



High Quality Audio Dual Operational Amplifier

■ GENERAL DESCRIPTION

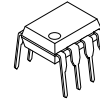
The **MUSES8820** is a high quality audio operational amplifier, which is optimized for high-end audio and professional audio applications.

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

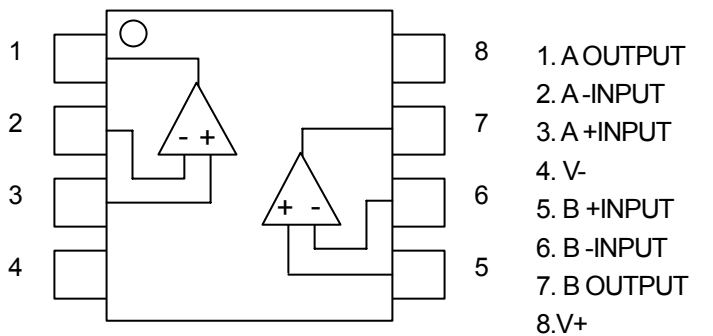


MUSES8820D
(DIP8)



MUSES8820E
(SOP8)

■ PIN CONFIGURATION



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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 | 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, $A_V=-+100$, $R_S=1k\Omega$, $R_L=2k\Omega$ | - | 140 | - | 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 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, 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 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.

