



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

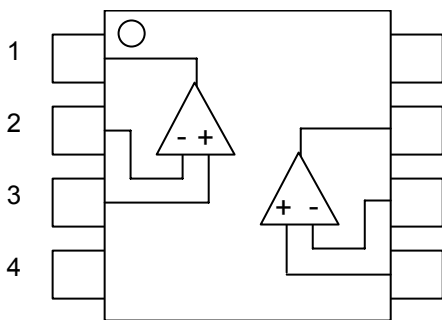
The **MUSES01** is a dual J-FET input high quality audio operational amplifier, which is optimized for high-end audio and professional audio applications with advanced circuitry and layout, unique material and assembled technology by skilled-craftwork.

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                             |

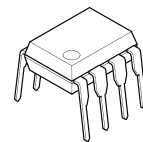
### ■ PIN CONFIGURATION



### 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



**MUSES01D**



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# MUSES01

## ■ ABSOLUTE MAXIMUM RATINGS (Ta=25°C)

PARAMETER	SYMBOL	RATING	UNIT
Supply Voltage	V <sup>+</sup> /V <sup>-</sup>	±18	V
Common Mode Input Voltage	V <sub>ICM</sub>	±15 (Note1)	V
Differential Input Voltage	V <sub>ID</sub>	±30	V
Power Dissipation	P <sub>D</sub>	910	mW
Output Current	I <sub>O</sub>	±25	mA
Operating Temperature Range	T <sub>opr</sub>	-40 to +85	°C
Storage Temperature Range	T <sub>stg</sub>	-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 <sup>+</sup> /V <sup>-</sup>	-	±9	-	±16	V

## ■ ELECTRIC CHARACTERISTICS

DC CHARACTERISTICS (V<sup>+</sup>/V<sup>-</sup>=±15V, Ta=25°C unless otherwise specified)

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Operating Current	I <sub>cc</sub>	No Signal, R <sub>L</sub> =∞	-	8.5	12.0	mA
Input Offset Voltage	V <sub>IO</sub>	R <sub>s</sub> ≤10kΩ (Note2, 3)	-	0.8	5.0	mV
Input Bias Current	I <sub>B</sub>	(Note2, 3)	-	200	800	pA
Input Offset Current	I <sub>IO</sub>	(Note2, 3)	-	100	400	pA
Voltage Gain	A <sub>V</sub>	R <sub>L</sub> ≥2kΩ, V <sub>o</sub> =±10V	90	105	-	dB
Common Mode Rejection Ratio	CMR	V <sub>ICM</sub> =±8V (Note4)	60	75	-	dB
Supply Voltage Rejection Ratio	SVR	V <sup>+</sup> /V <sup>-</sup> =±9.0 to ±16.0V (Note2, 5)	70	83	-	dB
Max Output Voltage 1	V <sub>OM1</sub>	R <sub>L</sub> =10kΩ	±12	±13.5	-	V
Max Output Voltage 2	V <sub>OM2</sub>	R <sub>L</sub> =2kΩ	±10	±12.5	-	V
Input Common Mode Voltage Range	V <sub>ICM</sub>	CMR≥60dB	±8	±9.5	-	V

(Note2) Measured at V<sub>ICM</sub>=0V

(Note3) Written by the absolute rate.

(Note4) CMR is calculated by specified change in offset voltage. (V<sub>ICM</sub>=0V to +8V and V<sub>ICM</sub>=0V to -8V)

(Note5) SVR is calculated by specified change in offset voltage. (V<sup>+</sup>/V<sup>-</sup>=±9V 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	$f=10kHz$	-	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.

