

Device Modeling Report

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Bee Technologies Inc.

DIODE MODEL

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

BIPOLAR JUNCTION TRANSISTOR MODEL

Pspice model parameter	Model description
NR	Reverse Emission Coefficient
RB	Base Resistance
RC	Series Collector Resistance
CJE	Zero-bias Emitter-Base Junction Capacitance
CJC	Zero-bias Collector-Base Junction Capacitance
TF	Forward Transit Time
TR	Reverse Transit Time

VOLTAGE CONTROLLED VOLTAGE SOURCE MODEL(VCVS)

E<Name><(+)Node><(−)Node>VALUE={Expression}

E<Name><(+)Node><(−)Node>TABLE={Expression}

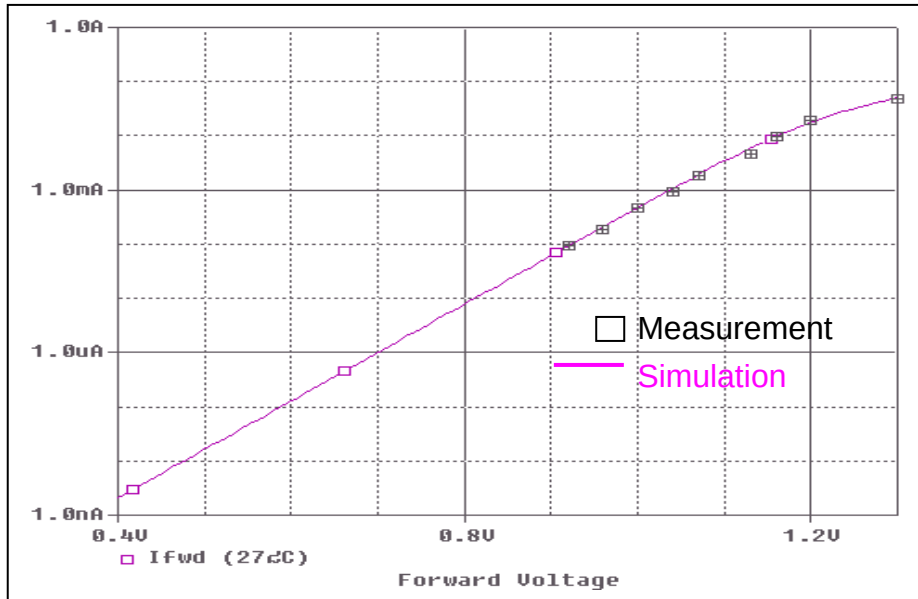
VOLTAGE CONTROLLED CURRENT SOURCE MODEL(VCCS)

E<Name><(+)Node><(–)Node>VALUE={Expression}

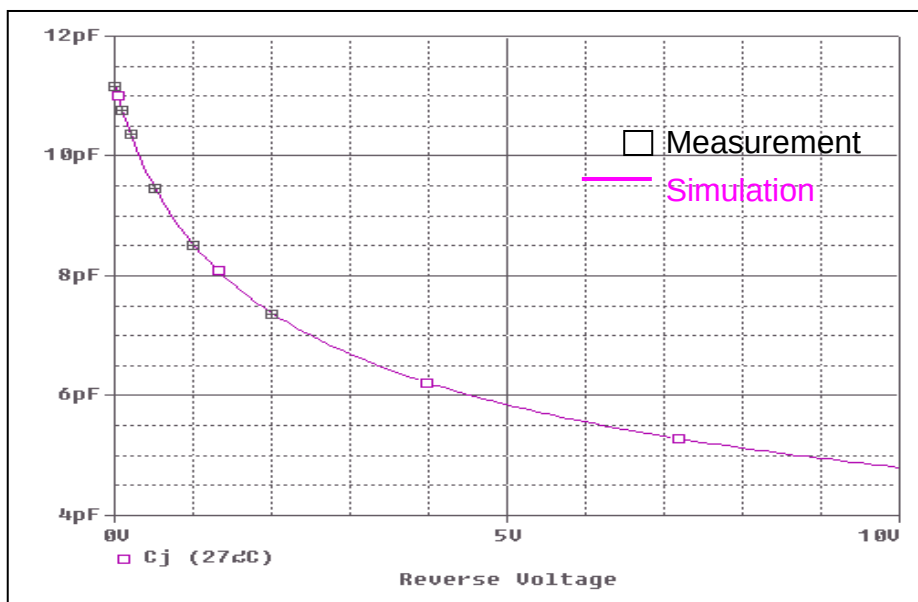
CURRENT CONTROLLED MODEL(W)

