

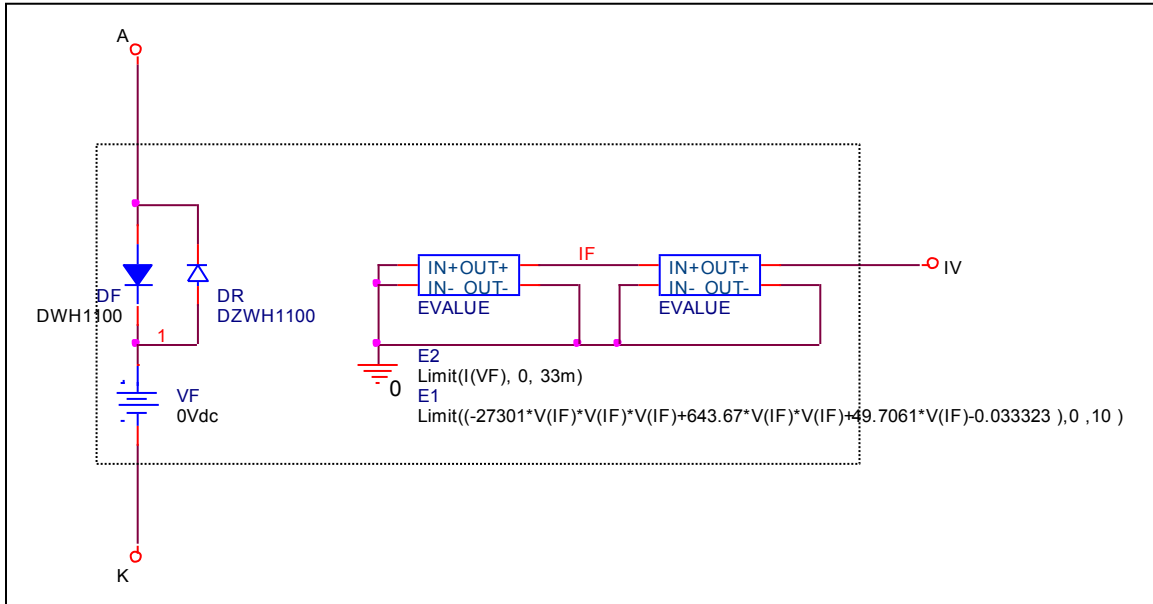
Device Modeling Report

COMPONENTS: LED Lamps (Standard)
PART NUMBER: TLWH1100 (T11)
MANUFACTURER: TOSHIBA
REMARK: TA= -20C



Bee Technologies Inc.

