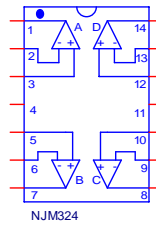# Device Modeling Report

COMPONENTS:MOSFET: OPERATIONAL AMPLIFIER
PART NUMBER:NJM324
MANUFACTURER: NEW JAPAN RADIO CO.,LTD

Bee Technologies Inc.

SPice Model


NJM324

```
*$
* PART NUMBER: NJM324
* MANUFACTURER: NEW JAPAN RADIO
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.Subckt NJM324 AOUT A-IN A+IN V+ B+IN B-IN BOUT COUT C-IN
+ C+IN V- D+IN D-IN DOUT
X_U1   A+IN A-IN V+ V- AOUT NJM324_ME
X_U2   B+IN B-IN V+ V- BOUT NJM324_ME
X_U3   C+IN C-IN V+ V- COUT NJM324_ME
X_U4   D+IN D-IN V+ V- DOUT NJM324_ME
.ends  NJM324
*$
.subckt NJM324_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 29.069E6 -1E3 1E3 29E6 -29E6
  ga    6  0 11 12 137.60E-6
  gcm   0  6 10 99 43.513E-9
  iee   3 10 dc 15.040E-6
  hlim 90  0 vlim 1K
  q1   11  2 13 qx1
  q2   12  1 14 qx2
  r2    6  9 100.00E3
  rc1   4 11 7.2673E3
  rc2   4 12 7.2673E3
  re1  13 10 3.8089E3
  re2  14 10 3.8089E3
  ree  10 99 13.298E6
  ro1   8  5 50
  ro2   7 99 25
  rp    3  4 43.865
  vb    9  0 dc 0
  vc    3 53 dc 2.2979
  ve   54  4 dc .79791
  vlim  7  8 dc 0
  vlp  91  0 dc 20
  vln   0 92 dc 20
.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=322.58)
.model qx2 PNP(Is=883.9173E-18 Bf=447.76)
.ends
*$
```
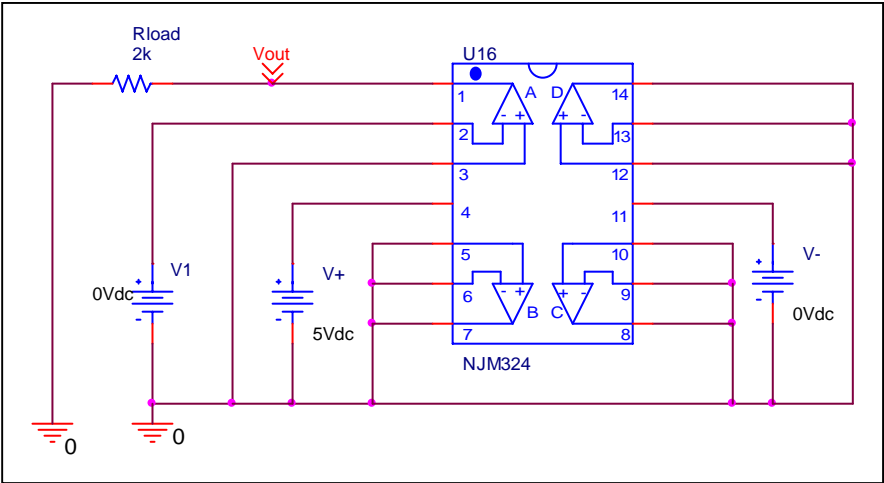
Output Voltage Swing

V(Vout)

