# Device Modeling Report

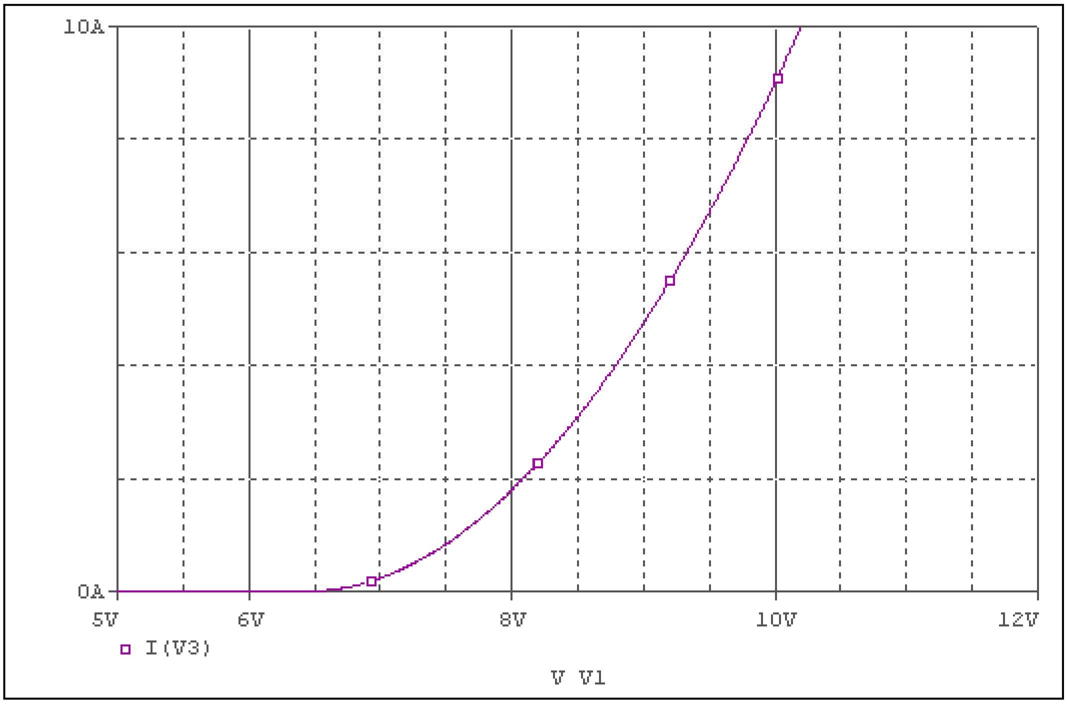
COMPONENTS: Insulated Gate Bipolar Transistor (IGBT)
PART NUMBER: IRG4IBC20KD
MANUFACTURER: International Rectifier

**Bee Technologies Inc.**

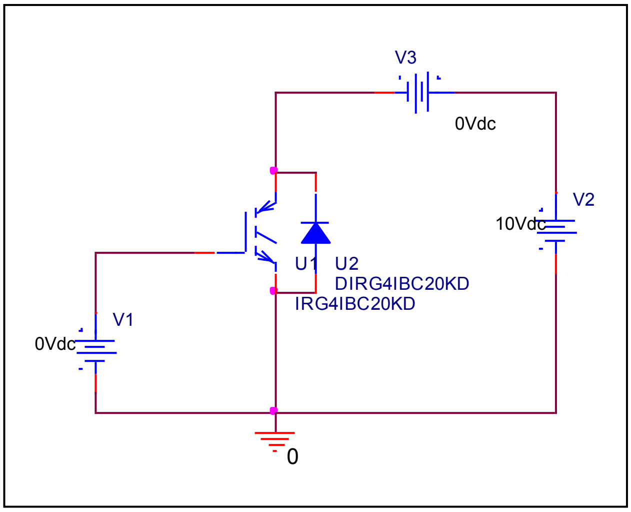
| Pspice model parameter | Model description |
|---|---|
| TAU | Ambipolar Recombination Lifetime |
| KP | MOS Transconductance |
| AREA | Area of the Device |
| AGD | Gate-Drain Overlap Area |
| WB | Metallurgical Base Width |
| VT | Threshold Voltage |
| KF | Triode Region Factor |
| CGS | Gate-Source Capacitance per Unit Area |
| COXD | Gate-Drain Oxide Capacitance per Unit Area |
| VTD | Gate-Drain Overlap Depletion Threshold |

