Low Noise, High-Speed Dual Operational Amplifier

■ GENERAL DESCRIPTION

The NJM2719 is a high speed voltage feedback dual operational amplifier specifically optimized for low voltage noise.

Combining a voltage noise of 2.5nV/√Hz typ. (at f =100kHz) and unity gain of 100MHz, the NJM2719 is ideal for I/Q baseband amplifier, RFID reader application and other wireless communication system designs.

The NJM2719 is available in three 8-lead package options: surface mount (DMP), tiny fine pitch surface mount (SSOP/MSOP).

■ PACKAGE OUTLINE

NJM2719M
(DMP8)

NJM2719V
(SSOP8)

NJM2719RB1
(MSOP8(TVSP8))

■ FEATURES

●Low Noise	V_{ni} = 2.5nV/√Hz typ. (at f=100kHz)
	V_{ni} = 3nV/√Hz typ. (at f=10kHz)
●Unity Gain Bandwidth	f_T = 100MHz typ. (at V^+/V^- = ±5V)
	f_T = 90MHz typ. (at V^+/V^- = ±2.5V)
●Phase Margin	Φ_m = 60deg typ.
●Slew Rate	60V/μs typ. (at V^+/V^- = ±5V)
	35V/μs typ. (at V^+/V^- = ±2.5V)
●Output Rail-to-Rail	V_{OH} ≥ +4.7V, V_{OL} ≤ -4.8V (at V^+/V^- = ±5V)
	V_{OH} ≥ +2.4V, V_{OL} ≤ -2.4V (at V^+/V^- = ±2.5V)
●Operating Voltage	±2.25V ~ ±5V
●Bipolar Technology	
●Package Outline	NJM2719M : DMP8
	NJM2719V : SSOP8
	NJM2719RB1 : MSOP8 (TVSP8) MEET JEDEC MO-187-DA / THIN TYPE

■ APPLICATION

- ●Wireless Communication Equipment
- ●I/Q Baseband Application
- ●RFID Reader Application
- ●Active Filter
- ●ADC/DAC Buffer
- ●Ultrasound Amplifier

■ PIN CONFIGURATION

(Top View)

A OUTPUT	1
A -INPUT	2
A +INPUT	3
V⁻	4

8	V⁺
7	B OUTPUT
6	B -INPUT
5	B +INPUT
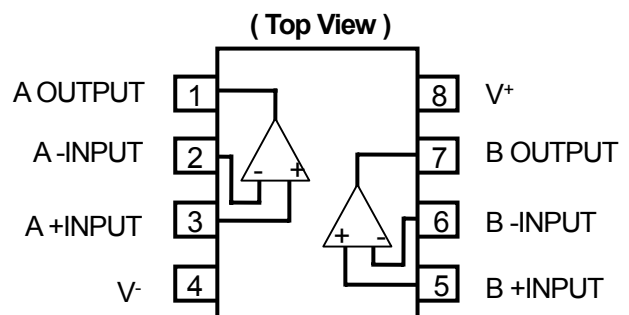
DMP8 [NJM2719M]
SSOP8 [NJM2719V]
MSOP8(TVSP8) [NJM2719RB1]

NJM2719

■ ABSOLUTE MAXIMUM RATINGS (Ta=25°C)

PARAMETER	SYMBOL	RATINGS	UNIT
Supply Voltage	V^+	±5.5	V
Common Mode Input Voltage Range	V_{ICM}	±5.5 (Note1)	V
Differential Input Voltage Range	V_{ID}	±3	V
Power Dissipation	P_D	370[DMP8], 310[SSOP8], 400[MSOP8(TVSP8)]	mW
		470[DMP8](Note2), 410[SSOP8](Note2), 510[MSOP8(TVSP8)] (Note2)	mW
Operating Temperature Range	T_{opr}	-40 to +85	°C
Storage Temperature Range	T_{stg}	-50 to +150	°C

(Note 1) The output voltage of normal operation will be the Output Voltage Swing of electrical characteristics.

(Note 2) On the PCB " EIA/JEDEC (114.3x76.2x1.57mm, two layers, FR-4) "

