Low Noise, Rail-to-Rail Input/Output Dual Operational Amplifier

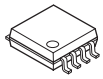
■ GENERAL DESCRIPTION

The NJM2737 is a Rail-to-Rail Input/Output single supply dual operational amplifier featuring low voltage operation, low power and low noise. It is designed to offer a low voltage operating from 1.8V with a 5nV/√Hz low noise of the conventional low noise operational amplifiers such as the NJM4580 and NJM 5532.

The Combination of Rail-to-Rail Input/Output, low voltage operation and low noise makes the NJM2737 well-suited for single supply low voltage operation applications such as PC audio, portable audio and others. The NJM2737 is available in a wide variety packages 8-lead DIP, and 8-lead surface-mount packages of SOP (DMP), SSOP and MSOP (TVSP).

■PACKAGE OUTLINE

NJM2737D
(DIP8)



NJM2737M
(DMP8)

NJM2737V
(SSOP8)

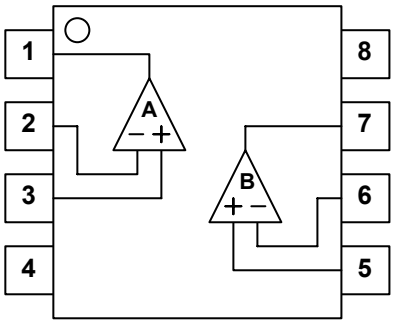
NJM2737RB1
(MSOP8 (TVSP8))

■ FEATURES

- Operating Voltage 1.8 to 6.0V
- Low Input Voltage Noise 5nV/√Hz typ.
- Gain Band Width product 3.1MHz typ. (at V^+=5V,R_L=2kΩ)
- Slew Rate 0.7V/μs typ. (at V^+=5V,R_L=2kΩ)
- Offset Voltage 5mV max
- Rail-to-Rail Input V_{ICM}= 0 to 5.0V (at V^+=5V)
- Rail-to-Rail Output $V_{OH} \geq$ 4.9V/ $V_{OL} \leq$ 0.15V (at V^+=5V,R_L=20kΩ)
- Load Drivability $V_{OH} \geq$ 4.75V/ $V_{OL} \leq$ 0.25V (at V^+=5V,R_L=2kΩ)
- Bipolar Technology
- Package Outline DIP8, DMP8, SSOP8, MSOP8 (TVSP8)MEET JEDEC MO-187-DA / THIN TYPE

■ PIN CONFIGURATION

(Top View)



PIN CONFIGURATION

1.OUTPUT1
2.-INPUT1
3.+INPUT1
4.GND(V^-)
5.+INPUT2
6.-INPUT2
7.OUTPUT2
8.V^+

■ ABSOLUTE MAXIMUM RATINGS

(Ta=25°C)

PARAMETER	SYMBOL	RATINGS	UNIT
Supply Voltage	V^+	7.0	V
Differential Input Voltage	V_{ID}	±1.0	V
Input Common Mode Voltage Range	V_{ICM}	0 to 7.0	V
Power Dissipation	P_D	500(DIP8) 300(DMP8) 250(SSOP8) 320(MSOP8 (TVSP8))	mW
Operating Temperature Range	Topr	-40 to +85	°C
Storage Temperature Range	Tstg	-40 to +125	°C

(Note1)If the supply voltage (V^+) is less than 7V, the input voltage must not over the V^+ level through 7V is limit specified.

■ RECOMMENDED OPERATING CONDITION

(Ta=25°C)

PARAMETER	SYMBOL	RATING	UNIT
Supply Voltage	V^+	1.8 to 6.0	V

■ ELECTRICAL CHARACTERISTICS

● DC CHARACTERISTICS

(V^+=5V,Ta=25°C)

PARAMETER	SYMBOL	TEST CONDITION	MIN	TYP	MAX	UNIT
Operating Current	I_{CC}	No Signal	-	1200	1600	μA
Input Offset Voltage	V_{IO}		-	1	5	mV
Input Bias Current	I_B		-	200	800	nA
Input Offset Current	I_{IO}		-	5	100	nA
Voltage Gain	A_V	R_L=2kΩ	60	85	-	dB
Common Mode Rejection Ratio	CMR	CMR+:2.5V≤V_{CM}≤5.0V, CMR-: 0≤V_{CM}≤2.5V(Note2)	55	70	-	dB
Supply Voltage Rejection Ratio	SVR	V^+/GND = ±2.0 to ±3.0V	70	85	-	dB
Maximum Output Voltage1	V_{OH1}	R_L=20kΩ	4.9	4.95	-	V
	V_{OL1}	R_L=20kΩ	-	0.05	0.1	
Maximum Output Voltage 2	V_{OH2}	R_L=2kΩ	4.75	4.85	-	V
	V_{OL2}	R_L=2kΩ	-	0.15	0.25	
Input Common Mode Voltage Range	V_{ICM}	CMR>55dB	0	-	5	V

(Note2) CMR is represented by either CMR+ or CMR- which has lower value.
CMR+ is measured with 2.5V≤V_{CM}≤5V and CMR- is measured with 0V≤ V_{CM} ≤ 2.5V .

