Quad, Wide Supply Range 3V~36V, Low Power 25μA/ch Rail-to-Rail Output Operational Amplifier

■ GENERAL DESCRIPTION

The NJM8524 is a Rail-to-Rail output quad operational amplifier that operates from a single supply of 3V to 36V, with low supply current 25uA/ch (Vcc = 5V) and low offset voltage 1.8mV max.

Rail-to-Rail output can secure output dynamic range easily. An input common-mode voltage range that includes GND is suitable for single supply applications.

■ PACKAGE OUTLINE

NJM8524V
(SSOP14)

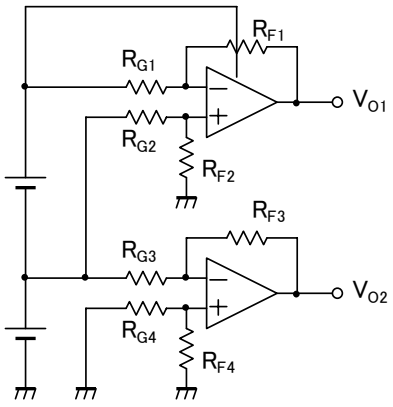
■ FEATURES

●Supply Current	25μA /ch (at V_{CC}=5V.)
●Rail-to-Rail Output	0.2V to 4.9V min. (at V_{CC}=5V, R_L=20kΩ)
●Operation Voltage	+3V to +36V
●Input Offset Voltage	1.8mV max.
●Input Bias Current	3nA typ.
●Slew Rate	0.025V/μs typ. (at V_{CC}=5V.)
●GBW	60kHz typ. (at V_{CC}=5V.)
●Over Input Voltage Tolerant	UP to 40V regardless of the supply voltage
●RF Immunity	Enhance the RF immunity
●Bipolar Technology	
●Package	SSOP14

■ APPLICATIONS

●Portable battery applications
●Portable Instrumentation

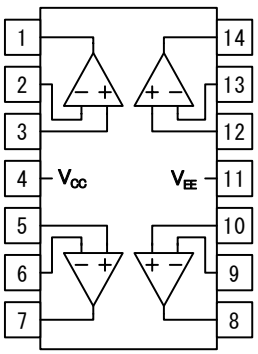
■ TYPICAL APPLICATION



Voltage sensing circuit

■ PIN CONFIGURATION

(Top View)



Pin Function	
1. OUTPUT 1	1. OUTPUT 3
2. −INPUT 1	2. −INPUT 3
3. +INPUT 1	3. +INPUT 3
4. V_{CC}	4. V_{EE}
5. +INPUT 2	5. +INPUT 4
6. –INPUT 2	6. –INPUT 4
7. OUTPUT 2	7. OUTPUT 4

■ **ABUSOLUTE MAXIMUM RATINGS** (Ta=25˚C)

PARAMETER	SYMBOL	RATING	UNIT
Supply Voltage	V^+	+40	V
Input Voltage Range	V_{ICM}	V_{EE} -0.3 ~ V_{EE} +40 (Note1)	V
Differential Input Voltage Range	V_{ID}	±40	V
Power Dissipation (Note3)	P_D	560(Note 3)	mW
Operating Temperature Range	Topr	-40~+85	ºC
Storage Temperature Range	Tstg	-55~+150	ºC

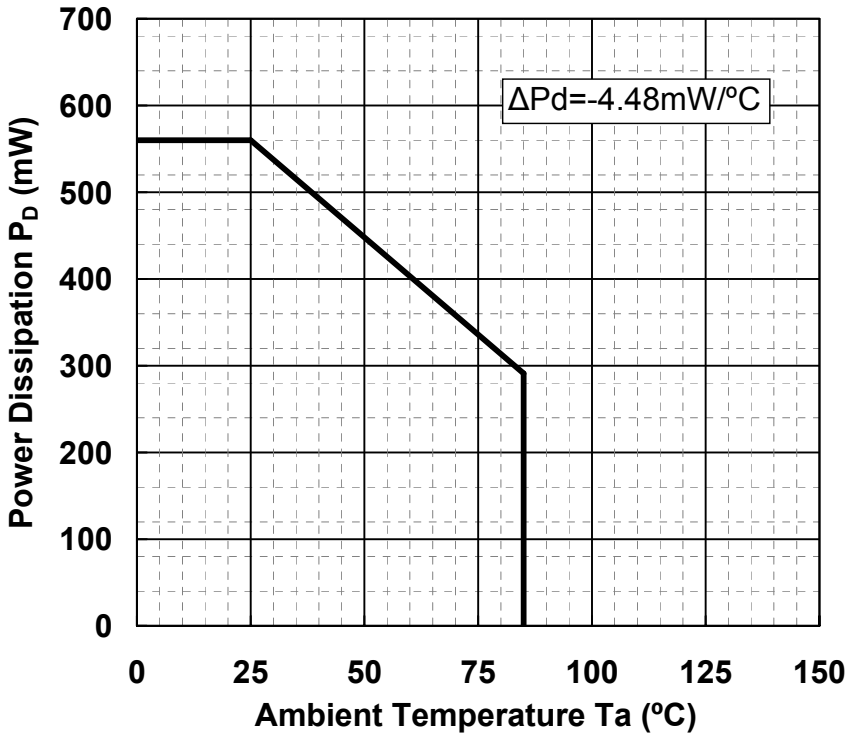
(Note1) It can be applied to the input terminals regardless of the supply voltage and must be less than the rating voltage.
The normal amplifier operation input voltage is within “Common Mode Input Voltage Range” specified in the Electrical characteristics.

