PRELIMINARY SPECIFICATIONS SUBJECT TO CHANGE

NJU7721x / NJU7722x

Ultra Low Power, Excellent EMI Immunity, Rail-to-Rail Input, CMOS Comparator

FEATURES

(V^+ = 3V, Typical value, T_a = 25°C)

- Ultra Low Power
  - Single 0.7µA (all channel)
  - Dual 1.2µA (all channel)
- Integrated EMI Filter EMIRR = 100dB (f = 1.8GHz)
- Rail-to-Rail Input
  -Common-Mode Input Voltage Range V^- to V^++0.2V
- Dynamic Transient Stabilizer ™
  - Rail-to-Rail Input with less propagation delay fluctuation
- 5.5V Input Tolerant
- Output Drive Current
  - Sink (V_O = 1V) 20mA
  - Source (V_O = 2V, NJU7721x) 20mA
- Push-Pull Output (NJU7721x)
- Open-Drain Output (NJU7722x)
- Supply Voltage 1.7V to 5.5V
- Propagation Delay 9.8µs
- Lead-less Small Package
  DFN6-G1 (ESON6-G1) (1.6 x 1.6 mm)
  DFN8-U1 (ESON8-U1) (2.0 x 2.0 mm)
- Standard Small Package
  SOT-23-5, SC-88A
  MSOP8 (VSP8)

APPLICATIONS

- Portable and battery-powered devices
- Alarm and Monitoring Circuits
- Gas / Smoke Detector
- Servo drive position sensor
- Window comparators
- Voltage Level Translators

DESCRIPTION

The NJU7721x / NJU7722x series are Rail-to-Rail input comparator featuring ultralow supply current of 0.7µA.

Designed to operate from 1.7V to 5.5V, and rail-to-rail input voltage range, make them suitable for use in a wide variety of battery-powered single supply applications.

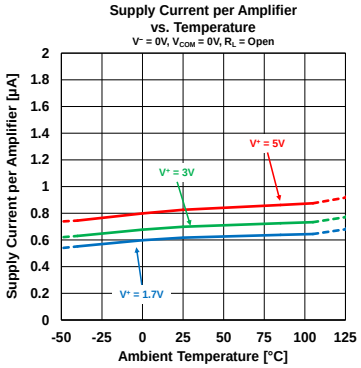
The NJU7721x, NJU7722x series features the newly developed circuit technology Dynamic Transient Stabilizer ™ realizes rail-to-rail input with suppressed fluctuation of propagation delay time.

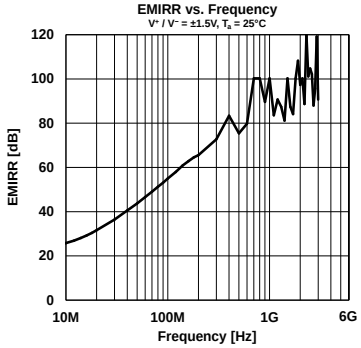
Integrated high EMI immunity can reduced malfunctions caused by RF-noises from mobile phones and other electronic devices. Also, the input voltage can be input up to 5.5V beyond the positive supply rail, and no output inversion even in this state. These make them well suited for precision voltage monitoring in harsh, noisy environments.

NJU7721x / NJU7722x series are available in ultra-small, leadless package measuring 1.6 mm x 1.6 mm (DFN6) and 2.0 mm x 2.0 mm (DFN8), and industrial standard leaded packages SOT-23-5, SC-88A, and MSOP8 (VSP8).

NJU772xx Series Comparator Lineup

Product Name	Output	Supply Current	Propagation Delay
NJU7721x	Push-Pull	0.7µA/ch	9.8µs
NJU7722x	Open-Drain	0.7µA/ch	9.8µs
NJU7723x	Push-Pull	6.0µA/ch	780ns
NJU7724x	Open-Drain	6.0µA/ch	840ns
NJU7725x	Push-Pull	140µA/ch	42ns
NJU7726x	Open-Drain	140µA/ch	125ns





■ PRODUCT NAME INFORMATION

NJU772XX a (bbb)

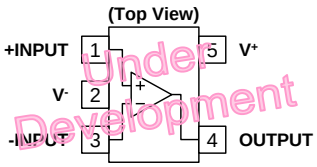
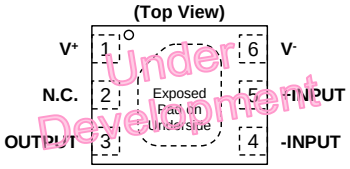
Description of configuration

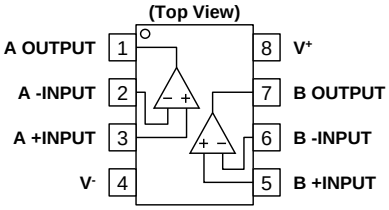
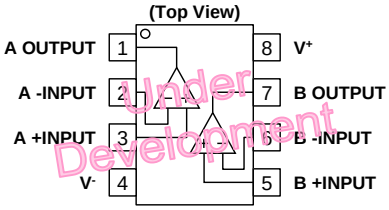
Suffix	Item	Description
a	Package code	Indicates the package. Refer to the order information.
bbb	Packing	Refer to the packing specifications.

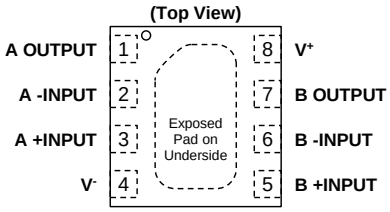
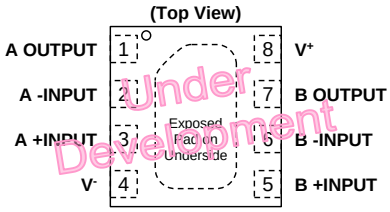
■ ORDER INFORMATION

Product Name (Insert direction)	Package	RoHS	Halogen-Free	Terminal Finish	Marking	Weight (mg)	MOQ (pcs)
NJU77210F (TE1)	SOT-23-5	Yes	Yes	Sn2Bi	D3	15	3000
NJU77210F3 (TE1)	SC-88A	Yes	Yes	Sn2Bi	F9	7.46	3000
NJU77210KG1 (TE3)	DFN6-G1 (ESON6-G1)	Yes	Yes	Sn2Bi	77210	3.5	3000
NJU77220F (TE1)	SOT-23-5	Yes	Yes	Sn2Bi	D4	15	3000
NJU77220F3 (TE1)	SC-88A	Yes	Yes	Sn2Bi	FA	7.46	3000
NJU77220KG1 (TE3)	DFN6-G1 (ESON6-G1)	Yes	Yes	Sn2Bi	77220	3.5	3000
NJU77212R (TE1)	MSOP8 (VSP8)	Yes	Yes	Sn2Bi	77212	21	2000
NJU77212KU1 (TE3)	DFN8-U1 (ESON8-U1)	Yes	Yes	Sn2Bi	77212	5.3	3000
NJU77222R (TE1)	MSOP8 (VSP8)	Yes	Yes	Sn2Bi	77222	21	2000
NJU77222KU1 (TE3)	DFN8-U1 (ESON8-U1)	Yes	Yes	Sn2Bi	77222	5.3	3000

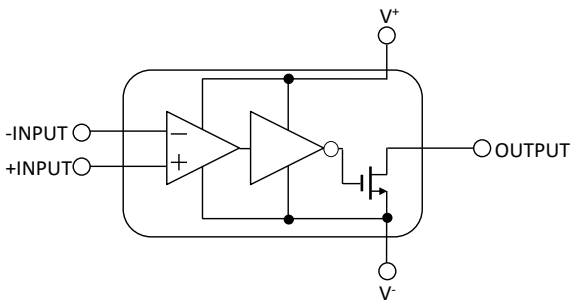
■ PIN DESCRIPTIONS

Product Name	NJU77210F NJU77220F	NJU77210F3 NJU77220F3	NJU77210KG1 NJU77220KG1
Package	SOT-23-5	SC-88A	DFN6-G1 (ESON6-G1)
Pin Functions			 *Connect to exposed pad to V⁻

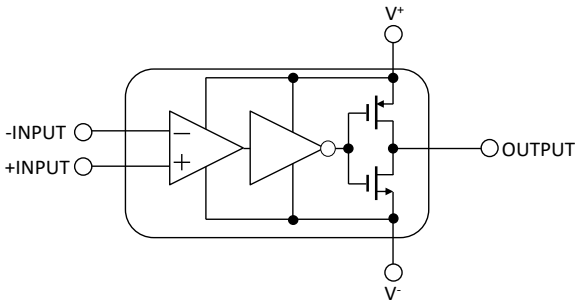
Product Name	NJU77212R	NJU77222R
Package	MSOP8 (VSP8)	MSOP8 (VSP8)
Pin Functions		

Product Name	NJU77212KU1	NJU77222KU1
Package	DFN8-U1 (ESON8-U1)	DFN8-U1 (ESON8-U1)
Pin Functions	 *Connect to exposed pad to V⁻	 *Connect to exposed pad to V⁻

■ BLOCK DIAGRAM



Open-Drain Output



Push-Pull Output

■ ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	Rating	Unit
Supply Voltage	$V^+ - V^-$	6.5	V
Input Voltage*1	V_{IN}	$V^- - 0.3$ to $V^- + 6.5$	V
Input Current *1	I_{IN}	-10	mA
Differential Input Voltage *2	V_{ID}	±6.5	V
Output Terminal Input Voltage	V_O	$V^- - 0.3$ to $V^+ + 0.3$*3	V
		$V^- - 0.3$ to $V^- + 6.5$*4	
Power Dissipation (T_a = 25°C) SOT-23-5 SC-88A DFN6-G1 (ESON6-G1) MSOP8 (VSP8) DFN8-U1 (ESON8-U1)	P_D	2-Layer / 4-Layer 390*5 / 520*5 280*5 / 390*5 260*6 / 950*6 400*5 / 530*5 360*6 / 940*6	mW
Storage Temperature	T_{stg}	-65 to 125	°C
Junction Temperature	T_j	125	°C

*1 Input voltages outside the supply voltage will be clamped by ESD protection diodes. If the input voltage exceeds the supply voltage, the current must be limited 10 mA or less by using a restriction resistance.

*2 Differential voltage is the voltage difference between +INPUT and −INPUT. The absolute maximum input voltage is limited at 6.5V.

*3 Rating of NJU7721X series. The output terminal input voltage is limited at 6.5V.

*4 Rating of NJU7722X series. The output terminal input voltage is limited at 6.5V.

*5 2-Layer: Mounted on glass epoxy board (76.2 mm × 114.3 mm × 1.6 mm: based on EIA/JEDEC standard, 2-layer FR-4).
4-Layer: 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.

*6 2-Layer: Mounted on glass epoxy board (101.5 mm × 114.5 mm × 1.6 mm: based on EIA/JEDEC standard, 2-layer FR-4) with exposed pad.
4-Layer: 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.)

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		Unit
	Thermal Resistance (Θja)	Thermal Characterization Parameter (ψjt)	
SOT-23-5 SC-88A DFN6-G1 (ESON6-G1) MSOP8 (VSP8) DFN8-U1 (ESON8-U1)	2-Layer / 4-Layer 256*6/192*6 357*6/255*6 385*7/104*7 250*6/189*6 278*7/104*7	2-Layer / 4-Layer 67*6 / 58*6 91*6 / 73*6 64*7 / 26*7 62*6 / 53*6 42*7 / 25*7	°C/W

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

*7 2-Layer: Mounted on glass epoxy board (76.2 mm × 114.3 mm × 1.6 mm: based on EIA/JEDEC standard, 2-layer FR-4).
4-Layer: 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.

*8 2-Layer: Mounted on glass epoxy board (101.5 mm × 114.5 mm × 1.6 mm: based on EIA/JEDEC standard, 2-layer FR-4) with exposed pad.
4-Layer: 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.)

■ ELECTROSTATIC DISCHARGE (ESD) PROTECTION VOLTAGE

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

ELECTROSTATIC DISCHARGE RATINGS
The electrostatic discharge test is done based on JEITA ED-4701. In the HBM method, ESD is applied using the power supply pin and GND pin as reference pins.

