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

■ FEATURES (V^+=5V, V^-=0V, Ta=25°C)

●Low Noise	15nV/√Hz
●Low Offset Voltage Drift	0.7µV/°C typ.
●Offset Voltage	4mV max.
●Rail-to-Rail Output	
R_L=10kΩ	50mV from rail
R_L=600Ω	140mV from rail
●Gain Bandwidth Product	2.1MHz
●Slew Rate	0.8V/µs
●Supply Current	260µA/ch typ.
●Supply Voltage	1.8V to 5.5V
●Thin and Ultra Small Package	DFN8-U1(ESON8-U1) 2.0 x 2.0 x 0.4 mm
●Integrated EMI Filter	EMIRR=59dB typ. @f=900MHz
●Ground Sensing	
●Unity-Gain Stable	
●Package	
NJU7056	SOT-23-5, SC-88A
NJU7057	MSOP8(TVSP8)* DFN8-U1(ESON8-U1) *meet JEDEC MO-187-DA / thin type
NJU7058	SSOP14

■ DESCRIPTION

The NJU7056/NJU7057/NJU7058 are Single/Dual/ Quad rail-to-rail output CMOS operational amplifiers. Low noise of 15nV/√Hz and low offset drift of 0.7µV/°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 sensing, rail-to-rail output that swings within 50mV from rail with 10kΩ 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 packages. NJU7057 is offered in 8-pin MSOP (TVSP): meet JEDEC MO-187-DA / thin type package and DFN that is thin and 2mm square small package. NJU7058 is offered in 14-pin SSOP package.

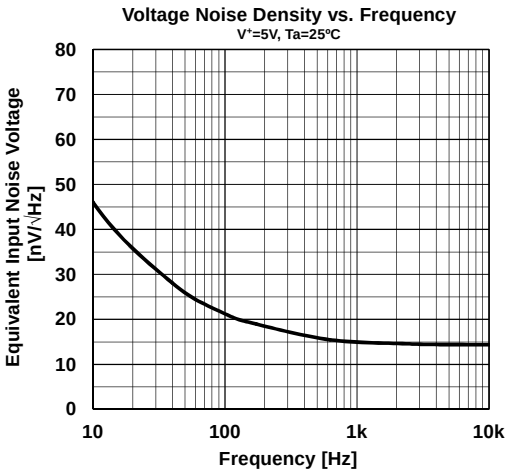
■ APPLICATIONS

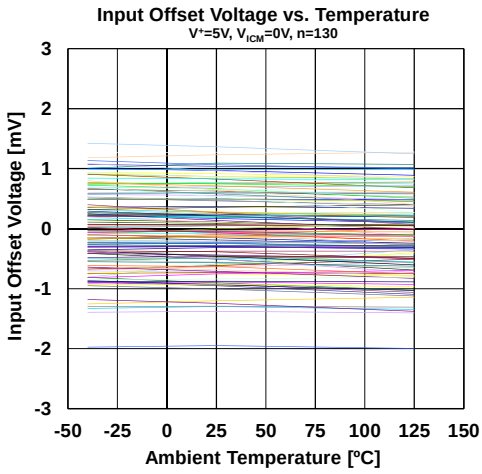
●Battery-Powered Instruments
●Current Sensor Amplifiers
●Audio Pre/Microphone Amplifiers
●Power Line Monitoring
●Current to Voltage Converter

■ RELATED PRODUCTS

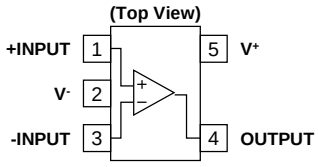
Features	Single	Dual	Quad
13µA/ch, Rail-to-Rail Output (Low power type)	NJU7026	NJU7027	NJU7028
9V/µs, 5MHz, Rail-to-Rail I/O (High slew rate type)	NJU7046	NJU7047	NJU7048

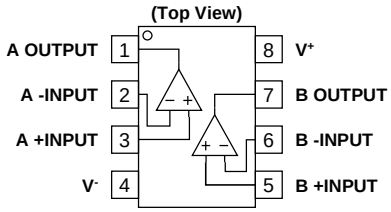
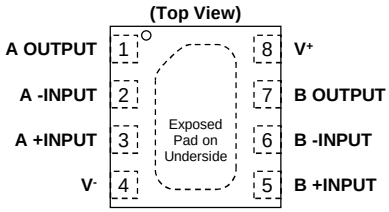
■ TYPICAL CHARACTERISTICS



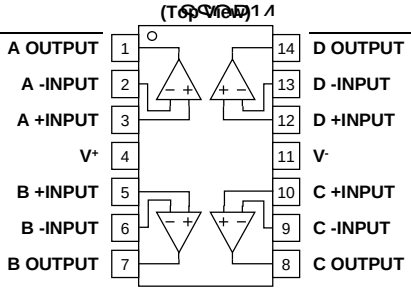


■ PIN CONFIGURATIONS

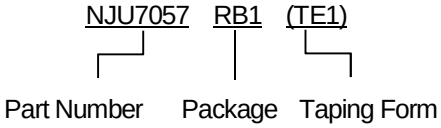
PRODUCT NAME	NJU7056F	NJU7056F3
Package	SOT-23-5	SC-88A
Pin Functions		

PRODUCT NAME	NJU7057RB1	NJU7057KU1
Package	MSOP8 (TVSP8)	ESON8-U1
Pin Functions		

*Connect to exposed pad to V-

PRODUCT NAME	NJU7058V
Package	
Pin Functions	

■ PRODUCT NAME INFORMATION



■ ORDERING INFORMATION

PRODUCT NAME	PACKAGE	RoHS	HALOGEN-FREE	TERMINAL FINISH	MARKING	WEIGHT (mg)	MOQ (pcs)
NJU7056F	SOT-23-5	Yes	Yes	Sn2Bi	115	15	3000
NJU7056F3	SC-88A	Yes	Yes	Sn2Bi	AG	7.5	3000
NJU7057RB1	MSOP8(TVSP8)	Yes	Yes	Sn2Bi	7057	18	2000
NJU7057KU1	DFN8-U1 (ESON8-U1)	Yes	Yes	Sn2Bi	7057	5.3	3000
NJU7058V	SSOP14	Yes	Yes	Sn2Bi	7058	65	2000

■ ABSOLUTE MAXIMUM RATINGS

PARAMETER	SYMBOL	RATING	UNIT
Supply Voltage	$V^+ - V^-$	7	V
Input Voltage (1)	V_{IN}	V^- - 0.3 to V^+ + 0.3	V
Input Current (2)	I_{IN}	10	mA
Differential Input Voltage (3)	V_{ID}	±7	V
Power Dissipation(Ta=25℃) SOT-23-5(4) SC-88A(4) MSOP8 (TVSP8) (4) DFN8-U1 (ESON8-U1) (5) SSOP14(4)	P_D	2-Layer / 4-Layer 480 / 650 360 / 490 510 / 680 450 / 1200 500 / 620	mW
Junction Temperature Range	T_{jmax}	150	°C
Storage Temperature Range	T_{stg}	- 55 to 150	°C

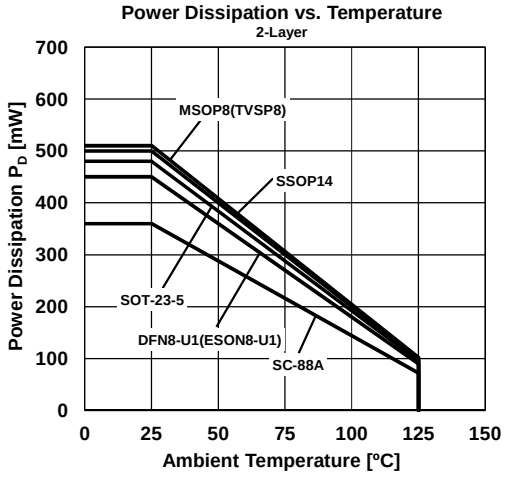
(1) The absolute maximum input voltage is limited at 7V.
(2) Input voltages outside the supply voltage will be clamped by ESD protection diodes. If the input voltage exceeds the supply voltage, the input current must be limited 10 mA or less by using a restriction resistance.
(3) Differential voltage is the voltage difference between +INPUT and - INPUT.
For supply voltage less than 7V, the absolute maximum rating is equal to the supply voltage.

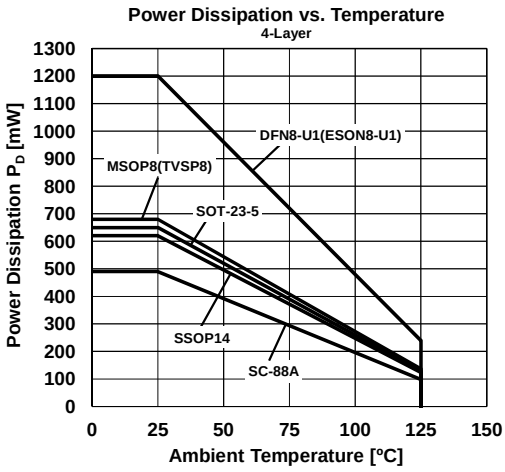
■ THERMAL CHARACTERISTICS

PARAMETER	SYMBOL	VALUE	UNIT
Junction-to-ambient thermal resistance SOT-23-5(4) SC-88A(4) MSOP8 (TVSP8)(4) DFN8-U1 (ESON8-U1)(5) SSOP14(5)	θja	2-Layer / 4-Layer 259 / 193 352 / 256 244 / 185 278 / 107 249 / 201	°C /W
Junction-to-Top of package characterization parameter SOT-23-5(4) SC-88A(4) MSOP8 (TVSP8)(4) DFN8-U1 (ESON8-U1) (5) SSOP14(4)	ψjt	2-Layer / 4-Layer 67 / 58 91 / 73 51 / 45 42 / 25 53 / 52	°C /W

(4) Mounted on glass epoxy board. (76.2×114.3×1.6mm:based on EIA/JDEC standard, 2-layer FR-4)
Mounted on glass epoxy board. (76.2×114.3×1.6mm:based on EIA/JDEC standard, 4-layer FR-4), internal Cu area: 74.2 x 74.2mm
(5) Mounted on glass epoxy board. (101.5×114.5×1.6mm: based on EIA/JEDEC standard, 2-layer FR-4, with Exposed Pad)
Mounted on glass epoxy board. (101.5×114.5×1.6mm: based on EIA/JEDEC standard, 4-layer FR-4, with Exposed Pad)
*For 4-layer: Applying 99.5×99.5mm inner Cu area and a thermal via hole to a board based on JEDEC standard JESD51-5)

■ POWER DISSIPATION vs. AMBIENT TEMPERATURE





■ RECOMMENDED OPERATING CONDITIONS

PARAMETER	SYMBOL	RATING	UNIT
Supply Voltage Single Supply Dual Supply	 V^+- V^- V^+ / V^-	 1.8 to 5.5 ±0.9 to ±2.75	V
Operating Temperature Range	T_{opr}	- 40 to 125	°C

■ ELECTRICAL CHARACTERISTICS

(V^+=5V, V^-=0V, Ta=25°C, unless otherwise noted.)

