Rail-to-Rail Output
Single CMOS Operational Amplifier

■ GENERAL DESCRIPTION

The **NJU7056** is a single CMOS operational amplifier that feature low noise as V_{NI}=15nV/√Hz (at V_{DD}= 5V, f=1kHz). It is tolerant to RF noise.

The NJU7056 can operate from a single-supply voltage of +1.8V to +5.5V. In addition, this amplifier features Rail-to-Rail output and low input bias current (1pA).

■ PACKAGE OUTLINE

NJU7056F
(SOT−23−5)

NJU7056F3
(SC88A)

■ FEATURES

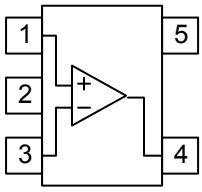
- ●Voltage Noise 15nV/√Hz (typ.) (at V_{DD}= 5V, f=1kHz)
- ●Low Operating Voltage 1.8V to 5.5V
- ●Rail-to-Rail Output V_{OH}=4.9V min./ V_{OL}=0.1V max. (at V_{DD}= 5V, R_L=10kΩ)
  V_{OH}=4.8V min./ V_{OL}=0.2V max. (at V_{DD}= 5V, I_O=2mA)
- ●Enhanced RF Noise Immunity
- ●CMOS Process
- ●Package SOT-23−5, SC88A

■ APPLICATION

- ●Sensor amplifiers
- ●Photodiode amplifiers
- ●Low noise signal processing applications
- ●Microphone amplifiers
- ●Battery-operated application

■ PIN CONFIGURATION

(Top View)



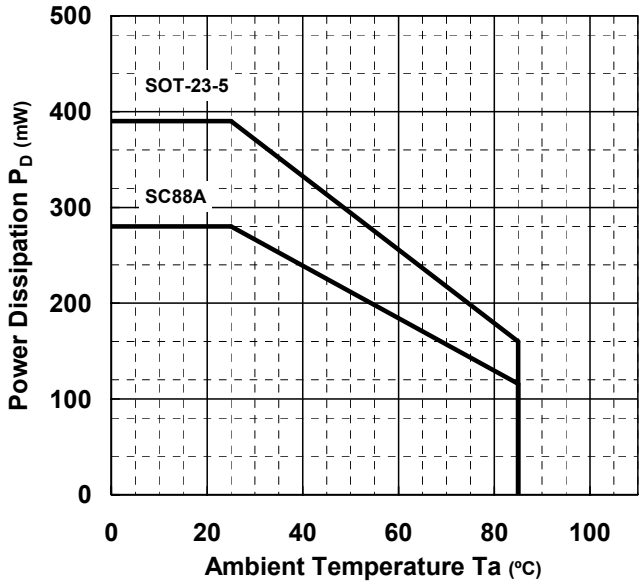
PIN FUNCTION
1: +INPUT
2: GND
3: -INPUT
4: OUTPUT
5: VDD

■ ABSOLUTE MAXIMUM RATINGS

PARAMETER	SYMBOL	RATINGS	UNIT
Supply Voltage	V_{DD}	+7	V
Input Common Mode Voltage	V_{ICM}	V_{SS}-0.3 to V_{DD}+0.3	V
Differential Input Voltage	V_{ID}	±7 (Note1)	V
Power Dissipation (Note3)	P_D	390[SOT−23−5],280[SC88A] (Note2)	mW
Operating Temperature Range	T_{opr}	-40 to +85	°C
Storage Temperature Range	T_{stg}	-55 to +125	°C

(Note1) For supply voltage less than +7V, the absolute maximum rating is equal to the supply voltage.
(Note2) EIA/JEDEC STANDARD Test board (76.2 x 114.3 x 1.6mm, 2layers, FR-4) mounting.
(Note3) Do not exceed "Power dissipation: P_D" in which power dissipation in IC is shown by the absolute maximum rating.
See Figure "Power Dissipation Curve" when ambient temperature is over 25°C.

Power Dissipation Curve



■ RECOMMENDED OPERATING CONDITION (Ta=25°C)

PARAMETER	SYMBOL	RATING	UNIT
Supply Voltage	V_{DD}	1.8 to 5.5	V

■ ELECTRICAL CHARACTERISTICS

DC CHARACTER (V_{DD}=5V, V_{SS}=0V, Ta=25˚C, unless otherwise noted.)

