

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

■ GENERAL DESCRIPTION

The NJU7040 is a Rail-to-Rail Input/Output single 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.

■ PACKAGE OUTLINE

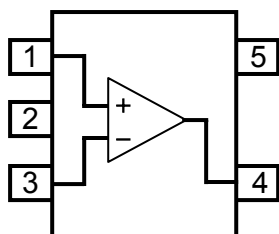


NJU7040F

■ FEATURES

- Operating Voltage: 2.2V to 5.5V
- Rail-to-Rail Input/Output
- Output Current: 40mA at $V_O=0V$
- Input Offset Voltage: $V_{IO}=10mV$ max.
- Wide Input Common Mode Voltage Range: V_{SS} to V_{DD}
- Operating Current: $I_{DD}=350\mu A$ typ. (at $V_{DD}=3V$)
- High Input Impedance: $1T\Omega$ Typ.
- Low Input Bias Current: $I_{IB}=1pA$ typ.
- Ground Sensing
- Tiny Package: MTP5

■ PIN CONFIGURATION



NJU7040F
(Top View)

PIN FUNCTION

1. +INPUT
2. V_{SS}
3. -INPUT
4. OUTPUT
5. V_{DD}

■ ABSOLUTE MAXIMUM RATINGS

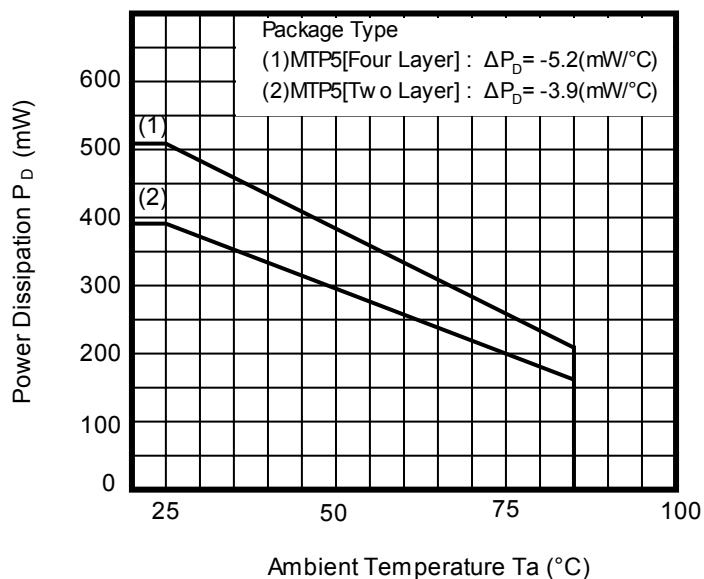
PARAMETER	SYMBOL	RATINGS	UNIT
Supply Voltage	V_{DD}	7	V
Common Mode Input Voltage Range	V_{ICM}	0 to 7 (Note 1)	V
Differential Input Voltage Range	V_{ID}	± 7	V
Power Dissipation	P_D	200 [MTP5] 390 [MTP5] (Note 2) 520 [MTP5] (Note 3)	mW
Output Current	I_O	± 75 [MTP5]	mA
Operating Temperature Range	T_{opr}	-40 to +85	$^{\circ}\text{C}$
Storage Temperature Range	T_{stg}	-55 to +125	$^{\circ}\text{C}$

(Note 1) For supply voltage less than 7V, the absolute maximum input voltage is equal to the supply voltage.

(Note 2) On the PCB " EIA/JEDEC (76.2x11.43x1.6mm, two layers, FR-4) "

(Note 3) On the PCB " EIA/JEDEC (76.2x11.43x1.6mm, four layers, FR-4) "

Power Dissipation vs. Ambient Temperature



(Note 4)

Please do not exceed "Power Dissipation (PD)" the power dissipation in IC is absolutely indicated to be in the maximum rating.

See the figure "Power Dissipation vs. Ambient Temperature" for information on temperature derating of this device.

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

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

■ ELECTRICAL CHARACTERISTICS

●DC CHARACTERISTICS

($V_{DD}=5V$, $T_a=25^\circ C$)

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Operating Current	I_{DD}	No Signal Apply	-	450	700	μA
Input Offset Voltage	V_{IO}		-	-	10	mV
Input Bias Current	I_B		-	1	-	pA
Input Offset Current	I_{IO}		-	1	-	pA
Large Signal Voltage Gain	A_V	$R_L=10k\Omega$ to 2.5V, $V_O=2.5V\pm 2.4V$	70	90	-	dB
Common Mode Rejection Ratio	CMR	CMR+: $2.5V \leq V_{CM} \leq 5V$ CMR-: $0V \leq V_{CM} \leq 2.5V$ (Note 5)	44	60	-	dB
Supply Voltage Rejection Ratio	SVR	$4.0V \leq V_{DD} \leq 5.5V$, $V_{CM}=V_{DD}/2$	55	85	-	dB
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
Output Voltage2	V_{OH2}	$R_L=600\Omega$ to 2.5V	4.9	-	-	V
	V_{OL2}	$R_L=600\Omega$ to 2.5V	-	-	0.1	V
Output Source Current	I_{SOURCE}	$V_O=2.5V$	70	-	-	mA
Output Sink Current	I_{SINK}	$V_O=2.5V$	70	-	-	mA
Input Common Mode Voltage Range	V_{ICM}	CMR $\geq 44dB$	0	-	5	V

(Note 5) CMR is represented by either CMR+ or CMR- has lower value.

