

Rail-to-Rail Output Quad CMOS Operational Amplifier

■ GENERAL DESCRIPTION

The **NJU7058** is a Quad CMOS operational amplifier that feature low noise as $V_{NI}=15nV/\sqrt{Hz}$ (at $V_{DD}=5V$, $f=1kHz$). It is tolerant to RF noise.

The NJU7058 can operate from a single-supply voltage of +1.8V to +5.5V. In addition, this amplifier features Rail-to-Rail output and low input bias current (1pA).

■ PACKAGE OUTLINE



**NJU7058V
(SSOP14)**

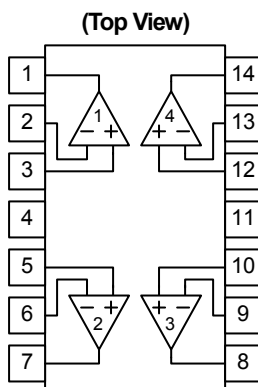
■ FEATURES

- Low Operating Voltage 1.8V to 5.5V
- Voltage Noise 15nV/ \sqrt{Hz} (typ.) (at $V_{DD}=5V$, $f=1kHz$)
- Rail-to-Rail Output $V_{OH}=4.9V$ min./ $V_{OL}=0.1V$ max. (at $V_{DD}=5V$, $R_L=10k\Omega$)
 $V_{OH}=4.8V$ min./ $V_{OL}=0.2V$ max. (at $V_{DD}=5V$, $I_O=2mA$)
- Package SSOP14
- Enhanced RF Noise Immunity
- CMOS Process

■ APPLICATION

- Sensor amplifiers
- Photodiode amplifiers
- Low noise signal processing applications
- Microphone amplifiers
- Battery-operated application

■ PIN CONFIGURATION (Top View)



Pin Function
 1. OUTPUT 1
 2. -INPUT 1
 3. +INPUT 1
 4. V_{DD}
 5. +INPUT 2
 6. -INPUT 2
 7. OUTPUT 2

8. OUTPUT 3
 9. -INPUT 3
 10. +INPUT 3
 11. V_{SS}
 12. +INPUT 4
 13. -INPUT 4
 14. OUTPUT 4

■ ABSOLUTE MAXIMUM RATINGS

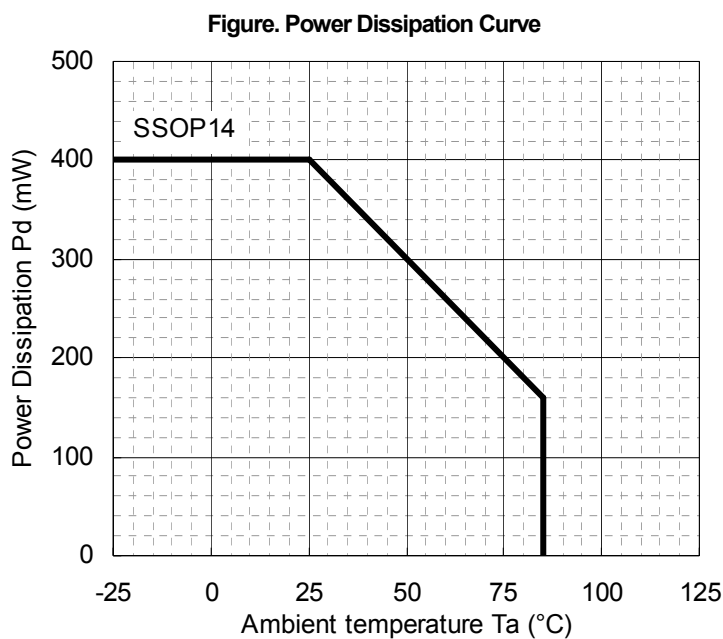
PARAMETER	SYMBOL	RATINGS	UNIT
Supply Voltage	V_{DD}	+7	V
Input Common Mode Voltage	V_{ICM}	$V_{SS}-0.3$ to $V_{DD}+0.3$	V
Differential Input Voltage	V_{ID}	± 7 (Note1)	V
Power Dissipation	P_D	400[SSOP14] (Note2)	mW
Operating Temperature Range	T_{opr}	-40 to +85	$^{\circ}C$
Storage Temperature Range	T_{stg}	-55 to +125	$^{\circ}C$

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

(Note2) EIA/JEDEC STANDARD Test board (76.2 x 114.3 x 1.6mm, 2layers, FR-4) mounting.

