NJU77000 - NJU77004

1.5V, 0.23μA/ch, Ultra-Low Power, High EMC Performance, Rail-to-Rail Input/Output, CMOS Operational Amplifiers

FEATURES (V^+ = 5V)

Supply Voltage	1.5V to 5.5V
Input Offset Voltage	
NJU77000 / NJU77001	1.0mV max.
NJU77002	1.3mV max.
NJU77004	1.5mV max.
Input Offset Voltage Drift	0.65μV/°C typ.
Input Bias Current	10pA max.
Integrated EMI Filter	EMIRR=89dB typ. @f=900MHz
Rail-to-Rail Input / Output	
CMOS Technology	
Slew Rate	0.7V/ms
Unity Gain Frequency	1.0kHz
Ultra-Low Power Supply Current	
NJU77000 / NJU77001	0.29μA typ.
NJU77002 / NJU77004	0.23μA/ch typ.
Package	
NJU77000	SOT-23-5
NJU77001	SC-88A, SOT-23-5
NJU77002	SOP8 (EMP8), MSOP8 (TVSP8) DFN8-U1 (ESON8-U1)
NJU77004	SSOP14

APPLICATIONS

Battery-Powered Instruments
Micro-Power Oxygen Sensors and Gas Sensors
Power Line Monitoring
Micro Power Current Sensing
Healthcare Instruments

GENERAL DESCRIPTION

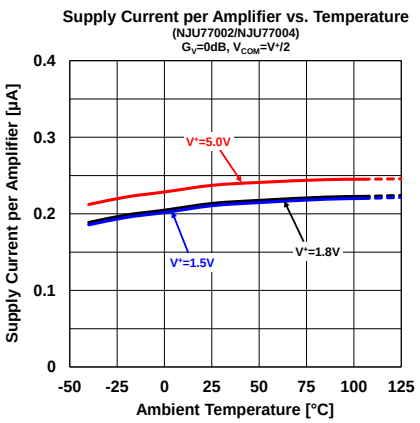
The NJU77000/NJU77001/NJU77002/NJU77004 are single/dual/quad ultra-low power CMOS operational amplifiers designed specifically to extend battery life and performance for portable applications. The supply voltage range is 1.5V to 5.5V and supply current is 0.29μA typ. (single), 0.23μA/ch typ. (dual/quad). The supply current is stable against ambient temperature and voltage change, making them suitable for micro power oxygen sensors, gas sensors, and remote sensor applications.

These devices also feature rail-to-rail I/O and input offset voltage of 1.0mV max. (single), 1.3mV max. (dual), 1.5mV max. (quad). Moreover, this series has excellent characteristics ideal for battery-powered applications, such as 0.65μV/°C typ. input offset voltage drift, input bias current of 10pA max. and ability of capacity load drive of 470pF.

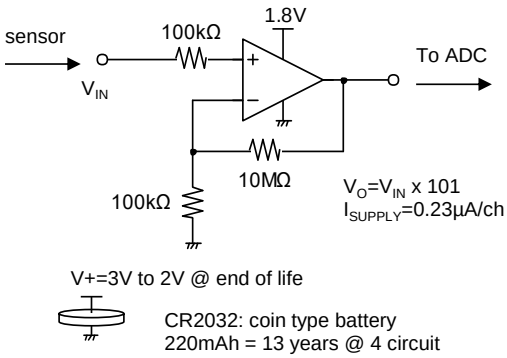
NJU77000 series has normal grade (NJU7700x) and A-Grade (NJU7700xA). A-Grade has improved offset voltage and supply current than normal grade, and other characteristics are also guaranteed from -40 to 105 °C.

The NJU77000 is available in a 5-pin SOT-23 package. NJU77001 is offered in 5-pin SOT-23 and SC-88A packages. NJU77000 and NJU77001 have different pin functions (see pin configurations). The NJU77002 is offered in 8-pin SOP (EMP), MSOP (TVSP) and DFN (ESON) that is thin and 2mm square small package. The NJU77004 is a 14-pin SSOP package.

TYPICAL CHARACTERISTIC



TYPICAL APPLICATION



40dB micro power sensor amplifier

Downloaded from Arrow.com.

■ PRODUCT NAME INFORMATION

NJU7700x a b (ccc)

Description of configuration

Composition	Item	Description
x	Number of circuits	Indicates number of circuits. 0: Single 1: Single 2: Dual 4: Quad
	Characteristic grade	Indicates the performance class. See the Electrical Characteristics table. NJU7700xA: A-Grade
b	Package code	Indicates the package. F: SOT-23-5 F3: SC-88A E: SOP8(EMP8) RB1: MSOP8(TVSP8) KU1: DFN8-U1(ESON8-U1) V: SSOP14
ccc	Packing	Insert Direction. Refer to the packing specifications.

■ ORDER INFORMATION

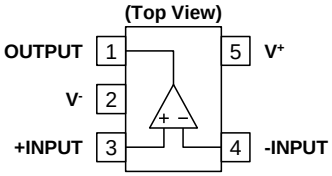
Product Name	Package	RoHS	Halogen-Free	Plating Composition	Weight (mg)	Quantity (pcs/reel)
NJU77000F (TE2)	SOT-23-5	✓	✓	Sn2Bi	15	3000
NJU77000AF (TE2)	SOT-23-5	✓	✓	Sn2Bi	15	3000
NJU77001F (TE2)	SOT-23-5	✓	✓	Sn2Bi	15	3000
NJU77001AF (TE2)	SOT-23-5	✓	✓	Sn2Bi	15	3000
NJU77001F3 (TE2)	SC-88A	✓	✓	Sn2Bi	7	3000
NJU77001AF3 (TE2)	SC-88A	✓	✓	Sn2Bi	7	3000
NJU77002E (TE2)	SOP8(EMP8)	✓	-	Sn2Bi	76	2000
NJU77002AE (TE2)	SOP8(EMP8)	✓	-	Sn2Bi	76	2000
NJU77002RB1 (TE2)	MSOP8(TVSP8)	✓	✓	Sn2Bi	18	2000
NJU77002ARB1 (TE2)	MSOP8(TVSP8)	✓	✓	Sn2Bi	18	2000
NJU77002KU1 (TE3)	DFN8-U1(ESON8-U1)	✓	✓	Sn2Bi	5	3000
NJU77002AKU1 (TE3)	DFN8-U1(ESON8-U1)	✓	✓	Sn2Bi	5	3000
NJU77004V (TE1)	SSOP14	✓	✓	Sn2Bi	65	2000
NJU77004AV (TE1)	SSOP14	✓	✓	Sn2Bi	65	2000

■ PRODUCT INFORMATION (T_a = 25°C)

Number of circuits	V_{IO} max.	I_{SUPPLY} max.	I_B max.	PACKAGE / PRODUCT NAME					
				SOT-23-5	SC-88A	SOP8 (EMP8)	MSOP8 (TVSP8)	DFN8-U1 (ESON8-U1)	SSOP14
Single	1.8mV	0.49µA	-	NJU77000F	-	-	-	-	-
	1.0mV	0.39µA	10pA	NJU77000AF	-				
	1.8mV	0.49µA	-	NJU77001F	NJU77001F3				
	1.0mV	0.39µA	10pA	NJU77001AF	NJU77001AF3	-	-	-	-
Dual	2.0mV	0.76µA	-	-	-	NJU77002E	NJU77002RB1	NJU77002KU1	-
	1.3mV	0.66µA	10pA	-	-	NJU77002AE	NJU77002ARB1	NJU77002AKU1	-
Quad	2.2mV	1.32µA	-	-	-	-	-	-	NJU77004V
	1.5mV	1.22µA	10pA	-	-	-	-	-	NJU77004AV

Downloaded from Arrow.com.

■ PIN DESCRIPTIONS (NJU77000)

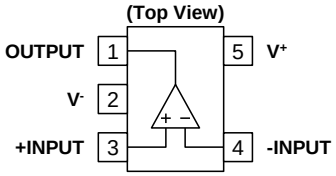


SOT-23-5

Pin No.	Pin Name	I/O	Description
1	OUTPUT	O	Output channel
2	V^-	-	Negative supply or GND (single supply)
3	+INPUT	I	Non-inverting input channel
4	−INPUT	I	Inverting input channel
5	V^+	-	Positive supply

Downloaded from Arrow.com.

■ PIN DESCRIPTIONS (NJU77001)

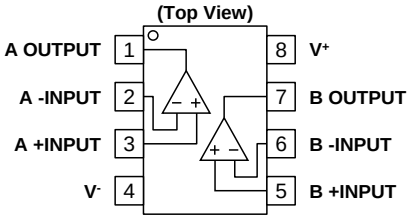


SOT-23-5, SC-88A

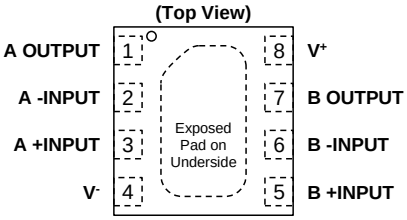
Pin No.	Pin Name	I/O	Description
1	+INPUT	I	Non-inverting input channel
2	V^-	-	Negative supply or GND (single supply)
3	−INPUT	I	Inverting input channel
4	OUTPUT	O	Output channel
5	V^+	-	Positive supply

Downloaded from Arrow.com.

■ PIN DESCRIPTIONS (NJU77002)



SOP8 (EMP8), MSOP8 (TVSP8)



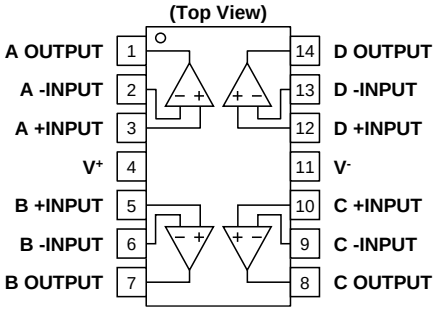
DFN8-U1 (ESON8-U1)

Pin No.	Pin Name	I/O	Description
1	A OUTPUT	O	Output channel A
2	A −INPUT	I	Inverting input channel A
3	A +INPUT	I	Non-inverting input channel A
4	V^-	-	Negative supply or GND (single supply)
5	B +INPUT	I	Non-inverting input channel B
6	B −INPUT	I	Inverting input channel B
7	B OUTPUT	O	Output channel B
8	V^+	-	Positive supply

*Connect exposed pad to V^-

Downloaded from Arrow.com.

■ PIN DESCRIPTIONS (NJU77004)



SSOP14

Pin No.	Pin Name	I/O	Description
1	A OUTPUT	O	Output channel A
2	A −INPUT	I	Inverting input channel A
3	A +INPUT	I	Non-inverting input channel A
4	V^+	-	Positive supply
5	B +INPUT	I	Non-inverting input channel B
6	B −INPUT	I	Inverting input channel B
7	B OUTPUT	O	Output channel B
8	C OUTPUT	O	Output channel C
9	C −INPUT	I	Inverting input channel C
10	C +INPUT	I	Non-inverting input channel C
11	V^-	-	Negative supply or GND (single supply)
12	D +INPUT	I	Non-inverting input channel D
13	D −INPUT	I	Inverting input channel D
14	D OUTPUT	O	Output channel D

Downloaded from Arrow.com.

■ ABSOLUTE MAXIMUM RATINGS

	Symbol	Ratings	Unit
Supply Voltage $V_S = V^+ - V^-$	$V^+ - V^-$	7	V
Differential Input Voltage *1	V_{ID}	±7 *2	V
Input Voltage	V_{IN}	V^- - 0.3 to V^+ + 0.3 *3	V
Storage Temperature Range	T_{stg}	-55 to 150	°C
Junction Temperature *4	T_j	150	°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 The absolute maximum input voltage is limited at 7V.

*4 Calculate the power consumption of the IC from the operating conditions and calculate the junction temperature with the thermal resistance.
Please refer to "Thermal characteristics" for the thermal resistance under our measurement board conditions.

ABSOLUTE MAXIMUM RATINGS
Electronic and mechanical stress momentarily exceeded absolute maximum ratings may cause permanent damage and may degrade the lifetime and safety for both device and system using the device in the field. The functional operation at or over these absolute maximum ratings is not assured.

■ THERMAL CHARACTERISTICS

Package	Measurement Result *1		Unit
	θja	ψjt	
SOT-23-5	192	58	°C/W
SC-88A	255	73	
SOP8(EMP8)	125	27	
MSOP8(TVSP8)	184	45	
DFN8-U1(ESON8-U1)	104 *2	25 *2	
SSOP14	202	52	

θja: Junction-to-Ambient Thermal Resistance
ψjt: Junction-to-Top Thermal Characterization Parameter

*1 Mounted on glass epoxy board (76.2 mm × 114.3 mm × 1.6 mm: based on EIA/JEDEC standard, 4-layer FR-4), internal Cu area: 74.2 mm × 74.2 mm.

*2 Mounted on glass epoxy board (101.5 mm × 114.5 mm × 1.6 mm: based on EIA/JEDEC standard, 4-layer FR-4) with exposed pad. (For 4-layer, applying 99.5 mm × 99.5 mm inner Cu area and a thermal via hole to a board based on JEDEC standard JESD51-5.)

Downloaded from Arrow.com.

■ ELECTROSTATIC DISCHARGE (ESD) PROTECTION VOLTAGE

	Conditions	Protection Voltage
HBM	C = 100 pF, R = 1.5 kΩ	±1000V
CDM		±1000V

ELECTROSTATIC DISCHARGE RATINGS
The electrostatic discharge test is done based on JEITA ED-4701.