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT
DC CHARACTERISTICS						
Input Offset Voltage	V_{IO}	V_{COM}=0V	-	0.8	4	mV
Input Offset Voltage Drift	$\Delta V_{IO}/\Delta T$	Ta = -40°C to 125°C	-	0.7	-	µV/°C
Input Bias Current	I_B		-	1	-	pA
Input Offset Current	I_{IO}		-	1	-	pA
Open-Loop 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^+=1.8V to 5.5V	70	90	-	dB
Common-Mode Input Voltage Range	V_{ICM}	CMR≥65dB	0	-	4.1	V
High-Level Output Voltage	V_{OH}	R_L=10kΩ to 2.5V R_L=10kΩ to 0V I_{SOURCE}=2mA	4.9 4.9 4.8	4.95 4.95 4.85	- - -	V
Low-Level Output Voltage	V_{OL}	R_L=10kΩ to 2.5V R_L=10kΩ to 0V I_{SINK}=2mA	- - -	0.05 0.02 0.15	0.1 0.05 0.2	V
Supply Current (All Amplifiers) NJU7056 NJU7057 NJU7058	I_{SUPPLY}	No Signal	 - - -	 0.26 0.52 1.1	 0.42 0.84 1.7	mA
AC CHARACTERISTICS						
Slew Rate(6)	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

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

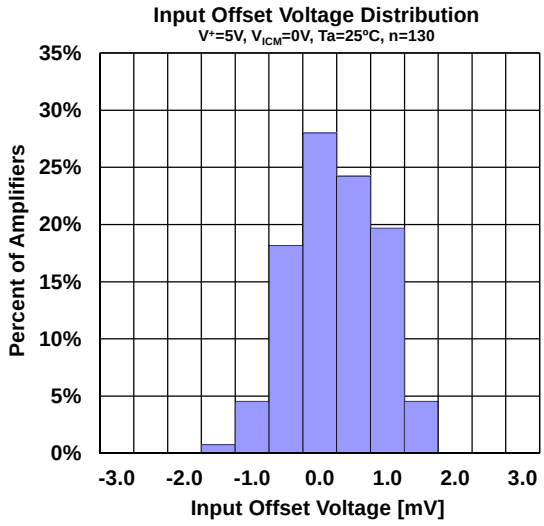
■ **ELECTRICAL CHARACTERISTICS (continued)**

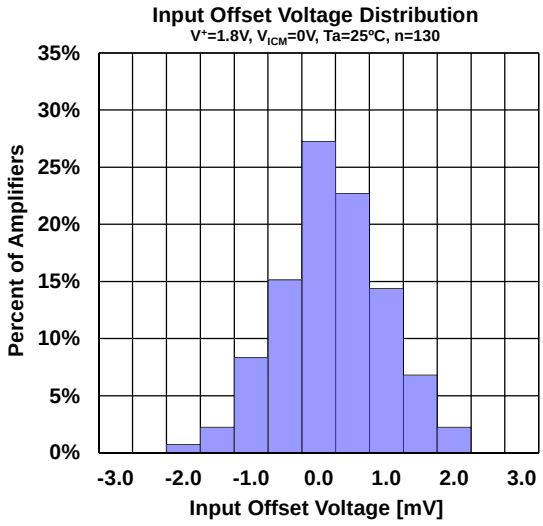
(V^+=1.8V, V^-=0V, Ta=25°C, unless otherwise noted.)

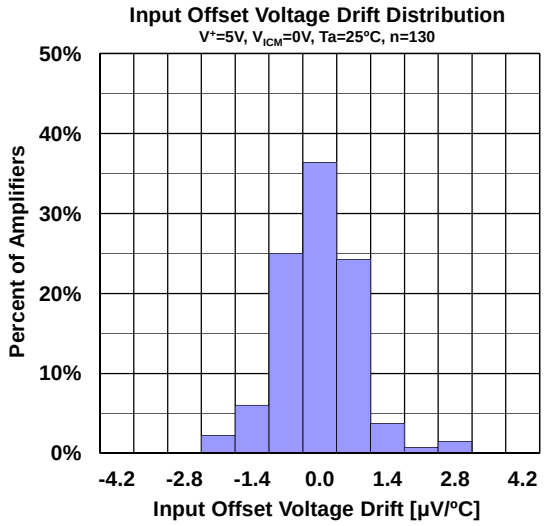
PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT
DC CHARACTERISTICS						
Input Offset Voltage	V_{IO}	V_{COM}=0V	-	0.8	4	mV
Input Offset Voltage Drift	$\Delta V_{IO}/\Delta T$	Ta = -40°C to 125°C	-	0.8	-	µV/°C
Input Bias Current	I_B		-	1	-	pA
Input Offset Current	I_{IO}		-	1	-	pA
Open-Loop Voltage Gain	A_V	R_L=10kΩ 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^+=1.8V to 5.5V	70	90	-	dB
Common-Mode Input Voltage Range	V_{ICM}	CMR≥65dB	0	-	0.9	V
High-Level Output Voltage	V_{OH}	R_L=10kΩ to 0.9V	1.7	1.75	-	V
		R_L=10kΩ to 0V	1.7	1.75	-	
		I_{SOURCE}=1mA	1.5	1.55	-	
Low-Level Output Voltage	V_{OL}	R_L=10kΩ to 0.9V	-	0.05	0.1	V
		R_L=10kΩ to 0V	-	0.02	0.05	
		I_{SINK}=1mA	-	0.25	0.3	
Supply Current (All Amplifiers)	I_{SUPPLY}	No Signal				mA
NJU7056			-	0.22	0.38	
NJU7057			-	0.44	0.76	
NJU7058			-	0.9	1.5	
AC CHARACTERISTICS						
Slew Rate(6)	SR	G_V=0dB, R_L=10kΩ to 0.9V, C_L=20pF, V_{IN}=0.5V_{PP} (0.3V to 0.8V)	-	0.6	-	V/µs
Gain Bandwidth Product	GBW	R_L=10kΩ to 0.9V, C_L=20pF, f=100kHz	-	1.7	-	MHz
Phase Margin	Φ_M	R_L=10kΩ to 0.9V, C_L=20pF	-	80	-	deg
Gain Margin	G_M	R_L=10kΩ to 0.9V, C_L=20pF	-	13	-	dB
Equivalent Input Noise Voltage	V_{NI}	f=1kHz	-	18	-	nV/√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

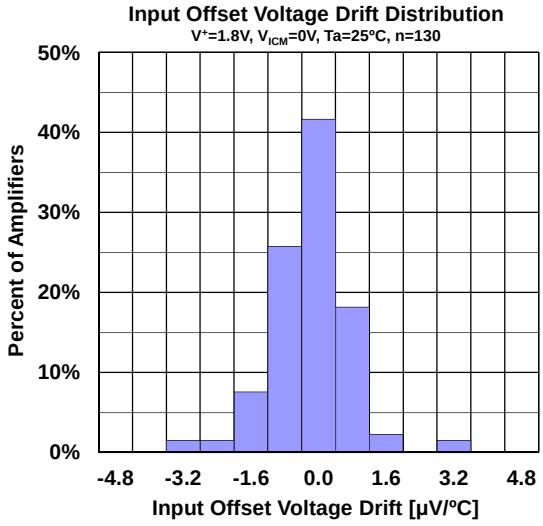
(6) Slew rate is defined by the lower value of the rise or fall.

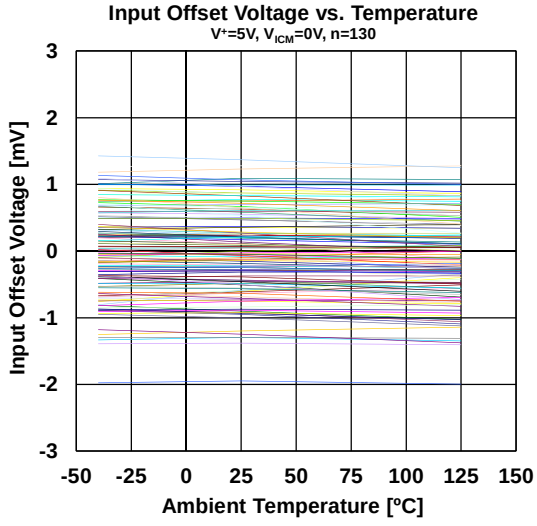
■ TYPICAL CHARACTERISTICS

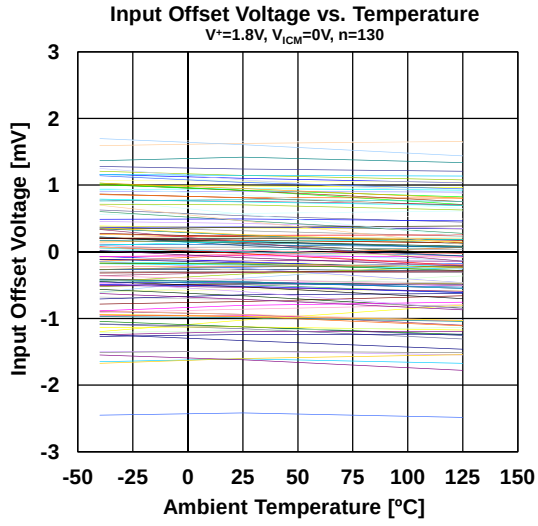






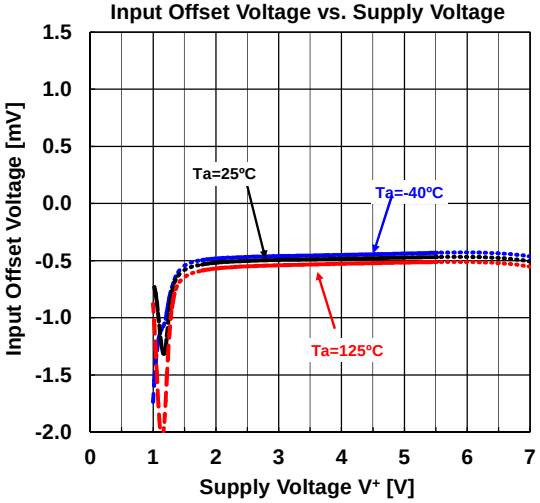




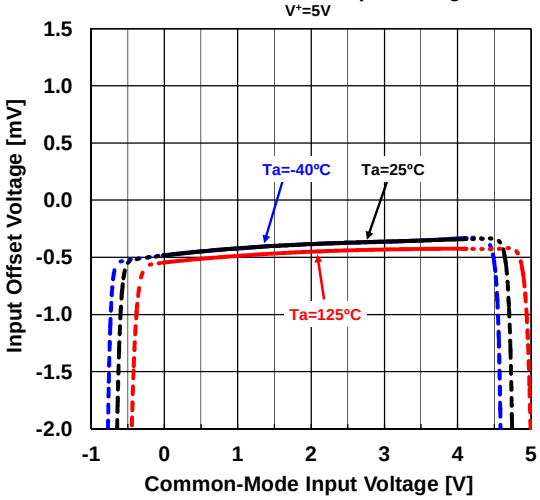


■ TYPICAL CHARACTERISTICS

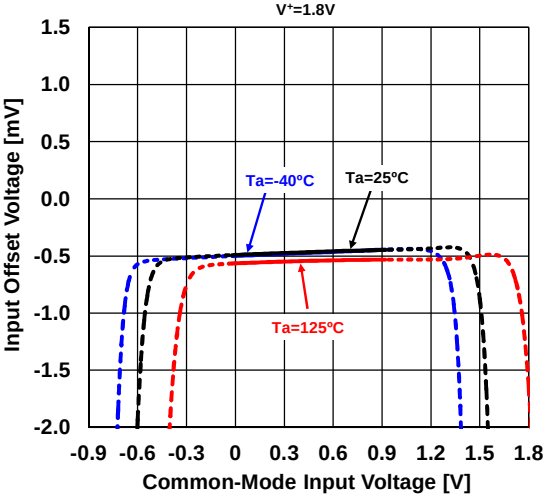
Input Offset Voltage vs. Supply Voltage



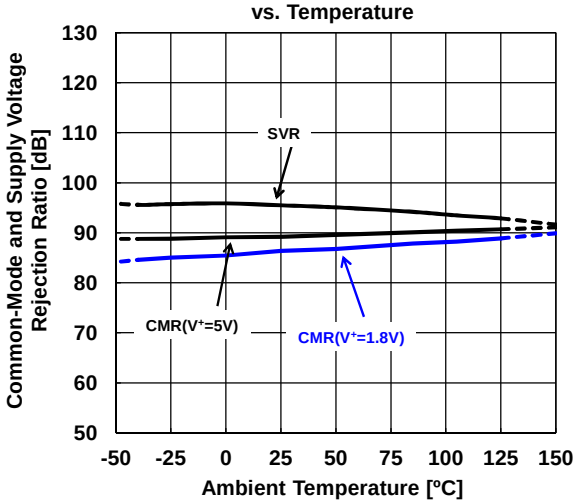
Input Offset Voltage
vs. Common-Mode Input Voltage
V+=5V



