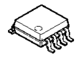
Precision, Dual, JFET Input Operational Amplifier

■ FEATURES

● Low Input Offset Voltage	V_{IO}=400μV max.
	V_{IO}=700μV max. (Ta= -40ºC to +125ºC)
● Low Input Offset Voltage Drift	$\Delta V_{IO}/\Delta T$=10μV/ºC max. (Ta= -40ºC to +125ºC)
● Small Package	MSOP8(VSP8) MEET JEDEC MO-187-DA
● Low Supply Current	Icc=3mA max.
● High Slew Rate	SR=20V/μs typ.
● Wide Bandwidth	GBP=7MHz typ.
● Low Noise	en=10nV/√Hz at f=1kHz typ.
● Low Input Bias Current	I_B=80pA max. at Ta=25ºC
● No Phase Reversal	
● Guaranteed Temperature	Topr= -40ºC to +125ºC
● Operating Voltage	Vopr= ±4.5V to ±16V

■ PACKAGE OUTLINE



NJM8502R
(MSOP8(VSP8))

■ GENERAL DESCRIPTION

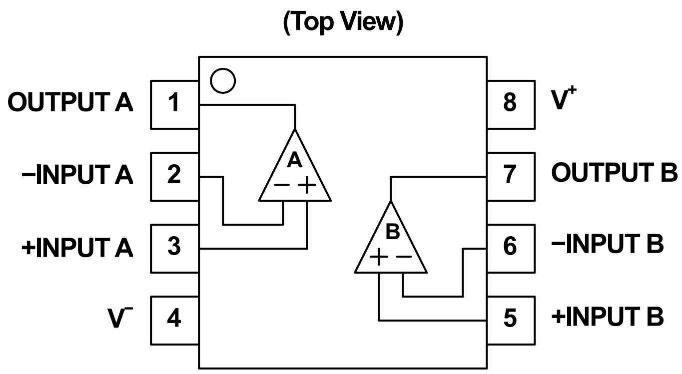
The NJM8502 is a dual high precision JFET input operational amplifier featuring low offset, low offset drift, low bias current, high slew rate, low noise and wide operating temperature range.

The precision performance, high speed and low noise make the NJM8502 especially suitable for filter and amplification of high speed and small signal in instruments, automated test equipment, sensors and other precision applications.

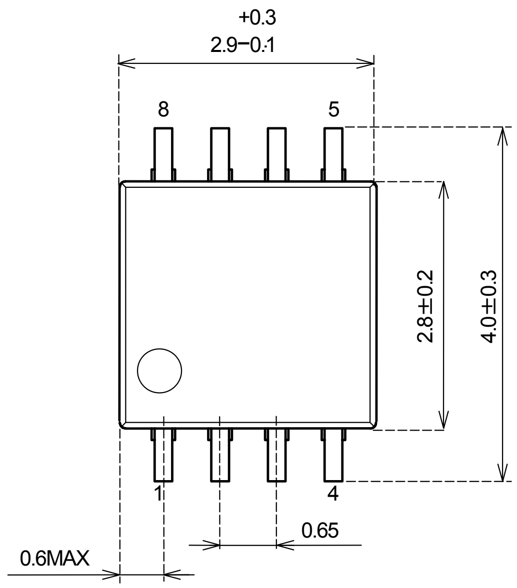
■ APPLICATIONS

- ● Current Sensor
- ● Photodiode Amplification
- ● Reference Voltage Circuit
- ● Automatic Test Equipment

■ PIN CONFIGURATION



■ PACKAGE DESCRIPTION

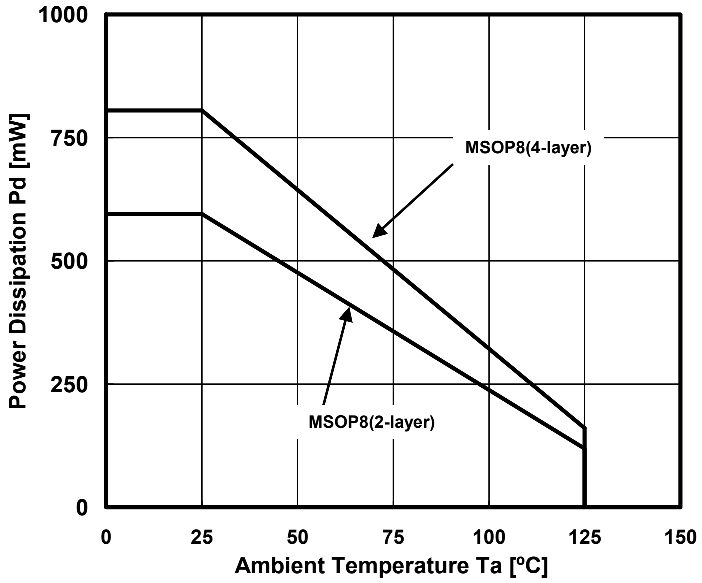


■ ABSOLUTE MAXIMUM RATINGS (Ta=25ºC, unless otherwise noted.)

PARAMETER	SYMBOL	RATING	UNIT
Supply Voltage	V^+/V^-	±18	V
Differential Input Voltage	V_{ID}	±36 (note1)	V
Input Voltage	V_{IN}	V^- - 0.3 to V^- + 36 (note2)	V
Input Current	I_{IN}	±10	mA
Power Dissipation MSOP8 (VSP8)	P_D	(2-layer / 4-layer) 595(note3) / 805(note3)	mW
Duration of short-circuit		Unlimited (Ta≦ 25°C) (note3)	
Operating Temperature Range	T_{opr}	-40 to +125	ºC
Storage Temperature Range	T_{stg}	-65 to +150	ºC

(Note1) Differential Input Voltage is the voltage difference between +INPUT and -INPUT.
(Note2) The normal operation will establish when any input is within the Common Mode Input Voltage Range of electrical characteristics.
(Note3) 2-layer : EIA/JEDEC STANDARD Test board (76.2 x 114.3 x 1.6mm, 2layers, FR-4) mounting.
4-layer : EIA/JEDEC STANDARD Test board (76.2 x 114.3 x 1.6mm, 4layers, FR-4) mounting.
See Figure “Fig.1-1 : Power Dissipation Curve” when ambient temperature is over 25°C.

