90E-12
+ CBD=1.1229E-9 MJ=.37995 PB=.52874 RG=1 ETA=10.000E-3
+ RB=1 N=5 IS=1E-15
.ENDS
.MODEL D2SJ492 D
+ IS=6.0241E-9 N=1.4092 RS=16.554E-3 IKF=1.0561
+ BV=20 IBV=1E-9 TT=35.00E-9
.ENDS
.subckt DZ2SJ492 1 2
D2 1 3 DZ2
D1 2 3 DZ1
.model DZ1 D
+ IS=0.01p N=0.1 ISR=0
+ CJO=3E-12 BV=26.45 IBV=0.001 RS=0
.model DZ2 D
+ IS=0.01p N=0.1 ISR=0
+ CJO=3E-12 BV=26.45 IBV=0.00101 RS=161.111111
.ENDS
*$
```

Circuit Configuration

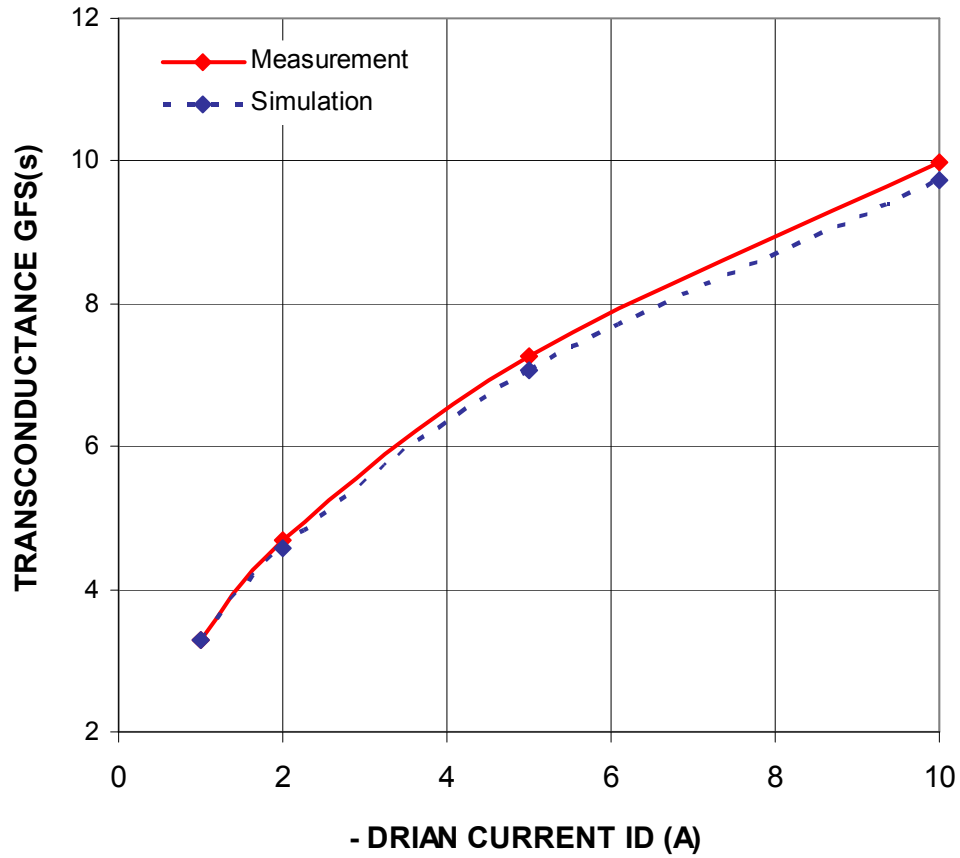


MOSFET MODEL

