



## High Quality Audio , J-FET Input, Dual Operational Amplifier

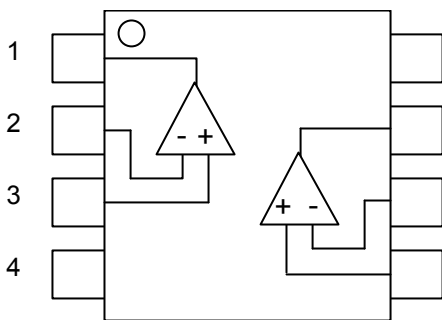
The **MUSES01** is a dual J-FET input high quality audio operational amplifier, which is optimized for high-end audio and professional audio applications with advanced circuitry and layout, unique material and assembled technology by skilled-craftwork.

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

### ■ FEATURES

- |                       |                                  |
|-----------------------|----------------------------------|
| ●Operating Voltage    | Vopr=±9V to ±16V                 |
| ●Output noise         | 9.5nV/√Hz at f=1kHz              |
| ●Input Offset Voltage | 0.8mV typ. 5mV max.              |
| ●Input Bias Current   | 200pA typ. 800pA max. at Ta=25°C |
| ●Voltage Gain         | 105dB typ.                       |
| ●Slew Rate            | 12V/μs typ.                      |
| ●Bipolar Technology   |                                  |
| ●Package Outline      | DIP8                             |

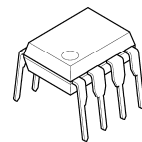
### ■ PIN CONFIGURATION



### 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



**MUSES01**



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# MUSES01

## ■ 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	$I_O$	±25	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	$V^+V^-$	-	±9	-	±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, $R_L = \infty$	-	8.5	12.0	mA
Input Offset Voltage	$V_{IO}$	$R_s \leq 10k\Omega$ (Note2)	-	0.8	5.0	mV
Input Bias Current	$I_B$	(Note2, 3)	-	200	800	pA
Input Offset Current	$I_{IO}$	(Note2, 3)	-	100	400	pA
Voltage Gain	$A_V$	$R_L \geq 2k\Omega$ , $V_o = \pm 10V$	90	105	-	dB
Common Mode Rejection Ratio	CMR	$V_{ICM} = \pm 8V$ (Note4)	60	75	-	dB
Supply Voltage Rejection Ratio	SVR	$V^+V^- = \pm 9.0$ to $\pm 16.0V$ (Note2, 5)	70	83	-	dB
Max Output Voltage 1	$V_{OM1}$	$R_L = 10k\Omega$	±12	±13.5	-	V
Max Output Voltage 2	$V_{OM2}$	$R_L = 2k\Omega$	±10	±12.5	-	V
Input Common Mode Voltage Range	$V_{ICM}$	CMR ≥ 60dB	±8	±9.5	-	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 +8V and  $V_{ICM} = 0V$  to -8V)

(Note5) SVR is calculated by specified change in offset voltage. ( $V^+V^- = \pm 9V$  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	$f=10kHz$	-	3.3	-	MHz
Unity Gain Frequency	$f_T$	$A_V=+100, R_S=100\Omega,$ $R_L=2k\Omega, C_L=10pF$	-	3.0	-	MHz
Phase Margin	$\phi_M$	$A_V=+100, R_S=100\Omega,$ $R_L=2k\Omega, C_L=10pF$	-	60	-	deg
Input Noise Voltage1	$V_{NI}$	$f=1kHz, A_V=+100,$ $R_S=100\Omega$	-	9.5	-	nV/ $\sqrt{Hz}$
Input Noise Voltage2	$V_{N2}$	RIAA, $R_S=2.2k\Omega,$ 30kHz LPF	-	1.2	3.0	$\mu V_{rms}$
Total Harmonic Distortion	THD	$f=1kHz, A_V=+10,$ $R_L=2k\Omega, V_o=5V_{rms}$	-	0.002	-	%
Channel Separation	CS	$f=1kHz, A_V=-+100, R_S=1k\Omega,$ $R_L=2k\Omega$	-	150	-	dB
Positive Slew Rate	+SR	$A_V=1, V_{IN}=2V_{p-p},$ $R_L=2k\Omega, C_L=10pF$	-	12	-	V/ $\mu s$
Negative Slew Rate	-SR	$A_V=1, V_{IN}=2V_{p-p},$ $R_L=2k\Omega, C_L=10pF$	-	13	-	V/ $\mu s$

# MUSES01

## ■ 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 MUSES01  $P_D$  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 MUSES01 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 MUSES01 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.