Figure1-1.Power Dissipation Derating Curve



■ RECOMMENDED OPERATING VOLTAGE

PARAMETER	SYMBOL	RATING	MIN	TYP	MAX	UNIT
Supply Voltage	V^+/V^-		±4.5	-	±16	V

■ ELECTRICAL CHARACTERISTICS

●DC CHARACTER (V^+/V^-=±15V, Ta=25ºC, V_{ICM}=0V, unless otherwise noted.)

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Input Characteristics						
Input Offset Voltage	$V_{IO}1$		-	80	400	µV
	$V_{IO}2$	Ta=-40ºC to +125ºC	-	-	700	µV
Input Offset Voltage Drift (Note5)	ΔVio/ΔT	Ta=-40ºC to +125ºC	-	1.0	10	µV/ºC
Input Bias Current	I_B1		-	25	80	pA
	I_B2	Ta=-40ºC to +125ºC	-	-	35	nA
Input Offset Current	$I_{IO}1$		-	6	75	pA
	$I_{IO}2$	Ta=-40ºC to +125ºC	-	-	2	nA
Common Mode Input Voltage Range	$V_{ICM}1$	CMR≥ 86dB	-12.5	-	+12.5	V
	$V_{ICM}2$	CMR≥ 80dB, Ta=-40ºC to +125ºC	-12.5	-	+12.5	V
Common Mode Rejection Ratio	CMR1	V_{CM}=-12.5V to +12.5V	86	108	-	dB
	CMR2	V_{CM}=-12.5V to +12.5V, Ta=-40ºC to +125ºC	80	-	-	dB
Voltage Gain	Av1	R_L=2kΩ, Vo= -13.5V to +13.5V	90	100	-	dB
	Av2	R_L=2kΩ, Vo= -13.5V to +13.5V, Ta=-40ºC to +125ºC	82	-	-	dB
Channel Separation	CS	DC	-	125	-	dB
Output Characteristics						
Maximum Output Voltage	$V_{OH}1$	R_L=10kΩ, Ta=-40ºC to +125ºC	+14.0	+14.2	-	V
	$V_{OL}1$	R_L=10kΩ, Ta=-40ºC to +125ºC	-	-14.9	-14.6	V
	$V_{OH}2$	R_L=2kΩ, Ta=-40ºC to +125ºC	+13.8	+14.1	-	V
	$V_{OL}2$	R_L=2kΩ, Ta=-40ºC to +125ºC	-	-14.8	-14.4	V
	$V_{OH}31$	R_L=600Ω	+13.5	+13.9	-	V
	$V_{OH}32$	R_L=600Ω, Ta=-40ºC to +125ºC	+11.4	-	-	V
	$V_{OL}41$	R_L=600Ω	-	-14.3	-13.8	V
	$V_{OL}42$	R_L=600Ω, Ta=-40ºC to +125ºC	-	-	-12.1	V
Supply Characteristics						
Quiescent Current	$I_{CC}1$	G_V=+1, R_L=∞	-	2.6	3.0	mA
	$I_{CC}2$	G_V=+1, R_L=∞, Ta=-40ºC to +125ºC	-	-	3.3	mA
Supply Voltage Rejection Ratio	SVR1	V+/V-=±4.5V to ±16V	86	110	-	dB
	SVR2	V+/V-=±4.5V to ±16V, Ta=-40ºC to +125ºC	80	-	-	dB

(Note5) Guaranteed by endpoint limits.

●AC CHARACTER (V^+/V^-=±15V, Ta=25ºC, V_{ICM}=0V, unless otherwise noted.)

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Dynamic Performance						
Unity Gain Frequency	f_T	G_V=+100, R_L=2kΩ, C_L=10pF	-	7.0	-	MHz
Slew Rate	+SR	RISE, G_V=+1, V_{IN}=1Vpp, R_L=2kΩ	-	20	-	V/µs
	-SR	FALL, G_V=+1, V_{IN}=1Vpp, R_L=2kΩ	-	20	-	V/µs
Total Harmonic Distortion	THD	f=1kHz, Gv=+1,R_L=2kΩ	-	0.0005	-	%
Noise Performance						
Input Voltage Noise	V_{NI}	fo=1Hz to 100Hz	-	0.18	-	µVrms
Input Voltage Noise Density	e_n	fo=1kHz	-	10	-	nV/√Hz

■ ELECTRICAL CHARACTERISTICS

●DC CHARACTER (V^+/V^-=±5V, Ta=25ºC, V_{ICM}=0V, unless otherwise noted.)

