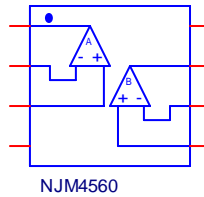# Device Modeling Report

COMPONENTS: OPERATIONAL AMPLIFIER
PART NUMBER:NJM4560
MANUFACTURER:NEW JAPAN RADIO CO.,LTD

Bee Technologies Inc.

Spice Model

NJM4560

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*$
* PART NUMBER: NJM4560
* MANUFACTURER: NEW JAPAN RADIO
* All Rights Reserved Copyright (c) Bee Technologies Inc. 2006
.Subckt NJM4560 OUT1 -IN1 +IN1 VEE +IN2 -IN2 OUT2 VCC
X_U1    +IN1 -IN1 VCC VEE OUT1 NJM4560_MODEL
X_U2    +IN2 -IN2 VCC VEE OUT2 NJM4560_MODEL
.ends  NJM4560
.subckt NJM4560_MODEL  1 2 3 4 5
 c1   11 12 7.1447E-12
 c2    6  7 24.750E-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 0 286.77E3 -1E3 1E3 290E3 -290E3
 ga    6  0 11 12 1.8284E-3
 gcm   0  6 10 99 57.819E-9
 iee   3 10 dc 120.08E-6
 hlim 90  0 vlim 1K
 q1   11  2 13 qx1
 q2   12  1 14 qx2
 r2    6  9 100.00E3
 rc1   4 11 546.92
 rc2   4 12 546.92
 re1  13 10 115.78
 re2  14 10 115.78
 ree  10 99 1.6656E6
 ro1   8  5 375
 ro2   7 99 185
 rp    3  4 1.8131E3
 vb    9  0 dc 0
