# Device Modeling Report

COMPONENTS: MOSFET (Model Parameters)
PART NUMBER: 2SK4125
MANUFACTURER: SANYO
REMARK: Body Diode (Model Parameters)

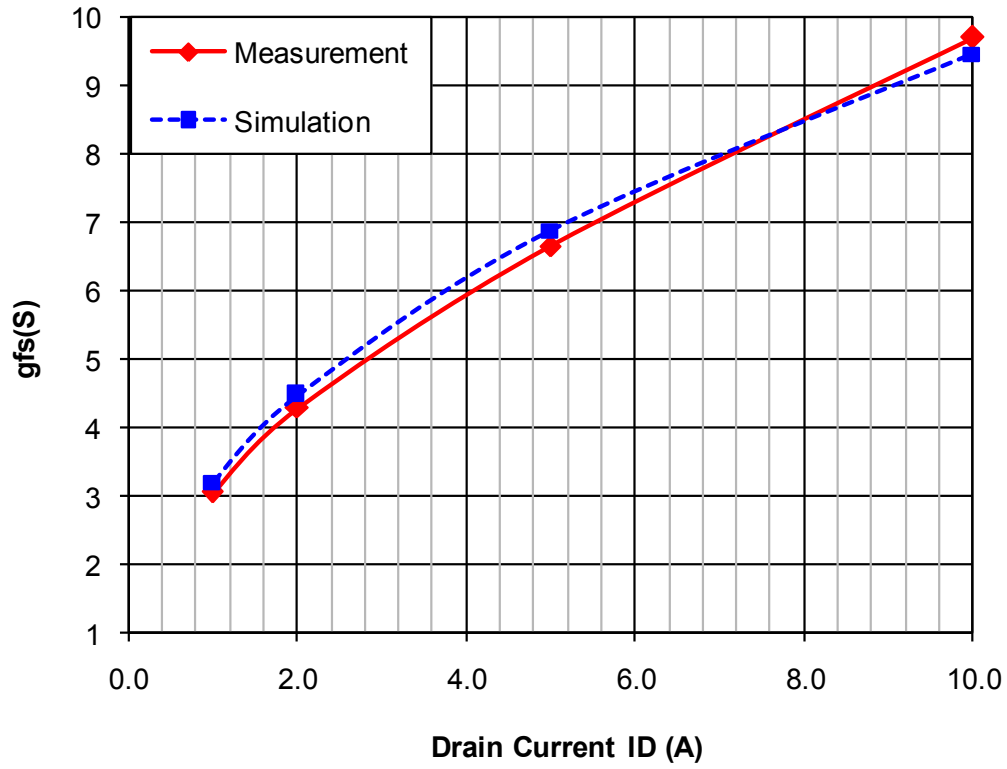
**Bee Technologies Inc.**

## 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

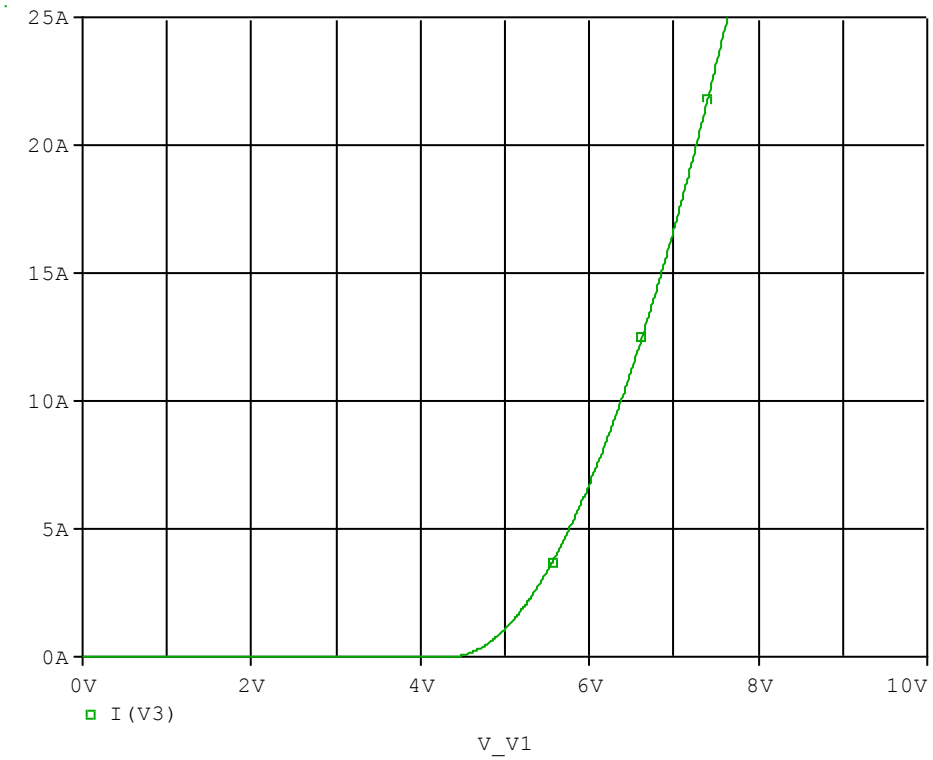



Comparison table

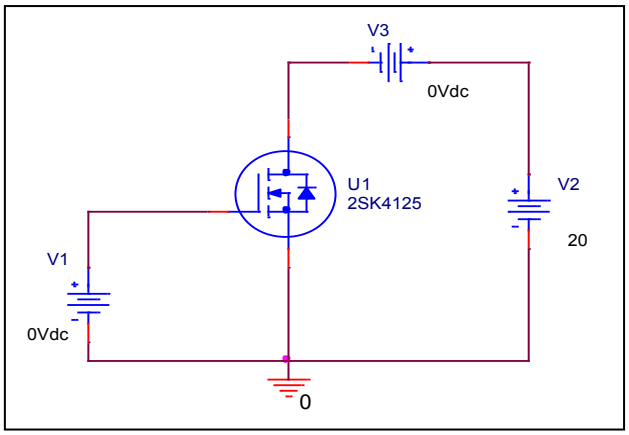
| Id(A) | gfs(S) | | Error (%) |
|---|---|---|---|
| | Measurement | Simulation | |
| 1 | 3.050 | 3.199 | 4.90 |
| 2 | 4.280 | 4.466 | 4.34 |
| 5 | 6.650 | 6.882 | 3.49 |
| 10 | 9.700 | 9.463 | -2.44 |