(Note3) Do not exceed "Power dissipation: P_D " in which power dissipation in IC is shown by the absolute maximum rating.

See Figure "Power Dissipation Curve" when ambient temperature is over 25 $^{\circ}C$.



■ RECOMMENDED OPERATING CONDITION (Ta=25 $^{\circ}C$)

PARAMETER	SYMBOL	RATING	UNIT
Supply Voltage	V_{DD}	1.8 to 5.5	V

■ ELECTRICAL CHARACTERISTICS

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

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Supply Current	I_{DD}	No Signal	-	1.1	1.7	mA
Input Offset Voltage	V_{IO}	$V_{ic}=0V$, $R_S=50\Omega$	-	1	4	mV
Input Offset Voltage drift	$\Delta V_{IO}/\Delta T$		-	0.7	-	$\mu V/^\circ C$
Input Bias Current	I_B		-	1	-	pA
Input Offset Current	I_{IO}		-	1	-	pA
Open loop gain	A_V	$V_o=0.5V$ to $4.5V$, $R_L=10k\Omega$ to $2.5V$	70	90	-	dB
Common Mode Rejection Ratio	CMR	$V_{ICM}=0V$ to $4.1V$	65	80	-	dB
Supply Voltage Rejection Ratio	SVR	$V_{DD}=1.8V$ to $5.5V$	70	90	-	dB
Maximum Output Voltage 1	V_{OH1}	$R_L=10k\Omega$ to $2.5V$	4.9	4.95	-	V
	V_{OL1}	$R_L=10k\Omega$ to $2.5V$	-	0.05	0.1	V
Maximum Output Voltage 2	V_{OH2}	$R_L=10k\Omega$ to $0V$	4.9	4.95	-	V
	V_{OL2}	$R_L=10k\Omega$ to $0V$	-	0.02	0.05	V
Maximum Output Voltage 3	V_{OH3}	$I_{source}=2mA$	4.8	4.85	-	V
	V_{OL3}	$I_{sink}=2mA$	-	0.15	0.2	V
Common Mode Input Voltage Range	V_{ICM}	CMR \geq 65dB	0	-	4.1	V

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

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Gain Bandwidth Product	GBW	$R_L=10k\Omega$ to $2.5V$, $C_L=20pF$, $f=100kHz$	-	2.1	-	MHz
Phase Margin	ϕ_M	$R_L=10k\Omega$ to $2.5V$, $C_L=20pF$	-	80	-	deg
Gain Margin	G_M	$R_L=10k\Omega$ to $2.5V$, $C_L=20pF$	-	10	-	dB
Equivalent Input Noise Voltage	e_n	$f=1kHz$	-	15	-	nV/\sqrt{Hz}
Slew Rate	SR	$G_v=0dB$, $R_L=10k\Omega$ to $2.5V$, $C_L=20pF$, $V_{in}=3V_{pp}$ (1V to 4V) (Note4) (Note5)	-	0.8	-	V/us
Channel Separation	CS	$f=1kHz$	-	120	-	dB
Total Harmonic Distortion	THD	$G_v=6dB$, $R_F=50k\Omega$, $R_G=50k\Omega$, $C_L=20pF$, $V_o=4V_{pp}$, $f=1kHz$ (Note6)	-	0.01	-	%

(Note4) Slew rate is defined by the lower value of the rise or fall.

(Note5) See figure2-1 for test circuit.

(Note6) See figure2-3 for test circuit.

