# Low Offset, Low Drift Dual JFET Input Operational Amplifier

## ■GENRRAL DESCRIPTION

The **NJM2749/2749A** is a Precision dual JFET input operational amplifier which includes low input offset voltage: 0.8mV (typ) / 2.5mV (max) and 6µV/°C typical offset drift.

The **NJM2749A** is guaranteed 20µV/°C maximum offset drift to perform a 100% tested.

The NJM2749/2749A have the following features: low bias current of 50pA (typ), high slew rate of 13V/µs (typ).

These features are suitable for signal processing amplifiers of instrumentation, measurement and industrial applications such as sensor amplifier, current sensing and sample-and-hold circuit.

## ■ PACKAGE OUTLINE




**NJM2749AD**



**NJM2749M / 2749AM**



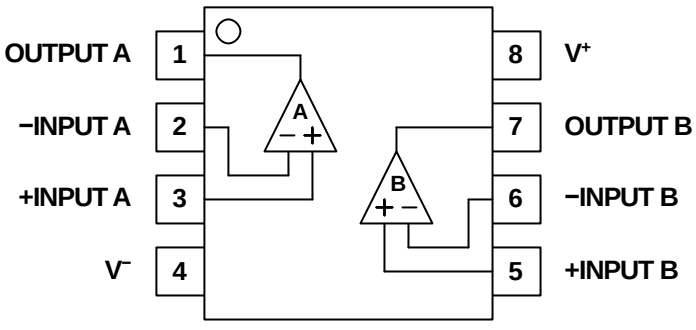
**NJM2749E / 2749AE**

## ■FEATURES

| | |
|---|---|
| ●Input Offset Voltage Drift | NJM2749: $\Delta V_{IO}/\Delta T$= 6µV/°C typ.<br>NJM2749A: $\Delta V_{IO}/\Delta T$=20µV/°C max. |
| ●Input Offset Voltage | 2.5mV max. @Ta=25°C ~ 85°C<br>3.5mV max. @Ta= -40°C |
| ●Input Bias Current | $I_B$= 50pA typ. 200pA max. @Ta=25°C |
| ●Slew Rate | SR=13V/µs typ. @Ta=25°C |
| ●Operating Voltage | Vopr= ±6.0V ~ ±16V |
| ●Voltage Gain | Av=100dB typ. |
| ●Bipolar Technology | |
| ●Dual channel | |
| ●Package Outline | NJM2749AD: DIP8<br>NJM2749M, NJM2749AM: DMP8<br>NJM2749E, NJM2749AE: EMP8 |

## ■PIN CONFIGURATION

(Top View)




**NJM2749/2749A**

## ■ABSOLUTE MAXIMUM RATING (Ta=25°C unless otherwise specified)

| PARAMETER | SYMBOL | RATING | | UNIT |
|---|---|---|---|---|
| Supply Voltage | $V^+/V^-$ | ±18 | | V |
| Common Mode Input Voltage | $V_{ICM}$ | ±15 | (Note1) | V |
| Differential Input Voltage | $V_{ID}$ | ±30 | | V |
| Power Dissipation | $P_D$ | 500 [ DIP8 ], 300 [ DMP8,EMP8 ] | | mW |
| | | 430 [ DMP8 ], 640 [ EMP8 ] | (Note2) | mW |
| | | 580 [ DMP8 ] ,1000 [ EMP8 ] | (Note3) | mW |
| Operating Temperature Range | Topr | -40 ~ +85 | | °C |
| Storage Temperature Range | Tstg | -50 ~ +125 | | °C |

(Note1) For supply voltage less than ±18V, the maximum input voltage is equal to the supply voltage.
(Note2) Mounted on the EIA/JEDEC standard board (76.2×114.3×1.6mm, two layers, FR-4).
(Note3) Mounted on the EIA/JEDEC standard board (76.2×114.3×1.6mm, four layers, FR-4).

## ■RECOMMENDED OPERATING VOLTAGE (Ta=25°C)

| PARAMETER | SYMBOL | RATING | MIN. | TYP. | MAX. | UNIT |
|---|---|---|---|---|---|---|
| Supply Voltage | $V^+/V^-$ | | ±6 | - | ±16 | V |

## ■ELECTRONIC CHARACTERISTICS

### •DC CHARACTERISTICS ($V^+/V^-$=±15V, Ta=-40 to +85°C (Note4) unless otherwise specified)

| PARAMETER | SYMBOL | CONDITION | | MIN. | TYP. | MAX. | UNIT |
|---|---|---|---|---|---|---|---|
| Input Offset Voltage Drift | $\Delta V_{IO}/\Delta T$ | NJM2749A | (Note5) | - | 6 | 20 | µV/°C |
| | | NJM2749 | | - | 6 | - | |
| Input Offset Voltage1 | $V_{IO1}$ | $R_S$=50Ω, Ta=+85°C | (Note6) | - | 0.7 | 2.5 | mV |
| Input Offset Voltage2 | $V_{IO2}$ | $R_S$=50Ω, Ta=+25°C | (Note6) | - | 0.8 | 2.5 | mV |
| Input Offset Voltage3 | $V_{IO3}$ | $R_S$=50Ω, Ta=−40°C | (Note6) | - | 1.0 | 3.5 | mV |
| Common Mode Rejection Ratio | CMR | $V_{ICM}$=±10V | (Note7) | 76 | 92 | - | dB |
| Supply Voltage Rejection Ratio | SVR | $V^+/V^-$=±6V ~ ±16V | (Note6, 8 ) | 80 | 100 | - | dB |
| Input Common Mode Voltage Range 1 | $V_{ICM1}$ | CMR≥76dB | (Note9) | +10 | +14.5 | - | V |
| Input Common Mode Voltage Range 2 | $V_{ICM2}$ | CMR≥76dB | (Note9) | - | −11 | −10 | V |
| Input Bias Current 1 | $I_{B1}$ | Ta=+25°C | (Note6) | - | 50 | 200 | pA |
| Input Bias Current 2 | $I_{B2}$ | Ta=+85°C | (Note6) | - | - | 4 | nA |
| Input Offset Current 1 | $I_{IO1}$ | Ta=+25°C | (Note6) | - | 25 | 100 | pA |
| Input Offset Current 2 | $I_{IO2}$ | Ta=+85°C | (Note6) | - | - | 2 | nA |
| Voltage Gain 1 | Av1 | $R_L$=2kΩ, Vo=±10V, Ta=+25°C | | 88 | 100 | - | dB |
| Voltage Gain 2 | Av2 | $R_L$=2kΩ, Vo=±10V | | 82 | 100 | - | dB |
| Maximum Output Voltage 1 | $V_{OM1}$ | $R_L$=10kΩ | | ±12 | ±13.5 | - | V |
| Maximum Output Voltage 2 | $V_{OM2}$ | $R_L$=2kΩ | | ±10 | ±11.5 | - | V |
| Supply Current | Icc | Voltage Follower, $R_L$=∞ | (Note6) | - | 3.8 | 5.6 | mA |

(Note4) These devices are measured under three temperature conditions of Ta=−40°C, +25°C, +85°C.
(Note5) Temperature coefficient is calculated by specified change in offset voltage. (Changes Ta=+25°C to −40°C and Ta=+25°C to +85°C)
NJM2749A is guaranteed maximum specification because these are 100% tested to operating temperature range.
NJM2749 is guaranteed only typical specification.
(Note6) Measured at $V_{ICM}$=0V
(Note7) CMR is calculated by specified change in offset voltage. ($V_{ICM}$=0V to +10V and $V_{ICM}$=0V to −10V)
(Note8) SVR is calculated by specified change in offset voltage. ($V^+/V^-$=±6V to ±16V)
(Note9) $V_{ICM}$ is input common mode voltage when tested meets specified change in offset voltage is CMR≥76dB.
(A point of reference is offset voltage of $V_{ICM}$=0V)