# Transfer Characteristics

## Circuit Simulation result



## Evaluation circuit



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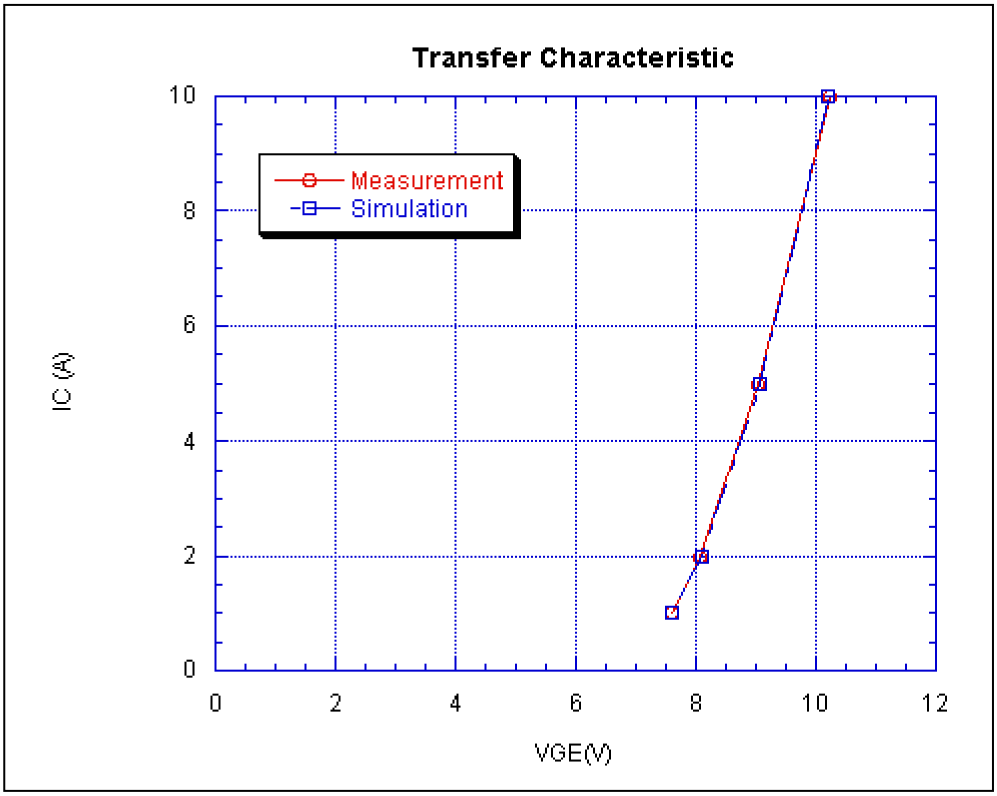
# Comparison Graph

Circuit Simulation Result



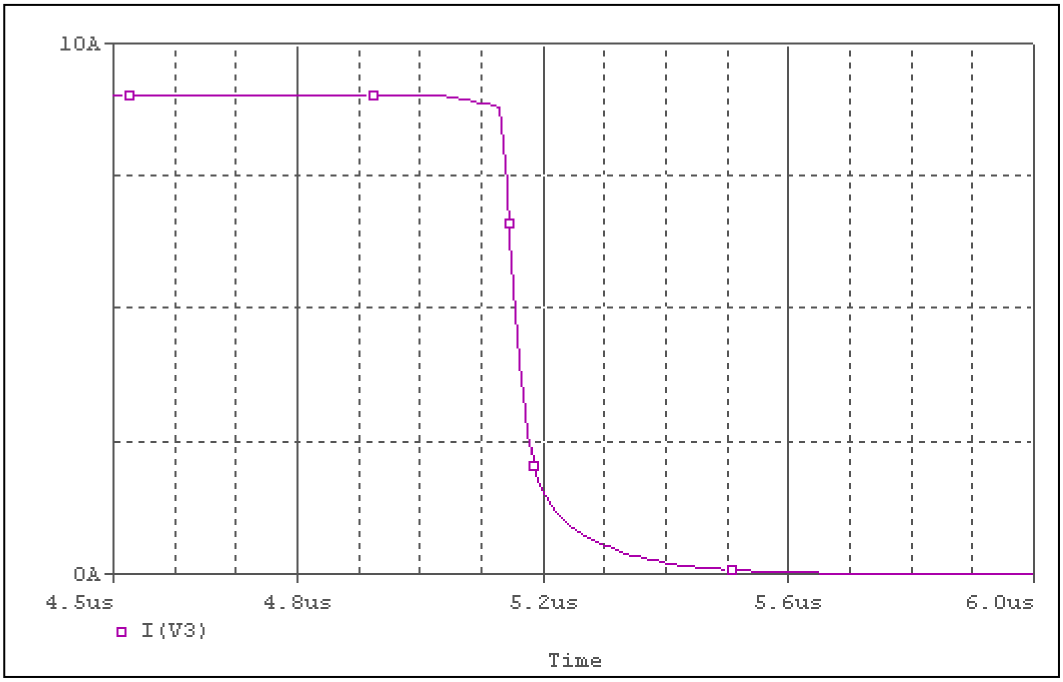
Simulation Result

**Test condition : Vce = 10 V**

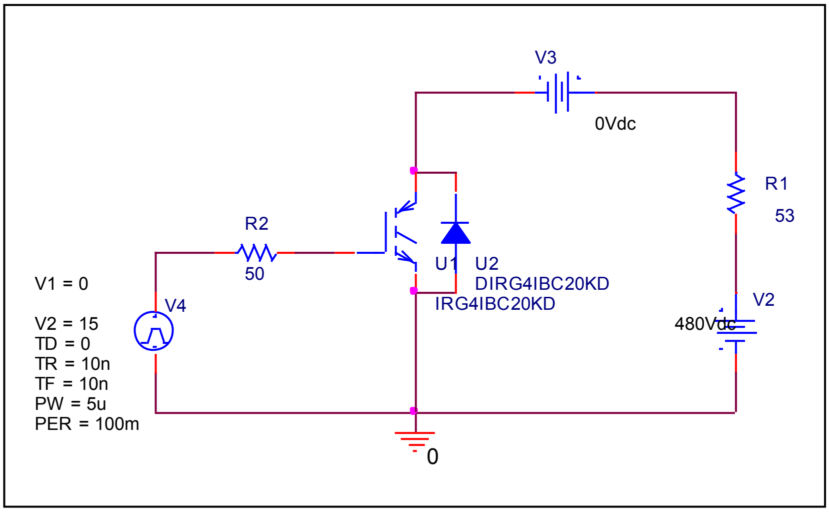
| Ic(A) | Vge(V) | | Error (%) |
|---|---|---|---|
| | Measurement | Simulation | |
| 1 | 7.6 | 7.5906 | -0.12368 |
| 2 | 8.08 | 8.0787 | -0.01609 |
| 5 | 9.05 | 9.0551 | 0.05635 |
| 10 | 10.24 | 10.1710 | -0.67383 |

