Device Modeling Report

COMPONENTS: Power MOSFET (Professional)
PART NUMBER: 2SK1544
MANUFACTURER: TOSHIBA
Body Diode (Professional)

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

Transconductance Characteristic
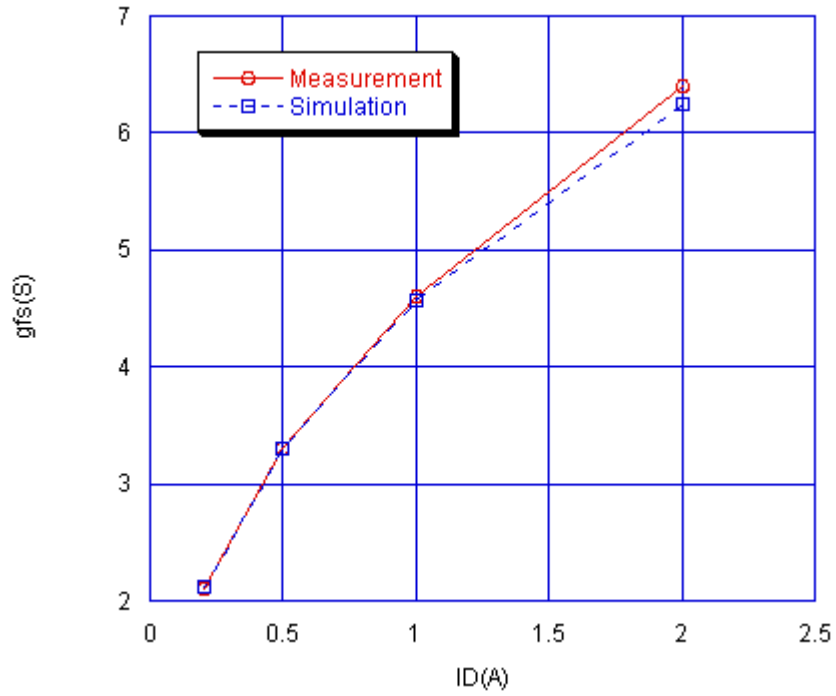
Id(A)	gfs		Error(%)
	Measurement	Simulation	
0.200	2.100	2.129	1.381
0.500	3.300	3.301	0.030
1.000	4.600	4.561	-0.848
2.000	6.400	6.249	-2.359

