Rail-to-Rail Input/Output Dual Operational Amplifier

■ GENERAL DESCRIPTION

The NJM2732 is a Rail-to-Rail Input/Output dual operational amplifier featuring low power, low noise and a low voltage operation from 1.8V.

The Rail-to-Rail Input/Output offers a wide input/output dynamic range from ground level to supply line, which provides both ground and Hi-side sensing applications.

The excellent features of low noise, low operating voltage and high phase margin make the NJM2732 well-suited for various applications such as battery powered devices, portable audio devices, sensor applications and others.

■ PACKAGE OUTLINE

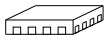
NJM2732D (DIP8)

NJM2732M (DMP8)

NJM2732E (EMP8)

NJM2732V (SSOP8)

NJM2732RB1 (TVSP8)



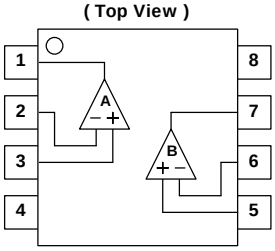
NJM2732SCC (PCSP20-CC)

■ FEATURES

●Operating Voltage	1.8 to 6.0V
●Rail-to-Rail Input	V_{ICM}= 0 to 5.0V, (at V^+=5V)
●Rail-to-Rail Output	V_{OH}≥4.9V/ V_{OL}≤0.1V, (at V^+=5V, R_L=20kΩ)
●Load Drivability	V_{OH}≥4.75V/ V_{OL}≤0.25V, (at V^+=5V, R_L=2kΩ)
●Offset Voltage	5mV max.
●Slew Rate	0.4V/μs typ.
●Low Input Voltage Noise	10nV/√Hz typ. (at f=1kHz)
●Adequate phase margin	Φ_M=75deg. typ. (at R_L=2kΩ, voltage follower)
●Bipolar Technology	
●Package Outline	DIP8, DMP8, SOP8 JEDEC 150mil, SSOP8, PCSP20-CC MSOP8 (TVSP8) MEET JEDEC MO-187-DA / THIN TYPE

■ PIN CONFIGURATION

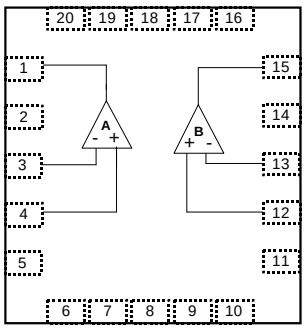
○ NJM2732D,E,M,V,RB1

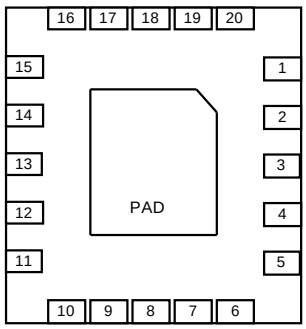


PIN FUNCTION

1. A OUTPUT
2. A -INPUT
3. A +INPUT
4. GND(V^-)
5. B +INPUT
6. B –INPUT
7. B OUTPUT
8. V^+

○ NJM2732SCC





PIN FUNCTION

1. A OUTPUT	11. NC
2. NC	12. B +INPUT
3. A -INPUT	13. B –INPUT
4. A +INPUT	14. NC
5. NC	15. B OUTPUT
6. NC	16. NC
7. NC	17. NC
8. GND(V^-)	18. V^+
9. NC	19. NC
10. NC	20. NC

(Note1) The NC pin and the PAD should connect with a GND terminal.

(Note2) The NC pin is electrically not connected to the die in a package.

(Note3) The PAD is electrically not connected to the backside of the die. The PAD cannot be used as GND pin.

■ ABSOLUTE MAXIMUM RATINGS

(Ta=25˚C)

PARAMETER	SYMBOL	RATINGS	UNIT
Supply Voltage	V^+	7.0	V
Differential Input Voltage Range	V_{ID}	±1.0	V
Common Mode Input Voltage Range	V_{IC}	0 ~ 7.0 (Note4)	V
Power Dissipation	P_D	(DIP8) 500 (DMP8) 300 (SOP8) 300 (SSOP8) 250 (MSOP8 (TVSP8))320 (PCSP20−CC)400 (Note5)	mW
Operating Temperature Range	T_{opr}	-40~+85	˚C
Storage Temperature Range	T_{stg}	-40~+125	˚C

(Note4) For supply voltage less than 7V, the absolute maximum input voltage is equal to the supply voltage.

(Note5) On the PCB " EIA/JEDEC (76.2x114.3x1.6mm, two layers, FR-4).