# Fall Time Characteristics

## Circuit Simulation result



## Evaluation circuit

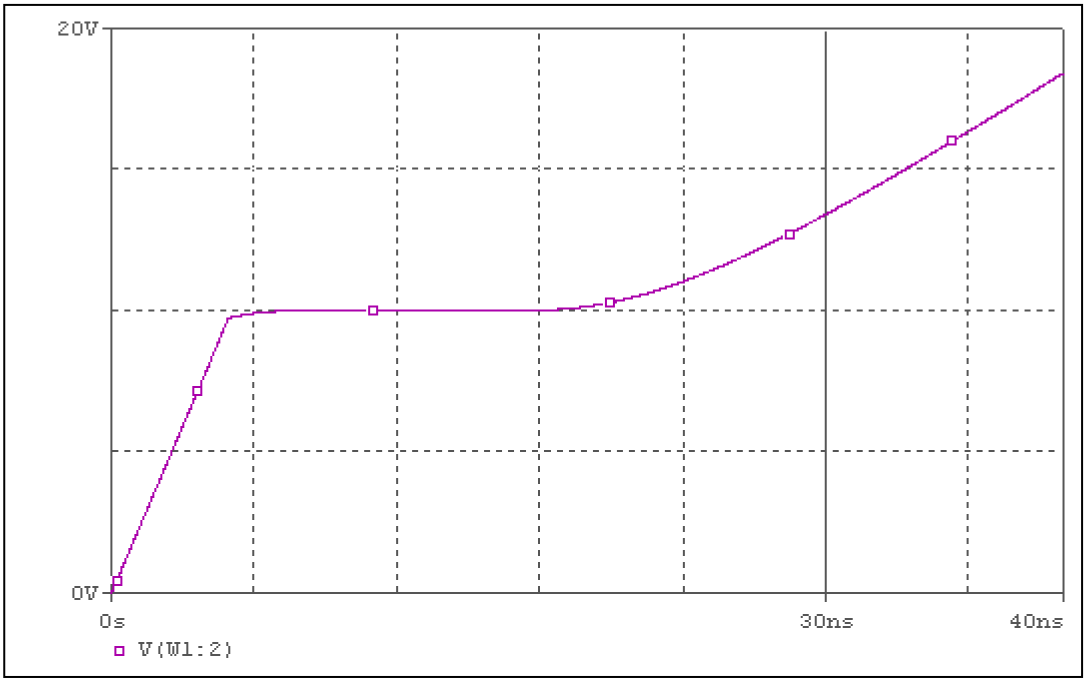


Test condition Ic=9(A) ,Vcc=480(V)

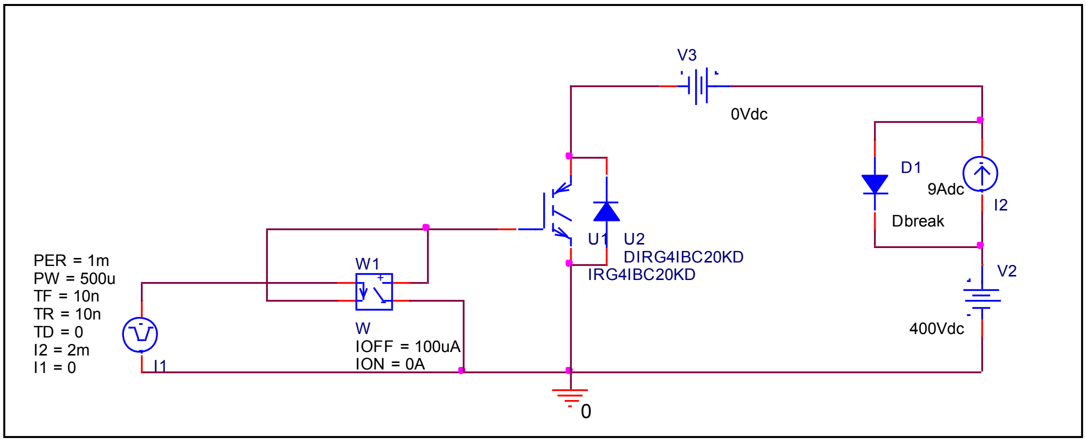
| tf | Measurement | | Simulation | |
|---|---|---|---|---|
| | **72[Typ.]~110[Max.]** | **ns** | **104.411** | **ns** |

