



## NJM7800

### 3-TERMINAL POSITIVE VOLTAGE REGULATOR

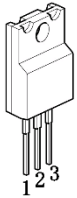
#### FEATURES

- Internal Short Circuit Current Limit
- Excellent Ripple Rejection
- Guarantee'd 1.5A Output Current
- Package Outline TO-220F, TO-252
- Bipolar Technology

#### GENERAL DESCRIPTION

The NJM7800 series of monolithic 3-Terminal Positive Voltage Regulators is constructed using the Nisshinbo Micro Devices planar epitaxial process. These regulators employ internal current-limiting, thermal-shutdown and safe-area compensation making them essentially indestructible. If adequate heat sinking is provided, they can deliver over 1A output current. They are intended as fixed voltage regulators in a wide range of applications including local (on card) regulation for elimination of distribution problems associated with single point regulation. In addition to use as fixed voltage regulators, these devices can be used with external components to obtain adjustable output voltages and currents.

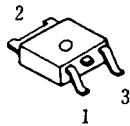
( TO-220F )



**NJM7800FA**

- 1. IN
- 2. GND
- 3. OUT

( TO-252 )

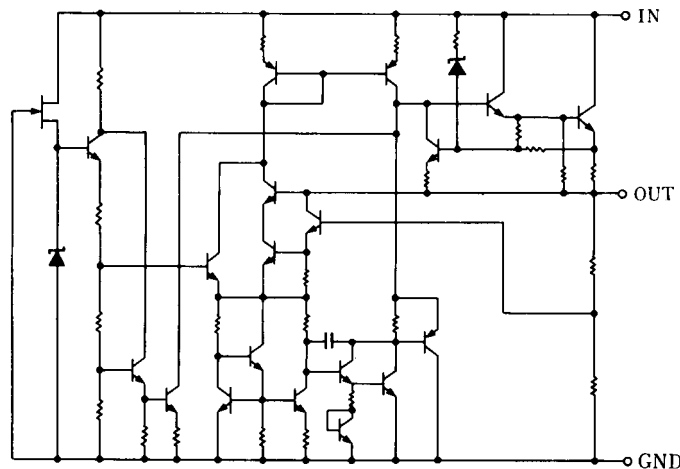


**NJM7800DL1A**

- 1. IN
- 2. GND
- 3. OUT

(note) The radiation fin is connected pin2.

#### EQUIVALENT CIRCUIT



■ ABSOLUTE MAXIMUM RATINGS

(Ta=25°C)

PARAMETER	SYMBOL	MAXIMUM RATINGS		UNIT	
Input Voltage	V <sub>IN</sub>	7805 to 7810 7812 to 7815 7818 to 7824	35 35 40	V	
Storage Temperature Range	T <sub>stg</sub>	-40 to +150		°C	
Operating Temperature Range		Operating Junction Temperature	T <sub>j</sub>	-40 to +150	°C
		Operating Junction Temperature	T <sub>opr</sub>	-40 to +85	
Power Dissipation	P <sub>D</sub>	TO-220F TO-252	16(T <sub>c</sub> ≤70°C) 10(T <sub>c</sub> =25°C) 1(T <sub>a</sub> ≤25°C)	W	

■ ELECTRICAL CHARACTERISTICS (C<sub>1</sub>=0.33μF, C<sub>O</sub>=0.1μF, T<sub>j</sub>=25°C)

Measurement is to be conducted in pulse testing.

PARAMETER	SYMBOL	TEST CONDITIONS	TO-220F			TO-252			UNIT
			MIN.	TYP.	MAX.	MIN.	TYP.	MAX.	
<b>NJM7805FA/DL1A</b>									
Output Voltage	V <sub>O</sub>	V <sub>IN</sub> =10V, I <sub>O</sub> =0.5A	4.8	5.0	5.2	4.8	5.0	5.2	V
Line Regulation	ΔV <sub>O</sub> - V <sub>IN</sub>	V <sub>IN</sub> =7 to 25V, I <sub>O</sub> =0.5A	-	3	50	-	3	100	mV
Load Regulation	ΔV <sub>O</sub> - I <sub>O</sub>	V <sub>IN</sub> =10V, I <sub>O</sub> =0.005 to 1.5A	-	15	50	-	15	100	mV
Quiescent Current	I <sub>Q</sub>	V <sub>IN</sub> =10V, I <sub>O</sub> =0mA	-	4.2	6.0	-	4.2	6.0	mA
Average Temperature Coefficient of Output Voltage	ΔV <sub>O</sub> /ΔT	V <sub>IN</sub> =10V, I <sub>O</sub> =5mA	-	-0.5	-	-	-0.5	-	mV/°C
Ripple Rejection	RR	V <sub>IN</sub> =10V, I <sub>O</sub> =0.5A, e <sub>in</sub> =2V <sub>P-P</sub> , f=120Hz	68	78	-	68	78	-	dB
Output Noise Voltage	V <sub>NO</sub>	V <sub>IN</sub> =10V, BW=10Hz to 100kHz, I <sub>O</sub> =0.5A	-	45	-	-	45	-	μV
<b>NJM7806FA/DL1A</b>									
Output Voltage	V <sub>O</sub>	V <sub>IN</sub> =11V, I <sub>O</sub> =0.5A	5.75	6.0	6.25	5.75	6.0	6.25	V
Line Regulation	ΔV <sub>O</sub> - V <sub>IN</sub>	V <sub>IN</sub> =8 to 25V, I <sub>O</sub> =0.5A	-	5	60	-	5	120	mV
Load Regulation	ΔV <sub>O</sub> - I <sub>O</sub>	V <sub>IN</sub> =11V, I <sub>O</sub> =0.005 to 1.5A	-	15	60	-	15	120	mV
Quiescent Current	I <sub>Q</sub>	V <sub>IN</sub> =11V, I <sub>O</sub> =0mA	-	4.3	6.0	-	4.3	6.0	mA
Average Temperature Coefficient of Output Voltage	ΔV <sub>O</sub> /ΔT	V <sub>IN</sub> =11V, I <sub>O</sub> =5mA	-	-0.6	-	-	-0.6	-	mV/°C
Ripple Rejection	RR	V <sub>IN</sub> =11V, I <sub>O</sub> =0.5A, e <sub>in</sub> =2V <sub>P-P</sub> , f=120Hz	65	75	-	65	75	-	dB
Output Noise Voltage	V <sub>NO</sub>	V <sub>IN</sub> =11V, BW=10Hz to 100kHz, I <sub>O</sub> =0.5A	-	45	-	-	45	-	μV

■ ELECTRICAL CHARACTERISTICS (C<sub>1</sub>=0.33μF, C<sub>O</sub>=0.1μF, T<sub>J</sub>=25°C)

Measurement is to be conducted in pulse testing.

