# Single Supply, Rail-to-Rail Output Quad Operational Amplifier

## ■GENERAL DESCRIPTION

NJM2747 is a low noise Rail-to-Rail Output quad operational amplifier.

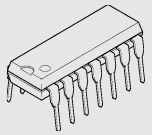
Rail-to-Rail Output function provides wide dynamic range, is from ground to power supply level. And Input range rails from ground level.

It is suitable for audio section of portable sets, PCs and any General-purpose applications.

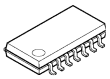
NJM2747SCC is available in the small PCSP package, which saves space on printed circuit boards and suitable for small portable devices.

## ■PACKAGE OUTLINE

Discontinued



NJM2747D



NJM2747M



NJM2747V



NJM2747SCC

## ■ FEATURES

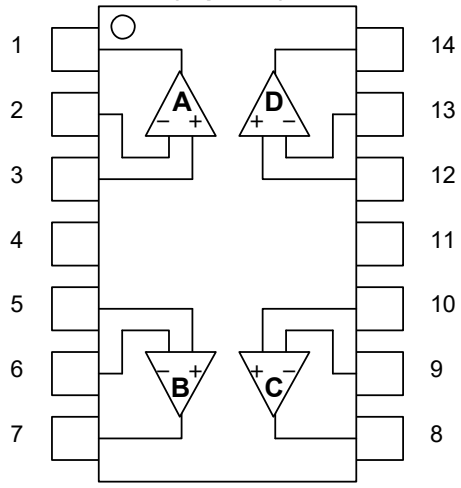
- ●Operating Voltage 2.5V to 14V
- ●Rail-to-Rail Output $V_{OH}$ ≥4.9V Typ. (at $V^+$=5V, $R_L$=5kΩ)
  $V_{OL}$ ≤0.1V Typ. (at $V^+$=5V, $R_L$=5kΩ)
- ●Offset Voltage 1mV Typ.
- ●Slew Rate 3.5V/μs Typ.
- ●Low Distortion 0.001% Typ. (at $V^+$=5V, f=1kHz)
- ●Low Input Voltage Noise 10nV/√Hz Typ. (at f=1kHz)
- ●Bipolar Technology
- ●Package Outline

| | |
|---|---|
| NJM2747D | DIP14 (Lead insertion type) (Discontinued) |
| NJM2747M | DMP14 (Surface mount type) |
| NJM2747V | SSOP14 (Surface mount type) |
| NJM2747SCC | PCSP20-CC (Surface mount type very small size package) |

## ■ PIN CONFIGURATION

● **NJM2747D** (Discontinued), **NJM2747M**, **NJM2747V**

(Top View)

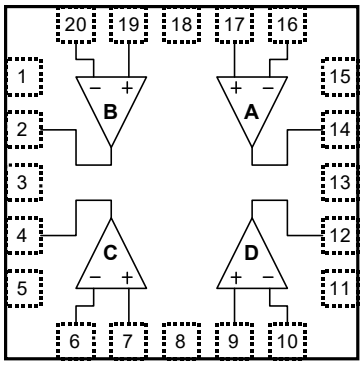



**PIN FUNCTION**

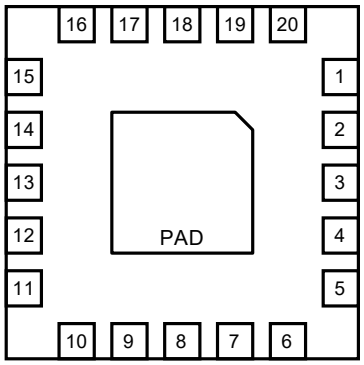
| | |
|---|---|
| 1. OUTPUT A | 8. OUTPUT C |
| 2. –INPUT A | 9. –INPUT C |
| 3. +INPUT A | 10. +INPUT C |
| 4. $V^+$ | 11. GND |
| 5. +INPUT B | 12. +INPUT D |
| 6. –INPUT B | 13. –INPUT D |
| 7. OUTPUT B | 14. OUTPUT D |

● **NJM2747SCC**

(Top View)




(Bottom View)




**PIN FUNCTION**

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

(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.
(Note4) NJM2747SCC package size is [W: 2.7mm, D: 2.7mm, H: 0.8mm]. Please confirm the size information by a package specification.

## ■ ABSOLUTE MAXIMUM RATINGS

| PARAMETER | SYMBOL | RATINGS | UNIT |
|---|---|---|---|
| Supply Voltage | $V^+$ | 15 | V |
| Differential Input Voltage Range | $V_{ID}$ | ±15 (Note5) | V |
| Common Mode Input Voltage Range | $V_{ICM}$ | 0 to 15 (Note5) | V |
| Power Dissipation | $P_D$ | 870 [DIP14] | mW |
| | | 450 [DMP14] (Note6),<br>420 [SSOP14] (Note6),<br>380 [PCSP20-CC] (Note6), | |
| | | 560 [DMP14] (Note7),<br>520 [SSOP14] (Note7),<br>550 [PCSP20-CC] (Note7), | |
| Operating Temperature Range | $T_{opr}$ | -40 to +85 | ˚C |
| Storage Temperature Range | $T_{stg}$ | -50 to +125 | ˚C |

(Note5) For supply voltage less than 15V, the absolute maximum input voltage is equal to the supply voltage.