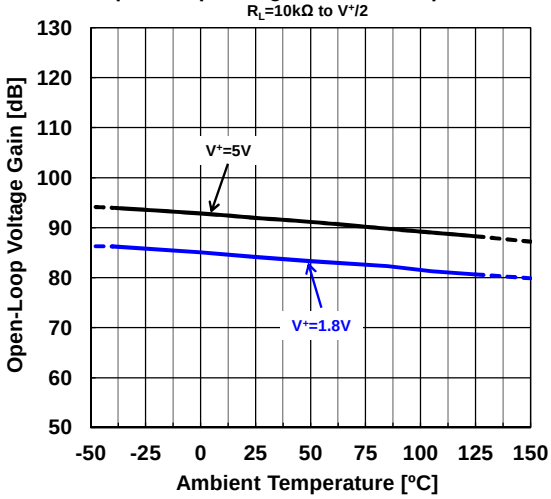
Input Offset Voltage
vs. Common-Mode Input Voltage
V+=1.8V



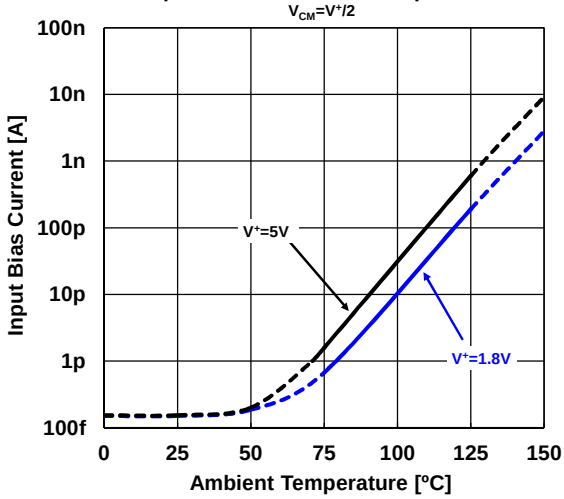
Common-Mode and Supply Voltage Rejection Ratio
vs. Temperature



Open-Loop Voltage Gain vs. Temperature
R_L=10kΩ to V+/2

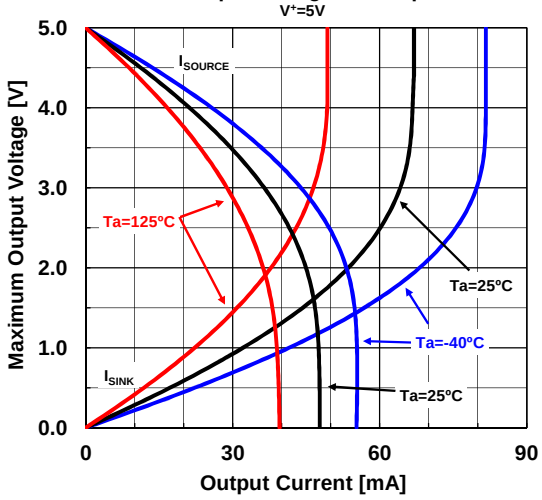


Input Bias Current vs. Temperature
V_{CM}=V+/2

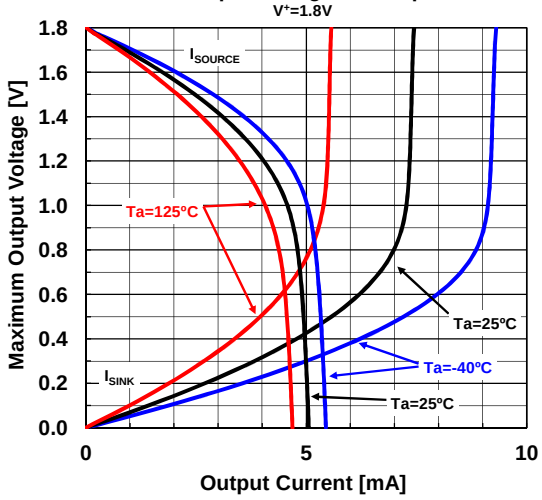


■ TYPICAL CHARACTERISTICS

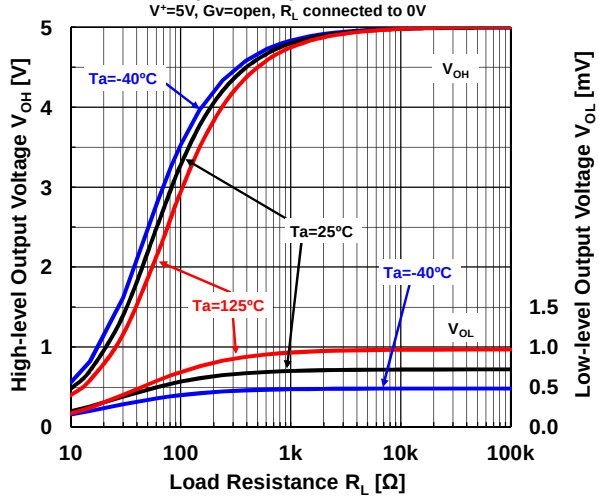
Maximum Output Voltage vs. Output Current
V⁺=5V



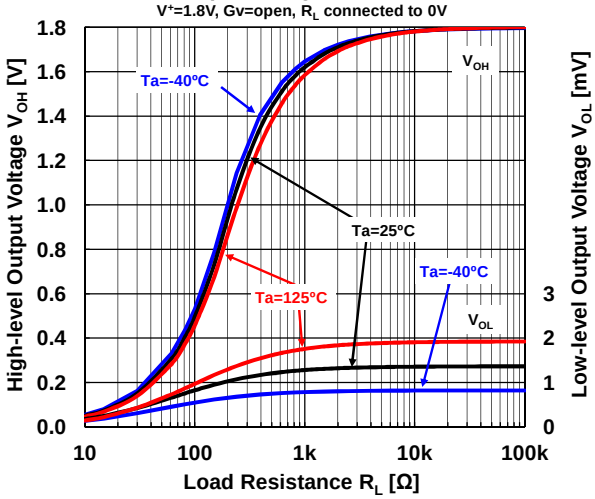
Maximum Output Voltage vs. Output Current
V⁺=1.8V



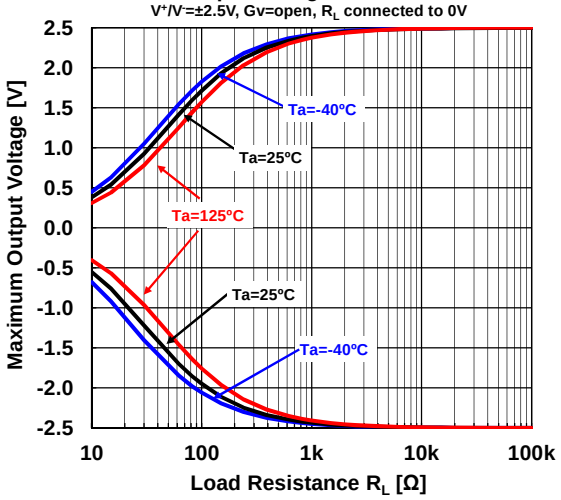
Maximum Output Voltage vs. Load Resistance
V⁺=5V, Gv=open, R_L connected to 0V



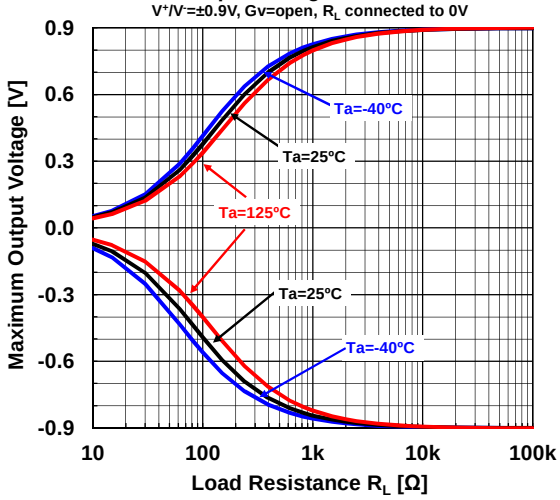
Maximum Output Voltage vs. Load Resistance
V⁺=1.8V, Gv=open, R_L connected to 0V



Maximum Output Voltage vs. Load Resistance
V⁺/V⁻=±2.5V, Gv=open, R_L connected to 0V

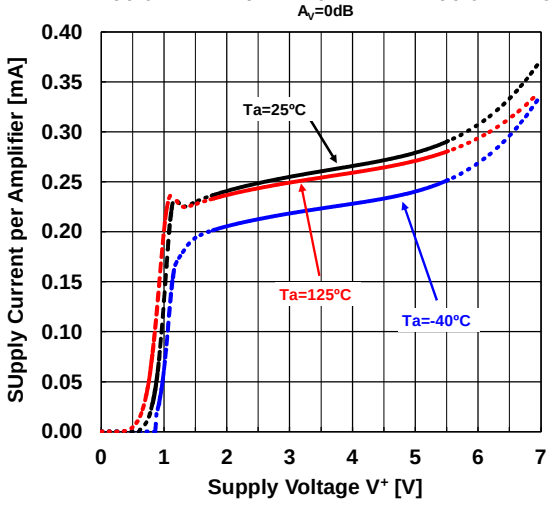


Maximum Output Voltage vs. Load Resistance
V⁺/V⁻=±0.9V, Gv=open, R_L connected to 0V

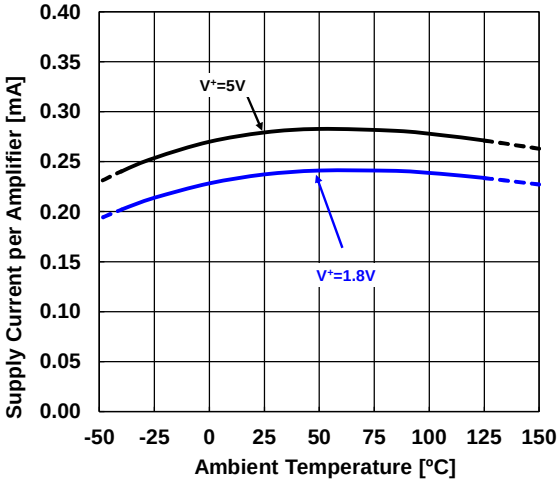


■ TYPICAL CHARACTERISTICS

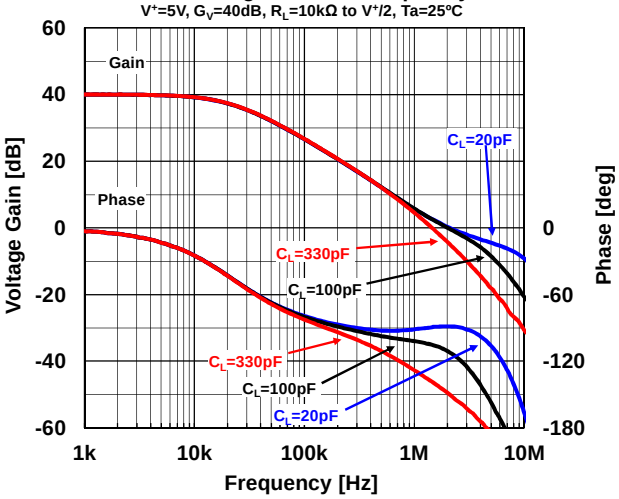
Supply Current per Amplifer vs. Supply Voltage
A_V=0dB



