

Low Noise Precision Rail-to-Rail Output Dual CMOS Operational Amplifier

■ GENERAL DESCRIPTION

The NJU7077 is a high precision Rail-to-Rail output dual CMOS operational amplifier featuring a low noise of $10\text{nV}/\sqrt{\text{Hz}}$ (typ.), low input offset voltage of $150\mu\text{V}$ (max.), low temperature drift of $0.5\mu\text{V}/^\circ\text{C}$ (typ.) and low bias current of 1pA (typ.). The output swing can reach 50mV from the rails, while driving a $10\text{k}\Omega$ load (at 5V operation). The NJU7077 also has a high RF noise immunity which can reduce malfunctions caused by RF noises from mobile phones and others. The combination of these specifications makes the NJU7077 well-sited for sensor applications such as a temperature sensor, weight sensor and others, high precision current sensing amplifiers and current voltage converters. The NJU7077 is available in a small surface mount package of MSOP8 (VSP8) meeting JEDEC MO-187-DA.

■ PACKAGE OUTLINE



**NJU7077R
(MSOP8 (VSP8))**

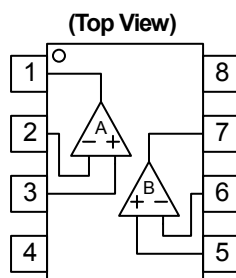
■ FEATURES

- Precision
 - Offset Voltage $150\mu\text{V}$ max.
 - Low Drift $0.5\mu\text{V}/^\circ\text{C}$ typ.
- Noise Voltage $10\text{nV}/\sqrt{\text{Hz}}$ typ.
- Low Bias Current 1pA typ.
- Rail-to-rail Output $+0.05\text{V}$ to $V_{\text{DD}} - 0.05\text{V}$ ($R_{\text{L}} = 10\text{k}\Omega$)
- RF Immunity
- Operating Voltage $+2.2\text{V}$ to $+5.5\text{V}$
- Package MSOP8 (VSP8) MEET JEDEC MO-187-DA

■ APPLICATIONS

- Thermocouple / Thermopile Amplifiers
- Strain Gauge / Pressure sensor Amplifiers
- Load Cell and Bridge Transducer Amplifiers
- High Resolution Data Acquisition
- Precision Current Sensing

■ Pin CONFIGURATION



PIN FUNCTION

- 1: A OUTPUT
- 2: A -INPUT
- 3: A +INPUT
- 4: VSS
- 5: B +INPUT
- 6: B -INPUT
- 7: B OUTPUT
- 8: VDD

■ABSOLUTE MAXIMUM RATINGS (Ta=25°C, unless otherwise noted.)

PARAMETER	SYMBOL	RATING	UNIT
Supply Voltage	V _{DD}	+7	V
Common Mode Input Voltage Range	V _{ICM}	V _{SS} - 0.3 to V _{DD} + 0.3	V
Differential Input Voltage Range	V _{ID}	±7 (Note1)	V
Power Dissipation(Note3)	P _D	500(Note2)	mW
Operating Temperature Range	Topr	-40 to +125	°C
Storage Temperature Range	Tstg	-55 to +150	°C

(Note1) For supply voltage less than 7V, the absolute maximum input voltage is equal to supply voltage.

(Note2) On the PCB "EIA/JEDEC(76.2×114.3×1.6mm, 2 layers, FR-4)"

(Note3) Do not exceed "Power dissipation: PD" in which power dissipation in IC is shown by the absolute maximum rating. Refer to following Figure 1 for a permissible loss when ambient temperature (Ta) is Ta≥25°C.

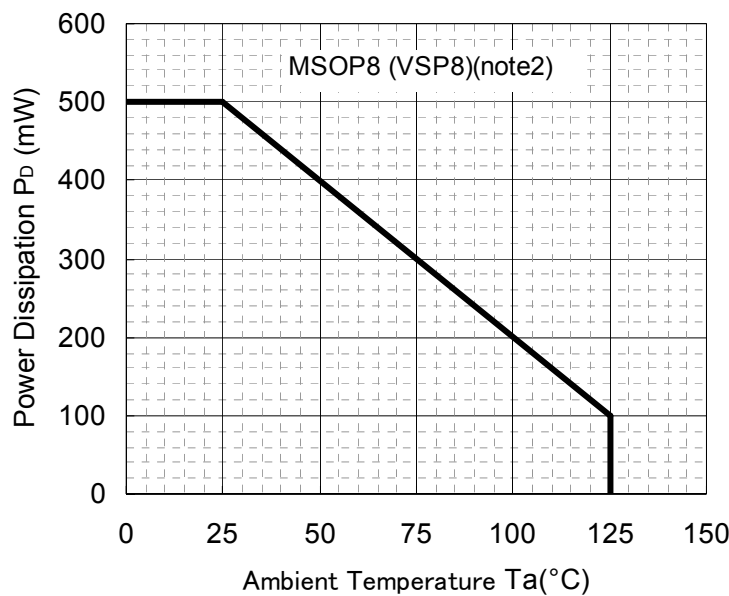


Figure1: PD – Temperature

■RECOMMENDED OPERATING CONDITIONS (Ta=25°C)

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Supply Voltage	V _{DD}		+2.2	-	+5.5	V

■ ELECTRICAL CHARACTERISTICS

● DC CHARACTERISTICS ($V_{DD}=5V$, $V_{SS}=0V$, $V_{ICM}=2.5V$, $T_a=25^\circ C$, unless otherwise noted.)

