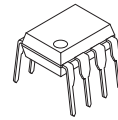


## LOW VOLTAGE OPERATION LOW OFFSET VOLTAGE DUAL C-MOS OPERATIONAL AMPLIFIER

### ■ GENERAL DESCRIPTION

The NJU7094, 95 and 96 are single supply dual C-MOS operational amplifiers featuring a low operating voltage from 1V, low operating current of 15 $\mu$ A/circuit (7094 typ.), 80 $\mu$ A/circuit (7095 typ.), 200 $\mu$ A/circuit (7096 typ.) and low offset voltage 2mV (max.). They also have a low input bias current of 1pA (typ.) and input voltage range from ground, which can provide a ground sensing, and rail-to-rail output swing in both rails. The NJU7094, 7095 and 7096 are available in a wide variety of 8-lead packages, dual-in-line DIP8, surface-mount SOP8 (DMP8), SSOP8, MSOP8 (VSP8), MSOP8 (TVSP8). The combination of these features makes them ideal for a variety of portable devices.

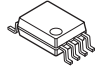
### ■ PACKAGE OUTLINE



NJU709XD  
(DIP8)



NJU709XM  
(DMP8)



NJU709XV  
(SSOP8)



NJU709XR  
(MSOP8 (VSP8))

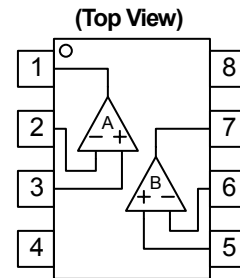


NJU709XRB1  
(MSOP8 (TVSP8))

### ■ FEATURES

- Single-Power-Supply
- Low Offset Voltage ( $V_{IO}=4\text{mV max}$ )
- Wide Operating Voltage ( $V_{DD}=1 \text{ to } 5.5\text{V}$ )
- Wide Output Swing Range ( $V_{OM}=2.9\text{V min. @ } 3.0\text{V}$ )
- Low Operating Current
- Low Bias Current ( $I_{IB}=1\text{pA typ.}$ )
- Compensation Capacitor Incorporated
- Package Outline  
DIP8, DMP8, SSOP8  
MSOP8 (VSP8) MEET JEDEC MO-187-DA  
MSOP8 (TVSP8) MEET JEDEC MO-187-DA/THIN TYPE

### ■ PIN CONFIGURATION



- 1: OUT 1
- 2: IN -1
- 3: IN +1
- 4: VSS
- 5: IN +2
- 6: IN -2
- 7: OUT 2
- 8: VDD

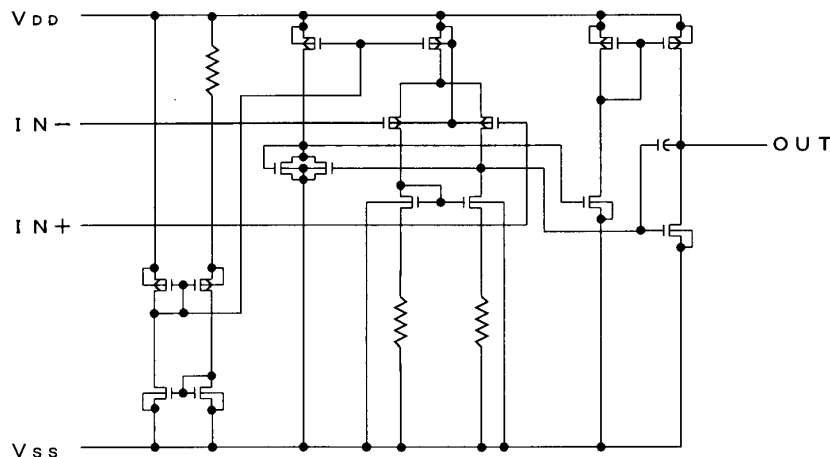
- C-MOS Technology

### ■ LINE-UP

( $T_a=25^\circ\text{C}, V_{DD}=3.0\text{V}, \text{Per Circuit}$ )

PARAMETER	NJU7094	NJU7095	NJU7096	UNIT
Operating Current	15	80	200	$\mu\text{A}$ (typ)
Slew Rate	0.1	1.0	2.4	$\text{V}/\mu\text{s}$ (typ)
Unity Gain Bandwidth	0.2	1.0	1.0	$\text{MHz}$ (typ)

