Rail-to-Rail Input,Push-Pull Output Low power CMOS Comparators

■FEATURES(V^+=3V, V^-=0V, Ta=25°C)

- ●Rail-to-Rail Input
- ●Push Pull Output
- ●Supply Current 6μA/ch typ.
- ●Propagation Delay 780ns typ.
- ●Operating Voltage 1.8 to 5.5V
- ●Input Offset Voltage 6mV max.
- ●Operating Temperature -40 to 125°C
- ●Integrated EMI filter
- ●Package

NJU77230	SOT-23-5, SC88A
NJU77231	SOT-23-5, SC88A, DFN6-G1(ESON6-G1)
NJU77232	MSOP8(TVSP8)* *meet JEDEC MO-187-DA / thin type, DFN8-U1(ESON8-U1)

■GENERAL DESCRIPTION

The NJU77230/NJU77231/NJU77232 are Rail-to-Rail Input CMOS comparators featuring Low-power and Push-Pull output.

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

The NJU77231/NJU77232 are available in small size Package, DFN6-G1(1616), DFN8-U1(2020), significantly reducing the required portable application's board area.

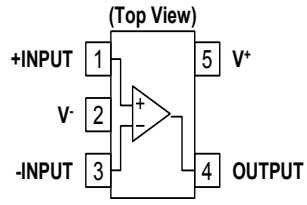
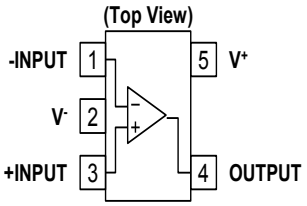
■APPLICATION

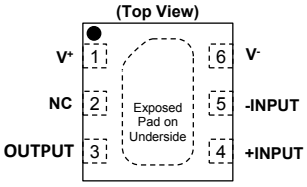
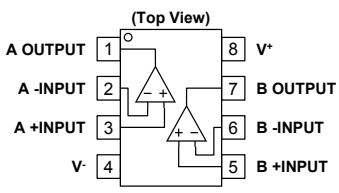
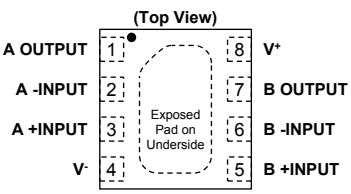
- ●Portable and Battery-Powered Applications
- ●Alarm and Surveillance Circuits
- ●Industrial Instruments
- ●Sensor Applications

■RELATED PRODUCTS

Features	Single	Dual
Rail-to-Rail Input Open-Drain Output Low power CMOS Comparators	NJU77240 NJU77241	NJU77242

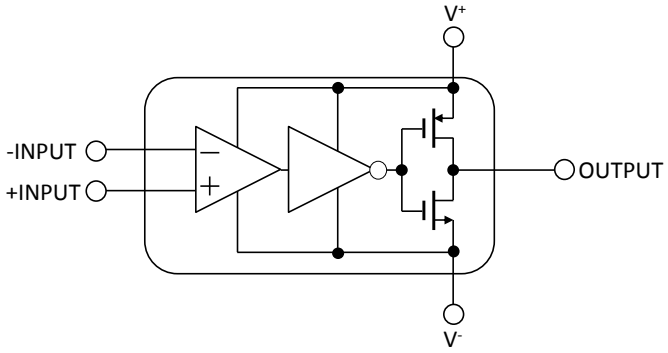
■PIN CONFIGURATION

Parts Number	NJU77230F	NJU77230F3	NJU77231F	NJU77231F3
Package Outline	SOT-23-5	SC-88A	SOT-23-5	SC-88A
Pin Function				

Parts Number	NJU77231KG1	NJU77232RB1	NJU77232KU1
Package Outline	DFN6-G1(ESON6-G1)(*)	MSOP8（TVSP8）	DFN8-U1(ESON8-U1) (*)
Pin Function			

(*)Connect to exposed pad to V^-

■BLOCK DIAGRAM



■PRODUCT NAME INFORMATION

NJU77230 F (TE1)

Part Number Package Taping Form

■ORDERING INFORMATION

PART NUMBER	PACKAGE OUTLINE	RoHS	HALOGEN-FREE	TERMINAL FINISH	MARKING	WEIGHT (mg)	MOQ (pcs)
NJU77230F	SOT-23-5	yes	yes	Sn2Bi	1H	15	3,000
NJU77230F3	SC-88A	yes	yes	Sn2Bi	F1	7.5	3,000
NJU77231F	SOT-23-5	yes	yes	Sn2Bi	1J	15	3,000
NJU77231F3	SC-88A	yes	yes	Sn2Bi	F2	7.5	3,000
NJU77231KG1	DFN6-G1	yes	yes	Sn2Bi	77231	3.5	3,000
NJU77232RB1	MSOP8(TVSP8)	yes	yes	Sn2Bi	77232	18	2,000
NJU77232KU1	DFN8-U1	yes	yes	Sn2Bi	77232	5.3	3,000

■ABSOLUTE MAXIMUM RATINGS

PARAMETER	SYMBOL	RATINGS	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 (1)	Vo	V^- - 0.3 to V^+ + 0.3	V
Power Dissipation(Ta=25°C) SOT-23-5 (4) SC-88A (4) DFN6-G1 (5) MSOP8(TVSP8) (4) DFN8-U1 (5)	P_D	(2-layer / 4-layer) 480 / 650 360 / 490 330 / 1200 510 / 680 450 / 1200	mW
Junction Temperature	T_{jmax}	+150	°C
Storage Temperature Range	T_{stg}	- 55 to +150	°C

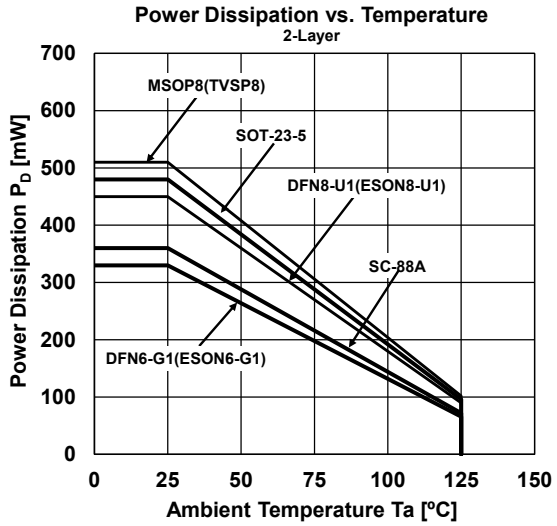
(1) Voltage values are limited at 7V.
(2) Input voltages outside the supply voltage will be clamped by ESD protection diodes. If the input voltage exceeds the supply voltage, the input current must be limited 10mA or less by using a restriction resistance.
(3) Differential voltage is the voltage difference between +INPUT and - INPUT.
For supply voltage less than +7V, the absolute maximum rating is equal to the supply voltage.
(4) Mounted on glass epoxy board. (76.2×114.3×1.6mm:based on EIA/JDEC standard, 2Layers FR4)
Mounted on glass epoxy board. (76.2×114.3×1.6mm:based on EIA/JDEC standard, 4Layers FR4), internal Cu area: 74.2 x 74.2mm
(5) Mounted on glass epoxy board. (101.5×114.5×1.6mm: based on EIA/JEDEC standard, 2Layers FR-4, with Exposed Pad)
Mounted on glass epoxy board. (101.5×114.5×1.6mm: based on EIA/JEDEC standard, 4Layers FR-4, with Exposed Pad)
*For 4Layers: Applying 99.5×99.5mm inner Cu area and a thermal via hole to a board based on JEDEC standard JESD51-5

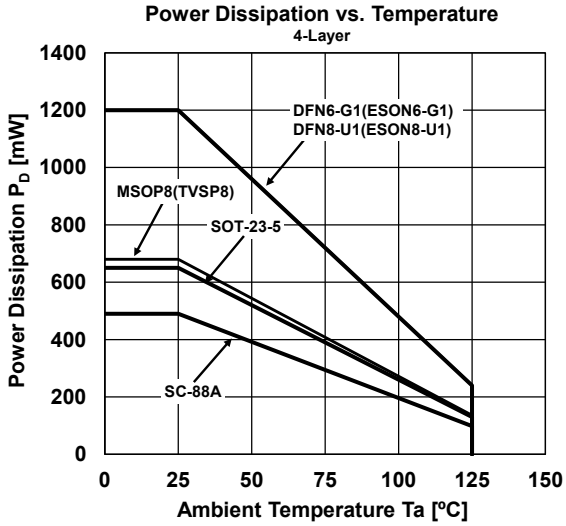
■THERMAL CHARACTERISTICS

PARAMETER	SYMBOL	VALUE	UNIT
Junction-to-ambient thermal resistance	θja	(2-layer / 4-layer)	°C /W
SOT-23-5(6)		259 / 193	
SC-88A(6)		352 / 256	
DFN6-G1(7)		381 / 106	
MSOP8(TVSP8)(6)		244 / 185	
DFN8-U1(7)		278 / 107	
Junction-to-Top of package characterization parameter	ψjt	(2-layer/ 4-layer)	°C /W
SOT-23-5(6)		67 / 58	
SC-88A(6)		91 / 73	
DFN6-G1(7)		64 / 26	
MSOP8(TVSP8)(6)		51 / 45	
DFN8-U1(7)		42 / 25	

(6) Mounted on glass epoxy board. (76.2×114.3×1.6mm:based on EIA/JDEC standard, 2Layers FR4)
Mounted on glass epoxy board. (76.2×114.3×1.6mm:based on EIA/JDEC standard, 4Layers FR4), internal Cu area: 74.2 x 74.2mm
(7) Mounted on glass epoxy board. (101.5×114.5×1.6mm: based on EIA/JEDEC standard, 2Layers FR-4, with Exposed Pad)
Mounted on glass epoxy board. (101.5×114.5×1.6mm: based on EIA/JEDEC standard, 4Layers FR-4, with Exposed Pad)
*For 4Layers: 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	RATINGS	UNIT
Supply Voltage			
Single Supply	V^+- V^-	+1.8 to +5.5	V
Dual Supply	V^+ / V^-	±0.9 to ±2.75	
Operating Ambient Temperature	T_{opr}	- 40 to +125	°C

■ELECTRICAL CHARACTERISTICS

●DC CHARACTERISTICS

(Unless otherwise specified, V+=3V, V-=0V, RL=OPEN, Ta=25°C)

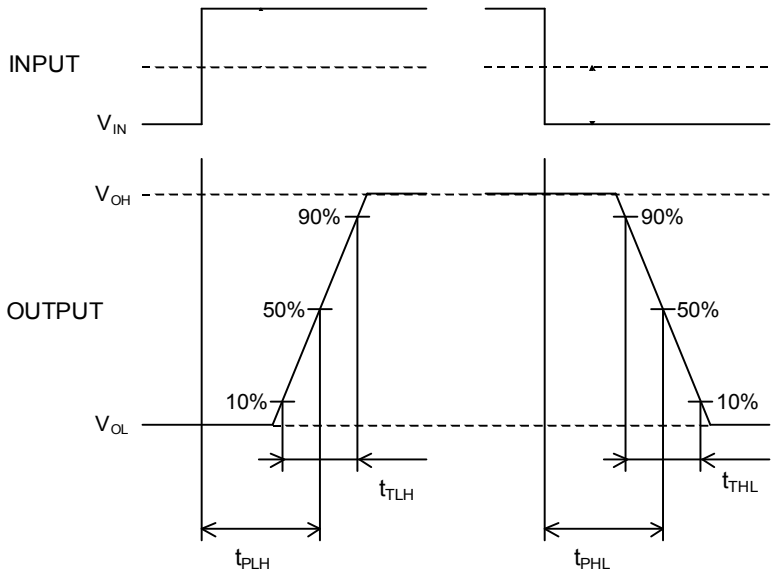
PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Supply Current (per comparator)	I_{SUPPLY}	V_{ID}=100mV,Vcom=0V	—	6	10	μA
		V_{ID}=100mV,Vcom=3V	—	9	14	μA
Input Offset Voltage	V_{IO}	V_{COM}=0V	—	1	6	mV
		V_{COM}=3V	—	1	7	mV
Input Offset Current	I_{IO}		—	1	—	pA
Input Bias Current	I_B		—	1	—	pA
Common Mode Input Voltage Range	V_{ICM}	CMR≥50dB	0	—	3	V
Open-Loop Voltage Gain	Av	R_L=5.1kΩ	—	100	—	dB
Common Mode Rejection Ratio	CMR	V_{ICM}=0 to 3V	50	70	—	dB
Supply Voltage Rejection Ratio	SVR	V_{COM}=0V, V^+=1.8 to 5.5V	65	85	—	dB
High-level Output Voltage	V_{OH}	I_{SOURCE}=3mA	2.7	2.8	—	V
Low-level Output Voltage	V_{OL}	I_{SINK}=3mA	—	0.2	0.3	V