## Vgs-Id Characteristic

Circuit Simulation result

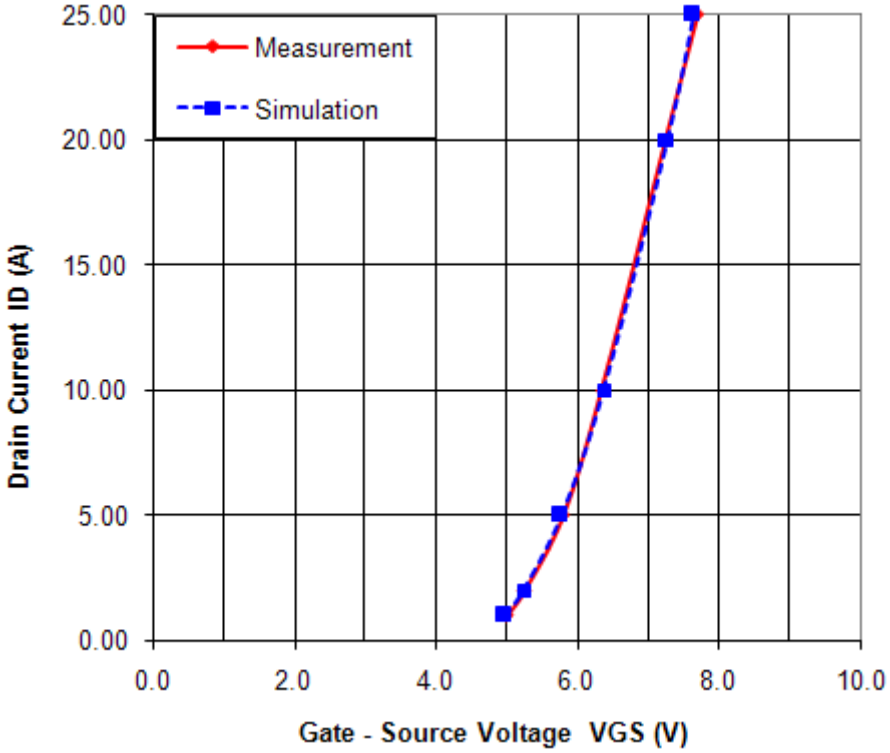



Evaluation circuit



## Comparison Graph

Circuit Simulation Result

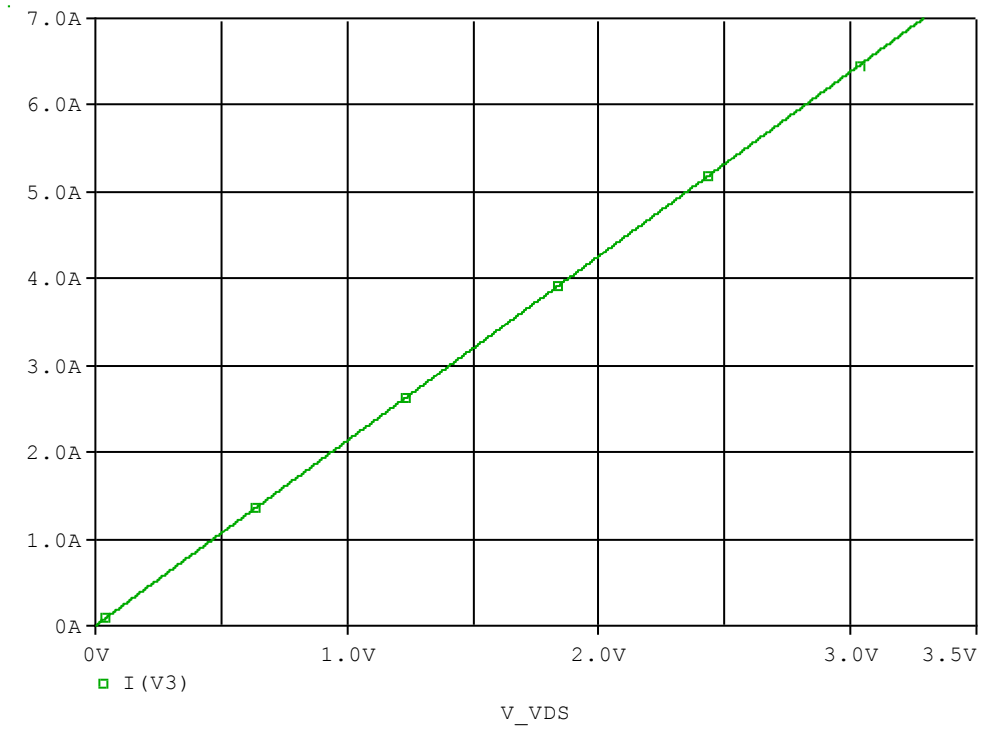



Simulation Result

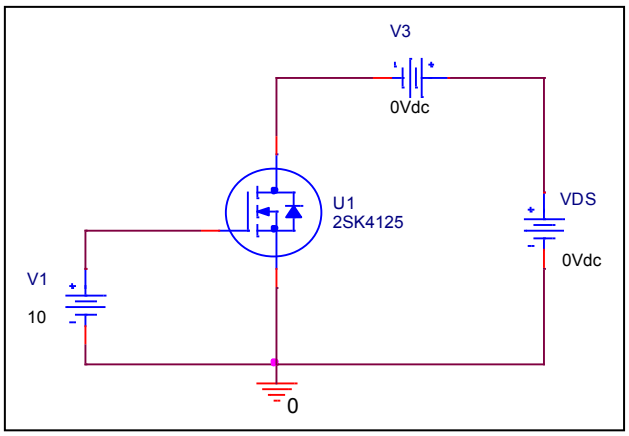
| $I_D$(A) | $V_{GS}$(V) | | Error (%) |
|---|---|---|---|
| | Measurement | Simulation | |
| 1 | 5.000 | 4.975 | -0.50 |
| 2 | 5.250 | 5.236 | -0.28 |
| 5 | 5.800 | 5.763 | -0.64 |
| 10 | 6.350 | 6.373 | 0.37 |
| 20 | 7.250 | 7.266 | 0.22 |
| 25 | 7.700 | 7.635 | -0.84 |

