

# Device Modeling Report

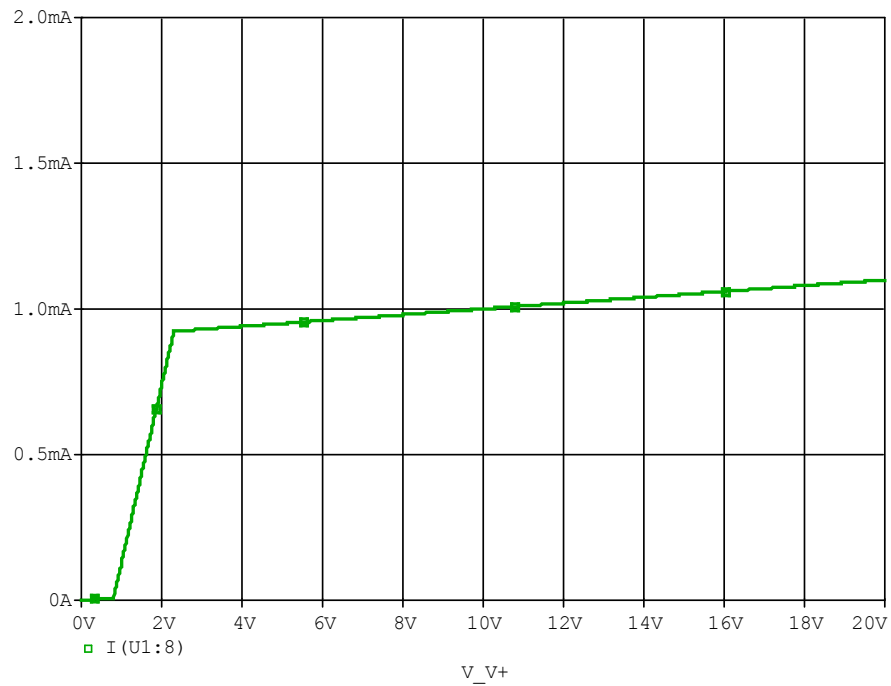
COMPONENTS: VOLTAGE AND CURRENT CONTROL IC  
PART NUMBER: NJM2146B  
MANUFACTURER: New Japan Radio Co., Ltd.



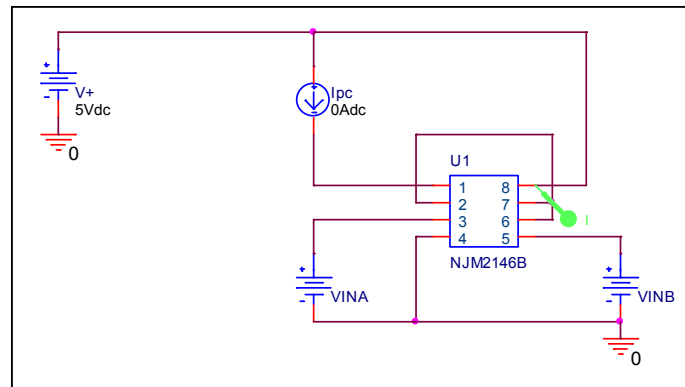
**Bee Technologies Inc.**

## Operating Current vs. Operating Voltage

### Circuit Simulation Result



Evaluation circuit

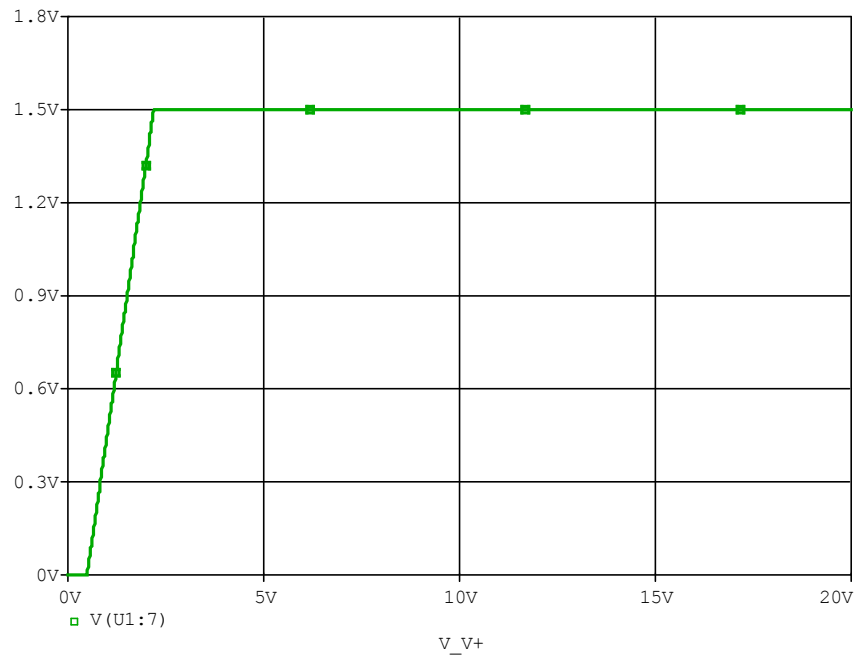


## Comparison table

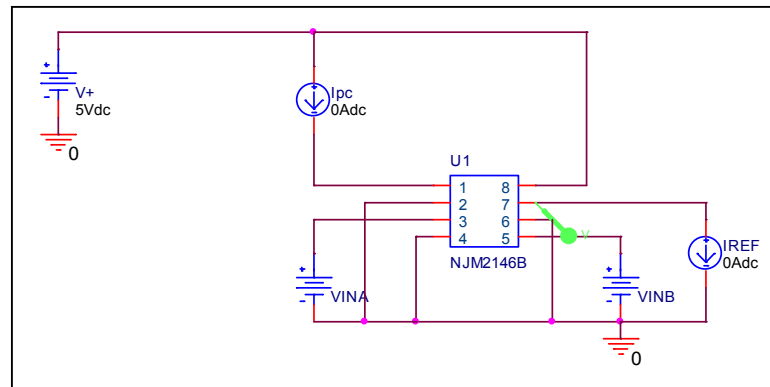
	Measurement	Simulation	%Error
I <sub>CC</sub> (mA)	0.950	0.950	0