●SWITCHING CHARACTERISTICS

(Unless otherwise specified,V^+=+3V, V^-=0V, Ta=25°C, C_L=15pF, R_L=5.1kΩ)

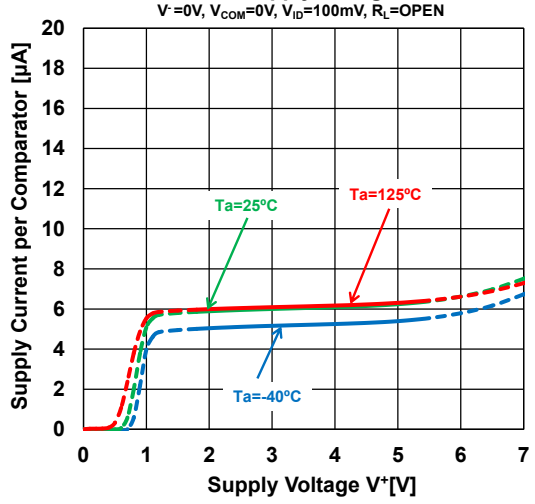
PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Propagation Delay Low to High	t_{PLH}	Overdrive=100mV	—	780	—	ns
Propagation Delay High to Low	t_{PHL}	Overdrive =100mV	—	480	—	ns
Output Signal Rising Time	t_{TLH}	Overdrive =100mV	—	20	—	ns
Output Signal Falling Time	t_{THL}	Overdrive =100mV	—	11	—	ns

■TIMING WAVEFORM

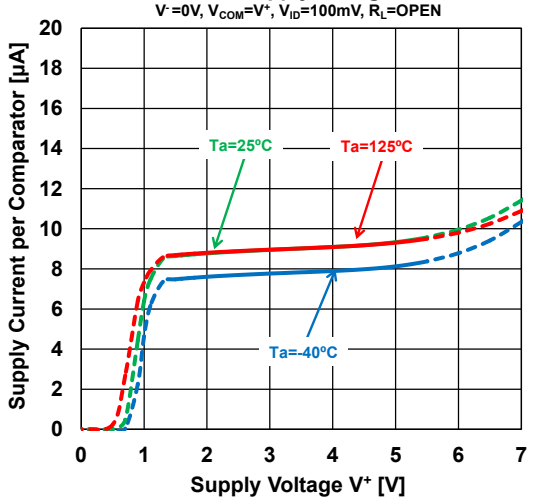


■TYPICAL CHARACTERISTICS

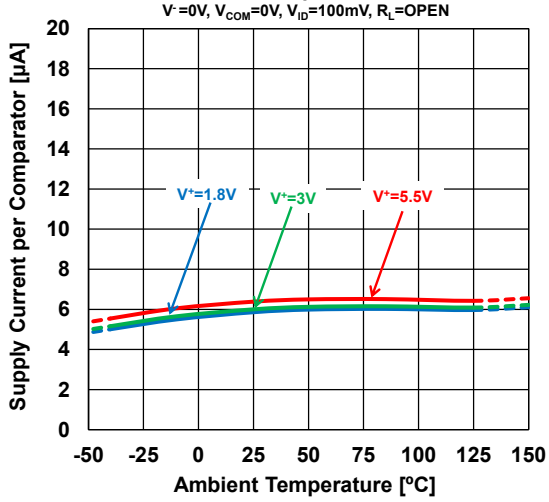
Supply Current per Comparator vs. Supply Voltage
V^-=0V, V_{COM}=0V, V_{ID}=100mV, R_L=OPEN



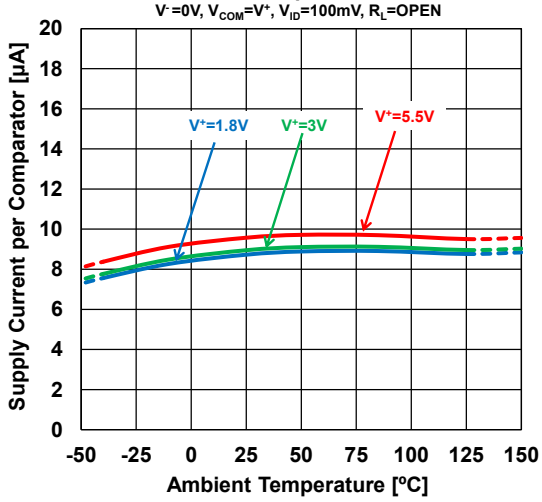
Supply Current per Comparator vs. Supply Voltage
V^-=0V, V_{COM}=V^+, V_{ID}=100mV, R_L=OPEN



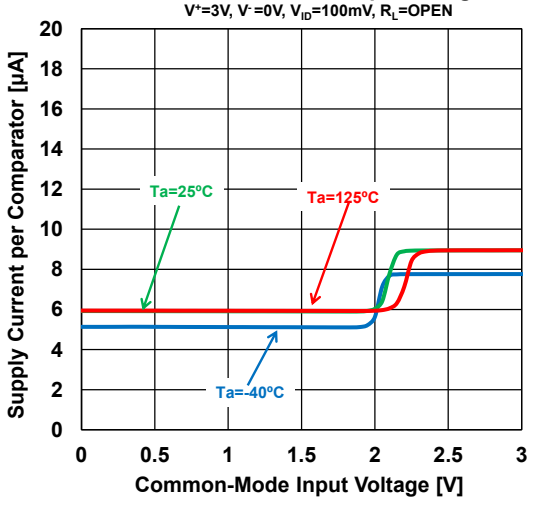
Supply Current per Comparator vs. Temperature
V^-=0V, V_{COM}=0V, V_{ID}=100mV, R_L=OPEN



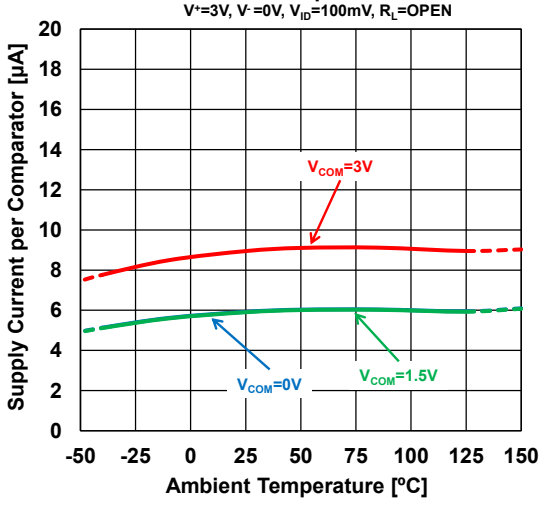
Supply Current per Comparator vs. Temperature
V^-=0V, V_{COM}=V^+, V_{ID}=100mV, R_L=OPEN



Supply Current per Comparator vs. Common-Mode Input Voltage
V^+=3V, V^-=0V, V_{ID}=100mV, R_L=OPEN

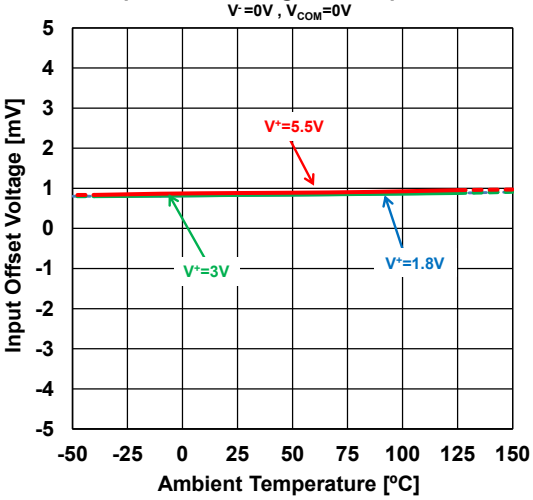


Supply Current per Comparator vs. Temperature
V^+=3V, V^-=0V, V_{ID}=100mV, R_L=OPEN

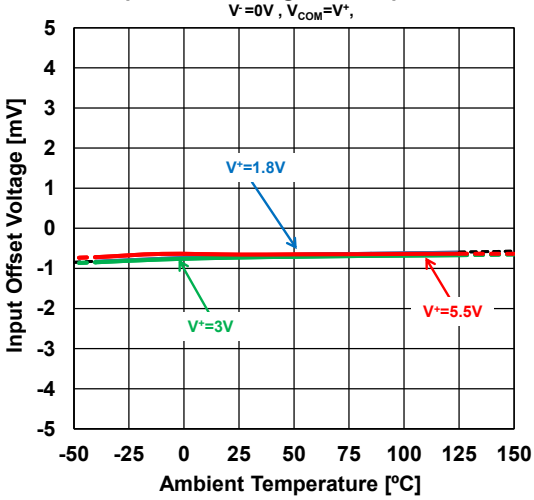


■TYPICAL CHARACTERISTICS

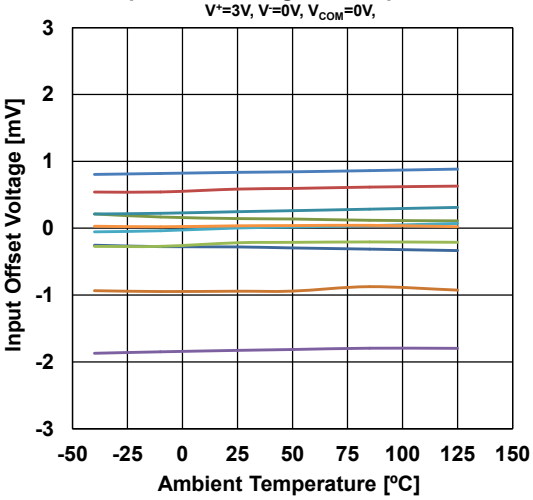
Input Offset Voltage vs. Temperature
V^-=0V , V_{COM}=0V



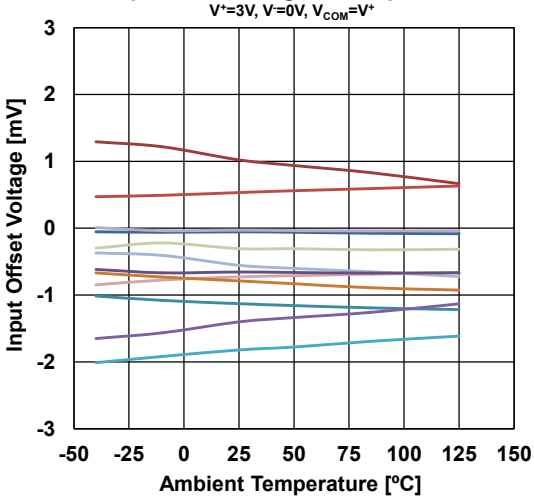
Input Offset Voltage vs. Temperature
V^-=0V , V_{COM}=V^+,



