

High Output Current, Rail-to-Rail Input/Output Quad CMOS Operational Amplifier

■ GENERAL DESCRIPTION

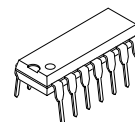
The NJU7044 is a Rail-to-Rail Input/Output quad CMOS operational amplifier.

Based on C-MOS technology, there are excellent features such as high output current, low current consumption, low operating voltage, and very high input impedance.

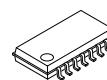
FEATURES

- Operating Voltage 2.2V to 5.5V
- Rail-to-Rail Input/Output
- Ground Sensing
- High Output Current: 40mA (short-circuit current)
- Input Offset Voltage: $V_{IO}=10\text{mV max.}$
- Input Common Mode Voltage Range: V_{SS} to V_{DD}
- Supply Current: $I_{DD}=1.4\text{mA typ. (at }V_{DD}=3\text{V)}$
- High Input Impedance: $1\text{T}\Omega$ Typ.
- Low Input Bias Current: $I_{IB}=1\text{pA typ.}$
- Package: DIP14, DMP14, SSOP14

■ PACKAGE OUTLINE



NJU7044D
(DIP14)

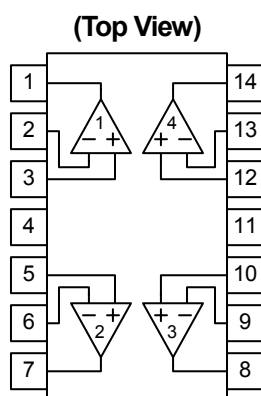


NJU7044M
(DMP14)



NJU7044V
(SSOP14)

■ PIN CONFIGURATION



NJU7044D
NJU7044M
NJU7044V

Pin Function

- | | |
|-------------|--------------|
| 1. OUTPUT 1 | 8. OUTPUT 3 |
| 2. -INPUT 1 | 9. -INPUT 3 |
| 3. +INPUT 1 | 10. +INPUT 3 |
| 4. V_{DD} | 11. V_{SS} |
| 5. +INPUT 2 | 12. +INPUT 4 |
| 6. -INPUT 2 | 13. -INPUT 4 |
| 7. OUTPUT 2 | 14. OUTPUT 4 |

■ ABSOLUTE MAXIMUM RATINGS

PARAMETER	SYMBOL	RATING	UNIT
Supply Voltage	V_{DD}	7	V
Common Mode Input Voltage Range	V_{ICM}	0~7(Note1)	V
Differential Input Voltage Range	V_{ID}	± 7	V
Power Dissipation	P_D	DIP14: 700 DMP14: 300, 500(Note2), 660(Note3) SSOP14: 300, 450(Note2), 570(Note3)	mW
Output Sink/Source Current for each one output terminal	I_{Oport}	± 75	mA
Sum total of Output Sink/Source Current of all output terminal	I_{ototal}	180(Note4)	mA
Operating Temperature Range	T_{OPR}	-40~+85	°C
Storage Temperature Range	T_{STG}	-55~+125	°C

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

(Note2) On the PCB " EIA/JEDEC (76.2x11.43x1.6mm, two layers, FR-4) "

(Note3) On the PCB " EIA/JEDEC (76.2x11.43x1.6mm, four layers, FR-4) "

(Note4) It individually takes the absolute value of the sink current and the source current of each output terminal, and it is assumed the sum total.

Calculation type: $I_{ototal} = |I_{Oport1}| + |I_{Oport2}| + |I_{Oport3}| + |I_{Oport4}|$

(Note5) Do not exceed "Power dissipation: P_D " in which power dissipation in IC is shown by the absolute maximum rating.

Refer to following Figure 1 and Figure 2 for a permissible loss when ambient temperature (T_a) is $T_a \geq 25^\circ\text{C}$.

Figure 1 : Power Dissipation - Ambient Temperature

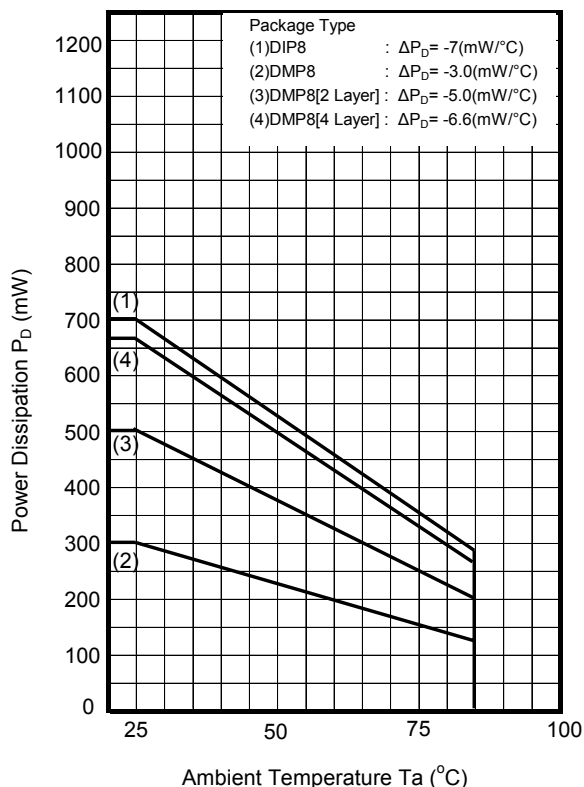
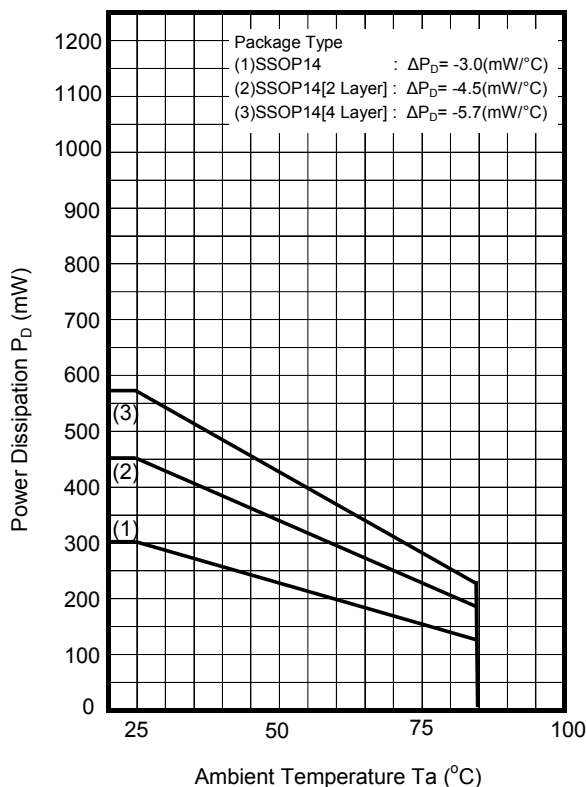


