

14μA/ch, 16V Operation, Rail-to-Rail Output Dual CMOS Operational Amplifier

■GENERAL DESCRIPTION

The NJU7067 is a low power, high Voltage operation, dual CMOS Operational Amplifier. It is tolerant to RF noise. The NJU7067 can operate wide voltage range from single-supply voltage of +4V to +16V. In addition, this amplifier features Rail-to-Rail output and low input bias current (1pA typ.). Because of these features, the NJU7067 is idea for low side current sense amplifier.

■PACKAGE OUTLINE



NJU7067M
(DMP8)



NJU7067V
(SSOP8)

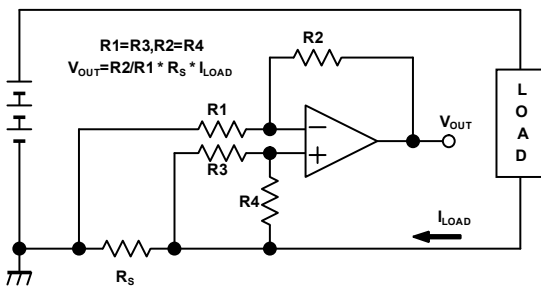
■FEATURES

- | | |
|-----------------------------|---|
| ●Low Supply Current | 14μA/ch typ. (at $V_{DD}=+5V$), 16.5μA/ch typ. (at $V_{DD}=+15V$) |
| ●Rail-to-Rail Output | GND + 0.05V to $V_{DD} - 0.1V$ min. ($R_L=10k\Omega$ to 0V) |
| ●Wide Operating Voltage | $V_{opr}= 4V$ to 16V |
| ●Input Offset Voltage | $V_{IO}=4mV$ max. |
| ●Low Input Bias Current | 1pA typ. |
| ●Slew Rate | 0.04V/μs typ. |
| ●Gain Bandwidth Product | 90kHz |
| ●Enhanced RF Noise Immunity | |
| ●Package Outline | DMP8,SSOP8 |
| ●CMOS Process | |

■APPLICATIONS

- Battery-operated application
- Battery Monitor
- Current Sensor
- Photodiode application

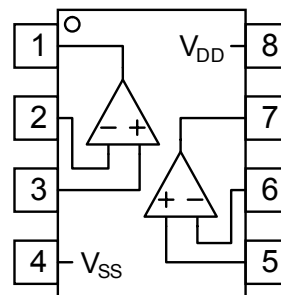
■APPLICATION CIRCUIT



Low-side Current Sensor

■PIN CONFIGURATION

(Top View)



PIN FUNCTION

- 1:A OUTPUT
- 2:A -INPUT
- 3:A +INPUT
- 4:V_{SS}
- 5:B +INPUT
- 6:B -INPUT
- 7:B OUTPUT
- 8:V_{DD}

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

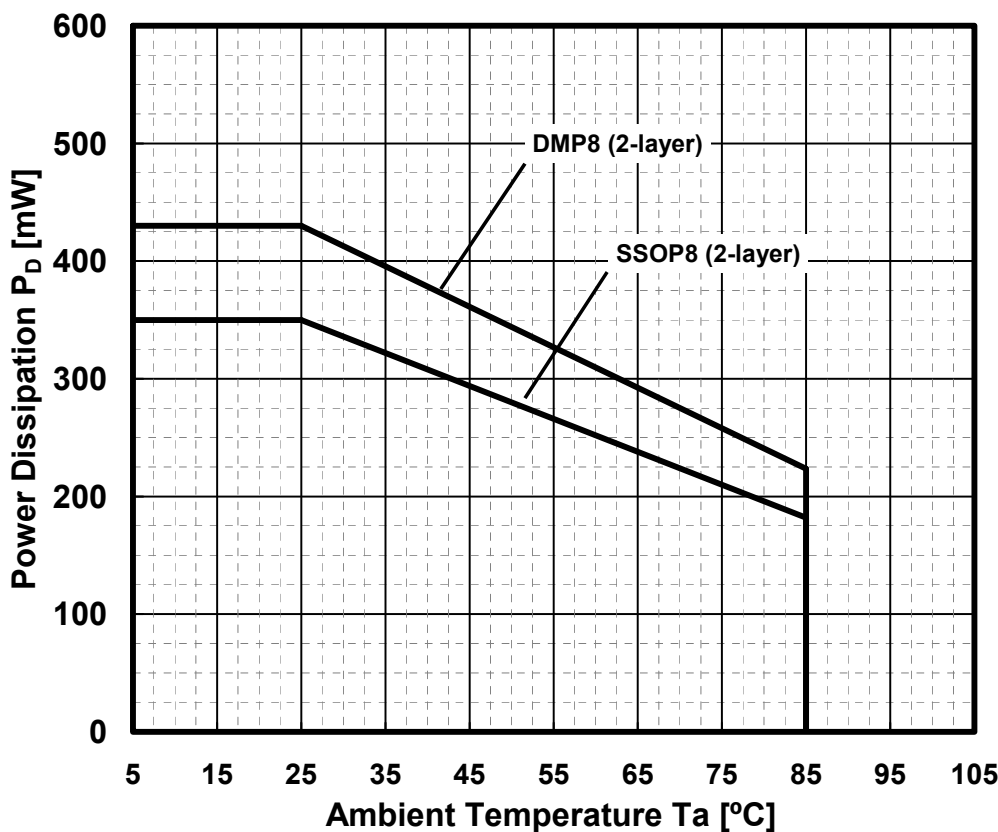
PARAMETER	SYMBOL	RATINGS	UNIT
Supply Voltage	V _{DD}	+18	V
Common Mode Input Voltage Range	V _{ICM}	V _{SS} -0.3~V _{DD} +0.3	V
Differential Input Voltage Range	V _{ID}	±18 (Note 1)	V
Power Dissipation	P _D	[DMP8] 430(Note 2,3) [SSOP8] 350(Note 2,3)	mW
Operating Temperature Range	Topr	-40~+85	°C
Storage Temperature Range	Tstg	-55~+150	°C

(Note 1) For supply Voltages less than ±18V, the maximum input voltage is equal to the Supply Voltage.