(Note6) On the PCB " EIA/JEDEC (76.2×114.3×1.6mm, two layers, FR-4) "

(Note7) On the PCB " EIA/JEDEC (76.2×114.3×1.6mm, four layers, FR-4) "

(Note8) Do not exceed "Power dissipation: PD" in which power dissipation in IC is shown by the absolute maximum rating.
Refer to following Figure 1A and Figure 1B for a permissible loss when ambient temperature (Ta) is Ta≥25˚C.

Figure 1A : Power Dissipation – Ambient Temperature

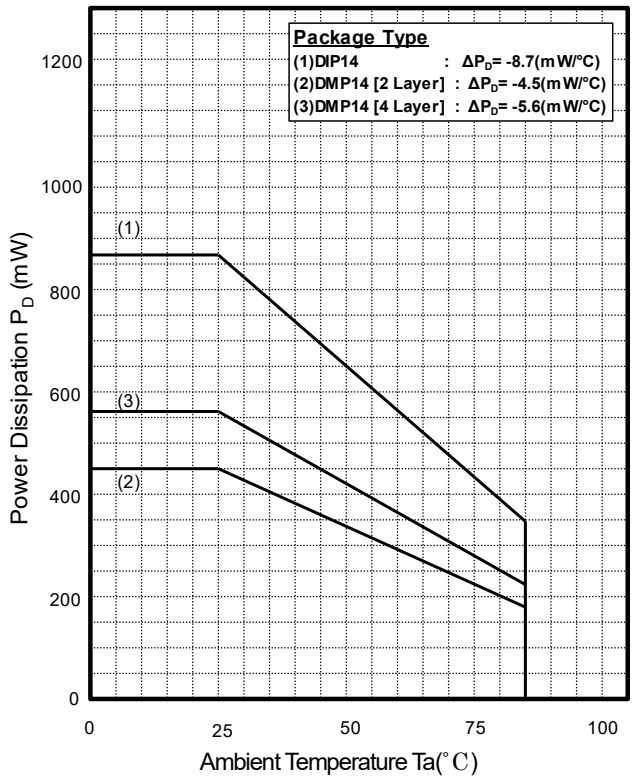
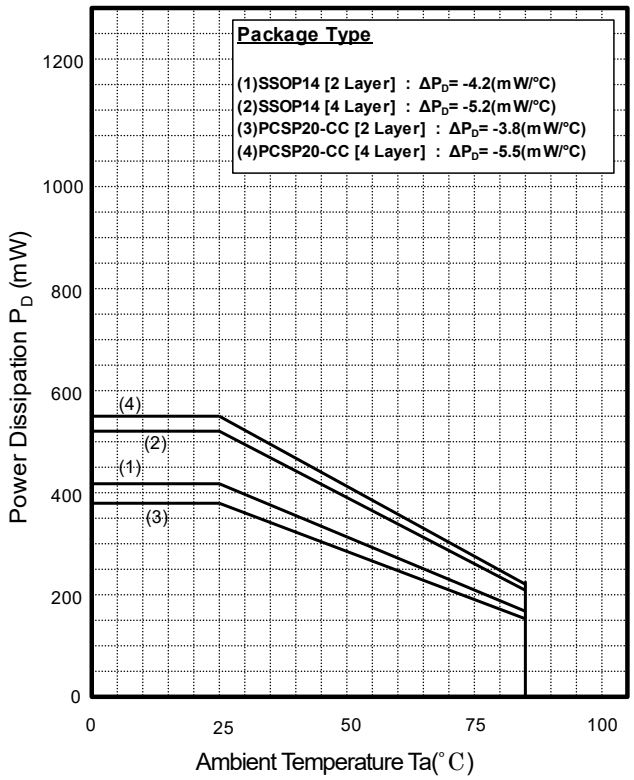



Figure 1B : Power Dissipation – Ambient Temperature




## ■ OPERATING VOLTAGE (Ta=25˚C)

| PARAMETER | SYMBOL | RATINGS | UNIT |
|---|---|---|---|
| Supply Voltage | $V^+$ | 2.5 to 14 (Note8) | V |

