



## High Quality Audio Dual Operational Amplifier

### ■ GENERAL DESCRIPTION

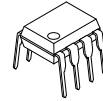
The **MUSES8820** is a high quality audio operational amplifier, which is optimized for high-end audio and professional audio applications.

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, SOP8 JEDEC 150mil

### ■ PACKAGE OUTLINE

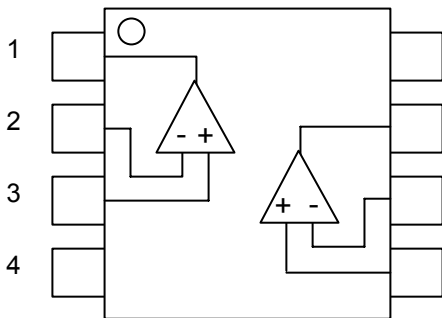


**MUSES8820D**  
(DIP8)



**MUSES8820E**  
(SOP8)

### ■ PIN CONFIGURATION



#### PIN FUNCTION

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



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# MUSES8820

## ■ 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	$P_D$	DIP8 : 870 SOP8 : 900(Note2)	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.

(Note2) Mounted on the EIA/JEDEC standard board (114.3×76.2×1.6mm, two layer, FR-4).

## ■ 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 ( $V^+ / V^- = \pm 15V$ , Ta=25°C unless otherwise specified)

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Operating Current	$I_{cc}$	No Signal, $R_L = \infty$	-	8.0	12.0	mA
Input Offset Voltage	$V_{IO}$	$R_s \leq 10k\Omega$ (Note3, 4)	-	0.3	3.0	mV
Input Bias Current	$I_B$	(Note3, 4)	-	100	500	nA
Input Offset Current	$I_{IO}$	(Note3, 4)	-	5	200	nA
Voltage Gain	$A_V$	$R_L \geq 2k\Omega$ , $V_o = \pm 10V$ $R_s \leq 10k\Omega$	90	110	-	dB
Common Mode Rejection Ratio	CMR	$V_{ICM} = \pm 12V$ (Note5) $R_s \leq 10k\Omega$	80	110	-	dB
Supply Voltage Rejection Ratio	SVR	$V^+ / V^- = \pm 3.5$ to $\pm 16.0V$ $R_s \leq 10k\Omega$ (Note3, 6)	80	110	-	dB
Max Output Voltage	$V_{OM}$	$R_L = 2k\Omega$	±12	±13.5	-	V
Input Common Mode Voltage Range	$V_{ICM}$	CMR ≥ 80dB	±12	±13.5	-	V

(Note3) Measured at  $V_{ICM} = 0V$

(Note4) Written by the absolute rate.

(Note5) CMR is calculated by specified change in offset voltage. ( $V_{ICM} = 0V$  to +12V and  $V_{ICM} = 0V$  to -12V)

(Note6) SVR is calculated by specified change in offset voltage. ( $V^+ / V^- = \pm 3.5V$  to  $\pm 16V$ )

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	$\phi_M$	$A_V = +100$ , $R_S = 100\Omega$ , $R_L = 2k\Omega$ , $C_L = 10pF$	-	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	$\mu V_{rms}$
Total Harmonic Distortion	THD	f=1kHz, $A_V = +10$ , $R_L = 2k\Omega$ , $V_o = 5V_{rms}$	-	0.001	-	%
Channel Separation	CS	f=1kHz, $A_V = -+100$ , $R_S = 1k\Omega$ , $R_L = 2k\Omega$	-	140	-	dB
Positive Slew Rate	+SR	$A_V = 1$ , $V_{IN} = 2V_{p-p}$ , $R_L = 2k\Omega$ , $C_L = 10pF$	-	5	-	V/ $\mu s$
Negative Slew Rate	-SR	$A_V = 1$ , $V_{IN} = 2V_{p-p}$ , $R_L = 2k\Omega$ , $C_L = 10pF$	-	5	-	V/ $\mu s$

## ■ 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 MUSES8820  $P_D$  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,  $\theta_{ja}$  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 MUSES8820 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 MUSES8820 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.

