



High Quality Audio, Bipolar Input, Dual Operational Amplifier

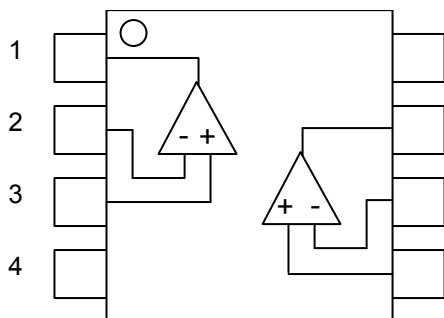
The **MUSES02** is a dual bipolar input high quality audio operational amplifier, which is optimized for high-end audio and professional audio applications with advanced circuitry and layout, unique material and assembled technology by skilled-craftwork.

It is the best for audio preamplifiers, active filters, and line amplifiers with excellent sound.

■ FEATURES

- | | |
|------------------------|---|
| ● Operating Voltage | $V_{opr} = \pm 3.5V$ to $\pm 16V$ |
| ● Output noise | $4.5nV/\sqrt{Hz}$ at $f=1kHz$ |
| ● Input Offset Voltage | 0.3mV typ. 3mV max. |
| ● Input Bias Current | 100nA typ. 500nA max. at $T_a=25^\circ C$ |
| ● Voltage Gain | 110dB typ. |
| ● Slew Rate | $5V/\mu s$ typ. |
| ● Bipolar Technology | |
| ● Package Outline | DIP8 |

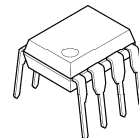
■ PIN CONFIGURATION



PIN FUNCTION

- | | |
|---|-------------|
| 8 | 1. A OUTPUT |
| 7 | 2. A -INPUT |
| 6 | 3. A +INPUT |
| 5 | 4. V- |
| | 5. B +INPUT |
| | 6. B -INPUT |
| | 7. B OUTPUT |
| | 8. V+ |

■ PACKAGE OUTLINE



MUSES02



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MUSES02

■ ABSOLUTE MAXIMUM RATINGS (Ta=25°C)

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	910	mW
Output Current	I _O	±50	mA
Operating Temperature Range	T _{opr}	-40 to +85	°C
Storage Temperature Range	T _{stg}	-50 to +150	°C

(Note1) For supply Voltages less than ±15 V, the maximum input voltage is equal to the Supply Voltage.

■ RECOMMENDED OPERATING CONDITION (Ta=25°C)

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Supply Voltage	V ⁺ /V ⁻	-	±3.5	-	±16	V

■ ELECTRIC CHARACTERISTICS

DC CHARACTERISTICS (V⁺/V⁻=±15V, Ta=25°C unless otherwise specified)

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Operating Current	I _{cc}	No Signal, R _L =∞	-	8.0	12.0	mA
Input Offset Voltage	V _{IO}	R _s ≤10kΩ (Note2)	-	0.3	3.0	mV
Input Bias Current	I _B	(Note2, 3)	-	100	500	nA
Input Offset Current	I _{IO}	(Note2, 3)	-	5	200	nA
Voltage Gain	A _V	R _L ≥2kΩ, V _o =±10V R _s ≤10kΩ	90	110	-	dB
Common Mode Rejection Ratio	CMR	V _{ICM} =±12V (Note4) R _s ≤10kΩ	80	110	-	dB
Supply Voltage Rejection Ratio	SVR	V ⁺ /V ⁻ =±3.5 to ±16.0V R _s ≤10kΩ (Note2, 5)	80	110	-	dB
Max Output Voltage	V _{OM}	R _L =2kΩ	±12	±13.5	-	V
Input Common Mode Voltage Range	V _{ICM}	CMR≥80dB	±12	±13.5	-	V

(Note2) Measured at V_{ICM}=0V

(Note3) Written by the absolute rate.

(Note4) CMR is calculated by specified change in offset voltage. (V_{ICM}=0V to +12V and V_{ICM}=0V to -12V)

(Note5) SVR is calculated by specified change in offset voltage. (V⁺/V⁻=±3.5V to ±16V)

■ AC CHARACTERISTICS ($V^+V^- = \pm 15V$, $T_a = 25^\circ C$ unless otherwise specified)

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Gain Bandwidth Product	GB	$f = 10kHz$	-	11	-	MHz
Unity Gain Frequency	f_T	$A_V = +100, R_S = 100\Omega,$ $R_L = 2k\Omega, C_L = 10pF$	-	5.8	-	MHz
Phase Margin	ϕ_M	$A_V = +100, R_S = 100\Omega,$ $R_L = 2k\Omega, C_L = 10pF$	-	48	-	deg
Input Noise Voltage1	V_{NI}	$f = 1kHz, A_V = +100,$ $R_S = 100\Omega, R_L = \infty$	-	4.5	-	nV/ \sqrt{Hz}
Input Noise Voltage2	V_{N2}	$f = 1kHz, A_V = +10$ $R_S = 2.2k\Omega,$ RIAA, 30kHz LPF	-	0.8	1.4	μV_{rms}
Total Harmonic Distortion	THD	$f = 1kHz, A_V = +10,$ $R_L = 2k\Omega, V_o = 5V_{rms}$	-	0.001	-	%
Channel Separation	CS	$f = 1kHz, A_V = +100,$ $R_S = 1k\Omega, R_L = 2k\Omega$	-	150	-	dB
Positive Slew Rate	+SR	$A_V = 1, V_{IN} = 2V_{p-p},$ $R_L = 2k\Omega, C_L = 10pF$	-	5	-	V/ μs
Negative Slew Rate	-SR	$A_V = 1, V_{IN} = 2V_{p-p},$ $R_L = 2k\Omega, C_L = 10pF$	-	5	-	V/ μs

■ Application Notes

•Package Power, Power Dissipation and Output Power

IC is heated by own operation and possibly gets damage when the junction power exceeds the acceptable value called Power Dissipation P_D . The dependence of the MUSES02 P_D on ambient temperature is shown in Fig 1. The plots are depended on following two points. The first is P_D on ambient temperature 25°C, which is the maximum power dissipation. The second is 0W, which means that the IC cannot radiate any more. Conforming the maximum junction temperature T_{jmax} to the storage temperature T_{stg} derives this point. Fig.1 is drawn by connecting those points and conforming the P_D lower than 25°C to it on 25°C. The P_D is shown following formula as a function of the ambient temperature between those points.

$$\text{Dissipation Power } P_D = \frac{T_{jmax} - T_a}{\theta_{ja}} \text{ [W]} \quad (T_a=25^\circ\text{C to } T_a=150^\circ\text{C})$$

Where, θ_{ja} is heat thermal resistance which depends on parameters such as package material, frame material and so on. Therefore, P_D is different in each package.

