High-Speed, Rail-to-Rail I/O,

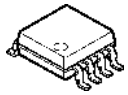
Dual CMOS Operational Amplifier

■GENERAL DESCRIPTION

The NJU7047 is a high-speed, rail-to-rail input/output, dual CMOS operational amplifier.

Its 9V/μs slew rate, 5MHz gain bandwidth product and rail-to-rail output into a 600Ω load, make it useful for a variety of wide dynamic range applications.

■PACKAGE OUTLINE



NJU7047RB1-T1
(MSOP-8(TVSP-8))

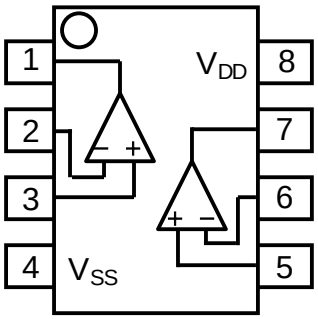
■FEATURES

- High Speed: Gain Bandwidth Product: 5MHz (at Ta=25 ºC)
  Slew Rate: 9V/μs. (at V_{DD}= 5V)
- Rail-to-Rail Input/Output: Input Voltage Range: GND to V_{DD}
  Output Voltage Range: GND + 0.14V to V_{DD} - 0.14V
  (at R_L = 600Ω, Ta= -40ºC to +125ºC)
- Operating Temperature: -40ºC to +125 ºC
- RF noise Immunity
- Package outline: MSOP8 (TVSP8) *
  *meet JEDEC MO-187-DA/ thin type
- CMOS process
- AEC-Q100 This product meets the reliability level required by AEC-Q100.

■APLICATIONS

- Current sensor
- Photodiode amplification
- ADC input buffers

■FEATURES



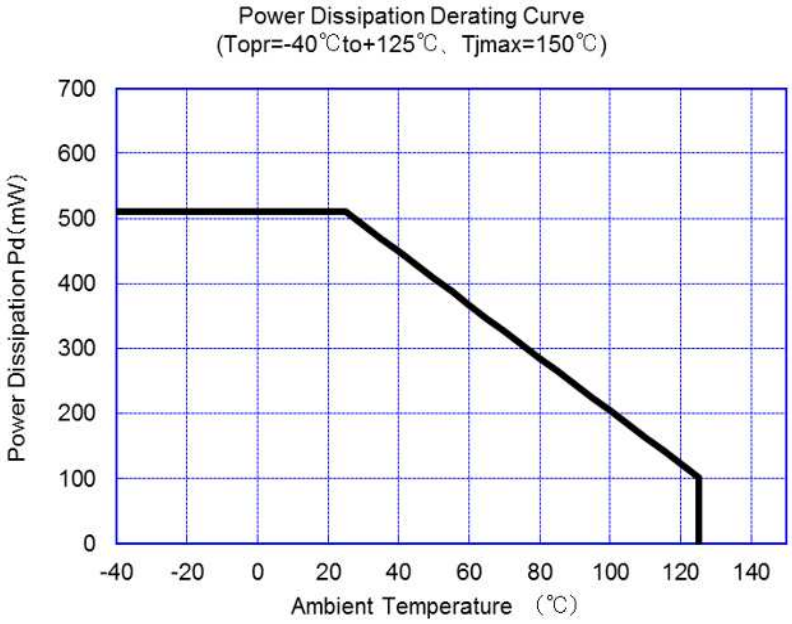
(Top View)
NJU7047RB1-T1

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}	+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	510 (Note2)	mW
Operating Temperature Range	T_{opr}	-40 to +125	˚C
Storage Temperature Range	T_{stg}	-55 to +150	˚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˚C.



■RECOMMENDED OPERATING CONDITION (Ta=25˚C)

PARAMATER	SYMBOL	MIN.	TYP.	MAX.	UNIT
Supply Voltage	V_{DD}	+2.7	-	+5.5	V

■**ELECTRICAL CHARACTERISTICS**(V_{DD}=5V, V_{SS}=0V, Ta=25˚C, unless otherwise noted.)