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Input Characteristics						
Input Offset Voltage	$V_{IO}1$		-	80	400	µV
	$V_{IO}2$	Ta=-40ºC to +125ºC	-	-	700	µV
Input Offset Voltage Drift (Note5)	ΔVio/ΔT	Ta=-40ºC to +125ºC	-	1.0	10	µV/ºC
Input Bias Current	I_B1		-	21	75	pA
	I_B2	Ta=-40ºC to +125ºC	-	-	31	nA
Input Offset Current	$I_{IO}1$		-	5	50	pA
	$I_{IO}2$	Ta=-40ºC to +125ºC	-	-	2	nA
Common Mode Input Voltage Range	$V_{ICM}1$	CMR≥ 86dB	-2.0	-	+2.5	V
	$V_{ICM}2$	CMR≥ 80dB, Ta=-40ºC to +125ºC	-2.0	-	+2.5	V
Common Mode Rejection Ratio	CMR1	V_{CM}=-2V to +2.5V	86	108	-	dB
	CMR2	V_{CM}=-2V to +2.5V, Ta=-40ºC to +125ºC	80	-	-	dB
Voltage Gain	Av1	R_L=2kΩ, Vo= -3V to +3V	85	93	-	dB
	Av2	R_L=2kΩ, Vo= -3V to +3V, Ta=-40ºC to +125ºC	80	-	-	dB
Channel Separation	CS	DC	-	125	-	dB
Output Characteristics						
Maximum Output Voltage	$V_{OH}1$	R_L=10kΩ, Ta=-40ºC to +125ºC	+4.1	+4.3	-	V
	$V_{OL}1$	R_L=10kΩ, Ta=-40ºC to +125ºC	-	-4.9	-4.7	V
	$V_{OH}2$	R_L=2kΩ, Ta=-40ºC to +125ºC	+3.9	+4.2	-	V
	$V_{OL}2$	R_L=2kΩ, Ta=-40ºC to +125ºC	-	-4.9	-4.5	V
	$V_{OH}31$	R_L=600Ω	+3.7	+4.1	-	V
	$V_{OH}32$	R_L=600Ω, Ta=-40ºC to +125ºC	+3.6	-	-	V
	$V_{OL}41$	R_L=600Ω	-	-4.8	-4.3	V
	$V_{OL}42$	R_L=600Ω, Ta=-40ºC to +125ºC	-	-	-4.2	V
Supply Characteristics						
Quiescent Current	$I_{CC}1$	G_V=+1, R_L=∞	-	2.0	3.0	mA
	$I_{CC}2$	G_V=+1, R_L=∞, Ta=-40ºC to +125ºC	-	-	3.3	mA

(Note5) Guaranteed by endpoint limits.

●AC CHARACTER (V^+/V^-=±5V, Ta=25ºC, V_{ICM}=0V, unless otherwise noted.)

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Dynamic Performance						
Unity Gain Frequency	f_T	G_V=+100, R_L=2kΩ, C_L=10pF	-	7.0	-	MHz
Slew Rate	+SR	RISE, G_V=+1, V_{IN}=1Vpp, R_L=2kΩ	-	18	-	V/µs
	-SR	FALL, G_V=+1, V_{IN}=1Vpp, R_L=2kΩ	-	18	-	V/µs
Total Harmonic Distortion	THD	f=1kHz, Gv=+1,R_L=2kΩ	-	0.0005	-	%
Noise Performance						
Input Voltage Noise	V_{NI}	fo=1Hz to 100Hz	-	0.18	-	µVrms
Input Voltage Noise Density	e_n	fo=1kHz	-	10	-	nV/√Hz

■ **TEST CIRCUIT**

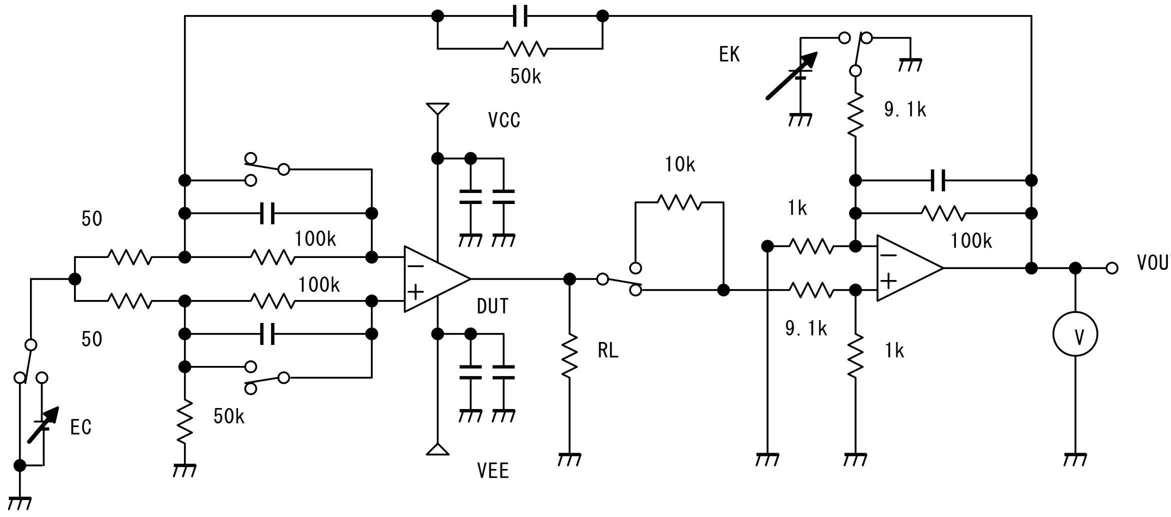


Fig.1 test circuit for Input Offset Voltage, Input Offset Current, Input Bias Current Voltage Gain, Supply Voltage Rejection Ratio, Common Mode Rejection Ratio