(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.
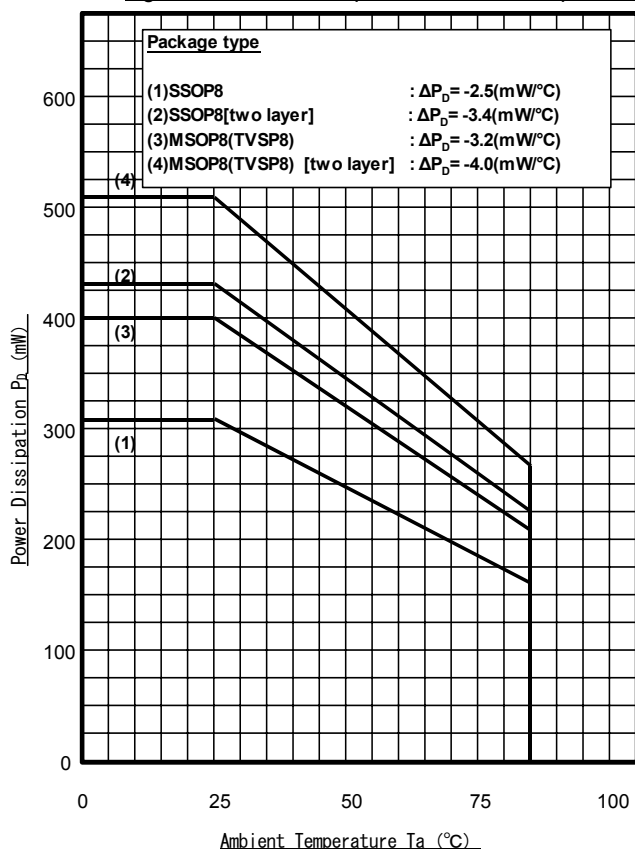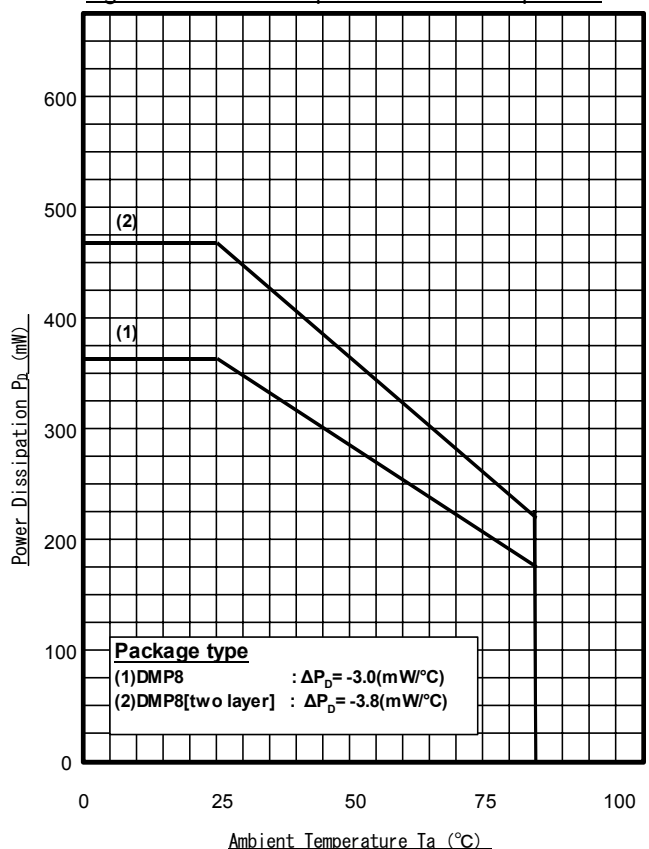

Figure1A:　Power Dissipation – Ambient Temperature

Package type
(1)SSOP8 　　　　　　　　　　: ΔP_D= -2.5(mW/°C)
(2)SSOP8[two layer] 　　　　　: ΔP_D= -3.4(mW/°C)
(3)MSOP8(TVSP8) 　　　　　　: ΔP_D= -3.2(mW/°C)
(4)MSOP8(TVSP8) [two layer] : ΔP_D= -4.0(mW/°C)

Figure1B:　Power Dissipation – Ambient Temperature

Package type
(1)DMP8 　　　　　　　　: ΔP_D= -3.0(mW/°C)
(2)DMP8[two layer] 　: ΔP_D= -3.8(mW/°C)

■ OPERATING VOLTAGE (Ta=25°C)

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Supply Voltage	V⁺ / V⁻	(Note3)	±2.25	-	±5.5	V

■ ELECTRICAL CHARACTERISTICS

● DC CHARACTERISTICS (V⁺/V⁻ =±2.5V, Ta=25°C)

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Supply Current	I_{CC}	No Signal	-	11	14	mA
Input Offset Voltage	V_{IO}	Rs=50Ω	-	1	9	mV
Input Offset Voltage Drift	$\Delta V_{io}/\Delta T$	Rs=50Ω	-	10	-	µV/deg
Input Bias Current	I_B		-	2.9	25	µA
Input Offset Current	I_{IO}		-	0.2	2	µA
Voltage Gain	A_V	R_L = 1kΩ to 0V, Vo = ±1V	68	91	-	dB
Common Mode Rejection Ratio	CMR	-2V ≤ V_{CM} ≤ +1.2V	82	92	-	dB
Supply Voltage Rejection Ratio	SVR	±2.25V ≤ V⁺/V⁻ ≤ ±5V	84	97	-	dB
Maximum Output Voltage 1	V_{OH1}	R_L = 1kΩ to 0V	+2.3	+2.4	-	V
	V_{OL1}		-	-2.4	-2.3	
Maximum Output Voltage 2	V_{OH2}	Isource =4mA, +Input =+0.1V, -Input =-0.1V	+2.2	+2.3	-	V
	V_{OL2}	Isink =4mA, +Input =-0.1V, -Input =+0.1V	-	-2.3	-2.2	
Common Mode Input Voltage Range	$V_{ICM}+$	CMR≥82dB	+1.2	-	-	V
	$V_{ICM}-$		-	-	-2	

● AC CHARACTERISTICS (V⁺/V⁻ =±2.5V, Ta=25°C)

