Wide-Band,High-Speed,Low-Offset,Low-Noise Rail-to-Rail Input/Output CMOS Operational Amplifier

■GENERAL DESCRIPTION

The NJU77701 are Rail-to-Rail input/output CMOS single/dual/quad operational amplifiers. They feature wide-band, high-speed, low-input-offset voltage and low-noise.

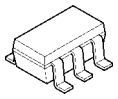
The NJU77701 has a high-speed characteristic of gain bandwidth 34MHz and slew rate 35V/μs. Moreover, the NJU77701 achieves temperature fluctuations low offset and low noise characteristic. 6nV/√Hz typ. at f=1kHz.

Therefore, the NJU77701 devices easily offer various sensing applications that require high speed and accuracy. With their rail-to-rail output characteristic and 600-ohm load driving, these devices are able to secure wide dynamic range for various applications.

■FEATURES

• WIde-Band	34MHz typ.
• High-SlewRate	35V/μs typ.
• Low Noise	6nV/√Hz typ. at f=1kHz
• Low Offset Voltage	1.5mV max.
• Low Offset Voltage Drift	3.0μV/°C max.
• Operating Current	3.8mA typ.
• Operating Voltage Range	+2.4V to +5.5V
• Wide temperature range	-40 to +125°C
• Rail-to-Rail Input/Output	
• RF Immunity	
• Package	SOT-23-5

■ PACKAGE OUTLINE



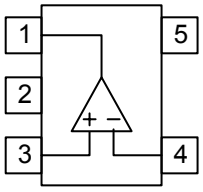
NJU77701F
(SOT-23-5)

■APPLICATIONS

- Low noise signal processing
- ADC buffers
- DAC output amplifiers
- Current Sense amplifiers
- Radio systems

■PIN CONFIGURATION

SOT-23-5
(Top View)



1. OUTPUT
2. V^-
3. + INPUT
4. - INPUT
5. V^+

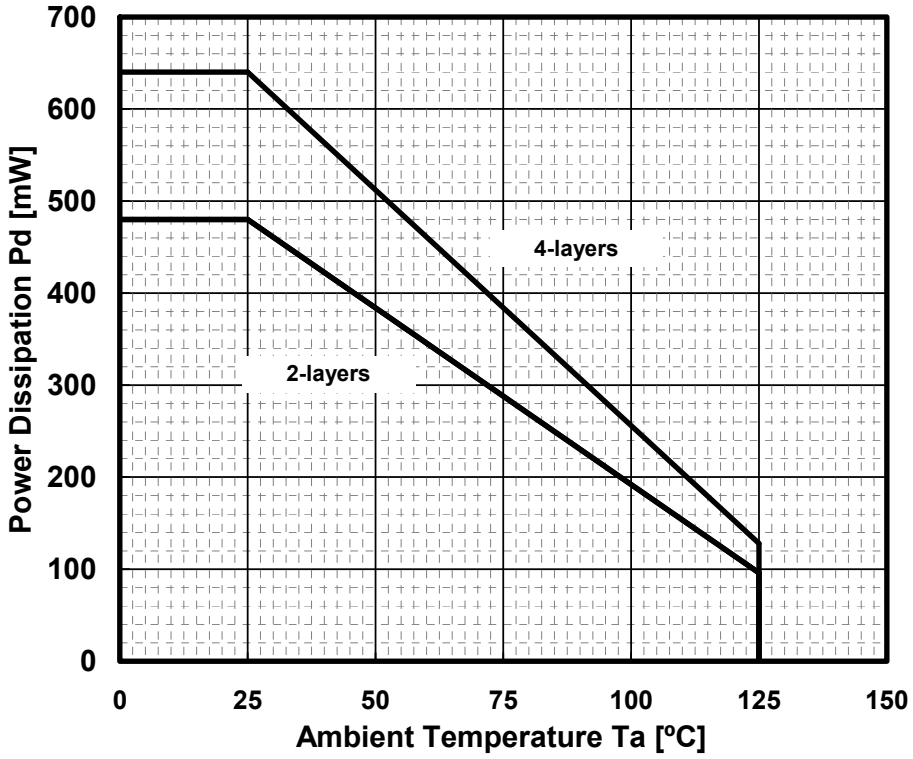
NJU77701F

■ABSOLUTE MAXIMUM RATINGS(Ta=25℃ unless otherwise noted.)

PARAMETER	SYMBOL	RATINGS	UNIT
Supply Voltage	$V^+ - V^-$	+7	V
Differential Input Voltage(1)	V_{ID}	±7	V
Input Voltage(2)	V_{IN}	V^- - 0.3 to V^+ + 0.3V	V
Input Current	I_{IN}	10	mA
Output Terminal Input Voltage	V_O	V^- - 0.3 to V^+ + 0.3V	V
Power Dissipation(3)	P_D	480 (2-layer) / 640 (4-layer)	mW
Operating Temperature Range	Topr	-40 to +125	°C
Storage Temperature Range	Tstg	-55 to +150	°C

(1) Differential voltage is the voltage difference between +INPUT and -INPUT.
For supply voltage less than +7V, the absolute maximum rating is equal to the supply voltage.
(2) The normal operation will establish when any input is within the Common Mode Input Voltage Range of electrical characteristics.
(3) EIA/JEDEC STANDARD Test board (76.2 x 114.3 x 1.6mm, FR-4) mounting.
Do not exceed "Power dissipation: P_D" in which power dissipation in IC is shown by the absolute maximum rating.
See Figure1 "Power Dissipation Curve" when ambient temperature is over 25°C.

Figure1.Power Dissipation Derating Curve



■ RECOMMENDED OPERATING CONDITION(Ta=25°C)

PARAMETER	SYMBOL		UNIT
Supply Voltage	$V^+ - V^-$	+2.4 to +5.5	V

■ ELECTRICAL CHARACTERISTICS

V^+=5V, V^-=0V, V_{ICM}=2.5V, Ta=25ºC, unless otherwise noted.

