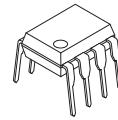


LOW VOLTAGE OPERATION LOW OFFSET VOLTAGE DUAL C-MOS OPERATIONAL AMPLIFIER

■ 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 μ A/circuit (7094 typ.), 80 μ A/circuit (7095 typ.), 200 μ 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.

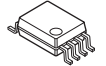
■ PACKAGE OUTLINE



NJU709XD
(DIP8)



NJU709XM
(DMP8)



NJU709XV
(SSOP8)



NJU709XR
(MSOP8 (VSP8))

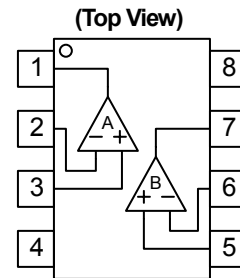


NJU709XRB1
(MSOP8 (TVSP8))

■ 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

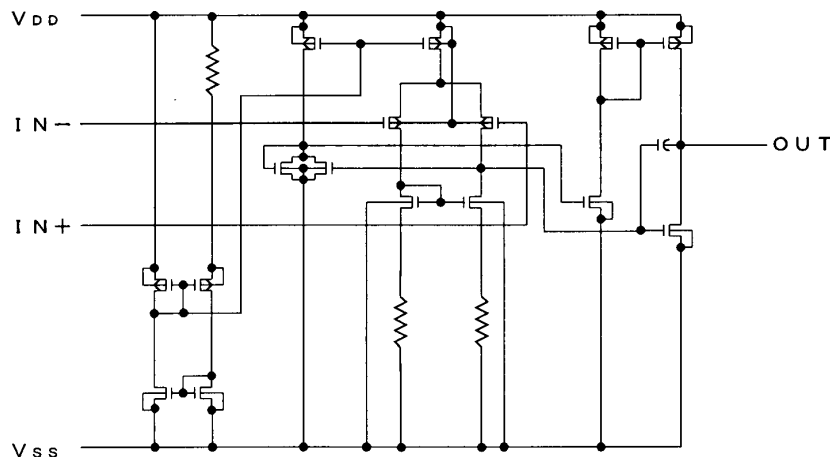
- C-MOS Technology

■ 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 | μA (typ) |
| Slew Rate | 0.1 | 1.0 | 2.4 | $\text{V}/\mu\text{s}$ (typ) |
| Unity Gain Bandwidth | 0.2 | 1.0 | 1.0 | MHz (typ) |

■ EQUIVALENT CIRCUIT



NJU7094/95/96

■ ABSOLUTE MAXIMUM RATINGS

(Ta=25°C)

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

(note1) If the supply voltage (V_{DD}) is less than 7V, the input voltage must not over the V_{DD} level though 7V is limit specified.

(note2) Decoupling capacitor should be connected between V_{DD} and V_{SS} for the stable operation.

■ ELECTRICAL CHARACTERISTICS

NJU7094

(Ta=25°C, V_{DD}=3.0V, R_L=∞)

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

(note3) The source current is less than 2.9μA (at V_{OM}/R_L=2.9V/1MΩ).

NJU7095

(Ta=25°C, V_{DD}=3.0V, R_L=∞)

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

(note4) The source current is less than 29μA (at V_{OM}/R_L=2.9V/100kΩ).

NJU7096

(Ta=25°C, V_{DD}=3.0V, R_L=∞)

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

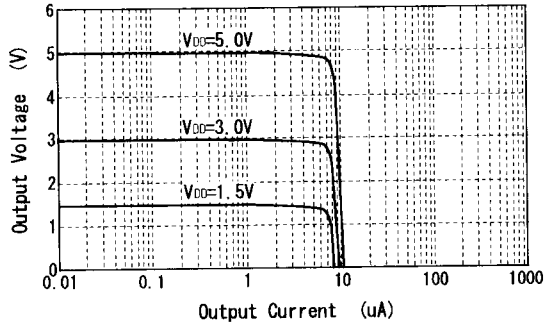
(note5) The source current is less than 58μA (at V_{OM}/R_L=2.9V/50kΩ).

