

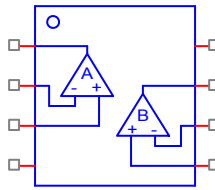
# Device Modeling Report

COMPONENTS : VOLTAGE COMPARATOR  
PART NUMBER : NJM12903  
MANUFACTURER : NEW JAPAN RADIO



**Bee Technologies Inc.**

## SPICE MODEL



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*$
*PART NUMBER: NJM12903
*MANUFACTURER: NEW JAPAN RADIO
*BJT COMPARATOR
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.subckt njm12903 OUTA IN-A IN+A GND IN+B IN-B OUTB V+
X_U1 IN+A IN-A V+ GND OUTA njm12903_s
X_U2 IN+B IN-B V+ GND OUTB njm12903_s
.ends njm12903
.subckt njm12903_s In+ li- V+ V- O/P
f1 9 V+ v1 0.84
iee V+ 7 dc 100.0E-6
vi1 21 In+ dc 0.7415
vi2 22 li- dc 0.751
i1 In+ 0 328.7n
i2 li- 0 -4n
q1 9 21 7 qin1
q2 8 22 7 qin2
q3 9 8 V- qmo
q4 8 8 V- qmi
.model qin1 PNP(Is=80.0E-18 Bf=1500 )
.model qin2 PNP(Is=80.0E-18 Bf=1745 )
.model qmi NPN(Is=80.0E-18 Bf=1002 )
.model qmo NPN(Is=124.20E-18 Bf=1000 Cjc=1E-15 Tr=197.3E-8)
e1 10 V- 9 V- 0.1259
v1 10 11 dc 0m
q5 O/P 11 V- qoc
