Rail-to-Rail Input/Output Dual Operational Amplifier

■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. (Ta=25ºC) 10mV max. (Ta= -40 ºC to +105 ºC)
●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	DMP8, MSOP8 (TVSP8) MEET JEDEC MO-187-DA / THIN TYPE
●AEC-Q100	This product meets the reliability level required by AEC-Q100.

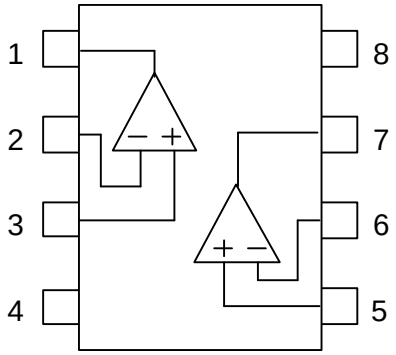
■ PACKAGE OUTLINE

NJM2732M-T
(DMP8)

NJM2732RB1-T
(MSOP8 (TVSP8))

■ PIN CONFIGURATION

(Top View)



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

NJM2732M-T
NJM2732RB1-T

■ 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 to 7.0 (Note1)		V
Power Dissipation	P_D	DMP8	380 (Note2)	mW
		MSOP8 (TVSP8)	410 (Note2)	
Operating Temperature Range	T_{opr}	-40 to +105		˚C
Storage Temperature Range	T_{stg}	-40 to +125		˚C

(Note1) For supply voltage less than 7V, the absolute maximum input voltage is equal to the supply voltage.

(Note2) On the PCB "EIA/JEDEC (114.3×76.2×1.6mm, 2 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
		No signal applied, Ta=-40 ˚C to +105 ˚C	-	-	1000	
Input Offset Voltage	V_{IO}		-	1	5	mV
		Ta=-40 ˚C to +105 ˚C	-	-	10	
Input Bias Current	I_B		-	50	250	nA
		Ta=-40 ˚C to +105 ˚C	-	-	275	
Input Offset Current	I_{IO}		-	5	100	nA
		Ta=-40 ˚C to +105 ˚C	-	-	100	
Large Signal Voltage Gain	A_V	R_L=2kΩ	60	85	-	dB
		R_L=2kΩ, Ta=-40 ˚C to +105 ˚C	58	-	-	
Common Mode Rejection Ratio	CMR	CMR+: 2.5V≤V_{CM}≤5V CMR-: 0V≤V_{CM}≤2.5V (Note3)	55	70	-	dB
		CMR+: 2.5V≤V_{CM}≤5V CMR-: 0V≤V_{CM}≤2.5V (Note3), Ta=-40 ˚C to +105 ˚C	55	-	-	
Supply Voltage Rejection Ratio	SVR	V^+/V^-=±2.0V to ±3.0V	70	85	-	dB
		V^+/V^-=±2.0V to ±3.0V, Ta=-40 ˚C to +105 ˚C	70	-	-	
Maximum Output Voltage 1	V_{OH1}	R_L=20kΩ	4.9	4.95	-	V
		R_L=20kΩ, Ta=-40 ˚C to +105 ˚C	4.85	-	-	
	V_{OL1}	R_L=20kΩ	-	0.05	0.10	V
		R_L=20kΩ, Ta=-40 ˚C to +105 ˚C	-	-	0.15	
Maximum Output Voltage 2	V_{OH2}	R_L=2kΩ	4.75	4.85	-	V
		R_L=2kΩ, Ta=-40 ˚C to +105 ˚C	4.70	-	-	
	V_{OL2}	R_L=2kΩ	-	0.15	0.25	V
		R_L=2kΩ, Ta=-40 ˚C to +105 ˚C	-	-	0.30	
Input Common Mode Voltage Range	V_{ICM}	CMR≥55dB	0	-	5	V
		CMR≥55dB, Ta=-40 ˚C to +105 ˚C	0	-	5	