Figure 2 : Power Dissipation - Ambient Temperature



■ RECOMMENDED OPERATING CONDITIONS ($T_a=25^\circ\text{C}$)

PARAMETER	SYMBOL	RATING	UNIT
Supply Voltage	V_{DD}	2.2 to 5.5	V

■ ELECTRICAL CHARACTERISTICS

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

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Supply Current	I_{DD}	No Signal	-	1.8	2.8	mA
Input Offset Voltage	V_{IO}		-	-	10	mV
Input Bias Current	I_B		-	1	-	pA
Input Offset Current	I_{IO}		-	1	-	pA
Voltage Gain	A_V	$R_L=10k\Omega$ to 2.5V, $V_O=2.5V\pm2.4V$	70	90	-	dB
Common Mode Rejection Ratio	CMR	(Note6)	44	60	-	dB
Supply Voltage Rejection Ratio	SVR	$4.0V \leq V_{DD} \leq 5.5V$, $V_{CM}=2.5V$	55	85	-	dB
Maximum Output Voltage1	V_{OH1}	$R_L=10k\Omega$ to 2.5V	4.95	-	-	V
	V_{OL1}	$R_L=10k\Omega$ to 2.5V	-	-	0.05	V
Maximum Output Voltage2	V_{OH2}	$R_L=600\Omega$ to 2.5V	4.88	-	-	V
	V_{OL2}	$R_L=600\Omega$ to 2.5V	-	-	0.12	V
Output Source Current	I_{SOURCE}	$V_O=3.5V$ (Note7)	50	-	-	mA
Output Sink Current	I_{SINK}	$V_O=1.5V$ (Note7)	50	-	-	mA
Common Mode Input Voltage Range	V_{ICM}	CMR $\geq 44dB$	0	-	5	V

(Note6) CMR is represented by either " $V_{CM}=0V$ to $2.5V$ " or " $V_{CM}=2.5V$ to $5V$ " has lower value.

(Note7) Please note the output current value to exceed neither I_{Oport} nor I_{Ototal} the absolute maximum rating.

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

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Gain Bandwidth Product	GB	$R_L=10k\Omega$ to 2.5V	-	0.8	-	MHz
Total Harmonic Distortion	THD	$f=1kHz$, $V_O=0.7V_{rms}$, $A_V=+1$, $R_L=10k\Omega$ to 2.5V	-	0.001	-	%
Equivalent Input Noise Voltage	V_{NI}	$f=1kHz$	-	40	-	nV/ $\sqrt{Hz}$
Channel Separation	CS	$f=1kHz$, $V_O=3V_{pp}$, $R_L=10k\Omega$ to 2.5V	-	120	-	dB

●TRANSIENT CHARACTERISTICS ($V_{DD}=5V$, $T_a=25^{\circ}C$, unless otherwise noted.)

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Slew Rate	SR	$R_L=10k\Omega$ to 2.5V	-	0.8	-	V/ μs

■ ELECTRICAL CHARACTERISTICS

●DC CHARACTERISTICS ($V_{DD}=3V$, $T_a=25^{\circ}C$, unless otherwise noted.)

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Supply Current	I_{DD}	No Signal	-	1.4	2.4	mA
Input Offset Voltage	V_{IO}		-	-	10	mV
Input Bias Current	I_B		-	1	-	pA
Input Offset Current	I_{IO}		-	1	-	pA
Voltage Gain	A_V	$R_L=10k\Omega$ to 1.5V, $V_O=1.5V\pm1.4V$	70	90	-	dB
Common Mode Rejection Ratio	CMR	(Note8)	42	60	-	dB
Supply Voltage Rejection Ratio	SVR	$2.7V \leq V_{DD} \leq 4.0V$, $V_{CM}=1.5V$	50	80	-	dB
Maximum Output Voltage1	V_{OH1}	$R_L=10k\Omega$ to 1.5V	2.95	-	-	V
	V_{OL1}	$R_L=10k\Omega$ to 1.5V	-	-	0.05	V
Maximum Output Voltage2	V_{OH2}	$R_L=600\Omega$ to 1.5V	2.9	-	-	V
	V_{OL2}	$R_L=600\Omega$ to 1.5V	-	-	0.1	V
Output Source Current	I_{SOURCE}	$V_O=1.5V$	30	40	-	mA
Output Sink Current	I_{SINK}	$V_O=1.5V$	30	40	-	mA
Common Mode Input Voltage Range	V_{ICM}	CMR $\geq 42dB$	0	-	3	V

(Note8) CMR is represented by either " $V_{CM}=0V$ to 1.5V" or " $V_{CM}=1.5V$ to 3V" has lower value.