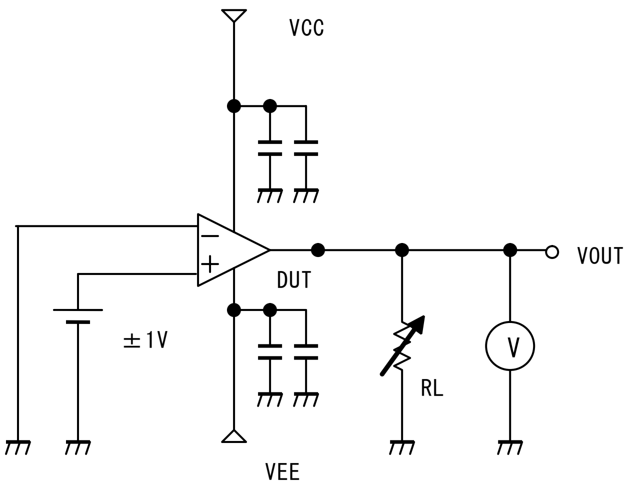


Fig.2 test circuit for Maximum Output Voltage

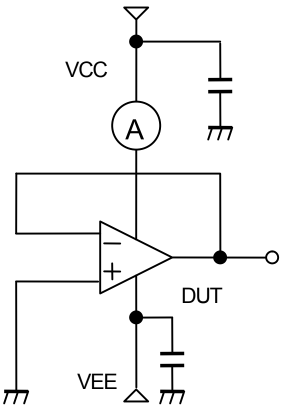
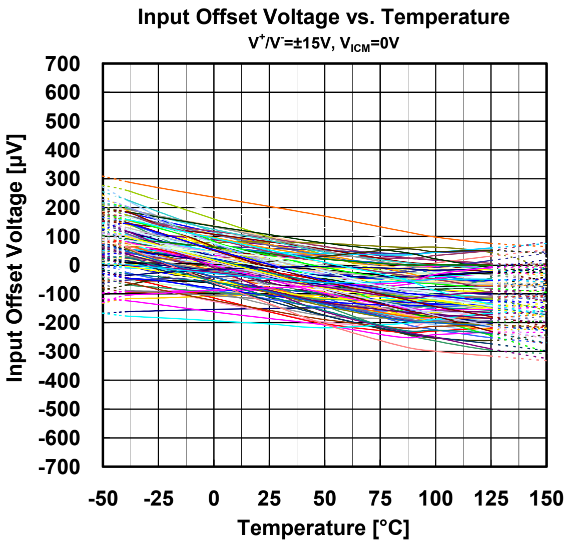
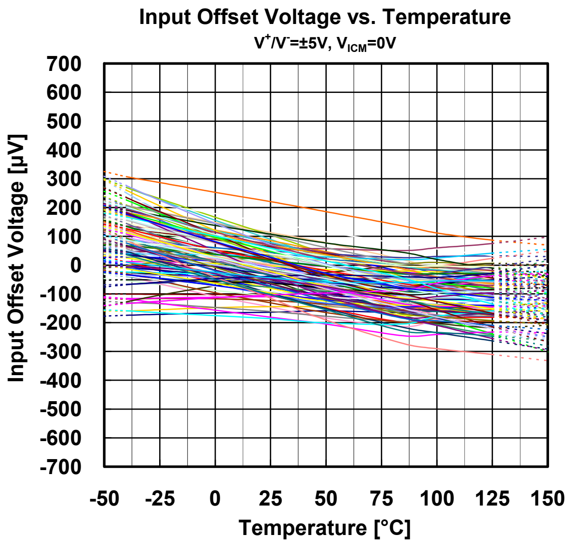
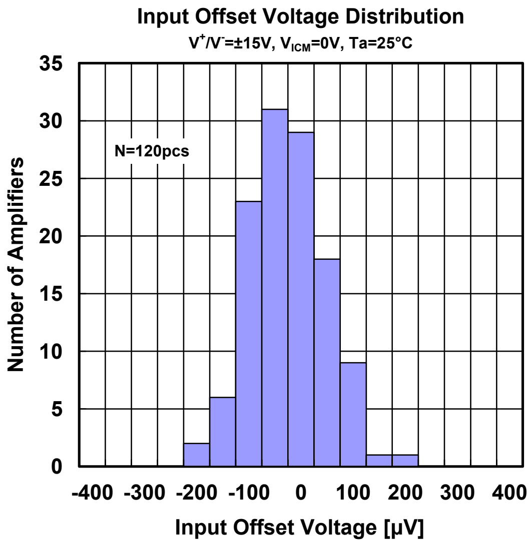


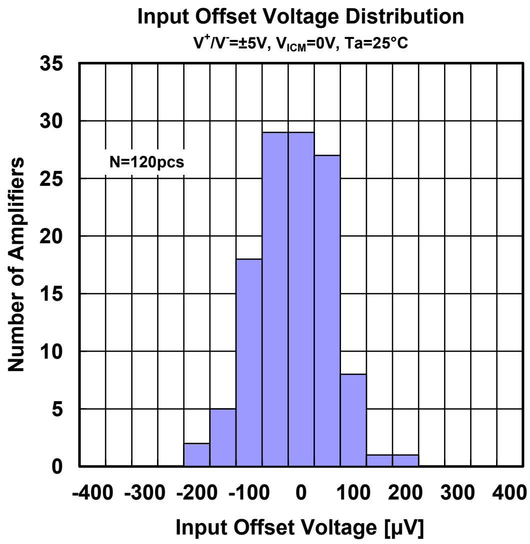
Fig.3 test circuit for Quiescent Current

