

Description

TL431 is a three-terminal adjustable regulator with a guaranteed thermal stability over applicable temperature ranges. The output Voltage may be set to any value between V_{ref} (approximately 2.495V) and 36 V with two external resistors. These devices have provides a very sharp turn-on characteristic, making these device excellent replacement for zener diodes in many applications.

The TL431K is three-terminal adjustable regulator with a guaranteed thermal stability over applicable temperature ranges. The output Voltage may be set to any value between V_{ref} (approximately 2.495V) and 36 V with two external resistors. These devices have provides a very sharp turn-on characteristic, making these device excellent replacement for zener diodes in many applications.

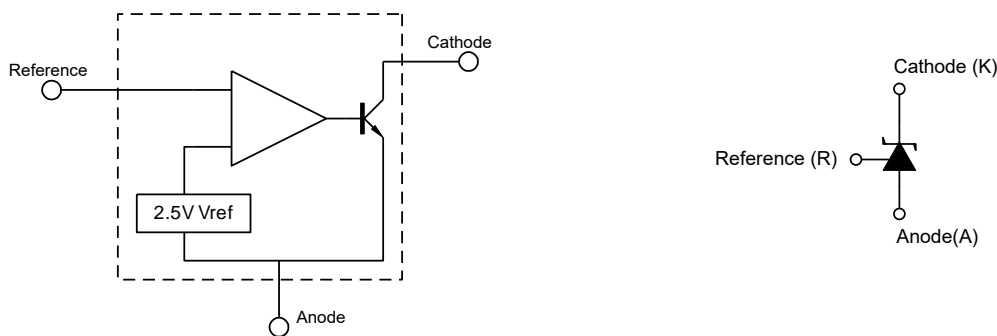
Features

- Wide programmable output voltage from 2.495V to 36V
- Sink current capability from 0.5mA to 100mA.
- Low output noise
- Wide Operating Range of -40 to 125°C

Application

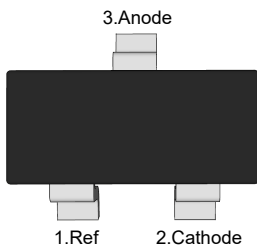
- Adjustable voltage and current references
- Voltage monitoring
- Replacement of zener diode
- Comparator with integrated reference

Functional block diagram



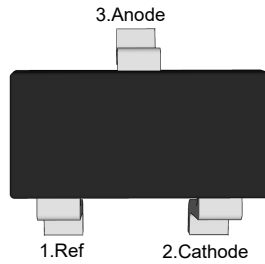
Pin Distribution

SOT-23



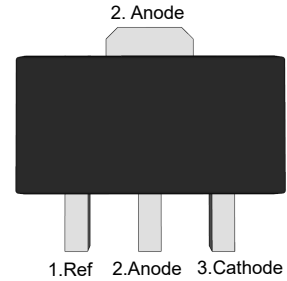
(Top View)

SOT-23-3



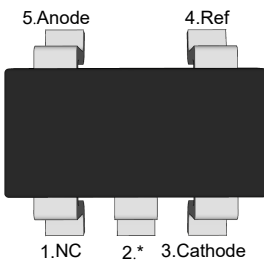
(Top View)

SOT-89



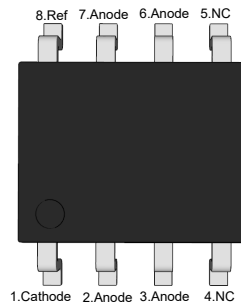
(Top View)

SOT-23-5



(Top View)

SOP-8



(Top View)

NC: No internal connection
 *: Attached to substrate and must be connected to Anode or left open

Ordering Information

TL431K□ □

- └ Package Type
 - (Blank): SOT-23
 - SC: SOT-23-3
 - SQ: SOT-89
 - SE: SOT-23-5
 - PA: SOP-8
- └ V_{REF} tolerance
 - (Blank): 1%
 - A: 0.5%
 - B: 0.4%

Orderable Device	Voltage Tolerance	Package	Reel (inch)	Package Qty (PCS)	Eco Plan ^{Note}	MSL Level	Marking Code
TL431K	1%	SOT-23	7	3000	RoHS & Green	MSL1	431K
TL431KA	0.5%	SOT-23	7	3000	RoHS & Green	MSL1	431KA
TL431KB	0.4%	SOT-23	7	3000	RoHS & Green	MSL1	431KB
TL431KSC	1%	SOT-23-3	7	3000	RoHS & Green	MSL3	431KC
TL431KASC	0.5%	SOT-23-3	7	3000	RoHS & Green	MSL3	431KAC
TL431KBSC	0.4%	SOT-23-3	7	3000	RoHS & Green	MSL3	431KBC
TL431KSQ	1%	SOT-89	7 / 13	1000 / 3000	RoHS & Green	MSL1	431K
TL431KASQ	0.5%	SOT-89	7 / 13	1000 / 3000	RoHS & Green	MSL1	431KA
TL431KBSQ	0.4%	SOT-89	7 / 13	1000 / 3000	RoHS & Green	MSL1	431KB
TL431KSE	1%	SOT-23-5	7	3000	RoHS & Green	MSL3	431KE
TL431KASE	0.5%	SOT-23-5	7	3000	RoHS & Green	MSL3	431KAE
TL431KBSE	0.4%	SOT-23-5	7	3000	RoHS & Green	MSL3	431KBE
TL431KPA	1%	SOP-8	13	4000	RoHS & Green	MSL3	431KP
TL431KAPA	0.5%	SOP-8	13	4000	RoHS & Green	MSL3	431KAP
TL431KBPA	0.4%	SOP-8	13	4000	RoHS & Green	MSL3	431KBP

Note:

RoHS: TN defines "RoHS" to mean semiconductor products that are compliant with the current EU RoHS requirements for all 10 RoHS substances, including the requirement that RoHS substance do not exceed 0.1% by weight in homogeneous materials.

Green: TN defines "Green" to mean Halogen-Free and Antimony-Free.

Absolute Maximum Ratings (Ta=25°C unless otherwise specified)

Parameter	Symbol	Value	Units
Cathode Voltage	V_{KA}	37	V
Cathode Current Range(Continuous)	I_{KA}	-100 ~ +150	mA
Reference Input Current Range	I_{REF}	-0.05 ~ +10	mA
Operating Temperature	T_{OPR}	-40 ~ +125	°C
Storage Temperature Range	T_{STG}	-65 ~ +150	°C

Note: Absolute maximum ratings are those values beyond which the device could be permanently damaged.
 Absolute maximum ratings are stress ratings only and functional device operation is not implied.

Recommended Operating Conditions

Parameter	Symbol	Min.	Max.	Units
Cathode Voltage	V_{KA}	V_{REF}	36	V
Cathode Current	I_{KA}	0.5	100	mA

Thermal Information

Parameter	Symbol	Value		Units
Junction-to-Ambient thermal resistance	$R_{\theta JA}$	SOT-23	416	°C/W
		SOT-23-3	416	°C/W
		SOT-23-5	416	°C/W
		SOT-89	156	°C/W
		SOP-8	208	°C/W

Electrical Characteristics (Ta=25°C unless otherwise specified)