(Note2) See “Figure1"Power Dissipation Derating Curve" when ambient temperature is over 25ºC.

(Note3) On the PCB "EIA/JEDEC (114.3×76.2×1.6mm, 2 layers, FR-4)"

Figure1

Power Dissipation Derating Curve



■ **RECOMMENDED OPERATING VOLTAGE** (Ta=-40~+85˚C)

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Supply Voltage	V_{CC}		3	-	36	V

■ ELECTRICAL CARACTERISTICS

● **DC CARACTERISTICS** (V_{CC}=5V, V_{EE}=0V, Ta=25˚C, unless otherwise noted.)

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Supply Current	Icc	No Signal	-	100	150	μA
Input Offset Voltage	V_{IO}	Rs=50Ω	-	0.25	1.8	mV
Input Offset Voltage Drift	$\Delta Vio/\Delta T$	Ta= -40ºC ~ +85ºC	-	3	-	μV/deg
Input Bias Current	I_B		-	3	30	nA
Input Offset Current	I_{IO}		-	0.5	10	nA
Voltage Gain	Av	Vo=1V to 4V, R_L=10kΩ to 2.5V	70	80	-	dB
Common Mode Rejection Ratio	CMR	V_{CM}= 0V ~ 3.4V	70	95	-	dB
Supply Voltage Rejection Ratio	SVR	V^+=3V ~ 36V	80	100	-	dB
Maximum Output Voltage1	V_{OH1}	R_L=20kΩ to 2.5V	4.95	4.99	-	V
	V_{OL1}	R_L=20kΩ to 2.5V	-	0.01	0.2	V
Maximum Output Voltage2	V_{OH2}	R_L=20kΩ to 0V	4.90	4.98	-	V
	V_{OL2}	R_L=20kΩ to 0V	-	0.01	0.15	V
Output Current	I_{SOURCE}	Vo =4V, V_{ID}=1V	5	6.5	-	mA
	I_{SINK}	Vo =1V, V_{ID}= -1V	2.5	10	-	mA
Common Mode Input Voltage Range	V_{ICM}	CMR≥70dB	0	-	3.4	V

● **AC CARACTERISTICS** (V_{CC}=5V, V_{EE}=0V, Ta=25˚C, unless otherwise noted.)

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Gain Bandwidth Product	GBW	R_L=20kΩ to 2.5V, C_L=10pF	-	60	-	kHz
Phase Margin	Φ_M	R_L=20kΩ to 2.5V, C_L=10pF	-	65	-	deg
Gain Margin	G_M	R_L=20kΩ to 2.5V, C_L=10pF		12		dB
Equivalent Input Noise Voltage	V_{NI}	f=100Hz	-	80	-	nV/√Hz
Slew Rate	SR	(Note4), A_V=0dB, R_L=20kΩ to 2.5V, C_L=10pF V_{IN}=1Vpp (2V to 3V)	-	0.025	-	V/μs

(Note4) Number specified is the slower of the positive and negative slew rates.

● **DC CARACTERISTICS** (V_{CC}=30V, V_{EE}=0V, Ta=25˚C, unless otherwise noted.)

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Supply Current	Icc	No Signal	-	150	250	μA
Input Offset Voltage	V_{IO}	Rs=50Ω	-	0.2	1.8	mV
Input Offset Voltage Drift	$\Delta V_{IO}/\Delta T$	Ta= -40ºC ~ +85ºC	-	3	-	μV/deg
Input Bias Current	I_B		-	3	30	nA
Input Offset Current	I_{IO}		-	0.5	10	nA
Voltage Gain	Av	Vo=2V to 28V, R_L=10kΩ to 2.5V	70	92	-	dB
Common Mode Rejection Ratio	CMR	V_{CM}= 0V ~ 28.4V	75	95	-	dB
Supply Voltage Rejection Ratio	SVR	V^+=3V ~ 36V	80	100	-	dB
Maximum Output Voltage1	V_{OH1}	R_L=20kΩ to 15V	4.93	29.98	-	V
	V_{OL1}	R_L=20kΩ to 15V	-	0.05	0.2	V
Maximum Output Voltage2	V_{OH2}	R_L=20kΩ to 0V	29.90	29.93	-	V
	V_{OL2}	R_L=20kΩ to 0V	-	0.01	0.15	V
Output Current	I_{SOURCE}	Vo =28V, V_{ID}=1V	7	8	-	mA
	I_{SINK}	Vo =2V, V_{ID}= -1V	3	15	-	mA
Common Mode Input Voltage Range	V_{ICM}	CMR≥75dB	0	-	28.4	V

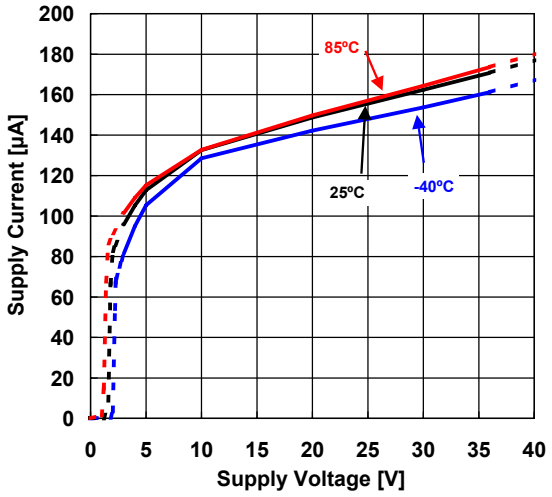
● **AC CARACTERISTICS** (V_{CC}=30V, V_{EE}=0V, Ta=25˚C, unless other wise noted.)