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

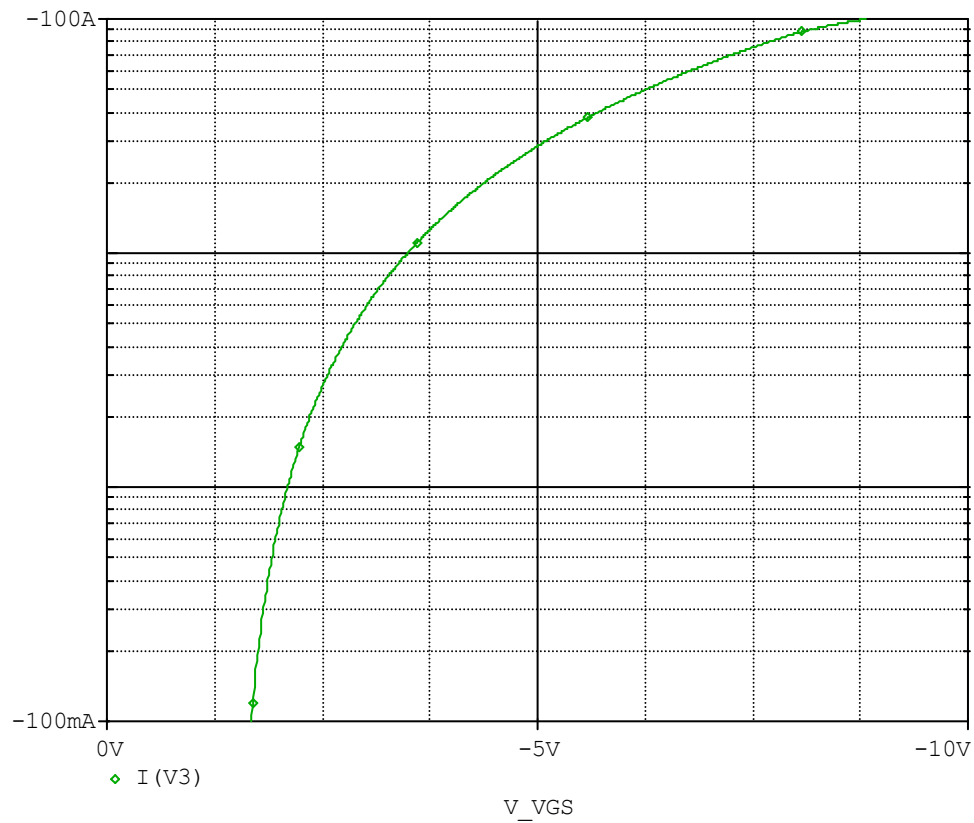


Comparison table

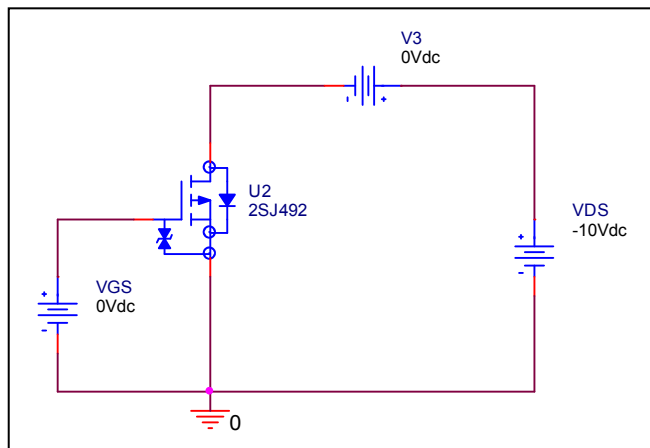
Id(A)	gfs		Error(%)
	Measurement	Simulation	
-1	3.298	3.289	-0.273
-2	4.700	4.587	-2.401
-5	7.280	7.072	-2.855
-10	9.980	9.718	-2.624

Vgs-Id Characteristic

Circuit Simulation result

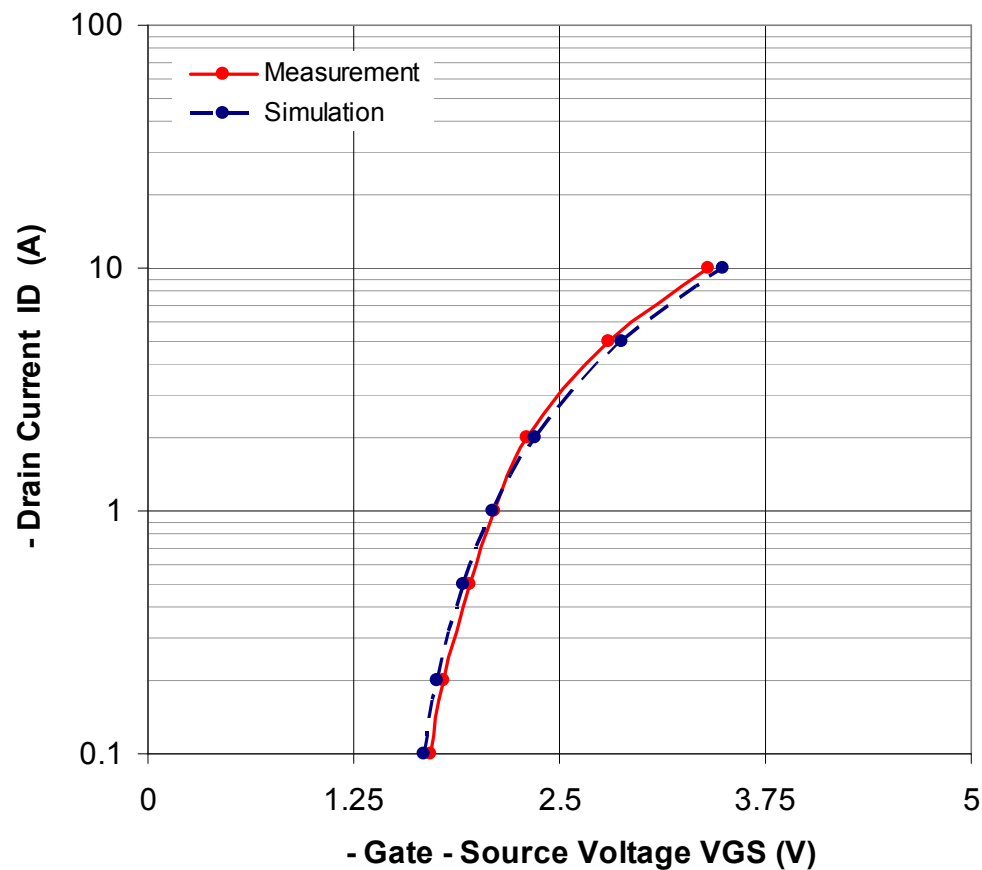


Evaluation circuit



Comparison Graph

Circuit Simulation Result

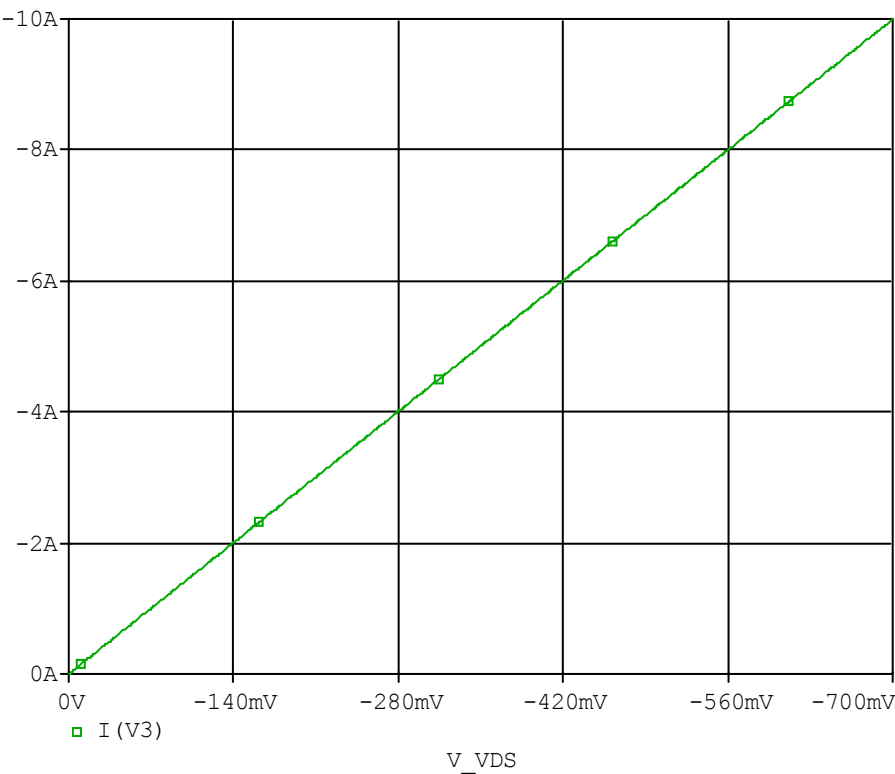