■ RECOMMENDED OPERATING CONDITIONS

Parameter	Symbol	Conditions	Rating	Unit
Supply Voltage	$V^+ - V^-$		1.7 to 5.5	V
Input Voltage	V_{IN}		V^- to V^- + 5.5	V
Output Terminal Input Voltage	V_O	NJU77220, NJU77222	V^- to V^- + 5.5	V
Operating Temperature	T_{opr}		-40 to 105	°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 when 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.

■ ELECTRICAL CHARACTERISTICS

V^+ = 3V, V^- = 0V, T_a = 25°C, unless otherwise specified.

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
POWER SUPPLY						
Supply Current (NJU77210, NJU77220)	I_{SUPPLY}	$V_{COM} = V^-$	-	0.7	1.2	µA
		$V_{COM} = V^+$	-	1.0	1.6	µA
Supply Current per Channel (NJU77212, NJU77222)	I_{SUPPLY}	$V_{COM} = V^-$	-	0.6	1.2	µA
		$V_{COM} = V^+$	-	0.9	1.6	µA
INPUT CHARACTERISTICS[*1]						
Input Offset Voltage	V_{IO}	$V_{COM} = V^-$	-	1	7	mV
		$V_{COM} = V^+$	-	1	7	mV
Input Bias Current	I_B		-	1	-	pA
Input Offset Current	I_{IO}		-	1	-	pA
Common-Mode Input Voltage Range	V_{ICM}	CMR ≥ CMR min.	V^-	-	V^+ + 0.2	V
Common-Mode Rejection Ratio	CMR	$V_{ICM} = V^-$ to V^+ + 0.2V	50	65	-	dB
OUTPUT CHARACTERISTICS						
High-level Output Voltage (NJU77210, NJU77212)	V_{OH}	I_{SOURCE} = 3mA	$V^+ - 0.3$	$V^+ - 0.2$	-	V
Low-level Output Voltage	V_{OL}	I_{SINK} = 3mA	-	0.2	0.3	V
Output Leakage Current (NJU77220, NJU77222)	I_{LEAK}	$V_O = V^+$	-	0.01	TBD	nA
Output Short-Circuit Current (NJU77210, NJU77212)	I_{SC}	I_{SOURCE}, $V_O = V^-$	10	25	-	mA
Output Short-Circuit Current	I_{SC}	I_{SINK}, $V_O = V^+$	10	20	-	mA
Transient Response (R_L = 5.1kΩ, C_L = 15pF, Overdrive = 100mV)						
(NJU77210, NJU77212)						
Propagation Delay (Low to High)	t_{PLH}		-	9.8	-	µs
Propagation Delay (High to Low)	t_{PHL}		-	4.8	-	µs
Rise Time	t_{TLH}		-	85	-	ns
Fall Time	t_{THL}		-	40	-	ns
(NJU77220, NJU77222)						
Propagation Delay (Low to High)	t_{PLH}		-	9.8	-	µs
Propagation Delay (High to Low)	t_{PHL}		-	4.5	-	µs
Rise Time	t_{TLH}		-	550	-	ns
Fall Time	t_{THL}		-	55	-	ns

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

■ ELECTRICAL CHARACTERISTICS

V^+ = 5V, V^- = 0V, T_a = 25°C, unless otherwise specified.

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
POWER SUPPLY						
Supply Current (NJU77210, NJU77220)	I_{SUPPLY}	$V_{COM} = V^-$	-	0.85	1.30	µA
		$V_{COM} = V^+$	-	1.10	1.70	µA
Supply Current per Channel (NJU77212, NJU77222)	I_{SUPPLY}	$V_{COM} = V^-$	-	0.70	1.30	µA
		$V_{COM} = V^+$	-	0.95	1.70	µA
INPUT CHARACTERISTICS[*2]						
Input Offset Voltage	V_{IO}	$V_{COM} = V^-$	-	1	7	mV
		$V_{COM} = V^+$	-	1	7	mV
Input Bias Current	I_B		-	1	-	pA
Input Offset Current	I_{IO}		-	1	-	pA
Common-Mode Input Voltage Range	V_{ICM}	CMR ≥ CMR min.	V^-	-	V^+ + 0.2	V
Common-Mode Rejection Ratio	CMR	$V_{ICM} = V^-$ to V^+ + 0.2V	52	67	-	dB
OUTPUT CHARACTERISTICS						
High-level Output Voltage (NJU77210, NJU77212)	V_{OH}	I_{SOURCE} = 3mA	$V^+ - 0.4$	$V^+ - 0.1$	-	V
Low-level Output Voltage	V_{OL}	I_{SINK} = 3mA	-	0.1	0.4	V
Output Leakage Current (NJU77220, NJU77222)	I_{LEAK}	$V_O = V^+$	-	0.01	TBD	nA
Output Short-Circuit Current (NJU77210, NJU77212)	I_{SC}	I_{SOURCE}, $V_O = V^-$	30	70	-	mA
Output Short-Circuit Current	I_{SC}	I_{SINK}, $V_O = V^+$	20	50	-	mA
Transient Response (R_L = 5.1kΩ, C_L = 15pF, Overdrive = 100mV)						
(NJU77210, NJU77212)						
Propagation Delay (Low to High)	t_{PLH}		-	16.5	-	µs
Propagation Delay (High to Low)	t_{PHL}		-	5	-	µs
Rise Time	t_{TLH}		-	150	-	ns
Fall Time	t_{THL}		-	50	-	ns
(NJU77220, NJU77222)						
Propagation Delay (Low to High)	t_{PLH}		-	17	-	µs
Propagation Delay (High to Low)	t_{PHL}		-	5	-	µs
Rise Time	t_{TLH}		-	630	-	ns
Fall Time	t_{THL}		-	70	-	ns

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

■ APPLICATION NOTE

Single and Dual Supply Voltage Operation

The NJU7721x, NJU7722x series works with both single supply and dual supply when the voltage supplied is between V^+ and V^-. These comparators operate from single 1.7V to 5.5V supply and dual ±0.85V to ±2.75V supply. The power supply pin should have bypass capacitor (i.e. 0.1µF).

Input Voltage

The NJU7721x, NJU7722x series are Rail-to-Rail input comparators. The common mode input voltage range is V^- to V^+, and the differential input voltage can be any voltage within supply voltage.

The NJU7721x, NJU7722x series has input tolerant function and maintain high input resistance not only in operating voltage range but also in input voltages exceeding V^+ voltage. The input bias current is minimized in the input voltage even in operating voltage range and exceeding the V^+ supply, and the comparator is protected from overvoltage current. The maximum input voltage is absolute maximum rating of V^- + 6.5V, but usually recommend design so that the input voltage is up to V^- + 5.5V.

Input protection

The NJU7721x, NJU7722x series are designed to operate with a input voltage of V^- − 0.1V, but when the input voltage is below the V^-, the bias current increases from the input terminal through the ESD diode (Figure 1).

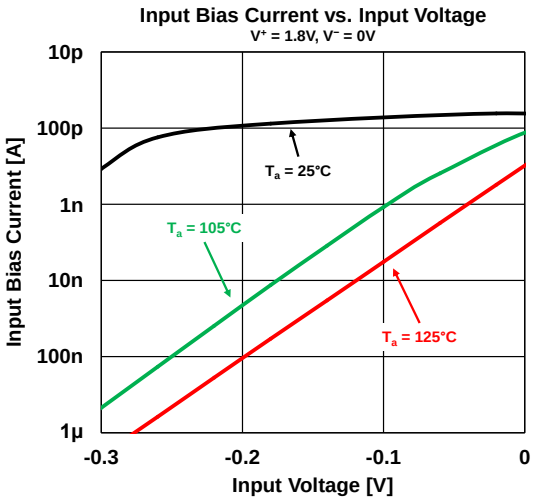
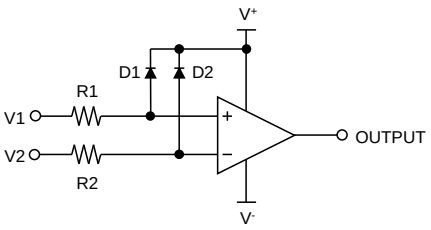


Figure 1. Input Bias Current vs. Input Voltage

The typical input bias current at V_{IN} = -0.1V is 100pA (T_a = 25°C) and 1nA (T_a = 105°C). Furthermore, for the input voltage 0.3V below the negative supply voltage, the ESD protection operates to protect the input terminal. At this moment, the current flowing in protection diodes is allowed up to 10mA. Momentary voltages above V^- + 6.5V, the ESD protection also activate, and clamp inputs, but cannot protect against overvoltage excepting ESD.

In some applications, it may be necessary to prevent excessive overvoltage. Figure 2 is example to protect input transistors. The external resistors R1, R2 limit the current through external diodes D1, D2.



$$(R1, R2) > \frac{V^-\text{-}(V1, V2)}{10mA}$$

$$(R1, R2) > \frac{(V1,\ V2)\text{-}V^+}{I_F}$$

I_F:Forward current of external diode.

Figure 2. Example of input protection

Output Voltage

The NJU7721x series features a push-pull output. The output logic level is the same as the supply rail. The circuit can be simplified without the need for an external pull-up resistor. The NJU7722x series has an open drain output. It can be pulled up to an external power supply up to V^- + 5.5V independent of supply voltage. It can be applied to window comparators and logic level converter.

Output Phase Reversal

For the NJU7721x and NJU7722x series, if the input pin on one side is within the common mode input voltage range, the input terminal on the other side can input from V^- to V^- + 5.5V independent of V^+. No phase inversion of the comparator output occurs even when the input pins exceed V^- and V^+.

However, both input pin voltages exceed V^+ (even if within V^- + 5.5V), the comparator output becomes undefined and phase inversion of the comparator output may occur. For stable operation of the comparator, design the input pin on one side to always be within the common mode input voltage range.

■ APPLICATION NOTE

Dynamic Transient Stabilizer ™

The NJU7721x and NJU7722x series use the new circuit technology Dynamic Transient Stabilizer ™ to realize a rail-to-rail input that suppresses fluctuations in propagation delay.

A general rail-to-rail input comparator operates within the supply rails, but when the input signal level is close to the supply voltage, the propagation delay will decrease and may not be as designed.

Figure 3 compares the NJU7721x and NJU7722x with a conventional rail-to-rail input comparators. Conventional comparators have a delay of 5 µs close to the supply voltage. This change in propagation delay requires a review of the design margin, which increases the design period.

By using the NJU7721x and NJU7722x series, stable response can be obtained in any voltage within supply voltage.

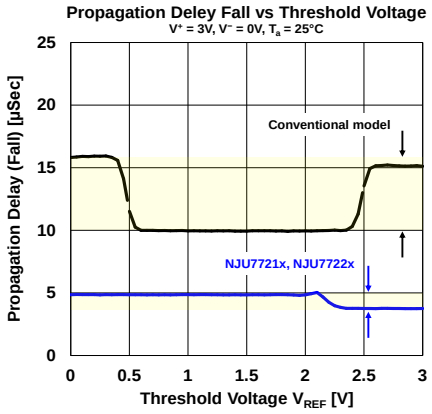
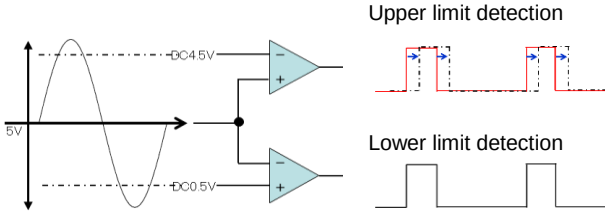


Figure 3. Propagation delay vs. V_{REF}

Figure 4 shows a window comparator circuit using the NJU7722x series. Even if the threshold setting is set near the power supply voltage, stable operation can be performed without delay in response time.



In conventional comparators, the upper limit detection was changed.
-> Lower limit detection and upper limit detection are different.

Figure 4. Level detection circuit using window comparator

Terminating unused comparators

Examples of common methods of terminating an uncommitted comparator are shown in Figure 5. Improper termination can be result increase supply current, heating and noise in comparators.

