

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.

■ 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 $V_{OH} \geq 4.9V / V_{OL} \leq 0.1V$, (at $V^+ = 5V, R_L = 20k\Omega$)
- Load Drivability $V_{OH} \geq 4.75V / V_{OL} \leq 0.25V$, (at $V^+ = 5V, R_L = 2k\Omega$)
- Offset Voltage 5mV max.
- Slew Rate 0.4V/ μ s typ.
- Low Input Voltage Noise 10nV/ \sqrt{Hz} typ. (at $f = 1kHz$)
- Adequate phase margin $\Phi_M = 75deg.$ typ. (at $R_L = 2k\Omega$, voltage follower)
- Bipolar Technology
- Package Outline

DIP8, DMP8, SOP8 JEDEC 150mil, SSOP8, PCSP20-CC
MSOP8 (TVSP8) MEET JEDEC MO-187-DA/ THIN TYPE

■ PACKAGE OUTLINE



NJM2732D
(DIP8)



NJM2732M
(DMP8)



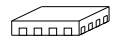
NJM2732E
(EMP8)



NJM2732V
(SSOP8)



NJM2732RB1
(TVSP8)

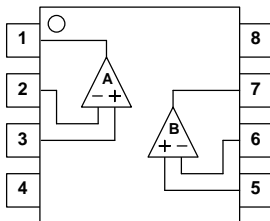


NJM2732SCC
(PCSP20-CC)

■ PIN CONFIGURATION

○ NJM2732D,E,M,V, RB1

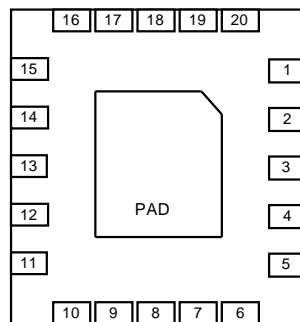
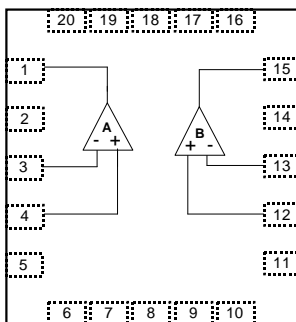
(Top View)



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.

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■ 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 ($V^+=3V, T_a=25^\circ C$)

●DC CHARACTERISTICS

($V^+=3V, T_a=25^\circ C$)

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	$R_L=2k\Omega$	60	84	-	dB
Common Mode Rejection Ratio	CMR	CMR+: $1.5V \leq V_{CM} \leq 3V$ CMR-: $0V \leq V_{CM} \leq 1.5V$ (Note7)	48	63	-	dB
Supply Voltage Rejection Ratio	SVR	$V^+V = \pm 1.2V \sim \pm 2.0V$	68	83	-	dB
Maximum Output Voltage 1	V_{OH1}	$R_L=20k\Omega$	2.9	2.95	-	V
	V_{OL1}	$R_L=20k\Omega$	-	0.05	0.1	V
Maximum Output Voltage 2	V_{OH2}	$R_L=2k\Omega$	2.75	2.85	-	V
	V_{OL2}	$R_L=2k\Omega$	-	0.15	0.25	V
Input Common Mode Voltage Range	V_{ICM}	CMR ≥ 48 dB	0	-	3	V

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

CMR+ is measured with $1.5V \leq V_{CM} \leq 3.0$ and CMR- is measured with $0V \leq V_{CM} \leq 1.5V$.

●AC CHARACTERISTICS

($V^+=3V, T_a=25^\circ C$)

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

●TRANSIENT CHARACTERISTICS

($V^+=3V, T_a=25^\circ C$)

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

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■ ELECTRICAL CHARACTERISTICS ($V^+=1.8V$, $T_a=25^\circ C$)

●DC CHARACTERISTICS

($V^+=1.8V$, $T_a=25^\circ C$)