## ■ ELECTRICAL CHARACTERISTICS

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

| PARAMETER | SYMBOL | TEST CONDITION | MIN. | TYP. | MAX. | UNIT |
|---|---|---|---|---|---|---|
| Operating Current | $I_{CC}$ | $R_L$=∞, $V_{IN}$=2.5V, No Signal Apply | - | 8 | 11 | mA |
| Input Offset Voltage | $V_{IO}$ | $R_S$ ≤ 10kΩ | - | 1 | 6 | mV |
| Input Bias Current | $I_B$ | | - | 100 | 350 | nA |
| Input Offset Current | $I_{IO}$ | | - | 5 | 100 | nA |
| Large Signal Voltage Gain | $A_V$ | $R_L$≥10kΩ to 2.5V, Vo=0.5V to 4.5V | 65 | 85 | - | dB |
| Common Mode Rejection Ratio | CMR | 0V ≤ $V_{CM}$ ≤ 4V | 60 | 75 | - | dB |
| Supply Voltage Rejection Ratio | SVR | $V^+$=2.5V to 14V | 60 | 80 | - | dB |
| Output Voltage | $V_{OH}$ | $R_L$=5kΩ to 2.5V | 4.75 | 4.9 | - | V |
| | $V_{OL}$ | $R_L$=5kΩ to 2.5V | - | 0.1 | 0.25 | V |
| Input Common Mode Voltage Range | $V_{ICM}$ | CMR ≥ 60dB | 0 | - | 4 | V |

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

| PARAMETER | SYMBOL | TEST CONDITION | MIN. | TYP. | MAX. | UNIT |
|---|---|---|---|---|---|---|
| Unity Gain Bandwidth | GB | f=10kHz | - | 10 | - | MHz |
| Phase Margin | $\Phi_M$ | $R_L$=10kΩ, $C_L$=10pF | - | 75 | - | Deg |
| Equivalent Input Noise Voltage | $V_{NI}$ | f=1kHz, $V_{CM}$=2.5V | - | 10 | - | nV/√Hz |
| Total Harmonic Distortion | THD | f=1kHz, $A_V$=+2 $R_L$=10kΩ to 2.5V, Vo=1.5Vrms | - | 0.001 | - | % |
| Amp to Amp Separation | CS | f=1kHz $R_L$=10kΩ to 2.5V, Vo=1.5Vrms | - | 120 | - | dB |

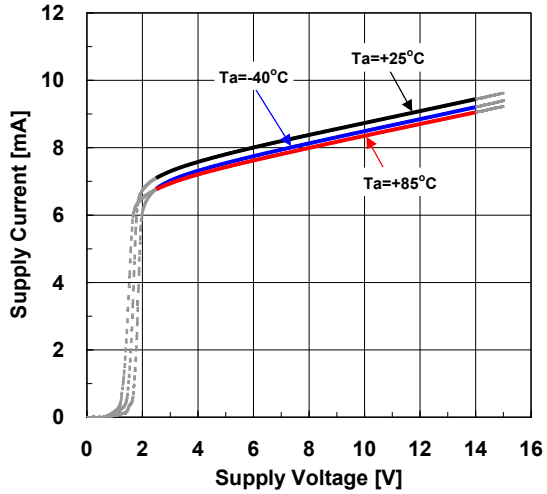
●AC CHARACTERISTICS ($V^+$=5V,Ta=25˚C)

| PARAMETER | SYMBOL | TEST CONDITION | MIN. | TYP. | MAX. | UNIT |
|---|---|---|---|---|---|---|
| Slew Rate | SR | (Note 9), $A_V$=1, $V_{IN}$=2Vpp $R_L$=10kΩ to 2.5V $C_L$=10pF to 2.5V | - | 3.5 | - | V/μs |

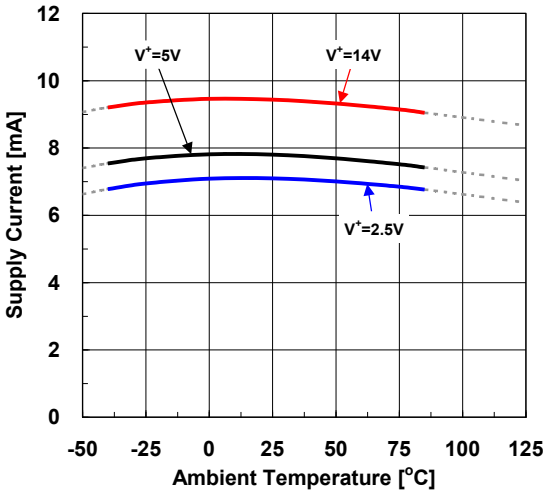
(Note 9) Number specified is the slower of the positive and negative slew rates.

## ■ TYPICAL CHARACTERISTICS

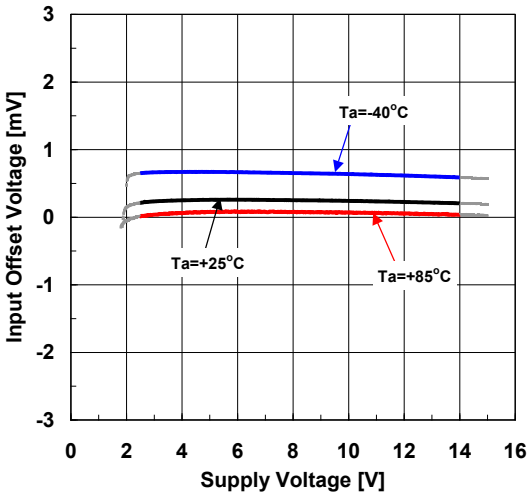
Supply Current vs. Supply Voltage
(Temperature)
$G_V$=0dB



