

Low Noise, Low Offset Voltage Drift Rail-to-Rail Output CMOS Operational Amplifier

FEATURES ($V_{DD}=5V, V_{SS}=0V, T_a=25^\circ C$)

•Low Noise	15nV/ \sqrt{Hz}
•Low Offset Voltage Drift	0.7 $\mu V/^\circ C$ typ.
•Offset Voltage	4mV max.
•Rail-to-Rail Output	
$R_L=10k\Omega$	50mV from rail
$R_L=600\Omega$	140mV from rail
•Gain Bandwidth Product	2.1MHz
•Slew Rate	0.8V/ μs
•Supply Current	260 $\mu A/ch$
•Supply Voltage	1.8V to 5.5V
•Thin and Ultra Small Package	ESON8-U1
	2.0 x 2.0 x 0.4 mm
•RF noise Immunity	
•Ground sense	
•Unity-Gain Stable	
•Package	
NJU7056	SOT-23-5, SC-88A
NJU7057	MSOP8 (TVSP8)*, ESON8-U1
	*meet JEDEC MO-187-DA / thin type
NJU7058	SSOP14

APPLICATIONS

- Battery-powered instruments
- Current sensor amplifiers
- Audio pre/mic. amplifiers
- Power line monitoring
- current to Voltage converter

DESCRIPTION

The NJU7056/NJU7057/NJU7058 are Single/Dual/Quad rail-to-rail output CMOS operational amplifiers. Low noise of 15nV/ \sqrt{Hz} and low offset drift of 0.7 $\mu V/^\circ C$ typ. make them suitable for several sensor amplifiers and preamplifiers.

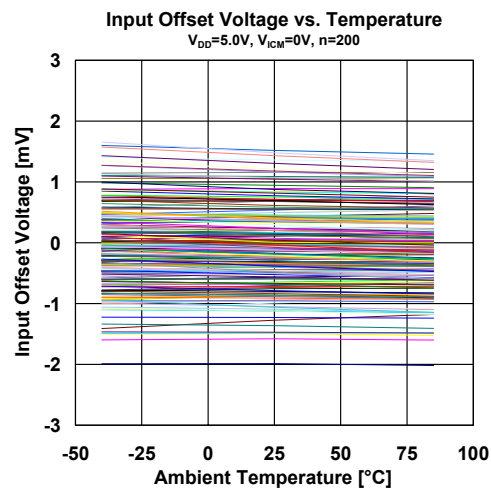
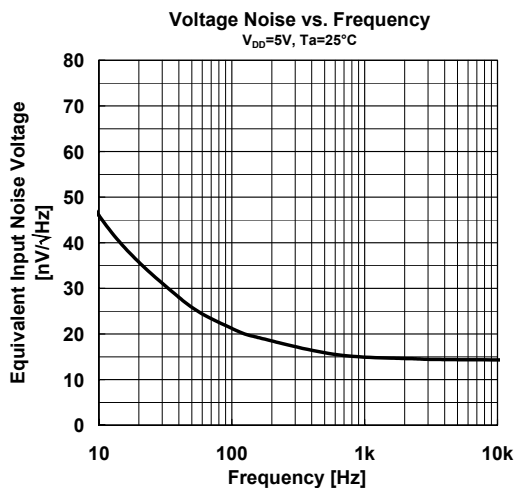
NJU7056/NJU7057/NJU7058 operate from 1.8V to 5.5V supply voltage. They are optimized for 2-cell battery systems and 1-cell li-ion battery systems. The NJU7056/NJU7057/NJU7068 have high-impedance inputs with ground sense, rail-to-rail output that swings within 50mV from rail with 10k Ω load at 1.8V supply, 2.1MHz Gain bandwidth and 0.8V/ μs Slew rate. These characteristics make them excellent performance for general-purpose applications.

The NJU7056 is available in 5-pin SC-88A and SOT-23 package. NJU7057 is available in 8-pin MSOP (TVSP): meet JEDEC MO-187-DA / thin type package and ESON that is thin and 2mm square small package. NJU7058 is available in 14-pin SSOP package.

RELATED PRODUCTS

Features	Single	Dual	Quad
13 $\mu A/ch$, Rail-to-rail Output (Low power type)	NJU7026	NJU7027	NJU7028
9V/ μs , 5MHz, Rail-to-rail I/O (High slew rate type)	NJU7046	NJU7047	NJU7048

TYPICAL CHARACTERISTICS



PIN CONFIGURATION / PRODUCT INFORMATION

Pin Function						
	Package	 SC-88A	 SOT-23-5	 MSOP8 (TVSP8)	 ESON8-U1	 SSOP14
Product Name	NJU7056F3	NJU77056F	NJU7057RB1	NJU7057KU1	NJU7058V	

■ ABSOLUTE MAXIMUM RATINGS

PARAMETER	SYMBOL	RATING	UNIT
Supply Voltage	V_{DD}	7	V
Input Voltage	V_{ICM}	$V_{SS} - 0.3$ to $V_{DD} + 0.3$	V
Differential Input Voltage ⁽¹⁾	V_{ID}	± 7 ⁽²⁾	V
Power Dissipation ⁽³⁾	P_D	(2-layer)	mW
SOT-23-5		390	
SC-88A		280	
MSOP8 (TVSP8)		410	
ESON8 SSOP14		360(2-layer) / 940(4-layer) 400	
Operating Temperature Range	T_{opr}	-40 to +85	°C
Storage Temperature Range	T_{stg}	-55 to +125	°C

(1) Differential voltage is the voltage difference between +INPUT and -INPUT.