Pspice model parameter	Model description
IOFF	Controlling current to Off state
ION	Controlling current to On state
ROFF	Off Resistance
RON	On Resistance

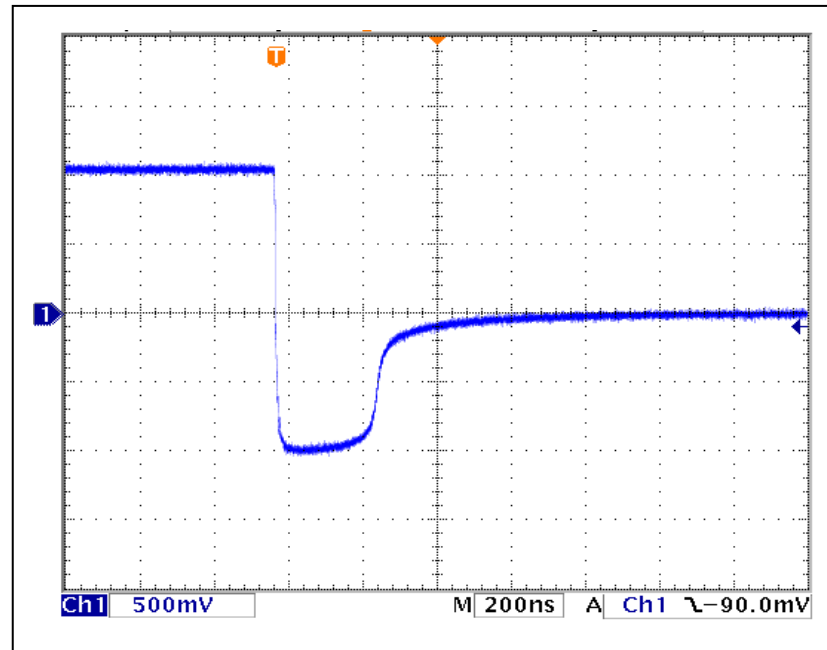
Input Device Forward Current Characteristics



Input Device Junction Capacitance Characteristics



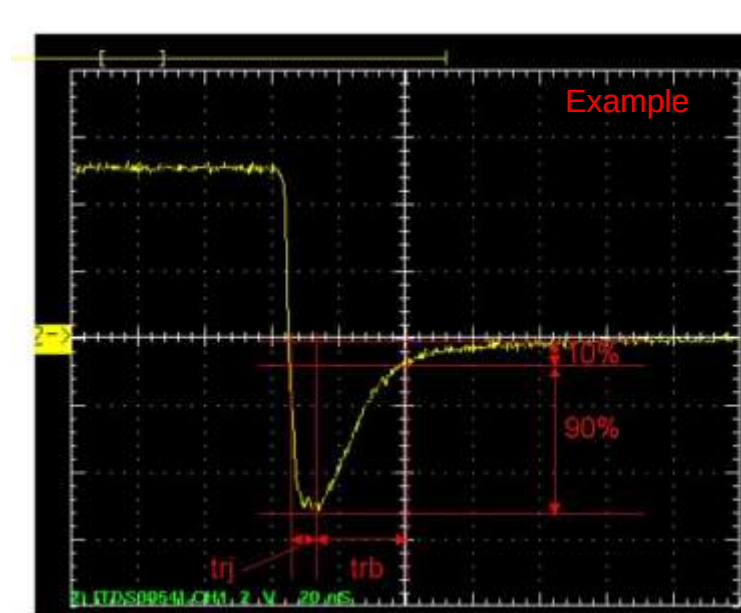
Input Device Reverse Recovery Characteristics



