



High Quality Audio, Bipolar Input, Dual Operational Amplifier

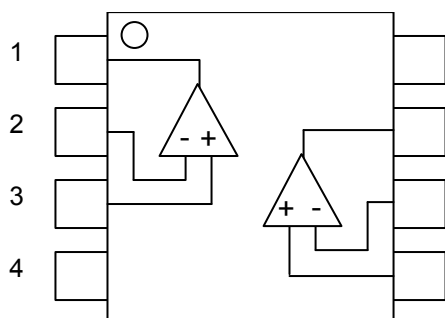
The **MUSES02** is a dual bipolar input high quality audio operational amplifier, which is optimized for high-end audio and professional audio applications with advanced circuitry and layout, unique material and assembled technology by skilled-craftwork.

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

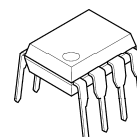
■ PIN CONFIGURATION



PIN FUNCTION

1.	A OUTPUT
2.	A -INPUT
3.	A +INPUT
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 ($V^+/V^- = \pm 15$ V, 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}	$R_s \leq 10k\Omega$ (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	$R_L \geq 2k\Omega$, $V_o = \pm 10$ V $R_s \leq 10k\Omega$	90	110	-	dB
Common Mode Rejection Ratio	CMR	$V_{ICM} = \pm 12$ V (Note4) $R_s \leq 10k\Omega$	80	110	-	dB
Supply Voltage Rejection Ratio	SVR	$V^+/V^- = \pm 3.5$ to ± 16.0 V $R_s \leq 10k\Omega$ (Note2, 5)	80	110	-	dB
Max Output Voltage	V_{OM}	$R_L = 2k\Omega$	± 12	± 13.5	-	V
Input Common Mode Voltage Range	V_{ICM}	CMR ≥ 80 dB	± 12	± 13.5	-	V

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

(Note3) Written by the absolute rate.

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

(Note5) SVR is calculated by specified change in offset voltage. ($V^+/V^- = \pm 3.5$ V to ± 16 V)

■ 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.