PARAMETER	SYMBOL	TEST CONDITIONS	TO-220F			TO-252			UNIT
			MIN.	TYP.	MAX.	MIN.	TYP.	MAX.	
<b>NJM7808FA/DL1A</b>									
Output Voltage	V <sub>O</sub>	V <sub>IN</sub> =14V, I <sub>O</sub> =0.5A	7.7	8.0	8.3	7.7	8.0	8.3	V
Line Regulation	ΔV <sub>O</sub> - V <sub>IN</sub>	V <sub>IN</sub> =10.5 to 25V, I <sub>O</sub> =0.5A	-	6	80	-	6	160	mV
Load Regulation	ΔV <sub>O</sub> - I <sub>O</sub>	V <sub>IN</sub> =14V, I <sub>O</sub> =0.005 to 1.5A	-	15	80	-	15	160	mV
Quiescent Current	I <sub>Q</sub>	V <sub>IN</sub> =14V, I <sub>O</sub> =0mA	-	4.3	6.0	-	4.3	6.0	mA
Average Temperature Coefficient of Output Voltage	ΔV <sub>O</sub> /ΔT	V <sub>IN</sub> =14V, I <sub>O</sub> =5mA	-	-0.8	-	-	-0.8	-	mV/°C
Ripple Rejection	RR	V <sub>IN</sub> =14V, I <sub>O</sub> =0.5A, e <sub>in</sub> =2V <sub>P-P</sub> , f=120Hz	62	72	-	62	72	-	dB
Output Noise Voltage	V <sub>NO</sub>	V <sub>IN</sub> =14V, BW=10Hz to 100kHz, I <sub>O</sub> =0.5A	-	55	-	-	55	-	μV
<b>NJM7809FA/DL1A</b>									
Output Voltage	V <sub>O</sub>	V <sub>IN</sub> =15V, I <sub>O</sub> =0.5A	8.65	9.0	9.35	8.65	9.0	9.35	V
Line Regulation	ΔV <sub>O</sub> - V <sub>IN</sub>	V <sub>IN</sub> =11.5 to 25V, I <sub>O</sub> =0.5A	-	7	90	-	7	180	mV
Load Regulation	ΔV <sub>O</sub> - I <sub>O</sub>	V <sub>IN</sub> =15V, I <sub>O</sub> =0.005 to 1.5A	-	15	90	-	15	180	mV
Quiescent Current	I <sub>Q</sub>	V <sub>IN</sub> =15V, I <sub>O</sub> =0mA	-	4.3	6.0	-	4.3	6.0	mA
Average Temperature Coefficient of Output Voltage	ΔV <sub>O</sub> /ΔT	V <sub>IN</sub> =15V, I <sub>O</sub> =5mA	-	-0.9	-	-	-0.9	-	mV/°C
Ripple Rejection	RR	V <sub>IN</sub> =15V, I <sub>O</sub> =0.5A, e <sub>in</sub> =2V <sub>P-P</sub> , f=120Hz	62	72	-	62	72	-	dB
Output Noise Voltage	V <sub>NO</sub>	V <sub>IN</sub> =15V, BW=10Hz to 100kHz, I <sub>O</sub> =0.5A	-	60	-	-	60	-	μV
<b>NJM7810FA/DL1A</b>									
Output Voltage	V <sub>O</sub>	V <sub>IN</sub> =17V, I <sub>O</sub> =0.5A	9.60	10.0	10.4	9.6	10.0	10.4	V
Line Regulation	ΔV <sub>O</sub> - V <sub>IN</sub>	V <sub>IN</sub> =12.5 to 25V, I <sub>O</sub> =0.5A	-	7	100	-	7	200	mV
Load Regulation	ΔV <sub>O</sub> - I <sub>O</sub>	V <sub>IN</sub> =17V, I <sub>O</sub> =0.005 to 1.5A	-	15	130	-	15	200	mV
Quiescent Current	I <sub>Q</sub>	V <sub>IN</sub> =17V, I <sub>O</sub> =0mA	-	4.3	6.0	-	4.3	6.0	mA
Average Temperature Coefficient of Output Voltage	ΔV <sub>O</sub> /ΔT	V <sub>IN</sub> =17V, I <sub>O</sub> =5mA	-	-0.9	-	-	-1.0	-	mV/°C
Ripple Rejection	RR	V <sub>IN</sub> =17V, I <sub>O</sub> =0.5A, e <sub>in</sub> =2V <sub>P-P</sub> , f=120Hz	62	72	-	62	72	-	dB
Output Noise Voltage	V <sub>NO</sub>	V <sub>IN</sub> =17V, BW=10Hz to 100kHz, I <sub>O</sub> =0.5A	-	60	-	-	65	-	μV

■ ELECTRICAL CHARACTERISTICS (C<sub>1</sub>=0.33μF, C<sub>O</sub>=0.1μF, T<sub>J</sub>=25°C)

Measurement is to be conducted in pulse testing.

