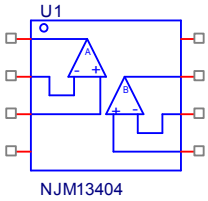
Device Modeling Report

COMPONENTS: OPERATIONAL AMPLIFIER
PART NUMBER:NJM13404
MANUFACTURER: NEW JAPAN RADIO CO.,LTD

Bee Technologies Inc.

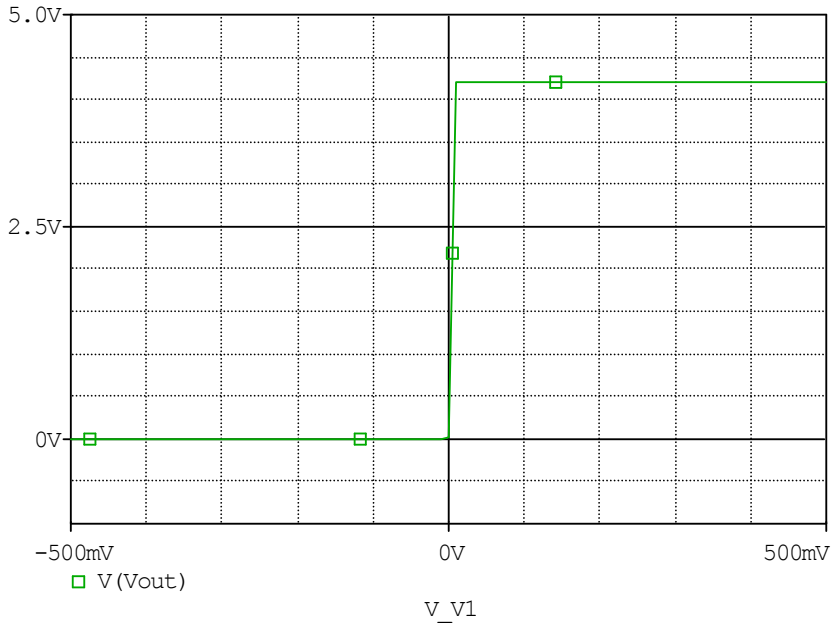
SPice Model



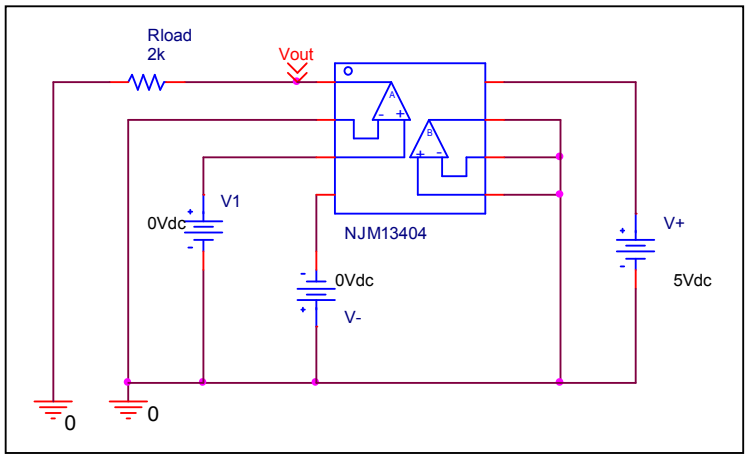

```
*$
* PART NUMBER:NJM13404
* MANUFACTURER: NEW JAPAN RADIO
* All Rights Reserved Copyright (C) Bee Technologies Inc. 2007
.Subckt NJM13404 OUT1 -IN1 +IN1 V- +IN2 -IN2 OUT2 V+
X_U1     +IN1 -IN1 V+ V- OUT1 NJM13404_ME
X_U2     +IN2 -IN2 V+ V- OUT2 NJM13404_ME
.ends  NJM13404
.subckt NJM13404_ME 1 2 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 9.4105E6 -1E3 1E3 9E6 -9E6
  ga    6  0 11 12 425.06E-6
  gcm   0  6 10 99 13.441E-9
  iee   3 10 dc 37.250E-6
  hlim 90  0 vlim 1K
  q1   11  2 13 qx1
  q2   12  1 14 qx2
  r2    6  9 100.00E3
  rc1   4 11 2.3526E3
  rc2   4 12 2.3526E3
  re1  13 10 960.81
  re2  14 10 960.81
  ree  10 99 5.3692E6
  ro1   8  5 50
  ro2   7 99 25
  rp    3  4 50.019
  vb    9  0 dc 0
  vc    3 53 dc 1.6080
  ve   54  4 dc .80796
  vlim  7  8 dc 0
  vlp  91  0 dc 29.500
  vln   0 92 dc 29.500
.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=681.32)
.model qx2 PNP(Is=933.8032E-18 Bf=834.08)
.ends
*$
```