Parameter	Symbol	Test Conditions	Min.	Typ.	Max.	Unit	
Reference Input Voltage Fig1	V _{REF}	V _{KA} =V _{REF} , I _{KA} =10mA	1%(Accuracy)	2.470	2.495	2.520	V
			0.5%(Accuracy)	2.483	2.495	2.507	V
			0.4%(Accuracy)	2.485	2.495	2.505	V
Deviation of Reference Input Voltage Over Temperature Fig1	ΔV _{REF}	V _{KA} =V _{REF} , I _{KA} =10mA T _{MIN} ≤ T _A ≤ T _{MAX}	--	--	25	mV	
Ratio of Change in Reference Input Voltage to The Change in Cathode Voltage Fig2	$\frac{\Delta V_{REF}}{\Delta V_{KA}}$	I _{KA} =10mA	ΔV _{KA} =10V~V _{REF}	--	-1.0	-2.7	mV/V
			ΔV _{KA} =36V~10V	--	-1.0	-2.0	
Reference Input Current Fig2	I _{REF}	I _{KA} =10mA, R1=10KΩ, R2=∞	--	1	2	μA	
Deviation of Reference Input Current Over Full Temperature Range Fig2	ΔI _{REF}	I _{KA} =10mA, R1=10KΩ, R2=∞, T _A =full Temperature	--	0.2	0.4	μA	
Minimum Cathode Current for Regulation Fig1	I _{KA(MIN)}	V _{KA} =V _{REF}	--	50	85	μA	
Off-State Cathode Current Fig3	I _{KA(OFF)}	V _{KA} =36V, V _{REF} =0	--	0.05	0.5	μA	
Dynamic Impedance	Z _{KA}	V _{KA} =V _{REF} , I _{KA} =1~100mA, f≤1.0KHz	--	--	0.5	Ω	

Figure 1. Test Circuit for V_{KA} = V_{REF}

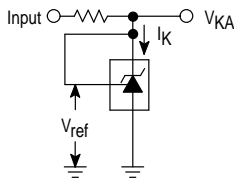


Figure 2. Test Circuit for V_{KA} > V_{REF}

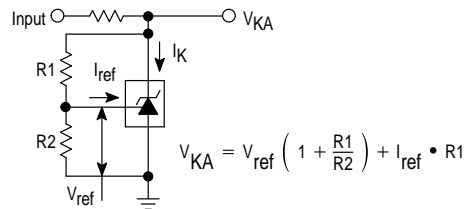
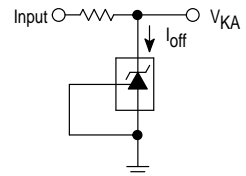
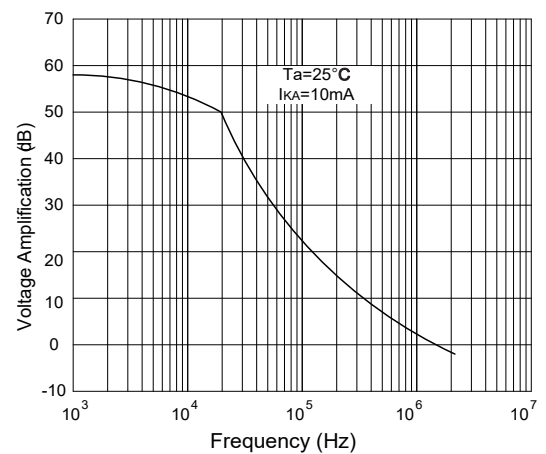
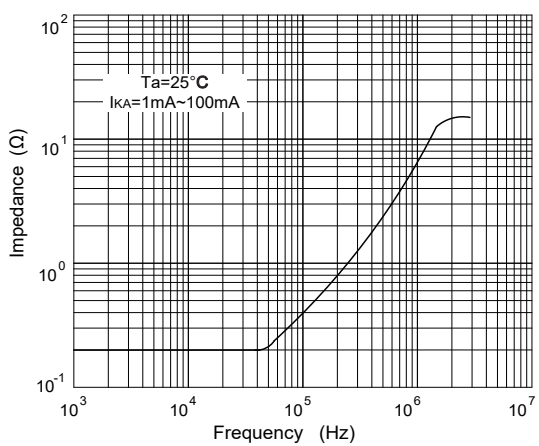
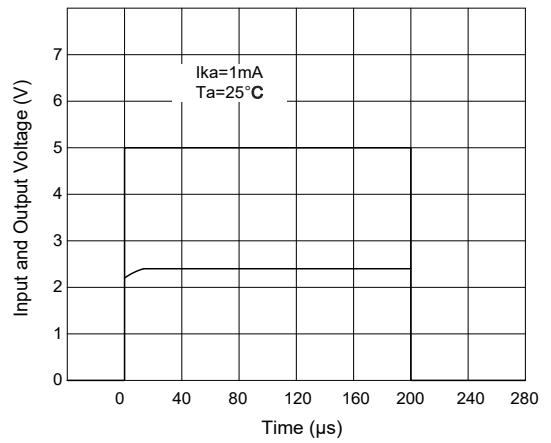
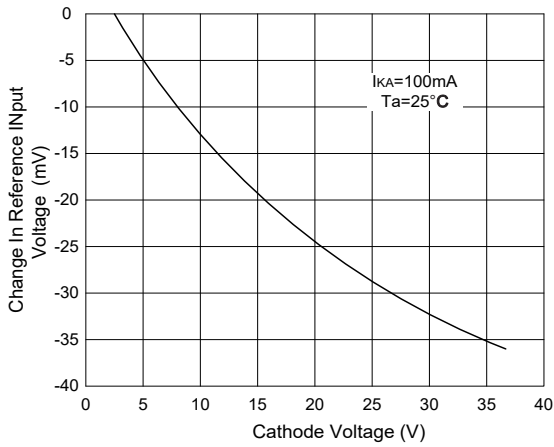
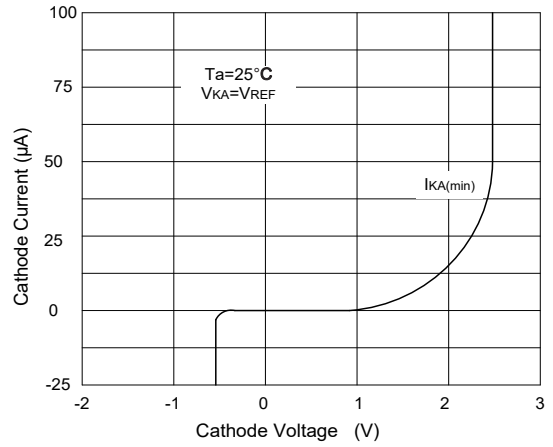
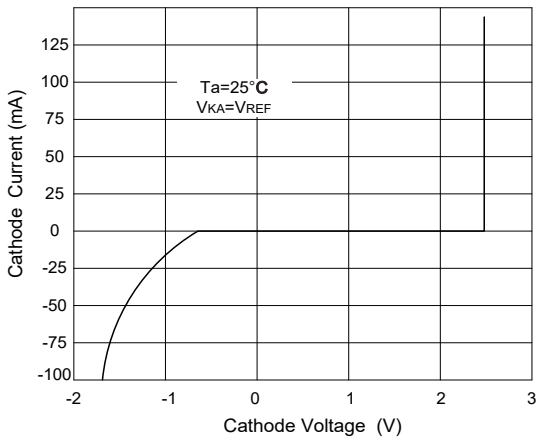