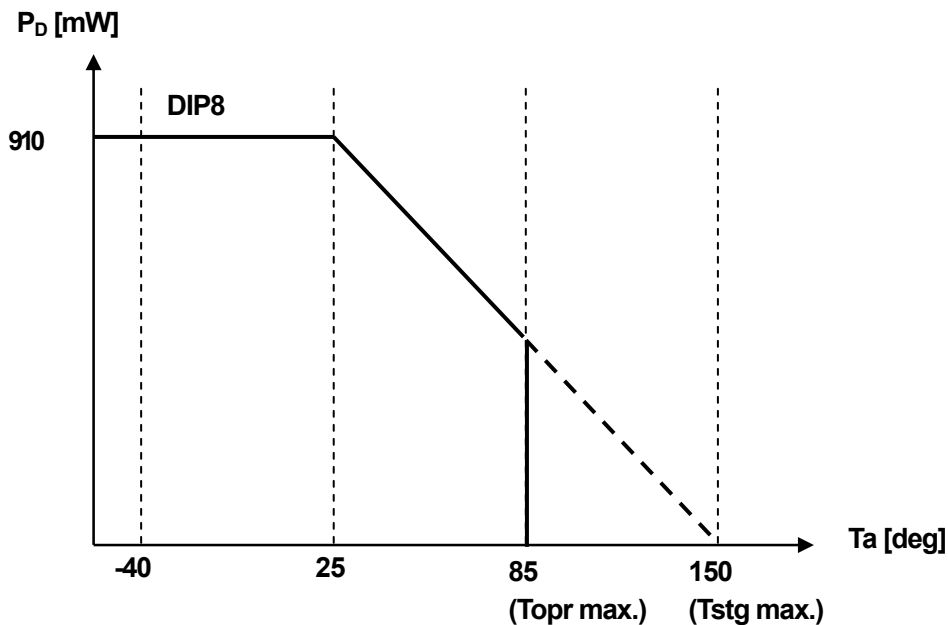
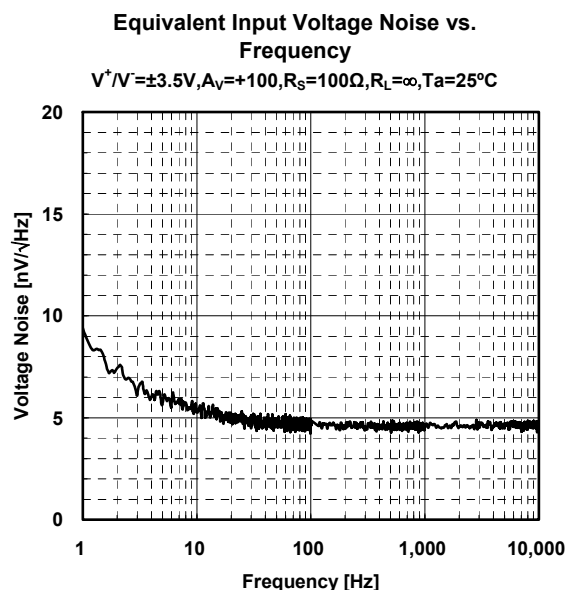
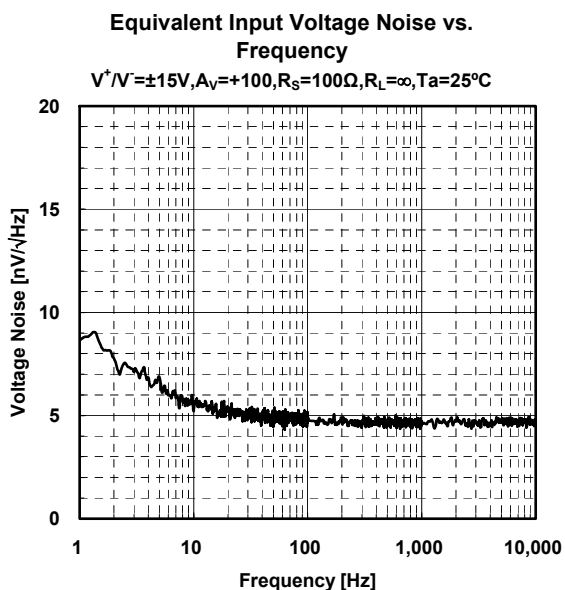
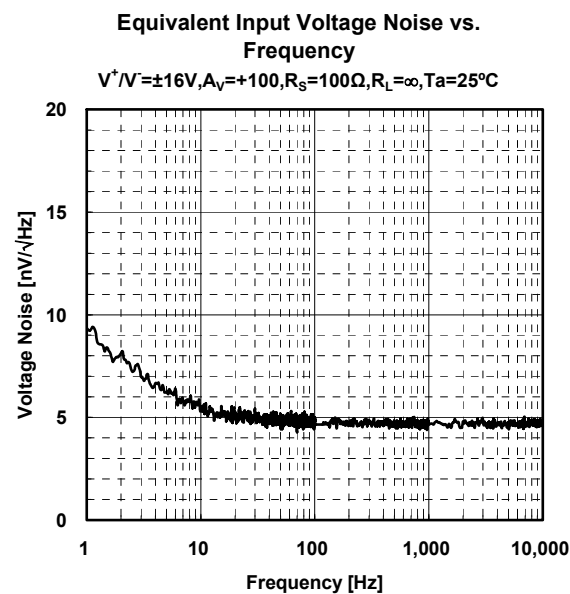
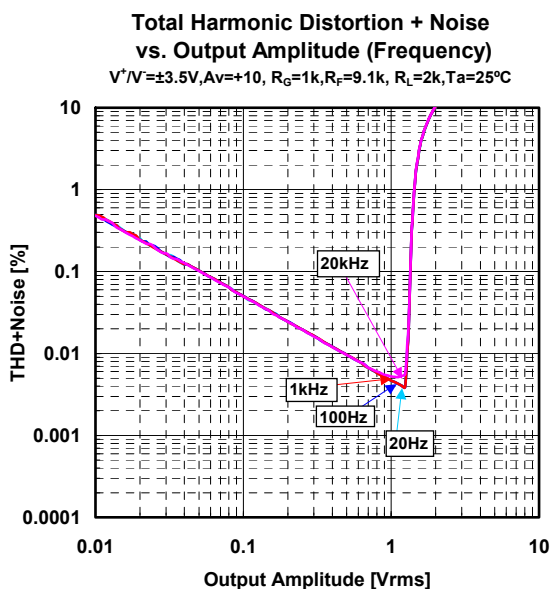
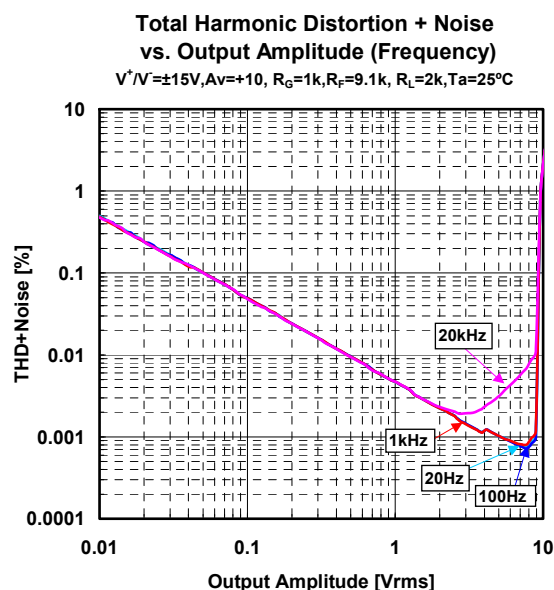
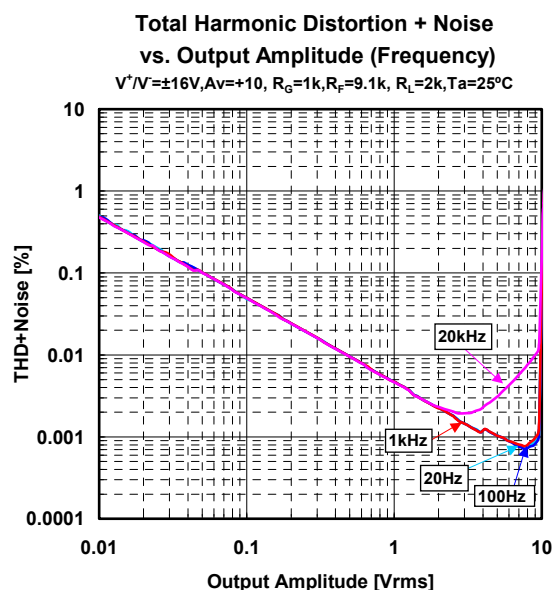
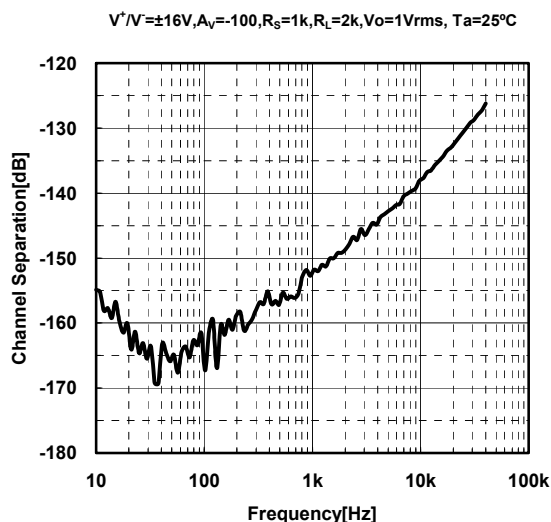


