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 15μA/circuit (7094 typ.), 80μA/circuit (7095 typ.), 200μA/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 theses features makes them ideal for a variety of portable devices.

■ PACKAGE OUTLINE

NJU709XD (DIP8)

NJU709XM (DMP8)

NJU709XV (SSOP8)

NJU709XR (MSOP8 (VSP8))

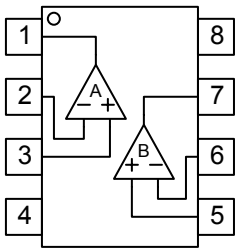
NJU709XRB1 (MSOP8 (TVSP8))

■ FEATURES

- Single-Power-Supply
- Low Offset Voltage (V_{IO}=4mV max)
- Wide Operating Voltage (V_{DD}=1 to 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 DIP8, DMP8, SSOP8
  MSOP8 (VSP8) MEET JEDEC MO-187-DA
  MSOP8 (TVSP8) MEET JEDEC MO-187-DA / THIN TYPE
- C-MOS Technology

■ PIN CONFIGURATION

(Top View)



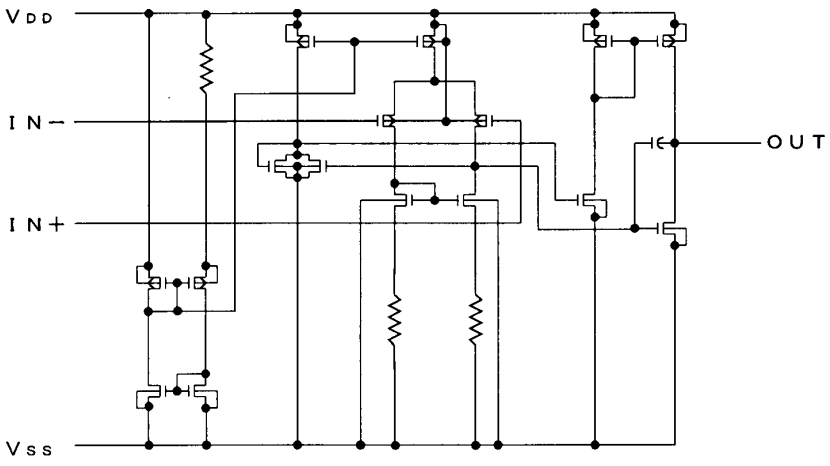
1: OUT 1
2: IN -1
3: IN +1
4: VSS
5: IN +2
6: IN –2
7: OUT 2
8: VDD

■ LINE-UP

(Ta=25°C,V_{DD}=3.0V,Per Circuit)

PARAMETER	NJU7094	NJU7095	NJU7096	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)

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=∞)

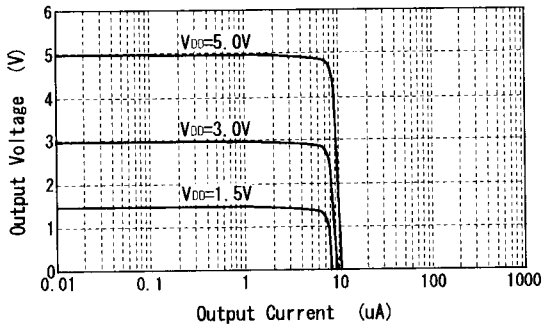
PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Input Offset Voltage	V_{IO}	V_{IN}=1/2V_{DD}	-	-	4	mV
Input Offset Current	I_{IO}		-	1	-	pA
Input Bias Current	I_{IB}		-	1	-	pA
Input Impedance	R_{IN}		-	1	-	TΩ
Large Signal Voltage Gain	A_{VD}		60	70	-	dB
Input Common Mode Voltage Range	V_{ICM}		0~2.5	-	-	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).