### ■ EQUIVALENT CIRCUIT



# NJU7094/95/96

## ■ ABSOLUTE MAXIMUM RATINGS

( Ta=25°C )

PARAMETER	SYMBOL	RATINGS	UNIT
Supply Voltage	V <sub>DD</sub>	7	V
Differential Input Voltage	V <sub>ID</sub>	± 7 ( note1 )	V
Common Mode Input Voltage	V <sub>IC</sub>	-0.3~7	V
Power Dissipation	P <sub>D</sub>	( DIP8 ) 500 ( DMP8 ) 300 ( SSOP8 ) 250 ( MSOP8 (VSP8) ) 320 ( MSOP8 (TVSP8) ) 320	mW
Operating Temperature Range	T <sub>opr</sub>	-40~+85	°C
Storage Temperature Range	T <sub>stg</sub>	-55~+125	°C

( note1 ) If the supply voltage ( V<sub>DD</sub> ) is less than 7V, the input voltage must not over the V<sub>DD</sub> level though 7V is limit specified.

( note2 ) Decoupling capacitor should be connected between V<sub>DD</sub> and V<sub>SS</sub> for the stable operation.

## ■ ELECTRICAL CHARACTERISTICS

### NJU7094

( Ta=25°C, V<sub>DD</sub>=3.0V, R<sub>L</sub>=∞ )

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Input Offset Voltage	V <sub>IO</sub>	V <sub>IN</sub> =1/2V <sub>DD</sub>	-	-	4	mV
Input Offset Current	I <sub>IO</sub>		-	1	-	pA
Input Bias Current	I <sub>IB</sub>		-	1	-	pA
Input Impedance	R <sub>IN</sub>		-	1	-	TΩ
Large Signal Voltage Gain	A <sub>VD</sub>		60	70	-	dB
Input Common Mode Voltage Range	V <sub>ICM</sub>		0~2.5	-	-	V
Maximum Output Swing Voltage	V <sub>OM1</sub>	R <sub>L</sub> =1MΩ	V <sub>DD</sub> -0.1	-	-	V
	V <sub>OM2</sub>	R <sub>L</sub> =1MΩ	-	-	V <sub>SS</sub> +0.1	V
Common Mode Rejection Ratio	CMR	V <sub>IN</sub> =1/2V <sub>DD</sub>	55	65	-	dB
Supply Voltage Rejection Ratio	SVR	V <sub>DD</sub> =1.5~5.5V	60	70	-	dB
Operating Current	I <sub>DD</sub>	Per Circuit	-	15	25	μA
Slew Rate	SR		-	0.1	-	V/μs
Unity Gain Bandwidth	F <sub>t</sub>	A <sub>v</sub> =40dB, C <sub>L</sub> =10pF	-	0.2	-	MHz

( note3 ) The source current is less than 2.9μA ( at V<sub>OM</sub>/R<sub>L</sub>=2.9V/1MΩ ).

## NJU7095

( Ta=25°C, V<sub>DD</sub>=3.0V, R<sub>L</sub>=∞ )

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Input Offset Voltage	V <sub>IO</sub>	V <sub>IN</sub> =1/2V <sub>DD</sub>	-	-	4	mV
Input Offset Current	I <sub>IO</sub>		-	1	-	pA
Input Bias Current	I <sub>IB</sub>		-	1	-	pA
Input Impedance	R <sub>IN</sub>		-	1	-	TΩ
Large Signal Voltage Gain	A <sub>VD</sub>		60	70	-	dB
Input Common Mode Voltage Range	V <sub>ICM</sub>		0~2.5	-	-	V
Maximum Output Swing Voltage	V <sub>OM1</sub>	R <sub>L</sub> =100kΩ	V <sub>DD</sub> -0.1	-	-	V
	V <sub>OM2</sub>	R <sub>L</sub> =100kΩ	-	-	V <sub>SS</sub> +0.1	V
Common Mode Rejection Ratio	CMR	V <sub>IN</sub> =1/2V <sub>DD</sub>	55	65	-	dB
Supply Voltage Rejection Ratio	SVR	V <sub>DD</sub> =1.5~5.5V	60	70	-	dB
Operating Current	I <sub>DD</sub>	Per Circuit	-	80	160	μA
Slew Rate	SR		-	1.0	-	V/μs
Unity Gain Bandwidth	F <sub>t</sub>	A <sub>v</sub> =40dB, C <sub>L</sub> =10pF	-	1.0	-	MHz

( note4 ) The source current is less than 29μA ( at V<sub>OM</sub>/R<sub>L</sub>=2.9V/100kΩ ).