**•AC CHARACTERISTICS** ($V^+/V^-$=±15V, Ta=+25°C unless otherwise specified)

| PARAMETER | SYMBOL | CONDITION | MIN. | TYP. | MAX. | UNIT |
|---|---|---|---|---|---|---|
| Gain Bandwidth Product | GB | f=10kHz | − | 2.2 | − | MHz |
| Unity Gain Frequency | $f_T$ | AV=+100, $R_S$=100Ω, RL=∞, CL=10pF | − | 2 | − | MHz |
| Phase Margin | $\Phi_M$ | AV=+100, $R_S$=100Ω, RL=∞, CL=10pF | − | 55 | − | deg |
| Input Noise Voltage1 | $V_{NI1}$ | f=1kHz, $A_V$=+100, RS=100Ω, RL=∞ | − | 20 | − | nV/√Hz |
| Input Noise Voltage2 | $V_{NI2}$ | RIAA, $R_S$=2.2kΩ, 30kHz, LPF | − | 2.5 | − | μVrms |
| Total Harmonic Distortion | THD | f=1kHz, $A_V$=+10, $R_S$=1kΩ, $R_L$=∞, $V_O$=5Vrms | − | 0.005 | − | % |
| Channel Separation | CS | F=1kHz, $A_V$=-100, $R_S$=1kΩ, $R_L$=10kΩ | − | 120 | − | dB |

**•TRANSIENT CHARACTERISTICS** ($V^+/V^-$=±15V, Ta=+25°C unless otherwise specified)

| PARAMETER | SYMBOL | CONDITION | MIN. | TYP. | MAX. | UNIT |
|---|---|---|---|---|---|---|
| Positive Slew Rate | +SR | $A_V$=+1, $V_{IN}$=2Vpp, $R_L$=10kΩ, $C_L$=10pF | − | 14 | − | V/μs |
| Negative Slew Rate | -SR | $A_V$=+1, $V_{IN}$=2Vpp, $R_L$=10kΩ, $C_L$=10pF | − | 12 | − | V/μs |

## ■IMPORTANT CONSIDERATIONS FOR USE OF NJM2749/2749A

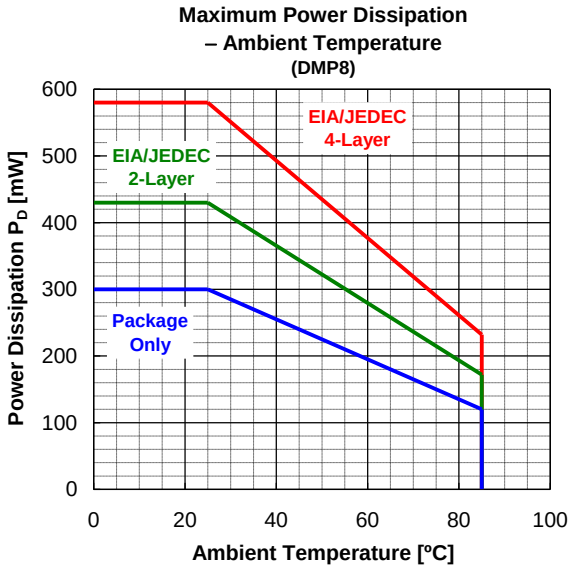
### •Supply Current

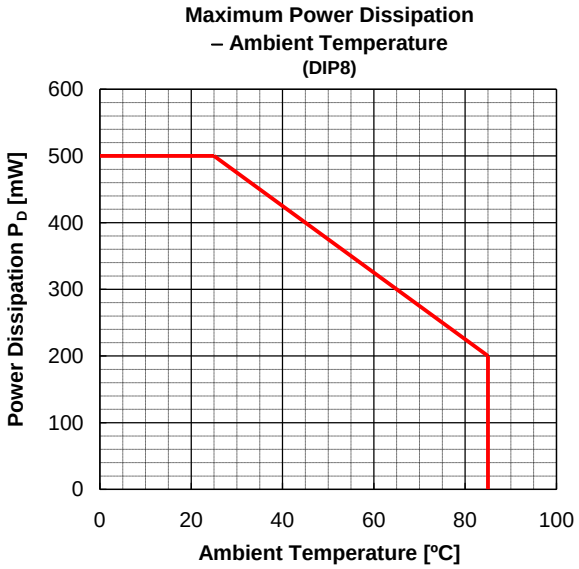
When Ta≥25°C, Power Dissipation $P_D$ is limited by junction temperature ($T_J$=125°C)
So maximum supply current is influenced by package, mounting board (board size, area of cupper foil), Mounting condition and etc.

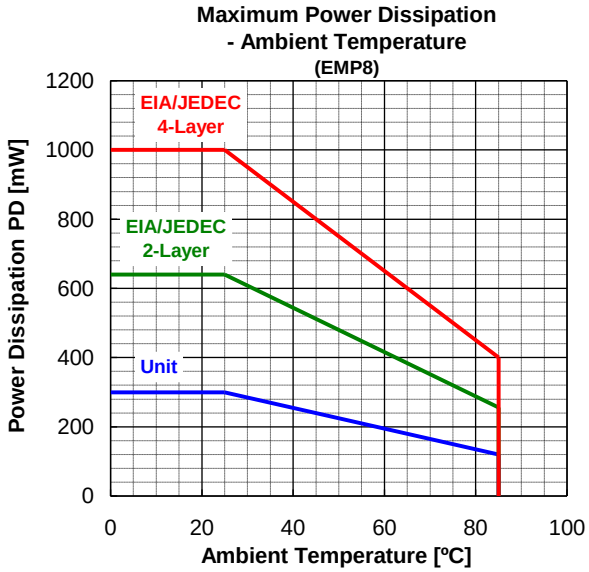
Following DMP8 Power Dissipation characteristic is a characteristic when mounted the following conditions supply.

- Two layer board: EIA/JEDEC 76.2×114.3×1.6mm, FR-4
- Four layer board: EIA/JEDEC 76.2×114.3×1.6mm, FR-4

Please refer to "Method of measuring the package thermal characteristic" published in our company web site for detailed information on the thermal characteristic.



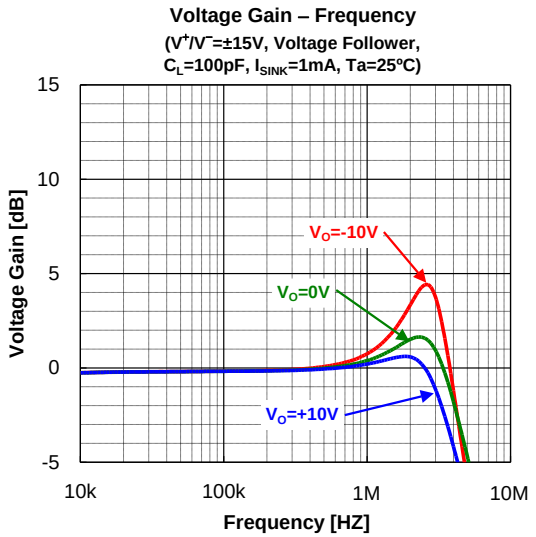
## ■IMPORTANT CONSIDERATIONS FOR USE OF NJM2749/2749A

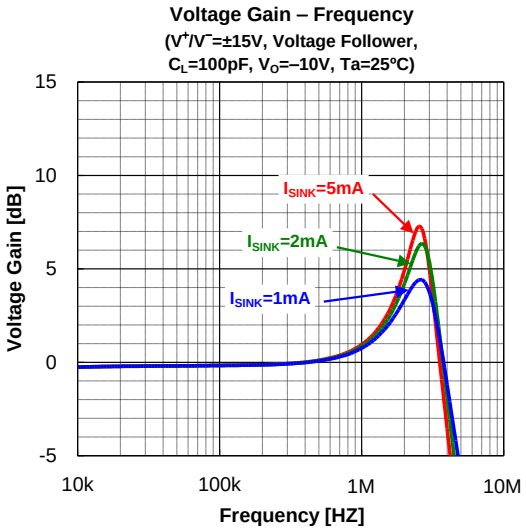
### •THE OSCILLATION WITH A CAPACITIVE LOAD

NJM2749/2749A tends to oscillate easily when it uses voltage-follower, and driving capacitive load.