## Reference Voltage vs. Operating Voltage

### Circuit Simulation Result



### Evaluation circuit

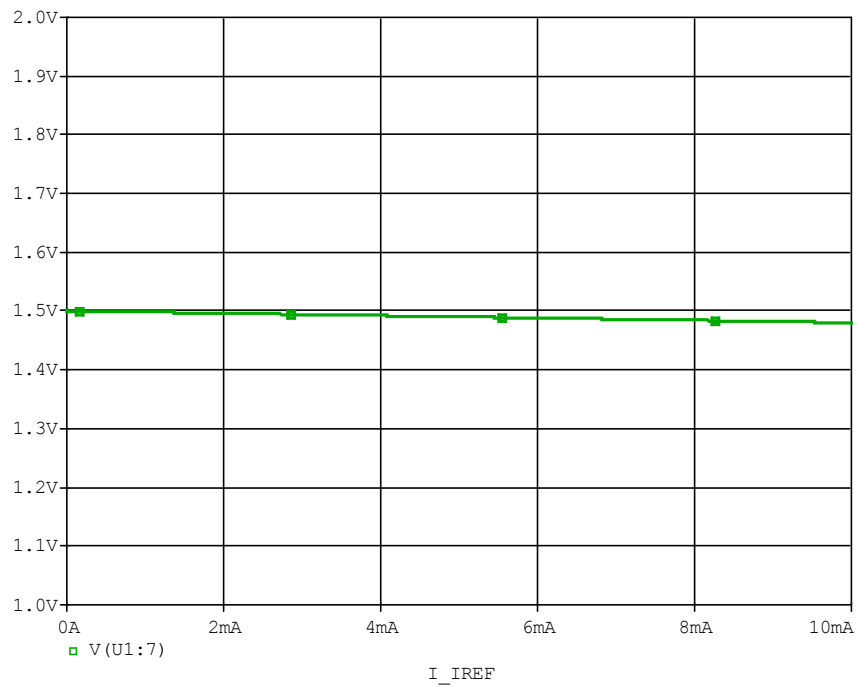


### Comparison table

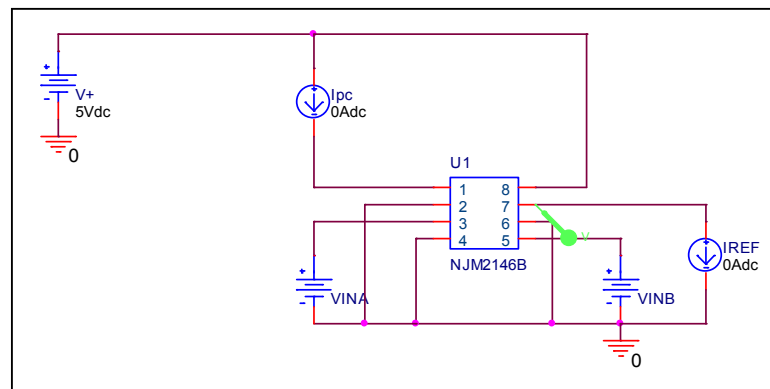
	Measurement	Simulation	%Error
<b>VREF (mV)</b>	<b>1500</b>	<b>1500</b>	<b>0</b>