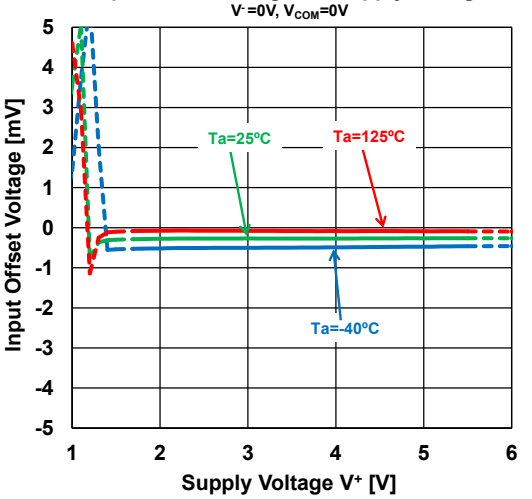
Input offset voltage vs. temperature
V^+=3V, V^-=0V, V_{COM}=0V,



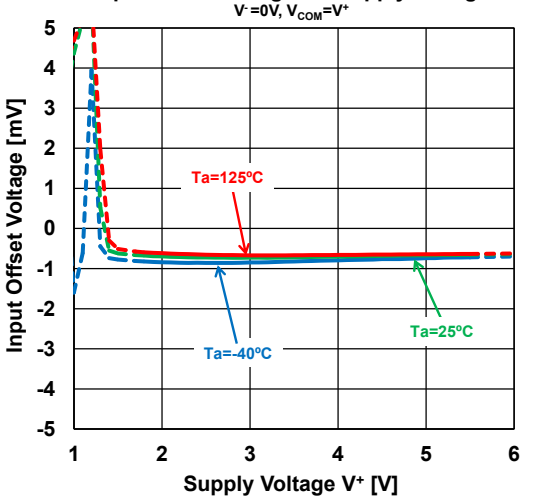
Input offset voltage vs. temperature
V^+=3V, V^-=0V, V_{COM}=V^+



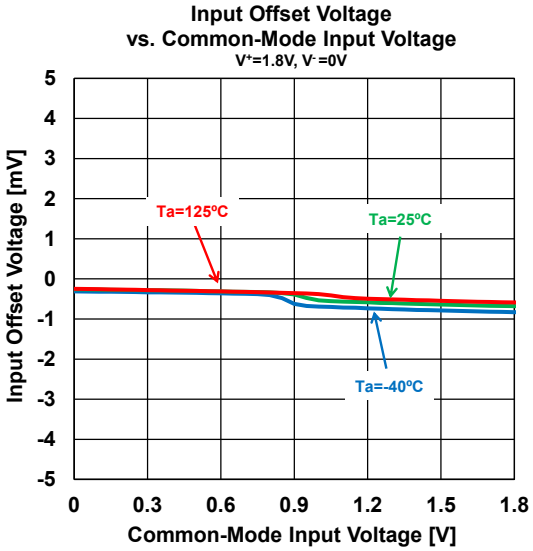
Input Offset Voltage vs. Supply Voltage
V^-=0V, V_{COM}=0V

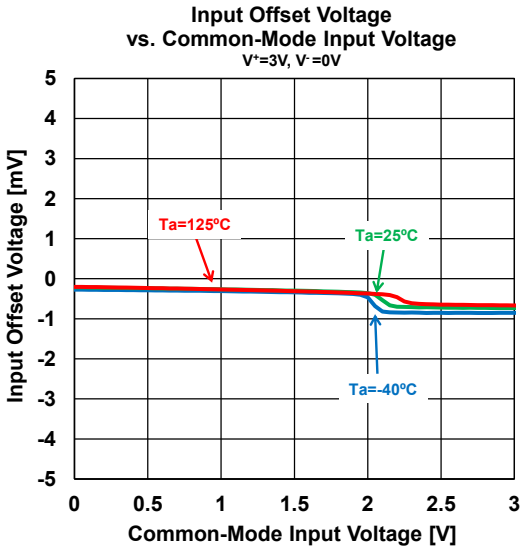


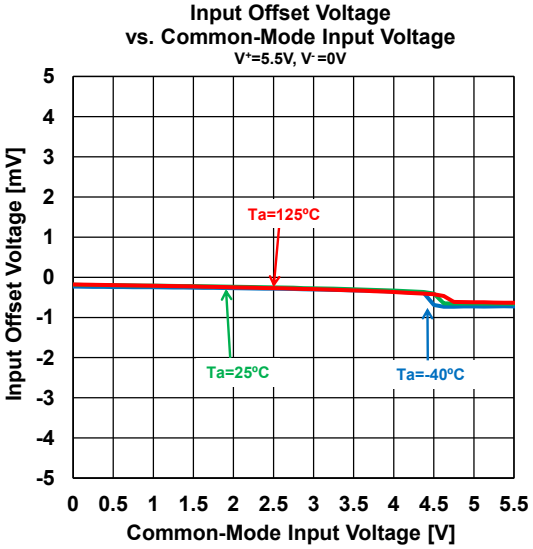
Input Offset Voltage vs. Supply Voltage
V^-=0V, V_{COM}=V^+



■TYPICAL CHARACTERISTICS

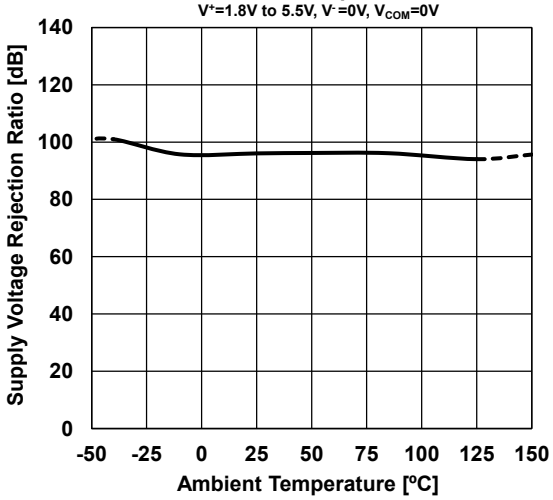




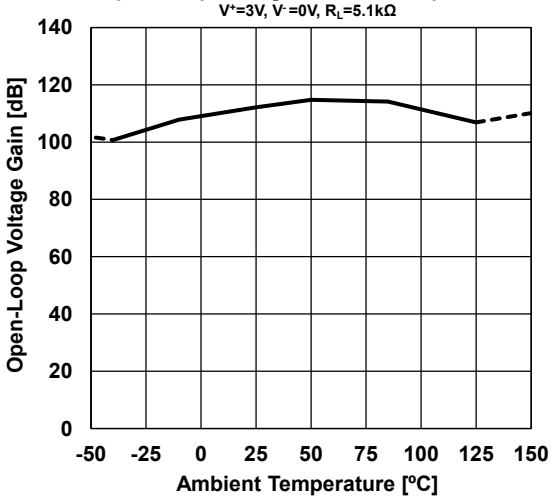


■TYPICAL CHARACTERISTICS

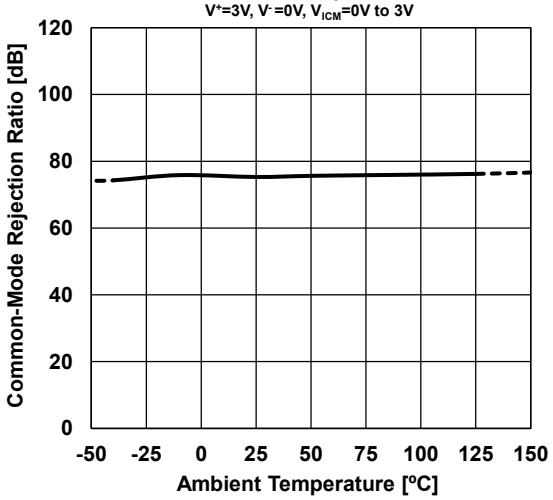
SVR vs. Temperature
V+=1.8V to 5.5V, V-=0V, VCOM=0V



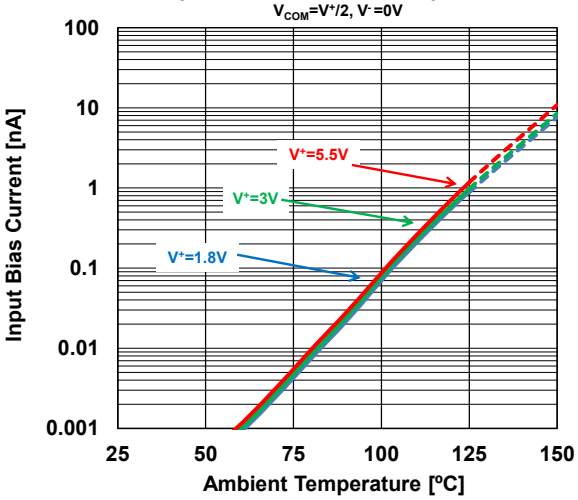
Open-Loop Voltage Gain vs. Temperature
V+=3V, V-=0V, RL=5.1kΩ



CMR vs. Temperature
V+=3V, V-=0V, VICM=0V to 3V

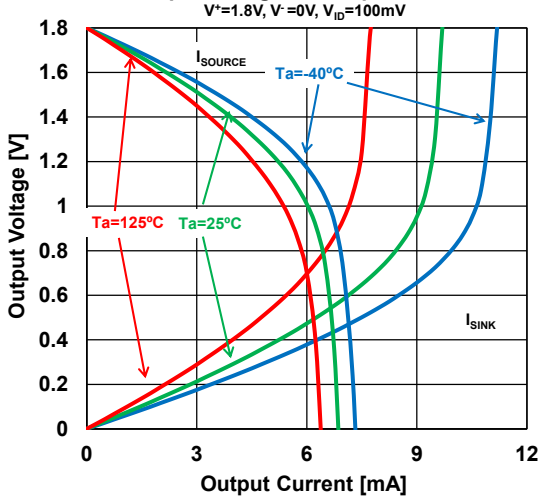


Input Bias Current vs. Temperature
VCOM=V+/2, V-=0V

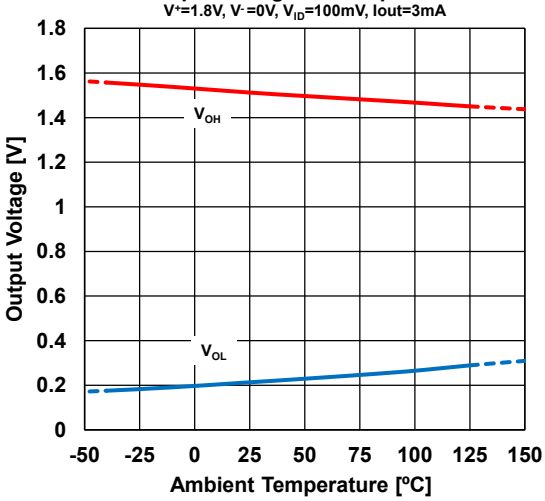


■TYPICAL CHARACTERISTICS

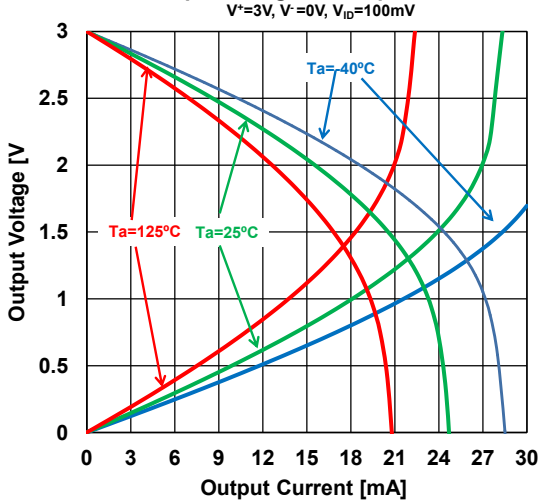
Output Voltage vs. Output Current
V+=1.8V, V-=0V, V_{ID}=100mV