V_V1
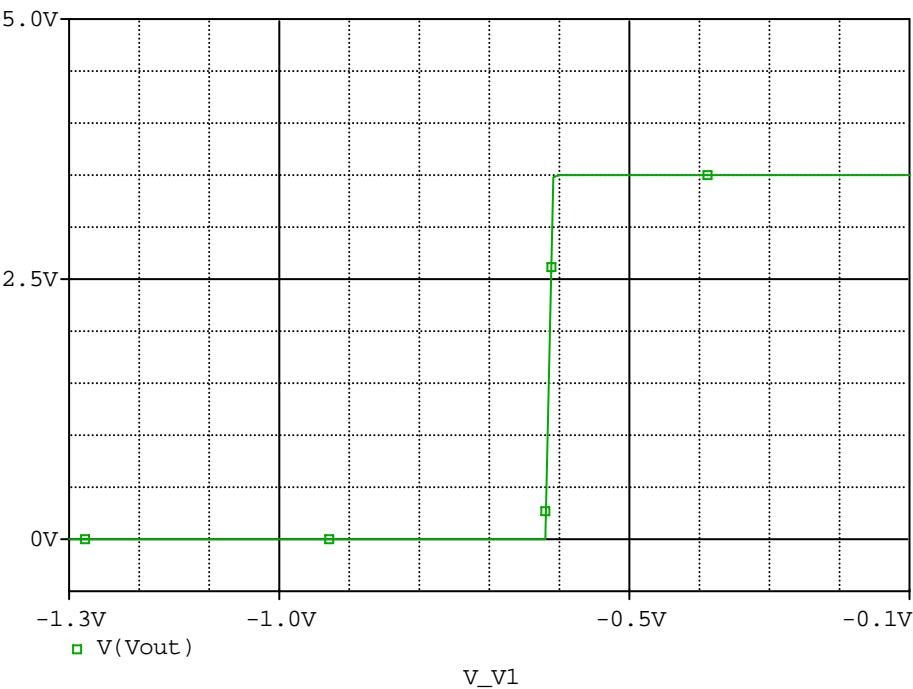
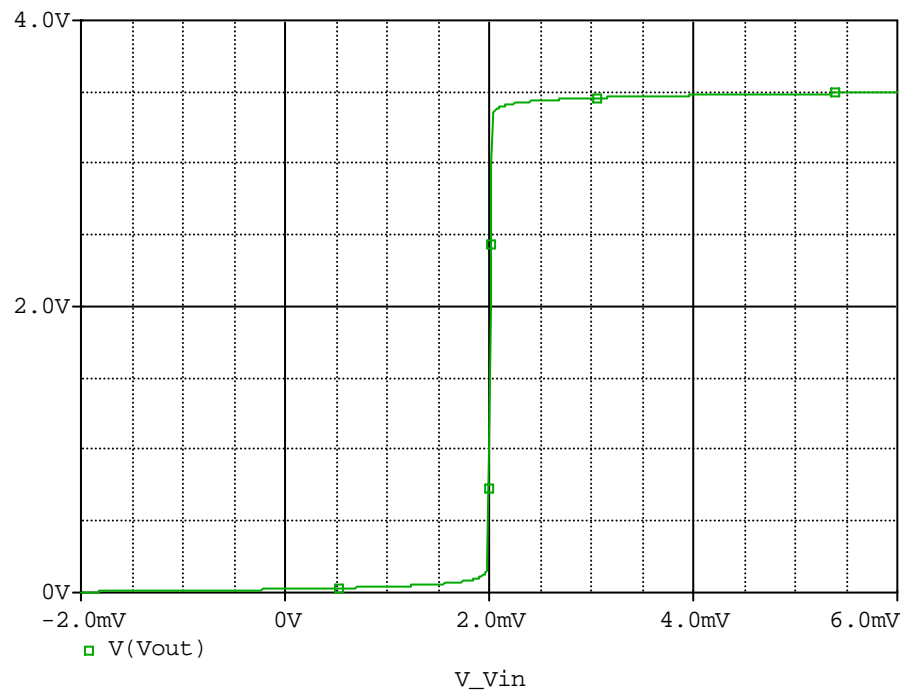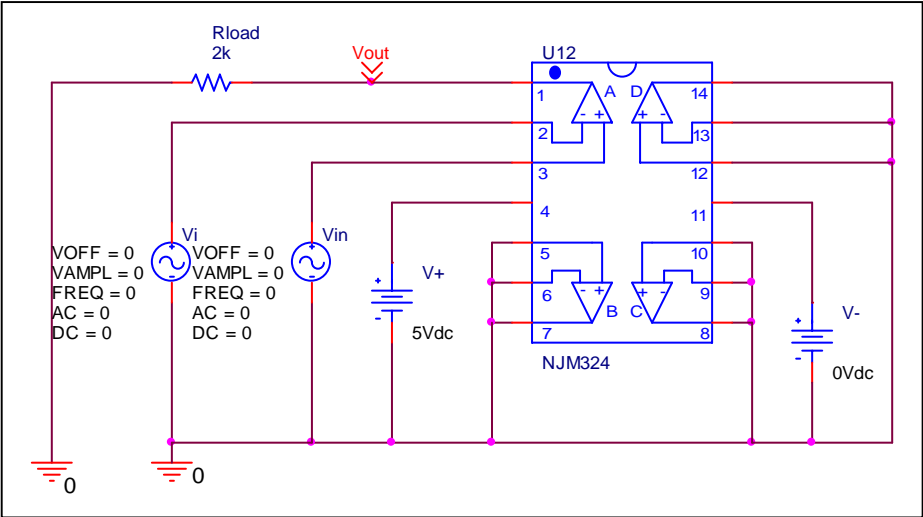Evaluation circuit