The figure below is a "Voltage Gain - Frequency characteristic" in the Voltage-Follower. (It is not the one to guarantee the characteristic of the product.)

Especially, it becomes easy to oscillate in the condition that the input voltage (output voltage) is near the minus supply voltage side and the condition with large output sink current. We will recommend use by some circuit gains.




### •INPUT COMMON MODE VOLTAGE RANGE

In this product, the input offset voltage drift is measured based on the input offset voltage at $V_{ICM}$=0V, and the input voltage range that satisfies the common mode rejection ratio 76dB is defined as the input common mode voltage range.

As an electric characteristic, $V_{ICM}$=−10V~+10V at Supply Voltage $V^+/V^-$=±15V is guaranteed.

It becomes below formula about the input common mode voltage range when the supply voltage changes.

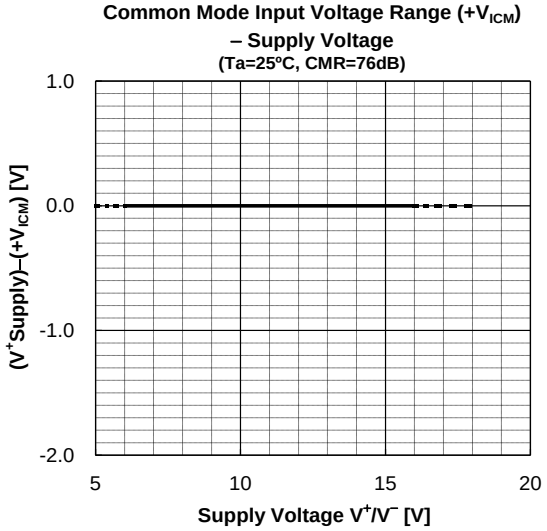
$+V_{ICM}$: ($V^+$ supply) − 5 [V] · · · reference

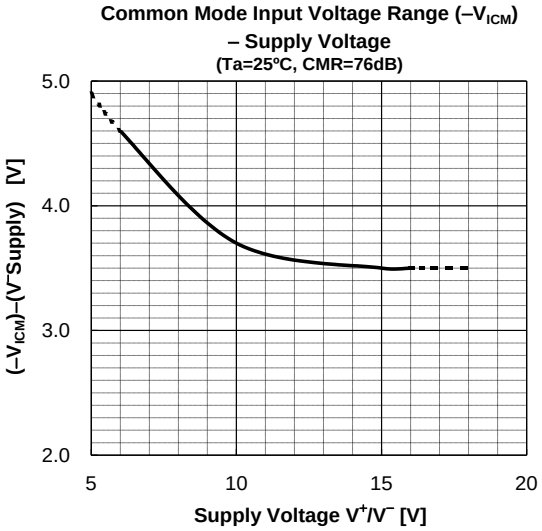
$-V_{ICM}$: ($V^-$ supply) + 5 [V] · · · reference

This figure below is "Input common mode voltage range – Supply voltage characteristics". (It is not the one to guarantee the characteristic of the product.)

+ $V_{ICM}$ is limited by the absolute maximum rating ($V^+$ supply) within the input common mode voltage range.

Moreover, $-V_{ICM}$ tends to rise by lowering of the supply voltage.



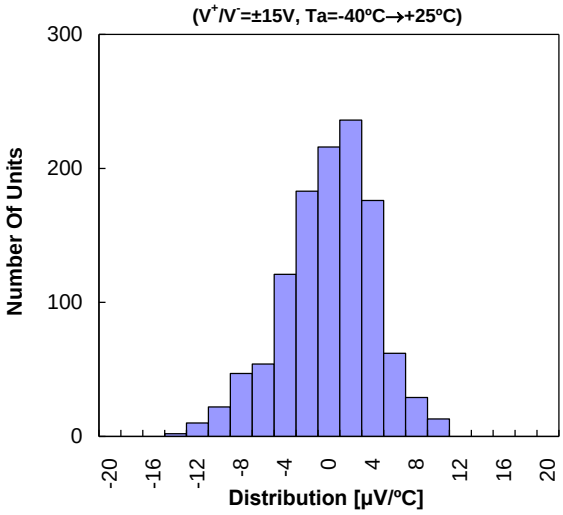

### •OTHERS

For the NJM2749/2749A are high-precision products, a surface leak by dirt and/or condensation on package can have a detrimental effect on precise characteristics of these products.

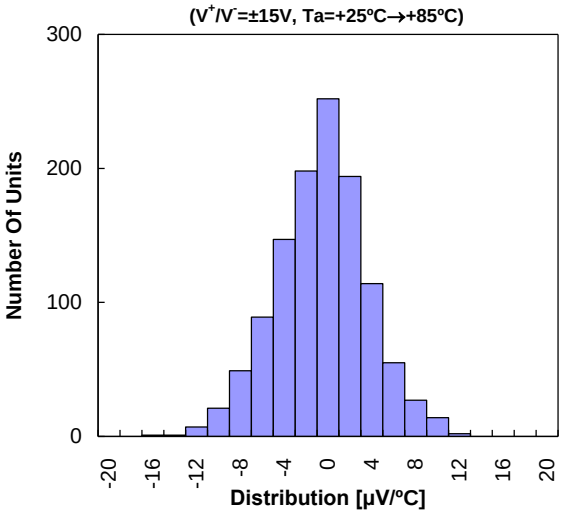
You should pay close attention to environment of storage and usage.

## ■TYPICAL CHARACTERISTICS

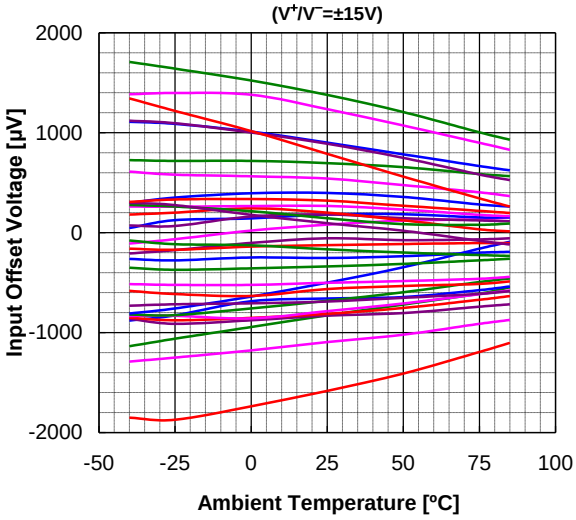
Input Offset Voltage Temperature Coefficient Distribution
($V^+/V^-$=±15V, Ta=-40ºC→+25ºC)