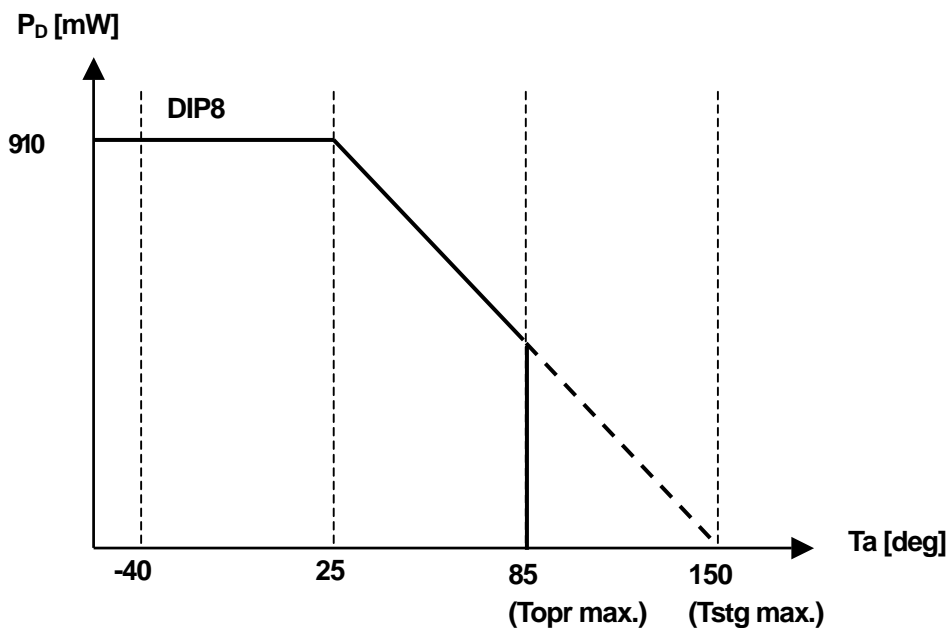
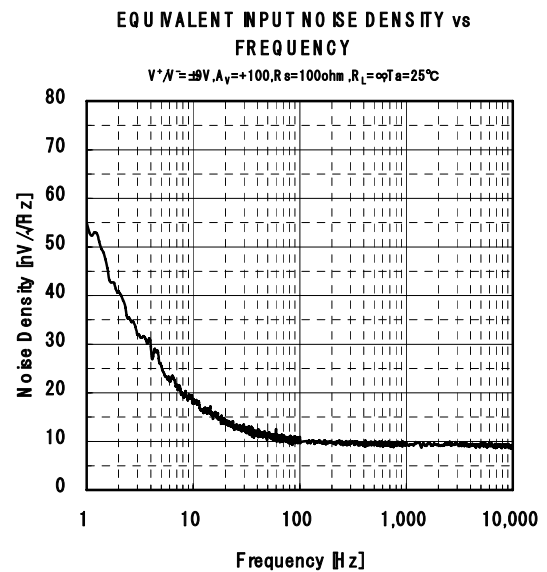
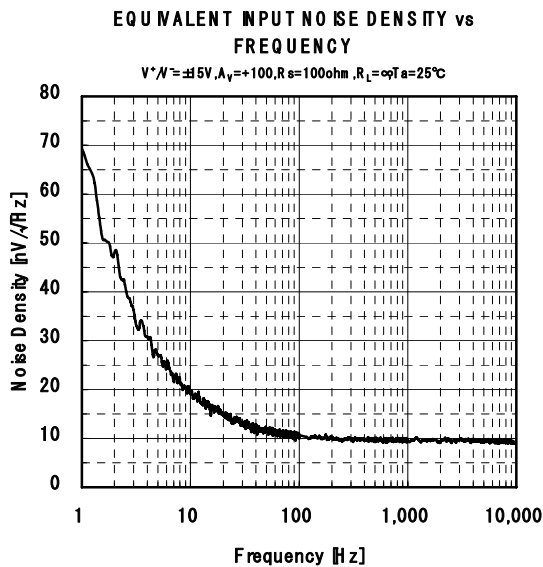
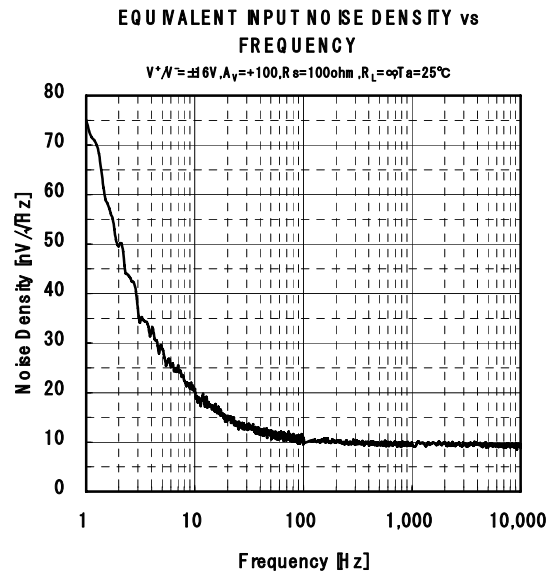
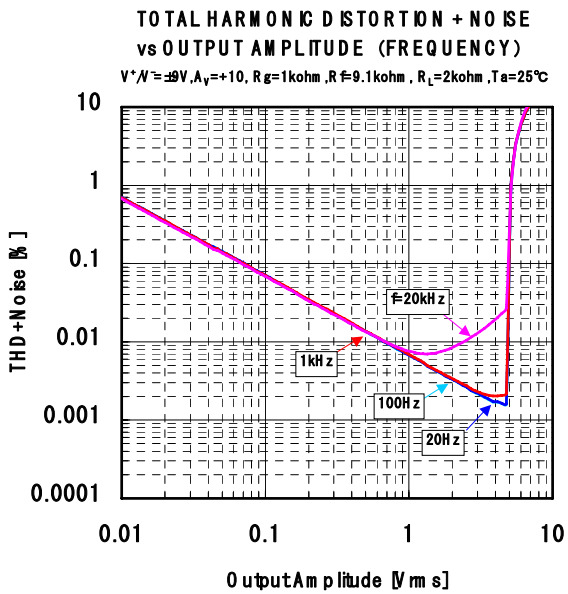
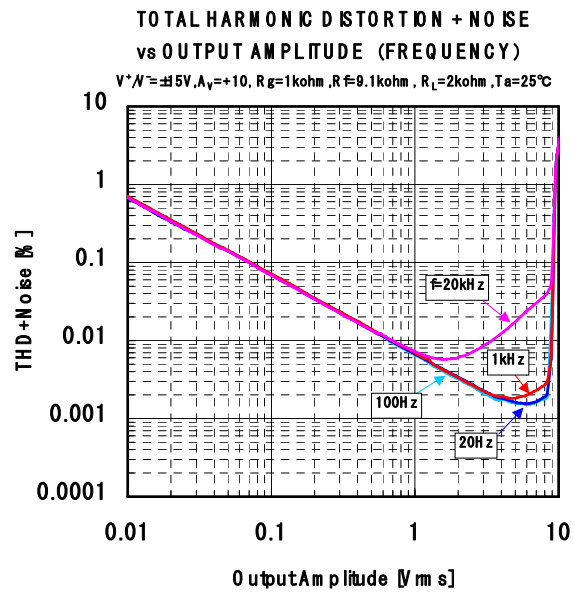
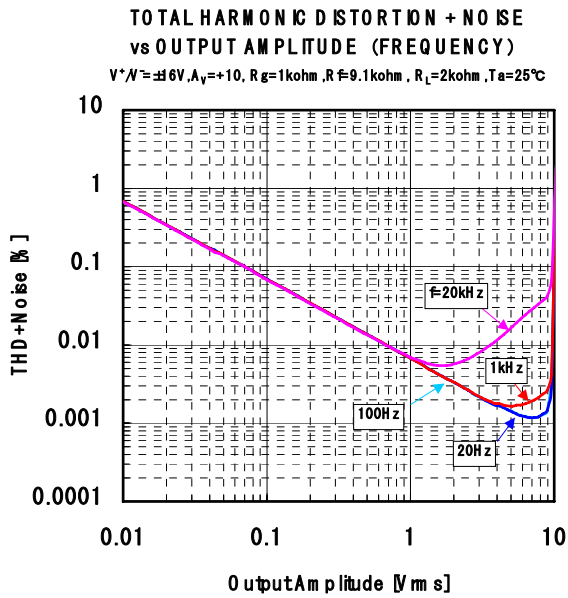
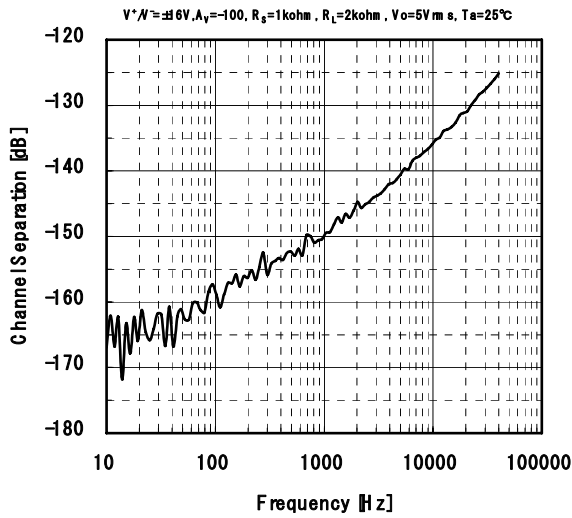