■ RECOMMENDED OPERATING CONDITIONS

	Symbol	Ratings	Unit
Supply Voltage	$V^+ - V^-$	1.5 to 5.5	V
Operating Temperature Range	T_a	-40 to 125	°C

RECOMMENDED OPERATING CONDITIONS
All of electronic equipment should be designed that the mounted semiconductor devices operate within the recommended operating conditions. The semiconductor devices cannot operate normally over the recommended operating conditions, even if they are used over such conditions by momentary electronic noise or surge. And the semiconductor devices may receive serious damage when they continue to operate over the recommended operating conditions.

Downloaded from Arrow.com.

■ ELECTRICAL CHARACTERISTICS

V^+ = 5V, V^- = 0V, V_{COM} = 2.5V, R_L = 100kΩ to 2.5V, T_a = 25°C, unless otherwise specified.

Parameter	Symbol	Conditions	NJU7700xA			NJU7700x			単位
			MIN	TYP	MAX	MIN	TYP	MAX	
INPUT CHARACTERISTICS *1									
Input Offset Voltage		V_{COM} = 0V							
NJU77000 / NJU77001			-	0.35	1.0	-	0.35	1.8	mV
		T_a = -40°C to 105°C	-	-	1.2	-	-	-	mV
NJU77002	V_{IO}		-	0.35	1.3	-	0.35	2.0	mV
		T_a = -40°C to 105°C	-	-	1.5	-	-	-	mV
NJU77004			-	0.35	1.5	-	0.35	2.2	mV
		T_a = -40°C to 105°C	-	-	1.7	-	-	-	mV
Input Offset Voltage Drift		V_{COM} = 0V, T_a = -40°C to 105°C							
NJU77000 / NJU77001	$\Delta V_{IO}/\Delta T$		-	0.65	17	-	0.65	-	µV/°C
NJU77002			-	0.65	21	-	0.65	-	µV/°C
NJU77004			-	0.65	24	-	0.65	-	µV/°C
Input Bias Current	I_B		-10	1	10	-	1	-	pA
		T_a = -40°C to 105°C	-100	-	100	-	-	-	pA
Input Offset Current	I_{IO}		-10	1	10	-	1	-	pA
		T_a = -40°C to 105°C	-100	-	100	-	-	-	pA
Open-Loop Voltage Gain	A_V	V_O = 0.5V to 4.5V	70	100	-	70	100	-	dB
		V_O = 0.5V to 4.5V, T_a = -40°C to 105°C	70	-	-		-	-	dB
Common-Mode Rejection Ratio	CMR	V_{COM} = 0V to 5V	60	80	-	60	80	-	dB
		V_{COM} = 0V to 5V, T_a = -40°C to 105°C	60	-	-	-	-	-	dB
Common-Mode Input Voltage Range	V_{ICM}	CMR ≥ 60dB	0	-	5	0	-	5	V
		CMR ≥ 60dB, T_a = -40°C to 105°C	0	-	5	-	-	-	V
OUTPUT CHARACTERISTICS									
High-level Output Voltage	V_{OH}		4.9	4.95	-	4.9	4.95	-	V
		T_a = -40°C to 105°C	4.9	-	-	-	-	-	V
Low-level Output Voltage	V_{OL}		-	0.05	0.1	-	0.05	0.1	V
		T_a = -40°C to 105°C	-	-	0.1	-	-	-	V
POWER SUPPLY									
Supply Current (All Amplifiers)		No Signal							
NJU77000 / NJU77001			-	0.29	0.39	-	0.29	0.49	µA
		T_a = -40°C to 105°C	-	-	0.39	-	-	-	µA
NJU77002	I_{SUPPLY}		-	0.46	0.66	-	0.46	0.76	µA
		T_a = -40°C to 105°C	-	-	0.66	-	-	-	µA
NJU77004			-	0.92	1.22	-	0.92	1.32	µA
		T_a = -40°C to 105°C	-	-	1.22	-	-	-	µA
Supply Voltage Rejection Ratio	SVR	V^+ = 1.5V to 5.5V, V_{COM} = 0V							
			70	90	-	70	90	-	dB
		T_a = -40°C to 105°C	70	-	-	-	-	-	dB
AC CHARACTERISTICS									
Slew Rate		G_V = 0dB, C_L = 20pF, V_{IN} = $1V_{PP}$							
NJU77000 / NJU77001	SR		-	0.8	-	-	0.8	-	V/ms
NJU77002 / NJU77004			-	0.7	-	-	0.7	-	V/ms
Unity Gain Frequency		G_V = 20dB, C_L = 20pF							
NJU77000 / NJU77001	f_T		-	1.1	-	-	1.1	-	kHz
NJU77002 / NJU77004			-	1.0	-	-	1.0	-	kHz
Phase Margin	Φ_M	C_L = 20pF	-	60	-	-	60	-	deg
Gain Margin	G_M	C_L = 20pF	-	30	-	-	30	-	dB
Equivalent Input Noise Voltage		f = 100Hz			-				
NJU77000 / NJU77001	V_{NI}		-	600	-	-	600	-	nV/√Hz
NJU77002 / NJU77004			-	700	-	-	700	-	nV/√Hz

*1 Input offset voltage and drift, Input bias and offset current are positive or negative, its absolute values are listed in electrical characteristics.

Downloaded from Arrow.com.

■ ELECTRICAL CHARACTERISTICS 2

V^+ = 1.8V, V^- = 0V, V_{COM} = 0.9V, R_L = 100kΩ to 0.9V, T_a = 25°C, unless otherwise specified.

Parameter	Symbol	Conditions	NJU7700xA			NJU7700x			単位
			MIN	TYP	MAX	MIN	TYP	MAX	
INPUT CHARACTERISTICS *1									
Input Offset Voltage		V_{COM} = 0V							
NJU77000 / NJU77001			-	0.35	1.0	-	0.35	1.8	mV
		T_a= -40°C to 105°C	-	-	1.2	-	-	-	mV
NJU77002	V_{IO}		-	0.35	1.3	-	0.35	2	mV
		T_a= -40°C to 105°C	-	-	1.5	-	-	-	mV
NJU77004			-	0.35	1.5	-	0.35	2.2	mV
		T_a= -40°C to 105°C	-	-	1.7	-	-	-	mV
Input Offset Voltage Drift		V_{COM} = 0V, T_a= -40°C to 105°C							
NJU77000 / NJU77001	$\Delta V_{IO}/\Delta T$		-	0.65	17	-	0.65	-	µV/°C
NJU77002			-	0.65	21	-	0.65	-	µV/°C
NJU77004			-	0.65	24	-	0.65	-	µV/°C
Input Bias Current	I_B		-10	1	10	-	1	-	pA
		T_a= -40°C to 105°C	-100	-	100	-	-	-	pA
Input Offset Current	I_{IO}		-10	1	10	-	1	-	pA
		T_a= -40°C to 105°C	-100	-	100	-	-	-	pA
Open-Loop Voltage Gain	A_V	V_O = 0.5V to 1.3V	70	100	-	70	100	-	dB
		V_O = 0.5V to 1.3V, T_a= -40°C to 105°C	70	-	-		-	-	dB
Common-Mode Rejection Ratio	CMR	V_{COM} = 0V to 1.8V	55	80	-	55	80	-	dB
		V_{COM} = 0V to 1.8V, T_a= -40°C to 105°C	55	-	-	-	-	-	dB
Common-Mode Input Voltage Range	V_{ICM}	CMR ≥ 55dB	0	-	1.8	0	-	1.8	V
		CMR ≥ 55dB, T_a = -40°C to 105°C	0	-	1.8	-	-	-	V
OUTPUT CHARACTERISTICS									
High-level Output Voltage	V_{OH}		1.7	1.75	-	1.7	1.75	-	V
		T_a= -40°C to 105°C	1.7	-	-	-	-	-	V
Low-level Output Voltage	V_{OL}		-	0.05	0.1	-	0.05	0.1	V
		T_a= -40°C to 105°C	-	-	0.1	-	-	-	V
POWER SUPPLY									
Supply Current (All Amplifiers)		No Signal							
NJU77000 / NJU77001			-	0.26	0.36	-	0.26	0.49	µA
		T_a= -40°C to 105°C	-	-	0.36	-	-	-	µA
NJU77002	I_{SUPPLY}		-	0.42	0.62	-	0.42	0.72	µA
		T_a= -40°C to 105°C	-	-	0.62	-	-	-	µA
NJU77004			-	0.84	1.17	-	0.84	1.27	µA
		T_a= -40°C to 105°C	-	-	1.17	-	-	-	µA
Supply Voltage Rejection Ratio	SVR	V^+ = 1.5V to 5.5V, V_{COM} = 0V							
			70	90	-	70	90	-	dB
		T_a= -40°C to 105°C	70	-	-	-	-	-	dB
AC CHARACTERISTICS									
Slew Rate		G_V = 0dB, C_L = 20pF, V_{IN} = $1V_{PP}$							
NJU77000 / NJU77001	SR		-	0.7	-	-	0.7	-	V/ms
NJU77002 / NJU77004			-	0.6	-	-	0.6	-	V/ms
Unity Gain Frequency		G_V = 20dB, C_L = 20pF							
NJU77000 / NJU77001	f_T		-	1.0	-	-	1.0	-	kHz
NJU77002 / NJU77004			-	0.9	-	-	0.9	-	kHz
Phase Margin	Φ_M	C_L = 20pF	-	60	-	-	60	-	deg
Gain Margin	G_M	C_L = 20pF	-	30	-	-	30	-	dB
Equivalent Input Noise Voltage		f = 100Hz			-				
NJU77000 / NJU77001	V_{NI}		-	700	-	-	700	-	nV/√Hz
NJU77002 / NJU77004			-	800	-	-	800	-	nV/√Hz

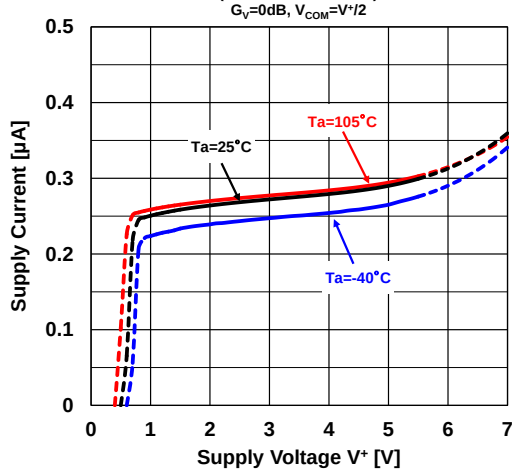
*1 Input offset voltage and drift, Input bias and offset current are positive or negative, its absolute values are listed in electrical characteristics.

Downloaded from Arrow.com.

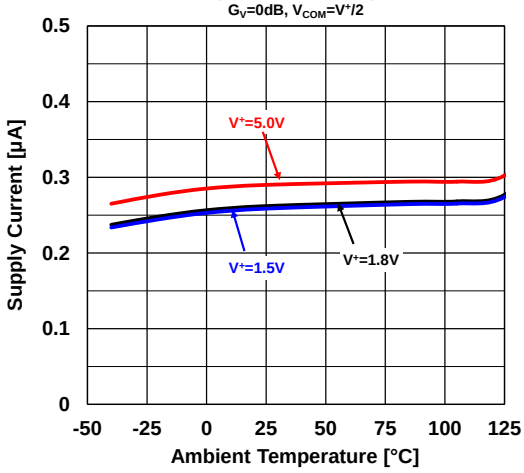
■ TYPICAL CHARACTERISTICS

Note: Typical Characteristics are intended to be used as reference data; they are not guaranteed.

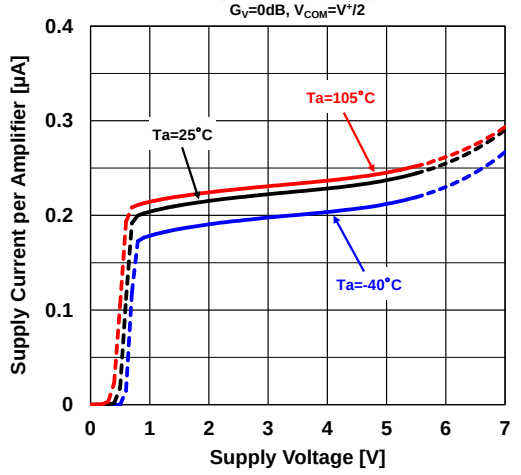
Supply Current vs. Supply Voltage
(NJU77000/NJU77001)
G_V=0dB, V_{COM}=V^+/2



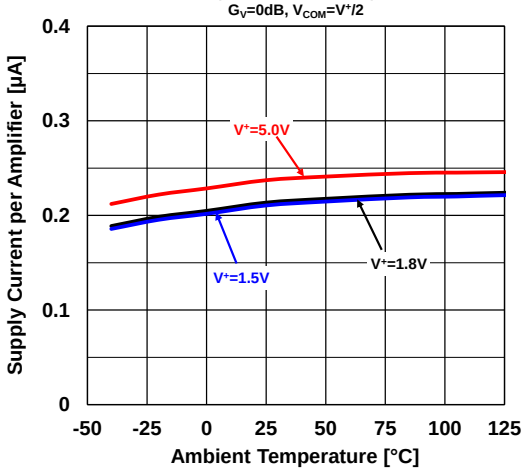
Supply Current vs. Temperature
(NJU77000/NJU77001)
G_V=0dB, V_{COM}=V^+/2



