

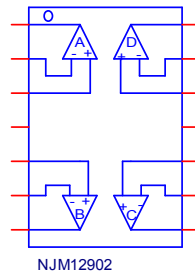
# Device Modeling Report

COMPONENTS: OPERATIONAL AMPLIFIER  
PART NUMBER: NJM12902  
MANUFACTURER: NEW JAPAN RADIO CO., LTD



**Bee Technologies Inc.**

## SPice Model



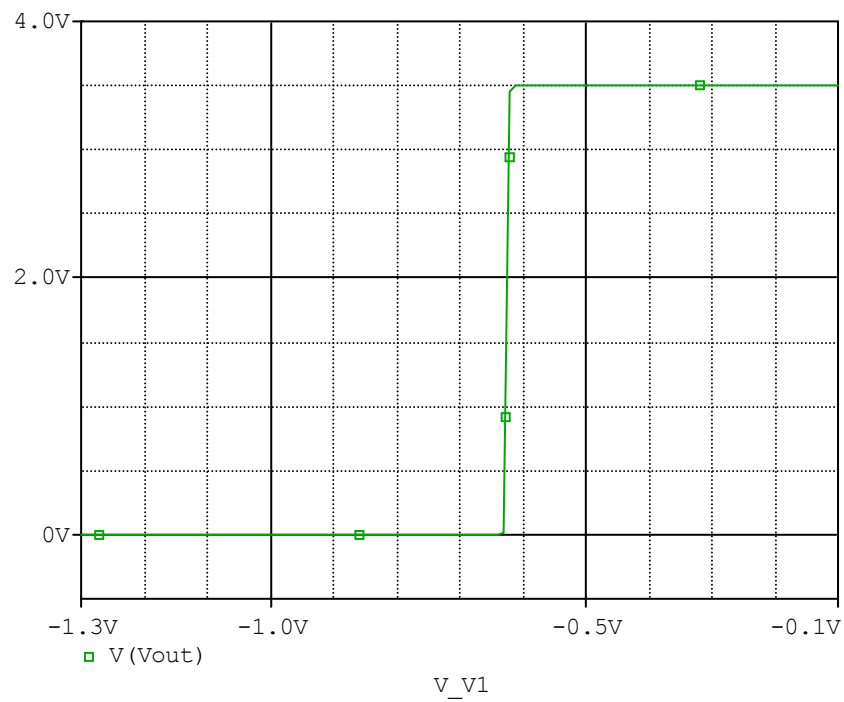
```

*$
* PART NUMBER: NJM12902
* MANUFACTURER: NEW JAPAN RADIO
* All Rights Reserved Copyright (C) Bee Technologies Inc. 2006
.Subckt NJM12902 OUT1 -IN1 +IN1 V+ +IN2 -IN2 OUT2 OUT3 -IN3 +IN3 V-
+ +IN4 -IN4 OUT4