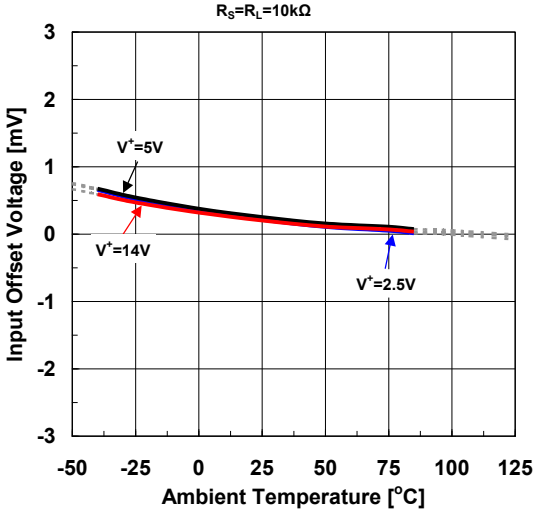

Supply Current vs. Ambient Temperature
(Supply Voltage)
$G_V$=0dB



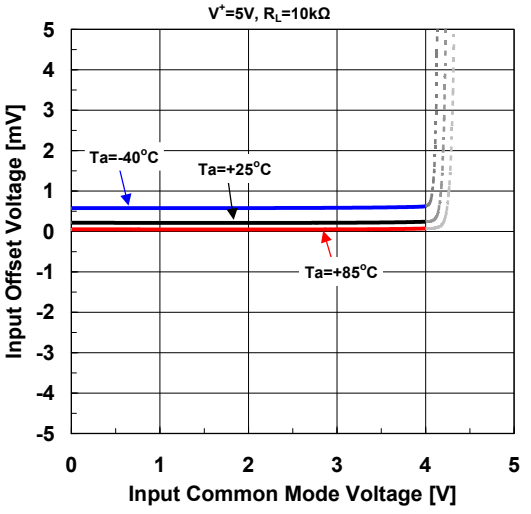

Input Offset Voltage vs. Supply Voltage
(Temperature)
$R_S$=$R_L$=10kΩ




Input Offset Voltage
vs. Ambient Temperature
(Supply Voltage)
$R_S$=$R_L$=10kΩ

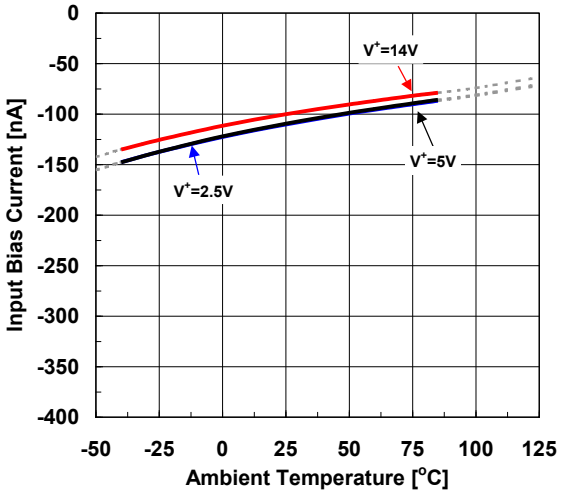



Input Offset Voltage
vs. Input Common Mode Voltage
(Temperature, $V^+$=5V)
$V^+$=5V, $R_L$=10kΩ

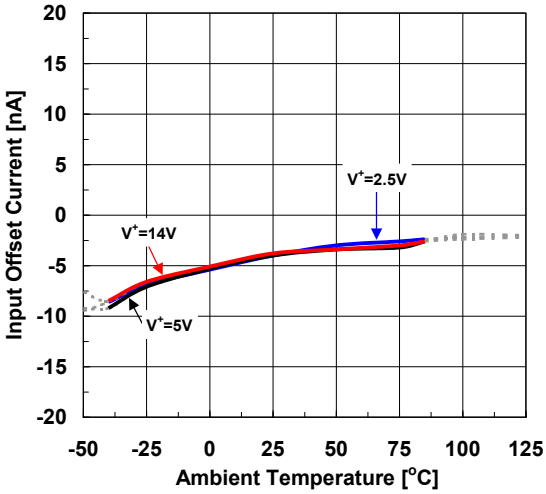


## ■ TYPICAL CHARACTERISTICS

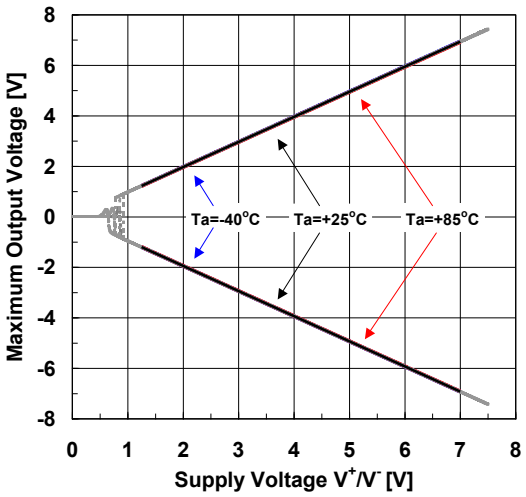
Input Bias Current vs. Ambient Temperature
(Supply Voltage)
$R_L$=10kΩ