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	$R_L=2k\Omega$	60	83	-	dB
Common Mode Rejection Ratio	CMR	CMR+: $0.9V \leq V_{CM} \leq 1.8V$ CMR-: $0V \leq V_{CM} \leq 0.9V$ (Note8)	40	55	-	dB
Supply Voltage Rejection Ratio	SVR	$V^+ / V = \pm 1.2V \sim \pm 2.0V$	65	80	-	dB
Maximum Output Voltage 1	V_{OH1}	$R_L=20k\Omega$	1.7	1.75	-	V
	V_{OL1}	$R_L=20k\Omega$	-	0.05	0.1	V
Maximum Output Voltage 2	V_{OH2}	$R_L=2k\Omega$	1.55	1.65	-	V
	V_{OL2}	$R_L=2k\Omega$	-	0.15	0.25	V
Input Common Mode Voltage Range	V_{ICM}	CMR ≥ 40 dB	0	-	1.8	V

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

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

●AC CHARACTERISTICS

($V^+=1.8V$, $T_a=25^\circ C$)

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

●TRANSIENT CHARACTERISTICS

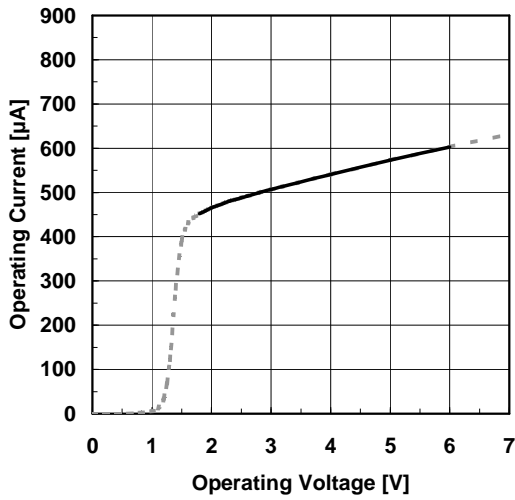
($V^+=1.8V$, $T_a=25^\circ C$)

