# Device Modeling Report
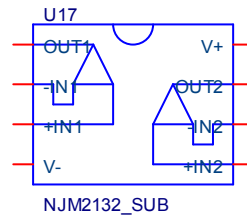
COMPONENTS:MOSFET: OPERATIONAL AMPLIFIER
PART NUMBER:NJM2132
MANUFACTURER: NEW JAPAN RADIO CO.,LTD

**Bee Technologies Inc.**

# Spice Model

U17

OUT1          V+
-IN1          OUT2
+IN1
V-          -IN2
         +IN2

NJM2132_SUB

```
*$
* PART NUMBER:NJM2132
* MANUFACTURER: NEW JAPAN RADIO
* All Rights Reserved Copyright (c) Bee Technologies Inc. 2004
.Subckt NJM2132 OUT1 -IN1 +IN1 V- +IN2 -IN2 OUT2 V+
X_U1    +IN1 -IN1 V+ V- OUT1 NJM2132_SUB
X_U2    +IN2 -IN2 V+ V- OUT2 NJM2132_SUB
.ends  NJM2132
*$
.subckt NJM2132_SUB  1 2 3 4 5
 c1   11 12 8.3716E-12
 c2    6  7 29.000E-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 53.178E6 -1E3 1E3 53E6 -53E6
 ga    6  0 11 12 375.99E-6
