

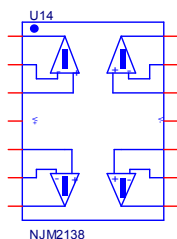
Device Modeling Report

COMPONENTS:MOSFET: OPERATIONAL AMPLIFIER
PART NUMBER:NJM2138
MANUFACTURER: NEW JAPAN RADIO CO.,LTD



Bee Technologies Inc.

Spice Model



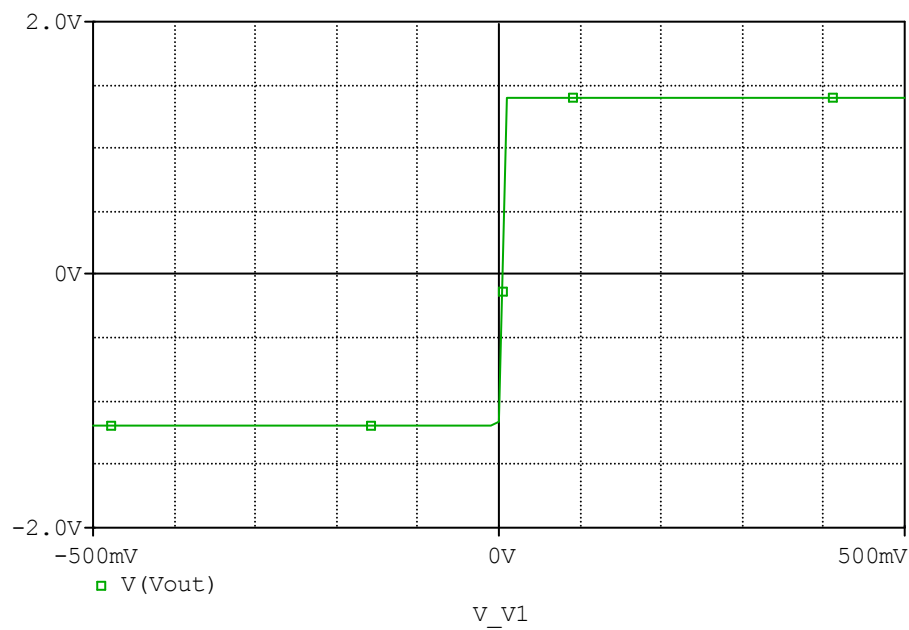
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*$
* PART NUMBER:NJM2138
* MANUFACTURER: NEW JAPAN RADIO
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.Subckt NJM2138 OUT1 -IN1 +IN1 V+ +IN2 -IN2 OUT2 OUT3 -IN3 +IN3 V-
+ +IN4 -IN4 OUT4
X_U1  +IN1 -IN1 V+ V- OUT1 NJM2138_ME
X_U2  +IN2 -IN2 V+ V- OUT2 NJM2138_ME
X_U3  +IN3 -IN3 V+ V- OUT3 NJM2138_ME
X_U4  +IN4 -IN4 V+ V- OUT4 NJM2138_ME
.ends NJM2138
.subckt NJM2138_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 0 270.00E3 -1E3 1E3 270E3 -270E3
ga  6 0 11 12 18.850E-3
gcm 0 6 10 99 33.520E-6
iee 3 10 dc 1.6510E-3
hlim 90 0 vlim 1K
q1  11 2 13 qx1
q2  12 1 14 qx2
r2  6 9 100.00E3
rc1 4 11 53.052
rc2 4 12 53.052
re1 13 10 21.688
re2 14 10 21.688
ree 10 99 121.14E3
ro1 8 5 50
ro2 7 99 25
rp  3 4 103.41
vb  9 0 dc 0
vc  3 53 dc 1.8979
ve  54 4 dc 2.0979
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=1.6035E3)
.model qx2 PNP(Is=790.5500E-18 Bf=1.6993E3)
.ends
*$