●AC CHARACTERISTICS

($V_{DD}=5V$, $T_a=25^\circ C$)

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Unity Gain Bandwidth	GB	$R_L=10k\Omega$ to 2.5V	-	0.8	-	MHz
Total Harmonic Distortion	THD	$f=1kHz$, $V_{IN}=1V_{pp}$, $A_V=0dB$	-	0.05	-	%
Equivalent Input Noise Voltage	V_{NI}	$f=1kHz$	-	40	-	$nV/\sqrt{Hz}$

●TRANSIENT CHARACTERISTICS

($V_{DD}=5V$, $T_a=25^\circ C$)

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Slew Rate	SR	$R_L=10k\Omega$ to 2.5V	-	0.85	-	$V/\mu s$

■ ELECTRICAL CHARACTERISTICS

●DC CHARACTERISTICS

($V_{DD}=3V$, $T_a=25^\circ C$)

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Operating Current	I_{DD}	No Signal Apply	-	350	600	μA
Input Offset Voltage	V_{IO}		-	-	10	mV
Input Bias Current	I_B		-	1	-	pA
Input Offset Current	I_{IO}		-	1	-	pA
Large Signal Voltage Gain	A_V	$R_L=10k\Omega$ to 1.5V, $V_O=1.5V\pm 1.4V$	70	90	-	dB
Common Mode Rejection Ratio	CMR	CMR+: $1.5V \leq V_{CM} \leq 3V$ CMR-: $0V \leq V_{CM} \leq 1.5V$ (Note 6)	42	60	-	dB
Supply Voltage Rejection Ratio	SVR	$2.7V \leq V_{DD} \leq 4.0V$, $V_{CM}=V_{DD}/2$	50	80	-	dB
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
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
Input Common Mode Voltage Range	V_{ICM}	CMR $\geq 42dB$	0	-	3	V

(Note 6) CMR is represented by either CMR+ or CMR- has lower value.

●AC CHARACTERISTICS

($V_{DD}=3V$, $T_a=25^\circ C$)

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Unity Gain Bandwidth	GB	$R_L=10k\Omega$ to 1.5V	-	0.8	-	MHz
Total Harmonic Distortion	THD	$f=1kHz$, $V_{IN}=1V_{pp}$, $A_V=0dB$	-	0.05	-	%
Equivalent Input Noise Voltage	V_{NI}	$f=1kHz$	-	40	-	$nV/\sqrt{Hz}$

●TRANSIENT CHARACTERISTICS

($V_{DD}=3V$, $T_a=25^\circ C$)

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

●DC CHARACTERISTICS

($V_{DD}=2.2V$, $T_a=25^{\circ}C$)

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Operating Current	I_{DD}	No Signal Apply	-	300	500	μA
Input Offset Voltage	V_{IO}		-	-	10	mV
Input Bias Current	I_B		-	1	-	pA
Input Offset Current	I_{IO}		-	1	-	pA
Large Signal Voltage Gain	A_V	$R_L=10k\Omega$ to 1.1V, $V_O=1.1V\pm 1.0V$	70	90	-	dB
Common Mode Rejection Ratio	CMR	CMR+: $1.1V \leq V_{CM} \leq 2.2V$ CMR-: $0V \leq V_{CM} \leq 1.1V$ (Note 7)	30	60	-	dB
Supply Voltage Rejection Ratio	SVR	$2.2V \leq V_{DD} \leq 2.7V$, $V_{CM}=V_{DD}/2$	45	70	-	dB
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
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
Input Common Mode Voltage Range	V_{ICM}	CMR $\geq 30dB$	0	-	2.2	V

(Note 7) CMR is represented by either CMR+ or CMR- has lower value.

●AC CHARACTERISTICS

($V_{DD}=2.2V$, $T_a=25^{\circ}C$)