● AC CHARACTERISTICS

(V^+=5V, Ta=25°C)

PARAMETER	SYMBOL	TEST CONDITION	MIN	TYP	MAX	UNIT
Unity Gain Bandwidth	f_T	R_L=2kΩ	-	3.1	-	MHz
Phase Margin	Φ_M	R_L=2kΩ	-	85	-	Deg
Equivalent Input Noise Voltage	V_{NI}	f=1kHz	-	5	-	nV/√Hz

● TRANSIENT CHARACTERISTICS (V^+=5V, Ta=25°C)

PARAMETER	SYMBOL	TEST CONDITION	MIN	TYP	MAX	UNIT
Slew Rate	SR	R_L=2kΩ	-	0.7	-	V/μs

● DC CHARACTERISTICS (V^+=3V,Ta=25°C)

PARAMETER	SYMBOL	TEST CONDITION	MIN	TYP	MAX	UNIT
Operating Current	I_{CC}	No Signal	-	1000	1500	μA
Input Offset Voltage	V_{IO}		-	1	5	mV
Input Bias Current	I_B		-	200	800	nA
Input Offset Current	I_{IO}		-	5	100	nA
Voltage Gain	A_V	R_L=2kΩ	60	85	-	dB
Common Mode Rejection Ratio	CMR	CMR+:1.5V≤V_{CM}≤3.0V, CMR-: 0≤V_{CM}≤1.5V(Note3)	48	63	-	dB
Supply Voltage Rejection Ratio	SVR	V^+/GND = ±1.2 to ±2.0V	68	83	-	dB
Maximum Output Voltage1	V_{OH1}	R_L=20kΩ	2.9	2.95	-	V
	V_{OL1}	R_L=20kΩ	-	0.05	0.1	
Maximum Output Voltage 2	V_{OH2}	R_L=2kΩ	2.75	2.85	-	V
	V_{OL2}	R_L=2kΩ	-	0.15	0.25	
Input Common Mode Voltage Range	V_{ICM}	CMR>48dB	0	-	3	V

(Note3) CMR is represented by either CMR+ or CMR- which has lower value.
CMR+ is measured with 1.5V≤V_{CM}≤3V and CMR- is measured with 0V≤ V_{CM} ≤ 1.5V .

● AC CHARACTERISTICS (V^+=3V, Ta=25°C)

PARAMETER	SYMBOL	TEST CONDITION	MIN	TYP	MAX	UNIT
Unity Gain Bandwidth	f_T	R_L=2kΩ	-	2.6	-	MHz
Phase Margin	Φ_M	R_L=2kΩ	-	85	-	Deg
Equivalent Input Noise Voltage	V_{NI}	f=1kHz	-	5	-	nV/√Hz

● TRANSIENT CHARACTERISTICS (V^+=3V, Ta=25°C)

PARAMETER	SYMBOL	TEST CONDITION	MIN	TYP	MAX	UNIT
Slew Rate	SR	R_L=2kΩ	-	0.6	-	V/μs

● DC CHARACTERISTICS (V^+=1.8V,Ta=25°C)

PARAMETER	SYMBOL	TEST CONDITION	MIN	TYP	MAX	UNIT
Operating Current	I_{CC}	No Signal	-	1000	1500	μA
Input Offset Voltage	V_{IO}		-	1	5	mV
Input Bias Current	I_B		-	200	800	nA
Input Offset Current	I_{IO}		-	5	100	nA
Voltage Gain	A_V	R_L=2kΩ	60	85	-	dB
Common Mode Rejection Ratio	CMR	CMR+:0.9V≤V_{CM}≤1.8V, CMR-: 0≤V_{CM}≤0.9V(Note4)	40	55	-	dB
Supply Voltage Rejection Ratio	SVR	V^+/GND = ±0.9 to ±1.2V	65	80	-	dB
Maximum Output Voltage1	V_{OH1}	R_L=20kΩ	1.7	1.75	-	V
	V_{OL1}	R_L=20kΩ	-	0.1	0.15	
Maximum Output Voltage 2	V_{OH2}	R_L=2kΩ	1.6	1.65	-	V
	V_{OL2}	R_L=2kΩ	-	0.15	0.25	
Input Common Mode Voltage Range	V_{ICM}	CMR>40dB	0	-	1.8	V

(Note4) CMR is represented by either CMR+ or CMR- which has lower value.
CMR+ is measured with 0.9V≤V_{CM}≤1.8V and CMR- is measured with 0V≤ V_{CM} ≤ 0.9V .