## NJU7096

( Ta=25°C, V<sub>DD</sub>=3.0V, R<sub>L</sub>=∞ )

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Input Offset Voltage	V <sub>IO</sub>	V <sub>IN</sub> =1/2V <sub>DD</sub>	-	-	4	mV
Input Offset Current	I <sub>IO</sub>		-	1	-	pA
Input Bias Current	I <sub>IB</sub>		-	1	-	pA
Input Impedance	R <sub>IN</sub>		-	1	-	TΩ
Large Signal Voltage Gain	A <sub>VD</sub>		60	70	-	dB
Input Common Mode Voltage Range	V <sub>ICM</sub>		0~2.5	-	-	V
Maximum Output Swing Voltage	V <sub>OM1</sub>	R <sub>L</sub> =50kΩ	V <sub>DD</sub> -0.1	-	-	V
	V <sub>OM2</sub>	R <sub>L</sub> =50kΩ	-	-	V <sub>SS</sub> +0.1	V
Common Mode Rejection Ratio	CMR	V <sub>IN</sub> =1/2V <sub>DD</sub>	55	65	-	dB
Supply Voltage Rejection Ratio	SVR	V <sub>DD</sub> =1.5~5.5V	60	70	-	dB
Operating Current	I <sub>DD</sub>	Per Circuit	-	200	400	μA
Slew Rate	SR		-	2.4	-	V/μs
Unity Gain Bandwidth	F <sub>t</sub>	A <sub>v</sub> =40dB, C <sub>L</sub> =10pF	-	1.0	-	MHz

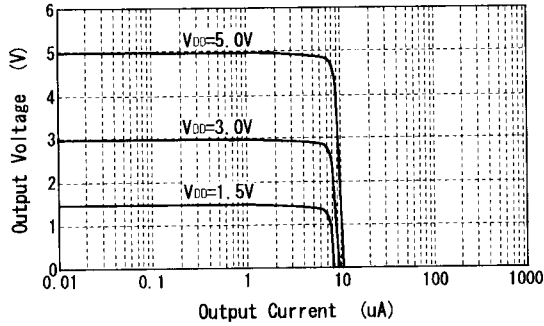
( note5 ) The source current is less than 58μA ( at V<sub>OM</sub>/R<sub>L</sub>=2.9V/50kΩ ).

# NJU7094/95/96

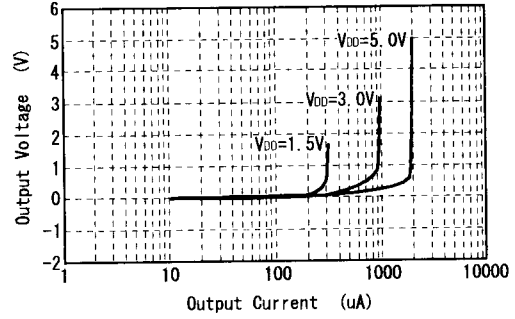
## ■ TYPICAL CHARACTERISTICS

(1) NJU7094

Output Voltage vs. Output Current (SOURCE)

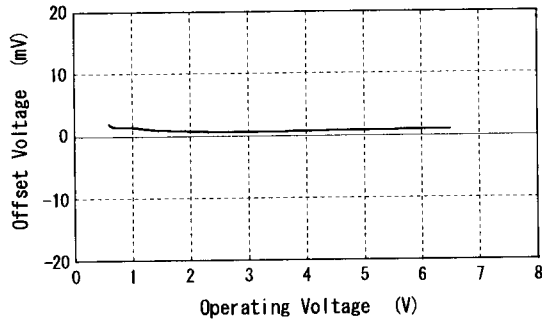


Output Voltage vs. Output Current (SINK)