■ RECOMMENDED OPERATING CONDITION

(Ta=25˚C)

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

■ ELECTRICAL CHARACTERISTICS (V^+=5V, Ta=25˚C)

●DC CHARACTERISTICS (V^+=5V, Ta=25˚C)

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Operating Current	I_{CC}	No signal applied	-	580	900	μA
Input Offset Voltage	V_{IO}		-	1	5	mV
Input Bias Current	I_B		-	50	250	nA
Input Offset Current	I_{IO}		-	5	100	nA
Large Signal Voltage Gain	A_V	R_L=2kΩ	60	85	-	dB
Common Mode Rejection Ratio	CMR	CMR+: 2.5V≤V_{CM}≤5V CMR-: 0V≤V_{CM}≤2.5V (Note6)	55	70	-	dB
Supply Voltage Rejection Ratio	SVR	V^+/V^-=±2.0V ~ ±3.0V	70	85	-	dB
Maximum Output Voltage 1	V_{OH1}	R_L=20kΩ	4.9	4.95	-	V
	V_{OL1}	R_L=20kΩ	-	0.05	0.1	V
Maximum Output Voltage 2	V_{OH2}	R_L=2kΩ	4.75	4.85	-	V
	V_{OL2}	R_L=2kΩ	-	0.15	0.25	V
Input Common Mode Voltage Range	V_{ICM}	CMR≥55dB	0	-	5	V

(Note6) CMR is represented by either CMR+ or CMR- has lower value.

CMR+ is measured with 2.5V≤V_{CM}≤5.0 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	GB	R_L=2kΩ	-	1	-	MHz
Phase Margin	Φ_M	R_L=2kΩ	-	75	-	Deg
Equivalent Input Noise Voltage	V_{NI}	f=1kHz	-	10	-	nV/√Hz

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

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Slew Rate	SR	R_L=2kΩ	-	0.4	-	V/μs

■ ELECTRICAL CHARACTERISTICS (V^+=3V, Ta=25˚C)

●DC CHARACTERISTICS (V^+=3V, Ta=25˚C)

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Operating Current	I_{CC}	No signal applied	-	510	880	μA
Input Offset Voltage	V_{IO}		-	1	5	mV
Input Bias Current	I_B		-	50	250	nA
Input Offset Current	I_{IO}		-	5	100	nA
Large Signal Voltage Gain	A_V	R_L=2kΩ	60	84	-	dB
Common Mode Rejection Ratio	CMR	CMR+: 1.5V≤V_{CM}≤3V CMR-: 0V≤V_{CM}≤1.5V (Note7)	48	63	-	dB
Supply Voltage Rejection Ratio	SVR	V^+/V^-=±1.2V ~ ±2.0V	68	83	-	dB
Maximum Output Voltage 1	V_{OH1}	R_L=20kΩ	2.9	2.95	-	V
	V_{OL1}	R_L=20kΩ	-	0.05	0.1	V
Maximum Output Voltage 2	V_{OH2}	R_L=2kΩ	2.75	2.85	-	V
	V_{OL2}	R_L=2kΩ	-	0.15	0.25	V
Input Common Mode Voltage Range	V_{ICM}	CMR≥48dB	0	-	3	V

(Note7) CMR is represented by either CMR+ or CMR-has lower value.

CMR+ is measured with 1.5V≤V_{CM}≤3.0 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	GB	R_L=2kΩ	-	1	-	MHz
Phase Margin	Φ_M	R_L=2kΩ	-	75	-	Deg
Equivalent Input Noise Voltage	V_{NI}	f=1kHz	-	10	-	nV/√Hz

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

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Slew Rate	SR	R_L=2kΩ	-	0.35	-	V/μs

■ ELECTRICAL CHARACTERISTICS (V^+=1.8V, Ta=25˚C)

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

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Operating Current	I_{CC}	No signal applied	-	460	800	μA
Input Offset Voltage	V_{IO}		-	1	5	mV
Input Bias Current	I_B		-	50	250	nA
Input Offset Current	I_{IO}		-	5	100	nA
Large Signal Voltage Gain	A_V	R_L=2kΩ	60	83	-	dB
Common Mode Rejection Ratio	CMR	CMR+: 0. 9V≤V_{CM}≤1.8V CMR-: 0V≤V_{CM}≤0.9V (Note8)	40	55	-	dB
Supply Voltage Rejection Ratio	SVR	V^+/V^-=±1.2V ~ ±2.0V	65	80	-	dB
Maximum Output Voltage 1	V_{OH1}	R_L=20kΩ	1.7	1.75	-	V
	V_{OL1}	R_L=20kΩ	-	0.05	0.1	V
Maximum Output Voltage 2	V_{OH2}	R_L=2kΩ	1.55	1.65	-	V
	V_{OL2}	R_L=2kΩ	-	0.15	0.25	V
Input Common Mode Voltage Range	V_{ICM}	CMR≥40dB	0	-	1.8	V

(Note8) CMR is represented by either CMR+ or CMR-has lower value.

CMR+ is measured with 0.9V≤V_{CM}≤1.8 and CMR- is measured with 0V≤V_{CM}≤0.9V.