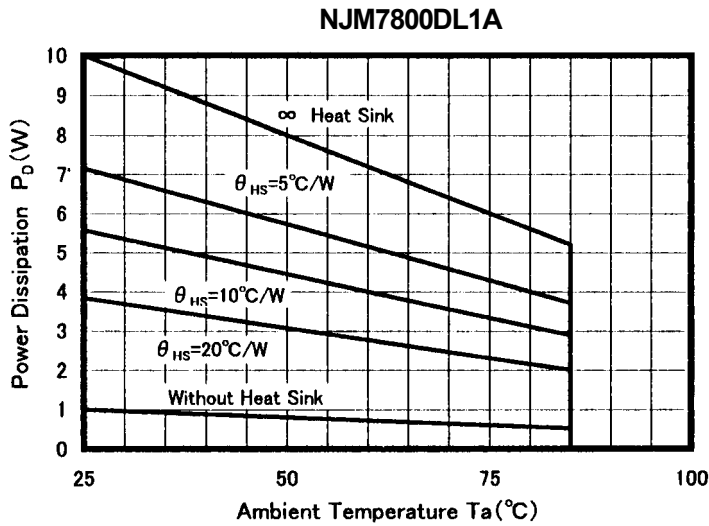
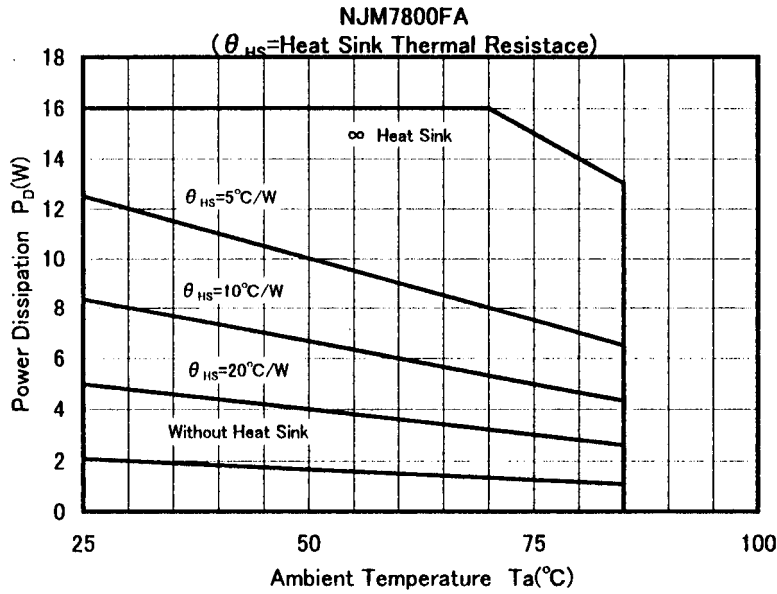
PARAMETER	SYMBOL	TEST CONDITIONS	TO-220F			TO-252			UNIT
			MIN.	TYP.	MAX.	MIN.	TYP.	MAX.	
<b>NJM7812FA/DL1A</b>									
Output Voltage	V <sub>O</sub>	V <sub>IN</sub> =19V, I <sub>O</sub> =0.5A	11.5	12.0	12.5	11.5	12.0	12.5	V
Line Regulation	ΔV <sub>O</sub> - V <sub>IN</sub>	V <sub>IN</sub> =14.5 to 30V, I <sub>O</sub> =0.5A	-	10	120	-	10	240	mV
Load Regulation	ΔV <sub>O</sub> - I <sub>O</sub>	V <sub>IN</sub> =19V, I <sub>O</sub> =0.005 to 1.5A	-	25	120	-	25	240	mV
Quiescent Current	I <sub>Q</sub>	V <sub>IN</sub> =19V, I <sub>O</sub> =0mA	-	4.3	6.0	-	4.3	6.0	mA
Average Temperature Coefficient of Output Voltage	ΔV <sub>O</sub> /ΔT	V <sub>IN</sub> =19V, I <sub>O</sub> =5mA	-	-1.2	-	-	-1.2	-	mV/°C
Ripple Rejection	RR	V <sub>IN</sub> =19V, I <sub>O</sub> =0.5A, e <sub>in</sub> =2V <sub>P-P</sub> , f=120Hz	61	71	-	61	71	-	dB
Output Noise Voltage	V <sub>NO</sub>	V <sub>IN</sub> =19V, BW=10Hz to 100kHz, I <sub>O</sub> =0.5A	-	75	-	-	75	-	μV
<b>NJM7815FA/DL1A</b>									
Output Voltage	V <sub>O</sub>	V <sub>IN</sub> =23V, I <sub>O</sub> =0.5A	14.4	15.0	15.6	14.4	15.0	15.6	V
Line Regulation	ΔV <sub>O</sub> - V <sub>IN</sub>	V <sub>IN</sub> =17.5 to 30V, I <sub>O</sub> =0.5A	-	11	150	-	11	300	mV
Load Regulation	ΔV <sub>O</sub> - I <sub>O</sub>	V <sub>IN</sub> =23V, I <sub>O</sub> =0.005 to 1.5A	-	35	150	-	35	300	mV
Quiescent Current	I <sub>Q</sub>	V <sub>IN</sub> =23V, I <sub>O</sub> =0mA	-	4.4	6.0	-	4.4	6.0	mA
Average Temperature Coefficient of Output Voltage	ΔV <sub>O</sub> /ΔT	V <sub>IN</sub> =23V, I <sub>O</sub> =5mA	-	-1.5	-	-	-1.5	-	mV/°C
Ripple Rejection	RR	V <sub>IN</sub> =23V, I <sub>O</sub> =0.5A, e <sub>in</sub> =2V <sub>P-P</sub> , f=120Hz	60	70	-	60	70	-	dB
Output Noise Voltage	V <sub>NO</sub>	V <sub>IN</sub> =23V, BW=10Hz to 100kHz, I <sub>O</sub> =0.5A	-	90	-	-	90	-	μV
<b>NJM7818FA/DL1A</b>									
Output Voltage	V <sub>O</sub>	V <sub>IN</sub> =27V, I <sub>O</sub> =0.5A	17.3	18.0	18.7	17.3	18.0	18.7	V
Line Regulation	ΔV <sub>O</sub> - V <sub>IN</sub>	V <sub>IN</sub> =21 to 33V, I <sub>O</sub> =0.5A	-	15	180	-	15	360	mV
Load Regulation	ΔV <sub>O</sub> - I <sub>O</sub>	V <sub>IN</sub> =27V, I <sub>O</sub> =0.005 to 1.5A	-	55	180	-	55	360	mV
Quiescent Current	I <sub>Q</sub>	V <sub>IN</sub> =27V, I <sub>O</sub> =0mA	-	4.5	6.0	-	4.5	6.0	mA
Average Temperature Coefficient of Output Voltage	ΔV <sub>O</sub> /ΔT	V <sub>IN</sub> =27V, I <sub>O</sub> =5mA	-	-1.8	-	-	-1.8	-	mV/°C
Ripple Rejection	RR	V <sub>IN</sub> =27V, I <sub>O</sub> =0.5A, e <sub>in</sub> =2V <sub>P-P</sub> , f=120Hz	59	69	-	59	69	-	dB
Output Noise Voltage	V <sub>NO</sub>	V <sub>IN</sub> =27V, BW=10Hz to 100kHz, I <sub>O</sub> =0.5A	-	100	-	-	100	-	μV
<b>NJM7820FA/DL1A</b>									
Output Voltage	V <sub>O</sub>	V <sub>IN</sub> =29V, I <sub>O</sub> =0.5A	19.2	20.0	20.8	19.2	20.0	20.8	V
Line Regulation	ΔV <sub>O</sub> - V <sub>IN</sub>	V <sub>IN</sub> =23 to 35V, I <sub>O</sub> =0.5A	-	16	200	-	16	400	mV
Load Regulation	ΔV <sub>O</sub> - I <sub>O</sub>	V <sub>IN</sub> =29V, I <sub>O</sub> =0.005 to 1.5A	-	61	200	-	61	400	mV
Quiescent Current	I <sub>Q</sub>	V <sub>IN</sub> =29V, I <sub>O</sub> =0mA	-	4.5	6.0	-	4.5	6.0	mA
Average Temperature Coefficient of Output Voltage	ΔV <sub>O</sub> /ΔT	V <sub>IN</sub> =29V, I <sub>O</sub> =5mA	-	-2.0	-	-	-2.0	-	mV/°C
Ripple Rejection	RR	V <sub>IN</sub> =29V, I <sub>O</sub> =0.5A, e <sub>in</sub> =2V <sub>P-P</sub> , f=120Hz	58	68	-	58	68	-	dB
Output Noise Voltage	V <sub>NO</sub>	V <sub>IN</sub> =29V, BW=10Hz to 100kHz, I <sub>O</sub> =0.5A	-	120	-	-	120	-	μV

■ ELECTRICAL CHARACTERISTICS (C<sub>1</sub>=0.33μF, C<sub>O</sub>=0.1μF, T<sub>J</sub>=25°C)

Measurement is to be conducted in pulse testing.