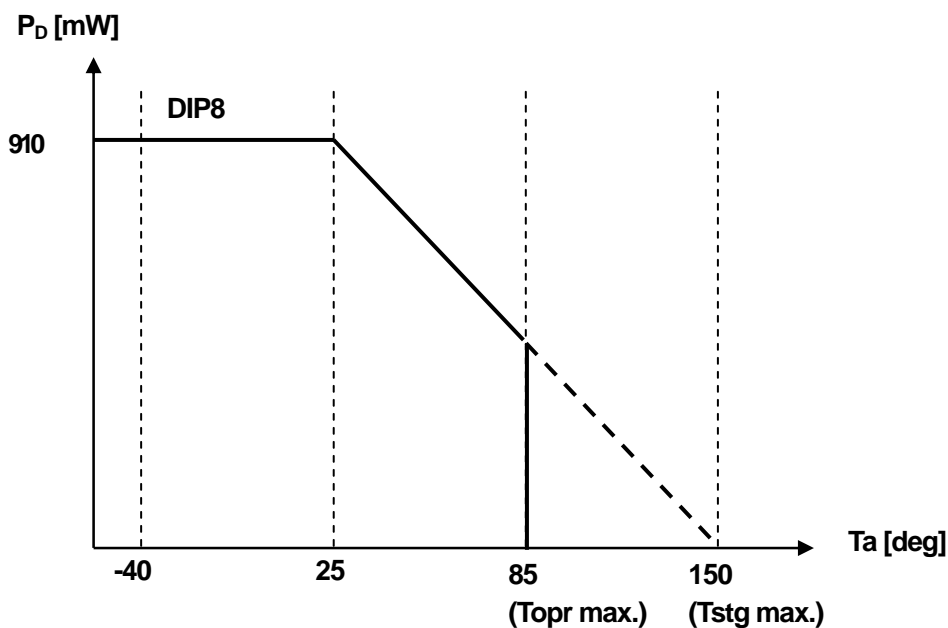
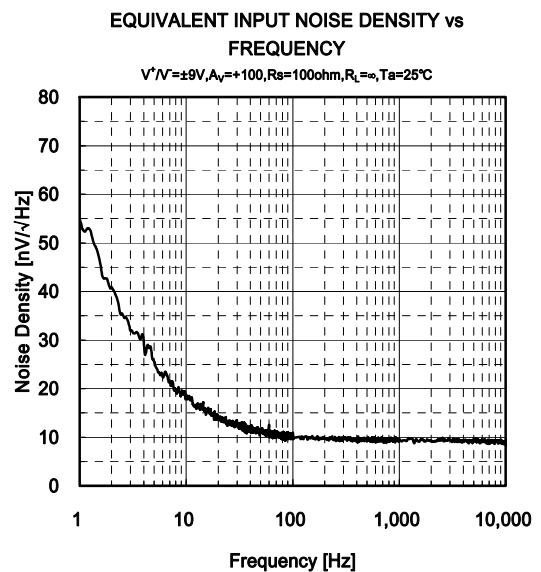
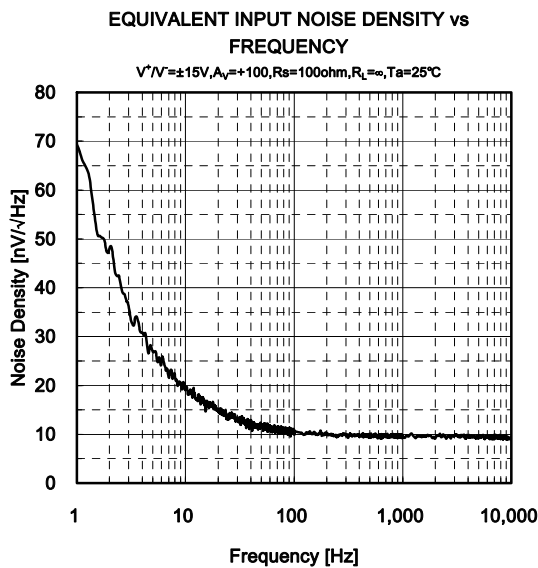
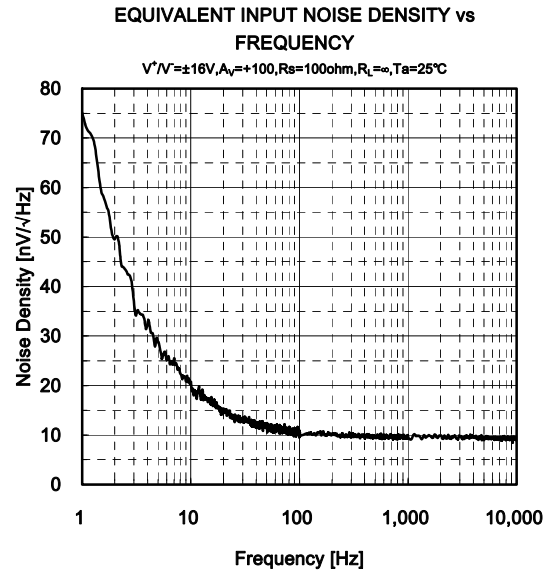
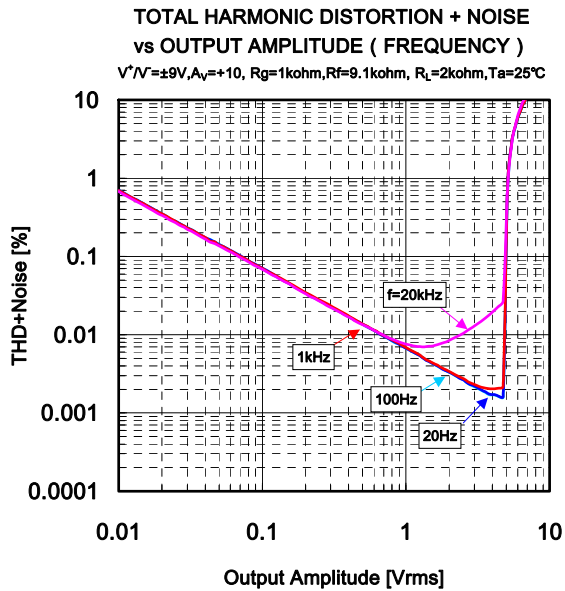
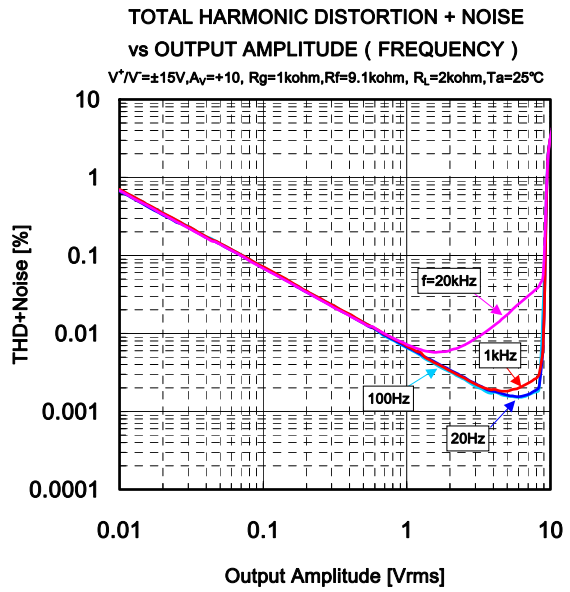
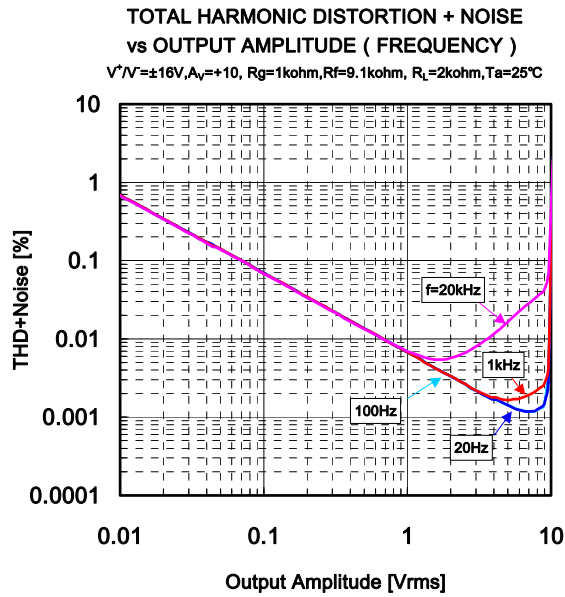
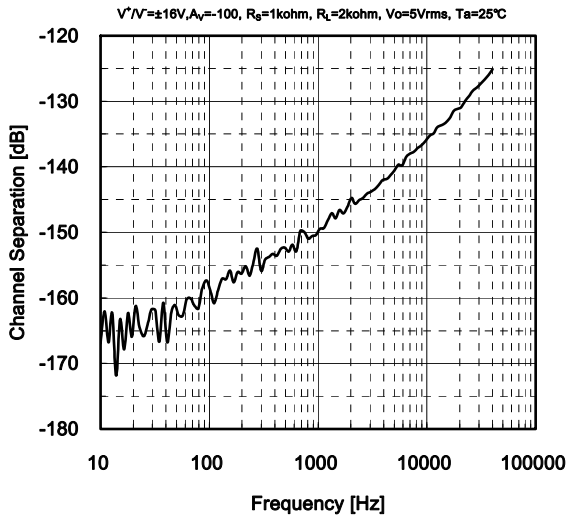