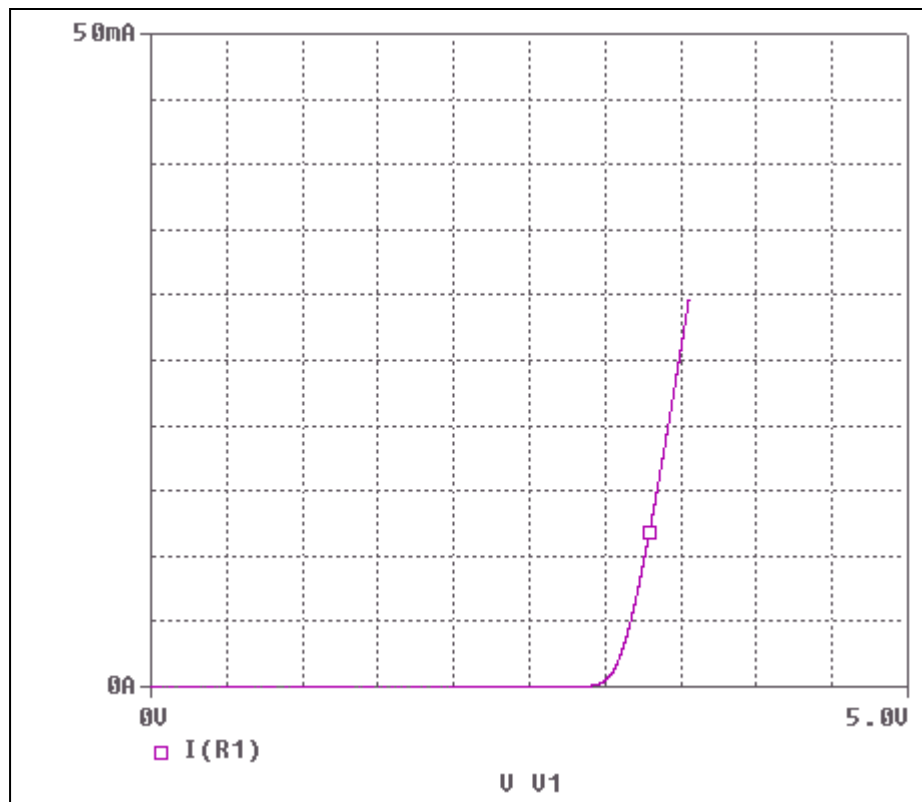
Equivalent Circuit



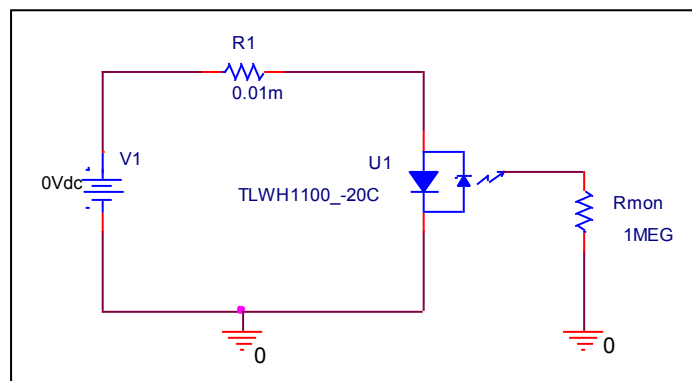
PSpice model parameter	Model description
IS	Saturation Current
N	Emission Coefficient
RS	Series Resistance
IKF	High-injection Knee Current
CJO	Zero-bias Junction Capacitance
M	Junction Grading Coefficient
VJ	Junction Potential
ISR	Recombination Current Saturation Value
BV	Reverse Breakdown Voltage(a positive value)
IBV	Reverse Breakdown Current(a positive value)
TT	Transit Time