PARAMETER	SYMBOL	TEST CONDITIONS	TO-220F			TO-252			UNIT
			MIN.	TYP.	MAX.	MIN.	TYP.	MAX.	
<b>NJM7824FA/DL1A</b>									
Output Voltage	V <sub>O</sub>	V <sub>IN</sub> =33V, I <sub>O</sub> =0.5A	23.0	24.0	25.0	23.0	24.0	25.0	V
Line Regulation	ΔV <sub>O</sub> -V <sub>IN</sub>	V <sub>IN</sub> =27 to 38V, I <sub>O</sub> =0.5A	-	18	240	-	18	480	mV
Load Regulation	ΔV <sub>O</sub> -I <sub>O</sub>	V <sub>IN</sub> =33V, I <sub>O</sub> =0.005 to 1.5A	-	65	240	-	65	480	mV
Quiescent Current	I <sub>Q</sub>	V <sub>IN</sub> =33V, I <sub>O</sub> =0mA	-	4.6	6.0	-	4.6	6.0	mA
Average Temperature Coefficient of Output Voltage	ΔV <sub>O</sub> /ΔT	V <sub>IN</sub> =33V, I <sub>O</sub> =5mA	-	-2.4	-	-	-2.4	-	mV/°C
Ripple Rejection	RR	V <sub>IN</sub> =33V, I <sub>O</sub> =0.5A, e <sub>in</sub> =2V <sub>P-P</sub> , f=120Hz	56	66	-	56	66	-	dB
Output Noise Voltage	V <sub>No</sub>	V <sub>IN</sub> =33V, BW=10Hz to 100kHz, I <sub>O</sub> =0.5A	-	120	-	-	120	-	μV

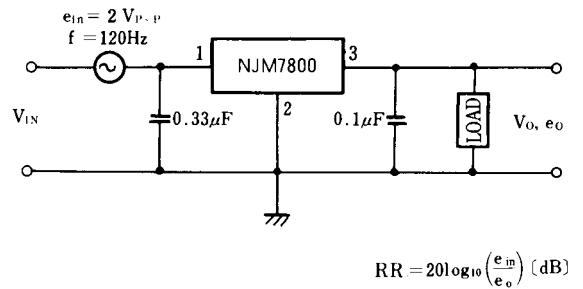
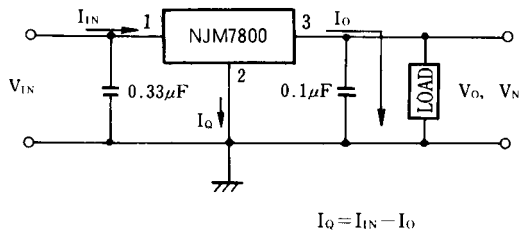
■ POWER DISSIPATION VS. AMBIENT TEMPERATURE



■ TEST CIRCUIT

1. Output Voltage, Line Regulation, Load Regulation, Quiescent Current, Average Temperature Coefficient of Output Voltage, Output Noise Voltage

2. Ripple Rejection



**■ Input Capacitor  $C_{IN}$** 

Input Capacitor  $C_{IN}$  is required to prevent oscillation and reduce power supply ripple for applications when high power supply impedance or a long power supply line.

Therefore, use the recommended  $C_{IN}$  value (refer to conditions of ELECTRIC CHARACTERISTIC) or larger and should connect between GND and  $V_{IN}$  as shortest path as possible to avoid the problem.

**■ Output Capacitor  $C_O$** 

Output capacitor ( $C_O$ ) will be required for a phase compensation of the internal error amplifier.

The capacitance and the equivalent series resistance (ESR) influence to stable operation of the regulator.

Use of a smaller  $C_O$  may cause excess output noise or oscillation of the regulator due to lack of the phase compensation.

On the other hand, Use of a larger  $C_O$  reduces output noise and ripple output, and also improves output transient response when rapid load change.

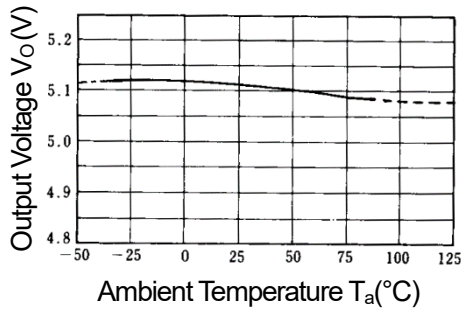
Therefore, use the recommended  $C_O$  value (refer to conditions of ELECTRIC CHARACTERISTIC) or larger and should connect between GND and  $V_{OUT}$  as shortest path as possible for stable operation

In addition, you should consider varied characteristics of capacitor (a frequency characteristic, a temperature characteristic, a DC bias characteristic and so on) and unevenness peculiar to a capacitor supplier enough.

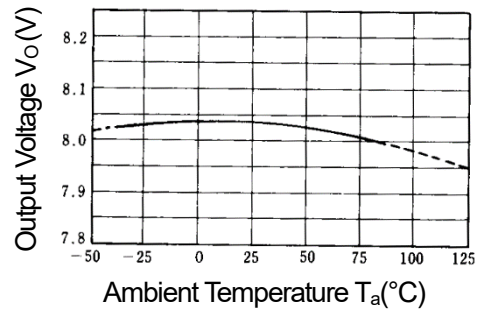
When selecting  $C_O$ , recommend that have withstand voltage margin against output voltage and superior temperature characteristic though

■ TYPICAL CHARACTERISTICS

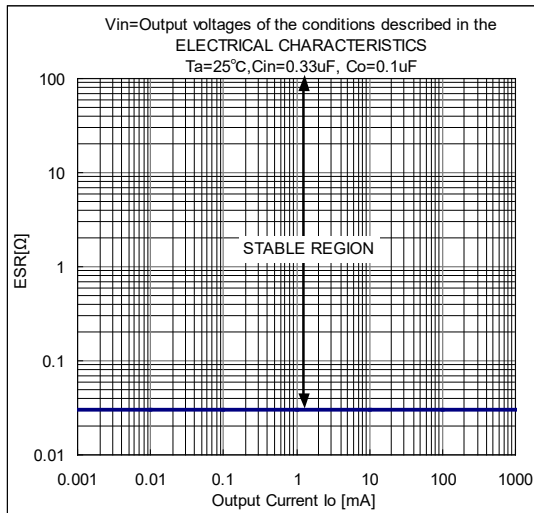
**NJM7805 Output Voltage vs. Temperature**



**NJM7808 Output Voltage vs. Temperature**



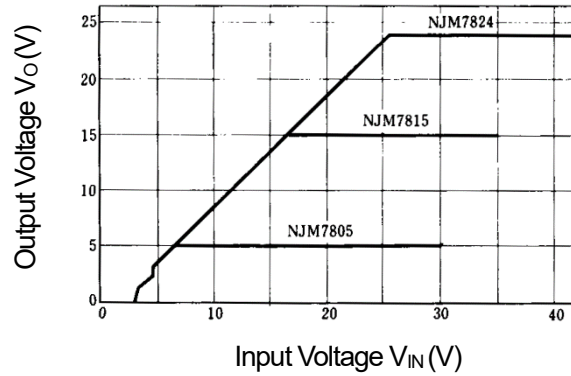
**NJM78M00 Series Equivalent Series Resistance vs. Output Current**