Fig.1 Power Dissipations vs. Ambient Temperature on the MUSES01

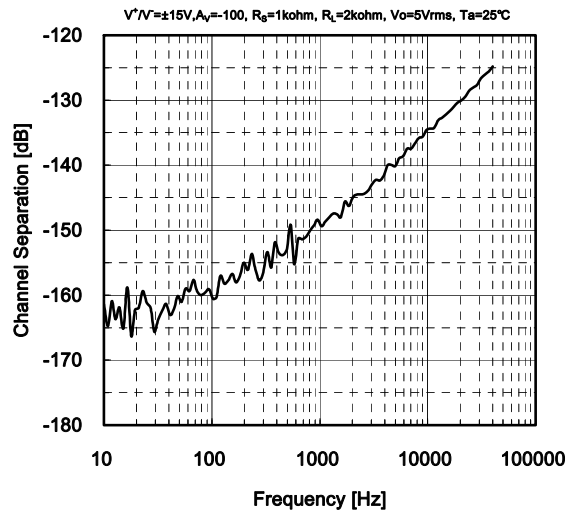
## ■ TYPICAL CHARACTERISTICS



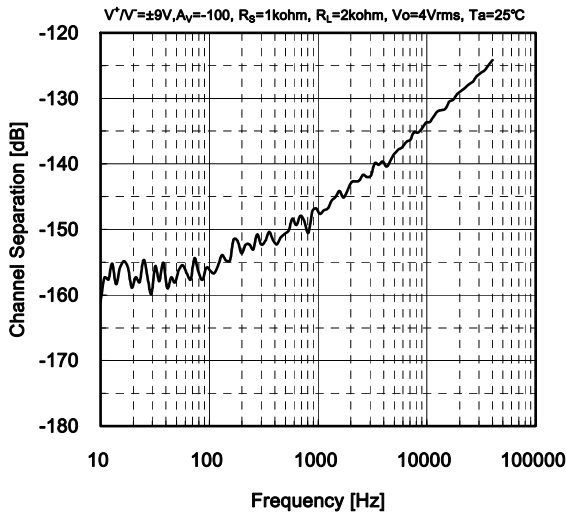
CHANNEL SEPARATION vs FREQUENCY



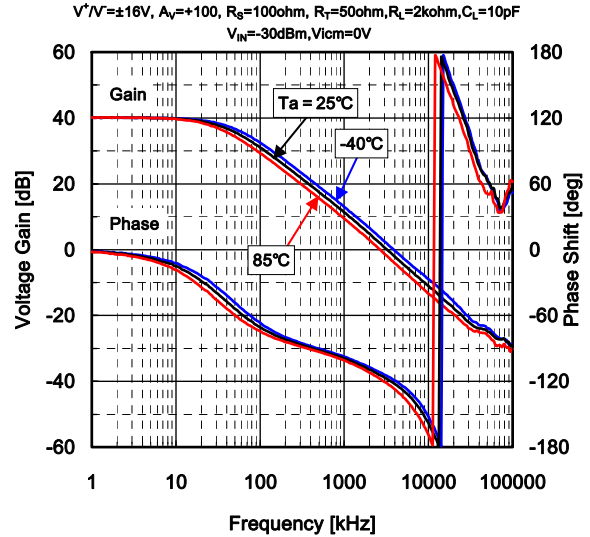
CHANNEL SEPARATION vs FREQUENCY



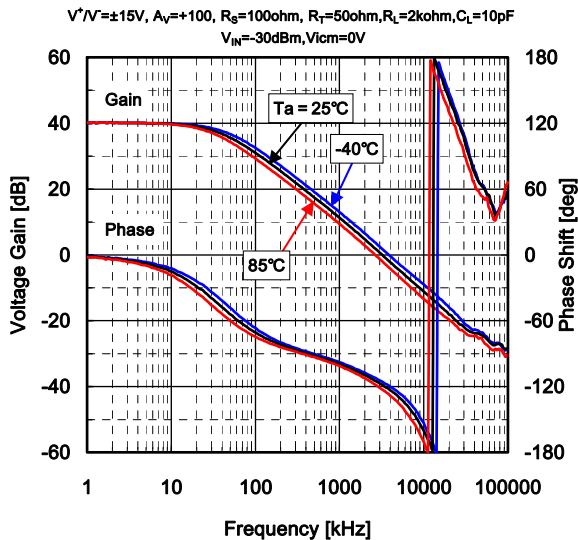
CHANNEL SEPARATION vs FREQUENCY



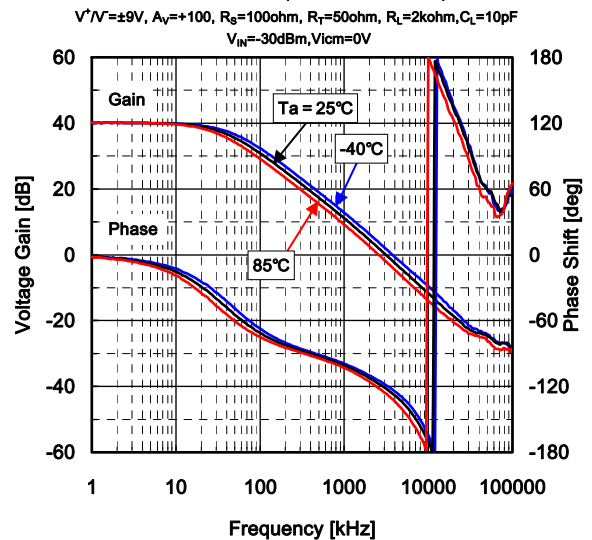
CLOSED-LOOP GAIN/PHASE vs FREQUENCY (TEMPERATURE)



CLOSED-LOOP GAIN/PHASE vs FREQUENCY (TEMPERATURE)