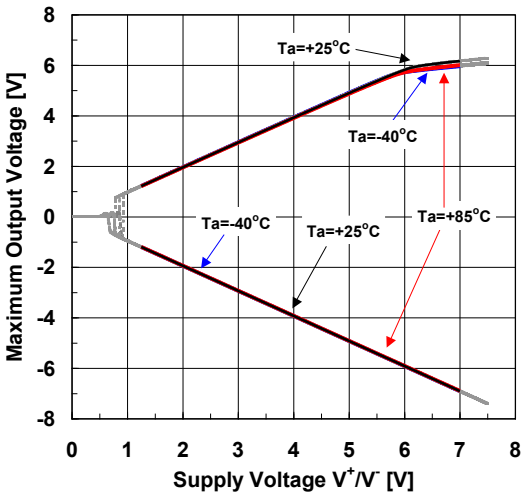

Input Offset Current
vs. Ambient Temperature (Supply Voltage)
$R_L$=10kΩ



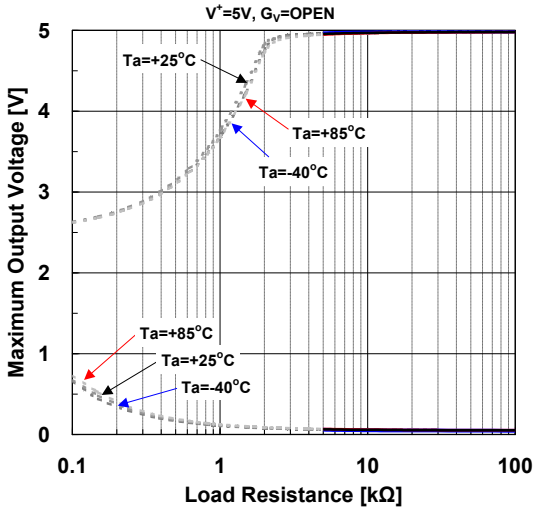

Maximum Output Voltage vs. Supply Voltage
(Temperature, $R_L$=10kΩ)
$G_V$=OPEN, $R_L$=10kΩ



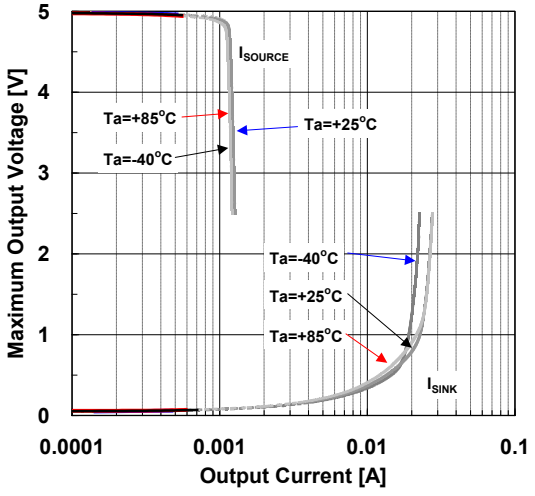

Maximum Output Voltage vs. Supply Voltage
(Temperature, $R_L$=5kΩ)
$G_V$=OPEN, $R_L$=10kΩ




Maximum Output Voltage
vs. Load Resistance
(Temperature, V+=5V)
V+=5V, $G_V$=OPEN