Forward Current Characteristic

Circuit simulation result

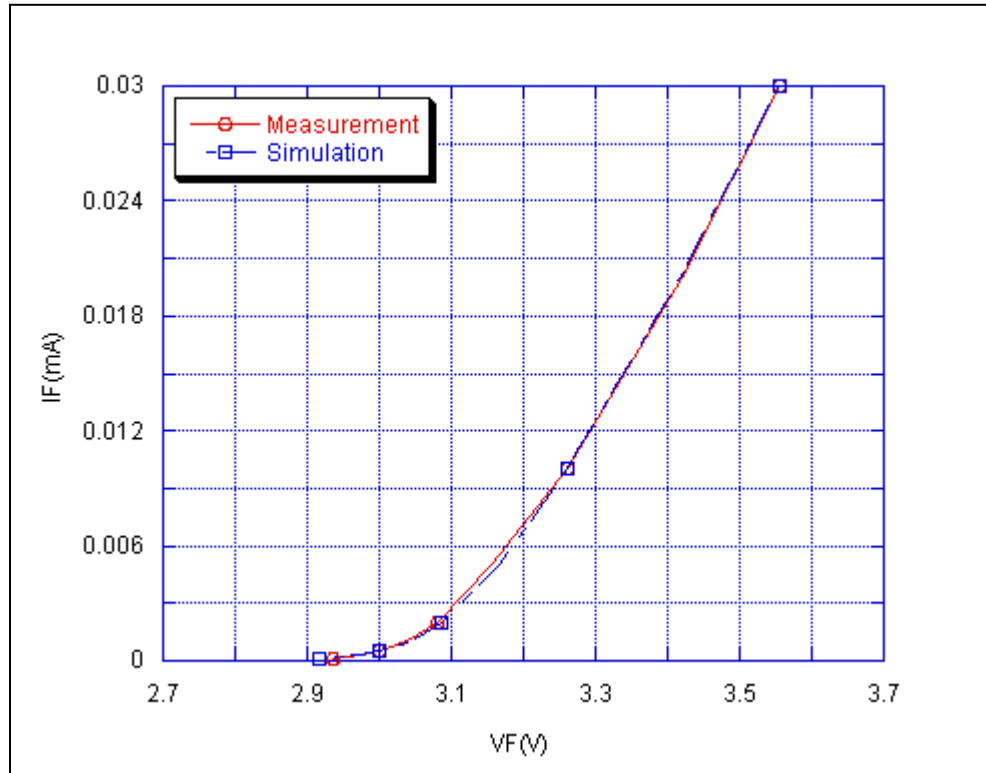


Evaluation circuit



Comparison graph

Circuit simulation result

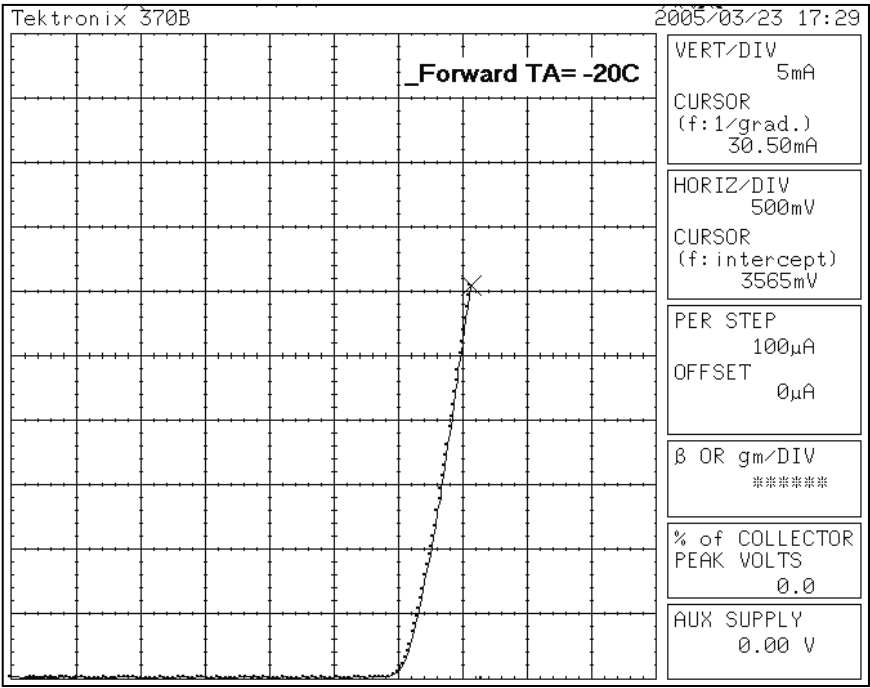


Simulation Result

IF(mA)	VF(V)		
	Measurement	Simulation	Error (%)
0.0001	2.9350	2.9175	- 0.5962
0.0003	2.9750	2.9734	- 0.0537
0.0005	3.0000	3.0007	0.0233
0.001	3.0400	3.0454	0.1776
0.002	3.0800	3.0864	0.2077
0.005	3.1550	3.1674	0.3930
0.01	3.2600	3.2617	0.0521
0.02	3.4200	3.4166	- 0.0994
0.03	3.5550	3.5550	0.0000