Fig.1 Power Dissipations vs. Ambient Temperature on the MUSES02

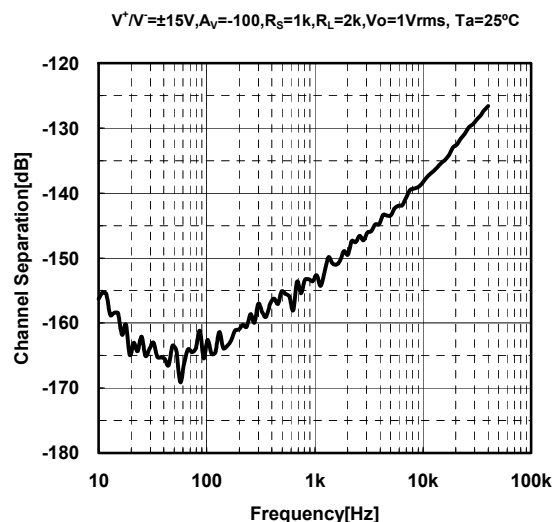
■ TYPICAL CHARACTERISTICS



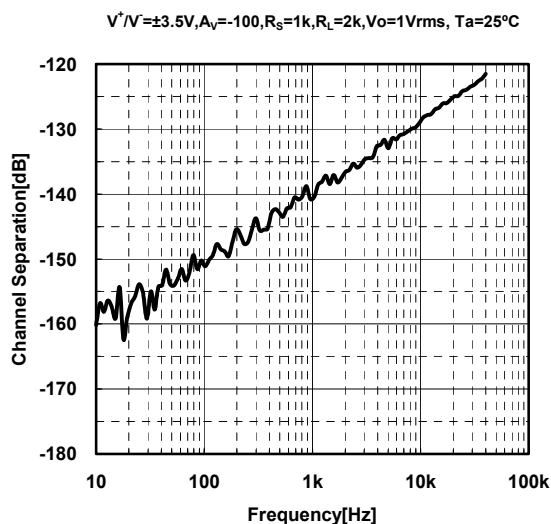
Channel Separation vs. Frequency



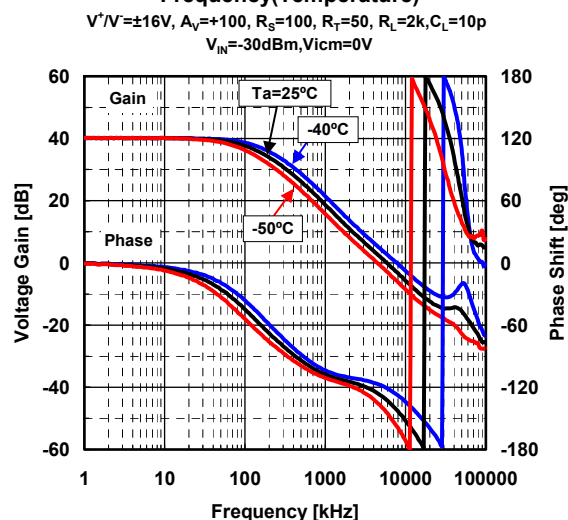
Channel Separation vs. Frequency



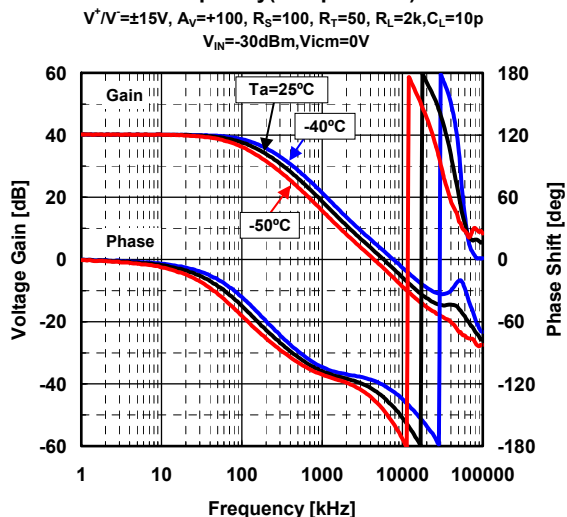
Channel Separation vs. Frequency



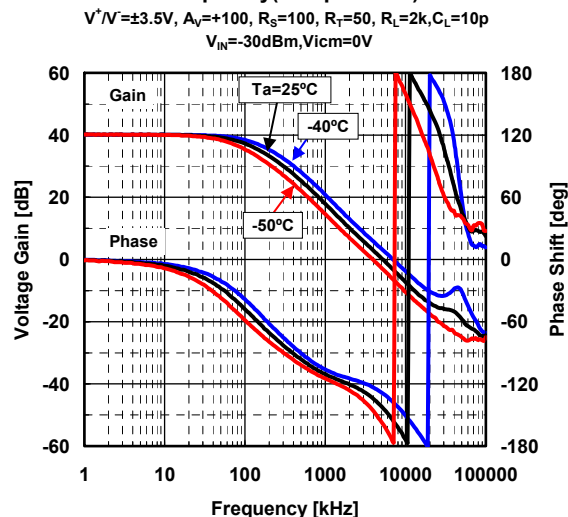
Closed-Loop Gain/Phase vs. Frequency(Temperature)



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



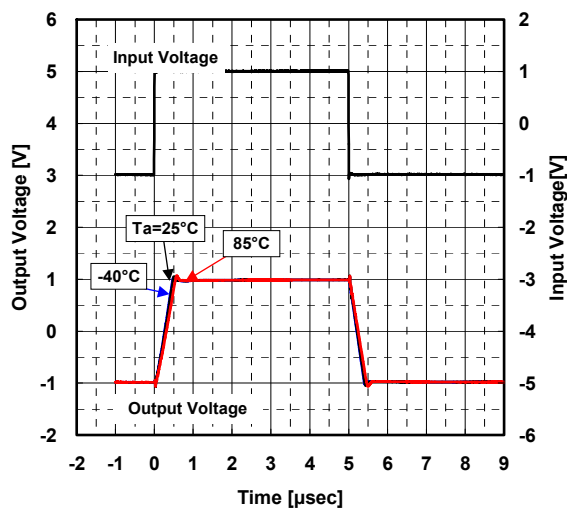
Closed-Loop Gain/Phase vs. Frequency(Temperature)



Transient Response (Temperature)