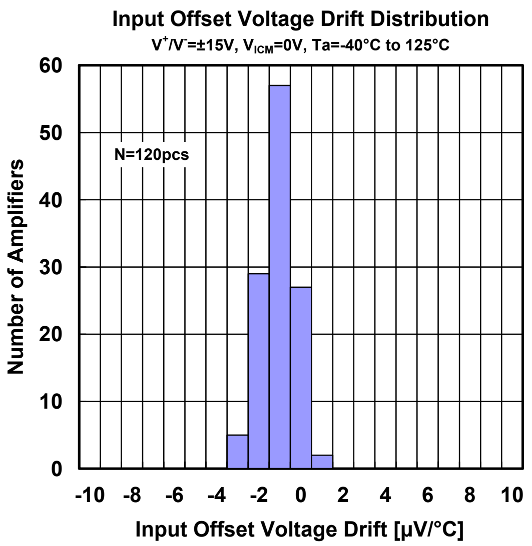
■ ELECTRICAL CHARACTERISTICS

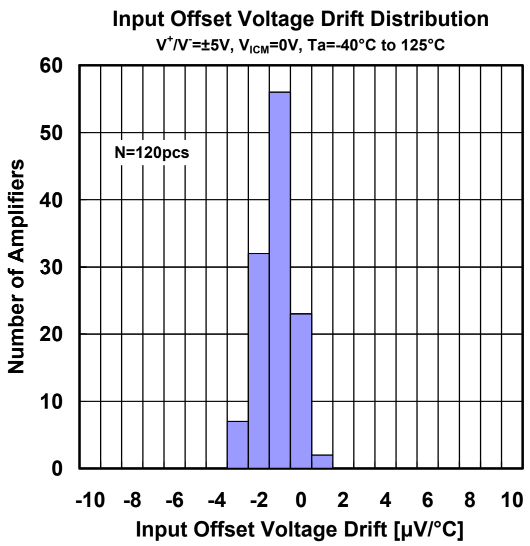




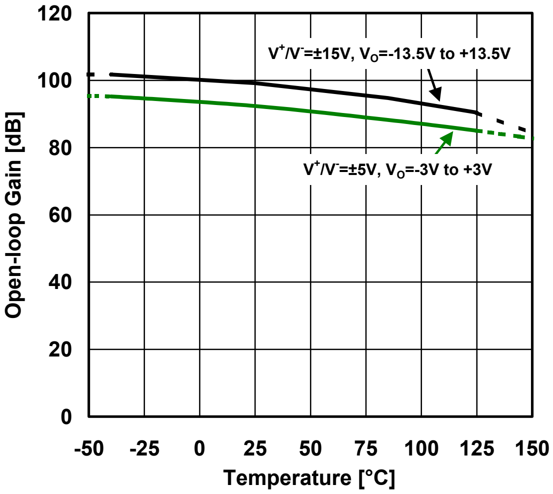




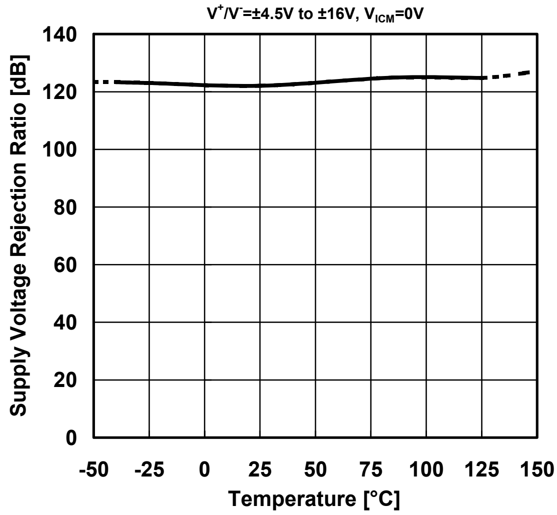




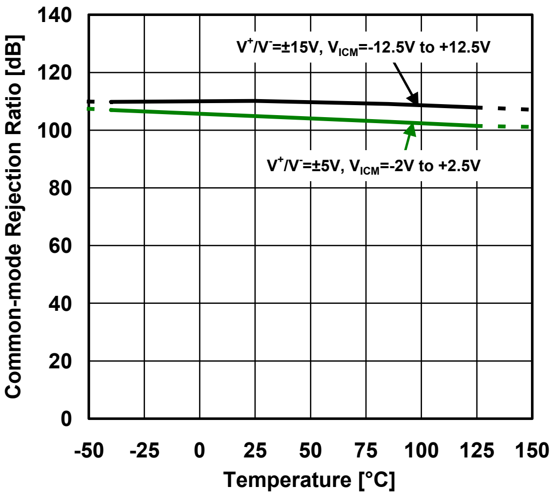
Open-loop Gain vs. Temperature
V_{ICM}=0V, R_L=2kΩ



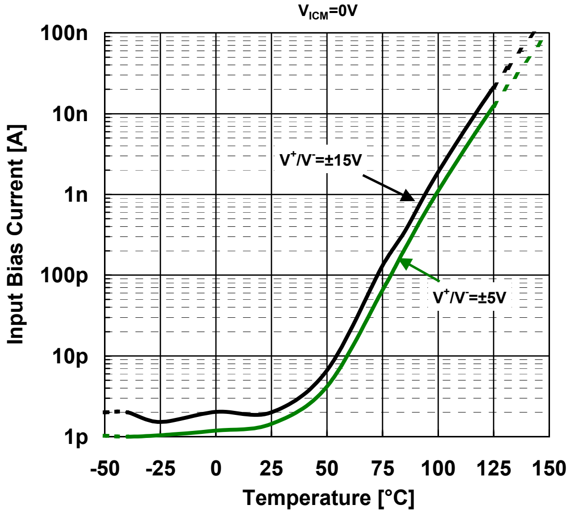
Supply Voltage Rejection Ratio vs. Temperature
V^+/V^-=±4.5V to ±16V, V_{ICM}=0V



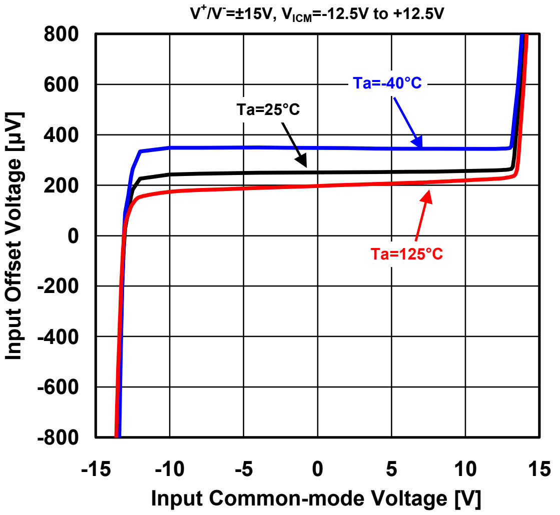
Common-mode Rejection Ratio vs. Temperature