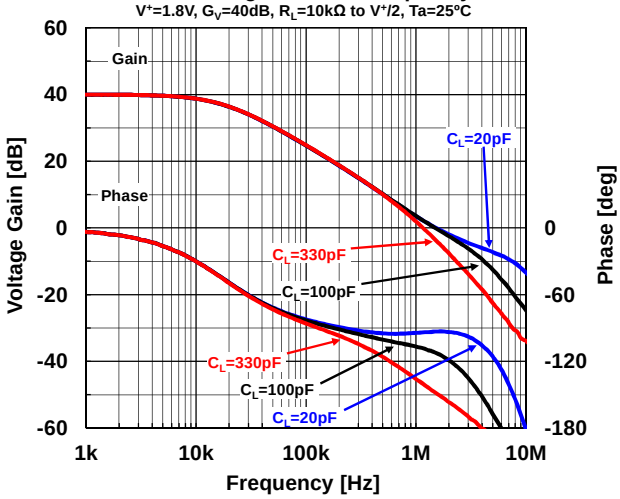
Supply Current per Amplifler vs. Temperture
A_V=0dB



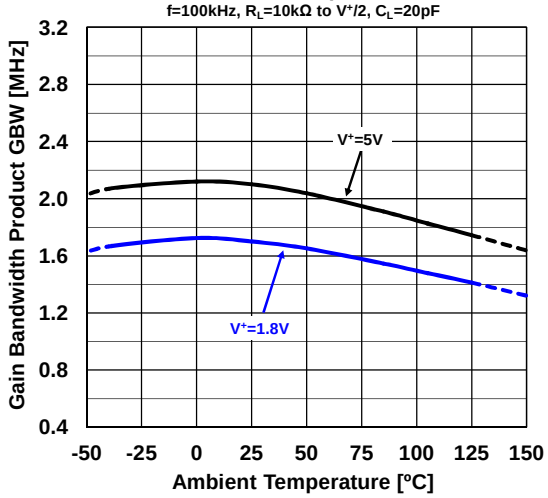
40dB Voltage Gain vs. Frequency
V^+=5V, G_V=40dB, R_L=10kΩ to V^+/2, Ta=25°C



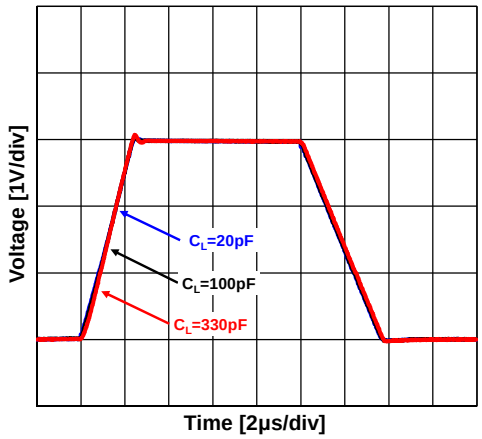
40dB Voltage Gain vs. Frequency
V^+=1.8V, G_V=40dB, R_L=10kΩ to V^+/2, Ta=25°C



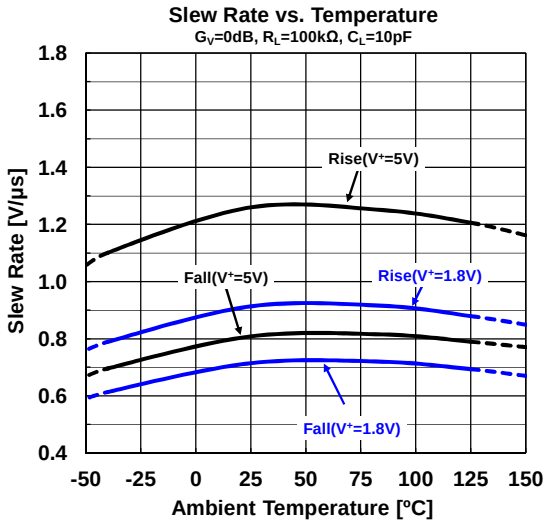
GBW vs. Temperature
f=100kHz, R_L=10kΩ to V^+/2, C_L=20pF

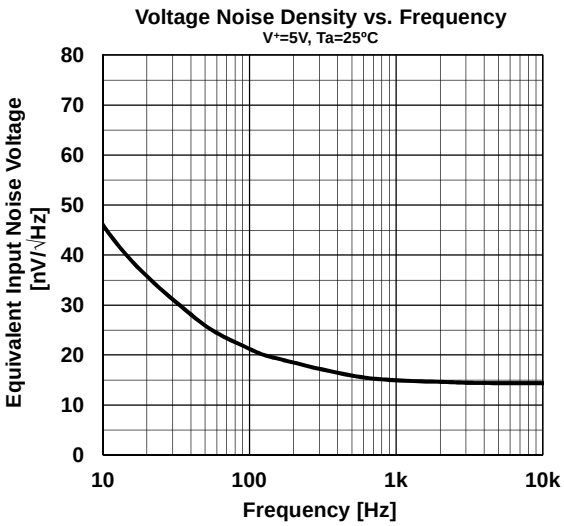


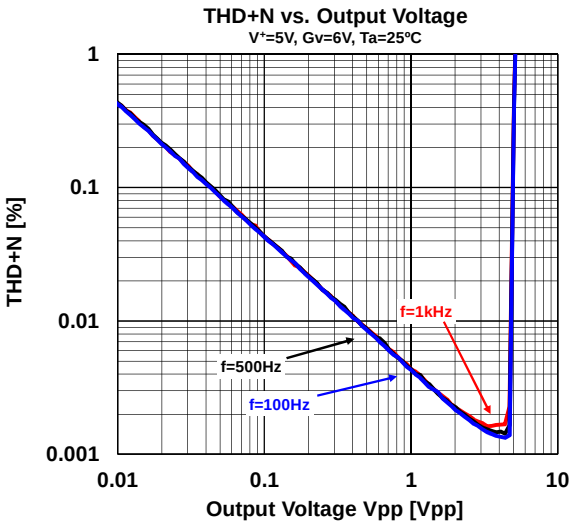
Pulse Response
V^+=5V, G_V=0dB, R_L=10kΩ to V^+/2, Ta=25°C



■ TYPICAL CHARACTERISTICS



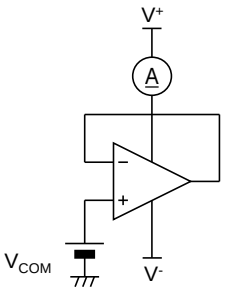




■ TEST CIRCUITS

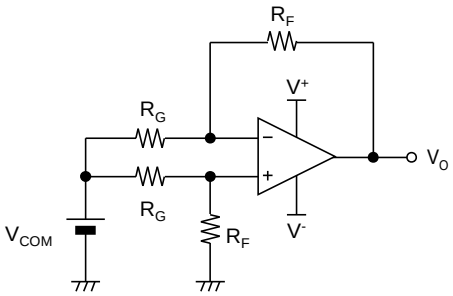
● I_{SUPPLY}

$V_{COM}=V^+/2$



● V_{IO}, CMR, SVR

$R_G=50\Omega$, $R_F=50k\Omega$



$$V_{IO}=\frac{R_G}{(R_G+R_F)}\times(V_O-Vcom)$$

$$CMR=20\log\frac{\Delta V_{com}\left(1+\frac{R_F}{R_G}\right)}{\Delta V_O}$$

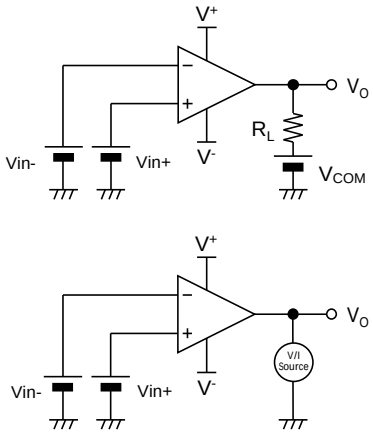
$$SVR=20\log\frac{\Delta V_S\left(1+\frac{R_F}{R_G}\right)}{\Delta V_O}$$

$V_S=V^+-V^-$

● V_{OH}, V_{OL}

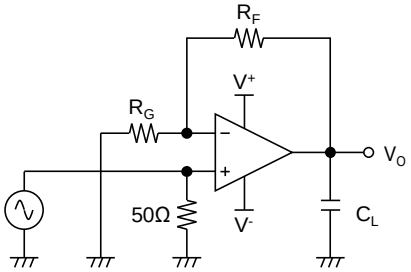
V_{OH}; Vin+ = $V^+/2$ +0.3V , Vin- = $V^+/2$, $V_{COM}=V^+/2$, V^-

V_{OL}; Vin+ = $V^+/2$, Vin- = $V^+/2$ +0.3V, $V_{COM}=V^+/2$, V^-

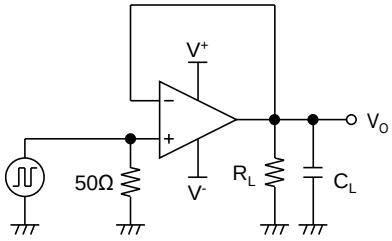


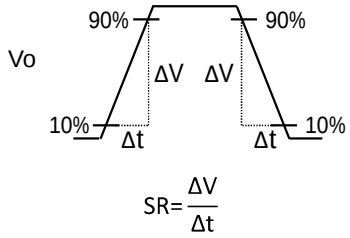
● GBW

$R_G=1k\Omega$, $R_F=100k\Omega$



● SR





$$SR=\frac{\Delta V}{\Delta t}$$

■ APPLICATION NOTE

Single and Dual Supply Voltage Operation

The NJU7056/NJU7057/NJU7058 works with both single supply and dual supply when the voltage supplied is between V^+ and V^-. These amplifiers operate from single +1.8 to +5.5V supply and dual ±0.9V to ±2.75V supply.

Common-Mode Input Voltage Range

When the supply voltage does not meet the condition of electrical characteristics, the range of common-mode input voltage is as follows:
V_{ICM} (typ.) = V^- to V^+-0.9 (Ta = 25°C)
Difference of V_{ICM} when Temperature change, refer to typical characteristic graph.
During designing, consider variations in characteristics for use with allowance.

Maximum Output Voltage Range

When the supply voltage does not meet the condition of electrical characteristics, the range of the typ. value of the maximum output voltage is as follows:
V_{OM} (typ.) = V^-+50mV to V^+-50mV (R_L=20kΩ to V^+/2, Ta=25°C)
During designing, consider variations in characteristics and temperature characteristics for use with allowance. In addition, also note that the output voltage range becomes narrow as shown in typical characteristics graph when an output current increases.

Input Voltage Exceeding the Supply Voltage

Inputs of the NJU7056/NJU7057/NJU7058 are protected by ESD diodes (shown in Figure1) that will conduct if the input voltages exceed the power supplies by more than approximately 300mV. Momentary voltages greater than 300mV beyond the power supply, inputs can be tolerated if the current is limited to 10mA. Figure2 is easily accomplished with an input resistor. If the input voltage exceeds the supply voltage, the input current must be limited 10mA or less by using a restriction resistance (R_{LIMIT}) as shown in figure2.

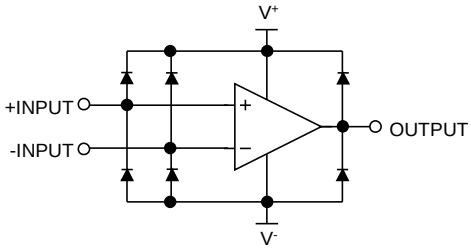


Figure1. Simplified Schematic

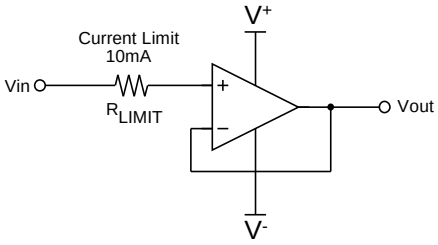


Figure2. Input Current Protection for Voltages exceeding the Supply Voltage.

