Low Offset, Low Drift single JFET Input Operational Amplifier

■GENERAL DESCRIPTION

The **NJM2748/2748A** is a Precision dual JFET input operational amplifier which includes low input offset voltage: 0.7mV (typ) / 2.0mV (max) and 6μV/°C typical offset drift.

The **NJM2748A** is guaranteed 20μV/°C maximum offset drift to perform a 100% tested.

The **NJM2748/2748A** 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

NJM2748D/2748AD

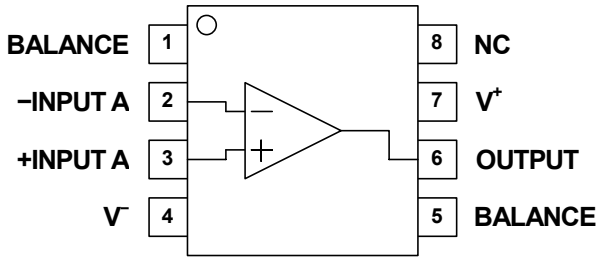
NJM2748M/2748AM

■FEATURES

●Input Offset Voltage Drift	NJM2748: $\Delta V_{IO}/\Delta T$= 6μV/°C typ. NJM2748A: $\Delta V_{IO}/\Delta T$=20μV/°C max.
●Input Offset Voltage	2.0mV max. @Ta=25°C ~ 85°C 3.0mV 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	
●Package Outline	NJM2748D, NJM2748AD :DIP8 NJM2748M, NJM2748AM :DMP8

■PIN CONFIGURATION

(Top View)



NJM2748/2748A

■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]		mW
		430 [DMP8]	(Note2)	mW
		580 [DMP8]	(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 layer, FR-4).
(Note3) Mounted on the EIA/JEDEC standard board (76.2×114.3×1.6mm, four layer, 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	$\Delta V_{IO}/\Delta T$	NJM2748A	(Note5, 6)	−	6	20	μV/°C
		NJM2748		−	6	−	
Input Offset Voltage1	V_{IO1}	R_S=50Ω, Ta=+85°C	(Note6, 7)	−	0.6	2.0	mV
Input Offset Voltage2	V_{IO2}	R_S=50Ω, Ta=+25°C	(Note6, 7)	−	0.7	2.0	mV
Input Offset Voltage3	V_{IO3}	R_S=50Ω, Ta=−40°C	(Note6, 7)	−	0.9	3.0	mV
Common Mode Rejection Ratio	CMR	V_{ICM}=±10V	(Note8)	76	92	−	dB
Supply Voltage Rejection Ratio	SVR	V^+/V^-=±6V ~ ±16V	(Note7, 9)	80	100	−	dB
Input Common Mode Voltage Range 1	V_{ICM1}	CMR≥76dB	(Note10)	+10	+14.5	−	V
Input Common Mode Voltage Range 2	V_{ICM2}	CMR≥76dB	(Note10)	−	−11	−10	V
Input Bias Current 1	I_{B1}	Ta=+25°C	(Note7)	−	50	200	pA
Input Bias Current 2	I_{B2}	Ta=+85°C	(Note7)	−	−	4	nA
Input Offset Current 1	I_{IO1}	Ta=+25°C	(Note7)	−	25	100	pA
Input Offset Current 2	I_{IO2}	Ta=+85°C	(Note7)	−	−	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=∞	(Note7)	−	2.0	3.4	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)
NJM2748A is guaranteed maximum specification because these are 100% tested to operating temperature range.
NJM2748 is guaranteed only typical specification.

(Note6) Written by the absolute rate.

(Note7) Measured at V_{ICM}=0V

(Note8) CMR is calculated by specified change in offset voltage. (V_{ICM}=0V to +10V and V_{ICM}=0V to −10V)

(Note9) SVR is calculated by specified change in offset voltage. (V^+/V^-=±6V to ±16V)

(Note10) 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	Φ_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	−	%

•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 NJM2748/2748A

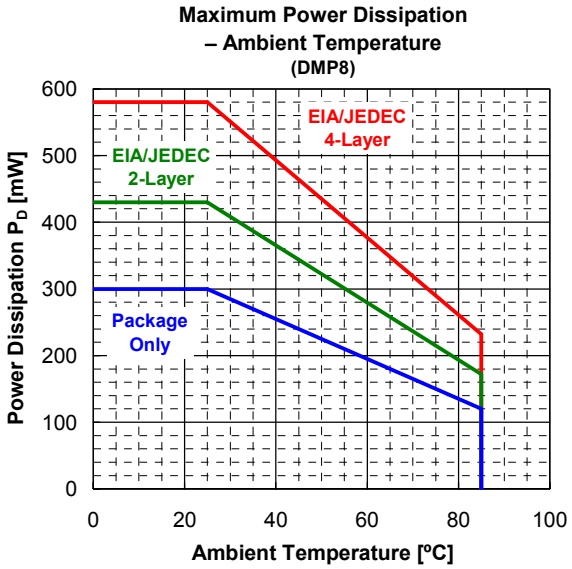
•Supply Current

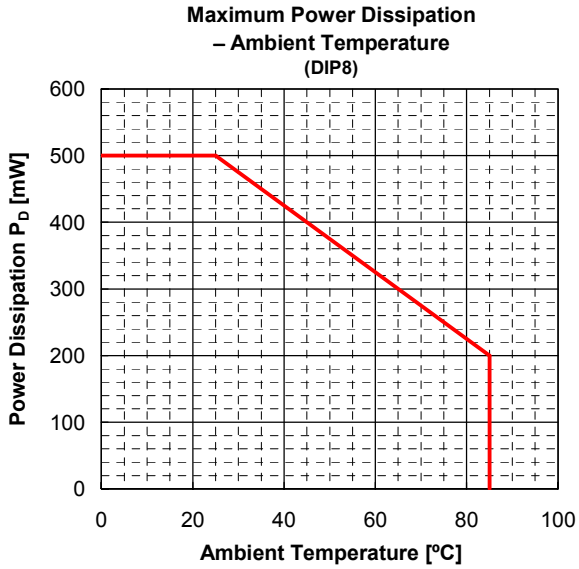
When Ta≥25°C, Power Dissipation P_D is limited by junction temperature (T_J=125°C)
So maximum supply current is influenced by package, mounting board (board size, area of cupper foil), Mounting condition and etc.

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.