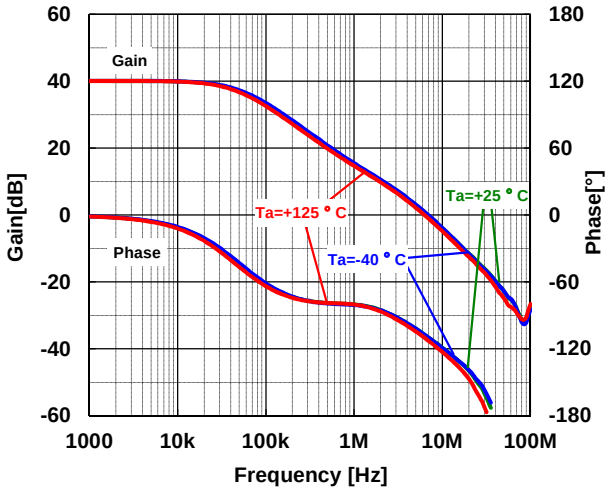
PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
DC CHARACTERISTICS						
Supply Current	I_{DD}	No Signal	-	2.7	4.3	mA
		No Signal, Ta= -40ºC to +125 ºC	-	-	4.5	
Input Offset Voltage	V_{IO}	V_{ICM}=0V, 2.5V, 5V	-	0.9	5	mV
		V_{ICM}=0V, 2.5V, 5V, Ta= -40ºC to +125 ºC	-	-	5	
Input Offset Voltage Drift	ΔVio/ΔT		-	2	-	µV/°C
Input Bias Current	I_B		-	1	-	pA
Input Offset Current	I_{IO}		-	1	-	pA
Open Loop Gain	A_V	Vout=1.5V to 3.5V, R_L=10kΩ to 2.5V	90	110	-	dB
		Vout=1.5V to 3.5V, R_L=10kΩ to 2.5V, Ta= -40ºC to +125 ºC	80	-	-	
Common Mode Rejection Ratio	CMR	V_{ICM}=0V to 5V	60	80	-	dB
		V_{ICM}=0V to 5V, Ta= -40ºC to +125 ºC	60	-	-	
Supply Voltage Rejection Ratio	SVR	V_{DD}=2.7V to 5.5V, V_{ICM}=0V	65	90	-	dB
		V_{DD}=2.7V to 5.5V, V_{ICM}=0V, Ta= -40ºC to +125 ºC	65	-	-	
Common Mode Input Voltage Range	V_{ICM}	CMR≥60dB	0	-	5	V
		CMR≥60dB, Ta= -40ºC to +125 ºC	0	-	5	
Maximum Output Voltage	V_{OH}	R_L=10kΩ to 2.5V	4.95	4.99	-	V
		R_L=10kΩ to 2.5V, Ta= -40ºC to +125 ºC	4.95	-	-	
		R_L=600Ω to 2.5V	4.88	4.93	-	V
		R_L=600Ω to 2.5V, Ta= -40ºC to +125 ºC	4.86	-	-	
	V_{OL}	R_L=10kΩ to 2.5V	-	0.01	0.05	V
		R_L=10kΩ to 2.5V, Ta= -40ºC to +125 ºC	-	-	0.05	
		R_L=600Ω to 2.5V	-	0.07	0.12	V
		R_L=600Ω to 2.5V, Ta= -40ºC to +125 ºC	-	-	0.14	
AC CHARACTERISTICS						
Slew Rate	SR	G_V=0dB, R_L=10kΩ, C_L=20pF, V_{IN}=2V_{PP}	5	9	-	V/µs
Gain Bandwidth Product	GBW	G_V=40dB, R_F=100kΩ, R_L=10kΩ, C_L=20pF	-	5	-	MHz
Phase Margin	φ_M	G_V=40dB, R_F=100kΩ, R_L=10kΩ, C_L=20pF	-	70	-	deg
Gain Margin	G_M	G_V=40dB, R_F=100kΩ, R_L=10kΩ, C_L=20pF	-	16	-	dB
Equivalent Input Noise Voltage	V_{NI}	f=1kHz	-	20	-	nV/√Hz
Total Harmonic Distortion + Noise	THD+N	G_V=0dB, R_L=10kΩ, f=1kHz, V_O=1Vpp	-	0.01	-	%
Channel Separation	CS	f=1kHz	-	130	-	dB

■**ELECTRICAL CHARACTERISTICS** (V_{DD}=2.7V, V_{SS}=0V, Ta=25˚C, unless otherwise noted.)