Vgs-Id Characteristic

Circuit Simulation result
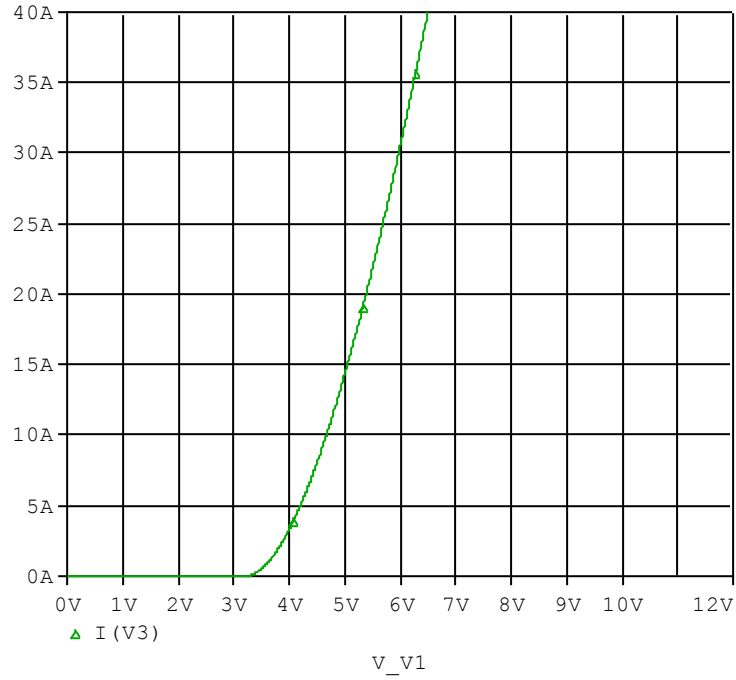
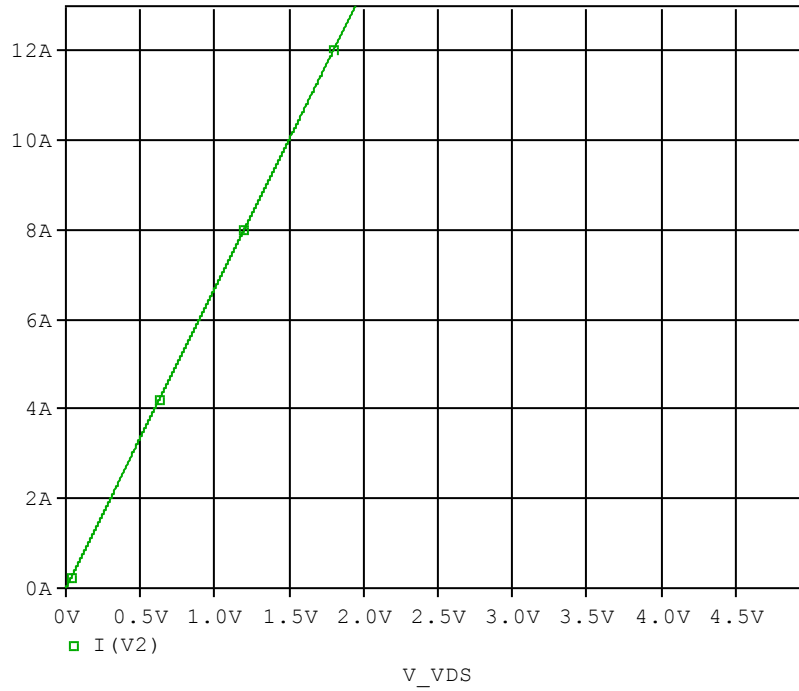Evaluation circuit
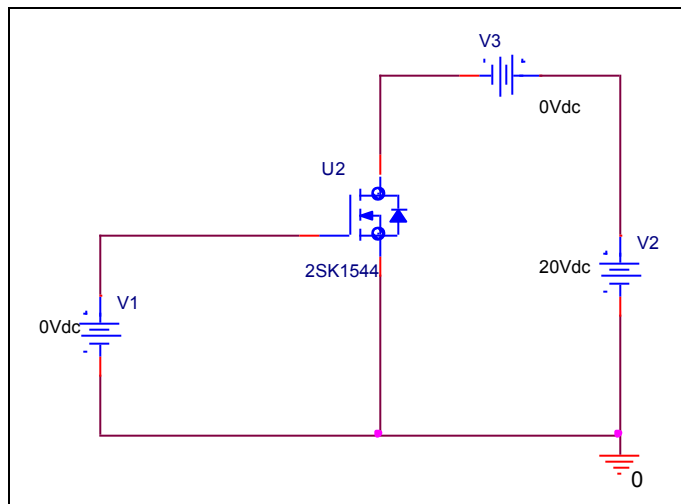
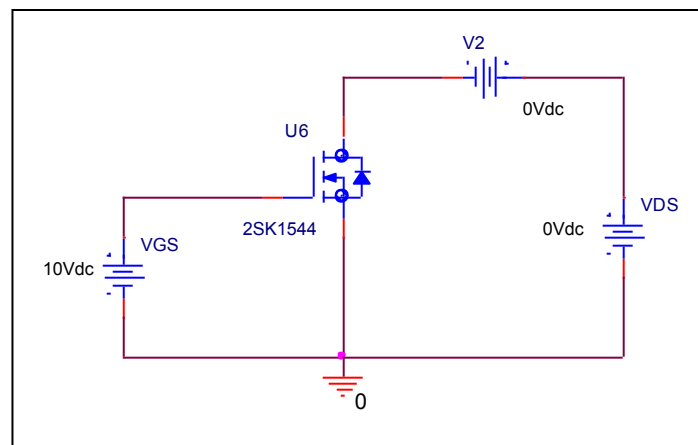# Comparison Graph