(Note 2) EIA/JEDEC STANDARD Test board (76.2x114.3x1.57mm, 2layer, FR-4) mounting

(Note 3) 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. Power Dissipation Derating Curve



■RECOMMENDED OPERATING CONDITION

(Ta=25°C)

PARAMETER	SYMBOL	RATING	UNIT
Supply Voltage	V _{DD}	+4 to +16	V

■ ELECTRICAL CHARACTERISTICS
● DC CHARACTERISTICS

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

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Supply Current	I_{DD}	No Signal	-	28	48	μA
Input Offset Voltage	V_{IO}	$V_{IC}=0V, R_S=50\Omega$	-	1	4	mV
Input Offset Voltage Drift	$\Delta V_{IO}/\Delta T$	$T_a = -40^{\circ}C$ to $+85^{\circ}C$	-	3.3	-	$\mu V/^{\circ}C$
Input Bias Current	I_B	$V_{IC}=0V, R_S=50\Omega$	-	1	-	pA
Input Offset Current	I_{IO}	$V_{IC}=0V, R_S=50\Omega$	-	1	-	pA
Large Signal Voltage Gain	A_V	$V_O=1V$ to $4V, R_L=10k\Omega$ to $2.5V$	90	110	-	dB
Common Mode Rejection Ratio	CMR	$V_{ICM}=0V$ to $3.4V$	65	80	-	dB
Supply Voltage Rejection Ratio	SVR	$V_{DD}=4V$ to $16V$	70	85	-	dB
Maximum Output Voltage 1	V_{OH1}	$R_L=10k\Omega$ to $2.5V$	4.95	4.98	-	V
	V_{OL1}		-	0.02	0.05	
Maximum Output Voltage 2	V_{OH2}	$R_L=10k\Omega$ to $0V$	4.90	4.96	-	V
	V_{OL2}		-	0.01	0.05	
Maximum Output Voltage 3	V_{OH3}	$I_{source} = 3mA$	4.65	4.75	-	V
	V_{OL3}	$I_{sink} = 3mA$	-	0.20	0.30	
Common Mode Input Voltage Range	V_{ICM}	CMR \geq 65dB	0	-	3.4	V

● AC CHARACTERISTICS

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

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Gain Bandwidth Product	GBW	$R_L=10k\Omega$ to $2.5V, C_L=20pF, f=1kHz$	-	60	-	kHz
Phase Margin	ϕ_M	$R_L=10k\Omega$ to $2.5V, C_L=20pF$	-	75	-	deg
Gain Margin	G_M	$R_L=10k\Omega$ to $2.5V, C_L=20pF$	-	22	-	dB
Equivalent Input Noise Voltage	V_{NI}	$f=1kHz$	-	45	-	nV/\sqrt{Hz}
Channel Separation	CS	$f=1kHz$	-	120	-	dB
Slew Rate	SR1	$G_V=0dB, R_L=10k\Omega$ to $2.5V, C_L=20pF, V_{in}=1V_{pp}$ (2V to 3V) (Note 4)	-	0.03	-	V/ μs
	SR2	$G_V=0dB, R_L=10k\Omega$ to $0V, C_L=20pF, V_{in}=1V_{pp}$ (2V to 3V) (Note 4)	-	0.03	-	
Power Band	PBW1	$G_V=+6dB, R_L=10k\Omega$ to $2.5V, C_L=20pF, V_{in}=2.5V_{pp}$ (1.25V to 3.75V), $V_o>4.8V_{pp}$	-	3.6	-	kHz
	PBW2	$G_V=+6dB, R_L=10k\Omega$ to $0V, C_L=20pF, V_{in}=2.5V_{pp}$ (1.25V to 3.75V), $V_o>4.8V_{pp}$	-	3.2	-	
Total Harmonic Distortion	THD1	$G_V=+6dB, R_L=10k\Omega$ to $2.5V, C_L=20pF, f=100Hz, V_{out}=2V_{pp}$	-	0.05	-	%
	THD2	$G_V=+6dB, R_L=10k\Omega$ to $0V, C_L=20pF, f=100Hz, V_{out}=2V_{pp}$	-	0.005	-	%

(Note 4) Slew rate is defined by the lower value of the rise or fall.

■ ELECTRICAL CHARACTERISTICS
● DC CHARACTERISTICS

 (V_{DD}=10V, V_{SS}=0V, Ta=25°C, unless otherwise noted.)

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Supply Current	I _{DD}	No Signal	-	31	57	μA
Input Offset Voltage	V _{IO}	V _{IC} = 0V, R _S =50Ω	-	1	4	mV
Input Offset Voltage Drift	ΔV _{IO} /ΔT	Ta = -40°C to +85°C	-	2.7	-	μV/°C
Input Bias Current	I _B	V _{IC} = 0V, R _S =50Ω	-	1	-	pA
Input Offset Current	I _{IO}	V _{IC} = 0V, R _S =50Ω	-	1	-	pA
Large Signal Voltage Gain	A _V	V _O =2V to 8V, R _L =10kΩ to 5V	100	120	-	dB
Common Mode Rejection Ratio	CMR	V _{ICM} =0V to 8.4V	65	85	-	dB
Supply Voltage Rejection Ratio	SVR	V _{DD} =4V to 16V	70	85	-	dB
Maximum Output Voltage 1	V _{OH} 1	R _L =10kΩ to 5V	9.95	9.98	-	V
	V _{OL} 1		-	0.02	0.05	
Maximum Output Voltage 2	V _{OH} 2	R _L =10kΩ to 0V	9.90	9.95	-	V
	V _{OL} 2		-	0.01	0.05	
Maximum Output Voltage 3	V _{OH} 3	I _{source} = 3mA	9.70	9.80	-	V
	V _{OL} 3	I _{sink} = 3mA	-	0.15	0.30	
Common Mode Input Voltage Range	V _{ICM}	CMR≥65dB	0	-	8.4	V

● AC CHARACTERISTICS

 (V_{DD}=10V, V_{SS}=0V, Ta=25°C, unless otherwise noted.)

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Gain Bandwidth Product	GBW	R _L =10kΩ to 5V, C _L =20pF, f=1kHz	-	80	-	kHz
Phase Margin	φ _M	R _L =10kΩ to 5V, C _L =20pF	-	75	-	deg
Gain Margin	G _M	R _L =10kΩ to 5V, C _L =20pF	-	23	-	dB
Equivalent Input Noise Voltage	V _{NI}	f=1kHz	-	45	-	nV/√Hz
Channel Separation	CS	f=1kHz	-	120	-	dB
Slew Rate	SR1	G _V =0dB, R _L =10kΩ to 5V, C _L =20pF, V _{in} =6Vpp (2V to 8V) (Note 4)	-	0.04	-	V/μs
	SR2	G _V =0dB, R _L =10kΩ to 0V, C _L =20pF, V _{in} =6Vpp (2V to 8V) (Note 4)	-	0.04	-	
Power Band	PBW1	G _V =+6dB, R _L =10kΩ to 5V, C _L =20pF, V _{in} =5Vpp (2.5V to 7.5V), V _o >9.8Vpp	-	1.6	-	kHz
	PBW2	G _V =+6dB, R _L =10kΩ to 0V, C _L =20pF, V _{in} =5Vpp (2.5V to 7.5V), V _o >9.8Vpp	-	1.6	-	
Total Harmonic Distortion	THD1	G _V =+6dB, R _L =10kΩ to 5V, C _L =20pF, f=100Hz, V _{out} =5Vpp	-	0.03	-	%
	THD2	G _V =+6dB, R _L =10kΩ to 0V, C _L =20pF, f=100Hz, V _{out} =5Vpp	-	0.003	-	%

(Note 4) Slew rate is defined by the lower value of the rise or fall.

■ ELECTRICAL CHARACTERISTICS
● DC CHARACTERISTICS

 (V_{DD}=15V, V_{SS}=0V, Ta=25°C, unless otherwise noted.)

