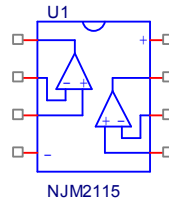# Device Modeling Report

COMPONENTS: OPERATIONAL AMPLIFIER
PART NUMBER:NJM2115
MANUFACTURER: NEW JAPAN RADIO CO.,LTD

Bee Technologies Inc.

Spice Model

U1

NJM2115

```
*$
* PART NUMBER:NJM2115
* MANUFACTURER: NEW JAPAN RADIO
* All Rights Reserved Copyright (c) Bee Technologies Inc. 2007
.Subckt NJM2115 OUT1 -IN1 +IN1 V- +IN2 -IN2 OUT2 V+
X_U1    +IN1 -IN1 V+ V- OUT1 NJM2115_S
X_U2    +IN2 -IN2 V+ V- OUT2 NJM2115_S
.ends  NJM2115
.subckt NJM2115_S  1 2 3 4 5
 c1   11 12 1.00E-15
 c2    6  7 30.0E-12
 cee  10 99 1.0000E-30
 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 0 187.00E3 -1E3 1E3 190E3 -190E3
 ga    6  0 11 12 2.600E-3
 gcm   0  6 10 99 430.19E-9
 iee   3 10 dc 124.70E-6
 hlim 90  0 vlim 1K
 q1   11  2 13 qx1
 q2   12  1 14 qx2
 r2    6  9 100.00E3
 rc1   4 11 400.26
 rc2   4 12 400.26
 re1  13 10 0.1
 re2  14 10 0.1
 ree  10 99 1.6038E6
 ro1   8  5 50
 ro2   7 99 25
 rp    3  4 125.39
 vb    9  0 dc 0
 vc    3 53 dc 1.0309
 ve   54  4 dc 1.0309
 vlim  7  8 dc 0
 vlp  91  0 dc 1.5000
 vln   0 92 dc 1.5000
.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=582.59)
.model qx2 PNP(Is=828.3277E-18 Bf=654.23)
.ends
*$
```
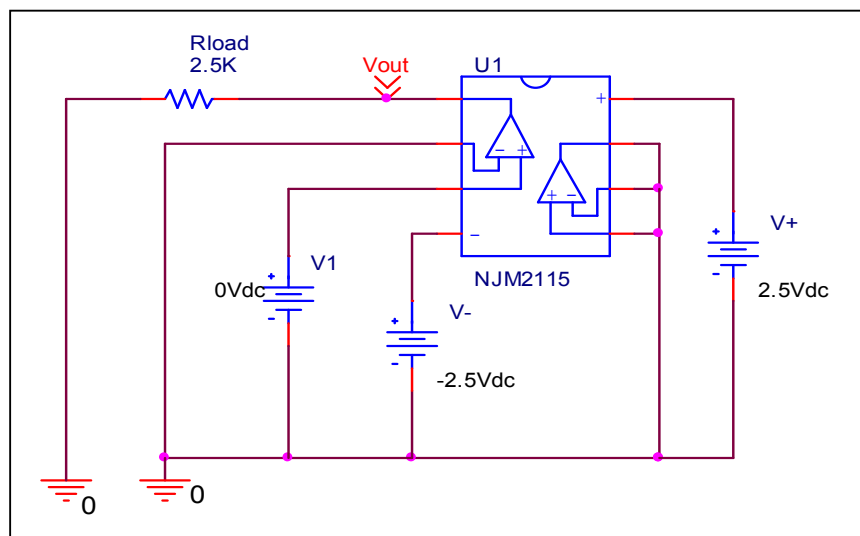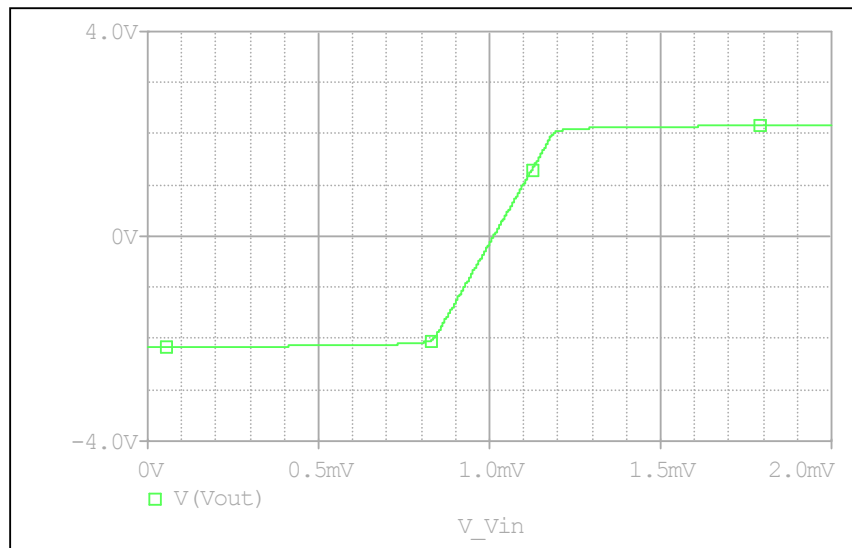
Output Voltage Swing
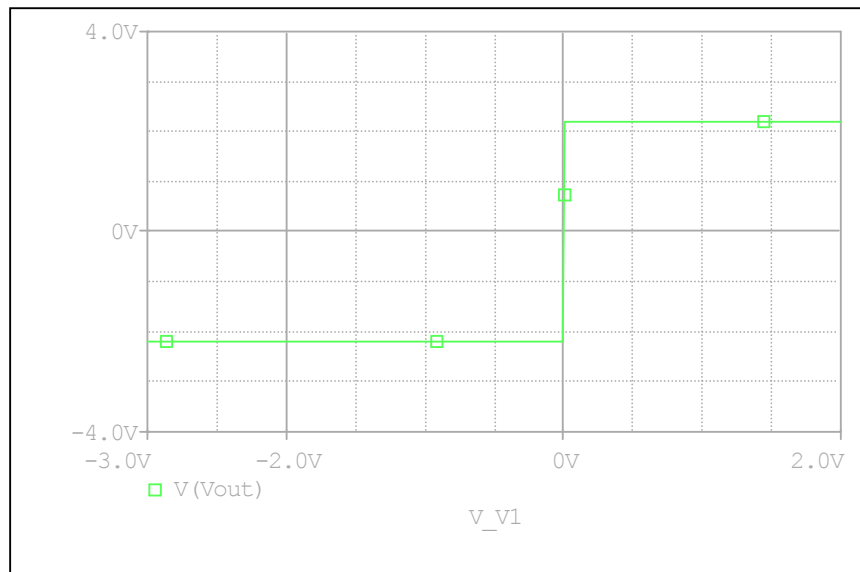
Evaluation circuit