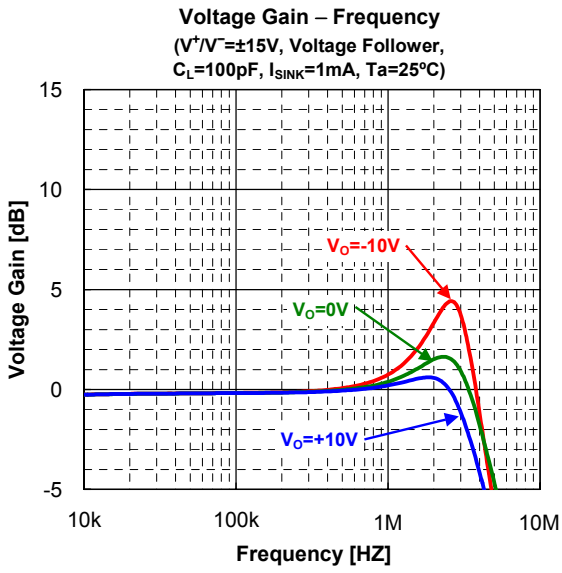


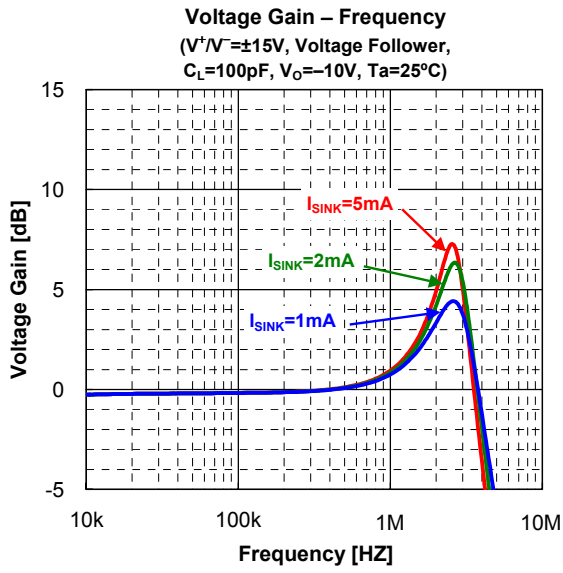
•THE OSCILLATION WITH A CAPACITIVE LOAD

NJM2748/2748A 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.





■IMPORTANT CONSIDERATIONS FOR USE OF NJM2748/2748A

●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.

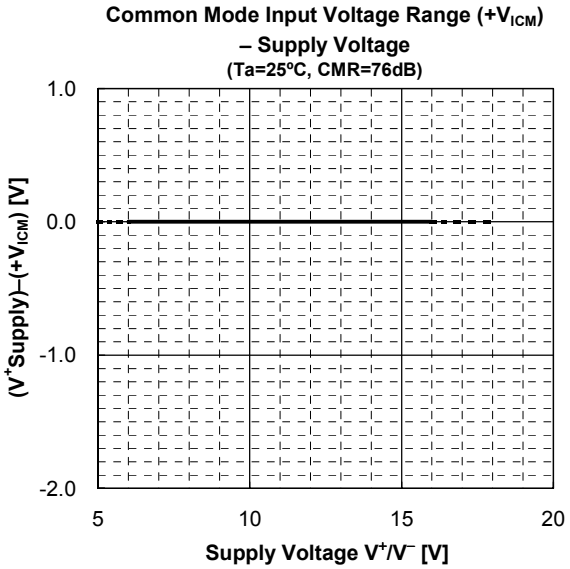
$+V_{ICM}$: (V^+ supply) − 5 [V] · · · reference

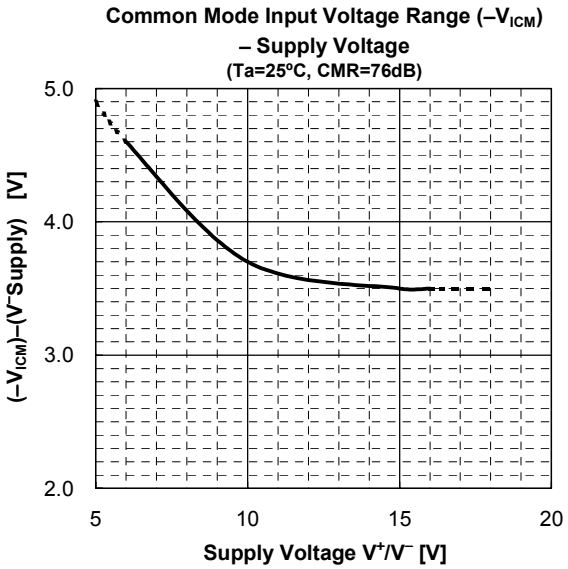
$-V_{ICM}$: (V^- supply) + 5 [V] · · · reference

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.

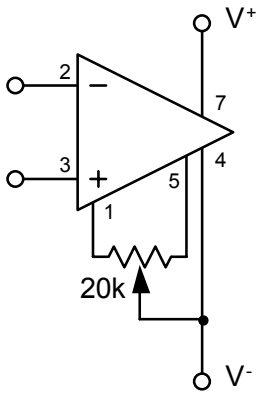
Moreover, $-V_{ICM}$ tends to rise by lowering of the supply voltage.

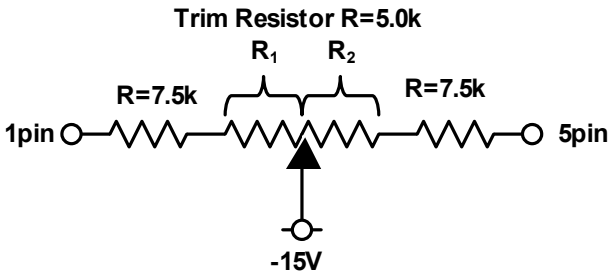


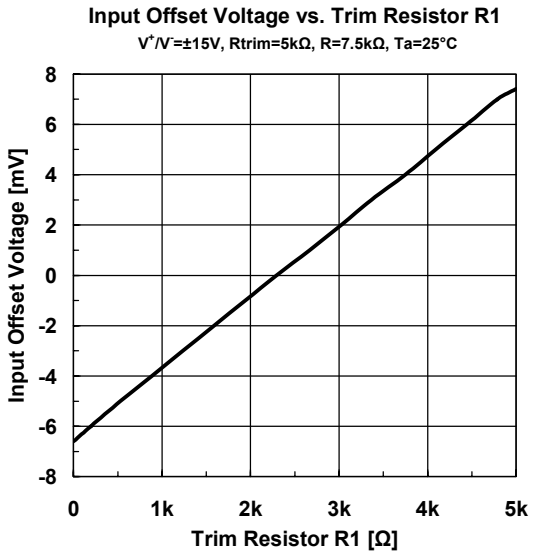


■OFFSET VOLTAGE TRIM CIRCUIT

The NJM2748 provides offset voltage trim connections on pin 1 and 5.
The offset voltage can be adjusted by connecting Potentiometer as shown in figure.
This function adjusts an initial offset voltage, and it doesn't become an improvement of the temperature drift.
Please make pin1 and pin5 open when you don't use this function.