 vc    3 53 dc 1.8037
 ve   54  4 dc 1.8037
 vlim  7  8 dc 0
 vlp  91  0 dc 25
 vln   0 92 dc 25
.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=1.4118E3)
.model qx2 PNP(Is=1.008877E-15 Bf=1.6000E3)
.ends
*$
```
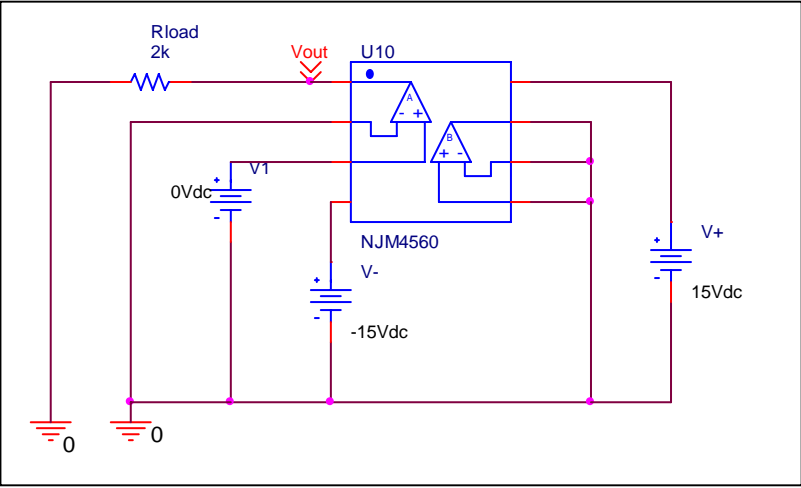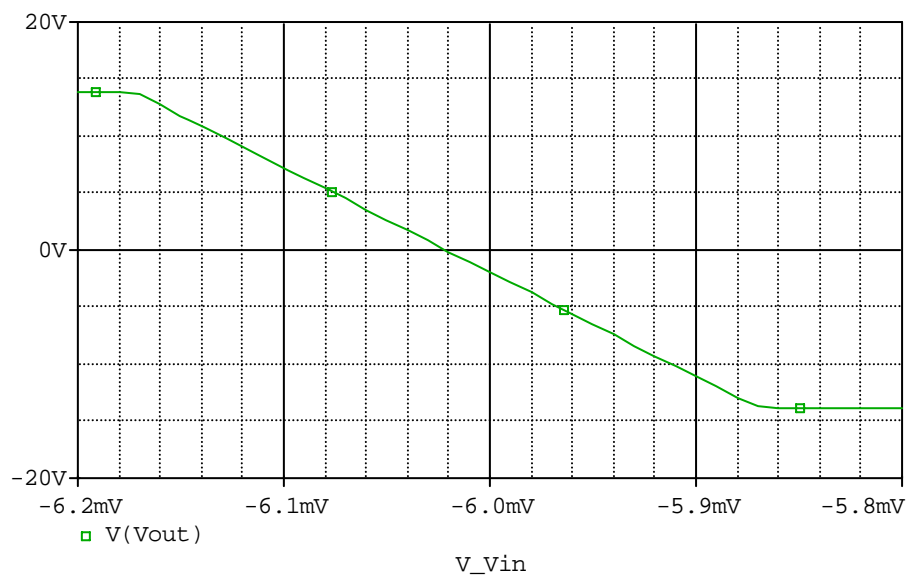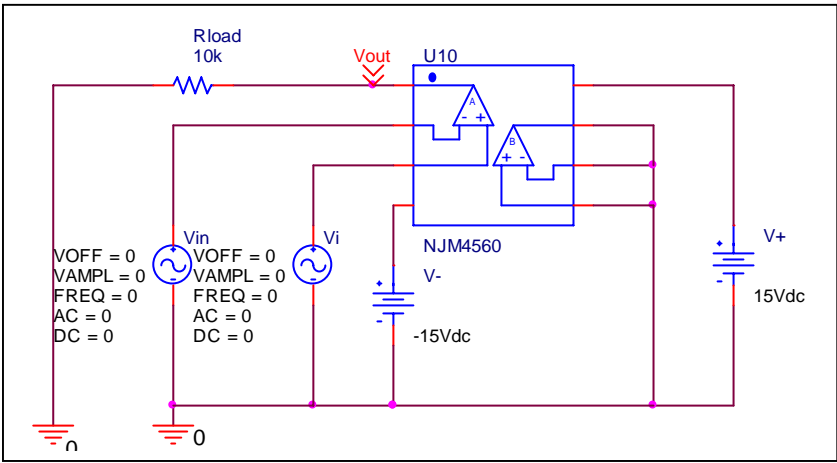
Output Voltage Swing

V_V1
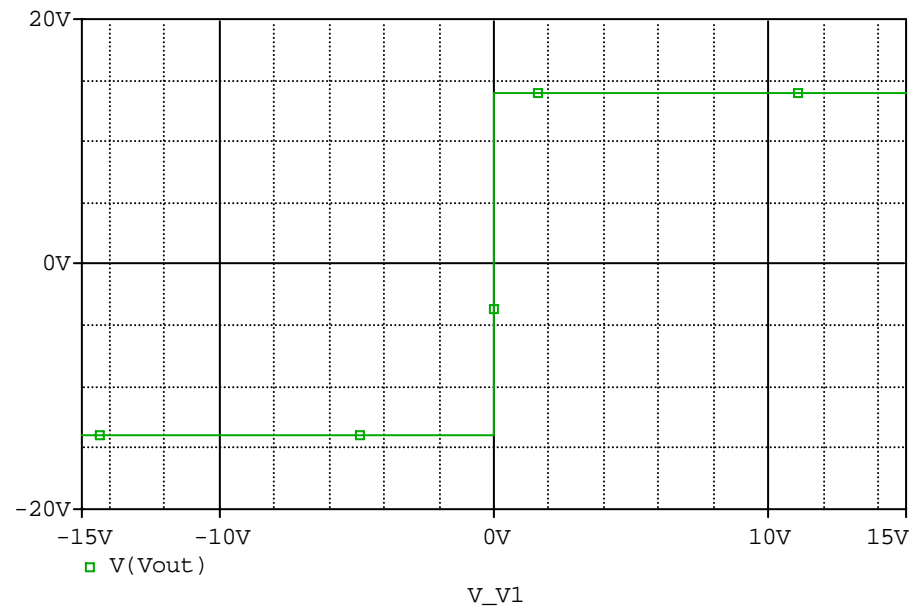
Evaluation circuit

Output Voltage Swing	Data sheet	Simulation	%Error
+Vout(V)	+14.000	+13.998	0.0142