■ ELECTRICAL CHARACTERISTICS

DC CHARACTER ($V_{DD}=1.8V$, $V_{SS}=0V$, $T_a=25^\circ C$, unless otherwise noted.)

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Supply Current	I_{DD}	No Signal	-	0.9	1.5	mA
Input Offset Voltage	V_{IO}	$V_{ic}=0V$, $R_S=50\Omega$	-	1	4	mV
Input Offset Voltage drift	$\Delta V_{io}/\Delta T$		-	0.8	-	$\mu V/^\circ C$
Input Bias Current	I_B		-	1	-	pA
Input Offset Current	I_{IO}		-	1	-	pA
Open loop gain	A_V	$V_o=0.5V$ to $1.3V$, $R_L=10k\Omega$ to $0.9V$	65	90	-	dB
Common Mode Rejection Ratio	CMR	$V_{ICM}=0V$ to $0.9V$	65	80	-	dB
Supply Voltage Rejection Ratio	SVR	$V_{DD}=1.8V$ to $5.5V$	70	90	-	dB
Maximum Output Voltage 1	V_{OH1}	$R_L=10k\Omega$ to $0.9V$	1.7	1.75	-	V
	V_{OL1}	$R_L=10k\Omega$ to $0.9V$	-	0.05	0.1	V
Maximum Output Voltage 2	V_{OH2}	$R_L=10k\Omega$ to $0V$	1.7	1.75	-	V
	V_{OL2}	$R_L=10k\Omega$ to $0V$	-	0.02	0.05	V
Maximum Output Voltage 3	V_{OH3}	$I_{source}=1mA$	1.5	1.55	-	V
	V_{OL3}	$I_{sink}=1mA$	-	0.25	0.3	V
Common Mode Input Voltage Range	V_{ICM}	CMR \geq 65dB	0	-	0.9	V

AC CHARACTER ($V_{DD}=1.8V$, $V_{SS}=0V$, $T_a=25^\circ C$, unless otherwise noted.)

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Gain Bandwidth Product	GBW	$R_L=10k\Omega$ to $0.9V$, $C_L=20pF$, $f=100kHz$	-	1.7	-	MHz
Phase Margin	ϕ_M	$R_L=10k\Omega$ to $0.9V$, $C_L=20pF$	-	80	-	deg
Gain Margin	G_M	$R_L=10k\Omega$ to $0.9V$, $C_L=20pF$	-	13	-	dB
Equivalent Input Noise Voltage	e_n	$f=1kHz$	-	18	-	nV/\sqrt{Hz}
Slew Rate	SR	$G_v=0dB$, $R_L=10k\Omega$ to $1.5V$, $C_L=20pF$, $V_{in}=0.5V_{pp}$ ($0.3V$ to $0.8V$) (Note4) (Note7)	-	0.6	-	V/us
Channel Separation	CS	$f=1kHz$	-	110	-	dB
Total Harmonic Distortion	THD	$G_v=+6dB$, $R_F=50k\Omega$, $R_G=50k\Omega$, $C_L=20pF$, $V_o=1V_{pp}$, $f=1kHz$ (Note8)	-	0.01	-	%

(Note4) Slew rate is defined by the lower value of the rise or fall.

(Note7) See figure2-2 for test circuit.

(Note8) See figure2-4 for test circuit.