Figure 3. Test Circuit for I_{OFF}



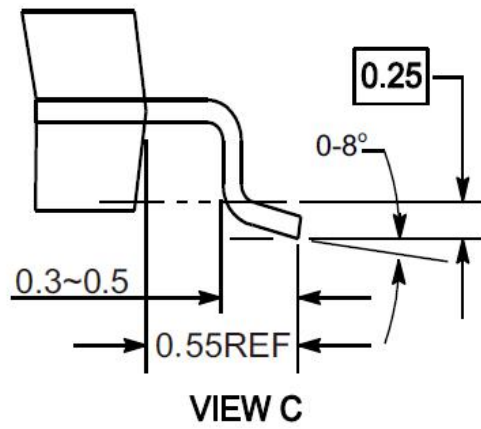
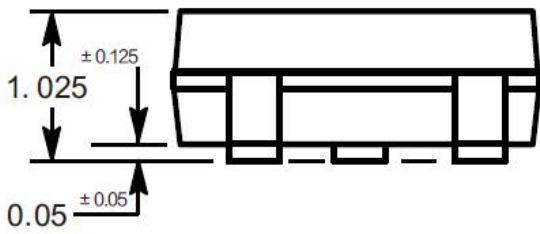
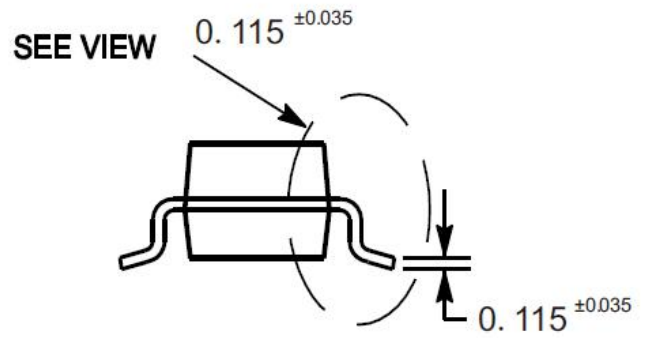
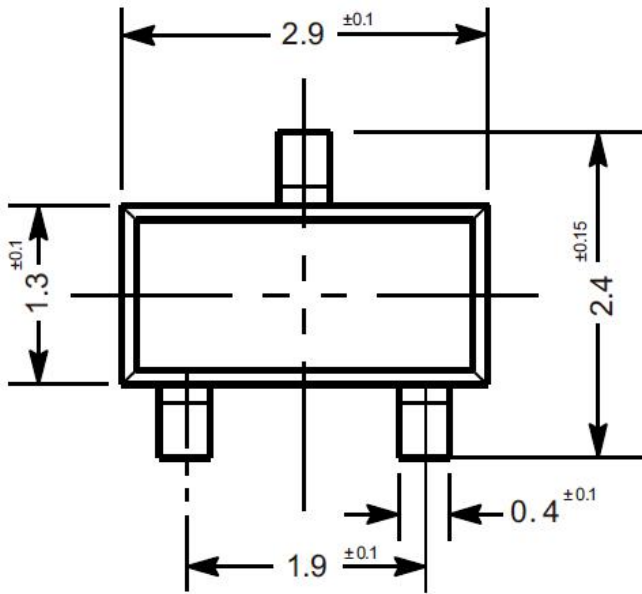
Typical Characteristic Curves



Package Outline

SOT-23

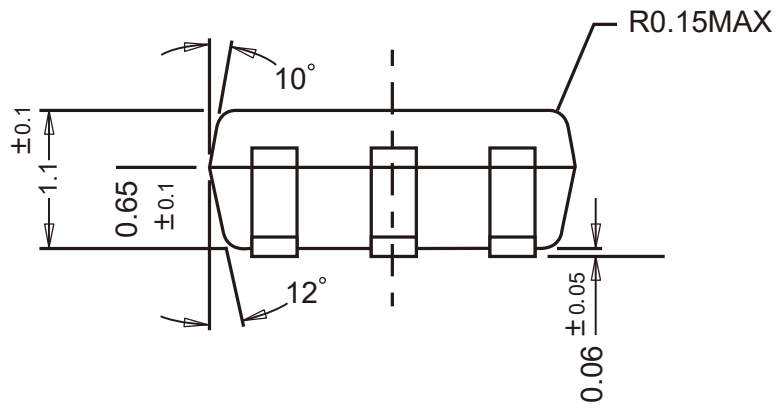
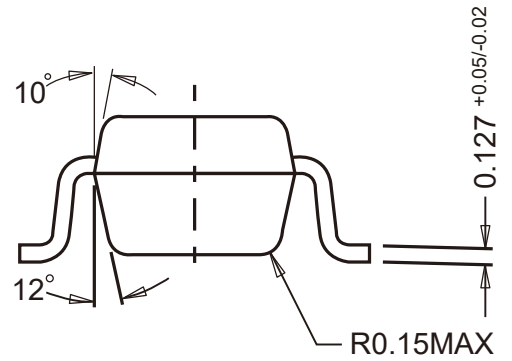
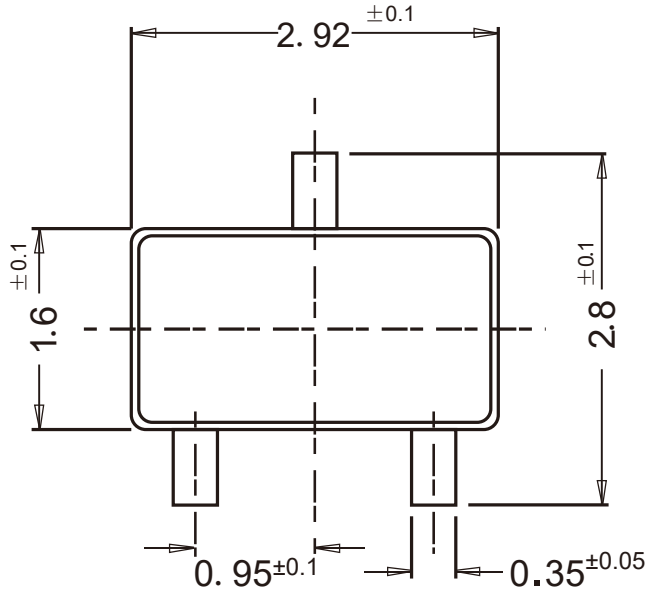
Dimensions in mm



Package Outline

SOT-23-3

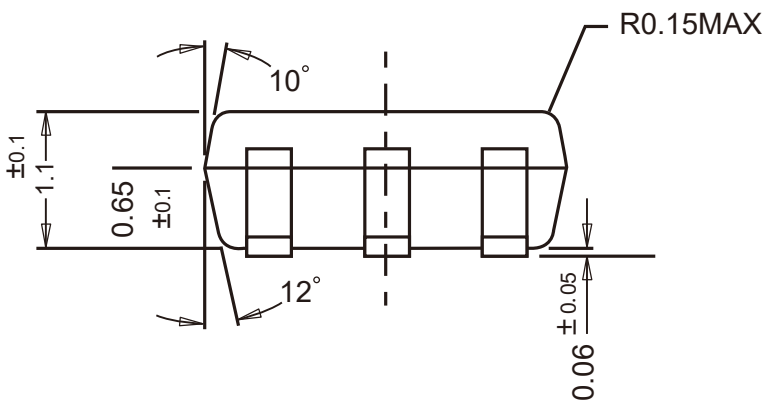
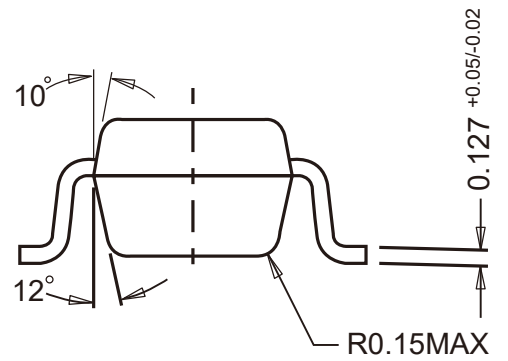
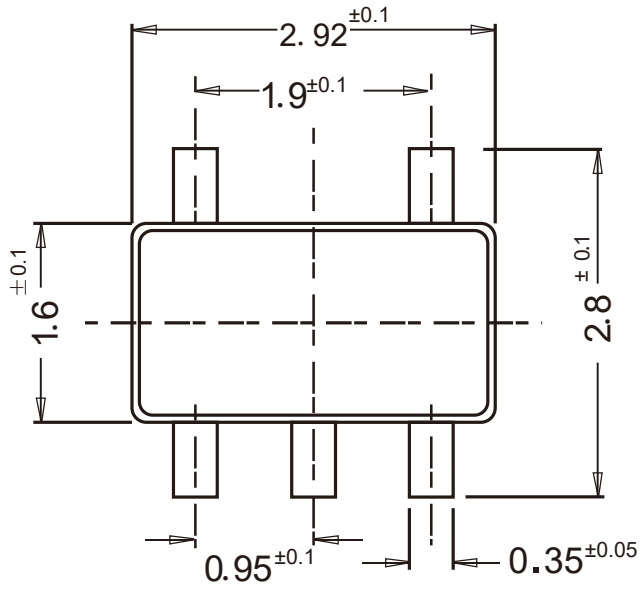
Dimensions in mm