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Gain Bandwidth Product	GBW	R_L=20kΩ to 15V, C_L=10pF	-	100	-	kHz
Phase Margin	Φ_M	R_L=20kΩ to 15V, C_L=10pF	-	65	-	deg
Gain Margin	G_M	R_L=20kΩ to 15V, C_L=10pF		10		dB
Equivalent Input Noise Voltage	V_{NI}	f=100Hz	-	60	-	nV/√Hz
Slew Rate	SR	(Note4), A_V=0dB, R_L=20kΩ to 15V, C_L=10pF V_{IN}=1Vpp (12.5V to 17.5V)	-	0.04	-	V/μs

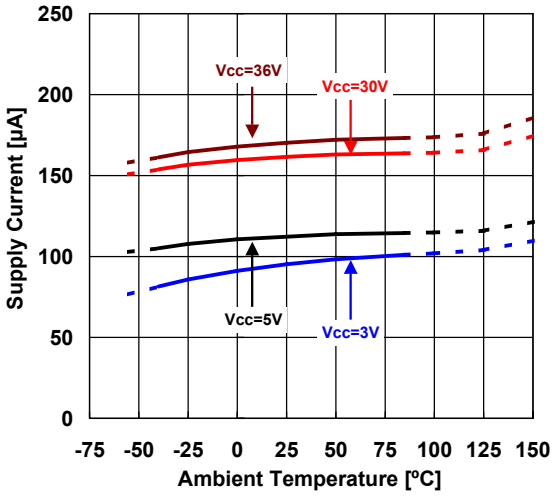
(Note4) Number specified is the slower of the positive and negative slew rates.

■ TYPICAL CHARACTERISTICS

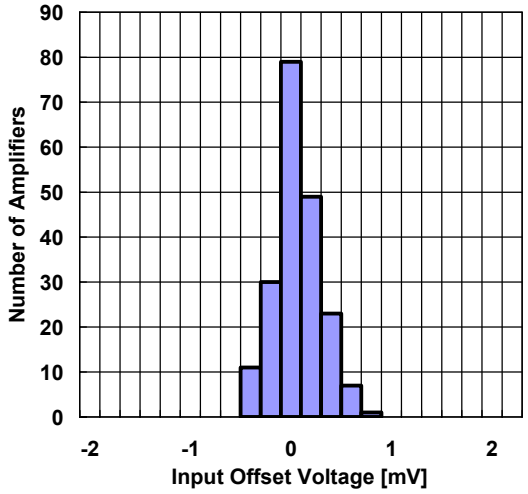
Supply Current vs. Supply Voltage
$V_{ICM}=V_{CC}/2$, Gv=0dB



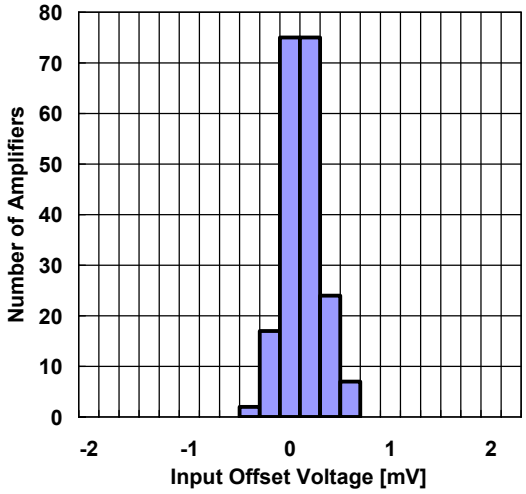
Supply Current vs. Temperature
$V_{ICM}=V_{CC}/2$, Gv=0dB



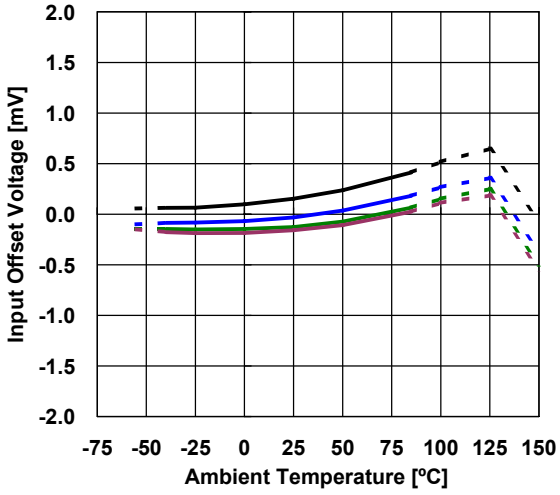
Input Offset Voltage Distribution
Vcc=5V, V_{ICM}=2.5V, Ta=25°C