(Note3) 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
		No signal applied, Ta=-40 ˚C to +105 ˚C	-	-	980	
Input Offset Voltage	V_{IO}		-	1	5	mV
		Ta=-40 ˚C to +105 ˚C	-	-	10	
Input Bias Current	I_B		-	50	250	nA
		Ta=-40 ˚C to +105 ˚C	-	-	275	
Input Offset Current	I_{IO}		-	5	100	nA
		Ta=-40 ˚C to +105 ˚C	-	-	100	
Large Signal Voltage Gain	A_V	R_L=2kΩ	60	84	-	dB
		R_L=2kΩ, Ta=-40 ˚C to +105 ˚C	58	-	-	
Common Mode Rejection Ratio	CMR	CMR+: 1.5V≤V_{CM}≤3V CMR-: 0V≤V_{CM}≤1.5V (Note4)	48	63	-	dB
		CMR+: 1.5V≤V_{CM}≤3V CMR-: 0V≤V_{CM}≤1.5V (Note4) Ta=-40 ˚C to +105 ˚C	48	-	-	
Supply Voltage Rejection Ratio	SVR	V^+/V^-=±1.2V to ±2.0V	68	83	-	dB
		V^+/V^-=±1.2V to ±2.0V, Ta=-40 ˚C to +105 ˚C	68	-	-	
Maximum Output Voltage 1	V_{OH1}	R_L=20kΩ	2.90	2.95	-	V
		R_L=20kΩ, Ta=-40 ˚C to +105 ˚C	2.85	-	-	
	V_{OL1}	R_L=20kΩ	-	0.05	0.10	V
		R_L=20kΩ, Ta=-40 ˚C to +105 ˚C	-	-	0.15	
Maximum Output Voltage 2	V_{OH2}	R_L=2kΩ	2.75	2.85	-	V
		R_L=2kΩ, Ta=-40 ˚C to +105 ˚C	2.70	-	-	
	V_{OL2}	R_L=2kΩ	-	0.15	0.25	V
		R_L=2kΩ, Ta=-40 ˚C to +105 ˚C	-	-	0.30	
Input Common Mode Voltage Range	V_{ICM}	CMR≥48dB	0	-	3	V
		CMR≥48dB, Ta=-40 ˚C to +105 ˚C	0	-	3	

(Note4) 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
		No signal applied, Ta=-40 ˚C to +105 ˚C	-	-	900	
Input Offset Voltage	V_{IO}		-	1	5	mV
		Ta=-40 ˚C to +105 ˚C	-	-	10	
Input Bias Current	I_B		-	50	250	nA
		Ta=-40 ˚C to +105 ˚C	-	-	275	
Input Offset Current	I_{IO}		-	5	100	nA
		Ta=-40 ˚C to +105 ˚C	-	-	100	
Large Signal Voltage Gain	A_V	R_L=2kΩ	60	83	-	dB
		R_L=2kΩ, Ta=-40 ˚C to +105 ˚C	50	-	-	
Common Mode Rejection Ratio	CMR	CMR+: 0. 9V≤V_{CM}≤1.8V CMR-: 0V≤V_{CM}≤0.9V (Note5)	40	55	-	dB
		CMR+: 0. 9V≤V_{CM}≤1.8V CMR-: 0V≤V_{CM}≤0.9V (Note5), Ta=-40 ˚C to +105 ˚C	40	-	-	
Supply Voltage Rejection Ratio	SVR	V^+/V^-=±1.2V to ±2.0V	65	80	-	dB
		V^+/V^-=±1.2V to ±2.0V Ta=-40 ˚C to +105 ˚C	55	-	-	
Maximum Output Voltage 1	V_{OH1}	R_L=20kΩ	1.70	1.75	-	V
		R_L=20kΩ, Ta=-40 ˚C to +105 ˚C	1.65	-	-	
	V_{OL1}	R_L=20kΩ	-	0.05	0.10	V
		R_L=20kΩ, Ta=-40 ˚C to +105 ˚C	-	-	0.15	
Maximum Output Voltage 2	V_{OH2}	R_L=2kΩ	1.55	1.65	-	V
		R_L=2kΩ, Ta=-40 ˚C to +105 ˚C	1.50	-	-	
	V_{OL2}	R_L=2kΩ	-	0.15	0.25	V
		R_L=2kΩ, Ta=-40 ˚C to +105 ˚C	-	-	0.30	
Input Common Mode Voltage Range	V_{ICM}	CMR≥40dB	0	-	1.8	V
		CMR≥40dB, Ta=-40 ˚C to +105 ˚C	0	-	1.8	

(Note5) 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)