Circuit Simulation Result
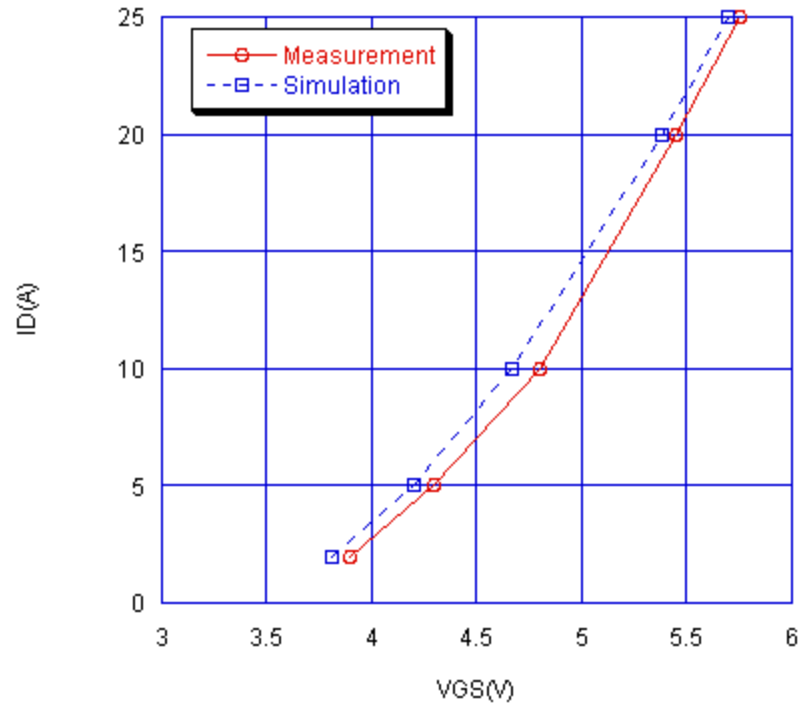
Simulation Result

I$_D$(A)	V$_{GS}$(V)		Error (%)
	Measurement	Simulation	
2.000	3.900	3.809	-2.333
5.000	4.300	4.201	-2.302
10.000	4.800	4.671	-2.687
20.000	5.450	5.386	-1.174
25.000	5.750	5.691	-1.026

Rds(on) Characteristic
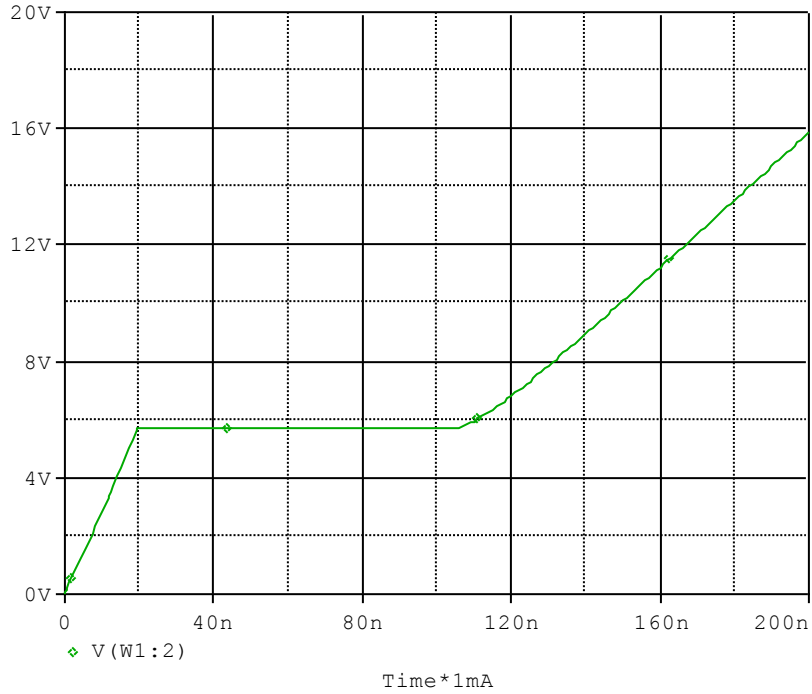
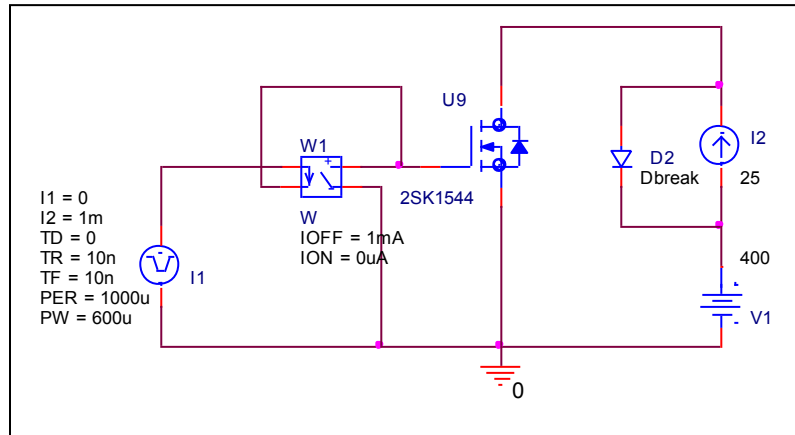Circuit Simulation result