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

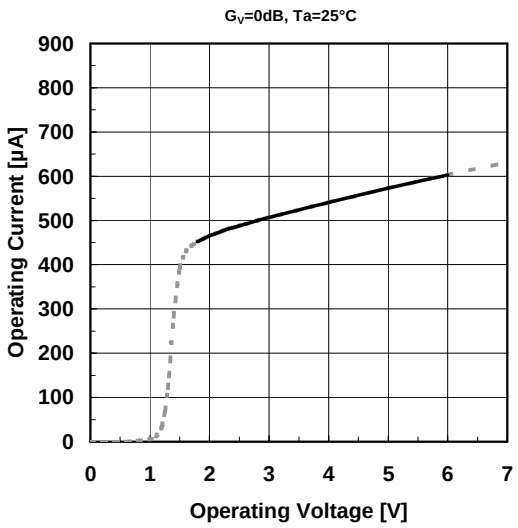
PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Unity Gain Bandwidth	GB	R_L=2kΩ	-	1	-	MHz
Phase Margin	Φ_M	R_L=2kΩ	-	75	-	Deg
Equivalent Input Noise Voltage	V_{NI}	f=1kHz	-	10	-	nV/√Hz

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

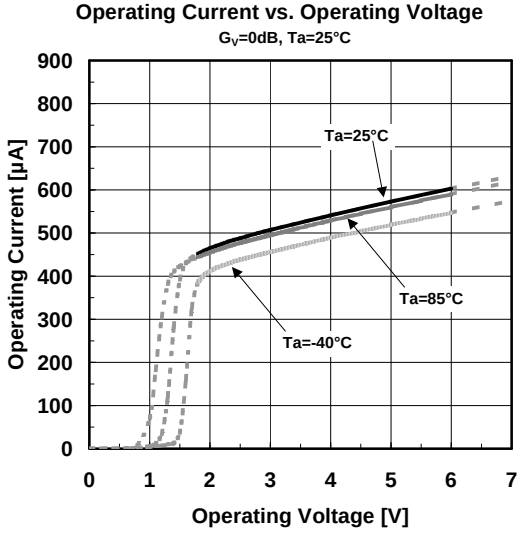
PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Slew Rate	SR	R_L=2kΩ	-	0.3	-	V/μs

■ TYPICAL CHARACTERISTICS

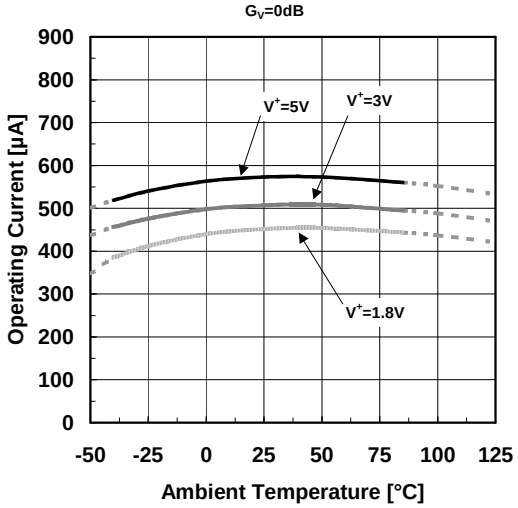
Operating Current vs Operating Voltage



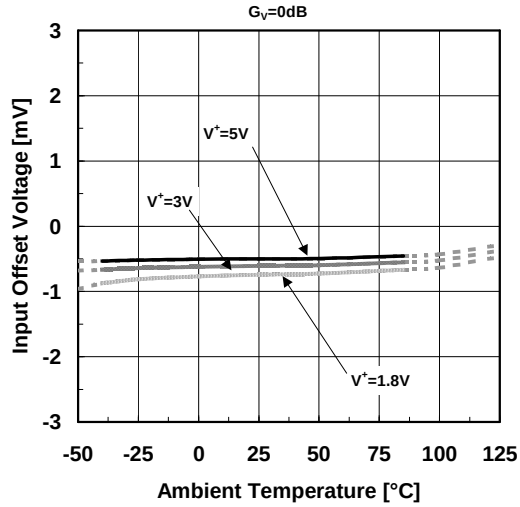
Operating Current vs. Operating Voltage



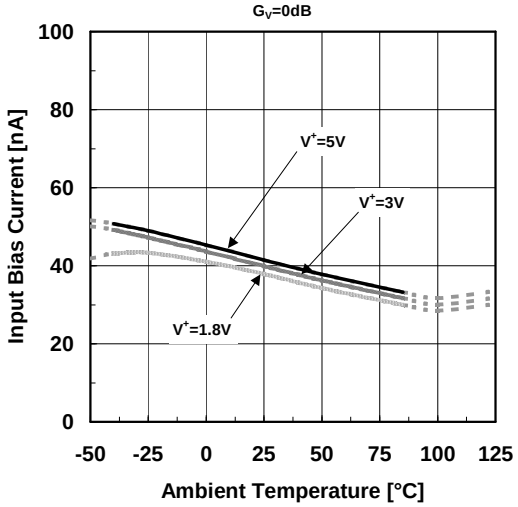
Operating Current vs. Ambient Temperature