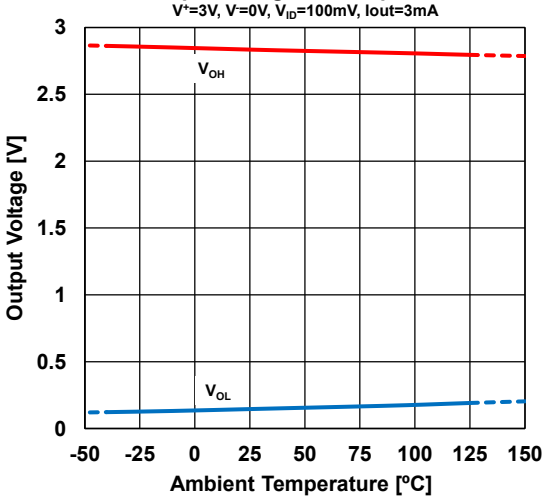
Output Voltage vs. Temperature
V+=1.8V, V-=0V, V_{ID}=100mV, Iout=3mA



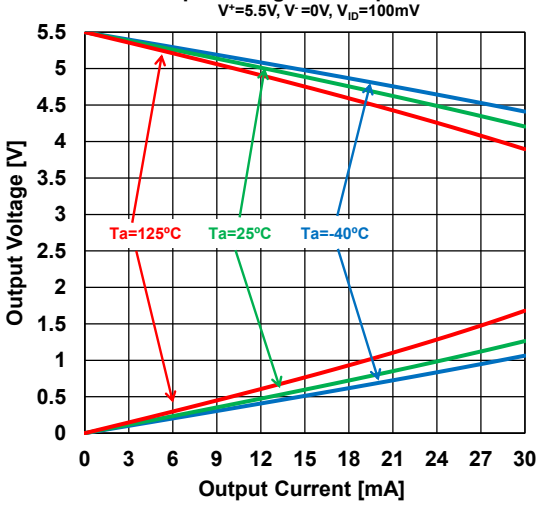
Output Voltage vs. Output Current
V+=3V, V-=0V, V_{ID}=100mV



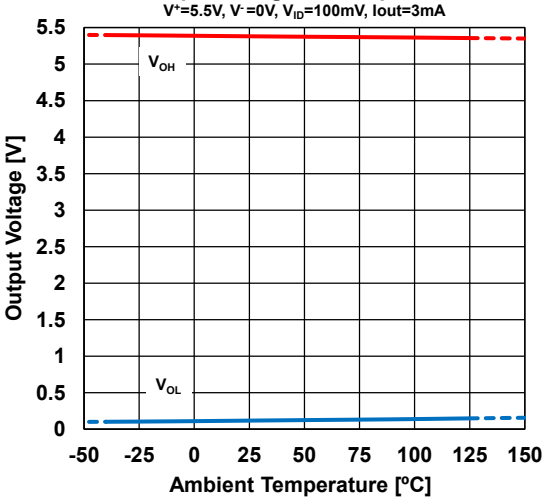
Output Voltage vs. Temperature
V+=3V, V-=0V, V_{ID}=100mV, Iout=3mA



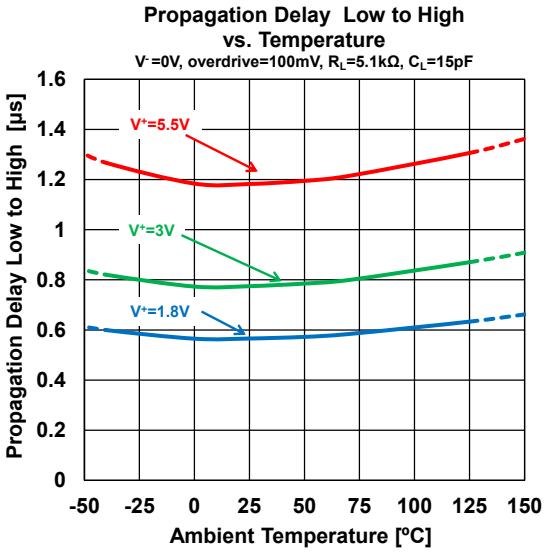
Output Voltage vs. Output Current
V+=5.5V, V-=0V, V_{ID}=100mV

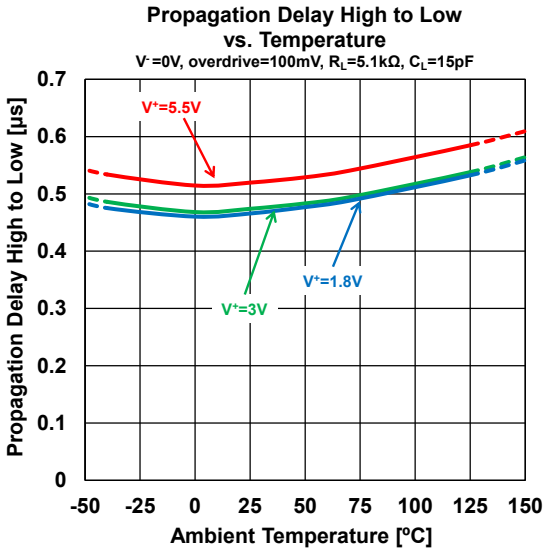


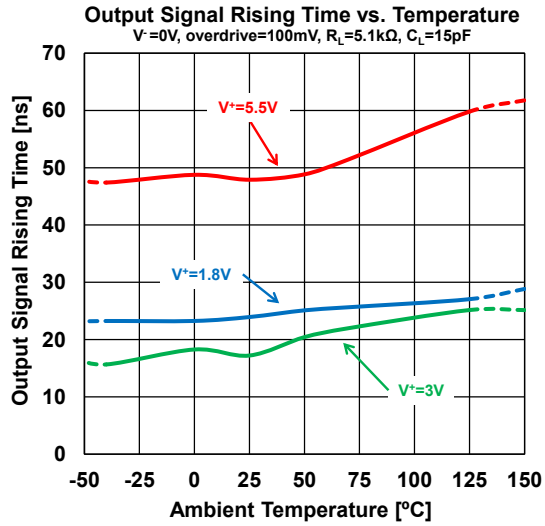
Output Voltage vs. Temperature
V+=5.5V, V-=0V, V_{ID}=100mV, Iout=3mA

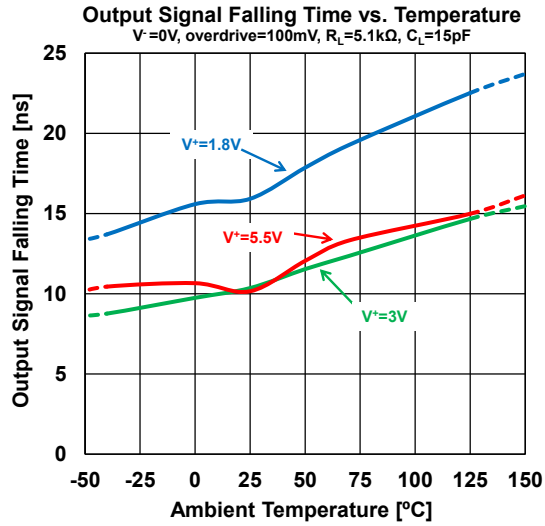


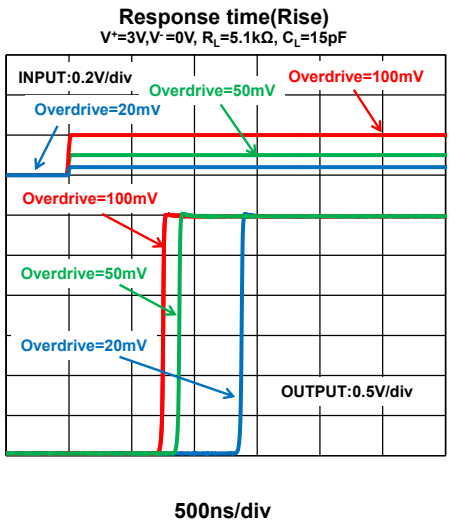
■TYPICAL CHARACTERISTICS

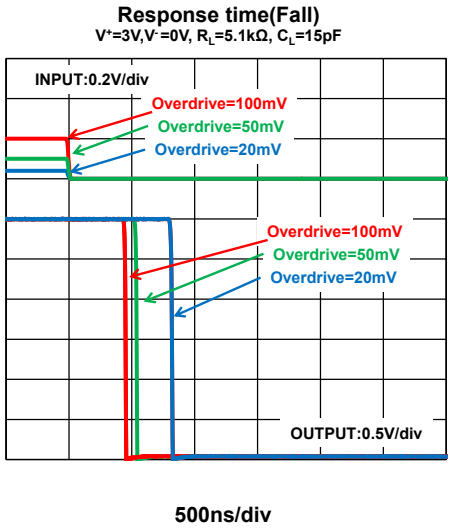










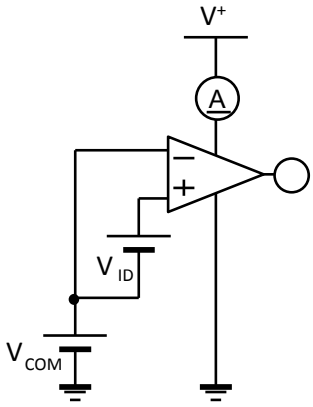


■TYPICAL TEST CIRCUIT

●Supply Current (I_{SUPPLY})

・V^+=3V,V^-=0V,Vcom=0V, V_{ID}=100mV

・V^+=3V,V^-=0V,Vcom=3V, V_{ID}=100mV

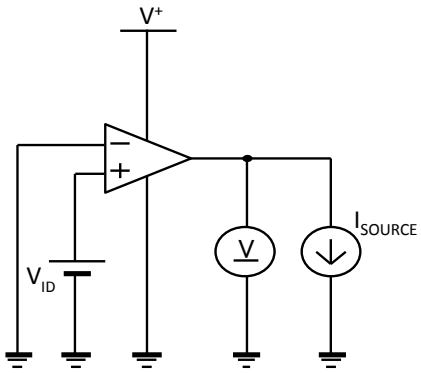


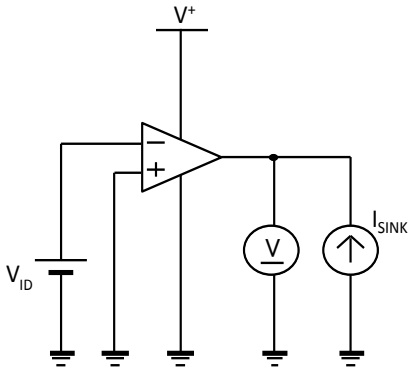
●High-level Output Voltage (V_{OH})

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

●Low-level Output Voltage (V_{OL})

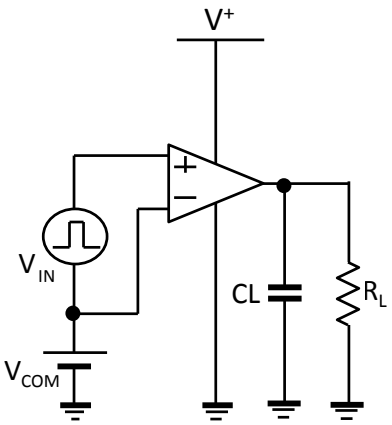
・V^+=3V,V^-=0V,I_{SINK}=3mA,V_{ID}=100mV



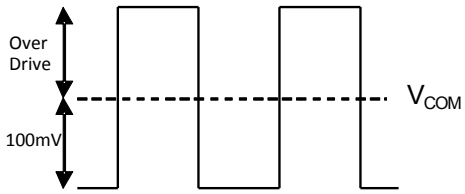


●Propagation Delay (t_{PLH}, t_{PHL}),Output Signal Rising Time (t_{TLH}),Output Signal Falling Time (t_{THL})

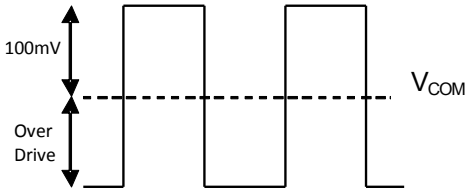
・V^+=3V,V^-=0V,V_{COM}=0V,R_L=5.1kΩ,C_L=15pF,Over drive=100mV



Input Wave Form
(Rise Measurement)



Input Wave Form
(Fall Measurement)



■APPLICATION NOTE

・Input Voltage Exceeding the Supply Voltage

Inputs of the NJU77230/ NJU77231/ NJU77232 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.