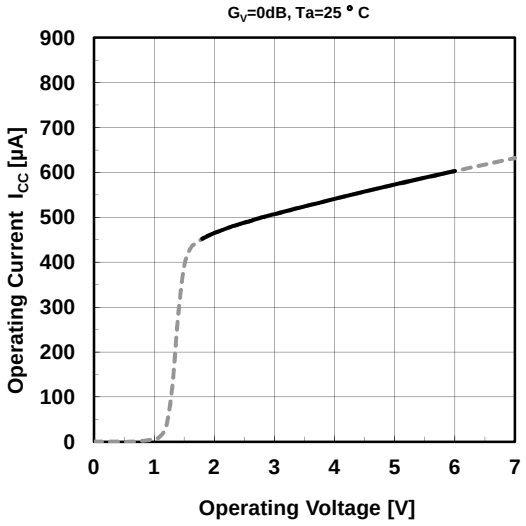
PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Unity Gain Bandwidth	GB	R_L=2kΩ	-	1	-	MHz
Phase Margin	Φ_M	R_L=2kΩ	-	75	-	Deg
Equivalent Input Noise Voltage	V_{NI}	f=1kHz	-	10	-	nV/√Hz

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

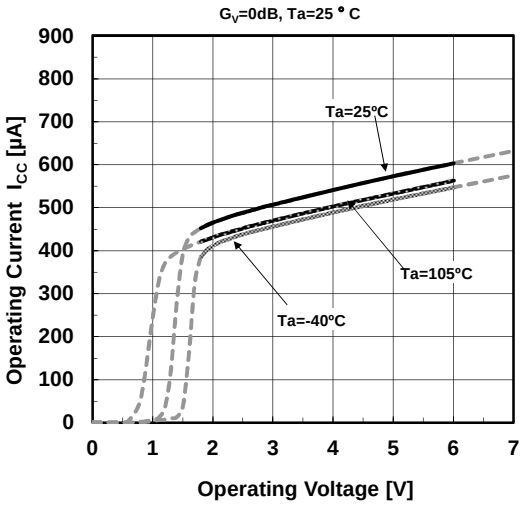
PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Slew Rate	SR	R_L=2kΩ	-	0.3	-	V/µs

■ TYPICAL CHARACTERISTICS

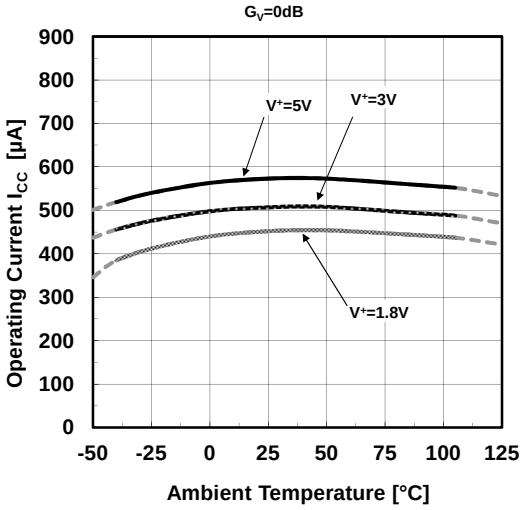
Operating Current vs. Operating Voltage



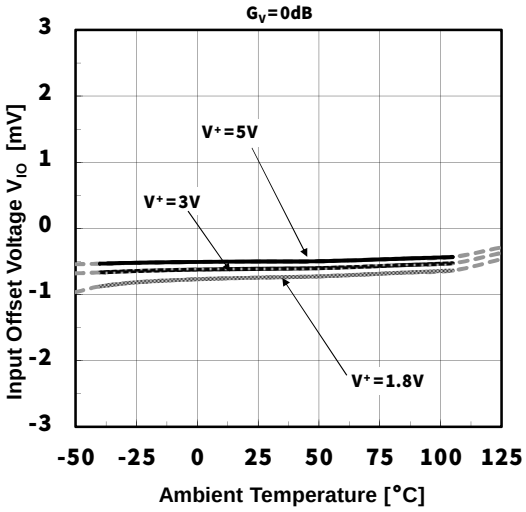
Operating Current vs. Operating Voltage (correlation with Ta)



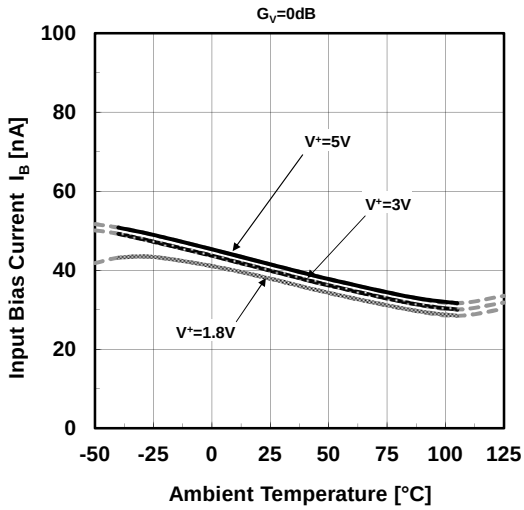
Operating Current vs. Ambient Temperature