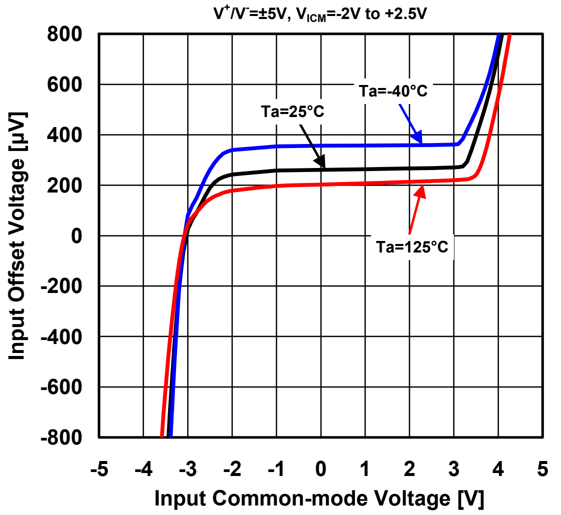
Input Bias Current vs. Temperature
V_{ICM}=0V



Input Offset Voltage vs. Common-mode Voltage
V^+/V^-=±15V, V_{ICM}=-12.5V to +12.5V

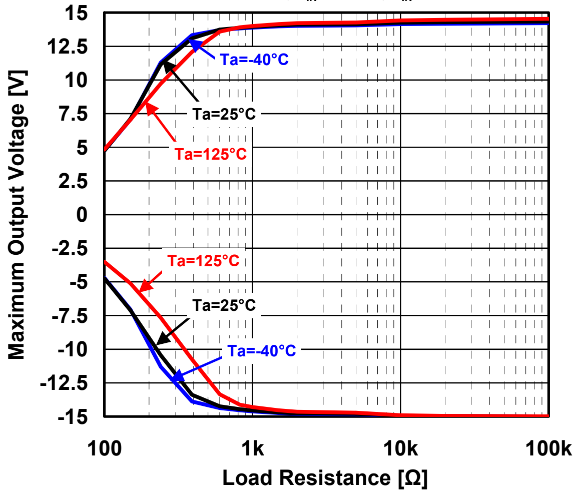


Input Offset Voltage vs. Common-mode Voltage
V^+/V^-=±5V, V_{ICM}=-2V to +2.5V



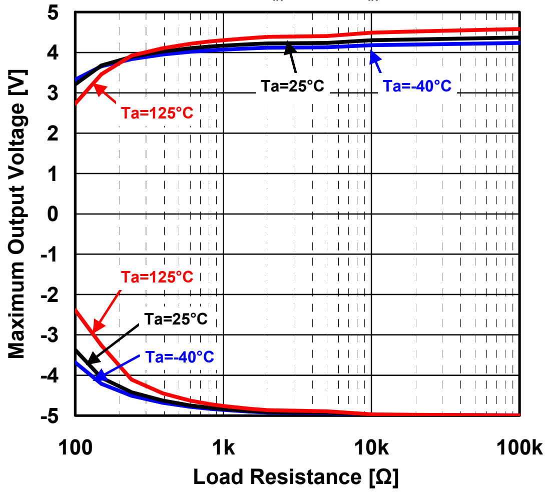
Maximum Output Voltage vs. Load Resistance

$V^+/V^-=\pm15V$, $V_{IN+}=1V/-1V$, $V_{IN-}=0V$



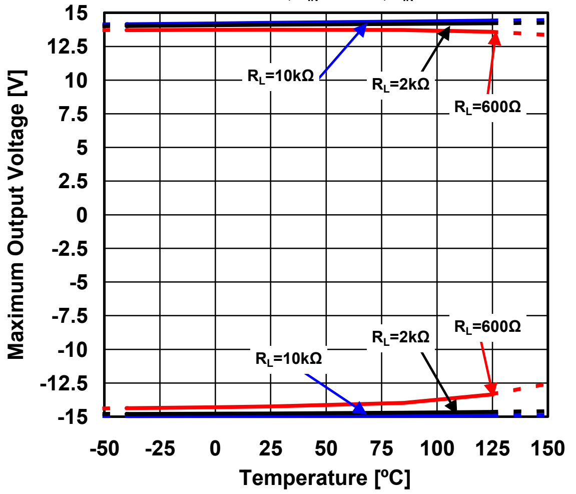
Maximum Output Voltage vs. Load Resistance