Fig.1 Power Dissipations vs. Ambient Temperature on the MUSES01

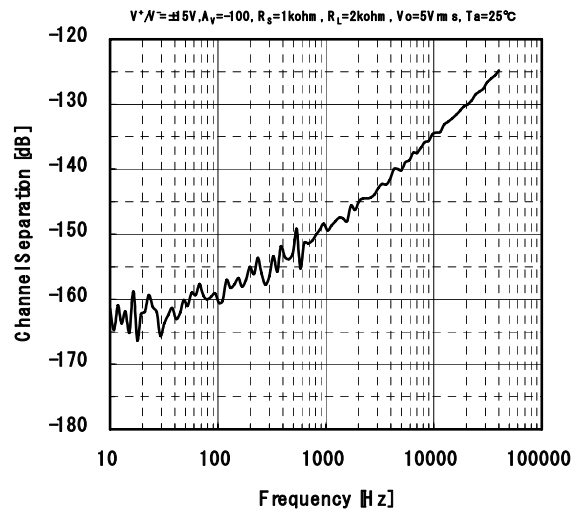
## ■ TYPICAL CHARACTERISTICS



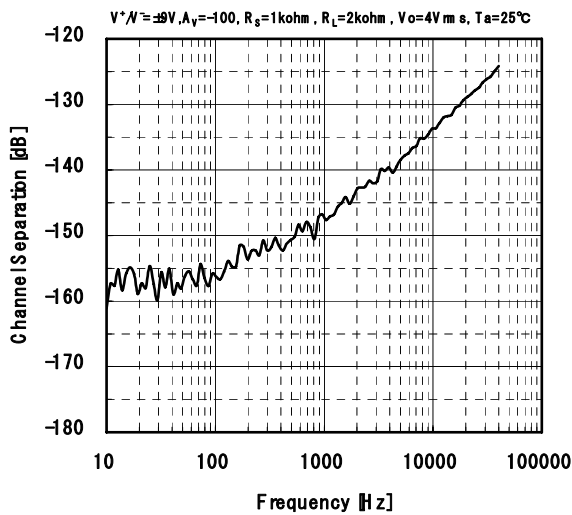
CHANNEL SEPARATION vs FREQUENCY



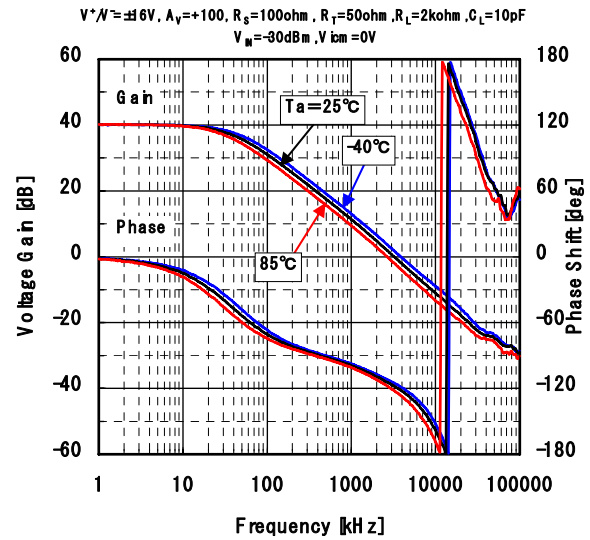
CHANNEL SEPARATION vs FREQUENCY



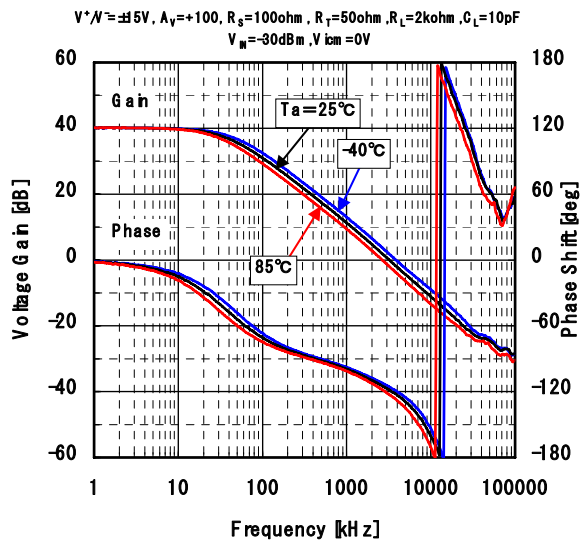
CHANNEL SEPARATION vs FREQUENCY



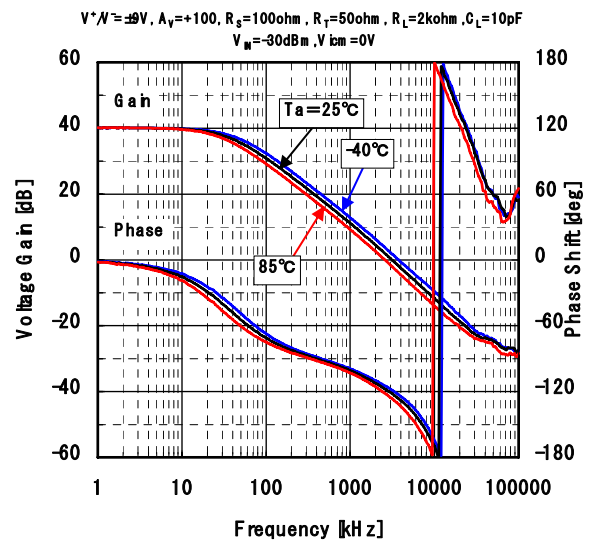
CLOSED-LOOP GAIN/PHASE vs FREQUENCY (TEMPERATURE)



CLOSED-LOOP GAIN/PHASE vs FREQUENCY (TEMPERATURE)

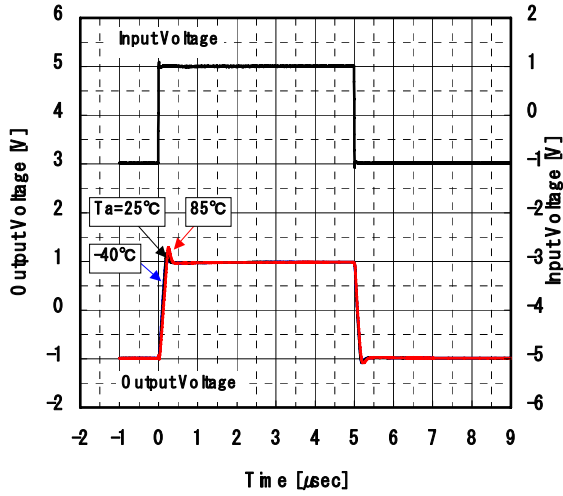


CLOSED LOOP GAIN/PHASE vs FREQUENCY (TEMPERATURE)