$V^+/V^- = \pm 16V, V_{IN} = 2V_{P-P}, f = 100kHz$

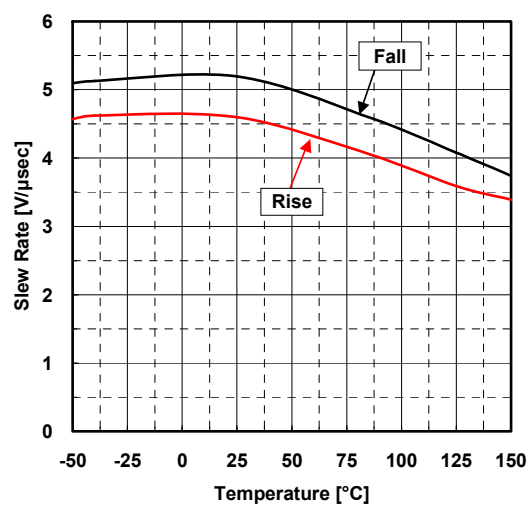
PulseEdge=10nsec, Gv=0dB, $C_L = 10p$, $R_L = 2k$



Slew Rate vs. Temperature

$V^+/V^- = \pm 16V, V_{IN} = 2V_{P-P}, f = 100kHz$

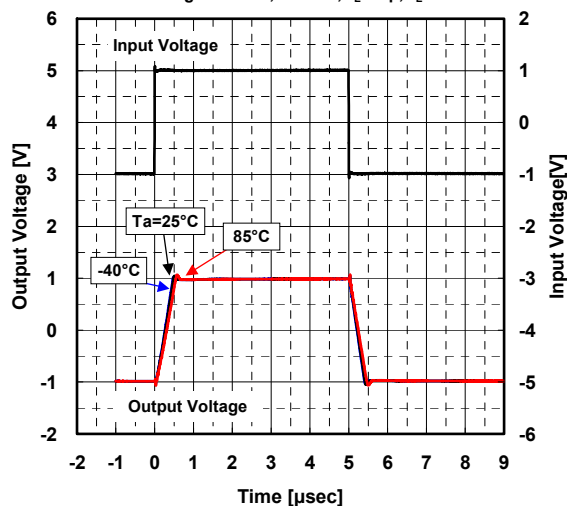
PulseEdge=10nsec, Gv=0dB, $C_L = 10p$, $R_L = 2k$



Transient Response (Temperature)

$V^+/V^- = \pm 15V, V_{IN} = 2V_{P-P}, f = 100kHz$

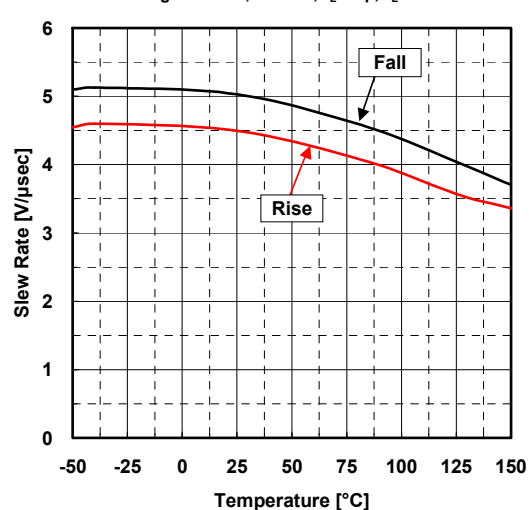
PulseEdge=10nsec, Gv=0dB, $C_L = 10p$, $R_L = 2k$



Slew Rate vs. Temperature

$V^+/V^- = \pm 15V, V_{IN} = 2V_{P-P}, f = 100kHz$

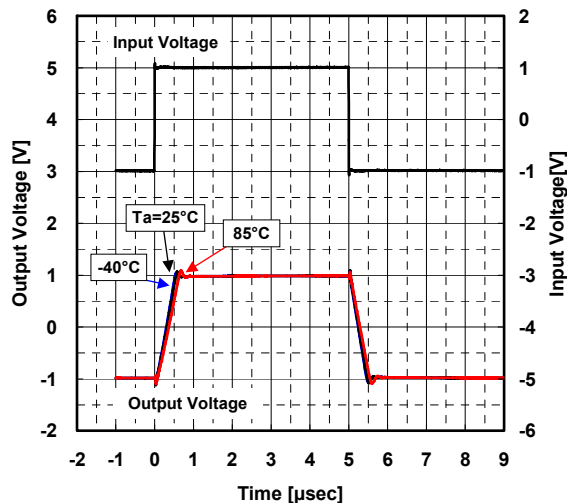
PulseEdge=10nsec, Gv=0dB, $C_L = 10p$, $R_L = 2k$



Transient Response (Temperature)

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

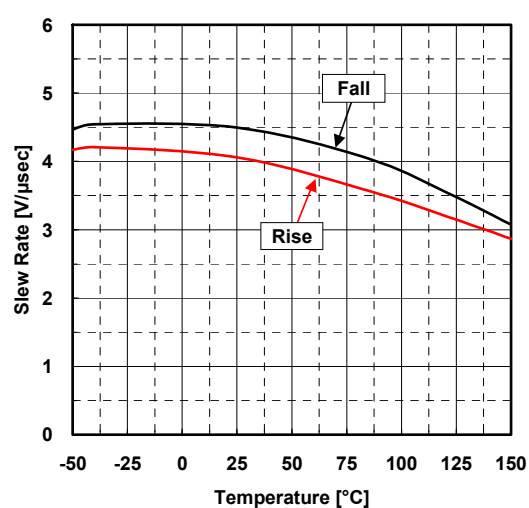
PulseEdge=10nsec, Gv=0dB, $C_L = 10p$, $R_L = 2k$