.model qoc NPN(Is=800.0E-8 Bf=6.7E3 Cjc=1E-15 Tf=5.1E-9
+ Tr=2.4E-8 )
dp V- V+ dx
rp V+ V- 53.47
.model dx D(Is=800.0E-18)
.ends njm12903_s
*$

```

## BJT MODEL

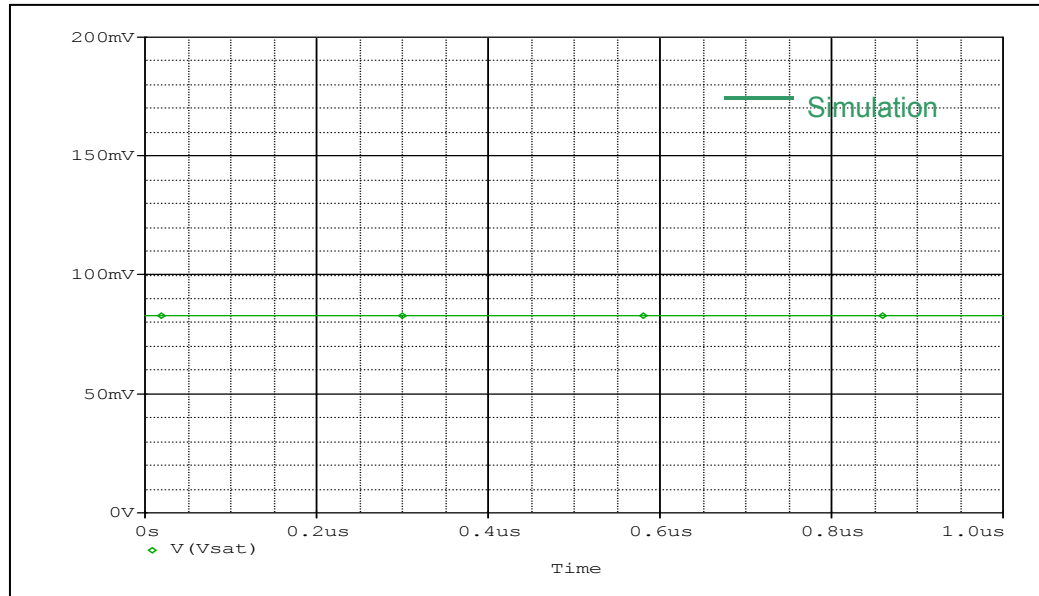
Pspice model parameter	Model description
IS	Saturation Current
BF	Ideal Maximum Forward Beta
CJC	Zero-bias Collector-Base Junction Capacitance
TF	Forward Transit Time
TR	Reverse Transit Time

## DIODE MODEL

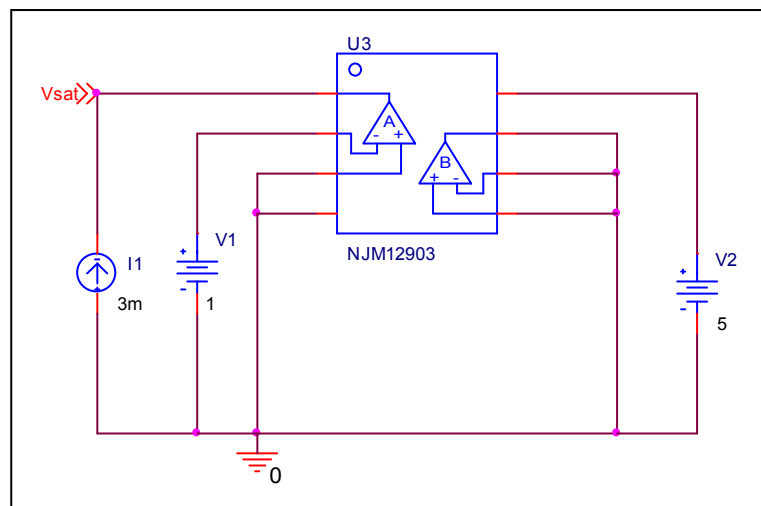
Pspice model parameter	Model description