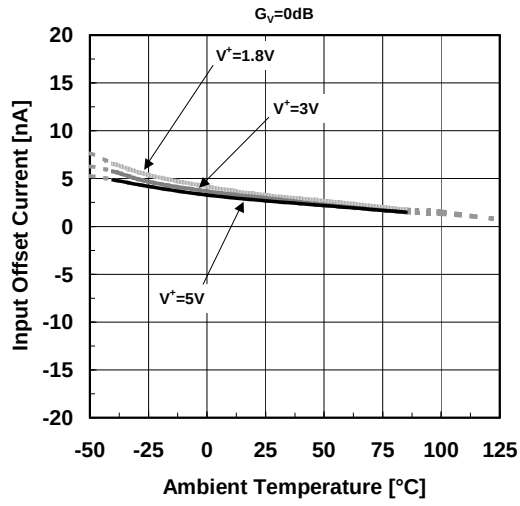
Input Offset Voltage vs. Ambient Temperature



Input Bias Current vs. Ambient Temperature



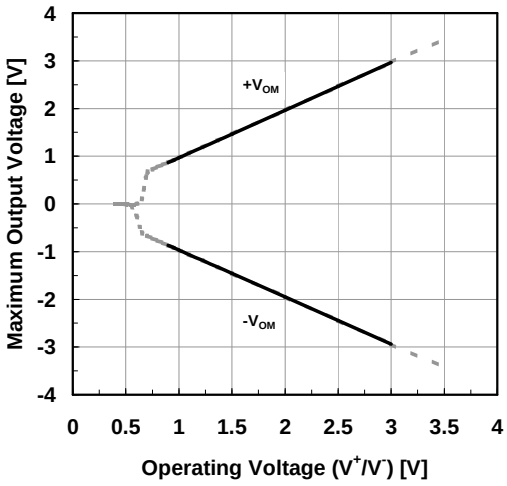
Input Offset Current vs. Ambient Temperature



■ TYPICAL CHARACTERISTICS

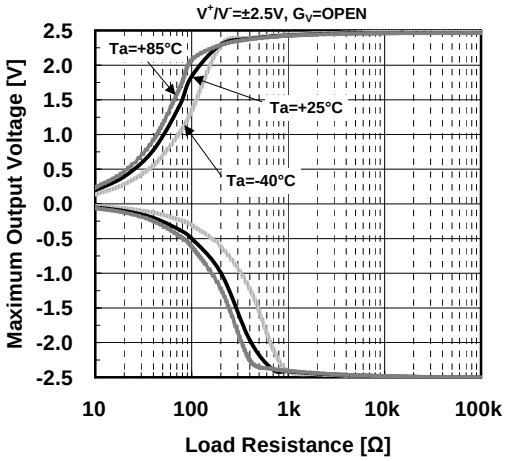
Maximum Output Voltage vs. Operating Voltage

G_V=OPEN, R_L=2kΩ to 0V, Ta=25°C



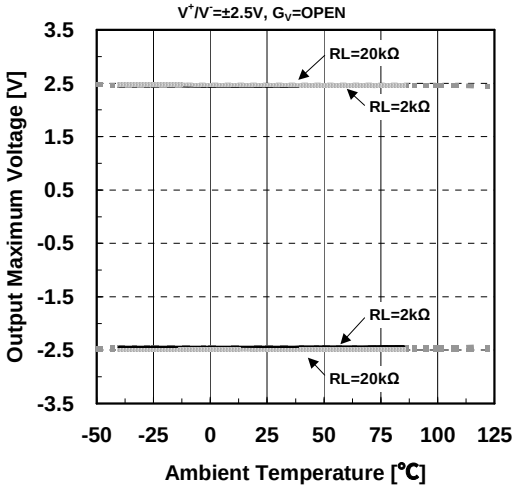
Maximum Output Voltage vs. Load Resistance

V^+/V^-=±2.5V, G_V=OPEN



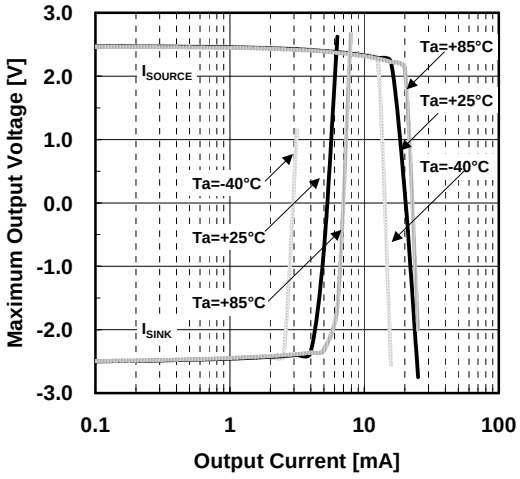
Maximum Output Voltage vs. Ambient Temperature