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Supply Current	I _{DD}	No Signal	-	33	68	μA
Input Offset Voltage	V _{IO}	V _{IC} = 0V, R _S =50Ω	-	1	4	mV
Input Offset Voltage Drift	ΔV _{IO} /ΔT	Ta = -40°C to +85°C	-	2.7	-	μV/°C
Input Bias Current	I _B	V _{IC} = 0V, R _S =50Ω	-	1	-	pA
Input Offset Current	I _{IO}	V _{IC} = 0V, R _S =50Ω	-	1	-	pA
Large Signal Voltage Gain	A _V	V _O =2V to 13V, R _L =10kΩ to 7.5V	100	120	-	dB
Common Mode Rejection Ratio	CMR	V _{ICM} =0V to 13.4V	65	85	-	dB
Supply Voltage Rejection Ratio	SVR	V _{DD} =4V to 16V	70	85	-	dB
Maximum Output Voltage 1	V _{OH} 1	R _L =10kΩ to 7.5V	14.95	14.98	-	V
	V _{OL} 1		-	0.02	0.05	
Maximum Output Voltage 2	V _{OH} 2	R _L =10kΩ to 0V	14.90	14.93	-	V
	V _{OL} 2		-	0.01	0.05	
Maximum Output Voltage 3	V _{OH} 3	I _{source} = 3mA	14.70	14.85	-	V
	V _{OL} 3	I _{sink} = 3mA	-	0.15	0.30	
Common Mode Input Voltage Range	V _{ICM}	CMR≥65dB	0	-	13.4	V

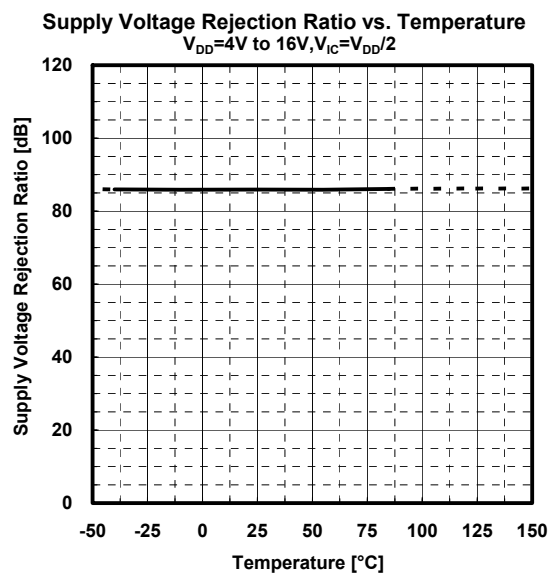
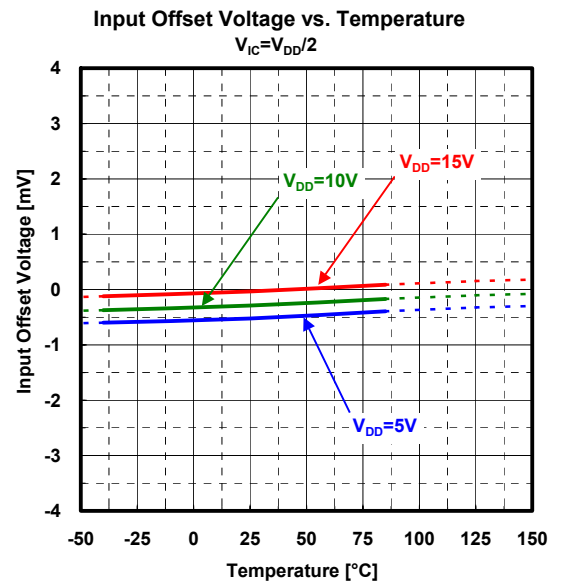
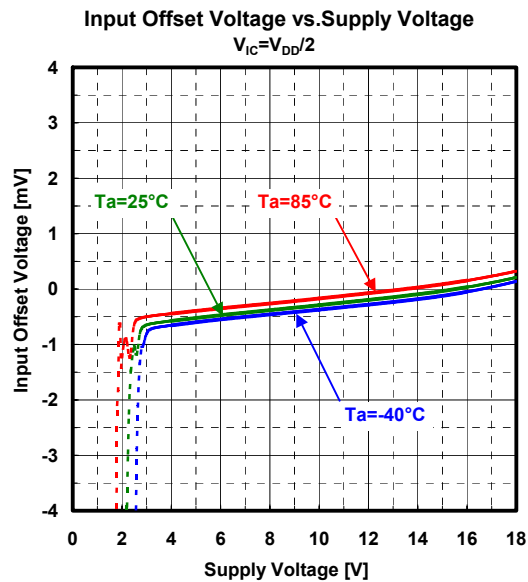
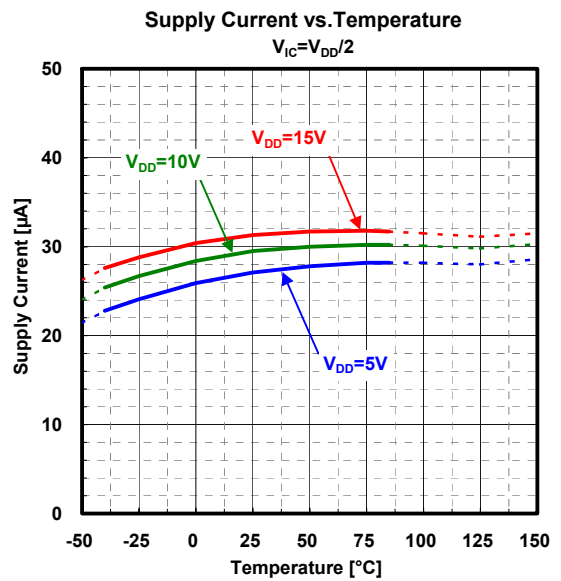
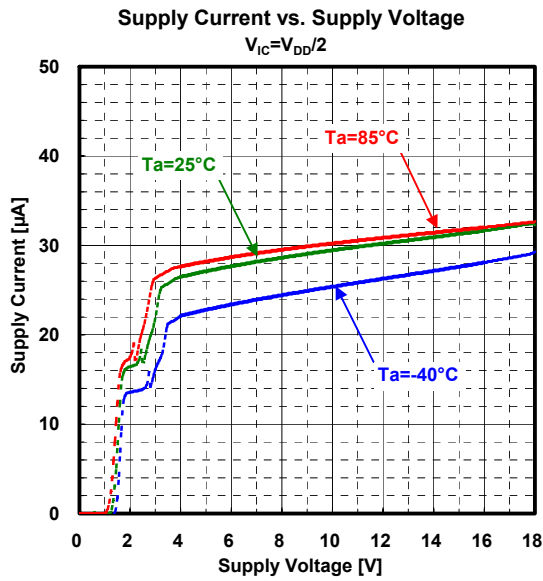
● AC CHARACTERISTICS

 (V_{DD}=15V, V_{SS}=0V, Ta=25°C, unless otherwise noted.)