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

■ TYPICAL CHARACTERISTICS

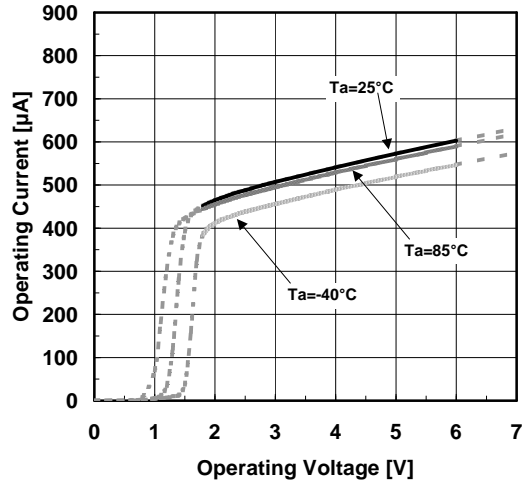
Operating Current vs Operating Voltage

$G_V=0\text{dB}$, $T_a=25^\circ\text{C}$



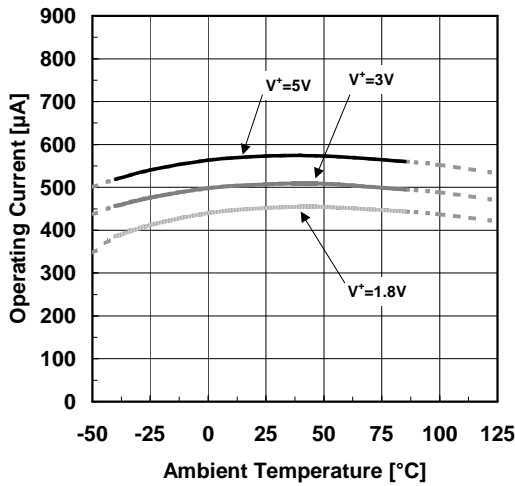
Operating Current vs. Operating Voltage

$G_V=0\text{dB}$, $T_a=25^\circ\text{C}$



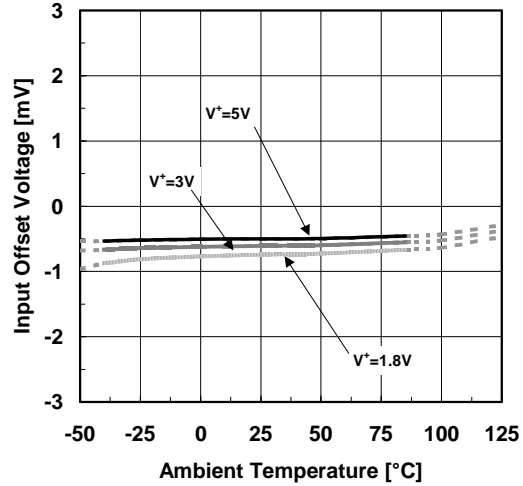
Operating Current vs. Ambient Temperature

$G_V=0\text{dB}$



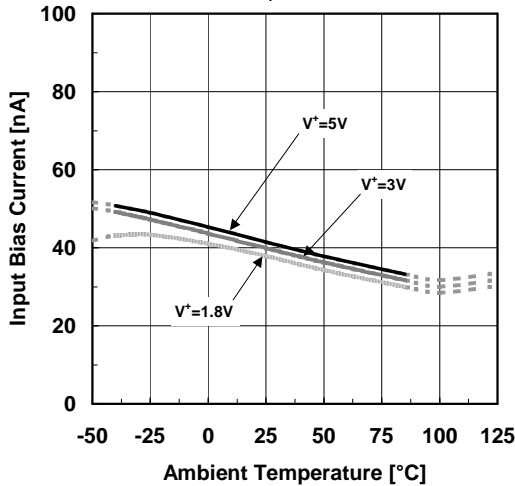
Input Offset Voltage vs. Ambient Temperature

$G_V=0\text{dB}$



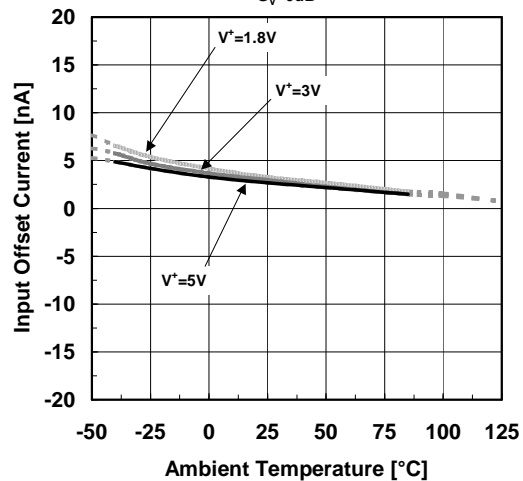
Input Bias Current vs. Ambient Temperature

$G_V=0\text{dB}$



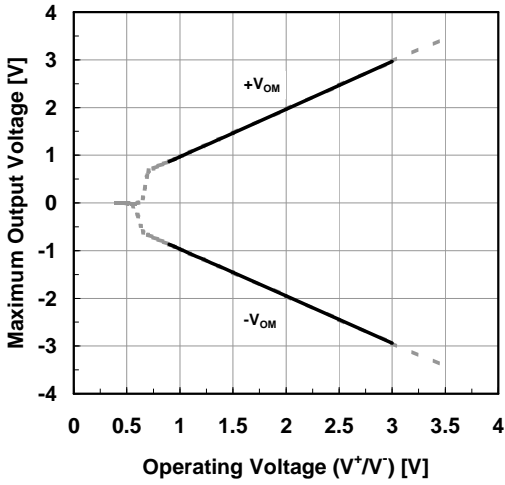
Input Offset Current vs. Ambient Temperature