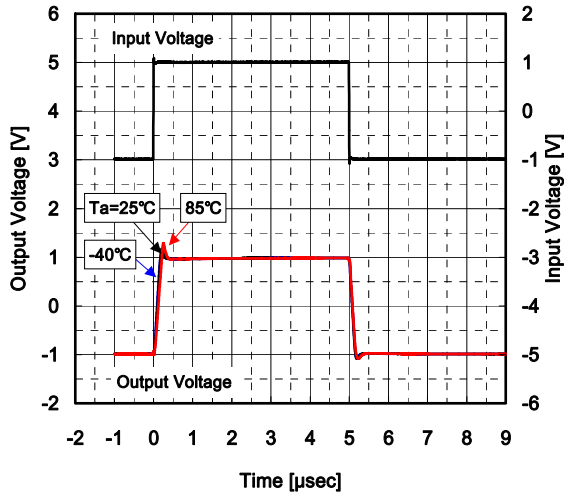
CLOSED LOOP GAIN/PHASE vs FREQUENCY (TEMPERATURE)



**TRANSIENT RESPONSE (TEMPERATURE)**

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

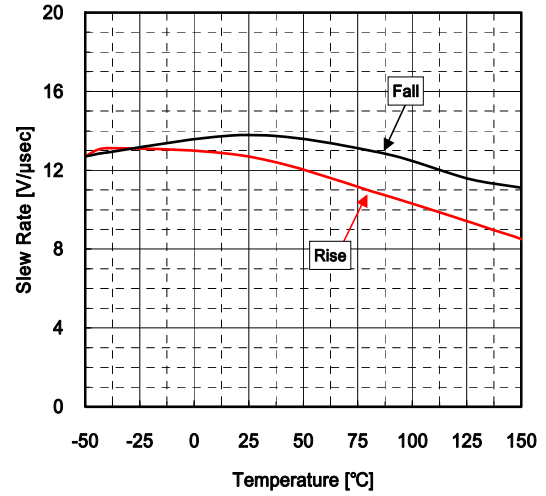
PulseEdge=10nsec, Gv=0dB,  $C_L = 10pF, R_L = 2kohm$



**SLEW RATE vs TEMPERATURE**

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

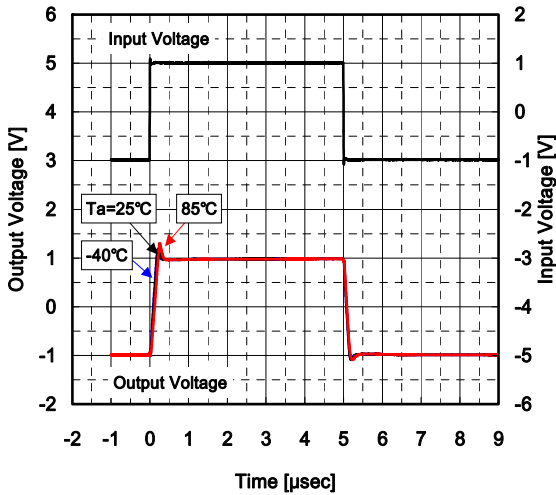
PulseEdge=10nsec, Gv=0dB,  $C_L = 10pF, R_L = 2kohm$



**TRANSIENT RESPONSE (TEMPERATURE)**

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

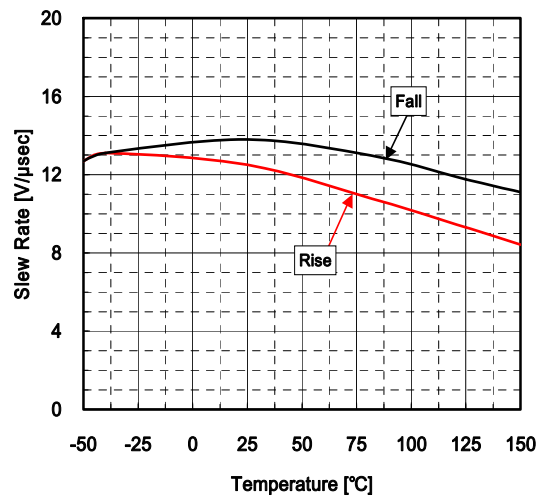
PulseEdge=10nsec, Gv=0dB,  $C_L = 10pF, R_L = 2kohm$



**SLEW RATE vs TEMPERATURE**

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

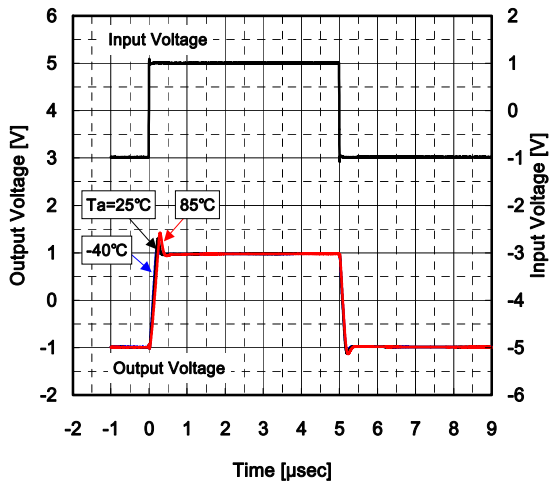
PulseEdge=10nsec, Gv=0dB,  $C_L = 10pF, R_L = 2kohm$



**TRANSIENT RESPONSE (TEMPERATURE)**

$V^+ / V^- = \pm 9V, V_{IN} = 2V_{P-P}, f = 100kHz$

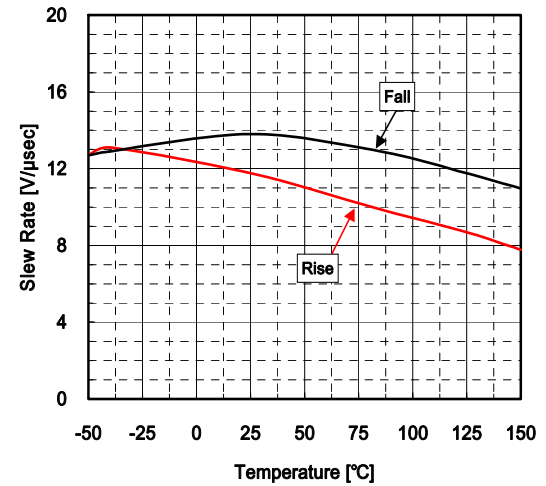
PulseEdge=10nsec, Gv=0dB,  $C_L = 10pF, R_L = 2kohm$