Evaluation circuit

Simulation Result

I_D=13A, V_GS=10V	Measurement		Simulation		Error (%)
R_{DS} (on)	0.150	Ω	0.149	Ω	-0.667

Gate Charge Characteristic

Circuit Simulation result

- V(W1:2)

Time*1mA

Evaluation circuit

I1 = 0
I2 = 1m
TD = 0
TR = 10n
TF = 10n
PER = 1000u
PW = 600u

W1
W
IOFF = 1mA
ION = 0uA

U9
2SK1544

D2
Dbreak

I2
25

400

V1

0

Simulation Result

V$_{DD}$=400V,I$_{D}$=25A ,V$_{GS}$=10V	Measurement		Simulation		Error (%)
Qgs	20.000	nC	19.551	nC	-2.245
Qgd	88.000	nC	86.517	nC	-1.685
Qg	150.00	nC	149.438	nC	-0.375

Capacitance Characteristic

Cj (27°C)
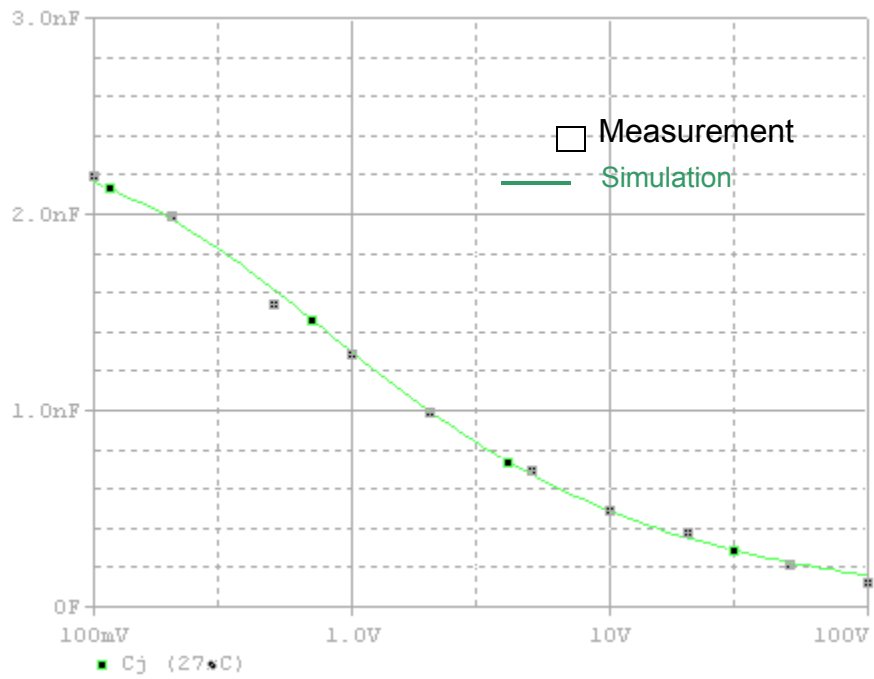
Simulation Result

| V_DS(V)	Cbd(pF)		Error(%)
	Measurement	Simulation	
0.100	2200.000	2100.000	-4.545
0.200	2000.000	1900.000	-5.000
0.500	1550.000	1600.000	3.226
1.000	1300.000	1300.000	0.000
2.000	1000.000	1000.000	0.000
5.000	700.000	680.000	-2.857
10.000	500.000	500.000	0.000
20.000	390.000	395.000	1.282
50.000	220.000	225.000	2.273
100.000	130.000	135.000	3.846

Switching Time Characteristic

Circuit Simulation result
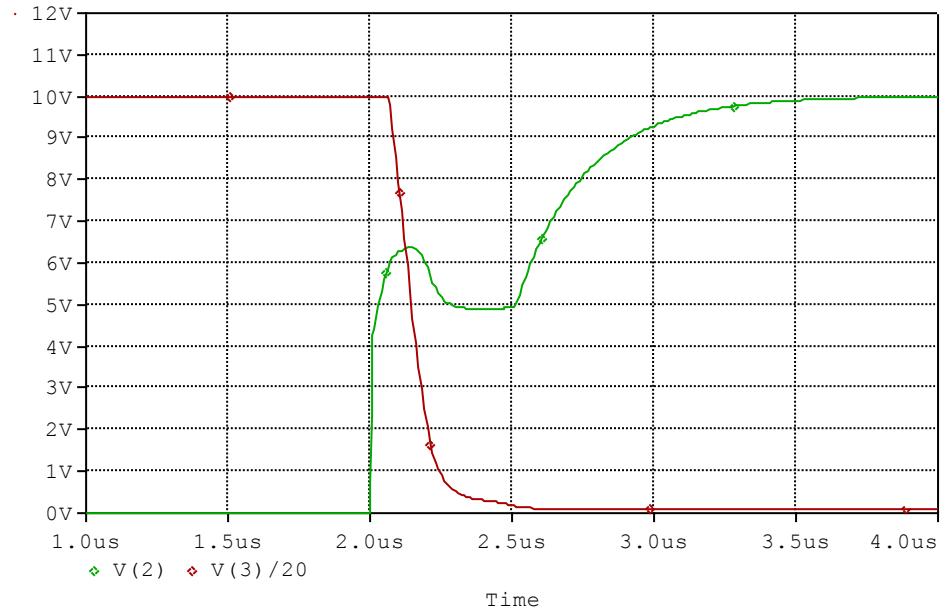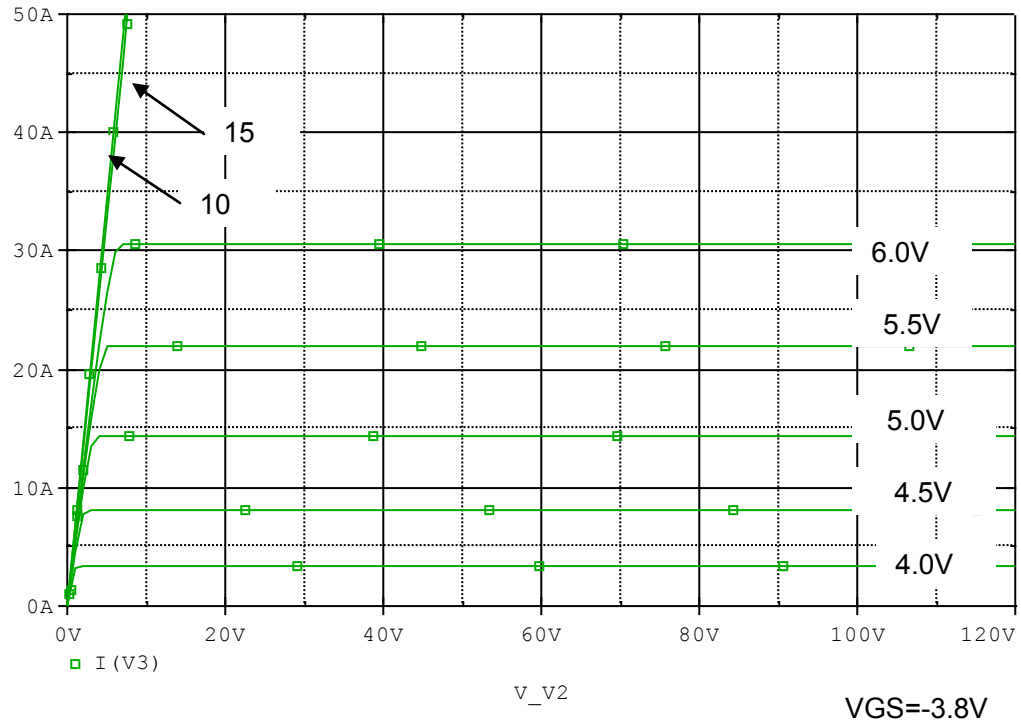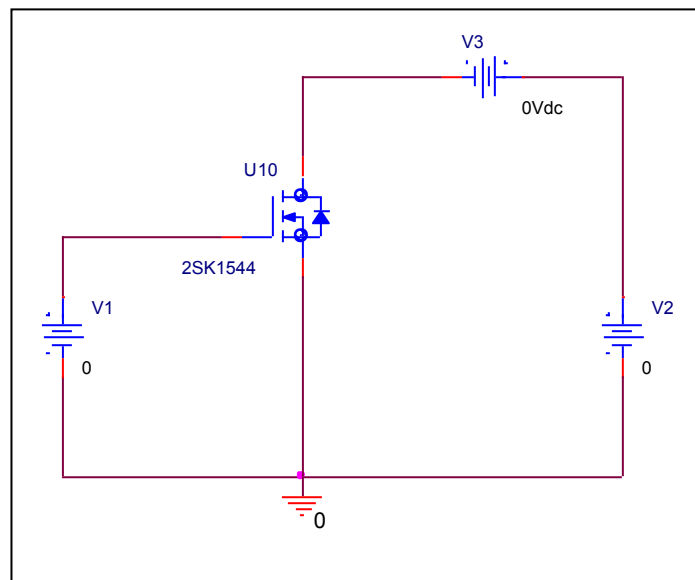