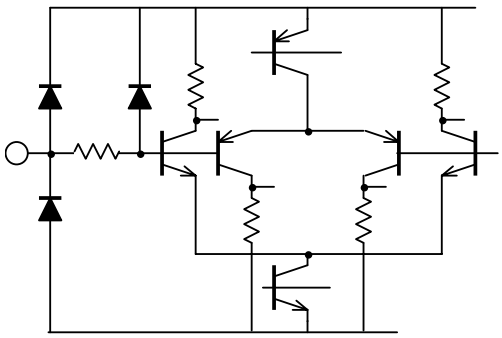
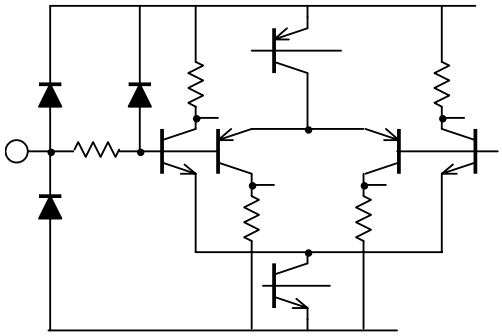
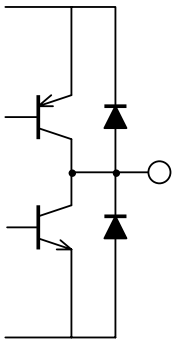
● AC CHARACTERISTICS (V^+=1.8V, Ta=25°C)

PARAMETER	SYMBOL	TEST CONDITION	MIN	TYP	MAX	UNIT
Unity Gain Bandwidth	f_T	R_L=2kΩ	-	2.3	-	MHz
Phase Margin	Φ_M	R_L=2kΩ	-	85	-	Deg
Equivalent Input Noise Voltage	V_{NI}	f=1kHz	-	5	-	nV/√Hz

● TRANSIENT CHARACTERISTICS (V^+=1.8V, Ta=25°C)

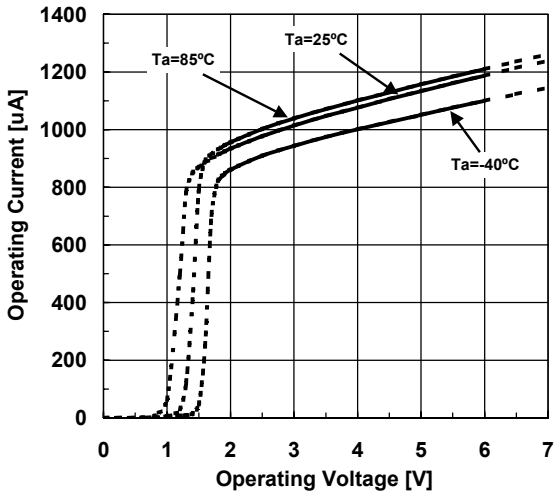
PARAMETER	SYMBOL	TEST CONDITION	MIN	TYP	MAX	UNIT
Slew Rate	SR	R_L=2kΩ	-	0.5	-	V/μs

■ TERMINAL CHARACTERISTICS

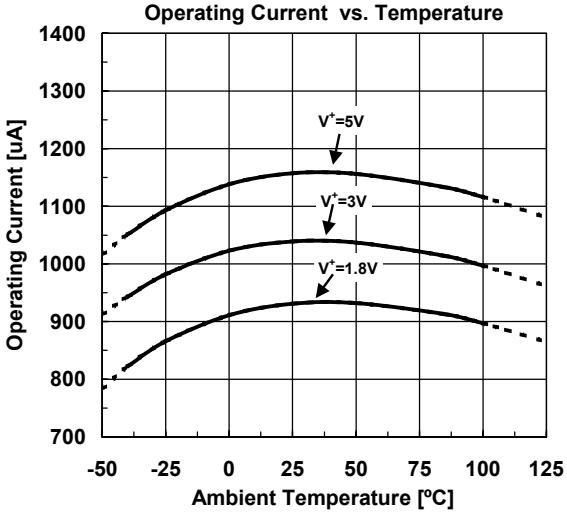
No.	Symbol	Equivalent Circuit	Typ.DC Voltage(V)	Function
3,5	+INPUT			non-inverting input
2,6	-INPUT			inverting input
1,7	VOUT			output

