

## 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

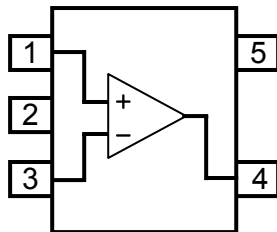


NJU7040F

### ■ 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: SOT-23-5

### ■ PIN CONFIGURATION



NJU7040F  
(Top View)

#### PIN FUNCTION

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

## ■ ABSOLUTE MAXIMUM RATINGS

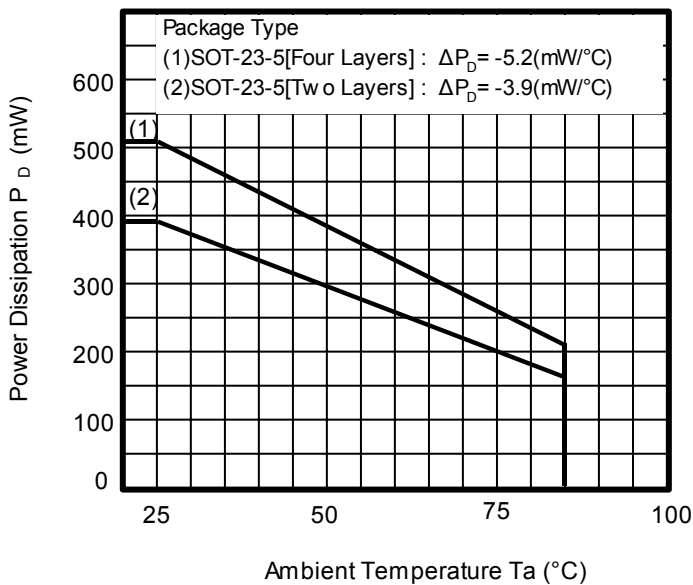
PARAMETER	SYMBOL	RATINGS	UNIT
Supply Voltage	$V_{DD}$	7	V
Common Mode Input Voltage Range	$V_{ICM}$	0 to 7 (Note 1)	V
Differential Input Voltage Range	$V_{ID}$	$\pm 7$	V
Power Dissipation	$P_D$	200 [SOT-23-5] 390 [SOT-23-5] (Note 2) 520 [SOT-23-5] (Note 3)	mW
Output Current	$I_O$	$\pm 75$ [SOT-23-5]	mA
Operating Temperature Range	$T_{opr}$	-40 to +85	$^{\circ}C$
Storage Temperature Range	$T_{stg}$	-55 to +125	$^{\circ}C$

(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 (76.2x114.3x1.6mm, two layers, FR-4) "

(Note 3) On the PCB " EIA/JEDEC (76.2x114.3x1.6mm, 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 ( $T_a=25^{\circ}C$ )

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

## ■ ELECTRICAL CHARACTERISTICS

### ●DC CHARACTERISTICS

(V<sub>DD</sub>=5V, Ta=25°C)

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Operating Current	I <sub>DD</sub>	No Signal Apply	-	450	700	μA
Input Offset Voltage	V <sub>IO</sub>		-	-	10	mV
Input Bias Current	I <sub>B</sub>		-	1	-	pA
Input Offset Current	I <sub>IO</sub>		-	1	-	pA
Large Signal Voltage Gain	A <sub>V</sub>	R <sub>L</sub> =10kΩ to 2.5V, V <sub>O</sub> =2.5V±2.4V	70	90	-	dB
Common Mode Rejection Ratio	CMR	CMR+: 2.5V ≤ V <sub>CM</sub> ≤ 5V CMR-: 0V ≤ V <sub>CM</sub> ≤ 2.5V (Note 5)	44	60	-	dB
Supply Voltage Rejection Ratio	SVR	4.0V ≤ V <sub>DD</sub> ≤ 5.5V, V <sub>CM</sub> =V <sub>DD</sub> /2	55	85	-	dB
Output Voltage1	V <sub>OH1</sub>	R <sub>L</sub> =10kΩ to 2.5V	4.95	-	-	V
	V <sub>OL1</sub>	R <sub>L</sub> =10kΩ to 2.5V	-	-	0.05	V
Output Voltage2	V <sub>OH2</sub>	R <sub>L</sub> =600Ω to 2.5V	4.9	-	-	V
	V <sub>OL2</sub>	R <sub>L</sub> =600Ω to 2.5V	-	-	0.1	V
Output Source Current	I <sub>SOURCE</sub>	V <sub>O</sub> =2.5V	70	-	-	mA
Output Sink Current	I <sub>SINK</sub>	V <sub>O</sub> =2.5V	70	-	-	mA
Input Common Mode Voltage Range	V <sub>ICM</sub>	CMR ≥ 44dB	0	-	5	V