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
INPUT CHARACTERISTICS						
Input Offset Voltage	V_{IO}	Ta=25°C	-	0.4	1.5	mV
		Ta= - 40°C to 125°C	-	-	1.8	mV
Input Offset Voltage Drift	$\Delta V_{IO}/\Delta T$	Ta= - 40°C to 125°C	-	0.5	3	uV/°C
Input Bias Current	I_B		-	1	-	pA
Input Offset Current	I_{IO}		-	1	-	pA
Open Loop Gain	A_V	R_L=10kΩ to 2.5V	102	110	-	dB
Common Mode Rejection Ratio	CMR	V_{ICM}=0V to 5V	70	92	-	dB
Common Mode Input Voltage Range	V_{ICM}	CMR≧70dB	0	-	5	V
Common Mode Input Resistance	R_{ICM}		-	1000	-	GΩ
Differential Mode Input Resistance	R_{IDM}		-	1000	-	GΩ
Input Capacitance	C_{IN}		-	11	-	pF
OUTPUT CHARACTERISTICS						
High-level Output Voltage	V_{OH}	R_L=10kΩ to 2.5V	4.95	4.99	-	V
		R_L=600Ω to 2.5V	4.90	4.95	-	V
Low-level Output Voltage	V_{OL}	R_L=10kΩ to 2.5V	-	7	40	mV
		R_L=600Ω to 2.5V	-	35	80	mV
Short-circuit Output Current	I_{SC}	Short to V+	70	110	-	mA
		Short to V-	70	110	-	
Output Resistance	R_O		-	95	-	Ω
AC CHARACTERISTICS						
Gain Bandwidth Product	GBP	Gv=60dB,Rs=500Ω,RL=10kΩ to 2.5V, C_L=20pF ,f=1MHz	-	34	-	MHz
Phase Margin	ϕ_M	Gv=14dB,Rs=500Ω,RL=10kΩ to 2.5V, C_L=20pF	-	60	-	deg
Gain Margin	G_M	Gv=14dB,Rs=500Ω,RL=10kΩ to 2.5V, C_L=20pF	-	20	-	dB
Slew Rate	SR	Gv=14dB(Non-Inverting Amplifier) Rs=500Ω,Rf=2kΩ,C_L=20pF,V_{IN}=0.4Vpp	18	35	-	V/us
Equivalent Input Noise Voltage	e_n	f=1kHz	-	6	-	nV/√Hz
		f=100kHz	-	5	-	
Total Harmonic Distortion + Noise	THD	Gv=14dB(Non-Inverting Amplifier) Rs=500Ω,Rf=2kΩ,,Vo=2Vpp,f=1kHz	-	0.0016	-	%
POWER SUPPLY						
Supply Voltage Rejection Ratio	SVR	V^+= 2.4V to 5.5V	78	98	-	dB
Supply Current	Icc	No Signal	-	3.8	4.5	mA

(Note) Applied circuit voltage gain is desired to operate above 14dB(5V/ V).

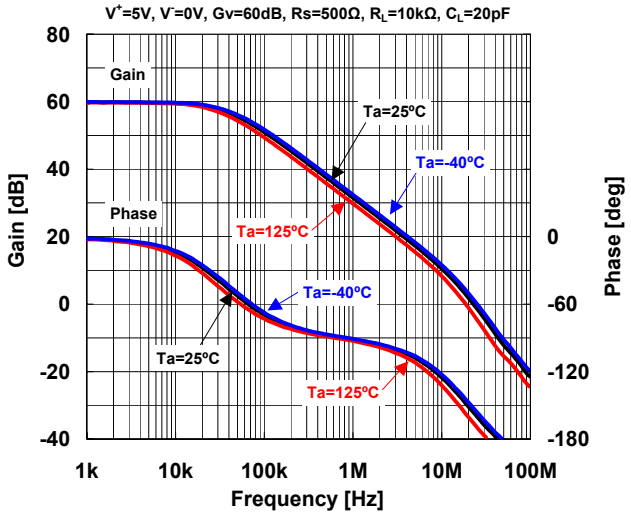
V^+=2.4V, V^-=0V, V_{ICM}=1.2V, Ta=25ºC, unless otherwise noted.

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
INPUT CHARACTERISTICS						
Input Offset Voltage	V_{IO}	Ta=25°C	-	0.4	1.5	mV
		Ta= - 40°C to 125°C	-	-	1.8	mV
Input Offset Voltage Drift	$\Delta V_{IO}/\Delta T$	Ta= - 40°C to 125°C	-	0.7	3.5	uV/°C
Input Bias Current	I_B		-	1	-	pA
Input Offset Current	I_{IO}		-	1	-	pA
Open Loop Gain	A_V	R_L=10kΩ to 1.2V	100	110	-	dB
Common Mode Rejection Ratio	CMR	V_{ICM}=0V to 2.4V	63	86	-	dB
Common Mode Input Voltage Range	V_{ICM}	CMR≧63dB	0	-	2.4	V
Common Mode Input Resistance	R_{ICM}		-	1000	-	GΩ
Differential Mode Input Resistance	R_{IDM}		-	1000	-	GΩ
Input Capacitance	C_{IN}		-	11	-	pF
OUTPUT CHARACTERISTICS						
High-level Output Voltage	V_{OH}	R_L=10kΩ to 1.2V	2.35	2.40	-	V
		R_L=600Ω to 1.2V	2.32	2.38	-	V
Low-level Output Voltage	V_{OL}	R_L=10kΩ to 1.2V	-	1.5	40	mV
		R_L=600Ω to 1.2V	-	16	60	mV
Short-circuit Output Currrent	I_{SC}	Short to V+	60	80	-	mA
		Short to V-	35	60	-	
Output Resistance	R_O		-	110	-	Ω
AC CHARACTERISTICS						
Gain Bandwidth Product	GBP	Gv=60dB,Rs=500Ω,RL=10kΩ to 1.2V, C_L=20pF ,f=1MHz	-	40	-	MHz
Phase Margin	ϕ_M	Gv=14dB,Rs=500Ω,RL=10kΩ to 1.2V, C_L=20pF	-	60	-	deg
Gain Margin	G_M	Gv=14dB,Rs=500Ω,RL=10kΩ to 1.2V, C_L=20pF	-	20	-	dB
Slew Rate	SR	Gv=14dB(Non-Inverting Amplifier) Rs=500Ω,Rf=2kΩ,C_L=20pF,V_{IN}=0.4Vpp	17	31	-	V/us
Equivalent Input Noise Voltage	e_n	f=1kHz	-	6	-	nV/√Hz
		f=100kHz	-	5	-	
Total Harmonic Distortion + Noise	THD	Gv=14dB(Non-Inverting Amplifier) Rs=500Ω,Rf=2kΩ,Vo=2Vpp,f=1kHz	-	0.01	-	%
POWER SUPPLY						
Supply Voltage Rejection Ratio	SVR	V^+= 2.4V to 5.5V	78	98	-	dB
Supply Current	Icc	No Signal	-	3.4	4.1	mA