While, the actual measurement of dissipation power on MUSES02 is obtained using following equation.

$$(\text{Actual Dissipation Power}) = (\text{Supply Voltage } V_{DD}) \times (\text{Supply Current } I_{DD}) - (\text{Output Power } P_o)$$

The MUSES02 should be operated in lower than P_D of the actual dissipation power.

To sustain the steady state operation, take account of the Dissipation Power and thermal design.

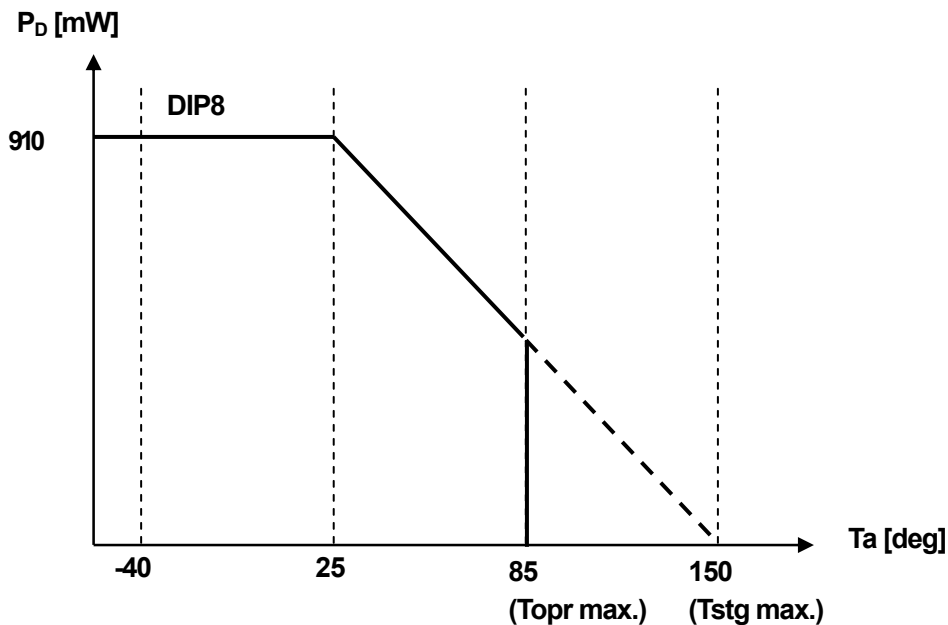
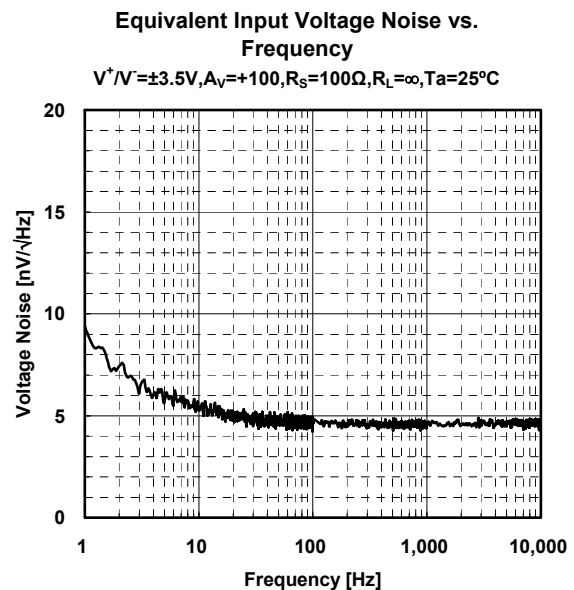
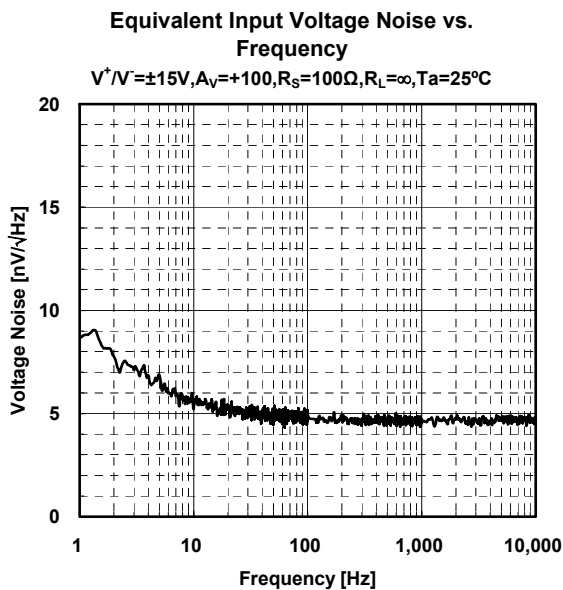
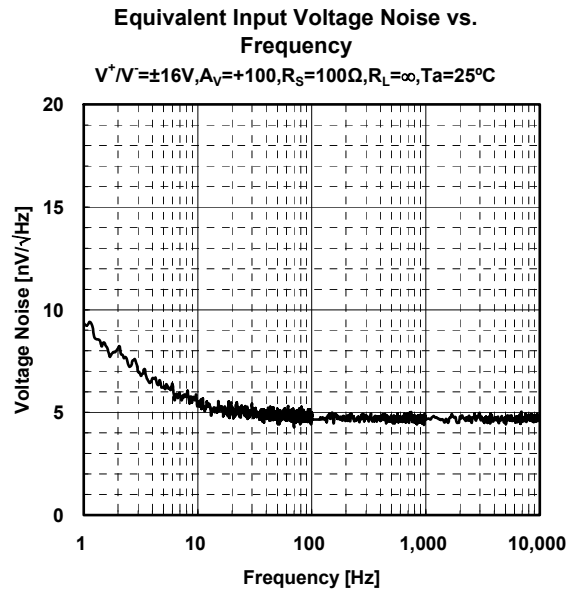
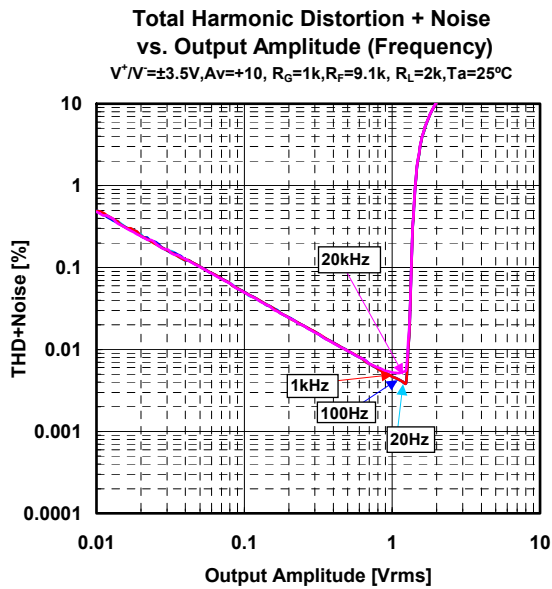
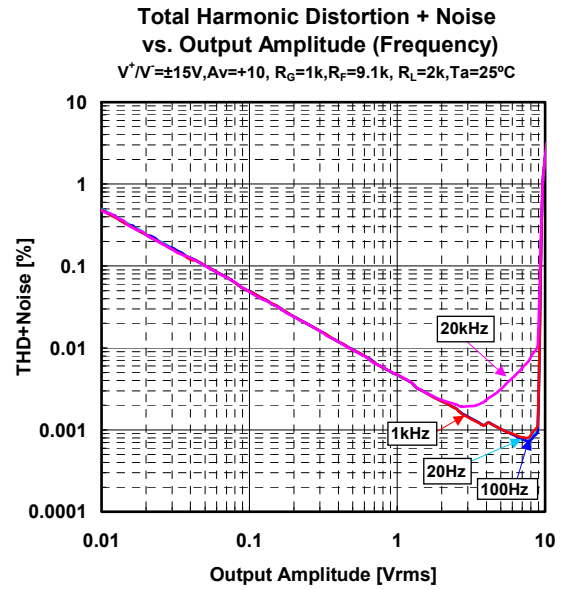
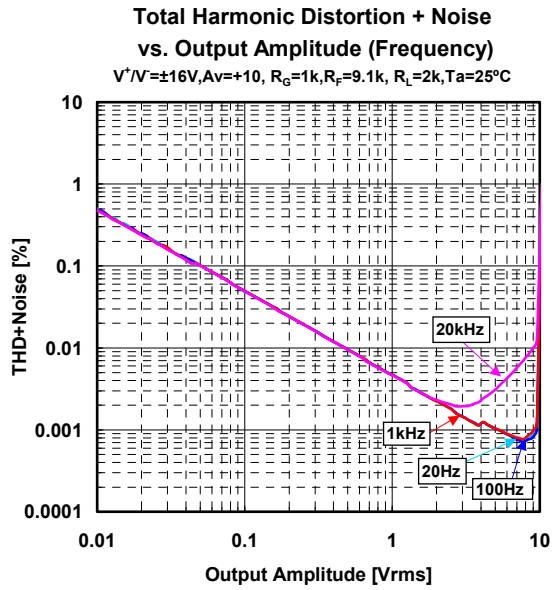
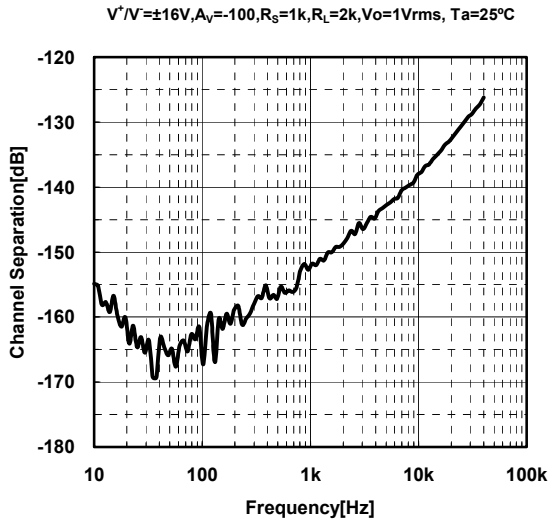