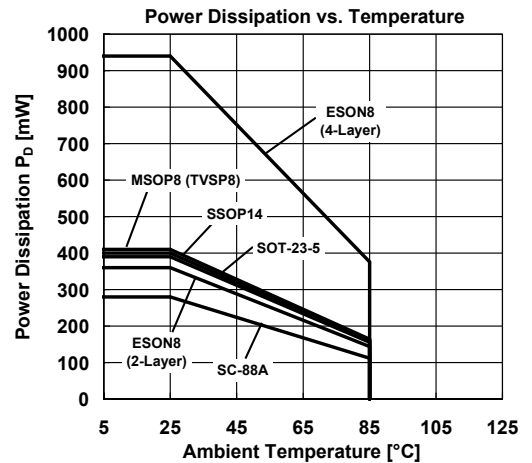
(2) For supply voltage less than +7V, the absolute maximum rating is equal to the supply voltage.

(3) Power dissipation is the power that can be consumed by the IC at $T_a=25^\circ\text{C}$, and is the typical measured value based on JEDEC condition.

When using the IC over $T_a=25^\circ\text{C}$ subtract the value $[\text{mW}/^\circ\text{C}] = P_D / (T_{stg}(\text{MAX}) - 25)$ per temperature.

2-layer: EIA/JEDEC STANDARD Test board (76.2x114.3x1.6mm, 2layers, FR-4) mounting

4-layer: EIA/JEDEC STANDARD Test board (76.2x114.3x1.6mm, 4layers, FR-4) mounting



■ RECOMMENDED OPERATING CONDITIONS ($T_a=25^\circ\text{C}$)

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Supply Voltage	V_{DD}		1.8	-	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						
Input Offset Voltage	V _{IO}	V _{ICM} = 0V	-	0.8	4	mV
Input Offset Voltage Drift	ΔV _{IO} /ΔT	Ta = -40°C to 85°C	-	0.7	-	μV/°C
Input Bias Current	I _B		-	1	-	pA
Input Offset Current	I _{IO}		-	1	-	pA
Voltage Gain	A _V	R _L =10kΩ 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
Common-Mode Input Voltage Range	V _{ICM}	CMR≥65dB	0	-	4.1	V
Maximum Output Voltage1	V _{OH1}	R _L =10kΩ to 2.5V	4.9	4.95	-	V
	V _{OL1}		-	0.05	0.1	
Maximum Output Voltage2	V _{OH2}	R _L =10kΩ to 0V	4.9	4.95	-	
	V _{OL2}		-	0.02	0.05	
Maximum Output Voltage3	V _{OH3}	I _{source} =2mA	4.8	4.85	-	
	V _{OL3}	I _{sink} =2mA	-	0.15	0.2	
Supply Current (All Amplifiers)	I _{DD}	No Signal	-	0.26	0.42	mA
NJU7056						
NJU7057						
NJU7058						
AC CHARACTERISTICS						
Slew Rate ⁽⁴⁾	SR	G _v =0dB, R _L =10kΩ to 2.5V, C _L =20pF, V _{in} =3V _{pp} (1V to 4V)	-	0.8	-	V/μs
Gain Bandwidth Product	GBW	R _L =10kΩ to 2.5V, C _L =20pF, f=100kHz	-	2.1	-	MHz
Phase Margin	φ _M	R _L =10kΩ to 2.5V, C _L =20pF	-	80	-	deg
Gain Margin	G _M	R _L =10kΩ to 2.5V, C _L =20pF	-	10	-	dB
Equivalent Input Noise Voltage	V _{NI}	f=1kHz	-	15	-	nV/√Hz
Total Harmonic Distortion + Noise	THD+N	G _v =6dB, V _o =4V _{pp} , f=1kHz	-	0.002	-	%
Channel Separation	CS	f=1kHz, NJU7057/NJU7058	-	120	-	dB

■ **ELECTRICAL CHARACTERISTICS** ($V_{DD}=1.8V$, $V_{SS}=0V$, $T_a=25^\circ C$, unless otherwise noted.)