$trj=132\text{n(s)}$

$trb=140\text{n(s)}$

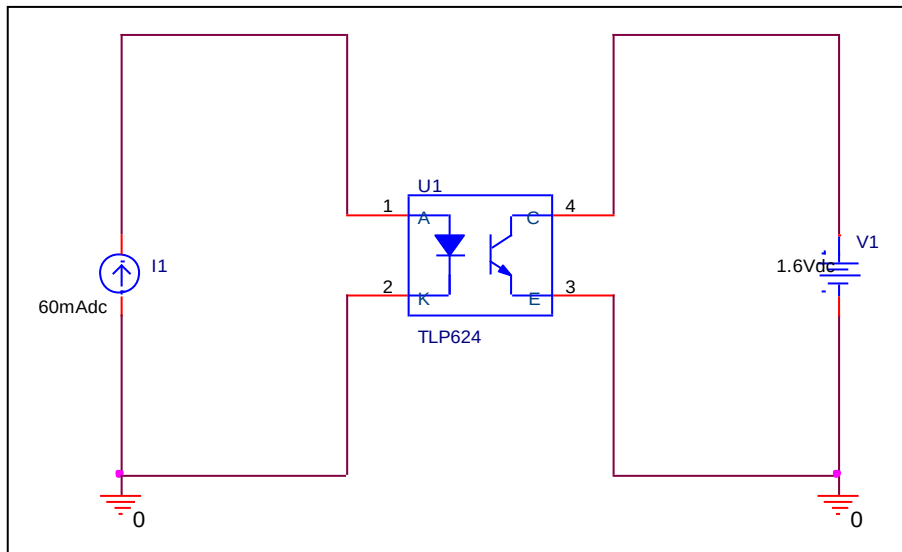
Conditions: $I_{fwd}=I_{rev}=0.04\text{(A)}$, $R_l=50$