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Supply Current	I_{DD}	No Signal	-	260	420	μA
Input Offset Voltage	V_{IO}	Vic=0V, R_S=50Ω	-	1	4	mV
Input Offset Voltage drift	ΔVio/ΔT		-	0.7	-	μV/ºC
Input Bias Current	I_B		-	1	-	pA
Input Offset Current	I_{IO}		-	1	-	pA
Open loop gain	A_V	Vo=0.5V to 4.5V, R_L=10kΩ to 2.5V	70	90	-	dB
Common Mode Rejection Ratio	CMR	V_{ICM}=0V to 4.1V	65	80	-	dB
Supply Voltage Rejection Ratio	SVR	V_{DD}=1.8V to 5.5V	70	90	-	dB
Maximum Output Voltage 1	V_{OH}1	R_L=10kΩ to 2.5V	4.9	4.95	-	V
	V_{OL}1	R_L=10kΩ to 2.5V	-	0.05	0.1	V
Maximum Output Voltage 2	V_{OH}2	R_L=10kΩ to 0V	4.9	4.95	-	V
	V_{OL}2	R_L=10kΩ to 0V	-	0.02	0.05	V
Maximum Output Voltage 3	V_{OH}3	Isource=2mA	4.8	4.85	-	V
	V_{OL}3	Isink=2mA	-	0.15	0.2	V
Common Mode Input Voltage Range	V_{ICM}	CMR≥65dB	0	-	4.1	V

AC CHARACTER (V_{DD}=5V, V_{SS}=0V, Ta=25˚C, unless otherwise noted.)

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Gain Bandwidth Product	GBW	R_L=10kΩ to 2.5V, C_L=20pF, f=100kHz	-	2.1	-	MHz
Phase Margin	□M	R_L=10kΩ to 2.5V, C_L=20pF	-	80	-	deg
Gain Margin	G_M	R_L=10kΩ to 2.5V, C_L=20pF	-	10	-	dB
Equivalent Input Noise Voltage	e_n	f=1kHz	-	15	-	nV/√Hz
Slew Rate	SR	G_V=0dB, R_L=10kΩ to 2.5V, C_L=20pF, Vin=3Vpp (1V to 4V) (Note4) (Note5)	-	0.8	-	V/us
Total Harmonic Distortion	THD	G_V=6dB, R_F=50kΩ, R_G=50kΩ, C_L=20pF, Vo=4Vpp, f=1kHz (Note6)	-	0.01	-	%

(Note4) Slew rate is defined by the lower value of the rise or fall.

(Note5) See figure2-1 for test circuit.

(Note6) See figure2-3 for test circuit.

■ ELECTRICAL CHARACTERISTICS

DC CHARACTER (V_{DD}=1.8V, V_{SS}=0V, Ta=25˚C, unless otherwise noted.)

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Supply Current	I_{DD}	No Signal	-	220	380	μA
Input Offset Voltage	V_{IO}	Vic=0V, R_S=50Ω	-	1	4	mV
Input Offset Voltage drift	ΔVio/ΔT		-	0.8	-	μV/ºC
Input Bias Current	I_B		-	1	-	pA
Input Offset Current	I_{IO}		-	1	-	pA
Open loop gain	A_V	Vo=0.5V to 2.5V, R_L=10kΩ to 0.9V	65	80	-	dB
Common Mode Rejection Ratio	CMR	V_{ICM}=0V to 0.9V	65	80	-	dB
Supply Voltage Rejection Ratio	SVR	V_{DD}=1.8V to 5.5V	70	90	-	dB
Maximum Output Voltage 1	V_{OH}1	R_L=10kΩ to 0.9V	1.7	1.75	-	V
	V_{OL}1	R_L=10kΩ to 0.9V	-	0.05	0.1	V
Maximum Output Voltage 2	V_{OH}2	R_L=10kΩ to 0V	1.7	1.75	-	V
	V_{OL}2	R_L=10kΩ to 0V	-	0.02	0.05	V
Maximum Output Voltage 3	V_{OH}3	Isource=1mA	1.5	1.55	-	V
	V_{OL}3	Isink=1mA	-	0.25	0.3	V
Common Mode Input Voltage Range	V_{ICM}	CMR≥65dB	0	-	0.9	V

AC CHARACTER (V_{DD}=1.8V, V_{SS}=0V, Ta=25˚C, unless otherwise noted.)