## Reference Voltage vs. 7pin Output Current

### Circuit Simulation Result



### Evaluation circuit

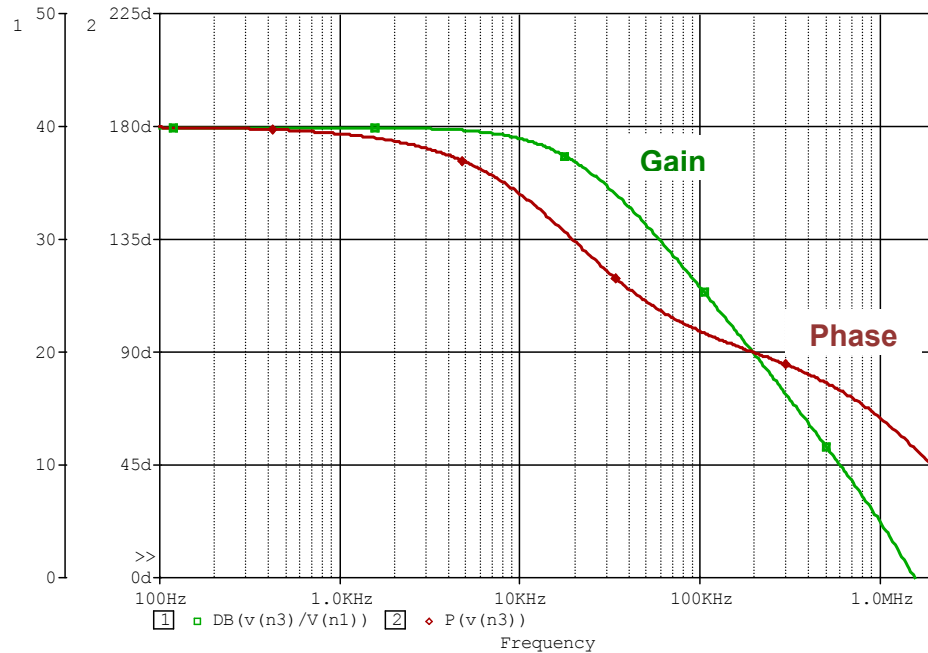


### Comparison table

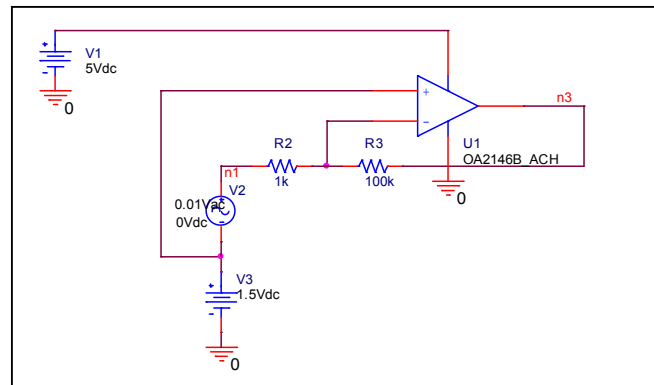
	Measurement	Simulation	%Error
$\Delta V_{REF} / \Delta I_{REF}$ (mV)	0.100	0.100	0

## [Ach] Voltage Gain, Phase Margin vs. Frequency

### Circuit Simulation Result



### Evaluation circuit

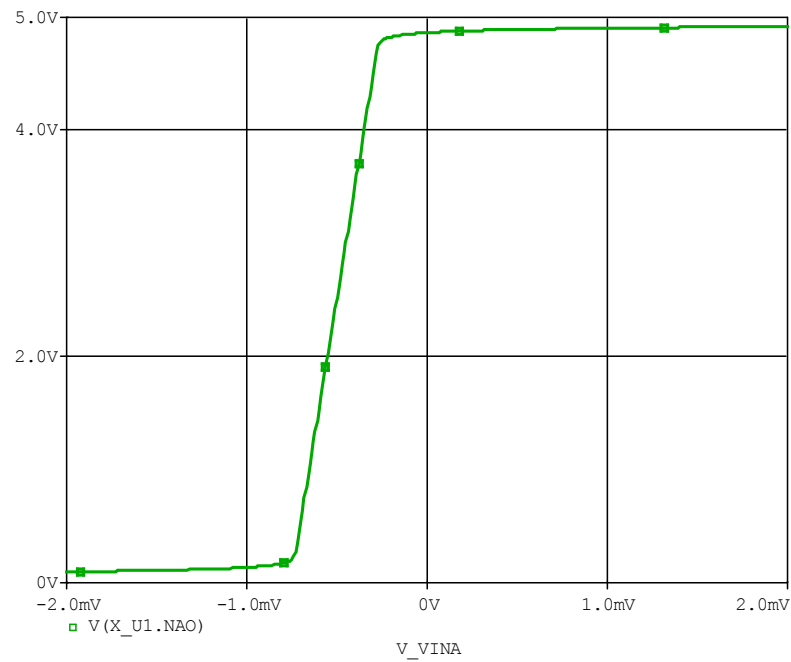


### Simulation result

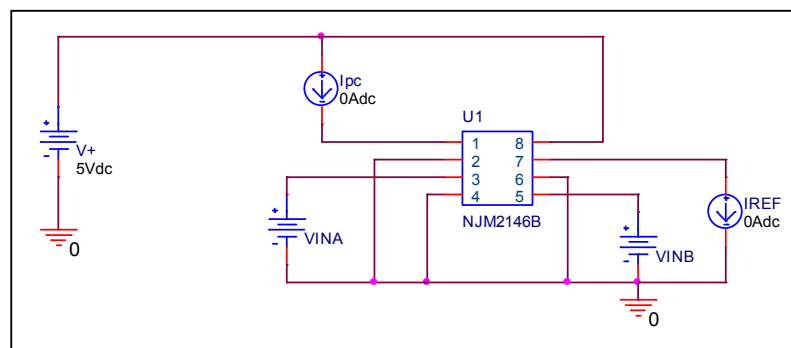
	Measurement	Simulation	UNIT	%Error
<b>Av</b>	<b>80</b>	<b>80</b>	<b>dB</b>	<b>0</b>
<b>GB</b>	<b>1.5</b>	<b>1.552</b>	<b>MHz</b>	<b>3.47</b>