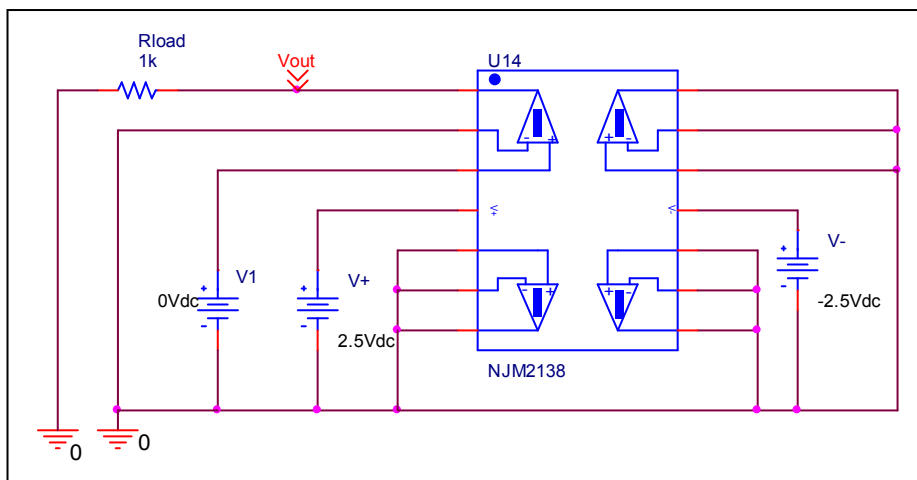
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Output Voltage Swing, +Vout and -Vout