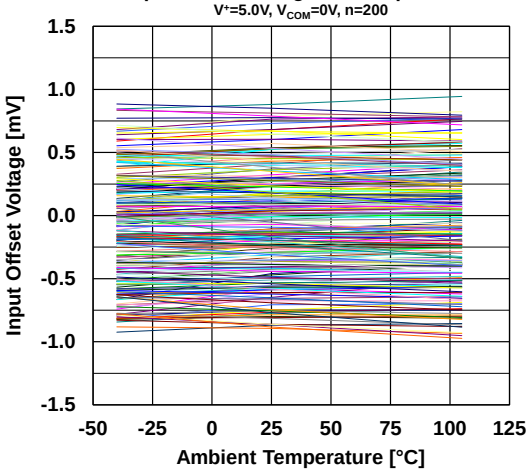
Supply Current per Amplifier vs. Supply Voltage
(NJU77002/NJU77004)
G_V=0dB, V_{COM}=V^+/2



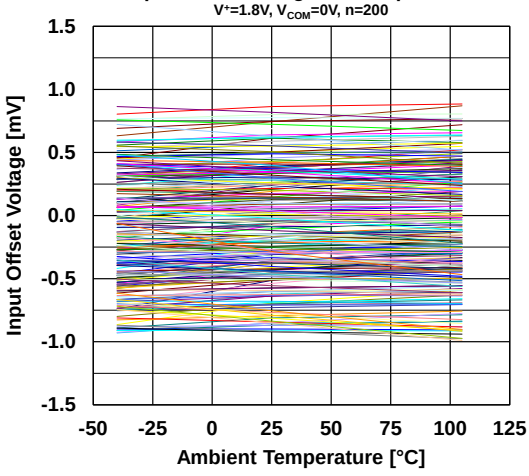
Supply Current per Amplifier vs. Temperature
(NJU77002/NJU77004)
G_V=0dB, V_{COM}=V^+/2



Input Offset Voltage vs. Temperature
V^+=5.0V, V_{COM}=0V, n=200



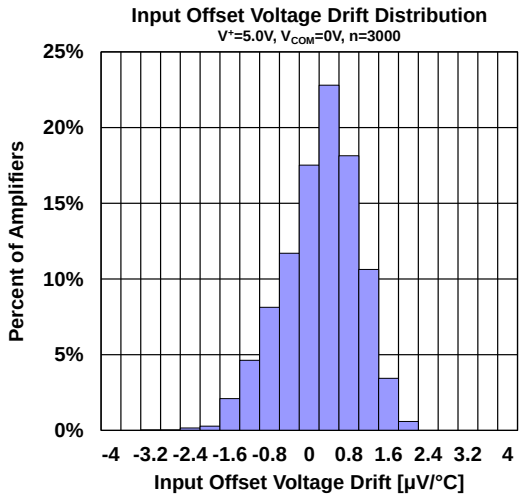
Input Offset Voltage vs. Temperature
V^+=1.8V, V_{COM}=0V, n=200

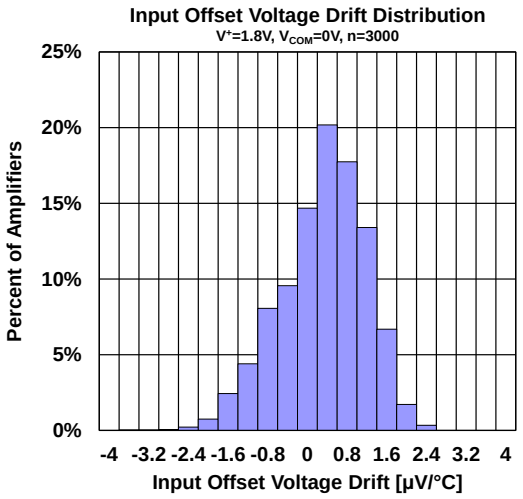


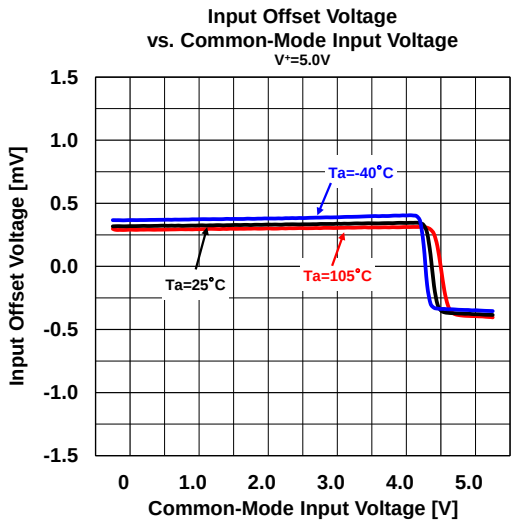
Downloaded from Arrow.com.

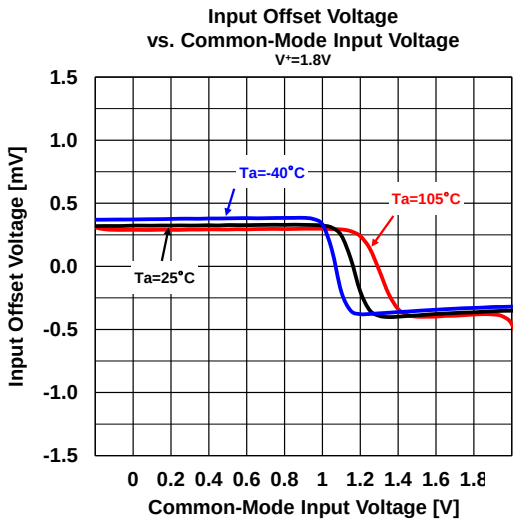
■ TYPICAL CHARACTERISTICS

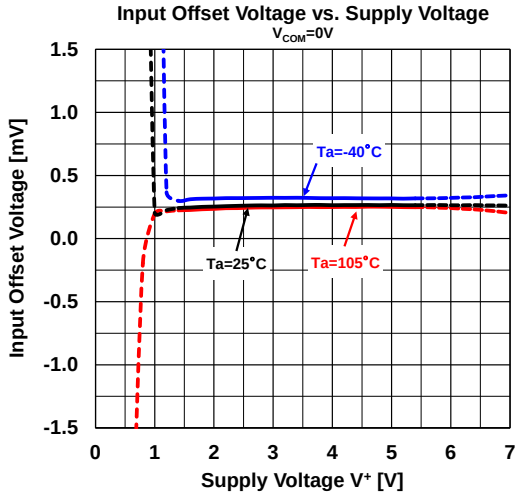
Note: Typical Characteristics are intended to be used as reference data; they are not guaranteed.

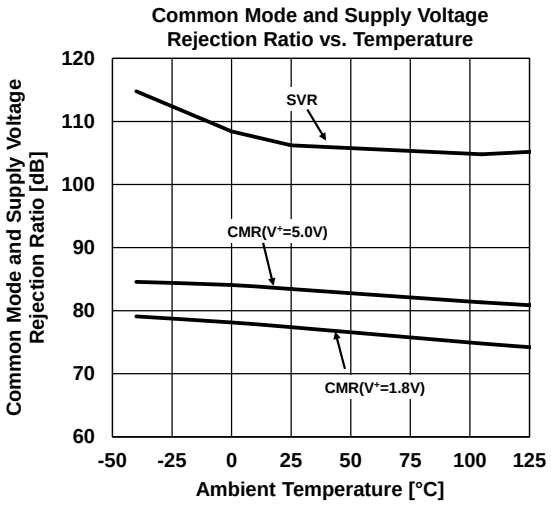










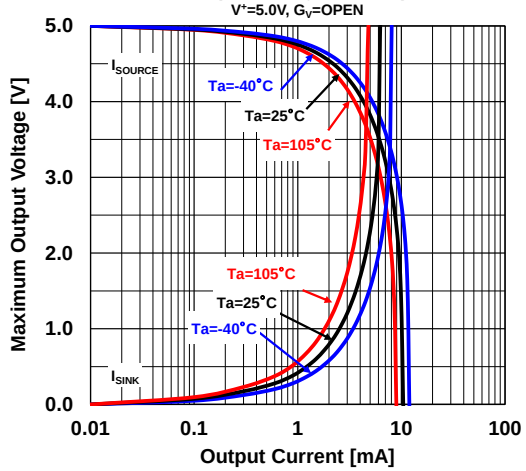


Downloaded from Arrow.com.

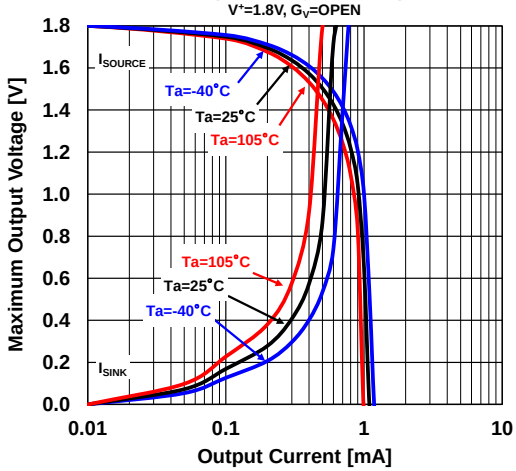
■ TYPICAL CHARACTERISTICS

Note: Typical Characteristics are intended to be used as reference data; they are not guaranteed.

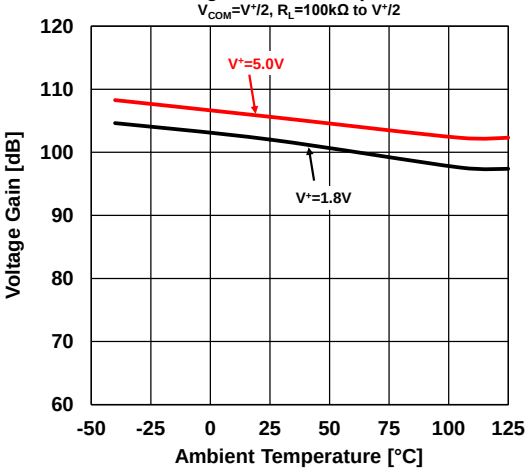
Maximum Output Voltage vs. Output Current
V⁺=5.0V, G_V=OPEN



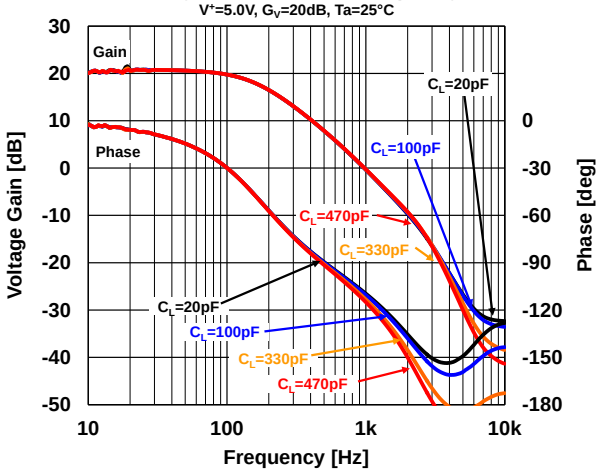
Maximum Output Voltage vs. Output Current
V⁺=1.8V, G_V=OPEN



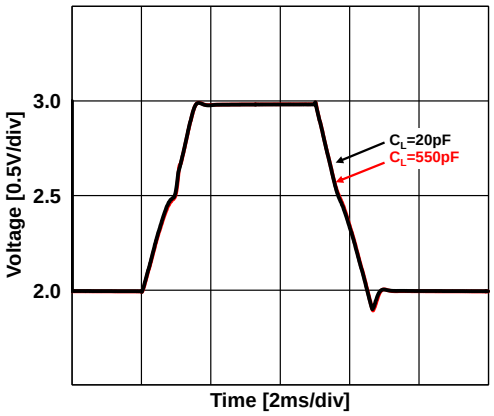
Voltage Gain vs. Temperature
V_{COM}=V⁺/2, R_L=100kΩ to V⁺/2



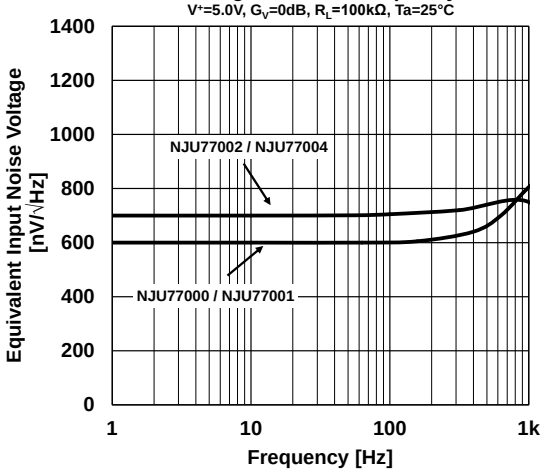
Voltage Gain/Phase vs. Frequency
V⁺=5.0V, G_V=20dB, Ta=25°C



Pulse Response
V⁺=5.0V, G_V=0dB, R_L=100kΩ to 2.5V, Ta=25°C



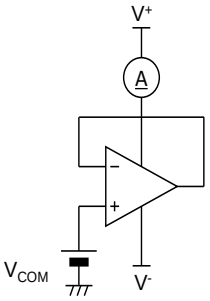
Voltage Noise vs. Frequency
V⁺=5.0V, G_V=0dB, R_L=100kΩ, Ta=25°C



Downloaded from Arrow.com.