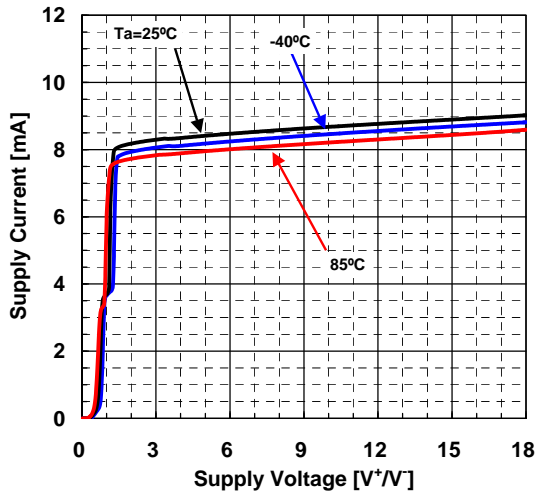
**SLEW RATE vs TEMPERATURE**

$V^+ / V^- = \pm 9V, V_{IN} = 2V_{P-P}, f = 100kHz$

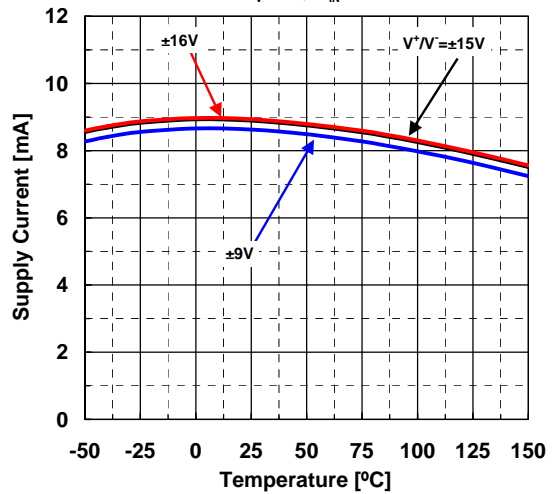
PulseEdge=10nsec, Gv=0dB,  $C_L = 10pF, R_L = 2kohm$



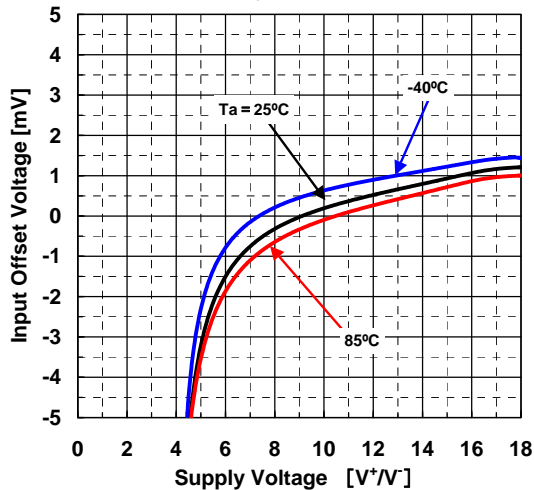
**SUPPLY CURRENT vs SUPPLY VOLTAGE**  
(TEMPERATURE)  
 $G_V=0\text{dB}$ ,  $V_{IN}=0\text{V}$



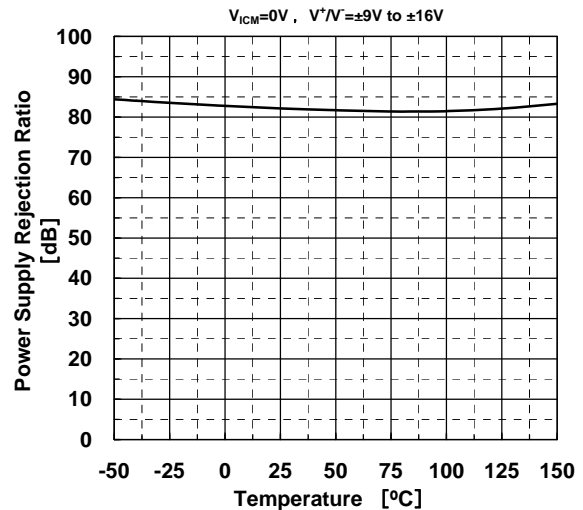
**SUPPLY CURRENT vs TEMPERATURE**  
(SUPPLY VOLTAGE)  
 $G_V=0\text{dB}$ ,  $V_{IN}=0\text{V}$



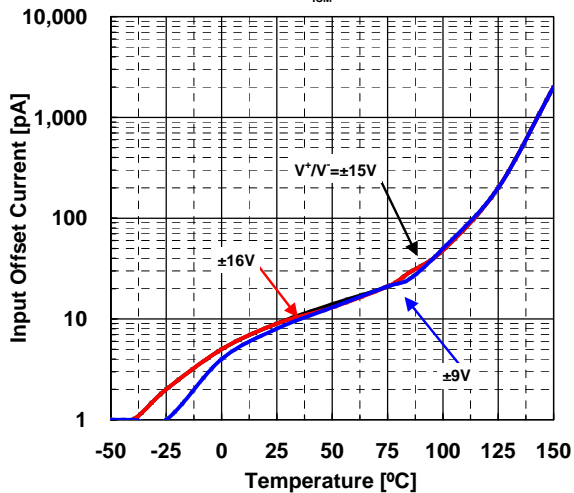
**INPUT OFFSET VOLTAGE vs SUPPLY VOLTAGE**  
(TEMPERATURE)  
 $V_{ICM}=0\text{V}$ ,  $V_{IN}=0\text{V}$



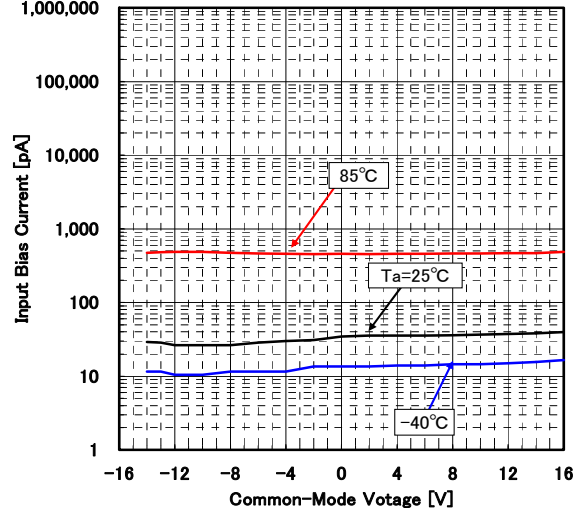
**POWER SUPPLY REJECTION RATIO vs TEMPERATURE**