Comparison table

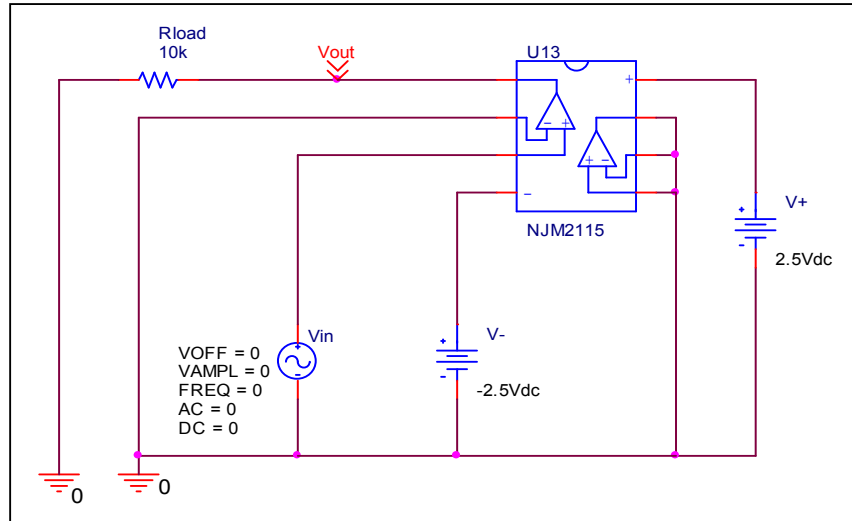| Output Voltage Swing	Measurement	Simulation	%Error
V+	+2.2	+2.1961	-0.177
V-	-2.2	-2.1961	-0.177