Capacitive Load

The NJU7056/NJU7057/NJU7058 can use at unity gain follower, but the unity gain follower is the most sensitive configuration to capacitive loading. The combination of capacitive load placed directly on the output of an amplifier along with the output impedance of the amplifier creates a phase lag which in turn reduces the phase margin of the amplifier. If phase margin is significantly reduced, the response will cause overshoot and ringing in the step response.
The NJU7056/NJU7057/NJU7058 is unity gain stable for capacitive loads of 200pF. To drive heavier capacitive loads, an isolation resistor, R_{ISO} as shown Figure3, should be used. R_{ISO} improves the feedback loop's phase margin by making the output load resistive at higher frequencies. The larger the value of R_{ISO}, the more stable the output voltage will be. However, larger values of R_{ISO} result in reduced output swing, reduced output current drive and reduced frequency bandwidth.

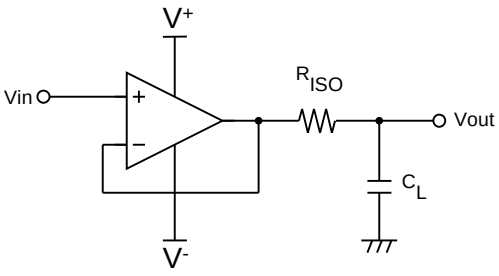


Figure3. Isolating capacitive load

■ APPLICATION NOTE

EMIRR (EMI Rejection Ratio) Definition

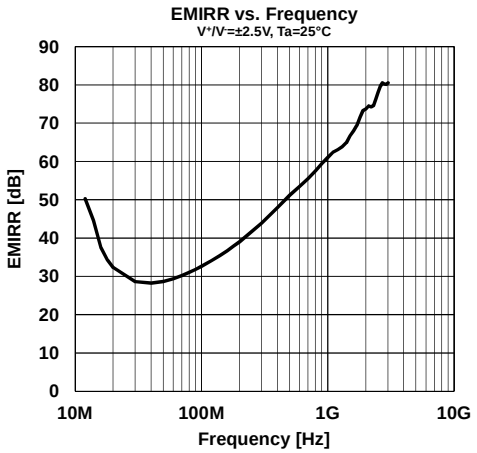
EMIRR is a parameter indicating the EMI robustness of an Op-Amp. The definition of EMIRR is given by the following equation1.

$$\mathrm{EMIRR} = 20 \cdot \log\left(\frac{V_{RF\_PEAK}}{|\Delta V_{IO}|}\right) \quad \text{---} \quad \text{eq. 1}$$

V_{RF_PEAK}: RF Signal Amplitude [VP]

ΔV_{IO}: Input offset voltage shift quantity [V]

The tolerance of the RF signal can be grasped by measuring an RF signal and offset voltage shift quantity. Offset voltage shift is small so that a value of EMIRR is big. And it understands that the tolerance for the RF signal is high. In addition, about the input offset voltage shift with the RF signal, there is the thinking that influence applied to the input terminal is dominant. Therefore, generally the EMIRR becomes value that applied an RF signal to +INPUT terminal.

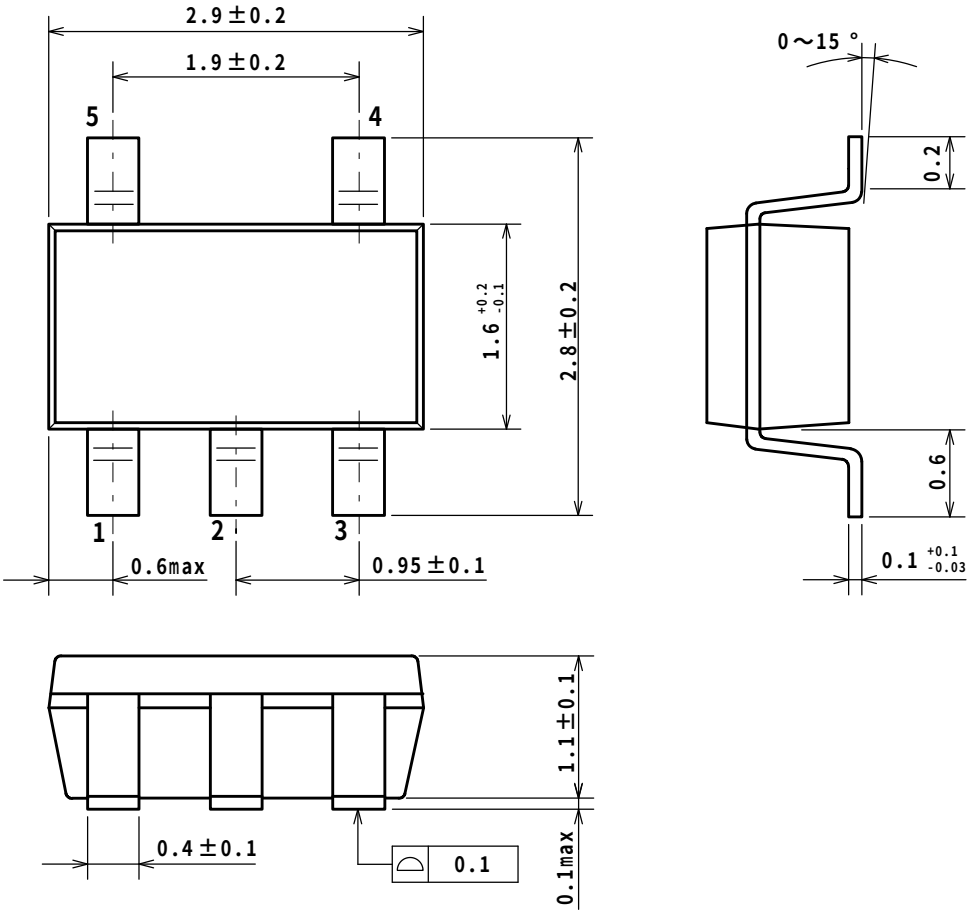


*For details, refer to “Application Note for EMI Immunity" in our HP: http://www.njr.com/