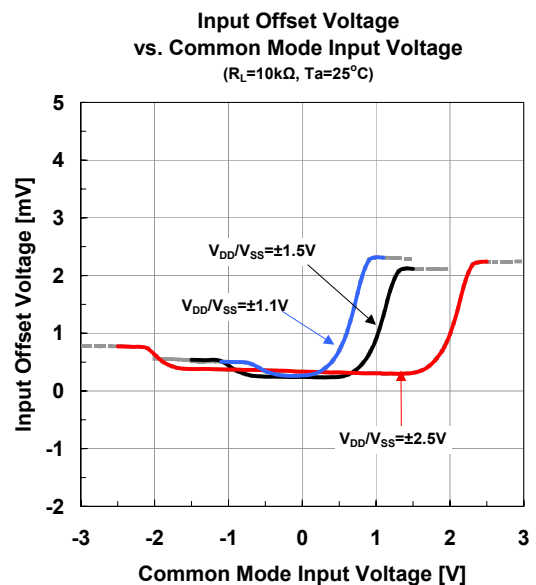
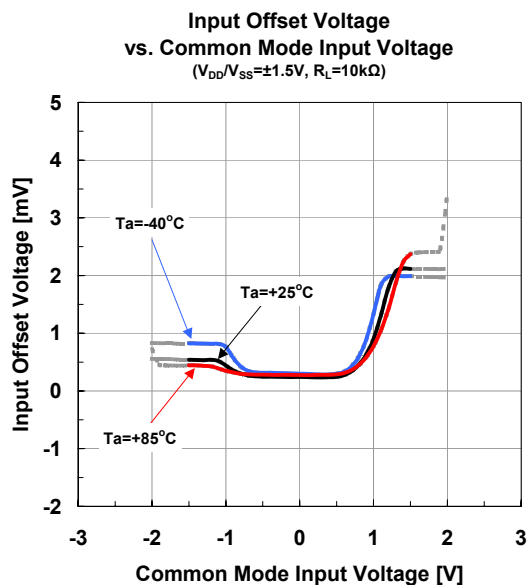
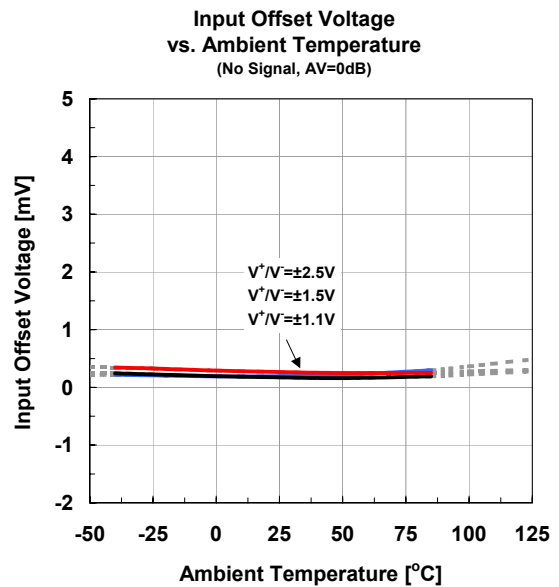
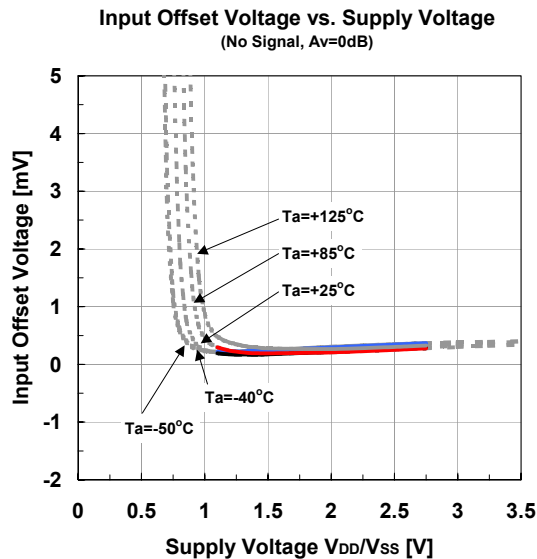
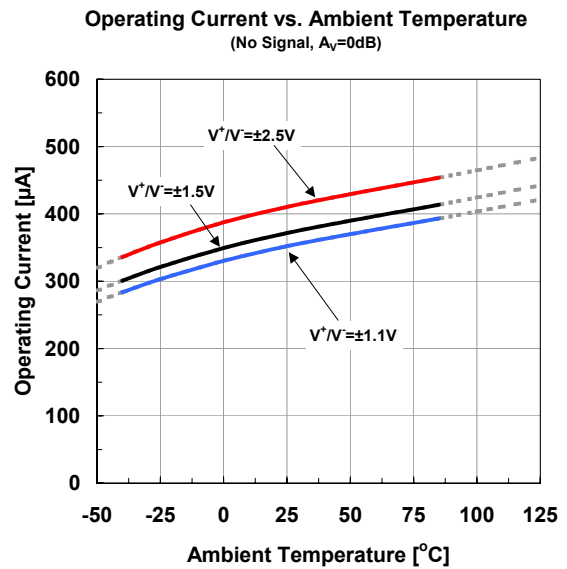
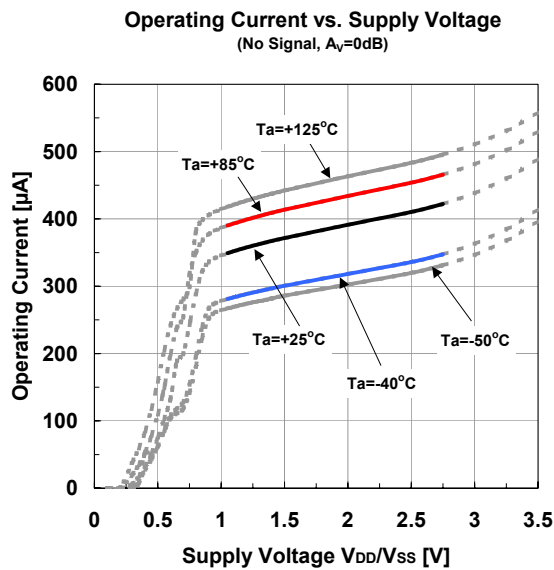
PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Unity Gain Bandwidth	GB	$R_L=10k\Omega$ to 1.1V	-	0.8	-	MHz
Total Harmonic Distortion	THD	$f=1kHz$, $V_{IN}=1V_{pp}$, $A_V=0dB$	-	0.05	-	%
Equivalent Input Noise Voltage	V_{NI}	$f=1kHz$	-	40	-	nV/ $\sqrt{Hz}$