Input Offset Voltage

Simulation result
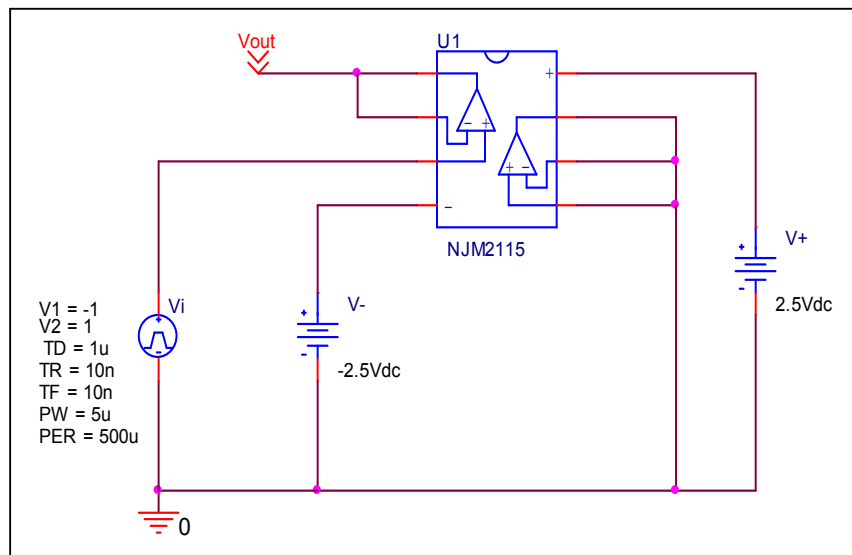

Evaluation circuit

Comparison table

	Measurement	Simulation	%Error
Vos (mV)	1	1.0118	1.18

Slew Rate
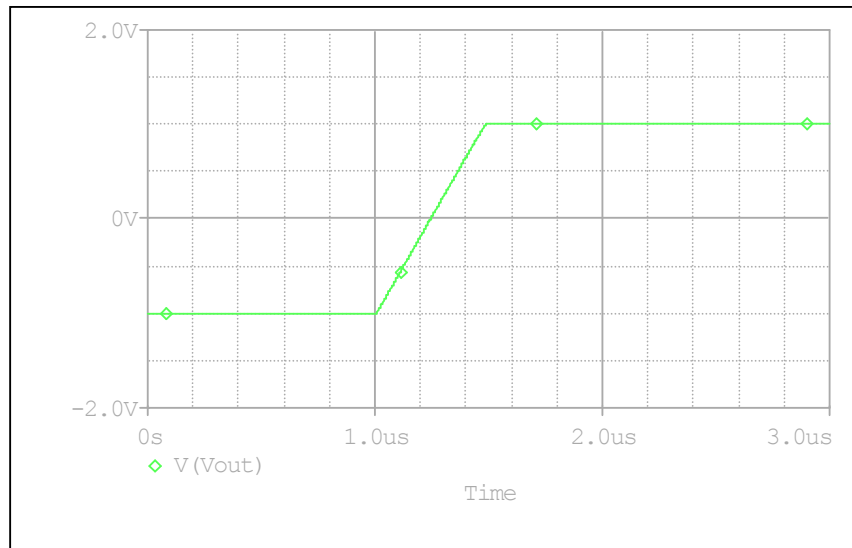
Evaluation circuit

Comparison table

	Measurement	Simulation	%Error
Slew Rate(v/us)	4	4.194	4.850

Input current

Simulation result
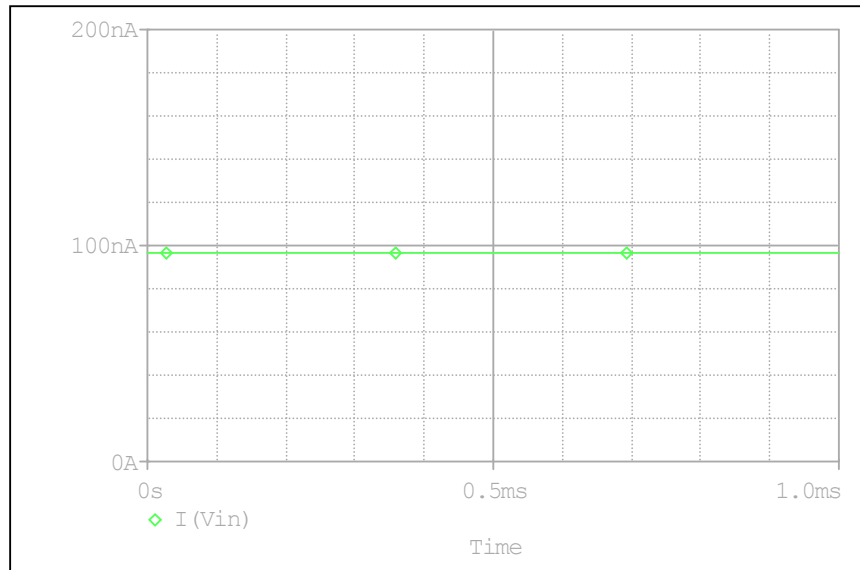
Evaluation circuit
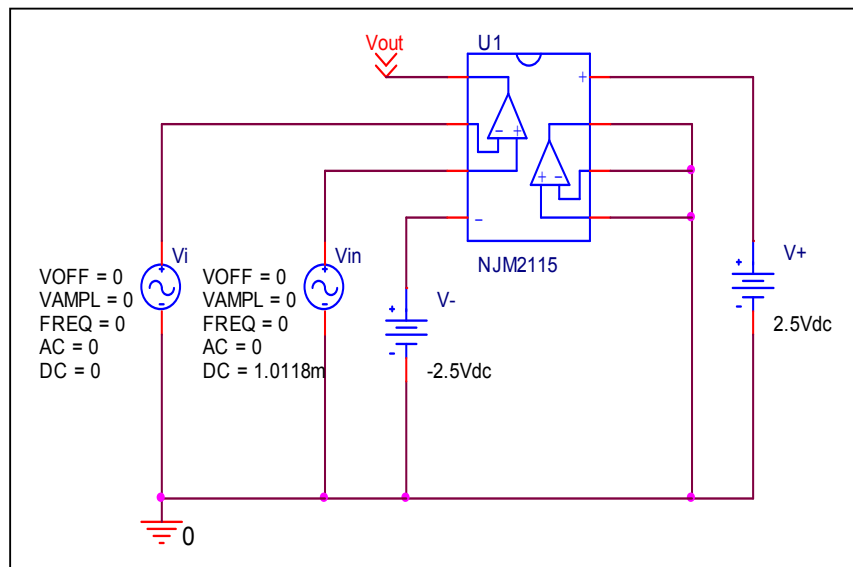
Comparison table