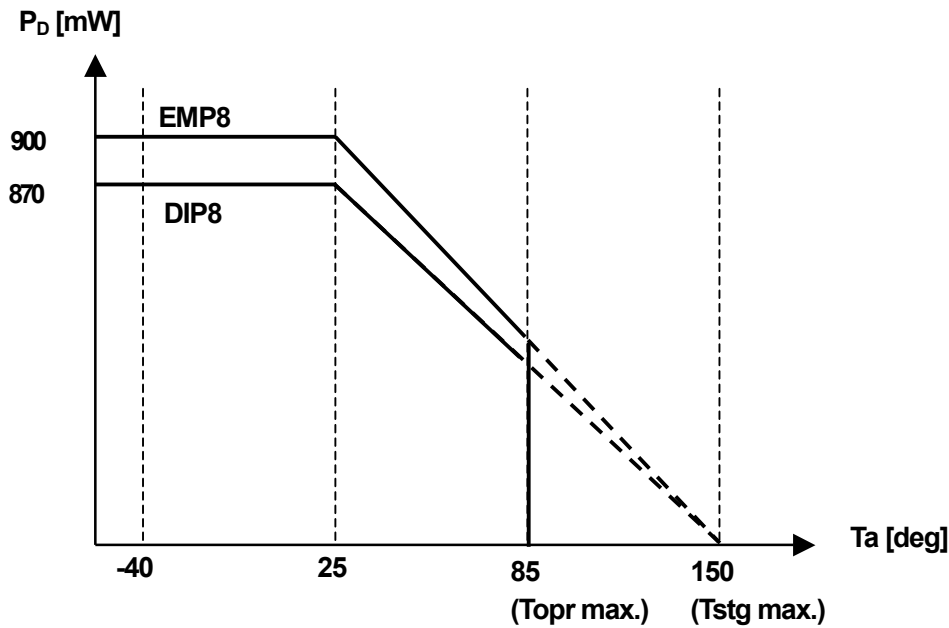
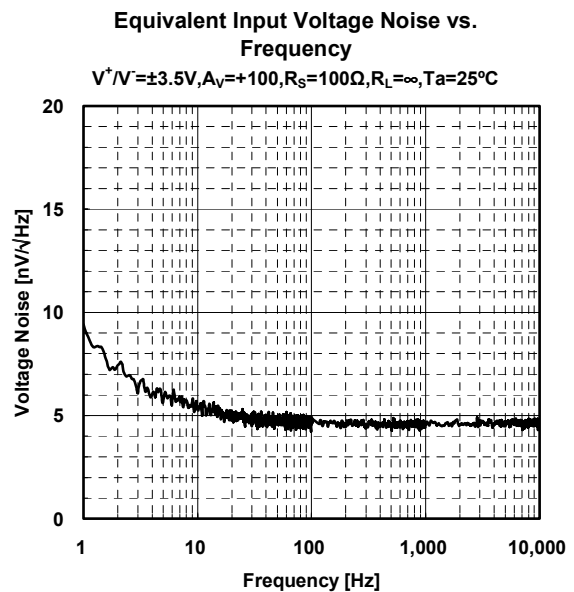
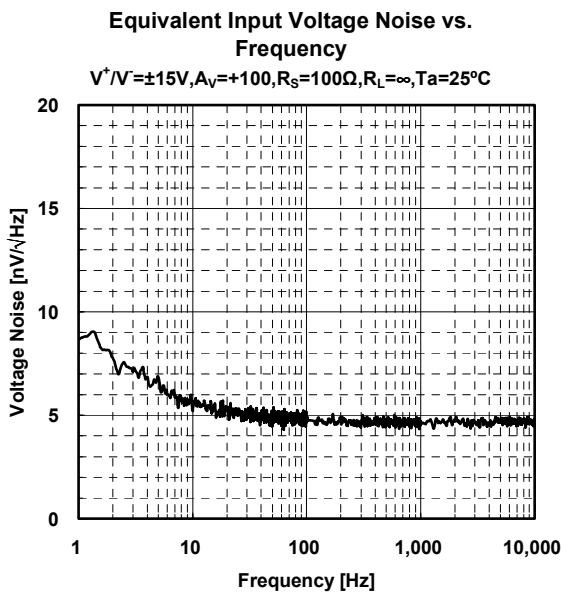
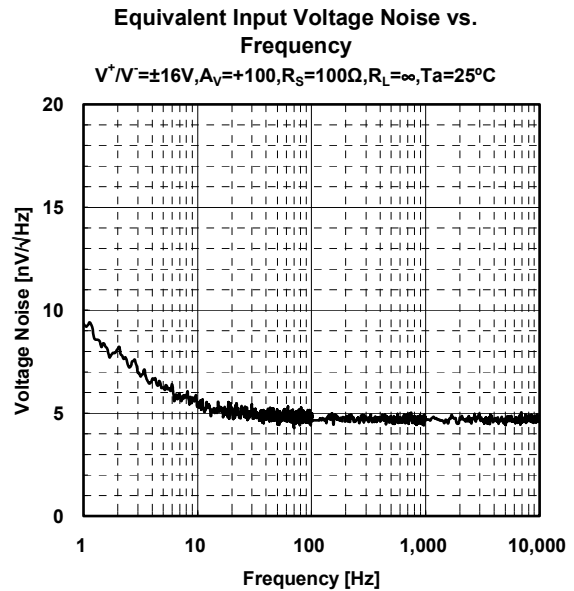
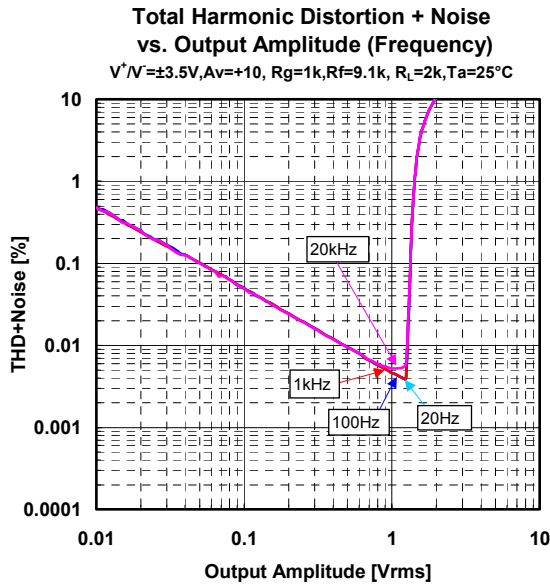
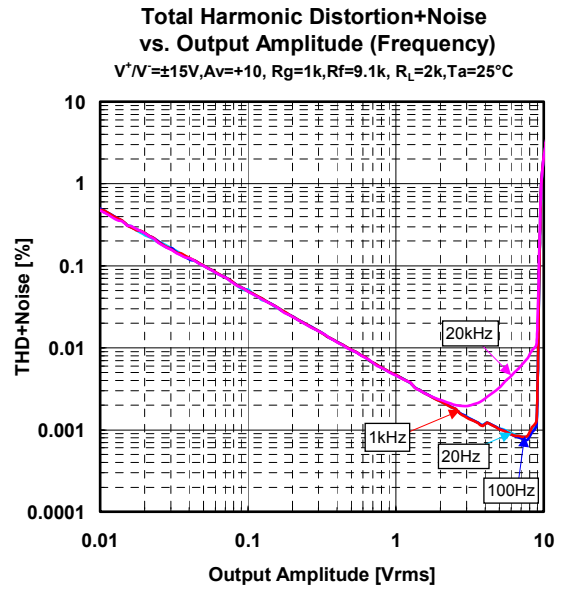
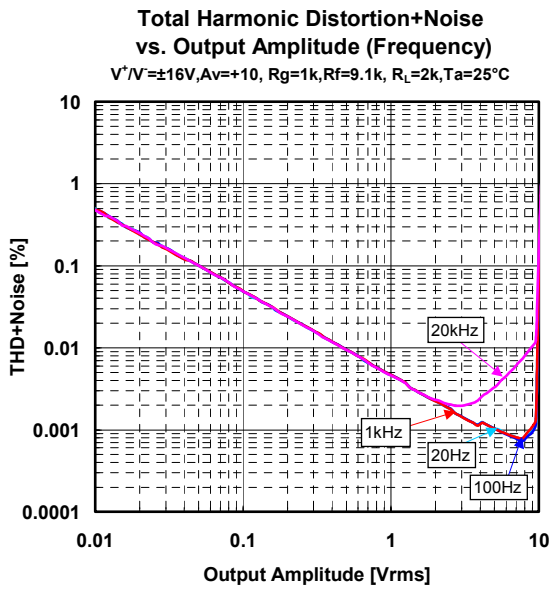
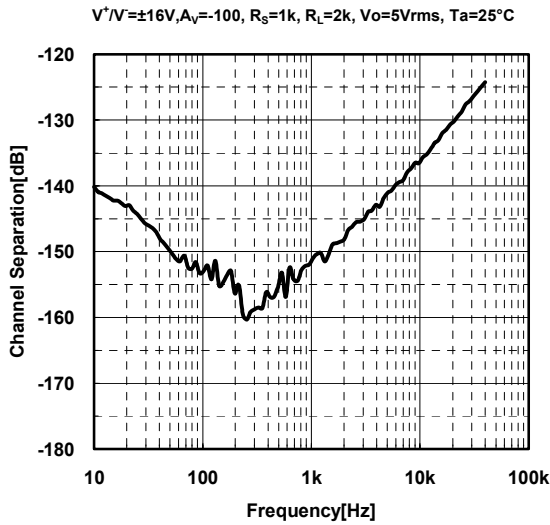