●TRANSIENT CHARACTERISTICS

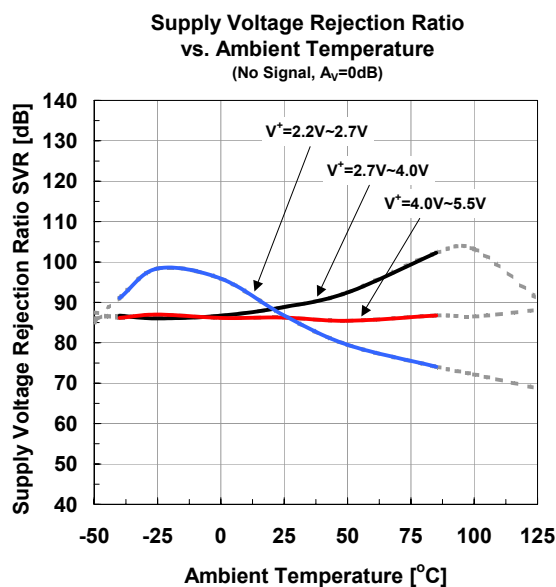
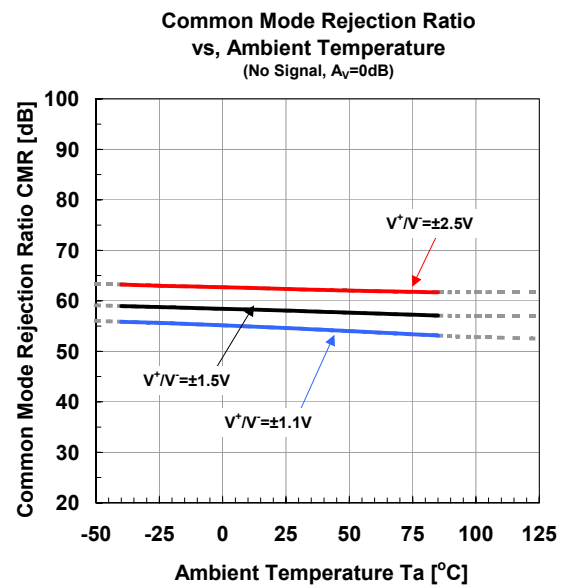
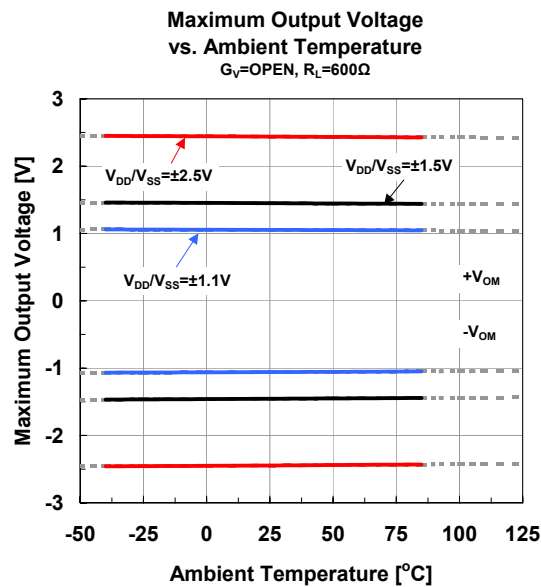
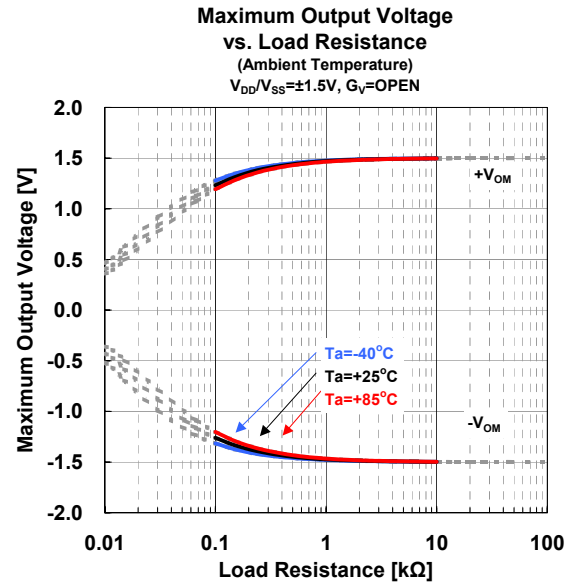
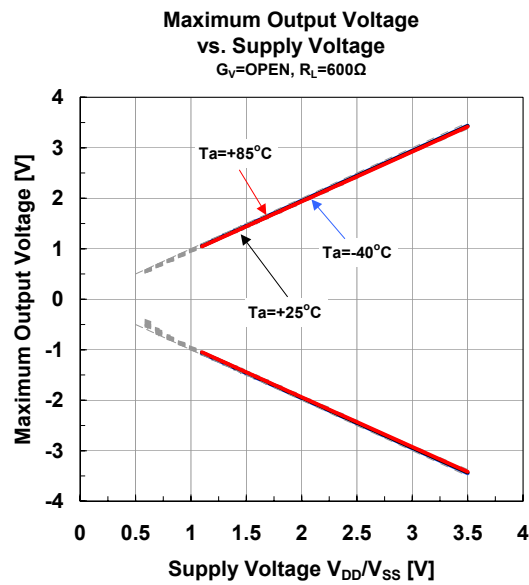
($V_{DD}=2.2V$, $T_a=25^{\circ}C$)

