

Excellent EMI Immunity Rail-to-Rail Input, Open-Drain Output Low power CMOS Comparators

■ FEATURES ($V^+=3V, V^-=0V, T_a=25^\circ C$)

- Rail-to-Rail Input
- Open-Drain Output
- Supply Current $6\mu A/ch$ typ.
- Propagation Delay $840ns$ typ.
- Operating Voltage 1.8 to $5.5V$
- Input Offset Voltage $6mV$ max.
- Operating Temperature -40 to $125^\circ C$
- Integrated EMI filter $EMIRR=62dB$ typ. @ $f=900MHz$
- Package
- NJU77240 SOT-23-5, SC88A
- NJU77241 SOT-23-5, SC88A,
 DFN6-G1 (ESON6-G1)
- NJU77242 MSOP8 (TVSP8)*
- *meet JEDEC MO-187-DA / thin type,
 DFN8-U1 (ESON8-U1)

■ GENERAL DESCRIPTION

The NJU77240/NJU77241/NJU77242 are rail-to-rail input CMOS comparators featuring low-power and open-drain output.

These comparators operate from $1.8V$ to $5.5V$ and low supply current of $6\mu A/ch$ typ. This feature is suitable for battery powered application.

The NJU77241/NJU77242 are available in small size package, DFN6-G1 (1616), DFN8-U1 (2020), significantly reducing the required portable application's board area.

■ APPLICATIONS

- Portable and Battery-Powered Applications
- Alarm and Surveillance Circuits
- Industrial Instruments
- Sensor Applications

■ RELATED PRODUCTS

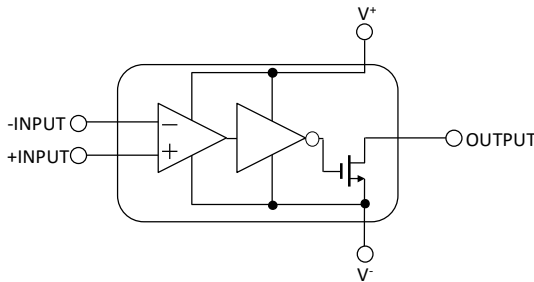
Features	Single	Dual
Rail-to-Rail Input Push-Pull Output, Low power CMOS Comparators	NJU77230 NJU77231	NJU77232

■ PIN CONFIGURATIONS

PRODUCT NAME	NJU77240F	NJU77240F3	NJU77241F	NJU77241F3
Package	SOT-23-5	SC-88A	SOT-23-5	SC-88A
Pin Functions				
PRODUCT NAME	NJU77241KG1	NJU77242RB1	NJU77242KU1	
Package	DFN6-G1 (ESON6-G1)*	MSOP8 (TVSP8)	DFN8-U1 (ESON8-U1) *	
Pin Functions				

*Connect to exposed pad to V^-

■ BLOCK DIAGRAM



■ PRODUCT NAME INFORMATION

NJU77240 F (TE1)

Part Number Package Taping Form

■ ORDERING INFORMATION

PART NUMBER	PACKAGE	RoHS	HALOGEN-FREE	TERMINAL FINISH	MARKING	WEIGHT (mg)	MOQ (pcs)
NJU77240F	SOT-23-5	Yes	Yes	Sn2Bi	1K	15	3000
NJU77240F3	SC-88A	Yes	Yes	Sn2Bi	F3	7.5	3000
NJU77241F	SOT-23-5	Yes	Yes	Sn2Bi	1L	15	3000
NJU77241F3	SC-88A	Yes	Yes	Sn2Bi	F4	7.5	3000
NJU77241KG1	DFN6-G1	Yes	Yes	Sn2Bi	77241	3.5	3000
NJU77242RB1	MSOP8 (TVSP8)	Yes	Yes	Sn2Bi	77242	18	2000
NJU77242KU1	DFN8-U1	Yes	Yes	Sn2Bi	77242	5.3	3000

■ ABSOLUTE MAXIMUM RATINGS

PARAMETER	SYMBOL	RATING	UNIT
Supply Voltage	$V^+ - V^-$	7	V
Input Voltage ^(1,2)	V_{IN}	$V^- - 0.3$ to $V^+ + 0.3$	V
Input Current ⁽²⁾	I_{IN}	10	mA
Differential Input Voltage ⁽³⁾	V_{ID}	± 7	V
Output Terminal Input Voltage ⁽⁴⁾	V_O	$V^- - 0.3$ to $V^+ + 7$	V
Power Dissipation ($T_a=25^\circ\text{C}$)	P_D	2-Layer / 4-Layer	mW
SOT-23-5 ⁽⁵⁾		480 / 650	
SC-88A ⁽⁵⁾		360 / 490	
DFN6-G1 ⁽⁶⁾		330 / 1200	
MSOP8 (TVSP8) ⁽⁵⁾		510 / 680	
DFN8-U1 ⁽⁶⁾	450 / 1200		
Junction Temperature Range	T_{jmax}	150	$^\circ\text{C}$
Storage Temperature Range	T_{stg}	- 55 to 150	$^\circ\text{C}$

(1) The absolute maximum input voltage is limited at 7V.

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

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

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

(4) The absolute maximum of Output Terminal Input Voltage is limited at 7V.

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

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

(6) 2-Layer: Mounted on glass epoxy board. (101.5×114.5×1.6mm: based on EIA/JDEC standard, 2-layer FR-4, with Exposed Pad)

4-Layer: Mounted on glass epoxy board. (101.5×114.5×1.6mm: based on EIA/JDEC standard, 4-layer FR-4, with Exposed Pad)

*For 4-layer: Applying 99.5×99.5mm inner Cu area and a thermal via hole to a board based on JEDEC standard JESD51-5

■ THERMAL CHARACTERISTICS

PARAMETER	SYMBOL	VALUE	UNIT
Junction-to-Ambient Thermal Resistance SOT-23-5 ⁽⁷⁾ SC-88A ⁽⁷⁾ DFN6-G1 ⁽⁸⁾ MSOP8 (TVSP8) ⁽⁷⁾ DFN8-U1 ⁽⁸⁾	θ_{ja}	2-Layer / 4-Layer 259 / 193 352 / 256 381 / 106 244 / 185 278 / 107	$^{\circ}\text{C}/\text{W}$
Junction-to-Top of Package Characterization Parameter SOT-23-5 ⁽⁷⁾ SC-88A ⁽⁷⁾ DFN6-G1 ⁽⁸⁾ MSOP8 (TVSP8) ⁽⁷⁾ DFN8-U1 ⁽⁸⁾	ψ_{jt}	2-Layer / 4-Layer 67 / 58 91 / 73 64 / 26 51 / 45 42 / 25	$^{\circ}\text{C}/\text{W}$

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

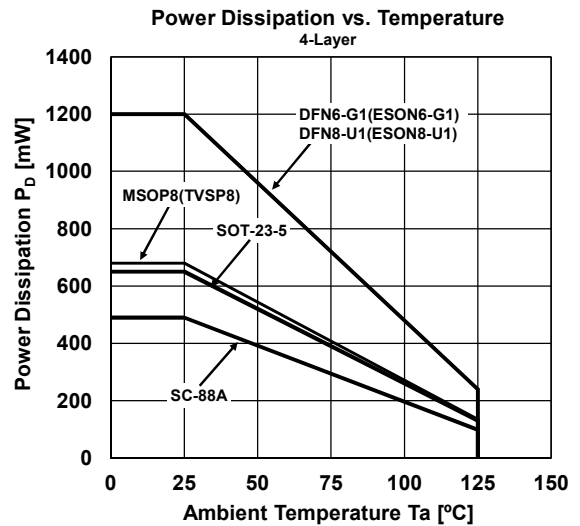
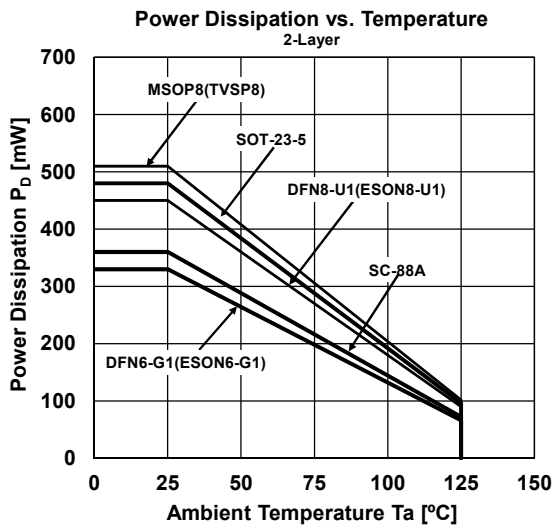
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*For 4-Layer: Applying 99.5×99.5mm inner Cu area and a thermal via hole to a board based on JEDEC standard JESD51-5)

■ POWER DISSIPATION vs. AMBIENT TEMPERATURE



■ RECOMMENDED OPERATING CONDITIONS

PARAMETER	SYMBOL	VALUE	UNIT
Supply Voltage			
Single Supply	$V^+ - V^-$	1.8 to 5.5	V
Dual Supply	V^+ / V^-	± 0.9 to ± 2.75	
Operating Temperature Range	T_{opr}	- 40 to 125	$^{\circ}\text{C}$
Output Terminal Input Voltage	V_o	V to V+5.5	V

■ ELECTRICAL CHARACTERISTICS

● DC CHARACTERISTICS

(Unless otherwise specified, $V^+=3V$, $V^-=0V$, $T_a=25^\circ C$) °C

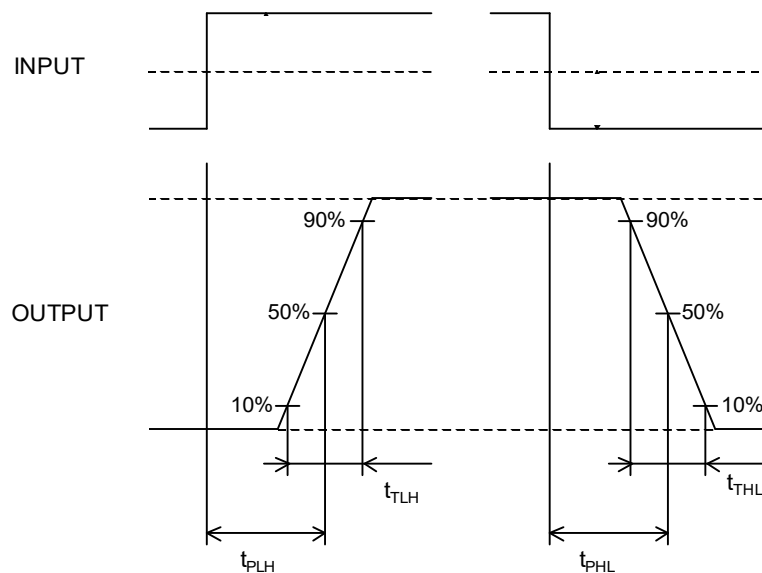
PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT
Supply Current (per comparator)	I_{SUPPLY}	$V_{ID}=100mV, V_{COM}=0V, R_L=\infty$	-	6	10	μA
		$V_{ID}=100mV, V_{COM}=3V, R_L=\infty$	-	9	14	μA
Input Offset Voltage	V_{IO}	$V_{COM}=0V$	-	1	6	mV
		$V_{COM}=3V$	-	1	7	mV
Input Offset Current	I_{IO}		-	1	-	μA
Input Bias Current	I_B		-	1	-	μA
Common Mode Input Voltage Range	V_{ICM}	CMR \geq 50dB	0	-	3	V
Open-Loop Voltage Gain	A_v	$R_L=5.1k\Omega$	-	100	-	dB
Common Mode Rejection Ratio	CMR	$V_{ICM}=0V$ to 3V	50	70	-	dB
Supply Voltage Rejection Ratio	SVR	$V_{COM}=0V, V^+=1.8V$ to 5.5V,	65	85	-	dB
Output Leakage Current	I_{LEAK}	$V_O=3.0V$	-	0.001	500	nA
Low-level Output Voltage	V_{OL}	$I_{SINK}=3mA$	-	0.2	0.3	V