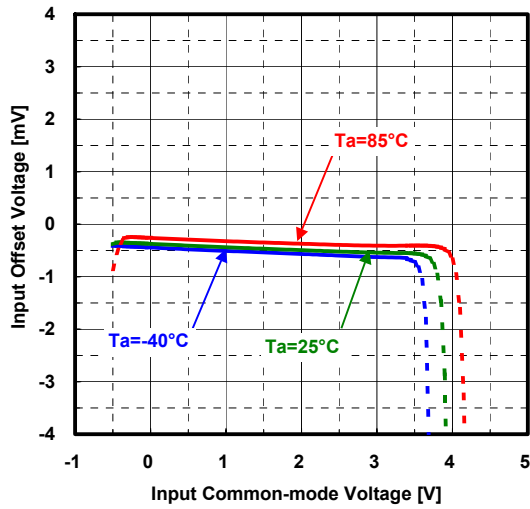
PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Gain Bandwidth Product	GBW	R _L =10kΩ to 7.5V, C _L =20pF, f=1kHz	-	90	-	kHz
Phase Margin	φ _M	R _L =10kΩ to 7.5V, C _L =20pF	-	75	-	deg
Gain Margin	G _M	R _L =10kΩ to 7.5V, C _L =20pF	-	23	-	dB
Equivalent Input Noise Voltage	V _{NI}	f=1kHz	-	40	-	nV/√Hz
Channel Separation	CS	f=1kHz	-	120	-	dB
Slew Rate	SR1	G _V =0dB, R _L =10kΩ to 7.5V, C _L =20pF, V _{in} =11Vpp (2V to 13V) (Note 4)	-	0.04	-	V/μs
	SR2	G _V =0dB, R _L =10kΩ to 0V, C _L =20pF, V _{in} =11Vpp (2V to 13V) (Note 4)	-	0.04	-	
Power Band	PBW1	G _V =+6dB, R _L =10kΩ to 7.5V, C _L =20pF, V _{in} =7.5Vpp (3.75V to 11.25V), V _o >14.8Vpp	-	1.1	-	kHz
	PBW2	G _V =+6dB, R _L =10kΩ to 0V, C _L =20pF, V _{in} =7.5Vpp (3.75V to 11.25V), V _o >14.8Vpp	-	0.8	-	
Total Harmonic Distortion	THD1	G _V =+6dB, R _L =10kΩ to 7.5V, C _L =20pF, f=100Hz, V _{out} =10Vpp	-	0.02	-	%
	THD2	G _V =+6dB, R _L =10kΩ to 0V, C _L =20pF, f=100Hz, V _{out} =10Vpp	-	0.003	-	%

(Note 4) Slew rate is defined by the lower value of the rise or fall.

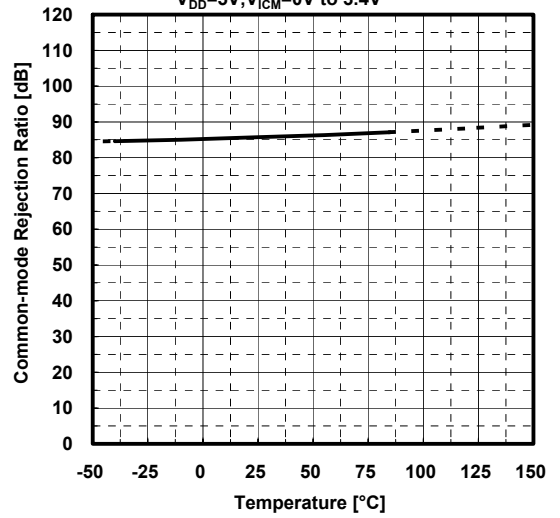
■ TYPICAL CHARACTERISTICS



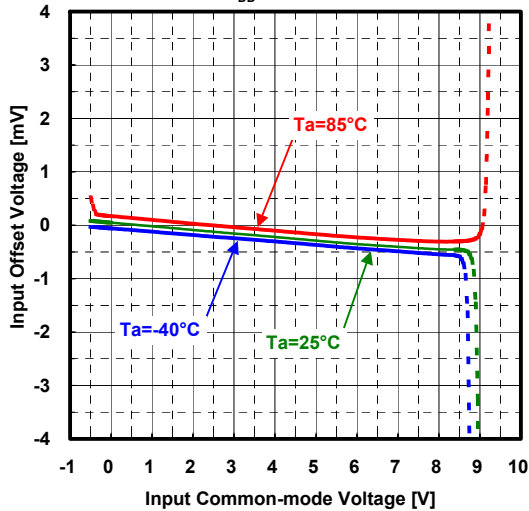
Input Offset Voltage vs. Input Common-mode Voltage
 $V_{DD}=5V$



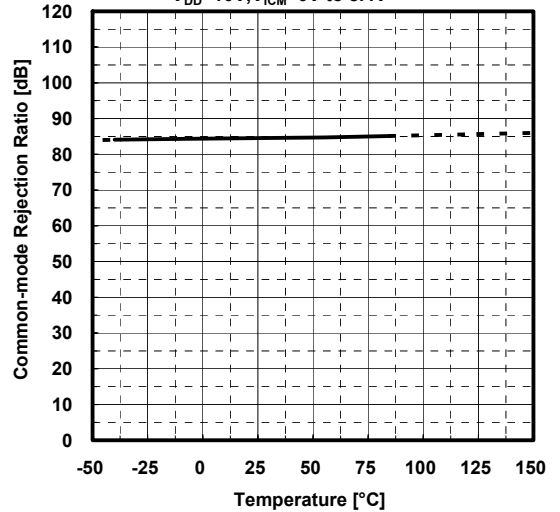
Common-mode Rejection Ratio vs. Temperature
 $V_{DD}=5V, V_{ICM}=0V \text{ to } 3.4V$



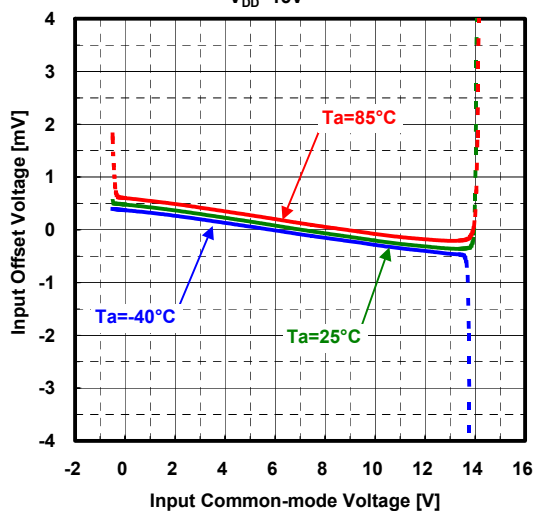
Input Offset Voltage vs. Input Common-mode Voltage
 $V_{DD}=10V$