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

■ Typical Characteristics

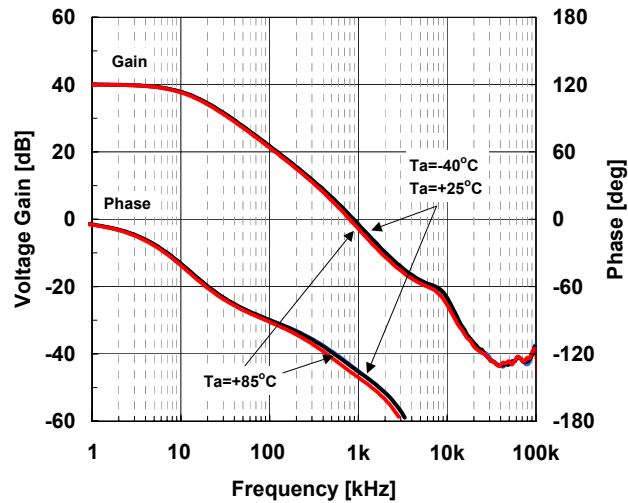


■ Typical Characteristics

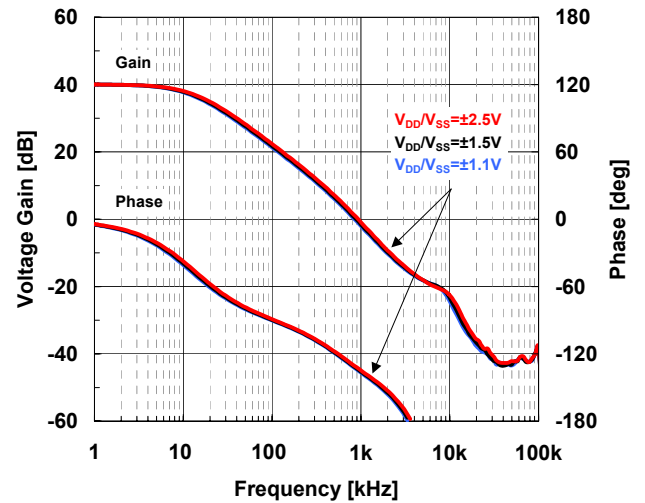


■ Typical Characteristics

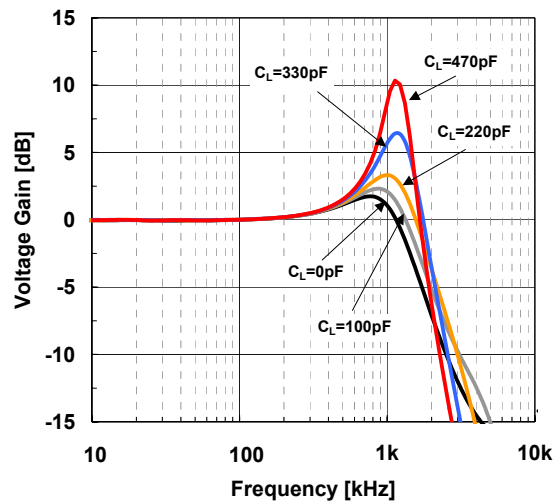
Voltage Gain / Phase vs. Frequency (Ambient Temp.)
 $V_{DD}/V_{SS}=\pm 1.5V$, $G_V=40dB$, $R_F=100k\Omega$,
 $R_G=1k\Omega$, $R_L=10k\Omega$, $C_L=3pF$, $V_{IN}=-30dBm$