● SWITCHING CHARACTERISTICS

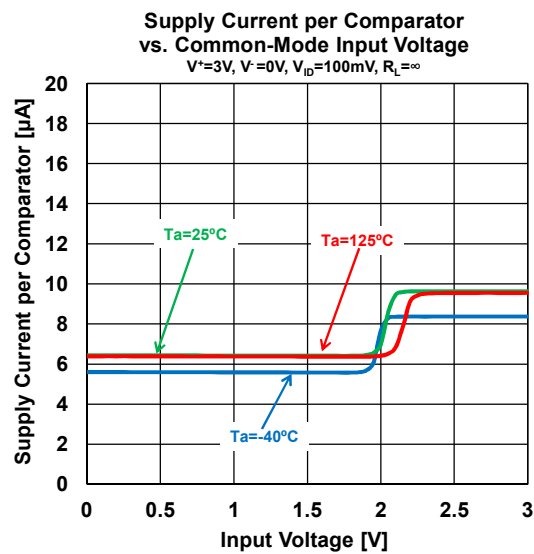
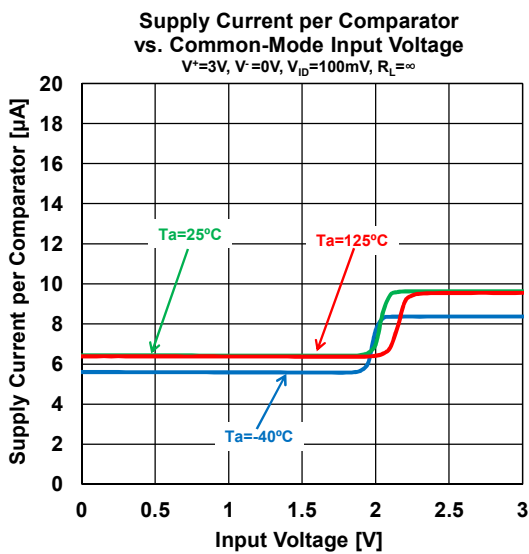
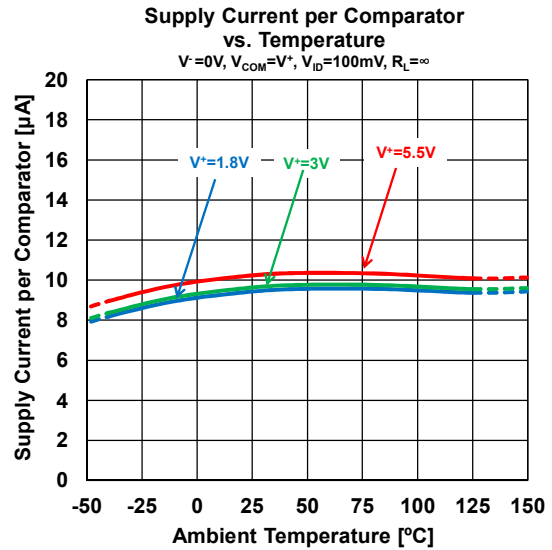
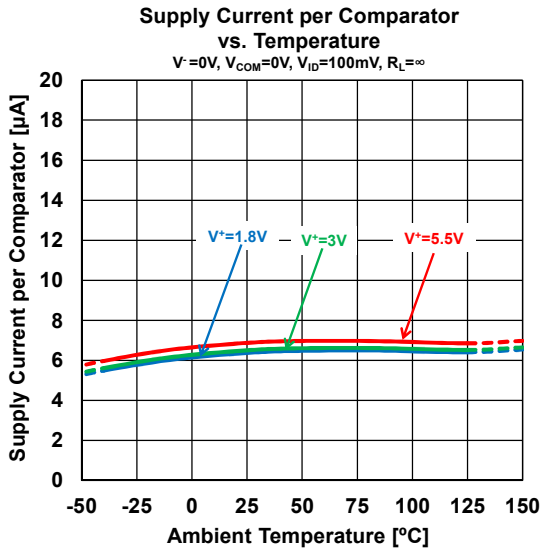
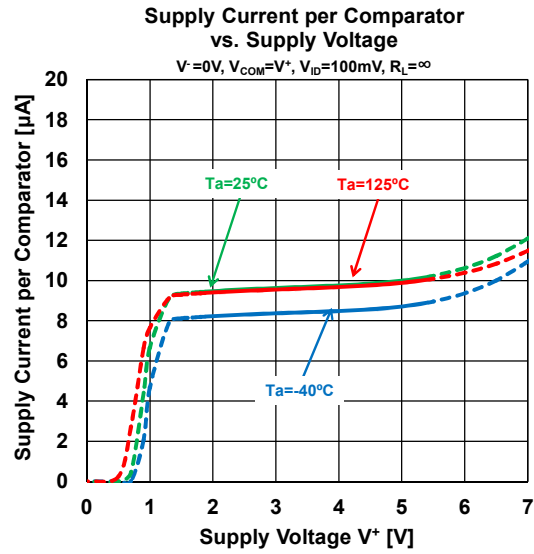
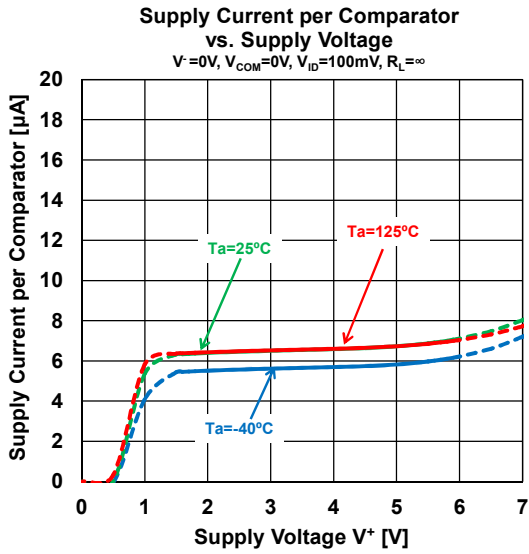
(Unless otherwise specified, $V^+=+3V$, $V^-=0V$, $T_a=25^\circ C$, $C_L=15pF$, $R_L=5.1k\Omega$)

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT
Propagation Delay Low to High	t_{PLH}	Overdrive=100mV	-	840	-	ns
Propagation Delay High to Low	t_{PHL}	Overdrive =100mV	-	450	-	ns
Output Signal Rising Time	t_{TLH}	Overdrive =100mV	-	260	-	ns
Output Signal Falling Time	t_{THL}	Overdrive =100mV	-	7	-	ns

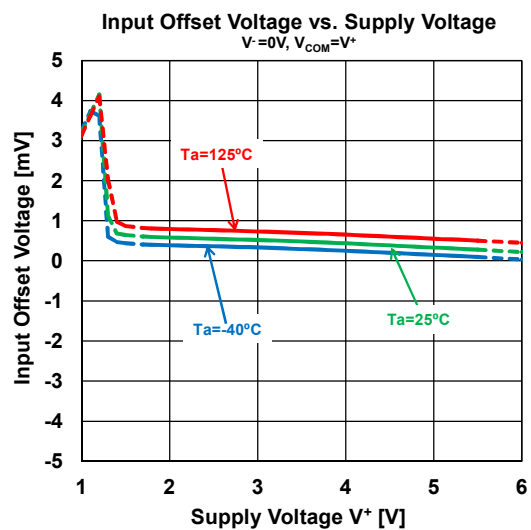
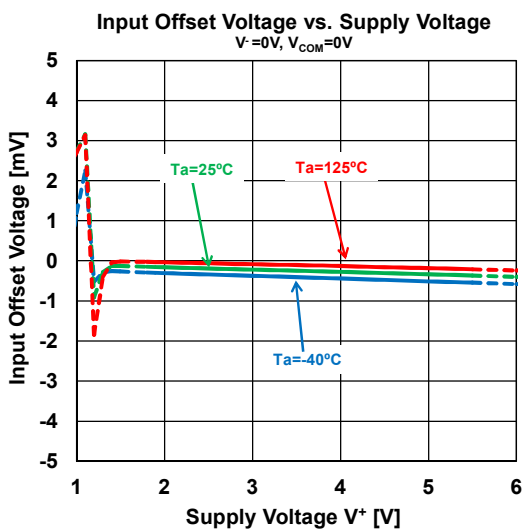
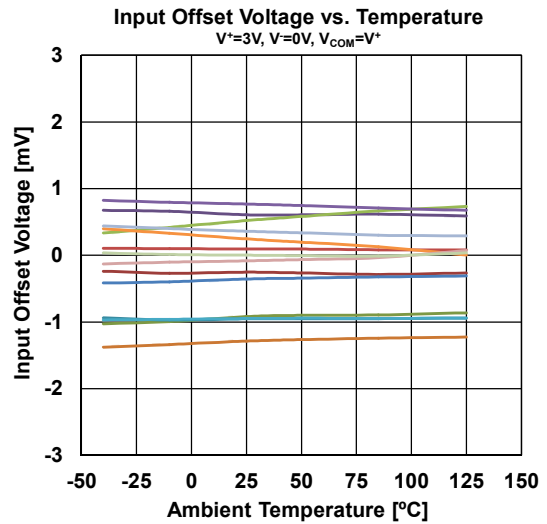
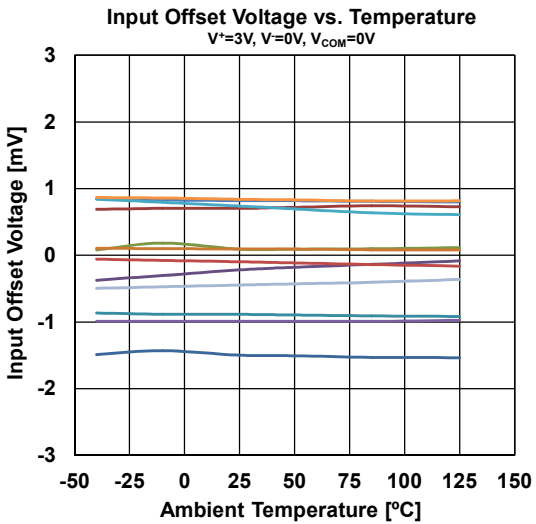
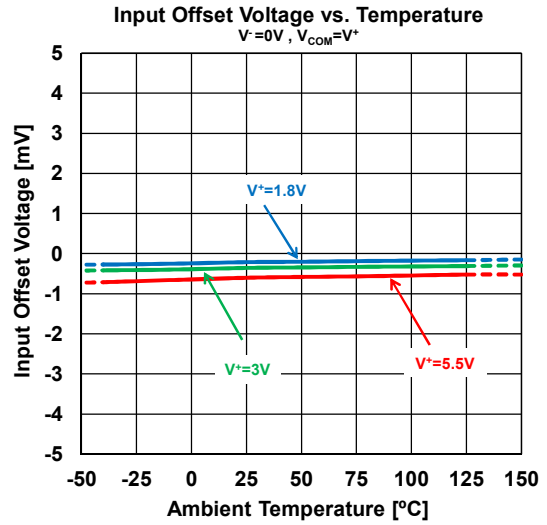
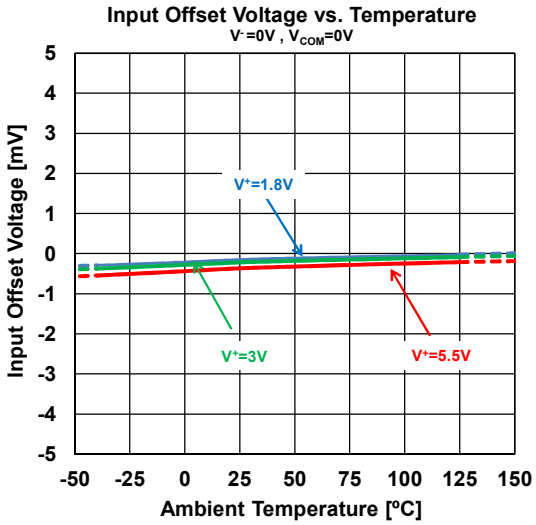
■ TIMING WAVEFORM