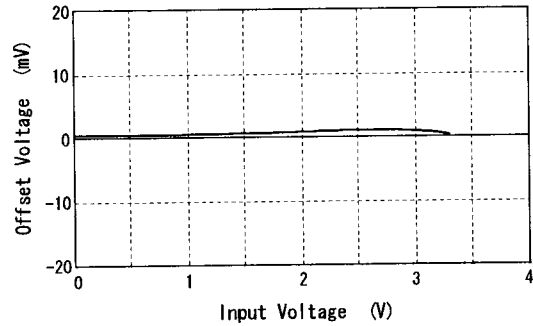
Offset Voltage vs. Operating Voltage

V<sub>IN</sub>=0.1V



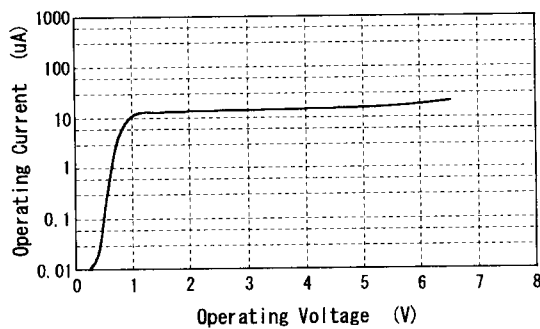
Offset Voltage vs. Input Voltage

V<sub>DD</sub>=3.0V



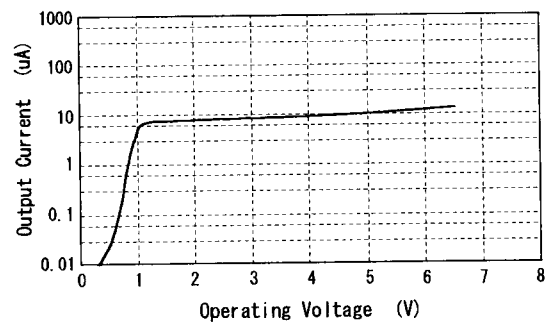
Operating Current vs. Operating Voltage

V<sub>IN</sub>=0.1V

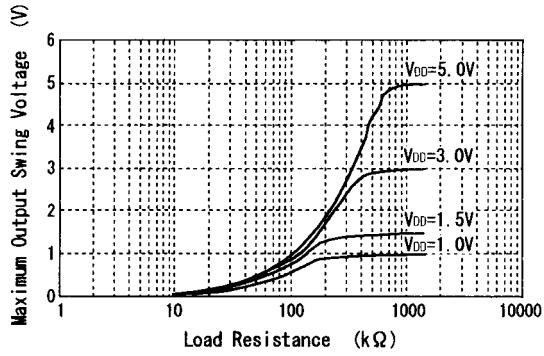


Output Current vs. Operating Voltage

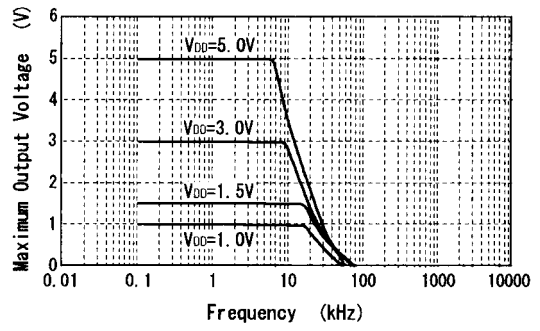
V<sub>IN</sub>=0.1V



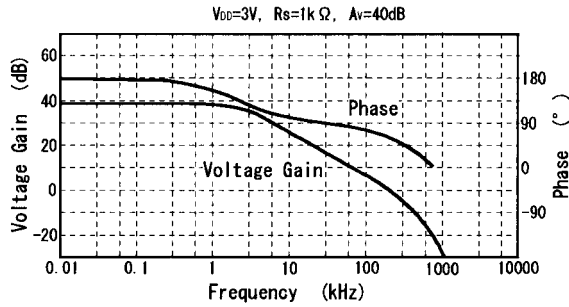
Maximum Output Swing Voltage vs. Load Resistance