Fig.1 Power Dissipations vs. Ambient Temperature on the MUSES02

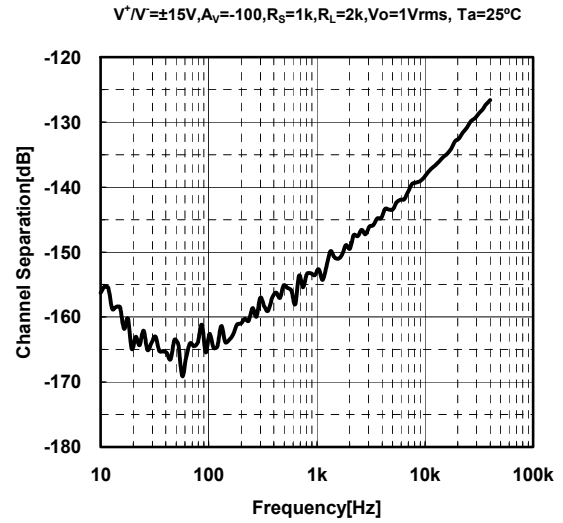
■ TYPICAL CHARACTERISTICS



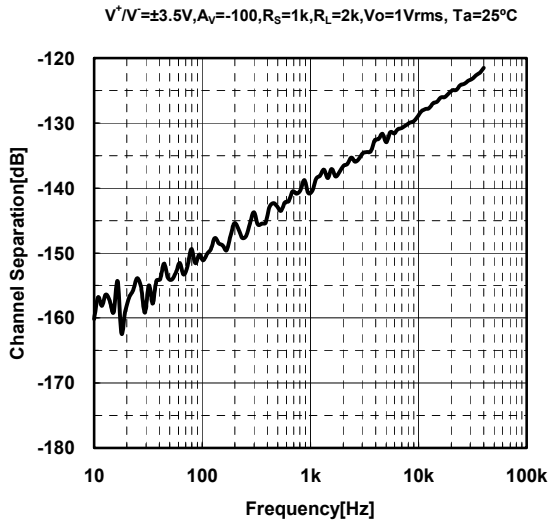
Channel Separation vs. Frequency



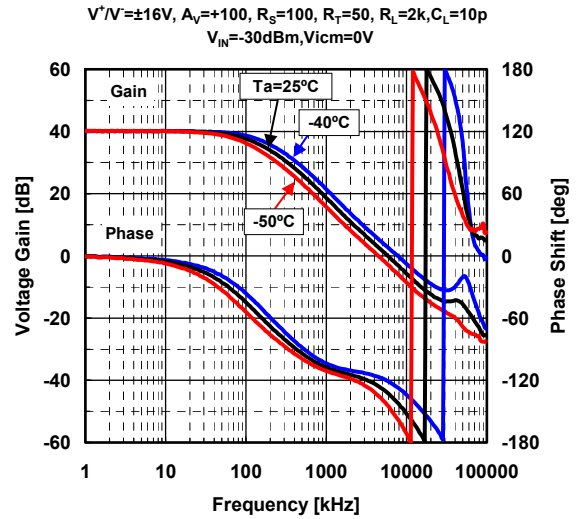
Channel Separation vs. Frequency



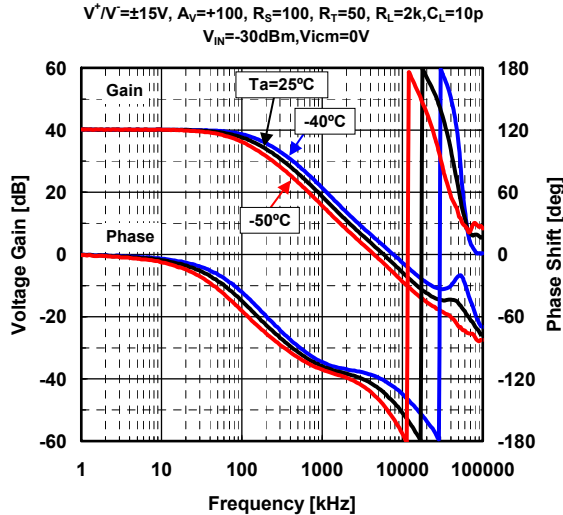
Channel Separation vs. Frequency



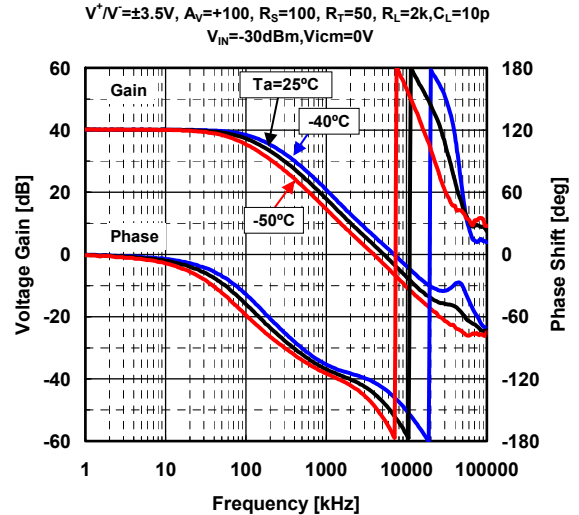
Closed-Loop Gain/Phase vs. Frequency(Temperature)



Closed-Loop Gain/Phase vs. Frequency(Temperature)

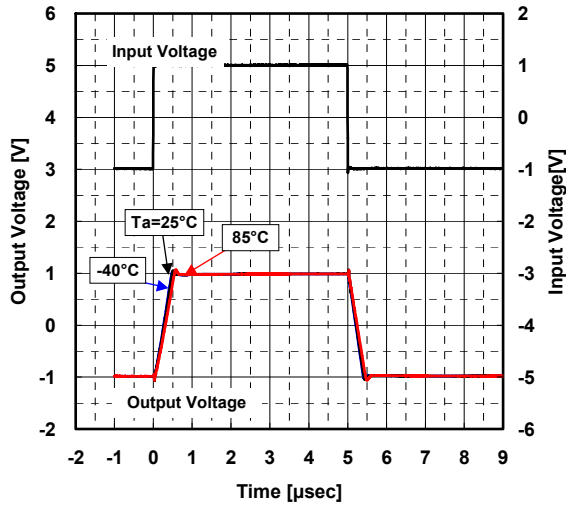


Closed-Loop Gain/Phase vs. Frequency(Temperature)



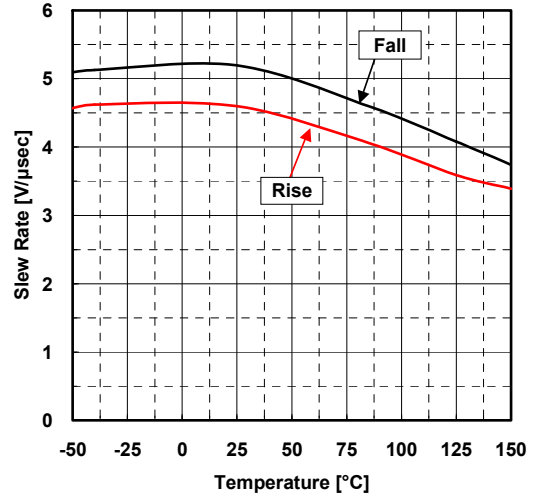
Transient Response (Temperature)

$V^+ / V^- = \pm 16V, V_{IN} = 2V_{P-P}, f = 100kHz$
 PulseEdge=10nsec, Gv=0dB, CL=10p, RL=2k



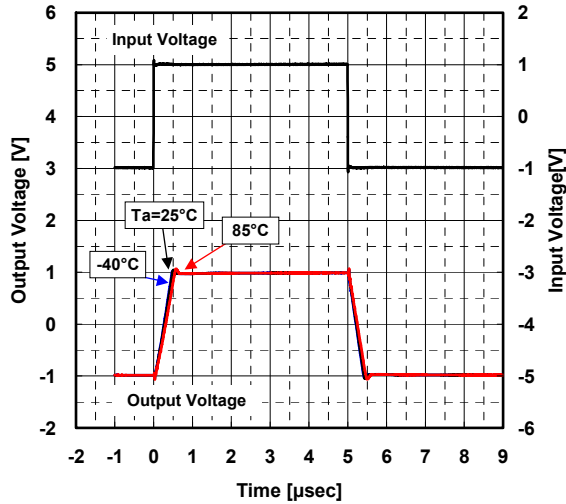
Slew Rate vs. Temperature

$V^+ / V^- = \pm 16V, V_{IN} = 2V_{P-P}, f = 100kHz$
 PulseEdge=10nsec, Gv=0dB, CL=10p, RL=2k



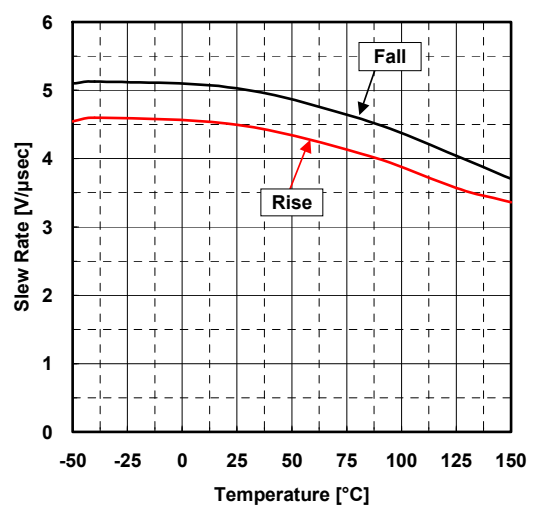
Transient Response (Temperature)

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 PulseEdge=10nsec, Gv=0dB, CL=10p, RL=2k