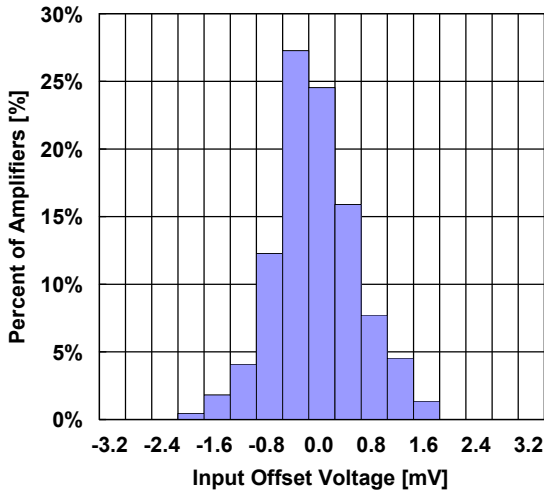
PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
DC CHARACTERISTICS						
Input Offset Voltage	V_{IO}	$V_{ICM}=0V$	-	0.8	4	mV
Input Offset Voltage Drift	$\Delta V_{IO}/\Delta T$	$T_a = -40^\circ C$ to $85^\circ C$	-	0.8	-	$\mu V/^\circ C$
Input Bias Current	I_B		-	1	-	pA
Input Offset Current	I_{IO}		-	1	-	pA
Voltage Gain	A_V	$R_L=10k\Omega$ 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
Common-Mode Input Voltage Range	V_{ICM}	$CMR \geq 65dB$	0	-	0.9	V
Maximum Output Voltage1	V_{OH1}	$R_L=10k\Omega$ to $0.9V$	1.7	1.75	-	V
	V_{OL1}		-	0.05	0.1	
Maximum Output Voltage2	V_{OH2}	$R_L=10k\Omega$ to $0V$	1.7	1.75	-	
	V_{OL2}		-	0.02	0.05	
Maximum Output Voltage3	V_{OH3}	$I_{source}=1mA$	1.5	1.55	-	
	V_{OL3}	$I_{sink}=1mA$	-	0.25	0.3	
Supply Current (All Amplifiers)	I_{DD}	No Signal	-	0.22	0.38	mA
NJU7056		No Signal	-	0.44	0.76	
NJU7057		No Signal	-	0.9	1.5	
NJU7058						
AC CHARACTERISTICS						
Slew Rate ⁽⁴⁾	SR	$G_V=0dB$, $R_L=10k\Omega$ to $0.9V$, $C_L=20pF$, $V_{in}=0.5V_{pp}$ ($0.3V$ to $0.8V$)	-	0.6	-	$V/\mu s$
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	V_{NI}	$f=1kHz$	-	18	-	nV/\sqrt{Hz}
Total Harmonic Distortion + Noise	THD+N	$G_V=6dB$, $V_o=1V_{pp}$, $f=1kHz$	-	0.005	-	%
Channel Separation	CS	$f=1kHz$, NJU7057/NJU7058	-	110	-	dB