Maximum Output Swing Voltage vs. Frequency

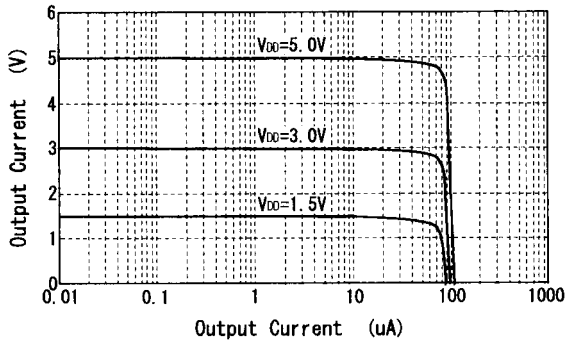


Voltage Gain-Phase vs. Frequency

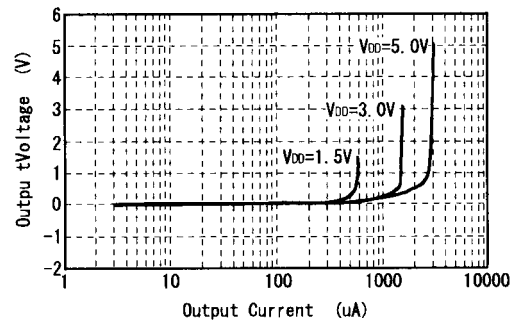


(2) NJU7095

Output Voltage vs. Output Current (SOURCE)

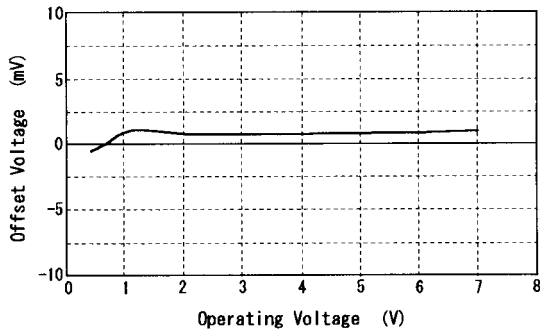


Output Voltage vs. Output Current (SINK)