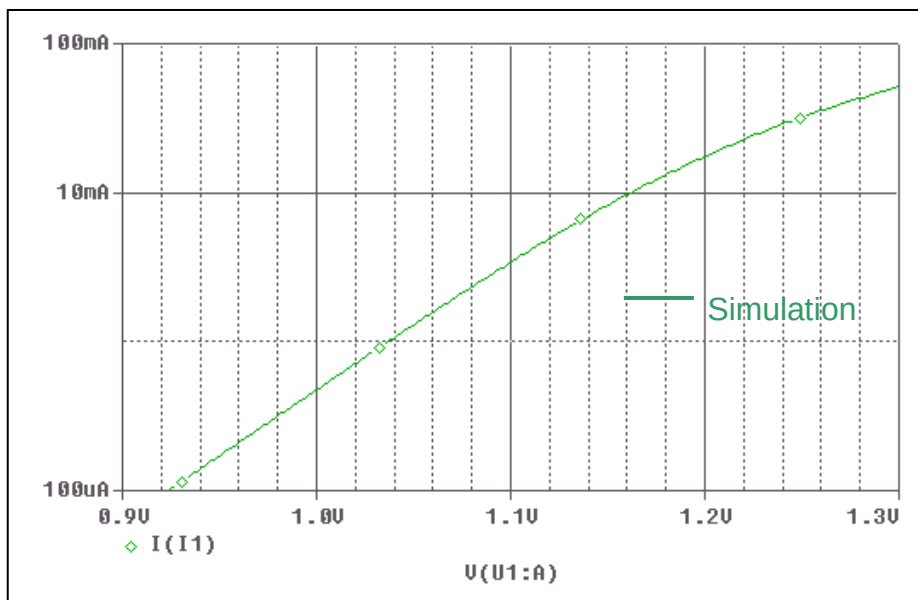
Relation between trj and trb

LED IV Curve Characteristics

Evaluation Circuit



Simulation result

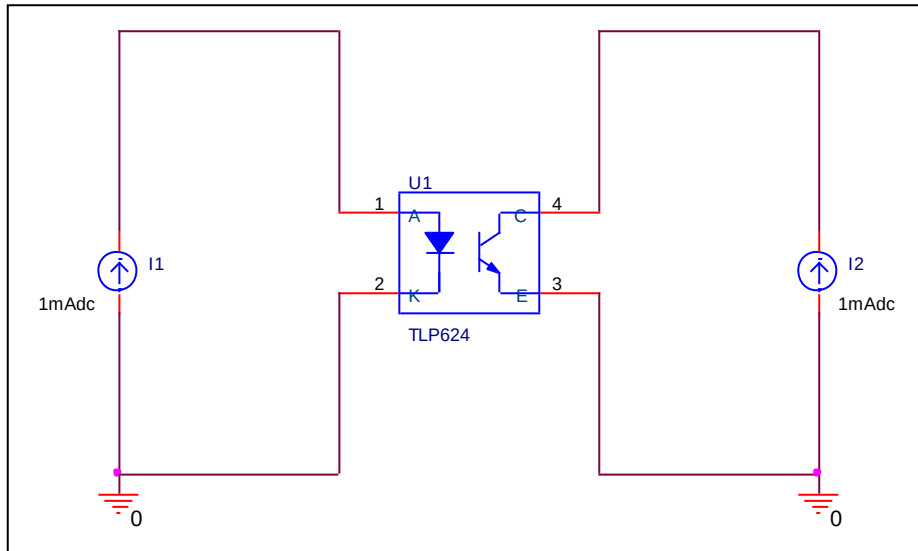


Comparison Table

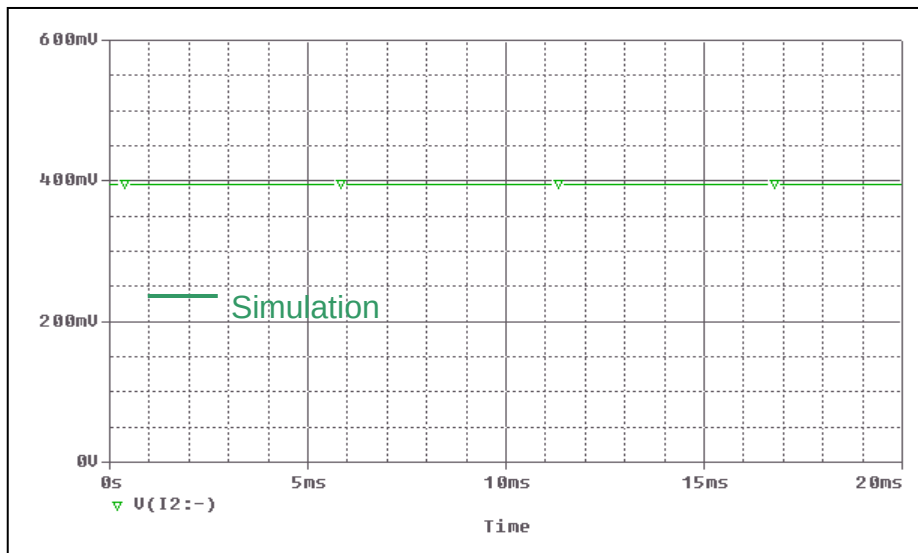
Ifwd(A)	Vfwd(V)		% Error
	Measurement	Simulation	
0.0001	0.91	0.923	1.429
0.0002	0.96	0.9573	-0.281
0.0005	1	1.0023	0.230
0.001	1.04	1.0367	-0.317
0.002	1.07	1.0718	0.168
0.005	1.13	1.1206	-0.832
0.01	1.16	1.1614	0.121
0.02	1.2	1.2094	0.783
0.05	1.3	1.2968	-0.246