Fig.1 Power Dissipations vs. Ambient Temperature on the MUSES8820

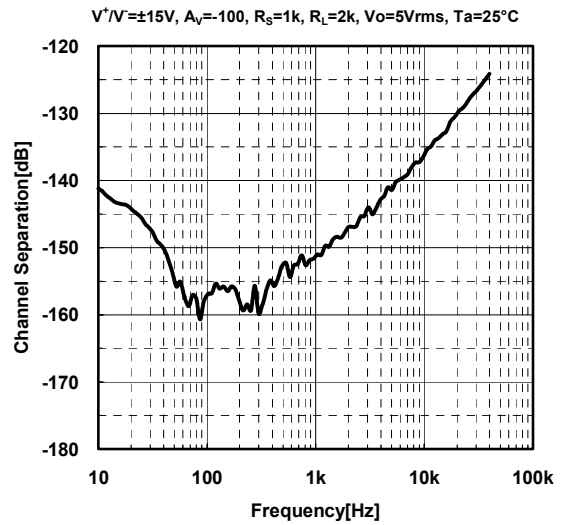
■ TYPICAL CHARACTERISTICS



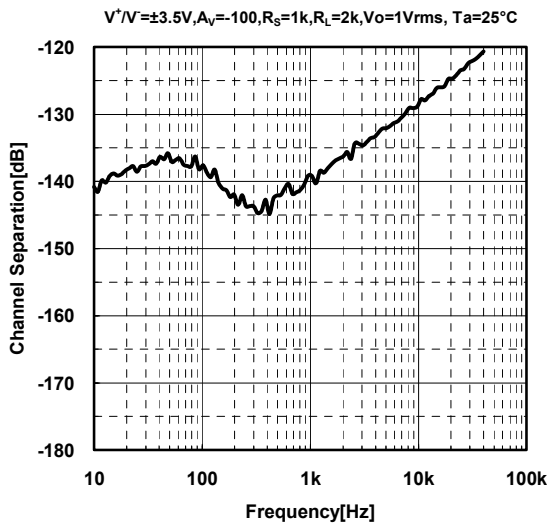
Channel Separation vs. Frequency



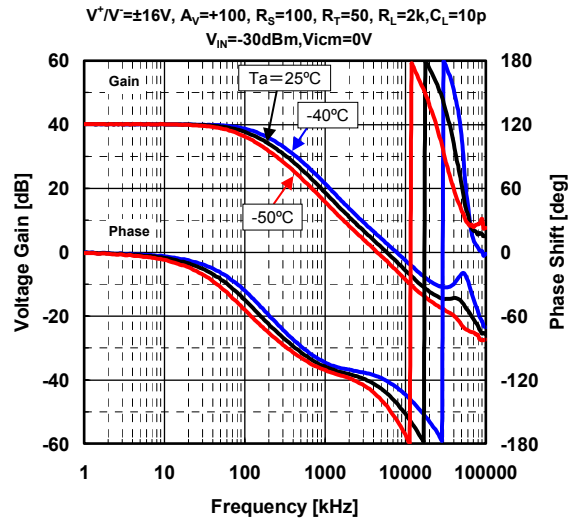
Channel Separation vs. Frequency



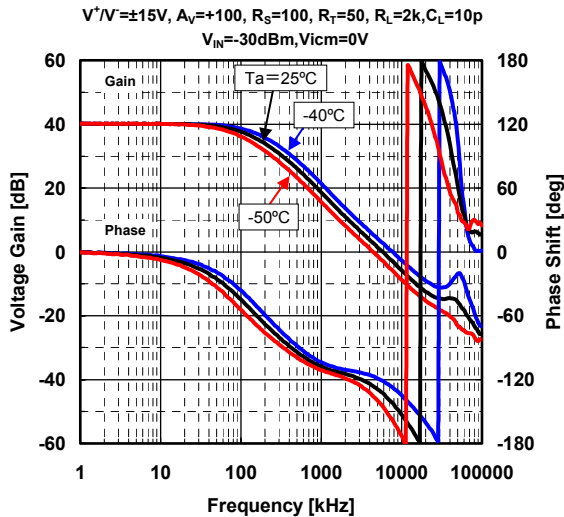
Channel Separation vs. Frequency



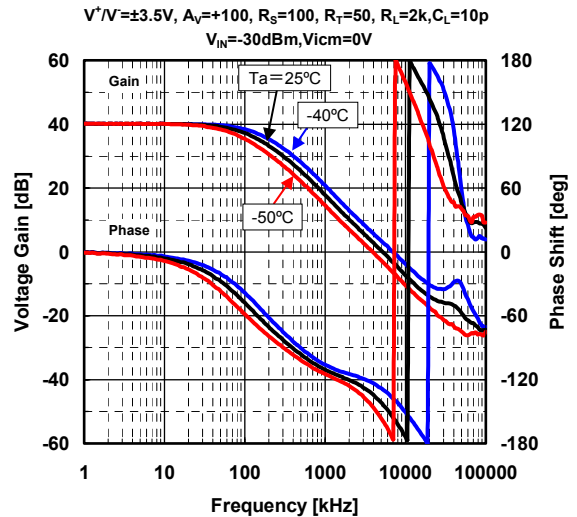
Closed-Loop Gain/Phase vs. Frequency(Temperature)



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

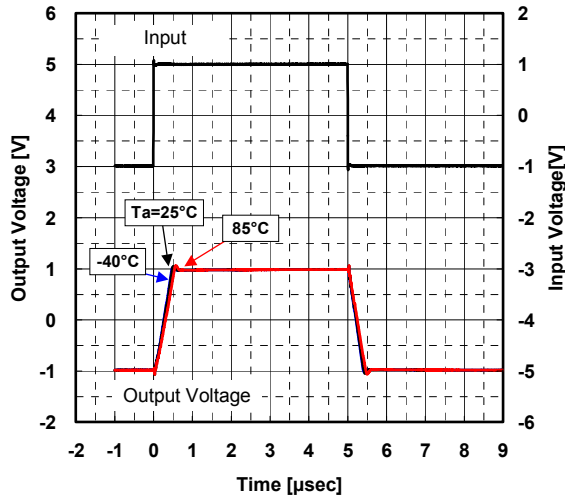


Closed-Loop Gain/Phase vs. Frequency(Temperature)