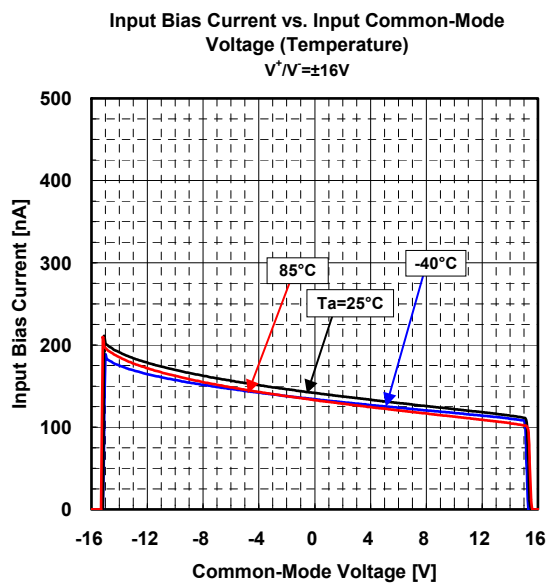
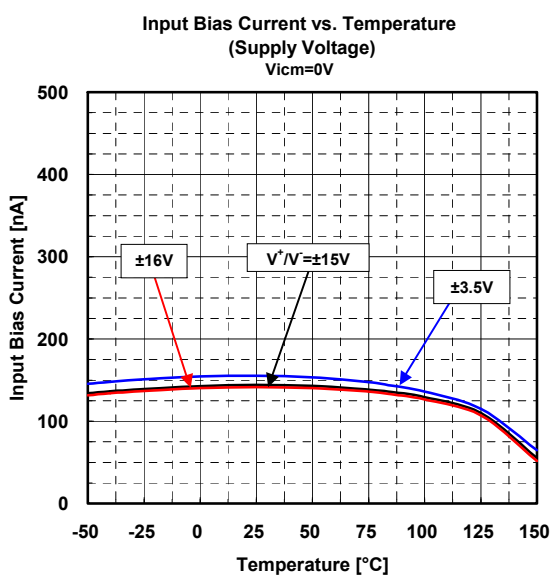
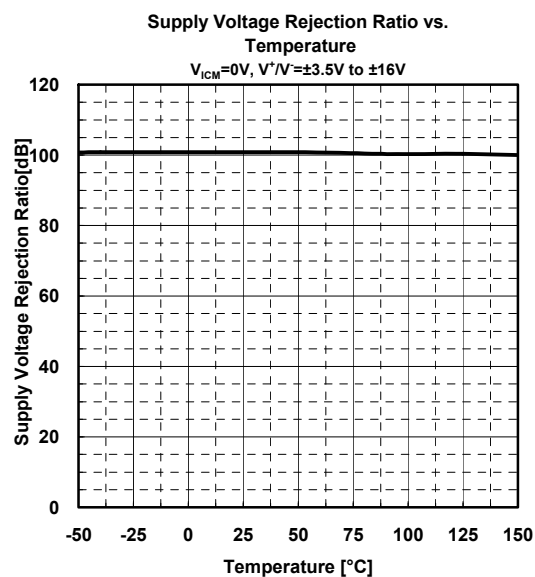
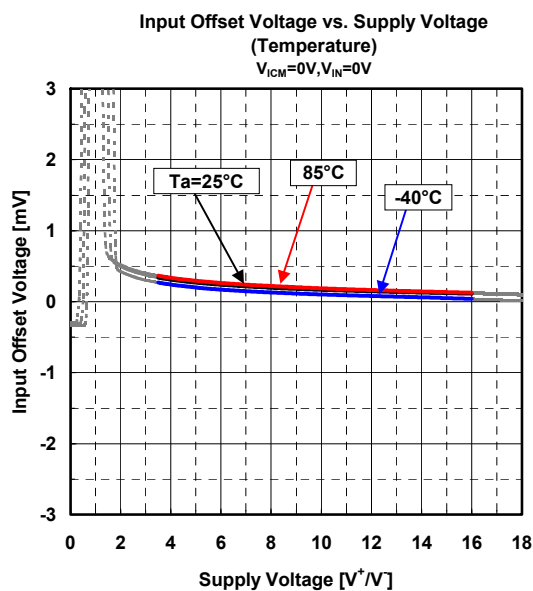
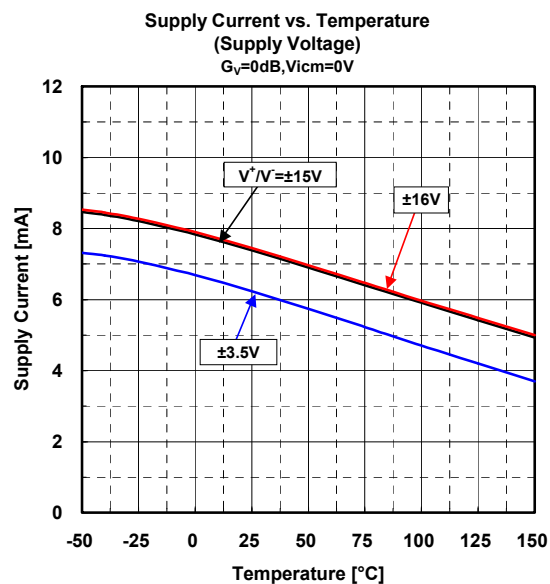
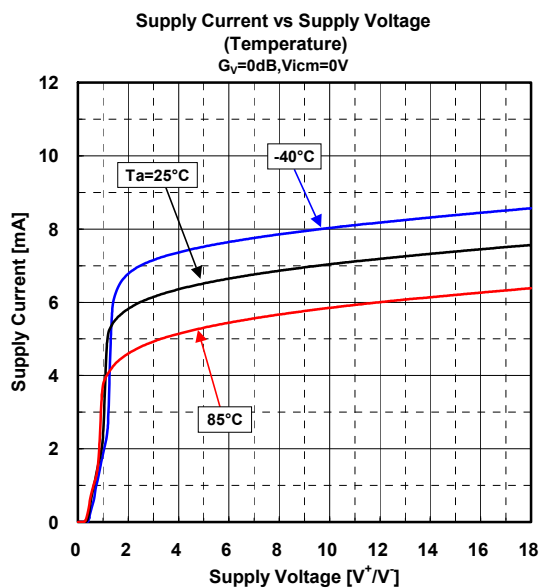