V^+/V^-=±2.5V, G_V=OPEN



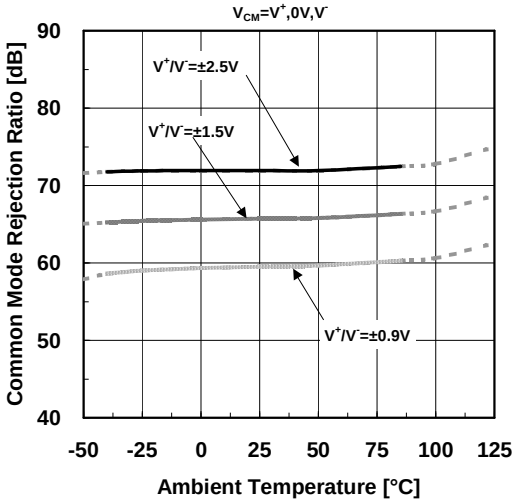
Output Voltage vs. Output Current

V^+/V^-=±2.5V, G_V=OPEN

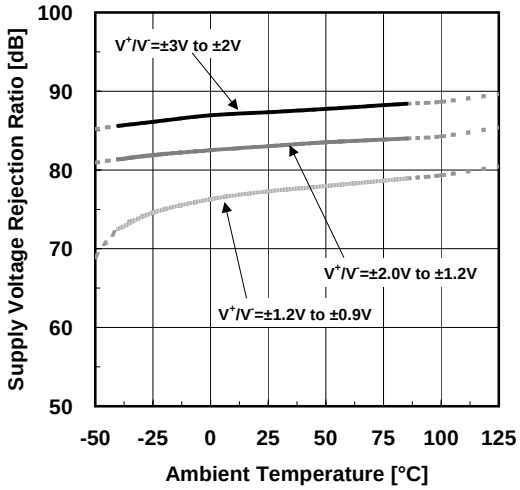


Common Mode Rejection Ratio vs. Ambient Temperature

V_{CM}=V^+,0V,V^-



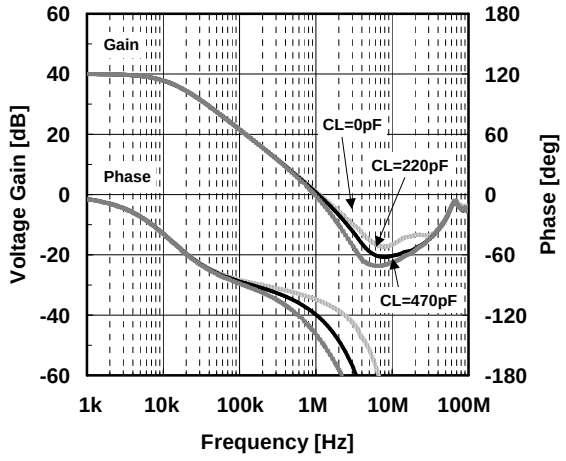
Supply Voltage Rejection Ratio vs. Ambient Temperature