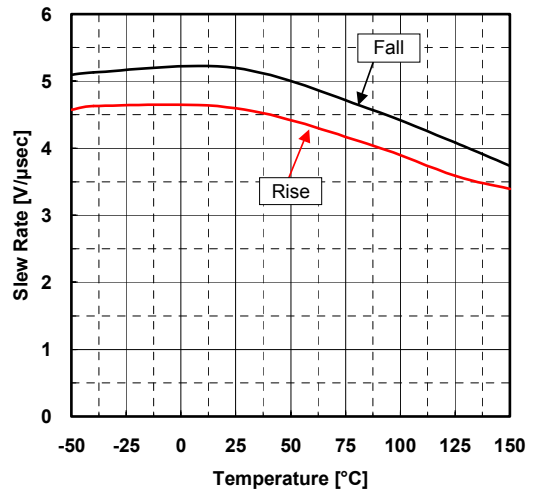
Transient Response (Temperature)

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



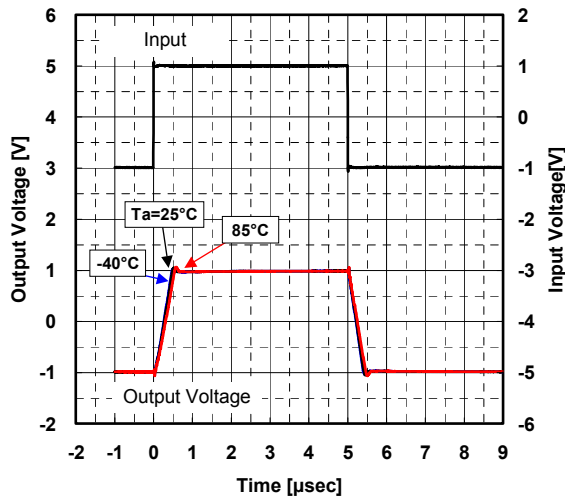
Slew Rate vs. Temperature

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



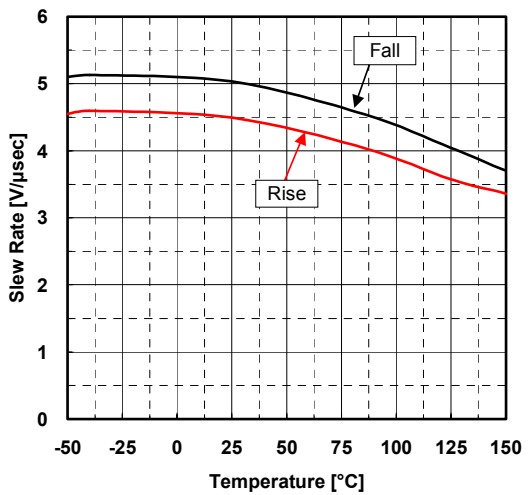
Transient Response (Temperature)

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



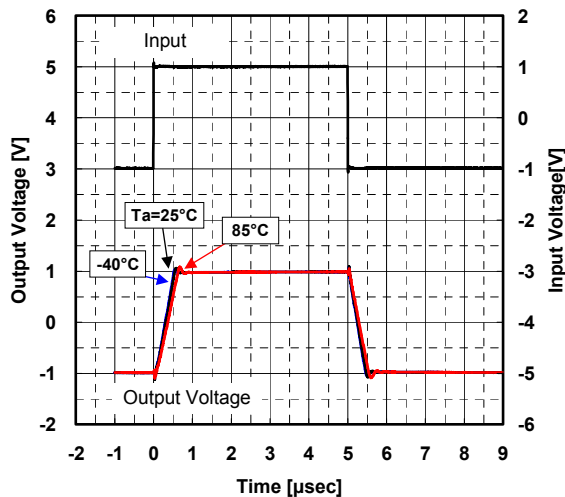
Slew Rate vs. Temperature

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



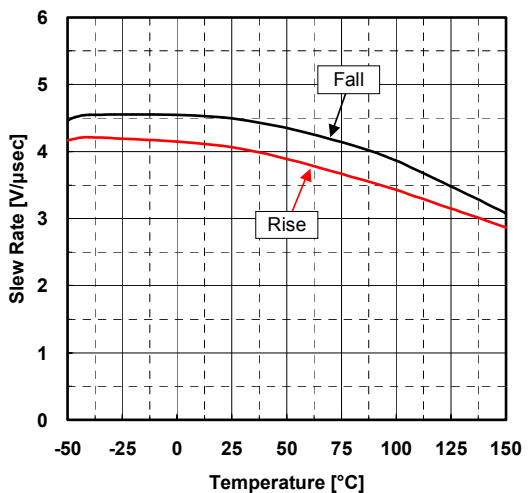
Transient Response (Temperature)