IS	Saturation Current
RS	Series Resistance

## Output Saturation Voltage

### Simulation result



### Evaluation Circuit

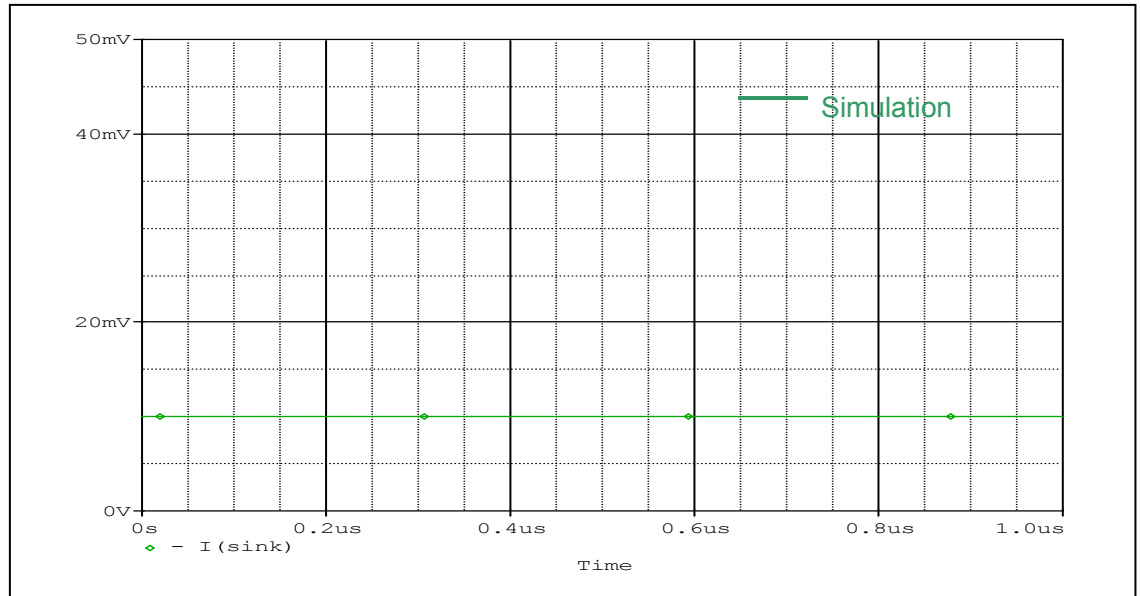


### Comparison Table

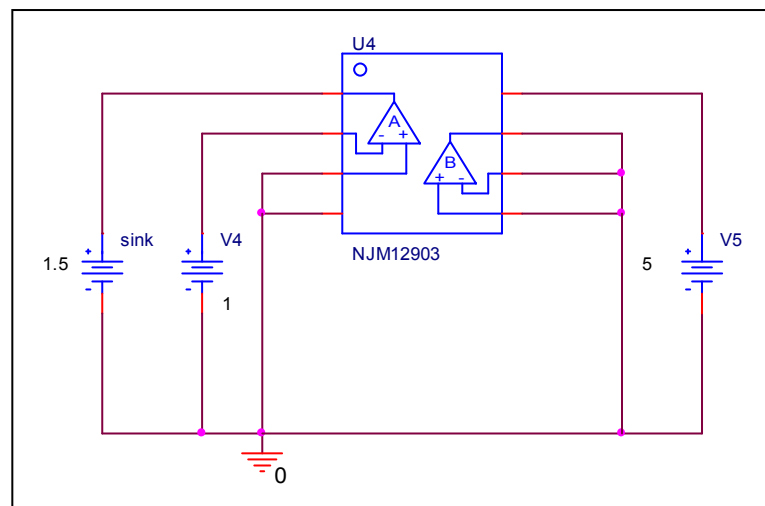
$I_{SINK} = 3 \text{ mA}$	Measurement	Simulation	%Error
$V_{SAT} \text{ (mV)}$	80.000	83.194	3.993

## Output Sink Current

### Simulation result



### Evaluation Circuit

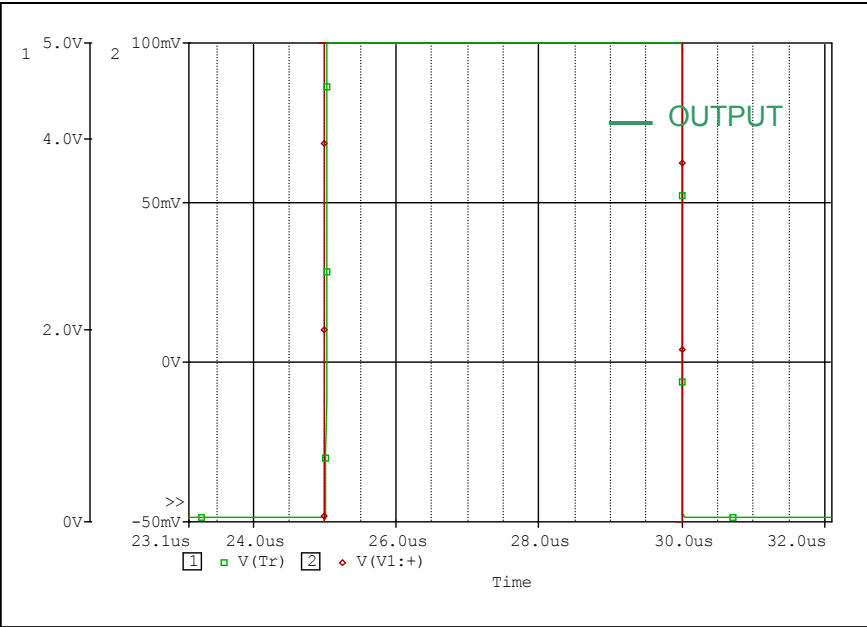


### Comparison Table

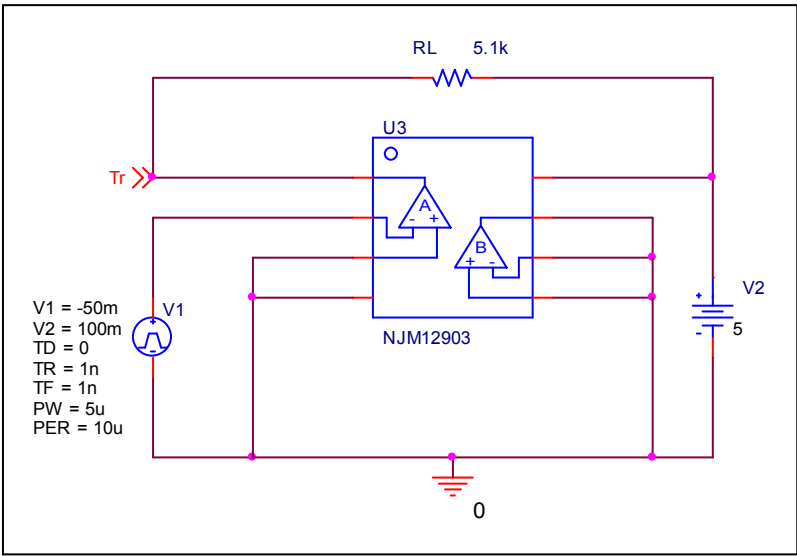