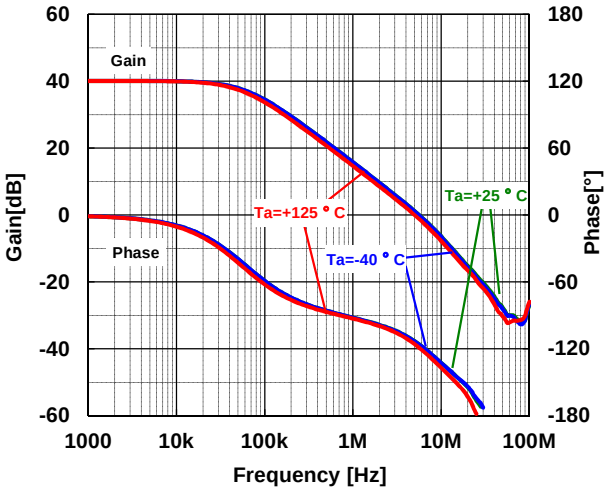
PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
DC CHARACTERISTICS						
Supply Current	I_{DD}	No Signal	-	2.5	4.0	mA
		No Signal, Ta= -40ºC to +125 ºC	-	-	4.2	
Input Offset Voltage	V_{IO}	V_{ICM}=0V, 1.35V, 2.7V	-	0.9	5	mV
		V_{ICM}=0V, 1.35V, 2.7V, Ta= -40ºC to +125 ºC	-	-	5	
Input Offset Voltage Drift	ΔVio/ΔT		-	2	-	µV/°C
Input Bias Current	I_B		-	1	-	pA
Input Offset Current	I_{IO}		-	1	-	pA
Open Loop Gain	A_V	Vout=0.35V to 2.35V, R_L=10kΩ to 1.35V	90	110	-	dB
		Vout=0.35V to 2.35V, R_L=10kΩ to 1.35V, Ta= -40ºC to +125 ºC	80	-	-	
Common Mode Rejection Ratio	CMR	V_{ICM}=0V to 2.7V	55	75	-	dB
		V_{ICM}=0V to 2.7V, Ta= -40ºC to +125 ºC	55	-	-	
Supply Voltage Rejection Ratio	SVR	V_{DD}=2.7V to 5.5V, V_{ICM}=0V	65	90	-	dB
		V_{DD}=2.7V to 5.5V, V_{ICM}=0V, Ta= -40ºC to +125 ºC	65	-	-	
Common Mode Input Voltage Range	V_{ICM}	CMR≥55dB	0	-	2.7	V
		CMR≥55dB, Ta= -40ºC to +125 ºC	0	-	2.7	
Maximum Output Voltage	V_{OH}	R_L=10kΩ to 1.35V	2.65	2.69	-	V
		R_L=10kΩ to 1.35V, Ta= -40ºC to +125 ºC	2.65	-	-	
		R_L=600Ω to 1.35V	2.60	2.64	-	V
		R_L=600Ω to 1.35V, Ta= -40ºC to +125 ºC	2.58	-	-	
	V_{OL}	R_L=10kΩ to 1.35V	-	0.01	0.05	V
		R_L=10kΩ to 1.35V, Ta= -40ºC to +125 ºC	-	-	0.05	
		R_L=600Ω to 1.35V	-	0.05	0.10	V
		R_L=600Ω to 1.35V, Ta= -40ºC to +125 ºC	-	-	0.12	
AC CHARACTERISTICS						
Slew Rate	SR	G_V=0dB, R_L=10kΩ, C_L=20pF, V_{IN}=2V_{PP}	3.5	7	-	V/µs
Gain Bandwidth Product	GBW	G_V=40dB, R_F=100kΩ, R_L=10kΩ, C_L=20pF	-	5	-	MHz
Phase Margin	φ_M	G_V=40dB, R_F=100kΩ, R_L=10kΩ, C_L=20pF	-	65	-	deg
Gain Margin	G_M	G_V=40dB, R_F=100kΩ, R_L=10kΩ, C_L=20pF	-	18	-	dB
Equivalent Input Noise Voltage	V_{NI}	f=1kHz	-	20	-	nV/√Hz
Total Harmonic Distortion + Noise	THD+N	G_V=0dB, R_L=10kΩ, f=1kHz, V_O=1Vpp	-	0.02	-	%
Channel Separation	CS	f=1kHz	-	130	-	dB