■ TYPICAL CHARACTERISTICS

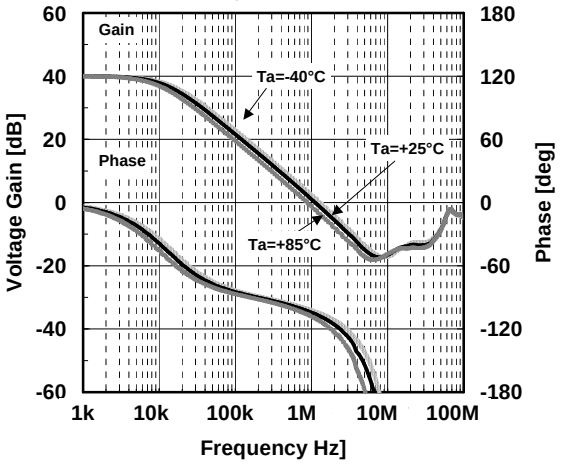
Voltage Gain/Phase vs. Frequency

V^+/V^-=±2.5V, G_V=40dB, R_F=2kΩ, R_G=20Ω, R_L=2kΩ, Ta=+25°C



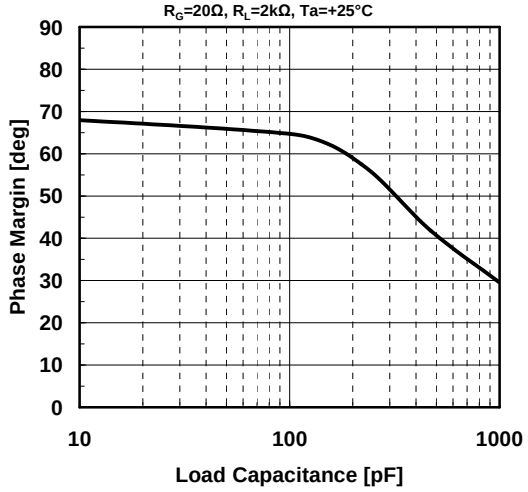
Voltage Gain/Phase vs. Frequency

V^+/V^-=±2.5V, G_V=40dB, R_F=2kΩ, R_G=20Ω, R_L=2kΩ, C_L=0pF



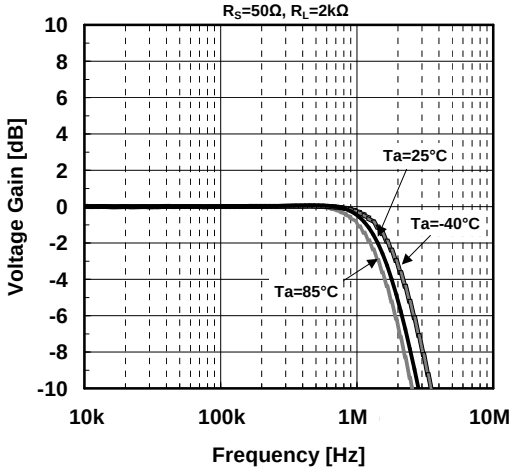
Phase Margin vs. Load Capacitance

V^+/V^-=±1.5V, G_V=40dB, R_F=2kΩ, R_G=20Ω, R_L=2kΩ, Ta=+25°C



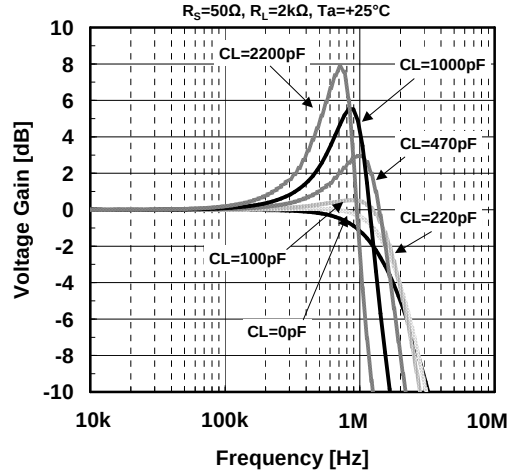
Voltage Gain vs. Frequency

V^+/V^-=±2.5V, G_V=0dB, C_L=100pF, R_S=50Ω, R_L=2kΩ



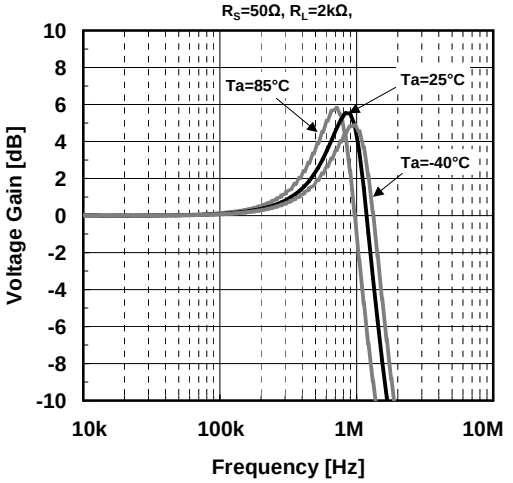
Voltage Gain vs. Frequency

V^+/V^-=±2.5V, G_V=0dB, R_S=50Ω, R_L=2kΩ, Ta=+25°C



Voltage Gain vs. Frequency

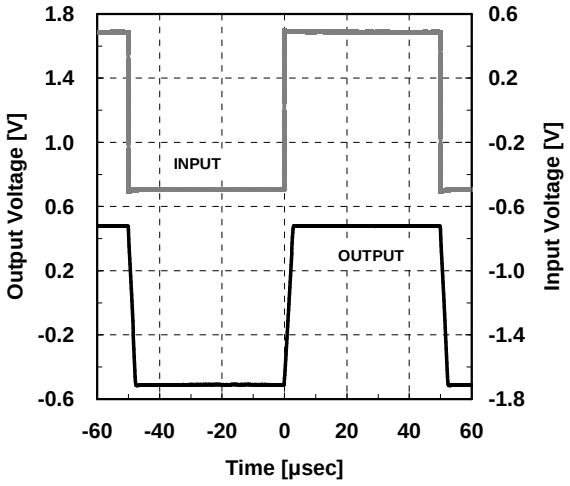
V^+/V^-=±2.5V, G_V=0dB, C_L=1000pF, R_S=50Ω, R_L=2kΩ,