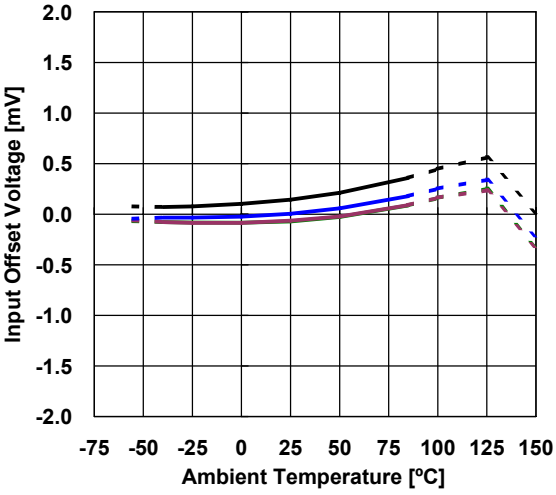
Input Offset Voltage Distribution
Vcc=30V, V_{ICM}=15V, Ta=25°C



Input Offset Voltage vs. Temperature
VCC=5V, V_{ICM}=2.5V

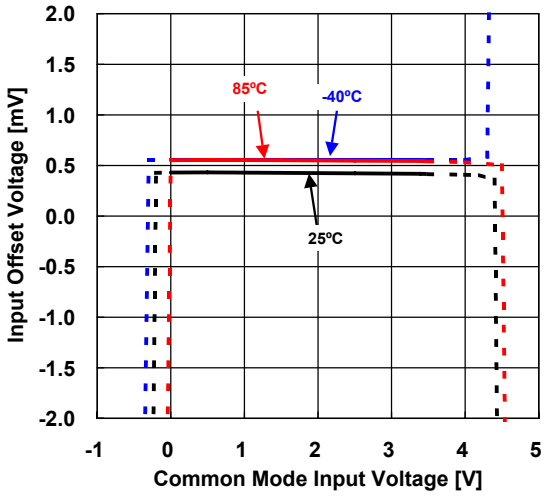


Input Offset Voltage vs. Temperature
VCC=30V, V_{ICM}=15V

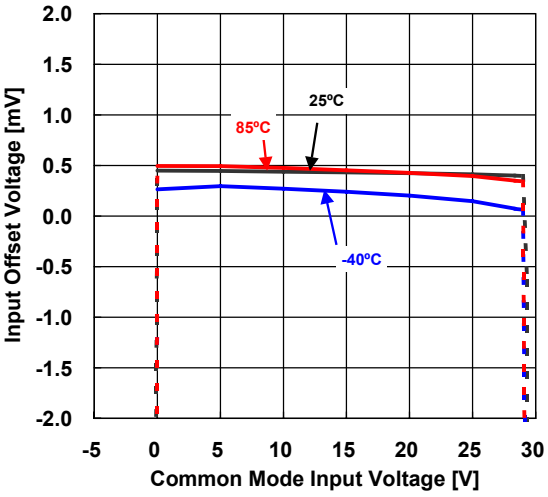


■ TYPICAL CHARACTERISTICS

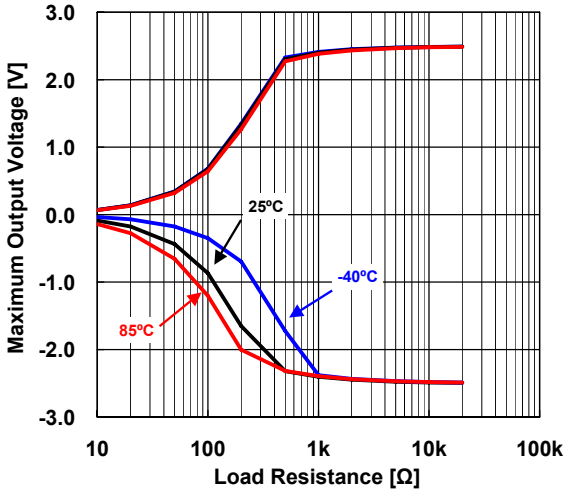
Input Offset Voltage vs. Common Mode Input Voltage
V_{CC}=5V, V_{ICM}=2.5V



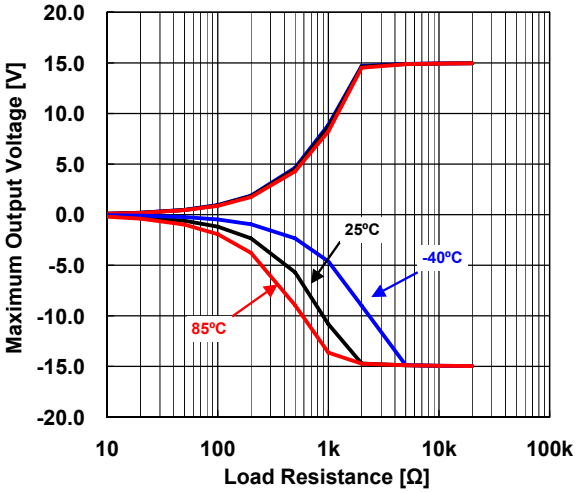
Input Offset Voltage vs. Common Mode Input Voltage
V_{CC}=30V, V_{ICM}=15V