■ TYPICAL CHARACTERISTICS

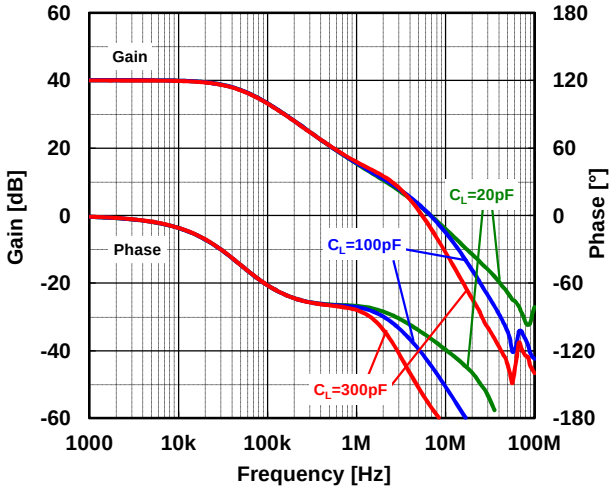
Gain/Phase vs. Frequency (Temperature)
G_V=40dB, V_{DD}=5V, R_F=100kΩ, R_G=1kΩ, R_L=10kΩ, C_L=20pF



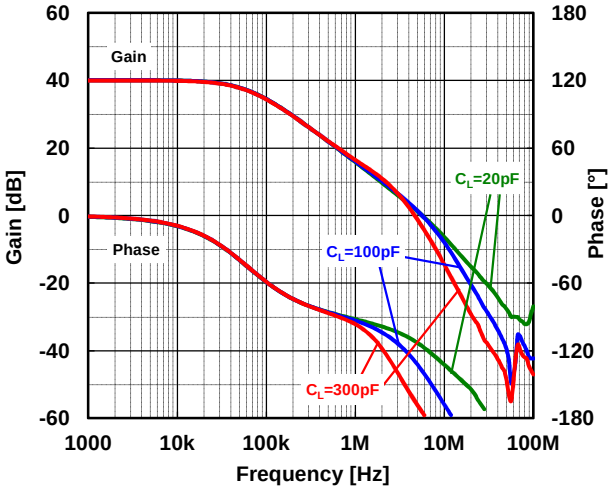
Gain/Phase vs. Frequency (Temperature)
G_V=40dB, V_{DD}=2.7V, R_F=100kΩ, R_G=1kΩ, R_L=10kΩ, C_L=20pF



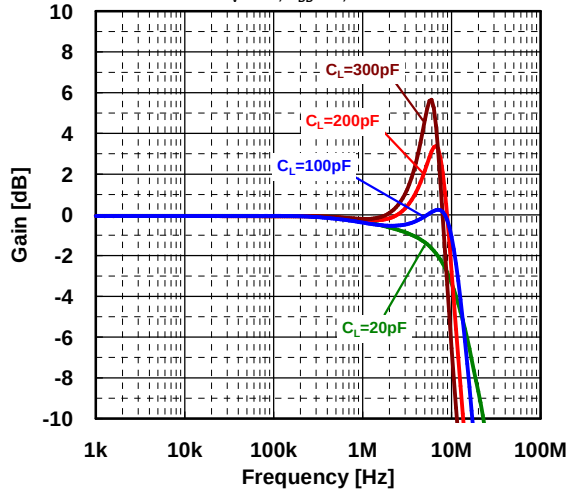
Gain/Phase vs. Frequency (Load Capacitance)
G_V=40dB, V_{DD}=5V, R_F=100kΩ, R_G=1kΩ, R_L=10kΩ, Ta=25°C



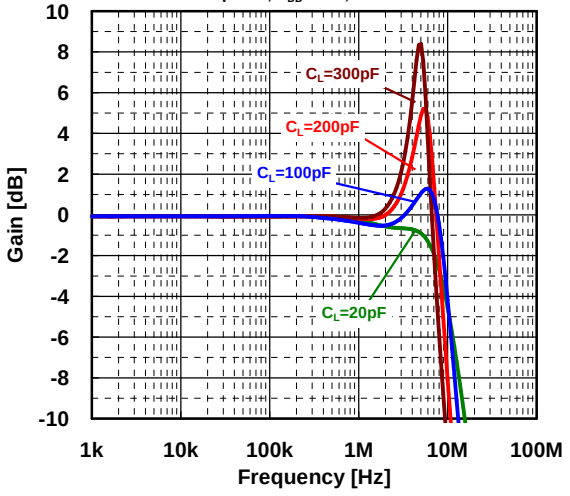
Gain/Phase vs. Frequency (Load Capacitance)
G_V=40dB, V_{DD}=2.7V, R_F=100kΩ, R_G=1kΩ, R_L=10kΩ, Ta=25°C