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Unity Gain	f_T	Av=+40dB,	-	90	-	MHz
Phase Margin	φm	Rf =1.98kΩ, Rg =20Ω,	-	60	-	deg
Gain Margin	Gm	R_L =1kΩ to 0V, C_L =5pF	-	10	-	dB
Equivalent Input Noise Voltage	V_{NI1}	f =100kHz	-	2.5	-	nV/√Hz
	V_{NI2}	f =10kHz	-	3	-	
Equivalent Input Noise Current	I_{NI}	f =100kHz	-	3	-	pA/√Hz
Channel Separation	CS	f =1MHz, Vin =0.2Vpp, Av =+1, R_L =1kΩ to 0V, C_L =5pF	-	70	-	dB

● TRANSIENT CHARACTERISTICS (V⁺/V⁻ =±2.5V, Ta=25°C)

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Slew Rate 1	+SR1	Av =0dB, R_L =1kΩ to 0V, C_L =5pF, Vout =2Vpp	-	35	-	V/µs
	-SR1		-	35	-	
Slew Rate 2	+SR2	Av =+6dB, R_L =1kΩ to 0V, C_L =5pF, Vout =2Vpp	-	30	-	V/µs
	-SR2		-	30	-	
Rise Time	tr	Av =+6dB, R_L =1kΩ to 0V, C_L =5pF, Vout =0.2Vpp, 10% to 90%	-	8.3	-	ns
Fall Time	tf		-	8.3	-	
Power Band Width	PBW	Av =+6dB, R_L =1kΩ to 0V, C_L =5pF, Vout =2Vpp, HD2 ≤-40dB, HD3 ≤-40dB	-	3	-	MHz
Total Harmonic Distortion	THD	Av =+6dB, R_L =1kΩ to 0V, C_L =5pF, f =10kHz, Vout =2Vpp	-	0.1	-	%
Second Harmonic	HD2	Av =+6dB, R_L =1kΩ to 0V, C_L =5pF, f =1MHz, Vout =2Vpp	-	-50	-	dBc
Third Harmonic	HD3		-	-50	-	
Settling time (1%)	ts1	Av =+6dB, R_L =1kΩ to 0V, C_L =5pF, Vout =2Vpp	-	100	-	ns
Settling time (0.1%)	ts2		-	110	-	

● DC CHARACTERISTICS (V⁺/V⁻=±5V, Ta=25°C)

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Supply Current	I_{CC}	No Signal	-	14	17	mA
Input Offset Voltage	V_{IO}	Rs=50Ω	-	1	9	mV
Input Offset Voltage Drift	$\Delta V_{io}/\Delta T$	Rs=50Ω	-	10	-	µV/deg
Input Bias Current	I_B		-	2.9	25	µA
Input Offset Current	I_{IO}		-	0.2	2	µA
Voltage Gain	A_v	R_L = 1kΩ to 0V, Vo = ± 1V	70	91	-	dB
Common Mode Rejection Ratio	CMR	-4.5V ≤ V_{CM} ≤ +3.7V	82	92	-	dB
Supply Voltage Rejection Ratio	SVR	±2.25V ≤ V⁺/V⁻ ≤ ±5V	84	97	-	dB
Maximum Output Voltage 1	V_{OH1}	R_L = 1kΩ to 0V	+4.6	+4.7	-	V
	V_{OL1}		-	-4.8	-4.7	
Maximum Output Voltage 2	V_{OH2}	Isource =5mA, +Input =+0.1V, -Input =-0.1V	+4.5	+4.6	-	V
	V_{OL2}	Isink =5mA, +Input =-0.1V, -Input =+0.1V	-	-4.7	-4.6	
Common Mode Input Voltage Range	$V_{ICM}+$	CMR≥82dB	+3.7	-	-	V
	$V_{ICM}-$		-	-	-4.5	

● AC CHARACTERISTICS (V⁺/V⁻=±5V, Ta=25°C)

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Unity Gain	fT	Av=+40dB, Rf =1.98kΩ, Rg =20Ω, R_L =1kΩ to 0V, C_L =5pF	-	100	-	MHz
Phase Margin	φm		-	60	-	deg
Gain Margin	Gm		-	10	-	dB
Equivalent Input Noise Voltage	V_{NI1}	f =100kHz	-	2.5	-	nV/√Hz
	V_{NI2}	f =10kHz	-	3	-	
Equivalent Input Noise Current	I_{NI}	f =100kHz	-	3	-	pA/√Hz
Channel Separation	CS	f =1MHz, Vin =0.2Vpp, Av =+1, R_L =1kΩ to 0V, C_L =5pF	-	70	-	dB

● TRANSIENT CHARACTERISTICS (V⁺/V⁻=±5V, Ta=25°C)