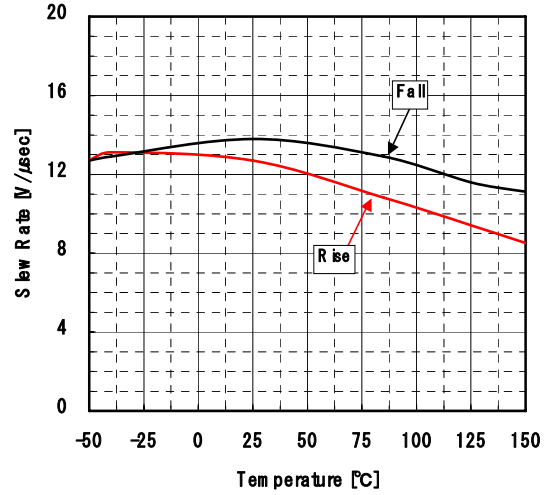
## TRANSIENT RESPONSE (TEMPERATURE)

$V^*N = \pm 6V, V_M = 2V_{P-P}, f = 100kHz$   
 PulseEdge=10nsec, Gv=0dB,  $C_L = 10pF, R_L = 2k\Omega$



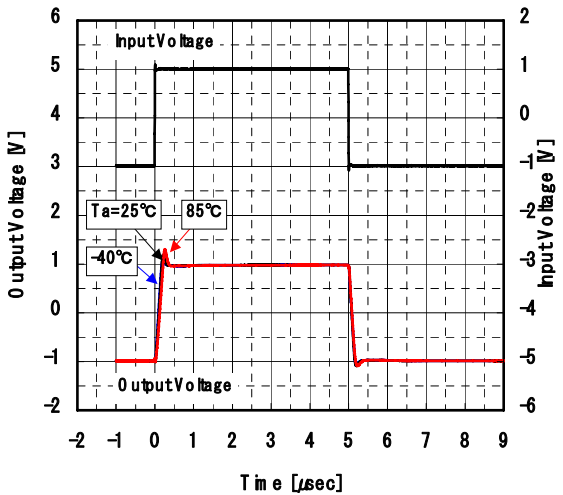
## SLEW RATE vs TEMPERATURE

$V^*N = \pm 6V, V_M = 2V_{P-P}, f = 100kHz$   
 PulseEdge=10nsec, Gv=0dB,  $C_L = 10pF, R_L = 2k\Omega$



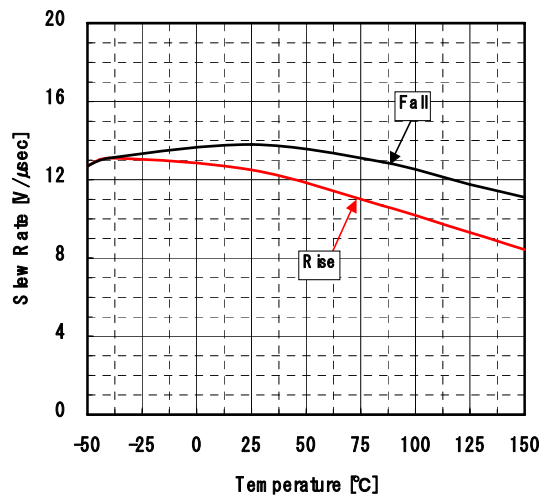
## TRANSIENT RESPONSE (TEMPERATURE)

$V^*N = \pm 5V, V_M = 2V_{P-P}, f = 100kHz$   
 PulseEdge=10nsec, Gv=0dB,  $C_L = 10pF, R_L = 2k\Omega$



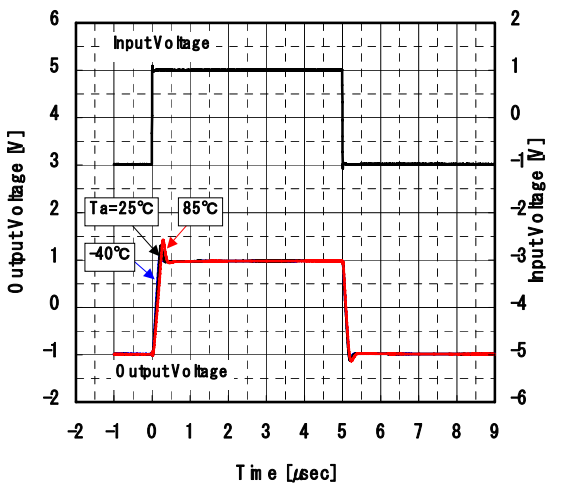
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$V^*N = \pm 5V, V_M = 2V_{P-P}, f = 100kHz$   
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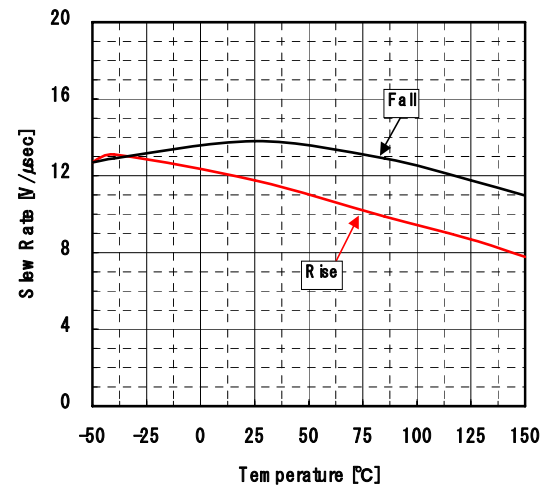
## TRANSIENT RESPONSE (TEMPERATURE)