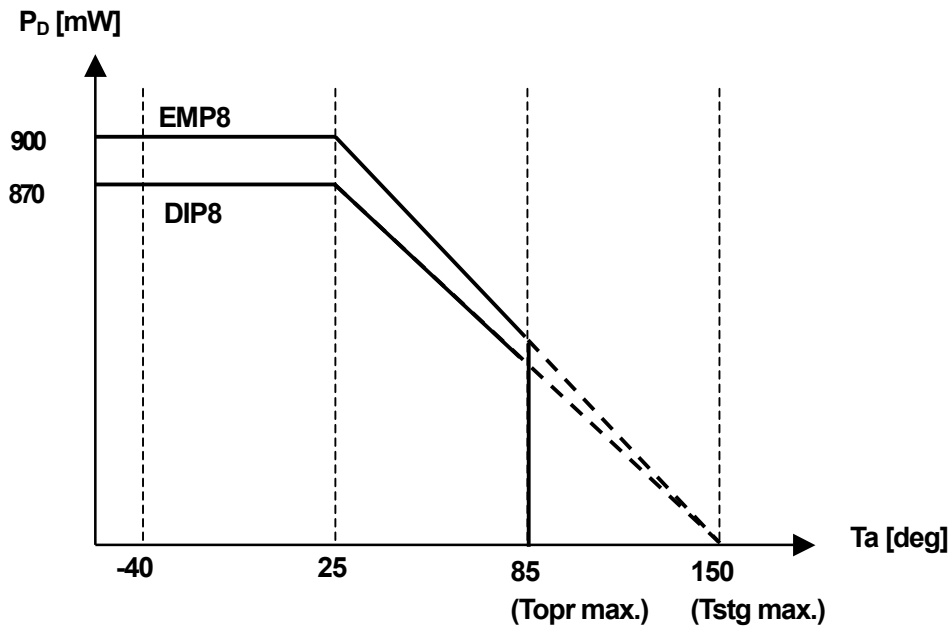
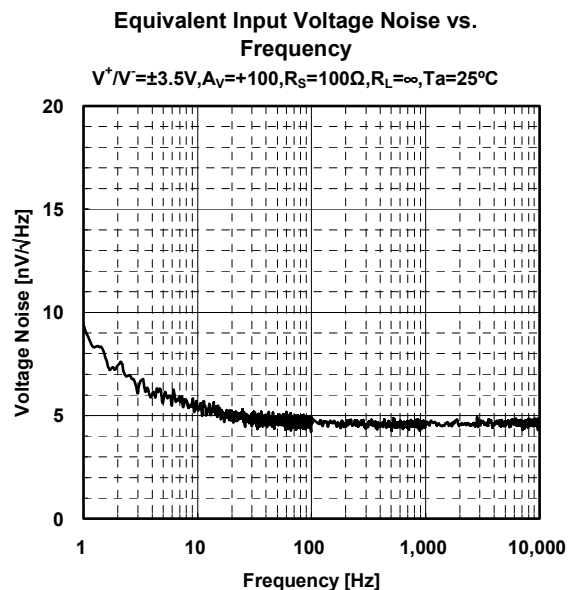
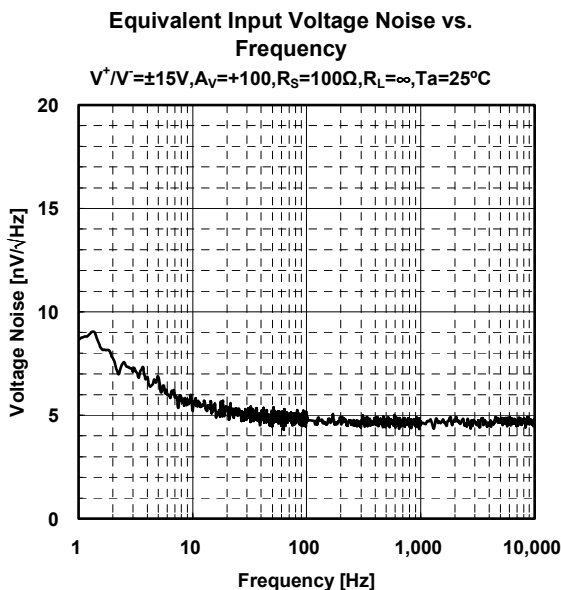
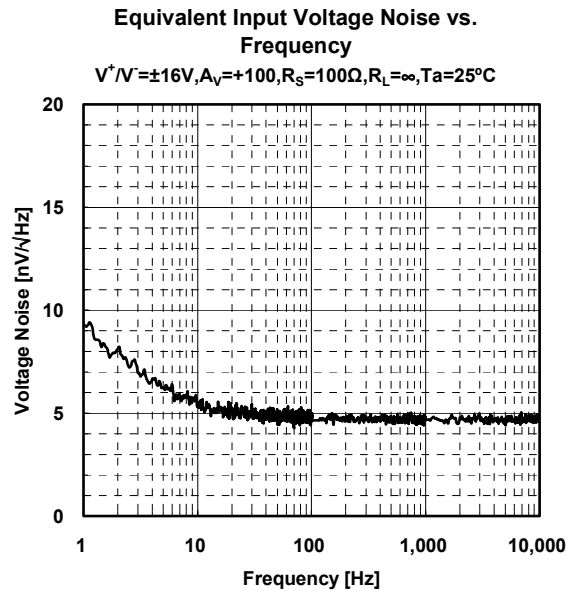
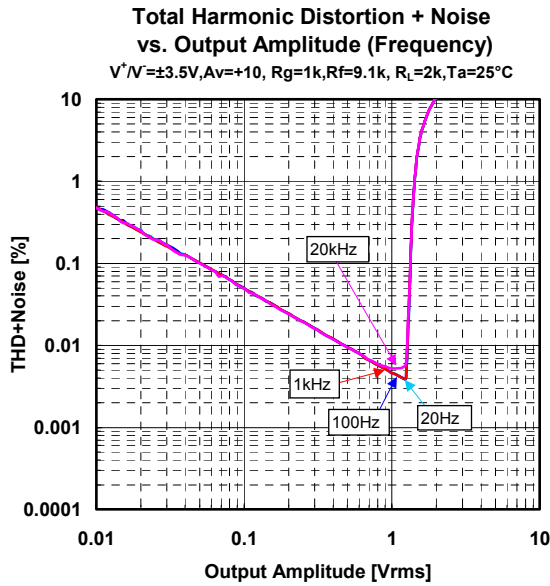
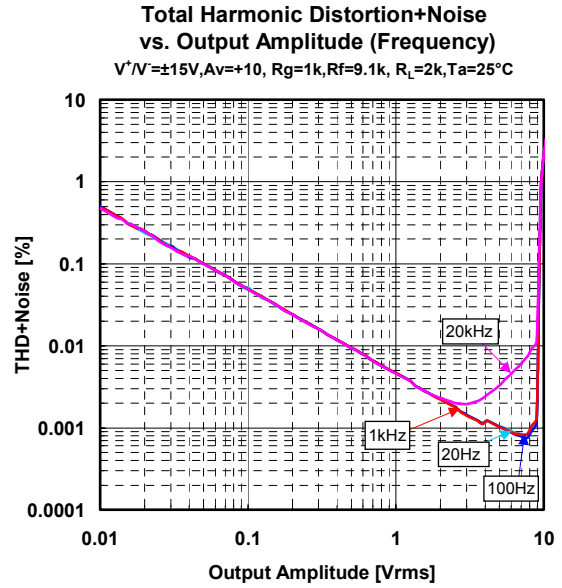
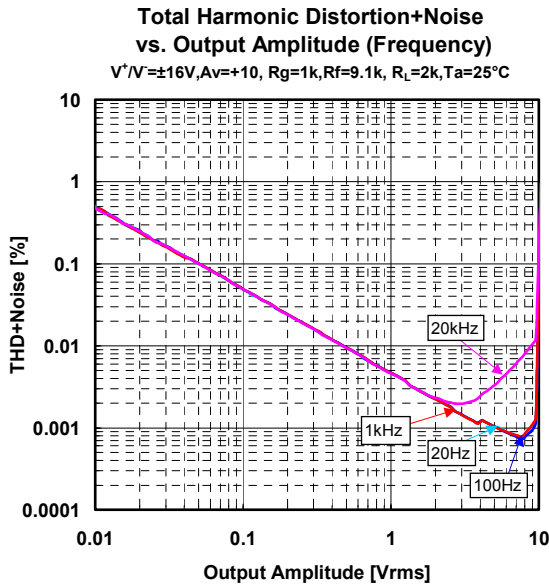
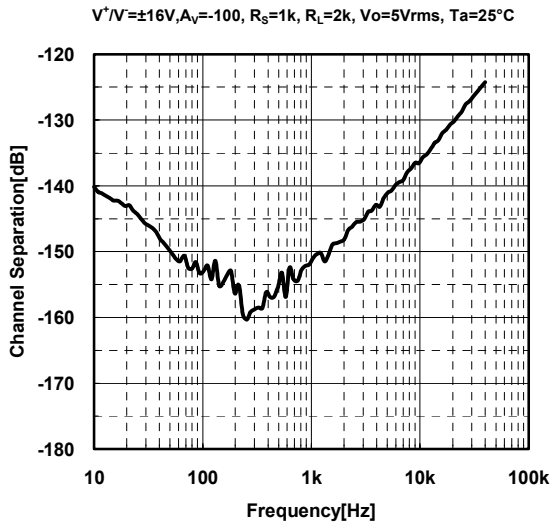