■ MEASUREMENT CIRCUITS

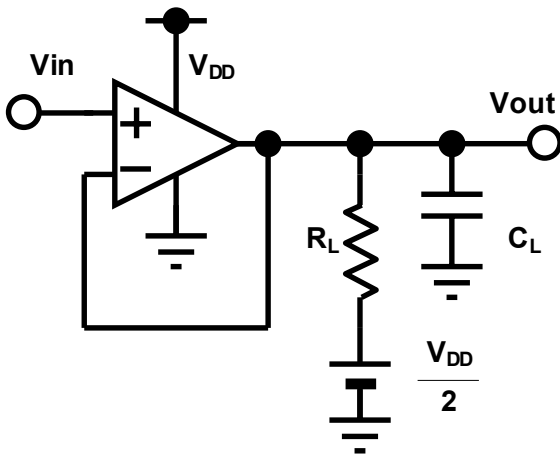


Figure 2-1: Measurement circuit 1

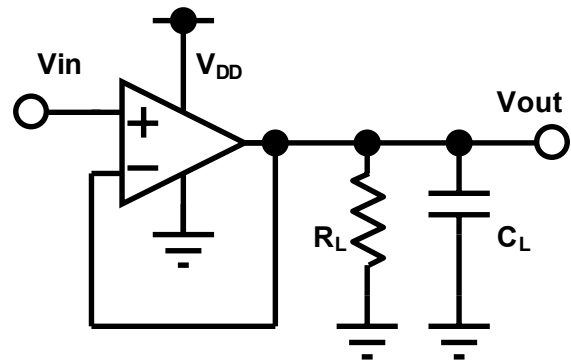


Figure 2-2: Measurement circuit 2

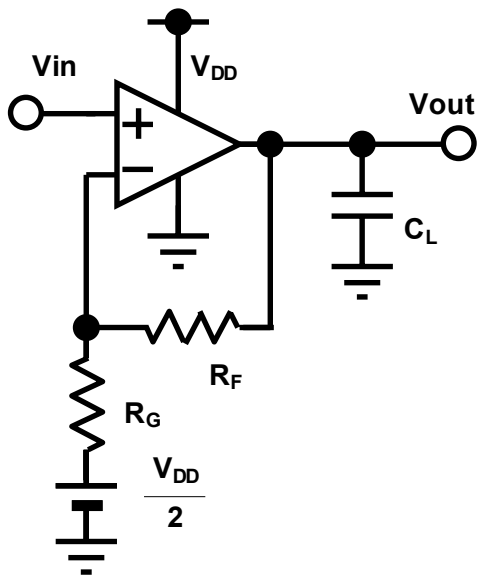


Figure 2-3: Measurement circuit 3

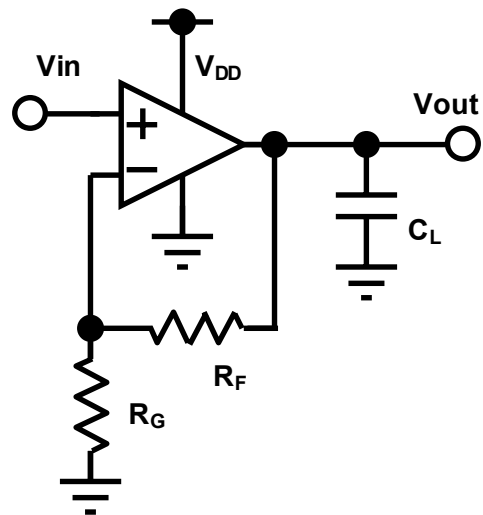
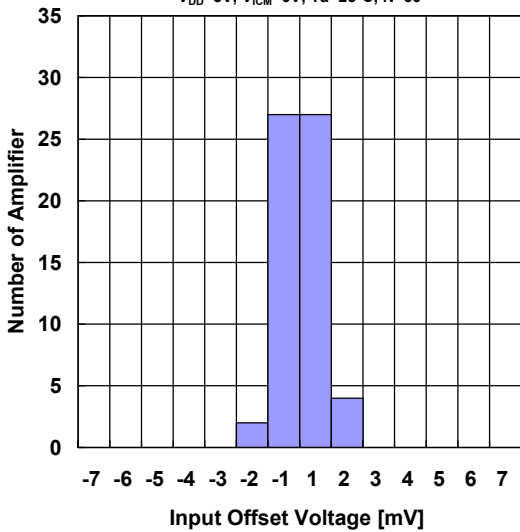