## [Ach] Input Offset Voltage - $V_{IO}$

### Circuit Simulation Result



### Evaluation circuit

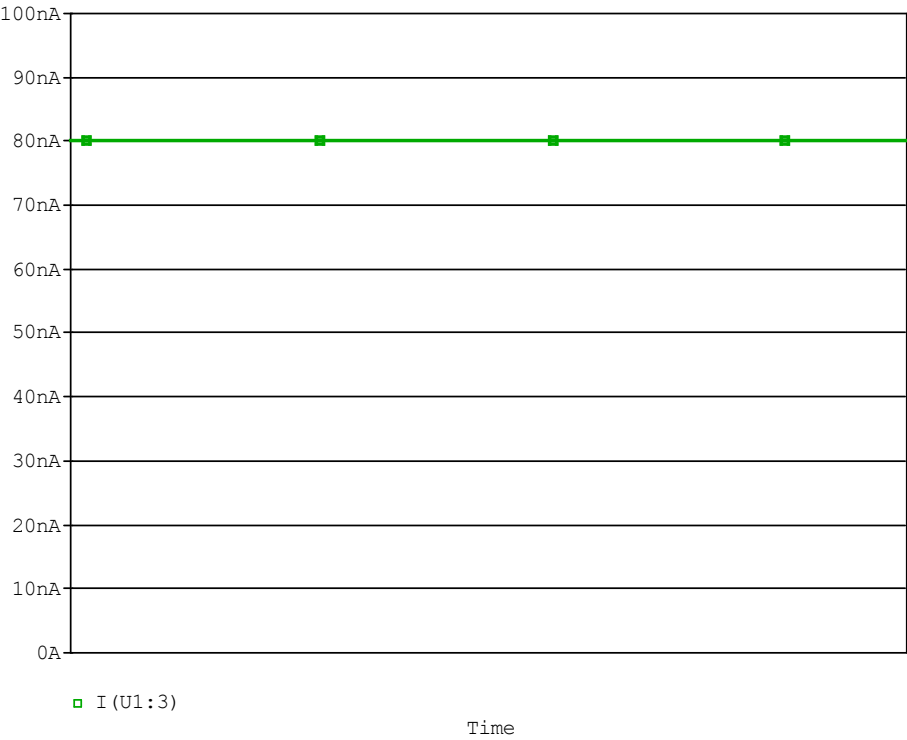


### Comparison table

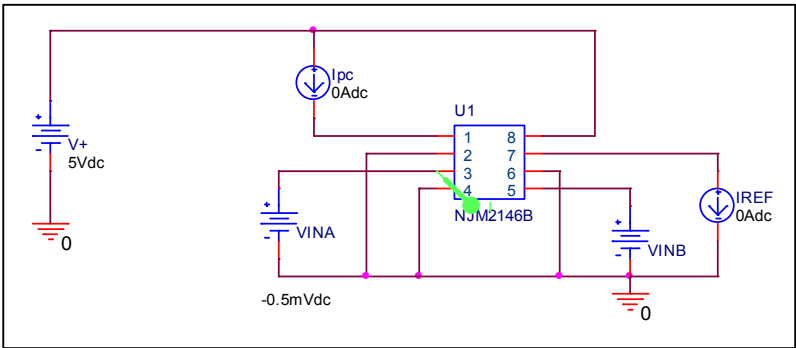
	Measurement	Simulation	%Error
$V_{IO}$ (mV)	0.500	0.502	0.40

# [Ach] Input Bias Current - $I_B$

Circuit Simulation Result



Evaluation circuit

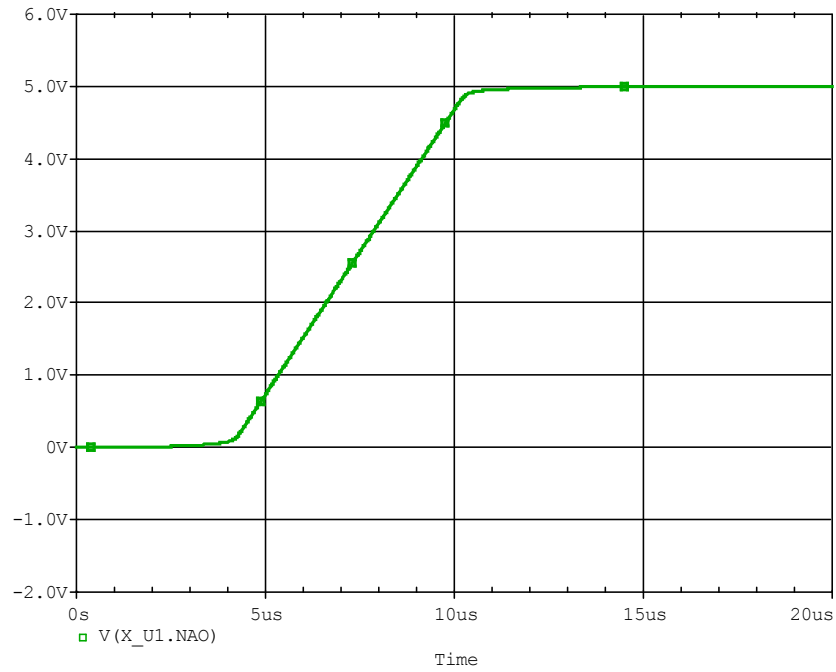


Comparison table

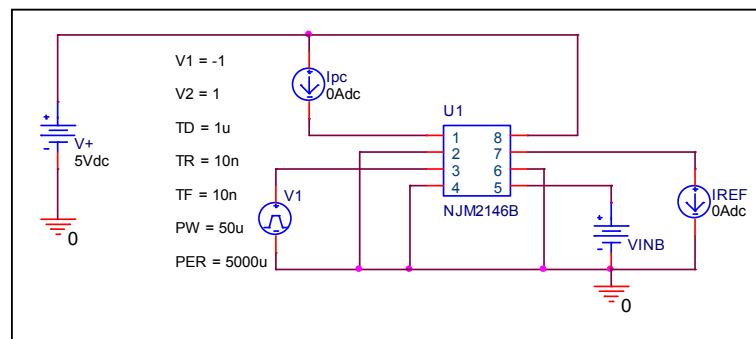
	Measurement	Simulation	%Error
$I_B$ (nA)	80.000	80.103	0.13