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Slew Rate 1	+SR1	Av =0dB, R_L =1kΩ to 0V, C_L =5pF, Vout =5Vpp	-	60	-	V/µs
	-SR1		-	60	-	
Slew Rate 2	+SR2	Av =+6dB, R_L =1kΩ to 0V, C_L =5pF, Vout =5Vpp	-	55	-	V/µs
	-SR2		-	55	-	
Rise Time	tr	Av =+6dB, R_L =1kΩ to 0V, C_L =5pF, Vout =0.2Vpp, 10% to 90%	-	8	-	ns
Fall Time	tf		-	8	-	
Power Band Width	PBW	Av =+6dB, R_L =1kΩ to 0V, C_L =5pF, Vout =2Vpp, HD2 ≤-40dB, HD3 ≤-40dB	-	4	-	MHz
Total Harmonic Distortion	THD	Av =+6dB, R_L =1kΩ to 0V, C_L =5pF, f =10kHz, Vout =2Vpp	-	0.1	-	%
Second Harmonic	HD2	Av =+6dB, R_L =1kΩ to 0V, C_L =5pF, f =1MHz, Vout =2Vpp	-	-50	-	dBc
Third Harmonic	HD3		-	-50	-	
Settling time (1%)	ts1	Av =+6dB, R_L =1kΩ to 0V, C_L =5pF, Vout =2Vpp	-	90	-	ns
Settling time (0.1%)	ts2		-	110	-	

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Equivalent Input Voltage Noise vs. Frequency

V⁺/V⁻=±2.5V, R$_S$=50Ω, R$_F$=2kΩ, R$_G$=20Ω, T$_a$=25°C

Closed-Loop Gain/Phase vs. Frequency

V⁺/V⁻=±2.5V, R$_S$=50Ω, R$_F$=2kΩ, R$_G$=20Ω, R$_L$=1kΩ, C$_L$=5pF

Unity Gain Frequency Response

V⁺/V⁻=±2.5V, R$_S$=50Ω, R$_L$=1kΩ, Ta=25°C

Unity Gain Frequency Response

V⁺/V⁻=±2.5V, R$_S$=50Ω, R$_L$=1kΩ, C$_L$=5pF

Unity Gain Frequency Response

R$_S$=50Ω, R$_L$=1kΩ, C$_L$=5pF, Ta=25°C

Channel Separation vs. Frequency

V⁺/V⁻=±5V, V$_O$=0.2Vpp, G$_V$=0dB, R$_L$=1kΩ, C$_L$=5pF,

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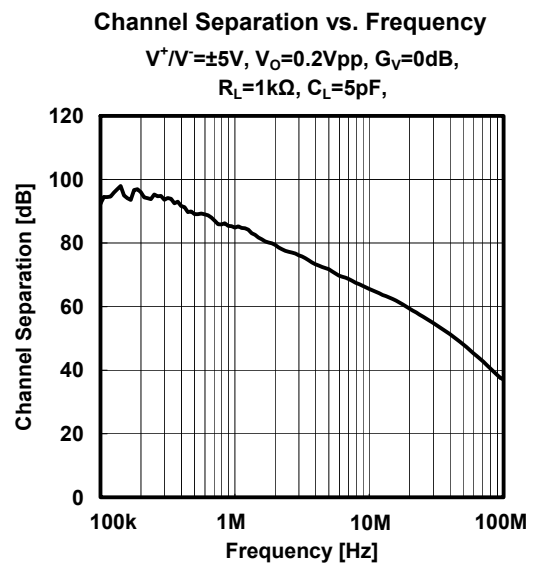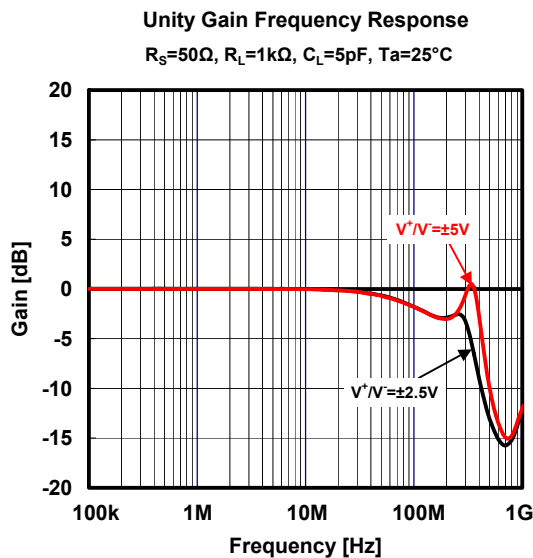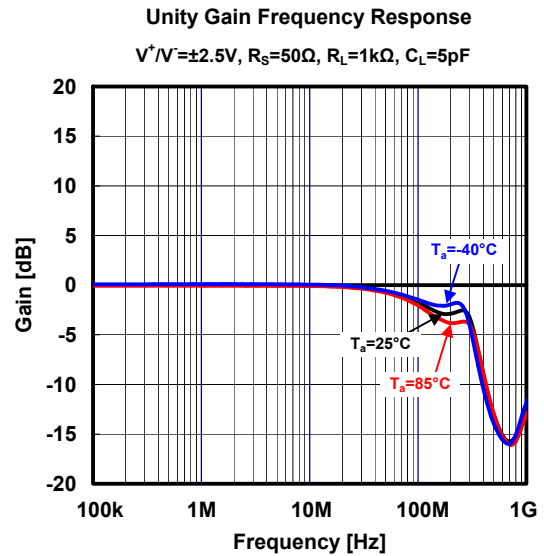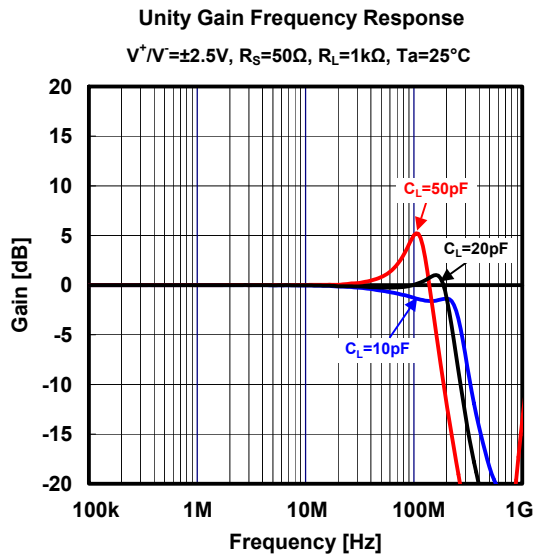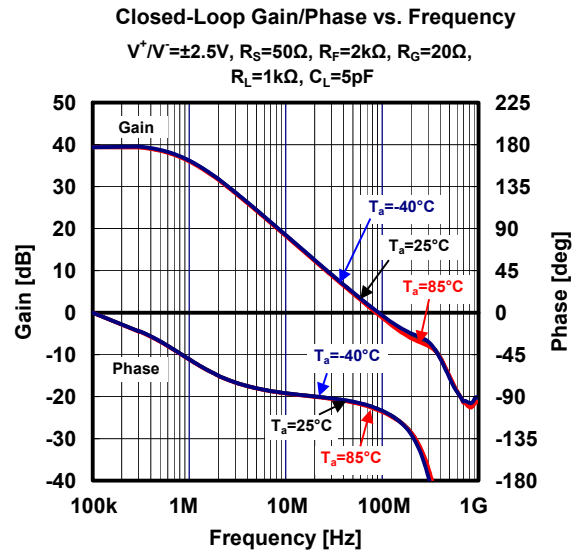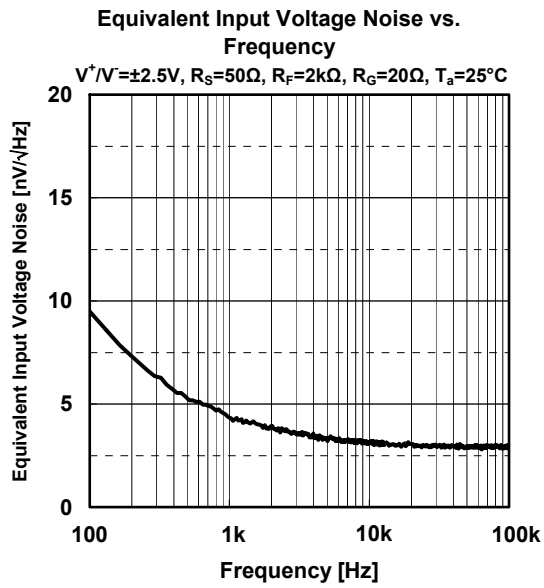
Transinet Response