Transistor Saturation Characteristics

Evaluation Circuit



Simulation result

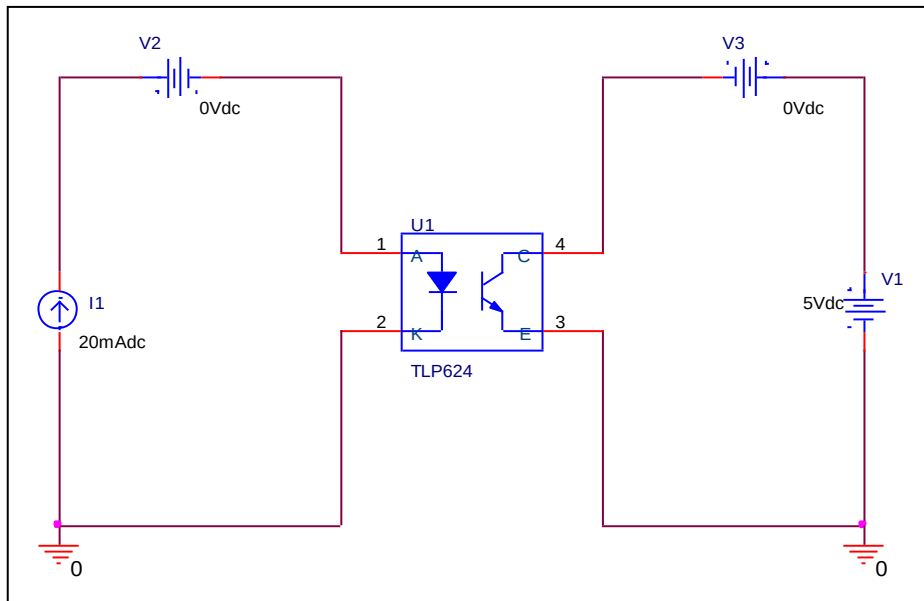


Comparison Table

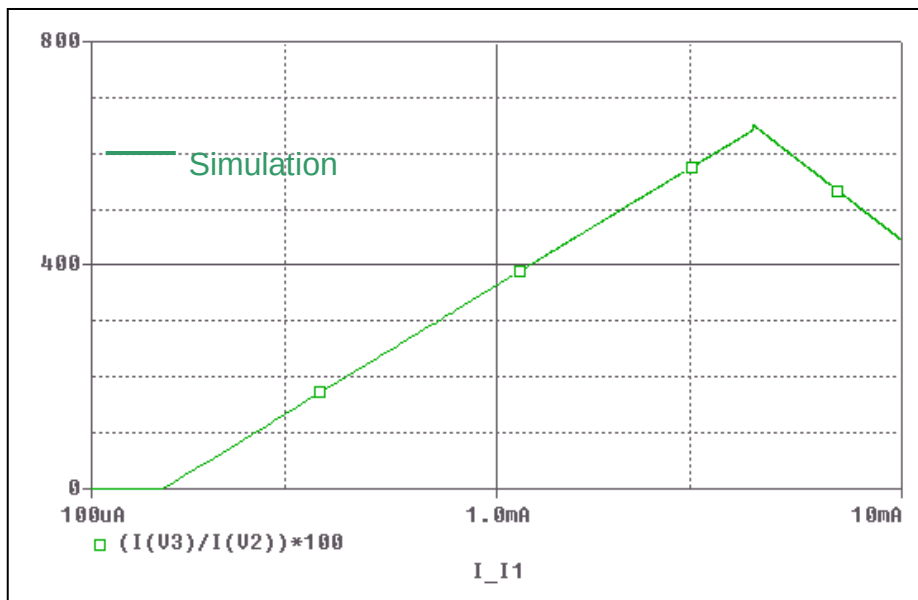
	Measurement	Simulation	% Error
Vce(sat) (V)	0.4	0.395	-1.25