## Gate Charge Characteristics

Circuit Simulation result



Evaluation circuit

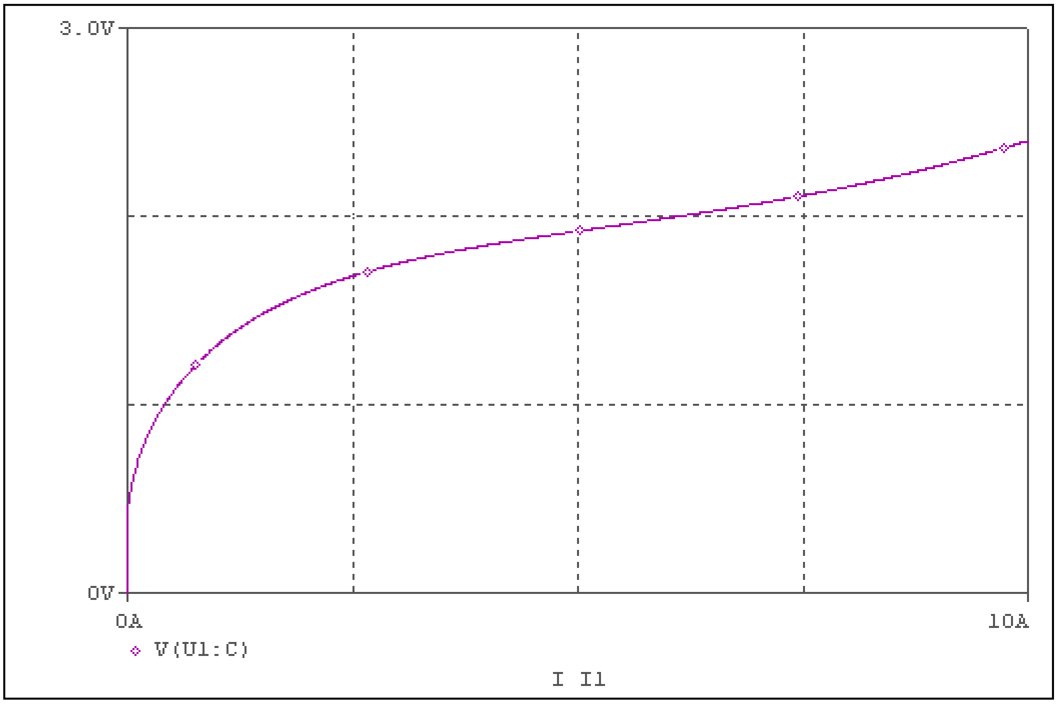


Test condition : Vcc=400(V) ,Ic=9(A) ,Vge=15(V)

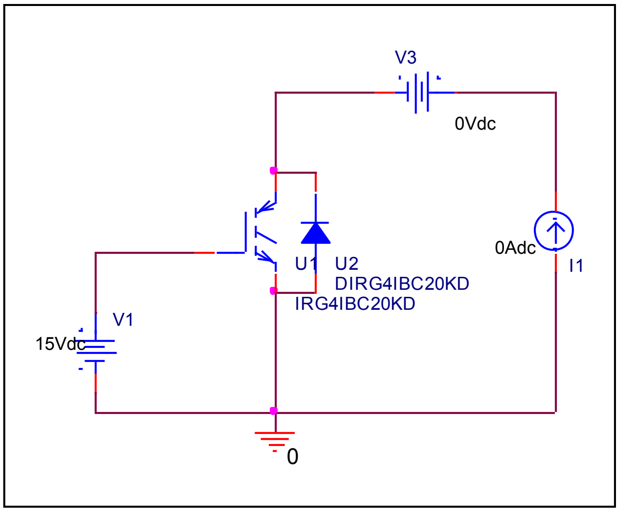
| | Measurement | | Simulation | | Error(%) |
|---|---|---|---|---|---|
| **Qge** | **5** | **nc** | **5.00** | **nc** | **0.0** |
| **Qgc** | **14** | **nc** | **14.054** | **nc** | **0.38571** |
| **Qg** | **34** | **nc** | **33.363** | **nc** | **-1.87353** |