X_U1  +IN1 -IN1 V+ V- OUT1 NJM12902_ME
X_U2  +IN2 -IN2 V+ V- OUT2 NJM12902_ME
X_U3  +IN3 -IN3 V+ V- OUT3 NJM12902_ME
X_U4  +IN4 -IN4 V+ V- OUT4 NJM12902_ME
.ends NJM12902
.subckt NJM12902_ME 1 2 3 4 5
c1  11 12 8.6603E-12
c2  6 7 30.000E-12
dc  5 53 dy
de  54 5 dy
dlp 90 91 dx
dln 92 90 dx
dp  4 3 dx
egnd 99 0 poly(2) (3,0) (4,0) 0 .5 .5
fb  7 99 poly(5) vb vc ve vlp vln 0 12.707E6 -1E3 1E3 13E6 -13E6
ga  6 0 11 12 310.79E-6
gcm 0 6 10 99 17.702E-9
iee 3 10 dc 21.940E-6
hlim 90 0 vlim 1K
q1  11 2 13 qx1
q2  12 1 14 qx2
r2  6 9 100.00E3
rc1 4 11 3.1767E3
rc2 4 12 3.1767E3
re1 13 10 813.26
re2 14 10 813.26
ree 10 99 9.1158E6
ro1 8 5 50
ro2 7 99 25
rp  3 4 35.720
vb  9 0 dc 0
vc  3 53 dc 2.3148
ve  54 4 dc .81485
vlim 7 8 dc 0
vlp 91 0 dc 39.500
vln 0 92 dc 39.500
.model dx D(Is=800.00E-18)
.model dy D(Is=800.00E-18 Rs=1m Cjo=10p)
.model qx1 PNP(Is=800.00E-18 Bf=486.67)
.model qx2 PNP(Is=970.6100E-18 Bf=625.71)
.ends
*$

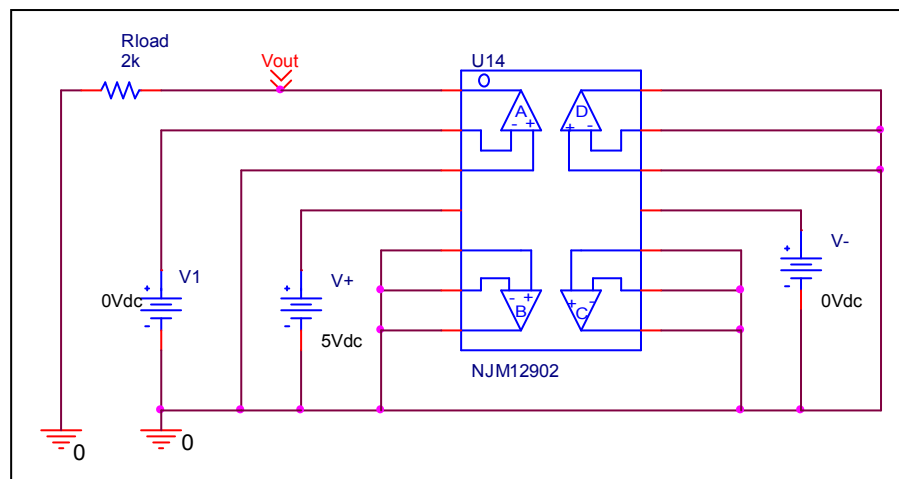