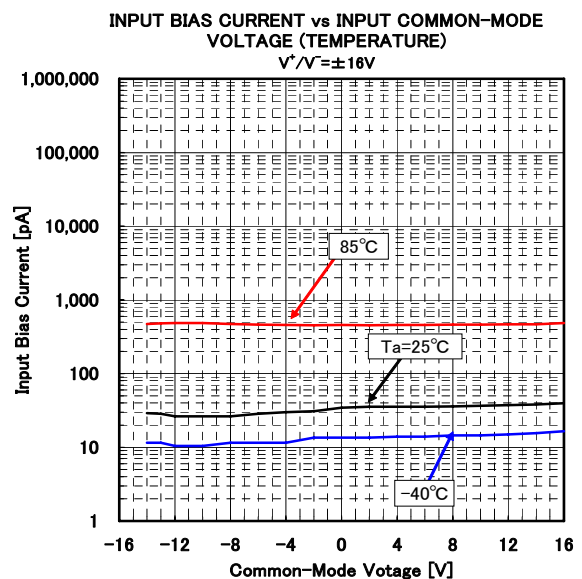
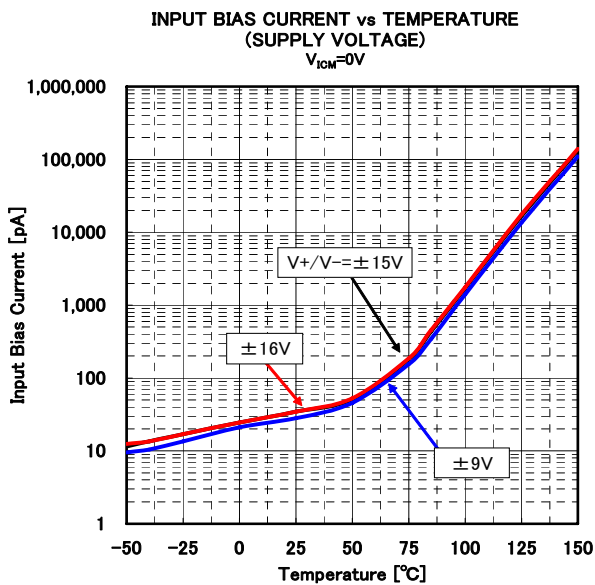
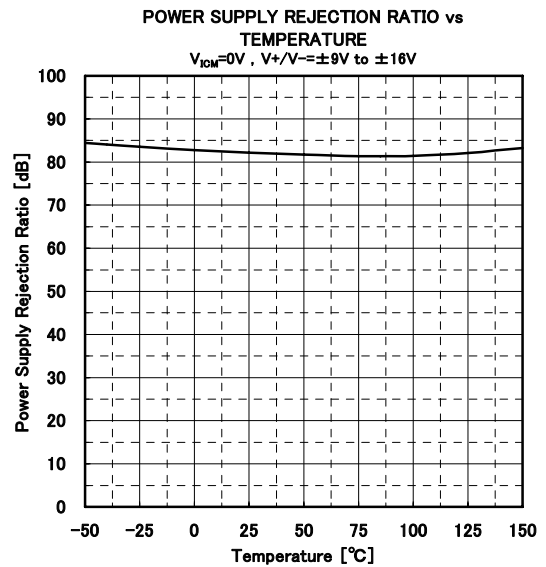
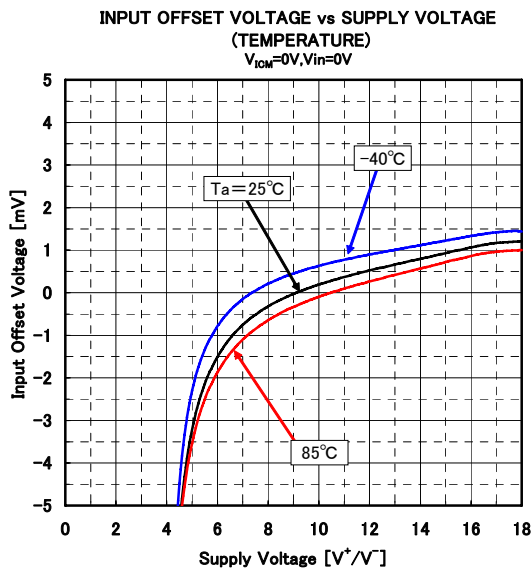
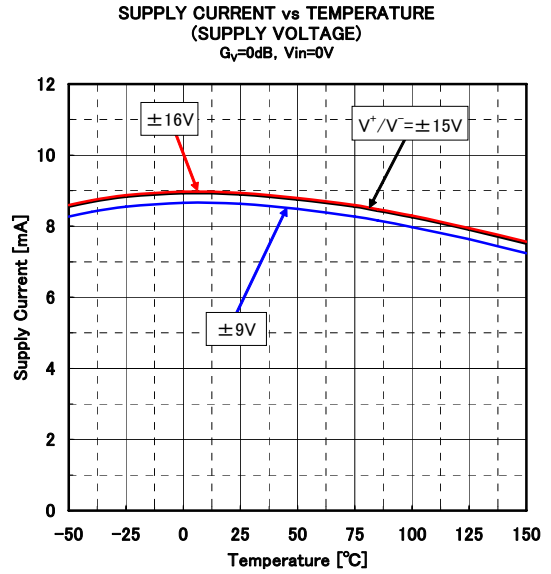
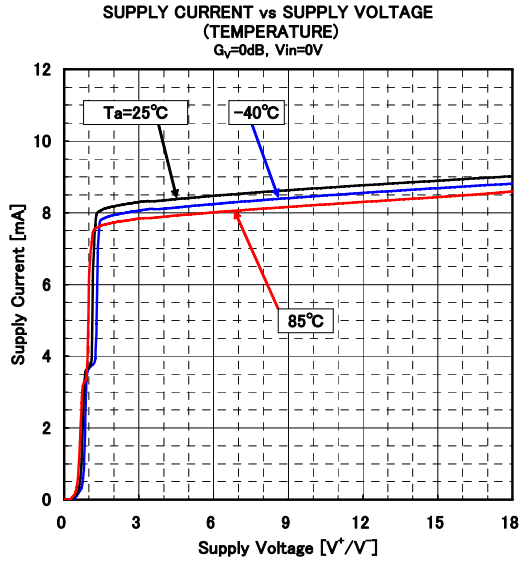
$V^*N = \pm 9V, V_M = 2V_{P-P}, f = 100kHz$   
 PulseEdge=10nsec, Gv=0dB,  $C_L = 10pF, R_L = 2k\Omega$