Simulation Result

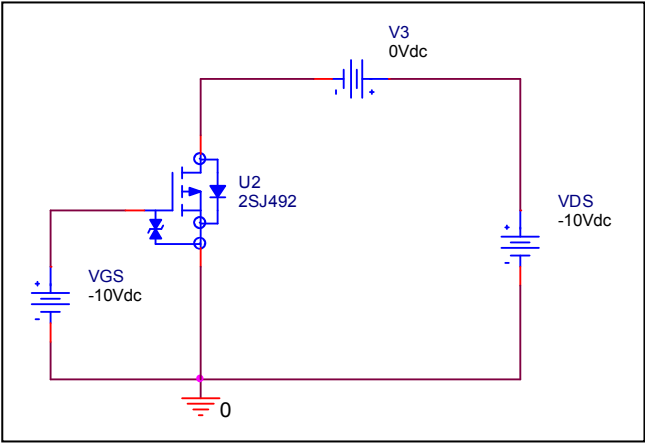
I_D (A)	V_{GS} (V)		Error (%)
	Measurement	Simulation	
-0.1	1.720	1.675	-2.628
-0.2	1.800	1.755	-2.511
-0.5	1.950	1.915	-1.821
-1	2.100	2.096	-0.186
-2	2.300	2.356	2.430
-5	2.800	2.882	2.921
-10	3.400	3.491	2.682

Rds(on) Characteristic

Circuit Simulation result



Evaluation circuit

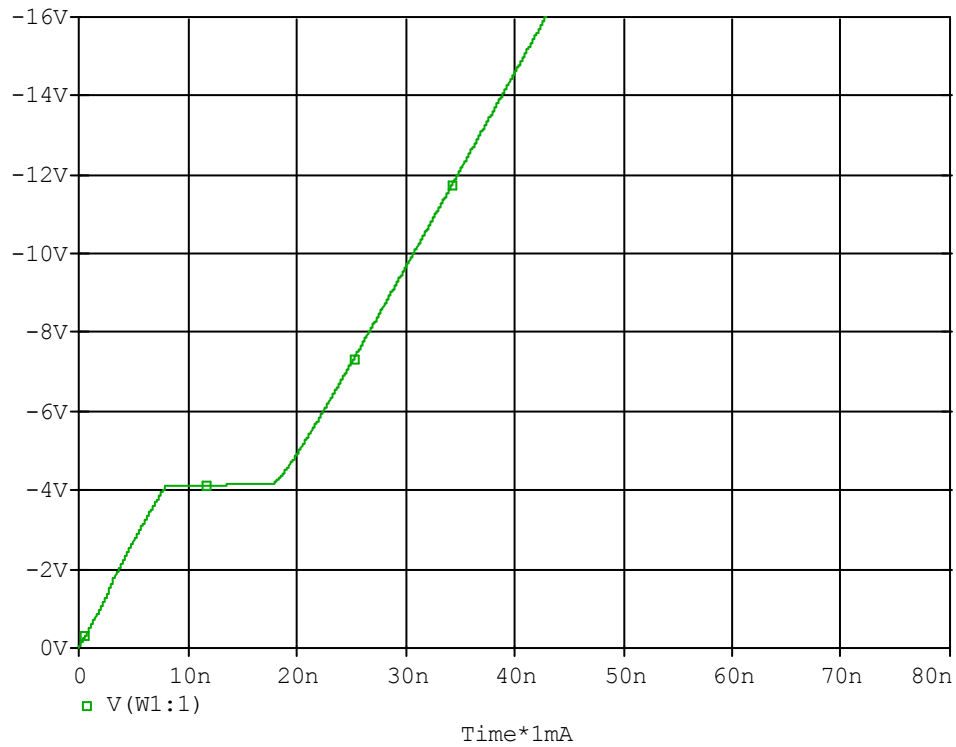


Simulation Result

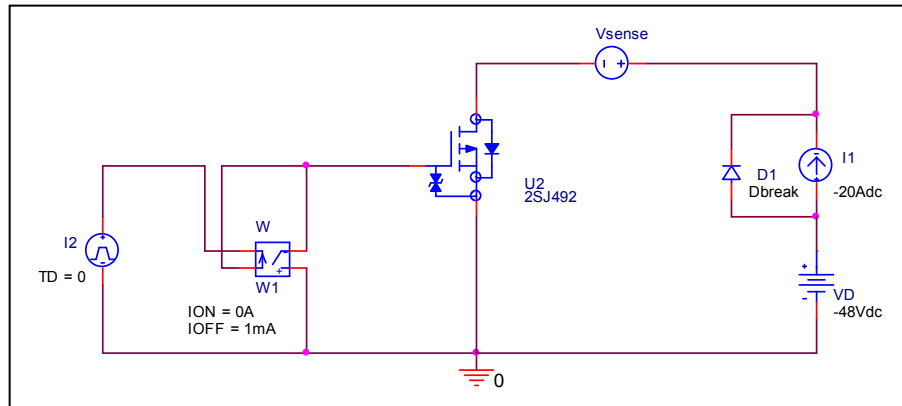