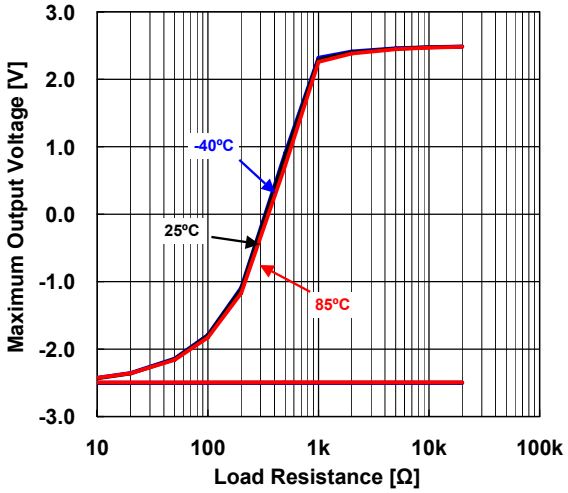
Maximum Output Voltage vs. Load Resistance
V_{CC}=2.5V, V_{EE}=-2.5V, V_{IN}=±1V, RL to 0V



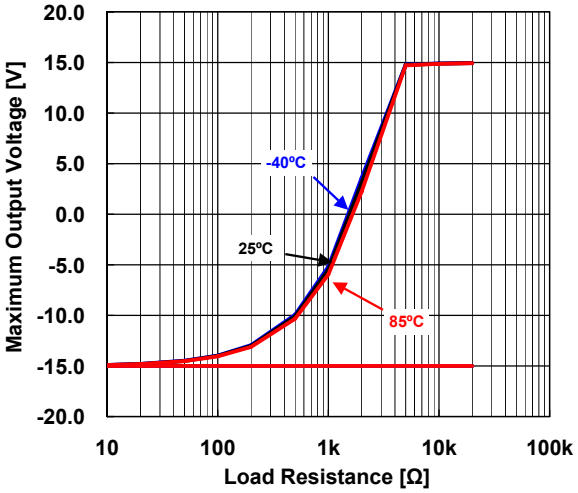
Maximum Output Voltage vs. Load Resistance
V_{CC}=15V, V_{EE}=-15V, V_{IN}=±1V, RL to 0V



Maximum Output Voltage vs. Load Resistance
V_{CC}=2.5V, V_{EE}=-2.5V, V_{IN}=±1V, RL to -2.5V

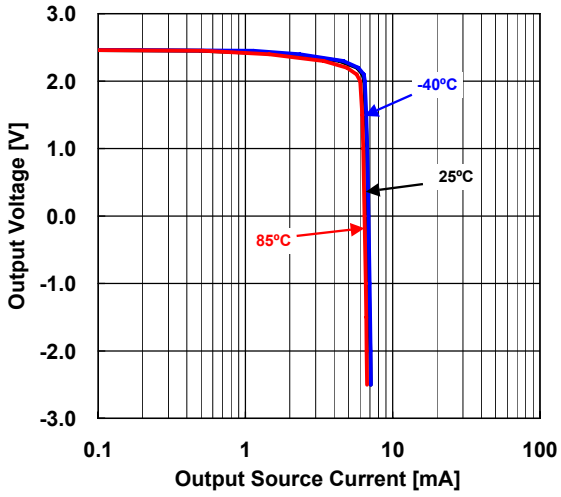


Maximum Output Voltage vs. Load Resistance
V_{CC}=15V, V_{EE}=-15V, V_{IN}=±1V, RL to -15V

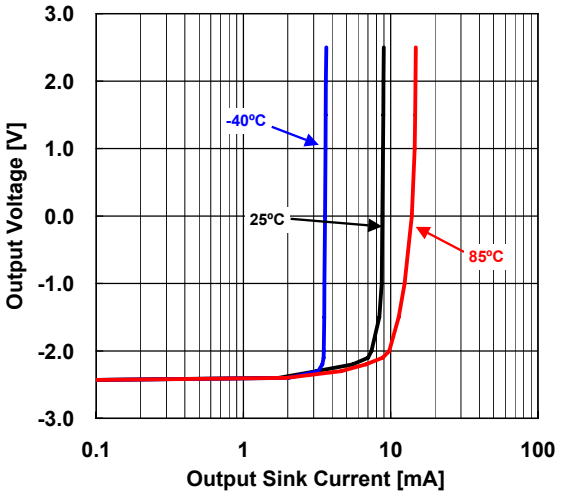


■ TYPICAL CHARACTERISTICS

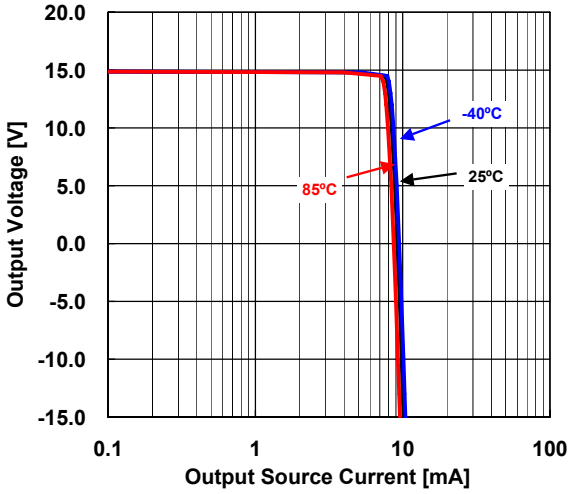
Output Voltage vs. Output Source Current
V_{CC}=2.5V, V_{EE}=-2.5V, V_{IN}=±1V