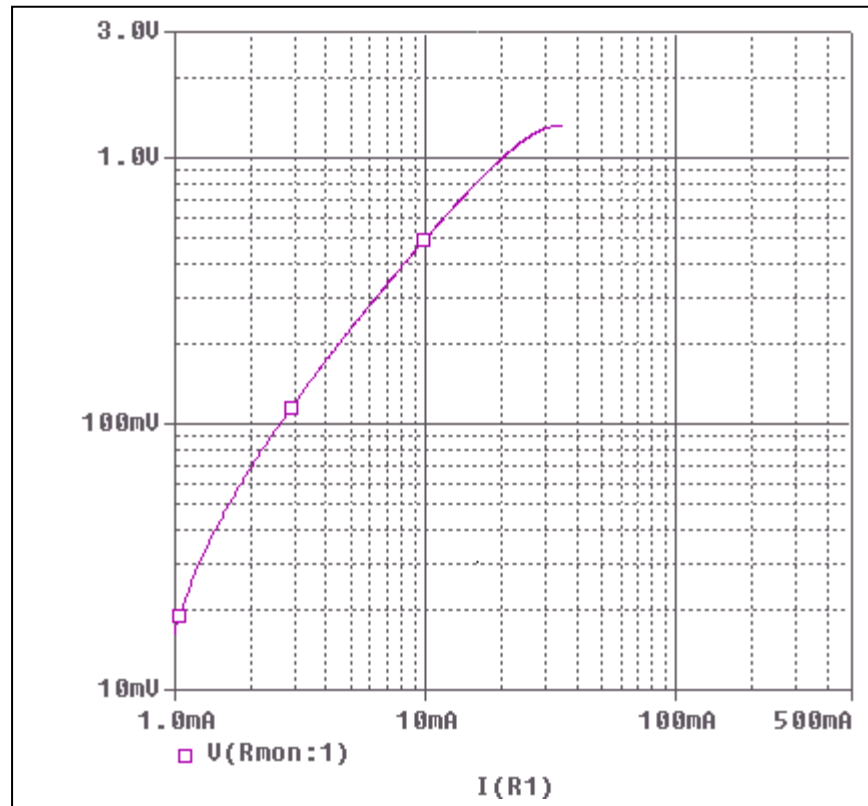
Forward Current Characteristic

Reference

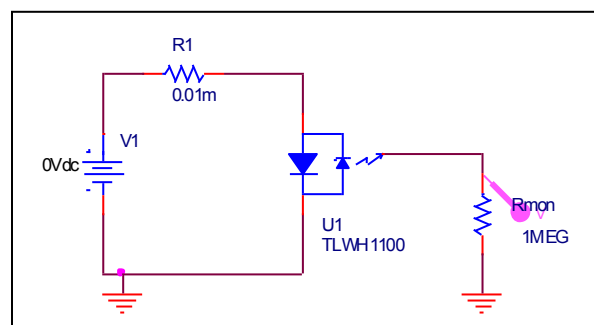


Luminous Intensity Characteristic ($I_V/I_V(20 \text{ mA}) - I_F$)