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## Output Voltage Swing

### Simulation result



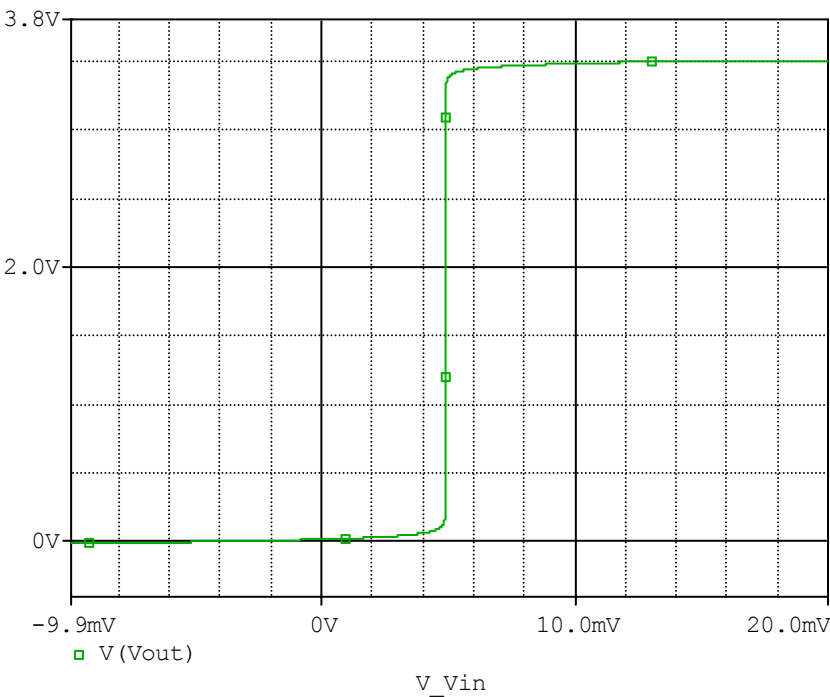
### Evaluation circuit



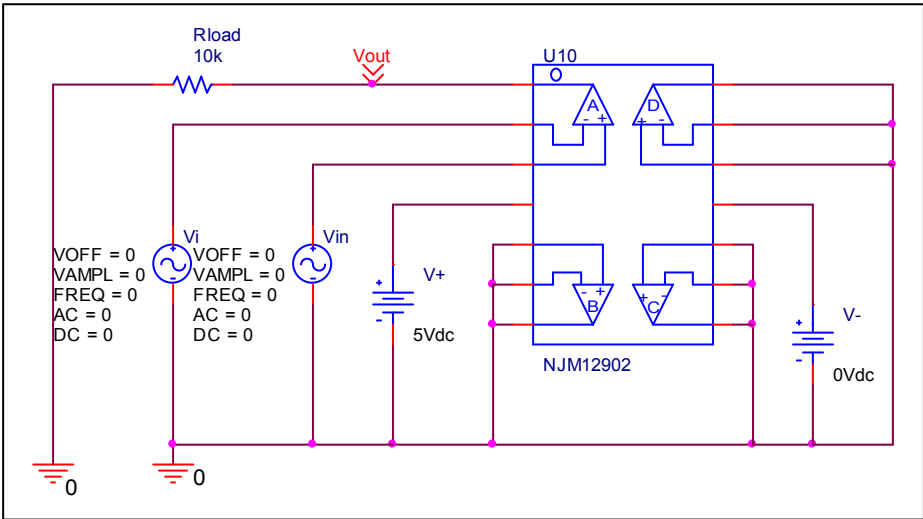
Output Voltage Swing	Data sheet	Simulation	%Error
+Vout(V)	3.500	3.500	0.000

# Input Offset Voltage

## Simulation result



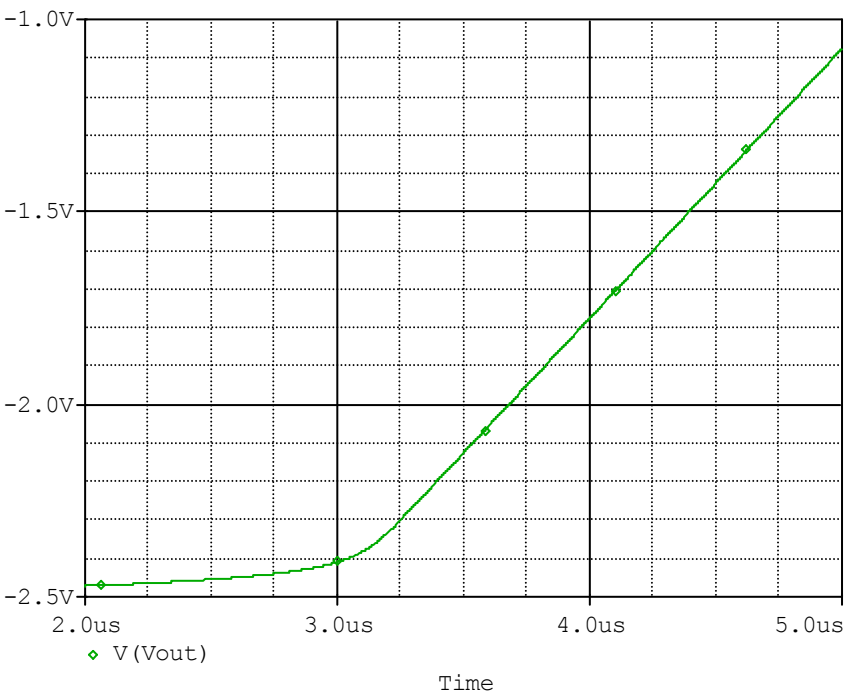
## Evaluation circuit



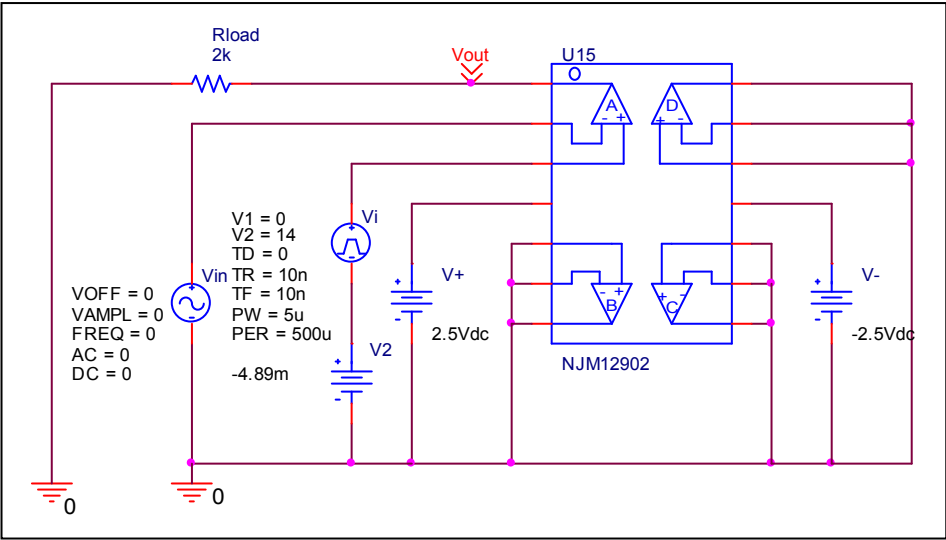