Figure 2-4: Measurement circuit 4

■ ELECTRICAL CHARACTERISTICS

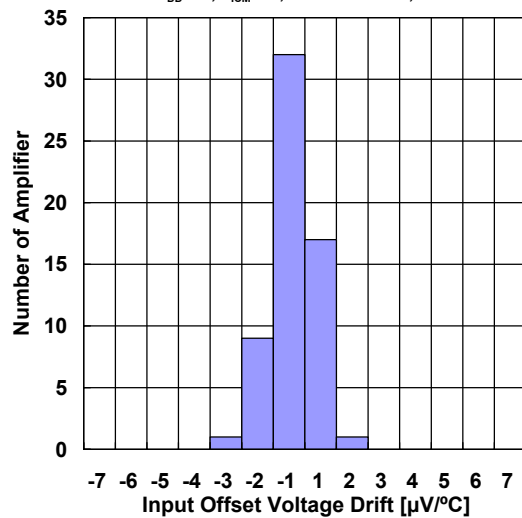
Input Offset Voltage Distribution

$V_{DD}=5V, V_{ICM}=0V, T_a=25^\circ C, N=60$



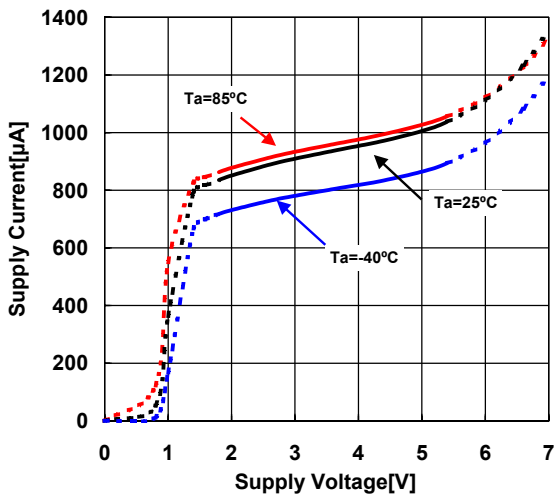
Input Offset Voltage Drift Distribution

$V_{DD}=5V, V_{ICM}=0V, T_a=-40^\circ C \rightarrow 85^\circ C, N=60$



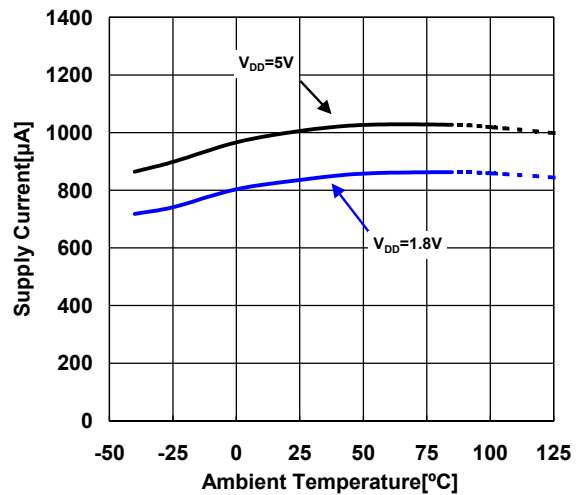
Supply Current vs Supply Voltage

$G_v=0dB$



Supply Current vs Temperature

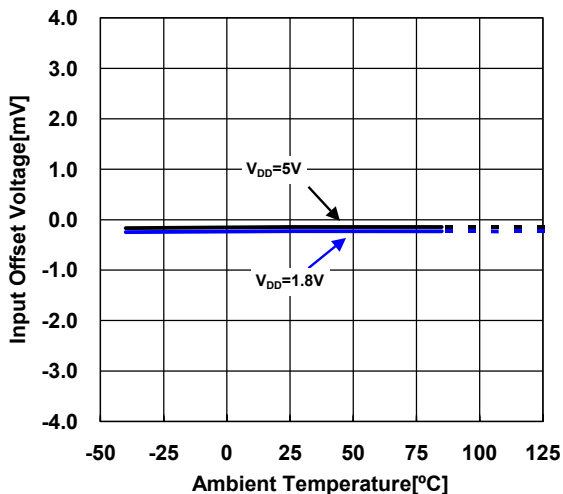
$G_v=0dB$



Input Offset Voltage vs Temperature

(Supply Voltage)