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

■ TYPICAL CHARACTERISTICS

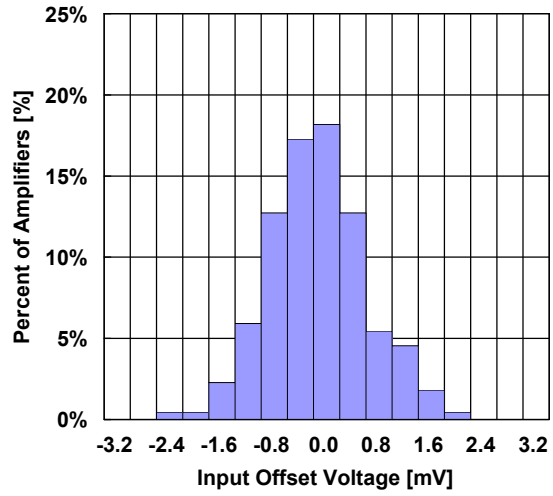
Input Offset Voltage Distribution

$V_{DD}=5.0V, V_{ICM}=0V, T_a=25^\circ C, n=200$



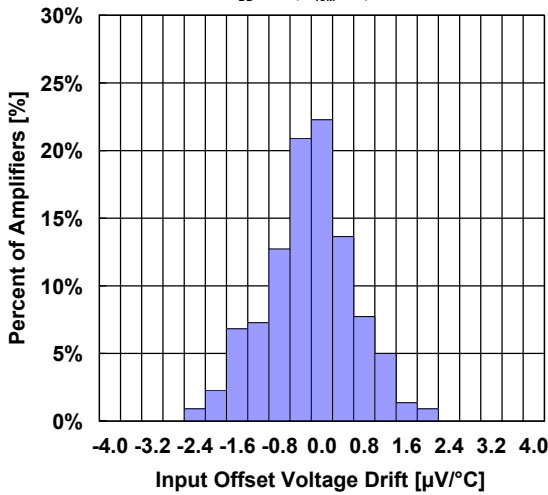
Input Offset Voltage Distribution

$V_{DD}=1.8V, V_{ICM}=0V, T_a=25^\circ C, n=200$



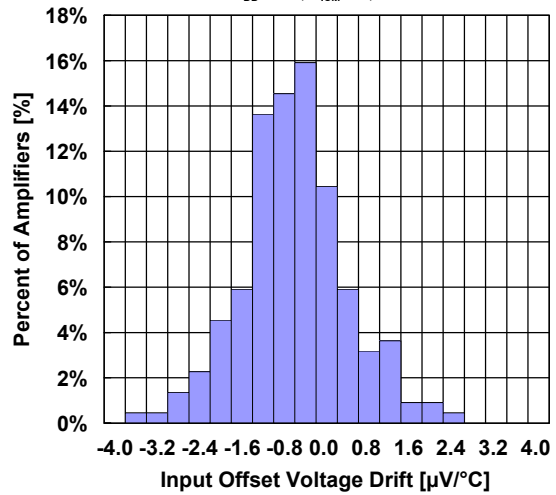
Input Offset Voltage Drift Distribution

$V_{DD}=5.0V, V_{ICM}=0V, n=200$



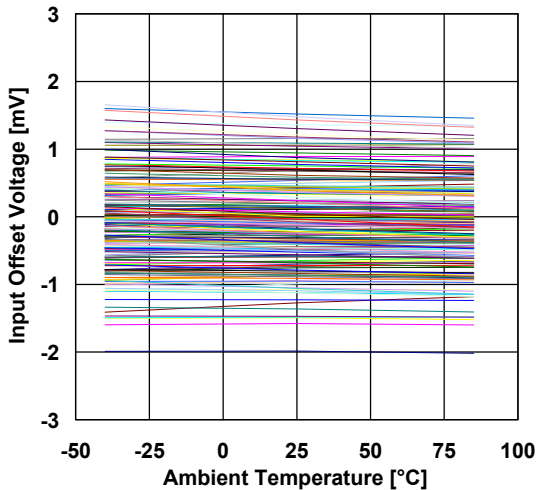
Input Offset Voltage Drift Distribution

$V_{DD}=1.8V, V_{ICM}=0V, n=200$



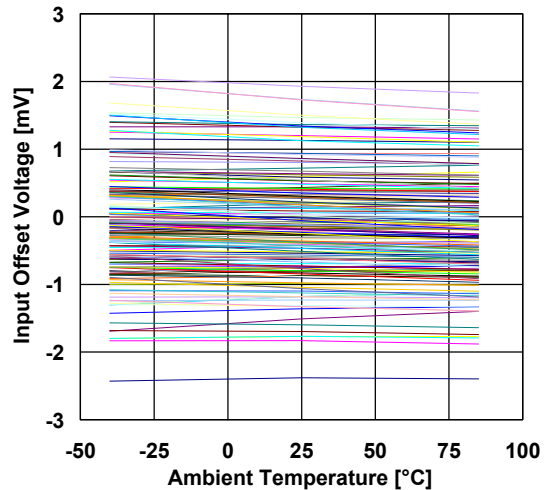
Input Offset Voltage vs. Temperature

$V_{DD}=5.0V, V_{ICM}=0V, n=200$



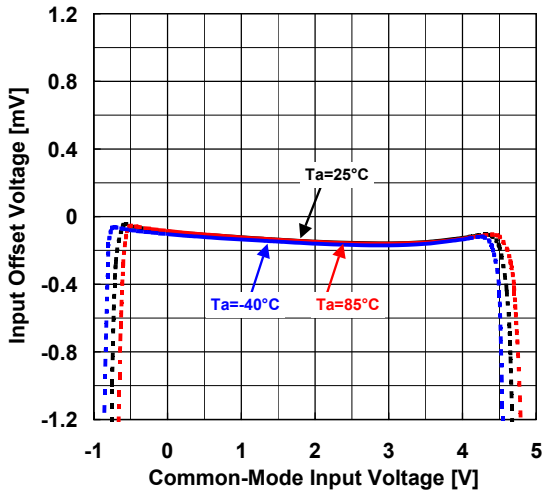
Input Offset Voltage vs. Temperature

$V_{DD}=1.8V, V_{ICM}=0V, n=200$

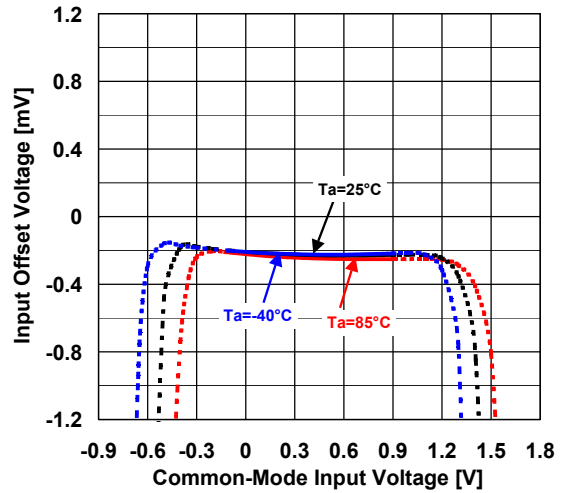


■ TYPICAL CHARACTERISTICS

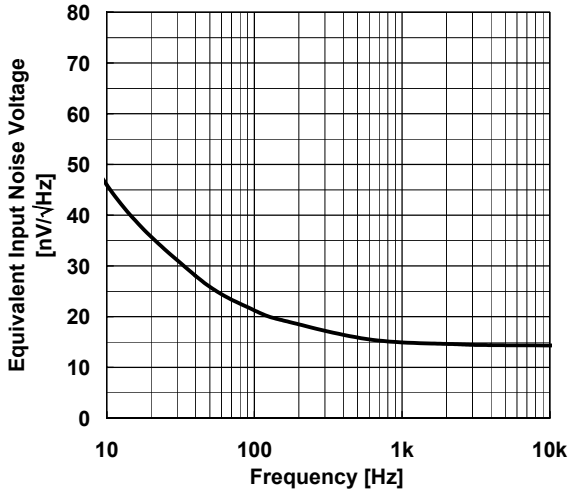
Input Offset Voltage vs. Common-Mode Input Voltage
 $V_{DD}=5V$