## [Ach] Slew Rate - SR

### Circuit Simulation Result



### Evaluation circuit



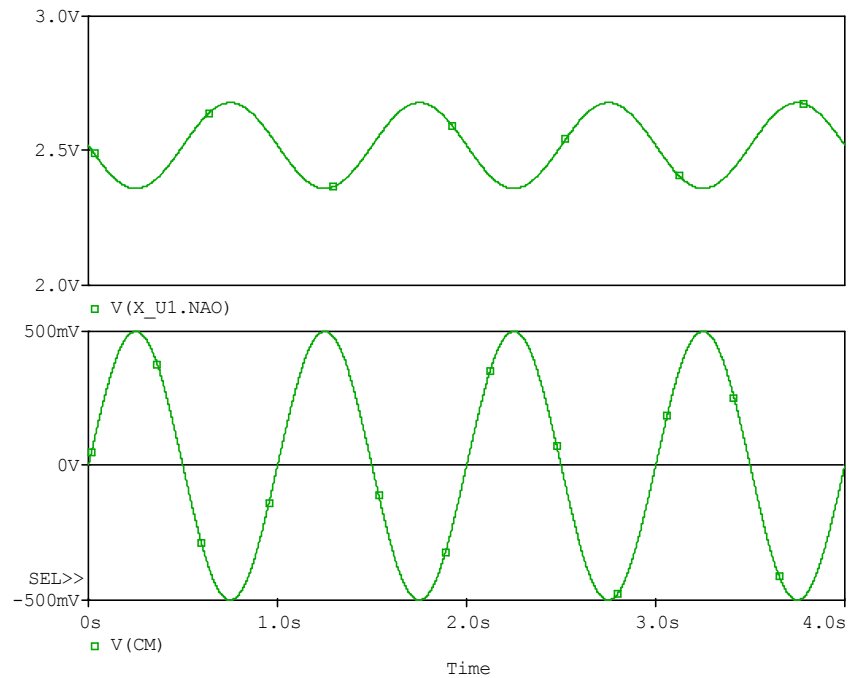
### Comparison table

	Measurement	Simulation	%Error
SR (V/ $\mu$ s)	0.800	0.797	-0.38

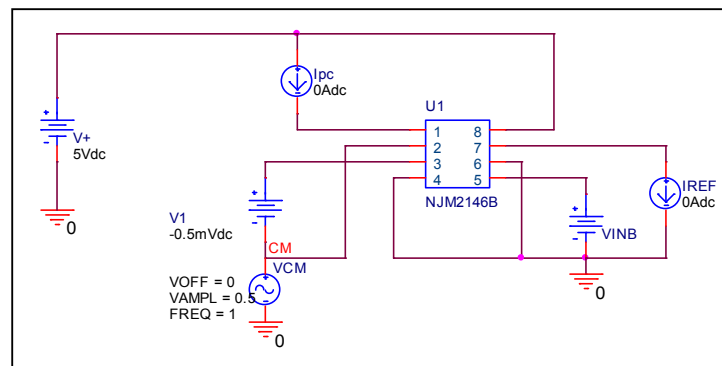


## [Ach] Common Mode Rejection Ration - CMR

### Circuit Simulation Result



### Evaluation circuit



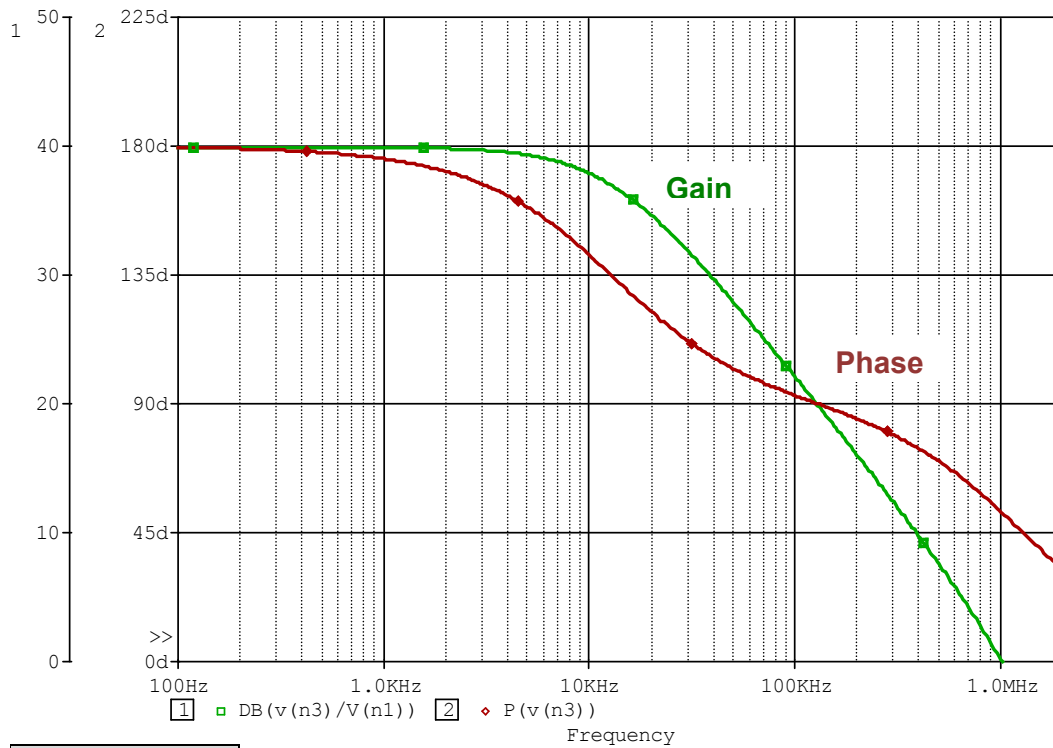
$$\text{CMRR} = 20 \cdot \log(\text{AV}/\text{ACMR})$$

### Comparison table

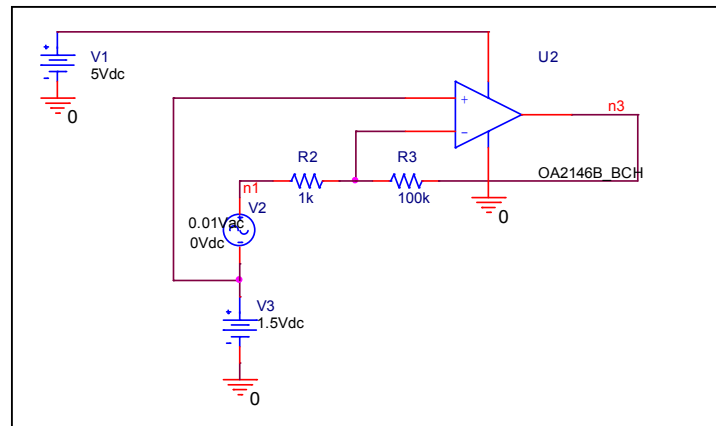
	Measurement	Simulation	%Error
CMR (dB)	90	89.90	-0.1