NJU7094/95/96

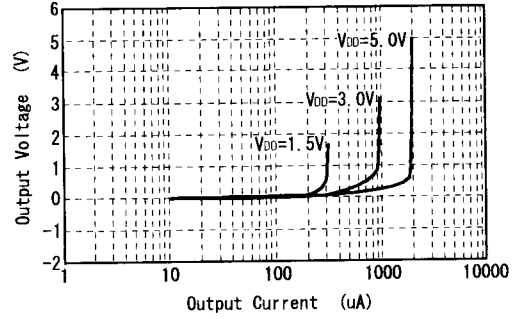
■ TYPICAL CHARACTERISTICS

(1) NJU7094

Output Voltage vs. Output Current (SOURCE)

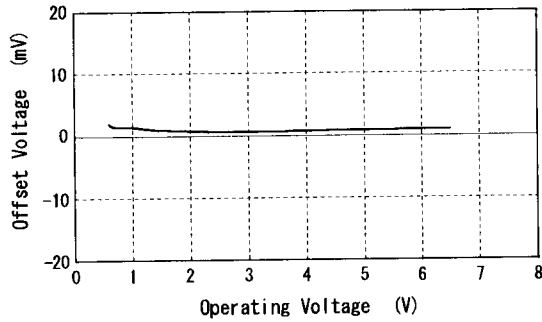


Output Voltage vs. Output Current (SINK)



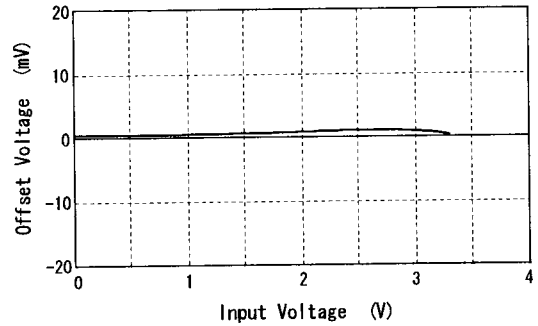
Offset Voltage vs. Operating Voltage

V_{IN}=0.1V



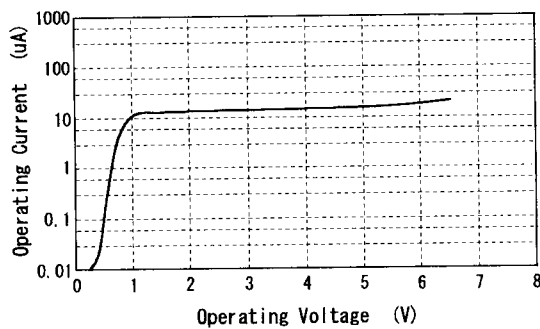
Offset Voltage vs. Input Voltage

V_{DD}=3.0V



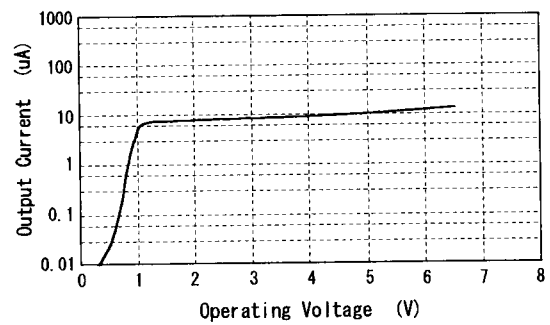
Operating Current vs. Operating Voltage

V_{IN}=0.1V

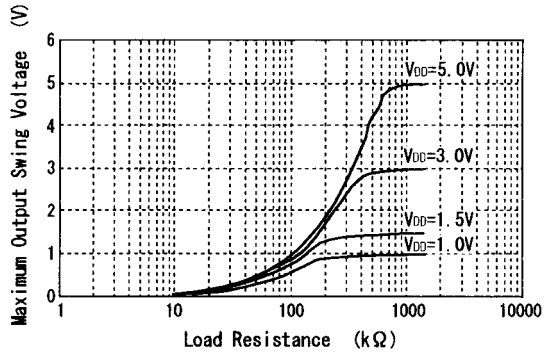


Output Current vs. Operating Voltage

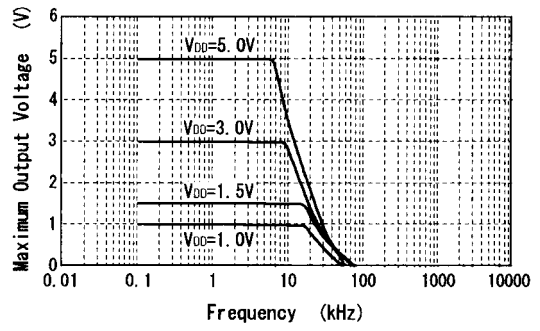
V_{IN}=0.1V



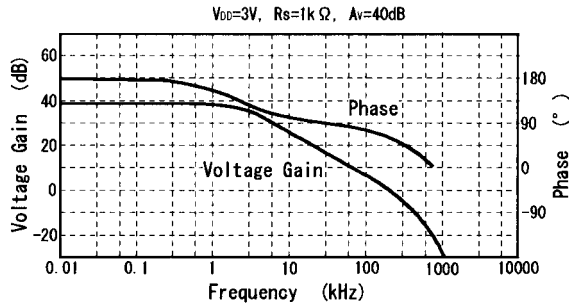
Maximum Output Swing Voltage vs. Load Resistance