	Measurement	Simulation	%Error
Ib(nA)	100	96.487	-3.513

Open Loop Voltage Gain vs. Frequency
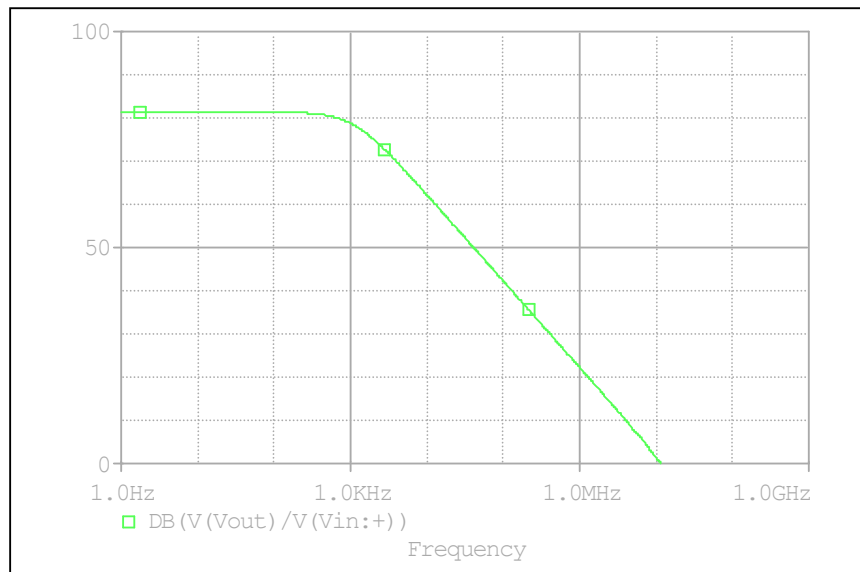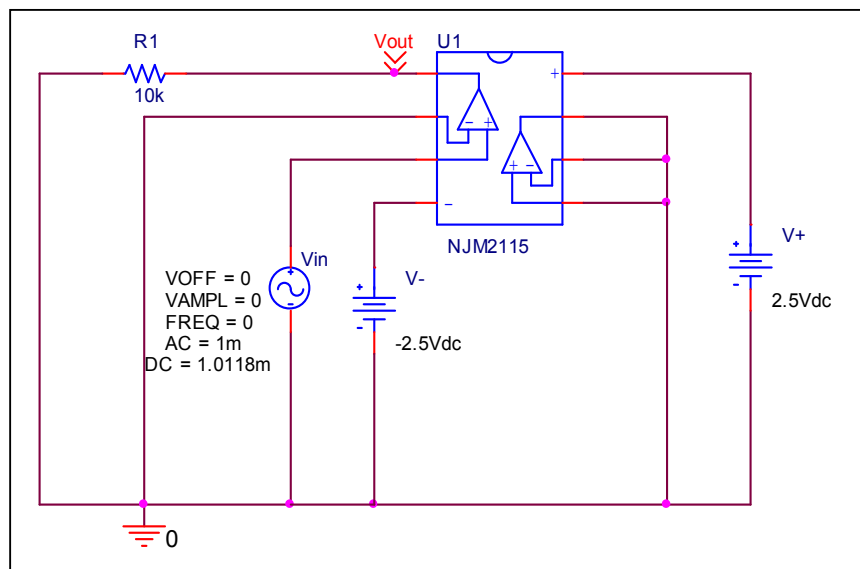
	Measurement	Simulation	%Error
f-0dB(MHz)	12	11.418	-4.850
Av-dc	80	81.275	1.594