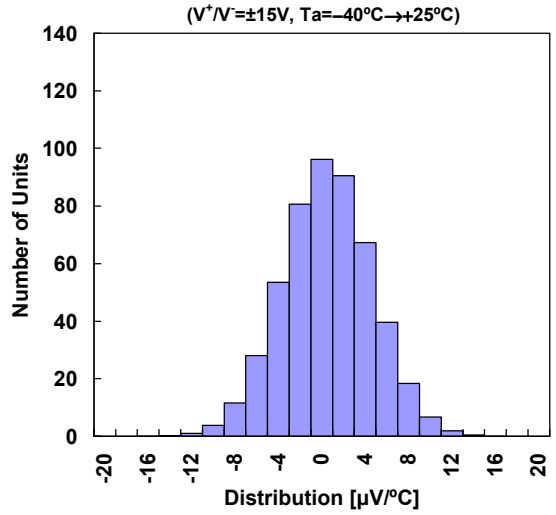
•OTHERS

For the NJM2748/2748A 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.

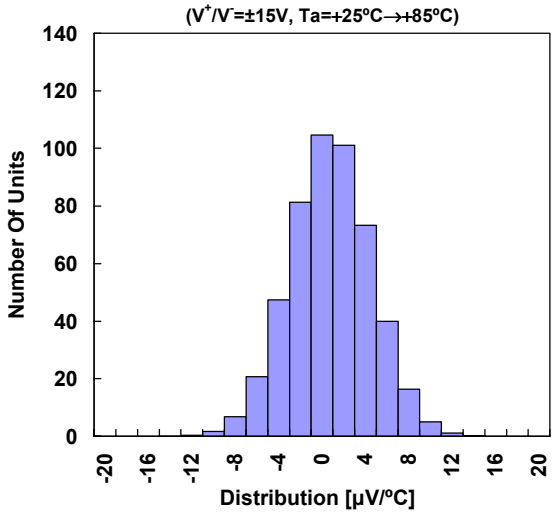
You should pay close attention to environment of storage and usage.

■TYPICAL CHARACTERISTICS

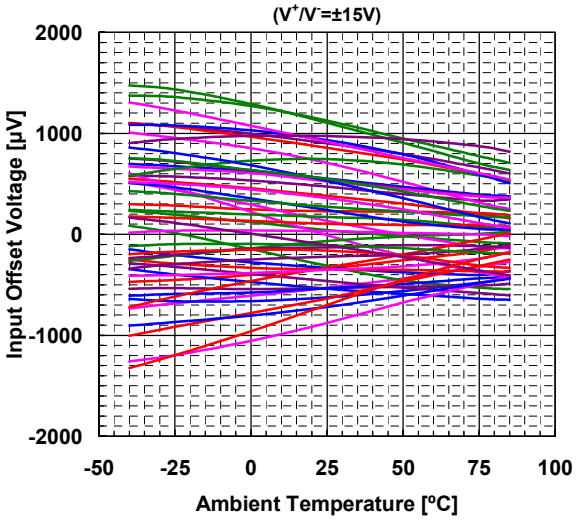
Input Offset Voltage Temperature Coefficient Distribution
(V^+/V^-=±15V, Ta=–40ºC→+25ºC)



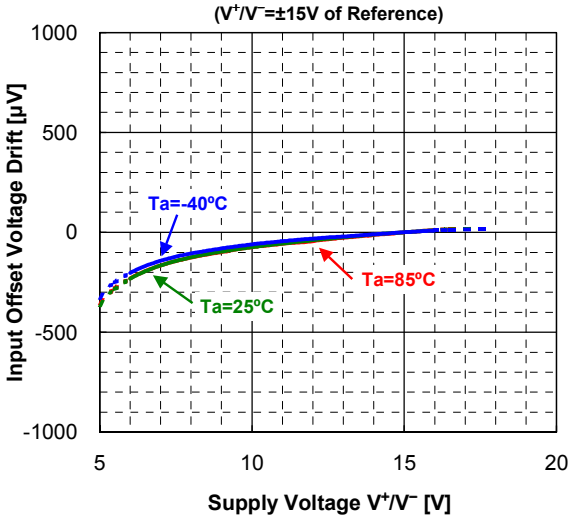
Input Offset Voltage Temperature Coefficient Distribution
(V^+/V^-=±15V, Ta=+25ºC→+85ºC)



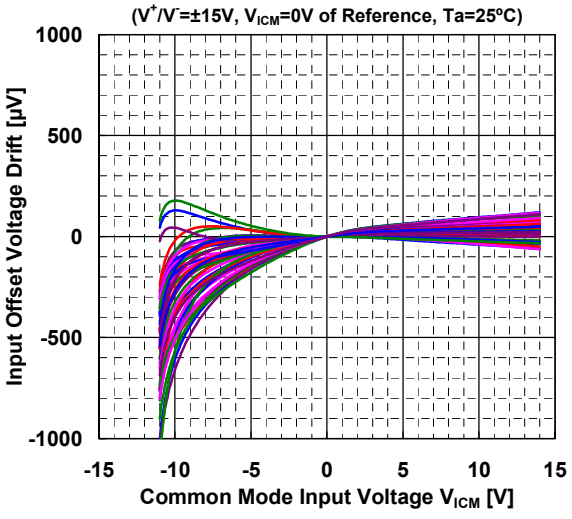
Input Offset Voltage – Ambient Temperature
(V^+/V^-=±15V)



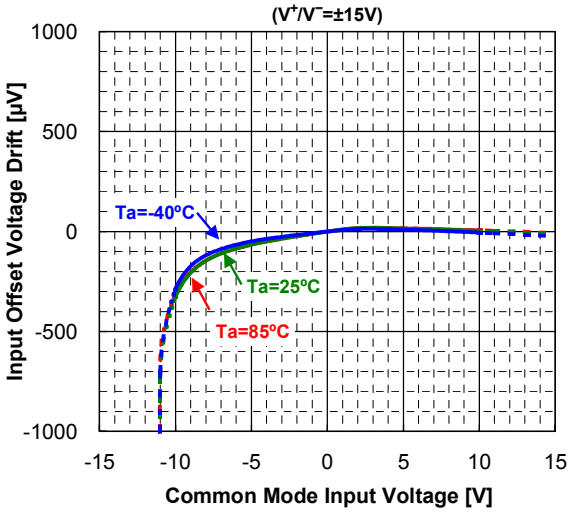
Input Offset Voltage Drift – Supply Voltage
(V^+/V^-=±15V of Reference)