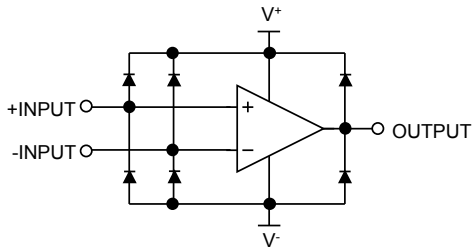


Figure1. Simplified Schematic

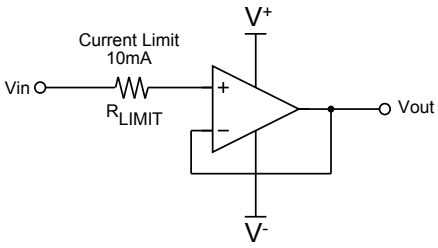


Figure2. Input Current Protection for Voltages exceeding the Supply Voltage.

・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.

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

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.

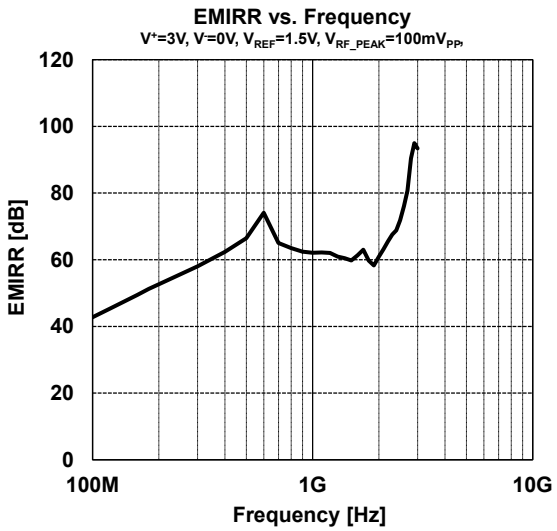


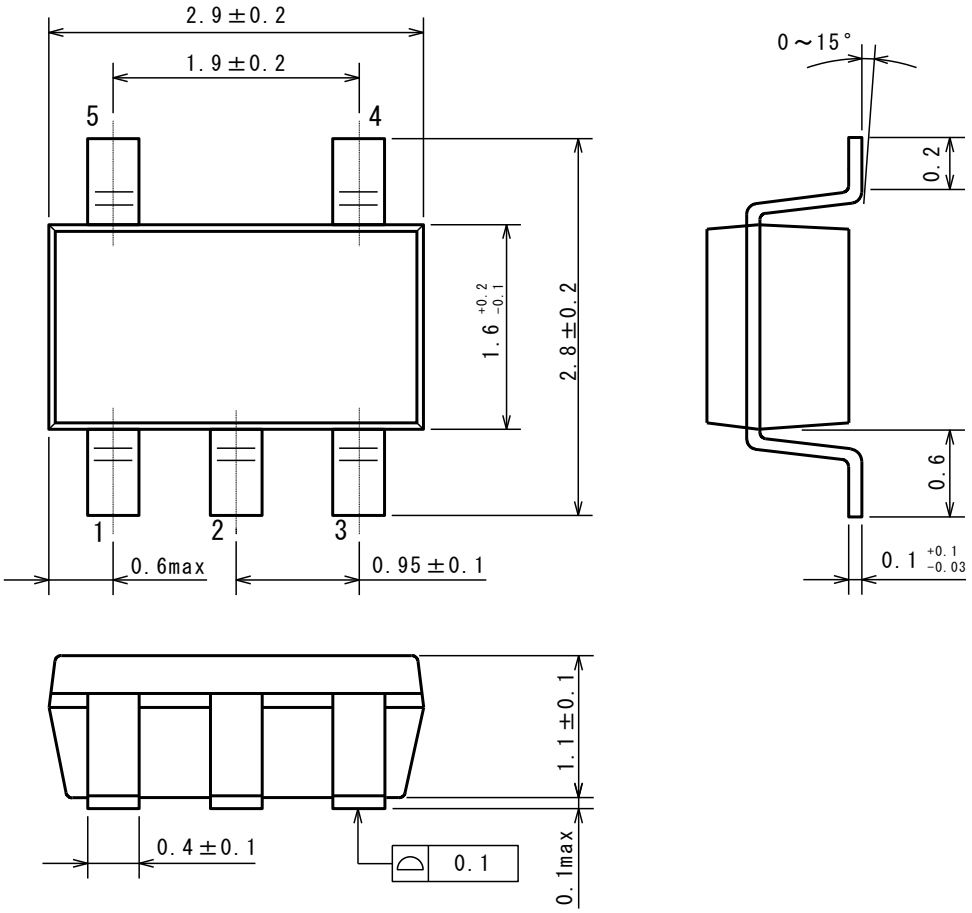
Figure3. EMIRR vs. Frequency

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

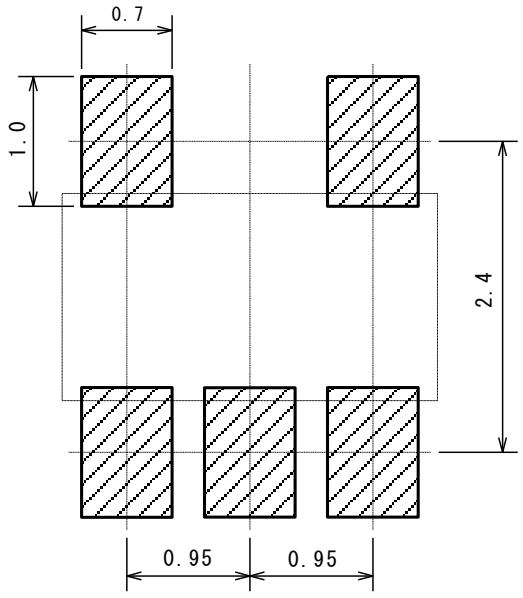
SOT-23-5

Unit: mm

■PACKAGE DIMENSIONS



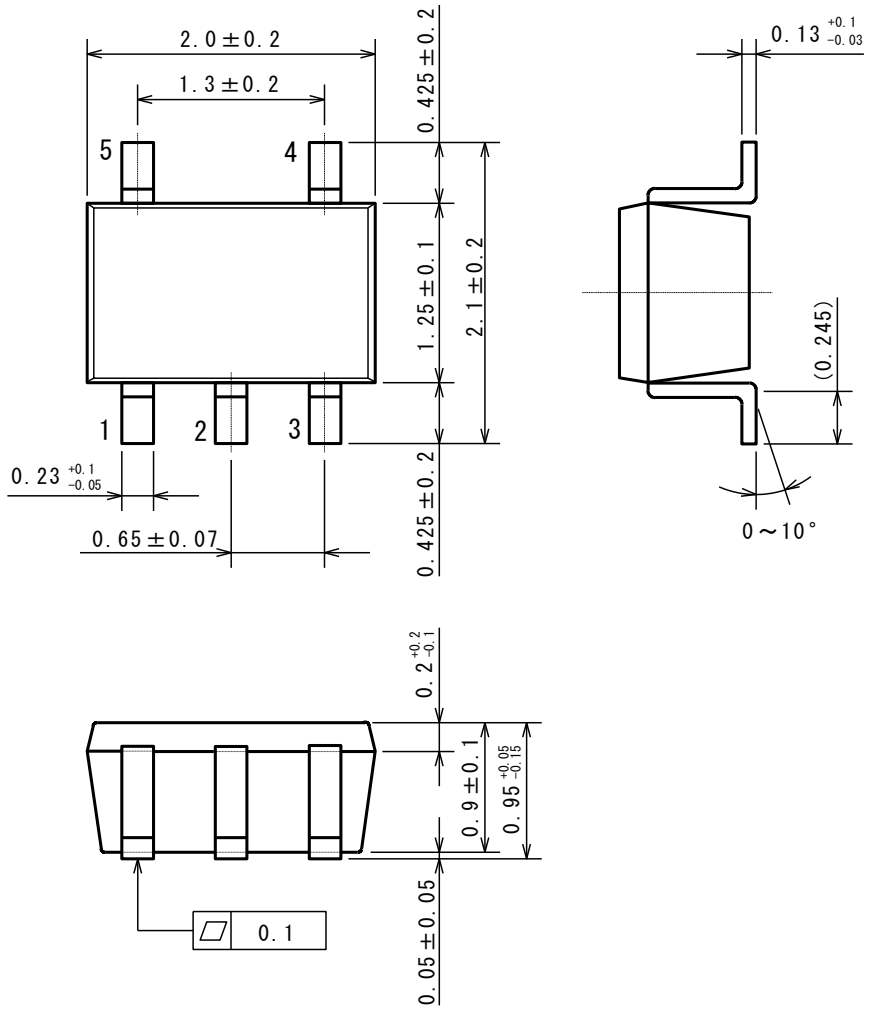
■EXAMPLE OF SOLDER PADS DIMENSIONS



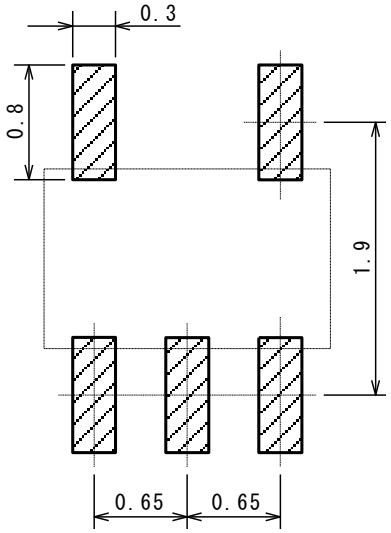
SC-88A

Unit: mm

■PACKAGE DIMENSIONS



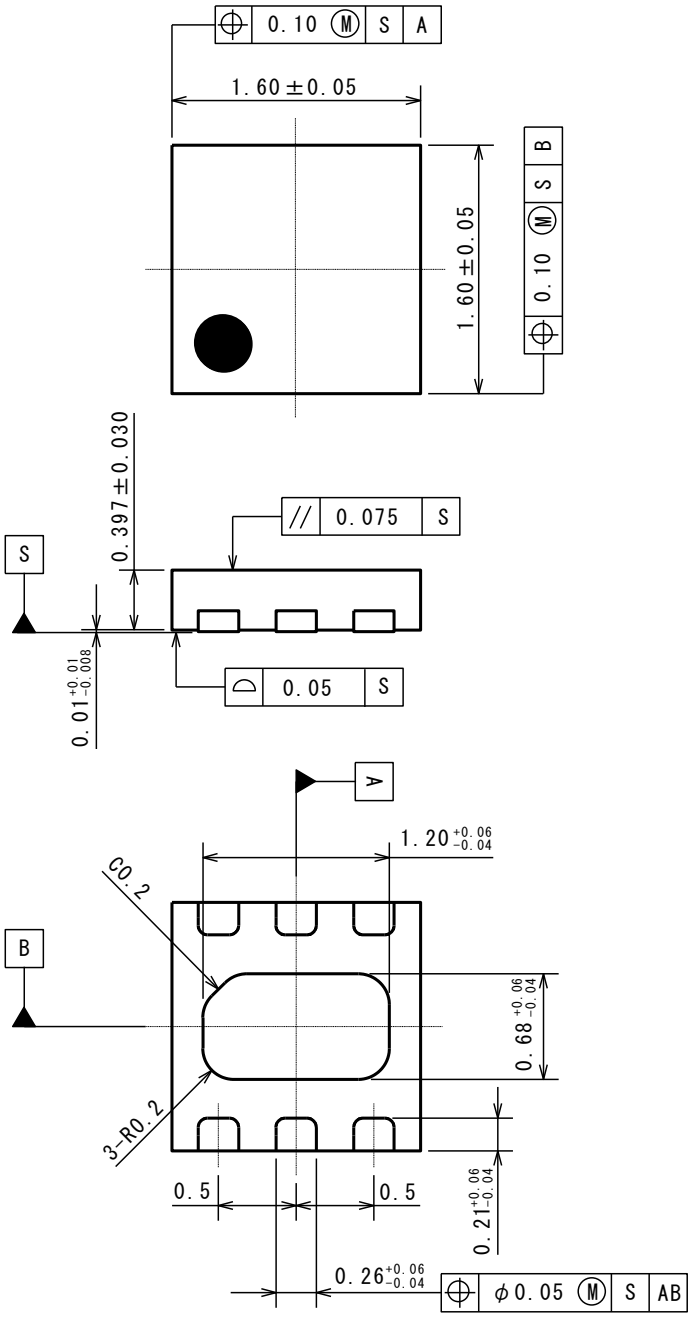
■ EXAMPLE OF SOLDER PADS DIMENSIONS



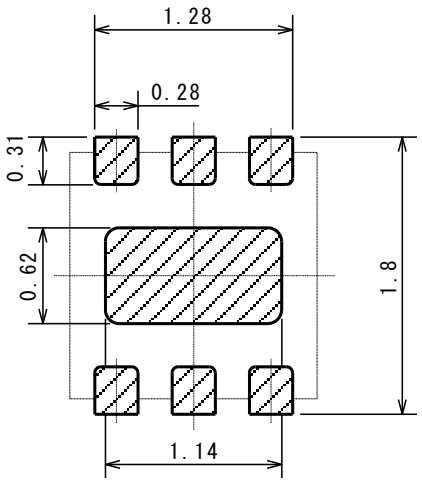
DFN6-G1(ESON6-G1)