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Supply Current	I_{CC}	No Signal	-	1.2	1.8	mA
		No Signal, $T_a=-40^\circ C$ to $125^\circ C$	-	-	1.8	
Input Offset Voltage	V_{IO}		-	20	150	μV
		$T_a=-40^\circ C$ to $125^\circ C$	-	-	400	
Input Offset Voltage Drift	TCV_{IO}	$T_a=-40^\circ C$ to $125^\circ C$ (Note4)	-	0.5	5.0	$\mu V/^\circ C$
Input Bias Current	I_B		-	1	-	pA
Input Offset Current	I_{IO}		-	1	-	pA
Voltage Gain	A_v	$V_{out}=0.5V$ to $4.5V$, $R_L=10k\Omega$ to $2.5V$	100	130	-	dB
		$V_{out}=0.5V$ to $4.5V$, $R_L=10k\Omega$ to $2.5V$, $T_a=-40^\circ C$ to $125^\circ C$	100	-	-	
Common Mode Rejection Ratio	CMR	$V_{ICM}=0V$ to $4V$	70	90	-	dB
		$V_{ICM}=0V$ to $4V$, $T_a=-40^\circ C$ to $125^\circ C$	70	-	-	
Supply Voltage Rejection Ratio	SVR	$V_{DD}=2.2V$ to $5.5V$	70	90	-	dB
		$V_{DD}=2.2V$ to $5.5V$, $T_a=-40^\circ C$ to $125^\circ C$	70	-	-	
Maximum Output Voltage	V_{OH}	$R_L=10k\Omega$ to $2.5V$	4.95	4.98	-	V
		$R_L=10k\Omega$ to $2.5V$, $T_a=-40^\circ C$ to $125^\circ C$	4.95	-	-	
		$R_L=600\Omega$ to $2.5V$	4.85	4.92	-	
		$R_L=600\Omega$ to $2.5V$, $T_a=-40^\circ C$ to $125^\circ C$	4.85	-	-	
		$I_O=2mA$	4.9	4.96	-	
	V_{OL}	$R_L=10k\Omega$ to $2.5V$	-	0.02	0.05	V
		$R_L=10k\Omega$ to $2.5V$, $T_a=-40^\circ C$ to $125^\circ C$	-	-	0.05	
		$R_L=600\Omega$ to $2.5V$	-	0.08	0.15	
		$R_L=600\Omega$ to $2.5V$, $T_a=-40^\circ C$ to $125^\circ C$	-	-	0.2	
		$I_O=2mA$	-	0.04	0.1	
Common Mode Input Voltage Range	V_{ICM}	CMR $\geq 70dB$	0	-	4	V
		CMR $\geq 70dB$, $T_a=-40^\circ C$ to $125^\circ C$	0	-	4	

(Note4) Guaranteed by two points of Temperature $-40^\circ C$ and $+125^\circ C$

● AC CHARACTERISTICS ($V_{DD}=5V$, $V_{SS}=0V$, $V_{ICM}=2.5V$, $T_a=25^\circ C$, unless otherwise noted.)

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Gain Bandwidth Product	GBW	$G_V=40dB$, $R_F=100k\Omega$, $R_L=10k\Omega$, $C_L=20pF$	-	1.3	-	MHz
Phase Margin	ϕ_M	$G_V=40dB$, $R_F=100k\Omega$, $R_L=10k\Omega$, $C_L=20pF$	-	60	-	deg
Gain Margin	G_M	$G_V=40dB$, $R_F=100k\Omega$, $R_L=10k\Omega$, $C_L=20pF$	-	12	-	dB
Equivalent Input Noise Voltage	V_{NI}	$f=1kHz$	-	10	-	nV/\sqrt{Hz}
Slew Rate	SR	$G_V=0dB$, $R_L=10k\Omega$, $C_L=20pF$, $V_{IN}=4V_{PP}$	-	0.5	-	$V/\mu s$
Total Harmonic Distortion	THD	$G_V=20dB$, $R_L=10k\Omega$, $f=1kHz$, $V_O=3V_{PP}$	-	0.01	-	%
Channel Separation	CS	$f=1kHz$	-	140	-	dB

NJU7077

●DC CHARACTERISTICS ($V_{DD}=2.2V$, $V_{SS}=0V$, $V_{ICM}=1.1V$, $T_a=25^\circ C$, unless otherwise noted.)