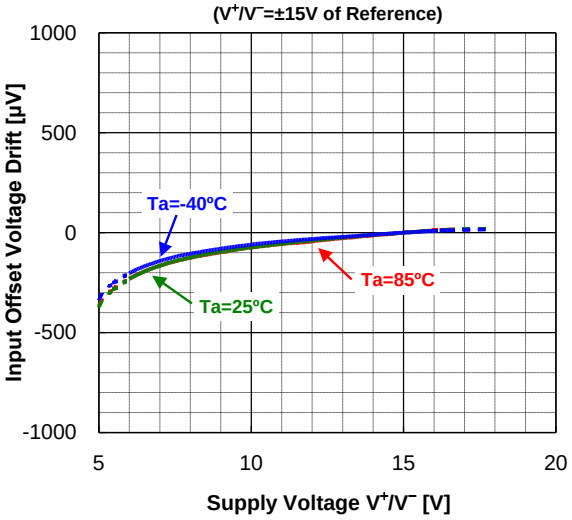

Input Offset Voltage Temperature Coefficient Distribution
($V^+/V^-$=±15V, Ta=+25ºC→+85ºC)



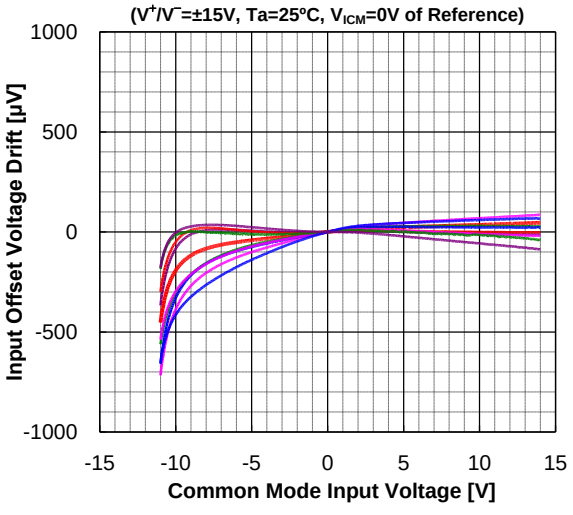

Input Offset Voltage – Ambient Temperature
($V^+/V^-$=±15V)



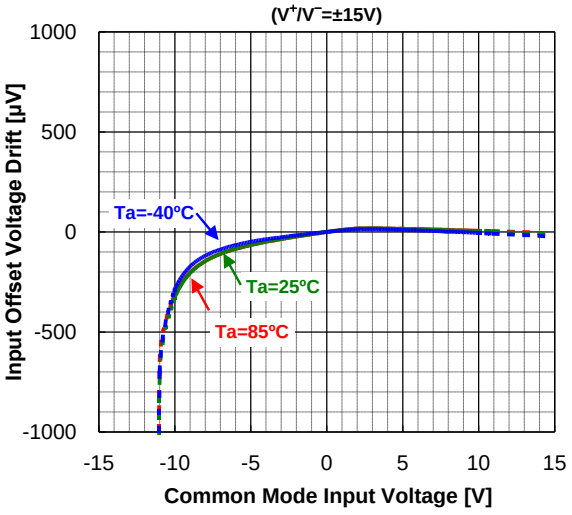

Input Offset Voltage Drift – Supply Voltage
($V^+/V^-$=±15V of Reference)




Input Offset Voltage Drift
– Common Mode Input Voltage
($V^+/V^-$=±15V, Ta=25ºC, $V_{ICM}$=0V of Reference)

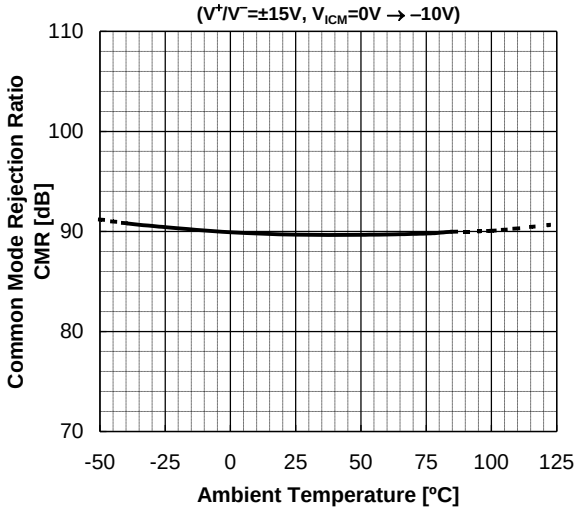



Input Offset Voltage Drift
– Common Mode Input Voltage
($V^+/V^-$=±15V)

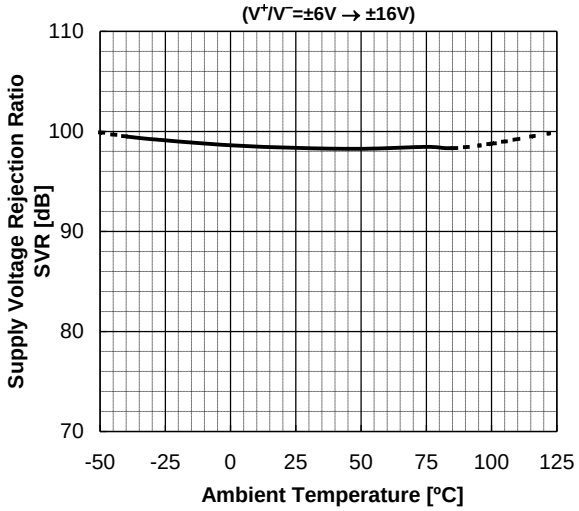


## ■TYPICAL CHARACTERISTICS

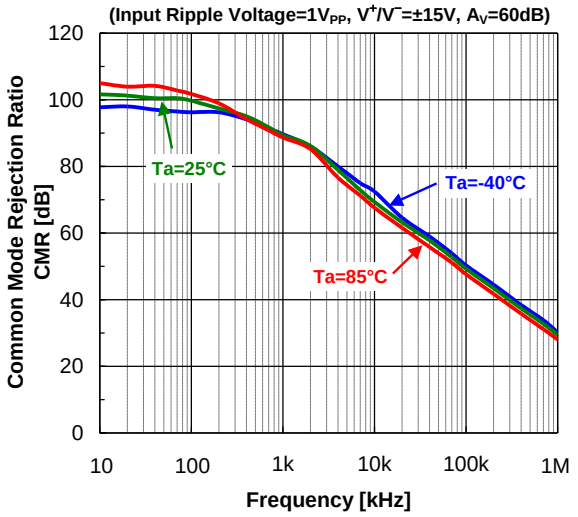
Common Mode Rejection Ratio – Ambient Temperature
($V^+/V^-$=±15V, $V_{ICM}$=0V → –10V)



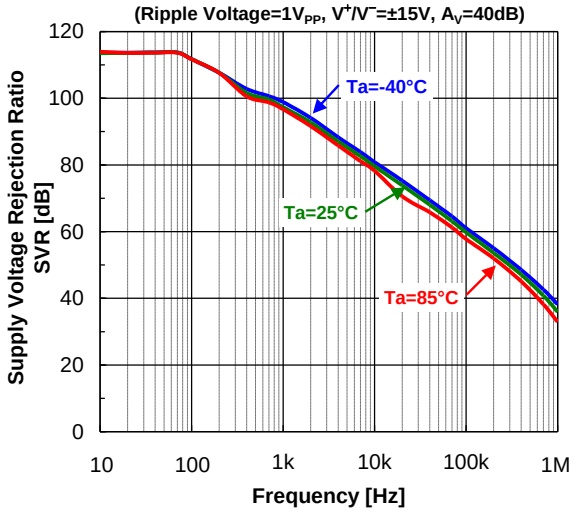

Supply Voltage Rejection Ratio – Ambient Temperature
($V^+/V^-$=±6V → ±16V)