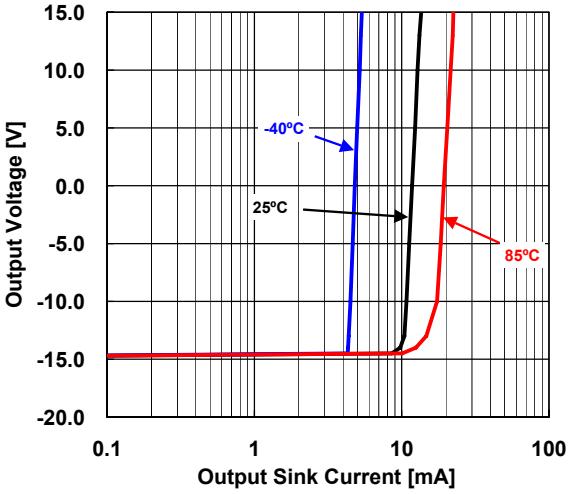
Output Voltage vs. Output Sink Current
V_{CC}=2.5V, V_{EE}=-2.5V, V_{IN}=±1V



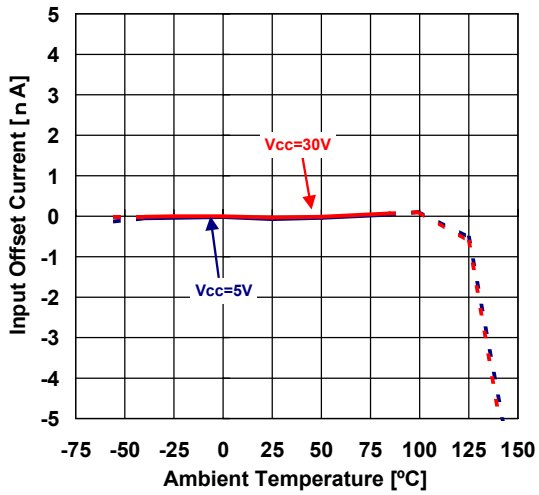
Output Voltage vs. Output Source Current
V_{CC}=15V, V_{EE}=-15V, V_{IN}=±1V



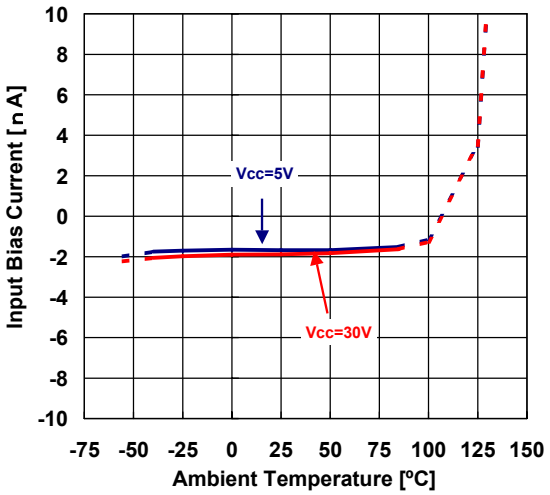
Output Voltage vs. Output Sink Current
V_{CC}=15V, V_{EE}=-15V, V_{IN}=±1V



Input Offset Current vs. Temperature
V_{ICM}=V_{CC}/2



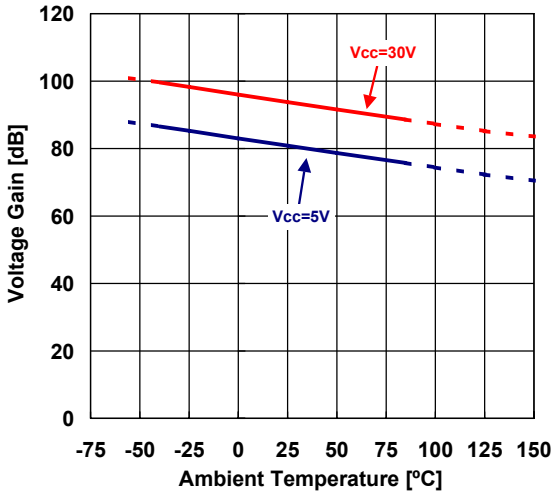
Input Bias Current vs. Temperature
V_{ICM}=V_{CC}/2