Fig.1 Power Dissipations vs. Ambient Temperature on the MUSES8820

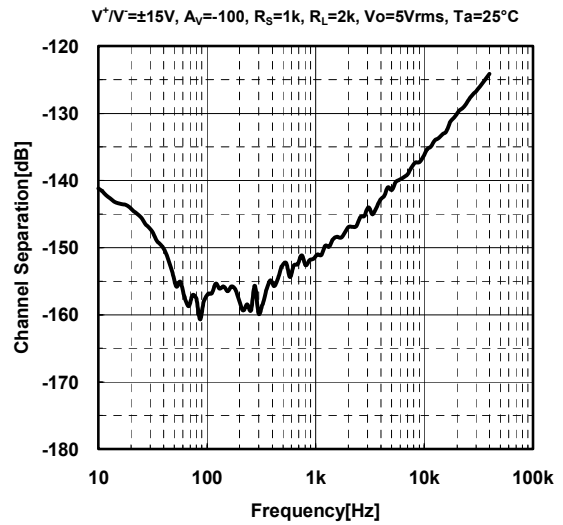
## ■ TYPICAL CHARACTERISTICS



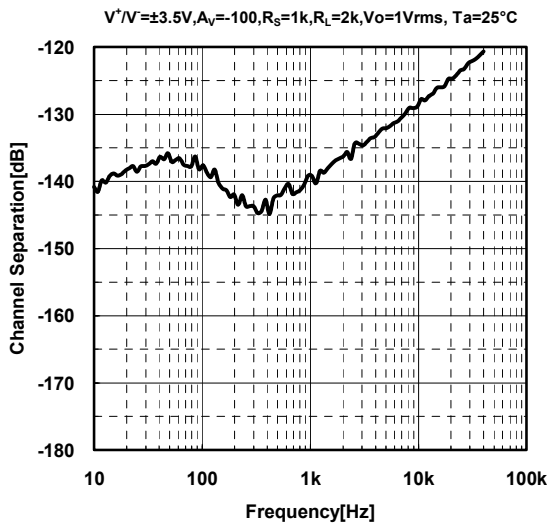
Channel Separation vs. Frequency



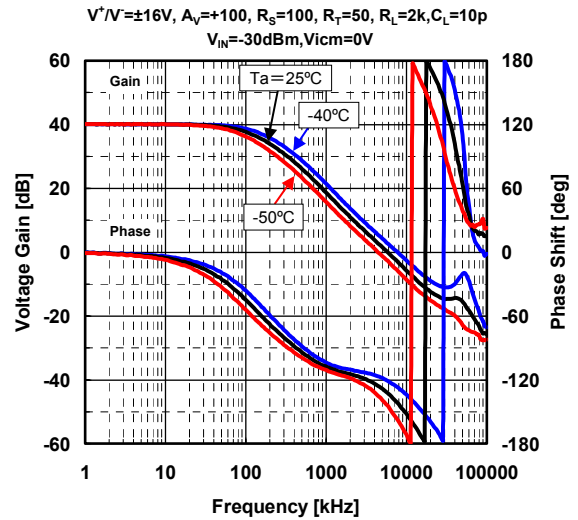
Channel Separation vs. Frequency



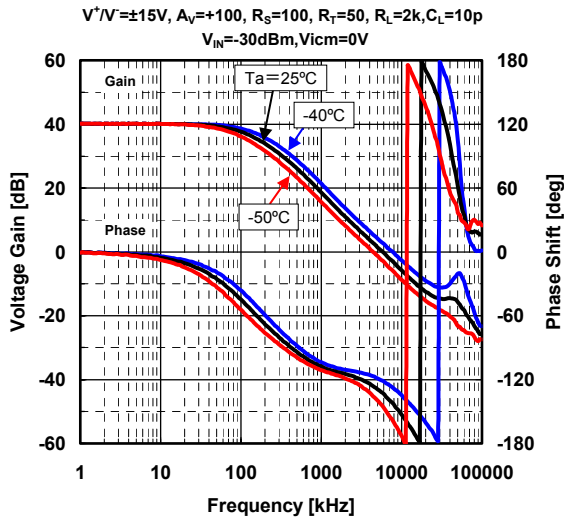
Channel Separation vs. Frequency



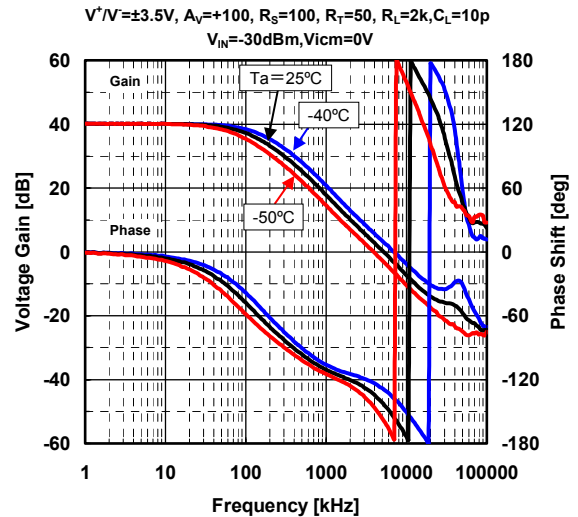
Closed-Loop Gain/Phase vs. Frequency(Temperature)