Circuit simulation result

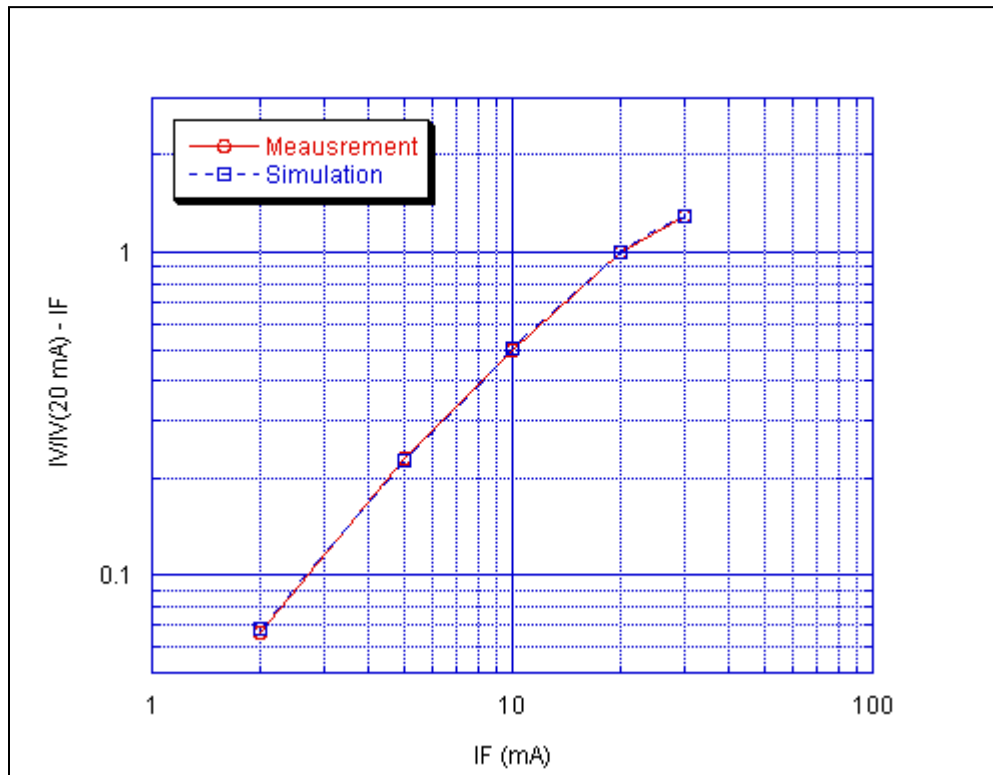


Evaluation circuit



Comparison graph

Circuit simulation result

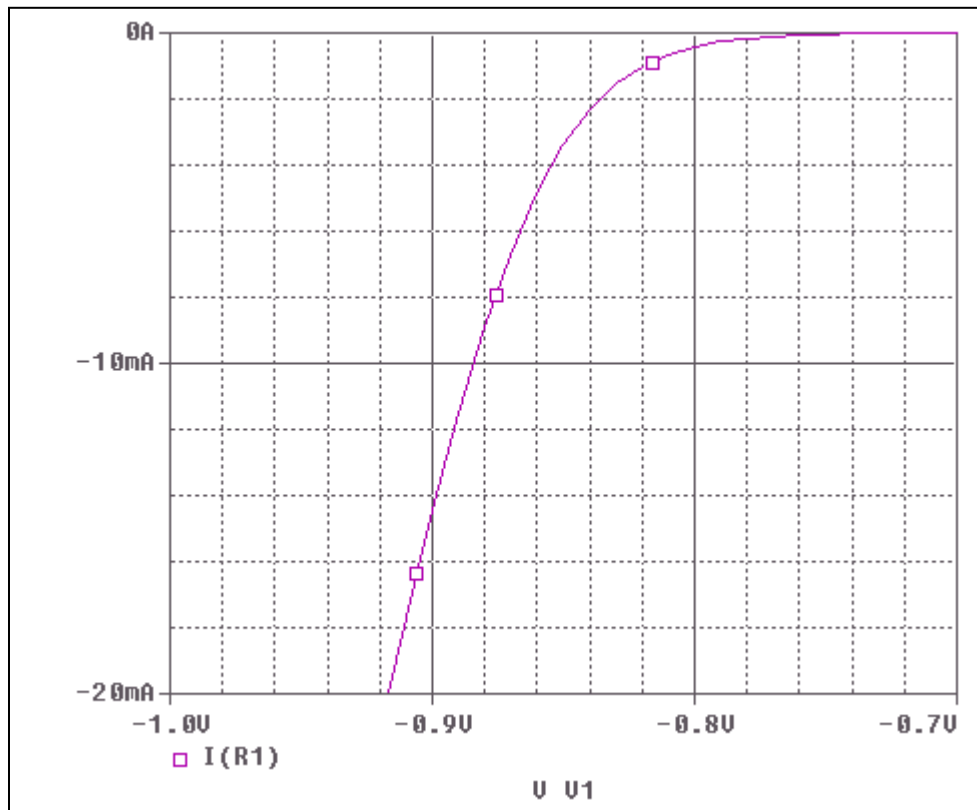


Simulation Result

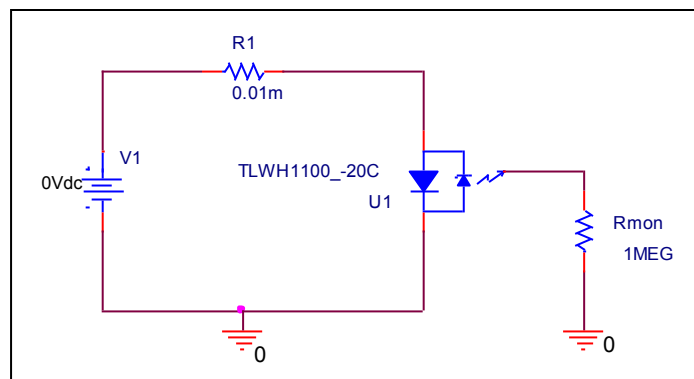
IF(mA)	$I_V/I_V(20\text{ mA})$		
	Measurement	Simulation	Error (%)
2	0.067	0.068173	1.751
5	0.230	0.227739	- 0.983
10	0.500	0.503048	0.609
20	1.000	1.000900	0.090
30	1.300	1.300200	0.154