## Rds(on) Characteristic

Circuit Simulation result




Evaluation circuit

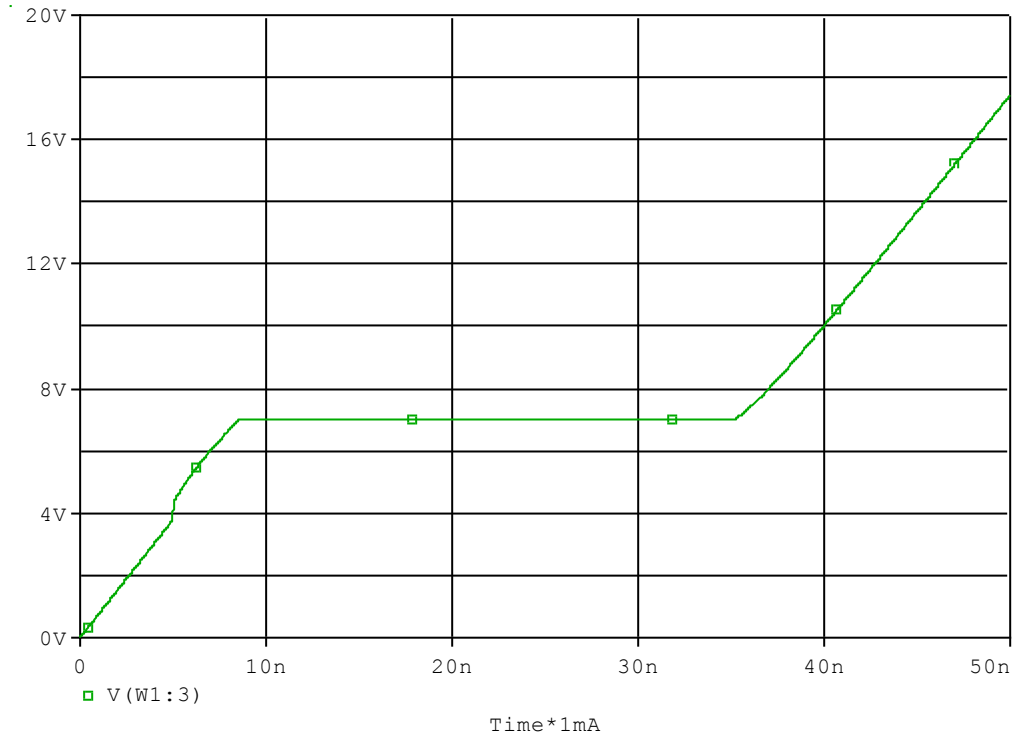



Simulation Result

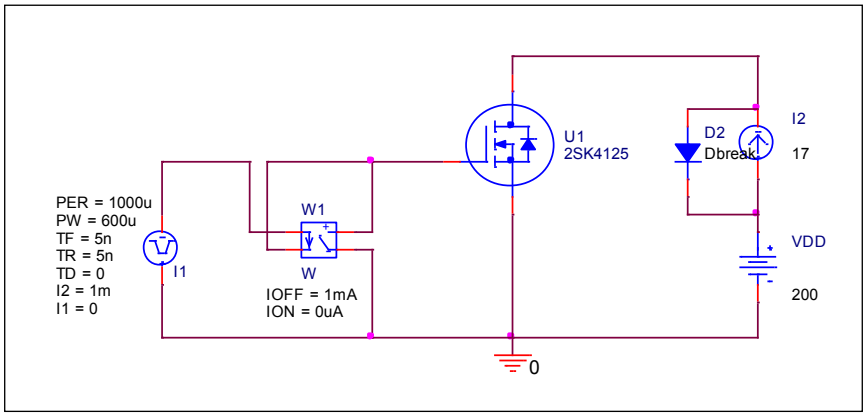
| $I_D$ = 7A, $V_{GS}$ = 10V | | Measurement | Simulation | Error (%) |
|---|---|---|---|---|
| $R_{DS}$ (on) | Ω | 0.4700 | 0.4700 | 0.00 |

## Gate Charge Characteristic

Circuit Simulation result



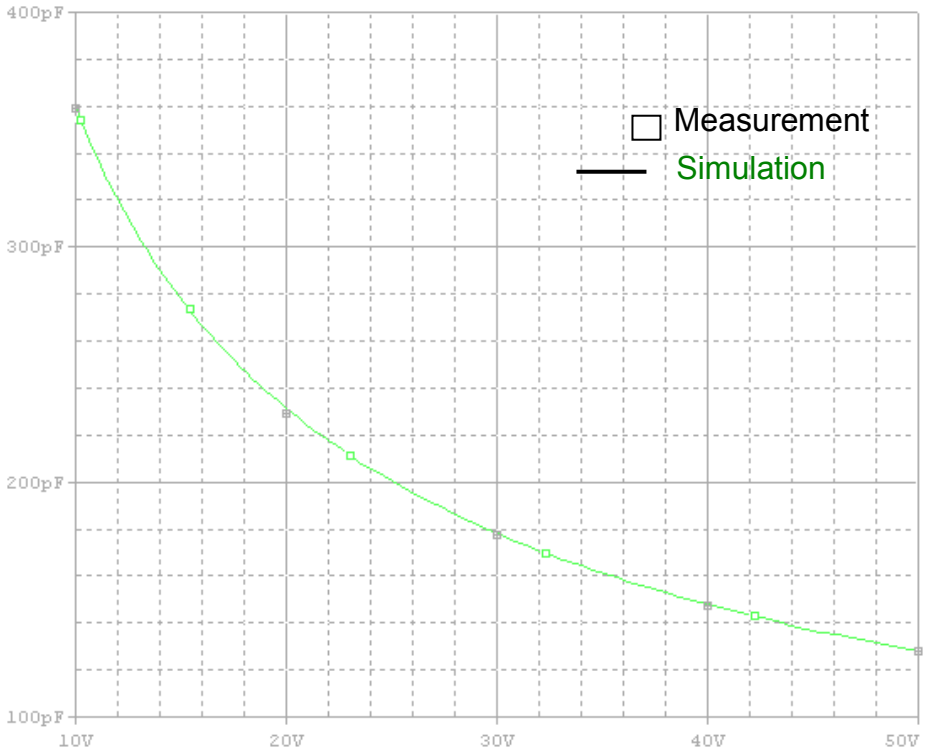

Evaluation circuit




Simulation Result

| $V_{DD}$=200V, $I_D$=17A, $V_{GS}$=10V | | Measurement | Simulation | Error (%) |
|---|---|---|---|---|
| Qgs | nC | 8.300 | 8.633 | 4.01 |
| Qgd | nC | 26.700 | 26.566 | -0.50 |
| Qg | nC | 46.000 | 39.961 | -13.13 |