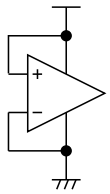


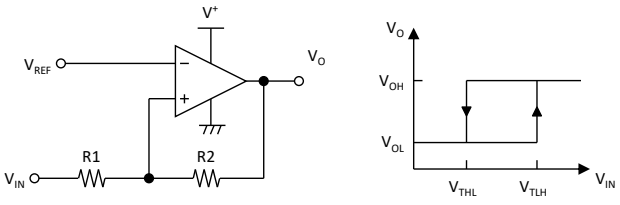
Figure 5. Terminating unused comparators

External Hysteresis

The comparator can change the threshold by using positive feedback. The difference in threshold voltage is called hysteresis, which can improve noise immunity and operation for low-speed signals.

Noninverting Comparator with Hysteresis

Figure 6 shows a hysteresis comparator circuit with two resistors. Assuming that the threshold at which the comparator output is Low - High is V_{TLH} and the threshold at which the comparator output is High - Low is V_{THL}, to achieve the following hysteresis are below.



$$V_{TLH} = \frac{R1+R2}{R2} V_{REF} - \frac{R1}{R2} V_{OL}$$

$$V_{THL} = \frac{R1+R2}{R2} V_{REF} - \frac{R1}{R2} V_{OH}$$

Figure 6. Noninverting Comparator with Hysteresis

■ APPLICATION NOTE

Inverting Comparator with Hysteresis

FIgure7 shows a hysteresis comparator circuit with three resistors.

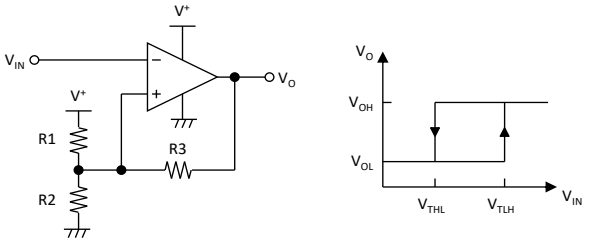
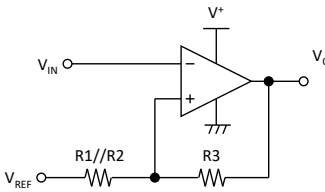


Figure 7. Inverting Comparator with Hysteresis

If R1 and R2 of the circuit in Figure 7 are represented by equivalent resistors, the circuit will be as shown in Figure 8. Since this circuit is the same as the noninverting hysteresis comparator, V_{TLH} and V_{THL} can be calculated by rearranging the equations.



$$R1 /\!/ R2 = \frac{R1R2}{R1+R2}$$

$$V_{REF} = \frac{R2}{R1+R2} V^+$$

$$V_{TLH} = \frac{R1 /\!/ R2}{R1 /\!/ R2+R3} V_{REF} + \frac{R1 /\!/ R2}{R1 /\!/ R2+R3} V_{OL}$$

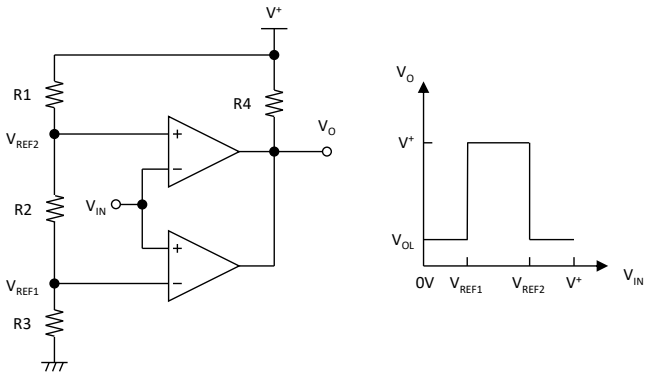
$$V_{THL} = \frac{R1 /\!/ R2}{R1 /\!/ R2+R3} V_{REF} + \frac{R1 /\!/ R2}{R1 /\!/ R2+R3} V_{OH}$$

Figure 8. Noninverting hysteresis comparator as equivalent circuits

Window Comparator

By using the open drain type NJU7722x in parallel, it is achieve to detect whether the signal is between two reference voltages. This circuit is commonly called a window comparator and can be used for monitoring the reference voltage and monitoring abnormal voltages such as signal voltage drop or overvoltage.

Figure 9 shows a simple window comparator circuit. The comparator output V_O is High only when V_{IN} is between V_{REF1} and V_{REF2}, and Low otherwise.



$$V_{REF1} = \frac{R3}{R1+R2+R3} V^+$$

$$V_{REF2} = \frac{R2+R3}{R1+R2+R3} V^+$$

Figure 9. Window Comparator with NJU7722x

Example)
Assuming V^+ = 3.3V, R1 = R2 = R3 = 1MΩ, R4 = 10kΩ, the thresholds from the formula in Figure 9 are V_{REF1} = 1.1V, V_{REF2} = 2.2V.
V_O is Low when V_{IN} < 1.1V or V_{IN} > 2.2V, and V_O is High when V_{IN} is between1.1V and 2.2V (Figure 10).

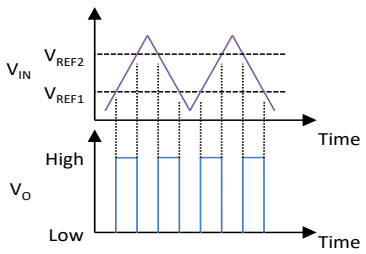


Figure 10. Window comparator output results

■ APPLICATION NOTE

Square Wave Oscillator

Figure 11 shows a simple square wave oscillator circuit. It can be used to digital circuits such as microcomputers, oscillation circuits, timing waveforms, and driver circuits for electronic buzzers.

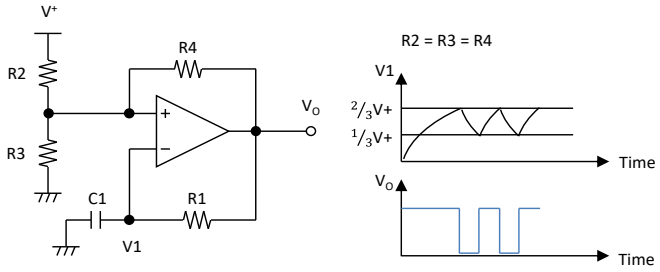


Figure 11. Square Wave Oscillator

When R2 = R3, the oscillator circuit has 50% duty, and the oscillation frequency is as follows.

$$f=\frac{1}{2R1C1\ln\left(1+\frac{R4}{R3}\right)}\ [Hz]$$

$$R2=R3$$

R4 sets the threshold of the comparator that switches between charging and discharging to C1. If R2 = R3 = R4, the oscillation frequency is as follows.

$$f=\frac{1}{2R1C1\ln 2}\ [Hz]$$

$$R2=R3=R4$$

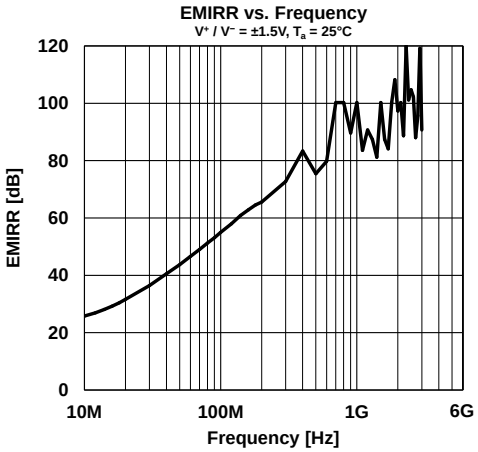
EMIRR (EMI Rejection Ratio) Definition

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

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

V_{RF_PEAK}: RF Signal Amplitude [V_P]
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.

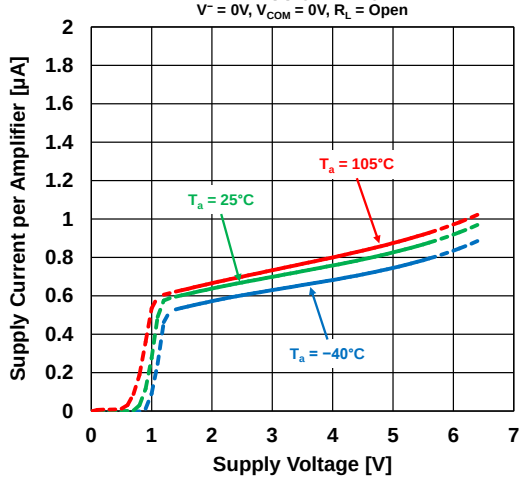


*For details, refer to “Application Note for EMI Immunity" in our HP: http://www.njr.com/

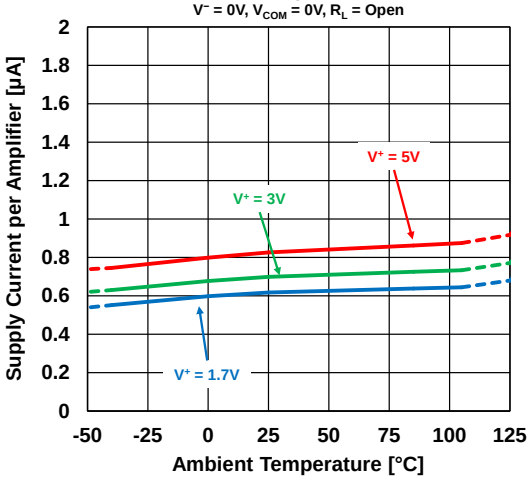
■ TYPICAL CHARACTERISTICS

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

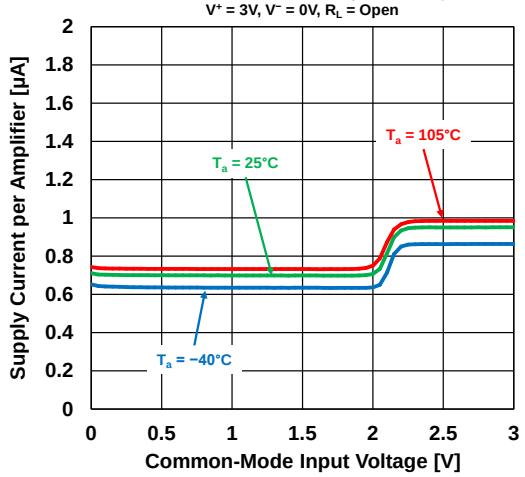
Supply Current per Amplifier vs. Supply Voltage
V^- = 0V, V_{COM} = 0V, R_L = Open



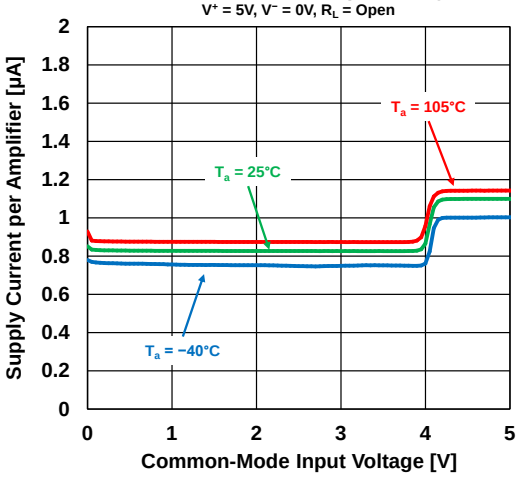
Supply Current per Amplifier vs. Temperature
V^- = 0V, V_{COM} = 0V, R_L = Open



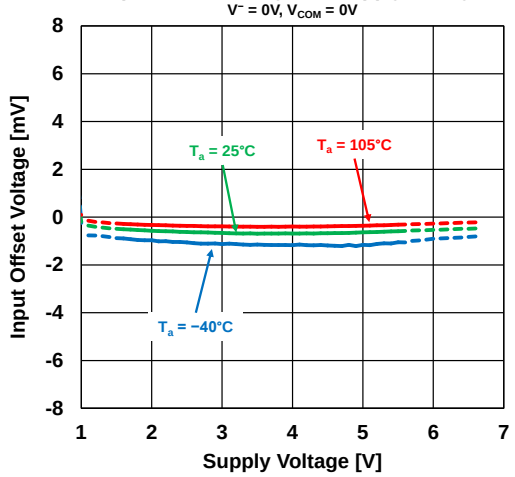
Supply Current per Amplifier vs. Common-Mode Input Voltage
V^+ = 3V, V^- = 0V, R_L = Open