Slew Rate vs. Temperature

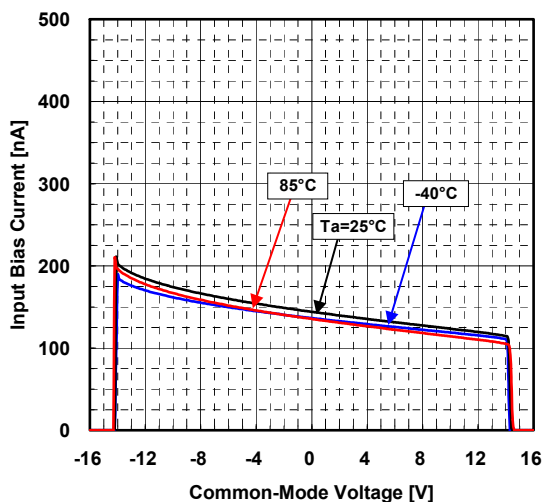
$V^+/V^- = \pm 3.5V, V_{IN} = 2V_{P-P}, f = 100kHz$

PulseEdge=10nsec, Gv=0dB, $C_L = 10p$, $R_L = 2k$

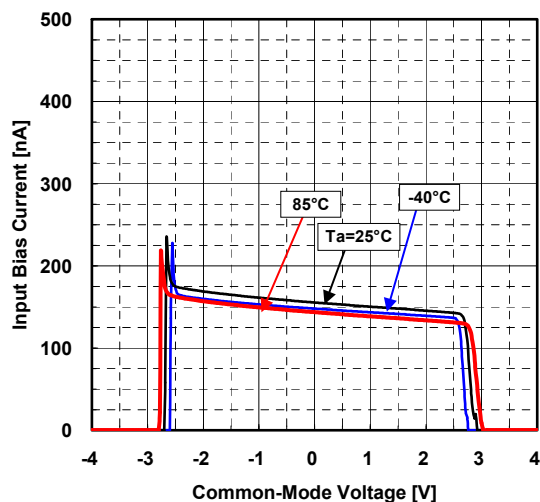




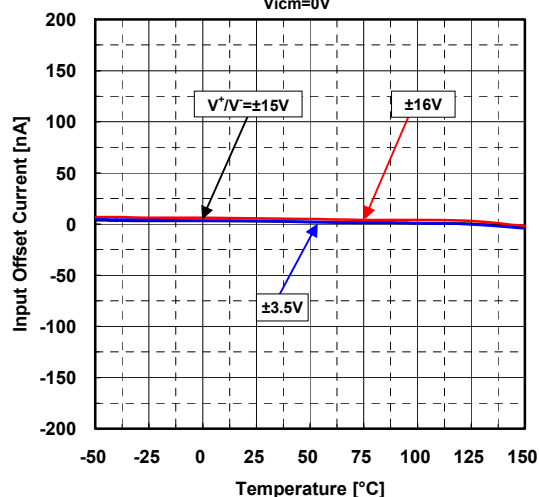
Input Bias Current vs. Input Common-Mode Voltage (Temperature)
 $V^+/V^-\approx\pm 15V$



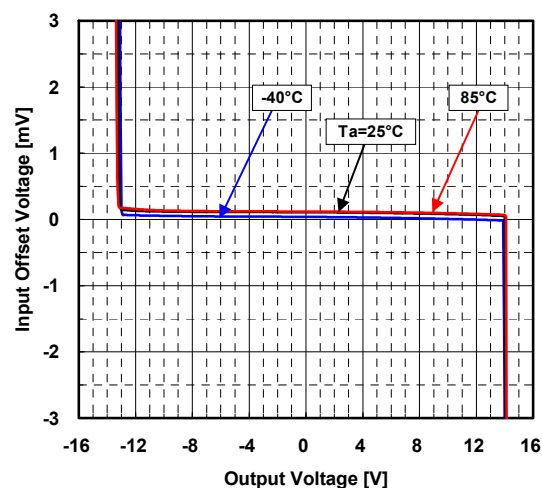
Input Bias Current vs. Input Common-Mode Voltage (Temperature)
 $V^+/V^-\approx\pm 3.5V$



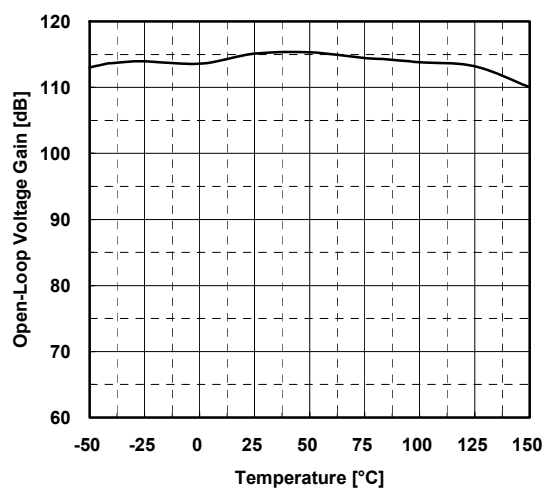
Input Offset Current vs. Temperature (Supply Voltage)
 $V_{cm}=0V$



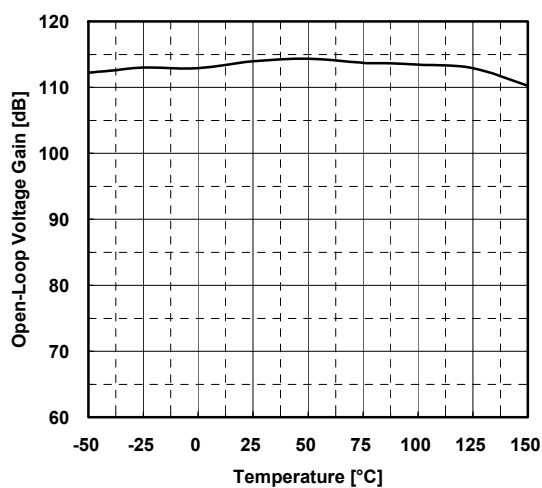
Input Offset Voltage vs. Output Voltage (Temperature)
 $V^+/V^-\approx\pm 15V, R_L=2k\Omega$ to $0V$

