

# LOW-POWER TINY SINGLE C-MOS OPERATIONAL AMPLIFIER

## ■ GENERAL DESCRIPTION

The NJU7011, 12 and 13 are single C-MOS operational amplifiers operated on a single-power-supply, low voltage and low operating current.

The input bias current is as low as than 1pA, consequently very small signal around the ground level can be amplified.

The minimum operating voltage is 1V and the output stage permits output signal to swing between both of the supply rails.

Furthermore, this series is packaged with very small MTP-5, therefore it can be especially applied to portable items.

## ■ PACKAGE OUTLINE



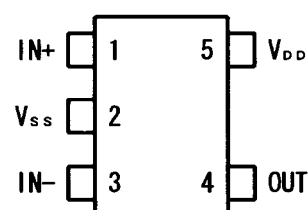
NJU701XF

## ■ FEATURES

- Single-Power-Supply
- Wide Operating Voltage  $V_{DD}=1\sim 5.5V$
- Wide Output Swing Range  $V_{OM}=2.9V$  min @3.0V
- Low Operating Current
- Low Bias Current  $I_{IB}=1pA$  typ
- Compensation Capacitor Incorporated
- Package Outline MTP-5
- C-MOS Technology

## ■ PIN CONFIGURATION

(Top View)

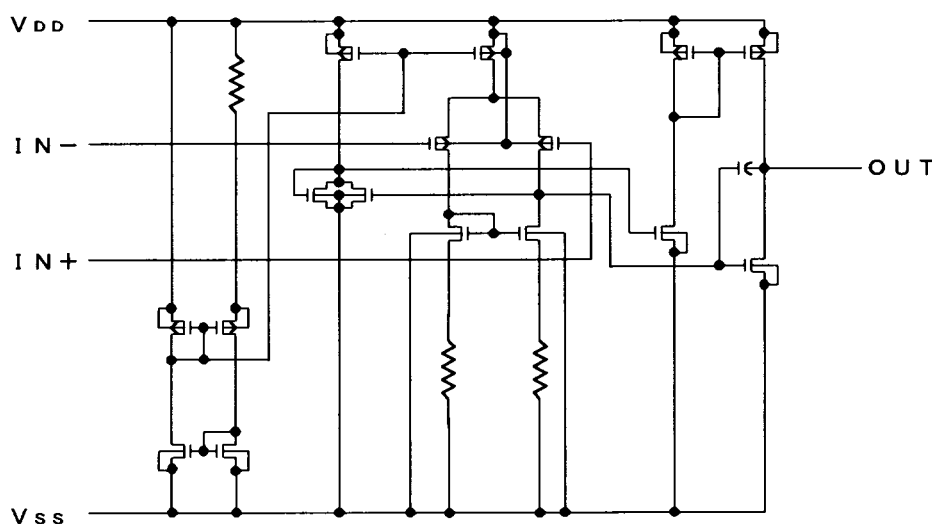


## ■ LINE-UP

(Ta=25°C, V<sub>DD</sub>=3.0V)

| PARAMETER            | NJU7011 | NJU7012 | NJU7013 | UNIT       |
|----------------------|---------|---------|---------|------------|
| Operating Current    | 15      | 80      | 200     | μA (typ)   |
| Slew Rate            | 0.1     | 1.0     | 2.4     | V/μs (typ) |
| Unity Gain Bandwidth | 0.2     | 1.0     | 1.0     | MHz (typ)  |

## ■ EQUIVALENT CIRCUIT



## ■ ABSOLUTE MAXIMUM RATINGS

(Ta=25°C)

| P A R A M E T E R          | SYMBOL    | R A T I N G S   | UNIT |
|----------------------------|-----------|-----------------|------|
| Supply Voltage             | $V_{DD}$  | 6.5             | V    |
| Differential Input Voltage | $V_{ID}$  | $\pm 6.5$ Note1 | V    |
| Common Mode Input Voltage  | $V_{IC}$  | - 0.3 ~ 6.5     | V    |
| Power Dissipation          | $P_D$     | 200             | mW   |
| Operating Temperature      | $T_{opr}$ | - 40 ~ + 85     | °C   |
| Storage Temperature        | $T_{stg}$ | - 55 ~ +125     | °C   |

Note1) If the supply voltage ( $V_{DD}$ ) is less than 6.5V, the input voltage must not over the  $V_{DD}$  level though 6.5V is limit specified.

Note2) Decoupling capacitor should be connected between  $V_{DD}$  and  $V_{SS}$  due to the stabilized operation for the circuit.