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

### ●AC CHARACTERISTICS

(V<sub>DD</sub>=5V, Ta=25°C)

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Unity Gain Bandwidth	GB	R <sub>L</sub> =10kΩ to 2.5V	-	0.8	-	MHz
Total Harmonic Distortion	THD	f=1kHz, V <sub>IN</sub> =1Vpp, A <sub>V</sub> =0dB	-	0.05	-	%
Equivalent Input Noise Voltage	V <sub>NI</sub>	f=1kHz	-	40	-	nV/√Hz

### ●TRANSIENT CHARACTERISTICS

(V<sub>DD</sub>=5V, Ta=25°C)

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Slew Rate	SR	R <sub>L</sub> =10kΩ to 2.5V	-	0.85	-	V/μs

# NJU7040

## ■ 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	$\mu A$
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	-	$V/\mu s$

## ●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	$\mu A$
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

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

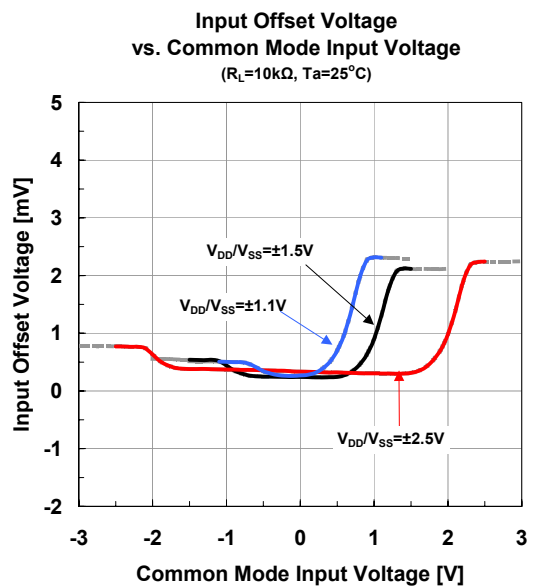
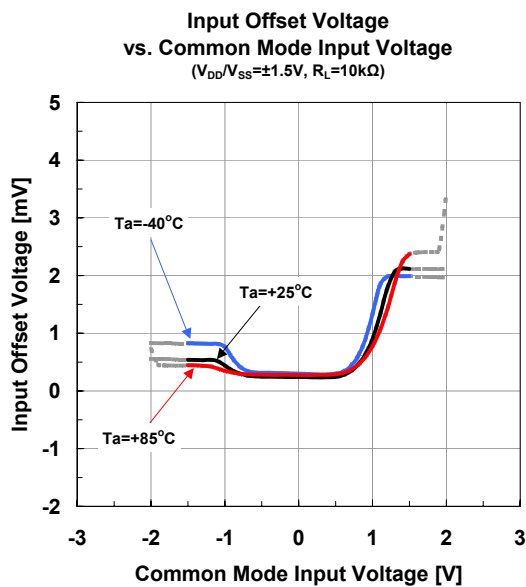
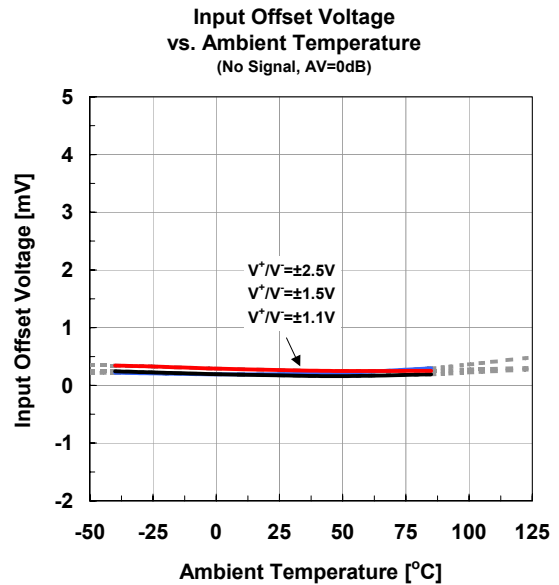
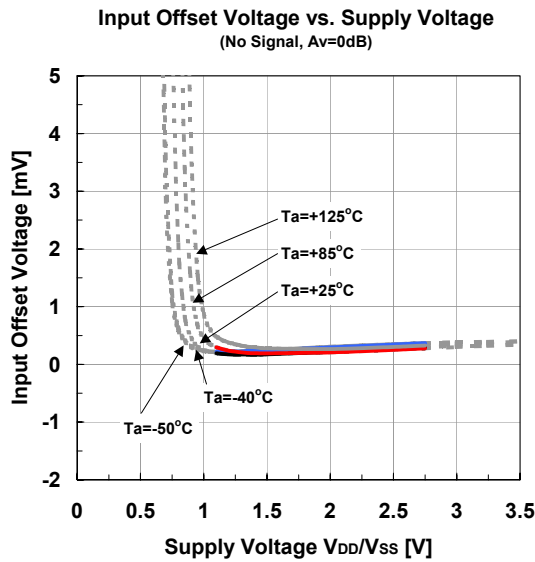
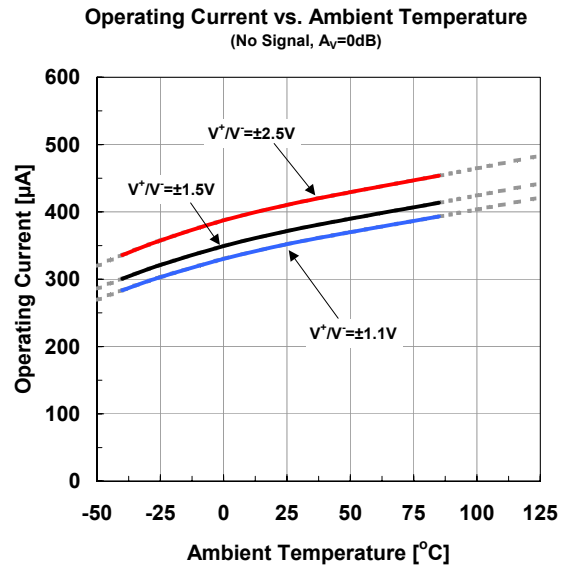
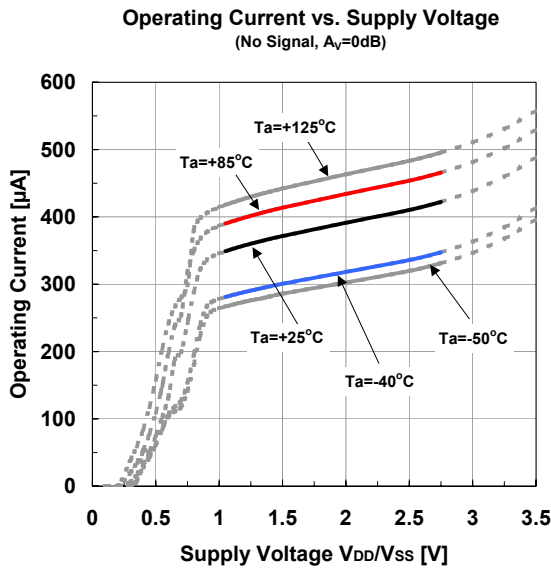
PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Unity Gain Bandwidth	GB	$R_L=10k\Omega$ to 1.1V	-	0.8	-	MHz
Total Harmonic Distortion	THD	$f=1kHz, V_{IN}=1V_{pp}, A_V=0dB$	-	0.05	-	%
Equivalent Input Noise Voltage	$V_{NI}$	$f=1kHz$	-	40	-	nV/ $\sqrt{Hz}$