Unit: mm

■PACKAGE DIMENSIONS



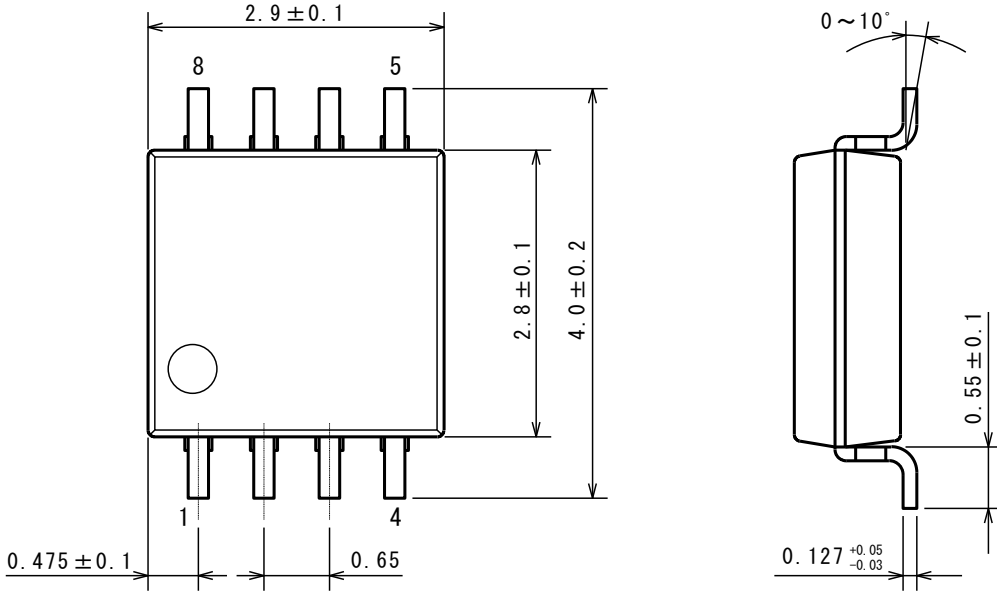
■EXAMPLE OF SOLDER PADS DIMENSIONS

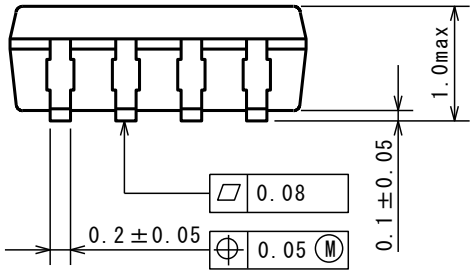


MSOP8(TVSP8)MEET JEDEC MO-187-DA/ thin type

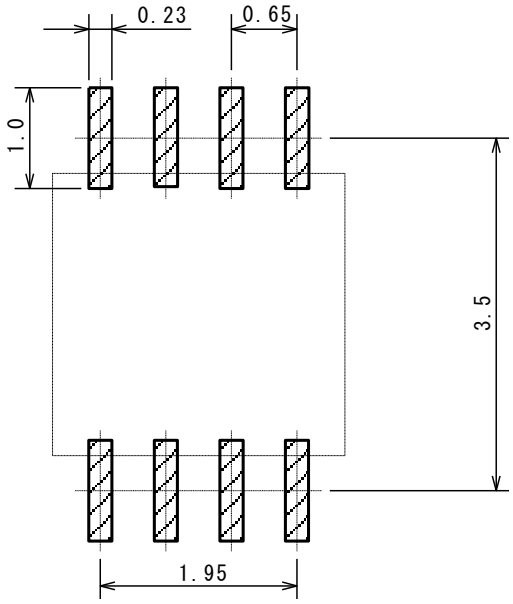
Unit: mm

■PACKAGE DIMENSIONS





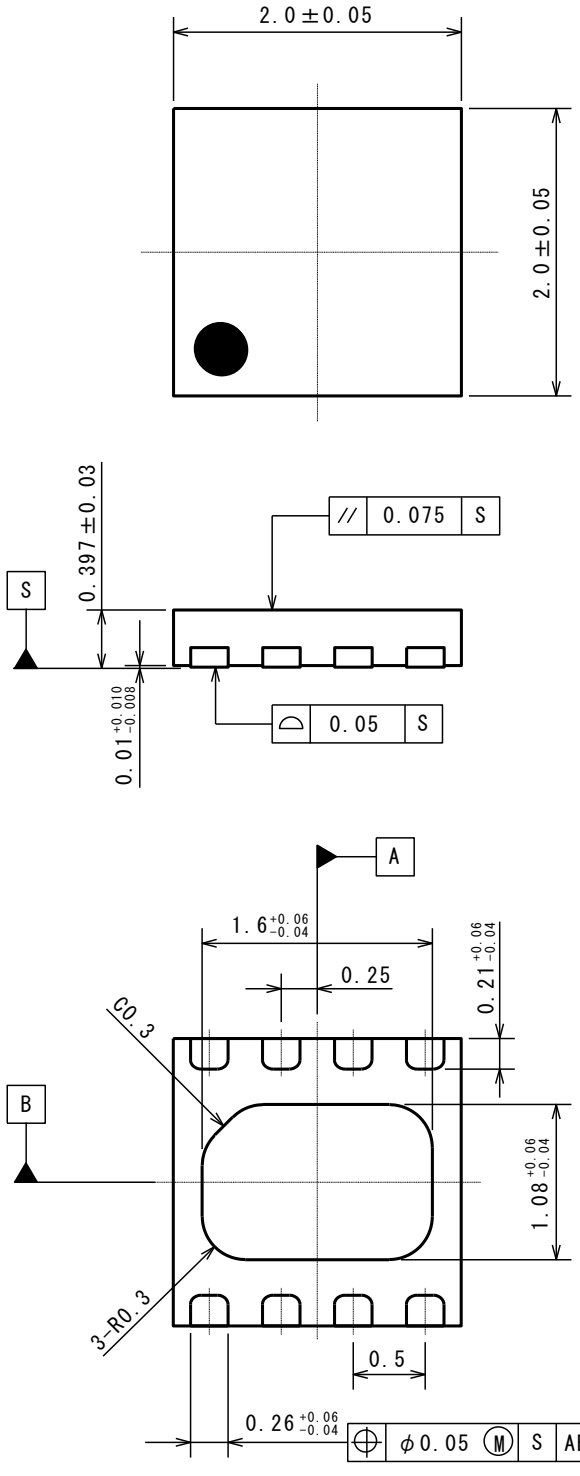
■EXAMPLE OF SOLDER PADS DIMENSIONS



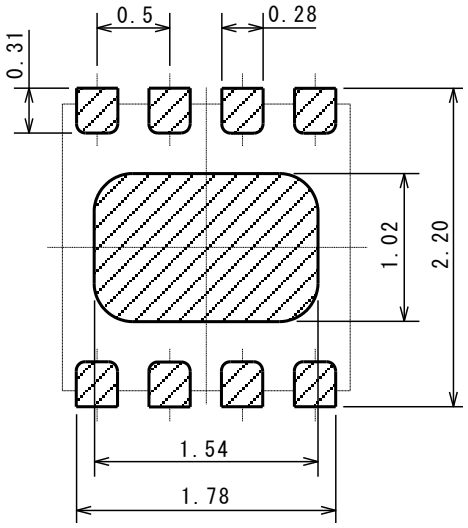
DFN8-U1(ESON8-U1)

Unit: mm

■PACKAGE DIMENSIONS



■EXAMPLE OF SOLDER PADS DIMENSIONS

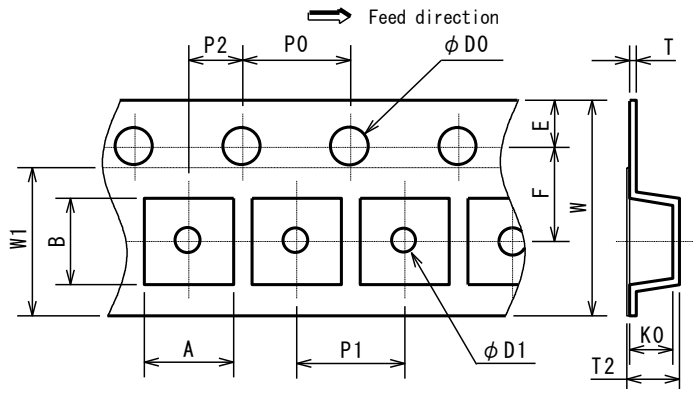


SOT-23-5

Unit: mm

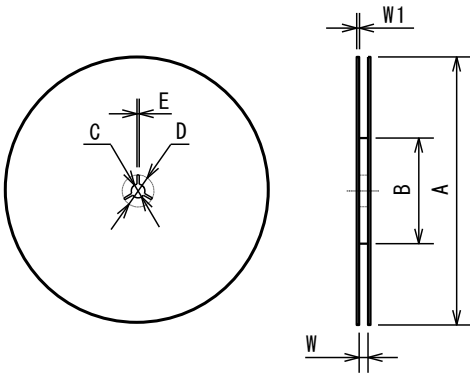
■ PACKING SPEC

TAPING DIMENSIONS



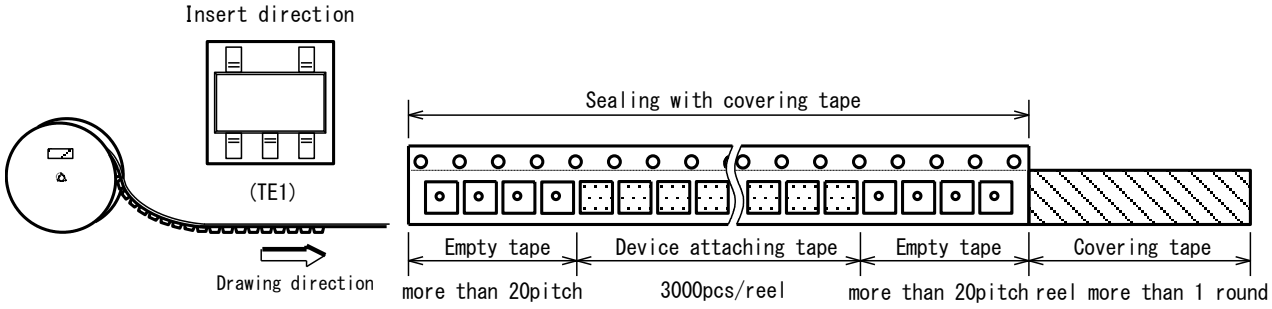
SYMBOL	DIMENSION	REMARKS
A	3.3±0.1	BOTTOM DIMENSION
B	3.2±0.1	BOTTOM DIMENSION
D0	1.55	
D1	1.05	
E	1.75±0.1	
F	3.5±0.05	
P0	4.0±0.1	
P1	4.0±0.1	
P2	2.0±0.05	
T	0.25±0.05	
T2	1.82	
K0	1.5±0.1	
W	8.0±0.3	
W1	5.5	THICKNESS 0.1MAX