$I_D = -10A, V_{GS} = -10V$		Measurement	Simulation	Error (%)
$R_{DS(on)}$	m Ω	70.00	70.00	0.00

Gate Charge Characteristic

Circuit Simulation result



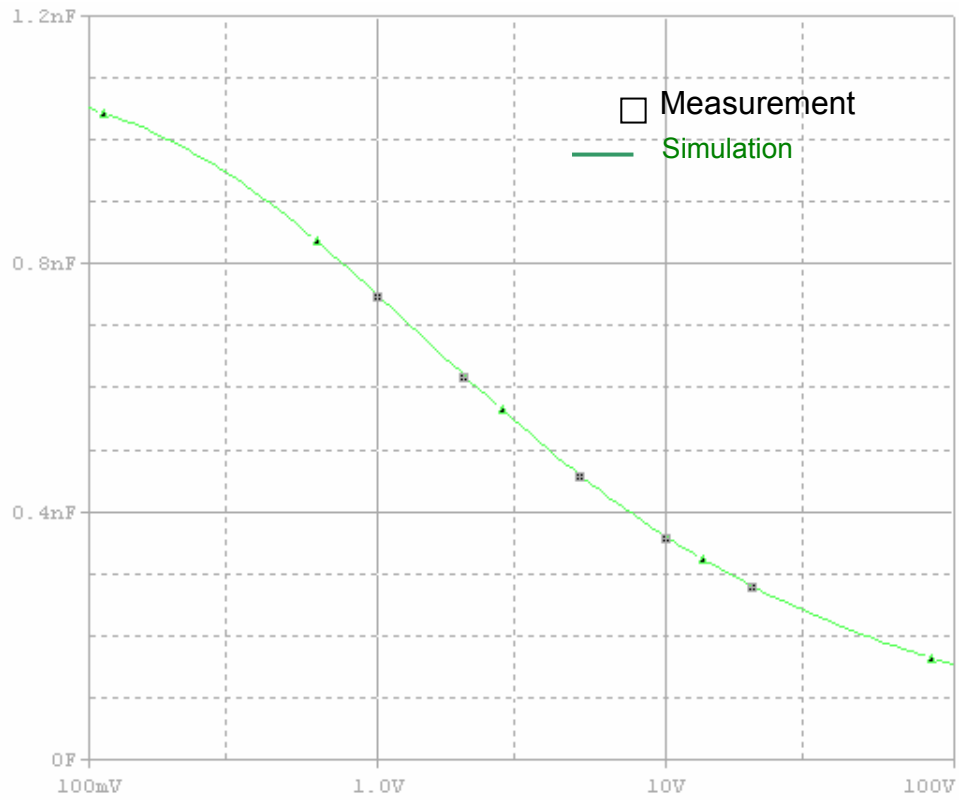
Evaluation circuit



Simulation Result

$V_{DD} = -48V, I_D = -20A$ $V_{GS} = -10V$		Measurement	Simulation	Error (%)
Qgs	nc	8.00	7.96	-0.46
Qgd	nc	10.00	10.00	0.00
Qg	nc	42.00	30.47	-27.45

Capacitance Characteristic

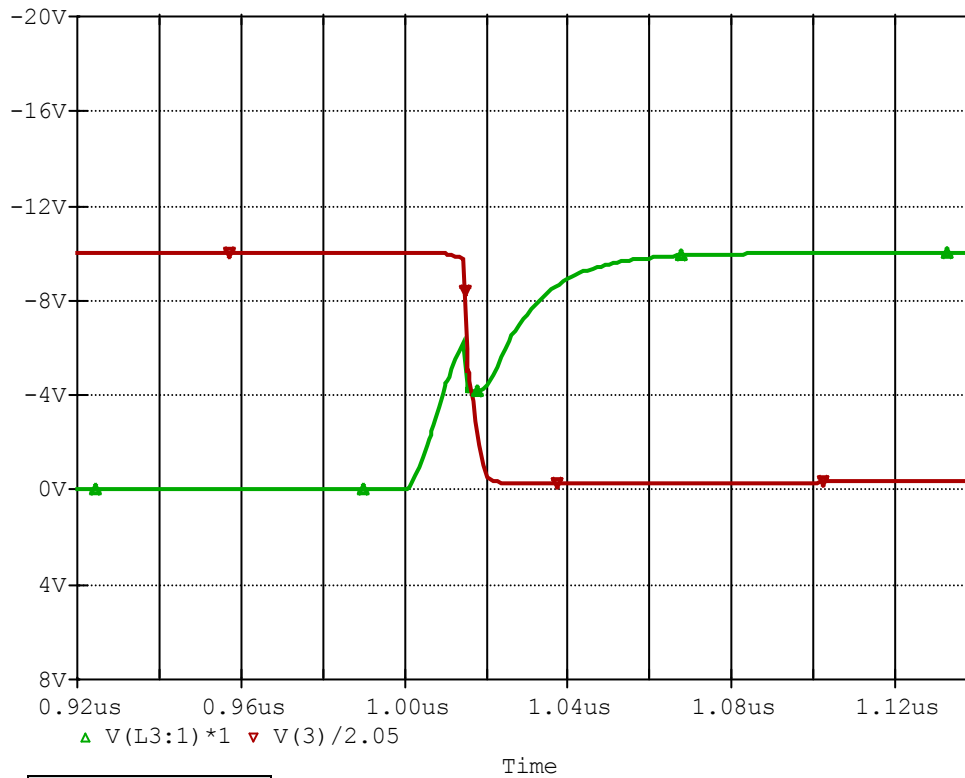


Simulation Result

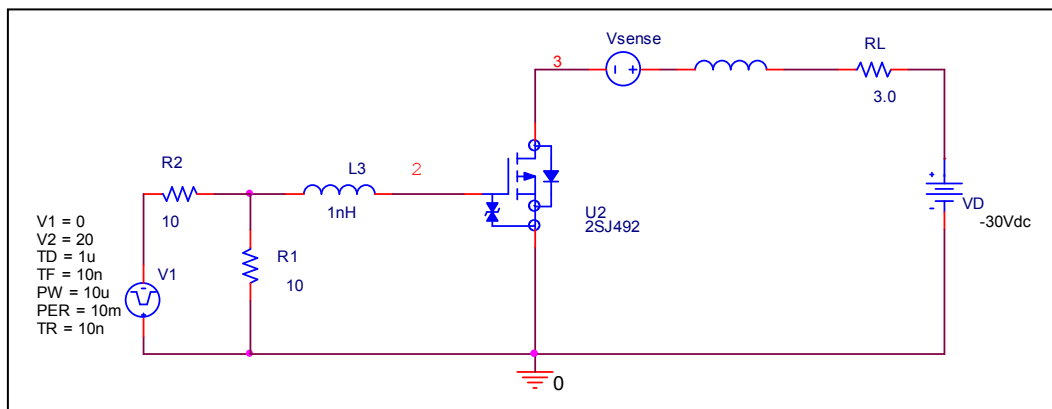