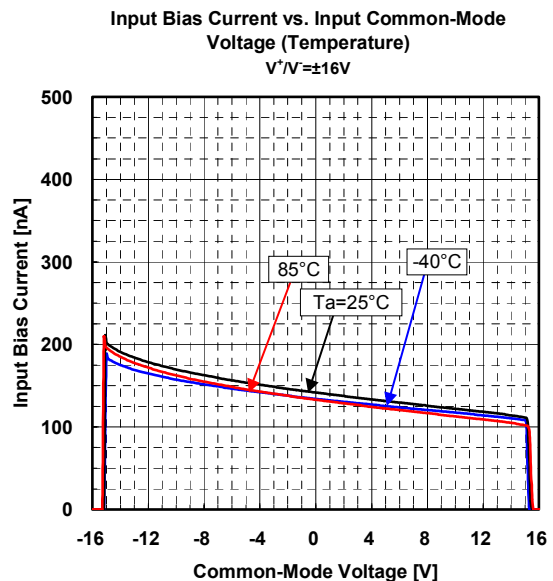
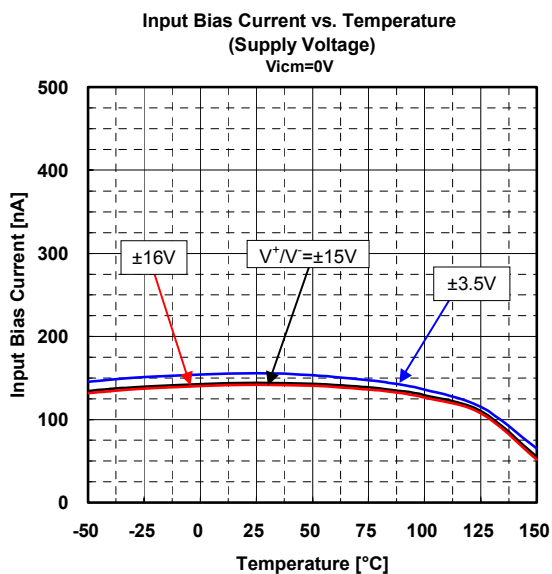
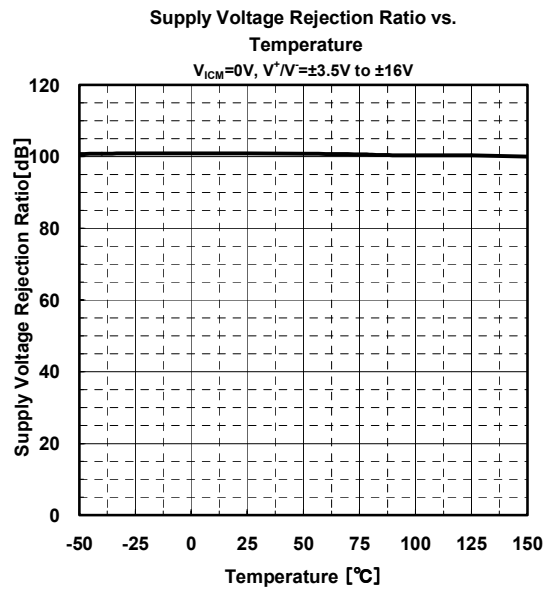
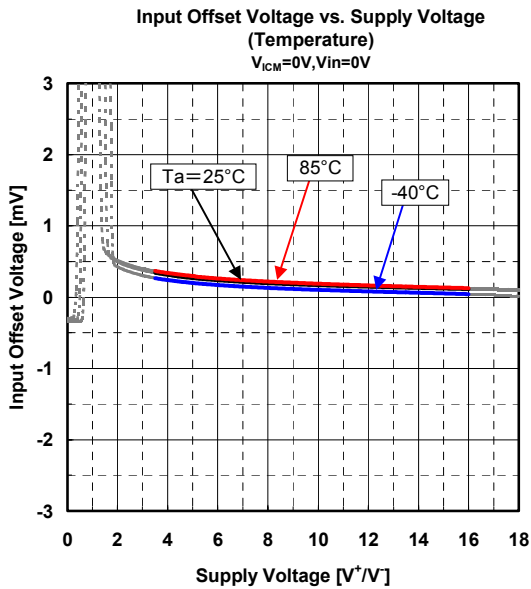
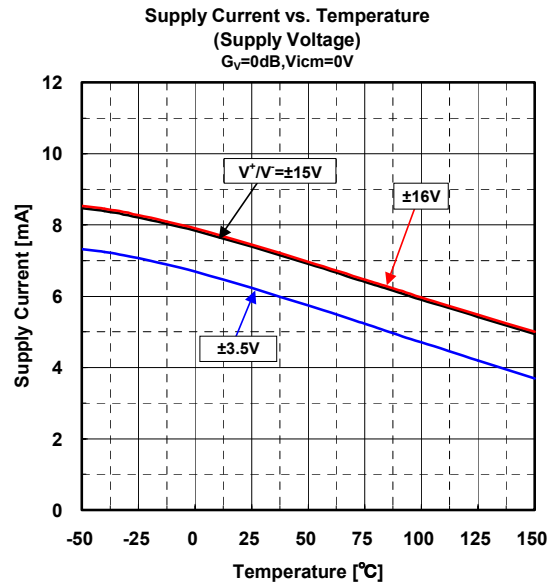
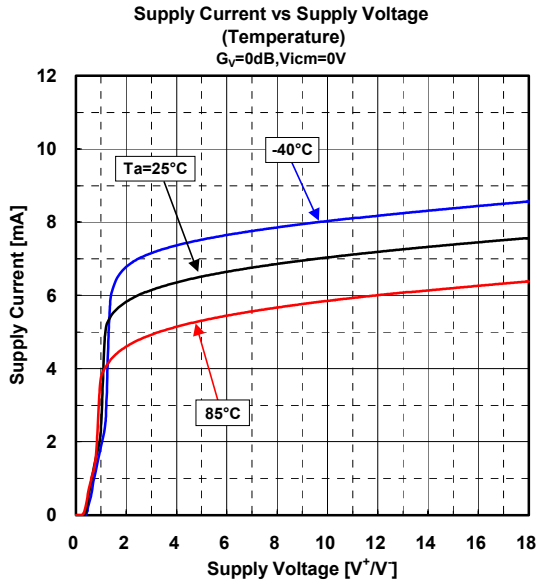
$V^+ / V^- = \pm 3.5V, V_{IN} = 2V_{P-P}, f = 100kHz$
 PulseEdge=10nsec, Gv=0dB, $C_L = 10p, R_L = 2k$