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

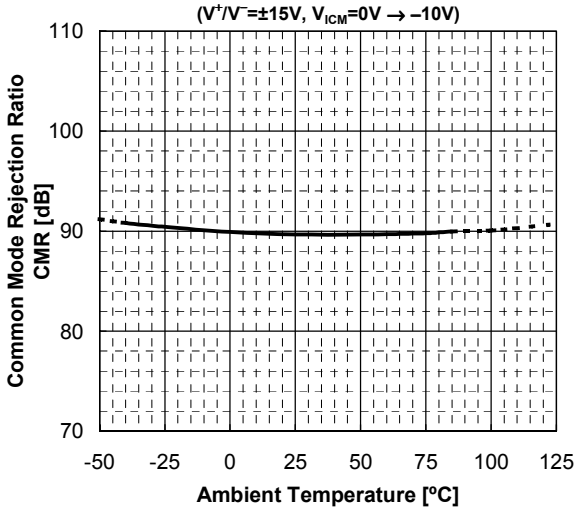


Input Offset Voltage Drift
– Common Mode Input Voltage
(V^+/V^-=±15V)

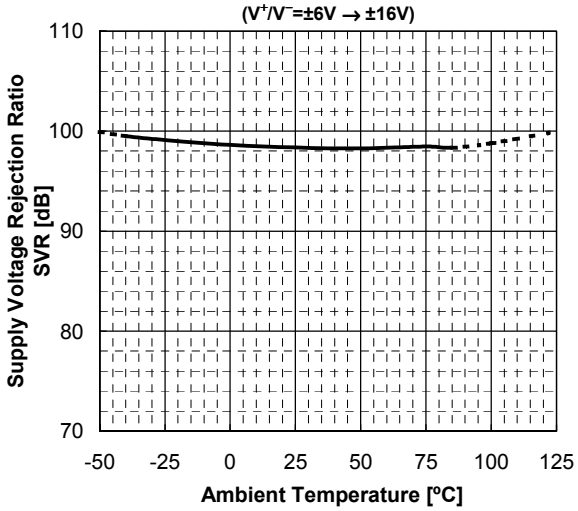


■TYPICAL CHARACTERISTICS

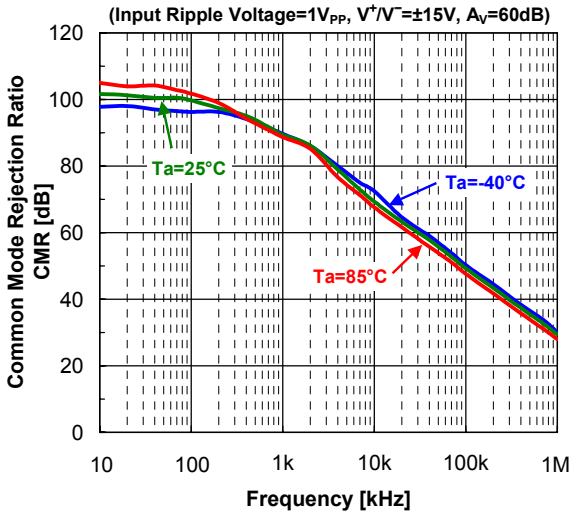
Common Mode Rejection Ratio – Ambient Temperature
(V^+/V^-=±15V, V_{ICM}=0V → –10V)



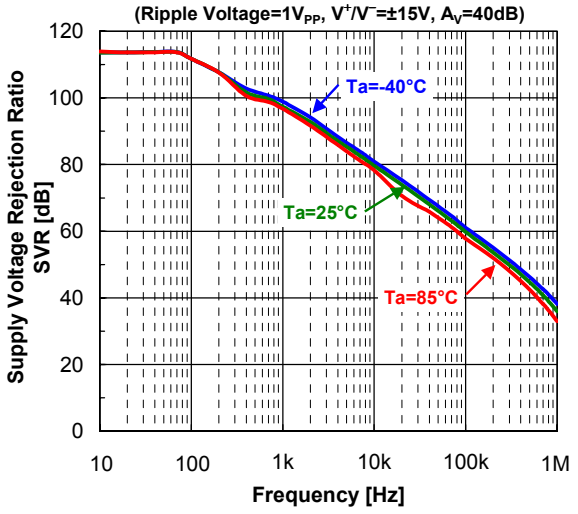
Supply Voltage Rejection Ratio – Ambient Temperature
(V^+/V^-=±6V → ±16V)



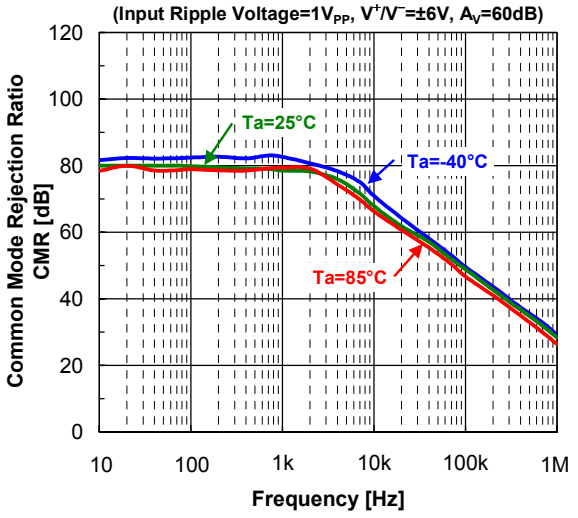
Common Mode Rejection Ratio – Frequency
(Input Ripple Voltage=1V_{PP}, V^+/V^-=±15V, A_V=60dB)



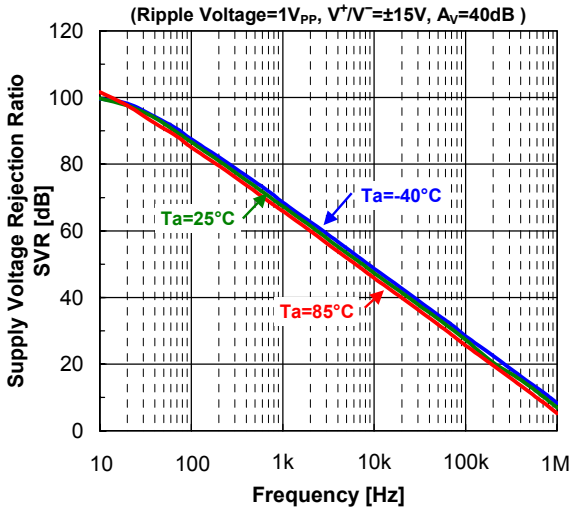
Supply Voltage Rejection Ratio (+Supply) – Frequency
(Ripple Voltage=1V_{PP}, V^+/V^-=±15V, A_V=40dB)