## ●TRANSIENT CHARACTERISTICS

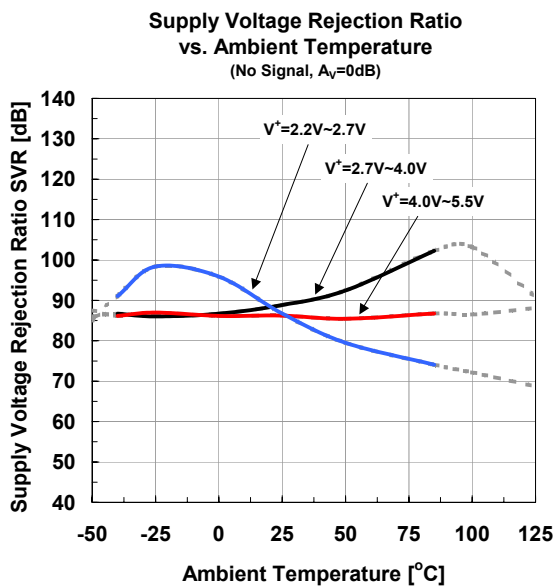
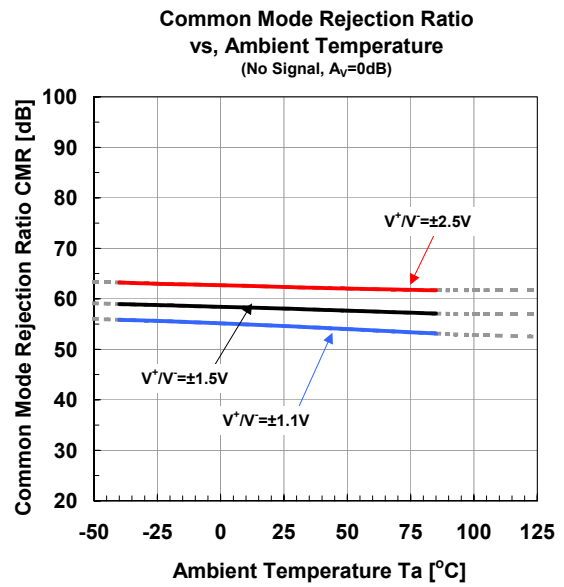
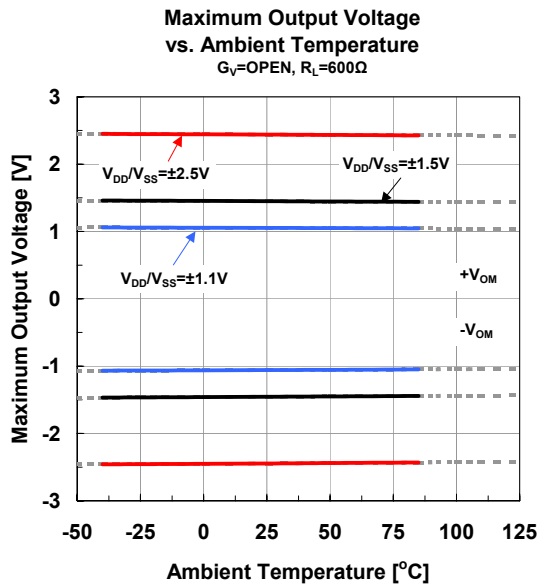
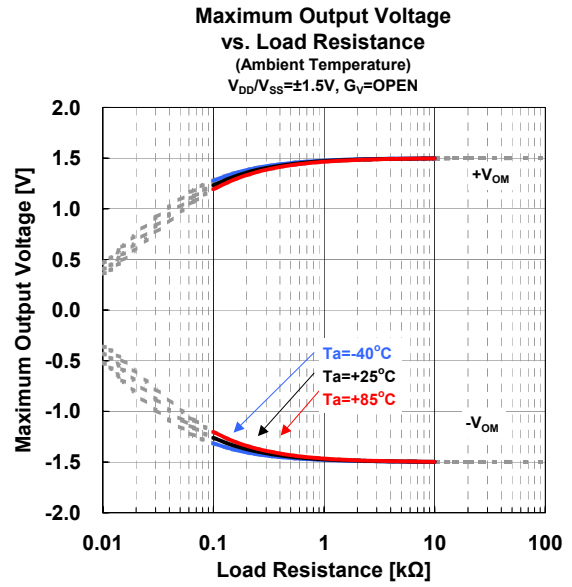
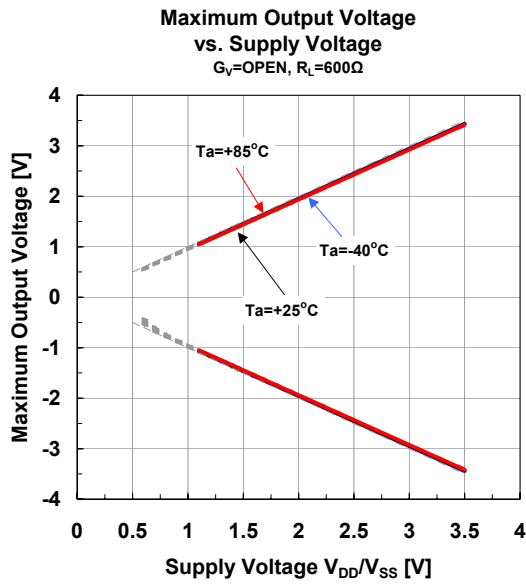
( $V_{DD}=2.2V, T_a=25^\circ C$ )