Common-Mode Rejection Voltage gain
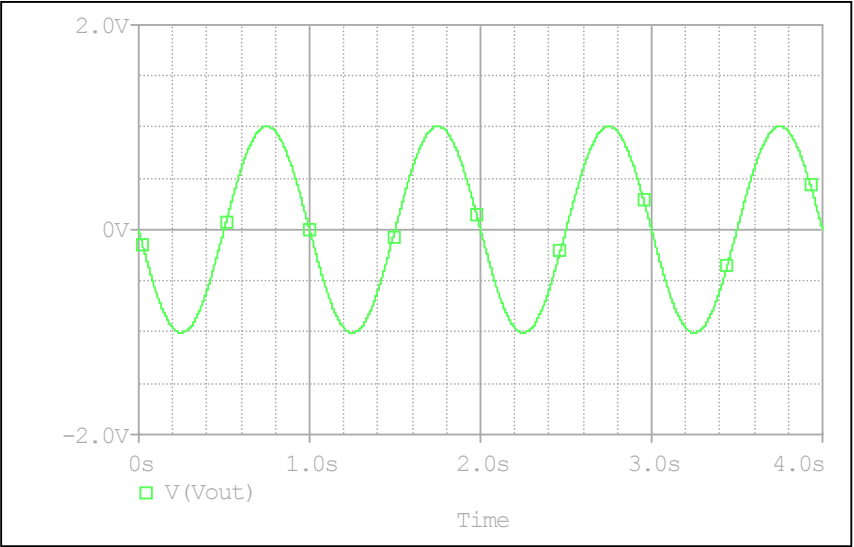
Evaluation circuit
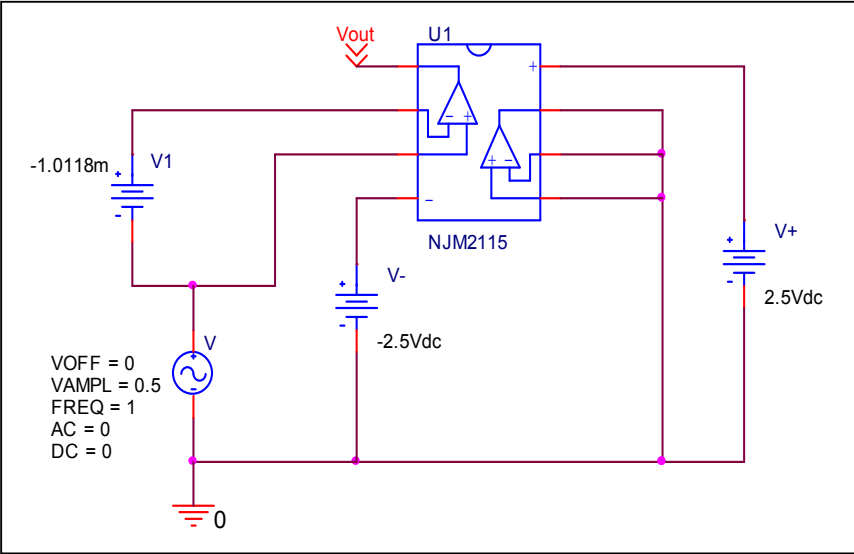
CMRR=20*LOG(11581.105/2.0174) = 75.179 dB