$G_V=0\text{dB}$

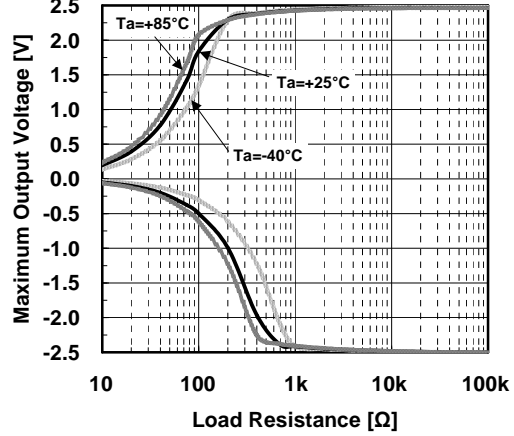


■ TYPICAL CHARACTERISTICS

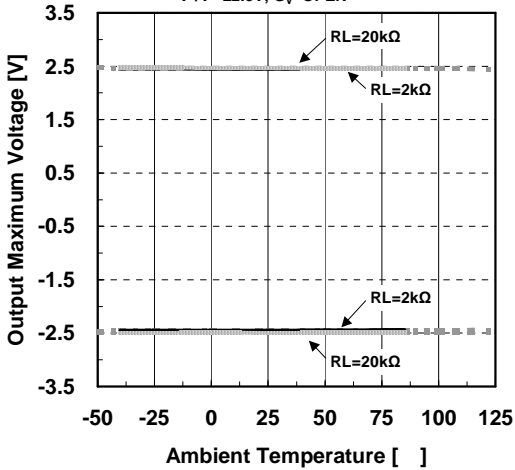
Maximum Output Voltage vs. Operating Voltage
 $G_V=OPEN, R_L=2k\Omega$ to $0V, T_a=25^\circ C$



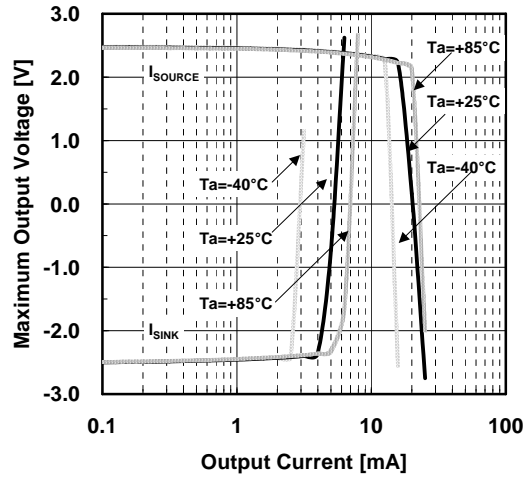
Maximum Output Voltage vs. Load Resistance
 $V^+/V^-=\pm 2.5V, G_V=OPEN$



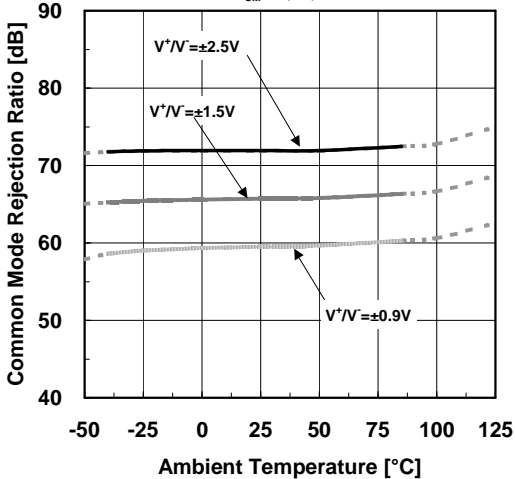
Maximum Output Voltage vs. Ambient Temperature
 $V^+/V^-=\pm 2.5V, G_V=OPEN$



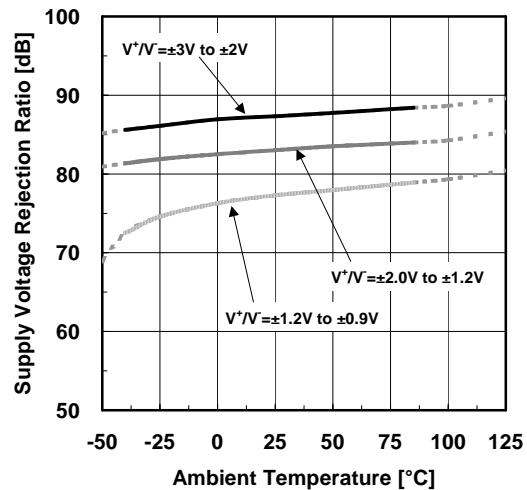
Output Voltage vs. Output Current
 $V^+/V^-=\pm 2.5V, G_V=OPEN$