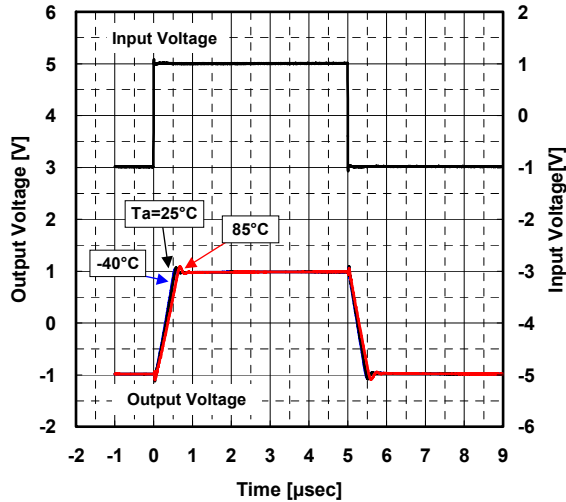
Slew Rate vs. Temperature

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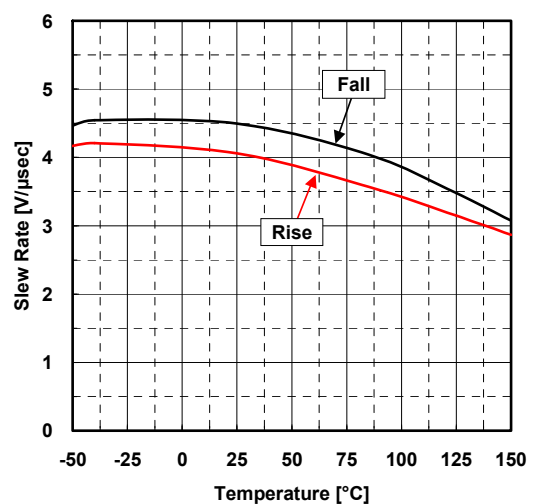
Transient Response (Temperature)

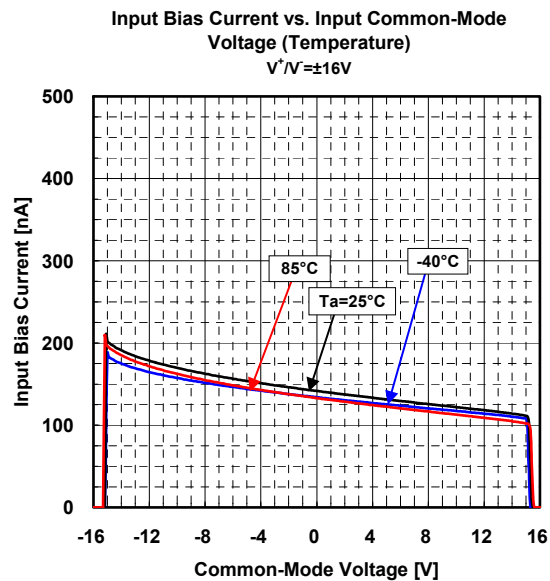
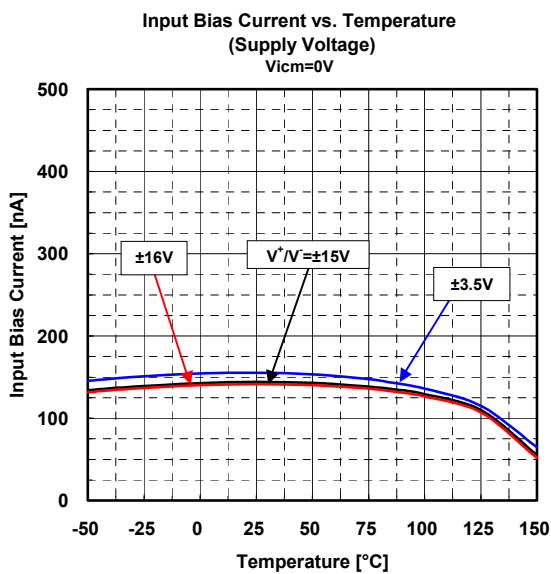
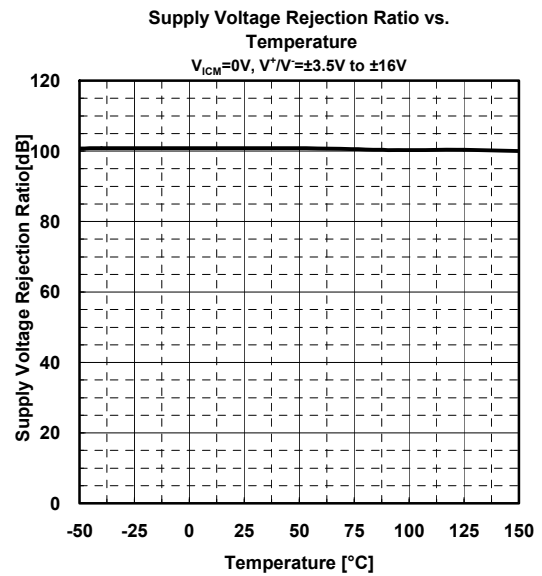
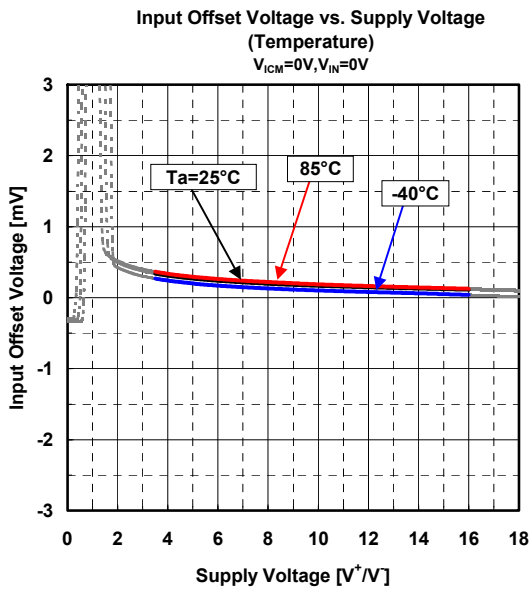
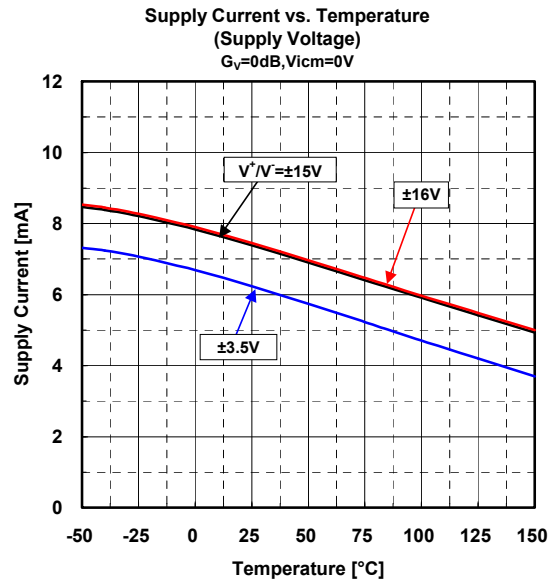
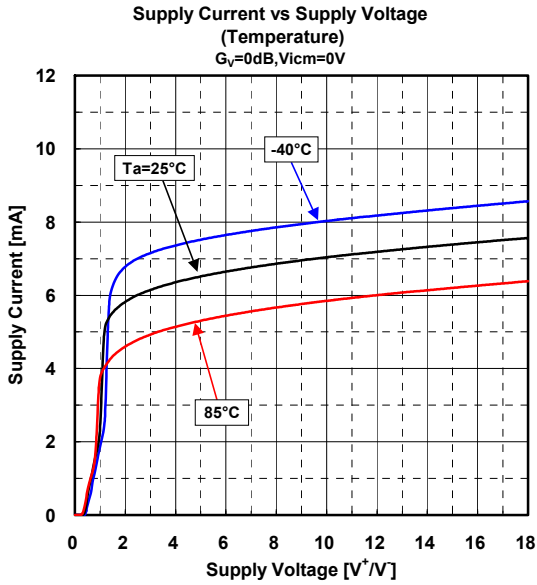
$V^+ / V^- = \pm 3.5V, V_{IN} = 2V_{P-P}, f = 100kHz$
 PulseEdge=10nsec, Gv=0dB, CL=10p, RL=2k