●AC CHARACTERISTICS ($V_{DD}=3V$, $T_a=25^{\circ}C$, unless otherwise noted.)

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Gain Bandwidth Product	GB	$R_L=10k\Omega$ to 1.5V	-	0.8	-	MHz
Total Harmonic Distortion	THD	$f=1kHz$, $V_O=0.35V_{rms}$, $A_V=+1$, $R_L=10k\Omega$ to 1.5V	-	0.002	-	%
Equivalent Input Noise Voltage	V_{NI}	$f=1kHz$	-	40	-	nV/ $\sqrt{Hz}$
Channel Separation	CS	$f=1kHz$, $V_O=1.8V_{pp}$, $R_L=10k\Omega$ to 1.5V	-	115	-	dB

●TRANSIENT CHARACTERISTICS ($V_{DD}=3V$, $T_a=25^{\circ}C$, unless otherwise noted.)

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Slew Rate	SR	$R_L=10k\Omega$ to 1.5V	-	0.7	-	V/ μs

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

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Supply Current	I_{DD}	No Signal	-	1.2	2	mA
Input Offset Voltage	V_{IO}		-	-	10	mV
Input Bias Current	I_B		-	1	-	pA
Input Offset Current	I_{IO}		-	1	-	pA
Voltage Gain	A_V	$R_L=10k\Omega$ to 1.1V, $V_O=1.1V\pm1.0V$	70	90	-	dB
Common Mode Rejection Ratio	CMR	(Note9)	30	60	-	dB
Supply Voltage Rejection Ratio	SVR	$2.2V \leq V_{DD} \leq 2.7V$, $V_{CM}=1.1V$	45	70	-	dB
Maximum Output Voltage1	V_{OH1}	$R_L=10k\Omega$ to 1.1V	2.15	-	-	V
	V_{OL1}	$R_L=10k\Omega$ to 1.1V	-	-	0.05	V
Maximum Output Voltage2	V_{OH2}	$R_L=600\Omega$ to 1.1V	2.1	-	-	V
	V_{OL2}	$R_L=600\Omega$ to 1.1V	-	-	0.1	V
Output Source Current	I_{SOURCE}	$V_O=1.1V$	10	15	-	mA
Output Sink Current	I_{SINK}	$V_O=1.1V$	10	15	-	mA
Common Mode Input Voltage Range	V_{ICM}	CMR $\geq 30dB$	0	-	2.2	V

(Note 9) CMR is represented by either " $V_{CM}=0V$ to 1.1V" or " $V_{CM}=1.1V$ to 2.2V" has lower value.