$V^+/V^-=\pm5V$, $V_{IN+}=1V/-1V$, $V_{IN-}=0V$



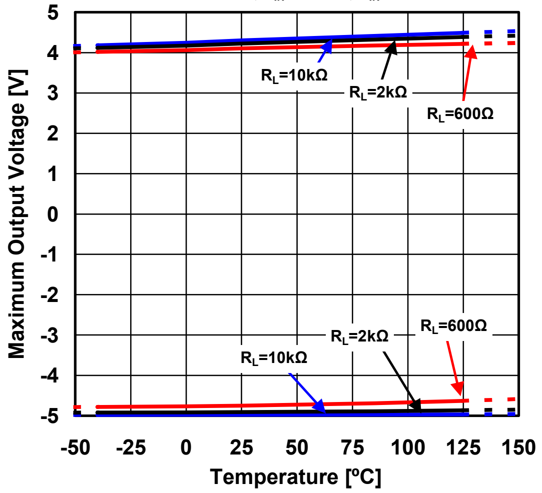
Maximum Output Voltage vs. Temperature

$V^+/V^-=\pm15V$, $V_{IN+}=1V/-1V$, $V_{IN-}=0V$



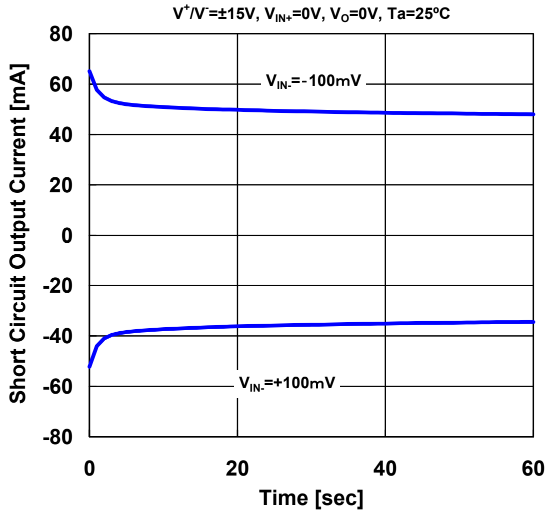
Maximum Output Voltage vs. Temperature

$V^+/V^-=\pm5V$, $V_{IN+}=1V/-1V$, $V_{IN-}=0V$

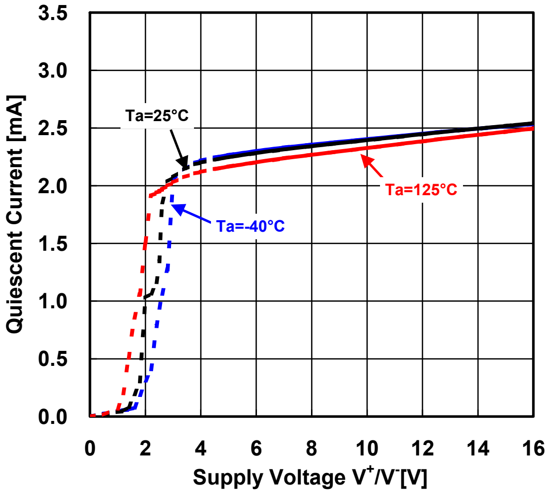


Short Circuit Output Current

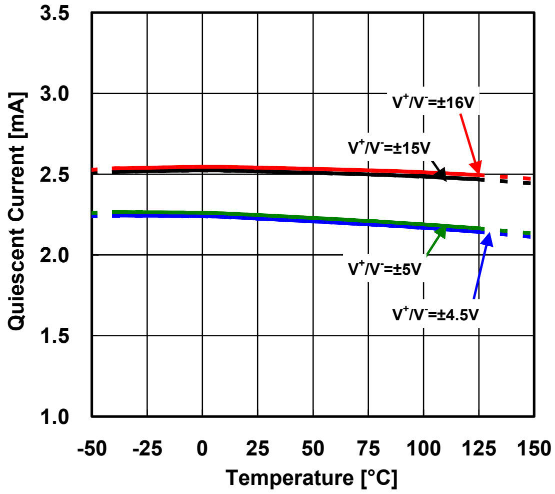
$V^+/V^-=\pm15V$, $V_{IN+}=0V$, $V_O=0V$, $Ta=25ºC$



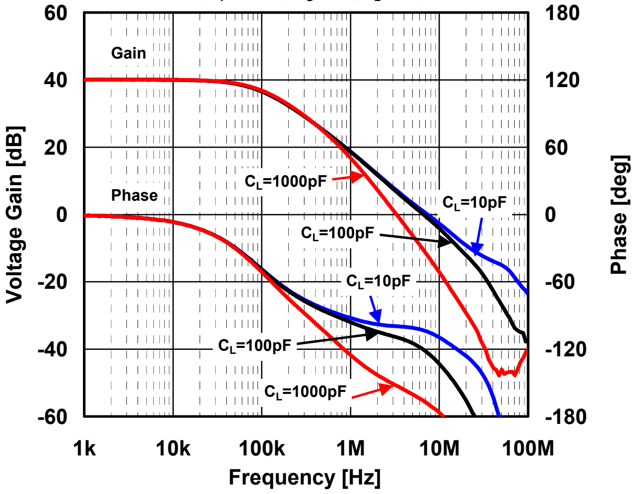
Quiescent Current vs. Supply Voltage
Gv=0dB, V_{ICM}=0V



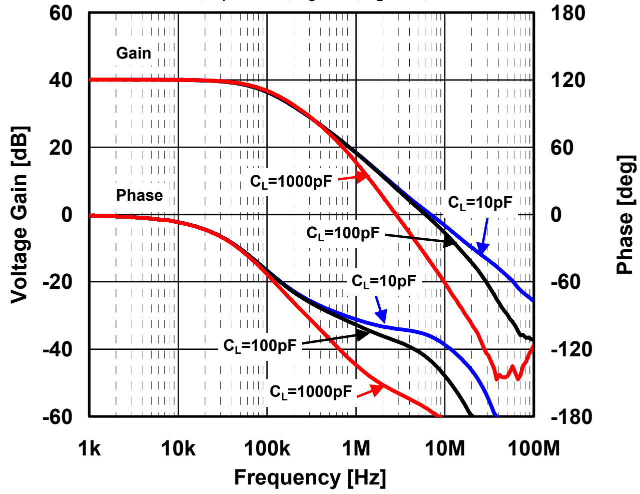
Quiescent Current vs. Temperature
G_V=0dB, V_{ICM}=0V



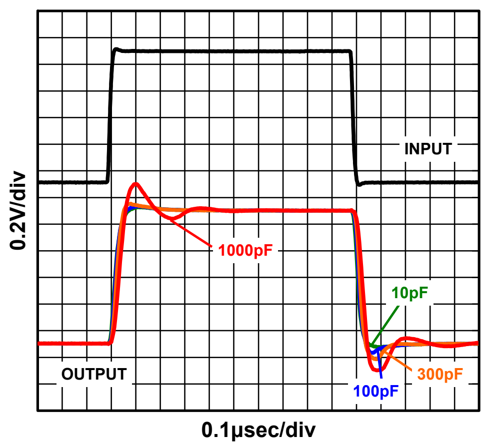
Gain/Phase vs. Frequency
V^+/V^-=±15V, R_F=100kΩ, R_G=1kΩ, R_L=2kΩ, Ta=25ºC