Reverse Current Characteristic

Circuit simulation result

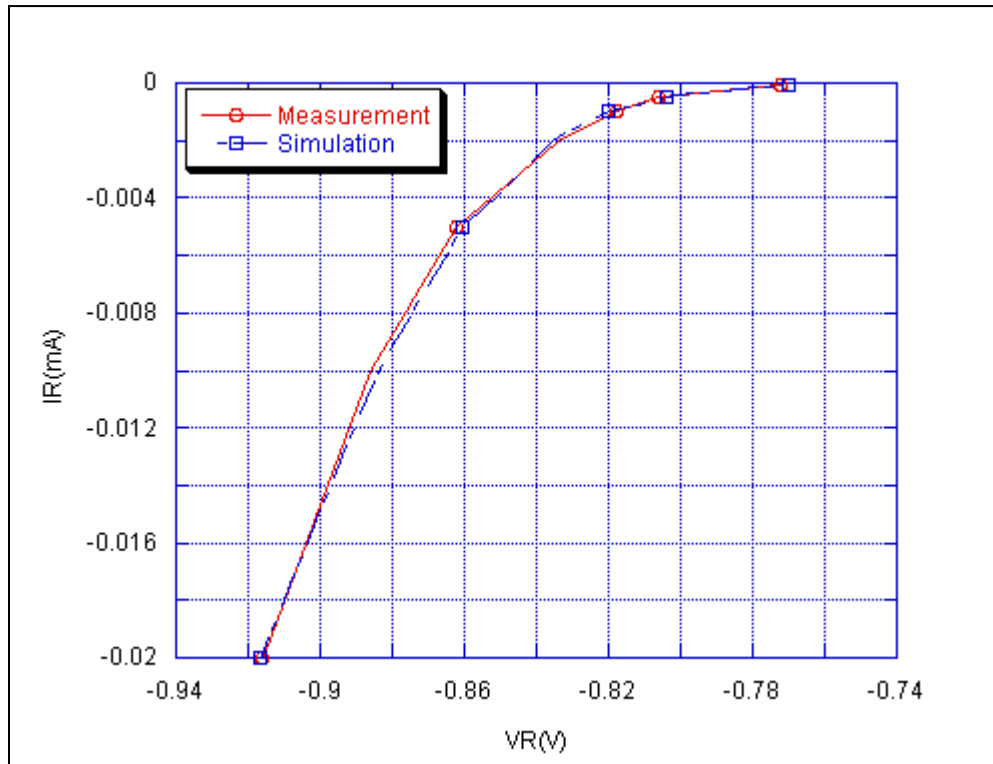


Evaluation circuit



Comparison graph

Circuit simulation result

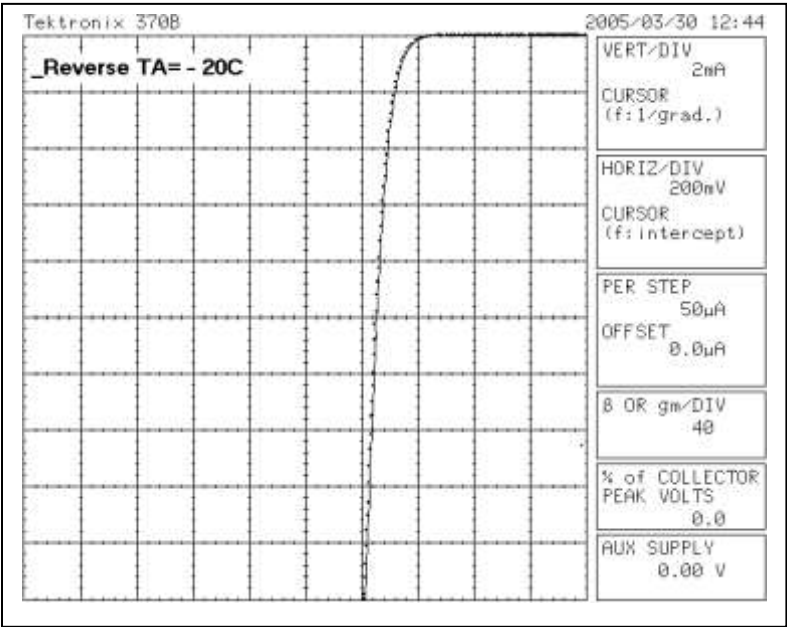


Simulation Result

IR(mA)	VR(V)		
	Measurement	Simulation	Error (%)
- 0.0001	- 0.7720	- 0.7701	- 0.2461
- 0.0002	- 0.7840	- 0.7843	0.0382
- 0.0005	- 0.8060	- 0.8040	- 0.2481
- 0.001	- 0.8180	- 0.8199	0.2322
- 0.002	- 0.8340	- 0.8358	0.2158
- 0.005	- 0.8620	- 0.8607	- 0.1508
- 0.01	- 0.8860	- 0.8841	- 0.2144
- 0.02	- 0.9160	- 0.9167	0.0764