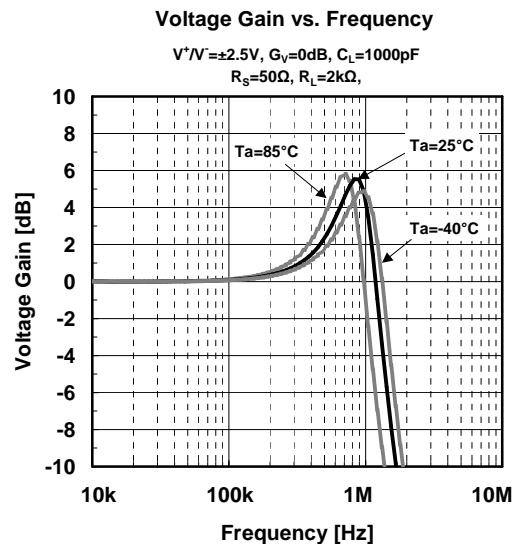
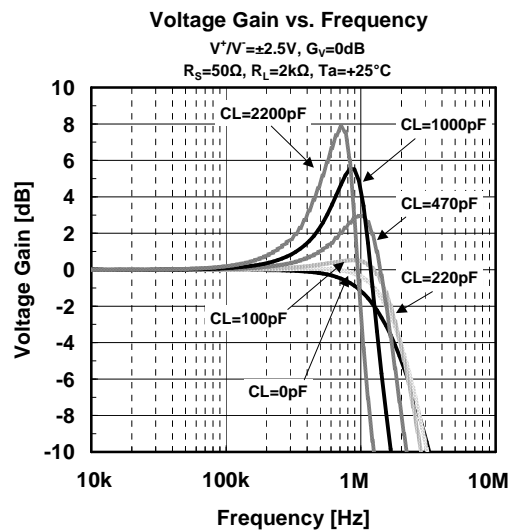
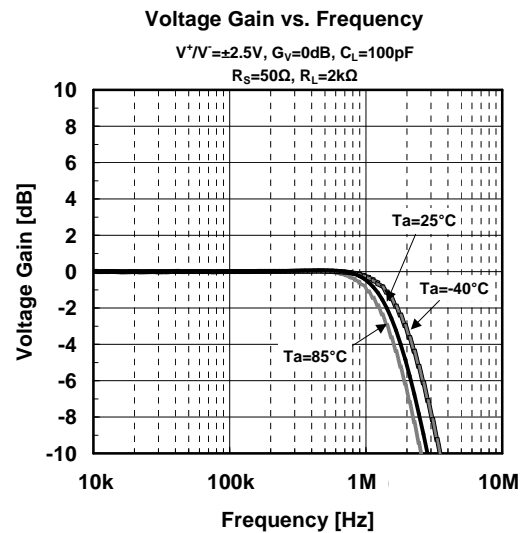
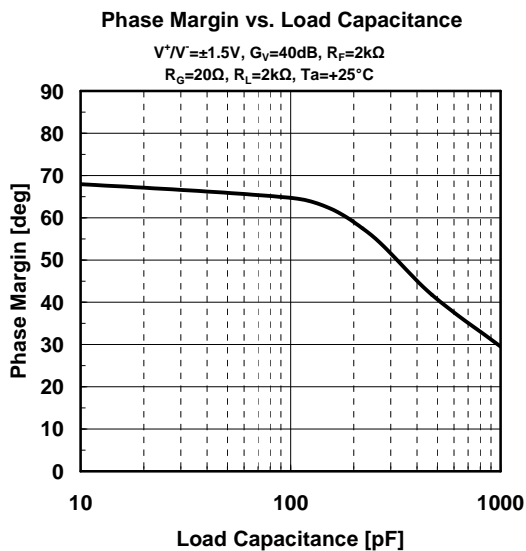
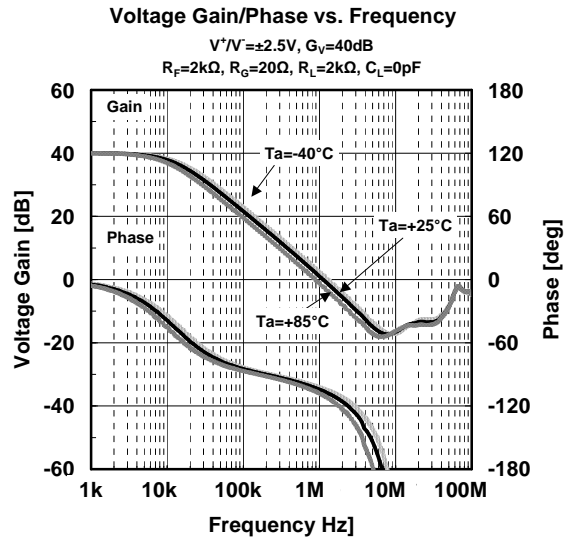
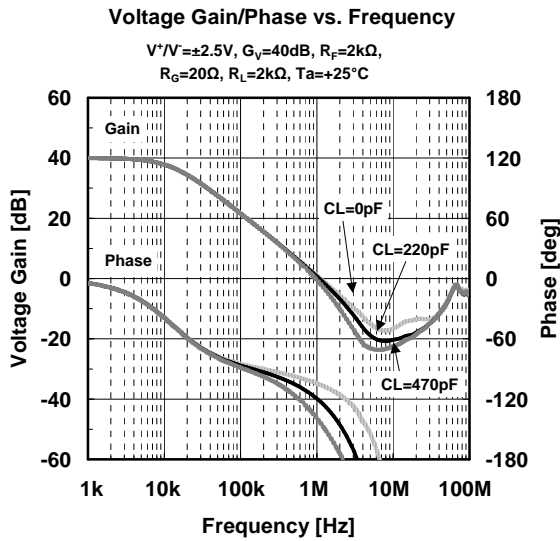
Common Mode Rejection Ratio vs. Ambient Temperature
 $V_{CM}=V^+, 0V, V^-$