 gcm   0  6 10 99 11.289E-9
 iee   3 10 dc 66.041E-6
 hlim 90  0 vlim 1K
 q1   11  2 13 qx1
 q2   12  1 14 qx2
 r2    6  9 100.00E3
 rc1   4 11 2.6526E3
 rc2   4 12 2.6526E3
 re1  13 10 1.8677E3
 re2  14 10 1.8677E3
 ree  10 99 3.0284E6
 ro1   8  5 50
 ro2   7 99 25
 rp    3  4 1.8072E3
 vb    9  0 dc 0
 vc    3 53 dc 1.5621
 ve   54  4 dc 1.5621
 vlim  7  8 dc 0
 vlp  91  0 dc 7.5000
 vln   0 92 dc 7.5000
.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=1.3764E3)
.model qx2 PNP(Is=952.0300E-18 Bf=1.9614E3)
.ends
*$
```
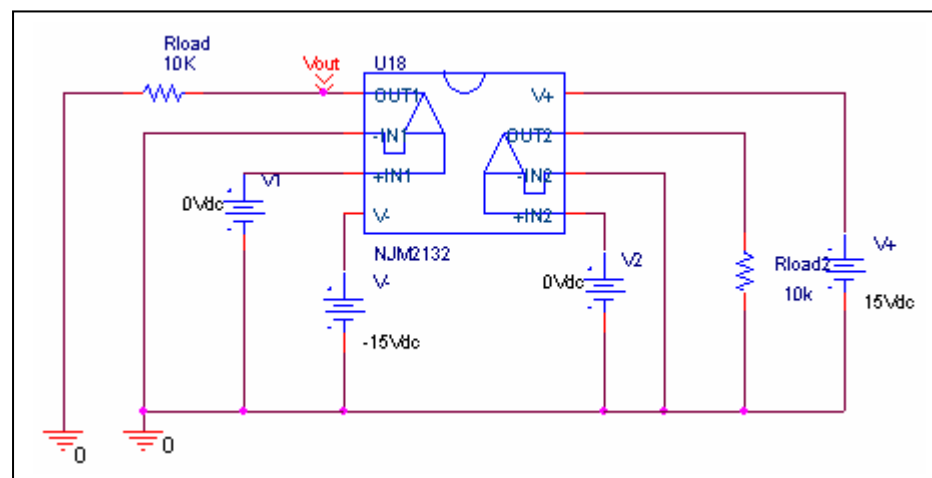
# Output Voltage Swing, +Vout and –Vout
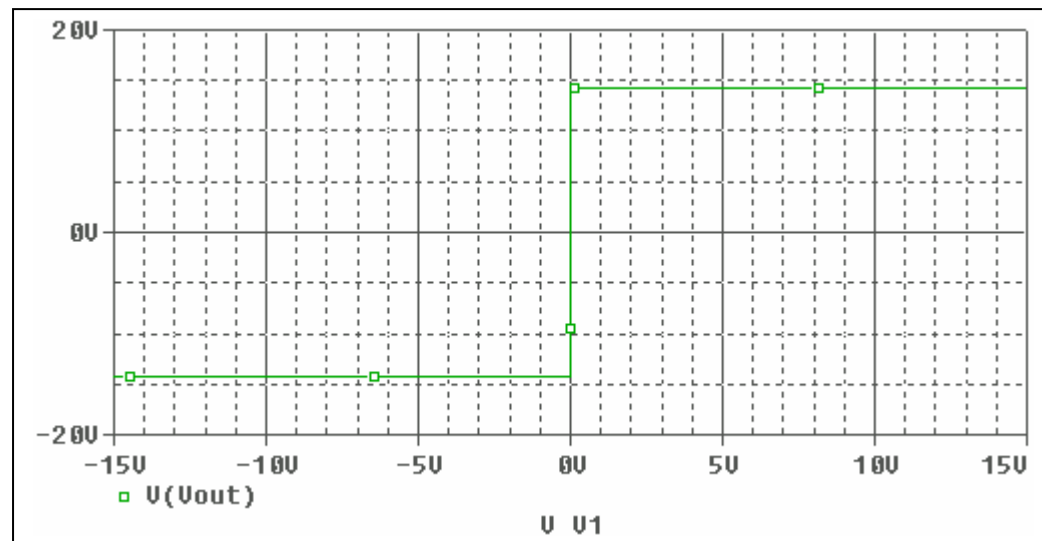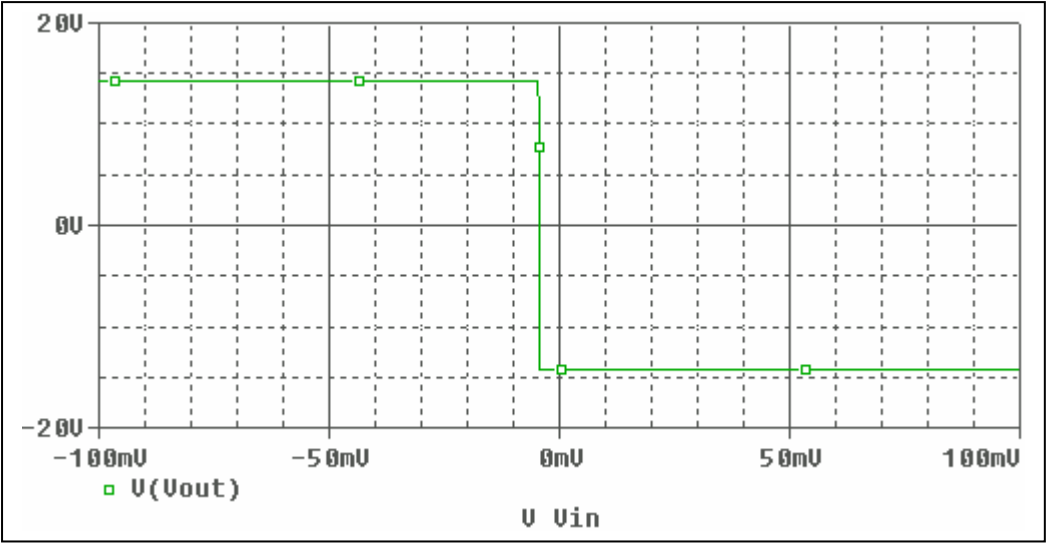
These simulation results are compared with +Vout