Comparison table

	Measurement	Simulation	%Error
CMRR(dB)	74	75.179	1.593

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Remark Output Voltage Swing

Before

Rload
10K

Vout

U18

+

−
+

+ −

−

V1

0Vdc

NJM2115

V+

2.5Vdc

V−

-2.5Vdc

0   0

After

Rload
2.5K

Vout

U1

+

−
+

+ −

−

V1

0Vdc

NJM2115

V+

2.5Vdc

V−

-2.5Vdc

0   0
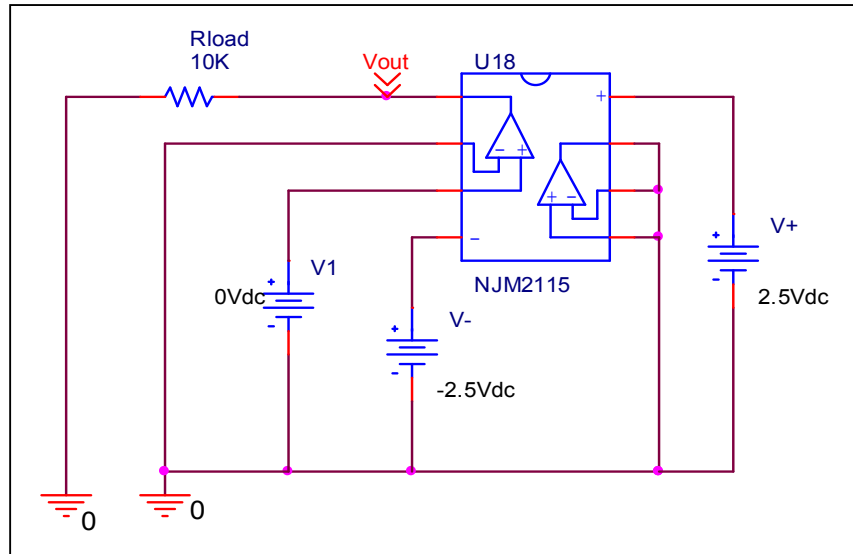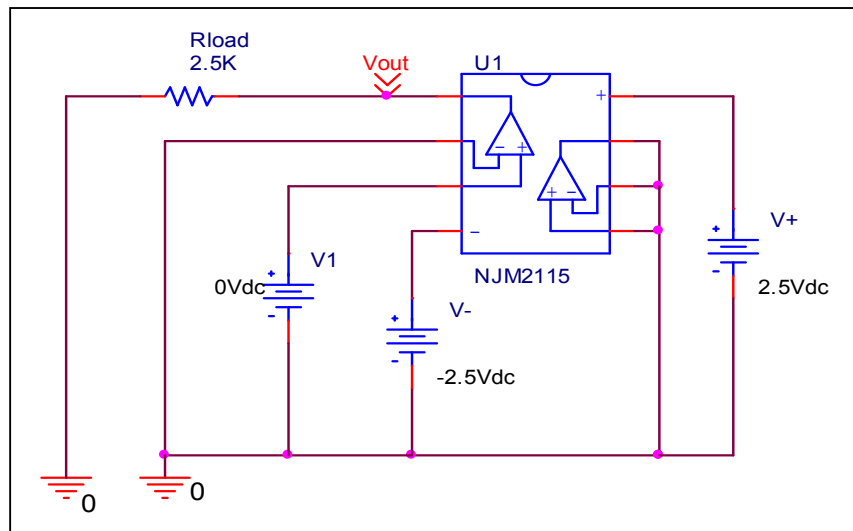
Remark Slew Rate
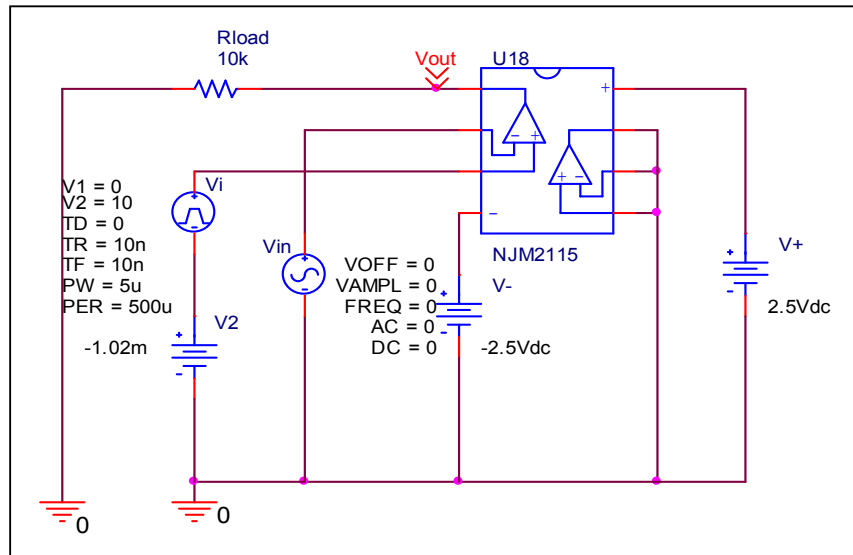
Before