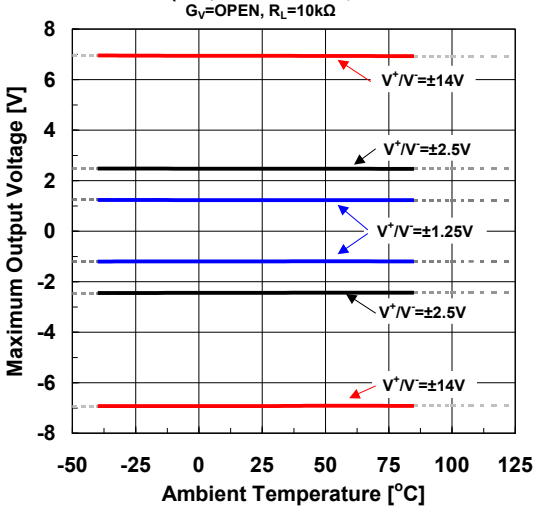



Maximum Output Voltage vs. Output Current
(Temperature, V+=5V)
V+=5V, $G_V$=OPEN

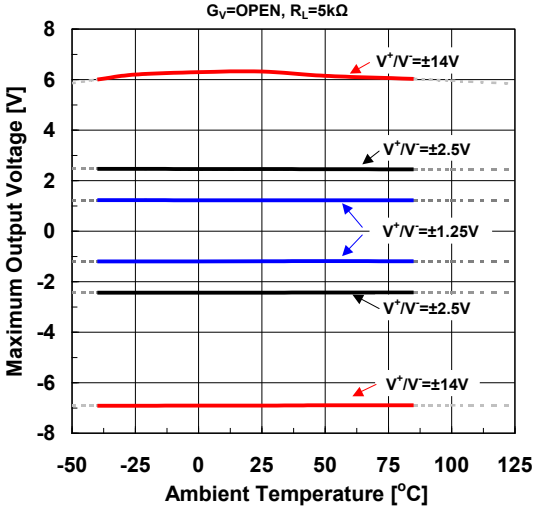


## ■ TYPICAL CHARACTERISTICS

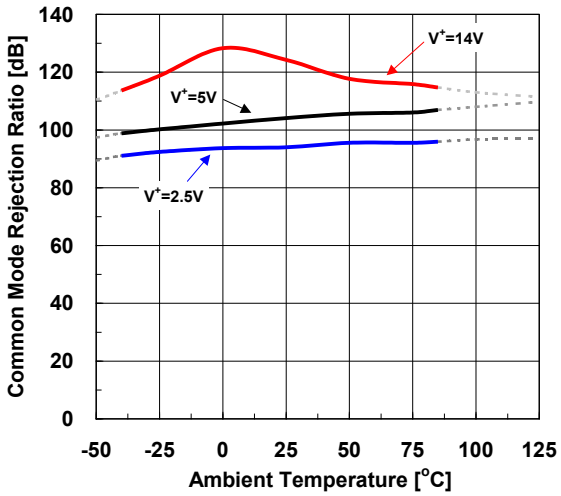
Maximum Output Voltage
vs. Ambient Temperature
(Temperature, $R_{L}$=10kΩ)
$G_V$=OPEN, $R_L$=10kΩ



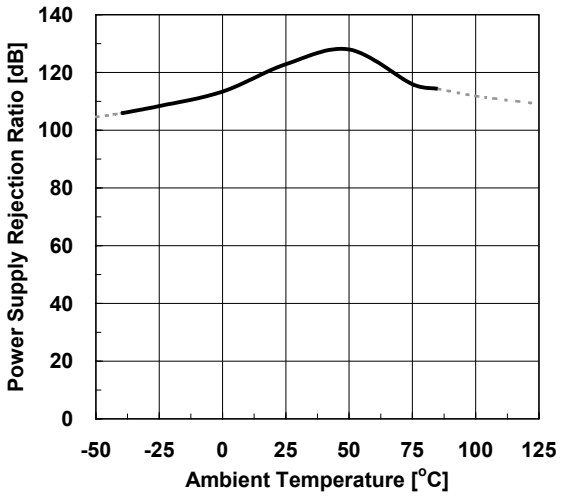

Maximum Output Voltage
vs. Ambient Temperature
(Temperature, $R_L$=5kΩ)
$G_V$=OPEN, $R_L$=5kΩ




Common Mode Rejection Ratio
vs. Ambient Temperature (Supply Voltage)
$R_L$=10kΩ, 0V ≤ $V_{ICM}$ ≤ $V^+$-1V



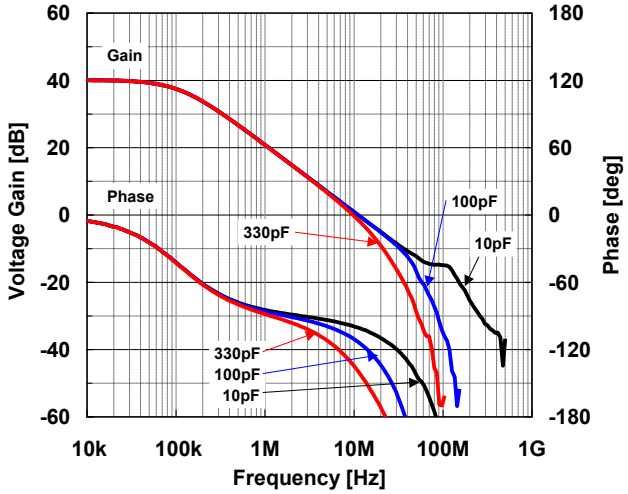

Power Supply Rejection Ratio
vs. Ambient Temperature
$R_L$=10kΩ, 2.5V ≤ $V^+$ ≤ 14V



## ■ TYPICAL CHARACTERISTICS

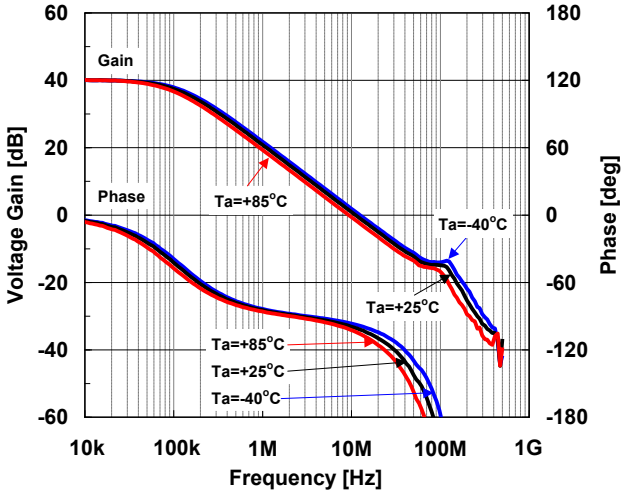
**Gain/Phase vs. Frequency** (Load Capacitance)