## SLEW RATE vs TEMPERATURE

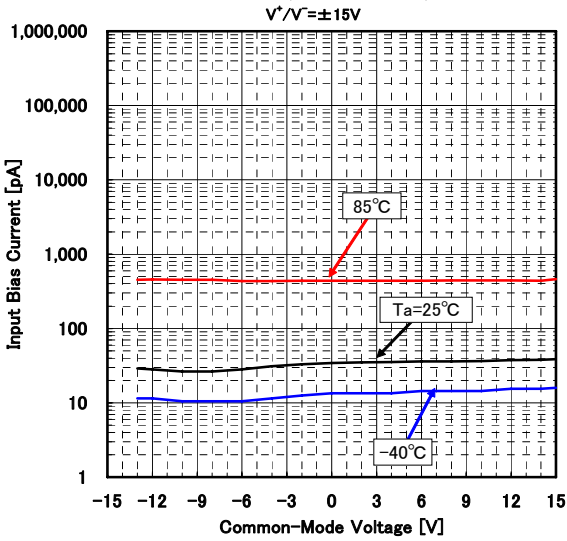
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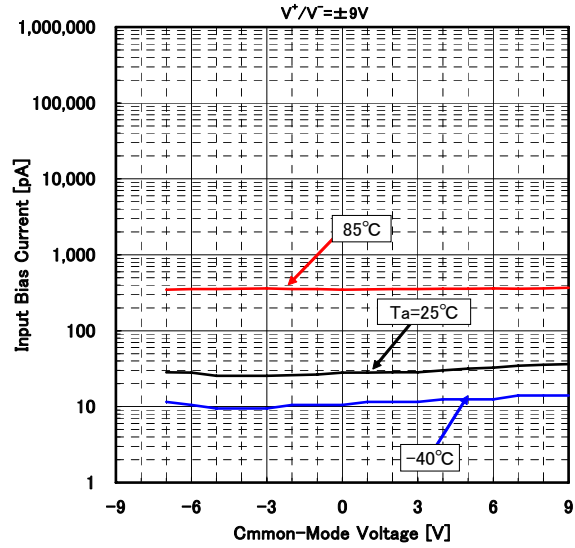




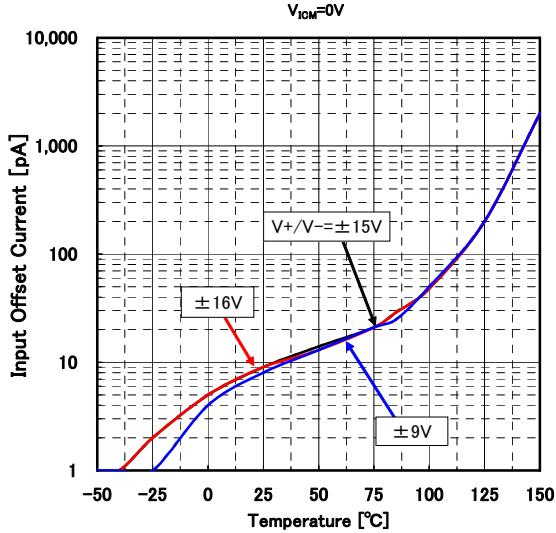
**INPUT BIAS CURRENT vs INPUT COMMON-MODE VOLTAGE (TEMPERATURE)**



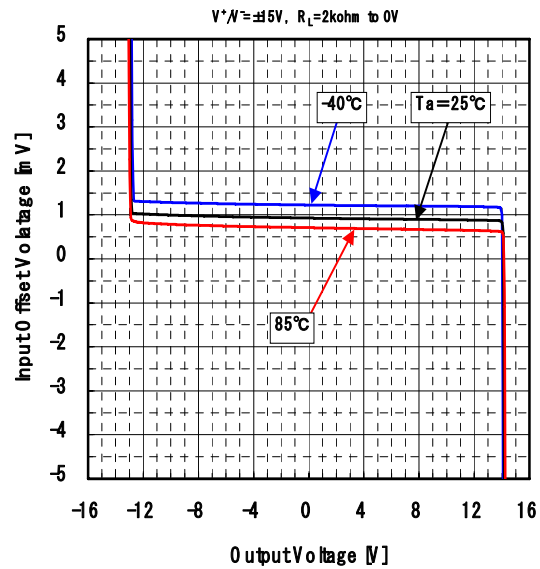
**INPUT BIAS CURRENT vs INPUT COMMON-MODE VOLTAGE (TEMPERATURE)**



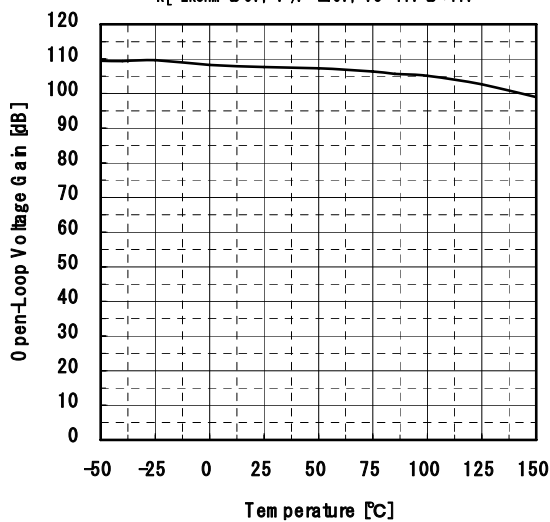
**INPUT OFFSET CURRENT vs TEMPERATURE (SUPPLY VOLTAGE)**



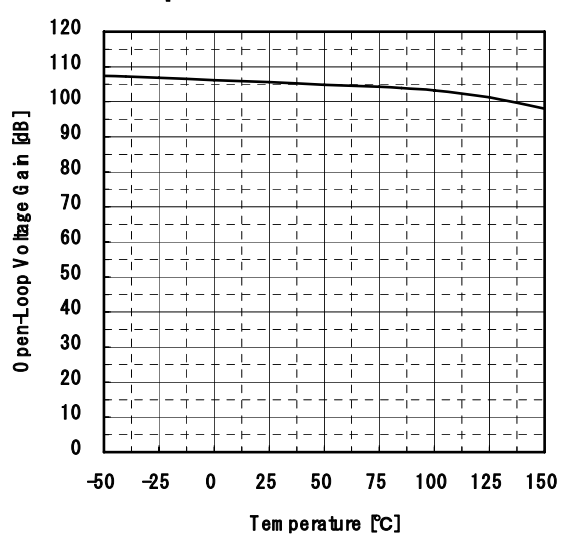
**INPUT OFFSET VOLTAGE vs OUTPUT VOLTAGE (TEMPERATURE)**



**OPEN-LOOP VOLTAGE GAIN vs TEMPERATURE**



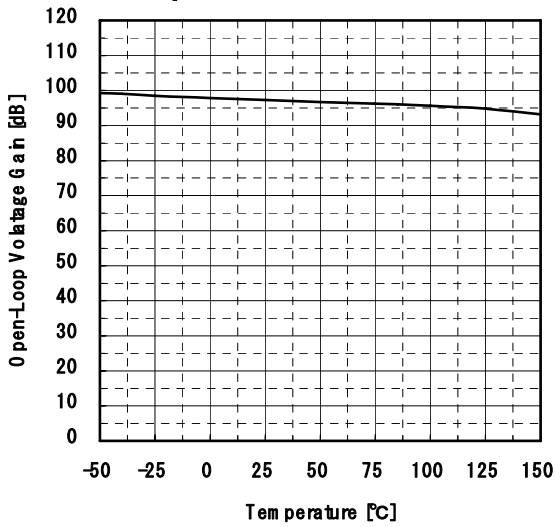
**OPEN-LOOP VOLTAGE GAIN vs TEMPERATURE**