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Gain Bandwidth Product	GBW	R_L=10kΩ to 0.9V, C_L=20pF, f=100kHz	-	1.7	-	MHz
Phase Margin	φ_M	R_L=10kΩ to 0.9V, C_L=20pF	-	80	-	deg
Gain Margin	G_M	R_L=10kΩ to 0.9V, C_L=20pF	-	13	-	dB
Equivalent Input Noise Voltage	e_n	f=1kHz	-	18	-	nV/√Hz
Slew Rate	SR	G_V=0dB, R_L=10kΩ to 1.5V, C_L=20pF, Vin=0.5Vpp (0.3V to 0.8V) (Note4) (Note7)	-	0.6	-	V/us
Total Harmonic Distortion	THD	G_V=6dB, R_F=50kΩ, R_G=50kΩ, C_L=20pF, Vo=1Vpp, f=1kHz (Note8)	-	0.01	-	%

(Note4) Slew rate is defined by the lower value of the rise or fall.

(Note7) See figure2-2 for test circuit.

(Note8) See figure2-4 for test circuit..

■ MEASUREMENT CIRCUITS

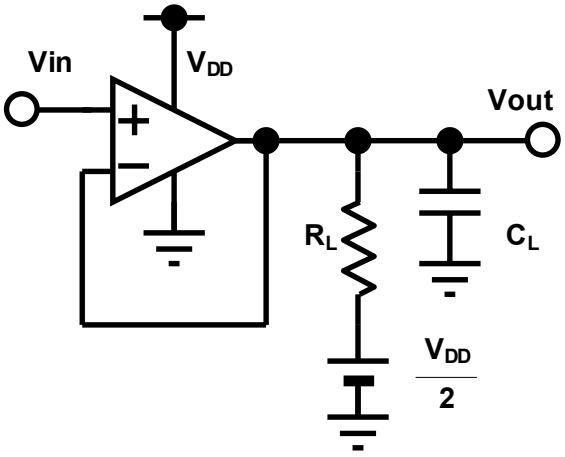


Figure 2-1:Measurement circuit 1

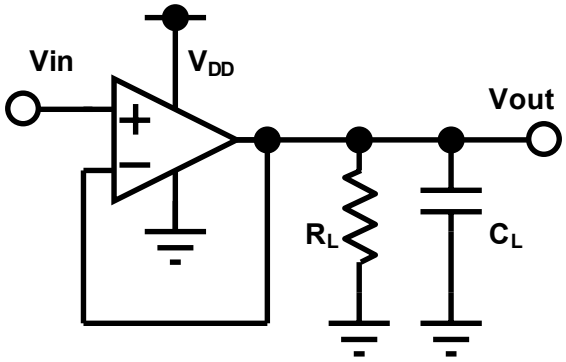


Figure 2-2:Measurement circuit 2

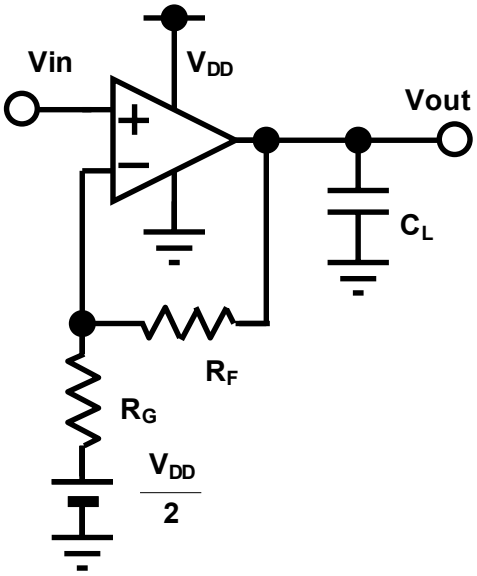


Figure 2-3:Measurement circuit 3

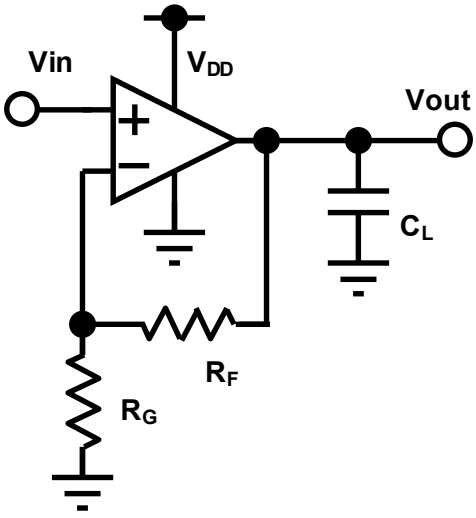
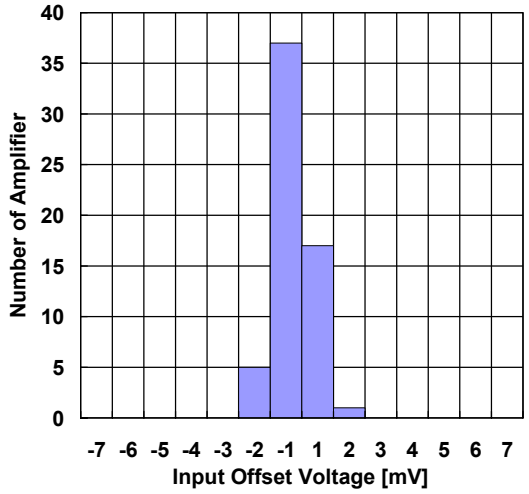