■ TYPICAL CHARACTERISTICS

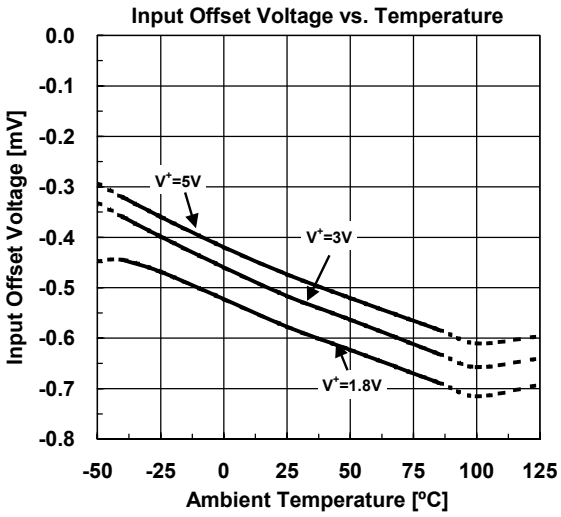
Operating Current vs. Operating Voltage



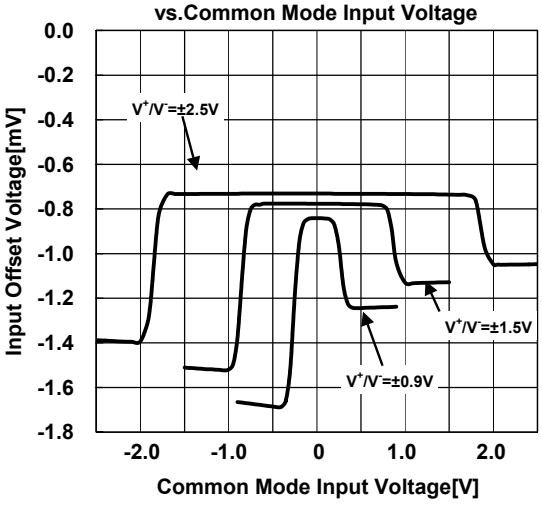
Operating Current vs. Temperature



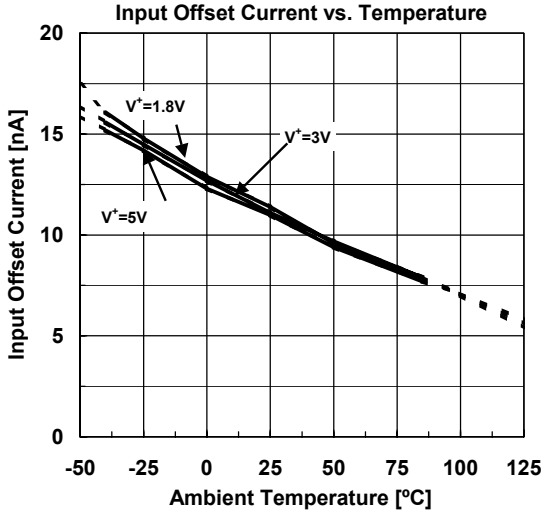
Input Offset Voltage vs. Temperature



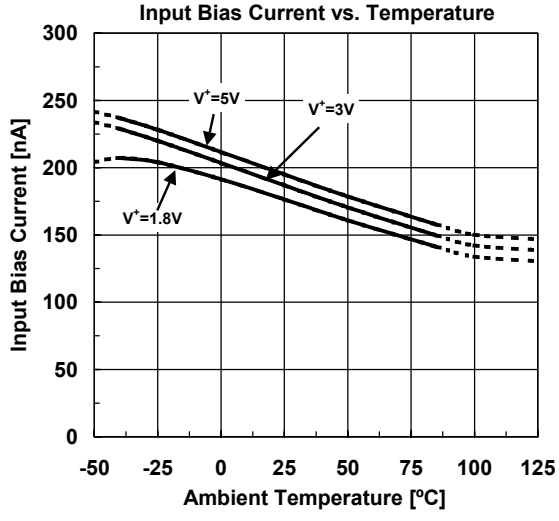
Input Offset Voltage
vs.Common Mode Input Voltage