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

## ■ Typical Characteristics

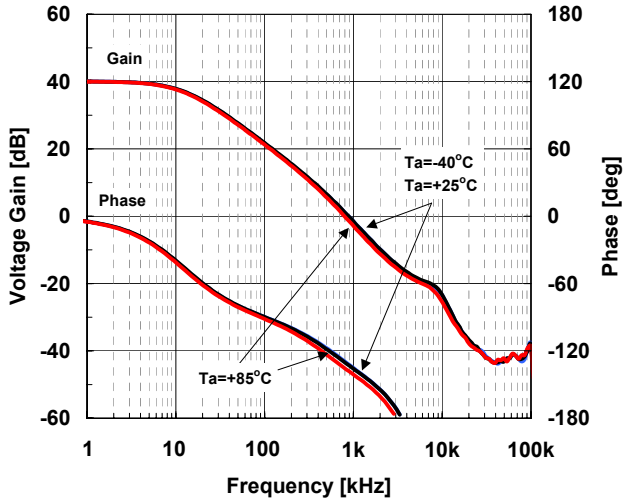


## ■ Typical Characteristics

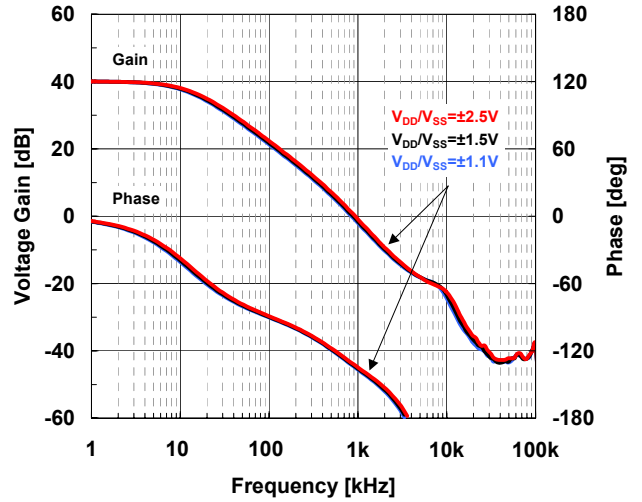


## Typical Characteristics

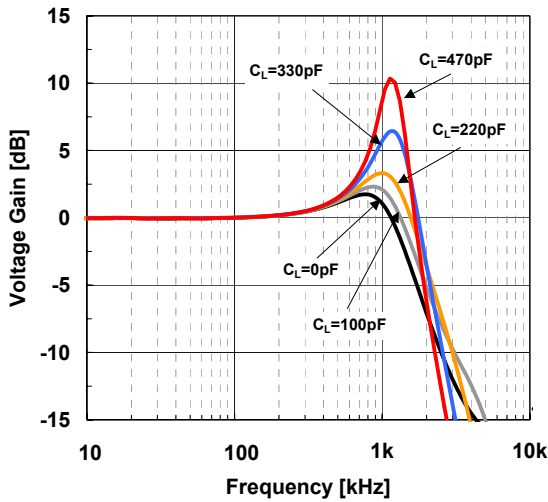
**Voltage Gain / Phase vs. Frequency (Ambient Temp.)**  
 $V_{DD}/V_{SS}=\pm 1.5V, G_V=40dB, R_F=100K\Omega,$   
 $R_G=1k\Omega, R_L=10k\Omega, C_L=3pF, V_{IN}=-30dBm$



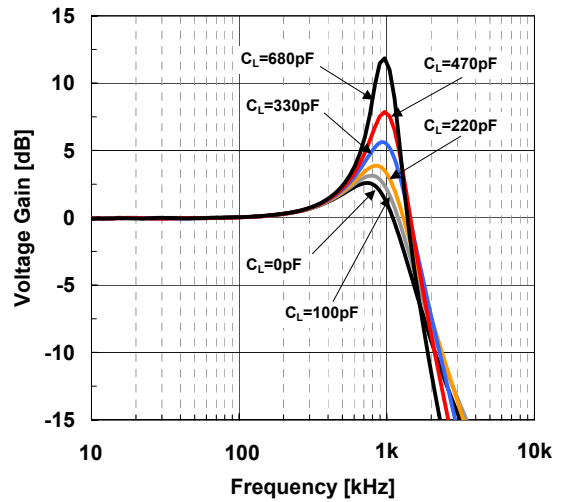
**Voltage Gain / Phase vs. Frequency**  
 $G_V=40dB, R_F=100K\Omega, T_a=+25^\circ C$   
 $R_G=1k\Omega, R_L=10k\Omega, C_L=3pF, V_{IN}=-30dBm$