## ■ ELECTRICAL CHARACTERISTICS

NJU7011

(Ta=25°C,  $V_{DD}=3.0V$ ,  $R_L=\infty$ )

| P A R A M E T E R               | SYMBOL    | CONDITIONS              | MIN          | TYP | MAX          | UNIT |
|---------------------------------|-----------|-------------------------|--------------|-----|--------------|------|
| Input Offset Voltage            | $V_{IO}$  | $V_{IN}=1/2V_{DD}$      | —            | —   | 10           | 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    | $V_{OM1}$ | $R_L=1M\Omega$          | $V_{DD}-0.1$ | —   | —            | V    |
|                                 | $V_{OM2}$ | $R_L=1M\Omega$          | —            | —   | $V_{SS}+0.1$ | V    |
| Common Mode Rejection Ratio     | CMR       | $V_{IN}=1/2V_{DD}$      | 55           | 65  | —            | dB   |
| Supply Voltage Rejection Ratio  | SVR       | $V_{DD}=1.5\sim 5.5V$   | 60           | 70  | —            | dB   |
| Operating Current               | $I_{DD}$  |                         | —            | 15  | 25           | μA   |
| Slew Rate                       | SR        |                         | —            | 0.1 | —            | V/μs |
| Unity Gain Bandwidth            | Ft        | $A_v=40dB$ , $C_L=10pF$ | —            | 0.2 | —            | MHz  |

Note3) The source current is less than 2.9μA (at  $V_{OM}/R_L=2.9V/1M\Omega$ ).

NJU7012

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

| P A R A M E T E R               | SYMBOL           | CONDITIONS                                 | MIN                  | TYP | MAX                  | UNIT |
|---------------------------------|------------------|--------------------------------------------|----------------------|-----|----------------------|------|
| Input Offset Voltage            | V <sub>IO</sub>  | V <sub>IN</sub> =1/2V <sub>DD</sub>        | —                    | —   | 10                   | 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>  |                                            | —                    | 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).

NJU7013

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

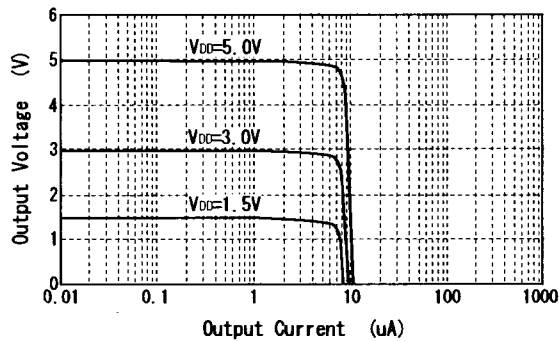
| P A R A M E T E R               | SYMBOL           | CONDITIONS                                 | MIN                  | TYP | MAX                  | UNIT |
|---------------------------------|------------------|--------------------------------------------|----------------------|-----|----------------------|------|
| Input Offset Voltage            | V <sub>IO</sub>  | V <sub>IN</sub> =1/2V <sub>DD</sub>        | —                    | —   | 10                   | 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>  |                                            | —                    | 200 | 400                  | 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  |

Note5) The source current is less than 58μA (at V<sub>OM</sub>/R<sub>L</sub>=2.9V/50kΩ).

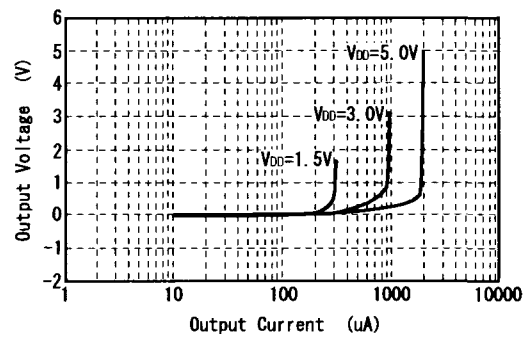
■ TYPICAL CHARACTERISTICS

(1) NJU7011

Output Voltage vs. Output Current (SOURCE)

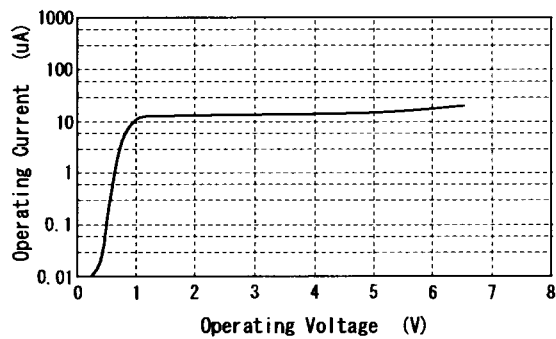


Output Voltage vs. Output Current (SINK)