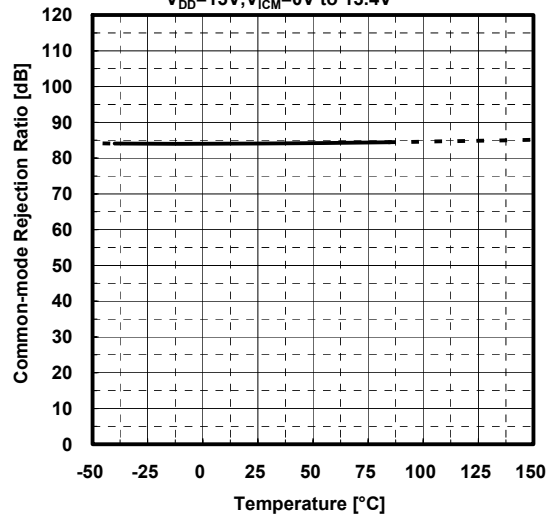
Common-mode Rejection Ratio vs. Temperature
 $V_{DD}=10V, V_{ICM}=0V \text{ to } 8.4V$

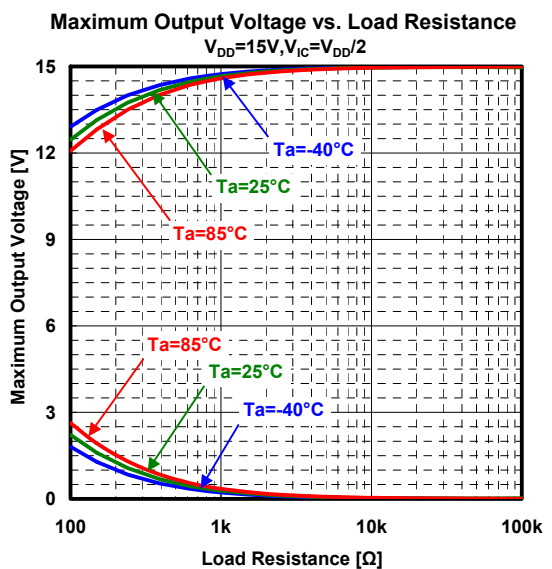
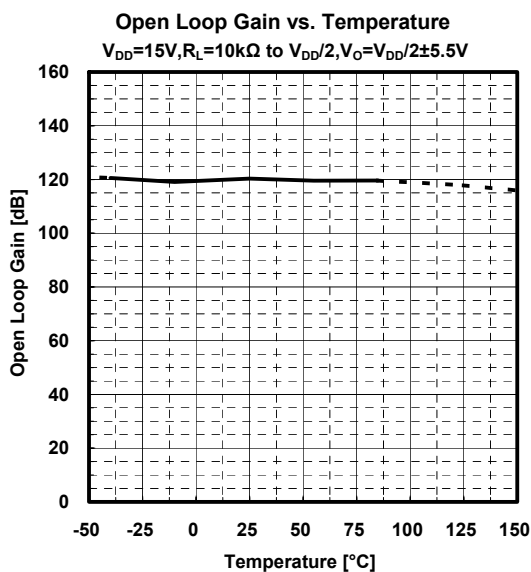
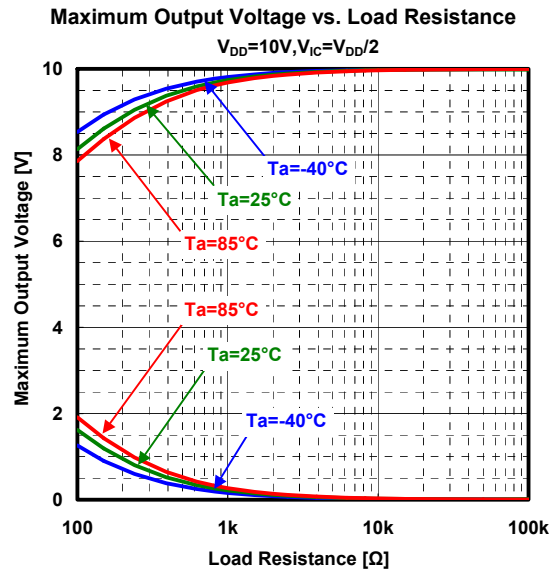
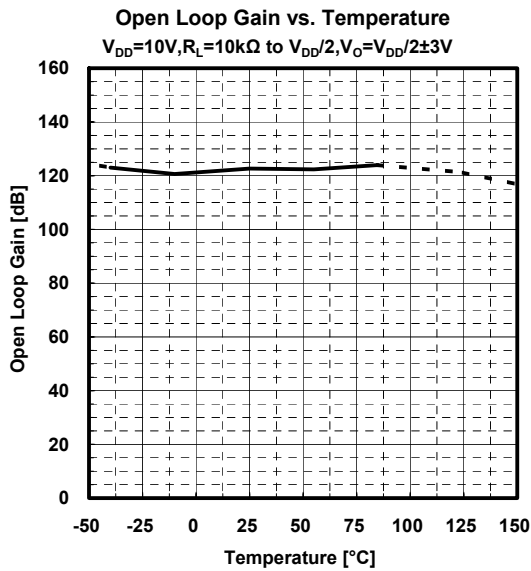
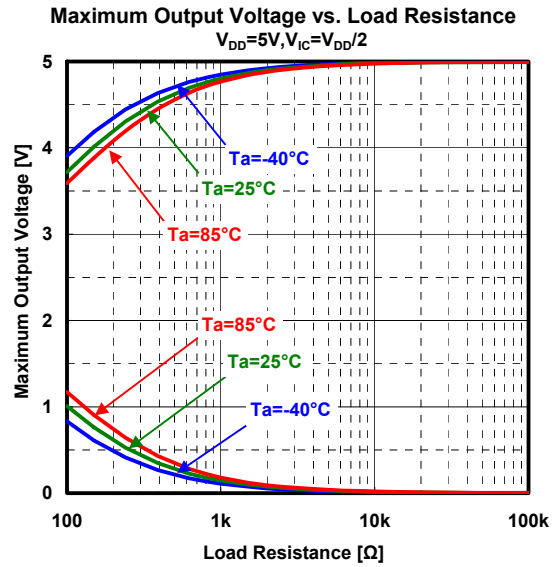
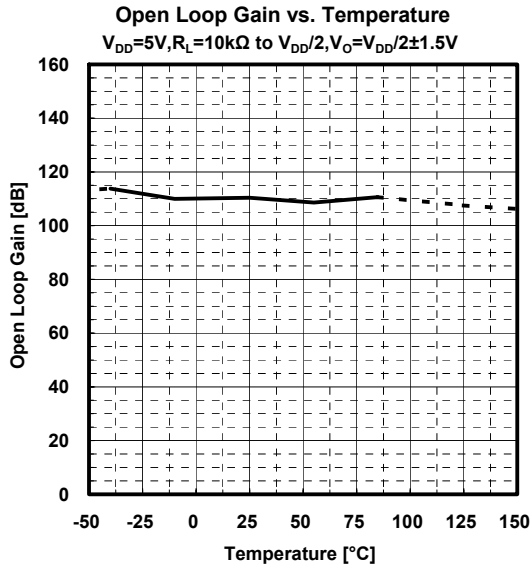