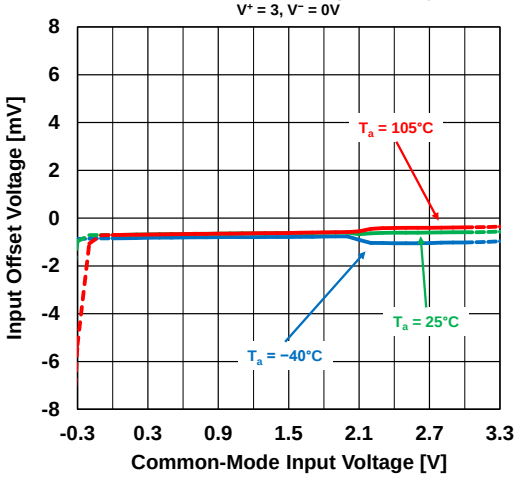
Supply Current per Amplifier vs. Common-Mode Input Voltage
V^+ = 5V, V^- = 0V, R_L = Open



Input Offset Voltage vs. Supply Voltage
V^- = 0V, V_{COM} = 0V



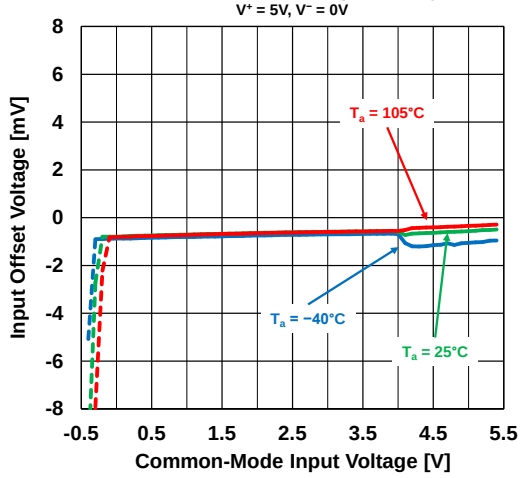
Input Offset Voltage vs. Common-Mode Input Voltage
V^+ = 3, V^- = 0V



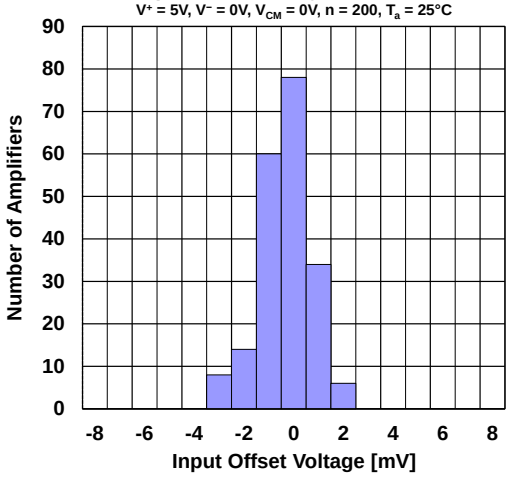
■ TYPICAL CHARACTERISTICS

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

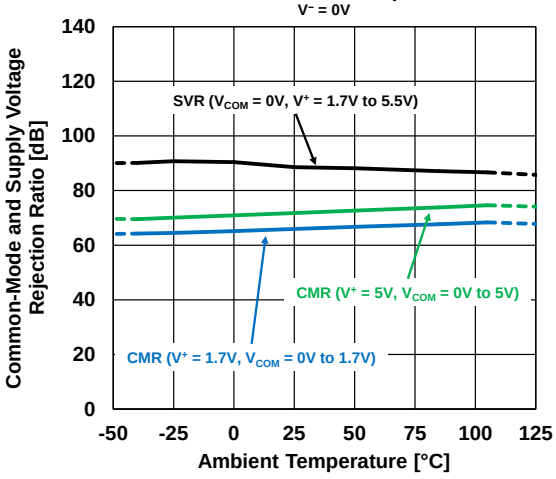
Input Offset Voltage
vs. Common-Mode Input Voltage
V+ = 5V, V− = 0V



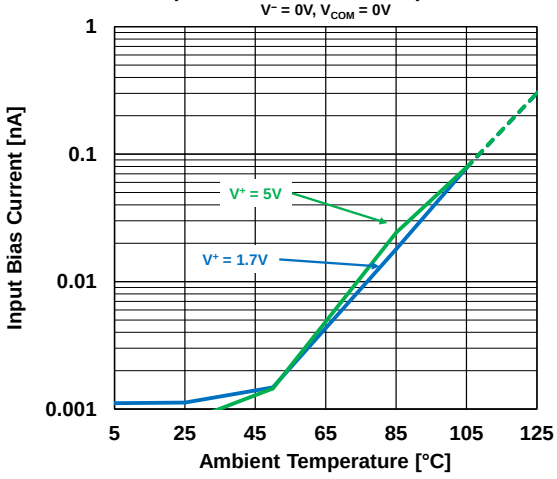
Input Offset Voltage Distribution
V+ = 5V, V− = 0V, VCM = 0V, n = 200, Ta = 25°C



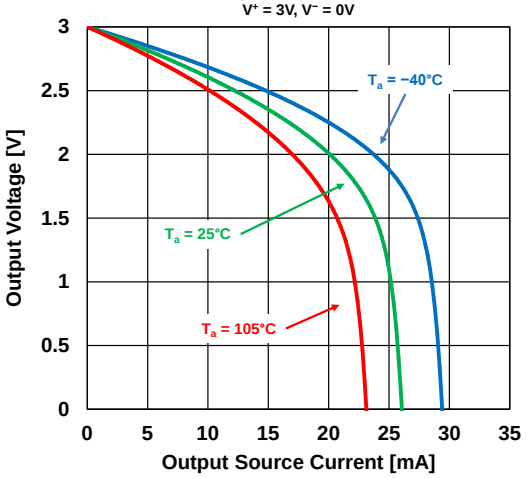
CMR and SVR vs. Temperature
V− = 0V



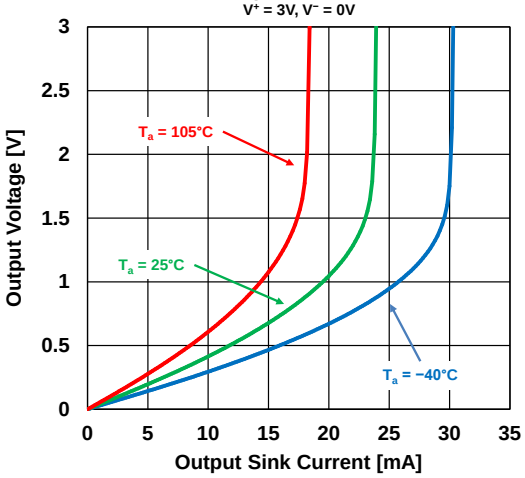
Input Bias Current vs. Temperature
V− = 0V, VCOM = 0V



High-level Output Voltage
vs. Output Source Current
V+ = 3V, V− = 0V



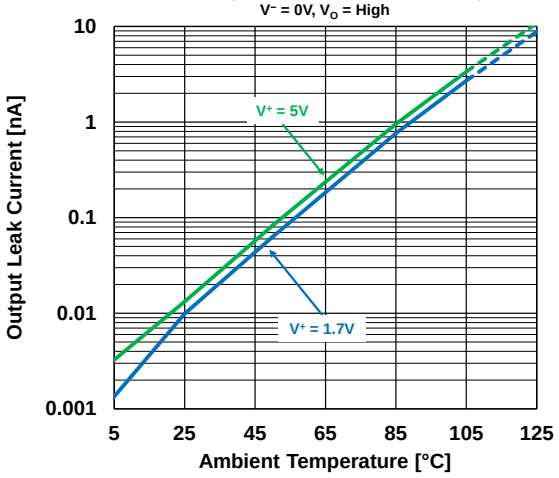
Low-level Output Voltage
vs. Output Sink Current
V+ = 3V, V− = 0V



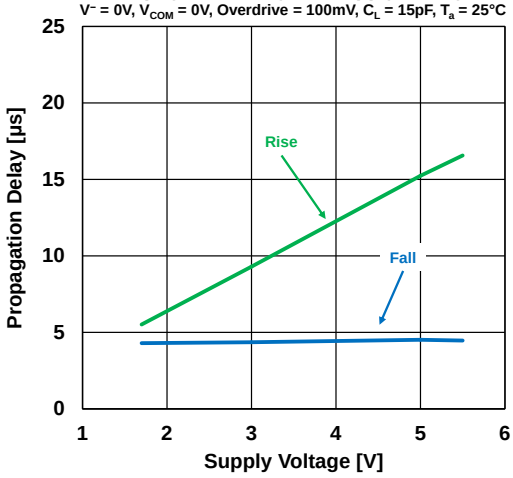
■ TYPICAL CHARACTERISTICS

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

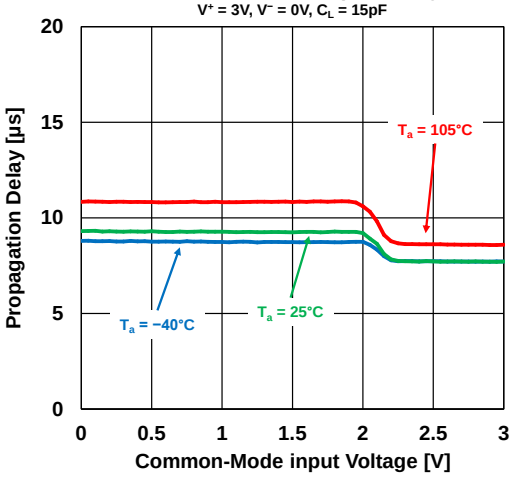
NJU7722x Output Leak Current vs. Temperature



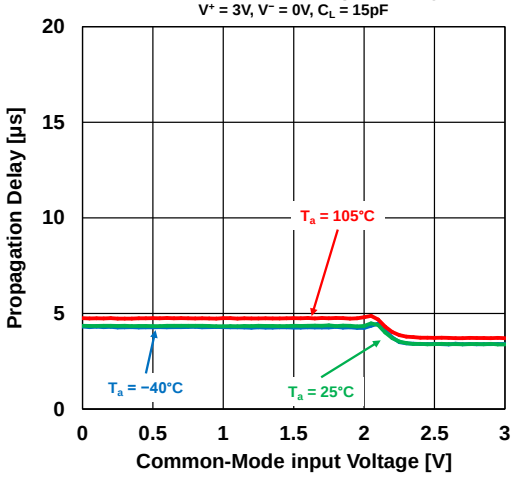
Propagation Delay vs. Supply Voltage



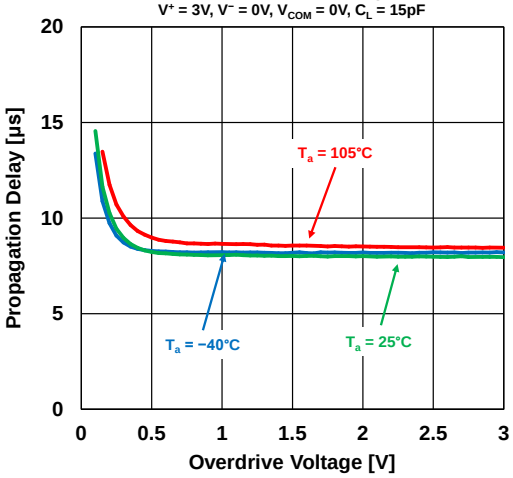
Propagation Delay (Low to High) vs. Common-Mode input Voltage



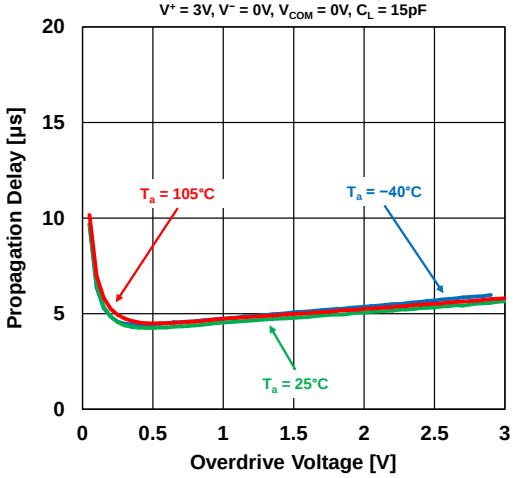
Propagation Delay (High to Low) vs. Common-Mode input Voltage