Vos	Measurement		Simulation		Error	
	5.000	mV	4.890	mV	-2.200	%

# Slew Rate

## Simulation result



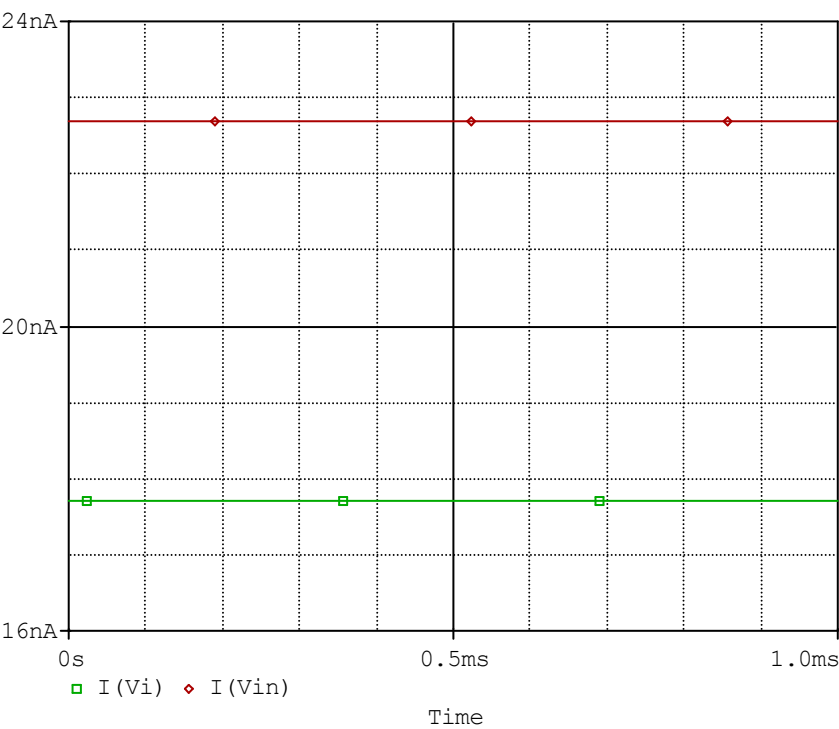
## Evaluation circuit



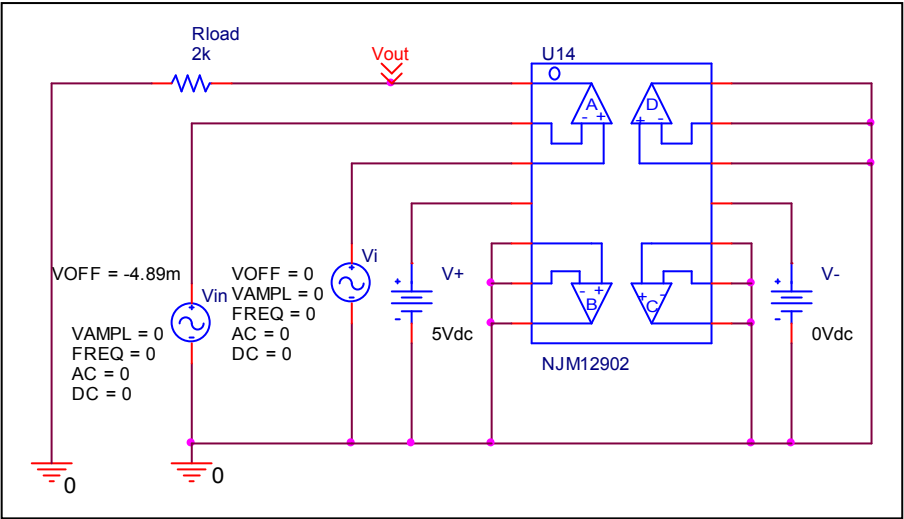
Slew Rate(v/us)	Data sheet	Simulation	%Error
	0.700	0.700	0.000

# Input current

## Simulation result



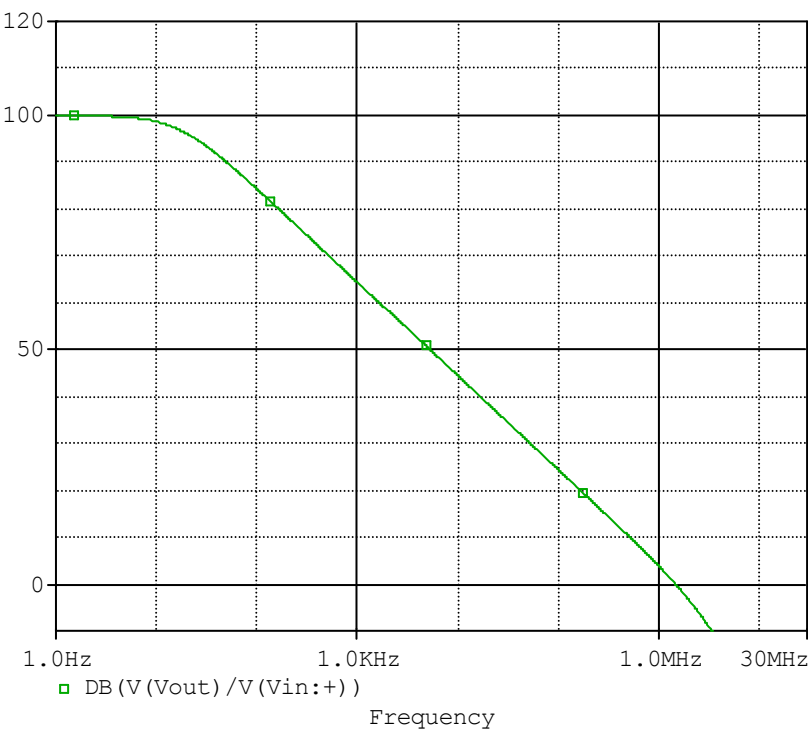
## Evaluation circuit



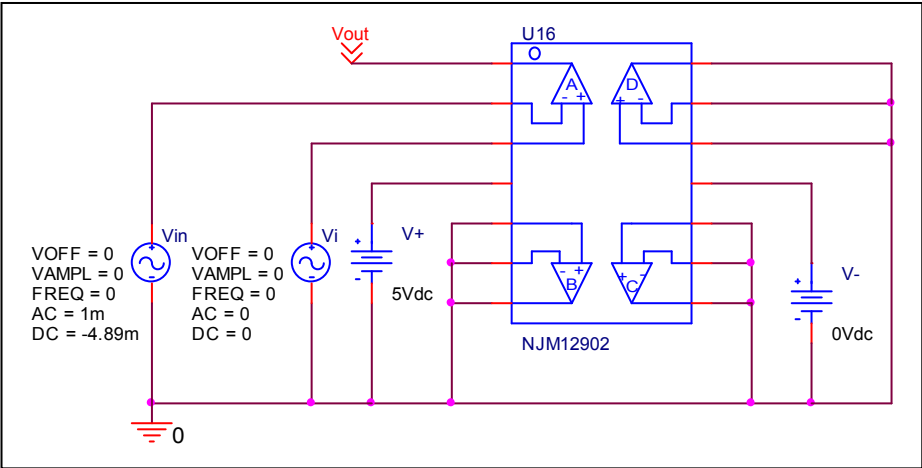
	Data sheet	Simulation	%Error
Ib(nA)	20.000	20.100	0.500
Ibos(nA)	5.000	4.980	-0.400