V _{DS} (V)	C _{bd} (pF)		Error(%)
	Measurement	Simulation	
-1	750.00	749.24	-0.10
-2	620.00	621.55	0.25
-5	460.00	455.88	-0.90
-10	360.00	358.54	-0.41
-20	280.00	275.44	-1.63

Switching Time Characteristic

Circuit Simulation result



Evaluation circuit

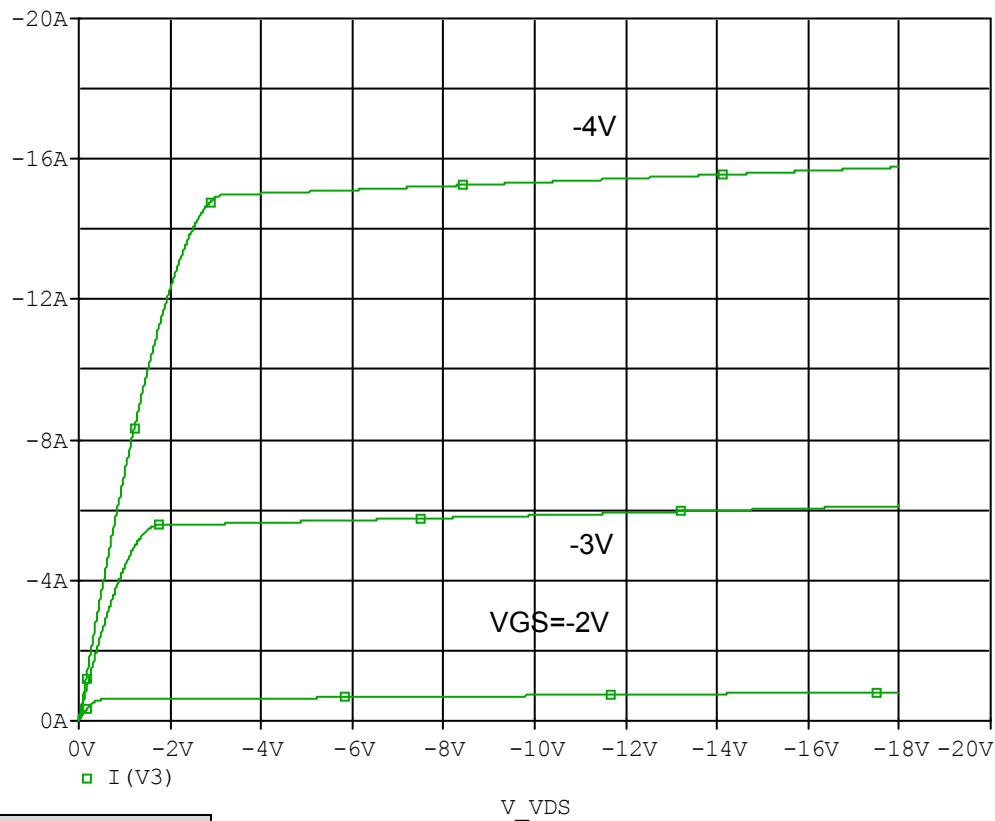


Simulation Result

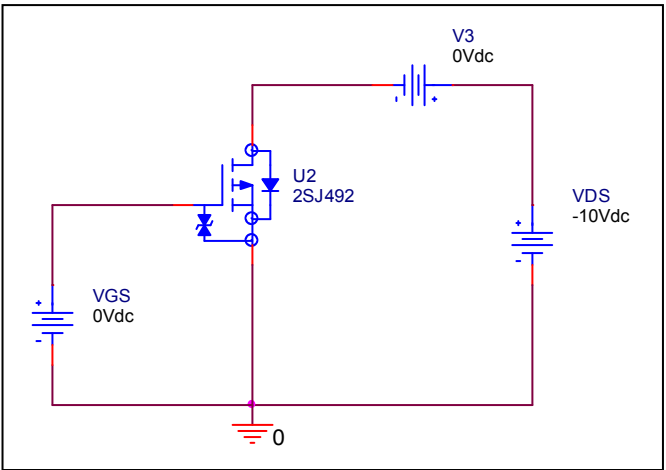
$I_D = -10A$, $V_{DD} = -30V$ $V_{GS} = 0/-10V$		Measurement	Simulation	Error(%)
td (on)	ns	16.000	15.786	-1.34