Simulation result



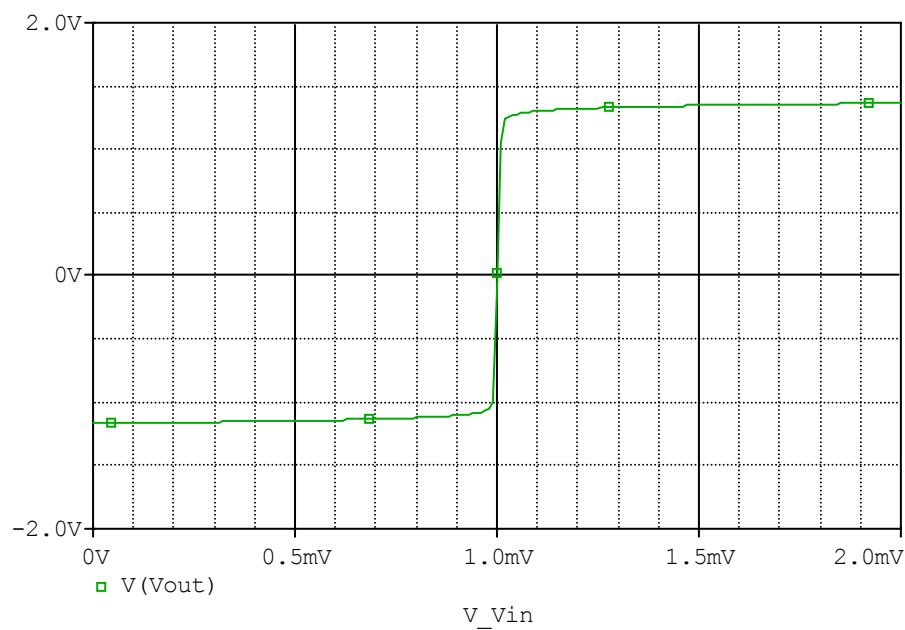
Evaluation circuit



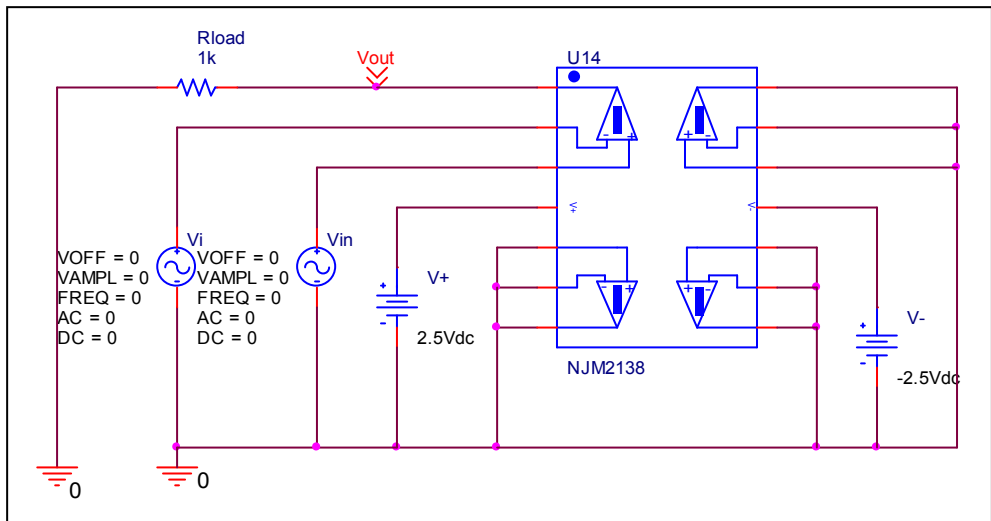
Output Voltage Swing	Data sheet	Simulation	%Error
+Vout(V)	1.400	1.400	0.000
-Vout(V)	1.200	1.200	0.000