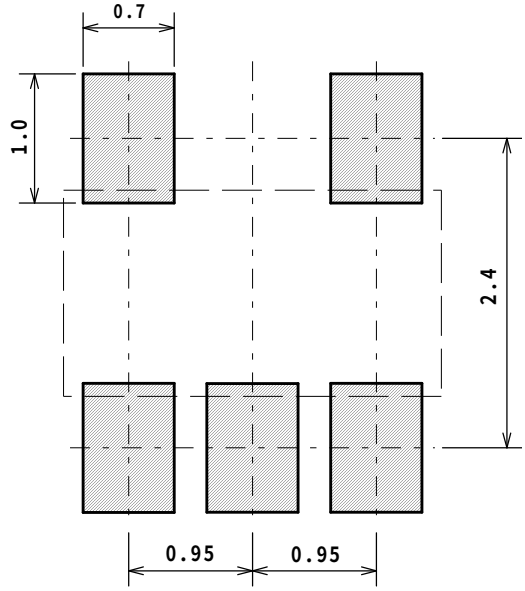
SOT-23-5

Unit: mm

■ PACKAGE DIMENSIONS



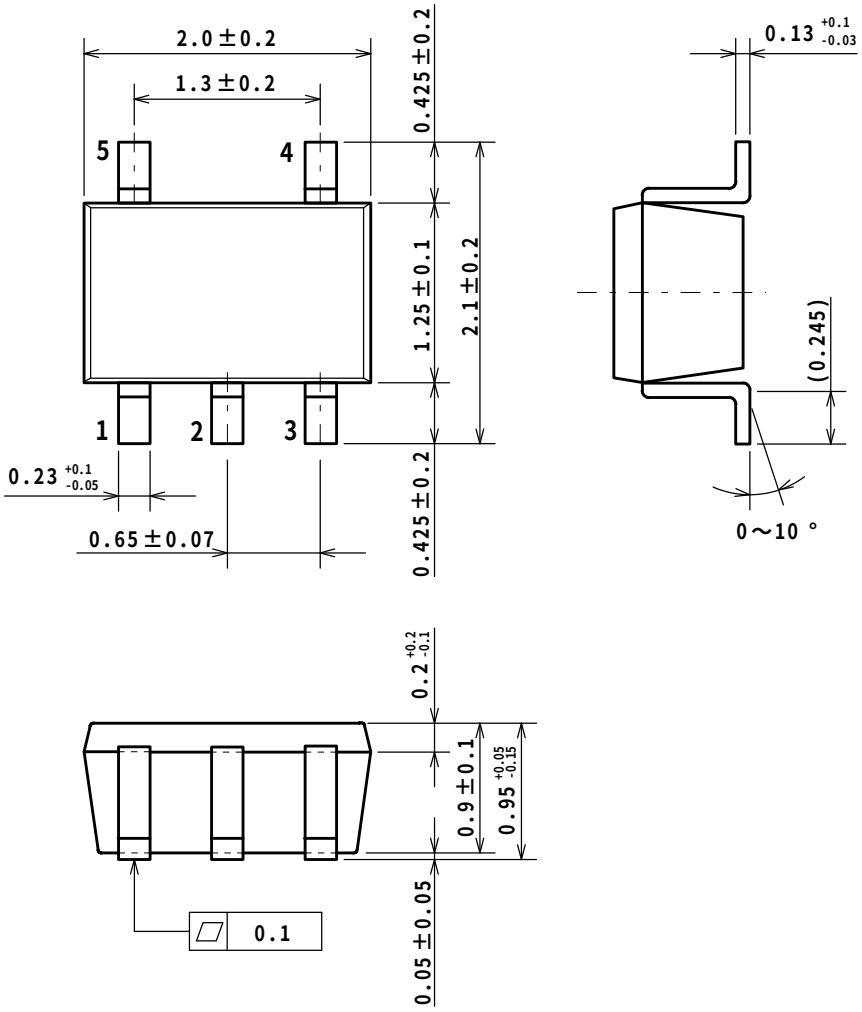
■EXAMPLE OF SOLDER PADS DIMENSIONS



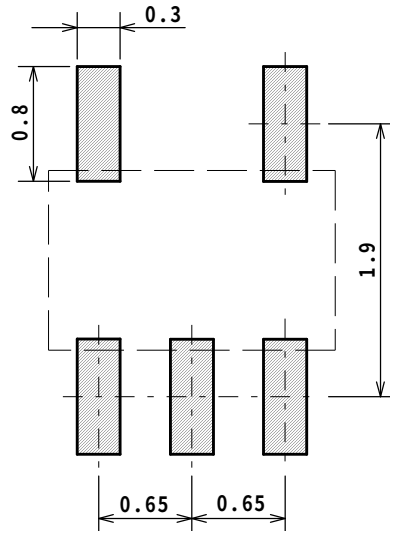
SC-88A

Unit: mm

■ PACKAGE DIMENSIONS



■EXAMPLE OF SOLDER PADS DIMENSIONS



MSOP8 (TVSP8) JEDEC MO-187-DA/THIN TYPE

Unit: mm

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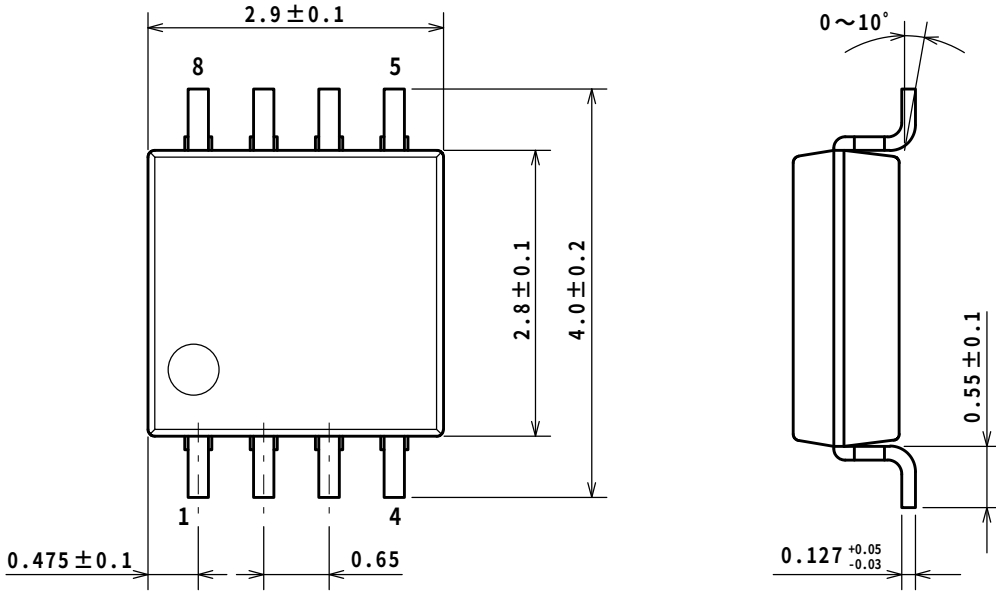
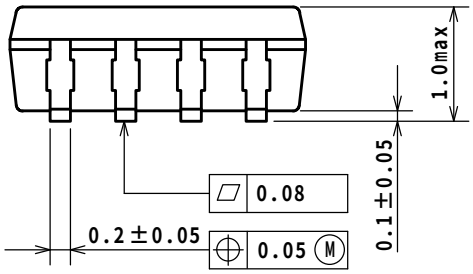
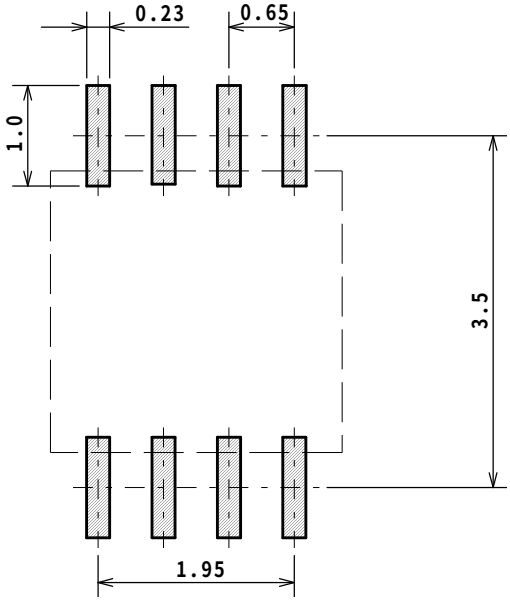




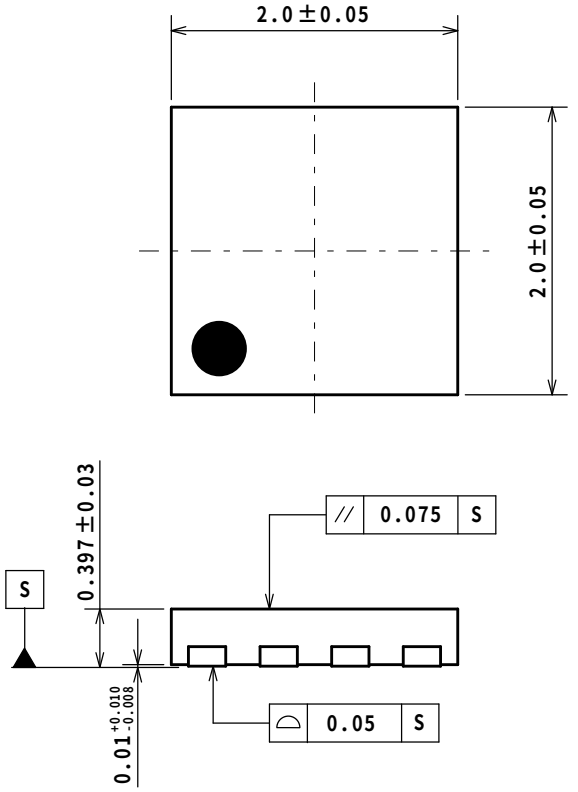
■EXAMPLE OF SOLDER PADS DIMENSIONS



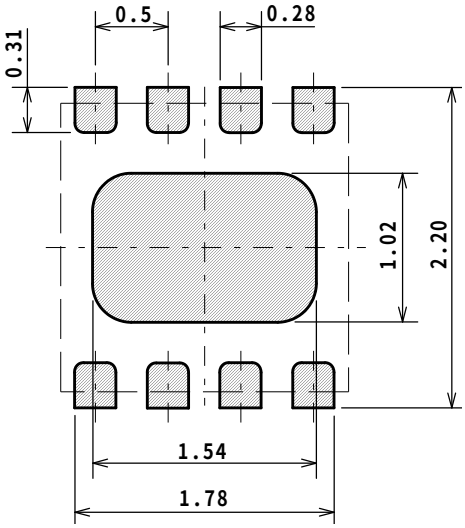
DFN8-U1 (ESON8-U1)

Unit: mm

■ PACKAGE DIMENSIONS



■EXAMPLE OF SOLDER PADS DIMENSIONS



SSOP14

Unit: mm

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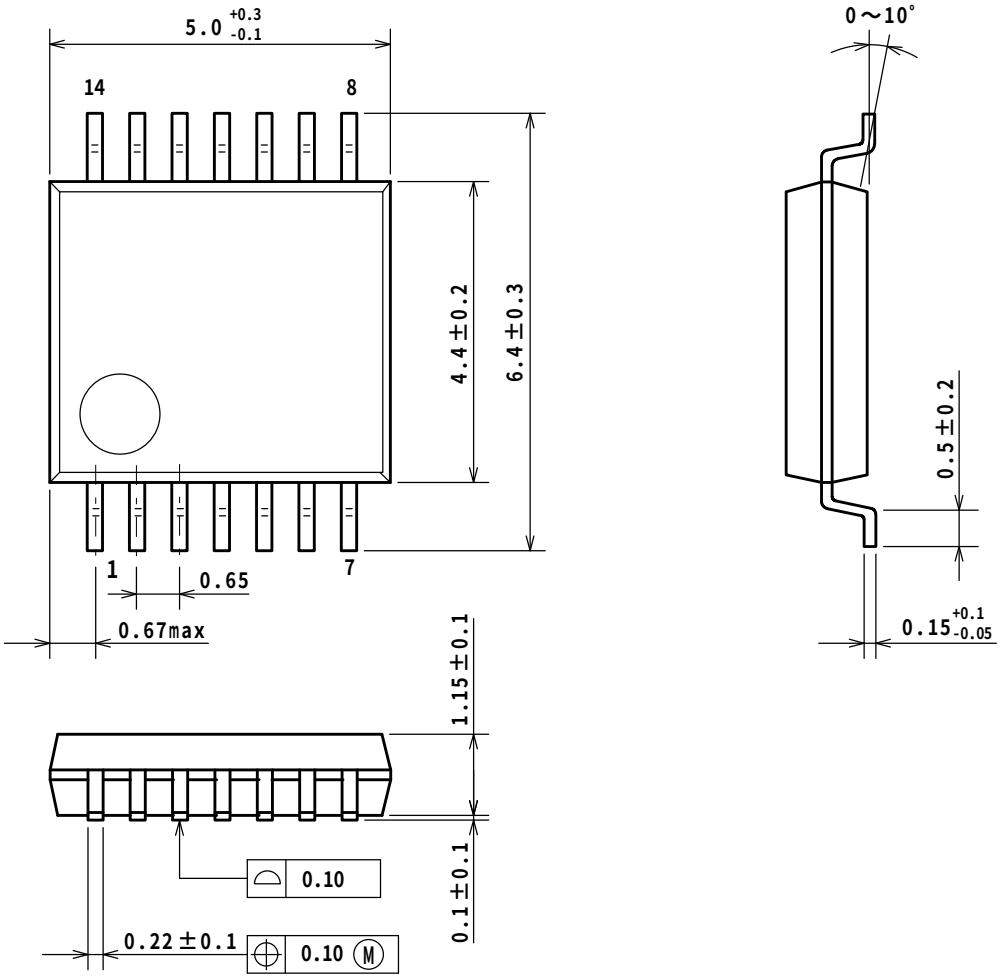
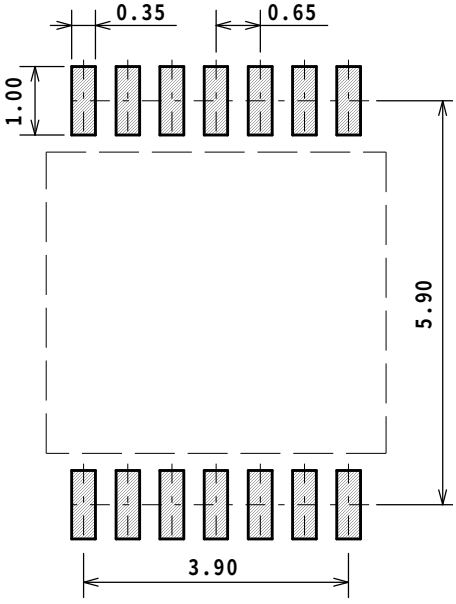


■EXAMPLE OF SOLDER PADS DIMENSIONS

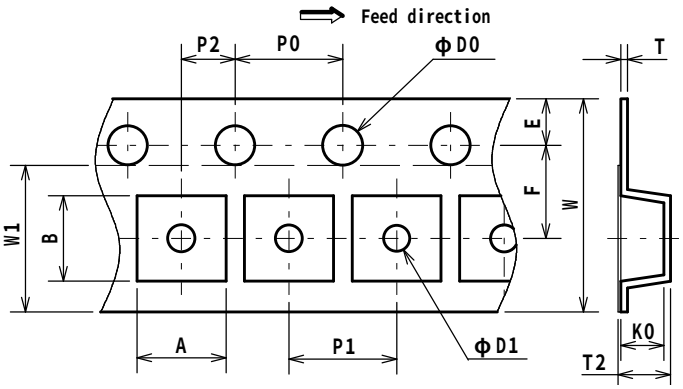


SOT-23-5

■ PACKING SPEC

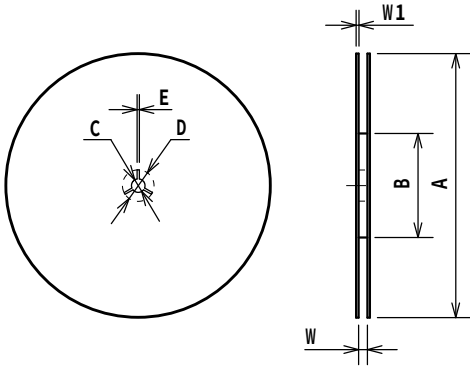
Unit: mm

TAPING DIMENSIONS



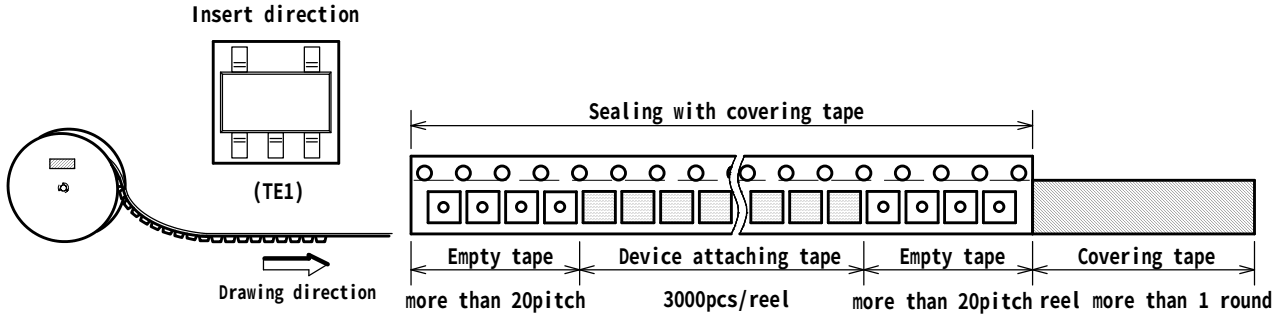
SYMBOL	DIMENSION	REMARKS
A	3.3±0.1	BOTTOM DIMENSION
B	3.2±0.1	BOTTOM DIMENSION
D0	1.55	
D1	1.05	
E	1.75±0.1	
F	3.5±0.05	
P0	4.0±0.1	
P1	4.0±0.1	
P2	2.0±0.05	
T	0.25±0.05	
T2	1.82	
K0	1.5±0.1	
W	8.0±0.3	
W1	5.5	THICKNESS 0.1MAX