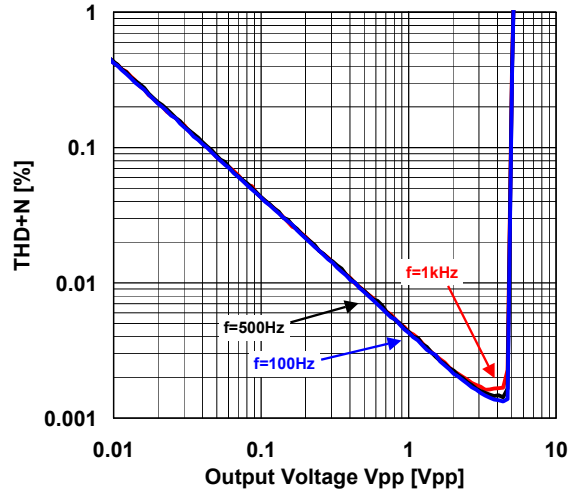
Input Offset Voltage vs. Common-Mode Input Voltage
 $V_{DD}=1.8V$



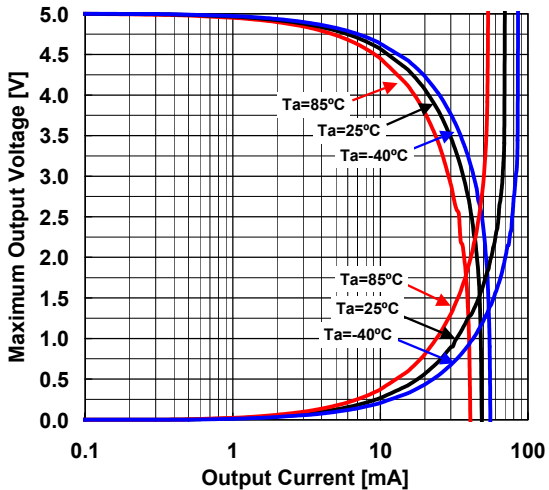
Voltage Noise vs. Frequency
 $V_{DD}=5V, T_a=25^\circ C$



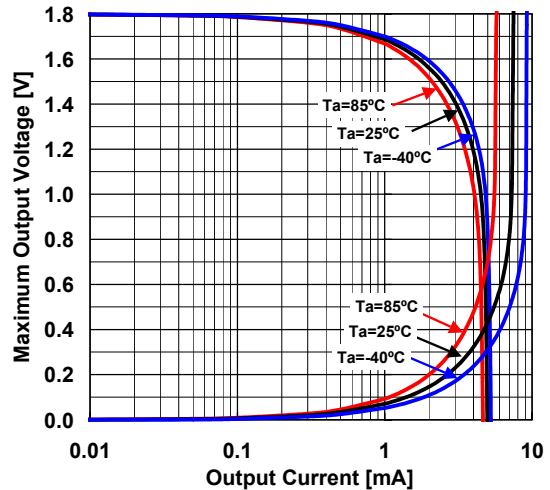
THD+N vs. Output Voltage
 $V_{DD}=5V, G_v=6V, T_a=25^\circ C$