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

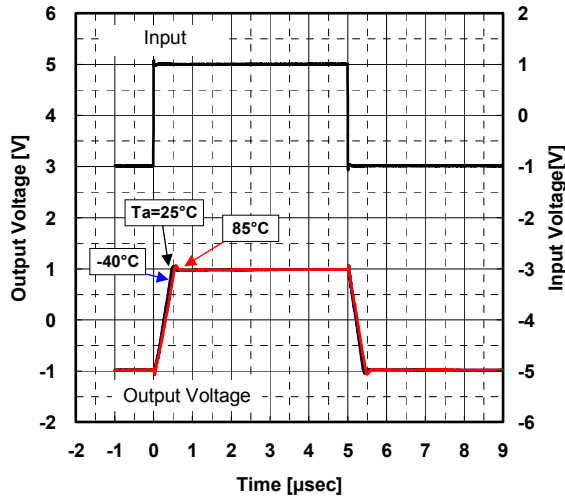


Closed-Loop Gain/Phase vs. Frequency(Temperature)



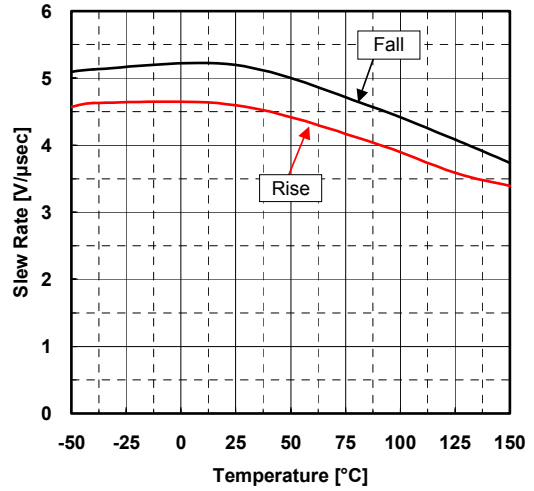
### Transient Response (Temperature)

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



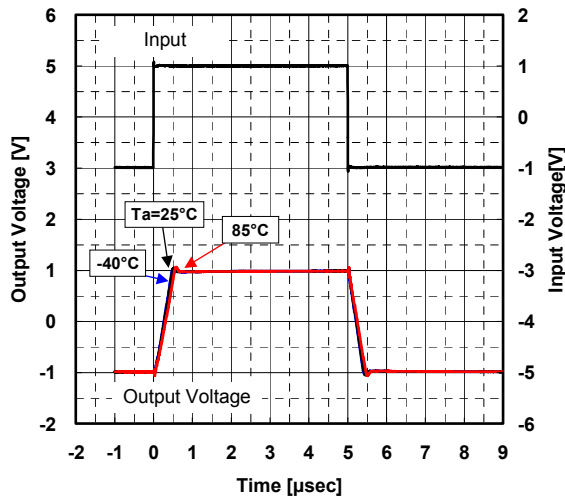
### Slew Rate vs. Temperature

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



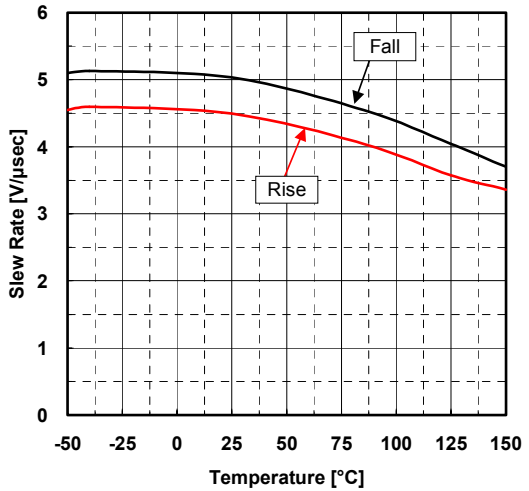
### Transient Response (Temperature)

$V^+ / V^- = \pm 15V, V_{IN} = 2V_{P-P}, f = 100kHz$   
 PulseEdge=10nsec, Gv=0dB,  $C_L = 10p, R_L = 2k$



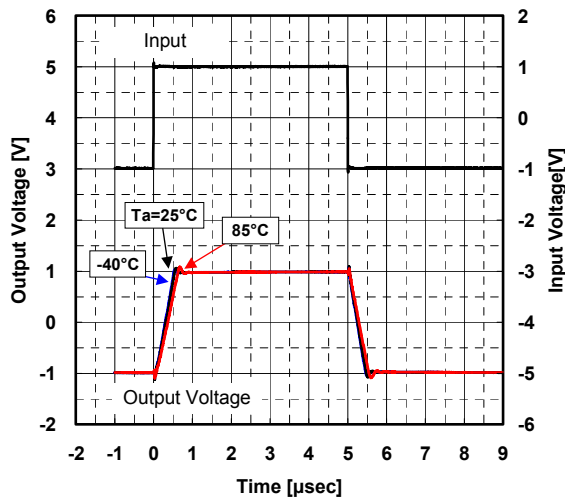
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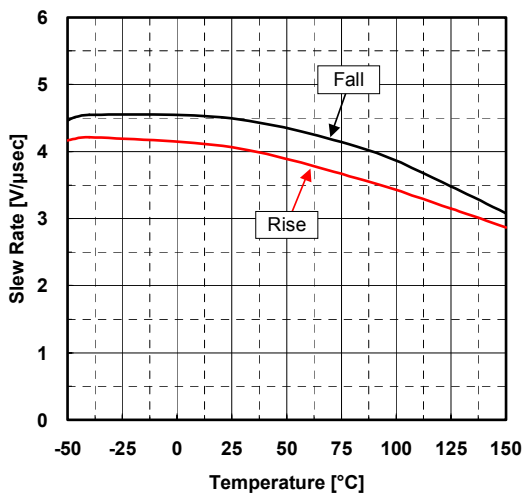
### Transient Response (Temperature)