Output Voltage Swing	Data sheet	Simulation	%Error
Vopp(V)	3.500	3.498	-0.057

Input Offset Voltage

- □ V(Vout)

V_Vin

Evaluation circuit

Vos(mV)	Measurement	Simulation	%Error
	2.000	2.007	0.350

Input current

Simulation result


```
24nA
20nA
16nA
      0s      0.2ms    0.4ms    0.6ms    0.8ms    1.0ms
        ◇ I(Vi)  ▽ I(Vin)
                           Time
```
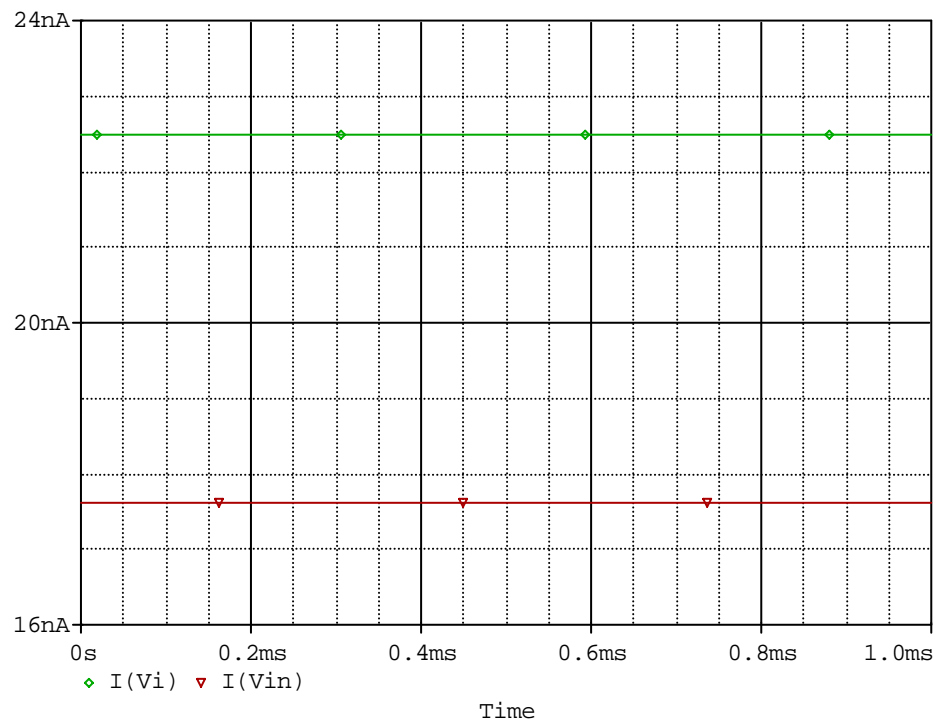
Evaluation circuit
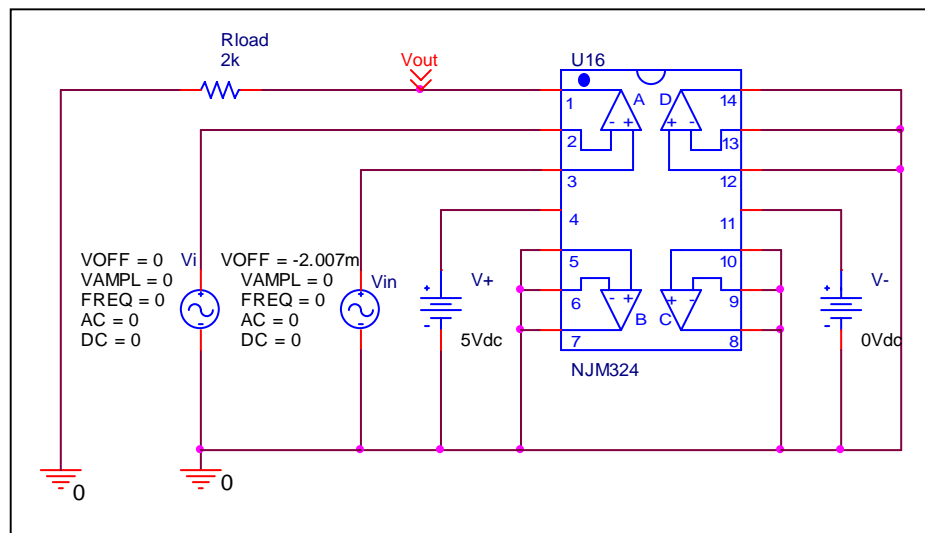
	Data sheet	Simulation	%Error
Ib(nA)	20.000	20.050	0.250
Ibos(nA)	5.000	4.861	-2.780