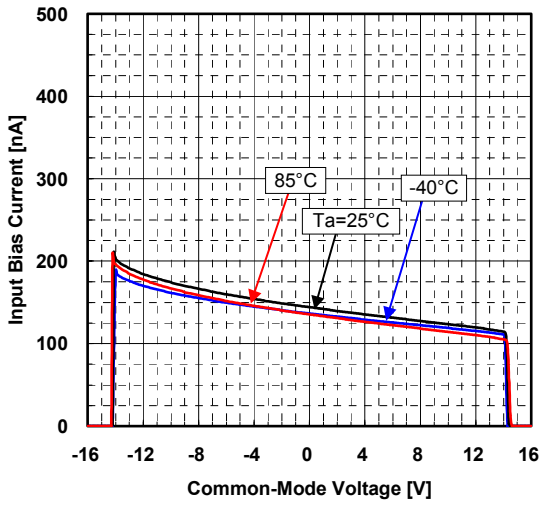
Slew Rate vs. Temperature

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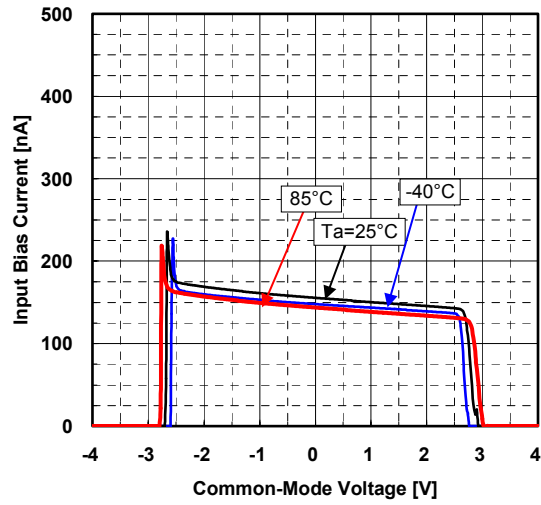




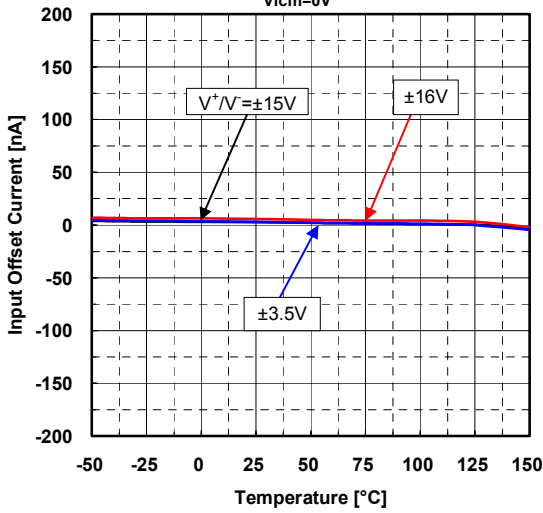
Input Bias Current vs. Input Common-Mode Voltage (Temperature)
 $V^+ / V^- = \pm 15V$



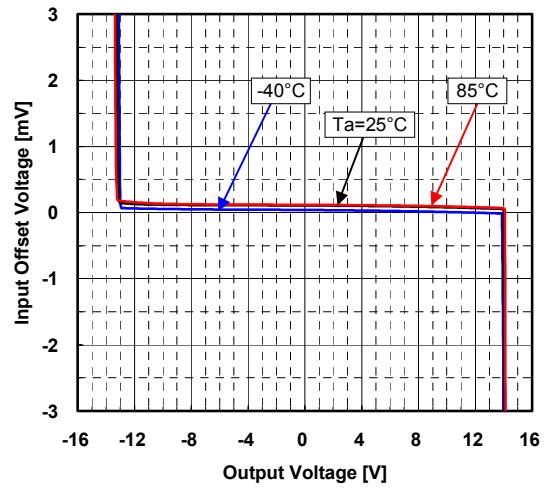
Input Bias Current vs. Input Common-Mode Voltage (Temperature)
 $V^+ / V^- = \pm 3.5V$



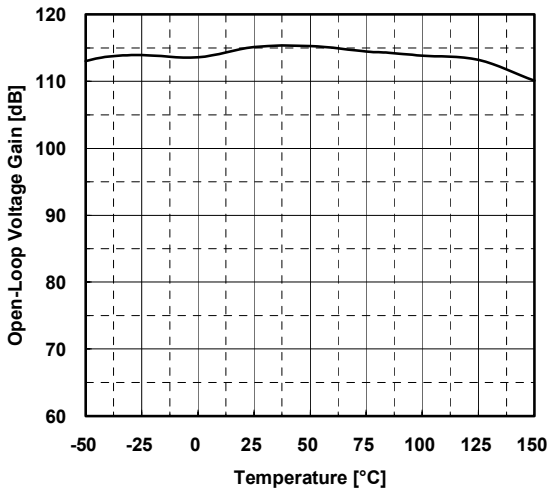
Input Offset Current vs. Temperature (Supply Voltage)
 $V_{icm} = 0V$



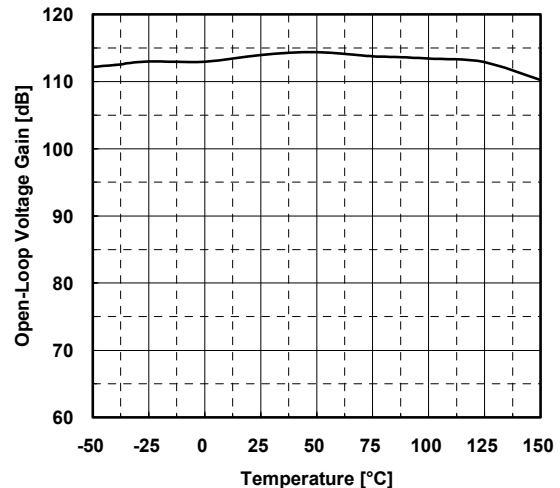
Input Offset Voltage vs. Output Voltage (Temperature)
 $V^+ / V^- = \pm 15V, R_L = 2k\Omega$ to $0V$



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

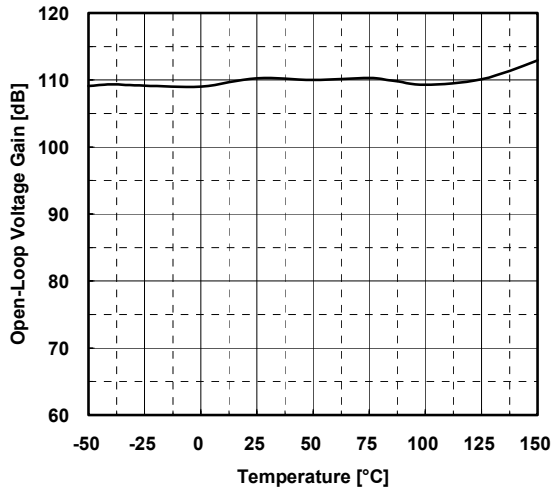


Open-Loop Voltage Gain vs. Temperature
 $R_L = 2k\Omega$ to $0V, V^+ / V^- = \pm 15V, V_o = -10V$ to $+10V$