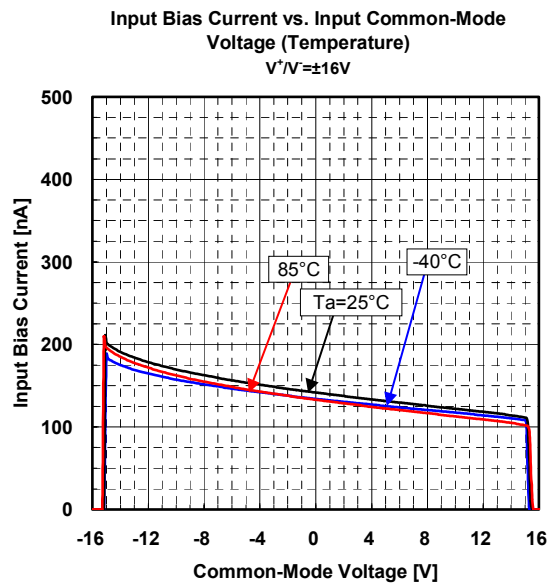
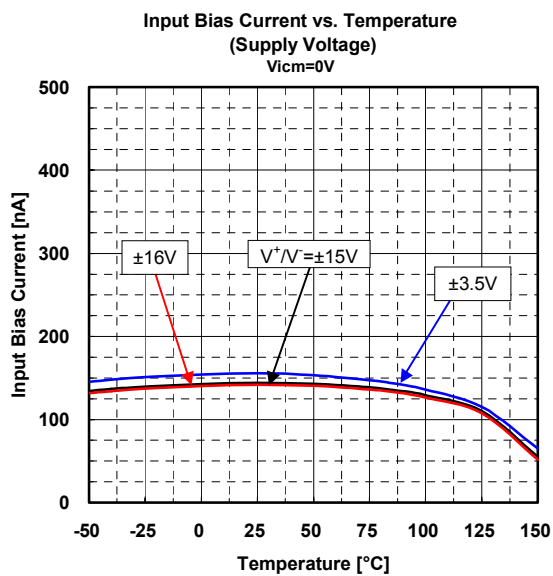
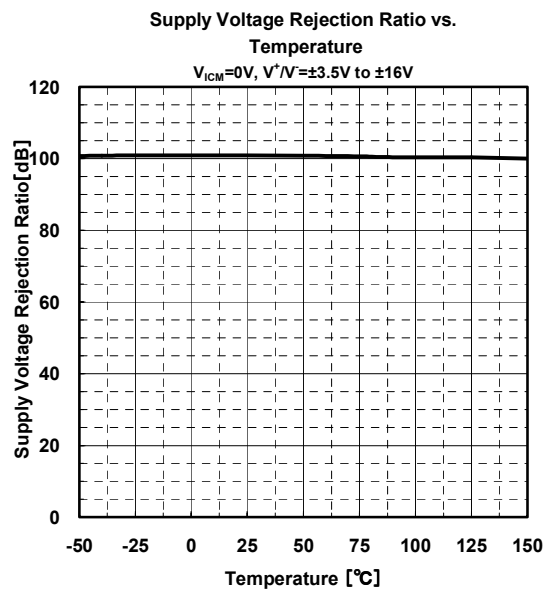
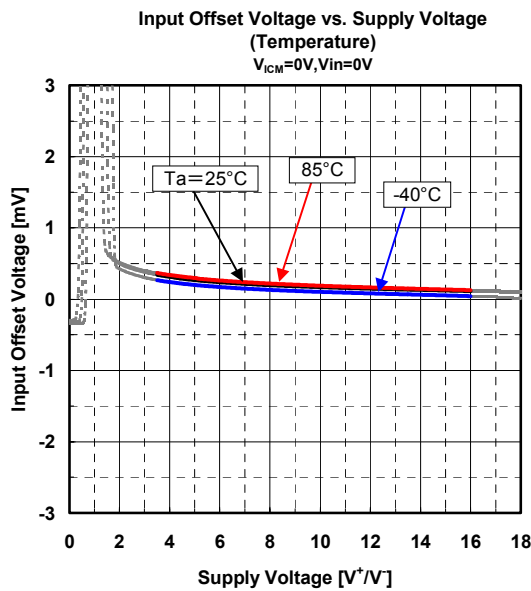
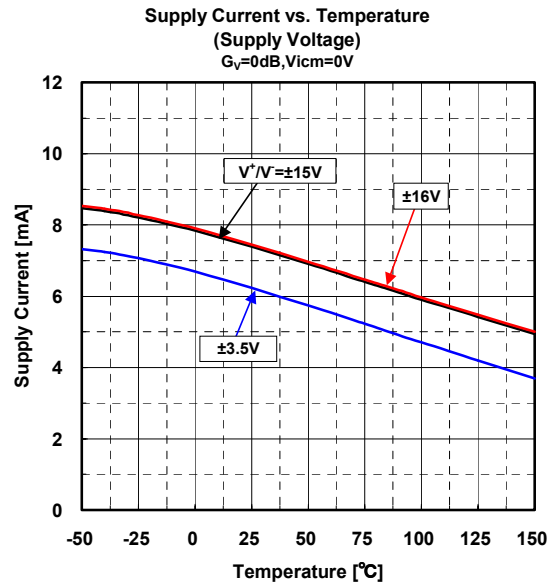
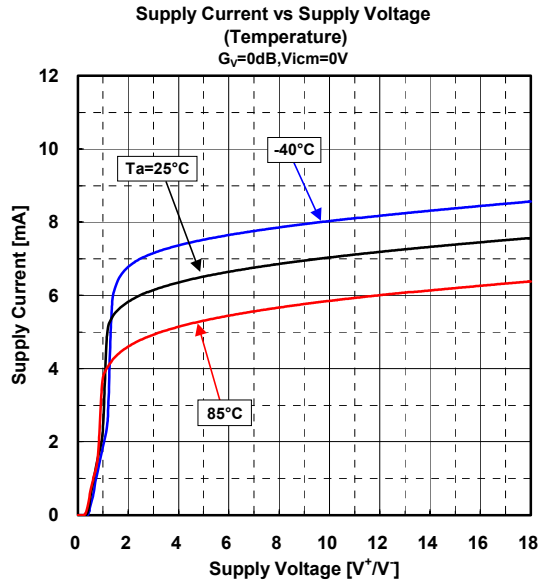
$V^+ / V^- = \pm 3.5V, V_{IN} = 2V_{P-P}, f = 100kHz$   
 PulseEdge=10nsec, Gv=0dB,  $C_L = 10p, R_L = 2k$