■ TYPICAL CHARACTERISTICS

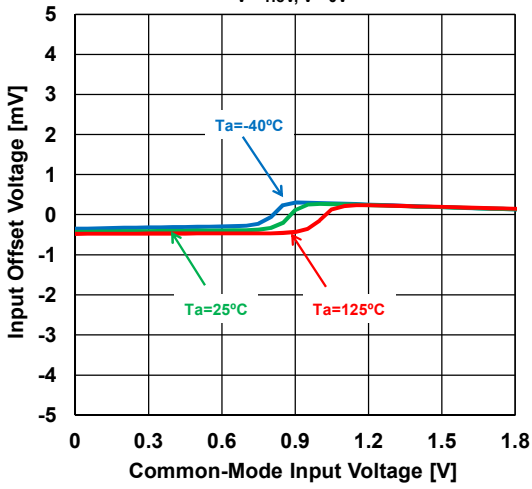


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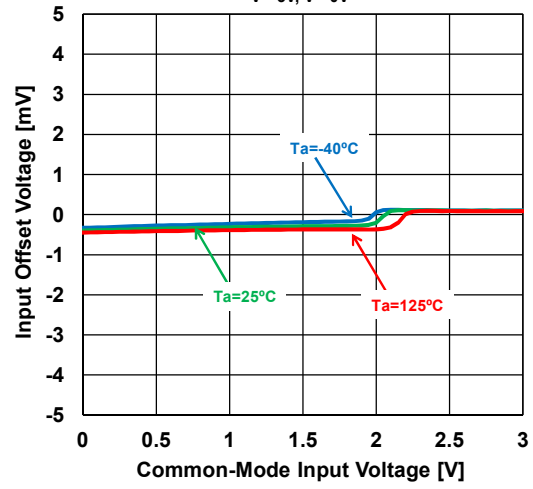


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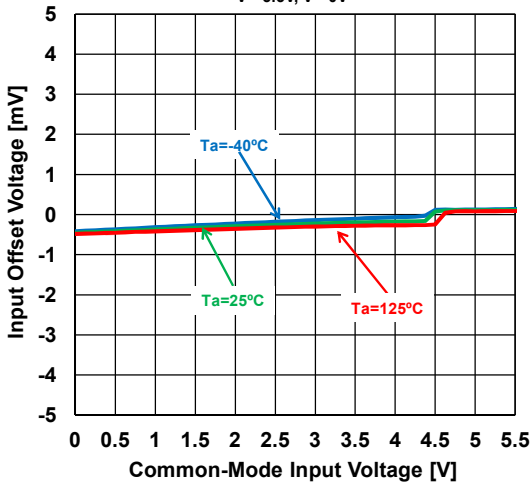
Input Offset Voltage vs. Common-Mode Input Voltage
 $V^+=1.8V, V^-=0V$



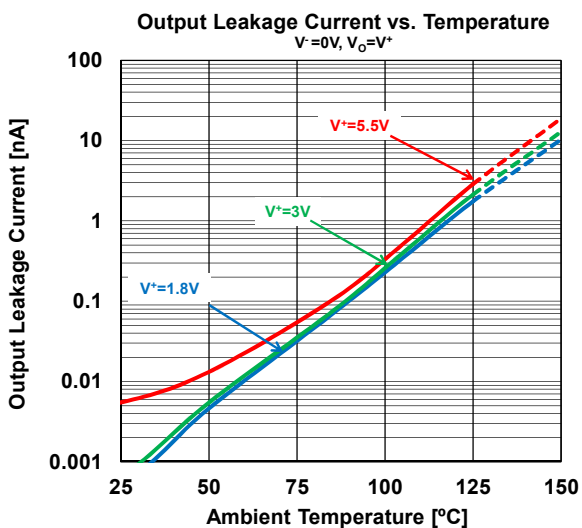
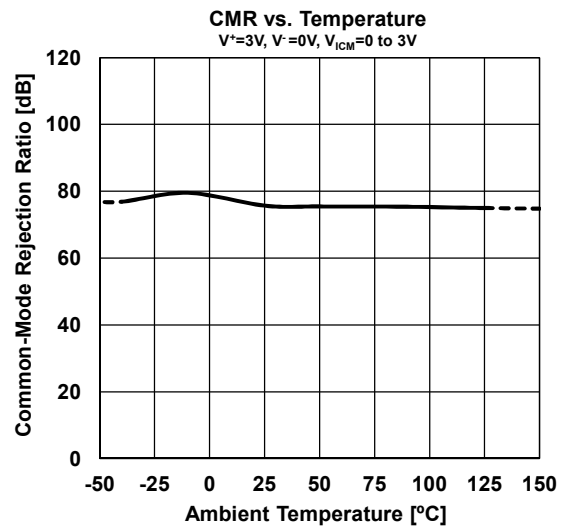
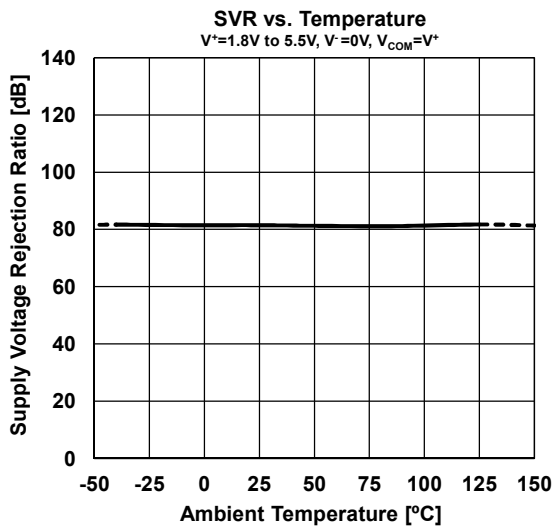
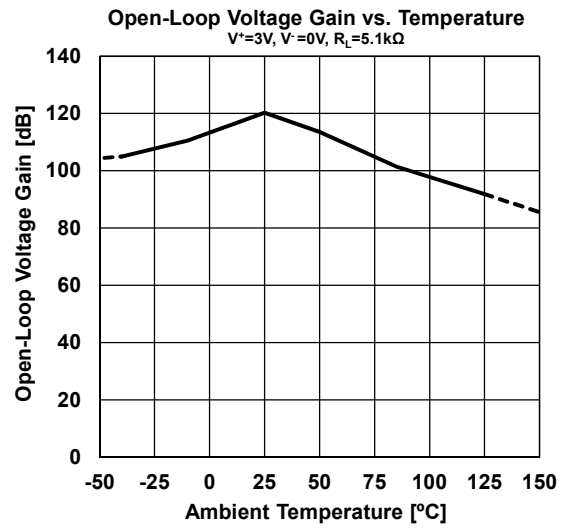
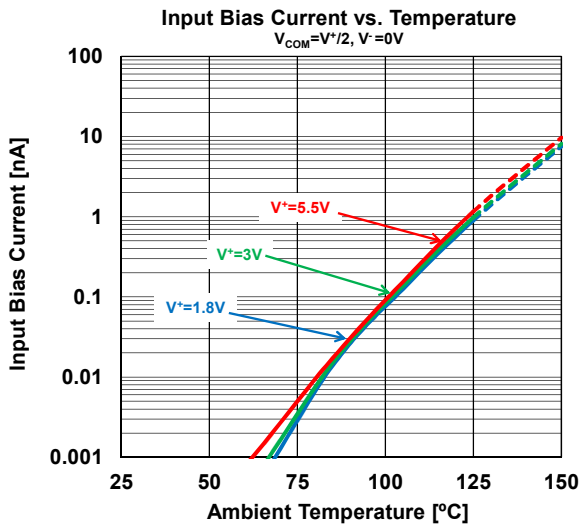
Input Offset Voltage vs. Common-Mode Input Voltage
 $V^+=3V, V^-=0V$