Output Characteristic

Circuit Simulation result

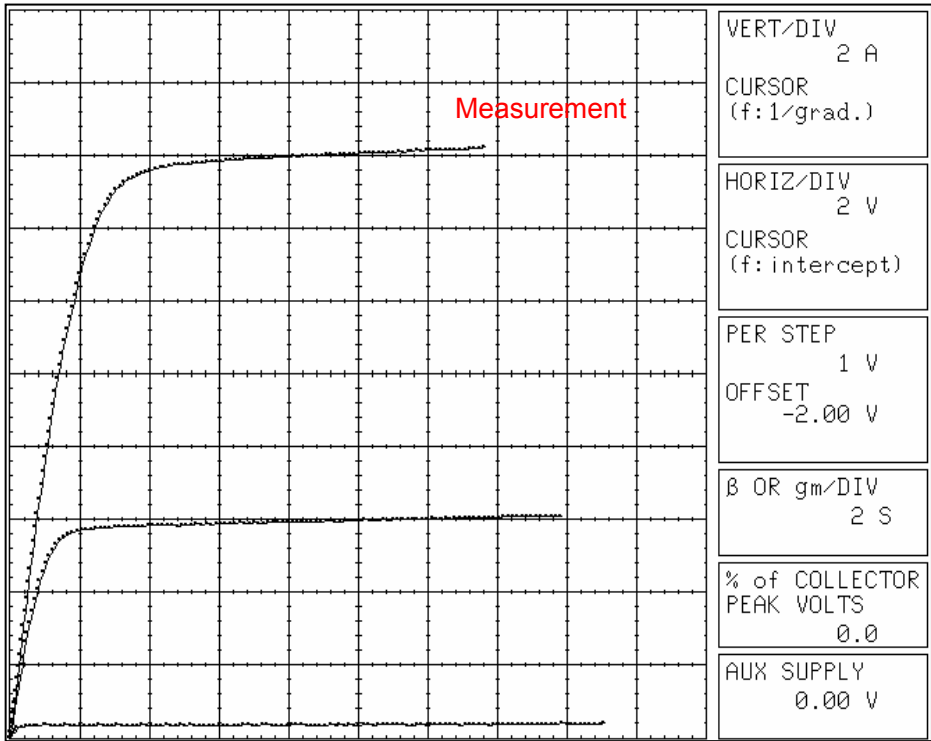


Evaluation circuit



Output Characteristic

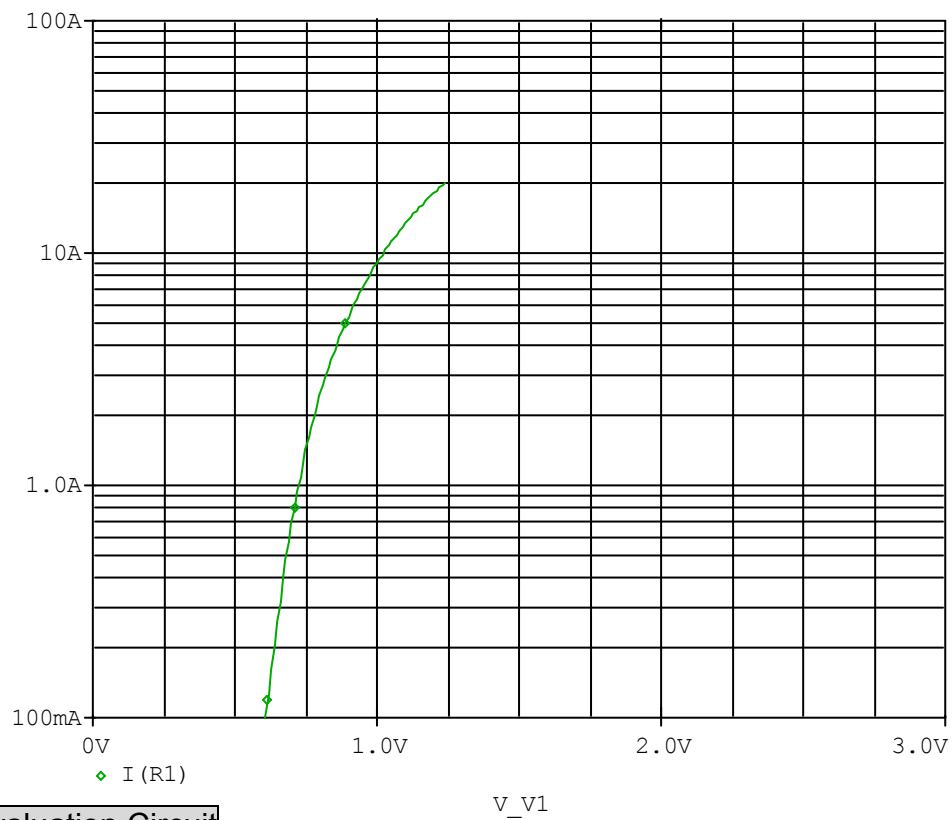
Reference



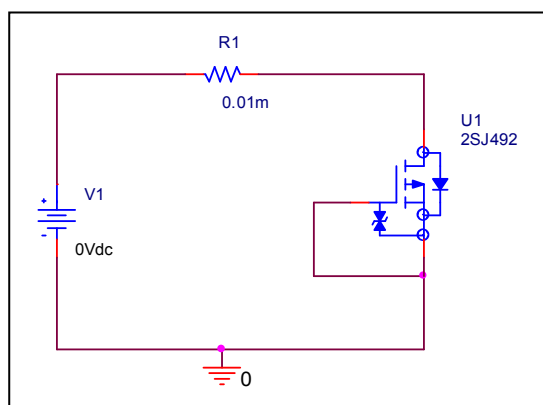
BODY DIODE

Forward Current Characteristic

Circuit Simulation Result

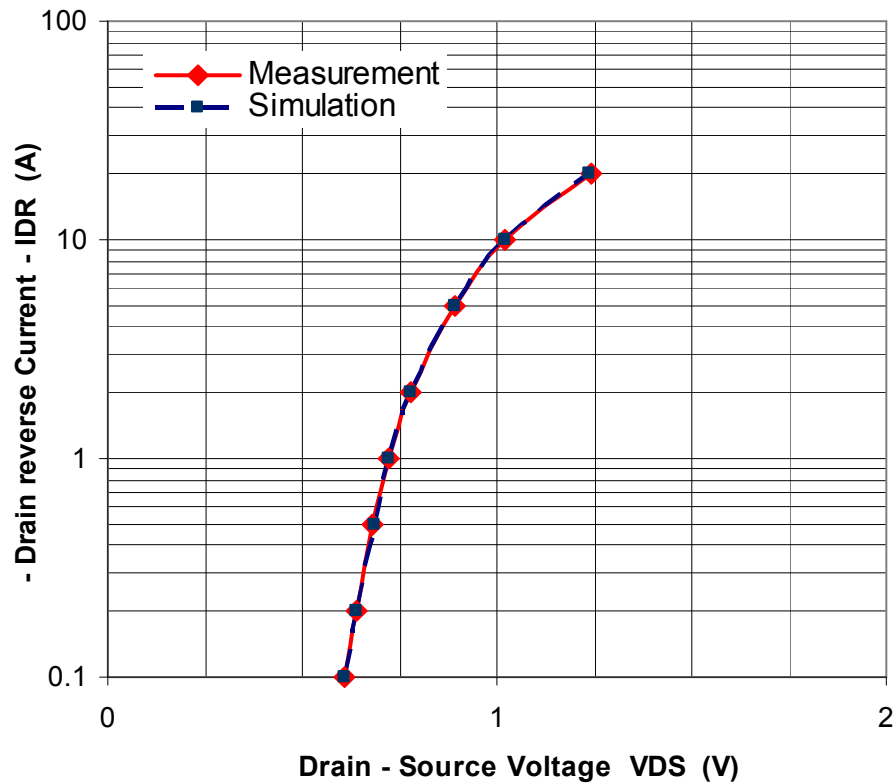


Evaluation Circuit



Comparison Graph

Circuit Simulation Result

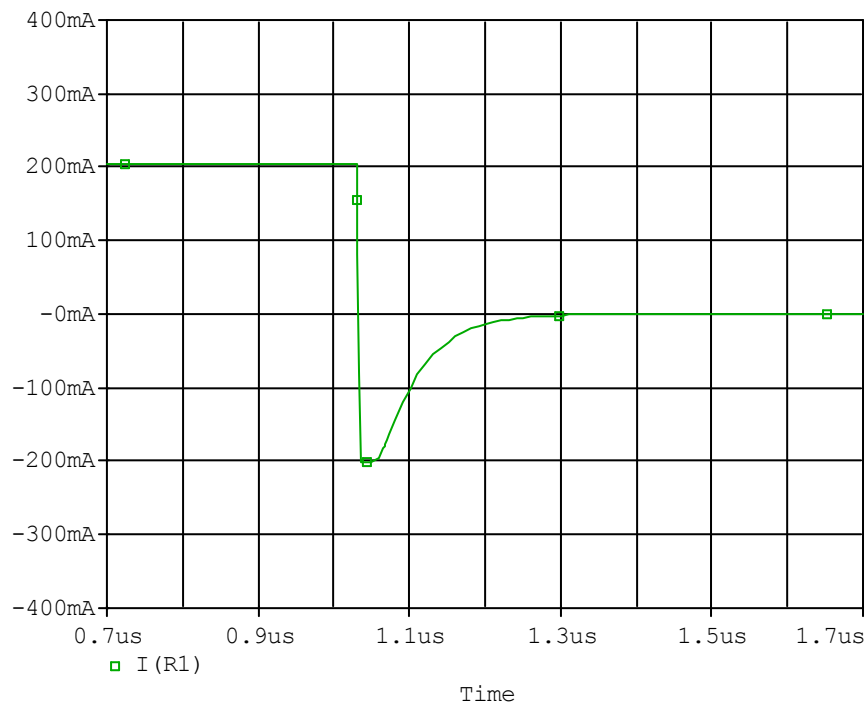


Simulation Result