## Saturation Characteristics

### Circuit Simulation result

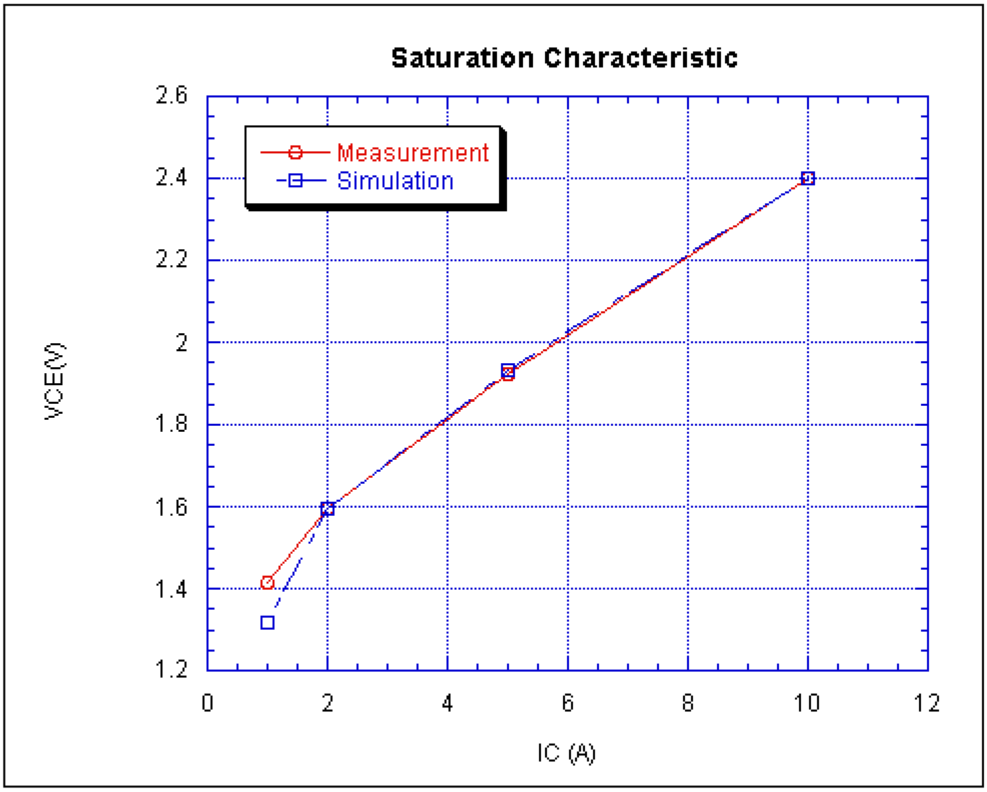


### Evaluation circuit



## Comparison Graph

Circuit Simulation Result

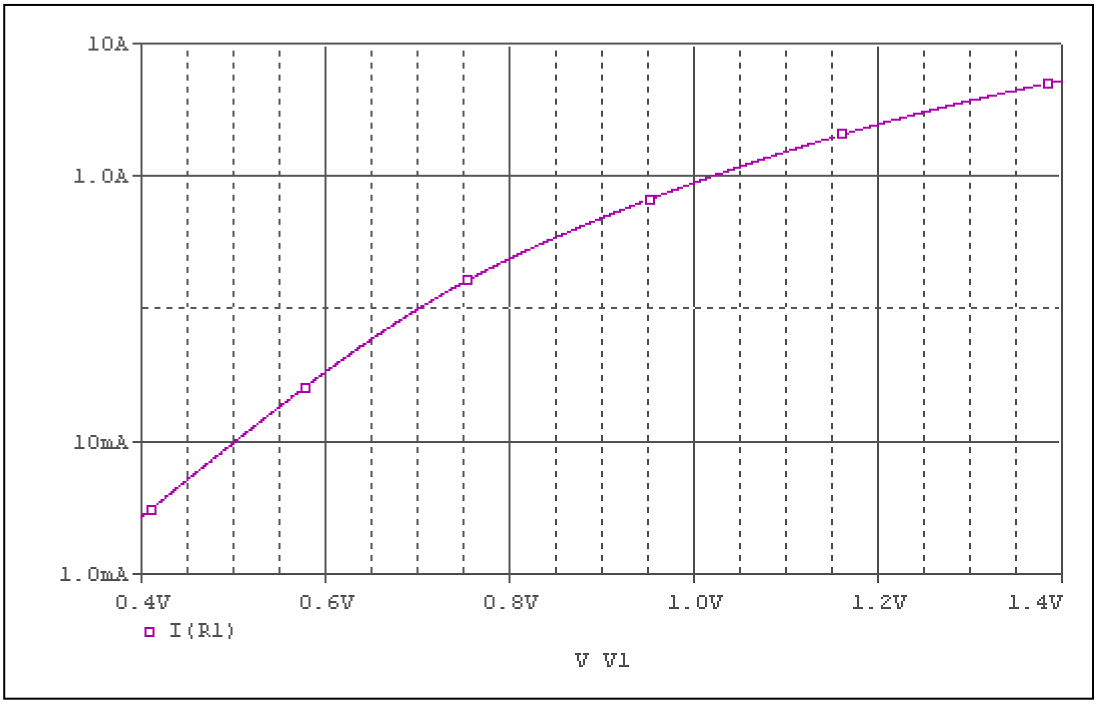


Simulation Result

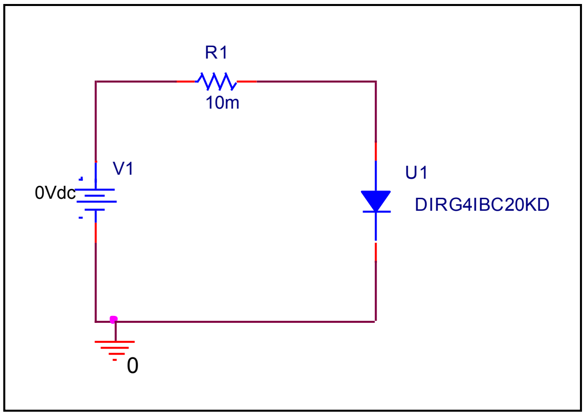
| Ic(A) | Vce(sat)(V) | | Error (%) |
|---|---|---|---|
| | Measurement | Simulation | |
| 1 | 1.415 | 1.3162 | -6.98233 |
| 2 | 1.595 | 1.595 | 0.00000 |
| 5 | 1.92 | 1.9202 | 0.01042 |
| 10 | 2.4 | 2.4001 | 0.00417 |