REEL DIMENSIONS

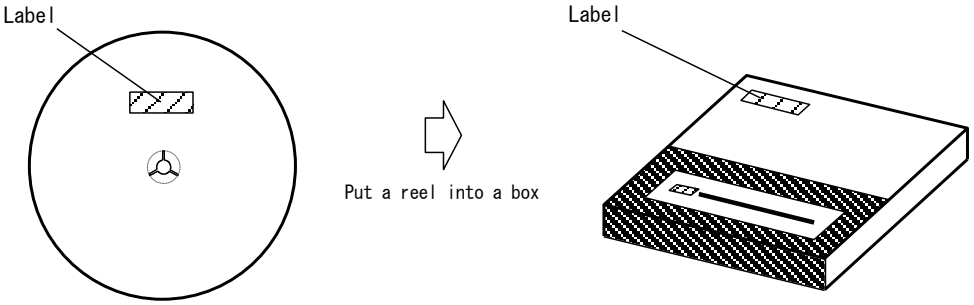


SYMBOL	DIMENSION
A	φ180±1
B	φ 60±1
C	φ 13±0.2
D	φ 21±0.8
E	2±0.5
W	9±0.5
W1	1.2±0.2

TAPING STATE



PACKING STATE

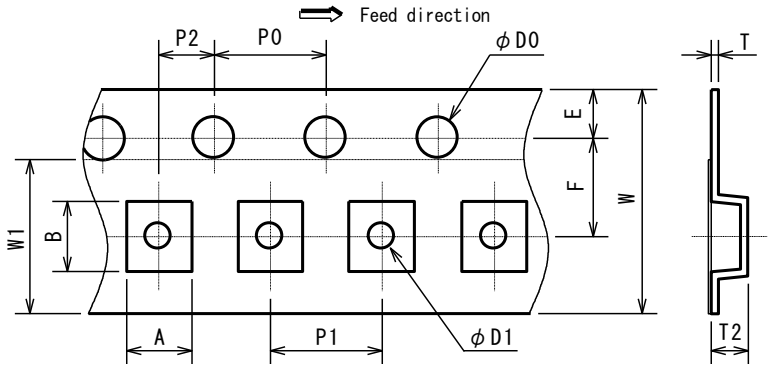


SC-88A

Unit: mm

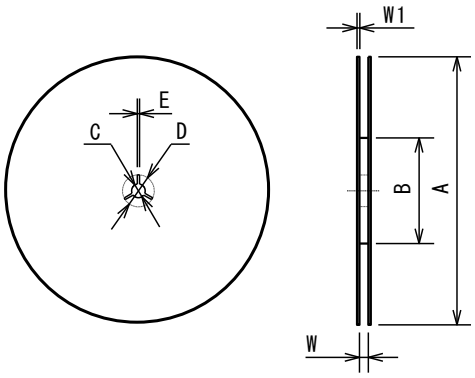
■ PACKING SPEC

TAPING DIMENSIONS



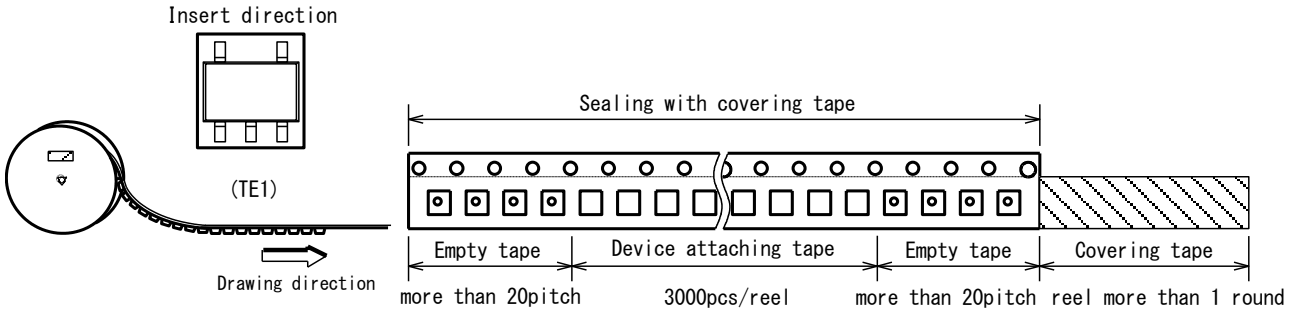
SYMBOL	DIMENSION	REMARKS
A	2.3±0.1	BOTTOM DIMENSION
B	2.5±0.1	BOTTOM DIMENSION
D0	1.55±0.05	
D1	1.05±0.05	
E	1.75±0.1	
F	3.5±0.05	
P0	4.0±0.1	
P1	4.0±0.1	
P2	2.0±0.05	
T	0.25±0.05	
T2	1.3±0.1	
W	8.0±0.2	
W1	5.5	THICKNESS 0.1max

REEL DIMENSIONS



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

TAPING STATE



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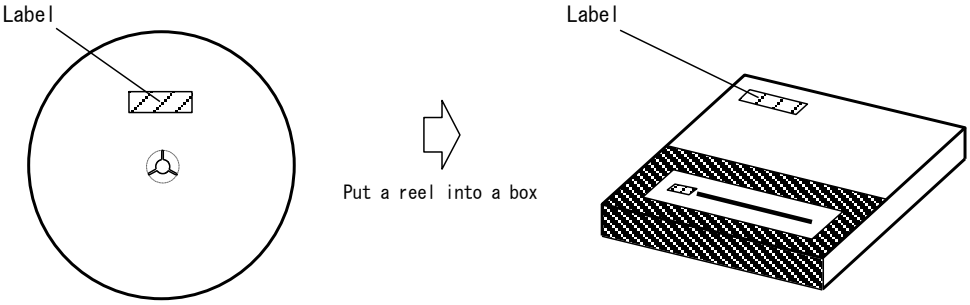
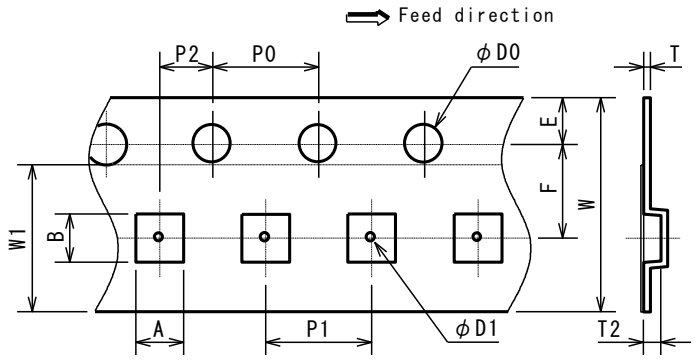


DFN6-G1(ESON6-G1)

■ PACKING SPEC

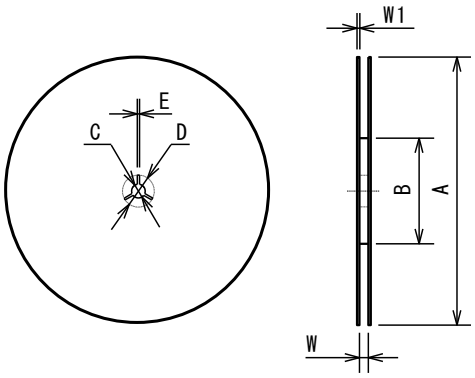
Unit: mm

TAPING DIMENSIONS



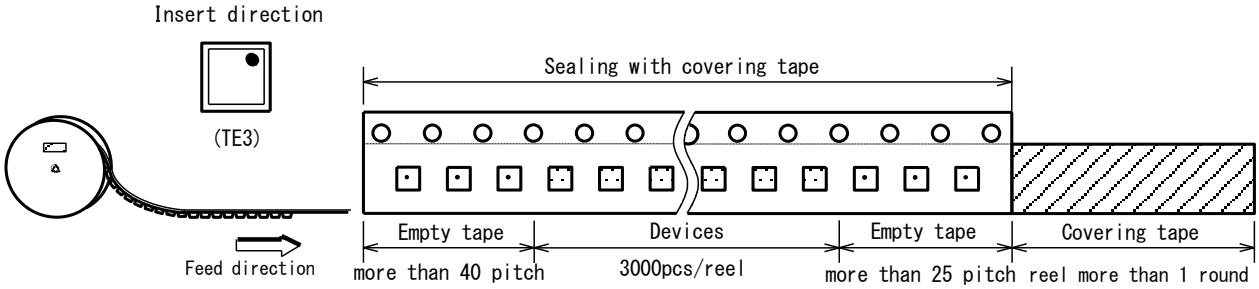
SYMBOL	DIMENSION	REMARKS
A	1.85±0.05	BOTTOM DIMENSION
B	1.85±0.05	BOTTOM DIMENSION
D0	$1.5^{+0.1}_{0}$	
D1	0.5±0.1	
E	1.75±0.1	
F	3.5±0.05	
P0	4.0±0.1	
P1	4.0±0.1	
P2	2.0±0.05	
T	0.25±0.05	
T2	0.65±0.05	
W	8.0±0.2	
W1	5.5	THICKNESS 0.1max

REEL DIMENSIONS

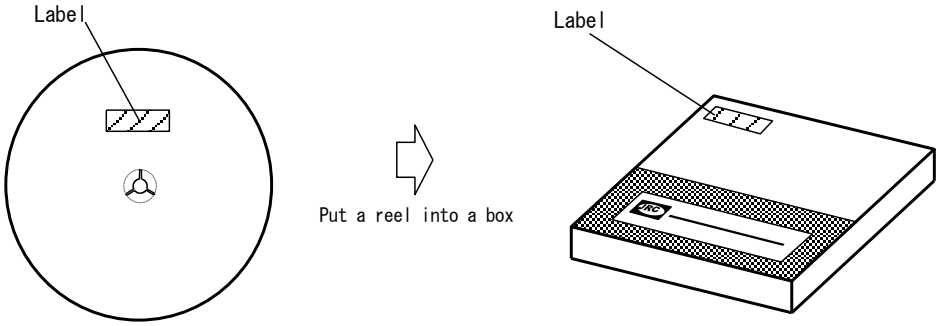


SYMBOL	DIMENSION
A	$\phi 180^{0}_{-1.5}$
B	$\phi 60^{+1}_{0}$
C	φ 13±0.2
D	φ 21±0.8
E	2±0.5
W	$9^{+0.3}_{0}$
W1	1.2