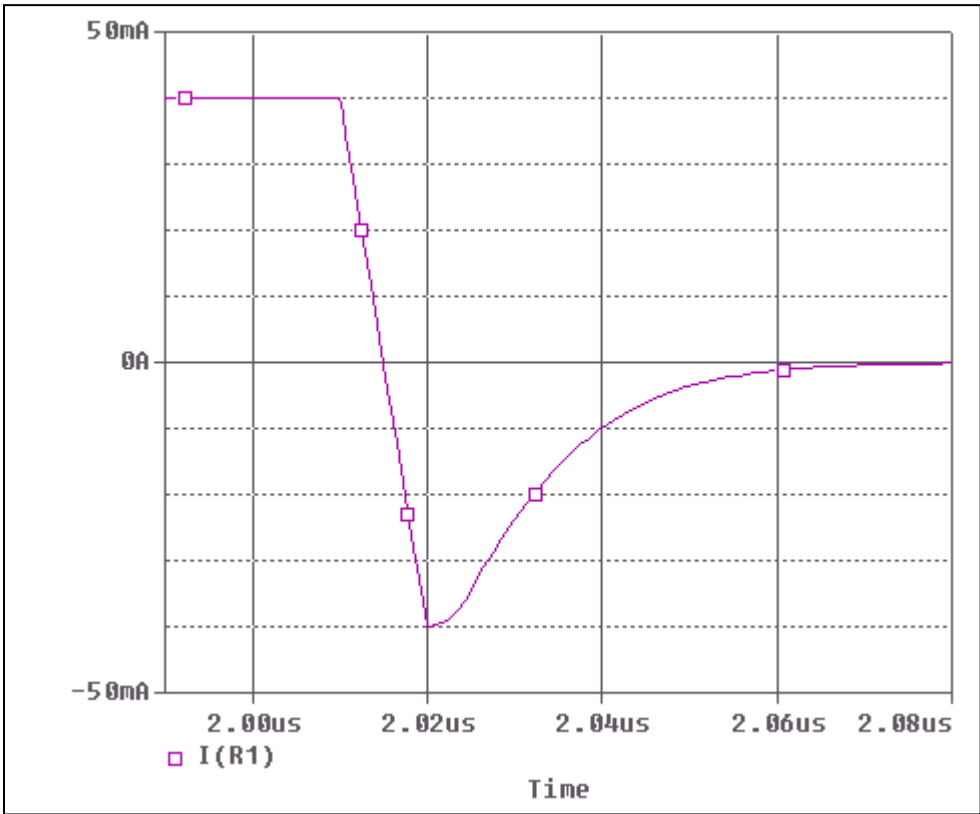
Reverse Current Characteristic

Reference

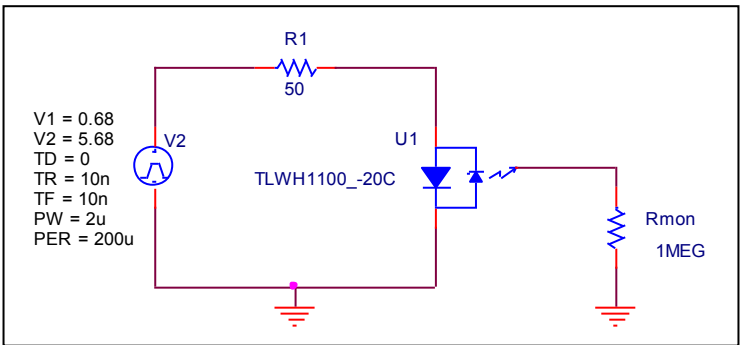


Reverse Recovery Characteristic

Circuit simulation result



Simulation Result

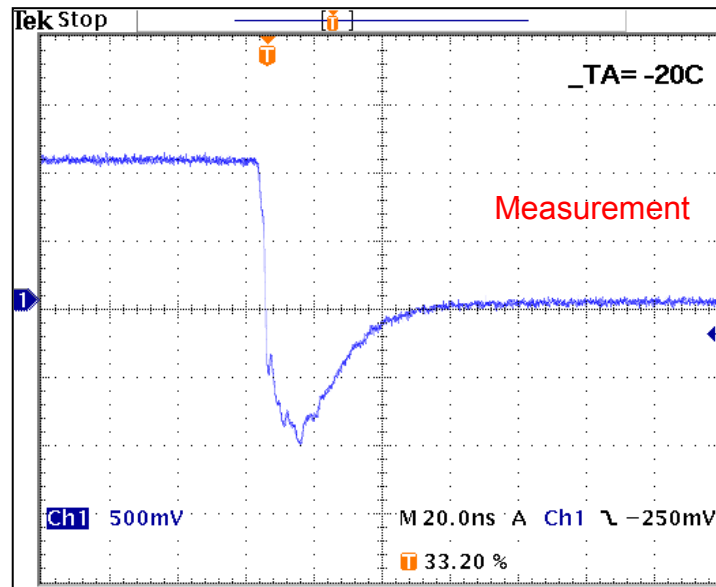


Compare Measurement VS. Simulation