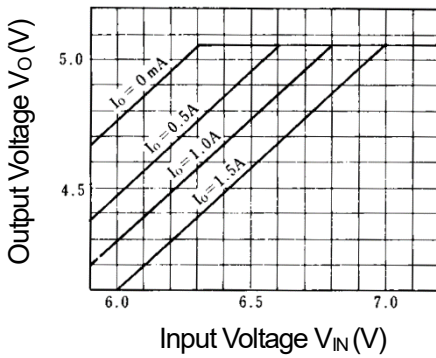


■ TYPICAL CHARACTERISTICS

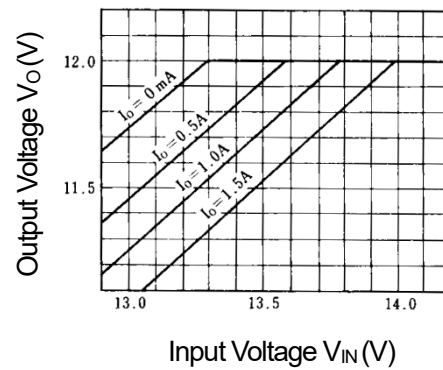
**NJM7805/15/24 Output Characteristics**  
( $I_o=0.5A, T_j=25^\circ C$ )



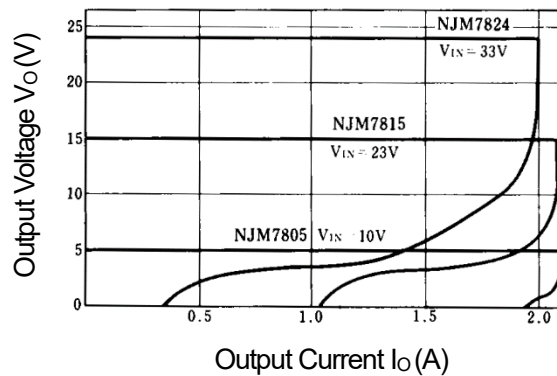
**NJM7805 Dropout Characteristics**  
( $T_j=25^\circ C$ )



**NJM7812 Dropout Characteristics**  
( $T_j=25^\circ C$ )

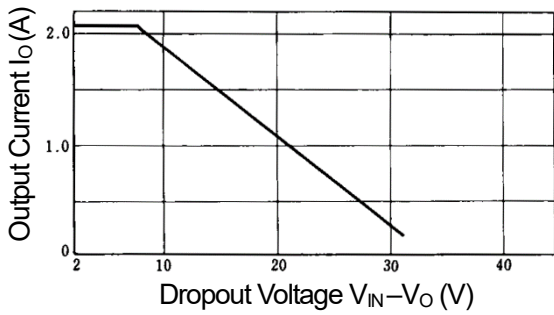


**NJM7805/15/24 Load Characteristics**  
( $T_j=25^\circ C$ )

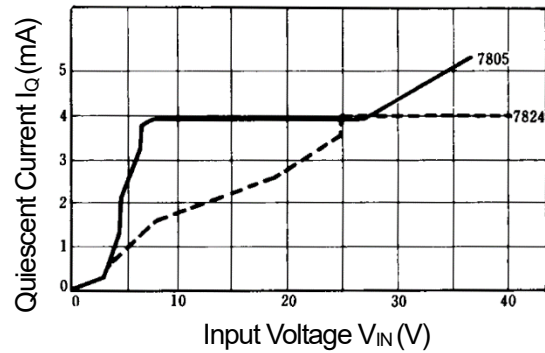


■ TYPICAL CHARACTERISTICS

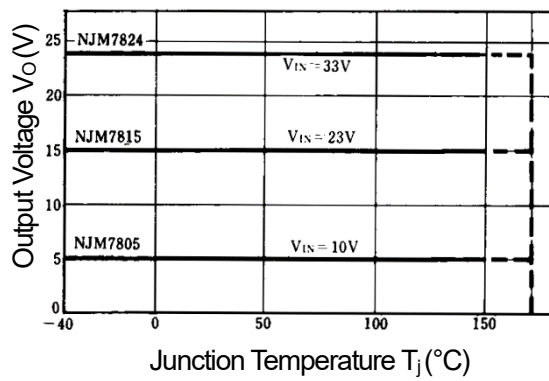
NJM7800 Series Short Circuit Output Current  
( $T_j=25^\circ\text{C}$ ,  $\infty$  Heat Sink)



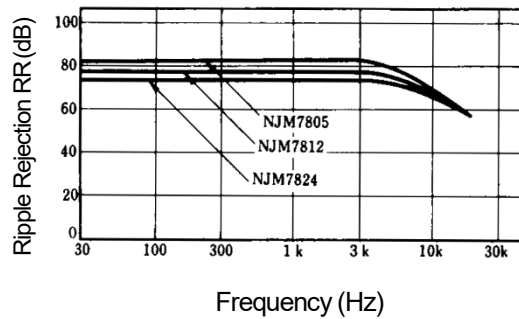
NJM7805/24 Quiescent Current vs. Input Voltage  
( $T_j=25^\circ\text{C}$ ,)



NJM7805/15/24 Output Voltage vs. Junction Temperature



NJM7805/15/24 Ripple Rejection vs. Frequency

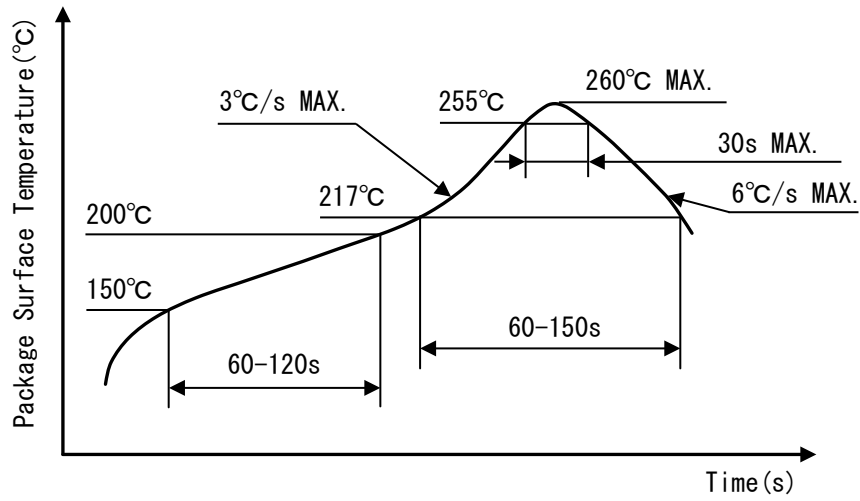


$V_{IN} = 10\text{V (05)}$   $e_{in} = 2V_{P-P}$   
 $19\text{V (12)}$   
 $33\text{V (24)}$   
 $T_j = 25^\circ\text{C}$

■ REVISION HISTORY

Date	Revision	Changes
January 08,2023	Ver. 1.0	<ul style="list-style-type: none"><li>• Change of company name and design form.</li><li>• Change of revision number (Ver.2019-11-14 → Ver.1.0)</li><li>• Added revision history</li></ul>