Package Outline

SOT-23-5

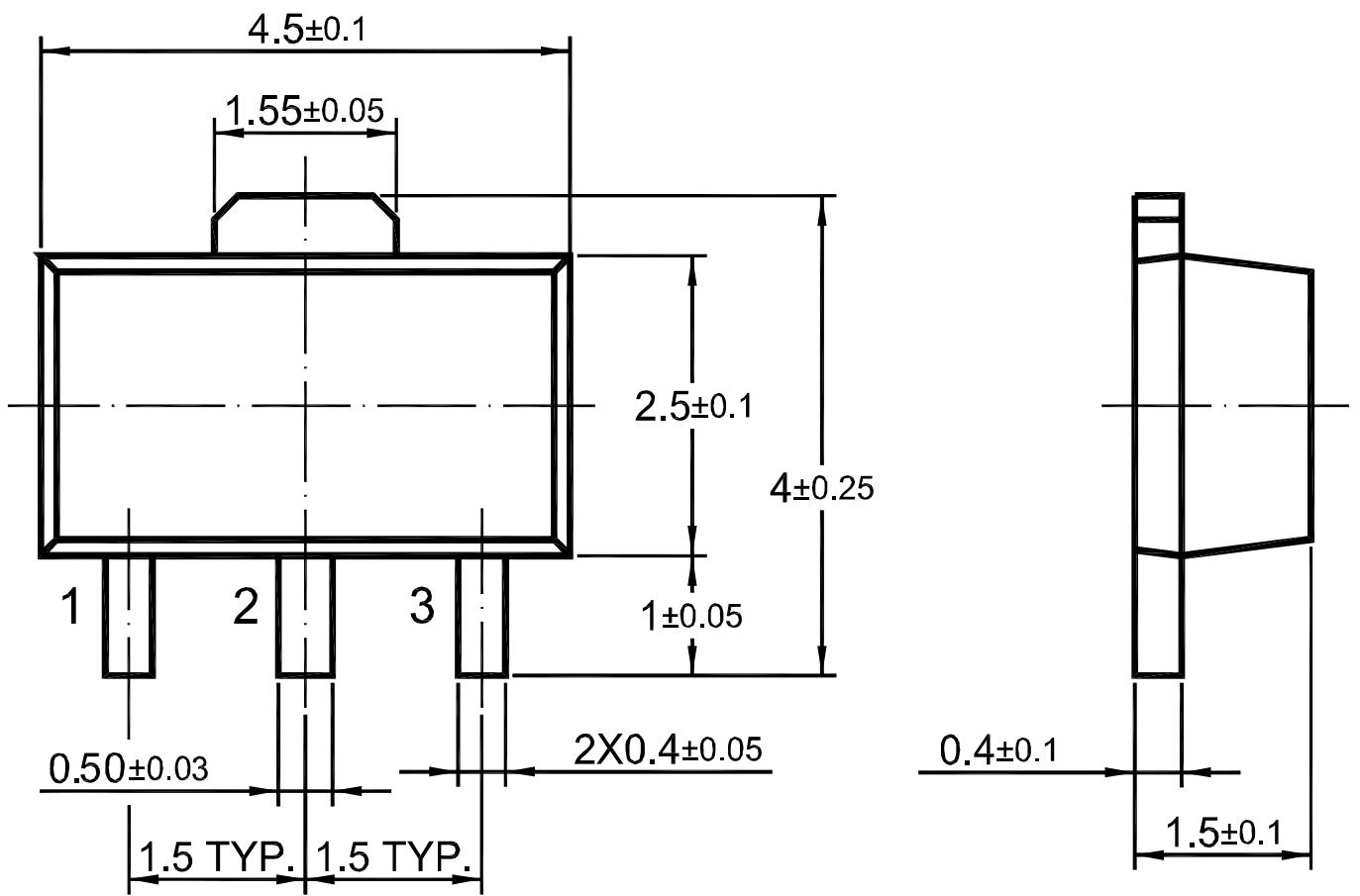
Dimensions in mm



Package Outline

SOT-89

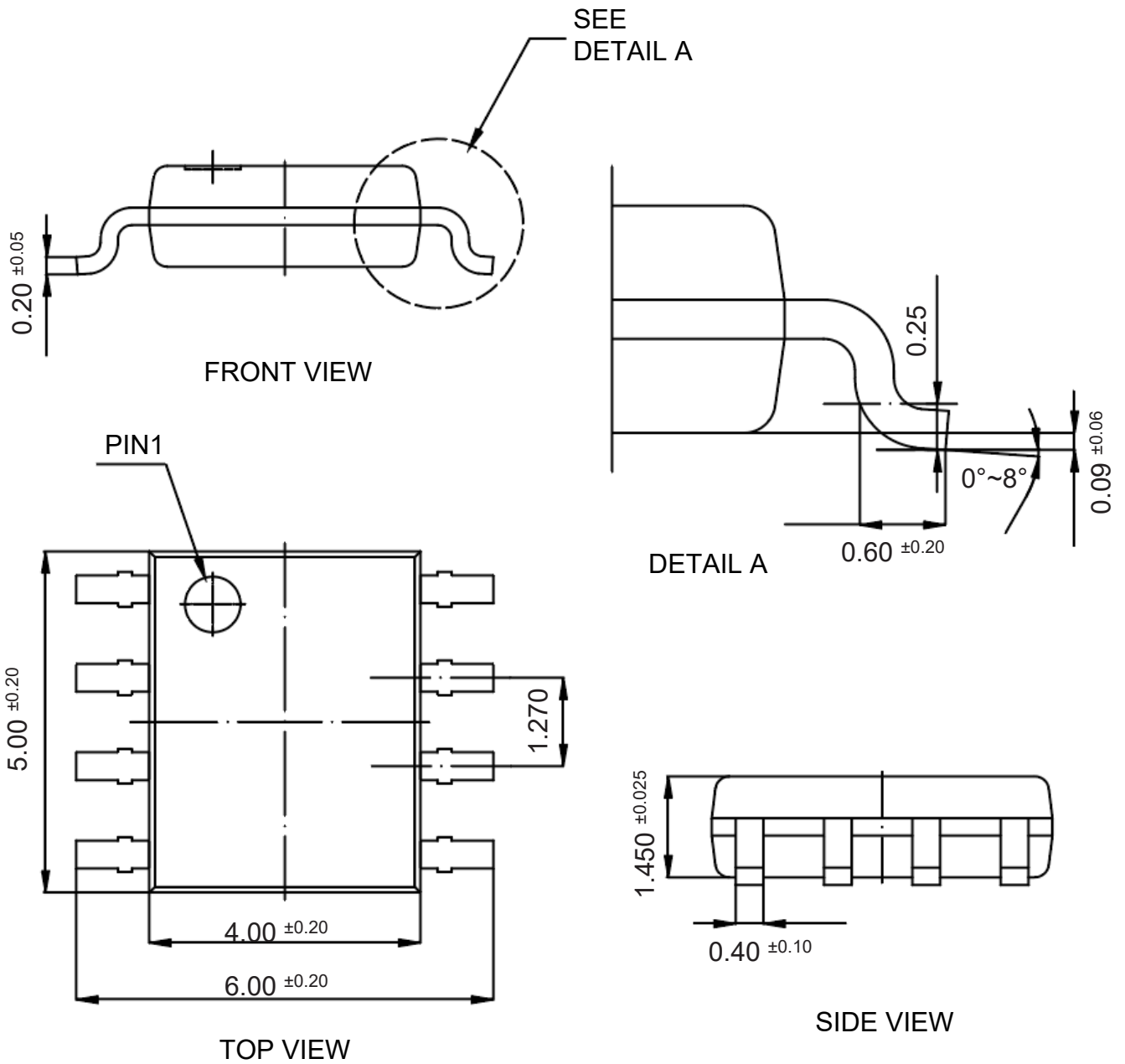
Dimensions in mm



Package Outline

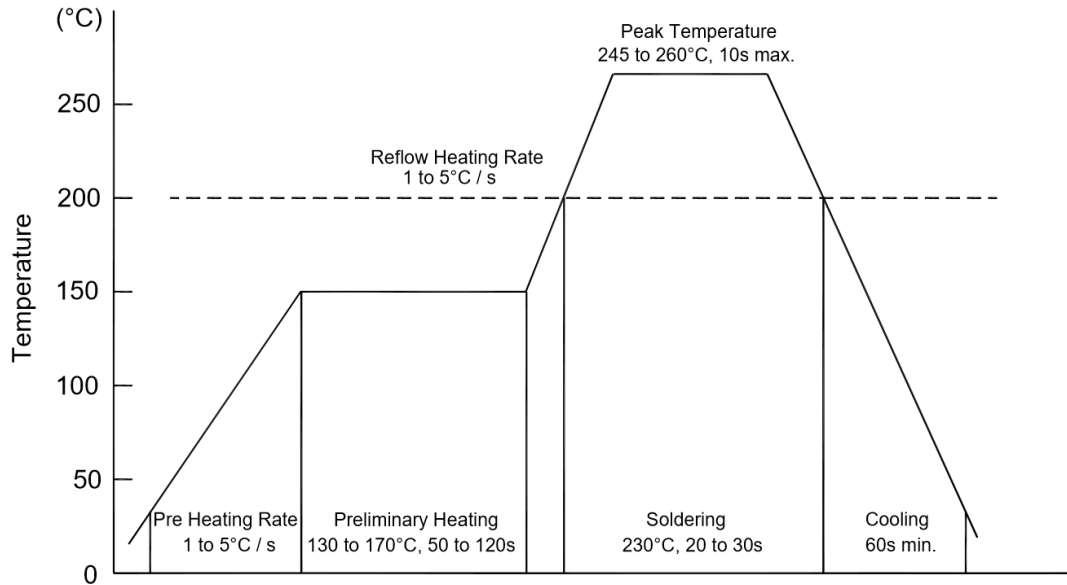
SOP-8

Dimensions in mm



Conditions of Soldering and Storage

◆ Recommended condition of reflow soldering



Recommended peak temperature is over 245°C. If peak temperature is below 245°C, you may adjust the following parameters:

- Time length of peak temperature (longer)
- Time length of soldering (longer)
- Thickness of solder paste (thicker)

◆ Conditions of hand soldering

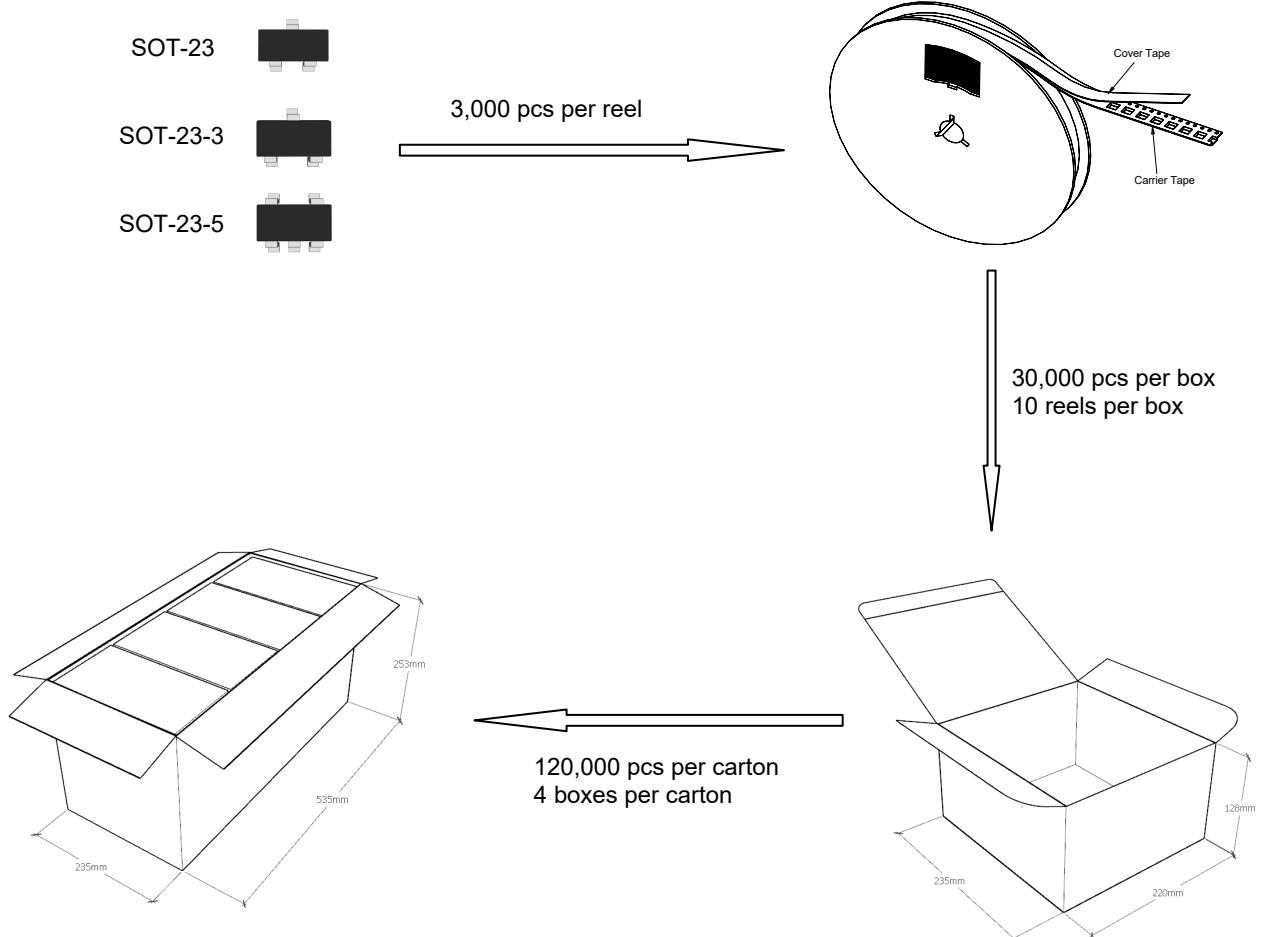
- Temperature: 300°C
- Time: 3s max.
- Times: one time

◆ Storage conditions

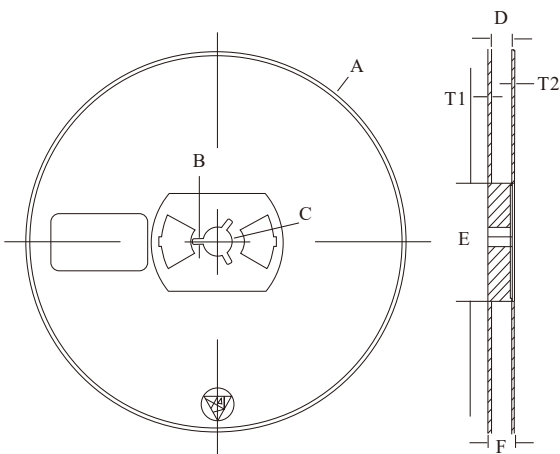
- **Temperature**
5 to 40°C
- **Humidity**
30 to 80% RH
- **Recommended period**
One year after manufacturing

Package Specifications (SOT-23/SOT-23-3/SOT-23-5)