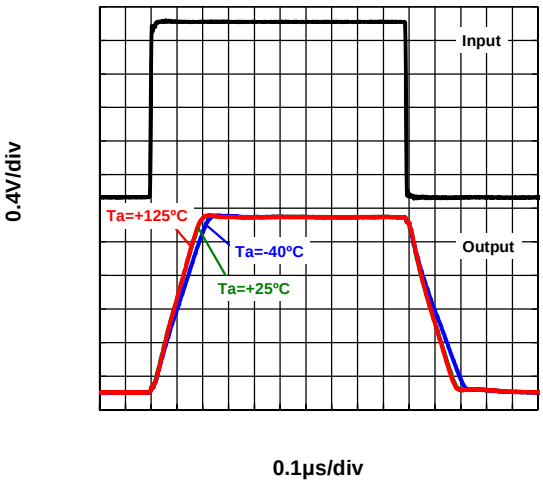
Unity Gain Frequency Response (Load Capacitance)
G_V=0dB, V_{DD}=5V, Ta=25°C



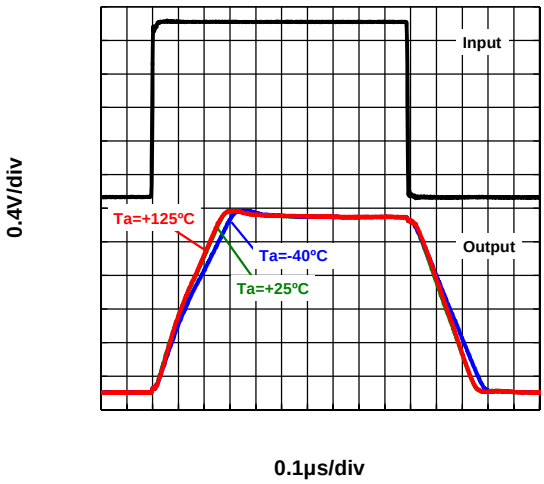
Unity Gain Frequency Response (Load Capacitance)
G_V=0dB, V_{DD}=2.7V, Ta=25°C



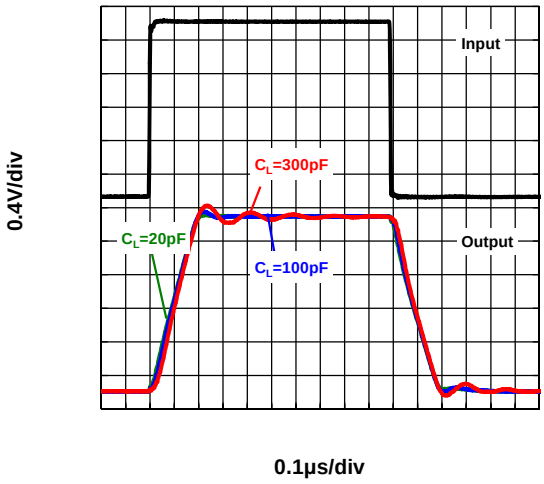
Transient Response (Temperature)
V_{DD}=5V, V_{IN}=2Vpp, R_L=10kΩ, C_L=20pF



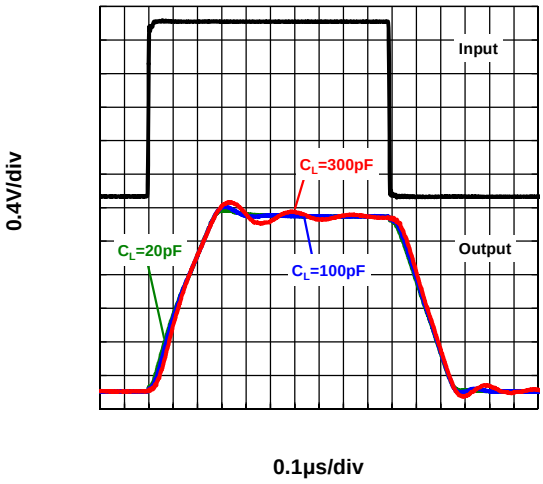
Transient Response (Temperature)
V_{DD}=2.7V, V_{IN}=2Vpp, R_L=10kΩ, C_L=20pF