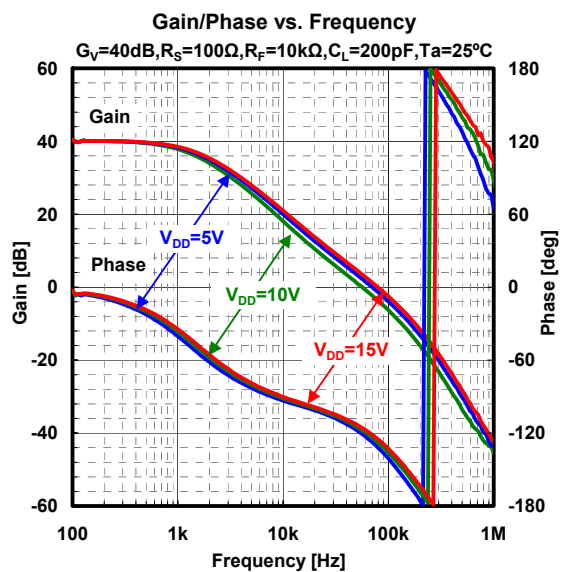
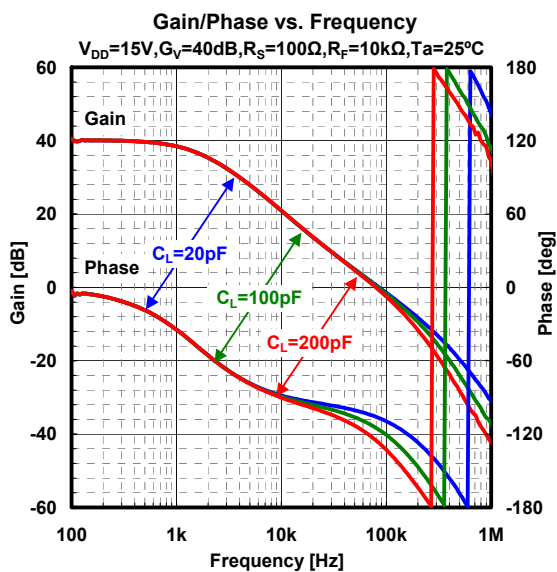
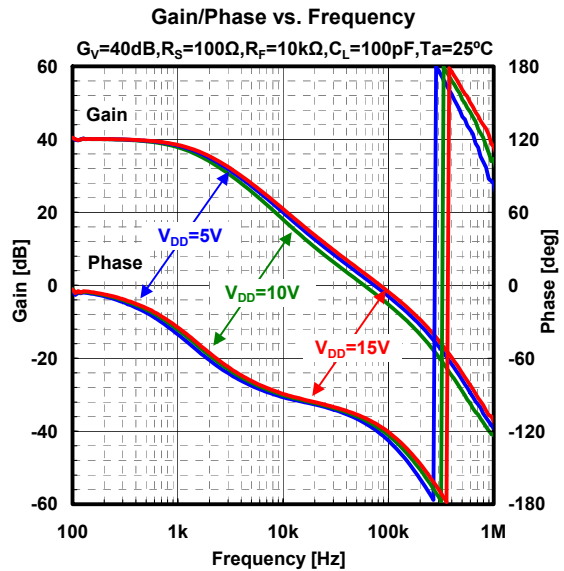
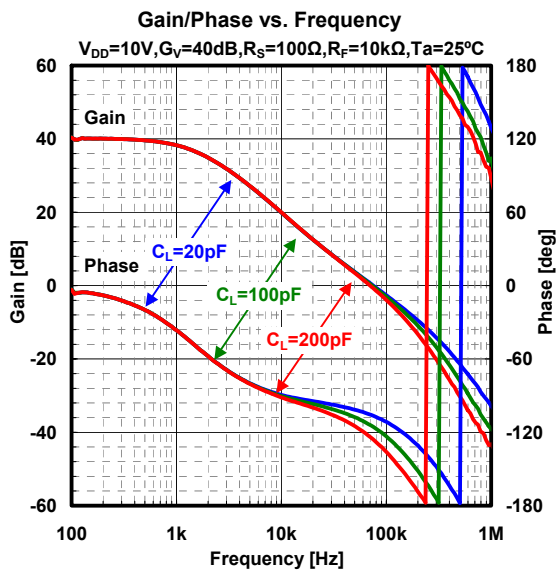
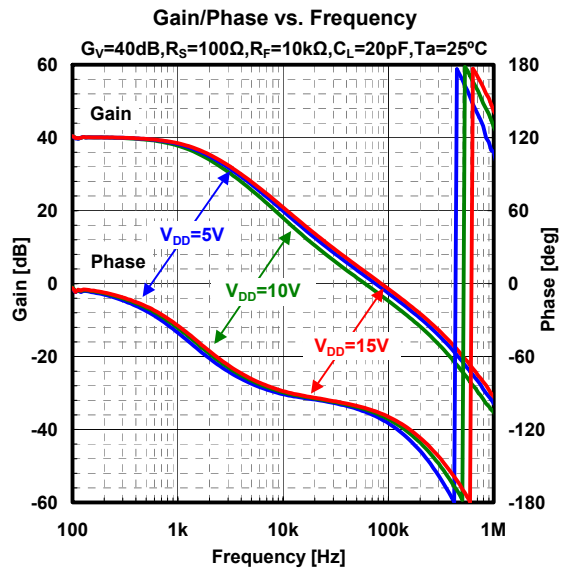
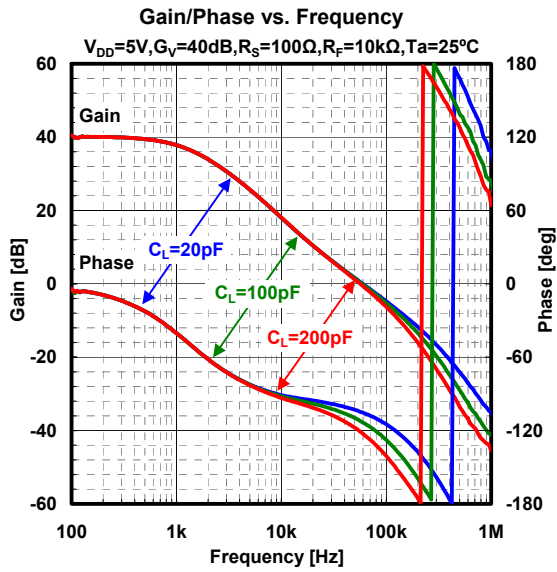
Input Offset Voltage vs. Input Common-mode Voltage
 $V_{DD}=15V$