- The method of packaging



◆ **reel data**

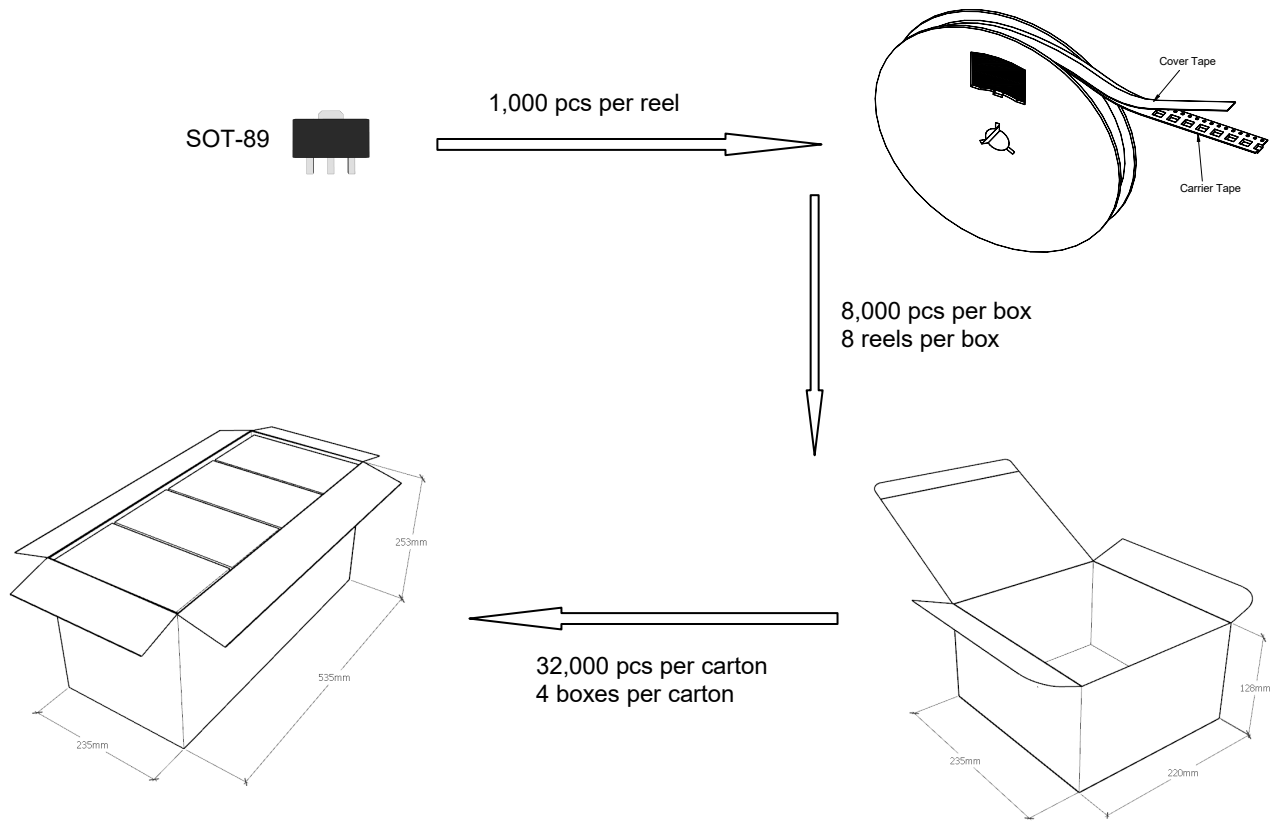


Reel (7")

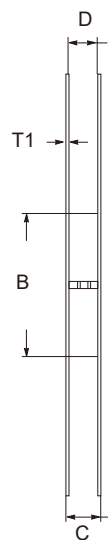
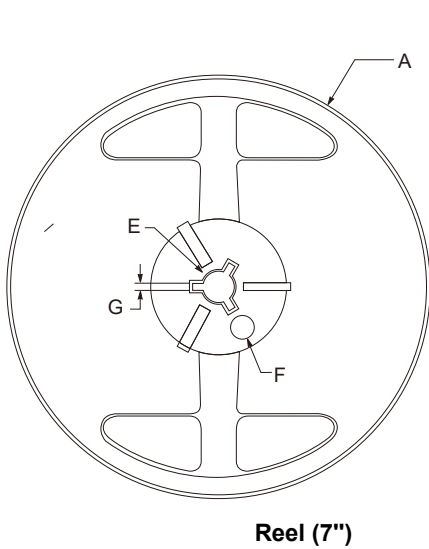
Symbol	Value (unit: mm)
A	Ø 177.8±1
B	2.7±0.2
C	Ø 13.5±0.2
E	Ø 54.5±0.2
F	12.3±0.3
D	9.6+2/-0.3
T1	1.0±0.2
T2	1.2±0.2

Package Specifications (SOT-89)

- The method of packaging (1,000PCS/Reel&7inches)