Output Voltage Swing

Simulation result



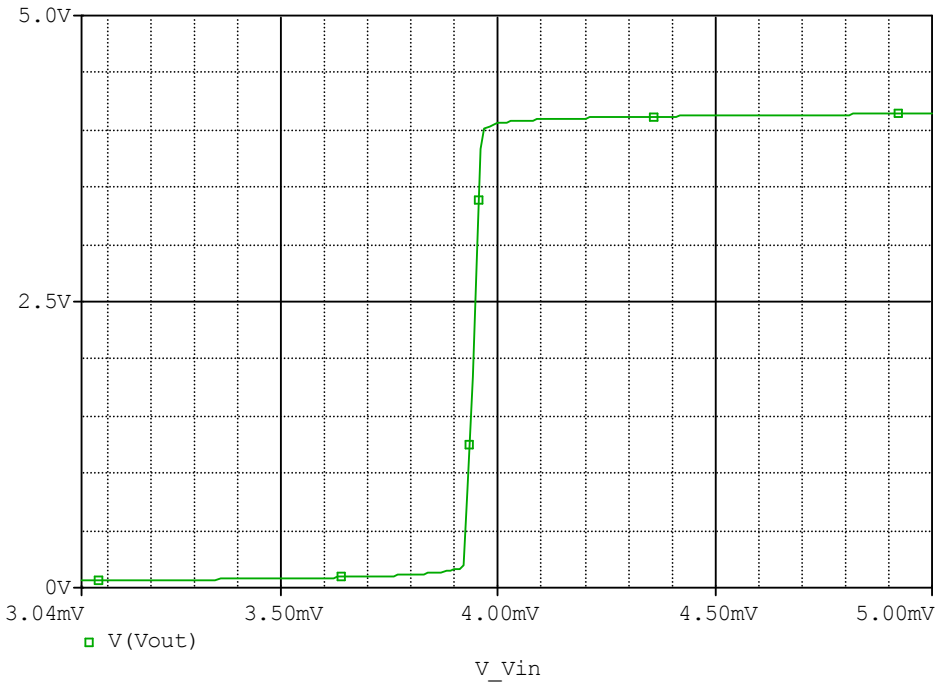
Evaluation circuit



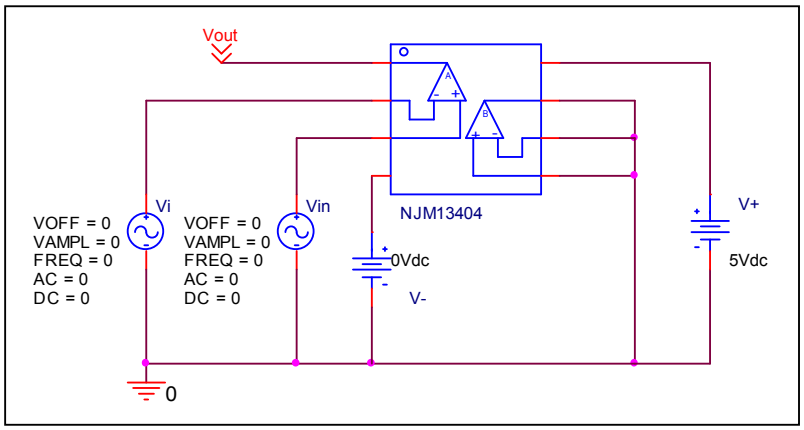
Output Voltage Swing	Data sheet	Simulation	%Error
+Vout(V)	4.200	4.1987	-0.031