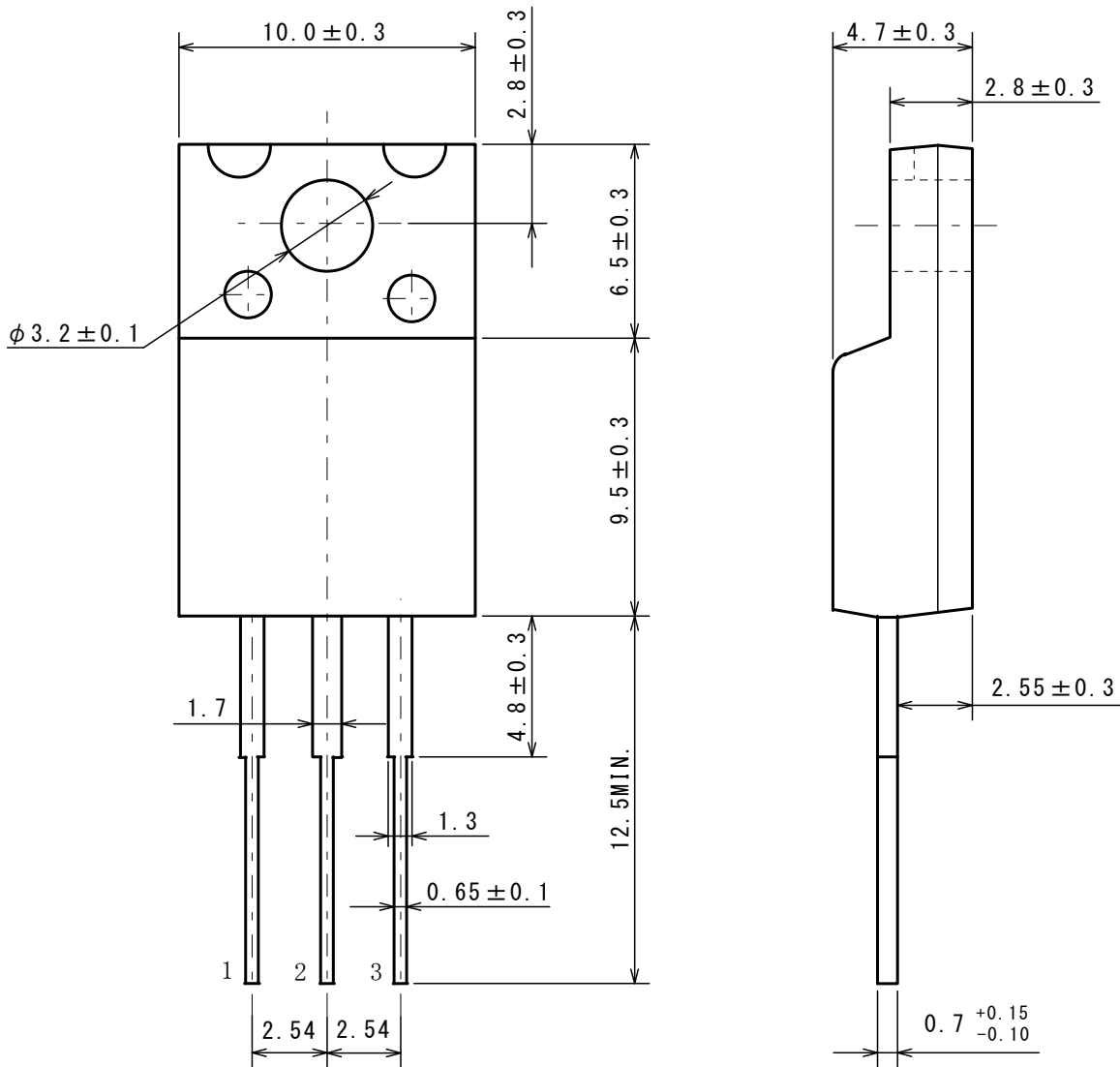
■ HEAT-RESISTANCE PROFILES



Reflow profile

■ PACKAGE DIMENSIONS

UNIT: mm



# Nisshinbo Micro Devices Inc.

TO-220F-3

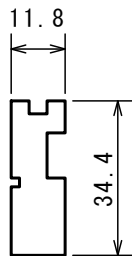
PI-TO-220F-3-E-B

■ PACKING SPEC

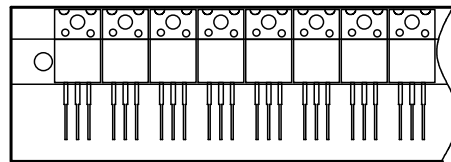
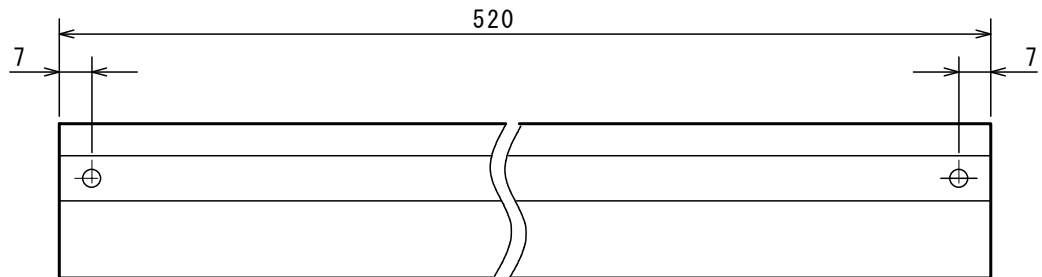
UNIT: mm

STICK STATE

Cross section

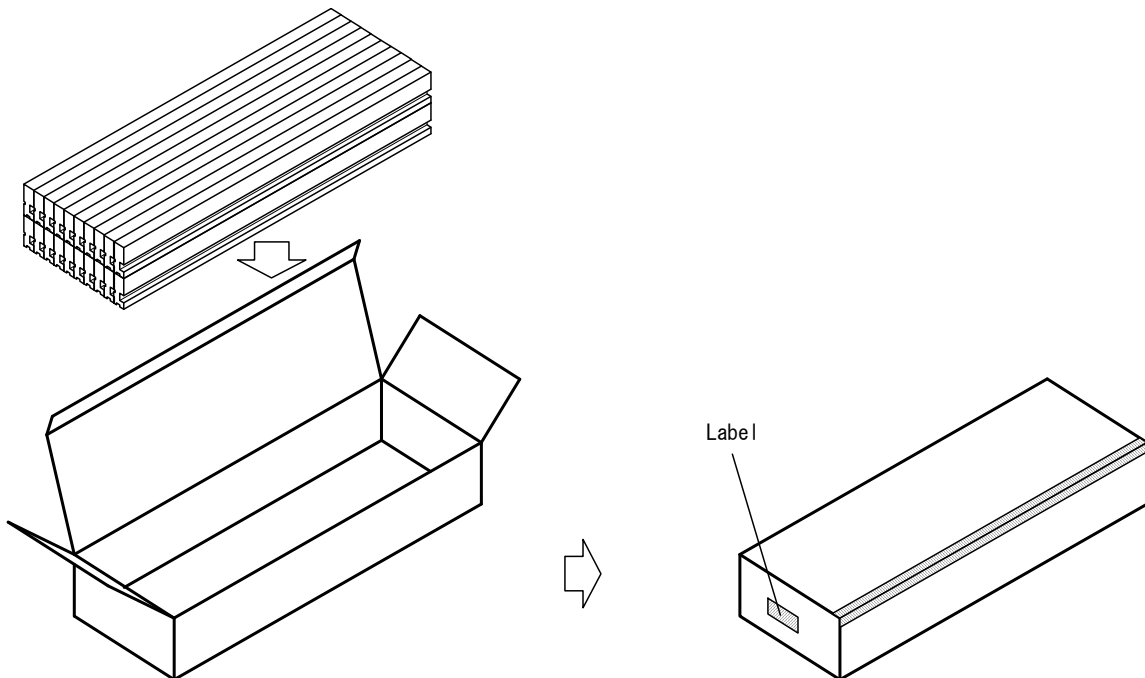


Stick (MAX. 50pcs)



Direction of 1pin.