$V^+$=5V, $V_{IN}$=-30dBm, $G_V$=40dB, $R_T$=50Ω,
$R_F$=10kΩ, $R_G$=100Ω, Ta=+25°C



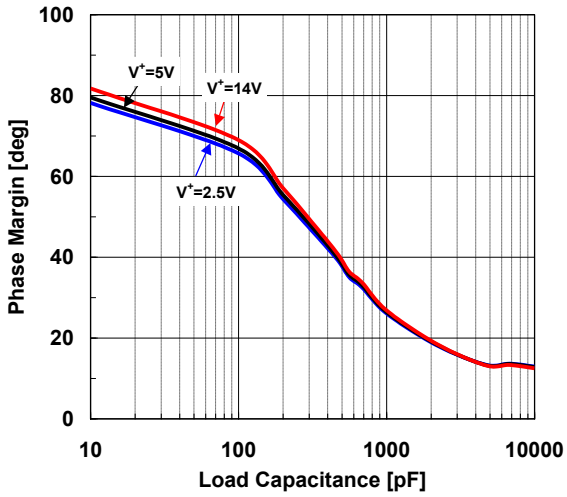

**Gain/Phase vs. Frequency** (Temperature)

$V^+$=5V, $V_{IN}$=-30dBm, $G_V$=40dB, $R_T$=50Ω,
$R_F$=10kΩ, $R_G$=100Ω, $C_L$=10pF



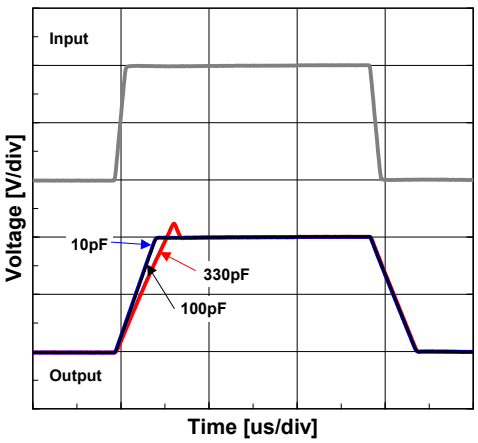

**Phase Margin vs. Load Capacitance**
(Supply Voltage)

$V_{IN}$=-30dBm, $G_V$=40dB, $R_T$=50Ω, $R_F$=10kΩ, $R_G$=100Ω, Ta=25°C



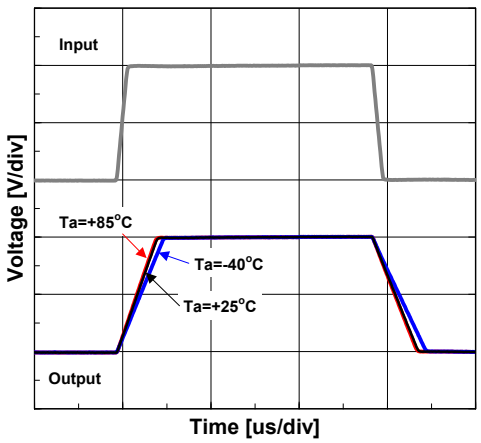

**Pulse Response**
(Load Capacitance, $V^+/V^-$=±2.5V)

$V^+/V^-$=±2.5V, $V_{IN}$=1Vp-p, $A_V$=+1, $R_L$=10kΩ, Ta=25°C




**Pulse Response**
(Temperature, $V^+/V^-$=±2.5V)

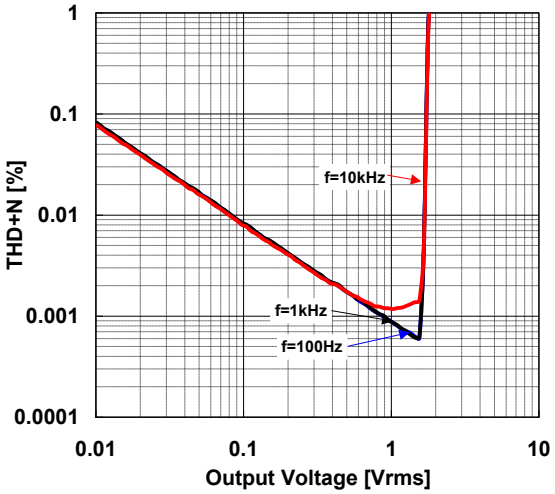
$V^+/V^-$=±2.5V, $V_{IN}$=1Vp-p, $A_V$=+1, $R_L$=10kΩ, $C_L$=10pF