$V_o = 1.5\text{ V}$	Measurement	Simulation	%Error
$I_{\text{SINK}}\text{ (mA)}$	10.000	10.003	0.030

# Response time (Rise time and Transition time)

## Simulation result



## Evaluation Circuit

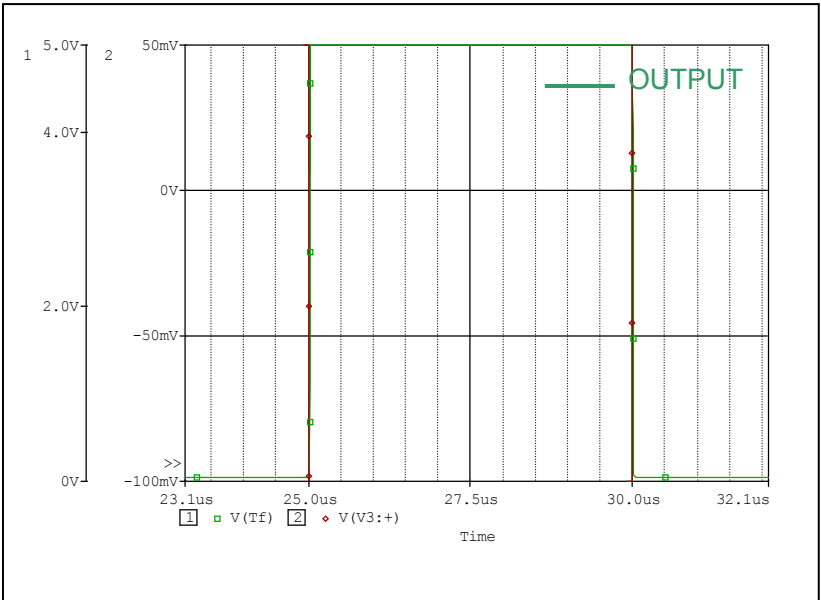


## Comparison Table

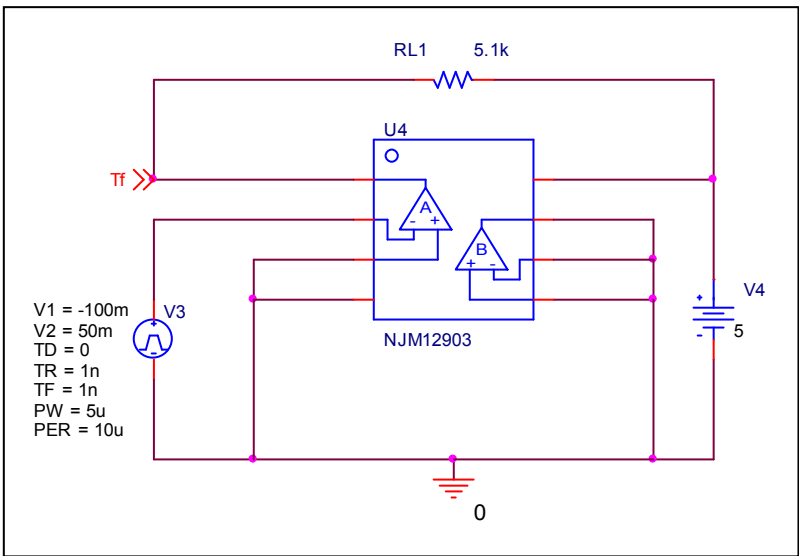
	Measurement	Simulation	% Error
<b>Rise time(us)</b>	0.030	0.0301	0.357
<b>Transition time(us)</b>	0.037	0.037	0.000