**INPUT OFFSET CURRENT vs TEMPERATURE**  
(SUPPLY VOLTAGE)  
 $V_{ICM}=0\text{V}$

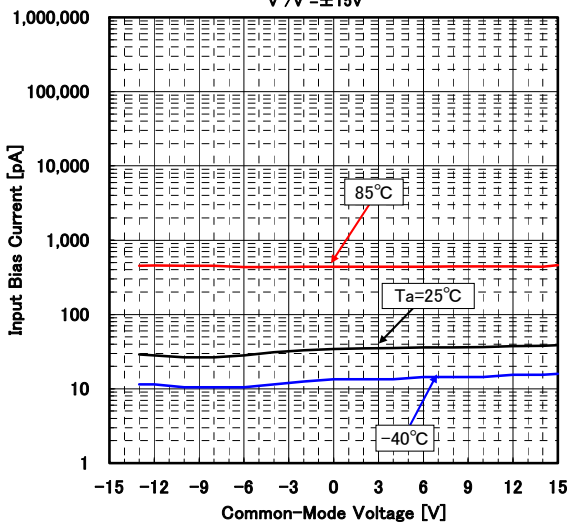


**INPUT BIAS CURRENT vs INPUT COMMON-MODE VOLTAGE**  
(TEMPERATURE)  
 $V/V=\pm 16\text{V}$

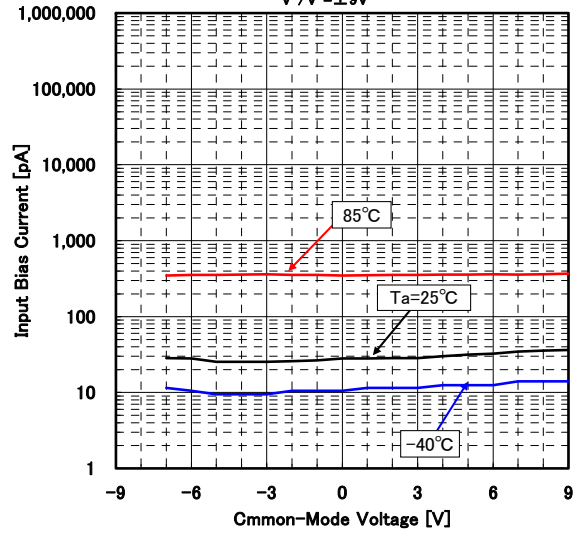




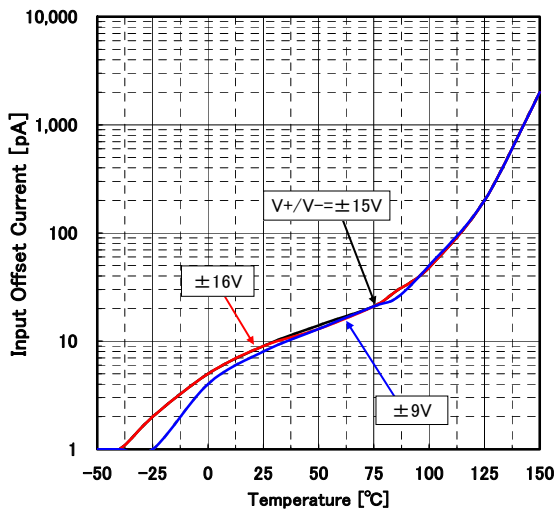
**INPUT BIAS CURRENT vs INPUT COMMON-MODE VOLTAGE (TEMPERATURE)**  
 $V^+/V^- = \pm 15V$



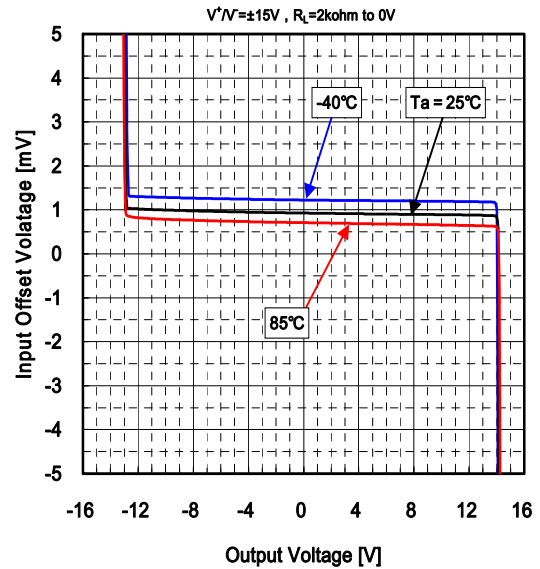
**INPUT BIAS CURRENT vs INPUT COMMON-MODE VOLTAGE (TEMPERATURE)**  
 $V^+/V^- = \pm 9V$



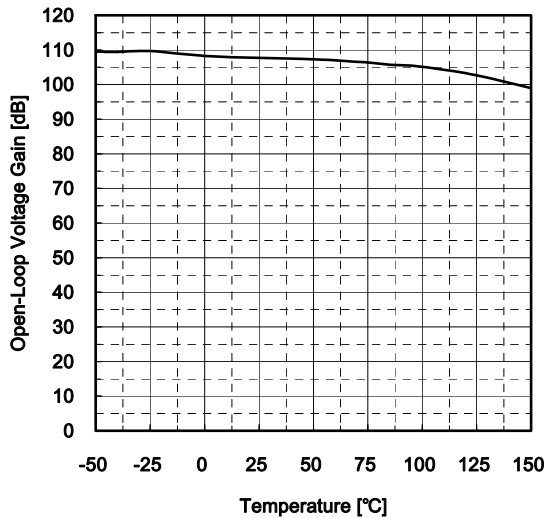
**INPUT OFFSET CURRENT vs TEMPERATURE (SUPPLY VOLTAGE)**  
 $V_{cm}=0V$



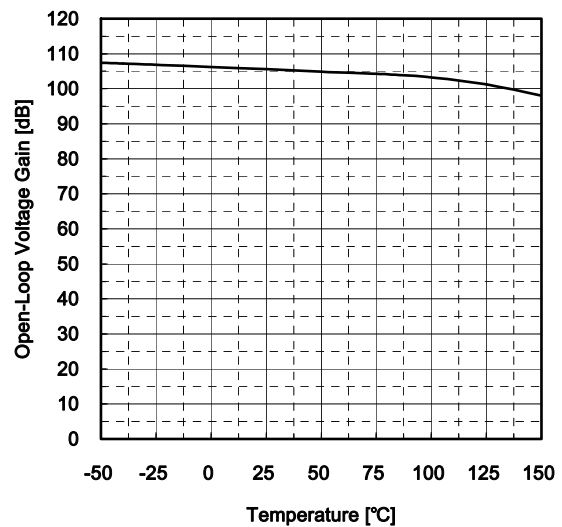
**INPUT OFFSET VOLTAGE vs OUTPUT VOLTAGE (TEMPERATURE)**