Input Offset Current vs. Temperature

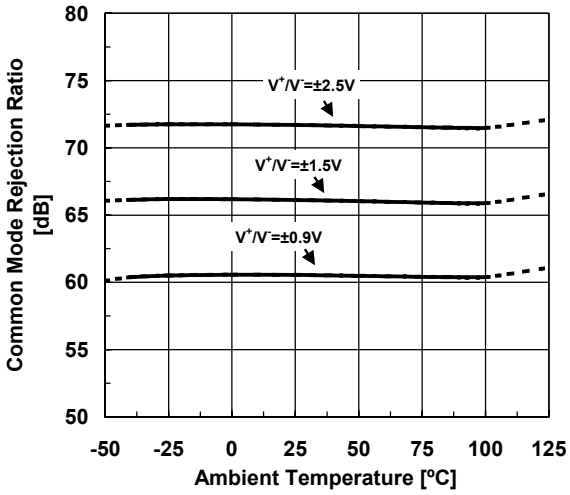


Input Bias Current vs. Temperature

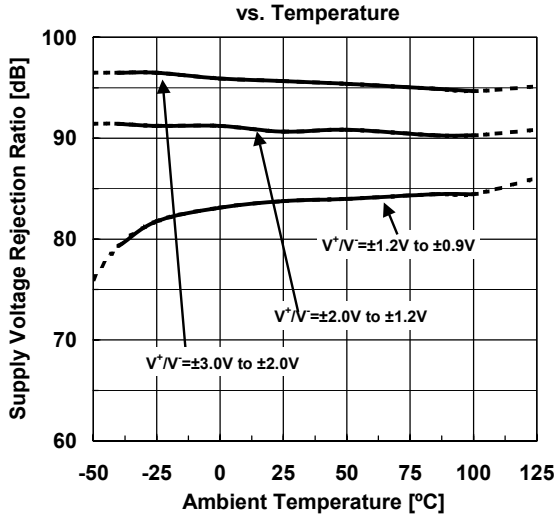


Common Mode Rejection Ratio vs. Temperature

$V_{IC}=V^+$, 0, V^-

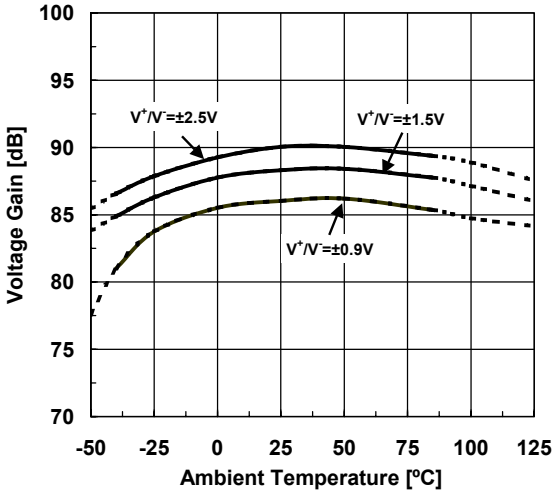


Supply Voltage Rejection Ratio vs. Temperature



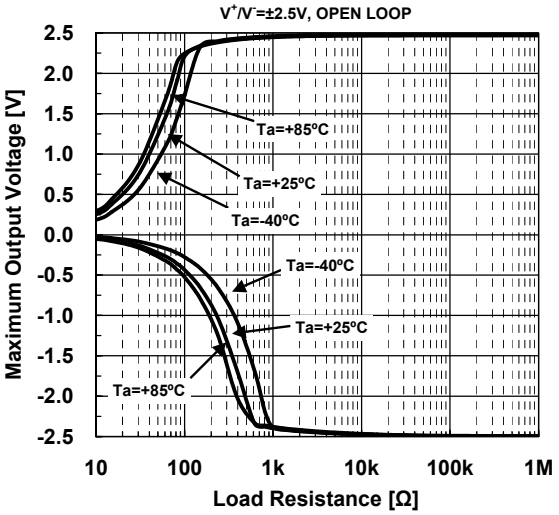
Voltage Gain vs. Temperature

R_L=2kΩ



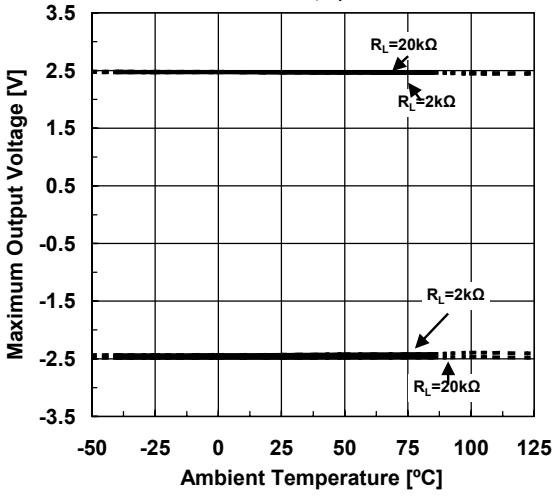
Maximum Output Voltage vs. Load Resistance