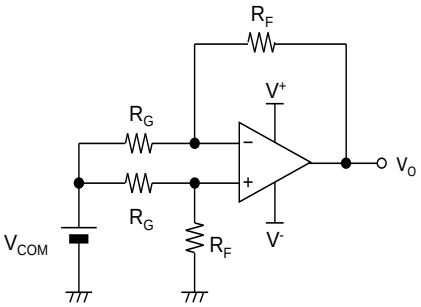
■ TEST CIRCUITS

● I_{SUPPLY}



● V_{IO}, CMR, SVR

R_G = 50Ω, R_F = 50kΩ



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

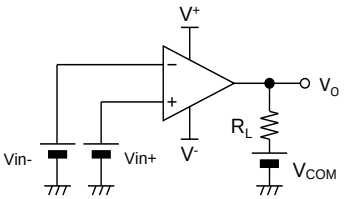
$$CMR=20\log\frac{\Delta V_{COM}\left(1+\frac{R_F}{R_G}\right)}{\Delta V_O}$$

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

$V_S=V^+-V^-$

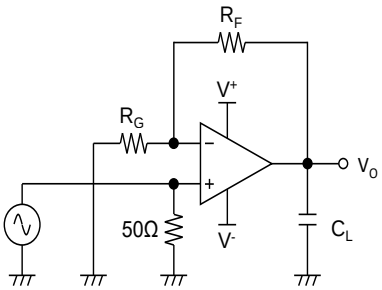
● V_{OH}, V_{OL}

V_{OH}; Vin+ = V^+/2 + 0.1V, Vin- = V^+/2, V_{COM} = V^+/2
V_{OL}; Vin+ = V^+/2, Vin- = V^+/2 + 0.1V, V_{COM} = V^+/2



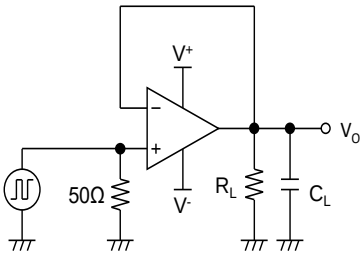
● GBW

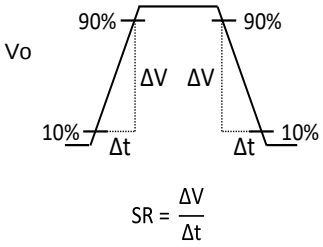
R_G = 1kΩ, R_F = 100kΩ



● SR

R_L = 100kΩ





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

Downloaded from Arrow.com.

■ APPLICATION NOTES

Capacitive Load

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 be either underdamped or the amplifier will oscillate.
The NJU77000/NJU77001/NJU77002/NJU77004 can directly drive capacitive loads of up to 470pF without oscillating. To drive heavier capacitive loads, an isolation resistor, R_{ISO} as shown Fig.1, 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.
Fig.2 shows R_{ISO} values at unity gain follower without oscillating. After selecting R_{ISO} for your circuit, double-check the resulting frequency response peaking and step response overshoot. Modify R_{ISO}'s value until the response is reasonable.

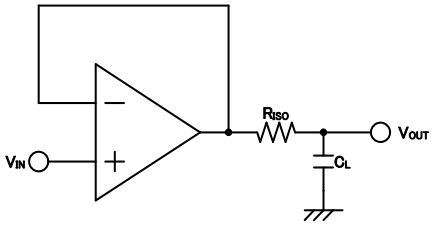


Fig.1. Isolating capacitive load

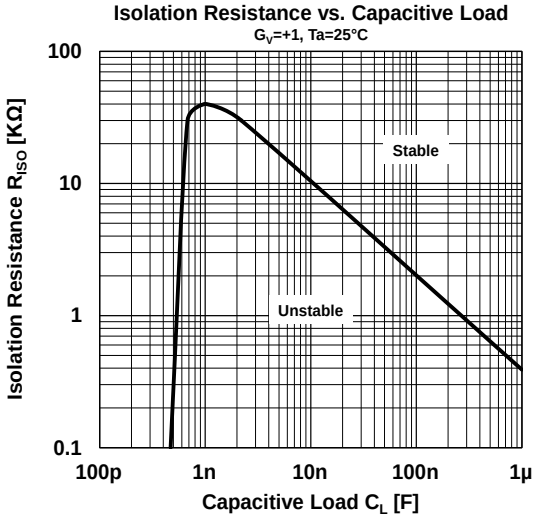


Fig.2. Isolation resistance to improve stability

Downloaded from Arrow.com.

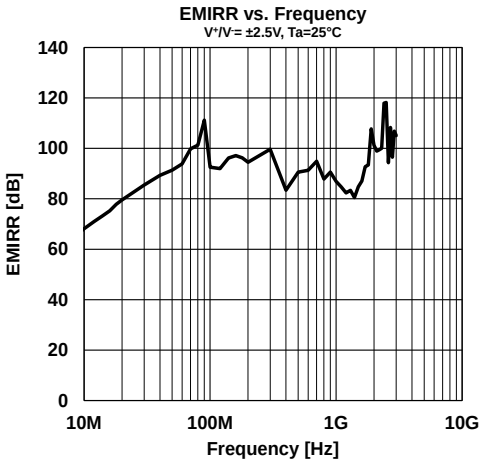
EMIRR (EMI Rejection Ratio) Definition

EMIRR is a parameter indicating the EMI robustness of an Op-Amp. The definition of EMIRR is given by the following eq.1.
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.

$$EMIRR = 20 \cdot \log\left(\frac{V_{RF_{PEAK}}}{|\Delta V_{IO}|}\right) \quad ---eq.1$$

$V_{RF_{PEAK}}$: $RF\ Signal\ Amplitude\ [VP]$

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

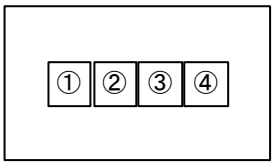


For details, refer to “Application Note for EMI Immunity" in our HP.

Downloaded from Arrow.com.

■ MARKING SPECIFICATION (SOT-23-5)

②③	Product Code	Refer to *Part Marking List*
①④	Lot Number	Alphanumeric Serial Number



1Pin

NOTICE
There can be variation in the marking when different AOI (Automated Optical Inspection) equipment is used. In the case of recognizing the marking characteristic with AOI, please contact our sales or distributor before attempting to use AOI.

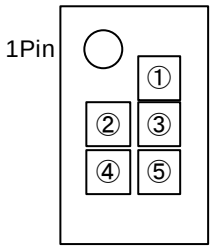
Part Marking List

Product Name	②	③
NJU77000F	1	7
NJU77000AF	1	A
NJU77001F	1	6
NJU77001AF	1	8

Downloaded from Arrow.com.

■ MARKING SPECIFICATION (SC-88A)

②③	Product Code	Refer to *Part Marking List*
①④⑤	Lot Number	Alphanumeric Serial Number



NOTICE
There can be variation in the marking when different AOI (Automated Optical Inspection) equipment is used. In the case of recognizing the marking characteristic with AOI, please contact our sales or distributor before attempting to use AOI.

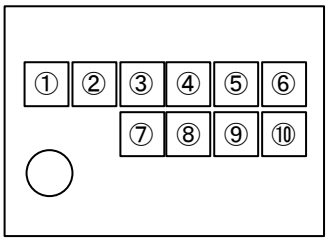
Part Marking List

Product Name	②	③
NJU77001F3	A	H
NJU77001AF3	A	K

Downloaded from Arrow.com.

■ MARKING SPECIFICATION (SOP8 (EMP8))

① to ⑥	Product Code	Refer to *Part Marking List*
⑦ to ⑩	Lot Number	Alphanumeric Serial Number



1Pin

NOTICE
There can be variation in the marking when different AOI (Automated Optical Inspection) equipment is used. In the case of recognizing the marking characteristic with AOI, please contact our sales or distributor before attempting to use AOI.

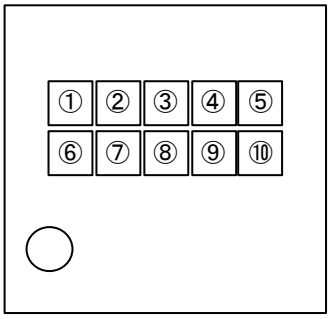
Part Marking List

Product Name	①	②	③	④	⑤	⑥
NJU77002E	7	7	0	0	2	-
NJU77002AE	7	7	0	0	2	A

Downloaded from Arrow.com.

■ MARKING SPECIFICATION (MSOP8 (TVSP8))

① to ⑥	Product Code	Refer to *Part Marking List*
⑦ to ⑩	Lot Number	Alphanumeric Serial Number



1Pin

NOTICE
There can be variation in the marking when different AOI (Automated Optical Inspection) equipment is used. In the case of recognizing the marking characteristic with AOI, please contact our sales or distributor before attempting to use AOI.

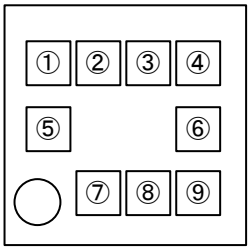
Part Marking List

Product Name	①	②	③	④	⑤	⑥
NJU77002RB1	7	7	0	0	2	-
NJU77002ARB1	7	7	0	0	2	A

Downloaded from Arrow.com.

■ MARKING SPECIFICATION (DFN8-U1 (ESON8-U1))

① to ⑥	Product Code	Refer to *Part Marking List*
⑦ to ⑨	Lot Number	Alphanumeric Serial Number



1Pin

NOTICE

There can be variation in the marking when different AOI (Automated Optical Inspection) equipment is used. In the case of recognizing the marking characteristic with AOI, please contact our sales or distributor before attempting to use AOI.

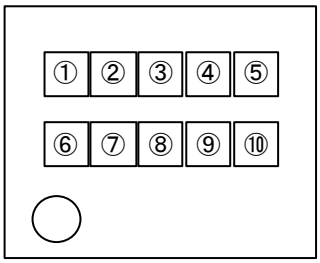
Part Marking List

Product Name	①	②	③	④	⑤	⑥
NJU77002KU1	7	7	0	0	2	-
NJU77002AKU1	7	7	0	0	2	A

Downloaded from Arrow.com.

■ MARKING SPECIFICATION (SSOP14)

① to ⑥	Product Code	Refer to *Part Marking List*
⑦ to ⑩	Lot Number	Alphanumeric Serial Number



1Pin

NOTICE
There can be variation in the marking when different AOI (Automated Optical Inspection) equipment is used. In the case of recognizing the marking characteristic with AOI, please contact our sales or distributor before attempting to use AOI.

Part Marking List

Product Name	①	②	③	④	⑤	⑥
NJU77004V	7	7	0	0	4	-
NJU77004AV	7	7	0	0	4	A

Downloaded from Arrow.com.

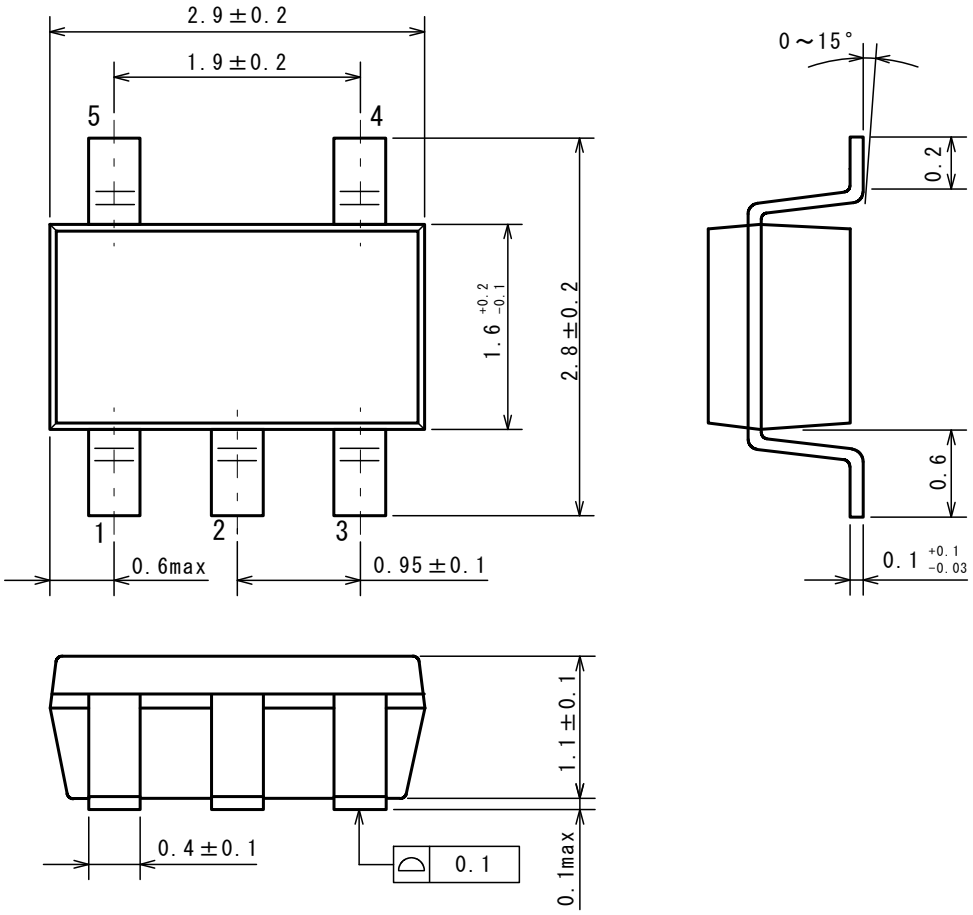
Nisshinbo Micro Devices Inc.

SOT-23-5

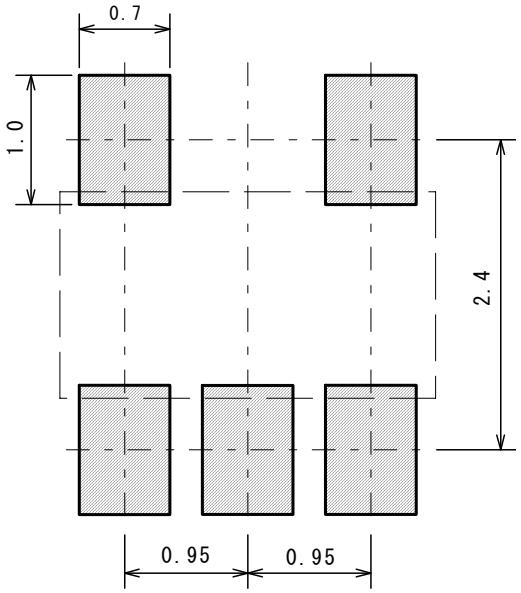
PI-SOT-23-5-E-B

■ PACKAGE DIMENSIONS

UNIT: mm



■ EXAMPLE OF SOLDER PADS DIMENSIONS



Downloaded from Arrow.com.