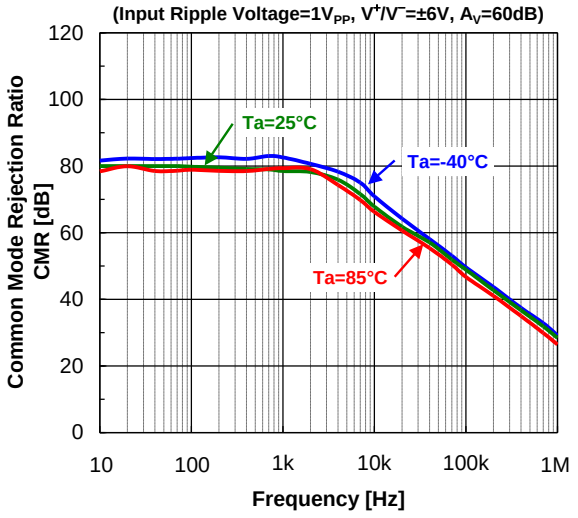

Common Mode Rejection Ratio – Frequency
(Input Ripple Voltage=1$V_{PP}$, $V^+/V^-$=±15V, $A_V$=60dB)



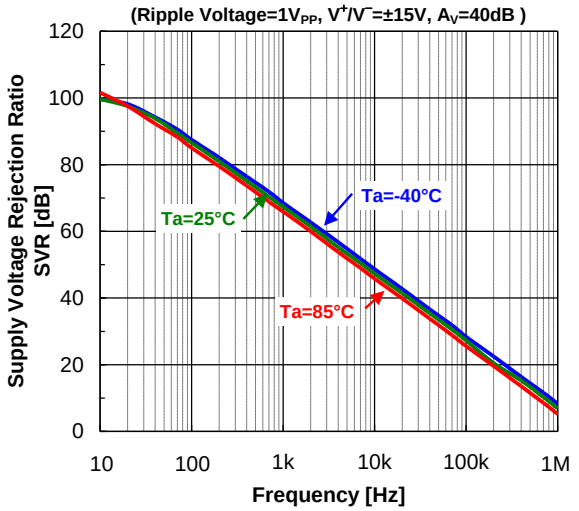

Supply Voltage Rejection Ratio (+Supply) – Frequency
(Ripple Voltage=1$V_{PP}$, $V^+/V^-$=±15V, $A_V$=40dB)




Common Mode Rejection Ratio – Frequency
(Input Ripple Voltage=1$V_{PP}$, $V^+/V^-$=±6V, $A_V$=60dB)

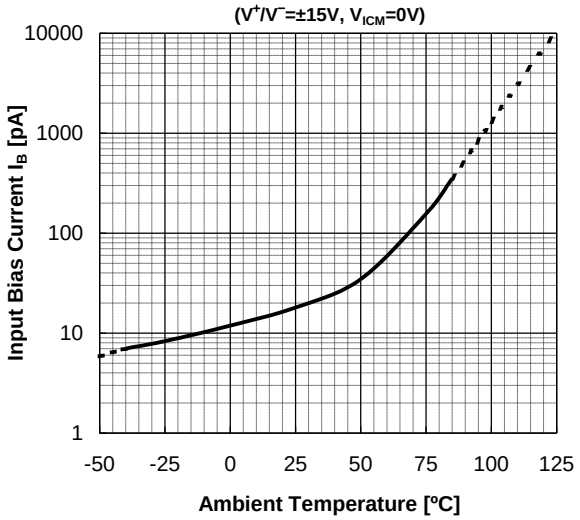



Supply Voltage Rejection Ratio (–Supply) – Frequency
(Ripple Voltage=1$V_{PP}$, $V^+/V^-$=±15V, $A_V$=40dB )

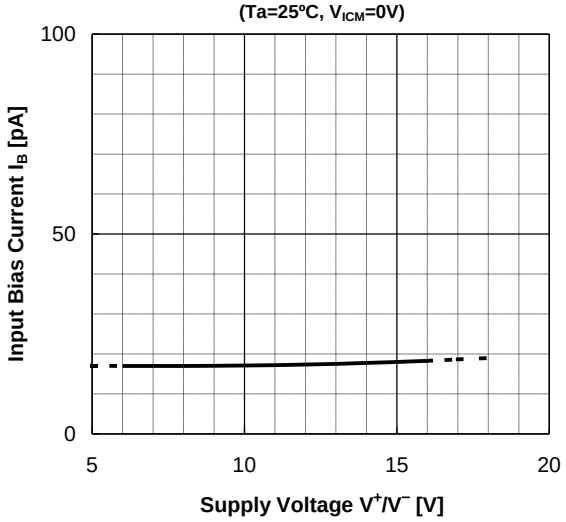


## ■TYPICAL CHARACTERISTICS

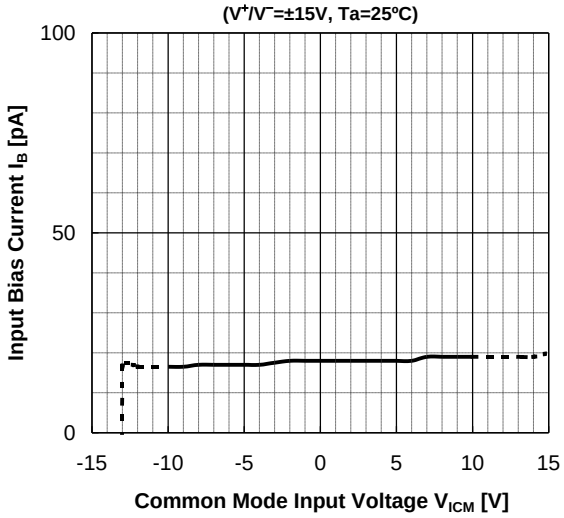
Input Bias Current – Ambient Temperature
($V^+/V^-$=±15V, $V_{ICM}$=0V)



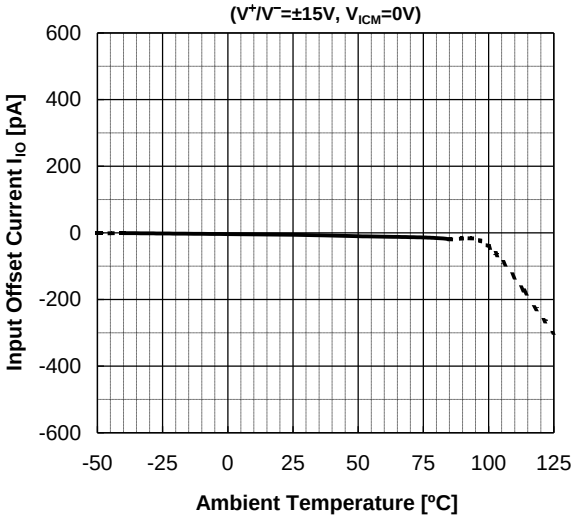

Input Bias Current – Supply Voltage
(Ta=25ºC, $V_{ICM}$=0V)



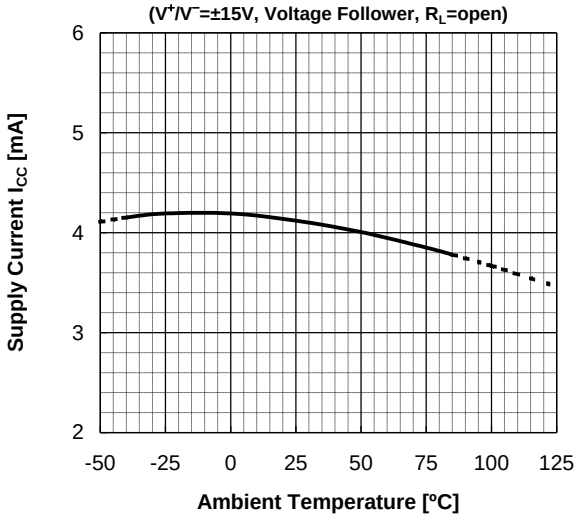

Input Bias Current – Common Mode Input Voltage
($V^+/V^-$=±15V, Ta=25ºC)