After
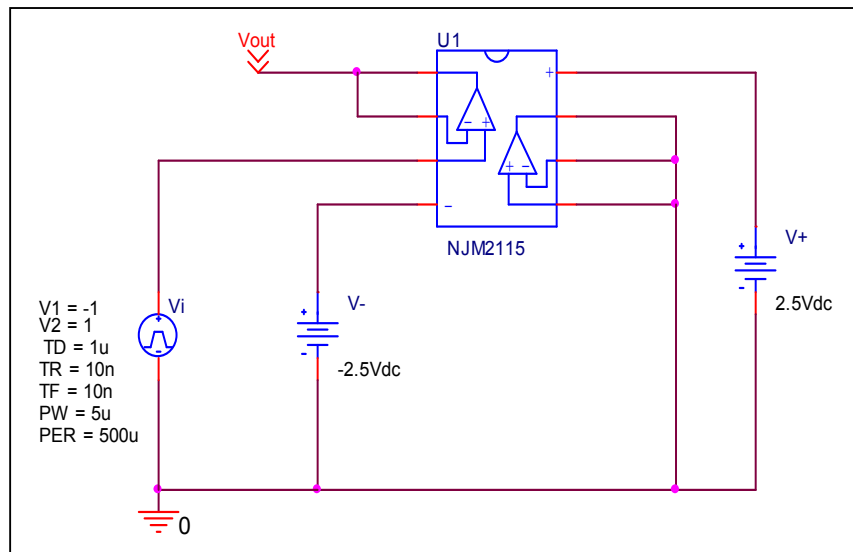
Remark Input current

Before

Rload
10k

Vout

U17

VOFF = -1.02m

Vin

VOFF = 0
VAMPL = 0
FREQ = 0
AC = 0
DC = 0

VAMPL = 0
FREQ = 0
AC = 0
DC = 0

NJM2115

V+

V-

2.5Vdc

-2.5Vdc

0

0

After

Vout

U1

Vi

Vin

VOFF = 0
VAMPL = 0
FREQ = 0
AC = 0
DC = 0

VOFF = 0
VAMPL = 0
FREQ = 0
AC = 0
DC = 1.0118m

NJM2115

V+

V-

2.5Vdc

-2.5Vdc

0
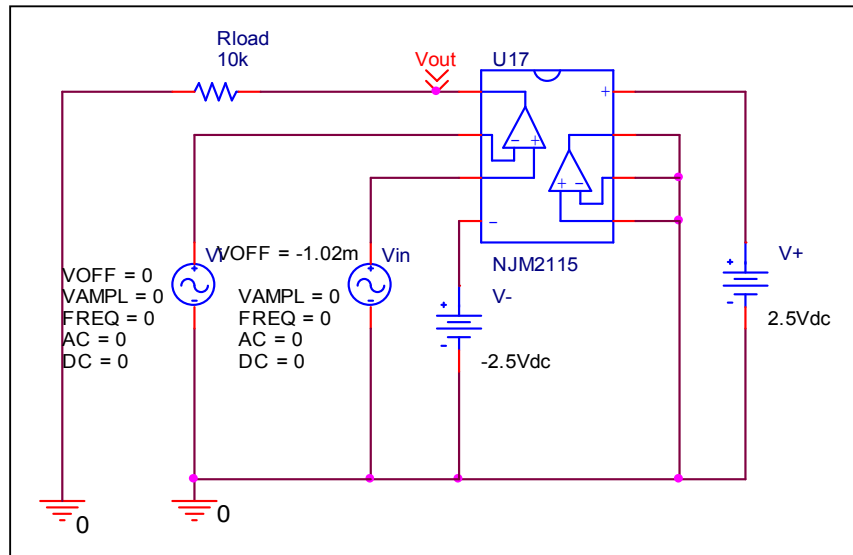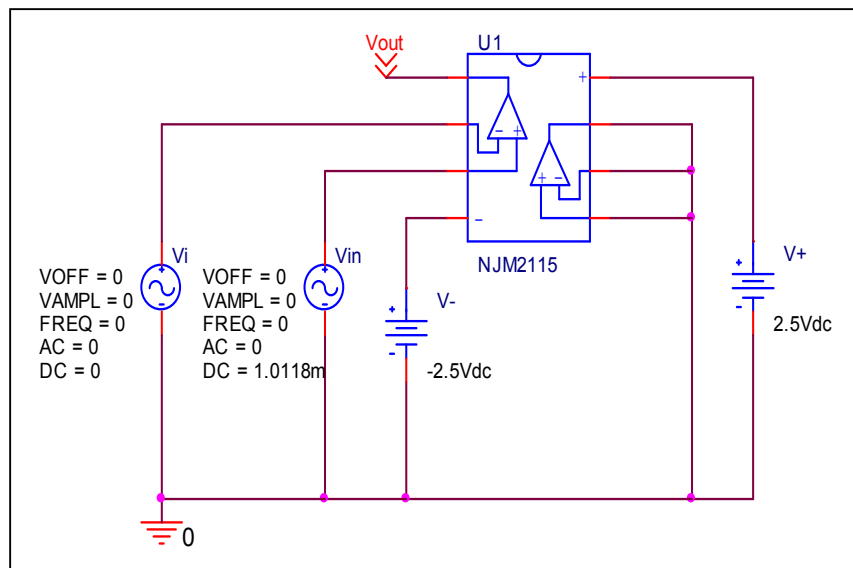
Remark Open Loop Voltage Gain vs. Frequency