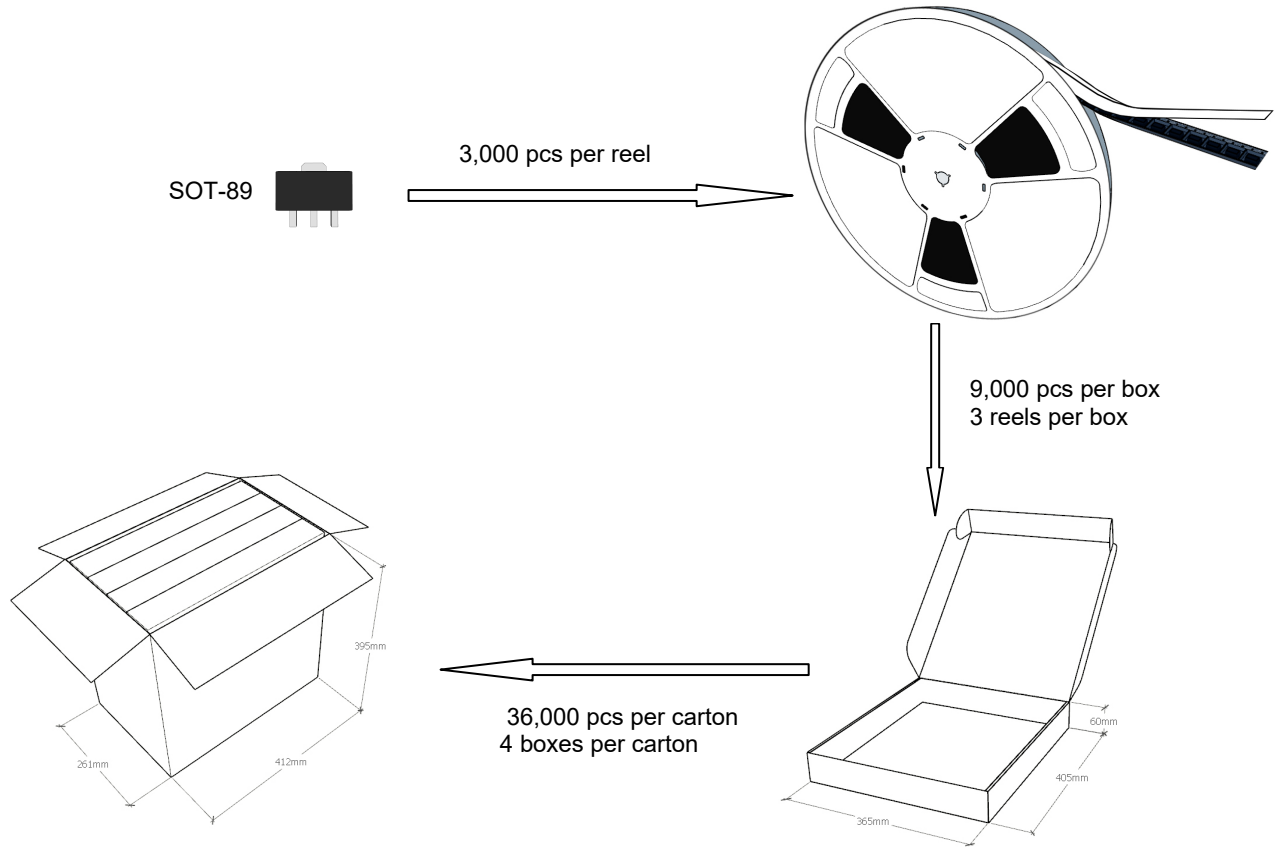
◆ **reel data**



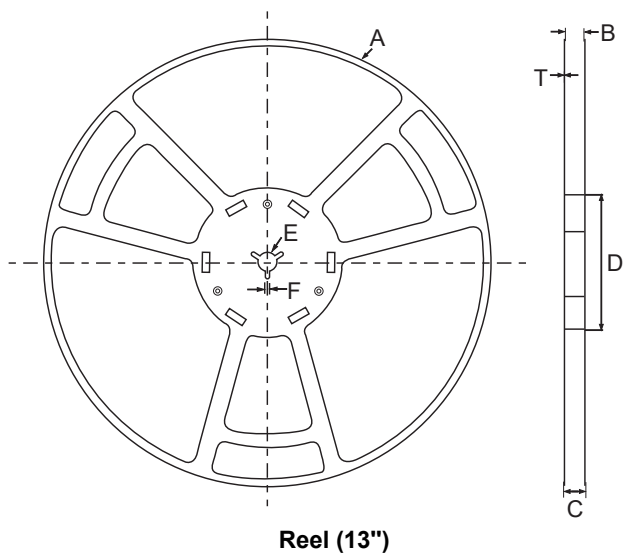
symbol	Value(unit:mm)
A	$\Phi 179 \pm 1$
B	60.5 ± 0.2
C	15.3 ± 0.3
D	12.5~13.7
E	$\Phi 13.5 \pm 0.2$
F	$\Phi 10.0 \pm 0.2$
G	2.7 ± 0.2
T1	1.0 ± 0.2

Package Specifications (SOT-89)

- The method of packaging (3,000PCS/Reel&13inches)



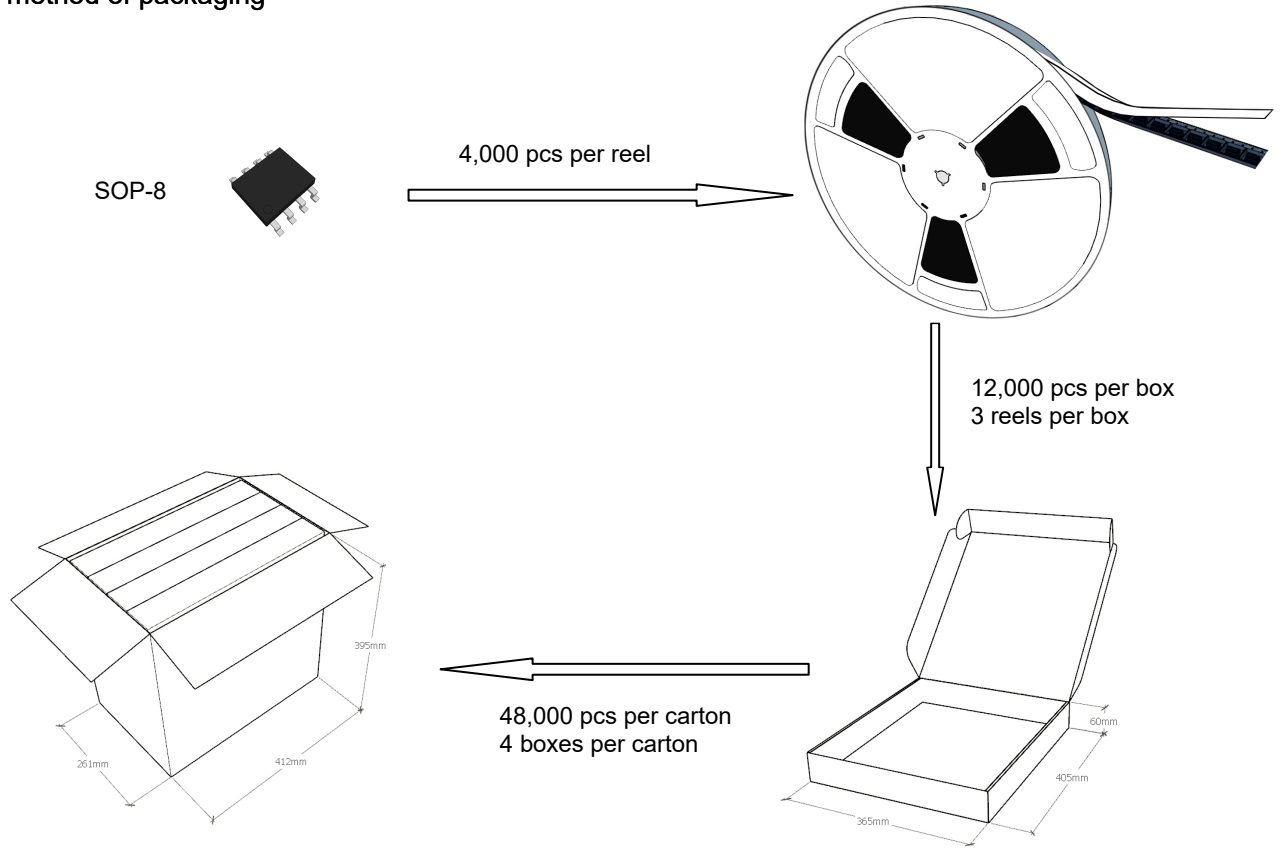
◆ reel data



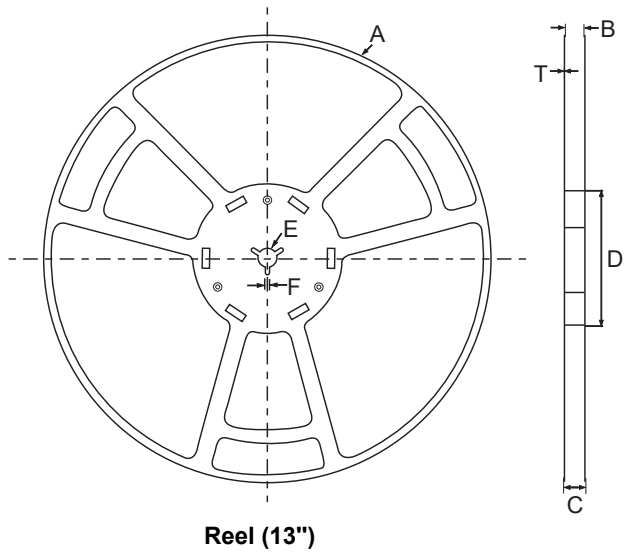
symbol	Value(unit:mm)
A	$\phi 330\pm 1$
B	12.7 ± 0.5
C	16.5 ± 0.3
D	$\phi 99.5\pm 0.5$
E	$\phi 13.6\pm 0.3$
F	2.8 ± 0.3
T	1.9 ± 0.2

Package Specifications (SOP-8)