Figure 2-4:Measurement circuit 4

■ ELECTRICAL CHARACTERISTICS

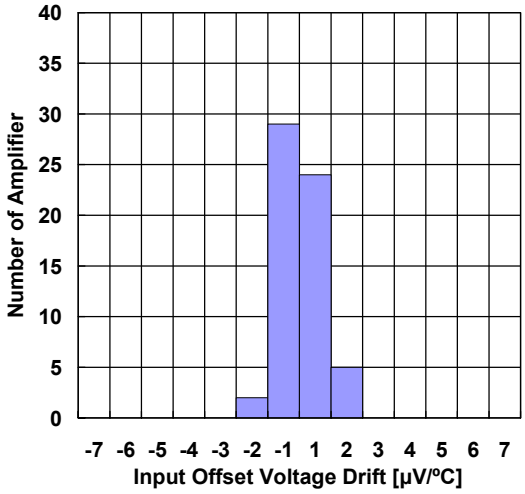
Input Offset Voltage Distribution

V_{DD}=5V, V_{ICM}=0V, Ta=25ºC N=60



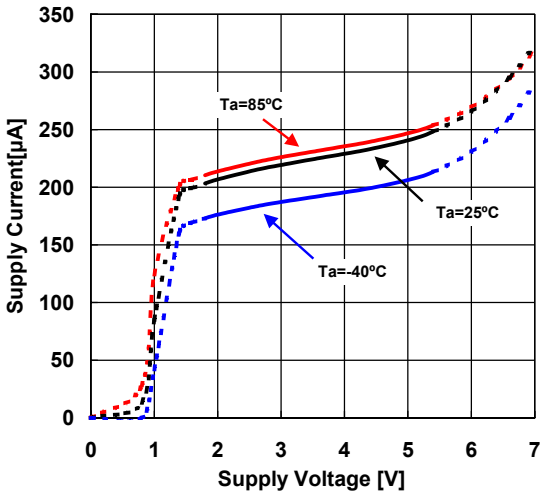
Input Offset Voltage Drift Distribution

V_{DD}=5V, V_{ICM}=0V, Ta=-40ºC→85ºC N=60



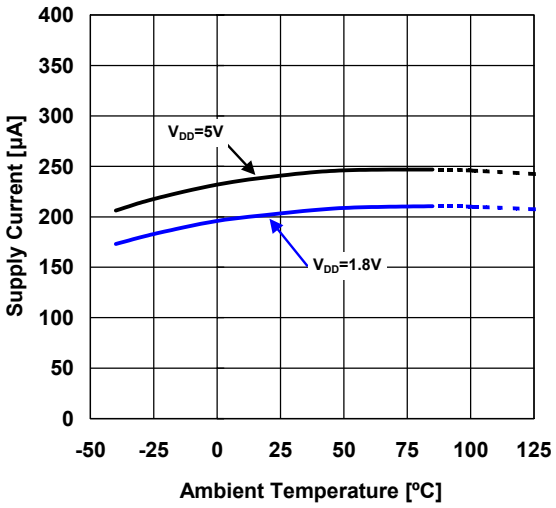