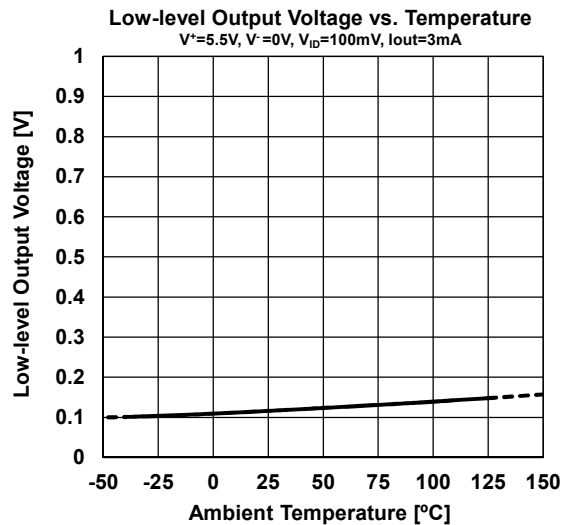
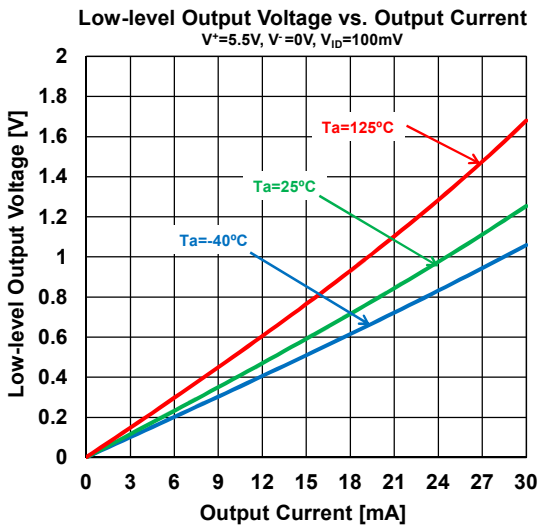
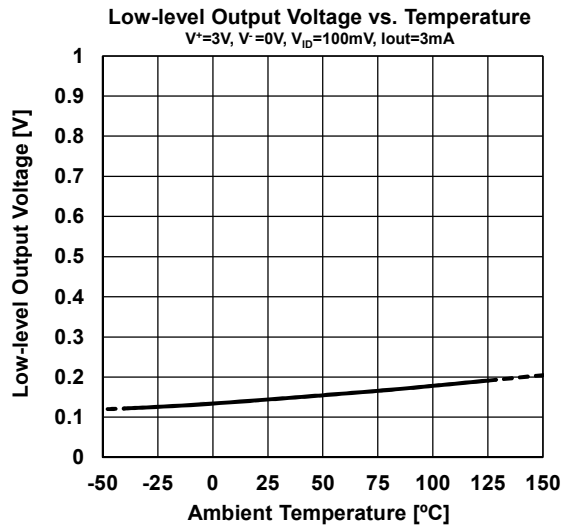
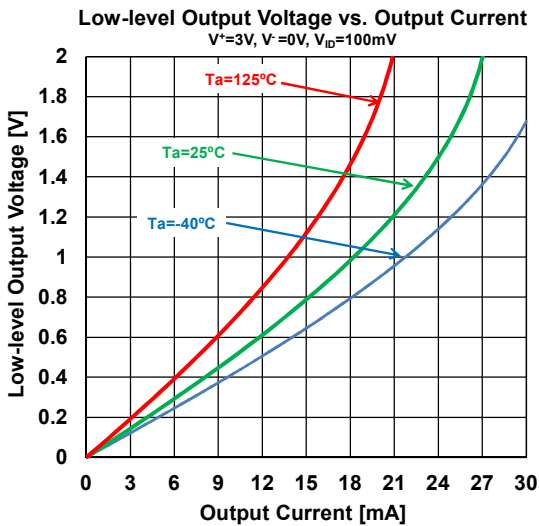
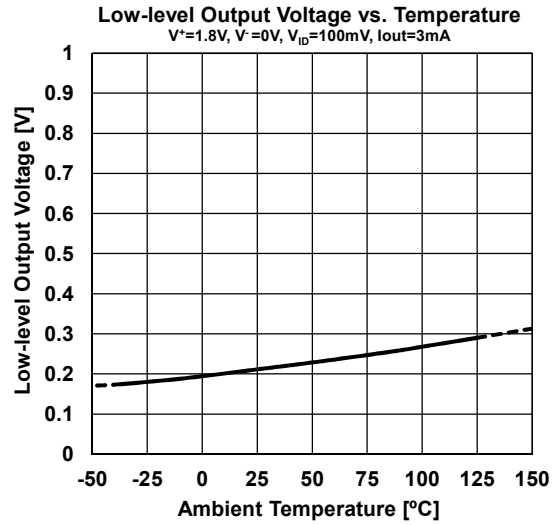
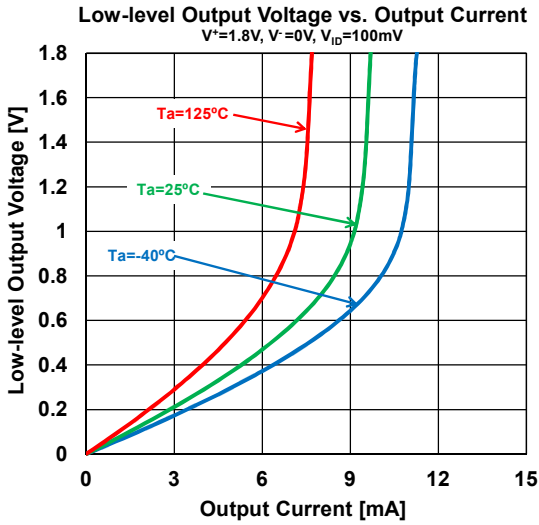
Input Offset Voltage vs. Common-Mode Input Voltage
 $V^+=5.5V, V^-=0V$



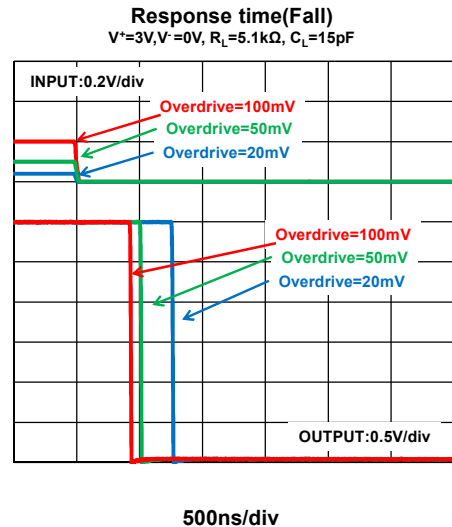
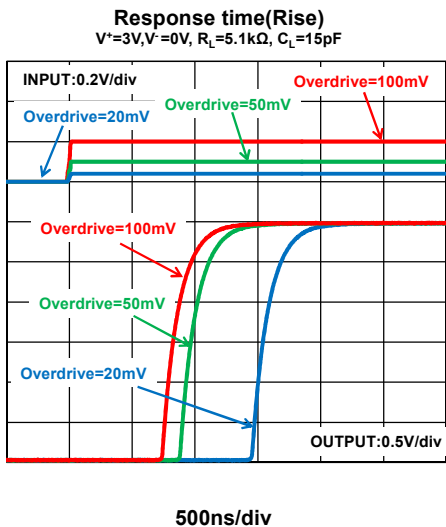
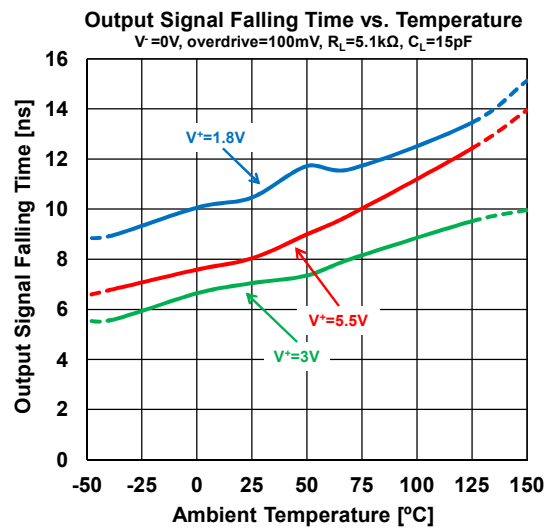
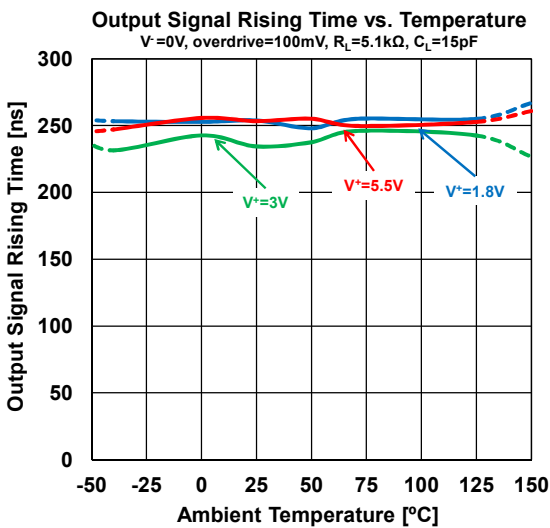
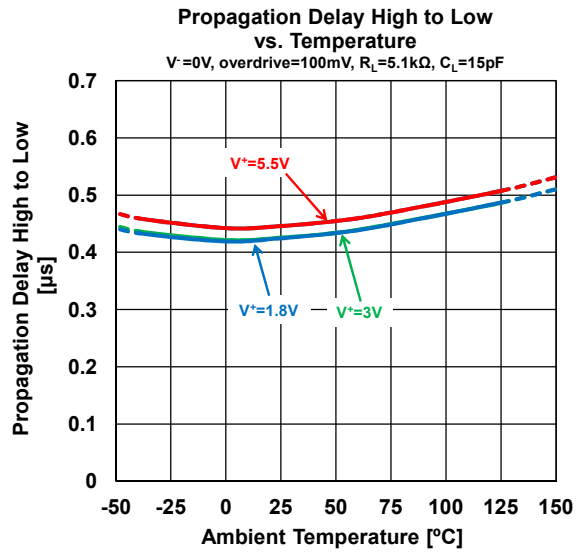
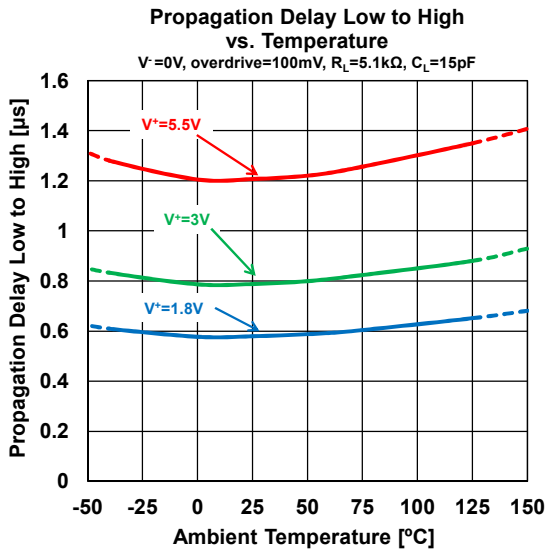
■ TYPICAL CHARACTERISTICS



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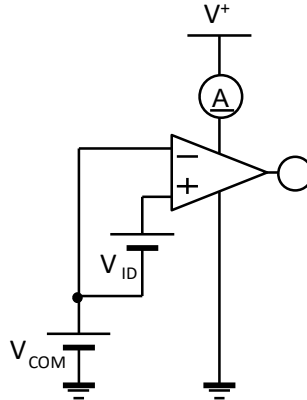
■ TYPICAL CHARACTERISTICS



■ TYPICAL TEST CIRCUIT

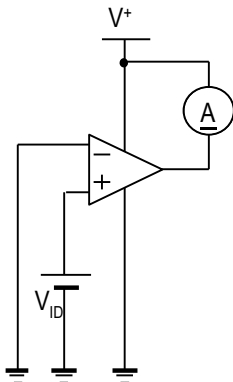
● Supply Current (I_{SUPPLY})

- $V^+ = 3V, V^- = 0V, V_{COM} = 0V, V_{ID} = 100mV$
- $V^+ = 3V, V^- = 0V, V_{COM} = 3V, V_{ID} = 100mV$



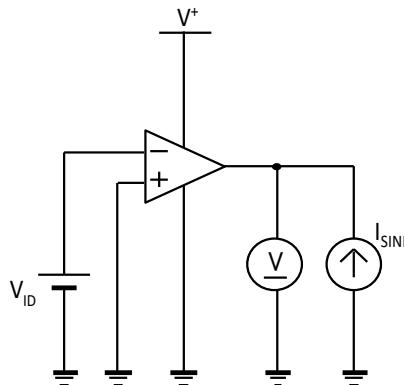
● Output Leakage Current (I_{LEAK})