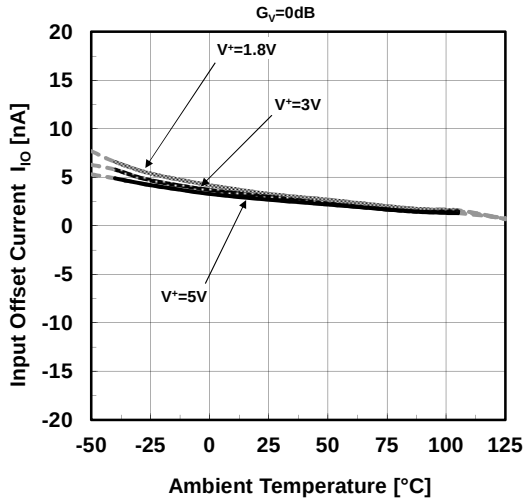
Input Offset Voltage vs. Ambient Temperature



Input Bias Current vs. Ambient Temperature

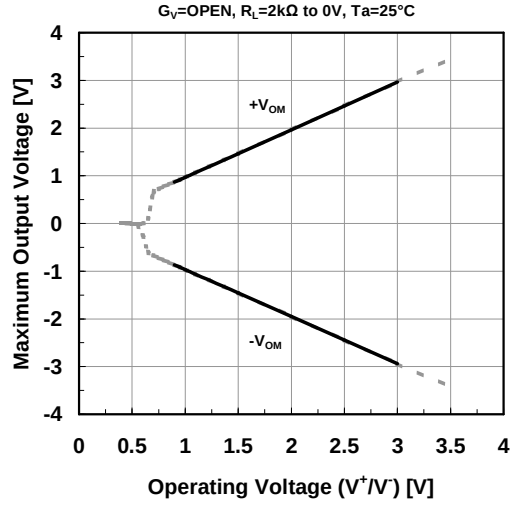


Input Offset Current vs. Ambient Temperature

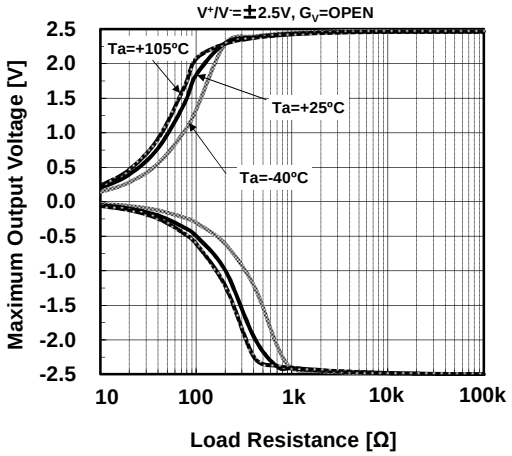


■ TYPICAL CHARACTERISTICS

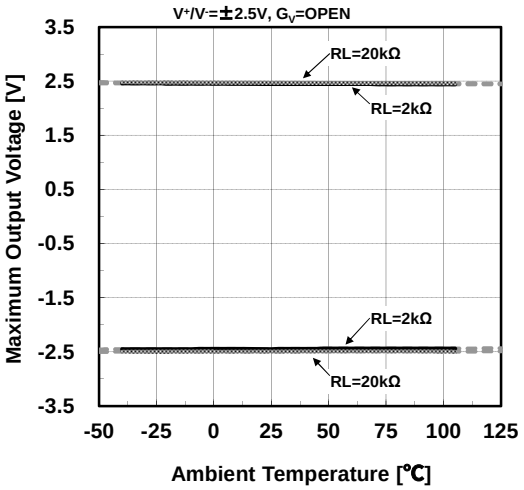
Maximum Output Voltage vs. Operating Voltage