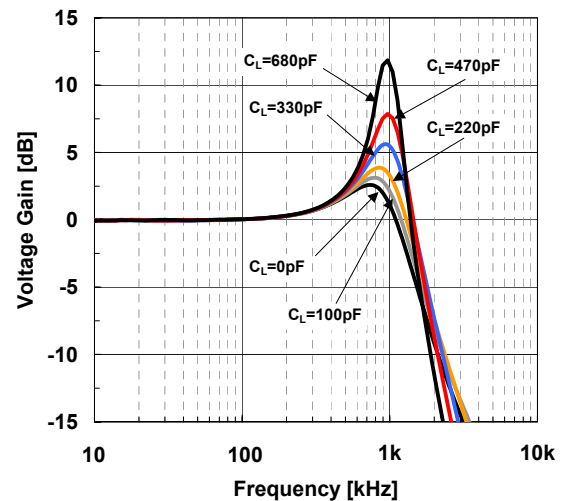
Voltage Gain / Phase vs. Frequency
 $G_V=40dB$, $R_F=100k\Omega$, $T_a=+25^\circ C$
 $R_G=1k\Omega$, $R_L=10k\Omega$, $C_L=3pF$, $V_{IN}=-30dBm$



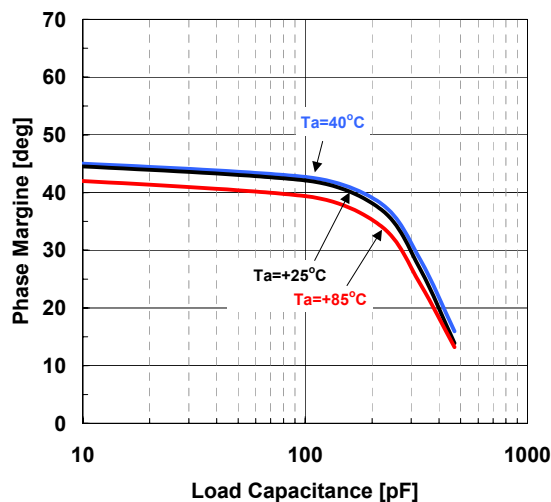
V.F. Peak vs. Frequency
 $V_{DD}/V_{SS}=\pm 1.5V$, $G_V=0dB$, $R_L=10k\Omega$,
 $V_{IN}=-30dBm$, $T_a=+27^\circ C$



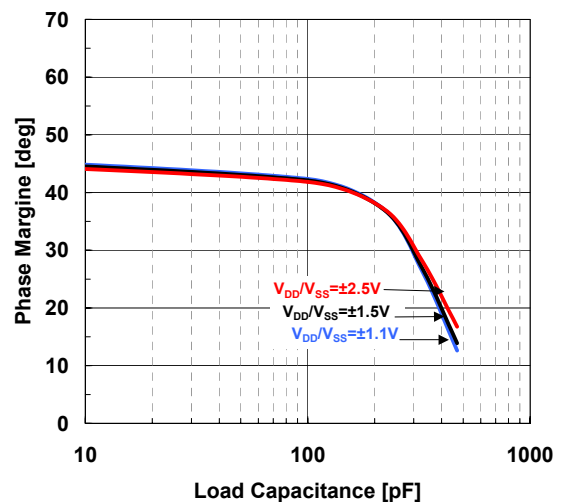
V.F. Peak vs. Frequency
 $V_{DD}/V_{SS}=\pm 1.5V$, $G_V=0dB$, $R_L=600\Omega$,
 $V_{IN}=-30dBm$, $T_a=+27^\circ C$