- $V^+ = 3V, V^- = 0V, V_{ID} = 100mV, V_o = 3V$



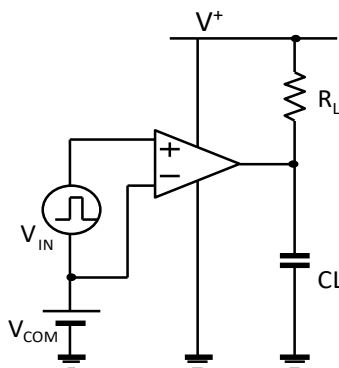
● Low-level Output Voltage (V_{OL})

- $V^+ = 3V, V^- = 0V, I_{SINK} = 3mA, V_{ID} = 100mV$

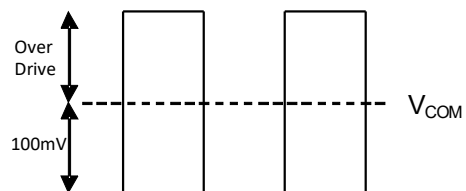


● Propagation Delay (t_{PLH}, t_{PHL}), Output Signal Rising Time (t_{TLH}), Output Signal Falling Time (t_{THL})

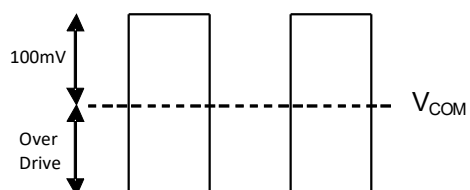
- $V^+ = 3V, V^- = 0V, V_{COM} = 0V, R_L = 5.1k\Omega, C_L = 15pF, \text{Over drive} = 100mV$



Input Wave Form
(Rise Measurement)



Input Wave Form
(Fall Measurement)



■ APPLICATION NOTE

▪ Input Voltage Exceeding the Supply Voltage

Inputs of the NJU77240/NJU77241/NJU77242 are protected by ESD diodes (shown in Figure1) that will conduct if the input voltages exceed the power supplies by more than approximately 300mV. Momentary voltages greater than 300mV beyond the power supply, inputs can be tolerated if the current is limited to 10mA. Figure2 is easily accomplished with an input resistor. If the input voltage exceeds the supply voltage, the input current must be limited 10mA or less by using a restriction resistance (R_{LIMIT}) as shown in figure2.

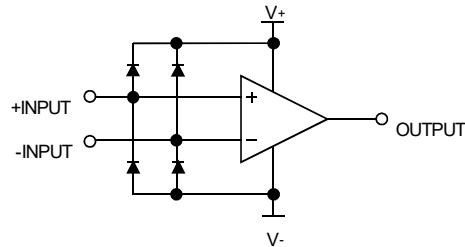


Figure1. Simplified Schematic

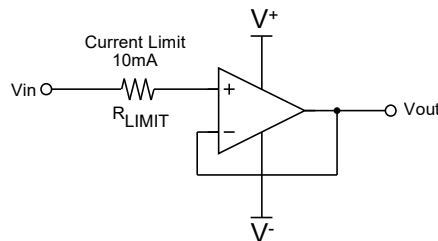


Figure2. Input Current Protection for Voltages exceeding the Supply Voltage.

▪ Bypass Capacitor

It is advised to add a bypass capacitor between the supply voltage and ground as close as possible to device.

▪ **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 a formula (1). We can grasp the tolerance of the RF signal by measuring an RF signal and offset voltage shift quantity.

$$EMIRR = 20 \cdot \log \left(\frac{V_{RF_PEAK}}{|\Delta V_{IO}|} \right) \quad \dots (1)$$

V_{RF_PEAK} : RF Signal Amplitude [V_P]

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

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.

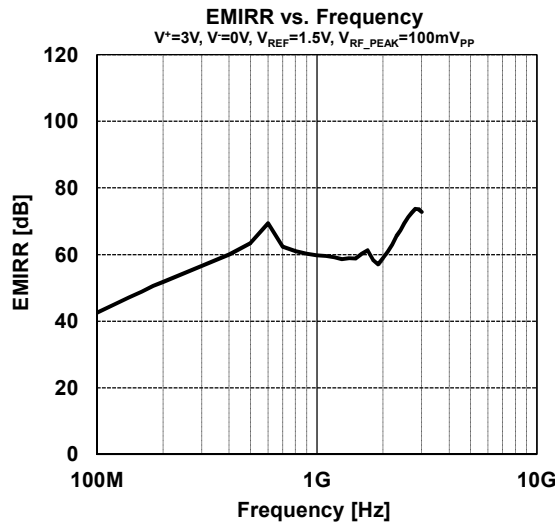
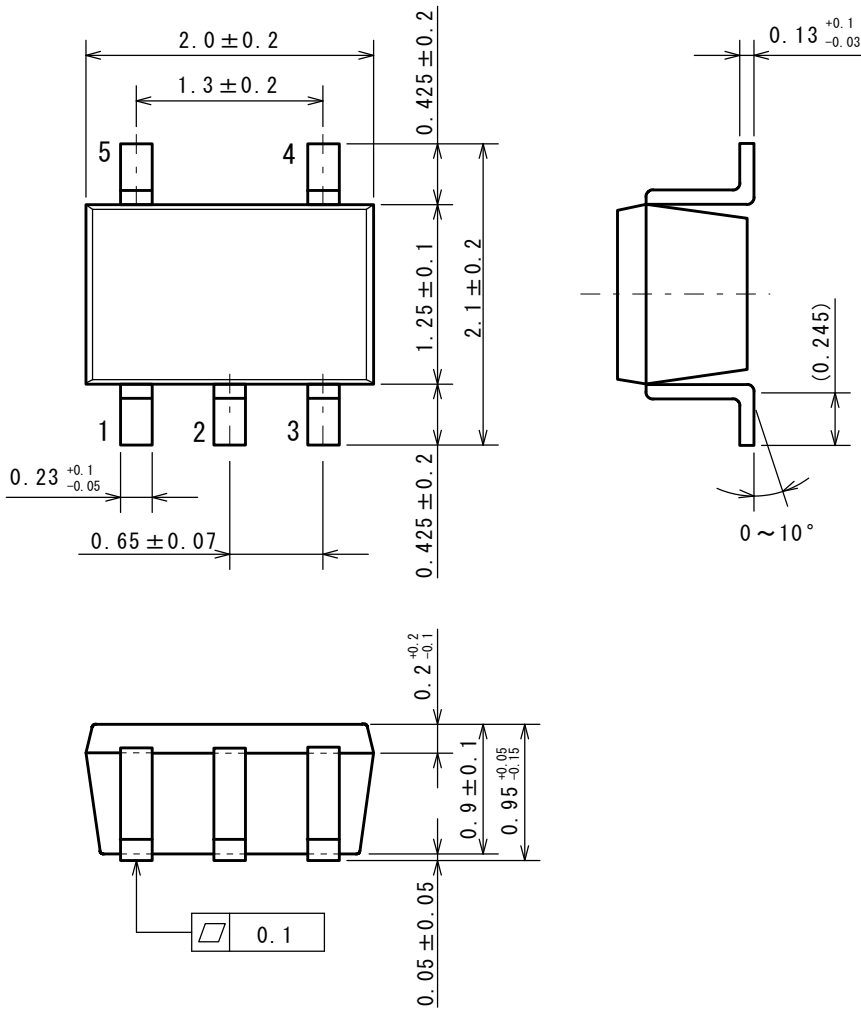


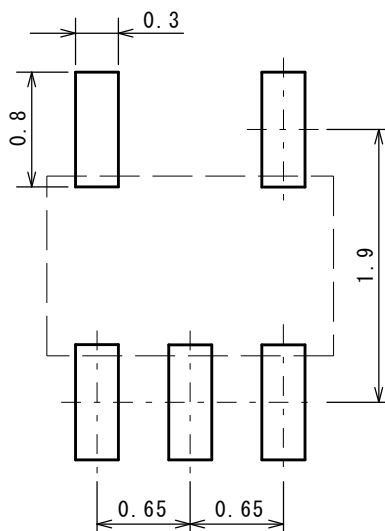
Figure3. EMIRR vs. Frequency

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

■ PACKAGE DIMENSIONS

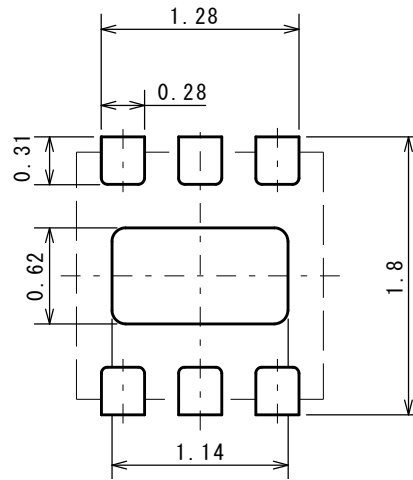
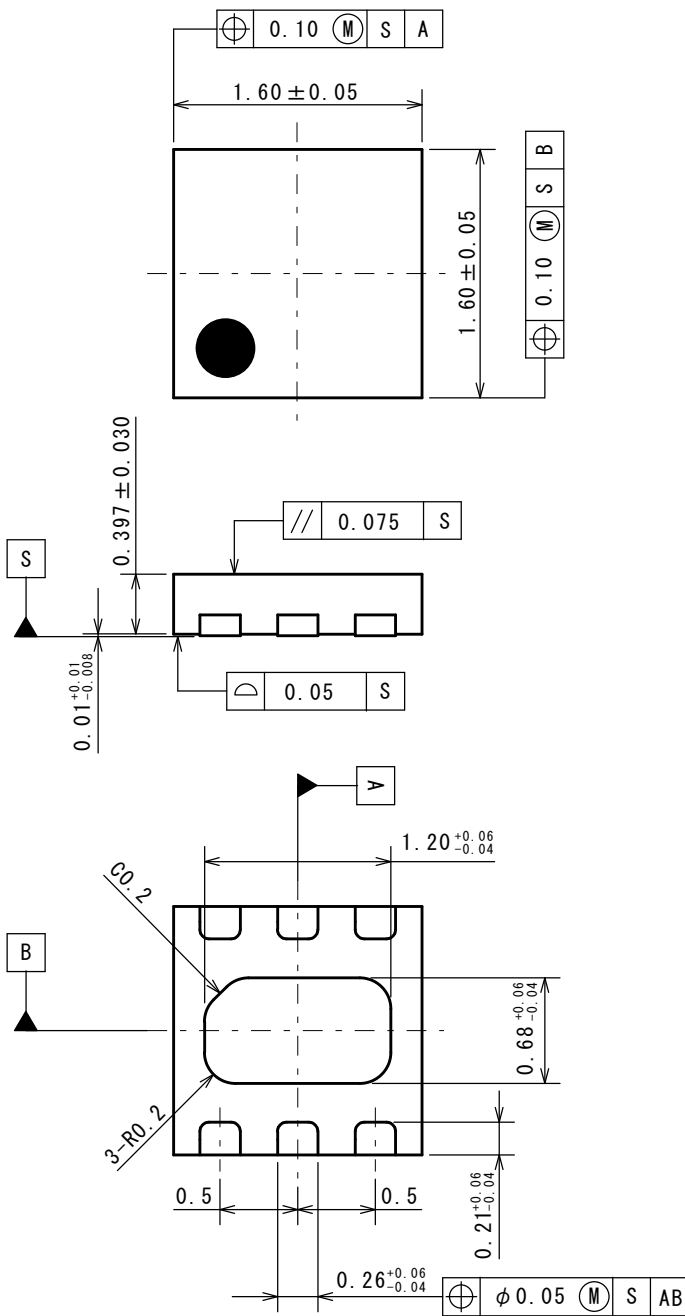