V^+/V^-=±2.5V, OPEN LOOP



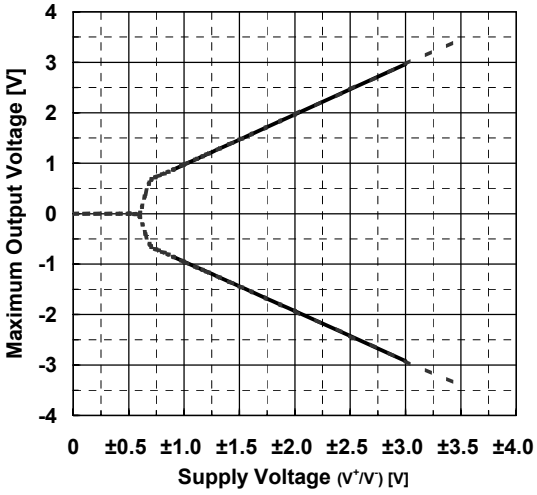
Maximum Output Voltage vs. Temperature

V^+/V^-=±2.5V, G_V=OPEN



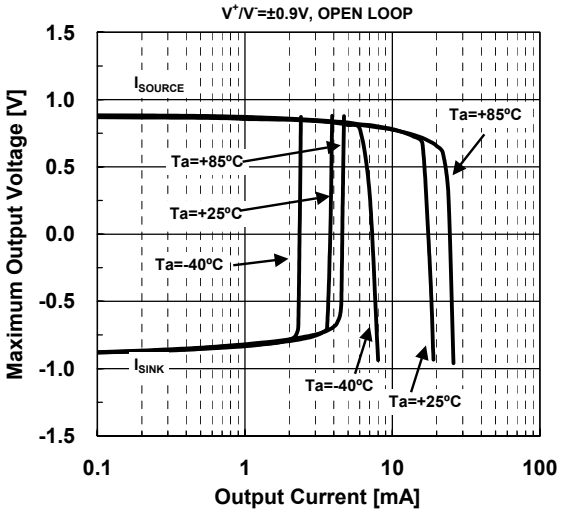
Maximum Output Voltage vs. Supply Voltage

OPEN LOOP, R_L=2kΩ, Ta=25ºC



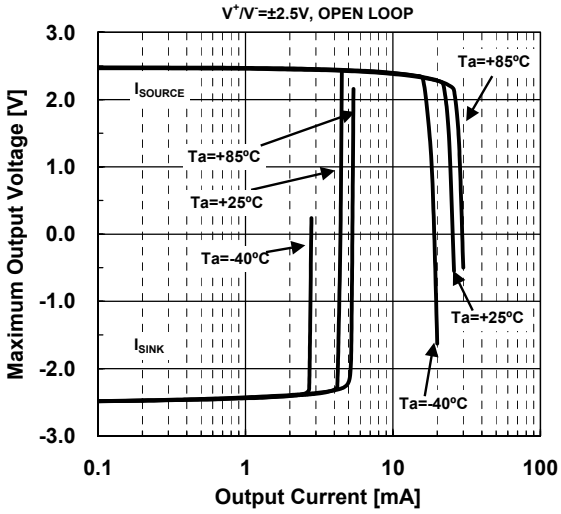
Maximum Output Voltage vs. Output Current