■ TYPICAL CHARACTERISTICS

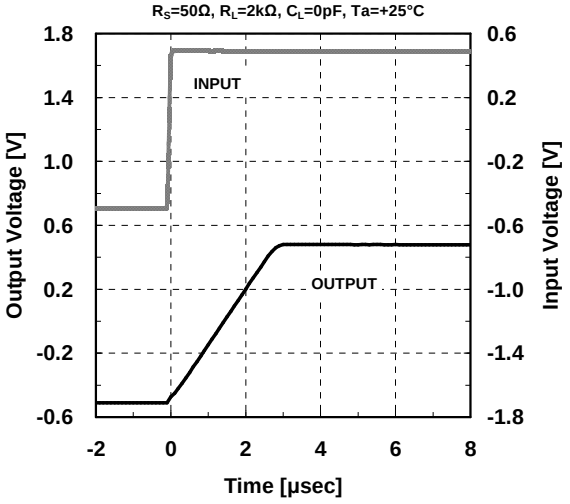
Pulse Response

V^+/V^-=±2.5V, G_V=0dB, f=10kHz, V_{IN}=1V_{PP}
R_S=50Ω, R_L=2kΩ, C_L=0pF, Ta=+25°C



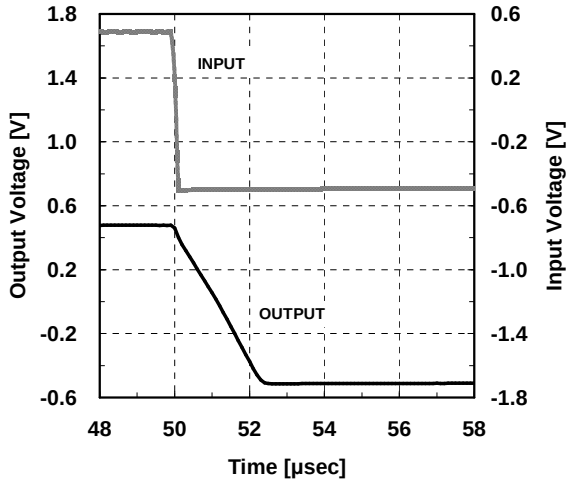
Pulse Response (Rise)

V^+/V^-=±2.5V, G_V=0dB, f=10kHz, V_{IN}=1V_{PP}
R_S=50Ω, R_L=2kΩ, C_L=0pF, Ta=+25°C



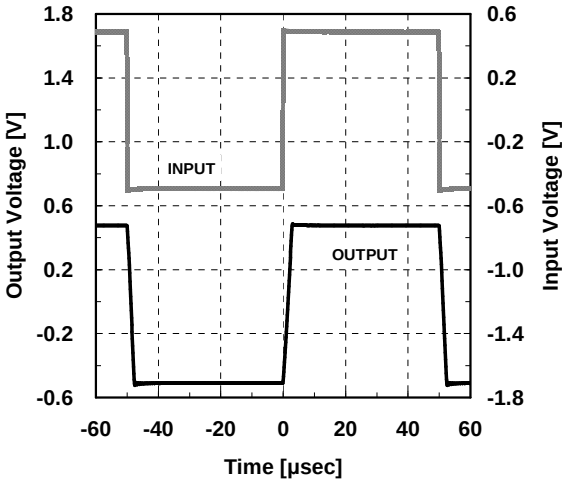
Pulse Response (Fall)

V^+/V^-=±2.5V, G_V=0dB, f=10kHz, V_{IN}=1V_{PP}
R_S=50Ω, R_L=2kΩ, C_L=0pF, Ta=+25°C



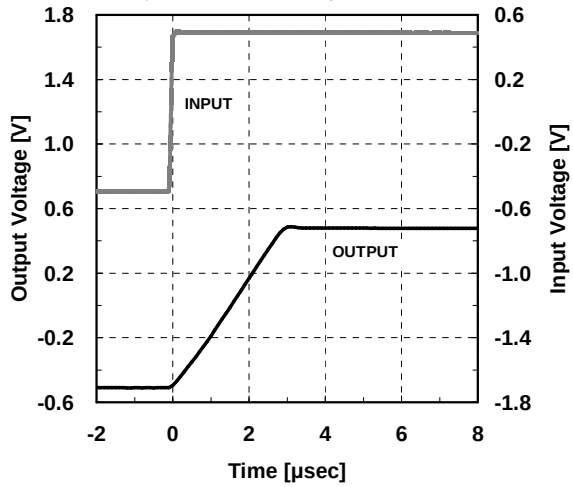
Pulse Response

V^+/V^-=±2.5V, G_V=0dB, f=10kHz, V_{IN}=1V_{PP}
R_S=50Ω, R_L=2kΩ, C_L=1000pF, Ta=+25°C