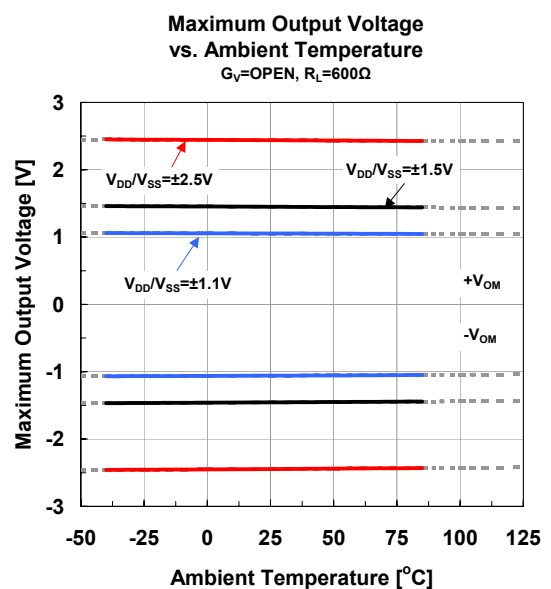
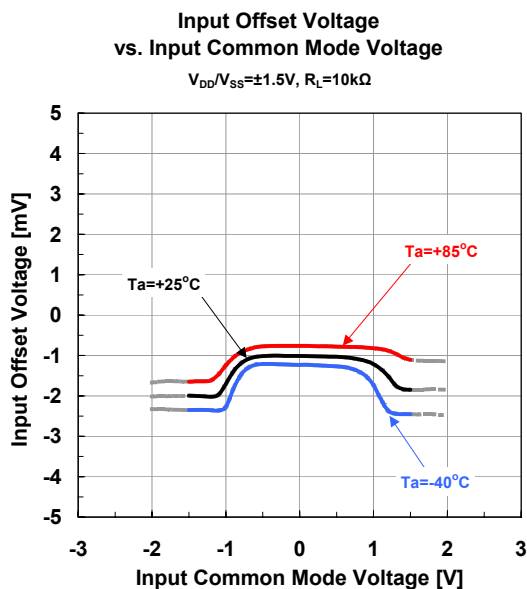
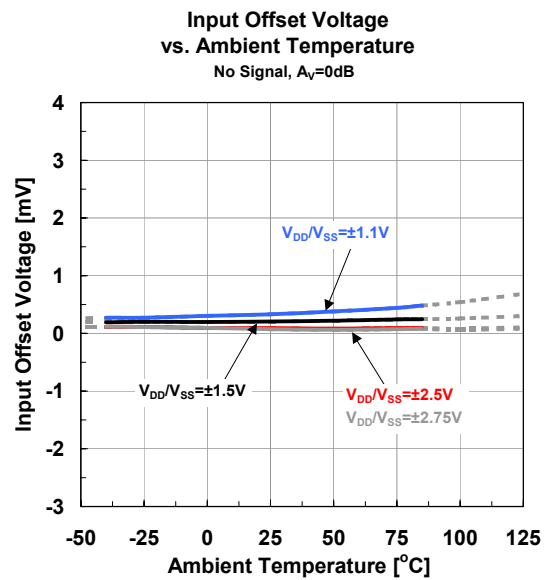
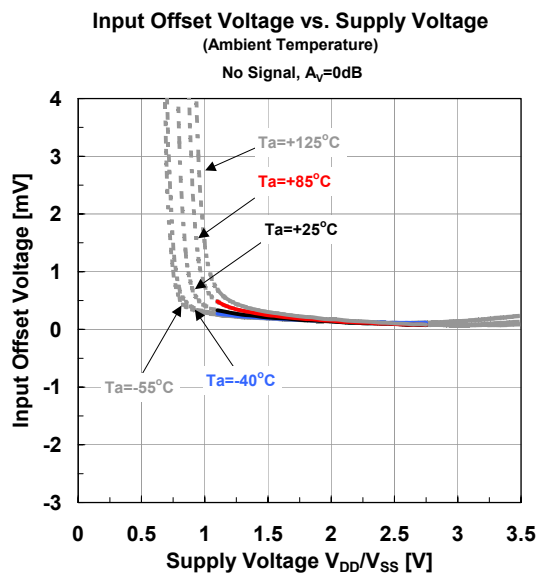
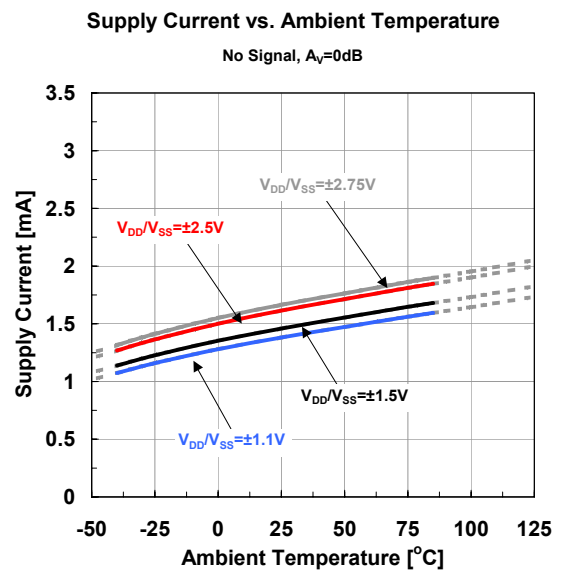
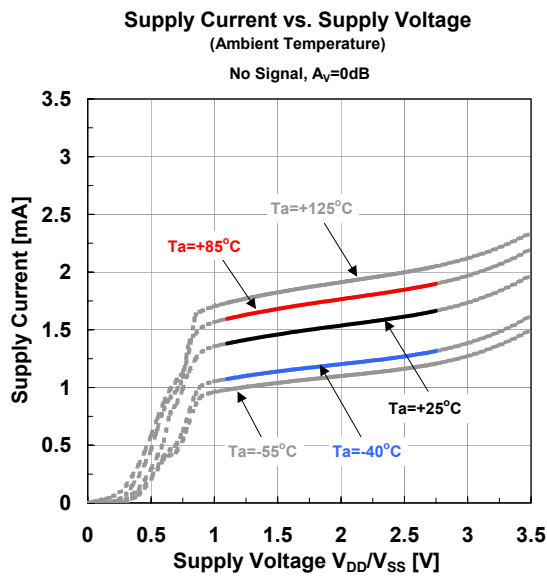
●AC CHARACTERISTICS ($V_{DD}=2.2V$, $T_a=25^\circ C$, unless otherwise noted.)

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Gain Bandwidth Product	GB	$R_L=10k\Omega$ to 1.1V	-	0.8	-	MHz
Total Harmonic Distortion	THD	$f=1kHz$, $V_O=0.18V_{rms}$, $A_V=+1$, $R_L=10k\Omega$ to 1.1V	-	0.004	-	%
Equivalent Input Noise Voltage	V_{NI}	$f=1kHz$	-	40	-	nV/ $\sqrt{Hz}$
Channel Separation	CS	$f=1kHz$, $V_O=1.2V_{pp}$, $R_L=10k\Omega$ to 1.1V	-	110	-	dB

●TRANSIENT CHARACTERISTICS ($V_{DD}=2.2V$, $T_a=25^\circ C$, unless otherwise noted.)

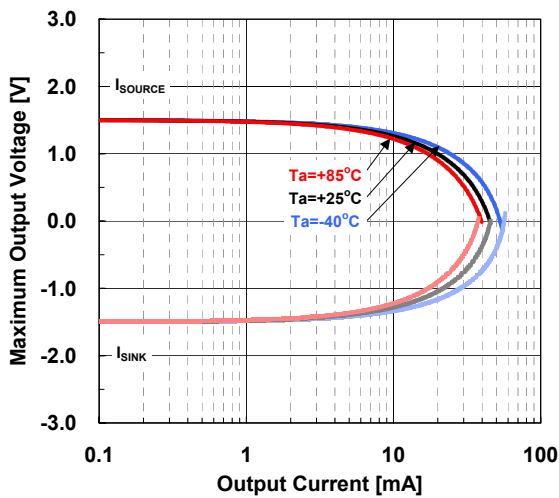
PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Slew Rate	SR	$R_L=10k\Omega$ to 1.1V	-	0.6	-	V/ μs