■ EXAMPLE OF SOLDER PADS DIMENSIONS

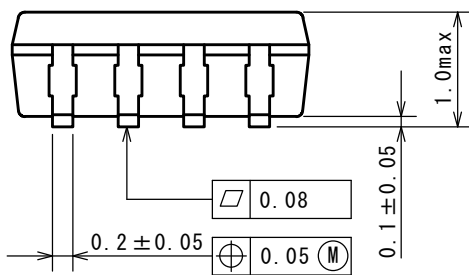
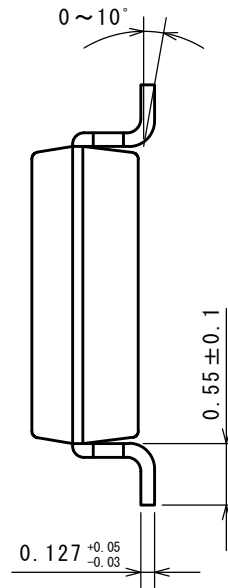
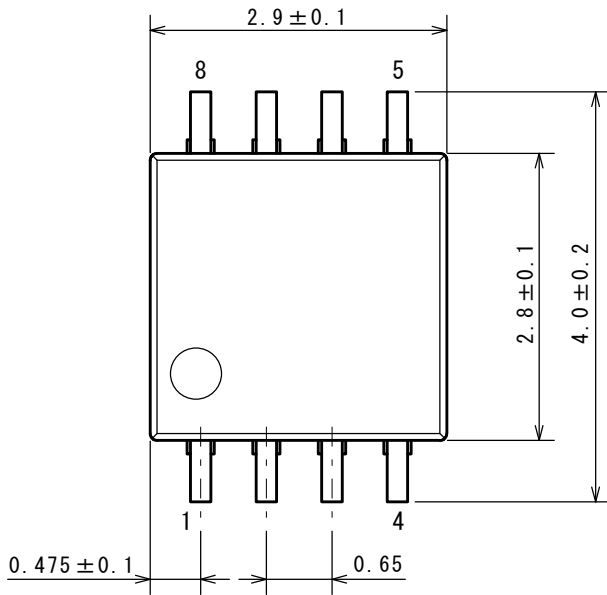


■ PACKAGE DIMENSIONS

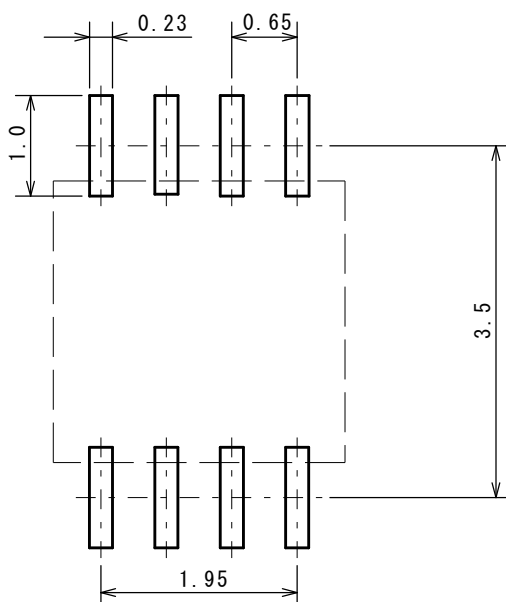
■ EXAMPLE OF SOLDER PADS DIMENSIONS



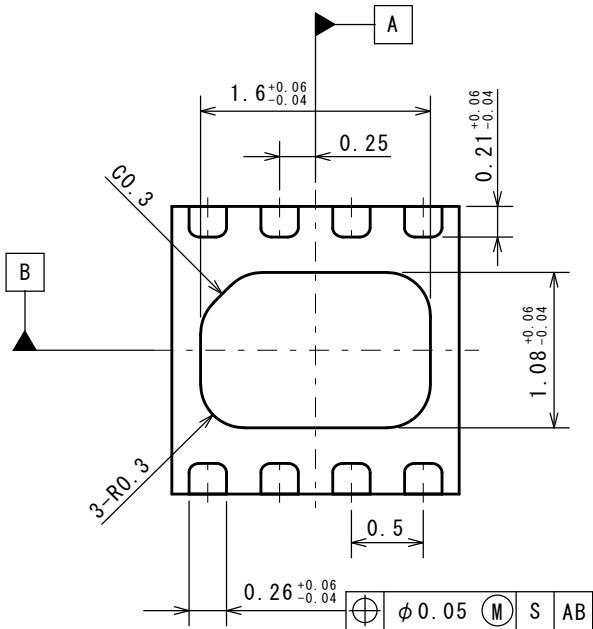
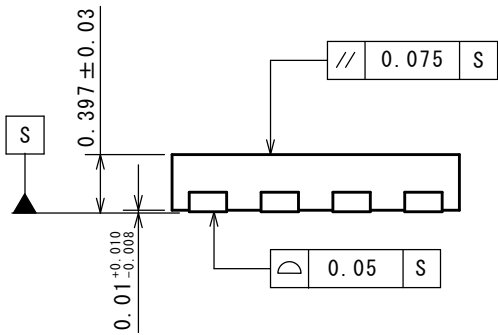
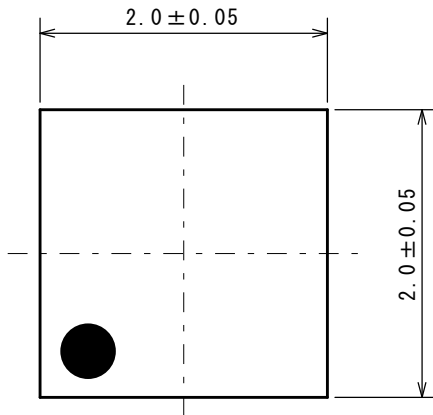
■ PACKAGE DIMENSIONS



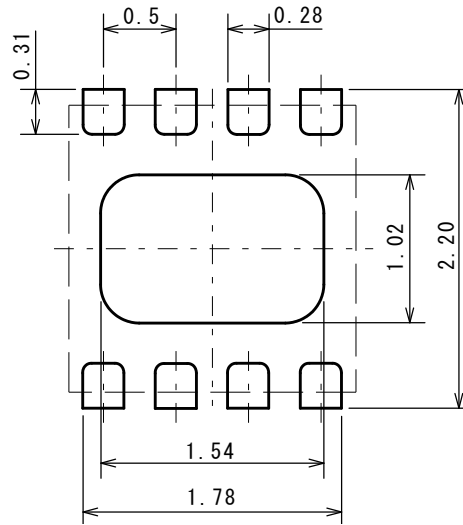
■ EXAMPLE OF SOLDER PADS DIMENSIONS



■ PACKAGE DIMENSIONS

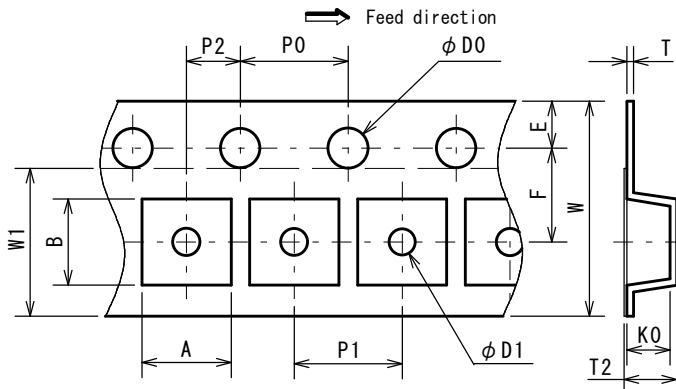


■ EXAMPLE OF SOLDER PADS DIMENSIONS



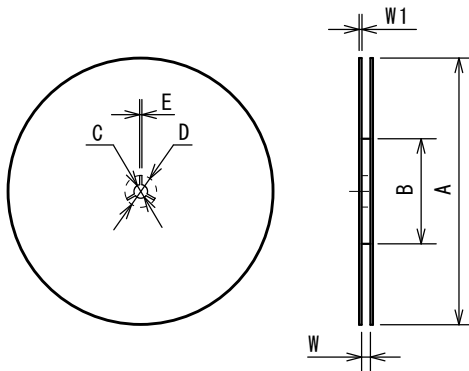
PACKING SPEC

TAPING DIMENSIONS



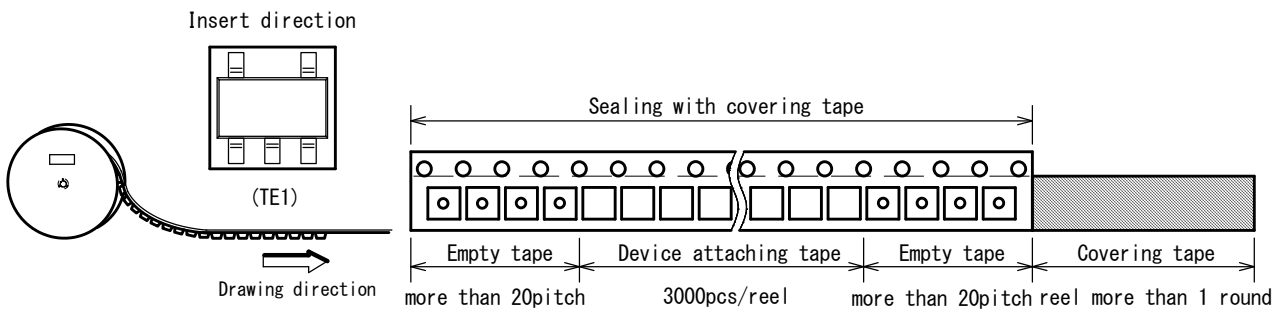
SYMBOL	DIMENSION	REMARKS
A	3.3±0.1	BOTTOM DIMENSION
B	3.2±0.1	BOTTOM DIMENSION
D0	1.55	
D1	1.05	
E	1.75±0.1	
F	3.5±0.05	
P0	4.0±0.1	
P1	4.0±0.1	
P2	2.0±0.05	
T	0.25±0.05	
T2	1.82	
K0	1.5±0.1	
W	8.0±0.3	
W1	5.5	THICKNESS 0.1MAX