Before

Vout   U18

NJM2115

V+

VOFF = 0   Vin
VAMPL = 0
FREQ = 0
AC = 1m
DC = -1.02m

V-

2.5Vdc

-2.5Vdc

0

After

R1   Vout   U1

10k

NJM2115

V+

VOFF = 0   Vin
VAMPL = 0
FREQ = 0
AC = 1m
DC = 1.0118m

V-

2.5Vdc

-2.5Vdc

0
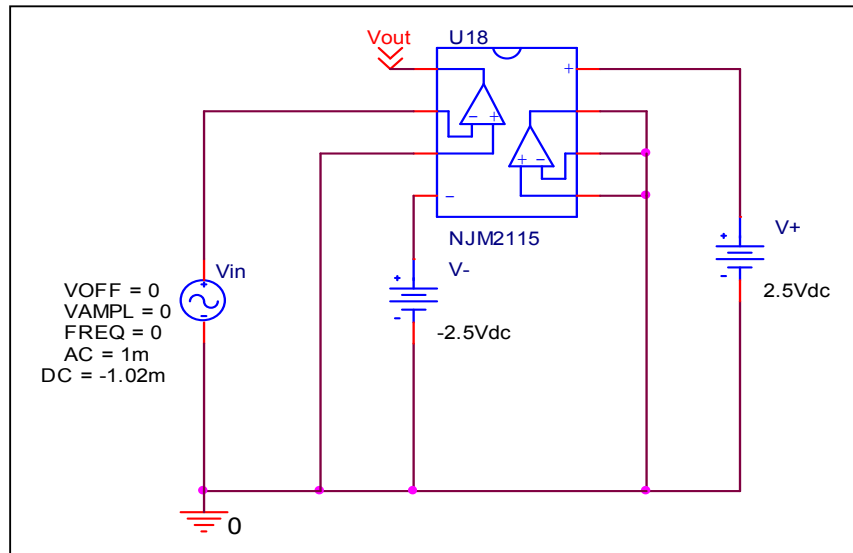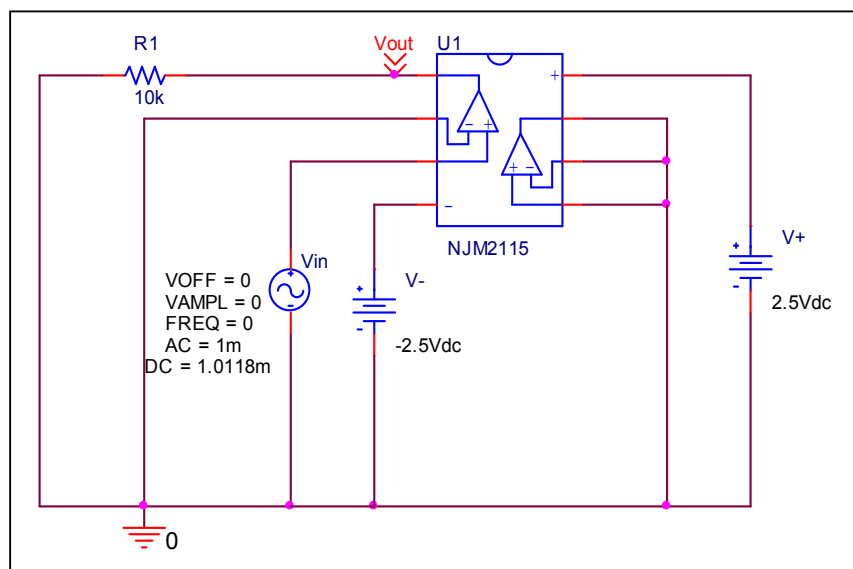
Remark Common-Mode Rejection Voltage gain
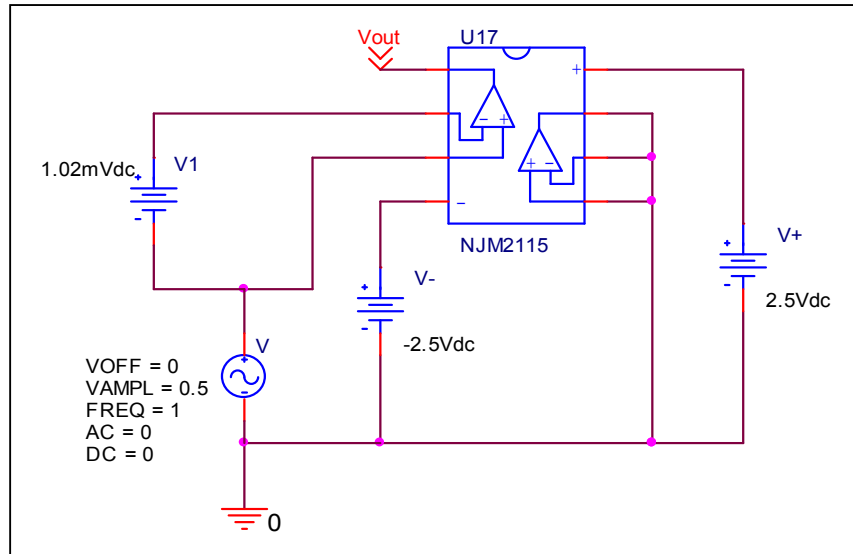
Before

Vout

U17

+

1.02mVdc V1

NJM2115

V+

-

2.5Vdc

V-

-2.5Vdc

VOFF = 0
VAMPL = 0.5
FREQ = 1
AC = 0
DC = 0

V

0

After

Vout

U1

+

-1.0118m V1

NJM2115

V+

-

2.5Vdc

V-

-2.5Vdc

VOFF = 0
VAMPL = 0.5
FREQ = 1
AC = 0
DC = 0

V

0