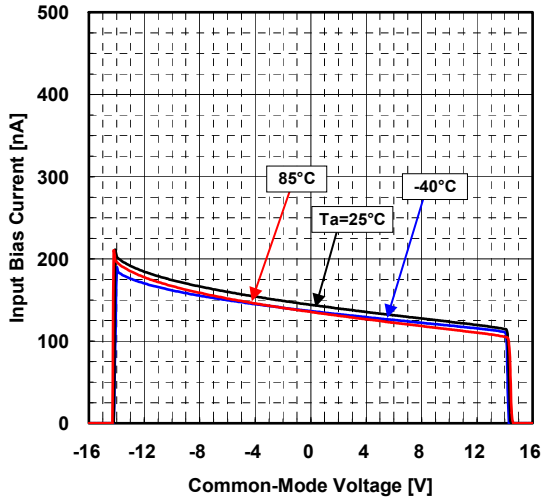
Slew Rate vs. Temperature

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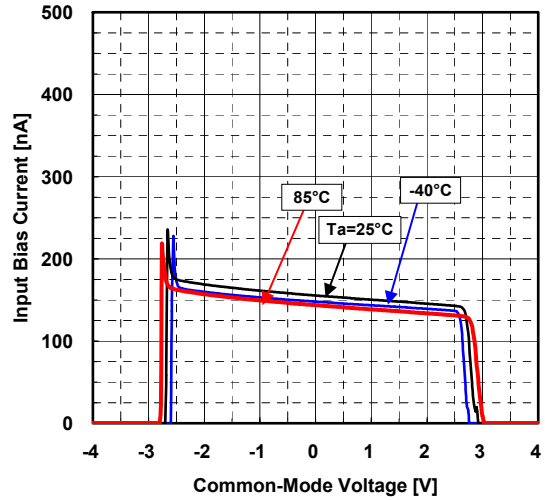




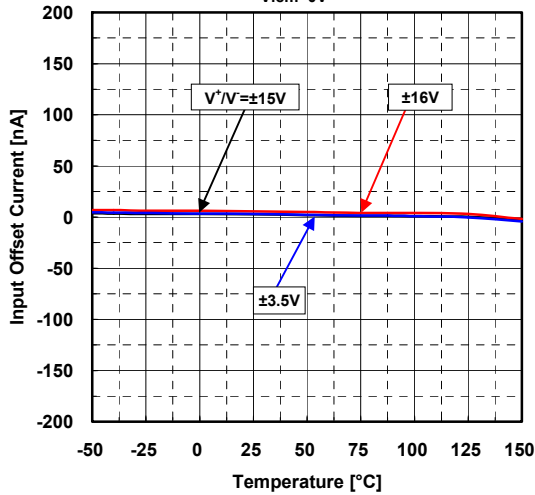
Input Bias Current vs. Input Common-Mode Voltage (Temperature)
 $V^+/V^-\pm 15V$



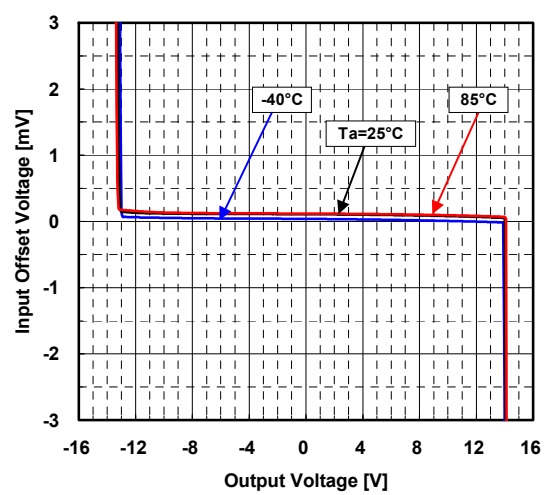
Input Bias Current vs. Input Common-Mode Voltage (Temperature)
 $V^+/V^-\pm 3.5V$



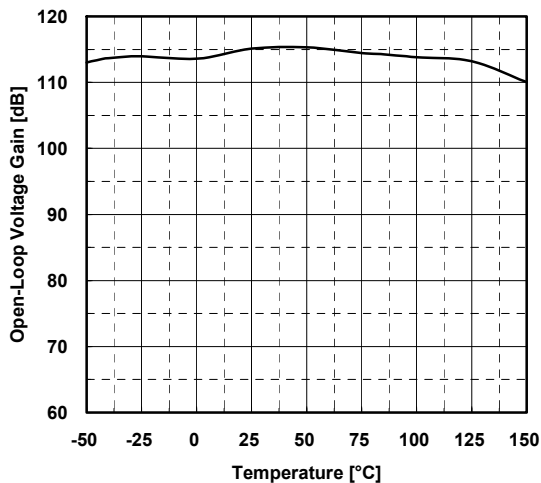
Input Offset Current vs. Temperature (Supply Voltage)
 $V_{icm}=0V$