### Slew Rate vs. Temperature

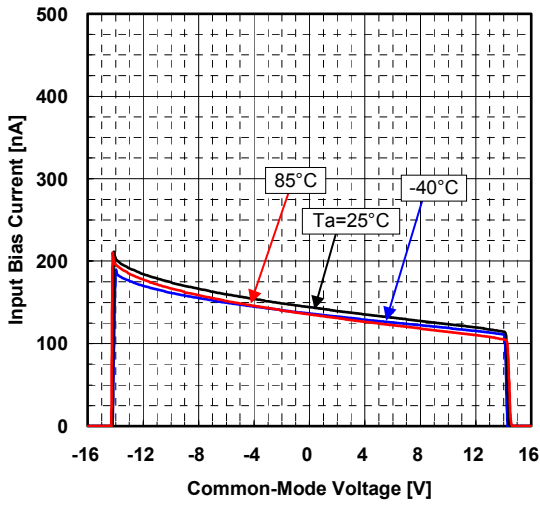
$V^+ / V^- = \pm 3.5V, V_{IN} = 2V_{P-P}, f = 100kHz$   
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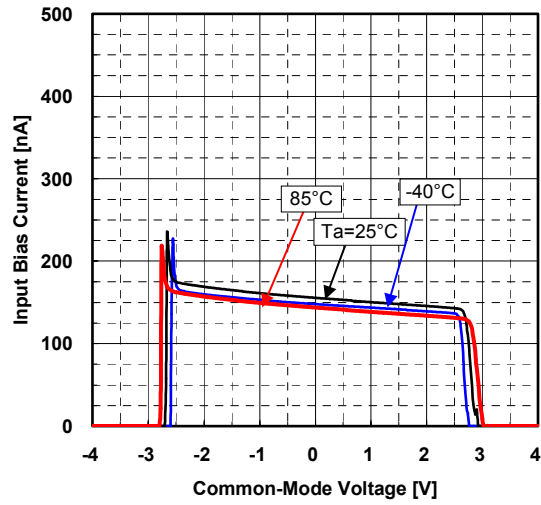




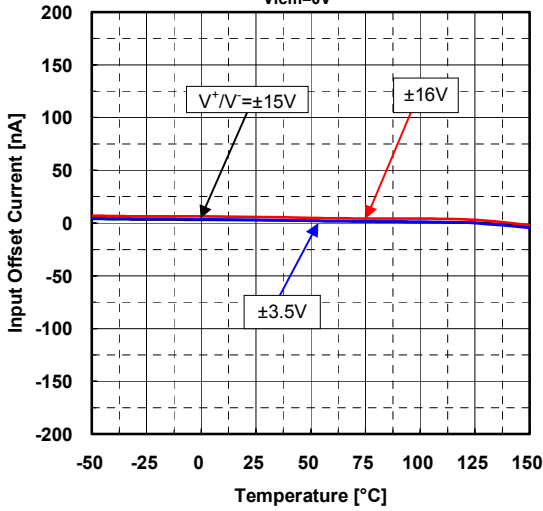
Input Bias Current vs. Input Common-Mode Voltage (Temperature)  
 $V^+ / V^- = \pm 15V$



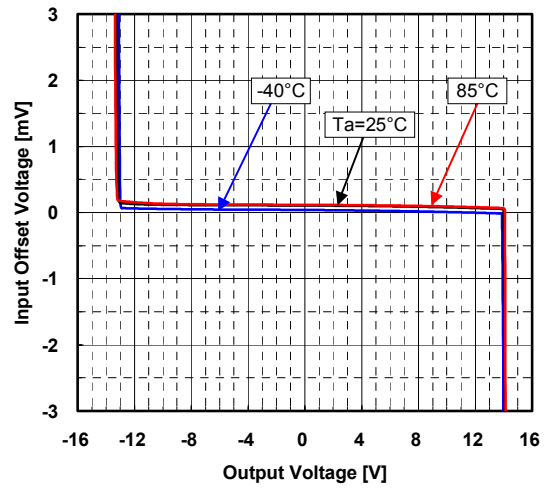
Input Bias Current vs. Input Common-Mode Voltage (Temperature)  
 $V^+ / V^- = \pm 3.5V$



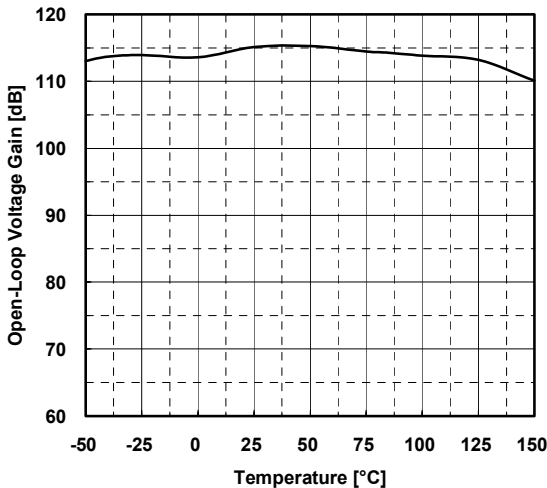
Input Offset Current vs. Temperature (Supply Voltage)  
 $V_{icm} = 0V$



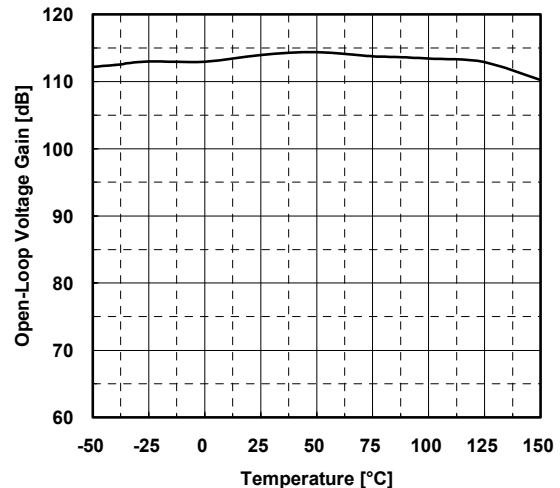
Input Offset Voltage vs. Output Voltage (Temperature)  
 $V^+ / V^- = \pm 15V, R_L = 2k\Omega$  to  $0V$