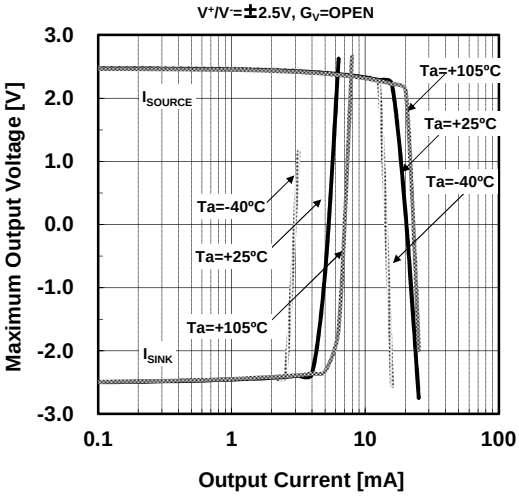
Maximum Output Voltage vs. Load Resistance (correlation with Ta)



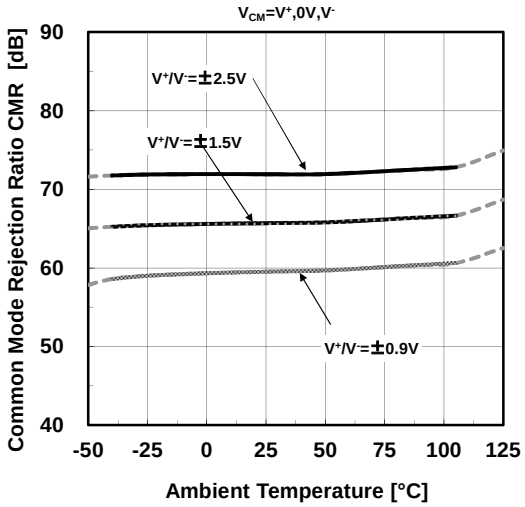
Maximum Output Voltage vs. Ambient Temperature



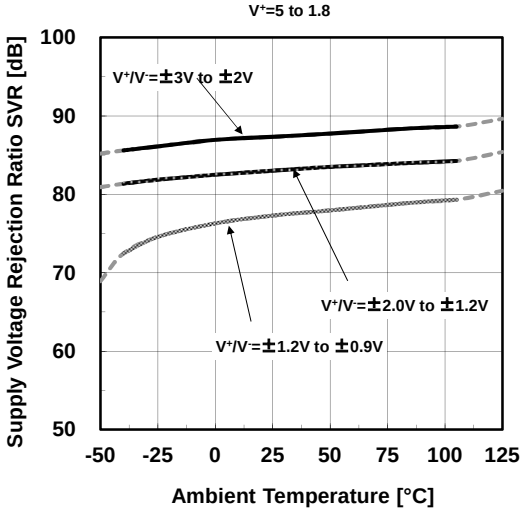
Output Voltage vs. Output Current (correlation with Ta)



Common Mode Rejection Ratio vs. Ambient Temperature



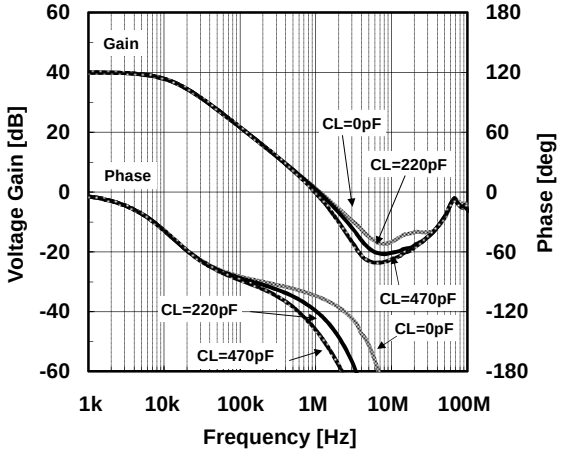
Supply Voltage Rejection Ratio vs. Ambient Temperature



■ TYPICAL CHARACTERISTICS

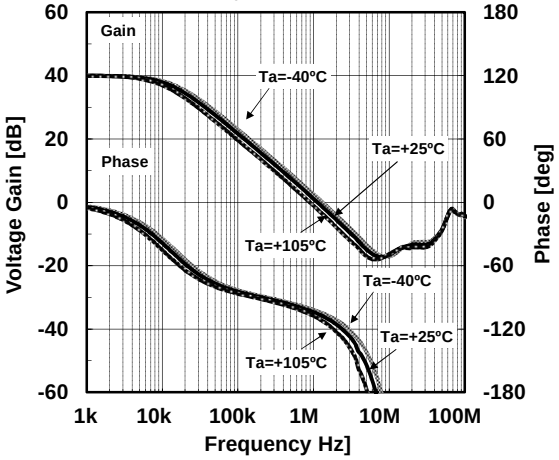
Voltage Gain/Phase vs. Frequency (with Capacitive load)