•Typical Characteristics

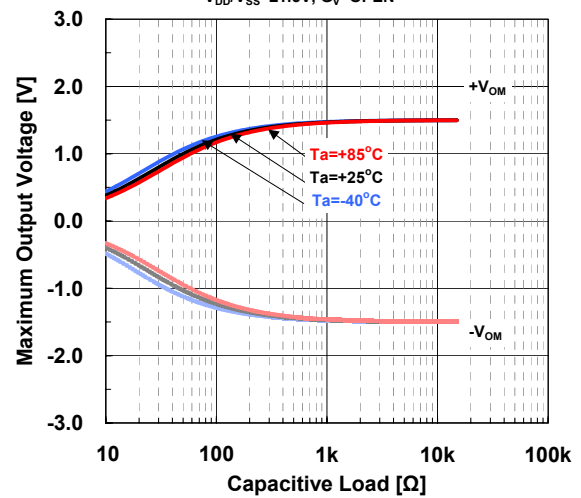


•Typical Characteristics

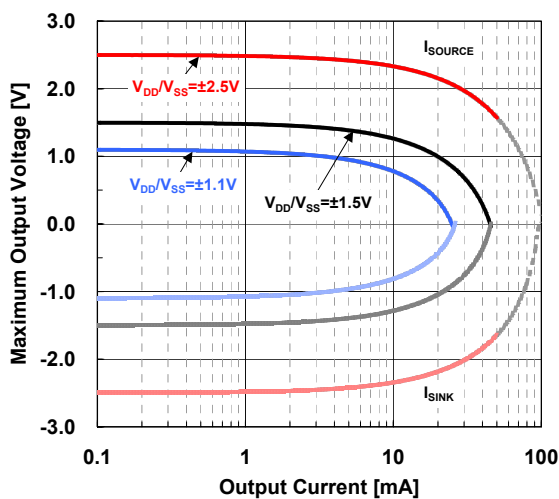
Maximum Output Voltage vs. Output Current
(Ambient Temperature)
 $V_{DD}/V_{SS}=\pm 1.5V$, $G_V=OPEN$



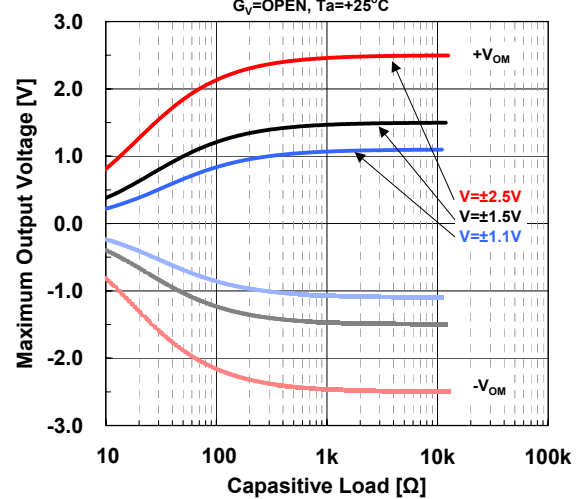
Maximum Output Voltage
vs. Capacitive Load
(Ambient Temperature)
 $V_{DD}/V_{SS}=\pm 1.5V$, $G_V=OPEN$



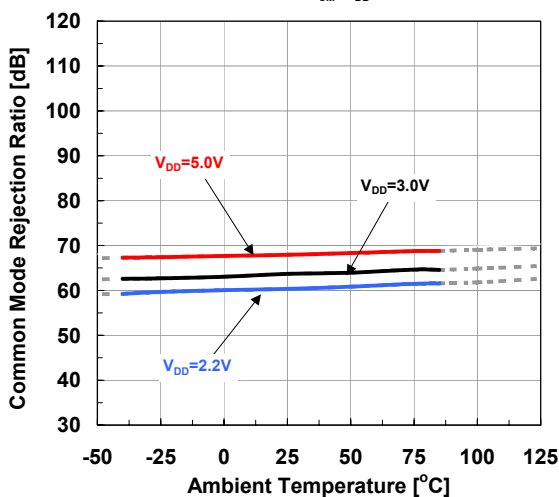
Maximum Output Voltage vs. Output Current
 $G_V=OPEN$, $T_a=+25^{\circ}C$



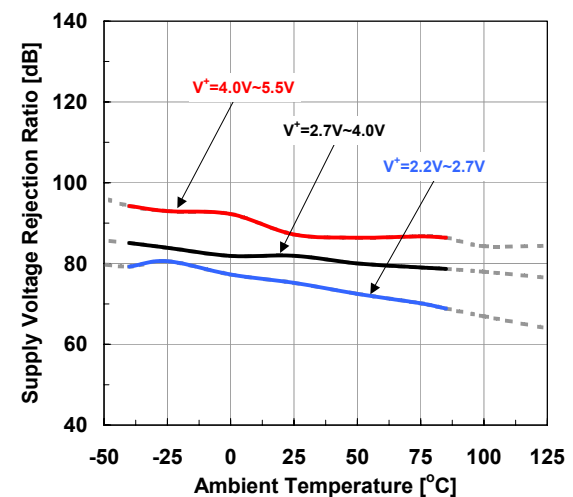
Maximum Output Voltage
vs. Capacitive Load
(Supply Voltage)
 $G_V=OPEN$, $T_a=+25^{\circ}C$