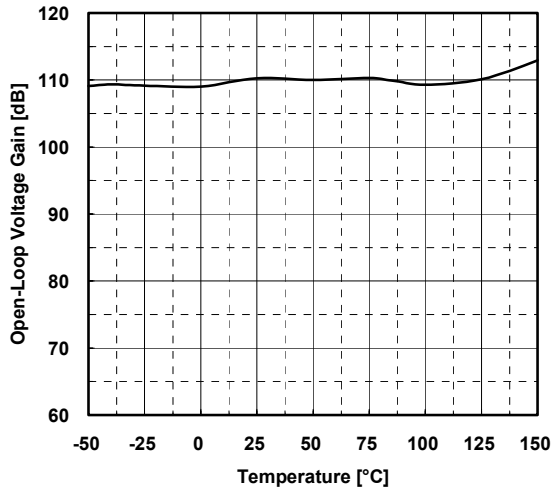
Open-Loop Voltage Gain vs. Temperature  
 $R_L = 2k\Omega$  to  $0V, V^+ / V^- = \pm 16V, V_o = -11V$  to  $+11V$



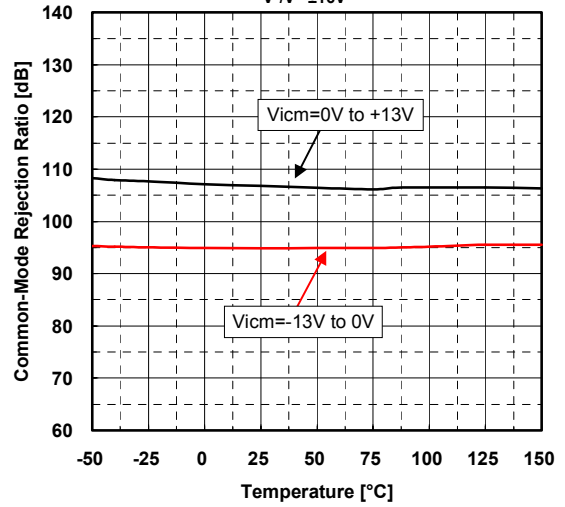
Open-Loop Voltage Gain vs. Temperature  
 $R_L = 2k\Omega$  to  $0V, V^+ / V^- = \pm 15V, V_o = -10V$  to  $+10V$



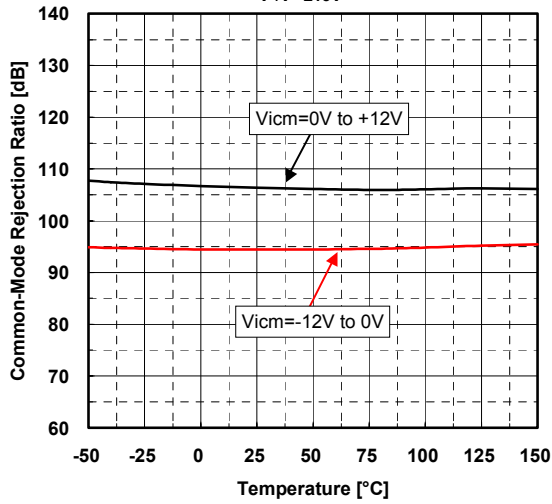
**Open-Loop Voltage Gain vs. Temperature**  
 $R_L=2k\Omega$  to 0V,  $V^+/V^-=\pm 3.5V$ ,  $V_O=-1V$  to +1V



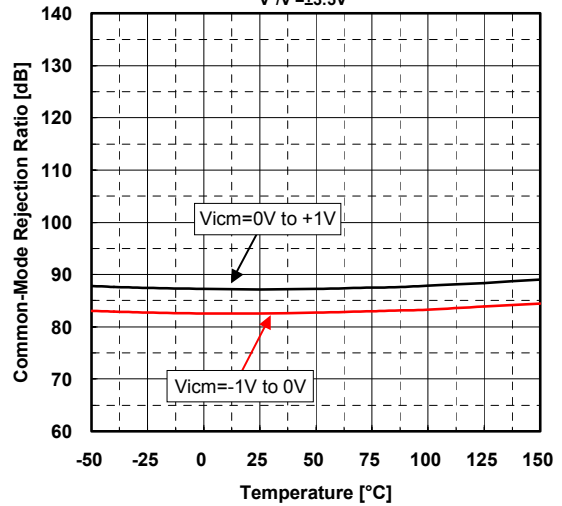
**Common-Mode Rejection Ratio vs. Temperature (Input Common-Mode Voltage)**  
 $V^+/V^-=\pm 16V$



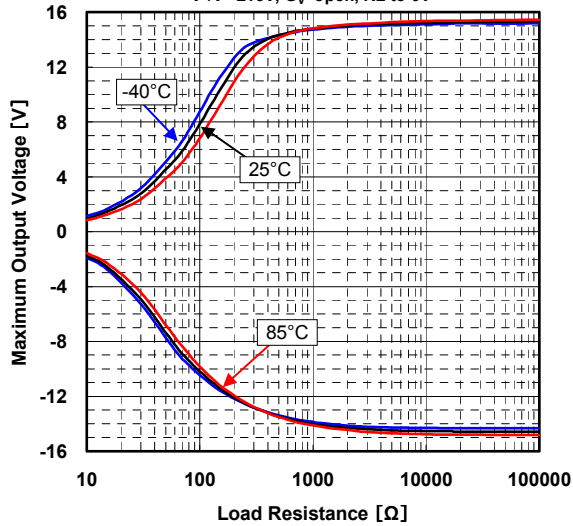
**Common-Mode Rejection Ratio vs. Temperature (Input Common-Mode Voltage)**  
 $V^+/V^-=\pm 15V$