V^+/V^-=±0.9V, OPEN LOOP



Maximum Output Voltage vs. Output Current

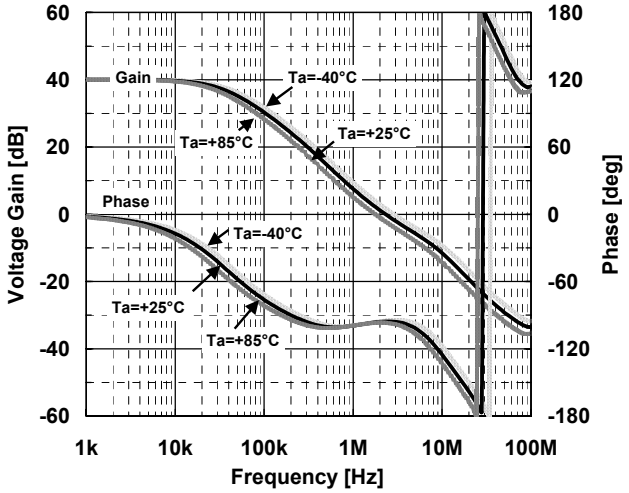
V^+/V^-=±2.5V, OPEN LOOP



Voltage Gain・Phase vs. Frequency

V^+/V^-=±0.9V, G_V=40dB

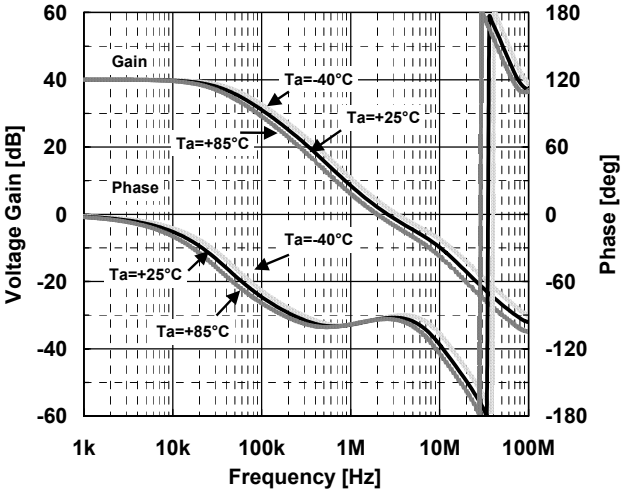
R_F=20Ω, R_G=2kΩ, R_L=∞, C_L=0pF



Voltage Gain・Phase vs. Frequency

V^+/V^-=±1.5V, G_V=40dB

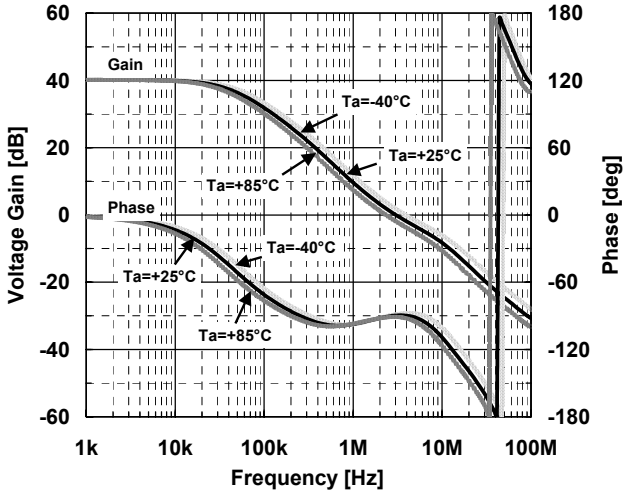
R_F=20Ω, R_G=2kΩ, R_L=∞, C_L=0pF



Voltage Gain・Phase vs. Frequency

V^+/V^-=±2.5V, G_V=40dB

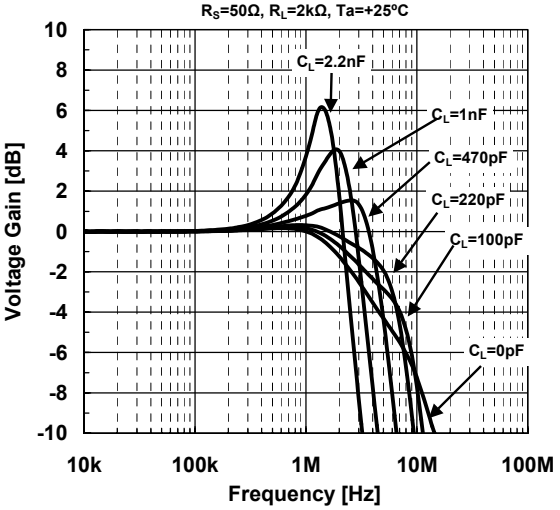
R_F=20Ω, R_G=2kΩ, R_L=∞, C_L=0pF



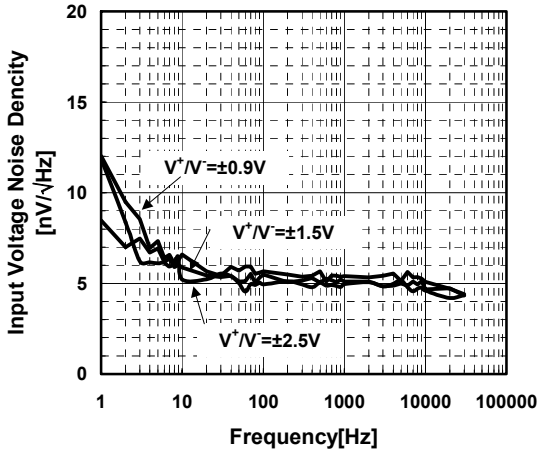
Peak Gain of Voltage Follower

V^+/V^-=±2.5V, G_V=0dB

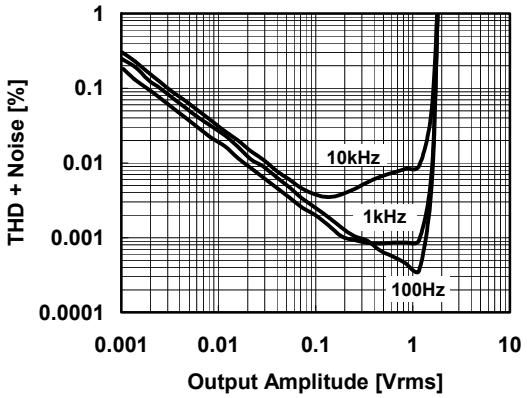
R_S=50Ω, R_L=2kΩ, Ta=+25ºC



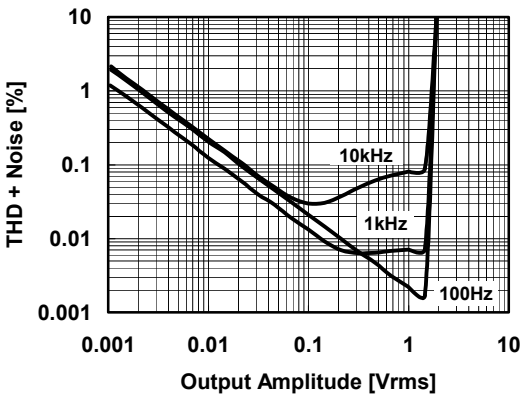
Input Voltage Noise Density vs. Frequency
GV=40dB,R_S=50Ω,R_G=20Ω,
R_F=2kΩ,CL=0pF,Ta=25°C