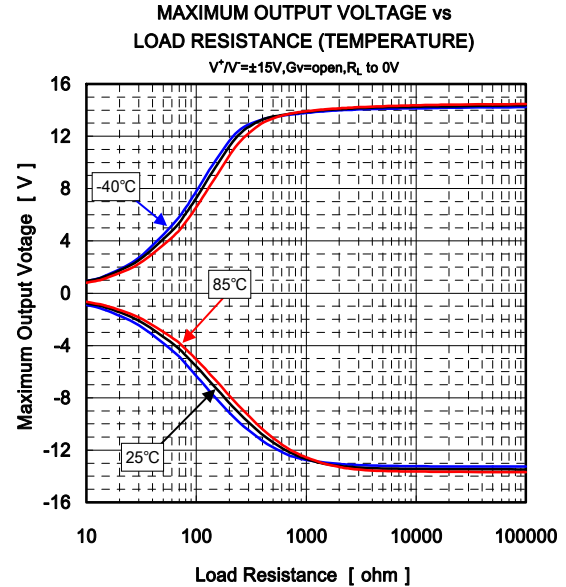
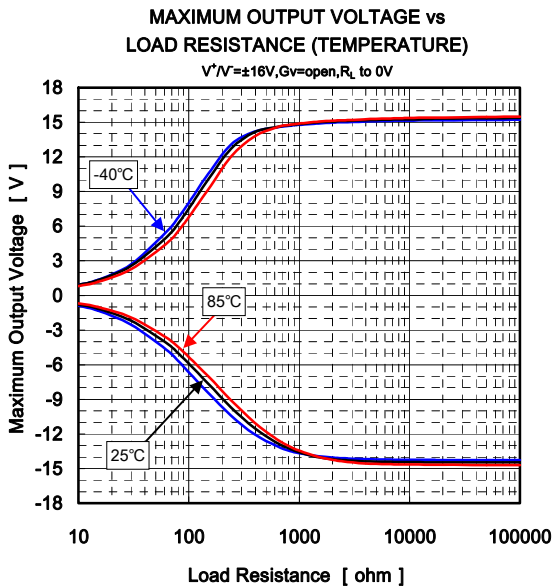
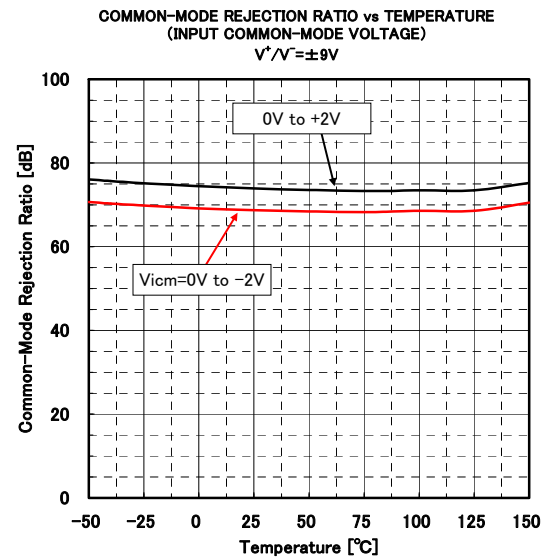
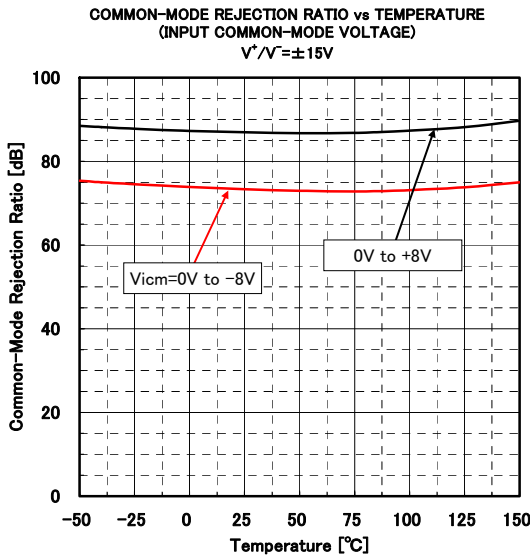
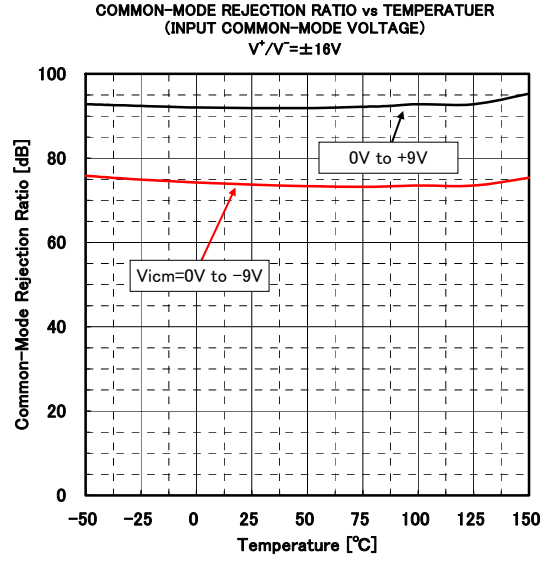
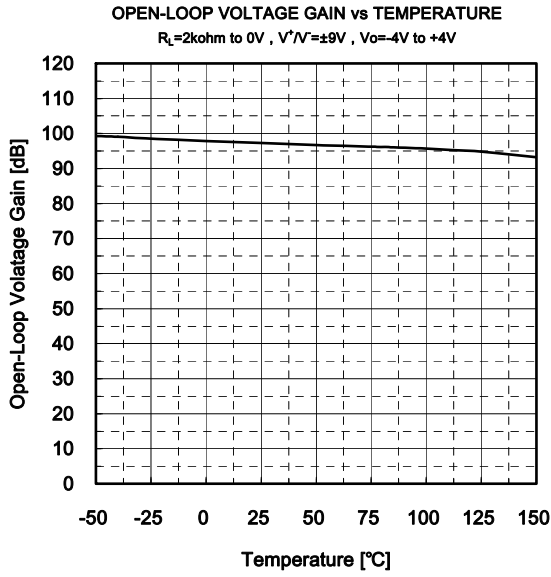
**OPEN-LOOP VOLTAGE GAIN vs TEMPERATURE**  
 $R_L=2k\Omega$  to  $0V$ ,  $V^+/V^- = \pm 16V$ ,  $V_o = -11V$  to  $+11V$