Evaluation circuit



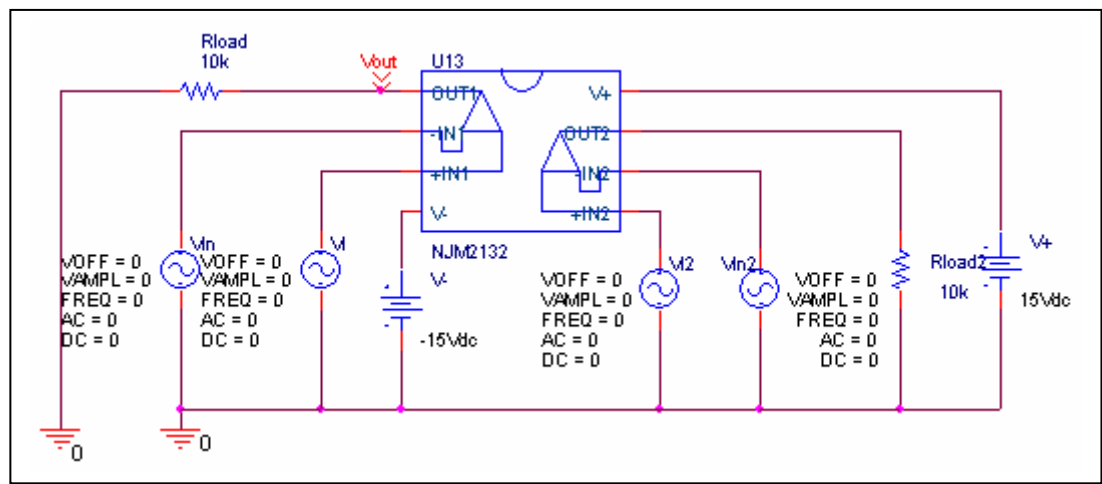| Output Voltage Swing | Data sheet | Simulation | %Error |
|:---:|:---:|:---:|:---:|
| **+Vout(V)** | +14.2 | 14.208 | 0.056 |
| **-Vout(V)** | -14.2 | -14.208 | 0.056 |

# Input Offset Voltage

| | Measurement | | Simulation | | Error | |
|---|---|---|---|---|---|---|
| Vos | 4.5 | mV | 4.5351 | mV | 0.78 | % |