CTR(Current Transfer Ratio) Characteristics

Evaluation Circuit



Simulation result



Rise Curve Table

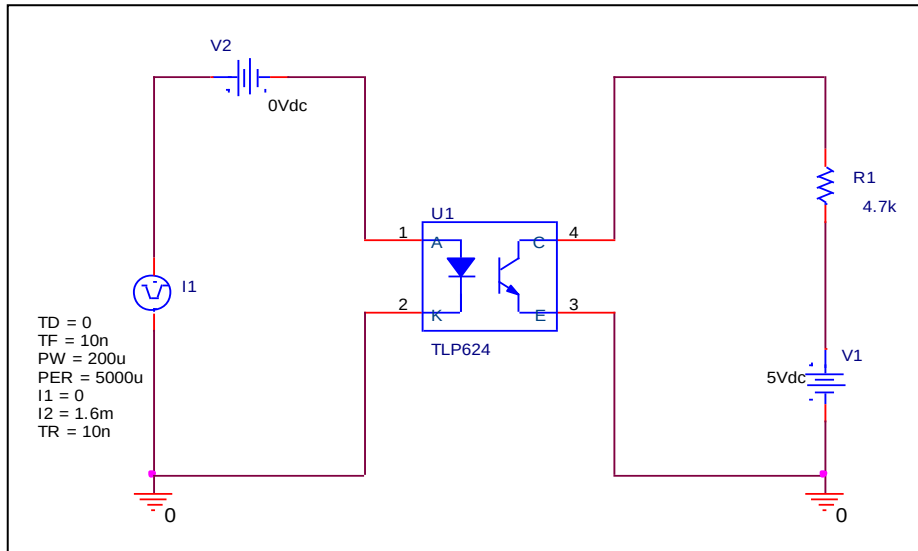
If(mA)	CTR(%)		% Error
	Measurement	Simulation	
0.3	140	133.654	-4.533
0.4	190	189.018	-0.517
2	510	496.654	-2.617
3	600	573.038	-4.494
4	640	628.154	-1.851
4.3	650	649.564	-0.067

Fall Curve Table

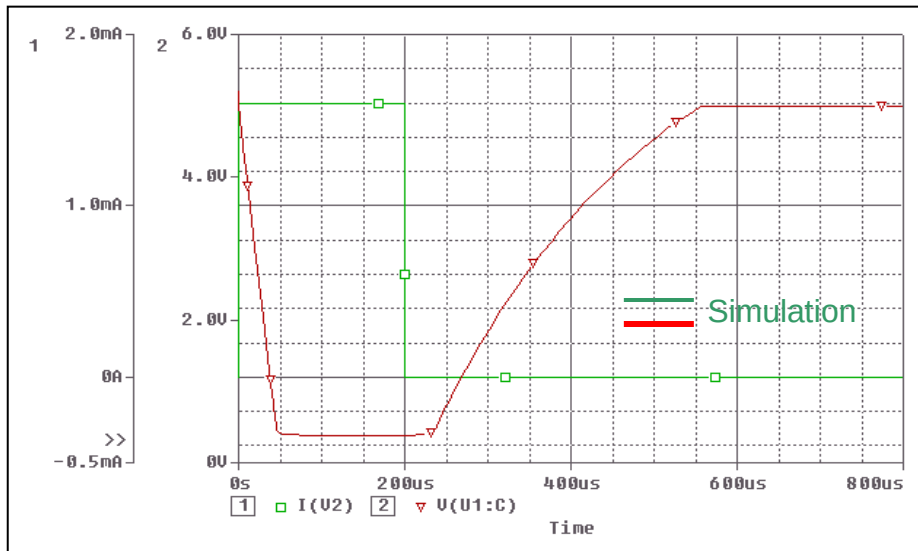
If(mA)	CTR(%)		% Error
	Measurement	Simulation	
4.3	650	649.564	-0.067
5	630	612.855	-2.721
6	595	568.520	-4.450
7	550	531.031	-3.449
8	500	498.567	-0.287
9	480	469.941	-2.096
10	450	444.340	-1.258

Switching Time Characteristics

Evaluation Circuit



Simulation result



Comparison Table

Vcc=5V, IC=16mA, RL=1.9kΩ	Measurement	Simulation	% Error
Ts (us)	50	51.423	2.846
Tf (us)	300	296.580	-1.140