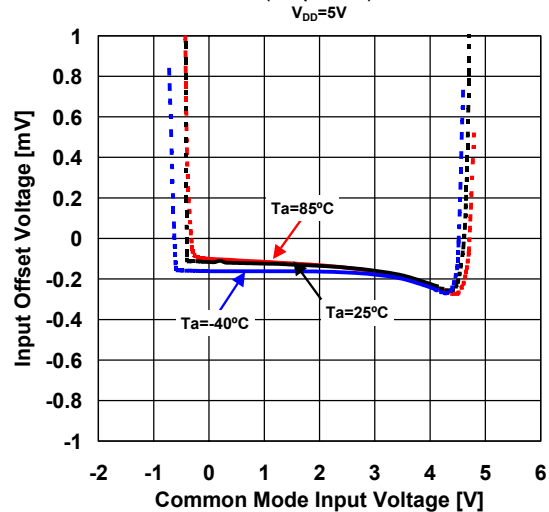
$V_{ICM}=V_{DD}/2$



Input Offset Voltage vs Common Mode Input Voltage

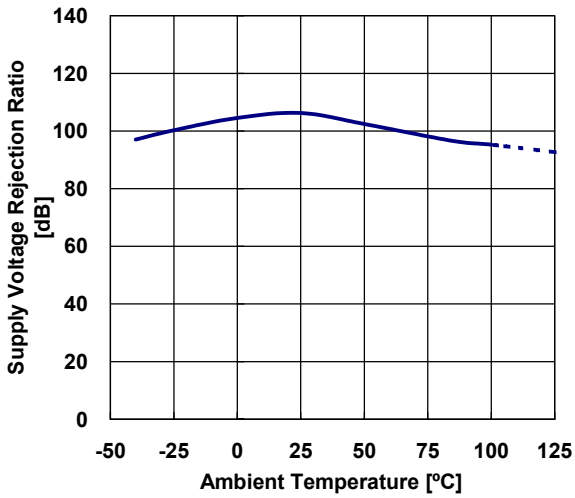
(Temperature)

$V_{DD}=5V$

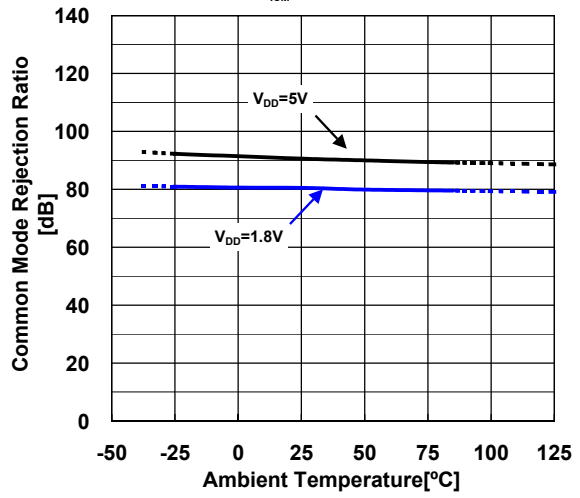


ELECTRICAL CHARACTERISTICS

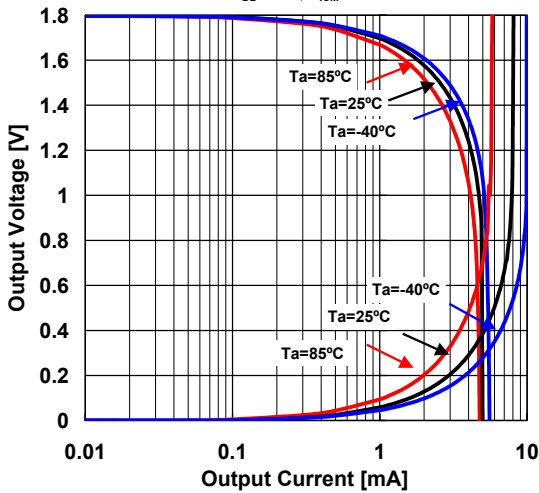
SVR vs Temperature
 $V_{DD}=1.8V \rightarrow 5.5V$