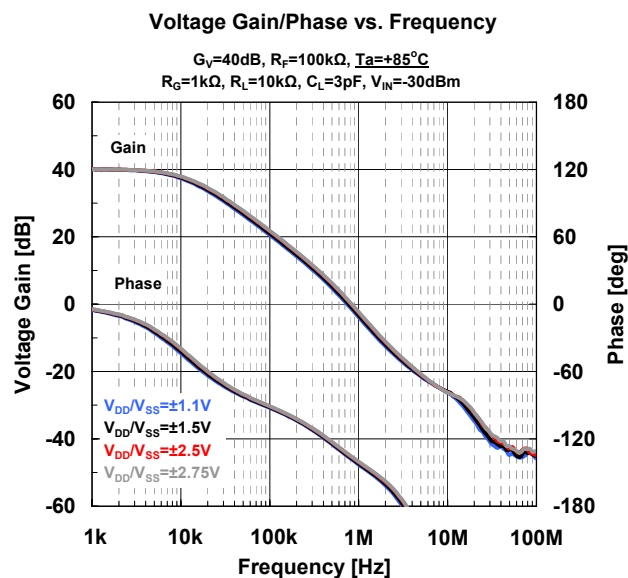
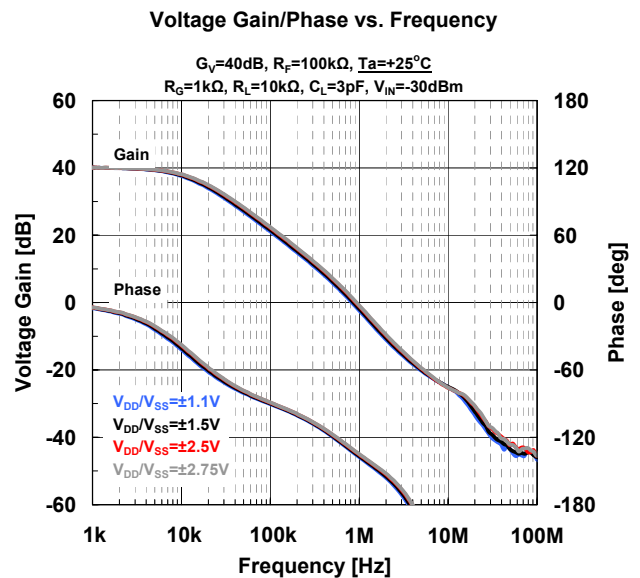
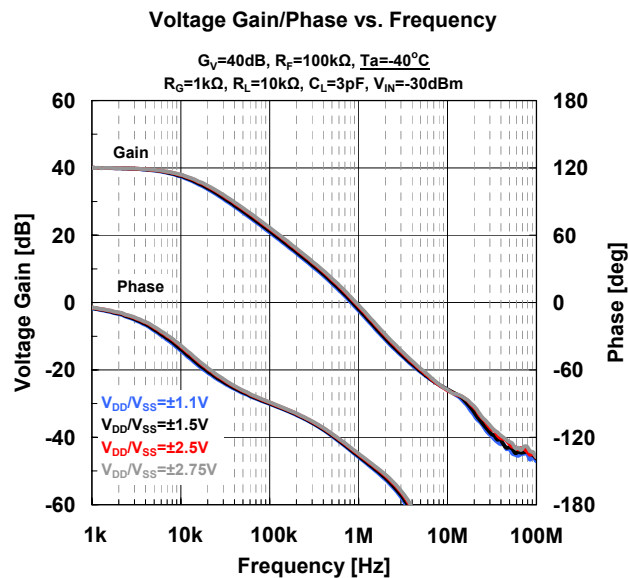
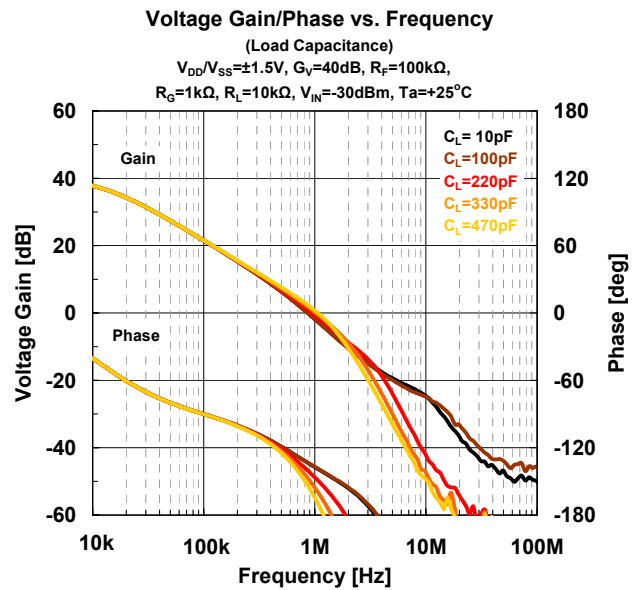
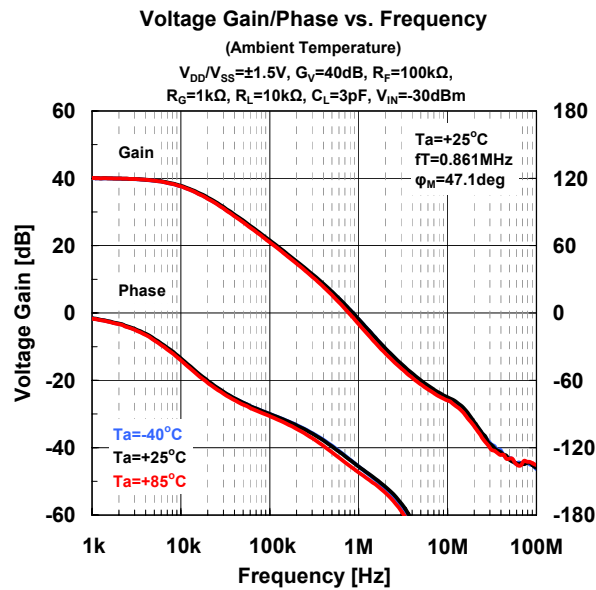
Common Mode Rejection Ratio
vs. Ambient Temperature
CMR : $GND \leq V_{CM} \leq V_{DD}/2$