-Vout(V)	-14.000	-13.998	0.0142

Input Offset Voltage

Simulation result

Evaluation circuit

	Measurement		Simulation		Error	
Vos	6.000	mV	6.0216	mV	0.360	%

Slew Rate
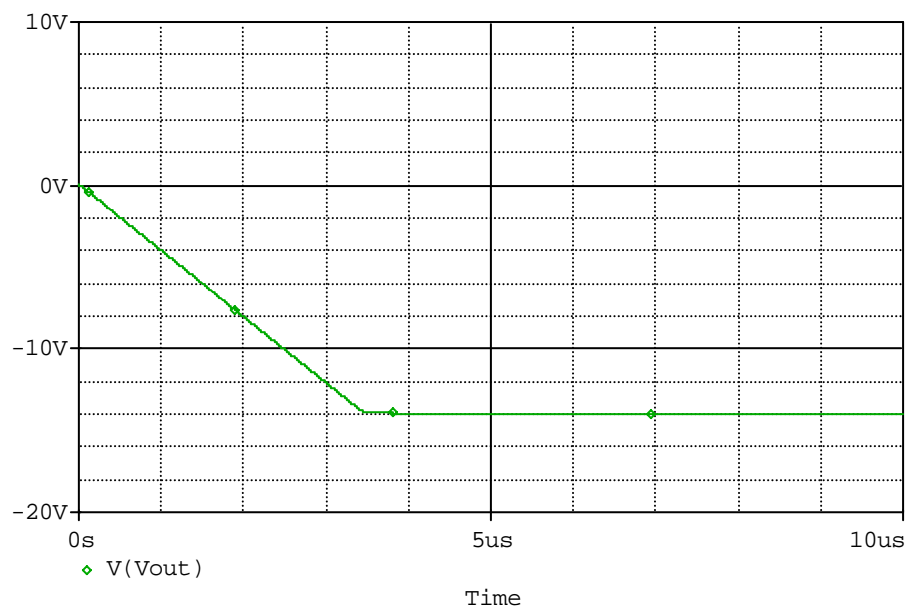
Evaluation circuit
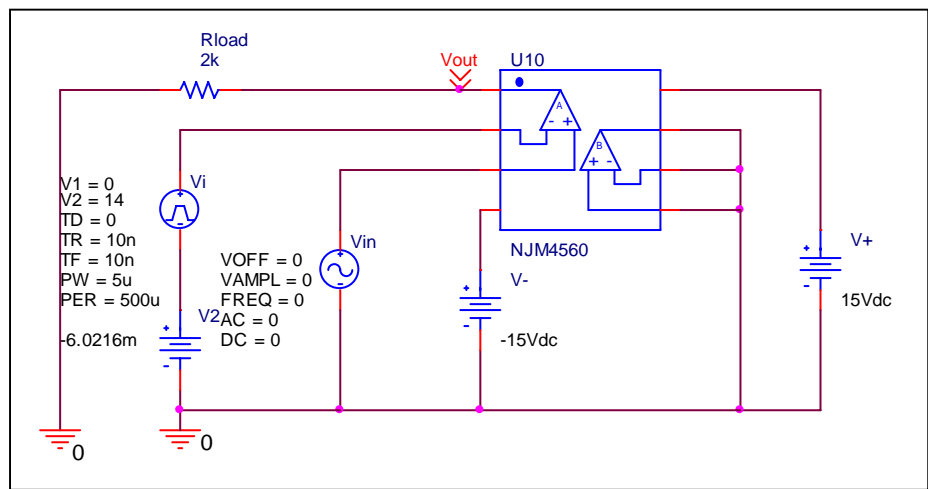
Slew Rate(v/us)	Data sheet	Simulation	%Error
	4.000	4.0619	1.540

Input current
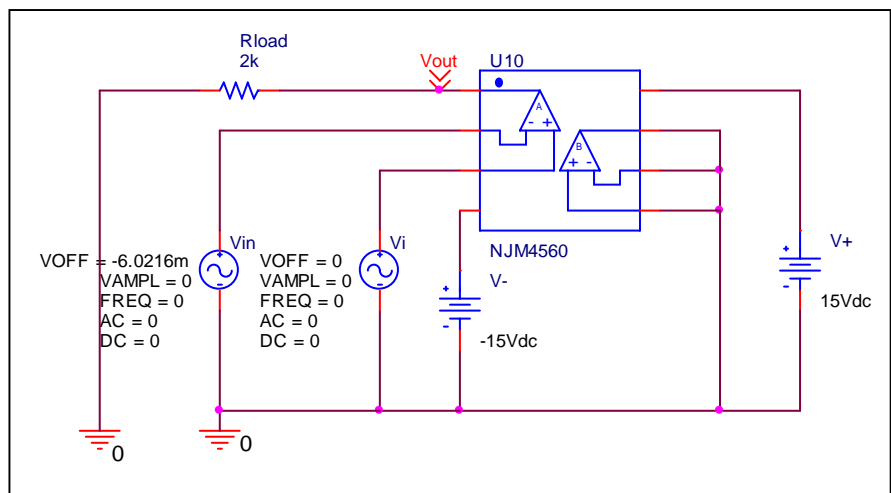
	Data sheet	Simulation	%Error
Ib(nA)	40.000	39.856	0.360
Ibos(nA)	5.000	5.011	0.220

Open Loop Voltage Gain vs. Frequency