# Slew Rate, +SR, -SR

Simulation result
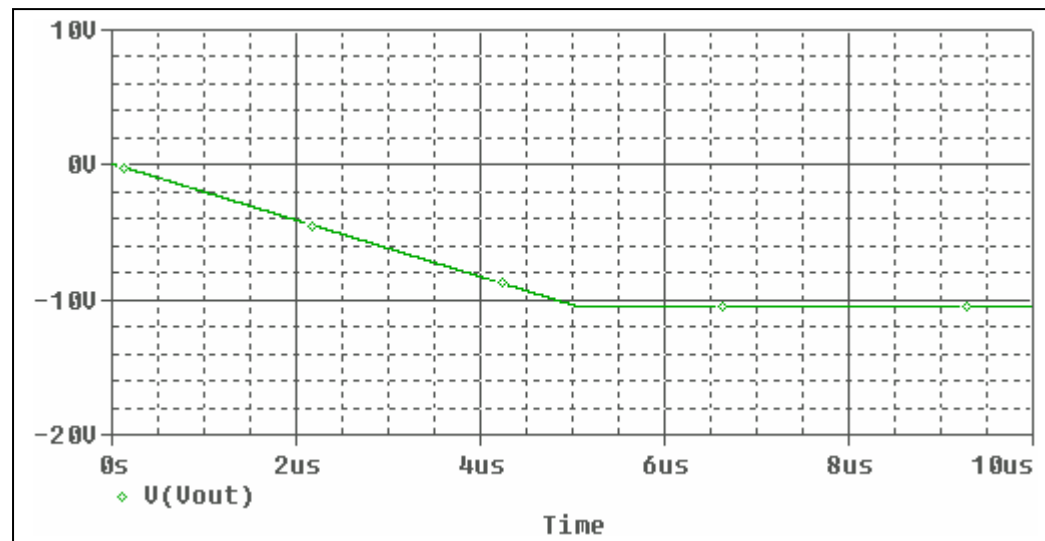


Evaluation circuit
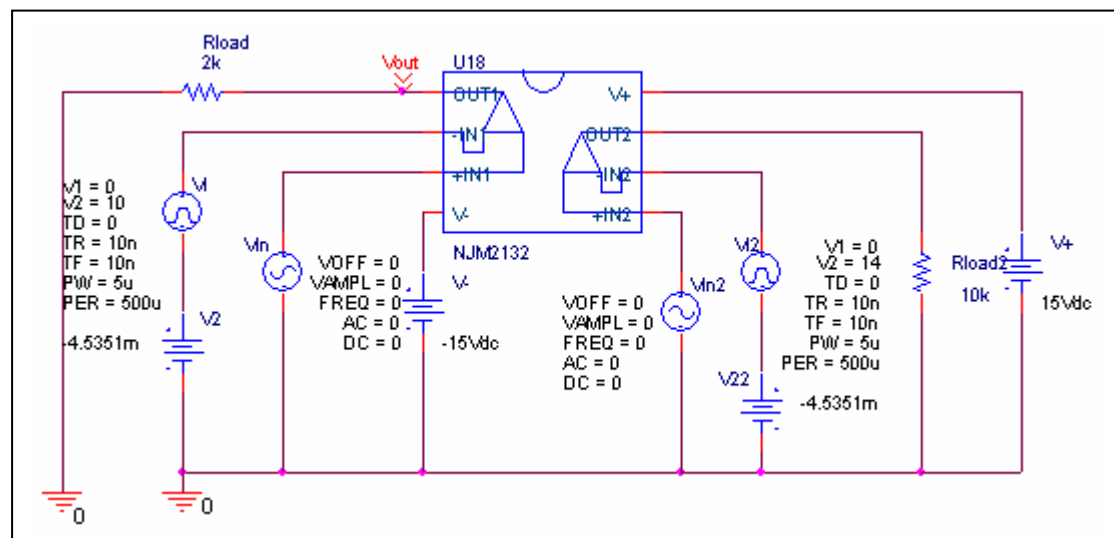


| Slew Rate(v/us) | Data sheet | Simulation | %Error |
|---|---|---|---|
| | 2.1V/us | 2.2V/us | 4.76 |