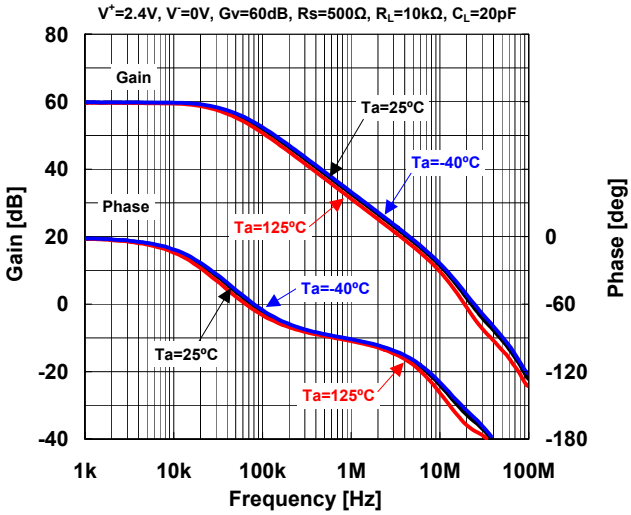
(Note) Applied circuit voltage gain is desired to operate above 14dB(5V/ V).

■ TYPICAL CHARACTERISTICS

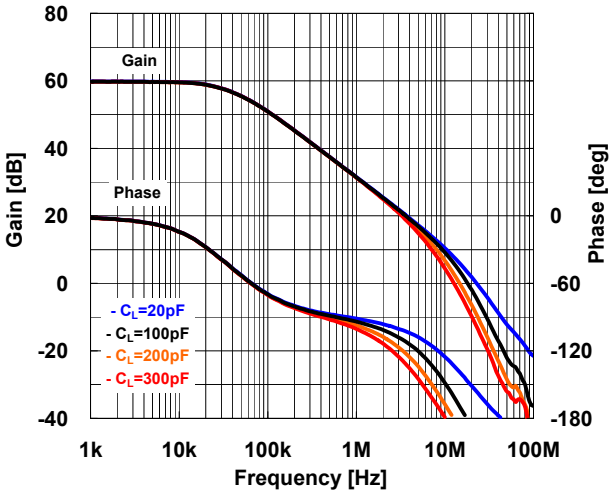
Gain/Phase vs. Frequency
V^+=5V, V^-=0V, Gv=60dB, Rs=500Ω, R_L=10kΩ, C_L=20pF



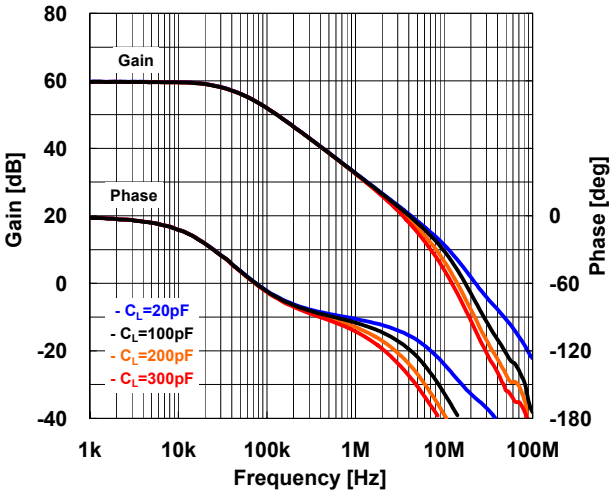
Gain/Phase vs. Frequency
V^+=2.4V, V^-=0V, Gv=60dB, Rs=500Ω, R_L=10kΩ, C_L=20pF



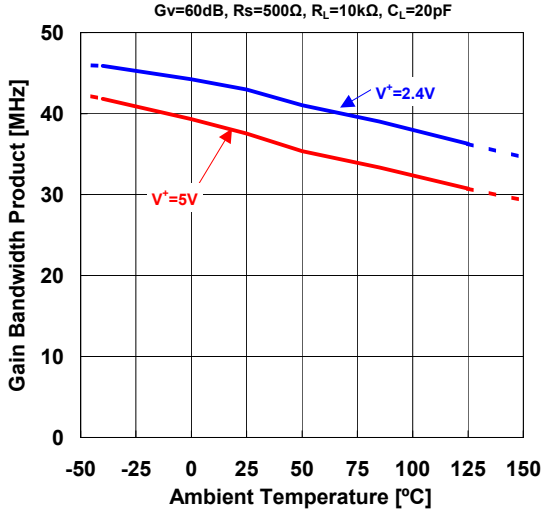
Gain/Phase vs. Frequency
V^+=5V, V^-=0V, Gv=60dB, Rs=500Ω, R_L=10kΩ, Ta=25°C