V⁺/V⁻=±2.5V,f=4MHz,V_O=2V_{PP},G_V=1,R_T=50Ω,
R_L=1kΩ,T_a=25°C
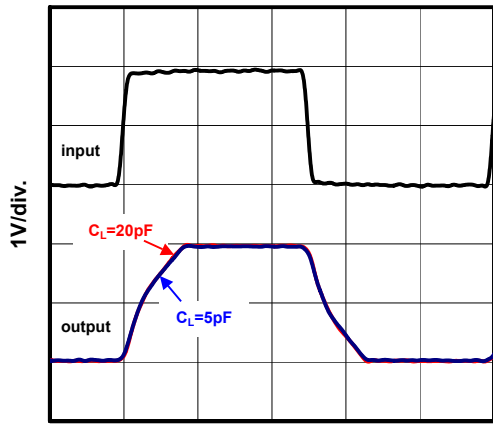
Transient Response

V⁺/V⁻=±5V,f=4MHz,V_O=5V_{PP},G_V=1,R_T=50Ω,
R_L=1kΩ,T_a=25°C
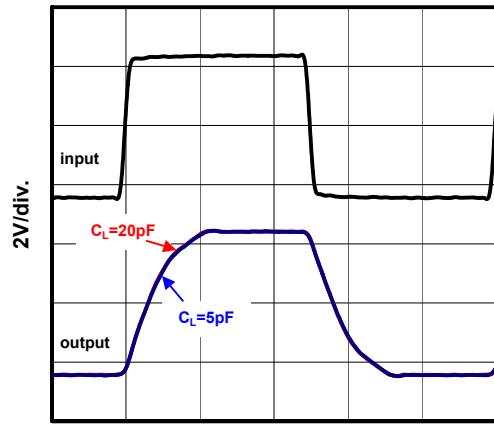
Transeint Response

V⁺/V⁻=±2.5V,f=4MHz,V_O=2V_{PP},G_V=1,R_T=50Ω,
R_L=1kΩ, C_L=5pF
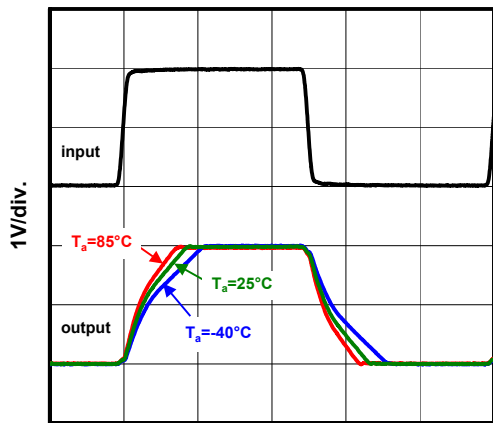
Transient Response