## ■ TYPICAL CHARACTERISTICS

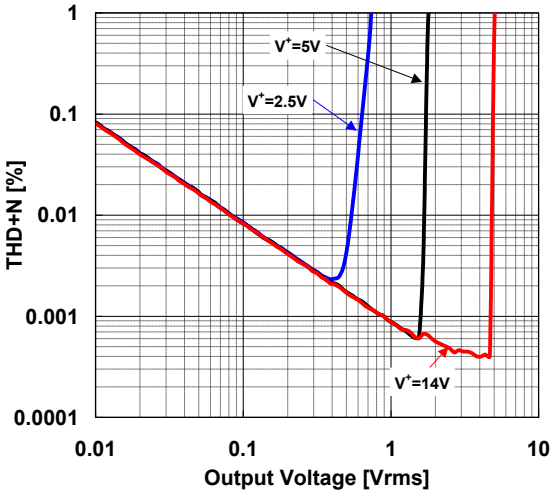
THD+N vs. Output Voltage (Frequency)

$V^+$=5V, $A_V$=+2, $R_S$=600Ω, $R_F$=5kΩ, $R_G$=5kΩ, BW=10Hz~80kHz, Ta=25°C



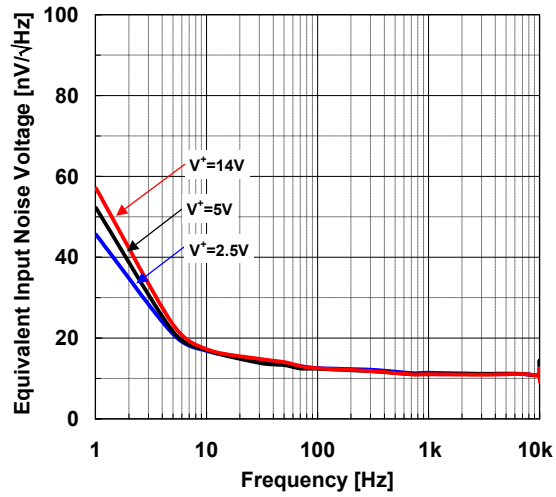

THD+N vs. Output Voltage (Supply Voltage)

f=1kHz, $A_V$=+2, $R_S$=600Ω, $R_F$=5kΩ, $R_G$=5kΩ, BW=10Hz~80kHz, Ta=25°C



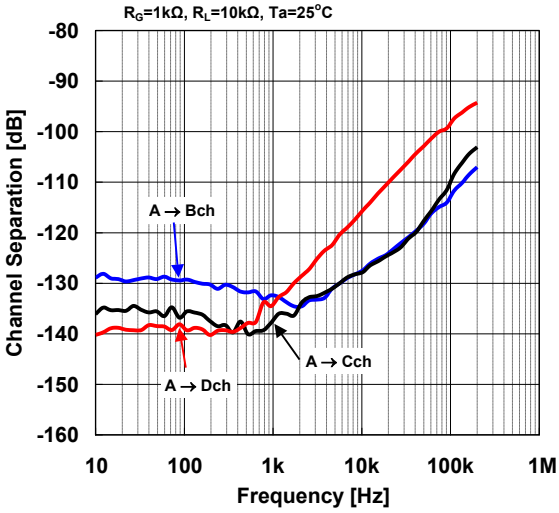

Equivalent Input Noise Voltage vs. Frequency (Supply Voltage)

$G_V$=60dB, $R_T$=600Ω, $R_F$=100kΩ, $R_G$=100Ω, Ta=25°C



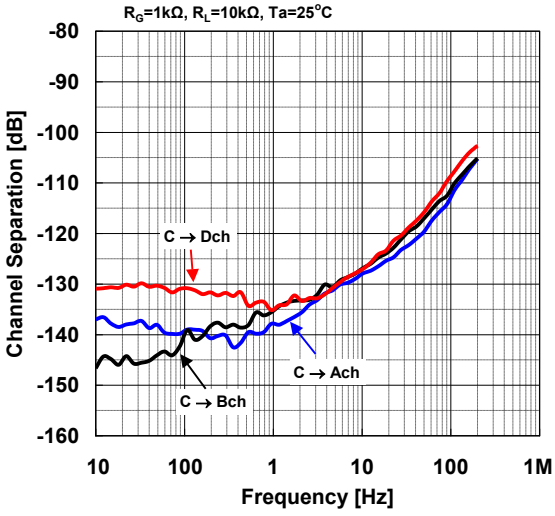

Channel Separation vs. Frequency

$V^+$=5V, Ach Input, $V_O$=1.5Vrms, $G_V$=40dB, $R_F$=100kΩ, $R_G$=1kΩ, $R_L$=10kΩ, Ta=25°C




Channel Separation vs. Frequency

$V^+$=5V, Cch Input, $V_O$=1.5Vrms, $G_V$=40dB, $R_F$=100kΩ, $R_G$=1kΩ, $R_L$=10kΩ, Ta=25°C




[CAUTION]
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