REEL DIMENSIONS

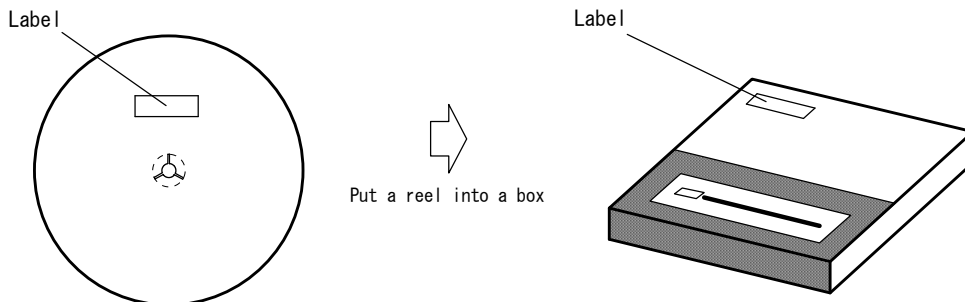


SYMBOL	DIMENSION
A	φ180±1
B	φ60±1
C	φ13±0.2
D	φ21±0.8
E	2±0.5
W	9±0.5
W1	1.2±0.2

TAPING STATE

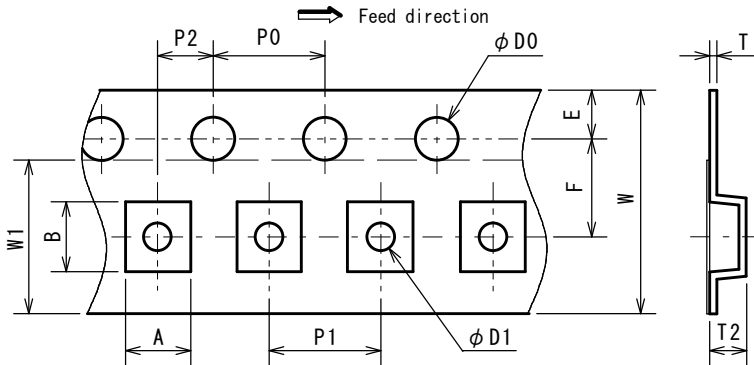


PACKING STATE



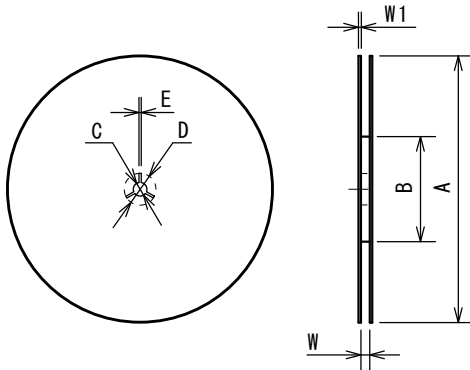
PACKING SPEC

TAPING DIMENSIONS



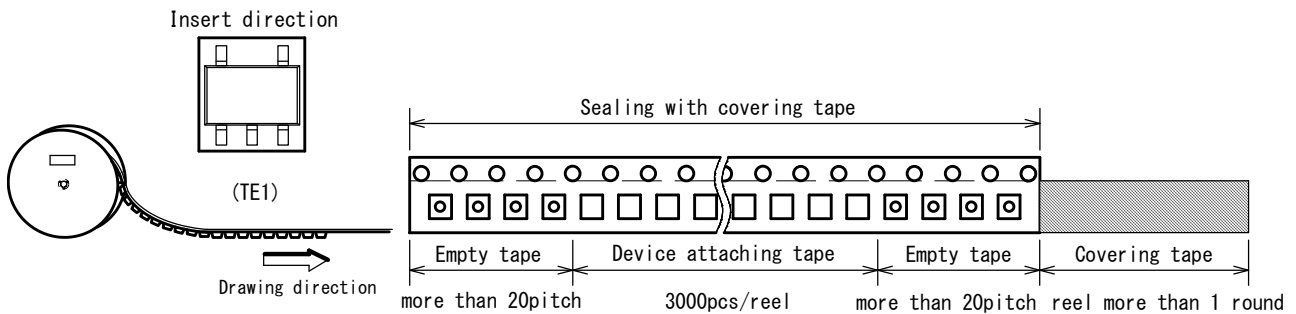
SYMBOL	DIMENSION	REMARKS
A	2.3±0.1	BOTTOM DIMENSION
B	2.5±0.1	BOTTOM DIMENSION
D0	1.55±0.05	
D1	1.05±0.05	
E	1.75±0.1	
F	3.5±0.05	
P0	4.0±0.1	
P1	4.0±0.1	
P2	2.0±0.05	
T	0.25±0.05	
T2	1.3±0.1	
W	8.0±0.2	
W1	5.5	THICKNESS 0.1max

REEL DIMENSIONS

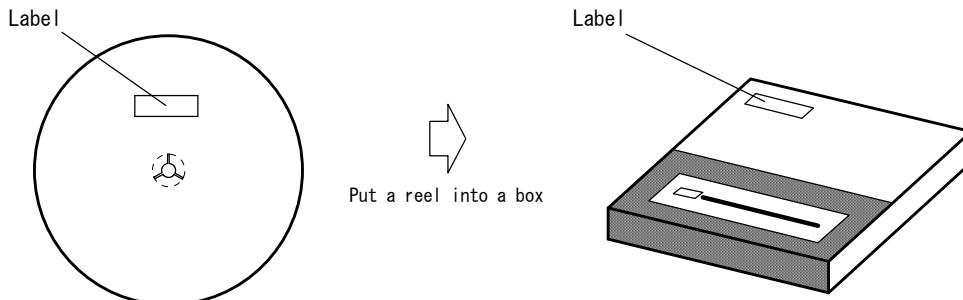


SYMBOL	DIMENSION
A	φ 180±1
B	φ 60±1
C	φ 13±0.2
D	φ 21±0.8
E	2±0.5
W	9±0.5
W1	1.2±0.2

TAPING STATE

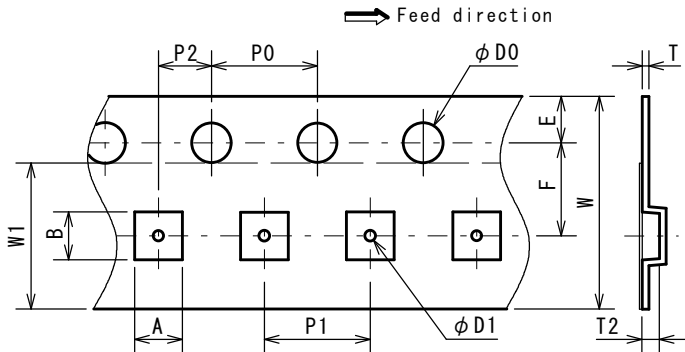


PACKING STATE



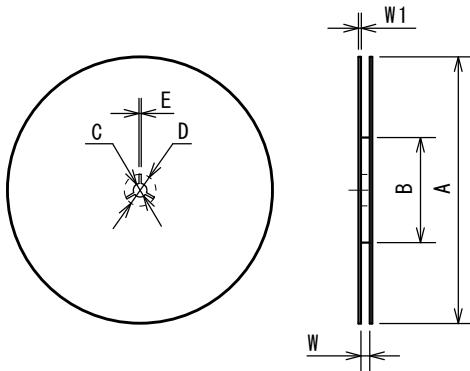
PACKING SPEC

TAPING DIMENSIONS



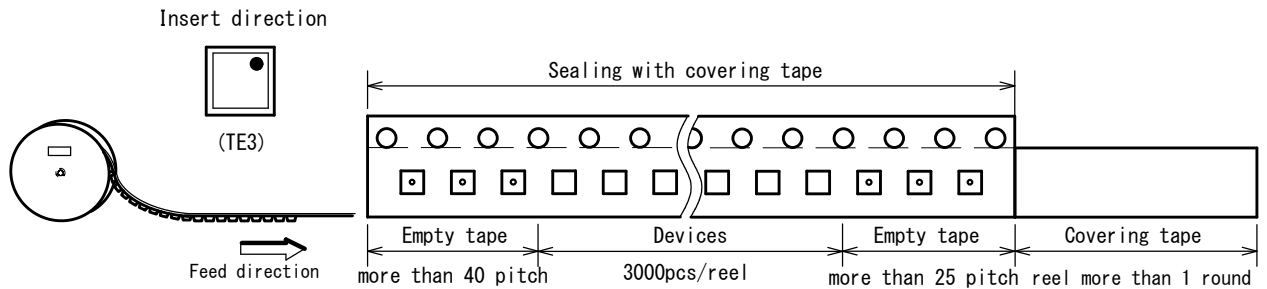
SYMBOL	DIMENSION	REMARKS
A	1.85±0.05	BOTTOM DIMENSION
B	1.85±0.05	BOTTOM DIMENSION
D0	1.5 ^{+0.1} ₀	
D1	0.5±0.1	
E	1.75±0.1	
F	3.5±0.05	
P0	4.0±0.1	
P1	4.0±0.1	
P2	2.0±0.05	
T	0.25±0.05	
T2	0.65±0.05	
W	8.0±0.2	
W1	5.5	THICKNESS 0.1max