Maximum Output Voltage vs. Output Current
 $V_{DD}=5V, V_{ICM}=2.5V$

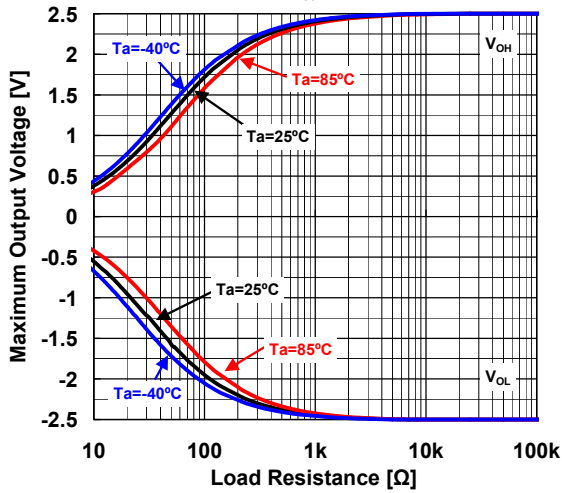


Maximum Output Voltage vs. Output Current
 $V_{DD}=1.8V, V_{ICM}=0.9V$

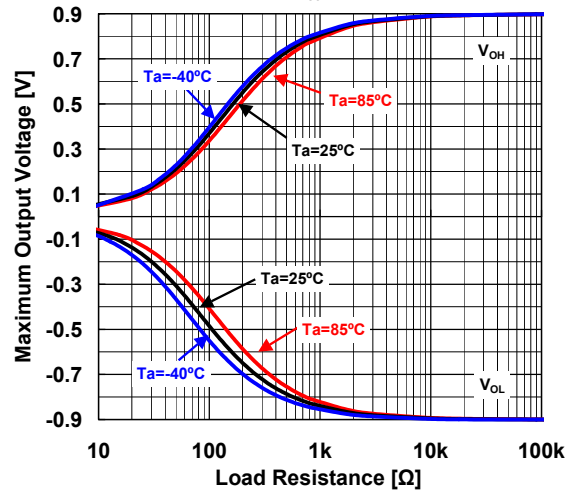


TYPICAL CHARACTERISTICS

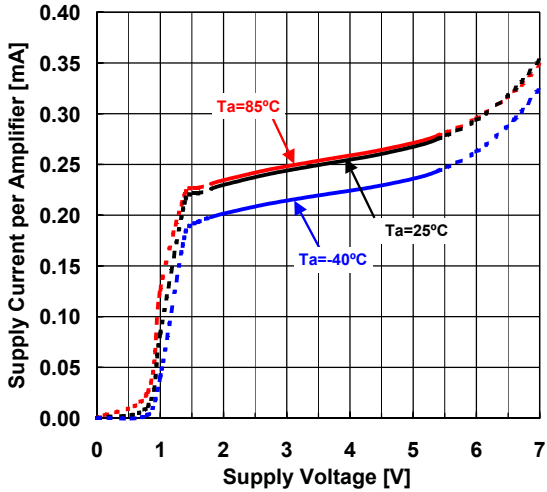
Maximum Output Voltage vs. Load Resistance
 $V_{DD}/V_{SS} = \pm 2.5V$



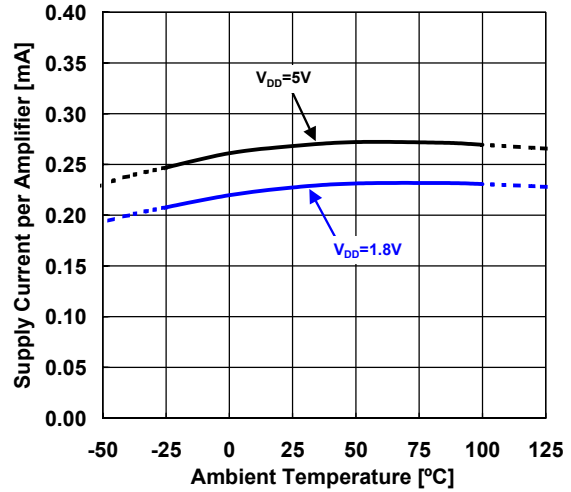
Maximum Output Voltage vs. Load Resistance
 $V_{DD}/V_{SS} = \pm 0.9V$



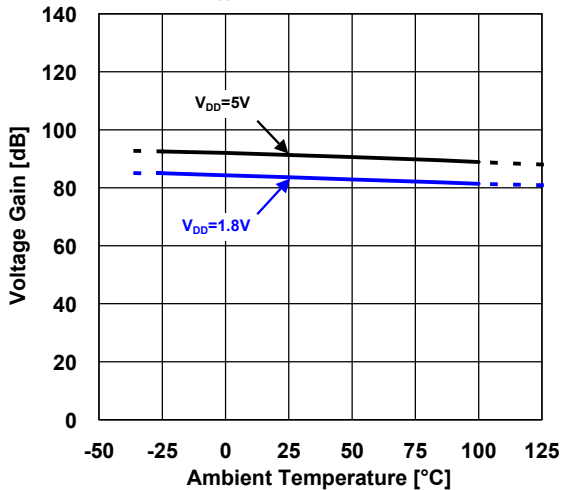
Supply Current per Amplifier vs. Supply Voltage
 $G_v = 0dB$



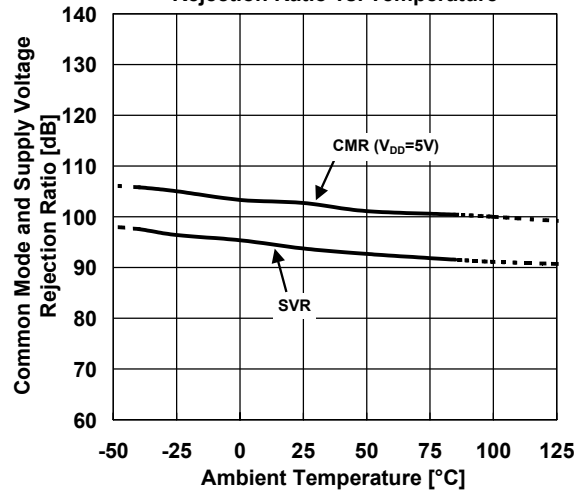
Supply Current per Amplifier vs. Temperature
 $G_v = 0dB$



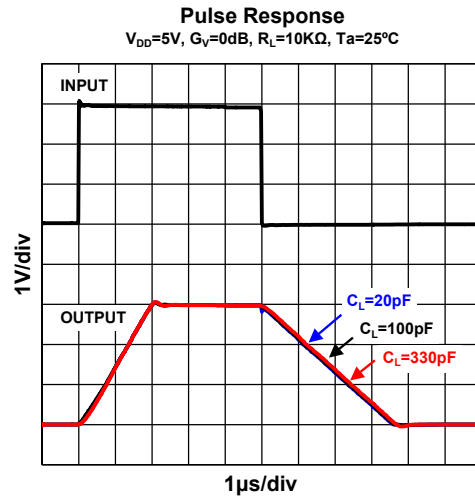
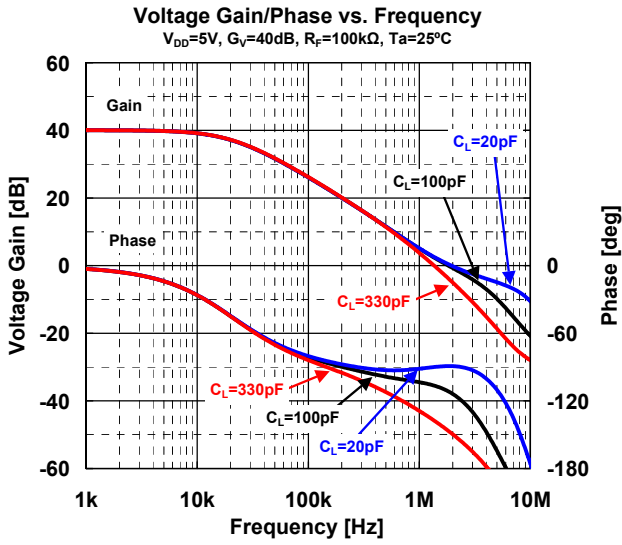
Voltage Gain vs. Temperature
 $V_{OUT} = 0.5V \text{ to } V_{DD} - 0.5, R_L = 10k\Omega$