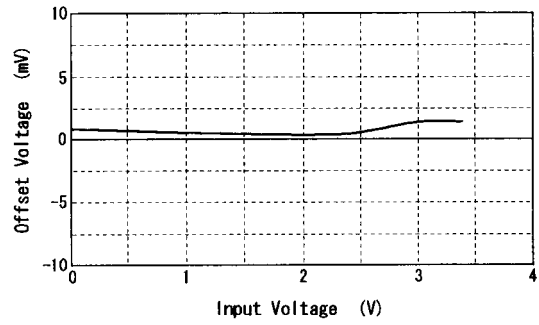
Offset Voltage vs. Operating Voltage

V<sub>IN</sub>=0.1V



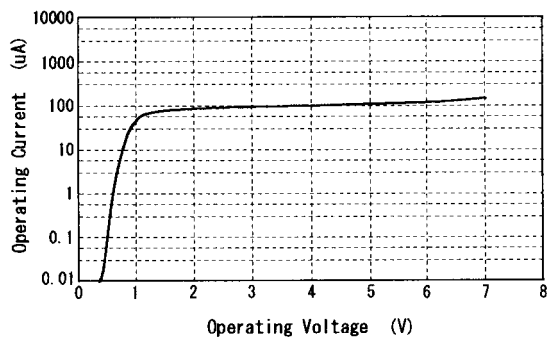
Offset Voltage vs. Input Voltage

V<sub>DD</sub>=3.0V



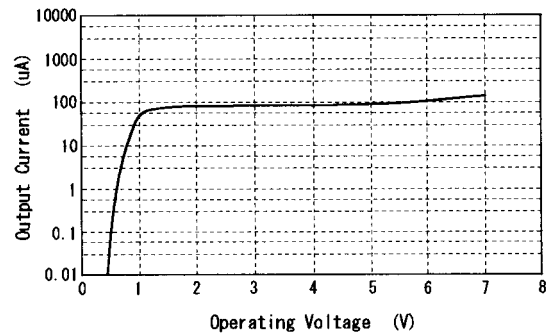
Operating Current vs. Operating Voltage

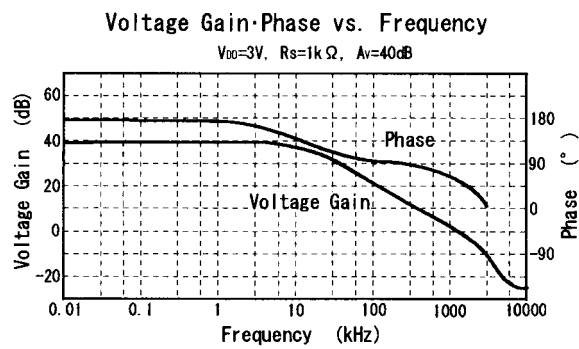
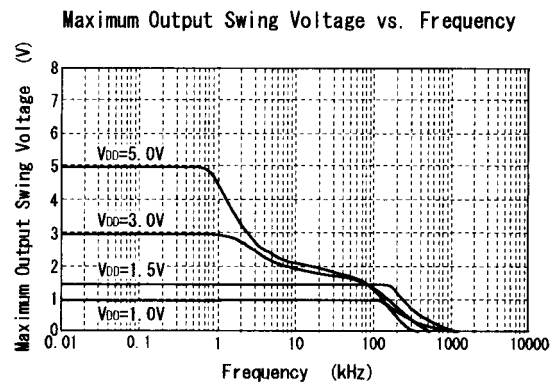
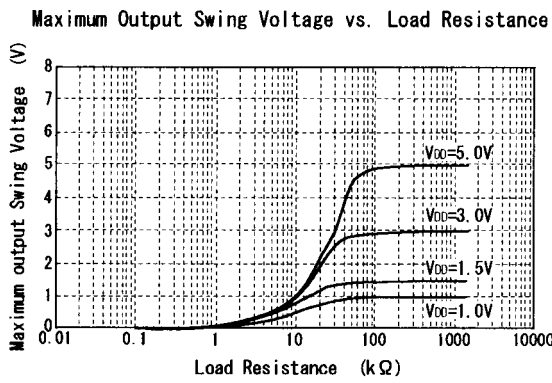
V<sub>IN</sub>=0.1V



Output Current vs. Operating Voltage

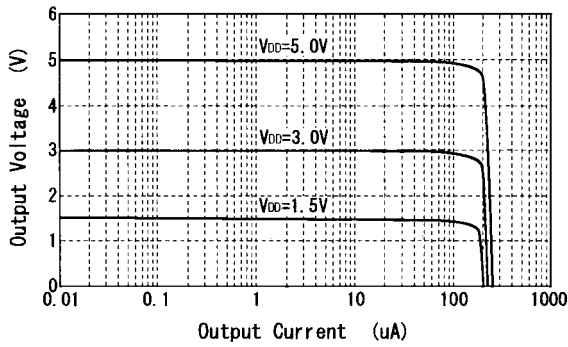
V<sub>IN</sub>=0.1V



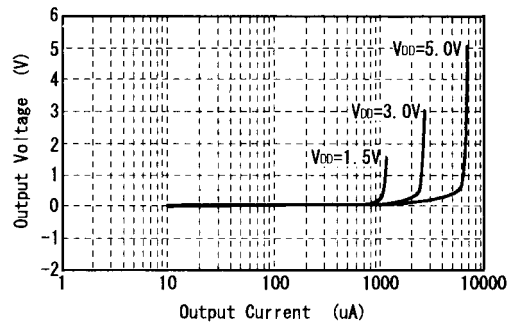


(3) NJU7096

Output Voltage vs. Output Current (SOURCE)

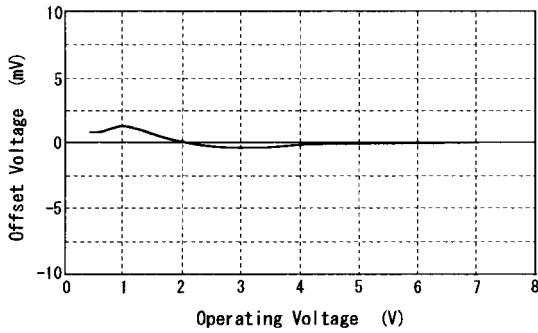


Output Voltage vs. Output Current (SINK)