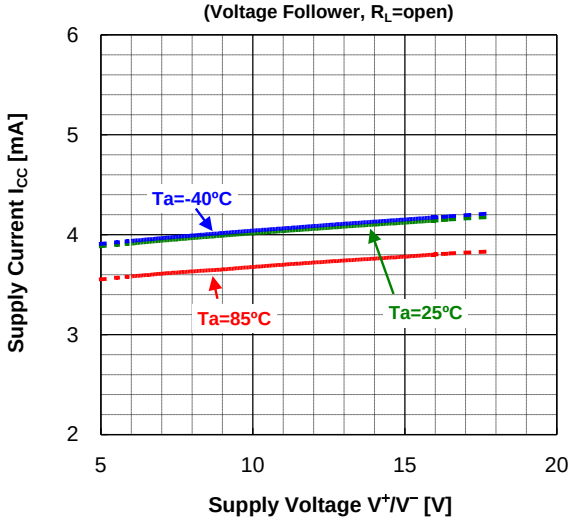

Input Offset Current – Ambient Temperature
($V^+/V^-$=±15V, $V_{ICM}$=0V)




Supply Current – Ambient Temperature
($V^+/V^-$=±15V, Voltage Follower, $R_L$=open)

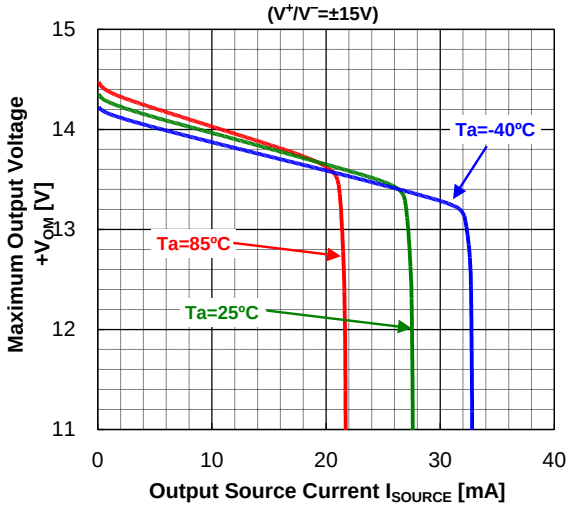



Supply Current – Supply Voltage
(Voltage Follower, $R_L$=open)

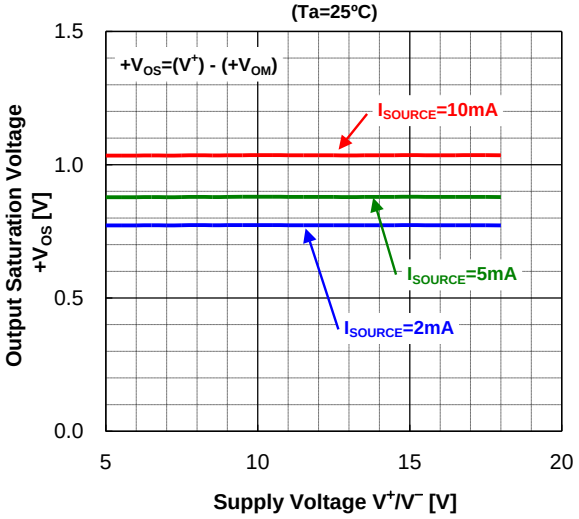


## ■TYPICAL CHARACTERISTICS

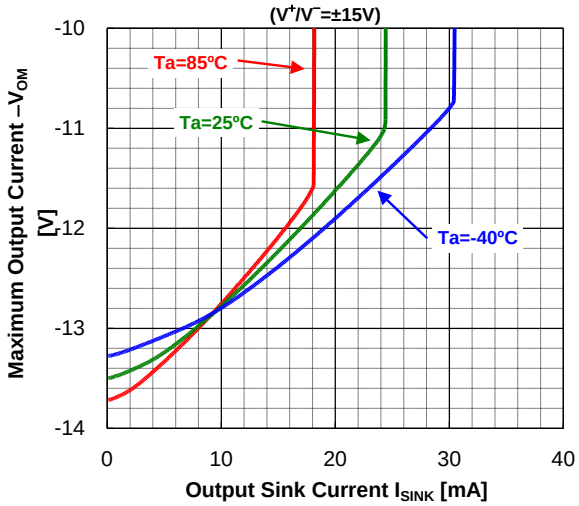
Maximum Output Voltage ($+V_{OM}$) – Output Source Current ($V^+/V^-$=±15V)



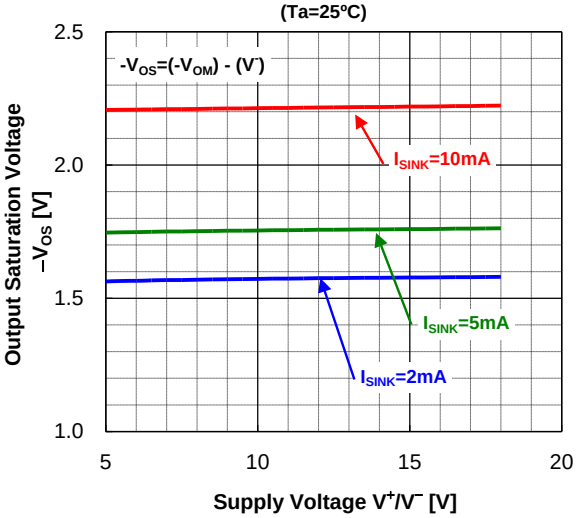

Output Saturation Voltage ($+V_{OS}$) – Supply Voltage (Ta=25°C)



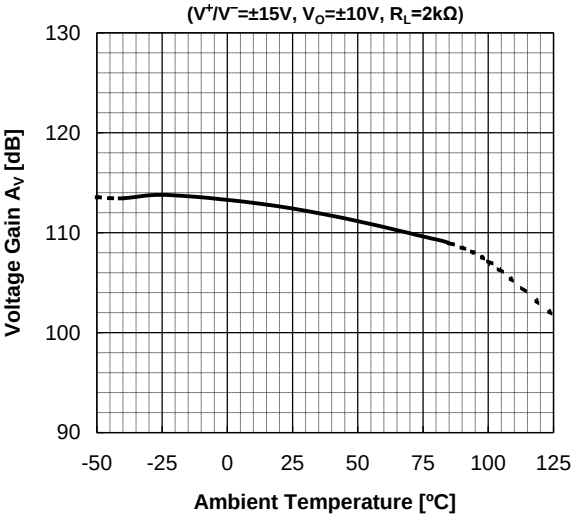

Maximum Output Voltage ($-V_{OM}$) – Output Sink Current ($V^+/V^-$=±15V)



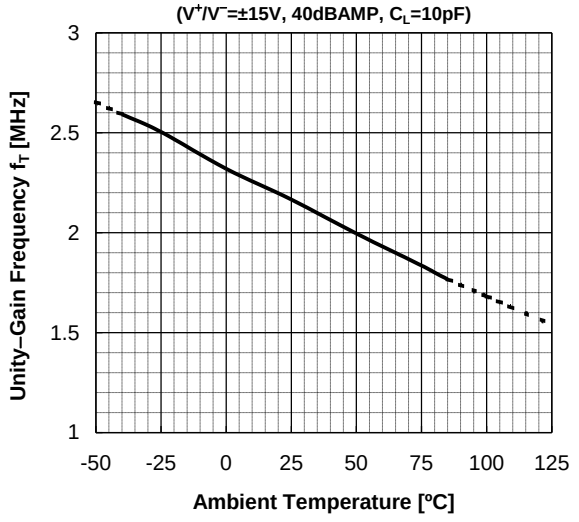

Output Saturation Voltage ($-V_{OS}$) – Supply Voltage (Ta=25°C)