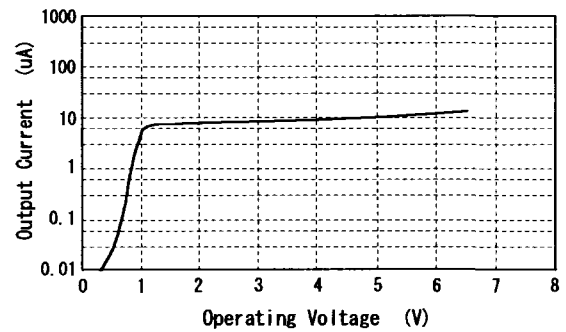
Operating Current vs. Operating Voltage

$V_{IN}=0.1V$

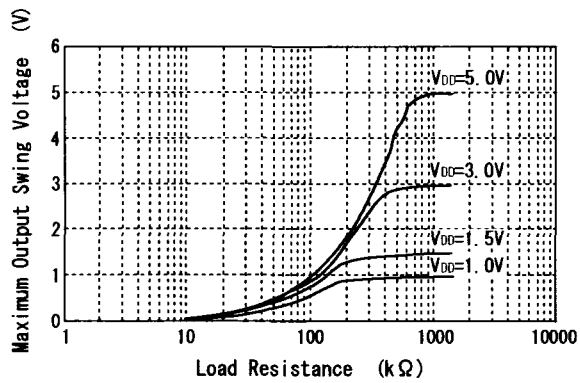


Output Current vs. Operating Voltage

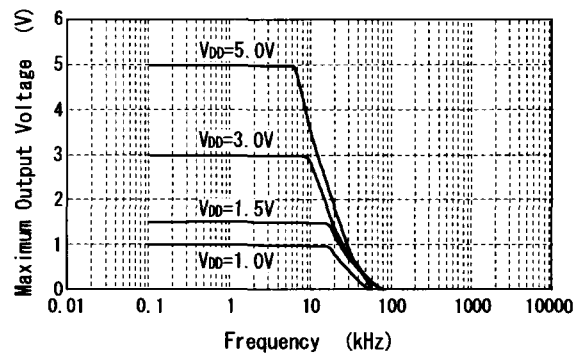
$V_{IN}=0.1V$



Maximum Output Swing Voltage vs. Load Resistance

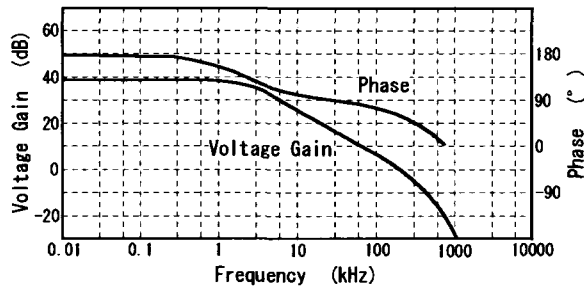


Maximum Output Swing Voltage vs. Frequency



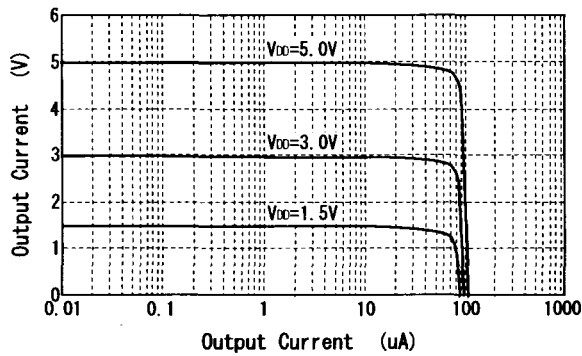