■ TYPICAL CHARACTERISTICS

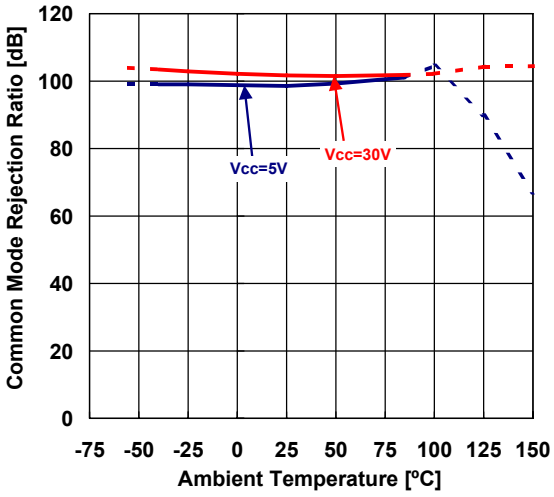
Gain vs. Temperature

$V_{ICM}=V_{CC}/2$, $R_L=20k\Omega$



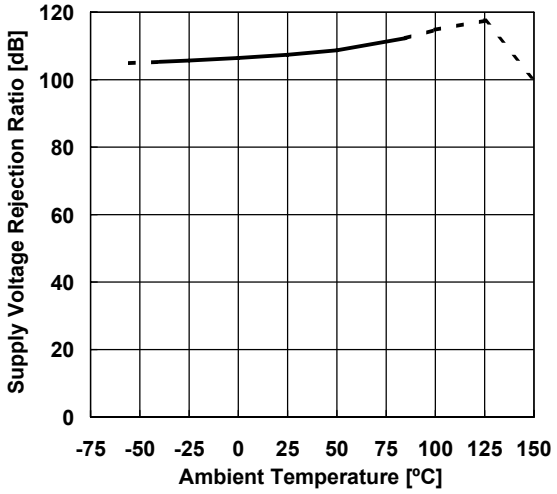
CMR vs. Temperature

V_{ICM}=0V~3.4V(V_{CC}=5V), V_{ICM}=0V~28.4V(Vcc=30V)