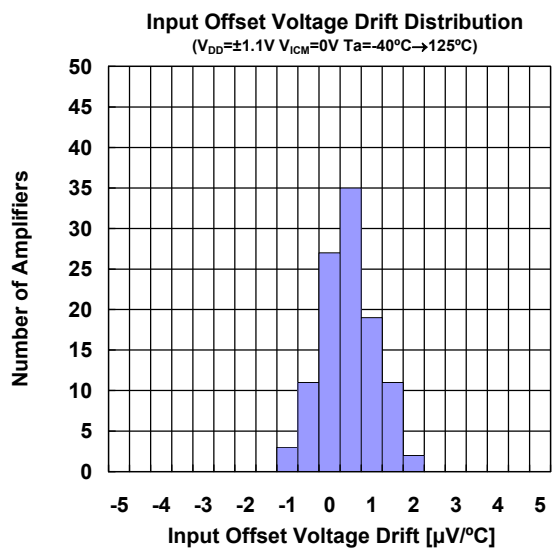
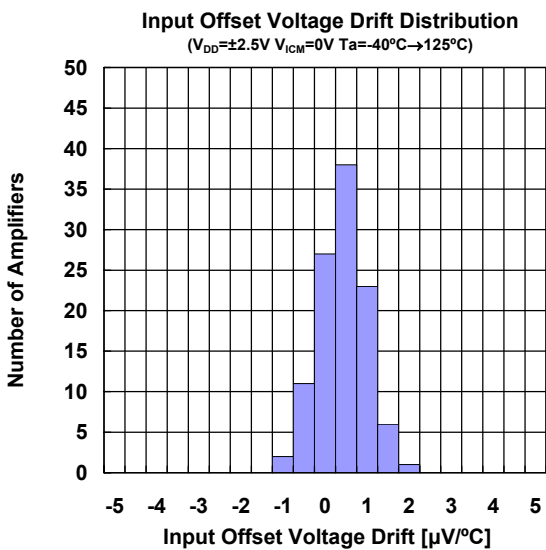
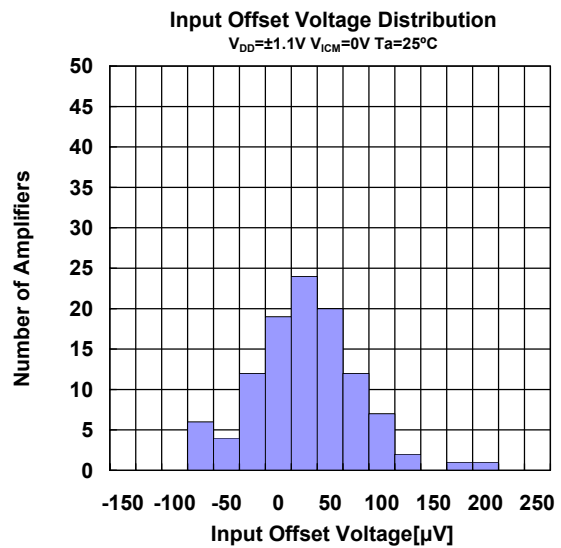
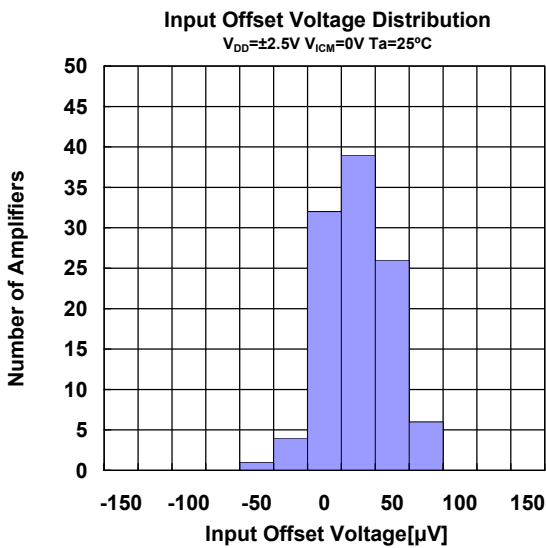
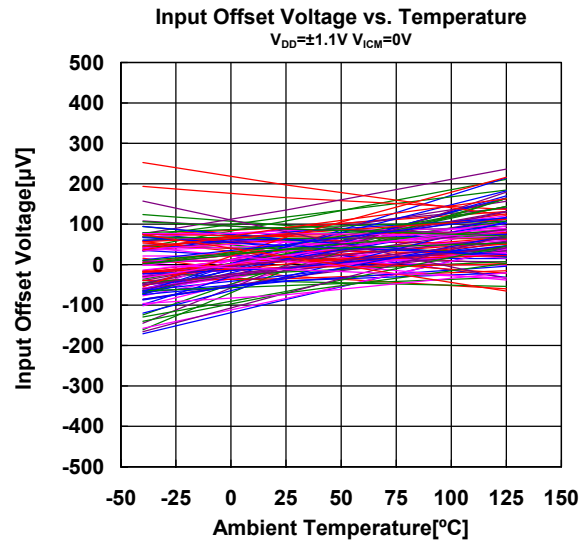
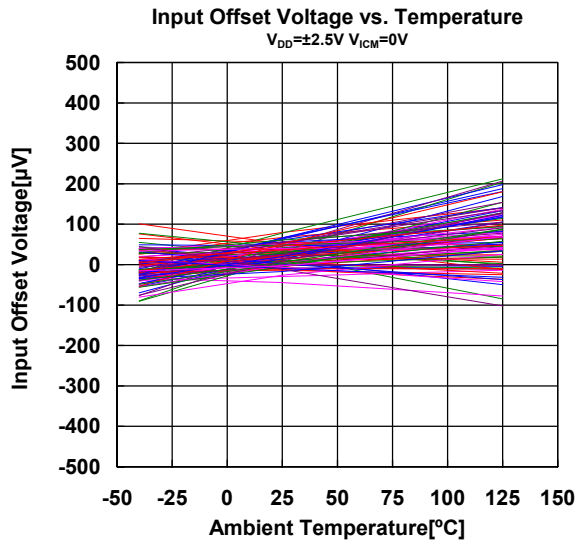
PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Supply Current	I_{CC}	No Signal	-	1.0	1.5	mA
		No Signal, $T_a=-40^\circ C$ to $125^\circ C$	-	-	1.5	
Input Offset Voltage	V_{IO}		-	60	250	μV
		$T_a=-40^\circ C$ to $125^\circ C$	-	-	400	
Input Offset Voltage Drift	TCV_{IO}	$T_a=-40^\circ C$ to $125^\circ C$ (Note4)	-	0.6	5.0	$\mu V/^\circ C$
Input Bias Current	I_B		-	1	-	pA
Input Offset Current	I_{IO}		-	1	-	pA
Voltage Gain	A_v	$V_{out}=0.6V$ to $1.6V$, $R_L=10k\Omega$ to $1.1V$	100	130	-	dB
		$V_{out}=0.6V$ to $1.6V$, $R_L=10k\Omega$ to $1.1V$, $T_a=-40^\circ C$ to $125^\circ C$	100	-	-	
Common Mode Rejection Ratio	CMR	$V_{ICM}=0V$ to $1.2V$	70	90	-	dB
		$V_{ICM}=0V$ to $1.2V$, $T_a=-40^\circ C$ to $125^\circ C$	70	-	-	
Maximum Output Voltage	V_{OH}	$R_L=10k\Omega$ to $1.1V$	2.15	2.18	-	V
		$R_L=10k\Omega$ to $1.1V$, $T_a=-40^\circ C$ to $125^\circ C$	2.15	-	-	
		$R_L=600\Omega$ to $1.1V$	2.1	2.14	-	
		$R_L=600\Omega$ to $1.1V$, $T_a=-40^\circ C$ to $125^\circ C$	2.05	-	-	
		$I_O=2mA$	2.05	2.13	-	
	V_{OL}	$R_L=10k\Omega$ to $1.1V$	-	0.02	0.05	V
		$R_L=10k\Omega$ to $1.1V$, $T_a=-40^\circ C$ to $125^\circ C$	-	-	0.05	
		$R_L=600\Omega$ to $1.1V$	-	0.06	0.1	
		$R_L=600\Omega$ to $1.1V$, $T_a=-40^\circ C$ to $125^\circ C$	-	-	0.15	
		$I_O=2mA$	-	0.07	0.15	
Common Mode Input Voltage Range	V_{ICM}	CMR $\geq 70dB$	0	-	1.2	V
		CMR $\geq 70dB$, $T_a=-40^\circ C$ to $125^\circ C$	0	-	1.2	

(Note4) Guaranteed by two points of Temperature $-40^\circ C$ and $+125^\circ C$

●AC CHARACTERISTICS ($V_{DD}=2.2V$, $V_{SS}=0V$, $V_{ICM}=1.1V$, $T_a=25^\circ C$, unless otherwise noted.)