## Capacitance Characteristic

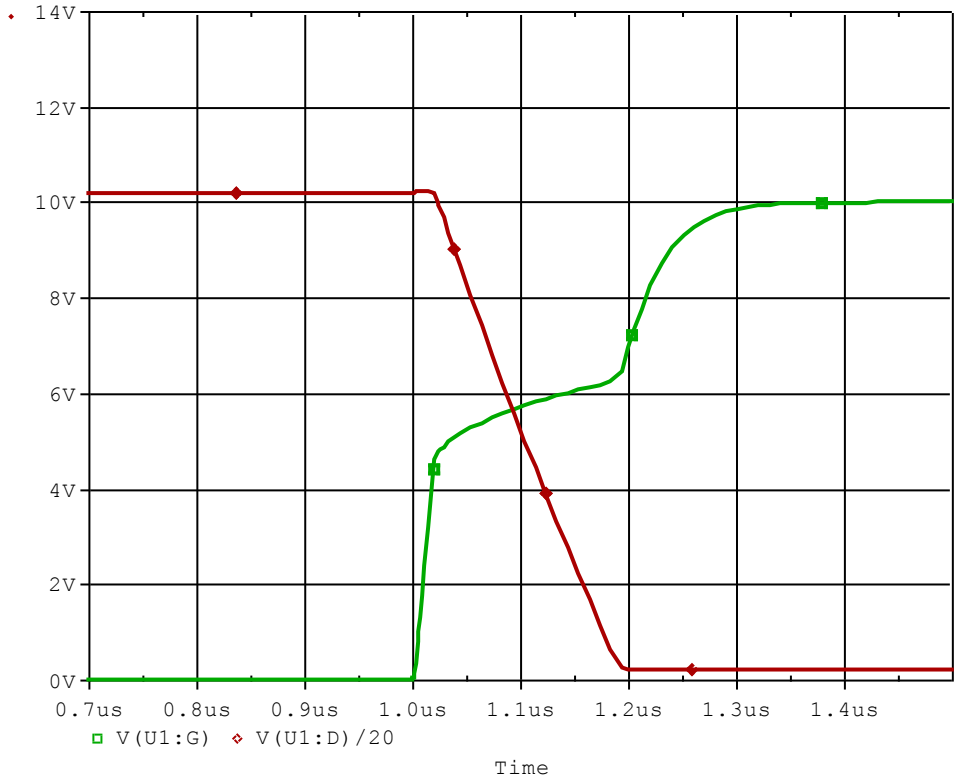



Simulation Result

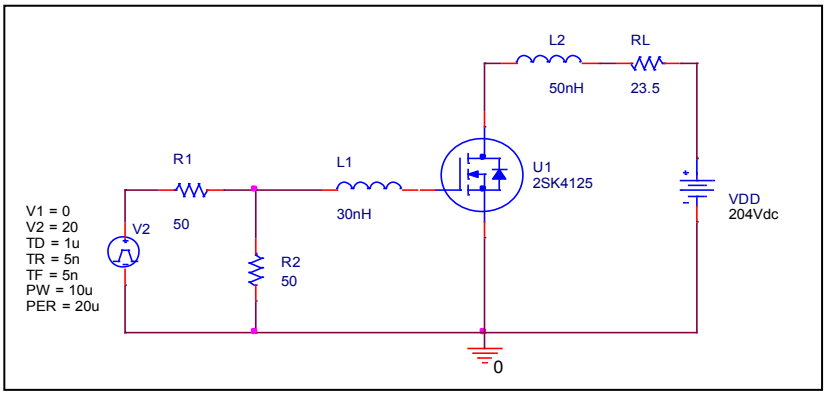
| $V_{DS}$ (V) | Cbd (pF) | | Error (%) |
|---|---|---|---|
| | Measurement | Simulation | |
| 10 | 360.000 | 359.460 | -0.15 |
| 20 | 230.000 | 231.290 | 0.56 |
| 30 | 178.000 | 178.142 | 0.08 |
| 40 | 148.000 | 147.890 | -0.07 |
| 50 | 129.000 | 127.963 | -0.80 |