Propagation Delay (Low to High) vs. Overdrive Voltage



Propagation Delay (High to Low) vs. Overdrive Voltage



■ TYPICAL CHARACTERISTICS

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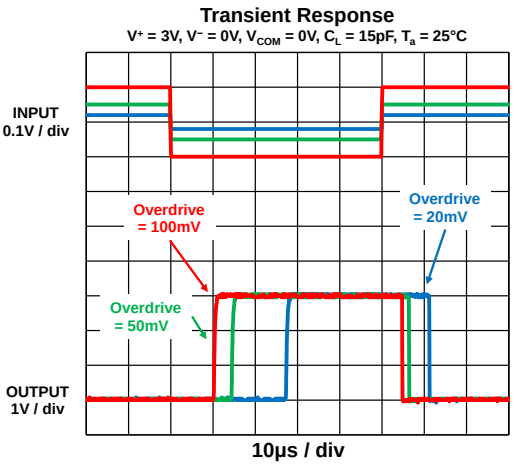
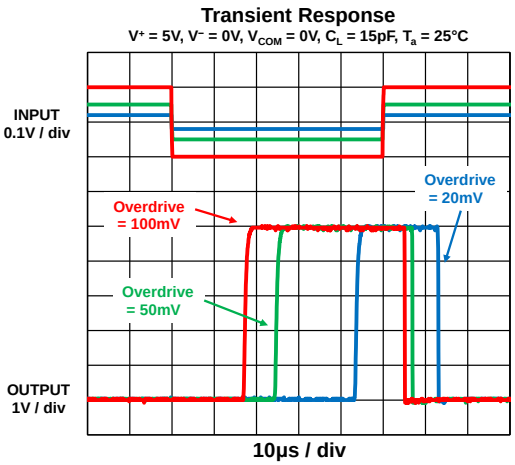
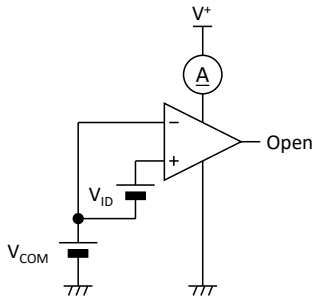




■ TEST CIRCUITS

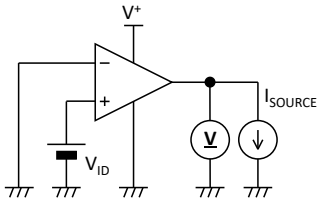
● I_{SUPPLY}

V_{ID} = 100mV



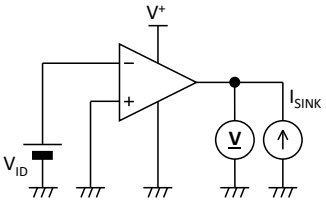
● V_{OH}

V_{ID} = 100mV



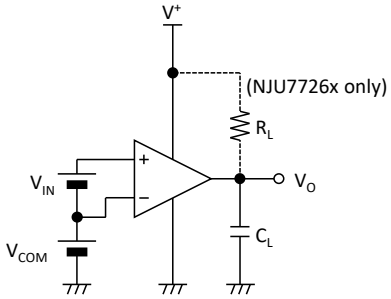
● V_{OL}

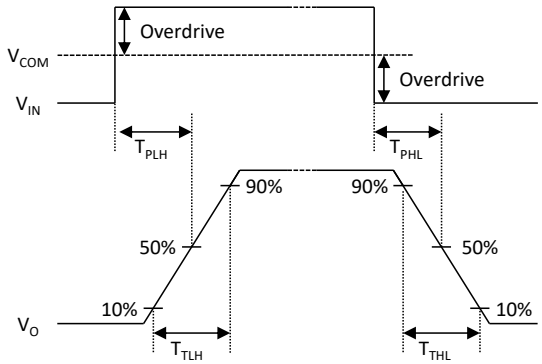
V_{ID} = 100mV



● Propagation Delay

R_L = 5.1kΩ, V_{COM} = 0V, V^+





■ REVISION HISTORY

Date	Revision	Changes
August 27, 2021	Ver.0.0	Initial Release
June 30, 2022	Ver.0.1	Updated Format Development status update

Nisshinbo Micro Devices Inc.

SOT-23-5

PI-SOT-23-5-E-A

■ PACKAGE DIMENSIONS

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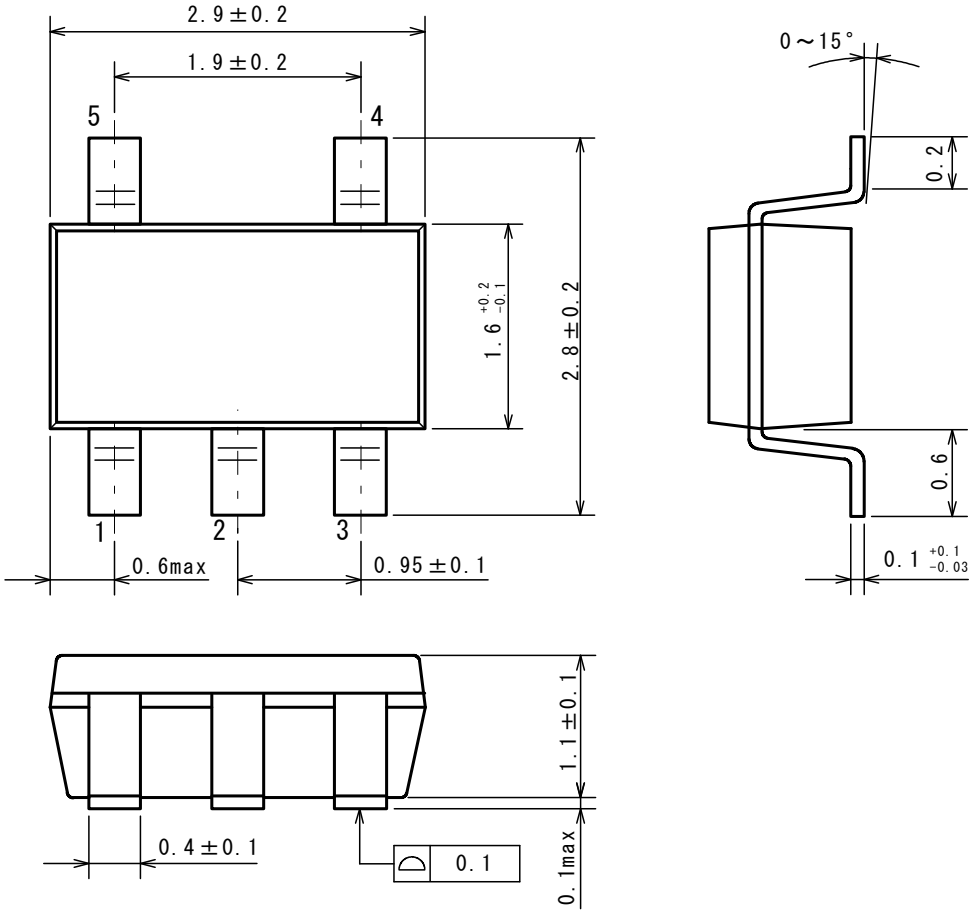


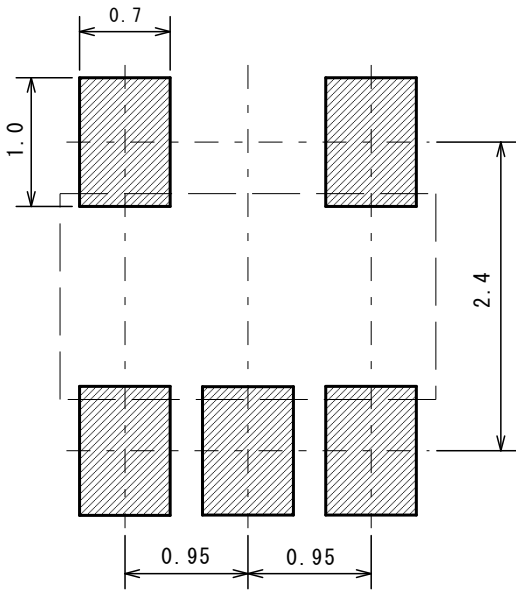
Nisshinbo Micro Devices Inc.

SOT-23-5

PI-SOT-23-5-E-A

■ EXAMPLE OF SOLDER PADS DIMENSIONS

UNIT: mm



Nisshinbo Micro Devices Inc.

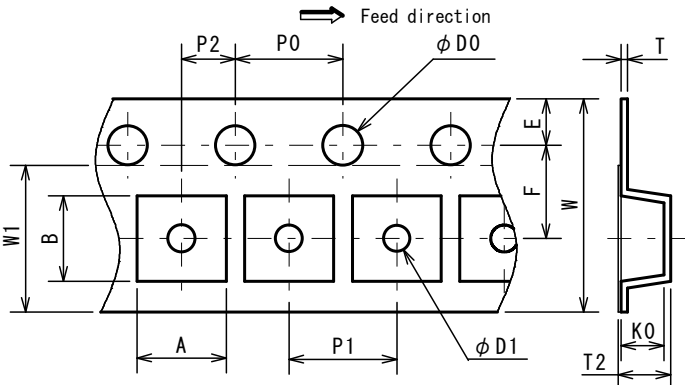
SOT-23-5

PI-SOT-23-5-E-A

■ PACKING SPEC

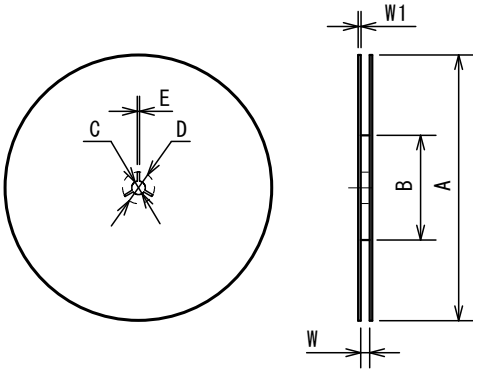
UNIT: mm

TAPING DIMENSIONS



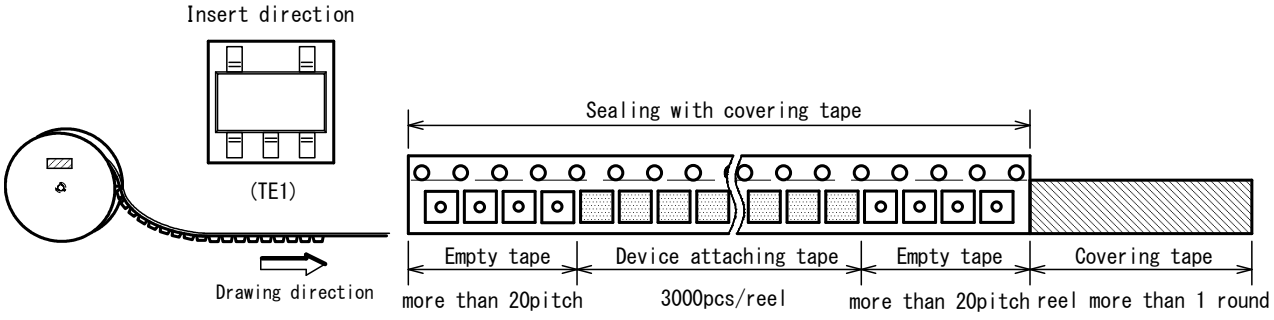
SYMBOL	DIMENSION	REMARKS
A	3.3±0.1	BOTTOM DIMENSION
B	3.2±0.1	BOTTOM DIMENSION
D0	1.55	
D1	1.05	
E	1.75±0.1	
F	3.5±0.05	
P0	4.0±0.1	
P1	4.0±0.1	
P2	2.0±0.05	
T	0.25±0.05	
T2	1.82	
K0	1.5±0.1	
W	8.0±0.3	
W1	5.5	THICKNESS 0.1MAX