Maximum Output Swing Voltage vs. Frequency

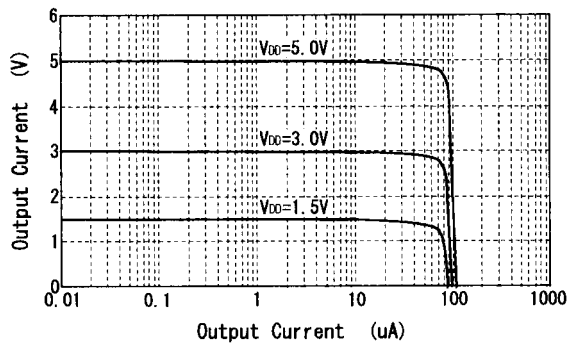


Voltage Gain-Phase vs. Frequency

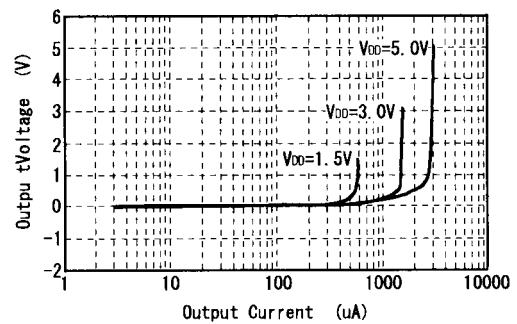


(2) NJU7095

Output Voltage vs. Output Current (SOURCE)

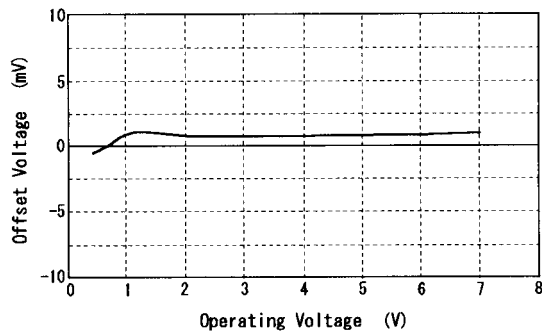


Output Voltage vs. Output Current (SINK)