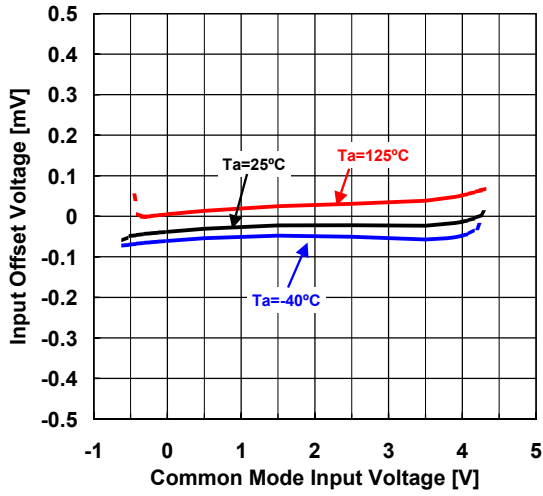
PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Gain Bandwidth Product	GBW	$G_V=40dB$, $R_F=100k\Omega$, $R_L=10k\Omega$, $C_L=20pF$	-	1.2	-	MHz
Phase Margin	ϕ_M	$G_V=40dB$, $R_F=100k\Omega$, $R_L=10k\Omega$, $C_L=20pF$	-	60	-	deg
Gain Margin	G_M	$G_V=40dB$, $R_F=100k\Omega$, $R_L=10k\Omega$, $C_L=20pF$	-	12	-	dB
Equivalent Input Noise Voltage	V_{NI}	$f=1kHz$	-	10	-	nV/\sqrt{Hz}
Slew Rate	SR	$G_V=0dB$, $R_L=10k\Omega$, $C_L=20pF$, $V_{IN}=1V_{PP}$	-	0.5	-	$V/\mu s$
Total Harmonic Distortion	THD	$G_V=20dB$, $R_L=10k\Omega$, $f=1kHz$, $V_O=1V_{PP}$	-	0.01	-	%
Channel Separation	CS	$f=1kHz$	-	140	-	dB

■ TYPICAL CHARACTERISTICS

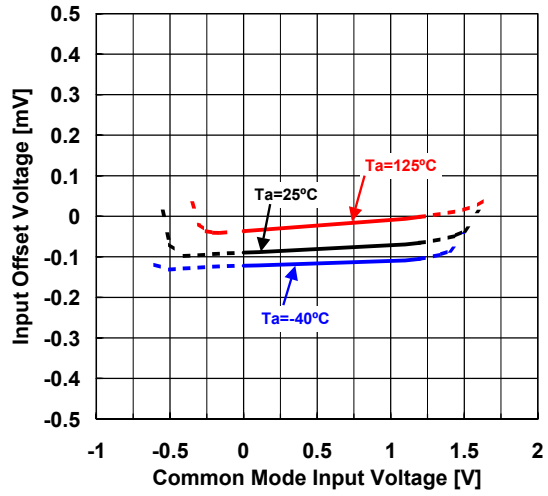


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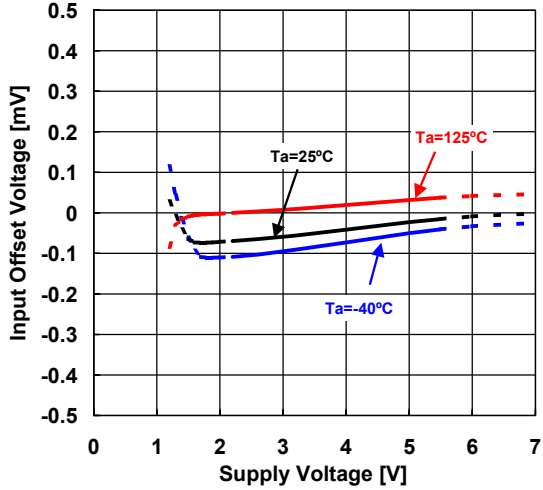
Input Offset Voltage vs. Common Mode Input Voltage (Temperature)
 $V_{DD}=+5V$



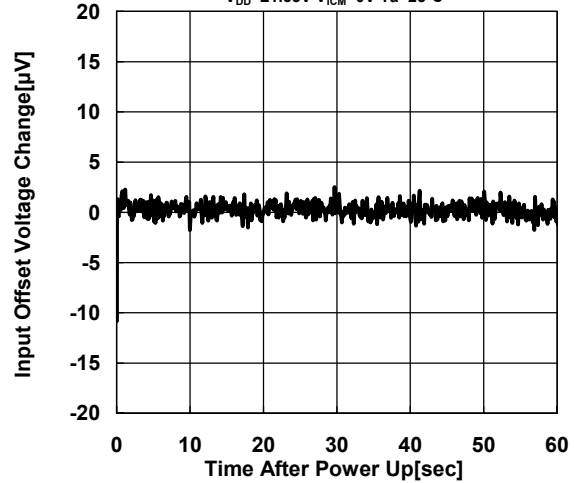
Input Offset Voltage vs. Common Mode Input Voltage (Temperature)
 $V_{DD}=+2.2V$



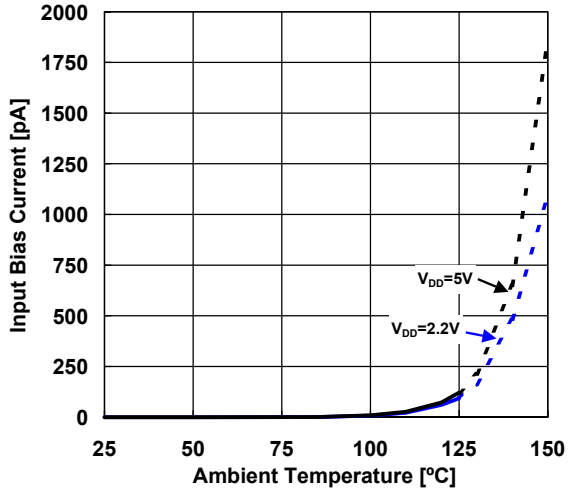
Input Offset Voltage vs. Supply Voltage (Temperature)
 $V_{ICM}=V_{DD}/2$