V⁺/V⁻=±5V,f=4MHz,V_O=5V_{PP},G_V=1,R_T=50Ω,
R_L=1kΩ, C_L=5pF
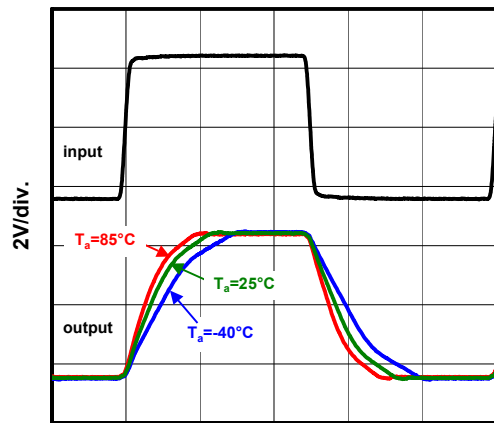
Supply Current vs. Supply Voltage

G_V=0dB, Ta=25°C
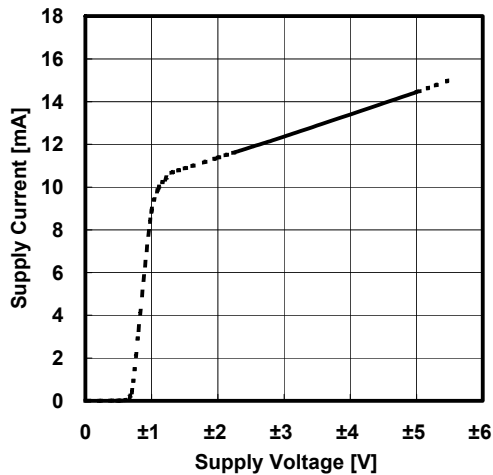
Supply Current vs. Temperature