# Input current  Ib, Ibos

Simulation result
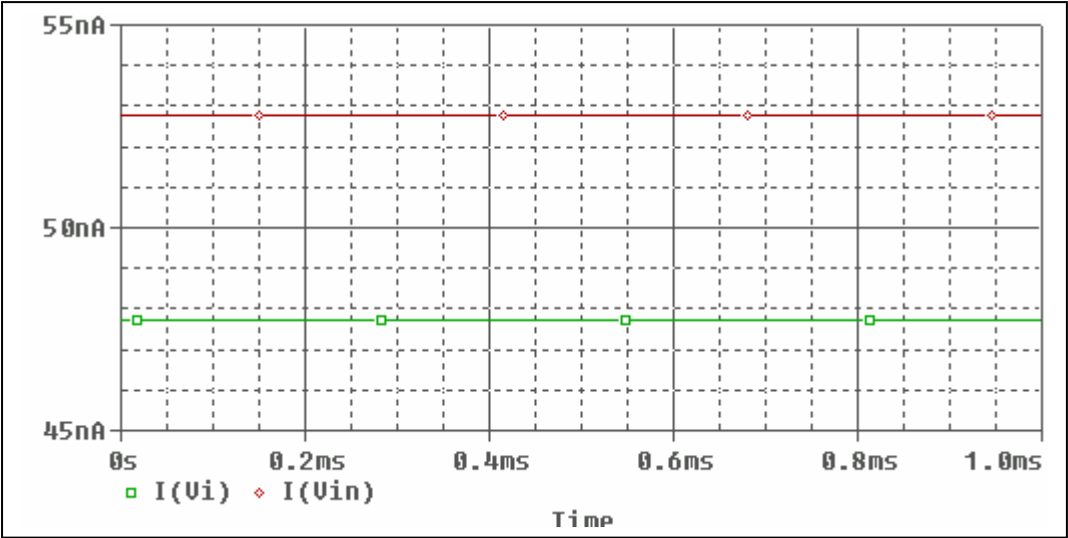


Evaluation circuit
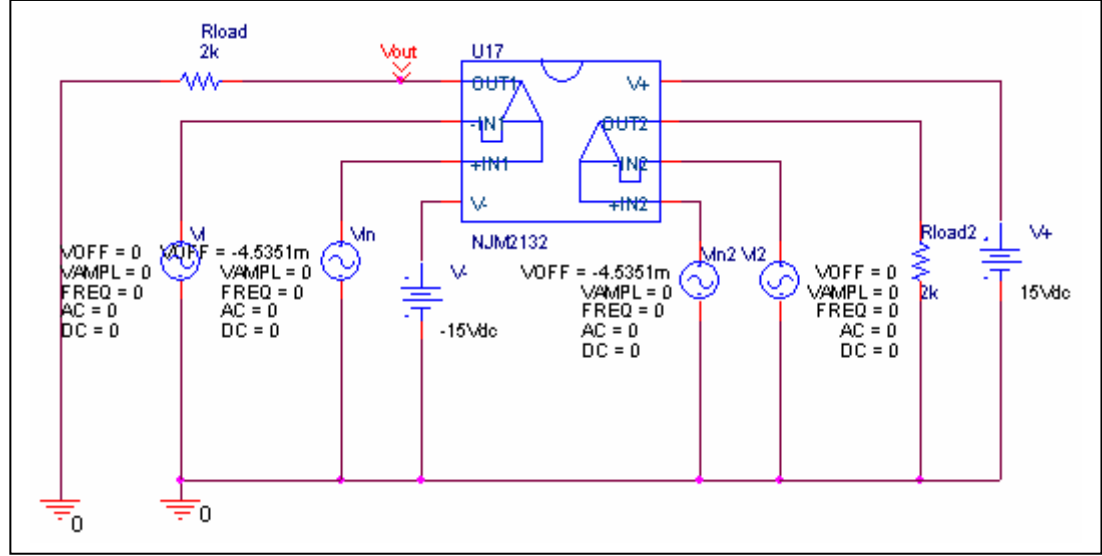


|  | Data sheet | Simulation | %Error |
|---|---|---|---|
| Ib(nA) | 20 | 20.1 | 0.5 |
| Ibos(nA) | 5 | 5.02 | 0.4 |