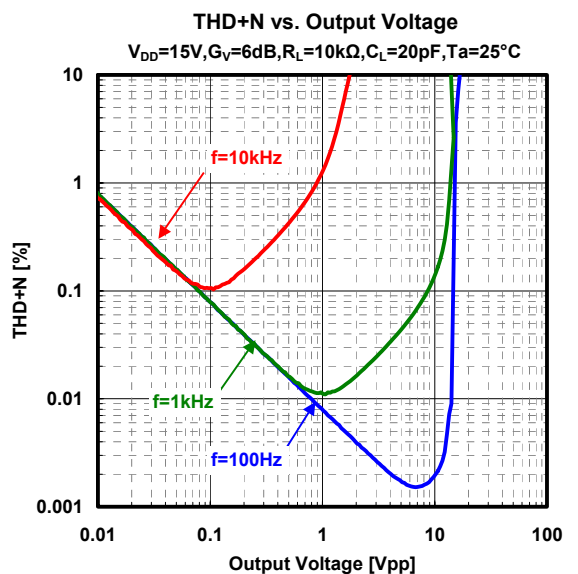
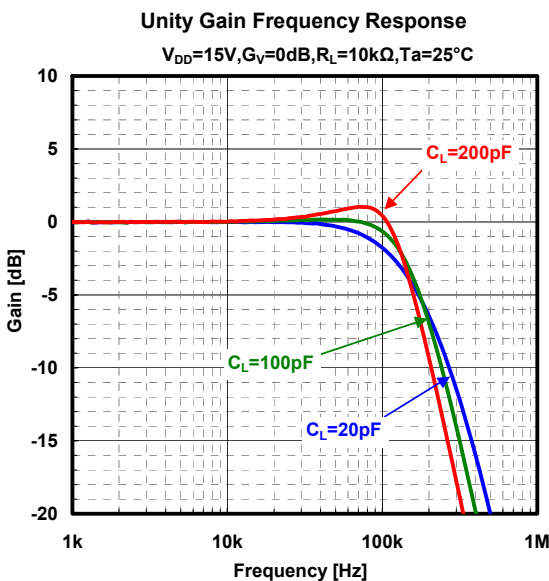
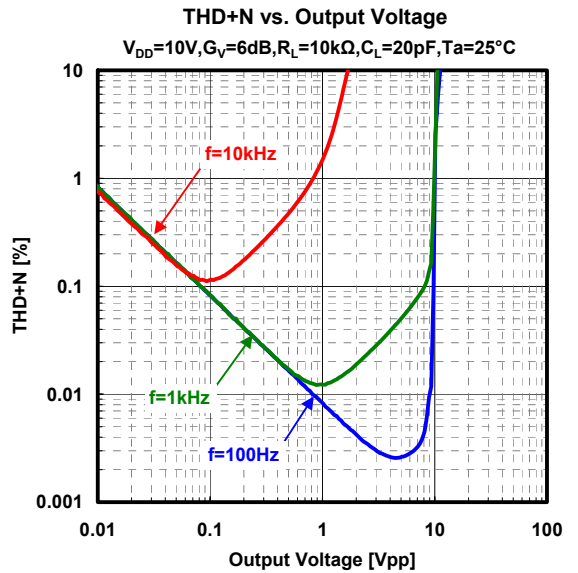
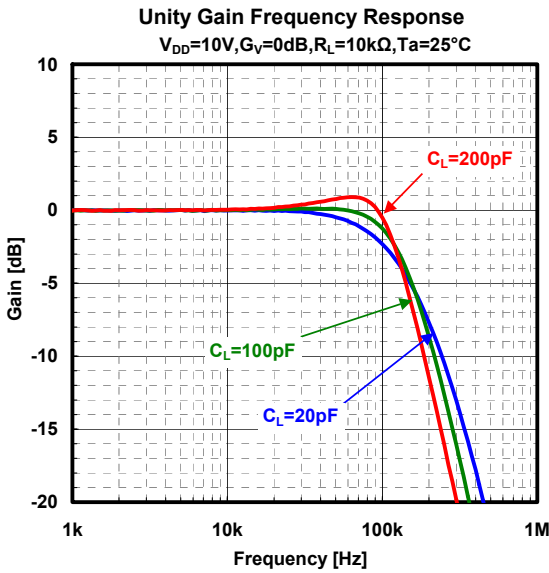
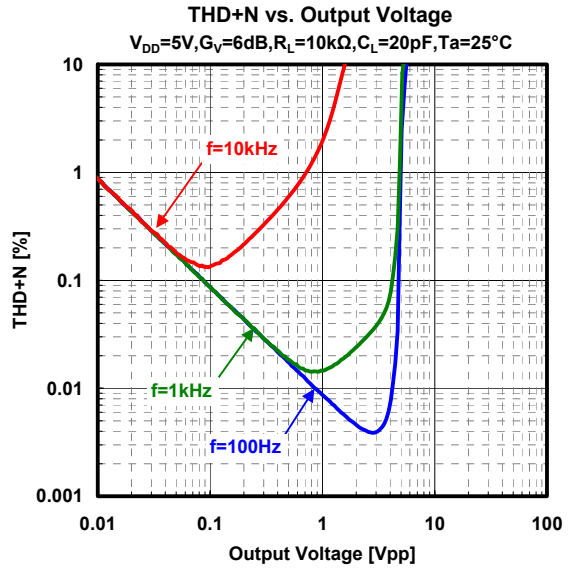
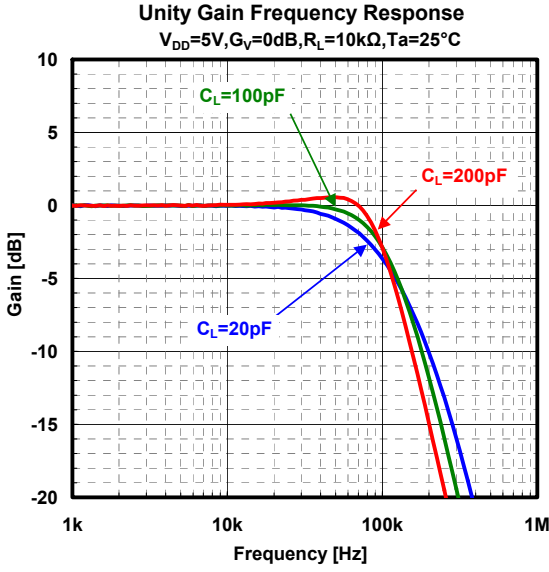


Common-mode Rejection Ratio vs. Temperature
 $V_{DD}=15V, V_{ICM}=0V \text{ to } 13.4V$