Input Offset Voltage

Simulation result



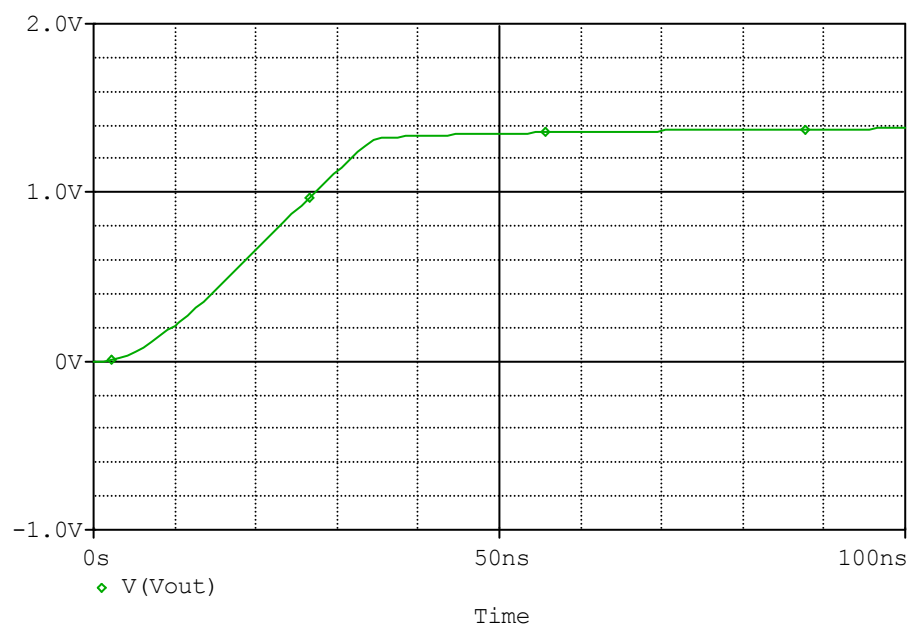
Evaluation circuit



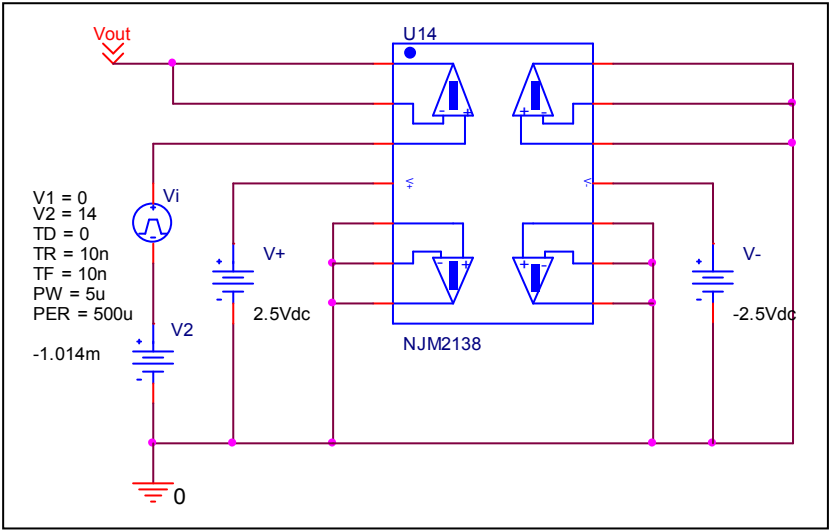
Vos	Measurement		Simulation		Error	
	1.000	mV	1.014	mV	1.400	%

Slew Rate, +SR, -SR

Simulation result



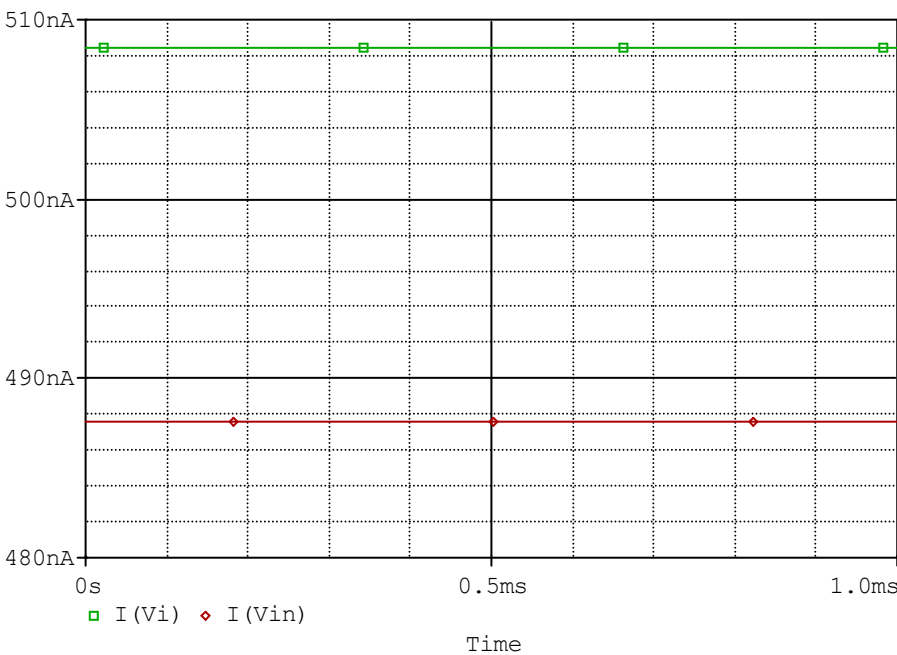
Evaluation circuit



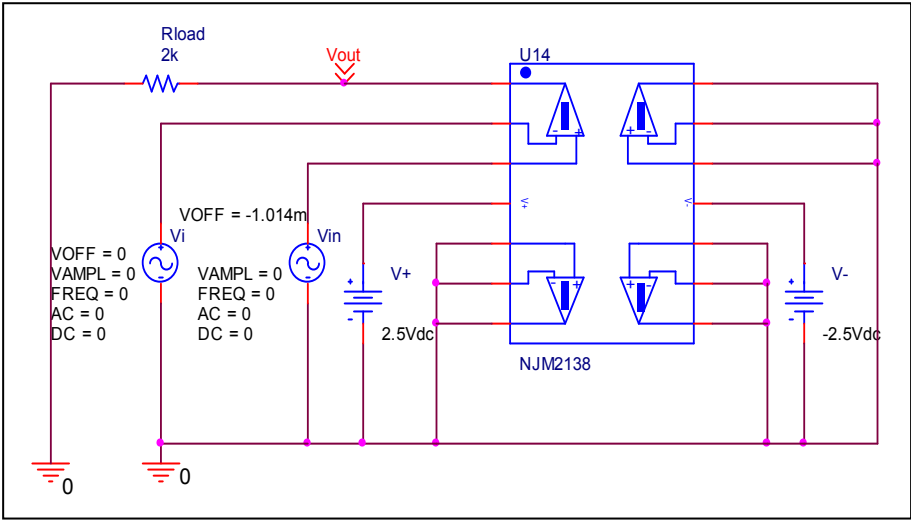
Slew Rate(v/us)	Data sheet	Simulation	%Error
	45.000V/us	44.600V/us	-0.889