Supply Current vs. Supply Voltage

Gv=0dB



Supply Current vs. Temperature

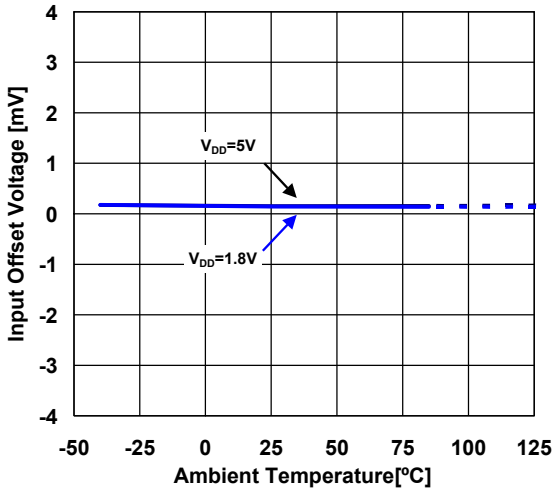
Gv=0dB



Input Offset Voltage vs. Temperature

(Supply Voltage)

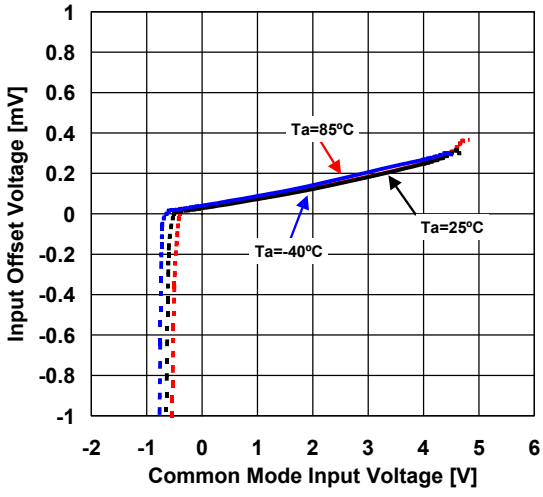
V_{ICM}=V_{DD}/2



Input Offset Voltage vs. Common Mode Input Voltage

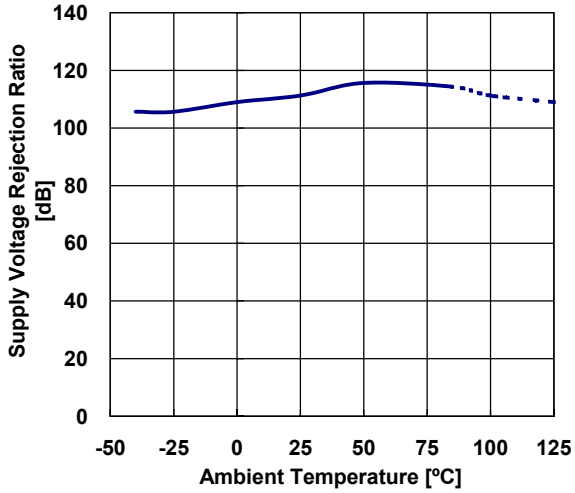
(Temperature)