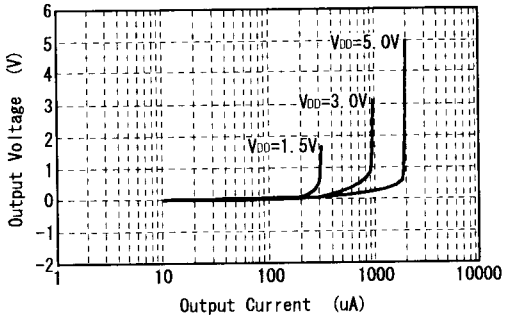
■ TYPICAL CHARACTERISTICS

(1) NJU7094

Output Voltage vs. Output Current (SOURCE)

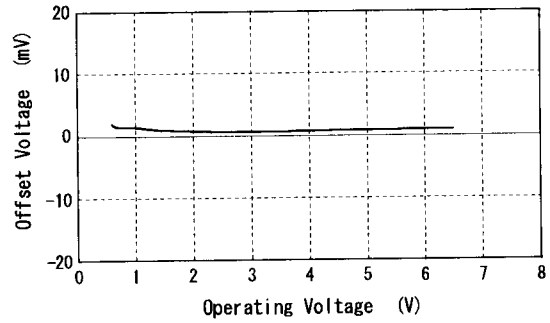


Output Voltage vs. Output Current (SINK)



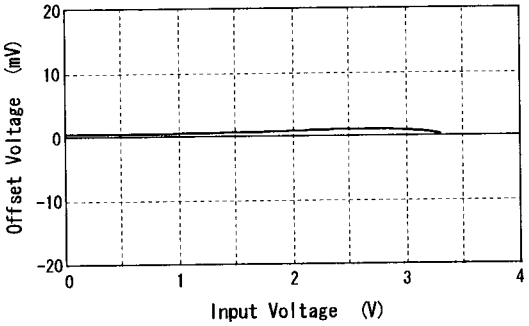
Offset Voltage vs. Operating Voltage

VIN=0.1V



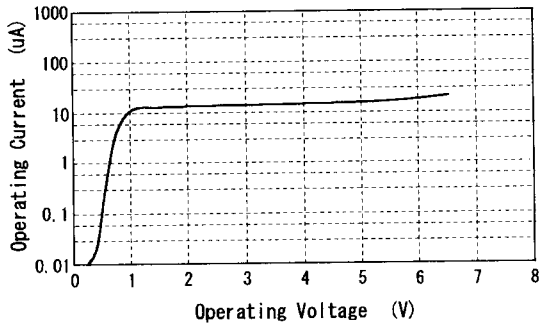
Offset Voltage vs. Input Voltage

VDD=3.0V



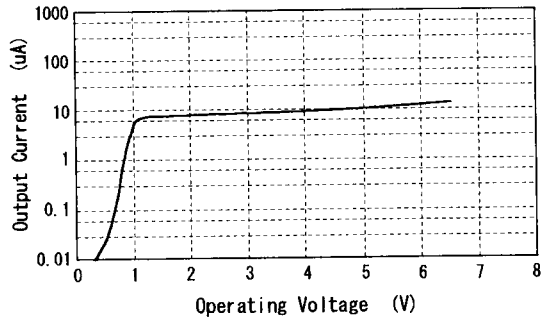
Operating Current vs. Operating Voltaga

VIN=0.1V

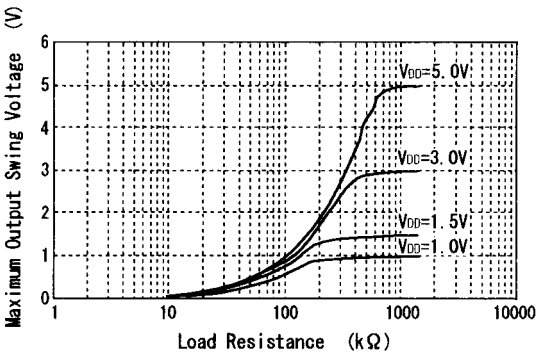


Output Current vs. Operating Voltage

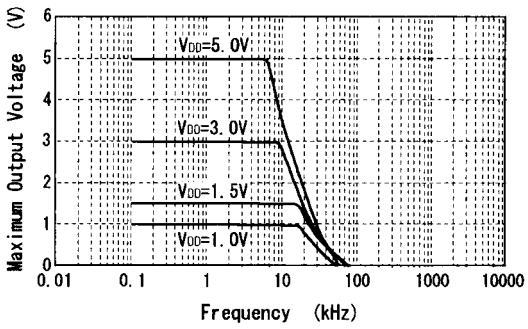
VIN=0.1V



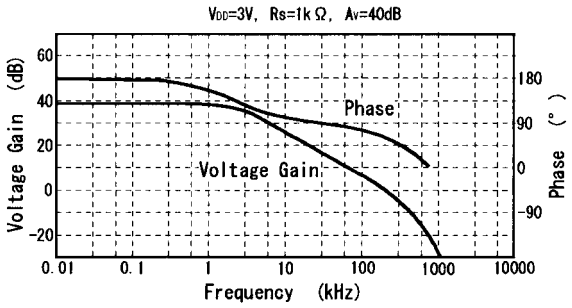
Maximum Output Swing Voltage vs. Load Resistance