Input current Ib, Ibos

Simulation result



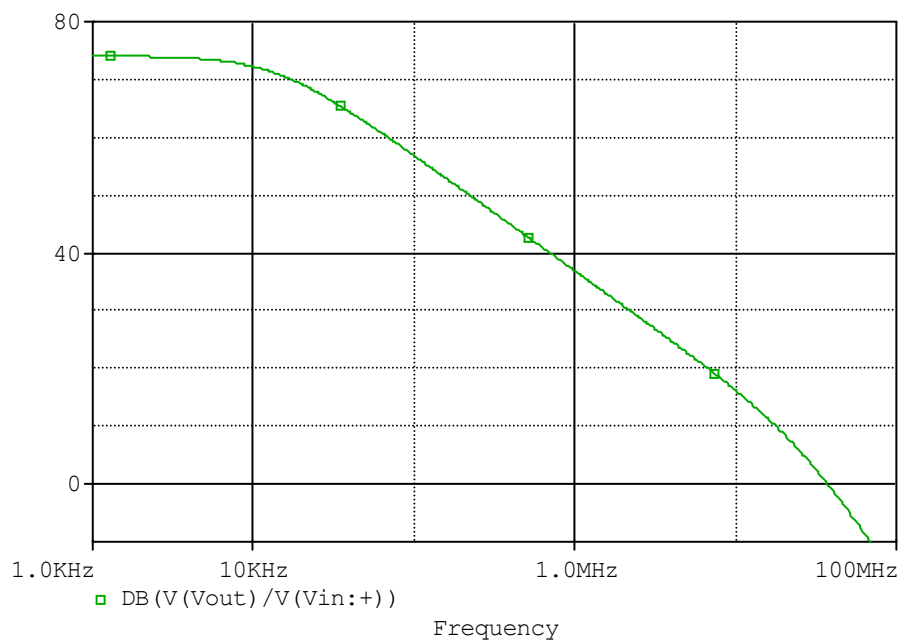
Evaluation circuit



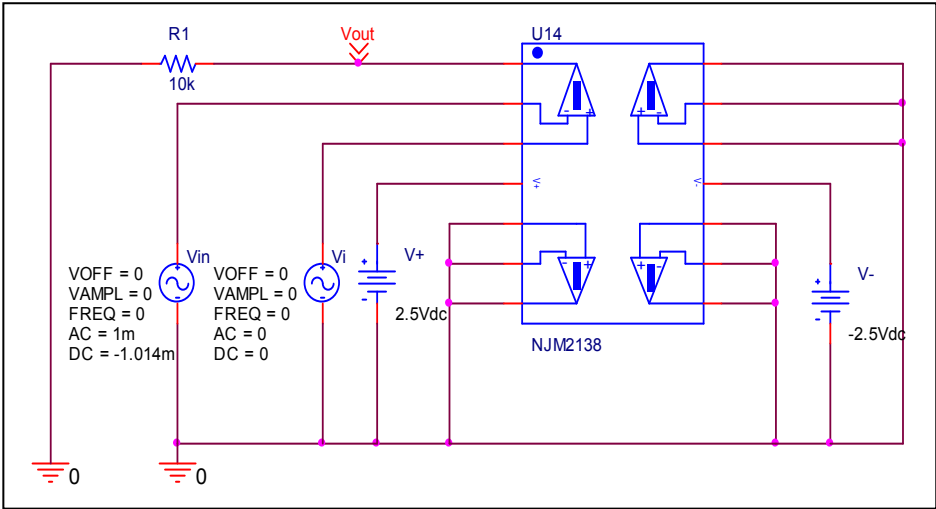
	Data sheet	Simulation	%Error
Ib(nA)	500.000	498.045	-0.391
Ibos(nA)	20.000	20.831	4.155