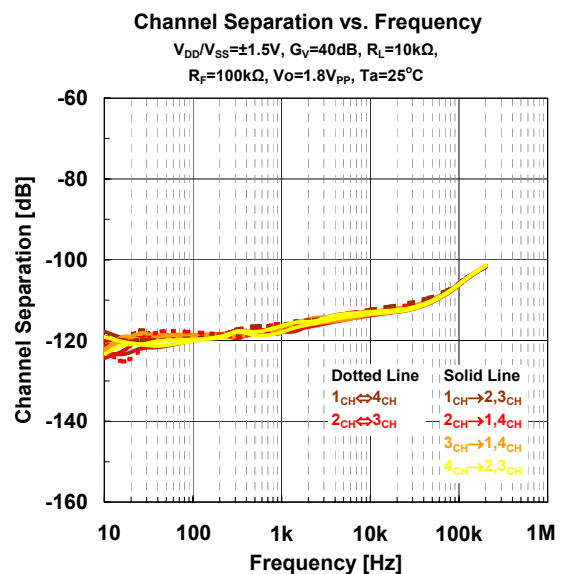
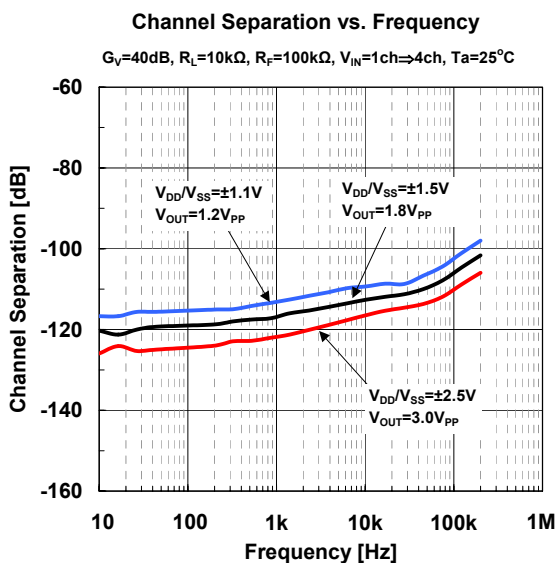
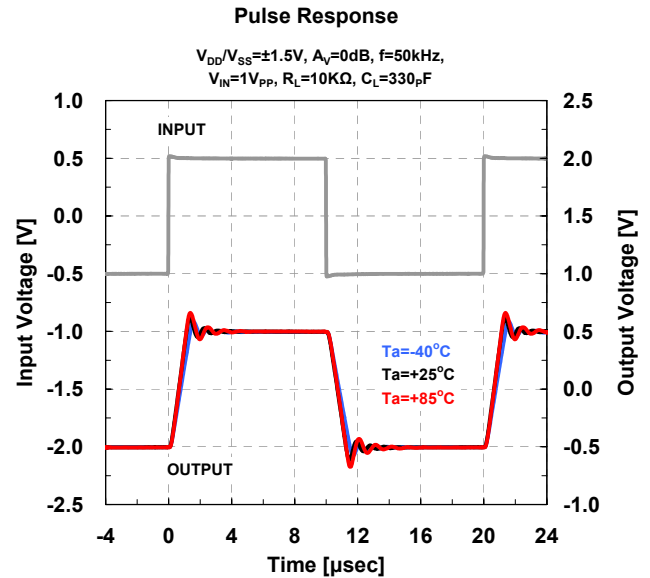
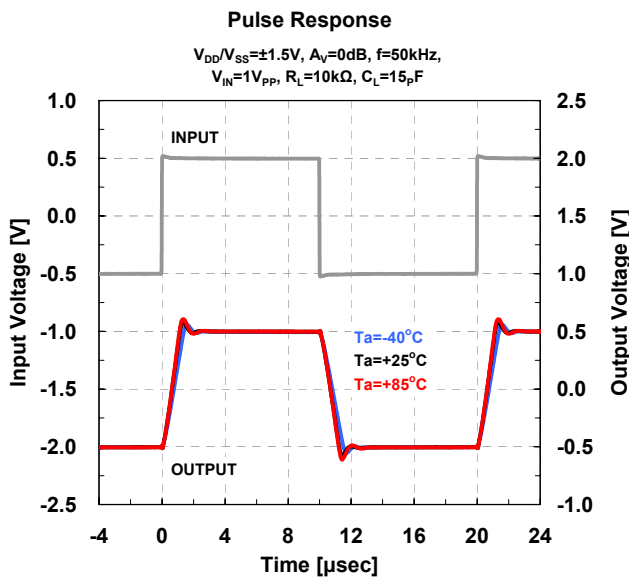
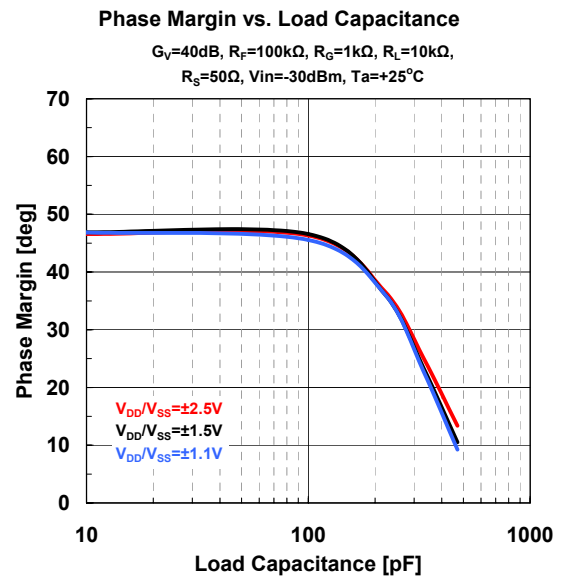
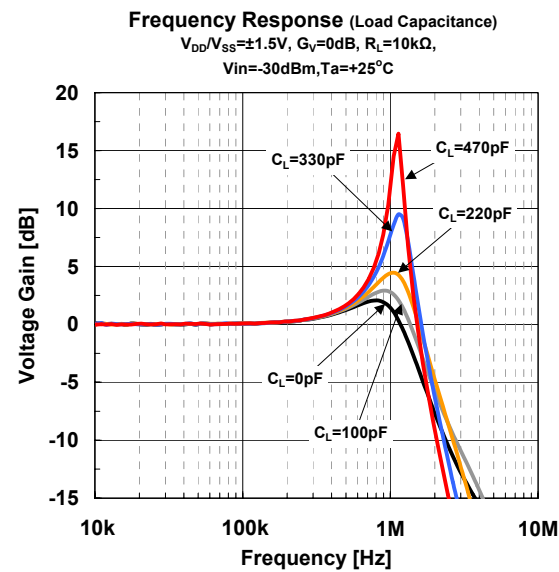
Supply Voltage Rejection Ratio
vs. Ambient Temperature
No Signal, A_v=0dB