Nisshinbo Micro Devices Inc.

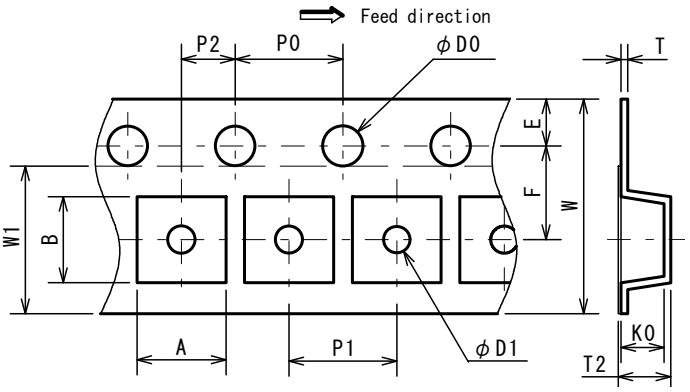
SOT-23-5

PI-SOT-23-5-E-B

■ PACKING SPEC

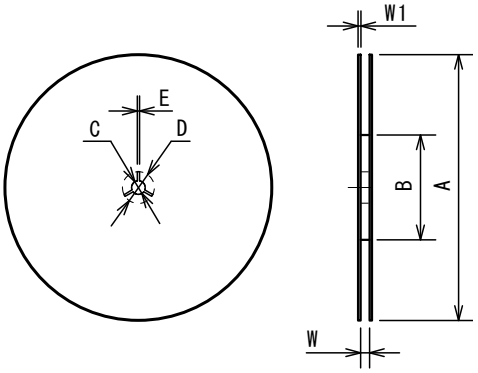
UNIT: mm

TAPING DIMENSIONS



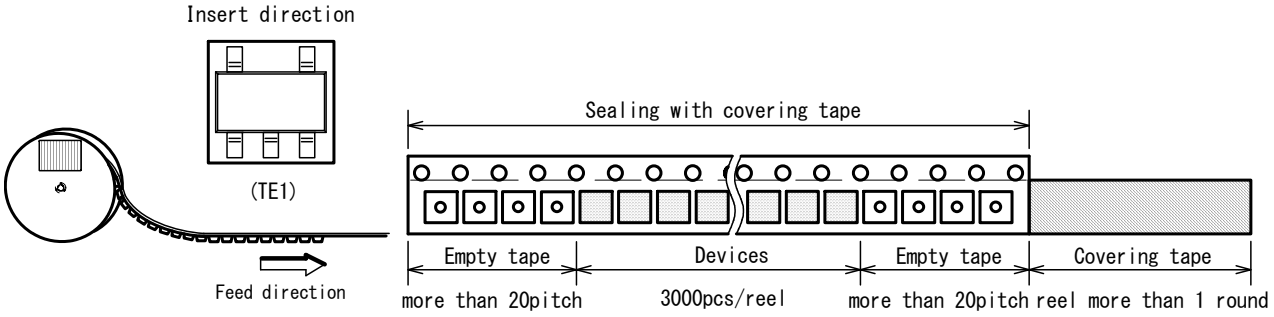
SYMBOL	DIMENSION	REMARKS
A	3.3±0.1	BOTTOM DIMENSION
B	3.2±0.1	BOTTOM DIMENSION
D0	1.55	
D1	1.05	
E	1.75±0.1	
F	3.5±0.05	
P0	4.0±0.1	
P1	4.0±0.1	
P2	2.0±0.05	
T	0.25±0.05	
T2	1.82	
K0	1.5±0.1	
W	8.0±0.3	
W1	5.5	THICKNESS 0.1MAX

REEL DIMENSIONS

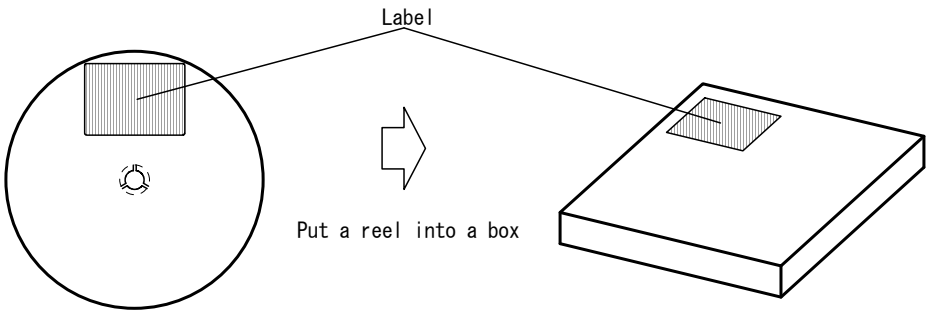


SYMBOL	DIMENSION
A	φ180±1
B	φ 60±1
C	φ 13±0.2
D	φ 21±0.8
E	2±0.5
W	9±0.5
W1	1.2±0.2

TAPING STATE



PACKING STATE



Downloaded from Arrow.com.

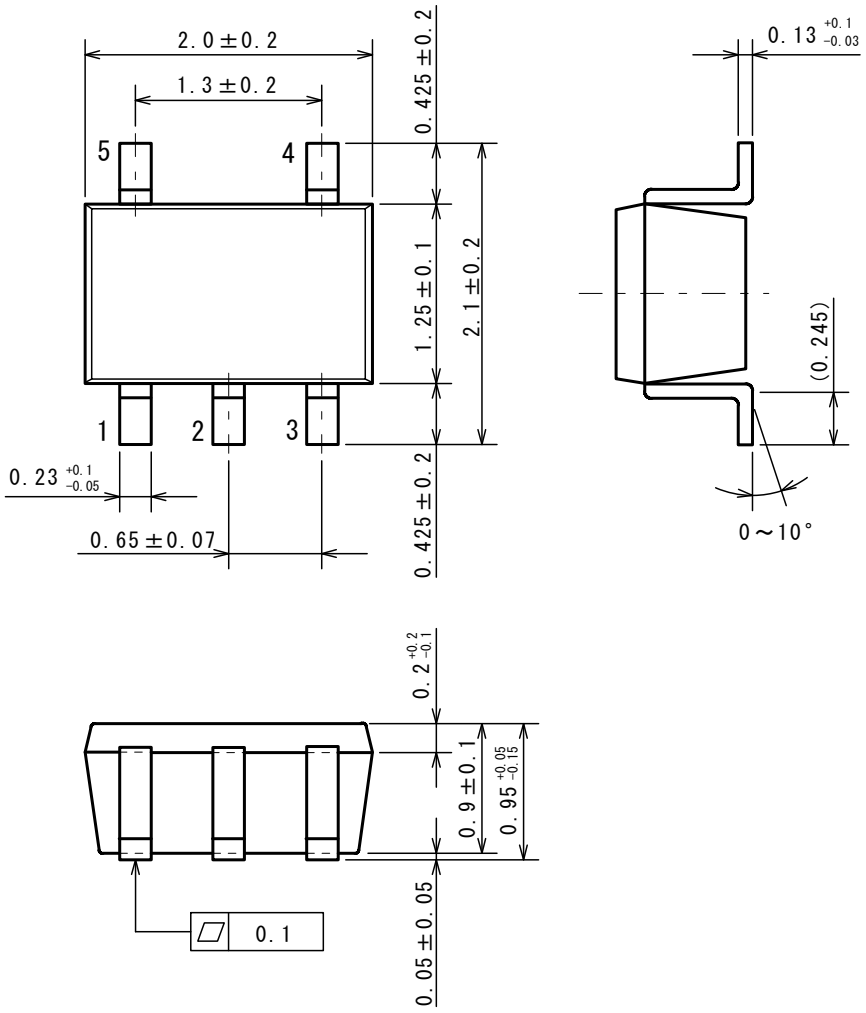
Nisshinbo Micro Devices Inc.

SC-88A

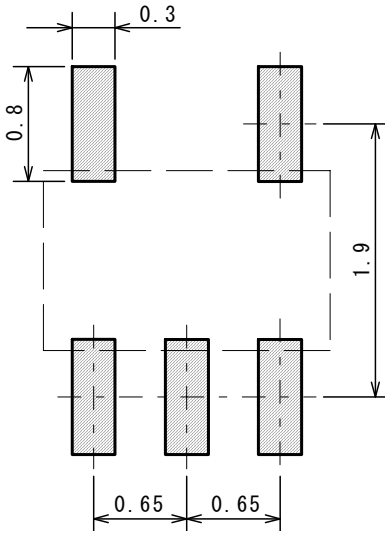
PI-SC-88A-E-B

■ PACKAGE DIMENSIONS

UNIT: mm



■ EXAMPLE OF SOLDER PADS DIMENSIONS



Downloaded from Arrow.com.

Nisshinbo Micro Devices Inc.

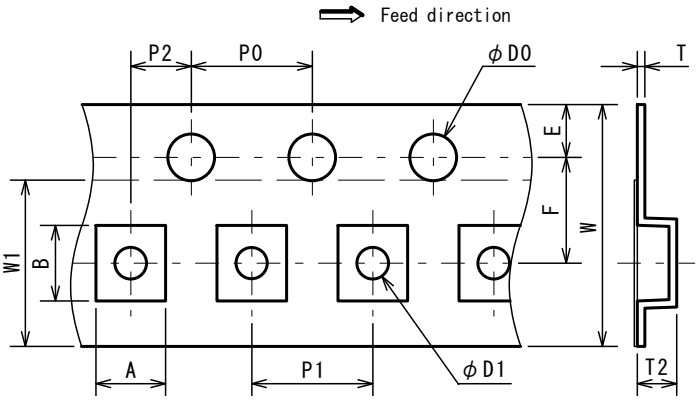
SC-88A

PI-SC-88A-E-B

■ PACKING SPEC

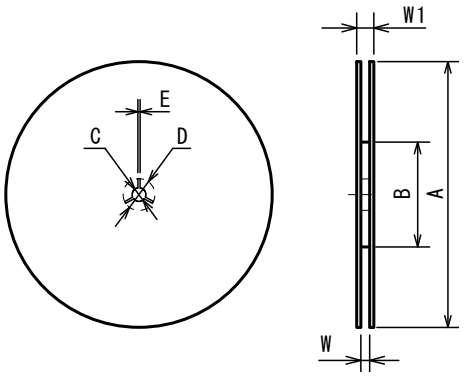
UNIT: mm

TAPING DIMENSIONS



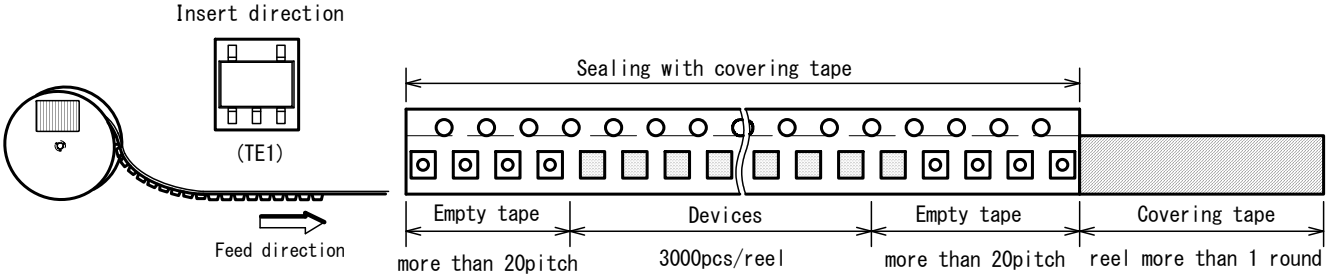
SYMBOL	DIMENSION	REMARKS
A	2.3±0.1	BOTTOM DIMENSION
B	2.5±0.1	BOTTOM DIMENSION
D0	1.55±0.05	
D1	1.05±0.05	
E	1.75±0.1	
F	3.5±0.05	
P0	4.0±0.1	
P1	4.0±0.1	
P2	2.0±0.05	
T	0.25±0.05	
T2	1.3±0.1	
W	8.0±0.2	
W1	5.5	THICKNESS 0.1max

REEL DIMENSIONS

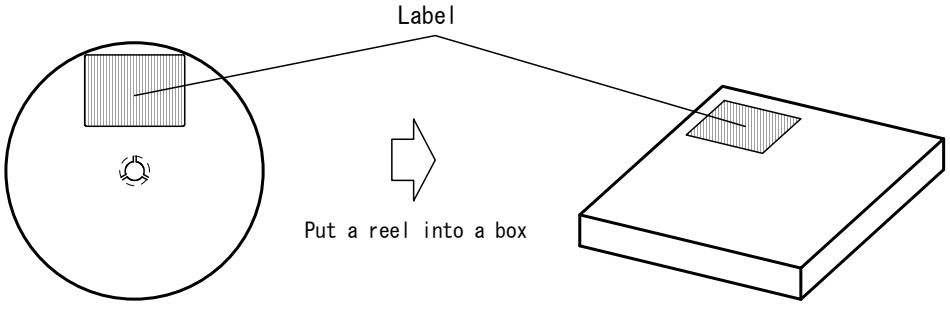


SYMBOL	DIMENSION
A	$\phi 180^{0}_{-3}$
B	$\phi 60^{+1}_{0}$
C	φ 13±0.2
D	φ 21±0.8
E	2±0.5
W	9^{+1}_{0}
W1	11.4±1

TAPING STATE



PACKING STATE



Downloaded from Arrow.com.