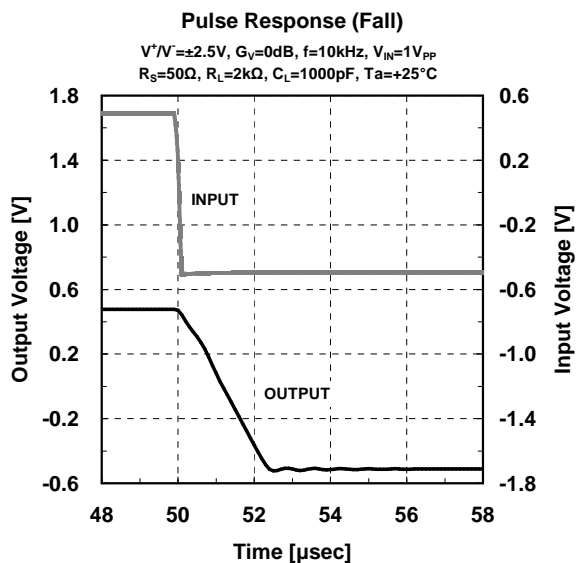
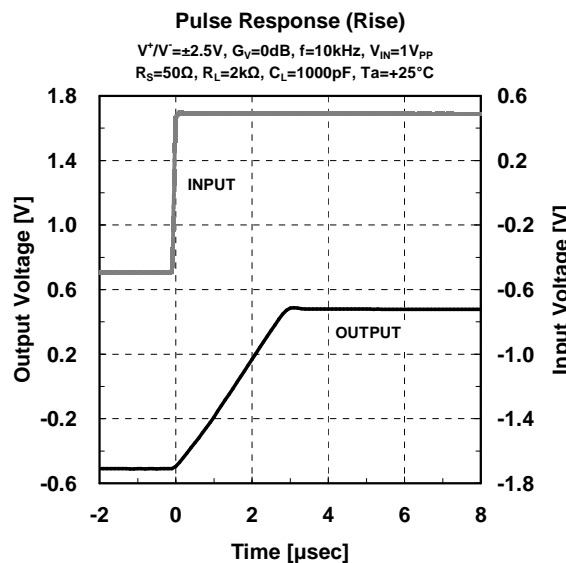
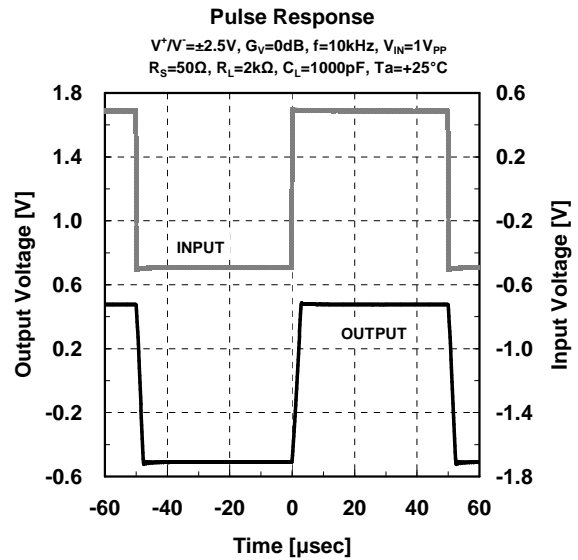
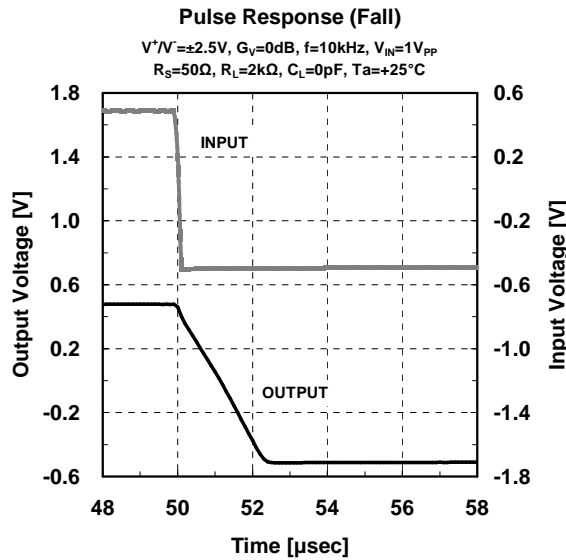