Maximum Output Swing Voltage vs. Frequency

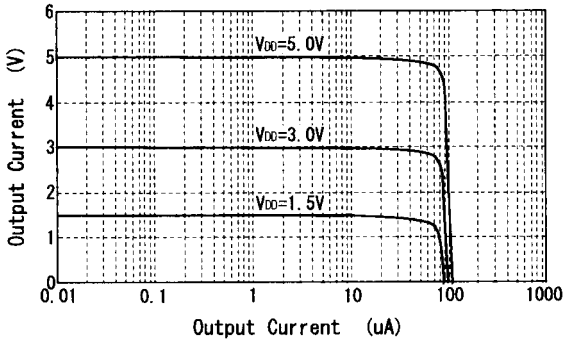


Voltage Gain·Phase vs. Frequency

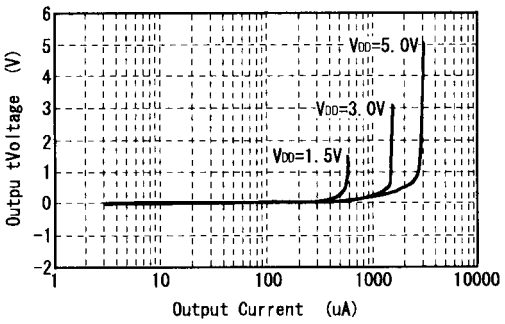


(2) NJU7095

Output Voltage vs. Output Current (SOURCE)

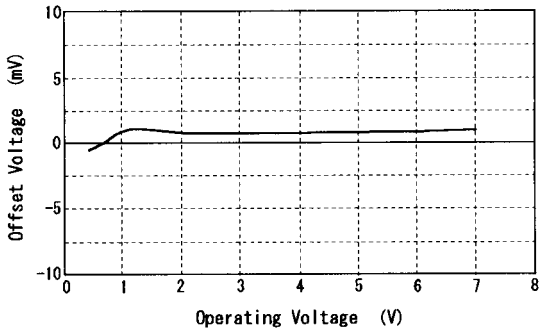


Output Voltage vs. Output Current (SINK)