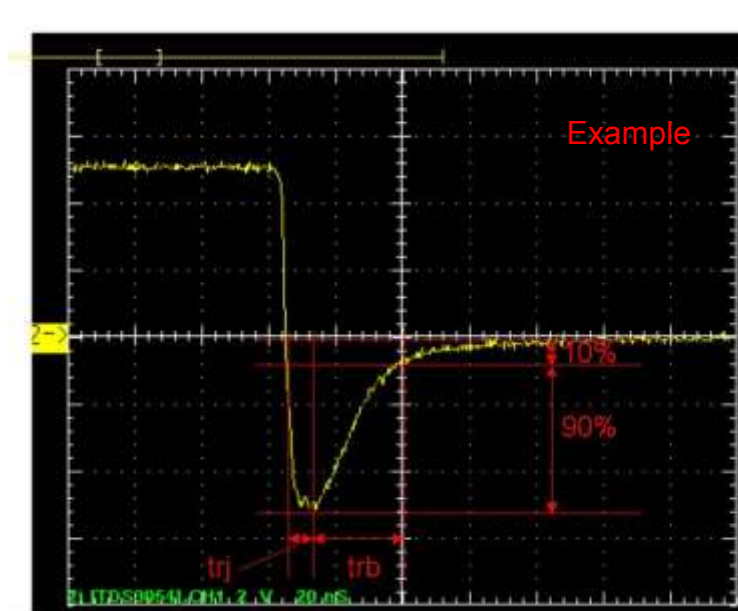
Symbol	Measurement		Simulation		Error (%)
Trr=trj+trb	33.6	ns	33.62	ns	0.0595

Reverse Recovery Characteristic

Reference



$t_{rj} = 9.2 \text{ (ns)}$
 $t_{rb} = 24.4 \text{ (ns)}$
Conditions: $I_{fwd} = I_{rev} = 0.04 \text{ (A)}$, $R_I = 50$



Relation between t_{rj} and t_{rb}