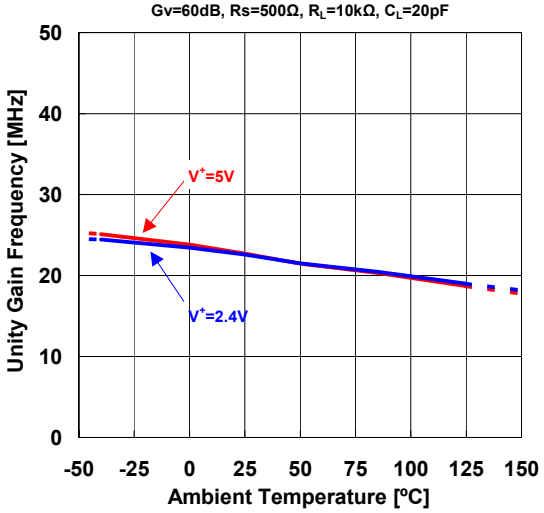
Gain/Phase vs. Frequency
V^+=2.4V,V^-=0V Gv=60dB, Rs=500Ω, R_L=10kΩ, Ta=25°C



GBW vs. Temperature
Gv=60dB, Rs=500Ω, R_L=10kΩ, C_L=20pF



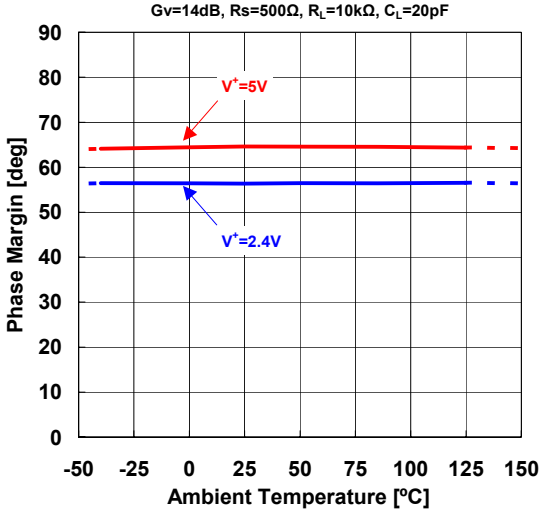
Unity Gain Frequency vs. Temperature
Gv=60dB, Rs=500Ω, R_L=10kΩ, C_L=20pF