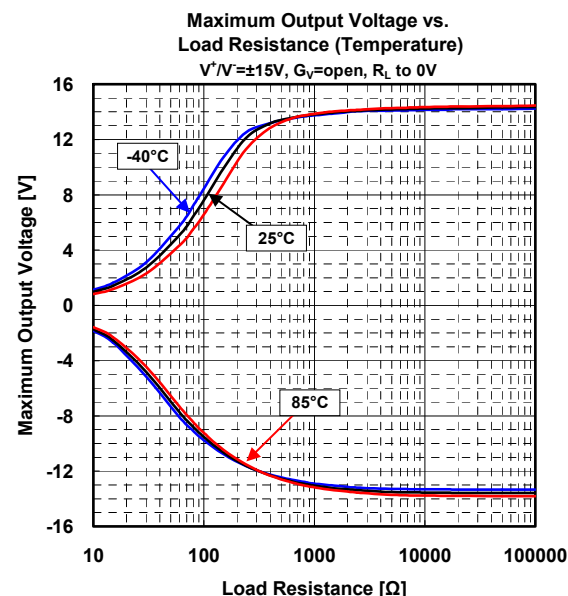
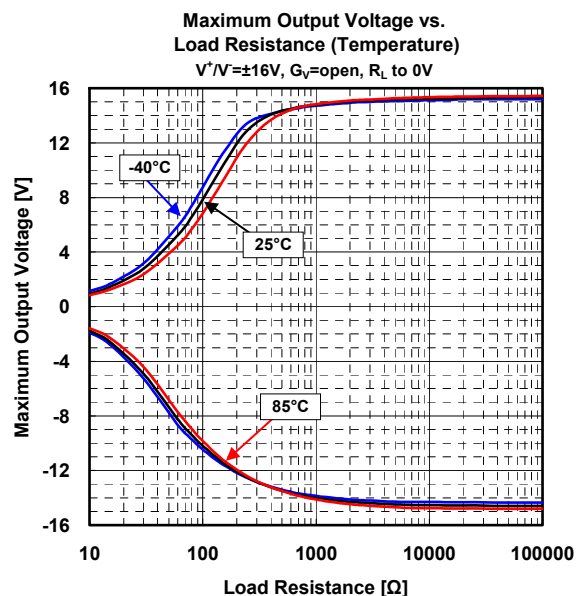
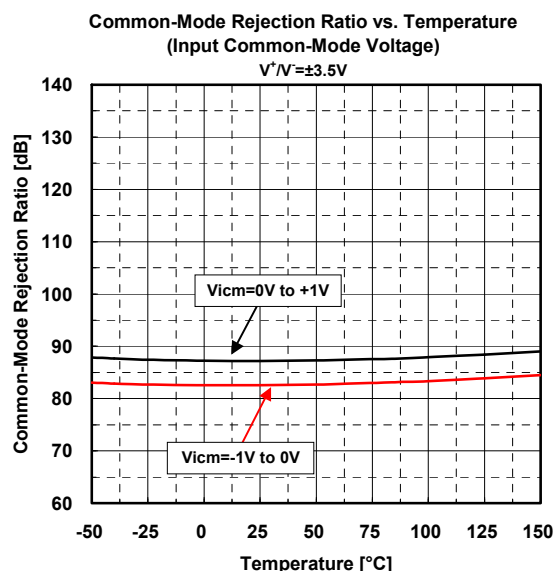
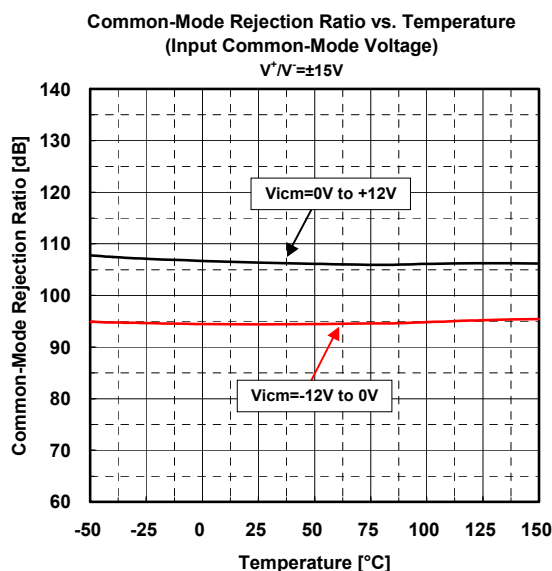
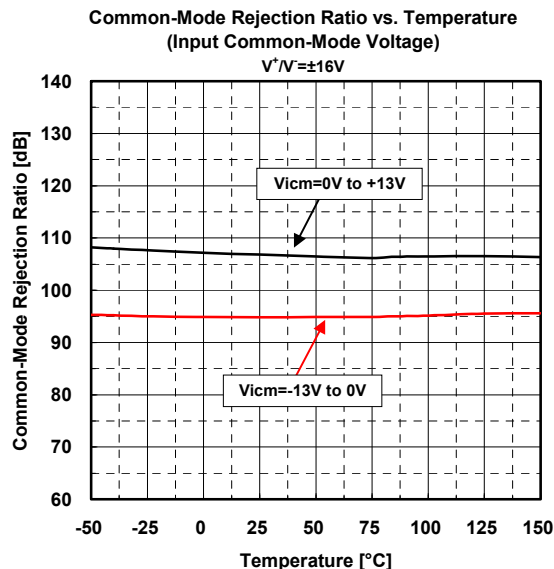
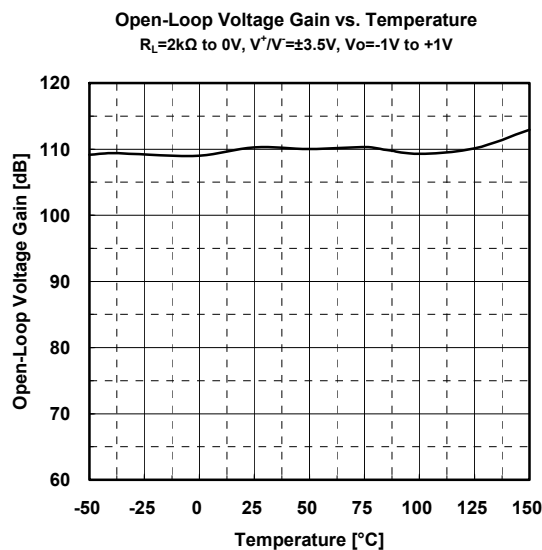