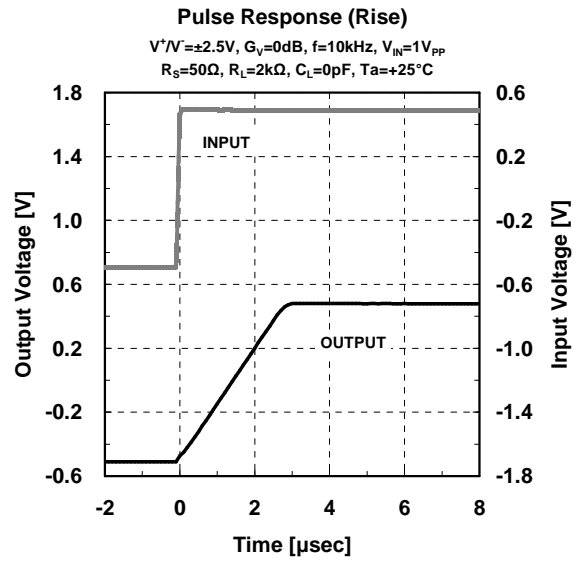
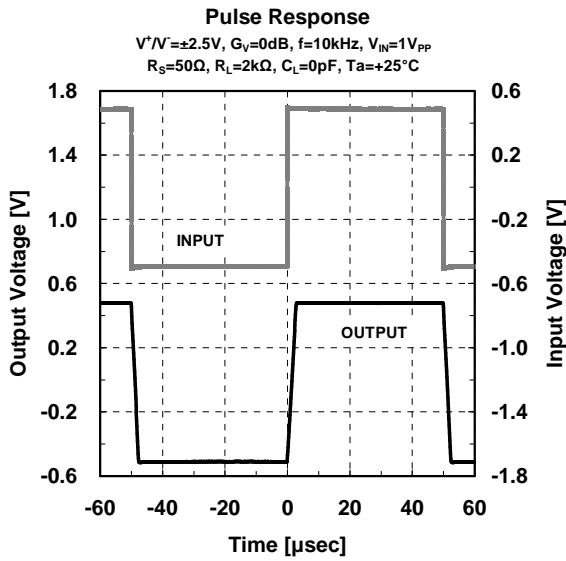
Supply Voltage Rejection Ratio vs. Ambient Temperature