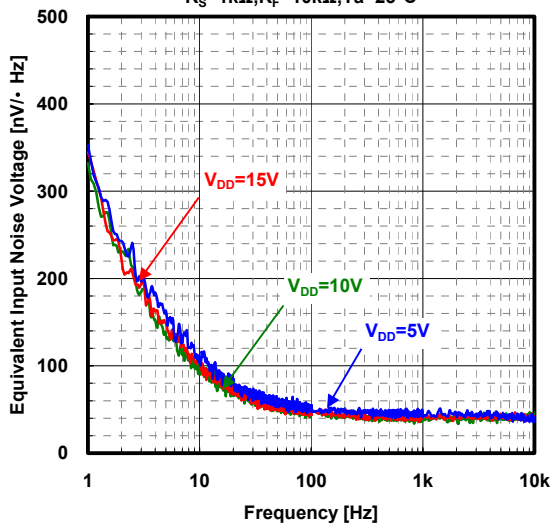






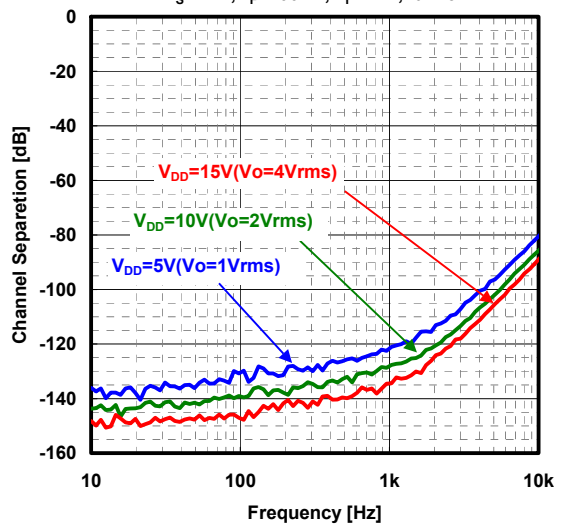
Equivalent Input Noise Voltage

$R_S=1k\Omega, R_F=10k\Omega, T_a=25^\circ C$



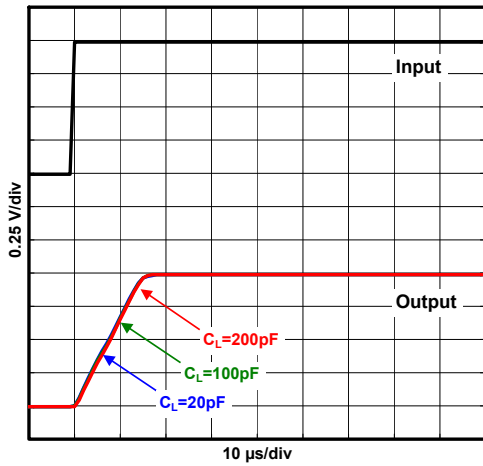
Channel Separation vs. Frequency

$R_S=1k\Omega, R_F=100k\Omega, R_T=1k\Omega, T_a=25^\circ C$



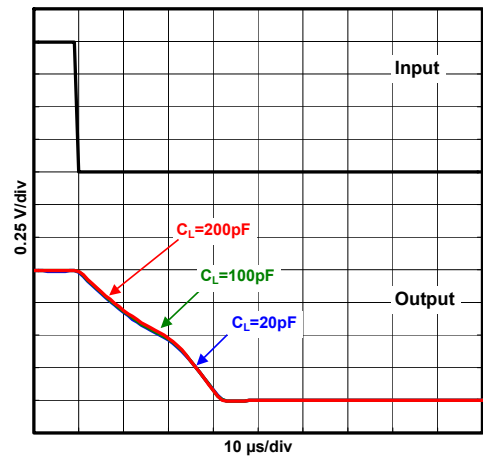
Transient Response

$V_{DD}=5V, G_V=0dB, V_{IN}=1V_{pp}, R_L=10k\Omega, T_a=25^\circ C$



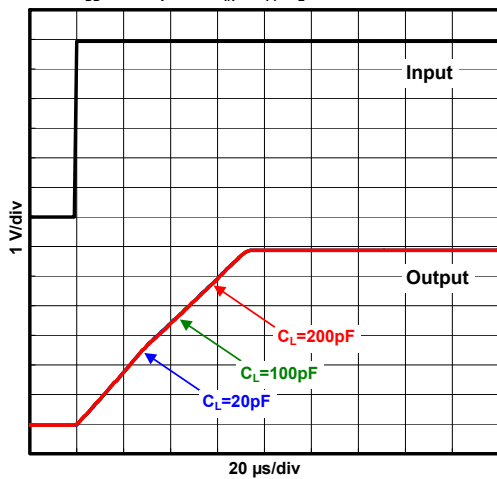
Transient Response

$V_{DD}=5V, G_V=0dB, V_{IN}=1V_{pp}, R_L=10k\Omega, T_a=25^\circ C$



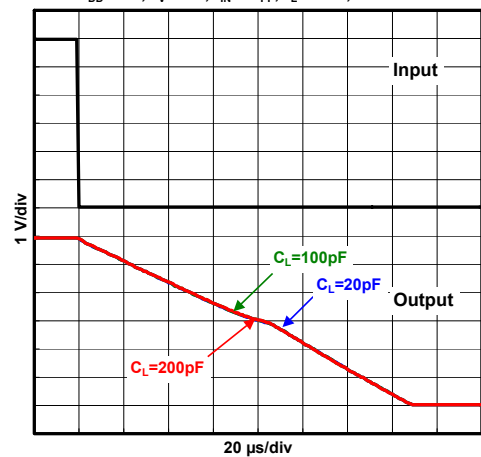
Transient Response

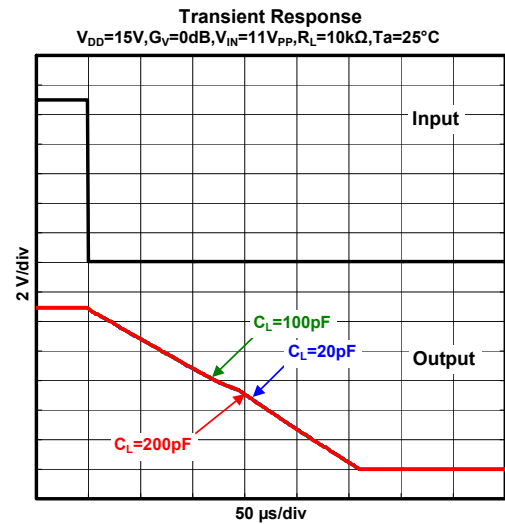
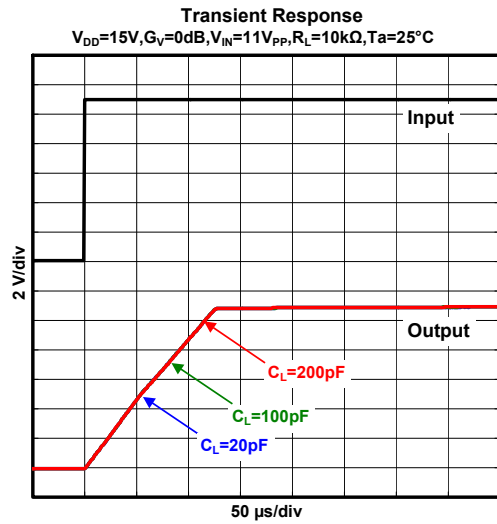
$V_{DD}=10V, G_V=0dB, V_{IN}=6V_{pp}, R_L=10k\Omega, T_a=25^\circ C$



Transient Response

$V_{DD}=10V, G_V=0dB, V_{IN}=6V_{pp}, R_L=10k\Omega, T_a=25^\circ C$





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