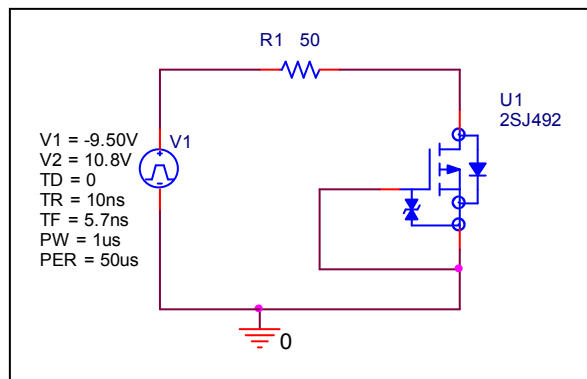
IDR(A)	VDS(V)		%Error
	Measurement	Simulation	
-0.1	0.610	0.609	-0.131
-0.2	0.640	0.638	-0.344
-0.5	0.680	0.683	0.441
-1	0.720	0.723	0.417
-2	0.780	0.779	-0.141
-5	0.890	0.890	-0.056
-10	1.020	1.022	0.176
-20	1.240	1.238	-0.194

Reverse Recovery Characteristic

Circuit Simulation Result



Evaluation Circuit

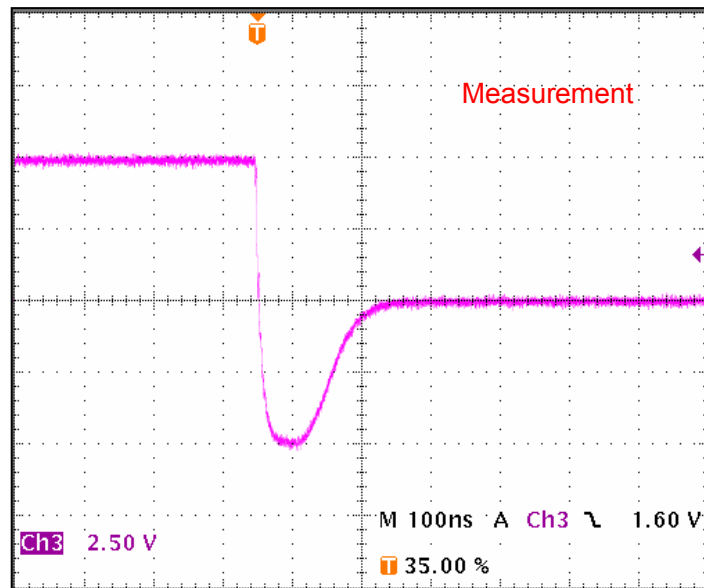


Compare Measurement vs. Simulation

		Measurement	Simulation	Error (%)