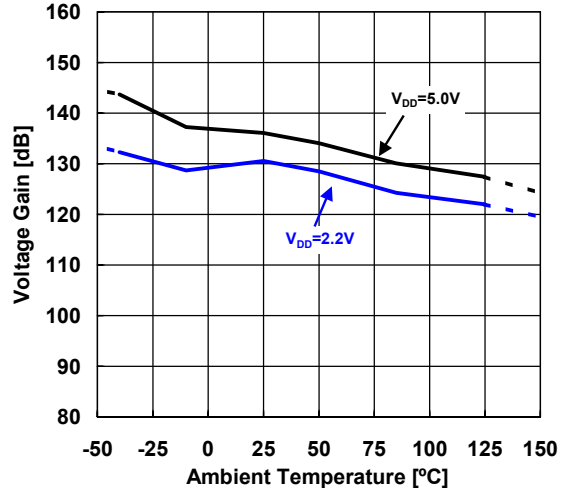
Warm-Up Vio Drift
 $V_{DD}=\pm 1.65V$ $V_{ICM}=0V$ $T_a=25^\circ C$



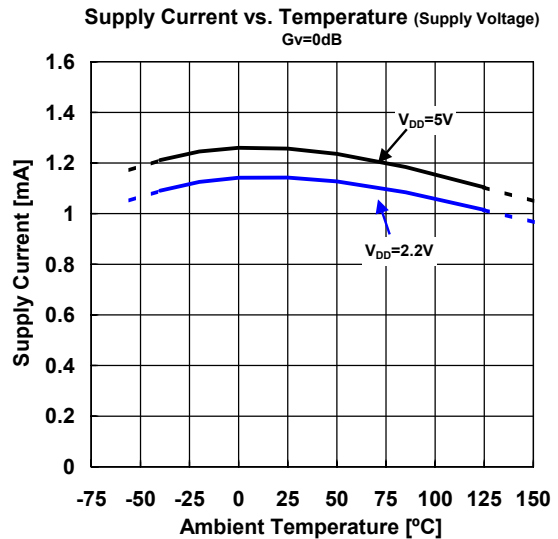
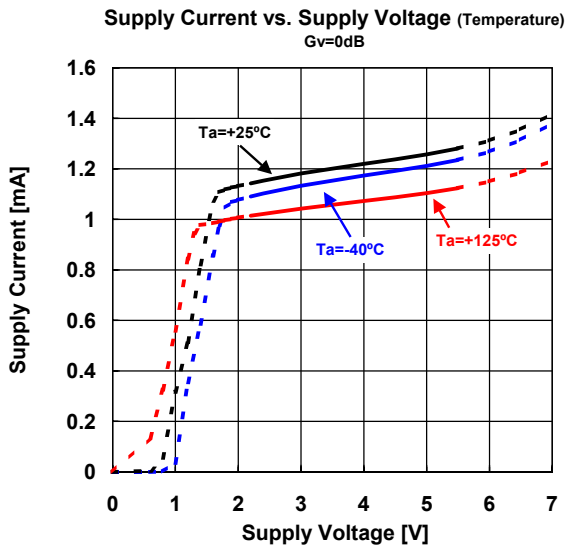
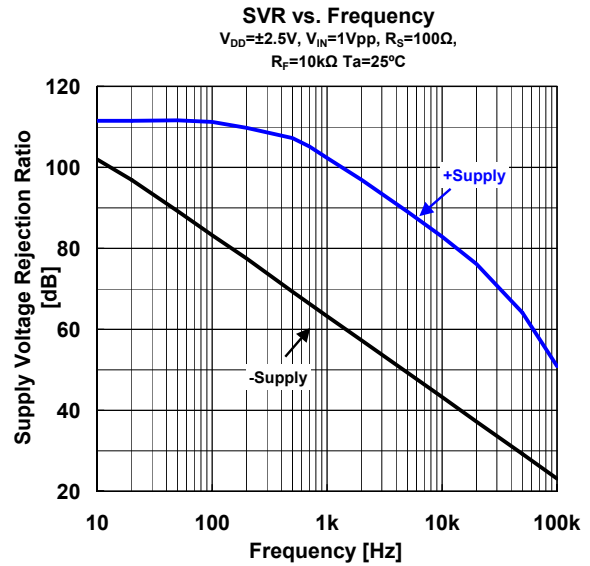
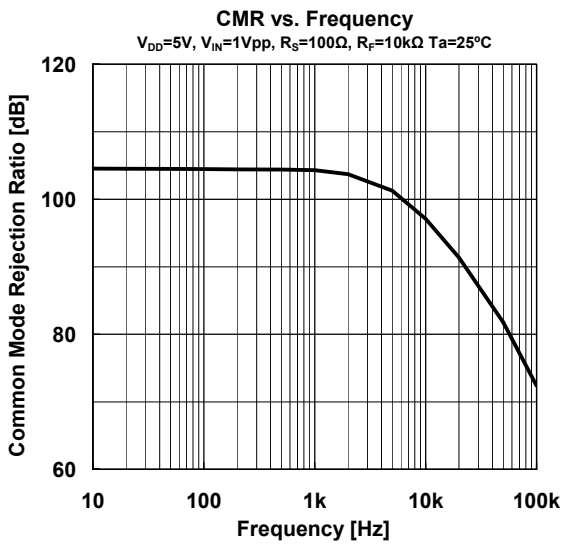
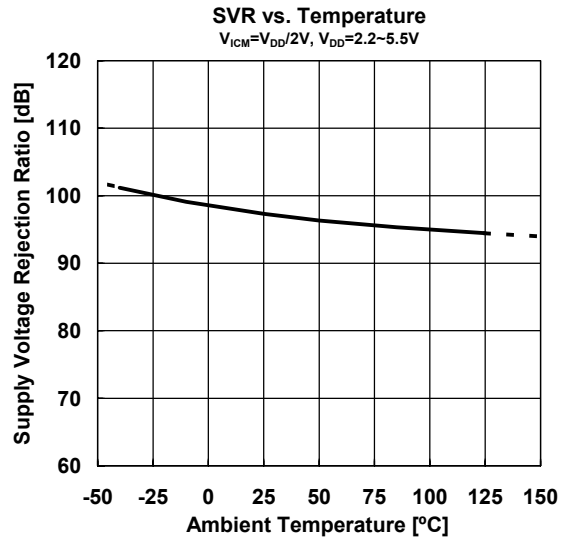
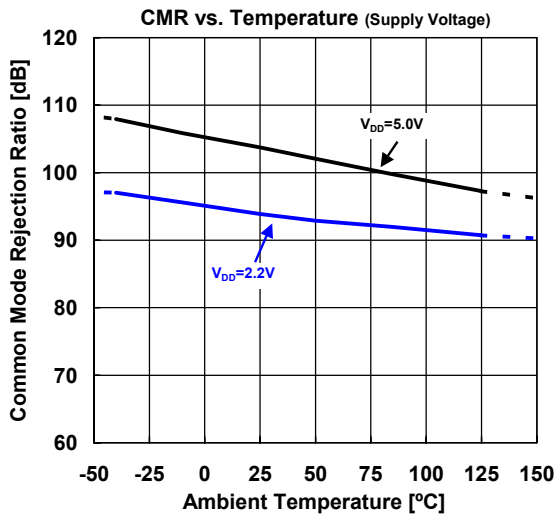
Input Bias Current vs. Temperature (Supply Voltage)
 $V_{ICM}=V_{DD}/2$