## Forward Current Characteristic

### Circuit Simulation Result

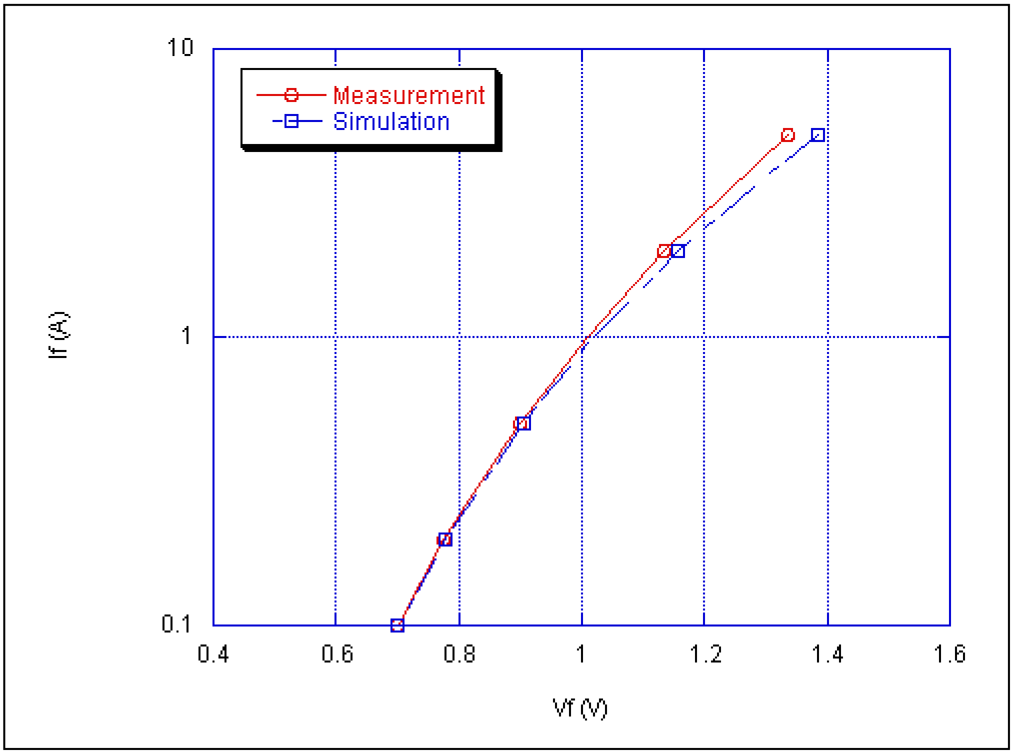


### Evaluation circuit



Circuit Simulation Result

## Comparison graph

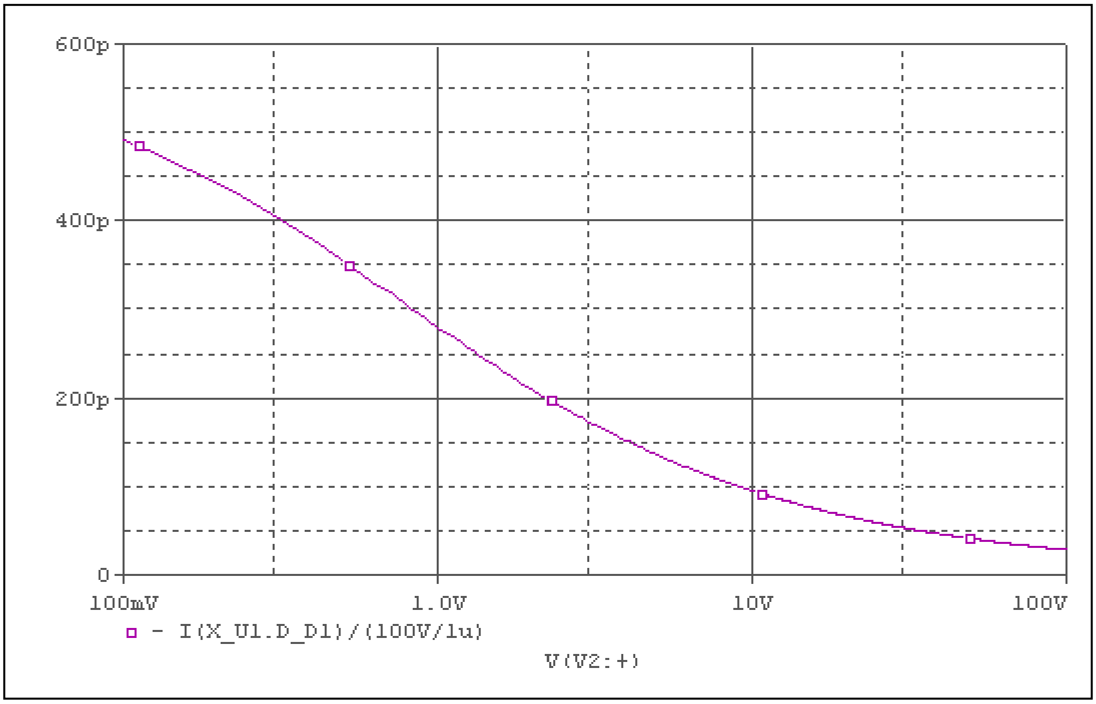


## Simulation Result

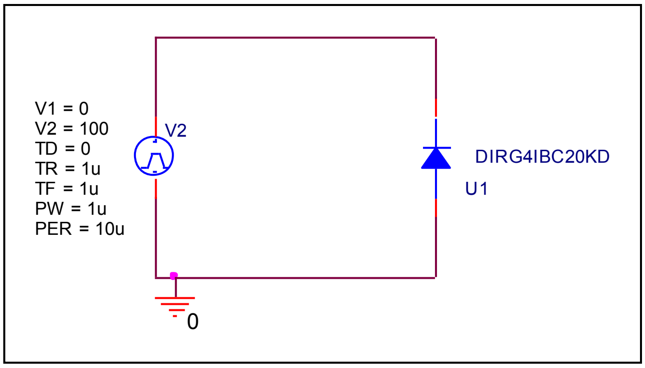
| Ifwd (A) | Vfwd(V) Measurement | Vfwd(V) Simulation | %Error |
|---|---|---|---|
| 0.1 | 0.7 | 0.701175 | 0.16786 |
| 0.2 | 0.775 | 0.778111 | 0.40142 |
| 0.5 | 0.9 | 0.904837 | 0.53744 |
| 1 | 1.01 | 1.0214 | 1.12871 |
| 2 | 1.135 | 1.1554 | 1.79736 |
| 5 | 1.335 | 1.3847 | 3.72285 |