Open Loop Voltage Gain vs. Frequency

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

Frequency
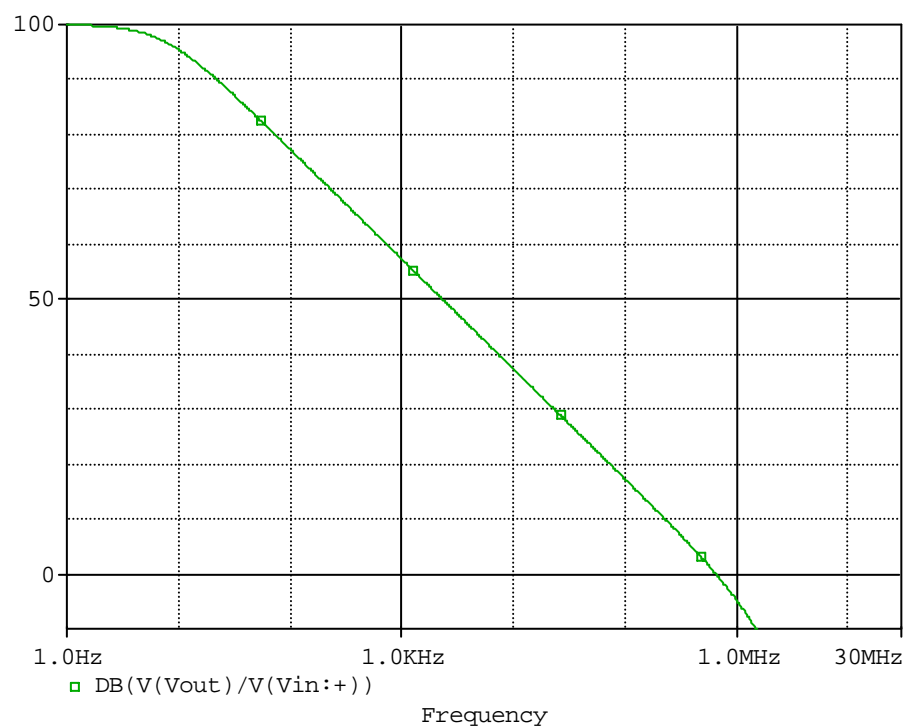
Evaluation circuit
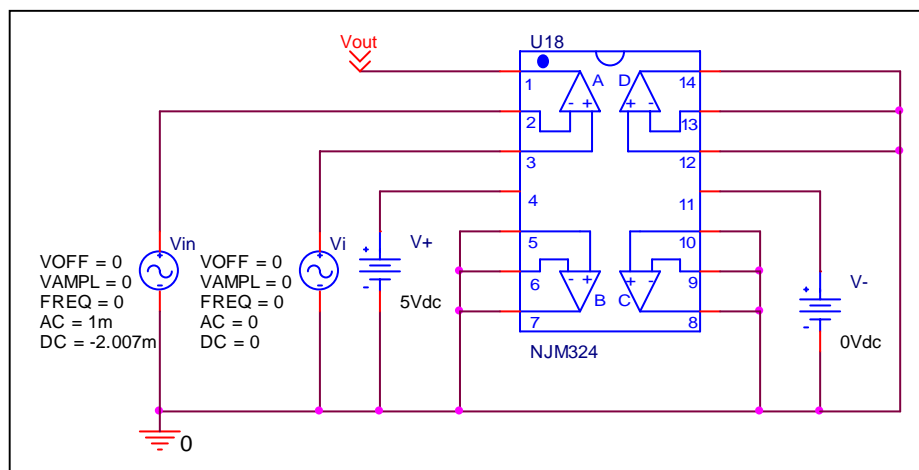
	Data sheet	Simulation	%Error
f-0dB(MHz)	0.650	0.652	0.308
Av-dc(dB)	100.000	99.958	-0.042