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



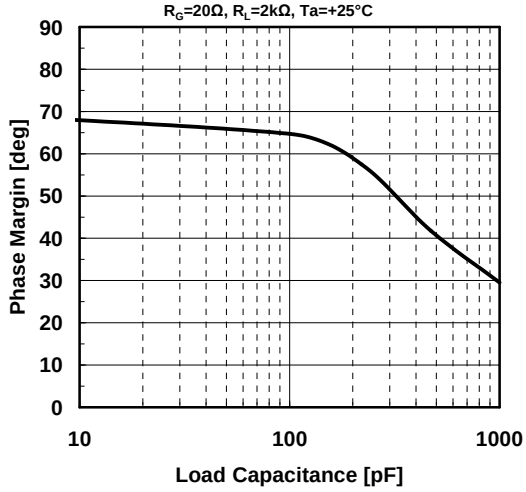
Voltage Gain/Phase vs. Frequency (correlation with Ta)

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



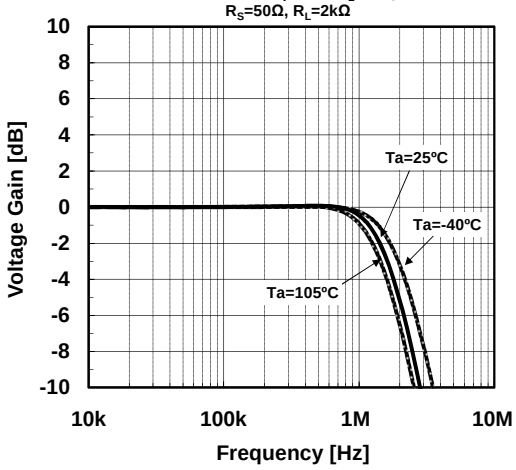
Phase Margin vs. Load Capacitance

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



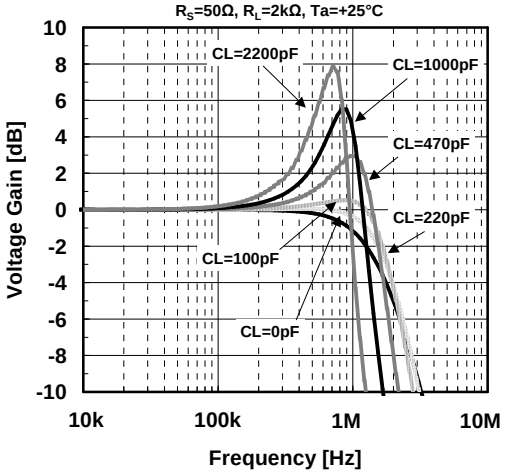
Voltage Gain vs. Frequency (correlation with Ta)

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



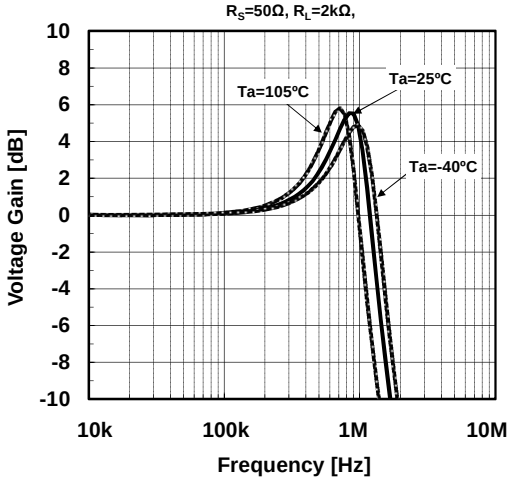
Voltage Gain vs. Frequency

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



Voltage Gain vs. Frequency (correlation with Ta)