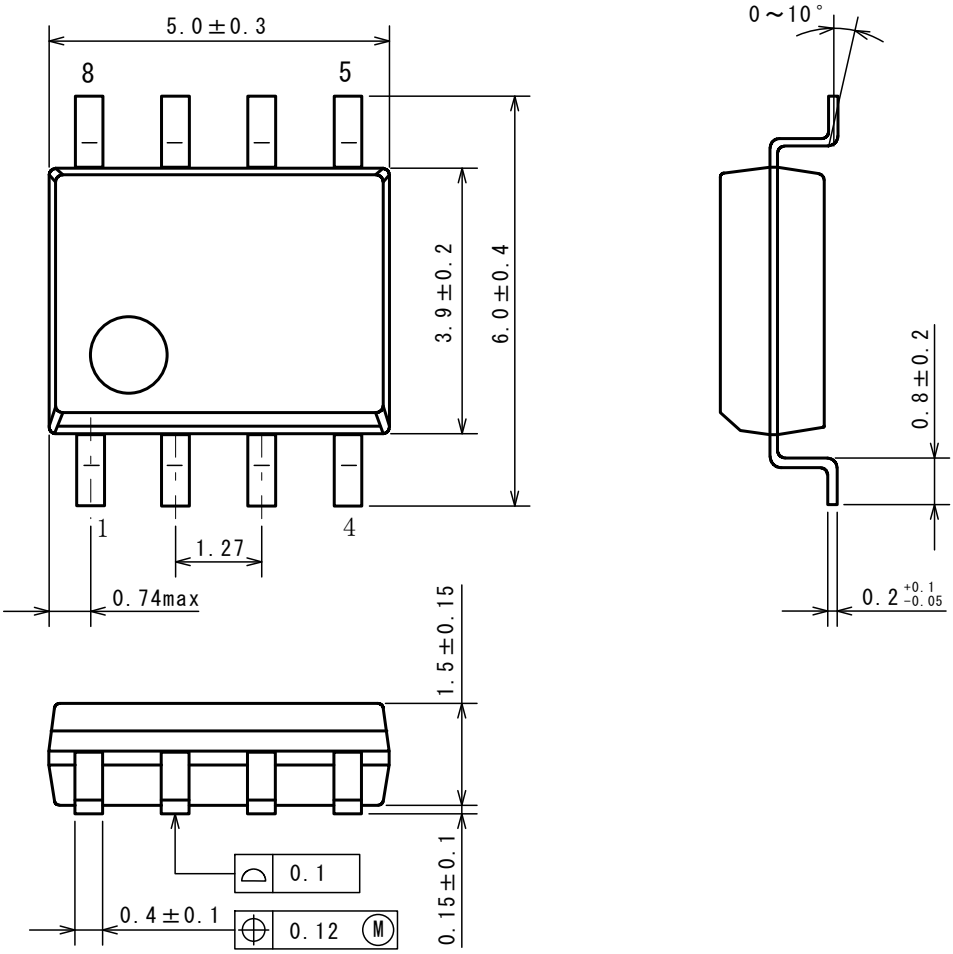
Nisshinbo Micro Devices Inc.

SOP8 JEDEC 150mil(EMP8)

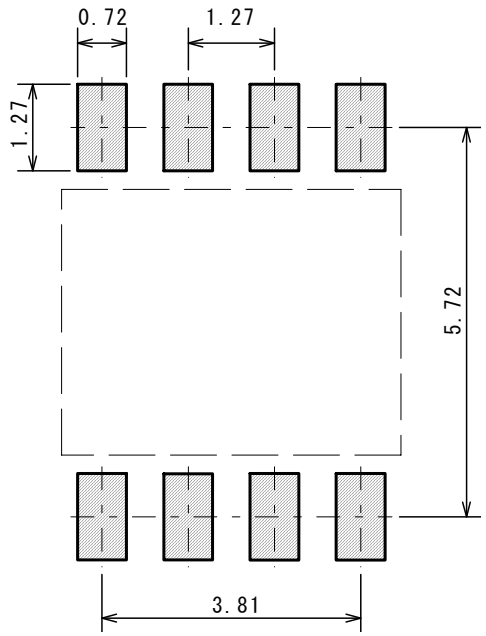
PI-SOP8 JEDEC 150mil-E-B

■ PACKAGE DIMENSIONS

UNIT: mm



■ EXAMPLE OF SOLDER PADS DIMENSIONS



Downloaded from Arrow.com.

Nisshinbo Micro Devices Inc.

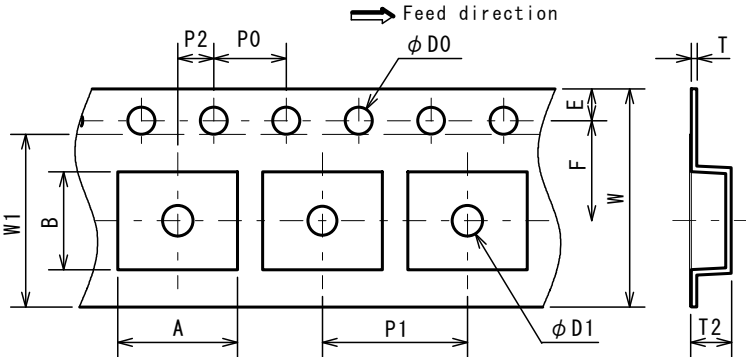
SOP8 JEDEC 150mil(EMP8)

PI-SOP8 JEDEC 150mil-E-B

■ PACKING SPEC

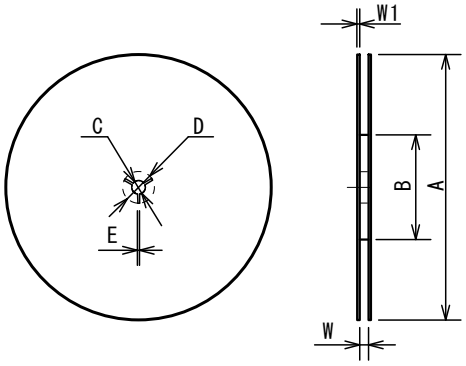
UNIT: mm

TAPING DIMENSIONS



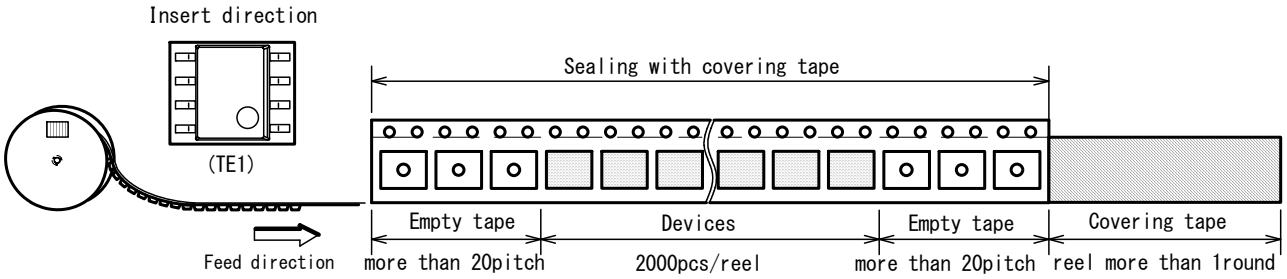
SYMBOL	DIMENSION	REMARKS
A	6.6	BOTTOM DIMENSION
B	5.4	BOTTOM DIMENSION
D0	$1.5^{+0.1}_{0}$	
D1	1.7±0.1	
E	1.75±0.1	
F	5.5±0.05	
P0	4.0±0.1	
P1	8.0±0.1	
P2	2.0±0.05	
T	0.30±0.05	
T2	2.2	
W	12.0±0.3	
W1	9.5	THICKNESS 0.1max

REEL DIMENSIONS

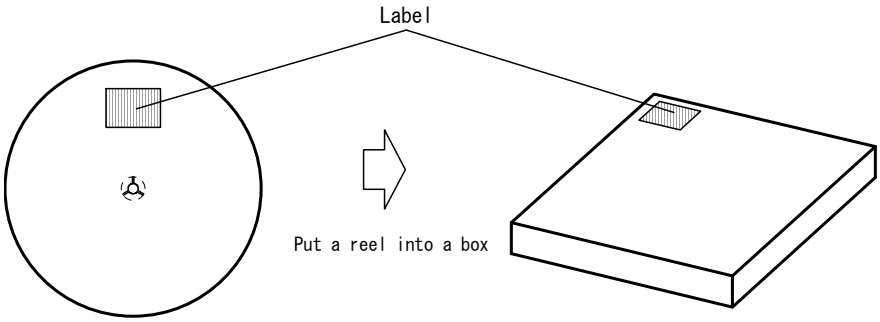


SYMBOL	DIMENSION
A	φ330±2
B	φ 80±1
C	φ 13±0.2
D	φ 21±0.8
E	2±0.5
W	13.5±0.5
W1	2.0±0.2

TAPING STATE



PACKING STATE



Downloaded from Arrow.com.

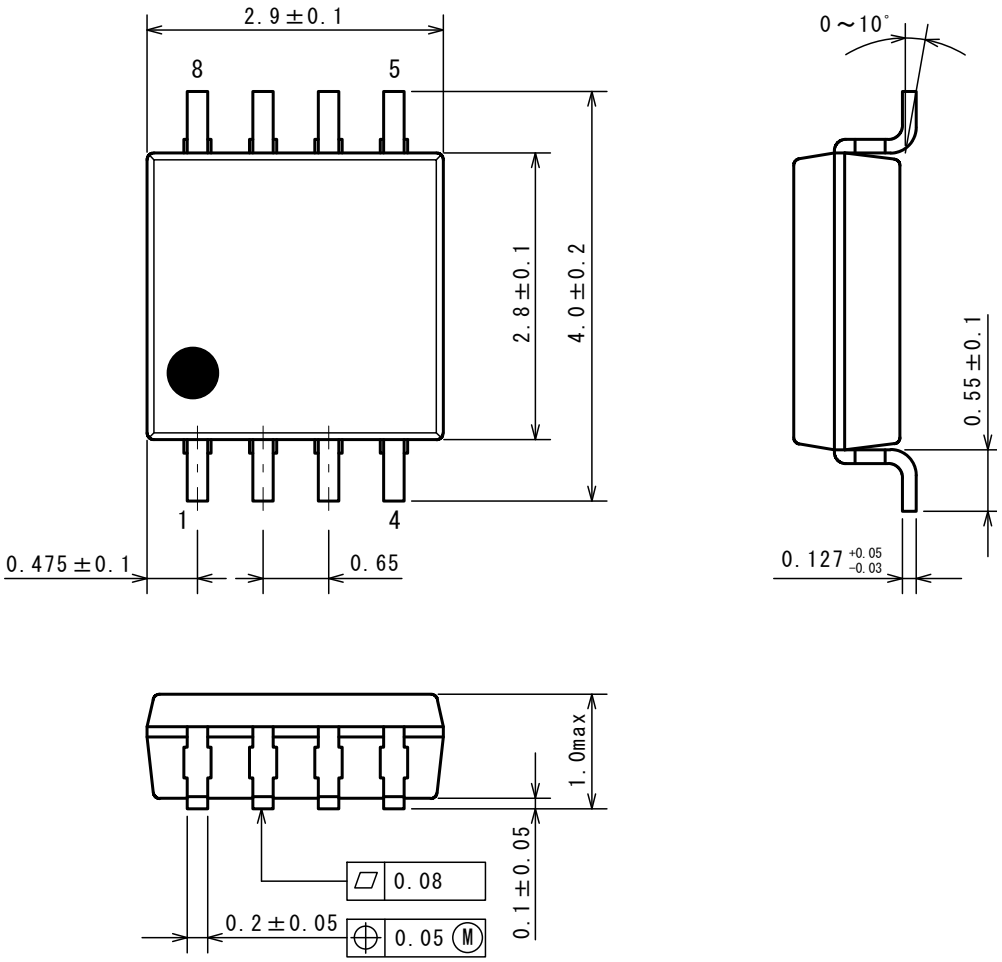
Nisshinbo Micro Devices Inc.

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

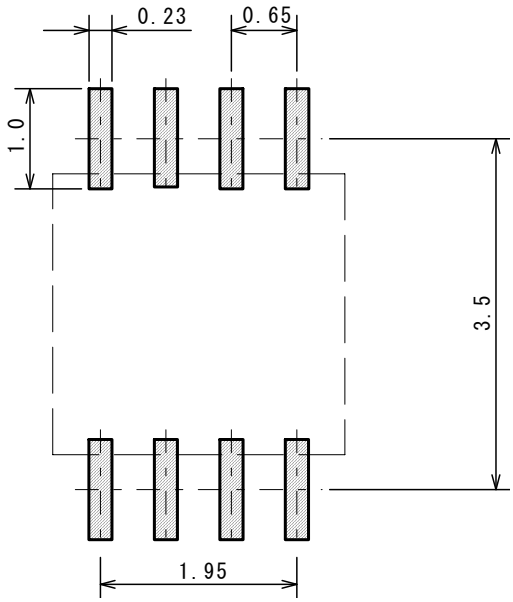
PI-MSOP8 / THIN TYPE-E-C

■ PACKAGE DIMENSIONS

UNIT: mm



■ EXAMPLE OF SOLDER PADS DIMENSIONS



Downloaded from Arrow.com.

Nisshinbo Micro Devices Inc.