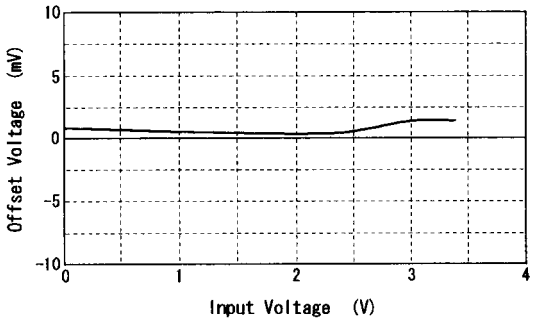
Offset Voltage vs. Operating Voltage

VIN=0.1V



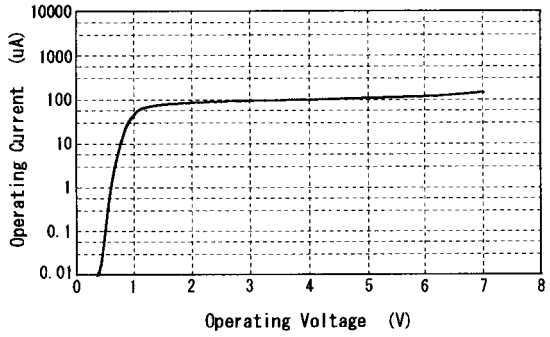
Offset Voltage vs. Input Voltage

VDD=3.0V



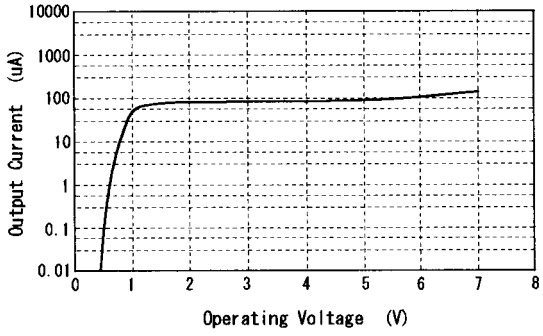
Operating Current vs. Operating Voltage

VIN=0.1V

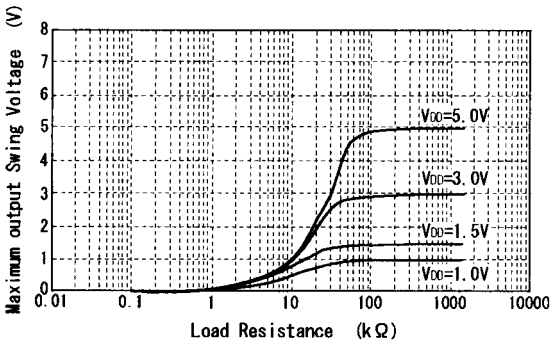


Output Current vs. Operating Voltage

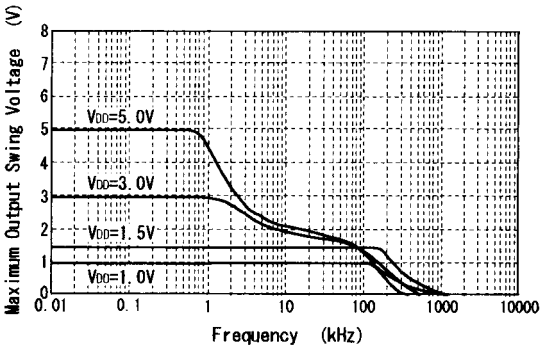
VIN=0.1V



Maximum Output Swing Voltage vs. Load Resistance

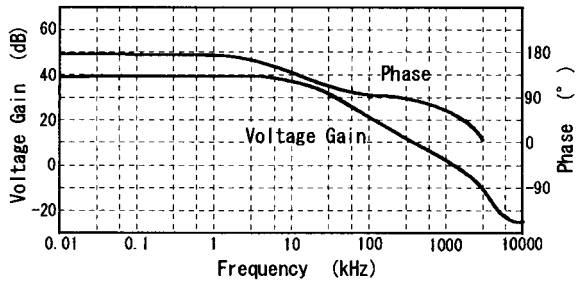


Maximum Output Swing Voltage vs. Frequency



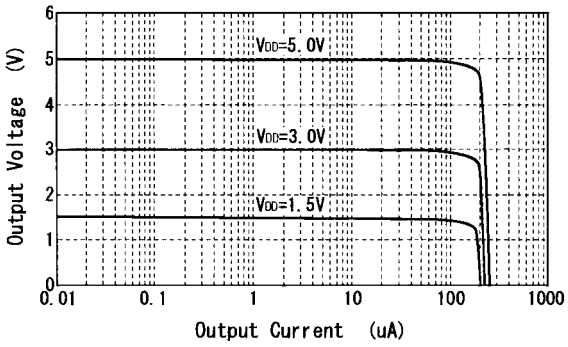
Voltage Gain·Phase vs. Frequency

VDD=3V, Rs=1kΩ, AV=40dB

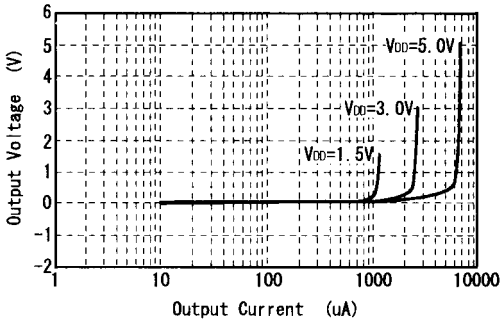


(3) NJU7096

Output Voltage vs. Output Current (SOURCE)

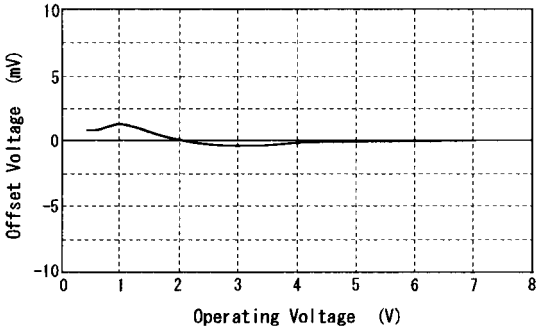


Output Voltage vs. Output Current (SINK)