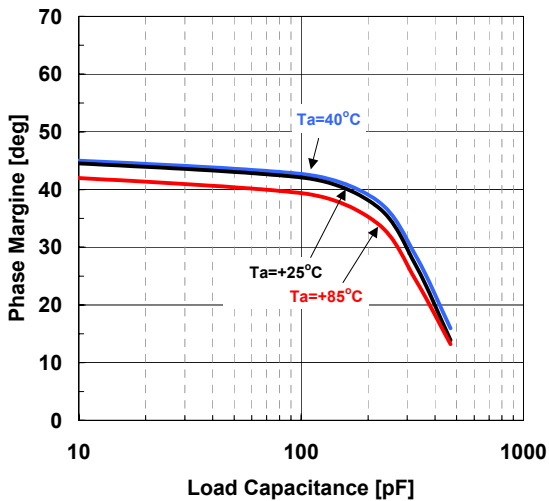
**V.F. Peak vs. Frequency**  
 $V_{DD}/V_{SS}=\pm 1.5V, G_V=0dB, R_L=10k\Omega,$   
 $V_{IN}=-30dBm, T_a=+27^\circ C$



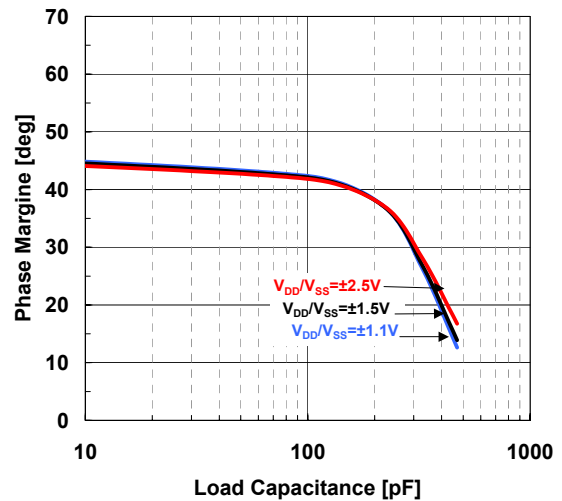
**V.F. Peak vs. Frequency**  
 $V_{DD}/V_{SS}=\pm 1.5V, G_V=0dB, R_L=600\Omega,$   
 $V_{IN}=-30dBm, T_a=+27^\circ C$