Open Loop Voltage

Simulation result



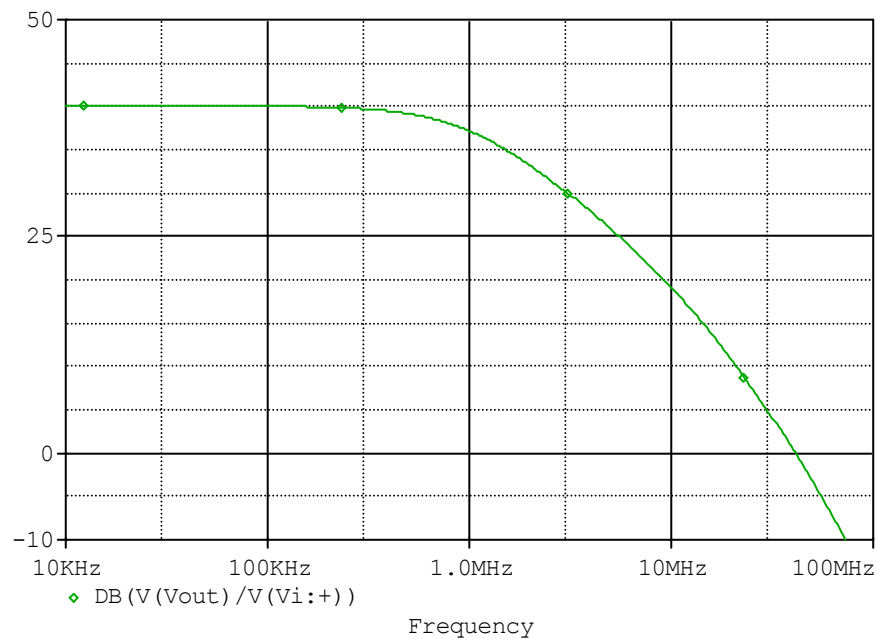
Evaluation circuit



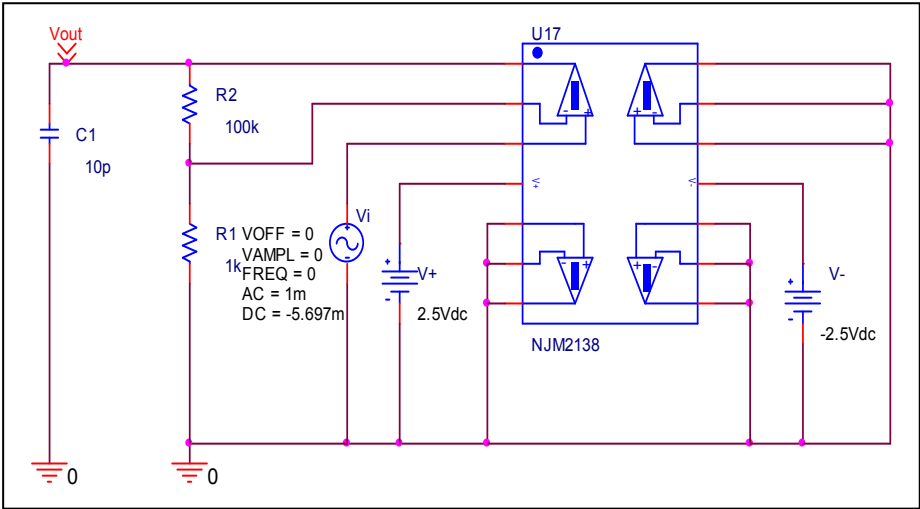
	Data sheet	Simulation	%Error
Av-dc(dB)	75.000	74.055	-1.260