# MUSES01

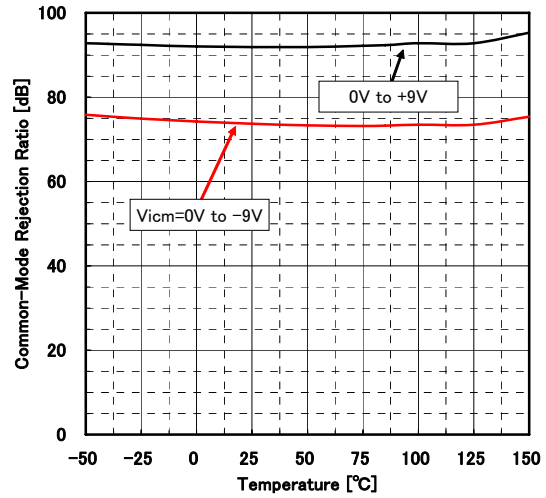
OPEN-LOOP VOLTAGE GAIN vs TEMPERATURE

$R_L = 2\text{k}\Omega$  to  $0V$ ,  $V^+ / V^- = \pm 9V$ ,  $V_o = -4V$  to  $+4V$



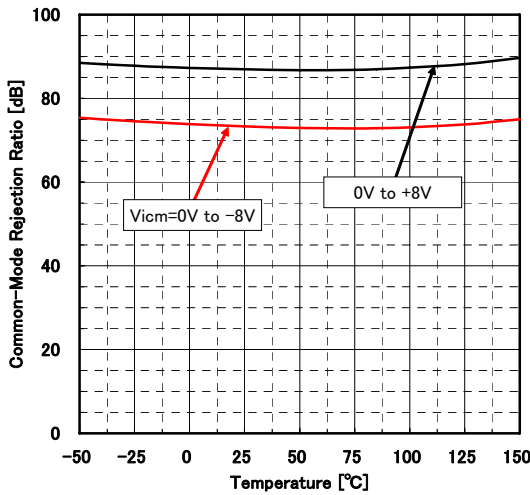
COMMON-MODE REJECTION RATIO vs TEMPERATURE (INPUT COMMON-MODE VOLTAGE)

$V^+ / V^- = \pm 16V$



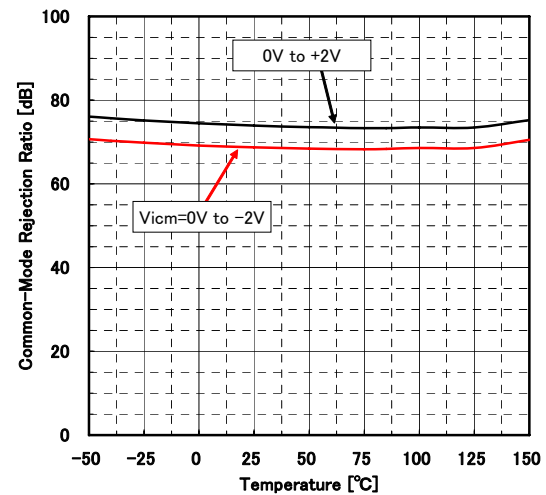
COMMON-MODE REJECTION RATIO vs TEMPERATURE (INPUT COMMON-MODE VOLTAGE)

$V^+ / V^- = \pm 15V$



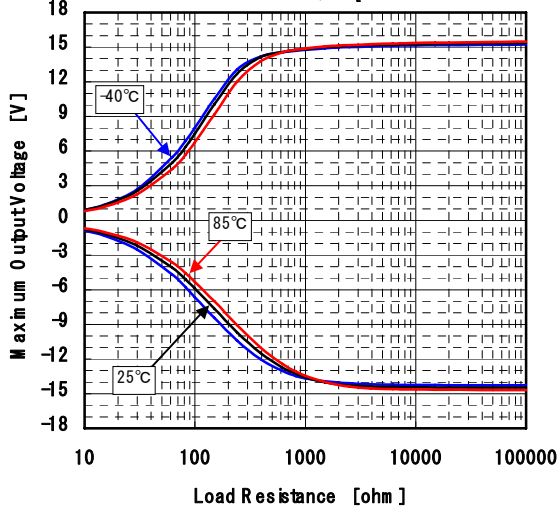
COMMON-MODE REJECTION RATIO vs TEMPERATURE (INPUT COMMON-MODE VOLTAGE)

$V^+ / V^- = \pm 9V$



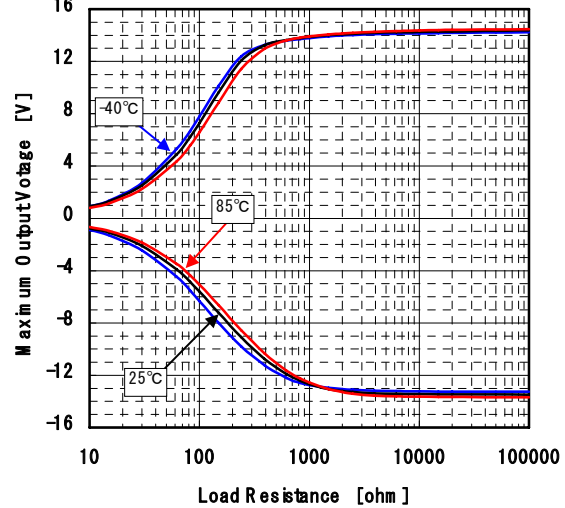
MAXIMUM OUTPUT VOLTAGE vs LOAD RESISTANCE (TEMPERATURE)