## Switching Time Characteristic

Circuit Simulation result




Evaluation circuit

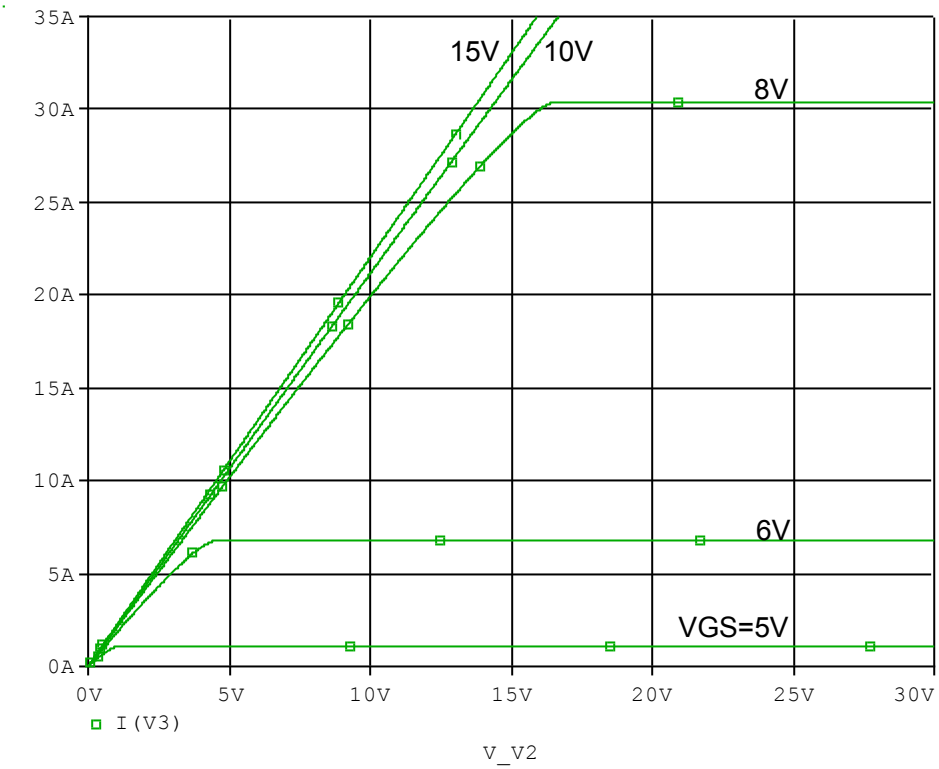



Simulation Result

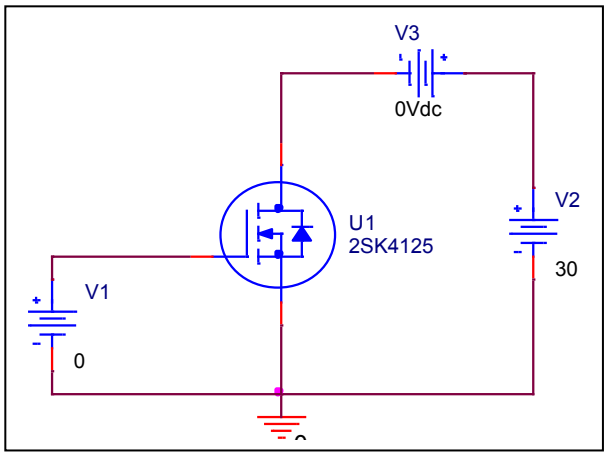
| $I_D$=8.5A, $V_{DD}$=200V $V_{GS}$=0/10V | | Measurement | Simulation | Error (%) |
|---|---|---|---|---|
| td(on) | ns | 26.500 | 33.107 | 24.93 |