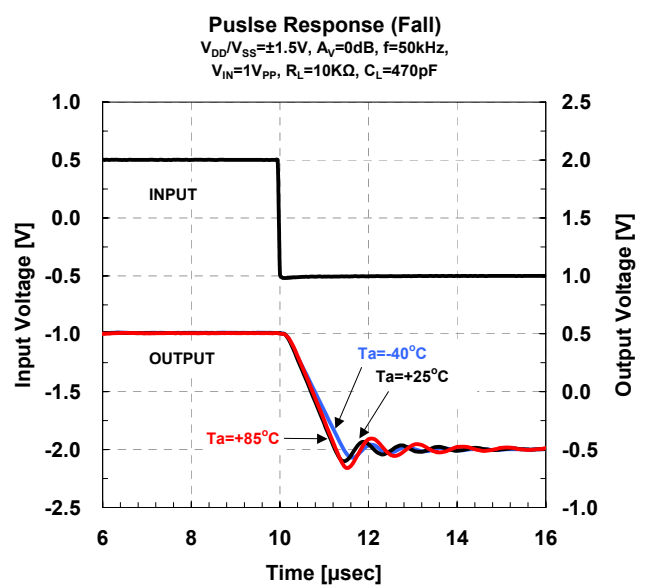
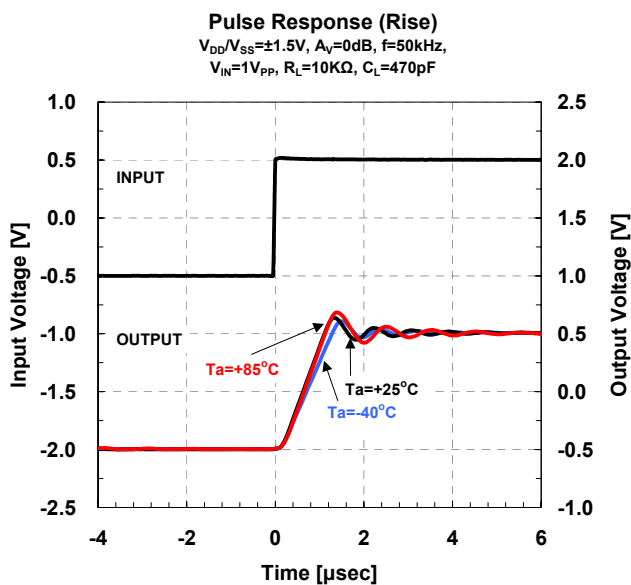
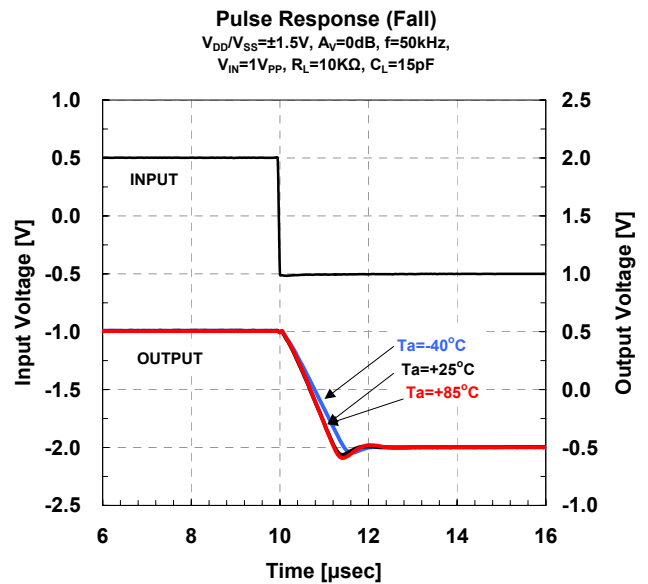
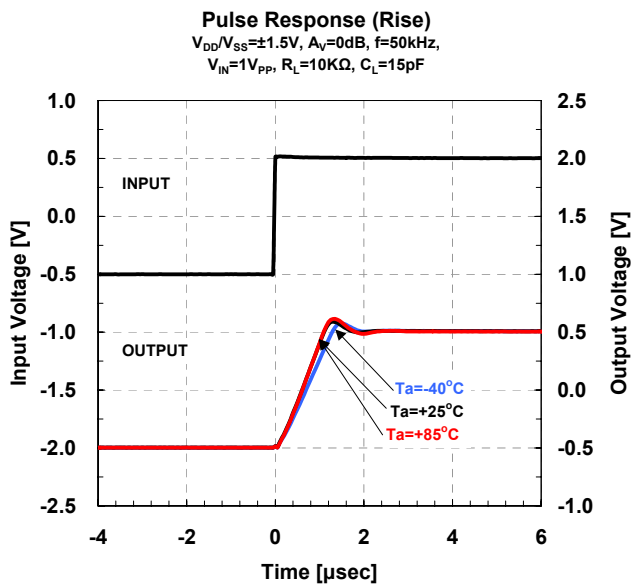
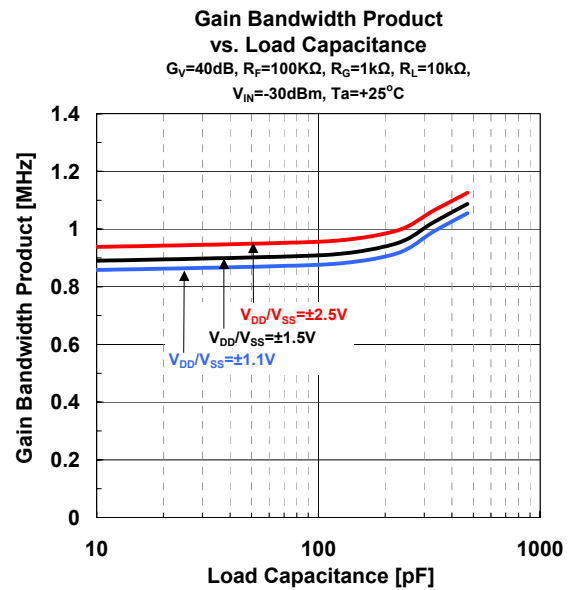
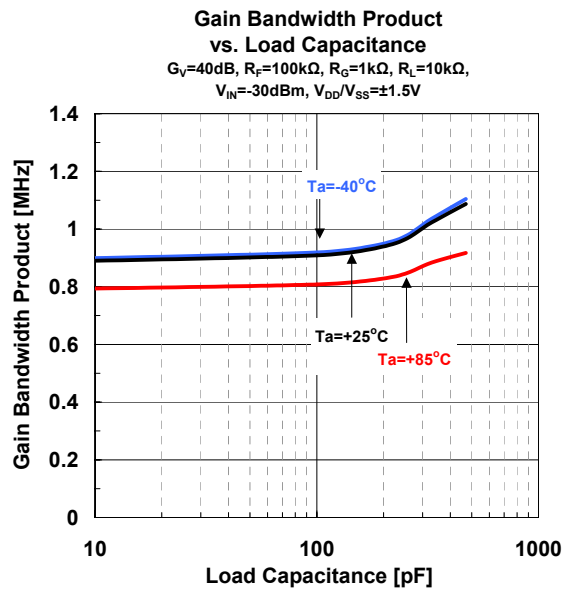
Phase Margin vs. Load Capacitance
 $G_V=40dB$, $R_F=100k\Omega$, $R_G=1k\Omega$, $R_L=10k\Omega$,
 $V_{IN}=-30dBm$, $V_{DD}/V_{SS}=\pm 1.5V$