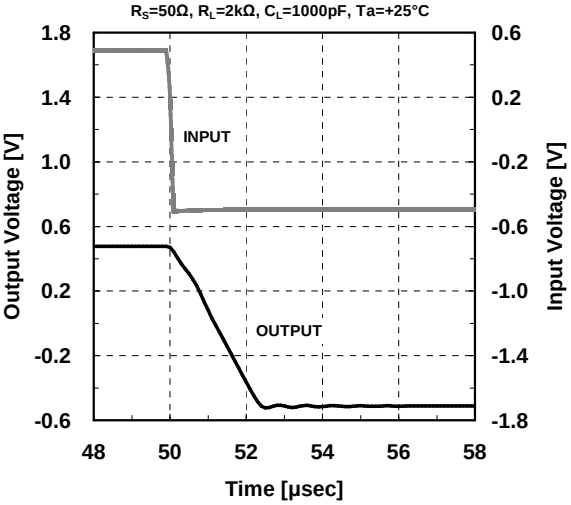
Pulse Response (Rise)

V^+/V^-=±2.5V, G_V=0dB, f=10kHz, V_{IN}=1V_{PP}
R_S=50Ω, R_L=2kΩ, C_L=1000pF, Ta=+25°C



Pulse Response (Fall)

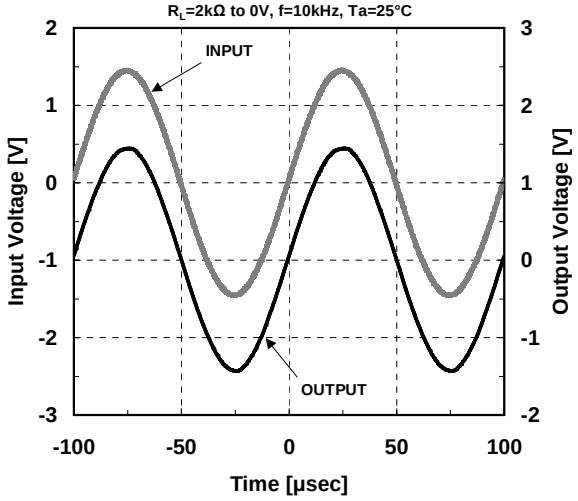
V^+/V^-=±2.5V, G_V=0dB, f=10kHz, V_{IN}=1V_{PP}
R_S=50Ω, R_L=2kΩ, C_L=1000pF, Ta=+25°C



■ TYPICAL CHARACTERISTICS

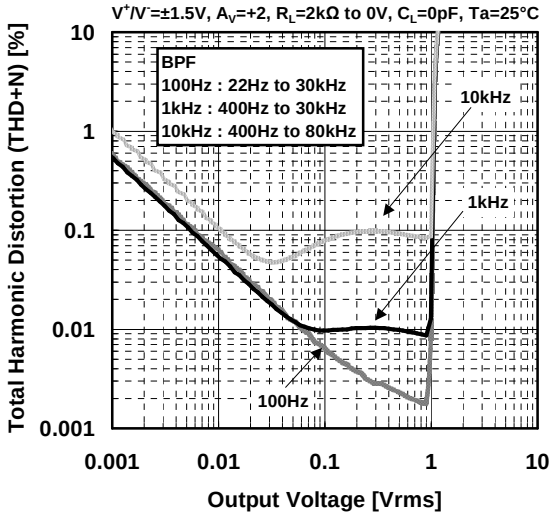
Sin Wave Response

V^+/V^-=±1.5V, A_V=0dB, V_{IN}=3V_{PP}
R_L=2kΩ to 0V, f=10kHz, Ta=25°C



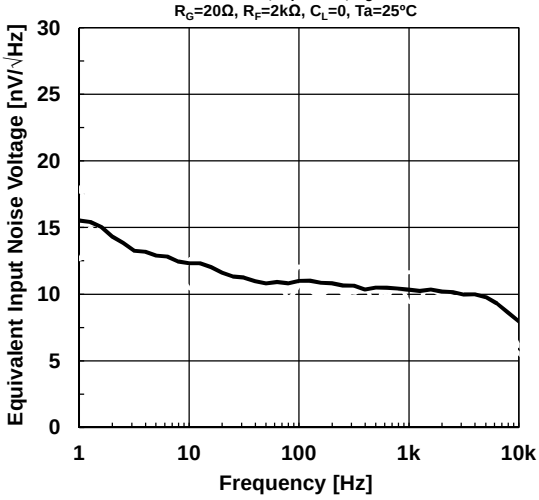
Total Harmonic Distortion vs. Output Voltage

V^+/V^-=±1.5V, A_V=+2, R_L=2kΩ to 0V, C_L=0pF, Ta=25°C



Equivalent Input Noise Voltage vs. Frequency

V^+/V^-=±2.5V, G_V=40dB, R_S=20Ω
R_G=20Ω, R_F=2kΩ, C_L=0, Ta=25°C



[CAUTION]
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