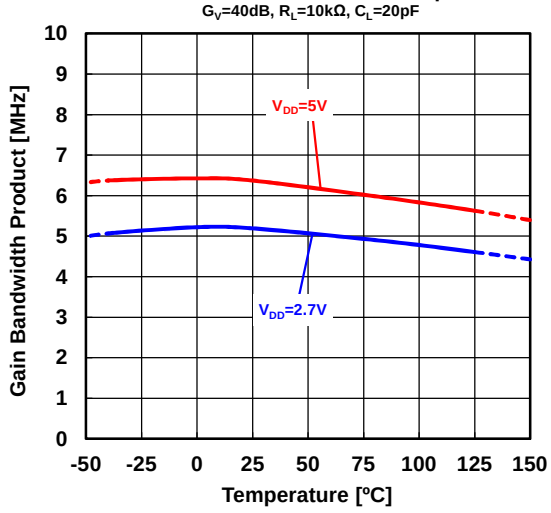
Transient Response (Load Capacitance)
V_{DD}=5V, V_{IN}=2Vpp, R_L=10kΩ, Ta=25°C



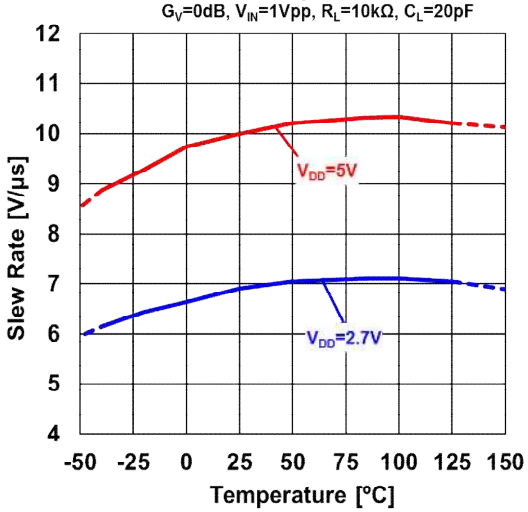
Transient Response (Load Capacitance)
V_{DD}=2.7V, V_{IN}=2Vpp, R_L=10kΩ, Ta=25°C



Gain Bandwidth Product vs. Temperature
G_V=40dB, R_L=10kΩ, C_L=20pF

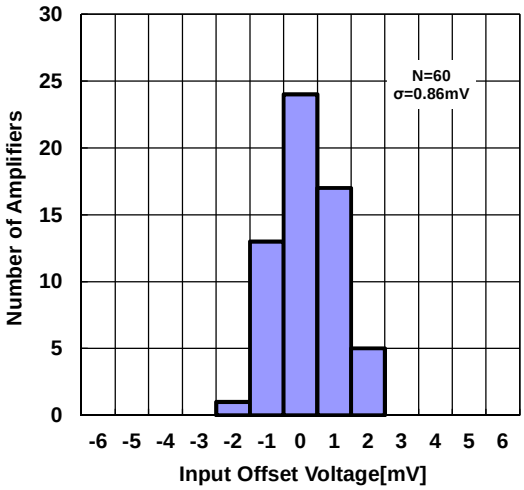


Slew Rate vs. Temperature (Supply Voltage)
G_V=0dB, V_{IN}=1Vpp, R_L=10kΩ, C_L=20pF