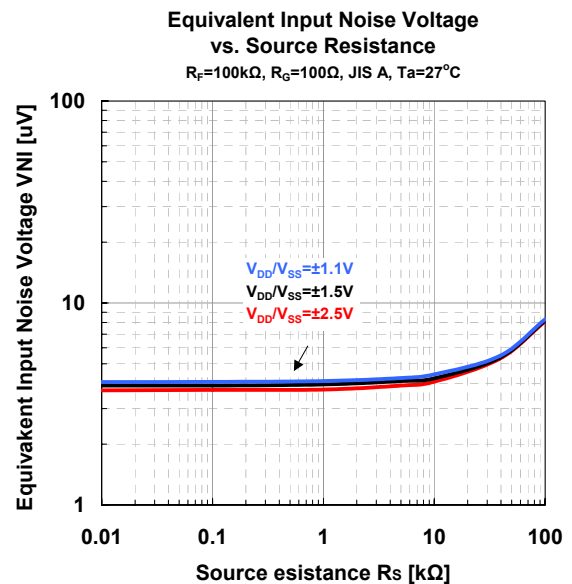
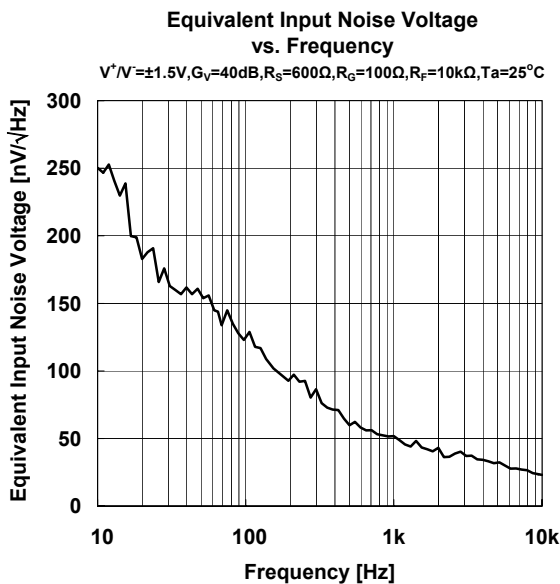
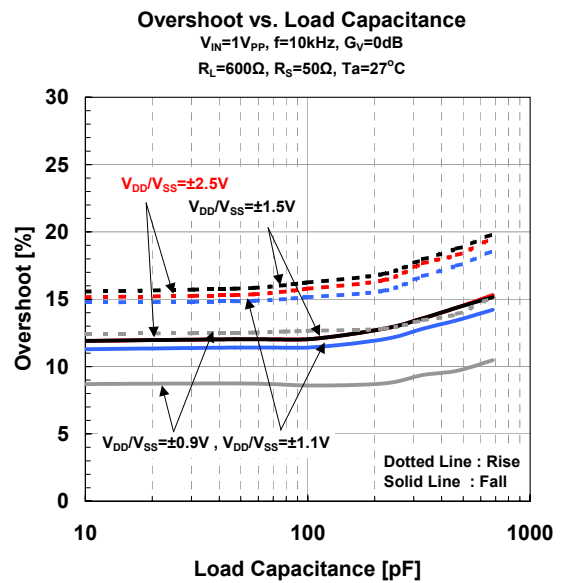
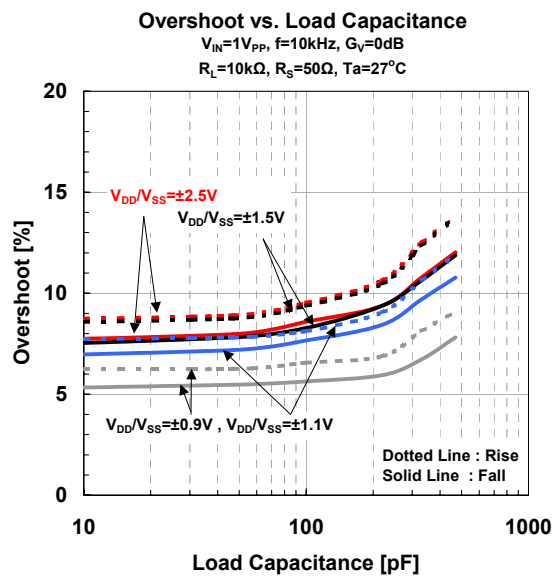
Phase Margin vs. Load Capacitance
 $G_V=40dB$, $R_F=100k\Omega$, $R_G=1k\Omega$, $R_L=10k\Omega$,
 $V_{IN}=-30dBm$, $T_a=+25^\circ C$



■ Typical Characteristics



■ Typical Characteristics



[CAUTION]

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