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

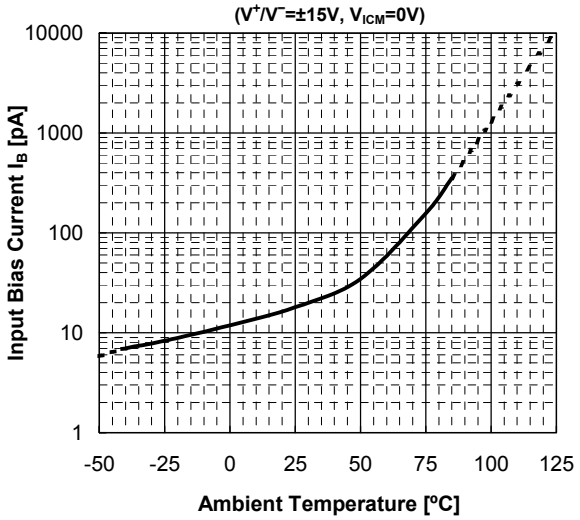


Supply Voltage Rejection Ratio (–Supply) – Frequency
(Ripple Voltage=1V_{PP}, V^+/V^-=±15V, A_V=40dB)

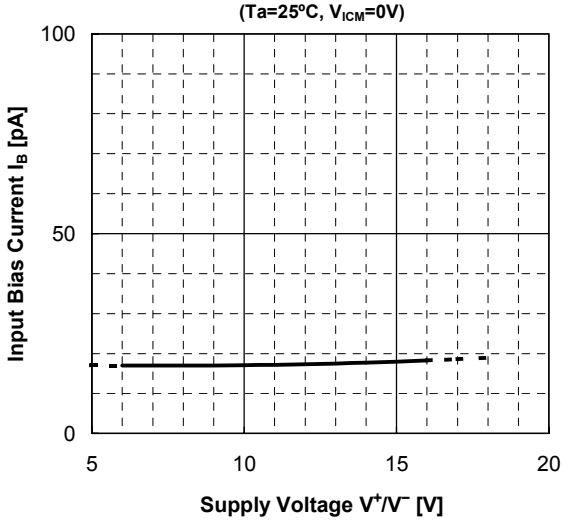


■TYPICAL CHARACTERISTICS

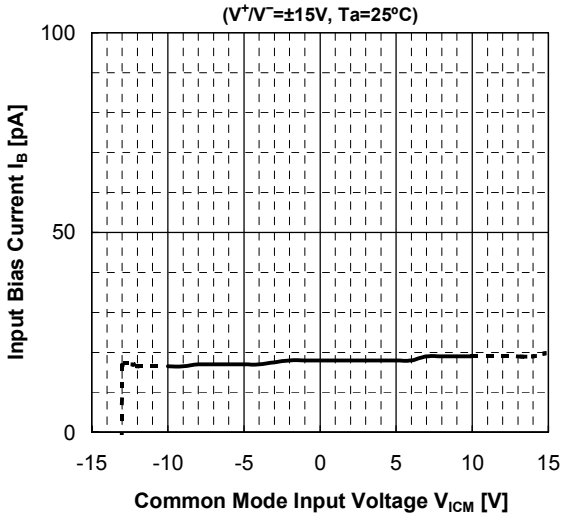
Input Bias Current – Ambient Temperature
(V^+/V^-=±15V, V_{ICM}=0V)



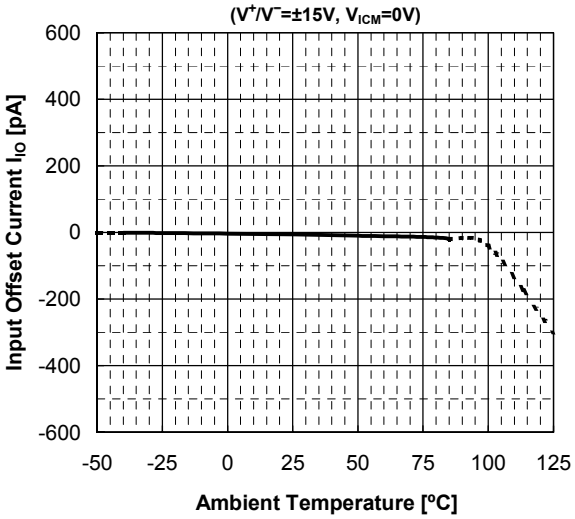
Input Bias Current – Supply Voltage
(Ta=25ºC, V_{ICM}=0V)



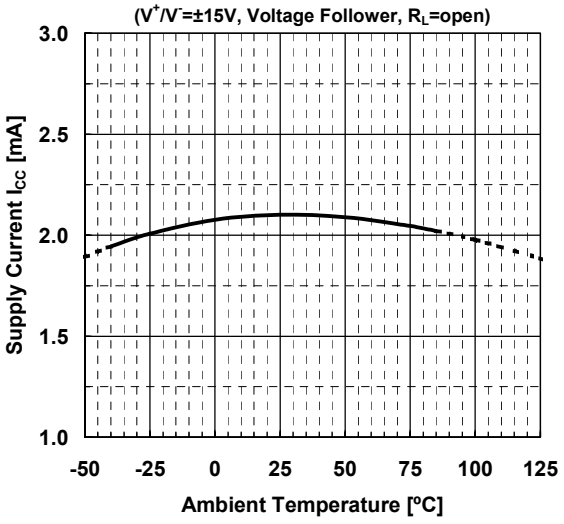
Input Bias Current – Common Mode Input Voltage
(V^+/V^-=±15V, Ta=25ºC)



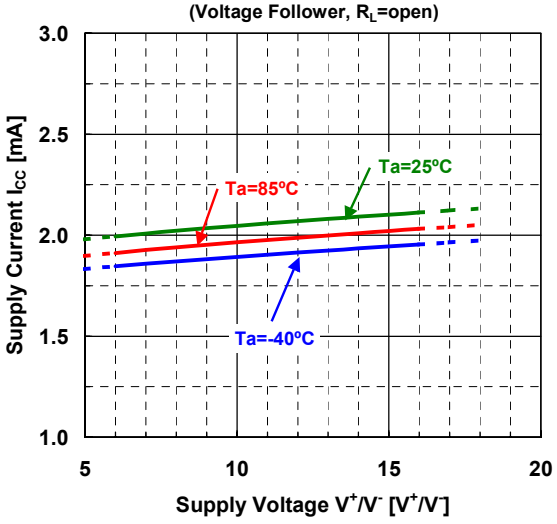
Input Offset Current – Ambient Temperature
(V^+/V^-=±15V, V_{ICM}=0V)