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

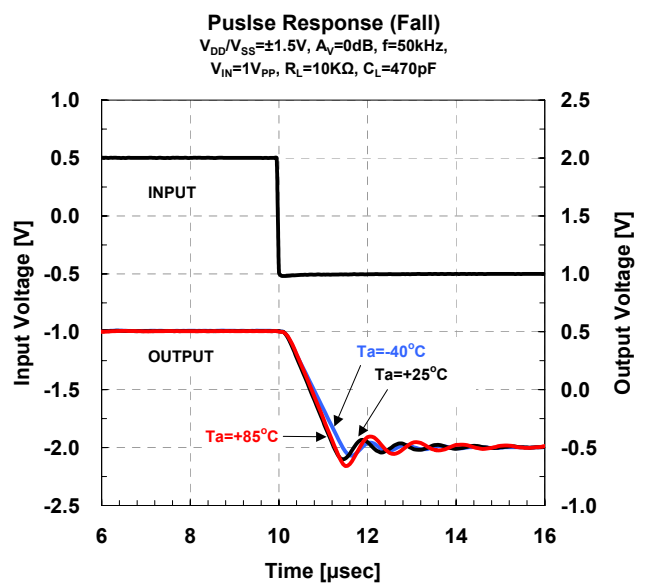
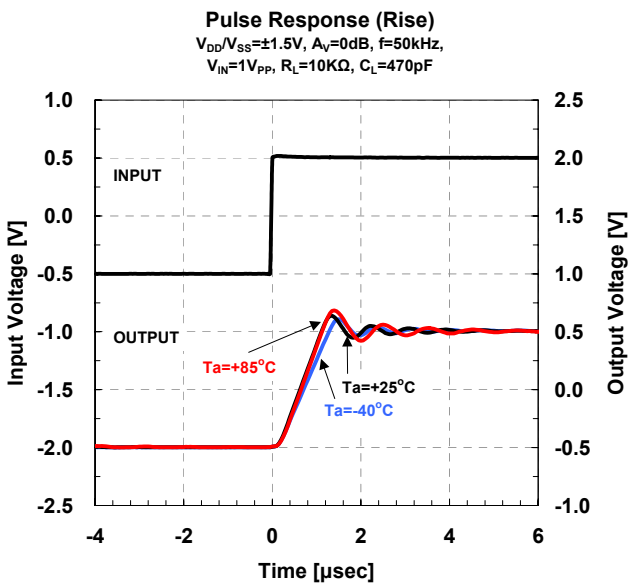
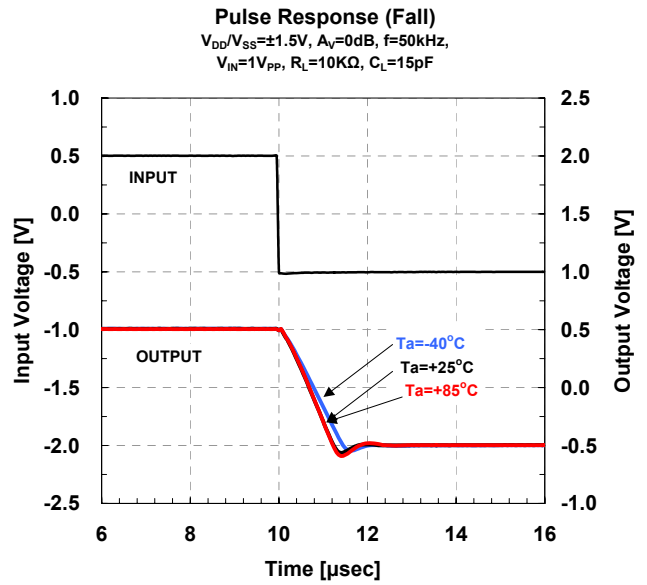
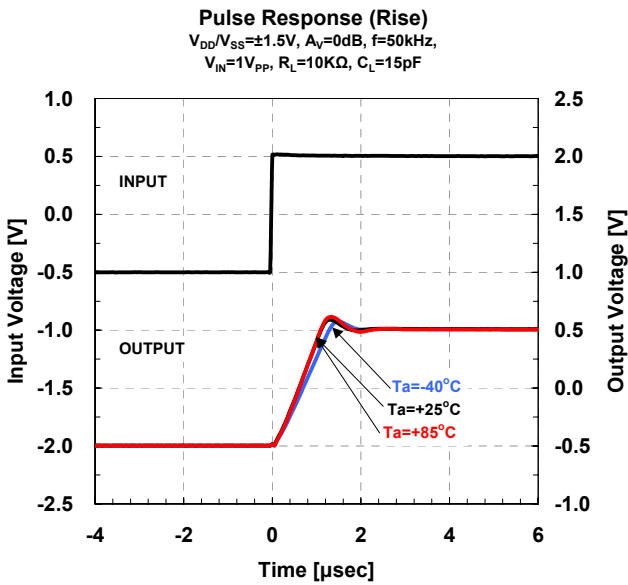
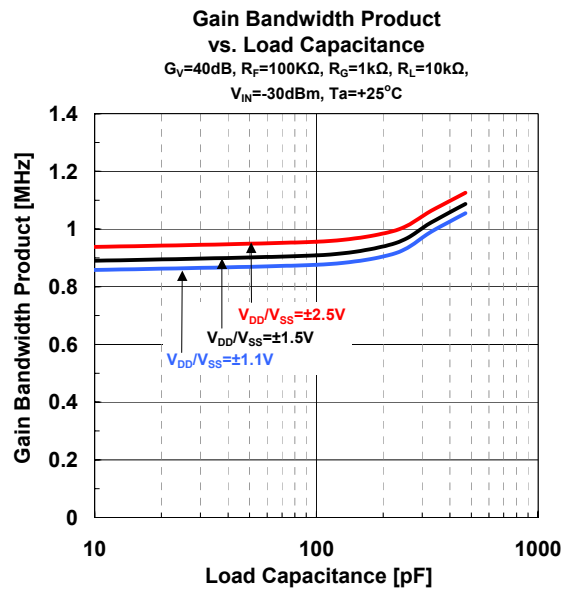
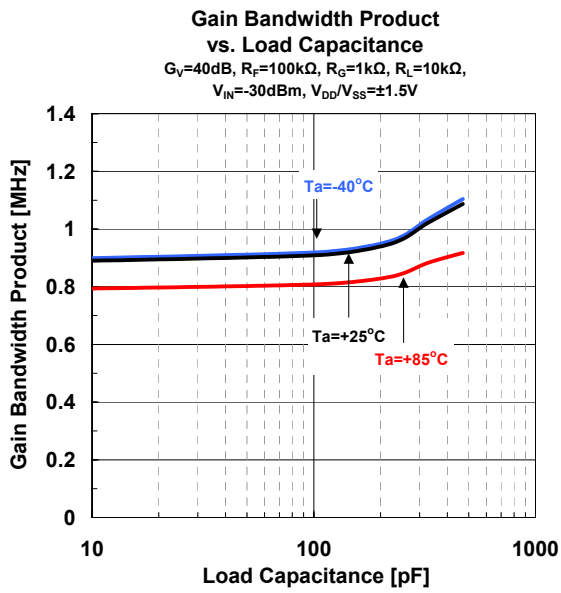