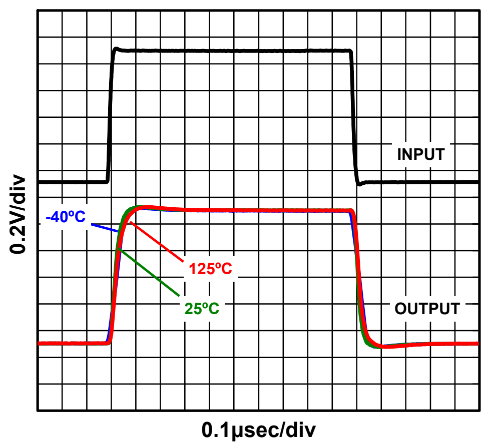
Gain/Phase vs. Frequency
V^+/V^-=±5V, R_F=100kΩ, R_G=1kΩ, R_L=2kΩ, Ta=25ºC



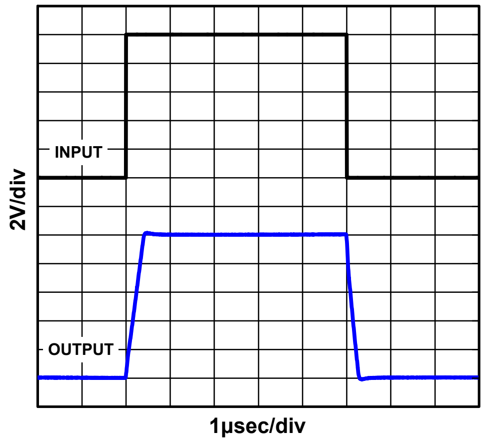
Small-Signal Step Response (Road Capacitance)
V^+/V^-=±15V, Gv=0dB, V_{IN}=1V_{PP}, R_L=2kΩ, Ta=25ºC



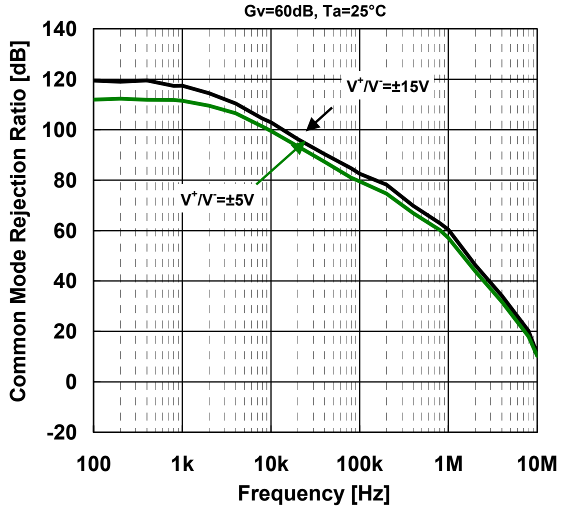
Small-Signal Step Response (Temperature)
V^+/V^-=±15V, Gv=0dB, V_{IN}=1V_{PP}, R_L=2kΩ, C_L=10pF



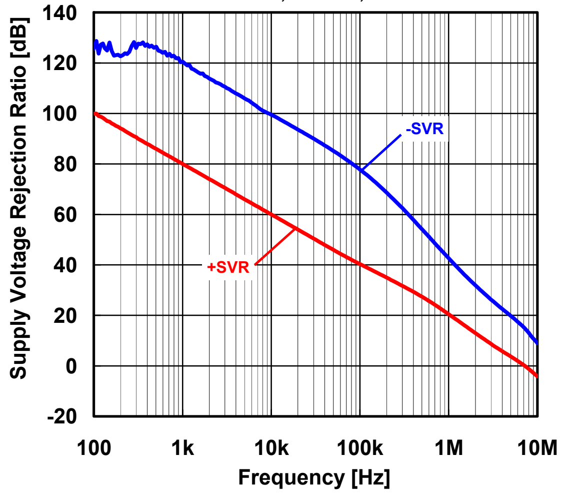
Large Signal Step Response
$V^+/V^-=\pm15V$, Gv=0dB, V_{IN}=10Vpp, R_L=2kΩ



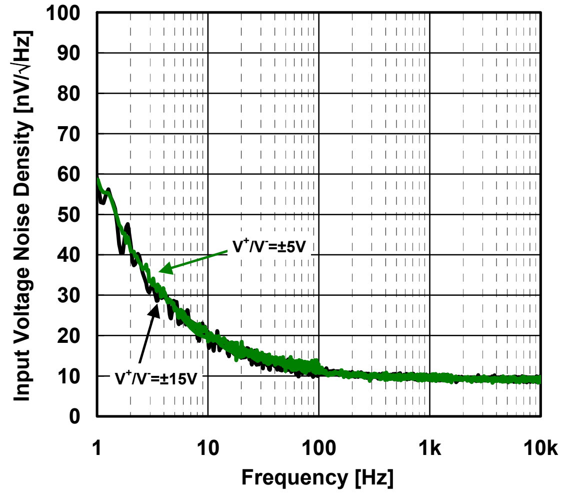
CMR vs. Frequency
Gv=60dB, Ta=25°C



Supply Voltage Rejection Ratio vs. Frequency
$V^+/V^-=\pm15V$, Gv=40dB, Ta=25ºC



Input Voltage Noise Density vs. Frequency
Gv=40dB, R_G=100Ω, R_L=10kΩ, Ta=25°C



1Hz to 100Hz Input Voltage Noise
$V^+/V^-=\pm15V$, 1 to 100Hz BPF