Input Offset Voltage

Simulation result



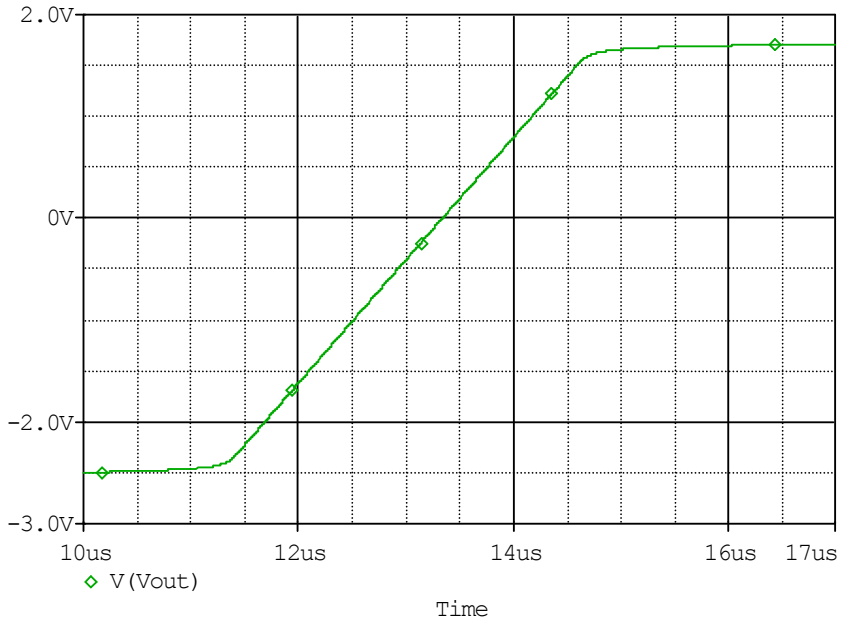
Evaluation circuit



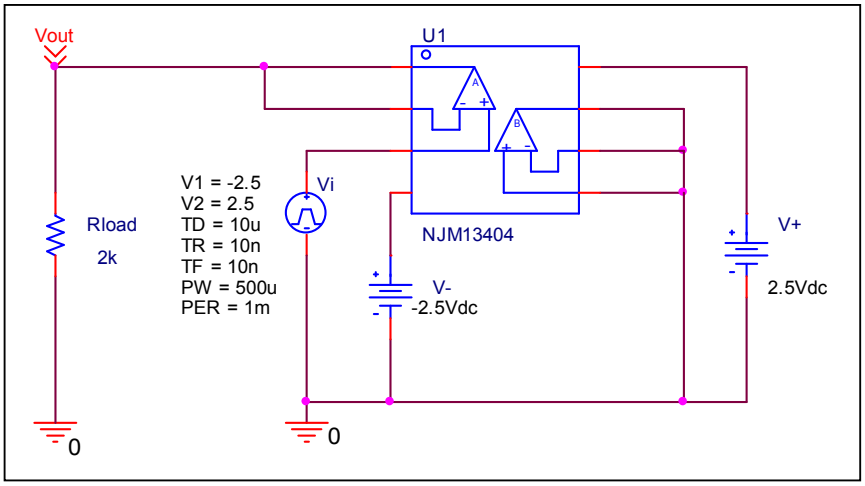
Vos	Measurement		Simulation		Error	
	4.000	mV	3.9422	mV	1.445	%