**Phase Margine vs. Load Capacitance**  
 $G_V=40dB, R_F=100K\Omega, R_G=1k\Omega, R_L=10k\Omega,$   
 $V_{IN}=-30dBm, T_a=+25^\circ C$

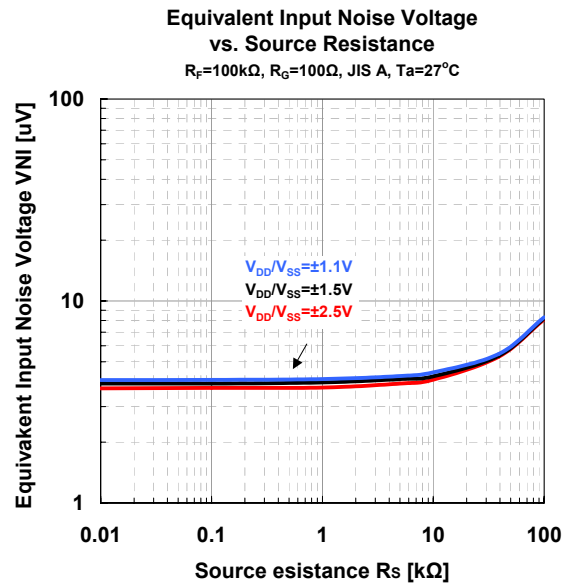
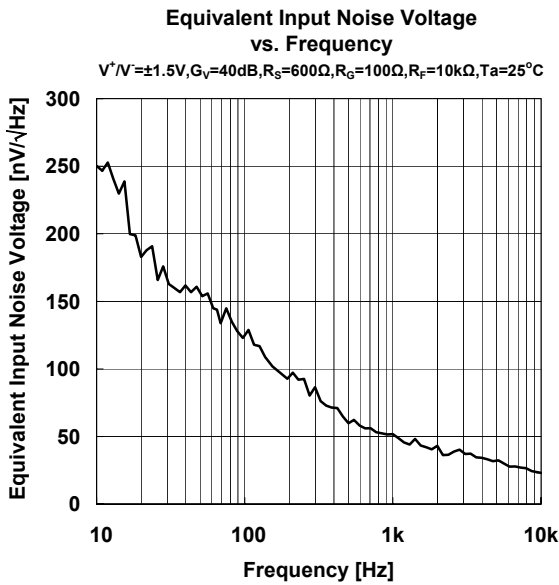
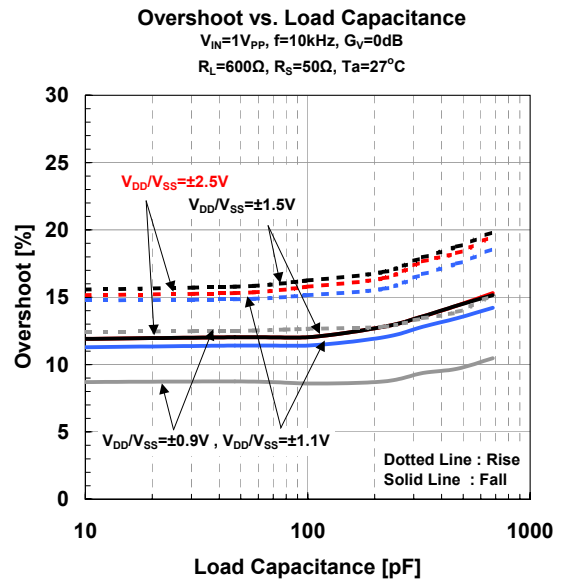
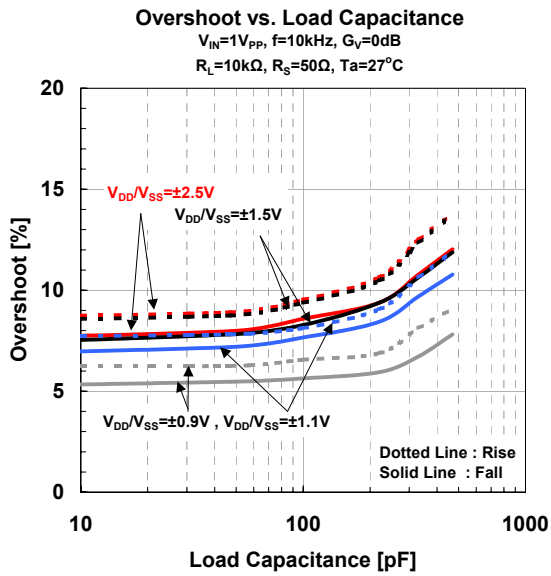




## ■ Typical Characteristics



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**[CAUTION]**

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