# Open Loop Voltage Gain vs. Frequency , Av-dc, f-0dB
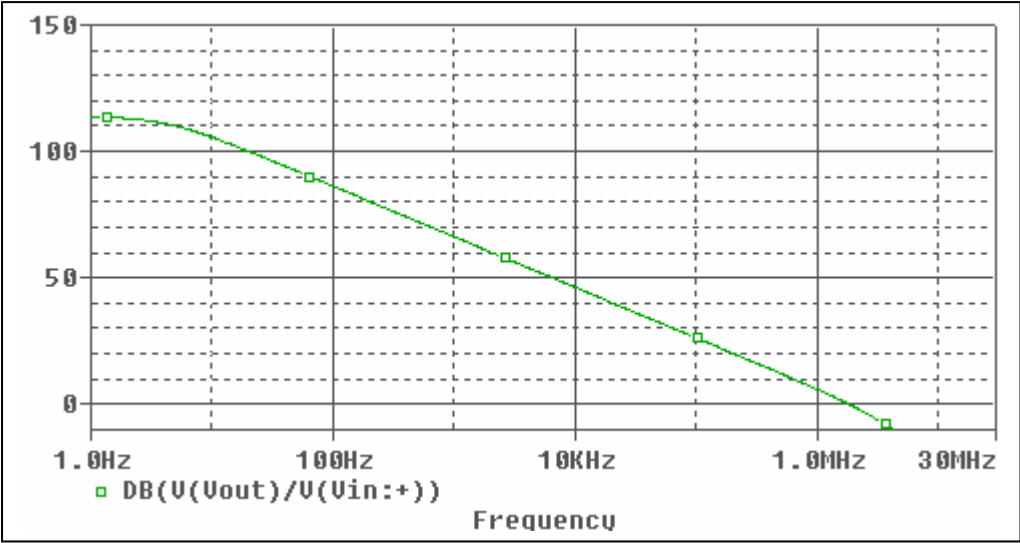
Evaluation circuit
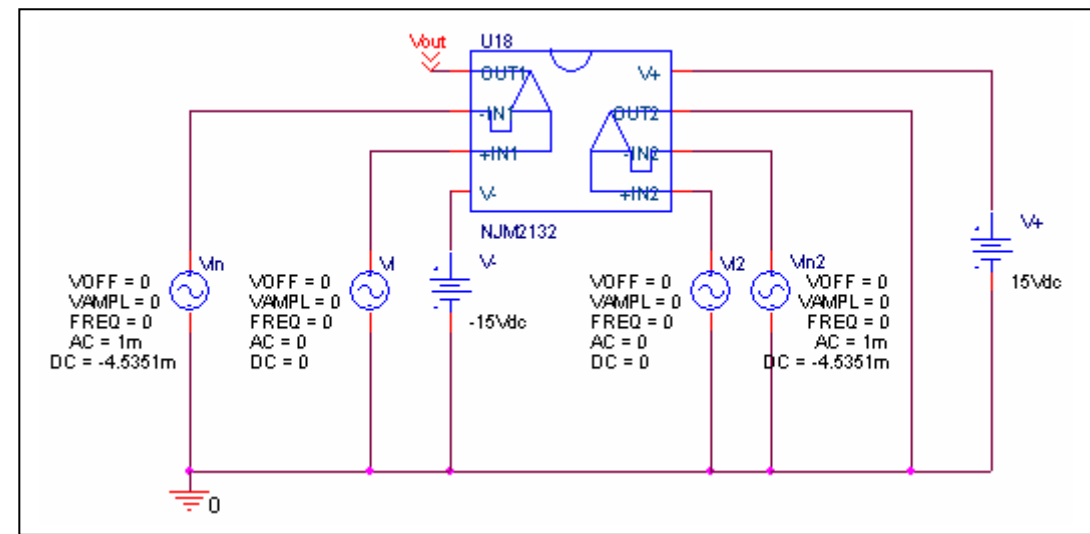


|  | Data sheet | Simulation | %Error |
|---|---|---|---|
| f-0dB(MHz) | 1.8 | 1.82 | 1.11 |
| Av-dc(dB) | 114 | 113.8 | 0.175 |