## [Bch] Voltage Gain, Phase Margin vs. Frequency

### Circuit Simulation Result



### Evaluation circuit

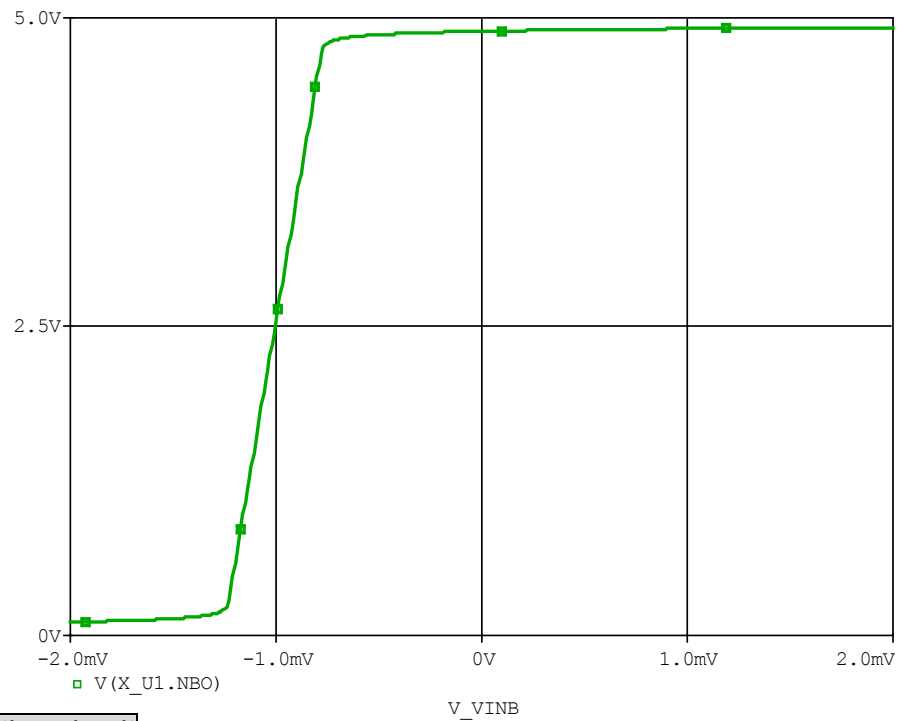


### Simulation result

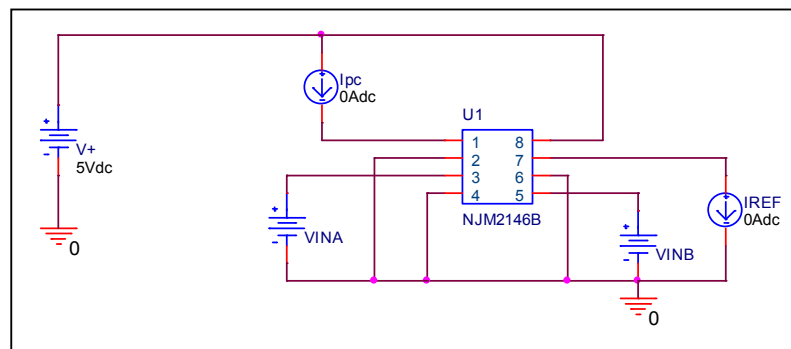
	Measurement	Simulation	UNIT	%Error
<b>Av</b>	<b>80</b>	<b>80</b>	<b>dB</b>	<b>0</b>
<b>GB</b>	<b>1.0</b>	<b>1.011</b>	<b>MHz</b>	<b>1.1</b>