Voltage Gain-Phase vs. Frequency

V<sub>DD</sub>=3V, R<sub>S</sub>=1kΩ, A<sub>v</sub>=40dB

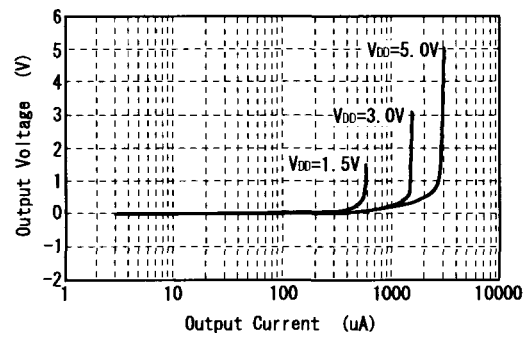
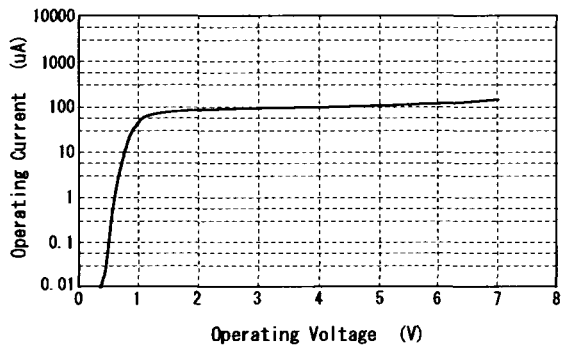
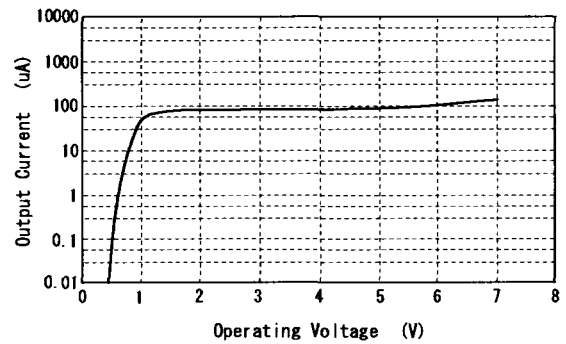


## (2) NJU7012

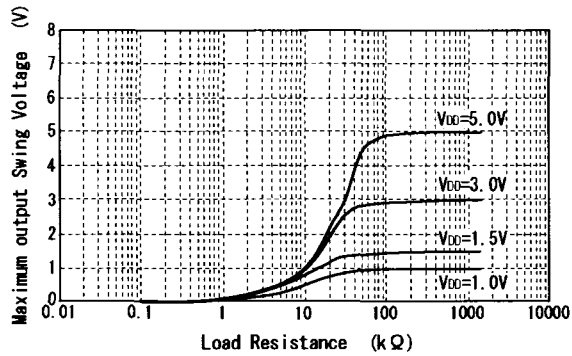
Output Voltage vs. Output Current (SOURCE)



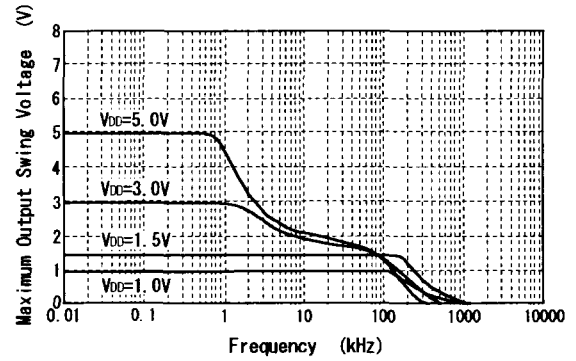
Output Voltage vs. Output Current (SINK)