REEL DIMENSIONS

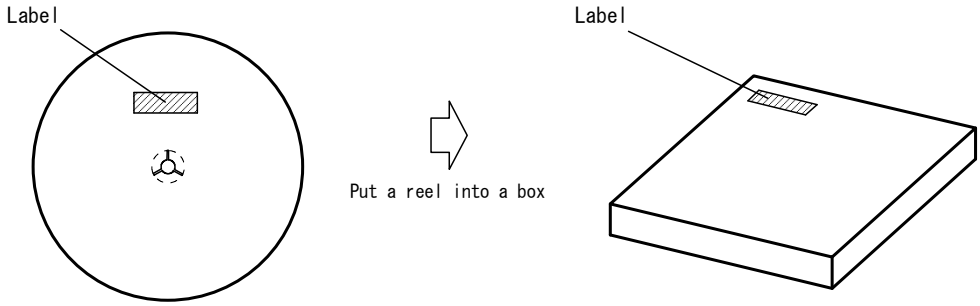


SYMBOL	DIMENSION
A	φ180±1
B	φ 60±1
C	φ 13±0.2
D	φ 21±0.8
E	2±0.5
W	9±0.5
W1	1.2±0.2

TAPING STATE



PACKING STATE



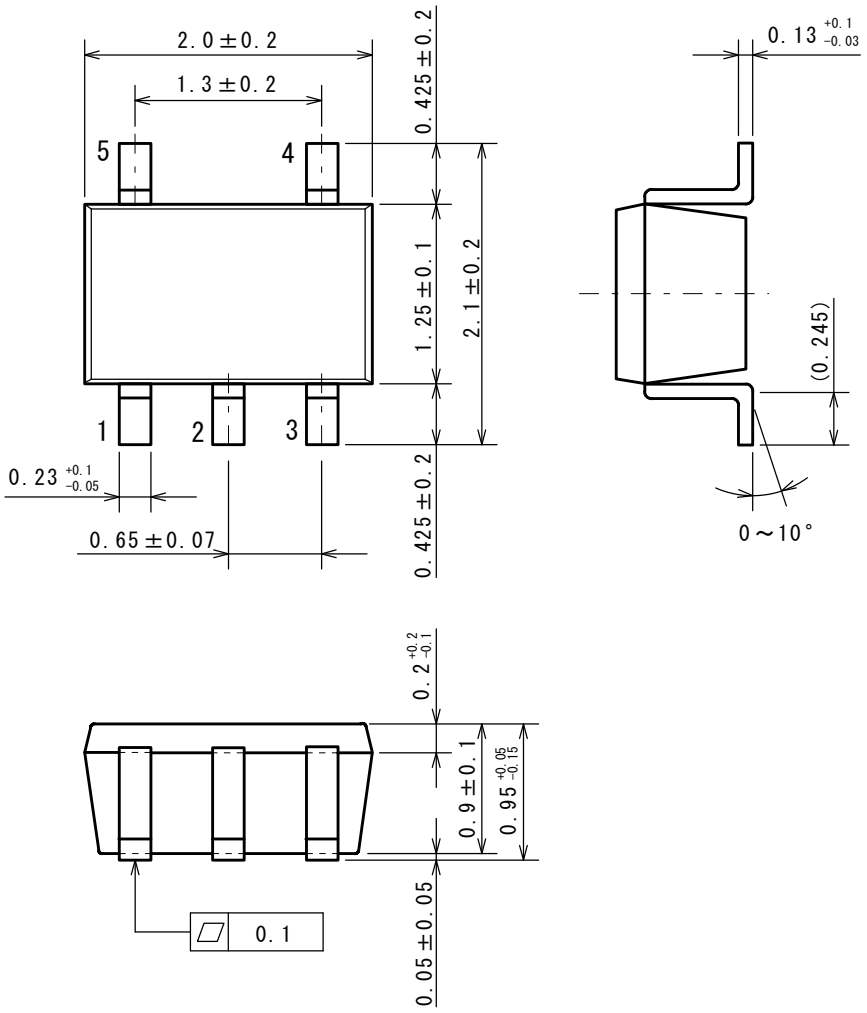
Nisshinbo Micro Devices Inc.

SC-88A

PI-SC-88A-E-A

■ PACKAGE DIMENSIONS

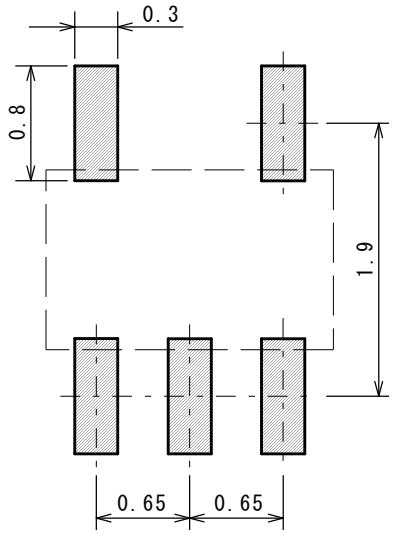
UNIT: mm



SC-88A

■ EXAMPLE OF SOLDER PADS DIMENSIONS

UNIT: mm



Nisshinbo Micro Devices Inc.

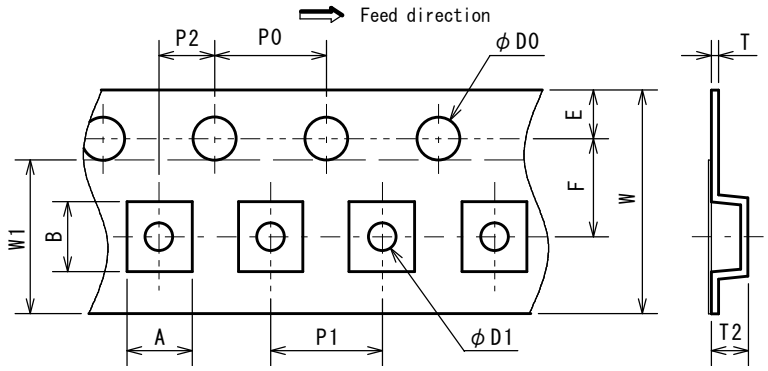
SC-88A

PI-SC-88A-E-A

■ PACKING SPEC

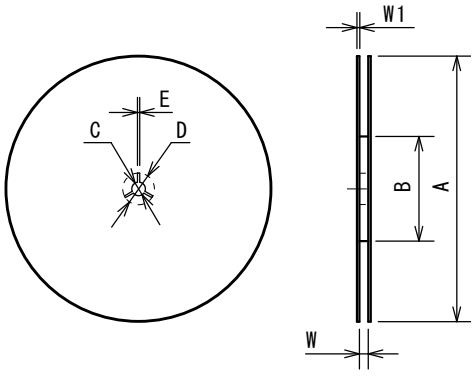
UNIT: mm

TAPING DIMENSIONS



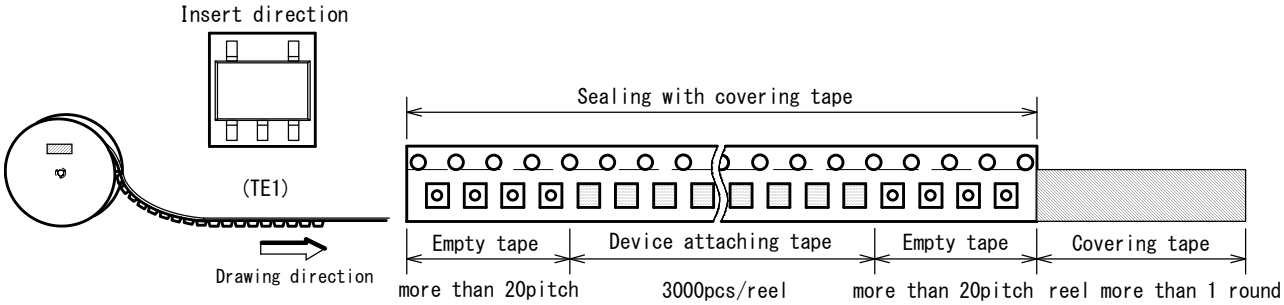
SYMBOL	DIMENSION	REMARKS
A	2.3±0.1	BOTTOM DIMENSION
B	2.5±0.1	BOTTOM DIMENSION
D0	1.55±0.05	
D1	1.05±0.05	
E	1.75±0.1	
F	3.5±0.05	
P0	4.0±0.1	
P1	4.0±0.1	
P2	2.0±0.05	
T	0.25±0.05	
T2	1.3±0.1	
W	8.0±0.2	
W1	5.5	THICKNESS 0.1max

REEL DIMENSIONS

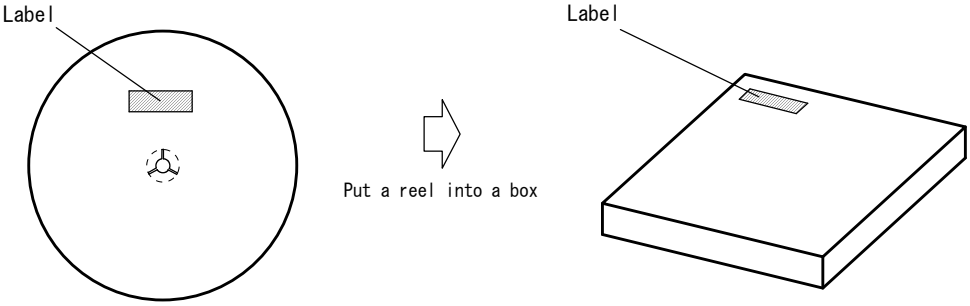


SYMBOL	DIMENSION
A	φ180±1
B	φ 60±1
C	φ 13±0.2
D	φ 21±0.8
E	2±0.5
W	9±0.5
W1	1.2±0.2

TAPING STATE



PACKING STATE



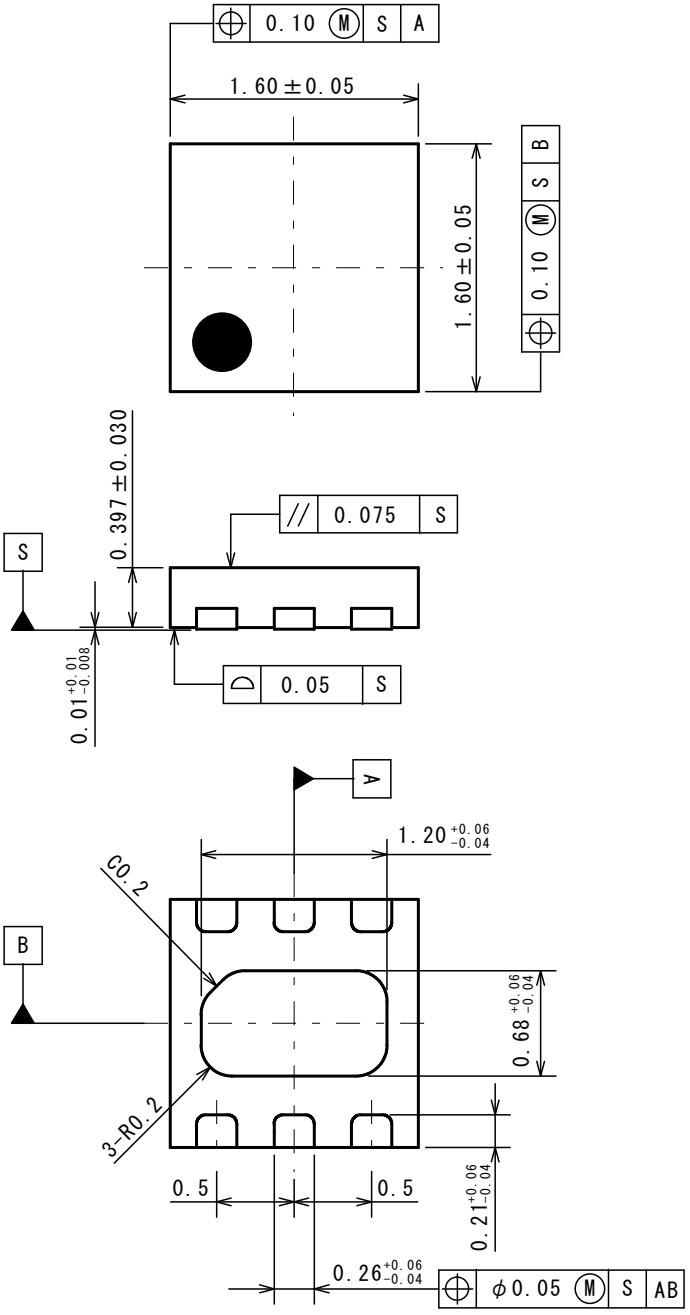
Nisshinbo Micro Devices Inc.