## [Bch] Input Offset Voltage - $V_{io}$

### Circuit Simulation Result



### Evaluation circuit

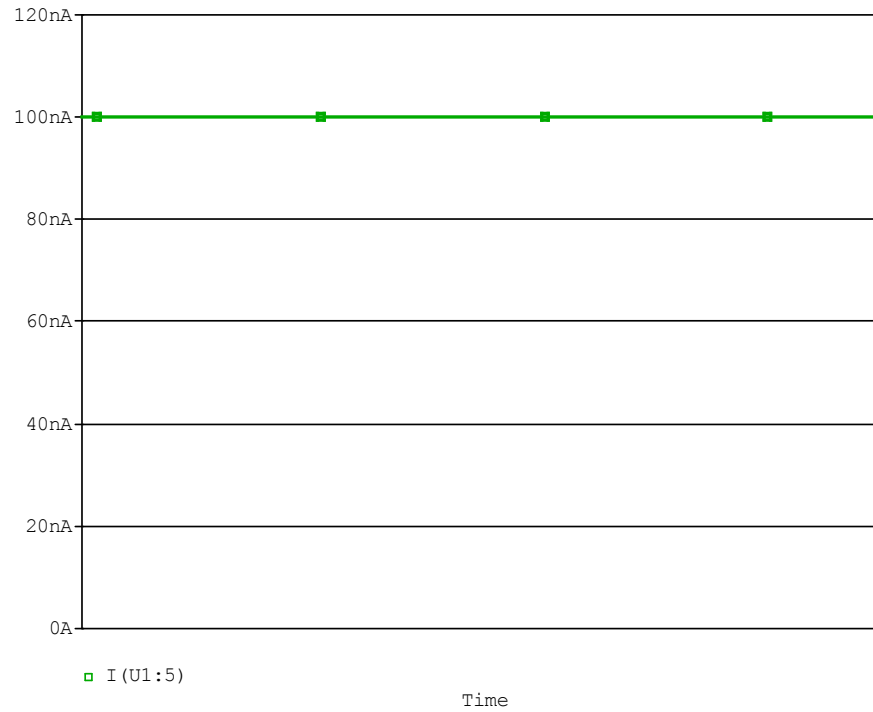


### Comparison table

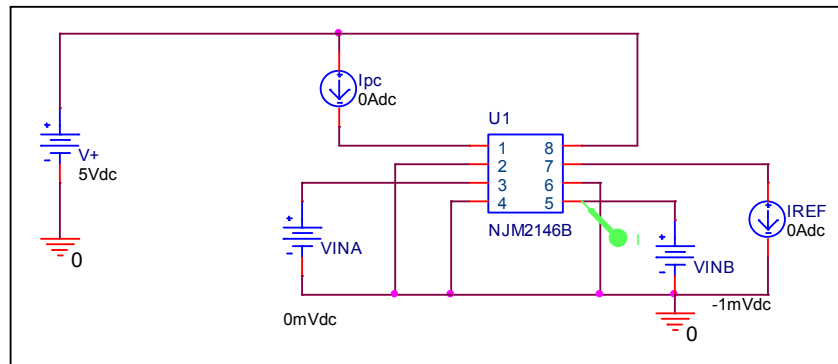
	Measurement	Simulation	%Error
$V_{io}$ (mV)	1.000	1.005	0.50

## [Bch] Input Bias Current - $I_B$

### Circuit Simulation Result



### Evaluation circuit

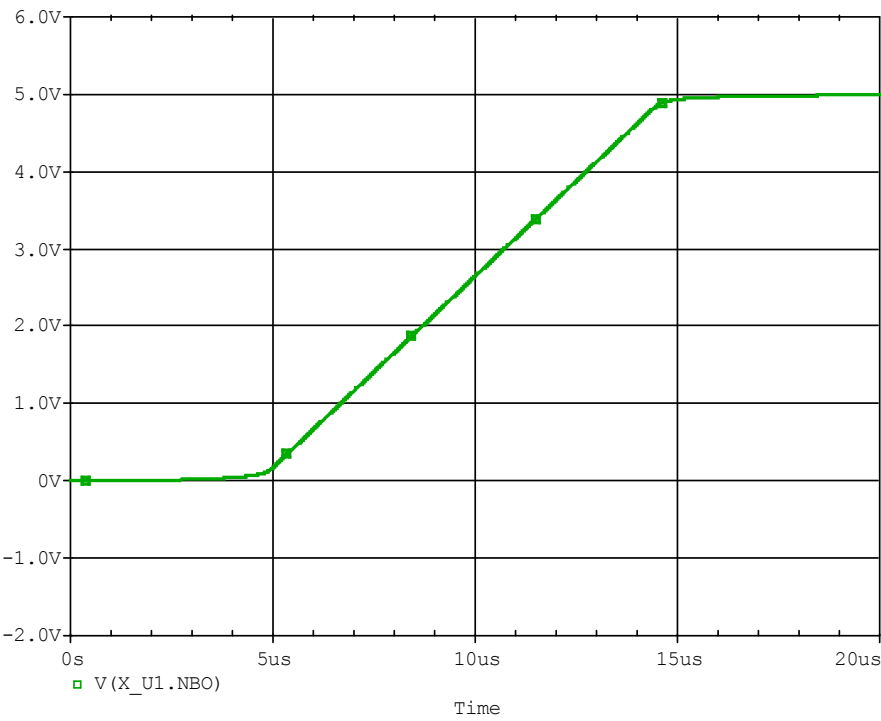


### Comparison table

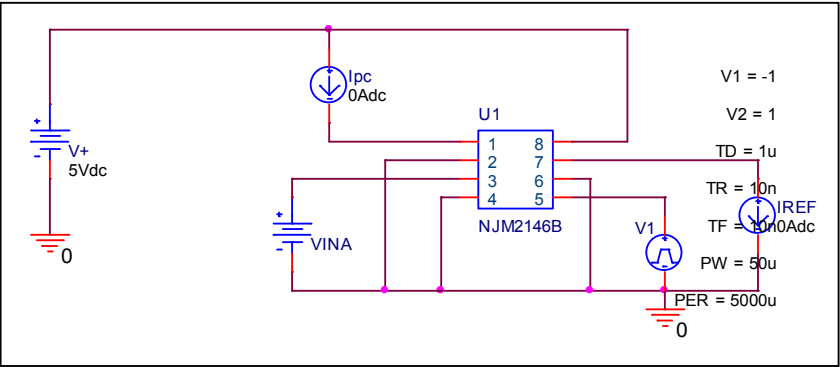
	Measurement	Simulation	%Error
<b><math>I_B</math> (nA)</b>	<b>100.000</b>	<b>99.963</b>	<b>-0.04</b>