# Output Short Circuit Current - Ios
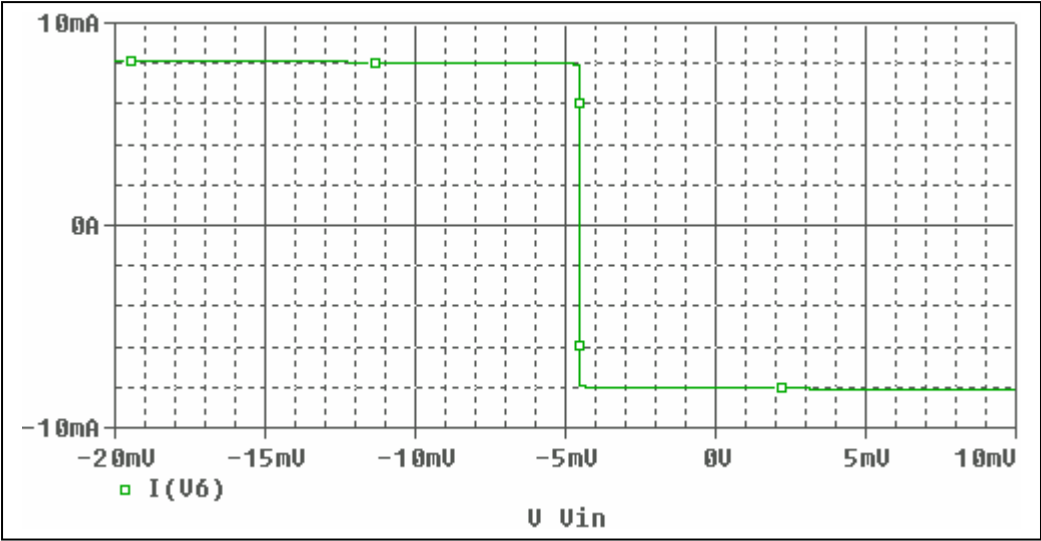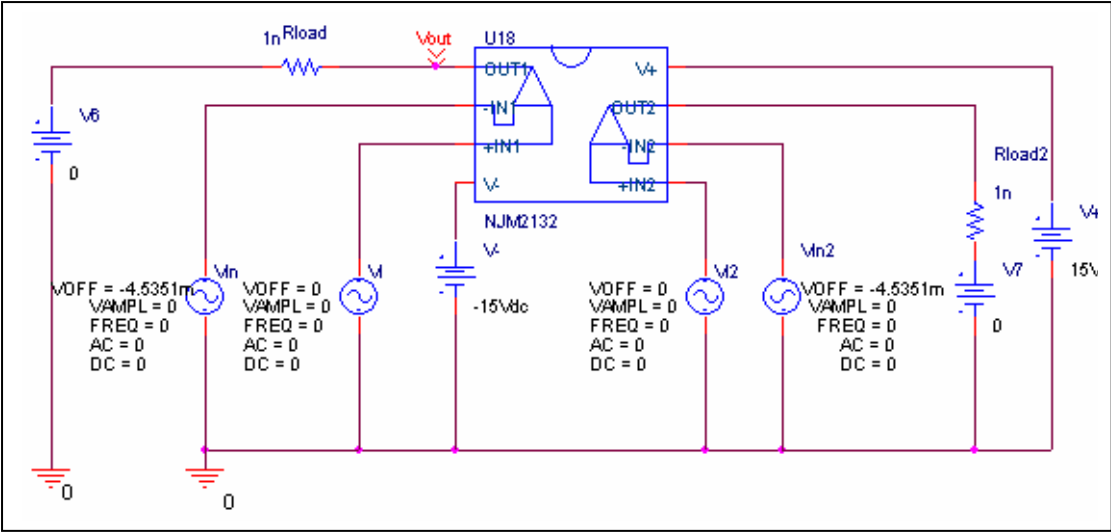
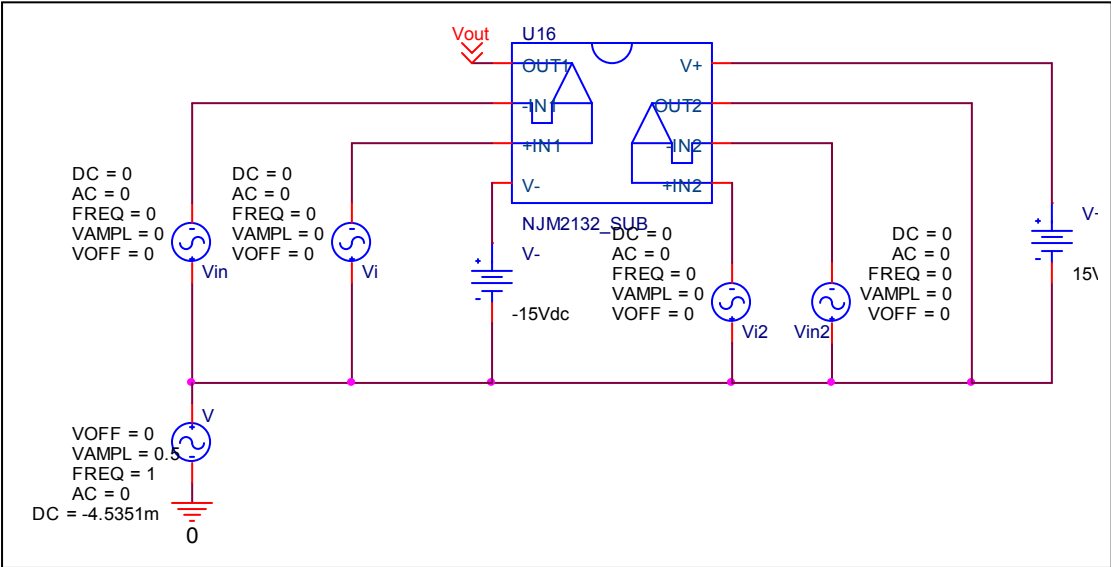|  | Data sheet | Simulation | %Error |
|---|---|---|---|
| **Short Circuit Current** | 8mA | 8.08mA | 1 |