■ TYPICAL CHARACTERISTICS

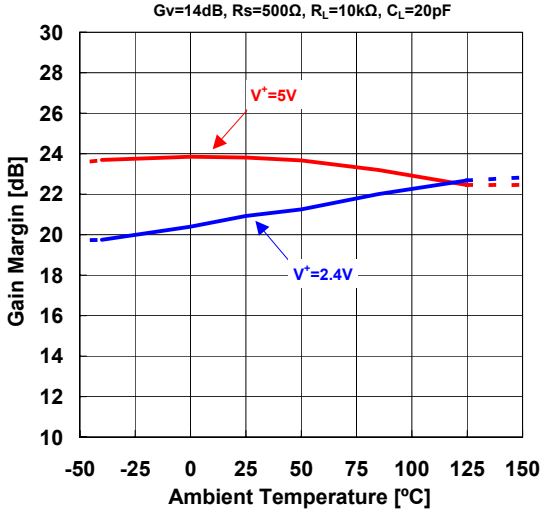
Phase Margin vs. Temperature

Gv=14dB, Rs=500Ω, R_L=10kΩ, C_L=20pF



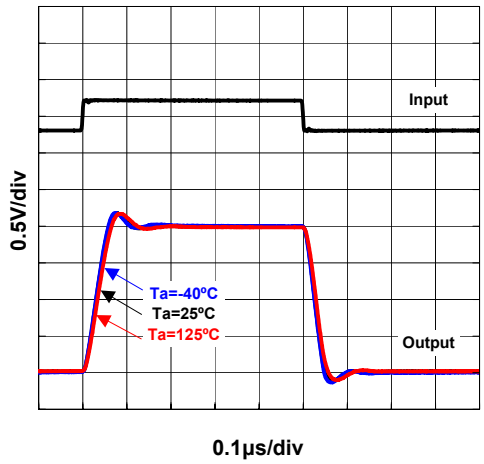
Gain Margin vs. Temperature

Gv=14dB, Rs=500Ω, R_L=10kΩ, C_L=20pF



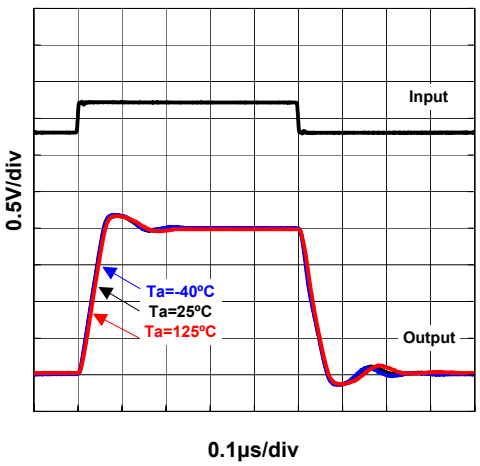
Pulse Response

V^+=5V, V^-=0V, V_{IN}=0.4Vpp, R_S=500Ω, R_F=2kΩ, C_L=20pF



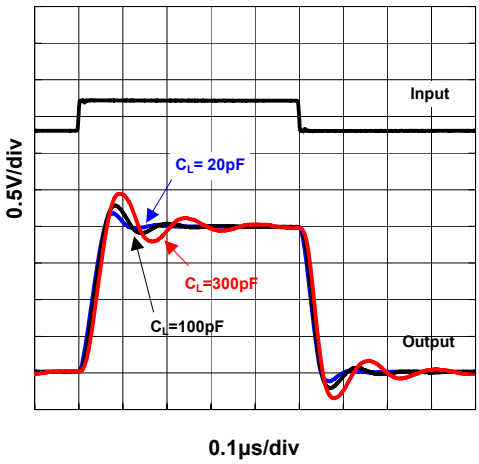
Pulse Response

V^+=2.4V, V^-=0V, V_{IN}=0.4Vpp, R_S=500Ω, R_F=2kΩ, C_L=20pF



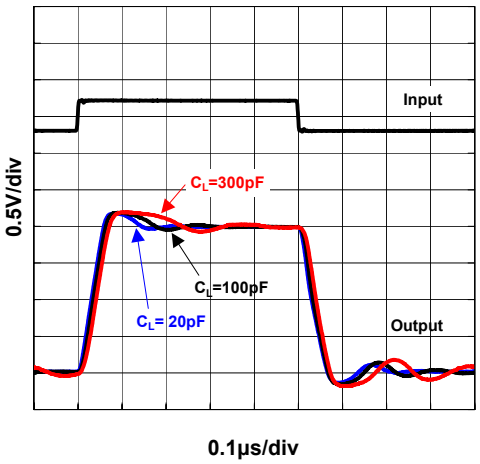
Pulse Response

V^+=5V, V^-=0V, V_{IN}=0.4Vpp, R_S=500Ω, R_F=2kΩ, Ta=25ºC



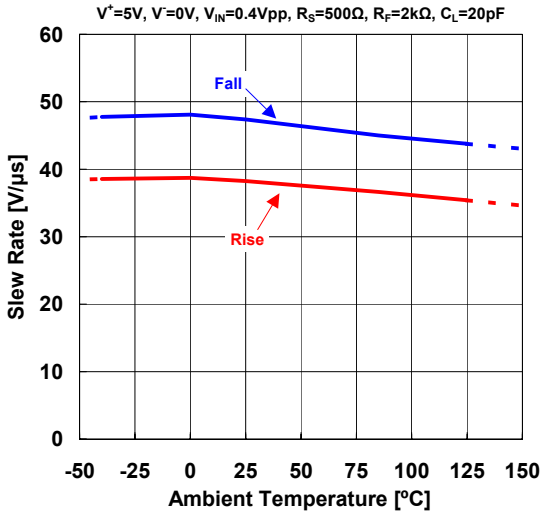
Pulse Response

V^+=2.4V, V^-=0V, V_{IN}=0.4Vpp, R_S=500Ω, R_F=2kΩ, Ta=25ºC

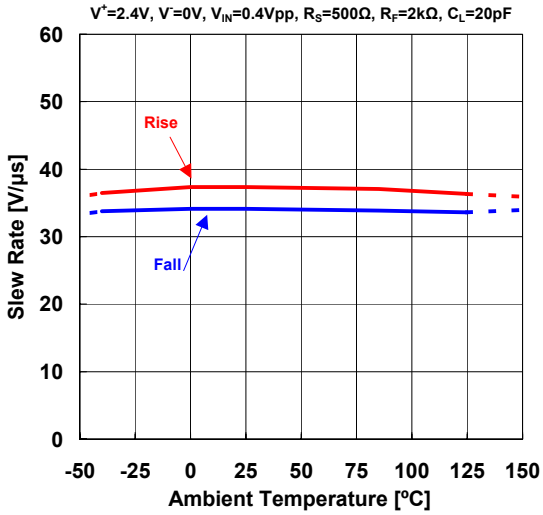


■ TYPICAL CHARACTERISTICS

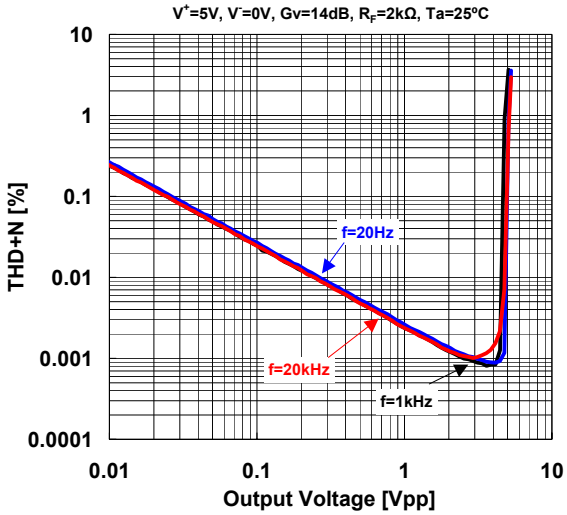
Slew Rate vs. Temperature
V^+=5V, V^-=0V, V_{IN}=0.4Vpp, R_S=500Ω, R_F=2kΩ, C_L=20pF



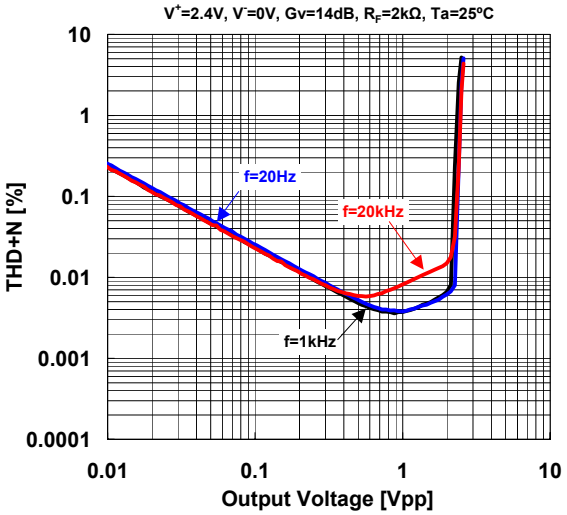
Slew Rate vs. Temperature
V^+=2.4V, V^-=0V, V_{IN}=0.4Vpp, R_S=500Ω, R_F=2kΩ, C_L=20pF