# Response time (Fall time)

## Simulation result



## Evaluation Circuit

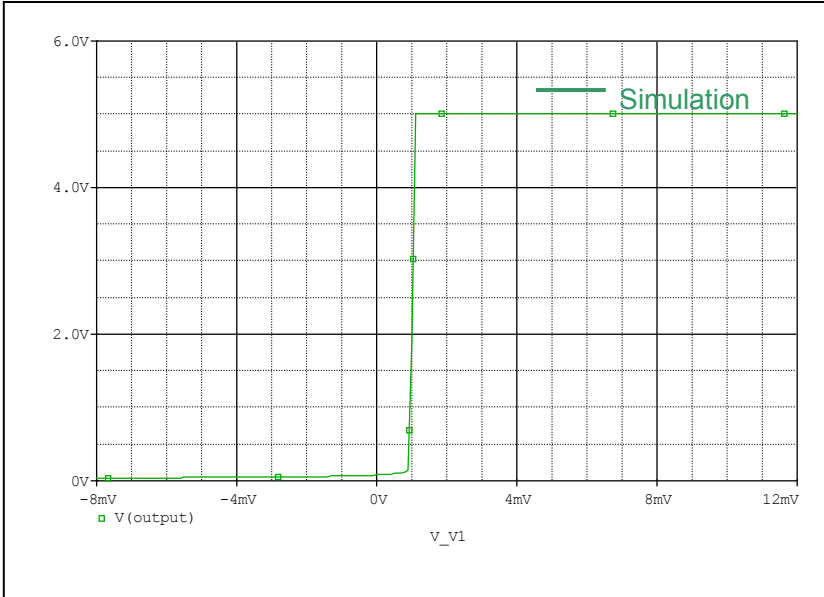


## Comparison Table

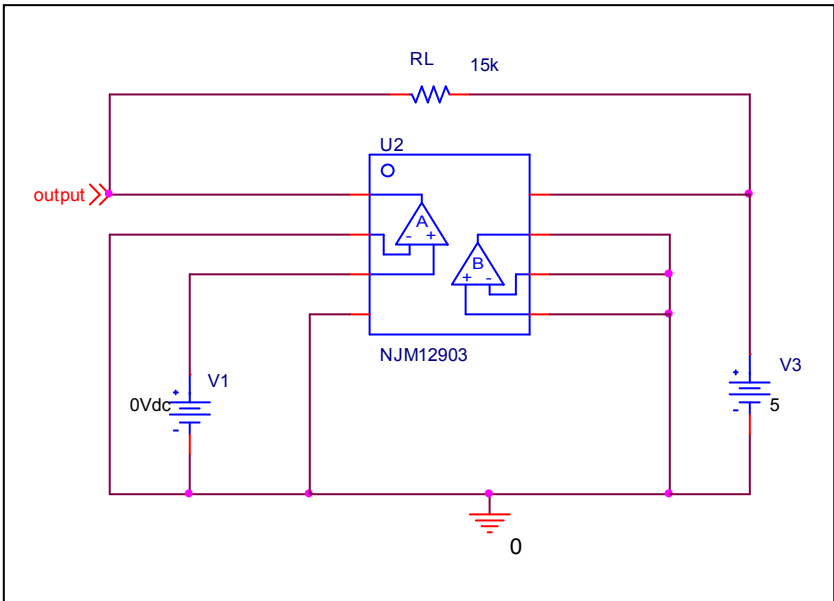
	Measurement	Simulation	% Error
Fall time(us)	0.050	0.051	2.000

# Input Offset Voltage Characteristics

Simulation result



Evaluation Circuit



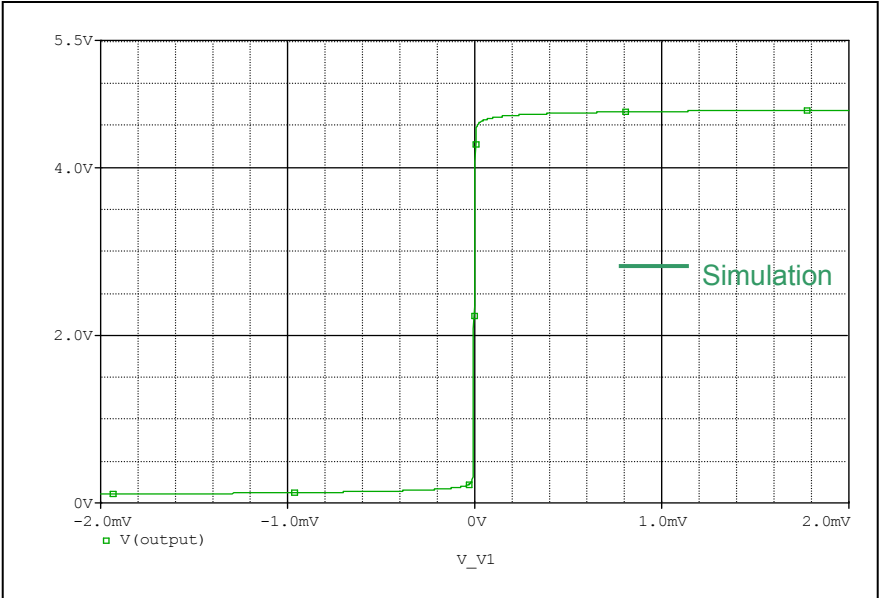
Comparison Table

	Measurement	Simulation	%Error
$V_{io}$ (mV)	1.000	1.043	4.300

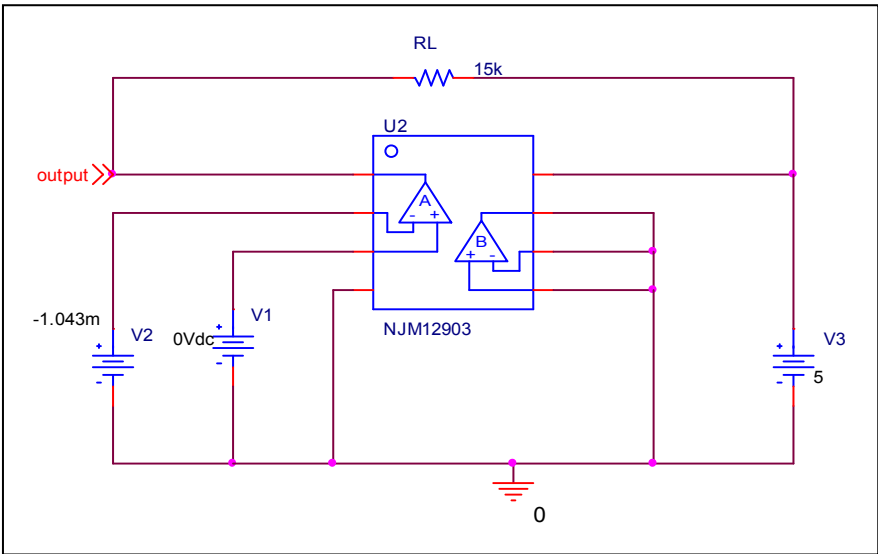