Evaluation circuit
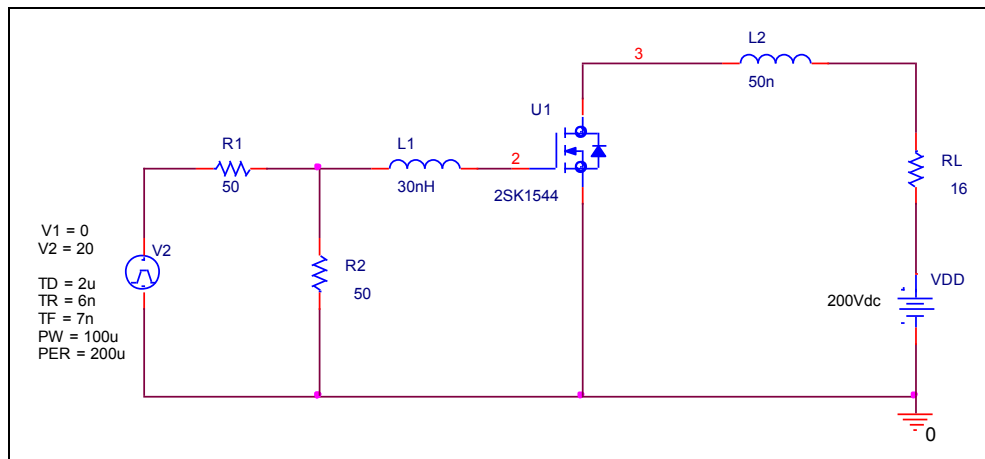
Simulation Result

I$_D$=25A, V$_{DD}$=200V V$_{GS}$=0/10V	Measurement		Simulation		Error(%)
ton	240.000	ns	241.273	ns	0.530