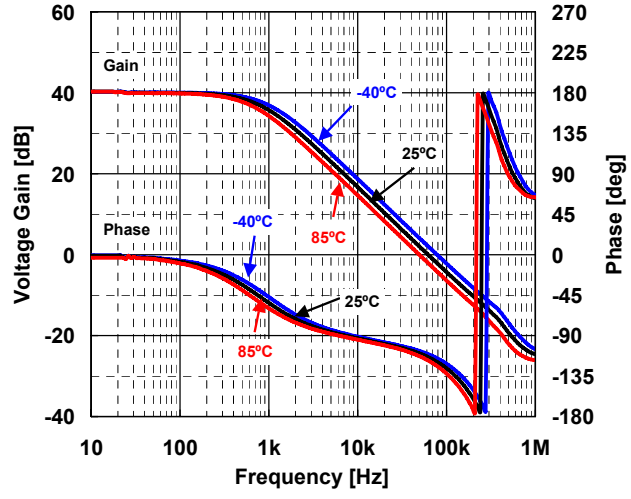
SVR vs. Temperature

V_{CC}=3V~36 V



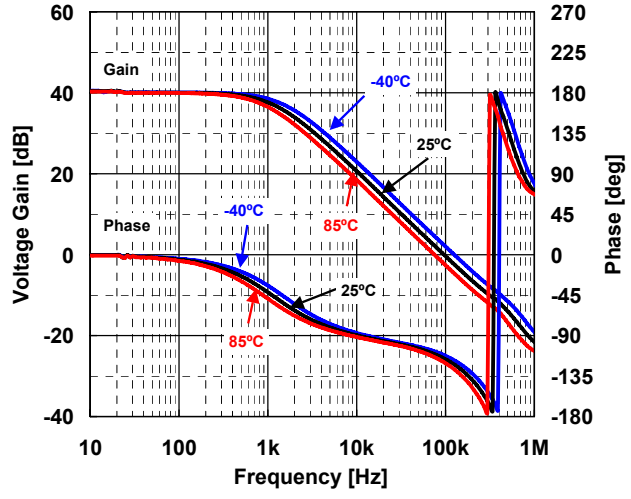
40dB Gain vs. Frequency

V_{CC}=2.5V, V_{EE}=-2.5V, Gv=40dB, R_F=100kΩ, R_L=20kΩ, C_L=10pF

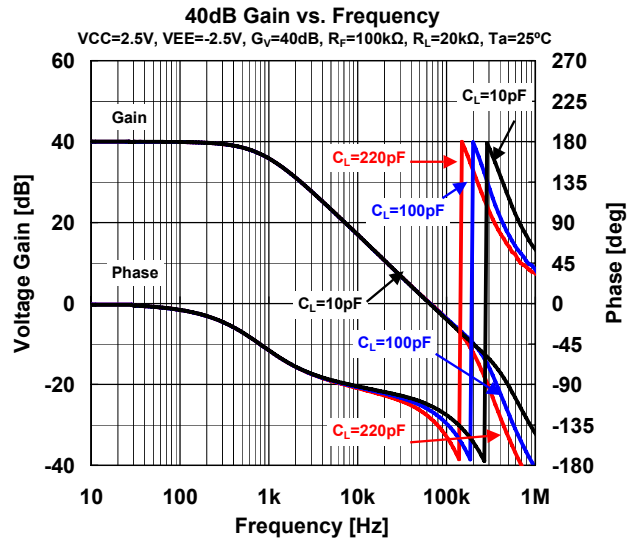


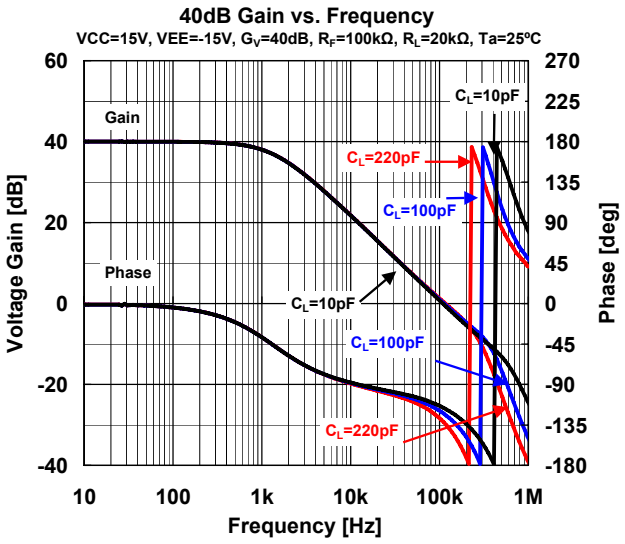
40dB Gain vs. Frequency

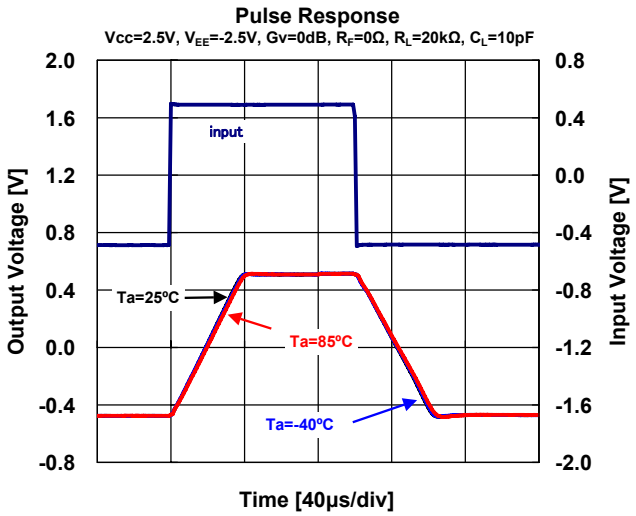
V_{CC}=15V, V_{EE}=-15V Gv=40dB, R_F=100kΩ, R_L=20kΩ, C_L=10pF

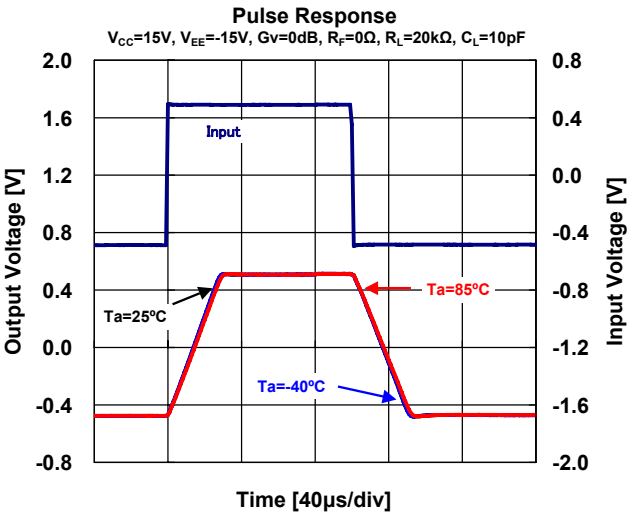


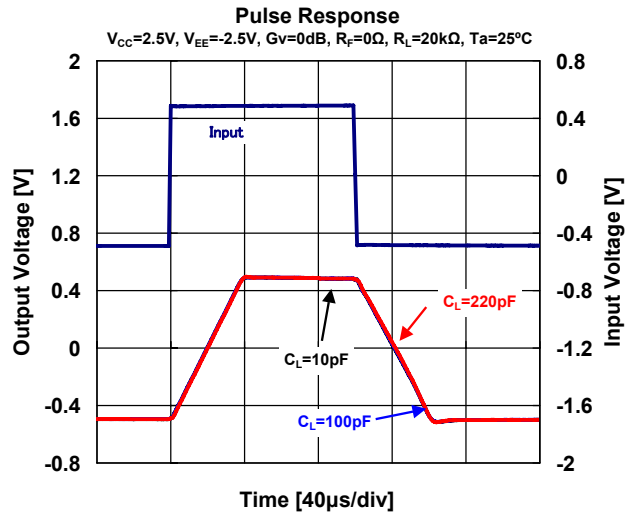
■ TYPICAL CHARACTERISTICS

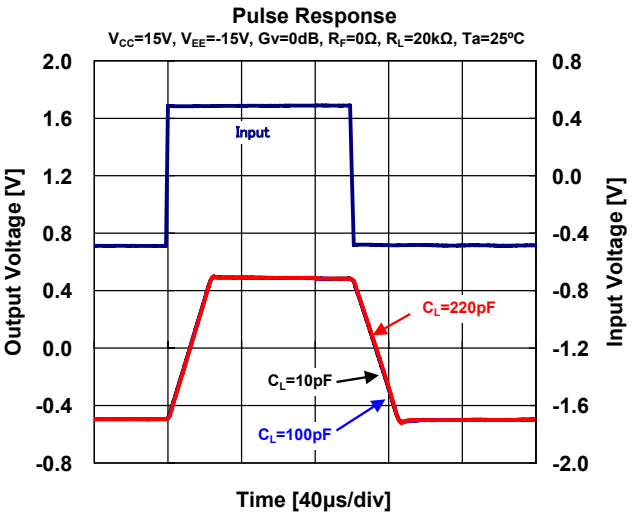












■ MEMO