# Common-Mode Rejection Voltage gain

Simulation result
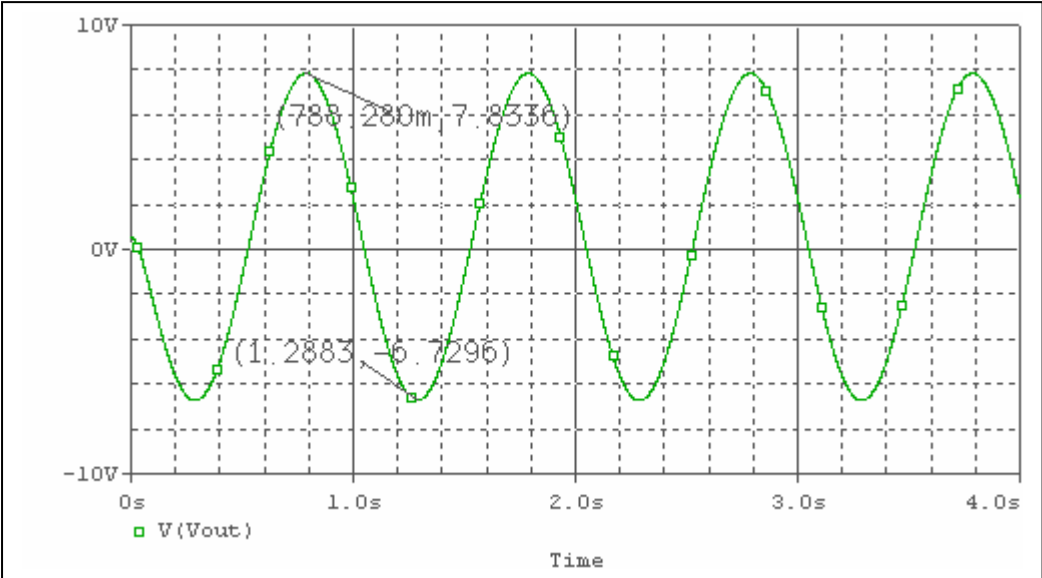


Evaluation circuit



Common mode gain=14.563/1
Common Mode Reject Ratio=489778/14.563=33631 = 90.5347dB

| CMRR(dB) | Data sheet | Simulation | %Error |
|---|---|---|---|
| | 90 | 90.5347 | 0.5941 |