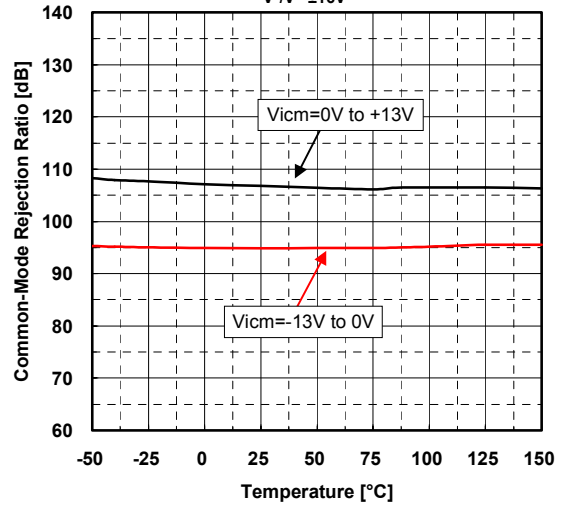


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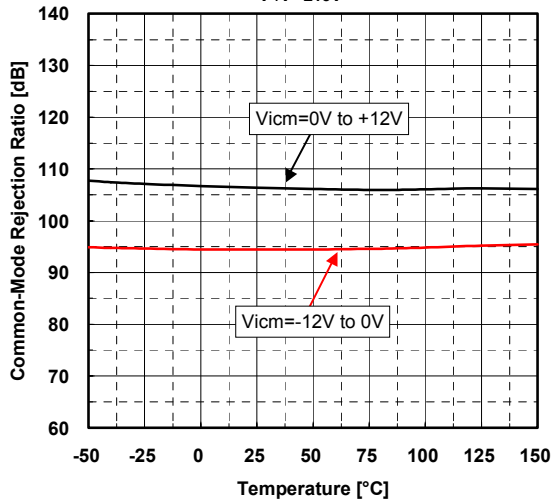
Open-Loop Voltage Gain vs. Temperature
 $R_L=2k\Omega$ to 0V, $V^+/V^-=\pm 3.5V$, $V_O=-1V$ to +1V



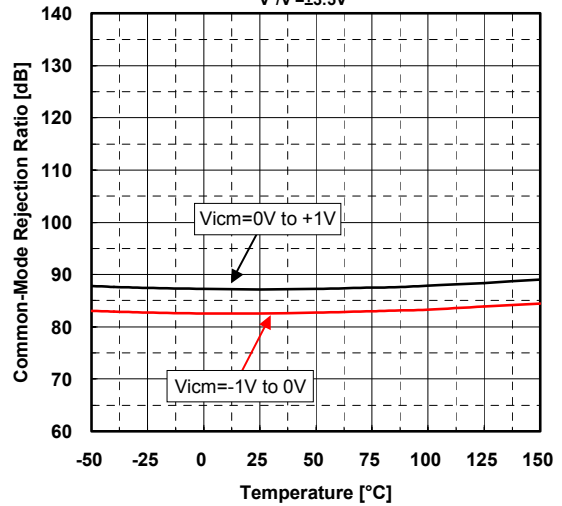
Common-Mode Rejection Ratio vs. Temperature
 (Input Common-Mode Voltage)
 $V^+/V^-=\pm 16V$



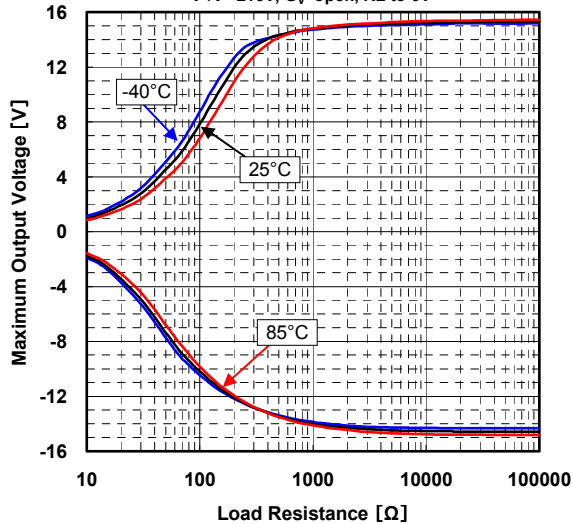
Common-Mode Rejection Ratio vs. Temperature
 (Input Common-Mode Voltage)
 $V^+/V^-=\pm 15V$



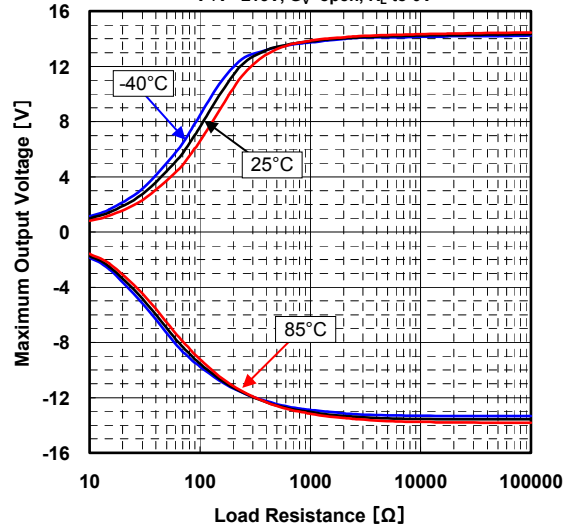
Common-Mode Rejection Ratio vs. Temperature
 (Input Common-Mode Voltage)
 $V^+/V^-=\pm 3.5V$