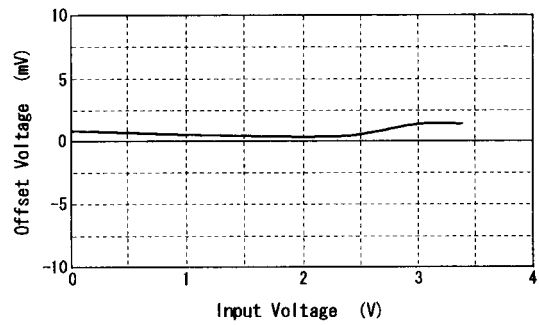
Offset Voltage vs. Operating Voltage

$V_{IN}=0.1V$



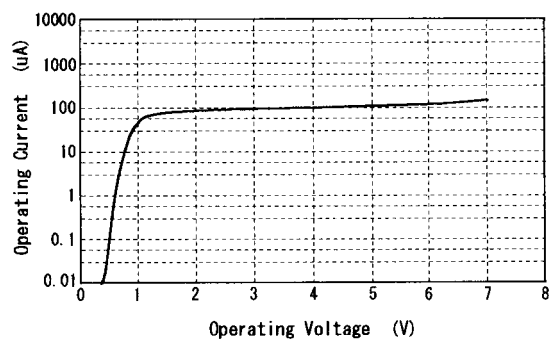
Offset Voltage vs. Input Voltage

$V_{OO}=3.0V$



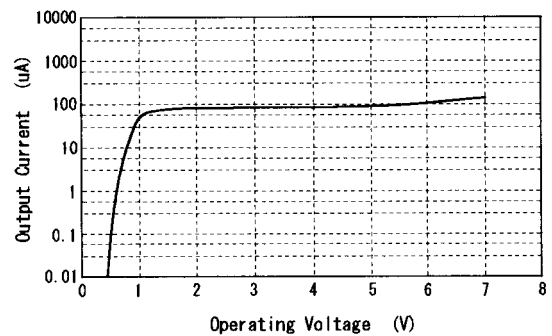
Operating Current vs. Operating Voltage

$V_{IN}=0.1V$

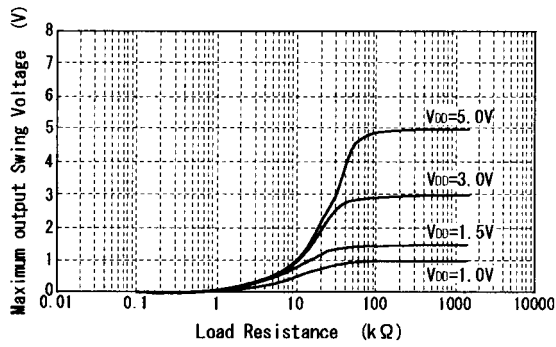


Output Current vs. Operating Voltage

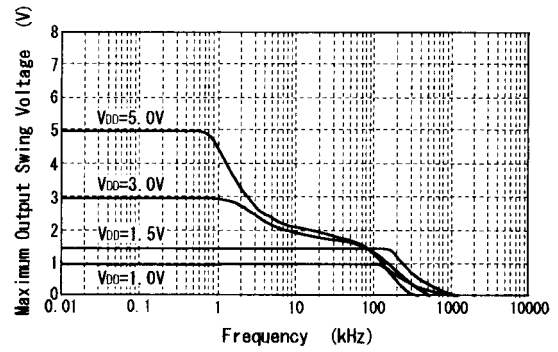
$V_{IN}=0.1V$



Maximum Output Swing Voltage vs. Load Resistance

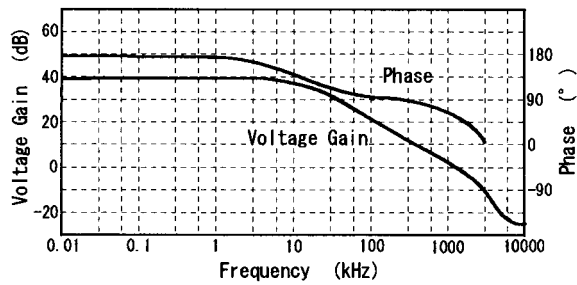


Maximum Output Swing Voltage vs. Frequency



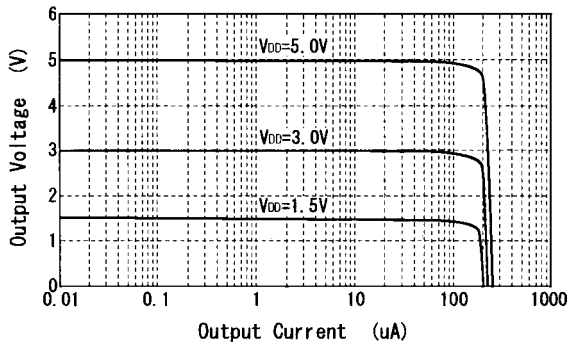
Voltage Gain-Phase vs. Frequency

V_{DD}=3V, R_s=1kΩ, A_v=40dB

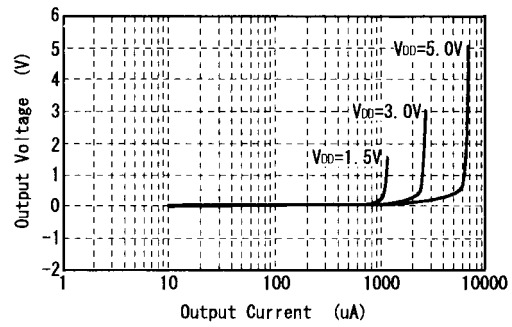


(3) NJU7096

Output Voltage vs. Output Current (SOURCE)

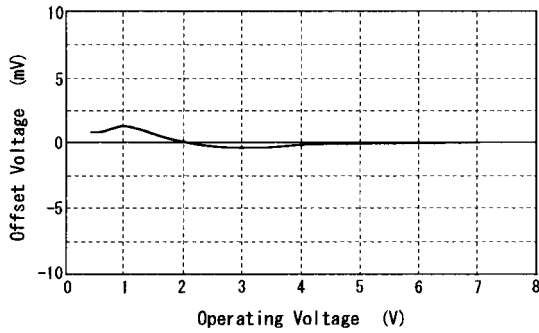


Output Voltage vs. Output Current (SINK)