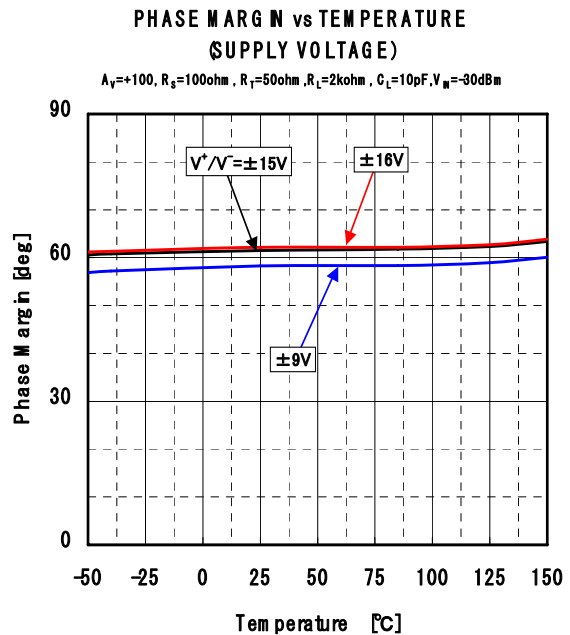
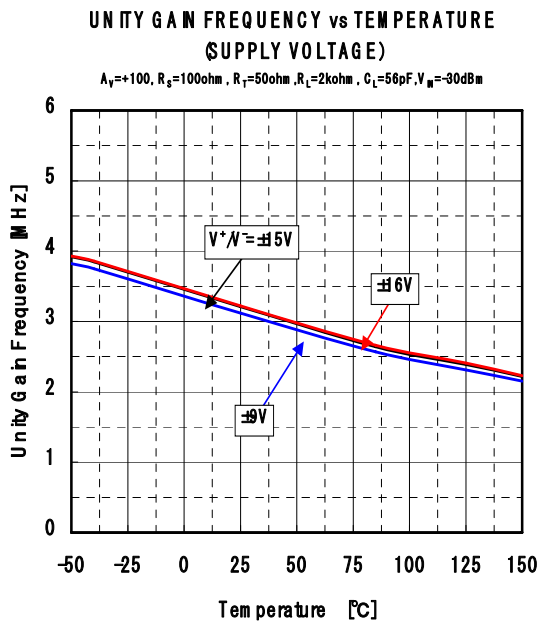
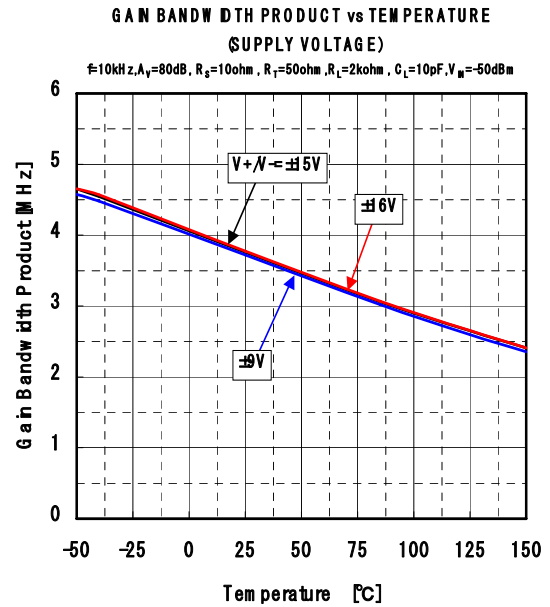
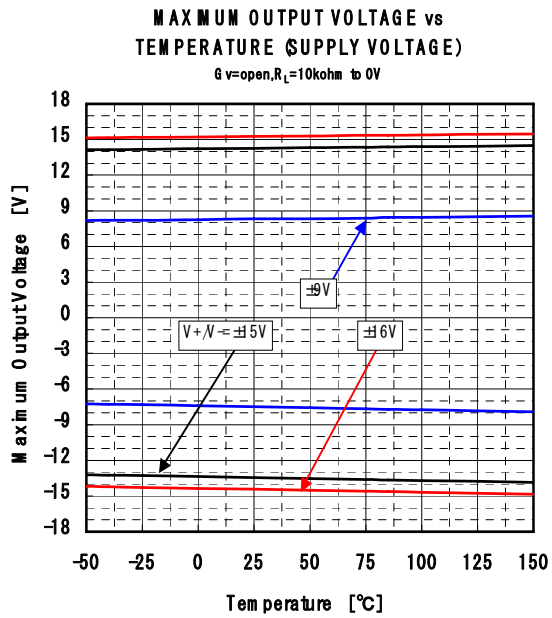
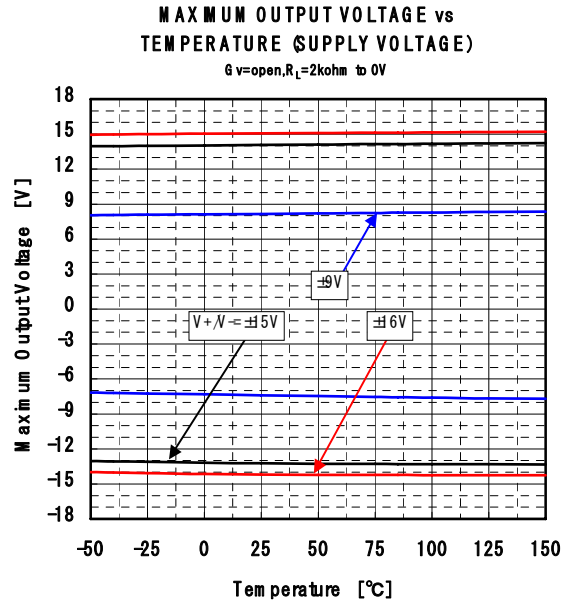
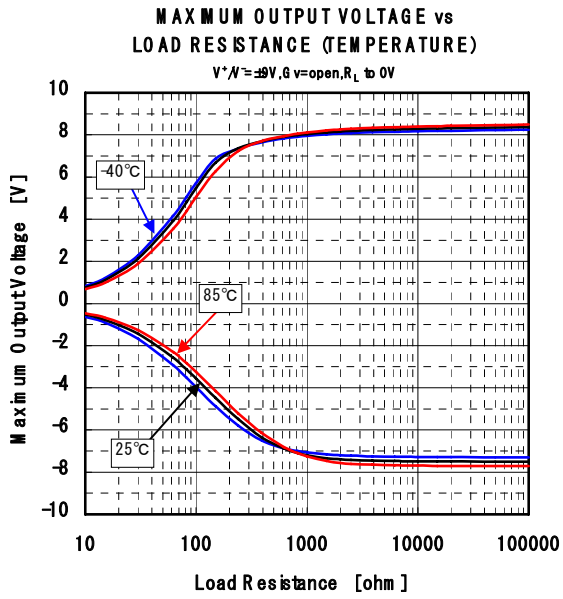
$V^+ / V^- = \pm 6V$ ,  $v = \text{open}$ ,  $R_L$  to  $0V$



MAXIMUM OUTPUT VOLTAGE vs LOAD RESISTANCE (TEMPERATURE)

$V^+ / V^- = \pm 5V$ ,  $v = \text{open}$ ,  $R_L$  to  $0V$





## MEMO

**[CAUTION]**

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