DFN6-G1 (ESON6-G1)

PI-DFN6-G1-E-A

■ PACKAGE DIMENSIONS

UNIT: mm



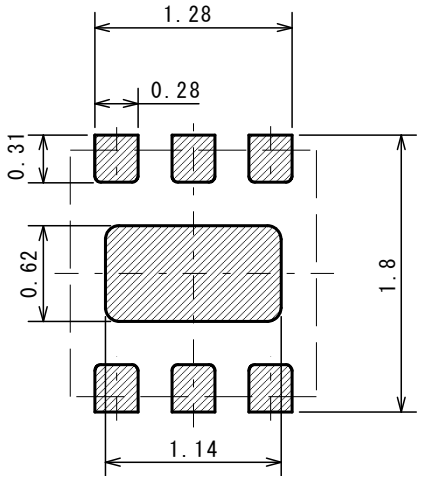
Nisshinbo Micro Devices Inc.

DFN6-G1 (ESON6-G1)

PI-DFN6-G1-E-A

■ EXAMPLE OF SOLDER PADS DIMENSIONS

UNIT: mm



Nisshinbo Micro Devices Inc.

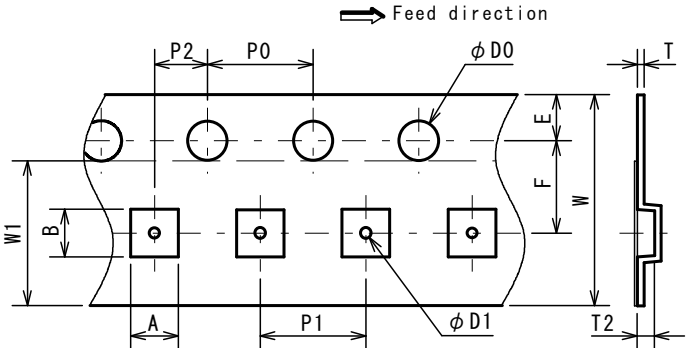
DFN6-G1 (ESON6-G1)

PI-DFN6-G1-E-A

■ PACKING SPEC

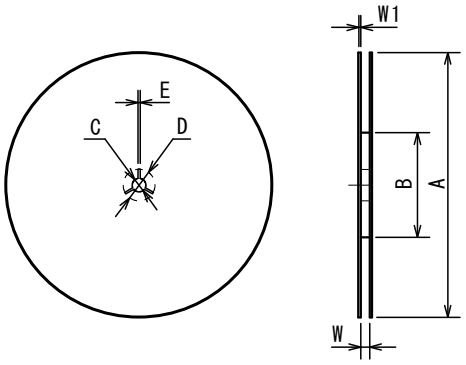
UNIT: mm

TAPING DIMENSIONS



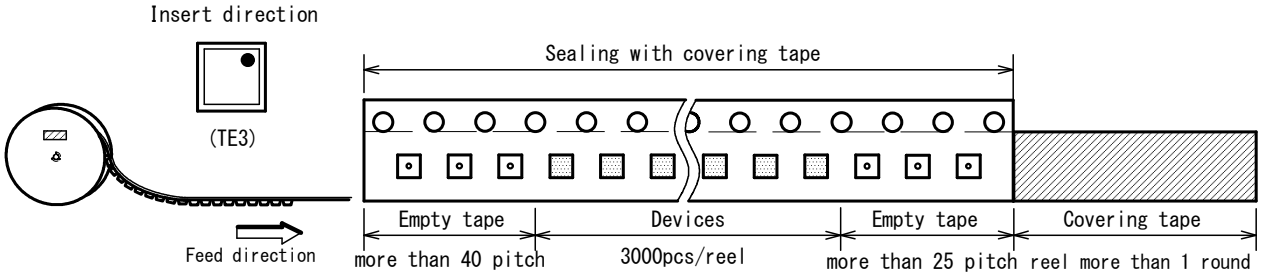
SYMBOL	DIMENSION	REMARKS
A	1.85±0.05	BOTTOM DIMENSION
B	1.85±0.05	BOTTOM DIMENSION
D0	$1.5^{+0.1}_{0}$	
D1	0.5±0.1	
E	1.75±0.1	
F	3.5±0.05	
P0	4.0±0.1	
P1	4.0±0.1	
P2	2.0±0.05	
T	0.25±0.05	
T2	0.65±0.05	
W	8.0±0.2	
W1	5.5	THICKNESS 0.1max

REEL DIMENSIONS

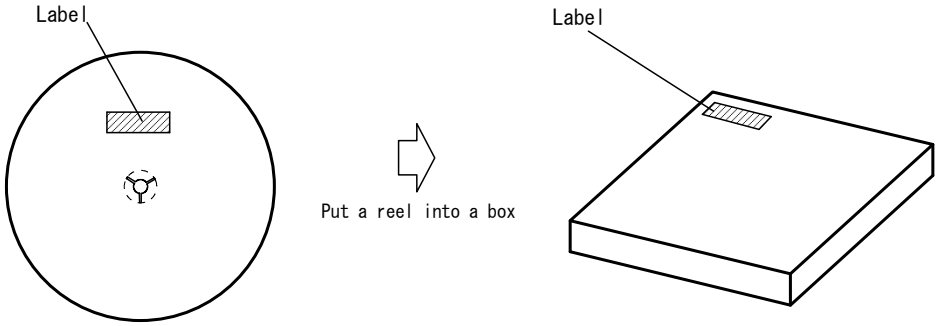


SYMBOL	DIMENSION
A	$\phi 180^{0}_{-1.5}$
B	$\phi\ 60^{+1}_{0}$
C	φ 13±0.2
D	φ 21±0.8
E	2±0.5
W	$9^{+0.3}_{0}$
W1	1.2

TAPING STATE



PACKING STATE



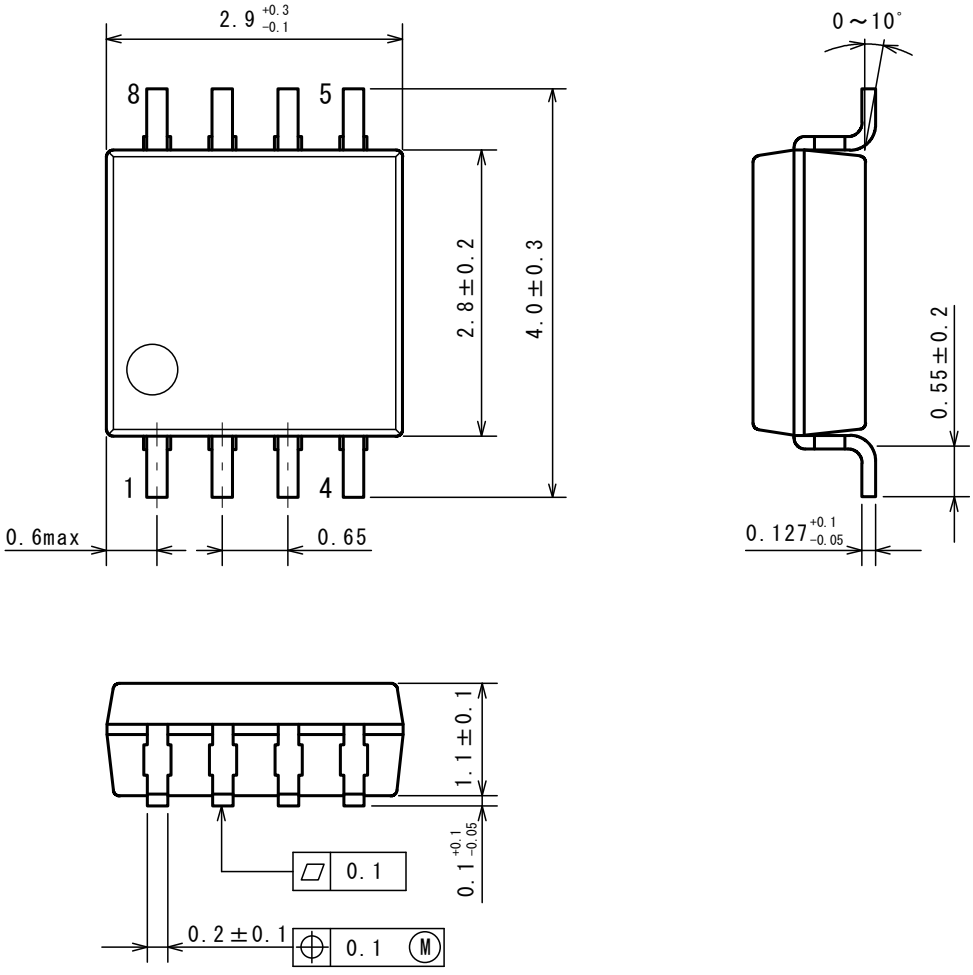
Nisshinbo Micro Devices Inc.

MSOP8 MEET JEDEC MO-187-DA (VSP8)

PI-MSOP8-E-A

■ PACKAGE DIMENSIONS

UNIT: mm



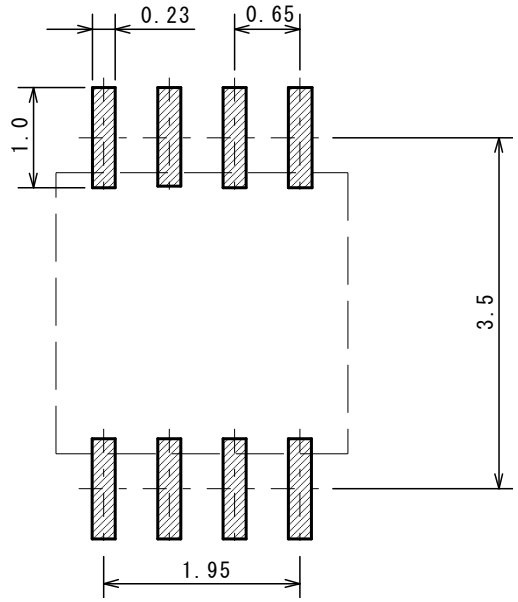
Nisshinbo Micro Devices Inc.

MSOP8 MEET JEDEC MO-187-DA (VSP8)

PI-MSOP8-E-A

■ **EXAMPLE OF SOLDER PADS DIMENSIONS**

UNIT: mm



Nisshinbo Micro Devices Inc.