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

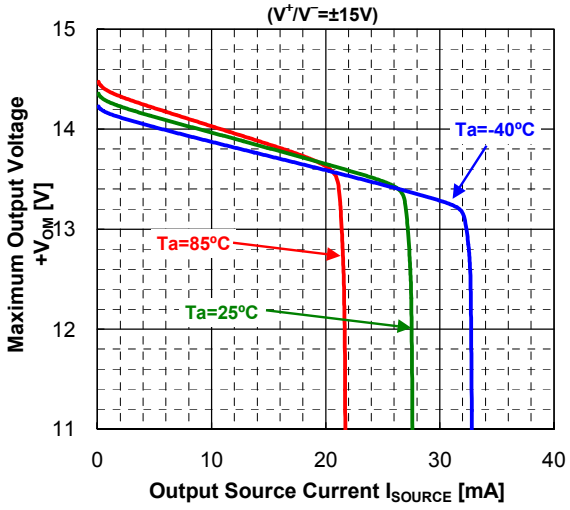


Supply Current – Supply Voltage
(Voltage Follower, R_L=open)

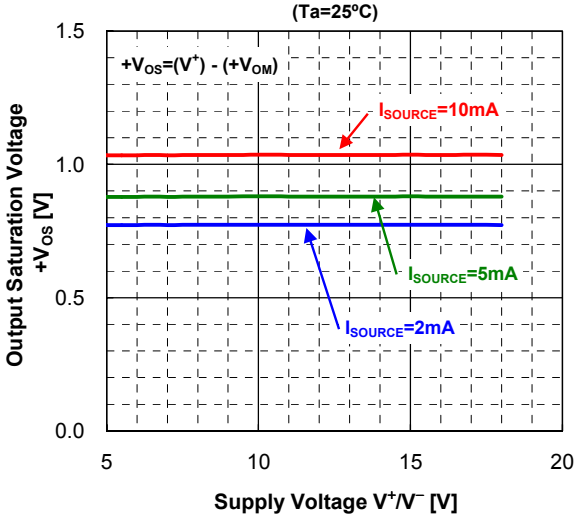


■TYPICAL CHARACTERISTICS

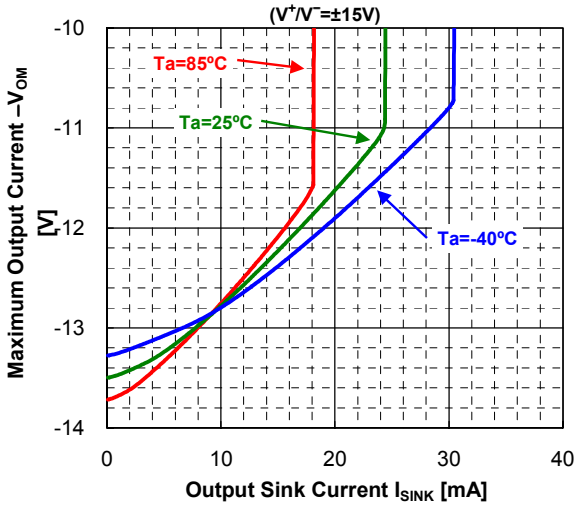
Maximum Output Voltage ($+V_{OM}$) – Output Source Current (V^+/V^-=±15V)



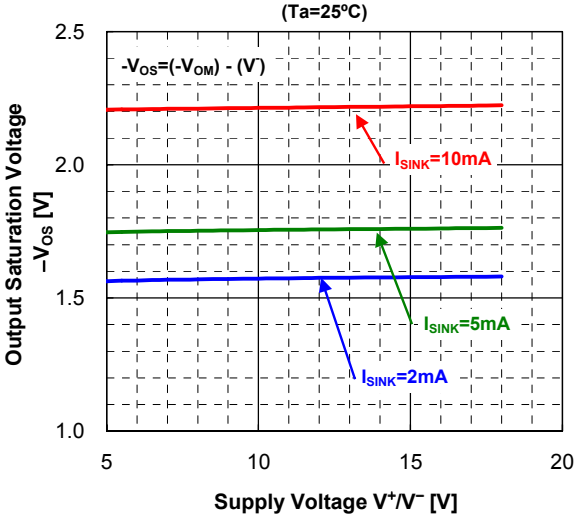
Output Saturation Voltage ($+V_{OS}$) – Supply Voltage (Ta=25°C)



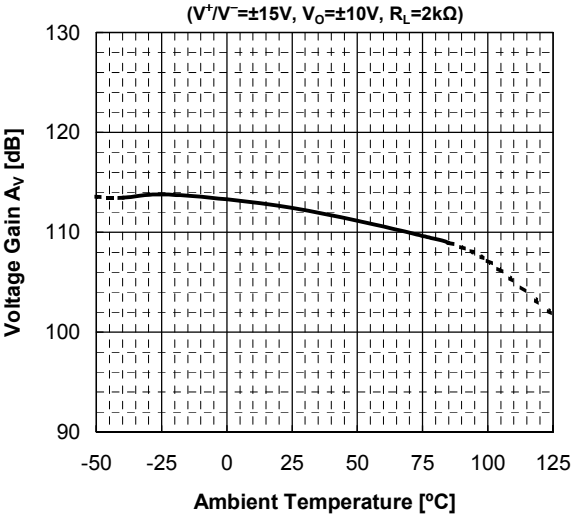
Maximum Output Voltage ($-V_{OM}$) – Output Sink Current (V^+/V^-=±15V)



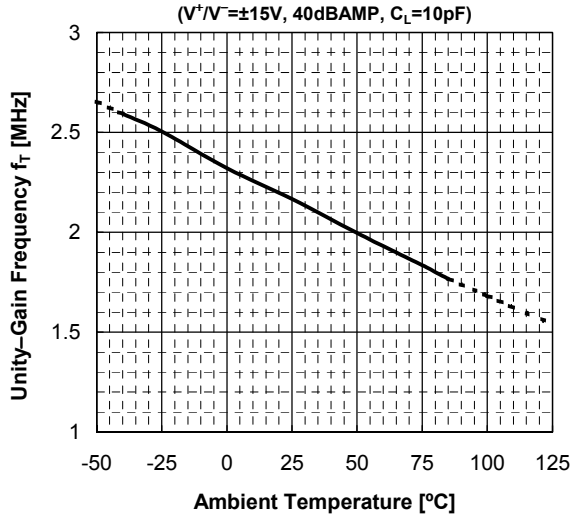
Output Saturation Voltage ($-V_{OS}$) – Supply Voltage (Ta=25°C)