REEL DIMENSIONS



SYMBOL	DIMENSION
A	Φ180±1
B	Φ 60±1
C	Φ 13±0.2
D	Φ 21±0.8
E	2±0.5
W	9±0.5
W1	1.2±0.2

TAPING STATE



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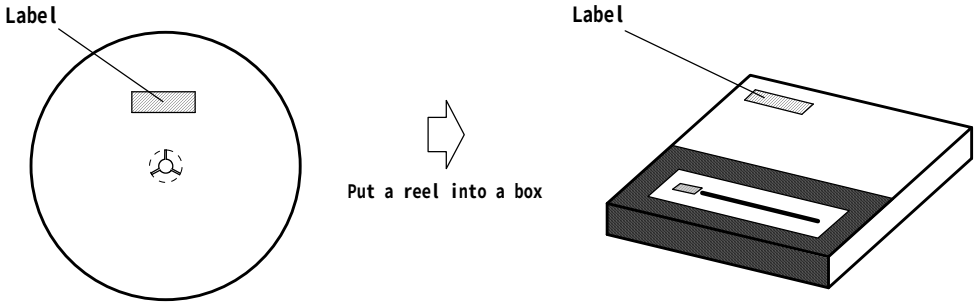
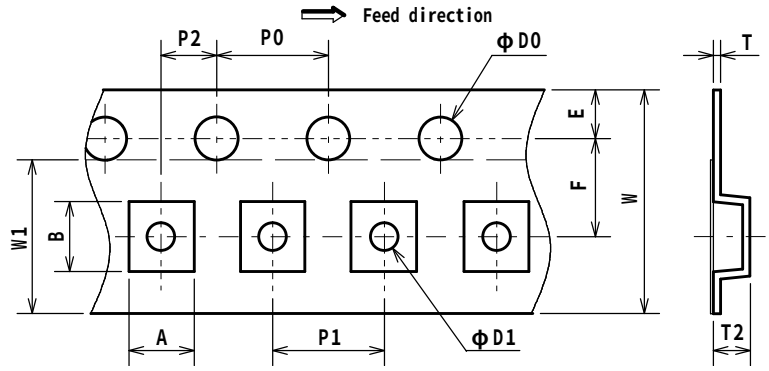


SC-88A

■ PACKING SPEC

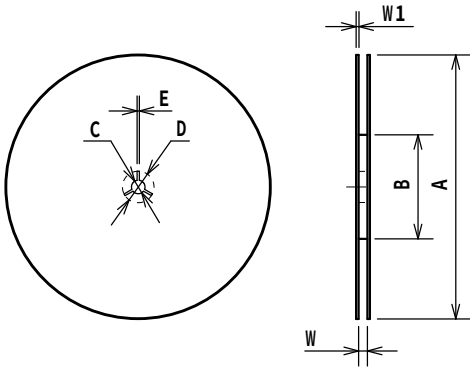
Unit: mm

TAPING DIMENSIONS



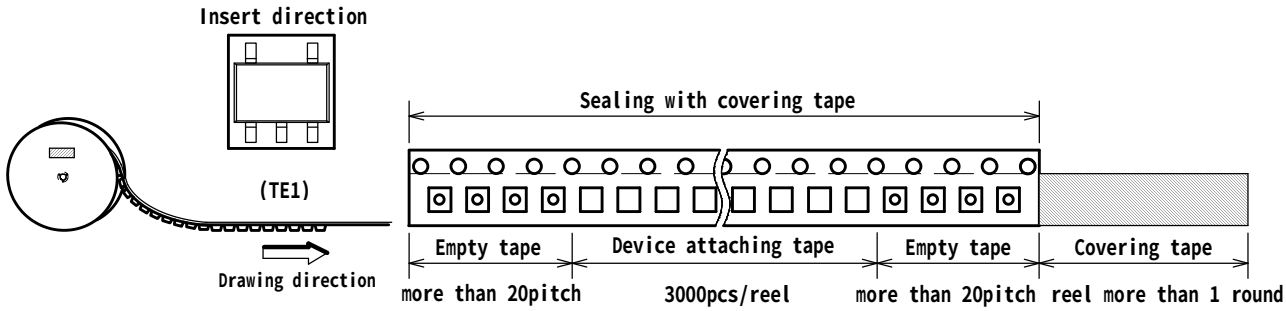
SYMBOL	DIMENSION	REMARKS
A	2.3±0.1	BOTTOM DIMENSION
B	2.5±0.1	BOTTOM DIMENSION
D0	1.55±0.05	
D1	1.05±0.05	
E	1.75±0.1	
F	3.5±0.05	
P0	4.0±0.1	
P1	4.0±0.1	
P2	2.0±0.05	
T	0.25±0.05	
T2	1.3±0.1	
W	8.0±0.2	
W1	5.5	THICKNESS 0.1max

REEL DIMENSIONS



SYMBOL	DIMENSION
A	φ180±1
B	φ 60±1
C	φ 13±0.2
D	φ 21±0.8
E	2±0.5
W	9±0.5
W1	1.2±0.2

TAPING STATE



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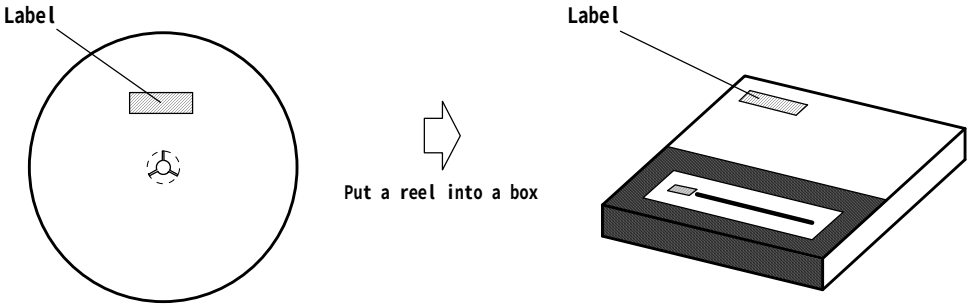
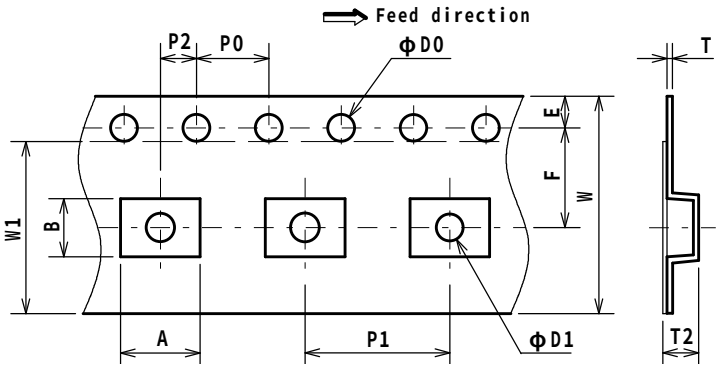


MSOP8 (TVSP8) MEET JEDEC MO-187-DA/THIN TYPE

Unit: mm

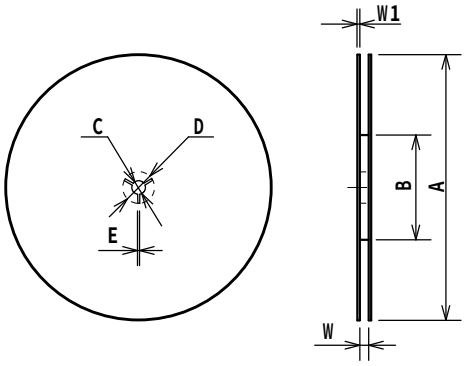
■ PACKING SPEC

TAPING DIMENSIONS



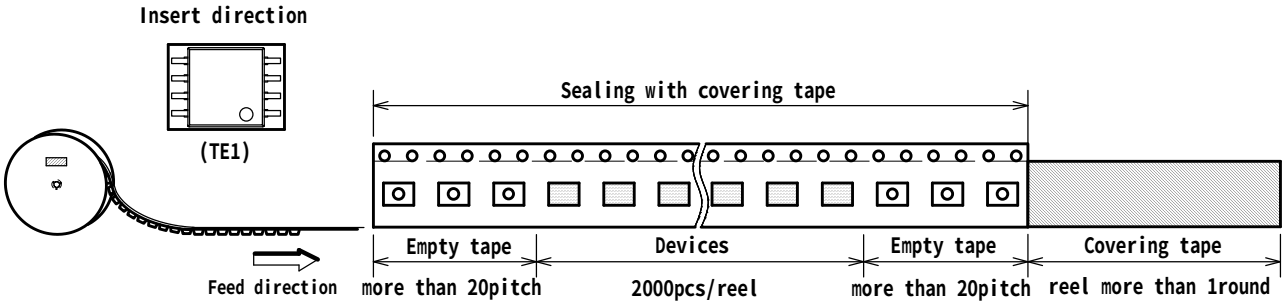
SYMBOL	DIMENSION	REMARKS
A	4.4	BOTTOM DIMENSION
B	3.2	BOTTOM DIMENSION
D0	$1.5^{+0.1}_{0}$	
D1	$1.5^{+0.1}_{0}$	
E	1.75±0.1	
F	5.5±0.05	
P0	4.0±0.1	
P1	8.0±0.1	
P2	2.0±0.05	
T	0.30±0.05	
T2	1.75 (MAX.)	
W	12.0±0.3	
W1	9.5	THICKNESS 0.1max

REEL DIMENSIONS



SYMBOL	DIMENSION
A	φ254±2
B	φ100±1
C	φ 13±0.2
D	φ 21±0.8
E	2±0.5
W	13.5±0.5
W1	2.0±0.2

TAPING STATE



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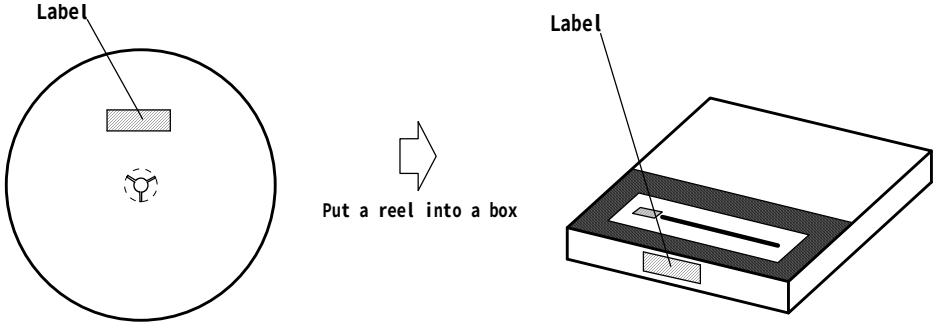
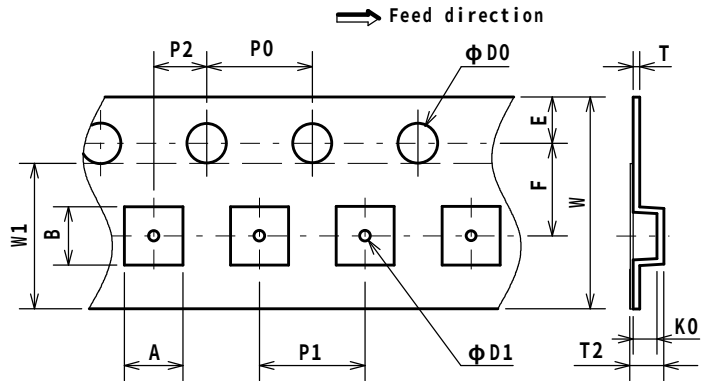