PACKING STATE



# Nisshinbo Micro Devices Inc.

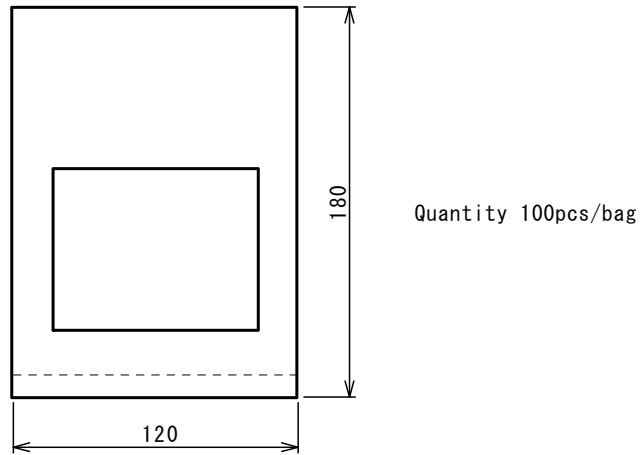
TO-220F-3

PI-TO-220F-3-E-B

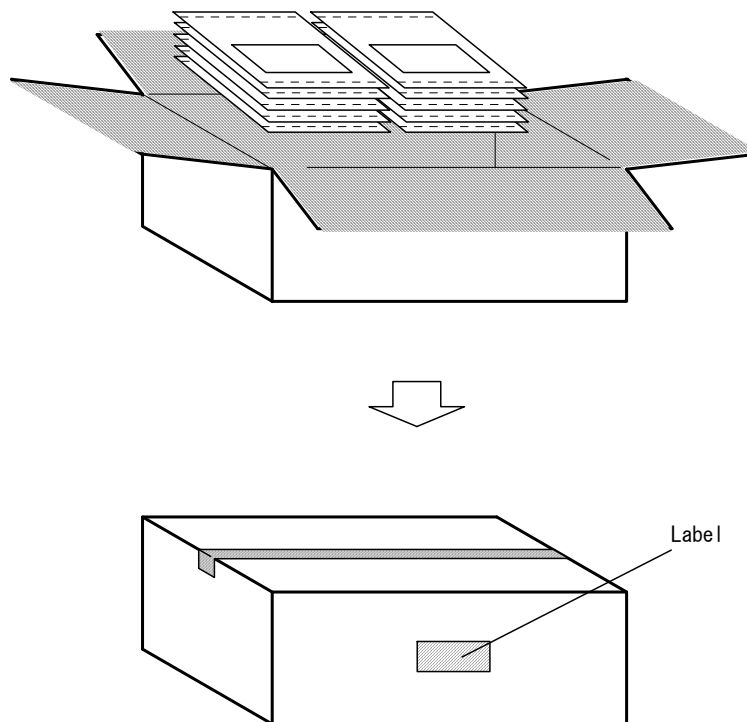
## ■ PACKING SPEC

UNIT: mm

### BAG STATE



### PACKING STATE



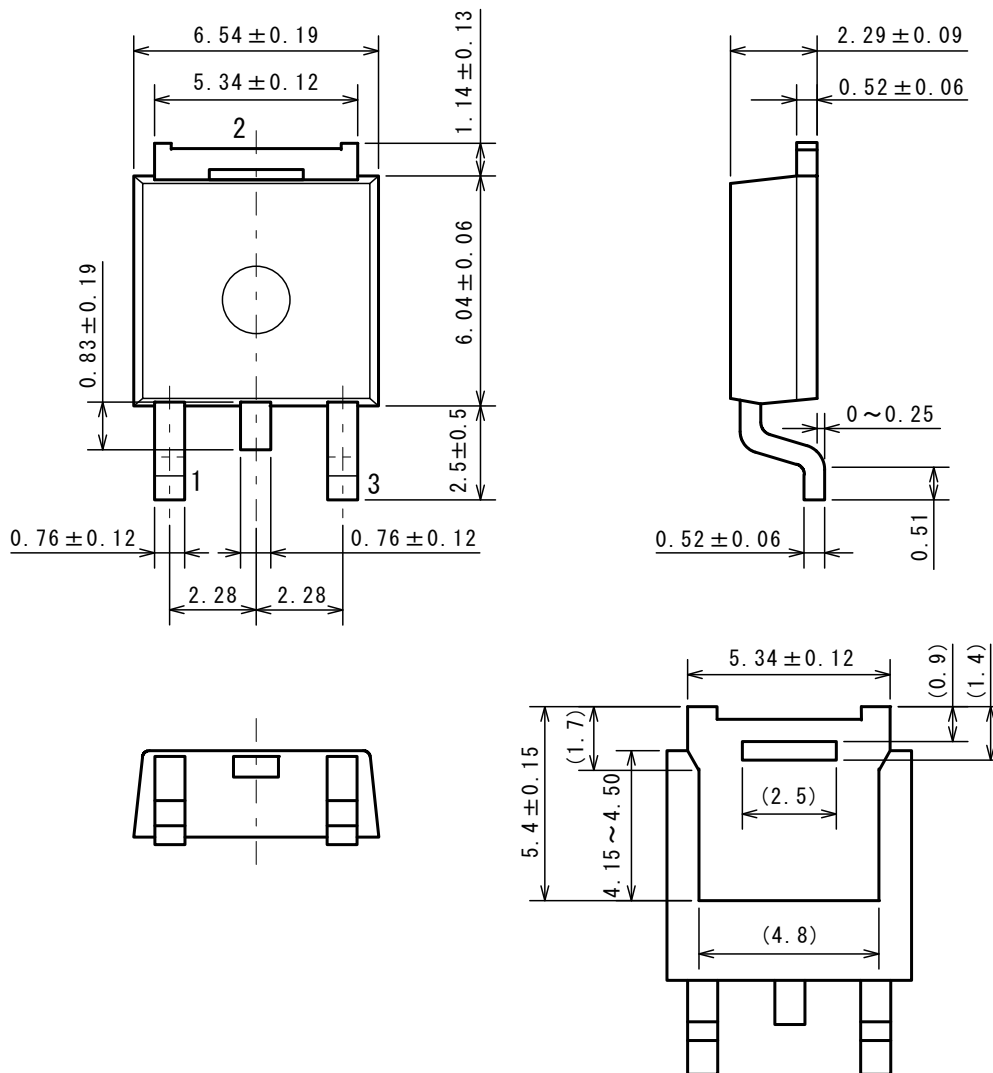
# Nisshinbo Micro Devices Inc.