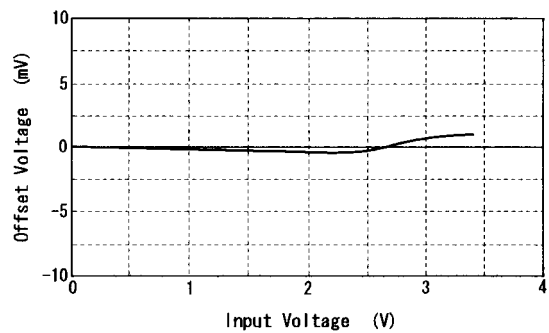
Offset Voltage vs. Operating Voltage

V_{IN}=0.1V



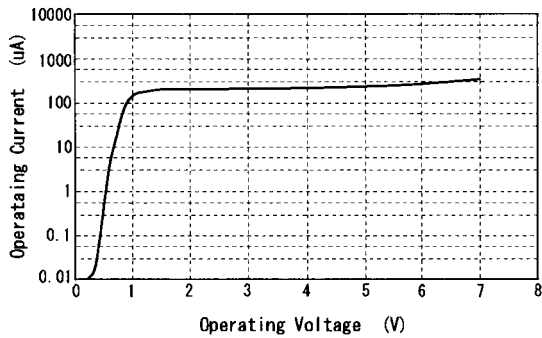
Offset Voltage vs. Input Voltage

V_{DD}=3.0V



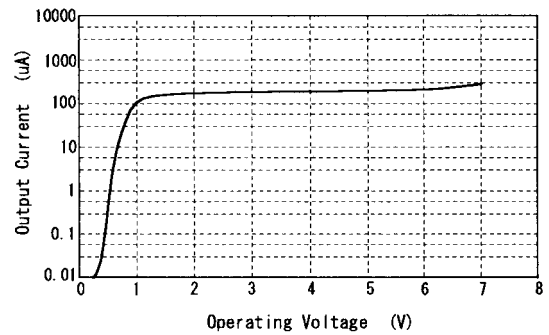
Operating Current vs. Operating Voltage

V_{IN}=0.1V

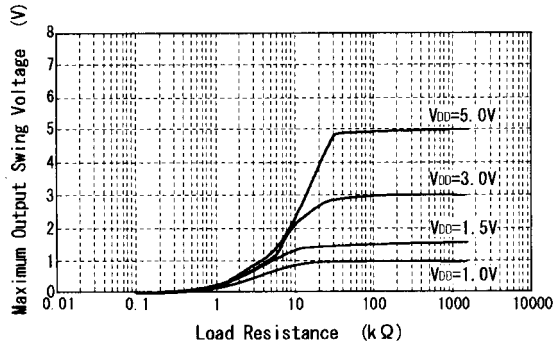


Output Current vs. Operating Voltage

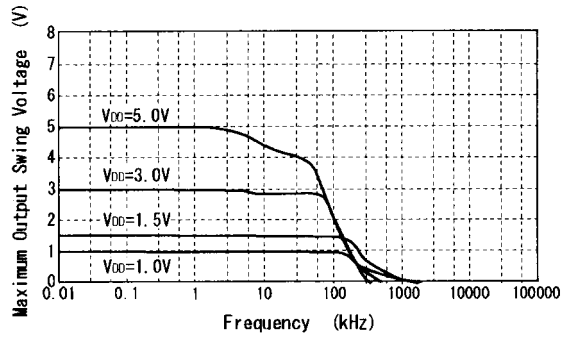
V_{IN}=0.1V



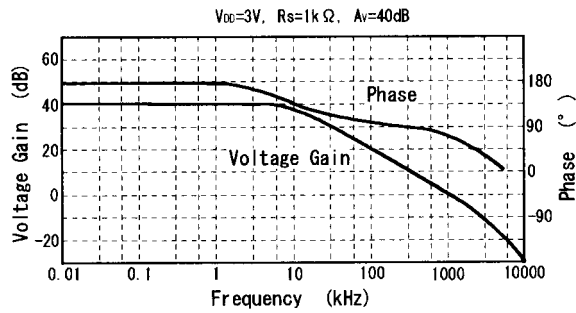
Maximum Output Swing Voltage vs. Load Resistance



Maximum Output Swing Voltage vs. Frequency



Voltage Gain-Phase vs. Frequency



[CAUTION]

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