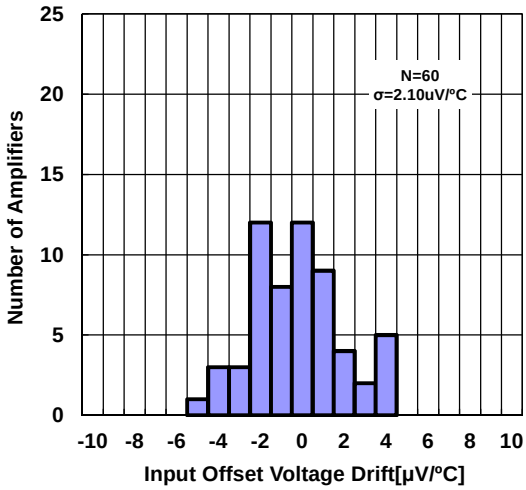
Input Offset Voltage Distribution

V_{DD}=5V, V_{ICM}=2.5V, Ta=25°C



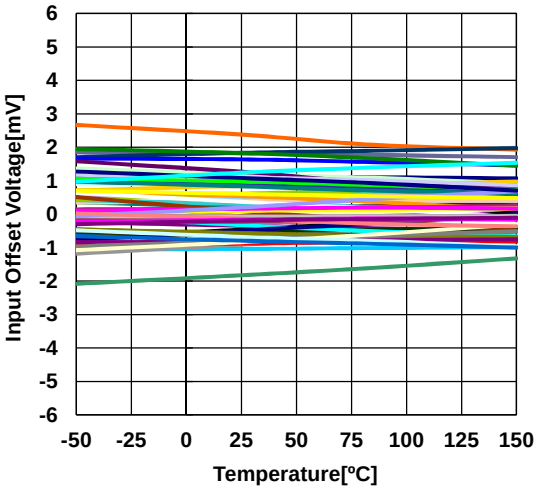
Input Offset Voltage Drift Distribution

V_{DD}=5V, V_{ICM}=2.5V, Ta=-40°C to +125°C



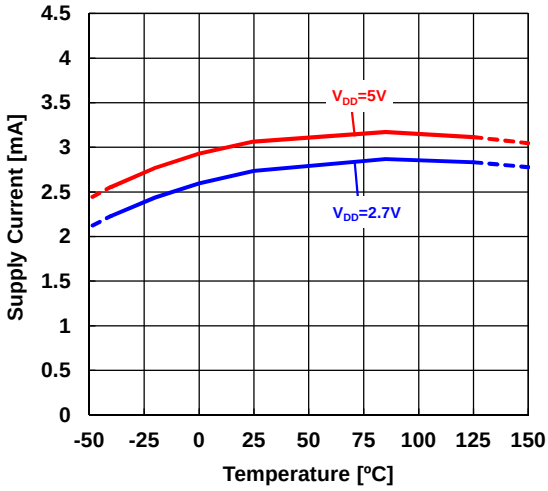
Input Offset Voltage vs. Temperature

V_{DD}=5V, V_{ICM}=2.5V



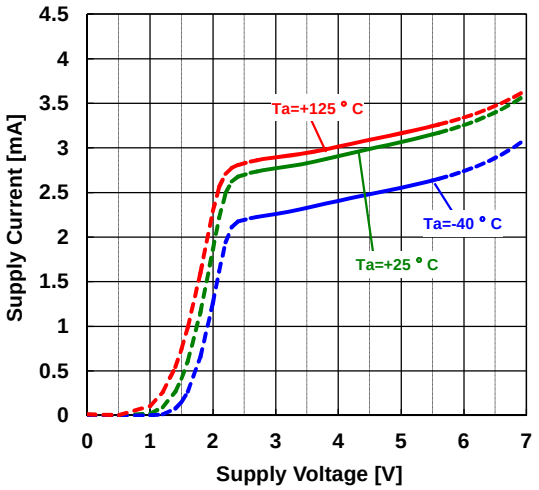
Supply Current vs. Temperature (Supply Voltage)

V_{ICM}=V_{DD}/2



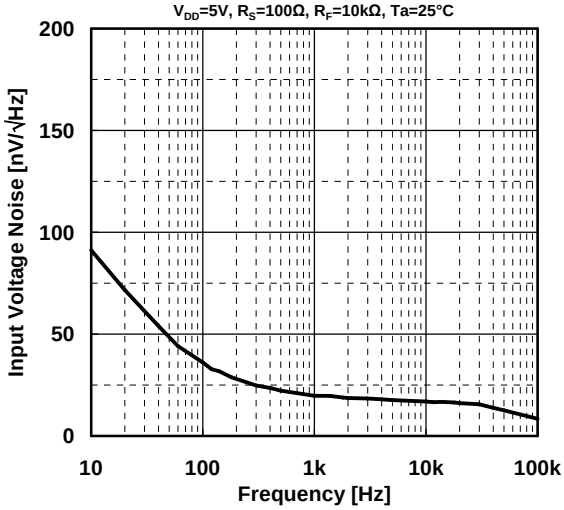
Supply Current vs. Supply Voltage (Temperature)