TO-252-3-L1

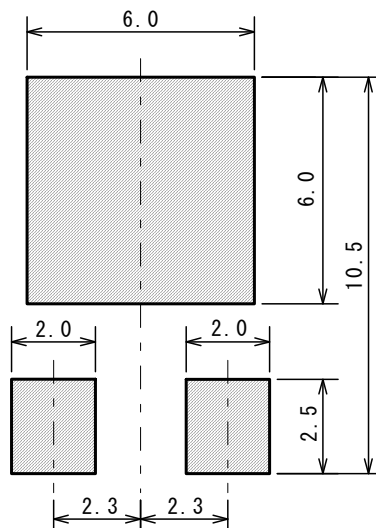
PI-TO-252-3-L1-E-A

## ■ PACKAGE DIMENSIONS

UNIT: mm



## ■ EXAMPLE OF SOLDER PADS DIMENSIONS





# Nisshinbo Micro Devices Inc.

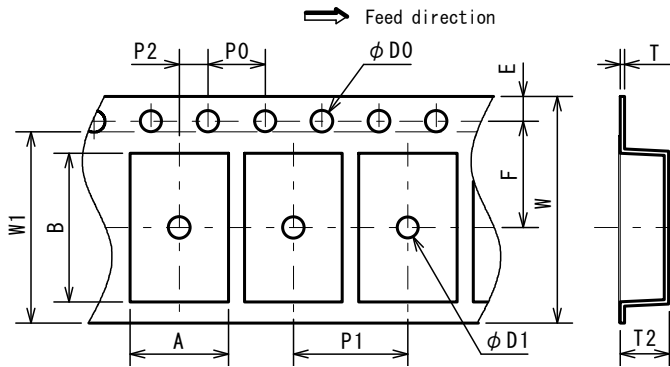
TO-252-3-L1

PI-TO-252-3-L1-E-A

## PACKING SPEC

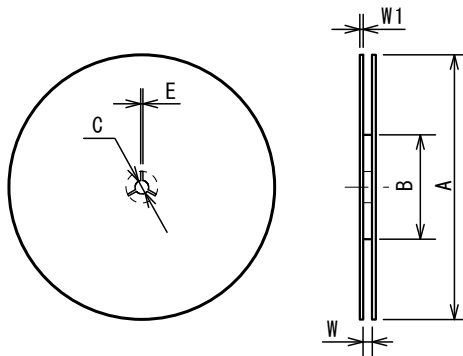
UNIT: mm

### TAPING DIMENSIONS



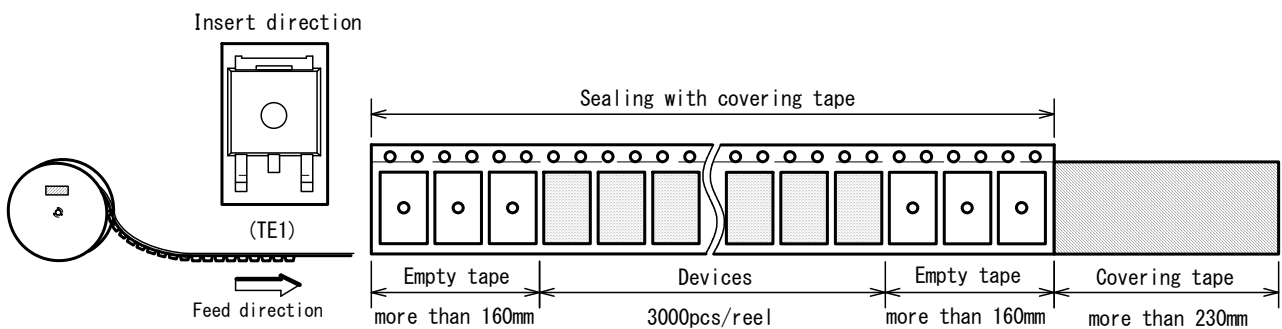
SYMBOL	DIMENSION	REMARKS
A	6.9±0.1	BOTTOM DIMENSION
B	10.5±0.1	BOTTOM DIMENSION
D0	1.5 <sup>+0.1</sup> <sub>0</sub>	
D1	1.5 <sup>+0.1</sup> <sub>0</sub>	
E	1.75±0.1	
F	7.5±0.05	
P0	4.0±0.1	
P1	8.0±0.1	
P2	2.0±0.05	
T	0.3±0.05	
T2	3.4 max	
W	16.0±0.3	
W1	13.5	THICKNESS 0.1max

### REEL DIMENSIONS

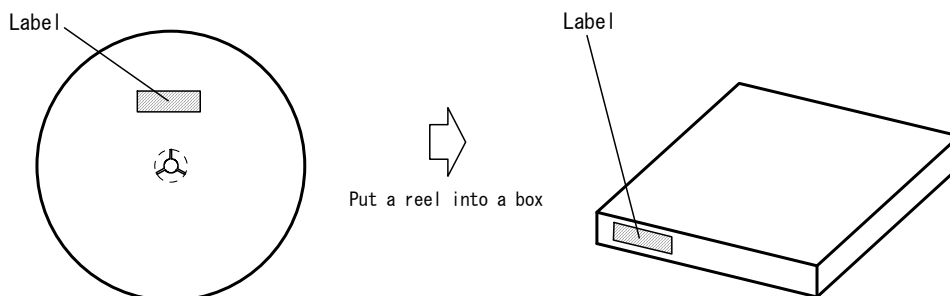


SYMBOL	DIMENSION
A	φ 330±2
B	φ 80±1
C	φ 13±0.5
E	2
W	17.5±0.5
W1	2±0.5

### TAPING STATE



### PACKING STATE



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  - Various Safety Devices
  - Traffic control system
  - Combustion equipment

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  - 8-1. **Quality Warranty Period**

In the case of a product purchased through an authorized distributor or directly from us, the warranty period for this product shall be one (1) year after delivery to your company. For defective products that occurred during this period, we will take the quality warranty measures described in section 8-2. However, if there is an agreement on the warranty period in the basic transaction agreement, quality assurance agreement, delivery specifications, etc., it shall be followed.
  - 8-2. **Quality Warranty Remedies**

When it has been proved defective due to manufacturing factors as a result of defect analysis by us, we will either deliver a substitute for the defective product or refund the purchase price of the defective product.

Note that such delivery or refund is sole and exclusive remedies to your company for the defective product.
  - 8-3. **Remedies after Quality Warranty Period**

With respect to any defect of this product found after the quality warranty period, the defect will be analyzed by us. On the basis of the defect analysis results, the scope and amounts of damage shall be determined by mutual agreement of both parties. Then we will deal with upper limit in Section 8-2. This provision is not intended to limit any legal rights of your company.
9. Anti-radiation design is not implemented in the products described in this document.
10. The X-ray exposure can influence functions and characteristics of the products. Confirm the product functions and characteristics in the evaluation stage.
11. WLCSP products should be used in light shielded environments. The light exposure can influence functions and characteristics of the products under operation or storage.
12. Warning for handling Gallium and Arsenic (GaAs) products (Applying to GaAs MMIC, Photo Reflector). These products use Gallium (Ga) and Arsenic (As) which are specified as poisonous chemicals by law. For the prevention of a hazard, do not burn, destroy, or process chemically to make them as gas or power. When the product is disposed of, please follow the related regulation and do not mix this with general industrial waste or household waste.
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