Voltage Gain – Ambient Temperature ($V^+/V^-$=±15V, $V_O$=±10V, $R_L$=2kΩ)

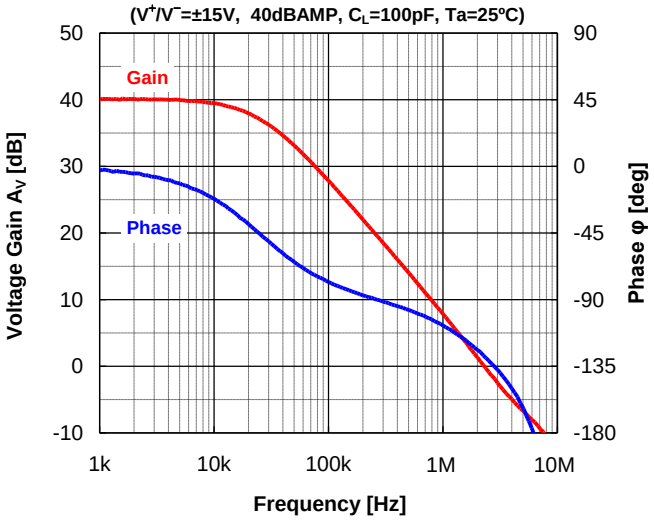



Unity–Gain Frequency – Ambient Temperature ($V^+/V^-$=±15V, 40dBAMP, $C_L$=10pF)

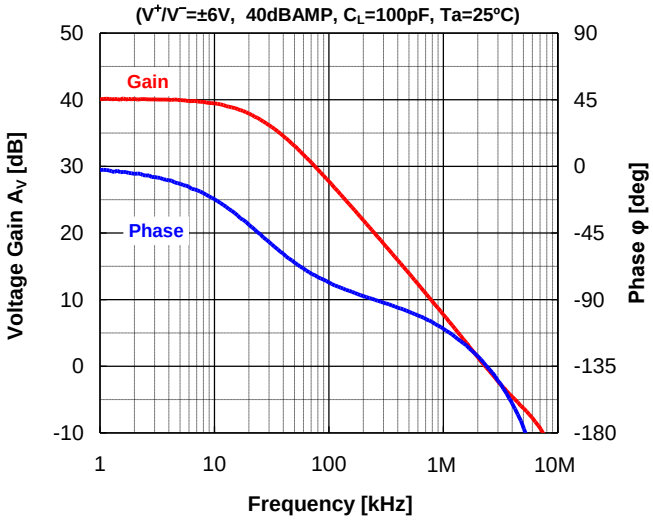


## ■TYPICAL CHARACTERISTICS

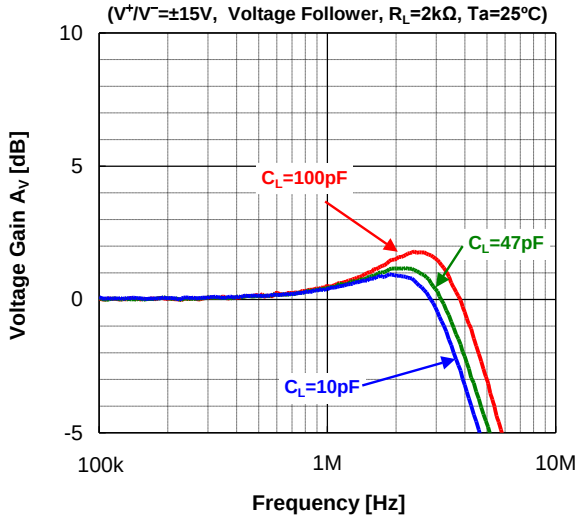
Gain/Phase – Frequency
($V^+/V^-$=±15V, 40dBAMP, $C_L$=100pF, Ta=25°C)



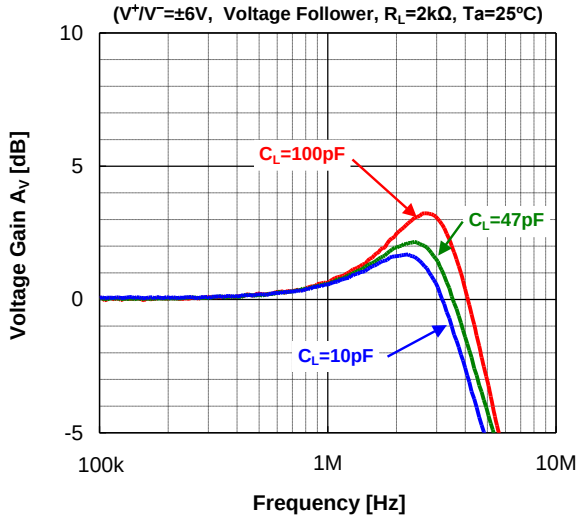

Gain/Phase – Frequency
($V^+/V^-$=±6V, 40dBAMP, $C_L$=100pF, Ta=25°C)



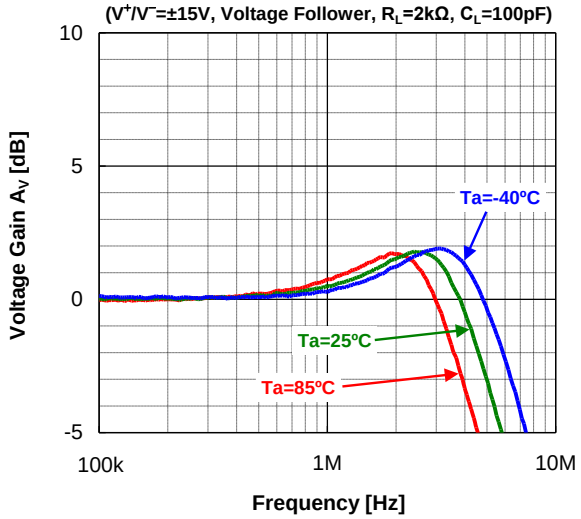

Voltage Gain – Frequency
($V^+/V^-$=±15V, Voltage Follower, $R_L$=2kΩ, Ta=25°C)



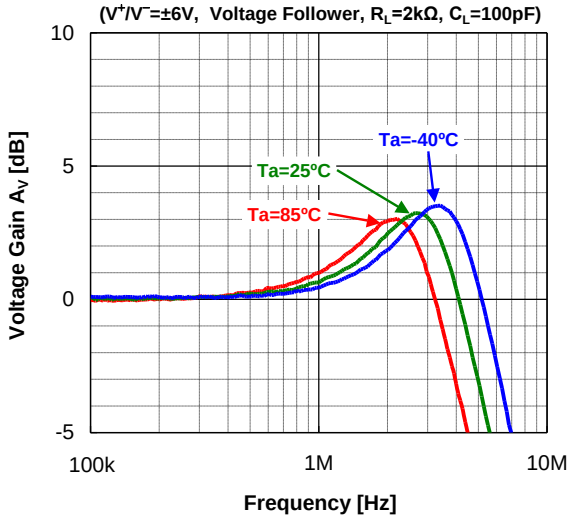

Voltage Gain – Frequency
($V^+/V^-$=±6V, Voltage Follower, $R_L$=2kΩ, Ta=25°C)




Voltage Gain – Frequency
($V^+/V^-$=±15V, Voltage Follower, $R_L$=2kΩ, $C_L$=100pF)