## Output Characteristic

Circuit Simulation result

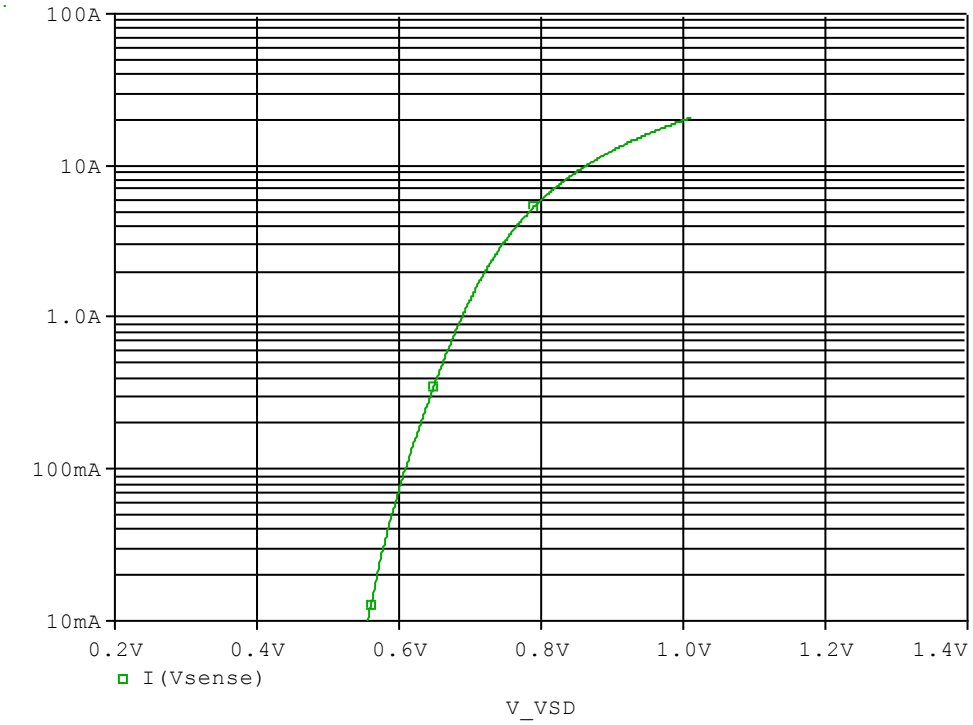



Evaluation circuit

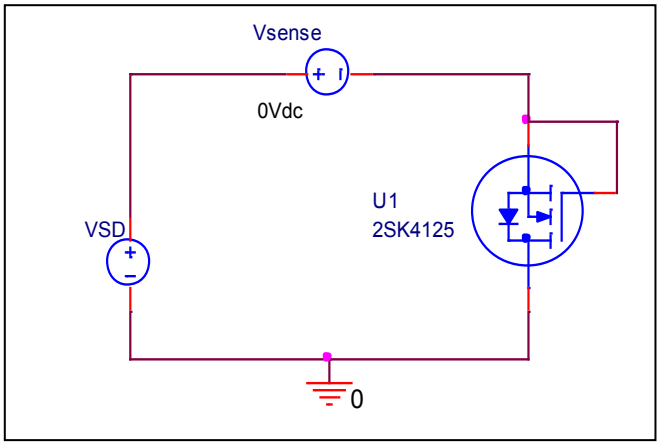


## Forward Current Characteristic

Circuit Simulation Result

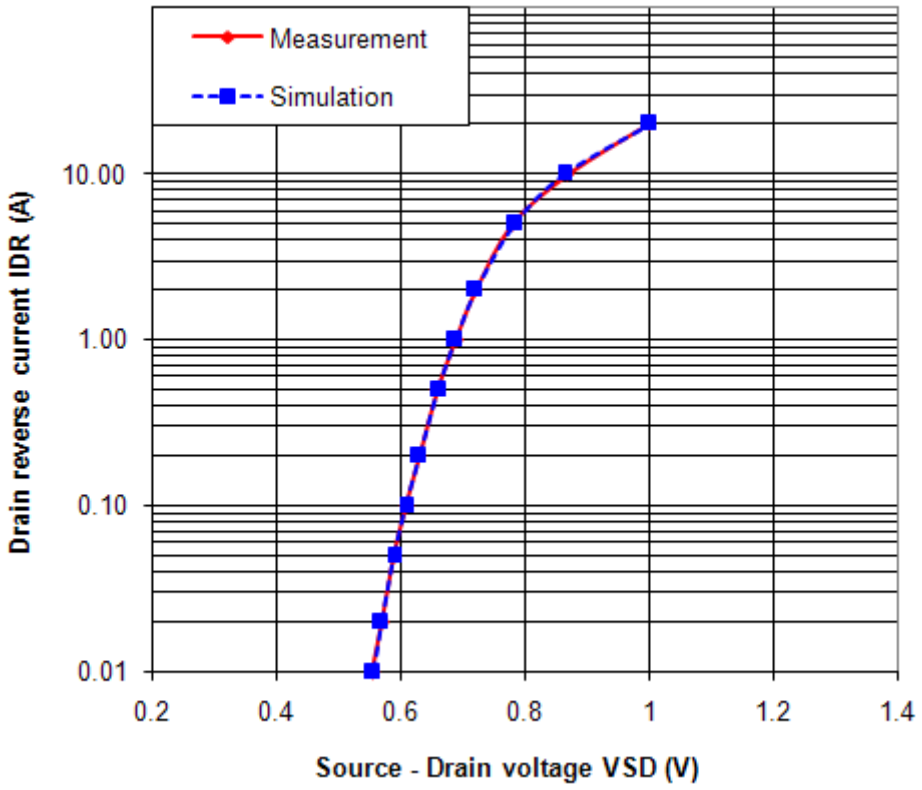



Evaluation Circuit



## Comparison Graph

Circuit Simulation Result

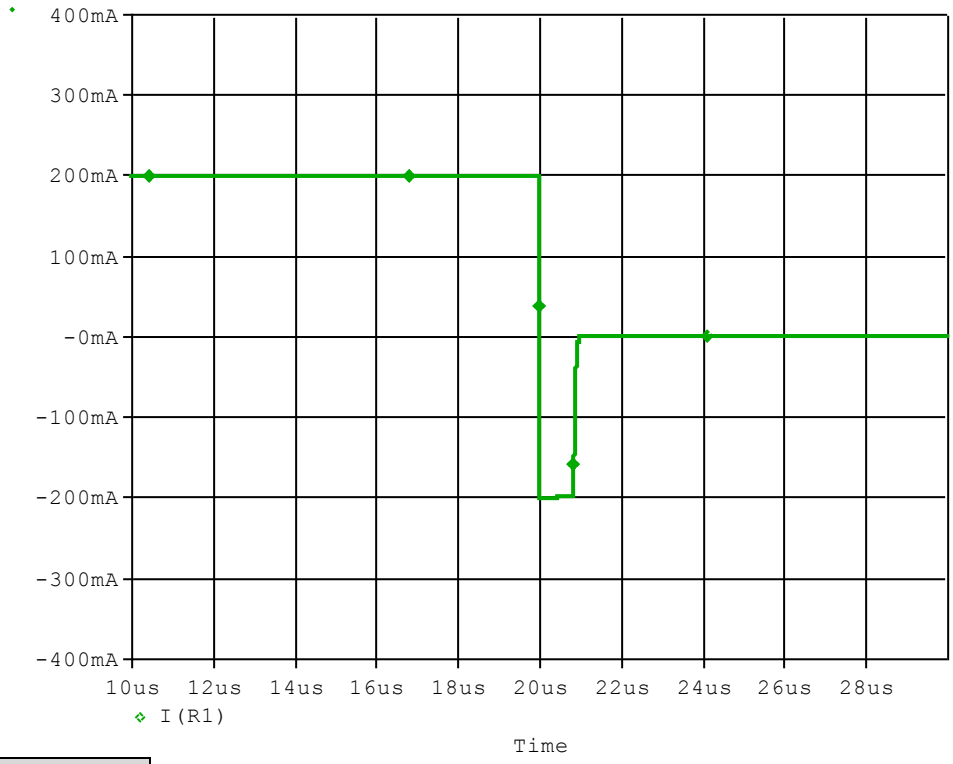



Simulation Result

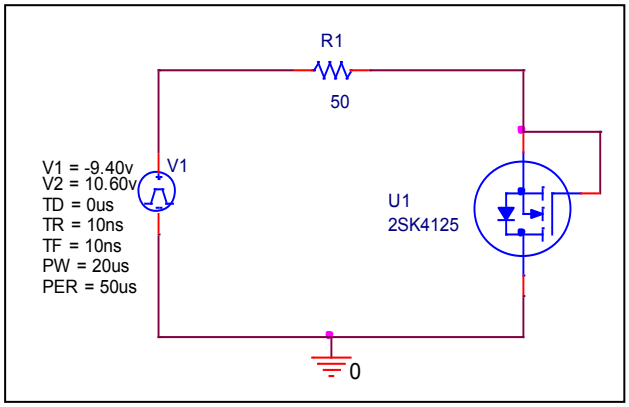