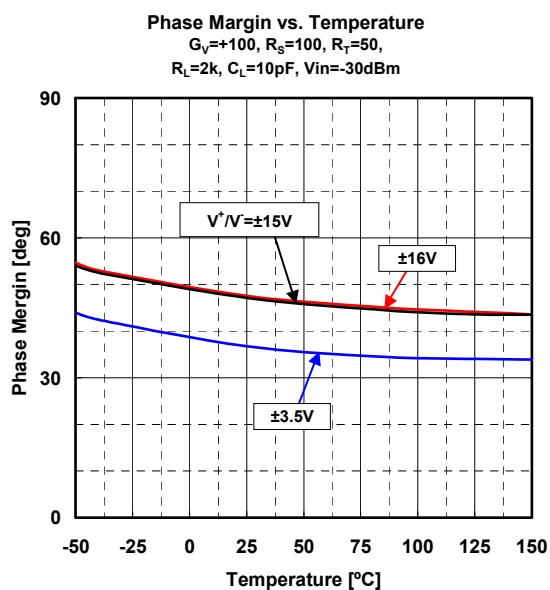
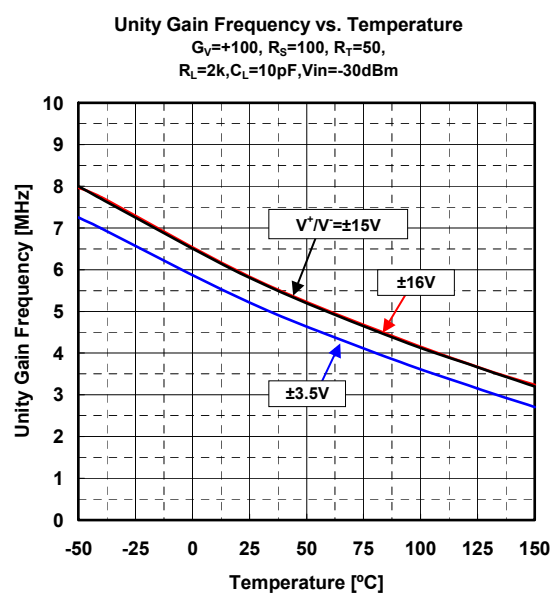
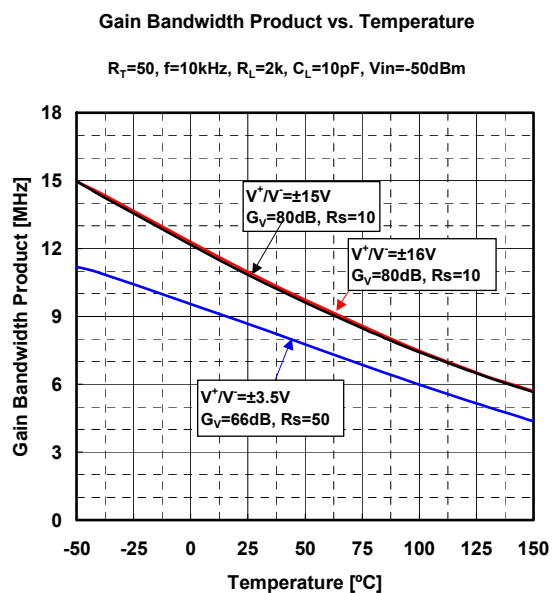
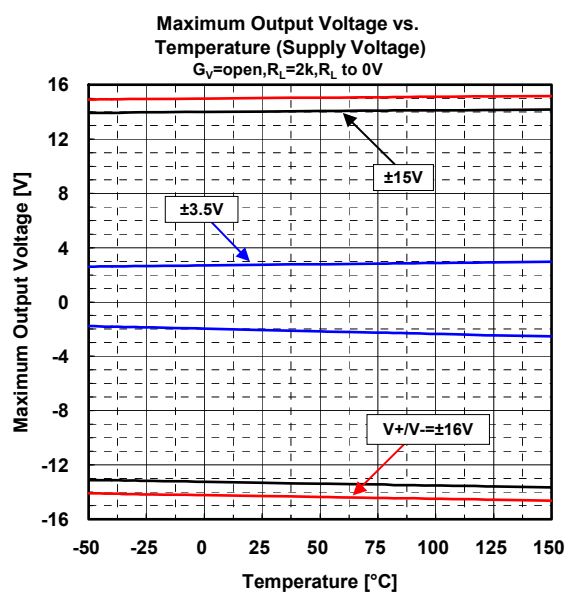
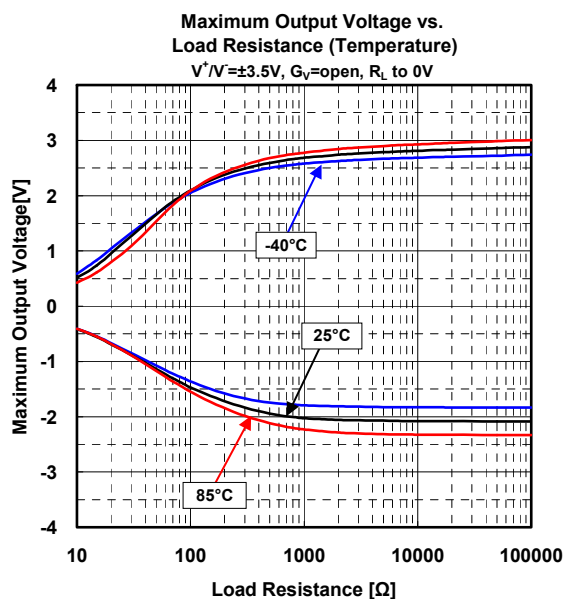
Open-Loop Voltage Gain vs. Temperature
 $R_L=2k\Omega$ to $0V, V^+/V^-\approx\pm 16V, V_o=-11V$ to $+11V$



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







MEMO

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