## Junction Capacitance Characteristic

### Circuit Simulation Result

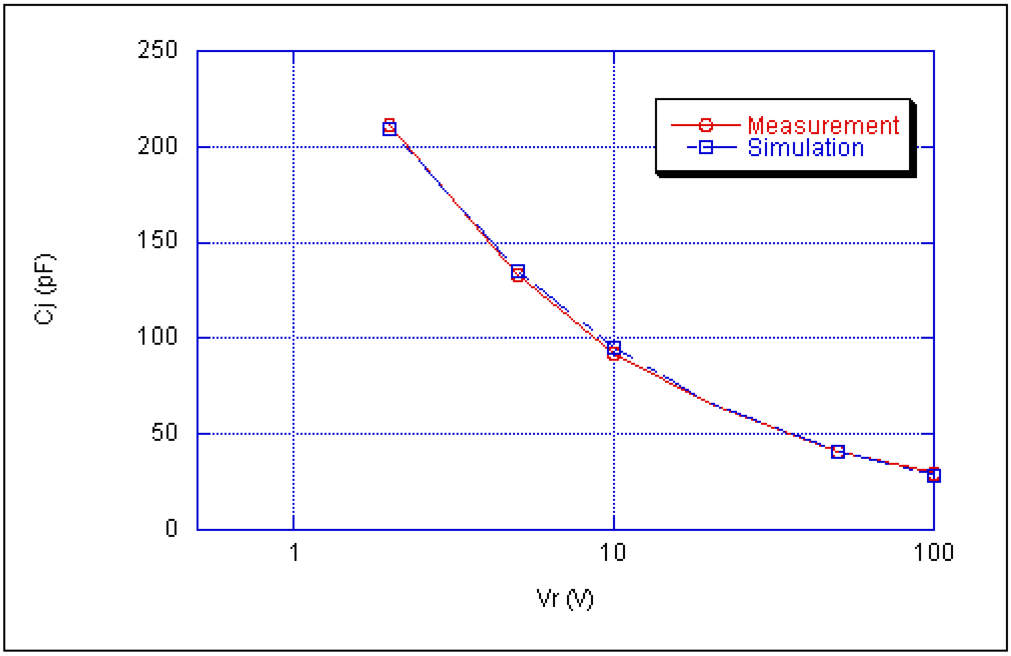


### Evaluation circuit



Circuit Simulation Result

## Comparison graph

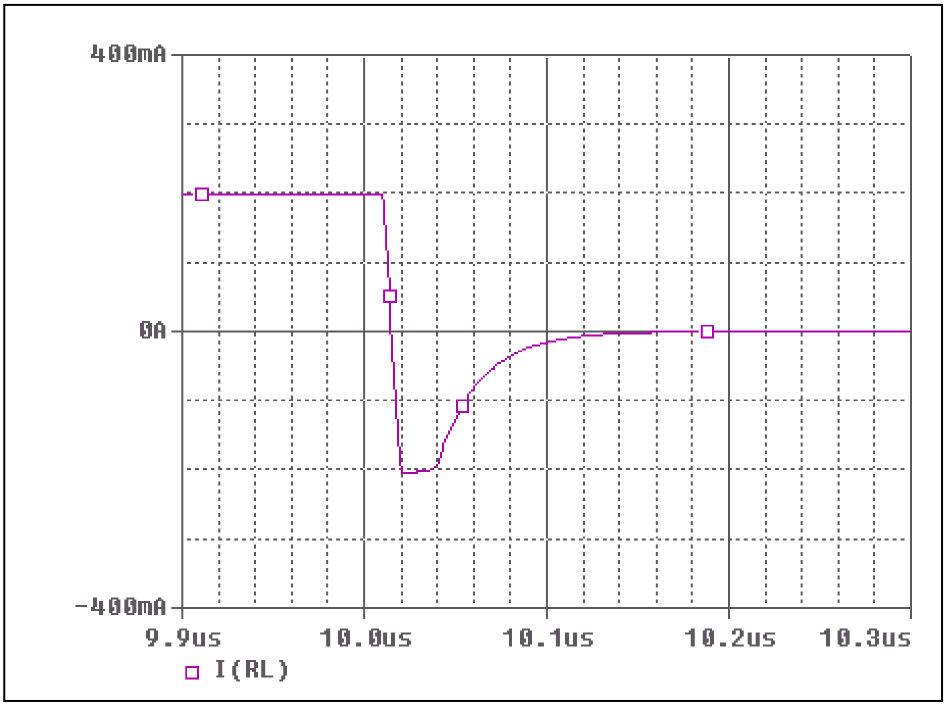


Simulation Result

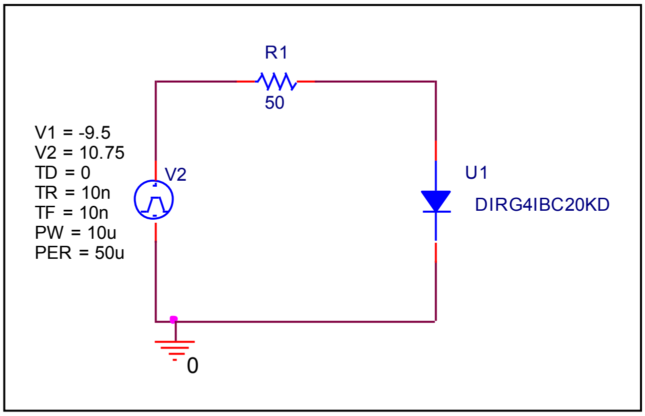
| Vrev (V) | Cj(pF) Measurement | Cj(pF) Simulation | %Error |
|---|---|---|---|
| **2** | **210.89** | **209.108** | **-0.84499** |
| **5** | **132.93** | **135.111** | **1.64071** |
| **10** | **91.99** | **95.155** | **3.44059** |
| **20** | **65.774** | **66.396** | **0.94566** |