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

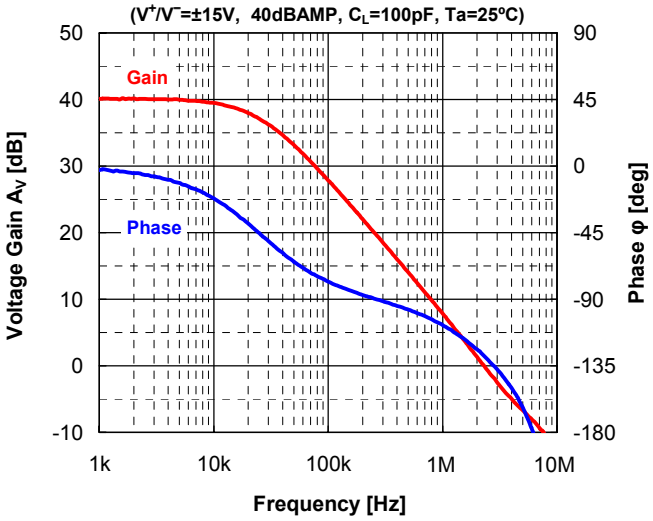


Unity–Gain Frequency – Ambient Temperature (V^+/V^-=±15V, 40dBAMP, C_L=10pF)

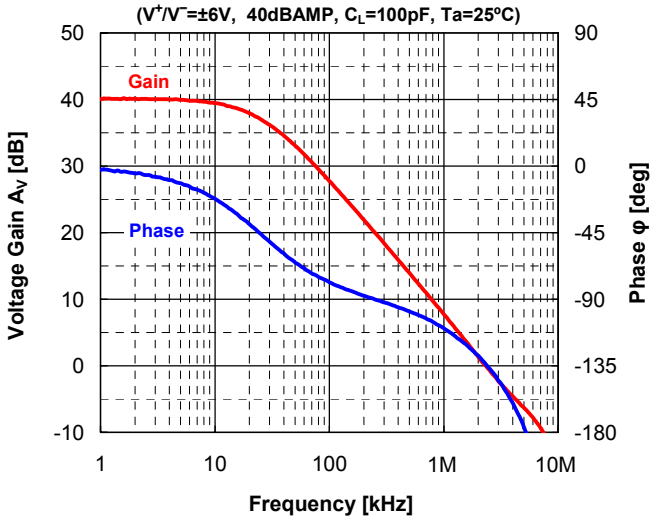


■TYPICAL CHARACTERISTICS

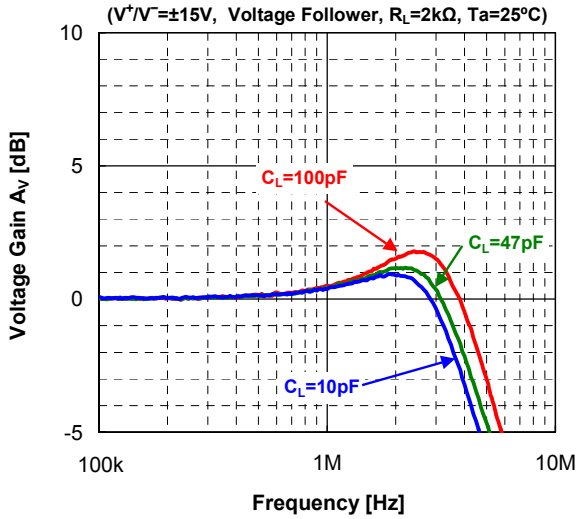
Gain/Phase – Frequency
(V^+/V^-=±15V, 40dBAMP, C_L=100pF, Ta=25°C)



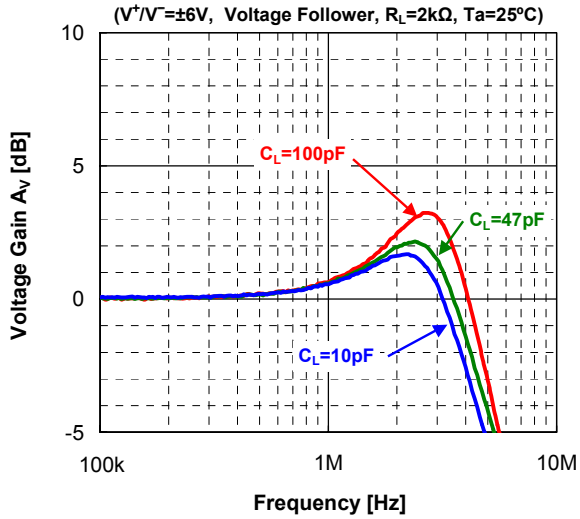
Gain/Phase – Frequency
(V^+/V^-=±6V, 40dBAMP, C_L=100pF, Ta=25°C)



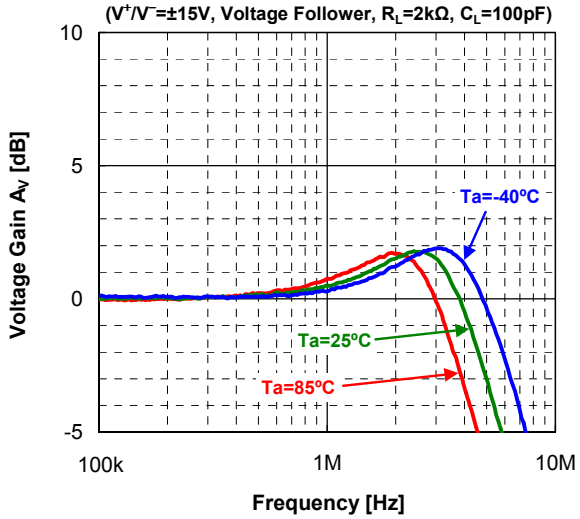
Voltage Gain – Frequency
(V^+/V^-=±15V, Voltage Follower, R_L=2kΩ, Ta=25°C)



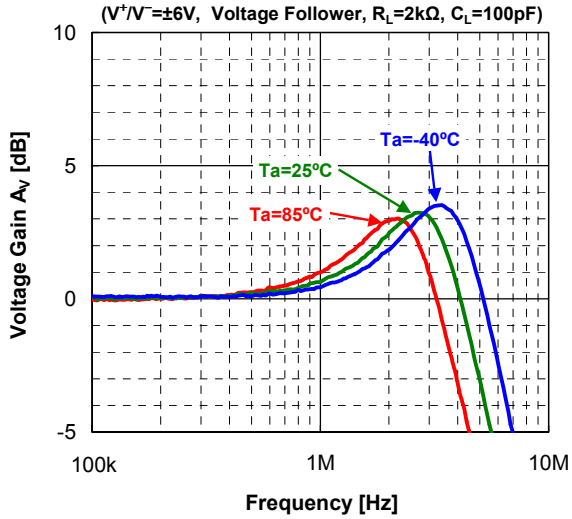
Voltage Gain – Frequency
(V^+/V^-=±6V, Voltage Follower, R_L=2kΩ, Ta=25°C)