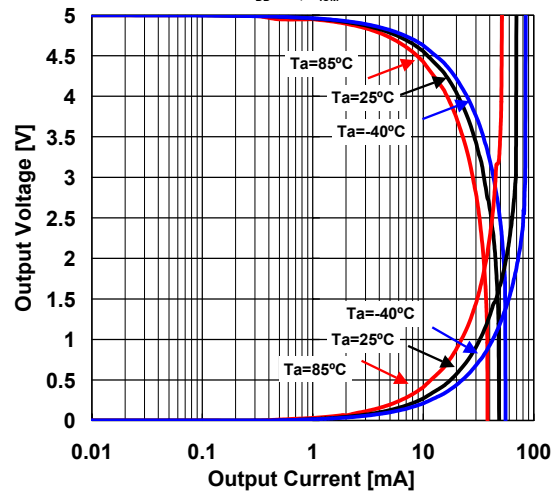
CMR vs Temperature
 (Supply Voltage)
 $V_{ICM}=0V \rightarrow V_{DD}-0.9V$



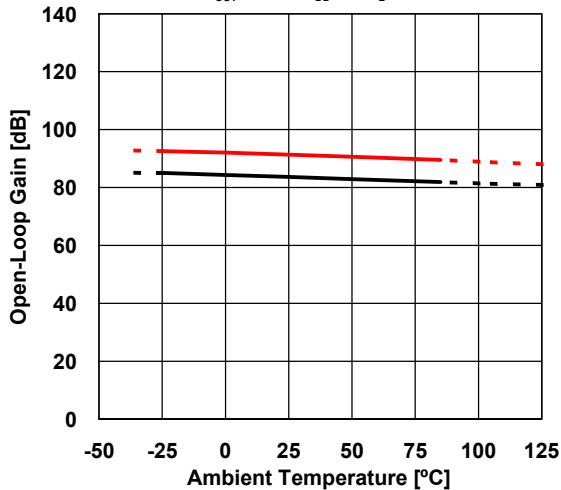
Output Voltage vs Output Current (Temperature)
 $V_{DD}=1.8V, V_{ICM}=0.9V$



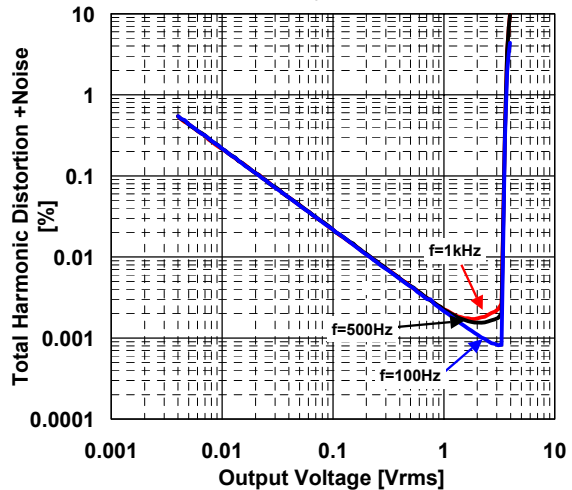
Output Voltage vs Output Current (Temperature)
 $V_{DD}=5V, V_{ICM}=2.5V$