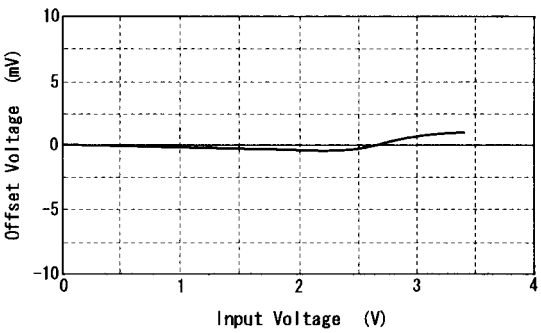
Offset Voltage vs. Operating Voltage

VIN=0.1V



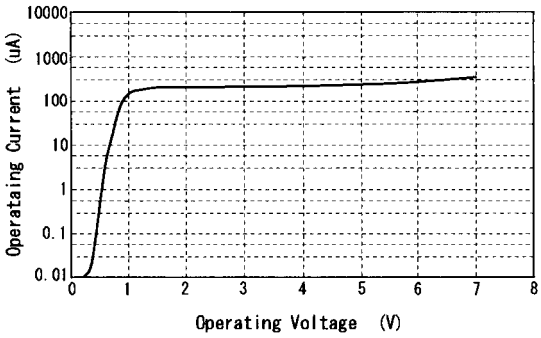
Offset Voltage vs. Input Voltage

VDD=3.0V



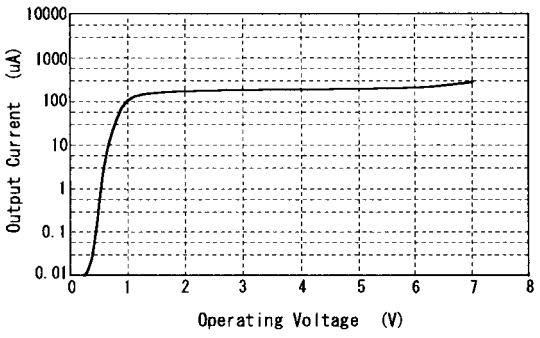
Operating Current vs. Operating Voltage

VIN=0.1V

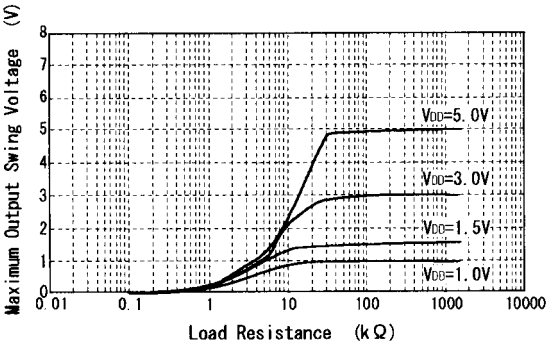


Output Current vs. Operating Voltage

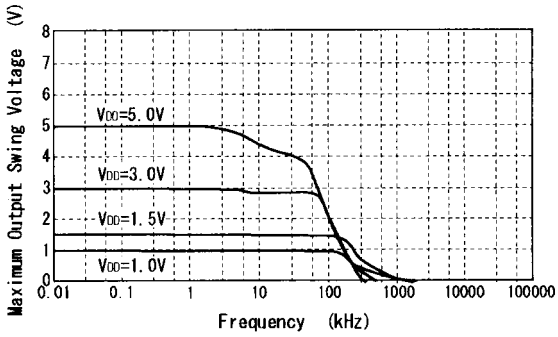
VIN=0.1V



Maximum Output Swing Voltage vs. Load Resistance

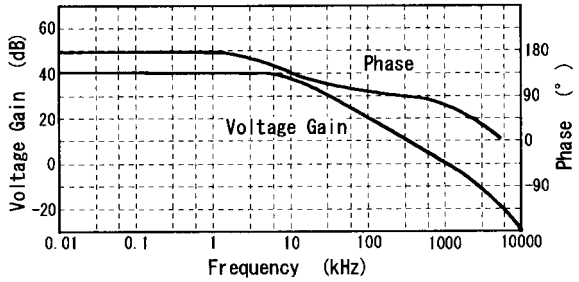


Maximum Output Swing Voltage vs. Frequency



Voltage Gain·Phase vs. Frequency

VDD=3V, Rs=1kΩ, AV=40dB



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