Open-Loop Gain vs. Temperature (Supply Voltage)
 $R_L=10k\Omega$

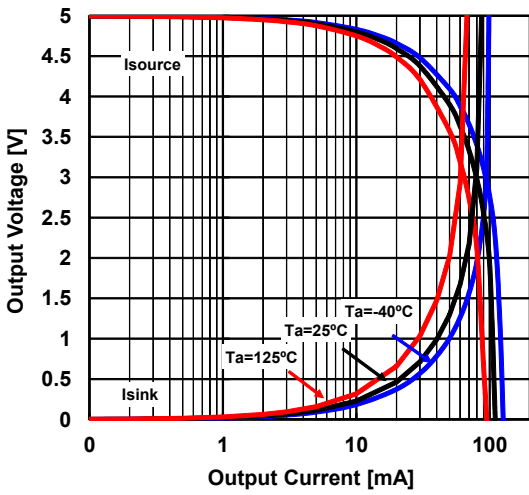


■ TYPICAL CHARACTERISTICS

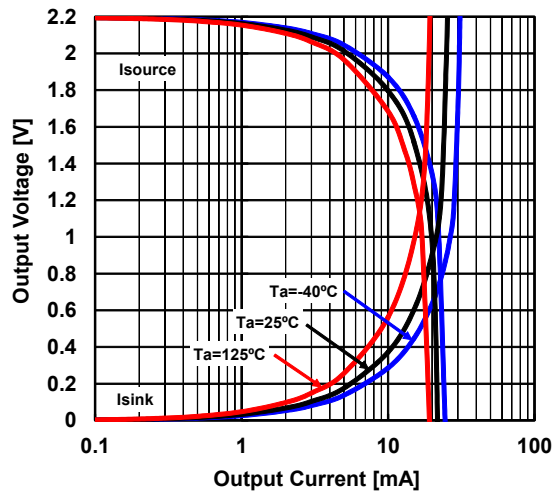


■ TYPICAL CHARACTERISTICS

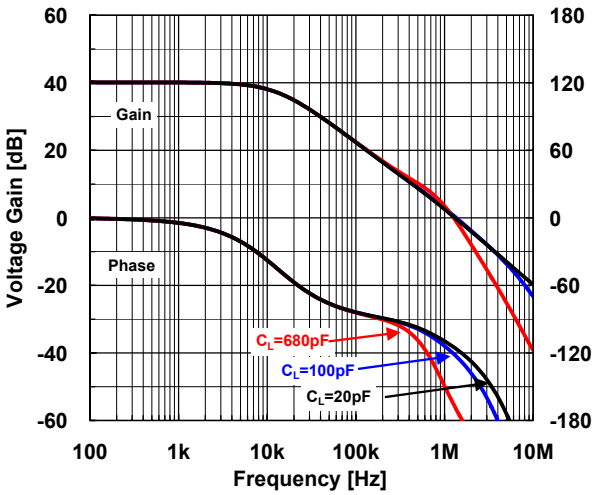
Maximum Output Voltage vs. Output Current
(Temperature)
 $V_{DD}=5V$



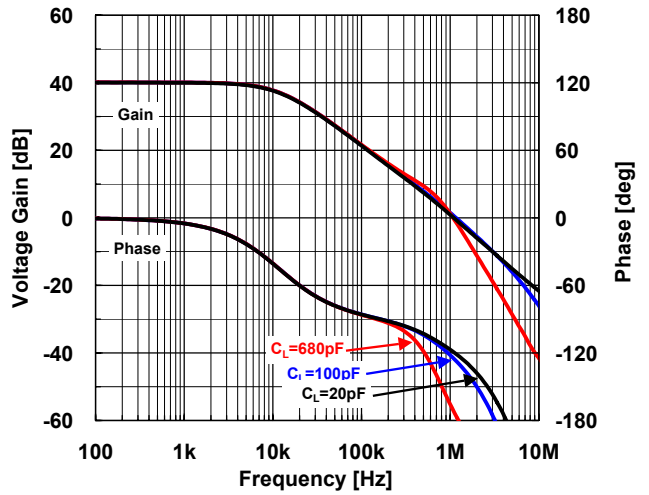
Maximum Output Voltage vs. Output Current
(Temperature)
 $V_{DD}=2.2V$