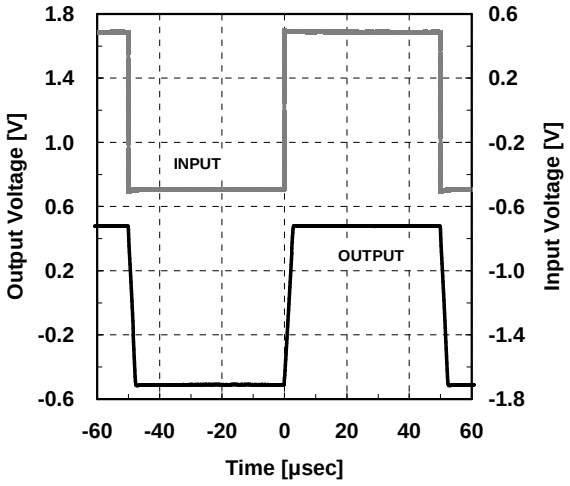
V^+/V^-=±2.5V, G_V=0dB, C_L=1000pF, R_S=50Ω, R_L=2kΩ,



■ TYPICAL CHARACTERISTICS

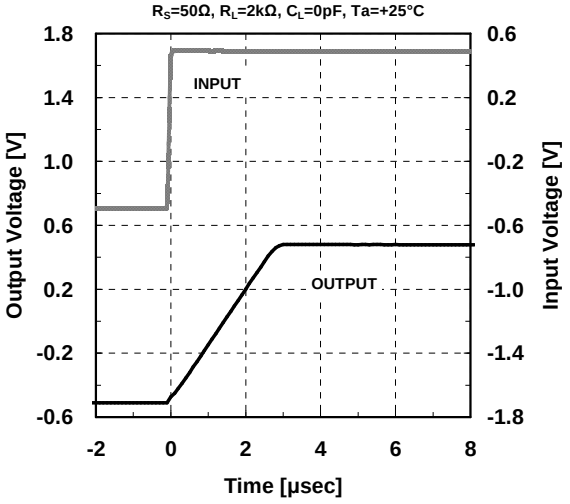
Pulse Response

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



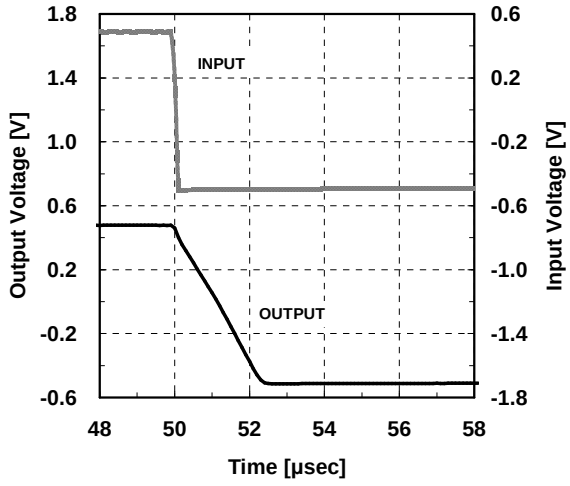
Pulse Response (Rise)

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



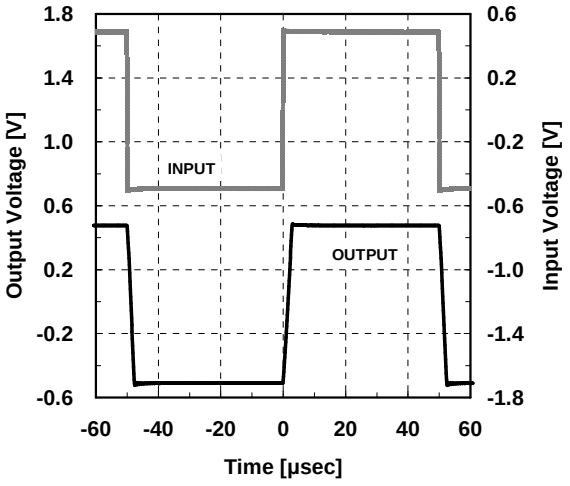
Pulse Response (Fall)