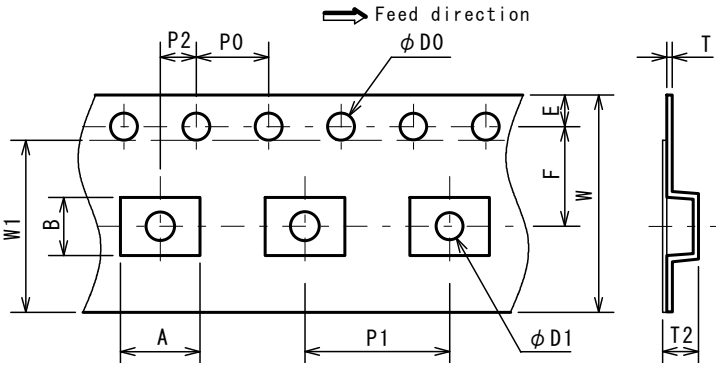
MSOP8 MEET JEDEC MO-187-DA / THIN TYPE (TVSP8)

PI-MSOP8 / THIN TYPE-E-C

■ PACKING SPEC

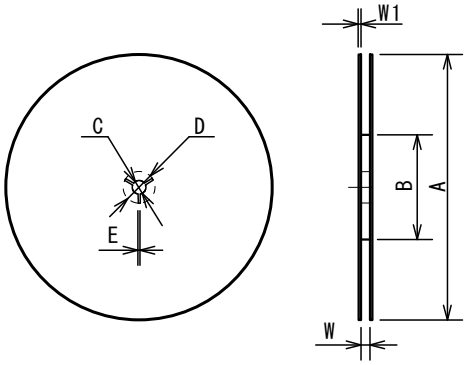
UNIT: mm

TAPING DIMENSIONS



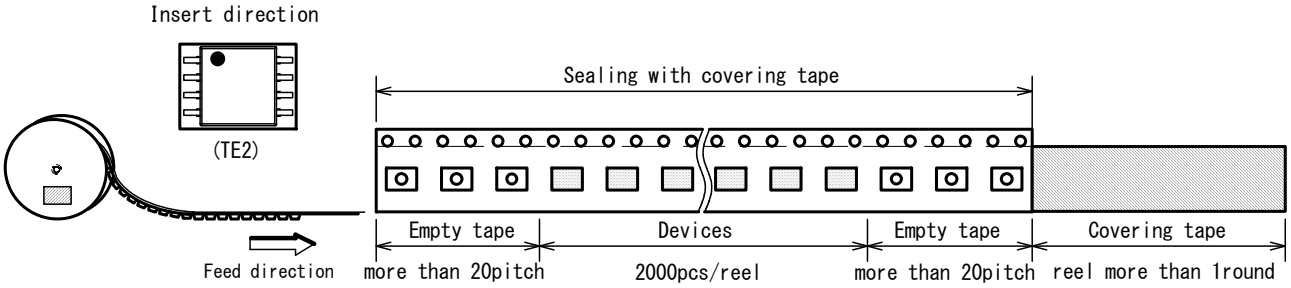
SYMBOL	DIMENSION	REMARKS
A	4.4	BOTTOM DIMENSION
B	3.2	BOTTOM DIMENSION
D0	$1.5^{+0.1}_{0}$	
D1	$1.5^{+0.1}_{0}$	
E	1.75±0.1	
F	5.5±0.05	
P0	4.0±0.1	
P1	8.0±0.1	
P2	2.0±0.05	
T	0.30±0.05	
T2	1.75 (MAX.)	
W	12.0±0.3	
W1	9.5	THICKNESS 0.1max

REEL DIMENSIONS

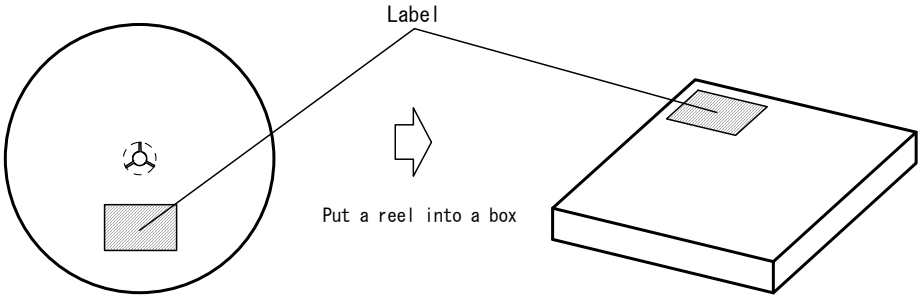


SYMBOL	DIMENSION
A	φ254±2
B	φ100±1
C	φ 13±0.2
D	φ 21±0.8
E	2±0.5
W	13.5±0.5
W1	2.0±0.2

TAPING STATE



PACKING STATE



Downloaded from Arrow.com.

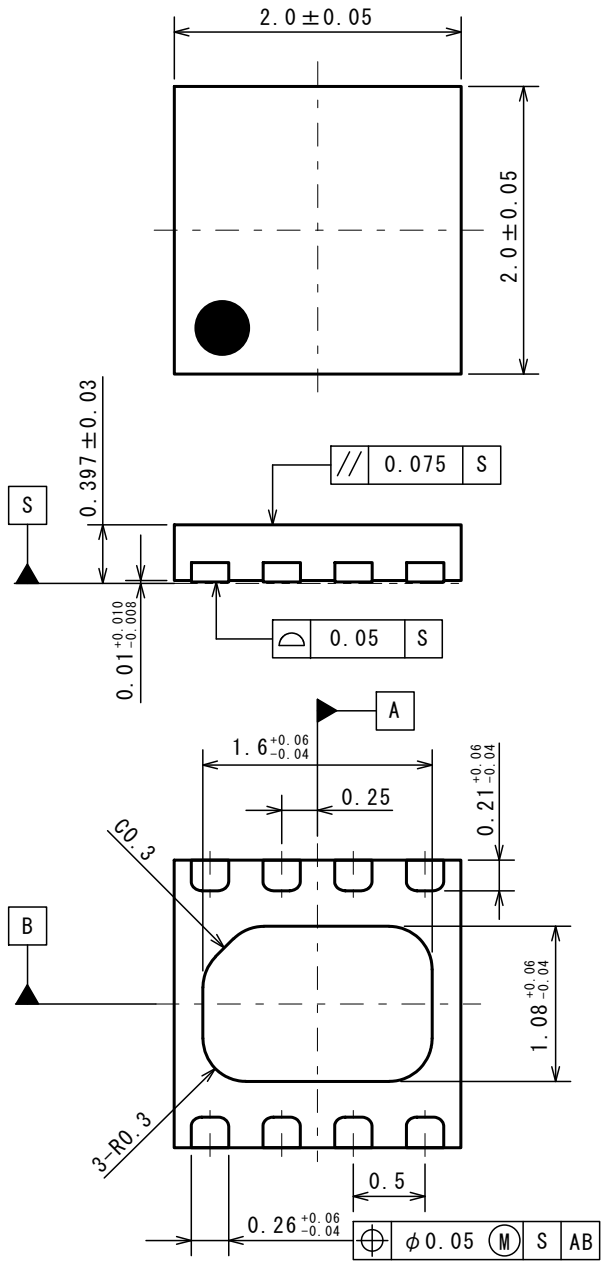
Nisshinbo Micro Devices Inc.

DFN8-U1

PI-DFN8-U1-E-C

■ PACKAGE DIMENSIONS

UNIT: mm



Downloaded from Arrow.com.

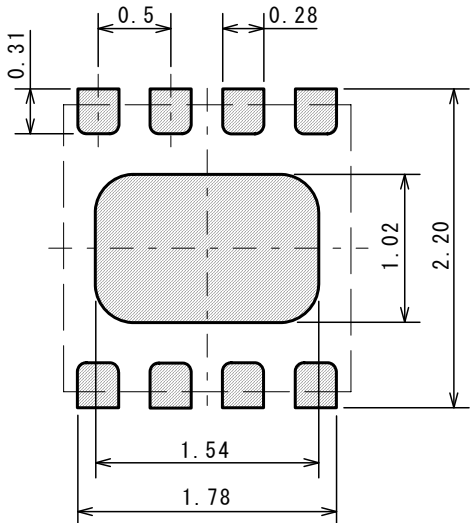
Nisshinbo Micro Devices Inc.

DFN8-U1

PI-DFN8-U1-E-C

■ EXAMPLE OF SOLDER PADS DIMENSIONS

UNIT: mm



Downloaded from Arrow.com.

Nisshinbo Micro Devices Inc.

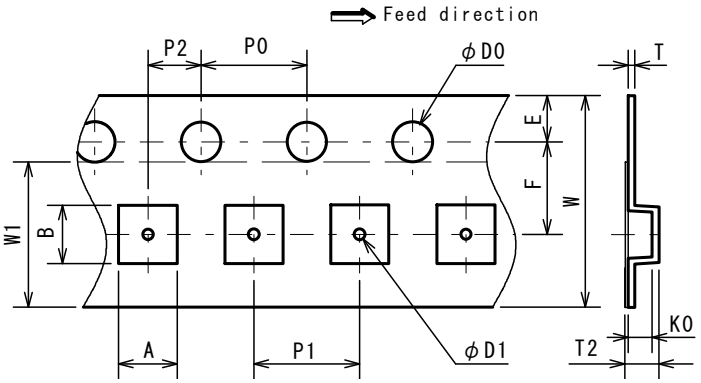
DFN8-U1

PI-DFN8-U1-E-C

■ PACKING SPEC

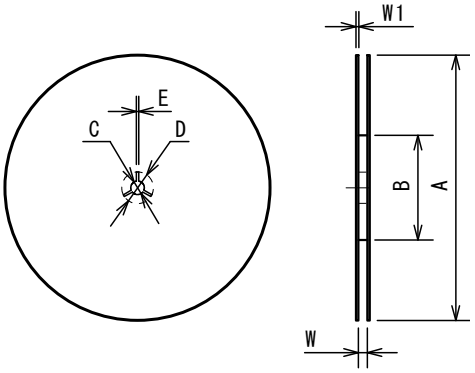
UNIT: mm

TAPING DIMENSIONS



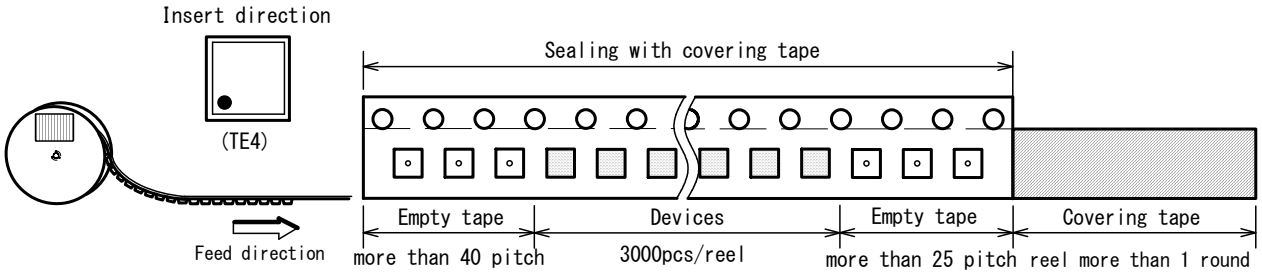
SYMBOL	DIMENSION	REMARKS
A	2.25±0.05	BOTTOM DIMENSION
B	2.25±0.05	BOTTOM DIMENSION
D0	$1.5^{+0.1}_{0}$	
D1	0.5±0.1	
E	1.75±0.1	
F	3.5±0.05	
P0	4.0±0.1	
P1	4.0±0.1	
P2	2.0±0.05	
T	0.25±0.05	
T2	1.00±0.07	
K0	0.65±0.05	
W	8.0±0.2	
W1	5.5	THICKNESS 0.1max

REEL DIMENSIONS

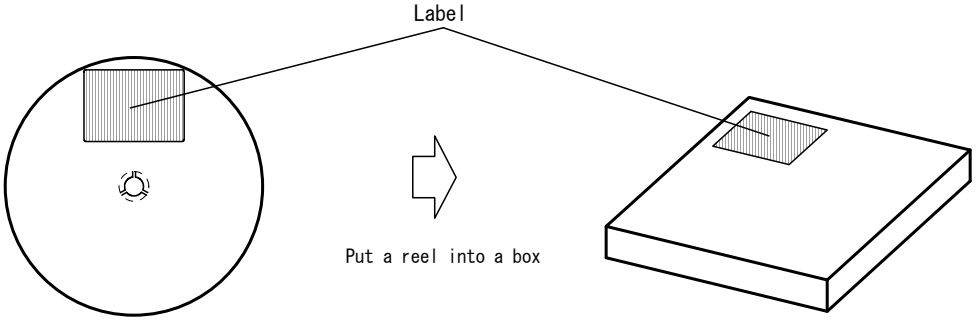


SYMBOL	DIMENSION
A	$\phi 180^{0}_{-1.5}$
B	$\phi 60^{+1}_{0}$
C	φ 13±0.2
D	φ 21±0.8
E	2±0.5
W	$9^{+0.3}_{0}$
W1	1.2

TAPING STATE



PACKING STATE



Downloaded from Arrow.com.