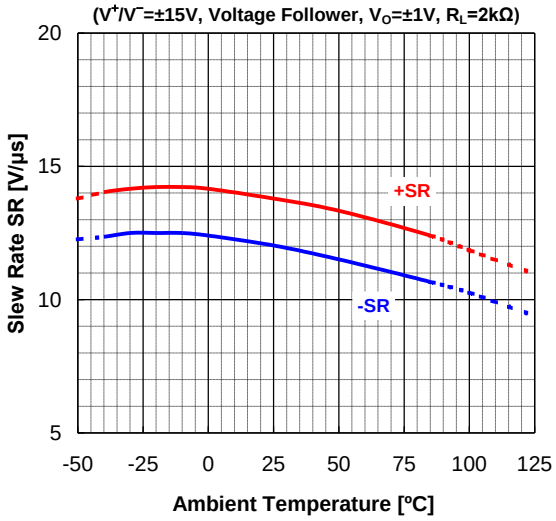



Voltage Gain – Frequency
($V^+/V^-$=±6V, Voltage Follower, $R_L$=2kΩ, $C_L$=100pF)

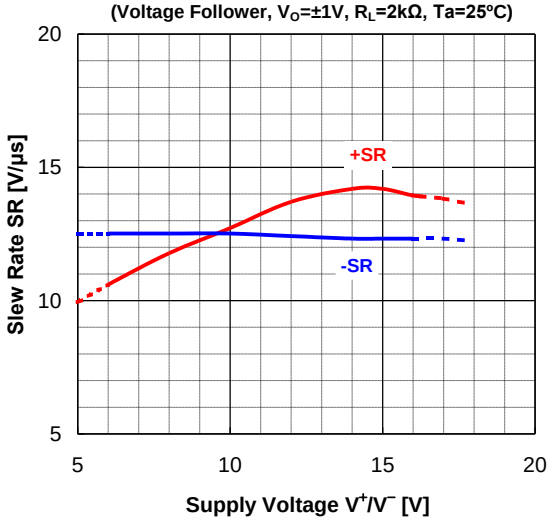


## ■TYPICAL CHARACTERISTICS

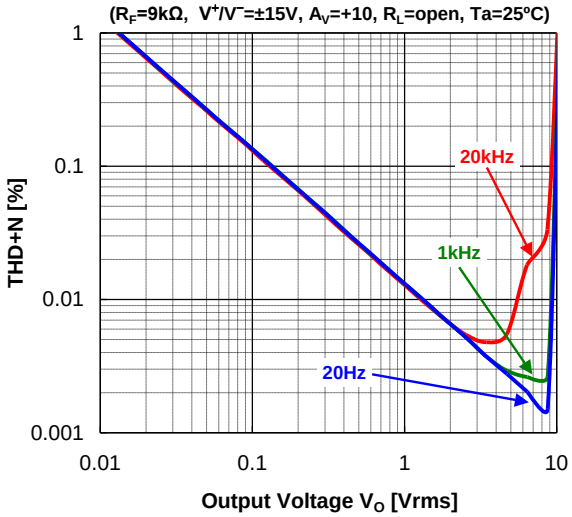
Slew Rate – Ambient Temperature
($V^+/V^-$=±15V, Voltage Follower, $V_O$=±1V, $R_L$=2kΩ)



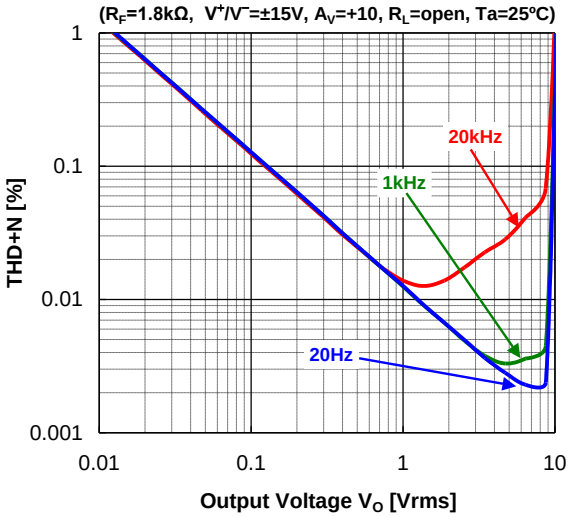

Slew Rate – Supply Voltage
(Voltage Follower, $V_O$=±1V, $R_L$=2kΩ, Ta=25ºC)



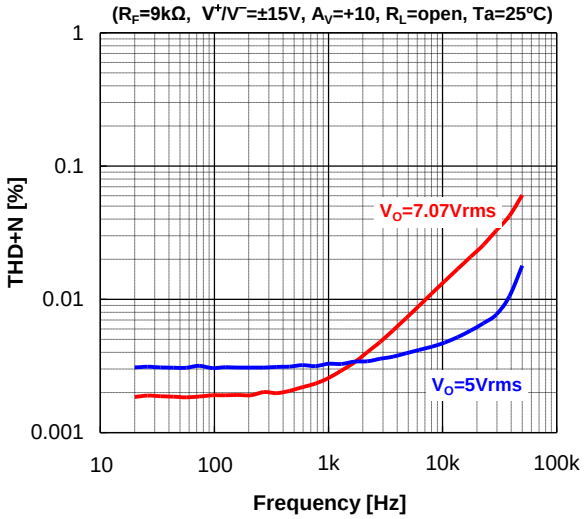

THD+N – Output Voltage
($R_F$=9kΩ, $V^+/V^-$=±15V, $A_V$=+10, $R_L$=open, Ta=25ºC)



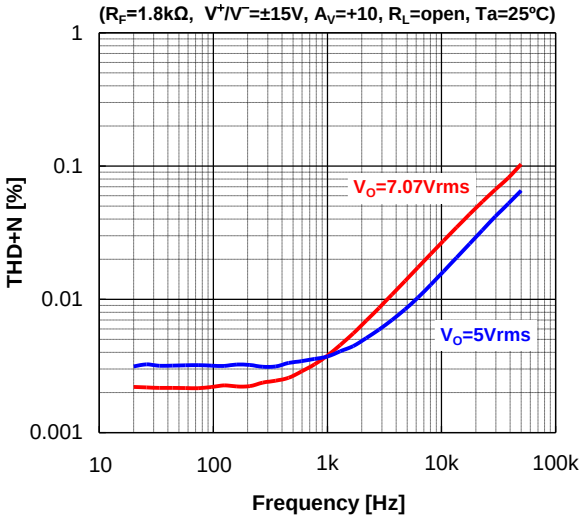

THD+N – Output Voltage
($R_F$=1.8kΩ, $V^+/V^-$=±15V, $A_V$=+10, $R_L$=open, Ta=25ºC)



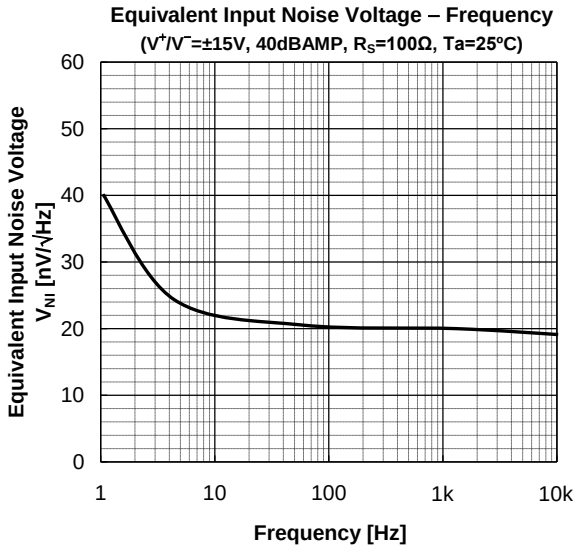

THD+N – Frequency
($R_F$=9kΩ, $V^+/V^-$=±15V, $A_V$=+10, $R_L$=open, Ta=25ºC)




THD+N – Frequency
($R_F$=1.8kΩ, $V^+/V^-$=±15V, $A_V$=+10, $R_L$=open, Ta=25ºC)



## ■TYPICAL CHARACTERISTICS




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