trr	ns	148.00	147.91	-0.06

Reverse Recovery Characteristic

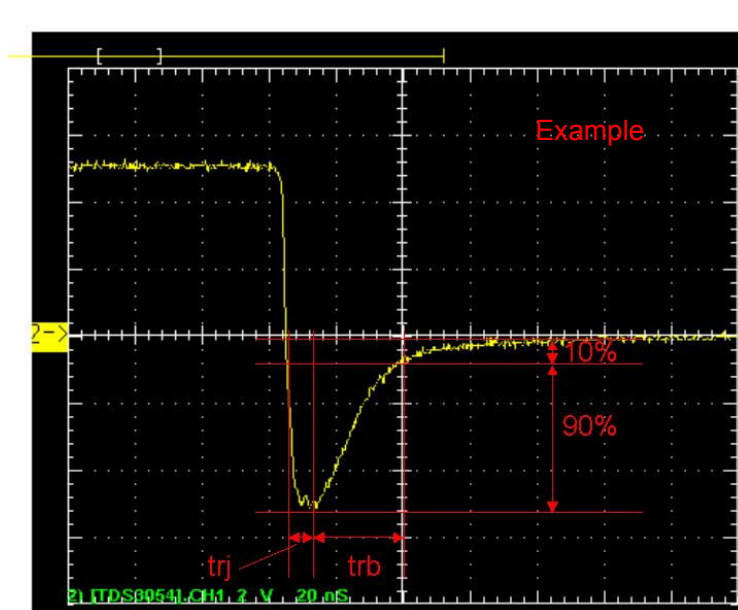
Reference



$T_{rj}=72.00(\text{ns})$

$T_{rb}=76.00(\text{ns})$

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

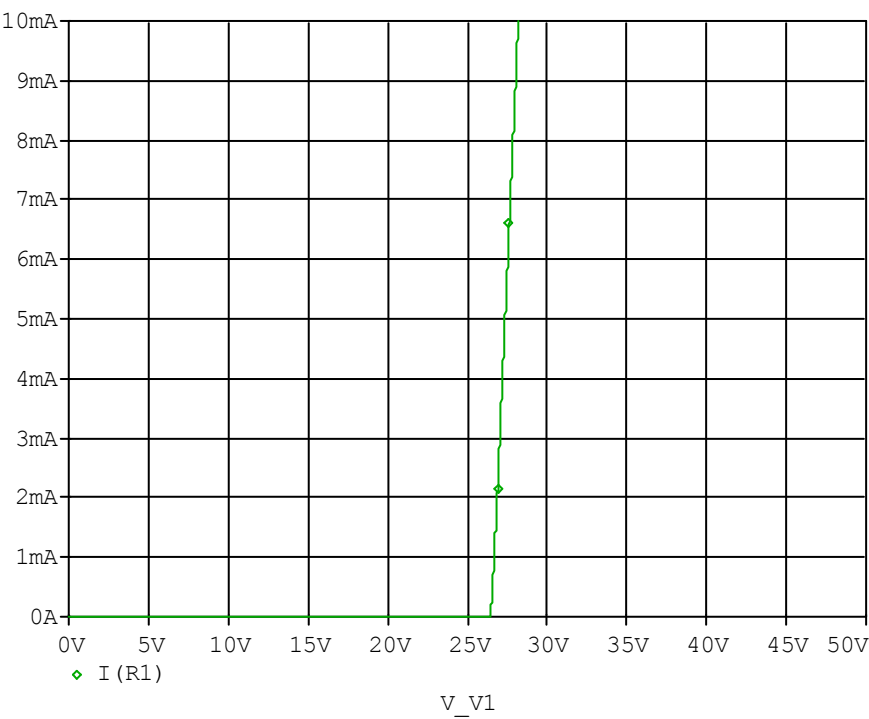


Relation between t_{rj} and t_{rb}

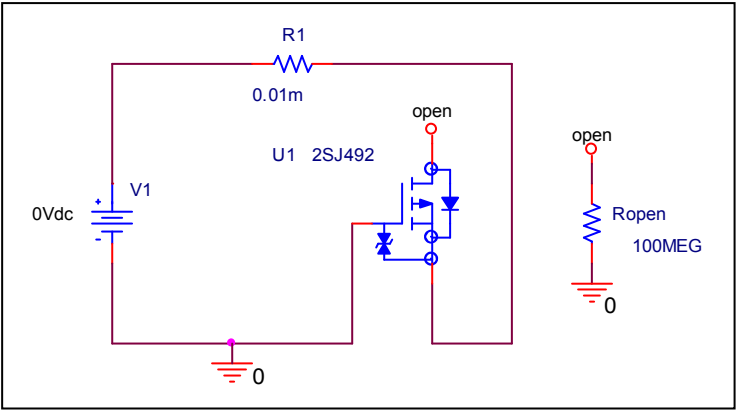
ESD PROTECTION DIODE

Zener Voltage Characteristic

Circuit Simulation Result



Evaluation Circuit



Zener Voltage Characteristic

Reference