# Open Loop Voltage Gain vs. Frequency

## Simulation result



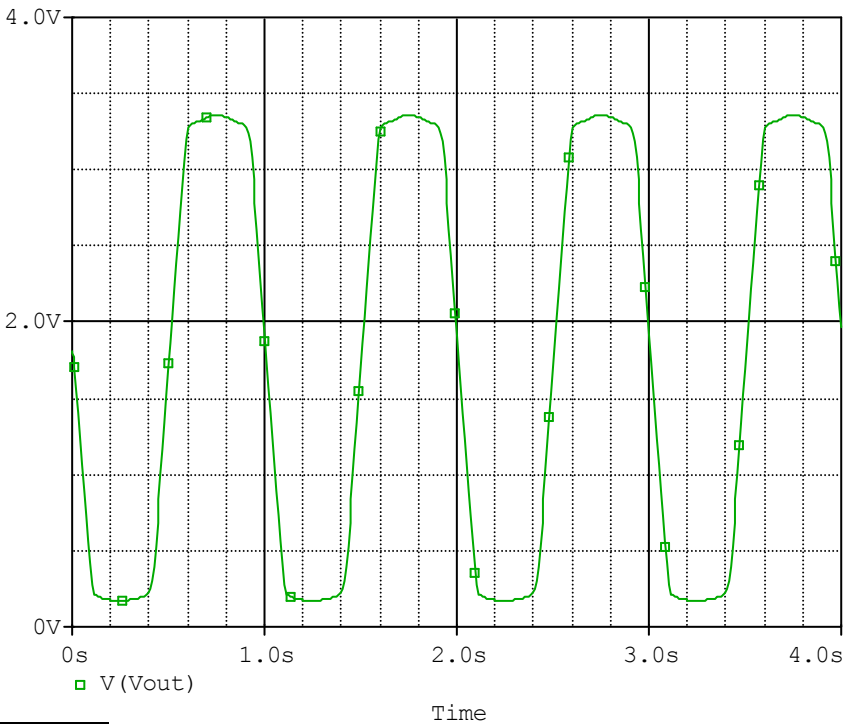
## Evaluation circuit



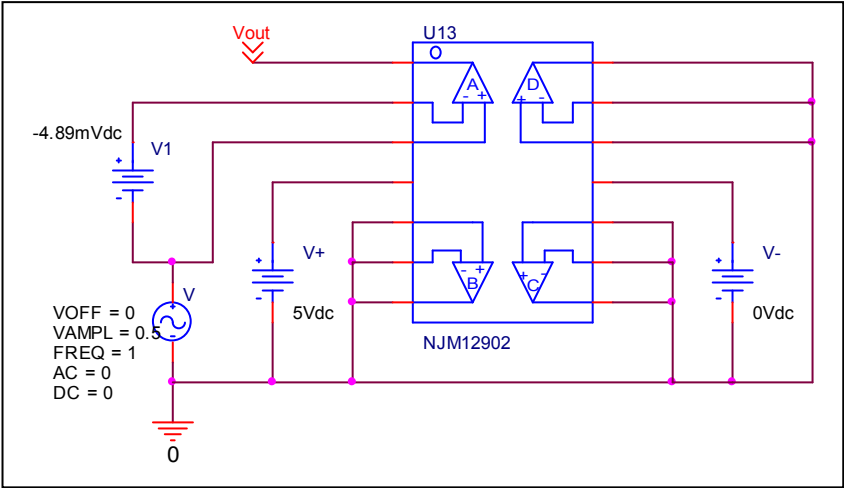
	Data sheet	Simulation	%Error
f-0dB(MHz)	1.500	1.480	1.330
Av-dc(dB)	100.000	98.570	-1.430

# Common-Mode Rejection Voltage gain

## Simulation result



## Evaluation circuit



Common Mode Reject Ratio= $84820.338/3.18=26673.062$

CMRR(dB)	Data sheet	Simulation	%Error
	85.000	88.521	4.142