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



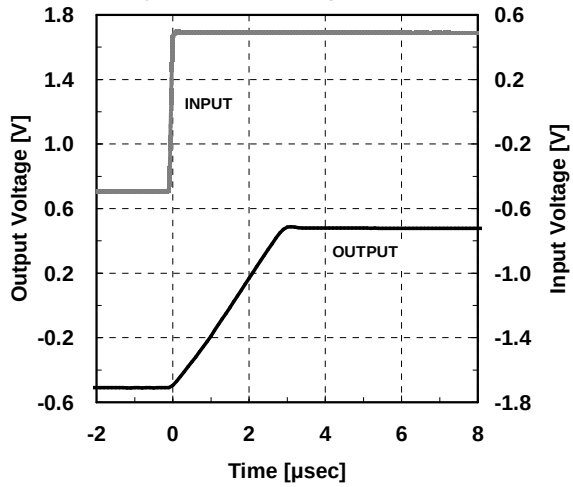
Pulse Response

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



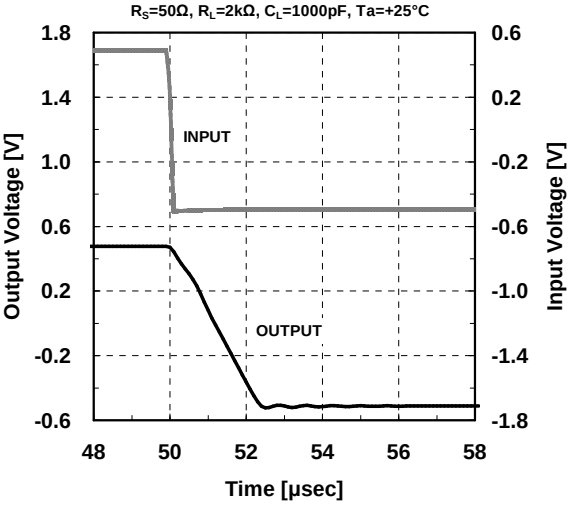
Pulse Response (Rise)

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)

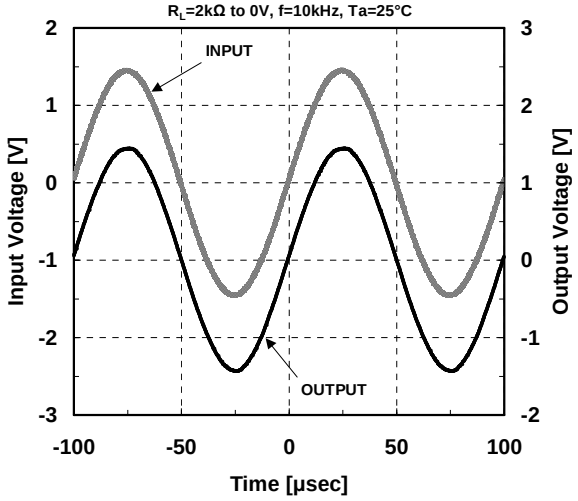
V^+/V^-=±2.5V, G_V=0dB, f=10kHz, V_{IN}=$1V_{PP}$
R_S=50Ω, R_L=2kΩ, C_L=1000pF, Ta=+25°C



■ TYPICAL CHARACTERISTICS

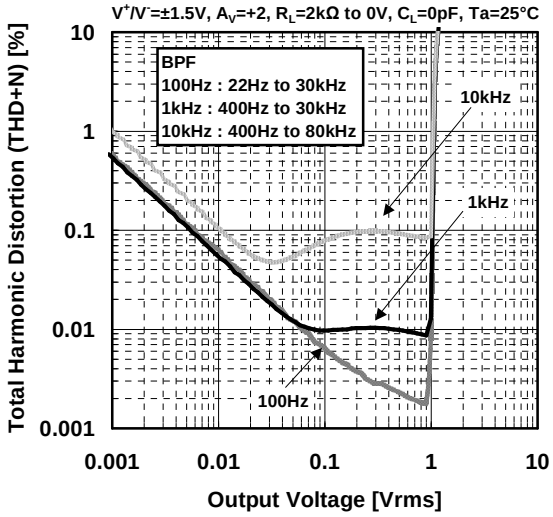
Sin Wave Response

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



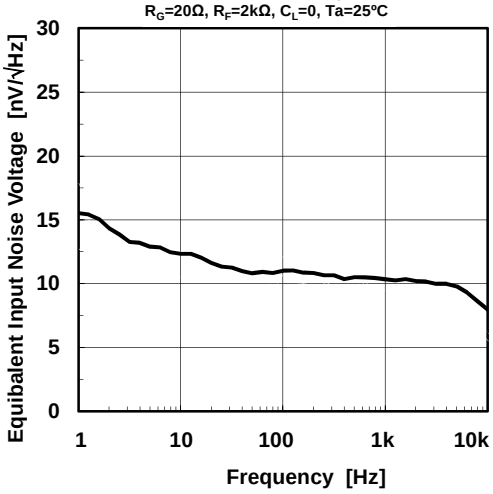
Total Harmonic Distortion vs. Output Voltage

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



Equibalent 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=25ºC



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