REEL DIMENSIONS

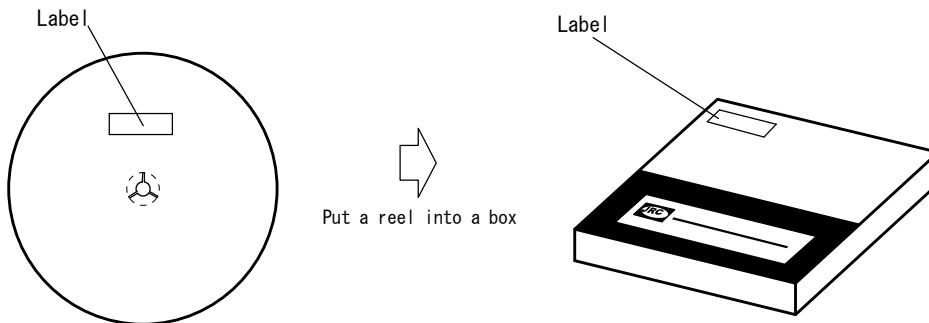


SYMBOL	DIMENSION
A	φ 180 ⁰ _{-1.5}
B	φ 60 ⁺¹ ₀
C	φ 13±0.2
D	φ 21±0.8
E	2±0.5
W	9 ^{+0.3} ₀
W1	1.2

TAPING STATE

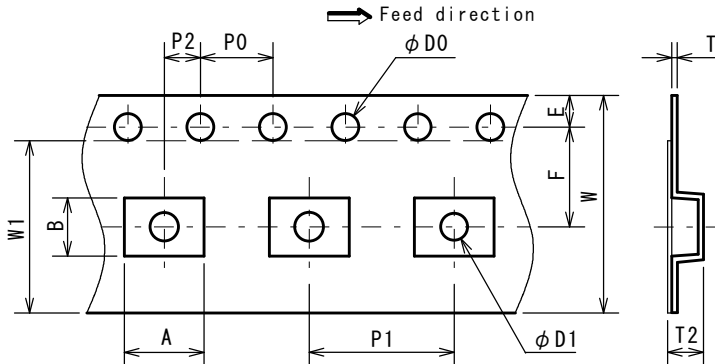


PACKING STATE



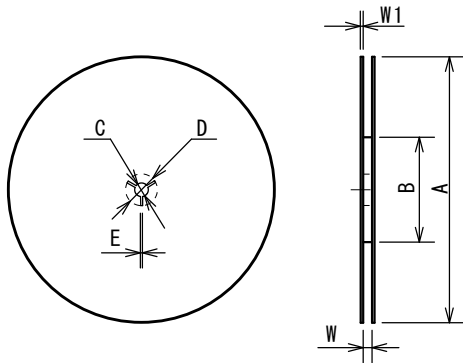
PACKING SPEC

TAPING DIMENSIONS



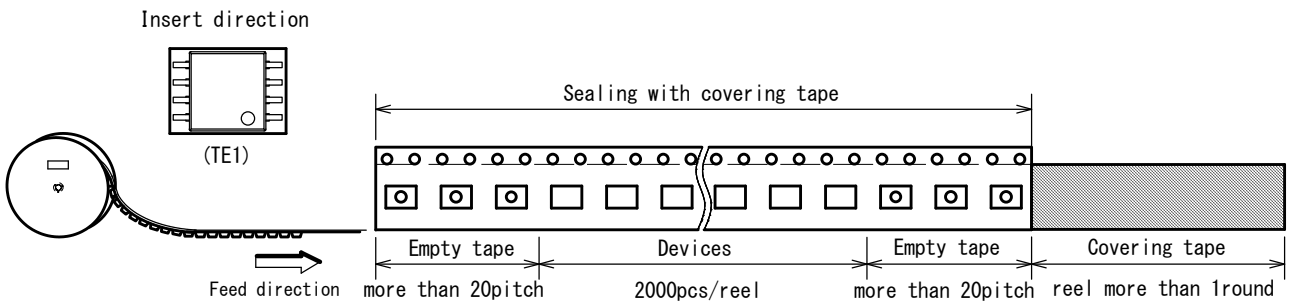
SYMBOL	DIMENSION	REMARKS
A	4.4	BOTTOM DIMENSION
B	3.2	BOTTOM DIMENSION
D0	1.5 ^{+0.1} ₀	
D1	1.5 ^{+0.1} ₀	
E	1.75±0.1	
F	5.5±0.05	
P0	4.0±0.1	
P1	8.0±0.1	
P2	2.0±0.05	
T	0.30±0.05	
T2	1.75 (MAX.)	
W	12.0±0.3	
W1	9.5	THICKNESS 0.1max

REEL DIMENSIONS

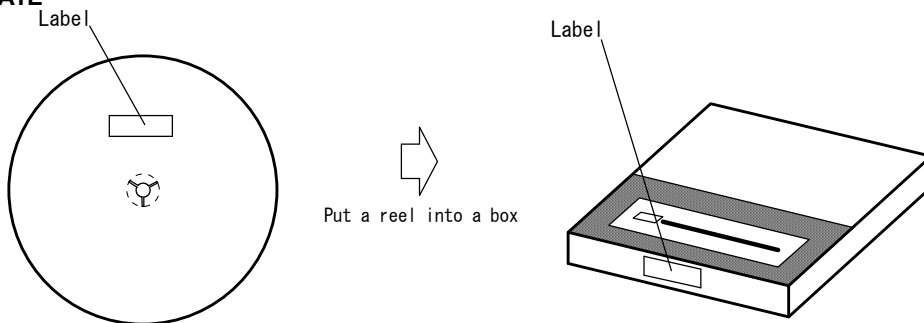


SYMBOL	DIMENSION
A	φ 254±2
B	φ 100±1
C	φ 13±0.2
D	φ 21±0.8
E	2±0.5
W	13.5±0.5
W1	2.0±0.2

TAPING STATE

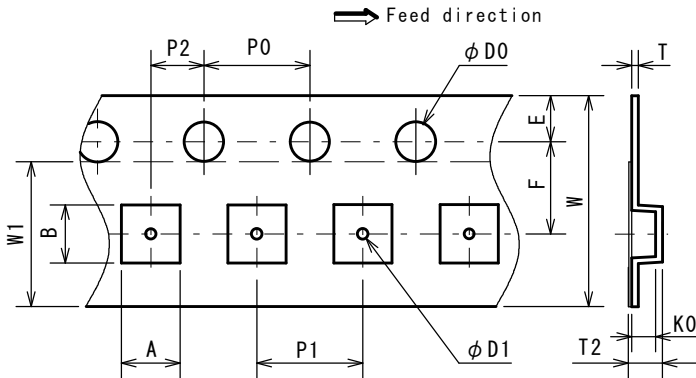


PACKING STATE



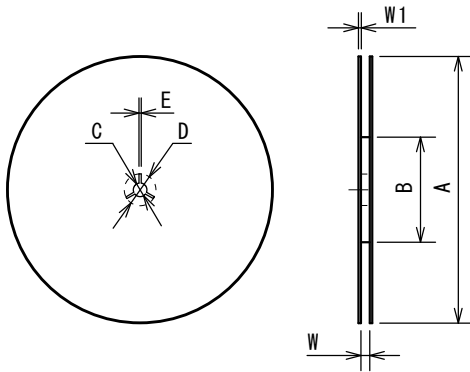
PACKING SPEC

TAPING DIMENSIONS



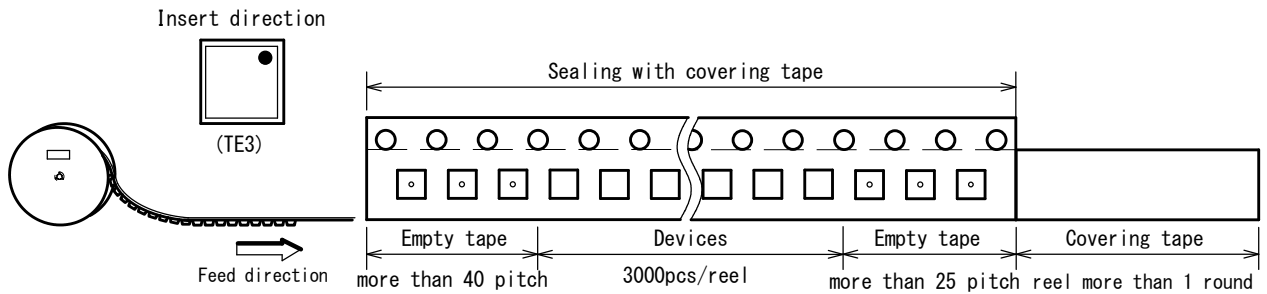
SYMBOL	DIMENSION	REMARKS
A	2.25±0.05	BOTTOM DIMENSION
B	2.25±0.05	BOTTOM DIMENSION
D0	1.5 ^{+0.1} ₀	
D1	0.5±0.1	
E	1.75±0.1	
F	3.5±0.05	
P0	4.0±0.1	
P1	4.0±0.1	
P2	2.0±0.05	
T	0.25±0.05	
T2	1.00±0.07	
K0	0.65±0.05	
W	8.0±0.2	
W1	5.5	THICKNESS 0.1max

REEL DIMENSIONS

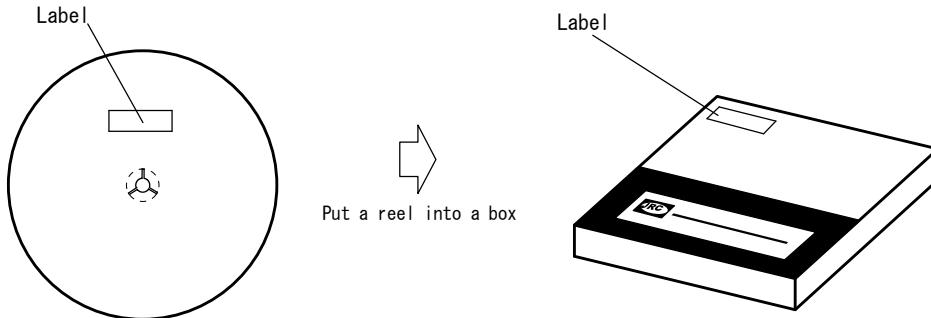


SYMBOL	DIMENSION
A	φ 180 ⁰ _{-1.5}
B	φ 60 ⁺¹ ₀
C	φ 13±0.2
D	φ 21±0.8
E	2±0.5
W	9 ^{+0.3} ₀
W1	1.2

TAPING STATE

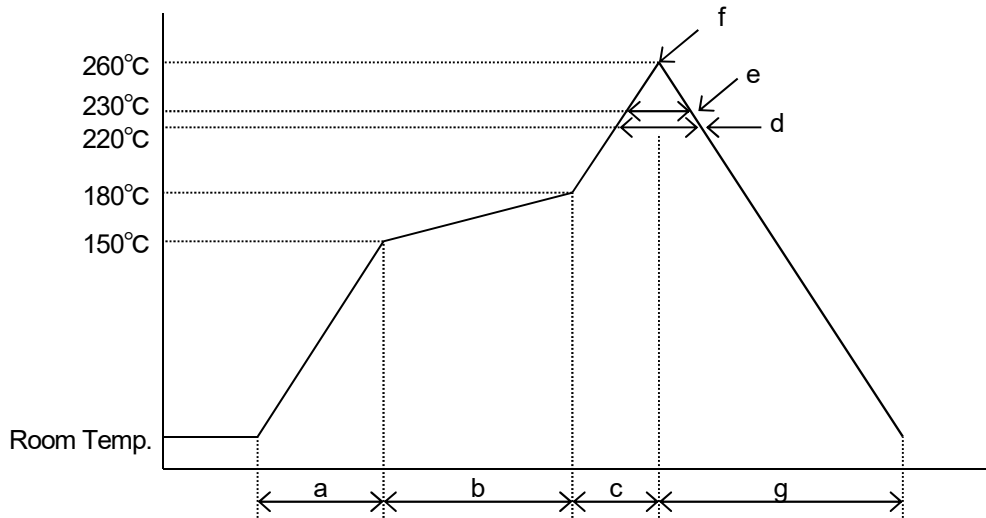


PACKING STATE



RECOMMENDED MOUNTING METHOD

*Recommended reflow soldering procedure



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

*The temperature indicates at the surface of mold package.

REVISION HISTORY

Date	Revision	Changes
2016/11/30	Ver.0	First edition
2017/5/24	Ver.1	Added information of NJU77242.
2017/6/6	Ver.2	Corrected BLOCK DIAGRAM.
2017/10/12	Ver.3	Changed GENERAL DESCRIPTION and APPLICATION Corrected ELECTRICAL CHARACTERISTICS
2017/12/1	Ver.4	Changed TITLE Corrected ELECTRICAL CHARACTERISTICS
2018/8/7	Ver.5	Changed TEST CONDITION in ELECTRICAL CHARACTERISTICS Changed RECOMMENDED OPERATING CONDITIONS Changed TEST CONDITION in TYPICAL CHARACTERISTICS
2019/3/29	Ver.6	Changed PARAMETER in RECOMMENDED OPERATING CONDITIONS Changed TIMING WAVEFORM Changed TEST CONDITION in TYPICAL CHARACTERISTICS

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 - Life Maintenance Medical Equipment
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 - Various Safety Devices
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9. The product specifications and descriptions listed in this datasheet are subject to change at any time, without notice.