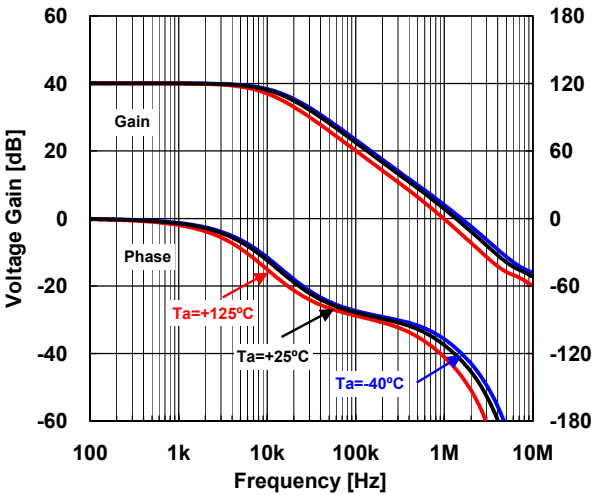
Gain/Phase vs. Frequency
 $V_{DD}=5V, G_v=40dB, R_F=100k\Omega, R_S=1k\Omega$
 $R_L=10k\Omega, T_a=25^\circ C$



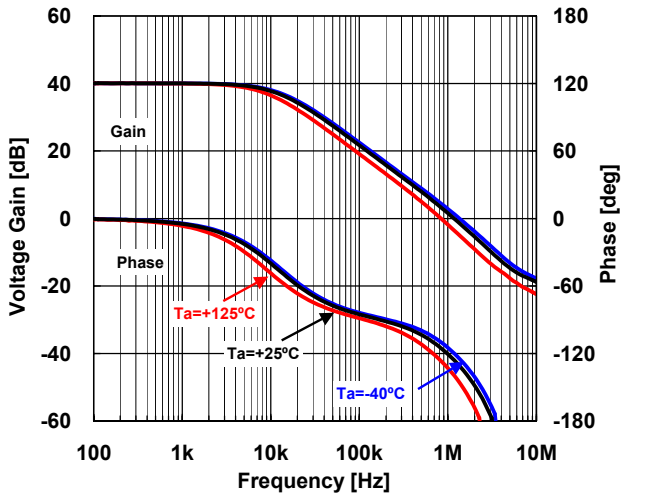
Gain/Phase vs. Frequency
 $V_{DD}=2.2V, G_v=40dB, R_F=100k\Omega, R_S=1k\Omega$
 $R_L=10k\Omega, T_a=25^\circ C$



Gain/Phase vs. Frequency (Temperature)
 $V_{DD}=5V, G_v=40dB, R_F=100k\Omega, R_S=1k\Omega$
 $R_L=10k\Omega, C_L=20pF$

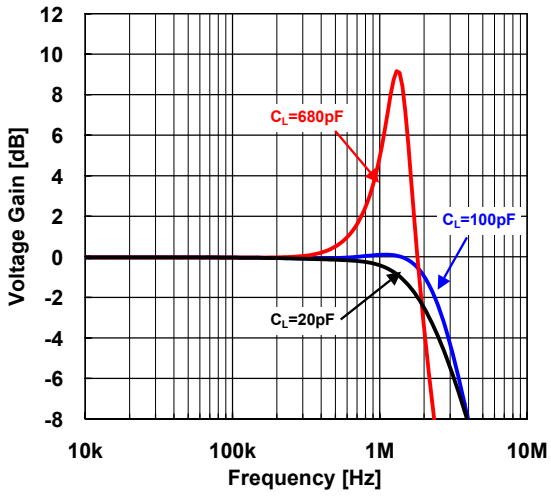


Gain/Phase vs. Frequency (Temperature)
 $V_{DD}=2.2V, G_v=40dB, R_F=100k\Omega, R_S=1k\Omega$
 $R_L=10k\Omega, C_L=20pF$

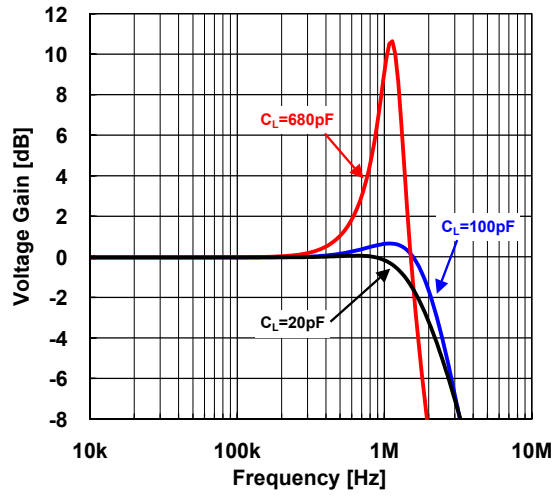


TYPICAL CHARACTERISTICS

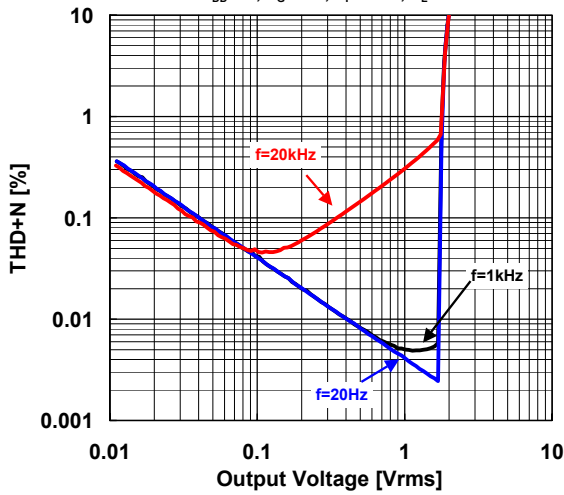
Gain vs. Frequency (Load Capacitance)
 $V_{DD}=5V, G_v=0dB, R_L=10k\Omega, T_a=25^\circ C$