Output Characteristic

Circuit Simulation result

50A ┤

40A

30A   6.0V

                                                                       5.5V

20A

                                                                       5.0V

10A   4.5V

                                                                       4.0V

0A ┤
   0V   20V   40V   60V   80V   100V   120V

   □ I(V3)

                          V_V2

                                              VGS=-3.8V

15

10

Evaluation circuit

V3
0Vdc

U10

2SK1544

V1
0

V2
0

0

Forward Current Characteristic

Circuit Simulation Result

Graph:
- Y-axis: 100A, 10A, 3.0A
- X-axis: 0V, 0.2V, 0.4V, 0.6V, 0.8V, 1.0V, 1.2V, 1.4V, 1.6V, 1.8V
- ◇ I(R1)
- V_V1

Evaluation Circuit

R1
0.01m

V1
0Vdc

U4
2SK1544

0

Comparison Graph

Simulation Result

IDR(A)	VDS(V) Measurement	VDS(V) Simulation	%Error
3.000	0.700	0.712	1.714
5.000	0.750	0.736	-1.867
10.000	0.790	0.782	-1.013
20.000	0.850	0.851	0.118
50.000	1.030	1.028	-0.194
100.00	1.320	1.298	-1.667

Reverse Recovery Characteristic

Circuit Simulation Result
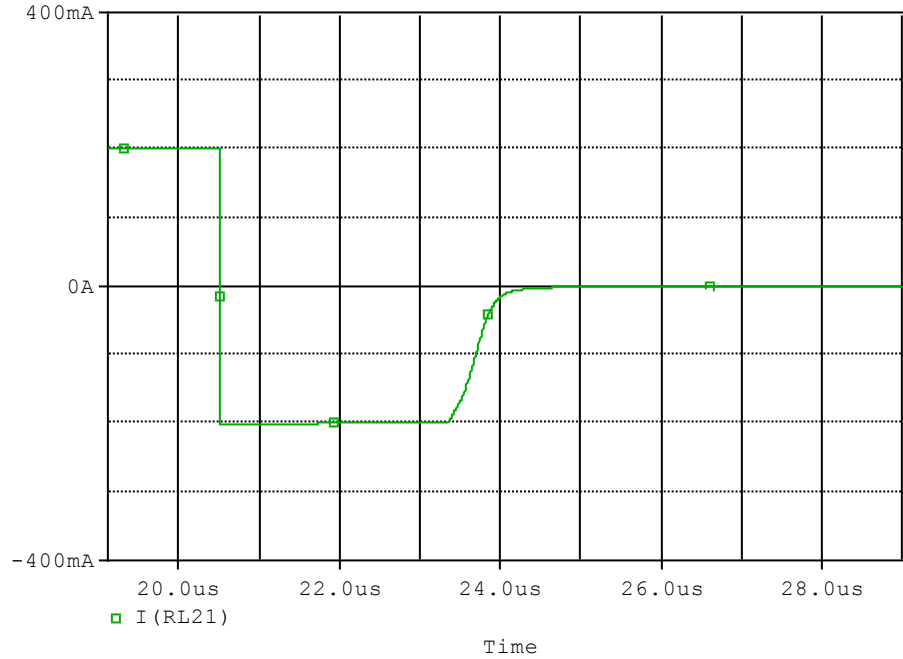
Evaluation Circuit
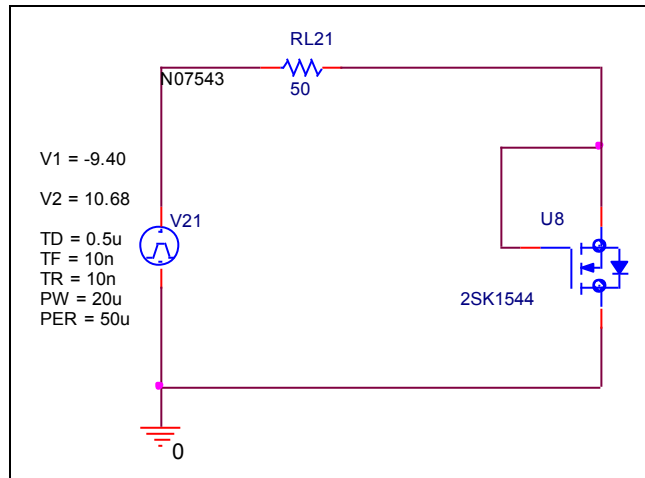
Compare Measurement vs. Simulation