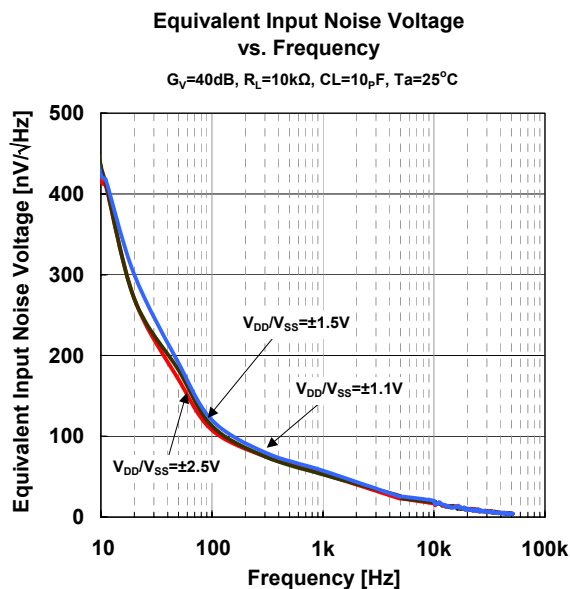
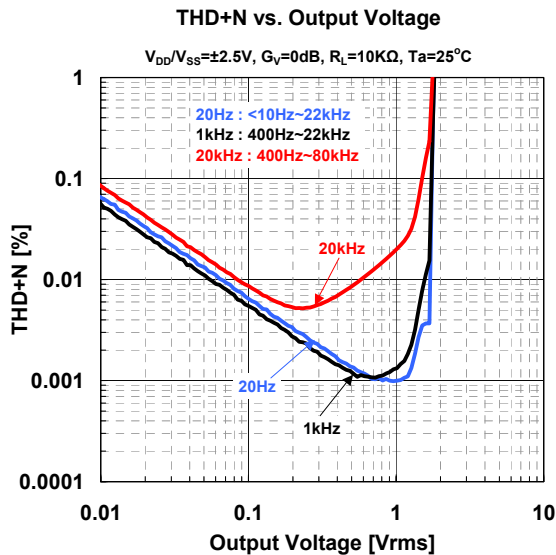
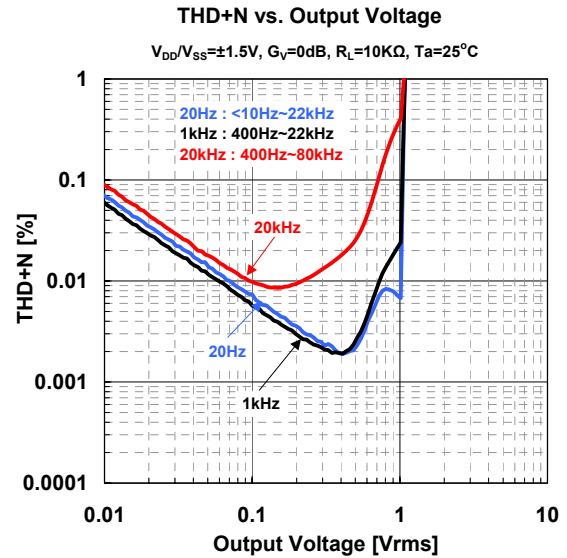
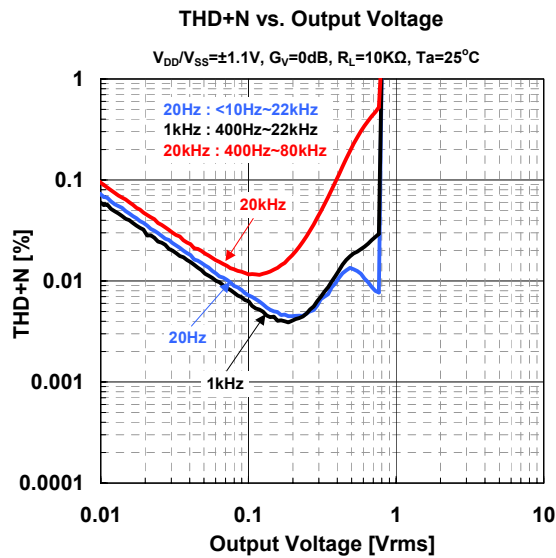
•Typical Characteristics



•Typical Characteristics



•Typical Characteristics



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