Common-Mode Rejection Voltage gain

Simulation result

V(Vout)

Time
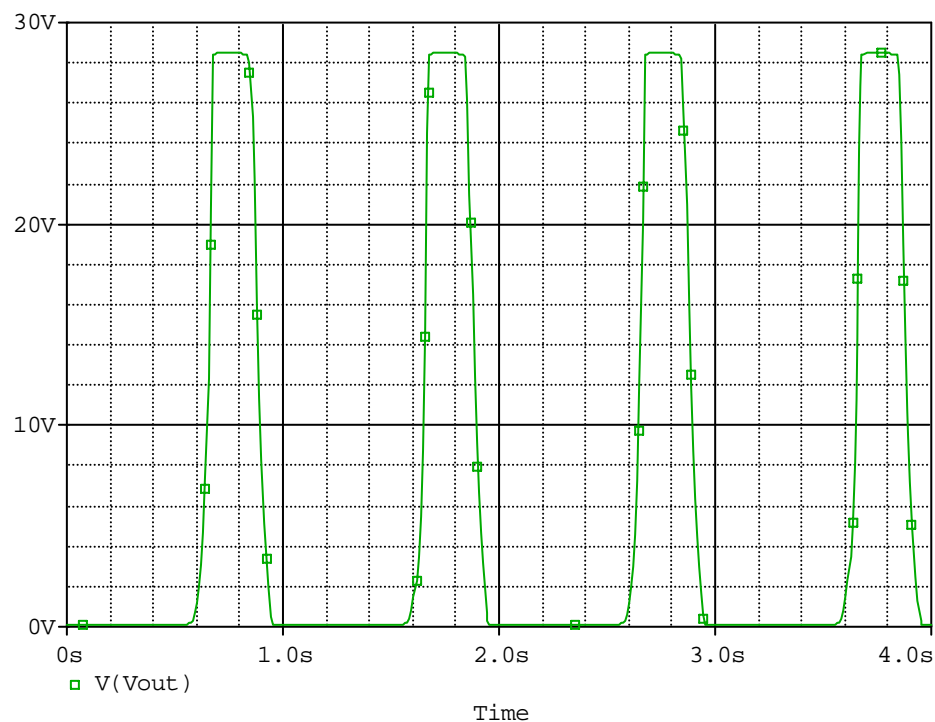
Evaluation circuit
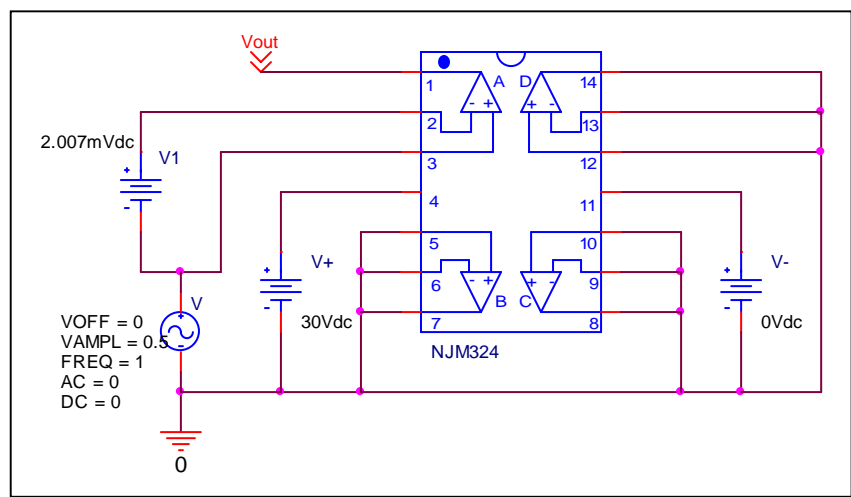
Common Mode Reject Ratio=99517/28.399=3504

CMRR (dB)	Data sheet	Simulation	%Error
	70.000	70.891	1.273