G_V=0dB, V_{CM}=0V
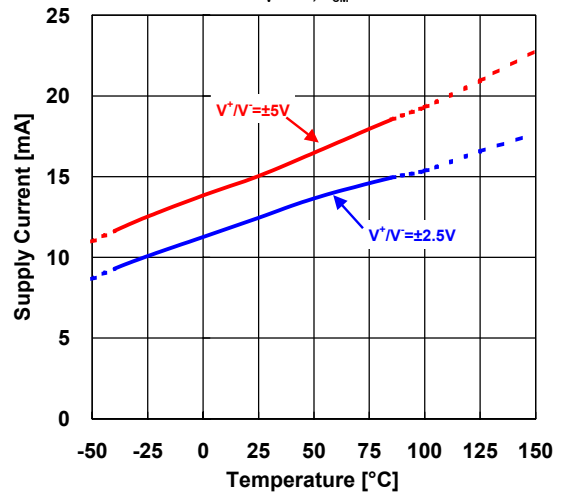
**Maximum Output Voltage
vs.Load Resistance
$V^+/V^-=\pm2.5V, V_{IN}=\pm0.2V$**
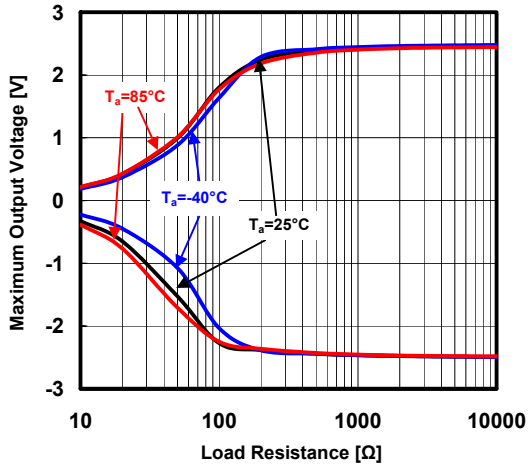
**Maximum Output Voltage
vs. Supply Voltage
$V_{IN}=\pm0.2V, R_L=1k\Omega$**
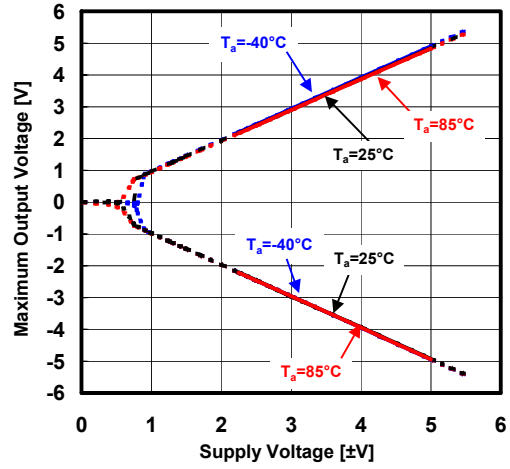
**Maximum Output Voltage
vs. Output Current
$V^+/V^-=\pm2.5V, V_{IN}=\pm0.2V$**
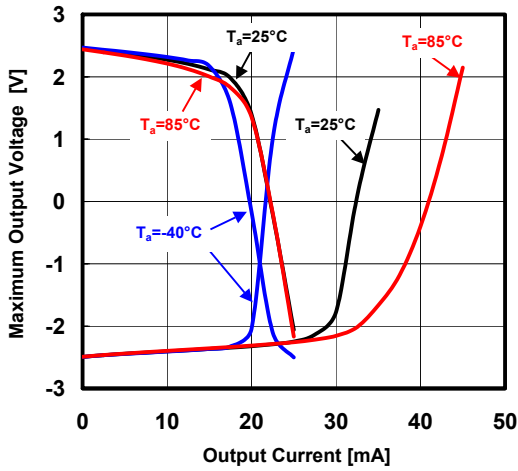
**Maximum Output Voltage
vs. Output Current
$V^+/V^-=\pm2.5V, V_{IN}=\pm0.2V$**
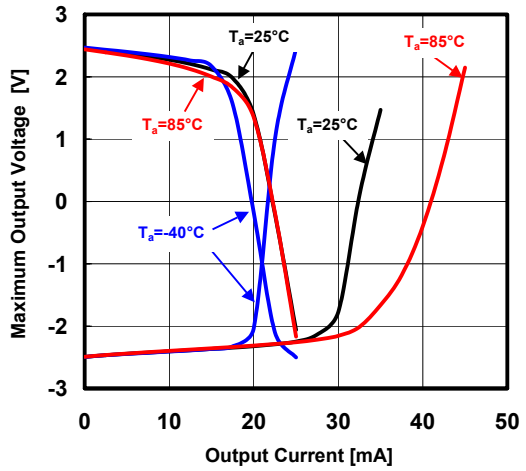
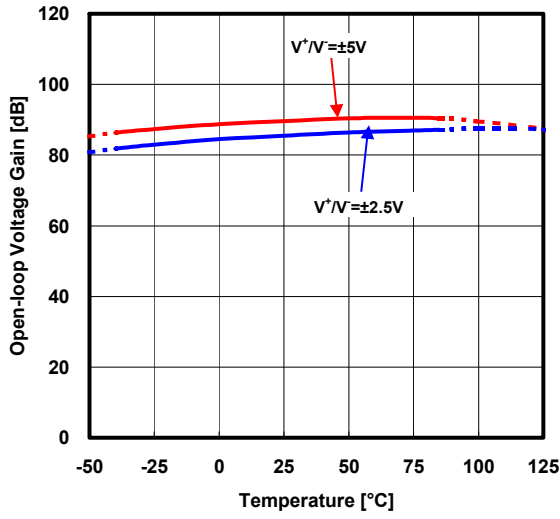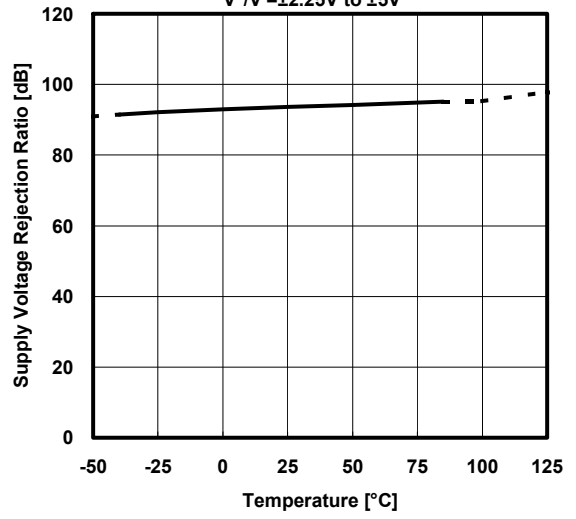**Input Offset Voltage vs. Temperature
$V_{CM}=0V$**
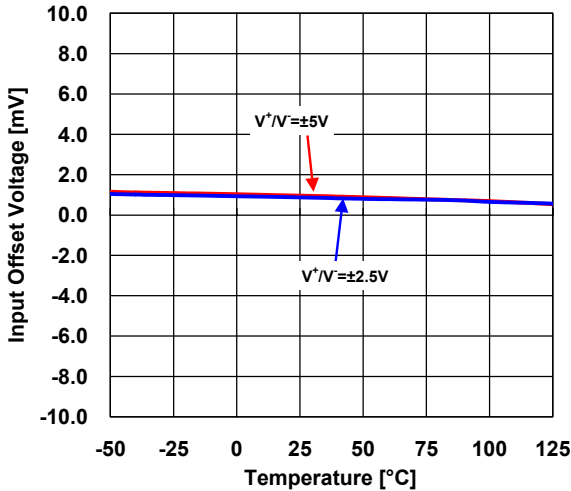
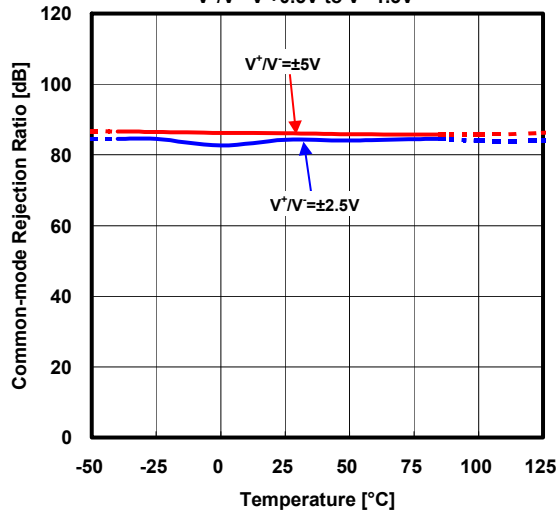**Input Offset Voltage
vs. Input Common-mode Voltage
$V^+/V^-=\pm2.5V$**