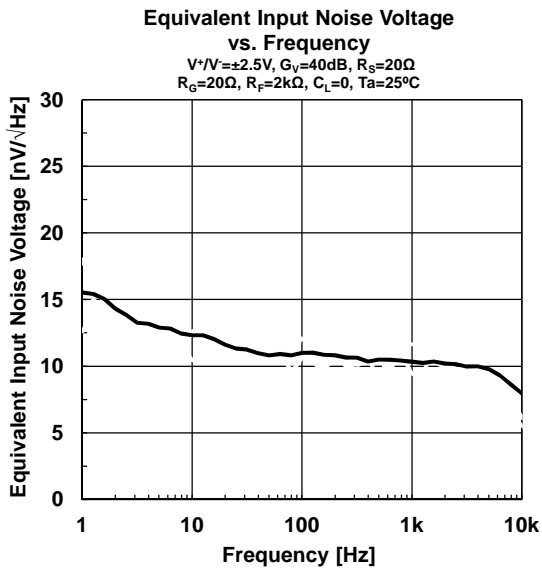
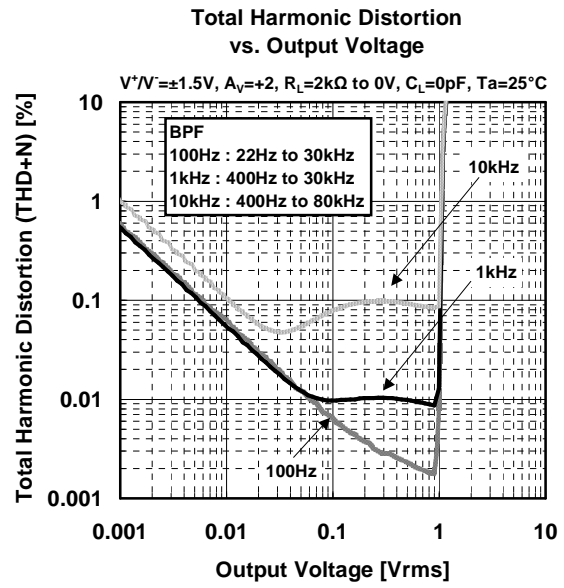
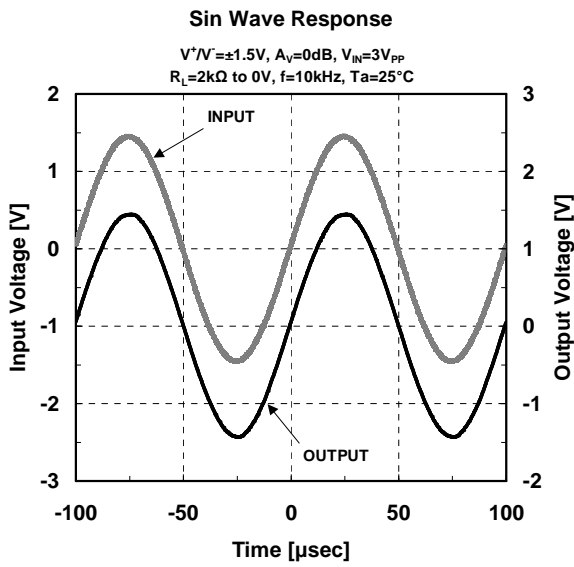
■ TYPICAL CHARACTERISTICS



■ TYPICAL CHARACTERISTICS



■ TYPICAL CHARACTERISTICS



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