Unity Gain Bandwidth

Simulation result



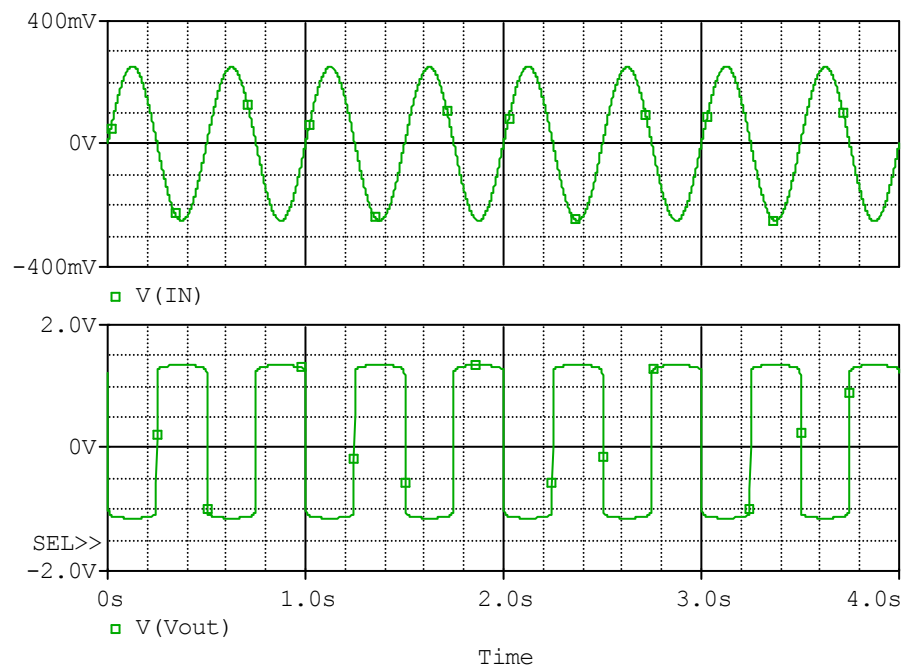
Evaluation circuit



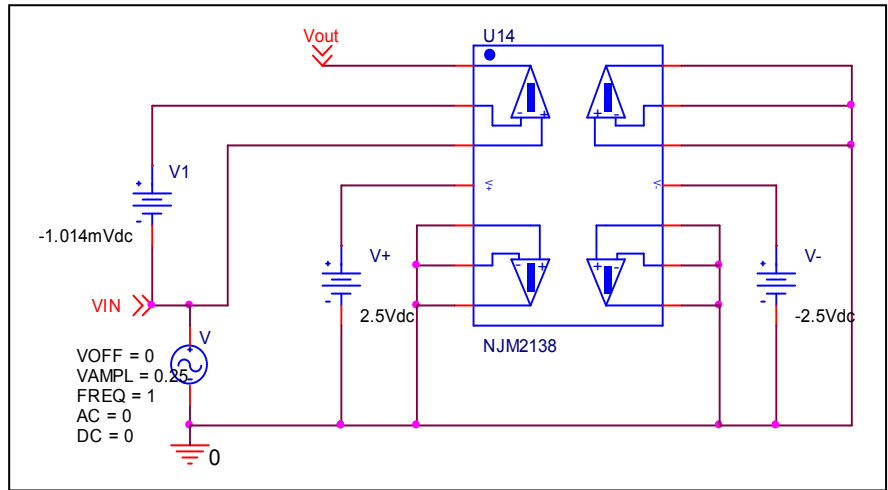
	Data sheet	Simulation	%Error
f-0dB(MHz)	40.000	40.561	1.403
Av-dc(dB)	40.000	40.077	0.192

Common-Mode Rejection Voltage gain

Simulation result



Evaluation circuit



Common Mode Reject Ratio= $5043.7/(2.485/0.5)=1014.83$

CMRR	Data sheet	Simulation	%Error
	60.000	60.127	0.212