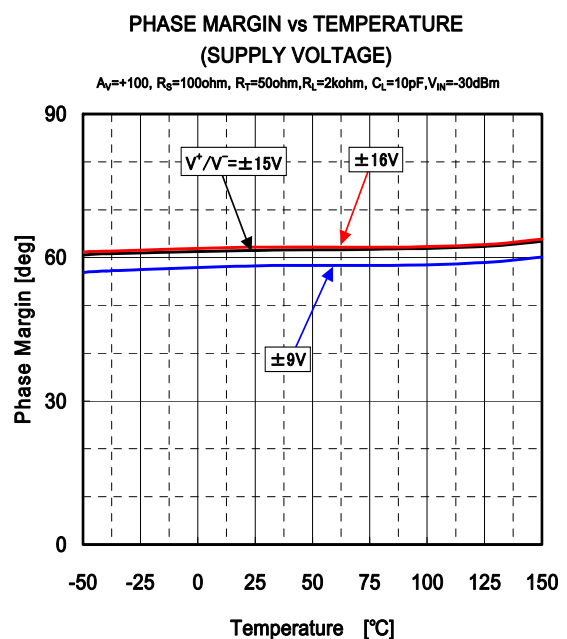
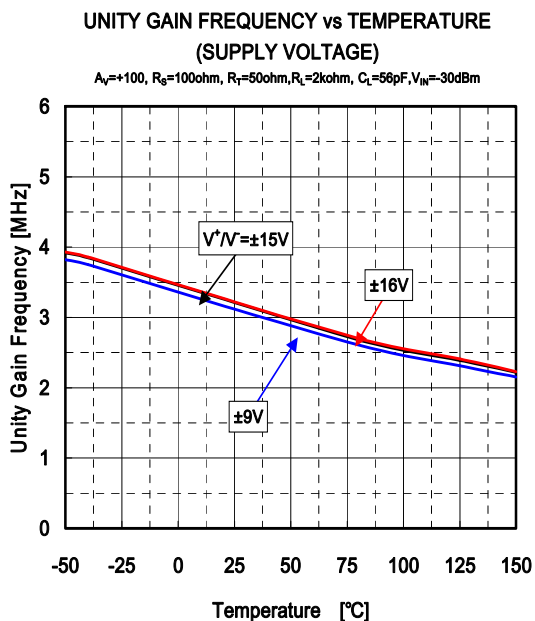
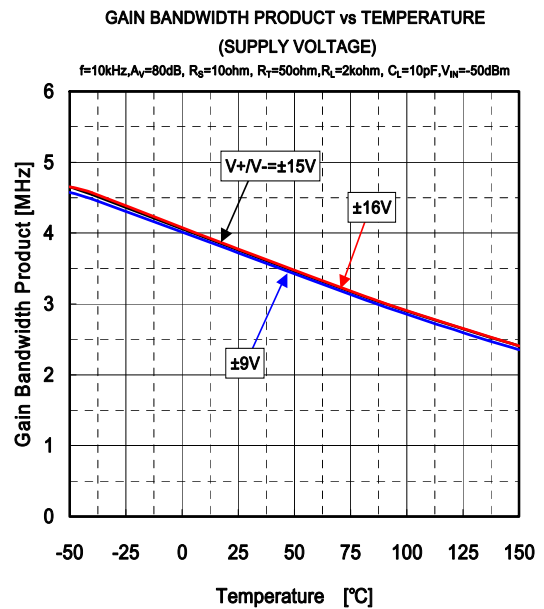
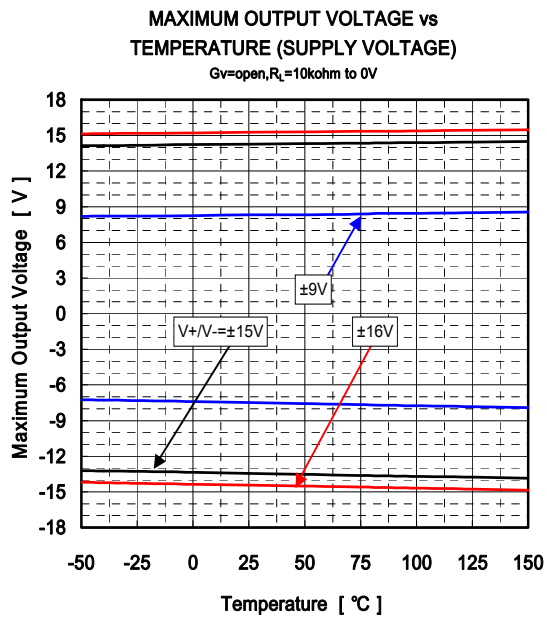
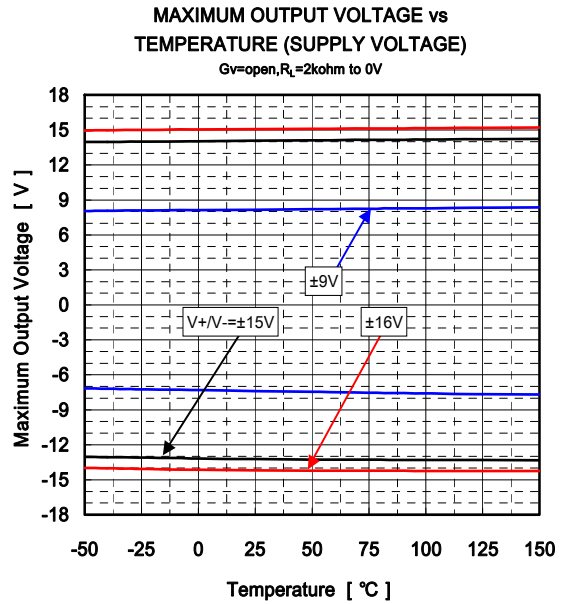
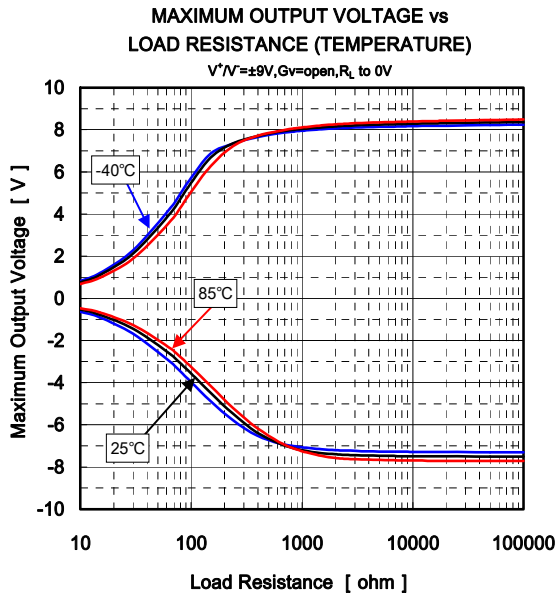


**OPEN-LOOP VOLTAGE GAIN vs TEMPERATURE**  
 $R_L=2k\Omega$  to  $0V$ ,  $V^+/V^- = \pm 15V$ ,  $V_o = -10V$  to  $+10V$



# MUSES01





## MEMO

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