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

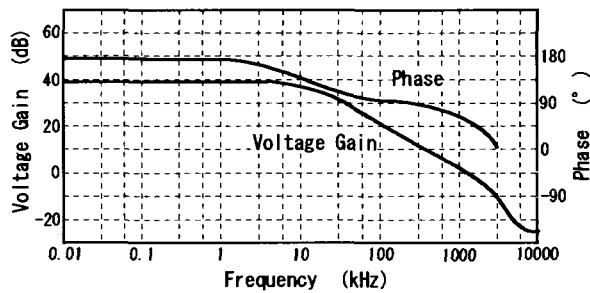


Maximum Output Swing Voltage vs. Frequency



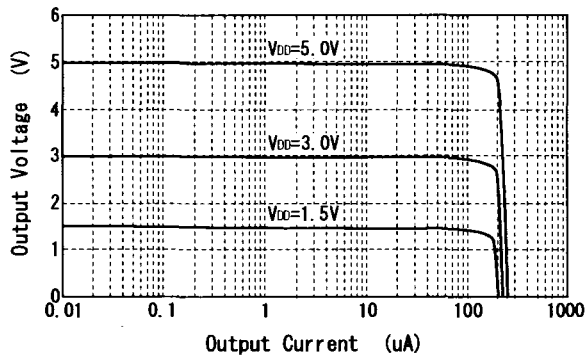
Voltage Gain-Phase vs. Frequency

V<sub>DD</sub>=3V, R<sub>S</sub>=1kΩ, A<sub>v</sub>=40dB

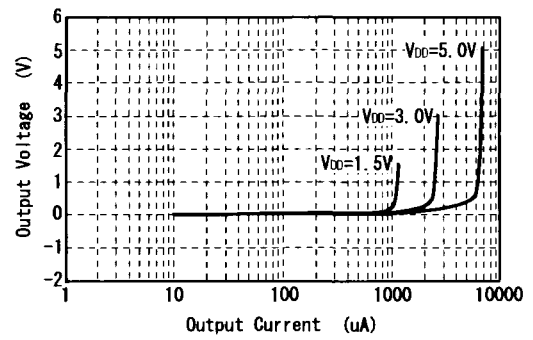


## (3) NJU7013

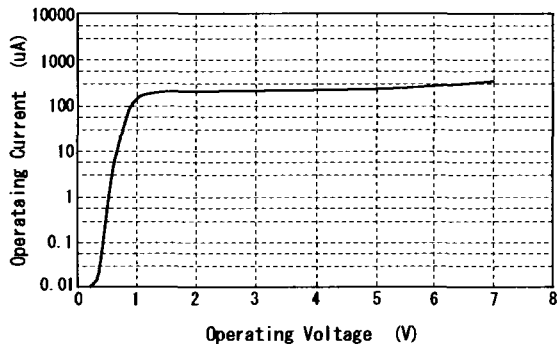
Output Voltage vs. Output Current (SOURCE)



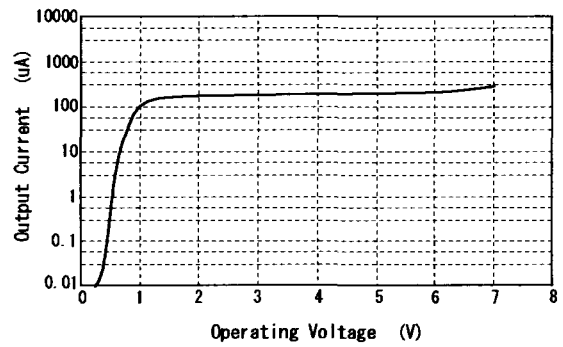
Output Voltage vs. Output Current (SINK)



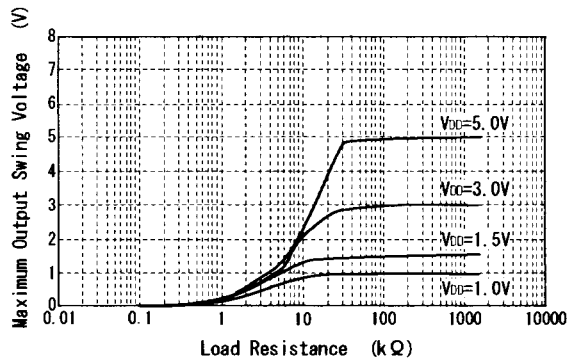
Operating Current vs. Operating Voltage

 $V_{IN}=0.1V$ 

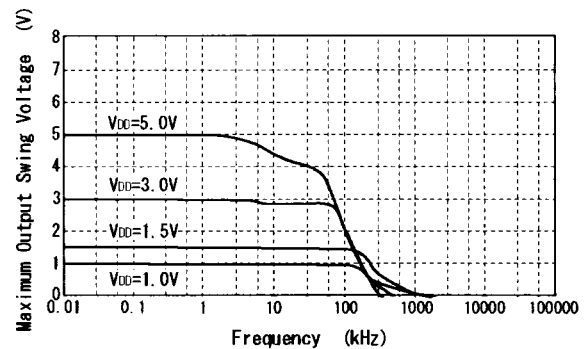
Output Current vs. Operating Voltage

 $V_{IN}=0.1V$ 

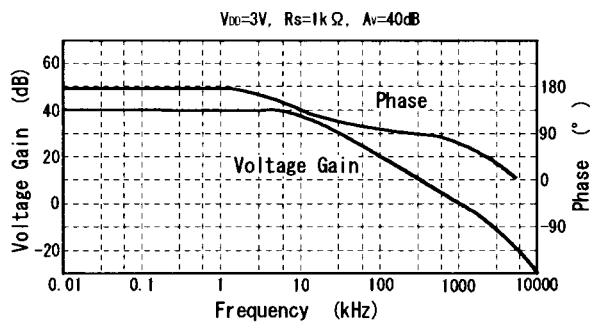
Maximum Output Swing Voltage vs. Load Resistance



Maximum Output Swing Voltage vs. Frequency



Voltage Gain-Phase vs. Frequency



## [CAUTION]

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