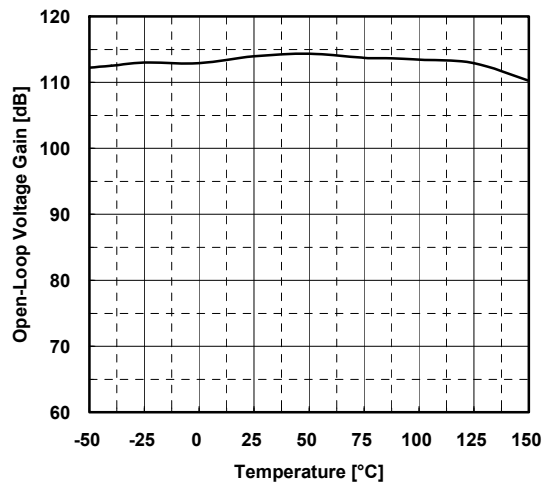
Input Offset Voltage vs. Output Voltage (Temperature)
 $V^+/V^-\pm 15V, R_L=2k\Omega$ to $0V$



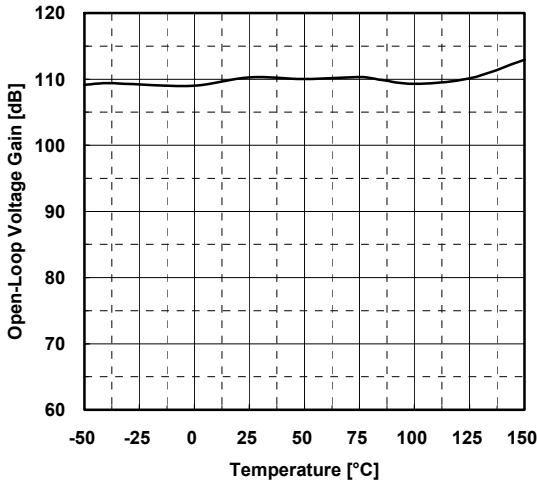
Open-Loop Voltage Gain vs. Temperature
 $R_L=2k\Omega$ to $0V, V^+/V^-\pm 16V, V_o=-11V$ to $+11V$



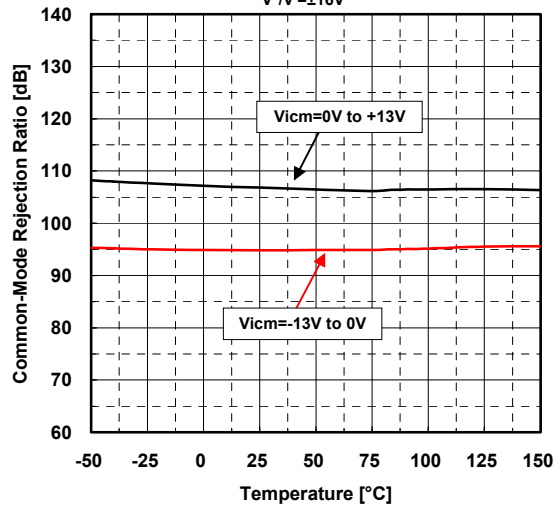
Open-Loop Voltage Gain vs. Temperature
 $R_L=2k\Omega$ to $0V, V^+/V^-\pm 15V, V_o=-10V$ to $+10V$



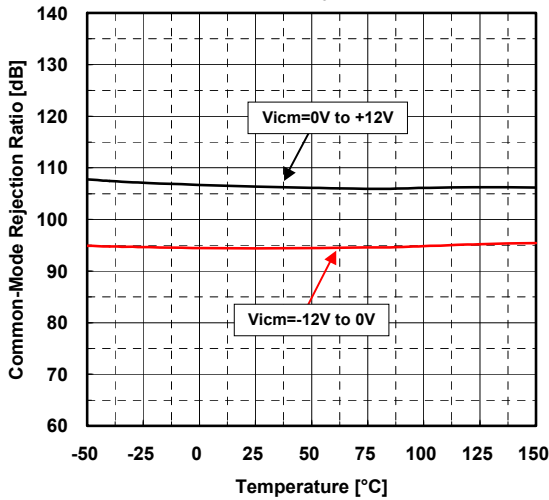
Open-Loop Voltage Gain vs. Temperature
 $R_L=2k\Omega$ to $0V$, $V^+/V^-=\pm 3.5V$, $V_o=-1V$ to $+1V$



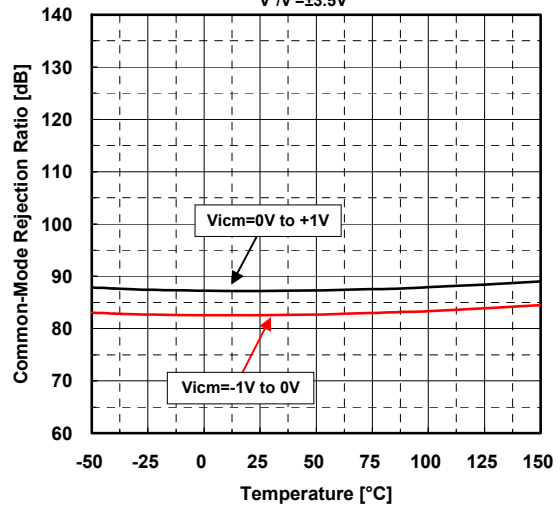
Common-Mode Rejection Ratio vs. Temperature
 (Input Common-Mode Voltage)
 $V^+/V^-=\pm 16V$



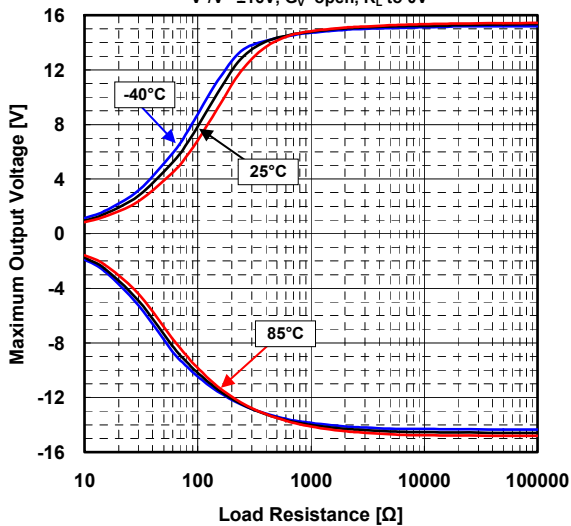
Common-Mode Rejection Ratio vs. Temperature
 (Input Common-Mode Voltage)
 $V^+/V^-=\pm 15V$