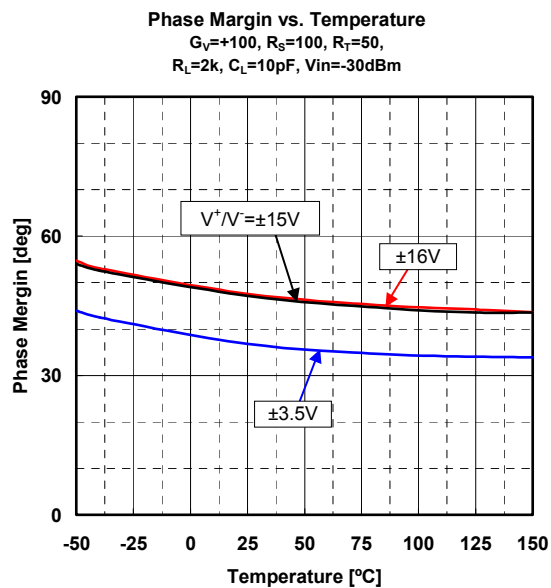
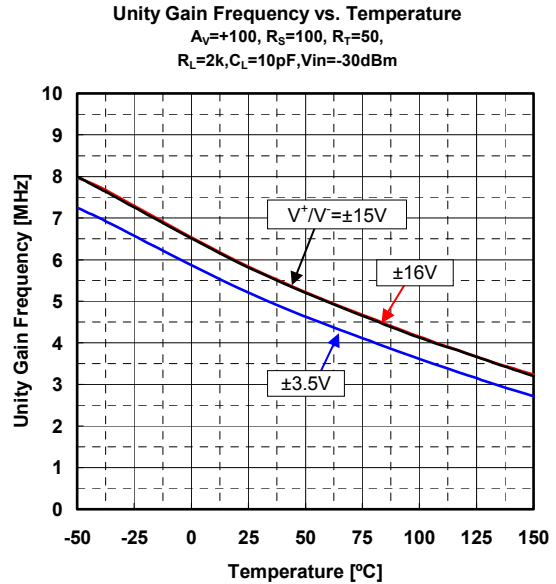
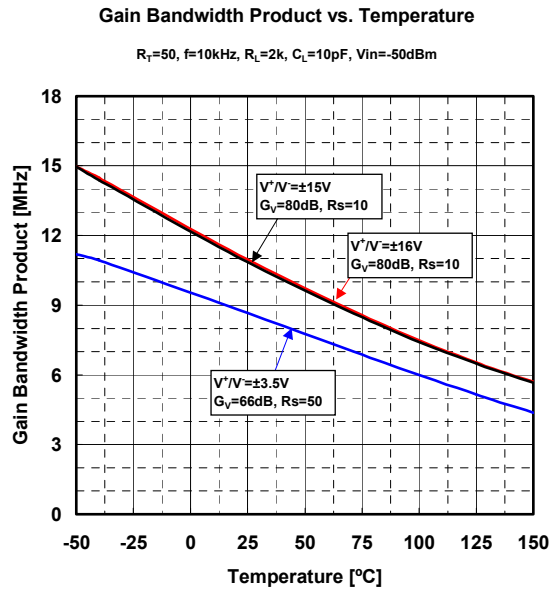
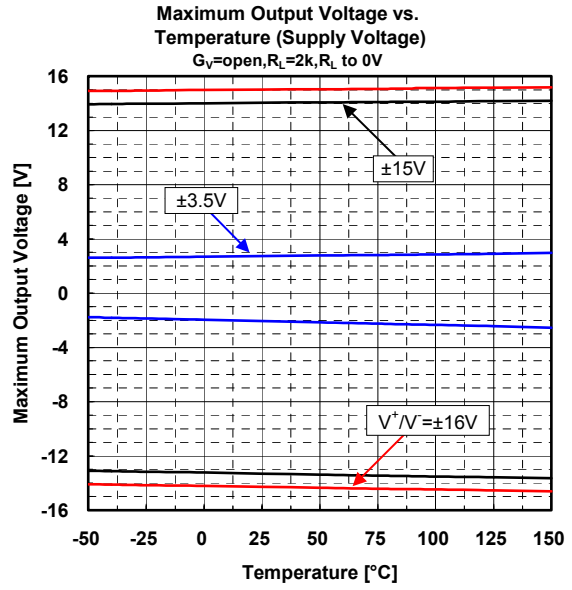
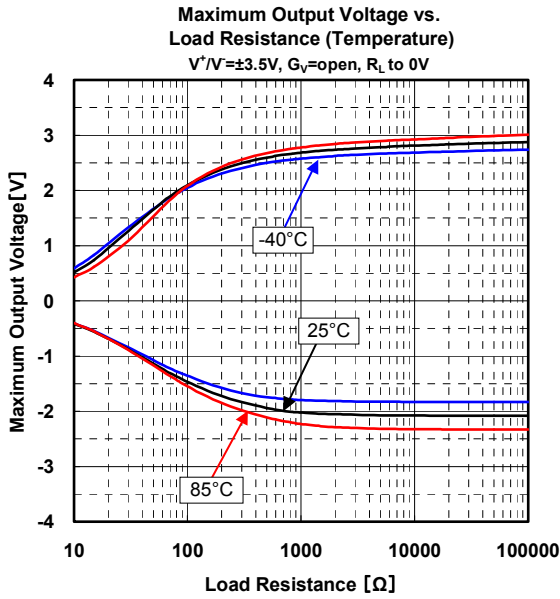


Maximum Output Voltage vs.
 Load Resistance (Temperature)
 $V^+/V^-=\pm 16V$, $G_V=open$, R_L to 0V



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





MUSES8820

MEMO

[CAUTION]
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