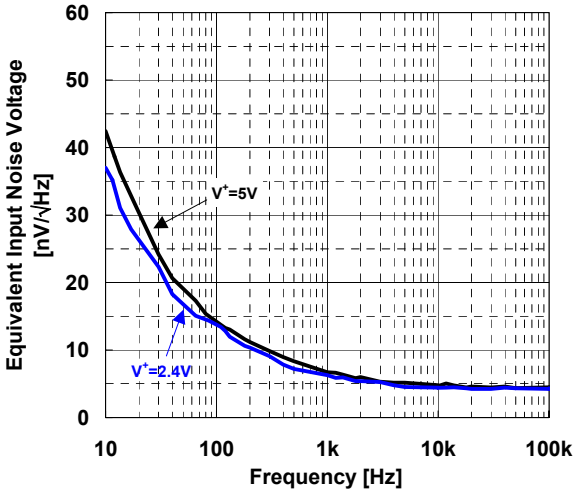
THD+N vs. Output Voltage
V^+=5V, V^-=0V, Gv=14dB, R_F=2kΩ, Ta=25ºC



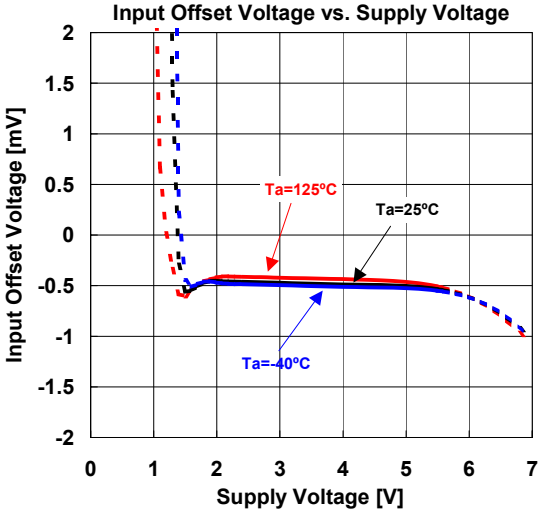
THD+N vs. Output Voltage
V^+=2.4V, V^-=0V, Gv=14dB, R_F=2kΩ, Ta=25ºC



Voltage Noise vs. Frequency
R_S=10Ω, R_F=10kΩ, Ta=25ºC

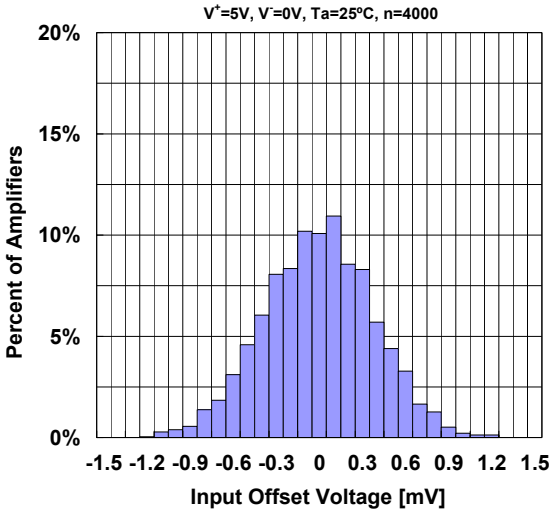


Input Offset Voltage vs. Supply Voltage

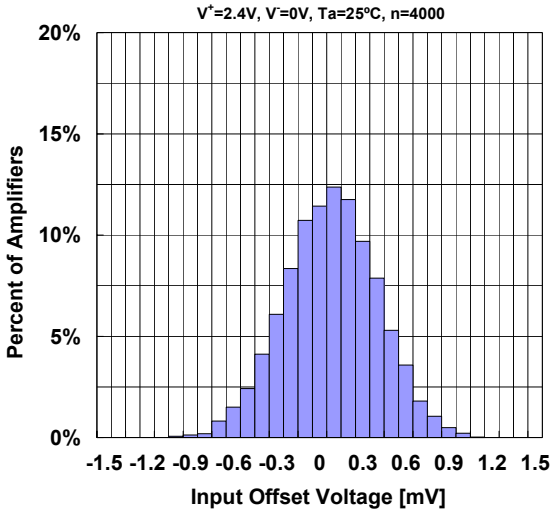


■ TYPICAL CHARACTERISTICS

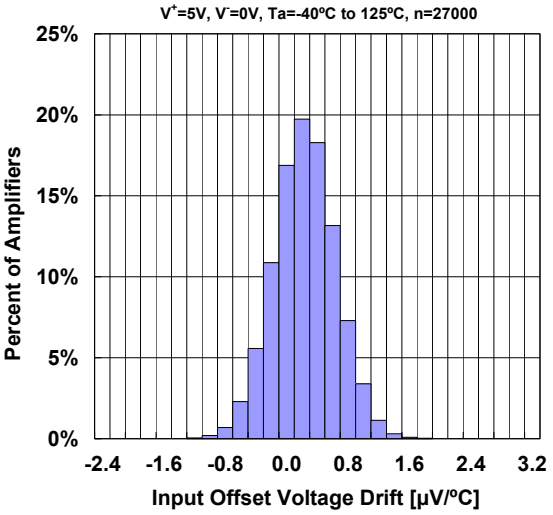
Input Offset Voltage Distribution
V^+=5V, V^-=0V, Ta=25ºC, n=4000



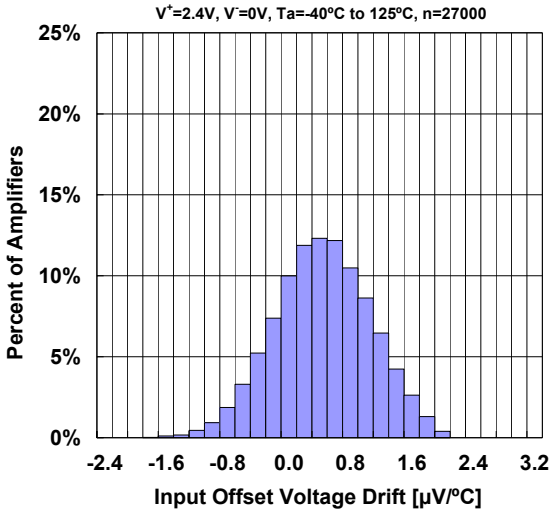
Input Offset Voltage Distribution
V^+=2.4V, V^-=0V, Ta=25ºC, n=4000