# Av Characteristics

## Simulation result



## Evaluation Circuit



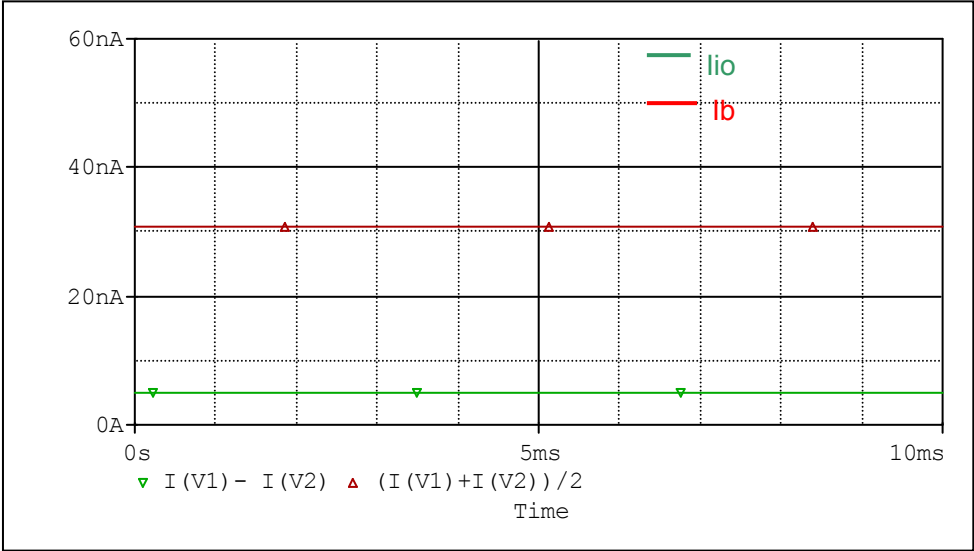
$$Av = 20 \cdot \text{LOG}(3.6/13.009\mu) \quad \text{dB}$$

## Comparison Table

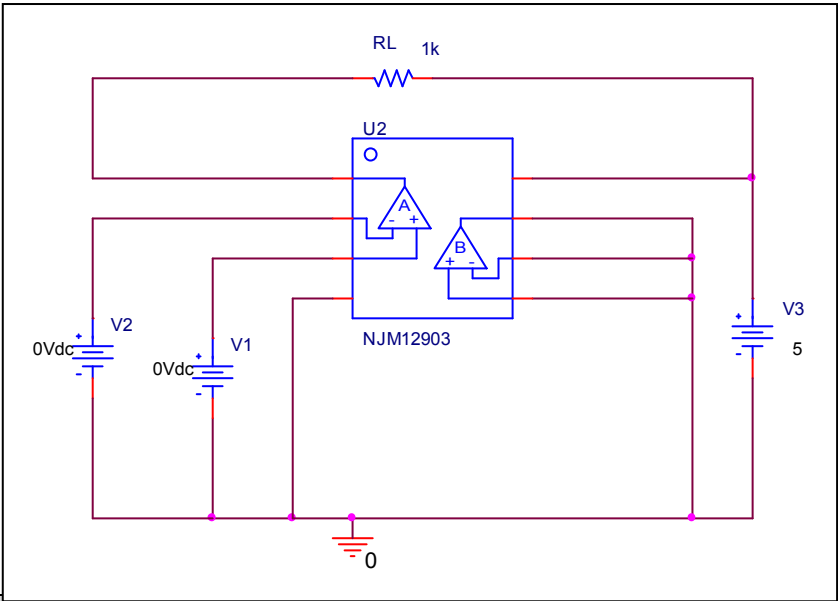
$R_L = 15 \text{ k}\Omega$	Measurement	Simulation	%Error
Av (dB)	106	108.855	2.693

# Input Bias Current Characteristics

## Simulation result



## Evaluation Circuit



## Comparison Table

	Measurement	Simulation	% Error
$I_b$ (nA)	30.000	30.812	2.707
$I_{io}$ (nA)	5.000	5.001	0.020