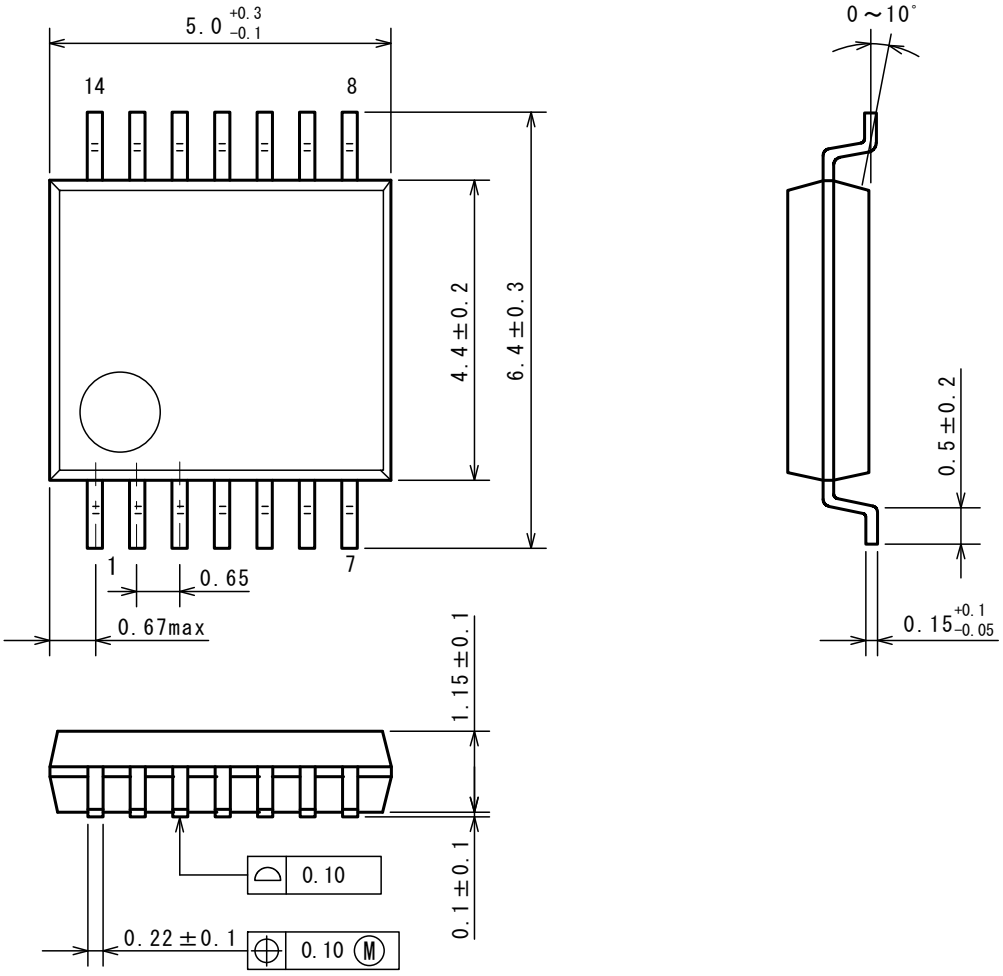
Nisshinbo Micro Devices Inc.

SSOP14

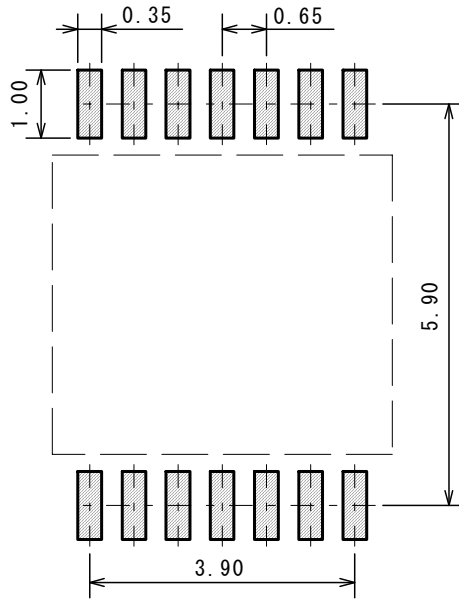
PI-SSOP14-E-B

■ PACKAGE DIMENSIONS

UNIT: mm



■ EXAMPLE OF SOLDER PADS DIMENSIONS



Downloaded from Arrow.com.

Nisshinbo Micro Devices Inc.

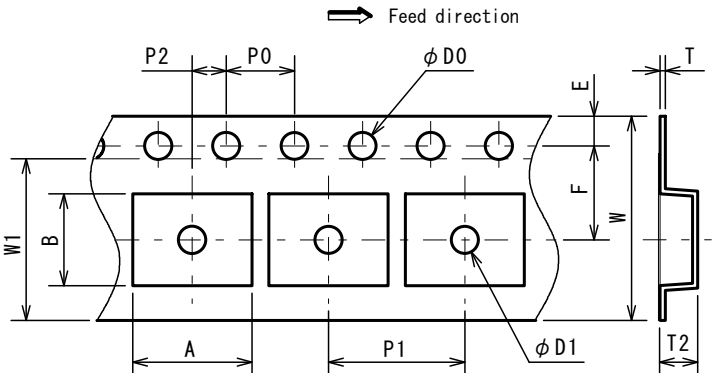
SSOP14

PI-SSOP14-E-B

■ PACKING SPEC

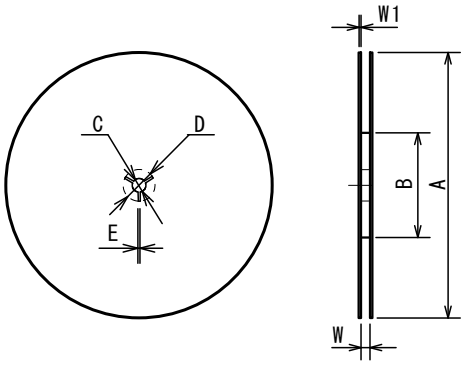
UNIT: mm

TAPING DIMENSIONS



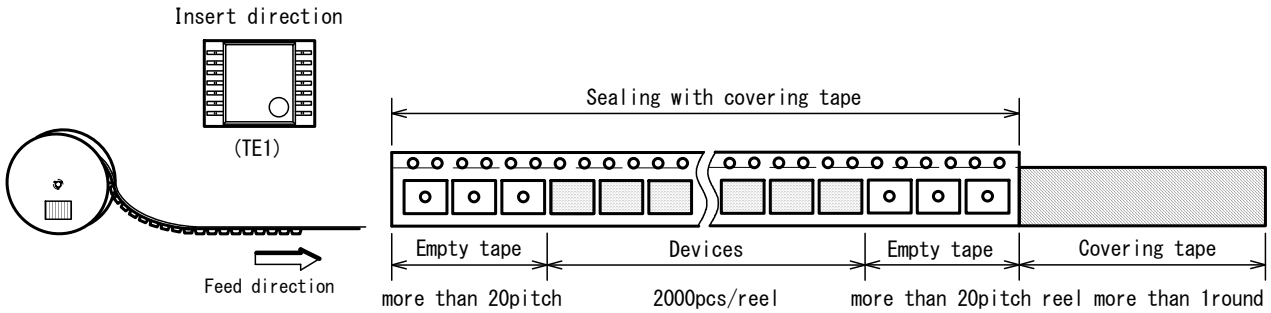
SYMBOL	DIMENSION	REMARKS
A	6.95	BOTTOM DIMENSION
B	5.4	BOTTOM DIMENSION
D0	1.55±0.05	
D1	1.55±0.1	
E	1.75±0.1	
F	5.5±0.05	
P0	4.0±0.1	
P1	8.0±0.1	
P2	2.0±0.05	
T	0.3±0.05	
T2	2.2	
W	12.0±0.3	
W1	9.5	THICKNESS 0.1max

REEL DIMENSIONS

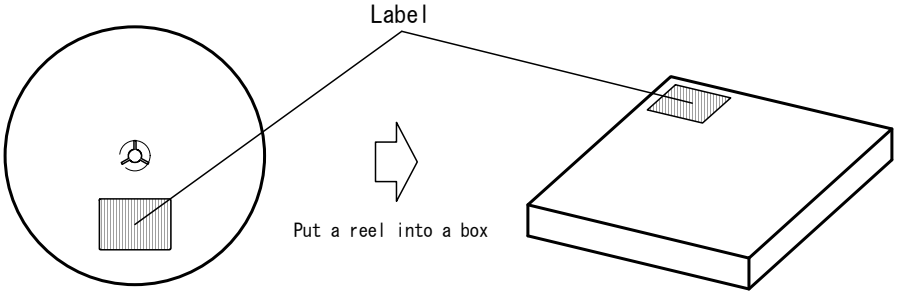


SYMBOL	DIMENSION
A	φ254±2
B	φ100±1
C	φ 13±0.2
D	φ 21±0.8
E	2±0.5
W	13.5±0.5
W1	2±0.2

TAPING STATE



PACKING STATE



Downloaded from Arrow.com.

■ REVISION HISTORY

Date	Revision	Contents of Changes
March 31, 2025	Ver.1.7	Changed datasheet format. Junction Temperature T_j = 125°C max, ⇒ T_j = 150°C max. Operating Temperature Range T_a = -40°C to 105°C ⇒ T_a = -40°C to 125°C Typical characteristics: Due to the operating temperature expansion, the curves from 105°C to 125°C change to solid lines. Electrical Characteristics: Note "*1 Input offset voltage and drift, Input bias and offset current are positive or negative, its absolute values are listed in electrical characteristics." added.

Downloaded from Arrow.com.

1. The products and the product specifications described in this document are subject to change or discontinuation of production without notice for reasons such as improvement. Therefore, before deciding to use the products, please refer to our sales representatives for the latest information thereon.
2. The materials in this document may not be copied or otherwise reproduced in whole or in part without the prior written consent of us.
3. This product and any technical information relating thereto are subject to complementary export controls (so-called KNOW controls) under the Foreign Exchange and Foreign Trade Law, and related politics ministerial ordinance of the law. (Note that the complementary export controls are inapplicable to any application-specific products, except rockets and pilotless aircraft, that are insusceptible to design or program changes.) Accordingly, when exporting or carrying abroad this product, follow the Foreign Exchange and Foreign Trade Control Law and its related regulations with respect to the complementary export controls.
4. The technical information described in this document shows typical characteristics and example application circuits for the products. The release of such information is not to be construed as a warranty of or a grant of license under our or any third party's intellectual property rights or any other rights.
5. The products listed in this document are intended and designed for use as general electronic components in standard applications (office equipment, telecommunication equipment, measuring instruments, consumer electronic products, amusement equipment etc.). Those customers intending to use a product in an application requiring extreme quality and reliability, for example, in a highly specific application where the failure or misoperation of the product could result in human injury or death should first contact us.
    - Aerospace Equipment
    - Equipment Used in the Deep Sea
    - Power Generator Control Equipment (nuclear, steam, hydraulic, etc.)
    - Life Maintenance Medical Equipment
    - Fire Alarms / Intruder Detectors
    - Vehicle Control Equipment (automotive, airplane, railroad, ship, etc.)
    - Various Safety Devices
    - Traffic control system
    - Combustion equipment

    In case your company desires to use this product for any applications other than general electronic equipment mentioned above, make sure to contact our company in advance. Note that the important requirements mentioned in this section are not applicable to cases where operation requirements such as application conditions are confirmed by our company in writing after consultation with your company.
6. We are making our continuous effort to improve the quality and reliability of our products, but semiconductor products are likely to fail with certain probability. In order to prevent any injury to persons or damages to property resulting from such failure, customers should be careful enough to incorporate safety measures in their design, such as redundancy feature, fire containment feature and fail-safe feature. We do not assume any liability or responsibility for any loss or damage arising from misuse or inappropriate use of the products.
7. The products have been designed and tested to function within controlled environmental conditions. Do not use products under conditions that deviate from methods or applications specified in this datasheet. Failure to employ the products in the proper applications can lead to deterioration, destruction or failure of the products. We shall not be responsible for any bodily injury, fires or accident, property damage or any consequential damages resulting from misuse or misapplication of the products.
8. Quality Warranty
    8-1. Quality Warranty Period
    In the case of a product purchased through an authorized distributor or directly from us, the warranty period for this product shall be one (1) year after delivery to your company. For defective products that occurred during this period, we will take the quality warranty measures described in section 8-2. However, if there is an agreement on the warranty period in the basic transaction agreement, quality assurance agreement, delivery specifications, etc., it shall be followed.
    8-2. Quality Warranty Remedies
    When it has been proved defective due to manufacturing factors as a result of defect analysis by us, we will either deliver a substitute for the defective product or refund the purchase price of the defective product.
    Note that such delivery or refund is sole and exclusive remedies to your company for the defective product.
    8-3. Remedies after Quality Warranty Period
    With respect to any defect of this product found after the quality warranty period, the defect will be analyzed by us. On the basis of the defect analysis results, the scope and amounts of damage shall be determined by mutual agreement of both parties. Then we will deal with upper limit in Section 8-2. This provision is not intended to limit any legal rights of your company.
9. Anti-radiation design is not implemented in the products described in this document.
10. The X-ray exposure can influence functions and characteristics of the products. Confirm the product functions and characteristics in the evaluation stage.
11. WLCSP products should be used in light shielded environments. The light exposure can influence functions and characteristics of the products under operation or storage.
12. Warning for handling Gallium and Arsenic (GaAs) products (Applying to GaAs MMIC, Photo Reflector). These products use Gallium (Ga) and Arsenic (As) which are specified as poisonous chemicals by law. For the prevention of a hazard, do not burn, destroy, or process chemically to make them as gas or power. When the product is disposed of, please follow the related regulation and do not mix this with general industrial waste or household waste.
13. Please contact our sales representatives should you have any questions or comments concerning the products or the technical information.

NISSHINBO

Nisshinbo Micro Devices Inc.

Official website
https://www.nisshinbo-microdevices.co.jp/en/

Purchase information
https://www.nisshinbo-microdevices.co.jp/en/buy/

Downloaded from Arrow.com.