V_{DD}=5V

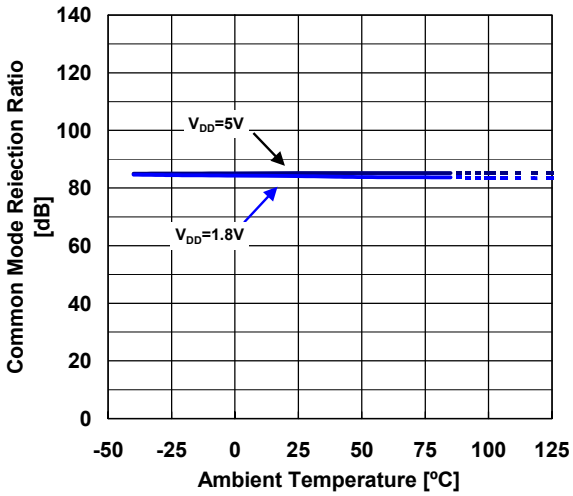


■ ELECTRICAL CHARACTERISTICS

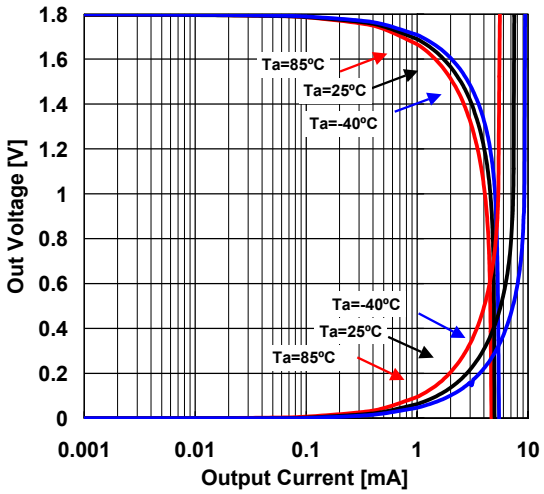
SVR vs. Temperature
V_{DD}=1.8V→5.5V



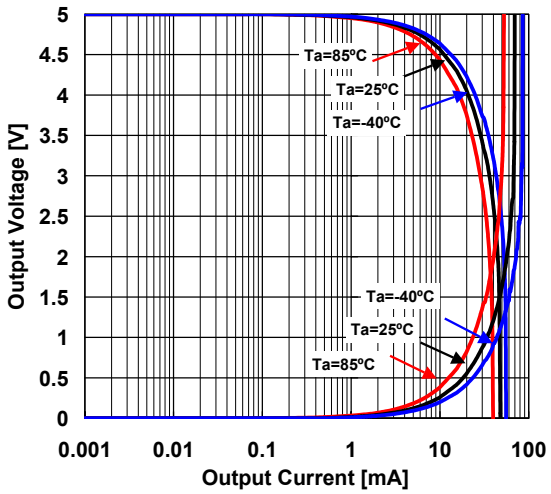
CMR vs. Temperature (supply Voltage)
V_{ICM}=0V→VDD-0.9V



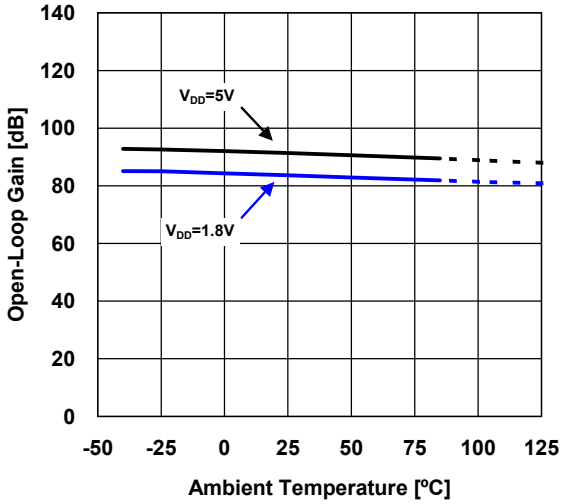
Output Voltage vs. Output Current (Temperature)
V_{DD}=1.8V, V_{ICM}=0.9



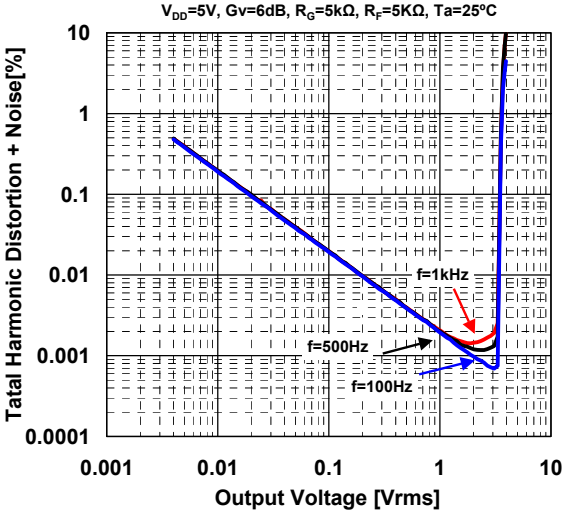
Output Voltage vs. Output Current (Temperature)
V_{DD}=5V, V_{ICM}=2.5V