TAPING STATE



PACKING STATE

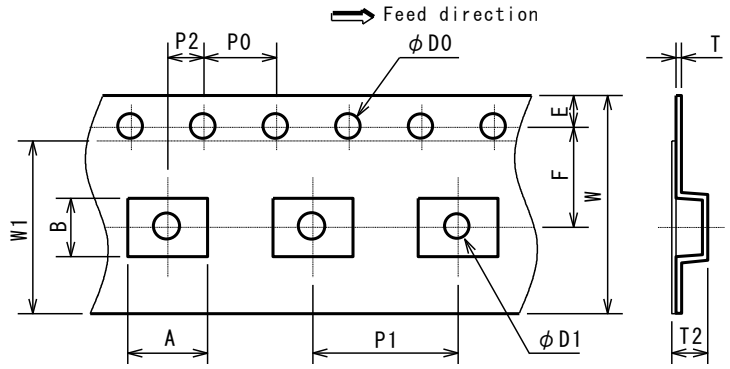


MSOP8(TVSP8)MEET JEDEC MO-187-DA/thin type

Unit: mm

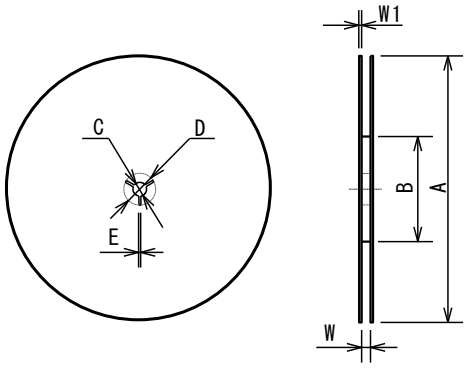
■PACKING SPEC

TAPING DIMENSIONS



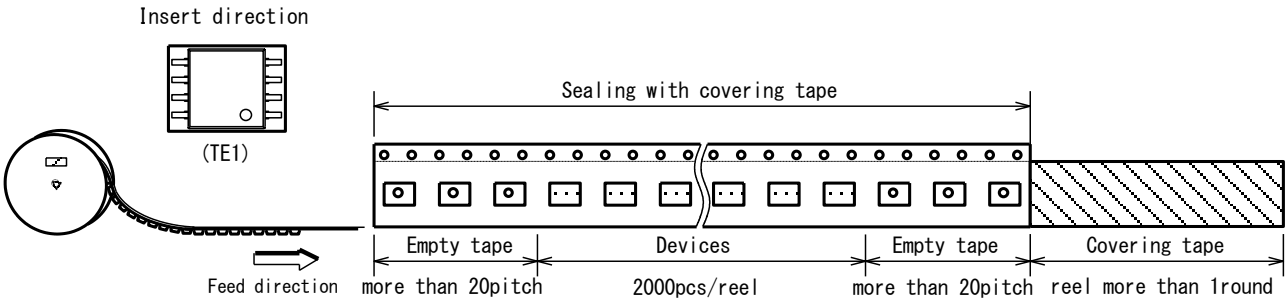
SYMBOL	DIMENSION	REMARKS
A	4.4	BOTTOM DIMENSION
B	3.2	BOTTOM DIMENSION
D0	$1.5^{+0.1}_{0}$	
D1	$1.5^{+0.1}_{0}$	
E	1.75±0.1	
F	5.5±0.05	
P0	4.0±0.1	
P1	8.0±0.1	
P2	2.0±0.05	
T	0.30±0.05	
T2	1.75 (MAX.)	
W	12.0±0.3	
W1	9.5	THICKNESS 0.1max

REEL DIMENSIONS

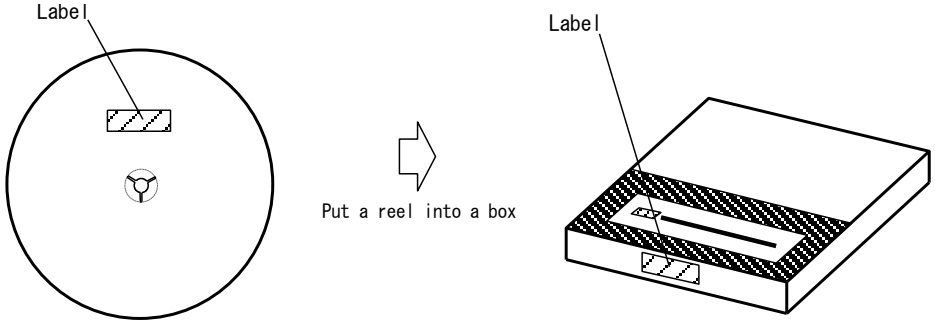


SYMBOL	DIMENSION
A	φ254±2
B	φ100±1
C	φ 13±0.2
D	φ 21±0.8
E	2±0.5
W	13.5±0.5
W1	2.0±0.2

TAPING STATE



PACKING STATE

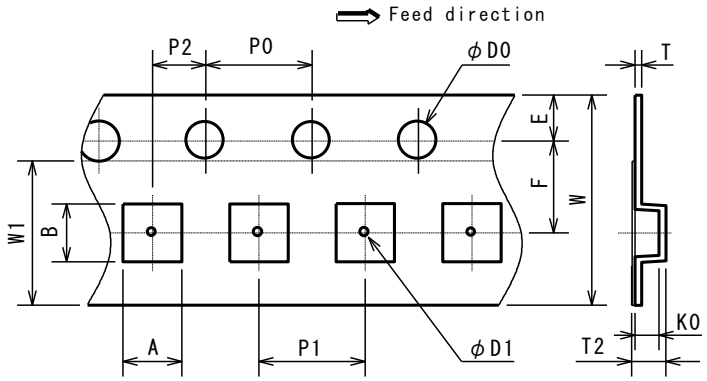


DFN8-U1(ESON8-U1)

Unit: mm

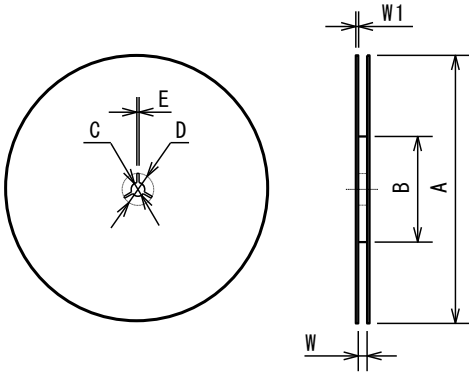
■PACKING SPEC

TAPING DIMENSIONS



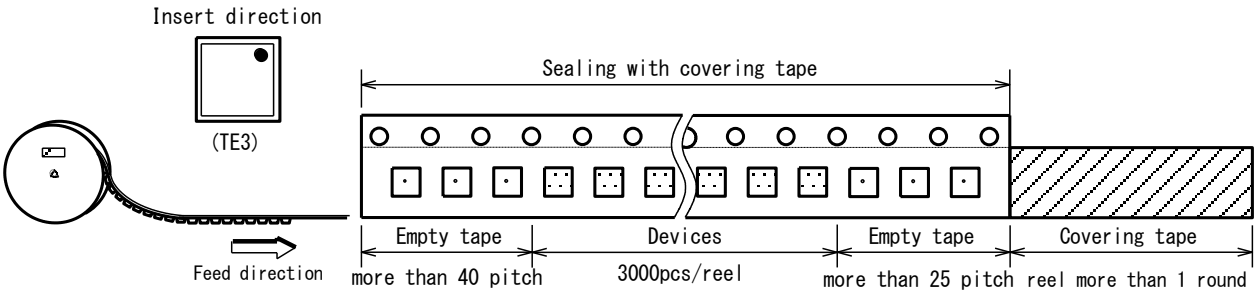
SYMBOL	DIMENSION	REMARKS
A	2.25±0.05	BOTTOM DIMENSION
B	2.25±0.05	BOTTOM DIMENSION
D0	$1.5^{+0.1}_{0}$	
D1	0.5±0.1	
E	1.75±0.1	
F	3.5±0.05	
P0	4.0±0.1	
P1	4.0±0.1	
P2	2.0±0.05	
T	0.25±0.05	
T2	1.00±0.07	
K0	0.65±0.05	
W	8.0±0.2	
W1	5.5	THICKNESS 0.1max

REEL DIMENSIONS

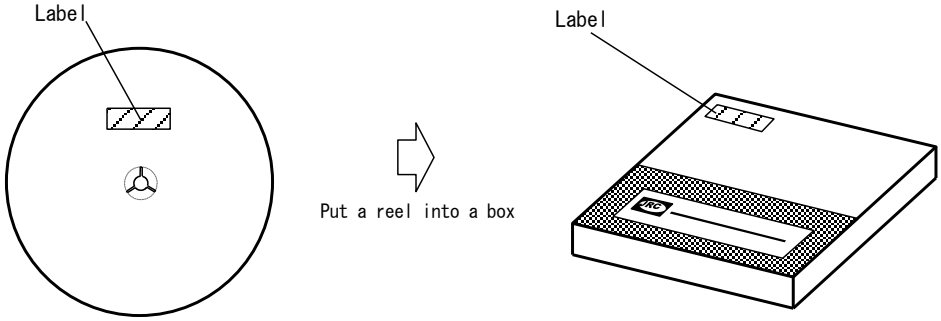


SYMBOL	DIMENSION
A	$\phi 180^{0}_{-1.5}$
B	ϕ 60 $^{+1}_{0}$
C	ϕ 13±0.2
D	ϕ 21±0.8
E	2±0.5
W	$9^{+0.3}_{0}$
W1	1.2

TAPING STATE

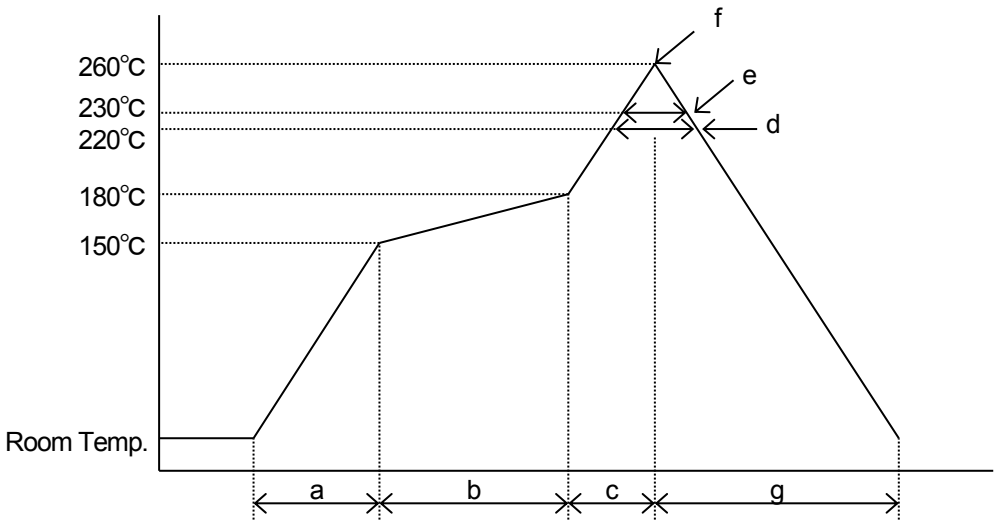


PACKING STATE



■RECOMMENDED MOUNTING METHOD

*Recommended reflow soldering procedure



a: Temperature ramping rate		: 1 to 4℃/s
b: Pre-heating temperature		: 150 to 180℃
	time	: 60 to 120s
c: Temperature ramp rate		: 1 to 4℃/s
d: 220℃ or higher time		: Shorter than 60s
e: 230℃ or higher time		: Shorter than 40s
f: Peak temperature		: Lower than 260℃
g: Temperature ramping rate		: 1 to 6℃/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 NJU77232.
2017/10/12	Ver.2	Changed GENERAL DESCRIPTION and APPLICATION
2017/11/10	Ver.3	Corrected ELECTRICAL CHARACTERISTICS

[CAUTION]

1. New JRC strives to produce reliable and high quality semiconductors. New JRC's semiconductors are intended for specific applications and require proper maintenance and handling. To enhance the performance and service of New JRC's semiconductors, the devices, machinery or equipment into which they are integrated should undergo preventative maintenance and inspection at regularly scheduled intervals. Failure to properly maintain equipment and machinery incorporating these products can result in catastrophic system failures

2. The specifications on this datasheet are only given for information without any guarantee as regards either mistakes or omissions. The application circuits in this datasheet are described only to show representative usages of the product and not intended for the guarantee or permission of any right including the industrial rights.
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   Power Generator Control Equipment (Nuclear, Steam, Hydraulic)
   Life Maintenance Medical Equipment
   Fire Alarm/Intruder Detector
   Vehicle Control Equipment (airplane, railroad, ship, etc.)
   Various Safety devices

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9. The product specifications and descriptions listed in this catalog are subject to change at any time, without notice.