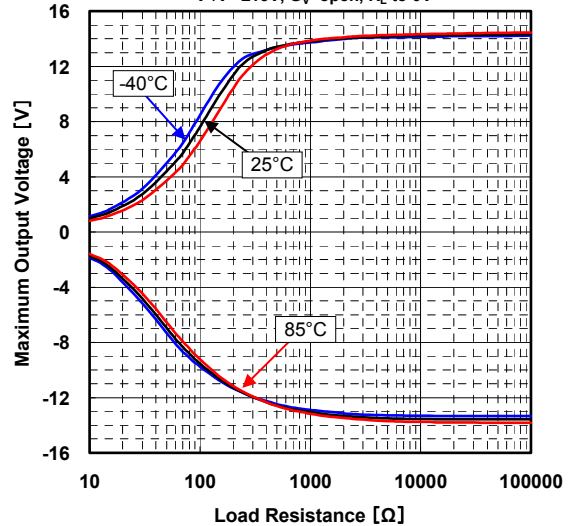
**Common-Mode Rejection Ratio vs. Temperature (Input Common-Mode Voltage)**  
 $V^+/V^-=\pm 3.5V$

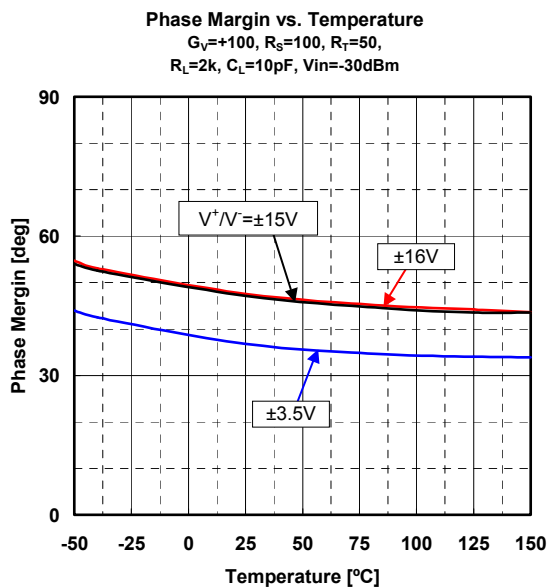
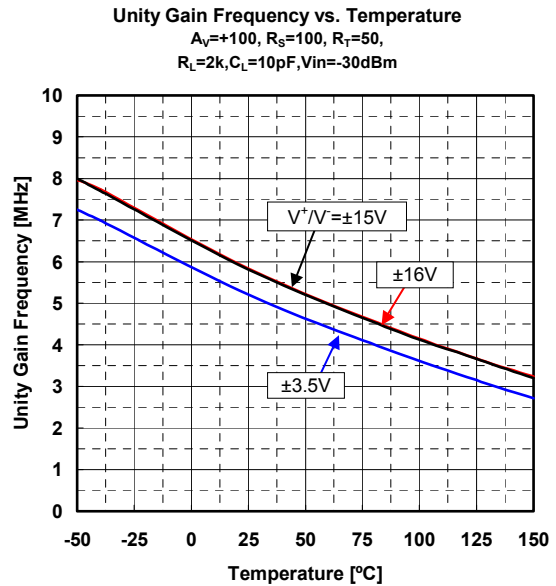
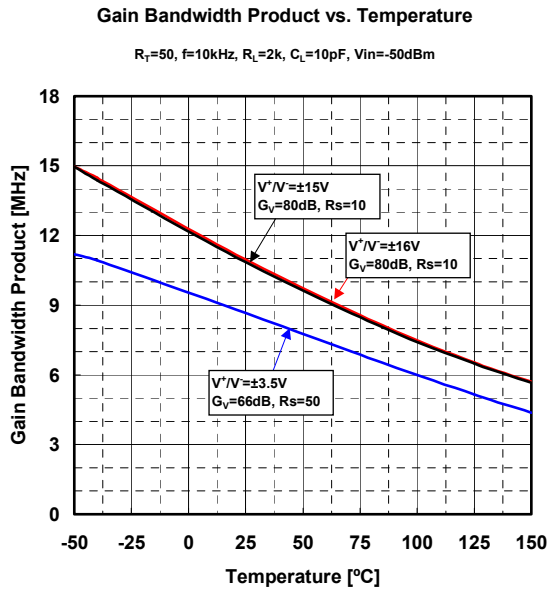
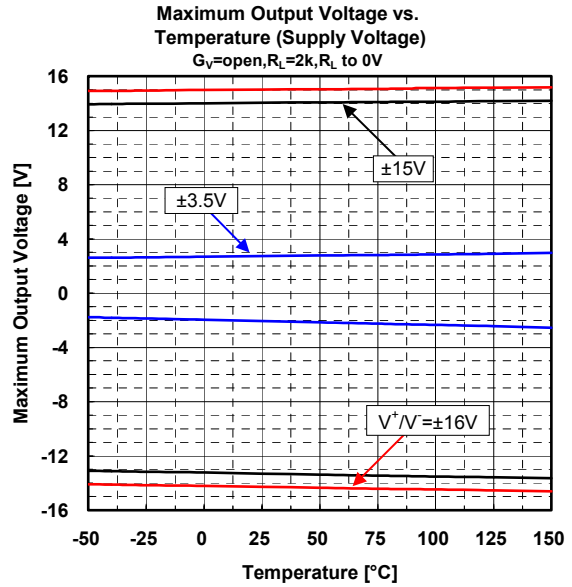
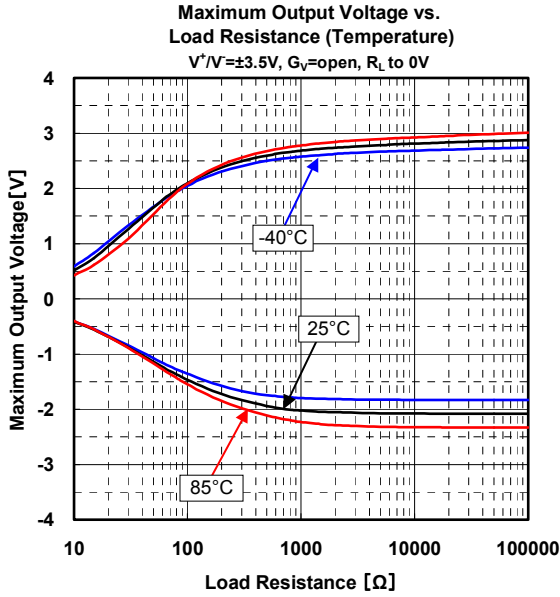


**Maximum Output Voltage vs. Load Resistance (Temperature)**  
 $V^+/V^-=\pm 16V$ ,  $G_V=open$ ,  $R_L$  to 0V



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





# MUSES8820

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MEMO

[CAUTION]  
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