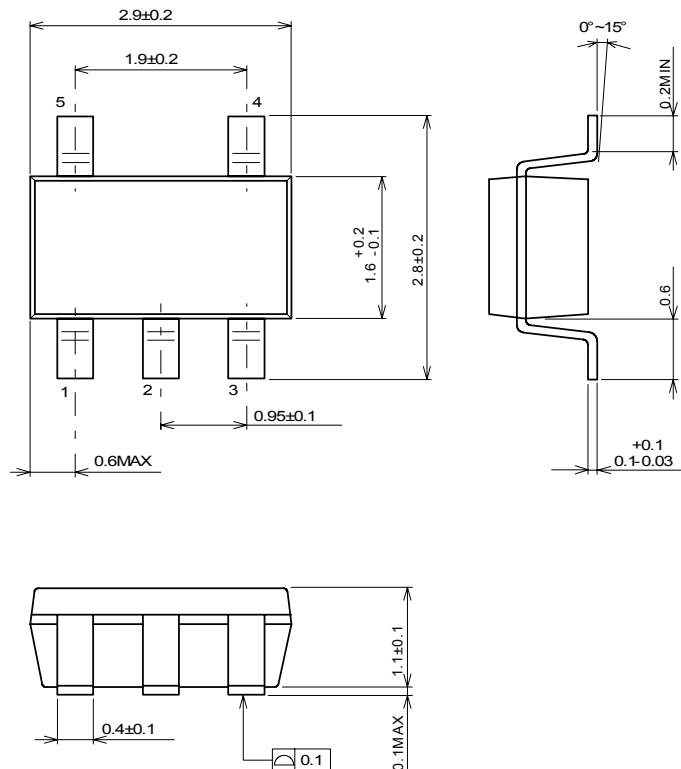
Common Mode and Supply Voltage Rejection Ratio vs. Temperature