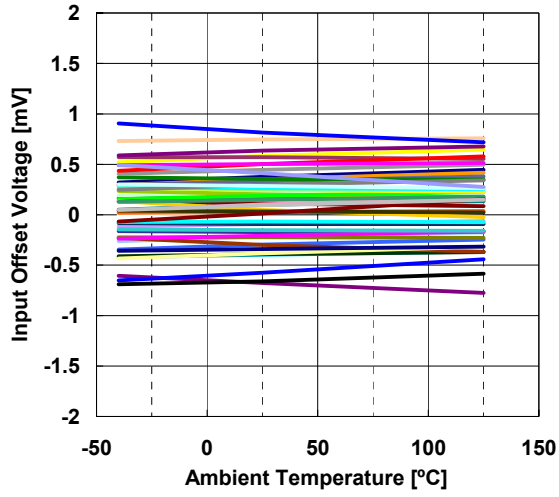
Input Offset Voltage Drift Distribution
V^+=5V, V^-=0V, Ta=-40ºC to 125ºC, n=27000



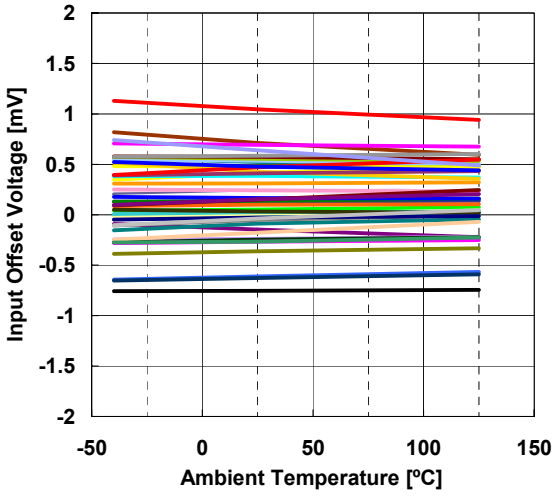
Input Offset Voltage Drift Distribution
V^+=2.4V, V^-=0V, Ta=-40ºC to 125ºC, n=27000



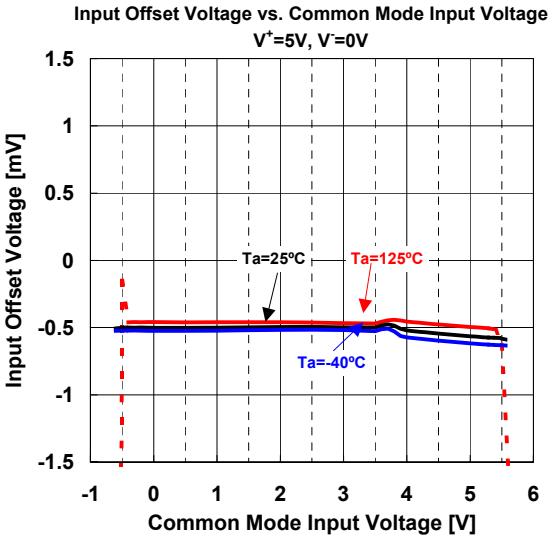
Input Offset Voltage vs. Temperature
N=48
V^+=5V, V^-=0V, V_{ICM}=2.5V

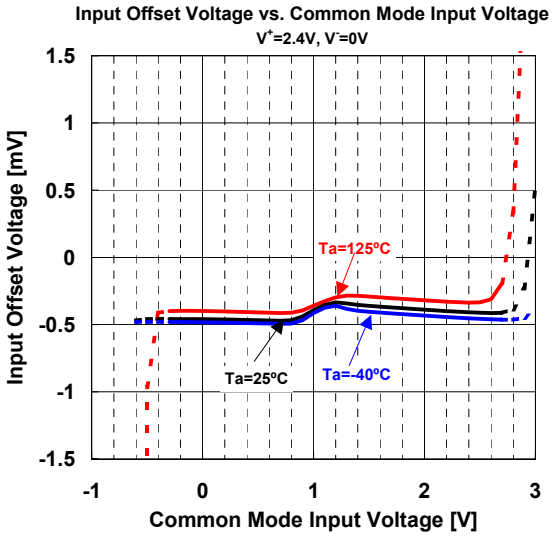


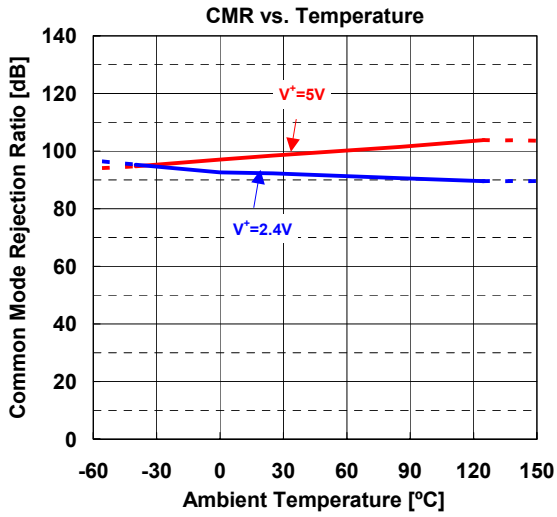
Input Offset Voltage vs. Temperature
N=48
V^+=2.4V, V^-=0V V_{ICM}=1.2V