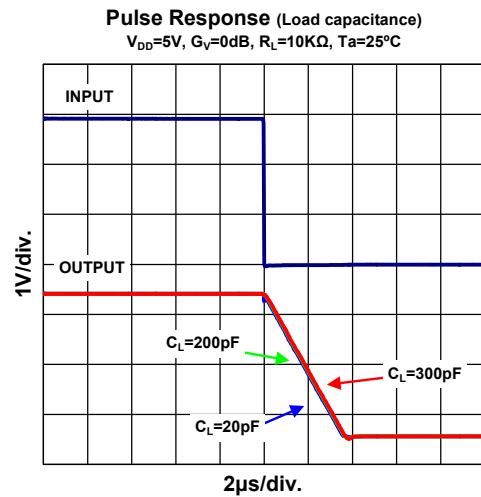
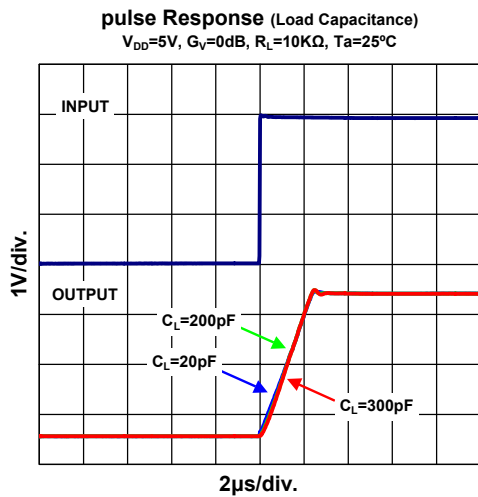
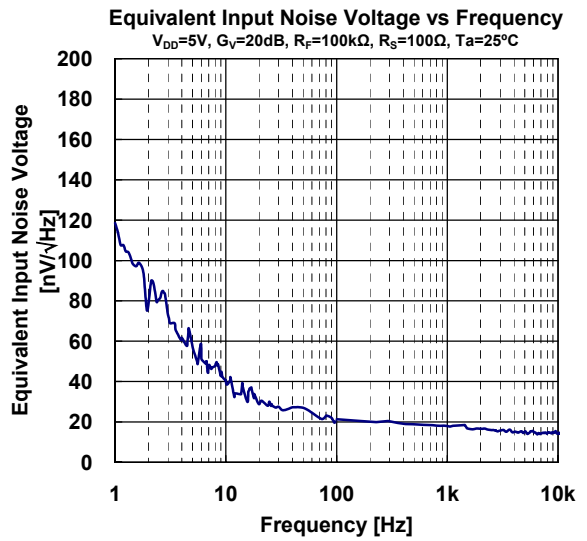
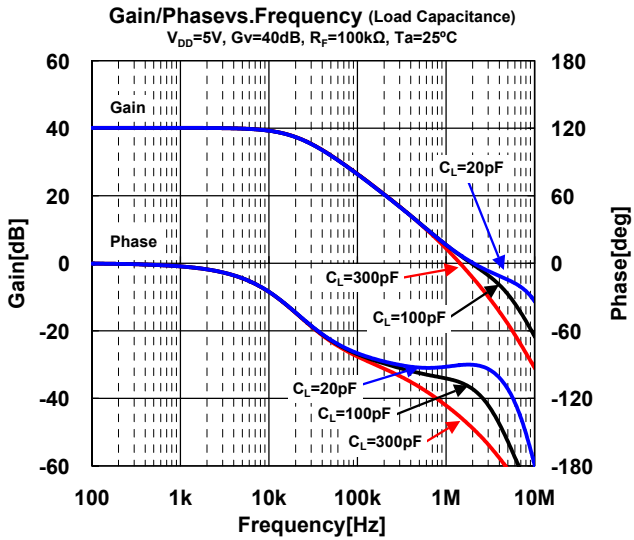
Open-Loop Gain vs Temperature
 $V_{OUT}=0.5V \rightarrow V_{DD}-0.5, R_L=10k\Omega$



THD + Noise vs. Output Voltage
 $V_{DD}=5V, G_v=6dB, R_G=5k\Omega, R_F=5k\Omega, T_a=25^\circ C$



■ ELECTRICAL CHARACTERISTICS



[CAUTION]
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