■ TYPICAL CHARACTERISTICS



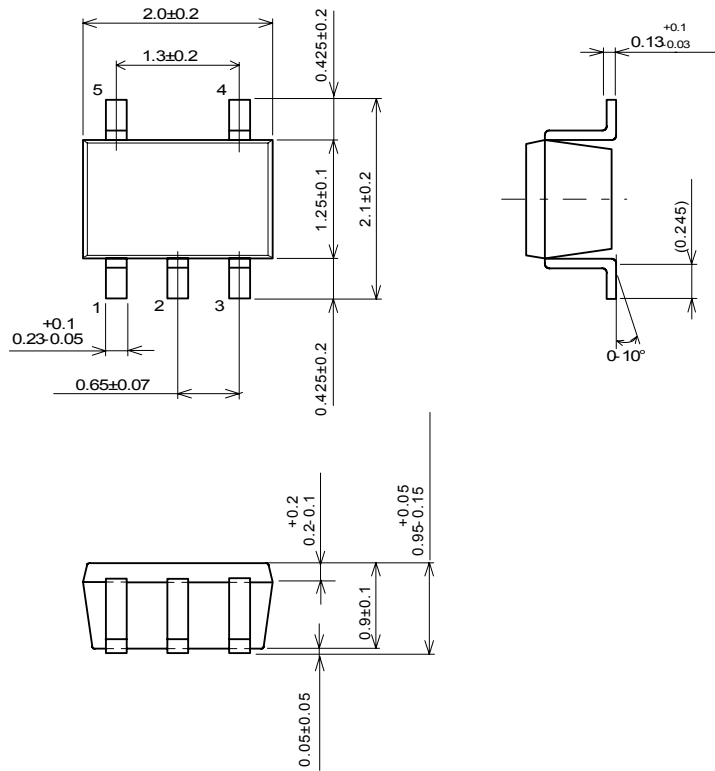
■ PACKAGE DIMENSIONS



Unit: mm

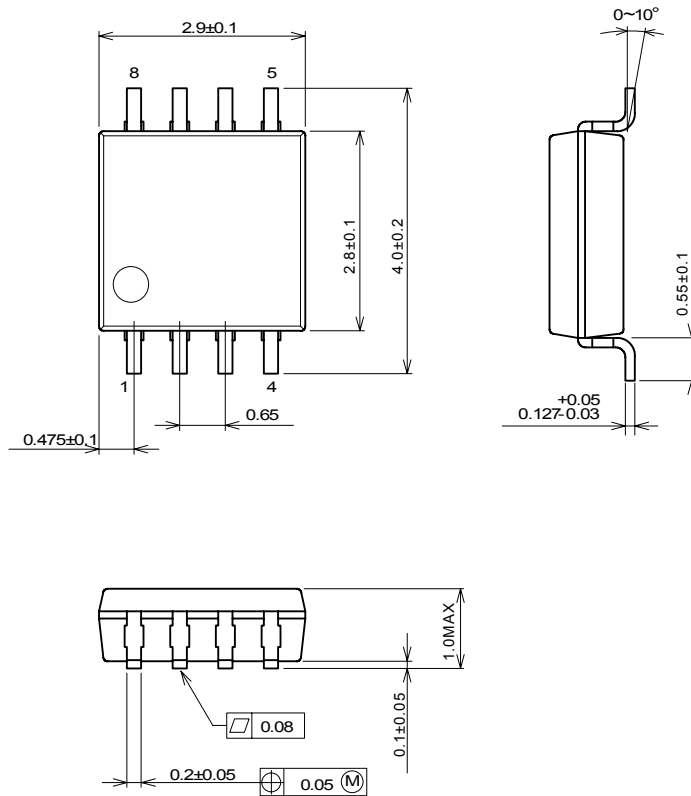
SOT-23-5 Package

■ PACKAGE DIMENSIONS



Unit: mm

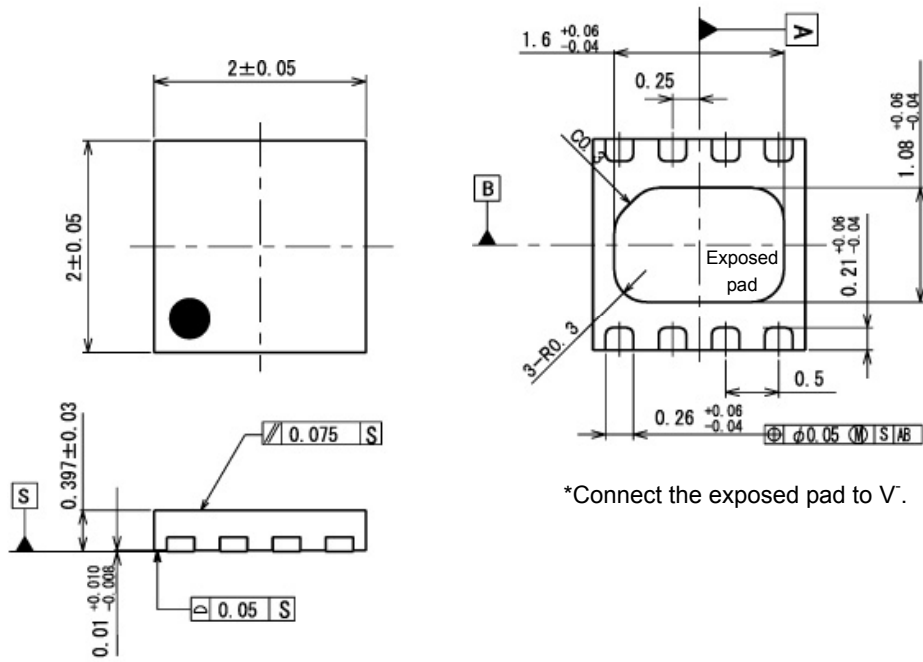
SC88A Package



Unit: mm

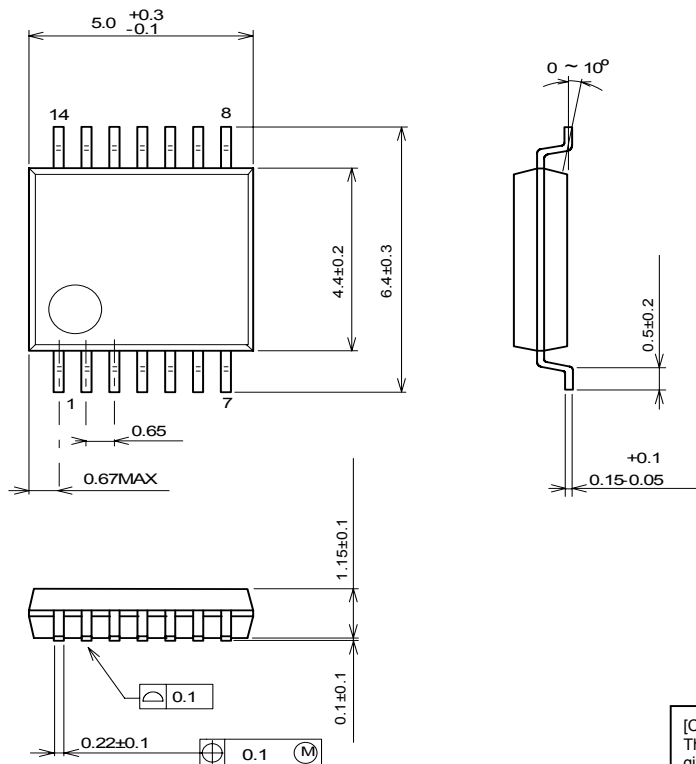
MSOP (TVSP8) meet JEDEC MO-187-DA / thin type Package

■ PACKAGE DIMENSIONS



Unit: mm

ESON8-U1 Package



Unit: mm

SSOP14 Package

[CAUTION]
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