- The method of packaging



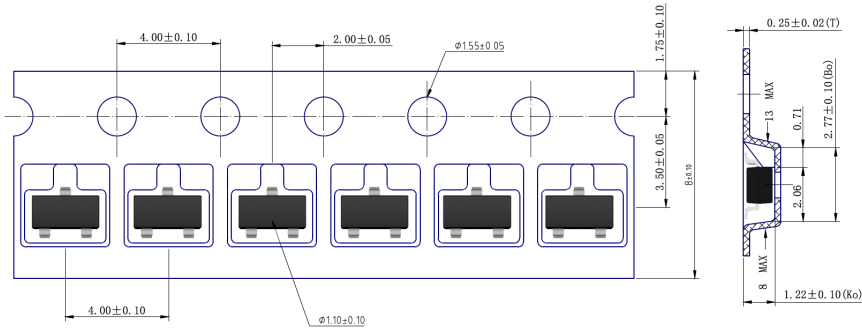
◆ **Embossed tape and reel data**



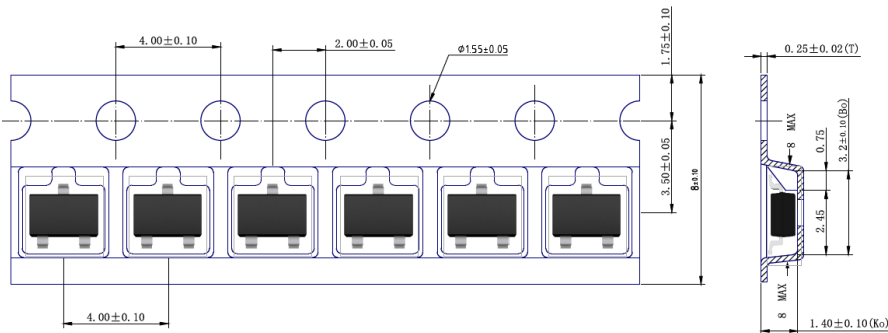
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A	$\phi 330\pm 1$
B	12.7 ± 0.5
C	16.5 ± 0.3
D	$\phi 99.5\pm 0.5$
E	$\phi 13.6\pm 0.3$
F	2.8 ± 0.3
T	1.9 ± 0.2

◆ Embossed tape data

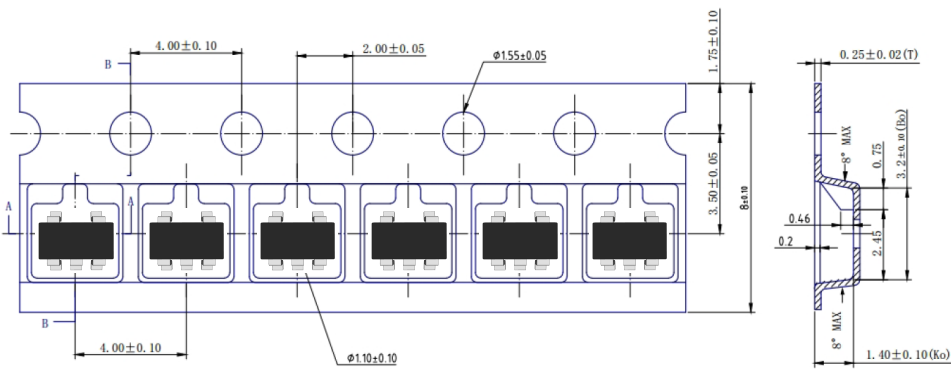
SOT-23



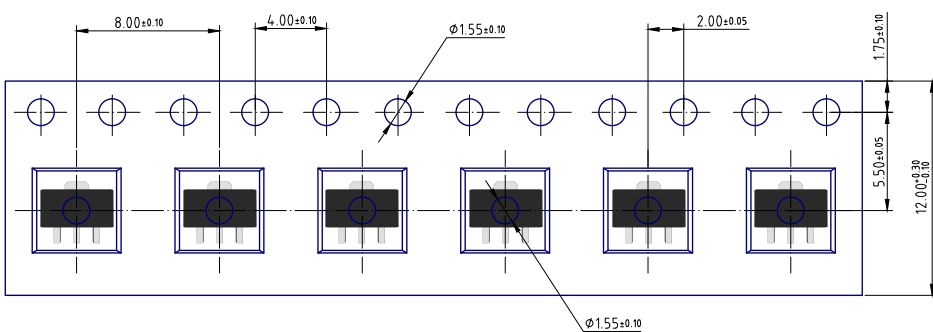
SOT-23-3



SOT-23-5

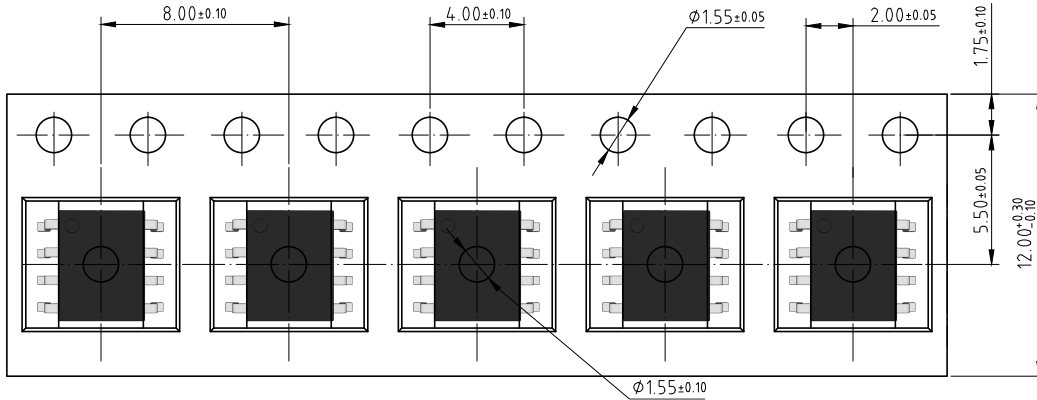


SOT-89



◆ Embossed tape data


SOP-8



Contact Information

TANI website: <http://www.tanisemi.com> Email: tani@tanisemi.com

For additional information, please contact your local Sales Representative.

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Product Specification Statement

The product specification aims to provide users with a reference regarding various product parameters, performance, and usage. It presents certain aspects of the product's performance in graphical form and is intended solely for users to select product and make product comparisons, enabling users to better understand and evaluate the characteristics and advantages of the product. It does not constitute any commitment, warranty, or guarantee.

The product parameters described in the product specification are numerical values, characteristics, and functions obtained through actual testing or theoretical calculations of the product in an independent or ideal state. Due to the complexity of product applications and variations in test conditions and equipment, there may be slight fluctuations in parameter test values. TANI shall not guarantee that the actual performance of the product when installed in the customer's system or equipment will be entirely consistent with the product specification, especially concerning dynamic parameters. It is recommended that users consult with professionals for product selection and system design. Users should also thoroughly validate and assess whether the actual parameters and performance when installed in their respective systems or equipment meet their requirements or expectations. Additionally, users should exercise caution in verifying product compatibility issues, and TANI assumes no responsibility for the application of the product. TANI strives to provide accurate and up-to-date information to the best of our ability. However, due to technical, human, or other reasons, TANI cannot guarantee that the information provided in the product specification is entirely accurate and error-free. TANI shall not be held responsible for any losses or damages resulting from the use or reliance on any information in these product specifications.

TANI reserves the right to revise or update the product specification and the products at any time without prior notice, and the user's continued use of the product specification is considered an acceptance of these revisions and updates. Prior to purchasing and using the product, users should verify the above information with TANI to ensure that the product specification is the most current, effective, and complete. If users are particularly concerned about product parameters, please consult TANI in detail or request relevant product test reports. Any data not explicitly mentioned in the product specification shall be subject to separate agreement.

Users are advised to pay attention to the parameter limit values specified in the product specification and maintain a certain margin in design or application to ensure that the product does not exceed the parameter limit values defined in the product specification. This precaution should be taken to avoid exceeding one or more of the limit values, which may result in permanent irreversible damage to the product, ultimately affecting the quality and reliability of the system or equipment.

The design of the product is intended to meet civilian needs and is not guaranteed for use in harsh environments or precision equipment. It is not recommended for use in systems or equipment such as medical devices, aircraft, nuclear power, and similar systems, where failures in these systems or equipment could reasonably be expected to result in personal injury. TANI shall assume no responsibility for any consequences resulting from such usage.

Users should also comply with relevant laws, regulations, policies, and standards when using the product specification. Users are responsible for the risks and liabilities arising from the use of the product specification and must ensure that it is not used for illegal purposes. Additionally, users should respect the intellectual property rights related to the product specification and refrain from infringing upon any third-party legal rights. TANI shall assume no responsibility for any disputes or controversies arising from the above-mentioned issues in any form.