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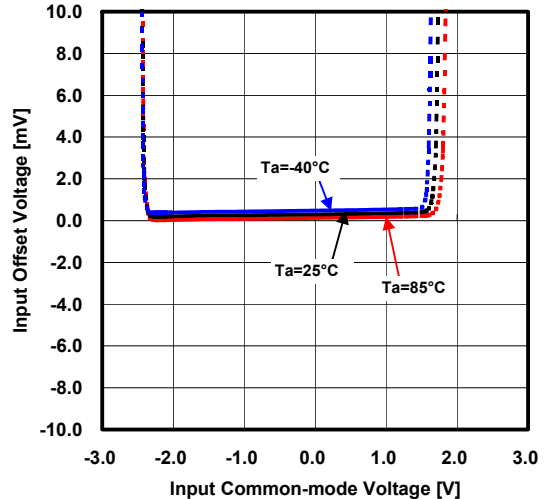
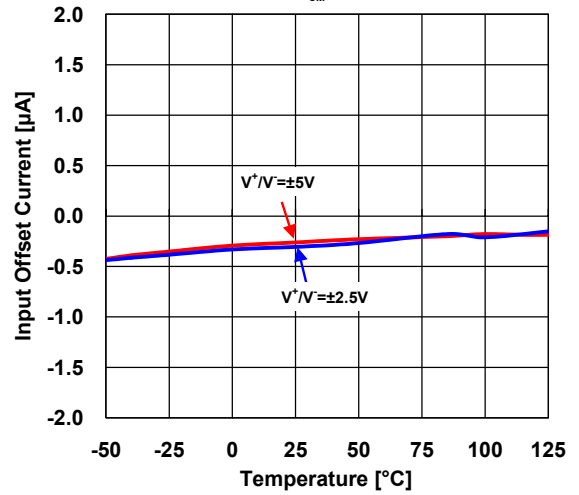### Open-loop Voltage Gain vs. Temperature
V_{OUT}=-1V to +1V, R_L=1kΩ

Supply Voltage Rejection Ratio vs. Temperature
V^+/V^-=±2.25V to ±5V

Common-mode Rejection Ratio vs. Temperature
V^+/V^-=V^-+0.5V to V^+-1.3V

Input Offset Current vs. Temperature
V_{CM}=0V

■ APPLICATION

●Stability

Generally, when driving a large capacitive load in low closed-loop gain or unity-gain configurations, circuit stability is reduced. In the case of using the NJM2719 for these configurations, it is necessary to care about unwanted oscillation.

An effective way to improve stability and to avoid oscillation is to add an isolation resistor as shown in Figure 1.

Figure 2 shows required resistor values (R_{ISO}) for stability versus load capacitances (C_L) in the unity-gain configuration (Figure 1). To ensure the stability, add a larger isolation resistor in Figure 2. (Resistor values in Figure2 are reference values when parasitic capacitance of an evaluation board is minimized.)
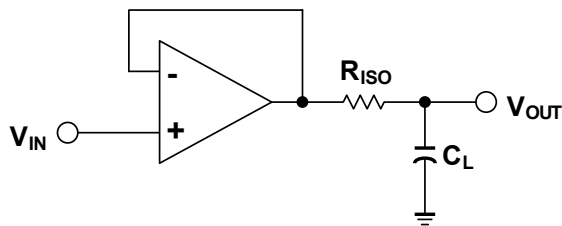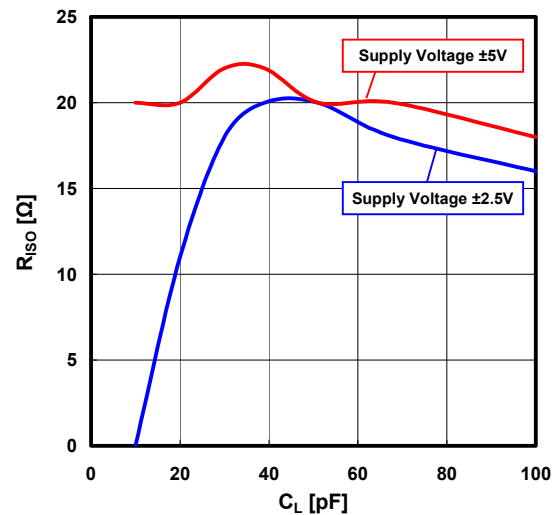
Figure 1.

Figure 2. Required Isolation Resistor values for stability, $R_{ISO}[\Omega]$, versus Capacitive Loads, $C_L[pF]$. (G_V=0dB)

■ **NOTE**

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