[Bch] Slew Rate - SR

Circuit Simulation Result



Evaluation circuit

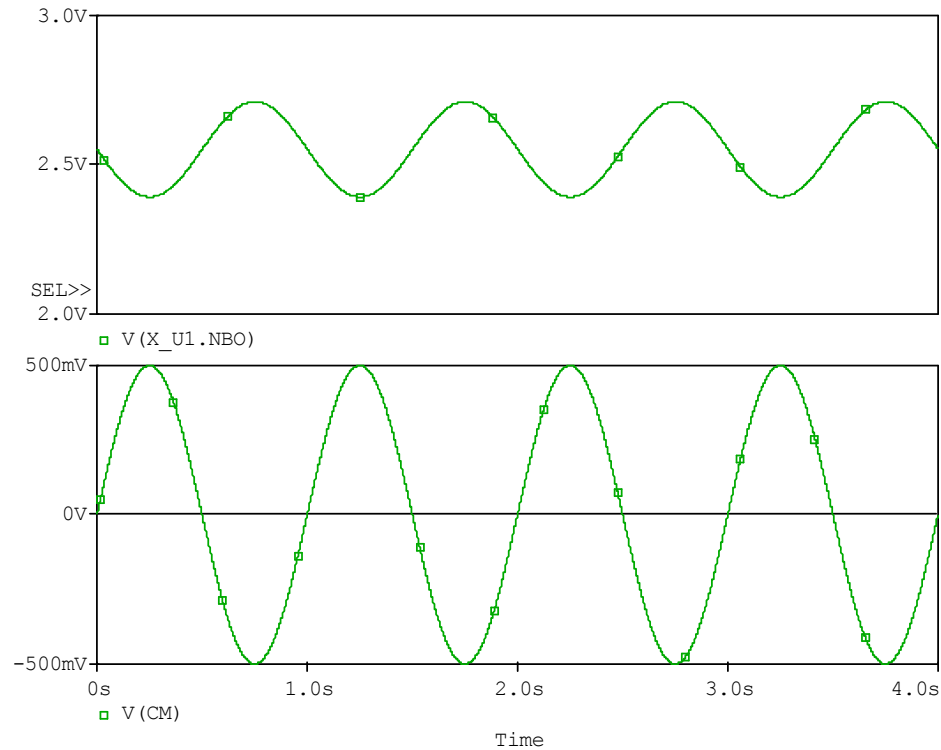


Comparison table

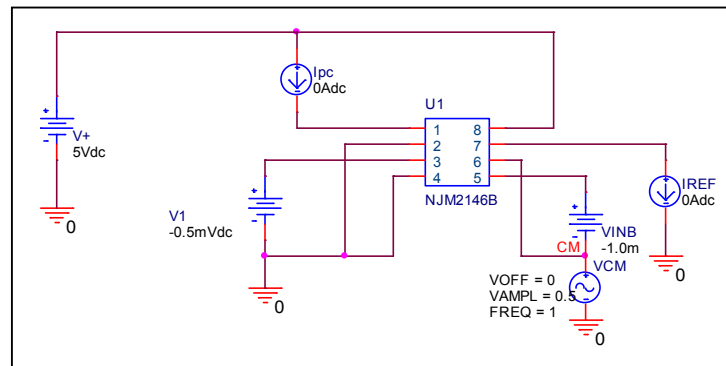
	Measurement	Simulation	%Error
SR (V/ $\mu$ s)	0.500	0.499	-0.2

## [Bch] Common Mode Rejection Ration - CMR

### Circuit Simulation Result



### Evaluation circuit



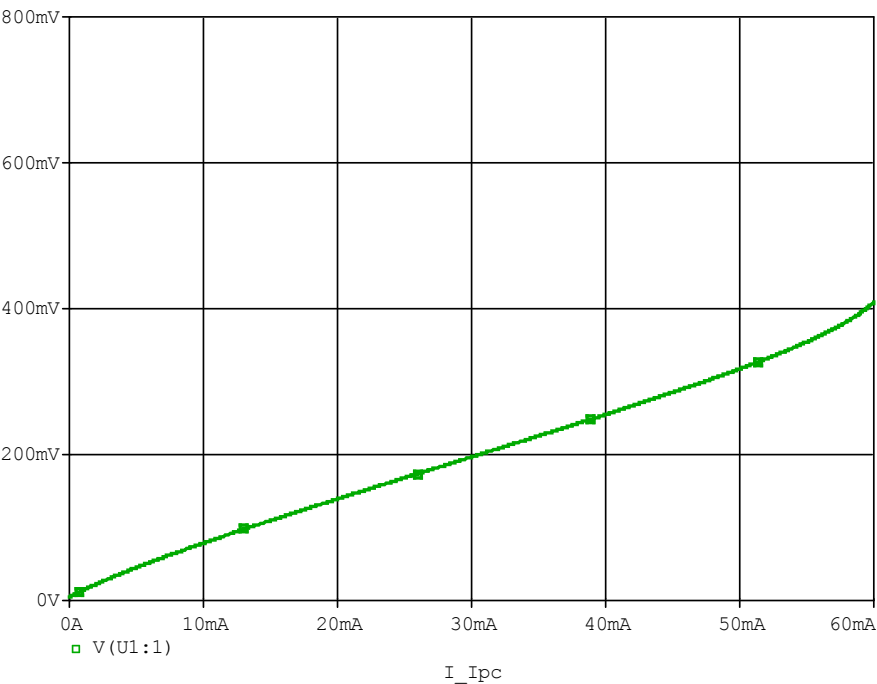
$$CMRR = 20 \cdot \log(AV/ACMR)$$

### Comparison table

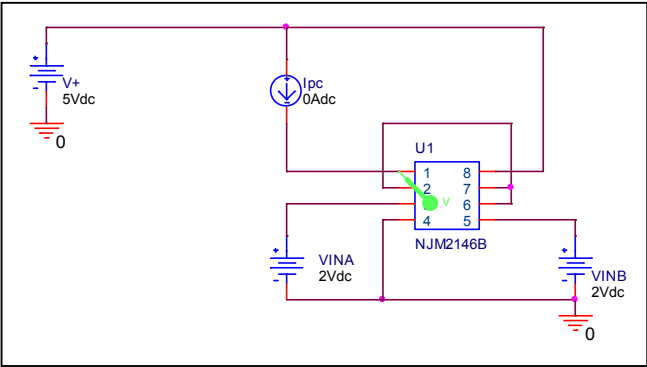
	Measurement	Simulation	%Error
CMR (dB)	90	89.90	-0.1

# Saturation Voltage vs. PC Terminal Current

Circuit Simulation Result



Evaluation circuit



Comparison table

CONDITION: I <sub>PC</sub> =50mA	Measurement	Simulation	%Error
Saturation Voltage – V <sub>PC(SAT)</sub> (V)	0.32	0.318	-0.625