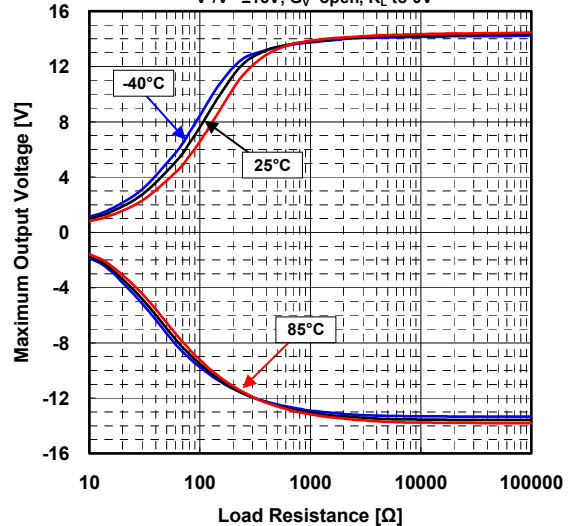
Common-Mode Rejection Ratio vs. Temperature
 (Input Common-Mode Voltage)
 $V^+/V^-=\pm 3.5V$

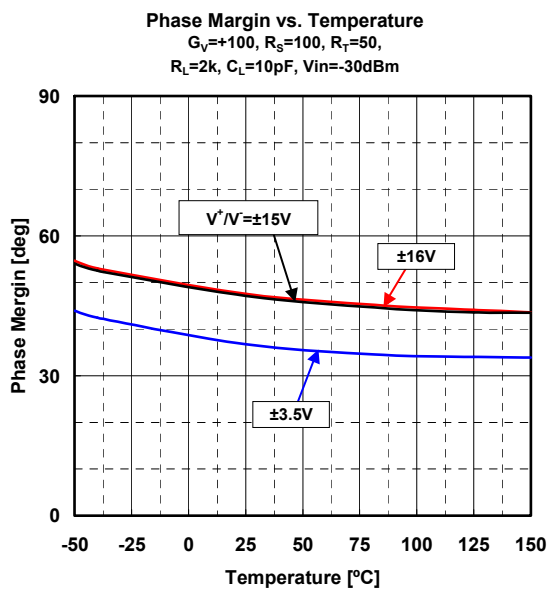
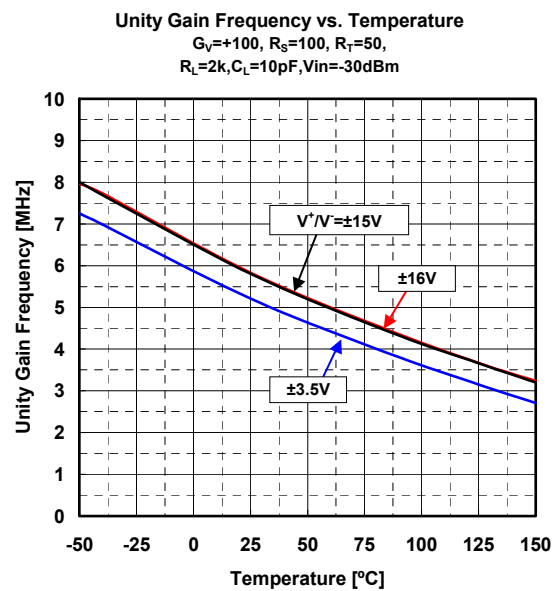
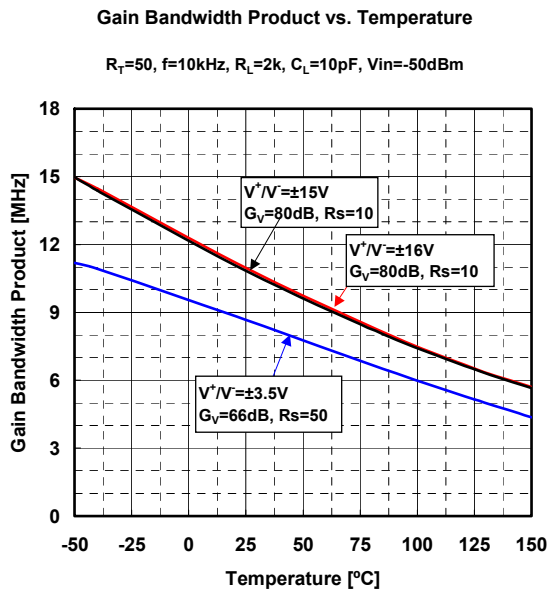
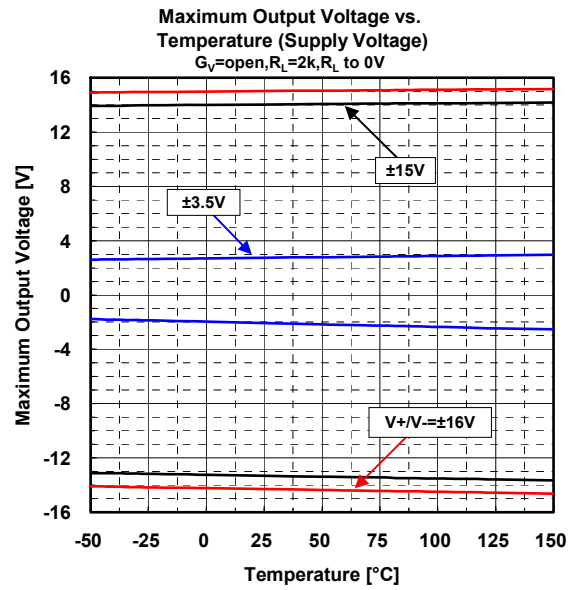
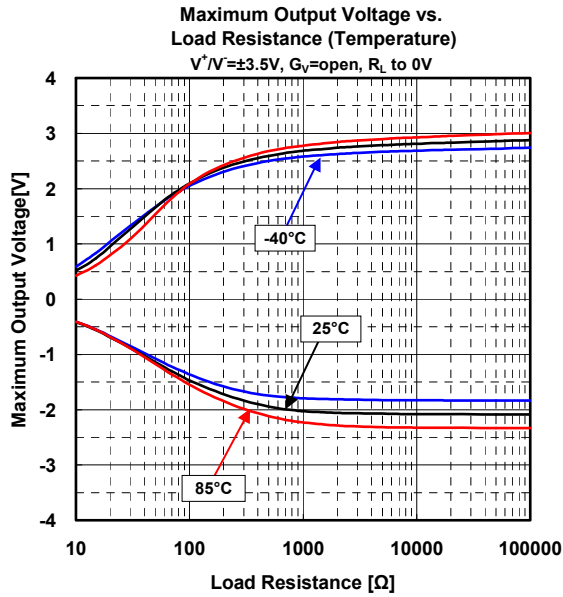


Maximum Output Voltage vs.
 Load Resistance (Temperature)
 $V^+/V^-=\pm 16V$, $G_v=open$, R_L to $0V$



Maximum Output Voltage vs.
 Load Resistance (Temperature)
 $V^+/V^-=\pm 15V$, $G_v=open$, R_L to $0V$





MEMO

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