Slew Rate

Simulation result



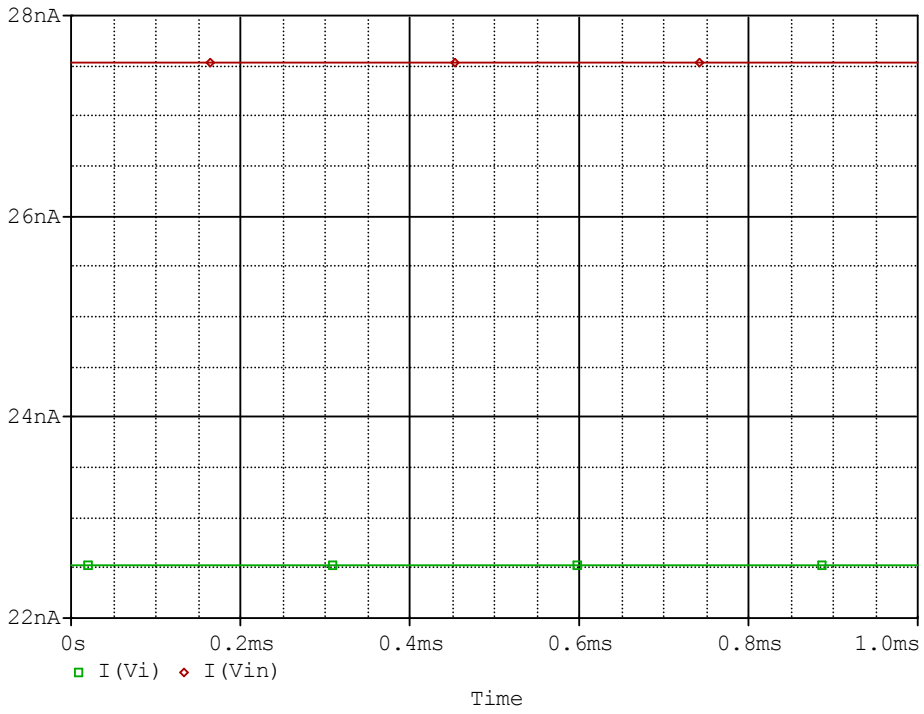
Evaluation circuit



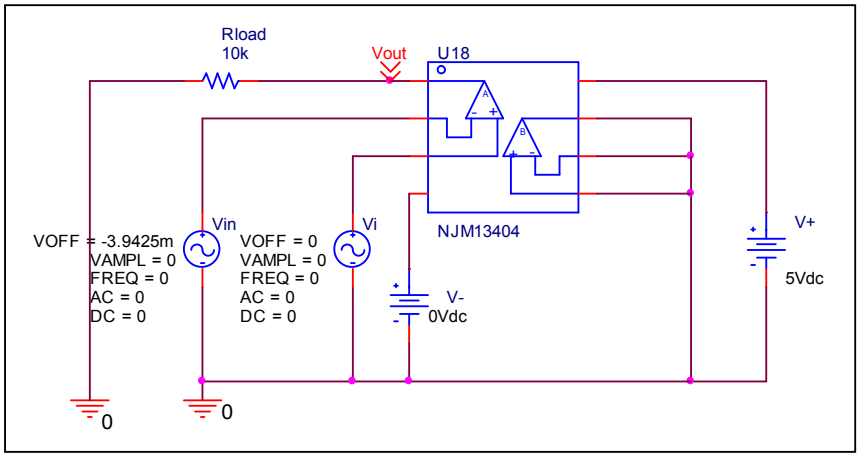
Slew Rate(v/us)	Data sheet	Simulation	%Error
	1.200	1.207	0.583