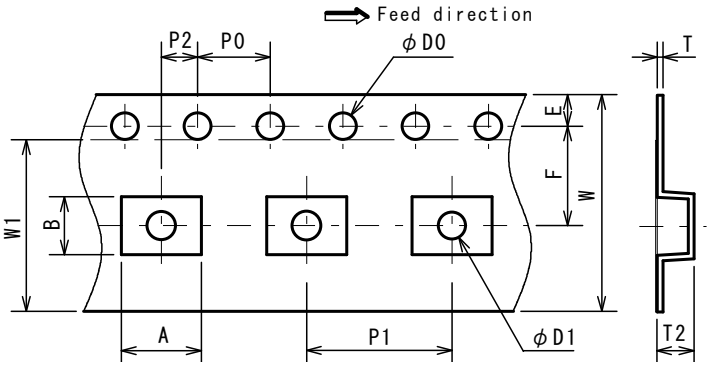
MSOP8 MEET JEDEC MO-187-DA (VSP8)

PI-MSOP8-E-A

■ PACKING SPEC

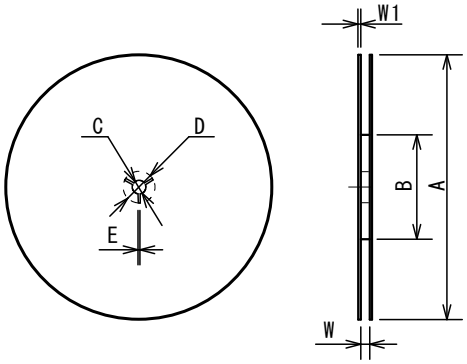
UNIT: mm

TAPING DIMENSIONS



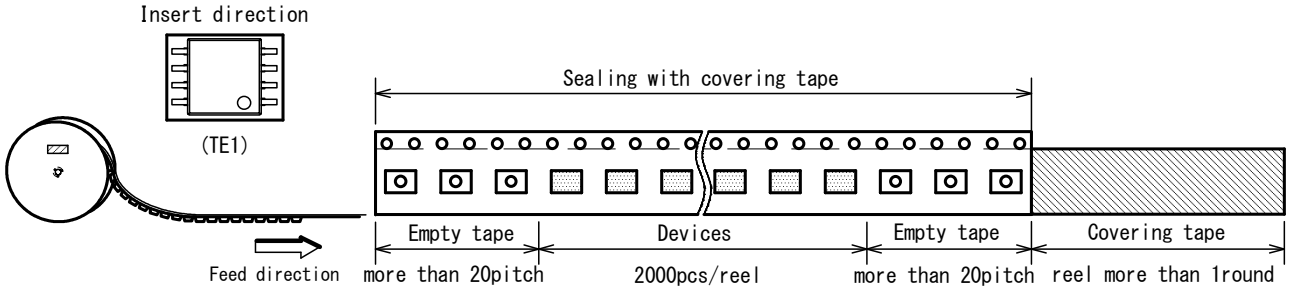
SYMBOL	DIMENSION	REMARKS
A	4.4	BOTTOM DIMENSION
B	3.2	BOTTOM DIMENSION
D0	$1.5^{+0.1}_{0}$	
D1	$1.5^{+0.1}_{0}$	
E	1.75±0.1	
F	5.5±0.05	
P0	4.0±0.1	
P1	8.0±0.1	
P2	2.0±0.05	
T	0.30±0.05	
T2	2.0 (MAX.)	
W	12.0±0.3	
W1	9.5	THICKNESS 0.1max

REEL DIMENSIONS

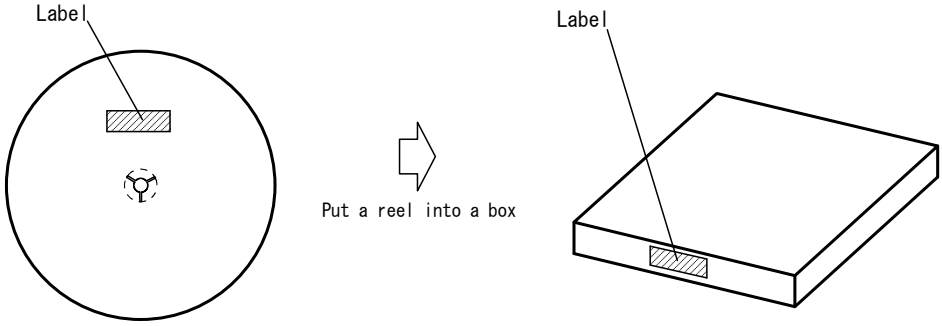


SYMBOL	DIMENSION
A	φ254±2
B	φ100±1
C	φ 13±0.2
D	φ 21±0.8
E	2±0.5
W	13.5±0.5
W1	2.0±0.2

TAPING STATE



PACKING STATE



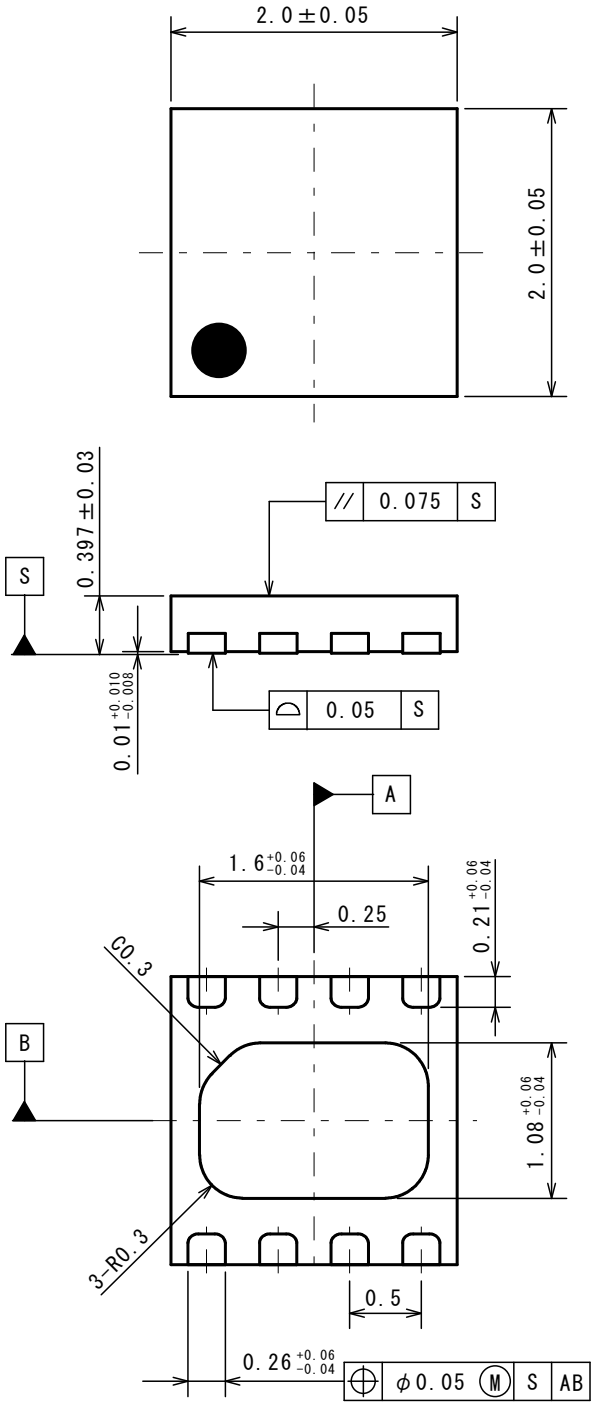
Nisshinbo Micro Devices Inc.

DFN8-U1 (ESON8-U1)

PI-DFN8-U1-E-A

■ PACKAGE DIMENSIONS

UNIT: mm



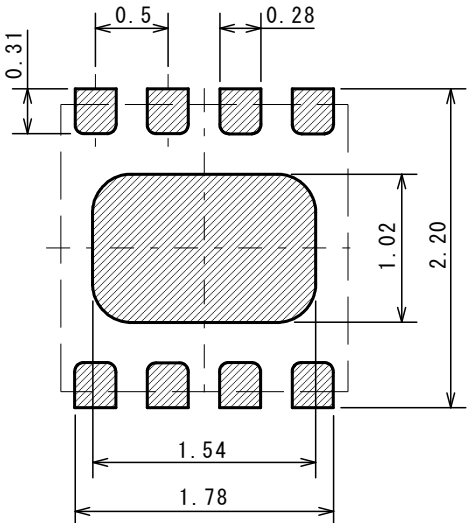
Nisshinbo Micro Devices Inc.

DFN8-U1 (ESON8-U1)

PI-DFN8-U1-E-A

■ EXAMPLE OF SOLDER PADS DIMENSIONS

UNIT: mm



Nisshinbo Micro Devices Inc.

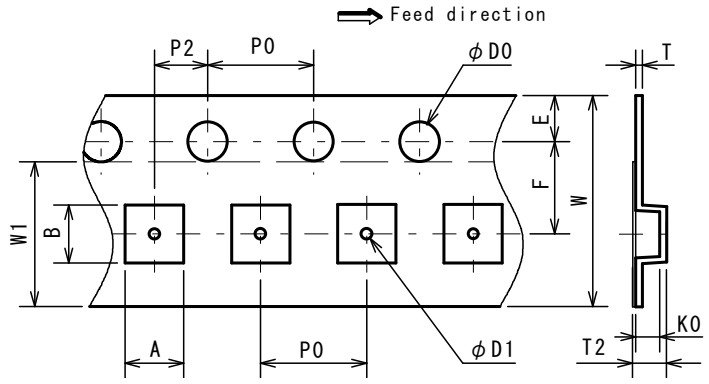
DFN8-U1 (ESON8-U1)

PI-DFN8-U1-E-A

■ PACKING SPEC

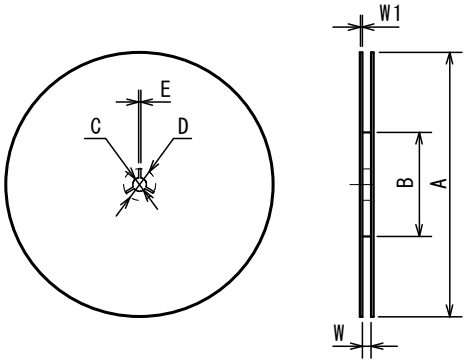
UNIT: mm

TAPING DIMENSIONS



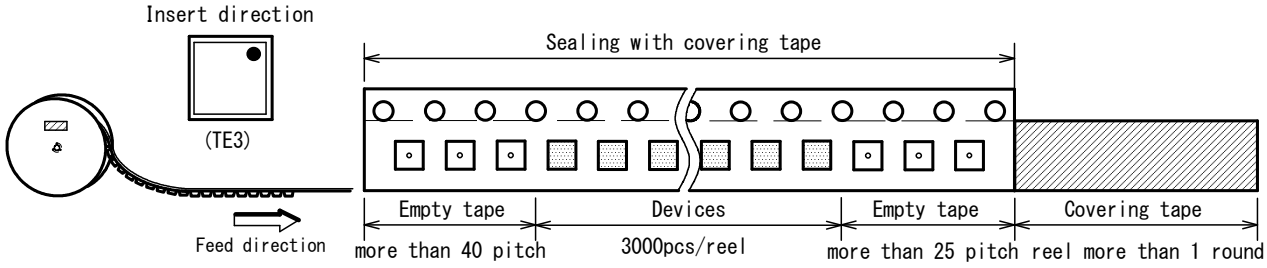
SYMBOL	DIMENSION	REMARKS
A	2.25±0.05	BOTTOM DIMENSION
B	2.25±0.05	BOTTOM DIMENSION
D0	$1.5^{+0.1}_{0}$	
D1	0.5±0.1	
E	1.75±0.1	
F	3.5±0.05	
P0	4.0±0.1	
P1	4.0±0.1	
P2	2.0±0.05	
T	0.25±0.05	
T2	1.00±0.07	
K0	0.65±0.05	
W	8.0±0.2	
W1	5.5	THICKNESS 0.1max

REEL DIMENSIONS

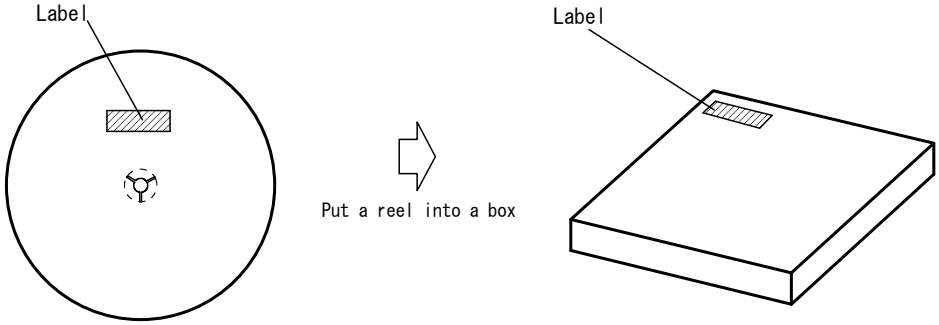


SYMBOL	DIMENSION
A	$\phi 180^{0}_{-1.5}$
B	$\phi 60^{+1}_{0}$
C	φ 13±0.2
D	φ 21±0.8
E	2±0.5
W	$9^{+0.3}_{0}$
W1	1.2

TAPING STATE



PACKING STATE



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