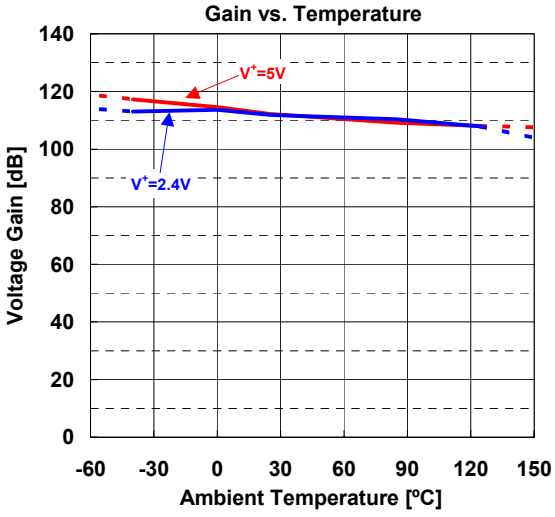


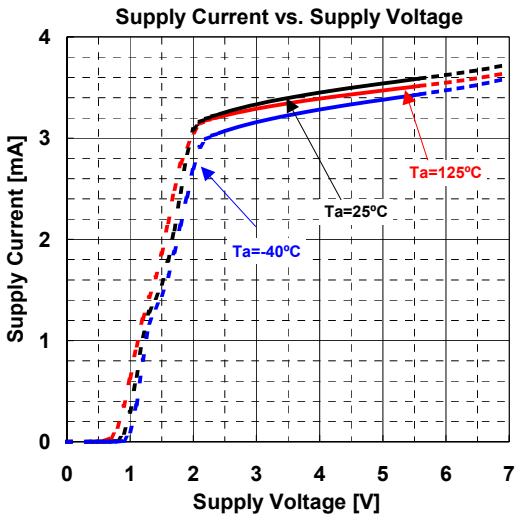
■ TYPICAL CHARACTERISTICS

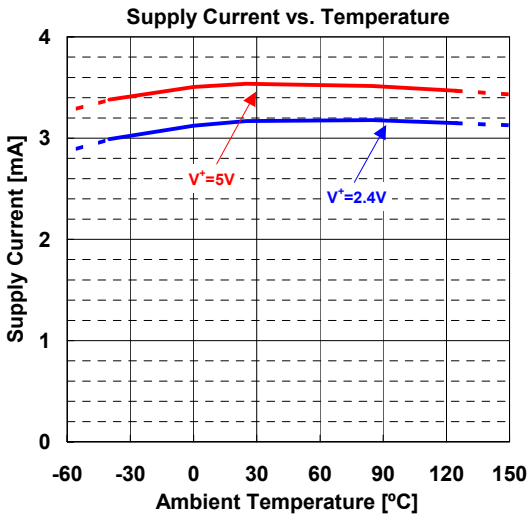




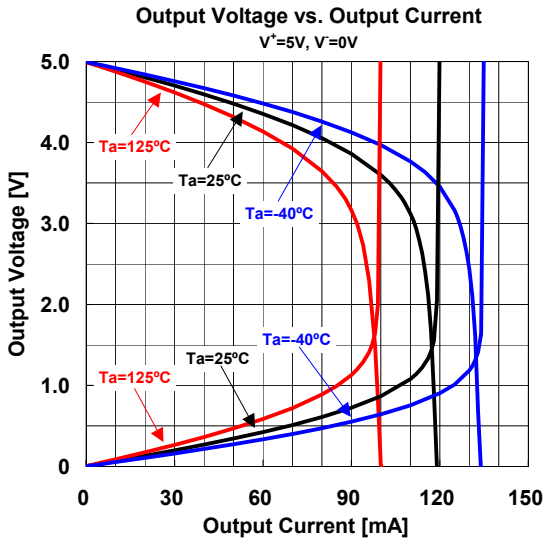


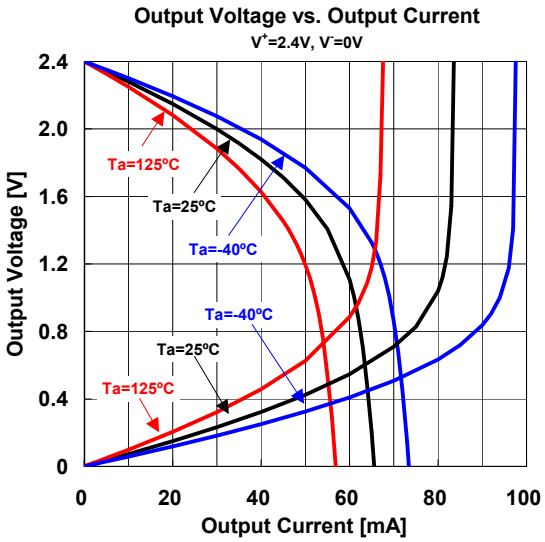


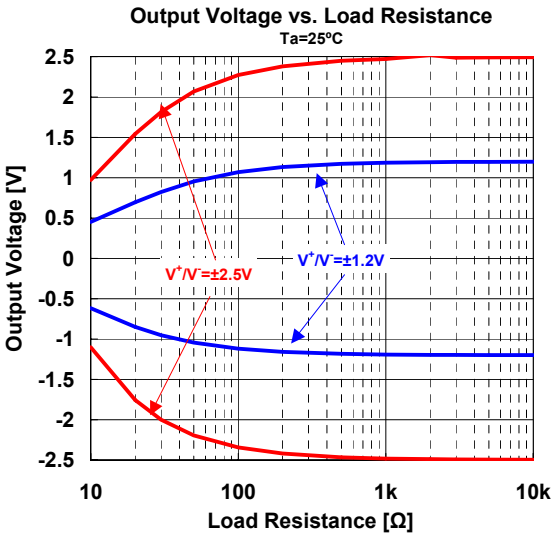




■ TYPICAL CHARACTERISTICS







■ PACKAGE DIMENSIONS