| IDR(A) | VSD(V) | | Error (%) |
|---|---|---|---|
| | Measurement | Simulation | |
| 0.01 | 0.5550 | 0.5560 | 0.18 |
| 0.02 | 0.5700 | 0.5691 | -0.16 |
| 0.05 | 0.5900 | 0.5898 | -0.03 |
| 0.1 | 0.6100 | 0.6089 | -0.18 |
| 0.2 | 0.6300 | 0.6303 | 0.04 |
| 0.5 | 0.6600 | 0.6614 | 0.21 |
| 1 | 0.6900 | 0.6883 | -0.24 |
| 2 | 0.7200 | 0.7211 | 0.16 |
| 5 | 0.7800 | 0.7842 | 0.53 |
| 10 | 0.8700 | 0.8638 | -0.71 |
| 20 | 1.0000 | 1.0020 | 0.20 |

## Reverse Recovery Characteristics

Circuit Simulation Result



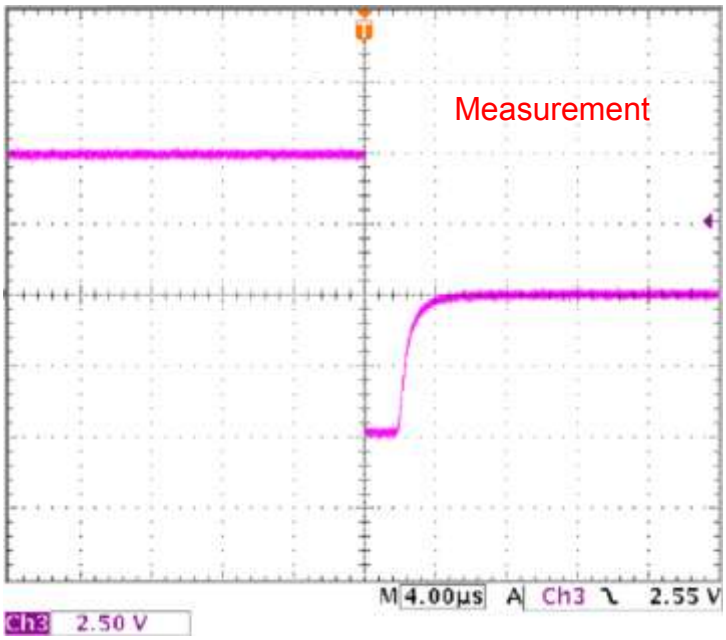

Evaluation Circuit



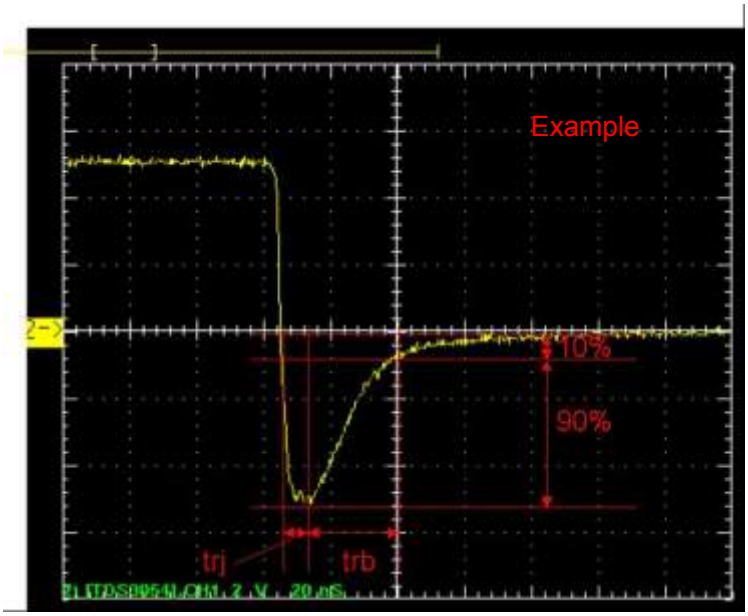

Compare Measurement vs. Simulation

| Characteristic | Unit | Measurement | Simulation | Error (%) |
|---|---|---|---|---|
| trj | us | 0.800 | 0.792 | -1.06 |

## Reverse Recovery Characteristic Reference




Trj=0.80(us)
Trb=1.12(us)
Conditions:Ifwd=Irev=0.2(A),Rl=50




Relation between trj and trb