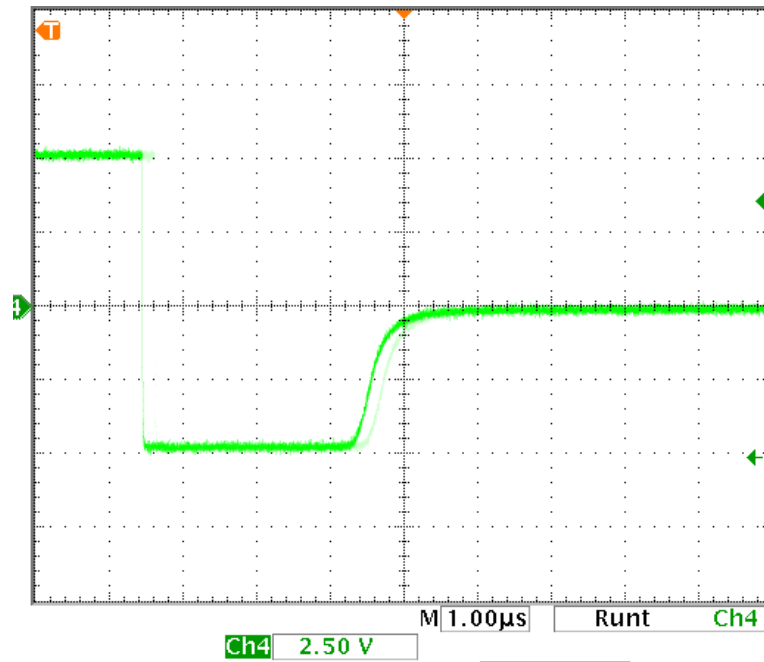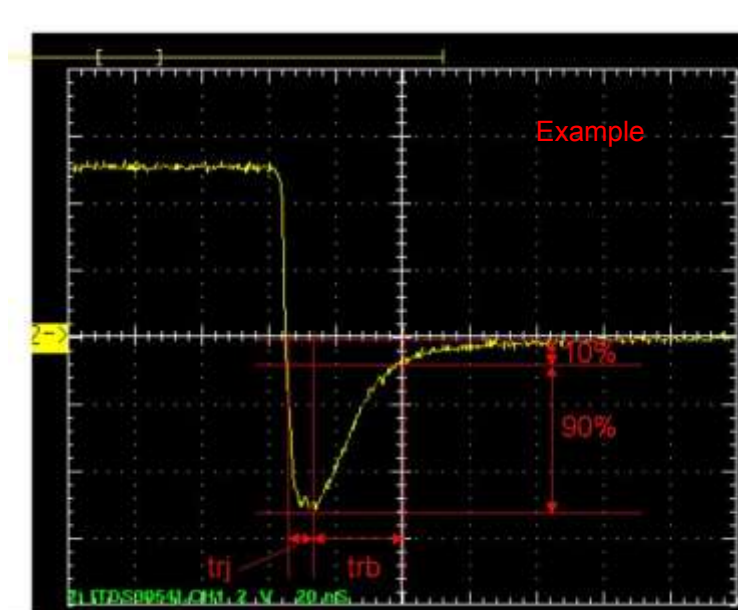|	Measurement		Simulation		Error (%)
trj	2.820	us	2.827	us	0.248
trb	720.000	ns	720.650	ns	0.090
trr	3.540	us	3.547	us	0.198

Reverse Recovery Characteristic

Trj=2.82(us)
Trb=720(ns)
Conditions:Ifwd=Irev=0.2(A),Rl=50

Relation between trj and trb