TOTAL HARMONIC DISTORTION + NOISE
vs OUTPUT AMPLITUDE
(Voltage Follower)
V^+/V^-=±2.5V,Gv=20dB
R_L=2kΩ,Ta=25℃



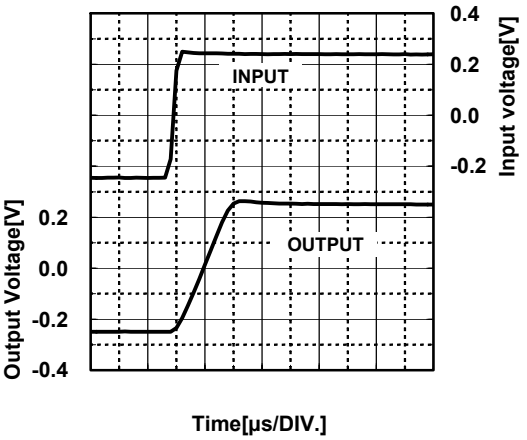
TOTAL HARMONIC DISTORTION + NOISE
vs OUTPUT AMPLITUDE
(×10 Amplifier)
V^+/V^-=±2.5V,Gv=20dB
R_L=2kΩ,Ta=25℃



Positive Transient Response

V^+/V^-=±0.9V,GV=0dB,f=10kHz,V_{IN}=0.5VPP

R_S=50Ω,RL=2kΩ,CL=0pF,Ta=+25°C

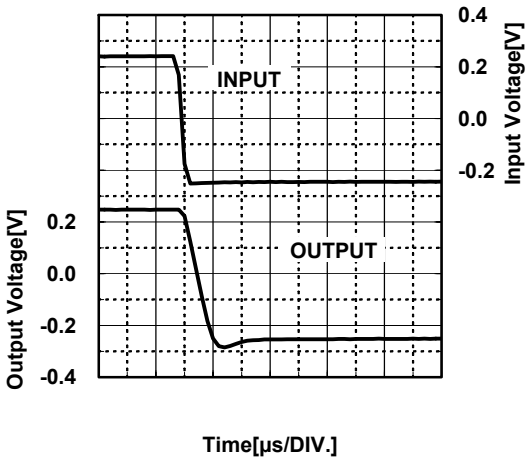


Time[µs/DIV.]

Negative Transient Response

V^+/V^-=±0.9V,GV=0dB,f=10kHz,V_{IN}=0.5V_{PP}

R_S=50Ω,RL=2kΩ,CL=0pF,Ta=+25°C

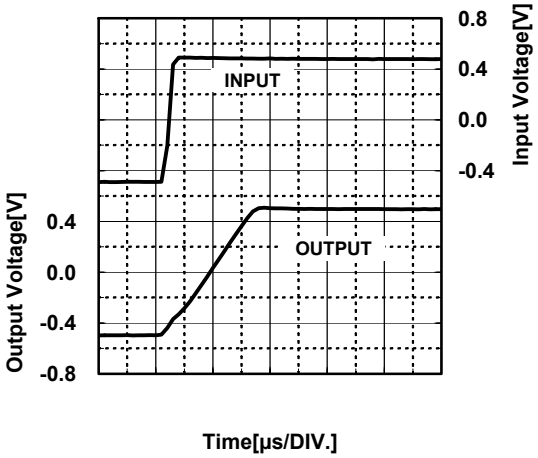


Time[µs/DIV.]

Positive Transient Response

V^+/V^-=±1.5V,GV=0dB,f=10kHz,V_{IN}=1V_{PP}

R_S=50Ω,RL=2kΩ,CL=0pF,Ta=+25°C

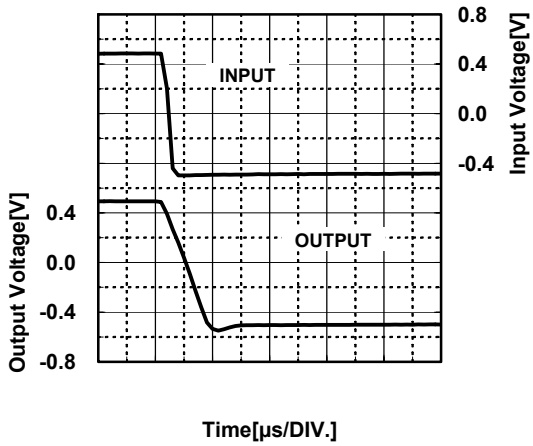


Time[µs/DIV.]

Negative Transient Response

V^+/V^-=±1.5V,GV=0dB,f=10kHz,V_{IN}=1V_{PP}

R_S=50Ω,RL=2kΩ,CL=0pF,Ta=+25°C



Time[µs/DIV.]

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