Input current

Simulation result



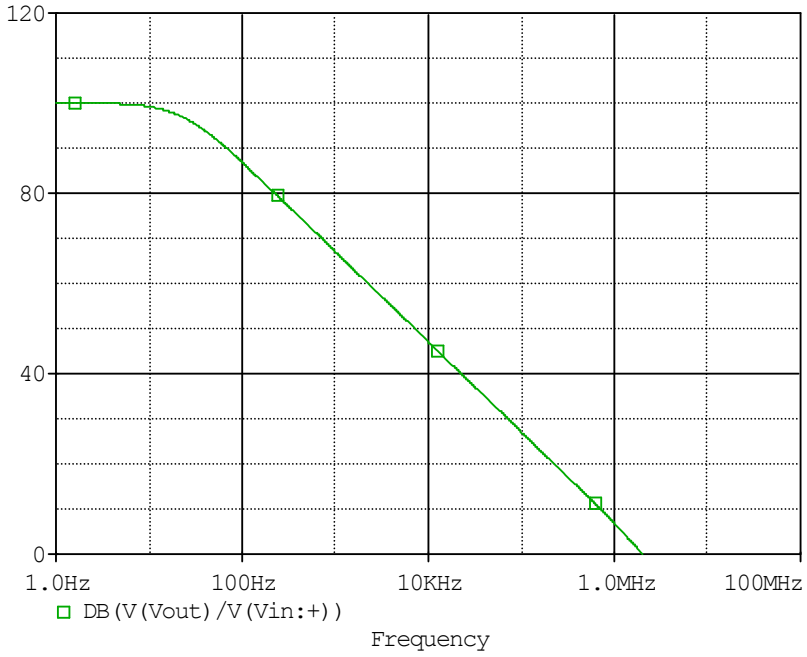
Evaluation circuit



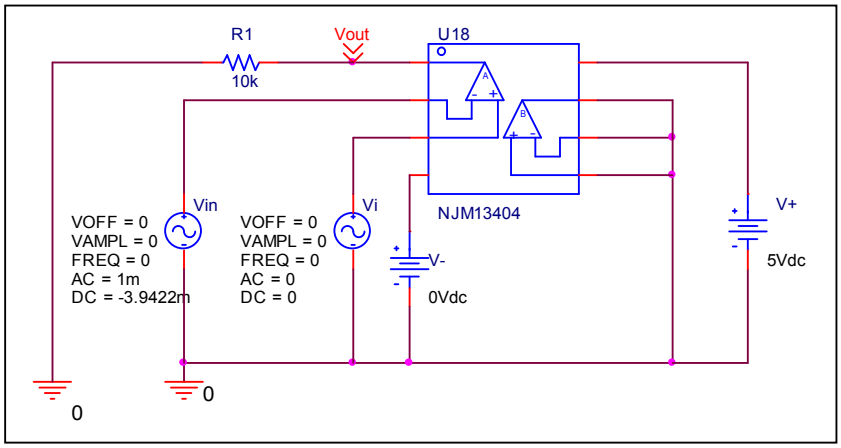
	Data sheet	Simulation	%Error
Ib(nA)	25.000	25.030	0.120
Ibos(nA)	5.000	5.0112	0.224

Open Loop Voltage Gain vs. Frequency

Simulation result



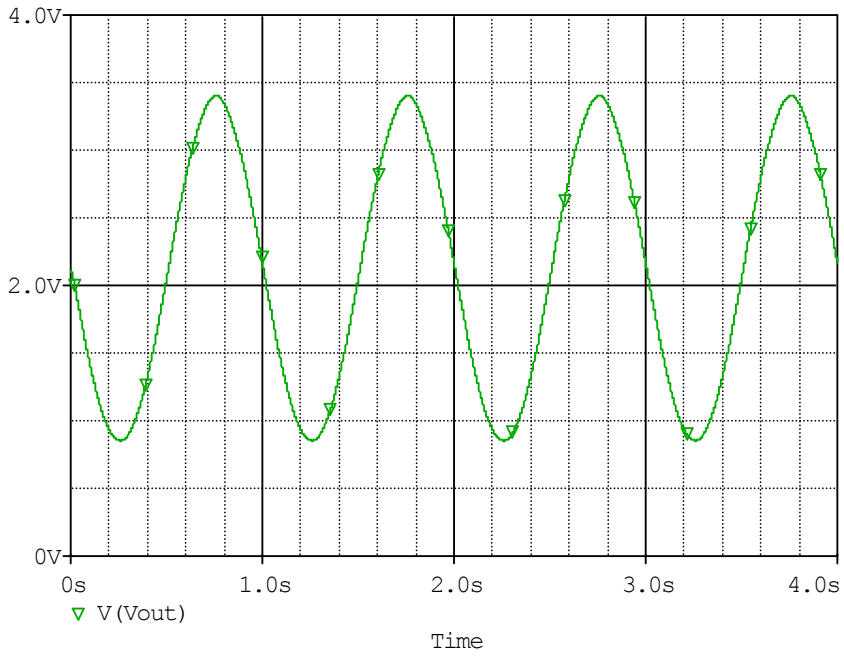
Evaluation circuit



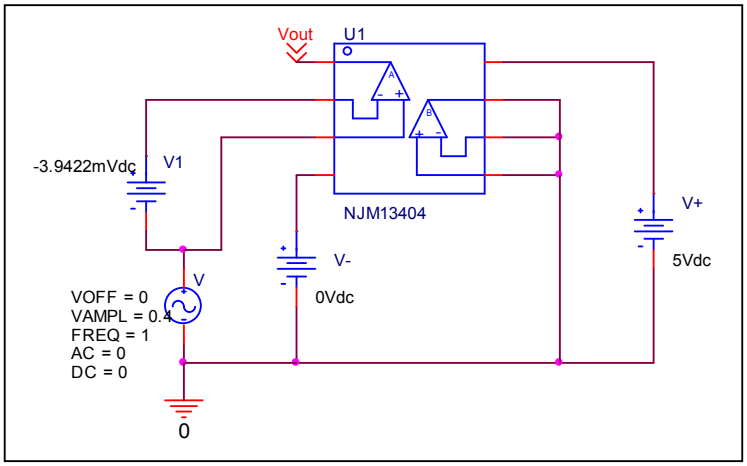
	Data sheet	Simulation	%Error
f-0dB(MHz)	2.000	2.006	0.300
Av-dc(dB)	100.000	99.974	-0.026

Common-Mode Rejection Voltage gain

Simulation result



valuation circuit



Common Mode Reject Ratio=99701.111/(2.5502/0.8)= 31276.327
= 89.904 dB

CMRR(dB)	Data sheet	Simulation	%Error
	90.000	89.904	-0.107