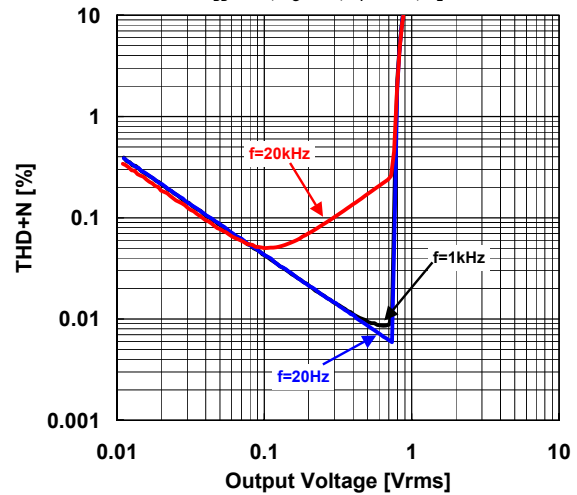
Gain vs. Frequency (Load Capacitance)
 $V_{DD}=2.2V, G_v=0dB, R_L=10k\Omega, T_a=25^\circ C$



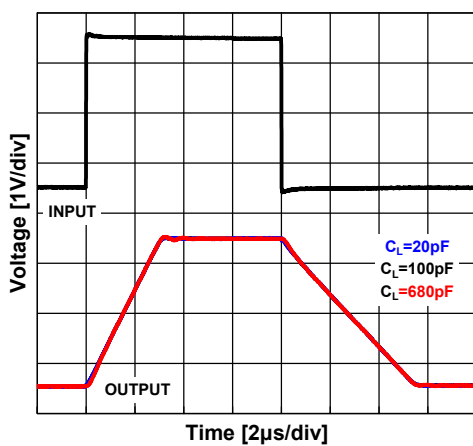
THD+N vs. Output Voltage
 $V_{DD}=5V, R_G=1k\Omega, R_F=10k\Omega, R_L=\infty\Omega$



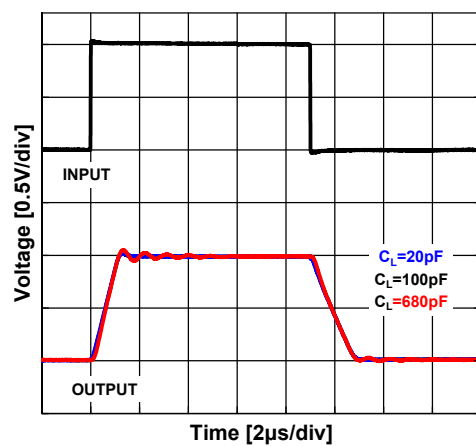
THD+N vs. Output Voltage
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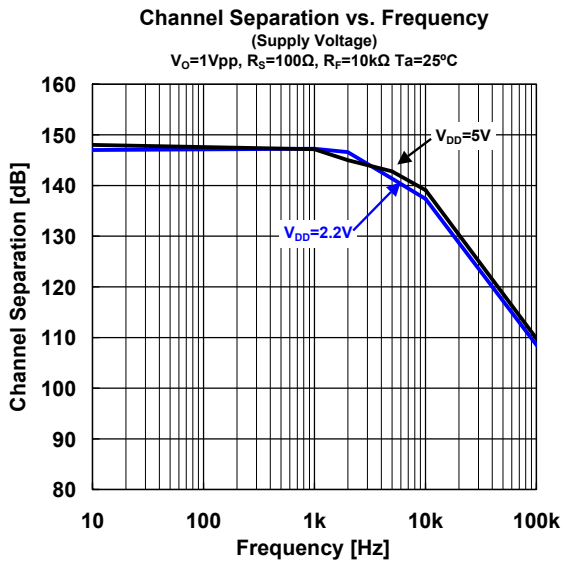
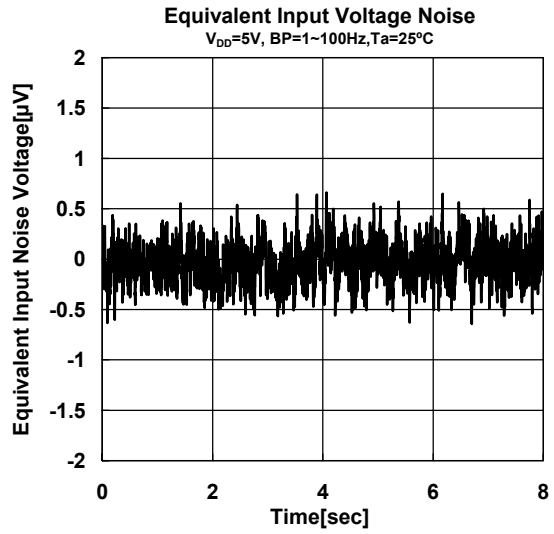
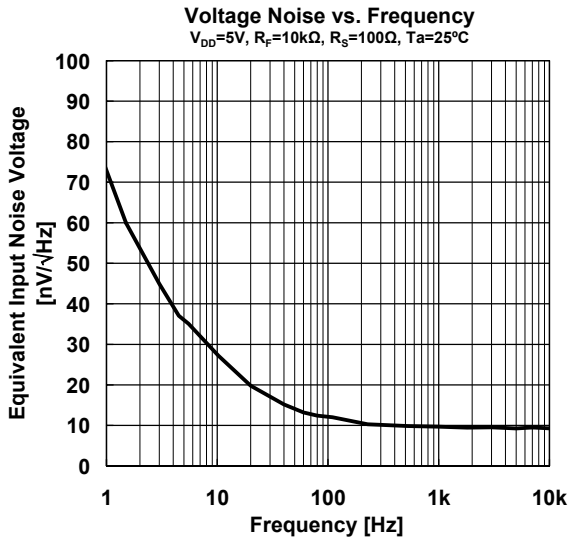
Pulse Response (Load Capacitance)
 $V^+/V^-=\pm 2.5V, R_L=10k\Omega, G_v=0dB, T_a=25^\circ C$



Pulse Response (Load Capacitance)
 $V^+/V^-=\pm 1.1V, R_L=10k\Omega, G_v=0dB, T_a=25^\circ C$



■ TYPICAL CHARACTERISTICS



[CAUTION]
 The specifications on this databook are only given for information, without any guarantee as regards either mistakes or omissions. The application circuits in this databook are described only to show representative usages of the product and not intended for the guarantee or permission of any right including the industrial rights.