| **50** | **41.3** | **40.853** | **-1.08232** |
| **100** | **29.88** | **28.244** | **-5.47523** |

# Reverse Recovery Characteristic

## Circuit Simulation Result



## Evaluation circuit

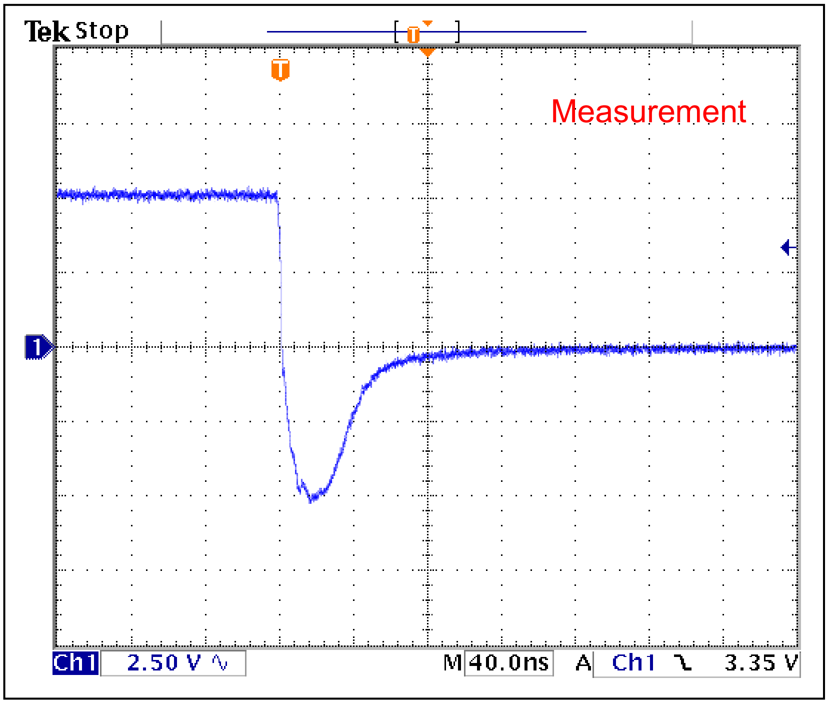


## Compare Measurement vs. Simulation

| | Measurement | | Simulation | | Error(%) |
|---|---|---|---|---|---|
| trj | 20.8 | ns | 20.717 | ns | -0.39904 |
| trb | 56.8 | ns | 57.770 | ns | 1.70775 |

## Reverse Recovery Characteristic

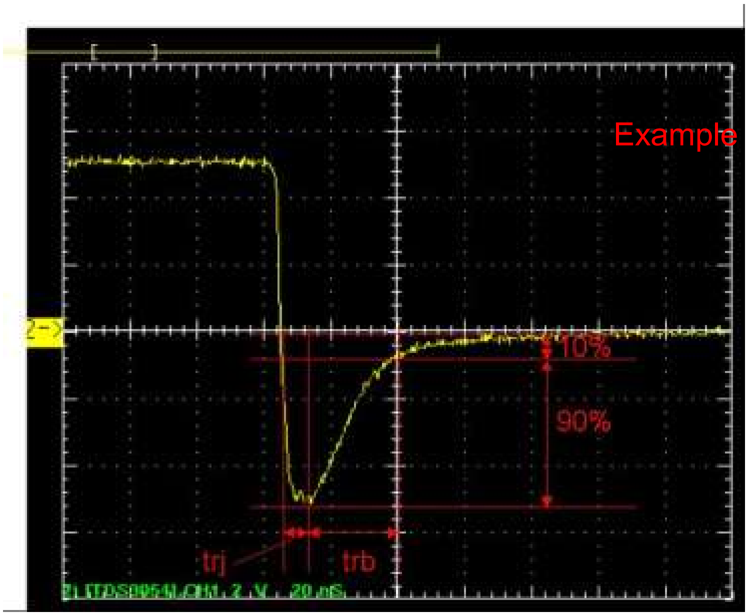
**Reference**



trj=20.8(ns)

trb=56.8(ns)

Conditions:Ifwd=Irev=0.2(A),Rl=50



Relation between trj and trb