Open-Loop Gain vs Temperature
V_{OUT}=0.5V to V_{DD}-0.5, R_L=10KΩ



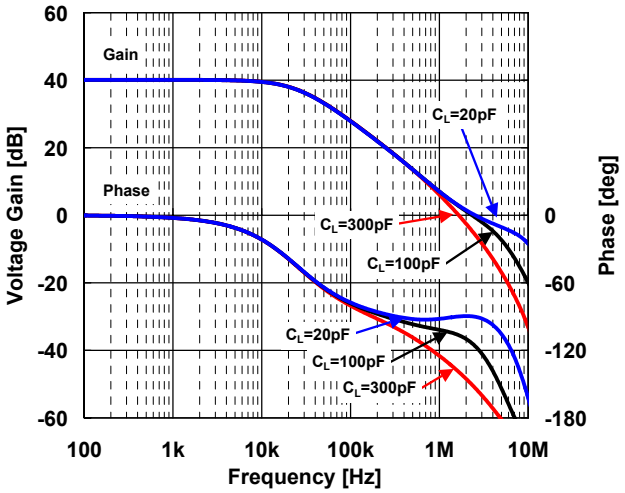
THD + Noise vs. Output Voltage
V_{DD}=5V, Gv=6dB, R_G=5kΩ, R_F=5KΩ, Ta=25ºC



■ ELECTRICAL CHARACTERISTICS

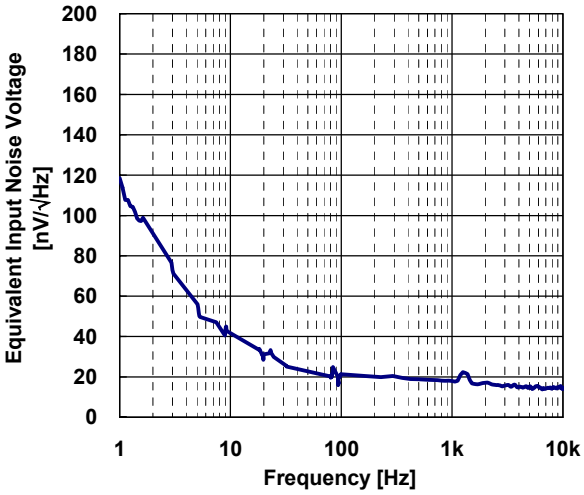
Gain/Phase vs. Frequency (Load Capacitance)

V_{DD}=5V, Gv=40dB, R_F=100kΩ, Ta=25ºC



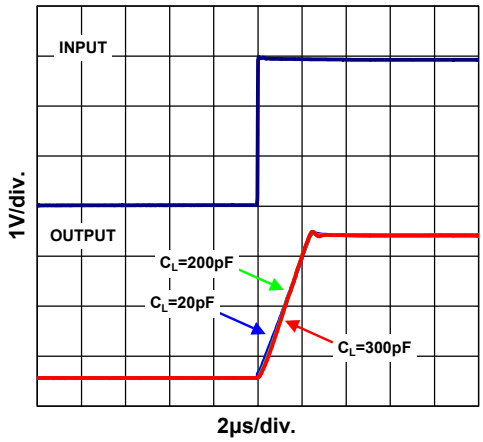
Equivalent Input Noise Voltage vs. Frequency

V_{DD}=5V, G_V=20dB, R_F=100KΩ, R_S=100Ω, Ta=25ºC



pulse Response (Load Capacitance)

V_{DD}=5V, G_V=0dB, R_L=10KΩ, Ta=25ºC



Pulse Response (Load capacitance)

V_{DD}=5V, G_V=0dB, R_L=10KΩ, Ta=25ºC