V_{ICM}=V_{DD}/2

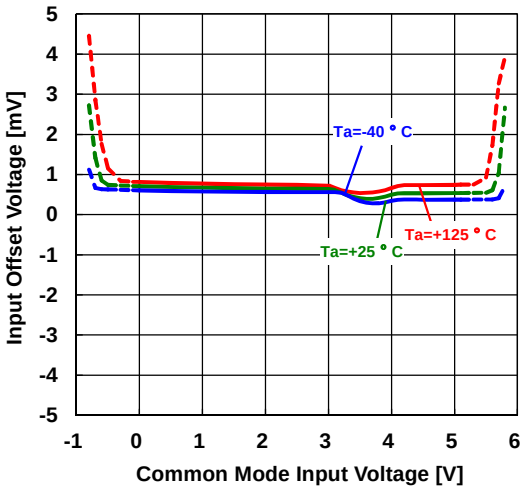


Input Voltage Noise vs. Frequency

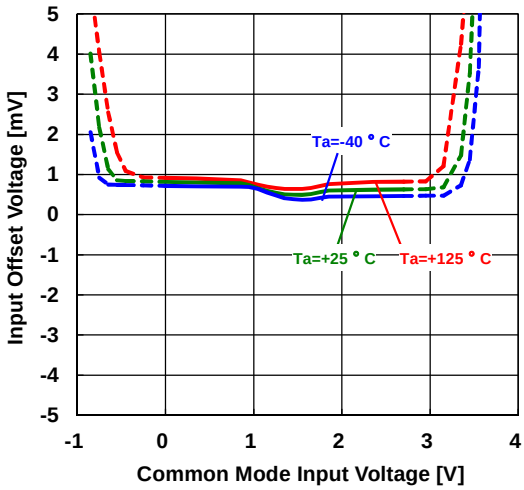
V_{DD}=5V, R_S=100Ω, R_F=10kΩ, Ta=25°C



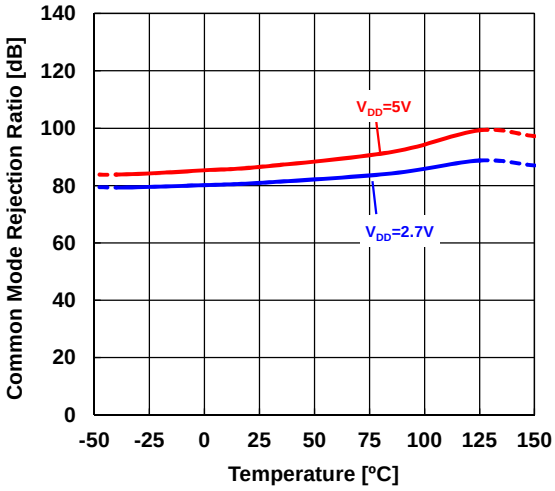
Input Offset Voltage vs. Common Mode Input Voltage (Temperature)
V_{DD}=5V, V_{ICM}=V_{DD}/2



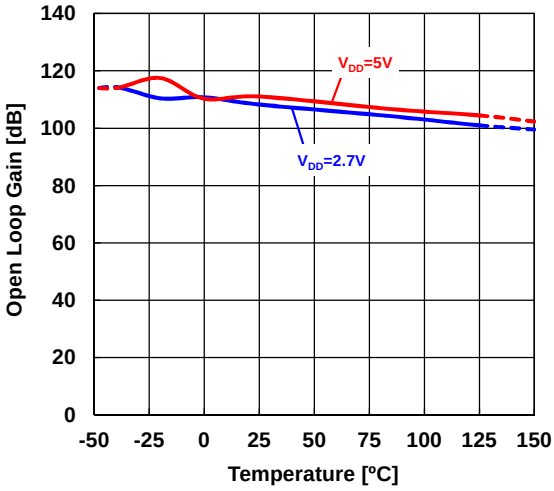
Input Offset Voltage vs. Common Mode Input Voltage (Temperature)
V_{DD}=2.7V, V_{ICM}=V_{DD}/2



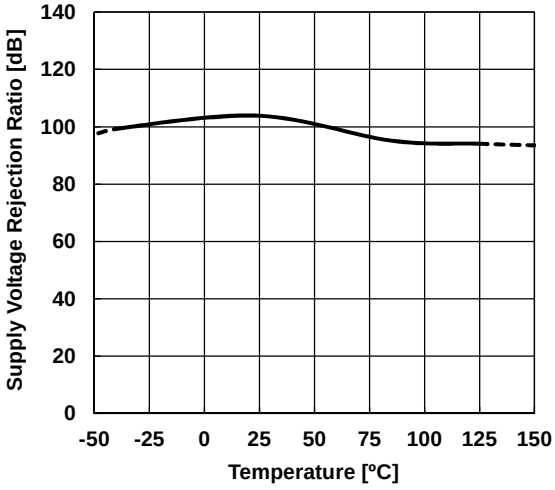
CMR vs. Temperature (Supply Voltage)
V_{ICM}=V_{SS} to V_{DD}



Open Loop Gain vs. Temperature (Supply Voltage)
V_O=V_{DD}/2 ± 1V



SVR vs. Temperature
V_{DD}=2.7V to 5.5V



Maximum Output Voltage vs. Load Resistance
Ta=25ºC