DFN8-U1 (ESON8-U1)

Unit: mm

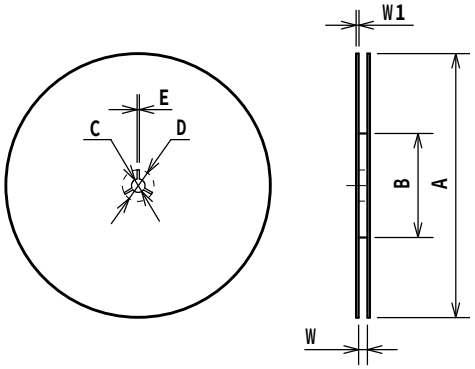
■ PACKING SPEC

TAPING DIMENSIONS



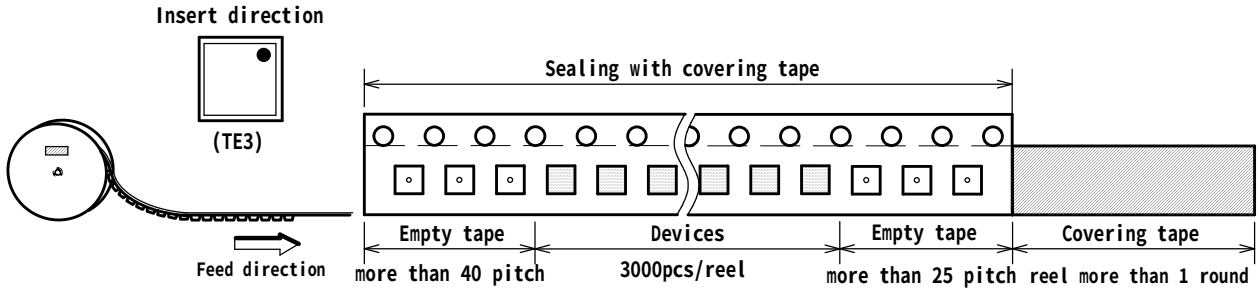
SYMBOL	DIMENSION	REMARKS
A	2.25±0.05	BOTTOM DIMENSION
B	2.25±0.05	BOTTOM DIMENSION
D0	$1.5^{+0.1}_{0}$	
D1	0.5±0.1	
E	1.75±0.1	
F	3.5±0.05	
P0	4.0±0.1	
P1	4.0±0.1	
P2	2.0±0.05	
T	0.25±0.05	
T2	1.00±0.07	
K0	0.65±0.05	
W	8.0±0.2	
W1	5.5	THICKNESS 0.1max

REEL DIMENSIONS

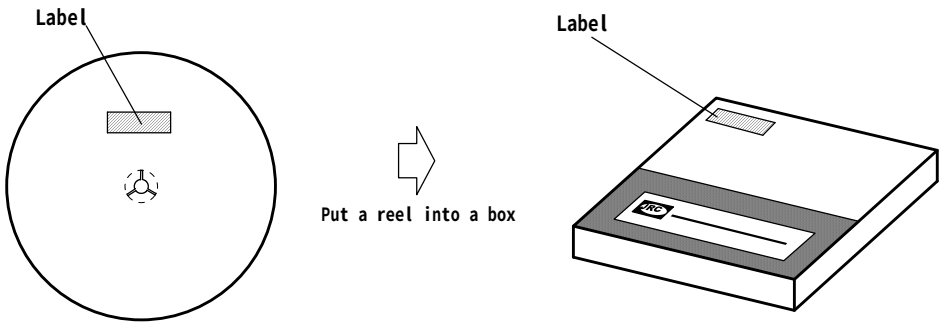


SYMBOL	DIMENSION
A	$\phi 180^{0}_{-1.5}$
B	ϕ 60 $^{+1}_{0}$
C	ϕ 13±0.2
D	ϕ 21±0.8
E	2±0.5
W	$9^{+0.3}_{0}$
W1	1.2

TAPING STATE



PACKING STATE

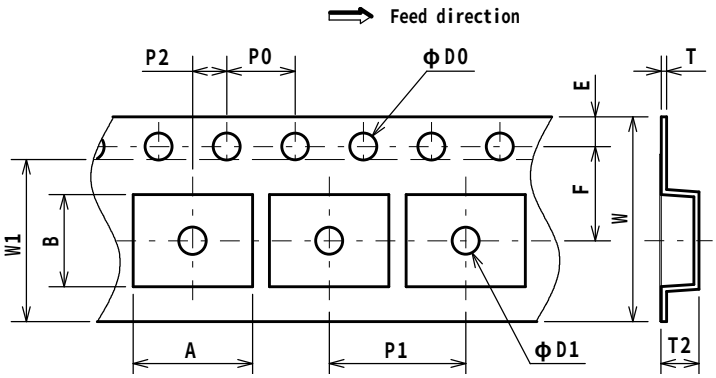


SSOP14

■ PACKING SPEC

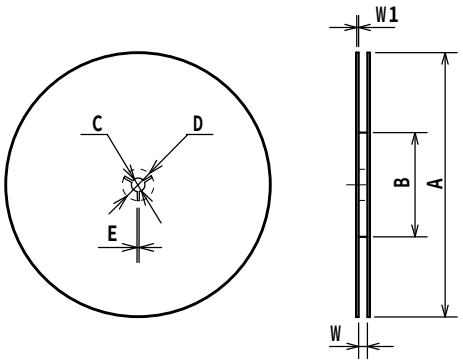
Unit: mm

TAPING DIMENSIONS



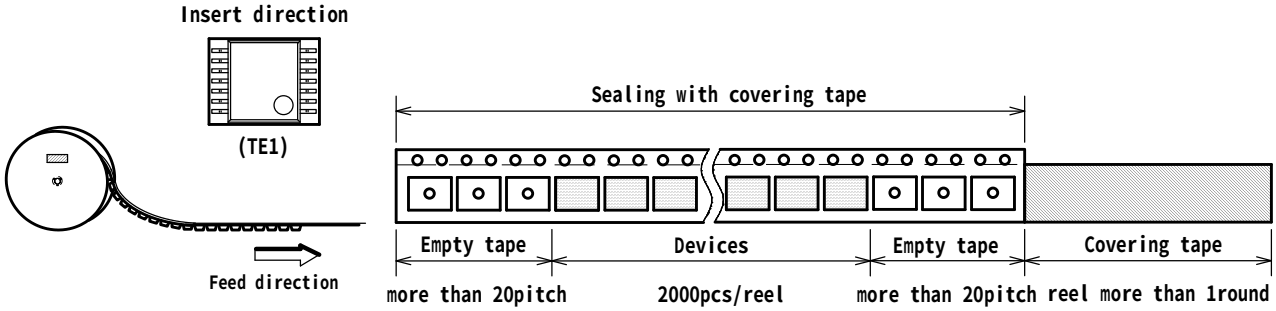
SYMBOL	DIMENSION	REMARKS
A	6.95	BOTTOM DIMENSION
B	5.4	BOTTOM DIMENSION
D0	1.55±0.05	
D1	1.55±0.1	
E	1.75±0.1	
F	5.5±0.05	
P0	4.0±0.1	
P1	8.0±0.1	
P2	2.0±0.05	
T	0.3±0.05	
T2	2.2	
W	12.0±0.3	
W1	9.5	THICKNESS 0.1max

REEL DIMENSIONS

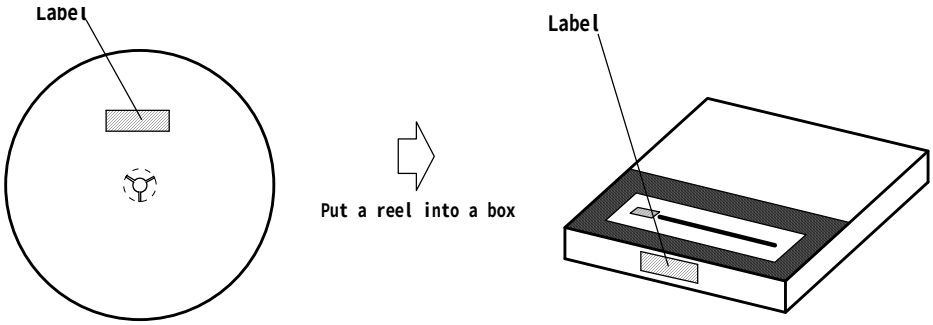


SYMBOL	DIMENSION
A	Φ254±2
B	Φ100±1
C	Φ 13±0.2
D	Φ 21±0.8
E	2±0.5
W	13.5±0.5
W1	2±0.2

TAPING STATE

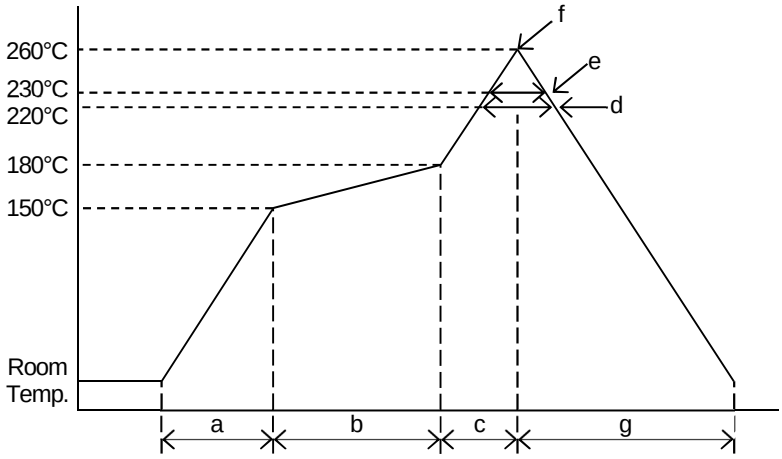


PACKING STATE



■ RECOMMENDED MOUNTING METHOD

INFRARED REFLOW SOLDERING PROFILE



a	Temperature ramping rate	1 to 4°C/s
b	Pre-heating temperature Pre-heating time	150 to 180°C 60 to 120s
c	Temperature ramp rate	1 to 4°C/s
d	220°C or higher time	shorter than 60s
e	230°C or higher time	shorter than 40s
f	Peak temperature	lower than 260°C
g	Temperature ramping rate	1 to 6°C/s

The temperature indicates at the surface of mold package.

■ REVISION HISTORY

DATA	REVISION	CHANGES
2. Aug. 2016	Ver.6	Data sheet format revision.
12. Jun. 2017	Ver.7	Changed ψjt data for thermal characteristics table.
25. Oct. 2017	Ver.8	Corrected test condition of electrical characteristics.
22. Feb. 2019	Ver.9	Revision data sheet format, application note and add EMIRR.
26. Oct. 2020	Ver.9.1	Corrected the unit of Supply Current per Amplifer vs. Supply Voltage. Corrected the unit of Supply Current per Amplifler vs. Temperture.

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3. To ensure the highest levels of reliability, NJR products must always be properly handled.
   The introduction of external contaminants (e.g. dust, oil or cosmetics) can result in failures of semiconductor products.

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   - Equipment Used in the Deep Sea
   - Power Generator Control Equipment (Nuclear, steam, hydraulic, etc.)
   - Life Maintenance Medical Equipment
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   - Vehicle Control Equipment (Airplane, railroad, ship, etc.)
   - Various Safety Devices

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