Simulation result

DB(V(Vout)/V(Vin:+))

Frequency
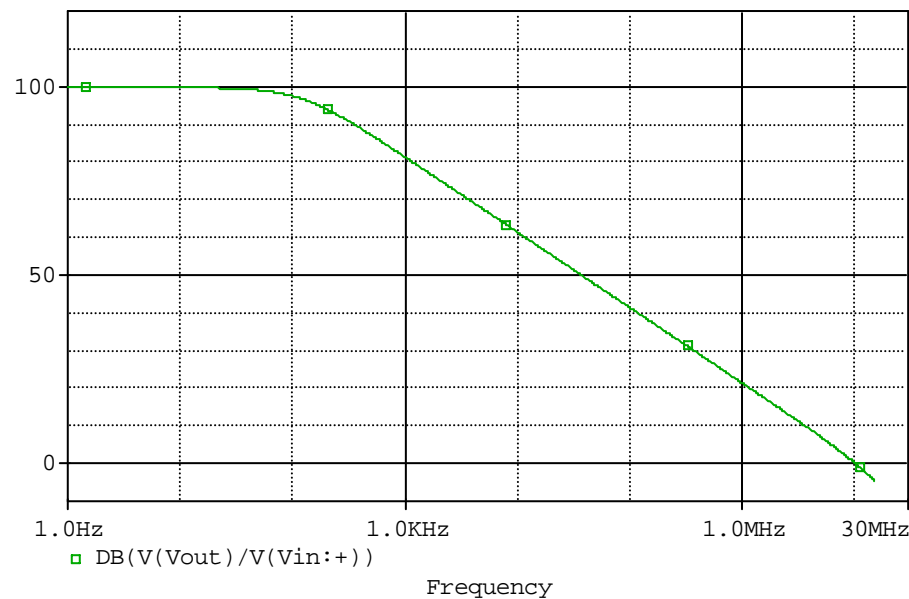
Evaluation circuit
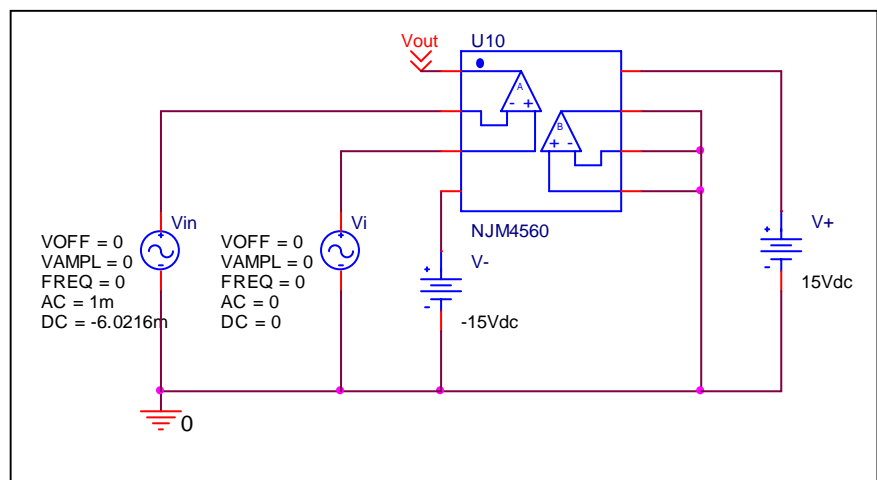
	Data sheet	Simulation	%Error
f-0dB(MHz)	10.000	10.165	1.650
Av-dc	100.000	99.799	-0.201

Common-Mode Rejection Voltage gain

V(Vout)

Time
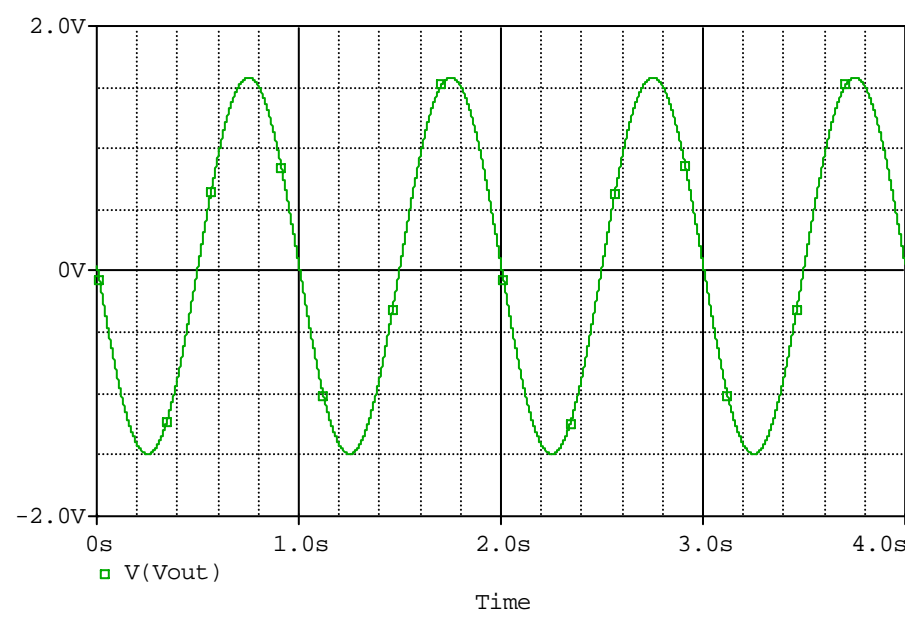
Common Mode Reject Ratio=97723/3.074=31790.17530900

CMRR	Data sheet	Simulation	%Error
	90.000	90.045	0.050

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