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

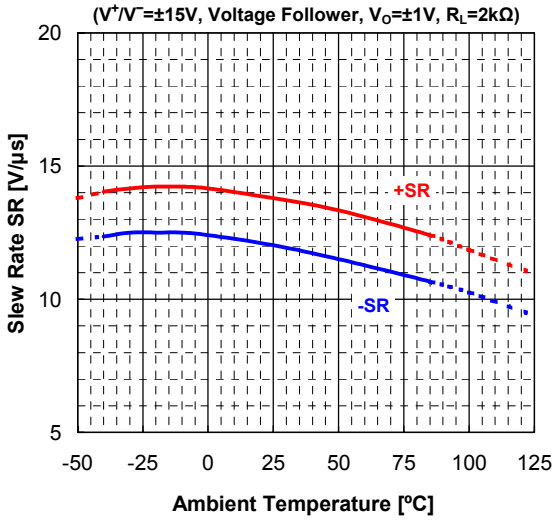


Voltage Gain – Frequency
(V^+/V^-=±6V, Voltage Follower, R_L=2kΩ, C_L=100pF)

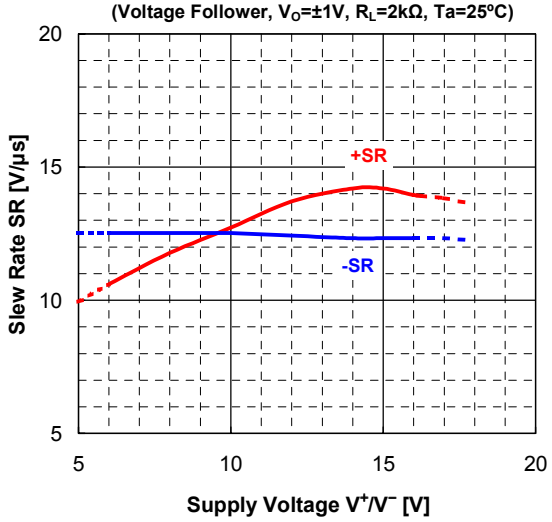


■TYPICAL CHARACTERISTICS

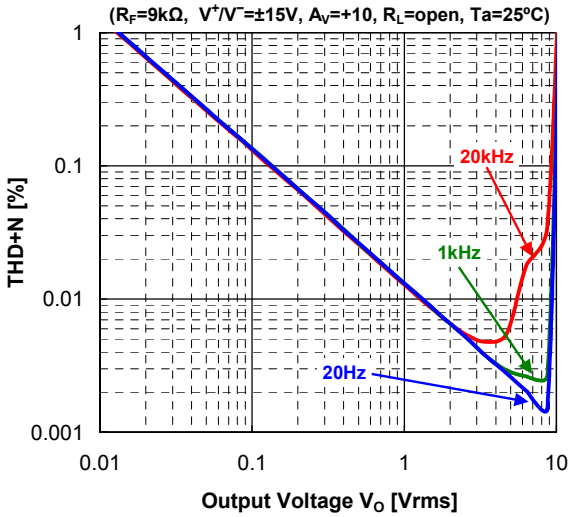
Slew Rate – Ambient Temperature
(V^+/V^-=±15V, Voltage Follower, V_O=±1V, R_L=2kΩ)



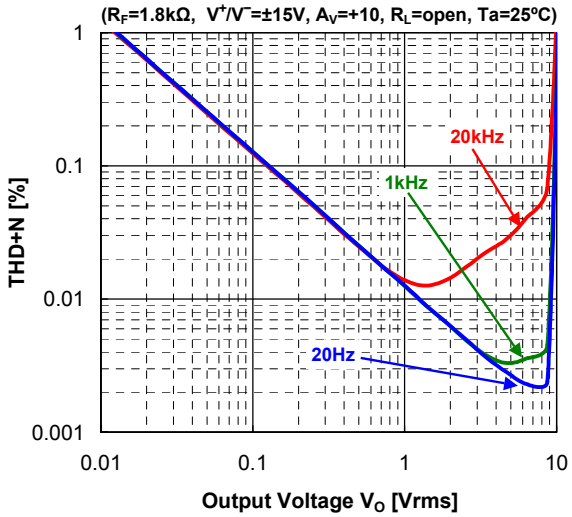
Slew Rate – Supply Voltage
(Voltage Follower, V_O=±1V, R_L=2kΩ, Ta=25ºC)



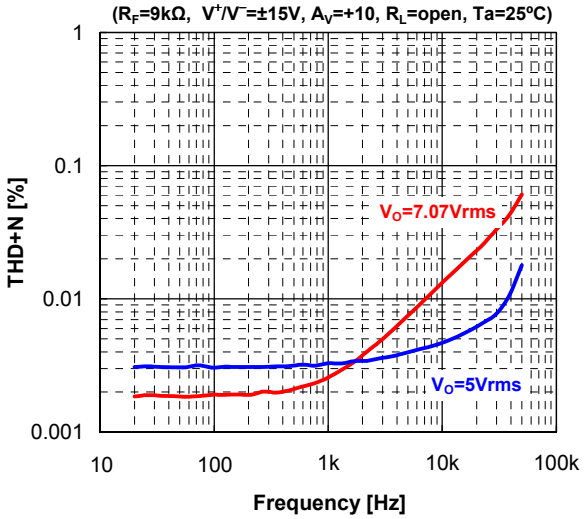
THD+N – Output Voltage
(R_F=9kΩ, V^+/V^-=±15V, A_V=+10, R_L=open, Ta=25ºC)



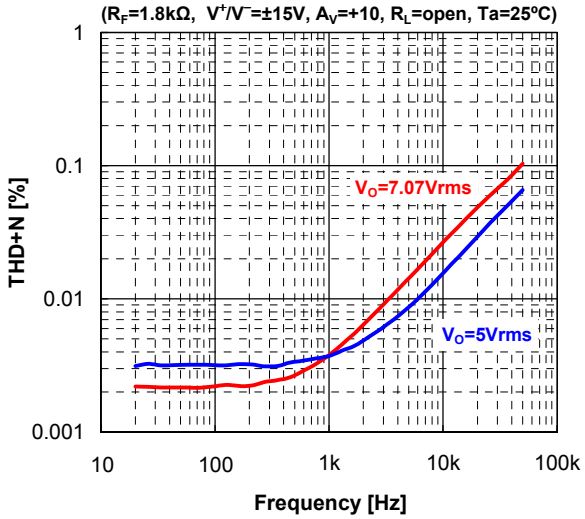
THD+N – Output Voltage
(R_F=1.8kΩ, V^+/V^-=±15V, A_V=+10, R_L=open, Ta=25ºC)



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