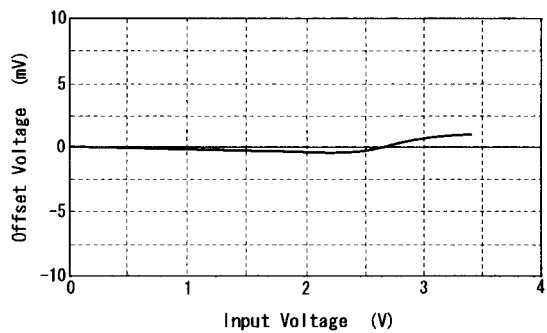
Offset Voltage vs. Operating Voltage

V<sub>IN</sub>=0.1V



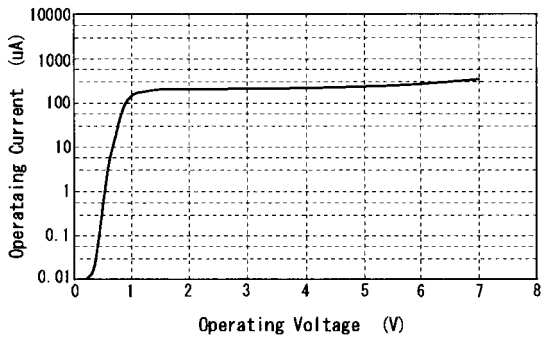
Offset Voltage vs. Input Voltage

V<sub>DD</sub>=3.0V



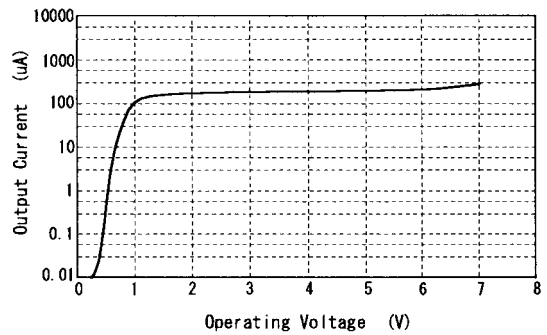
Operating Current vs. Operating Voltage

V<sub>IN</sub>=0.1V



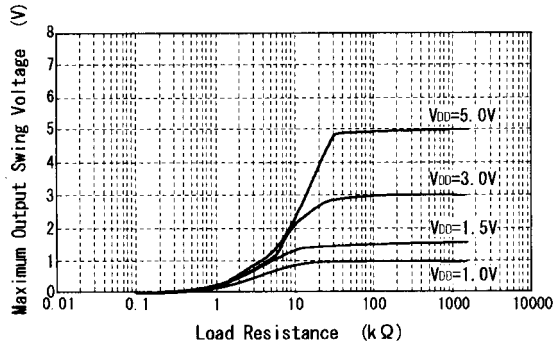
Output Current vs. Operating Voltage

V<sub>IN</sub>=0.1V

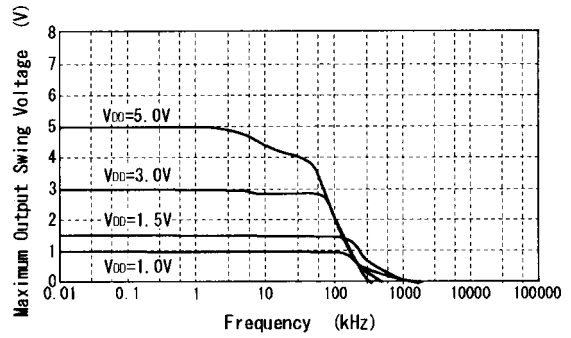




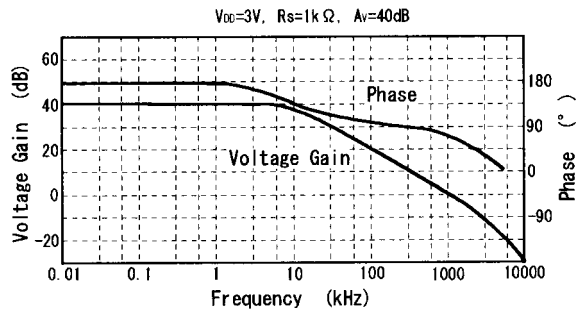
Maximum Output Swing Voltage vs. Load Resistance



Maximum Output Swing Voltage vs. Frequency



Voltage Gain-Phase vs. Frequency



[CAUTION]

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